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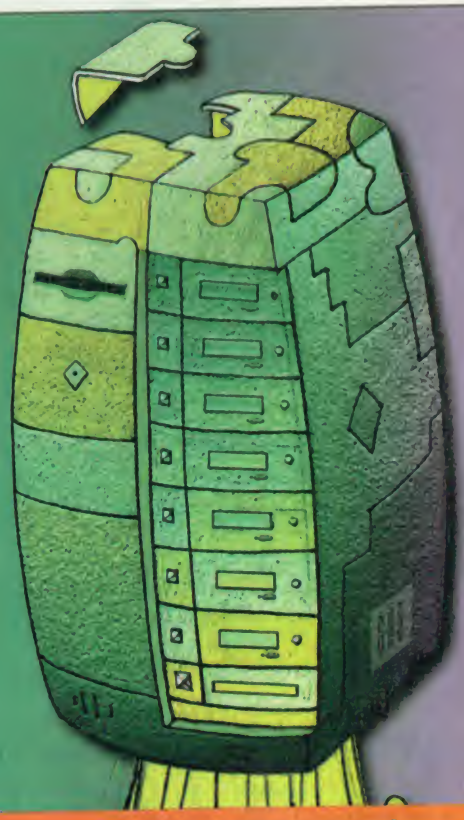

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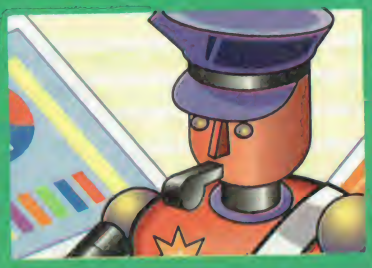

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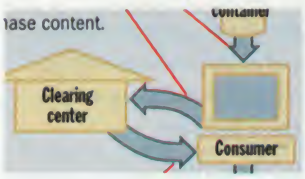

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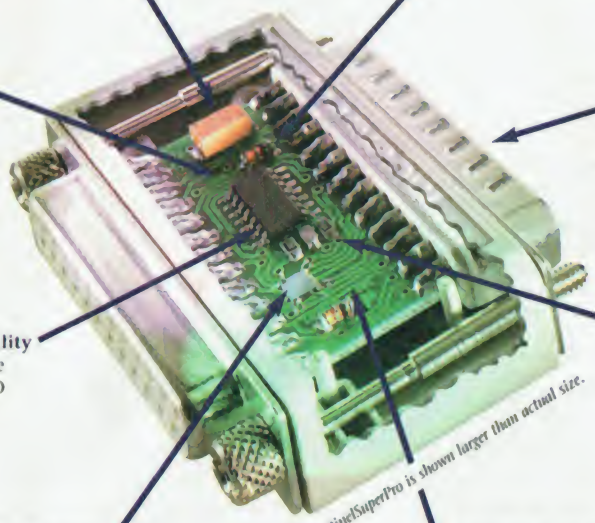

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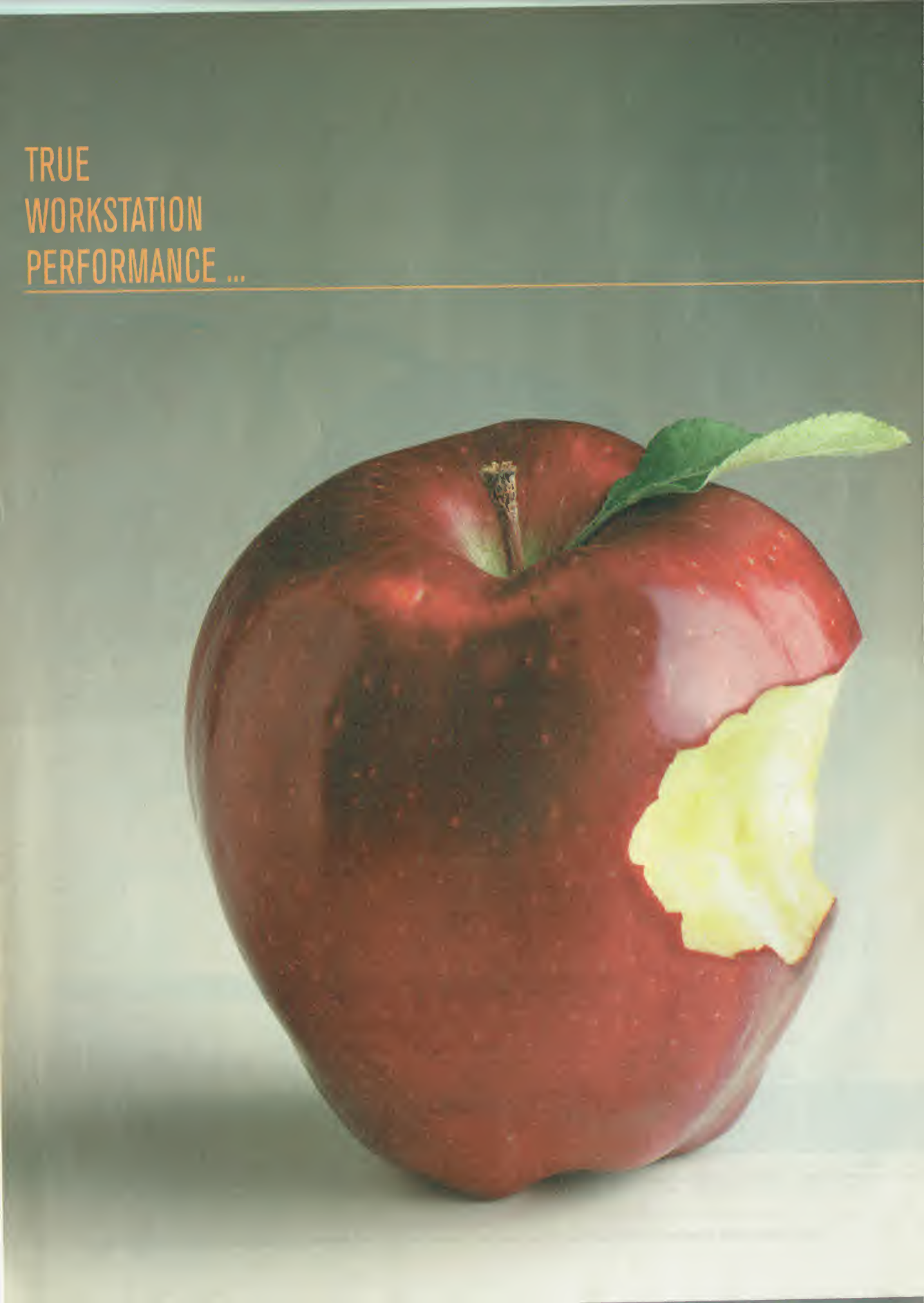

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editorial

Serve Yourself

Writing custom server applications was often daunting—until now.

I've been writing in this space a lot recently about a golden age of server applications that we're hopefully entering. When I started thinking about that, I had in mind Web-enabled commercial packaged applications. But as you'll read in our Cover Story, "Web Components," there's every reason to believe we'll see an even more dramatic change in custom-built server applications.

For all its successes, the client/server revolution was a dramatic failure in eliminating the application backlog. During the mainframe era, generating a simple report required someone to write a program. The PC improved on that, but few large-scale business-critical applications migrated to the stand-alone PC. Many companies were still three years behind on applications development when client/server computing hit the scene. If your backlog is less than three years, chances are management just stopped approving anything that takes too long.

That's why RAD-style (rapid application development) fat client applications have been all the rage, though they're not always the answer. Custom logic on the server has been mostly confined to a controllable number of database triggers and stored procedures.

Anything more complex usually gets done by packaged applications, today's equivalent of the minicomputer application. There are now millions of users of client/server packaged applications such as Oracle Financials, PeopleSoft HRMS human-resources software, Lotus Notes, and SAP's R/3 business applications running on Windows NT, OS/2, or Unix on LAN servers. Yet these don't fit every business need. If there's one lesson from the business reengineering craze, it's "fit the technology to the business need."

The problem still remains: How do you design, build, test, and maintain good server applications in a timely fashion if you're not a software company with hundreds of highly skilled C programmers (or their equivalent)? Two technologies are changing the power equation: the Web and components. The Web settles the issue of client interface. Components and scripting, for the first time, bring high-productivity programming to the 80 percent of server code that doesn't need highly tuned, compiled C code. Even better, you can build components yourself using higher-level languages.

We have been learning this lesson at BYTE as we build our own intranet. We've built newsgroup-style internal discussion groups that let our geographically dispersed editors work collectively. Dissatisfied with the first generation of Internet calendaring software, we've assembled a simple but effective group calendar. As we look at our work flow and data gathering (in some ways we're just an assembly line, with an output of a unit per month), we've opted for a combination of packaged software and homegrown Webware. In many cases, we've accomplished a lot with a pleasantly small development effort (for greater detail, follow Jon Udell's Web Project each issue).

We have been learning this lesson at BYTE as we build our own intranet.

That's because we're leveraging what's already been done in Internet and Web technology, as well as a good deal of client/server technology. This style of development is not about learning one tool and using it for everything. What's important about our tools is that they use only a few key technologies: HTML, NNTP, SMTP, components, scripting,

TCP/IP. An analogous list for early 1990s client/server computing might be C, 4GLs, database, and NetWare. The lists are complementary: Don't forget everything you know, only what never worked anyway.

More than any development philosophy to date, componentized Web-server applications lend themselves to modular design and deployment. They even lend themselves to modular learning. No need to hole up for six weeks studying an arcane methodology. Do something useful, learn from it, improve it, add to it, scale it up.

Eventually, faster hardware will remove the performance issues behind componentized server programming. For now, you can still be a hero. Automate a time-consuming task. Automate several, and you've got a whole process licked.

Mark Schlack

Mark Schlack, Editor in Chief
mschlack@bix.com

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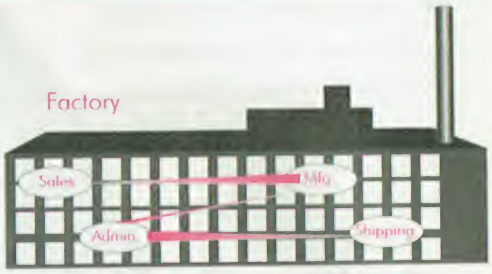

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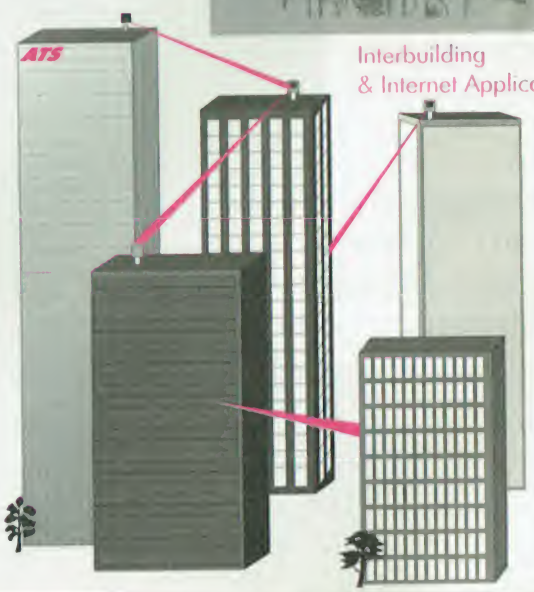

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inbox

The Nonexistent NC

After reading everything I could find on network computers (NCs), I have come to several conclusions:

The $500 NC does not exist. If and when it is deployed, it will be of limited use, especially in the business community.

Machines useful in the business environment will cost about $1200 to $1500. There will be no significant savings in the hardware investment.

There are potential savings in administration and maintenance, but the hidden costs of creating the support systems are not yet clearly understood.

The savings most quickly realized will be in centralized administration. Version control of the installed software base will become simpler. (Current products provide all or parts of the solution to software distribution and version control.)

The end user must surrender much flexibility. Some types of customization will be difficult, and installation of unauthorized software will become a political issue.

Many applications might have to be rewritten. Custom client/server applications might not be supportable on some types of NCs.

While the NC concept is fascinating, it is not truly viable for the business user at present.

Bruce E. Golightly
Principal Software Engineer
Carnegie Mellon University
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I don't disagree with all your points, but I think you've overlooked a few things. Although reduced administration is considered to be the larger benefit, $1200 for a decked-out NC is about half the average price now paid by corporations for a similar PC, and NCs probably won't have to be replaced as often. There's a myth that PCs represent flexibility and freedom, and NCs the opposite. Most companies already dictate what kind of PC users get, how it is configured, and what kind of software must (and must not) be installed on it. Many corporations also monitor Internet use. NCs are much more secure than PCs because they don't persistently store information. Most of the critical information amassed by companies is stored on centralized computers. NCs won't replace all PCs. They are just a lower-cost way to get some jobs done.
—Tom R. Halfhill,
senior editor

Cheaper Computing

After reading "Cheaper Computing" (April Cover Story), I can only conclude that any computer is an NC provided it is connected to a network. NCs might cost less than $500, but then again, they might not. NCs should run Java, but then again, they should not. NCs ought to execute programs on the desktop, but then again, they ought not. NCs are not supposed to have hard drives, but then again...

Perhaps I am one of those who still can't get it.

Johan Couder
Antwerp, Belgium

All NCs have one thing in common: From the user's point of view, they are stateless. NCs store or mirror their local state on a server. That means the NC is like an interchangeable part. Stateless NCs also eliminate all the problems that afflict PCs related to persistent storage: software conflicts, installation hassles, etc. Even if an NC has a hard drive, it's used only as a cache. The user's data and software are kept on a server, and servers are more physically secure, are more reliable, and are backed up regularly by professionals. Statelessness is what makes NCs easier and cheaper to maintain, and that's the main thing that distinguishes NCs from PCs.—Tom R. Halfhill

Let Robots Find You

In "The Internet Robot's Guide to a Web Site" (May's Core: Programming column), Tonya Engst explains how to deter search engines from picking up your site. What about the opposite? Could you provide some tips about the best ways to get picked up by search engines?

Kulvir Singh Bhogal
bicky@mail.utexas.edu

Basically, the trick is to submit your URL to the various search engines. A good jumping-off point is Submit It (http://www.submit-it.com). Different search engines use different criteria to determine whether they pull your page up first in response to a search or put it down near the end of the list. Perhaps the best tip is to make the title and first paragraph on

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your home page a good description of the page, since that's often what will show up in the search engine's list.
—Tonya Engst

Turn It Off

It was great to see an article discussing the strengths of Developer/2000: "Oracle's Web-Footed Friend" (June Reviews). However, I'd like to correct one statement made about the frame object, which is used by the Layout wizard to modify the layout. By default, the frame does have a visual border, but this can be turned off by selecting the frame in the Layout Editor, selecting Line Color from the palette, and choosing No Line. The frame's border will disappear and will be replaced by blue dashed lines representing the extent of the frame. These resemble blue drafting lines found on engineering or architecture drawings and do not show up in the form at run time.

John Cobb
Development Manager
Oracle Developer/2000 Form Builder
JCOBB@us.oracle.com

That is correct. To clarify my point, if you delete the frame instead of making the line transparent through the Line Color tool, you lose any ability to revise the block using the new wizards, which can lead to other problems with maintenance. Never delete the frame, just turn it off.
—Robert J. Muller

On State Tables

While the review of Check Point FireWall-1 ("Firewall Software for NT and Unix," June Software Lab Report) was favorable overall, it was inaccurate regarding Check Point's Stateful Inspection technology. Stateful Inspection implements state tables, which maintain extensive state-related information regarding active and subsequent communications attempts and are used to make intelligent security policy–related decisions to allow or disallow communications through the firewall.

The article asserted incorrectly that if the state tables become corrupt, the network could be exposed. The state tables are kept in the OS kernel memory and cannot become corrupted like disk files. If the system fails due to a hardware or software error, new tables are allocated and no old (corrupted) data is valid. Furthermore, the data in the state tables represents active connections, so if a hardware or software error were to occur, the connections would no longer be active and therefore disabled, preserving the security of the network. Readers can obtain more information at http://www.checkpoint.com/products/firewall/stateful/index.html or by sending e-mail to info@checkpoint.com.

Deb Triant, President and CEO
Check Point Software Technologies
Redwood City, CA

A World CA?

In "Who Goes There?" (June Cover Story by Peter Wayner), the figure "How to Trust" (page 78) depicts a hierarchical certificate world, in which the United Nations is positioned above the national government. Does this symbolize the U.N.'s role in ensuring the standardization of the certificates for global economical reasons? If so, would the U.N. act as the central data center for the certificate authorities?

Eric Funk
funk_eric@wes.twc.com

I don't know of particular plans for any government to get involved in the certificate business. But many current schemes anticipate such a

role, and, in fact, it makes sense for any organization to certify the keys of its members. It allows the members to communicate among themselves with assurance that the channel is secure.
—Peter Wayner

FPUs: No Contest

Do you know if Cyrix's M2 will have a better (or at least similar) FPU than Intel's Pentium? Does the M2 or AMD's K6 have a pipelined FPU? Why do Cyrix and AMD pay less attention to the FPU than anything else? If Cyrix and AMD chips had similar integer performance and a better FPU, I think their CPUs would be superior to Intel's.

Faris Elkurd
faris@uakron.edu

Intel's x86 chips definitely have better floating-point (FP) performance than AMD's or Cyrix's chips. Intel's FPUs are pipelined, and AMD's and Cyrix's are not. Intel has done other optimizations as well. However, AMD and Cyrix design their chips for the mainstream PC user, and the majority of PC applications largely consist of integer operations and don't need much FP performance. Intel wants the mainstream user, but it also wants a piece of the Unix workstation market and uses its x86 processors in supercomputers, which are mainly designed for FP-intensive applications. If FP performance really does matter to you, then you're better off with a RISC-based system. To participate in more discussions about this and related matters, try our public "chipcon" conference. You can find a link on the BYTE home page, or go directly to http://dev4.byte.com/chipcon.—Eds.

Global Faux Pas

I was surprised to see such a badly done comparison in the table "Six World Views" ("Global from Day One," March, page 102). The U.S. and U.K. you got roughly right, although the 24-hour clock is probably used a bit less often than a.m./p.m., and leading zeros are rarely, if ever, used in the short date.

In Germany, the thousands separator is a stop (.), not a space, and the decimal separator is a comma: 1,234.56 is written 1.234,56. The German currency symbol is placed at the end of the number (0,23 DM), not at the front. For France, you got the thousands separator right, but not the decimal. The currency sign also goes after the number. This is disappointing because you're usually so good on technical accuracy.

Paul Durrant
pdurrant@durrant.demon.co.uk

Your letter illustrates the difficulties software developers face in addressing a global

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market. To summarize—and correct our table: For France, Germany, and Greece, the decimal separator is a comma (i.e., 123,45, not 123.45). Either a period or a space is sometimes used as the thousands separator (i.e., 1.234,56 or 1 234,56). Leading zeros in date and time formats (shown for hours and months in the table) are, in fact, rarely used. The minus symbol for negative amounts precedes the number, not the currency symbol. In Greece, a minus symbol rather than parentheses is used to indicate a negative amount, whereas in France, parentheses are often used. To further complicate matters, some rules are less stringently followed than others. Germans, for example, usually put the currency symbol before, but sometimes after, the amount. Developers are wise to allow for user choice in format details.
—Udo Flohr, contributing editor

COMING UP IN SEPTEMBER

COVER STORY

ActiveX Controls

Depending on who's talking, Microsoft's ActiveX technology is either the next great thing or a time bomb. BYTE dissects this component model, weighing its strengths and weaknesses for developers, users, and Webmasters.

NETWORK INTEGRATION

Publish and Subscribe

The only true push technology on the Web, publish and subscribe, has often been overlooked as too complex or too fragile. We go inside the technology of several major publish and subscribe products to see how they may change information distribution.

REVIEWS

Netscape Netcaster

As Microsoft moves to merge Windows and Internet Explorer interfaces in Memphis and Internet Explorer 4.0, Netscape counters with its own take on the Web as desktop.

The New Pentium II and K6 Systems

NSTL tests the first crop of desktop systems based on competing high-end CPUs from Intel and AMD.

IP Conferencing

In the Software Lab Report, we check out software that enables videoconferencing over the Internet without the need for dial-up phone connections.

Oracle 8

An Oracle expert takes an in-depth look at the long-awaited upgrade of this leading relational database manager.

CORE

A Web Server for Device Control

We take a peek inside emWare's Embedded Micro Interface Technology, a device controller in the guise of a Web server that uses only 30 bytes of RAM and 750 bytes of ROM.

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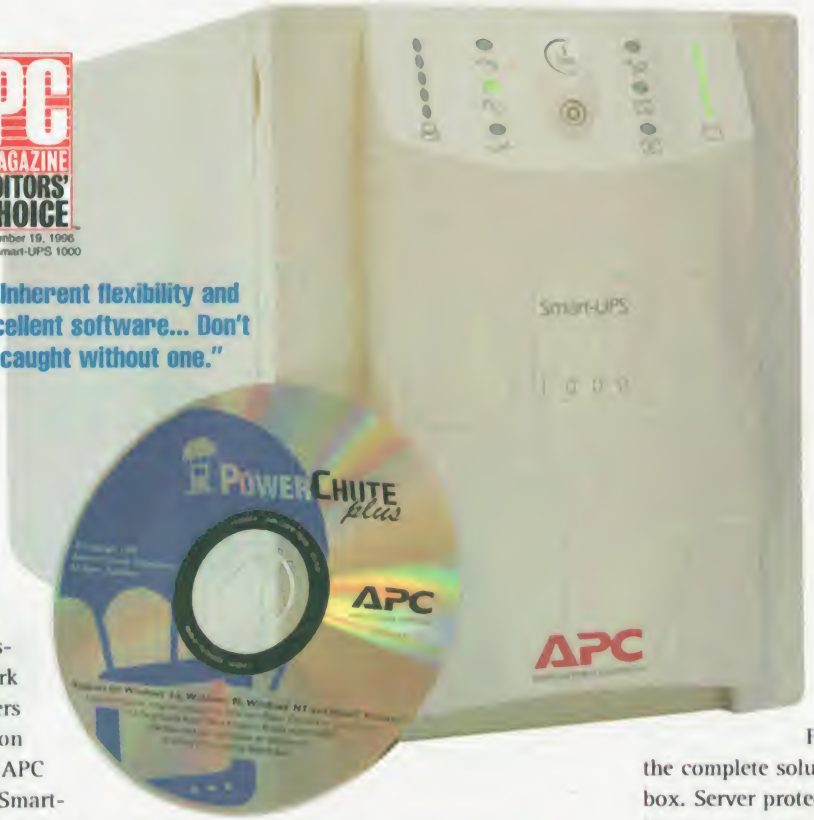

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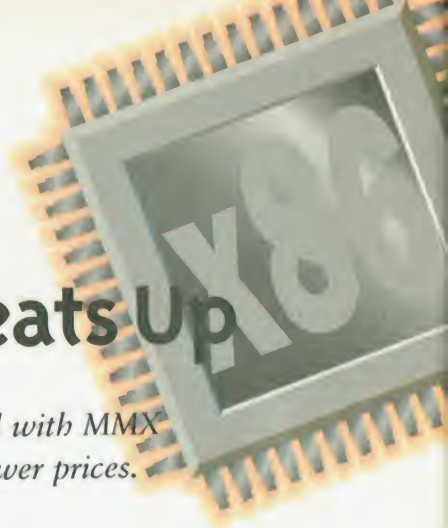


x86 Competition Heats Up

Two new x86 microprocessors challenge Intel with MMX compatibility and strong performance at lower prices.

It's turning into a hot summer for x86 processors. Following closely behind Intel's 300-MHz Pentium II, Intel's 233-MHz Pentium, and AMD's 233-MHz K6 are two more chips: one from Cyrix, and an innovative entry from a newcomer, Centaur Technology. Both chips offer MMX compatibility and strong performance for low-to mid-range desktop systems.

The Cyrix 6x86MX (formerly the M2) supersedes the current 6x86 by adding MMX instructions, quadrupling the size of the on-board cache (now 64 KB), doubling the resources for branch prediction, supporting CPU-bus speeds as high as 83 MHz, and adding a special scratch-pad feature to boost MMX throughput.

Initial shipments of Cyrix's new chip come in three speed grades: the PR233, PR200, and PR166. According to these Cyrix "performance ratings," they compare to a 233-MHz Pentium II, a 200-MHz Pentium/MMX, and a 166-MHz Pentium/MMX, respectively. (Note that Cyrix's comparisons to Intel processors vary according to the speed grade.) Actual clock speeds are 187.5, 166.5, and 150 MHz.

The PR233 costs only $320, about half the price of a 233-MHz Pentium II. Business application benchmark tests that BYTE ran on a Cyrix reference PC indicate that a PR233-equipped system delivers slightly better performance than one with AMD's 233-MHz K6 processor, which also had a bigger L2 cache than the Cyrix reference system (see the chart below). The PR233 PC's performance did not quite match that of a 233-MHz Pentium II PC, but PR233 systems are less ex-

Cyrix 6x86MX Approaches Pentium II Performance

Cyrix straddles Pentium and P6 performance on the BYTEmark integer tests but stays on pace with the NT application tests.

BYTEmarks measure raw CPU–not overall system–performance.

SysMark for Windows NT 4.0 application benchmark ratings reflect total system–not just CPU–performance. All systems were tested with 1024- by 768-pixel resolution and 64 MB of RAM. AMD's K6 reference system: 1-MB L2 cache, Matrox Millennium with 4 MB of WRAM, and Seagate Cheetah ST34501W (SCSI) hard drive. Cyrix reference system: Seagate Cheetah hard drive, STB Nitro 3D with 4 MB of VRAM, and 512-KB L2 cache. For 233-MHz Pentium II: Digital Celebris GL-2 with Quantum Atlas-2 SCSI drive, Matrox Millennium (4-MB), 512-KB L2 cache, Diamond Stealth 3D 2000, and Maxtor 85120A EIDE hard drive.

New PC Processors at a Glance

	AMD K6	Centaur IDT-C6	Cyrix 6x86MX	Intel Pentium	Intel Pentium II
x86 class	P6	P5	P6	P5	P6
MMX-compatible	Yes	Yes	Yes	Yes	Yes
Current top clock speed (actual)	233 MHz	200 MHz	187.5 MHz	233 MHz	300 MHz
Top clock speed (perf. ratings)	233 MHz	200 MHz	233 MHz	233 MHz	300 MHz
L1 cache (instruction + data)	32 KB + 32 KB	32 KB + 32 KB	64 KB unified	16 KB + 16 KB	16 KB + 16 KB
Transistors (in millions)	8.8	5.4	6.5	4.5	7.5
Pin-out	Socket 7	Socket 7	Socket 7	Socket 7	SEC slot 1
Power dissipation (W)*	28	14	20.6	17	42

*Power dissipation for desktop version.

pensive. Prices will vary, but vendors such as CyberMax (800-443-9868) say PR233-based PCs will sell for about $400 less than similarly equipped Pentium II PCs. The PR200 costs $240, and the price of the PR166 is $190. All three Cyrix chips target the sub-$1500 PC market.

Centaur, a new subsidiary of Integrated Device Technology (IDT), raises the number of companies currently making Pentium-class processors to four. Centaur's new IDT-C6 chip will come in three speeds: 200, 180, and 150 MHz. At 200 MHz, it matches the performance of a Pentium-200 with MMX, according to Centaur's benchmarks. (Centaur did not make an IDT-C6 system available to BYTE in time for this article.)

The architect behind the IDT-C6 is Glenn Henry, Centaur's president. Henry was a well-known RISC architect at IBM and Mips, and he also led research into emulating x86-on-RISC. By applying RISC principles to the x86, Henry has masterminded a remarkably efficient CPU. The IDT-C6 is about half the size of a Pentium, even though IDT fabricates the chip on a comparable 0.35-micron, four-layer-metal, CMOS process. Of its 5.4 million transistors, only 1.4 million are located in the logic circuits. The rest are in the 64 KB of on-board cache. And because the mobile version of the chip dissipates only 7.1 to 10.6 W at 150 to 200 MHz, Centaur is targeting it for notebooks as well as sub-$1500 desktop PCs.

Centaur faces stiff competition, however. Intel introduced 200- and 233-MHz mobile Pentiums in May and a 0.35-micron, 233-MHz desktop Pentium with MMX ($594 in quantities of 1000) in June. Thanks to a new 0.25-micron process, Intel's new 200- and 233-MHz mobile Pentiums (code-named Tillamook), dissipate less than 8 W. Both of the new mobile Pentiums will appear later this year, while the new desktop CPU is available now.

Another challenge for both Centaur and Cyrix is MMX compatibility. Neither company has a patent cross-licensing agreement with Intel, as AMD does. And each company is taking a different approach to MMX.

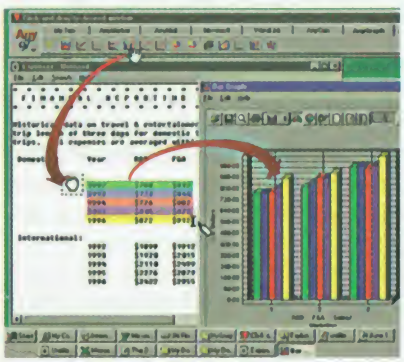
For example, Cyrix uses the FPU's multipliers and adders to execute MMX instructions. Intel uses the integer units, while AMD and Centaur use dedicated MMX units. Cyrix's approach requires fewer transistors and executes some MMX instructions in fewer cycles, but Intel's CPUs can handle two MMX instructions at a time. To compensate, Cyrix added a scratch-pad feature that preserves MMX data when the CPU flushes its cache. This, plus the larger cache, could make the 6x86MX more efficient at manipulating large MMX data sets. Look for BYTE to test the 6x86MX's MX performance in a future issue.

Centaur is still running validation tests on the CPU, which is scheduled to ship in the third quarter of this year and is still unpriced. However, the additional competition for Intel will almost certainly result in lower PC prices.

–Tom R. Halfhill

Natural Dictation Wins Best of Comdex

Dragon Systems' NaturallySpeaking ($695), a Windows program that lets you speak naturally to your PC as you dictate text, won BYTE's Best of Show award at Comdex. BYTE's awards recognize new products that are innovative and will impact the industry. NaturallySpeaking (for more information, see "I Say! An Understanding Application" on page 33), slated to ship this summer, won because it's the first general-purpose, large-vocabulary product we've seen that lets you dictate to your PC without having to pause between each word.



Any97 lets you build applications from components without programming.

The Iridium project, a satellite-based, wireless personal communications network, won the Best Technology award. The Iridium constellation will consist of 66 interconnected satellites that will allow voice, data, fax, and paging traffic to reach its destination anywhere on earth.

Geek Mystique

Software Ranks Just Behind Cars and Gadgets

Software ranks just behind cars and electronics in revenue generated in 1996, according to a recent study by Nathan Associates (Arlington, VA). The study concludes that the U.S. software industry generated revenues of $102.8 billion in 1996. Since 1990, the software industry has grown at an annual rate of 12.5 percent, which is nearly 2.5 times faster than the general economy. Software companies employ 619,000 people.

Death, Taxes, and Bugs

Nothing is certain but death and taxes—and, in these modern times, software slips. The U.S. Internal Revenue Service is intimately familiar with the latter two—taxes and software slips—which is why the new commissioner of the IRS will not be a lawyer or an accountant, but a geek. The reason: the IRS's well-publicized problems with modernizing its computer systems.

The new job for Charles Rossotti, formerly chairman of the Virginia-based consultancy American Management Systems, is to manage a big fix for the IRS's computer woes. These problems were highlighted last year by such boo-boos as the $400 million that was spent on an in-house application that never worked and other expensive snafus.

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Best of Comdex

Best of Show, Best Application/Utility: Dragon Systems (800-437-2466, http://www.naturalspeech.com)

Best Application/Utility finalists: AnySoft (617-868-3397, http://www.anysoft.com) and Intrasoft (919-419-9427, http://www.keyvision.com)

Best Technology: Iridium LLC (202-408-3800, http://www.iridium.com)
Finalists: Microsoft (206-882-8080, http://www.microsoft.com) and Harris Semiconductor (800-442-7747, http://www.semi.harris.com/fingerloc)

Best Portable: Gateway 2000 (800-846-2000, http://www.gw2k.com)
Finalist: Toshiba (800-457-7777, http://www.computers.toshiba.com)

Best Multimedia Hardware: Matrox Graphics (800-361-1408, http://www.matrox.com/mga)
Finalists: ATI (905-882-2600, http://www.atitech.com) and Xirlink (408-324-2100, http://www.xirlink.com)

Best Multimedia Software: MetaCreations (805-566-6200, http://www.metacreations.com)
Finalists: MetaCreations and LogOn Technologies (800-710-9099, http://www.logontech.com)

Best Connectivity Solutions: Hilgraeve (313-243-0576, http://www.hilgraeve.com)
Finalists: Bay Networks (800-822-9638, http://www.baynetworks.com) and Equinox (954-746-9000, http://www.equinox.com)

Best Workstation: IBM (800-426-2968, http://www.pc.ibm.com/intellistation)
Finalist: Digital Equipment (800-344-4865, http://www.workstation.digital.com)

Best Peripheral: Nikon (516-547-4200, http://www.nikonusa.com)
Finalists: Visionics (908-744-1585, http://www.faceit.com) and Visioneer (510-608-0300, http://www.visioneer.com)

Best Development Software: Antares Alliance Group (972-447-5500, http://www.edgesite.com)
Finalists: Hitachi (800-558-1413, http://www.zoosoft.com) and ChiliSoft (717-290-8346, http://www.versicom.com/chilisoft)

Best Web/Internet Product: Wall Data (Kirkland, WA, 800-915-9255, http://www.walldata.com)
Finalists: Cardiff Software (760-752-5244, http://www.cardiffsw.com) and TSP Companies (770-622-2840, http://www.opalis.com)

Gateway's Solo 9100 won the Best Portable category at Comdex.

Iridium is slated to begin operation in 1998. Best Technology finalists were Microsoft's "Wolfpack" fail-over clustering, which will soon be part of the Enterprise Edition of the NT OS (slated to ship in the third quarter), and Harris Semiconductor's FingerLoc System, a complete personal fingerprint-identification system in a low-cost IC chip set.

A finalist in the Best Application/Utility category was AnySoft's Any97, a user-component-management system that lets you assemble your own task-specific applications that use Any97's included components or OLE Server components. Support for ActiveX and Java is due this summer. The other finalist was Intrasoft's KeyVision, which lets network administrators manage multiple Windows 95 and NT system registries simultaneously from the Web.

Best Portable winner was Gateway's Solo 9100, a high-end, 8½-pound notebook packed with a 13.3-inch display, up to 192 MB of SDRAM, USB and NTSC in and out ports, and many other features at prices starting at $4200. Finalists were Toshiba's 3.8-pound Portégé 300CT (about $3499), which has a 133-MHz Pentium with an MMX CPU and a 1024- by 600-pixel display; and Toshiba's Satellite 6.9-pound 440CDX, a 133-MHz Pentium with MMX–based notebook available with a TFT or Toshiba's FastScan display. It delivers active-matrix-like display quality, but with passive-matrix's lower weight and power requirements, for about $2500.

Matrox Graphics' Millenium II graphics accelerator card (from $269), which provides 2-D and 3-D graphics acceleration (including support for a 32-bit z-buffer for improved depth precision) and up to 16 MB of WRAM, won for Best Multimedia Hardware. Finalists were ATI's Xpert@Play 2-D/3-D graphics accelerator and Xirlink's USB Digital Video Phone, an audio/video digital camera that connects to a PC via the USB port.

In the Multimedia Software category, the winner was MetaCreations' Kai's PhotoSoap, which brings high-quality photo cleanup to a new level of ease and affordability (for more information, see the What's New Software Preview on page 166). Finalists were LogOn Technologies' e-Logic, a powerful interactive multimedia marketing applications suite for the Web, and MetaCreations' Ray

Future Watch

Digital Ink Gives New Meaning to Paper Recycling

Imagine that, instead of tossing your newspaper into the recycling bin, you keep the paper and rewrite the next day's news onto the same piece of paper. While such a dream is still years away, researchers at the MIT Media Lab are working on a process that could someday do just that.

With the technology's current state of development, you have to feed each sheet through a modified inkjet printer to erase the old text and print new text. But this is an interim step toward a matrix-addressable paper. Ultimately, each sheet might have its own processor or a wireless receiver to facilitate updating.

What makes all this possible is a special ink that contains tiny microencapsulated electrophoretic particles. When voltage is applied, the particles are drawn to one side and appear white. When attracted to the opposite side, they flip and appear dark. The resulting display has good contrast, consumes very little power, and has a wide viewing angle–just like paper. –Chris Chinnock

Dream Studio 5, a new version of the 3-D animator for Windows and the Mac that adds new animation, rendering, and object-creation tools.

Best Connectivity Solutions winner was Hilgraeve's DropChute+, a product slated to ship this summer that reliably transfers files over phone lines or the Internet. Finalists were Bay Networks' Instant Internet 4.0, which adds high-speed Internet connectivity options from 56-KBps DDS to T1, and Equinox's SuperSerial Modem Pool PAC Option with EquiView Plus release 2. Equinox's product is an Ethernet-ready NT Remote Access Server in a box plus software.

The award for Best Workstation went to IBM's Intellistation M Series, which features a Pentium II and support for advanced desktop-management features, such as Wake on LAN and LANdesk client support. Finalists were Digital Equipment's Celebris GL-2 dual-CPU-capable Pentium II NT system and Personal Workstation 500au, which can run NT or Unix.

Winner of the award for Best Peripheral was Nikon's (516-547-4200, http://www.nikonusa.com) Coolpix 300 Personal Imaging Assistant, which offers powerful imaging and communications capabilities in a pocket-size unit. Finalists were Visionics' FaceIt PC, face-recognition software that uses monitor-mounted cameras to identify a user's face for computer access, and Visioneer's Paperport Strobe Scanner, an updated version of the company's scanner with document-management software that adds support for color.

Arpeggio Live, Wall Data's ODBC-compliant database and host-system data-publishing tool, won in the Best Web/Internet Product category. Finalists were Cardiff Software's Teleform, an HTML forms creator, and TSP Companies' (http://www.opalis.com) OpalisRendez Vous, a file-synchronization add-on tool to Windows NT.

Antares Alliance Group's EdgeworX release 1.1 won the Best Development Software category for bringing the familiarity of Visual Basic for Applications to Web-site development. Finalists were Hitachi's Appgallery, a rapid prototyping tool that uses AI techniques to automate the linking of ActiveX and CORBA objects, and ChiliSoft's ChiliASP, which allows Active Server applications to run on Web servers other than Microsoft's Internet Information Server.

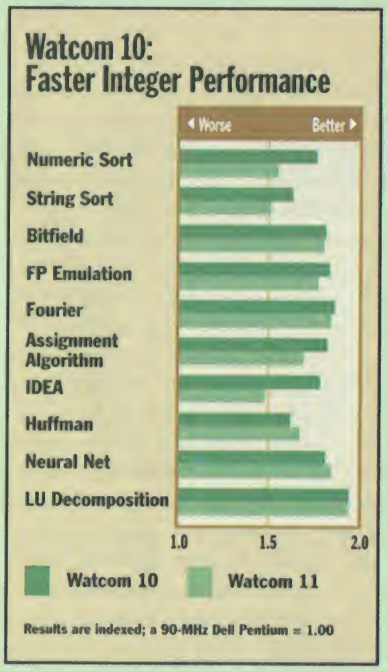
Bug of the Month

BYTEmarks Unearth Compiler Discrepancy

Sybase Waterloo (formerly known as Watcom) says it's investigating a possible bug in Watcom C/C++ version 11 that's related to integer-operation performance. BYTE discovered the performance discrepancy when recompiling version 2 of our BYTEmark Native Mode benchmarks.

Because the BYTEmark suite is written in ANSI C, the results you get from the benchmarks can vary from compiler to compiler if one compiler's optimizations are better than another's. Occasionally, BYTE will recompile the benchmarks to take advantage of a compiler's new performance optimizations. BYTE discovered a possible problem with Sybase's compiler when recompiling the x86 version of the BYTEmark suite to take advantage of the performance improvements of Watcom C/C++ version 11, which was released earlier this year.

As you can see from the chart above, the BYTEmark tests involving integer operations actually ran faster on a 166-MHz Pentium-based PC when compiled by Watcom version 10 than they did when recompiled using version 11 running on the same PC. Many of these tests, such as Numeric Sort, String Sort, Assignment Algorithm, and International Data Encryption Algorithm (IDEA), perform the same types of fundamental operations as do word processing, spreadsheet, and communications programs. (For more information about the BYTEmark suite, see page 74 of the March 1995 BYTE or http://www.byte.com/bmark/bdoc.htm.) Sybase says that it hopes to have a solution to this problem available by early this summer.



BYTEmarks compiled with Watcom 10 run faster than with Watcom 11.

Send yours to 76443.1723@compuserve.com!

Color Lasers: Cheaper, More Compact

The dizzying pace of change in the color ink-jet printer market—lower prices, faster output, and better images—might make it easy to overlook the laser-printer arena. But a flurry of new products plus new players has resulted in smaller and less-expensive options for those who prefer the higher speeds and other business-oriented features that laser printers can provide.

These new color laser printers are easier to use, smaller, provide better color, and, probably most important, are approaching the prices of comparable monochrome products. One of the most interesting is the Xerox (800-349-3769, http:\\www.xerox.com) DocuPrint C55, which delivers 600- by 600-dpi resolution, 3-ppm color output, and speeds of about 12 ppm in black and white. Measuring 18½ by 16½ by 16½ inches, this printer is also very compact, making it more natural for desktop use, although it still weighs over 90 pounds.

Several DocuPrint features make the C55 (which has an estimated price of $3500, but add $1000 for PostScript and networking) attractive as a single-printer solution for businesses. These features include automatic conversion of colors to black-and-white patterns for legibility while faxing and automatic enhancement of photos. Plus, with the PostScript option installed, the printer can produce near-continuous-tone photo output.

At $3999, Lexmark's (800-539-6275, http://www.lexmark.com) Optra SC 1275 color laser printer is a bit more expensive

than the C55, but it comes standard with PostScript Level 2 and matches the 12-ppm monochrome and 3-ppm color speed of the C55. And, like the C55, the Optra SC 1275 features 600-dpi printing, an image (i.e., photo) print mode, and nifty software. The ColorSharp software analyzes the page and adjusts the printer to produce the best output regardless of document content. A networked version, the SC 1275Sn, costs $4450.

A new entrant into this market is Minolta (888-2Minolta, http://www.minoltaprinters.com), which up to now has focused more on selling print engines to other printer vendors rather than selling printers. Minolta's new PageWorks line includes an inexpensive color laser printer that will sell for under $3000. The Color PageWorks uses a Minolta engine that delivers 3-ppm color and 12-ppm monochrome printing at 600 dpi. Meauring just a bit larger than the Xerox C55, the PageWorks ships with just 4 MB of RAM. Minolta claims its image-compression technology enables full-page graphics to print in just 4 MB.

While these three printers are the most notable current models, you can expect new color lasers from Hewlett-Packard, Tektronix, and others to further accelerate the downward price/performance trend in this market. IDC estimates the color laser market should reach $2.8 billion by 2001. The number of color lasers sold should jump eightfold in the same period, from about 100,000 this year to 800,000 in 2001.

Monochrome laser printers are getting better, too. Along with its new color model, Lexmark also offers a new family of monochrome products, the 1200-dpi Optra S series. Ranging in price from $1125 to $2650, the S series can handle printing needs ranging from one user to a department, with duplexing and other paper-handling options. And Minolta has 6- to 20-ppm models of its PageWorks series, with prices as low as $1499 for the 20-ppm, 1200-dpi model. **–Jon Pepper**

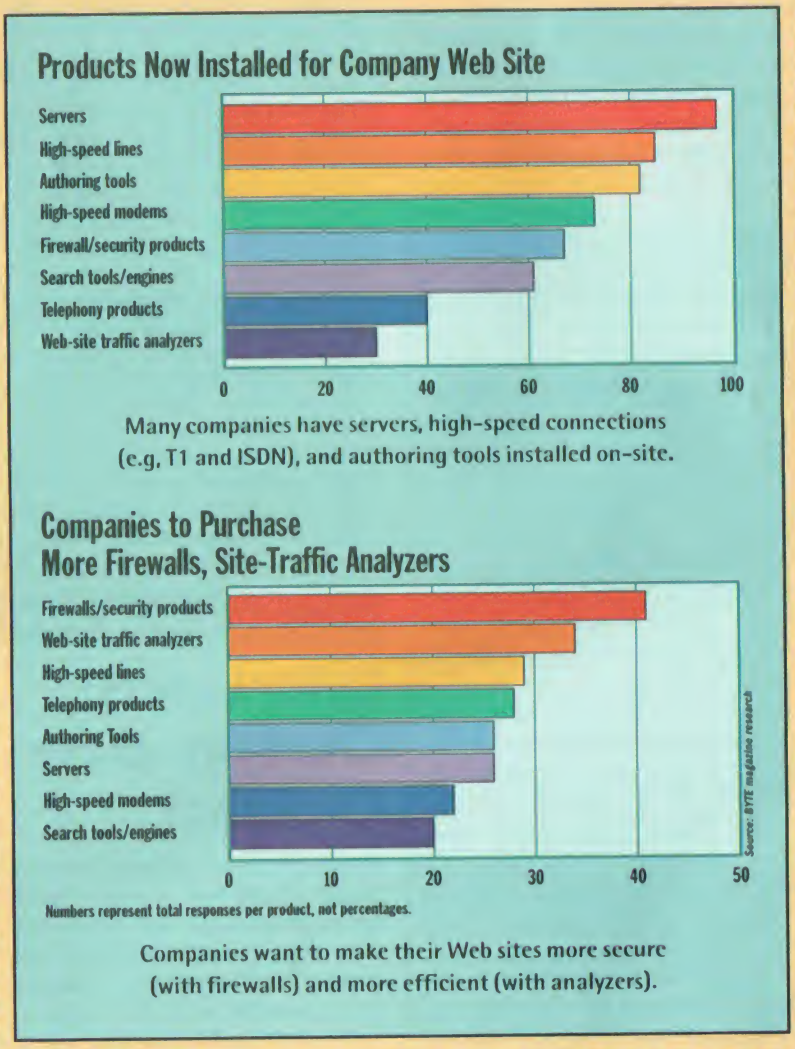
Survey

Web Sites to Gain Security, Efficiency

Results from a recent BYTE survey on product-purchase plans for company Internet or Web-site development needs suggest that businesses most want to add security and efficiency to their sites.

Survey respondents picked firewalls and other security products as the top category that will be purchased during the next year for company Internet or Web-site development. Close behind were Web-site traffic analyzers, which are products that help Webmasters determine the most heavily used sections of a site.

In December 1996, BYTE did a similar survey and found that Web-site development tools were tops on the list of planned purchase items. It appears that, now that the Web sites are built, Webmasters want to be better prepared for their visitors.

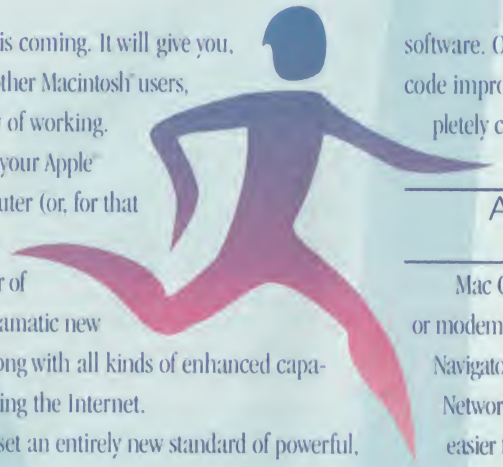


Champagne Performance at Beer Prices

What a difference a faster system bus makes. With its PowerCenter Pro 210, Power Computing (Round Rock, TX, 512-246-7807; http://www.powercc.com) sets a new standard in Mac-compatible pricing. The 210-MHz 604e-based system ($2444 in the configuration we tested) approaches the performance of the company's flagship PowerTower Pro 250 (which would cost about $3700 if available in a similar configuration as the 210) and paces the Pentium II at 266 MHz. Although the CPU itself runs at only 210 MHz, compared to the PowerTower Pro's 250-MHz 604e, the PowerCenter's overall performance is boosted by a 60-MHz processor-to-main-memory (i.e., system) bus. (The PowerTower Pro's system bus

The Mac OS Report

Number two in a series—the facts about Mac OS 8



Mac® OS 8 is coming. It will give you, and millions of other Macintosh® users, a whole new way of working.

It will give your Apple® Macintosh computer (or, for that matter, any other Mac OS computer of your choice) a dramatic new look and feel, along with all kinds of enhanced capabilities for accessing the Internet.

It will also set an entirely new standard of powerful, intuitive computing—a standard the competition can try to catch up to. (Again.)

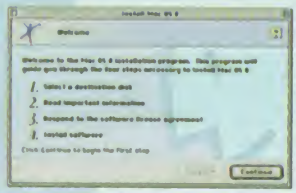
A new way of working

The moment you start using Mac OS 8, you'll feel the difference: you'll find yourself accomplishing more in less time. A multi-threaded Finder™ lets you execute multiple tasks simultaneously, such as launching applications and copying files. Mac OS 8 includes new information-management tools, such as contextual pop-up menus and spring-loaded folders, that give you quicker and easier access to all your information. A scalable environment lets you either limit your menu and window options, or expand them—whichever works better for you. A new, dimensional look makes the interface more dynamic and engaging than ever. And Mac OS 8 also includes the latest versions of QuickTime® with its MPEG support, QuickTime VR and QuickDraw™ 3D.

How easy is it to get going with all these new technologies and features? Very. Because our new installer and setup assistants take you through each step of configuring your new system software. Once you're up and running, PowerPC™-native code improves your performance. Mac OS 8 is also completely compatible with all PowerPC and 68040-based hardware and software.

A new way of accessing the Internet

Mac OS 8 includes TCP/IP and PPP for easy network or modem access direct from the Finder. You get Netscape Navigator,™ Microsoft® Internet Explorer™ and the PointCast Network.™ And a new Internet Setup Assistant makes it easier than ever to get on the Net, whether you're doing it from home with a modem or from work with a high-speed connection. Personal web sharing is standard, so you can turn any Mac into an Internet web server. And Java™ support is built in, so you can run Java applications just as though they were any other desktop applications. (If you were wondering, Windows® 95 can't do this.)



And more advancements are on the way

Mac OS 8 is one of the most significant advances in OS technology ever. And it's just the beginning—additional upgrades are planned. And our support for the Mac OS will continue for years.

At the same time, we're also working on an industrial-strength OS, code-named Rhapsody, that will offer features such as protected memory, preemptive multitasking and symmetric multiprocessing. Rhapsody will also provide backwards compatibility, so you can be sure that the vast majority of your Mac OS apps will run on Rhapsody, too.

In other words: Apple is still developing the most innovative, user-friendly and consistently superior products on the market. That's one part of our system that won't change. To learn more, visit www.macos.apple.com.

If you want to use Netscape Navigator to browse the Net, you'll like this: it's an integrated part of Mac OS 8.

Microsoft®

Internet Explorer

Microsoft Internet Explorer fans will be happy to know that this powerful web browser is also built right in. Choice is just one of the many Mac OS 8 perks.

PointCast®

It's the PointCast Network. It comes with Mac OS 8. And it grabs the news you want directly off the Net to create customized desktop news pages. Daily. Hourly. As often as you want.

When you get Mac OS 8, you also get built-in Java support, so you can run both local and network-based Java software just like other desktop applications.

Mac OS

Mac OS has always been the easiest and most intuitive of all operating systems. Now, Mac OS 8 brings this kind of computing to a whole new level.

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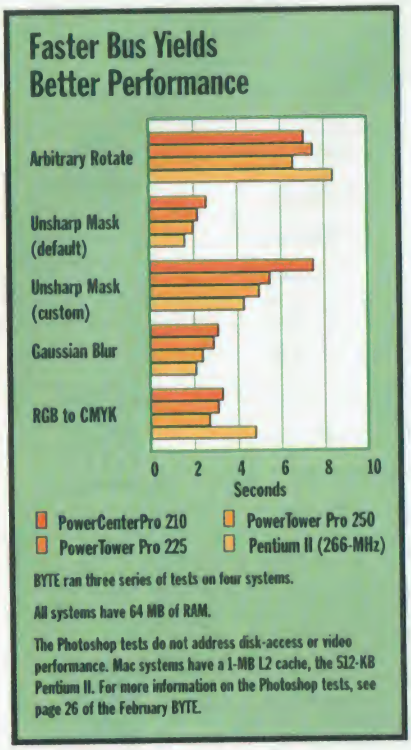
runs at 50 MHz.)

The PowerCenter Pro is the only 604e system we've seen with a system bus running at that speed. The system comes standard with 1 MB of Level 2 cache and 2-MB ATI Mach64/3-D GT video.

Available in both low-profile and minitower formats, the $2395 base system includes 64 MB of RAM (expandable to 512 MB with four DIMM slots) and a 2-GB IBM DCAS-32160 5400-rpm fast (20-MBps), but not wide, SCSI hard drive. It also has a Teac 16X CD-ROM drive, AAUI and RJ-45 10Base-T ports, a second 5-MBps external SCSI port for an additional seven devices, sound support, and bundled software. Three PCI slots are available for AV, SCSI, or networking upgrades. The CPU is on a daughtercard for upgrading, but the Catalyst system board does not support a second processor. The 4-MB video upgrade in our test system adds another $49 to the price. Power Computing also sells a 180-MHz version.



The PowerCenter Pro 210 delivers high-end performance at mid-range prices.

Although they don't have support for interleaved memory or as many PCI slots or expansion bays as the PowerTower Pro, these PowerCenter models bring excellent performance to the market, without the higher price of the fastest Mac OS clones. **–G. Armour Van Horn**

Datapro Report

Enterprise Applications Use Web to Reduce Costs, Improve Service

Now that they've reduced costs and improved efficiency through employee layoffs and reengineering, businesses are downsizing their enterprise applications, too. To take advantage of cost savings over the lifetime of these applications compared to traditional PC/LAN environments, enterprise-level applications providers are adding Web-access and network-computing (NC) support to their accounting, banking, manufacturing, enterprise-resource-planning, and other applications.

The Web's global reach alone is a compelling factor. A big benefit of the Internet is its ability to let businesses get closer to their customers. Any enterprise-wide application that has potential for improving communications with customers or employees is a good candidate for Web integration. In recent months, IBM, Microsoft, Oracle, PeopleSoft, and SAP have introduced Java- and/or Web-enabled applications. What follows is a snapshot of the major vendors' strategies and progress to date.

IBM

HR Access, IBM's Internet-ready human-resources package, is tightly integrated with Lotus Notes and the Domino Web applications server in order to supply work-flow capabilities. IBM is aggressively pushing the NC model, focusing its hardware strategy in support of thin clients and fat servers and providing secure electronic-transaction technology.

Microsoft

The company's cross-industry object strategy is based on its ActiveX Store Architecture and Value-Chain Initiative. This initiative specifies the interfaces required to develop ERP applications, while the Store Architecture specifies ways to connect a business's back office and front office. Both of these approaches are inherently Web enabled.

Microsoft hopes to build a generic, business-to-business, electronic-commerce-type infrastructure and sit clusters of industries on top of it. Hardware and software suppliers will use common ActiveX components and interfaces to build applications that use the Web to link the constituencies of a vertical market together.

Oracle

The database vendor is focused on supplying transaction-based applications over the Web that support corporate work-flow and business processes. Oracle Financials, HR, Manufacturing, Web Customers, and Web Employees were among the first Web and work-flow applications on the market.

PeopleSoft

Developers can use Spider Technologies' NetDynamics and OneWave's OpenScape to build custom Web interfaces to PeopleSoft applications and extend those applications to the Web. PeopleSoft plans to roll out its own Web-client capability this year. PeopleSoft's latest release, version 6, also has many Web-enabled modules for bills and routings, production management, cost management, and work flow. PeopleSoft is currently migrating from a two-tier to a three-tier architecture, which will allow more flexibility in the partitioning of applications across the enterprise, including the Web.

SAP

R/3 System 3.1 features easy-to-use-and-tailor Internet capabilities for all R/3 business processes. The package is Java enabled and offers improved administration and support for new platforms, including NCs and thin clients. In addition, new out-of-the-box Internet functionality is available through 25 ready-to-use application components, 10 employee self-service applications, and more than 150 Java-enabled business application programming interfaces (BAPIs). Because R/3 System 3.1 is Java enabled, system administration is simplified by eliminating the need to maintain presentation code on the client.

Datapro expects to see the widespread deployment over the next year of Web-based applications and modules for enterprise software vendors that automate simple customer interactions. From mid-1998 on, we expect to see fairly complex transactions and work flow occurring across the Internet and on intranets using NC platforms that extend the supply chain from corporations to customers on one side and suppliers on the other.

Bob Anderson, *managing analyst, enterprise systems software at Datapro. For more information about Datapro reports, call 609-764-0100; fax 609-764-2814; or send e-mail to http://www.datapro.com.*

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Book Reviews

Apocalyptic Programming

Three recently published books guide you in recognizing, assessing, and addressing the now-well-known year-2000 (Y2K) problem. Each approaches the subject with different levels of intensity, tailored to different audiences.

Solving the Year 2000 Problem

Jim Keogh's book is the most approachable and enjoyable of the trio. Keogh treats the Y2K problem seriously but cheerfully. Information managers need to understand the Y2K problem before they can fix it. This book provides basic information unburdened with minutiae.

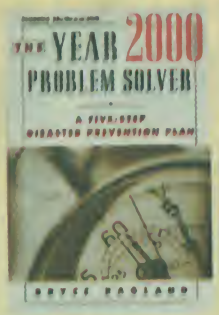
Keogh uses examples in each chapter to gradually reinforce the idea that Y2K is a real problem with consequences at every level of business. Then he guides you toward a solution via a series of simple steps.

Keogh also addresses the trade-offs between contracted and in-house solutions, including warning signs for detecting unscrupulous or ill-informed consultants. The book ends with pointers to more information, including Web resources, newsletters, journals, and vendors specializing in Y2K solutions.

The Year 2000 Problem Solver

This concise guidebook, by Bryce Ragland, is best suited for experienced information professionals. To get the most out of this book, you should understand the Y2K problem and the programming consequences. Of the book's 270 pages, 165 are devoted to a bibliography of article references, analysis and conversion tools, vendors offering conversion services, help resources, and case studies.

Instead of focusing solely on fixing applications, Ragland correctly places higher value on the data itself. He discusses how to keep existing legacy data from being corrupted during conversion of existing applications or by updates from newer Y2K-aware applications.



Ragland's recommendations, such as creating task teams and motivating upper management, are appropriate to larger, enterprise settings.

The Year 2000 Software Crisis

This tome, by William M. Ulrich and Ian S. Hayes, is dry and ponderous. But given its encyclopedic coverage of the Y2K problem, it could hardly be otherwise. From history to management issues, asset management to mobilization, and implementation to validation, this book leaves no subject pertinent to Y2K unexplored.

The authors, professional IT consultants, are heavily involved in Y2K consulting, seminars, expos, and solution marketing. Their goal is to expose the reader to the full range of possible issue and the multitude of solutions for those issues, and they succeed. The expertise and experience the authors provide makes the journey worthwhile.

Those just coming up to speed on the Y2K problem would be well advised to start with one of the other two books reviewed here. But once you master the basic concepts of the Y2K problem and need a solid conversion plan, this book will provide chapter and verse for an effective strategy.

Rob Hummel *(Sullivan, NH) is a frequent contributor to BYTE. You can reach him by sending e-mail to rhummel@cheshire.net.*

Solving the Year 2000 Problem by Jim Keogh; AP Professional; ISBN 0-12-575560-0; $27.95

The Year 2000 Problem Solver by Bryce Ragland; McGraw-Hill; ISBN 0-07-052517-X; $29.95

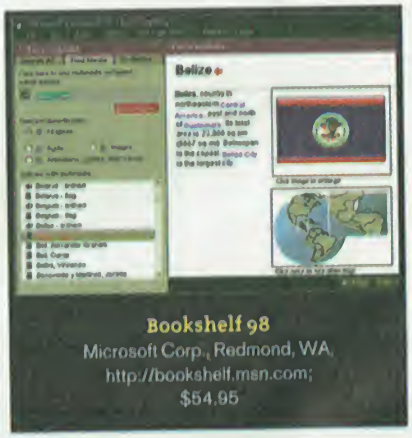
The Year 2000 Software Crisis by William M. Ulrich and Ian S. Hayes; Prentice Hall; ISBN 0-13-655664-7; $39.95

More than Just Facts

New and improved Bookshelf reference

Whether you're a student, publisher, lawyer, or business manager, Microsoft's Bookshelf 98 will help you clarify and improve your writing. The product description claims it's "one-stop shopping for reference information." This may be true, depending on how extensive your reference needs are. However, for most simple tasks, the new and improved Bookshelf 98 is ideal.

This version's new features include QuickFootnote, which allows you to footnote documents automatically, and QuickShelf, which lets you click on any other program while still staying in the current one. Other key new features include an Internet Dictionary; an Encarta 98 Desk Encyclopedia, which contains nearly 16,000 entries; and a Columbia Dictionary of Quotations, which has more than 18,000 remarks and quotations on over 1500 subjects.



Bookshelf 98
Microsoft Corp., Redmond, WA
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Updated versions of *The World Almanac and Book of Facts 1997*, *The American Heritage Dictionary of the English Language*, and the *National Five-Digit ZIP Code and Post Office Directory* are also included. A new parental-control feature enables parents and educators to block words and phrases that they consider unsuitable for children. With these new features, Bookshelf 98 is easier, quicker, and more enjoyable to use.

–Jesse Friedman

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Circle 140 on Inquiry Card.

Blasts from the Past

5 Years ago in BYTE

We discussed parallel-processing issues, such as shared memory and cache-coherency architectures. A summary of Digital Equipment's Alpha CPU was written by its co-developer. A review of OS/2 2.0 found gold in that there OS, but it required more digging than most users were willing to do. Also covered: Paradox 4, CorelDraw 3, Adobe Illustrator 4, DSPs, and the Mac LC II.

10 Years ago in BYTE

Editorials and features pondered the meaning of, and the difficulty of cloning, IBM's Micro Channel. An ad featured a 2400-bps modem selling for $445. We reviewed the 68000-based Mac SE ($3698) in addition to two 286-based ATs and two 386 accelerator cards for AT clones.

15 Years ago in BYTE

We devoted numerous articles to the Logo programming language. In our Letters column, readers debated the merits of Unix and CP/M. One reader even suggested that Unix, C, and Pascal are excellent teaching tools but perhaps not good for commercial projects.

20 Years ago in BYTE

Controlling small DC motors with analog signals and the APL programming language were two of the topics in this issue.

Beyond Goggles and Gloves

Jaron Lanier, pioneer and proponent of virtual reality, discusses VR's potential and hurdles.

BYTE: *Virtual reality is an intriguing exercise for the mind, but what are some practical applications for VR gloves and goggles?*
Lanier: One practical application is in medicine. VR gives surgeons the ability to bring in consultants in real time when they're in the middle of operating [on a patient]. When we apply the power of networking to the VR world, the potential for stretching the limits of human abilities becomes very powerful.

For instance, in a shared virtual world, a surgeon can point to something that he or she cannot identify—a peculiar lump, perhaps—and say to an expert 1000 miles away, "What's THIS thing?" It would be difficult to describe the lump to the consultant over the phone. But when they can both see it simultaneously and explore it together, they can immediately intuit its significance.

This gets into the most fundamental capabilities of human perception. When humans were evolving out on the Savannah, they had no language. When they needed to communicate about a relevant object or event, they could simply point to it and refer to it physically. In that way, they developed a more sophisticated way of communicating about their shared environment.

BYTE: *You've said that VR can reveal new directions for human potential that we didn't know before. Can you elaborate?*
Lanier: The brain's model of what the body is like is not as fixed as we might have thought. If you change the sensory motor loop to reflect a different body, the brain adapts to its new body parts really quickly. People can learn to use these custom bodies or body parts.

If we use VR as an interface to control different surgical instruments at the end of a fiber-optic channel in keyhole surgery, we can create a new body for the doctor, where his or her fingers become the scissors in a virtual model. This lets the doctor use these microscopic tools more effectively, more reliably, and with less chance for error.

BYTE: *Will people really use VR—that is, put on the gloves and goggles—as part of normal business practice?*
Lanier: They will when absolute peak human performance is required. If you want to see people thinking their best, you'll see them interacting physically with things. We interpret information much more efficiently when we have a physical model for it.

BYTE: *What hurdles do we need to overcome in VR?*
Lanier: One difficult area is software development. Software for VR applications is very complex and hard to write. In a typical Windows-type application, for instance, at any one time there may be a hundred or so possibilities. You can copy something, save a file, delete, and so on, and the software needs to be able to predict those potential actions and carry them out.

But if you're in a virtual room and you pick up a virtual ball, you can throw it in millions of possible directions. The VR software needs to be able to foresee all these millions of possibilities and react accordingly. There are very few people at this time who can actually write software for VR.

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BYTE EXTRA

INTERNATIONAL

Translate English Web Pages to Chinese

A Chinese-to-English version of the software is in the works.
Page 32IS 3

ADSL or Cable?

European carriers are slow to embrace ADSL Internet access.
Page 32IS 4

Mainboard Road Map

New CPUs and chip sets usher in the next generation of mainboards. *Page 32IS 6*

Benchmarking R/3 on Windows NT

NT is becoming an excellent platform for mission-critical applications. *Page 32IS 13*

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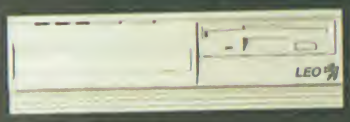

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Browser Add-On Translates English Web Pages into Chinese

A Chinese-to-English translator will be released soon.

If you're fluent in Mandarin Chinese and recognize the phrase *dian yi xia zhe li,* then read no further. But if you don't know it means *click here*, you may be interested in a series of translation applications from Otek International (Taipei, Taiwan).

Otek, founded in 1989 by former Wang Computer employees, has developed several translation packages over the past four years. The latest of these, Web Page Translator, is designed to make the English-dominated World Wide Web more accessible to the world's more than a billion Chinese speakers. The $58 program floats a small button bar above Netscape's Navigator browser or Microsoft's Internet Explorer and, at the click of a button, automatically translates English Web pages into Chinese. Translations aren't instantaneous, generally requiring around one minute per page of text on a fast Pentium machine; the program does run in the background, however, so you can continue surfing the Internet while it works.

Of more interest to English-speaking BYTE readers, who may have stumbled upon Web pages of Chinese characters coded in double-byte format, are Otek's plans to develop a Chinese-to-English version of the program. Like the English-to-Chinese version, the upcoming program, due for release by the end of the year, will require either a Chinese version of Windows or a Chinese environment manager—from a company such as Twinbridge—to actually display Chinese characters. Development should be fairly simple, says Otek vice president Anno Huang, because the company already has a full-fledged Chinese-to-English translation product that's designed to work with word processing software rather than with Web browsers.

At the heart of all of Otek's translation applications is the same knowledge-based translation engine. Functional differences between Chinese-to-English and English-to-Chinese versions are minimal.

