Winning Moves
How to Choose the Right CPU

REVIEWS:
Fastest PCs on the Planet:
66-MHz 486DX2s
HP LaserJet 4M:
The 600-dpi Printer to Beat

STATE OF THE ART:
Objects Are Changing
Computing, page 142
- Weight: 2.75 Lbs. (HandBook & Battery)
- Dimensions: 5 5/8" x 9 7/8" x 1 1/4".
- 4 1/8" x NiMH Battery, 1.25 Lb. AC Adaptor/Charger, 6.5" x 2.5" x 1.5".
- Traveling Weight: 4.0 Lbs. (HandBook, Battery & Charger).
- GE Processor. 286-Class Performance.
- EMB RAM Uppgradeable to 3MB.
- 4MB Hard Drive.
- Backlit 7.6" Double-Scan CGA Screen, 640 x 400 Resolution.
- 1 Parallel/1 Serial Port.
- 70-Key Keyboard, 101-Key Emulation, Inverted T Cursor Pad.
- MS DOS 5.0, LapLink XL, MS Works, Central Point Desktop & Serial Download Cable.
- Carrying Case.
Try One On For Size!

You can’t fully appreciate the amazing little HandBook™ from Gateway 2000 until you’ve tried one on for size!

Put your fingers on the actual-size keyboard printed here. We’ve tailored it for comfortable touch typing, even though the HandBook measures less than 6 x 10 inches.

Look at the backlit screen. It’s bright, easy to read and easy on your eyes in any setting, with any lighting.

Imagine the HandBook tucked in your briefcase. It leaves plenty of room for important papers, and it doesn’t weigh much more than this magazine — just 2.75 pounds, including battery!

Now imagine it seamlessly running all your DOS applications with 286-class performance, and 4.5 hours battery life with power management.

We’ve sewed up the HandBook with plenty of hard-working PC features, and added a convenient Auto Resume: when you pause in your work, just close the cover to put the HandBook to “sleep.” Open the cover and it automatically resumes wherever you left off. No need to close files, quit applications and shut down the system — then open everything up again. Conserve battery power and time!

The HandBook is a one-of-a-kind portable PC — a true designer original that’s causing real excitement in the PC industry. In fact, Popular Science recently named the HandBook one of the year’s top 100 “Best of What’s New” achievements!

Do we have you on pins and needles? Then call Gateway 2000 today to try one on for size. It’s definitely dressing for success!

$1295

HandBook options include 2400 bps data/9600 bps send-and-receive fax modem, portable printer, extra AC adapter, extra 2.3Ah battery, RAM upgrade to 3MB, combo unit (1.44MB external floppy drive with one parallel and one serial port) and extended VIP warranty.
Transform Your PC With The INTERACTIVE UNIX System.
Unleash the 32-bit power in your PC with the INTERACTIVE UNIX System from SunSoft. Charge through applications at record speeds. Use real-world multitasking and networking. Get on the path to a distributed computing future.

Just Say No To SCO.
Why? The INTERACTIVE UNIX System is easy to use, simple to administer, all at a great price.

Open Systems Today* says the INTERACTIVE UNIX “system management... is easier to use and more comprehensive” than SCO” and “is simply a masterpiece of good design.”

Looking Glass Professional™ desktop manager makes the INTERACTIVE UNIX System easy enough for novices, yet powerful enough for experienced UNIX users. And the award winning Easy Windows makes setting up graphic environments infinitely simpler.

You can’t afford not to take advantage of the already low cost of the INTERACTIVE UNIX System.

And SCO UNIX/XENIX® users can save an additional 50% by switching to the INTERACTIVE UNIX System today. That’s something to say yes to.

Everything You Like About Your PC—And A Lot More.
INTERACTIVE UNIX System V386 Release 3.2 supports hundreds of the most popular Intel-based platforms and peripherals. So getting started is fast, easy, and cost-effective.

Thousands of UNIX and XENIX applications are at your command. And our VP/ix package runs virtually all DOS software.

You get Lotus®, WordPerfect®, and Oracle®. You get SCO applications. You get it all.

See What Develops.
The INTERACTIVE UNIX System is the environment of choice for 80X86 application development. You get access to a full range of development tools including compilers, debuggers and libraries. And for graphical applications, the X11 INTERACTIVE environment is a revelation.

Partner With Power.
The INTERACTIVE UNIX System is a powerful business partner for companies who know something about power. Companies like BMW, Goodyear, Leica, and Dunlop to name a few. That power can be yours, too. All from SunSoft, the leading supplier of 32-bit UNIX system software.

Call today and save 50% on UNIX power that’s so cost-effective, it can’t be anything but a PC. 1-800-227-9227.
COVER STORY

FEATURE

Make the Right CPU Move
PAGE 114

NEWs

30 MICROBYTES
SPARC-compatible workstations, priced similarly to high-end PCs, are expected by early 1993.

41 REPORT FROM ISRAEL
Coming In from the Cold
by Andy Reifman
As Mideast tensions wane, Israel can sell its wares more openly.

44 FIRST IMPRESSIONS
New Macs for the Desktop and Road
by Tom Thompson
Apple is updating computers and introducing new ones as rapidly as possible.

51 Microsoft's Windows Database
by Jon Udell
Microsoft Access, the happy union of SQL and Visual Basic.

52 Apricot XEN-LS II,
Is value-added worth it?
Video for Windows, coming soon to a PC near you
Convertible, pen computing without compromises
R4000 upgrade, a leap in power for SGI's Iris Indigo
Gateway 2000 4DX2-66V and Hyundai 46602, low-cost DX2 local-bus systems
HP Vectra 486/33N, a low-cost system from an upscale vendor

72 WHAT'S NEW
Watch TV on the 486SX/25 Multimedia Computer System; centrally manage electrical power to local or remote LAN components with LanSafe II; and more.

FEATURES

114 Make the Right CPU Move
by Andy Reifman
New CPUs confuse PC buying decisions.
LAB TESTS: DOES BRAND MATTER?
by Raymond GA Côté
OTHER PLAYERS FIND NICHES
by Andy Reifman, Dave Andrews, Andy Reinhardt, and Tom Halfhill

129 TrueType A to Z
by Greg Loveria
Why TrueType is a key part of Windows 3.1.

137 Lower the Voltage, Raise the Power
by Jeffrey D. Shepard

STATE OF THE ART

142 Objects for End Users
Overview:
Objects for End Users
by Cary Lu
Document-oriented computing is the logical culmination of the object-oriented revolution.
WHAT'S IN AN OBJECT?
by Mark Clarkson

153 Brave New Desktop
by Peter Wayner
Object technologies will let you shape your computing environment.
OBJECTS AND PENPOINT
by Mark Clarkson

161 Relating to Objects
by Daniel W. Rasmus
Object technology finds a place in database management.

167 Objects of Substance
by Sergiu S. Simmel and Ivan Godard
Object storage is a natural for persistent-data servers.

172 Resource Guide: Object-Oriented Database Managers

COVER PHOTOGRAPHY: JIM SCHERER © 1992
SOLUTIONS FOCUS
Grab Your Audience with Audio
by Tom Yager and Rick Grehan
With current sound boards, sequencers, and editors, you don’t have to be a recording engineer to add audio to your presentations.

Windows BASICS
by Mike Wiggins
Three Windows BASIC programs square off.

Clocking the Fastest PCs on the Planet
by Steve Apiki
Performance comparison of 66-MHz DX2 systems from Compaq, Dell, ALR, and NEC.

A New LaserJet, a New Standard
by Shelley Cryan
Hewlett-Packard’s LaserJet 4M should shake up the printer market.

TypeReader Takes OCR Toward Better Recognition
by D. Barker
ExperVision’s TypeReader OCR software is a step toward better recognition.

The Phaser II SD Prints Dazzling Dyes
by Tom Thompson
Tektronix’s new dye-sublimation printer costs under $10,000.

Stepping Up to XVT 3.0
by Raymond GA Côté
The latest XVT marks interface library improvements and new development tools.

The Windows File Shuffle
by Stanford Diehl and Dana Hudes
File conversion under Windows solves the complex problem of divergent graphics formats.

Reviewer’s Notebook: A Real-World Notebook Battery Test
by Howard Egelstein
Notebook battery-life testing.

SOFTWARE CORNER
Audit Your LAN
by Barry Nance, Tom Thompson, and Ben Smith
Easy LAN inventory, a crash disk for System 7.0, and face-saving Unix utilities.

BEYOND DOS
Object-Oriented DLLs
by Gen Kiyooka
Build reusable objects with Windows DLLs.

ASK BYTE
The BYTE Lab responds on clock inconsistencies, loopback plug pin-outs, and other issues.

USER’S COLUMN
A Computer in the Hand
by Jerry Pournelle
Palmtops, PCMCIA, virus newsletters, and the BBS scene.

BOOK AND CD-ROM REVIEWS
Photographic Lies
by Hugh Kenner, Tom Yager, Tom Thompson, Jon Udell, and Stanford Diehl
The search for visual truth, design tips, TCP/IP explainer, the times of physicist Richard Feynman, and more.

STOP BIT
Technology and the New World Order
by James Burke
Advancing technology is creating a new, more complex social order.

EDITORIAL
Testing and CPUs
by Dennis Allen
Unix lives!

LETTERS
Unix lives!

READER SERVICE

BUYER’S GUIDE

PROGRAM LISTINGS
From BIX: Join “listings/frombyte92”

CHESSET COURTESY OF THE LONDON HARNESS COMPANY, BOSTON, MASSACHUSETTS
Other laser printers play leapfrog trying to catch up with the HP LaserJet.

The new HP LaserJet 4 printer isn't a hopped-up version of the past generation. Its new, advanced design sets much higher standards for print quality, speed, built-in features and value than ever before.

**Higher resolution. More typefaces.**

Unlike other 600 dpi laser printers, the HP LaserJet 4 was designed for 600 dpi printing from the ground up. As a result, it produces the best 600 x 600 dpi resolution ever for noticeably crisper, clearer text and graphics. At less than a 300 dpi price.

Microfine toner and HP's exclusive Resolution Enhancement technology give you razor-sharp edges and much smoother curves.

With 45 scalable typefaces built into the printer, users can produce a wide variety of documents. Without hassling with downloading or accessory cartridges. Or buying additional typefaces.

**More speed, more trays, more flexibility.**

Thanks to a new RISC processor, tuned vector graphics and faster I/Os, the HP LaserJet 4 also sets new standards for speed. It even prints many 600 dpi graphics at a true 8 pages per minute. It's faster on networks, too.

With 2 MB of memory built in and new internal memory compression algorithms, virtually all 300 dpi and many 600 dpi documents print from standard memory. Two standard paper trays, with a total capacity of 350 sheets, and an optional 500-sheet tray let users keep printing without constantly reloading different sizes and types of paper. And the optional 75-capacity power envelope feeder saves them from manual feeding or dealing with jams.
Introducing the new HP LaserJet 4 printer.
So advanced, there's no catching it.

Mixed environment compatibility.
Faster Windows.
The LaserJet 4 is very much at ease with most languages and personal computing platforms. Automatic switching lets it switch between HP's PCL 5 printer language and optional PostScript Level 2 software from Adobe. Hot I/Os allow different hosts to be connected simultaneously.

Optional JetDirect cards provide LAN connections to Ethernet, TokenRing, TCP/IP and LocalTalk/EtherTalk. This makes it easy to plug into just about any network, including PC and Mac LANs. And to get really fast network performance.

To optimize the LaserJet 4 for Windows printing, we codeveloped some breakthroughs with Microsoft. Including Windows 3.1 TrueType fonts and rasterizer built in to make sure your users get fast, WYSIWYG printing. The fast Windows driver with HP-GL/2 vector graphics also enhances printing speed.

Several popular software drivers are included: Windows, WordPerfect and Lotus. As well as the new HP Explorer PC utility software, which provides a printing tutorial to guide your users through set-up and operation of the printer's new features.

All this makes the HP LaserJet 4 printer supremely simple to plug-and-play. As you'd expect, it also offers complete document and software compatibility with the HP LaserJet III printer.

Setting the standard in price, too.
With all these advances and more, you'd expect a big jump in price. Quite the opposite. At just $2,199, the HP LaserJet 4 printer lists for less than the printer it replaces. And, of course, it comes with pace-setting HP quality and reliability.

Call 1-800-LASERJET (1-800-527-3753), Ext. 7133 for the name of your nearest authorized HP LaserJet dealer. And ask for a print sample to see just how great the output looks.**

If it isn't a LaserJet, it's only a laser printer.
DATA COMPRESSION LIBRARIES™

PKWARE's® Data Compression Libraries™ allow software developers to add data compression technology to software applications. The application program controls the input and output of data allowing data to be compressed or extracted to or from any device or area of memory.

- All Purpose Data Compression Algorithm Compresses ASCII or Binary Data Quickly with similar compression achieved by the popular PKZIP software, however the format used by the compression routine is completely generic and not specific to the PKZIP file format.
- Application Controlled I/O and memory allocation for extreme flexibility.
- Adjustable Dictionary Size allows software to be fine tuned for Maximum Size or Speed.
- Approximately 35K memory needed for Compression, 12K memory needed for Extraction.
- Compatible with most popular Languages: C, C++, Pascal, Assembly, Basic, Clipper, Etc.
- Works with any 80x86 family CPU in real or protected mode. $295.00
- No runtime royalties.

RUNNING OUT OF EXPENSIVE DISK SPACE?

PKZIP can help! PKZIP compresses your files to free up disk space and reduce modem transfer time. You can compress a single file or entire directory structures with a single command. Compressed files can be quickly returned to their normal size with PKUNZIP.

Software developers can reduce the number of diskettes needed to distribute their product by using PKZIP. Call for Distribution License information.

The included PKZIP utility lets you store compressed files as a single self-extracting .EXE files that automatically uncompressed when run. Only $47.00

PKWARE
THE DATA COMPRESSION EXPERTS®

9025 N. Deerwood Dr.
Brown Deer, WI 53223
(414) 354-8699
Fax (414) 354-8559

Circle 135 on Inquiry Card.
Cool, Quiet, Reliable Power

**ECONOMICAL UNITS**

These UL/CSA approved, fully-tested power supplies are the best basic units available.

- STANDARD 200 XT .................. $69
- STANDARD 205 SLIM ............... $89
- STANDARD 220 BABY ............... $89
- STANDARD 220 AT/TOWER ........ $89

**ULTRA-QUIET UNITS**

Unrattle your nerves with a Silencer power supply. They're cooled by our ThermaSense SQ, a custom, variable-speed fan that automatically maintains the correct system temperature while reducing noise up to 95%. Virtually inaudible! Perfect for the executive suite or home office.

- SILENCER 205 SLIM ............... $119
- SILENCER 220 AT/TOWER ........ $129
- SILENCER 270 AT/TOWER ........ $179

**HIGH-PERFORMANCE UNITS**

Upgrade your computer with one of our premium Turbo-Cool power supplies—the choice of PC professionals. You'll get 30% - 100% more power, built-in line conditioning, a dual-stage EMI filter, super-tight regulation, ultra-clean DC output, our high-capacity ThermaSense variable-speed fan (300W models), UL/CSA/TUV approvals, and a no-hassle 2-year warranty! Ideal for high-end workstations and network file servers.

- TURBO-COOL 200 XT .............. $159
- TURBO-COOL 300 SLIM ........... $169
- TURBO-COOL 300 BABY ........... $169
- TURBO-COOL 300 AT/TOWER ...... $189
- TURBO-COOL 450 AT/TOWER ...... $349

**REDUNDANT POWER SYSTEM**

Eliminate the risk of costly downtime or data loss due to power supply failure with the TwinPower 900 Redundant Power System. The TP900 consists of two Turbo-Cool 450 power supplies in parallel, utilizing a special power-management interface module. The system provides complete power redundancy with hot-swap capability.

**486 CPU COOLER**

Prevent random system errors and extend the life of your 80486 processor by more than 10 times with the CPU-Cool. Reduces the operating temperature of a typical 486-50 from 185°F (Intel's max. spec) to a safe 90°F! Consists of an ultra-quiet mini-fan embedded in a sculptured heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

CPU-COOL ................................................ $39

**WE REPAIR ALL BRANDS**

We provide fast, low-cost, expert repairs and upgrades on Compaqs and other proprietary computer power supplies. Requests for custom outputs, cable harnesses, and cooling fans are welcome.

**INTERNAL ON-LINE UPS**

Protect your PC and its data from power surges, sags, and outages with our UL-approved InnerSource, a combined AT/Tower power supply and On-Line UPS. Its auto-recharge battery provides up to 15 minutes of backup power for both your PC and monitor. This reliable, integrated protection costs less than an equivalent 550VA external UPS, and it saves space too! A Novell interface is available.

INNERSOURCE AT/TOWER ............ $349

---

**PC POWER & COOLING, INC.**

"THE LEADER OF THE PACK"

5995 Avenida Encinas, Carlsbad, CA 92008 • (619) 931-5700 • (800) 722-6555 • Fax (619) 931-6988

Most orders shipped same day. We accept Visa, MC, COD, or PO on approved credit. Turbo-Cool and TwinPower models guaranteed for 3 years. All other products guaranteed for 1 year. Hours: 7 a.m. - 5 p.m. (PT) Mon. - Fri.

©1992 PC Power & Cooling, Inc. Silencer, Turbo-Cool, ThermaSense, TwinPower, CPU-Cool, and InnerSource are trademarks of PC Power & Cooling, Inc. All other brand names are trademarks or registered trademarks of their respective companies.

Circle 130 on Inquiry Card (RESELLERS: 131).
Introducing Intel OverDrive® Processors for your i486™ DX PC.

Would you like to visibly increase the speed of all your applications? Then it's time you shift your i486 DX or SX system into high gear. Using Intel's ingenious "speed doubling" technology, an OverDrive Processor gives you plenty of added power—up to a 70% performance boost systemwide.

And that power will benefit every application you run on DOS, OS/2®, Windows®, or UNIX®—from AutoCAD® to WordPerfect® and

©1992 Intel Corporation. i486 and OverDrive are trademarks of Intel Corporation. *All products are trademarks of their respective companies.

In cases where there is no OverDrive socket, Intel recommends installation by a qualified technician.

---

Shift all of your soft

**i486™ DX System Performance**

- Word for Windows: 43% OverDrive
- Lotus 1-2-3: 72% OverDrive
- AutoCAD: 103% OverDrive
over 50,000 applications in between.

It's easy to install an OverDrive Processor. Just plug the single-chip upgrade into the vacant OverDrive socket and you're ready to go. Faster.

So to rev up your i486 system and keep up to speed on all the latest software developments, you need the future of PC upgradability: Intel OverDrive Processors.

To find out which OverDrive Processor is right for your system or to locate your nearest dealer, call 1-800-538-3373, ext. 228. Because when it comes to running software, there's only one gear. High.

ware into high gear.

WE MAKE COMPUTERS WORK HARDER.

Find out more. Ask for ext. 228
1-800-538-3373

Circle 107 on Inquiry Card.
EDITORIAL

TESTING AND CPUS

Does it really have to be Intel inside? Frankly, that's a good question, and it's a question that CPU makers Cyrix and AMD—who make Intel-compatible CPUs—would like you to ask. To make matters even worse, if you take the CPUs made by those companies and throw in a few from IBM, there are 14 varieties of Intel-compatible CPUs available, and the list is continually growing.

So the BYTE Lab took on the task of answering that question, and our testing editors began looking for the best way to evaluate the different processors. Performance benchmarks alone do not work—they're designed for testing complete systems. Moreover, system performance testing doesn't tell you much, if anything, about compatibility. And compatibility is the first concern buyers have in considering an Intel alternative. In the end, speed matters only if the CPU can run the software you want to use.

To address the compatibility issue, as well as to test the CPU speeds, we joined forces with the National Software Testing Laboratory, the leading testing company in the computer industry. NSTL was a pioneer in compatibility testing, and you may be familiar with the testing reports it publishes: Software Digest, PC Digest, and LAN Reporter.

NSTL has dozens of testing experts and occupies 20,000 square feet of a state-of-the-art test facility. The NSTL staff, much like the BYTE Lab staff, includes many of the most knowledgeable testing engineers and analysts in the world. By working with the talents of these people, we were able to answer some fundamental questions about CPUs. The whole story starts on page 114, and anyone who needs to know whether to buy an SX, SL, DX, or Intel-compatible CPU needs to read "Make the Right CPU Move."

This whole issue of testing is worth exploring. It seems like every computer magazine has some kind of lab, and readers must find it all a little confusing. Why, there are interoperability labs, LAN labs, Unix labs, multimedia labs, and so on and so forth. A photo of a competitor's lab even showed what looked like fiber-optic cable running around the room. On closer examination, however, that "fiber-optic cable" turned out to be a flashing disco light like the kind you can buy at Radio Shack.

The real worth of a testing lab is not measured by its name, its looks, or even its test equipment. It's the people who plan, develop, and conduct those tests and write the analysis that matter. The quality of the test data depends on the ability and the integrity of the technical people who operate a testing lab.

It's one thing to write an article for BYTE—that takes considerable talent and expertise. But to develop and conduct a test to meet BYTE's requirements is something that only a few people are qualified to do. Our standards are tough because that's what you demand, and I'm happy to say that NSTL meets those standards.

In fact, I'm particularly delighted to announce that NSTL and its staff are now part of the BYTE family. Wait, delighted is too mild a word—I'm really excited. This new alliance with NSTL will let BYTE bring you the absolute best information on products and technology.

NSTL has a large suite of over 60 testing methodologies that range from performance to compatibility to usability. NSTL's commercial testing division has performed private tests for customers with familiar names like AMD, Borland, Cyrix, IBM, Intel, Lotus, Microsoft, and others.

NSTL has developed the most extensive private testing facility for computers in the world. And like BYTE, NSTL is a worldwide leader, with locations or affiliate operations in France, the U.K., Canada, and Singapore.

Highly skilled people, a worldwide operation, a large-scale testing facility, expertise in compatibility testing—it's easy to see that NSTL and BYTE are a good match. You can also bet your bottom dollar that in a few short months, our joined forces will bring something new to computer publishing.

No, we won't make BYTE one big product review. We'll continue to provide proportioned coverage of technology and products that helps you make strategic decisions. BYTE is committed to delivering the information you need—not a lot of fluff.

So what's really cooking at BYTE and NSTL?

WATCH THIS SPACE.

—Dennis Allen
Editor in Chief
The most advanced Windows spreadsheet starts with an elementary concept

Introducing Quattro® Pro for Windows.
Quattro Pro for Windows is the most usable spreadsheet ever made. Built with Borland's renowned object-oriented technology, Quattro Pro for Windows is packed with hot new features you won't find in any other spreadsheet.

**NEW! Spreadsheet Notebooks** with customizable Tabs are nothing less than a revolution in spreadsheet ease of use. Now you can intuitively organize and manage your spreadsheet data.

**NEW! Object Inspector** menus end the hassle of searching through menus. They're simpler than 1-2-3. Just click the right mouse button anywhere on the screen to get a list of what you can change and change it right there.

**NEW! Database Desktop** is the easiest way to incorporate dBASE® and Paradox® data into your spreadsheet. Just what you'd expect from Borland, the leader in database technology.

**NEW! SpeedFill** and **SpeedFormat** slash setup time by automatically filling in spreadsheet headings and formats.

**NEW! SpeedBars** are context-sensitive and customizable. SpeedBar icons give you pushbutton access to your most frequently used commands.

**NEW! Presentation Graphics** and drawing tools that rival those of Freelance and Harvard Graphics are built-in. You don't need to buy a separate graphics package.

**YES! Compatible** with Lotus 1-2-3 files, macros, and publishing styles and with Excel .XLS files.

Find your spreadsheet information in a flash!

From everyday tasks to complex projects, Spreadsheet Notebooks are the easiest way to work with your spreadsheets. By incorporating multiple spreadsheet pages in a single file (one notebook can handle up to 256 spreadsheet pages), you can break any complex spreadsheet into easy-to-manage pieces. Assign meaningful names to your notebook tabs and finding information is as easy as flipping through a notebook.

Notebooks are the smart way to do 3-D spreadsheets! You can present data in flip-chart style and format pages in a group, like chapters. Because you navigate easily, it's simple to build multi-page models.
<table>
<thead>
<tr>
<th>Location</th>
<th>Qtr 1</th>
<th>Qtr 2</th>
<th>Qtr 3</th>
<th>Qtr 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>America</td>
<td>7.6</td>
<td>5.7</td>
<td>4.3</td>
<td>3.2</td>
<td>23.6</td>
</tr>
<tr>
<td>North America</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7.1</td>
<td>4.6</td>
<td>6.5</td>
<td>10.2</td>
<td>28.4</td>
</tr>
</tbody>
</table>

Notebooks

You may never open the manual

Quattro Pro for Windows is the most usable spreadsheet ever. With Quattro Pro for Windows' object-oriented user interface, every action you take is easier and faster.

Object Inspector menus let you make one-step changes to any object on your screen with just a click of the right mouse button—no more searching through layers of pull-down menus.

Context-sensitive, customizable SpeedBars™ give you pushbutton access to your frequently used commands.

Drag and Drop lets you move or copy data instantly with the mouse.

Built-in graphics rival standalone packages

Quattro Pro for Windows gives you extraordinarily powerful graphics tools built-in. You'll never have to learn a separate graphics package.

Get 35 2-D and 3-D graph types—with thousands of variations. Then enhance your graphs by adding text, lines, arrows, and built-in clip art.

Use the Slide Show and Light Table to create incredible electronic presentations. Arrange and rearrange slide shows in seconds and customize them with dazzling transition effects.

You can create 35mm slides and overheads, too. No other spreadsheet gives you all this presentation power.

*Quattro Pro for Windows and Spreadsheet Notebooks have patents pending.

Circle 73 on Inquiry Card
(RESELLERS: 74).
**Outstanding 1-2-3 and Excel compatibility**

Quattro Pro for Windows is the next-generation Windows spreadsheet. It is the only spreadsheet that gives you both innovation and compatibility with Lotus 1-2-3, Excel, and Quattro Pro. Quattro Pro for Windows supports 1-2-3 files, macros, and publishing styles, including Always, Impress, and WYSIWYG. It also supports Excel XLS 3.0 and 4.0 files. What’s more, Quattro Pro for Windows is much more compatible with 1-2-3 than Excel. For example, unlike Excel, Quattro Pro formulas, ranges, and command actions (like moving blocks) work as 1-2-3 users would expect.

**Fast database access to dBASE and Paradox**

Only Quattro Pro for Windows gives you easy access to database information. Borland’s unique Database Desktop™ lets you view, edit, and copy dBASE and Paradox tables directly from within Quattro Pro. And only Quattro Pro for...
1-2-3 and Excel!

Windows has Query By Example, so you can ask questions about your data with point-and-click ease. Since it's from Borland, the database leader, you can count on it working right, even in network environments.

Create custom applications in minutes
Because of its object-oriented design, only Quattro Pro for Windows makes it easy to customize your spreadsheet. All the tools are there for you to create your own custom dialog boxes, powerful time-saving macros, and SpeedBars.

Don't settle for second best
Independent tests conducted by Usability Sciences Corporation find that two out of three Windows spreadsheet users tested preferred Quattro Pro for Windows. Don't settle for second best—get Borland's Quattro Pro for Windows today!

Quattro Pro for Windows and DOS now together for the price of one!
Imagine! Getting the world's best Windows spreadsheet and best DOS spreadsheet for the price you'd ordinarily pay for just one. We call it WinDOS, an unprecedented offer that makes the transition from DOS to Windows fast, easy, and painless.

Buy Quattro Pro WinDOS because it's the hands-down best Windows spreadsheet, and get the top DOS spreadsheet FREE! Or buy Quattro Pro WinDOS because it's the absolute best DOS spreadsheet, and move to Windows at your own pace—your Windows spreadsheet is already bought and paid for.

See your dealer today or call now!
1-800-331-0877, ext. 5726
In Canada, call 1-800-461-3327
Limited-time offer!

"Quattro Pro for Windows is [what] Lotus should have released, but didn't."
InfoWorld

"Quattro Pro 4.0 [is] the ultimate DOS spreadsheet."
PC Magazine

BORLAND
Software Craftsmanship

Copyright © 1992 Borland International. Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. BI 1542.1

Circle 73 on Inquiry Card (RESELLERS: 74).
No Limits!
Introducing Borland Pascal with Objects 7.0

Break the 640K barrier
Borland just blew away the limits to programmer productivity. Now you can break through the 640K barrier with DOS Protected-mode (DPMI) applications that give you up to 16Mb for code and data. There's even a DOS extender included, free.

Cross-platform DLLs in Windows or DOS
You get the full power of Object-Oriented Programming for creating full-blown Windows or DOS applications. Every DOS DLL that you create to run in protected mode is automatically binary-compatible with Windows. That means you can share and swap DLLs between Windows and DOS, and even link with DLLs written in C and C++!

Everything the professional needs in one box
First we combined Turbo Pascal Professional and Turbo Pascal for Windows. Then we added hot new professional tools to create the most complete Pascal development system ever. Included are:
- Integrated Development Environments for Windows and DOS
- Application Frameworks" for Windows and DOS give you great-looking user interfaces with just a few lines of code.
- Break the 640K barrier with DPMI
- ObjectBrowser™ for Windows and DOS lets you see class relationships at a glance.
- Fastest compiler—85,000 lines per minute*
- Color syntax highlighting helps you spot errors quickly.
- Turbo Debugger," Turbo Profiler," and Turbo Assembler
- Resource Workshop and WinSight™

Get the most significant upgrade in Pascal history today!
You'll be amazed at the power and productivity capacity built into this breakthrough new version of Pascal. Best of all, Borland has accomplished this without sacrificing the legendary ease of use and learning that has made Pascal from Borland the world's most productive programming language.

Get Borland Pascal with Objects 7.0 today, and there will be no limit to your programming productivity.

To get Borland Pascal with Objects today, see your dealer or call now,
1-800-331-0877, ext. 5019
In Canada, call 1-800-461-3327

BORLAND
The Leader in Object-Oriented Programming

* On Compaq 88633. Copyright © 1992 Borland International, Inc. All rights reserved. All Borland product names are trademarks of Borland International, Inc. Bl 1536

Circle 73 on Inquiry Card (RESELLERS: 74).
Now, buying a hot new system from the IBM PS/ValuePoint line is as easy as picking up the phone. It's the quick, direct way to order a new ThinkPad, other portable computers, and IBM personal printers, too.

Simply call us 9 a.m. to 5 p.m., any business day. Most orders will be shipped within 48 hours.

PS/ValuePoint computers are inexpensive, but deliver true IBM quality. So now you can spend less without settling for less.

Each PS/ValuePoint system is engineered and tested to meet not only industry standards, but also rigorous IBM standards for performance and reliability.
The HelpWare Advantage

1-year onsite warranty
Service response time: 4 hours on average
800# assistance—7 days a week, 24 hours a day
30-day money-back guarantee

Configuration pictured:
386SLC™/25 MHz
80MB hard drive
2MB RAM
PS/2® 8511—VGA
5 slots, 5 bays & mouse
DOS 5.0 pre-installed

$1,299*

486 SX/25 MHz
80/170MB hard drive
8MB RAM
PS/ValuePoint 6312—SVGA
5 slots, 5 bays & mouse
OS/2® 2.0 pre-installed
$1,629* 80MB
$1,849* 170MB

386SLC/25 MHz
170MB hard drive
4MB RAM
PS/ValuePoint 6312—SVGA
5 slots, 5 bays & mouse
DOS 5.0 pre-installed
$1,599*

The PS/ValuePoint line features a range of 386 to 486 processors, 80 to 170MB hard drives and standard 2 to 8MB RAM. And each system is easily expandable and ready to network. So it keeps your costs down and protects the investments you’ve already made.

Plus, every PS/ValuePoint comes with IBM HelpWare™ our comprehensive service and support plan that’s unmatched in the industry.

To put a very affordable PS/ValuePoint to work for your business, call today. Or visit your IBM authorized dealer (dealer prices, terms and offerings may vary).

IBM

two new lines.

Circle 102 on Inquiry Card.
Is Unix Dead?

In “Is Unix Dead?” (September), Tom Yager and Ben Smith delivered a cogent discussion of the current state of Unix. The U.S. Department of Commerce’s Thomas Giammo notwithstanding, the article did not, as its title suggested, buy into the Windows NT scam. Giammo’s assertion that Windows NT will wipe out Unix by the mid-1990s reflects the marketing hysteria perpetuated on corporate America by Microsoft.

To suggest that Windows NT is going to blow Unix off the desktop and into programming oblivion is to forget a simple truth: Unix is simply one of many capable players in the field. And it has just started to move to the desktop in the last five years. Business is making a heavy investment in Unix worldwide for a very good reason. Unix is not simply another operating system. It is the lingua franca of operating systems.

Mike McKinlay
Dubuque, IA

Your September cover story, wherein you suggest that Windows NT would provide the “most powerful adversary [to Unix] to date,” was published at the wrong time. April 1 would have been more apropos.

On the other hand, I might be wrong. As soon as Windows NT is available in Cray XMP or Convex C-220 versions, I’ll be happy to consider turning these machines into single-user systems for the sake of a “well-integrated scalable font subsystem.”

My research group and I would like to thank you for a good belly laugh.

Daniel P. Dolata
Tucson, AZ

I was befuddled by your September cover story, which states that “soon, Unix will face its most powerful adversary to date: Microsoft Windows NT. Will Unix survive?” How can BYTE make a comparison between a venerable, proven operating system like Unix and a big question-mark vaporware operating system like Windows NT? Unix, like DOS, is here to stay. But Windows NT? Couldn’t you have compared Unix with an operating system (e.g., OS/2) that is on the market today and has known features and capabilities? I was amazed that the authors mentioned OS/2 only three times, as little more than a footnote to the imagined “big battle” between Unix and Windows NT.

Dan Butterfield
Keller, TX

I would like to respond to “Is Unix Dead?” and Dennis Allen’s editorial comments regarding Unix-specific magazines. While Unix has a tradition of technical innovation, that is not the reason for its past growth and continuing global success. What your story fails to mention is the desire, on the part of the world’s major computer customers, not to be tied to a single vendor for any computing solution. Using open systems such as Unix, these companies have been freed from the bonds of proprietary mainframe and minicomputer vendors. So why would they want to return to a single vendor for their desktop solution? The answer is that growing numbers don’t and won’t.

At UnixWorld, we regularly address the shortcomings of Unix and the potential of its challengers. Although we respect the marketing clout of Microsoft, we won’t fall for its hype about Windows NT so hard that we write a premature obituary for Unix.

Dave Flack
Editor in Chief
UnixWorld

BYTE International

Thank you for the editorial announcing BYTE’s new international focus and the elimination of the separate International and U.K. pages. I had been planning to write to say that I would prefer to receive a U.S. version of BYTE, since I already read about U.K. developments in the U.K. magazines. I am pleased, therefore, to see the removal of the U.K. section in BYTE.

John Bamfield
Croydon, U.K.

The Artichoke Theory

Nolan Bushnell is right on target with his artichoke theory about the need to make user interfaces simpler and easier to learn (see “The Artichoke Theory,” September). However, simplicity on a program-by-program basis is not enough. We need a way of working the low-level functions of every program into identical keyboard commands so that new users won’t have to learn so many commands.

Why not design a new expanded keyboard with two or three rows of named universal function keys on the left as well as the usual function keys across the top and to the right? A few suggestions for new keys include Help, Print, Copy, Save, Macro, Find, and Exit. Programs would then be modified to support these function keys. Once a program was learned, the user could learn any other program without learning a new set of keystrokes.

Susan A. Henderson
Chicago, IL

I read “The Artichoke Theory” (September) and “The Productivity MacGuffin” (August) with interest. I think that the following factors are crucial to the lack of productivity: (1) People don’t realize the value of system administration expertise, and (2) people don’t use Unix.

Marty Leisner
Rochester, NY
We slash interface development time across DOS, UNIX, POSIX, VMS... (and we can prove it!)

C-Programmers: See for yourself how Vermont Views™ can help you create powerful user interfaces—whatever your environment!

If you want to create sophisticated user interfaces—and save tremendous time and effort doing it—Vermont Views is exactly what you need.

Vermont Views isn’t just a common interface package. It’s a deep, flexible, menu-driven screen designer supported by a C library of over 580 functions. It lets you create the ultimate user interfaces for complex database applications—in a fraction of the time it would take to code them yourself!

With Vermont Views, you can create screens interactively. Designing is fast, and creative. And changes—both tiny adjustments and huge reworks—are incredibly easy.

Pull-down menus, window-based data-entry forms with tickertape or memo fields, scrollable form regions, choice lists, context-sensitive help... All these interface objects (and more) are immediately accessible. And with Vermont Views, even terminal-based applications can have the elegant features usually found only on micros.

Fast prototypes, faster applications.

With most systems, you have to throw away your prototypes when coding begins. But with Vermont Views, prototypes become the actual applications!

Menus, data-entry forms, and all screen features are usable in the final applications without change. So not only do you avoid creating code from scratch once, you don’t have to do it twice!

It’s the universal solution.

Vermont Views operates completely independent of hardware, operating system, and database. Any interface you create can be ported easily among DOS, UNIX, POSIX, and VMS.

You can use Vermont Views with any database that has a C-language interface (including Oracle, Informix, db_Vista, and C-Tree). You can run it on PCs, DEC, NCR, HP, AT&T, and other systems. You don’t have to pay runtime fees or royalties. And full library source is available, too.

What’s more, your DOS applications can have full mouse control, and work in graphics as well as text modes!

Don’t take our word for it—put Vermont Views to the test. Call or fax now for your personal, free demonstration kit. Or order Vermont Views with our 60-day, money-back guarantee.

Either way, you’ll see immediately that Vermont Views is a cut above the rest.

Call for your FREE demo kit! 800-848-1248

©Copyright 1991 Vermont Creative Software
IF YOU CAN FIND ANYTHING WE'VE PLEASE SEND YOUR RESUME TO
They say nothing's perfect.

We say, they haven't seen our T3300SL. The notebook that leaves so little room for improvement, the editors of PC Magazine named it one of their Editors' Choices for 1992.

From its bright, easy-to-read LCD screen to its light-as-a-feather weight, the T3300SL may very well be the best-designed 386 notebook you can buy.

And mind you, by "best-designed," we don't just mean "most features."

By "best-designed," we mean a combination of technology that's been chosen because it's even more impressive in the real world than it is on paper.

Our engineers gave this Toshiba a rapid fire 25 MHz 386SL microprocessor, a PCMCIA slot, and your choice of an 80MB or 120MB hard drive, not to mention all the other qualities that make a Toshiba a Toshiba. Namely, standard size keys with full key travel. Compatibility with our DeskStation IV And Maxtime™ power management, which lets you get the most out of yet another virtuous feature: a powerful Nickel Hydride battery.

So like we said, if you can build a better balanced 386 notebook, talk to Engineering. And if you can't, talk to your nearest Toshiba dealer. The toll-free number is below.

(Surely you didn't think we'd overlook that, did you?)
PC Environmentalism

I'm grateful for the much-needed discussion you provided of the environmental costs associated with personal computing ("The Greening of Computers," September), but I must take issue with the authors' estimate of PC power consumption. The figure of 150 watts is hopelessly low. Perhaps they were confusing output supplied with input required. Even the original IBM PC, rated at a measly 63.5-W DC output, consumed 300 W, according to the technical reference manual.

My current 386/25 clone has a 200-W power supply, so it can support three times as much drain on its I/O bus as the original IBM PC, but its power consumption is listed as "90-130 VAC 6 AMP"—in other words, 110 volts x 6 amperes, or 660 W. Leaving my PC on all the time, even with the peripherals turned off, would consume 5780 kilowatt-hours—four times more than the figures given in the article.

Norm Gabowitiz  
Halifax, Nova Scotia

I am skeptical about the "greening of computers." I am not opposed to the idea insofar as it flows naturally from basic improvements to hardware and software. (The current 0.5-micron semiconductor technology is a good example.) But given the marginal quality of most hardware and software, I tremble at the consequences of making greening a major priority. When you make the machine ecologically pure, it is likely to be at the expense of functionality and reliability.

Turning a high-voltage device such as a monitor on and off more frequently is likely to accelerate the inevitable date when it blows out. The suggestion that it is ecologically desirable to put documentation on-line instead of printing it is nonsense, since computer manuals, unlike newspapers, are not normally discarded. It may be good to have on-line manuals for context-sensitive help, but much on-line documentation is not very context-sensitive. In the end, one is likely to print the documentation out, using far more paper and ink than would a printing press.

Let computers prove themselves as computers before vendors start asking for special favors because their computers are "green."

Andrew D. Todd  
Philadelphia, PA

I'm encouraged by the efforts made by some in the computer industry to be part of the environmental solution. When is BYTE going to take up the cause and list the various environmental attributes of tested equipment in its BYTE Lab reports? Publishing power consumption, average material waste in production, and the like would be a powerful tool to encourage computer equipment vendors to consider more seriously the economic costs of ignoring their environmental record.

Rob Taylor  
Vancouver, British Columbia

Object-Oriented Objections

I read "In Search of an Object-Oriented File System" (September) with some irritation. While Jon Udell is correct about the division of data and executable files in Windows and the need to use file extensions to specify who created what file, he's mostly wrong about OS/2.

My understanding of OS/2's extended file attributes and the Mac resource fork suggests that the two systems work rather similarly. If you use the HPFS (High Performance File System), you can name a file anything you damn well please, as long as it's less than 256 characters long. One of my Excel spreadsheets is named "Biosym Costs.92-94." If you inspected the properties of this file, you'd find that the extended attributes include both the fact that it's an Excel spreadsheet and the appropriate icon. What's the difference between this and the Mac resource fork? While it is true that the number of properly HPFS-aware applications is small, they do exist and do work.

Finally, Udell's object-oriented file system allows him to search by file category. He can already do that through the HPFS and search by file type. This puts up a scroll list of all the registered file types (ASCII, OS/2 command file, and so on); he can pick one and search for it. A lot of what he describes works now in OS/2 and has since version 1.2. Udell ought to publish a clarification.

Adrian Goldman  
Piscataway, NJ

Jon Udell may have erred in his discussion of the Workplace Shell. Native WPS applications should include document templates that contain associations, thus linking all documents to applications that can act on them. A true WPS application need not, and should not, have either print or file open options.

DOS applications are linked to their creators by file extensions. Linking each data file manually would be tedious, and because of the way that DOS applications save files, using extended attribute-based linkage is risky. File extension linkage is very simple. Within a program reference object, the Association Settings option lets you add "names." The file extension is added in the form of * .txt, *.wk1, and so on. It is simple and effective. DOS applications also naturally support drag-and-drop launching.

John Faughnan, M.D.  
Escanaba, MI

Dr. Faughnan points out that you can associate FAT (file allocation table) files with program reference objects by way of filename extensions. That's true. Mr. Goldman adds that HPFS files created by HPFS-aware OS/2 programs can also supply a type attribute (e.g., Excel spreadsheet) that you can use as a search key. That's also true.

My point, however, was that OS/2 2.0's WPS object system inhabits one hierarchical name space, and its file system inhabits another. You can build mappings between the two by creating WPS objects that refer to files. But when you search for something, where do you look: in the object system or the file system? Until the object system can seamlessly acquire the contents of existing file systems and capture all new work, you'll always be living in two parallel universes. This is emphatically not just an OS/2 WPS issue. Windows, NewWave, and the various Windows shell alternatives have the same problem (although NewWave, in particular, is more aggressive than OS/2 about acquiring existing files into the object system). I stand by what I said. We need real unification of objects and files, and finding an evolutionary solution is going to be tricky.—Jon Udell
Delivering the Power: WATCOM C9.0/386

Unleash 32-bit Power!

WATCOM C9.0/386 lets you exploit the two key 32-bit performance benefits. The 32-bit flat memory model simplifies memory management and lets applications address beyond the 640K limit. Powerful 32-bit instruction processing delivers a significant speed advantage: typically at least a 2x speedup.

You Get:

- 100% ANSI and SAA compatible compiler and libraries C9.0/386 passes all Plum Hall Validation Suite tests
- Extensive Microsoft compatibility simplifies porting of 16-bit code
- Royalty-free run-time for 32-bit DOS, Windows and OS/2 apps
- Comprehensive toolset includes debugger, linker, profiler and more
- DOS extender support for Rational, Phar Lap and Ergo
- Run-time compatible with WATCOM FORTRAN 77/386

32-bit DOS support includes the DOS/4GW 32-bit extender by Rational Systems with royalty-free runtime license
- Virtual Memory support up to 32Mb

32-bit Windows support enables development and debugging of true 32-bit GUI applications and DLL's
- Includes licensed Microsoft SDK components

32-bit OS/2 2.0 support includes development for multiple target environments including OS/2 2.0, 32-bit DOS and 32-bit Windows
- Access to full OS/2 2.0 API including Presentation Manager
- Integrated with IBM Workframe/2 Environment

AutoCAD ADS and ADI Development: Everything you need to develop and debug ADS and ADI applications for AutoCAD Release 11

Novell's Network C for NLM's SDK includes C/386

The Industry's Choice.

Autodesk, Robert Wenig, Manager, AutoCAD for Windows: "At Autodesk, we're using WATCOM C/386 in the development of strategic new products since it gives us a competitive edge through early access to new technologies. We also highly recommend WATCOM C/386 to third party AutoCAD add-on (ADS and ADI) developers."

Fox Software, David Fulton, President: "FoxPro 2.0 itself is written in WATCOM C, and takes advantage of its many superior features. Optimizing for either speed or compactness is not uncommon, but to accomplish both was quite remarkable."

GO, Robert Carr, Vice President of Software: "After looking at the 32-bit Intel 80x86 tools available in the industry, WATCOM C was the best choice. Key factors in our decision were performance, functionality, reliability and technical support."

IBM, John Soyring, Director of OS/2 Software Developer Programs: "IBM and WATCOM are working together closely to integrate these compilers with the OS/2 2.0 Programmer's Workbench."

Lotus, David Reed, Chief Scientist and Vice President, Pen-Based Applications: "In new product development we're working with WATCOM C because of superior code optimization, responsive support, and timely delivery of technologies important to us like p-code and support for GO Corp's PenPoint."

Novell, Nancy Woodward, VP and G.M., Development Products: "We searched the industry for the best 386 C compiler technology to incorporate with our developer toolkits. Our choice was WATCOM."
Pick your power! 486SX-25 thru the 486DX2-66. And upgrading is easy with our Zero Insertion Force (ZIF) socket. Note the extra row of pins for the future OverDrive™ CPU based on Intel's P5 technology.

The on-board SCSI option lets you add SCSI I or II devices anytime. SCSI hard drives, opticals and more are easy to add.

When you buy any ZEOS Windows system you can choose 2 of 3 Windows applications: Lotus 1-2-3 for Windows, Ami Pro and Freelance Graphics for Windows!

ZEOS® Gives You More.

You simply get more. For less. When everyone else started cutting prices by giving less, ZEOS had a better idea—Use the very latest technology to design an entirely new line of high performance upgradables that allow us to charge less while giving more. You're going to love it!

ZEOS. THE UPGRADEABLE EXPERTS.

Nobody knows upgradability better than ZEOS. After all, ZEOS was one of the first to introduce truly high-performance upgradeable PCs. Now using the latest in high-integration technology we've made a good thing even better, right up to the 486DX2-66 and beyond. How far beyond?

Try the future OverDrive™ processor based on Intel's P5 technology! Start today with the 486 CPU of your choice. Select between the 486SX-25 or 33, the 486DX-33, the 486DX2-50 or the 486DX2-66. Then, in 1993, you'll be able to add the new super processor (you'll note the extra row of pins around each side of your CPU upgrade socket; that's what they're for). Maximum power today and tomorrow.

TWO VESA STANDARD LOCAL BUS SLOTS.

While the others are talking about local bus, often creating their own non-standard solutions, ZEOS gives you a VESA future. As a working member of the VESA Standards Committee, ZEOS has incorporated two slots conforming to the recently established VESA standard.

What does this mean to you?

Unparalleled VESA local bus performance! We've taken one of your two VESA local bus slots (which can also be used for standard 16-bit cards if you wish) and added a screaming local bus video card. Windows has never moved so fast! And with our bus mastering capability, a second local bus card can be added in the future as well. ZEOS gives you more performance options than anyone else. Take a closer look!

PEAK PERFORMANCE. A ZEOS STANDARD.

With ZEOS, performance enhancements are standard. If you have a technical bent you'll love reading about them. If you're a typical user, just tell your friends your new ZEOS system has these things. They'll be impressed. Like what?

Mention your new system has FLASH
You can upgrade your system now or in the future with our optional 128K or 256K secondary cache modules.

ZEOS systems feature award-winning reliability and support. Nine times PC Magazine's Editors' Choice.

You can upgrade your system now or in the future with our optional 128K or 256K secondary cache modules.

THE CACHE OPTION IS YOURS.

Because painfully missing from many competitors' offerings is the option for a secondary cache. With ZEOS you can add a secondary cache of 128K or 256K. This speeds up many memory-intensive applications. Take it now or add it later if you wish. ZEOS gives you the option. And that's just for starters.

ON-BOARD SCSI IF YOU WISH!

Because your new ZEOS upgradable offers you the additional option of on-board SCSI. By simply adding a single socketed SCSI chip to the board your new ZEOS system supports both SCSI I and SCSI II-type devices. You can now have SCSI hard drives (running in addition to your standard IDE drives) plus tape backups, optical drives and a host of other SCSI peripherals. Take it now or add it later. Only from ZEOS.

MORE FEATURES, MORE BENEFITS.

Like the two cooling fans you'll find in every ZEOS system. While ZEOS systems run cooler than most with one fan we still give you two whisper-quiet cooling fans. The cooler your system runs the longer it will last. We also include a built-in surge suppressor in every system. These are extra features the others can't or won't offer you. From ZEOS, they're yours. No additional charge.

FREE LOTUS SOFTWARE TOO!

And don't forget, when you purchase any new ZEOS Windows-based system, you will also receive your choice of two: Lotus 1-2-3 for Windows, Ami Pro, and Freelance Graphics. The software alone carries a suggested retail price of over $1,000 and we're giving it to you absolutely free. Now that's ZEOS Value.

24-HOUR-A-DAY SUPPORT.

And more!

Remember too, ZEOS provides you with our top-rated 24-Hour-a-Day Toll-Free Technical Support. Plus your new ZEOS system is covered by our 30-Day Money-Back Guarantee, One Full Year Limited Warranty, and our Express Parts Replacement Policy.

CALL NOW TOLL FREE.

800-423-5891

Ordering your new ZEOS upgradable system is easy. Simply pick up the phone and give us a call. A friendly and knowledgeable ZEOS Systems Consultant is ready to answer any questions you may have. You're going to love your new ZEOS system.

Why not give us a call right now!
Coming Soon: Sparc Workstations at PC Prices

SPARC-compatible workstations priced similarly to high-end PCs are expected on the market by early 1993, thanks to a new low-cost microprocessor announced in October by Texas Instruments (Houston, TX). The new RISC-based microSparc (code-named Tsunami) delivers about 40 MIPS and costs only $179 in production quantities. Other comparable SPARC chips cost more than $500, and Intel’s 486DX/50, a CISC microprocessor also rated at about 40 MIPS, costs $502.

TI developed the microSparc (see the photo) with Sun Microsystems (Mountain View, CA) and Mentor Graphics (Wilsonville, OR). The 50-MHz chip is compatible with SPARC International’s Version 8 architecture and SPARC software.

Packing 800,000 transistors in a 0.8-micron CMOS, the microSparc includes a 32-bit integer unit, an FPU, an MMU (memory management unit), a data aligner/parity checker, a DRAM controller that you can configure, an I/O bus controller supporting five SBus slots, a 4-KB instruction cache, and a 2-KB data cache. Power consumption is less than 4 W. By comparison, a Sun Sparstation IPX workstation requires 29 chips for the same functions and consumes more than 20 W.

Memory is addressed on a glueless 64-bit bus, allowing up to 128 MB of RAM. By mating the new microSparc chip with a pair of highly integrated I/O chips from NCR, systems designers need to add little more than memory and a clock crystal to build a workstation that includes a parallel port, serial ports, a SCSI connection, an Ethernet connector, and peripheral controllers.

Several companies are working on microSparc-based systems for delivery early next year. Hyundai Electronics America (San Jose, CA) says it will have a workstation priced at under $5000 that will offer better performance than a high-end PC. Faye Briggs, Hyundai’s senior director of engineering, said, “It [the microSparc] allows SPARC to come into a price range and achieve performance that no other chip can match today. IBM is trying to do the same thing with the PowerPC, but this chip is here today.”

A British laptop maker, Cambridge-based Tadpole, is said to be developing a microSparc portable, but company officials had no comment.

—Tom R. Halfhill

Windows Encroaches on Mac Color Publishing

SAN FRANCISCO—Microsoft Windows is rapidly invading Apple’s turf of color desktop publishing, judging from new hardware and software shown at the Seybold Desktop Publishing Conference in September. Several companies are porting major Mac products to Windows 3.1.

For example, Quark (Denver, CO) announced that it had begun shipping to distributors its long-awaited Windows version of QuarkXPress, a desktop publishing program now popular on the Mac. Although users have access to rival applications (e.g., Frame Technology’s FrameMaker for Windows), QuarkXPress has been an established tool among Mac users, especially professional desktop publishing bureaus, since version 3.0 was introduced in 1990.

SuperMac Technology (Sunnyvale, California) has also announced a port of its popular SuperMac ImagePlus application. A beta version of this program is being distributed to select hardware and software developers in order to create new Windows applications.

Representatives for Microsoft (Redmond, WA) have confirmed that Windows NT won’t ship in 1992 and may not ship before June 1993. Linda O’Neill, a spokesperson for Microsoft, said the company plans to follow this fall’s beta release of Windows NT with another beta drop in January. She said that Microsoft will not release the operating system until the first or second quarter of 1993. Although many developers were expecting Microsoft to release the operating system by the end of the year, O’Neill said, “All along, the goal was to ship the product when done. It’s not like we have to ship by December 31.”

John Warnock, CEO of Adobe Systems (Mountain View, CA), says his company is porting Photoshop to Silicon Graphics, Inc., RISC-based machines. During a demonstration of Photoshop on one of SGI’s machines, he said that although the port “is in the early stages, the windowing speed and tiling of images is very encouraging. The ability to pan across images is impressive, and we haven’t even done any optimization.” Warnock said the company is talking to third-party vendors to get their filters ported to SGI machines. Asked what would be the speed difference between the SGI version and Photoshop running on the fastest Mac, Warnock said, “A lot.” Adobe’s Premiere program for assembling and editing digital video movies is also being ported to SGI machines. Don’t forget: Apple’s QuickTime is also being ported to the SGI platform.
To anyone who has ever dreamed that personal computing could be even easier than it is today.
Microsoft Windows makes computers easier for everyone.

To date, millions of people have already opened their eyes to the Microsoft® Windows operating system.

Why? Because Windows makes their computing easier. Faster. And more reliable.

But we weren't about to stop there. After all, people need their computers to do more these days than increase their level of personal productivity. They need PCs to help them work together. And they need affordable ways to run powerful new programs.

So we've added two new operating systems to the Windows family.

To help people work together, we have just introduced Microsoft Windows for

Windows for Workgroups lets people work together through built-in electronic mail, file sharing, printer sharing and scheduling.
Wake-up call.

Workgroups 3.1. It has built-in networking that gives you a whole new level of productivity.

And we'll soon be releasing the Microsoft Windows NT™ 3.1 operating system.

As a server or a desktop, Windows NT makes powerful computing easier. And it's ideal for people who need to use the most powerful hardware and applications available.

But here's the best part: They all share the intuitive Windows interface. And run the same applications. So you can preserve and build on all your investments in Windows.

If you'd like more information, call us at (800) 426-9400, Department HM4, for your free 8-page color brochure. It's time for you to get started on a new day.

Microsoft
Making it easier
Introducing Wind
It's based on the idea that you require a generous amount of simplicity and efficiency in your day-to-day work. All it takes is a few clicks of the mouse to share files and information. No more long walks down the hall.

Since we've included Microsoft Mail, you can instantly send electronic mail to individuals or everyone in your workgroup. You can even add sounds and pictures.

MICROSOFT
WINDOWS FOR
WORKGROUPS

Now several people can share printers, so everyone can use the printer that best suits their needs, just by clicking a button.

We've also included Microsoft Schedule+, so you can manage calendars and schedule meetings with others. And you can spend more of your workday actually working.
As anyone in business would tell you, success often depends on how well you can work with others.

Not coincidentally, this is the strength of the Microsoft Windows® for Workgroups 3.1 operating system.

In fact, with its built-in networking, one could describe Windows for Workgroups as downright gregarious.

For starters, you can say goodbye to the old “mind if I borrow your disk?” routine. With Windows for Workgroups, you’ll be able to share files and applications, even printers, faster than you can say “eject.”

And then there’s this handy little feature called Schedule+.

Say you want a meeting on Tuesday with Matt, who has a meeting with Duncan and Karen, who, wouldn’t you know it, are meeting with Jim that same day.

No problem.

Just a couple of clicks and, zip, everyone’s schedules are laid out right in front of you. So you can book a meeting without making a jillion phone calls.

Even things as basic as sending memos are simplified with Microsoft Windows for Workgroups. Now you can send electronic mail, including voice and graphics, to anyone in your workgroup.

In other words, Windows for Workgroups lets you share something with your coworkers other than frustration.

But just because it has these advanced capabilities doesn’t mean that you’ll need an advanced degree to understand it.

Quite the contrary.

Microsoft Windows for Workgroups is based on the familiar interface that millions of people have come to love. Even if you’ve never used Windows, it’s the ideal starter network.

And since it works with Windows-based and MS-DOS® applications just like Windows 3.1, you can preserve and build on any investment you make in Windows.

Which brings up our final point.

Windows for Workgroups is great for creating workgroups on existing networks, like LAN Manager and NetWare, as well.

All in all, Microsoft Windows for Workgroups will give you an entirely new level of productivity.
CA, a company that used to make only Mac products, is releasing five new products for the Windows platform. Among them are a 24-bit-color accelerated-video card that uses proprietary chips originally developed for the Mac version and a relatively low-cost color-proofing system built around a dye-sublimation printer and color-calibration software. The new SuperMac products for PCs will be marketed under the SuperMatch label—not because SuperMac fears its name would deter PC users, but because the company doesn’t want to upset Apple.

In other cross-platform developments, RasterOps (Santa Clara, CA) said it will incorporate Adobe Systems’ (Mountain View, CA) newly announced PixelBurst graphics coprocessor in add-on boards not only for the Mac but also for PC and Sparc-station platforms. Adobe’s PixelBurst, an application-specific IC that is said to accelerate high-resolution screened images up to 10 times faster than software-based rendering, will also be sold to makers of PostScript printers and scanners.

Adobe also revealed a joint-development agreement with Silicon Graphics (Mountain View, CA) to port Adobe Photoshop to Silicon Graphics’ Unix-based Indigo RISC workstations. Adobe, which is believed to be developing a Windows version of Photoshop, plans to ship its first Unix port of the program in 1993.

—Tom R. Halfhill and Patrick Waurzyniak

Intel Introduces Speedier 486SX and OverDrive Chips

SANTA CLARA, CA—Intel has upped the ante again, introducing in September its fastest 486SX microprocessor and a new speed-doubling OverDrive chip. The new CPUs will accelerate the trend away from 386-based systems and put more pressure on Intel’s competitors, who have yet to market a full-fledged 486-compatible processor.

The new 486SX is clocked at 33 MHz and is rated at 27 MIPS. That’s about twice as fast as a 33-MHz 386DX. Until now, the fastest 486SX was the 25-MHz version, which delivers 20 MIPS. Intel also makes 16- and 20-MHz versions of the 486SX.

Unlike the 486DX series, the 486SX chips lack an FPU. Intel’s OverDrive chips are designed to provide an upgrade path for 486SX systems. When plugged into a special socket on the motherboard, an OverDrive chip replaces the 486SX and becomes the new CPU. The OverDrive is functionally equivalent to a 486DX with an FPU, but it runs twice as fast internally as the 486SX it replaces and communicates with external devices over the CPU bus at only half the OverDrive’s clock rate. The OverDrive chip announced as a companion for the 486SX/33 is locked at 66 MHz and improves performance by about 70 percent.

More than a dozen manufacturers joined Intel’s introduction with announcements of new 486SX/33 boards and systems. Among them are AST, Apricot, Asustek, Elitegroup, Epson, First International, Gateway 2000, Gecco, Juko, NCR, Olivetii, Tandy, and Zeos. System prices range from $1600 to $2200.

Intel’s list price for the 486SX/33 is $189 in 1000-unit quantities. That translates to $109 for the 486SX/25 and $94 for the 16- and 20-MHz versions of the 486SX.

—Tom R. Halfhill

New Interrupt Architecture Supports Multitasking

In October, Intel introduced a new interrupt architecture designed to improve multitasking performance and pave the way for multiprocessing operating systems, such as the unreleased Windows NT. The architecture has been adopted by major hardware and software companies and is expected to begin appearing in computers late this year or early in 1993.

At the very heart of the architecture is a new interrupt controller chip, the Intel 82489DX. It supersedes the 8259A, which made its debut in 1978 and is found in almost all PC compatible chips. The 8259A has no support for multitasking or multiprocessing, although it can be tricked by software to accommodate the kind of cooperative multitasking used in Windows 3.1.

Intel says that the 8259A has been rendered obsolete by the arrival of more...
Don’t send your words out naked into the world.

Dress them up with Microsoft® TrueType® Font Packs for the Microsoft Windows® operating system version 3.1 and Windows-based applications.

Because now, in addition to the original Microsoft TrueType Font Pack, you can have more ways than ever to make your point.

Introducing TrueType Font Pack 2.


(By the way, Font Pack 2 also has a handy type organizer called Font Assistant. It’s like an electronic chest of drawers for your fonts.)

We even have a font set to update your HP® printer called, you guessed it, Microsoft Hewlett-Packard® Font Set.

So your ideas can always be dressed to a T. In fact, even your T’s can be dressed to a T.

Which is important when your words are out there for all the world to see.

Microsoft®
Making it easier

---

**A FRIENDLY REMINDER**

Unfortunately, we have not received payment for the 12 Tahitian Swayback Guppies you ordered. It may have just slipped your mind. Or more likely, you’ve already sent in your payment, so just ignore this notice. We don’t know what got into us. Sorry to bother you.

You’re special to us.

---

**2nd Notice**

Your account is now 60 days PAST DUE.

We hope you are paying more attention to your guppies than you are to us. Remit your payment to avoid further action.

Please pay your bill so we can pay our bills.

---

**3rd and FINAL NOTICE**

Your account is now Seriously Delinquent. If you do not pay the total amount due by Friday midnight, your guppies will be repossessed, your credit damaged and your fishing license revoked.

Remember, we know where your guppies live.

---

**Thank You**

We appreciate your prompt payment. As always, we value your patronage and we look forward to seeing you soon.

P.S. By now you’ve discovered the phenomenal rate at which a Tahitian Swayback Guppy grows. Coincidentally, for a limited time, our 100-gallon aquariums are now on sale.

Have a nice day!
IBM Now Aims AIX at Commercial Markets

NEW YORK—Despite its much-publicized efforts to promote OS/2, IBM is still deeply committed to Unix, said James Cannavino, IBM vice president and general manager of the Personal Systems line of business, at Unix Expo. In fact, the company seeks to parlay its success in the PC market and four times that of the industry as a whole. But Cannavino is taking aim at the commercial Unix market, where he says the growth rate will be even higher—17 percent.

AIX, IBM’s version of Unix, runs on a wide range of platforms, from PS/2s to mainframes. But the company’s strongest weapon in the Unix arena is its array of RISC System/6000 workstations and servers, which have been popular in the technical Unix market.

To bolster the system’s presence in the commercial market, Cannavino announced that IBM would transplant its CICS (Customer Information Control System) transaction-processing software to the RISC System/6000 from its traditional mainframe roots. The company also introduced modular transaction-processing products that use the DCE (Distributed Computing Environment) developed by the Open Software Foundation. From now on, says Cannavino, IBM will concentrate on commercial and technical Unix systems equally.

IBM is so eager to promote AIX as a world-class operating system that it did something at the Unix Expo that would have been unthinkable just a short time ago. To prove that its version of Unix could be run on a wide range of systems, IBM showed AIX running on personal computers from arch-rivals Dell, Tandy, AST, and Compaq.

IBM Unveils PowerPC Precursor

IBM has outlined the growth path for the single-chip version of its RISC System/6000 processor. The single-chip processor is being used in the 220 version of the IBM RISC System/6000, which has a base price of only $3750 yet reportedly delivers 27 SPECmarks. This processing chip is a forerunner of the PowerPC chip being codeveloped by IBM and Motorola. The next version of the chip, called the 601, is significantly faster than the current version and will be optimized for commercial applications.

The first versions of the 601 chip will be ready by the end of 1992. IBM and other companies will offer computers that are based on the chip late next year. In 1994, three new versions of the chip will appear: the 603, which offers better performance; the 604, which includes power management capabilities; and the 620, which will be used in symmetric multiprocessing systems.

IBM Officially Introduces PowerPC Chip

IBM has officially introduced its single-chip PowerPC processor, codeveloped with Motorola, which can be used in symmetric multiprocessing systems.

The new chip, called the 601, is significantly faster than the current version and will be optimized for commercial applications.

The first versions of the 601 chip will be ready by the end of 1992. IBM and other companies will offer computers that are based on the chip late next year. In 1994, three new versions of the chip will appear: the 603, which offers better performance; the 604, which includes power management capabilities; and the 620, which will be used in symmetric multiprocessing systems.

James Cannavino, IBM vice president and general manager of the Personal Systems line of business, says that IBM will demonstrate a version of OS/2 based on a Mach microkernel before the end of the year. The primary reason that IBM is interested in basing a new version of OS/2 on the Mach kernel, which was developed at Pittsburgh’s Carnegie Mellon University, is that the kernel is open, according to one IBM official. Developers that have written programs to run on Mach-based operating systems (e.g., AIX, IBM’s version of Unix) want to be able to run them on OS/2, and they can’t do that on current versions of OS/2. IBM says the plan is for the Mach-based OS/2, which should be released within 18 to 24 months, to run DOS, Windows, OS/2 2.0, and Unix programs. One way to think of the new version, which might be called Portable OS/2 or OS/2 3.0, is as OS/2 with a new engine under the hood.

Eleven companies—including Apple, Tandem Computers, BRHC U.S. West, and Kaleida Labs—have joined a consortium to investigate the extent of public demand for providing interactive multimedia technology to U.S. homes through either the TV or the PC over telephone, cable, or fiber-optic lines.

Have you been following the emerging trend of personal computers merging with TVs? If so, you will be interested in Hewlett-Packard’s latest plans for the HP 95LX. The company says it plans to offer a way to link its palmtop system with an interactive TV system that is produced by TV Answer, which is based in Reston, VA.
Sorry, you're going to have to plug it in yourself.