Web Page Translator incorporates a 70,000-word basic dictionary. (Supplemental dictionaries are available, covering fields such as computing, medicine, law, and finance.) As well as holding the English equivalent of each word, the dictionary contains additional information that is used to improve translation accuracy. Nouns, for example, can be tagged as referring to a person or place, or to a number of other broad categories; verbs are marked as transitive, intransitive, and

Type Chinese with Only Eight Keys

Any person able to write Chinese can now type Chinese with EasyWord97, new software that works with the English version of Microsoft Word 97. The program lets you enter Chinese characters into MS Word 97 documents with an average of just under three strokes per character.

You can write Chinese with only eight keys.

Asian Communications, developer of the software, discovered that all the strokes used to write Chinese characters could be grouped into eight stroke-type categories. These stroke-type categories could be represented by eight keys on any device having input keys, such as a computer keyboard or even a telephone. The stroke keys are then pressed in the order taught for writing the actual strokes of Chinese characters, and the computer uses a retrieval strategy to bring the desired characters to the screen. Obviously it takes a little time to learn to use the system.

Prices for EasyWord start at $39.

–Rich Friedman

Asian Communications Pty, Ltd.
Queensland, Australia
http://easyword.bluesky.net.au

so on. The difference between Otek's translation engine and a simple dictionary-based word-replacement system is the program's database of 10,000 grammatical rules. Expressed in a conditional syntax devised by the company, each rule defines how the translation of a particular word can be changed by words preceding or following it.

The English word *take*, for example, is represented in the program's dictionary by a Chinese word meaning *pick up* or *carry*. This might be described as the word's basic definition, and in the majority of cases, it is substituted directly for *take*. However, when *take* is followed by the noun *bath* or *shower*, one of the grammatical rules is activated, overriding the dictionary definition and substituting a Chinese verb meaning *wash*. The ability to handle regular tense and plural suffixes is hard-wired into the program. So variations, such as *took a bath* and *taking baths*, can be handled by the same rule.

What about a phrase such as *he takes a bath in the house*? A further grammatical rule checks for the presence of prepositions such as *in* and ensures that the correct translation of *take* is used.

Successful translation beyond basic word-for-word replacement depends upon the integrity of the grammatical rule database. Although Otek's software development team includes one linguistics specialist who majored in English, none of the programmers are native English speakers. It's possible that some of the program's translation errors—which, as is typical of this kind of application, are not infrequent—actually reflect its developers' imperfect grasp of English.

All computer translation products should be marked with a warning: "Not for mission-critical applications." Otek's Web Page Translator is no exception. It handles straightforward sentences quite well, sometimes perfectly, in fact, but its performance with complex idioms and slang can vary from borderline acceptability to unintentional hilarity. However, the forthcoming Chinese-to-English version of Web Page Translator is well worth consideration by anyone who has ever wondered what those mysterious hieroglyphics on that site in Shanghai or Xian might mean.

–Simon Burns

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Broadband Services in Europe: ADSL or Cable?

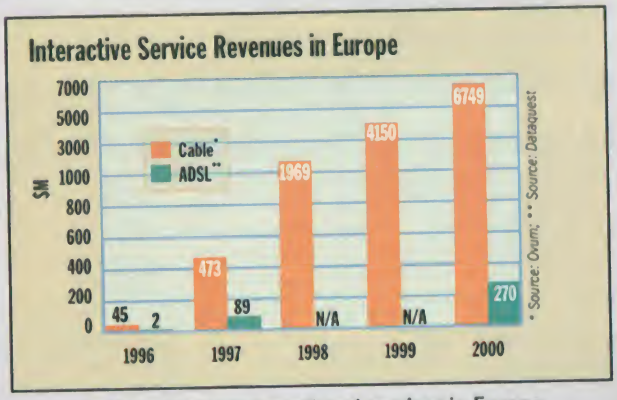
Europe's businesses will have to wait six months to a year until carriers can offer high-speed Internet access over Asymmetric Digital Subscriber Line (ADSL). That's the indication of a poll conducted by BYTE and backed by market researchers at Analysis (Cambridge, U.K.). Although ADSL is seen as an excellent access technology to broadband services, European carriers are not offering the new services yet. The carriers closest to a commercial launch are Telia (Sweden), BT (U.K.), Tele Denmark, and Telecom Finland.

The telcos' slow response to the broadband market means that an opportunity is opening up for cable service providers. The development is similar to what happened with Internet service providers (ISPs) when the Internet began to experience explosive growth. Says Paul Knott, author of a study (published by Analysis) on broadband technologies and their implications, "Telecommunications operators' local access monopoly will no longer exist in a market where cable, satellite, and terrestrial TV broadcasters provide alternative distribution mechanisms."

Cable operators across Europe, especially in Northern Europe, Switzerland, Netherlands, Belgium, France, and Austria, are already offering commercial services such as fast access to the Internet. However, they are currently concentrating on the residential subscriber market.

There are several reasons for the slow uptake of ADSL in Europe. BT has completed its ADSL trials but has no immediate plans to offer such services. The carrier is experiencing very high growth in its ISDN Basic Rate services, a spokesperson notes. Deutsche Telekom officials say that with one of the highest ISDN installed bases in the world, they don't feel an immediate need to rush into offering a high-speed service.

On the other hand, confusion about xDSL standards, marketing strategies, and positioning is slowing things down. Telia, for example, was about to launch ADSL-based interactive services on a commercial basis earlier this year but now says it has decided to put this off until it has completed further trials. The reason for the slowdown is that Telia's research group is debating the use of Very High-Speed Digital Subscriber Line (VDSL) technology instead of ADSL.



In the near term, broadband services in Europe will be dominated by cable operators.

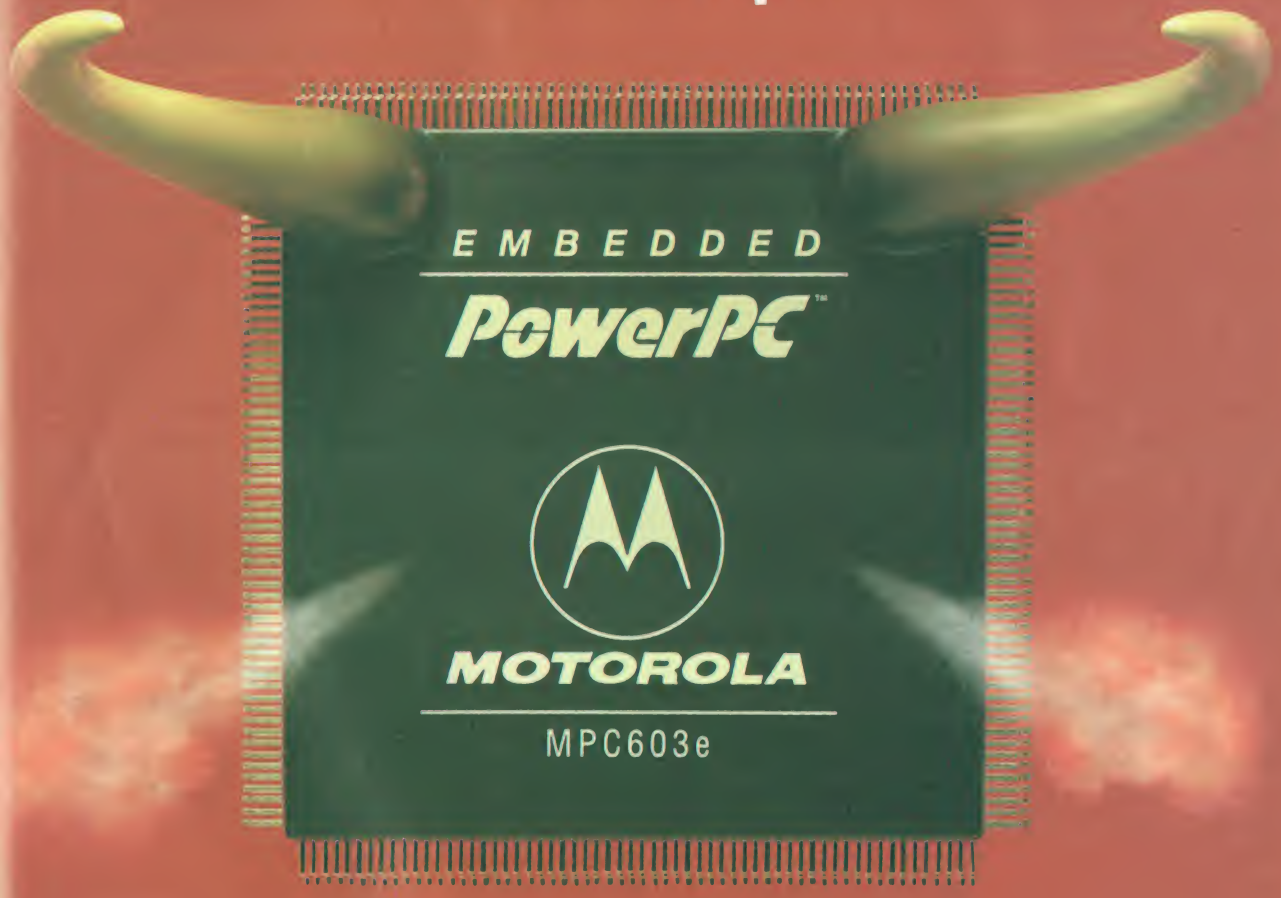
Much of the hardware required for a coherent ADSL service strategy is still not commercially available. However, some new developments from ATML (Cambridge, U.K.) and Orckit Communications (Tel Aviv, Israel) could change this situation in the near future. ATML launched a family of new communication chips earlier this year. Called Hydrogen (available now) and Helium (to be released by the end of 1997), these RISC-based processors handle asynchronous transfer mode (ATM) over xDSL very efficiently and are expected to significantly reduce cost and time to market for ADSL equipment suppliers developing modems, multiplexers, and network adapters.

Orckit's new ADSL-over-ISDN modem could be an opportunity for the large installed base of ISDN business users in Europe to increase bandwidth. Orckit's passive ISDN splitter enables parallel and transparent transmission of both ADSL and ISDN over twisted-pair telephone lines. Says Dan Arazi, Orckit's executive VP of marketing and sales, "ADSL over ISDN offers telcos a new option to enhance their subscriber services without undermining ISDN services already in place."

–Valerie Thompson

Embedded PowerPC microprocessors.

There's nothing tame about these chips.



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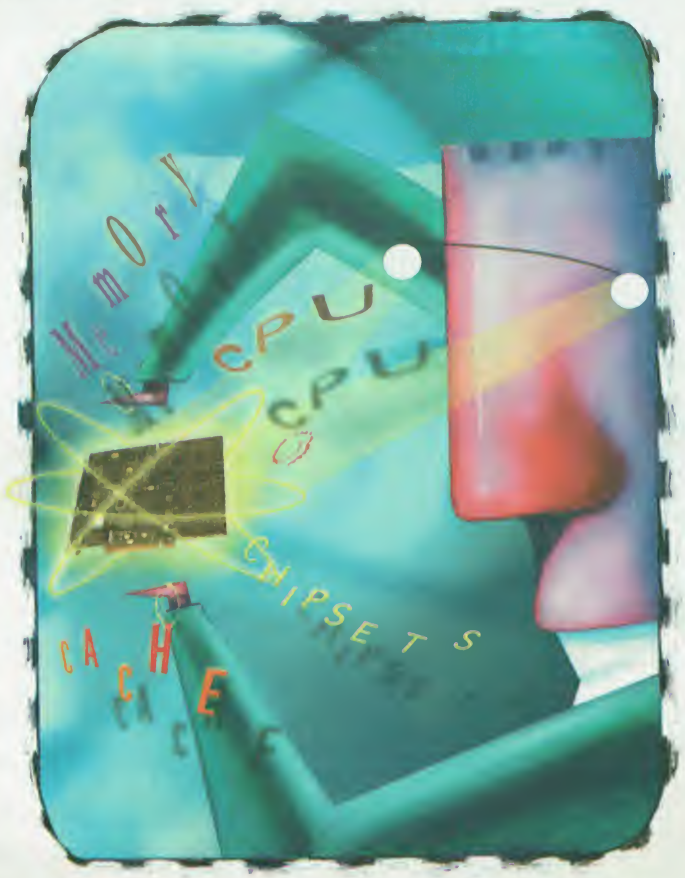
New Mainboards

The next generation of mainboards are starting to appear, but early adopters of Pentium II boards may not see the huge speed increases they desire.

By Nebojsa Novakovic

This year brings yet another generational switch in PC mainboards, although initially users might not see a big performance increase. The best example is the Pentium II, whose slot 1 requires a new generation of mainboards, but it delivers only slight performance improvements over the Pentium Pro. Its clock has been upped by 33 percent to 266 MHz, but the cache runs at only 133 MHz instead of 200 MHz; its memory-bus speed is the same. Another result of the increased power requirements of slot 1 is that only a few boards, such as the Tyan Tahoe series, offer dual Pentium II capability.



Form Factors

Despite the onslaught of new, technically superior form factors, the venerable Baby AT is still alive and kicking. Literally every x86 mainboard design is available in a Baby AT version. But if you're integrating a new system, ATX, which offers all full-length slots and component positioning to provide better airflow, is the clear choice. Slim desktops are the only exception, due to their modular NLX form factor with riser card.

The ATX and full-size AT formats are both present in the workstation and server arenas, and the latter format is still popular in dual-processor designs. The key issues here are dual-processor (and sometimes quad-processor) support, airflow, the power requirements of the processors, and memory and I/O expandability.

CPU Choices

With the advent of new x86 CPUs this year, it's easy to get confused by all the choices: Pentium "classic"; Pentium MMX, K6, or 6x86MX in standard Pentium mainboards with socket 7; Pentium Pro in mainboards with socket 8; and Pentium II in mainboards with slot 1. But what differences matter most to the user?

Currently all these sockets share the same bus bandwidth: 528 MBps on a 64-bit, 66-MHz system bus, a trait inherited from the first 66-MHz Pentium in 1993. The only exceptions are the Cyrix 6x86 and 6x86MX processors, some of which (e.g., the 6x86-150, 6x86MX-187.5, and 6x86MX-225) support a 75-MHz bus for 600-MBps bandwidth. Of course, the actual bandwidth over that bus has improved; the fast-page DRAM used in 1993 has been replaced by synchronous DRAM (SDRAM), which increases the bandwidth fourfold. In addition, new-generation processors, such as the Pentium II, provide separate secondary cache buses to off-load the main system bus.

Socket 7 supports only Pentium-class processors that use standard TTL signal levels, while socket 8 and slot 1 support Pentium Pro/Pentium II Gunning Transistor Logic (GTL) signal levels. GTL is supposedly more suited for higher-frequency system buses with more loads (i.e., those with several processors and/or multibank memory arrays).

Intel's move toward proprietary daughtercard modules in slot 1 and the future slot 2 is influenced—at least to a certain extent—by the company's desires to keep the competition from sharing the same socket design. It also lets Intel provide more cache-subsystem variations over a separate 64-bit cache bus on the module. For instance, a 512-KB half-speed cache (133 MHz on a 266-MHz CPU) is present in the first Pentium II slot 1 iteration, and up to 2 MB of the new full-speed dual-data-rate static RAM (DDR-SSRAM) cache might be present sometime next year in some Pentium II server versions using slot 2.

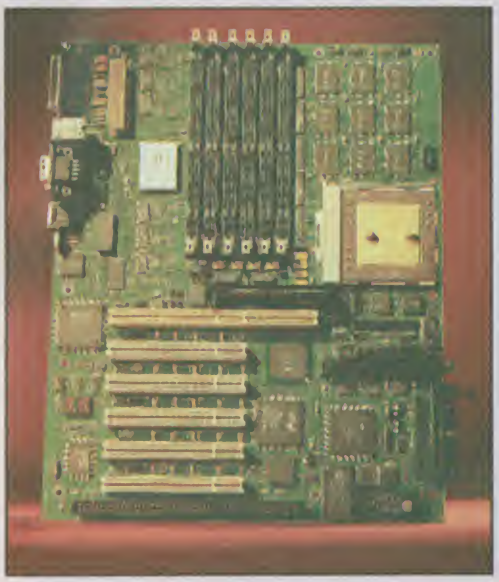
However, the actual technological life of each slot comes into question: The initial slot 1 running off a 66-MHz bus is expected to support the Pentium II at up to 333 MHz, but 350- and 400-MHz Deschutes versions of the Pentium II will use a 100-MHz bus version of slot 1 in early 1998. Then the servers will

RISC-Based Mainboard Advancements

Right now, there are three RISC platforms that offer standard PCI-based desktop mainboards on the open market: Alpha running Windows NT, PowerPC running Mac OS, and Sparc running Solaris (for Sun UltraAX boards only, using the UltraSparc II CPU).

For the PC market, Alpha is now the only RISC Windows platform, and its three CPU suppliers (Digital Semiconductor, Mitsubishi, and Samsung) are strongly driving the push into the mainstream with a new series of Alpha mainboards in standard ATX, which are set to come out this year. For the standard midrange 21164 processor at frequencies up to 600 MHz (800 MHz if supercooling is used), the PC164LX mainboards from Digital are available with 2 MB of 128-bit burst cache, as well as a 128-bit, 66-MHz SDRAM main memory bus with four DIMMs, providing up to 512 MB of RAM.

The new mainstream 21164PC processor runs at frequencies up to 533 MHz and is supported by the PC164SX mainboard, which is similar to the LX but with only 1 MB of burst cache. Both boards use the 21174 Pyxis chip set, integrating the whole North Bridge core logic with a 64-bit PCI interface in a single BGA chip. The mainboard designer can then choose from a variety of South Bridge chips from Cypress, Intel, VIA, or VLSI Technology. While the LX uses the Intel 82378ZB bridge, the SX uses the new Cypress bridge, which provides USB functionality. Importantly, Digital Semiconductor offers design information on these reference mainboards to mainboard makers interested in embracing the Alpha.



The DeskStation RPX164-2 supports the Alpha 21164 microprocessor at 600 MHz.

VLSI Technology offers the new Polaris single-chip North Bridge for the 21164PC Alpha, providing even tighter integration and saving a lot of external discrete logic. The PC164ZX mainboard from Digital, similar in specs to the PC164SX, will use the Polaris. Several mainboards from other Alpha manufacturers are also expected to use Pyxis or Polaris chip sets for the 21164 generation. In fact, the new PCA 57 0.25-micron successor to the 21164PC, expected to arrive around year's end, will be supported by the AGP-capable Polaris 2 chip set. The PCA 57, expected to be produced by all three Alpha CPU vendors, should reach 800 MHz in desktop versions and 600 MHz in low-voltage notebook versions. With its dual-CPU support, ultrafast cache and memory buses, and very small die size, the PCA 57 will be a fantastic competitor to Intel's 350-to-400-MHz Deschutes.

On the high end, the 21264 EV 6, running at 600 MHz and higher, should be supported around year's end by a series of reference mainboards: the PC264 uniprocessor, the PC264DP dual processor, and, later, the PC264QP quad processor. All are based on configurations of the Tsunami 21272 chip set in either integrated or modular configurations.

With their separate cache and memory paths for each CPU; 6.4-GBps peak total main memory bandwidth from a 512-bit-wide, 100-MHz SDRAM memory; and multiple, parallel 64-bit PCI and AGP buses, these boards should offer the closest one can get to a real supercomputer on a desk, running either Digital Unix or 64-bit Windows NT 5.0. In addition, features such as USB, PC97, UW SCSI, wavetable audio, and Fast Ethernet are expected to appear on some of these boards, with IEEE 1394B Firewire II and 66-MHz, 64-bit PCI 3.0 for1998 revisions. Further speedups will come from the 800-MHz+ 21264 EV67 and 21264PC PCA67 processors in late 1998, as well as the 1-GHz, 100-SPECint95+ 21364 EV7 Alpha in late 1999, which is expected to keep Intel's Merced at bay.

probably use the 100-MHz slot 2, which has full-speed cache capability and support for four or even eight processors—yet another new footprint. Therefore, users of current slot 1 mainboards don't have much to hope for in terms of long-term upgrading.

On the other hand, AMD and Cyrix are trying to squeeze as much potential as possible from the standard Pentium socket 7 footprint. In fact, AMD's new K6 owes much of its initial popularity to the socket 7 footprint, which enables Pentium-class mainboards to match the Pentium Pro at least in uniprocessor performance.

Cyrix was the first company last year to drive socket 7 successfully to 75 MHz with its 150-MHz 6x68-P200+ processor. Its new M2 line will also support that bus frequency, as well as an 83-MHz bus. An 83-MHz, 64-bit memory bus could be a better choice than 75 MHz, as it can be easier to synchronize to 33-MHz, 32-bit PCI. The bandwidth of the memory bus in this case would be precisely five times that of the PCI.

While the first members of the K6 family (up to 266 MHz) use a standard 66-MHz bus, AMD seems poised to accelerate the socket 7 bus all the way to 100 MHz by year's end, and even 133 MHz next year, with a 250-/83-MHz interim stop this quarter. The first 0.25-micron iteration of the K6, running at 300 MHz, is expected to use a 100-MHz bus in socket 7. Such a move can help AMD to not only dramatically improve the external cache and memory performance of the K6, resolving the bottleneck that kept it from fully matching the Pentium II, but also extend the life of socket 7 for another year or so.

In any case, the current K6 and M2 processors already have 64 KB of on-chip full-speed primary cache, double the capacity of the cache on the Pentium II and Pentium MMX. Larger on-chip cache can somewhat buffer the effect of relying on a slower system bus for both cache and memory transfers; this is the most serious limitation of socket 7.

Cache and Memory

In 1996, literally every new Pentium-class and higher PC had pipelined burst static RAM (PBSRAM) chips for secondary cache, which made the most out of the available bus speed. This year, two new SRAM types will appear in PC caches. The first is late-write burst SRAMs, which boost the frequency to about 250 MHz

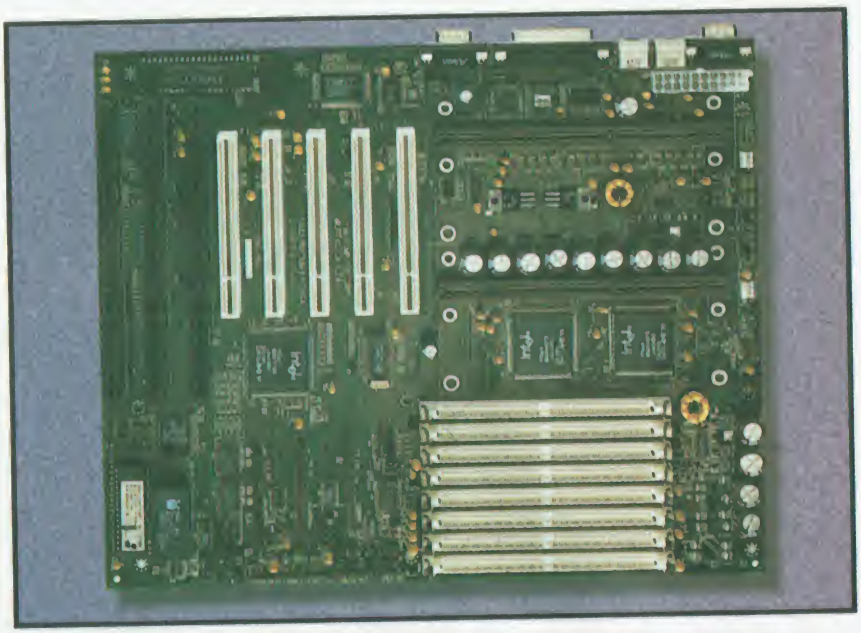
by supplying the write data to the memory one clock after address. These SRAMs are already supported by some RISC CPUs, such as the Mips R10000/R12000, UltraSparc, PA-8x00, and Alpha 21264.

You can add the dual-clock capability of transferring data on both clock edges to create the second new SRAM type, the aforementioned DDR-SSRAM. It offers data rates up to 400 MHz at 200-MHz clock speeds (envisioned for 4-Mb generation in early 1998) and up to 500 MHz (for 8-Mb generation in late 1998). Most new processors, including Intel's Katmai Pentium II and Digital Equipment's 21264 and PCA57 low-power 21164, are expected to support DDR-SSRAM for added cache bandwidth.

The challenges that await mainboard designers at such cache-frequency levels are enormous, even when the CPU and cache are isolated on symmetric multiprocessing (SMP)–optimized modules, as is the case with Intel's Pentium II family and multiprocessor 21264 Alpha mainboards. It becomes almost necessary to move the full cache control onto the CPU via a dedicated backside cache bus, which is physically separate from the main memory bus. Ultrafast processors, such as the 21264 and R12000, which have 128-bit-wide cache buses at these frequencies, will be the testing ground for top mainboard designers' skills.

On the memory front, SDRAM has secured the leadership for 1997 and probably 1998, although its prospects beyond that look a bit insecure due to Intel's support for competing Direct RDRAM, initiated by Rambus. But the bandwidth-capacity limits of SDRAM have not yet been reached—currently you can obtain 125-MHz, 64-bit, 128-Mb SDRAM dual in-line memory modules (DIMMs) composed of 64-Mb chips (5-1-1-1 burst transfers at 83 MHz). You can expect to see in 1998 256-Mb DDR-SDRAMs approaching 300-MHz throughput on a 150-MHz clock using both clock edges to transfer data, as RDRAM and DDR-SSRAM now do.

Current X86 mainboards using SDRAM do not have more than four DIMMs, and most of them do not support 72-bit error-correction-code (ECC) SDRAM DIMMs. But Alpha-based SDRAM boards, such as the Digital PC164LX and DeskStation RPX164 series, support parity or ECC SDRAM DIMMs. The new Intel 440LX chip set for the Pentium II is also expected to provide ECC SDRAM support.



The Tyan Computer Tahoe 2 ATX board has a clock speed up to 300 MHz using two Intel Pentium II processors.

I/O Bus Improvements

Now that ISA has been thrown out of the PC98 spec, it's clear that in a year's time, PCI will handle all your system's I/O except for graphics, which will probably use the new Accelerated Graphics Port (AGP) bus defined by Intel.

While its architecture is very similar to that of PCI, AGP's 32-bit bus differs; here it's a "point-to-point" connection between the main memory and the graphics circuitry, enabling only one AGP slot to be present in a system. AGP-2x achieves 533 MBps by transferring data on both edges of a 66-MHz clock cycle. AGP-4x will deliver 1066 MBps by pushing the clock rate to 133 MHz. Many new graphics chip sets—from mainstream ATI and S3 offerings to high-end chips, such as 3DLabs' Glint Gamma—will directly support AGP, enabling them to access main memory for texture storage or to use the faster interface for better performance.

In addition to its current presence on the Alpha, some industry observers expect to see the 64-bit PCI bus extension implemented on the Intel platform. This extension doubles the I/O bandwidth to 264 MBps, enough for 200-MBps dual-port Fibre Channel cards. You can also pair two 64-bit PCI buses with separate paths to the main memory for a total I/O bandwidth of 528 MBps. This feature is provided in the Digital AlphaServer 4000. But other sources say that 64-bit PCI is not imminent on x86 PCs, as there will be less need to speed up PCI after the graphics traffic is off-loaded onto AGP.

As mainboard designers have learned to handle PCI electrical load limitations, the past few months have seen the first batch of mainboards to offer five PCI slots on a single PCI bus—an improvement over the usual four. For even more slots, the mainboard needs to have either a PCI-to-PCI bridge, as the Digital 21153 does, or two parallel PCI buses.

PCI-to-PCI bridging is also a part of the first I20 Intelligent I/O implementations, which have already appeared on some Pentium Pro server mainboards, including the Tyan Talon 2. Intel's new 960RD processor—the successor to the first I20 processor, the 960RP—is implemented on several Pentium Pro mainboards; it has a dedicated secondary PCI bus with three or four slots that are I20 compliant.

PC97 Compliance

PC97 compliance, smart power management, and remote power management are must-have features for new mainboards in the second half of this year. The trend is to embed more of these features in the chip set itself.

Toward year's end, the first mainboards compliant with the new PC98 specification should arrive, minus the set of old, huge ISA bus slots. While this ISA bus

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elimination may cause some temporary compatibility problems with some standards, such as Sound Blaster, it's something that's overdue. After all, the 16-year-old ISA standard does not stand up to the bandwidth demands of today, even for slower cards and peripherals.

Device Bay, developed by Compaq, Intel, and Microsoft, is also expected to be supported in 1998 mainboards. In addition, the IEEE 1394 "Firewire" interface becomes a requirement in PC98; it was just a recommendation for PC 97.

Graphics, I/O, and Multimedia Integration

Mainboards with some degree of integrated I/O will continue to be popular on both Intel and Alpha platforms during the latter part of this year. What are the key devices that customers want to see on a mainboard? Power desktop and small-server users usually want to see UltraWide or Ultra2Wide SCSI, as well as Fast Ethernet built in. This not only saves slots but also a couple hundred dollars off the cost of a system.

An affordable integrated audio processor sitting directly on the mainboard's PCI bus and handling Dolby AC-3 five-channel sound with wave table and 3-D surround sound is now a reality, although Sound Blaster compatibility might be a problem without the ISA bus that the original Sound Blaster sits on. Good examples of advanced audio processors for possible mainboard implementation include the CS4610 PCI audio accelerator from Crystal Semiconductor, the Creative EMU-8008, and the SonicVibes from S3.

Graphics will continue to be integrated into mainboards for low-priced systems only, as midrange and high-end users like the flexibility of choosing their graphics cards. But Intel might produce some Pentium II mainboards that have the 440LX chip set and AGP bus and integrate the 740 Auburn AGP 3-D processor (which Intel co-developed with Lockheed Martin's Real3D division) toward year's end at the earliest.

New Chip Sets

Although Intel's chip sets populate most x86 mainboards, other vendors, such as VIA, now have offerings that often surpass Intel's equivalents. In the Pentium market, the old Triton II i430HX chip set was not fully replaced by the new i430TX. While the i430TX offers SDRAM and UltraDMA/33 IDE support, as well as better PC97 compliance with ACPI support, it still lacks the ability to, say, cache the full 512 MB of addressable RAM or support ECC memory.

This is the arena where Cypress, Opti, VIA, VLSI, and other chip-set vendors can compete with Intel. For instance, the VIA Apollo VP2/97, besides offering full support for all AMD, Cyrix, and Intel socket 7 CPUs (including the 6x86MX and K6), handles up to 2 MB of cache at a bus speed of either 66 or 75 MHz; supports SDRAM, Ultra DMA/33, and ECC on all DRAM types, as well as USB; and even integrates a keyboard controller in its two-chip count. It can also cache the whole 512 MB of DRAM-addressable space.

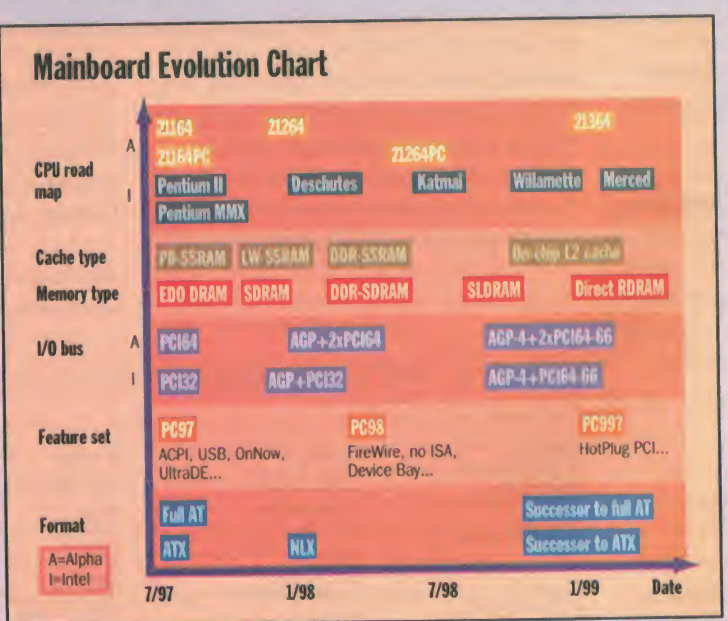
AMD has licensed this chip set to use with the K6 in its 640 chip set. The 640 is also supposed to support the OpenPIC multiprocessing protocol for eventual Dual K5 systems. Later this year, a new version of this chip set is expected, which

PC Mainboard Road Map for 1997–1998

It's never easy to predict the long-term evolution of any computer product; in the case of mainboards, it's particularly tough. But here are some educated guesses about how these products will evolve.

The ATX and NLX form factors will hold on for quite some time—at least until the end of the century for mainstream systems. However, the "sealed-case" NetPC intitiative may bring up yet another format optimized for such systems.

With the entry of a new player—IDT spin-off Centaur Technologies, with its C6 200-MHz MMX-enabled processors for the mainstream PC market—it's clear that there's still a lot of life left in socket 7, even if Intel finally abandons it next year. Expect to see slot cards take off further than using just slot 1 and slot 2, as well as 21264 CPU cards in multiprocessor Alpha mainboards in six months. The ability to keep tight control of electrical parameters on small modules will become especially important as cache and memory buses cross the 200-MHz margin and 128-bit widths and dual-data transfers become the norm. Expect a new format to appear that will specifically cover dual- or quad-processor desktop and server systems with slot cards sometime during 1998, a possible successor to the venerable full-size AT form factor.



After its initial glitches, Plug and Play is becoming real, and it will become even more stable after the ISA is (hopefully) gone in 1998. Integrating on-board I/O to some degree will become the norm, even on high-end boards; the Tyan Tahoe 2 and Digital Alpha mainboards are examples. Expect hot-plug PCI to appear on mainboards, as well as integrated CardBus support to share the cards with your notebook, next year.

Finally, there will be even more layers and even finer line pitch, increasing board complexity even as chip sets become more integrated. However, this scenario is understandable, especially with the top-end boards.

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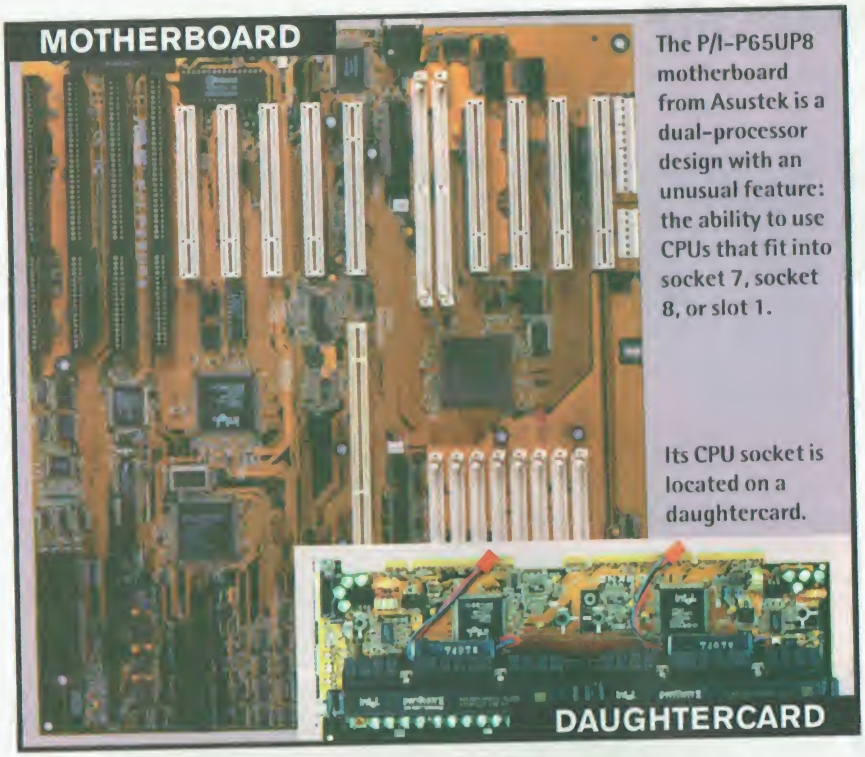
will support a 100-MHz system bus for the upcoming 300-MHz K6 processor, as well as the AGP graphics bus and the Firewire interface.

On the Pentium Pro/Pentium II level, VIA will offer the Apollo Pro chip set late this year. It will support AGP, dual parallel PCI, and Firewire, as well as the usual PC97 and ECC SDRAM features already present in the existing Apollo P6 chip set. But Intel is still expected to keep the leadership in this arena due to its tight control over the processor and chip-set design of the Pentium II series. In September, Intel is expected to offer the i440LX chip set, which will feature ECC SDRAM, AGP, On-Now, and the Ultra DMA/33. It will support 266-, 300-, and 333-MHz single- or dual-Pentium-II systems.

The Deschutes variant of the Pentium II, with a 100-MHz system bus, is slated to appear during the second quarter of 1998. These 350- and 400-MHz processors should use the i440BX chip set and offer enough support for the 100-MHz SDRAM bus and 800-MBps main memory bandwidth, as well as Firewire and Device Bay features. This chip set should be followed by the i450NX server chip set, which will implement a version of the Pentium II that uses the 100-MHz slot 2 with full-speed cache, aimed at servers.



The P/I-P65UP8 motherboard from Asustek is a dual-processor design with an unusual feature: the ability to use CPUs that fit into socket 7, socket 8, or slot 1.

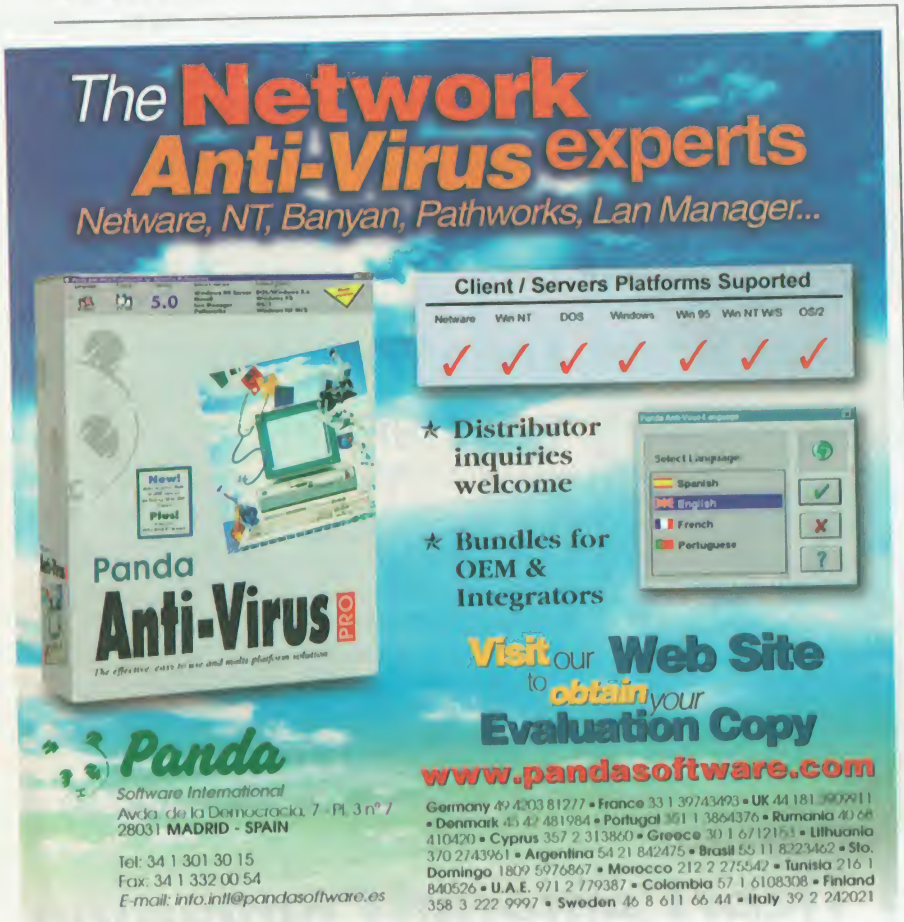
Its CPU socket is located on a daughtercard.

Future Developments

Mainboards will continue to be almost as important to the differentiation of systems as the CPUs that fit in their sockets. Unless Digital wins its current patent-infringement lawsuit and disturbs the production of the Pentium family (and, perhaps even more disruptive, Intel's P7 Merced plans), Intel will continue to dominate this market. But it's likely that more U.S. and Taiwanese mainboard makers will support the increasingly successful new-generation AMD and Cyrix devices and related chip sets.

The dual-21264 Alpha mainboard design, described in the text box "RISC-Based Mainboard Advancements" on page 32IS 7, shows what will most likely also appear in top-end PC mainboards two years from now: ultrafast crossbar-switch-based main memory paths, very high external bus frequencies, and multiple high-speed I/O buses operating in parallel, all fitting in the standard form factor. The earliest Intel designs supporting such features could appear in early 1999 with the P68 Willamette next-generation Pentium Pro or, more likely, Merced in late 1999. From that point onward, one can only speculate. B

Nebojsa Novakovic is a freelance writer based in Singapore. You can reach him by sending e-mail to **nova@po.pacific.net.sg**.



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R/3 Soars on Windows NT

New benchmarking results reveal that Windows NT is becoming an excellent platform for large-scale mission-critical applications.

By Katrin Lang and Stefan Lauritzen

How can you guarantee that your company's servers and software modules work together reliably and predictably? For R/3, SAP says the only way of assuring the appropriate level of reliability for its suite of business applications is to certify the server hardware.

"We cannot expect our customers to stress-test hardware. That's why we installed a certification program for Windows NT servers," says Günther Tolkmit, vice president of corporate marketing at SAP.

Since its release in 1994, the number of installations of the NT version of R/3 has increased substantially. Today, 28 percent of all installations and 42 percent of new installations are on Microsoft's enterprise OS.

Testing NT Servers

SAP has defined a complex certification procedure that includes functional, stress, and performance tests to guarantee that a server provides the necessary reliability and scalability.

IXOS's (Munich, Germany) Competence Center for Windows NT on R/3 (R/3NTC) performs all certification tests on behalf of SAP. There are now 18 certified server platforms. They are from these companies: Amdahl, Bull/Zenith, Compaq, Data General, Dell, Digital Equipment, Fujitsu, Hewlett-Packard, Hitachi, IBM, Intergraph, Mitsubishi, NCR, NEC, Sequent, Siemens Nixdorf, Tandem, and Unisys.

Certification is not a one-time occurrence. Instead, it's a process that includes regular tests to ensure that the system still operates perfectly when there are new NT releases and hardware upgrades. In an initial test phase, engineers monitor critical components (e.g., processor, mainboard, and I/O controller), peripherals (e.g., hard drive, memory, and network adapter), and noncritical components (e.g., monitor and graphics adapter).

The functional tests evaluate the installation and upgrade of R/3, the underlying database, and the OS. They also include verification of the R/3 base modules and a detailed backup/recovery test. Stress tests and performance tests run in a distributed, real-world environment that includes a database server and several applications servers. A typical stress test simulates 900 users running the Sales and Distribution (SD) benchmark on nine applications servers and one database server.

The minimum stress-test duration is 8 hours with an average CPU load of 60 percent, generated by a standardized benchmark program that invokes R/3 base functions and the most popular transactions of various modules. A database backup running simultaneously increases the system load.

Scalable Systems

The R/3 benchmarks measure performance on different platforms. They also help SAP's hardware partners to adapt their servers to work in the most optimal way with R/3 and provide consultants and network managers with guidelines for fine-tuning various installations. Because SAP's benchmarks are available on all OSes, they can be useful in comparing configurations and hardware architectures, but also OS and database performance.

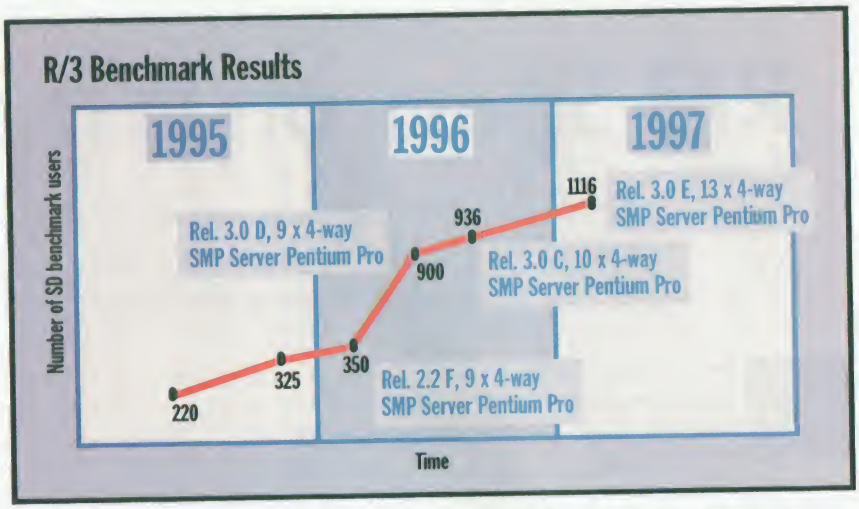
The most widely quoted benchmark deploys the R/3 SD module. Because SD is the most CPU-intensive module, the certification performance tests also use the SD benchmark. It works with predefined data that resembles the data sets of a large company. It simulates a typical user's actions and executes the most popular transactions of the SD module.

The results of the SAP standard benchmarks include average dialogue response times (e.g., 100 SD benchmark users obtain an average response time of 1.2 seconds) and throughput in SAP Application Benchmark Performance Standard (SAPS) units. For example, 100 SAPS correspond with 2000 processed order-line

items per hour in the SD benchmark. The benchmark simulates the entire work flow of an order-line item, including delivery notes, list orders, and creation of invoices, which translates into 6000 screen changes and 2000 postings per hour.

A typical R/3 benchmark curve shows average response time over the number of users. Typically, it remains constant over a broad range and then rises abruptly to the high-load range. The constant area reveals the basic response time that corresponds directly to the hardware characteristics. Even if you use sophisticated tuning techniques, you won't reduce basic response times.

The high-load range, which is where the benchmark curve leaves its horizontal course and rises exponentially, defines the maximum number of users. However, you shouldn't think that the maximum number of users in a certain configuration isn't variable. With the right R/3 buffer sizes and optimal load balancing as well as optimization of database buffers, indexes, and storage parameters, it is, in almost all cases, possible to increase the number of concurrent users up to a point.



The maximum number of users, measured by the SD benchmark, increases over time. One benchmark equals three users. (Source: IXOS)

It's not difficult to interpret the benchmark results. They clearly reveal that in a three-tier NT configuration with separate Pentium Pro–based database and applications servers, the maximum number of real users is around 2500. In a central configuration with database and applications servers in one system, up to 200 real users will gain reasonable average response times. Considering that an R/3 installation typically has a few hundred

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Higher Availability for R/3 Under Windows NT

Clusters provide better database- and applications-server functionality. Clustering has been around for years on platforms such as VMS and Unix, but it's relatively new to NT. NT cluster nodes share access to data and communicate on a private network via a cluster protocol that is mostly based on common protocols such as TCP/IP and NetBEUI. All clients communicate with the virtual cluster without addressing a specific server. Because existing clustering solutions for NT have been proprietary, Microsoft's Wolfpack aims at standardizing clustering under NT. It uses a series of APIs to separate applications from hardware components.

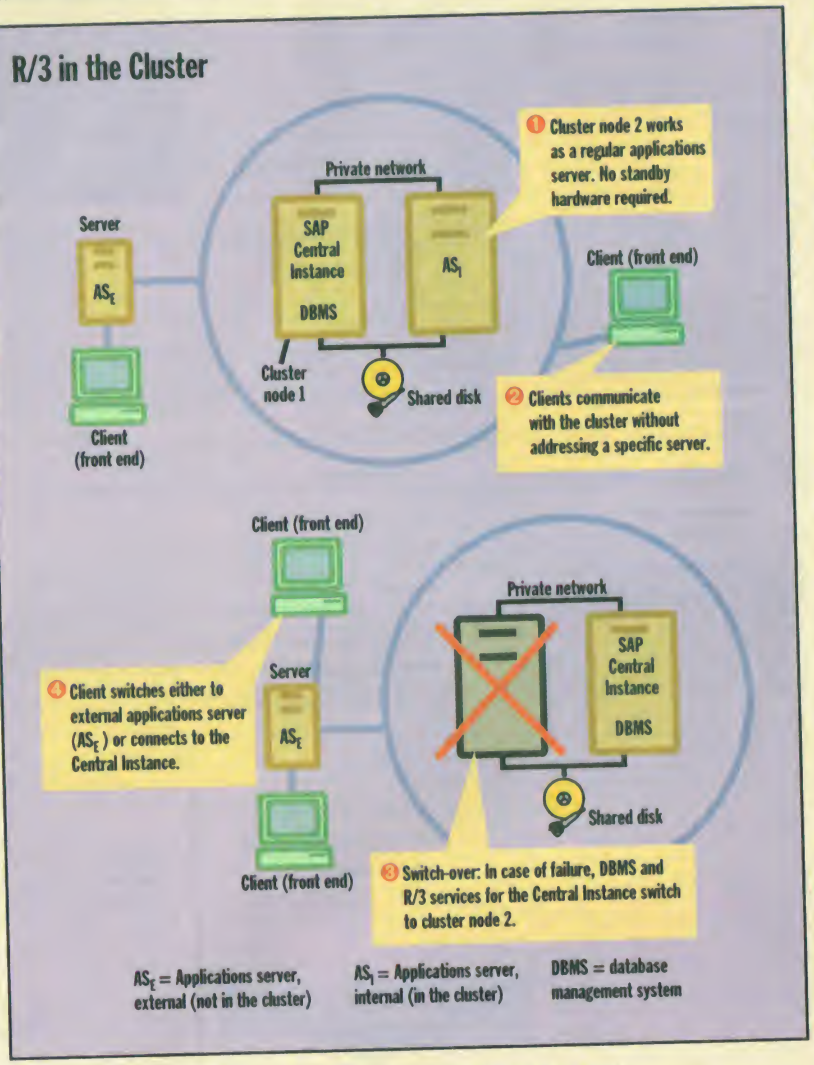
Wolfpack phase 1, released early this year, is restricted to two cluster nodes and is based on NT Server 4.x. Phase 2, slated for release in 1998, will include an extension to 16 nodes and expanded functionality on the basis of NT Server 5.x.

R/3 includes an internal load-distribution and redundancy concept. However, the R/3 server services that manage file sharing and interprocess communications (IPC)—as well as the DBMS and the SAP Central Instance (CI) containing lock-manager and message services—can exist only once on a network. That's why these single points of failure need to be secured via clustering.

The DBMS and the CI are usually the major components of a cluster. This means that despite clustering, the R/3 database, which usually comprises several hundred gigabytes, exists only once. However, in the future, DBMS replication mechanisms may reside inside the cluster.

The implementation of the DBMS and the CI inside the cluster allows for several scenarios in case of failure, the only restrictions being a uniform OS in the cluster, which is relevant for mixed Unix/NT environments, and the maximum number of two NT cluster nodes.

In a typical NT failover scenario (see the figure "R/3 in the Cluster"), the DBMS and the CI may be located on cluster node 1. The second cluster node may operate as an applications server. In case of the failure of cluster node 1, all server services (DBMS and R/3 services for the CI) must be shifted to cluster node 2 (switch over).



The type of failover scenario depends on user requirements and performance of cluster nodes.

Switch-Over Scenarios

Situation Before Switch-Over			Situation After Switch-Over		
Cluster nodes		**External node**	**Cluster nodes**		**External node**
Cluster node 1	Cluster node 2	External node	Cluster node 1	Cluster node 2	External node
CI	DBMS	AS	Failed	CI+DBMS	AS
DBMS	CI	AS	Failed	CI+DBMS	AS
CI/DBMS	AS	AS	Failed	CI/DBMS	AS
CI	AS	DBMS	Failed	CI	DBMS
DBMS	Idle	CI	Failed	DBMS	CI

CI = Central Instance AS = Applications server

However, because coexistence of the applications-server functionality and the CI is not possible on one cluster node, the applications server must be stopped beforehand. Users working on this applications server have to log on to an external applications server (AS_E) or automatically be requested to reconnect to the CI. The latter assumes that the corresponding user interaction processes have been configured on the CI. This means that R/3 enables reconnections of the front end to the applications server as well as of the AS_E to the CI and the CI to the DBMS. (The latter two depend on the corresponding functions of the DBMS Networking Transport Mechanism such as Oracle SQL Net.)

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users, it's obvious that the performance of NT Server is not a limiting factor in mission-critical R/3 applications. The benchmark results revealed by IXOS during the last three years show that software optimization and the dramatic increase in computing power of Pentium and Alpha servers have made NT a viable OS alternative for R/3. The figure "R/3 Benchmark Results" on page 32IS 14 shows that the maximum number of users, as a result of the SD benchmark, rose from 220 in June 1995 to 1116 in March. (One SD benchmark user corresponds to three real users.)

However, if you plan to run an R/3 installation with more than 2500 users, you may want to go for a homogeneous Unix configuration. If you still want to use NT, you can use a Unix database server coupled with NT applications servers. Both configurations can easily serve more than 2500 users.

Scalability is not the only crucial issue in mission-critical applications. High-availability concepts and sophisticated clustering solutions (see the text box "Higher Availability for R/3 Under Windows NT" on page 32IS 16) are equally important. There are a few possible failover scenarios (see the table "Switch-Over Scenarios" on page 32IS 16). The selection of a scenario depends on individual user requirements such as the overall performance of cluster nodes and the combination of server OSes (e.g., the DBMS on the Unix server outside the cluster and Central Instance [CI] on the NT server inside the cluster). Typically, the R/3 CI and the DBMS reside inside the cluster. If one of these cluster nodes fails, the other one immediately takes over all the services of the failed node.

The first clustering NT solutions for R/3 were on display at CeBIT this spring. Expect to see commercially available R/3-specific Wolfpack components later this year (see "Wolfpack Howls Its Arrival" on page 126). However, clustering solutions for R/3 that include load balancing inside the cluster may not be on the market before 1998. B

The Case for R/3 on Windows NT

About 40 percent of all R/3 installations in 1996 were on Windows NT. Here are some reasons why organizations chose to go with NT.

Price/performance ratio: There is a significant cost advantage of NT hardware and system tools over Unix systems.

Human resources: It's often easier to find people to administrate an NT network, as opposed to a Unix one.

Homogeneous environment: If the OS for R/3, network, database, and front end is the same one, implementation and administration are simpler.

Katrin Lang and Stefan Lauritzen are engineers at the IXOS R/3NTC in Munich, Germany. You can reach them at **katharina.lang@ixos.de** *and* **stefan.lauritzen@ixos.de.**

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You can use MultiCom LAN Access Center to build a secure virtual private network (VPN) over the Internet. The device not only checks the IP addresses of all incoming data packages but also controls the addresses of the servers that routed the packages on their way over the Internet. Similarly, if you use the device to secure dial-up ISDN lines, it not only checks that the number given by the central exchange switch is correct but also that the caller didn't manipulate the number, which is possible with some national Euro-ISDN services.

Swiss banks don't accept DES encryption because of the short 52-bit key lengths. That's why the MultiCom router uses IDEA encryption with 128-bit keys. Furthermore, every ISDN or leased line can have its own key. If you use IP-router-level encryption, the device can even assign a key to each IP address.

Overall, the MultiCom LAN Access Center is a good solution for securely linking several remote sites to a central site. The manufacturer says you can connect up to 60 branch offices.

—Rainer Mauth

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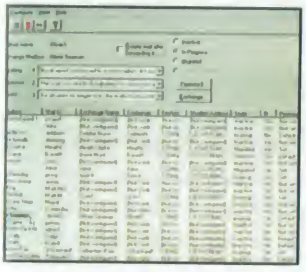
The caption referring to immersive VR on page 321S 12 of the July feature on virtual reality should have read as follows: Projection systems allow for communication between users in cyberspace.

SOFTWARE

Communications

Easy Migration to MS Exchange

If you're planning to migrate from MS Mail to MS Exchange Server, MaX Migrator may help you manage the upgrading process more efficiently. This auto-forwarding tool allows administrators to decide when to forward a user's mail and allows reply messages to be sent to the mail's originator. When the administrator decides that it's time to switch off auto-forwarding and force users to use the new Exchange mail address, incoming mail can be



returned to the sender, stating the new address.
Price: £225.
Contact: C2C Systems, Ltd., Reading, U.K., +44 118 951 1211; http://www.c2c.co.uk.
Enter 1006 on Inquiry Card.

Internet

JavaVision Makes 2-D Graphics Dynamic

JavaVision, a 2-D graphics publishing tool for Intranets and the Internet, lets you generate graphical primitives, such as lines, circles, rectangles, and polygons, and assign dynamic attributes to them. For example, you can make a graphical entity rotate or change its color with a mouse-click. The tool uses a sophisticated Java class library that's compatible with the vendor's existing graphics databases.
Price: DM 390.
Contact: in-integrierte informationssysteme GmbH, Konstanz, Germany, +49 7531 81450; http://www.in-gmbh.de.
Enter 1007 on Inquiry Card.

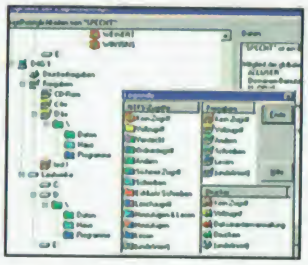
Access Your Database via a Web Browser

With the DB4Web database gateway you can access relational databases, such as Access, Adabas, CA/Ingres, and Oracle, from any Web browser. The system interoperates with standard Web severs and deploys a comprehensive Java class library. The DB4Web gateway is aimed at electronic commerce applications on the Internet.
Price: Call company.
Contact: Siemens Anlagentechnik, Erlangen, Germany, +49 9131 743892; http://www.anl.siemens.de.
Enter 1008 on Inquiry Card.

Networking

Manage NT Networks Off-Line

Caeneus Superior, a network management program for Windows NT, enables you to configure a remote site LAN and check new configurations off-line. To trace network problems, the software lets you create a snapshot of all network parameters so you can more easily check the impact of configuration changes. In addition, the software lets you create NT domains and



monitor user privileges.
Price: Starts at DM 2970.
Contact: Gerich, Bretzfeld, Germany, +49 7946 91190; http://www.gerich.de.
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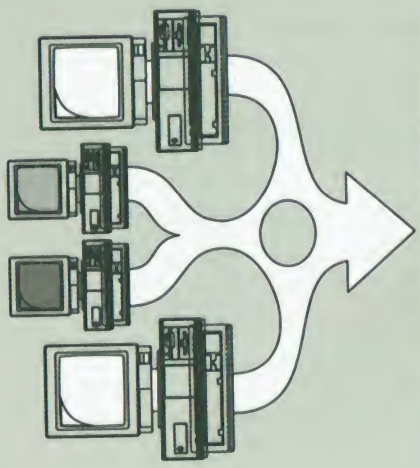

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Cyberlogic

Even if your spouse doesn't understand you, at least now your computer will. By Steve Gillmor

I Say! An Understanding Application

Until recently, affordable speech-recognition products required you to commit a highly unnatural act. You/had/to/insert/a/short/but/distinct/pause/between/each/word/as/you/spoke. This is called discrete-speech input.

Dragon Systems' NaturallySpeaking allows users to talk normally, dictating spell-corrected text at over 100 words per minute. The product ships with a 30,000-word active vocabulary, a 230,000+ total vocabulary, and a high-quality, noise-canceling microphone headset. During installation, a setup wizard adjusts your sound card's audio-input level and then leads you into a training session, where you read for about 20 minutes from one of several supplied book passages.

On-screen, NaturallySpeaking looks a lot like WordPad. Unique utilities include Train Words, Find New Words, and Vocabulary Editor. You can feed in a mix of your e-mail, memos, and other documents. The program scans your data, adds new words, and adjusts its vocabulary and word-usage information.

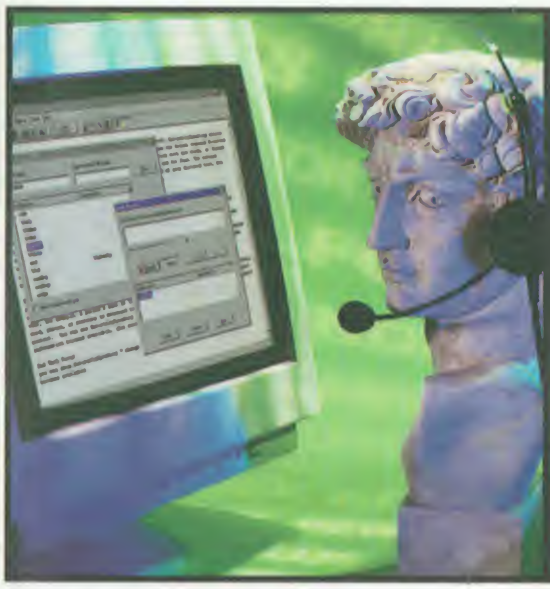
Dragon's earlier, discrete-input DragonDictate program required the user to correct errors at once. With NaturallySpeaking, you can either use the "Correct That" command now or edit later. To change a word or phrase, you say "Select," followed by the text you're looking for. Then you can replace the selection with new words or format the text. Currently, "Move to End of Line" returns you to the end of your dictated text, but Dragon plans to add a "Go Back to Where I Was" command.

You don't need a special "Alpha-Bravo" alphabet to spell out words, and you can issue commands without changing modes. With the Personal Edition, you can't dictate inside other applications (e.g., Microsoft Word and Lotus Notes), but you can move your work around with "Copy All to Clipboard," "Switch to Previous Screen," and "Paste That."

This program wants a lot of memory. I could run it along with Notes, Word, and Internet Explorer in NT Workstation 4.0 on a 64-MB Pentium-166MMX, although NaturallySpeaking still took a long 30 seconds to load from disk.

NaturallySpeaking is science fact, not fiction. It's a revolutionary breakthrough that delivers more than I expected. B

Steve Gillmor is a consultant for Southern Digital, Inc. (Charleston, SC). You can reach him at **sgillmor@aol.com**.



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Enter 995 on Inquiry Card.

In a short "training" period, NaturallySpeaking learns your accent and pronunciation and also lets you add specialized vocabulary.

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

TECH FOCUS

Sound and Sense

NaturallySpeaking converts voice input to a neutral pitch, eliminating the need for separate male/female files. A batch process compares spoken phonemes against its speaker-independent model, subtly adjusting duration, weight, and pitch to optimize the acoustic match for your individual accent and pronunciation.

Given one word, the language model predicts the next, reducing the searching required for a particular match. For example, "Mister" is likely to be followed by a name. Beyond two-word pairs, entire phrases or sentences are examined to determine the correct word in context. You can actually see the program "change its mind" as more information becomes available. NaturallySpeaking excels with complete sentences, producing as much as 95 percent accuracy after a day of steady use.

PHOTOGRAPH: LIGHTWORKS PHOTOGRAPHIC © 1997

Eval/lhp.eps

Eval

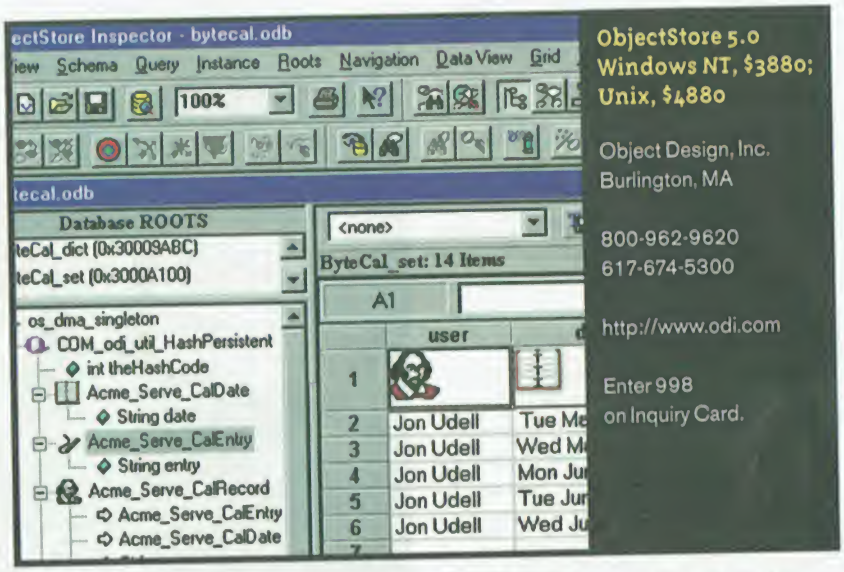
Object Database

Object Design's venerable object database adds interfaces to Java and ActiveX. By Jon Udell

What's in Store for the Web

Object databases map transient program data to and from permanent storage. It's a neat trick that Object Design has been perfecting for years. Version 5.0 of ObjectStore adds failover and replication features and responds to new opportunities and challenges. Opportunities? Web applications that play to millions need fast direct access to clusters of linked items. SQL can't do this. Challenges? Web-tool vendors have to cover a lot of bases nowadays. Object Design does.

An ObjectStore application binds user-written code to a client library that talks to the database server and maps persistent data into transient virtual memory. Version 5.0 supports three ways to package these kinds of applications: as an ActiveX control, a Java servlet, or an ObjectForms service. The ActiveX approach yields a scriptable component that you can plug into the Active Server Pages environment. I used the Java interface to enhance my group-calendar servlet (see the Web Project on page 109). If you use ObjectForms, Object Design's answer to Web/database integration tools such as Allaire's Cold Fusion, you can leverage an HTML template processor and Web gateway to ObjectStore services written in C++ or Java. Version 2.0 of ObjectForms includes Publisher, an interactive builder of ObjectForms services.



The new Collection Window, available in Inspector 2.1 and Publisher 2.0, displays object data in tabular form.

What are the trade-offs? Not all ObjectStore applications are created equal. Under the hood is a C++ engine that Java interface users can't yet run on all cylinders: The database viewer in ObjectForms Publisher 2.0 has limited access to objects created by Java programs. You can query your data if you derive your objects from the ObjectStore Collections class, but you can't order the results of those queries. Nor can Java programs create and use relationships—a powerful feature of the engine that automates the cross-linking of related objects.

Java users also face the ugly issue of postprocessing. Object Design supplies "persistence-aware" versions of basic Java classes (String, Hashtable, Vector), but you have to run a postprocessor (literally rewriting your .class files) to make your own classes persistent. I should have postprocessed my servlet's classes and those belonging to the Java Web server running it, but uncertain which classes comprise that server, I didn't. Everything worked, but I felt uncomfortable.

Caveats aside, I got a good result. My Java-based calendar can now scale up impressively. You'll get the most mileage out of version 5.0, though, if you're a C++ programmer deploying to the Web. New features of ObjectForms Publisher (for generic platforms) and the new ActiveX interface (for Active Server Pages environments) make it easier than ever to build applications that leverage ObjectStore's power. B

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

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

TECH FOCUS

ObjectStore Relationships

ObjectStore supports direct two-way links between object types: Declare such relationships in C++ with special macros, and referential integrity among related objects is maintained. The benefit is speed. With no linking table or join operation, as with SQL, ObjectStore encodes relationships directly to quickly retrieve clusters of linked items no matter how large the database grows. Relationships are available to C++ applications, but not yet for the Java interface.

*Jon Udell (**jon_u@dev5.byte.com**) is BYTE's executive editor for new media.*

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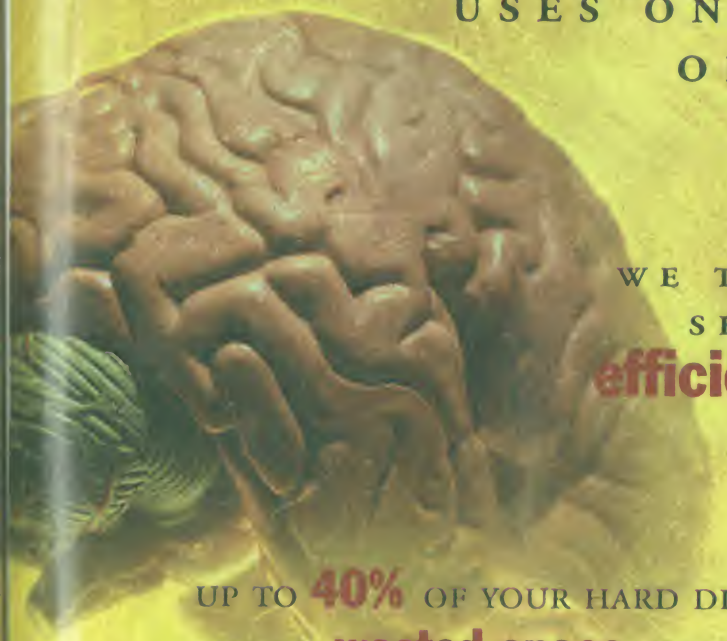

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POWER PQ QUEST

Circle 163 on Inquiry Card (RESELLERS: 164).

The UltraDaytona RAIDarray
Storage that gives you peace of mind

The new UltraDaytona RAIDarray™ is welcome news if storage problems have been weighing on your mind. That's because the UltraDaytona takes just thirty minutes to install and is so reliable, once you're up and running, you can forget it's there.

With the UltraDaytona, you can swap drives, power supplies, or fans without taking the subsystem off-line, so you can perform maintenance during "normal" hours without interrupting data availability.

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

Each UltraDaytona includes CMD StorageView™ Lite, an easy-to-use GUI for setting up and monitoring the subsystem, as well as alarms that tell you when something needs attention. That way, you can address problems before data goes off-line, which makes the UltraDaytona a surprisingly stress-free storage solution.

With that it mind, it should come as no surprise that CMD technical support is available 24 hours a day, seven days a week, 365 days a year. Just one more way owning an UltraDaytona will put your mind at ease.

For more information, and a free white paper on RAID solutions, visit our web site at **www.cmd.com** or call us at **800-426-3832** or **714-454-0800.**

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Circle 170 on Inquiry Card (RESELLERS: 171).

Smaller, moderately priced, and networkable, Xerox's C55 laser will bring color printing to many offices. By Russell Kay

Laser Color, Inexpensive and Quick

In 1984, Hewlett-Packard revolutionized office paperwork with a $3500 laser printer that fit on a desktop and produced 4 high-quality pages per minute at 300 dots per inch. We may be on the verge of a new revolution, but this time it's being led by Brand X. The new DocuPrint C55 from Xerox is a $3500 networkable desktop laser that gives great color at 3 ppm and 600 dpi.

First, some specs. The C55 is a compact cube occupying only 306 square inches of desktop—less than two-thirds the footprint of color lasers from HP, Lexmark, and Tektronix. It's a dense cube, though, at a surprisingly hefty 90 pounds. It prints at 3 ppm in full color, 12 ppm in black and white, and 6 ppm in a special two-color "Fast Blue" mode. Consumables cost a mere dime per color page, and a draft mode prints pastel pages at 5 cents each.

The C55 can use legal-size paper. It automatically detects and adjusts color for transparencies. The standard 30 MB of RAM is upgradable to 70 MB. An included printer cable hooks up to the printer's new mini-Centronix connector.

Printers don't usually include a floppy drive, but there's one (called a "media server") here. Print from your application to a PRN file using the C55 driver and put that file on a floppy, and you can take the disk to the printer. The front-panel LCD lets you select filenames for printing.

The MP model I tested adds PostScript (with Mac, OS/2, and Unix drivers), an Ethernet card, and network software. PostScript also adds continuous-tone printing and a "Fax Friendly" mode that converts colors to black hatching.

DocuPrint C55MP
$4999
with PostScript and 8-MB network card ($4500 street price); C55 standard model, $3999 ($3500 street price); 30 MB of RAM standard on both

Xerox Corp.
Rochester, NY

716-425-5230

http://www.xerox.com/

Enter 996 on Inquiry Card.

No 90-pound weakling, this wonder of a desktop color laser is inexpensive to buy and to run, and it's made for networking.

How Fast? Hmmm...

With an 80-KB JPEG file, the C55MP, running PostScript, delivered the first print of a photo in 45 to 50 seconds, with additional copies every 20 seconds (right on the 3-ppm claim), except for an occasional hesitation. But with the PCL driver, it took nearly 90 seconds for the first page.

Another photo, with heavy color, took nearly 6 minutes to print. A typographically complex WordPerfect page with two color JPEGs and clip art printed in 110 seconds (with PostScript or PCL). A simpler page with one JPEG printed in 64 seconds with PostScript, and 110 seconds with PCL.

Nothing but Net

The C55MP was designed for networking, and the setup CD includes everything needed. However, the NetWare instructions fail to note that you need to run the 32-bit NetWare client, even for NetWare 3.1x LANs. Nice for LAN users is a "Hold Job" feature that lets you walk down the hall and change paper before beginning printing. All C55s have an embedded HTTP server that allows remote monitoring—even temperature, humidity, voltages, and toner levels.

No color printer does it all. Xerox's DocuPrint C55 offers an intriguing mid-dle-ground option between the big, costly, high-end color lasers and the small, slow, value-priced ink-jets. Time will tell if this new Xerox design is really the spiritual successor to the original LaserJet. But it's one dandy printer. B

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

Russell Kay is a BYTE technical editor who's been printing things all his life. You can reach him at **russellk@bix.com**.

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

Eval/lhp.eps

Offering a scalable, modular design and numerous configuration options, APC's redundant UPS hits the market. By Michelle Campanale

Never-Ending Power Supply

Hell hath no fury like a network administrator after a power outage. Fortunately, a UPS that offers both scalability and N+1 redundancy has arrived. The Symmetra Power Array, which represents American Power Conversion's first UPS over 5 kVA, operates much like a server or storage device with RAID. Using double-conversion on-line technology, all the modules in the Power Array run in parallel and share the load evenly.

With a full output of 16 kVA, when all power and battery bays are fully loaded, the Symmetra can effectively power 32 NT servers. The unit's copious expansion options, or "smart slots," enable augmentation or reconfiguration simply by adding or removing modules. Additionally, APC offers a number of choices for managing the system.

The Symmetra contains hot-swappable parts: power modules, battery modules, a main intelligence module, and a redundant intelligence module. Many users will appreciate the Symmetra's four back panels—smart slots that offer a selection of added management connections. The system supports an Ethernet ($199)or a Token Ring ($399) SNMP module, allowing any networked PC, with permission, to connect to the UPS through the file server. A $179 out-of-band or in-band modem module is also supported. The out-of-band UPS call-up card is capable of paging the administrator when the unit experiences problems, and it provides terminal emulation for dial-in management of the unit.

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

The tiny hard-wired LCD console module on the front of the unit can be used to manage the system. It displays menus for diagnostics, system status, and configuration. The Symmetra ships with APC's PowerChute Plus 5.0, a Web-enabled utility designed to shut down the OS and close all files prior to a UPS power failure. Additionally, the unit comes with HP OpenView. APC plans to soon release an add-on card that lets you assign an IP address directly to the Symmetra, bypassing the server.

The Symmetra product line includes five models that scale from 8 kVA to 16 kVA, with redundancy starting at 4 kVA. Prices range from $10,500 to $16,600.

Similarly priced products like Liebert's UPStation S ($4000 to $15,000) can have a certain level of redundancy, analogous to disk mirroring, where a UPS is backed up by an equivalent UPS. Of course, the price doubles and there is no load balancing. By using small modules that are hot-swappable, APC's Symmetra eliminates a single point of failure and promotes quick, do-it-yourself servicing. These features, combined with the Symmetra's multiple configuration and management options, constitute a compelling UPS solution at a competitive price. B

Symmetra Power Array
$10,500 to $16,600

American Power Conversion
West Kingston, RI

800-800-4272
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http://www.apcc.com

Enter 993 on Inquiry Card

You can easily install or remove the Symmetra's individual power, intelligence, and battery modules to manage redundancy.

The backside has four slots for management connections.

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Michelle Campanale is a BYTE technical editor based in the San Mateo, California, bureau. You can reach her at **michelle@dev5.byte.com.**

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

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CommuniCard PLUS 10BT/33.6 Ethernet/modem 344.76

Lucent

NFS Maestro V5.1.3 WIN/95/NT/DOS 229.18
Exceed V5.1.3 WIN/95/NT 319.94

intel

EtherExpress PRO 100 PCI 81.46
EtherExpress PRO/10+ PCI combo 119.07
NetPortExpress PRO Ethernet internal 268.54
NetPortExpress PRO Ethernet external 367.15

NETGEAR

10/100 Fast Ethernet PCI adapter 61.94
EN104 4-port 10BT slimline Ethernet hub 65.09
EN108 8-port 10BT slimline Ethernet hub 87.02

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SMC

EtherEZ 5T 10BT hub 83.15
EtherEZ 8TC 10BT hub 129.82
EtherEZ 16TC 10BT hub 278.49
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EtherPower 10/100BTX PCI 71.72

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Zip drive 100MB internal SCSI 149.95
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Jaz drive 1GB external SCSI-2 ..... 399.95
Ditto drive 2GB internal 149.95
Ditto drive 2GB external 159.95
Ditto Dash Card 59.95

PHILIPS

EasyWRITER CD recorder internal 499.00
EasyWRITER CD recorder external 599.00

SyQuest

EZFlyer 230MB external 199.00
SyJet 1.5GB SCSI internal 399.00
SyJet 1.5GB SCSI external 499.00

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Adesso NU-Form keyboard/touchpad 58.09
Alps GlidePoint Wave keyboard/touchpad 66.69
Alps GlidePoint Windows 95 keyboard 93.94
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Casio QV-300 digital camera 655.65
Connectix Color QuickCam V2.0 ..... 209.57
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Epson Expression 636 Exec scanner 799.00
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UMAX Astra 600S scanner 235.65
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Visioneer PaperPort mx scanner 179.37
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MAG Innovision 510V2 15" 0.28mm 289.78
MAG Innovision 710V2 17" 0.28mm 495.76
Magnavox MB4010 14" 0.28mm 229.71
Magnavox MV5011 15" 0.28mm 277.56

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NEC XV17+ 17" 0.28mm 679.69
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Princeton E070 17" 0.28mm 489.49
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Sony Multiscan 100sf 15" PnP 0.25mm 397.07
Sony Multiscan 200sf 17" PnP 0.25mm 775.83
Sony Multiscan 300sf 20" PnP 0.30mm 1565.46
Sony Multiscan GDM-W900 24" 0.25mm 4239.99
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ViewSonic E655 15" 0.28mm 294.93
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PC CARDS

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3Com 33.6 10BT LAN+modem 306.72
3Com 33.6 10BT LAN+modem combo 339.08
Hayes ACCURA 336 ..... 159.60
Hayes OPTIMA 336 w/EZjack 189.28
Hayes OPTIMA 56K 207.04
Motorola Montana 33.6 ..... 179.06
Motorola Mariner 33.6 ..... 349.54
New Media PC Card joystick adapter 58.23
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U.S. Robotics Ethernet adapter w/XJACK 109.00
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Xircom 33.6 ..... 189.55
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OPTIMA 336 Business Modem external 236.48
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ACCURA 56K external 169.97
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OPTIMA 56K external 279.73
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MOTOROLA

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V.34X Plus 33.6 faxmodem external 99.30
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HP DeskJet 820Cse color printer 299.00
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HP LaserJet 6Lse printer 399.00
HP LaserJet 6MP printer 878.00
HP LaserJet 6Pse printer 799.00
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LEXMARK

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- 7201 5/200 MMX 32MB 3GB 12X CD ... 1989.24

Equium Desktops
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- 5200D 5/200 MMX 32MB 2.5GB 12X CD ... 1847.45
- 6200D 6/200 32MB 3GB 12X CD ... 2234.52

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- 806 5/133 16MB 1GB 11.3" active ... 2239.97
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- LC 5166 5/166 16MB 1.2GB ... 1076.79
- LC 5166 5/166 16MB 2GB ... 1125.05
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- 4171T 5/133 16MB 1.4GB 12.1" active ... 2849.00
- 7710MT 5/150 MMX 16MB 1.0GB 12.1" active ... 4399.00
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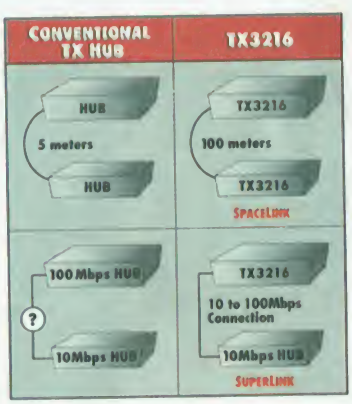

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A data warehouse does more than collect data. It reflects a valid and consistent image of the business. By Richard Hackathorn

Data Warehousing's Credibility Crisis

You gaze with pride at your latest handiwork, the company's new data warehouse. At 11:35, the phone rings. You scoop it up. The voice on the other end says, "This is Marlena Price, VP of finance. I just got the first reports from your new warehouse system. They look nice, but the numbers that you generated don't jibe with our standard reports. Would you meet with me after lunch to explain?"

Your blood runs cold. Calmly, you reply, "Sure. Where exactly are you seeing problems?" She explains that some of the regional reports have questionable results. You ask her a few more questions and then hang up.

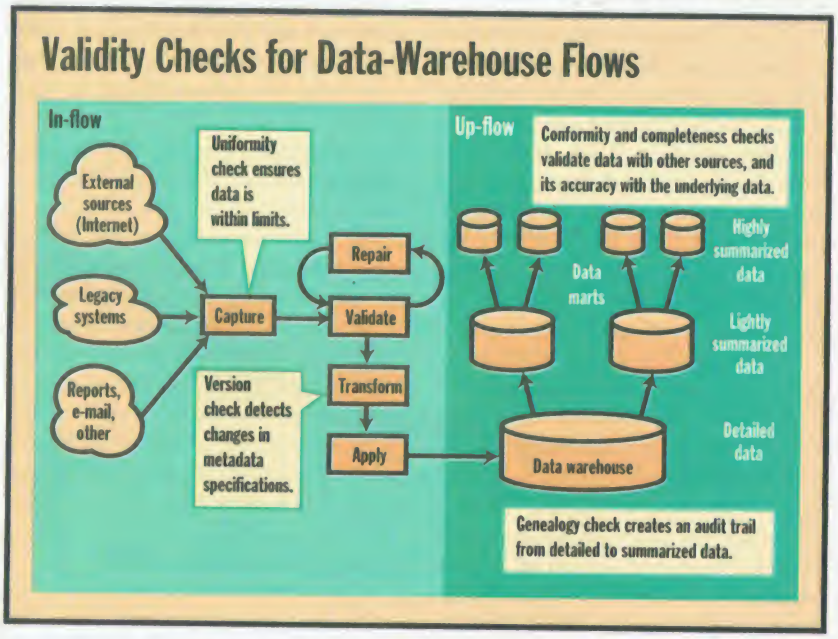
Next you dial Eric, the data administrator. "We've got a problem," you begin. "The VP of finance is questioning our reports."

The popularity of data warehousing (DW) has, unfortunately, obscured its basic objectives. Many people construct DW systems for simplistic reasons and with unrealistic expectations. Neglecting to establish and maintain credibility in the reported data until it's too late has caused many DW efforts to fail in their early stages. To deal with this credibility crisis, you must grapple with one big question: Does the data warehouse convey a consistent and valid image of your business operations?

A Constant Struggle

The term *data warehousing* emphasizes an overall process and architecture, while the terms *data warehouse* and *data mart* refer to a collection of data managed within a database. A data mart is a data warehouse that deals with a specific organizational function. In this context, DW is the discovery, management, and dissemination of informational data. This data, which is derived from various sources, provides a consistent and valid image of the business that it documents.

Maintaining this image presents a constant struggle of integrating an ever-changing variety of models that attempt to describe the business. Because of this, you must confront validity issues right from the start when constructing a data warehouse.



Information entering the data warehouse must be monitored for consistency and completeness.

First, there's the challenge of understanding the warehouse's data properly from a business perspective. The ability to audit any data element is an essential for instilling confidence in the data. Second, there's the challenge of consistency in data usage. Two users might think they're debating over similar data elements when in fact the elements indicate different aspects of the business, either because of naming inconsistencies or nonsynchronized data. Third, there's the problem of properly building SQL queries. Slight variations in SQL syntax can produce widely differing results from the same set of data. Most of SQL's syntax is poorly understood, requiring an expert to use it properly. Fourth, there's the challenge of expanding access to the data warehouse to people who might be unfamiliar about the precise business interpretation of a specific data element. Subsequent analyses based on such a data element can easily lead to erroneous business decisions. Finally, there's the ever-present demand of rapidly inventing new queries and reports as business requirements change.

Eric taps furiously at a workstation's keyboard. "Here's the drill-down program I whipped up when it took us forever to track down that problem with the currency conversions in the overseas reports," he says. "You enter SQL queries

here, and the results are colored-coded according to tolerances that you set here," he adds, pointing at a pane on the screen. You nod, sit at another workstation, start the program, and type in a SQL query. Rows of data begin to scamper up the screen. You roll your chair to another workstation, and soon it, too, has data streaming up-screen, the result of a slightly different SQL query.

On one of the workstations, several rows of data glow angry red, and the display halts. Eric clicks on a field in the offending row, and a pop-up window displays an exhaustive trace of the data's origins. You jab at the window: "Got it." You type in more commands, and paper starts coming out of a printer.

Checks for Validity

To ensure that your data warehouse provides a consistent and valid image of business reality, several types of validity checks must be designed into the system from the beginning. You must be able to audit the contents and structure of data flows. Such checkpoints must be located at various points in the flows from data sources to data consumption, as shown in the figure "Validity Checks for Data-Warehouse Flows" on page 43.

There should be a *uniformity check* that ensures data values are within prescribed limits. This should be a basic component when acquiring new data for the warehouse. Based on predefined or statistically set parameters, filters should detect whether data values are within expected limits and also report any exceptions. The uniformity check occurs during in-flow, where data creation or capture flows into the warehouse. (For a more-detailed description of in-flow, see the glossary below.) The in-flow consists of a sequence of steps from data capture to validation. As the figure on page 43 shows, these steps might require repair and transformation operations before the data is loaded into the database.

A *version check* is similar to the uniformity check. It also occurs during the in-flow and detects changes in the metadata specifications. For example, an unexpected change in the encoding of data values, such as a shift from a 1 or 2 encoding to *M* or *F*, should be caught during comparisons with the metadata specification. Other examples include new or missing columns in relational tables and an increased width in a fixed field size.

A DW Glossary

In-flow: Describes the data flow from creation or capture into the data warehouse. Data sources can be systems that provide internal information on business operations (e.g., sales) plus various external sources (e.g., e-mail and the Internet).

Up-flow: Involves summarizing data into a form relevant to users. Through the use of projections, aggregation functions, and groups, detailed data is refined and packaged into views that focus on specific business problems.

Metadata: Deals with the modeling and control of data in the warehouse. It handles system modeling, which is the technical analysis of those systems that act as data sources. Metadata is also the analysis of usage patterns, which guides the design of information objects, which in turn models business processes.

Situations that are difficult to catch include changes in the timing of data capture, such as one region reporting on a calendar year while another uses the fiscal year. Many exceptions to the version check imply the need for new transformation routines during data loading and possibly the restructuring of the warehouse itself.

A *completeness check* determines if aggregations of data are complete and correct. It occurs during data analysis and reporting in the up-flow, where value is added through summarization (the aggregations) and packaging (e.g., spreadsheets). Aggregations are useful but may hide (i.e., destroy) important data. For example, an average sales figure may be misleading if values are missing (i.e., null) from critical sales regions because of data-collection problems. A completeness check is more difficult if the aggregation is a complex procedure rather than a simple average or total.

A *conformity check* does proper correlation of data with standard sources. It occurs during data analysis and reporting and validates that the data conforms with other data sources and reports. An important use for the conformity check is the correlation between key financials reported to the IRS and the SEC and various internal indicators. Another use for some companies is a historical correlation in sales for various regions. A sudden change in this correlation could indicate a fundamental shift in the business or simply bad data collection or faulty analysis.

Finally, when all else fails, a *genealogy check* provides a complete audit trail to the data source. It occurs during data reporting when the consumer of the information questions the validity of the data. This check should generate a trace of the information through its transformations and back to its sources. With on-line analytical processing (OLAP) tools, a genealogy check on data values is referred to as a "drill-down" upon a specific aggregation so that data values at a finer granularity can be viewed. Likewise, you should be able to perform a drill-down into the metadata all the way back to the source.

Instilling Confidence

Ms. Price looks closely at the printouts, then at you. You explain, "Over the years, we've added new products and removed obsolete ones. Furthermore, some of the accounting procedures have been revised. This is especially evident in the overseas results, which require different recording and reporting of sales. Each division developed its own ad hoc solution for these changes, but we had to set up some new calculations to correct for these situations." Because of your quick and thorough explanation of the discrepancy, the VP of finance becomes an ally of yours.

Many well-executed DW efforts fail simply because the implementers neglect to establish and maintain confidence in the generated data. The basic issue with any DW system is: Does the warehouse's information represent a consistent and valid image of business reality?

Every manager of a DW effort should be equipped to answer this question easily and quickly. The alternative is a continuing series of credibility crises that will tarnish your DW efforts. B

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

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Internet Foundation Classes lets you build Java applets with useful features such as drag and drop. ***By Andy Turk***

Building a Better Interface with Java

If you've ever tried to build a significant application using Java, you have probably run into some of the limitations of Sun's Abstract Window Toolkit (AWT) that's provided with the Java Development Kit (JDK) 1.0.2. The AWT was actually designed for building small applets, but with the increasing popularity and acceptance of the language, many developers are going beyond simple applets to write full-blown applications in Java. If this sounds like you, then you should take a look at the Internet Foundation Classes (IFC), from Netscape, before starting your next project.

The IFC is a library of user interface (UI) widgets, along with a set of tools for building your own widgets. All the IFC code is written in Java that runs on top of AWT, so Java's promise of platform independence is preserved, as shown in the figure "IFC in a Java Application." Just recently, Sun and Netscape announced that they are combining AWT and IFC technologies into a set of Java Foundation Classes (JFC) that implements an extendible look and feel to Java applications. JFC will be part of the next release of the Java Development Kit, thus making these interface classes a dependable standard that developers can rely on.

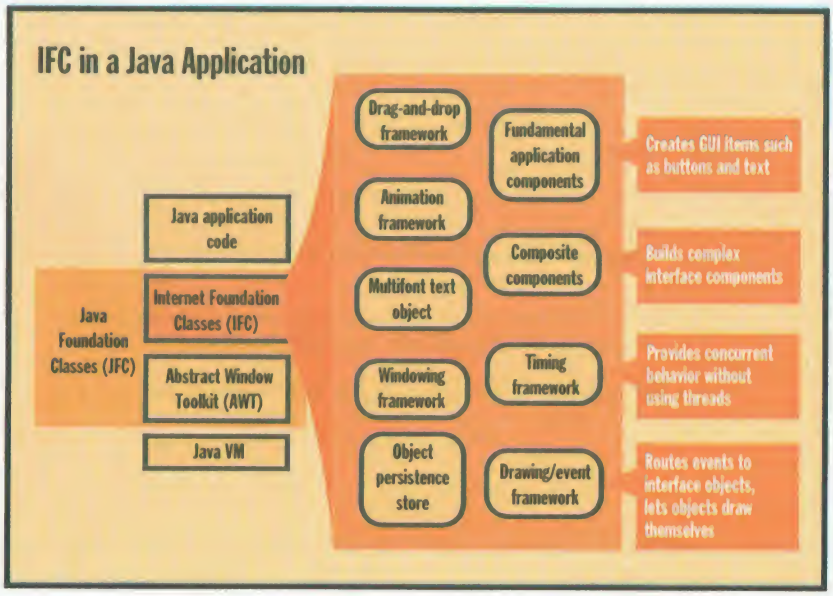
For those who want to experiment now, you can download the IFC from http://developer.netscape.com/library/ifc, and you can get the AWT from Sun at http://java.sun.com/products/jdk/1.1/. This article will focus on the capabilities of IFC and compare it to the once-separate AWT.

Building a Better UI

Distinctive UIs stand out from the crowd by paying attention to detail and avoiding overuse of the same old "cookie cutter" buttons, fields, and list boxes found in most other applications. AWT makes such enhancements difficult because it provides few opportunities for going beyond the bare minimum. To be fair, AWT's emphasis is on event handling, whereas IFC concentrates on extendibility and attempts to impart a consistent appearance across platforms.

For example, most AWT buttons look the same except for their titles. Without writing your own button class from scratch, it is difficult to change much more than the title of a stock AWT button. IFC's `Button` class, on the other hand, has a surprisingly wide variety of attributes that can be combined to make buttons more versatile and pleasing to the eye. Along with changing the button's title, you can also change the font and color in which the title is displayed. You can associate an image with the button and specify where the image should be displayed relative to the title. You can even use an animation instead of a static image through the use of a `DrawingSequence` class. If all these options still aren't enough, you can always override the draw method of the `Button` class to do exactly what you want.

Another example of the power of IFC is its `TextView` class. This class is essentially a mini word processor that lets you display and edit text using different fonts, colors, and sizes. With the `TextView` class, you can add in-line attachments that represent figures, file attachments, or other graphic elements that need to flow with the text. `TextView` even provides a conversion method that parses and displays HTML. Attempting any of this with standard AWT widgets is next to impossible. IFC also provides other UI elements that aren't found in AWT. A good example of this is the `ColorChooser` object that



Internet Foundation Classes (IFC) implements a consistent interface and behavior for a Java application.

allows a user to display and manipulate colors.

Powerful Views

You may be wondering how IFC is able to do all these things. The answer is that IFC is built around a powerful UI element called a `View` object. A `View` is simply a rectangular area on the screen that knows how to draw itself, and it also knows what to do with mouse and keyboard events. `Views` are subclassed to provide widget-like behavior. For instance, `Buttons`, `TextViews`, and all the other widgets that come with IFC are subclasses of `View`. Thus you construct complete UIs by simply connecting several `View` objects together in a hierarchy. IFC `Views` are written entirely in Java and are used to implement all of IFC's standard UI components, as well as any components you write for your own application. What this means is that you, as an application programmer, have access to the same tools as the programmers who wrote the IFC widgets, and you can implement your own custom drawing and event-handling behavior if you need to. This is a big improvement over AWT's peer model, in which the widget methods are implemented in C, without any option to be overridden in Java.

Another benefit of IFC's `View` model is that it provides the tools to implement drag-and-drop capability. This is a type of UI where a user clicks on something and drags it with the mouse to another part of the screen, where an operation is performed. The `ColorChooser` object makes good use of this technique: The user drags a color "chip" from it, then drops this on any `View` that knows what to do with colors.

Behind the scenes, the color "chip" is simply a tiny `View` object that knows how to track the mouse and draw a color. For example, suppose that you're writing a drawing application that needs to let the user apply a color to a shape. As a programmer, all you need to do is implement a few methods in your `Shape` object to accept a color that was dragged out of the `ColorChooser`. The code sample in "Dragging and Dropping a Color" shows how easy this is to do. Implementing drag-and-drop capability is nearly impossible with AWT alone because the standard widgets won't allow a color "chip" to be dragged over their part of the screen.

Dragging and Dropping a Color

```
public class Shape extends View implements DragDestination {
 protected Color myColor;
 public DragDestination acceptsDrag(DragSession session, int
 x, int y) {
  if(session.data() instanceof Color) {
   return this;
  } else {
   return null;
  }
}
 public boolean dragDropped(DragSession session) {
  if(session.data() instanceof Color) {
   myColor = (Color) session.data();
   drawView();
   return true;
  } else {
   return false;
  }
}
}
```

Designing a UI

One of the best things about IFC is its application builder, called Constructor, which streamlines the process of building a UI. With Constructor, you can design how the UI will look without writing any code. In this respect, Constructor is similar to many other application builders, such as Apple's OpenStep Interface Builder. However, Constructor gains extra leverage because it is tightly integrated with IFC. In fact, Constructor is a Java application and runs under any OS with a Java virtual machine.

Constructor won't help you write code—it has no built-in text editor. Constructor's primary purpose is to help you design how the application's interface is going to look. To do this, you simply drag IFC widgets from a tray and drop them onto the panel that you're building. From there you can reposition and resize the widgets, and you can set various display attributes.

Once you've positioned your widgets, the next step is to use the "Wire" mode to hook those widgets together. For instance, the `Button` object sends a message when it receives a mouse click, and you use Constructor to determine not only the message sent but also the object that receives it. You can even test out the user interface by running it from inside Constructor itself. Once your design is complete, Constructor saves the information in a file that's loaded at run time over the network.

The Catch

There's always a catch, and the catch with IFC is that it's big. The library of `.class` files that comprise IFC is nearly a megabyte in size. If you are writing a Java application that must be downloaded over a narrow data pipe, like a modem, you should think twice before using IFC. On the other hand, if you're planning to develop a full-blown application that's deployed on an Ethernet-based intranet, the size of the IFC class library won't be an issue.

Another factor to consider is that IFC comes with its own unique look and feel. IFC buttons look a little different than buttons on other platforms, and the same is true for scroll bars. Some aspects of the IFC UI are slightly quirky, like the corners of resizable windows. However, the graphic design is consistent throughout all the IFC widgets, and they work well once you get used to them. It's this consistent appearance, combined with the Java virtual machine, that will help establish Java applets as an industry-wide standard. Users will know what behavior to expect, regardless of their platform of choice. B

Andy Turk is the founder and president of Sarrus Software, Inc. (Burlingame, CA). You can reach him at **andy@sarrus.com.**

Speed Internet surfing by caching DNS information on your desktop computer. ***By Jonathan E. Brickman***

Faster Internet Access

Most workstations with a connection to the Internet are by default configured to use a Domain Name System (DNS) server. Such a server belongs to an Internet Service Provider (ISP) or is on a LAN that has Net access. Before a workstation can establish a connection with any server on the Net, it must first obtain the server's address from the DNS, as shown in the figure at right. Because this initial communication to a DNS server often passes through a congested link to an ISP, it can result in delays and an unresponsive Net connection.

Fortunately, there's a good alternative: Instead of relying on an ISP's DNS server, a workstation can run its own DNS software in the background. If all DNS requests are made through the workstation's local DNS, that DNS can cache the results. Such a cache doesn't simply store recent host-name/IP equivalents: It also stores routes by which it obtains more data about domains. Thus, the local server accumulates a hierarchical list of what it learns about the Net's structure.

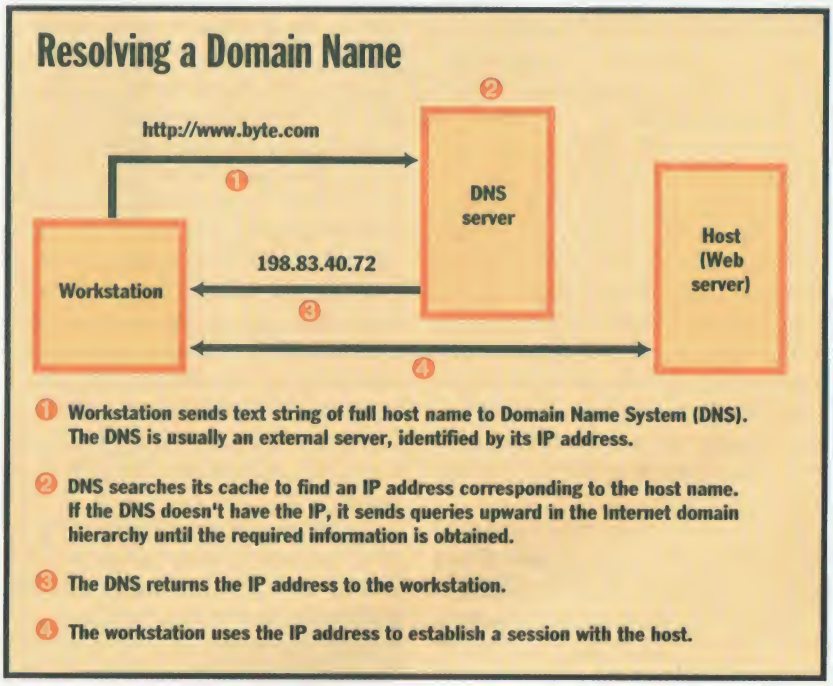
Since the local DNS builds its knowledge from fresh data each time it starts up, and since it doesn't touch the ISP's overloaded DNS at all, using a local DNS alone almost always enhances the performance of a Net connection. This article focuses on installing such a server on Windows 95 and Linux. But DNS server software exists for almost every platform currently in widespread use.

DNS Considerations

When running a local DNS on a workstation, you should keep a few things in mind. First, the software uses up system resources. See the text box on page 48 for basic information. Under Win 95, it requires enough resources that you should seriously reconsider the recommended amount of minimum memory. Under Linux, resource use of a DNS is almost imperceptible.

Another key point is bandwidth. This approach has been tested only with 28.8-Kbps and faster connections to the Net. The server works well for any TCP/IP connection: PPP and SLIP, static and dynamic IP, modem, ISDN, or T1. The server is also robust enough that it does not have to be restarted when a dynamic IP connection is broken and reestablished.

Another significant factor exists only under Win 95. The best DNS software available for Win 95 was written for Windows NT, and the documentation recommends against running it on Win 95. This is because of memory leaks in Win 95's integral TCP/IP stack. Despite this, I have been running the software continuously on a Win 95 machine for several weeks without problems. However, I've installed all of Microsoft's Win 95 updates, including the ISDN Acclerator Pack, which updates Dial-up Networking. Using this software on any Win 95 computer not running with all updates reliably is not recommended.



Name servers obtain IP addresses for given host-name strings; the results can be cached locally for speed.

Doing Windows

The best DNS server software now available for Win32 is almost certainly Bind-95/NT. A 1.6-MB download, it's available from http://www.windows95.com/apps/servers-misc.html. It is assumed that your computer accesses the Net using Microsoft's TCP/IP stack and Dial-up Networking software if you use a PPP or SLIP connection. This software might not work

with third-party TCP/IP stacks.

The file that you download is a ZIP file. There are two directories within the archive: DISK1 and DISK2. Unpack this file to a temporary directory, preserving this directory structure. Run SETUP.EXE in the DISK1 subdirectory. If you wish to look at the README, do so. You'll note hardware minimums, as well as some strong warnings about using Win 95 with this software. There's also mention of a registry edit to increase the amount of Windows sockets available; so far this hasn't been necessary.

Next you'll see a prompt that reads, in part, "Enter this machine's Host name..." Type `local` into the dialog box and then type `localhost` into the next dialog box. Then you're asked to enter the subnet for your network. If you're using a modem or ISDN ISP connection, 255.255.255.0 works fine. On a LAN connection, ask your system administrator for the correct value.

Now choose a directory for the program files. The default, `C:\var\named`, is fine. The installer then creates directories and copies files. After this, you get a prompt that reads, "For creation of configuration files, please select the setup you want for BIND." You have three options at this point: primary DNS, secondary DNS, and caching-only DNS. Since you're configuring for a single workstation and not setting up primary or secondary DNS for an entire domain or subnet, you want caching-only DNS.

The installer creates the appropriate files for the selected server type. When it's done, you're told that the server is running. In the list of current processes, there's one called `named95`; this is it. Now you need to open or create a file called C:\WINDOWS\HOSTS in a text editor. If the file doesn't exist, create it with the following lines as its content:

```
127.0.0.1       localhost
127.0.0.1       local.localhost
```

If the file already exists, add the lines if they're absent. They set up a local domain (`.localhost`) and also set up the workstation as a host on the domain (`local.localhost`). Thus, the workstation will be interacting with the Net as if it had its own domain—which, in fact, it does, albeit one known only to the workstation.

If you use a dial-up connection, open the Dial-up Networking folder and right-click on a preconfigured connection icon. Choose Properties in this window and then click on Server Type. Click on TCP/IP Settings and choose Server Assigned Name Server Addresses. Click OK several times to back out to the Choose Properties window. Repeat these steps for each dial-up connection you use.

Next, bring up the Network Control Panel. Click on the TCP/IP->Dial-up adapter and click on Properties. Click on the DNS Configuration tab. If DNS is not enabled, click on Enable DNS and type `local` in the host box and `localhost` in the domain box. In the DNS Server Search Order address dialog box, type `127.0.0.1`, click on Add, and click on OK.

When you exit the Network Control Panel, don't restart the system if asked to do so. On some systems, the installer doesn't place a shortcut in the Startup menu to automatically start the server. Check your Startup settings to see if one is present, and add one if it isn't. Then restart.

You'll notice that a DOS shell window, titled "named95," comes up minimized. This is your local DNS process. If you shut it down for any reason, you'll need to restart this process to access the Net. Unfortunately, limitations in Win 95 mean that a shortcut can't start this process without a DOS window. It's a minor irritation, but the advantages have so far vastly outweighed the irritation.

Linux

Any useful current distribution of Linux will have Bind version 4.9.3 or higher available. Even if you're already running Linux, you might not have it installed. If not, the executable `named` will not be found on a full-file-system search. These instructions assume that bind is installed, along with the rest of the standard utilities that ship with it in the Slackware, RedHat, and Debian distributions.

Download the DNS configuration files, which are archived in linux_caching_dns.tar.gz on The BYTE Site (http://www.byte.com/art/download/download.htm). Log in as a non-superuser. Unpack the archive into your user directory, preserving the directory structure.

The unpacked files include the following: `etc/resolv.conf`, `etc/named.boot`, `etc/hosts`, `etc/rc.d/rc.inet2`, `var/named/db.127.0.0`, and `var/named/db.cache`. If your Linux box is on a LAN, you'll have to add the contents of `etc/resolv.conf` and `etc/hosts` to the existing files. Now edit `etc/rc.d/rc.inet2`. You'll notice that several lines are uncommented:

```
# Start the NAMED/BIND name server.
if [ -f ${NET}/named ]; then
  echo -n " named"
  ${NET}/named
fi
```

Uncomment similar script lines in your machine's equivalent of `/etc/rc.d/rc.inet2`. This starts the named daemon at system boot-up. If your Linux installation is recent or standard enough, these lines are already present in `/etc/rc.d/rc.inet2`. If not, you must locate them or add them to `/etc/rc.local`. Copy the files in `var/named` to `/var/named`; you may need to create the directory. Copy `etc/named.boot` to `/etc`.

If all is well, you should have a caching-only DNS server running on your Linux box when you reboot. Old or nonstandard installations of Linux may require more alterations in the procedure; make sure that the daemon is not being started twice. If you're running an old or incompatible beta kernel, you may have to compile a newer or more compatible one. B

Minimum Platform Recommendation

Windows

Windows 95, 486/66 or faster, 16 MB or more of RAM, 5 MB or more of free hard disk space, and a working PPP, SLIP, or LAN Internet connection using Windows 95's built-in TCP/IP stack.

Linux

Any current standard Linux distribution, 386DX/33 or faster, 8 MB or more of RAM, and a working PPP, SLIP, or LAN Internet connection. SLiRP, TIA, and term should work, although none of these has been tested.

Jonathan E. Brickman is president of River City Computing, Inc., a computer consulting and training company in Topeka, Kansas. You can reach him at **brickman@cjnetworks.com.**

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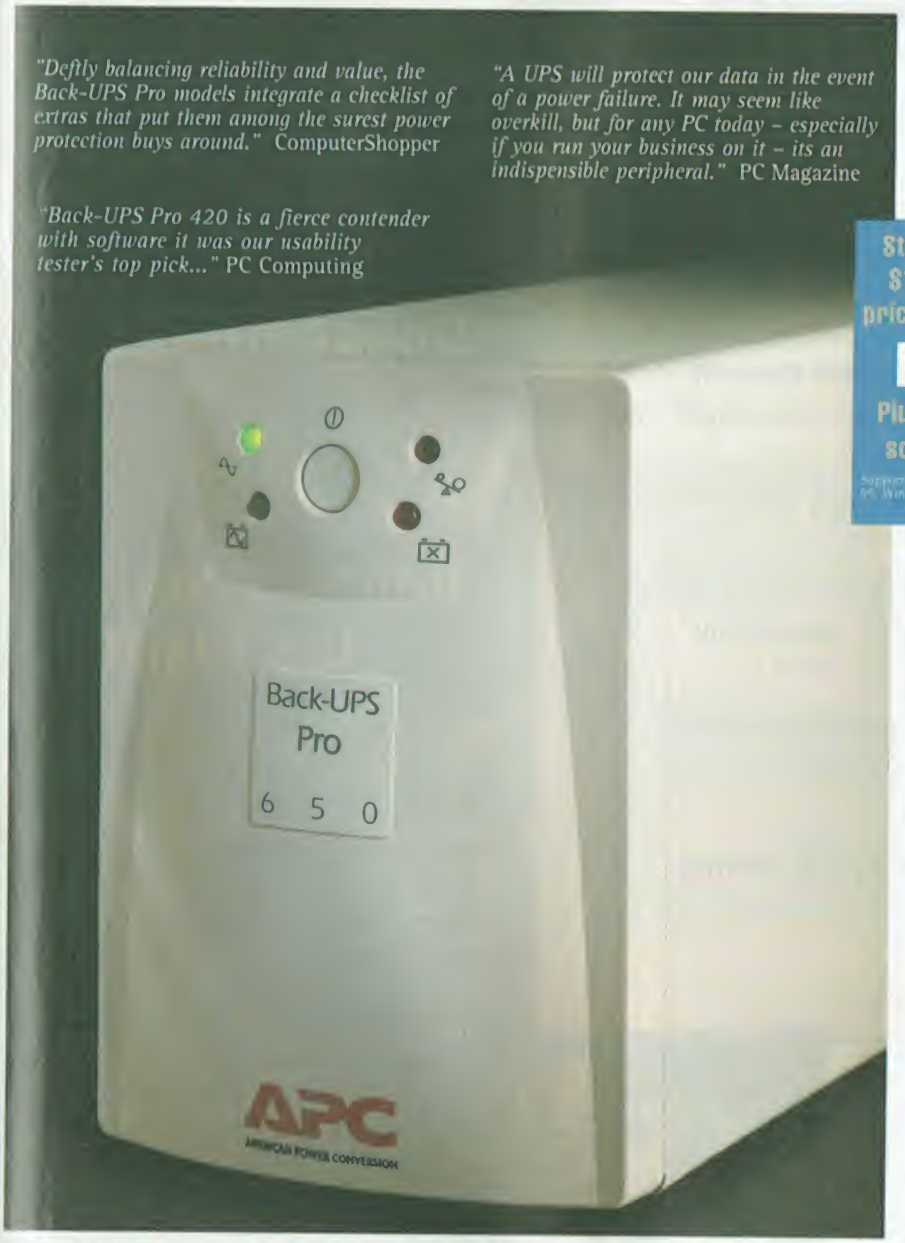

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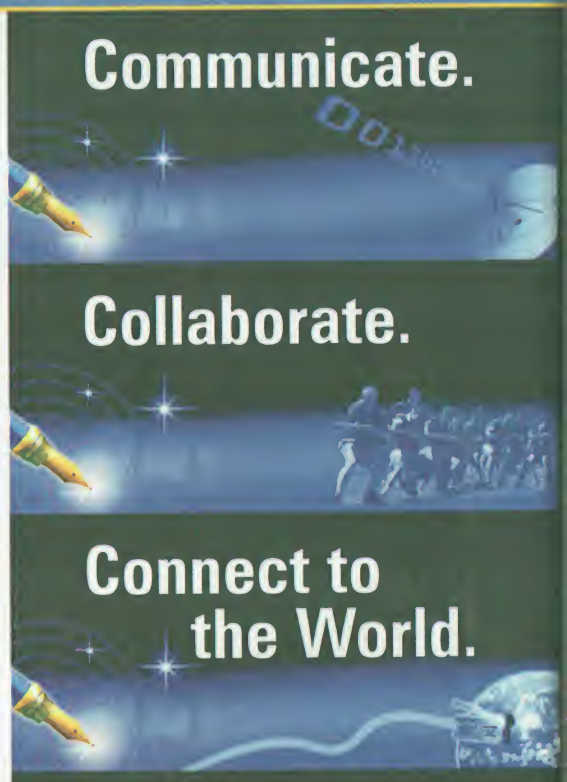
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New processors make possible the delivery of digital video through existing phone lines. By Dick Pountain

Atomic Power Speeds Data into the Home

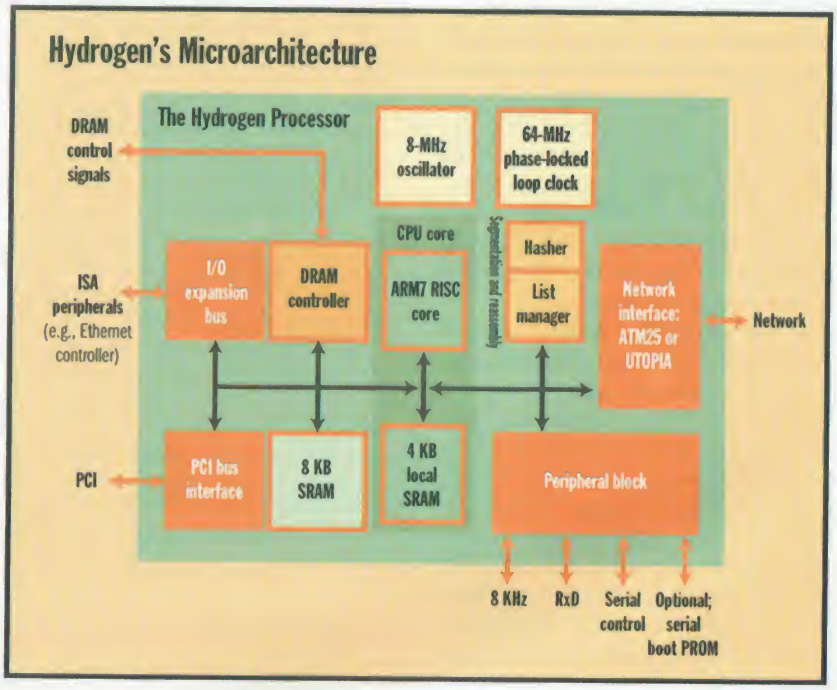
Nowadays asynchronous transfer mode (ATM) is regarded as a technology strictly for high-speed network backbones, but one day it will act as a broadband public communications network that carries multimedia services to the home. Digital Subscriber Line (DSL) technologies promise to bring that day closer by allowing high-bandwidth ATM connections to be carried over the existing copper wire telephone infrastructure.

Advanced Telecommunications Modules Ltd. (ATML, Cambridge, U.K.) has launched an integrated hardware and software solution optimized for building xDSL systems. (xDSL is the industry acronym covering all four current DSL technologies: ADSL, HDSL, SDSL, and VDSL, as explained in "xDSL in a Nutshell" (page 52). Called Atom Accelerator, this suite of network building blocks is based on several ASICs designed by ATML. It uses a high-performance ARM RISC processor core to provide on-chip intelligence. Also supplied is the ATMOS embedded operating system; a library of software modules that includes device drivers, signaling stacks, debugging and testing tools; and reference designs for modems and network interface cards (NICs) using the Atom chip sets. The Atom chips' on-board intelligence will enable firms to design xDSL modem cards or NICs that require little or no external software.

A Periodic Table of ASICs

ATML's Atom Accelerator suite is aimed at developers of equipment at all three of these levels: the central office (CO), the distributed loop carrier (DLC), and the customer premises. The first ATOM ASIC to ship is a multifunction endpoint chip called Hydrogen, which supports ATM25, Ethernet, and a PCI controller. It will soon be followed by Helium, which adds multiple line drivers, and Oxygen, which implements a universal switching fabric. The Hydrogen chip can drive the xDSL modems required in the home and at the DLC. Helium is intended for building Digital Subscriber Line access multiplexers (DSLAMs) used at local switching centers. The Oxygen switch chip will be used in both DLC and CO switching equipment.

ATML developed Hydrogen in collaboration with Cirrus Logic, which is fabricating the chip. Atom is available for evaluation at $75 in small quantities, and the price falls to under $30 in large volumes. The low price is achievable thanks to the tiny ARM core, which permits a small overall die size. The chip is fabricated in 0.5-micron CMOS and comes packaged as a 208-pin quad flat pack. The pricing makes Atom viable for very low-cost consumer equipment and DSLAMs, which are price-sensitive items.



Hydrogen supports ATM25, Ethernet, and a PCI bus interface, allowing for a low-cost endpoint chip.

Hydrogen is a universal endpoint chip suitable for video, voice, and data devices such as NICs, modems, cable modems, and set-top boxes that require a very low chip count. For example, you could build a PC-based internal xDSL modem with just three chips: a Hydrogen, one SIMM, and an xDSL line driver. The main function units, shown in "Hydrogen's Microarchitecture" above, are: a 32-bit ARM7 CPU core (which has 4 KB of in-core SRAM instead of a cache) clocked at 32 MHz; 8 KB of on-chip SRAM outside the CPU core; a controller for up to 32 MB

of external EDO DRAM; a PCI bus interface capable of acting as master and slave; an I/O expansion bus that can connect an ISA peripheral such as an Ethernet controller; two ATM interfaces (one for direct ATM25 and one for 8-bit UTOPIA); a segmentation and reassembly unit (SAR) for manipulating ATM packets; and an IrDA- and MIDI-compliant serial port.

Software Nucleus

ATMOS, the microkernel-based real-time operating system supplied with the Hydrogen chip, is a very simple multithreaded OS that supports a single processor and a flat memory model. It's completely modular, consisting only of the kernel and an arbitrary number of modules, which run as separate processes. All modules get complete access to the hardware, and so device drivers are no different than any other module. The kernel handles interrupts, process scheduling, and interprocess communications using a proprietary lightweight message protocol. The kernel's scheduler supports time-slicing, thread blocking and unblocking, and dynamic context switching in response to external interrupts.

The ATMOS kernel needs around 32 KB of memory and runs entirely off-chip. It requires 1 MB minimum of external memory to run simple applications (e.g., a PC-based ATM/Ethernet NIC), while up to 8 MB is necessary for an ADSL application that does routing and bridging. Hydrogen's on-chip memory is for use by time-critical nonkernel tasks: For example, the fastest 4 KB of in-core memory is typically occupied by the rate-pacing and cell-reception routines of the ATM driver.

ATMOS comes with device drivers for Ethernet and ATM, and various stacks for signaling, IP routing, Ethernet bridging, remote management via SNMP, Telnet and serial port management, and ATM Forum LAN emulation. The ATM driver supports all the required quality of service (QoS) levels: constant bit rate, variable bit rate, available bit rate, and unspecified bit rate. ATMOS supports the ATM Adaptation Layers 0, 3/4, and 5, which enable other network protocols to run on top of ATM. It also supports proper rate pacing for ATM cells.

Some older ATM controllers achieve a particular cell rate by sending bursts of cells at maximum line speed for a while, then pausing briefly until the average throughput is the desired rate. This simplifies the circuitry but means that cells are not equally spaced in time. The Atom driver sends evenly spaced cells at a software-determined rate, and this rate can be changed for different virtual circuits. This lets developers write sophisticated rate-based tariff schemes in software. It's possible for your Atom-based modem to be simultaneously hooked up to three different ISPs via three different virtual circuits, and all of them would still charge you for the correct number of cells used.

The development environment for ATMOS runs on a Sun workstation and is based on the GNU C and C++ tools that generate ARM code. There are simple post-mortem debugging facilities built into ATMOS itself (to inspect registers and memory contents after a crash), and ARM's EmbeddedICE debugging system is available as an option.

ATML hopes that the Atom Accelerator architecture will be attractive to xDSL developers because purchasing a single-chip ATM controller, OS, and development software from one vendor ensures that they all work together smoothly—which is too often not the case when you buy them from separate sources. ■

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

xDSL in a Nutshell

Digital Subscriber Line (DSL) technology enables a digital modem to use a standard pair of copper telephone wires to carry far more data than is possible using older, conventional methods. It employs sophisticated modulation schemes to achieve data rates of up to 50 Mbps under some circumstances. DSL variants are what the telecommunications business calls "last mile" technologies because they carry the signal just that last mile into your home rather than across or between countries. The best-known DSL variant is Asymmetric DSL (ADSL), which carries high-quality video data. "Asymmetric" here means that much more information goes to the subscriber than can be returned to the central office (CO). The downstream (to the subscriber) rate depends on distance: 8.4 Mbps at 9000 feet, which drops to 1.5 Mbps (just enough to support one MPEG video stream) at 18,000 feet. The upstream rate (to the CO) is only 16 to 640 Kbps. This makes ADSL better suited for distribution services (including Web browsing) than for any-to-any connections. On an ADSL line you can continue a phone conversation along with streaming digital video, and basic phone service is possible even if the ADSL modem fails. High-data-rate Digital Subscriber Line (HDSL) uses more advanced modulation techniques to deliver 2 Mbps at up to 12,000 feet without repeaters. Single-line Digital Subscriber Line (SDSL) delivers the same rates as HDSL over a single line. Both HDSL and SDSL are symmetric: Data flows both ways at the same rate, and SDSL can often be used on existing standard phone connections. Very-high-data-rate Digital Subscriber Line (VDSL) is currently asymmetric, but with a higher data rate than ADSL: Downstream it can deliver from 13 Mbps at 4500 feet to 50 Mbps at 1000 feet (capable of carrying an HDTV signal). Upstream rates are around 2 Mbps. VDSL is intended mainly for implementing ATM LANs, and both VDSL and ADSL support error correction.

Implementing a DSL system involves two levels of switching. COs receive lines from the main public backbone and fan them out to local switching centers called distributed loop carriers (DLCs). The DLCs contain devices called Digital Subscriber Line access multiplexers (DSLAMs). DSLAMs are the crucial new component needed for DSL. They combine LAN and ATM switches and routers into a single unit that multiplexes and routes different data types (including ATM and frame relay) to the xDSL service subscribers. In each subscriber's home there's an xDSL modem, contained within a set-top box, network computer, PC, or other device.

Any of these DSL technologies might be a good candidate for a broadband phone system to replace (or bypass) ISDN, since running optic fibre into each neighborhood and then picking up the existing copper phone lines to subscribers' homes requires far less investment than running fibre all the way into the home.

WHERE TO FIND

Advanced Telecommunications Modules Ltd.
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Microsoft's ODBCDirect offers programmers better ways of processing ODBC data sources. By Rick Dobson

Fast and Flexible Access to Databases

The crown jewels of your company's data will often be in back-end databases, such as Oracle, SQL Server, and Sybase. Microsoft Office 97's Data Access Objects (DAO) introduces a new technology—ODBCDirect—that manages interactions with back-end databases. Besides Microsoft's Access 8 database, you can use this technology from within other applications, such as Excel 8, Visual Basic 5, and Visual C++ 4.2 and 5.0. Third-party database applications that use Visual Basic for Applications can readily access ODBCDirect's functions through DAO. Developers must have a license for Jet, the traditional ODBC database engine that ships with Access and uses DAO as its programming interface. Database development products such as Powersoft's PowerBuilder use their own interfaces to back-end databases and thus do not need DAO.

ODBCDirect offers several advantages over Jet. First, when working with an application other than Access, developers can use familiar DAO code without loading Jet. Second, developers can create stored procedures and run them on a back-end server. Third, asynchronous queries do not "freeze" a local workstation while the back-end server processes the query. Fourth, developers can speed performance and reduce network traffic by building applications that cache changes locally and update the back-end server in one batch.

ODBCDirect Object Model

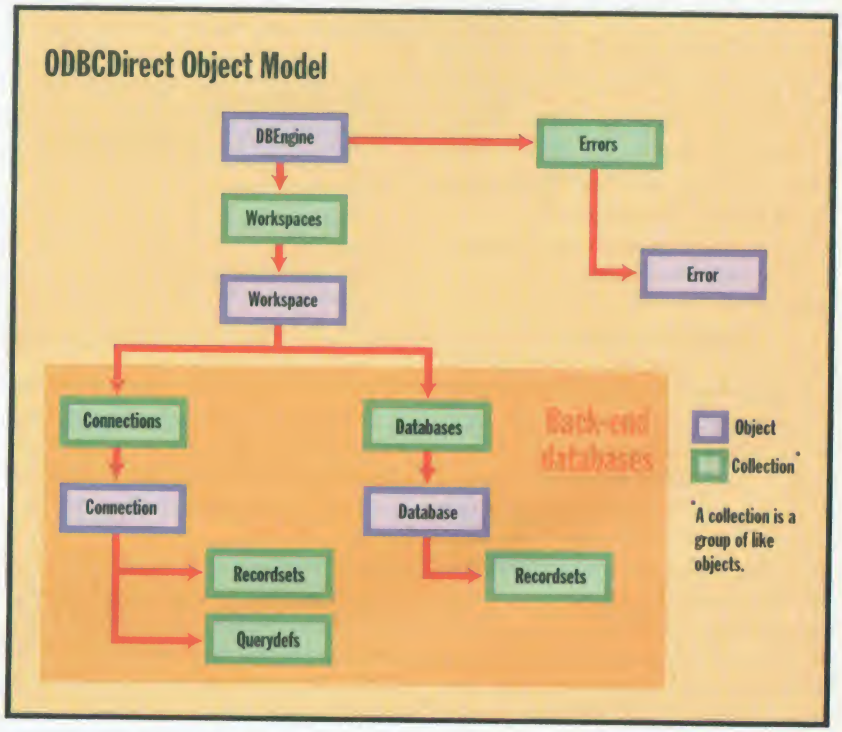
The ODBCDirect object model has two types of objects. One group manages connections to back-end databases, while the second set processes objects in a database, as shown in the figure "ODBCDirect Object Model."

The top or root DAO object is `DBEngine`. You create either ODBCDirect or standard Jet workspaces from this object, where a workspace corresponds to a session. Each session can contain one or more databases and connections, and a procedure can consecutively open multiple sessions. Each workspace type has its own object model. DBEngine's `Errors` collection permits custom procedures to override system responses to run-time errors. (A *collection* is a group of like objects.)

Procedures can connect to back-end databases through either a Database or a Connection object, but connections offer three advantages. First, Connection objects permit asynchronous operations. Second, Connection objects permit the use of `querydef` objects. Third, ODBCDirect `querydefs` enable client workstations to create and run server-side stored procedures under program control.

Recordset collections belong to either Connection or Database objects. A `recordset` represents a return set (a table of data) from a query. Recordsets contain collections that comprise all the fields in a `recordset`. You use the `OpenRecordset` method of a `Database`, a `Connection`, or a `querydef` to create a `recordset` and append it to the Recordset collection. You can also use a Jet workspace `recordset` that refers to a local base table in an ODBCDirect workspace.

`Querydef` collections also belong exclusively to connections in ODBCDirect workspaces. This collection contains all the `querydefs` in a Connection



Some ODBCDirect objects allow asynchronous operations and access to server-side scripts.

object. ODBCDirect querydefs can contain parameters for dynamically setting criteria. Note that Querydefs in ODBCDirect workspaces do not have field collections. Use a querydef's OpenRecordset method to view its return set.

Connecting to the Database

Before using ODBCDirect, you must register your back-end database. You can accomplish this manually with the 32-bit ODBC icon in the Control Panel, or programmatically with the RegisterDatabase method of DAO's DBEngine object.

After registering your ODBC data source, you can connect to it with just two steps. First, establish a Workspace. Second, create either a Connection or a Database object. The CreateWorkspace method creates DBEngine workspaces. Set this method's type argument to dbUseODBC to open an ODBCDirect workspace. Alternatively, set DBEngine's DefaultType property to dbUseODBC. This causes the CreateWorkspace method to generate ODBCDirect workspaces without a type argument.

The second step involves establishing a link to a back-end database via a workspace's OpenConnection or OpenDatabase methods. Since the OpenConnection method generates a more flexible outcome, developers will often prefer it.

OpenConnection takes four arguments. The name argument defines the connection's name property. The options argument accepts constants that specify if the connection will be asynchronous, and to determine the types of prompts permitted during an ODBC link attempt. The readonly argument accepts a Boolean value designating whether the link is read-only. The connect argument specifies the information that the ODBC driver needs to make the link, such as back-end database name, user's server ID, user's password, and data source name (DSN).

Access Forms

"Using ODBCDirect" presents a pair of procedures that work together to update an Access form based on ODBCDirect processing. The first, AuthorTitleCount, conducts a pair of queries against the Pubs database that ships with SQL Server. It transfers the results to a table that serves as the record source for an Access form. The second cmdComputeIt_Click event procedure launches AuthorTitleCount and moves its form to the record storing return values from the two back-end queries. Clicking the cmdComputeIt button invokes cmdComputeIt_Click.

AuthorTitleCount starts with an On Error statement to trap errors followed by a series of variable declarations. After the declarations, the code establishes an ODBCDirect link to the Pubs database. It creates a workspace with the CreateWorkspace method. Notice the listing sets the last argument to dbUseODBC. Next, it uses the OpenConnection method to link the workspace to the Pubs database. The stConnect string sets the connect parameters for the back-end database. Pubs is the DSN name for the Pubs database.

The subsequent block of code computes the number of authors in the Authors table and the number of titles in the Titles table. The outcomes are stored in two recordsets. The next code segment transfers the results from the temporary recordsets to a recordset based on a local table, tblPubs. This segment also time-stamps the transfer. The local table is the record source for the form with the command button that launches AuthorTitleCount. The final code block before the error trap procedure closes both the connection and the workspace, freeing those resources for use by others.

The error routine (not shown) traps two common conditions, and it presents a helpful hint to resolve the problem. (The complete listing can be downloaded from the BYTE Site at http://www.byte.com/art/download.htm.) The routine also traps other errors and writes their number and description to the debug window. This avoids an abnormal end that can lock up the local workstation.