By now, you really should know that the Microsoft Windows™ operating system makes computing easier.

Now Microsoft is working with personal computer manufacturers to make it even easier for you to get up and running.

We call it Microsoft Windows Ready-to-Run. Quite simply, when you see the Ready-to-Run logo, it means that a PC already has Microsoft Windows installed.

There is no need for installation disks. No set-up procedures. No additional steps.

What's more, it means the personal computer has already been optimized to run Windows-based applications.

Just flip a switch and you're ready to start working with Microsoft Windows.

Oh, there is one little technical matter concerning an electrical plug and a wall outlet. We apologize for any inconvenience this may cause.

Microsoft
Making it easier
Electronic Phone Directory Service Comes to the U.S.

PARIS—Lucky phone subscribers in the U.S. are to get an electronic telephone directory that is directly accessible by videotex. This will be useful to microcomputer users in corporate sales and marketing departments who use database and word processing programs to launch targeted promotional mailings. With the new phone directory, direct-marketing companies should no longer have a problem acquiring a list of, say, beekeepers in the Minneapolis-St. Paul area.

The new service is the result of an agreement announced in September between BRHC U.S. West (Englewood, CO) and France Telecom. Under its official name, Teletel, the latter has pioneered the use of videotex on a mass scale in France, where more than 6 million Minitel terminals are supplied free to users.

For its part, the French electronic-directory service supports 10,000 simultaneous accesses. With its 50,000 daily updates of over 26 million records, the Teletel transactional database is claimed to be the largest of its type in the world. The BRHC U.S. West service will initially be housed on the same database. U.S. users can either use a PC or a Mac equipped with a V.23bis-standard modem with Teletel emulation software or a Minitel 2 set that has been adapted to U.S. power standards. For now, the BRHC U.S. West electronic-directory service will be limited to the Minneapolis-St. Paul area.

—Raymond Boult

Board Makers Expand Mac, Windows Video

Over the past 10 years, personal computer makers have proved their ability to manage data: The majority of people likely to buy a computer, especially in the business sector, have done so. Now the computer industry is anxious to attract users to computing who haven’t yet seriously considered buying a PC. The attractions are Apple’s QuickTime and Microsoft’s new Video for Windows on the PC.

Both Apple’s and Microsoft’s software-only video/sound solutions are impressive technical advancements because they offer video to the broadest possible consumer base. When played without hardware acceleration, however, these video solutions make you watch digital movies through video windows that are about one-quarter the size of the computer screen.

When Microsoft introduces Video for Windows in November (see “Microsoft’s Small-Screen Debut” on page 56), several familiar hardware companies will be right there with it, announcing—and in some cases already shipping—low-cost graphics accelerators that provide fullscreen, full-motion color video. For example, ATI Technologies’ (Scarborough, Canada) Mach 32 graphics accelerator chip, as found in the company’s Graphics Ultra and Graphics Ultra Pro Windows accelerator cards, will offer Video for Windows users full-screen, 30-frame-per-second playback, with up to 65,000 colors at resolutions of up to 1024 by 768 pixels or 24-bit color at 800- by 600-pixel resolution. PC manufacturers like Hyundai Electronics America and Gateway 2000 plan to bundle manufacturer versions of the boards in their new PCs.

Matrox (Dorval, Quebec, Canada) is developing MGA (Multimedia Graphics Architecture) boards that can play video from NTSC or PAL sources (e.g., cameras, VCRs, and videodiscs) and convert them on the fly to support 8-, 16-, and 24-bit displays. Alain Belanger, group director at Matrox, says the company’s Marvel capture and MGA graphics boards will offer video-color-enhancement technology for improving the quality of decompressed video as it plays on a PC. For users who want to do more than just play Video for Windows’ movies, companies such as Media Vision (Fremont, CA), Creative Labs (Milpitas, CA), and Matrox will offer boards at various performance and cost levels for authoring digital movies on the desktop. Media Vision, whose technology is used in the Microsoft Video for Windows general-purpose codec, will likely bundle Macromedia’s Action multimedia presentation program and players that let you run movies on DOS and Mac computers with its playback/capture card, which is expected to retail for just $349.

On the Mac, companies such as SuperMac Technology (Sunnyvale, CA), New Video (Santa Monica, CA), and RasterOps (Santa Clara, CA) have developed various adapters that support full-screen, full-motion playback/capture of QuickTime movies.

—Dave Andrews
This Hyundai 486SX-33 can out-muscle those barnyard bovines of cow country. But you be the judge.

Our 32 Megapixel “Longhorn” Local Bus?... or a 1 Megapixel moo cow? Our “faster-than-a-blink” Windows accelerator video processing tied to the speed of your 486 CPU?... or an old-fashioned bottleneck? Our 1MB VRAM controller producing 1024 x 768 ultra-high, non-interlaced resolution?... or their tired cow VGA? Clearly, the prize goes to the Hyundai New Breed.

Compare our standard 128KB of zero-wait state cache with non-cached cows. And don’t forget, the Hyundai 433S flexes its processing muscle up to 256KB of cache expansion. This system runs at the head of the stampede!

And we don’t just drive the Hyundai stampede, we overdrive it! Double your speed by simply snapping in the Intel Overdrive Processor. And our advanced “warp-speed” L2 cache and “Longhorn” Local Bus graphics engine give your upgraded system the 32-bit video and fast SRAM you’ll need for your higher-speed 486 CPU.

Want to talk add-ins? We test our 486 systems with literally hundreds of industry-standard cards and software applications. We test software compatibility on Novell (we’re fully certified and a Novell Alliance Program member), Banyan Vines, OS/2 2.0, LAN Manager, and SCO UNIX, plus hundreds of programs running under Windows and MS DOS.

Trouble on the data frontier? Relax. The Hyundai 433S is loaded. A beefy 120MB superfast hard disk, two floppy drives, five external/two internal drive bays, and seven expansion slots mean you won’t go hungry for performance. And dressed up with our 14” flicker-free, non-interlaced, color display, the New Breed 433S is the new king of PC country.

**Hyundai 433S**
- 33MHz 486SX w/ 8KB integrated cache
- 32-bit VESA local bus UVGA graphics w/1MB VRAM
- 128KB “warp-speed” write-back 20ns SRAM L2 cache (expandable to 256KB)
- Upgradable to 486DX power via Intel “Overdrive” socket
- 4MB system memory expandable to 64MB on system board
- 120MB 133ms IDE HDD, 32KB disk buffer
- 1.44MB 3-1/2” and 1.2MB 5-1/4” FDDs, (2.88MB-ready FDD interface)
- 14” non-interlaced, ultra-high resolution, .28 dot pitch, 72Hz refresh rate, flicker-free, color display w/1024 x 768 resolution, tilt and swivel base
- 25/1P, integrated PS/2 mouse port
- 5 external drive bays, 2 internal
- 7 expansion slots, including 1 VESA local bus slot
- 200 watt power supply
- 101 keyboard, 2 button mouse
- Built-in virus protection, front keylock, 2 level password
- MS DOS 5.0 and MS Windows 3.1

**Hyundai 433S**

FOR DIRECT SALES
1-800-933-3445
That thunder you hear on the PC prairie is the New Breed Hyundai 486 stampede. The hardest-charging, price-lean, MIPS-mean herd of computers you’ll ever see. We’re bringing everything from powerful 66MHz 486DX2 machines to Overdrive-Upgradable 486SX-25 computers. And with our 50MHz 486DX2 desktop PC and 486DX-33 blasters, you can handle today’s demanding applications.

**Do something “Longhorn” Local Bus.**

That flash you see on the graphics horizon is the image of our Windows processing power triggering the Hyundai 486 stampede.

Your 486 processor was meant to run today’s applications. So why rein in all that power? That out-to-pasture, 16-bit VGA card can only deliver 2 Megapixels at best. That’s already dated technology. Let her rip with 32-no-blink-bits of “Longhorn” Local Bus video acceleration. And with up to 28 Megapixels standard, believe it, you’ll see an incredible difference in Windows performance.

**Do something thunderbolt.**

Lightning-fast “warp speed” L2 caching is another max-performance feature that’s designed into every Hyundai 486. Thunderbolt write-back operations blast your DOS, Windows, or OS/2 data into a box canyon of ultra-fast SRAM. Start out with 128KB standard (more than the cow computers), then expand to 256KB to handle today’s big applications. Cache hit for cache hit, the Hyundai 486 Family, with 128KB standard caching, delivers twice the MIPS of non-cached cows.

**Do something upgradable.**

The Hyundai 486 New Breed Family is designed in Silicon Valley, U.S.A., to out-perform the herd.

All of our systems are CPU-upgradable through a single chip via a ZIF or Overdrive socket, so the New Breed lets you double your speed. We won’t let tomorrow’s 32-bit operating systems blast a hole in your productivity. Just upgrade your Hyundai 486 to any higher-speed Intel 486 CPU in the future.
AND PUT THE OLD BREED OUT TO PASTURE.

Every cow has its day. But it's time to put that milker out to pasture and make way for the Hyundai 486 stampede. It's time to Do Something New Breed®.

Say goodbye to “cow-shed” engineering and mother-board-of-the-month manufacturing. At Hyundai, we're doing U.S.-based, end-to-end, value engineering and manufacturing. That means benchmark-blasting power from the new Hyundai family of 486 Systems.

And with up to 32 Winmarks of Windows processing power, Hyundai’s bulletproof, 32-bit 486 Systems are designed and engineered for your high-throughput applications. For instance, Local Bus Graphics are standard on every system, from our entry-level computers up through our top-of-the-line desktops. You’ll tear through Windows with our razor-sharp, 32-bit processing. Plus, up to 32 Megapixels of mind-bending GUI acceleration is standard with every New Breed 486 from Hyundai. And here’s more New Breed value engineering. Our expandable, “warpspeed” L2 cache architecture is standard on every Hyundai 486 system.

Made-in-America engineering excellence is coming through the gates with the backing of a global high-tech leader. Now Do Something New Breed. And turn the page....

HYUNDAI

PCs designed and built in America
Somewhere east of Sioux City
<table>
<thead>
<tr>
<th><strong>i486SX-25 SYSTEM</strong></th>
<th><strong>HYUNDAI</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>WITH NEW BREED POWER</td>
<td><strong>GATEWAY</strong></td>
</tr>
<tr>
<td>• 32-bit Local Bus Windows Accelerator</td>
<td>YES</td>
</tr>
<tr>
<td>• -15 Plus Winmarks of GUI Performance</td>
<td>YES</td>
</tr>
<tr>
<td>• -Motherboard Video w/1 MB VRAM</td>
<td>NO</td>
</tr>
<tr>
<td>• 486 Level 2 Caching</td>
<td>YES</td>
</tr>
<tr>
<td>• -128KB Standard</td>
<td>NO</td>
</tr>
<tr>
<td>• -256KB Maximum Expansion</td>
<td>YES</td>
</tr>
<tr>
<td>• 11 MIPS Max-Throughput</td>
<td>NO</td>
</tr>
<tr>
<td>• Intel &quot;Overdrive&quot; Upgrade Socket</td>
<td>NO</td>
</tr>
</tbody>
</table>

**$1699**

**433DP SYSTEM**

**WITH NEW BREED POWER:**

SAME FEATURES AS 425SP WITH 33MHZ INTEL 486DX

**$1999**

**DO SOMETHING 66MHZ**

<table>
<thead>
<tr>
<th><strong>Hyundai 466D2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• 66MHz Intel 486DX2 w/8KB integrated cache and advanced &quot;clock doubler&quot;</td>
</tr>
<tr>
<td>• 32-bit VESA local bus UVGA graphics w/1MB VRAM</td>
</tr>
<tr>
<td>• 128K &quot;warpspeed&quot; write-back 20ns 3AM L2 cache (expandable to 256K)</td>
</tr>
<tr>
<td>• Processor upgradable via ZIF socket</td>
</tr>
<tr>
<td>• 8MB system memory expandable to 64MB on system board</td>
</tr>
<tr>
<td>• 360MB 12ms IDE HDD, 256KB disk buffer</td>
</tr>
<tr>
<td>• 1.44MB 3-1/2&quot; and 1.2MB 5-1/4&quot; FDDs</td>
</tr>
<tr>
<td>• 14&quot; non-interlaced ultra-high resolution, flicker-free, color display w/1024 x 768 resolution, 72Hz refresh rate, tilt-and-swivel base</td>
</tr>
<tr>
<td>• 2S/2P, Integrated PS/2 mouse port</td>
</tr>
<tr>
<td>• 5 external drive bays, 2 internal</td>
</tr>
<tr>
<td>• 7 slots incl. 1 VESA local bus slot</td>
</tr>
<tr>
<td>• 200 watt power supply</td>
</tr>
<tr>
<td>• 101 keyboard, 2 button mouse</td>
</tr>
<tr>
<td>• Built-in virus protection, front keylock, 2 level password</td>
</tr>
<tr>
<td>• MS DOS 5.0 and MS Windows 3.1</td>
</tr>
<tr>
<td>• Optional cost: Floor Model Server. Call us.</td>
</tr>
</tbody>
</table>

**$2995**

**450D2 SYSTEM**

**WITH NEW BREED POWER:**

SAME FEATURES AS 466D2 WITH 50MHZ 486DX2

**$2599**

**DO SOMETHING SMART. CALL HYUNDAI DIRECT SALES.**

**HYUNDAI**

PCs designed and built in America

**1-800-933-3445**

BYT-101

166 Baypointe Pkwy, San Jose, CA 95134  Hours: 6AM-5PM PST M-F

We accept MasterCard, Visa, money orders, certified checks (allow 10 days for processing), CODs, approved company and institutional purchase orders, and wire transfers. All return items must be accompanied by a return merchandise authorization (RMA) number. Opened, defect-free software is non-refundable. Prices and product descriptions are subject to change without notice. Hyundai is not liable for damage due to omissions or typographical errors. All trademarks are the property of their respective companies. The Do Something logo is a trademark and Do Something New Breed is a registered trademark of Hyundai. © 1992 Hyundai Electronics America. All rights reserved. *All Gateway prices are quoted from PC Magazine, October 27, 1992*
We'll give you more than you bargained for. When you go with the 486 stampede, from our 425SP to our powerhouse 466D2TE, we give you exclusive low prices on software. Our size and reputation allow us to forge alliances with all the major players in the industry, which means we can bring you software specials from firms like Microsoft, Borland, Lotus, and Symantec.

**Do something safe.**

The PC range war can shake everybody's confidence. Except ours. We're a $50 billion global company, which means we have the resources to guarantee outstanding service and support. When you buy New Breed technology, you get New Breed service from a worldwide leader.

In addition to our service and support, we have a TQC (Total Quality Care) program that makes us the double-safe buy. Our 18-month warranty on all systems is a soft ride in the saddle.

The bottom line is your satisfaction. Buy the Hyundai 486 stampede, and you get more than New Breed technology. You get New Breed Service that leaves that old breed behind.

---

**NEW BREED SERVICE AND SUPPORT**

- One-year, next-business-day, on-site service with all direct orders, followed by 6-month, ship-in warranty on parts and labor.
- 30-day, no-risk, money-back guarantee on anything you buy direct from Hyundai.

- 48-hour turnaround on ship-in repairs.
- Beginners Help Line: 800-933-9917.
- Product spec fax: 800-723-4843.
- 7-days-a-week tech support:
  - 24-hour lifetime tech support: 800-289-4986.
  - 24-hour tech fax: 800-283-4986.
  - 24-hour tech bulletin board: 800-955-5432.
- Tech support through CompuServe access.

---

**Hyundai 466D2TE**

New Breed Power Server

- 66MHz 486DX2 CPU w/8KB integrated cache
- 128KB high-speed L2 cache
- 32-bit EISA architecture
- 8MB RAM standard (expandable to 32MB on system board and 96MB via memory expansion board)
- 32-bit caching SCSI host adapter
- 340MB 12ms SCSI HDD, 256KB disk buffer
- 1.44MB 3-1/2" and 1.2MB 5-1/4" FDDs
- VGA graphics card
- 14" interlaced, ultra-high resolution, flicker-free, color display with 1024 x 768 resolution, 28 dot pitch, 72Hz refresh rate
- Seven 32-bit EISA slots, one ISA slot
- 5 external and 2 internal drive bays
- 390 watt power supply
- Built-in virus protection, front keylock, 2 level password
- 101 keyboard, 2 button mouse
- MS DOS 5.0 and Windows 3.1

---

$3995

---

**HYUNDAI**

PCs designed and built in America

FOR DIRECT SALES 1-800-933-3445
Hey, do something pronto! Fax your standard (or targeted) system configuration to one of our System Specialists. We'll spec it out and call you back with a system quote that beats the cows. Or anyone else!

Fax your specs to 1-800-283-4986

Your Name __________________________________________ Title __________________________

Company __________________________________________

Address __________________________________________

City __________________ State ______ Zip ____________

Phone( ) __________________________ FAX( ) __________________________

Number of PCs in your current site_________ Brans you have standardized on__________

Other brands you are considering __________________________

Number of PCs installed 486____ 386____ 386SX____ 286____

Tell us about your targeted system configuration

CPU Type

- 486
- 486SX
- 386DX
- 386SX
- Notebook

Architecture

- ISA
- EISA

Memory

- __MB installed
- Cache Memory 128 KB
- 256 KB

Floppies

- 1.44MB 3-1/2"
- 1.2MB 5-1/4"

Hard Disks (IDE)

- 100MB
- 120MB
- 200MB
- 250MB
- 330MB
- 500MB

(SCSI) 3.5"

- 360MB
- 540MB
- 1.2GB

5.25"

- 330MB
- 760MB
- 1.6GB
- 2.0GB

- Tape __MB
- Sound Card
- Other __
- Fax/Modem
- CD-ROM

Call for more options! Number of PCs you intend to order: ______________________

Other special needs: __________________________________________________________

Hyundai's recommendation and quote. Based on your input, here's what we recommend:

And here's our price: __________________________

If we don't beat your other quotes, call us.

Call Hyundai Direct at 1-800-933-3445

HYUNDAI

For the dealer nearest you call 1-800-288-4986

Headquarters: San 136-1, Ami-Ri, Bubal-Myun, Ichon-Kun, Kyungki-Do, Korea. Tel: (02) 741-0661/4. TLX : K23955/7. HDETN Fax: (02) 741-0737

Worldwide PC Operations:166 Baypointe Parkway San Jose, CA 95134 (408) 473-9200
COMING IN FROM THE COLD

JERUSALEM—The religious persuasion of a software developer is usually irrelevant in the marketing of a product in Europe or the U.S. But in the Middle East, careful consideration of the cultural image you present is crucial. Computers, politics, and religion may be oceans apart in some places, but here politics and religion often influence decisions before anything else. That, however, may be slowly changing.

As an example of how religion may influence computers, consider Iran, perhaps the most sensitive of all Middle Eastern countries. An Apple dealer in Iran was forced to modify the familiar Apple logo to a whole green apple: There was a fear that the traditional Apple logo with the bite missing was an unfortunate reminder of the story of Adam and Eve bringing sin into the world through the tree of knowledge.

Many Israelis take a more pragmatic and even lighthearted view of computers, politics, and religion. As we drove from Jerusalem Airport to Jerusalem, Ben Gruber, the director of the local Apple Center, laughed as he explained that the same journey on the Sabbath was doubly dangerous. “You get stoned by the Palestinians as you cross the Intifada, and by the religious Jews as you drive through Jerusalem.”

The Israelis have become sensitized to the concerns of the countries around them. Of course, they have to be. The indigenous Israeli computer market is small—after all, the Israeli population is just 4 million—and software developers need to look to overseas markets to make the development cost effective.

One of the best markets is right next door in the various Arab countries. Hebrew and Arabic share some common features (e.g., reading from right to left). Thus, creating an Arabic version of a Hebrew product is a relatively simple task.

But selling software with an Israeli address in an Arab nation would be ill-advised even for the most progressive of companies. They therefore must practice sleight of hand. One Israeli company (which asked to remain nameless for obvious reasons) develops one of the leading pieces of Arabic software, but it uses an overseas office to supply the software.

Many overseas companies are more direct in their dealings with Israel and eager to invest in its technology. The investment is obvious when you realize that Motorola is the fifth biggest electronics company in Israel and Intel comes in a creditable ninth.

But surprisingly, until recently, one of the world’s leading high-tech nations was missing from Israel. Japan’s dependence on Arab oil had forced it to toe the Arab League’s Israeli boycott. However, Noam Eshkol of the Israeli Export Institute believes that, since the Gulf War, the Japanese are finally coming. “In the last year, we have seen a dramatic increase in the numbers of Japanese companies arriving in Israel,” he says. And they’re not here to sell—they’re here to buy Israeli high-tech skills.

Combining high-tech skill with marketing sleight of hand creates a perfect breeding ground for high-tech trickery. Illegal software copying in Israel is rife. At least four of the world’s computer viruses and some of the world’s more infamous hackers have emerged from Israeli universities.

Yanki Margalit believes that this places Israeli virus- and copy-protection software at the technological forefront. His company, Aladdin Knowledge Systems, has produced more than 350,000 dongles in seven years and claims that almost 80 percent of the software sold in Israel is protected. His eyes light up as he fingers one of his dongles and explains the ingenuity that is required in beating the software thieves: “We always have to innovate to beat the hacker, especially in this country.” His techniques include modifying interrupts and creating write-only code, and even self-modifying code, just to beat the ingenious pirate.

A new hope appears to be dawning in Israel. The slowly emerging peace is bringing economic dividends to Israel, especially to its high-tech industry.

Although it is still perhaps far off, someday it may be possible for a computer product to be judged not by its country of origin, but solely by the ingenuity of its design and the quality of its implementation. Maybe that day will come sooner than we think.
Now you can make your computing investment work twice as hard with the Northgate® ZXPortable™

At first glance, this powerful solution looks like a desktop computer. And it is...complete with 486SX™/25 power and performance. But take a closer look. The heart of this system is actually an 8.5"x11" notebook computer.

This insightful "two-in-one" engineering is ideal for corporate settings. The 486SX/25 power speeds you through the most demanding applications.

You get exceptional connectivity as well, letting you take full advantage of your existing network.

Active Cowr Matrix system also available for only $3799 Features 512 colors, plenty of contrast and superior video response.
When business takes you out of town, simply slide the ZXPortable out of the docking station and take it with you. The quick, 120MB hard drive gives you excellent storage capabilities — even for Windows™ OS/2® and other complex operating systems.

Select our popular $1999 monochrome system, or our Active Color Matrix model priced at an incredibly-low $3799. Either way, you'll enjoy sharp, 640x480 video and Advanced Power Management benefits. Docking station prices begin at just $599 including 5.25" floppy drive.

Call now and we'll explain all the other advanced features and service and support policies that made Northgate a leader.

Call For More Information
800-345-0178

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-858-0870

GSA #GS00K91AGS5193 PSO1

Major Credit Cards, money orders, direct wire and approved company purchase orders accepted.

Call For More Information
800-345-0178

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-858-0870

GSA #GS00K91AGS5193 PSO1

Major Credit Cards, money orders, direct wire and approved company purchase orders accepted.

Call For More Information
800-345-0178

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-858-0870

GSA #GS00K91AGS5193 PSO1

Major Credit Cards, money orders, direct wire and approved company purchase orders accepted.

Call For More Information
800-345-0178

Major corporations, volume purchasers and government agencies call National Business Accounts: 800-858-0870

GSA #GS00K91AGS5193 PSO1

Major Credit Cards, money orders, direct wire and approved company purchase orders accepted.
New Macs for the Desktop and Road

TOM THOMPSON

To stay ahead of the pack in the highly competitive personal computer market, Apple is updating its computers and introducing new ones as rapidly as possible. Apple is beefing up the aging Mac II line with two new members: the Mac Ilvi and Ilvx. The notebook line is gaining the PowerBook 160 and 180. Finally, two other Macs, the PowerBook Duo 210 and 230, are fresh on the scene. Duo comes from their dual personalities. Alone, they act as 4'/2-pound notebooks. When parked in a unique docking station, however, they function as desktop computers.

These six new Macs come with System 7.1, a significant revision of System 7.0 that supports the new computers and manages 2-byte foreign-language typefaces.

Apple rolls out
inexpensive desktop systems, beefed-up notebooks, and its first notebook/docking station

New Members of the Mac II Family
The Mac Ilvi (available only overseas) and Ilvx share a IIci-style chassis, a 68030 CPU, a SIMM socket for ROM upgrades, three NuBus slots, the usual I/O ports, and built-in video. The Mac Ilvi operates at 16 MHz, and it has a socket for an FPU. The Ilvx's CPU and 68882 FPU are clocked at 31.3344 MHz, and the unit has a 32-KB on-board cache of 25-nanosecond SRAM (static RAM). (See the table for further feature information.)

If you ignore the new systems' different processor speeds, much of this hardware seems like a 25-MHz Mac IIci, but there are differences. These new Macs have a metal housing that can support the weight of a 16-inch monitor. They also have a larger power supply (112 watts) to run half-height 5¼-inch SCSI peripherals (e.g., a CD-ROM drive) that might occupy the big bay at the machine's front. An internal bay accommodates smaller 3½-inch SCSI peripherals.

The main logic board has 4 MB of RAM, and you can expand memory up to 68 MB. The ROMs are 1 MB. The Ilci's PDS (Processor Direct Slot) cache slot has become an accelerator slot in these computers. It's missing the cache-control lines found in the Ilci's PDS slot, but all the processor bus signals are there, so you can plug the accelerator board into it.

The circuitry in the Ilvi's and Ilvx's built-in video recognizes 12- to 14-inch monitors and is capable of supporting 16-bit-deep displays when you upgrade video memory. The video screen's frame buffer occupies dual-ported VRAM (video RAM) rather than residing in main memory.

Sound capabilities on the Ilvi and Ilvx are provided by a modified Mac LC ASIC (application-specific IC), rather than the Apple Sound Chip found in the IIci. The ASIC handles sound input and output, and the sound circuitry musters a respectable 7.1-kHz range at a 22-kHz sample rate. Finally, like the video frame buffer, the sound buffers live in VRAM, an arrangement that eliminates a performance hit when sounds are played.

Next-Generation PowerBooks
The PowerBook 160 and 180 both use the proven PowerBook 140/170 design, which
The PowerBook software boasts fastening the LCD screen to the computer. As do their predecessors, the PowerBook 160 and 180 weigh 6.8 pounds. Apple equipped each with 4 MB of PSRAM (pseudostatic RAM). The PowerBook 160 has a 25-MHz 68030 CPU and no FPU; it uses 80-ns PSRAM. The 180 has a 33-MHz 68030 CPU and a 68882 FPU; it uses 70-ns PSRAM. For sound generation, they use the Enhanced Apple Digital Sound Chip, which provides an 11-kHz frequency range.

Memory on the new PowerBooks is expandable to 14 MB, up from the 8-MB limit imposed by the previous design. If you simply can’t fit your files on an 80-GB SCSI hard drive, a 120-GB version is available. The 10-inch-diagonal backlit LCD screens, engineered to be brighter with more contrast, support 16 levels of gray. The PowerBook 160 uses a super-twist LCD screen, and the 180 uses an active-matrix LCD screen. If you take your presentations on the road, a built-in video port at the rear of the computer drives 12- to 16-inch color monitors.

The PowerBook system software boasts some improvements as well. You can set the backlight to automatically switch off when the PowerBook sits idle for a certain time interval, extending battery life. The newest system software feature isn’t new, however, coming from the low-end PowerBook 100: A Control Panel lets you assign the SCSI ID of the PowerBook’s main logic board. With the proper SCSI cable, this lets you mount the PowerBook 160 or 180’s hard drive as a volume on your desktop Mac to easily move massive amounts of data between your desktop computer and the PowerBook.

Is It a Notebook or a Desktop? Although it’s nice to talk about exchanging files between an office Mac and a PowerBook to let you work on the road, the reality is that some of us can’t afford two computers. Apple’s answer for this is a new line of computers: the PowerBook Duos. These powerful yet lightweight notebook computers are designed to operate either stand-alone or inside a docking station called the Duo Dock. The Duo Dock provides ample expandability and resources, while the PowerBook Duos pack enough horsepower to function as desktop computers.

The PowerBook Duo line comes in two versions: the PowerBook Duo 210, with a 25-MHz 68030 CPU, and the Duo 230, with a 33-MHz 68030 CPU. The Duos are small, dark slabs just 1.4 inches thick and weighing only 4.2 pounds each. Apple achieved the low weight by using a magnesium frame that provides structural strength and acts as a heat sink. A smaller, recessed trackball helps achieve the computer’s low profile. Nickel-metal-hydride batteries provide sufficient power and should last 4 to 4.5 hours.

Both computers use a 9-inch-diagonal super-twist LCD screen that supports 16 levels of gray. Standard memory is 4 MB of DRAM (80 ns for the 210, 70 ns for the 230) located on the main logic board, expandable to 24 MB via a memory board plugged into a RAM-expansion connector. To add RAM, you remove the keyboard, plug the memory board into the RAM connector underneath, and replace the keyboard. There’s also a modem connector for an optional internal fax modem board. Like the PowerBook 160 and 180, the Duo carries a built-in microphone on the case near the hinge.

The Duos’ main logic board is packed with the 68030 CPU, 1 MB of ROM, an SRAM that stores power management code, DRAM, and custom ASICs. The main system-controller ASIC manages most I/O, the sound system, and timing. A microcontroller handles much of the power-saving operation, and a Combo chip provides SCSI and serial I/O. The

---

**PRELIMINARY BENCHMARK RESULTS**

<table>
<thead>
<tr>
<th>CPU index</th>
<th>FPU index</th>
<th>Disk index</th>
<th>Video index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mac Classic II</td>
<td>PowerBook 160</td>
<td>PowerBook 170</td>
<td>PowerBook 180</td>
</tr>
<tr>
<td>PowerBook Duo 210</td>
<td>PowerBook Duo 230</td>
<td>Mac Iici</td>
<td>Mac Ilvx</td>
</tr>
<tr>
<td>Mac SE/30</td>
<td>Mac Iivi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Relative subsystem performance of the new Macs. For all tests, a Classic II = 1. Higher numbers indicate better performance. The Mac Iici didn’t have a cache board, and the Iivi had an FPU. Existing Macs ran System 7.0.1, while the new Macs ran beta System 7.1 software. The Duos were docked and had access to an FPU.

---

DECEMBER 1992 • BYTE 45
sound system has a frequency response of 7.1 kHz.

It's important to note, however, that there's no 68882 FPU or built-in floppy drive, and while the I/O subsystems are present, many of the ports and their interface chips are absent. These lines and CPU bus signals get routed to a covered 152-pin expansion connector at the computer's rear. The connector communicates to the docking station. Besides this connector, the only other ports are a LocalTalk port and a RJ-11 socket for a modem board. The bulk of the fax modem board's functions are implemented in software. This provides design flexibility for adding features, but it also burdens the CPU when sending a fax or data file.

The Duo Dock docking station provides what the PowerBook Duos lack. Outside, it resembles a Mac IIfx, but in front is a flat opening into which you insert the PowerBook Duo. At the rear are all those missing I/O connectors: ADB (Apple Desktop Bus), two serial, SCSI (uses the funky PowerBook HD1-30 connector), sound I/O, RJ-11 modem passthrough, and DB-15 video. A SuperDrive floppy drive is located on the right side. Inside, the Duo Dock has a 75-W power supply, an FPU socket, and built-in video support for 12-to-16-inch monitors. You can expand VRAM to provide 16-bit color on 13-inch and VGA monitors.

The station also has two NuBus slots and room for an internal 3½-inch SCSI hard drive. The housing is reinforced with steel beams to support large monitors. Inside the Duo Dock, the expansion connector passes I/O and processor bus signals to the docking station's hardware and the I/O ports in back. The Duo Dock charges the PowerBook Duo's battery as necessary.

Putting the PowerBook Duo into the Duo Dock is as easy as placing a videotape into a VCR. First, you move the expansion connector's hood and slip the PowerBook into the docking station. As the Duo slides into the Duo Dock, it blocks an optical sensor. Two hooks come forward, grab onto holes beside the expansion connector, and haul the computer inward the last 5 millimeters. This pulls the expansion connector onto a plug inside the Duo Dock. A motorized, damped ejection mechanism gently pushes the computer
Configuration and price*

<table>
<thead>
<tr>
<th>RAM/Drive</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 MB RAM/40-MB drive</td>
<td>$2600</td>
</tr>
<tr>
<td>4 MB RAM/80-MB drive</td>
<td>$2900</td>
</tr>
<tr>
<td>5 MB RAM/80-MB drive, plus CD-ROM</td>
<td>$3400</td>
</tr>
<tr>
<td>4 MB RAM/80-MB drive, plus CD-ROM</td>
<td>$2949</td>
</tr>
<tr>
<td>4 MB RAM/230-MB drive, plus CD-ROM</td>
<td>$3319</td>
</tr>
<tr>
<td>5 MB RAM/80-MB drive, plus CD-ROM</td>
<td>$3219</td>
</tr>
<tr>
<td>4 MB RAM/40-MB drive</td>
<td>$2429</td>
</tr>
<tr>
<td>4 MB RAM/80-MB drive</td>
<td>$2789</td>
</tr>
<tr>
<td>4 MB RAM/120-MB drive, plus CD-ROM</td>
<td>$3149</td>
</tr>
<tr>
<td>4 MB RAM/80-MB drive, plus CD-ROM</td>
<td>$3869</td>
</tr>
<tr>
<td>4 MB RAM/120-MB drive, plus CD-ROM</td>
<td>$4229</td>
</tr>
<tr>
<td>4 MB RAM/80-MB drive</td>
<td>$2249</td>
</tr>
<tr>
<td>4 MB RAM/80-MB drive</td>
<td>$2609</td>
</tr>
<tr>
<td>4 MB RAM/120-MB drive, plus CD-ROM</td>
<td>$2969</td>
</tr>
</tbody>
</table>

Tom Thompson is a BYTE senior editor at large with a B.S.E.E. from Memphis State University. He is an associate Apple developer. You can contact him on BIX as "tom_thompson" or on the Internet at tomt@bytepb.byte.com.

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(800) 776-2333

Options:
Mac Duo Dock, $1079;
Mac Duo MiniDock, $589;
PowerBook Duo Floppy Adapter, $135

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(800) 776-2333
(408) 996-1010
fax: (408) 974-6412

Circle 1162 on Inquiry Card.

DECEMBER 1992 • BYTE 47
As they say, it's all in the genes. Introducing the ThinkPad™ from IBM. The slickest, sleekest little number that ever crunched one. A mere seven-and-a-half pounds of brains and beauty that begs you to take it anywhere. And once you own one, that's exactly what you'll do.

Introducing

ThinkPad

The top-of-the-line ThinkPad 700C sports a screaming 486 SLC™ 25 MHz processor. But it's built for comfort too. There's a surprisingly roomy interior, with a full-size, ergonomically designed keyboard. And a screen that literally bends over backwards.

Strategically placed on the keyboard is a little red spot called the TrackPoint II. It does what a mouse would do with a few million more years of evolution. Nothing dangles; it's part of the soul of the machine. You can operate it with one fingertip. And it lets you think on any terrain, even one without any flat surfaces.

The ThinkPad's screen is a thing of almost aching beauty. Its 640 × 480 VGA resolution is sharper than that of many desktop computers. It displays 256 colors. And it's the biggest screen on any notebook. So it's very easy on the eyes.

The ThinkPad comes standard with things some other notebooks don't even offer as options. Like 4MB

*Depending on usage and configuration. **MSRP. Dealer prices may vary. fWarranty information available from the Personal Systems HelpCenter or an IBM authorized dealer. IBM 700T warranty is available in USA and Canada only. 1-1 in Canada, call 1 800 465-7999. IBM is a registered trademark and ThinkPad, HelpWare, HelpCenter, SLC and TrackPoint II are trademarks of International Business Machines Corporation. PRODIGY is a registered trademark of Prodigy Services Company. © 1992 IBM Corp.

Its mother was

Its father was
of memory upgradable to 16MB. 120MB of hard disk space. Pre-installed DOS 5.0 and PRODIGY.® You can soup it up with a turbo-charged 486SLC 50/25 MHz processor—just one of the upgrade products IBM offers. And the hard disk is removable, so it's easy to upgrade and share your ThinkPad, not to mention the great security and virtually unlimited storage.

ThinkPad blows the doors off its competition in an even more surprising arena. Price. Any ThinkPad in the line will give you more for your money—and for your psyche—than any other notebook.

If you have questions along the way, ThinkPad Models 700C and 700 are supported by HelpWare®, an invaluable service package that includes a three-year international warranty.

<table>
<thead>
<tr>
<th>ThinkPad</th>
<th>Model 700C</th>
<th>Model 700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>486 SLC/25 MHz</td>
<td>486 SLC/25 MHz</td>
</tr>
<tr>
<td>Display</td>
<td>10.4” Active Matrix 256-Color Screen</td>
<td>9.5” Monochrome Display 64 Grayscale Screen</td>
</tr>
<tr>
<td>Battery Life*</td>
<td>2–4 Hours</td>
<td>3.6–7.5 Hours</td>
</tr>
<tr>
<td>Weight</td>
<td>7.6 Lbs. with Battery</td>
<td>6.5 Lbs. with Battery</td>
</tr>
<tr>
<td>Warranty</td>
<td>3 Years (International)</td>
<td>3 Years (International)</td>
</tr>
<tr>
<td>Price**</td>
<td>$4,350</td>
<td>$2,750</td>
</tr>
</tbody>
</table>

For more information or an IBM authorized dealer near you, call our Personal Systems HelpCenter® 24 hours a day, 7 days a week at 1 800 772-2227.++

Then just park one in your lap and see what happens.

Circle 103 on Inquiry Card.
CA-REALIZER—Now For A Limited Time Only $99.

Above And Beyond Basic.

INTRODUCING THE EASIEST BASIC DEVELOPMENT SYSTEM FOR WINDOWS.
Compared to Visual BASIC, CA-REALIZER® is half the cost and twice the product.

Develop applications using the familiar procedural language model and a large array of powerful tools. You don’t need to learn all kinds of confusing new techniques. Just type in programs or design them visually with FormDev. It’s an interactive WYSIWYG, point and click tool that generates code. With a single command you can add Programmable Application Tools like spreadsheets, charts, text editors, animation, graphics tablets and user-friendly forms. And CA-REALIZER offers many features other BASICs don’t, like automatic array processing.

Arrays are re-dimensioned and processed automatically. Algorithms can be written as formulae instead of complex looped expressions.

Once an application is complete, you can compile it into a stand-alone Windows application and distribute it royalty-free with the runtime module that’s included. And you can generate an installation disk with the push of a button.

PC Computing said, “No other Windows BASIC can match it for power and breadth of features.”

And at $99, they can’t match the price either.
So call 1-800 CALL CAI today for more information and the name of your nearest dealer.

---

<table>
<thead>
<tr>
<th>Feature</th>
<th>CA-REALIZER</th>
<th>Visual BASIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive WYSIWYG Application &amp; Form Designer</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Generates User Accessible &amp; Modifiable BASIC Code</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Familiar Procedural Programming Model</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Integrated Full-Featured Debugger</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Single-Stepping, Call-Tree, Variable Display</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Automatically Expandable Dynamic Arrays</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Full Range Of Fast Array Operators &amp; Functions</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Mathematical, Statistical, Date-Time Functions</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Dynamic Addition &amp; Removal Of Form Objects</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Fully-Integrated Programmable Application Tools:</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Charts, Spreadsheets, Text Editors, Graphics, Animation, Scheduler</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Ability To Run Multiple Applications Simultaneously</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Full Support For DDE &amp; DLLs</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Direct MDI Support &amp; Serial Communications Library</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Import/Export Of 1-2-3, Excel, CA-SuperCalc Files</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Extensive Context Sensitive On-Line Help</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Clip Art Library With Over 250 Bitmaps</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>QuickBASIC Version 7.0 Compatibility Libraries</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Don’t waste another day trying to figure out Visual BASIC.
Leave that for your competition.

CA-Realizer


Circle 84 on Inquiry Card.
Microsoft's Windows Database

JON UDELL

SQL and ISAM data meet Visual Basic in Access, Microsoft's powerful new database tool

Microsoft’s long-rumored Windows database has finally arrived, and it’s been worth the wait. In brief, Microsoft Access is a marriage of SQL (Structured Query Language) and Visual Basic, and it’s a happy union.

The Access development environment is a tour de force of user-interface design. MDI (Multiple Document Interface) child windows contain multiple active tables, forms, and reports. The object editors and subeditors manage hundreds of properties cleanly, offering drop-down lists of valid options wherever possible. You can hop instantly between design and execution modes using toolbar buttons. Drag-and-drop opportunities are pervasive. And intelligent assistants help you create standard forms and reports, specify visual motifs (e.g., chiseled or embossed), and populate them with database fields.

In Access, you can program on two levels: macros or an embedded language called Access Basic, which extends Visual Basic in several ways. Access Basic’s new data types include tables, queries, forms, and fields. It also adds some handy features not in the current version of Visual Basic: variant data types that convert between strings and numbers as needed, group property assignment for multiple selected objects, and listboxes that you can populate by means of user-defined callback functions.

Because macros and Access Basic functions can call each other, there are always several approaches to any programming problem, which is a good thing. However, I found that the two languages can differ subtly in how they interact with data and user-interface objects. Understanding the best uses of each will take time, although it’s clearly a key to proficiency with Access.

SQL Without Programming

Although it speaks a SQL dialect natively, you’ll have to go out of your way to find a SELECT or UPDATE statement. Access wraps a rich set of table, query, form, and report objects around its SQL. Using these alone—without any programming—you can cover a lot of ground.

Consider my test application (see the screen). It relates a parent table of authors to a child table of articles through an intermediate table that handles the many-to-many relationship of authors to articles. Access can enforce referential integrity, and I exploited that feature to ensure that the intermediate table would reject entries containing authors or articles not present in their respective primary tables. The author table includes a whimsical map field with an active OLE link to a Paintbrush bit map. Both tables feature VCR-style controls. They are fully editable and lock automatically in multiuser mode. The find drop-down listbox presents a picklist of authors, and the filter drop-down listbox offers a list of fields available for filtering. All this took zero lines of code.

Like most SQL databases, Access maintains a single disk file per database, storing multiple tables within that file. It’s not a database server, however. In a multiuser situation, each Access client must fetch records from shared storage and process them locally.

Little or no programming yields impressive results, thanks to the rich set of objects available to the Access developer.
With the Open Database Connectivity driver, though, you can connect Access to remote SQL servers. The beta version of Access I tested came with the generic Windows ODBC driver and an ODBC setup script for Microsoft’s SQL Server. Installing the Windows driver makes Access (or any ODBC-aware Windows application) a potential client of SQL Server (or any ODBC-aware SQL data source). Running the SQL Server script adds the necessary stored procedures on the server side and drives the golden spike.

Access can attach and work with Paradox, dBase, and Btrieve files. (FoxPro support is in the works, but it won’t be available when Access ships.) Access includes engines that understand Paradox, dBase, and Btrieve engines, and it will maintain foreign indexes in place. That means that Access and, say, Paradox can enjoy live multiuser access to shared files. Access’s update capability will also be a great enhancement to products such as Btrieve and FoxPro.

Although it lacks FoxPro’s blazing speed when querying single tables, Access holds its own, and it really cranks through multitable queries. Queries continue to run in the background even as you’re editing the first screenful of data—a real productivity boon. Access is simply a tremendous piece of work. Multituser relational database programming for Windows remains a daunting task, but I can’t think of a better tool for the job.

Jon Udell is a BYTE senior technical editor at large. You can contact him on BIX as “judell” or on the Internet at judell@byte-ph.byte.com.

**THE FACTS**

**Microsoft Access**

$695

System requirements:
A 386 or higher with DOS 3.1 or higher, Windows 3.0 or higher, 4 MB of RAM, and 10 MB of available hard drive space.

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329

Circle 1163 on Inquiry Card.

---

Apricot XEN-LS II Adds Multimedia Value

**GLENROTHES, SCOTLAND**—According to an old English saying, nothing is a bargain if you didn’t need it in the first place. In these times of acute recession, multimedia has been hyped mercilessly as the future of computing, giving suppliers something to do with available computing power. This is the approach that Apricot Computers seems to have taken with its Apricot XEN-LS II, a multimedia station that brims with added value—value, that is, if you need it.

The XEN-LS II is designed like a PC buyer’s Christmas stocking. It’s packed full of everything you could possibly want: Apricot’s proprietary LOC Technology security features, plug-and-play networking, professional audio (it’s equipped with a CD-ROM drive, stereo speakers, and a software mixing desk), and large amounts of memory and storage space. The question, however, is, will people buy a system with so many extra features when their value remains unproven?

The XEN-LS II we looked at was a 66-MHz 486DX2-based machine with 16 MB of RAM, a 200-MB hard drive, and a high-resolution Super VGA 17-inch color monitor. The system unit is a wide, low-slung charcoal gray box. On either side sit speakers (with volume control). Floppy drives are fitted snuggly above the speakers. In the center of the plastic facade is a drawer that protects the optional CD-ROM drive.

The professional audio capabilities qualify the XEN-LS II as MPC compliant—that is, in line with the specifications laid down by a group of manufacturers, led by Microsoft, that make up the MPC conso-

---

**THE FACTS**

**Apricot XEN-LS II**

with a 486DX2/66, 16 MB of RAM, a CD-ROM drive, a 200-MB hard drive, and a 17-inch color Super VGA monitor: about $6500 (£3825)

Apricot Computers
3500 Parkside
Birmingham Business Park
Birmingham B37 7YS
U.K.
+44 21 7177171
fax: +44 21 7177799

Circle 1164 on Inquiry Card.
The Sound Choice
In Multimedia Upgrade Kits.

If upgrading your PC to MPC standards sounds good to you, we can make it sound even better. With a multimedia upgrade kit from Creative Labs.

For only $799, you get the only multimedia upgrade kit with Sound Blaster™ Pro, winner of the MULTIMEDIA WORLD Readers’ Choice Award for “Best Sound Board.” Experience true-to-life 8-bit stereo audio effects from applications and games. With MIDI adapter cable and sequencing software, plus a 20-voice, 4-operator FM music synthesizer, Sound Blaster Pro is one sound investment!

And that’s only the beginning. There’s a high-performance CD-ROM drive that surpasses MPC specifications. Plus a FREE library of CDs that will open your PC to all the possibilities of multimedia computing. Over $3,000 worth of the hottest CD titles for multimedia authoring and enhanced education, entertainment, and productivity capabilities for your computer.

You get Microsoft® Windows™ 3.1, Microsoft Bookshelf,® a reference resource with an encyclopedia, thesaurus, and dictionary. Microsoft Works for Windows,® an integrated productivity package. MacroMind® Action!,™ Authorware® Star™ and Tempra™ from Mathematica, presentation tools for DOS and Windows. Sherlock Holmes, Consulting Detective, the award-winning mystery game. And many, many more.

The Sound Blaster Multimedia Upgrade Kit. At only $799! To find out more, visit your computer retailer or call Creative Labs at 1-800-998-LABS.

And see why choosing our multimedia upgrade kit is the most sound decision you’ll ever make.

Sound Blaster is a trademark of Creative Labs, Inc.
All other marks are owned by their respective companies. © 1992 Creative Labs, Inc. All rights reserved.
International inquiries: Creative Technology, Ltd., Singapore Tel 65-773-0233 Fax 65-773-0353

Circle 172 on Inquiry Card.
When you own a Northgate® ZXP™ system, you'll never have to worry about what the future of computing holds. That's because Northgate designed total 486 upgradability into every one of these powerful systems – from 486SX/25 to OverDrives. You can also choose from a complete selection of networking options.

These systems feature our unique ZIF socket that gives you the most cost-efficient upgrade path on the market. In fact, all it takes is a flip of a lever and a new processor. Select our SlimLine™ with 32-bit local bus video and virtual caching, or one of our three Elegance™ cabinet styles.

Call now and one of our sales reps will help you select the system that's right for you.

Here's One Of Our Feature-Rich "Solutions For Workgroups"

- Intel® 80486DX/33 MHz processor
- ZIF (Zero Insertion Force) socket for easy upgrades
- 4MB RAM
- 100MB hard drive
- 1.2MB 5.25" and 1.44 MB 3.5" floppy drives
- 1024 x 768 color monitor
- MS-DOS® 5.0
- Microsoft® Windows™ 3.1 and mouse
- Award-winning service and support
- 30-day money back guarantee
Northgate ZXP 486DX/33
Configured As Shown

SlimLine™ ZXP™ 486DX/33 .... $2299
(Lease it for $85.06 per month)*

Elegance™ ZXP Space-Saving
Desktop Case .......................$2349
(Lease it for $89.91 per month)*

Elegance ZXP Desktop Case .... $2399
(Lease it for $88.76 per month)*

Elegance ZXP Tower Case ...... $2499
(Lease it for $85.47 per month)*

486SX/25, 486DX2/50, 486DX2/66
and OverDrives are also available.

Call For More Information
800-521-1496

Major corporations, volume purchasers and
government agencies call National Business
Accounts: 800-828-6132

GSA #GS00R91AGS5193 PSO1

Major credit cards, money orders, direct wire and
approved company purchase orders accepted.

“Solutions For Workgroups™
7075 Flying Cloud Drive, Eden Prairie, Minnesota 55344

shipping/handling charges or appropriate sales taxes. Offer valid in the U.S. and Canada only. Prices and specifications subject to change without notice. Northgate reserves the
right to substitute components of equal or greater quality or performance. All items subject to availability. We support the ethical use of software. To report software copyright
violations, call the Software Publishers Association Anti-Piracy Hotline at 1-888-588-PIRR. *Monthly lease payments are based on a 60-month standard, fair market value
open-ended lease. 12-60 month leasing options available for qualified businesses.
Microsoft's Small-Screen Debut

On the Mac, QuickTime has turned multimedia from a hollow buzzword to a vibrant technological frontier. QuickTime's most visible contribution is a standardized scheme for capturing, storing, and playing back digital full-motion video. Microsoft has finally taken the wraps off its answer to the video component of QuickTime: Video for Windows.

Video for Windows, formerly known as Audio-Video Interleaved (AVI), is a software module that plugs into Windows 3.1. Like QuickTime, it creates a hardware-independent foundation for full-motion video. The beta version of Video for Windows I looked at included drivers for a handful of video-capture boards. I used the Video Blaster from Creative Labs installed in a Unique-486/50. The video was brought in from a Panasonic AG-7650 Super-VHS industrial VCR and a Sony V-deck computer-controllable Hi8 VCR.

Video for Windows installs through Windows' loadable driver mechanism. It's unclear what form the software will take when it ships, but the beta version included an automated installation procedure that set up all of Video for Windows' components. Video for Windows includes an MCI (Media Control Interface) driver that adds the AVIvideo media type to Windows' multimedia extensions. MCI provides the Video for Windows programming interface, using simple commands such as open, play, and seek to control the playback of video files.

Microsoft provides a fairly capable capture program, VidCap, in its package. VidCap shows the flexibility of the system underneath it and provides a remarkably broad range of choices that lets you tune the ratio between quality and storage space. You can set audio parameters as you would in any Windows 3.1 audio program; you can choose 11-, 22-, or 44-KHz rates, in 8 or 16 bits and in mono or stereo, for each new capture you do. Similarly, you can set the video-capture frame rate, resolution, and bit depths (i.e., 8, 16, or 24 bits per frame) before you start to record. Freshly captured files are recorded raw, with no compression.

Video for Windows processes 8-bit video using an interesting paletizing scheme. Incoming video is instantly matched to a user-defined palette. You can load and save palettes by name. The default palette displays captured video in shades of gray. You can set the number of colors occupied by the video, so you can leave room in the palette for other Windows applications.

This is a good approach. If you want your palette to be dominated by flesh tones, you can select a portion of your video that primarily features people's faces. What VidCap can't match directly in the palette you select, it approximates with dithering.

Raw AVI files can be compressed after the fact by firing up Microsoft's video editor, VidEdit. The beta kit included a set of software-based compression algorithms. Like other elements of Video for Windows, the software compressors are supremely tunable, letting you target a specific data transfer rate to cover fast and slow hard drives and CD-ROM drives. For some of the compressors, a sliding scale lets you set the relative video quality. Lower quality settings negatively impact the video's appearance.

VidEdit's compression interface (see the screen) is unique: It puts up a preview window that lets you see a continuously updated video frame (which you select) that is run through the compressor in response to changes in the compressor settings. Once you tune the compressor, VidEdit reinterleaves and compresses the data, showing each frame as it's compressed. In addition to compression, VidEdit handles rudimentary cut-and-paste editing. It's miles below Adobe Premiere, but it's good enough to illustrate Video for Windows' capabilities.

The inevitable tendency is to compare Video for Windows to QuickTime, especially since Apple plans to get QuickTime running under Windows. Compared to QuickTime on the Mac, I think Video for Windows looks better. What gives Video for Windows an edge is the multimedia infrastructure it plugs into. Windows' multimedia extensions provide developers with a unified programming interface to digital audio, MIDI, CD audio, animation, video overlay, external video device control, and now digital video. On the downside, Video for Windows retails for $199, whereas QuickTime is part of the Mac's system software.

With Video for Windows, Microsoft closes the gap that once made Windows a second-class multimedia environment. The real measure of its future success will be the speed with which vendors move to implement it in their software. If Apple's experience with QuickTime is any indication, you'll be seeing a lot of digital video on Windows desktops soon.

—Tom Yager

**THE FACTS**

**Video for Windows**

$199

**System requirements:**

A 16-MHz 386SX or higher with a multimedia PC audio board, an 8-bit or greater VGA board, and a large hard drive or CD-ROM drive. Video capture and playback require a 33-MHz 386 or higher with a video-digitizing (or capture) board and Windows 3.1.

Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 936-7329
Circle 1165 on Inquiry Card.
Here.

There.

Everywhere.

The HP DeskJet Portable.
$599.

Hewlett-Packard presents the DeskJet for the jet set. The new HP DeskJet Portable printer lets you create great-looking documents anywhere you go. It’s small enough to fit in a briefcase and weighs only 4.4 pounds. But the DeskJet Portable prints high-quality 300 dpi black and white text and graphics on plain paper, transparencies or labels.

It’s everything you expect from your office printer in a portable package. Compatibility with most major software. A fast print speed of up to three pages per minute. A wide variety of typefaces, sizes and styles. And Hewlett-Packard inkjet technology, so you don’t have to sacrifice print quality for portability.

The DeskJet Portable is built tough to take more than the usual amount of jostling. And, to make it even more versatile, an optional rechargeable battery is available, along with a Worldwide Rapid Recharger, a 50-page cut-sheet feeder and a handy carrying case.

To top it off, the DeskJet Portable has a price tag befitting its small size. Just $599.* Who says you can’t take it with you? Call 1-800-552-8500, Ext. 7108,† for the name of the authorized HP dealer nearest you. To receive information by fax call 1-800-333-1917, choose HP FIRST, document #9606.

DeskJet Printers
Make it happen.

* Suggested U.S. list price. Optional cut-sheet feeder set included.
† In Canada call 1-800-387-5883, Ext. 7108.
A world of change is coming.

Portable products like computers and cellular phones are fast becoming a part of our everyday life. And as the market for these portable products grows and shifts to mass retail distribution, so will consumer demand for a readily available, long lasting rechargeable battery.

Introducing DURACELL® Nickel-Metal Hydride Rechargeable Batteries, a limited number of standard sized packs that will soon be conveniently available in millions of retail outlets worldwide. Exactly where your portable products must be found if you hope to gain a larger share of the growing consumer market.
Consider the advantages DURACELL Rechargeables offer you, the manufacturer. Up to 40% longer life than ordinary nickel-cadmium. Freedom from the burden of custom pack design and inventory. Reduced product costs and cycle time to market. Worldwide availability of replacement packs.

DURACELL Nickel-Metal Hydride Batteries can make your portable computers and cellular phones as convenient, affordable and consumer friendly as your changing market demands. Join Duracell in a power partnership today.
Is It a Penbook or a Notebook?

With the failure of Momenta earlier this year, the wisdom of adding pen functionality to a notebook PC has been called into question. Was Momenta’s design wrong, or is there simply no demand for pen-based notebooks? Grid Systems is about to answer these questions with its Convertible pen-based notebook, which I have been using in its preproduction form.

A brief examination of the Convertible reveals just how compromised the Momenta design was. At first glance, Grid’s system looks similar to many of the vertically oriented pen systems (e.g., the NCR 3125). It’s an 11½-by-9½-by-1½-inch, 5½-pound tablet that you can cradle in your arm. Press two tabs on either side of the unit, and the screen lifts up and tilts to a viewing angle, revealing a keyboard underneath (see the photo).

In contrast, Momenta’s design was bigger and heavier than most notebooks. It used a separate keyboard and required a custom-made carrying case to transport it. The capper was that it was priced high at nearly $5000. It made trade-offs to the point where it was neither an adequate pen system nor a usable notebook PC.

Grid seems to have found a middle ground with few compromises. Powered by a 25-MHz Intel 386SL, the Convertible comes standard with a 120-MB hard drive, 2 MB of RAM, a PCMCIA 2.0 slot, and a 387 math coprocessor. The VGA video is backlit. The machine is ruggedly built—a Grid hallmark—with a tempered-glass screen overlay and magnesium case. Windows for Pen Computing is standard.

Grid sacrificed a few keys on the keyboard. The most important ones are the cursor-control keys (i.e., PageUp, PageDown, Home, and End), although those functions are accessible by two-key combinations. The floppy drive is an external unit. Claimed battery life is a subpar 2½ hours. The most important trade-off, however, is the price. Although Grid had not released pricing information as of this writing, the company said that the Convertible would be about $500 more than its Model 1660 notebook, which sells for about $3000.

You can get equivalent notebook functionality, sans pen input, for about $1500. You will pay roughly $3000 for a similarly configured pen system. Assuming you need both pen input and a fully functional notebook, the Convertible represents an estimated savings of $1000.

Grid says the Convertible is “the first pentop for everyone.” The company is hoping to profit from the established base of Windows users and the anticipated introduction of Windows applications adapted for pen input.

Putting a dollar value on the added functionality is difficult. You have to consider not only the additional cost of the hardware, but also the cost of the pen-enabled software. It’s unlikely that notebook users will make the investment just to have the convenience of a pen device. First-time buyers or users looking to upgrade, however, might find pen capability compelling if the trade-offs are few. For notebook users already considering a pen device, the choice is clear. Grid offers the best choice to date for combining the world of the pen with the world of the notebook.

—Michael Nadeau

The Facts

Convertible
Price not available at press time.

Grid Systems Corp.
47211 Lakeview Blvd.
Fremont, CA 94538
(800) 222-4743
(510) 656-4700
fax: (510) 683-0902
Circle 1166 on Inquiry Card.

Deep Purple Fire

Silicon Graphics, Inc., began showing up at Macintosh trade shows a few months ago. As one SGI representative explained: “We believe Mac users are interested in the best level of technology rather than the least common denominator.” SGI is trying to make the Indigo appealing to the Macintosh community. You can expect popular Mac desktop publishing products (e.g., Adobe Illustrator and Photoshop) to become available for SGI systems. These applications stretch the Mac to its limits, but imagine them running on a relatively low-price, high-performance graphics workstation such as the Iris Indigo.

Now, thanks to SGI’s R4000 upgrade for the R3000-based Iris Indigo, you can get an even better price/performance value. You can power your Indigo with the same processor as the one in SGI’s Iris Crimson (see “First of the Red-Hot R4000s,” July BYTE)—the 64-bit superpipelined Mips R4000SC. Even though SGI isn’t the first Unix company to try to tap the Mac market, it may be the most likely to succeed, because it has already established itself for superiority in graphics performance.

Before I powered up the 64-bit Indigo, the only distinctive features I noticed were the little red R4000 snap-on hood ornament and a daughterboard (with a monstrous heat sink) mounted on the CPU card. continued
Now you can compile most dBASE IV applications in just three easy steps. First, create an application using all the dBASE IV tools you're already familiar with. Next, test and optimize the code to ensure it performs to specifications. Then use the DPRP program to compile it and produce an executable, .EXE file that gives you all the speed and efficiency CA-Clipper® is famous for.

Finally, dBASE IV provides compatibility and database interactivity with most dBASE IV applications. And it's implemented using the open architecture of CA-Clipper, including the preprocessor, the Extend System and the RDDs.

Call 1-800 CALL CAI for the name of your nearest dealer and a free statement of direction entitled "The Future of Xbase". Call right now. Haven't you waited long enough?
Actually, we'd say impossible to beat. And so will you.

Just compare Express notebooks to the competition — the way leading computer publications have been doing. And you'll see that we have the most features at the lowest prices.

You'll see why Computer Shopper (8/92) said the Express 325NXL was "...destined to be the power accessory of the future." Why Computer Buying World (8/92) praised its "small, light, attractive and reasonably priced package." Why PC Magazine (8/92) said the 325NXL is the notebook made for "those looking for a good value at the $2,000 price point."

And why there should be no question which notebook computer to buy.

"... will help you get your work done comfortably at the right price."

PC Magazine, August 1992

These are the notebooks you've been waiting for — whether you need a 25MHz 386SX like our 325NXL or a 25MHz 486 like our 425CXL. As Computer Buying World said, "CompuAdd Express' 325NXL has most of the extras every notebook should have." So does the 425CXL. And they've got performance, too. PC Magazine gave the 325NXL high marks on video and graphics benchmarks and on battery life tests — "the third-highest score of the 70 systems tested."

Our super-twist backlit liquid crystal display has 64 levels of gray scale and a .30mm dot pitch. It measures 9.4" diagonally.

We install a 9600 baud fax/2400 baud modem, both with send/receive capabilities. And we include Quick Link II fax/modem software FREE.

Brightness and other display controls are on the keyboard surface.

Most notebook microprocessors run at only 16MHz or 20MHz. Ours run at 25MHz. 425CXL contains Cyrix CX486SLC; 325NXL contains AMD 386SX.

Sleep button and built-in power management logic for up to 3 hours battery life on the 425CXL; 3 to 4 hours on the 325NXL.

High density 1.44MB 3.5" internal floppy drive.

Two click buttons work with the trackball to select icons and commands.

See For Yourself. Express Has The Most Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Express 325NXL</th>
<th>Dell 325N</th>
<th>Compaq 3865XL/25</th>
<th>Gateway 325XSL</th>
<th>Austin 3865X/25</th>
<th>PC Brand 3865X/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-DOS/Win</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>HD Size</td>
<td>80</td>
<td>60</td>
<td>7.6LBS</td>
<td>7.6LBS</td>
<td>8.7LBS</td>
<td>8.8LBS</td>
</tr>
<tr>
<td>Win w/Adapter RAM</td>
<td>66 LBS</td>
<td>4MB</td>
<td>2MB</td>
<td>2MB</td>
<td>1MB</td>
<td>2MB</td>
</tr>
<tr>
<td>RAM</td>
<td>Yes</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
</tr>
<tr>
<td>FAX/Modem</td>
<td>Yes</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>GRAY SCALE</td>
<td>256</td>
<td>3hr 12min</td>
<td>3hr 12min</td>
<td>3hr 12min</td>
<td>3hr 40min</td>
<td>2hr 45min</td>
</tr>
<tr>
<td>BLT N TRKBALL PRCT</td>
<td>$2,095</td>
<td>$2,698</td>
<td>$1,806</td>
<td>$2,095</td>
<td>$2,293</td>
<td>$1,944</td>
</tr>
</tbody>
</table>

Based on PC Magazine Survey. August 1992

"The clear winner... with its terrific balance of performance and extras."

Computer Buying World, August 1992
Weighs only 5.3 pounds, even including the battery. Add the AC adapter, and it still weighs only 6.6 pounds.

425CXL includes a math coprocessor; 325NXL contains socket for Cyrix FasMath™ 83587 math coprocessor

One serial port, one parallel port. External 800x600 VGA video, PS/2 keyboard and PS/2 mouse connectors.

Both the 425CXL and the 325NXL have an 80MB hard drive, and both have 4MB of RAM — so big Windows programs run great!

101-key function keyboard implemented with 84-key layout has an IBM "feel" because it's made by Lexmark, formerly IBM's keyboard division. Fullsize function keys, too!

Built-in trackball with 200dpi for accurate pointing.

Our FREE carrying case has a shoulder strap and pockets. Pack adapters, diskettes and other supplies.

Inverted "T" arrow keys are in the lower right hand corner, where they belong.

FREE LotusWorks integrated business software pre-loaded.

FREE AC wall adapter

FREE Windows 3.1 and MS DOS 5.0

FREE Microsoft Windows Ready-to-Run

Express 325NXL Everybody loves our notebooks' features.

Computer Shopper wrote that "The built-in 2,400bps fax/modem is snazzy" and called the keyboard, sliding door covering ports and general design "an admirable piece of work."

PC Magazine wrote: "The Lexmark keyboard is comfortable to use. Large and prominent function keys are ranged along the top, and the cursor keys are in an inverted-T layout just left of the trackball."

Computer Buying World also praised the keyboard, which it said "is remarkably well laid out."

Express 425CXL The 425CXL has all the terrific features that made its 386 partner so popular. But it has extra speed, thanks to its Cyrix CX486SLC microprocessor.

This processor is smaller than other 486 chips, so it fits easily into a portable computer. It uses less power than other 486 chips, so you're less likely to run out of juice in the middle of a big job. Yet it has a built-in cache. And the 425CXL contains a math coprocessor, so applications that use floating point instructions are swift indeed.

Lease for only $70/mo

WAS $2,245

$2,245

17 Times Faster!

The 425CXL has a built-in math coprocessor. You can add one to your 325NXL. So programs that use floating point instructions run 17 times faster than an equivalent system without a coprocessor. Test: PC Tech FFT.

12301 Technology Boulevard, Austin, Texas 78727

Circle 81 on Inquiry Card.
After I added power and started running applications, though, it was obvious that the Indigo’s distinctive deep-purple case no longer contained an ordinary RISC processor. The system was now working with a 64-bit processor and 1 MB of secondary general-purpose cache memory connected to the CPU. (There’s also 8 KB each of instruction and data primary cache memory.)

The video hasn’t changed from that in the R3000-based machine. As with the original Indigo system, all GL (Graphics Language) operations that would otherwise be handled by a dedicated graphics board are accomplished in software, and the 24-bit color is dithered for 8 bits in hardware.

The advantages of having a 64-bit processor didn’t become apparent until I tackled compute-intensive work with high precision. It may seem unlikely that a tiny desktop workstation such as the Iris Indigo would run applications that take advantage of the processor depth of the R4000. Remember, though, that the Indigo comes from the leader in systems for creating and viewing 3-D image rendering and animation. A single 24-bit-color, 1280-by-1024-pixel image needs 3.75 MB; 45 seconds of video (at only 24 frames a second) requires more than 4 GB.

Although the Indigo is limited to 384 MB of RAM, the trend is to take advantage of virtual memory addressing and memory-mapped files. For the kind of applications that SGI workstations are destined to run, 32-bit processing clamps down the possibilities.

Thanks to the R4000, my integer performance moved from 47,000 Dhrystones per second (on the R3000 Indigo) to 108,000 Dhrystones per second. My double-precision floating-point performance (BYTE’s Unix benchmark) increased from 13,000 loops per second to 22,000 loops per second.

Credit these performance increases to the superpipelined R4000 (it runs at 100 MHz internally while maintaining a 50-MHz appearance to the external bus) and to a floating-point processor that’s internal to the single CPU chip. Even programs compiled for the R3000 processor will run noticeably faster. To take full advantage of the R4000, though, you must recompile programs specifically for it.

In spite of these impressive performance increases, some aspects of the system (in particular, spawning new processes and system loading) show little or no improvement from having the powerful R4000 64-bit processor. If your system performance demands are focused on the speed of creating and killing processes, you’ll have to reconfigure your Unix kernel or step up to the Crimson.

The R4000 Indigo offers image manipulation and graphics design power to Mac users (or anyone else, for that matter) at a price/performance level beyond that of even a Quadra with graphics coprocessors. If SGI continues in this direction, the Indigo is going to be an attractive Unix alternative to the Mac.

—Ben Smith

**High Speeds, Low Prices from Gateway and Hyundai**

When we heard that Gateway and Hyundai both had DX2/66 VESA (Video Electronics Standards Association) local-bus systems priced at $2995, we had to take a closer look. Fortunately, both companies had preproduction systems we could try out.

On paper, the **Gateway 2000 4DX2/66** looks like a screamer. Inside the AT-size desktop enclosure is a 33-/66-MHz 486, arguably the fastest Intel-compatible processor available—this week at least. The system is also turbocharged with an external 64-KB cache, which is expandable to 256 KB.

For additional speed, the processor is connected to one of the first implementations of a VESA VL-local bus with two slots. One of these local-bus slots is taken up by a new ATI Technologies local-bus video card with 1 MB of VRAM (video RAM). This card can display up to 64,000 colors and resolutions of up to 1280 by 1024 pixels. Also on the local bus is an IDE drive controller connected to a 340-MB hard drive.

Contrary to common expectations, this power does come cheaply—relatively speaking. The system, with a 15-inch color monitor, two floppy drives, 8 MB of memory, Windows 3.1, a mouse, and one Windows application, has a direct-from-Gateway price of $2995.

How fast is this thing? Very. Preliminary tests with BYTE benchmarks give this system very high CPU and video index. This may be the machine to beat in the DX2 series.

Call it a reverse of the Asian model of computing: Hyundai, in order to get closer to its U.S. customers, has moved its PC manufacturing, marketing, and development operations from South Korea to San Jose, California. Expect Hyundai Electronics America to introduce 40 desktop and notebook PCs by the end of the year.

HEA’s plan is to compete head-on in the U.S. with companies such as Gateway 2000 and Dell. The preproduction Hyundai 466D2 we previewed was a VESA VL-bus 486DX2/66 system with a Super VGA monitor, a 200-MB hard drive, 128 KB of write-back cache memory (expandable to 256 KB), 4 MB of RAM, and two floppy drives.

When running compute-intensive applications like a Windows word processor or a 3-D modeling program, the Hyundai system turned in impressive results. HEA shipped the system with a 33-MHz chip. A few days later, the 66-MHz OverDrive upgrade arrived. Upgrading the system wasn’t much of a fuss. All it involved was rotating a lever, pulling out the old chip, aligning a dot to a notch, and dropping the new processor in the socket. Even so, new users may find the procedure complicated. To take advantage of the speed upgrade, you need to verify that your jumpers are properly configured, and the jumpers are somewhat hidden under the removable hard drive, which is mounted
**WATCOM SOL Developer's Edition**

Complete client/server development tool allows you to develop and deploy single-user standalone applications, and to develop applications for use with the Network Server Edition (sold separately). Includes: Single-user database server (both 16 and 32-bit versions); ACME application development system; Embedded SOL/C preprocessor; SOL libraries for WATCOM C, C/386, MS C/C++ and BC/C++.

List: $795  
Ours: $309  
FAX center #: 1269-0014

---

**Microsoft C/C++**

The best way to create Windows and MS-DOS Applications! Microsoft Foundation Classes encapsulate full Windows functionality into 50 reusable classes, providing more of what you need. Use MFC with existing C code and make direct calls to the Windows API. Microsoft's compact C-code can reduce the size of generated code by as much as 50% and you get the smallest, fastest code available from a PC-based C/C++ Compiler.

List: $499  
Ours: $309  
FAX center #: 1269-0014

---

**Microsoft Test**

Makes comprehensive testing easier, reduces testing code and validates the quality of software as you write it. Test the production version of any application for the Windows environment. Capture simple test scripts with a recorder or create sophisticated scripts in the TestBasic macro language. Catch bugs faster and produce fully functional programs in less time, for lower overall development costs.

List: $335  
Ours: $279  
FAX center #: 1269-0035

---

**Outside In for Windows**

Outside In for Windows is a file viewing and data import utility. Use it to copy data from 90 word processing, database and spreadsheet formats to the Clipboard with formatting intact. It also prints files and launches applications. Use it as a stand-alone utility or as part of Norton Desktop, Windows 3.1 or the major word processors. Outside In supports DOS, Windows and Macintosh files.

List: $89  
Ours: $69  
FAX center #: 1001-2001

---

**SlickEdit**

Programmer's editor now with mouse support (DOS, OS/2, Windows NT) and hypertext help! Typeless REXX-style macro language, undo/redo 32k steps, multiple windows, multiple clipboards, compiler error message processing, procedure tagging, programmable file manager. Multiple files to 1 Gigabyte. BRIEF and Emacs emulation. DOS, OS/2, Windows NT, Unix, Xenix, AIX RS6000, Sun HP9000, more.

List: $195  
Ours: $149  
FAX center #: 1997-0001

---

**N-TRAIN™**


C Library  
List: $239  
Ours: $229

w/source  
List: $469  
Ours: $419

Develop System  
List: $747  
Ours: $689

FAX center #: 1004-5401

---

**dANALYST Gold 6.0**

A complete multi-user development environment for the C programmer. Standard features include complete source code generation for Microsoft Windows SDK including relational DBMS interactions with full SQL client-server capabilities. Create source screens that make calls to Video Libs and DBMS calls to create complete applications, not just video I/O.

SPECIAL OFFER!  
List: $495  
Ours: $79  
FAX center #: 1873-0001

---

**Call Programmer's Paradise® Today!**

And mention this ad when placing your order!
Developers, we're here to serve you. Programmer's Paradise offers the world's largest selection of software development tools and utilities at guaranteed low prices. If you don't see what you want, call us! And don't forget to ask for our free comprehensive catalog.

WindowsMAKER Professional 4.0

NEW VERSION! Next generation of industry standard C/C++ development tool for Windows. The easiest, fastest way to create Windows apps, just point and click. New architecture uses Switch-N"Code Generation Modules for generating ANSI C, MFC C++ or OWL C++ code, among others. Award-winning Visual Prototyper lets you test the look & feel and make changes on the fly. TrueCode technology ensures that user code is preserved during code regeneration. Generates Windows .EXE w/fully commented C or C++ source. CUA & SAA compliant.

List: $395 Ours: $299

FAX: 303-455-0033

386/486 Development
Intel 386/486 C Code Builder 575
Lahaye EM/22 5.0 1015
MetaWare High C/C++ 609
Phar Lap 386/DOS-Extender 435
Prof. Pascal Ext. DOS 749
SVS Products CALL
WATCOM CS/386 599
Zortech C++ Devol. 3.0 445

Basic
Dazle/VB 269
GFA Basic for Windows 239
MS Basic PDS 349
Prelax 5.0 169
Q+E Database/VB CALL
Realizer CALL
Visual BasicWin CALL
Visual Basic Prof. Edition 727
Visual Basic for DOS 139
Professional 225
Competitive Upgrade CALL

C/++ Compilers
Borland C++ 319
w/App. Frameworks 339
High C/C++ CALL
Microsoft C/C++ 7.0 325
MS QuickC for Windows 139
Turbo C++ 69
for Windows 112

C-Application Generators
CASEW Corporate CALL
dANALYST GOLD 89
PRM-C 99
WindowsMAKER Prof. 695

C/++ Libraries/Utilities
C++Views 449
Codebase 4.5 295
Greenleaf C++ 209
KPFWin CALL
object-Menu 299
Object Professional for C++ 199
Past 369
Rogue Wave Mpath++ 269
Rogue Wave Tools++ 269
Style 199
Win++ 185
Zinc 3.0 395

C Communications
Borland C++ 225
C++ Windows Toolkit 179
Greenleaf Data Windows 335
Instant Windows 419
Island Pk Pak 486
Quick4Windows Advanced 119
V-C Screen 125
Vitamin C 339

C Screens
C-screen 449
C++Win++ Toolkit 179
Greenleaf Data Windows 335
Instant Windows 419
Island Pk Pak 486
Quick4Windows Advanced 119
V-C Screen 125
Vitamin C 339

ED – The Programmers Editor for Windows
At last! A full-featured windows-based programmers editor is here! ED is setting the standard with features like background compilation, automatic code indenting and completion, hypertension function/procedure lookups, "smart" language-specific editing, a fast "C" extension language, Windows Toolbar, unlimited undo and redo, keyboard macros and remapping, and simulation of popular DOS editors (BREVIEW, Wordstar, Qedit, Norton). Discover the Windows editing tool for the 90s.

List: $269 Ours: $199

FAX: 303-455-0011

C/++ Compilers
Borland C++ 319
w/App. Frameworks 339
High C/C++ CALL
Microsoft C/C++ 7.0 325
MS QuickC for Windows 139
Turbo C++ 69
for Windows 112

C-Application Generators
CASEW Corporate CALL
dANALYST GOLD 89
PRM-C 99
WindowsMAKER Prof. 695

C/++ Libraries/Utilities
C++Views 449
Codebase 4.5 295
Greenleaf C++ 209
KPFWin CALL
object-Menu 299
Object Professional for C++ 199
Past 369
Rogue Wave Mpath++ 269
Rogue Wave Tools++ 269
Style 199
Win++ 185
Zinc 3.0 395

NEW! The fastest way to program for Windows just got faster. When you need to create a Windows application quickly, nothing offers the sheer productivity of Microsoft Visual Basic 2.0 Standard Edition. A visual development environment, flexible programming language, and fast runtime execution make this the shortest route to full-featured Windows applications. The Professional Edition includes messaging and data access capabilities, a wide variety of add-on tools, and more.

Standard Edition
List: $199 Ours: CALL

Professional Edition
List: $495 Ours: $337

FAX: 303-455-0033

Product of the Month:
Microsoft Visual Basic 2.0

ED – The Programmers Editor for Windows
At last! A full-featured windows-based programmers editor is here! ED is setting the standard with features like background compilation, automatic code indenting and completion, hypertension function/procedure lookups, "smart" language-specific editing, a fast "C" extension language, Windows Toolbar, unlimited undo and redo, keyboard macros and remapping, and simulation of popular DOS editors (BREVIEW, Wordstar, Qedit, Norton). Discover the Windows editing tool for the 90s.

List: $269 Ours: $199

FAX: 303-455-0011
PLink86 + Network Server Edition CALL

Changes from April 5, 1992

• Applicable to pricing on current version of software listed.
• December issue prices only. Subject to same terms and conditions.

 ProtoGen 3.0

NEW VERSION! The industry standard for code generation and prototyping. Develop the user interface of your application using Visual prototyping methods. ProtoGen generates expert level, commented code for ANSI C, Microsoft MFC C++, Borland OWL C++, Turbo Pascal, and Microsoft NT Win32. All generators included! Use User Code is preserved from one generation to the next. It’s easy and fast.

List: $199 Ours: $99
FAX orders at 2553-0002

Copyright © 1992 Paradise

Microsoft Visual Basic for DOS

Award-winning productivity—now available for DOS! Draw forms and controls, write event procedures, use and create custom controls—in DOS! Create all-new apps or combine with existing C/C++ or Pascal code. Highly compatible with VB/Win for multi-platform development. Even run existing MS Quick Basic/Basic PDS code! Includes a native 80x86 compiler that creates 100% standalone.EXE files, 386 code generation, MOVE overlays, an integrated ISAM and much more!

List: $179 Ours: $139
FAX orders at 1269-0039

GUARANTEED BEST PRICES*

Terms of offer:
• Offer good through December 31, 1992. Other offers may apply towards obvious errors in competitors’ ads.
• Applicable to pricing on current version of software listed.

* Subject to same terms and conditions.
sideways over the motherboard.

The inside of HEA's 33/66 system is roomy indeed. The system has six 16-bit slots; one VL-bus expansion slot, which was taken up by the same ATI local-bus video card found in the Gateway system; and seven (four 3½-inch, three 5½-inch) storage bays. The advanced CMOS Setup program lets you change or enable/disable the addresses for the on-board COM and LPT ports, automatic IDE drive-type detection, and an antivirus boot block.

Perhaps the most interesting element of both the Gateway and HEA machines is their ATI VESA local-bus graphics adapters. Not only does the card improve the performance of the systems' displays of standard graphics images, it has built-in drivers to support Microsoft's Video for Windows. With the ATI card, you can play full-screen (i.e., 1024- by 768-pixel) movies in 65,000 colors at 30 frames per second.

The Gateway and Hyundai systems we previewed pack a lot of value for less than $3000. Expect other PC vendors to follow suit.

—Rich Malloy and Dave Andrews

Juxtaposing “HP” and “Low-Cost”

Hewlett-Packard’s new 486N series represents what’s become a familiar trend in the PC marketplace: a low-cost entry from a high-end vendor. In introducing its inexpensive desktop series, HP follows in the footsteps of Compaq, IBM, and DEC. But HP has put more on the line than these others: It’s risked its cachet among engineers, who associate HP with top-shelf equipment in everything from oscilloscopes to Unix workstations. Can HP make a low-cost PC up to its own reputation?

Frankly, yes. I tested an HP Vectra 486/33N, the middle configuration in HP’s 486N line. The Vectra 486/33N combines excellent components with high integration to deliver a very usable configuration for $2299. The design also indicates that attention has been paid to expandability, ease of maintenance, and ergonomics. For example, the system board supplies both 25- and 33-MHz clocks and has processor sockets for chip upgrades.

The system board is a model of high integration, a big contributor to reliability. The most noticeable motherboard features are the two CPU sockets (one soldered in on my 486DX model), a VLSI 486 chip set, and the on-board Super VGA. HP includes an S3 graphics accelerator wired to the CPU local bus for excellent video performance; the graphics system also supports high-resolution and high-refresh-rate monitors.

The system’s N designation comes from the bundling of HP EtherTwist or token-ring cards in some models. HP also installs DOS and Windows, and it includes a mouse in most configurations.

What’s missing? Well, expansion is limited by the 70-watt power supply, three ISA slots, and little room for disk storage, but that is justified in a network client workstation. More critical is its lack of second-level cache memory, which makes it somewhat sluggish in BYTE’s benchmark tests compared to high-end systems, including HP’s own 486/33u (see the table). However, the accelerated video and fast IDE drive make the system highly responsive under Windows.

But besides cutting-edge performance, there’s really nothing left out. Considerations such as a snap-off case and security features make the HP Vectra 486/33N ideal for multituser environments, where easy maintenance and plug-and-play operation are essential. It’s also an appealing machine for those of us who have always wanted an HP system but couldn’t get beyond the price tag.

—Steve Apiki

BYE LOW-LEVEL BENCHMARK INDEXES

The lack of second-level cache memory prevents the HP Vectra 486/33N from competing with higher-end systems. The unit performs well in video testing under Windows, however. (Higher numbers are better.)

<table>
<thead>
<tr>
<th></th>
<th>HP Vectra 486/33N</th>
<th>HP Vectra 486/33u</th>
<th>Compaq Deskpro 433i</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>1.14</td>
<td>1.39</td>
<td>1.41</td>
</tr>
<tr>
<td>FPU</td>
<td>2.25</td>
<td>2.31</td>
<td>2.31</td>
</tr>
<tr>
<td>Disk</td>
<td>1.05</td>
<td>1.28</td>
<td>0.98</td>
</tr>
<tr>
<td>Video</td>
<td>1.57</td>
<td>1.49</td>
<td>1.63</td>
</tr>
</tbody>
</table>

HP Vectra 486/33N
with 4 MB of RAM and a 170-MB hard drive, $2299
HP 14-inch Super VGA display, $499

Hewlett-Packard Co.
Direct Marketing Organization
P.O. Box 58059
MS511L-SJ
Santa Clara, CA 95051
(800) 752-0900
Circle 1170 on Inquiry Card.
"...the industry's best keyboard."
— Personal Computing

"...a byword for quality and tactile feedback..." — Which Computer?

"...it's the leader among computer keyboards." — PC Magazine

"...nobody has been able to match the quality..." — PC World

Now We'd Like To Give You A Quote On Price.

The "industry's best keyboard" is now for sale. If you're putting together systems or need keyboards customized for your OEM operation, we make the best, in 35 languages. Call (33) 38 83 4308 in Europe, or 1-800-777-4886 in the U.S.A. Our quotes will impress you as much as those above.

Lexmark International, Inc., a former division of IBM, is an independent, worldwide company that develops, manufactures, and markets IBM personal printers, IBM typewriters, related supplies and keyboards.

Lexmark

Circle 173 on Inquiry Card (RESELLERS: 174).
Our newest PS/2 servers will stay alive and kicking. Even when others are dead and gone. The PS/2 line of servers delivers industry-leading performance and reliability that's hard to beat. So when you turn up the heat, they really cook.

For growing file and print server environments, the affordable new PS/2 Server 85 gives you a lot to look forward to. Its powerful 486 SX/33 MHz processor is upgradable to 66 MHz, and hardfiles can grow to 3.2GB under the covers. For advanced file/database server needs, the Server 95 XP 486 series offers two high-performance models. One cranks out 486 DX2 50/25 MHz power. The other is a high-availability 486 DX/50 MHz server with 40MB data streaming for great performance and ECC memory for superior reliability. It provides fast response with a PS/2 3515 High Performance Disk Subsystem. Our 3514 High Availability Disk Array brings the reliability of RAID5 technology to any new PS/2 server.

At the very top of our line sits the new Server 295. This mission-critical, 486 DX/33 or 50 MHz multiprocessor powerhouse is hard to find fault with. It combines advanced fault tolerance and sophisticated system management for enterprise
Though many have died trying.

computing with personal system flexibility.

All new PS/2 servers feature advanced Micro Channel® architecture and will support OS/2®.

The HelpWare Advantage.

<table>
<thead>
<tr>
<th>Feature</th>
<th>DELL™ Performance Series</th>
<th>COMPAQ®</th>
<th>PS/2***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warranty</td>
<td>1 Year</td>
<td>1 Year</td>
<td>3 Years</td>
</tr>
<tr>
<td>Service Response Time</td>
<td>Next Business Day</td>
<td>Second Business Day</td>
<td>4-Hour¹ Average</td>
</tr>
<tr>
<td>800# Assistance</td>
<td>7 Days/18 Hours</td>
<td>5 Days/12 Hours</td>
<td>7 Days/24 Hours</td>
</tr>
<tr>
<td>Trade-in Program</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Licensed Education Centers</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>30-Day Money-Back Guarantee</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Windows®, Novell® NetWare® and other operating systems.** And they're all backed by HelpWare®; a range of service and support that crushes the competition with a three-year on-site warranty, 24-hour-a-day/seven-day-a-week assistance and more.

We know you expect a lot out of a server. That's why we put so much in ours. After all, the last thing you need is for your network to not work. For more information or an IBM authorized dealer near you, call our Personal Systems HelpCenter™ at 1 800 772-2227.++

Source: Dataquest Ledgeway, 7/92.
Desktop Multimedia

Packard Bell's 486SX/25 Multimedia Computer System includes all the components you need for animating your presentations, getting the latest TV news, and accessing comprehensive reference tools. The system has 4 MB of RAM, a 210-MB hard drive, and dual high-density floppy drives.

Featuring an internal 630-MB CD-ROM drive, a three-speaker amplified micro stereo system, and Sound Blaster Pro II, the system has an extended VGA (1024-by-768-pixel resolution) video controller with 512 KB of memory (expandable to 1 MB). A built-in fax/data modem sends faxes at 9600 bps, receives them at 4800 bps, and sends and receives data at 2400 bps. The company's PBTV3 TV/video board and a monitor complete the package.

Price: $2999.
Contact: Packard Bell, Chatsworth, CA, (818) 886-4600; fax (818) 773-9521.

Cost-Effective Computing

Elonex makes high-speed 486-based computing cost effective with its PC-425X modular ISA desktop system. The entry-level configuration includes 2 MB of RAM (expandable to 32 MB), a 64-KB external cache, a Microid Research BIOS, a 50-MB hard drive, a mouse, a low-resolution Super VGA color monitor, one parallel and two serial ports, DOS 5.0, and Windows 3.1. The on-board floppy drive controller supports up to two devices, and the unit provides a connector for an IDE hard drive.

The Super VGA adapter contains 512 KB of VRAM (video RAM), which supports resolutions of 640 by 480 pixels and 800 by 600 pixels with 256 colors and 1024 by 768 pixels with 16 colors. A feature bus connector allows pass-through to high-resolution graphics cards.

Price: About $1700 (£895).
Contact: Elonex plc., London, U.K., +44 81 452 4444; fax +44 81 452 6422.

Multifunctions from a 486

An integrated desktop system that's a combination of a 486 computer, a plain-paper fax machine, a digital copier, a scanner, a laser printer, and a modem, the Gateware 3370 is also networkable. You customize and upgrade the system by adding new software. The 33-MHz 486 PC comes with 8 MB of RAM, a 120-MB IDE hard drive, and four AT bus slots. Features include CCITT Group 3 or Group 4 fax compatibility, 300- or 400-dpi scanner resolution, any emulation on the 6-ppm laser printer, and 9600-bps send/receive capability on the data modem. The system accepts any AT card and has connections for AppleTalk, Ethernet, and IBM coaxial and twin-axial cables.

Price: $3995.
Contact: Digital Design, Inc., Jacksonville, FL, (800) 733-0908 or (904) 737-0908; fax (904) 737-1162.

Direct Data Collection

ShopPoint, designed for networked data-collection applications, lets you gather information directly through its bar code port. The DOS unit has a built-in thin-wire Ethernet interface, so you can add it directly to a NetWare or LANtastic network.

The less than 1-pound computer has a built-in backlit 2-row by 40-column LCD that shows operator-entered data and prompts; you can add graphics and full-screen capabilities through the standard CGA interface. Bar code capabilities let you collect data via a bar code wand (included), a slot reader, a laser scanner, or a CCD scanner. The unit automatically recognizes most bar code symbologies.

Price: $1500.
Contact: Burr-Brown Corp., Tucson, AZ, (602) 746-1111; fax (602) 889-1510.

Multifunctions from a 486

A n integrated desktop system that's a combination of a 486 computer, a plain-paper fax machine, a digital copier, a scanner, a laser printer, and a modem, the Gateware 3370 is also networkable. You customize and upgrade the system by adding new software. The 33-MHz 486 PC comes with 8 MB of RAM, a 120-MB IDE hard drive, and four AT bus slots. Features include CCITT Group 3 or Group 4 fax compatibility, 300- or 400-dpi scanner resolution, any emulation on the 6-ppm laser printer, and 9600-bps send/receive capability on the data modem. The system accepts any AT card and has connections for AppleTalk, Ethernet, and IBM coaxial and twin-axial cables.

Price: $3995.
Contact: Digital Design, Inc., Jacksonville, FL, (800) 733-0908 or (904) 737-0908; fax (904) 737-1162.

Circle 1272 on Inquiry Card.
Portable Hard Drive

A

vailable in 80- and 120-MB capacities, the 30 Series portable hard drive subsystems have a SCSI connection as well as a parallel port that allows pass-through connectivity. Each unit has a self-contained power supply with an optional built-in battery charger.

You can connect the 3- by 2½- by 5¼-inch subsystems to PCs via the parallel port or the SCSI controller; you connect them to Macs or Next machines via a SCSI bus.

With an optional backplane connector, the units are compatible with Liberty Systems' 10 Series drives, which can be piggybacked as removable media for infinite storage capacity.

Price: $899 and up; optional battery and charger, $199.

Contact: Liberty Systems, Santa Clara, CA, (408) 983-1127; fax (408) 243-2885.

Circle 1277 on Inquiry Card.

CD-ROM with Cache

T

he external Relax 680-MB Mesa CD-ROM drive has an access time of 650 ms and a sustained data transfer rate of 150 Kbps. Compatible with PCs and Macs, the Relax Mesa's 64 KB of cache memory makes it fully compatible with the MPC and QuickTime standards. A headphone jack provides audio output capability.

Price: $299.

Contact: Relax Technology, Inc., Union City, CA, (510) 471-6112; fax (510) 471-6267.

Circle 1278 on Inquiry Card.

Plotters' Choice

A

24-wire dot-matrix personal printer/plotter, the Accel-244 Personal Plotter has a resolution as high as 360 by 360 dpi and scaling capabilities of from 1 to 999 percent. The unit has internal Hewlett-Packard Graphics Language 2 and AutoCAD Device Interface processors and supports A- through C-size media.

The Select-dial feature lets you choose from a variety of plot qualities and speeds, automatically scale and rotate drawings, position drawings on the page, assign line weights, save up to five plotter setups, and control an internal queue of up to 20 drawings. The print head's 8-mil wires provide smoothness and clarity while supporting all the standard line weights.

Price: $995.

Contact: Advanced Matrix Technology, Inc., Camarillo, CA, (800) 992-2264 or (805) 388-5799; fax (805) 484-5282.

Circle 1279 on Inquiry Card.

Compact Thermal Printing

T

he Sejus ThermalPrinter is a self-contained, compact thermal printer designed to fit a standard 5¼-inch half-height floppy drive bay in Hewlett-Packard technical workstations. The print mechanism is housed in a drawer that slides in and out of the drive bay as needed.

An Epson-compatible nine-pin serial connector and a standard disk power connector facilitate installation. The Sejus ThermalPrinter can print in columns up to 80 characters wide in condensed type. It can print at speeds of 37 cps in standard mode and 50 cps in condensed mode. The continuous-roll paper is 38 feet long and provides about 2800 lines at 6 lines per inch.

Price: About $1611 (£895).

Contact: Workstation Source, Ltd., Berkshire, U.K., +44 628 752 752; fax +44 628 751 57.

Circle 1280 on Inquiry Card.

A Light Pen for Your PC

T

he Light Pen Port lets you add light pen compatibility to computers that do not have built-in support for light pens. Consisting of a light pen and an external interface unit about the size of a deck of cards, the Light Pen Port supports all current graphics standards and has drivers for versions 3.0 and higher of DOS and Windows. The software lets the pen and your mouse run concurrently.

Price: $350.

Contact: Design Technology, Santee, CA, (619) 448-2888; fax (619) 448-3044.

Circle 1281 on Inquiry Card.
Now the software you always work with can produce the color you've always dreamed of.

That's because the Canon CJ10 Color Bubble-Jet® Copier is compatible with virtually all the Macintosh® and Windows® software* from leading manufacturers, such as Aldus.® Lotus.® Adobe.® Microsoft.® WordPerfect.® Micrografx.® you name it.

But it's not just software compatibility that makes the CJ10 so extraordinary. It's color. The same vivid color and crisp, clear, black text that made our Color Laser Copiers the industry standard.

Whether you need to scan, print or simply produce photographic-quality, full-color copies, the CJ10 brings the power and vitality of color to your favorite desktop applications at a surprisingly affordable price.

For even more versatility, Canon has developed Windows and QuickDraw® printing and scanning drivers for the CJ10. And with third party software products, the CJ10 becomes a PostScript™ language.

* Requires IPU SS and CJ10 IPU Kit.

All trademarks are property of their registered owners. Canon is a registered trademark and Bubble-Jet is a trademark of Canon, Inc. Macintosh and QuickDraw are registered trademarks of Apple Computer, Inc. Microsoft and Windows are registered trademarks of Microsoft Corporation. Aldus is a registered trademark of Aldus Corporation.
MINGLY WITH ALL YOUR FAVORITE SOFTWARE.

compatible printer. So no matter what you want to create—documents, presentations, newsletters, trans­parencies and more, you have all the tools you need right at your fingertips.

Superior color, wide-ranging software compatibility and a very affordable price. It's an unbeatable — and unprecedented — combination that can turn your desktop into a powerful business resource.

The Canon CJ10 Color Bubble-Jet Copier. It's a wise investment for your brightest ideas.

For more information simply call 1-800-OK-CANON.
See us at Comdex Booth # 1658.

Lotus is a registered trademark of Lotus Development Corporation. Adobe and PostScript are registered trademarks of Adobe Systems, Inc. WordPerfect is a registered trademark of WordPerfect Corporation. ZSoft is a trademark of ZSoft Corporation. Micrografx is a registered trademark of Micrografx, Inc. Freedom of Press is a registered trademark of Custom Applications, Inc.

Circle 187 on Inquiry Card.
Windows at Warp Speed

The low-cost Volante Warp 10 Windows graphics accelerator card not only displays 24-bit true color at 640-by-480-pixel resolution, it also makes Windows operate at refresh rates of from 60 to 72 Hz, the ISA-bus card also offers resolutions of 800 by 600 pixels in 65,536 colors and 1024 by 768 pixels in 256 colors. The card also can display 16 colors at 1280- by 1024-pixel resolution in interlaced mode and 16 colors at 1152- by 900-pixel resolution in non-interlaced mode.

The Volante Warp 10 ships with drivers for several applications, including AutoCAD and Lotus 1-2-3. National Design also includes its proprietary Fast Forward driver for further optimizing Windows operations. The board also features an adapter for multimedia.

Price: $299.
Contact: National Design, Inc., Austin, TX, (512) 329-5055; fax (512) 329-6326.

Circle 1283 on Inquiry Card.

Turn VGA into Video

The 1000V series of VGA-to-video adapters use the Tseng 4000 VGA chip. Available in 512-KB, 1-MB, and high-color versions, the adapters include S-video, composite, and RGB video output formats in NTSC and PAL versions.

Price: $395.
Contact: Adda Technologies, Inc., Richmond, BC, Canada, (604) 278-3224; fax (604) 278-2909.

Circle 1287 on Inquiry Card.

A Board for Viewing TV

WatchITV lets you view TV while working in your computer application. You can position the TV window anywhere on the screen and size it to ¼ or ⅛ of the viewing area; or you can have it take up the entire screen. You can freeze a TV image for transfer into other PC applications and use the pop-up control pad to change channels; adjust volume, color, and screen size; and save still images. A programmable timer turns on the TV at the time and channel you select.

Price: $349.
Contact: New Media Graphics, Billerica, MA, (508) 663-0666; fax (508) 663-6678.

Circle 1284 on Inquiry Card.

Multimedia on Your AT

Arocom Control Systems' PCVideo multimedia board lets you combine color video and VGA signals into a single display. You use software to select camera, VCR, or TV video source (in PAL, NTSC, or SECAM format) from the board’s three inputs. You can display, scale, and position video windows in the VGA graphics/text display by color-keying to the VGA signal or by defining x, y coordinates. The PCVideo board lets you display one live video window plus an unlimited number of captured or frame-grabbed still images.

Price: About $1332 (£740).
Contact: Arocom Control Systems, Ltd., Cambridge, U.K., +44 223 411200; fax +44 223 410457.

Circle 1288 on Inquiry Card.

Get Dolby Sound from Your PC

A digital audio board with Dolby AC-2 coding, the Antex SX-20 provides real-time professional broadcast-quality stereo sound on your PC or PS/2. The board is based on Texas Instruments' advanced floating-point TMS320C31 DSP (digital signal processor) chip.

The Antex SX-20 provides direct-to-disk storing or transmitting of audio at 20 Hz to 20 kHz frequency response at 128 Kbps, letting you add CD-quality digital sound to your applications and transmit the sound over T-1 phone lines. The full-size board plugs directly into a single expansion slot and features software-selectable storage formats. Languages supported by the board include C, Pascal, QuickBasic, and assembly. Software drivers for Windows 3.1 are included.

Price: $2195.
Contact: Antex Electronics Corp., Gardena, CA, (310) 532-3092; fax (310) 532-8509.

Circle 1285 on Inquiry Card.

Hard Drives on a Card

Hardcard EZ hard drives on a card are guaranteed to be compatible with all AT-class computers; all popular operating systems, including DOS, OS/2, and Windows; and all conventional installed hard drives. The Hardcard EZ drives fit in a 16-bit ISA slot and have 42, 85, 127, or 240 MB of storage capacity.

Typical seek time on the drives ranges from 16 to 19 ms, and sustained data transfer rates are 1.3 or 1.4 MBps. A patented Airlock feature automatically retracts the read/write heads if the power supply is interrupted; Defect Free Interface technology identifies and marks bad sectors, eliminating data loss.

Price: $269 to $749.
Contact: Quantum Corp., Milpitas, CA, (408) 432-1100; fax (408) 434-0420.

Circle 1286 on Inquiry Card.
Picture This...a real-time television monitor built right into your PC... Now, picture using this monitor while running Windows™ 3 applications at the same time... And, picture taking that video image and resizing, (right down to crystal-clear icon size!) or clicking and dragging it to any position on the screen as easily as moving any other Window...

Now you can! Any Windows 3 user can access 122 channel television reception with the built-in tuner, PLUS two additional video sources, (such as VCR, video camera, laser disk, etc.,) all with stereo audio capability! Automatically fit real-time video images into any size Window while running your other Windows 3 programs. Hauppauge Computer Works introduces Win/TV™, the Windows television adapter.

Picture Perfect. A “frame-grabber” feature allows you to capture any desired “still” from a video source and save it to disk. With Win/TV, you can integrate video images into multi-media applications such as training or marketing presentations. All you need is Windows 3, a VGA monitor, and a system with a spare 16-bit I/O slot, and you are ready to view a whole new world of video creativity!

Picture Yourself owning your own “Windows on the World”! Maybe you want to work on your spreadsheets but don’t want to miss an important news flash or a current stock market report. Win/TV is perfect for you. Keep an eye on current events while keeping control of your inventory... No problem!

Get the new Win/TV and open a window on some fresh, new and exciting possibilities.

Available Internationally from:
Western Computer, Australia 07-262-3122  E.I.E., Japan 03-3572-3442
Hauppauge, Germany 02161-17063  Hauppauge, U.K. 071-378-7309

GSA # GS00K02AG56156

Hauppauge Computer Works, Inc.
91 Cabot Court • Hauppauge, N.Y. 11788
In N.Y.: Tel: (516) 434-1600 • Fax (516) 434-3198
Toll Free: 800-443-6284 • In Europe: (49)-2161-17063

Circle 101 on Inquiry Card.
or years, the Amiga* name has been synonymous with multimedia. We've proven to the world that when you combine the brilliance of video, audio, and animation with a computer, incredible things can happen.

Well, now that the world has finally caught on to the concept, Commodore takes the medium to an entirely new level: With the all-new Amiga 4000.

The A 4000 frees you to do more multimedia computing for less than any other personal computer. It empowers you to create exciting professional television effects, stimulating interactive training programs, and more powerful presentations like never before.*

That's because the Amiga is the only computer designed as a multimedia machine from the ground up. Which means the A 4000 doesn't suffer the handicaps other so-called multimedia machines endure. There is no need for costly, cumbersome add-ons, no need to kludge together potentially incompatible components. So it gives you spectacular multimedia performance right out of the box, at a price that keeps the cost of imagination very realistic.

Sit in front of the A 4000 and instantly you enter a world filled with high-resolution graphics simultaneously displayed in up to 256,000 colors from a palette of over 16.8 million hues. You gain a heightened ability to create exciting graphics with full video overscan. And you attain the freedom to create complex animations at a full 30 Frames Per Second, not at 15 FPS.

You even have the option of choosing from a spectrum of high resolution modes while still maintaining NTSC scan rate capability.

All this multimedia muscle, of course, comes through true design elegance. At the heart of every A 4000 lies our new, unique, custom coprocessors, the Advanced
68040 Chip (which other computer companies consider to be enough on its own), and not only is the A4000 blindingly quick, it literally gives you true workstation power.

Of course, there's much more to the A4000 than just being the ultimate tool for creativity. It also comes with a large capacity hard drive, and a 1.76 MB dual speed high density floppy drive which, combined with Cross-DOS, allows you to read and write MS-DOS® files. And a design that allows for expandability, compatibility, and the capability for hundreds of business applications.

In fact, the A4000 even fits seamlessly into whatever operating system you're currently using by coexisting and communicating with your Macintosh® or MS-DOS computers in a Novell® network.*

And we back all this technology up with a potent service package that is second to none: Including a 24 hour hotline and optional on-site service.**

To find out more about Commodore Multimedia and the all-new Amiga 4000, call 1-800-66-AMIGA. (In Canada, call 1-800-661-AMIGA.) We'll show you an outstanding performance that will certainly bring you to your feet.
Three-in-One Communication

A telecommunications system manager from SIIG, The Telecommunicator combines voice-mail, fax, and modem capabilities into one card for the IBM AT. The card operates in the background, so you can use other Windows-based applications while it administers all phone line-based communication, automatically switching between voice communications and receiving faxes.

The voice-mail system provides a phone book, remote operation, message forwarding, password protection, and 999 voice mailboxes. The Telecommunicator’s Group 3 fax capability includes a Fax Scheduler, a Fax Server, the ability to merge text and graphics on a single fax, and the ability to send faxes as text files in PCX, TIF, IMG, or BFX formats.

The card’s Hayes-compatible modem features include MNP 5 data compression and V.42 error correction. You can use The Telecommunicator with most popular communications software packages.

Price: $349.
Contact: SIIG, Inc., Fremont, CA, (510) 657-8688; fax (510) 657-5962.
Circle 1330 on Inquiry Card.

Log-in Security

Nok Pro, a security, accounting, and performance tool for use on AppleShare 3.0 servers, provides a detailed log of connections, the capability to disconnect idle users, and identification of guest users. The software also alerts the network administrator to log-ins as they occur.

As a security measure, Nok Pro watches as guests log onto the servers and determines who they are; it then alerts the administrator or creates an entry in the log. Nok Pro keeps the log in an easily exportable format, which lets the administrator track departmental and individual usage statistics. The software also lets the administrator determine peak usage times and set disconnect times based on total connect or idle time.

Price: $295 per server.
Contact: Trik, Inc., Woburn, MA, (800) 466-8745 or (617) 933-8810; fax (617) 933-8648.
Circle 1291 on Inquiry Card.

Secure Your Network Power

LanSafe II, an integrated power management system, lets network administrators centrally manage electrical power to local and remote network components. The system lets you troubleshoot power problems and monitor real-time loads and battery voltage status. In the event of a prolonged power outage, LanSafe II begins an orderly shutdown of the network.

The system has automatic daily hardware and battery self-testing and software-controlled preventive maintenance procedures. Pull-down menus let you change power and program settings, conduct networkwide tests, reboot or shut down nodes, and view a historical log of power events. The PowerPro feature lets you set upper and lower voltage limits to optimize the brownout voltage range of your system.

Price: $135; upgrade from LanSafe/A.I.+, $69.
Circle 1290 on Inquiry Card.

Two Tiny Modems

About the size of an electric razor, the Transportable 14.4/14.4 fax/data modem sends and receives faxes and data at 14,400 bps and has optional OCR (optical character recognition) capabilities. Designed for duty on your desk and on the road, the modem operates in DOS and Windows and on the Mac via the serial port. The Sol ektex modem is compatible with the Hayes data communications standard and Group 3 Class 1 and 2 fax standards. It supports MNP 2 through 4, MNP 5, V.42, and V.42bis. Features include group broadcasting, call logging, and background operation. When using V.42bis, the unit has an effective speed of up to 57,600 bps.

Price: $599.
Contact: Solectek Corp., San Diego, CA, (619) 450-1220; fax (619) 457-2681.
Circle 1292 on Inquiry Card.

PCL/PostScript Printing

Extended Systems’ BridgePort ESI-2679C allows a single PostScript printer to support multiple computing platforms. The device can switch between PCL and PostScript languages on a variety of Lexmark, Apple, and Hewlett-Packard printers, automatically configuring the printer to the appropriate language.

The BridgePort connects to PCs, workstations, and Macs through its Centronics, ExtendedLink, and AppleTalk ports. It connects to the PostScript printer via serial, parallel, or LocalTalk ports.

Price: $595.
Contact: Extended Systems, Boise, ID, (800) 235-7576 or (406) 587-7575.
Circle 1331 on Inquiry Card.
Now, backing up your computer is easier than ever. Simply unpack Trakker and connect it to your computer's parallel printer port. That's it. No installation, no switches, no floppy disk shuffle. This is tape backup that's ready to go. And it goes anywhere. Trakker is light and compact, the ideal solution for backing up notebooks and laptops. And it goes fast. Trakker 250 boasts a data transfer rate of up to 8 MB/minute, easily the fastest in its class. At $448, Trakker 120 is the price leader as well.

Choose either Trakker 120 (120 MB with data compression) or Trakker 250 (250 MB with data compression). Both offer QIC Industry Standard Recording Format, as well as Novell® and LANtastic® certification.

For more information, please call 1-800-451-0897 ext. 1657 today.
Your Natural Resource

1-800-8

Keyboards

- 8088/286/386/486 compatible
- Automatically switch between XT or AT
- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB17128</td>
<td>E040</td>
<td>Fujitsu 101-key enhanced keyboard</td>
<td>$79.95</td>
</tr>
<tr>
<td>DB17136</td>
<td>FK5001</td>
<td>130-key enhanced keyboard with calculator</td>
<td>$99.95</td>
</tr>
<tr>
<td>DB20474</td>
<td>JE2015</td>
<td>32-key serial keypad</td>
<td>$99.95</td>
</tr>
<tr>
<td>DB67432</td>
<td>K101</td>
<td>101-key enhanced keyboard (90-day warranty)</td>
<td>$49.95</td>
</tr>
<tr>
<td>DB20431</td>
<td>JE2015</td>
<td>84-key keyboard (original AT style layout; 90-day warranty)</td>
<td>$49.95</td>
</tr>
</tbody>
</table>

Power Supplies

- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB19465</td>
<td>E1030</td>
<td>120 watt 8088</td>
<td>$69.95</td>
</tr>
<tr>
<td>DB76746</td>
<td>E1068</td>
<td>200 watt 8088</td>
<td>$89.95</td>
</tr>
<tr>
<td>DB19545</td>
<td>E1060</td>
<td>200 watt 286/386/486</td>
<td>$89.95</td>
</tr>
<tr>
<td>DB19570</td>
<td>E1068A</td>
<td>250 watt 286/386/486</td>
<td>$99.95</td>
</tr>
<tr>
<td>DB57528</td>
<td>E1069A</td>
<td>300 watt 286/386/486</td>
<td>$149.95</td>
</tr>
</tbody>
</table>

Kalok Hard Disk Drive

- 90-day warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB22322</td>
<td>XL320</td>
<td>20MB MFM hard drive</td>
<td>$169.95</td>
</tr>
</tbody>
</table>

Call for information on controller cards.

Hard Drives (IDE)

Conner IDE

- 8088/286/386/486 compatible
- Requires host IDE adapter
- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Capacity</th>
<th>Speed</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB14038</td>
<td>CP3000</td>
<td>40MB</td>
<td>25ms</td>
<td>$249.95</td>
</tr>
<tr>
<td>DB14066</td>
<td>CP3004</td>
<td>80MB</td>
<td>25ms</td>
<td>$359.95</td>
</tr>
<tr>
<td>DB14074</td>
<td>CP5010H</td>
<td>120MB</td>
<td>19ms</td>
<td>$429.95</td>
</tr>
<tr>
<td>DB14120</td>
<td>CP3020</td>
<td>200MB</td>
<td>16ms</td>
<td>$699.95</td>
</tr>
</tbody>
</table>

Controllers

IDE Disk Drive

- Interfaces two IDE hard drives to system
- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB10233</td>
<td>ADP20</td>
<td>16-bit hard adapter</td>
<td>$29.95</td>
</tr>
<tr>
<td>DB10250</td>
<td>ADP20F</td>
<td>16-bit hard/floppy adapter</td>
<td>$39.95</td>
</tr>
<tr>
<td>DB10256</td>
<td>ADP50</td>
<td>8-bit hard adapter</td>
<td>$79.95</td>
</tr>
<tr>
<td>DB10276</td>
<td>ADP50</td>
<td>16-bit hard adapter with BIOS</td>
<td>$79.95</td>
</tr>
<tr>
<td>DB10284</td>
<td>ADPG0</td>
<td>16-bit hard/ floppy adapter</td>
<td>$79.95</td>
</tr>
<tr>
<td>DB74114</td>
<td>ADPG0F</td>
<td>16-bit hard/ floppy adapter</td>
<td>$99.95</td>
</tr>
</tbody>
</table>

Jameco Power Base

- Master power switch and 5 auxiliary switches for each outlet

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB20159</td>
<td>JE1190</td>
<td>Six-Outlet Power Strip</td>
<td>$29.95</td>
</tr>
</tbody>
</table>

Six-Outlet Power Strip

- Built-in safety circuit breaker (15 amp)
- Master switch with pilot light
- Three-prong, 6-foot power cord
- UL listed

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB20175</td>
<td>JE1191</td>
<td>$11.95</td>
</tr>
</tbody>
</table>

Floppy Disk Drives

Toshiba 1.44MB

- IBM PC/XT/AT and compatibles
- 3.5" and 5.25" disk drives in a 5.25" half height drive bay
- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB40774</td>
<td>356KV</td>
<td>1.44MB</td>
<td>$99.95</td>
</tr>
</tbody>
</table>

Adatitional Internal Floppy Disk Drives

- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Product No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB17099</td>
<td>FD555</td>
<td>DE1090 Floppy controller for IBM machine</td>
</tr>
<tr>
<td>DB17101</td>
<td>FD555</td>
<td>5.25&quot; TEAC 1.2MB</td>
</tr>
</tbody>
</table>

Floppy Controllers

- One-year warranty

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB19667</td>
<td>JE1040 88/286/386/486 two-drive</td>
</tr>
<tr>
<td>DB19668</td>
<td>JE1040 88/286/386/486 four-drive</td>
</tr>
</tbody>
</table>

Call for information on controller cards.
31.4242

Only A Phone Call Away

80386/80486 Motherboards

- One-year warranty
- RAM not included

Part No. Description Price
DB7561 80386DX 33Mhz 2MB $489.95
DB7562 80386DX 40Mhz 4MB $589.95
DB7563 80486DX 50Mhz 8MB $1,009.95
DB7564 80486DX 50Mhz 16MB $1,639.95
DB7565 80486DX 50Mhz 24MB $2,749.95

Additional JAMECO Motherboards

- One-year warranty
- RAM not included

Part No. Description Price
DB83383 JE3616SN 80386SX 16Mhz motherboard $209.95
DB82994 JE3006 80286 12Mhz motherboard $124.95
DB86951 JE1020E 8088 10MHz motherboard $69.95

Call for additional software options and information on our 386 and 486 computer kits!

Memory

Expand your memory. See our excellent selection at low prices for all types of RAM. JAMECO also offers memory modules for Apple, AST, Compaq, Epson, IBM, Hewlett-Packard and Toshiba computers.

Part No. Product No. Description Price
DB84159 41256-120 16 256K $1,299.95
DB84147 41256-150 16 256K $1,299.95
DB84225 11000-80 10 1MB $89.95
DB84229 11000-10 10 1MB $100.95

SIPPs and SIMMs

Part No. Product No. Description Price
DB84145 41256/8A-10 256K SIPP $18.95
DB84152 41256/4B-40 256K SIMM $16.95
DB84178 412000/8A-8 1MB SIPP $44.95

Call for additional information on our selection of math coprocessors.

Computers

16-bit VGA Card

- 8088/286/386/486 compatible
- Comes with 256KB video RAM expandable to 512KB
- Capable of 640 x 480 with 256 colors, 800 x 600 with 256 colors, 1024 x 768 with 16 colors (512KB RAM required for all modes)
- One-year warranty

Part No. Description Price
DB67459 VG7700 $99.95

Additional Cards

Part No. Description Price
DB19794 JE1060 8088 floppy controller $19.95
DB19823 JE1060A 8088/286/386/486 monochrome graphics adapter $49.95
DB19793 JE1050 8088/286/386/486 Super VGA $159.95
DB19829 JE1062 8088/286/386/486 RS232 serial $29.95

Cables, Gender Changers, and Adapters

Part No. Description Price
DB28708 PPC12 12-foot parallel DB25-pin male to Centronics male printer cable $7.95
DB31721 SAT6 6-foot 9-pin serial DE9 female to DB25 male $5.95
DB39551 25M10F 10-foot DB25-pin male to female $9.95
DB39552 25M10M 10-foot DB25-pin male to male $9.95
DB18420 GC25F DB25-pin female slim line gender changer $4.49
DB18446 GC25M DB25-pin male slim line gender changer $4.49
DB10055 AD29S DE9 female to DB25 male $4.95
DB10321 AD926 DE9 male to DB25 female $4.95

JAMECO ELECTRONIC COMPONENTS

COMPUTER PRODUCTS

1355 Shoreway Road, Belmont, CA 94002
Sales: 1-800-831-6242
Outside US: 415-592-8097
Fax: 1-800-237-6948
Jameco Service Line: 1-800-831-8020
Technical Support: 1-800-831-0084

GET A FREE JAMECO CATALOG
CALL 1-800-637-8471
For expedited order placement, mention your V.I.P. number DB2

© 1992 JAMECO Electrical Components/Computer Products All trademarks are registered trademarks of their respective companies. Terms: Prices are subject to change without notice. Items subject to availability and price sale. Complete list of terms/warranties is available upon request.
Manage Change Requests

Hewlett-Packard's ChangeVision, a software change-request management environment for its SoftBench tool-integration platform for Unix PCs, helps development teams change new or existing software to eliminate defects, add new features, or port the software to different computer systems. Once the team defines a process, ChangeVision provides real-time communication and status reports that link back to the people who perform the tasks and the software they use.

ChangeVision collects, analyzes, and correlates software measurements such as code complexity, defect density, test coverage, and schedule status. The system collects these measurements automatically and provides software teams with insight into the status of their projects.

Price: $2950.
Contact: Hewlett-Packard Co., Santa Clara, CA, (800) 637-7740 or (303) 229-4527; fax (303) 229-2180.
Circle 1294 on Inquiry Card.

The Programmer's Speech Toolkit

With ProVoice, you can add synthesized speech to your DOS applications. The package uses First Byte Software's Speech Engine, which processes strings of text, numbers, and data into words and sentences using a dictionary and English grammar rules. You can edit the dictionary to include words that ProVoice doesn't recognize or mispronounces.

The toolkit provides source code bindings to the ProVoice Speech Engine for Microsoft C, Turbo C++, Turbo Pascal, Turbo Assembler, and Microsoft Assembler. The bindings allow applications to make calls to a TSR speech engine, which translates the text into speech.

Price: $995.
Contact: First Byte Software, Torrance, CA, (800) 523-2983 or (310) 793-0600; fax (310) 793-0601.
Circle 1295 on Inquiry Card.

Five DLLs for Windows

The Out of Controls package from Celect Software provides five DLLs that developers can use in software running under Windows 3.0 or higher. The DLLs—Spin Box, Multicolumn List Box, Modal Spawning Library, Text Editor, and Line Object Editor—enhance the functionality and appearance of Windows applications while saving programming and debugging time.

Price: $229; with C source code, $459.
Contact: Celect Software, Mason, OH, (513) 573-6800; fax (513) 573-6888.
Circle 1296 on Inquiry Card.

Faster Unix Development

Using an intuitive user interface based on a point-and-click structure, C/Spot/Run combines semantic analysis, syntax checking, dependency analysis, source code filtering and navigation, graphical representation of function calls, and error filtering and navigation. The programming tool for Unix helps you spot errors, understand dependency relationships, and evaluate code structure to achieve running code faster. You can filter code to focus on lines of interest and expand context around those areas. The software identifies potential compiler and linker errors for host and remote environments.

Price: $995.
Contact: ProCase Corp., Santa Clara, CA, (408) 727-0714; fax (408) 492-1814.
Circle 1298 on Inquiry Card.

Create Demos and Tutorials

Genus Microprogramming has added more than 35 video and animation effects, Music Definition Language support, Sound Blaster voice file support, extended memory support, and control sets with variables and tests to the new version of Proteus, its prototype/demo tool for the PC. Proteus 6.0 helps you easily create demos, tutorials, and software prototypes that combine text on graphics with advanced effects and custom sounds and music. The package also lets you group demo files into a single.EXE file and set the demo to expire after a specified date.

Price: $349.
Contact: Genus Microprogramming, Houston, TX, (800) 227-0918 or (713) 870-0737; fax (713) 870-0288.
Circle 1299 on Inquiry Card.

Real-Time Kernel

Written to support a virtual single-processor model, the RTXC/MP package is a fully distributed real-time kernel that bridges the gap between single and parallel processing systems. With RTXC/MP, the step to multiprocessor applications involves minor changes to the system-definition file, the automatic regeneration of the include files, and recompilation of the application.

The RTXC/MP package is for DOS, OS/2, Unix, and OS/9 host environments and comes in four versions (i.e., basic and full library, single-processor and multiprocessor support) with the same API for all target processors. The package includes a standard I/O and graphics library, a task-level debugger, and a tracing monitor.

Price: $900 to $12,900, including source code.
Contact: Intelligent Systems International N.V./S.A., Linden, Belgium, +32 16 62 15 85; fax +32 16 62 15 84.
Circle 1297 on Inquiry Card.

Create Demos and Tutorials

Genus Microsystems has added more than 35 video and animation effects, Music Definition Language support, Sound Blaster voice file support, extended memory support, and control sets with variables and tests to the new version of Proteus, its prototype/demo tool for the PC. Proteus 6.0 helps you easily create demos, tutorials, and software prototypes that combine text on graphics with advanced effects and custom sounds and music. The package also lets you group demo files into a single.EXE file and set the demo to expire after a specified date.

Price: $349.
Contact: Genus Microprogramming, Houston, TX, (800) 227-0918 or (713) 870-0737; fax (713) 870-0288.
Circle 1299 on Inquiry Card.

Create Demos and Tutorials

Genus Microprogramming has added more than 35 video and animation effects, Music Definition Language support, Sound Blaster voice file support, extended memory support, and control sets with variables and tests to the new version of Proteus, its prototype/demo tool for the PC. Proteus 6.0 helps you easily create demos, tutorials, and software prototypes that combine text on graphics with advanced effects and custom sounds and music. The package also lets you group demo files into a single.EXE file and set the demo to expire after a specified date.

Price: $349.
Contact: Genus Microprogramming, Houston, TX, (800) 227-0918 or (713) 870-0737; fax (713) 870-0288.
Circle 1299 on Inquiry Card.
Since when is Raima first in Corporate Database Development?

Since April 7, 1992

Raima Database Manager was the database of choice in the First Annual Windows World Open. The competition featured innovative custom applications built with Windows development tools. Three of the seven winners, and two of the finalists, used Raima Database Manager to solve their critical application needs.

For professional developers like yourself, Raima products offer:

- High performance: unmatched application speed.
- Portability: runs on DOS, Windows, OS2, UNIX, VMS, QNX.
- Royalty-free distribution: increase your profits.
- Source-code availability: total programming flexibility.
- Affordable pricing: starting at just $995.

Listen to what some of our customers say about our products:

"No other products matched Raima for the price."
James Usiski, developer, Chevron

"Raima provided us with speed, flexibility, and royalty-free distribution which allowed us to meet and exceed our customers' needs."
Dave Cooper, developer, Atlantic Research Corp.

"Database Manager gave us the edge we needed to handle large amounts of data quickly and efficiently within Microsoft Windows."
Kelly Patrick, developer, PHH Fantus

If you're looking for an award-winning application development tool, give us a call. And discover the Raima advantage.

Raima Database Manager The high-performance DBMS
Raima Object Manager The object storage class library

1-800-DB-RAIMA Also available for DOS, OS/2, and UNIX

Circle 140 on Inquiry Card.
SOME COMPANIES WILLING TO PAY FOR A N
IT’S THE ONLY

Design. Engineering. Testing. Service. Support. When you think about it, these are what make one computer better than the next. Which makes it all the more surprising that companies are cutting back in these areas. And, amazingly, some do little but stick their name on at the end of somebody else’s assembly line.

It would be like buying a car, looking under the hood, and discovering that it was built by a company you’d never heard of from a place you’d have trouble finding on the map.

It makes you wonder about the kind of company that would do it. Why they would make the decision to put their name on a product over which they maintain little control. And why they would then sell it to their customers.

Obviously, at some point during some meeting in some boardroom, the mandate came down: Find a way, any way, to cut costs.

At Compaq, when we set out to build affordable PCs, we took a decidedly different approach.

All three of the new COMPAQ computers—the COMPAQ ProLinea, COMPAQ Contura, and COMPAQ DESKPRO/i—are Compaq designed. Compaq built. Compaq tested. And, perhaps most telling of all, each one is Compaq supported.

Precisely because all three of our new, affordable computers are true COMPAQ products, we back them with the same comprehensive service and support as the rest of our computers.

Other PC companies do things differently, like offering substantially limited service and support for products they apparently have less confidence in. Dell has even gone so far as to withdraw their
compatibility guarantee for the Dimension Line. How can they be a product about it, how can you?

Comparing COMPAQ computers with today's "name brand" clone PCs reveals other important differences as well. And if they can't be sure for the Dimension Line, how can you?

So the choice before you isn't simply between different computers. It's between different computer companies. The kind of companies that are willing to sell out their name to sell you a computer. And a company whose name stands for everything you want in a computer.

The others offer you no such assurances. After all, some ideas are better than others. Unlike a lot of today's clones, the new COMPAQ PCs are all designed, engineered and tested by Compaq.

For more information, just call 1-800-345-1518 in the U.S., or 1-800-263-5868 in Canada.

Circle 80 on Inquiry Card.
Intelligent Task Automation

Office Accelerator uses DDE and word processing macros to let you transport names, company names, phone numbers, addresses, notes, and other information from its integrated relational database (Phone Book) into letters, envelopes, labels, business forms, and faxes that you have composed within Word for Windows, Ami Pro, WordPerfect for Windows, or Lotus Write. In addition, the Office Accelerator Phone Book accepts information, such as vendors, customers, investors, friends, parties, Christmas cards, and birthdays, that can serve as the basis for future searches.

The Multiples feature lets you do a mail merge; print multiple envelopes, labels, and forms; and fax to multiple recipients. With the Reports feature, you can print out phone lists for all or any part of your Phone Book, as well as modify and create your own reporting formats.

The Create/Edit feature lets you create or modify any letter, label, envelope, or form template using all the tools available in your word processor. You can add text, clip art, or scanned images; copy, add, or move merge fields for form letters and memos; and save the new templates for future use.

PostScript Fonts for WordPerfect

The PrimeType package provides WordPerfect users with on-the-fly, transparent access to 20 PostScript language fonts handpicked from the Adobe Type Library. PrimeType makes your WordPerfect printing device independent, so you can print WPPOS or WPWIN documents on most dot-matrix, ink-jet, PostScript, or laser printers without reformattting. The PrimeType package includes Adobe Type Manager for Windows, so you can also use the package’s fonts with your Windows applications.

Price: $99.95.
Contact: LaserTools Corp., Emeryville, CA, (800) 767-8004 or (510) 420-8777; fax (510) 420-1150.
Circle 1301 on Inquiry Card.

Contact Management

With features such as group scheduling, remote transfer synchronization, user-definable screens and fields, unlimited additional contacts, and five levels of security, GoldMine 2.5 may be the contact management package you've been looking for. The software for the PC lets you instantly retrieve, review, and analyze each recorded activity and view activities in list, statistical, or graphical formats.

The group-scheduling features let you quickly schedule users and resources, finding available times automatically and with RSVP verification. The new Remote Transfer Synchronization feature updates remote GoldMine systems with any changes, including notes, history, calendar, and messages, on records at the field level. With user-definable screens and fields, each department can create a different user screen suited to its needs.

Contact: Elan Software Corp., Encino, CA, (818) 999-9872; fax (818) 999-9903.
Circle 1302 on Inquiry Card.

A Desktop Calendar

Calendar Wise is a multi-subject planner/tracker that simulates a calendar on your PC. The package offers 100 calendars (10 lists with 10 calendars each) that let you keep unrelated planning separate. You enter information using recurring yearly, monthly, weekly, daily, and movable frequencies (e.g., second Tuesday of the month). Calendar Wise lets you change the calendar format so that you can view different numbers of weeks, and you can reference multiple calendars at once to be displayed or printed together.

Price: $25.
Contact: Blue Cannon Software, Charlotte, NC, (800) 779-0850 or (704) 398-0850; fax (704) 398-0928, ext. 22.
Circle 1303 on Inquiry Card.

Unix-Based Communication

If you are a Sun Sparcstation user, Power Base can help you manage your contacts and appointments. The communication system lets you streamline telephoning, faxing, E-mail, and postal and express mail tasks to your needs. The system reminds you of important dates and obligations and highlights critical action items and time lines in contact records. In a workgroup, department, or company, everyone can share information while maintaining separate confidential databases.

Price: Single-client license, $395; server license, $995.
Contact: The Bristol Group Ltd., Larkspur, CA, (415) 925-9250; fax (415) 925-9278.
Circle 1304 on Inquiry Card.
The Evolution of CAD

From the beginning of time, we have tried to express ourselves through graphics.

In the beginning of time people had to use primitive design tools for creating any type of graphics.

By the 18th Century we had advanced to the drafting table with T-squares, and the dreaded eraser.

In the 15th Century design tools were quill ink pens and crude styles of paper.

In the 20th Century the first CAD programs were very slow and extremely difficult to use, not to mention the expense of buying them.

Now step into the 21st Century...

DesignCAD

NEW

Professional Version

DesignCAD Professional is the only complete CAD solution. It's 6 packages in one!

- **DesignCAD 2D** has all the tools and power necessary to produce professional architectural or mechanical blueprints. With DesignCAD 2D you will become extremely productive.

- **DesignCAD 3D** gives you the power to create and manipulate solid or wireframe objects with quick and easy commands. Render your designs with outstanding photorealistic color!

- **Video Training Tapes** for DesignCAD Professional, are produced in a state-of-the-art facility using award winning writers, and professional technicians. Using these video tapes will assure you of learning faster with higher retention, while becoming more productive!

- **SmartEST** quickly generates a spreadsheet from your DesignCAD drawings so you may estimate cost, and do take-offs for accurate bidding.

- **Symbol Libraries** contain over 6700 pre-drawn Architectural and industry standard symbols. These alone will save you a tremendous amount of time and money!

- **ScanPRO** converts (Raster to Vector) scanned images into files that can be read by DesignCAD or most other CAD programs.

Call, fax or write for a FREE brochure & demo!
Future Database Consultant

Future Author

Future Entrepreneur

It's that easy.

Introducing the friendliest, easiest, biggest family of Windows software you'll ever meet.

The CA Family of Windows software.

Covering virtually every category from accounting to database to word processing to graphics, CA Windows software sets the standard for ease of use.

If you can click a mouse, CA Windows software can help you work smarter, faster and more efficiently than you ever thought possible.

Underneath the simple, user-friendly interface lies some of the most advanced and powerful Windows technology in the industry.

Literally hundreds of dazzling push buttons, floating windows, pull-down menus, pop-up dialog boxes, colors, fonts and graphics, all designed with the same basic goals: Making...
Future Executive  Future Project Manager  Future Artist

your computer a lot friendlier—and your life a little easier.

Behind all of these wonderful Windows stands the world’s leading software company, Computer Associates.

With service and support that goes around the clock and around the world, CA is the software company that more than 95% of the Fortune 500 depend on.

Dial 1-800 CALL CAI Today For A Free Demo Disk.

So, pick up the phone right now and order a free Demo Disk that will show you just how easy it is.

It’s the Windows software that anyone can use.

And we mean anyone.
Process and Plot Data

TechPlot, a technical data processing and plotting package for the PC, performs statistical analysis, data transformation, digital signal processing, nonlinear parameter fitting, and experimental model development. In addition, the software provides a plot-editing toolbox and a wide variety of 2-D and 3-D plot types. With TechPlot you can place multiple coordinate systems, axes, and plots on one page.

You can exchange data with most popular spreadsheet file formats and use TechPlot to produce publication-quality graphics output on dot-matrix and laser printers, plotters, and slide makers. TechPlot can also produce color EPS, CGM, TIFF, BMP, PCX, and HPGL files. Price: $69.95.

Contact: Software Marketing Corp., Phoenix, AZ, (602) 893-2400; fax (602) 893-2042.

Circle 1307 on Inquiry Card.

An Observatory on Your Desktop

Epoch 2000 offers amateur astronomers a desktop planetarium, image-processing capabilities, and access to the future Remote Telescope Network. The package, for Windows 3.0, can display the sky from anywhere on Earth at any time between 4713 B.C. and 10,000 A.D.

The desktop planetarium displays 45,000 stars; 13,000 clusters, nebulae, galaxies, and other deep-sky objects; 7700 asteroids; and 650 comets. You can zoom in to a field of view less than 1 second of arc, measure angular distances between stellar objects, and determine each star's magnitude and velocity. Price: $329.

Contact: Farpoint Research, Downey, CA, (800) 858-9795 or (310) 861-6606; fax (310) 862-1546.

Circle 1308 on Inquiry Card.

New Features for PC-OPT+

Electrical Engineering Software has added support for simultaneous optimization in more than one domain and PC-OPTlib, a discrete component library of more than 8500 fully characterized parts, to PC-OPT+. Its electronic circuit optimizer for the PC, PC-OPT+, performs rapid, SPICE-like simulation and can change selected component parameters to make circuits meet your performance specifications. Price: $950 and up.

Contact: Electrical Engineering Software, Inc., Santa Clara, CA, (408) 296-8151; fax (408) 296-7563.

Circle 1309 on Inquiry Card.

Residential Floor Plans

Designed as a Windows application, Chief Architect can quickly and accurately produce a floor plan for an entire residence or an addition to a home. The object-oriented system uses architectural entities (e.g., walls, windows, doors, and cabinets) and can handle diverse processes such as dimensioning, placement of electrical outlets, and placement of fixtures, cabinets, doors, windows, and appliances.

The software's symbol library includes predrawn standard residential building components, as well as graphics for finishing touches such as furniture and cars. Chief Architect lets you export all or parts of your plan to Windows-based word processors and desktop publishing programs, as well as to CAD systems. You can also print or plot your plans to any scale. Price: $495.

Contact: Advanced Relational Technology, Morgan Hill, CA, phone and fax (408) 776-0310.

Circle 1311 on Inquiry Card.

Analyze Experiments

Jandel Scientific designed its SigmaStat statistical package for scientists who need to efficiently compute statistics to analyze real-world experiments. SigmaStat can handle missing and unbalanced data and automatically creates detailed reports of all statistical procedures. SigmaStat's Advise command helps you select the most appropriate statistical procedure for your data and then automatically performs the test. You can use SigmaStat with SigmaPlot to create publication-quality graphs. Price: $395.