Now that we've got the basics down, next month I'll demonstrate ODBCDirect's more advanced features. B

Rick Dobson, Ph.D., is president of CAB, Inc., a database and Internet development consultancy. You can send e-mail to him at **Rick_Dobson@msn.com.**

Using ODBCDirect

Manage ODBCDirect Link

```
Public Sub AuthorTitleCount()
On Error GoTo _
  AuthorTitleCount_Trap
Dim wspPubs As Workspace
Dim conPubs As Connection
'Other variable declarations
'   omitted to save space
Set wspPubs =
   CreateWorkspace _
   ("PubsSession", _
   "admin", "", dbUseODBC)
stConnect = "ODBC;DSN=Pubs; _
UID=sa;PWD=;" & _
    "DATABASE=Pubs"
Set conPubs = _
  wspPubs.OpenConnection("", _
  dbDriverNoPrompt, True, _
  stConnect)
stASQL = "SELECT _
  Count(Authors.Au_id)" & _
  "'AuthorCount' FROM Authors"
stTSQL = "SELECT _
Count(Titles.Title_id)" & _
 "'TitleCount' FROM Titles"
Set qdAuthors = _
 conPubs.CreateQueryDef("", _
 stASQL)
Set rsACount = _
  qdAuthors.OpenRecordset
Set qdTitles = _
  conPubs.CreateQueryDef("", _
  stTSQL)
Set rsTCount = _
  qdTitles.OpenRecordset
Set dbsMyDb = CurrentDb
Set rsPubs = _
  dbsMyDb.OpenRecordset( _
  "tblPubs")
rsPubs.AddNew
   rsPubs![AuthorCount] = _
     rsACount![AuthorCount]
   rsPubs![TitleCount] = _
     rsTCount![TitleCount]
   rsPubs![Date] = Now()
rsPubs.Update
AuthorTitleCount_Exit:
conPubs.Close
wspPubs.Close
Exit Sub
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Private Sub _
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AuthorTitleCount
Me.Requery
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Web Components

Components and the Web are a match made in developer heaven.

By Dick Pountain and John Montgomery

A cordon bleu chef may spend days preparing a dish. Everything from selecting the vegetables to creating the sauce requires absolute concentration. The results are unique. If that same chef substituted sauce from a jar and had the vegetables delivered in bulk, the dish could be reduced to hours. However, it wouldn't be unique anymore.

Developers, in large, aren't chefs. They want McDonald's. They want their applications done. Now. If they can get the job done by stringing existing components, they will. Components for developing interfaces have been around for a while. However, any developer working on a three-tier application can tell you that components for the middle tier are scarce.

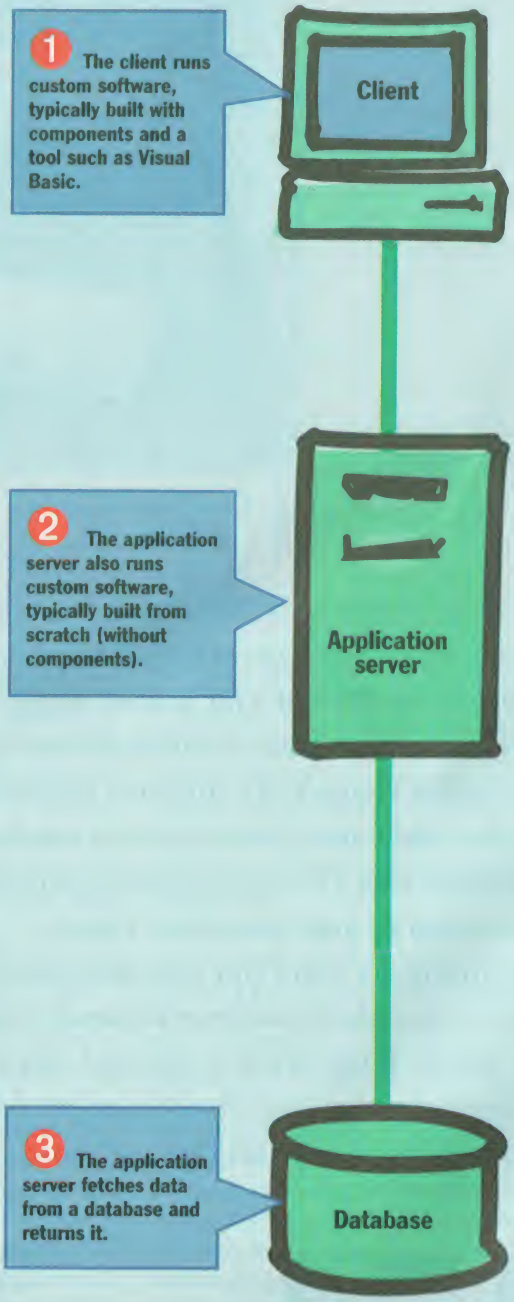
That's changing, thanks to the Web. "The Web is a huge accelerator to the three-tier paradigm," says Greg Hope, Component Object Model (COM) group product manager at Microsoft. Client components save developers time by encouraging reusability. Throw some ActiveX controls together in Delphi or Visual Basic, and you have an application. On the server, they go a step further. If you build your middle-tier business logic from small, quick-to-write components, you can just replace parts when they are superseded. "You can stage it all on the middle tier, and it's instantly deployed," according to John Dawes, group product manager for Netscape Enterprise Server. Not only that, if your application breaks into neat chunks, it's easier to spread the load across multiple servers.

Microsoft calls it Web computing. Netscape calls it (in a somewhat cumbersome way) Crossware. And it sounds great—on paper. But a ream of incompatible interfaces and untested standards can face middle-tier developers. Disputes follow everything from network component models—ActiveX, JavaBeans, COM, Common Object Request Broker Architecture (CORBA), IIOP, remote method invocation (RMI)—to transaction systems—Customer Information Control System (CICS), Tuxedo, Microsoft Transaction Server.

Where is the matrix that makes sense of all the combinations of Web servers, component models, and programming platforms? It doesn't exist. In fact, it can't yet exist—the equations

Componentizing the Web

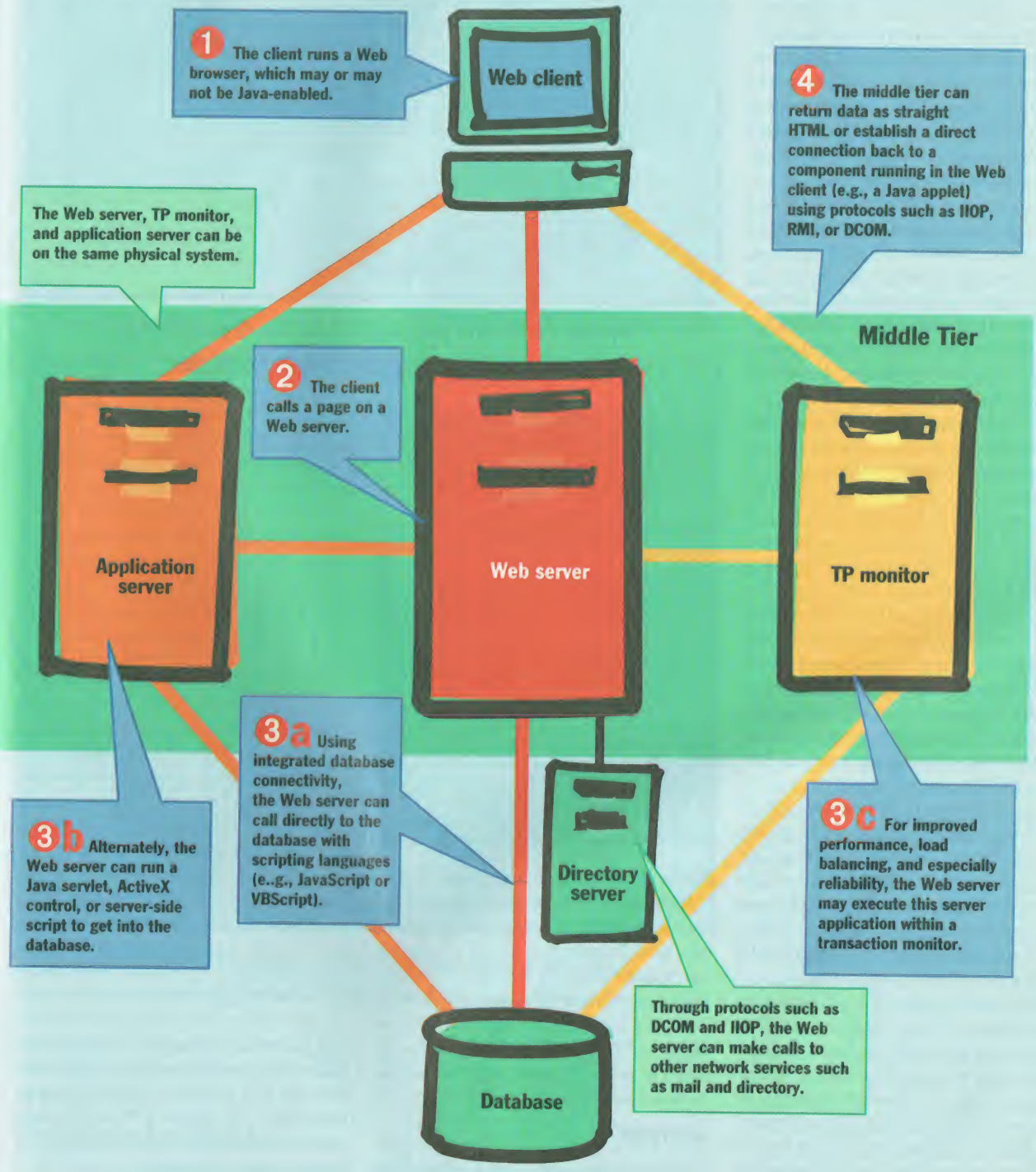
In a classic three-tier environment, a client connects to an application server, which, in turn, pulls data from a database.



Web computing is a very flexible variation on three-tier computing.

In a Web application, the client talks to a Web server, which may handle the request itself or activate connections to application servers or TP monitors to pull data from a database.

These applications running on the middle tier are probably components—sometimes called servlets—that represent discrete chunks of business logic.



are still too complex, and the data too sparse. However, some analysis of the technologies involved can help you make some decisions about how you should implement server componentware.

Three Tiers for the Web!

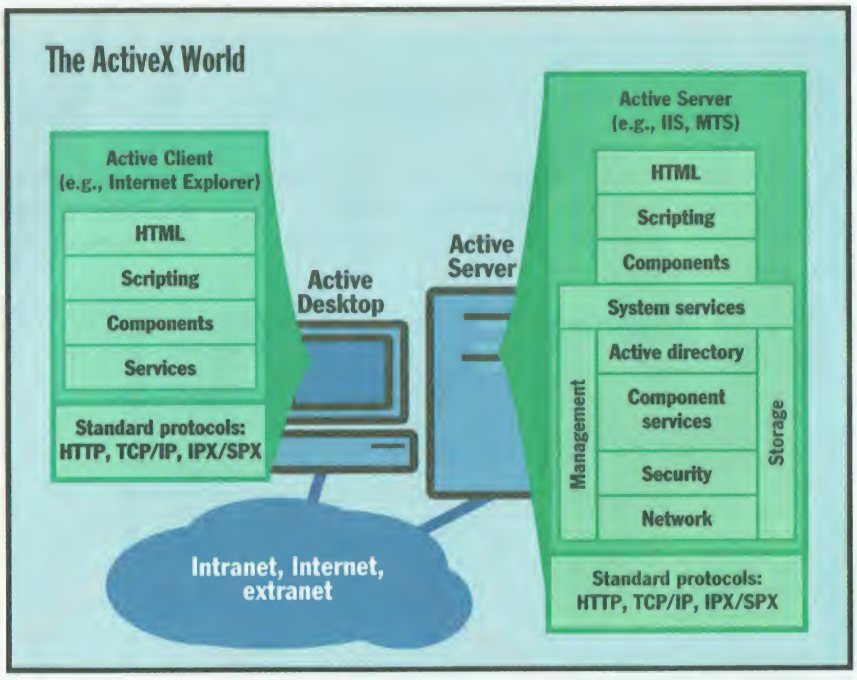
The classic two-tier client/server-computing model off-loads work from enterprise servers by separating presentation and calculation from data. Two-tier programming gave rise to rapid application development (RAD) tools such as PowerBuilder and component models such as Microsoft's Visual Basic custom control (VBX), both of which eased user-interface (UI) development. In short, two-tier development made components real.

However, two-tier architectures had problems when it came time to upgrade an application or distribute load processing. Enter three-tier architectures, separating presentation from business logic from data. Developers could still use components, but the available components were still largely targeted at UI development. Middle-tier developers were left out in the cold.

The Web is beginning to change that. Originally conceived as a two-tier system, demands for dynamic content quickly turned it into a three-tier system. The Web's original middle tier was made up of applications that use the Common Gateway Interface (CGI). CGI enabled you to extend a Web server to access nearly any OS-level function, using development environments as simple as a shell script and as complex as C++. Also, because CGI is portable, applications you wrote for an Apache server could usually run against Netscape or Microsoft servers with little or no porting. CGI programs were the first pieces of Web componentware.

Once developers realized what CGI could do, some amazing applications began to appear. The Illustra database, for example, had a CGI interface (the Web driver) that let developers write Web pages that could access a SQL database. If they could write SQL and HTML, they could create a client/server application.

Why was this a good thing? There were three reasons. First, the client—a Web browser—was virtually universal. Second, distribution of the application was as simple as clicking on a hyperlink. Finally, you could administer all that code centrally. The Web had solved three of the largest problems facing client/server computing in a single swipe. Needless to say, all the database vendors quickly followed suit.



Active Platform's parallel architectures enable high component mobility from client to server.

ActiveX

OSes Supported
Windows

HTTP Servers Supported
Microsoft IIS

Programming Languages
C, C++, Visual Basic, Java

Component Model
COM

Network Component Model
COM (formerly DCOM)

It wasn't perfect, however. In particular, invoking CGI applications can be very slow. To solve that and to give developers access to server internals, Netscape and Microsoft created server-specific APIs. Netscape Server API (NSAPI) and Internet Services API (ISAPI) enabled significant speed improvements. They also enabled more kinds of Web components.

ActiveX

Paralleling the client world, which first saw components as VBXes and OLE Controls (OCXes), server components came in two main forms: Netscape server plug-ins and Apache modules. These component systems work fine but are restricted to specific Web servers. Thus, they aren't tapping into a broad base of component development talent. To fix that, we enter the present (ActiveX) and future (JavaBeans) of server components. These models aren't just for specific servers, and in fact aren't just for servers at all, but are just popular ways to package software as components.

In an absolute ActiveX world, clients run Active Desktop (an integral part of Windows from NT 5.0 onwards), where embedded ActiveX controls can provide a UI to remote services. These components send requests via either HTTP or COM and Microsoft's Advanced Data Connector (ADC) to a middle-tier application server. There, Active Server Pages (ASPs) may employ server-side Visual Basic scripts to query a SQL database via ActiveX Data Objects (ADOs). The ADOs generate dynamic HTML pages for returning the query results to the client and call server-side ActiveX components running under Microsoft Transaction Server (MTS) that perform any application processing (see the figure "The ActiveX World"). Note that the client and server pieces of this picture are entirely separable.

The key to this picture is MTS, which

will be integrated into Microsoft Internet Information Server (IIS) 4.0. MTS provides an environment for executing distributed applications built from ActiveX components communicating with each other via the COM protocols. You can write a component as a single-user ActiveX DLL and simply install it into MTS, which will run it as a secure multiuser application.

MTS handles all the management of sharing, processes, and threads. It maintains pools of threads, network sessions, and database connections, automatically recycling them when they're no longer being used. All the components that make up an application can share these resource pools. Consequently, using MTS may actually improve performance compared to stand-alone execution, in both time and memory (see the text box "Microsoft's Efficient Transactions" on page 62).

Don't sell IIS short, however. By itself, it manages a pool of threads and a file cache on behalf of multiple services: the Web server, news server, and FTP server. It can also cooperate with ODBC 3.0 connection pooling.

Enterprise JavaBeans

The Enterprise JavaBean architecture looks similar, although with three differences. First, unlike Microsoft, JavaSoft isn't supplying a full transaction-server environment (it's relying on big names such as IBM and BEA). Second, JavaSoft is sticking to an OS-independent architecture, relying on the cross-platform nature of the Java Virtual Machine (JVM). Third, it isn't real yet.

Java began as a platform-independent language for creating client-side applets that run inside your Web browser. Release 1.1 of the Java Development Kit (JDK) adds vital features such as object serialization and database access; and you can get a servlet API to make it equally suitable for writing server-side programs (servlets). Of course, JavaSoft also has a component model called JavaBeans. Put it all together, and you get what JavaSoft announced in April: the Java Platform for the Enterprise.

JavaBeans

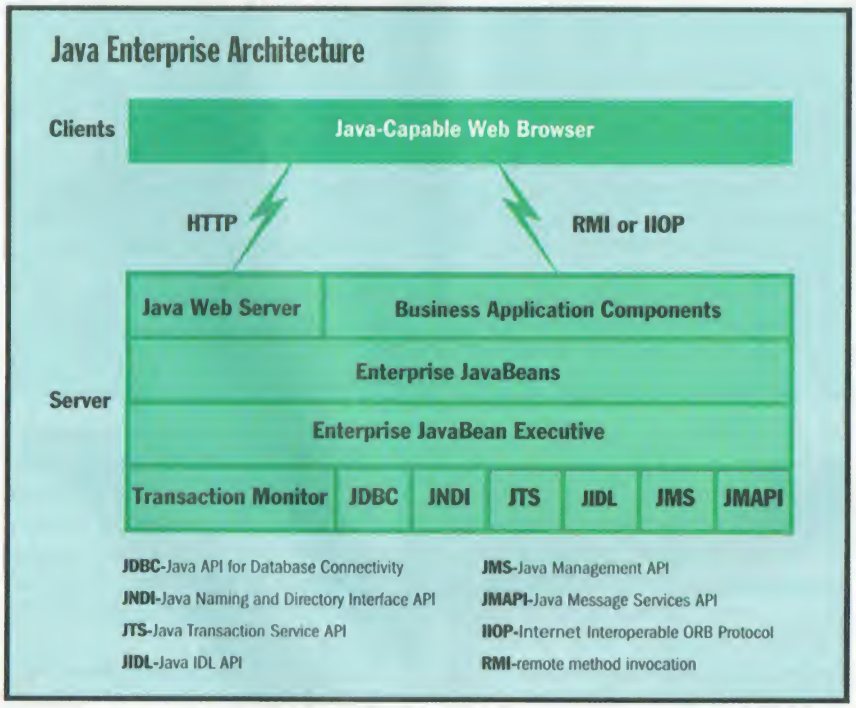
OSes Supported
Virtually all

HTTP Servers Supported
JavaSoft's Java Web Server; others to come

Programming Languages
Java

Component Model
JavaBeans

Network Component Model
CORBA IIOP or Java RMI



Enterprise JavaBeans are transaction-aware and use a high degree of abstraction from base APIs.

The Java Platform for the Enterprise consists of a suite of APIs such as JDBC (database connectivity), JNDI (directory services), and JTS (transaction services). Key to the Java Platform for the Enterprise are Enterprise JavaBeans. "Enterprise JavaBeans is an extension to the JavaBeans model targeted at the middle tier," says Sharada Achanta, product line manager for the Java Enterprise Platform at JavaSoft. Enterprise JavaBeans take the lightweight JavaBean model and extend it with multiuser security and resource management similar to that in the ActiveX model. (To Web-enable Enterprise JavaBeans, you need a Java-capable Web server; see the text box "A Java Web Server" on page 60.)

The initiative's architecture places Enterprise JavaBean components on top of the Enterprise JavaBean Executive, sometimes called the BeanStalk (see the figure "Java Enterprise Architecture"). The Executive, in turn, gives Enterprise JavaBeans access to APIs (e.g., JDBC and JNDI), remote objects (e.g., through IIOP or Java RMI), and transaction services. Part of the attraction of the Enterprise JavaBean architecture, according to Achanta, is "the developer doesn't need to know about Java interface definition language [IDL], JTS, multithreading, or security—the Executive run time abstracts APIs and remote object calls."

Enterprise JavaBeans need some kind of transactionally aware execution environment such as a transaction processing (TP) server or database engine. So far, the likes of Sybase, BEA, IBM, Oracle, and Tandem have all at least voiced support for the Enterprise JavaBeans, if not yet writing the necessary extensions to their products.

The Java model of distributed computing is coming together. The JavaBeans API offers a format for creating reusable, platform-neutral Java components (and they can interwork with other component standards such as ActiveX and the nascent OpenDoc). The Java RMI and Java Serialization interfaces allow such components to migrate around the network, heedless of what hardware platform they land on, and then control each other

remotely. Using RMI calls, an applet running on your client can control a servlet more directly and efficiently than is possible using HTTP. Enterprise JavaBeans provide a high layer of abstraction as well as features suited to multiuser execution.

Currently, Enterprise JavaBeans are a specification and some prototype code at JavaSoft, according to Achanta. Support, however, appears to be strong, and the specification is moving quickly (it should be available during this quarter). If all goes well, Enterprise JavaBeans could be a good server-side component solution, especially for heterogeneous environments.

There are other component initiatives from players such as the Object Management Group (OMG) and IBM (see the text box "IBM Takes on Objects" on page 66). According to sources at both, however, they seem to be leaning heavily toward some kind of adoption of the JavaBeans model. Netscape, too, is behind JavaBeans, effectively making it a Microsoft-versus-everybody contest.

Do It with Transactions

The issue of competing component models aside, as we move closer to this service-based model of distributed computing, it becomes impossible to ignore the issues of robustness, reliability, and quality of service. Having easy access to both local and remote services means that more jobs will involve multiple, geographically spread-out resources.

The reliability of the links in this application span the whole spectrum from highly reliable (your local disk), through variable performance (your LAN, depending on load), to transient, slow, and unreliable (the Internet connection). Any attempt to automate such an application must deal with the possibility that one or more of the connections may fail, as otherwise you will end up with a half-finished job and data left in an inconsistent state.

The mainframe world has learned how to deal with this issue by deploying TP monitors. A TP monitor manages all the processes involved in performing a job and makes the whole job into an atomic transaction (i.e., a transaction that must succeed completely or fail completely). In case of a failure in any part, the TP monitor will undo any partial changes that were made and then restart the whole transaction and try again. The cliché example of a task that needs atomic transactions is moving money between two bank accounts. A failure after the first account has been debited but before the second has been credited would lose the customer's money. After such a failure, the transaction must be rolled back to undo the original debit before trying again.

Mainframe TP monitors such as CICS, Tuxedo, and Encina are ferociously complex pieces of software—in effect, they're distributed OSes. They've evolved within a model of a few huge servers supporting thousands of clients each, and they may manage messaging, load balancing, failover after hardware failure, and restarting as part of maintaining the integrity of data operations.

A TP monitor is usually partnered with message-queuing software that ensures that information sent between applications can never be lost due to communications failures. Message-queue managers (e.g., IBM's MQSeries) define various levels of secure messaging protocol between applications (e.g., synchronous, asynchronous, and store-and-forward), which can work across different kinds of OSes and communications links, including wireless ones. One application sends a message to another by placing it into a queue. It can then continue processing without waiting for a reply. The queue manager guarantees that the message will be delivered once and once only, so if any link fails, any queued messages will be sent once it is restored.

The service-based distributed-computing model implies there will be more, smaller servers than are usual in mainframe on-line TP and more complex connectivity among them. To apply the principles of TP in such an environment means developing distributed TP monitors and messaging services that are integrated with the component software model. Ideally, the whole environment should have commit/roll back and exactly once delivery characteristics.

TP guru Jim Gray (now at Microsoft) has described mainframe TP monitors as being "more like the mortar between rocks in a wall than they are like glue" because of the large granularity of the applications they manage. TP monitors for the service-based network need to have a much finer granularity, right down at the level of individual components and even individual method calls.

Big strides are being made toward this goal. At a briefing in London on Microsoft's COM-based Active Server strategy, James Utzschneider, program manager for COM, said, "The name Transaction Server doesn't do it justice. The product does automatic load balancing, security, thread management, connection pooling, and component management. Now that MTS is being integrated into NT, it defines the programming model for building business applications in Windows."

MTS also automatically manages the

A Java Web Server

For Web-enabled access to Enterprise JavaBeans, you'll need a JavaBean-capable Web server. The easiest way to get this is to use JavaSoft's own Java Web Server (previously code-named Jeeves) currently in alpha release and downloadable free of charge. Note that currently, servlets running on Java Web Server are not JavaBeans or Enterprise JavaBeans and use a different API.

Java Web Server is written entirely in Java. It supports all the usual Web-server functions such as Secure Sockets Layer (SSL) security and Common Gateway Interface (CGI). But there's a difference: Java servlets. These small Java components can do any job a CGI script can do, often doing it with lower invocation overhead and fewer resources. And even though Java is interpreted, execution speed is not a problem for many server-side tasks. For example, BYTE's Jon Udell found that rewriting Perl scripts on the BYTE site as servlets made them run faster. Perl is interpreted, too. (So, too, did using Internet Service API [ISAPI] Perl, which also cuts invocation overhead.) Native Java compilers such as Asymetrix's promise to remove performance as an issue entirely.

It's probably unlikely that you're willing to throw out your existing Web server to get Java Web Server's servlet capabilities. And you don't have to. Thanks to the universal middleware of URLs, you can just refer from Internet Information Server (IIS)– or Apache-hosted pages to servlet functions running under the control of your Java Web Server.

But that's OK. JavaSoft also has a package that will enable servlet support on other popular Web servers such as Apache, Netscape, and IIS. O'Reilly's WebSite 2.0, forthcoming, will host servlets. Also, Netscape Enterprise Server 3.0 has its own notion of servlets.

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transactional behavior of your components, with full rollback semantics, in a way that is much simpler to program than is normal with TP monitors. To make any ActiveX component transactional, a programmer need only set its transactional property to Transaction Required and then call one of the API routines (SetComplete or SetAbort) at a point in the code where the transaction should either be complete or have failed.

In other words, MTS is not just about financial transactions. It's the manager within which all server-side ActiveX components ought to be deployed, for reasons of efficiency as much as reliability and security. MTS will shortly be joined by Microsoft's own message-queue server (code-named Falcon).

Another product poised to aid the service architecture is BEA's Tuxedo. Tuxedo is widely used to implement large, mission-critical distributed applications in the banking and financial industries. It's not unusual to build Tuxedo-based systems with over 1000 physical servers handling 25,000 clients.

Tuxedo is now available in a native NT version, and it's accompanied by a new tool called BEA Builder for ActiveX, which lets developers see Tuxedo services as ActiveX objects from NT or Windows 95 clients. You can build the client applications using Visual Basic, PowerBuilder, or Delphi and still have access to all the powerful Tuxedo features such as access-control lists (ACLs) for security, the EventBroker for publish-and-subscribe communication between applications, and Management Information Bases (MIBs) for application management. PowerBuilder also allows you to access legacy

Microsoft's Efficient Transactions

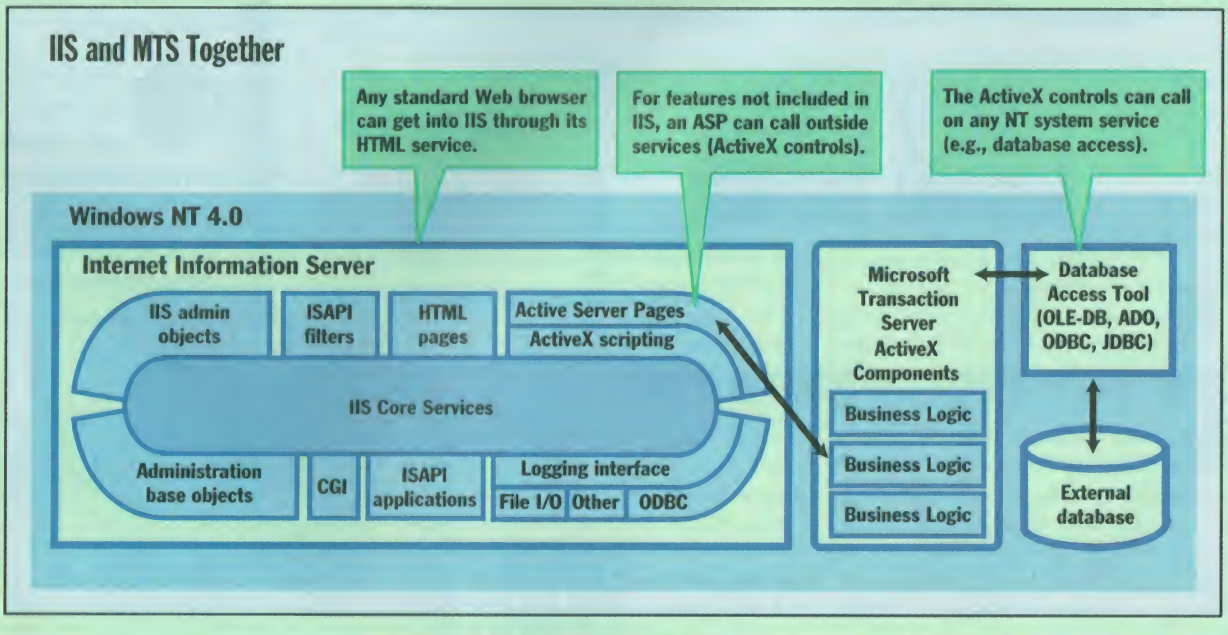
Microsoft Transaction Server (MTS) isn't just about guaranteeing completion of transactions. It's about performance. MTS can offer an immediate increase in processing and memory efficiency to applications. For example, if the third tier of your application requires connection to several SQL databases, MTS's Connection Pool will create those connections just once when it initializes, rather than incurring the repeated overhead of remaking connections.

How? Conventional distributed object systems store all data inside objects and maintain long-lived references to them. Under MTS, all the persistent data remains stored in the back-end database and is fetched only fleetingly into middle-tier objects for processing. A new instance of a component is created "just in time" by the first call to one of its methods, which then populates it with data from the database. Once the method calls SetComplete, the instance relinquishes all its state information and is deactivated. It may be reactivated and reused by another process in the future (actually, every new instance gets assigned a context object that preserves some state—the transaction status and security ID—between activations). This way, many client processes can use the same instance, thus avoiding the proliferation of objects that often plagues object-oriented designs.

On the other hand, should a method need to access the database many times, it can keep reusing the same instance and avoiding the overhead of setting up a new object and connection. This scheme encourages a programming style that's a clever compromise between classical object-orientation and on-line transaction processing (OLTP) techniques.

There are some downsides. In its first release, MTS's multithreading support is restricted to "apartment" threading, where only instances of the same class can run on different threads. Later versions will support "worker" threading, where any instance can run on any thread. And by using ODBC and Distributed Transaction Coordinator (DTC), which ships with Microsoft SQL Server, MTS applications can participate in Extended Architecture (XA) transactions, but X/Open TP monitors can't call components running under MTS. And MTS doesn't support nested transactions (i.e. atomic subtransactions within transactions), though the MTS architects claim these are an unattainable academic mirage and that MTS's fine granularity renders them unnecessary.

In May, Microsoft announced that MTS was to be integrated into Windows NT 4.0, making its transactional abilities available to all applications and file systems.



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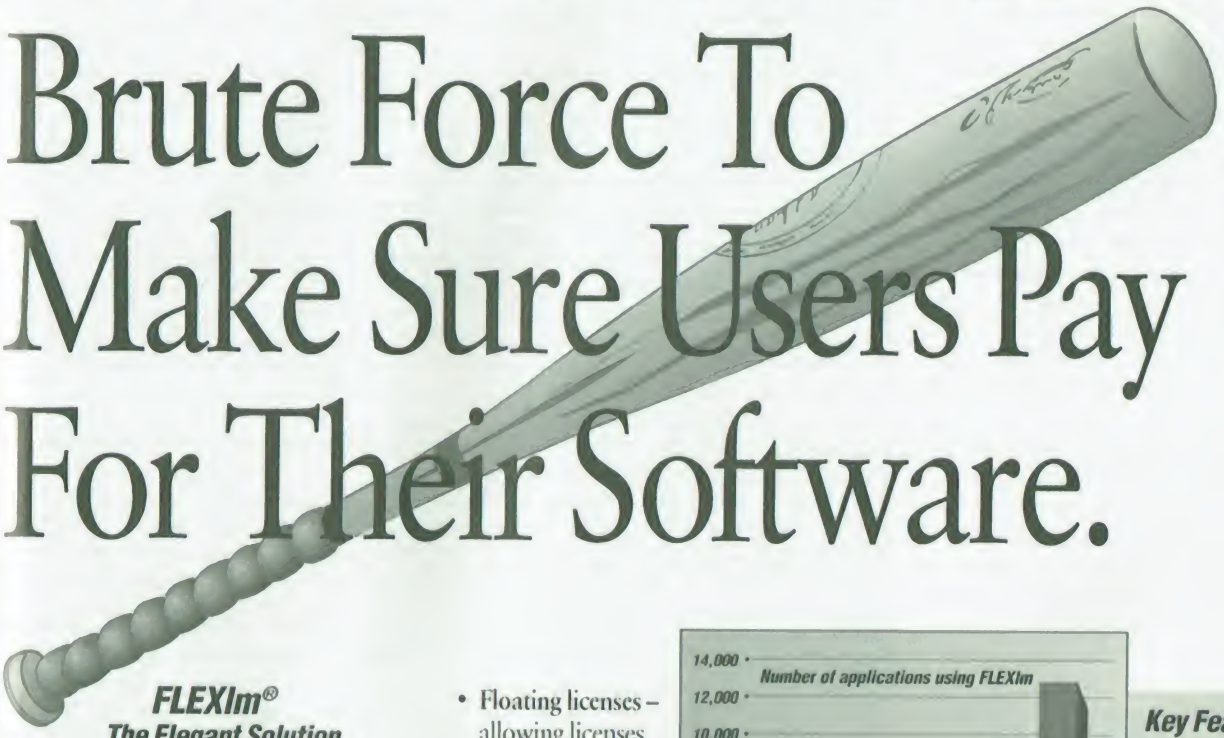

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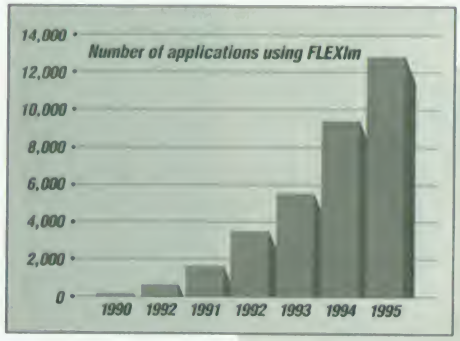

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systems based on CICS or IMS via the Tuxedo middleware.

In March, BEA purchased Digital Equipment's ObjectBroker object request broker (ORB) and its Desktop Connection technology. Desktop Connection lets you write applications that will work with any CORBA 2–compliant transaction manager. According to BEA's CTO Alfred Chuang, "Developers can now create interactive applications that take advantage of two different object systems—CORBA and ActiveX—without retraining or having to write extra code."

The next step for BEA will be seen in Tuxedo's successor, code-named Iceberg, due in September. Iceberg will be object-based and both COM- and CORBA-compliant. "Tuxedo today is procedurally driven and not object-oriented," says Chuang "But in Iceberg, we want to hide all these procedural interfaces." Why? If you're following the COM, CORBA, or Java development model, you are fundamentally writing stateful applications—the application at all times has control of the state of the transaction.

"When you're deploying something in a lot of places, a complex system with massive transactions that involve many different components, that's a really painful thing to have to clean up if the transaction fails," says Chuang. Load balancing and the ability to group these objects onto a single physical server and move them around are going to be very critical to scalability. "What you really want to do eventually is to hand over the management of all these objects to the system and have them run in a stateless environment."

Other commercial CORBA Object Transaction Monitors (OTMs) that offer transaction services compliant with the CORBA 2 standard are starting to appear on the market, too. A recent example is Iona Technologies' Orbix/OTM, which incorporates Transarc's Encina Object Transaction Engine.

For more on transaction monitors, see "Guaranteed Delivery" on page 77.

Run Over the Network

Once you have components running on your Web server, there's still the not-so-small matter of getting these components to talk to each other over the network. At the simplest level, you can pass one component URL-encoded information from another. However, more elegant solutions abound. Microsoft's COM is probably already familiar to Win32 programmers. Netscape is using the CORBA IIOP for its interobject communication. JavaSoft is pushing Java RMI.

Right now, the main network object models are Microsoft's COM, JavaSoft's Java RMI, and the OMG's CORBA IIOP (see the text box "The CORBA Connection"). These models aim to be platform-neutral by forcing objects to communicate only by calling each others' methods, which are exposed via an abstract interface that's defined in an IDL.

COM and CORBA use almost identical IDLs, both of which are derived from the Open Software Foundation's (OSF) Distributed Computing Environment (DCE). Programming tools then compile these interfaces into proxies, stubs, and type libraries that a developer can access from

The CORBA Connection

The Object Management Group's (OMG) effort to define interoperability for distributed objects began well before the current obsession with the Internet. As a result, its Common Object Request Broker Architecture (CORBA) 2 standard now looks slightly old-fashioned, though perhaps classic would be a kinder word. This is the classical view of object orientation, where all the data is encapsulated into objects that communicate by sending messages to each other via well-defined interfaces. CORBA is supported on all the major versions of Unix, on IBM's OSes, and on Windows NT. Netscape is even adding support for CORBA's IIOP to future versions of its products, so that you will be able to browse CORBA objects as well as Web pages. The notable missing name here is Microsoft, whose ActiveX/Component Object Model (COM) is in direct competition with (and incompatible with) CORBA (although you can bridge them together with interworking products).

The problem with CORBA is that it took such a long time to achieve a workable standard, and the result is so complex that there's still no retail market in reusable CORBA objects. Most vendors are still at the stage of selling ORBs. Many smaller developers are not prepared to wait and are settling for simpler solutions based on ActiveX or Java. Also, the existing CORBA model presupposes that objects are so large that they will stay put and send messages to each other, rather than moving around the network. (There is a request for proposal [RFP] that would extend CORBA to enable passing objects [including Java objects] by value, solving that problem to some extent.) This puts it out of step with the latest Internet/intranet thinking. It doesn't help CORBA that none of the current generation of Web browsers are IIOP-enabled.

Nevertheless, several large firms are using CORBA-based technologies successfully, including Federal Express, Boeing, Chevron Petroleum, and Motorola. Wells Fargo Bank built a mission-critical three-tier customer service system in 1993 using Digital Equipment's ObjectBroker (now owned by BEA). The learning curve for implementing CORBA is higher than for ActiveX or Java, but once that's been climbed, it seems to deliver industrial-strength results and supports features such as implementation inheritance that COM lacks.

This suggests that CORBA objects will remain part of the mix in any service-based future. But they will remain in large corporations and will stay on the server. That makes the issue of talking to CORBA objects from ActiveX and Java clients crucial. Fortunately, there are some powerful tools to help do this. CORBA ORBs can be made to talk to COM components—that's what ORBs do. However, programming to raw CORBA or COM interfaces is too tedious for any developer weaned on Visual Basic. Iona Technologies' Orbix offers an automation interface to ActiveX objects via Visual Basic scripting. BEA's ObjectBroker Desktop Connection goes further still. It can take the interface definition language (IDL) of a remote CORBA object and generate an ActiveX control—complete with GUI—which you can embed in any OLE container. The first version of Desktop Connection supports only objects on ObjectBroker servers, but future versions aim to support objects on any CORBA 2–compliant ORB, as well as remote COM objects.

On the Java side, JavaSoft, SunSoft, and Netscape are all working on Java support for IIOP, so that Java programs can interact with CORBA object services. Also, Visigenic Software is shipping a Java-based ORB called VisiBroker, which Netscape now bundles with its Enterprise Server 3.0. VisiBroker contains a native implementation of IIOP as well as a tool that compiles CORBA IDL into client- or server-side Java code. Netscape's LiveConnect (a layer of the ONE architecture that enables HTML, Navigator plug-ins, Java applets, and JavaScript to interact with each other in the client) will be extended to support IIOP, so that ONE applications can access remote CORBA services as named components.

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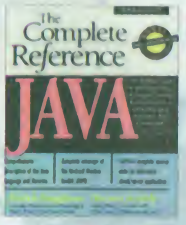

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IBM Takes on Objects

How much code do you write that you don't have to? For example, tax calculation is a well-known problem. So is currency conversion. And address manipulation. Why should you waste your time reinventing these wheels? Well, if IBM and more than 100 independent software vendors (ISVs) have their way, you won't have to. Called the San Francisco Project, this Java-based, cross-platform, multilayer framework allows you to string together components to handle the more mundane aspects of business applications, leaving you free to concentrate on writing code that must be unique.

San Francisco can be described by a three-tier model (see the figure "IBM's San Francisco Frameworks"). At the bottom is the base technology infrastructure, which includes basic capabilities such as printing, conflict control, persistence, transactions, and object model classes. On top of that lie the common business objects (e.g., currency manipulation, tax calculations, and address manipulation). Next up the ladder are the core business processes, such as general ledger, warehouse management, and order management. On top of all that lie commercial applications.

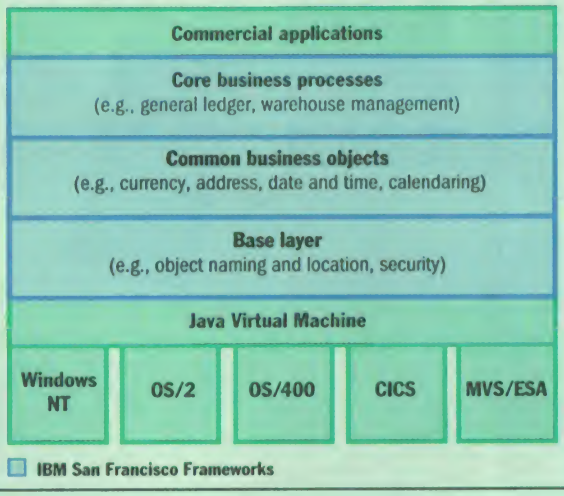
So what does it take to develop an application using San Francisco? It depends on which level you're developing for. You're going to need a modeling tool such as Rational Rose (IBM will have a Rose-to-Java generator this summer) as well as a Java development environment such as Symantec's Visual Café or IBM's VisualAge Java.

There are still some problems with writing business applications in Java. "Right now, they're pretty slow," admits Daniel Sabbah, vice president of applications development architecture for IBM's Software Solutions Division. "But that's going to change," he continues. IBM is working on the performance of the Java Virtual Machine (JVM) in its OSes, and is even working on a native compiler for server-based Java applications (which don't need to worry about transportability). Even with the performance considerations, Java holds some great advantages for IBM's multiplatform environments—so much so that by the end of this year and into early next year, you should expect to see VMs for Customer Information Control System (CICS) and DB2. According to Sabbah, IBM is even working on a universal VM with extended bytecodes that will be able to host Smalltalk and object-oriented BASIC in addition to Java.

Many companies are endorsing San Francisco (at least on paper), especially European companies such as Software AG and Siemens AG. You'll find some U.S. names in there, as well, including Borland and Dun and Bradstreet.

–John Montgomery

IBM's San Francisco Frameworks



San Francisco abstracts business processes and should enable developers to focus on building unique applications.

the actual applications development language, such as C++, Visual Basic, Java, or Smalltalk. For a Java RMI, Java itself is the IDL (which works because the language is itself platform-neutral). This simplifies development both conceptually and in practice.

Most of us will be familiar with components through COM, which underlies the ActiveX components that you can deploy from C++ and Visual Basic programs, and from Office applications. How a COM object calls methods in another COM object depends on where they are running. If they are in the same process, they can call each other via pointers. Objects running in different processes interact via proxy objects and stubs that pack and unpack the call parameters into a standard format for transmission. Communication between components running on different machines takes place via remote procedure calls (RPCs)—the core technology inside distributed COM.

In all these cases, however, the client object's method doesn't need to know the details of how the communication is done (location transparency.) Proxies and stubs provide a static link between components, but COM also enables components to discover and call new interfaces at run time. This is the basis of ActiveX. You can assemble an application by dragging and dropping components that have no prior knowledge of each other onto the same form. Automation between, say, Microsoft Word and Excel works because these Office applications make their key internal functions visible to other programs as COM objects.

CORBA works through software engines called ORBs. Whenever one object needs to call another, it sends a message to an ORB, which handles the whole transaction on its behalf. An ORB can translate between different data formats, processor-endianisms, and other attributes, making CORBA objects processor-, OS-, and language-independent. CORBA makes no distinction between client-side and server-side objects: They're all just objects. The basic CORBA 2 ORB specification doesn't deal with issues such as concurrency, integrity, and security, all of which must be provided as separate CORBA services. For example, transactions are handled via OTMs that work alongside an ORB.

Java, like COM, provides a mechanism for components to discover each other's interfaces at run time, but they can also run on different platforms by virtue of the JVM. JavaBeans can also run as applets outside any container application, and Java Class Loaders can download any libraries a component needs along with the component. Consequently, JavaBeans don't need to be registered the way that ActiveX components do, which makes them very suitable for building highly dynamic systems. JavaBeans score over ActiveX in the more flexible way that they

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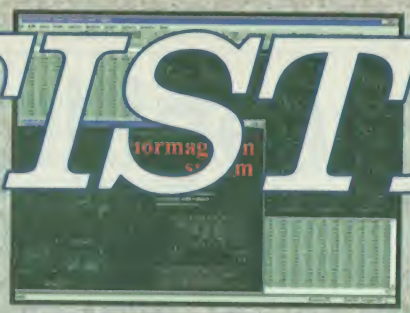

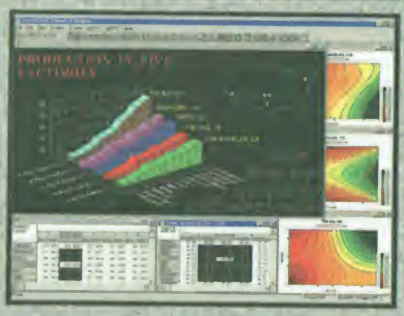

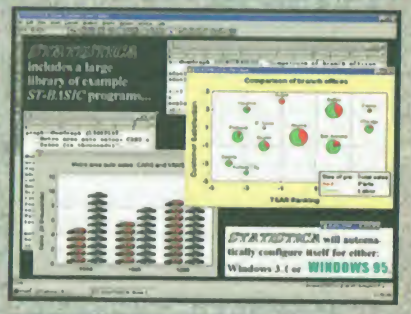

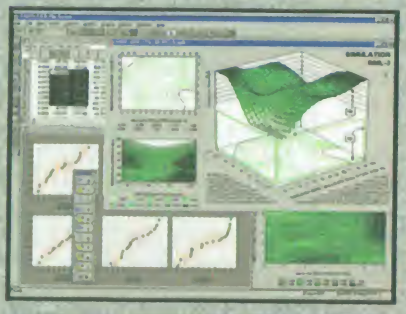

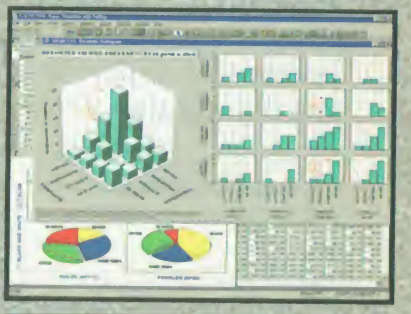

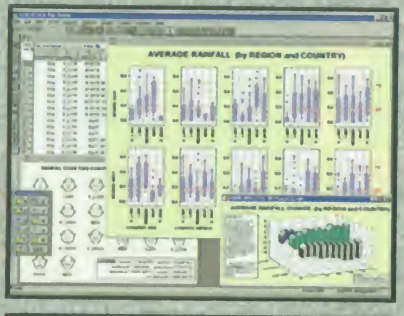

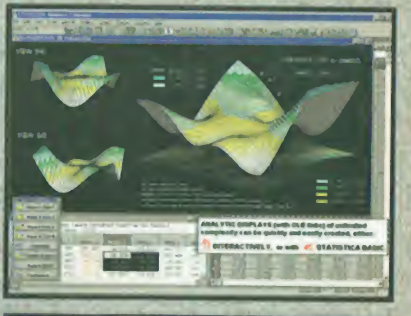

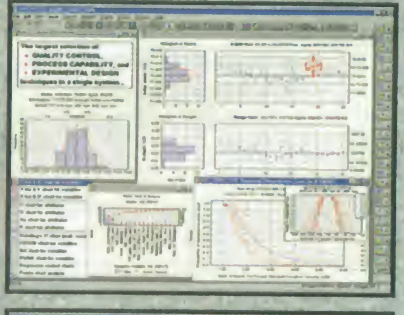

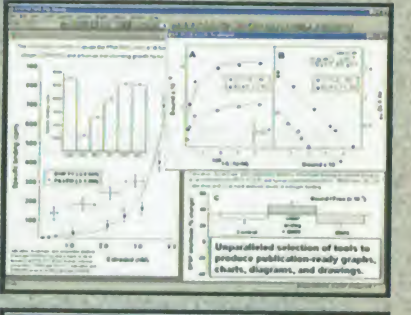

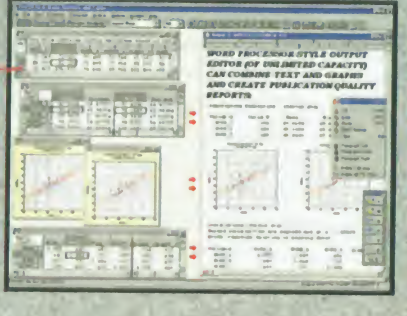

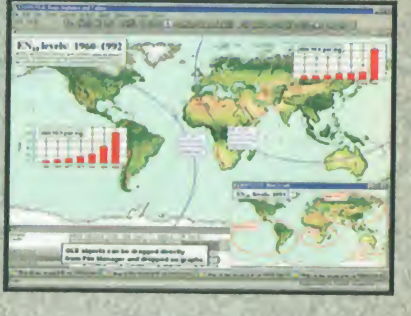

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can interact with application builder tools.

Java applications can use RMI to call methods in components on remote machines. RMI resembles COM. If all goes according to their plans, cooperation among JavaSoft, Netscape, IBM and others will also also make it possible for JavaBeans to communicate using CORBA IIOP, opening the way to provide secure transactions via a CORBA-compliant OTM.

In theory, COM, CORBA IIOP, and Java RMI could all be platform-neutral component standards. But the commercial reality is different. First, while CORBA and Java are available for a variety of platforms, issues with their interoperability remain to be found and ironed out. Microsoft has so far implemented COM only for Windows platforms (although Digital, Hewlett-Packard, and Software AG are all working on ports to other OSes).

Just Plumbing

The service-based architecture, for all its advantages, still has some problems facing it. One example is object management. A service-based application could consist of some ActiveX controls running in MTS and an Enterprise JavaBean connected by JavaScript executing on either the client or the server. JavaScript itself is an object, with properties, methods, and events. By what mechanism can anyone manage that mess? Right now, the answer is none. Directory services such as LDAP and Microsoft's Active Directory will provide some relief, but not enough.

And, of course, there's the overwhelming problem that most of what we can get today is plumbing. For all their promise, these object models and APIs aren't at the level that we've come to expect, thanks to client-side ActiveX controls that we can twist together in minutes to create applications (although many vendors are working toward that). Not only is it plumbing, much of it is incompatible—for example, JavaBeans can't run in MTS, and ActiveX controls can't run in CICS.

But you have to start somewhere. Which architecture do you adopt? It depends on the size of your application, your existing hardware, your software environment, and whether your application's function is stable or highly changeable. For example, Java servlets are a very good choice for those applications that might now be done by CGI scripts, such as reformatting tables retrieved from a database. The investment is small, so you just throw them away and rewrite them as requirements change.

If your site is already Windows-based, ActiveX under MTS looks like a sensible way to go, whereas CORBA ORBs may make more sense for large Unix installations and industrial-control applications. The telecommunications industry is strongly committed to CORBA, particularly in Europe, which might be an influence for some people. If you use Java extensively, you'll likely work extensively with JavaBean components and RMI.

To some extent, your decision will be affected by the market in shrink-wrapped components. Here, Microsoft has the advantage of its dedicated band of third-party vendors such as Sheridan and MicroHelp, already experienced in VBXes and OCXes, who are gearing up to produce server-side components. Wall Data's server-based ActiveX screen scraper is another example of an ActiveX server component. With it, an HTML client can render green screens without any client-side ActiveX intelligence. But the sheer enthusiasm of the Java world is a powerful force, and the list of off-the-shelf JavaBeans on sites like http://www.gamelan.com grows daily.

Whichever technology you decide to use, you can be sure that by adopting a component approach to server applications, you will save time and money on maintenance, as well as increasing your options for future enhancement.

These decisions are rarely mutually exclusive. You can deploy "competing" technologies right in the same box (e.g., Java servlets and ASP-based scripts). You can use Java to create ActiveX controls or CORBA objects. You can use IIOP to communicate between ActiveX controls or JavaBeans. Because you can use each of these server technologies to target the universal client (any HTML/JavaScript-capable browser), they are entirely complementary. Each solution has advantages not currently otherwise available. B

Dick Pountain is a longtime BYTE contributor based in London. You can contact him at **dickp@bix.com.** *John Montgomery is BYTE's West Coast bureau chief. You can reach him at* **jmontgomery@bix.com.**

Knowing the Terms

JavaBeans: JavaSoft's component standard, backed by Sun, Netscape, and IBM.

ActiveX: Microsoft's component standard, now administered by the Open Group.

COM: Microsoft's Component Object Model and what was formerly the Distributed Component Object Model. COM provides a standard way for objects to pass pointers locally or over networks. It is being ported to non-Windows platforms by Software AG, Digital Equipment, and Hewlett-Packard.

CORBA: The Object Management Group's Common Object Request Broker Architecture is a set of definitions for how objects should interact over networks using object request brokers (ORBs). You can find ORBs for nearly every OS.

IIOP: The Internet Interoperable ORB Protocol is a subset of CORBA and provides a standard way for ORBs to communicate.

RMI: Java's remote method invocation provides methods for Java objects to talk over networks.

COM-CORBA Interworking: A specification for enabling COM and CORBA objects to work together.

OLE: Microsoft's Object Linking and Embedding, a Windows compound-document architecture. OLE Automation, a kind of cross-application scripting, is now called simply automation.

OpenDoc: Another compound-document architecture, backed by a large consortium, including IBM and Apple, largely found on OS/2 and the Mac.

CICS, Tuxedo, MTS: Transaction monitors from IBM, BEA, and Microsoft.

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Intelligent Intranets

Intranets can be anarchy until you manage who can do what where.

By Udo Flohr

What could be better than an intranet? You have your own internal enterprise-wide Internet or Web system where you can post and retrieve company news and information, work in progress, and gossip about coworkers. And the potential for group work with colleagues all over the globe is limitless. Really, the only flaw is that your intranet can be utter chaos from Day One—until you realize you have to start managing content and controlling access.

Intranets contain many documents and other data items, prepared by many people from many departments. How do you manage the process of creation and maintenance in this free-for-all environment? How do you use your intranet to improve your business?

Setting up an intranet is probably too easy and inexpensive, as Steven L. Telleen, the person credited with coining the term *intranet*, has found. Formerly of Amdahl Corporation and now director of strategy and business development at Intranet Partners (Santa Clara, CA), Dr. Telleen's mission is fighting the "lack of business scrutiny that is going into intranet projects."

An intranet uses Internet protocols—TCP/IP—and Internet tools on an organization's LAN or WAN. The structure often uses Web-style pages of information. Users within the organization can post information and can access posted information. Although usually intended for internal use, sometimes the enterprise allows the outside world access to part or all of the intranet.

Open standards make intranets wildly popular. They are flexible, easy to implement and use, and platform- and vendor-independent. Web browsers render information more accessible. Helper applications and plug-ins integrate browsers with existing applications. According to Netscape, about 50 percent of its Web servers are for intranets.

Web tools for receiving and publishing information are deceptively easy to use—and often deceptively free. All you need to start an intranet are a free server and free Web clients. A skilled user may be able to set up a Web site from scratch in an afternoon. And that is just where the problems can begin. It's as easy as finger-painting, and it can be just as messy.

ILLUSTRATION BRAD HAMANN © 1997

Step 1: Make a Mess

As the first pages start going on-line, you start wishing for an HTML editor. Soon, users discover that the technology is simple enough for them to publish information on their own, and pages and servers start sprouting like weeds all over an organization. Telleen recounts that when information managers at large corporations run a Web crawler on their intranets for the first time, they often discover that about 30 percent of the servers that appear were previously unknown to them. "Unofficial applications and information seem to be the trademark of intranets," he notes. While the unknown may be exciting, it's not easy to control.

Whether official or unofficial, an intranet needs managing. Probably the first thing a Web administrator will need is a set of administration tools to check links and fight "spaghetti."

Then mail and, perhaps, news servers become part of the system. As the organization starts using the net more interactively, CGI scripts implement on-screen forms, and back-office applications collect the data and feed it to an order processing or workflow system. To allow information to flow the other way, the Web needs a database link.

continued

The intranet is not open to outsiders by definition, but it soon becomes obvious that not even all insiders should have access to all information. An access control system, something conceptually foreign to Web structures, needs implementing, and that costs.

Of course, access control can extend to "outsiders," namely one's customers and business partners. Giving them access to price lists and planning materials can be a boon to business—but a security nightmare. The Web is already notoriously permeable. Clearly, some kind of rational access control is necessary.

If the allegedly free intranet has not already turned out to be costly by this time, the final straw may be load balancing: Servers and communications links give way, a distributed infrastructure becomes unavoidable. This may be easy enough for the information itself, but not for add-on applications and access control.

Notice that all these additions have been serving useful purposes within the organization. Information is available for circulation, although exactly where might be a mystery. The infrastructure for group collaboration is there, even if that bozo from Finance messed up your masterpiece of a proposal: Who let them get access? And why are there 52 drafts of the company holiday schedule, and what is the difference between them?

Companies are struggling with information delivery, as well as work flow, revision tracking, and document security, says Thomas Bjelkeman-Pettersson, a U.K.-based intranet consultant and codesigner of an architecture called Intra.doc. Despite its problems, Bjelkeman-Pettersson believes that the Web and Web-derived or Web-integrated tools "will be king of the hill." But, as IDC analyst Evan Quinn points out, the ubiquity of Web tools has made "every seat in the enterprise with a browser a 'developer' on the intranet." As a Mortice Kern Systems (MKS)white paper puts it, intranets are "rich with opportunities but loaded with peril." Corporations should be wary of placing "responsibility of maintaining and publishing this information in the hands of their employees," as this also means "accountability for ensuring this critical corporate information is valid, accurate, and legal." The intranet enhances employee productivity and helps create a truly global corporate communications platform, but MKS notes that its "grassroots origin...is also its Achilles' heel." Who will be responsible if errors make their way into on-line price lists or quarterly financial statements?

By this time the Web administrator will start thinking about what the organization has gotten itself into. Maybe an off-the-shelf solution, perhaps even something like Lotus Notes, would have been better. In any event, it's time to start reining in the intranet.

Step 2: Clean It Up

There is hope. The problem at this stage, Steve Telleen writes in his upcoming book *Understanding Intranets*, is not things being out of control but people feeling out of control. The first challenge is "a change in roles and responsibilities. In the past, IT professionals controlled the flow of computerized information by virtue of the technology barrier. Almost overnight, this barrier has come down. [But] control is not gone, only shifting."

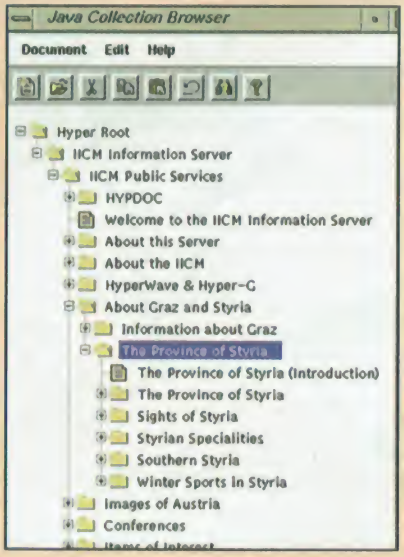
Industry analyst Stan Lepeak of the Meta Group (Stamford, CT) warns that thick manuals with rules and regulations will not help at this point. Corporate legal departments, requesting the right to examine all Internet and intranet content, are more likely to create bottlenecks. One day, Lepeak says, "an IT manager wakes up and discovers his organization has 600 Web servers." They have security and integrity problems, but "those departments that have been so busy working on the intranet will have to get back to their real work."

The solutions to intranet chaos are not hard to find. In fact, they are already in use in groupware, software configuration management (SCM), and document control systems. One necessity is access control: Not everyone in an organization can have unlimited access to everything

Products That Help

Hyperwave's Information Server

Previously known as Hyper-G (see "Hyper-G Organizes the Web," November 1995 BYTE) and using proprietary formats and protocols, Hyperwave Information Server is now fully



Information Server transforms intranets into dynamic linked objects.

compatible with HTTP, HTML, and standard Web browsers.

Hyperwave features dynamically generated, bidirectional hyperlinks. The system knows not only where links point to, but also where they come from, which makes dead links virtually impossible. Links may attach to arbitrary documents, including MPEG video or PostScript files or documents from application suites such as Microsoft Office. The server automatically indexes documents as they check in. You can search on content and metadata such as creation date and author, as well as on custom, application-specific attributes. Navigation aids include dynamic maps and 3-D representation of content, as well as personalized, structured views.

Hyperwave cuts site administration costs dramatically by handling most maintenance tasks automatically. It includes sophisticated access control and provides for collaborative and remote authoring as well as annotations, which any Web browser can make.

IntraNet Solutions' Intra.doc

The Intra.doc "information delivery architecture" helps companies automatically maintain Web sites (see the figure "Intra.doc Eases Management," page 72). Document conversion is often not necessary at all. Native format viewers (for example, for PostScript or a proprietary CAD format) start a helper application through a Web browser. The Intra.doc system provides review and approval functions. It supports scheduled releases of documents: The person releasing a document can specify the time when the new version should become active.

on the intranet. The access control should have gradations. Some items might be read-only (like corporate information and policies); some items might be accessible only by users in a certain group (like workers on a particular project); still others might be invisible to all but a select few (for sensitive documents); and yet others might be wide open to anyone.

Another need is for version control. A user with the right to write should not make changes to the original document itself: You might want that original back again. So making changes to a document would actually create a new version automatically, stamped with the name of the modifier, the date, and other information. This permits tracking changes as work progresses. The downside is that having many versions of documents takes up space on your drives. But once documents reach certain "plateaus" of doneness, intermediate versions can vanish.

Related to version control is check in/check out of documents. When a user checks a document out of a repository, no one else can modify that document, although it's okay to merely view it. Once the document checks in again, then others can modify it (or its successor if the first user modified it).

Search capabilities are essential, of course. It does no good to produce intranet content if no one can find it.

Finally, the user interface is of prime importance. Surprisingly, not all your content producers are going to be super-Webheads. The interface must be simple enough so that any user can get things done. It should be robust but not restrictive. You want control over the process, but you don't want the process to be daunting. It does you no good if the controls are so rude and rigid that users prefer to find ways to circumvent them.

While these are old concepts, new technologies can give them new twists. For example, if documents exist as related objects in an object-oriented system, then many of the above interactions occur as part of what the documents "are." Furthermore, since many intranets are Web-based, preserving links to documents is an important feature. Besides, a single Web page is a complex object in itself, with multiple contributors from different locations, both internal and external, supplying text, graphics, multimedia information, and even software.

Web Object Management

According to analysts, an organization may typically spend between $100,000 and $2 million to develop a Web site, and up to half a million a year to maintain the information and keep it up-to-date. The

Ikonic's Ringmaster

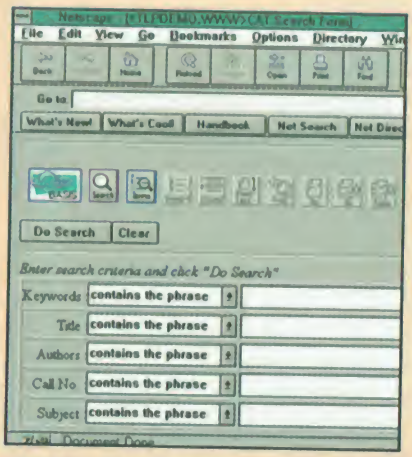
Ikonic's Ringmaster is a tool to automate the content aspect of Web site production. Authors can drag-and-drop their items into a project folder. If a supervisor approves them, they automatically go to a Web server, while rejects get comments and go back for revision. The program synchronizes links, tracks versions, controls access rights, and generates content maps.

Mortice Kern Systems' Web Integrity

MKS has joined the fray with its own intranet content manager, Web Integrity. It helps coordinate the internal collaboration process that ensues when many coworkers try to publish at the same time. Even off-site workgroups can publish to the site. Web Integrity also deals with the problem of version tracking.

Vignette's StoryServer

StoryServer, developed by Vignette in collaboration with Web news site CNET, is a dynamic publishing server and content management system for producing Web sites. It separates content authoring from Web page design, enables control over site-wide look and feel, offers advanced personalization capabilities, and scales to deliver millions of page views without performance or cost penalties (see the figure "StoryServer Supports Content Providers," page 76). With minimal effort, StoryServer lets a site grow from hundreds of pages to thousands, even with content and site structure constantly changing. The software handles many chores automatically.



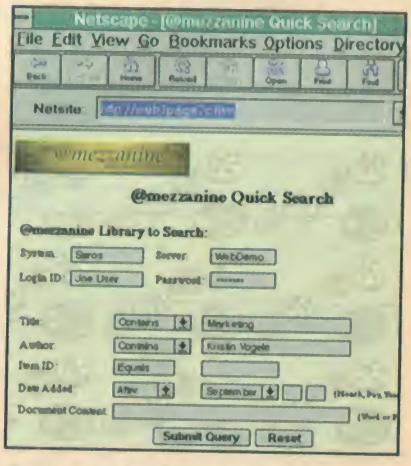
BASIS adds new intranet search and navigation features to client browsers.

Information Dimensions' BASIS

BASIS provides an open, scalable, client/server architecture that includes a comprehensive set of document management services, a robust document storage manager, an enterprise-wide access interface, and a suite of application development interfaces. The BASIS Document Manager ensures efficient control, management, retrieval, and navigation of document collections. It includes complete library services, full-text retrieval, document control, document delivery, security, and authentication. Supported document types include SGML, HTML, tagged text, word processor formats, and bibliographic records. A Web gateway provides access through standard servers.

FileNet's Saros Discovery Suite

Saros Discovery Suite includes Document Manager, which provides an easy, intuitive way to organize word processing, spreadsheet, and graphic documents. It provides version control, document security, and detailed search and retrieval. Another component is Watermark Client, which captures paper-based information and allows users to share document images and facsimiles. The Ensemble component helps create work flows that popular e-mail applications can launch,



Saros provides document management and searching in ordinary browsers.

distribute, and monitor. These bundled tools mean you don't have to integrate third-party utilities. The Saros Discovery Suite is a key component in FileNet's Foundation for Enterprise Document Management strategy.

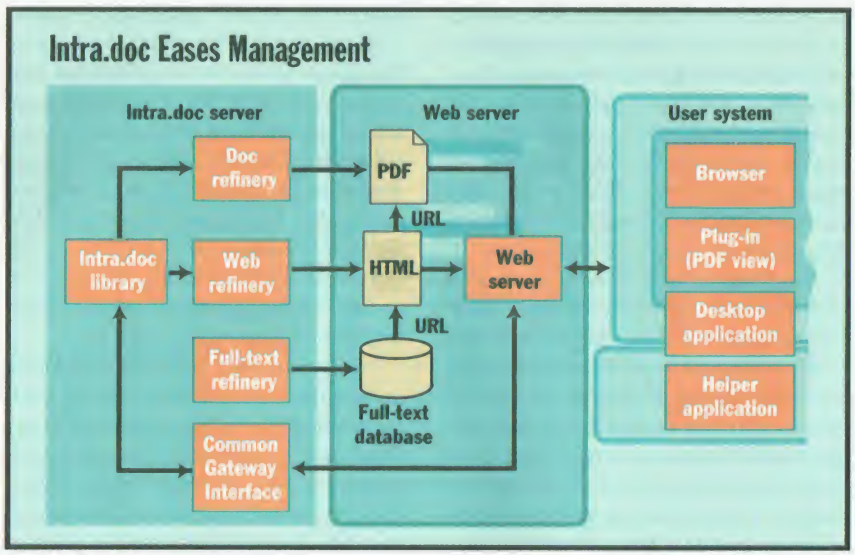
challenge is to improve quality and usability of the content while lowering the associated costs.

Intranet users also need different views of information, tailored to what is relevant for them. Because the Web cannot provide that, many organizations resort to publishing the same content to everyone. The result is quiltwork at best, infoglut at worst. Some information is isolated from the intranet for security reasons. Furthermore, the static information structure causes frustration.

To stem the flow of entropy, some organizations rely on multiple Web administrators, while others have none at all. As the Web itself lacks means of controlling, reviewing, and versioning content, these have been manual tasks—a classic situation where a computer might help or might make things worse.

Enter Web object management (WOM), or Web content management. These technologies marry traditional SCM functionality with Web-specific features, making control central but lightweight. WOM products try to foster collaboration, remove bottlenecks, automatically enforce corporate look-and-feel standards, and safeguard business-critical information. It helps the Web administrator centrally organize Web objects, including text, graphics, and Java files.

Naturally, the two heavyweights to watch are Microsoft and Netscape. Microsoft's Visual SourceSafe began life performing version control as part of software development products like Visual Basic, Visual Studio 97, and FrontPage 97. It also appears in Visual InterDev as well as in NT 4.0 Enterprise Edition. Now it controls a variety of items in a variety of formats, including HTML documents and Java code.



Intranet Solutions' Intra.doc automates intranet maintenance and simplifies document conversion, all using standard browsers.

SourceSafe provides all the major functions you would want. Its version control offers features specific to Web management. "Shadowing" maps a SourceSafe database to other sites. As product manager Lloyd Arrow says, this is handy during development and staging of sites, before they're ready for prime time. "Deploy" creates a "consistent state" of a site: a collection of certain versions of files that belong to a certain level of a site's development. Deploy ensures that with new changes to the site, the links are okay and everything works. A click of a button publishes the consistent state to the Web.

SourceSafe access control offers four levels of security, plus a superuser level, for each project or collection of files. Allowed access includes read-only, check in/check out, edit, remove, and delete (at the highest level). Besides the usual check in/check out (where one person can have file out at a time), it offers a multiple check in/check out option. With this, several people can each have the same file out—to work on the text or graphics of a Web page separately, for example. When they check the file in again, any discrepancies flash the warning light: The person then decides which version of each file element to use. No changes are lost, though: Each version of the file gets saved separately, just in case.

Searching with SourceSafe can be content-based—looking for a word or phrase in a document, or by filename, or by other features like file state ("What files do I have checked out?"). The user interface closely resembles Windows Explorer's hierarchical view of files. Plus, as Chris Stirrat, program manager, notes, SourceSafe integrates easily with third-party products. This allows SourceSafe to become part of another product and also permits using a variety of development tools with SourceSafe.

Netscape's own offering, Enterprise (Web) Server 3.0, provides many features for managing intranet content. These include automatic link management,

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Interoffice memo	Delays or inefficiencies in company operations	Important
Internal help desk postings	Duplication of effort or loss of efficiencies	Important
Marketing and sales literature	Reduced effectiveness	Important
Competitive research	Revenue and profit loss, market share standing	Critical
Corporate policies on safety regulation compliance	Lawsuits, heavy fines, shutdown of operations, loss of life	Critical
Material and safety data sheets	Lawsuits, heavy fines, shutdown of operations, loss of life	Critical
Procedures or records supporting ISO 9000 certification	Lost business, shutdown of operations, loss of ISO 9000 certification	Critical
Legal regulation compliance records	Lawsuits, heavy fines, shutdown of operations	Critical

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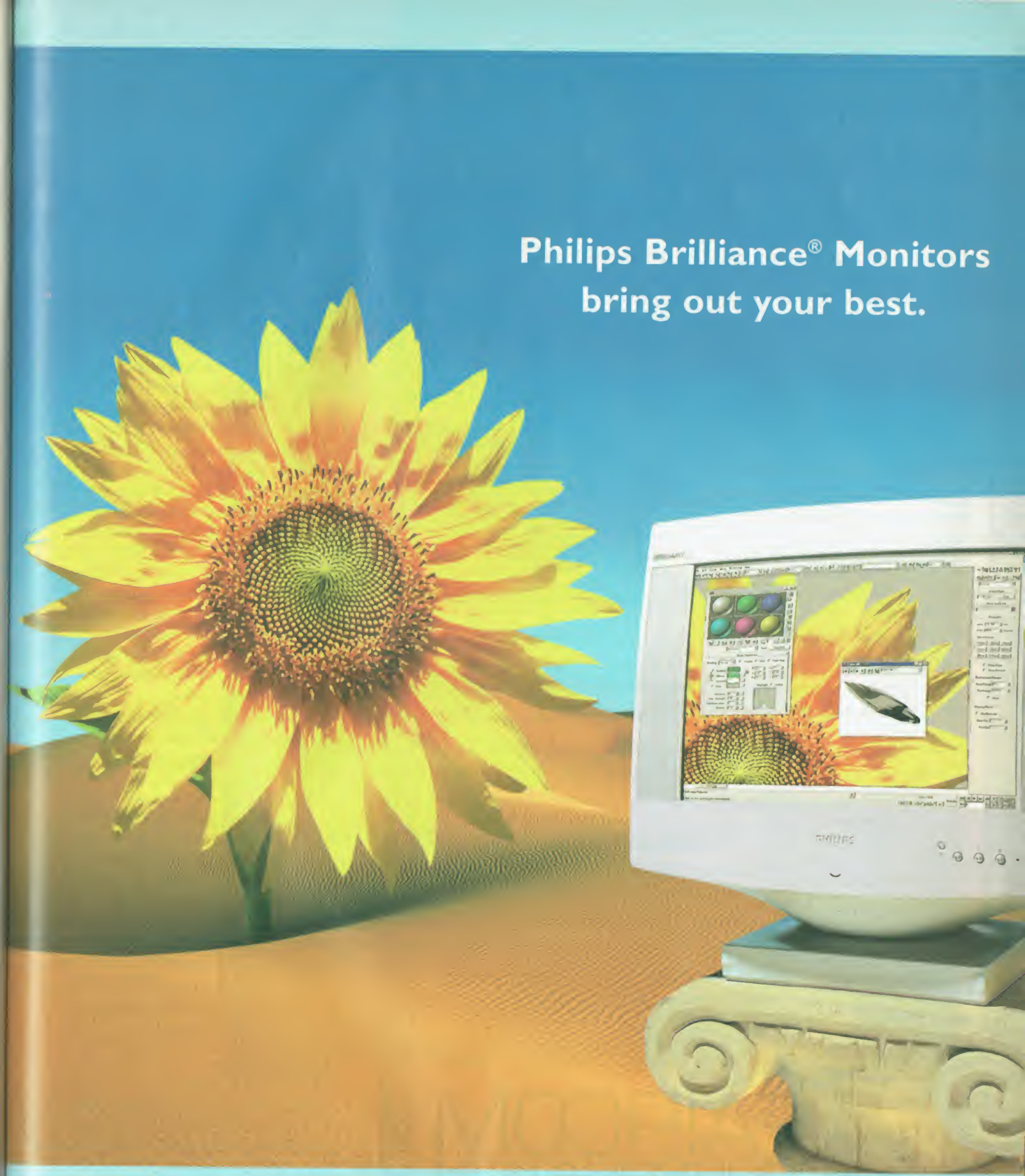
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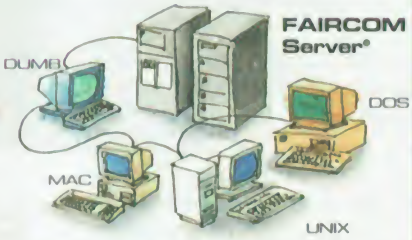

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version control, control of access to documents at several levels, and intelligent agents that can inform a user if certain Web documents update.

The Netscape server includes pieces from several sources. Netscape's own LiveWire technology enables link management and the creation and management of Web content that can include documents and JavaScript applications. Netscape has licensed MKS's Integrity Engine for document version control and check-in/check-out features. Netscape has also licensed Verity's search engine technology for indexing and searching not only the content of documents (which can be the usual ASCII or HTML or a variety of other supported formats) but metadata about the documents, such as title and author. Netscape's Catalog Server provides automatic document cataloging.

Netscape's SuiteSpot comprises a whole family of Web server products. It has the advantage of being OS-independent, and Netscape claims it integrates easily into existing infrastructures. SuiteSpot includes nine products, among them Enterprise Server and Catalog Server. Also included is Collabra Server, a full-blown groupware package.

MKS also partnered with Informix Software, developing a DataBlade for the Informix Universal Server. It helps manage and retrieve revisions of new dynamic forms of objects, such as sound, video, geospatial maps, and graphics from an object relational database. Using HTTP, workgroups using Web Integrity can surf, edit, approve, and publish Web objects while working off-site.

Documentum describes its similar product, RightSite, as a Web content manager. Based on Documentum's Enterprise Document Management System, RightSite brings Web pages under the control of a dynamic document repository. It helps Web administrators manage the life cycle of Web pages in the same manner as other documents. RightSite controls the actual content of a site, automating the process of contributing and updating Web pages and tailoring their delivery based on a user's rights and preferences. RightSite's Virtual Link Processor generates hyperlinks dynamically, enabling the system to select the appropriate version and rendition of a page based on the user's requirements and security clearance; this also takes care of dead links. The Dynamic Page Assembler uses a combination of

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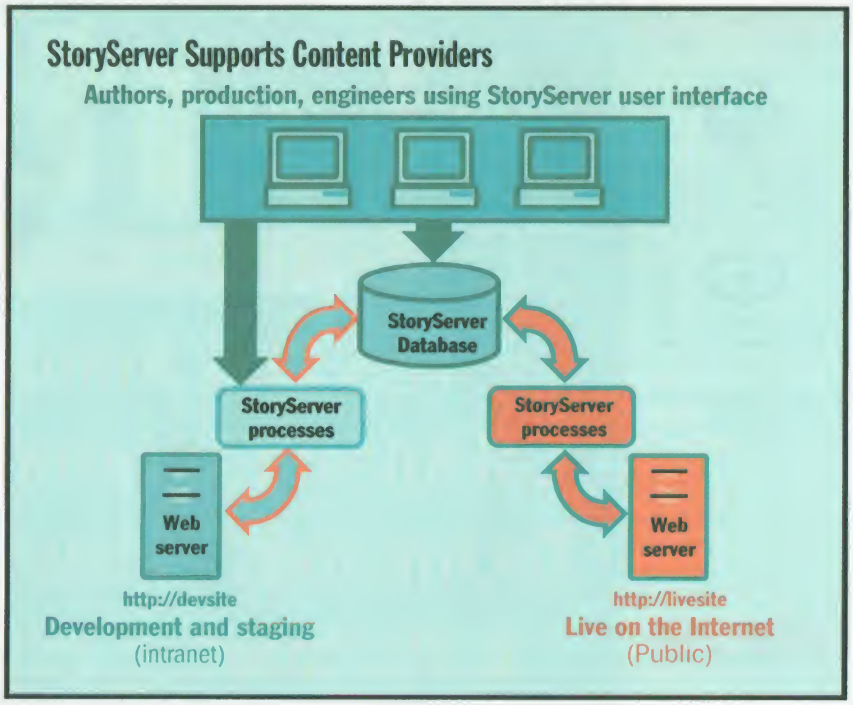

StoryServer provides sophisticated publishing management for content providers.

server-based business rules and the attributes associated with a query to assemble Web pages appropriate for a user's rights, profile, and preferences.

Tools Aren't Everything

While having competent tools to manage content certainly simplifies the problem, there are other aspects to the intranet content management solution. Methodology can heal the madness. For example, it is important for an organization to maintain as much of a sense of inherent information structure as possible. Once such a framework is in place, it greatly facilitates do-it-yourself publishing by team members: The information should more or less automatically show up in its logical place. Should any reorganization become necessary, it will help avoid having to actually move information: adjusting links should suffice. Once managers and Web administrators start reviewing content, a threaded discussion or, better, an annotation system is invaluable for channeling comments.

Whether you are just starting your intranet or trying to streamline an existing one, it may help to sit back and think about the intranet's implications for your corporate culture. Intranets cause the distinction between formal and informal information to blur, for example. Employees discover it can help them circumnavigate the chain of control by allowing them to publish and share information directly. While some organizations will view this as defying a corporate policy of top-down decision flow, others may interpret the same situation as empowering. Either way, it might be necessary to redefine management control roles. Understanding these new paradigms is an important first step to taming the chaos. B

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Guaranteed Delivery

Can you have multiple Web servers, application servers, and database servers without transaction-oriented middleware? We doubt it.

By Barry Nance

Oh, what a tangled Web we weave when first we practice to write three-tier Web-based applications without using transaction processing (TP) monitor middleware. The same software technology mainframes use to process millions of transactions per day, recast into Web-suitable form, is a sine qua non for developing and running business-automation applications on an intranet or the Internet.

The effort to program the business logic isn't the issue here. Supporting thousands of clients is. Business logic analysts and programmers have neither the time nor the expertise to create the transaction-oriented, network-based architecture a high-volume application will demand in everyday use; they have enough work to do automating business procedures and rules.

Fortunately, a small but growing group of vendors offers Web-aware TP monitor tools you can choose from. Some of these are mature, pre-Web products to which vendors have added Web awareness, while others are new tools designed expressly for use within applications based on Web browsers and HTTP servers. Read on to explore the software technologies embodied by Web-based TP monitors.

ILLUSTRATION: ROB WILKINSON © 1997

Transactional Superglue

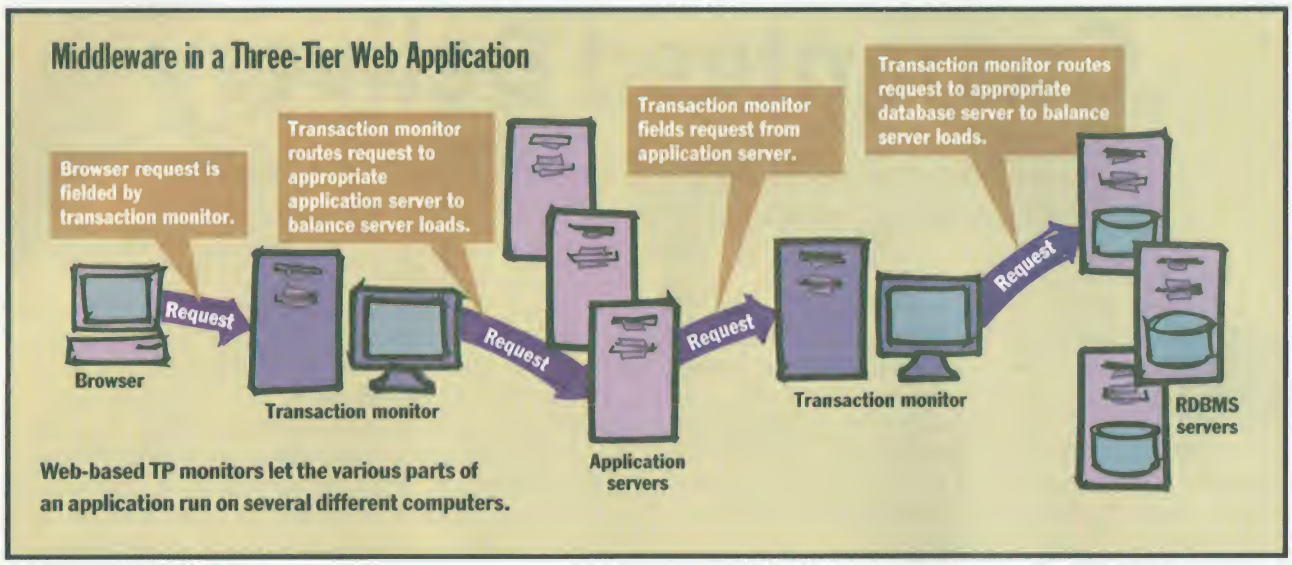
People sometimes call middleware "glue" or "plumbing," and a few even mystically say, "If you need to ask what middleware is, you don't need it." Web-based TP monitor middleware is simpler to understand than vague metaphors and churlish misdirections imply.

The levels of a three-tier architecture are presentation, business logic, and data storage. Middleware exists between each of the tiers, connecting the presentation layer to the business logic layer and the business logic layer to the data storage layer. For example, you might use a Cisco router or a transaction-aware Java class library to distribute incoming HTTP traffic among several Web servers—the router or the Java class performs a middleware role. Software you incorporate into the application to help distribute transactions among multiple application servers (running the business logic) is middleware. Whether purchased or home-grown, application components that distribute database server requests across several relational database management system (RDBMS) servers are also middleware. The connectivity software (or, in some cases, hardware) is the middleware, and its place in the system assures transaction integrity and enforces security, in addition to balancing the work load. Web middleware, and TP monitors in particular, gives designers and programmers the intra-application network linkages and services that let a distributed Web-based application handle a large number of clients.

TP Middleware

Middleware categories include TP monitors, Distributed Computing Environment (DCE) and remote procedure call (RPC) environments, messaging, object request brokers (ORBs), and database access tools. TP monitor products offer a middleware environment oriented toward handling transactions over a network. For example, TP monitors bracket developer-defined application operations with implied BEGIN TRANSACTION and END TRANSACTION. By using TP monitor services, applications don't have to specifically provide for transaction integrity.

TP monitors help the various parts of an application running on several computers coordinate with each other, performing tasks such as queuing transactions, balancing transaction work load, managing and isolating transaction processes and threads, monitoring the completion of transactions, and verifying rights and permissions. Further, a Web-based TP monitor overcomes HTTP's inherent statelessness by recognizing which HTTP messages (Web pages, most likely) belong to each transaction, or by



augmenting HTTP with the monitor's own state-maintaining protocol.

You integrate TP monitor services into an application in several ways. You can insert statements into your application program that call the TP monitor's APIs, or register with the TP monitor those application components and resources that relate to a transaction, or sometimes by taking both actions. Some TP monitor APIs are extremely simple, while others are more involved. In either case, invoking the APIs is usually quite easy once you identify where in your application's flow the transactions occur. TP monitor vendors currently have proprietary APIs, but most say they plan to implement the new X/Open standard APIs.

Here's another example of how a Web-based TP monitor can help an application run smoothly in the face of a high volume of transaction requests. Because you configure the middleware with information about which database servers are equivalent copies of each other, as well as which databases a transaction can affect, the middleware can monitor server activity and send SQL messages to less busy database servers. If a particular server fails, the middleware queues the SQL request and delivers it when the server returns to the network. Alternatively, the middleware can reroute the message to a different database server that (as you've designed) is a replicated copy of the failed server (see the figure "TP to the Rescue" on page 80). Without faltering, the system continues to process transactions that don't need access to the failed server. Some middleware products can even route HTTP messages to Web servers that are less busy.

Web-Based Solutions

Companies such as BEA Systems, IBM, Microsoft, Oracle, Prolifics, Visigenics, and KIVA are in the forefront of Web TP monitor technology. Each takes a somewhat different approach to helping your application process transactions.

BEA offers Java programmers transaction services with its Jolt product, a collection of class libraries and functions that complement BEA's well-known Tuxedo middleware. Jolt also replaces HTTP with its own Jolt Transaction Protocol (JTP), which gives Jolt-based Java programs extra capabilities beyond the limited, document-presentation-oriented HTTP. JTP helps Jolt maintain transaction state information and helps servers distribute transaction workloads.

Tuxedo, which supplies the basic middleware services to a Jolt/Java application, is a distributed transaction monitor. It gives developers message-oriented functions implemented in terms of transaction semantics. Tuxedo consists of a transaction manager, queue services, a domain feature, DCE integration functions, and client components. The transaction manager provides naming services, dynamic message routing, load balancing, configuration management, transaction management, and security. Queue services provide a messaging framework that insulates business logic from the specifics of the underlying transport layers of the network. The domain feature allows you to segment application components on a large network into administratively autonomous groups. Tuxedo's DCE integration is a set of utilities and libraries that can provide DCE services and functions to Tuxedo-based applications.

Programmers use Application-to-Transaction Manager Interface (ATMI), a set of 30 API function calls, to incorporate Tuxedo into their applications. The Open Group has adopted ATMI as a standard X/Open API. The ATMI toolset gives developers asynchronous service calls (callback functions), typed buffers, service request forwarding, service request prioritization, and dynamic, programmatically controlled data routing.

Prolifics, a company that offers a product of the same name, gives Tuxedo-based application designers a visual tool for incorporating database-oriented business logic. The tool emits HTML, JavaScript, and (soon) Java to help Tuxedo IS shops develop three-tier Web applications.

Borland's Midas (a not-quite acronym for Multitier Distributed Application Services), in development as we went to press, is an object monitor for Web applications. It consists of three broker components: Business ObjectBroker, Remote DataBroker, and ConstraintBroker. The Business ObjectBroker performs load balancing and assures transaction integrity for OLE Automation objects (i.e., ActiveX components) registered with it. The Remote DataBroker acts as an intermediary between thin clients (e.g., browsers), business logic, and database servers. ConstraintBroker copies database constraint logic onto the computer running the business logic and lets the business logic use

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those constraints as data edits. Without ConstraintBroker, applications must either contain data edits that express the same database integrity rules as the constraints in the database or face the likelihood of insert/update failures when issuing SQL statements to the RDBMS. Constraint Broker reduces network traffic and simplifies application maintenance.

Likely the neatest feature of Borland's Midas technology is that you don't have to insert code into your applications to take advantage of it. Borland says it will supply graphical tools for registering applications with Midas and configuring their behaviors.

IBM's numerous middleware products currently connect more computers and applications, in more diverse ways, than any other. For Web-based applications, IBM supplies developers with IBM Transaction Server, which runs on OS/2 Warp, AIX, and Windows NT and was formerly called CICS for OS/2, CICS for AIX, and CICS for NT. It acts as an enterprise-wide coordinator and integrator of servers and clients, managing applications and data sources across a network. IBM also offers Encina, MQSeries, and the CICS Gateway for Java.

IBM Transaction Server is a TP monitor middleware product that ensures integrity for transactions involving a set of related updates (all the updates succeed or all the updates fail and get rolled back), allocates system resources to transaction-oriented applications, launches applications as necessary to process transactions, balances workloads across application servers, and even initiates transactions within Lotus Notes. IBM bundles CICS Gateway for Lotus Notes and IBM CICS Internet Gateway with its Transaction Server products. The CICS Internet Gateway interfaces Web servers and CICS applications, translating between HTML and 3270 data streams in order to, for example, let Web browsers display 3270 screens as if they were Web pages.

IBM's complementary products for Transaction Server include Encina and MQSeries. Encina is a DCE-integrated (and RPC-based) transaction processing solution. MQSeries is a platform-neutral messaging facility; it uses a message queue coupled with a transaction monitor to free interbusiness developers from having to comply with one another's network infrastructure and timing requirements. The CICS Gateway for Java consists of small Java class libraries developers can use to connect their applets to CICS programs running elsewhere on the network.

Microsoft Transaction Server manages low-level operating system resources, such as processes and threads, thus allowing concurrent client access to applications. It synchronizes access to shared data, lessening the effect of multiuser database access as it routes transactions to application servers and database servers. Transaction Server supports ActiveX, has a simple programming interface for hooking into your application, and offers just-in-time instantiation of object components. This middleware product manages a pool of ODBC connections that clients can draw from, and it can act as a repository for shared data variables that multiple concurrently executing processes can access. The application components that Transaction Server manages are location-transparent, meaning they can reside virtually anywhere on the network without the application having to keep track of which server, drive letter, or directory structure contains them.

An application environment that includes Transaction Server has an architecture consisting of base processes (client programs, which might be browsers), application components (implementation of business logic, written as ActiveX components), the Transaction Server Executive (manages transactions and provides services to application components), resource dispensers (distribute and control shared resources, such as database connections), and resource managers (SQL Server is an example).

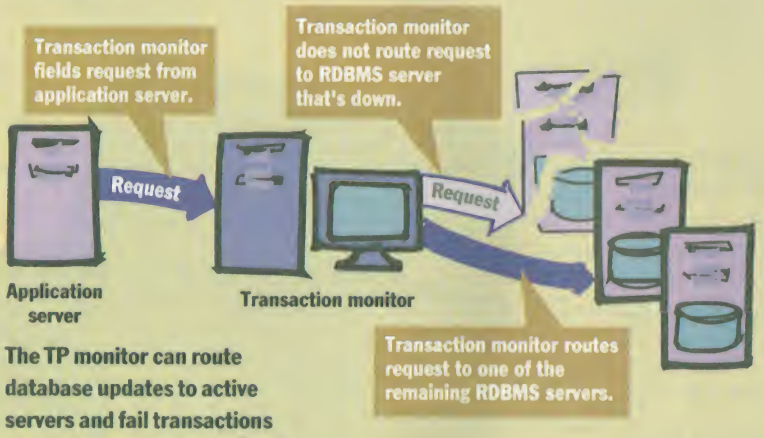
Microsoft Transaction Server, like most other TP monitors, has a proprietary API. While other vendors plan to implement the new X/Open standard APIs, Microsoft plans to stick with its ActiveX component model and simple calling conventions. Transaction Server adds just two new APIs: GetObjectContext() and SafeRef().

KIVA's product is a TP monitor specially built for the Web. KIVA designed its Enterprise Server product as an application server environment for Web-based business applications; it contains no support for legacy (pre-Web) applications. KIVA's middleware works with Web browser clients and supports both Java and ActiveX.

Enterprise Server consists of a transaction and request manager, several APIs for programmatic control over transaction processing activities, a security module, administrative tools, a deployment manager, and a data access manager. The transaction and request manager relies on state and session information to manage multistep complex requests as atomic transactions. The security module can use cookies, database access controls, Secure Sockets Layer (SSL), Secure HTTP (S-HTTP), and HTTP challenge-response authentication, and it creates an audit trail of transaction events.

Enterprise Server has six service classes: transaction management, application and

TP to the Rescue



The TP monitor can route database updates to active servers and fail transactions requiring access to tables that are unavailable.

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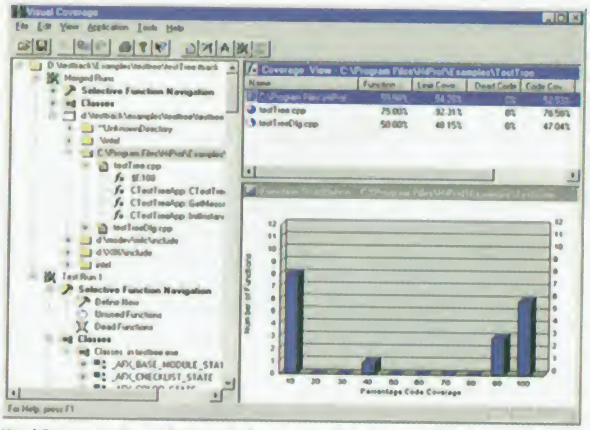

Visual Coverage works on Win32 applications developed using Microsoft Visual C++ 2.X, 4.X, and 5.0 and Microsoft Developer Studio 4.X and later.

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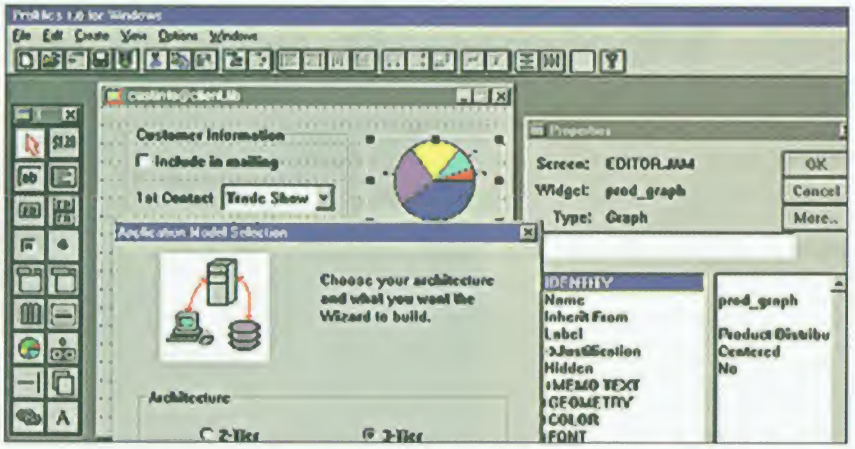