Contact: Jandel Scientific, San Rafael, CA, (800) 874-1888 or (415) 453-6700; fax (415) 453-7769.

Circle 1310 on Inquiry Card.

Study Chemical Elements

Chemistry Works, The Computerized Periodic Table, streamlines your PC the processes of identifying, cross-referencing, comparing, and studying detailed information about all 108 elements. The software features atomic number, radius, volume, and weight; boiling point; covalent radius; crystal structure; density; electrical conductivity; electron configuration; electronegativity; heat of fusion; melting point; name; oxidation state; specific heat; state (solid, gas, or liquid); symbol; and thermal conductivity.

Price: $449.

Contact: Dowdy Research, Downey, CA, (800) 858-9795 or (310) 861-6606; fax (310) 862-1546.

Circle 1308 on Inquiry Card.

WHAT'S NEW • SCIENCE/ENGINEERING SOFTWARE

BYTE • DECEMBER 1992
In the information-packed '90s, good graphics are more important than ever to get your message across quickly and effectively. And now it's easier than ever to use graphics—with CorelDRAW 3.0! Everything you need is in one value-packed box. There is no longer any need to buy separate illustration, charting, painting, and presentation packages. CorelDRAW 3.0 does it all with unmatched power and ease-of-use! And, as an unprecedented bonus, Corel has included a CD-ROM with over 14,000 clipart images and over 250 fonts! You'll get fingertip convenience for software that would otherwise occupy over 500 floppy disks and cost thousands of dollars.

Outstanding Reviews!

"CorelDRAW remains the easiest-to-use graphics product on the market...the ultimate graphics bargain!"
PC Magazine, August, 1992

"CorelDRAW is a phenomenal bargain"
Michael Burgard, PC/Computing, July, 1992

"CorelDRAW – ALL THAT MOST PEOPLE WILL EVER WANT in the way of a graphics software..."

"Business users who need a wide variety of graphics functions shouldn't pass up this package. It is an amazing bargain."
Luisa Simone, PC Magazine, August, 1992

"CorelDRAW 3.0 is without doubt the most powerful, feature-laden, and best value for money graphics systems for Windows, at any price point. Full stop, end of discussion."
Jon Honeyball, Windows Magazine UK, August, 1992

"Endowed with paint, chart and presentation capabilities, this upgrade of the leading PC draw package is a stunning example of increased power at a reduced price."
Christina Wood, PC WORLD, July, 1992

"It's hard to find a more value-laden offering. We rate the value as excellent."
Mike Heck, INFOWORLD, July 13, 1992

"Total relative value of CorelDRAW modules, clipart and fonts is $15,000."

Outstanding Value!

Other companies need several packages to do what Corel does in one!

<table>
<thead>
<tr>
<th>Company</th>
<th>Drawing/ Illustration</th>
<th>Charting/ Presentation</th>
<th>Photo-Editing</th>
<th>Fonts</th>
<th>Clipart</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micrografx</td>
<td>Designer</td>
<td>Chromino</td>
<td>Picture Publisher</td>
<td>251</td>
<td>3940</td>
<td>$1685</td>
</tr>
<tr>
<td>Aldus</td>
<td>Freehand</td>
<td>Persuasion</td>
<td>PhotoStyler</td>
<td>12</td>
<td>385</td>
<td>$1885</td>
</tr>
<tr>
<td>Corel</td>
<td>CorelDRAW!</td>
<td>CorelDRAW!</td>
<td>CorelDRAW!</td>
<td>286</td>
<td>14,900</td>
<td>$595</td>
</tr>
</tbody>
</table>

No wonder CorelDRAW is the world's best selling graphics software for Windows!

FREE 24 hour Technical Support
CorelDRAW is MULTIPLATFORM
for corporate standardization:
Windows, OS/2, UNIX
And soon available on the
MAC, and in 20 languages!

Call now for
a free demo-disk and brochure!

Circle 88 on Inquiry Card.
Compudyne™. Latest Technology. Highest

Compudyne is the PC manufacturing and direct marketing arm of CompUSA™, the Computer SuperStore (NASDAQ symbol: CUSA)—inventors of big volume, deep discounting PC retailing, and the largest chain of computer super stores in the country. Compudyne manufactures top quality, fully-supported computers as available from only the largest PC manufacturers at prices typically found only at garage shop clone houses.

Result? We’re already one of the largest direct PC companies in the country and guarantee that our prices are the lowest of any currently advertised.

Feast your eyes on “one of the best notebook values around” (Mobile Office 7/92), snugly packed into a slim, trim, 5.5 lb package (including battery). All include these nifty features:

- **11” x 8.5” x 1.6”** (yes, only 1.6” thick!)  
- Full 10”, 64 grayscale brilliant VGA screen

**Notebooks**

<table>
<thead>
<tr>
<th>Notebook</th>
<th>CPU</th>
<th>RAM (MBs)</th>
<th>HD (MBs)</th>
<th>Battery Life (hrs)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>386SX/20</td>
<td>386 SX/20 MHz Optional 8087SX</td>
<td>2 standard, 16 max</td>
<td>60</td>
<td>1.5+</td>
<td>$999</td>
</tr>
<tr>
<td>386SX/25</td>
<td>386 SXL - 25 MHz Optional 8087SX</td>
<td>2 standard, 4 &amp; 8 options</td>
<td>60</td>
<td>3.5+</td>
<td>$1,399</td>
</tr>
<tr>
<td>386SL/20</td>
<td>386 SL/20 MHz Optional 8087SX</td>
<td>2 standard, 4 &amp; 8 options</td>
<td>60</td>
<td>3.5+</td>
<td>$1,599</td>
</tr>
<tr>
<td>386SL/25</td>
<td>386 SL - 25 MHz, 94 K CPU cache Advanced 8087 co-processor</td>
<td>as above</td>
<td>60</td>
<td>3.5+</td>
<td>$1,799</td>
</tr>
<tr>
<td>486SX/35</td>
<td>486 SX/35 Mhz, Built-in 8K CPU cache</td>
<td>4 standard, 8 &amp; 16 options</td>
<td>80</td>
<td>2.5+</td>
<td>$1,999</td>
</tr>
<tr>
<td>486DX/33</td>
<td>486 DX/33 MHz, Built-in 8K CPU cache</td>
<td>as above</td>
<td>120</td>
<td>2.5+</td>
<td>$2,899</td>
</tr>
</tbody>
</table>

**ORDERING**
- 1-800-932-COMP (2667)
- International callers dial: 1-214-702-0055
- 24 hour fax: 1-214-702-0300
- Corporate credit and volume terms available.

**NEW HOLIDAY HOURS**
- 7am-8pm (CST) Mon.-Fri. and 9am-5pm (CST) Sat.

**WARRANTIES**
- 30-day, no questions asked, return policy
- 1 year limited warranty.

**SERVICE & SUPPORT**
- Toll-free technical support
- On-site service for desktops and overnight replacement for portables.
- Next-day shipping for most systems.

**DIAL TO SAVE DOLLARS**
**Quality. Lowest Prices. Guaranteed.**

**Desktops**

Order one of our pre-configured systems or custom-configure your own, choosing from a myriad of options. All systems include...

- Microsoft® Windows 3.1 and MS/DOS 5.0
- Microsoft compatible serial mouse
- 200 watt power supply
- 101 AT-style keyboards
- FCC Class B certification
- Built in serial (2), parallel (1) and game (1) ports
- Artisoft's LANtastic® LAN
- 8 I/O board slots
- U/L listing

For quick easy upgrades. They support 3 externally accessible 5.25" drive bays and 2 internal 3.5" units.

### Get Vertical...

For those who prefer the aesthetics and footprint of a desktop tower or need the added drive capacity for file server applications, our mini tower offers an astonishing 6 drive capacity; 4 external plus 1 internal 5.25" and 1 internal 3.5" unit in a mere 8"x16" desktop footprint for only $100 more.

### Options, Options, Options...

- Displays: Mono or color VGA; 1024 and 1280 interlaced or non-interlaced; 14" to 20"
- Hard Drives: 40; 80; 105; 120; 211; 483; 680 MBs or 1.2 GBs
- Internal CD-ROM (inc. Grolier's Encyclopedia, Toolworks, Reference Library and PC-SIG)
- Internal Fax/Modem: 9600 bps send/receive fax; 2400 bps modem; inc. WinFax and Quicklink Software.
- Built in serial (2), parallel (1) and game (1) ports
- Artisoft's LANtastic® LAN
- 8 I/O board slots
- U/L listing

**Get Horizontal...**

Our standard desktop systems feature aesthetic yet rugged plastic-over-steel construction with "one screw" assembly for quick easy upgrades. They support 3 externally accessible 5.25" drive bays and 2 internal 3.5" units.

<table>
<thead>
<tr>
<th>Desktop</th>
<th>CPU</th>
<th>RAM (MBs)</th>
<th>HD (MBs)</th>
<th>Floppy</th>
<th>Display</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>386DX/33</td>
<td>Intel 80386DX-33 MHz</td>
<td>1 standard</td>
<td>40</td>
<td>1.2c</td>
<td>16-bit VGA card, 14&quot; 640x480 VGA</td>
<td>$849</td>
</tr>
<tr>
<td>386DX/33 or 486DX/25</td>
<td>Intel 80386SX-25 MHz, built-in 8K CPU cache</td>
<td>2 standard</td>
<td>80</td>
<td>as above</td>
<td>as above</td>
<td>$999</td>
</tr>
<tr>
<td>486DX/25</td>
<td>Intel 80486SX-25 MHz, built-in 8K CPU cache</td>
<td>as above</td>
<td>80</td>
<td>1.2c &amp;</td>
<td>16-bit VGA card, 14&quot; 1024x768 SVGA</td>
<td>$1,199</td>
</tr>
<tr>
<td>386DX/33 Cache</td>
<td>Intel 80386DX-33 MHz</td>
<td>4 standard</td>
<td>120</td>
<td>as above</td>
<td>16-bit VGA card &amp; Hi-Color Support</td>
<td>$1,399</td>
</tr>
<tr>
<td>486DX/33 Cache</td>
<td>Intel 80486SX-25 MHz</td>
<td>64K CPU cache</td>
<td>as above</td>
<td>120</td>
<td>as above</td>
<td>$1,399</td>
</tr>
<tr>
<td>486DX/33 Cache</td>
<td>Intel 80486DX-25 MHz</td>
<td>8K CPU cache</td>
<td>as above</td>
<td>120</td>
<td>as above</td>
<td>$1,499</td>
</tr>
<tr>
<td>486DX/33 Cache</td>
<td>Intel 80486DX-33 MHz</td>
<td>128K CPU cache</td>
<td>as above</td>
<td>120</td>
<td>as above</td>
<td>$1,499</td>
</tr>
<tr>
<td>486DX/50 Cache</td>
<td>Intel 80486DX-50 MHz</td>
<td>256K CPU cache, True 50 MHz CPU</td>
<td>as above</td>
<td>120</td>
<td>as above</td>
<td>$1,799</td>
</tr>
<tr>
<td>486DX/66 Cache</td>
<td>Intel 80486DX-66 MHz, 138K CPU cache</td>
<td>8 standard</td>
<td>200</td>
<td>as above</td>
<td>16-bit VGA, Superfast Windows, Accelerator card, 1MB RAM, 14&quot; 1024x768 SVGA</td>
<td>$2,499</td>
</tr>
</tbody>
</table>

**Compudyne**

THE LOWEST OF THE LOW PRICES. GUARANTEED.

Prices and specifications subject to change without notice. Compudyne Direct, 15151 A Surveyor, Addison TX 75001.

Circle 181 on Inquiry Card.
File Management and Retrieval

With Golden Retriever, you can create, store, track, and fetch spreadsheets, letters, memos, proposals, reports, presentations, and other data files. The management and retrieval system for Windows visually organizes and stores your documents in electronic file drawers and hanging files under filenames similar to those you would use to file paper documents (e.g., subject, project, author, addressee, and date). When you open a file folder in a drawer and double-click with a mouse on the name of a document, Golden Retriever automatically tracks down the application used to create that document, launches the application, and opens the file.

Price: $99.
Contact: Above Software, Inc., Irvine, CA, (800) 344-0116 or (714) 851-2283; fax (714) 851-2285.
Circle 1312 on Inquiry Card.

Mac Multimedia Tools

Interactive Media’s Special Delivery and Media Cataloger for the Mac help you present or communicate information using interactive digital multimedia. Special Delivery integrates existing graphics, pictures, movies, and sound into interactive multimedia. Media Cataloger, a stand-alone application, organizes, finds, and retrieves graphics, pictures, movies, and sound in formats that you can use in other applications.

Price: Special Delivery, $399; Media Cataloger, $99.

Scan Images and Visualize Data

Linneas Informationstechnik offers SGIs Scan and CADview, two software packages for use with workstations such as those from Silicon Graphics, Siemens, and Bull. SGIs Scan lets you control scanner parameters and save scanned images in popular formats for integration in desktop publishing programs. Other features include a rubber-band rectangle for specifying the scanning area, zooming, and image rotation.

With CADview, you can visualize, evaluate, and edit CAD data from different formats and sources. The program offers 3-D representation of loaded objects in user-defined views, common geometry formats, and support for 2-D formats such as PostScript, TIFF, and HPGL. CADview also lets you edit CAD data before integrating it into word processing or desktop publishing systems.

Price: SGIs Scan, $3700 (about 2500 deutsche marks); CADview, $6216 (starts at 4200 deutsche marks).
Contact: Linneas Informationstechnik GmbH, Braunschweig, Germany, +49 531 380 11 40; fax +49 531 380 11 59.
Circle 1314 on Inquiry Card.

Protect Your DOS PCs

IronClad is a high-end security and antivirus program for DOS-based PCs and networks. The program lets you apply attributes to drives, subdirectories, users, and even individual files to suit your security requirements. It prevents viruses without the need for upgrades; performs transparent file encryption; and prevents execution of programs from any source, including disks, removable drives, or CD-ROM drives.

The program also includes an audit trail, keyboard locking, log-on scripts, password aging, format protection, setup and audit reports, emergency deactivation, and facility encapsulation.
Price: $195.
Contact: Silver Oak Systems, Inc., Silver Spring, MD, (301) 585-8641; fax (301) 586-6484.
Circle 1315 on Inquiry Card.

Extend a Portable PC’s Battery Life

Lucid’s Battery Boost package reduces power demands on your portable PC’s battery to increase the battery’s usable life. Features include a Power Manager, which turns off the screen backlight and hard drive motor after a user-specified period of inactivity; Deep Discharge, which increases the battery’s charge-holding capability by making sure it is fully discharged before recharging; Battery Gauge, which shows you the remaining battery life; SCRBoost, which eliminates lags in the video BIOS so directories scroll much faster; and KeyBoost, which eliminates keyboard delays.

Price: $195.
Contact: Lucid Corp., Dallas, TX, (214) 994-8100; fax (214) 994-8103.
Circle 1316 on Inquiry Card.

SPREAD THE WORD

Please address new product information to New Products Editors, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Better yet, use your modem and mail new product information to the microbytes.bw or microbytes.sw conferences on BIX. Please send the product description, price, ship date, and an address and telephone number where readers can get more information.
Glad you could stop and look at our ad.

Reading this magazine is confusing, isn’t it? Every PC ad says the same thing these days. Who can you believe? Believe in yourself. You’re smart. Strip away all the hype and you’ll know a good buy when you see one. You want a great computer at a great price—from a solid company that’ll take care of you. At Gateway, that’s what we offer. Take a look at our products and services—then give us a call. Simple!
MINI DESKTOP SYSTEMS

GATEWAY 2000

3SX-25

■ 25MHz Intel® 386SX Processor
■ 4MB RAM
■ 5.25" and 3.5" Diskette Drives
■ 80MB 17ms IDE Hard Drive
■ Windows Accelerated Video with 1MB DRAM (Faster Than Local Bus VGA!)
■ 14" Color CrystalScan™ 1024NI
■ Mini Desktop Case
■ 5 16-Bit ISA Slots
■ 124-Key AnyKey™ Keyboard
■ MS-DOS®, Windows™ & Mouse
■ Cool Tools for DOS
■ MS Works for Windows™ 2.0

$1295

GATEWAY 2000

4SX-25

■ 25MHz Intel 486SX Processor
■ 4MB RAM
■ 5.25" and 3.5" Diskette Drives
■ 170MB 13ms IDE Hard Drive
■ Local Bus IDE Interface
■ Windows Accelerated Video with 1MB DRAM (Faster Than Local Bus VGA!)
■ 14" Color CrystalScan 1024NI
■ Mini Desktop Case
■ 5 16-Bit ISA Slots
■ 124-Key AnyKey Keyboard
■ MS-DOS, Windows & Mouse
■ Cool Tools for DOS
■ MS Works for Windows 2.0

$1495

■ Gateway ranked #1 in PC Magazine’s 1992 Service & Reliability Survey
■ Gateway systems give you the ultimate performance
■ All 486 ISA systems have an Intel OverDrive socket
GATEWAY 2000

ASX-33

- 33MHz Intel 486SX Processor
- 4MB RAM, 64K Cache
- 5.25" and 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Windows Accelerated Video with 1MB DRAM (Faster Than Local Bus VGA!)
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$1695

GATEWAY 2000

DX-33

- 33MHz Intel 486DX Processor
- 4MB RAM, 64K Cache
- 5.25" and 3.5" Diskette Drives
- 200MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Windows Accelerated Video with 1MB DRAM (Faster Than Local Bus VGA!)
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$1995

- One-year limited warranty and 30-day money-back guarantee
- All systems are FCC Class-B, UL and CSA certified
- Free lifetime toll-free technical support
**DESKTOP AND TOWER SYSTEMS**

**4SX-33V**
- 33MHz Intel 486SX Processor
- 8MB RAM, 64K Cache
- 5.25" and 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- VESA Local Bus ATI Ultra Pro with 1MB VRAM (Faster Than The New ATI Graphics Ultra!)
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$2195

**4DX-33V**
- 33MHz Intel 486DX Processor
- 8MB RAM, 64K Cache
- 5.25" and 3.5" Diskette Drives
- 250MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- VESA Local Bus ATI Ultra Pro with 1MB VRAM (Faster Than The New ATI Graphics Ultra!)
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$2495

- Gateway's local bus meets VESA standards for compatibility
- On-site service available to most locations
- Free lifetime BBS membership
4DX2-66V

- 66MHz Intel 486DX2 Processor
- 8MB RAM, 64K Cache
- 5.25" and 3.5" Diskette Drives
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- VESA Local Bus AT1 Ultra Pro with 1MB VRAM (Faster Than The New AT1 Graphics Ultra!)
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 8 16-Bit ISA Slots, 2 with 32-Bit VESA Local Bus
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$2995

4DX2-66E

- 66MHz Intel 486DX2 Processor
- 8MB RAM, 128K Cache
- 5.25" and 3.5" Diskette Drives
- 500MB 11ms SCSI Hard Drive
- 32-Bit EISA SCSI Controller
- Windows Accelerated Video with 1MB DRAM (Faster Than Local Bus VGA!)
- 14" Color CrystalScan 1024NI
- Tower Case
- 8 32-Bit EISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS, Windows & Mouse
- Cool Tools for DOS
- Choice of Application Software

$3795

- We custom-build each Gateway 2000 system to your specifications
- Please call a sales representative for other configurations
- All software is pre-installed and ready to run

GATEWAY 2000

800-523-2000
PORTABLE SYSTEMS

GATEWAY 2000 HANDBOOK™

- Weight: 2.75 Lbs.
- Dimensions: 5.9" x 9.75" x 1.4"
- 4.5-Hr. NiMH 2.3Ah Battery and AC Adapter/Charger
- 286-Class Performance
- 1MB RAM, Upgradeable to 3MB
- 40MB Hard Drive
- Backlit 7.6" CGA Screen
- 1 Parallel and 1 Serial Port
- 78-Key Touch-Type Keyboard
- MS-DOS 5.0, LapLink® XL, MS Works™ for DOS, Central Point® Desktop & Serial Download Cable
- Carrying Case
- $1295

GATEWAY 2000 NOMAD

- Weight: 5.8 Lbs.
- Dimensions: 8.5" x 11" x 1.8"
- 6-Hr. NiCad 5.7Ah Battery and AC Adapter/Charger
- 4MB RAM
- 3.5" Diskette Drive
- Backlit 10" VGA Screen, 64 Grays
- Simultaneous Video
- 1 Parallel and 1 Serial Port
- 79-Key Keyboard & FieldMouse™
- MS-DOS 5.0 and Windows 3.1
- MS Works for Windows 2.0

NOMAD 325SXL $1795
25MHz 386SXL, 80MB hard drive

NOMAD 420SXL $1995
20MHz 486SXL, 80MB hard drive

NOMAD 425DXL $2695
25MHz 486DXL, 120MB hard drive
**Peripherals and Upgrades**

**CD-ROM Kit**
- MPC-compliant, manufactured by Sony®
- $225

**Microsoft Windows Sound System™**
- Speak to your PC for hands-free operation
- PC reads numbers back for proofing
- Embed audio messages in OLE applications
- Soundboard, microphone, headset and software
  - $149 (with the purchase of a system)

**The TelePath™ Fax/Modem**
- 14,400 bps modem/9,600 fax, V.32bis
- Includes WinFax Pro™, Crosstalk™ for Windows, Qmodem™ and more
- $195

**CrystalScan™ 15-Inch Monitor**
- Flat, square screen, non-interlaced
  - $100 (to upgrade from 14-inch 1024NI)

**Panasonic KXP2123 Color-Capable Printer**
- 24-pin dot matrix, includes Adobe Type Manager®
- Printer $259, Color Option $50

---

**Free Software**

For systems with “choice of application software,” pick the latest version of one of the following:

- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft® Word and Bookshelf 92,® CD-ROM edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- The MS Entrepreneur Pack (Works,™ Publisher,™ Money,™ and games)
- Borland Paradox® and Turbo Pascal or C++®
- The Windows Programmer Pack (MS Quick C,™ Visual Basic and more)
- Upgrade to Microsoft Office™ for $175

**Cool Tools for DOS**, a diagnostic and utilities package, comes with all Gateway desktop systems and includes:

- QA Plus™ from DiagSoft™
- Central Point® Anti-Virus, RAM Boost, Defrag and Emergency Disk

For details on our complete line of components, peripherals and software, call direct to our special Enhancements Division at 800-252-3333.

---

**Gateway2000**

8 0 0 - 5 2 3 - 2 0 0 0
GOOD BUY

800 - 523 - 2000

610 Gateway Drive • P.O.Box 2000 • North Sioux City, SD 57049-2000 • 605-232-2000 • Fax 605-232-2023
Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)

©1992 Gateway 2000, Inc. AnyKey, HandBook, FieldMouse, CrystalScan and TelePath are trademarks of Gateway 2000, Inc. Intel is a trademark of Intel Corporation. All other brands and product names are trademarks or registered trademarks of their respective companies.
Prices and configurations are subject to change without notice. Prices do not include shipping.
A COMPUTER IN THE HAND

Another month on the road. I think they're trying to kill me. First it was Denver, as guest of the International BBS and Electronics Communication Conference, or IBECC. No sooner was I back than I was off to a science conference in Korea. Before that was over, I found myself in the Olympic stadium watching the Rev. Moon marry 25,000 couples, many of whom met for the first time that morning. Next was Comdex, come ask me about that at the BYTE booth.

I hadn't been to Korea since the war. Of course, you expect things to change in 40 years, and I'd read a number of reports on the growing Korean economy, but I still wasn't ready for what I saw.

Seoul is a thoroughly modern city. People my age associate an Oriental capital with rickshaws and bicycles zipping along wide new boulevards that cut through areas of narrow streets and hovels. Not so here. All the streets are wide and straight, and if there are any hovels, they're well hidden from both the main highways and the extremely efficient elevated railway. I did not see one single rickshaw or bicycle. What I did see were cars and trucks, enough of them to create traffic jams all day, not just during rush hour; and this in a well-laid-out modern city. If they didn't have the elevated railway and subways, no one would get anywhere.

A number of economic forecasts put Korea ahead of Japan by the end of the century. I thought those ridiculous until last week. Now I'm not so sure. Korea is a nation of hardworking people who take education very seriously. It's also an orderly nation. Data point: there were 100,000 people in the Olympic stadium for the mass wedding. Granted, half were brides and grooms (all dressed alike, dark suits and white bridal gowns), and half those not being married were press, government officials, and invited guests; but in that crowd of over 100,000 people, I saw not one policeman and only a few dozen ushers. No one was armed. Four to 6 hours in the hot sun, and not one incident: no pickpockets, no demonstrators, no fights, no arguments, not even raised voices.

We think of Japan as competition, and rightly so, but we'd do well not to overlook Korea.

Gateway HandBook
It's nearly 12 hours each way from Los Angeles to Seoul, and more time in the lounges waiting to board. With my deadlines, I certainly didn't have any 24 hours to spare, so I was prepared to work on the flight. Korean Airlines has wonderful business-class service, and I had plenty of room to set up the Zenith Mastersport laptop.

I had a minor panic when I realized I'd left with the wrong mouse clamps. The Microsoft Ballpoint trackball is supposed to attach to your laptop; but there are two sets of clamps, and I'd brought the wrong ones. There was no way I could attach the Ballpoint to the Mastersport's case. It turns out, though, that you can lay the Ballpoint on the table next to the machine, and it works just about as well. I'd hate to do that holding the computer on my lap. The moral of the story is to check things out before leaving the house, which I already knew.

Korean electricity is 220 volts AC at 50 cycles. The hotel furnished a converter about the size of a large automobile battery charger. It worked fine, but I'm sure glad I didn't have to carry that in my luggage. Incidentally, given the falling dollar, most stuff—clothes, electronics, optics—in the upscale Korean department stores costs just about what it would in the Fashion Square Mall in Los Angeles.

I didn't get too far from the World Trade Center. I was in Seoul to attend a science conference and present a paper. The conference was excellent, organized as I like things: the papers were printed up and distributed beforehand, so most of us used our time for comments on other papers. Alas, a few attendees painstakingly read prepared papers. Worse, some Russians (and a few Italians and Chinese) weren't very fluent in English. There are few experiences in life that are more excruciatingly boring than to sit quietly and pretend to listen to someone who doesn't speak English read a paper that you've already read.

At least it's boring if you have nothing else to do. Of course, it would be rude to read a book no matter how badly the speaker reads; but it's flattering to see someone taking notes while you speak. In my case, I was actually working on what I would say when it was my turn, but no
USER'S COLUMN

one had to know that as I typed away on the Gateway HandBook.

The Korean trip served multiple duty: a really fascinating scientific conference, a chance to see the payoff from the Korean War—when I left, Korea was free but a wreck—and an excellent chance to test several palmtop computers.

It soon became apparent which one I liked most. The Poqet PC has some excellent points—my son Phillip still runs his division on the USS Tripoli with a Poqet, and he'd be lost without it. The HP 95LX also has its points. For that matter, there's a good bit to be said for the Atari Portfolio. However, all three are just too small for a touch-typist—or at least for this touch-typist. Phillip types two-finger style and swears he's a lot faster on the Poqet than on a full-size machine, and I believe him; and TV commentator Bruce Herschensohn can type two-fingered on his Atari Portfolio about as fast as I can touch-type. Me, though, I want to get my hands on them home keys, and I can do that with the HandBook.

Indeed, the HandBook was the hit of our conference. If I had been a Gateway dealer, I could have made a mint: I think everyone who saw the HandBook wanted one.

The HandBook isn't as small as the Poqet or the HP 95LX. Closed, it measures 10 by 6 by 1½ inches, making it too large to put into a coat pocket, where you might stuff the HP 95LX (or a Wizard, Boss, or Franklin Academy). You might get a Poqet into a very large pocket, but not the HandBook. You carry that in a shoulder bag or briefcase, or just as you would a book.

I've seen Portfolio users type with three fingers of one hand, with the thumb of the other working Shift and the space bar. They really fly along. I suppose that such a technique could be developed for the HandBook, but it's a bit large for that; where the HandBook shines is when you can set it on a table or on your lap. Then it's wonderful. The screen is backlit and large enough to see. The keyboard is excellent: quiet, good feel, decent layout, smaller than a standard keyboard, but large enough—a really good compromise.

I found I could type as fast on the HandBook as I can on the NCR Safari NSX/20. That surprises me. It's something about the feel of the keys, I think. I also found that I can see the screen through the bottoms of my bifocals; I don't have to put on my special computer glasses.

Understand, the HandBook is a 286-performance computer, with 1 MB of memory and a 42-MB hard drive. Unlike the Safari (which is one of the smallest and best notebook-size machines), it won't run Windows; but it will sure run any DOS programs you're used to. My HandBook came with Microsoft Works. I hadn't previously used Works much, but I found it nearly ideal in combination with the HandBook. The word processor is intuitive. So is the spreadsheet. Microsoft Works on the HandBook is a wonderful combination for a beginner, say, someone just going off to college; and I found it good enough for all my conference work, including using the spreadsheet and BASIC to do some quick computations at the conference while Professor Fred Singer of George Mason University gave us up-to-the-minute climate and temperature data.

There's no modem, but that wasn't a problem. I use a small Supra modem. The HandBook has a normal DB-9 serial port.

The other port on the HandBook is a parallel port; it looks like a very small Centronics connector. They furnish an adapter to turn that into the standard DB-25 parallel connector.

The HandBook comes with LapLink XL, a scaled-down OEM version of Travelling Software's LapLink Pro. Like LapLink Pro, LapLink XL will send itself to another DOS computer, such as the Mastersport. You need this, of course, because there's no floppy drive on the HandBook. They do sell an external floppy drive, but I don't have one yet. I presume it's like the Safari's external floppy drive, and I can't think of any reason why it wouldn't work properly.

I used the serial port and LapLink XL to peel all my work off the HandBook and onto the Mastersport. Incidentally, the HandBook off-loads files at high speed, but incoming was slow; I think I may have a noisy serial port, which gives me a lot of retry errors. But everything I wanted in the HandBook got there, while files coming out of the HandBook were no problem at all. Gateway assures me this is covered by the warranty, and they'll be glad to swap machines, but I'm off for another trip tomorrow—they are trying to kill me—and the thought of going to a science fiction convention without the HandBook to show off is appalling; which may tell you something about how much I like it.

I haven't yet tested the HandBook with BSE's external Flashdrive hard drive because installing the BSE software requires a floppy drive. I did connect the Flashdrive to the Mastersport, and I was then able to access it through LapLink as the Mastersport's D drive.

You can see from that all this is leading: on trips, do I need any computer other than the HandBook? The first experiment will be tomorrow: I'm off for Florida, and I'm going to put the Mastersport, well padded,
MINUTEMAN TAKES CHARGE IN OVER 1000 JCPENNEY STORES.

Every time JCPenney sells a pair of jeans, a toaster or a bottle of perfume, MINUTEMAN takes charge. That's because more than one thousand JCPenney stores rely on MINUTEMAN UPS systems to back up power to their point-of-sale systems.

Every day your company relies on its voice and data communications equipment to stay productive. Unfortunately, the electricity that powers these vital systems is not reliable.

Blackouts, brownouts, spikes, surges and even lightning strikes are common in most business environments. And the high cost of losing vital information and productivity due to power outages and surges calls for preventive measures.

Power requirements can be confusing. And your company has unique needs that often require custom solutions.

MINUTEMAN PRODUCTS:
- On-line and standby UPS 300VA to 10KVA
- Shutdown software for every available operating system
- Automatic voltage regulators
- Surge suppressors
- International models
- Two year warranty

Call our toll-free POWER HOTLINE now for your free Power Protection Guide.
(800) 238-7272

Reduced prices up to 36%
Call for complete price list.

Recently JCPenney Co., Inc. changed its operations from the old POS systems to the new PC-based technology, relying on PC platforms for point-of-sale and in-store support. And they back each one up with help from MINUTEMAN.

"There was a violent surge in one of our stores," says Patefield. "If we didn't have the MINUTEMAN unit, it probably would have seriously damaged all of our point-of-sale equipment.

"The key was the switch-over time from AC to battery," says Patefield. "It really has the best continuity of the UPS systems we evaluated. Also, the price was very favorable. When you're installing them in as many locations as we are, the pricing was very attractive."

Circle 128 on Inquiry Card.
Your Fortran code is important. Trust it to the company that has been writing award-winning Fortran language systems for 25 years.

(800) 548-4778
Lahey
Fortran is our forte
(702) 831-2500 • Fax: (702) 831-8123 • P.O. Box 6991 • Incline Village NV 89450

PCMCIA
The only problem with the Gateway Handbook is that it doesn’t have a PCMCIA slot. All that’s a serious deficiency. Poor面向 (Fujitsu) did a lot of pioneering in PCMCIA, and the Poqet has two slots, which is a great idea. The Safari has one. So does the HP 95LX palmtop. Alas, the Franklin Academy and Atari Portfolio don’t have one, although they have something proprietary that’s like it. The Zenith Mastersport doesn’t have PCMCIA, and it needs it.

For those who are wondering what in the world a PCMCIA interface is, it’s a gizmo that accepts a PC card about the size of a baseball card, but about 3 millimeters thick. The whole thing is very small, since the only moving part is the mechanical button to eject the PC card. Internally, the interface connects directly to the machine’s I/O bus. The result is that the computer can see the PCMCIA device as a hard drive holding up to 20 MB (at present; larger cards may be coming) of very fast nonvolatile read/write memory.

You can take the card out and transfer it and its files to another computer equipped with PCMCIA (which is why PCMCIA compatibility is important, and it’s unfortunate that the Atari Portfolio doesn’t have it). PCMCIA makes it really simple to save your work and remove it from the machine without a floppy drive; or to transfer up-to-the-minute stuff, such as databases, calendars, and last-minute reminders.

You can also put programs on it. Phillip has WordPerfect on a PCMCIA card on his Poqet; in the other slot he has a memory card. Understand, you can change those cards at any time, with the same ease that you change floppy disks. I don’t use WordPerfect, but I do use Derive, a mathematics program, and that’s available in PCMCIA format now. So are many other programs. I doubt it will be long before all your popular software programs are available that way—and, for that matter, since PCMCIA is a read/write medium, there’s nothing to prevent you from making up your own card library of programs you want to have handy on trips.

A new specification from the PCMCIA extends the PC card standard to accommodate other peripheral devices (e.g., modems, network adapters, and even disk drives) on a PC card (see this month’s Under the Hood, “The PCMCIA Redefines..."
The best place to get your photos printed.

You don't need a photo lab to get computer output like this. A Phaser™ llsd color printer by Tektronix will do just fine. It's the only dye sublimation printer that gives you detailed, photorealistic images with crisp, clean text—that's TekColor Photofine technology. But you also get Adobe PostScript Level 2 and TekColor PS to match and adjust colors. Plus Pantone certification, networkability, a 24MHz RISC processor for speedy output, a $9995 price tag and a print cost of only $2 per page. All in one little machine. That's what we call picture perfect. Call the leader in color printers at 1-800-835-6100 Dept. 25A for a free output sample. Or call (503) 682-7450, ask for Document 1222 and we'll send information by fax.

Tektronix
Computer Graphics

Phaser, TekColor and Photofine are trademarks of Tektronix, Inc.
PostScript is a trademark of Adobe Systems, Inc.
All other marks are trademarks or registered trademarks of their respective companies.

Circle 159 on Inquiry Card.
Portability,” for more details).

It’s my guess that within a year every respectable laptop and palmtop will have PCMCIA; and within three years, most new desktops will have them.

It’s relatively easy to retrofit a desktop machine with PCMCIA; you insert a bus card and connect it to the PCMCIA drive, which can mount internally. It’s a bit like adding an extra floppy drive to your system. Since PCMCIA connects to the bus, it’s not quite so easy to retrofit cardless computers, but Trantor has made SCSI work through the parallel port; and I’ve seen ads for PCMCIA drives to connect to the parallel port. I suppose those won’t be as fast as a DMA connection, but they should work. I’ll get one and find out.

Gateway is aware of the growing interest in PCMCIA, and I’m sure that not long after you read this, it will be offered as an option for the HandBook.

Anyway: the bottom line is, I love that little HandBook. Highly recommended.

HP 95LX
It’s powerful. It has a PCMCIA slot. It’s well supported. It’s small. It’s the latter that limits its usefulness to me: it’s too small. This is one of those machines that you’ll either love or hate because of the form factor. If you can manage two-finger typing and can live with a small screen, this is a real computer you can truly put in your pocket.

It’s a bit tricky learning to use it, but actually it’s easier than learning the Wizard or the Boss or one of the other pocket date/calendar/notebook devices. After all, the HP 95LX is really a tiny PC running programs under DOS. There are buttons that do some fancy switching among programs, and some programs such as Lotus 1-2-3 are preloaded into ROM for you; but through the magic of PCMCIA, you can run almost any program you can get onto a desktop PC. The PCMCIA slot is the A drive, and you can load programs from there as well as save data to it. There are screen limits. The HP 95LX’s screen is 16 rows by 40 columns. It’s not backlit.

One very innovative feature: an infrared communications port. At the moment, that will talk only with a properly equipped HP LaserJet laser printer, but it’s an interesting feature other palmtop makers should study.

There are keyboard limits. The keys are in a QWERTY pattern, but the numbers are in a number pad to the right rather than across the top. Across the top are dedicated keys that jump to programs such as the phone and memo applications, a full HP calculator, and Lotus 1-2-3, all of which you can jump to at any time. Above those keys is a line of function keys: F1–F10.) The colon and semicolon, left and right arrows, and the like are Shift-numbers, while special characters (e.g., #, $, and %) are Shift-symbol keys. All these keys are tiny chiclet affairs; it’s meaningless to talk about their feel. The space bar is about 2 inches wide. There are Alt and Control keys. The whole thing is very small. After all, the entire unit measures only 6 1/4 by 1 by 3 1/4 inches when closed.

And that’s both the strength and weakness of the HP 95LX. It’s small enough to put in your pocket and considerably more powerful than a Wizard or Boss. You can add tons of accessories to make it work better, communicate better, and hold more data. Add an external hard drive. Add an external modem. What you cannot do is change its fundamental size.

The Safari has got notebook computers down to about as small as they’re going to get and still have a full-size keyboard. Get any smaller, and it’s not a notebook; it’s something else. HP has
How do you move volumes of data from your SCSI device fast and efficiently? With the Fast Disk EISA SCSI Caching Host Adapter from American Megatrends.

THE SUPERIOR PERFORMANCE SOLUTION
The Fast Disk SCSI controller supplies the industry’s highest transfer rates and uses a 386SX CPU to manage up to 16MB of cache.

"...superlative disk performance - the best seen by PC Labs thus far - thanks to AMI’s Fast Disk Controller, a 32-bit SCSI EISA card with a 386SX/16 microprocessor and 16MB cache."PC Magazine - June 16, 1992

UNBEATABLE COMPATIBILITY
The Fast Disk SCSI Host Adapter is compatible with the popular Adaptec 154X and BusLogic drivers, and supports a wide assortment of SCSI devices, including hard drive, tape, CD-ROM and WORM.

FROM THE LEADING EISA DEVELOPERS
As the leading developer of EISA motherboards and EISA BIOS, American Megatrends has the knowledge and resources to support your EISA applications. With over 150 combined years of EISA/SCSI design experience and the only company with both board and BIOS design knowledge, you are ensured compatible designs that work.

For full information on America’s premium EISA peripheral cards, call American Megatrends today and see why more people move more data with AMI.

AMERICAN MEGATRENDS, INC.
6145-F NORTHBELT PARKWAY
NORCROSS, GA 30071
(404) 263-8181, FAX (404) 263-9381
(800) 828-9264, (800) U-BUY-AMI
IN SINGAPORE (65) 294-6714
IN THE U.K. (0293) 536-365

Distributed by MERISEL (800) MERISEL
Circle 63 on Inquiry Card (RESELLERS: 64).
The only Windows™ statistics package you’ll ever need.

**#1 for DOS and Windows**
Rated "the best general-purpose statistics program" for the PC by *Software Digest*, SYSTAT for DOS is now joined by SYSTAT for Windows. This addition to the SYSTAT family takes full advantage of Windows, with pull down menus, dialog boxes, sizable windows, and the ease of use you expect in a Windows package.

SYSTAT for Windows runs in standard and 386 enhanced modes and can take advantage of Windows advanced memory management. No matter how large or complex your analysis is, you can use SYSTAT.

SYSTAT delivers a balance of power and simplicity. It lets you analyze and manipulate data with a comprehensive range of advanced statistical procedures, and present your results with stunning graphics.

**Just point and click**
SYSTAT is a full-fledged Windows application. Just point and click. SYSTAT's QuickStat™ buttons give you simple, single-click shortcuts to common statistical analyses.

**More statistics, from the basic to the most sophisticated**
A full range of univariate and multivariate statistics—from t tests to multidimensional scaling. With a few clicks you can turn most statistics into graphs and perform:

- multiway crosstabs with log linear modeling
- nonparametric statistics
- principal components and factor analysis
- cluster analysis
- time series
- nonlinear estimation
- correlation matrices
- means, effect, and dummy models
- post hoc tests

SYSTAT offers the most advanced multivariate general linear model available for Windows.

**The most graphics**
No other statistical or graphics package can produce all the scientific and technical graphs that SYSTAT can—or surpass its ease of use. Graphics capabilities include:

- histograms
- single, multiple, stacked, and range bar graphs
- single and grouped box plots
- stem-and-leaf diagrams
- pie charts
- scatterplot matrices
- 3-D data and function plots
- contour plots
- control charts
- maps with geographic projections
- Chernoff faces
- complete color spectrum
- log and power scales
- confidence intervals and ellipses
- linear, quadratic, step, spline, polynomial, LOWESS, exponential, and log smoothing

**A compatible family of products**
Whichever you choose—SYSTAT for Windows, SYSTAT for DOS or both—you'll enjoy the most powerful statistics and scientific graphics software available for the PC.

For more information, special offers for current users, and demo disks, call:

708-864-5670
For Windows circle 157,
For IBM/DOS circle 158.
done about the same thing here. Smaller is a stunt. It looks as if they’ve gone about as far as folks can go...

If you have any interest at all in a tiny computer, this is the one you want to look at. The PCMCIA slot will keep it up to date and make it easy to add software. There’s already plenty of support: to see just how much, get a sample copy of the HP Palmtop Paper, a bimonthly 40+-page 8X- by 11-inch newsletter with articles on using the 95LX and ads for nifty accessories and programs. Contact Hal Goldstein at P.O. Box 869, Fairfield, IA 52556, (515) 472-6330.

I still prefer the Gateway HandBook, but then I deal with words more than numbers; if your life revolves around Lotus 1-2-3, or if all you want is an electronic calendar and appointment book, you will probably love the HP 95LX. For that matter, I don’t intend to let go of mine. Sometimes I don’t want to carry a shoulder bag.

Meanwhile, the Poqet PC is a compromise between the really tiny HP 95LX and the nonpocketable Gateway HandBook. One of these ought to fit any need.

More on these machines another time.

The Virus Scene

Don’t panic. I mean that literally. There are a lot of people out there who want to scare you into buying expensive antivirus software. Mind you, some of that software is very good. The question is whether you need it.

The answer for most of you is, probably not. There are a growing number of reported cases of viruses appearing “in the wild” (as opposed to being seen in laboratories), but the actual number of people harmed by them is small compared to the population of computer users; and this despite the growing sophistication of viruses, and the growing number of people who think it a clever idea to write one and release it to the world.

The main reason there’s so little damage from computer viruses is that there are a number of dedicated people collecting viruses, analyzing them, and writing programs that find and get rid of the pests; and that presents a dilemma. Virus analysis is expensive, and it’s often a thankless task since the usual result of analysis is to show that the virus wasn’t much of a threat.

Most “wild” viruses can be detected with simple scanners available as freeware or shareware on most computer BBSe s. If you take elementary precautions and use one of those scanners before installing new software, your chances of being harmed by a virus are very low.

Unfortunately, things change, and some-times the threat is all too real. The monthly Virus News International ($120 per year from Ontrack Computer Systems or £178 per year from Virus News International, Berkley Court, Mill St., Berkhamsted, Hertfordshire HP4 2HB, U.K., +44 0442 873033) recently published an interview with the Central European virus writer often called “Dark Avenger.” It’s chilling. The interview was done through a BBS, and there was apparently no chance of finding the true name of this chap; but a number of items left the editors of Virus News International in no doubt that they were talking with the actual author of some of the nastiest viruses ever found in the wild. The man is clearly brilliant. He also has no sense of remorse. I don’t know his reasoning, but it’s my guess that he figures that he’s improving the breed, somewhat in the way that wolves improve caribou herds.

He is not the only person with considerable skill who seems dedicated to doing as much harm to the computer community as possible; and the viruses seen by the editors at Virus News International are becoming increasingly sophisticated. For individual users who use sane backup procedures and reasonably regular detection scans, this still isn’t a great threat.

However, imagine this scenario: you are part of a large organization absolutely dependent on your database, which is available to hundreds of employees through your network. One day you discover that something is wrong with the data: something just doesn’t make sense. A closer look reveals your whole database is corrupted. Sophisticated investigation detects a virus. It has been operating for months, never manifesting itself, and confining its activities to making random changes in your database.

It has been operating long enough that many—perhaps all—of your backup files are also contaminated.

What would it cost you to recover? Could you recover at all?

Of course, that’s not likely to happen to you; but it’s possible, and the less you know about the virus scene, and the fewer clever people who are working to detect and eliminate viruses before they can do this, the more possible it becomes.

And thus I recommend that if your company can afford it, you should subscribe to one or both of the English virus news

We didn’t start the PC price war.

(We’d never back down on quality.)
services, Virus News International or Virus Bulletin ($395 from Virus Bulletin, Ltd., 590 Danbury Rd., Ridgefield, CT 06877, (203) 431-8720. In Europe, the address is 21 The Quadrant, Abingdon Science Park, Abingdon, Oxfordshire OX14 3YS, U.K., +44 223 555139). Both are published by organizations that sell antivirus software. Virus News International is part of S&S International Ltd., the outfit that distributes Dr. Solomon’s Anti-Virus Toolkit, the program I heartily recommend. Monthly updates to the Toolkit come with your subscription.

Virus Bulletin presents a different viewpoint. It’s quite readable, and one of its functions is to keep other virus prevention services on their toes. It, too, deserves support.

Neither of these is anything like cheap. They don’t come in fancy wrappers, they are not printed on slick paper, and there aren’t any pretty pictures. They’re pretty thin, for that matter. Are they, then, worth their cost? In my judgment, resoundingly yes; we would be in sad shape without them. If they didn’t exist, we would pretty soon have to create them, and we would probably do that in a panic, possibly as a government agency. That would likely end up costing us considerably more than the industry pays with tax-deductible subscriptions to these services.

S&S and Virus Bulletin are not part of the “scare them into buying virus protection” school. There are some firms that produce good programs but are just awful that way.

As to why support these two as opposed to excellent organizations such as Symantec (producer of Norton AntiVirus), it’s a judgment call, and I might easily be wrong. I’ve watched all the antivirus groups for several years now, and I think the British groups are more on top of the situation than the several good-to-excellent American research/publishing firms. This may be because most of the dangerous viruses lately come out of the former Evil Empire (and you could write a book about why that should be so), and the British groups are closer to the front lines. They tend to see the new viruses first.

Whatever, I don’t insist that you support the companies I recommend here. I do suggest strongly that if your company would be greatly harmed by virus infections as I described above, you support some organization that engages in virus collection and analysis. Don’t be a free rider.

Ramas/age

One of the things we discussed at my meeting in Seoul was population trends; so when I came back home, I decided to play around with some population models to see what’s likely for my children and grandchildren. After all, the total population and its age distribution will be one of the most important parameters setting the quality of life 20 and 30 years from now.

Moreover, population trends are hard to change. If we started right now on a campaign to produce more young people to enter the work force, it would be 18 years before any of our new products came online. The U.S. inevitably faces an aging population: fewer working-age people and vastly more retired people. It looks to me as if our choices are very limited: increase productivity, or have a declining standard of living. Or both.

Unfortunately, most increases in productivity are eaten by new measures, such as the Clean Air Act, which mandates that all coal plants have stack scrubbers, even though exhaust gas from burning Western coal goes into the scrubbers with less sulfur content than Eastern coal gas leaves with. It may be a good thing to use up productivity increases this way rather than investing in future productivity gains; but we ought to be aware of the consequences, too. It’s my opinion that most of the productivity increases made possible by small computers have disappeared into increased regulations.

In any event, Ramas/age lets you do population modeling; for those familiar with the lingo, you set up your own Leslie matrices, and you put in stochastic variations. For those unfamiliar with those terms, it’s all explained in the documents. You don’t have to be a sociologist to play around with this and get a feel for the age distribution of the American population over the next century. It may scare the daylights out of you.

Writer’s Toolkit for Windows

I’ve had this around for a long time without installing it, because I didn’t think I needed it. After all, my word processor is Q&A Write, which comes with an excellent spelling checker as well as Word Finder. I also have the Definitions Plus implementation of The American Heritage Dictionary. If I want to check grammar, I have Grammatik V. All those programs work within Q&A Write. Furthermore, if those aren’t enough, I have Microsoft Bookshelf on a CD-ROM. I didn’t figure that I would...
ever need Writer’s Toolkit.

That’s true enough as long as I’m working at Chaos Manor with my big Cheetah 486 and all its accessories; but on the road it’s different. Laptop machines are slower and have smaller disk drives; and besides, who wants to install all those different programs on a laptop? So, last time I went on a trip, I carried Writer’s Toolkit along just to see how it would work.

It works fine. It’s easy to install, and all the parts work together. I still like Grammatik V better than the Houghton Mifflin Grammar and Style Checker, but the latter is good enough. I still like Definitions Plus better than the Writer’s Toolkit implementation of The American Heritage Dictionary, but, again, Toolkit is good enough; and with Toolkit, I get the Columbia Dictionary of Quotations, which, once again, isn’t as nifty as the Bartlett’s in Microsoft Bookshelf—but it’s good enough.

Which is the bottom line. If you’re a professional wordsmith, you may want to build up your own toolkit; but for something you can just drop into your computer and start using immediately, Writer’s Toolkit will do quite well, thank you. It’s great for students: easy to use, which encourages them to use it often. I also know professional writers who like Toolkit just fine and use it all the time. I’ll probably go on using my collection of tools here at Chaos Manor, but Writer’s Toolkit goes onto all my portables. Recommended.

The BBS Scene

There’s so much going on here that it’s silly even to try to cover it all. The important thing is that people are making money by setting up specialized computer BBSes. Indians in North Dakota are selling art over BBSes using NAPLPS (North American Presentation-Level Protocol Syntax) protocols. The software for creating graphical art that can be distributed over BBSes is now shareware. The Big Sky Telegraph educational network is changing the way education is done in the Dakotas.

It was predictable, of course, but it’s all happening faster than you’d imagine.

David Hughes, Col. USA (Ret.), operates both free and commercial services. On his BBS, Old Colorado City ((719) 632-2658, 1200 to 14,400 bps, V.32, V.32bis), you can find out more about shareware graphics systems from him in 10 minutes than you can from me in a lifetime. He set up Big Sky Telegraph, too.

Write IBECC (P.O. Box 486, Louisville, CO 80027). Say hello to Debbie Weisblatt and ask for a copy of their newsletter. Since IBECC is a nonprofit organization, slip a couple of bucks in the envelope to help them with postage expenses. If you’re interested in the flavor of what’s happening in the BBS world, this is a good way to get started. You might be amazed at what you find out.

To get in on it, and toot my own horn, Pournelle’s Communications Bible from Microsoft Press is no bad start. Since my coauthor Mike Banks did more than half...
Now we've got the shot.

486N Specifications • 32-bit Intel SX, DX and DX2 processors at 25, 33, 50 and 66 MHz • 4 MB RAM, expandable to 48 MB • Local bus integrated Ultra VGA+ Video with graphics accelerators • 85-430 MB hard drive • 3.5" Floppy drive • Three 16-bit expansion slots • ROM-based internal diagnostic and system guide • Integrated Flash BIOS and boot-ROM • Multilevel hardware security • Chip-upgradable

HP's new low-priced PCs don't surrender features.

Those cheap PCs don't stand a chance. Hewlett-Packard has introduced 486 models starting at under $1,200.* With prices of our entire line of HP 486 and 386 PCs down as much as 42% in the last 9 months.

But our low prices have not come at the expense of quality, performance or the features you want.

To scream through those high-powered Microsoft® Windows and CAD projects, our revolutionary local-bus technology and fast graphics accelerators really fly. And, with true multivendor compatibility, HP PCs fit easily into your computer environment.

We've also made big advances on the networking front. Many models come with preinstalled network interface cards and boot-ROMs. And, of course, HP PCs are fully tested and certified with all the major NOSes.

Our security features are so convenient people actually use them. And our 486 desktop PCs are chip-upgradable. So you can count on always having the latest and greatest.

All this for as little as $1,200! And for a few hundred dollars more, we'll throw in a hard drive with pre-installed DOS 5.0, Windows 3.1 and a mouse.

To be a winner in the price wars, call 1-800-752-0900, Ext. 7094 for your nearest HP PC dealer. Or call 1-800-333-1917 from your fax handset for immediate details! Then start calling the shots.
the work on the book, I don't feel too bad about recommending it.

**Microsoft Operations Research**

The word processor wars have been raging since the days of Electric Pencil and WordStar 1.0, and they show no signs of abating. A publisher will add a feature to a product; soon every other word processor must have that feature. Soon after that all the word processor programs are fat, complicated, and overgrown; and the feature wars continue even so.

Whatever else you can say about Microsoft, they do their homework. I spent an afternoon with the Microsoft Word program managers, and it's astonishing how much trouble they've been to in finding out just how people really use their word processing software. They went to user establishments and requested, "Show me the last thing you just created on a word processor. Show me exactly what you did."

One result of that research was a considerable understanding of what features people really use, which don't make any difference, and which ones people would use if they understood how to do it.

The first product to be influenced by that understanding was the latest edition of Word for Windows integrated with Bookshelf. This is a smooth integration of two major and important products. I'm still in the process of restructuring computing at Chaos Manor, so although I have Word/Bookshelf up, it's not on my main machine. I'm still using Q&A Write to create text and then putting it into Word for Windows for a final edit and printing. That's likely to change.

The Word/Bookshelf integration is very good. It's still a bit slower than I like—but Definitions Plus, I get my dictionary definitions instantly—but CD-ROM drives are getting faster, and there's better caching software all the time. Fast and slow are relative to what you're used to: it's sure quicker to look up quotations and find entries in the *Columbia Desktop Encyclopedi*a from the CD-ROM than to get up, get the print copy, and look things up.

I'm confident enough that we'll see a lot more improvements in Word that I'm making the time investment to learn Word for Windows; and I haven't regretted that.

**Winding Down**

We're still working on networks at Chaos Manor. It's not that it's so difficult; it's just that I'm not here enough, and when I am here, I have to work on fiction. We'll get to it Real Soon Now.

The book of the month is Freeman Dyson's *From Eros to Gaia* (HarperCollins, ISBN 0-06-039111-1, $22.95). I've always thought Dyson one of the sanest men I ever met, and this collection of essays on a dozen subjects ranging in time from the 1940s to the 1990s does not change my opinion.

The computer book of the month is *Inside the Norton Desktop for Windows 2.0* by Peter Norton and René Gentry (Brady Books, ISBN 0-13-474503-5, $26.95). If you're a Windows user wondering if you want Norton Desktop, this will let you make up your mind.

The game of the month is the Strategic Studies Group's *Carriers at War*. I've always been interested in the Pacific War, and this is a good game/simulation. It's an all-new version of their popular oldie. The graphics are stunning.

As usual, I've run out of room, but not things to write about. We're continuing our investigations of OS/2. There is an Amiga show just after I get back from Florida; interesting things are happening.
"Sure, I remember my first modem...

"My first modem? It was a cheap thrill. And that impulsiveness really cost me. Now I know better. The DataPort 14.4 Data/Fax Modem gives me real value; even puts money in my pocket!"

Now I Know Better:"

THE NEW AT&T DATAPORT™
14.4/FAX MODEM

Introducing the powerful, robust V.32bis DataPort 14.4/Fax Modem. It pays for itself by significantly reducing your long distance costs—and features fax capability, too! For IBM PC/AT/XT and Macintosh, it:

- Sends/receives text, data, and images
- Links PCs to PCs, fax machines, and mainframes anywhere in the world
- Transfers data files; exchanges images with fax machines
- Accesses E-mail, bulletin boards, and information services

THRILLING, AND PAYS FOR ITSELF

It's all in the technique. The DataPort 14.4/Fax Modem features AT&T's exclusive, new Optical phone Line Interface (OLI), pat. pending; and V.42bis data compression and error correction. It excels in performance, especially on extremely weak "real world" lines!

This faster transmission, with effective throughput of up to 57,600 bps, significantly reduces your long distance costs. And it improves your productivity—no more waiting for your screen to refresh; no standing in line to send faxes.

YOU INHERIT AT&T VALUE

Designed by AT&T Bell Labs and AT&T Paradyne. With built-in reliability. And the industry's widest compatibility—tested and proven. Further, AT&T backs its entire DataPort family with a lifetime warranty and helpful, toll-free service and support.

READY TO GET SERIOUS?

Choose from 5 models to meet your exact needs for price, speed, features, and functions: the DataPort 14.4/Fax Modem and DataPort 9.6/Fax Modem, in standalone and PC-internal card models; and the DataPort 14.4 Modem standalone.

Proudly made by AT&T Paradyne in the U.S.A.

For more information on the DataPort family or the name of the dealer nearest you—call us at 1 800 554-4996 ext. 96.

SOLIDLY-BUILT, SOLIDLY-BACKED BY AT&T

Circle 182 on Inquiry Card.

© 1992 AT&T Paradyne. DataPort is a trademark of AT&T. All other products or services mentioned here are the trademarks, service marks, registered trademarks, or registered service marks of their respective owners. Lifetime warranty is limited and applies to original purchaser only.
USER'S COLUMN

CorelDraw is improved yet once more, and the CD-ROM version is nifty. I've got a number of math programs, ranging from Derive to Mathematica, and with luck I can do some comparisons. Apple's Lisp is exciting Lisp programmers, and I have an evaluation by Steve Mitchell. We are also gathering information on networks.

And if all that weren't enough, I have the new Kyocera Ecosys laser printer that should run for years without a cartridge change—we'll see—and a new MacPowerBook.

Stay tuned.

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

ITEMS DISCUSSED

Carriers at War
Strategic Studies Group, Inc.
8348 Monticello Dr.
Pensacola, FL 32514
(904) 494-9373
fax: (904) 494-9374
Circle 1146 on Inquiry Card.

Dr. Solomon's Anti-Virus Toolkit 5.61
Ontrack Computer Systems
6321bury Dr., Suite 15-19
Eden Prairie, MN 55346
(800) 752-1323
(612) 937-1107
fax: (612) 937-5815
Circle 1147 on Inquiry Card.

Grammatik V for DOS and Windows
Reference Software International
330 Townsend St., Suite 123
San Francisco, CA 94107
(800) 872-9933
(415) 541-0222
fax: (415) 541-0509
Circle 1148 on Inquiry Card.

HandBook
Gateway 2000, Inc.
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1149 on Inquiry Card.

HP 95LX with 512 KB of RAM
Hewlett-Packard, Inc.
1000 Northeast Circle Blvd.
Corvalis, OR 97330
(800) 443-1254
(503) 757-2004
Circle 1150 on Inquiry Card.

Microsoft Word for Windows and Bookshelf Multimedia
Microsoft Corp.
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8010
Circle 1151 on Inquiry Card.

Poqet PC
Fujitsu Personal Systems, Inc.
5200 Patrick Henry Dr.
Santa Clara, CA 95054
(408) 764-9443
fax: (408) 496-0609
Circle 1152 on Inquiry Card.

Ramas/age
Exeter Software
100 North Country Rd.,
Building B
Setauket, NY 11733
(516) 689-7838
Circle 1153 on Inquiry Card.

Writer's Toolkit for Windows
Systems Compatibility Corp.
401 North Wabash, Suite 600
Chicago, IL 60611
(800) 333-1395
(312) 329-0700
fax: (312) 670-0820
Circle 1154 on Inquiry Card.
It works for beginners as well as experts.

And no matter how hard you try, you can't exhaust its potential.

In many ways, it's a lot like CompuServe.

For the beginner at interactive computer services, we've got news, travel information, stock quotes, entertainment and games, a complete encyclopedia, free time to sharpen your online skills, and more.

For the experienced user, we feature hardware and software support, special-interest forums, free software, a wealth of online computer expertise, and sophisticated research tools. In fact, no computer service offers the choices that CompuServe does.

Now, for just $7.95 a month, and a one-time membership fee, you get all the basics as often as you like: news, sports, weather, shopping, a complete encyclopedia, and much more, plus up to 60 E-mail messages a month. And, there are lots of other valuable services available on a nominal pay-as-you-use basis.

Whether you're a beginner or an expert, to choose the right interactive service, just use your brain. Pick CompuServe.

For more information or to order, see your computer dealer or call 1 800 848-8199. Outside the United States, call 1 614 457-0802.

CompuServe®
The information service you won't outgrow.
CPU competition has brought confusion along with lower system prices for PC buyers

ANDY REDFERN

A dizzying array of CPU choices awaits the prospective buyer of a DOS-based PC. Four companies—Intel, AMD, Cyrix, and IBM—offer at least 14 varieties of 386- and 486-class processors with clock speeds ranging from 16 to 66 MHz. Intel alone offers over 100 varieties of 80x86 CPUs, with plans for 25 versions of the 486 range in 1993. And don't forget the pending introduction of the Intel P5 chip and promised new 80x86 clones from other vendors early next year.

You can't even make your selection based simply on price and performance any more. Power consumption, math-processing capability, and level of integration all weigh heavily on how well a CPU handles your important applications. Who can blame the PC buyer for being confused?

The people who are most confused are the individual and small-business users, says Paul Nikolas, a salesperson at Fry's Electronics (Palo Alto, CA). "Is a 386/40 faster than a 486SX/20? Even I have trouble with that." Users are especially confused by the differences between SX- and DX-class chips, he says. "I don't even try to explain it all to them. I just try to fit them with the best system I can to meet their needs."

The proliferation of CPUs is partly a product of more vendors jockeying for market position, but most of the diversification serves true user needs. For example, Intel's new low-power 486SL is targeted primarily at notebook PCs, where long battery life and high performance had previously been mutually exclusive concepts. Cyrix's upcoming DRu processor will be sold as a drop-in 486SX-class upgrade product for users of Intel 386DX machines.

To make the best system choice, you need to know the inherent strengths and weaknesses of the available and announced processors. You also need to know relative prices versus performance as well as which CPUs provide the best upgrade paths.

Fortunately, compatibility is not an issue. BYTE has interviewed numerous sources and, in conjunction with the NSTL (National Software Testing Laboratory), has conducted a suite of tests on chips from Intel, AMD, and Cyrix (see the text box "Lab Tests: Does Brand Matter?" on page 116). No one reported any compatibility problems, and the BYTE Lab found none. AMD is "100 percent compatible" with Intel, says Ronald Chwang, president and chief operating officer of Acer America.

continued
MAKE THE RIGHT CPU MOVE

Lab Tests: Does Brand Matter?

RAYMOND GA CÔTE

While the amount and variety of processor choices may be bewildering, the real question is whether or not you should be concerned about which chip—Intel, AMD, or Cyrix—is at the heart of your new computer. The BYTE Lab and NSTL (National Software Testing Laboratory—like BYTE, a McGraw-Hill company) explored two likely areas of differentiation: speed and compatibility. We also interviewed a number of people who are knowledgeable about the behavior of the popular CPUs.

We ran our tests on a Tandon PC386 system, which provides a set of daughtercards that use four key processors: a 33-MHz Intel 486DX, an AMD 25-MHz 386SXL and 40-MHz 386DXL, and a 25-MHz Cyrix 486SLC. Our evaluation shows that the core processor is not the only factor to consider. The 25-MHz Cyrix part performed appreciably better than the Am386SXL of the identical speed (see figure A). This is not surprising, considering that the Cyrix has an on-chip processor cache. The processor cache, however, has little effect on non-CPU-bound operations such as database operations.

In another test, we evaluated Cyrix’s claim to perform integer multiplications four times quicker than competing processors. We ran a test that performed a tight loop with a series of 16-bit multiplies. The Cyrix claim holds true: The integer-multiply function yields a throughput improvement of approximately 400 percent (see figure B).

Our multiplication tests also demonstrated the fragility of speed-improvement claims based solely on small code tests. While developing our test code, we received widely varying results based on the position of the test code in our executable file. Test results varied by as much as 50 percent. This was due solely to whether or not the test code ran entirely from within the processor cache. Cache also comes into play when comparing the 40-MHz Am386DXL with the 33-MHz i486DX, since the Am386DXL had 32 KB of external cache on the daughtercard.

Nothing You Can Do...

To achieve compatibility, AMD uses Intel’s microcode. Cyrix claims a from-the-ground-up implementation of the 80x86 processor, which it has tested at the signal level to determine full compliance with Intel requirements.

Companies such as BIOS vendor Award (Los Gatos, CA) say that they have not needed to change a single line of their code due to incompatibility with non-Intel chips. Any difficulty in

Figure A: As expected, the Intel 486/33 is faster for most operations. AMD’s faster clock speed gives it an advantage in other areas.

For John Patterson, Tandy’s senior vice president of R&D, “compatibility is an absolute.” Tandy is confident enough about Cyrix’s 486SLC to use it in its 3800 HD notebook PC. The most serious problem our lab tests found was the failure of some older software to properly recognize the newer CPUs.

Driving Forces

Competition has accelerated the rate of CPU development. When Intel had the 80x86 market to itself, it could afford longer development cycles. Now, AMD and Cyrix are producing processors that either compete with existing Intel units or offer greater
identifying the Cyrix chip is solved by a special identification register on the Cyrix parts. Jeffrey Flink, an Award engineer, says that the diversity of chip sets, the "glue" chips that connect the processors to the rest of the computer, present a greater design challenge.

Likewise, several ICE (in-circuit emulator) vendors did not identify any specific compatibility problems with the AMD or Cyrix processors. Successfully running an ICE provides a level of confidence in the chip's compatibility at the pin level. Although compatibility is not a problem, nobody yet supports the special functions (such as power management and internal cache) available on the Cyrix chips.

We sanctioned NSTL to run compatibility tests against the four Tandon processor modules. Rather than use application software, we based our tests on utility software, which is more likely to delve into less-traveled paths in the processor. Most products ran with no problem, but there were a few surprises.

The first discrepancy had to do with software that tries to identify the type of processor it is running on. For the Cyrix chip, three chip-identification programs found different processors. Norton's SysInfo thought it was a 28-MHz Intel 486DX; PCTools SI found a 25.5-MHz Intel 486SX; and Control Room saw a 50-MHz 386. This highlights the problem of identifying new processors with old software and should warn software developers to stay away from code that is processor-speed dependent.

A more serious problem was exhibited by CPBackup, part of the PCTools 7.1 package from Central Point Software. Before performing a backup, CPBackup does a DMA confidence test. This test hangs the computer when run on a minimally configured system (i.e., no device drivers loaded). According to Central Point engineers, the problem is caused by a software timing loop in their code. (Central Point says it has addressed the problem in an upcoming release by removing the processor-dependent software timing loop.) Although not strictly a compatibility problem in terms of whether or not particular instructions operate properly, it does point out problems that can be encountered when processor configurations are altered. To demonstrate the sensitivity of the problem, running any memory manager, such as QEMM, causes the problem to disappear.

The last problem we uncovered indicates there is as much concern with the complete system interaction as with the individual processor. This problem appeared while running Nu Mega's Softice (a low-level debugger) with the Am386DXL/40 processor module. Tracing through a sample program that calls the BIOS Event Wait function (INT 15h, function 83h) causes an internal stack overflow and halts the system. Running this same program at full speed from within Softice does not exhibit the problem. At this time, we have been unable to isolate the cause of this problem. Nu Mega and Tandon engineers attempted unsuccessfully to duplicate the problem on other systems using the Am386DXL/40.

We believe these processors are compatible with the Intel standard. Speed and performance are as dependent on the total system environment as they are on the processor itself. It is no surprise that a 40-MHz processor is quicker than a 33-MHz processor, but adding extra external support hardware can balance the comparison. In the final analysis, purchasing your system from a reputable manufacturer is the best way to ensure complete compatibility.

Raymond GA Côté is a BYTE Lab testing editor who has worked in industry designing interpretive languages and user interfaces. You can reach him on BIX as "rgacote" or on the Internet as rgacote@bytep.bybyte.com.
MAKE THE RIGHT CPU MOVE

CPU PRICE COMPARISON TIME LINE

- Intel 386DX/33
- AMD 386DXC/33/40
- Intel 386SX/20
- AMD 386SLC/20
- Intel 486DX/20
- AMD 486SLX/33/40
- Intel 486SX/25
- Cyrix 486SLC/25
- Cyrix 486DLC/33

Figure 1: This chart reveals the full impact of competition that compatible-chip makers like AMD have brought to the CPU market. Since AMD entered the market in March 1991, Intel has reduced the price of the 33-MHz 386DX chip from $208 to $107. All Cyrix prices include a separate math coprocessor. All prices are cost per unit in lots of 1000.

AMD has forced Intel to “throw away” the 386-family price list. Figure 1 shows the impact of competition on Intel’s CPU pricing. Intel’s price for the 16-MHz 386DX dropped about 20 percent from the third quarter of 1988 to the second quarter of 1991, when AMD introduced its 386DX. From the time of AMD’s introduction to today, Intel has dropped the 386DX price by about 43 percent in less than a third of the time.

Designing a state-of-the-art CPU is no simple task. Cyrix spent $10 million bringing its 486SLC and 486DLC to market, a piddling amount compared to the $250 million Intel spent developing its 486. The size of the microprocessor market, however, is seductive. The market research firm Dataquest (San Jose, CA) estimates that the total CPU market (including non-80x86 chips) for 1990 to 1991 was almost $4 billion, with 70 percent belonging to Intel and AMD, representing almost all 80x86 sales in that year. The pie is big enough for new products in both the large and small niches, as AMD has discovered.

AMD introduced the first clone of the Intel 386 chip after a long legal battle with Intel. The court ruled that AMD had the right to sell its CPU because of a licensing agreement with Intel signed during the heyday of the 286. Since then, AMD has been very successful in the 386 market; the company expects to sell over 1 million 386-class CPUs in the last quarter of this year, for what it claims is nearly a 50 percent market share.

AMD has shown a system running a 50-MHz 486DX-class chip, but the chip uses copyrighted Intel microcode. Company president Jerry Sanders says that by early 1993, AMD will bring the CPU to market either by winning the right to do so in court or by writing new microcode.

The diversification of PC systems has created opportunity for new CPU designs; the one-CPU-fits-all approach of the past has been replaced by processors designed for specific form factors. Energy-saving SL-class 386 and 486 CPUs are used almost exclusively in battery-powered portable systems. Low-cost SX-class processors have become the chip of choice for entry-level desktop systems. The high-performance 486DX class powers high-end workstations and servers. And now, highly integrated 8086 and 286-class CPUs are becoming popular for the emerging hand-held category (see the slide box “Other Players Find Niches” on page 119).

BYTE spoke to 20 leading PC vendors from around the world. Of those, only 25 percent said they were in the Intel-only camp. Some of those vendors have announced, but not yet shipped, non-Intel systems. Others, such as Dell, plan to stick with Intel exclusively. “The Intel chips offer the performance that we want and the prices that we want to pay,” says Dean Kline, public relations manager for Dell.

What’s in a Name?
Chip vendors are doing little to help users make direct comparisons. In fact, their marketing departments seem to be deliberately adding to the confusion. For example, Cyrix calls its chips the 486SLC and the 486DLC. However, the chips have no math coprocessor, and they have a different pin-out and a much smaller cache than the Intel 486. They do, however, support the 486 instruction set, and the Cyrix chips perform integer multiplications four times faster than 386-class CPUs.

PC vendors know the difference, but users may not. The Cyrix CPUs are “much higher performance 386s,” says Acer’s Chwang. He says that the 486SLC performs around 20 percent to 30 percent slower than the Intel 486SX and recent tests performed in the BYTE Lab on 486SLC systems support his claim.

Bill Berkman, director of product marketing at Mylex (Fremont, CA), a system-board vendor, claims that Cyrix’s price is not competitive with Intel’s or AMD’s 386 pricing—a 40-MHz Cy486DLC costs twice as much as a 40-MHz Am386DXL (although Cyrix includes a separate math coprocessor). He says users would rather spend an extra $100 for a true 486 machine.

Still, companies such as Tandy, Tandon, Compaq, and U.K.-based Opus use the Cyrix processors. “Cyrix is a new adventure for us,” says Tandy’s Patterson, referring to potential customer

Reasons to Upgrade
- Higher performance
- Money saved over new system
- Less downtime during change
- Greater ease in getting purchase approval
- Greater ease in keeping equipment up to date
Other Players Find Niches

ANDY REDFERN, DAVE ANDREWS, ANDY REINHARDT, AND TOM HALFILL

A host of CPU manufacturers have revealed plans to produce Intel-compatible processors for more specialized applications. These companies include NEC Technologies, Chips & Technologies, International Meta Systems, Vadem, and NexGen.

The earliest player in the Intel-compatible market was NEC, with its 80386 range of processors, launched in 1984. The original CPUs were of Intel design, and NEC was a licensed second source. NEC then supplemented the range with chips of its own design. NEC now sells 30 versions of the V range, including the VHL lower-power, 3.3-voi CPU. Its processors turn up in machines as diverse as Olivetti's Quaderno Sub-Notebook and Compaq's IDA drive controller. The latest processor is the V55—an 80186-compatible processor running at 12.5 MHz. The original microcode used in the 8086 and 80186 has been implemented in hardware so that the majority of the instructions execute in one clock cycle.

International Meta Systems (Fur, CA) has more ambitious plans. IMS claims it has a new 100-MHz RISC microprocessor, scheduled for mid-1993 production, that can emulate an Intel 486 or a Motorola 68040 at their full native speeds—and at a fraction of their cost. IMS is pitching the CPU for pen computers that need high performance for such tasks as handwriting recognition, but it also says the chip could be used to make a "chameleon computer" that runs both PC and Macintosh software.

In April, the small San Jose-based chip-set designer Vadem introduced a single-chip, palmtop PC-on-a-chip design. Computer manufacturers can use the VG-230 Sub-Notebook Engine to bring small, inexpensive palmtops to market quickly. Vadem's chip design incorporates a 16-MHz NEC V30HL microprocessor into a single-chip device that holds an LCD controller, an internal keyboard scanner, and a built-in power management unit. A PCMCIA 2.0 module provides peripheral support. The latest version of the chip now supports digital ink—a facility aimed at pen-based systems designers. A secondary area of display memory contains an ink trail of where the pen has been moved, allowing the system to process for gesture and handwriting recognition without affecting the original image.

C&T is also turning its attention to the hand-held market. In August, it announced that it will concentrate on integrated processor and logic chips that will allow PC vendors to buy a single-chip solution for their hand-held and notebook products. C&T already has the PC/Chip integrated processor that adds PC functionality to a high-speed 8086 core. It will now develop a 386 core for the PC/Chip and a VGA controller to replace the PC/Chip's low-resolution CGA display driver. Gordon Campbell, CEO of C&T, claims that the first significant systems that offer 20 hours of battery life from four to six AA-size batteries will appear before the end of this year.

The Strange Case of NexGen

Vapor is as common in Silicon Valley as morning fog is in San Francisco. Yet even in an industry where the horizon is frequently clouded by unreleased products, NexGen Microsystems of San Jose, CA, is an enigma.

Founded in 1986, NexGen began work on a 386-compatible microprocessor. Six years later, the company has yet to market a finished chip. In 1990, NexGen seemed to be on the verge of something when it announced a chip set that used CISC architecture to achieve RISC-like performance while emulating 386/486 instructions. Computers based on this chip set would run twice as fast as a 486, SPARC, or Mips system and would approach an IBM RISC System/6000, promised NexGen. Most recently, NexGen said it will have a P5-compatible chip within a month or so after Intel introduces its next-generation microprocessor in early 1993.

This time, some observers think that where there's smoke, there could be fire. Industry analysts speculate that NexGen could take the 486 core it has apparently developed, add parallel integer units, expand the clock, crank up the clock speed, and sell the chip as a "P5 compatible" by mid-1993.

"They don't have a P5 chip," says Michael Slater of Microprocessor Report. "What they have is a fast implementation of the 486 instruction set that approaches P5-like performance."

Ken Lowe, an analyst at the market research firm Dataquest (San Jose, CA), agrees: "NexGen is trying to do with its P5-compatible product what Cyrix has done with its 486-compatible product. They're comparing themselves to the P5 because they're trying to achieve P5-level performance. It's a reasonable marketing ploy." Whatever NexGen has under wraps, it may be the company's last chance to prove itself.


acceptance. Tandy chose the Cx486SLC because it met the company's requirements for performance and price.

Intel believes that users have a hard time distinguishing among the different CPUs, and it has developed a performance rating system that it claims will clarify the issue: iComp (Intel Comparative Microprocessor Performance), a benchmark suite that provides a single index rating for overall CPU performance. The baseline CPU, a 25-MHz 486SX, has a rating of 100. Intel intends iComp to be a quick-and-dirty means of ranking only its own CPUs, although it could be used for any Intel-compatible processor.

System naming conventions confuse the issue, too. A product name that includes 486 (or just 4) or no clear indication that a
**MAKE THE RIGHT CPU MOVE**

**Figure 2:** Cyrix's DRu² is a drop-in replacement for the Intel 386DX/20. BYTE Lab tests indicate that the overall performance boost could be as much as 28 percent. The main CPU is the large square in the lower left; the other items on the 2- by 2½-inch board are support chips.

Cyrix chip is used is misleading. Compaq, for example, has a range of Intel and Cyrix machines including the 425SLC, 425SX, 433i, and 433DLC. Knowledgeable buyers will spot that two of those machines carry Cyrix processors; the average mail-order customer may not be aware of the differences.

Gordon Curran, European vice president of Eurocorp, a European-based market research company, says, "It has been known for some companies to sell machines with AMD 386 processors inside with 'Intel Inside' stickers on the outside." The moral is: Confirm which CPU is used before you buy.

Naming could be a problem for Intel in the future because the U.S. Patent and Trademark Office does not consider three numbers (e.g., 586) to be a legitimate trademark. There is nothing to stop other chip vendors from calling their CPUs 586 to deliberately create confusion.

**Upgrades Considerations**

The major issues to consider when selecting a CPU are upgradability, performance, and price. Finding the right combination of benefits is tied tightly to the system form factor. The ability to upgrade, for example, is most important to desktop users, although OverDrive sockets—used on Intel 486SX—based systems as a means of installing a 486DX-class CPU—are beginning to appear on portable systems.

Upgrading allows your older system to keep pace with the performance advances in CPUs so you needn't replace the entire box. For a few hundred dollars, you can turn, say, a 16-MHz 486SX PC into a 50-MHz 486DX2 (see "Reasons to Upgrade" on page 118). Few people have actually upgraded their systems.

Eric Clow, an analyst at Infocorp, says that the market has not yet completed a cycle. In other words, buyers of upgradable models have not owned them long enough to feel that they are grossly lacking in performance compared to the processing power of state-of-the-art models.

Intel pioneered the concept of a single-chip upgrade with its OverDrive processor, which doubles the internal clock speed of a processor and increases its overall performance by about 50 percent. Prior to the OverDrive chip, most upgrades were accomplished either by replacing the motherboard or by installing an add-in card or daughterboard. "People just didn't want to spend $2000 more for an AST Premium [which was upgradable via an add-in card] knowing that it's upgradeable, when they could buy a new motherboard for another $1500," says Doreen Rubin, a Chemical Bank senior report analyst and a member of the Microcomputer Managers Association. But with the double chip, upgradability has become a vital issue. Says Rubin, "Until the doubler technology, [upgrading] wasn't something we could sell to the users."

Intel's competitors are just now entering the upgrade market. Cyrix has recently announced a version of its 486DLC chip, the DRu¹, that can be used to upgrade IBM and Compaq 386DX/20 systems in the field (see figure 2). You simply remove the 386DX chip and drop in the DRu¹. Cyrix says that the DRu¹ will work with other 386DX systems, although mechanical considerations—it is about twice as high as an Intel 386DX—might prevent it from fitting in some PCs. Facilities in the 486 DLT that require hardware support, such as the cache and power management, will not work optimally, but the performance increase will still be significant. The most important element of the speed improvement will be Cyrix's clock-doubling technology, which will allow a chip clocked at 20 MHz to run internally at 40 MHz.

BYTE tested a prototype 33-MHz version of the DRu¹ in an IBM PS/2 Model 80. Overall, it showed a 28 percent improvement over the 16-MHz Intel 386DX in our processor benchmark tests. Low-level video benchmark improvements varied from a minimal 5 percent for scrolling to an impressive 59 percent for graphics. Overall, the video benchmark improved 35 percent. As expected, the low-level disk tests displayed the smallest improvement—only 10 percent overall. Although files were read up to 22 percent quicker, a general throughput test requiring random reads and writes showed only a 1 percent improvement, since it is bound to the speed of the drive, not the processor.

For the time being, Cyrix will sell the chip directly to large customers; no retail is planned yet. Cyrix estimates that the DRu¹ will be priced between $200 and $300.

There is some skepticism in the industry as to just how many users will upgrade. Jim Chapman, vice president of marketing for Cyrix, says that if only 1 percent of the 30 million 386DX-based machines get upgraded, it will be a major market for Cyrix to support. AMD also sees upgrades as a lucrative market. It has publicly stated that it will support the OverDrive socket that many 486SX machines now include.

**Need for Speed**

The performance differences among the 386- and 486-class chips are also confusing. AMD keeps one step ahead of Intel's 386SX and 386DX lines by launching faster versions of its 386SXL and 386DXL processors before Intel does.

Cyrix claims performance improvement using an arithmetic unit to perform integer multiplication. Daniel Oulette, vice president of engineering at pen systems vendor Microslate, says he benchmarked the Cyrix 486SLC as 1.8 to 1.9 times faster than the Intel 386SX running at identical clock speeds. But with application tests, the performance was even more noticeable. Microslate's
pen-based systems are popular among users of geographic information systems. "We were seeing four to five times' increase in redraw speeds," Oulette says.

By the time you read this, Cyrix is planning to have introduced a new version of its popular Cx486 chips, the Cx486S2/50. Unlike the 486SLC and 486DLC, the clock-doubled 50-MHz Cx486S2/50 fits into a 486 socket. Since there is no math co-processor on the chip, it is being called a 486SX equivalent.

Cyrix claims improved performance for the Cx486S2/50 by using a write-back cache, which produces higher throughput with a smaller cache. The Cx486S2/50 will use a 2-KB cache, which Cyrix says is equivalent to Intel's 8-KB write-through cache. A write-through cache operates at the speed of the cache only on read operations. When the processor writes to memory, it has to wait until the result has been written through to the much slower main memory. A write-back cache writes changes back to the cache memory until a cached block goes out of scope. At that point, the whole of the memory block is copied into main memory in fast block-move operation. On an average piece of 80x86 code, this represents a significant speed-up. Cyrix claims average application performance equivalent to a 50-MHz Intel 486DX2; graphics performance shows about a 10 percent improvement.

Cyrix's chip will also be able to access memory in one clock cycle instead of two. It will use a superset of the 486SX instruction set and Cyrix's fast integer-multiply capability. Cyrix expects the price of the Cx486S2/50 to be in the $250 range for OEM customers.

Long used in minicomputer and mainframe environments, instruction profiling has arrived in microprocessors. Instruction profiling is the analysis of the relative frequency of instructions used by a suite of applications. With this information, engineers can tune an architecture to execute frequently used instructions in fewer cycles, even at the expense of using more cycles to execute less frequently used instructions, resulting in significant performance gains.
Build great applications all over the nation...

WATCOM SQL Developer's Edition
by WATCOM

New Product—Special Introductory Offer.
Complete client/server development tool allows you to develop and deploy single-user standalone applications, and to develop applications for use with the Network Server Edition (sold separately). Includes: Single-user database server (both 16- and 32-bit versions); ACME application development system; Embedded SQL/C preprocessor; SQL libraries for WATCOM C, C/386, MS GC++, and BOB++.

LIST: $395 PS Price: $379
FastFax 1044-025

C-Debug™ and C-Verify™
by Softran Corporation

C-Debug automatically evaluates every transaction involving data pointers and arrays. It displays variable name, source line number and an explanation of the error. C-Verify is a QA tool which identifies untested code. A cross-referencing tool shows the new tests required for 100% coverage. Available for DOS, OS/2, UNIX, QNX and VAX/VMS.

LIST:

C-Debug
$249 $239

C-Verify
$395 $385

FastFax 3674-001 (C-Debug), 3674-003 (C-Verify)

High C/C++ v3.0
by MetaWare Incorporated

MetaWare Incorporated introduces its newest product: the 32-bit High C/C++ compiler, version 3.0. High C++ is a true compiler, not a C to C++ translator. "Incremental Strengths" lets you specify the level of C++ compilation, allowing you to migrate from C to C++ one C++ block at a time. Included in the package is a C++-tailed source-level debugger, and a 32-bit Application Development Kit for Windows. MetaWare offers a full line of multi-language, multi-platform compilers for professional software developers.

LIST: $795 PS Price: $749
FastFax 1083-001

Easy Boot v1.0
by Clear Software Inc.

Easy Boot allows you to maintain 15 different system configuration sets, so that you can reboot your machine with the optimal configuration every time. Maintain 15 different AUTOEXEC.BAT and CONFIG.SYS files that can easily be copied, edited and printed. It’s the perfect solution to lots of accessories.

LIST: $50 PS Price: $45
FastFax 873-011

WATCOM C9.0/386
by WATCOM

Develop and debug 32-bit applications for extended DOS, Windows and OS/2 2.0. Includes royalty-free 32-bit DOS extender, true 32-bit Windows GUI Application Kit, our fast, tight, and reliable 32-bit Code Optimizer, licensed Microsoft Windows SDK Components, an interactive Source-Level Debugger, an Execution Profiler and more! Now includes OS/2 2.0 support.

LIST: $995 PS Price: $999
FastFax 1044-029

The PKWARE Data Compression Library
by PKWARE

The PKWARE Data Compression Library allows software developers to add data compression technology to applications. The application program controls all data I/O, allowing data to be compressed or extracted to any device or area of memory. Only 35K of memory is needed to compress data, and only 11K is needed to extract data. Compatible with MISC, BC++, TC, TP 6.0, Clipper, Basic 4.5, 7.1, ASM.

LIST: $295 PS Price: $275
FastFax 3043-011

SAYWHAT?! (v4.0)
by Software Science Inc.

Designing screens should be simple! With SAYWHAT?! , it is! Create slide shows. A terrific prototyping tool—design user interfaces with your user in seconds! Supports all programming languages, template-based code generator, mouse, moving bar menus, screen libraries. If you use dBASE files, access them while building screens. Sample screens, code and utilities, plus free technical support. Upgrade policy for owners of other screen designers. 60 day money back, no questions!

LIST: $79 PS Price: $59
FastFax 1098-001

HardLock
by Bigfoot Development

HardLock is a hard disk security system that provides continuous password protection for your PC's hard disk. If the correct password is entered at boot time, the hard drive is unlocked and you have complete access to your computer. Without the proper password, the hard disk cannot be accessed, even from a floppy boot. Takes up no system RAM.

LIST: $49 PS Price: $46
FastFax 3020-001

To Order Call 1-800-421-8006
Visual Basic for DOS
Microsoft Corporation

Draw forms, controls; write event-procedures; create custom controls—in DOS! Create new apps or combine with existing C++ or Pascal code. Highly compatible with Visual Basic for Windows. Run existing QuickBasic/Basic/PC DOS code 80x86 compiler creates 100% standalone .EXE files; 886 code generation; MOVE overlays; an integrated ISAM and much more!

<table>
<thead>
<tr>
<th></th>
<th>PRO</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST</td>
<td>$495</td>
<td>$199</td>
</tr>
<tr>
<td>PS Price</td>
<td>$415</td>
<td>$99</td>
</tr>
<tr>
<td>FastFaxts 502-408</td>
<td>(PRO), 502-407</td>
<td>(Stand.)</td>
</tr>
</tbody>
</table>

Visual Basic for Windows 2.0
by Microsoft Corporation

When you need to create a Windows application quickly, nothing offers the sheer productivity of Microsoft Visual Basic 2.0, Standard Edition. A visual development environment, flexible programming language, and fast runtime execution make this the shortest route to full-featured Windows applications. The Professional Edition includes messaging and data access capabilities, a wide variety of add-on tools, and more!

<table>
<thead>
<tr>
<th></th>
<th>LIST</th>
<th>PS Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>$199</td>
<td>$89</td>
</tr>
</tbody>
</table>

OS/2 2.0
by IBM

Your ideal development platform—no matter where your applications end up. A better DOS than DOS, OS/2 runs virtually all DOS and Windows applications on a wide range of hardware. Save 34% on your OS/2 2.0 upgrade and take advantage of super bundle savings on Borland C++ v3.1 and Watcom C 9.0/386. Save 53% on Borland C++ v3.1 or 56% on Watcom C 9.0/386. Special upgrade pricing and bundle savings good through November 30.

<table>
<thead>
<tr>
<th></th>
<th>LIST</th>
<th>PS Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS Price</td>
<td>$139</td>
<td></td>
</tr>
<tr>
<td>FastFaxts 2829-012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WindowsMAKER™ Professional
by Blue Sky Software™

Considered the easiest and fastest way to create MS-Windows applications in C++. Generate the Windows .EXE with complete source & production files (no royalties). Just Point & Click to define the Windows user interface. Let you animate your design to instantly test look & feel and make changes on the fly without needing to compile. Custom code is preserved during code regeneration. The leading development tool for Microsoft Windows. Highly Recommended.

<table>
<thead>
<tr>
<th></th>
<th>LIST</th>
<th>PS Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS Price</td>
<td>$899</td>
<td></td>
</tr>
<tr>
<td>FastFaxts 2001-006</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ProtoGen 3.0
by Protoview

NEW VERSION! The industry standard for code generation and prototyping Windows applications. Develop the user interface of your applications using Visual prototyping methods. ProtoGen generates expert level, commented code for ANSI C, Microsoft MFC++, Borland OWL C++, Turbo Pascal, and Microsoft NT Win32. All generators included! User Code is preserved from one generation to the next. It's easy and fast.

<table>
<thead>
<tr>
<th></th>
<th>LIST</th>
<th>PS Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS Price</td>
<td>$99</td>
<td></td>
</tr>
<tr>
<td>FastFaxts 2115-009</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q+E Database Library
by Pioneer Software

Q+E Database Library provides complete database connectivity to Windows and OS/2 applications using Dynamic Link Libraries. QELIB can read, insert, update, create or delete database records for the following database formats: Btrieve, dBASE, DB2, Excel files, INGRES, NetWare SQL, Oracle, OS/2 DBM, Paradox, SQL/400, SBase, SQL/DOS, SQL Server, Sybase, Tandem NonStop SQL, text files, and XDB.

<table>
<thead>
<tr>
<th></th>
<th>LIST</th>
<th>PS Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS Price</td>
<td>$339</td>
<td></td>
</tr>
<tr>
<td>FastFaxts 2137-012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

But wait, there's more: Bargains galore!

<table>
<thead>
<tr>
<th></th>
<th>LIST</th>
<th>PS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>After Dark for Windows</td>
<td>50</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Blinker</td>
<td>299</td>
<td>269</td>
<td></td>
</tr>
<tr>
<td>Borland C++ 3.1</td>
<td>495</td>
<td>319</td>
<td></td>
</tr>
<tr>
<td>Btrieve for DOS</td>
<td>595</td>
<td>399</td>
<td></td>
</tr>
<tr>
<td>Carbon Copy 6.1</td>
<td>199</td>
<td>139</td>
<td></td>
</tr>
<tr>
<td>Clarion Prof. Developer 2.1</td>
<td>845</td>
<td>469</td>
<td></td>
</tr>
<tr>
<td>Clipper</td>
<td>795</td>
<td>499</td>
<td></td>
</tr>
<tr>
<td>DESQview 386</td>
<td>220</td>
<td>149</td>
<td></td>
</tr>
<tr>
<td>DR DOS</td>
<td>99</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Laplink Pro</td>
<td>170</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Lotus 1-2-3 for Windows</td>
<td>595</td>
<td>349</td>
<td></td>
</tr>
<tr>
<td>MS Excel</td>
<td>495</td>
<td>329</td>
<td></td>
</tr>
<tr>
<td>MS Windows 3.1</td>
<td>150</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td>MS Word (Windows)</td>
<td>495</td>
<td>329</td>
<td></td>
</tr>
<tr>
<td>Norton Desktop for Windows</td>
<td>179</td>
<td>125</td>
<td></td>
</tr>
<tr>
<td>Norton Utilities</td>
<td>179</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>ObjectVision 2.1</td>
<td>150</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>ProComm Plus</td>
<td>129</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>QuattroPro</td>
<td>495</td>
<td>349</td>
<td></td>
</tr>
<tr>
<td>R&amp;R Report Writer Xbase Ed.</td>
<td>249</td>
<td>159</td>
<td></td>
</tr>
<tr>
<td>Watcom C 9.0/386</td>
<td>895</td>
<td>599</td>
<td></td>
</tr>
<tr>
<td>WordPerfect</td>
<td>495</td>
<td>279</td>
<td></td>
</tr>
<tr>
<td>286/DOS Extender SDK 2.5</td>
<td>495</td>
<td>435</td>
<td></td>
</tr>
<tr>
<td>286/DOS Extender SDK</td>
<td>495</td>
<td>435</td>
<td></td>
</tr>
</tbody>
</table>

Call the Programmer’s Shop today: 1-800-421-8006

Mention Code BYC92

Call FastFax for product information any time, day or night. 617-740-0025.
Get free information on all of our more than 10,000 products any time you like • Dial from a fax machine or fax-board equipped PC • Follow the voice computer’s instructions • Receive literature instantly via fax

Canada 800-446-3846
MA 617-740-2510
FAX: 617-749-2018
90 Industrial Park Road, Hingham, MA 02043

Credit card orders processed only when product is shipped • All prices subject to change

*International prices will vary
The New VEDIT PLUS.
The World's First Multi-Mode
Universal File Editor

• Drop-down menus, mouse support
• Columnar blocks, regular expressions, undo
• Also VEDIT for $69, VEDIT Jr. for $29

The most
powerful
text editor
for program development and text processing

The fastest
text editor
for mainframe, CD ROM and other huge files

• Edit up to 2 Gigabyte text, binary, mainframe files
• Edit in ASCII, EBCDIC or Hexadecimal
• Emulate Wordstar, Word Perfect, Brief, vi, others

The new VEDIT PLUS is today’s finest programmer’s editor. Small (80K) and lightning fast, it is written entirely in assembly language. VEDIT PLUS is the only programmer’s editor that can edit any text or binary file you will ever encounter.

Incredibly, VEDIT is over 20 times faster than other editors on just a 3-megabyte file. When editing multi-megabyte files, only VEDIT has the speed to get the job done.

### Benchmarks In 3 Meg File

<table>
<thead>
<tr>
<th></th>
<th>VEDIT</th>
<th>BRIEF</th>
<th>Sage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save and continue</td>
<td>52 sec</td>
<td>3:52 min</td>
<td>1:47 min</td>
</tr>
<tr>
<td>Load, modify, save, exit</td>
<td>21 sec</td>
<td>49 sec</td>
<td>1:38 min</td>
</tr>
<tr>
<td>Block-column copy (40x200)</td>
<td>2 sec</td>
<td>30 sec</td>
<td>2 sec</td>
</tr>
<tr>
<td>Delete one column in file</td>
<td>9:58 min</td>
<td>1:50 hour</td>
<td>1:03 hour</td>
</tr>
<tr>
<td>60,000 search &amp; replace</td>
<td>3:18 min</td>
<td>1:44 hour</td>
<td>1:32 hour</td>
</tr>
</tbody>
</table>

The extensive compiler support runs popular compilers and also your favorite linkers, debuggers and Make from within VEDIT. It even integrates tools from different vendors. When shelling to DOS, VEDIT swaps itself and TSRs out of memory, giving you a much as 620K of available memory for compiling the biggest programs. Only VEDIT gives you the advantages of a powerful editor with the convenience of an integrated environment.

VEDIT PLUS has every advanced feature you might expect. Simultaneously edit numerous files, split the screen into windows, search/replace with regular expressions. Automatic indent, block indent, parentheses matching and block operations by character, line, file or column speed program development. Word wrap, paragraph formatting, justification, centering and many printing options are ideal for text processing.

VEDIT PLUS has the most powerful macro programming language of any editor. It eliminates repetitive editing tasks and lets you create your own editing functions. It includes testing, branching, looping, user prompts, keyboard input, string and numeric variables, complete control over windows plus access to hardware interrupts, memory and I/O ports. Source-level debugging helps you develop new macros quickly and easily.

VEDIT is a registered trademark of Greenview Data, Inc. All other product names are trademarks or registered trademarks of their respective holders.

The fastest
text editor
for mainframe, CD ROM and other huge files

Until now, few PC text editors could even begin to handle huge mainframe, CD ROM, postscript, plotter output and other multi-megabyte files. The new VEDIT PLUS, with its unique virtual memory management, handles them all effortlessly.

Edit in ASCII, EBCDIC or Hexadecimal modes, or split the screen for any combination of modes. File modes support DOS text, UNIX text, binary and many fixed-length record formats.

An intuitive user interface with drop down menus, hot keys, mouse support, optional scroll bars, context-sensitive help, point and shoot file selection, 1000-level undo and unlimited keystroke macros make VEDIT PLUS easy to use, easy to learn. And it can emulate the keystrokes of almost any editor you already know.

Everything in VEDIT PLUS is configurable. The keyboard layout, the screen colors, displaying control characters, long lines, and window borders, and much more, are all configured with easy to use menus.

Confidently order your copy of VEDIT PLUS today; it comes with a 90-day money-back guarantee. VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT PLUS-DOS single user license: $125; DOS network 5-user license: $269; UNIX/XENIX, QNX: $249; FlexOS/IBM 4680 single CPU license: $259. Site license pricing is available.

FREE Demo!
Call 1-800-458-3348 for a fully functional demo disk of VEDIT PLUS. Demo and shareware of VEDIT Jr. on the BBS at 1-313-996-1304

Greenview Data
MAKE THE RIGHT CPU MOVE

New Chips on the Horizon

In the next six months, you can expect to see these new processors from the major players in the Intel-compatible CPU market. Since CPU vendors work with systems manufacturers well in advance of their new product announcements, systems using these chips will likely follow soon after.

Intel 486SX/33
The 486SX/33 is simply a faster version of the existing line. Introduced in September.

IBM 486SLC
IBM version of the Intel 486SLC. Introduced in October.

Cyrix 33-MHz 486SLC
A faster version of the SLC with a whole new set of power management features. Intended to compete directly with Intel's SL. Introduced in October.

Intel 486SL
The 486SL delivers low power consumption with SX performance. Many notebook vendors have already committed to using it. Available in November.

Cyrix DRu²
A 486DLC that doubles the performance of 20-MHz 386DX systems. Intended to be a user-upgrade product. Available in November.

Cyrix 486S2/50
A 486SX-compatible processor with a smaller cache than Intel's equivalent. Cyrix claims that making its cache write-back compensates for the smaller size. Available in November.

Intel P5
The still-unnamed chip that displaces the 486 as the top of Intel's product line. Expected to be available in the first quarter of 1993.

AMD 486 range
AMD promises 25-, 33-, and 50-MHz versions of its 486-compatible CPU, although analysts suggest a clock-doubling range may also be available. Could be available by the end of this year or by the middle of 1993, depending on the outcome of legal issues involving the use of Intel microcode.

Chips & Technologies' PC/Chip with 386 core
C&T has pulled out of the discrete processor market, and this new chip will be the first of its products to exploit its huge effort in producing a 386-compatible processor for use in hand-held systems and small notebooks. Expected to be available in 1993.

Intel P24T
The Intel P24T is an upgrade processor for 486DX2 systems. Sockets for the chip are already being designed into some motherboards. The socket is similar to a conventional OverDrive socket but has an extra row of pins. The P24T will use P5-based technology to increase performance. Intel won't say exactly what "P5-based technology" means, but it's possible the P24T will incorporate the P5's improved FPU or parallel integer pipes. Intel plans to introduce this CPU in early 1994.

NexGen's P5 clone
A P5-type chip that NexGen hopes will appear shortly after Intel finally ships the P5. Given NexGen's history, you may have to wait until 1994 before it actually ships.

Intel uses instruction profiling extensively in the design of new processors and is accumulating an enormous database of instruction traces of various commercial applications. One result of Intel's profiling has been the difference in instruction use between applications written in C++ and those written in other languages, which shows the close relationship between compilers and processors. If C++ comes to dominate commercial development environments, Intel and others may find it beneficial to tune their architectures to the instruction frequency of the language.

Performance on Batteries
Performance takes on another dimension in the portable PC arena, where power conservation and a high level of integration are primary concerns. Intel is scheduled to announce its low-power 486SL family by the time you read this. The first two microprocessors are clocked at 25 and 33 MHz, and both have integrated math coprocessors. Intel says that, because the 486SL is physically smaller and more highly integrated than the 386SL, vendors will be able to reduce the size of notebook motherboards by 60 percent. The 25-MHz chip is already in production, and the 33-MHz version is scheduled for the first quarter of 1993.

The 486SL (see figure 3) is a significant improvement over the 386SL. Intel claims that performance ranges from 11 MIPS for the 25-MHz 486SL to 14.5 MIPS for the 33-MHz version. By comparison, the fastest 386SL (25 MHz) is rated at 5.2 MIPS.

Equally important is the 486SL's "flexible voltage" feature. Although the 486SL is a 3.3-volt static device, it can also operate at 5 V. Thanks to this—and to the 486SL's compatibility with the 386SL's SMM (system management module) and companion I/O chip—laptops with the new CPU should be available by the end of the year. While some vendors may simply adapt the 486SL to existing 5-V motherboards, the more advanced machines will operate at 3.3 V. When the 486SL is mated to other 3.3-V parts, power consumption is reduced 50 percent from a 5-V 386SL system. Intel says this should yield 1 to 4 hours of additional battery life.

Like the 386SL, the new 486SL has a PI (Peripheral Interface) bus that's functionally equivalent to a local bus in a desktop computer. The PI bus allows a graphics controller or flash card to bypass the I/O bus and link directly to the CPU. The PI bus operates at the CPU's full clock speed, compared to the relatively slow 8-MHz bandwidth of the I/O bus.

The Price Factor
Competition has reduced chip prices, and initially it reduced system prices. The 25-MHz 486DX originally cost $950 (in quantities...
**Make the Right CPU Move**

Intel is even willing to develop chips customized for specific applications. Its RapidCAD coprocessor, launched last February, is a two-chip upgrade that uses both the 386 and 387 sockets. The 386 socket is occupied by a hybrid 386 and 387 combination chip, while the 387 socket is occupied by a custom...

---

**Space-Savers**

**Popular Space-Saver Keyboard**

$98.00

First successful alternative to conventional keyboard saves 60% desk space with a footprint of 27.3 x 15.2 cm. Has full travel tactfully responsive keys with standard left-right spacing for easy touch typing. 100 keys, compatible with IBM XT/AT PS/2. Many language versions available.

**Stand-Alone LCD Monitor**

$995.00

This 10” black on white monitor is easy-to-read, yet compact. Resolution is 640x480 with sharp, flicker-free image. Sharp’s high refresh rate, triple supertwist nematic technology with back lighting provides a super bright, low radiation screen with a wide viewing angle. The adjustable monitor base is only 29x14 cm. No external power required. IBM AT compatible.

**Diskless LANStation**

$1995.00

Combines Space-Saver Keyboard, LCD Monitor and 20 Mhz 386sx CPU w/2 Meg RAM (4 Meg optional) in a single very small footprint (27.4 X 26.0cm). Network ready with 10 Base2, 10 BaseT NE-2000 compatible network adapter built-in. Unit does not fold for portability.

**To Order Call Toll Free**

1-800-DATALUX

1 year warranty on all products shown. Order direct from stock with 15 day full return privileges. Visa, MasterCard, AmEx charges and COD accepted. OEM and reseller volume discounts available.

**Spec Sheets Sent**

By Automatic 24 hr. FAX Transmission

1-703-662-1675

**DATALUX**

First Choice In Space-Saver Peripherals

2836 Cessna Drive • Winchester, VA 22601

Phone 703 662-1500 • Fax 703 662-1682

---

**MAKE THE RIGHT CPU MOVE**

of 1000) in 1989 and was a significant contributor to the total system price; it now costs $328. According to Steve Warren, vice president of Altima Systems (Concord, CA), a laptop manufacturer, the CPU price now has a much less significant effect on system cost. Altima sells an AMD 386XSL-based system and an Intel 386SL system. Altima’s AMD-based system is 10 percent less expensive than its Intel version, but Warren says that the added performance provided by an external cache on the Intel portable compensates for its extra cost.

Intel has one price advantage over its competitors: cooperative advertising. Intel pays system vendors to support the “Intel Inside” campaign, subsidizing part of a vendor’s ad cost. This arrangement is particularly attractive to mail-order companies that depend entirely on advertising to generate revenue. Two U.K. manufacturers, Elionex and Viglen, claim that Intel reimburses 5 percent of their total magazine and newspaper advertising costs as long as they use the “Intel Inside” logo on their ads. A U.S.-based manufacturer says it has a similar deal, but Intel pays only 3 percent of its costs. For many vendors, this deal more than makes up for the price differential between Intel and its competitors.

Many users and vendors feel safer with Intel. Marc Vena, a product manager at Epson America (Torrance, CA), says, “If you have two processors—one from AMD and one from Intel—priced the same, we’d go with Intel because of the resources and relationships we formed with them.”

This view is echoed by the software developer WordPerfect (Orem, UT). Peter Maughan is in charge of providing the company’s staff with networks and network workstations. He tests any machine WordPerfect might purchase. He says, “The machines we have the least problems with have Intel processors.”

**Function Fits Form**

Systems are becoming more diverse (see figure 4). Areas that were once considered to be a niche market have become mainstream. For example, the market share taken by desktop systems has fallen as notebooks have become powerful enough to be considered an acceptable alternative. Predictions by InfoCorp, a market research firm, for growth in the worldwide notebook market reveal that although sales by volume represented just 14.5 percent of the total PC market in 1992, it will rise to 22.7 percent within two years.

Intel has broadened its range of processors to meet the competition from other chip vendors in niche markets, as evidenced by its planned introductions of 25 versions of the 486 CPU in 1993. The range of processors that system vendors will support is large. Processors will get faster and run on lower power. AMD and Cyrix will have full 486-compatible chips, and even Intel’s big hope, the PS, looks under threat from NexGen and others. Microprocessor Report’s Slater says, “It is inevitable that Intel’s share of the microprocessor market, as well as its profit margins, will decline.” He would not estimate by how much.

The divergence of technology allows Intel’s competitors to succeed with processors that take advantage of emerging niche markets and holes in Intel’s product line. AMD, for example, succeeded with its 40-MHz 386DX because it met a demand for a higher-performance 386. Intel is being squeezed out of certain market segments and has yet to get a serious foothold in the hand-held market. Intel has, however, joined forces with VLSI Technology to eventually produce a 386SL-based chip set for hand-held machines.

Intel is even willing to develop chips customized for specific applications. Its RapidCAD coprocessor, launched last February, is a two-chip upgrade that uses both the 386 and 387 sockets. The 386 socket is occupied by a hybrid 386 and 387 combination chip, while the 387 socket is occupied by a custom...
Don’t Shoot It, Troubleshoot It.

PC WON’T BOOT? KICKSTART IT!

Don’t replace your motherboard, use KickStart 2: When serious hardware problems occur, nothing gets you up and running as fast. KickStart 2 measures power within 2.5% on all four voltages, shows Power-On Self-Test (POST) failure codes, and features on-board ROM-based diagnostics allowing you to determine and remedy the problem quickly, easily, and inexpensively!

Built-in serial and parallel I/O allows for testing remote via modem, or simply logging results to a remote terminal, printer, or laptop. You can configure your own test routines and store them in KickStart 2’s battery-backed CMOS RAM for quick future use. On-board switches, LEDs, and digital displays allow complete control over testing in systems lacking video or disk.

KickStart 2 is the ultimate SECURITY CARD, too. With two levels of password protection and pre-DOS activation, you can confidently prevent unauthorized use of your PC.

Includes serial and parallel loopback plugs and the Landmark JumpStart™ AT ROM BIOS for testing ATs that don’t issue POST codes. KickStart 2 works independent of your operating system. You can use it on DOS or UNIX systems. CALL for current pricing.

THE 5 MINUTE SOLUTION TO FLOPPY DRIVE FAILURE

With AlignIt™ you can clean, diagnose, and align your floppy drives in minutes at a fraction of the cost of professional service. Patented technology requires only a screwdriver to perform ANSI-accurate alignments (.3 mils).

AlignIt is ideal for corporate users with multiple PCs. The GOLD STANDARD feature allows you to align all your PCs to the same in-house standard, guaranteeing that all your floppies are perfectly interchangeable between PCs! Available in 3.5" or 5.25" for both high and low densities. CALL for current pricing.

PROFESSIONAL LEVEL PC TROUBLESHOOTING

Landmark Service Diagnostics™ is ideal for professionals requiring the most exhaustive diagnostic test capabilities.

Service Diagnostics is not just a single product, but a complete LINE of products. It’s comprised of software, hardware, and firmware so you can choose the best “tool” for the job.

When your PC won’t boot, you’ll need ROM POST firmware, a plug-in chip that virtually “jumpsstarts” the system to determine what’s wrong. And, when your printer isn’t working, you won’t know whether it’s the LPT port, cable, or printer without hardware, like our loopback plugs (which together with our software completely test the COM ports).

To provide you a complete troubleshooting resource, Service Diagnostics is offered in single modules or in “kits.” Components include: CPU specific software (PC, XT, AT, 386/486, PS/2), ROM POSTS (PC, AT), and floppy alignment disks (3.5" and 5.25").

All the Service Diagnostics software modules are available in self-booting versions for use with non-DOS operating systems like UNIX.

Service Diagnostics is powerful and flexible. Hundreds of tests can be performed on your motherboard, memory, video, COM ports, floppy and hard drives, printer, and more. CALL for a customized quote on the kit that’s right for you!

LANDMARK... the widest selection of PC diagnostic software, firmware, and hardware in the world!

PC DIAGNOSTICS MADE EASY

You don’t need to be technical to use PC Probe™. With clear, intuitive, pull-down menus and 206 pages of on-line help, troubleshooting your PC is truly MADE EASY!

And, you don’t have to be handy with a screwdriver to make PC Probe pay for itself. Just by providing a diagnostic report to your service and repair shop, you’ll save money and receive quicker service.

PC Probe runs over 150 tests including: motherboard and CPU, memory, video card and display, keyboard, COM ports, floppy drive and controller, hard drive and controller, and more. Includes VirusCure, Landmark Speed Test, AT SetUp & loopback plugs. CALL for current pricing!

SLASH HARD DISK SET-UP TIME

If you install, upgrade, or maintain hard drives, then you need DiskBase™. It’ll save you boat-loads of time and money by putting the exact hard disk information you need at your fingertips... whenever you need it.

DiskBase reveals 12 technical specs on over 2500 hard disk drive models and 8 technical specs on over 220 controllers. Once you’ve located the correct hard disk model, you can instantly bring up a listing of all compatible controllers. CALL for current pricing!

CALL (800) 683-6696
FAX (813) 443-6693 • Int’l (813) 443-1331

LANDMARK RESEARCH INTERNATIONAL CORPORATION
703 Grand Central Street • Clearwater, Fl. 34616
Circle 188 on Inquiry Card.

PROTECT YOUR SOFTWARE

NO BUTTON, NO ACCESS.

Dallas Semiconductor is reshaping the world of software protection and distribution control with a new family of microchips called Buttons. We put the lid on software piracy by packaging microchips in button-shaped, stainless steel cans. The chips contain missing but critical information to make the software run.

We offer a variety of Authorization Buttons and features so you can select the level of protection and price point that are right for you.

Security Continuum

<table>
<thead>
<tr>
<th>Button Type</th>
<th>Unique Serial</th>
<th>Read/Write Memory</th>
<th>Password Protection</th>
<th>Expiration Timer</th>
<th>Decoy Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1420 ID Button</td>
<td>X</td>
<td>4k bits</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DS1427 Timer Button</td>
<td>X</td>
<td>4k bits</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DS1425 Mult Button</td>
<td>X</td>
<td>2k bits</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Complete Compatibility

Buttons are compatible across all ISA, EISA, and MCA machines — on underpowered notebooks as well as the anti-compatible Brand X's. We achieve this total compatibility through microchips that are self-powered, unlike other protection devices that must draw power from the host machine.

Snap In, Snap Out

Authorization Buttons interface to the PC's parallel port via the DS1410 Button Holder. They simply snap in and out. The DS1410 accepts two Buttons concurrently.

The future will be a dongleless world. New computers that accept Buttons directly, including palm and notebook computers, are being designed at OEM's today.

Made in the U.S.A.

At Dallas Semiconductor, we design and manufacture our own microchips. And we’re the only ones in the software protection business who do. Sixty intricate process steps and a 64-bit unique serial number lasered into each chip prevent duplication.

To learn how to button down your software, give us a call.

FREE! Authorization Button. Call 800-258-5061

Dallas Semiconductor
4401 South Beltwood Parkway, Dallas, Texas 75244-3292
Telephone: 214-450-8170 FAX: 214-450-3715

MAKE THE RIGHT CPU MOVE

CPU performing exception handling (e.g., divide-by-zero errors). The chip set works in any 386 machine up to 33 MHz and provides an average performance increase of 20 percent to 30 percent on graphics-intensive applications such as CAD.

The Next Generation

Although Intel does not expect to launch the P5 until early in 1993, many of its design details have been made public. It will use a superscalar architecture, which means that it will have two or more execution units. This will allow the processor to perform a number of instructions in parallel during one clock cycle.

The integer unit makes the five-stage pipeline of the 486 even quicker by running two in parallel. The pipeline decodes two instructions simultaneously, and if they do not conflict, they execute in parallel. This double pipeline could represent a 50 percent speed-up over the previous design. Two other key parts of the integer unit are a branch target buffer and a dual-access data cache. The branch target buffer predicts the outcome of branches; if correct, the branch executes without delay. The dual-access cache handles both data and addresses from the pipes and contains logic for resolving address dependencies.

The P5 math coprocessor has three dedicated arithmetic units and an eight-stage pipeline that’s integrated with the integer pipeline but includes two more execution stages. Although the math coprocessor is tuned for double-precision memory-to-register operations (the most common type expected), Intel says the unit handles single-precision and register-to-register operations just as quickly.

The 486 uses 1-micron technology to pack 1.2 million transistors; the P5 uses 0.8-micron separation and has 3 million transistors. Intel says the first version of the P5 will run at 66 MHz and exceed 100 MIPS. Graphics-intensive applications, database servers for client/server systems, and multitasking applications are some of the uses that could make the most of this power.

But Intel isn’t the only manufacturer looking beyond the 486 (see the text box “New Chips on the Horizon” on page 125). Subodh Toprani, director of marketing and systems engineering for AMD’s personal computer products, says that his company has “significant plans beyond the 486.” Toprani notes that AMD is a leading supplier of RISC architecture products. This is important because RISC technology will be a major factor in the next generations of chips. Toprani says the company will offer a “new generation” of chips sometime in 1993 that will “transcend” the current generation.

Cyrix claims that it will offer a P5-compatible chip shortly after Intel introduces its version early next year. Cyrix also claims that it will come out with the next generation of chips, the so-called 886, before Intel. Cyrix says this is possible because its production cycles are shorter than Intel’s. Microprocessor Report’s Slater says, “Almost everyone has underestimated the difficulty of implementing these superscalar designs. Until Cyrix ships, such statements can be regarded only as unsubstantiated claims.”

The multitude of microprocessors has made it difficult to choose a system. But that problem has been more than offset by performance gains and lower system costs brought on by competition among CPU vendors. “Using a computer is becoming so much easier,” says Chemical Bank’s Rubin. “The more power you give people, the more they’re going to use it.”

BYrE editors Rich Malloy, Gene Smarte, Dave Andrews, Ed Perratore, Patrick Waurzyniak, and Tom Halfhill also contributed to this article.

Andy Redfern is BYTE’s U.K./Europe bureau chief based in London. You can reach him on BIX as “aredfern.”
TrueType
A to Z
TrueType helps make typeface technology easier
for Windows 3.1 users

GREG LOVERIA

The multitude of available typeface technologies and formats and the way each is implemented into personal computer applications are daunting. For example, Adobe Systems offers over 13,000 typefaces in Type 1 scalable-outline format and Type 3 bit-map format. Before the release of ATM (Adobe Type Manager), you could print Adobe typefaces only on devices that implemented Adobe’s own PostScript printer language.

Other typeface offerings use incompatible typeface formats, such as Bitstream’s Speedo and Fontware, Hewlett-Packard’s Soft Fonts, and Agfa Compugraphic’s Intellifont. Also, some typefaces are application-specific and won’t function with multiple publishing applications. To that last bit of ultimate confusion, add a sprinkling of inexact type vernacular (see the text box “The Terminology of Type” on page 132).

Fortunately for Windows 3.1 users, Microsoft’s inclusion of TrueType’s scalable typeface technology may help clear up the confusion. TrueType, developed and released by Apple in May 1991, is now part of Windows 3.1. Apple’s goal for TrueType was to simplify font installation and management chores. Another major objective was for TrueType’s printed characters to match those on-screen, with screen and printer resolutions being the only slight visual difference.

Comparing PostScript and TrueType
Adobe’s PostScript is a complete PDL (page-description language) and excels at printing fonts and graphics. In a Windows environment, ATM lets applications access Type 1 typefaces and instantly produce smooth, antialiased Type 1 screen fonts at any point size, emulating on-screen what the Type 1 printer font will look like when printed. When you modify text by changing a font’s point size, ATM instantly scales and builds screen fonts on the fly to the new point size needed.

Before ATM, users of Type 1 typefaces had to prebuild screen fonts at multiple point sizes for each typeface in use. ATM also allows dot-matrix and non-PostScript printer owners to print Type 1 typefaces. Bitstream’s FaceLift functions much like ATM and uses Bitstream’s Speedo and Adobe’s Type 1 typeface formats.

By contrast, TrueType uses a separate type management and scaling management program. TrueType has auto-scaling and antialiasing algorithms built into each typeface. TrueType fonts print to any device—including PostScript devices—supported by Windows 3.1’s printer drivers. However, TrueType is strictly a typeface display and print solution, not a combined typeface and graphics print solution such as
Generally, only two classes of fonts are built for any given point size from a typeface family: printer fonts and screen fonts. Printer fonts are built for any given point size from a typeface family: printer and screen fonts. The need for separate printer and screen fonts arose because monitors can display fonts only at resolutions of from 72 to 120 dots per inch on-screen, while standard laser-printer output resolutions range from 300 to 600 dpi. Because of these device-resolution differences, display fonts were needed to visually estimate prior to printing how printer fonts would output from desktop publishing applications.

The solution was Windows 3.0, which shipped with a limited set of combined screen and printer typeface families that included Helvetica and Times Roman. Before TrueType and ATM, if typefaces were added, you had to build separate screen fonts from the new typeface, one for each font point size used in a document. For nonoutline bit-mapped typefaces, this required building screen and printer fonts not only for Windows applications but also for DOS programs, such as Ventura Publisher or First Publisher. Because Adobe’s PostScript typefaces have always used scalable-outline technology, you haven’t had to build printer fonts, but you have had to build screen fonts.

For desktop publishing printing, there are two broad classes of laser printers: PCL (based on HP’s Printer Command Language) and Adobe’s PostScript. To print fonts, PCL printers required that you first build the soft fonts and then download them to your printer’s memory from a hard disk. If the printer was turned off, you would have to download the soft fonts again before starting the next printing session. Building, maintaining, and managing display and printer fonts was time-consuming and rapidly depleted hard disk space.

Another solution was to use a font cartridge that stored typefaces in a hardware cartridge’s nonvolatile EPROM. Font cartridges plugged directly into a PCL printer and circumvented the soft-font uploading process, but you still needed to build screen fonts.

PostScript printers use a mathematical outline description of each typeface that can instantly rescale a printer font to any point size. When Apple released its LaserWriter printer in 1984, it included 35 PostScript scalable-outline fonts along with Adobe’s PostScript rasterizing algorithms resident in the printer’s ROM. Any Macintosh-based application could display these 35 typefaces in almost any font point size because of the Mac’s built-in GUI environment. On the PC side, VGA displays were nonexistent. As VGA and higher-resolution displays became a mainstay on the PC platform, Windows users wanted access to the same typefaces used on the Mac, so Adobe released ATM for Windows 3.0.

Currently, Windows 3.1 ships with five typeface families: Arial, Courier New, Symbol, Times New Roman, and Wingdings. Except for the above system typefaces, all TrueType typefaces contain screen and printer information—called hints—on how to correctly display and print fonts at any point size selected from a TrueType typeface family. Because TrueType typefaces are outline representations, they are instantly rescalable and can function with any Windows 3.1-supported monitor and printer (see the screen). TrueType system typefaces are read/write enabled, so you can embed complete typefaces (not just a font) in a document.

### Embedding

Any TrueType typeface that a type manufacturer designs as read/write enabled can be embedded directly into and shipped along with a document file. Since TrueType typefaces contain both printer and display fonts, any Windows 3.1 user who receives a document with read/write enabled typefaces can view, edit, and print the document exactly as its originator created it. Windows 3.0 users can often display version 3.1 files without difficulty because of Windows’ GDI (Graphics Device Interface). If Windows 3.0’s GDI cannot find the font in use in a Windows 3.1 document, it displays the nearest corresponding screen font installed in Windows 3.0. However, because a type manufacturer’s revenues depend on typeface sales, not all TrueType typefaces are designed with read/write capabilities, which means some typefaces cannot be embedded and distributed.

Fortunately, three restriction levels of embedding protect TrueType typeface manufacturers from copyright infringement and from illegally embedded typeface distribution. At the same time, these restrictions provide Windows 3.1 users with varying degrees of typeface functionality. In the first level of embedding, a manufacturer may design the typeface to be unembeddable, or unprotection. Only applications that have TrueType’s typeface embedding feature built into them can include TrueType typefaces with a document file. At this writing, the only application supporting TrueType embedded typefaces is Microsoft’s PowerPoint; however, Microsoft and other Windows 3.1 software developers are upgrading applications to support typeface embedding. You should expect to see many of these applications in the near future.

Also in the first level of embedding, you must buy and install the exact TrueType typefaces used in the original document to

### Key TrueType Features
- Separate type management program
- Separate scaling management program
- Auto-scaling/antialiasing algorithms for each typeface
- Support for Windows 3.1-compatible printers

---

**TRUETYPE A TO Z**

BY TYPE • DECEMBER 1992

130
Welcome to Open Country.

If you've been hankering to move to open systems, there's good news. CICS, the world's most popular online transaction processing (OLTP) program, now runs on the RISC System/6000. With CICS/6000 for AIX, IBM's enhanced version of UNIX, you'll discover the flexibility of open distributed computing using the same investment you've already made in training and applications on your mainframe CICS.

Nobody knows OLTP or distributed processing like IBM, and with our support and service, you'll never feel lost in the wilderness. IBM also offers Encina, an exciting new OLTP product for multivendor distributed environments.

We're also introducing the new RISC System/6000 Models 580 and 980, the perfect partners for your open computing needs. Both provide leading price performance that's not a kick in the head.

Call your IBM marketing representative or Business Partner. For literature, call 1 800 IBM-6676, ext. 723. We think you'll have only one thing to say.

Yippee.

Introducing CICS/6000.

- Leverages your investment in CICS.
- Interoperability for PCs through mainframes.
- Built on OSF's DCE.
- Introducing the RISC System/6000 Models 580 and 980.
The Terminology of Type

In addition to multiple typeface formats, typesetting terms are often used differently in desktop publishing environments, which creates confusion. Typesetters use the word *font* to specifically describe point sizes, weights, and styles selected from an individual typeface, as in "We used a 12-point Times Roman Italics font in the document." In typesetting terms, Times Roman 12 point and Times Roman 18 point are both fonts, not typefaces. Typeface families are designated into groups such as Times Roman Italic or Times Roman Bold and are part of the same typeface family, but each designation contains complete sets of characters all representative of that typeface's designated stroke, weight, slant, and width.

On the other hand, desktop publishers often interchange the terms *font* and *typeface* to describe whole typeface families, as in "I would like to use Helvetica and Times Roman fonts in the document," when they actually mean they would like to use the Helvetica and Times Roman typeface families in the document. Fonts are built individually at different point sizes selected from a chosen typeface.

correctly display the document you receive. If you already own the proper typefaces, you can also print and edit the document.

In the second level of embedding, manufacturers can design typefaces that have read-only protection. You can view and print the received document, but you cannot edit it. Disabling the editing function restrains end users from deleting text and from using the empty document as a template to create future documents using typefaces included in the original document file.

The third level of embedding lets typeface designers create typefaces that are both read- and write-enabled. You can view, edit, or print documents received with read/write typefaces embedded to meet your requirements.

Applications that support embedding also provide an option that lets you permanently install into Windows the new read/write typefaces embedded in a document. These applications can automatically perform new typeface installations by updating Windows 3.1 typeface lists in the WIN.INI file and then auto-extracting the embedded typeface files (e.g., FONTPNAM.FOT and FONNTNAME.TTF) to the WINDOWS\SYSTEM subdirectory. There are pros and cons to read/write embedding. Users without extensive hard disk capacity who receive large multi-font documents may find themselves out of storage space, because TrueType generally occupies about 70 KB of storage space per typeface (versus about half this amount for Type 1 typefaces).

Take a Hint

*Hintering algorithms* are calculations that improve the quality of typefaces on both printer and screen output. Without hinting instructions, characters would have random pixels sticking haphazardly out of a character, or crossbars might disappear on A or H characters. This is due to the relatively small number of dots a 300-dpi printer and a 72- to 120-dpi VGA monitor have. Hints are usually applied to typefaces at sizes below 12-point for 300-dpi printers and 18-point for VGA displays; printer hints are not necessary when the output resolution of a device is above 600 dpi.

Hints are designed as integral parts of a TrueType typeface. Adobe's Type 1 typefaces include few hinting instructions and use the PostScript rasterizer in the printer to apply most hinting instructions.

Sampo Kaasila, Type Solution's president and founder, described Adobe's Type 1 hints as declarative: they merely identify certain strokes within a typeface that need hinting, which for the most part leaves hint decisions to Adobe's PostScript rasterizing process. Type Solutions manufactures TypeMan, typeface development software that Microsoft used for applying hints to Windows 3.1's system typefaces, as well as to its TrueType FontPak typefaces. With Adobe's Type 1 typefaces, on-screen, ATM's rasterizer performs the final hinting decisions; in a PostScript printer, the ROM-based rasterizer performs the hinting. On the other hand, TrueType hinting is a procedural process built into every TrueType typeface. This process doesn't just suggest how to apply hints to a font—it gives direct orders.

These direct hinting instructions included in every TrueType typeface are one reason why TrueType typefaces are somewhat larger in file-size bytes than comparable Type 1 typefaces. Having these direct hints applied by the typeface designer certifies that once the designer releases a TrueType typeface, an engineer making hint improvements to a rasterizer cannot change the typeface. Hinting improvements to PostScript typefaces are applied globally via rasterizer updates, as in the case of the upgrade from ATM 1.0 to 2.0. Hints for all 13,000 Type 1 typefaces were modified by the ATM 2.0 rasterizer upgrade. However, future TrueType typeface designer hint improvements on any typeface will require you to purchase a complete new typeface, not just a rasterizer.

Using a program such as TypeMan, you could change any singular TrueType typeface's hint instructions.

There is much debate over which hinting procedure will prove most effective for the end user. For users with large collections of Adobe Type 1 typefaces, it's obviously much easier just to apply future Adobe hinting updates globally to every typeface in one procedure. The TrueType camp believes that Windows users will find purchasing singular typefaces that include hint improvements less time-consuming and easier.

At present, most typeface modification and conversion programs apply hints automatically between typeface formats. However, future typeface creation programs will require an understanding of hints and their importance when designing typefaces.

Print Considerations

Using TrueType typefaces, Windows 3.1 examines each document line-by-line at print time. Only specific TrueType characters needed to print documents are downloaded to the printer. After printing, printer memory is cleared for the next print job. For laser printers with more than 2 MB of RAM, setting printer memory options on the Control Panel instructs the Windows 3.1 printer driver in use to retain previously downloaded TrueType characters in printer memory. This alleviates the need for character uploading, which makes printing from Windows even faster in this configuration. Printers with less than 2 MB of RAM cannot retain
The more information your business generates, the more you stand to lose. Because not all the 8mm tapes used by business are designed for business.

So before risking valuable data to a tape made for saving video memories, rely on new Sony Enhanced Data Grade D8.

This compact D8 cartridge starts out where our video grade leaves off, holding up to 5 gigabytes, for today's high-capacity storage and archiving. With data security features you'd only expect from the inventor of the 8mm video format.

For instance, new D8 has a more durable media for greater data integrity, taking over 1,500 full back-ups, to keep your business moving forward.

The shell is made to resist warping, while an improved lid reduces friction through over 10,000 openings and closings. The result is a shelf life that will exceed 30 years under recommended conditions. So your data will be around when you need it.

Since lost data can cost your business its lifeblood, trust yours to the safest place of all. Sony Enhanced Data Grade D8. A memory worth celebrating.

Circle 149 on Inquiry Card.
## TrueType A to Z

TrueType characters because this base memory is used for printing full-page graphics. As mentioned earlier, TrueType is only a font-scaling and printing technology, while Adobe PostScript is a PDL technology. PostScript uses a rasterization process to convert whole pages, including fonts and graphics, into one large bit-mapped image. There are trade-offs to either technology.

Complete PostScript pages are rasterized bit-mapped images that, depending on your system configuration and available printer memory, can have slower printing times than a similar page using TrueType typefaces on a non-PostScript printer implementing HP's PCL. At one point, while seeking to enhance graphics printing by increasing TrueType print times, Microsoft established a TrueImage group to accomplish these tasks. But Microsoft's engineers developed the character-by-character download process that enhanced print speeds considerably and incorporated it directly into Windows 3.1. The TrueImage technology was subsequently licensed to third-party printer manufacturers, such as LaserMaster and Microtek.

On the other hand, Adobe's claim that "PostScript prints anything" rings true. When you combine graphics with TrueType fonts and then print the document on a PCL printer, you still get a less-than-desired appearance; the text looks great, but the graphics images look only fair. Windows 3.1, however, can convert and print documents using TrueType typefaces and graphics directly to PostScript devices with excellent results. In TrueType, conversion of font outline to PostScript bitmap is automatically accomplished within Windows and is controlled by the specific printer device selected in the Windows Printer Control utility.

For Windows users with PCL or dot-matrix printers, one solution to PCL/PostScript print differences may be Zenographics' SuperPrint, a $149 software package. SuperPrint installs its LaserJet SuperDriver into the Windows Control Panel, and when selected, it lets you print both graphics and text up to PostScript quality on PCL or dot-matrix printers. Even if you have only a nine-pin dot-matrix printer, the characteristic dot-matrix banding virtually disappears. In PCL print tests on a LaserJet TIP, SuperPrint rivaled PostScript graphics and text output.

### Coexisting Peacefully

With the success of Windows 3.1, many of the old digital type manufacturing professionals, such as Agfa and Bitstream, are rapidly converting original typeface families from proprietary and Type 1 formats to TrueType formats. It is improbable that TrueType typefaces will outpace Adobe's and other manufacturers' sizable leads in the digital typeface marketplace in the near future. In addition, you will soon be able to modify a typeface without external programs by using Adobe's Multiple Master and TrueType GX typefaces.

With Windows applications moving rapidly into MPC and nonlinear video editing, typeface manufacturers will find new markets, as these applications will use typefaces for character generation and video titling. Just as multiple typeface vendors have survived using unique technologies in past markets, you can expect TrueType to coexist with other typeface formats. One thing is certain: TrueType has heightened the personal computer user's typeface awareness, and most users will never look at digital type in the same light again.

### ACKNOWLEDGMENT

Steve Puntolillo, a Zenographics typeface and print specialist, contributed technical information for this article.

Greg Loveria is a computer graphics and desktop publishing consultant, animator, and writer in Binghamton, New York. He can be reached on BIX as "loveria."
The World’s Best Selling UNIX Clone Just Got Better.

Now with full 32-bit implementation!

If you wish to ignite your 32-bit hardware with the multi-user, multi-tasking power of UNIX, Coherent 4.0 has arrived. And if you’re operating or selling small business network systems with dozens of users, that’s really good news. Because Coherent 4.0 is what you want in UNIX at a price that’s hard to believe.

Run UNIX applications today!

Coherent is now binary compatible with UNIX. Most UNIX PC applications port with a simple recompile and many now run right out of the box. The list is growing everyday; so call for details.

Yes, It’s For Real!

How can it be? First of all, Coherent was independently developed by the Mark Williams Company, so you don’t pay for UNIX licensing fees. You don’t pay any mark-up or reseller costs either. Coherent is only sold directly to you.

Small, But So Complete.

Make no mistake, Coherent is a wholly professional development system. You get a complete C compiler, assembler and over 200 UNIX commands including full sets of functions for development, administration, maintenance and text processing.

Yes, It’s For Real!