server management, system services (such as load balancing), thread management and application partitioning, data access, and application logic management. KIVA's implementation of these service classes is modularized, so you can configure them to run on one or several (distributed) machines. Enterprise Server is multithreaded and includes caching and streaming functions to minimize response times. The load-balancing feature doles out transaction requests to instances of application programs running on multiple networked computers.

Visigenic's VisiBroker for Java and C++ is a CORBA 2.0 ORB that uses the Internet Interoperable ORB Protocol (IIOP) for interprocess communication between network nodes. Visigenic's paradigm for transaction processing is ORB-based and well suited for applications whose development follows object-oriented programming standards. The IIOP within the C++ product is a native implementation, while the IIOP of VisiBroker for Java is written entirely in Java.

Both the Java and C++ versions of VisiBroker use an agent-based architecture, perform automatic configuration (and reconfiguration as the network changes), balance transaction work loads across a network, and offer smart binding. Multiple instances of VisiBroker "smart agents" keep track of which network server objects are running and which are down. These same agents perform load balancing by keeping track of transaction activity and response times.

VisiBroker for Java features a code generator that goes from interface definition language (IDL) to Java. VisiBroker is multithreaded, and it supports both client-side and server-side Java. The design-time



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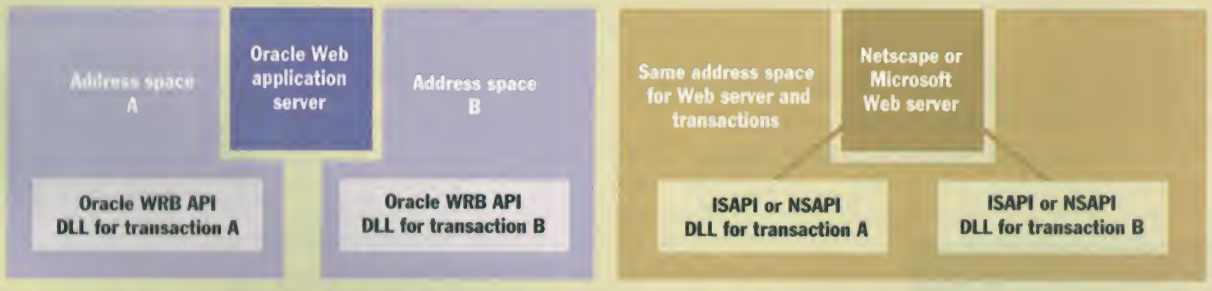
portion of VisiBroker for Java converts object interfaces, rendered in IDL, into skeleton Java code. The run-time portion manages communications between distributed applets and other objects.

VisiBroker for C++ offers an IDL-to-C++ compiler, static and dynamic invocation interfaces, an object-activation daemon, and object administration and ORB monitoring tools. The IDL compiler is a full CORBA implementation and complies with CORBA's C++ Mapping specification. The object-activation daemon conserves server resources by making sure only those objects that are currently in use (or that are frequently needed, a configuration option a developer can select) are running and available.

Web Application Server, from Oracle, consists of a Web server, TP monitor function, and a set of development tools for Web-based applications. Oracle calls its TP monitor the Web Request Broker (WRB). The Web server, a relabeled version of the Spyglass server and termed the Web Listener, accepts incoming HTTP requests from the browser and passes them directly to the WRB, which examines the requests. If an association exists between a request and an entry in the WRB configuration file, WRB forwards the request to the appropriate *cartridge*—a program built with Oracle's development tools. For unassociated HTTP messages, the Web Listener behaves as an ordinary Web server.

The WRB itself consists of three separate components types: the Dispatcher (WRBD), one or more Execution Engines (WRBXes) associated with each WRB service (such as Java or PL/SQL), and a common API to interface with each WRBX. The WRBD recognizes the object types specified by incoming URL requests by examining the WRB configuration file and identifying a match between the URL and a list of virtual directories. Each of these directories is associated with a WRB

Oracle's WRB API vs. ISAPI and NSAPI



In Oracle's Web Request Broker (WRB) API environment, each transaction's business logic runs in its own address space and is less likely to crash the Web server (or another transaction's logic) when bugs crop up.

In the ISAPI and NSAPI environments, DLLs that process transactions exist in the same address space as the Web server, which can be risky if a transaction DLL contains bugs.

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service, which is conceptually a combination WRBX and associated shared library. For instance, a URL directory field starting with /Java might be configured to initiate the Java interpreter. The WRBD also controls the number of incarnations of WRB service initiated from a particular WRBX. Programmers create WRB cartridges by registering three callback functions with the WRBX: an initialization function, a request handler, and a shutdown function.

Web Application Server, in contrast to products such as Microsoft's Transaction Server, lets developers treat multiple related Web pages (HTML requests) as a single atomic transaction. Additionally, the WRB instantiates a separate process to handle each different transaction type, thus isolating the handling of transactions from the TP monitor and Web server processes. If the business logic handling a particular transaction crashes, the failure will likely not affect the WRB or the Web server (see the figure on page 82). Web Application Server, Oracle says, will become more object-oriented later this year when the product gains an IDL compiler and ORB features.

Which One for You?

If you have existing application code that you need to incorporate into a transaction processing environment, BEA's Tuxedo/Jolt (along with the Prolifics tools) or IBM's Transaction Server may be the best answer. For new development projects revolving around other Microsoft developer tools, Microsoft's Transaction Server is worth a look. KIVA's Enterprise Server is appropriate for new development that's entirely Web-based. Oracle's Web Application Server has a robust architecture and promises great things in the future. If you're involved in a development effort not needing TP monitor support until later this year, you might want to defer choosing a TP monitor until Borland's Midas suite is available. And if you're a heavily object-oriented shop, Visigenic Software's VisiBroker for Java will help you distribute the work load.

Complex, high-volume, Web-based applications are the wave of the future for many companies. TP monitor middleware technology can save these companies (perhaps yours?) many person-months of time and effort. B

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Barry Nance, a computer analyst and consultant for 25 years, is a BYTE contributing editor and author of Introduction to Networking *(Que, 1997),* Using OS/2 Warp *(Que, 1994), and* Client/Server LAN Programming *(Que, 1994). You can reach him at* **barryn@bix.com**.

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I_2O Beats I/O Bottlenecks

High-performance servers will start using a new I/O architecture to boost performance without costing a fortune.

By Tom Thompson

Today's PC servers face ever-daunting demands on their resources. Beside traditional roles of file, mail, and print services, such machines must now handle new tasks, such as database queries, on-line transaction processing, and streaming video for multimedia applications. The explosive growth of the Internet and corporate intranets hasn't helped: Now servers must manage numerous high-speed network connections and churn out graphics and Java applets for content-rich Web applications. A PC server's architecture wasn't designed to deal with the large throughput that these tasks demand. Boosting throughput to handle these loads has meant adding more hardware to the server, such as more processors for symmetric multiprocessing (SMP) and specialized (read: expensive) high-speed peripherals. How far you could improve your corporate network's capacity going this route has been determined by the size of your equipment budget.

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However, a recently introduced I/O architecture called Intelligent I/O, or I_2O, changes the situation. I_2O-compliant servers will be able to administer more tasks despite a limited amount of hardware because the architecture off-loads portions of the work onto intelligent I/O subsystems. Dedicated I/O processors (IOPs) on these subsystems take care of the gritty details of interrupt handling, buffering, and data transfers. This improves the server's I/O throughput and frees the server's main processors so that they can handle more critical tasks.

I_2O in a Nutshell

An independent standards body known as the I_2O Special Interest Group (SIG) manages I_2O's architecture and specifications; see the group's Web site at http://www.i2osig.org/. The standard has widespread support, with the list of members on the steering committee reading like a Who's Who of the computer industry. System OEMs such as Compaq, NetFrame, and Hewlett-Packard are on it, as are OS vendors such as Microsoft, Novell, and the Santa Cruz Operation (SCO). Networking companies such as Bay Networks, Cabletron Systems, and Eicon Technology are also members. Version 1.5 of the I_2O specification was approved by SIG members this March.

While we have covered I_2O before (see "Smarter and Faster I/O for Servers" in the May BYTE), a brief summary won't hurt. I_2O features a hardware-independent architecture centered around a "split driver" model. An I_2O driver consists of an OS-specific module (OSM) and a hardware device module (HDM). The OSM manages OS-specific details such as the file system or higher-level network protocols, while the HDM understands device arcana, such as control register addresses and I/O port addresses, and deals with interrupt handling. The OSM typically operates in main memory as an OS process, while the HDM executes on an IOP. A server's firmware must be modified so that when it scans the PCI buses for devices at boot time, it recognizes I_2O-compliant devices and uses a different procedure to install their drivers, as shown in the figure "Boot Sequence Using I_2O" (page 87).

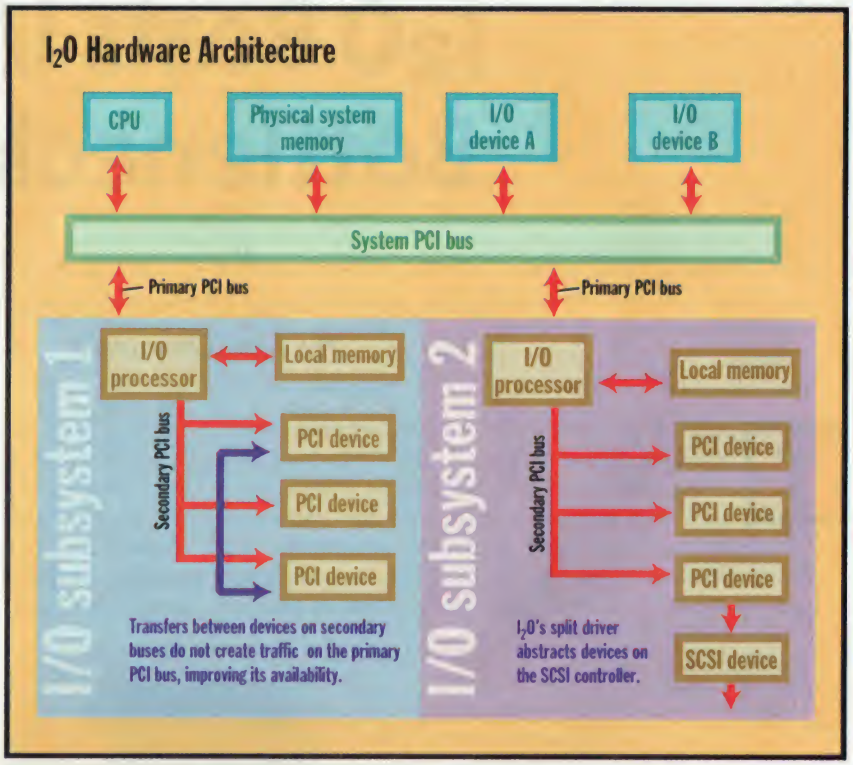
The modules communicate by passing messages (typically pointers to data) through a communications layer, which is actually a queue. There is a standard set of message types for block storage devices (hard disks and CD-ROM drives), network interfaces (Ethernet and Fiber Distributed Data Interface, or FDDI),

RAID arrays, and other services. OSMs will be implemented in Windows NT 5.0 as a DLL and as a NetWare loadable module (NLM) in Novell's IntranetWare. The HDM portion of the I2O architecture is currently built around Intel's i960 RP and i960 RD IOPs. These IOPs run Wind River's IxWorks, a multithreaded real-time OS (RTOS). IxWorks implements the object-oriented API described by the I2O standard, which simplifies driver design. Because the driver halves converse by passing messages, there is no reason other IOPs could not be used. Furthermore, the common communications interface allows, say, a block-storage OSM to interoperate with the HDM of any vendor's mass storage device.

The Throughput Problem

Because of I2O's divide-and-conquer strategy, it promises to wring more performance out of existing hardware. To understand why, we have to look at two big issues that server architectures must face: availability and scalability. Availability is where the server has sufficient resources (memory, disk drives, network interfaces, and processor capacity) to instantly process requests. Given enough users bombarding a server with requests, such resources become scarce, and the server's availability then plummets.

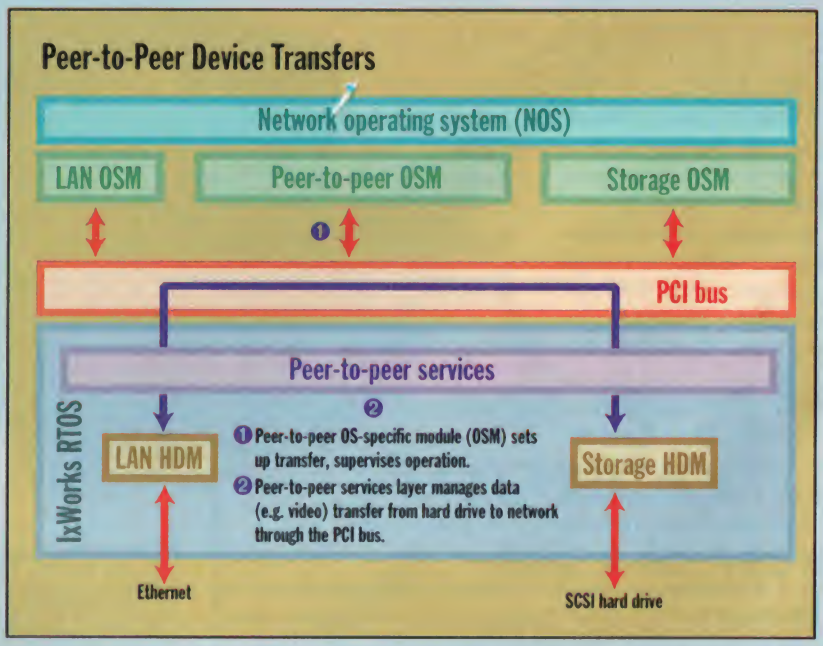
Scalability means that when you do add more resources to a server, the cumulative effect on its performance should be



The I2O architecture is flexible, and it's capable of abstracting many layers of I/O controllers from the OS.

By Your Peers

One of the most interesting aspects of I2O is a mechanism called peer-to-peer communications. Championed by Xpoint Technologies, which gave the technology to the I2O Special Interest Group, it lets two or more devices transfer data between themselves with little or no involvement on the part of the OS or main processor. This enables a new category of "brilliant handlers" that run on an I/O processor (IOP). For example, a peer-to-peer hardware device module (HDM) might monitor block-storage data traffic to implement disk mirroring. It could also copy recently modified files from a hard drive to a backup tape. A peer-to-peer OS-specific module (OSM) provides OS information, such as file system type, to the HDM so that it can set up the transfers. Additionally, the OSM acts as a traffic cop to monitor file access rights and supervise the transfer. The peer-to-peer specifications did not make it into the I2O 1.5 release, but they will be provided as an addendum later. They will become part of version 2.0, which is due out in March 1998.



The peer-to-peer layer allows devices to communicate and move data without involving the main processor.

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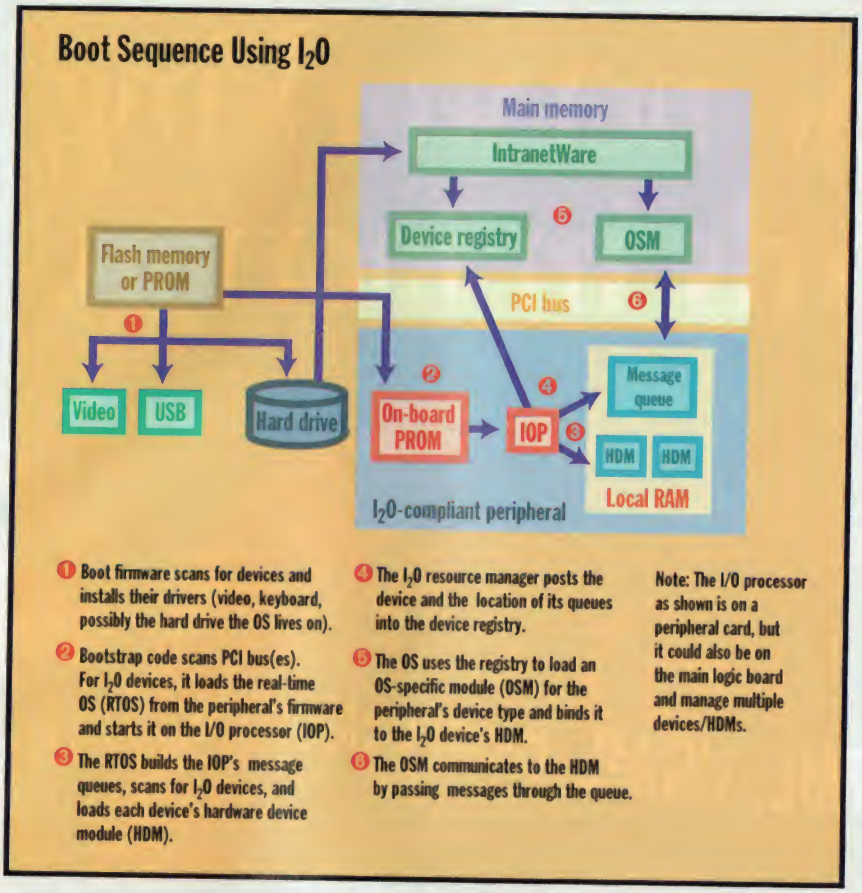

New boot firmware that recognizes I$_2$O devices is necessary because they're owned by an IOP and use a different setup sequence.

linear. This approach works—up to a certain point. Adding more resources to the server means that more devices compete for the same system bus. It can become so congested that the additional processors and peripherals wind up waiting for a chance on the bus. Now the system bus is the scarce resource, and adding extra hardware does little to improve performance. One solution is to add more buses to the system—a technique supercomputer designers have used (see "The World's Fastest Computers," January 1996 BYTE). This remedy works, but the extra hardware and the complex design drive up the system's price tag.

I/O exerts an effect on a design's scalability in another way. The server's main processor—and thereby its buses—can be tied up for thousands of cycles when performing a low-level I/O task such as executing a network interrupt handler. Furthermore, the jumps from the server application to the interrupt handler and back can create cache misses. For 200-MHz or faster processors, the pipeline delays that occur while the cache refills from slower main memory add up to more lost cycles, thus hampering performance.

I$_2$O enables the efficient use of the server bus because the IOP fields the low-level interrupts in local memory provided for it. Furthermore, the HDM uses the bus only when transferring data in bulk to or from main memory. With a less congested bus, the server hardware can handle more tasks. The performance improvements can be dramatic: "Some of our tests have shown an I$_2$O implementation confers a 495 percent efficiency gain for Windows NT throughput," says David Miller of Xpoint Technologies, a company working on I$_2$O products. This additional capacity also contributes to better scalability for the server. "While a conventional dual-Pentium Pro server can manage only two Fast Ethernet cards, both at 40 Mbps, with an I$_2$O-compliant system and our software you can have several Fast Ethernet cards and operate them at full capacity [nearly 100 Mbps]," Miller

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What to Look for in I$_2$O Servers

At the time of this writing, I$_2$O-compliant devices are just starting to appear on the market. To ensure that a potential server can take advantage of I$_2$O's capabilities, look for the following features in its design:

- Flash memory for the boot ROM: I$_2$O requires a revised boot sequence to detect I$_2$O-compliant devices and install the drivers. If the server's current firmware doesn't support I$_2$O, its flash memory lets you add this ability through an inexpensive software download. Even for an I$_2$O-savvy server, you'll want this feature so that you'll be able to add I$_2$O capabilities coming later, such as Fibre Channel, ATM, and clustering, which will require a change in the boot process.
- ISA buses need not apply: I$_2$O leverages off the capabilities of the PCI bus for device installation and performance. There's no support for the older bus architecture.

adds. I$_2$O also specifies a unique mode of operation, termed *peer-to-peer,* where devices can communicate directly with one another with little intervention from the server OS. (See "By Your Peers" on page 86 for more details.)

As an enabling technology, I$_2$O's capabilities can be used to provide a host of services, both new and old, with little impact on the server's throughput. Certain of these services would be implemented either as intermediate service modules (ISMs) or through peer-to-peer services. For network operations, I$_2$O can off-load repetitive chores that make heavy use of interrupts onto smart network interface cards (NICs). At a minimum, the NIC's IOP would execute an ISM that implements the algorithms used to encrypt or decrypt secure data streams, sparing the server's host processors from this computational overhead. However, given a fast IOP, it's possible to go a lot further in relieving the server of network operations. For example, another ISM would handle the handshake used in a firewall's verification process, and any associated IP security. Other ISMs could manage HTTP lookups and process FTP transfers. Finally, in concert with peer-to-peer transfers with a hard drive, the IOP could facilitate Web page caching. Thus, through I$_2$O ISMs and peer-to-peer services, most of the I/O-intensive operations of both a Web server and a proxy server could be combined on the same NIC. Peer-to-peer operations could be used to improve network reliability by implementing load balancing on multiport NICs. If a LAN segment fails on a network, an ISM on the NIC could detect this, examine the incoming network packets, and reroute them to a port that's connected to the backup LAN segment.

For disk storage, an IOP could execute an ISM that implements RAID functions. The ISM would then operate I$_2$O-compliant hard drives as parts of a RAID array. While such a design lacks the speed of a dedicated RAID controller board, it allows low-cost servers to reap the benefits of RAID's storage integrity. Other ISMs could perform on-the-fly data compression/decompression between the OS and the hard drive.

Devil in the Details

The I$_2$O specification is broad, so a wide range of system designs is possible, each addressing a different market (see "Types of I$_2$O Designs," page 91). Supermicro's Super P6DNH and Microconics Computers' M6DPd incorporate an i960 IOP on the main logic board for a low-cost I$_2$O implementation. The on-board IOP performs most of the interrupt handling for "dumb" peripherals, and so improves throughput. The trade-off is that while the design is cost-effective, it's not very scalable. Another issue with this design is how much intelligence for I/O handling should be moved to the IOP. Says Gary Abbott, server technology strategist at Dell Computer: "Compared to the clock speeds of IOPs, chip designers are rapidly boosting the speed of the main processors. In six months, the increase in speed of the main processor could negate any advantage to executing code on an IOP." Other system designers agree. "Compaq focuses on investment protection for our server customers; therefore, the fixed performance of an IOP on a motherboard has long-term problems," comments Karl Walker, director of technology development for server products at Compaq. Although Compaq won't comment on future products, the IOP could be placed on a removable daughtercard, which would extend the system's lifetime for the

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Types of I2O Designs

Single IOP on main logic board

Pros:
- Low cost
- Improved availability because I/O interrupts handled by I/O processor (IOP)

Cons:
- Little to no concurrent processing
- Limited scalability

IOPs on peripheral cards

Pros:
- Concurrent processing possible
- Good scalability—more peripherals add more IOPs
- PCI bridge chip can filter traffic to minimize bus congestion

Cons:
- Raises price of peripheral boards
- Overkill in a small server

customer. Still, the lone IOP can be of great value processing lightweight, highly repetitive operations that involve lots of interrupts. This reduces the effects of heavy I/O traffic on the server, and thus improves its availability.

Another server design has each peripheral board supplying its own built-in IOP. This enables concurrent I/O operations to occur in the server, thus boosting its availability and scalability. If a busy peripheral happens to be on a secondary PCI bus, the PCI bridge chip can filter out its bus traffic, thus keeping the primary PCI bus clear so that it can manage other high-speed peripherals. The IOP adds about $50 to the cost of the peripheral card, but that's less than the cost of adding another main processor to the system (about $500). For certain peripherals, such as Gigabit Ethernet devices, the inclusion of an IOP is virtually assured, since a dedicated processor is required to manage the interface's high throughput.

From the OS vendor's point of view, adding support for I2O isn't difficult. Says Michael Rex of Novell, "Because of IntranetWare's modular design, we don't have to modify the OS. We are providing I2O OSMs that will run on our existing OS product." To IntranetWare, OSMs are simply NLMs. Specifically, software engineers revised existing disk and LAN drivers so that they convert standard requests into I2O messages. The messages are then passed to a specific HDM, which speaks to the hardware. Support NLMs for handling PCI operations and the I2O device registry were also added. The peripheral vendor provides the HDM, typically in firmware on the PCI expansion card. Novell is working closely with peripheral vendors to ensure a good fit between OSMs and HDMs. The company is a key supporter of the I2O SIG.

The Changing State of Servers

I2O improves a PC server's availability and scalability by shifting most of the I/O interrupt handling onto a less costly IOP, which makes it attractive to both IS managers and system vendors. Equally attractive is the fact that this performance win can be done with only minor revisions to the server OS and no modifications to existing applications.

Since the 1.5 spec was approved early this year, there are just a few I2O-compliant peripherals available at this time. But this situation should change as high-speed network cards using Gigabit Ethernet become more common, and server OEMs modify their boot firmware to recognize I2O devices. Peer-to-peer implementations won't arrive until late next year, but when they do, they have the potential to radically change how servers get their work done. B

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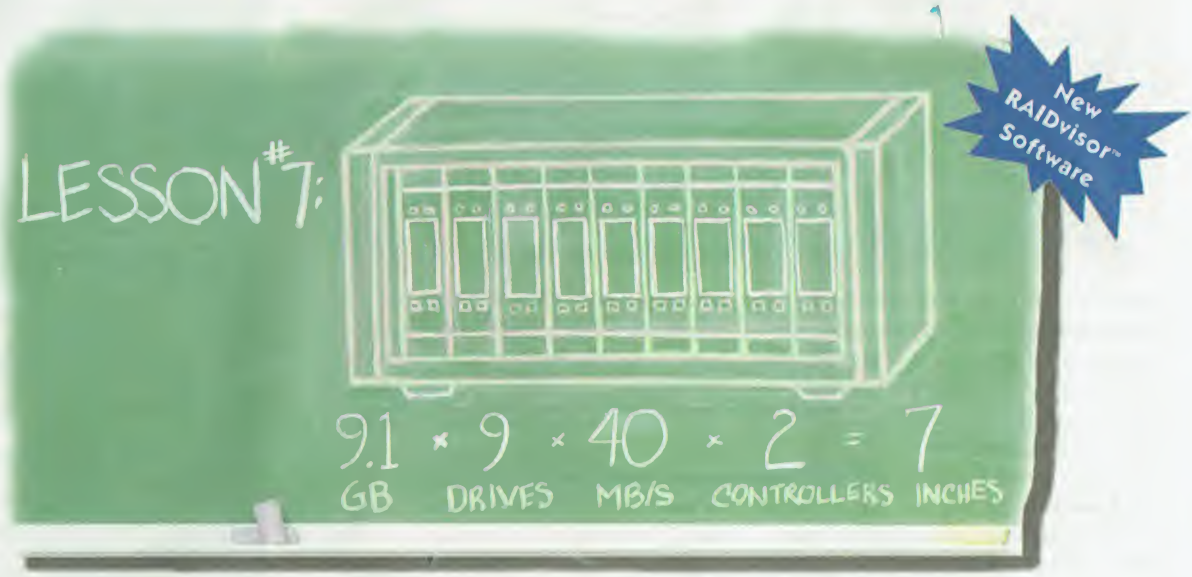

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Air War

Digital cellular is the future. But which digital-cellular technology is the one for your company?

By Marty Jerome

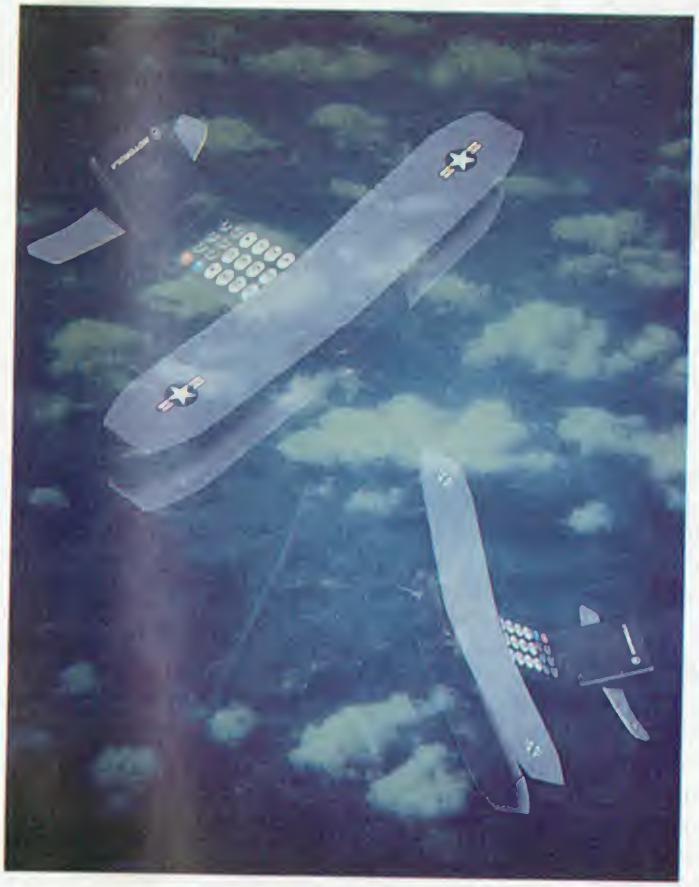
Who can blame today's mobile workers for feeling like marionettes—every transaction, every movement in the field acquiescent to a physical line? The increase in efficiency and productivity provided by the cellular phone and pager only hints at the bonanza a true wireless world will offer. However, getting to that heady future has proven to be perilously slow going. The providers of today's cellular networks can subdivide cells into yet smaller bits, adding antennas and phone lines linking them.

However, the strain is starting to show. The traditional analog cellular frequency division multiple access (FDMA) methods of sharing radio spectrum—assigning specific frequencies to each cellular-phone user—cannot keep up with the demand.

The only way to get a tenfold or 15-fold increase in capacity is with digital-cellular networks. Virtually every cellular carrier plans to convert its networks to digital technology within the coming decade. But to which standard? Three digital technologies currently vie for your company's dollars. The one you choose will affect the scope, reliability, and costs of your cellular applications for years to come.

All three digital technologies are heirs to the Cellular Digital Packet Data (CDPD) technology that's used today. CDPD technology can transmit data at speeds of up to 10 Kbps, sent in the unused channels of existing analog networks. Despite this, CDPD is a greatly underused interim solution. Its three successors will add better network quality, clearer voice transmissions, higher capacity, faster throughput, and lower power consumption.

Which cellular technology will succeed CDPD? Looking at the three contenders, time division multiple access (TDMA) is a well-entrenched and mature technology with excellent capacity. Second, code division multiple access (CDMA) offers even larger capacity and superior voice quality, even if some of its promised capabilities are still untested. CDMA is also the dominant standard in the new Personal Communications Services (PCS) frequencies (see the text box "PCS Goes National" on page 96). Finally, Global System for Mobile Communications (GSM) enjoys outstanding international coverage, especially in Europe.



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CDPD: Today's Solution

Standardized in 1993 as a bridge to true digital wireless communications, CDPD uses the existing cellular infrastructure as traditional analog advanced mobile phone service (AMPS) in the 800- to 900-MHz range of the spectrum. Because CDPD modems transmit during idle times—when voice calls are not being made—their impact on cellular voice traffic is negligible, which has given CDPD broad appeal to service providers. That said, data traffic is at the mercy of voice traffic.

CDPD offers other advantages. For example, it uses TCP/IP, which makes any CDPD modem a true IP node, unlike earlier modems, which required a persistent connection, just like a land-line-based phone call. With CDPD's so-called wireless IP, modems can receive data anytime they are powered on and within network range, with minimal setup time and connect charges. CDPD's greatest appeal lies in coverage, which includes 40 of the 50 largest Metropolitan Statistical Areas (MSAs) in the U.S. Each MSA represents a region by the population it represents, not its geographical size, so coverage of only top MSAs can still leave gaps in sparsely populated areas. CDPD also covers international sites: four in Canada, four in Ecuador, one in Indonesia, and two in Mexico.

continued

CDPD operates not only over AMPS, but also over other technologies, which lets users share frequencies, including CDMA and TDMA.

There's a broad range of development tools for CDPD, such as Unwired Planet's UP.Link Internet access software or its Handheld Device Markup Language (HDML) 2.0 specification, released in May, for developing applications. Cellular phone/modems cost under $500. For businesses that need digital wireless communications now, CDPD is available. It works, and declining costs make it a feasible technology.

As a packet-based service effectively limited to 10 Kbps, CDPD is best suited to transferring small files, rather than browsing the Web, using workgroup applications, or remotely accessing a workstation. Because of this limitation, in 1996 the CDPD Forum industry association developed a circuit-switched specification for CDPD, called CS-CDPD. Now available, CS-CDPD modems function as wired modems—they can set up dedicated calls. Recent cellular-network enhancements are pushing CS-CDPD throughput to a level comparable to landline connections, though actual performance varies according to carrier, geographic location, and time of day.

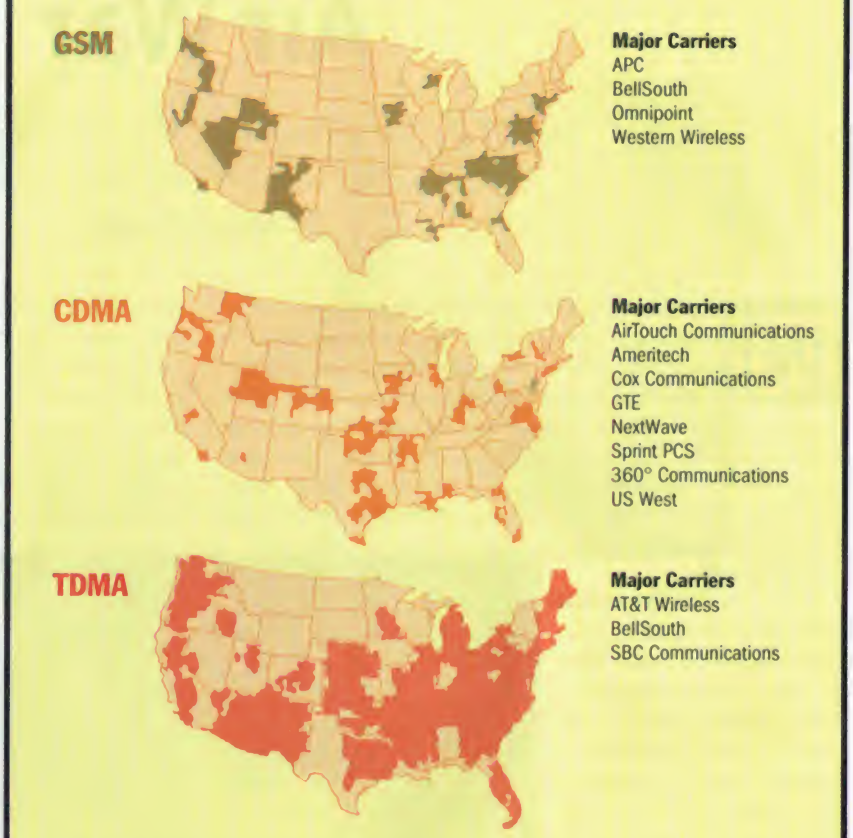
Currently, Ameritech, GTE Mobilnet, Bell Atlantic Nynex Mobile, and AT&T Wireless Services have CDPD networks that let customers link in 60 U.S. markets. There are a variety of CDPD modems, from PC Card devices to analog phones with digital modems to hand-held computers. Transmission costs have come down to 8 to 20 cents per kilobyte, on average; most carriers vary prices according to volume.

TDMA: Tried and True

The best advantages of digital-cellular technology are manifested in TDMA: at least three—and in one case 15—times the capacity of analog networks, voice encryption, caller ID, and text messaging. TDMA systems are being designed to operate with 14.4-Kbps data transmission, simultaneous with voice.

To these features, the latest version of the TDMA standard, IS-136, adds extended battery life (by allowing user devices to "sleep" between transmissions), over-the-air activation, and, according to its proponents, better voice reproduction than its competitors.

Wireless Digital Coverage in the U.S.



TDMA dominates current coverage of the newer wireless technologies, although CDMA licenses dominated the most recent round of FCC spectrum auctions.

Source: AT&T Wireless Services

TDMA offers Short Message Service (SMS). With SMS, you can switch off the phone, yet messages still arrive, waiting on the network, presented to the subscriber on the phone's display the next time the phone is switched on. TDMA even allows advanced voice-mail systems to send users SMS pages. The information could be the weather, traffic information, taxi information, or other useful local information.

In addition, TDMA's alphanumeric paging is two-way, with the help of a keyboard or stylus on a personal communicator or the alphanumeric keypad on a wireless phone such as the forthcoming Nokia 9000. Subscribers can send messages of up to 160 characters. TDMA offers enormous advances over analog cellular communications to both customers and carriers. TDMA supports seamless roaming between the AMPS and PCS spectra. It will work across carriers, and users might be notified about a change in billing with a message on their phone's status display.

The IS-136 standard also uses a digital data path called a *digital control channel*, which allows, among other capabilities, the phone to operate in sleep mode. Because TDMA phones are digitally synchronized with the wireless network, phones sleep for all but the 6 milliseconds of every second cycle and awaken when the user receives a call. This extends battery-charge life by as much as 100 percent over analog cellular phones.

For carriers, the IS-136 standard provides for a wide range of service offerings—even for a single subscriber. The phone alerts the wireless network of the subscriber's location. When subscribers are within their office area, the wireless network may give them PBX functions (e.g., extension dialing and conference calls). When subscribers leave these

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areas—or after a certain time of day—their phones may lose these advanced features and function as any analog cellular phone. Billing could automatically switch over as well. The phones can even display location identification on their screens, detailing the current billing rate.

Hughes Network Systems enhanced TDMA with its own version, which is called Extended TDMA (E-TDMA). This version more than quadrupled the capacity of the original specification. E-TDMA networks may be able to carry 15 times more mobile traffic than today's analog carriers.

Hughes accomplishes this through digital speech interpolation, in which the transmitter is turned off during pauses and while the user is listening—as much as 60 percent of the total channel time. This idle capacity can be reassigned to other users. Incidentally, E-TDMA networks are backward-compatible with the existing TDMA infrastructure, so the upgrading shouldn't interfere with current service.

The technology behind TDMA has been around since 1967 and is well tested and well understood. It enjoys the staunch backing of LM Ericsson, which is the manufacturer of 40 percent of all cellular equipment sold worldwide and 30 percent of all cellular equipment that's used in the U.S.

TDMA technology is currently embroiled in a small controversy that could become a regulatory petard. Apparently, time-division-multiplexing devices can cause interference with a wide range of electronic devices, from hearing aids to camcorders, laptop PCs, automobile air bags, and pacemakers. GSM devices seem to be even worse offenders. But this is not so with CDMA phones and modems. At press time, a spokeswoman for the FCC had no comment about this, though she confirmed that the matter was under investigation.

A lesser problem has been with audio quality. Early tests over TDMA networks proved to be disappointing. Even analog phones rendered better voice reproduction. TDMA supporters say that these problems have been largely eliminated, thanks to the IS-136 standard. CDMA's proponents, Qualcomm in particular, insist that their technology is far superior in terms of audio reproduction. However, until there's national coverage with millions of subscribers using CDMA networks, the claims are unsubstantiated.

The more important hurdle is whether TDMA networks will be able to provide adequate coverage fast enough to overcome CDMA's onslaught. Currently, AT&T Wireless is the leading carrier. By the end of the year, the company expects to provide a coverage area that includes almost 80 percent of the U.S.'s populated areas, with 41 of the 49 largest cities.

CDMA: The Technology to Beat

It would seem that TDMA would have the market wrapped up were it not for CDMA, which is purportedly twice as efficient and promises to deliver even better voice quality. CDMA has been gathering slow but important momentum in the past two years, as evinced in part by last year's PCS auction.

Of the 2958 PCS licenses that were awarded in the U.S. last year, 51 percent chose CDMA (with 28 percent going to GSM and 20 percent going to TDMA, according to Edge, the research publication of AT&T). This larger number of licensees means that both consumers and enterprises will be able to choose from a greater selection of carriers. This, in turn, should provide the kind of price competition that will make the technology imminently appealing.

Even so, CDMA is a new technology. Many of its capabilities are untested. Others were exaggerated in its early going, which has tended to make carriers suspicious of it.

Dataquest predicts that the number of CDMA users will grow to 60 million by 2000. Some $6 billion has been poured into the technology's infrastructure over the past two years. At least six vendors have committed to manufacturing handsets and modems for the standard. CDMA will putatively deliver all the benefits of TDMA—higher capacity, extended battery-charge life, SMS, over-the-air activation, 14.4-Kbps data transmission, and improved audio reproduction—and then some.

Like TDMA, CDMA features seamless roaming not only between carriers, but also between PCS and traditional cellular systems. However, supporters say that its network capacity could be 10 to 20 times higher than an analog cellular network's. Supporters claim that it delivers a clearer signal than TDMA, that it entails lower infrastructure costs, and that users would experience fewer dropped calls.

Has CDMA lived up to its billing? Critics, including Bill Frezza, president of Wireless Computing Associates, a Yardsley, Pennsylvania–based consulting firm, have warned that the theoretical potential of the technology would never bear out in the field. Interference would limit its purported capacity, networks under heavy loads could become unstable, and infrastructure costs would be far higher than initially projected.

In practical terms, the technology has stumbled. Construction snafus and lawsuits between several key players have delayed deployment of CDMA networks well beyond early forecasts. Early field tests of CDMA failed to sustain its claims of superior audio quality and network

PCS Goes National

When the FCC divvied up the 1850- to 2200-MHz part of the radio spectrum into 10-MHz bands, many industry pundits saw the foreshadowings of a revolution in low-cost cellular communications.

This narrowband part of the radio rainbow was dubbed Personal Communications Services (PCS). Various cellular carriers began snapping up the six bands for consumer use, lettered A–F, beginning in 1994. When will enterprises be able to enjoy national PCS coverage? All major licensees are vying for cross-carrier agreements. Some analysts believe that by early 1998, at least two carriers will offer free roaming across the U.S.

Freed from the legacy of analog technology, PCS promises high-capacity digital communications. Voice pagers that can deliver up to 20 seconds of clear audio are already available in some areas. PrimeCo's new phones (available in parts of the midwest and southeast) show customers their account balances and provide caller ID. Some PCS handsets provide links to e-mail and encryption. They feature lower power requirements (that can extend standby time on some phones for up to 60 hours). A new technology called Subscriber Identity Module (SIM), which is much like a smartcard, allows you to plug your SIM into any GSM handset and then make calls billed to your account.

capacity. Meanwhile, field tests of TDMA's network capacity now approach a ratio of 7 to 1 over analog technology.

Blame the CDMA's youth and inexperience for these blunders and oversights. Introduced with exuberant claims by Qualcomm in 1989, the technology caught the fancy of engineers and carriers because it allowed multiple users to share the same channel.

The costs that both enterprises and consumers will pay for digital-cellular service obviously depend on coverage and competition among the carriers. CDMA now has the advantage on the latter, thanks to the broad appeal of its higher capacity and better voice quality. Several disappointing cases may slow its implementation.

AirTouch Communications, one of the first cellular carriers to commit to CDMA, began plans for upgrading its congested analog system in Los Angeles in 1989. Construction was delayed until 1994, with the planned commercial launch scheduled for 1995. Implementation was plagued by interference from analog service, power-balancing problems, and poor voice quality. By late 1996, AirTouch had 250 cell sites on-line.

Worse, CDMA network capacity ultimately may reach only six to seven times that of an analog network—which is roughly the equivalent of today's TDMA networks. CDMA's vocoder, the technology that turns analog speech into digital signals, must be set at 8 Kbps to achieve this capacity. That rate is decidedly inferior to the 13-Kbps standard CDMA has adopted.

AirTouch's experiences haven't been enough to frighten carriers away from CDMA, though a string of internal skirmishes have slowed the technology's march. Nokia, Lucent Technologies, Sony (outside the U.S.), Oki America, Motorola (due out in the U.S. by the time you read this), and Samsung all currently offer or plan to introduce CDMA handsets and modems within the year.

However, Qualcomm and Oki are embroiled in a lawsuit (with Ericsson, which does not make CDMA handsets) over patent-infringement claims, the outcome of which could ultimately bear on devices made by other manufacturers. In a highly publicized reversal, Motorola has dropped its plans to supply base stations for Sprint because of financial terms. Qualcomm and Motorola also filed patent-infringement suits against each other.

Even so, all but one major manufacturer have made commitments to making CDMA devices (many also make user devices for TDMA). A joint venture between Qualcomm and Sony alone could deliver as many as 3 million handsets a year. The company even boosted name recognition recently by paying $18 million to rename the home of the San Diego Padres and San Diego Chargers Qualcomm Stadium.

CDMA also enjoys an enormous advantage in the Block C PCS spectrum (see the figure "PCS Block Party" on page 99), thanks largely to NextWave Telecom, which was the largest bidder in last year's auction. NextWave plans to build a nationwide "carrier's carrier" network and maintains that it has already sold 10 billion minutes of use to MCI Communications. The company is committed to CDMA.

Lucent Technologies, which claims to be the largest CDMA vendor, has begun an aggressive vendor-financing package, whereby it effectively underwrites the cost of building the network.

While impressive, this kind of industry backing doesn't ensure that CDMA will become the dominant technology. Coverage will. According to the CDMA Development Group, CDMA carriers cover 100 percent of the U. S. Japan recently committed to the standard. Hong Kong and Seoul, South Korea, also provide coverage. Outside the U.S., TDMA still enjoys better coverage. And GSM is unbeatable. But within the continental U.S., CDMA is clearly the market leader for digital-cellular communications.

GSM: Is Europe's Standard Coming to America?

As pricing goes, enterprises and consumers alike stand everything to gain from the PCS spectrum, which will put enormous competitive pressure on cellular carriers. GSM, which uses TDMA technology in the 900-MHz spectrum, enjoys a larger market share worldwide than either TDMA or CDMA—some 70 countries and still growing. With the auction of the PCS F-block last year, the standard, now encompassing PCS-1900, is now poised to offer 80 percent coverage of the U.S. as well.

What's more, it can provide that coverage far faster than its leading competitor, CDMA. GSM technology already owns a large share of the world's wireless user devices, second only to pagers. Carriers are attracted to the technology in part because vocoder standards and voice-compression algorithms have been perfected since the mid-1980s. Transferring GSM to the North American 1.9-GHz spectrum promises to be

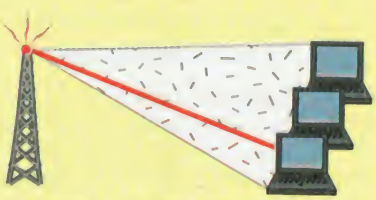
Getting More Out of Thin Air

Frequency Division Multiple Access

FDMA carves up radio frequencies into thinner slices. This allows many simultaneous transmissions, but eventually too many users gobble up the relatively small number of frequencies available.

Time Division Multiple Access

TDMA can push a single frequency a bit further by slicing it up into microsegments of time. It means users receive data or voice a split second earlier or later than other users. The frequency conserved by this triples the number of possible users.



Code Division Multiple Access

CDMA pushes each frequency even further by digitally coding each transmission. In an instant, each recepient's phone or modem perceives only the data or voice encoded for them, ignoring the rest as background noise.

both quick and relatively inexpensive. GSM carriers who paid exorbitant sums for their PCS bandwidth can expect a shorter time to a positive cash flow than CDMA carriers.

Ericsson, Mitsubishi, and Nokia already provide GSM handsets. Various manufacturers supply PC Card modems. The technology can already deliver to users the same benefits you'd get from CDMA and TDMA technologies, including better voice quality, higher network capacity, SMS, data and voice encryption, international roaming, and billing flexibility. It can also simultaneously process voice and 9600-Kbps data. It is not surprising that Pacific Bell, BellSouth, American Personal Communications, Go Communications, and Microcell 1-2-1 (Canada) have chosen the technology over CDMA.

Pacific Bell, which has inaugurated service in California and Nevada, has become a showcase for the technology's potential. When subscribers press the send button on their Pacific Bell handsets, they're automatically connected to a customer-care representative. Subscribers can program the network to have specific calls follow them. They can store both voice mail and pages in a universal wireless mailbox. SMS service includes multiple languages. Pacific Bell and Ericsson (which manufactures the handset) have agreed to develop an interim solution that would block the interference that people with hearing aids currently encounter.

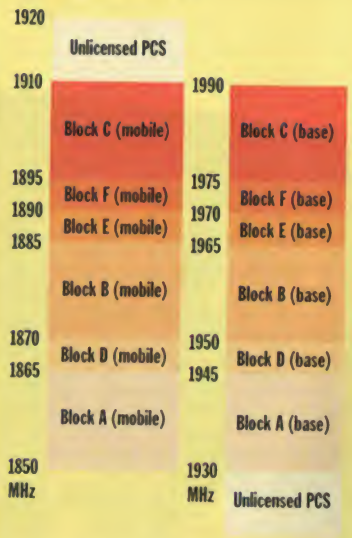
Eventually, a triple-mode, triple-frequency, triple-codec handset using GSM technology could bring about a world phone, which would be compatible with GSM networks at 900 MHz and the DCS-1800 networks at 1.8 GHz used outside the U.S., as well as the PCS-1900 network used in North America. In effect, it would be a world communicator, which could be carried and used anywhere in the world.

Meanwhile, GSM continues to enjoy double-digit growth everywhere outside the U.S. and Japan. Some estimates give it 50 percent of the world mobile-phone market by the year 2000. Thus, it should take hold in the American PCS market

How the Wireless Technologies Compare

	Technology	Pro	Con	Carriers
TDMA	TDMA supports a hierarchical cell structure, which lets you add capacity using microcells in an existing service area, such as a campus or building. The center hex of a TDMA cell is assigned one frequency; the surrounding cells are assigned six others. TDMA also uses direct-sequence transmissions, where each call is assigned a designated radio channel in a cell. TDMA squeezes more out of each channel by placing up to three signals into that channel, giving each signal a fixed, rotating amount of time on that channel.	Easier to scale within a geographic area; seamless roaming between PCS and AMPS; in use since 1967.	Adding infrastructure (transmitters and the phone links linking them) is expensive; CDMA's technological superiority in network capacity, voice quality, and costs is rapidly eroding its market share; emits radio interference with some devices.	AT&T Wireless Services, BellSouth Cellular, GTE Mobilnet, Northern Telecom, PCSI, Southwestern Bell Mobile Systems.
CDMA	CDMA modems and phones, which rely on spread-spectrum technology, simultaneously communicate with the current base station as well as a secondary or approaching station before making a soft handoff. The other advantage of using spread-spectrum technology: By shifting a signal from one frequency to another over a wide bandwidth, calls can shift from one narrowband frequency to another to avoid static conditions. In CDMA, the device stays on the same frequency from cell to cell. In theory, it means fewer dropped bits. Critics point out that cell strength must be carefully tuned at each boundary to avoid interference.	Wide industry backing; easier to scale as geographic area grows; devices don't need to use as much power to transmit or receive; nature of wideband avoids problems with static; easier to add cells.	Largely untested; early snafus and legal battles have delayed its deployment; transceivers require more circuitry to support spread-spectrum technology.	AirTouch Communications, Ameritech Cellular Services, Bell Atlantic Nynex Mobile, Clearnet, DDI, GTE Mobilnet, LG Telecom, MCI, NextWave Telecom, PrimeCo Personal Communications, SK Telecom, Sprint PCS, 360° Communications
GSM	GSM uses TDMA in the 890- to 960-MHz frequencies as well as in the PCS-1900 spectrum. Eventually, a triple-mode, triple-frequency, triple-codec handset using GSM technology could bring about a world phone, which would also be compatible with DCS-1800 networks at 1.8 GHz used outside the U.S. as well as the PCS network used in North America.	The reigning standard in Europe; provides 80 percent coverage in the U.S. in the PCS band with an easy migration path for vendors who choose it; an exceptionally wide variety of handsets are available, though less so for modems.	Limited backing from carriers in the U.S.; limited network expansion when compared with CDMA; emits interference with some devices.	Aerial Communications, American Personal Communications (Sprint Spectrum L.P.), BellSouth Cellular, Omnipoint Communications, Pacific Bell Mobile Services, Pocket Communications, Powertel, Western Wireless (VoiceStream)

PCS Block Party



The FCC divided the newly available PCS spectrum from 1850 MHz to 1990 MHz into six licensed blocks and one unlicensed block, each of which has separate frequencies for base stations and mobile devices. FCC auctions of this spectrum have raised billions for the U.S. government.

long before its biggest competitor, CDMA, is able to get a footing, and even before TDMA networks are up and running. Over the long haul, it is the single best solution for worldwide roaming.

On the other hand, GSM can't match CDMA's purported network capacity. Many analysts are skeptical about GSM North America's claim of 98 percent coverage in the U.S. This has prevented more than a few carriers from signing on to the technology. CDMA still has the edge in North America. For most enterprises—even those with manifold international offices—universal coverage in the 48 contiguous states is of paramount importance in building wireless applications. For most U.S. organizations, the rest of the world can wait.

Your Best Choice

Can TDMA, CDMA, and GSM coexist? For the foreseeable future, there's no question they will. Sooner or later, however, one will predominate, ushering CDPD and analog cellular communications out of the picture altogether. But betting on one technology over the other today is a precarious gamble. This is especially true for enterprises making broad-based and long-term investments in developing wireless applications. For all practical purposes, the troika of digital standards will continue to battle each other well into the next century.

Besides, venturing into a true digital world may be premature. CDPD has much to offer companies that need to create wireless applications today. It doesn't require a large cash, time, or technology investment in standards that could be swept away in the next five years.

The choice between TDMA and CDMA is more difficult. TDMA enjoys broad coverage throughout the U.S. and, to a lesser extent, in Europe and Asia. It is a well-known technology in terms of its capabilities and limitations and, more important, in terms of costs. Some incremental improvements—especially the advent of Hughes' E-TDMA—make it highly competitive with CDMA, even if both carriers and user-device makers are marching en masse toward the latter. (Don't be fooled: Both contingents are ready to jump ship if the other standard prevails.)

CDMA has real technological advantages—especially in terms of future expansion of networks. This explains why so many carriers are infatuated with the technology. The more, the merrier, since the resulting competition will push subscriber costs downward. However, the technology has gotten off to a slow start. Its much-trumpeted potential hasn't yet borne out in early implementation. Industry infighting continues to plague it. The digital wireless war is CDMA's to lose. It's too bad the technology has thus far been its own worst enemy.

GSM is the wild card in this contest. Widely used in Europe and other parts of the world (including many places where it is cheaper than copper wiring to set up and use), it should be your first choice for wireless applications on an international scale—at least for today. Even in the U.S., it has an aggressive presence in the PCS spectrum. Also, it's based on the same time division technology as TDMA, which means that its capabilities and limitations are well known. Coverage in North America is good, if not complete. But can GSM entice enough carriers to its standard so that pricing would be pushed to competitive levels with CDMA? Can it build adequate capacity so that your enterprise can depend on it?

All these unknowns reinforce the fact that digital wireless technology, though no longer inchoate, still has a long way to go. There's far more certainty about the kinds of services and applications that you can expect than there was five years ago. There are also a world of ways you can harness the technology today. But reaching the point where you have a single reliable standard served by multiple carriers is still several years away. Getting there is going to be very slow indeed. B

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A Kinder, Smaller Windows

Porting from Win32 to Windows CE can be a simple matter—if you know what to watch for.

By Jim Geier

Microsoft's third attempt at coming out with an OS designed specifically for hand-held PCs seems to finally have taken hold. The company's Windows CE leverages the company's colossal presence in the desktop computing market with an OS and applications that are already greatly familiar to millions of computer users.

Can CE give the slow and stumbling hand-held PC market the kind of kick start that will finally lure legions of businesspeople into its fold? Resistance has come from many fronts. Most hand-held PCs are relatively expensive given the low volume of information they manage; for many people, a far less expensive, paper-bound calendar works just as well. And until handwriting-recognition algorithms are sufficiently advanced, data entry via a stylus offers few advantages over pencil and paper; tiny QWERTY keyboards don't allow for fast touch-typing. Finally, proprietary OSes throw up a host of compatibility problems, steep learning curves, and a dearth of familiar applications already used on the desktop.

Windows CE devices promise to make the greatest headway against this latter obstacle. Porting Windows applications to CE is remarkably easy. And anyone currently developing applications for Windows 95 can develop CE applications with little advanced training. With growing support from wireless-device manufacturers, the OS finally stands to give hand-held computers a nascent, but important, role in a wide array of large enterprises.

If you're a Windows developer, you'd better start considering how to port your applications to Windows CE today. Many existing desktop applications that are scaled down to run on CE offer many benefits to business users.

The OS at a Glance

Windows CE is a small but powerful 32-bit, multitasking, multithreaded OS that is a subset of the popular Win32 model (see the figure "The Windows CE Architecture" on page 104). On the development side, CE supports approximately 500 of the 1500 Win32-based APIs. This offers developers a relatively familiar, easy-to-learn environment for building mobile applications. On the other hand, it means you can't run 16-bit Windows or MS-DOS applications on the CE platform.

Windows CE consumes small amounts of RAM, connects easily to the Internet and desktop PCs, and supports a wide array of hardware. It makes use of ROM for running applications, thus minimizing the use of RAM. In addition, CE allows users to seamlessly extend their computing activities to locations away from the desk. Consequently, it's an excellent OS not only for hand-held computers but also for Global Positioning System (GPS)–based mapping systems, digital information pagers, cellular smart phones—and even future household appliances.

But don't expect to go buy a copy of Windows CE off the shelf. It's available only to OEMs, hardware manufacturers, and software developers. Current versions exist for the Hitachi SH3, NEC 4100-MIPS, and Philips 3900-MIPS processors.

Currently, hand-held PCs built from a reference platform written by Microsoft are the only commercial devices that support

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the Windows CE OS. Microsoft's concerted effort to simultaneously establish both hardware and software specifications for the OS was intended in part to head off the disasters that befell the company's previous attempts at hand-held OSes. First there was WinPad, which ran on x86 CPUs with a stripped-down version of Windows 3.1. Input to this machine was limited to handwriting recognition via a stylus—it had no keyboard. Next, Microsoft attempted to develop Pulsar, which turned out to be a glorified pager. Pulsar offered wireless connectivity, but it had a very small screen and just a few buttons for input.

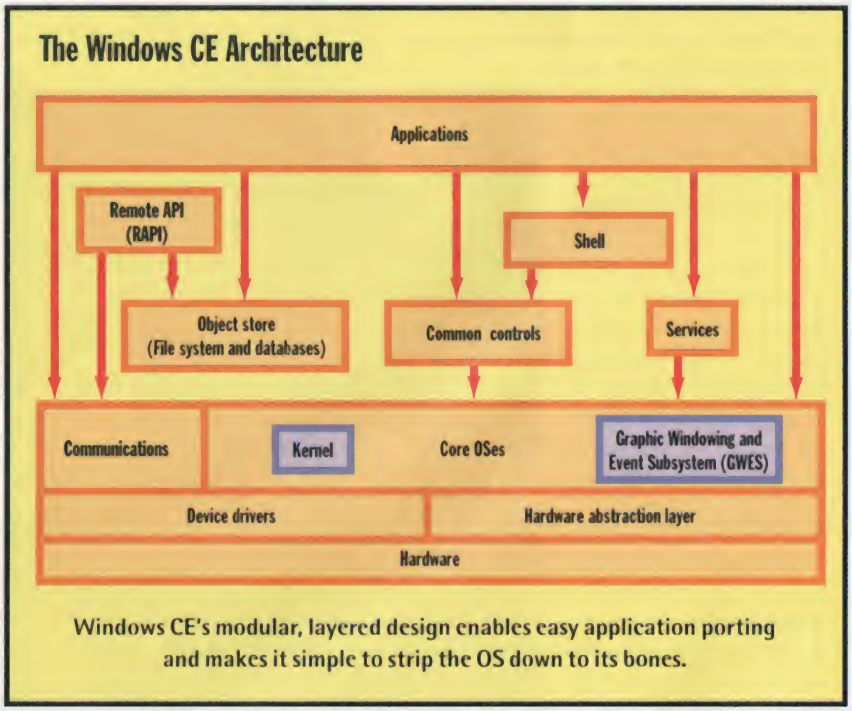
As Microsoft scrapped these projects, it invested in market research that uncovered the following information: Potential customers need to organize, communicate, and access information while they're away from their desks, and all or most of them have PCs running Windows. As a result, the Windows CE Handheld PC was conceived; it was announced at the fall 1996 Comdex show in Las Vegas.

Microsoft strove for several key goals with the Handheld PC: long battery life, an affordable price (about $500), compactness and light weight, a familiar interface, easy PC connection, and effective keyboard input. The company signed up seven hardware partners to develop handheld PCs based on the core specifications of its reference platform, allowing each to build on features and capabilities as they saw fit. These hardware partners included Casio (http://www.casio.com), Compaq (http://www.compaq.com), Hewlett-Packard (http://www.hp.com), Hitachi (http://www.hitachi.com), LG Electronics, NEC (http://www.nec.com), and Philips Electronics (http://www.philips.com).

Although all Windows CE devices differ in price and certain capabilities, they also share many features, which are listed below.

- An embedded QWERTY keyboard with alphanumeric keys, including standard punctuation, a Control key, an Alt key, and two Shift keys. Other vendor-specific keys are optional. Japanese and Chinese versions will not have keyboards but will instead rely on handwriting recognition alone for data input.
- An embedded touchscreen with resolutions of 480 by 240 or 640 by 240 pixels, four gray scales, and 2-bit pixel depth (see the screen above).
- A stylus that acts like a mouse when it's tapped on the touchscreen.
- A docking cradle to recharge the machine's batteries and connect it to a desktop PC for file transfer/synchronization.
- One PC Card slot, one serial connector, and one infrared port (IrDA).
- A minimum of 2 MB of RAM and 4 MB of ROM.

Windows CE's desktop is minimal (especially in gray scale), but it contains all the essentials.



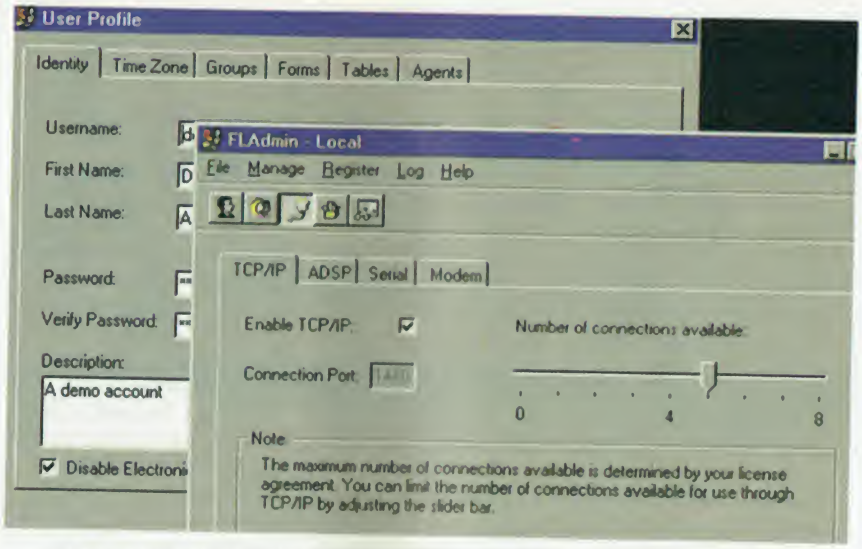
Windows CE's modular, layered design enables easy application porting and makes it simple to strip the OS down to its bones.

Windows CE has no standard memory map or interrupt structure, which is typical of PCs. Developers interface Windows CE to their respective hardware platforms by writing interrupt service routines. Therefore, Windows CE will not run on a desktop PC or on a standard laptop.

Most Likely to Succeed

Given these specifications, most applications that you'd want to take with you away from your desk can be ported to the Windows CE environment, minus some functionality. The current version, 1.01, does not support the following:

- OLE
- ActiveX
- COM



FormLogic's administration console enables the controlled distribution of Windows CE software.

Windows CE 2.0

The current version of CE, 1.01, should be replaced with version 2.0 by the time you read this (it's currently in a beta-test phase). Users will be able to upgrade to the new version by swapping out ROM chips. Release 2.0 will contain several welcome enhancements:

- support for 486 processors from Intel and AMD
- support for the 82X series of the PowerPC chip from Motorola
- support for up to 24-bit color
- printing support
- LAN connectivity via NDIS and SMB
- Widely available support for ActiveX, Java, Visual Basic run-time, and Microsoft Foundation Classes

- MAPI
- ODBC
- DDE
- multimedia (except WAV files)
- color video

Windows CE offers great relief to users who travel. Imagine you're in your office preparing to leave on a three-day business trip. It's four in the afternoon, you're tired, and your flight leaves at 5:30 p.m. You've spent all day ironing out your travel agenda. Now you're frantically working at your desktop PC, copying files onto a disk, reading and sending last-minute e-mail, and jotting down contact numbers and appointments from your electronic calendar so you'll have them during the trip. After gathering all this information, you throw the disk into your briefcase, grab your laptop, and then hurriedly head for the airport.

Sound familiar? More than 30 million other mobile professionals in the U.S. share this type of last-minute scurry, often forgetting to take along important telephone numbers, schedule information, and files. The answer to this problem is to use a hand-held PC running Windows CE and associated applications. This will make your life much easier in these situations by allowing you to smoothly move from working at your PC to continuing your work while you're away from the office and your desk.

Standard Windows 95 word processors and spreadsheets are particularly prime for porting. In fact, Microsoft bundles companion versions of Word, Excel, and Schedule+ with CE. Given that Word and Excel currently dominate more than 80 percent of the market, few enterprises will see any reason to develop stand-alone versions of basic productivity applications for the OS.

All hand-held PCs equipped with Windows CE include a full-featured suite of personal information management (PIM) software, complete with a calendar, an address book, and tasks that seamlessly and automatically integrate with Microsoft Schedule+ 7.0a on the desktop PC. After you connect the hand-held PC to the desktop, the two automatically initiate synchronization. The user can then enable synchronization, set the window of opportunity for synchronization to recognize, and choose which appointments and tasks to synchronize.

Of course, Windows CE also lends itself well to mobile communications applications, such as e-mail, faxing, and Web browsing. For example, it includes an e-mail application called Inbox, which uses standard SMTP and POP3 protocols. Inbox works as a companion to Microsoft Exchange, and e-mail files are easily transferred back and forth between hand-held and desktop PCs.

Most vendors, including Motorola and AT&T, have adapted their radio modems to work with Windows CE using ARDIS, RAM Mobile Data, or CDPD wireless WAN services. In addition, companies such as RadioMail Cooperation (http://www.radiomail.net) offer wireless Internet-access applications for the CE platform. RadioMail for Windows CE extends Internet applications over wireless networks and includes two-way wireless e-mail and wireless workgroup messaging for communications among members of a mobile staff. These services also include basic Web access, faxing, paging, stock quotes, and news. The RadioMail service costs approximately $20 per month.

In addition to the common productivity and communications applications, there is already a wide array of vertical applications for CE devices. Physix (http://www.physix.com), for example, offers PocketChart for Windows CE, an electronic medical-record and clinical-information system that runs on a hand-held PC. PocketChart offers a full set of features, such as patient lists, chart notes, a lab browser, on-line billing codes, automated prescription writing, and dosage checking.

TeleType (http://www.teletype.com) provides a GPS for Windows CE. A GPS receiver incorporated into PC Card form factor provides latitude and longitude information from a satellite to applications running on the hand-held PC. This keeps the hand-held PC informed of its exact geographical location, providing the basis for some interesting applications. TeleType's application has a moving map on the hand-held PC screen that corresponds to your location.

Roving Software (http://www.roving.com) offers the Roving Reporter for Windows CE, an application and correspond-

ing service that allow you to create a personalized newspaper that automatically receives news, weather, sports, financial data, and any Internet- or LAN-based corporate data. You just turn on your hand-held PC and read current stories.

Many enterprises have begun developing applications for the OS on their own. CE is particularly well suited to data-collection systems. For example, a hand-held PC interfaced with a bar code scanner, radio network, and applicable Windows CE–based applications software can improve the accuracy and efficiency of identifying and tracking items in manufacturing plants, hospitals, stores, and so on.

A bar code can identify an inventory item with a number, much like a license plate on a car. After scanning the bar code using a scanner appliance, the identification number maps to the status of the item stored in a database and then reports corresponding information back to the user via the Windows CE interface. At this time, the user can change the status of the item by entering applicable data, which updates the database.

Think Small

For developers and end users alike, Windows CE is very similar to the Windows 95 and NT Workstation 4.0 environments. The important differences between developing for these larger OSes and developing for CE revolve around hand-held PCs' small form factor, low memory, and tiny displays.

The Windows CE shell and user interface, as shown in the figure "The Windows CE Architecture," provide a look and feel similar to that of Windows 95 and NT Workstation. The shell includes the desktop, the taskbar, and a recycle bin. Windows CE differs from these OSes in its limitations in the windowing subsystem. CE doesn't support multiple overlapped windows, and you can't resize windows. Microsoft decided not to include these features because users would be unlikely to have multiple windows open within such a small screen size.

Nearly all standard and common controls exist; however, they have limited features. For example, property sheets are supported, but wizards are not available because they take up too much memory space. Also, CE supports only two common dialog boxes: File Open and File Save As. Other dialog boxes, such as the color and print boxes, don't make sense on a hand-held PC because the display is in black and white. In addition, Windows CE does not directly support printing. It has a new control, called the CommandBar, which combines a window's caption bar, menu bar, and toolbar into a single entity.

The Windows CE memory architecture consists of both RAM and ROM. ROM contains the system kernel and a set of applications, including Explorer, Calculator, and Control Panel applets.

In a 2-MB system (a typical configuration), RAM consists of two 1-MB sections. Section 1 of RAM is the object store, which functions like a single hard drive. The user saves new applications and data files in the object store. Section 2 of RAM, which Microsoft refers to as the *system storage area*, is for storing process heaps, thread stacks, application code, virtual memory allocation, and so forth.

The system always compresses files in RAM, generally at a 2:1 compression ratio. When a user runs an application, Windows CE decompresses the program and places it in system storage. Files in RAM take precedence over files in ROM. If there are two programs with the same filename, one in ROM and the other in RAM, the OS will run only the program that's located in RAM. In other words, you'll want to make sure that your filenames are unique—take advantage of CE's support for long filenames.

The base-level configuration of the OS requires about 150 KB of ROM and 400 KB of RAM to run, with the full H/PC OS taking up about 2 MB. To optimize performance, users and developers can divide the usage of the object store and system storage via the "memory tab" in the control panel's system applet. This allows you to adjust memory availability based on the applications that are running on the hand-held PC.

Because of the portable intentions of Windows CE, it has very good power-management and user-notification features. The OS constantly monitors the system, looking for ways to conserve power. For example, the OS suspends the processor when all threads are waiting for events, which is the case most of the time. To support PIM-type applications, Windows CE consists of special commands that allow developers to alert users with dialog boxes. For example, the command `PegGet_UserNotificationPreference` displays a dialog box for users to respond to a notification. CE also supports the ability to run applications on triggers, such as when the machine boots or a power supply is connected.

In addition to the support it offers for Windows PC Card and Socket Services, Windows CE includes the following connectivity features:

- TCP/IP and PPP, which allow easy integration with server software.
- A subset of the TAPI, Unimodem, and RAS APIs for dial-up connections.
- An HTML version of Microsoft Internet Explorer—however, the small screen on

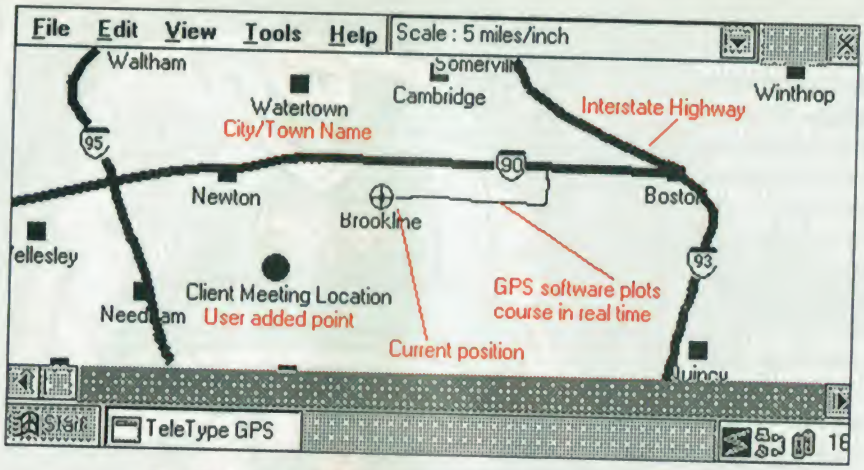
Unplugging Windows CE

A wireless network enables users to continue to access data stored on a host or a server from their Windows CE device in mobile situations. The problem, though, is that wireless networks offer limited bandwidth, which significantly degrades the operation of host and server interface protocols, such as 3270, 5250, VT100, and ODBC.

Middleware providers have an answer to this problem. CIM Concepts (http://www.cim-rf.com), for example, will release in September a Windows CE version of its Data Integrator product, offering a highly efficient interface among CE clients, hosts, and servers.

Data Integrator consists of a Java client running on the CE OS that communicates over the wireless network to gateway software. The Java client interfaces with the gateway using CIM's packet-based protocol, which is streamlined for RF networks. The gateway, located on the wired network, then communicates directly to multiple hosts and servers using their specific native protocols.

To develop applications, you use CIM's visual development tools, which are located on the gateway. After making modifications to an application, the gateway updates the Java client(s). This approach offers developers the ability to scrape and shape applicable portions of a 5250 screen from an AS/400, for example, to fit within the tiny screen of a hand-held PC, or to interface directly to an ODBC-compliant database.



The TeleType GPS Highway Navigator includes all U.S. interstate highways.

a hand-held PC makes it difficult to see where you're surfing.

- The file filter converts color bit-map and icon files to 2-bit-per-pixel bit maps during the copying process.

Choose Your Tools

A variety of tools are already available for developing CE applications—from Microsoft and other vendors. Development for CE is somewhat different from Windows 95 and NT development because of CE's limited APIs and functionality.

The best results come from developing and simulating an application's behavior on a desktop PC. Once the application has been thoroughly tested and refined, the port to a hand-held PC should be a relatively quick and painless matter. When adapting an existing desktop application to run on Windows CE, most likely it must be scaled down in terms of features and functionality to fit within the constraints of Windows CE.

Visual C++ developers can turn to Microsoft's newly released Visual C++ for Windows CE. Priced at $199, it's an add-on component to Visual C++ 5.0. It uses the same C11 compiler technology used in Visual C++ 5.0 for the desktop; it also includes new cross-compilers for CPUs that Windows CE currently supports.

For developers who must tie Windows CE to new hardware platforms, Microsoft offers the OEM Adaptation Kit. OAK provides the CE code for adapting the OS to particular hardware platforms. Microsoft has also carefully selected a number of system integrators who can assist OEMs in adapting Windows CE to their particular hardware platform. OAK requires you to get an OEM license from Microsoft; it's not a generally available tool.

Microsoft's Windows CE Desktop Emulation SDK is currently available free for downloading from http://www.microsoft.com/windowsce/developer/. Using your desktop development tools, you can create Windows CE applications that run in emulation on your PC; Visual C++ for Windows CE's cross-compilers and remote tools are required for targeting Windows CE devices.

Many third-party companies have tools that add features to Windows CE. Metrowerks (http://www.metrowerks.com), for example, will offer later this year development tools for CE via its CodeWarrior products for embedded and consumer-electronics software development. CodeWarrior's cross-platform compilers support C, C++, Pascal, and Java and allow programmers to build applications for a number of target platforms from a single development environment.

In addition, Syware (http://www.syware.com) offers Dr. DeeBee, an ODBC driver for Windows CE. Dr. DeeBee allows Windows CE–based hand-held computers to act as data servers to desktop applications. This provides connectivity to desktop-based applications, such as Microsoft Access, Excel, and Visual Basic. The ODBC 2.1–compliant driver is Windows 3.X based on the desktop PC, thereby consuming none of the hand-held's memory space. By utilizing the Dr. DeeBee ODBC driver, desktop software developers can communicate with Windows CE without writing code to a new API.

Another useful product is Wright Strategies' (http://www.wrightstrat.com) FormLogic. This package is a development environment that replaces field-based paper processes with hand-held computers; eases the development, deployment, and management of hand-held applications for occasionally connected mobile workers; and enables the connection of hand-held computers to network data sources and existing systems (see the screen on page 105).

The future for Windows CE appears bright because of its efficient standards-based development environment. If you are a Windows programmer, you'd better get proficient in writing CE applications. More than 1000 developers have already enrolled in the Windows CE Technical Beta Program, and more than 90 software and hardware companies have already announced products for the hand-held PC. If you're a user, then start looking—many Windows CE applications for the hand-held PC are on the way. B

WHERE TO FIND

CIM Concepts
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http://www.cim-rf.com

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http://www.radiomail.net

Wright Strategies
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http://www.wrightstrat.com

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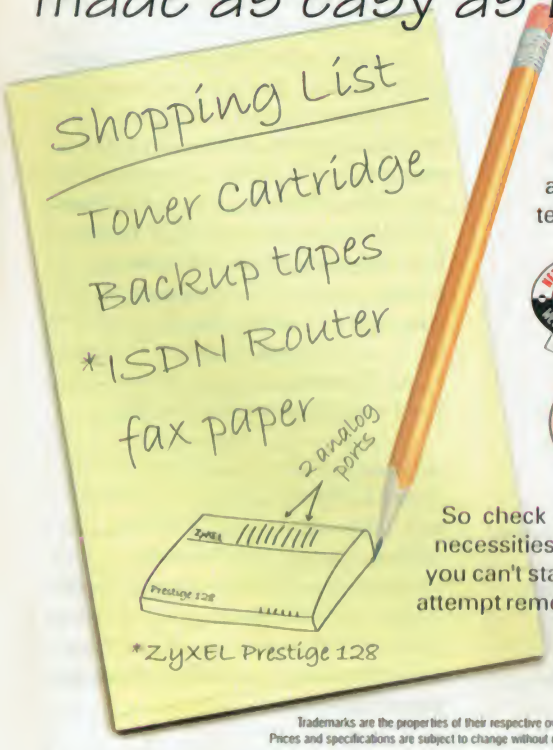

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Jon Udell

Web Project

Persistent Java

A servlet-based group calendar becomes a surprising success and prompts an exploration of ways to bind Java programs to persistent storage.

Group scheduling tends to generate fairly small amounts of complex object data. With nothing more than a servlet engine, the JDK 1.1, and a bit of ingenuity, you can create useful applications in this domain very quickly.

—from the June "Java Servlets" column

Boy, was I right about that! As I predicted, a modest effort—about three days' worth of work and 500 lines of Java code—yielded the simple Web-based group calendar that BYTE staffers had been clamoring for.

We're serious about Web-based collaboration lately. In March, BYTE's headquarters relocated from Peterborough, New Hampshire, to Lexington, Massachusetts. We retain satellite offices in Peterborough, San Mateo, and Frankfurt—and, of course, staffers are as likely to log in from their homes, or from hotel rooms, as they are from any of these official locations. The Web is fast becoming the glue that holds our company together.

Two applications in particular help us collaborate: private news servers that we use for free-form document exchange and discussion, and now the Java-based calendar that enables us to share structured, time-based information. I'll say more about how we use news servers in another column. This time I'll focus on some lessons about Java persistent storage that I learned while building and using the BYTE calendar.

About the BYTE Calendar

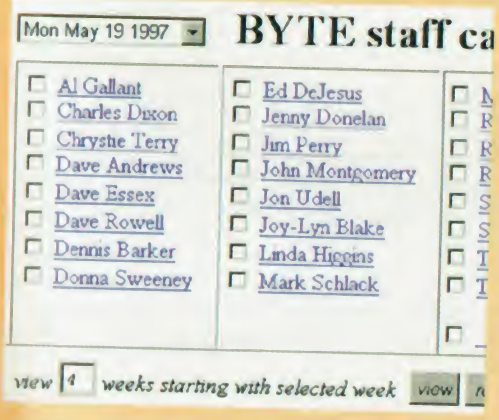
This simple Web application (see "ByteCal, the BYTE Calendar, in Action" at right) aims to do nothing more than provide an electronic bulletin board, in the form of a calendar, that's universally available to BYTE staffers worldwide.

continued

ByteCal, the BYTE Calendar, in Action

The calendar presents three screens to users: Main, View, and Edit.

The Main screen presents a list of weeks, a set of checkbox/name pairs, a limit field (which defaults to 4), and buttons labeled View and Reset. Here are the things you can do from this screen:

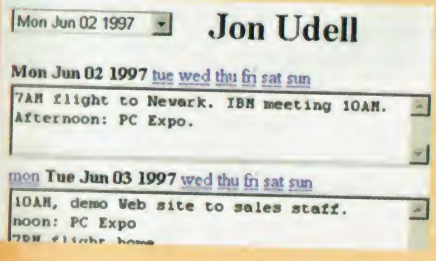


Edit a user's calendar
–click a hyperlinked name for the current week

View all calendars for four weeks from current week
–click View

View selected calendars for eight weeks from current week
–check boxes next to a set of names, change limit to 8, and click View

Change the current week
–adjust the date listbox

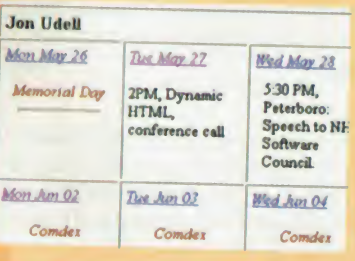


On the Edit screen, you can:

Input data–either plain text or HTML–for one or more days
–enter data; click Submit

Jump from day to day
–use clickable tabbed index

Change the current week
–adjust the date listbox



On the View screen, you can:

Review calendars for selected user(s)
–view the Web page

Print calendars for selected user(s)
–print the Web page

Jump directly to the Edit screen for any visible user/date combination
–click the hyperlinked date

PHOTOGRAPH: KELLIE WALSH © 1997

Like the Polls servlet that I described in the June column, ByteCal just manages a simple namespace. In fact, the two servlets share the same data structure—a hashtable of hashtables. In ByteCal's case, the keys of the top-level hashtable are a set of user names, and the values are secondary hashtables. The keys of each secondary hashtable—one per user—are date strings, such as "Mon May 19 1997"; the values are user-supplied strings, such as "Dentist appointment 8 AM."

One user name, _Global, is special: All other user names inherit from it. For example, the Edit screen for user "Jon Udell" and week "Mon May 26 1997" contains no data for Monday, but the View screen for me (or any other user) reports that Monday is Memorial Day. Why? There's an entry for Memorial Day on the global calendar. This inheritance helps keep ByteCal's data structure lean and sparse.

Data grows slowly for other reasons, too. Secondary hashtables spring into existence only when first referenced. They add new entries only for days that record activities. And an entry does not consume many more bytes than the combined lengths of "Mon May 19 1997" and "Dentist appointment 8 AM."

So what? Well, consider that, after a month of use, the disk file to which ByteCal serializes the calendars of two dozen staffers is still under 40 KB—the size of an average Web page. Not everyone on staff uses ByteCal yet, so let's assume a doubling or quadrupling of users and entries in the coming months. Still, a year's worth of calendar data uses up just a megabyte or two.

Where's a good place to manage a megabyte or two of data? How about in RAM? In fact, that's just where ByteCal keeps the data. Updates flush to disk for safekeeping and so that ByteCal can restore state when the server restarts. But when you fetch eight weeks' worth of calendar data for viewing, it comes straight from memory. I can't think of a better use for the 2 of the 64 MB of RAM in the server that runs ByteCal. When you're dialing into the Internet from a notebook PC over a crummy hotel phone line, you don't need any unnecessary delays.

Synchronization + Serialization = Persistence

As I explained in the June column, you can use a Java servlet to solve a difficult problem—safe multithreaded use of complex data—in a simple way. Just add the "synchronized" keyword to the methods that touch in-memory objects. The Java virtual machine (VM) ensures orderly thread-at-a-time access to those objects.

If servers never had to restart, synchronization alone would solve the entire problem for data sets small enough to fit conveniently in memory. In the real world, of course, power occasionally fails and servers sometimes crash, so ByteCal serializes its data to disk. This technique, new with JDK 1.1, primarily serves the needs of Java's Remote Method Invocation (RMI) facility. RMI needs to flatten Java objects into bit streams in order to pass them over networks. But you can also easily redirect these bit streams to disk files, which become a primitive but surprisingly handy form of persistent storage.

As does the Polls servlet, ByteCal takes the path of least resistance. On every update it calls the `WriteObject` method of the root hashtable, thus serializing the calendars of all users at once. With a database that's still tiny, there's currently no reason not to do it this way. Clearly, as the database grows, so will the time required to complete this write operation. I can think of three ways to combat this problem:

1) Serialize in a background thread. Users now wait for the write to complete, but they don't really need to.

2) Serialize on a scheduled basis and supplement with a transaction log.

3) Subdivide the data. Currently there's just a single disk file, called `bytecal.obj`, containing the whole set of calendars. But an update actually involves only one user's calendar. Saving the per-user hashtables in per-user files would yield a much more granular process of serialization.

All three approaches would make the application more complex. I prefer the last one because it's a minimal solution that rewrites only what needs rewriting. However, I don't think I'll ever implement any of these schemes. Why not? Object data-

Surprising Uses for Servlets

Servlets, like all Web applications, have dual personalities. They're applications that people use interactively, but they're also components that programs can use. This duality, plus the protean power of URLs, makes ByteCal useful in ways that I didn't even anticipate:

1) Personalization
ByteCal's main screen lists all the users in the system. But users can skip that screen and jump straight to their own calendars. How? ByteCal's "API" includes this idiom for viewing data:

```
http://byte.com/bytecal?who=Jon+Udell&view=yes&limit=8
```

which says: "Show Jon's calendar for the next eight weeks." The function "Show Tom's calendar for the next six weeks" is just a variant of this expression. If Tom puts that expression into a bookmark, he's created a personal calendar.

2) Importing data
"Great stuff," said BYTE editor John Montgomery when he first saw ByteCal. "But can I import my Ecco database into it?" My first response was: No way. My second was: Why not? ByteCal's "API" includes this idiom for editing data:

```
http://byte.com/bytecal?who=Jon+Udell&edit=yes&Mon+May+19=Dentist+appt
```

which says: "Record a dentist appointment for Jon on May 19." When you use ByteCal interactively, its Web forms construct this syntax for you. But you can also issue these URLs under program control, from any URL-aware language (Perl, Python, Java), using ByteCal as a component.

3) Printing
Anyone who's ever written a Windows or Mac data-viewing application knows that printing support gets done last, and often poorly. It wasn't until I saw pages of ByteCal output floating around the office that it dawned on me: ByteCal can print! Navigator and MSIE do a perfectly acceptable job of printing the HTML table that ByteCal's viewer produces.

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KEYCODE BYT 08/97

bases are a better way to make nontrivial Java data sets persistent.

Java-Aware Object Databases

Java and object databases are a marriage made in heaven. If you prowl around in comp.databases.object, you will sense a ground swell of interest in the subject. Why? Java's immature SQL foundation worsens the impedance mismatch that always plagues object applications wired to relational data stores. So, developers are looking for ways to connect those apps to persistent object storage. Of course, Java's ODBMS foundation is no Rock of Gibraltar yet, either. But my experiments with ObjectStore 5.0 (see "What's in Store for the Web" on page 34) convinced me that persistent Java is a reality now—and a promising future direction.

I should mention that Object Design (http://www.odi.com/) isn't the only provider of persistent Java. Poet Software (http://wwww.poet.com/) offers a solution I haven't yet tried, and I bet there will be others by the time you read this.

TOOLWATCH

pat 1.0
$10 (shareware)
Steven R. Brant
http://www.win.net/~stevesoft/pat
This Java library does regular expression matching à la Perl 5. Even better, you can extend the pattern matcher so that it recognizes user-defined classes of strings—for example, valid dates.

BOOKNOTE

Java Threads
$29.95
by Scott Oaks and Henry Wong
O'Reilly and Associates
http://www.ora.com/

Java makes thread synchronization seem easy, but under the hood it's still a scary subject. This excellent guide delves deeply into scheduling, synchronization, and deadlock avoidance. Halfway through I jumped up to rewrite a servlet that, I then realized, was unnecessarily calling one synchronized method from another, risking possible deadlock.

At the moment, though, Object Design's low-end PSE (Persistent Storage Engine) for Java, which both Netscape and Microsoft are bundling with their next-generation browsers, seems the most convenient way to get started. It's a self-contained, pure-Java implementation. PSE for Java, which is freely downloadable, delivers simple persistence. PSE Pro, which currently costs $250, adds a database-recovery tool and the ability to open multiple databases at once.

The PSE products share a common Java API with the flagship product, ObjectStore. Object Design hopes you'll like the rowboat and trade up to the ocean liner. Note, though, that while PSE was conceived for browser-based local storage, it's not restricted to that use. In my case, although I still have little use for client-side Java, I'm forging ahead with server-side Java. PSE is nominally a single-user product, but that's not necessarily so if you bind it to a servlet. Use Java synchronization to isolate servlet invocations from one another, and you can actually deploy PSE in a multiuser application.

Making ByteCal Persistent

ByteCal serializes a hashtable of hashtables, plus several vectors. ObjectStore can't store objects of the native Java types `Hashtable` and `Vector`. But it does provide persistence-capable equivalents to these classes: `OSHashtable` and `OSVector`. Converting to these types was a simple search-and-replace operation. Since `OSHashtable` mirrors the interface of `Hashtable`, none of the code that does Get and Put operations had to change.

Simple? So far, but things got trickier. Matching the thread model of the servlet engine, Acme.Serve, to the thread model of ObjectStore's Java interface was a puzzle. I was glad I had an Object Design engineer on hand to help—the company says this is standard practice for all customers, not just BYTE reviewers—and even he had to call the home office for help.

What finally worked was to record the servlet engine's thread ID in a class variable and then refer to it from a database-initialization call in each invocation of ByteCal. With this arrangement, the servlet engine owned a pipe to the database that many invocations of ByteCal (or, for that matter, other servlets running in the same Java VM) could share.

Next came transactions. You can't read or write persistent data outside transaction boundaries. I fiddled with different schemes for a while and finally settled on a single pair of transaction calls bracketing ByteCal's main service routine. There is a trade-off here between transaction granularity and simplicity. I took the easy route, but if I deploy ByteCal using ObjectStore, I'll need to revisit this issue.

Note that neither version of ByteCal currently does pessimistic locking. So, if I'm editing my calendar for the week of June 2, and you are, too, the last writer wins. In ByteCal's case, the probability of such a collision is small. But the transactional semantics of ObjectStore don't help here. Synchronizing multiple live copies of a record in multiple workstations is a classic problem. A Web application, like any application, must deal with it (by providing users with abort/retry options) or accept the consequences.

Finally, I wanted to create a reusable reference to my top-level hashtable. Persistent Java programs begin by associating transient objects with database roots. In the case of ByteCal, a reentrant servlet, you have to re-create that association each time. Isn't there some way to remember, across invocations, that an `OSHashtable` object called `hByteCal` represented the database root `ByteCal`? Yes, there is. If you call the transaction-commit routine with the flag RETAIN_HOLLOW, ObjectStore remembers the association.

A Smooth Migration Path

I'm still running ByteCal in serialization mode. But I've got an ODBMS-aware version waiting. For our own use, PSE Pro will likely suffice. Its pure-Java implementation of persistent storage can't deal with thousands of users or gigabytes of data, but it ought to handle our calendar just fine.

Would ByteCal ever need to scale massively? It's conceivable. A future version of The BYTE Site might offer calendar services as a subscriber benefit. I don't know if that will ever happen, but if it does, a ByteCal/ObjectStore capable of handling 10,000 users is ready to go. B

Jon Udell is BYTE's executive editor for new media. You can reach him by sending e-mail to **jon_u@dev5.byte.com.**

Note: I'll be speaking at the O'Reilly Perl Conference, August 19–21, at the Fairmont Hotel in San Jose, California. See **http://www.ora.com/info/perl/conference.** Hope to meet some of you there.

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Rick Grehan

Javatalk

Write Cosmic Code

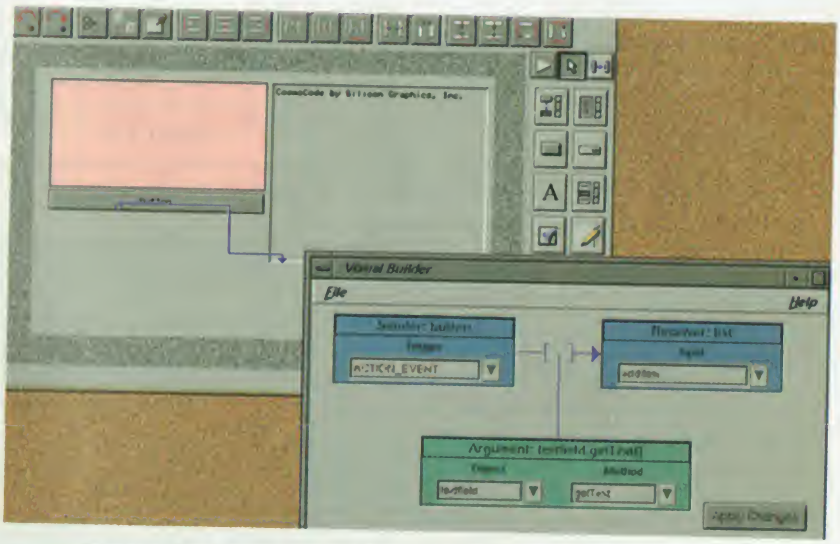
Cosmo Code, soon to be combined with SGI's Cosmo Worlds 3-D development system, is a worthy Java IDE on its own.

With its "Cosmo" family of Web and 3-D development tools, Silicon Graphics, Inc. (SGI), is paving the way to a richer, more realistic experience on the Web. Tools now available from SGI's Cosmo Software business include Cosmo Worlds, a Virtual Reality Modeling Language (VRML) 2.0 authoring environment for creating interactive, 3-D Web applications; and Cosmo Code, a Java development system that's the subject of this month's column.

In the future, Cosmo Code and Cosmo Worlds will be combined to provide the core elements of Cosmo Studio, which will be a complete 3-D authoring system with VRML as the graphics backbone and Java as the binding glue. SGI officials won't say exactly when Cosmo Studio will ship, but you can get a glimpse into the future by using Cosmo Code today. I did, and I liked what I saw; Cosmo code is as good a Java integrated development environment (IDE) as I've seen.

Currently, Cosmo Code ($495) is available only for SGI workstations running Irix, but a Windows version should be released by the end of the year. All the elements of the Cosmo Code main window exist in other Java IDEs in one form or another. At the top are the menu and toolbar, just below is a pane for displaying source code, and at the bottom is a tabbed collection of panes called the "card panel."

The source-display pane also shows status information, such as compiler-error or warning messages. During a debugging session, just above this pane appears the thread bar. This is a series of tabs bearing the names of threads existing in the program. Colored indicator lights and icons affixed to each tab reveal the state of each thread, such as currently running, suspended, or dead.



Cosmo Code's wire-guided programming is reminiscent of IBM's Visual Age for Java.

The card panel provides different views into an application during development, execution, or debugging. You select which view is active by clicking on the appropriate tab, which brings the associated card to the top. These tabs are grouped into three broad categories—development, debugging, and compile/execute.

For example, click on the project tab, and you're shown what amounts to a small file-manager window holding icons that represent the various files that make up your project. Click on the overview tab, and Cosmo Code shows you an inheritance diagram of the classes in the current project. During debugging, you can click on the call stack and follow the chain of methods calling methods as your program executes. Click on the data tab, and you can inspect the contents of variables, arrays, or even objects.

What makes the card panel useful (and permits it to bear the name "card") is the fact that you can "tear" a card off the panel and place it anywhere on-screen. The torn-off card becomes an independent window. Consequently, you can have several cards active at once, each providing different views into your application. Therefore, during a debugging session, you can concurrently view the progress of your application through a callback card while watching the state of variables in a data card.

Building Visually

Like other visual IDEs, Cosmo Code's Visual Builder lets you construct the visual aspects of your applet with drag-and-drop ease. Once you've dropped a visual object onto your applet's panel, you

PHOTOGRAPH: KELLIE WALSH © 1997

VRML and Java

The acronym VRML stands for Virtual Reality Modeling Language; it's a language used to describe 3-D worlds for display on a 2-D computer screen. VRML is based on Silicon Graphics' Open Inventor, a library of C++ routines and an associated language syntax for describing 3-D objects.

Actually, it would be more accurate to say that VRML lets you build 3-D scenes. A scene is more than just its component objects. For example, a scene also has a light source and might have a background. (VRML even lets you specify "fog"; the entire scene can be shrouded in haze.) VRML has been extended from its roots as a language for describing complex 3-D scenes and now includes features that allow those scenes to support animation.

That VRML Look

A VRML program is nothing more than an ASCII file. (VRML is an interpreter; you don't compile VRML programs.) The fundamental building block of a VRML program is called a "node." In a sense, a node describes a kind of object, but it serves more to aggregate than to encapsulate. A node is composed of fields, which are named entries holding data that describes the characteristics of a node. This is best illustrated by an example:

```
Cube {
width 20
height 5
depth 3
}
```

The above node describes a cube object. It contains three fields: width, height, and depth. (VRML reminds me of the NewtonScript language: VRML nodes correspond to NewtonScript frames, while VRML fields correspond to NewtonScript slots.)

VRML nodes are typed; each type of node performs a different function. Shape nodes describe 3-D objects that make up a scene—spheres, cones, cubes, and so forth. (The example above is a shape node.) Property nodes give objects their specific traits—color, texture, size, and so forth. Grouping nodes serve to gather other nodes so that the collection is treated as a single unit.

It's the grouping of nodes that allows the VRML programmer to build complex shapes from simple ones. A robot, for example, would consist of grouped nodes that define its head, torso, arms, and legs. As you might guess, grouping can be nested. Therefore, the robot's arms would in turn consist of grouped nodes defining the upper arm, forearm, and hand; its hand would consist of nodes defining palm and fingers; and so on.

In this way, operations applied to the robot affect the entire robot. If, for example, you wanted the robot to change color, you could apply that operation to the robot node as a single unit rather than painstakingly changing the color for each component shape.

VRML 2.0

VRML 1.0 defined static worlds. It enabled you to create 3-D objects constructed from elementary shapes, as well as define colors, textures, light sources, and so forth. But it was like creating a 3-D still life. Users could "enter" such a 3-D world and roam through it, viewing it from various angles. But what does any of this have to do with Java?

VRML 2.0 has added script nodes, which can contain executable code, and route statements, which send events from node to node. This combination allows programmers to build dynamic VRML worlds. And here is where Java comes in.

Currently, script nodes can include VRMLScript code (which is similar to JavaScript) or JavaScript code, or they can point to Java class files. In the last case, a script node can call a Java method, and—with the help of the VRML 2.0 Java API—the Java code can access nodes and their fields in the VRML world. In short, a programmer can manipulate the VRML world from Java. Java becomes a *deus ex machina* ("a god from a machine").

Hearkening back to the robot example, not only can the robot move, but with Java in control, it can move intelligently. The robot can also navigate doorways and halls. It might even chase you.

Author's note: *A number of VRML plug-ins are already available on the Internet. I used Silicon Graphics' Cosmo Player, which is available for Windows 95, NT, and Irix running Netscape Navigator 2.0 or higher and Microsoft Internet Explorer 3.0 or higher. Look for it at http://vrml.sgi.com. Also, the VRML 2.0 specification was close to being finalized at the time of this writing. Look for the final specification at http://vag.vrml.org.*

can double-click on that object; Cosmo Code then opens an object-inspector dialog box through which you can alter the object's properties (text, background color, events supported, and so forth).

Once you have a panel populated with visual objects, the real programming task begins: associating events triggered by one object to resulting behavior by another. I have always admired IBM's Visual Age products' approach, in which you "wire" together source and destination objects on-screen and then specify the characteristics of the interaction through IDE-guided dialog boxes. Cosmo Code's tack is similar. To program the causal relationship between, say, a button being clicked and a text box being cleared, you select the wire tool, click on the source button, and drag to the destination text box. This establishes the button as the source of the event, and the listbox as the respondent of the action. A dialog box pops up, in which you specify which event triggers the action as well as the method to be called on the receiving object.

Once you've done all this wire programming for the objects in an applet, Visual Builder lets you run the visual component portion of the application to verify that it functions as you meant it to. But this simulation goes only so far. You might, for example, want to code special behavior into your application that the Visual Builder does not support. In this case, Cosmo lets you resort to user-defined methods—those that you write by hand and that are called in response to whatever events with which you associate them. (For example, you may want the clicking of a button to perform some elaborate calculation.)

Since Visual Builder can't compile and execute Java code on the fly, it's unable to execute user-defined methods. But this is a small and understandable limitation.

Cosmo Code is able to handle the 1.0.2 event model as well as the newer delegated event model released with the JDK 1.1. As you wire objects together and select events, Cosmo Code's dialog boxes point out which events and methods are deprecated (in the 1.0.2 version). This dual support is for compatibility reasons: Even now many of the browsers at work on people's desktops are still not up to the JDK 1.1 standard. So, were Cosmo to emit 1.1 code only, that code would likely break at most client sites. B

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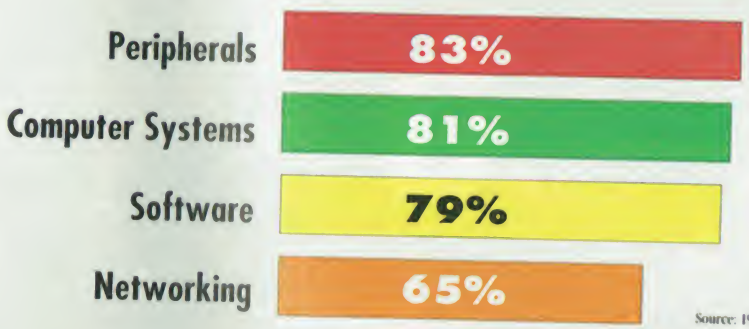

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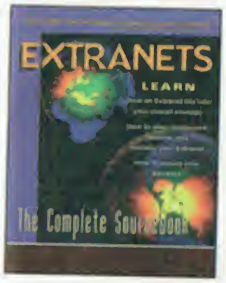

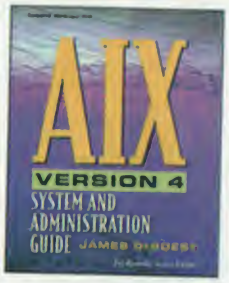

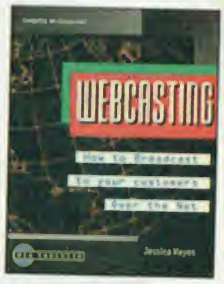

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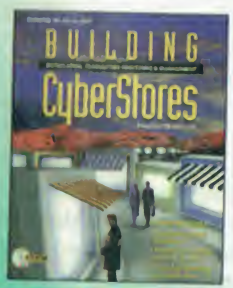

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Hand-Helds Get Serious

These tiny computers offer robust performance, surprising functionality, and true portability.

By Michelle Campanale

You've heard the argument that hand-held computers cannot replace laptops. But pocket-size, sub-1-pound systems are making serious advances in power, functionality, and communications. Many of the things you do with a laptop—reading e-mail, taking notes, adding to a contact list—you can now do with the kinds of hand-held PCs we tested for this report. All this makes us wonder if low-end laptops or subnotebooks will soon become obsolete.

What's more, Intel's new Pentium II architecture currently will not fit into a case that is less than 1½ inches thick, leaving open a niche for small, pocketable machines that can handle the basics, like reading e-mail, composing notes, and using simple spreadsheets. Hand-helds' growing popularity is evident in a recent Dataquest study, which reveals that in 1996 the market for standard hand-held computers grew 80 percent.

As our review of the most recent crop of hand-held PCs reveals, these units won't replace your laptop today. But they are starting to become truly practical, standardized, and able to do just about anything a notebook or desktop can do (aside from running Doom or Diablo, of course).

The Players

We judged 10 hand-held computers for their usability, features, and performance. Six run Windows CE, Microsoft's scaled-down version of 32-bit Windows designed specifically for hand-helds: Casio's Cassiopeia A-11 Plus, NEC's MobilePro 450, Hewlett-Packard's 320LX Palmtop PC, Hitachi's HPW-10E4MB, Compaq's PC Companion C140, and Philips' Velo 1. These devices run on two AA batteries, have an LCD touchscreen, an IrDA (Infrared Device Association) port, and a minimum of 4 MB of RAM and 4 MB of ROM.

We also tested systems based on proprietary OSes, such as Sharp's Zaurus ZR-5800FX, Psion's Series 3C, U.S. Robotics' Palm Pilot Professional, and Apple's Newton MessagePad 2000. We passed on Nokia's Communicator 9000 because, at press time, it required a GSM European cellular network. Additionally, Psion's Series 5 was in early beta when we tested, and Sharp's SE 500 was in alpha stage as we went to print. The Toshiba Libretto 50CT, which is similar in size and features to many of the hand-helds we tested, runs full versions of Windows 95 as well as full applications and costs just under $2000. It missed our price cap, so we did not include it in our tests.

BYTE BEST HAND-HELDS

Hewlett-Packard 320LX
With its 640 x 240 screen, this is the outstanding Windows CE-based unit. It outperformed all other CE systems in our file transfer tests, is very usable, and has lots of features.

NEC MobilePro 450
For the price, this Windows CE low-cost winner is a solid choice, besting its closest competitor, the Philips Velo1, in price and features.

Psion 3C
Fastest of the hand-helds, this unit leads the way in price, usability, and features among the proprietary-OS systems we tested.

Weighing the Features

Two camps of hand-held users are emerging. Some prefer the small, light, cheap, appliance-like computers, such as the USR Pilot Professional or the Sharp 5000. Others, like Psion and Velo1 users, want as many bells and whistles as conceivable packed into the smallest device possible.

All Windows CE hand-helds have the advantage of an interface that is familiar, is easy to use, and offers the closest thing to the Windows 95 desktop. Because Windows CE is an open standard, various processors and software applications can be ported to the OS. On the downside, software development for the platform is in its early stages, and the multithreaded, multitasking OS is resource-intensive. This may explain why our tests showed that Windows CE hand-helds were 28 percent slower in overall file transfer speed than the proprietary systems.

That's not to say that non-CE devices are perfect. Inherent to the proprietary systems is a learning curve required to master both the OS and some applications, including handwriting recognition software. Architecture can differ dramatically among systems, so there's no guarantee of interoperability or backward compatibility between different proprietary hand-helds. But each has a strong community of users plus active software development that, for the time being, surpasses that of Windows CE.

The Next Generation

I have small fingers. So it wasn't all too difficult to successfully touch-type on many of the hand-held computers we test-

BOTTOM VIEW

Illustration based on Hewlett-Packard 320LX

ILLUSTRATION SANDERS/TIKKANEN DESIGN & ILLUSTRATION © 1997

ed. Enhancements in keyboard design, such as Butterfly-like or external keyboards, are making it easier than ever to type notes. In fact, I drafted a rough cut of this review on a hand-held computer. Such productivity would not have been possible with an early-generation PDA, such as the Sharp Wizard OZ 5100 that I carried around a few years ago. Interestingly, many of the systems in this review are the same size, or only slightly larger than, my old Wizard—yet they are all much more functional and loads more powerful.

Number one on my wish list for future generations of hand-held computers is voice control, which would be of greater value than pen input and handwriting recognition. Future hand-helds are also expected to make use of built-in pagers. This is likely not too far off since Hitachi's SH-3 RISC processor, which powers the Hewlett-Packard, Casio, Compaq, and Hitachi models we tested, includes support for (among other things) voice-activated control and two-way paging.

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BEST OVERALL HAND-HELD COMPUTERS

We chose the Hewlett-Packard 320LX Palmtop PC as the Windows CE-based winner. It was the performance leader among the six CE systems we tested for this report.

The HP did very well in the usability category, placing third after the Philips Velo1 and the NEC MobilePro 450. Its display is impressive; the 320LX is currently the only CE-based system that features a 640- by 240-pixel full-width screen. The screen constitutes the widest viewing area of all the CE machines we tested, allowing us to view information just as it would appear on a desktop PC.

The keyboard on the HP has sloping keys that work well with the heavy, angled stylus. We found the battery compartments easy to access; you don't need a screwdriver to open them. The spare battery compartment includes a reset button to clear the system's memory, which we found helpful when resetting the unit between file transfers.

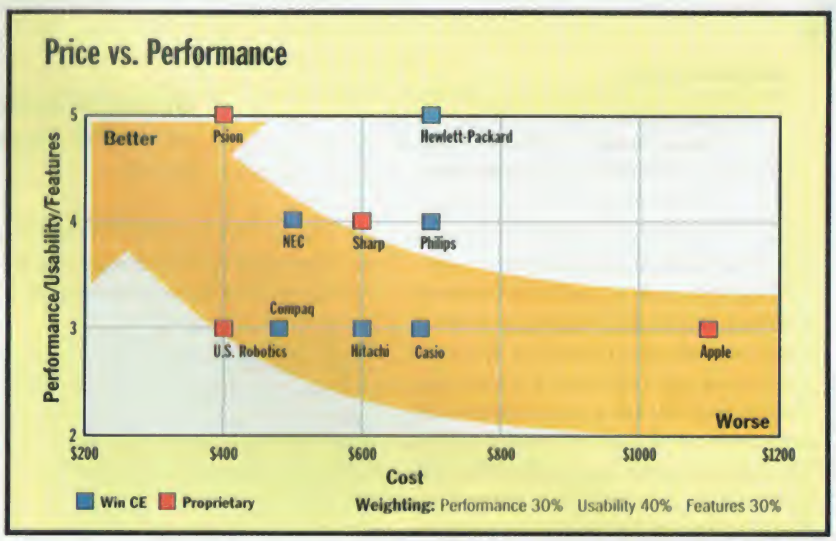
The HP also did fairly well on features, placing fourth after the NEC, Hitachi, and Philips models. One major problem is its on/off buttons, which are located on the space bar. This makes it easy to accidentally turn on the machine when the cover is closed by simply pressing down on the closed case.

Among the CE hand-helds, the HP was the fastest in our file transfer tests: 217.33 seconds to upload 100 schedules and 200 contact files, and 47.83 seconds to download the same number of files.

The NEC MobilePro 450 is the winner in our Low Cost category for CE-based machines. It comes with a number of built-in functions and connectivity options, such as a PC Card modem and a 115.2-Kbps infrared port. We found the stylus to be sturdy and the keys tactile.

We also liked the built-in stylus cradle on the combination serial port-A/C adapter. In fact, we found the attachment itself handy for easing the hand-held into the cradle for a convenient, one-step connection. Additionally, data transfer was easy. However, we did not like the shiny screen, which caused glare and made viewing difficult.

We chose the Psion Series 3 as the winner among the hand-held computers that use a proprietary operating system. It was the clear performance winner in both OS categories, taking only 5.8 seconds for file uploads and 6.5 seconds for file downloads. It tied with the Sharp 5800 for first place in usability with its 5- by 2-inch screen, easy-to-use multifunction buttons, and keys that make an audible click. The Psion Series 3 came in first place for features as well, due to its multitude of applications and its battery life (estimated at 80 hours). Communications options on this system were impressive, with PC Card compatibility and synchronization software. The unit comes with its own development software, Psion's Object-Oriented Visual Application Language (OVAL), which is compatible with Visual Basic. The Psion also supports C++ and Organizer Programming Language (OPL). Additionally, we found the Psion's external sound recorder with playback capability to be indispensable.



Second Place

Second place for the Windows CE-based systems went to the Hitachi HPW10E4. The system is fast, landing in second place for performance among the six Windows CE machines. It boasts a good download time of 51.3 seconds and a decent upload time of 215.03 seconds. However, it is mediocre in the areas of usability and features. We found some serious design flaws, in addition to an annoying screen flicker.

To change the backup battery, we had to unscrew an underside panel, exposing the DSP modem board and other circuitry. Although the keyboard is easy to type with, we found the screen to be somewhat unresponsive for writing with the stylus. Additionally, the PC Card eject button is located directly below the cover release, which makes it easy to accidentally eject the card when opening the cover.

The Sharp Zaurus 5800 is our second-place winner among the units using a proprietary OS. It ranked number one in usability among all the proprietary-based systems we tested. Its multifunction buttons are easy to use, and its large, backlit screen is impressive. The Zaurus is slow at transferring files, however. It ranked last in terms of performance (159 seconds for downloads and 62.4 seconds for uploads) among all the proprietary-OS systems we tested.

Notable Toteable

We make special note of the Philips Velo 1, which came out on top in usability among the CE machines. The keyboard has well-spaced oval keys and useful multifunction buttons. The touchscreen was the most responsive of all those we tested. The Velo 1 comes with a built-in 19.2-Kbps modem and RJ-11 connector. Its voice-memo feature is extremely useful, storing 16 minutes of sound per megabyte. With the ability to handle both flash or DRAM, the Velo 1's upgradability is a welcome benefit. However, you cannot add a flash minicard if you already installed an OS upgrade ROM in that slot.

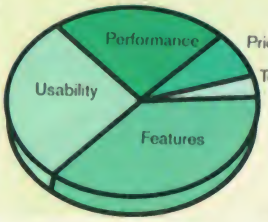
LAB RATING RESULTS

BEST HAND-HELD RUNNING WINDOWS CE

Hewlett-Packard 320LX

The Hewlett-Packard 320LX is the champion of the Windows CE-based crop, equaling or surpassing the other CE systems in features, usability, and performance. Its full-width screen measures 640 by 240 pixels. But the unit is on the low end of the battery-life spectrum; HP says the 320LX will run for 12 hours if no PC Card is connected.

WEIGHTING



BEST BARGAIN CE-BASED HAND-HELD

NEC MobilePro 450

If price is a major concern, we recommend the NEC MobilePro 450, our Windows CE low-cost winner. It scored well in our file transfer tests, and its extensive feature set, plus $499 price, make it an excellent price/performance value. Its claimed battery life spans 30 hours if you're not using a PC Card.

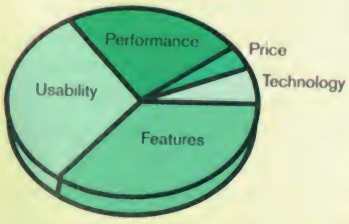
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Hewlett-Packard 320LX	**$699**	★★★★	★★★★★	★★★★★	★★★★	★★★★	★★★★★
Casio Cassiopeia A-11 Plus	$689	★★★★	★★	★★★★	★★	★★★	★★
Hitachi HPW-10E4	$599	★★★★	★★★	★★★★	★★★★	★★	★★★
NEC MobilePro 450	$499	★★★★	★★★★	★★★★★	★★★★	★★★★	★★★★
Compaq PC Companion C140	$479	★★★★	★★★	★★★	★★★	★★★	★★★
Philips Velo 1	$699	★★★★	★★★★★	★★★	★★★	★★★★★	★★★★

BEST HAND-HELD WITH A PROPRIETARY OS

Psion 3C

Excellent performance and an exceptional value. With PsiWin, Psion's optional PC connectivity package, you can share with Windows 3.1 and Windows 95 files as well as back up to any PC drive. The built-in PIM also synchronizes with Windows PIMs. The PC Card attachment is self-powered, so estimated battery life is 80 hours. The ease of use, robust OS, application development environment, and software options add up to a compelling hand-held computer.

WEIGHTING



	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	FEATURES	USABILITY	OVERALL RATING
Psion 3C	**$399**	★★★★	★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Sharp Zaurus ZR-5800FX	$599	★★★★	★★★	★★★	★★★★	★★★★★	★★★★
U.S. Robotics Palm Pilot Professional	$399	★★★★	★★★★★	★★★★	★★	★★★★	★★★★
Apple Newton MessagePad 2000	$1099	★★★★	★★	★★★★★	★★★★	★★★	★★★

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

PHOTOGRAPHS: DARYL SOLOMON © 1997

Plus, the Velo 1 loses pocketability when you connect an extra half-inch-thick module for PC Card support.

Size Matters

The largest system of the lot, Apple's Newton MessagePad 2000 weighs 1.4 pounds and measures 1.1 inches high by 4.7 inches wide, with a depth of 8.3 inches. But it represents the only option among the units we tested for someone who wants a Macintosh-like OS. Thanks to its 160-MHz StrongARM SA-110 RISC processor, the system is quite fast—just seconds behind the Psion. Additionally, the Newton's 480 by 320 transflective LCD offers resolution of 100 dots per inch and 16 levels of gray scale. The Newton is a veteran in the field, so there's plenty of software available. But it will cost you. The system is priced at $1099, which includes an external keyboard, case, and software.

The smallest footprint belongs to the U.S. Robotics Palm Pilot Professional, which weighs a mere 5.7 ounces and measures 0.7 by 3.2 by 4.7 inches. Its super-long battery life of two months, in combination with its $399 price and tiny size, make it the market leader. (The Pilot captured 51 percent of the hand-held market in 1996, according to Dataquest.) Our performance tests showed it to be quite fast, scoring 20.9 seconds for file uploads and 19.6 seconds for downloads. However, its scores were only fair in features and usability. The Pilot is an excellent choice for people who want smallness and long battery life but could care less about extra bells and whistles.

DETAILS

Philips Velo 1

A few things stand out on the Philips Velo 1. Its unique, rounded keys work well with the stylus pen and provide adequate tactile return. Its multifunction buttons make switching between applications both fast and easy. Though it lacks a PC Card slot, the Velo 1 provides an upgradable fax modem, a voice recorder, and support for a broad range of communications

software. The Velo also conforms to Intel's Miniature Card standard, which allows for easy, though expensive, memory upgrades. In addition, the integrated modem and dual expansion slots mean that a user can expand memory and upgrade software while still using the modem.

Hitachi HPW-10E4MB

We couldn't help but notice a design flaw in the Hitachi when we went to change the backup battery. After we unscrewed an underside panel and located the coin-style battery, we noticed that the DSP modem board and other circuitry were exposed to our hands, dirt, and airborne dust. After inserting a new backup battery, we eventually noticed we had lost quite a bit of battery power: The system had turned itself on immediately after we put in the new power cell.

Apple Newton MessagePad 2000

The Newton MessagePad 2000 can be carried with or without its external, serial keyboard, an option that comes with some configurations. We've heard the argument that if you plan to carry the Newton keyboard around you might as well use a small laptop instead. However, if you decide to travel light once in a while, it is not easy to remove a laptop's keyboard. Also, a laptop's batteries will fizzle out in a couple hours; the Newton's battery, according to Apple, can last for three to six weeks.

For Road Warriors Only

Psion makes some exciting advancements in usability and convenience with its Psion Series 5. We were unable to test the system because, at press time, the PsiWin 2.0 software was in early beta. However, we were impressed with the look and feel of the unit. A touchscreen and a stylus are used for data input. It has a large screen—5.5 inches wide by 2.75 inches tall—with a resolution of 640 by 240, the same as the HP 320LX's display. Its relatively large QWERTY keyboard—6.5 inches wide by 2.5 inches tall—expands outward, like the IBM Butterfly, when you open the cover. The keys are more than half an inch apart from each other, making it easy to touch-type and not have to hunt and peck the way most handhelds' keyboards make you do.

The Series 5's 32-bit multitasking EPOC32 operating system can share files with Windows 95 and Windows NT PCs and Macintosh systems, and it can synchronize with Microsoft, Lotus, and Corel office suites out of the box. The system comes equipped with standard CompactFlash and an RS-232 port. You also get an external voice recorder that can record for 30 minutes on an 8-MB machine. Psion estimates up to 35 hours of typical-use battery life. Besides already supporting Organizer Programming Language (OPL) and C++, Psion plans to add Java support for application development in 1998. Available in August, the Psion series 5 will sell for $599 for the 4-MB model and $699 for the 8-MB configuration.

–Michelle Campanale

We rated these hand-held computers on the basis of their usability, features, performance, technology, implementation, and price, all on a scale of five stars—except for price, which we factored in at 10 percent for the Windows CE machines and 5 percent for the proprietary machines. Because the CE machines are essentially commodity items, price becomes a key determining factor. The features set and usability factor higher for the proprietary machines, as people buy them for their specific features.

We derived the performance rating by averaging the results of our speed tests. First, we measured each system's throughput during a file transfer from the hand-held computer to a laptop. The second test consisted of a download from the laptop to the hand-held.

To judge usability we graded the unit's characteristics in a few key areas. We evaluated the device's ease of use when transferring data, the screen size, and the backlighting. We judged their keyboard functionality, system labeling, and hardware documentation. We also looked for a reset button on the systems, and we gauged the size and portability of the A/C adapter. A hand-held earned extra points if it came bundled with applications.

To evaluate features, we looked at the processor speed, the screen, the data entry options, and the amount of memory that's included. We paid close attention to systems with existing upgrade paths. Because many users of hand-held PCs are mobile workers, communications options such as a modem, an infrared port, and a docking station are crucial. Sound, power supply, and battery life were also important in our features scores.

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

Test Methodology

For our performance tests we timed a serial download of 300 files. These included 100 schedules and 200 contact lists, which were 28.2-KB .SCD files. We transferred the files to and from a Dell Latitude XPI CD with 32 MB of RAM and a 166-MHz processor.

Our performance testing consisted of three downloads from the laptop to the hand-held, as well as three uploads from the hand-held to the laptop. After completing three file downloads, and before starting the uploads, we reset the system by popping out both the spare batteries and the primary batteries and replacing them. We also used the reset button to assure proper flushing of the static memory. We did this to make sure that the data bank was empty, putting the machine in the same state for each iteration of the test.

After each upload or download, we replaced a new, uncorrupted file with the transferred file. Additionally, we did all our performance tests with the A/C adapter, and not the battery, powering the unit because battery levels can affect the results. All cables and A/C adapters used in our tests came with the particular system being tested.

Kill Two Birds with One Phone

Though it has identical data functionality to the Nokia 2110 digital cellular phone, Nokia's Communicator 9000 is a new hybrid of data and communications. Its two-in-one design includes an innovative pocket-size personal organizer encased in the shell of a cellular phone. Weighing just a little over 2 pounds, the Communicator comes with the GEOS 3.0 operating system, which acts as a virtual processor. It also ships with 2 MB of flash memory, plus 2 MB of additional RAM. The Communicator's standard applications include a scheduler, contact directory, diary, address book, and file transfer option, which dispatches information from the Communicator to a PC using either infrared or serial connections. The unit's portable access terminal allows for Internet connections with Web, Telnet, and VT100 terminal emulation. Features of the personal organizer include an address book, calendar, note-editor, to-do list, calculator, and world clock. Available in the U.S. this fall, the 1900-MHz Communicator will work on GSM 1900 PCS networks (such as PacBell, Aerial, and VoiceStream) and will sell for around $1000.

HAND-HELD COMPUTERS FEATURES

	Apple Newton Message-Pad 2000	Casio Cassiopeia A-11 Plus	Compaq Computer PC Companion (C140)	Hewlett-Packard HP 320LX Palmtop PC
Price as tested (MSRP)	$1099 (includes keyboard, case, and software)	$689	$479	$699
Overall rating	★★★	★★	★★★	★★★★★
PROCESSOR				
Manufacturer and model	StrongARM SA-110	Hitachi SH3	Hitachi SH3	Hitachi SH3
Operating system	Newton 2.1 OS	Windows CE	Windows CE	Windows CE
SCREEN				
Resolution (dpi)	480×320	480×240	480×240	640×240
Screen area (inches)	4.9×3.3	4×2	4×2	6.3×2.5
On-screen function icons				
DATA ENTRY				
Touchscreen with pen stylus navigation	✔	✔	✔	✔
Keypad	External	✔	✔	✔
Both	✔	✔	✔	✔
Handwriting recognition software included	✔			
On-screen keyboard	✔			
CASE				
Height × width × depth (inches)	1.1×4.7×8.3	1×6×3	1×6.8×3.6	1.1×7.2×3.6
Weight	1.4 lbs. (including batteries)	13.4 oz. (incl. batteries)	13.4 oz. (incl. batteries)	15.6 oz. (incl. batteries)
MEMORY				
Amount of RAM	5 MB	6 MB	4 MB	4 MB
BUILT-IN FUNCTIONS				
Word processor	✔	✔	✔	✔
Spreadsheet		✔	✔	✔
Standard features **	✔	✔	✔	✔
Sketch/paintbrush	✔	Optional capture	✔	✔
Alarm clock	✔		✔	
Games		✔	✔	✔
Expense filer				
Financial management				
Pager			Optional	
Internet access/Web browser	✔	✔	✔	✔
Faxing	✔	✔	✔	✔
E-mail	✔	✔	✔	✔
COMMUNICATIONS				
Interface cable included	✔	✔	✔	✔
Printer link	✔	Optional		✔
PC Card-compatible	✔	✔	✔	✔
Other	N/A	N/A	N/A	N/A
MODEM				
On-board modem				
PC Card modem available		✔	✔	✔
Speed	N/A	N/A	N/A	N/A
INFRARED PORT				
IR port included	✔	✔	✔	✔
File transfer range (distance)	3.2 feet	3 feet	3 feet	3 feet
Data transfer speed	115.2-Kbps	115.2-Kbps	115.2-Kbps	115.2-Kbps
DOCKING STATION				
Docking station required for HPC/PC connectivity				
SOUND				
External sound-recording/playback capabilities	✔			
Integrated speaker	✔	✔	✔	✔
POWER SUPPLIES				
AC power adapter	✔	Optional	Optional	✔
Battery type	4 AA	2 AA	2 AA	2 AA
Does AC adapter have a battery recharger?	✔	No (rechargeable battery pack available)	Optional	✔ (through docking station)
Backup batteries/type	NimH	Lithium	NimH (optional)	NiCad
Estimated battery life without PC Card	3–6 weeks	20 hours	20 hours	4–6 weeks
CUSTOMER SUPPORT				
Toll-free telephone	800-462-4396	800-96-CASIO	800-652-6672	800-443-1254
Phone	408-996-1010	888-204-7765	287-370-0670	970-392-1001
On-line address	http://www.newton.apple/connect	http://www.casio.com	http://www.compaq.com	http://www.hp.com/handheld
Inquiry number	**980**	**981**	**982**	**983**

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

Hitachi Handheld PC HPW-10E4MB	NEC Computer Systems MobilePro 450	Philips Consumer Electronics Velo 1	Psion Series 3C	Sharp Zaurus ZR-5800FX	U.S. Robotics Palm Pilot Professional
$599	$499	$699	$399	$599	$399
★★★	★★★★	★★★★	★★★★★	★★★★	★★★★
Hitachi SH3 Windows CE	NEC Vr4101 Windows CE	Philips R3910 Windows CE	NEC V30H Psion EPOC 16	Motorola Dragon Chip Zaurus Synergy	Motorola 68328 Palm OS
480×240 5×2	480×240 4.5×2.2	480×240 5×2	480×160 5×2 ✔	320x240 4×2.7 ✔	160×160 2.5×3.25 ✔
✔ ✔ ✔	✔ ✔ ✔ ✔	✔ ✔ ✔	 ✔ Keyboard-driven	✔ ✔ ✔	✔ ✔ ✔
1×6.58×3.78 13.6 oz. (incl. batteries)	1.07×6.89×3.74 0.88 lbs. (incl. batteries)	1.25×6.75×3.75 13.2 oz. (not incl. batteries)	6.5×3.35×0.87 9.7 oz. (incl. batteries)	1x6.7x3.9 14.7 oz. (incl. batteries)	0.7×3.2×4.7 5.7 oz.(incl. batteries)
4 MB	4 MB	4 MB	2 MB*	2 MB	1 MB
✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔	✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔	✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔	✔ ✔ ✔ ✔ Optional Optional Optional Optional Optional Optional	✔ ✔ ✔ ✔ Optional	 ✔ ✔ ✔ ✔ ✔
✔ ✔ N/A	✔ 1 (via b2 software) ✔ N/A	✔ No (via desktop) Mini PC Card *** N/A	 ✔ (cable/wireless) ✔ (via adapter) OVAL VB-compatible programming tool	✔ ✔ Wireless e-mail	✔ No (via desktop apps) No N/A
✔ ✔ 28.8-Kbps	 ✔ N/A	✔ ✔ 19.2-Kbps	 ✔ N/A	 ✔ N/A	✔ (snap-on modem) No 14.4-Kbps
✔ 50 cm 115.2 Kbps	✔ 8–12 inches 115.2 Kbps	✔ 2 meters 115.2 Kbps	✔ 3 feet 115.2 Kbps	✔ 20 inches 115.2 Kbps	 N/A N/A
	✔	✔			✔
✔	✔	✔ ✔	✔ ✔		
✔ 2 AA Lithium 12 hours	✔ 2 AA 3-V lithium 30 hours	✔ 2 AA Optional Lithium 15 hours	Optional 2 AA Lithium 80 hours (PC Card attachment is self-powered)	Optional 2 AA Optional Lithium 100 hours	 2 AAA N/A 2 months
800-HITACHI http://www.hitachi-ce.com **984**	800-632-4525 508-264-8000 http://www.nec-computers.com **985**	888-367-8356 408-523-2800 http://www.velo1.com **986**	800-99PSION 508-371-0310 http://www.psion.com **987**	800-BE-SHARP 201-529-8700 http://www.sharp-usa.com **988**	800-881-7256 415-237-6000 http://www.usr.com/palm **989**

* Can add 16 MB of RAM

** Standard features = Database/contact manager and agenda/organizer/synchronization software

*** Can use standard PC Card with adapter

www.byte.com

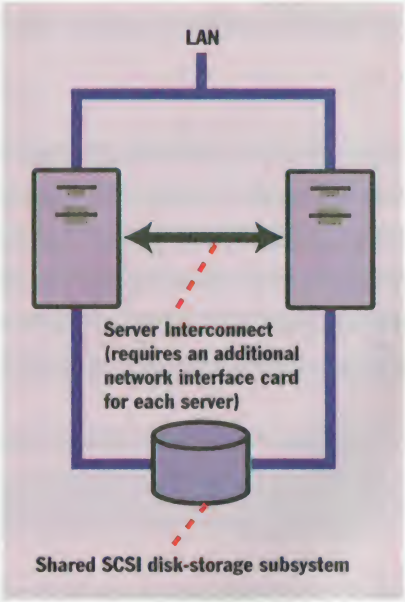
With Wolfpack, two NT servers can act as standbys for each other while both still do useful work.
By BYTE Editors

Wolfpack Howls Its Arrival

Microsoft, the 800-pound gorilla of the software industry, is set to release a new extension for its NT Server OS that will dramatically change the server landscape and allow NT networks an unprecedented degree of reliability and fault tolerance. Popularly known as Wolfpack, this new product will, for the first time, allow built-in clustering—the ability to interconnect two or more servers so that one can automatically take over another's processing in case of failure, with minimal disruption to end users. To a user, clustered servers appear as a single entity, even when the client is accessing several servers in different locations.

Clustering NT servers (not to mention those using other OSes) isn't a brand-new idea, but it's never been hooked directly into the OS before—where it really belongs, in our judgment. Heretofore, there have been a variety of clustering solutions from a number of vendors, most of them requiring dedicated hardware links and proprietary hardware/software bundles. Many of these vendors have been working with Microsoft and are making plans and products to confront what will be the new market reality. Phase one of Wolfpack's release is scheduled for this month. It will support two-server clusters. The second phase will follow in 1998 and enable clustering more than two servers.

This report is based on tests by both BYTE and NSTL of the second beta release of Wolfpack. In addition, we look at some important issues surrounding clustering technology, many of which involve limitations that have been ignored or glossed over by vendors. Finally, we take a quick survey of the existing products in the market, with a table summarizing their features and a text box describing their plans and positions vis-à-vis Wolfpack. (Early on, we planned to conduct a comparative look at cluster solutions, but because no common hardware configuration has been feasible, we couldn't conduct BYTE's usual apples-to-apples performance comparisons.) To help you better understand Wolfpack's capabilities and limitations, we'll quickly review the basics of clustering.



The basic configuration of a Wolfpack cluster is quite simple.

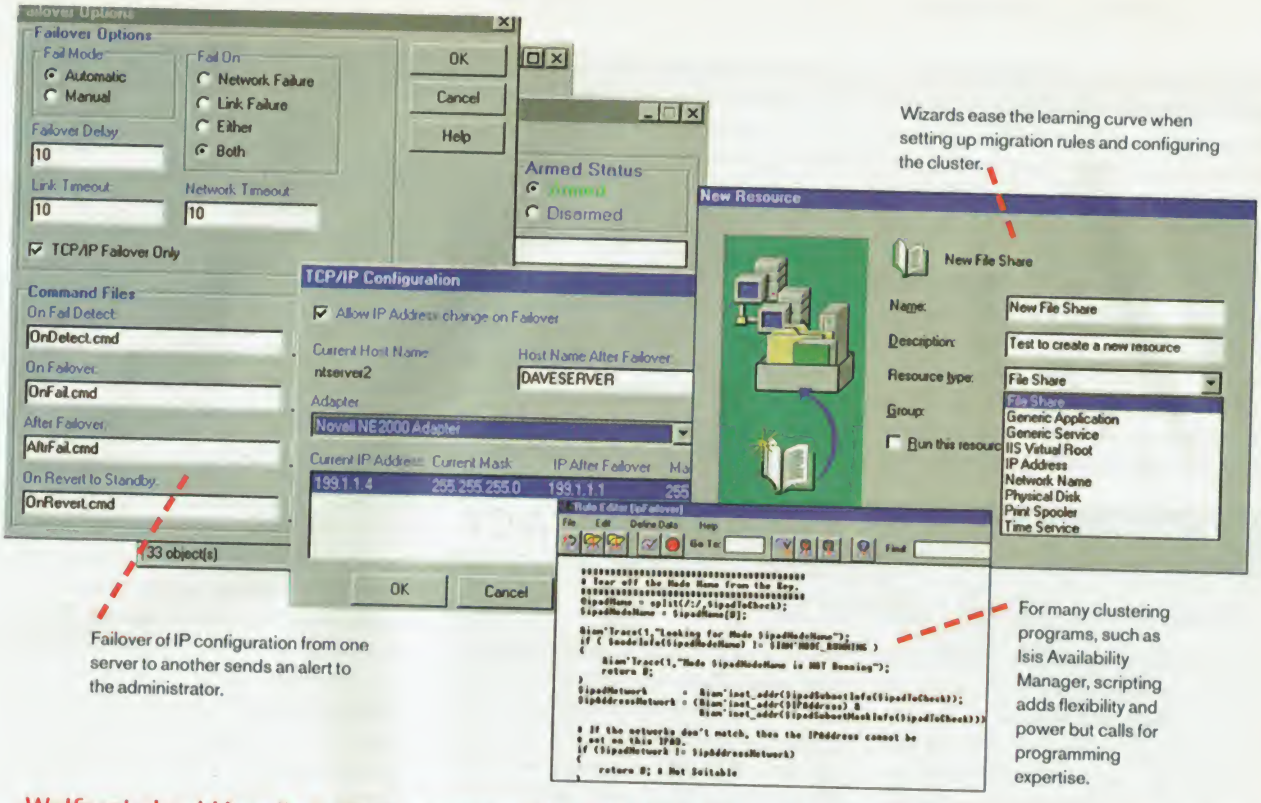
Why Cluster?

The whole point of clustering is to maintain "high availability" of computing resources to end users. To do this involves three essential functions: fault tolerance (called *failover*), load balancing, and centralized administration and monitoring. Fault tolerance ensures a backup to replace a failed resource (e.g., server, router, or network). Load balancing detects when processing overloads one resource to the point that it's virtually unavailable and distributes the load among less-burdened resources. Central management of clustered servers lets administrators monitor and control the cluster from a single console, both to troubleshoot failures and shift resources for routine maintenance.

Unfortunately, most clustering products, including Wolfpack, provide only automatic failover and management. Load balancing is a manual operation, though some third-party systems may provide additional software components or add-on products to help with this.

The heart of any clustering implementation is redundancy. Have two or more of everything, so that if any single resource on the network fails—whether it be a server, server network adapter, disk drive, application, router, or segment—the system will automatically detect this and swap in a standby component. Wolfpack knows about the following NT resource types: Fault-Tolerant Disk Set, File Share, Generic Application, Generic Service, Internet Information Server (IIS) Virtual Root, IP Address, Network Name, Physical Disk, Print Spooler, and Time Service.

While it's clearly possible to set up a cluster with an extra server standing by, connected to the network but idle, waiting to take over if it's needed, this configuration (called active/passive or asymmetric) is



Wizards ease the learning curve when setting up migration rules and configuring the cluster.

Failover of IP configuration from one server to another sends an alert to the administrator.

For many clustering programs, such as Isis Availability Manager, scripting adds flexibility and power but calls for programming expertise.

Wolfpack should handle failover automatically, but a lot of manual administration goes into configuration.

hardly cost-efficient and rarely justifiable. Instead, the usual practice is to have each server active, doing useful work but ready to take over the other's processing if it should fail. In addition to the servers' LAN connections, a second private connection, called the *interconnect*, is usually established so the two servers can monitor each other.

Achieving fault tolerance in a client/server information technology (IT) environment means addressing a number of hardware and software issues: continuing electrical power, multiple servers, redundant data storage, backup network links, and failover management software.

- **Power to the Process.** All hardware required for continual services must be connected to an uninterruptible power supply (UPS) that allows time to switch to a backup generator or, if necessary, to conduct a fast but orderly shutdown.

- **Many Machines.** You can reduce the possibility of downtime simply by dividing tasks up. A Web server on one machine and an e-mail server on another means that one server going down won't cause both applications to fail.

- **Share the Storage.** Disk mirroring or replication techniques between servers ensure that data—and possibly applications—will be available should a disk drive or server fail. Right now, SCSI is the gold standard for shared-disk technologies, but it has limits (see the Tech Focus on page 128). One of them is that the distance between clustered servers is limited to only 25 meters. Also, non-SCSI failover systems can make the server cluster vulnerable to network partitioning. In the future, technologies such as Fibre Channel, Serial Storage Architecture (SSA), or I_2O may provide dedicated disk sharing over longer distances.

- **The Dept. of Redundancy Dept.** Adding an additional connection between servers helps reduce the possibility of communications failure over the network.

- **Manage the Monster.** Failover management software offers a way to detect hardware and software failures and invoke backup, standby, or takeover technologies. Failure-detection parameters require some fine-tuning by the administrator. A too-sensitive failure test will cause needless switch-overs, but a test that's not sensitive enough risks the loss of services. A redundant dedicated interconnect between servers makes for more reliable failure detection. NSTL technicians had difficulties with NT's deadly "Blue Screen" after trying to uninstall some clustering packages. Thus, it's prudent to make an emergency repair disk prior to installation.

Simple stateless Web services are fairly straightforward to migrate, but stateful applications (e.g., database applications) are more difficult and may require special add-on kits. For greatest flexibility, failover software should offer an API to let in-house programmers add failover code to custom and homegrown applications.

What Wolfpack Does

To create a Wolfpack-based cluster, you need two (no more, no less) NT 4.0 servers (with Service Pack 3 installed) that share a SCSI bus supporting an external disk-storage subsystem (see the figure on page 126). Both servers must be members of the same NT domain, and each must have its own system disk on a local, unshared bus.

Wolfpack enables the two servers to exchange their status, resources being run, and activity with each other. Two components of the clustering software are the Cluster Service and the Resource Monitor. The Cluster Service, which runs on every clustered server, controls cluster activity, communication between servers,

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and failure operations. The Resource Monitor checks the assigned states of targeted resources (i.e., off-line, off-line pending, on-line, on-line pending, or failed) and reports any state changes to the Cluster Service. Each server can run one or more Resource Monitors.

The primary monitoring communication between Wolfpack nodes is called *heartbeat synchronization*. Basically, each node is always checking whether the other is still there and ticking. If a node's Resource Monitor determines that the other node has disappeared, the Cluster Service executes the predefined failover instructions. Because there is a separate Cluster Service and one or more Resource Monitors on each node, this cluster communication takes the form of interprocess communications (IPC) and requires little network overhead. This traffic is small enough that it can be run over a private Ethernet LAN (usually called an Interconnect), a public LAN, a serial connection, or even the SCSI bus, though the last one isn't recommended.

The administrator can specify two polling intervals and a time-out value for resources. The polling intervals affect how often the Resource Monitor does its checks. There are two levels of polling, known in Wolfpack jargon as Looks Alive and Is Alive. In Looks Alive polling, Wolfpack performs a cursory check to determine if the resource is available and running. Is Alive polling is more thorough, with Wolfpack determining if the resource is fully operational. The time-out value specifies how long the Resource Monitor should wait for a response before it considers the resource failed.

Planning to Fail

The most significant advantage Wolfpack offers over current clustering solutions is its tight integration with NT. For example, Wolfpack lets you group NT resources with applications into failover groups. When a single resource fails, Wolfpack fails over the entire group to which the failing resource belongs. This provides a handy means of creating failover dependencies and ensures that a failed service will have the appropriate resources it needs to restart. Some systems require involved scripts to accomplish what Wolfpack allows via prompted dialog boxes and mouse-clicks.

Automatic failover isn't always possible, unfortunately. Some applications can run on only one node on the cluster and in case of failover would have to be manually started on the other node. Some applications (e.g., IIS, FTP) can be managed and configured to automatically start on the other node in the event of a failover.

Wolfpack's migrating functions and resources to the alternate server, when its cluster cousin fails, let the IT staff troubleshoot and fix the problem. But how do you restore resources to the original, failed-but-fixed server (a process called failback)? Can you, and should you, automate it? It might seem that automatic failback is the best solution, but only if the problem is really fixed and unlikely to recur. If not, automatic failback can cause subsequently failed resources to bounce back and forth between servers, causing problems for users. Restricting failback to a deliberate manual action by IT personnel can eliminate this ping-pong effect.

Cluster Management

In an ordinary server environment, users employ a number of administrative tools to identify the servers and monitor their contents and activities. Wolfpack uses a

TECH FOCUS | BALANCING ACT

Shared Access, Divided Load? Not Exactly

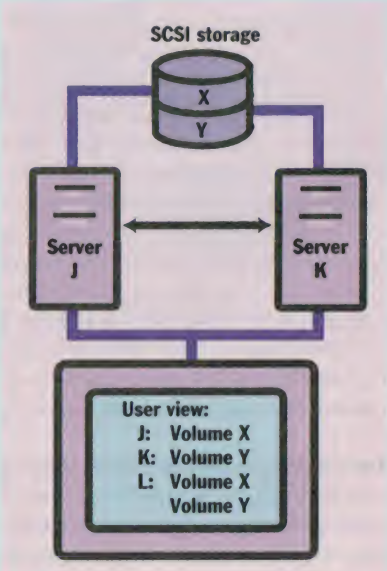
The siren song of clustering is that it enables shared, simultaneous disk access and divides the processing load between servers. Unfortunately, the reality is that neither of these benefits is fully realized, primarily because of limitations in both SCSI and disk partitioning.

Consider the simple cluster shown at the right. Two servers, J and K, share a SCSI array that's organized as volumes X and Y. The reality of SCSI is that you must access each volume through a single server. Depending on how the cluster is set up, you might actually see three servers: J, which sees disk X; K, which sees disk Y; and L (a node alias for IP and Microsoft networking), which sees both disks. Thus, you can access disk Y through either server K or L, but in truth, K does all the work.

If both J and K have SQL Server running on them (currently possible with Digital Clusters for Windows NT, but not on the initial Wolfpack release), either one can access databases on the volumes they see. However, if K wants to access a database on disk X, it has to pass the request to server J, which performs the requested operations and passes the results back to K. This has serious consequences for load management.

Say there are 100 users on L, with 50 using an application on J and 50 on a K-based application, but all are accessing data on disk X. Remember, all X access has to go through J. In reality, J is doing everything for its 50 users as well as all the file handling for an additional 50 users, while K is humming along with just the I/O for its 50 users to keep it busy. Server J could be seriously overworked, and response for all users would suffer as a result.

What happens if poor, overworked J can't take it and goes down? The clustering software instantly fails over and reassigns volume X to server K, which all of a sudden has to do some real work. The good news is that users will notice little degradation of service and little or no disruption in their applications; in the worst case, failover may look to them like a quick server reboot. Now, K may be in the same overworked and underpowered situation that J was just in. Load balancing this is not.



Both servers can access both disks—sort of.

At the moment, only an Oracle-based cluster gets around this one-server-per-volume restriction. It does this by creating its own file and data structures.

FEATURES

	Digital Clusters for Windows NT	FirstWatch for Windows NT Server	HACMP	Isis Availability Manager	LifeKeeper for Windows NT	Octopus and SASO	Standby & On-line Recovery Server	Standby Server for NT	Wolfpack
Number of servers clustered	2	2	16	Up to 100	2 or 3	2	2	2	2
Supported OSes	NT 4.0 SP2	NT 3.51 or 4.0; Solaris	AIX	NT; Solaris,	NT	NT	NT 3.5x, 4.0	NT 3.5 or higher; NetWare; OS/2 Warp	NT 4.0 SP3
Systems supported, if restricted			RS/6000 family	HP-UX	NCR Worldmark or S series		ProLiant & ProSignia		
Identical servers required							(Standby only)		
Requires shared-disk subsystem	✔	✔			✔		✔		✔
GUI-based management	✔	✔	✔	✔	✔		Use Compaq Insight Manager		✔
Load balancing			Use Load Leveler	✔					
Client software required	✔								
Special API supplied		✔		✔					
Interconnect type	NIC	2 NICs/ server	NIC	NIC	NIC	NIC	Serial	NIC	NIC
Failover mode: A/A or A/P	A/A	A/A	A/A or A/P	A/A	A/A, A/P, three-way	(N/A)	A/A (on-line); A/P (standby)	A/P	A/A
RESOURCES PROTECTED									
Shared disk					✔				✔
Generic applications				✔	✔				✔
Specific applications, via kits					✔				
Generic services									
IP address	✔		✔	✔	✔	✔			✔
Network name						✔			✔
File sharing			✔		✔				✔
Print services				✔	✔				✔
Time service				✔					✔
Name service									✔
Microsoft Exchange									
PROTOCOLS SUPPORTED									
TCP/IP	✔	✔	✔		✔				
NetBEUI	✔								
IPX/SPX	✔								
HEARTBEAT MONITORING									
Network connection	✔	✔	✔	✔	✔	✔		✔	✔
Shared disk		✔ (Unix)			✔				
Serial port					✔		✔		

✔ = yes A/A = Active/Active A/P = Active/Passive N/A = not applicable

single program, the Cluster Administrator, to centralize control over applications and services. You can run it as a client from any NT workstation attached to the cluster. All cluster resources appear as hierarchically organized objects that you can assign and configure with relative ease.

Cluster Administrator manages services, file shares, and directory replication. It allows reviewing the activities and failures of the computers in each cluster to determine which nodes are currently running applications and services. Color denotes resource ownership—that is, the colors change when a failover occurs, an instant notification that also tells you which server owns what resources. Cluster Administrator lets you specify the applications and related components that run on the servers and establish policies that monitor availability and recovery failure detection. Manually taking individual nodes off-line for maintenance involves only a right mouse-click to fail services and resources over to the other server.

While failover and failback are handled well, load balancing is still a problem under Wolfpack. It's neither automatic nor dynamic; in fact, it's completely a manual process. Therefore, you need to carefully monitor cluster loads, because it's possible for one node on the cluster to be serving 200 users and the other node handling only a few clients. And, unfortunately, there may be nothing you can do to fix it.

At BYTE, we installed Wolfpack on two

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The Rest of the Wolves

To paraphrase the old E. F. Hutton commercial, when Microsoft talks, other vendors listen. Mindful of the importance of open specifications and industry-standard hardware, Microsoft enlisted a group of technology partners to assist in Wolfpack's early development: Compaq, Digital Equipment, Hewlett-Packard, IBM, Intel, NCR, and Tandem. Digital, in particular, was a key player. Microsoft licensed Digital's clustering source code, which forms the heart of Wolfpack.

All but Intel plan to distribute Wolfpack-based clusters. Amdahl, Siemens Nixdorf, and Stratus Computer have announced plans to certify and offer Wolfpack clusters this year. Computer Associates, Oracle, and SAP have publicly discussed plans for Wolfpack-enabled products.

Once Microsoft releases Wolfpack, Digital will no longer sell its Clusters for NT package. Digital's customers will migrate to Wolfpack, which Digital will support with an enhancement package that includes increased scalability, disaster tolerance, and administrative tools.

Veritas plans to make FirstWatch as compatible with Wolfpack as possible, although some Wolfpack application- and device-dependency issues don't apply.

Isis, a division of Stratus Computer, offers Isis Availability Manager, which currently supports up to 100 servers, a capability far beyond Wolfpack. Nonetheless, Isis is committed to Wolfpack as its strategic API for clustering and maintaining compatibility with NT-based solutions. Thus, Stratus's Radio Cluster users will have an easy migration path to future Wolfpack-based products.

NCR sees its LifeKeeper, with extensive capabilities in both Unix and NT environments, as its premium high-availability enterprise offering, and considers the more-focused Wolfpack an entry-level offering.

Octopus Technologies offers a data-mirroring system that can work with Wolfpack as well as provide an alternative, stand-alone fault-tolerant solution for NT environments. Also, Octopus works in one-to-one, one-to-many, many-to-one, and many-to-many configurations, not just Wolfpack's initial one-to-one. Octopus will support all Wolfpack APIs as they become available. Some users may choose Wolfpack to implement local clusters and use Octopus to provide data mirroring and failover between clusters—in other words, cluster clustering.

Soon, Compaq expects to introduce a multiserver failover system with full Wolfpack functionality, additional administrative tools, and Fibre Channel–attached external storage. Vinca plans to improve its Standby Server for NT by adding advanced features and Wolfpack compatibility. At the same time, Vinca is developing Wolfpack enhancements, utilities, and cluster-aware applications, allowing its customers a future migration to Wolfpack.

Digital Equipment servers (200- and 166-MHz Pentium systems) sharing a single external SCSI cabinet with two 2-GB hard drives. Setup was quick and easy. The first node creates the cluster—cluster name, IP address, alias information, groups, etc. When the second node joins this existing cluster, we could assign resources and define failover procedures.

We tested manual failover (of IIS server, SQL server, and disk resources) by moving resources back and forth using Cluster Administrator. We shut down one node to test automatic failover. In all cases, recovery seemed nearly instantaneous. Cluster Administrator was also smart enough to prevent us from assigning new resources to the now-missing node.

Pick the Pack?

The reality of clustering for NT, right now, is that neither Wolfpack nor any of the available clustering products for NT fully implements all the functions and concepts that BYTE believes constitute true clustering. Available products provide add-on kits to support a short list of programs, mostly databases. Wolfpack adds much of the required functionality directly into the OS and provides common APIs for custom solutions. But if you need to cluster more than two servers, you probably can't wait until Wolfpack grows up some more. Thus, one of the other products, including some non-NT clustering solutions, may be a better choice. Still, there seems little doubt that Microsoft will soon be the leader of the pack. B

PRODUCT INFORMATION

Digital Clusters for Windows NT
$995
Digital Equipment Corp.
Maynard, MA
800-344-4825
http://www.digital.com/
Enter 1013 on Inquiry Card.

FirstWatch for Windows NT Server
$4995
Veritas Software
Mountain View, CA
800-258-8649
415-335-8000
http://www.veritas.com/
Enter 1014 on Inquiry Card.

HACMP
IBM Corp.
Somers, NY
800-225-5249
http://www.ibm.com
Enter 1015 on Inquiry Card.

Isis Availability Manager
$1500–$2500, NT;
$5000–$10,000, Unix
Isis Distributed Systems
Marlborough, MA
800-258-0990
508-460-2430
http://www.isis.com
Enter 1016 on Inquiry Card.

LifeKeeper for Windows NT
$1495
NCR
Dayton, OH
800-774-7406
937-445-5000
http://www.ncr.com
Enter 1017 on Inquiry Card.

Octopus and SASO
$1499
Octopus Technologies
Langhorne, PA
800-919-1009
215-579-5600
http://www.octopustech.com
Enter 1018 on Inquiry Card.

Standby & On-line Recovery Server
$1499
Compaq Computer
Houston, TX
800-652-6672
281-370-0670
http://www.compaq.com/
Enter 1019 on Inquiry Card.

Standby Server for NT
$2999
Vinca Corp.
Orem, UT
888-808-4622
http://www.vinca.com
Enter 1020 on Inquiry Card.

Wolfpack
Price to be determined
Microsoft Corp.
Redmond, WA
206-882-8080
http://www.microsoft.com
Enter 1021 on Inquiry Card.

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Evaluations in this report represent the judgment of BYTE editors, based in part on extensive tests conducted by NSTL, Inc., as documented in a recent issue of its monthly Software Digest. *To purchase a copy of that report, with its own evaluations and data on eight clustering systems, 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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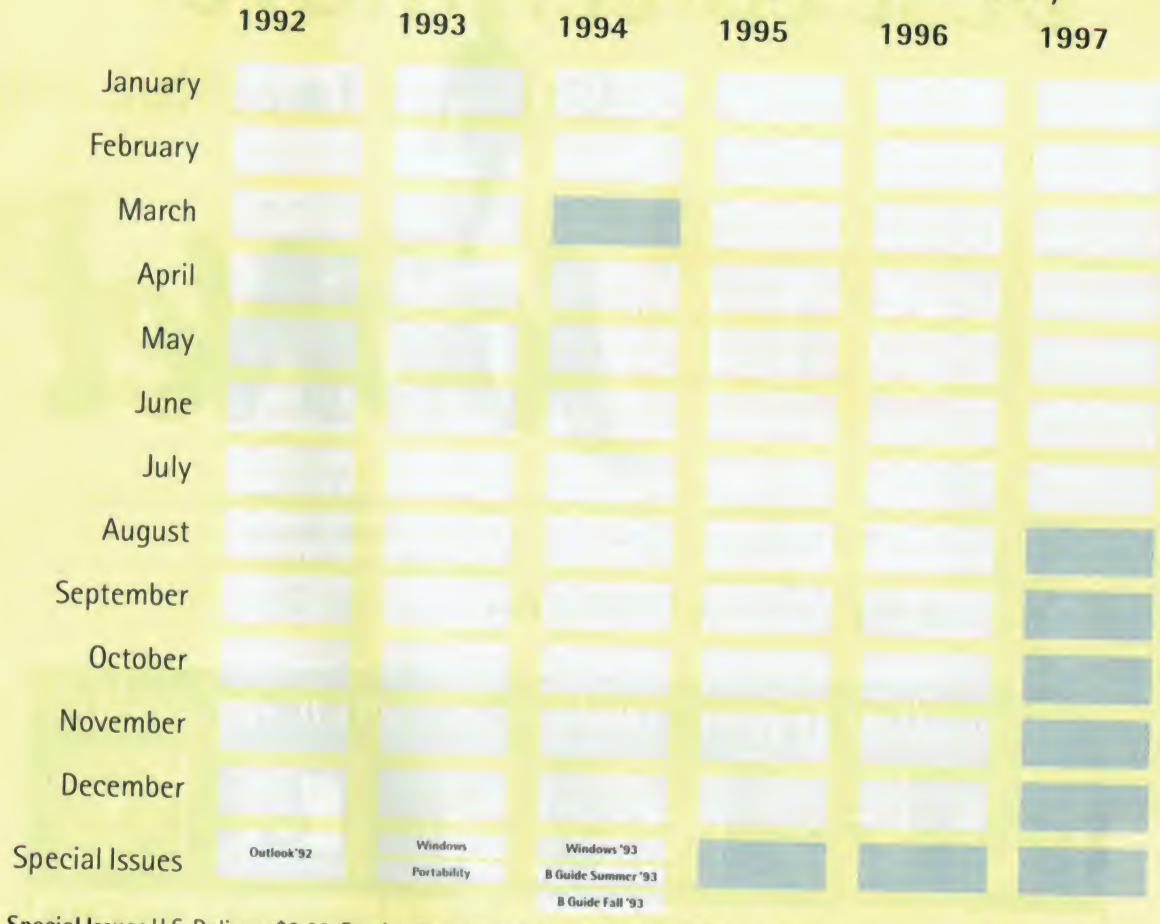

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With significant enhancements, DB2 Universal Database 5.0 works better and on more platforms. By Barry Nance

IBM Builds a Better DBMS

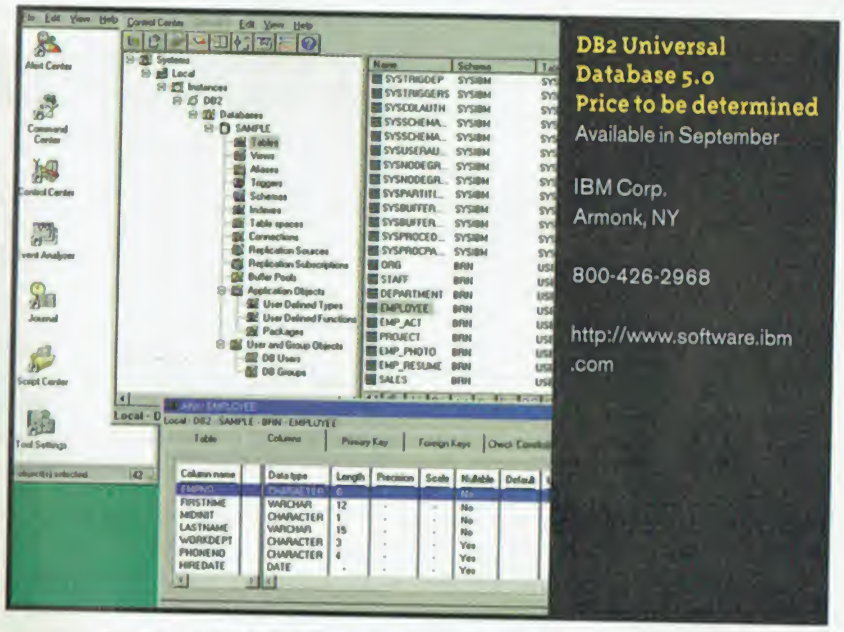
Although nearly every DBMS these days wants to call itself universal—as, for example, the new Oracle 8 (to be reviewed in the September BYTE)—IBM has co-opted the field by incorporating the term into the name of its flagship database product, DB2 Universal Database 5.0. If anyone is entitled to use this term, it's probably IBM. According to some estimates, nearly 80 percent of the world's digitized data resides in DB2 databases on IBM-compatible mainframes. The remainder is scattered across a variety of platforms—primarily Unix, OS/2, and Windows NT—running Oracle, DB2, Sybase, Informix, or other relational DBMSes (RDBMSes).

This nonmainframe market—encompassing client/server systems, the Internet, and intranets—is the hot spot for both sales growth and new features. In the race for speed, ease of use, features, and scalability, IBM's DB2 Universal Database 5.0 is challenging Oracle's commanding lead in this market.

Available for NT, AIX, HP-UX, Solaris, and OS/2 platforms, the new DB2 stores and retrieves audio, pictures, movies, user-defined data types, and, of course, numeric data. I tested the beta 4 version, which included (on nine CD-ROMs!) the database software, multimedia "extenders," Lotus Approach 97, Visual Age for Basic (OS/2 and Windows), client-side driver software, Net.Data (for integrating DB2 into a Web environment), and a System Development Kit (SDK).

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

Clients for DB2 can be any combination of Unix, Windows (NT or 95), OS/2, and Macintosh System 7 computers.



DB2 Universal Database 5.0
Price to be determined
Available in September

IBM Corp.
Armonk, NY

800-426-2968

http://www.software.ibm.com

The Control Center is a new and useful graphical tool set that DB2 administrators have wanted.

They can connect to DB2 via IPX/SPX, NetBEUI, APPC (LU 6.2), and TCP/IP network protocols.

Applications programmers can choose from a variety of APIs for delivering SQL to the database engine, embedded SQL (processed by a precompiler), DB2's callable programming interface, or Microsoft's ODBC Level 3. In the SDK, IBM explains how to access DB2 from a wide variety of computer languages, including C, C++, COBOL, FORTRAN, BASIC, and Java (via IBM's supplied Java Database Connectivity [JDBC] driver).

BYTE's testing shows that DB2 Universal Database 5.0 scales well, runs quickly, is easy to administer, and adapts painlessly to Web-site use. I exercised DB2 running on NT Server and AIX, accessed by Windows, Mac, and OS/2 clients. In the lab, many of the tests focused on the integration of the NT version of DB2 with Microsoft's Internet Information Server (IIS) HTTP server and Netscape's browser, letting DB2 play a central role in a TCP/IP-based intranet environment.

Scalability

One of DB2's greatest strengths is its ability to uniformly scale from notebooks to clustered environments and massively parallel processors. In past versions, developers and network administrators had to work around subtle differences among the various DB2 versions, because the package behaved somewhat differently on each platform.

For instance, the Data Definition Language for OS/2 wasn't exactly the same as the one for NT. This current version corrects these discrepancies. For as many platforms as it runs on, however, DB2 Universal Database 5.0 still lags behind Oracle's ability to run on 92 platforms.

continued

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

Ease of Use

Lotus Approach 97 proved an effective and easy-to-use front end for DB2, supplying decision-support functions not available in the core DB2 product. Approach was particularly good for formulating queries and graphing the data I'd stored in DB2.

A central tool set called the Control Center holds DB2's graphical database management tools for administering, configuring, and tuning DB2. I believe that IBM did an excellent job of combining most of DB2's administrative functions (i.e., performance configuration, monitoring, and operation scheduling) into this easy-to-use interface. Control Center is a major improvement over the limited tools of previous versions of DB2.

DB2 5.0 incorporates wizard-like functions called SmartGuides. Using the Performance Configuration SmartGuide, for example, I made tuning changes to improve DB2's performance for my setup. The SmartGuide allowed me to review a summary of proposed changes, execute those changes, or save them to a script for later processing. DB2's familiar command-line interface is still available.

Speed

For larger enterprise-level environments, this new release of DB2 has improved performance optimizations for handling parallel transactions and complex queries. It boosts performance with large buffer pools, 64-bit memory support, and programming enhancements to the SQL optimizer. In the lab tests, this new version responded 15 percent faster to SQL requests, on average, than its predecessor.

IBM continues to distinguish between dynamic and static SQL in DB2. Dynamic SQL can be a string of text that you type into a program at a command-line prompt. Static SQL, by contrast, consists of statements, embedded directly in the program, that are fully known at program compile time. Like other RDBMSes, DB2 can compile and optimize dynamic SQL at run time. However, DB2 gives developers precompile and postcompile options (IBM calls the process *binding*) that store static SQL statements in files with a BND extension. In general, static SQL executes much faster than dynamic SQL.

Reliability

In the lab, when I emulated an enterprise-level environment with multiple database servers and clients running continuously and concurrently, DB2 showed itself especially strong in the areas of load balancing, redundancy, and back-up-and-restore capabilities. Its replication feature let me push and pull database updates among servers with ease, and I had the option of replicating updates on an asynchronous or synchronous basis.

In tests that ran 24 hours a day, unattended, DB2 provided consistently high levels of uptime. In addition, other enhancements to this new version include clustering support (i.e., load sharing and redundancy) for a variety of operating environments, fast restart, and point-in-time table space and table-level data recovery.

Versatile and Valuable

DB2's extenders, similar to Informix's DataBlade technology, let developers store and retrieve multimedia data types. IBM ships four extenders with DB2 Universal Database 5.0 for handling text, image, audio, and video data. Furthermore, IBM says it's coordinating with third-party vendors to create extenders for additional data types.

The new version of DB2 offers stored procedures, triggers, and constraints, like previous versions, but it goes a step further to allow the storage of business logic and rules as objects. With a view toward the future, IBM has provided the option of coding stored procedures in Java.

DB2 Universal Database 5.0 has a new Table function for better integration of external data into a DB2 database. I used this function in the lab to capture nonrelational data and process that data with DB2 SQL statements, which I couldn't do with other products or earlier DB2 versions.

IBM has improved DB2 considerably, matching most of the features offered by other RDBMSes with its new support for Rollup and Cube functions. Rollup is a data-grouping function, while Cube is useful for cross-tabulations of data.

The ease with which I could incorporate DB2 into a Web environment (intranet) impressed me. DB2 Universal Database 5.0 includes support for Java and JDBC, and its Net.Data component made database access from HTML easy. Net.Data lets HTML developers insert database-access macros into their Web pages. I used Net.Data to quickly and painlessly create JavaScript-based Web pages that accessed a DB2 database. Like Microsoft's Active Server Pages technology, Net.Data is a server-based scripting facility. It works on Unix and NT with HTTP servers from Microsoft, IBM, and Netscape.

DB2 Universal Database 5.0 also has expanded support for accessing very large databases as well as databases that extend across multiple nodes of a network. For mainframe or minicomputer database access, via a gateway, the new DB2 supports IBM's Distributed Relational Database Architecture (DRDA). This is the middleware through which DB2 Universal Database 5.0 can connect to and interact with other instances of DB2 running on platforms that support DRDA. These include MVS on mainframes and OS/400 on mid-range computers.

In my opinion, almost all current DB2 users will want to upgrade to DB2 Universal Database 5.0. And anyone who isn't using DB2 but needs a scalable, robust, versatile database manager should take a good look at this new release. B

Barry Nance, a computer analyst and consultant for 25 years, is a BYTE consulting editor and the author of Introduction to Networking *and* Client/Server LAN Programming. *You can reach him via the Internet at* **barryn@bix.com**.

TECH FOCUS OPTIMIZATION

Optimizing SQL Queries

DB2 subjects SQL statements to one of nine levels of optimization just prior to processing those statements. The nine levels, configurable by a database administrator or settable by applications software, allow precise tuning of database response times. For example, you'd use level 0 or 1 for SQL that's already optimized by the programmer. Higher levels let DB2 examine and reformat SQL that's been submitted by, for instance, a front-end query tool such as Microsoft Access or Lotus Approach 97.

The SQL optimizer uses cost-based algorithms to determine the most efficient execution method. The optimizer finds the best join order, for example, and it decides whether the execution of the SQL statement will be CPU- or I/O-bound. The optimizer chooses an execution path for the SQL statement that will result in the quickest response from the database engine.

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Assigning roles to users with TrustedWeb enables the publication of sensitive data. By Tom Yager

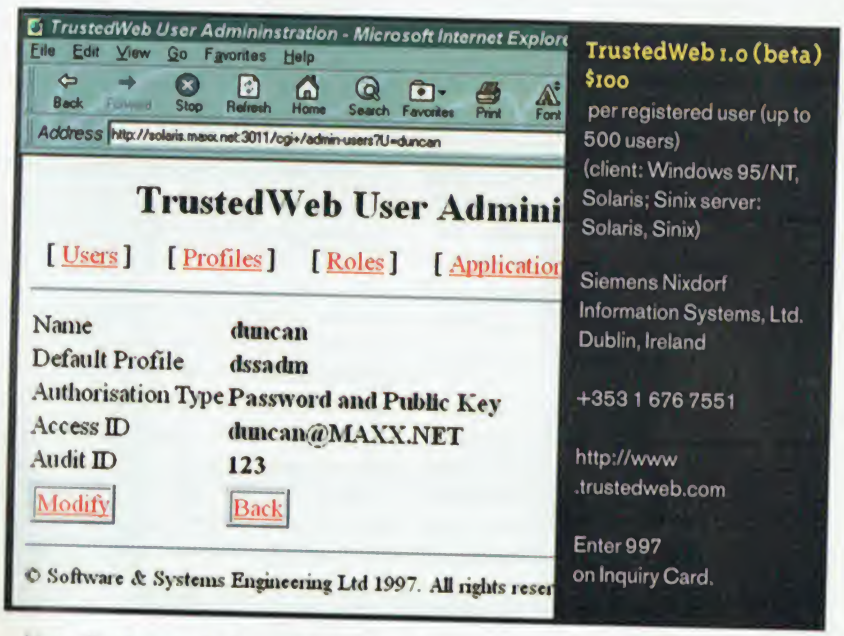
All the Web's a Stage

On the Internet, whether you're paranoid or not, there probably is somebody out to get your data. Inexpensive Internet access puts millions of juicy targets within an aspiring hacker's reach; therefore, any system or network that's accessible through the Internet is automatically on the target list.

One popular cure for security problems, the firewall, only does part of the job of keeping unauthorized users out. A single sign-on product, such as TrustedWeb from Siemens Nixdorf's Software and Systems Engineering Division, provides an alternative to publishing only the data you don't mind anyone seeing. Despite many warts, the public beta version that I tested offered a unique and promising approach to Internet security.

Based on the Kerberos authentication technology, TrustedWeb adds SESAME (Secure European System for Applications in a Multivendor Environment) extensions to provide role-based access control and public-key encryption. Roles typically group users by their work function. TrustedWeb protects Web pages, scripts, downloadable files, and anything else that can be addressed with a URL. Only validated users engaged in an authorized role can access the data.

The TrustedWeb server components run on Solaris and Sinix (Siemens Nixdorf's flavor of Unix); Windows NT support is expected in July. The client runs on 32-bit Windows, Solaris and Sinix; other Unix flavors for both client and server will follow later. I installed the TrustedWeb server on a Solaris box, and the client on a Pentium system running Windows NT 4.0 with Service Pack 2.



You display and change user profiles, server-access controls, and most of TrustedWeb's operating parameters via a Web interface.

Role-Based Protection

The notion of role-based security isn't new; it's implemented in commercial databases, OSes (including NT), and other secure applications. The theory is wonderfully simple: Organize those who have physical access to your data into groups based on their job descriptions and/or the tasks they perform. For instance, the woman in accounting who handles some basic administrative chores might be assigned the roles "accounting" and "system operator." Roles are usually arranged in hierarchies that make some roles composites of others.

RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★

Roles simplify administration. Access rights to files and services are usually assigned on a per-user basis. Adding, removing, and modifying access permissions becomes tedious when you must track individual users. Role-based access is an extension of simple groups; you could build yourself a basic role-based security system on any OS that supports groups—with a couple of twists. Each user is assigned a single default role, but not all OSes have the notion of a default group. If a user wants to switch to another role, that role can have different attributes associated with it. Its transactions might be more heavily logged, or the user might have to supply a password to switch to that role.

In Operation

One of TrustedWeb's most appealing aspects is that it should seamlessly interoperate with virtually any Web server. TrustedWeb's server components sit between users and your Web content; the Domain Security Server sets up a conversation with the TrustedWeb client and determines whether the user is authen-

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

tic. The Domain Security Server, like the rest of TrustedWeb, takes its data from a configuration file. When the client hands over its authentication data, the Domain Security Server compares that data with the fields in its configuration file until it finds a match.

Once the Domain Security Server authenticates the user, the separate TrustedWeb Server determines whether the user is allowed to access a particular URL resource. TrustedWeb Server creates proxy connections between clients and one or more Web servers. Configure your Web server to refuse all connections except those that go through the TrustedWeb proxy, and you can secure your content.

Each user has five key properties set in the Domain Security Server's configuration file: domain, user name, default profile, audit identity, and allowed profiles. The domain and user name uniquely identify the user. The default profile names the role the user is assigned if none is requested. Typically, users don't change to a role other than the default.