How can it be? First of all, Coherent was independently developed by the Mark Williams Company, so you don’t pay for UNIX licensing fees. You don’t pay any mark-up or reseller costs either. Coherent is only sold directly to you.

In fact, over 40,000 copies of Coherent have already been sold. And, like the ones we quote here, virtually every critic who’s reviewed Coherent has raved about it.

So Much Less, Yet So Much More.

As a virtual clone of UNIX, Coherent embraces the original UNIX philosophy: Small is beautiful. Small price, yes. But there’s more, much more, to Coherent than its amazing price.

Requiring only 10 megabytes of disk space, Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. And it runs with as little as 1 MB of memory versus 4 MB for other UNIX versions.

The World’s Only Plug And Play UNIX Clone.

You’ll have Coherent up and running with a fraction of the time and effort it takes for other UNIX versions. Our

six disk installation is a breeze compared to their 25. You’ll also learn it faster and increase overall performance. All because Coherent is smaller, faster... and better.

“Coherent comes so fully qualified as a UNIX clone, you find yourself thinking, ‘I can’t believe, it’s not UNIX!’” –Sean Fulton, UNIX Today!

C compiler, assembler and over 200 UNIX commands including full sets of functions for development, administration, maintenance and text processing.

Coherent also comes with UUCP capabilities that connect you to a world-wide network of free software, news and millions of UNIX users. And it’s all clearly documented in Coherent’s highly praised 1200 page manual.

Experienced, Supported, Guaranteed.

Mark Williams Company has been developing professional programming tools since 1976. Our commitment to our products and users is unsurpassed. Users applaud our popular BBS and the widely acclaimed telephone support they get free from Coherent developers.

Still, we’re not asking you to take a chance on Coherent. We’ve made it fool-proof to see for yourself—with a 60-day money-back, no hassles guarantee. So pick up that phone and order Coherent now And the best way to UNIX will be on its way to you!

800-MARK WMS
(800-627-5967 or 708-291-6700, FAX: 708-291-6750)
60-DAY MONEY BACK GUARANTEE!

Mark Williams Company
60 Revere Drive, Northbrook, IL 60062

Coherent is a trademark of Mark Williams Company. UNIX is a trademark of USL.

Distributors: Australia (07) 266-2270, Chile (02) 2235538, Czechoslovakia 632-62877, Denmark 42-88-72-49, Finland 41-871-201, France (1) 46-72-80-74, Germany (0511) 53-72-95/(030) 313-7015, Norway 211-0950, Sweden (0) 660-192-90, UK (091) 4276430.
Once Again, CA-SuperCalc’s Numbers Crunched ’Em.

This year’s spreadsheet shootout is over. And like last year, the big winner is CA-SuperCalc.

Coincidence? Hardly. Because once again, the judges were the people who know spreadsheets best—the ones who sell, install and support them for a living. Hundreds of dealers and resellers who know a good program when they see it.

CA-SuperCalc gives them plenty to see: spreadsheet linking, 3-D graphics, beautiful, presentation-quality output...and it runs on just about any PC.

According to the experts, it also outruns Lotus® 1-2-3® and Microsoft® Excel. What’s more, Computer Associates’ spreadsheet for DEC® users, 20/20, beat 1-2-3 as well, giving us two of the top four programs reviewed by VARBUSINESS.

As you can see, CA-SuperCalc dominated the product support categories, so you can buy it with confidence. And when you factor in the price—just $149—you can buy it with ease.

Windows® Version Coming Soon!
Dial 1-800 CALL CAI To Receive A Free DOS Or Windows Demo Disk.

Shouldn’t you be using the spreadsheet that beat the big boys?
CA-SuperCalc. Number One in number-crunching.

© Computer Associates International, Inc., One Computer Associates Plaza, Islandia, NY 11788-7000. All product names referenced herein are trademarks of their respective companies.
Lower the Voltage, Raise the Power

Advantages of 3.3-volt technology include higher performance, low energy consumption, and smaller systems

JEFFREY D. SHEPARD

Higher clock speeds, faster data communications rates, lower energy consumption, and smaller and lighter systems are being made possible by emerging low-voltage (i.e., 3.3-volt) technologies. Users of all classes of personal computers will enjoy more functionality as a result of the new technologies. Hybrid 3.3- and 5-V systems are now here. Chip vendor AMD claims that within six months, the first completely 3.3-V palmtop systems will be introduced.

Among the first new varieties of computers to use low-voltage technology will be ultracomact, fanless desktop machines consuming under 30 watts, 486-based subnotebooks weighing under 3 pounds with VGA video, and application-specific palmtop computers that run on AA batteries.

Low-voltage computing is expected to migrate from the palmtop to the desktop by early 1994. Industry leaders predict that shortly after that milestone is reached, the highest-volume microprocessors will be of the 3.3-V variety. The benefits, from energy conservation to raw computing power, all favor the dominance of low-voltage computing over today’s 5-V technology.

New Voltages, New Microprocessors
The higher clock speeds possible with optimized 3.3-V chips will be a primary reason for the adoption of low-voltage technology in high-performance microprocessors. Designers are putting more logic on smaller and smaller dies using smaller transistors. These smaller transistors have less delays, which improves the clock speed.

Smaller transistors force the use of lower voltages because they can’t withstand the electrical stresses of 5-V operation. Also, when a system operates at 3.3 V rather than at 5 V, its speed increases, because the transition time from a logic 0 to a logic 1 is less.

Intel’s P5 may be the last generation of PC-level microprocessors that can be economically fabricated using either 5-V or 3.3-V processes, according to Ravi Nagaraj, senior applications engineer at Intel. Future generations after the P5 are expected to operate at 3.3 V or less.

The Alpha microprocessor from DEC is an extremely dense, high-performance (64-bit, 100-MHz) device. Because of the small transistor geometries needed, it cannot be fabricated to operate on 5 V and is offered only in a 3.3-V version.

AMD and Motorola are examples of companies adapting existing designs to 3.3-V operation. Both companies recently announced 3.3-V versions of parts previously offered in 5-V versions only. AMD’s 40-MHz 386DX and 25- and 33-MHz 386SX processors all operate on 3.3 V. The new lower power specifications for the Am386 devices provide a 28 percent
reduction in power dissipation over previous specifications.

Because power is proportional to voltage squared, the most efficient voltage to use for any system is the minimum voltage at which the system operates. A change from 5-V operation to 3 V can result in a factor of 5 in power savings. Most 5-V CMOS parts operate at 3 V, but they operate slower.

Lowering the frequency (and voltage) while the system is processing doesn’t by itself reduce the energy used; it simply spreads the same energy over a longer period of time. On the other hand, lowering the frequency (and voltage) while the system is performing less intensive tasks (e.g., word processing) and raising it when the system is performing more intensive tasks (e.g., spreadsheet recalculations) reduces overall energy consumption.

Except for the electrical specifications, Motorola’s 3.3-V 68340V is identical to the original 5-V 68340. The new 68340V dissipates just 140 milliwatts from a power supply of 3.3 V when clocked at 8.3 MHz. By contrast, the 5-V 68340 dissipates 650 mW when clocked at 16.78 MHz. By design, Motorola’s 68000 32-bit products are well suited to power-critical applications. For example, the 68300 family is a low-power HCMOS static design with specific features that let software adjust power consumption according to performance demands.

These chips also illustrate the trade-off between operating voltage and clock speed that exists in most of today’s 3.3-V microprocessors. In most cases, the 3.3-V devices are “recharacterized” 5-V parts.

For example, the Motorola 68340 is fabricated using the same masks in both the 3.3- and 5-V versions; the only difference is the electrical characterizations and maximum clock speeds. The 3.3-V version is slower than the 5-V chip. The same is true of the majority of today’s 3.3-V microprocessors. When dealing with devices optimized for operation at 5 V, operation at lower voltages leads to slower clock rates, primarily due to higher capacitance effects inherent in the relatively large geometries of 5-V devices. Chips optimized for 3.3-V operation, however, will operate at the same or higher clock speeds than their predecessors optimized for operation at 5 V.

The VG230 subnotebook engine from Vadem recently introduced a single-chip 8680 single-chip PC from Chips & Technologies was designed for palmtop systems and is specified to operate on any voltage from 3 to 5 V. In a single device, the PC/Chip 8680 implements an 8086-compatible microprocessor running at up to 14 MHz, IBM XT-equivalent logic, a CGA-compatible graphics controller, a serial port, and built-in power management.

The VG230 subnotebook engine from Vadem has been called a complete DOS-compatible computer on a single chip and illustrates another trend toward the development of flexible devices (see the photo). The 160-pin device is offered in both 3- and 5-V versions. It contains an 8086-compatible 16-MHz NEC V30HL microprocessor core and a set of functional blocks that can be optimized for specific applications.

Intel and VLSI Technology have joined forces to make chips that will let system makers build low-power hand-held computers compatible with the estimated 100 million 80x86-based PCs now in use.

“Everyone has such different needs, and system manufacturers are addressing specific niche markets,” says Betsy Jones, a product manager at Intel. “Before, customization to specific applications was on the software side of the system; now we are seeing customization to particular user needs in both hardware and software. The result will be more choices for users.”

Zenith Data Systems sees a future in customizing hardware. Instead of trying to develop one perfect PC, vendors will create multiple, limited-function, microprocessor-based devices. “We are getting to the point that we can talk about sub-$500 prices. At those prices, people will buy multiple devices,” says Chris Gladwin, product strategy and planning manager for Zenith.

### Low Voltage on the Desktop

While the impetus for using low-voltage components in portable systems is almost solely to save energy, desktop systems will turn to the new technology to offer extremely high levels of performance or to save energy.

Current high-performance microprocessors operate at 50 MHz. By 1993, 100-MHz systems will be here, and by the end of the decade, 500-MHz or higher systems will be common, says Richard Sites, a DEC senior consulting engineer and a key architect of DEC’s Alpha CPU. Several PC makers are already examining 100-MIPS microprocessors in their development labs.

Today’s high-performance devices operate on 5 V and often require heat sinks, fans, and other elaborate (and expensive) cooling techniques. In addition, the heat that these high-performance microprocessors generate requires that they be packaged in ceramic rather than in relatively low-cost plastic.

The large number of transistors in 100-MIPS microprocessors creates an even more critical heat problem. Zenith’s Gladwin says that 3-V operation is necessary to meet the performance demands of future generations of PCs.

High-performance machines will not be the only ones turning to low-voltage computing. Conventional desktops are expected to turn to the power management and low-voltage technologies developed for portable systems to reduce their own energy consumption. According to the U.S. Environmental Protection Agency, office equipment is the fastest-growing electricity load in the commercial sector. Computer systems alone are believed to account for 5 percent of commercial electricity consumption.
Close the Windows. Lock the DOS.

COMPLETE SECURITY, ACCIDENT & VIRUS PROTECTION

Failsafe Computer Guardian.
Complete Protection At A Sensible Price—$59.95

Guard valuable files and programs. Never again delete or change anything accidentally. Keep out snoops, thieves, vandals. And prevent virus attacks. All at one low price!

- Easy enough to use at home
- Supports DOS, Windows and Networks in one single package
- Indispensable for government, business and power-users
- Allow selective access by user, function or file

Available at leading software stores everywhere!
For more information, call 1-708-433-0500 or Fax 1-708-433-1485
Villa Crespo Software
1725 McGovern Street, Highland Park, Illinois 60035
© 1992 Villa Crespo Software, Inc. • All products mentioned are Registered Trademarks of their respective companies

Made in USA

Look for the box with the Failsafe Beacon™

End Users circle 239; International circle 240; Dealers circle 241 on Inquiry Card.
Good-Bye RS-232, Hello 562

The move to 3.3-volt systems will cause two problems for today's RS-232 serial interface. First, no RS-232 serial interface ICs are designed to work from a single 3.3-V supply. Second, as the power consumption of palmtop computers is reduced, the power used for the serial interface becomes a higher percentage of total power dissipation. To support the emerging 3.3-V technology, a new serial communications standard, EIA/TIA-562 (Electronic Industries Association/Telecommunications Industry Association), has been developed.

The new standard also allows for compatibility with existing RS-232 interfaces. For example, 562 is compatible with printers, peripherals, and computers that have 232C, 232D, or 232E serial interfaces. Equally important, 562 allows and guarantees 64-Kbps operation, compared to the 232E specification limit of 20 Kbps. The higher data rate of the new standard allows various new applications to be developed, such as 64-Kbps synchronous communications.

EIA/TIA-562 has specifications regarding waveform shape and ripple that 232E doesn't include (see the figure). It's these additional specifications, as well as the increased maximum slew rate specification, that allow 562 to guarantee its higher-speed operation. The more stringent waveform specifications of 562 ensure errorless operation at higher speeds. For example, a 562 driver must have ripple no larger than 5 percent of the voltage swing.

The 232 specification allows the output of the driver to momentarily stop in the middle of the transition zone, as long as the total time required to move from -3 V to +3 V meets the specification. But if the driver output stops near the threshold of the receiver, the output of the receiver could make several rapid transitions, perhaps causing data errors. EIA/TIA-562 interface ICs can use less power since the minimum allowable output voltage at the driver output is ±3.7 V, while the minimum acceptable 232E output voltage is ±5 V. This means that the minimum power delivered to the load by a 562 driver need only be 55 percent of the minimum power delivered to the load by a 232E driver. The power consumption is determined by the type of driver, not the receiver.

If you use a palmtop computer with a 562 interface IC, you'll enjoy the same power savings whether the equipment is connected to a 232 load or a 562 load. The only disadvantage of the new 562 standard compared to 232 is a reduction in noise margin from 2 V to 0.7 V. The noise margin is required to take care of several problems: external noise pickup, cross talk or coupling of signals between wires in the cable, and differences in ground voltages.

Most serial-interface cables are shielded, and you should experience no problems with external noise pickup, regardless of the interface standard used. The coupling (i.e., cross talk) of signals via the mutual capacitance between wires in the cable is most often a problem in systems that use the older (pre-232) drivers. The newer standards have a maximum slew rate specification (the maximum rate of change in the signal voltage) of 30 V per microsecond. The maximum slew rate reduces the amount of coupling or cross talk.

Differences in ground voltages can be a significant problem for users of serial interfaces when the two pieces of equipment are powered by different AC power outlets that are not grounded to the same point. The difference in ground potentials is typically several volts, and neither 232E nor 562 will work when there is such a big difference. In those few cases where the ground voltage difference is greater than 0.7 V and lower than 2 V, a 562 system may not necessarily work, but a 232E system will work.

Designers have been designing 562-like devices for years. Lower voltage parts and parts that do not meet the RS-232 voltage limits are commonly used for these designs. Apple, for example, uses its own, more stringent standard.

"If you look at the Apple interface for RS-232, it uses a chip that doesn't meet RS-232 standards, but it works with RS-232 very well. In fact, it doesn't even meet the new 562 standards, but it also works very well with 562," says Brett Fox, business manager with Maxim Integrated Products. Maxim has introduced the first serial driver IC designed to the new 562 standard, called the Max561.

Designed to operate at 3.3 V, the consumption and for potentially 10 percent by the year 2000. Systems left on but inactive (often overnight or through the weekend) consume energy needlessly (see "The Greening of Computers," September BYTE).

Howard Fullmer, executive vice president of system-design and consulting firm IQV, says that 3.3-V technology "could push the entire desktop market in the direction of ultracompact, low-power systems based on the PCMCIA card concept."

Within two to three years, active-matrix color LCD technology, PCMCIA expansion cards, and 3.3-V microprocessors developed for portable systems will be used in desktops, says Fullmer. VGA drivers, wireless LAN adapter cards, and a flood of other PCMCIA cards are expected before the end of this year.

Anything found in desktop systems can be put on a PCMCIA card. According to Fullmer, the PCMCIA standard cannot accommodate mixed-voltage 3.3- and 5-V systems; however, existing PC bus structures do.

Hand-Held Voice Recognition

While the transition from 5 to 3.3 V has hardly begun, makers of microprocessors and RAM are already planning for devices with even lower operating voltages. There is a general acknowledgment that even lower voltages will be seen, but there is little agreement about what the next low-voltage standard will be. Devices are being planned with operating voltages of from 1 to 2.7 V. Hitachi recently disclosed the development of a 4-Mb
CMOS SRAM (static RAM) that operates on 1 V and a DRAM that operates on 1.5 V.

RAMs such as these are expected to find widespread use in the palmtop market. “By 1995, we expect to see hybrid designs that are below 3.3 V. The capability exists to go below 2 V,” says Subodh Toprani, director of marketing and system engineering with the PC division of AMD.

As an example of the high-performance segment of the PC market, the next generation of DEC’s Alpha 64-bit microprocessor is expected to be a 2.5-V device operating at between 300 and 500 MHz, according to DEC’s Sites.

Today, a 386 microprocessor contains about 375,000 transistors, while a 486 has about 1.2 million transistors. By the end of the decade, microprocessors running at 500 MHz and containing 40 million transistors are expected to be available. By the year 2000, low-voltage technology will make enough transistors available on a single IC that if voice recognition is needed in a $995 machine, it will be on the same chip as the microprocessor. New output methods, such as 3-D graphics now seen in workstations and the voice and sound capabilities of multimedia systems, may one day be found in low-cost hand-held machines. For the desktop, compact 64-bit machines running at 500 MHz are expected to be available.

Jeffrey D. Shepard is a freelance writer living in Corona, California. You can contact him on BIX c/o “editors.”
For over a decade, visionaries have been pushing object orientation as the best way to deal with the enormous difficulties inherent in developing software. More recently, companies such as Apple, Go Corp., and IBM have been hawking the benefits of object-oriented operating systems, and a number of smaller companies have made the case for object-oriented databases. However, for most people outside the software development community—which is just about everybody who uses a computer—object orientation has been only of peripheral or academic interest. After all, how is a programming paradigm going to help you produce your next quarterly sales report?

The answer to that question lies in the DOI (document-oriented interface). Built on—and intimately tied to—an object-oriented foundation, the DOI is a more powerful and intuitive way to work with your computer than any of the other available interfaces. Instead of emphasizing the individual software programs that you need to do your job, the DOI concentrates on the task at hand, such as producing a quarterly report or the specification for a new widget, and it orchestrates transparent access to and cooperation among the necessary software programs. From an end user’s standpoint, DOI computing is the logical culmination of the object-oriented revolution. It provides a natural way of interacting with the daunting world of objects (see the text box “What’s in a Object?” on page 148).

Two Sides of the Coin

The DOI isn’t here yet, but given the companies behind it, you may not have to wait long to see it. The vision of using documents as a natural vehicle for interaction between users and computers has been adopted by Microsoft for an upcoming version of Windows (code-named Cairo) and by Apple, which has slated it for the Mac. Taligent, the Apple-IBM joint venture, is also developing an object-oriented operating system, named Pink. Given the enormous installed base of command-line and GUI-oriented systems, it’s obvious that the transition to the DOI will not be short or without a certain amount of dislocation on the part of both end users and software developers. What’s just as obvious—at least to the Micrososfts and Apples of the world—is that moving to this interface is worth the effort.

The DOI is an advanced user interface that makes documents, not applications, the focus of personal computing. Optimists believe that the DOI will usher in a golden age of computing where virtually all documents and software will be compatible, software development will be quicker, and any software developer who has a good idea will have a fair chance in the marketplace.

Pessimists believe that the industrywide standardization and cooperation necessary for the DOI to work will be difficult or even impossible to achieve. Software support will become a nightmare, because many problems will result from the interaction between products from different vendors.

Almost everyone agrees successful DOI computing would provide users with significant advantages. Mark Vickers, chief technologist for Taligent, predicts that new system software will “promote the development of [applications] software.” And Jim Allchin, vice president for advanced systems at Microsoft and a manager of the Cairo project, believes the DOI will open up a new world where people can spend more...
time thinking about how to solve problems and less time on how to run their software.

**A Completely Different Approach**

Today, you compute by first starting up a software application and then opening a document. Most electronic documents limit you to viewing and modifying them only with the application that created them. The DOI ultimately changes the structure of computing across the board, from what you see on-screen to how software operates to the file architecture on the disk drive.

To work in a DOI mode, you start by opening a document rather than an application (see the screen on page 146). The operating system, viewing software, or the document itself has the necessary code for viewing and/or modifying the contents. Documents can contain any kind of data object—text, graphics, sound, or full-motion video. Objects can be copied or moved anywhere in the document, placed in another document, sent over a network, printed on paper, or transferred to videotape. Computing with a DOI would replace applications—as we know them today—with tools. For instance, instead of working in a massive word processing application with a laundry list of features, by using a collection of word processing tools (i.e., *applets*), you'd perform the same functions in a text object. A text object could be any size (as large as a book or as small as a graph's label), and you'd use the same text-editing tool with all of them.

Of course, any text tool (e.g., an editor, a spelling checker, or a typeface modifier) would work with any text anywhere, including text in a spreadsheet or names in a map. A page-layout tool would place and adjust text objects for the printed page, but unlike today's PageMaker-style programs, it would no longer need to incorporate text editing or spelling checking.

You could also mix and match tools. If you like your text editor but need more powerful search-and-replace features, change the search-and-replace tool and keep the text-editing tool. Do you need to put mathematical equations in a graph? Add an equation tool. For a portable computer with limited storage and RAM, you install just the essential tools rather than large toolkits or complete applications.

In any document, when you select an object, the appropriate tools would become available. The system might first look for the same tool that created the object; if that tool was not installed in your computer, the system would look for compatible tools. According to Tandy Trower, director of advanced-user-interface design at Microsoft, "The object could say, 'If you can't render me as an x, then render me as a y.'" If you had several tools with overlapping functions, you could tell the system which one you prefer to use. If no appropriate tools were available, you'd have to settle for only being able to view the contents of an object.

For a given document object type, there can be several levels of tools. The simplest is a viewer, and basic viewers will probably be built into the system software. For rare object types, the document might

---

**The DOI**

- Task-oriented
- Allows access to applications through documents
- Seamless and transparent integration of applications

---

You Can Look

See Us At Booth #H7662
COMDEX/Fall '92
November 16-20, 1992
Las Vegas, Nevada USA

9065s

And you'll want to take a look at NANA0's newest monitors. All day. Every day. Because these NANA0 monitors deliver the highest *flicker-free* resolution in their class and conform to the strict new Swedish MPR II requirements. Some even meet the TCO guidelines, the world's toughest VLF and ELF emission standards. You'll also find that each monitor has NANA0's *intelligent* front control panel.

T560i

Designed for computer graphics professionals, the award-winning FLEXSCAN T-Series features Trinitron CRTs, providing the sharpest contrast and brightest images in the industry. Low distortion and a wider display

---

1991 BYTE AWARD OF DISTINCTION applies to T560i monitor.
include a viewing tool. A software developer might give away viewing tools to promote the sale of a full-fledged editing tool that can create and modify objects. An intermediate class of tool might be able to view and extract static or dynamic information from an object but wouldn’t have the ability to modify the object.

Objects will support and maintain links among themselves when you request this function. For example, a global search-and-replace function could apply not only to the text object on-screen but to any other document with that same object or to every text object on a network—if a company changed its name, you could replace every instance of it, even in the titles in a presentation video sequence.

Protection schemes would block inadvertent changes. Objects could also contain themselves, so version control would become much simpler (e.g., instead of separate files, one object could contain all the versions you want to preserve).

**Developers and the DOI**

Because it’s based on object-oriented programming technology, the DOI will also have a profound effect on in-house and commercial developers. Says Taligent’s Vickers, “If software developers’ applications already share common features by the nature of the object code, we want them to be able to do new things directly without having to wait for a system software crew to come out with new interfaces.

“How quickly new software ideas are integrated will be the key. Today, if you have a new idea, you have to start from scratch. Now, software developers spend too much time maintaining applications for changes in hardware and system software; they don’t have time to create new application categories.

“We have to change people’s focus from having to rebuild the world from scratch; with objects, it’s easier and faster to deliver new ideas and make money by leveraging on others’ work. [We’ve] got to get the industry into a mode of being able to leverage its previous products rather than having to throw things away.”

Today, using Macs and Windows frees programmers from having to fuss with printer drivers, file handling, or interface details, such as window management. But to create a product, a software developer usually must write either an entire application or create an add-on product that will work only with a specific application.

Building a full-scale application is usually beyond the capability of a small developer, and the market for add-on products is limited. For example, a Lotus 1-2-3 add-on doesn’t work with Excel. In DOI computing, a software developer with a good idea can focus on that idea instead of producing an entire application. In a DOI environment, competition could be fierce because all DOI tools would be universal and compatible with all other tools. “With the DOI,” predicts Chris Espinosa, Apple’s Taligent business manager, “you aren’t locked into buying from a particular vendor; vendor-hopping and stealing market shares would be much easier.”

**Working Together**

How will the small developer be affected by the coming of the DOI? In a speech to Windows developers last year, Bill Gates proclaimed that DOI computing would lead to a golden age for small developers. David Canfield Smith of Apple’s advanced technology group thinks that [in a world with the DOI,] “the rate of progress would shoot up, and people would come out of performance and ergonomics of NANAIO monitors.

Take a look at your nearest NANAIO dealer today, or for more information call NANAIO.

F750i

area make the flat-square FLEXSCAN F- Series the ideal monitors for those seeking an ideal Graphical User Interface and Desktop Publishing environment. For uncompromising quality at an affordable price, the FLEXSCAN S-Series is your choice. And every NANAIO monitor comes with a relentless attention to detail.

Whether you work in front of a 14" or 21" monitor, for two hours or twelve, you’ll appreciate the
OBJECTS FOR END USERS

When you select an object in a DOI, a pop-up menu offers the relevant choices (e.g., a layout tool or a text tool). Relationships to other objects can be found or established with the link tool.

The DOI doesn’t require that a class of tools (e.g., text-editing tools) adopt a standard file format. Such tools can use a proprietary method of coding and storing information in an object, but the object must send and receive information in a form that other objects and tools can understand. There appears to be no technological barrier to this, but a vast range of issues and details remain to be worked out.

In principle at least, you should be able to use a Lotus Ami tool to edit a text object created by a WordPerfect tool and vice versa, even if each tool uses a proprietary data format within its text objects. The tools and objects should perform any necessary conversion transparently. "Objects will force programmers to pay more attention to protocols and interoperability," says Taligent's Espinosa.

How will interoperability be accomplished? According to Espinosa, there are three possible modes. In mode one, "developers turn their backs on each other, look to see who has survived, and then build bridges to the surviving products out of sheer necessity. In mode two, a dominant company sets the de facto standard and everyone follows, sometimes pushing the standard and dragging the dominant company along.

"Two powerful players are in the game: Microsoft and the Taligent combination of Apple and IBM. And, to some degree, Sun Microsystems and Hewlett-Packard are also factors. Adobe is small but has key leverage [through its PostScript standard] against others in the industry—especially with Apple, HP, and Microsoft. In mode three, nondominant players get together and create a de jure standard."

Getting to the point where DOI computing would be commonplace could happen either incrementally or as a result of a major change. Microsoft is taking the incremental route with Windows. As Microsoft's Allchin says, "I don't believe in discontinuities. It is a rare occurrence when someone comes out with something radical that works."

Apple is trying both approaches. The Mac System Software Group believes in incremental improvements to the Mac OS, but some of Apple's senior executives think Taligent's more radical departure will yield a stronger foundation. According to Taligent's Vickers, "We will start with raw hardware and build the entire system. We want to inspire [the creation of] a new generation of hardware—both computers and networks." But Vickers stresses that "compatibility with existing systems is very important."

Taking the Hurdles

The first steps toward creating the DOI have already been taken. The most DOI-like system today is PenPoint, the pen-based operating system from Go Corp. (see the text box "Objects and PenPoint" on page 158). In this operating system, the pen tool controls all pen input for every application. Next year, Microsoft plans to release OLE 2.0, a protocol that enables Windows documents to contain information from several applications.

Apple has two technologies that compete with OLE: AppleScript and Bento. AppleScript gives applications a protocol for exchanging commands and data. According to Jed Harris, Apple's Ben­

to software architect, "Bento, named after the Japanese word for a tray with compartments for food items, is a library for reading and writing compound documents. The content of a file is open-ended. A Bento file is very inspec­tible, because information on how to read the data is explicit and accessible. Your computer can
Serius Introduces a Better Way to Create Powerful Software

Introducing Serius Workshop. The first visual application development system for both Macintosh and Windows. Simply connect Serius's objects together on the screen, and the integrated compiler will build a professional, “double-clickable” application in seconds. No low-level coding to learn, debug, or maintain.

Features
• Builds fast, compiled applications
• Includes objects for GUI and database management
• Intuitive, icon-based interface
• Seamless, bug-free integration
• With the Serius Object Construction Kit, programmers can create their own objects

“Serius Workshop made it possible to build our expense accounting application in a fraction of the time required by other tools we’ve tried. Conventional programming languages took too long and database tools proved to be too inflexible. With Serius Workshop, the entire development process—design, implementation, and debugging—took just 2 weeks instead of 30.”

—CHRIS VEAL, DIRECTOR OF TECHNOLOGY, ERNST & YOUNG

GET SERIUS. 1-800-876-6847

Circle 145 on Inquiry Card.
What's in an Object?

MARK CLARKSON

An object is just a chunk of data. But unlike passive chunks of data, which just lie there letting procedures manipulate them, an object can be active data. An object might be a number, a word, a spreadsheet program, or a digital image of an IC. If a number, it may know how to double itself, compute its reciprocal, or multiply itself by pi. You elicit these actions by sending the object a message telling it to perform some action.

Objects manipulates themselves; nothing reaches inside and stirs their contents around. Their interfaces are clean and distinct. They send and receive messages—nothing more. Objects are private, insular, self-contained, and inviolate.

A class is a group of objects that share the same behaviors and capabilities. Consider a class of objects called animals. If one animal can breathe, eat, and reproduce, all animals can.

You can create a subclass of objects, which has special capabilities. For example, mammals are a subclass of animals, with their own unique capabilities—the mothers make milk for the babies. Similarly, subclasses can be further broken down into other subclasses. You could move from mammals to humans to children to little girls, and so on, ad infinitum.

Each subclass inherits all the capabilities of its parent class (or superclass). Because animals can breathe, little girls can breathe. And if you add a new capability to the class, that new capability is inherited by all the subclasses. If you say animals can now zoom around like Superman, little girls inherit the gift of flight.

The reverse, incidentally, is not true. It does not follow that if little girls can jump rope, all animals can. Inheritance only flows downhill.

Better, More Consistent Software

The encapsulation provided by objects lets developers create complex applications out of relatively simple and easy-to-debug objects. According to Keith Wales, vice president of R&D for PenMagic (North Vancouver, Canada), "the first thing you should get out of [object technology] is better software. Software should be more consistent, smaller, and more error-free."

Objects represent software components that have been extensively tested. If a company is building two different applications that share some functionality, its developers can write the applications so that the shared functionality is embodied in shared objects. One application might be a specialized subclass of another. With object orientation, code reuse becomes convenient—almost inevitable—reducing development time. Thus, objects make it unnecessary to reinvent the wheel each time you write an application.

No Free Lunch, Yet

The benefits of object orientation don't come without some pain. For developers, the price is retraining a generation of programmers immersed in the procedural programming paradigm and reworking existing code so that it can exist in an object-oriented framework.

For end users, the price is speed. There is overhead involved in all these messages being passed to and fro. Although an object-oriented operating system provides capabilities that a standard operating system can't, simple things (e.g., copying files) can take longer to accomplish. But the benefits to both developers and end users make the costs well worth bearing the pain.

Mark Clarkson is a freelance science writer based in Wichita, Kansas. You can reach him on BIX c/o "Editors."

look inside the file and display any contents that it can handle. Any application [or tool] that comes with the Beunto library has this feature."

This year, Adobe is planning to release a document-interchange format for electronic documents, code-named Carousel. Frank Boosman, senior product marketing manager at Adobe, says Carousel will "enable people to exchange documents that retain their look and feel after the exchange. In the first version, you won't be able to edit a Carousel file, but by version two, we will add that capability."

For the Bento project, Jed Harris points out that Apple is "working with Adobe to make sure Bento and Carousel will work together. We don't define how to render information on the screen; Adobe has a well-developed concept of how to do that. In the short term, the natural thing to do is to combine Carousel and the original files and bundle up everything in Bento. In the long term, we want to converge on a common format." The results won't be an Apple-proprietary format. "We want to hand it off to an industry alliance," says Harris.

Meanwhile, Microsoft has announced extensions of OLE for the Mac environment, and Apple will offer AppleScript and Bento for Windows. Bento is already running experimentally on Windows, DOS, Unix, and the Mac. Conceivably, more than one ODI standard will be adopted by the industry. Translation between multiple object protocols is possible, although some features undoubtedly will be lost. Enactment of multiple standards is almost inevitable for the many new kinds of digital devices that appear on the market (e.g., hand-held digital organizers and electronic newspapers).

Dealing with Diversity

The number and complexity of available and soon-to-be-available object protocols place a great burden on end users. In the short run, you will have to cope with many issues. For instance, an object can have several representations: a static PostScript-like view, a dynamically linkable version, and a native data format. If you use a specialized object for which you lack an editing tool, should you include only a static view, or the entire object in case someone might need to modify it?

Embedding a graphic in a document seems simple, but what if you were to change and enlarge the graphic? Should the document shrink the graphic to fit? If
He wasn’t famous. He didn’t drive a fancy car, but dressed in his favorite Comdex T-shirt and faded blue jeans, he set out to change the course of the computer software industry. Quite a task for a lonely software developer.

Sitting in front of his computer, drinking pots of coffee and smoking cartons of cigarettes, he’d write pages of code.

It took time. Years in fact. But he did it. He wrote the most powerful computer program in the world. Now came the hard part. Selling it.

The Most Powerful Program in the World
Determined to make those long years pay off, he called on every distributor, VAR and dealer in the world. He drove from Beantown to San Diego. Flew from Dublin to Borneo. Everyone loved the program. So he sold a few. Only a few.

Back in Boston he waited. After a long year with only 13 orders he set out to see what happened. As he drove across the country and flew around the world he discovered everyone knew about his program. Everyone had it too.

The Global Marketplace
From Paris to Prague, his program was everywhere in Europe. When he got off the plane in Hong Kong he found his program stacked to the ceiling in every computer store. Amazed in disbelief, he bought a hundred cartons of cigarettes and a hundred pounds of Indonesian coffee and flew back to Boston.

Beaten, battered and bruised he went back to the drawing board. This time he would really change the face of the software industry. He would develop a device that would prevent unauthorized distribution of software programs.

Call It What You Like
He developed a hardware key. His peers applauded his efforts. Finally, a solid solution for revenue protection.

But he didn’t know what to call it. He thought of naming it after an exotic place he visited in his travels. Madagascar was a bit too long, though.

“Name it after you, Don!”, urged his peers. So he did. Soon everyone was calling the key a dongle, after Don Gall — the lonely software developer who did what he had to do.

You’ve Come A Long Way, Baby
Today, dongles are different. Fact is, they’ve come a long way. Leading the industry with security solutions, Rainbow Technologies has changed the face of hardware keys. They work with multiple applications, are programmable and network versions control concurrent usage. And they’re always transparent to the end-user.

Sentinel Family from Rainbow
Truth is, more and more developers are using keys. And the Sentinel Family is the most widely used in the world. In fact, over 6,000 developers use Sentinel from Rainbow. Why? They are simply the most effective, reliable and easy to implement keys on the market.

Learn more about securing your software and how keys provide developers with extra value. Call for a free copy of “The Sentinel Guide to Securing Software.” And see just how easy it is to install a hardware key into your application in just minutes. Try it with our low cost Sentinel Evaluation Kit. Order one for your DOS, OS/2, Windows, Macintosh or UNIX based application.

And remember, when you need a dongle, you need Sentinel — the only dongle Don Gall would use.

CALL
800/852-8569
FOR YOUR FREE GUIDE TO SECURING SOFTWARE

Some call it a dongle. Those who know, call it Sentinel.

9292 JERONIMO ROAD, IRVINE, CALIFORNIA 92718 • 714/454-2100 • fax 714/454-8557
International offices are located in the United Kingdom, Germany and France.

Circle 141 on Inquiry Card (RESELLERS: 142).
one item shrinks to invisibility, should the document be reformatted? Should you be alerted about the change? Changing a frequently used object (e.g., the boilerplate for a legal contract) might result in changes in hundreds of other objects.

You must plan ahead when you use objects. For example, a company logo could be an object. If you change the logo, every document—electronic or paper—changes as well. What if the new logo runs down the left side of the page and the old one ran across the top? You could scramble every document because you treated the logo as a dynamic object.

Not a Free Ride
For all its advantages, the DOI is not risk-free. “Beware of the idea that objects will solve everything,” warns Taligent’s Vickers. Already manufacturers are finding it hard to support the interaction of different products; what happens when almost everything involves interactions?

DOI computing doesn’t require new hardware, but the computing necessary to support dynamic links and data conversion among object types will consume considerable processing power and require higher network bandwidth on future computers. For Cairo, Microsoft is building a file system that differs from DOS’s file-allocation table and the HPFS (High Performance File System) developed for OS/2.

“It is very hard to find things and organize things, very hard when you want an object-oriented view, very hard to map into the traditional file system what the user interface wants,” says Microsoft’s Allchin. “The current file systems don’t store small objects, embed variable elements within a file, or store relationships and transactions. There are object-oriented databases and file systems. But we are building something in the middle: We are creating the object filing system.”

Microsoft is patenting its ideas on how to find things fast on both a volume and a network; Allchin promises Microsoft will publish the protocols for the filing system. But the company will support the existing DOS file structure for users with networks and storage devices, where compatibility is more important than performance.

DOI computing should cover systems from laptops to high-end machines, but it will not affect small pocket organizers. “The super-low end is not part of it; the user interface design does not necessarily apply. Small screen sizes cannot handle big displays, and small images do not scale up,” observes Allchin. “We are trying to take the machines that are popular today and make them better.”

Vickers says Pink will “target high-volume hardware platforms. What has driven us in our design is that not everyone will use Pink, so Pink has support for digital multiculturalism. If one person with a Pink system connects to a network composed of other operating systems, he or she can at least connect and preserve data, maybe even programs. We connect to networks through high-level object-oriented abstractions, so we can connect and respect the idea of there being many standards.”

Because document objects will often be carried in portable devices, all the system software under development will have features for intermittently connected computers. Objects stored on any device can be updated automatically on reconnection.

“We are redoing the user interface for Cairo,” Allchin says. “We want to leverage the object rather than the overall document. The context menus will apply to

Your Choice of Keyboard Monitor Switches

Access multiple computers with a single keyboard and monitor to cut equipment costs, save valuable space, and end clutter

- Simple pushbutton operation for quick selection
- Four, eight, or twelve ports per unit
- Daisy-chaining connects unlimited number of CPUs
- Compatible with EGA, VGA, Macintosh, Sun, and others
- Optional keyboard booting for 266, 386, and 486
- Optional RS232 or PS/2 mouse interface
- PCB construction for high reliability and low crosstalk
- Rack mount, matrix, and customized units available

Make the Rose Connection

10850 Wilcrest Drive • Houston, Texas 77099 • Phone (713) 933-7673 • Fax (713) 933-0044

Circle 143 on Inquiry Card.

BYTE • DECEMBER 1992
Isn't it time you experienced the benefits of object-oriented programming?

You can with DataFlex.

DataFlex's comprehensive 4GL, robust class libraries, object-oriented program generators, and proven database management system provide you with a complete library of tools for application development.

Generating complete object-oriented programs is as easy as clicking on AUTOCREATE in DataFlex's menu system. Utilizing DataFlex's many other language features lets you create fully customized CUA applications.

Experience faster development, easier maintenance, re-usable code, and better looking applications now with DataFlex for $795.

The benefits of object-oriented programming are here now. Don't get left behind.

Take the lead... with DataFlex!

**Features of DataFlex:**
- Object-Oriented Programming
- Application Generators
- Relational DBMS
- Portability (DOS, DOS Networks, Unix, Windows)
- Client/Server Solutions

**Time Saving Benefits of DataFlex:**
- Reusable Code
- Easier Design
- Speed
- Flexibility
- Reliability

Call 1-800-451-FLEX for complete DataFlex information and the dealer nearest you.

**DATA ACCESS CORPORATION**
Miami, FL. U.S.A.

Circle 89 on Inquiry Card
(RESSELLERS: 90).
OBJECTS FOR END USERS

You basically see that the user interface becomes a minimalist approach to glue objects together, to organize objects, and to help find objects.

"We can do a lot better metaphorically than the representation of file cabinets in today’s interface—we can organize information the way you organize your desk. We want fast ways to find stuff, particularly on a network. The current eight-dot-three names and directory structure are very poor. [We'll] have both the navigation approach and the query approach. It's not just promises. We have code running."

The Advanced Technology Group at Apple has been studying many interface enhancements for DOI computing. Among the enhancements are translucent layers over documents for annotations, “piles” of related documents, and the ability to riffle through thumbnail views.

DOI computing may bring many other changes. People have long talked about agents, pieces of software that can perform a task on their own. With the DOI, agents become easier to develop. David Canfield Smith of Apple says that “instead of a reactive machine, we will have a proactive machine that does things. With agents installed, the machine is never idle; it’s always working.”

Something New Under the Sun?
Although the DOI represents a significant advance in computer software and interfaces, the concept isn’t new. According to Bruce Tognazzini, formerly of Apple and now interface evangelist at Sun Microsystems, “The plain-paper metaphor this idea [the DOI] is based on was invented 25 years ago. It could have been done five years ago but wasn’t, because [developers] weren’t ambitious enough. It requires a real partnership between system software vendors and applications vendors.

“One of the interesting things about the plain-paper metaphor is that it’s as much a social problem as a technical problem. Plain paper requires that developers give up quite a bit more control over software design. [The DOI] requires a mature, sophisticated industry. This has held back the metaphor more than the technology. Users, however, gain a lot, because the interface is easier and cleaner.”

Bill Verplank, one of the designers of the Xerox Star, the first commercial computer with a GUI, recalls, “At Xerox, we never wanted the user to see the workings of an application. With the DOI, there would only be documents and folders; you create or get frames and put them into documents. You wouldn’t have to deal with separate applications.”

Computer documents using the DOI gain some of the universality of paper documents. When you read a paper document, you don’t stop to search for a text reader or a graph interpreter. You simply read. Similarly, you can put a DOI document in a computer and read it without searching for a compatible application.

The DOI will also make publishing and distributing computer documents easier than publishing paper ones. Publishers of electronic books, magazines, and newspapers won’t have to cope with printing, shipping, and storing paper copies.

The time of the computer document is coming. It will probably be a golden age for those who are nimble enough—or powerful enough—to take advantage of it.

Cary Lu is the author of The Apple Macintosh Book (Microsoft Press, 1992). He has done research on human vision at Bell Laboratories and the California Institute of Technology. You can reach him on BIX c/o “editors.”
In a classic line from the movie *The Graduate*, the character played by Dustin Hoffman learns from an overbearing relative that the key to future success is "plastics." If you talk to systems developers, they'll use the word *objects* with the same reverence, and they'll have the same idea in mind. *Plastics* and *objects* both convey the idea of flexible and mutable worlds, where form is easy to change and all-accommodating. That utopia is the goal of the designers of the latest versions of operating systems such as the Windows and Mac systems.

When you begin to compute using objects, you'll find that all your applications will automatically be able to communicate with each other. The change will be dramatic. The best manifestation of such an environment is the PenPoint operating system from Go Corp. (Foster City, CA) (see the text box "Objects and PenPoint" on page 158).

You won't work with a hard disk full of programs—you'll have a seamless system that will do just about everything you want without your having to slough your way in and out of a bunch of applications. As soon as more software is written for the newer systems, the applications running on your machine will be able to work together without relying on—or bothering—you.

What's more, you'll be able to create many push-button applications or macros that will string together commands that affect many other applications simultaneously. You won't "install a new spreadsheet application"; you will "integrate a new spreadsheet module into your object domain." And when the word processor of the future needs a file converted, it can...
request the result from an all-powerful file-conversion program. You won’t have to do the conversion for it. In addition, all your applications will be able to share this central file-conversion software.

With the coming of objects, you’ll also see the new operating systems providing better ways of automating familiar chores. For instance, computer lab managers will be able to write scripts that will scan for viruses and reset a machine to a standard configuration after it has been modified by a user.

Objects will take many different forms. A number of companies are already making announcements concerning their versions of object-oriented software. Apple introduced Apple events with System 7.0 more than a year ago. And Microsoft is due to provide something with these features for Windows 3.1 using its OLE. Meanwhile, established minicomputer manufacturers such as DEC and Hewlett-Packard are entering the field with their own interlinking environments, which can hook up applications and documents from different machines. OS/2 comes bundled with a scripting language called REXX, which is descended from the REXX (Restructured Extended Executor) used on IBM’s mainframes. A version of REXX called AREXX is also the standard IAC (Interapplication Communication) language on Commodore’s Amiga.

Workstation manufacturers are providing products that will link not only programs running on their systems but also programs running on the systems of other vendors. Sun Microsystems will offer Tooltalk and collaborate with HP. IBM is working with everyone. And Next is pushing to offer its object-oriented operating system on Intel 80x86 platforms.

Moving Toward Object Orientation
IAC and object-oriented technology have been around for some time. Mainframe operating systems and more general systems like Unix had object-oriented features long ago, although these features were not always classified as such. The designers of Unix let programmers take advantage of the system’s modularity by supporting the creation and linking of a number of small, generalized programs. The system provides shell scripts, similar to a powerful programming language, that can run any program or application and feed its results into another program.

The textual nature of these earlier systems actually proved to be a big advantage. Because GUIs seem to have more ambiguity than their older textual counterparts, their use makes writing a meta-level control language difficult. In GUIs, dialog boxes can appear in different places or have different shapes, and screens can be different sizes. The big challenge for GUI manufacturers is to find a natural way to incorporate scripting and events into the graphical world. Text, on the other hand, is just text.

The REXX language is included by IBM with OS/2. A number of companies distribute their own versions of REXX. The language is powerful and clean but dated. Still, it’s a big improvement over DOS batch files, because it contains all the control structures you expect in a high-level language. REXX is stable; it’s been well developed over the years. Given its support on multiple platforms, it is sure to be with us for a while longer.

The Apple Pie
In 1991, Apple’s new System 7.0 included many cosmetic changes to the user interface, but fundamental differences existed deep below the surface, where most users never dare to venture. Apple’s gurus embedded in the system a new technology called Apple events, which allows applications running on the Mac to communicate with each other.

At the outset, only sophisticated programmers were able to take advantage of Apple events. It required a C or Pascal program to issue a system call with the message. Even the best programmers agreed that it wasn’t easy to add event-parsing functionality to their software with the new technology. But once Apple events is built into the software base, life will become easier for everyone, and developers will be able to take advantage of features of other programs.

Apple defined a few simple events (e.g., open a file or print a document) and relied on developers to come up with additional features. One example is a freeware editing program called BBEdit. It can query the On Location indexing software to quickly search a disk for files that contain particular keywords. It sends the right Event messages to the On Location program and waits for a response. The author of the program didn’t have to build a

Key Players in Object Technology

- Apple
- DEC
- HP
- IBM
- Microsoft
- Next
- Sun Microsystems
search-and-find command to maintain an index. He just planned ahead to use the Apple events link to On Location.

For the rest of us, uses of Apple events are starting to appear. The latest version of HyperCard can issue Apple events to Apple events-aware programs and to other versions of HyperCard running on the same network.

HyperCard is a more accessible language than C or Pascal, making it possible for many people to create systems that communicate among themselves. It is easy to imagine (and program) a network of HyperCards that exchange data and maintain a consistent database. Such a network might not be the fastest, but it would be easy to develop.

UserLand Frontier is a general front end for the Apple events package. With this central program, you can control all the Apple events applications. The UserLand Frontier software can issue Apple events commands to all the other applications on a disk. The front end also provides an editor and an outlining program with which you can easily string together many of these commands in a script.

The clever enhancements created for UserLand Frontier hint at the shape of operating systems to come. One simple command creates an icon that will compress objects into self-extracting archives. The program intercepts the dropped icon event, translates it into a turn into a self-extracting archive event, and passes the new element to the compression program via Apple events.

UserLand Frontier includes various ways to access Apple events, and it’s possible to create more complicated spin-offs. In the future, Apple will incorporate UserLand Frontier-like features in a technology known as AppleScript. This process will link all applications by the use of a common method of distinguishing mouse-clicks and similar features. With this capability, you will be able to build macros and scripts that operate on all “scriptable” applications.

Apple is beginning to discuss a new system called OCE (Open Collaborative Environment), which will provide deeper and more sophisticated file and networking commands. One will be low-level support for groupware applications, such as Group Technologies’ Aspects. On the network, using the current version of the software, more than one person can edit a document concurrently. Changes on one version show on both screens, but you must be using the word processor and drawing program bundled with the system. Eventually, all applications will recognize these low-level OCE events.

Ultimately, file systems and networks will also become more transparent. System 7.0 already lets you “publish” and “subscribe” to files on the network and control their access. OCE will link most of these capabilities with the mail system and provide a file-store-and-forward mechanism. Right now, mail systems only handle text, but eventually they’ll be able to allow all files to move transparently across the network.

In addition to the Mac file system’s becoming more flexible, it will also become more secure. OCE technology will include system calls for digital signatures and secure public-key encryption. Using these features, you will be able to send sensitive documents over the network without worrying that they will be read or tampered with en route. The signature system is considered secure enough that payment vouchers can be exchanged over the network. Original signatures on real paper will no longer be needed to process documents.

Opening Up Windows

Microsoft is also pursuing a similar system of links and connections to run under Microsoft Windows. The first level is called DDE. With this toolkit, programmers can have Windows applications communicate with each other.

Symbiotics (Cambridge, MA) has extended the DDE protocol to work over a network with a product called Networks. With it, you can devise group-productivity solutions using existing Windows applications. Networks lets you create point-and-click connections between two Windows applications over a network.

Microsoft has built a more sophisticated protocol, called OLE 1.0, on top of DDE. OLE lets you share drives from two different files in an object-oriented way. You can easily create a graph in a spreadsheet and paste it into a word processing document. You could do the same thing with the old paste command, but now the paste command can link the graph in the text document with the graph in the file created by the spreadsheet. If the numbers in the spreadsheet change, these links will carry the changes through to the final word processing document (see the screen).

The links can also work differently. Let’s say you’re editing a document that has a spreadsheet pasted into it and the spreadsheet contains an error. OLE 2.0 will let you click on the table of numbers and have the spreadsheet—Excel, in this case—take over the machine. The menus would change to Excel menus, and all commands except the file open and save commands would be passed directly through the word processor to the Excel application. Excel would hand off all screen-drawing commands to OLE, which would pass
The current version of OLE lets you embed links to objects in a document, but it doesn't allow you to edit objects in the document's edit space. Version 2.0 will correct this deficiency.

OLE also provides hooks so that documents can be edited by different objects if the appropriate application isn't handy. Lotus 1-2-3, for instance, could take the place of Excel, even if Excel created the table in the first place.

Microsoft has also been planning for the time when everything is interconnected. Version 2.0 of OLE will be built on top of a more sophisticated Unix-like exchange mechanism called RPC (remote procedure call) (see figure 1). OLE 2.0 also includes a system for handling free-roaming objects by attaching a unique name to each of them. The application will ask for the object by name, and the system will find it. Even if these objects lie in another state, OLE will contain the hooks for finding the correct network connections and obtaining access to the objects—whatever is necessary to get the job done, such as dialing up Prodigy and downloading a file.

Architectural Considerations
Up jumps the problem of heterogeneous networks. What happens when there are different machines on the same network? Connecting two applications from Microsoft that run on a PC is something that's just starting to happen. How long will it be before all computers can speak to each other?

Although DEC has never been a big player in the microcomputer environment, it is moving to address this issue with its ACA (Applications Control Architecture), CDA (Compound Document Architecture), and DDIF (Digital Document Interchange Format). These are elements of the object-oriented world that allow applications to communicate with each other and with bundle files from multiple sources. The only conceptual difference between ACA and OLE is that ACA will run on multiple architectures.

The process of getting a standard accepted for multiple machines may be difficult, but here's another case where object-oriented software proves its worth. Windows applications running on a PC won't need to be modified to handle both OLE and ACA. ACA will translate its messages intended for Windows machines into OLE requests. The programmers need choose only one standard for the machine and work with it.

The translation functions, however, will work only when both ACA and OLE share the same features. There must still be something that all the applications agree on. The DDIF is intended to provide this commonality by prescribing a format for all documents.

Microsoft is already promoting a candidate called RTF (Rich Text Format) and is encouraging all word processor vendors to support it. Some word processing vendors are balk ing at accepting this proposal, however, because the format is somewhat provincial: It has commands only for features that are supported by Microsoft Word. DEC is attempting to produce a richer language that supports features on all word processors, and it plans to upgrade the standard frequently.

DEC seems to be the first manufacturer with a well-developed multiproduct system, perhaps because the company has such a diverse installed base (i.e., VAXes, R3000/R4000-based workstations, and PCs). All the other software system developers, however, are planning to develop this type of intermachine management.

OLE, for instance, will run on the Mac. The workstation companies (e.g., Sun Microsystems, HP, and DEC) have joined the Object Management Group to develop a standard for distributed object systems. This group plans to disseminate its standard in the same way the Open Software Foundation has. Its challenge is to come to an agreement on the particulars.

Leveraging NewWave
HP introduced NewWave some years ago as a meta-operating system that would sit on top of Windows and DOS and provide an object-based environment. The data files and applications are primal objects. Thus, you can link them as well as create complicated but versatile scripts. Many of the ideas that are part of the Windows and Mac interfaces were previously incorporated in NewWave.

HP and Sun Microsystems are also building a distributed object management facility that will lie underneath NewWave and allow objects to be shared over a wide range of machines. This system will provide many of the same features that OLE and ACA are planned to offer.
Introducing Power Windows For Project Managers.

The #1 Rated Project Manager Now Available For Windows.

Power changes people. Especially project managers. They're working smarter and faster with new CA-SuperProject® For Windows.

It's the world's most advanced, efficient and reliable project management software — and now it's incredibly easy to use.

Total power is yours with just a few mouse clicks. Create and edit projects. Specify resources, task types and durations. Define integrated sub-projects. Build top-down hierarchies and task-dependency relations. Link multiple projects together for cross-project leveling. Perform extensive "what-if" analysis, revising schedules as projects progress. You can bet your career on its advanced and efficient scheduling algorithms.

A recent study of the five leading project managers proved it. Each was assigned the same project, but the finish dates varied by as much as five months. CA-SuperProject For Windows finished first in 214 working days—leaving Microsoft Project, Timeline 4.0, Project Workbench and Project Scheduler in the dust.

There's also a wide array of state-of-the-art graphics and detailed reporting tools to help bring your projects to life.

For your free Demo Disk, call 1-800-CALL CAI. Call today.

And find out what our power windows can do for you.

CA-SuperProject® For Windows

Computer Associates International, Inc., One Computer Associates Plaza, Isla Vista, NY 11788-7000. All product names referenced herein are trademarks of their respective companies.
Traditional operating systems force you to distinguish between where data is stored and where you work on it, and between a file and the application used to manipulate it. In Go Corp.'s (Foster City, CA) PenPoint operating system, there is no such distinction between these locations—its notebook-metaphor interface is the place where documents are stored and worked on. Likewise, there is no distinction between a file and the application used to manipulate it—there are only documents. The application and the data it's working with merge and become one. You just turn to a page and start to work. PenPoint treats applications as objects; the operating system can stop and start them on demand just by sending messages (see figure A).

The Inside Story

The most salient object-oriented benefit of PenPoint to both users and applications developers is its EDA (embedded document architecture). Where traditional operating systems support pasting and linking between applications, the EDA allows an application to run inside another (e.g., spreadsheets inside CAD drawings). You can embed graphics into a spreadsheet, even if the two programs come from different vendors. The embedded documents are live: The applications behind them are running; you can manipulate them as you would if you were running them individually.

"It's much better if you can buy smaller, more focused programs that excel at doing the things they do," says Robert Carr, president of Go. "Then, if the operating system can support their working well with each other, you get the best of both worlds."

Jim Poole, vice president of sales and marketing for Ink Development (San Mateo, CA), agrees: "Under PenPoint, you can have applications that have a focused set of features. If you need to add additional features, you can do it through embedding. It allows you to take advantage of what you've purchased and what you've learned."

Ink Development's president, Matt Kursh, foresees in-house applications developers becoming "solution developers." They would integrate components from other vendors into something that to you is a seamless application. For example, a developer could assemble a personal information system from a database, graphics program, calculator, and note taker.

An example of the EDA is the table of contents in a PenPoint Notebook, which displays the names of the documents a Notebook contains and the page numbers on which they are found (see the screen). To open a document, you tap on its icon or its page number with the pen, and the Notebook turns to that page. To remove the document, you turn to the table of contents and cross out the document with the pen.

Figure A: Objects interact with each other by passing messages (represented by arrows). Applications usually communicate with the operating system via the application-framework object. Applications can also communicate directly with operating-system components (e.g., the file system) or with other applications.

Objects and PenPoint

MARK CLARKSON

A developer can also make public the messages its applications respond to so that other developers can tailor their applications to interact more directly with them. But applications needn't pass messages to—or embed in—each other. To keep a spreadsheet handy while you work on a report, you can simply pin the spreadsheet to the report's cork margin. That's an area at the bottom of an application window where other applications can be attached, just as notes can be pinned to a bulletin board.

Instant Updates

A class is a group of objects that share common behaviors and capabilities. All applications under PenPoint, for instance, are members of the class clsApp. Under clsApp, there are a number of Pen Magic Software's (North...
Vancouver, Canada) Numero products (e.g., Sketch, Graph, and Formula). Specific applications are subclasses of clsApp (e.g., clsNumeroSketch). A subclass inherits all the capabilities of its parent class.

During its development, the appearance of PenPoint—the shape of the buttons, the system font sizes, and the look of the menus—changed constantly, but developers didn't have to do any extra tweaking. Because applications use subclasses of user-interface objects (e.g., buttons and menus) that the operating system provides, the programs automatically conformed to the new defaults, a benefit that resulted in decreased development time.

As PenPoint gains features, so do the applications running on it. For example, Carr says that when Go adds E-mail or voice support to PenPoint, all PenPoint applications will support it instantly, even those already installed.

Recycling Code

Because of its object-oriented design, PenPoint lets developers reuse code, increasing the reliability of new products and shortening the time required before they arrive in the market. Code reuse also results in tremendous consistency and enables applications to occupy less space. Ink Development's NoteTaker and NoteTaker Photo, for example, share 180 KB of code. Because programs share the same code, they seem to occupy the same space. NoteTaker is about 300 KB, and NoteTaker Photo is about 250 KB. But loaded on your system together, they occupy not 550 KB, but only 370 KB.

Breaking programs into independent objects allows them to interact with each other and with the operating system in ways unheard of in conventional operating systems. For example, Numero stores all its financial data in a database object that is active all the time. Many different worksheets can access the database, providing tight linking and updating of data across all the documents.

Direct Effects

Object orientation can affect you directly. For example, NoteTaker provides a set of drawing tools (e.g., pencils and erasers) and different colors of ink. To change the attributes of the pen (or any other user-interface object under PenPoint), you can draw a check mark over its icon. An option sheet appears, allowing you to change the pen width, color, and shape of the tip.

This is pretty standard stuff. But because this program exists under PenPoint, the pen is an object, and objects can copy themselves. Make a copy of the original pen, select gray ink and a fat tip, and rename it Fat Gray Pen: You've created a new tool. If you don't like the selection of ink colors, you can change or delete them. They're just objects.

Because the operating system already provides for copying objects, displaying their icons, and changing their labels, the drawing program inherits this power. You inherit the power to manipulate these applications in ways that would be difficult to achieve under traditional operating systems. Entire documents can be manipulated in the same way as other objects in PenPoint. You can insert a live document into a paragraph of your PenPoint word processor as easily as you can insert a word into a paragraph in a traditional word processor. This is the essence of an object-oriented operating system.

Mark Clarkson is a freelance science writer living in Wichita, Kansas. You can reach him on BIX c/o "editors."
Object-Oriented CASE

DANIEL W. RASMUS

Our rapport with computers has steadily evolved, from switches to machine code to assembly language to third- and fourth-generation languages. Now we have CASE, which was supposed to help nonprogrammers design and, eventually, implement complex software projects. But this promise remains unfulfilled, because the chasm between a CASE model and a program is often unbridgeable.

Objects help. OOP (object-oriented programming) represents the real world in a less abstract way than relational databases or conventional languages. Rather than partition the world into computerized chunks, objects create organic representations. More important, the objects you design in the analysis stage of a project directly correlate to the objects you implement in code.

Objects already provide support for heterogeneous development and a tight coupling between the data and the process. Object CASE represents a movement beyond simple thinking and organizational tools. The future of CASE should include a clear connection between business rules, data and processes, and the systems they buttress.

CASE support for objects is sparse, and where it does exist, it follows older CASE tools down the drawing path and away from the touchy issues of implementation and testing. Many methodologies exist to support OOP, but they usually stop at the analysis stage. At Object World 1992 in San Francisco, the first glimmers of something better arrived.

Merging CASE with Objects

IntelliCorp (Mountain View, CA), the grandaddy of AI companies, has struck two deals that will influence the future of CASE. The first integrates the Prokappa client/server development environment with KnowledgeWare’s ADW (Application Development Workbench) CASE tool. That connection translates ADW Entity Relationships models, associations, and properties into Prokappa object relationships, attributes, and facets.

The imported objects are immediately ready to implement Prokappa programs through high-level programming and graphical interface tools. Thus, the abstract becomes concrete.

James Martin, one of the KnowledgeWare founders, created the second deal through James Martin & Co. This agreement will support IntelliCorp’s development of new CASE tools to support Martin’s Object-Oriented Planning and Analysis and Enterprise Engineering methods. By creating object-oriented CASE tools, information engineering practitioners can quickly simulate the results of analysis and implement production-quality code in one environment.

Object-oriented CASE does not eliminate the thinking part of systems development. It may, however, reflect the first steps toward CASE tools that let end users create complex software systems.

Daniel W. Rasmus is a freelance writer specializing in technology topics. You can reach him on BIX as "drasmns."

The Rosy Future

For both the Mac and the IBM-compatible worlds of Windows and OS/2, good IAC mechanisms have been announced or installed. The real future, though, lies in the shift to object-oriented technology, which is just a stepping stone to greater advances.

Apple is sure to include more voice-recognition technology in future versions of its operating system. The company is also preannouncing several of its coming Newton Personal Digital Assistants. And Microsoft is developing a version of Windows for pen interfaces. Many other technologies are bound to be developed that will change how you work with data.

Object-oriented systems are the foundation of a significant shift. Developers used to assume that they had control of the machine, and this inertia slowed change. Today, you can hook up a voice-recognition system to your machine, but most software still can’t take advantage of it.

The object-oriented environment brings into being user interfaces and applications that will come in separate layers. The interface layer might send its drawing commands off to a 3-D virtual reality rendering system that receives all its commands from subdermal neural contacts. System software like OLE or Apple events will carry the messages back and forth between the two layers. As a result, you will be able to customize everything—you’ll be able to mix and match to your heart’s content.

In addition, object-based technology could also make it easier to automate the design and production of complex software systems. The marriage of object technology and other software-engineering technologies (e.g., CASE) could make it much easier to develop high-end business software systems (see the text box "Object-Oriented CASE" above).

Grains of Salt and Sand

The problem with buzzwords like plastics or objects is that they represent an ideal. Much work still lies between the dream and a disk filled with object-oriented software. Many programmers need to rework their software to take advantage of the new object hooks. And you’ll need to ask for these features and learn how to use them. Before you can begin this journey, however, the world must agree on a standard. Programmers aren’t likely to put much work into developing the necessary hooks until they’re sure that it will pay off.

Political battles remain to be fought. DEC’s ACA talks to Microsoft’s OLE, but many differences still exist between any two versions of an object-oriented operating system. Objects will resolve these issues more easily, but the dust won’t settle for a long time to come. When the fray’s over, your desktop will be different from the one you have today.

Peter Wayner is a consulting editor for BYTE. You can contact him on BIX as "pwayner."
RELATING TO OBJECTS

Object technology is supplementing and supplanting traditional relational DBMSes for some database applications

DANIEL W. RASMUS

The traditional database notion of storing data in two-dimensional tables or in flat files breaks down quickly in the face of the complex data structures and data types used in applications such as CAD and multimedia. For example, a contact's name and company are easily expressed in tabular form. However, the design of a new product or the factory that builds it can't be expressed so neatly in tuples and relations.

OODBMSes (object-oriented database management systems) are designed for use in areas such as manufacturing, document management, engineering, and software development (see the text box "Object Databases Find Their Niche" on page 164). All these areas use data types not easily manipulated with conventional databases. Easily shareable versions of product designs—complete with structures, simulations, schematics, and other complex data—are difficult to realize without a common object metaphor. In fact, some business data (e.g., bills of material) translates better into objects than into tuples.

In software engineering, many companies are expected to follow the lead of Next, which hopes to make its development environment more robust by storing its graphical objects in an OODBMS. That will make the objects persistent and reusable and allow easy tracking of versions and implementations.

A Database Is a Database

OODBMSes do everything required of a database and add innovative elements of their own. They provide the same functions (e.g., persistence, concurrency, recovery from hardware and software faults, and support for ad hoc queries) as do
standard databases.

The important difference between an OODBMS and a RDBMS (relational database management system) is the basic data model. RDBMSes are derived from strict mathematical concepts, whereas object-oriented databases have evolved from semantic databases and other more touchy-feely disciplines. Thus, object-oriented databases have less of a standard theoretical underpinning than relational databases and differ more from implementation to implementation.

An Object Is an Object
Besides being good members of the database community, OODBMSes must be good members of the object-oriented community. An OODBMS consists of a data model for persistent objects that inherits its basic structure from nonpersistent OOP (object-oriented programming) languages. In addition, OODBMSes must support the basic features of object-oriented languages (e.g., classes and inheritance).

The principal differentiator between OODBMS and OOP languages is the persistence of the objects. With an OODBMS, the objects remain when you turn off your computer or leave an application. In most OOP systems, the results of an application may end up in an RDBMS or a flat file, but the objects—and their complex relationships and activities—cease to exist when the last electron scoots through the CPU.

With their persistence, OODBMSes allow long-term storage of complex objects, such as compound documents, computer network simulations, or models of DNA. The objects remain intact from session to session, eliminating the necessity of piecing together models from a hundred joins, as you do in the relational realm.

Configuration and History
An important difference between relational databases and object-oriented databases is in the creation of new versions of data. When an RDBMS creates a new table from an existing one, it does not maintain a relationship between the previous table and the new one. In an object-oriented environment, however, you can always trace the family history of a class of objects. Even if all attribute similarities disappear between the parent and the child, you can always see the historical linkage.

This configuration management capability works well for system developers, but it’s even more important for end users. Manufacturing people and engineers need to know about the different versions of objects they are working with. Keeping track of various configurations in a relational database requires some tuffy program-

ming: You must keep track of several tables and keys, and the information contained in these configurations is complex and linked to several other pieces of complex information, such as drawings.

In the OODBMS answer to this problem, different configurations exist as subclasses of an original configuration. In a conventional relational world, tracking the history of real-world or software objects falls within the purview of the application program; with object-oriented databases, objects maintain their own versions.

Relationships and Transactions
Object-oriented languages support two basic relationship concepts: IS-A and PART-OF. IS-A relationships indicate that an object is a kind of something (e.g., a football is a kind of ball). The PART-OF relationship indicates that an element is part of something (e.g., a tire is part of a bicycle).

OODBMses go beyond these basic relationships to include complex notions like OWNS or LIVES-IN. Inverse relationships also exist in an OODBMS. A car bumper, for example, exists as a thing that is part of a car, and the bumper object has a slot that stores the type of car it is part of (the PART-OF relationship). The synchronization of inverse relationships and other relationships causes potential difficulties with referential integrity. Each object-oriented database implements its own relationships and integrity semantics.

Another area where object-oriented databases differ from relational systems is in their support for cooperative transactions, which include long transactions and nested transactions. A long transaction, for example, might be one that allows multiple reviewers to add their comments to a single document. A nested transaction might take place on a bill-of-material file that is made up of lower-level subassemblies. Even though the transaction would need completion before commitment, lower-level subassemblies that don’t create contention could be committed before the main transaction. Many OODBMS products implement soft locks, which notify the initiator of a violated lock. Just as with other enhancements made by OODBMS products, cooperative transactions make it possible for developers to create new classes of applications through embedded capability rather than through application-level trickery.

OODBMses also present new issues for the security-minded. Instead of control over tables and database sets, OODBMS practitioners must concern themselves with authorized access to classes, instances of classes, and methods.

Fitting In
Relational databases will continue to dominate the market for the foreseeable future, with object-oriented applications developing in areas not strongly supported by relational systems. Thus, to prove useful, object-oriented databases must be able to be integrated into a relational world.

There are two ways to deal with the relational world when you are using objects: interfacing and encapsulation. Interfacing requires no new magic, just detailed instructions that link object systems with relational systems.

In encapsulation, object-oriented databases play the role of information brokers, and the relational database becomes an abstract data definition. By encapsulating a relational database and transforming its access into methods, developers and end users would see only the object-level interfaces rather than the syntax and semantics of differing databases.

What’s Missing
Commercial acceptability of object-oriented databases hinges on vendor independence, transportability, and investment insurance. If you buy Oracle and something happens to the company, you can, with relatively little effort, transport your data to another relational database product.

The OODBMS Difference
- Manages complex data types
- Supports OOP concepts (e.g., inheritance and polymorphism)
- Handles cooperative transactions
- Allows distributed applications
IBM PS/2 Models 70 & 80 and Compaq Deskpro 386 systems have a future with 486/Now! processor upgrades.

Every year or so, a new version of your favorite software comes out. Ideally, the updated version is easier to use, has new features and hopefully makes you more efficient. To get the most from these improvements, you need 486 processing power. Until now, your only solution was to buy a whole new system. In addition to the cost, this meant re-installing software and buying new peripherals.

Don't Replace the System—Simply Upgrade the Processor.

A better alternative is to upgrade only the processor. 486/Now! from Kingston is a great way to get the processing power you need for business applications, network file servers, graphics programs and CAD/CAM. 486/Now! is available with either a 486DX 33MHz or a 486SX 25MHz, and has an on-board clock for optimum processor performance.

SX/Now! is a great way to upgrade 286 systems from IBM, Compaq, AST, HP, Epson, NEC, Toshiba and Zenith to a Windows and OS/2 ready Am386SX, the fastest 386SX available. SX/Now! features 16kb of fast cache memory, supports a 387SX co-processor and has an on-board clock.

Easy Installation, Compatibility, Unquestioned Reliability.

Kingston processor upgrades plug directly into the system board, won't interfere with bus slots and take only about ten minutes to install. They're guaranteed fully compatible with both the systems for which they were designed, plus all popular operating systems and applications. 486/Now! and SX/Now! carry five-year warranties.

For the power you need and the reliability you expect, call Kingston at (800) 835-6575 for more information or the name of a reseller near you.

Comparison of native Compaq Deskpro 386/20e and same system with 486/Now! 486DX-33MHz Landmark Speed Test 2.02. Comparison of native IBM PS/2 Model 30 and same system with SX/Now! 386SX-33MHz Landmark Speed Test 2.03. All trademarks are of their respective owners.

Kingston Technology Corporation

The Inside Name in Upgrades

17600 Newhope Street, Fountain Valley, California 92708 (714) 435-2600 Fax (714) 435-2699

Circle 110 on Inquiry Card (RESELLERS: 111).
Object Databases Find Their Niche

OODBMSes (object-oriented database management systems) do not have a wide following. As yet, no standards have been written for them, and no one implementation runs on more than a handful of platforms. OODBMSes, however, are making their presence felt. Their ability to capture complex data and relationships makes them ideal for engineering, manufacturing, and document management projects. Many of these disciplines now use custom databases or none at all.

OODBMSes are having a great impact on the engineering community. People who must deal with requirements for engineering data management and product data exchange find object-oriented databases a desirable alternative to older database technologies.

Mozaic, from Auto-trol Technology (Denver, CO), uses Object Design’s (Burlington, MA) ObjectStore to implement a data structure compliant with STEP (Standard for Exchange of Product Model Data) to capture complex information about parts and assemblies. STEP goes beyond previous standards like IGES, which only represent geometric data, and includes information about versions, tolerance specifications, surface finish, definitions, geometry, and topology. Several other companies, including STEP Tools (Troy, NY) and DEC (Maynard, MA), are using object-oriented databases to accomplish STEP compliance.

Not every firm needs STEP. One of the earliest adopters of object-oriented databases was Computervision (Bedford, MA). At that time, the company’s developers wrote most of its CADD product with C++. From that experience, they realized that their next-generation CAD systems needed object-oriented databases. Computervision undertook a 50-person-month effort to evaluate object-oriented database technologies.

The evaluation team set aggressive goals. They wanted to be able to select 100 objects from a three-level hierarchy of 1 million objects in less than 2 seconds. The database also needed to provide fast vector calculations and to be able to support large structures.

Estimates of structure size ran from 1000 to 100,000 objects. Every design would contain several versions, each with from 0.5 to 5 MB in storage. The team estimated a design history would consume between 10 and 1000 GB. No available relational database was able to handle the complexity of that data with volumes that large and still maintain acceptable performance.

After undertaking extensive tests, Computervision chose a partnership with Object Design. Because Object Design’s ObjectStore interfaces directly with C++, the benchmarking team had to modify only 64 lines of code (out of 6223) and add 69 more. OODBMSes had more than proven their worth to Computervision.

Wisdom Systems (Pepper Pike, OH) recently teamed with Itasca Systems (Minneapolis, MN) to integrate its Concept Modeller intelligent CAD system with the Itasca object-oriented database. Concept Modeller’s Lisp-based design aids help put manufacturability checks and design-synthesis tools on the engineering desktop, where they can improve quality long before products are manufactured.

The combined product, called Questa:Base, implements several advanced features. They include fully distributed, multiclient, multiserver architecture; two-phased commits and pessimistic locking for data integrity; and site schemata to improve performance.

Manufacturing Objects

The MKS (Manufacturing Knowledge System) from Enterprise Integration Technologies (Palo Alto, CA) integrates process design, equipment engineering, plant management, facilities engineering, diagnosis, monitoring, and control with simulation and scheduling. MKS targets wafer-fabrication facilities but can be modified to handle other manufacturing environments.

MKS was always object-oriented, but its objects were the transient objects of run-time Lisp (i.e., they disappear after the machine shuts down).

Most OODBMS products don’t support query languages outside of C, C++, or Lisp. All the major developers are working on tools for development, but these will also lack standards. You will not be able to translate your knowledge about ObjectStore to an Objectivity/DB database in the near future. Significant differences in semantics and syntax preclude the portability of both data and knowledge.

The Object Management Group, an industry standards body based in Framingham, Massachusetts, is working on solutions to this problem with specifications like the ORB (object request broker). This suggested standard does not detail the development portion of an OODBMS, but it does dictate how objects communicate with each other. If ObjectStore and Objectivity/DB databases exist in the same distributed environment and are ORB-compliant, they will be able to exchange information with each other regardless of their development peculiarities. Query syntax, data definition, communication, security, and other issues require standards.
RELATING TO OBJECTS

Enterprise Integration Technologies recently started exploring the implementation of Objectivity’s (Menlo Park, CA) database. Objectivity/DB, as a supporting object structure for representing the machines, parts, and processes that make up a wafer-fabrication plant.

Texas Instruments went it alone in its effort to build a wafer-fabrication computer-integrated manufacturing system, but its people still saw object-oriented databases as a key technology. TI uses Servio’s (Alameda, CA) Smalltalk-based GemStone database. Along with GemStone, TI also uses Geode, Servio’s applications development environment, so that end users can easily develop custom queries and reports from the active GemStone database.

Managing Complexity
At Goodyear Tire and Rubber (Akron, OH), Itasca’s database is helping manage the resources of entire networks of computers. Taken individually, active user files on a single system are easy to manage. But operators start losing track of files on floppy disks or file servers.

Goodyear’s network patrons submit files to the Itasca database through a transparent RPC (remote procedure call). The database keeps track of file locations and histories. Goodyear uses a combination of hard disks, optical disks, and CD ROMs to store the data. Itasca indexes every file on the heterogeneous network.

The problem at Cold Spring Harbor Laboratory, a privately funded research facility on Long Island, New York, isn’t old files but capturing the complexity of DNA. As a member of the Human Genome Project, Cold Spring Harbor Laboratory must track and analyze thousands of DNA sequences. Using GemStone, the laboratory’s scientists can capture linear DNA sequences in 3-D representations.

Another GemStone application, a medical database called Helios, is scheduled to manage the medical data of patients in the EEC (European Economic Community). The result of an ESPIRIT/AIM Program consortium that includes Hôpital Broussais (Paris, France), the German Center for Cancer Research (Heidelberg, Germany), and the Geneva University State Hospital (Geneva, Switzerland), Helios handles multimedia medical information—from MRI (magnetic resonance imaging) and x-ray results to admission records. It will eventually be used to integrate medical records throughout Europe as part of the EEC Ward Information System.

And there are other object-oriented database applications. These include Bellcore’s (Livingston, NJ) Geographical Information System, Obsidian Technologies’ Document Management System, and the National Oceanic and Atmospheric Administration’s (Rockville, MD) nautical and aeronautical chart system.

The Future of Persistent Objects
Object-oriented databases are ideal tools for representing complex real-world entities and the relationships between such entities on a computer. Unlike relational databases, the elements in an object-oriented database remain whole, and the associations explicit.

Ovum, a British market research firm, forecasts that the OODBMS market and products will mature by 1995, as MIS shops adopt the technology and vendors see returns on their capital. Ovum estimates that by that time the world OODBMS market will reach $560 million, or 7 percent of all DBMS. According to Ovum, by 1995, Extended RDBMS models that include object characteristics or can integrate with object systems will account for $4.2 billion, or 52 percent of the DBMS market.

Engineering will continue to be a primary driver of OODBMSes. Many other disciplines will also put persistent objects to use as they discover the flexibility and organic representations some object-oriented systems allow. Don’t expect to see crowds of companies rushing to convert their accounts payable systems to objects. But the idea of coupling data with process will lead companies to new ways of bringing software applications into the realm of persistent objects.

before object-oriented databases gain the same kind of respect their relational counterparts enjoy.

The Vision Thing
There is a misconception that object-oriented databases should represent only physical things (e.g., compound documents, engineering designs, or DNA models). These databases are as capable as any database at capturing lofty abstract notions or at storing mundane information, such as people’s phone numbers.

Phone numbers do not invoke complexity, but they relate to complex things: people and places. The narrow view of objects focuses on complex things not easily handled by relational databases, yet OODBMSes can represent both traditional data and more complex data.

OODBMSes will not overtake the relational model any time soon. Like all technologies, the keepers of the purse strings must examine their investments wisely and only build object-oriented databases where the solution calls for it. Standards do not exist yet for OODBMSes, and it helps if you are C++ for CLOS (Common Lisp Object System) literate. But object-oriented databases can make your life easier in a number of application areas. ■

Daniel W. Rasmus is a writer based in Laguna Hills, California, specializing in management, AI, and future computing. He is the western regional editor of Manufacturing Systems Magazine and a contributing editor to PC AI. You can contact him on BIX as "drasmus."

DECEMBER 1992 • BY T E 165
"I couldn't find a powerful CASE tool that was affordable. So I designed one."  

JAN POPKIN, CHIEF SCIENTIST  
POPKIN SOFTWARE & SYSTEMS, INC.

"I'm an engineer. And I know what it's like to need a high-performance and easy-to-use CASE tool. One that I could afford to place on every project team member's desk, not just a select few. That's why I developed System Architect."

As Chief Scientist at Popkin Software, my role is to bring the real-world experiences of our developers to bear on the design and implementation of the best CASE tool possible. System Architect is the result. It's also the result of listening to our more than 10,000 users. We take your advice because we know it's real. Then we incorporate it and feed it back to you in real-world solutions and new product innovations."

Low Price. High Performance.

Since its introduction in 1988, System Architect (SA) has proven that many of the features offered by more expensive CASE tools are available for a fraction of the cost. There are now more than 10,000 SA copies in use at 2,500 installations worldwide.

Quick and Easy.

System Architect works on IBM® and IBM-compatible PCs running MS Windows® and OS/2 PM®. It comes with an integrated data dictionary that users can customize to meet their needs. Project personnel can easily share information both on and off a network. It's so user-friendly that even from the first day you can sit down, get to work, and produce results.

Multiple Choice.

System Architect works with multiple methodologies: Yourdon/DeMarco, Gane & Sarson, Ward & Mellor (real-time), Booch, Shlaer/Mellor (OO), Coad/Yourdon, Information Engineering and SSADM. And diagram types and charts including: DFDs, Entity Relation diagrams, Decomposition diagrams, State Transition diagrams, Structure Charts, and Flow Charts.

The Power To Grow.

To respond to advances in technology such as Client/Server Architecture, SA continues to grow in functionality and productivity. A few optional modules now offered are:

SA Schema Generator: Translates entity models from the encyclopedia into schema for DB2, Oracle, Ingres, SQL Server, Rdb, PROGRESS, Paradox, SQL Base, AS400, (SQL & DDS), Interbase, OS/2 DBMS, dBASE III, XDB, SYBASE, and Informix. Generates Windows DLGs, and C type data definitions or COBOL data structures.

SA Screen Painter: Develops screens for GUI or character-based applications, which are automatically populated from your SA Data Dictionary/Encyclopedia; generates MS Windows dialogs and Microsoft or Microfocus COBOL Screen Sections.

SA Object Oriented Analysis & Design (OOA/OOD): Supports Booch 91 and Coad/Yourdon.

SA Network Version: Diagram and data dictionary record locking allows multiple project members to work concurrently on the same project.

Built for Engineers.

SA also has other advantageous features: automated documentation; extensible data dictionary; normalization, rules and balancing; requirements traceability; import/export; custom reporting; and CRUD Matrices.

Call us toll-free today at 800-REAL-CASE, x109.

To find out how to qualify for your free 30-day evaluation copy, simply call us today or fax us at 212-571-3436.

SYSTEM ARCHITECT

Popkin Software & Systems, Inc., 11 Park Place, New York, NY 10007

© 1992 Popkin Software & Systems Incorporated. The System Architect logo is a trademark of Popkin Software & Systems, Inc. All other brand names and products are trademarks or registered trademarks of their respective holders. Specifications subject to change at the sole discretion of the company.

Circle 136 on Inquiry Card.
One criticism often made of software objects is that they are transient. An object is defined, manipulated, and destroyed by the program that creates it. It has no existence beyond the program. Unlike real-world objects or computer-generated data that exists outside of a program in a file system or a database system, software objects are not persistent. The only way one program can share an object it creates with another program is for the two programs to be executing at the same time. This requirement puts a crimp in any plans for developing distributed object systems.

OODBMSes (object-oriented database management systems) provide one means of giving objects persistence; file systems provide another. Neither solution, however, is ideal for all applications, situations, and implementations. That's the rationale behind a new class of storage software called persistent-data servers.

Hobson's Choice
The simplest persistent-data storage available is the file system of your hard disk. File systems have attractive characteristics: They perform well, can hold any data, are easy to use, and are most affordable. Conversely, files are unreliable. They provide no mechanisms for maintaining data consistency and afford only primitive data-sharing facilities. Few file systems offer version control, and all require you to transform data whenever you move it between internal and external forms.

Unlike a file system, a true DBMS provides mechanisms for sharing data and for ensuring its integrity. A DBMS supports transactions and version control, although the specifics of these functions may not
be exactly what your application needs. Finally, a database system is scalable and more robust than a file when your hardware or software fails.

The downside to a database system is that it’s slower than a file system by an order of magnitude or more. In addition, a database is usually complicated, difficult to learn and use, and expensive in terms of your cost of operation and the amount of system resources it consumes.

Whether you choose a file system or a DBMS, you have to sacrifice either robustness or performance. Is there a happy medium—something with the speed and flexibility of files, the reliability and shareability of databases, a price tag that won’t break your wallet, and requirements that your hardware can handle? A new breed of products, persistent-data servers, aims at the yawning gap between DBMSes and file systems.

One Alternative
One persistent-data server that’s now available is Penobscot Development’s (Arlington, MA) Kala. It’s a software subassembly, available to applications and database managers, that manages both the state and visibility of persistent data.

Kala takes care of how data is stored and retrieved as well as where it’s stored. It also copes with who can store and retrieve data, which data is available, and when it can be accessed.

Managing State
Like file systems, a persistent-data server offers a get/put interface to the storage subsystem and can store any kind of data. Unlike file systems or the BLOBs (binary large objects) used by some database systems, a persistent-data server lets the stored data retain its internal structure, no matter how complex it is.

Suppose your application builds a linked list in memory and saves the list to a persistent-data store. When you retrieve the data, it will still be a linked list—topologically the same as the original, even though the memory addresses of the nodes are different (see the figure).

Of course, object-oriented databases can also store references, but the links used by the persistent-data server are regular machine pointers, not performance-costly object-oriented pointers. Your stored data can have any representation, including packed structures and executable code. You aren’t restricted to a few primitive data types or the type of structures offered by a specific access language. A persistent-data server is as happy storing C++ or COBOL data as it is Lisp, assembly language, or Smalltalk data.

Development Steps
Penobscot Development’s Kala provides the persistent-data storage that lets you forget the distinction between in-memory and on-disk data or object formats. You can program using Kala as if your code never had to remember anything across executions or applications. Write your applications as a demo, with dummy data and no storage I/O. You can lay out your data or objects in memory in the way best suited for in-memory-only processing and the fastest execution of your algorithms.

Once you’re satisfied with the execution of your demo application, you can think about a production-level persistent-data store for your objects. You first decide what the unit of transfer is: which data should go to store and come back as a unit. The ability to choose the transfer unit improves performance because you can bring all the data your application requires at one time. These pieces can be many different objects or parts of objects—Kala doesn’t care.

For example, if the data you are using is a linked graph structure, you can either transfer the entire graph in one movement or call each node as you need it. You can also load a graph, excluding the contents of a large but rarely referenced field in each node. And you can bundle the graph with other data or choose another unit of transfer. The transfer unit can consist of bits and pointers spread all over memory.

Using convenient calls to the API, you tell the software where the data is and where, within that data, the machine pointers are. The persistent-data storage software takes care of the rest. It copies the data onto the persistent-data store and gives you a claim check in return. When you present the claim check, the server will promptly retrieve the same data and lay it out in the application memory.

Types Without Limit
Persistent-data servers can handle anything that’s made out of bits and pointers. This model neutrality makes a persistent-data server an ideal interoperability point in the storage domain. It can reside below all other subassemblies and components that support only a few data organizations.

In this respect, the role of a persistent-data server in the storage domain resembles the X Window System in the display domain or PostScript in the printing domain.

For example, an object management system can interpret data as object slots and methods. Because a persistent-data server isn’t bound to a particular notion of object, it can simultaneously support several types of objects. The access to and visibility of these objects are guaranteed to remain the same for different language systems, hardware platforms, and object management systems.

Managing Visibility
Conventional DBMSes and file systems treat transactions, access control, security, licensing, version control, and configuration control as separate services. This practice has led to a proliferation of transaction managers, security managers, configuration managers, and so forth. The result is unnecessarily complex, large, and overhead-burdened products.

A persistent-data server can work differently. It recognizes that all the services offered by traditional DBMSes are facets of the same basic problem: controlling the visibility of data.

If you analyze the nature of a transaction commit in a conventional database, you find that it is a means of making new values visible to the rest of the world by replacing the old values. Look at security grants: They are simply ways of making data accessible (i.e., visible) to qualified agents until access is revoked. You can think of a license as a means of making a data set available (visible) to someone on the basis of prepaid rights. And a configuration is the bundling of a collection of data so that it is always visible as a unit. Each DBMS has its own idea of how to implement the semantics of these services.

Take transactions, for example. Many useful transaction models exist, because the needs of applications are different. Several useful access control schemes also exist. Security is treated differently in each organization, and the licensing models of information vendors have unique needs of their own. Mathematically, all models are equivalent, because each can be used to implement any of the others. But in practice, this leads to unwarranted complications, overhead, and bulkiness.

Persistent-data software should be different. A persistent-data server like Kala doesn’t provide a one-size-fits-all solution for each service. Instead, it provides a handful of primitives that you can use to build the right model for the application. Simple models, typical of conventional DBMSes, are supplied prebuilt.
Name the International Windowing standard that is the fastest, the most powerful, the most flexible, the easiest to learn and use and now, thanks to Quarterdeck, the least expensive.

YOU HAVE A CHOICE. You can develop your next generation products today on the platform that spans DOS and UNIX, that has a ten year history of success, and that runs on PCs, Workstations, minis and mainframes, or you can wait for your competition to get there first.

The X Window system is the world wide standard. From state-of-the-art CAD/CAM to the most powerful typesetting programs, to the latest multimedia extensions. From IBM and DEC to HP and SUN and NCR and...

And you can develop X Window apps more easily and more quickly than you ever imagined. You've never had so much power, with so little effort.

THERE IS A BETTER WAY. X Window is the future. Take a look for yourself and you'll be convinced. (Anyway, you wouldn't want the other guy to have both the DOS and UNIX world markets all to himself, would you?)

Call 800-354-3222 ext 5G2 today to order your DESQview/X DEVELOPER'S TOOLKIT!

- DESQview/X X11 Starter Kit $50
- DESQview/X X11 Library Kit $300
- DESQview/X X11 Toolkit $750
- DESQview/X OSF/Motif Toolkit $150

See last month's Byte insert for a complete Technical Overview of X Window Programming!
Take a commanding lead over your competition, and put the power of X to work for you today! Return this card (in an envelope if you prefer) to order your copy of:

**DESQview / X11 Starter Kit**  
- 3.5  
- 5.25  
- $50

**DESQview / X11 Library Kit**  
- 3.5  
- 5.25  
- $300

**DESQview / X11 Complete Toolkit**  
- 3.5  
- 5.25  
- $750

**DESQview / X11 OSF/Motif Toolkit**  
- 3.5  
- 5.25  
- $150

(please allow one to two weeks for shipping)

Shipping & Handling 15.00

CA Tax 8.25%

Total

☐ VISA  ☐ MASTERCARD  ☐ AMEX  ☐ DISCOVER  ☐ CHECK  

EXP. ___________________________ SIGNATURE

NAME __________________________

TITLE __________________________ COMPANY __________________________

ADDRESS __________________________

CITY __________________________ STATE ______ ZIP ______

PHONE _______________ FAX _______________

☐ Please send details on how to get the Starter Kit (without docs) off Internet for free!  
☐ Fax me an order form for the toolkits.  
☐ Please have a salesman call.  
☐ Please send me a copy of the DESQview/X Technical Perspective immediately!

▼ Fold here and tape top to mail—Postage paid ▼
End PC Envy

A Window on the Network

As you can see, DOS programs run alongside Microsoft Windows programs. You’ve seen this all before in our DESQview, right? Yes, but now there’s more. DESQview/X lets you access and control a wide variety of PCs and workstations through your own PC. This feature is called remote computing.

In the example to the right, Lotus 1-2-3 is running in its own 386SX PC. The window at top center is a DOS window running on a remote 486 PC under DESQview/X. Below left is a FrameMaker file running on a remote IBM RS/6000 workstation in another part of the company.

Brand and Platform Freedom

DESQview/X runs on 386SX PCs and above. And from within windows on those PCs, you can use programs running on any number of remote DESQview/X PCs if your network supports NetWare or NetBIOS. Add DESQview/X’s optional network interface for TCP/IP networks, and you can also access programs running on IBM RS/6000s to HP 9000 to Sun workstations. And it works the other way, too: these workstations can view and use DOS and MS-Windows programs in their windows.

* DOS graphics programs currently run only on your local PC.

Works the Way You Want

You can change menus, add sub-menus. Add menu items that run remote programs. Change commands. DESQview/X gives you a menu to use for your macros. And if you prefer a graphical desk top instead of a menu, DESQview/X’s Application Manager gives you buttons for opening a set of programs used in a project or even for launching remote programs. What’s more, you can specify window size and color. And if you are using DOS text programs, you can set them up so that the font changes size as you change the size of the window. We call this feature scalable DOS windows (see the Lotus 1-2-3 window at the lower right of the screen).

Easy to Set Up and Administer

DESQview/X asks three questions: Do you wish other people to have access to programs on your computer? That’s all it takes for DESQview/X to set itself up. DESQview/X incorporates QEMM-386 to assure maximum memory utilization and Manifest for easy diagnosis and problem-solving.

Introducing DESQview/X for DOS

Now everyone can access the power of the fastest PC—or workstation—on the network.

DESQview/X literally turns DOS PCs into graphical workstations. With DESQview/X, you can run DOS and Microsoft Windows programs simultaneously, view them in windows, transfer between them, create DESQview/X global or program macros and manage your files. That makes computing lots easier, more productive, and more fun.

With DESQview/X, you can now run programs and access files on other computers on the network and view them in windows on your own PC. Distribute tasks among computers based on their capabilities and available resources.

Remote diagnosis and support is now a reality. With DESQview/X you can support, instruct; even remotely demonstrate programs right at your user’s computer.

If you have X Window workstations, our optional ‘DESQview/X to Other X Systems’ TCP/IP Network Manager allows you to run workstation programs remotely from PCs.

For all this power, DESQview/X is stunningly easy to set up and use, and can run on any 386 or 486 PC with as little as 4MB RAM and 40MB hard disk.

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405  (310) 392-9851 Fax (310) 314-4219
Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire Co. Dublin, Ireland  Tel.(353) (1) 284-1444 Fax: (353) (1) 284-4380

© 1992 Quarterdeck Office Systems. Trademarks are property of their respective owners.
Managing Performance

The performance of a persistent-data server for a single user is equal to the performance of a good file system when reading and writing the same data. Perhaps surprisingly, its relative performance improves when there are multiple users in a client/server configuration. This phenomenon occurs partly because of the seek optimization and shared buffering of common data used by persistent-data servers and partly because it's not necessary for each application to open and close files.

Kala, for example, is algorithmically faster than equivalent conventional technology exactly when you need it most: at peak server loads. It uses a non-write-in-place strategy, never overwriting a prior value. This particular feature gives it an effective 50 percent update performance advantage in transaction-context applications (e.g., on-line transaction processing). It requires only 1 + 1/n disk accesses per update (one to write the new data to free storage and a fraction to record the commit where the commit record is shared with other transactions). A high-performance conventional DBMS must have 2 + 1/n disk accesses for the same task (one to write the former value in case of a crash, one to write the new data back over the former value, and a fraction for the commit). This performance gain is not at the expense of data reliability and recoverability.

Persistent-Data Servers vs. Object Databases

Any quality OODBMS can recover all transactions that have been committed, even if they were performed only milliseconds before a crash. Persistent-data servers can do the same, working as fast as less reliable systems (i.e., file systems).

Many conventional OODBMSes, which perform well as single-client applications with systematic access patterns, degrade badly in multiple-client applications, such as groupware, or when used concurrently by different applications that randomly access large pools of data. Many OODBMSes are tuned to display quick response to predictable access patterns. Thus, they often achieve local (i.e., per-client) optimums at the expense of global (i.e., across-client) slowdown.

Some OODBMSes improve object-faulting performance by page-mapping databases using the file-mapping facilities of the operating system. In this instance, the unit of transfer is the fixed-size virtual-memory page (or a multiple of it). These OODBMSes show no sensitivity to the access patterns of the application.

For example, an application may need records scattered throughout a database. In a page-based OODBMS, a 4- or 8-KB page may be brought into memory to get an object that may be only a few hundred bytes. The remainder—perhaps 80 or 90 percent of the total space and access time—is wasted. The OODBMS may be performing well, but the application grinds to a halt due to thrashing in the operating system's page manager.

In contrast, a persistent-data server's user-specified units of transfer should eliminate internal fragmentation. You get only what you requested. In a multiuser environment, this feature also takes care of the severe security loopholes introduced by page-mapping-based approaches, another acute real-world problem.

In conventional systems with single users, you can overcome thrashing and other performance problems by having the user manually cluster the data, relying on the programmer's ability to predict the access patterns of an application and to optimize the database for that application. However, this traditional technique breaks down badly when one application needs one selection of data from the database and a second application, perhaps running concurrently for other users, needs different selections. The result is less-than-optimal global behavior.

Persistent-data servers offer an alternative. Kala, for example, doesn't use such local optimizations. Instead, it uses access history to dynamically rearrange the store so that global optimization occurs. If there is only a single user application, the software should be able to achieve clustering as well as the best manual packing. It also should give globally optimum performance in multiple applications without requiring the services of an expensive database administrator to tune the clustering.

Moving Forward

Persistent-data servers such as Kala provide a new and exciting middle ground between the performance of file systems and the capabilities of database managers. They are particularly useful as the underpinnings of object stores because they maintain the structure of the data on the disk, making it independent of the application that created it.

More and more, applications need access to complex data types, and increasingly, applications must support multiple users in distributed environments. From flat files to objects, persistent-data servers can handle them all.

Sergiu S. Simmel and Ivan Godard are the cofounders of Penobscot Development. You can reach them on BIX c/o "editors" or on the Internet at kala@world.std.com.
Stay on top of current events, business trends, sports, the weather, and the world of entertainment with USA TODAY®

Your entire family will benefit from the complete, regularly updated Academic American Encyclopedia from Grolier’s®

Keep up-to-date with stock market quotations on Financial Market Quotations. Also check commodities, currencies, options, and bonds.

American Airlines' EASY SABRE® reservation system lets you shop for the best fares and make your flight, hotel, and car reservations online. With EASY SABRE you can plan every business trip and family vacation with ease and efficiency.

No matter what you're interested in, satisfy your curiosity about the world and the people in it with the National Videotex Network (NVN). Easy to use, with high resolution graphics, and an even better-looking price. And NVN features AT&T's state of the art digital network.

For just $5.95 a month, NVN gives you unlimited access 24 hours a day to over 80 basic services including news, sports, financial information, games, entertainment, education, and so much more. You get 60 free electronic mail messages a month, with additional messages costing only $0.20 each.

You'll experience “real-time” conversation on our exclusive, premium service, Let's Chat USA®, where you can meet and talk with hundreds of people throughout the country.

For only $5.95 a month, there's no reason not to satisfy your curiosity. To join NVN simply set your 1200 or 2400 baud modem and dial 800-336-9092. Upon connection enter BM920L then press <Return>. Call now to order and receive your software absolutely free.

*Basic Package price of $5.95 a month does not include premium services. Price and service content subject to change. Some features subject to surcharge. Connect time for premium services will be billed at $9.00/hour 6am-8pm weekdays, $6.00/hour all day Saturday and Sunday, Central time zone. National Videotex is a pending mark of National Videotex Network Corp. All others are for identification purposes only and belong to their respective companies or organizations.

800-336-9096

NATIONAL
VIDEOTEX

Circle 171 on Inquiry Card.
Object-Oriented Database Managers

At the heart of most corporate information systems—and a good number of smaller ones—is a database system that stores and retrieves information of value to an organization. Most databases installed over the past decade have been of the relational type, but with the increasing importance of complex data types (e.g., those used in multimedia applications) that are not easily handled by relational systems, some organizations are moving toward OODBMSes (object-oriented database management systems) to handle their storage needs. Listed below are some of the major players in the OODBMS market.

**GemStone**
The GemStone OODBMS is the centerpiece of a complete object-oriented application development environment from Servio. In conjunction with GeODE, Servio’s object-oriented rapid development system, GemStone lets you create GUI-based multimedia applications without having to know how to program in C++. GemStone supports a client-server architecture and provides gateways to RDBMSes (relational database management systems).

**Itasca Systems, Inc.**
7850 Metro Pkwy.
Minneapolis, MN 55425
(612) 851-3155
fax: (612) 851-3157
Platforms: Various workstation systems.
**Circle 1156 on Inquiry Card.**

**Objectivity/DB**
Objectivity/DB is designed to support multimedia applications such as ECAD, MCAD, CASE, publishing, and multimedia that are not well supported by RDBMS technology. Objectivity/DB provides interoperability between the many platforms it supports in the form of transparent byte ordering, floating-point representation, and alignment. It features peer-to-peer communications, strong configuration management support, and flexible data modeling.

**Ontos DB**
Ontos DB is a distributed-object database that uses objects throughout the system. It is designed to facilitate workgroup computing; the latest release (2.2) uses high-concurrency object technology that makes it possible for many users to access specific objects simultaneously. Ontos, Inc., supplies a range of development tools for the Ontos DB system.

**ObjectDesign**
ObjectDesign is an object-oriented CASE tool that provides multimedia object handling in an ANSI SQL (Structured Query Language)-compliant environment. In the UniSQL/X environment, the relational aspects of the system are an instantiation in the object-oriented class hierarchy. The system retains relational behavior—and SQL compatibility—while at the same time supporting the rich data types of an OODBMS.

**ObjectStore**
ObjectStore is a client-server OODBMS designed to facilitate cooperative workgroup activities and the storage and retrieval of multimedia data types. ObjectStore features single-level storage, which doesn’t differentiate between an object in memory and an object on disk.

**O² Technology**
O² is initially designed and developed within the Altair research consortium. O² is a client-server OODBMS that provides a complete application development environment. Among the tools that come with the system are a query language, a user-interface generator, an object-4GL (fourth-generation language), and a graphical programming environment.

---

Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation.
Share a single LaserJet® 4 with up to 10 people, simultaneously

Easy to use—includes all the cables, adapters, and software needed
- Provides fast printed output
- Low priced sharing solution—up to $800 less than competitive products
- Unbeatable customer support—lifetime warranty, unlimited technical support at no cost, 60-day money back guarantee of satisfaction
- Supports both PCs and Macintoshes

The new LaserJet® 4 has arrived. Pacific Connect Xi lets you share the good news.

If you’d like more information on the best way to share your LaserJet printer, or about our Pacific 4 SIMM Memory upgrades for the LaserJet 4, call Pacific Data Products at (619) 625-3593, Fax (619) 552-0889.
GRAB YOUR AUDIENCE WITH AUDIO

Sound boards and software can jazz up your presentations

Tom Yager and Rick Grehan

Computers can help with the visual part of a presentation, but don’t you often find yourself talking over your visuals as if they were overheads or slides? With just a little more effort, you can also use the computer to grab your audience by its ears. Technology has advanced to the point where it’s inexpensive and easy to add audio to business presentations.

In this review, we’ve assembled 20 audio products for the PC, Macintosh, and Amiga that help you bring sound to your presentations. These products represent three basic categories: sound boards, digital audio editors, and sequencers.

To test these products, we built the audio component of a business presentation. We began with canned MIDI music and digitized production music from Voyetra and Prosonus and added our own CD audio and narration. We also played custom MIDI music into the sequencers we tested. The most important factors for us when evaluating each product were how well it worked, how easy it was to use, and what quality of sound it produced.

Intuitive Software Meets Less Expensive Hardware

You don’t have to be a recording engineer to add audio to your presentations. Sampling rates, kHz, MIDI tracks, and time codes may be strange terms for many computer users, but editing programs and sequencers have interfaces that make the job of acquiring and manipulating sounds an approachable task. While some of the packages have interfaces that resemble the control panel of an engineering console, others look very much like an ordinary tape deck. These desktop-studio programs are doing for digital audio what desktop publishing programs did for design and page layout: making a technology accessible to nonexpert users.

Besides intuitive software, the other element bringing digital audio to the masses is less expensive, higher-quality sound boards. You can now buy a board that generates CD-quality sound for less than $500. Combine that with editing and sequencing software and you have everything you need to make your next presentation really sing.
WHAT AUDIO PRODUCTS DO
Sound boards, editors, and sequencers enable you to produce, record, and edit the audio component of a presentation.

LIKES
You don’t have to be a recording engineer to develop audio for a presentation; sound boards are sounding better and costing less; audio-editing software makes it easy to manipulate sound files.

DISLIKES
Digital audio consumes vast amounts of disk space.

RECOMMENDATIONS
Buy a good 16-bit audio board. Turtle Beach Systems’ Multi-Sound, Digidesign’s Audiomedia II, and SunRize’s AD516 are all excellent choices. In the lower-price category, the Media Vision Pro Audio Spectrum 16 and Roland SCC-1 GS are terrific. Then decide if you need to work with MIDI files, digital audio files, or both. Your source for sound will determine what type of software you need.

It Takes Three to Tango
We’ll begin with some details about the three product categories we tested. A digital audio board accepts input from an analog source (e.g., a microphone or a CD player) and turns it into a file that you store on your hard drive. You can then play the file back, with the board turning the digital data back into analog signals that can go to headphones, an amplifier, speakers, or any other device that accepts line-level audio input.

Two factors determine how accurately an audio board reproduces sound: sample rate and resolution. The sample rate, measured in kHz (i.e., thousands of cycles per second), determines how many times per second the sound board samples the incoming audio signal and digitizes it. The higher the sample rate, the better the quality. High sample rates, however, consume lots of disk space. Resolution refers to the number of bits used to store each sample.

Digital audio editors drive the sound boards to capture and play back sound, usually at varying rates and resolutions. They also let you edit the digital data, cutting and pasting it, making it fade in and out, and “overdubbing” one digital audio file on another. It’s here that the digital...
audio portion of your presentation comes together, so when we looked at the editors, we paid special attention to the quality of the interface.

MIDI sequencers capture and play back music by turning the notes and related events (e.g., presses of the sustain pedal) into a compact stream of digital data. The sound itself is not digitized, just the representation of the notes, so sequencers can adapt MIDI music to change the instruments and the tempo, adjust a note’s duration, or even add notes and move notes around.

You don’t have to be a musician to use a sequencer. To develop presentations with an audio bang, you need a sequencing package to tailor a piece of music to your particular show. And you don’t have to have the composing genius of Duke Ellington: There are lots of prepackaged music files that you can edit with a sequencer to fit your presentation. (For more about sequencers, see the text box “The Advantages of Sequencers” on page 192.)

Most of the sequencers we tested visually resemble a tape recorder. Those that are MIDI only—all the PC sequencers covered here are MIDI only; some audio-and-MIDI sequencers on the Mac are available in MIDI-only form—allow either direct editing of the MIDI data in numeric form or provide some variant of the “piano-roll” representation of notes. This latter technique of displaying data shows notes as rectangles on the screen; time is indicated on the horizontal axis and pitch on the vertical axis, so the display looks like a player-piano roll stretched horizontally across your screen.

The sequencers that can handle both digital audio and MIDI display audio signals as graphical waveforms, with time on the horizontal axis and amplitude on the vertical axis. All sequencers allow you to cut, paste, insert, and delete regions of the waveform much as you would manipulate a graphical image in a paint program.

Synchronization is a critical issue when it comes time to commit your composition to a final tape, particularly if the composition is the sound track to a videotape. You want to make sure that the audio (i.e., music or narration) comes up at the appropriate visual cue. The simplest synchronization mechanism—which all sequencers can receive and many can transmit—is the MIDI time clock (i.e., the timing packets sent down a MIDI cable at regular intervals). A more accurate mechanism is MTC (MIDI Time Code), which is the MIDI equivalent of SMPTE, the Society of Motion Picture and Television Engineers’ synchronization mechanism that video systems use to align sound tracks to video frames. SMPTE-to-MTC converters are widely available, and all the sequencers we tested for this review accept MTC synchronization. (See the table for other features of the sequencers we reviewed.)

To test the PC products, we used a Uniq 486/50 EISA cube with 8 MB of memory, running Windows 3.1. We used an Ensoniq EPS 16-Plus sampling keyboard to create and play MIDI music. To test the Amiga products, we used an Amiga 3000T tower system with a 25-MHz 68030, 7 MB of RAM, and an Ensoniq keyboard. We used a Roland SCC-1 GS sound card to test PC and Amiga MIDI sequencers. To test the Mac products, we used a Mac II with 8 MB of RAM running System 7.0. A Roland Sound Canvas and Synth Plus 10 connected via a Passport Designs MIDI interface made up our MIDI test network. A Fostex MN-50 mixer/compressor helped during mix-down when the spaghetti of cables got too thick.

---

**ARE YOU SPENDING TOO MUCH TIME DRAWING FLOWCHARTS?**

**YOU NEED FLOW CHARTING™ 3.**

Every day, professionals worldwide save time and money using Flow Charting 3. It's fast, efficient, easy to use, and always produces presentation-perfect charts and diagrams.

With Flow Charting 3’s built-in flexibility, you can create customized charts using a variety of shapes, lines, and text—placed where you want them.

Plus, Flow Charting 3 is now available in a LAN version. Making it easy to share files and set up work groups for specific projects.

And it’s backed with free technical support and a 90-day no-risk guarantee. So if you’re spending too much time drawing charts, call for a free demo and see for yourself what makes Flow Charting 3 the best-selling flowcharting software.

See your dealer today! Or for a free interactive demo disk, call 1-800-525-0082, ext. 112

International: 408-778-6557, ext. 112

Novell is a registered trademark of Novell, Inc.

Patton & Patton Software Corp. 485 Cochrane Circle, Morgan Hill, CA 95037

**EXCELLENCE IN CHARTING THE FLOW OF IDEAS!**

Patton & Patton Software Corporation
IN A HARSH ENVIRONMENT, AN ORDINARY PC IS A DEAD PC. A lot of PCs do well to survive a desktop. But on the production floor or in the field, the dust, heat, vibration and traffic can finish an ordinary PC—and your operation—in a hurry. Even if your PC has to withstand hell, your business doesn’t have to. As long as you’re using ruggedized PCs from Texas Micro.

OUR PCS TAKE A BEATING FROM THE FORTUNE 100. In fact, 70 of them put Texas Micro PCs through the wringer every day, in everything from industrial applications to severe office environments.

And we don’t spare our PCs, either. During factory tests, we shake, bake and beat them like there’s no tomorrow. Because with an ordinary PC, there may be none.

OUR PCS ARE THE BEST BECAUSE THEY’RE BUILT FOR THE WORST. We design our 286, 386 and 486 systems using rugged design techniques that give them up to three times the life expectancy of other PCs.

Our passive backplane, for example, gives you instant access to plug-in CPU cards and components, reducing Mean Time To Repair to under 10 minutes.

We shock-mount the drives within our nickel-plated, all-steel chassis to withstand vibration. We implement VLSI and PAL technology to increase component reliability. And we use positive airflow filtration to reduce contamination and system heat.

STRONG SUPPORT IS OUR STRONG SUIT. We provide toll-free technical assistance and a regional network of field application engineers. We also customize PCs to meet your particular specifications.

FIND OUT WHAT OUR PCS ARE REALLY MADE OF. Call us for complete product information and specifications. Or send in the attached card.

But don’t delay. The pathway to hell is paved with good intentions.
Gain speed in your problem solving and confidence in your answers with Maple V...

3-D Tube Plot created with Maple V.

The symbolic math software for engineering, science, and education professionals.

Maple, developed at the University of Waterloo, is today's complete symbolic math package, and it's now available from MathSoft, the makers of Mathcad. Maple's comprehensive library of over 2,000 built-in functions and easy-to-use interactive environment delivers a maximum strength program in a surprisingly uncomplicated package.

- Provides power and flexibility. You won't believe that something so powerful runs on everything from supercomputers to computers with as little as 1MB of memory. And Maple's flexibility makes it easy to share files across all platforms. It's completely programmable... and Maple's user interface supports natural mathematical calculations, so you can request an infinite variety of computations and graph your output in two or three dimensions.

- Use for a wide range of applications. Maple is ideal for a wide range of applications, including helicopter blade design, VLSI design, chemistry, satellite guidance systems, econometrics, electrical engineering, and applied mathematics - to name just a few. Maple frees you from the "bookkeeping" of complex calculations and lets you concentrate on modeling and problem solving.

Call us toll-free at 800-628-4223 or use this coupon to request more information on Maple.

In Massachusetts call 617-577-1017 or fax this coupon to 617-577-8829.

[ ] Yes! Tell me more about Maple.
Name___________________________
Title____________________________
Company or institution______________
Address___________________________
City ____________________________ State __ Zip ___________
Phone ( ) ____________________________

Mail this coupon to: MathSoft, Inc.
201 Broadway
Cambridge, MA 02139
USA

Circle 242 on Inquiry Card.

Adding Sound to Presentations

Audio Boards

AudioMaster
Omni Labs' AudioMaster is the first board we've seen that adheres to the Media Master Sound Standard developed by Ensoniq (a maker of professional keyboards and musical equipment) to create synthesized music. The Media Master Sound Standard uses a 68008 microprocessor and on-board instrument RAM.

The AudioMaster board uses downloadable wave tables, or short recordings of sounds (e.g., those made by real instruments), as the basis for its synthesis. Not all of the AudioMaster's instruments were sampled from the real thing—Omni Labs took some shortcuts to conserve wave table memory. But those that were sampled (e.g., drums and piano) sounded authentic enough. The board delivers 24-voice polyphony. The fact that the wave tables reside in RAM means that they can be changed. The AudioMaster board that we tested had no provision for downloading new instruments.

The AudioMaster's digital audio section supports a maximum 44.1-kHz sample rate, with a resolution of 12 bits. Twelve-bit audio is a very noticeable step up from 8-bit. However, 60 seconds of 12-bit audio take up as much disk space as 60 seconds of 16-bit audio.

The AudioMaster is limited to mono digitizing, regardless of the sample rate. We don't think that's too limiting (mono recording is a good way to keep files to a reasonable size), but it's certainly a valid point of comparison.

Omni Labs' board comes bundled with a useful selection of software split between DOS (Voyetra's Sequencer Plus Jr. and PG Music's Band in a Box) and Windows (Voyetra's WinDAT digital audio recorder/editor, First Byte's Monologue speech synthesis, and a program for playing audio CDs). The board's software is all installed through an automated program that first checks its ability to communicate with the hardware.

The board's overall quality is good. There is a nondefeatable automatic level control on the digitizing input, which flattens the dynamics of files recorded with it. The digitized audio carries some audible high-frequency noise, and the synthesizer output suffers from noticeable hiss when you hear it played through good headphones or speakers.

Still, we think that the AudioMaster's mostly great-sounding instruments with hiss are preferable to FM synthesizers, no matter how clean. As an inexpensive step up from an 8-bit FM synthesizer-based sound board, the AudioMaster, at $299, is a good choice.

MultiSound
For $599, Turtle Beach Systems' MultiSound board delivers uncompromising quality for both digital audio and synthesized music. The MultiSound's digital audio is among the best: 16-bit stereo at 44.1 kHZ. It is a fully MPC-compatible board that can play audio files created elsewhere, and it's capable of recording audio for playback on non-16-bit boards. While the MultiSound's sound is costly in terms of disk space (176.4 KBps of digitized audio), the quality is out of this world. We haven't found a PC board that sounds better than MultiSound.

Music synthesis on the MultiSound is handled by an E-mu Proteus chip, which can produce 32 simultaneous voices from a ROM-based selection of instruments. The chip specializes in realistic-sounding acoustic instruments; its piano, strings, and ensemble horns are very impressive, and the drum sounds are clean, realistic, and hard-hitting.

Compared to other MPC-compatible boards, the MultiSound is sparse on options; except for software (e.g., a Proteus patch librarian and the Wave digital audio editor reviewed elsewhere in this article), there are no available add-ons. The board does have a nine-pin connector for hooking up a MIDI cable, but you can't get Sound Blaster compatibility or a CD-ROM controller. The back panel is simple: 1/4-inch stereo input and output jacks and a recording-volume control knob. Standard software includes a Windows mixer, a diagnostic tool, and a front-panel emulator that lets you adjust the Proteus chip's settings as though you were using a stand-alone MIDI box.

Some might worry that the E-mu Proteus synthesizer chip isn't part of some widely implemented emerging standard, like the Roland GS chip. Standards aren't quite as important here, however, since Windows' MIDI Mapper tends to iron out the differences in instrument assignments between synthesizers. As long as the overall quality of sound is still suitable for professional use (which the MultiSound's E-mu is), adherence to a standard other than General MIDI isn't all that important.

The combination of superclean digital audio with the stunning Proteus synthesizer makes the MultiSound the perfect choice for demanding professional applications. At its newly reduced price, it's an excellent deal.
Fault-Tolerant File Servers, Fast as 5.5 ms

Today's network managers face more mission-critical data residing on individual servers. MicroNet knows you need cost-effective storage solutions offering the ultimate in performance plus protection.

We've engineered our storage systems, featuring Seagate high performance drives, to optimize the built-in features of NetWare. By spanning multiple Elite-2 hard disc drives, and multiple host adapters, access times drop as low as 5.5 ms and sustained data transfers climb to an astonishing 12 MB/sec.

But there is another side to the story. Your data needs protection. If a server goes down, rapid data recovery is essential. Mirroring the hard disc system creates an on-line duplicate of the data, should anything go wrong with the primary drive. If a fault occurs with the CPU, the complete drive chain can be moved to an ISA, EISA, or MCA workstation using a MicroNet host adapter to create an instant file server!

MicroNet systems offer full protection all the way to the controller card level. Our NetWare device drivers allow a disc drive to be changed on-the-fly. And we offer these features without being locked into a proprietary software or hardware system.

Protection while minimizing down-time is one side of the story. Productivity is the other. By utilizing a MicroNet high performance storage solution, you get performance plus protection. Call MicroNet today for more information. 1-714-581-1540.

Performance Plus Protection, Without Compromise.

MicroNet Technology, Inc.

20 MASON • IRVINE, CA 92718 • TEL: (714) 837-6033 • FAX: (714) 837-1164
AppleLink: MICRONET.SLS • Compuserve: 76004,16111

Seagate and the Seagate logo are registered trademarks, and Elite is a trademark of Seagate Technology, Inc. All other trademarks are property of their respective owners.

Circle 116 on Inqury Card (RESELLERS: 117).
Pro Audio Spectrum 16

This is the best PC sound board in its price range. The $299 board from Media Vision mixes top-quality digital audio (44.1 kHz, in stereo, in 16 bits) with a fitting array of standard software.

Installation is easy, with all the board’s options being software-programmable. It has the widest range of IRQ and DMA settings of all the boards tested. A DOS installation program configures and tests the board (and can be used to reconfigure it later). The DOS installation launches Windows, loads the Windows drivers, and creates a program group for all the Windows applications.

A pair of programs, Pocket Recorder and Pocket Mixer, provide quick access to digital audio recording and playback and input-source mixing (see the screen above). Pocket Recorder is just right for a lot of quick digital audio work, and it’s a big improvement over the standard Windows Sound Recorder. Pocket Recorder won’t let you do cut-and-paste editing, but it does let you record in stereo and set the recording rate and resolution. Pocket Mixer is a compact, attractively presented control panel from which you set the volume, bass, treble, and balance for each of the Pro Audio Spectrum 16’s inputs. You can then save your settings in a file and reload them later.

Media Vision also includes a more capable mixer, through which you can select which audio inputs will be recorded, view sound levels, and switch in loudness and stereo-enhancement filters (the latter fattens the sound with a nice delay effect).

The Pro Audio Spectrum 16 sounds great. Audio digitized at the 44.1-kHz rate and 16-bit resolution plays cleanly, although some hiss becomes evident if you turn the board’s master volume too high. Even quiet digitized musical passages, played through a sensitive amplifier or professional headphones, come through clearly. For a business presentation, the Pro Audio Spectrum 16’s digital audio reproduction is impressive, although it’s not as good as that of the higher-priced MultiSound.

SCC-1 GS

Roland’s $499 SCC-1 GS is a board-level version of the company’s knockout Sound Canvas external MIDI synthesizer module. Like the Sound Canvas box, the SCC-1 uses Roland’s PCM technology to bring up to 24 simultaneous voices (some instruments use up to two voices) of wonderfully clean music to PCs. What is true of the SCC-1 is also true of the external Sound Canvas module.

The SCC-1’s sounds (like those produced by the Proteus chip on the MultiSound) are based on pulse-code modulation, so they are clean and realistic. The acoustic instruments are supplemented with a solid selection of obviously synthetic sounds that provide dreamy backgrounds and rocking leads. In fact, the only thing that places this board a bit behind the MultiSound is the limit on the number of voices. Some of the board’s richer sounds, including orchestral sounds and synthesized pads (both used heavily in presentations), use two voices for each note played, cutting the number of simultaneous voices to as few as 12. This might leave you scrambling to find a way to orchestrate your music using as few two-voice sounds as possible. That shouldn’t be hard; for most two-voice sounds, there are suitable one-voice alternatives, and staple instruments (e.g., acoustic piano and drums) are done with one voice.

Polyphony limits aside, the SCC-1’s sound is very clean and professional, realistic when it needs to be, and worthy of inclusion in your most important presentations. The on-board effects give the SCC-1 a slight edge over other synthesizer boards. The effects are simple—chorus and reverberation—but they can have a dramatic impact on the perceived quality of your music.

This board is MID-only; it has no digital audio or CD-ROM controller capabilities. In a typical Windows setup, you must route the output of the SCC-1 to the auxiliary input of your digital audio board and use the board’s mixer application to bring the SCC-1’s signal through.

You can use the SCC-1 to replace the FM synthesizer included on so many Windows sound boards. The improvement in quality is significant.

SoundStudio

Cardinal Technologies’ $269 SoundStudio was the most difficult of the tested boards to configure and install, and it produced what our ears judged to be the poorest-quality sound. The board itself is loaded with settings; nothing is software-configured. Software installation is straightforward, but if the board’s factory-supplied settings aren’t right, expect to have some trouble, both with the poor documentation and the necessary yank-adjust-replace-test cycle. To its credit, the SoundStudio comes with MIDI cables and drivers for the onboard SCSI CD-ROM controller; these are typically options with other boards.

SoundStudio’s software bundle is supplied entirely (except for the SCSI driver) by Voyetra, and the Windows software includes only the WinDAT digital audio editor, a “jukebox” MIDI/audio-file player, and a mixer. The board is capable of recording in stereo at 44.1 kHz (with a resolution of 12 bits), but the supplied WinDAT was only willing to record up to 22 kHz. Wave for Windows drove the board at its highest rate, but regardless of the rate, the quality of the digital audio output was poor. Even though the board passed the CD’s line input through to the speakers cleanly, both 22- and 44.1-kHz recordings were distorted and scratchy. We tried several board adjustments, only to find that some settings locked up our
Sound Blaster Book
This book is your guide to the Sound Blaster, from installation to custom programming. It includes an overview of the different Sound Blaster boards, many specific software products and much more. Also includes simple MIDI system to use with your Sound Blaster.
#B164. ISBN 1-55755-164-2. $34.95 with 3½" companion diskette.

Windows 3.1 Complete
Learn to optimize & customize Windows 3.1.
- Improve your productivity with built-in Windows applications
- Includes dozens of useful tips and techniques
- Includes two valuable Windows utilities: Backup & SnapShot

Windows 3.1 Intern
Introduces the reader to the overall concept of Windows programming and events using dozens of easy-to-follow examples. It's a solid guide for beginners to intermediate Windows programmers who need to know more, faster.
#B159. ISBN 1-55755-159-6. $49.95 with 3½" companion diskette. 1200+ pages.

OS/2 2.0 Complete
From installation and overview, to mastering the Presentation Manager, you'll learn how to take full advantage of this new operating environment.

Stepping Up To OS/2 2.0
The upgrader's guide to learning OS/2 in a hurry.

The 486 Book
Explains the features that make this processor so advantageous - the memory capabilities, the math coprocessor, the specialized software that maximizes the CPU's performance and more. PC INFO program on companion diskette.
#B155. ISBN 1-55755-155-3. $34.95 with 3½" companion diskette. 420 pages.

Windows Intern 3.1
Introduces the reader to the overall concept of Windows programming and events using dozens of easy-to-follow examples. It's a solid guide for beginners to intermediate Windows programmers who need to know more, faster.
#B159. ISBN 1-55755-159-6. $49.95 with 3½" companion diskette. 1200+ pages.

Turbo C++ Step by Step
Teaches you step by step C++, the language of choice among professional developers.
- The lessons are designed to be short, progressive and to the point, so you can learn quickly.
- #B156. ISBN 1-55755-156-1. $34.95 with 3½" companion diskette. 390 pages.

Turbo Pascal for Windows
Introduction to the standard elements of Turbo Pascal.
- Development of the WinCrt, WinDOS and Win32 units
- Comprehensive coverage of the Object Oriented Programming (OOP) features

PC Intern
The encyclopedia of DOS programming know-how for the professional programmer. Includes parallel working examples in Turbo Pascal, C, BASIC and assembly language.
- DOS and BIOS internal structures and functions
- Programming video cards, sound, TSSs

PC Assembly Language Step by Step
Teaches you machine language from the ground up, at your own pace. Learn assembly language using the unique assembly language simulator which shows how each instruction functions as the PC executes it. You'll get hands-on training with this exceptional book/disk combination.
#B096. ISBN 1-55755-096-4. $34.95 with two 5½" companion diskettes.

The 486 Book
Explains the features that make this processor so advantageous - the memory capabilities, the math coprocessor, the specialized software that maximizes the CPU's performance and more. PC INFO program on companion diskette.
#B155. ISBN 1-55755-155-3. $34.95 with 3½" companion diskette. 420 pages.

Turbo C++ Step by Step
Teaches you step by step C++, the language of choice among professional developers.
- The lessons are designed to be short, progressive and to the point, so you can learn quickly.
- #B156. ISBN 1-55755-156-1. $34.95 with 3½" companion diskette. 390 pages.

Turbo Pascal for Windows
Introduction to the standard elements of Turbo Pascal.
- Development of the WinCrt, WinDOS and Win32 units
- Comprehensive coverage of the Object Oriented Programming (OOP) features

PC Intern
The encyclopedia of DOS programming know-how for the professional programmer. Includes parallel working examples in Turbo Pascal, C, BASIC and assembly language.
- DOS and BIOS internal structures and functions
- Programming video cards, sound, TSSs

PC Assembly Language Step by Step
Teaches you machine language from the ground up, at your own pace. Learn assembly language using the unique assembly language simulator which shows how each instruction functions as the PC executes it. You'll get hands-on training with this exceptional book/disk combination.
#B096. ISBN 1-55755-096-4. $34.95 with two 5½" companion diskettes.

For fast delivery Order Toll Free 1-800-451-4319 ext. 212, or FAX (616) 698-0325
Or mail this coupon to: Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512
Method of Payment: □ Visa □ Master Card □ Am.Express □ Check □ M.O.
Card#:__________________________ Exp:__________________________
Name:__________________________
Company:_______________________
Address:________________________
City:_________________________ State:________ Zip:______________
Phone:________________________ Fax:________________________
CA & MI orders include sales tax:
In US & Canada add $5.00 shipping:
Foreign orders add $13.00 per item
Total amount (US funds):____________
☐ Yes, please rush your free catalog of PC books and software.
system with parity errors and others seemed to run but produced no sound (and no error messages).

**Audiomedia II**

Digidesign's Audiomedia II ($1295) is a DSP-based audio digitizing and playback board for the Mac (see the Sound Designer II section for bundled software). The board can plug into any Mac II–series machine with a free NuBus slot (you'll need a NuBus adapter for a Mac IIci).

The Audiomedia II is compatible with a number of digitizing and sequencer programs: Sound Designer II, Deck, Studio Vision, and Cubase, to name a few. (Sound Designer II is bundled with the Audiomedia II.)

The Audiomedia II uses a Motorola 56001 DSP (digital signal processor) running at 33 MHz, capable of inputting or outputting two 16-bit channels of 44.1- or 48-kHz audio. (The 48-kHz sample rate is used by most DAT [digital audiotape] recorders. We did all our testing at the CD speed of 44.1 kHz.) Along the board's back are six jacks: two RCA audio jacks, two stereo-input jacks, and two stereo-output jacks. The board also has connectors that let it talk directly (i.e., digitally) to DAT drives.

Installing the board is simple. There are no DIP switches, and the supplied installation floppy disk moves the drivers into their proper place in your system folder. For the most part, the board is self-configuring, and it delivers high-quality audio that sounds as if it came straight from a CD player.

**Our Favorite Sound Boards**

MultiSound is our clear choice among PC sound boards because of its combination of high-quality digital audio sound and the Proteus synthesizer chip. You can get pretty close to it, however, by pairing the Pro Audio Spectrum 16 and the Roland SCC-Audiomedia II section for bundled software). The board can plug into any Mac II–series machine with a free NuBus slot (you'll need a NuBus adapter for a Mac IIci).

The Audiomedia II is compatible with a number of digitizing and sequencer programs: Sound Designer II, Deck, Studio Vision, and Cubase, to name a few. (Sound Designer II is bundled with the Audiomedia II.)

The Audiomedia II uses a Motorola 56001 DSP (digital signal processor) running at 33 MHz, capable of inputting or outputting two 16-bit channels of 44.1- or 48-kHz audio. (The 48-kHz sample rate is used by most DAT [digital audiotape] recorders. We did all our testing at the CD speed of 44.1 kHz.) Along the board's back are six jacks: two RCA audio jacks, two stereo-input jacks, and two stereo-output jacks. The board also has connectors that let it talk directly (i.e., digitally) to DAT drives.

Installing the board is simple. There are no DIP switches, and the supplied installation floppy disk moves the drivers into their proper place in your system folder. For the most part, the board is self-configuring, and it delivers high-quality audio that sounds as if it came straight from a CD player.

**Wave for Windows**

Turtle Beach Systems, maker of the Multi-Sound audio board, also created this worthwhile digital audio editor for Windows. For some applications, Wave ($149) is overkill. It offers so many ways to alter your data and such minute control that its overhead can make big jobs almost too tedious to bear. But much of that tedium isn't Wave's fault. The huge amounts of data it had to move around considerably slowed even the Uniq 486/50 with its cached EISA SCSI controller. So take what follows with this caveat: If you're dealing with more than a few seconds of data, the results we rave about take time to produce when you're working with 16-bit 44.1-kHz audio.

Wave uses the Windows Multimedia Extensions to acquire and play digital audio files, but everything else it does is pure Wave. Well-constructed dialog boxes guide you through operations such as the blending of multiple audio files into one and translating into different file formats and resolutions. Again, some of Wave's most advanced features can take several minutes per second of audio to enact. The wait, however, is worth it.

Wave has one feature—a time compression/expand filter—that seems made expressly for presenters. To reduce a sound clip's playing time, you drag a slider until either the percentage of playback speed or your desired target playing time appears. In one case, we took a 10-second clip of 22-kHz stereo audio and cut it to 65 percent of its original playing time. Wave churned for a couple of minutes, but when it was done, the time-compressed audio was indistinguishable from that which followed it—its pitch, dynamics, and all other attributes remained identical, but the file played in less time. It was so accurately converted that we could not identify the exact place where playing speed returned to normal.

Wave successfully wraps complex transforms (essential when you're building audio for presentations) in an interface that simplifies them. Those who take the time to learn to use its less apparent riches will find Wave to be one of the most worthwhile MPC-compatible tools yet offered.

**Sound Designer II**

Digidesign's Sound Designer II is a digital audio recording, editing, and playback package for the Mac. (The company bundles it with its Audiomedia II board.) Sound Designer II deals only in digital audio tracks. You will want a MIDI driver and interface, however, since Sound Designer II's output can be transferred to virtually all the popular samplers. You will want a MIDI connection for synchronization purposes: Sound Designer II understands MTC.

Under Sound Designer II's hood you'll find a 10-band graphics equalizer, a parametric equalizer, and other features that let you improve or alter sounds. A built-in mixer lets you mix up to four sound files (mono or stereo) into a single sound file. A
We Proudly Announce SummaSketch II Plus

The world's best selling, most emulated, most acclaimed desktop tablet just got better. We've taken SummaSketch II, the industry standard, and added several new features to create a tablet that is, unquestionably, the world's best.

Unlike some competitors, we put everything in the box—4-button cursor and 2-button stylus (or 16-button cursor), interface cables and a utilities diskette with Windows® 3.0 and ADI® drivers. Plus we've added things like 2000 lines per inch resolution and 10 mil accuracy—standard. Plus the fastest, easiest set-up and configuration procedure. Plus an offer for a free AutoCAD® or CADKEY® Master Template (a $245 value). Plus software compatibility with over 400 programs, and hardware compatibility with PCs and Macintosh®. Best of all, it's still 100% pure SummaSketch— the editor's choice, winner of every major editorial accolade for graphics tablets. And the people's choice, with well over one-half million sold to demanding computer graphics professionals.

Every decision should be this easy. In fact, the only tough decision is which Plus to choose: 12" x 12" or 18" x 12" Professional. For literature, or the name of your local dealer, call 1-800-729-7866. For technical information call 203-881-5400.
SunRize for the Amiga
TOM YAGER

The AD516 audio board from SunRize Industries is a great application of DSP (digital signal processor) technology. This board, which fits in an Amiga 2000 or 3000 series, delivers up to eight independent channels of 16-bit audio, with sampling rates of up to 48 kHz. (The Audiomedia II for the Mac, by contrast, has only two channels.) It understands SMPTE time codes, allowing for precise synchronizing of audio and video.

Taking Advantage
The $1495 combination of the AD516 and Studio 16 (the software that drives it) brings you very close to having an eight-track professional recording studio in your computer. Studio 16's interface takes marvelous advantage of the Amiga's multitasking capabilities by assigning the tasks of recording, editing, and playing digital audio to individual tools that can be launched and dismissed as you need them.

Using Studio 16 feels very much like working with a multitrack audio recorder. The difference is that you can record only two tracks simultaneously. That's not a hindrance for most kinds of presentation audio work, where you most commonly bring together elements that need not be precisely synchronized (e.g., music and narration). Studio 16's interface makes that kind of project a breeze, even allowing you to digitally mix-down multiple audio tracks into a more compact single file. Studio 16's editing capabilities are limited compared to some of the Mac and PC tools reviewed in this Solutions Focus, but the essentials—fade, resample, cut, and paste—are all available.