The audit identity field determines how a user is listed in TrustedWeb's logs. Some users might prefer to use an alias rather than the true user name that's listed in the logs, and usage patterns might be more than some wish to reveal to others. Finally, the allowed profiles provide the names of all roles a user is permitted to take on.

Entries in the TrustedWeb Server's configuration file use wild-carded URLs to protect hierarchies of Web resources. Each line describes a resource or group of resources and assigns to it an access type of open, entry, or hidden. Open access allows all browsers to access the resource; no authentication is requested or required. Entry access lets all browsers know the page exists on the server, but the content isn't delivered until the user is authenticated. Hidden access lets an unauthenticated user see nothing; even the structure of the content is concealed until the security data is exchanged. For entry and hidden resources, TrustedWeb accepts a list of roles that are permitted access to each resource.

The TrustedWeb client, available for 32-bit Windows, Sinix, and Solaris, links the user's browser with the remote TrustedWeb Domain Security Server and exchanges authentication data. The client runs in the background, separate from the browser. Once a user logs in through the TrustedWeb client, his or her credentials are valid for the remainder of the session or until a configurable time-out expires.

Unlike straight Kerberos, which is strictly for authentication, TrustedWeb supports the negotiation of encrypted channels using the RSA algorithm for public-key encryption. As a non-U.S. company, Siemens Nixdorf is not subject to U.S. export restrictions for cryptography; thus, it can deliver full-strength TrustedWeb internationally.

Miles to Go

TrustedWeb represents a marvelous seed of an idea, but it falls short in its implementation. With its $100-per-registered-user price tag for clients (for up to 500; after that, Siemens Nixdorf will talk site license), even after applying the forgiveness filter common to reviews of beta software, TrustedWeb's basic flaws seriously diminish its appeal.

For example, the product's role structure is too simple to suit most complex organizations. It's flat, except for the domain prefix, which allows you to set up a basic two-level hierarchy. Also, the roles themselves have no properties associated with them. They work too much like groups, delivering the convenience of pooling similar users together, but without the functionality one expects from a true role-based system.

In addition, TrustedWeb's setup and administration are nightmarishly complex. Someone who already understands X.509 certificates and proxy servers will be able to get through it just fine. But if you're a little fuzzy on either of these concepts, expect to be bewildered by the 35 pages of related documentation that accompanies TrustedWeb.

I tested the Solaris version of the TrustedWeb server. Perhaps the NT release will show some improvement in ease of setup and administration. The client, which has no user interface and provides no feedback, was no walk in the park, either. When it didn't work, there wasn't much to go on. The promised appendix covering appropriate registry entries wasn't part of the beta documentation.

Siemens Nixdorf's Web-based administrative interface is shaky in the beta version; it doesn't commit changes and fails to bring up some pages. But something as convoluted as TrustedWeb needs better graphical administration tools.

In the end, TrustedWeb feels less like a commercial product than an internal hack that the company chose to release. That's no slam—lots of worthwhile solutions started life as internal hacks—but it would be worth hanging back to give Siemens Nixdorf a chance to make TrustedWeb ready for prime time.

At this stage, the package doesn't seem quite ready for an external beta test. I look forward to taking another look at TrustedWeb when it's more mature. B

Tom Yager is a software project manager and a freelance analyst and writer located in north Texas. You can reach him by sending e-mail to **tyager@maxx.net**.

TECH FOCUS: PROXY SERVERS

Proxies Serve to Supplement Security

TrustedWeb is able to maintain compatibility with most Web servers by implementing what is known as a proxy server. This is a piece of server software that acts as an intermediary between a browser and a Web server. All requests for access to protected Web, FTP, and other content are filtered through the proxy server. In addition, the proxy server can allow or deny access based on rules configured by administrators. In TrustedWeb's case, its rules are based on user roles (as described in the main article).

A proxy server receives access requests from Web browsers (and other Internet tools, such as FTP clients) through a special TCP port. It analyzes each request, checking to see whether the system making the request is on the list of systems permitted access. In intranets, proxy servers are configured to deny access to IP addresses outside the company's assigned ranges. Individual users might have their access to certain (or all) external sites logged or restricted. And proxy servers offer the ability to use a low-cost (i.e., single IP address) Internet link to bring Internet services to a number of systems. Microsoft's Proxy Server product, for instance, automatically dials your Internet provider on demand.

Proxy servers and firewalls usually operate together; they can even be combined into a single product. Working together, a firewall and a proxy server provide an excellent defense against unauthorized external access.

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Until e-mail-attachment standards become standard, Tumbleweed's Posta is ready to ease your file-delivery phobias. ***By Pete Loshin***

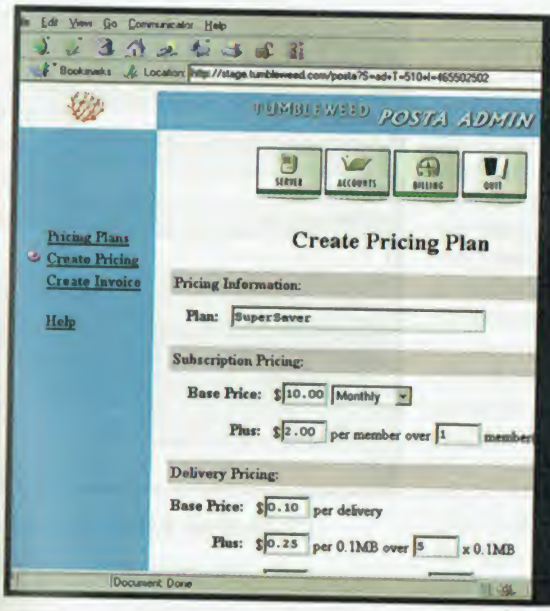
Speedy File Delivery on the Web

File transfer, whether it's done over old 300-bps dial-up lines or as file attachments to e-mail messages, is far from foolproof. Tumbleweed Software claims up to 50 percent of e-mail file attachments don't reach their destinations—that's why it created Posta.

The idea is simple: E-mail a URL and have the recipient get the file via the Web instead of having to figure out how to encode the file attachment (see the Tech Focus below). As a bonus, recipients download only the files they need.

Posta executes nicely on the user side. Receiving an attachment is simple and requires no special software at all: An attached file shows up in a message as a rather hairy-looking URL pointing to the file as it sits in a SQL database that you've set up on Posta Server. With Web-enabled e-mail clients, you're just a click away from opening the file remotely.

If you're licensed to send files with Posta, you can use a Web front end if your browser can upload files, or the Posta Desktop client if it can't. Account management is done through the Web, so if you have no browser you can send only attachments. Tumbleweed plans to integrate Posta into other e-mail clients and already has separate DLLs that add Posta to the Microsoft Office toolbar and to Visioneer scanning software.



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Reducing network traffic by charging for big e-mail file transfers is easy with a Posta pricing plan, administered through the server.

Although the client side is easy to use, the server is tough to set up. Posta Server includes some SMTP server functions, but it needs your SMTP server and more: Windows NT Server 4.0, SQL Server 6.5, Internet Information Server 3.0, 64 MB of RAM, almost a gigabyte of disk space, and full TCP/IP services, including Domain Name System (DNS). You will need expertise with NT Server, SQL Server, and TCP/IP; plus, you'll have to coordinate with firewall, proxy, and DNS configurations. Once you're done, though, administration through the Web interface, including account management, server monitoring, and configuration, is simple and straightforward.

Posta works, and it's a worthy solution to a pressing need. One little nit: Posta purchasers must submit their server's URL before getting a license, which seems overly protective and a potential source of problems for buyers who change server names down the road and forget to call Tumbleweed for a new license. My biggest complaint is Posta's lack of integration with my e-mail client, but that should be coming soon. If you've got the resources, your users will love Posta. B

RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Pete Loshin is a BYTE technical editor and author of Extranet Design and Implementation *(Sybex, 1997). You can contact him at* **ploshin@mgh.com.**

TECH FOCUS

Mail-Attachment Troubles

Internet e-mail is designed to handle ASCII text: 7-bit characters from the basic text selection. Attach binary data and intervening e-mail servers, and gateways will convert your bytes to ASCII text that looks like gibberish. UUencode turns binary data into ASCII text but requires UUdecode to turn it back to binary. The newer Multipurpose Internet Mail Extensions (MIME) standard, which can encapsulate many different types of files within e-mail messages, must also be supported by both sender and recipient.

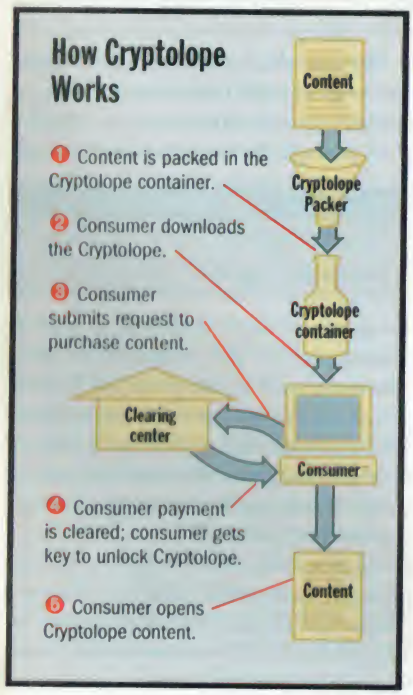
★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

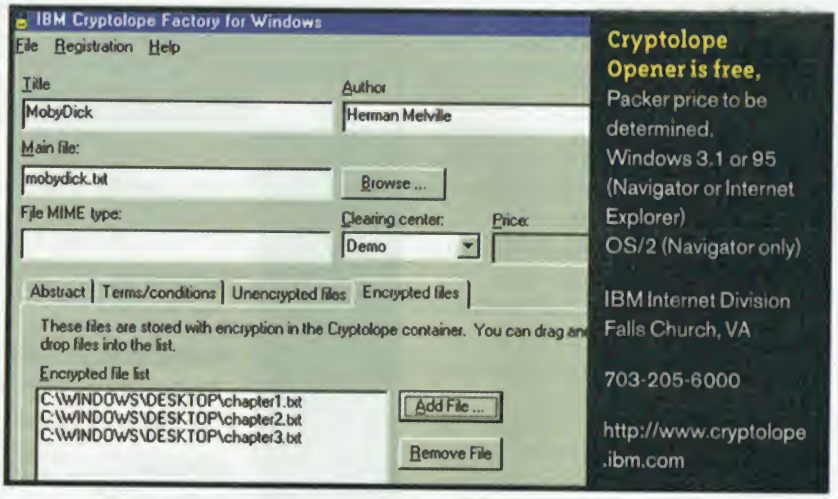
Hunting elusive Internet commerce with the wild Cryptolope. By Pete Loshin

IBM's Digital Shrinkwrapper

As with other cool things you can do over the Internet, executing commercial transactions on-line sometimes means installing an applet, plug-in, or control. IBM's Cryptolope commerce technology for Internet content sellers is no exception. Cryptolope containers work with two kinds of clients: the Opener for the consumer and the Packer for the merchant; IBM controls the transaction service technology.

Cryptolope technologies won't be released as products until later this year. Combining encryption and digital signatures to package a digital product so it can be transmitted and copied freely, the Cryptolope can be viewed or used only after a payment is made. The idea is to prevent pirates from instantly and exactly copying digital products—news stories, books, music, pictures, or video—yet not mean a hassle for paying customers.





Cryptolope Packer is a no-nonsense utility for stuffing for-pay data into Internet-safe containers.

The Opener browser plug-in, which has been available from IBM's Web site since last year, is the only way to open Cryptolope containers. According to the download page, Opener works with Microsoft's Internet Explorer and Netscape's Navigator on Windows platforms; IBM has plans for a Java version. Content sellers use the Packer application to load Cryptolope content: data, preview, description, and licensing information. IBM claimed as many as 70 Cryptolope merchants as of this April, but the Packer isn't yet publicly available. The server technology, called Rights Management and Payment, handles Cryptolope payment transactions; IBM might at some point license it to third parties.

I got a chance to play with what I was told would be the public beta version of Cryptolope Packer; frankly, it was disappointing. Though it does pack encrypted, compressed, and digitally signed files into a Cryptolope container, that's it. There's no facility for opening or even previewing files. You can drag and drop a file into any part of the Cryptolope (encrypted or unencrypted contents, abstract, or terms and conditions), and you can save a template of your Cryptolope, but you can't edit an existing Cryptolope, nor can you directly edit an existing container: You must create a template for a container and modify it—you can't even resize the Packer window.

RATINGS	
TECHNOLOGY	★ ★ ★
IMPLEMENTATION	★ ★

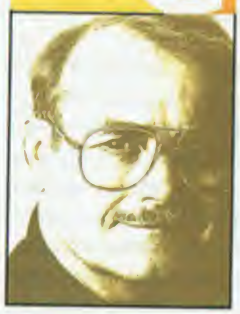
IBM has high hopes that Cryptolope containers will enable individual Internet content sellers, but success or failure depends on consumer acceptance of Opener, yet another plug-in—and on merchant acceptance of Packer in whatever form and at whatever price it eventually comes to market. B

Pete Loshin (**ploshin@mgh.com**) *is a BYTE technical editor and author of* Extranet Design and Implementation *(Sybex, 1997).*

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

Jerry Pournelle

Chaos Manor



Some Things Make You Feel Stupid

Jerry is plagued this month by things that he should have known—but a new high-end graphics program cheers him up.

I may pretend to know everything, but if I'm ever tempted to believe it, my computers disabuse me of the notion.

Case in point: I've long had problems with DOS-based games running under Windows 95 (Win 95). It turns out that there is a simple remedy: right-click on the icon that launches the game, bring up Properties, and select the Memory tab. There's a small box labeled "Protected"; by default, it is not checked. Check that box. End of most game problems. In particular, several games that I thought could be run only from a DOS-exclusive session no longer blow up spectacularly. That may not have fixed all the problems, but it seems to have fixed most of them.

I have more than 20 books on Win 95, and few tell me anything at all about this. *Inside Windows 95, Deluxe Edition* (New Riders, ISBN 1-56205-695-6)—a huge 1200-page reference work—has two inconspicuous sentences buried deep in it. Even if you happen upon that section, there's nothing about how important this can be, and the book leaves you with the clear impression that there's a severe performance hit for making your DOS session protected, so you're better off not doing it. (I've noticed no performance effect at all.) Other books have less.

One exception is Glenn E. Weadock's *Bulletproofing Windows 95* (McGraw-Hill, ISBN 0-07-067631-3). I don't often use the book of the month as my lead, but this one deserves it. I found out more about Win 95 problems in half an hour with it than I have in a month of experimenting. It doesn't cover everything, and some of the problems covered are obscure, but this is a book you really need.

For example, not only does it tell about the DOS "Protected" box, but it has the only solution I've seen so far to a Win 95 registry bug that makes it inadvisable to designate your Win 95 machine as a "network server" in the "Typical Use" dialog box. There's much more like that. The book is written for someone who maintains a number of Win 95 systems. However, individual users can benefit from both the specific bulletproofing tips and the general discussion of how Win 95 does things. Highly recommended.

The only problem with this book is that it adds to the things that make me feel stupid: stuff I ought to have known. I've had several of those experiences this month.

Example: we opened up Cyrus the Cyrix 6x86-P166 the other day. While we had him open, I decided to install a new video board. There was nothing wrong with the Orchid Fahrenheit board we had in there; but several new 3-D video boards had come in, and I was feeling a bit guilty about not doing anything with them. The board I installed was fast and came with good drivers, so I left it in when we closed Cyrus back up.

I've long had problems with DOS-based games running under Windows 95.

The next day, I found vertical stripes in my video. Turning the machine off and back on didn't cure them. Leaving it off for an hour got rid of the stripes, but they soon came back. Time to put the old board back in, which I did.

We've had this problem before, and every time it has turned out to be caused by one or more bad memory chips on the video board. In one case, three successive boards from the same manufacturer had nearly identical problems. It turns out they had bought a bad batch of memory and had to recall that board series. I expect that was the problem here, and I told the board maker, who sent another board, which I'll get to Real Soon Now.

Alas, the vertical stripes remained in one place: on the small icons on the Office 95 toolbar. Resetting the machine, changing the location of the toolbar, and changing the color of the toolbar: none of that helped. Then I noticed: right-click on the toolbar and up comes a menu; the last item on it, just above the customize command I used to change the colors, is "Refresh Icons." Duh.

Games in DOS windows blew up more frequently under Microsoft IntelliMouse (i.e., wheel mouse) software than vanilla Win 95 mouse drivers, so I uninstalled the IntelliMouse driver; but now that I've found the "Protected" box in DOS Properties, I've installed it again, so far with no problems. The IntelliMouse is about the best mouse I know of, and the IntelliMouse software makes it better. Recommended, but if you play DOS games, be sure to use the "Protected" trick.

ANOTHER THING TO MAKE ME feel stupid: Princess, our Compaq Professional Workstation 5000, is more and more becoming the main machine here. The main limitation has been the time needed to transfer all my daily-use software over and get Princess configured properly.

There's the secondary problem that while Princess runs Win 95 just fine, she's much faster in Windows NT 4.0 because

PHOTOGRAPH: THEO FRIDLIZIUS © 1997

Win 95 has no way to use her dual Pentium processors; and while NT is more stable than Win 95, it's also harder to configure some programs for NT. Indeed, with some programs such as Earthlink's Total Access, you're better off letting your Internet-access company's automatic installer set up under Win 95, logging all the data such as Domain Name System (DNS) address numbers and the like, and then doing a manual installation in NT.

Actually, you ought to keep a good logbook anyway. I'm partial to Boorum and Pease bound composition books. Logbooks are important because neither Win 95 nor NT keeps any decent journal of what you have done; and sometimes the only way to get back to where you started is to painstakingly undo each thing you've done since the system last worked. I wish Microsoft or someone else would do a computer program to generate a journal, but if there is one, I don't know about it. The best substitute is a real logbook, not scraps of paper and fragile memory.

Anyway, we recently used the Win 95 settings to install Dialup Networking in NT. I'm pleased to report that I now have very fast and reliable Internet communications with the U.S. Robotics 56-Kbps Sportster external modem. Earthlink has an experimental 56-Kbps link that ought to be public about the time you read this.

A few of us remember that we weren't supposed to have these problems now. Cairo was supposed to integrate DOS, Windows, and NT into a single OS. Somehow, On to Cairo! got bogged down in the Second Battle of Tobruk.

Somehow, On to Cairo! got bogged down in the Second Battle of Tobruk.

However, I'm told by good sources that NT 5.0 is as close to Cairo as you need to be: it will do everything DOS, Windows, Windows 95, NT, and Memphis will do. It's a memory hog. You won't want to try it with less than 32 MB, and most of us will want 128 MB. Memory is cheap and getting cheaper. It's a small price to pay for a reliable integrated system. We'll be testing beta versions of Memphis and NT 5.0 in the next few weeks; stay tuned.

WE SPENT LAST MONDAY AT the Santa Monica offices of Softimage. Softimage is a wholly owned but independent subsidiary of Microsoft. It's symbolic that Microsoft has offices next door in the same single-story converted warehouse as Softimage, but there is no internal connection between the office suites.

Softimage was originally written for Silicon Graphics workstations and sold for $60,000 in the mid-1980s. Softimage 3D Extreme now runs under NT 4.0 as well as IRIX (Silicon Graphics' Unix) and costs $13,995. While the company doesn't publish sales figures, Softimage 3D Extreme is one of the two leading 3-D image-processing programs among professionals.

There are three basic tasks for computer-animated graphics. First is modeling: creating the image, including mapping the relationship of its parts. Second is animation: taking a number of poses of the image and blending or morphing smoothly among them so that you get realistic flowing action. Third is rendering, which is taking the animated images and building the final film frame by frame.

Computer graphics were relatively obscure until *Jurassic Park* demonstrated spectacularly just what was possible.

The special effects in that movie were largely done with three programs. Modeling was done with Alias, a Silicon Graphics program that runs exclusively on their systems. Animation was done with Softimage, also mostly on Silicon Graphics machines. Rendering was done with a program called Renderman. It required all the MFLOPS of computing power the industry could get. Note the specialization. That continues at the very highest level of computer graphics work, but Softimage has the capability to do all three tasks, and many shops now use it exclusively.

Softimage has always been a no-compromise professional system for professional artists. It is under continuous development, taking advantage of feedback from its professional user base to add features and improve its interface. There's an excellent Developer Kit for adding customization features. Big shops such as Industrial Light & Magic have developed whole suites of plug-ins for Softimage.

Its strongest point is the integration of

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features and functions: where some systems require a variety of programs and plug-ins to finish a job, most of those features will typically be present in Softimage. There will be several hundred such tools, including ways to join two objects, explode an object (the function is called kaboom) and control what happens when the pieces hit other objects, smoothing functions, and so forth.

The result is a bewildering—one Softimage executive unapologetically said frightening—array of tools and options that can overwhelm a beginner. It's precisely the opposite of Microsoft's approach to software, although all future upgrades of Softimage will run in NT.

Those familiar with the software can do wonders. They're not up to Adam Selene, the computer-generated personality in Robert Heinlein's classic *The Moon Is a Harsh Mistress*, but they're closer than I thought anyone would be now.

In particular, it's possible to model a semiclothed human body so realistically that you have trouble determining if this is a computer-generated animation or a human actor. The face, however, is a dead giveaway; no one would think even the best computer-generated human face is a real person. Put a Darth Vader or storm trooper mask on it, though, and you could probably bring it off, and I doubt that it would be a problem to do a convincing alien. That may explain why my agent reports new interest in the movie rights to *The Mote in God's Eye*.

One of the impressive tools used by Softimage is a MIDI sound box—the kind with the sliders that sound mixers use—set up to control the movements of a computer object. One slider might control the mouth, another the hand. The result is something like the control of a puppet with a dozen invisible strings.

We saw other marvels, including talking dragons. It's hard not to leave there talking to yourself.

WE NOW HAVE SOFTIMAGE 3D Extreme running in NT 4.0, and my artist associate David Em will be comparing it to its chief rivals. While Softimage at $13,995 for software alone won't be something you'll use this year, one of my goals in this column is to keep an eye on the future, and computer graphics is a fast-growing area. I suspect that a significant number of BYTE readers will be working in that field by 2001. By then, programs with this power will be available at office suite prices. Meanwhile, Softimage won't be standing still. Lord knows what capabilities they'll have programmed in by then.

If you're thinking of a career in 3-D graphics, the best preparation is to start off at home. You'll need NT on a Pentium system with a decent monitor, a Wacom tablet, as much memory as you can afford, and a lot of disk-storage space. That will be working space; if you want to keep your early efforts, add something like a Fujitsu DynaMO drive.

Then buy Caligari's trueSpace—the current version is called trueSpace3—and get to work. While trueSpace doesn't have anything like the capability of Softimage, it's plenty powerful enough to learn with. There are tutorials to help you create and animate some objects, and more than enough power to teach the basics of computer graphics. The Softimage people estimate that even experienced designers need three months and more to learn Softimage; I've heard estimates of as long as six months. Practice with trueSpace can cut that time significantly.

I haven't taken a survey, but it's my impression that most successful 3-D graphics artists come from architecture and industrial-design backgrounds rather than fine arts or computer science. Of course, there are exceptions, David Em being one of them; but then David has always been as interested in sculpture as in graphic arts.

I suspect that a significant number of BYTE readers will work in computer graphics by 2001.

Anyway, if you're thinking of getting into computer graphics and you're still in school, you certainly won't go wrong by taking design courses. Meanwhile, spend a lot of time just fooling around learning the tools. To become a writer, you have to write, which includes finishing what you write; to be a graphic artist, you have to produce finished graphic art. It takes about a million words to get started in writing.

A FEW DAYS AGO, WE GOT THE new Fujitsu DynaMO 640, an external SCSI big brother to the DynaMO 230 we've had for more than a year. We have a big dual Pentium-based server running under NT 4.0 back in the cable room, but it already has enough external devices that adding another makes the SCSI string long enough to be unstable; so we decided to install the DynaMO 640 on Princess.

My usual routine with new SCSI devices is to ignore the cables they come with and set up with Granite Digital SCSI cables. Since about 90 percent of all SCSI problems are cable-related, and Granite Digital cables always work, I can get things running with one less darned thing to worry about and then switch to the included cables. Granite Digital cables and terminators also have diagnostic lights. If you don't have a set for SCSI setup, I bet you wish you did.

We powered Princess down, installed the cables, noted that the green light on the cable came on, and powered up. Alas, the controller didn't see any SCSI device. We fooled around awhile and concluded that the unthinkable had happened: we had a bad Granite Digital cable. So we swapped for another one. That didn't work either. Then I swapped the DynaMO 640 for the DynaMO 230 hooked up to Cyrus. It worked fine over there. However, the DynaMO 230, which had no problems on Cyrus, wasn't visible to the Compaq's controller.

We must have fooled around for an hour. I was very reluctant to believe there was anything wrong with Princess's SCSI controller, because that runs her hard drive just fine. What was there about the external connection that made it fail?

Eventually we got back there with a flashlight. The external SCSI connector is attached to the case with two small hex nuts that are themselves tapped to accept the screw fasteners on the cable. Princess is a preproduction model, and whoever assembled her put two tiny lock washers under those hex nuts. Those caused the nuts to stand away from the case by about a millimeter more than normal, but, of course, the SCSI connector didn't protrude any further. The result was that while some of the SCSI connector pins made contact—enough that the lights came on in the cable—at least one didn't.

We removed the nuts, attached the SCSI cable without fasteners, and voilà! As I said, 90 percent of all SCSI problems are cable-related. There are two morals to this story: doubt everything else before concluding you have a bad Granite Digital

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cable, and use a strong light to examine your connections.

Meanwhile, the DynaMO 640 works very well indeed. There was one more problem: if you boot up your system with an unformatted disk in a SCSI drive, the controller will hang up. There's no problem with a formatted cartridge or with no cartridge at all.

One test was to transfer files from the 230 to the 640; it's clear from watching the lights blink that the 640 writes about as fast as the 230 reads. The 640 will read and write to 230 disks, so any archives in 230 format are available after an upgrade to the 640. The 640 is a larger and more rugged unit than the 230. The 640's power supply is integral; the 230 uses a line lump. Unlike the 230, the 640 has a "power on" light as well as a "being accessed" light, which is just as well. At one point, we had everything working right and then tried to bring the system up with the 640's power off, and wondered why the SCSI controller couldn't find it. Duh.

SyQuest SCSI cartridge drives are fast and reliable, but Iomega drives are fast becoming standard for data exchange: Zip for text and Jaz for big image files. You'll find Iomega drives at Kinko's as well as in image-processing houses. They work, although I'm inclined to think of them as a little less reliable than SyQuest drives.

The files on a DynaMO cartridge will be safe for many years.

Both are faster than DynaMO drives. However, I never tire of saying, Zip (and SyQuest) cartridges are both larger and more fragile; I can put a DynaMO 640 cartridge in my shirt pocket. The files on that cartridge will be safe for years, and the cartridge costs only a fraction of what a Jaz cartridge costs. I have long been a fan of glass disks. I still have a Maximum Storage 300-MB-per-side cartridge drive online on the network as part of my backup system. The 640 gets that much on a single side (the cartridges are single-sided), takes up less room, and is much faster.

When you absolutely must use your cartridge drive as a hard drive, go for SyQuest or Iomega. However, for archive-quality storage with reasonable speed, you can't beat the Fujitsu DynaMO.

One last point: my associate Alan Ogden has managed to get a system working using my SyQuest SyJet 1.5-GB cartridge drive as the boot disk. He can now boot up in NT 4.0, DOS, Win 95, and OS/2 Warp depending on the disk cartridge he puts in at start-up. Alan reports that it's tricky getting it to work, but it can be done. I'll have details next month.

CHAOS MANOR INTERN ERIC Pobirs reports that if you don't have Microsoft Word but you need to read Word documents, WordPad, which comes with Win 95, works just fine. Eric says:

"I've gotten in the habit of using the WordPad accessory bundled in Win 95 and NT for most text generation. While supposedly limited to 32-KB files, this is rarely a problem for the length I tend to work in. Although it loaded the 69-KB Chaos Manor column without any problem, Netscape wanted to launch Word even though it isn't on this machine. This has never happened before.

"The vast majority of what I do gets transmitted, so the compact size of WordPad keeps the system from dragging. On the receiving end, WordPad has one big advantage: it understands Word 7 files but has no macro functions. If someone sends an infected file, the code is never run and is stripped during the save. No macro virus, ever."

If you have Windows 95 or NT, you have WordPad, and it's often good enough.

THE GAME OF THE MONTH IS Fragile Allegiance from Interplay, but I'm not really recommending it. There's a good game in there, but it's hard to find. Fragile Allegiance is a game of asteroid mining, a sort of SimCity in space with the complications of enemy missiles. There's also trading activity. Alas, while it's supposed to be a game of strategy in real time, it soon becomes a form of whack-a-mole.

Fragile Allegiance is vastly improved if you have a second computer available: there are a number of complex decisions you have to make, and the game gives you no help. What you need is a spreadsheet to add up the income potential of an asteroid so you can decide what kind of investment to make there. You can play Fragile Allegiance in a DOS window (be sure to check the "Protected" box in the program information file [PIF] launching

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it), but it won't restart: you still won't be able to get at Excel and return to the game. There's nothing for it but to bring in a second computer, which is wretched excess.

Fragile Allegiance assumes a major corporation would send you out to manage a multibillion-dollar operation with inadequate manuals and about half the equipment you absolutely must have to do the job. They graciously allow you to buy that equipment, but they don't tell you what you'll need. There are other insults to your intelligence, and I'm afraid my willing suspension of disbelief went all to hell quite early on.

The good news is that Interplay has made a number of improvements to Conquest of the New World. These are available from their Web site. I'm undecided which is the better game, the old one with bugs fixed or the new Deluxe Edition, which not only has bug fixes but new features. Either is more fun than Fragile Allegiance as released. Maybe they'll improve it, too.

The book of the month is *The Trap* by James Goldsmith (1994, Carroll & Graf, ISBN 0-7867-0185-4).

The theory of free trade is that the competition will keep your domestic industries efficient, and thus provide cheaper and better consumer goods. I have often asked economists, including one Nobel winner, what happens to that theory if you impose the political constraint (in economic terms, an externality) that those U.S. workers unemployed because their company couldn't compete with low-wage offshore workers must be supported at above-poverty levels by those who retain jobs.

Given that unemployment has social costs—my mother used to say idle hands are the devil's workshop and certainly high unemployment seems to be accompanied by high crime rates—and given the costs of unemployment compensation and welfare, are those taxpayers who retain their jobs sufficiently compensated by the availability of cheaper consumer goods? I have never got a satisfactory answer, and one well-known economist literally shouted at me, "You haven't read Ricardo," as if that were a sufficient answer to what I thought was a reasonable question.

James Goldsmith has read Ricardo. He asks my question and others like it, and concludes that global free trade is a deadly trap for the West. Whether he's right or wrong, I think his questions need answers.

The first computer book of the month is the previously mentioned *Bulletproofing Windows 95*. I've found two others I can recommend. The first is Dan Gookin's *Web Wambooli* (Peachpit Press, ISBN 0-201-88597-2). Most beginner's guides to the Internet break off just as they get to the interesting parts. Gookin goes a bit beyond that, and his irreverent style makes this a good book to read as you sit and watch nothing happen on the Web. If you know someone contemplating Web entry, this is a good book for them to start with.

Paul Gilster's *The Web Navigator* (Wiley, ISBN 0-471-16495-X) isn't as good a beginner's introduction as Gookin's book but goes well beyond it. There's a lot about browsers and plug-ins and customizations. All the information here is available on the Web itself, but here it's well organized and available for reference. Most Web and Internet books are obsolete before they're published, but this one should be useful for another year or so.

I can see five other items I wanted to write about, but I'm way beyond my word limit, both for the magazine and the Pournelle Web exclusive. B

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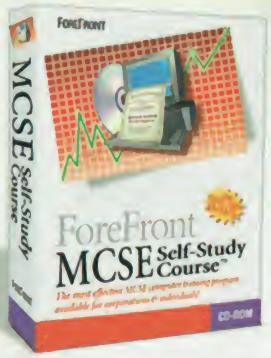

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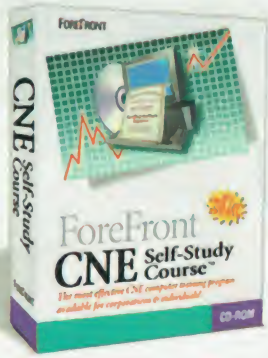

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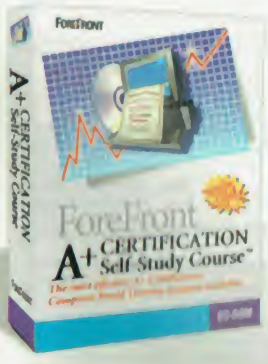

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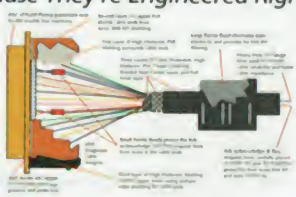

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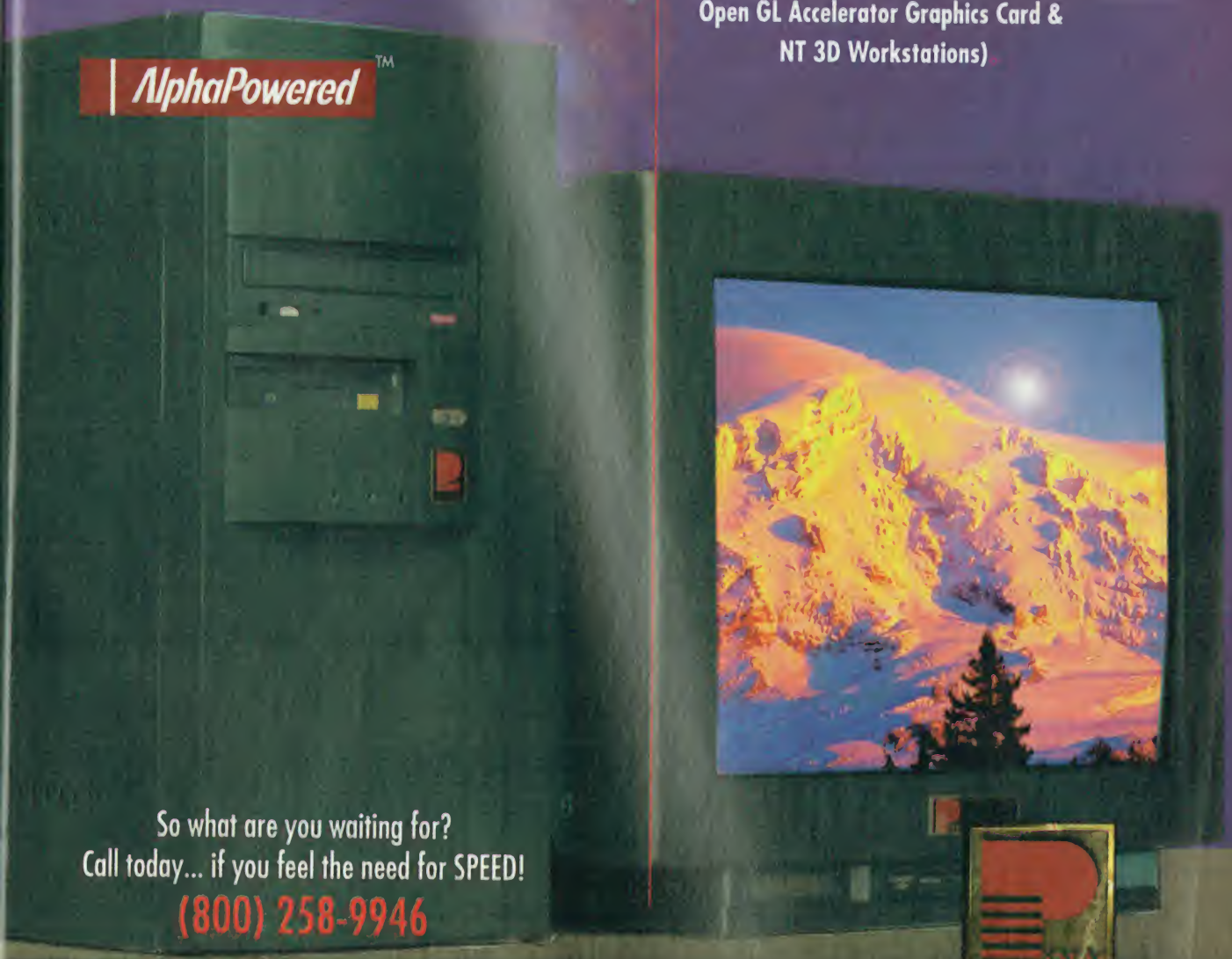

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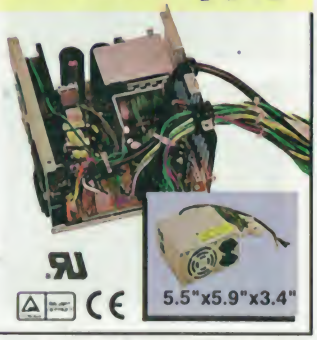

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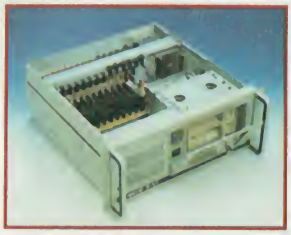

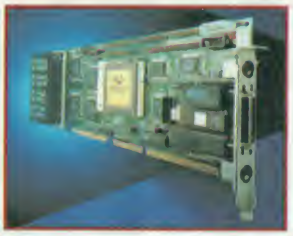

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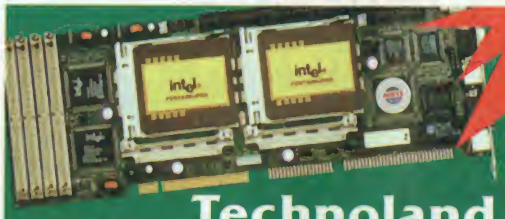

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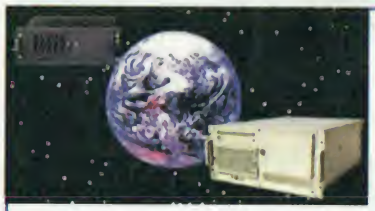

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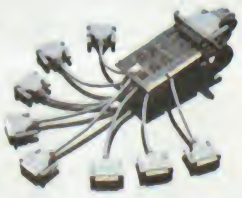

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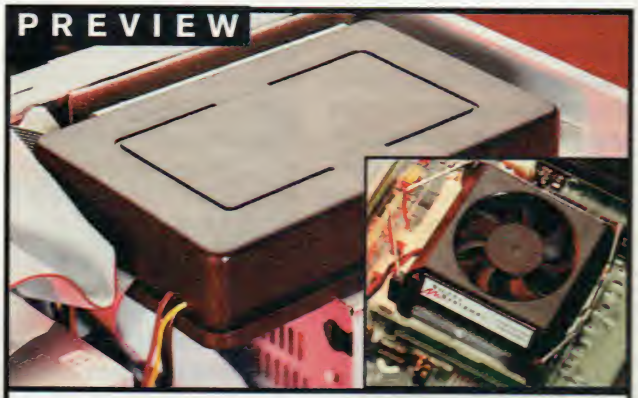
www.byte.com

What's New

Hardware

This month, our previews look at a quieter-than-average PC from AST and a package to make image editing more accessible.

PREVIEW



Bravo MS
$1255-$2210

Enter 1054 on Inquiry Card.

AST
Irvine, CA
800-876-4278
714-727-4141
http://www.ast.com

Pentium Power with Less Rattle and Hum

In 1994, Silent Systems introduced the FE 4, a system that was for all practical purposes inaudible. The original FE 4, which cost up to $4000, had intricate thermal-conducting technology and plastic acoustic-dampening shields that were too expensive and cumbersome to implement for mass production. To make quieter systems practical, Silent Systems is now selling sound-dampening PC internals based on the FE 4, but which are not as fully noise-retardant, to PC manufacturers.

One of the first systems using this technology is the AST Bravo MS, which comes with a 133-, 166-, or 200-MHz Pentium processor or a 166- or 200-MHz Pentium with MMX technology, up to 256 MB of SDRAM, a 512-KB L2 pipeline burst cache, and a 2- or 3-GB hard drive.

The AST machine I previewed had a Silent Systems Eldorado silent fan and SilentDrive hard drive, which is encased in an acoustical shield. Unlike the FE 4, which eliminated all internal fans, the Bravo needs the quiet Eldorado fan to cool the processor and the other internals. Thermal-conducting plates cool the hard drive. The power supply is not silent, although Silent Systems does market a silent one. The power supply is the main source of noise that the machine makes.

The CD-ROM drive and hard drive are not silent components, either. Compared to the average noisy desktop system, the Bravo MS is a marked improvement, but it's not perfect. The preview system's power supply emitted a faint high-pitched whine, and I could hear a quiet hum from the fan and the occasional churning of the hard drive. This machine was quieter than the average PC but not quiet enough for those who demand monastic seclusion and silence.

–Jason Krause

PHOTOGRAPH: LIGHTWORKS PHOTOGRAPHIC © 1997

Programming

Java Applications Server

USE THE GEMSTONE/J ($4995) JAVA applications server to build Java applications involving several hundred million Java objects and thousands of users in transaction-intensive environments. The server has a transactional JVM, a shared object manager, and an integrated repository for enabling Java applications. The Gemstone/J is fully Java-compliant and is engineered for server-centric, multiuser applications with heavy computational demands and disk-based object access. Included with this development tool is Gemstone's GemBuilder/J for Beans. Therefore, developers can easily manage JavaBeans applications from a GUI environment.
Contact: Gemstone
Beaverton, OR
503-533-3577
http://www.gemstone.com
Enter 1027 on Inquiry Card.

Systems

Java Netstations

JAVA'S CROSS-PLATFORM CAPABILITY allows single-desktop access to all network resources through Hewlett-Packard's Java-capable Entria II and Envizex II netstations (starting at $700 without monitor). Netstations provide thin-client access to Internet/intranet applications, Unix systems, Windows NT, and legacy systems. Currently, HP netstations support server-based Internet browsers and the JVM, and are slated to support Netscape's Navio Navigator for integrated thin-client Web

access and local Java VM.
Contact: Hewlett-Packard
Palo Alto, CA
415-857-1501
http://www.hp.com
Enter 1024 on Inquiry Card.

New Windows-Based PCs from Digital

DIGITAL EQUIPMENT'S NEW LINE OF PCs and workstations offer options for early adopters of the Pentium II with MMX technology. The Workstation 266 ($5200) offers single or dual Pentium II processors, and the Celebris GL-2 is a dual Pentium II PC for enhanced Windows NT performance. The Celebris FX-2 ($1500) models come with 166- or 200-MHz Pentium processors with optional MMX technology. The Celebris GL-2 ($2500) features a 233- or 266-MHz Pentium II processor with MMX and is dual-processor-capable for computation-intensive applications.
Contact: Digital Equipment Corp.
Maynard, MA
http://www.digital.com
Enter 1025 on Inquiry Card.

Add-ins

DVD for Your PC or TV

THE SIGMA DESIGNS REALMAGIC DVD/MPEG-2 playback card ($500) plays DVD video, CD-ROMs, CD

audio, Video CD, and DVD-ROM. It has the Sigma DVD-Station software for navigation and control. You can display images on TV or VGA monitors, simultaneously, if need be. The card works with 133-MHz and higher systems. It has no audio decoder. Instead, audio decoding is handled by the CPU. It has 1280- by 1024-pixel desktop resolution.

Contact: Sigma Designs
Fremont, CA
800-845-8086
510-770-0100
http://www.sigmadesigns.com
Enter 1026 on Inquiry Card.

Peripherals

Road Warrior's Digital Camera

THE PDR-2A HAS NO FLASH, AND THE LCD is tiny. However, this digital camera offers a new imaging technology, a tiny form factor, and a weight of 5.3 ounces. With a built-in PC Card, it will dock with a notebook's PC Card slot for maximum mobility. The camera features CMOS imaging, rather than traditional CCD imaging technology. CMOS is less expensive than CCD sensors and, Toshiba claims, now offers nearly the same quality as CCD. Toshiba's SmartMedia card can save 48 images on a 2-MB card or 96 images on a 4-MB card and allows for easy loading and transfer of data. All files are saved as JPEG and are compliant with any OLE software. You also get Sierra Imaging's Image Expert software, which gives drag-and-drop capabilities to photo-imaging software.

Contact: Toshiba
Irvine, CA
714-583-3000
http://www.toshiba.com
Enter 1031 on Inquiry Card.

The EggCam Coo-Coo Ca-Choo

THE PANASONIC EGGCAM ($199) IS A 3.2-inch-high by 1.6-inch-wide by 1.8-inch-deep desktop video camera for 24-bit color e-mail video. The camera can capture images as close as 3.9 inches away and out to infinity, and produces images with up to 542 by 496 pixels and 330 TV lines of horizontal resolution. There

is a built-in microphone for capturing audio. EggCam is designed for personal video messages that you can capture and compress with bundled SmithMicro VideoLink Mail software for e-mail attachments. The bundled CU-SeeMe software makes real-time video-conferencing possible.

Contact: Panasonic
Secaucus, NJ
201-348-7000
http://www.panasonic.com
Enter 1032 on Inquiry Card.

Scanners

SOHO Scanner

PLUSTEK'S OPTICPRO 9630P'S ($299) 600 dpi, 30-bit color depth, and image-editing software bring high-resolution scanning capabilities to

entry-level scanners. Bundled software makes faxing, copying, and scanning easier by automating any function into a single touchbutton utility. You install the scanner through a parallel-port interface.

Contact: Plustek
Sunnyvale, CA
408-745-7111
http://www.plustekusa.com
Enter 1033 on Inquiry Card.

Networking

Router for SOHO

THE LANLINKER DUAL ANALOG ROUTER (priced under $795), from U.S. Robotics, integrates two ×2 modems into one unit, giving you twice the speed of V.34 modems and greater routing functionality over analog phone lines. The LANLinker facilitates download speeds of up to 112 Kbps over phone lines and up to 450 Kbps with compression. The LANLinker gives near-ISDN speeds without the cost of digital phone lines.

Contact: U.S. Robotics
Skokie, IL
847-982-5001
http://www.usr.com
Enter 1028 on Inquiry Card.

Storage

New Life for Microfilm Archives

FOR THOSE WHO THINK MICROFILM IS A storage-and-retrieval method for musty libraries, Fuji introduces M Drive ($20,000), a PC-based microfilm system. You connect M Drive directly to a PC through a standard SCSI connection. It has the footprint of a traditional tower PC. M Drive scans 16mm microfilm for display on a PC or digitizes it for storage on a CD-ROM, disk, or other format where you can view, edit, store, and print the data. The system runs on Windows 3.x or higher and is compatible with existing PCs and printers.

Contact: Fuji
Elmsford, NY
800-755-3854
http://www.fujifilm.com
Enter 1036 on Inquiry Card.

Tough New Disk Arrays

THE ARTECON LYNXARRAY RAID ($18,995–$44,995) can extinguish itself in case of fire, withstand 8000 V of electricity or temperatures as extreme as -4 to 140°F, and sustain a major earthquake. It also has up to 82 GB of backup storage space. The LynxArray controller is based on an Intel 486 microprocessor. It also has Ultra-Wide SCSI channels for 40-MBps burst and 33-MBps sustained transfer rates. Multihosted controllers support any combination of 3½-inch or half-height 5¼-inch devices such as tape drives for in-line backup options. The high-end configurations have failover hot-swap removable controllers, disk drives, and power supplies. This makes serviceability possible with zero downtime.

Contact: Artecon
Carlsbad, CA
760-931-5500
http://www.artecon.com
Enter 1038 on Inquiry Card.

Hard Drive with Legs

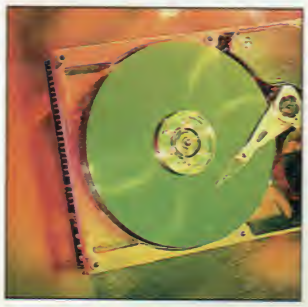
THE EXP HD TRAVELER ($499 TO $679) is a pocket-size external hard drive for notebooks. The HD Traveler fits into a Type I PC Card slot and complements the existing hard drive with 1, 1.4, or 2.1 GB of extra storage capacity. The HD Traveler hard

drive weighs 12 ounces and is 2.8 inches tall by 6 inches wide by 1.1 inches high. It can be powered by a notebook's internal power supply. You can use an external 5-VDC power supply to bolster the internal battery supply. The HD Traveler is ready to use with Windows 95 and includes a built-in port adapter for gaming joystick use.

Contact: EXP Computer
Irvine, CA
714-453-1020
sales@expinc.com
http://www.expnet.com
Enter 1034 on Inquiry Card.

Hard Drives for PCs and Workstations

FOR ALL OF US CRAVING MORE DISK SPACE, Micropolis introduces two new lines of hard drives for performance PCs, entry-level servers, and workstations. The Stinger ($550) is a 3½-inch 4.3-GB UltraSCSI hard drive designed for entry-level servers and



workstations. It has a 512-KB buffer and 5400-rpm rotational speed for low noise and heat production, and low power consumption without performance loss. The Mustang 3½-inch drive, for high-end PCs and workstations, offers 5200 rpm and 2.5, 4, or 5 GB ($250, $300, and $400, respectively).

Contact: Micropolis
Chatsworth, CA
818-709-3300
http://www.micropolis.com
Enter 1037 on Inquiry Card.

New Tape Storage Technology

THE MLR1 IS A DATA-STORAGE SOLUTION using multichannel recording, a 5¼-inch tape technology that is designed for better reliability and lower cost with the same or better capacities as DLT and other tape types. Tandberg's MLR tape drive has a data transfer rate of 3 MBps and employs "servo tracking," which prevents accidental overwriting of older files. MLR improves robustness over other storage types because it has two reels and does not need to be unspooled like other storage types with one reel. Tandberg's first MLR product is the MLR1 ($2749), starting at 26 GB. Future versions will increase capacities.

Contact: Tandberg Data
Simi Valley, CA
800-826-3237
805-579-1000
http://www.tandberg.com
Enter 1035 on Inquiry Card.

Business

Paperless Office

THE PAPERLESS OFFICE, AN OFFICE INFORmation manager files, stores, retrieves, annotates, and distributes more than 100,000 electronically created or paper-based documents for whole departments. The Paperless Office ($199.95) works in the NT or Windows 95 environment and uses a SQL relational database to store e-mail, faxes, PC files, or scanned documents for downloading. The software offers autosearch, export, and backup capabilities and password options for security.

Contact: Computhink
Chicago, IL
312-357-9100
Enter 1029 on Inquiry Card.

Servers

Remote LAN Access

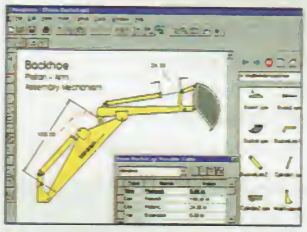
THE OFFICECONNECT REMOTE ACCESS Server 1000 ($1195), from 3Com, gives mobile workers access to office LANs. OfficeConnect has IP/IPX dial-in for remote access and IPX dial-out for Internet access and fax/modem pooling. The server automatically detects and configures your PC Card analog modem. It includes a management feature that monitors network conditions and makes appropriate configuration adjustments. This server provides two ports for ISDN and/or analog PC Cards. It includes four-, eight-, and 16-port Fast Ethernet hubs; a 10Base-T/100Base-T switch; remote-access routers; enterprise routers; an Internet gateway; and network print, fax, and CD-ROM servers.

Contact: 3Com
Santa Clara, CA
408-764-5000
http://www.3Com.com
Enter 1030 on Inquiry Card.

SOFTWARE
CAD

Smarter, Quicker 2-D CAD

IMAGINEER TECHNICAL 2.0 ($495), A CAD tool from Intergraph Software Solutions, is a Web-enabled native Windows seat that reads and writes AutoCAD and MicroStation files. Imagineer Technical features include the ability to resize drawings automatically. That is, when you adjust one line, the rest of the design will make corresponding adjustments. You can animate diagrams to simulate mechanical motions. The product is OLE 2.0–compliant, can cut and paste to any Office 97 program, is designed for



Windows 95 or NT 4.0, and can be modified to work with different work-flow environments.

Contact: Intergraph Software Solutions
Huntsville, AL
800-692-8069
http://www.intergraph.com
Enter 1042 on Inquiry Card.

Video

Video Postproduction Tools

INTERGRAPH'S VIZFX ($299) IS A PLUG-IN that expands the capabilities of Adobe Premier and in:sync Speed Razor, two popular video-editing applications. The product has more than 50 multithreaded special

effects that fall into the following six categories: geometric transformations, color transformations, masks, composites, transitions, and shines. The effects are Open-GL-accelerated and resolution-independent, meaning editors can use them for broadcasting, as well as lower-resolution applications such as the Internet.

Contact: Intergraph Computer Systems
Huntsville, AL
800-692-8069
http://www.intergraph.com
Enter 1043 on Inquiry Card.

Programming

Create Universal Applications

FORMIDA'S UNIVERSAL DEVELOPMENT Environment ($5000 per development seat) is a tool to create new classes of applications or to extend existing ones using Universal Server–based enterprise-computing environments. This application intends to integrate information resources from heterogeneous or legacy systems by migrating them to next-generation systems. It integrates various databases (RDBMS, GIS, CAD) and applications into newer databases and management systems. The Universal Development Environment is an object-oriented 4GL development with a C API.

Contact: Formida
San Jose, CA
888-736-7643
408-558-3200
http://www.formida.com
Enter 1045 on Inquiry Card.

The Web

Web Data Mining

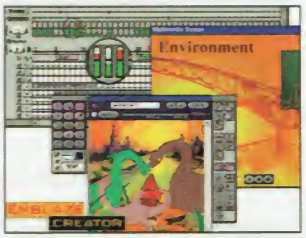
ONDISPLAY'S CENTERSTAGE ACCESSES DATA from multiple Web sites and extracts data and categorizes it by data type for integration with business applications for analysis and processing. CenterStage uses parsing algorithms to overcome the

limitations of HTML, which is a read-only language and otherwise ill-suited for data extraction. The software supports ODBC, ActiveX, LiveWire, CGI interfaces, and Microsoft's ASP, as well as HTML. OnDisplay offers these producrs: a CenterStage Developer kit ($995 per developer) for programming desktop applications, a Server ($9995 for 100 users; $39,995 for unlimited users), the CenterStage Desktop ($295) tool for personalized applications, and the CenterStage WebAnalyst ($39.95 per user) for data manipulation.

Contact: OnDisplay
San Ramon, CA
510-355-3200
http://www.ondisplay.com
Enter 1047 on Inquiry Card.

Internet Multimedia Authoring Tool

EMBLAZE CREATOR FROM GEO-INTERACTIVE is an authoring environment built for the Internet, offering data compression and continuously streaming video and animation. The product has two environments, one for novice designers with drag-and-drop capabilities and another with JavaScript capabilities for more advanced programming. A bandwidth/data stream monitor lets you adjust bandwidth bottlenecks. Emblaze supports BMP, PICT,



JPEG, GIF, AVI, and QuickTime file formats. It is 100 percent Java-compatible, so that animations and video creations are available through any Java-enabled browser.
Contact: Geo-Interactive Media
Givataim, Israel
888-436-4999
818-993-9696
http://www.emblaze.com
Enter 1046 on Inquiry Card.

Business

Sell Your Wares on the Web

SPEEDWARE'S ORDERPOINT ($20,000 FOR NT, $30,000 for Unix) is an application that handles business-to-business ordering over the Web. A tool set called Speedware Autobahn facilitates the creation of hyperlinks and the deployment of commercial applications. The product is designed to be installed by a nontechnical staff. It provides

search options and point-and-click icons for merchandise selection. It records transactions and tracks and calculates payments. The program can be deployed from Windows 95 or NT, HP-UX, and Sun and AIX platforms. It works with Oracle, Informix, Sybase, SQL/Server, Allbase, and ISAM databases.
Contact: Speedware
Toronto, Ontario, Canada
416-408-2880
http://www.speedware.com
Enter 1050 on Inquiry Card.

E-Mail

Talk to Your PC

MILLENNIA SOFTWARE'S E-MAIL READER Plus ($89.95) lets you access and respond to e-mail messages over the phone with simple voice commands. The software uses AT&T's Watson voice-processing technology and Millennia's own VoiceLink engine to convert spoken words into commands a computer can understand. You can call a PC from any telephone and have the PC respond with requested information. The software can read any POP3-compliant e-mail account or any account that can be accessed through Microsoft Exchange, as well as any Microsoft Word Attachment. The software requires a Pentium PC running at or above 75 MHz, Windows 95, and a TAPI-compliant voice modem. A complementary product is Millennia's Fax Sender software ($49.95), which uses the same technology to locate and send files from a PC hard drive as faxes.
Contact: Millennia Software
Saratoga, CA
408-867-8900
http://www.msw.com
Enter 1048 on Inquiry Card.

PREVIEW

Kai's Photo Soap
$49

Enter 1055 on Inquiry Card.

MetaCreations Corp.
Carpinteria, CA
800-472-9025
805-566-6200
http://www.metacreations.com

Clean Up Pictures with Photo Soap

Kai's Photo Soap combines a unique interface and intuitive operation to make image editing more accessible, especially for those of us who aren't Photoshop wizards. Where Photoshop, PhotoDeluxe, and others of that ilk let you slice and dice and otherwise manipulate photos, the raison d'être for Photo Soap is cleaning up poor-quality photos (hence the moniker).

I previewed the Win 95/NT 4.0 version of the program, which requires a Pentium processor, but the program is also available for the Mac OS on PowerPC hardware. At press time, MetaCreations was tracking down a bug that prevented the program from running on a Cyrix processor.

Like other programs from MetaCreations, Photo Soap has a nontraditional Windows look, with all sorts of buttons, sliders, and even a TV-like remote control to executive functions, instead of the classic Windows pull-down menus.

Photo Soap does a fine job at making photos look better, and it includes all the classic fix-up operations: removing scratches, enhancing poor color, removing red-eye, and so on. As you work on photos, you move them from room to room: the in room, the detail room, the finish room, and so on. Though it isn't a substitute for print-shop programs, it does include plenty of backgrounds and clip art to let you make calendars, cards, and invitations.

Photo Soap did a great job at making mediocre photos look better and helped good photos sparkle, but it still has room for improvement. Because it works in real time, it runs a lot faster if you don't have other Windows applications loaded. And, if you are used to looking for everything in a Windows menu, it may take a bit of playing around to understand how Photo Soap is organized. Otherwise, this is top-notch software. And at $49, it is a bargain, too.

–Jon Pepper

More Powerful E-Mail

EMAIL 97 ($29.95) IS A NEW NATIVE Windows 95 interface with a 32-bit e-mail program designed to handle 3.2-Mb and larger files with a number of enhanced features. The program builds address books automatically on installation with files from other e-mail programs and can search remote address directories. It has two-way pager support, meaning it can print, file, and compress messages, but also send a reduced message to your pager in real time. Other functions are multiple account support; drag-and-drop attachment creation; two-way, six-language international translation; and a preview function for viewing messages while still on the server.
Contact: E Corp.
Pittsburgh, PA
412-921-2900
http://www.e-corp.com
Enter 1049 on Inquiry Card.

Software Update

Mathsoft's **S-Plus 4.0** ($1790) is an enhanced version of the popular statistical data-mining tool. The program features a new GUI and is customizable and extensible with scripting in the data-mining language, S. There is a base library of 2000 statistical functions, which you can add to. You can access information from SAS and SPSS data tools as well as Excel and any OLE 2.0–compatible application. The graphics generated by the program can be exported as EPS, GIF, and WMF files for export to presentation applications.
Mathsoft, Cambridge, MA, 800-569-0123 or 617-577-1017, http://www.mathsoft.com.
Enter 1039 on Inquiry Card.

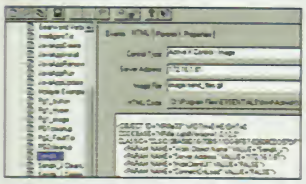
Corel's **WordPerfect Suite 8** ($395 or $179 for upgrade) is the latest version of the desktop suite of applications for Windows 95 and Windows NT 4.0. The same core applications are included as past versions; WordPerfect 8, Corel Quattro Pro 8, and Corel Presentation 8. Other applications include Netscape Navigator; Corel Photo House 1.1, for photo editing; Corel Barista, a Java tool for Web programming and publishing; and Corel Versions, which tracks document revisions. Improvements include the PerfectExpert for help functions, consistent menus and toolbars across the core applications, and the core applications now all write to HTML for creating Web pages. The Desktop Application Director gives one-click access to all applications through the Windows 95 task bar, and, according to the manufacturer, these improvements make for better integration between applications.
Corel Corp., Ottawa, Ontario, Canada, 613-728-8200, http://www.corel.com.
Enter 1040 on Inquiry Card.

Softway's **OpenNT 2.0** upgrades version 1.0, which licensed Microsoft's source code for NT to create a native Unix system environment for Windows NT. OpenNT provides integration between Unix and Windows environments on a single machine in NT, giving simultaneous access to Unix programs and utilities and Windows applications. OpenNT sits alongside the Win32 structure and works with the NT kernel, meaning it is not an emulation product. Unfortunately, version 1.0 supported no Unix networking or graphical information, which version 2.0 now supports. Version 2.0 is geared for Internet designers who need Unix tools and scripting—Apache, Perl, and Unix shells are all supported—as well as if you simply want to open Unix and Windows applications on the same machine.
Softway, San Francisco, CA, 415-896-0708, http://www.OpenNT.com.
Enter 1041 on Inquiry Card.

Networking

Easier Remote Access

SESSIONXPRESS ($5000) IS THE FIRST product in a planned suite of software called XcelleNet Essentials that will automate remote-access functions. SessionXpress includes a class I server and automates the



delivery, retrieval, and update of enterprise information and applications. It is a browser-based application for session management. Through scripting executed on both the client and server sides, a network administrator can use standard Internet technology to provide incremental content updates to users. SessionXpress runs on Windows NT 4.0 or Windows 95 and Windows NT clients.
Contact: XcelleNet
Atlanta, GA
770-804-8100
http://www.xcellenet.com
Enter 1051 on Inquiry Card.

Hey! You've Got Unix in My Windows!

WINTED 2.0 ($149.99 PER CLIENT) USES an X server to provide native access to Unix, Windows 95 and NT, and network resources on a single PC for improved enterprise network interoperability. The program automatically places applications icons from different environments into the Windows Start Menu so you can click to launch any application. WinTed uses the PCX server to transparently launch Unix in the Windows environment and has an

integrated ICA client, which provides access to remote NT servers.
Contact: Triteal Corp.
Carlsbad, CA
760-930-2077
http://www.triteal.com
Enter 1053 on Inquiry Card.

Keep an Eye on Your Network

TECHNICALLY ELITE OFFERS DOMAINMETER 7000 ($6995), an RMON-based network monitoring and troubleshooting tool for Web-based network management. The system automatically generates summary reports to its own Web page for a variety of data on network performance and traffic. DomainMeter 7000 is installed on an individual network domain and can monitor a single remote LAN or worldwide enterprise network.
Contact: Technically Elite
San Jose, CA
408-574-2300
http://www.tecelite.com
Enter 1052 on Inquiry Card.

Peripherals

Retouch Your Personal Photos

POLAROID'S BEFORE AND AFTER ($29.95) software sharpens, brightens, and enhances digitized photos on a home PC. Scanned photos and images from digital cameras can be manipulated and tweaked to improve image quality. The product does not tie into proprietary solutions but works with standard JPEG, TIFF, and BMP file formats. The package is available on CD-ROM for Windows 95.
Contact: Polaroid
Cambridge, MA
800-533-9680
http://www.polaroid.com
Enter 1044 on Inquiry Card.

Technology comes to the rescue for parents and programmers alike.

Advances and Retreats in Computing

The Programmer's Best Friend

Programmers work night and day. Programmers forget to eat. Programmers forget to sleep. More important, there's the matter of social graces. Some programmers forget about them entirely.

For all these problems there is now a single, happy solution. The savior is a package, from Dionne Diuretic Workflow Systems, called the Dionne Programmer's Friend. It's named in homage to a device, called the "policeman's friend," that's familiar to generations of traffic cops. (It lets police officers do things such as direct traffic for 8 hours straight without having to take a break—and without having to suffer distress.)

The Programmer's Friend is a program for your PDA/scheduler. It monitors your intake of food and drink and beeps when it's time for you to go to the bathroom. When it's time for you to go to sleep, the Programmer's Friend tells you so.

When a nonprogrammer approaches you and makes a social sound, the Programmer's Friend tells you to say hello. This facility is what makes the package invaluable. Speech recognition, despite all its limitations, can reliably identify a stranger's hello. It's also a simple matter to detect the long silences characteristic of programmers' speech. When a silence extends beyond 20 minutes, the Programmer's Friend tells you to say, "How ya doin'?" Thus, the device successfully turns the most taciturn coder into a social animal. A lower-order social animal, perhaps, but well up from the bottom of the social food chain.

In sum, the Programmer's Friend will improve your metabolism, your bladder, and your social life. Best of all, it occupies well under a megabyte of disk space. Who could ask for anything more?

CYBER BABEWATCH

Cyber Babewatch (CB) is a new product for imminent parents. CB lets you watch your child develop and grow in the womb. This nifty package includes an ultrasound device that you hook up to your PC to watch the baby. We could say that CB is endlessly useful, except that its usefulness ends at the time of birth. However, CB makes the whole process so fascinating that many parents will race to conceive another baby.

The most obvious thing to do with CB is to take ultrasound photographs of the coming kiddo and send them to friends over the Internet. Even better, you can take several photos each day and compile them into a QuickTime time-lapse movie. So, it's now a snap to document junior's first–and let us assure you, cutest–gestures.

The manufacturer, Cyber Belly Products, touts CB as a safety and health product, and surely it is. The wireless modem has three options:

Option 1 **sends ultrasound pictures of the developing fetus to the parents' health-care provider, thus reducing the number of costly visits to the doctor's office. It takes the idea of having a sound monitor in baby's room and extends it both visually and aurally to mommy's womb.**

Option 2 **Daddy can go about his daily activities and watch baby develop merely by glancing at a little video device. The tiniest model even builds the viewscreen into a wristwatch, à la Dick Tracy. In practice, most people turn the sound off, as it tends to be dominated by maternal stomach rumblings.**

Option 3 **will thrill fathers and delight mothers throughout the pregnancy's final months. Tiny tactile transducers attach to both the mother's and the father's stomachs. Every time baby kicks mommy, the CB parental transducer kicks daddy. The sensation is fun, at least for the first few times. For mothers, it can be profoundly satisfying. This is technology at its best, enabling a couple to truly share the sensations of pregnancy.**

Marc Abrahams is the editor of the Annals of Improbable Research. *You can contact him by sending e-mail to* **marca@improb.com.**

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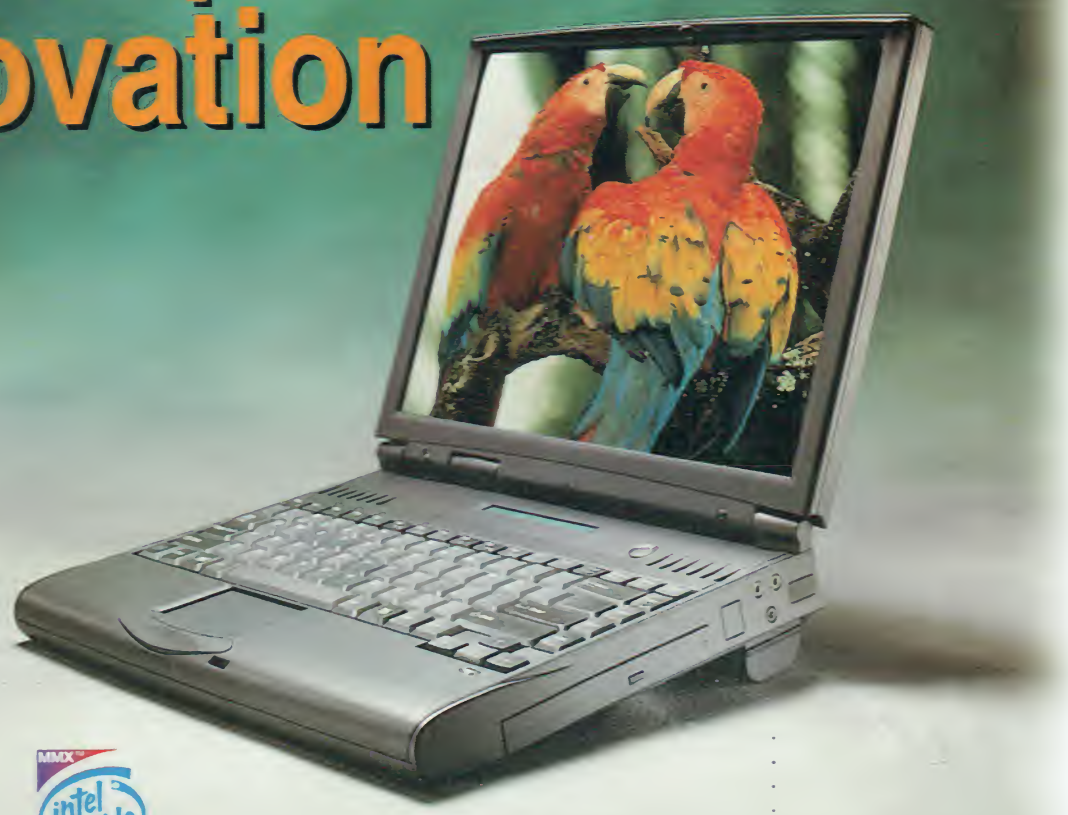
Experience Innovation



MMX™ intel inside pentium

Not only is the system's 14.2" LCD in a class of its own, MITAC's 5027 also offers the best CPU performance on the notebook platform, ideal for today's executive. Supporting Intel MMX™ microprocessor speeds of up to 233MHz, as well as up to 128 MB of DRAM, a high-speed CD-ROM drive, IrDA and other speed-charged specs, the system lets the user zap through multimedia applications like never before. What's more, its multipurpose bay and second battery provide top modularity and operating longevity.

"It's a product we'd love to have ourselves." That's what BYTE's man says. What about you? Try a MITAC 5027 for yourself and experience the taste of innovation, firsthand.

BEST OF EDITORS' CHOICE BYTE COMPUTEX Taipei '97

Hear what one expert says:

"We pick products by their impact in the industry, their innovation and excitement … MITAC's 5027 stands out because it has all the bells and whistles. The battery design, for example, is unparalleled. So is its port replicator and its large LCD. The sleek machine just felt nice typing using its full-sized keyboard."

Rich Friedman, BYTE magazine's Executive Editor International

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* Specifications are subject to change without notice

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E-mail: market@smtplink.mic.com.tw **(URL):** http://mitac.mic.com.tw/

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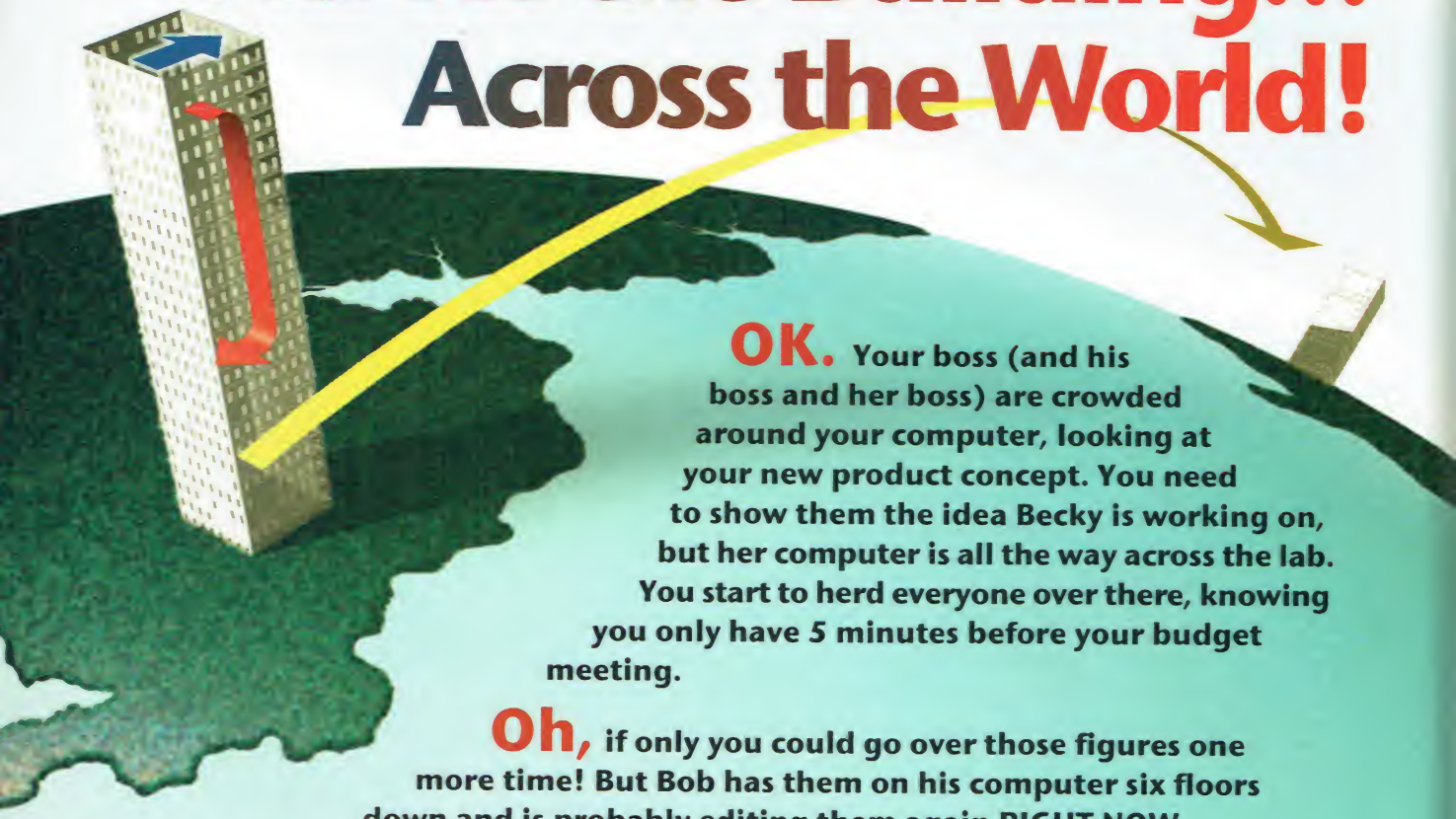
Across the Office... Across the Building... Across the World!



OK. Your boss (and his boss and her boss) are crowded around your computer, looking at your new product concept. You need to show them the idea Becky is working on, but her computer is all the way across the lab. You start to herd everyone over there, knowing you only have *5* minutes before your budget meeting.

Oh, if only you could go over those figures one more time! But Bob has them on his computer six floors down and is probably editing them again RIGHT NOW.

But, you can still make it ... until you get the call (you know you shouldn't have answered it) telling you that your server has gone down at the Atlanta office. You could fix it - if you weren't in Frankfurt.

If you had been using a Cybex Solution, you could have done all that and more right from your desk.

No matter how far your work takes you from your computers, Cybex keeps you in the driver's seat. With our hardware, you can access and operate most any computer, anywhere, just as if you were sitting in front of it.

One company. One solution. Cybex.

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Tel. 353-61-471877 • FAX 353-61-471871
E-mail inquiry@cybex.ie

Yes NetWare. BANYAN LANtastic Compatible

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