Hear the Effects
The AD516 board can capture fresh audio at any of 14 sample rates ranging from 5.5 to 48 kHz. The board's 22-kHz setting is astonishingly good. When you pop up the dialog box for choosing the sample rate, the AD516's audio input is processed by the DSP in real time, so you can immediately hear the effects of varying rates before you commit any disk space. The 44.1-kHz setting produced music indistinguishable from the CD that I was using as input.

The total cost of an AD516 board, an Amiga, and a large SCSI hard drive represents a fraction of the cost of analog systems that deliver comparable quality and capabilities. No analog system offers you the benefits of instant random access and digital processing.

unique twist on the concept of mixing is Sound Designer II's ability to merge two sounds. This is a kind of audio equivalent to video morphing, letting you transform one sound into another in a controlled way. As you build up a collection of sounds, Sound Designer II lets you organize them into a playlist, a list of files containing your digital audio effects or snippets of music. So, for example, if you've made a single recording of a number of industrial sounds—drills whirring, hammers banging, and the like—you can seek through that track and mark the beginning and ending points of the individual tool sounds. You name these intervals of sound and use them to build your playlist, which lets you call up each element individually or in a predefined sequence. A playlist can handle most jobs that you might initially think would require cutting and pasting—and do the job faster, thanks to a smaller processor load.

You can tweak Sound Designer II to optimize its performance on your hardware. For example, you can tell it to pre-allocate space for incoming digital audio; this option creates a large contiguous file before the system begins recording, thus eliminating the operating-system overhead that would take place as the file grows during the recording process.

As you might expect, Sound Designer II's record and playback window uses the tape-deck paradigm. It was so simple to operate that we made our first recordings without cracking the manual. That's how Sound Designer is: You need the manual only when you want to explore the package's more esoteric features.

Audioshop
Opcode Systems' Audioshop is a painless digital audio recording, editing, and playback system for the Mac. As the screen above shows, the interface looks like a CD player seen head on. Its output is through the Mac speaker, and it takes its input from whatever hardware is using your Mac's sound manager. (Newer Macs include a built-in microphone port; otherwise, you use a third-party device, such as MacroMedia's MacRecorder, that plugs into one of the serial ports.)

continued
All across America, people are moving up to the power of award-winning Micrografx Designer®

Designer is the only illustration software declared “1991 Product of the Year” by InfoWorld. The only illustration software named “Editor’s Choice” by PC Magazine for three straight years. The only illustration software to rate a perfect five stars from Software Digest.

That’s because Designer delivers an unbeatable combination of precision drawing power and ease-of-use. With features like multiple layers, dimensioning, full-color, full-screen editing, and built-in type-handling software plus 180 Type 1 fonts worth over $5,000!

“New text, blend and color features combine to keep Designer competitive in a fast-moving field. This precise, tool-rich drawing package has its roots in CAD, but it attracts other graphics users as well.”

Move up to Designer now and get 70% off!
If you use Corel Draw 2.0 or Arts & Letters, call us with your serial number and we’ll upgrade you to Micrografx Designer for only $199 (regularly $695) plus $10 shipping and handling. If you’re not blown away by how much more you can do with Micrografx Designer, return it for a full refund.* This is a limited-time offer, so act now!

Why settle for a product of the past when the future of PC illustration is Micrografx Designer? Call today to order or request a free working model!

30-day money-back guarantee!
1-800-998-1981

MICROGRAFX®

*Shipping & handling charge not refundable. Other restrictions may apply. Please call customer service for return authorization number. Micrografx reserves the right to cancel or amend the above offer at any time.


All rights reserved. Micrografx is a registered trademark and Micrografx Designer is a trademark of Micrografx, Inc. All other products are trademarks of their respective owners.

Designer system requirements: 286 IBM recommended; IBM PC or compatible; 3MB, 1 MB RAM & 2 MB RAM recommended; 20 MB (or larger) hard disk; Windows 3.0, DOS 3.1 (or higher).

Mouse or digitizing pad. Window-compatible monitor.

Circle 115 on Inquiry Card.
COMPARISON OF SEQUENCERS

The major difference among these sequencers is whether they can handle digital audio files. (● = yes; ○ = no; N/A = not applicable.)

<table>
<thead>
<tr>
<th></th>
<th>Macintosh</th>
<th>Amiga</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cubase</td>
<td>Deck</td>
</tr>
<tr>
<td></td>
<td>Steinberg</td>
<td>Digidesign</td>
</tr>
<tr>
<td></td>
<td>Jones</td>
<td>Passport Designs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Opcode Systems</td>
</tr>
<tr>
<td></td>
<td>384</td>
<td>384</td>
</tr>
<tr>
<td>MIDI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum pulses per quarternote</td>
<td>Q &amp; H</td>
<td>Q &amp; H</td>
</tr>
<tr>
<td>Quantize/humanize</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Graphical edit of continuous data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Audio</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Maximum number of audio tracks</td>
<td>Unlimited²</td>
<td>4</td>
</tr>
<tr>
<td>Normalizing</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Noise gating</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Equalizing</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>SD2, STDM</td>
<td>AIFF, SD2, STDM</td>
</tr>
<tr>
<td>Import formats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export formats</td>
<td>SD2, STDM</td>
<td>AIFF, SD2, STDM</td>
</tr>
<tr>
<td>Notation display</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Multiple tempo settings</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Mix-down automation</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Synchronization</td>
<td>MC, MTC</td>
<td></td>
</tr>
<tr>
<td>Audio file compresion</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Most significant features</td>
<td>True real-time operation; nondestructive quantize</td>
<td>Track bouncing</td>
</tr>
<tr>
<td>Price</td>
<td>$299</td>
<td>$349</td>
</tr>
</tbody>
</table>

1 Studio Vision uses sequences and tracks; 96 tracks per sequence.
2 With Cubase Audio add-on.

Like Sound Designer II, Audioshop builds playlists, assigning each element of a playlist a track number. You call up a particular track via the keypad on the Audioshop front panel. Pressing the playlist button reveals a scrollable window of playlist items. You simply double-click on an item name to open the waveform editing window. From here, you are able to perform all your cutting, pasting, and other digital audio magic, as well as manipulate special effects such as echo, reverb, and flanging.

When you are done editing, you can save tracks in a number of formats, including AIFF (Audio Interchange File Format—simply put, a format that specifies how to store digital audio), as a sound resource, or for use in programs such as Macromind Director.

Audioshop ($89.95) comes with two disks of sampled sounds. One is a collection of 25 sound effects—all quite good—and four or five musical passages—all mediocre.

SEQUENCERS

Studio Vision

Opcode Systems' Studio Vision for the Mac ($995) is a digital audio and MIDI sequencer that runs atop OMS (Opcode MIDI System), an elaborate MIDI manager that can recognize various MIDI interfaces. Applications that are "OMS-aware" can request OMS to describe the current MIDI arrangement and thereby configure themselves.

Most sequencers store information on tracks, in keeping with the analogy to tracks on tape decks. Not so with Studio Vision. Instead, you build up a composition as a collection of sequences. The program allows up to 26 sequences, but within each sequence is a virtually unlimited number of subsequences. You determine your composition's overall form by telling Studio Vision the order in which to play the sequences. This naturally moves you in the direction of building phrases that you connect to form the complete piece.

Studio Vision's mix-down features allow up to 32 faders, each of which you can set to send to a MIDI controller (e.g., velocity) on a selected instrument. If you move a fader while you're recording, Studio Vision repeats that movement on playback. Also, if you want to control Studio Vision's faders during a live presentation, you can program them to be driven by an external MIDI device. You can also associate a Studio Vision command with an event sent from a MIDI device (e.g., the topmost F# on your keyboard can trigger Studio Vision to begin playing a sequence).

Studio Vision's combination of digital audio and MIDI data made it our Mac favorite. Other packages (see below) have similar capabilities, but Studio Vision made it easy to get as deep into both audio and MIDI data as we wanted. It's a marvelously complete package.
Cubase
Cubase from Steinberg Jones is a $299 Mac sequencer that distinguishes among various “track” types: MIDI tracks, drum tracks, group tracks, mix tracks, and tape tracks. If you add Cubase Audio—a module that you “plug into” the basic Cubase—the system can handle audio tracks. Although drum tracks internally carry the same kind of data as MIDI tracks, drum tracks are treated differently because MIDI systems can assign different drum sounds to different notes; it would get confusing if you had to remember which key was your cymbal and which key was your snare drum. Group tracks let you collect tracks together that represent, for example, your string section, and operate on the group as a unit.

Cubase lets you examine your music in standard music notation form through the Score Edit window. There are options for fine-tuning what you see in the notation window. For example, you have to tell it what key the music is in. The results are often bizarre, but remember, the poor thing is trying to ascertain the nuances expressed in music notation from raw MIDI data.

One of the package’s more interesting editing capabilities lets you perform logical operations on tracks of MIDI data. You tell it something like “for all notes below middle C, add +1 to their velocity”; it’s not unlike group operations you might perform on a database. This makes what would otherwise be difficult editing easy, as well as allowing for the creation...
of musical effects that would be tedious to duplicate.

Cubase supports most audio-editing capabilities, such as cutting and pasting and modulating tempo and volume. The audio editor window’s magnification controls are blessedly easy to operate.

Cubase is a good choice for synchronizing audio and video because the program can output MTC, MIDI clocks, and pure SMPTE time code. Steinberg Jones also offers a Windows version.

**Deck**

Developed by OSC Products and sold by Digidesign (maker of the Audiomedia II board), Deck for the Mac ($349) takes the model of the simulated tape deck to an extreme. When you launch Deck, you are presented with a screen-size image of a four-track tape deck complete with faders, push buttons, bar-graph meters, and transport buttons. Actually, Deck is more than just a four-track system; there are four audio tracks, but the program can handle up to 32 MIDI tracks as well.

Although Deck doesn’t let you dig into the actual data on a track (there are no waveform displays, piano rolls, or MIDI data list displays), you can perform filtering, effects, and editing operations on both MIDI and audio data. If your audio data has become noisy or has incurred a 60-Hz hum, you can unleash Deck’s noise gate or hum-removal signal processing on the data. Many of the audio effects are available to Deck only if you are running it with the Audiomedia II.

Deck’s MIDI-editing window lets you merge tracks (the MIDI equivalent of mixing two audio tracks together). You can also filter specified MIDI events or delete all MIDI events associated with a specified channel within a track.

Deck’s automated mix-down capabilities are especially well done. Essentially, you build a collection of up to eight mixer states; a state is a particular arrangement of all the controls on the display. You can call up a state by pressing one of the state buttons at the bottom of the display. You then play your session, pressing state buttons as you listen to the playback. The next time you play back your session, Deck recalls the states for you at precisely the times you selected them.

**Master Tracks Pro 5**

MTP5 is Passport Designs’ no-nonsense MIDI sequencer for the Mac. (The PC version is discussed below.) MTP5 ($495) is strictly MIDI, and although it has no digital audio component, it’s no product to look down your nose at.

MTP5 handles MIDI data display and editing via a modified piano-roll display, but that’s not your only way to modify data. The program has an impressive set of filters that let you target specific kinds of MIDI events for editing. For example, one change filter lets you raise the velocity of every third beat in a four-beat measure.

You can edit continuous data by simply drawing and erasing waveforms in one of the controller windows. If your continuous data becomes too dense (e.g., your composition is sending so many pitch-bending commands that it’s overwhelming the MIDI port), MTP5 lets you “thin” the controller commands. This has the effect of sending fewer control-change commands. Of course, this also produces a coarser resolution (in our pitch-bending example, the pitch would change in possibly audible jumps), but MTP5 lets you tweak the thinning to strike a balance between MIDI traffic and sound quality.

All in all, this is a fine product. Its designers have had time enough to work out the kinks and perfect its user interface.

---

*continued*
A chain is as strong as it’s weakest link.

Picture your Hardlock™ key as a bike lock, and the accompanying software routines used to implement the copy protection as the chain. You can own the best lock that money can buy, but that lock is useless if the chain is weak.

Introducing HL-CRYPT, a major breakthrough in copy protection. HL-CRYPT is not just a shell or simple conditional response checker. Using our proprietary Patcher Technology, HL-CRYPT is a one path security compiler protection linker that encrypts and binds the application to your Hardlock™ device. HL-CRYPT features an end-user selectable modular protection technique that secures the application against piracy, reverse engineering, debugging, and more.

Picture HL-CRYPT as an ironclad chain. The only ironclad chain in the industry today.

For more information, call 1-800-562-2543
MASTER TRACKS PRO 4 FOR WINDOWS

MTP4’s standard screen—a track-editor window split between a graphical score and a track-parameter area—puts more useful information in your face than any other sequencer we have seen. Volume, MIDI channel, instrument (program) number, track play/record status, and measure-by-measure activity indicators all appear in one window. This effective use of limited screen space is one thing that sets Passport Designs’ MTP4 apart. Its long, impressive list of capabilities distinguishes it as well.

MTP4’s multitrack mode will record multiple MIDI channels simultaneously. This is useful for transferring data from an external sequencer. MTP4 lets you very easily move the data around, copying, cutting, pasting, or inserting as little as a beat’s worth of music to any track.

If you want more detail, pop up the step editor, which shows either note data alone or all MIDI data as bars whose length and position reflect the pitch and duration of every note in your score. If you want still more detail, you can pop up a MIDI event editor. This shows every aspect of every MIDI event, including the key-down, key-up, and aftertouch velocities. You can edit any piece of data in the event editor.

A special record mode lets you alter a track’s volume while it plays, interleaving those volume changes with the track data. MTP4 remembers where and when you moved them, creating a fully automated mix. Another notable feature is “humanization,” which randomizes a note’s starting time, duration, and velocity to give computer-generated music a less mechanical feel.

MTP4 ($395) is the best Windows sequencer for making changes to canned MIDI music and for packaging original MIDI sequences into well-orchestrated sound tracks. You needn’t be a musician or a producer to run it, but the closer you are to one of these, the more you’ll get out of MTP4.

Cakewalk has a nicely done staff sheet, but the values are hard-to-read columns of unadorned text. But the score window sometimes appears without a vertical scroll bar, forcing you to grow the window to see even one staff. Similarly, when the MIDI event editor first appears, it comes up in a window without a title bar; there is no system-menu icon and no cancel button, and hence no obvious way to dismiss it. As it turns out, the title bar and system menu appear when you resize the window. These are only two examples of how Cakewalk’s interface gets in the way of even simple tasks.

To its credit, Cakewalk’s score view is notable. Its functionality is limited, but you can edit notes. For those who can sight-read, the score view is extremely valuable. You would not use it to build a song from scratch, but as a proofreading and simple editing tool, the score view adds considerably to the value of Cakewalk. Despite its sometimes awkward interface, Cakewalk proved reliable and capable enough.

CADENZA FOR WINDOWS

Big Noise Software’s Cadenza ($299.95) is a bit less capable than MTP4, but it’s distinguished in its own right for being capable and compact. The interface is manageable and unpretentious, and it places in your hands most of the tools you need to mold a MIDI song to your liking.

The track view lacks program names and presents its data in raw and somewhat hard-to-read columns of unadorned text. But the values are editable, each responding to a double-click of the mouse with a dialog box that presents the valid options for change. You can drag down a column of entries and change them all at once—a real time-saver for the wholesale changes involved in a reorchestration session.

continued
When your reputation's at stake...

We know how much work you put into building your product. Why use inferior tools that often create more problems than they solve? With a Phar Lap DOS-Extender, you know you're getting industry-leading, market-tested tools that have worked reliably for thousands of developers. Other DOS extenders simply can't measure up. Let Phar Lap show you what a DOS extender should be.

**Build multi-megabyte DOS programs with Phar Lap's DOS-Extenders!**

**286 DOS-Extender™** - it's never been so easy! With our 286DOS-Extender and your Microsoft C/C++, Borland C++ or Microsoft Fortran Compiler, you've got all the tools you'll need to quickly and easily build multi-megabyte protected-mode applications — often by simply relinking without making source code changes. Now you can build protected mode applications that access up to 16 megabytes of memory on any DOS-based 80286, 386, 386SX, or i486 PC — without changing development tools! 286DOS-Extender is also compatible with both Borland's Turbo Debugger and Microsoft's linker and CodeView debugger.

**386 DOS-Extender™** — the ultimate in 32-bit power. 386DOS-Extender turns DOS into a true 32-bit operating system with a flat, 32-bit address space. Your program can access all the memory available in the machine — up to 4 gigabytes! 386DOS-Extender runs on any DOS-based 80386, 386SX, or i486 PC, and has been used in over 800 applications, including AutoCAD 386 and IBM's Interleaf Publisher. It is backed by a full complement of 32-bit languages, including C, C++, Fortran, Pascal, Ada and Assembler. With true 32-bit performance, you can finally build workstation-class applications for the PC.


**Attention Windows NT Developers:**

Run Microsoft's 32-bit NT tools under DOS with Phar Lap's QuickStart™! Call today for your FREE copy! 617-661-1510

**Phar Lap Software: Chosen 10 to 1 over all other DOS extenders. Here's why:**

<table>
<thead>
<tr>
<th>Phar Lap DOS-Extender</th>
<th>Vendor A</th>
<th>Vendor B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maturity</td>
<td>Over 5 years and 1000 applications</td>
<td>Less than a year</td>
</tr>
<tr>
<td>Memory Model</td>
<td>Safe</td>
<td>Dangerous</td>
</tr>
<tr>
<td>Compatibility</td>
<td>INT 15, XMS, VCPI, DPMI</td>
<td>XMS, DPMI</td>
</tr>
<tr>
<td>Library Support</td>
<td>Extensive list of 32-bit libraries</td>
<td>Limited library support</td>
</tr>
<tr>
<td>Documentation</td>
<td>Extensive and detailed</td>
<td>Limited</td>
</tr>
</tbody>
</table>

**640K DOS Barrier**

Shatter the 640K barrier and build multi-megabyte DOS applications.

**Overlay Linkers**

No more suffering with overlays or EMS.

**Unsafe Memory Models**

Other DOS extenders can let common programming errors cause system crashes.

Phar Lap Software, Inc.
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

Circle 134 on Inquiry Card.
The Advantages of Sequencers

The first computer-based sequencers were MIDI-only. Now, thanks to large, fast hard drives coupled with large memory capacities and powerful CPUs, a new generation of sequencers can handle MIDI and audio tracks. Here are a few of the many benefits sequencers give to people developing presentations:

- A sequencer package’s simulated tape deck suffers from none of the disadvantages of a real tape deck. There is no tape hiss; you can rewind instantaneously; you can replay, erase, and rerecord indefinitely with no degradation to the medium; and you can position the tape precisely where you want it and overdub with microscopic accuracy. In short, all the problems associated with moving parts, friction, and analog electronics are pretty much gone.

- With sequencers that can handle digital audio as well as MIDI tracks, you can now record voice along with your musical production, and the voice will be in synchronization with the MIDI data. There’s no need for an external tape deck. If you’re carrying hardware to a presentation, that’s one less box you have to worry about.

- You can build up a library of sound effects. Suppose you’re doing a presentation and want the sound of an explosion to usher in a critical frame in your visual sequence. You can just pull the sound from the proper subdirectory and punch it into an audio track right where you need it.

- Most sequencers provide graphical editing of the audio data, so they’re relatively easy to use. Tape splicing becomes a cut-and-paste operation. And you can undo many editing mistakes as if you were working in a word processor—operations that a real tape deck simply can’t handle.

- Many sequencers provide automated mix-down. In its simplest form, this means that you can program faders (volume controls) for each track so that, at playback time, the faders move according to your preprogrammed sequence. For a 32-track system, it’s like having 32 robot hands on each of the volume knobs, making one instrument louder in the beginning, another one softer to the end, and so on. This puts recording-studio sophistication into the reach of small TV and radio stations, company PR departments, and others.

Many elements in Cadenza bear similarities to elements in MTP4, from the “one block per beat” song editor to the bar-oriented note editor (see the screen). The resolution of the note editor proved insufficient at times, with very brief notes refusing to respond to any mouse action but a lengthening of their duration. Notes in the note editor play when you move them but not when you click on them.

Control changes can be made not only in the event editor, but also in editors in which you draw curves to represent the control’s setting over time. Volume, velocity, aftertouch—any MIDI controller can be set in this way. We found the mechanism flawed, however. When we used the control editor to fade a drum track in through increasing velocities, it imposed velocity changes on portions of the track that should have remained unaffected. Cadenza will undo your most recent change on request, and that returned the music score to its original state, but we were not able to make the desired change.

In another test, we tried applying the humanizing filter to a selected block of MIDI data. Although we used very modest randomizing values, several notes simply vanished from the score. We liked Cadenza—it’s a good, basic MIDI sequencer—but the problems we encountered forced us to give it lower marks than other contenders.

Bars&Pipes Professional
Blue Ribbon SoundWorks’ sequencer for the Commodore Amiga, Bars&Pipes Professional ($379), is among the best available. The program’s interface relies on the elements that make up its name. The bars represent musical notes and their durations; the pipes are the virtual conduits through which MIDI track data flows. The theory and Bars&Pipes’ implementation of it add up to a compelling program.

Called tools, Bars&Pipes’ filters are represented by icons you drag into position in either the inflow or outflow pipes. They lock into position and modify the MIDI data flowing through them. One tool transposes MIDI notes, and another creates complex counterpoint melodies. One of the remarkable aspects of Bars&Pipes’ tools is that they all work in real time.

Bars&Pipes places an incredible number of resources in the hands of those creating production music. Reorchestration by changing instrument assignments is easy, but Bars&Pipes also lets you create counterpoint and harmony, arpeggiate chords, and filter out notes that fall outside a specified key. Normally, the tools don’t affect the score; they operate on MIDI data after it comes in from an external source, before it flows out through the Amiga’s serial port, or both. You can, however, apply any tool to a track or part of a track to permanently alter the track’s data. You can save the altered result as an ordinary MIDI file.

Bars&Pipes’ mostly graphical approach to sequencing makes this program perfect for those unfamiliar with MIDI. If you have no preconceived notions of how sequencers should behave, learning will go smoothly. But the graphical approach also makes editing individual MIDI events harder than necessary by making it an exclusively point-and-click affair. If you plan to work with presentation music, even a low-end Amiga paired with this program gives you all the power you need.

Our Favorite Sequencers
On the PC running Windows, Master Tracks Pro 4 is the best sequencer for
These are typical AutoCAD drawings.

Even the most technical AutoCAD® drawings become dangerously seductive with Autodesk® 3D Studio® Release 2. 3D Studio software seamlessly imports your AutoCAD DXF™ files and turns them into captivating presentations. You can add photorealistic textures, reflections, light and shadows. Or effortlessly change perspective. It’s also easy to add motion, for detailed product demonstrations, architectural walk-throughs or fly-bys. Can such a revolutionary creative tool be mastered easily by AutoCAD users? Of course: 3D Studio is made by Autodesk, the makers of AutoCAD. It even comes with a free CD-ROM packed with 500 megabytes of backgrounds, textures, and 3D objects. So you can get up to speed quickly. Want proof? For $9.95* we’ll send you an eye-opening video that shows how 3D Studio helps you sell your best work. Or we’ll send you more information, free. Just call 1-800-879-4233, ext. 221. Outside U.S. and Canada, fax 415-491-8303.


Circle 68 on Inquiry Card.
making changes to canned MIDI music and for assembling original MIDI sequences into a presentation soundtrack.

If you’re a Mac user working only with MIDI files, Master Tracks Pro 5 is as solid as a rock. If all you’re after is capturing digital sound effects for playback during an application program on your Mac, Audioshop is easy to handle and provides plenty of special effects. Music professionals who need digital audio plus MIDI, but who aren’t enthralled with personal computers, will likely feel most comfortable with Deck. However, for a package that lets you get down into the data—MIDI and digital audio—Studio Vision is our favorite.

On the Amiga, Bars & Pipes Professional gets our vote as the top sequencer.

**Encore**

At the heart of Passport Designs’ notation editor is a desktop publishing system for music. If printed sheet music is your objective, Encore ($595) is a fine way to get it. The software can convert MIDI data to notation and notation to MIDI data. One of the slickest uses for a program like this is to transcribe orchestral scores and turn them into lush, multitrack MIDI sequences. Encore lets you do that, but it’s not as good at it as we had hoped it would be.

Encore uses Adobe Type Manager and Adobe’s Sonata music font to display and print beautifully drawn notes and symbols. That’s where Encore excels: It produces gorgeous sheet music from original compositions, copied scores, and MIDI files. Where it falls short is in its ability to translate what appears on the page to MIDI data.

Getting notes onto Encore’s electronic staff is easy. You can either drag them from a note palette (shown in the screen above) or use the keyboard to select note durations. As you place a note, it plays through whatever MIDI device you’ve configured under Windows. Encore automatically beams notes together according to beat, and it lets you create as many staves as you like in as many different configurations as you like.

Once you get the notes down, Encore lets you add lyrics and graphical elements like dynamics, crescendos, slurs, and pedal marks. Unfortunately, Encore ignores these elements when it plays your MIDI score. You do have control over most of those things, either by setting playback attributes in Encore or (more easily) changing them in another sequencer. The problem, however, is that you have to do everything but the notes twice: once to get the score right on the screen, and again to make the MIDI playback match the display’s representation.

That makes Encore a poor choice for turning printed scores into presentation music. It is skilled at turning MIDI data into great-looking notation, and it gives you a fine set of publishing tools.

---

Tom Yager is director of the BYTE Multimedia Lab and author of the Multimedia Producer’s Handbook (Academic Press, forthcoming). You can contact him on BIX as “tyager” or on the Internet at tyager@bytepb.byte.com. Rick Grehan is technical director of the BYTE Lab. You can reach him on BIX as “rick_g.”

---

**COMPANY INFORMATION**

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Address</th>
<th>Phone</th>
<th>Fax</th>
<th>Card Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Noise Software</td>
<td>P.O. Box 23740, Jacksonville, FL 32241</td>
<td>(904) 750-0734</td>
<td></td>
<td>Circle 1318 on Inquiry Card.</td>
</tr>
<tr>
<td>Blue Ribbon SoundWorks</td>
<td>P.O. Box 8689, North Highland Station, Atlanta, GA 30306</td>
<td>(404) 377-1514</td>
<td></td>
<td>Circle 1317 on Inquiry Card.</td>
</tr>
<tr>
<td>Cardinal Technologies, Inc. (SoundStudio)</td>
<td>1827 Freedom Rd., Lancaster, PA 17601</td>
<td>(717) 293-3000</td>
<td></td>
<td>Circle 1319 on Inquiry Card.</td>
</tr>
<tr>
<td>Media Vision, Inc. (Pro Audio Spectrum 16)</td>
<td>47221 Fremont Blvd, Fremont, CA 94538</td>
<td>(510) 770-8800</td>
<td>fax: (510) 770-8648</td>
<td>Circle 1321 on Inquiry Card.</td>
</tr>
<tr>
<td>Omni Labs and RTM, Inc. (AudioMaster)</td>
<td>13177 Ramona Blvd., Suite F, Irwindale, CA 91706</td>
<td>(818) 813-2630</td>
<td>fax: (818) 813-2638</td>
<td>Circle 1322 on Inquiry Card.</td>
</tr>
<tr>
<td>Passport Designs (Encore, Master Tracks Pro)</td>
<td>100 Stone Pine Rd., Half Moon Bay, CA 94019</td>
<td>(415) 726-0280</td>
<td>fax: (415) 726-2254</td>
<td>Circle 1324 on Inquiry Card.</td>
</tr>
<tr>
<td>Roland Corp. (SNC-1 GS, Sound Canvas)</td>
<td>7200 Dominioin Cir., Los Angeles, CA 90040</td>
<td>(213) 685-5141</td>
<td></td>
<td>Circle 1325 on Inquiry Card.</td>
</tr>
<tr>
<td>Steinberg Jones (Cubase)</td>
<td>17700 Raymer St., Suite 1001, Northridge, CA 91325</td>
<td>(818) 993-4091</td>
<td>fax: (818) 993-4091</td>
<td>Circle 1326 on Inquiry Card.</td>
</tr>
<tr>
<td>SunRize Industries (AD516, Studio 16)</td>
<td>2959 South Winchester Blvd., Suite 204, Campbell, CA 95008</td>
<td>(408) 374-4962</td>
<td></td>
<td>Circle 1327 on Inquiry Card.</td>
</tr>
<tr>
<td>Turtle Beach Systems (MultiSound, Wave for Windows)</td>
<td>1600 Pennsylvania Ave., Unit 33, York, PA 17404</td>
<td>(717) 843-6916</td>
<td>fax: (717) 843-6917</td>
<td>Circle 1328 on Inquiry Card.</td>
</tr>
<tr>
<td>Twelve Tone Systems, Inc. (Cakewalk Professional for Windows)</td>
<td>P.O. Box 760, Watertown, MA 02272</td>
<td>(617) 924-2480</td>
<td>fax: (617) 924-6657</td>
<td>Circle 1329 on Inquiry Card.</td>
</tr>
</tbody>
</table>
If you work with DATA...

DADiSP is for you!
The Standard Worldwide — adopted by thousands of scientists and engineers for data analysis and graphics.

If you collect data, reduce it, analyze it, transform it, edit it, and plot it, then DADiSP will increase your productivity. DADiSP's point-and-click menus make the complete process, from input to output, easier than you ever thought possible.

Choose from hundreds of powerful functions for data reduction and editing, series and scalar math, matrix math, table manipulation, statistics, peak analysis, FFTs and convolutions, digital filtering, image manipulation and display as XY plots, contours, 3-D/4-D graphics, and shaded surfaces. And DADiSP's unique interactive spreadsheet environment helps you create your own programs and templates, without any programming, with macros and command files for custom work.

DADiSP is currently in use in engineering, laboratory data collection, matrix processing, manufacturing, science, signal processing, chemical and mechanical applications in automotive, aerospace, defense, medical, and other industries.

CALL 1-800-777-5151
for your free DADiSP Trial Kit. DADiSP is available for SUN, HP, IBM, NEXT, DEC, Concurrent, and Silicon Graphics workstations, and of course, IBM PC compatibles.

One Kendall Square
Cambridge, MA 02139
617-577-1133
FAX: 617-577-8211

Circle 93 on Inquiry Card.
Since Windows first came out, non-professional programmers have been screaming themselves hoarse for an easier way to access the power of the environment. While the resource editors available for C have come a long way, the C environment still leaves people a bit dry.

Windows BASICS make it easier for people to program Windows. Specifically, they allow any programmer with reasonable experience to create a user interface without having to know the API calls. The ability to create a full-blown Windows application without the tedious programming is quite appealing.

Who can use Windows BASICS? Anybody who wants to create a program in Windows and doesn't have the time to learn C and Microsoft's SDK (Software Development Kit). Getting your first program up and running may take hours instead of weeks and months. If you need to develop any type of DLL, you can't use a Windows BASIC program for that yet; none of these packages provides that level of complexity.

The latest Windows BASIC packages blend a rich programming environment with an intimate control over the Windows API (see the features table). CA-Realizer 1.0 ($395) offers a run-time compiler and Programmable Application Tools while shielding you from the naked Windows API calls.

GFA-BASIC 4.10 for Windows ($295) offers over 800 BASIC and Windows commands, direct calls to the API without the need for a DLL, and full 32-bit support for 386/486 processors. GFA Software Technologies also sells a $99 "QB" version of the package designed to take QuickBasic programs and convert them for use in Windows with minimal change.

Finally, Microsoft's Visual Basic 1.0 with Professional Toolkit offers the development environment, a run-time compiler, and a rich set of extensions with the Professional Toolkit. Visual Basic lists at $199 or, bundled with the Professional Toolkit, at $499. Microsoft is readying a significant upgrade of the product (see the text box "Coming Soon: Visual Basic 2.0" on page 200).

Each package lets you write Windows code without knowing C or the SDK. CA-Realizer and Visual Basic provide alternative SDK functions; GFA-BASIC offers direct access to the full complement of API calls.

The Language of Windows
Programming in C is the conventional way of programming Windows. For most folks, this is not an easy task, because you have to learn the ins and outs of Windows as well as C's elaborate syntax. Conquering both at the same time is like trying to take a drink from a fire hose; you'll get some of it, but a lot will get by you.

Another way to program Windows is to use a visual programming language. These are generally believed to be easy to use, but they lack the full power of a programming language. Windows BASICS are somewhere in between the visual languages and C. They give you the ability to access Windows without having to deal with all the endless details of pointers and the details of the API calls.

The heart of a Windows BASIC program is the form. The form contains the primary user-interface elements: control buttons, data-entry fields, and cubbyholes to tuck executable code into. In essence, a form is a Windows window, but an enriched one with your program's control structure built into it. In the old days, it was necessary to write pages of code to create interfaces; now there are handy resource editors to reduce that task to dragging buttons and checkboxes from a toolbox. When you combine the graphical design tools, straightforward BASIC syntax, and integrated Windows API calls, you get a Windows BASIC.

If you're not a programmer, the only thing these packages allow you to do is create a pretty screen. At that point, you'll have to find a friendly programmer to help you fill in the underlying structure.

Take a Message
To test these packages, I designed a simple application that duplicates the common "While You Were Out" message pad. It contains areas for whom the message was to and from, the date and time of the message, the phone number, a series of action checkboxes, and a short narrative message. A control panel next to the pad controls the application. The controls let you create a new message, save changes, and browse through the message database. The entire front end of the application uses Windows API calls through the environment's libraries and/or API access, and the back end uses the standard BASIC file I/O to manage a straightforward fixed-length record structure.

The first step in writing the application is designing the form. That's the resource editor's job, and each of the packages takes a slightly different approach to the problem. The resource editor is your primary interface to the package, so it had better
be a good one.

Each control then gets a connecting link to the underlying BASIC code. The general procedure is to select the button or checkbox and assign it a piece of code to execute. To build the database records, you extract the entered data from the form. The data elements have to be combined into a record and stored into a random-access BASIC file.

After you complete the form, the Action Item function in the Edit menu lets you write a chunk of BASIC code and attach it to that control. For example, in my sample application, when you press the Next button, its handler increments a record counter and reads the next message from the database. When you save the file, Realizer merges your neatly encapsulated routines into the main program.

CA-Realizer is an interpretive environment that lets you run your code right from the editor. Your program will probably work the first time (mine always do), but if not, Realizer’s debugger lets you step through the program. The program editor is a standard Windows-style editor with multiple edit windows, cut-and-paste operations, and all the menu options where you expect them to be.

Realizer’s Programmable Application Tools are roughly analogous to Visual Basic’s design tools were superior to the others and felt the most like other Windows applications.

CA-Realizer 1.0

CA-Realizer lets you create a Windows application without extensive knowledge of the Windows SDK. You create the Windows front end with FormDev, a resource editor provided with Realizer that uses a convenient WYSIWYG drawing package to design the program’s form. In Realizer, each form is a separate window. FormDev’s toolbox contains the usual assortment of Windows drawing tools; you select objects with the arrow selection tool, place buttons with a tool shaped like a button, and create editing fields with the text tool (see screen 1). During the editing and design process, each element gets assigned a unique item number.

Screen 1: CA-Realizer’s resource editor uses a convenient WYSIWYG drawing package to design the program’s form. At your disposal are the usual assortment of Windows drawing tools.
Basic's Professional Toolkit. The tools appear in the FormDev toolbox and include number functions such as charts, spreadsheets, boards, logs, active bit maps, and animation libraries. Realizer lets you expand your application through the use of DLLs and share information with other Windows applications though DDE.

Delivering the Goods
When you finish your application, you'll want to get it into your users' hands. Realizer's Project Builder is a simple way to create a Windows executable file, complete with its own icon and Realizer runtime library. The Project Builder scans the file and compiles a list of resources required to build the program. The end result is an installation disk complete and ready for royalty-free distribution.

I had CA-Realizer installed and my program running in a matter of hours. The documentation was easy to follow. The sample programs and on-line help system came in handy more than once.

A few things about the product annoyed me. Realizer fills the screen with a default window, and your application appears as a smaller child window. I would have liked to have my application fill the parent window. I worked around the problem by replacing the parent window's menu and pretending that the window came from my application. On FormDev, I'd like to see better control of the toolbox set, a global grid system so you can align items, and a grouping function that lets you move multiple items as a group.

I recommend Realizer to anyone with minimal programming experience and little or no prior knowledge of Windows API calls. CA-Realizer gives you plenty of examples, including the source for both FormDev and the tutorial. Of the three packages reviewed here, it has the highest level of abstraction to protect you from those tedious API calls. However, if you need to get to the API, you can—through the use of DLLs.

GFA-BASIC 4.10
A vast collection of BASIC commands and direct Windows API calls makes GFA-BASIC very powerful—perhaps the most powerful of the three products in this review. When you install the package, you select from a number of optimized interpreters and run-time DLLs for the various Intel processors, from the 286 to the 486 with full 32-bit support. GFA Software Technologies offers two flavors of its package: an MS-DOS version and a Windows version. Code written for one environment will run on the other if you simply recompile the program.

Your link to the package is the GFA-BASIC editor, which gives you a complete environment with a debugger and the RCS (Resource Construction Set)—similar to CA-Realizer's FormDev. Programmers familiar with WordStar editing commands can use those same commands in the GFA editor. For others, there's a Windows-style cut-and-paste interface. Unfortunately, the Windows editing controls are nonstandard and take a bit of getting used to.

You use the RCS to create dialog boxes. For the test application, I ended up creating a message-form dialog box and then calling it from the parent window (see screen 2). Another approach would have been to create the message form as part of the parent window and then use CreateWindow calls to define the form in the code without the benefit of a resource editor. That's harder from a programmer's point of view, but it lets you take better advantage of GFA's extensive Windows support.

GFA-BASIC has two primary advantages over its competition. First, the 800 functions, give or take a few, include math, communications, graphics, matrix, and dBase functions, all from the standard package. But it doesn't stop there. GFA also gives you full Windows API support without the need to call a DLL. Support for MDI (Multiple Document Interface),
This team created a professional BBS for you.

We're usually a little more modest. But we couldn't help feeling proud of what this team has created — a professional, reliable Bulletin Board System — that you can relate to.

The Major BBS® Version 6 provides:

• **ELECTRONIC MAIL** with file attachments, carbon copies, return receipts, message forwarding, message quoting, distribution lists, and user preferences.

• **PUBLIC FORUM AREAS** (up to 3500) with file attachments, message threading, "Quickscan", keyword searching, and fully configurable security access levels.

• **MULTI-USER TELECONFERENCE** with 65,535 channels, conference "moderators", and a private chat mode.

• **FILE LIBRARY** supporting over 10,000 sub-libraries and over 1,000,000 files, file tagging, CD-ROMs, keyword searching, and optional file approval restrictions.

• **MHS MESSAGE NETWORKING** with DaVinci E-Mail, cc:Mail, MCI Mail, the Internet, CompuServe, X.400 networks, and other third-party message networks.

• **FULL SCREEN EDITOR** with block commands, paragraph formatting, and message importing.

• **FILE TRANSFERS** via ZMODEM, YMODEM-g, YMODEM-Batch, XMODEM, KERMIT, Super-KERMIT, and ASCII protocols.

• **MULTI-USER SUPPORT** for up to 256 simultaneous users — all on a single desktop computer — via modems and serial ports at up to 38,400 bps, and Novell LAN channels.

• **PLUS:** questionnaires, global commands, a user registry, file displays, remote system management tools, and much more.

We went all out to make your life as Sysop easier, too. Installation is super-easy, with automatic modem detection and customization utilities. Fully configurable menus, screens, prompts, help messages, and user accounting options, together with our Locks and Keys™ security system, give you total control.

Add-on options include advanced LAN support, The Major Database™, X.25 connectivity, a Dial-Out package, a QWK-mail interface, C source code, and dozens of third-party software products.

But The Major BBS is more than just bits and bytes. The design is well thought out from a human point of view. The documentation is thorough and comprehensive, yet "reader-friendly". World-class tech support is just a phone call away.

We want your business. Call now and we'll send you literature and a free demo disk.

**Sales & Literature Hotline**

1-800-328-1128

The Major BBS Version 6 requires a 286 or better, with 2MB or more, running MS-DOS 3.3 or higher.
Coming Soon: Visual Basic 2.0

TOM R. HALFHILL

Visual Basic 2.0, announced in early November, promises to be a significant revision that adds more of everything: controls, properties, keywords, events, debugging tools, programming aids, and—perhaps most important—performance. What follows is a look at some of the significant new additions, based on preliminary documentation, a beta version of the software, and Microsoft sources.

VB 2.0 will be available in both a Standard Edition and a Professional Edition. The Professional Edition replaces the Professional Toolkit 1.0 and the Control Development Kit, and several features from Toolkit 1.0 have been added to the new Standard Edition. Among these are the OLE client control and the grid control, a spreadsheet object that has been improved over the version in Toolkit 1.0.

The toolbox in both editions has two new controls. The graphical control lets you create shapes, lines, and labels like earlier controls, but it uses fewer Windows resources so you can build bigger applications. The other new control is the image box. Like a picture box, it can display BMP and ICO graphics files, but unlike a picture box, it can resize the images as well. Also, graphics can be displayed in 256 instead of 16 colors.

All control properties in VB 2.0 are now displayed in a movable, scrolling window instead of a static list box. Global and type definitions, formerly allowed only in the GLOBAL.BAS file, can now be included in any code module (but not form modules). If you begin your declarations section with the new Option Explicit statement, VB 2.0 requires all variables to be declared before use. Although this feature imposes somewhat more structure on the programmer, it makes the source code easier to understand and maintain, especially in projects involving workgroups.

Several improvements make it possible to write larger applications. VB 2.0 allows four times as many procedures per application, twice as many variables per module, twice as many global variables, twice as many controls per form, unlimited string space (up to the limit of available memory), and arrays that break the 64-KB memory barrier (but only in Windows enhanced mode). You can put more than 255 controls on a form by grouping the controls in arrays, and you can also include arrays in user-defined variable types.

All indications suggest that Visual Basic 2.0 will be a significant upgrade and a release worth watching closely.

Tom R. Halfhill is BYTE’s senior news editor in San Francisco. You can contact him on BIX as “thalfhill.”

Building an Application

I used the RCS to create the message pad as a dialog box. The RCS offers a click-and-drag WYSIWYG interface. Oddly, font control wasn’t one of the toolbox features. You can set a global font characteristic for the entire dialog box, but you can’t set font styles for individual control elements. The “Please Call” area of the form should have used a smaller font for the checkboxes. In this case, picking one style for the whole dialog box caused the elements to be truncated on-screen.

After completing the form in the RCS, you save the form and send the code to the text editor. Once in the editor, you can view and change the CONTROL statements that make up the dialog box.

A conventional Windows program is based on a simple event-handling loop with separate handlers for each process. GFA-BASIC achieves its event-driven control with a different mechanism. The bulk of a GFA-BASIC program is a procedural program, written to look much like conventional BASIC. ON statements, such as ON MENU, provide each event with an interrupt handler, similar to the ON KEY and ON COM interrupts in conventional BASIC. When the event occurs, the procedural code is interrupted, and the interrupt handler takes over. Your program must use Windows-aware functions to give the events a chance to occur. The effect is similar to a pure event-driven model, but the details seem a bit odd at first.

Although GFA-BASIC gives you direct access to the Windows API, it can actually make the programming task harder, because you have to know a lot about Windows. Because I was already familiar with the API calls, I was able to flip through the manual and find what I needed. But a novice Windows programmer may have some difficulty.

The biggest problems with GFA-BASIC are cosmetic. The editor’s menu functions are not where Windows users expect to find them. The keyboard interface to the editor held true to the WordStar key- strokes but acted inconsistently with regard to block movement. The most glaring gaff is the drag-copy-paste method so often used in Windows to move large blocks of text. When you drag to the bottom of the screen, the screen should scroll and continue the selection. It doesn’t.

This package can be improved by cleaning up the inconsistencies of the editor and the RCS, adding more cross-references to the documentation, and including better font support to the RCS on a control-by-control basis.

Microsoft’s Visual Basic 1.0

It’s no surprise that the folks who wrote Windows have remained faithful to the object-oriented, event-driven programming model with their BASIC package. Of the three packages, Visual Basic offers the cleanest set of programming tools and environments. You start your program by designing the screens first (see screen 1). Once you create what the user will see, designing the code to interact with the screens is much simpler. Doing the screens first also helps provide a structure to build
Only MultiScope 2.0 has what it takes to nail the bugs in your code, whether in Borland® C++ 3.0 or 3.1; Microsoft® C/C++ 7.0; or Microsoft® C 6.0.

When it comes to true C++ debugging, there's only one way to go — directly to MultiScope Debuggers Version 2.0. That's because only MultiScope can offer you real C++ debugging in a Windows environment today.

It's The Real C++ Thing — MultiScope.

As the only Windows-hosted debugger on the market today, MultiScope 2.0 delivers powerful features you won't find elsewhere.

PLUS, MultiScope C debugging features include the capability of browsing pointers to structures as arrays by simply double-clicking on the desired array index, and the ability to browse any variable as if it was declared in any other type by simply using the sticky type transfer command.

Real Power Is In Sight.

More importantly, it's all there at your fingertips. The MultiScope screen you see here tells the whole story; it's a powerful, feature-rich, integrated Windows environment, where the capabilities you need are just a mouse-click away.

A Real Value

In addition to real C++ debugging, the new MultiScope Debuggers 2.0 offer you real value. The MultiScope Debuggers for Windows provide the Windows Run-Time Debugger, MED, the Crash Analyzer System and more — all in one package.

Act now! MultiScope retails for $379. To get corporate pricing, or additional information call 1-800-999-8846 or 1-408-252-1652. To order direct, please call: 1-800-228-4122 x 8354. We even offer a 60-day money-back guarantee.

© 1992 Symantec Corporation. * Offer valid in U.S. and Canada only — price in U.S. dollars. International phone: Canada, 1-403-465-2386; Europe, 31-71-352111; Australia, 0-879-6577; others, 1-408-252-3570. All trademarks or registered trademarks are those of their respective holders.
your event-driven Windows application. Visual Basic takes care of all the Windows-specific calls to the form objects and allows the programmer to concentrate on the task at hand: producing the important underlying application.

Visual Basic's forms-design tools are similar to those of the other two packages. A toolbox gives a selection of controls and buttons that you simply click on and drag to place on your form. Compared to the others, Visual Basic offers a better selection of control objects and generally handles them in a more consistent manner. The Professional Toolkit gives added zing to any application by offering a more exotic variety of control objects. Control objects can have English names for easier referencing within your program.

Writing code is simple. Just double-click on any control object within the form editor and bring up a text editor with a skeleton subroutine. There is a drop-down selection within this editor that allows you to define what event you want to write a handler for.

The Professional Toolkit is a collection of custom controls that load as extensions to Visual Basic. They become part of the toolbox and are used in the same manner as any other control when designing the form. Some of these controls are 3-D buttons, 3-D checkboxes, animated buttons, common dialogs, and graphs. Visual Basic also provides a Control Development Kit and documentation on how to develop your own custom controls (i.e., DLLs that are written to work specifically with Visual Basic). However, this requires a working knowledge of C. If your design tools adhere to the Windows style, the resulting code is more like Visual Basic than DLLs and stand-alone.EXE files. 

Creating the code for my message database was easy using standard BASIC commands. The application was up and running within a few hours of my loading the program. Visual Basic took care of all the Windows stuff; I had to concentrate only on getting the information from the screen fields and accessing the database on disk. I found the editor functions quite intuitive, although the editor displayed only one subroutine at a time. That turned out not to be a problem, as moving from procedure to procedure was fast and easy. I didn't notice any problems with performance. Visual Basic usually gets a bad rap for being somewhat sluggish, but I was working on a fast machine and my application was relatively simple. Your mileage may vary.

A BASIC Decision
Someone who knows a structured language such as dBase or Lotus macro programming would find CA-Realizer a suitable choice. It provides a layer of protection from the API while maintaining a rich language set. Novice BASIC programmers will appreciate Realizer's good on-line tutorials.

If you understand how event-driven programming works, you'll find Visual Basic an easy way to get a program written quickly. Even if the idea of event-driven programming puts you off, take a look at Visual Basic anyway. The help system and programming examples should help you figure it out.

I appreciated the rich language set and built-in API support in GFA-BASIC, but I would have found the package more useful if it provided a command-line compiler instead of the integrated environment. The text and resource editors were just too inconsistent to use. [Editor's note: GFA Software Technologies is currently beta-testing a true compiler for GFA-BASIC. The compiler will allow you to create DLLs and stand-alone.EXE files just as you would if you were programming in C. That's a development worth watching.]

Of the three packages, I preferred Visual Basic. The design tools were superior to the others and felt the most like other Windows applications. It makes sense that if your design tools adhere to the Windows style, the resulting code is more likely to as well.

Mike Wiggins was a founding member of Multimate International and currently operates a computer consulting firm in South Windsor, Connecticut. He can be reached on BIX c/o "editors."
Big Screen for Windows

No question... this 17-inch monitor from ViewSonic is the ideal “big screen” choice for Windows. In fact, Byte, PC Magazine, InfoWorld, PC Computing and Windows Magazine have all given rave reviews to the ViewSonic 7. It's the price/performance leader, designed for people who know what they want and won’t accept second best.

The competition claims we’re unfair. That’s because the ViewSonic 7, with resolution up to 1,280 x 1,024, features microprocessor-based memory along with 26 programmable preset modes. And it has a flat square, anti-static screen to eliminate distortion and provide a sharp, crisp to-the-edge picture. Plus, for a flicker-free image, it even boasts of ultra-high 76Hz refresh rate. For a safer environment, this monitor meets strict low-radiation Swedish MPR-II standards!

ViewSonic 7 and the 15-inch ViewSonic 6FS — the ideal monitors for full-scale Windows environments.
Microway has engineered four distinctive black tower systems. The 486-B²T is designed for high-end users. It comes standard with American 486 motherboards and power supplies, yet has a reasonable starting price of $2,195. A broad range of options can be installed including high speed and capacity hard disks, intelligent serial controllers, tape back-up units, high end graphics adapters and our Number Smasher-860. These systems are ideal for configuring Novell or UNIX file servers, multiuser systems, and workstations for graphics, CAD and scientific uses. The 486-B²T comes with dual fans, Across the Board™ Cooling and American industrial grade power supplies. All systems are thoroughly tested, burned in and include the best technical support in the industry, which we've provided since 1982.

The key to attaining workstation performance is Microway's 40M Hz Number Smasher-860. It features a four-way interleaved 64-bit memory system that runs at 160 megabytes/sec. The Number Smasher's i860 has been clocked at 80 megaflops doing matrix multiplies, 67 megaflops doing FFTs and 11.8 Double Precision Linpack Megaflops on large arrays—ten times the speed of a 486 and twice the speed of a Cray 1F! One happy user recently reported that his "Baby Cray" was happily humming away saving him thousands of dollars per month in 3090 rentals. The Number Smasher comes with the finest i860 compilers on the market, your choice of Microway's NDP™ FORTRAN, C/C++ or Pascal.

Call or write today for more information on Microway's new black tower systems.
HARDWARE

Clocking the Fastest PCs on the Planet

STEVE APIKI

Intel’s 66-MHz 486DX2 kicks in the afterburner for users tired of sluggish performance in complex applications or mired in high-overhead environments like Windows and OS/2. The clock-doubling DX2, which runs internally at 66 MHz in 33-MHz systems, offers a simple way for system vendors to revitalize 33-MHz 486DX and board-upgradable designs.

I compared four of the fastest PCs ever introduced: high-performance DX2/66 systems from ALR, Compaq, Dell, and NEC. BYTE Lab benchmark results appear in the figure on page 206 and configuration details are listed in the table on page 208. Each system, designed for modularity, is a board-level upgrade of an existing machine.

ALR Flyer 32LCT

ALR’s DX2/66 system consists of a new processor card installed in the company’s low-cost ISA tower. The Flyer’s tower configuration makes it the most expandable system in the group, with a generous 12 drive bays and 10 slots. However, choosing the $5188 Flyer will mean compromising on a few features, like a 32-bit expansion bus (the Flyer is the only non-ELSA system) and a flat-screen 15-inch monitor, which you’d get with the other systems I reviewed.

In addition to the 10 ISA slots, ALR puts system RAM and Western Digital 90C30-based Super VGA on the motherboard. A cached Ultrastor IDE controller takes up one slot. The processor fits on a daughtercard that mounts into one of two proprietary 32-bit slots. The second slot can be left empty, or you can install an optional ($395) 256-KB cache module.

I benchmarked the Flyer both with and without the optional cache for comparison, but only the cached results appear in the benchmark figure. On the BYTE Lab’s CPU test, the Flyer performed about 26 percent slower without the cache; on DOS and Windows applications, the difference was about 20 percent. In any case, I strongly recommend that you buy the cache option if you choose the Flyer.

Compaq Deskpro 66M

Up to this point, the fastest machine BYTE had testers was the Compaq Deskpro 486/50L. Despite the disadvantage of its 33-MHz external bus versus the full 50-MHz architecture of the 486/50L, the Deskpro 66M runs faster. It outscored the older Deskpro on our application tests, which are sensitive to I/O speed as well as raw processing power.

The Deskpro also outstripped the other DX2/66s on application tests, although the Dell 466DE was faster on pure CPU tests. The fast 510-MB hard drive was obviously a strong contributor to applications performance, but Compaq’s fast QVision graphics system also played a role.

The 32-bit QVision board is the only card that takes up one of the Deskpro’s EISA slots. Processor and memory-expansion cards fit in their own proprietary slots, and IDE and floppy drive controllers are on an I/O board that mounts under the power supply.

With a 15-inch QVision flat-screen monitor, the system sells for $6995—considerably higher than the rest. However, the Deskpro includes more memory and a larger hard drive than all but the PowerMate. Including these features, and considering street-price versus list-price differentials, the Deskpro 66M is a very attractive choice.

Dell 466DE

The $3869 466DE split most of the performance benchmarks with the Deskpro 66M. Although its lackluster drive held it back on DOS application tests, the 466DE earned the highest CPU index we’ve seen to date, well ahead of the rest of the 66-MHz pack.

Dell’s newest upgradable desktop unit
CLOCKING THE FASTEST PCS ON THE PLANET

BYTE BENCHMARK INDEXES

- ALR Flyer 32LCT
- Compaq Deskpro 66M
- Dell 466DE
- NEC PowerMate Express DX2/66e

DOS LOW-LEVEL

CPU: Better ▲
FPU: Better ▲
Disk: Better ▲
Video: Better ▲

DOS APPLICATIONS

Word Processing: Better ▲
Spreadsheet: Better ▲
Database: Better ▲
Development: Better ▲
Scientific/Engineering: Better ▲
CAD: Better ▲
Overall: Better ▲

WINDOWS APPLICATIONS

Word Processing: Better ▲
Spreadsheet: Better ▲
Database: Better ▲
Development: Better ▲
Scientific/Engineering: Better ▲
DTP: Better ▲
Overall: Better ▲

UNIX

Arithmetic: Better ▲
Dhrystone 2: Better ▲
Execl: Better ▲
File Copy Throughput: Better ▲
Pipe-Based Context Switching: Better ▲
Shell Scripts: Better ▲
Overall: Better ▲

All results are indexed, and higher numbers indicate better performance. For each index in the DOS and Windows tests, a Compaq Deskpro 386/33L, running Compaq DOS 5.0 and Windows 3.0, is used. For each index in the Unix tests, a Sun Sparstation IPC = 1. The overall index is the average of the individual tests.

The BYTE low-level benchmark suite identifies relative performance at the hardware level, breaking down performance by system component. The results of these tests can help you identify the relative performance of a given subsystem and determine where performance bottlenecks may lie. For a complete description of these tests, see "BYTE's New Benchmarks: A Look at New Numbers," August 1990 BYTE. The BYTE low-level benchmarks, version 2.2, are available in the byte.bmarks conference on BIX, or you can contact BYTE directly.

BYTE's application performance suite measures the performance you can expect to see running a given application category under a given operating environment. We test under two environments: DOS 5.0 and Windows 3.0. We test six application categories for each environment, running test scripts using WordPerfect 5.1 and Lotus Ami Pro 6.1, Microsoft Excel 3.0a for spreadsheet tests; Software Publishing Superbase 4 version 1.3 and Borland dBase IV for database tests; Borland Turbo Pascal for Windows and Microsoft C 6.0 for development; MathSoft Mathcad for Windows 3.0, The MathWorks MatLab 3.5k, and Computing Resource Center Bituino Stat 2.1 for scientific/engineering; Autodesk AutoCAD release 11 for CAD, and Aldus PageMaker 4.0 for desktop publishing. The data files and test scripts are available from BYTE.

Our Unix tests show relative performance for double-precision arithmetic, the Dhrystone 2 benchmark, spawning a process (exec()), file copy throughput, pipe-based context switching, and running a shell script with eight concurrent scripts running. Unix benchmarks are available on Usenet, in the listings area on BIX, or on disk.

Dell's 466DE shows a slight advantage on BYTE's low-level CPU benchmark, but the difference evaporates against the Deskpro 66M's faster hard drive when running real DOS applications. Accelerated graphics tie the Compaq and Dell systems running Windows applications, while the PowerMate's fast SCSI drive pushes it past the other systems on Unix.

includes an ATl Ultra Super VGA on an expansion card, favoring the ATl built into the motherboard in previous designs. The Ultra, coupled with the 66-MHz DX2 processor, delivers absolutely astounding Windows performance. The 466DE virtually ties the Deskpro 66M on Windows applications with this advantage.

The Ultra fits in a half-length EISA slot; the half-length processor module sits in a proprietary slot behind it. That leaves four slots for additional expansion. For such a compact case, the 466DE allows a lot of room for growth; Dell also includes a dual
We made this ad the same way some people still do calculations.

Aside from the quarter million or so people who already use Mathcad, most engineers and scientists continue to do calculations by hand. Using calculators and scratch pads, or jamming them into spreadsheets, or pounding away at code on their keyboards.

Which is all quite unnecessary when you consider that Mathcad provides a faster, more natural, less error-prone alternative. Simply enter equations anywhere on the worksheet. Graph results in 2-D and 3-D. Change variables and instantly update answers. Add text to support your work.

And print presentation quality documents complete with text, graphics and equations in real math notation.

Mathcad comes with more than 200 commonly used functions built-in, including exponentials, differentials, cubic splines, FFTs and more. Full symbolic capabilities are available with a menu pick, so you can evaluate any integral, Taylor series or infinite sum just by clicking.

Optional Electronic Handbooks give you instant access to fully interactive formulas, diagrams and data tables directly from popular reference books. Work with them right in the handbook itself. Or click and paste them for use in your Mathcad documents.

Plus optional Applications Packs with modifiable templates are available for all major engineering and science fields. So put down your pencil, pick up the phone and call now to get a free Mathcad Working Model and complete information. Or mail or fax the coupon below.

Once you get your hands on Mathcad, you'll never do math the same way again.

Call: 617-577-1017
Fax: 617-577-8829
1-800-MATHCAD

The Mathcad Working Model includes a concise demonstration and a fully functioning version of the product. It's the best way to introduce yourself to the power and ease of Mathcad.

FREE Mathcad Working Model.

The free Mathcad Working Model includes a concise demonstration and a fully functioning version of the product. It's the best way to introduce yourself to the power and ease of Mathcad.

Name:
Title:
Company:
Address:
City State Zip

MATHCAD is a registered trademark of MathSoft, Inc. Macintosh® is a registered trademark of Apple Computer, Inc. Windows® is a registered trademark of Microsoft Corporation. UNIX is a registered trademark of UNIX System Laboratories, Inc.

For information on Mathcad distributors outside of the U.S., contact MathSoft USA © 1992 MathSoft, Inc. TSI and © signifies manufacturer's trademark or registered trademark, respectively.

For information on Mathcad distributors outside of the U.S., contact MathSoft USA © 1992 MathSoft, Inc. TSI and © signifies manufacturer's trademark or registered trademark, respectively.

MathSoft, Inc. 201 Broadway Cambridge, MA 02139 USA • Phone: 1-800-623-0223 • 617-577-1017 • Fax: 617-577-8829

Circle 114 on Inquiry Card.
CLOCKING THE FASTEST PCS ON THE PLANET

DX2/66 SYSTEM FEATURES

Each of these systems includes performance features like controller cache and high-speed video, but differences in disk capacity and memory configuration make direct price comparisons difficult.

<table>
<thead>
<tr>
<th>COMPANY INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Logic Research, Inc.</td>
</tr>
<tr>
<td>Flyer 32LCT</td>
</tr>
<tr>
<td>(9401 Jeronimo Rd.)</td>
</tr>
<tr>
<td>Irvine, CA 92718</td>
</tr>
<tr>
<td>(800) 444-4257</td>
</tr>
<tr>
<td>(714) 581-6170</td>
</tr>
<tr>
<td>fax: (714) 581-9240</td>
</tr>
<tr>
<td>Circle 1223 on Inquiry Card.</td>
</tr>
</tbody>
</table>

| Dell Computer Corp. |
| (466DE) |
| 9505 Arboretum Blvd. |
| Austin, TX 78759 |
| (800) 289-3355 |
| (512) 343-3653 |
| fax: (512) 338-8700 |
| Circle 1225 on Inquiry Card. |

| Compaq Computer Corp. |
| Deskpro 66M |
| P.O. Box 692000 |
| Houston, TX 77269 |
| (800) 345-1518 |
| (713) 370-0670 |
| Circle 1222 on Inquiry Card. |

| NEC Technologies, Inc. |
| PowerMate Express DX2/66e |
| 1414 Massachusetts Ave. |
| Boxborough, MA 01719 |
| (508) 264-8000 |
| fax: (508) 264-8673 |
| Circle 1226 on Inquiry Card. |

1 As-tested price includes features listed below, including monitor.

1.44-/1.2-MB floppy drive that fits in a single half-height drive bay.

One of the weaker points in Dell’s desktop systems has been its somewhat fuzzy UltraScan monitor. The review 466DE came with a Dell UltraScan 15FS, a much better, brighter, flat-screen monitor that makes the 466DE much nicer to use.

NEC PowerMate Express DX2/66e

Local-bus graphics and a fast SCSI drive are the main performance-enhancing features on the PowerMate. Coupled with its 66-MHz DX2 processor, these features make the PowerMate a very fast platform for graphics work. However, the PowerMate’s somewhat underpowered processing system left it behind the rest of the systems on our DOS and Windows application tests.

The BYTE Lab’s CPU benchmark rated the PowerMate lower than the other DX2/66 systems. Despite good graphics and an excellent disk score, the CPU/memory bottleneck kept NEC’s machine slightly behind the leaders on the application benchmarks. However, its fast SCSI drive put it well past the others on the Unix File Copy tests, giving it the best Unix index overall.

NEC’s system is roomy for a desktop unit, with plenty of space for hard drive, peripheral card, and memory expansion.

The only card that used an EISA slot in my test system was a DPT SCSI controller, which had no cache as configured but which can accept several megabytes of disk cache.

The SCSI drive and controller enhanced performance, but the lack of controller cache slowed some disk-intensive applications. For example, PageMaker 4.0, part of our application suite, ran very slowly on a few operations.

With a 4PG monitor, the PowerMate DX2/66e sells for $5948. The outstanding monitor helps to make the PowerMate a great graphics platform: Its local-bus graphics system was not as fast as the accelerator-based designs under Windows, but the PowerMate’s graphics solution will speed up applications with or without special drivers.

Power Quartet

These four systems represent some excellent trends: higher clock speeds, upgradable CPUs, graphics optimizations, generally good monitors, and, of course, the trend toward low cost. However, these DX2 systems are still considerably more expensive than straight 486DX/33 designs.

But if performance is what you want, you’ll get a lot more for the extra money. Performance fails to differentiate the top two systems, the Compaq Deskpro 66M and the Dell 466DE; both are outstanding. Of the two, I’d narrowly choose the 466DE for its better price.

Steve Apiki is a BYTE technical editor with a B.S.E.E. from Rensselaer Polytechnic Institute. You can reach him on BIX as “apiki” or on the Internet at apiki@bytepb.bytec.com.

208 BYTE • DECEMBER 1992
YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

Yes, I want FREE information on the following products!

**Product Category Information**

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>Circle the numbers below for information on the entire category of products you're interested in.</td>
</tr>
<tr>
<td>Accessories/Supplies</td>
<td>7 Multimedia</td>
</tr>
<tr>
<td>Add-In Boards</td>
<td>Printers/Plotters</td>
</tr>
<tr>
<td>Bar Coding</td>
<td>Fax Boards/Machines</td>
</tr>
<tr>
<td>Communications/Networking</td>
<td>Graphics Tablets/Mouse</td>
</tr>
<tr>
<td>Computer Systems</td>
<td>Pen Input</td>
</tr>
<tr>
<td>Data Access</td>
<td>Tape Drives</td>
</tr>
<tr>
<td></td>
<td>Keyboards</td>
</tr>
<tr>
<td></td>
<td>UPS</td>
</tr>
<tr>
<td></td>
<td>Business Software</td>
</tr>
<tr>
<td></td>
<td>CAD/CAM</td>
</tr>
<tr>
<td></td>
<td>Communications/Networking</td>
</tr>
<tr>
<td></td>
<td>Data Acquisition</td>
</tr>
<tr>
<td></td>
<td>Database</td>
</tr>
<tr>
<td></td>
<td>Monitors &amp; Terminals</td>
</tr>
</tbody>
</table>

**Inquiry Numbers 52-223**

<table>
<thead>
<tr>
<th>Inquiry Numbers 52-223</th>
<th>Inquiry Numbers 409-580</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>409</td>
</tr>
<tr>
<td>53</td>
<td>434</td>
</tr>
<tr>
<td>54</td>
<td>435</td>
</tr>
<tr>
<td>55</td>
<td>436</td>
</tr>
<tr>
<td>56</td>
<td>437</td>
</tr>
<tr>
<td>57</td>
<td>438</td>
</tr>
<tr>
<td>58</td>
<td>439</td>
</tr>
<tr>
<td>59</td>
<td>440</td>
</tr>
<tr>
<td>60</td>
<td>521</td>
</tr>
<tr>
<td>61</td>
<td>522</td>
</tr>
<tr>
<td>62</td>
<td>523</td>
</tr>
<tr>
<td>63</td>
<td>524</td>
</tr>
<tr>
<td>64</td>
<td>525</td>
</tr>
<tr>
<td>65</td>
<td>526</td>
</tr>
<tr>
<td>66</td>
<td>527</td>
</tr>
<tr>
<td>67</td>
<td>528</td>
</tr>
<tr>
<td>68</td>
<td>529</td>
</tr>
</tbody>
</table>

**Inquiry Numbers 591-767**

<table>
<thead>
<tr>
<th>Inquiry Numbers 591-767</th>
<th>Inquiry Numbers 598-588</th>
</tr>
</thead>
<tbody>
<tr>
<td>591</td>
<td>598</td>
</tr>
<tr>
<td>592</td>
<td>599</td>
</tr>
<tr>
<td>593</td>
<td>600</td>
</tr>
<tr>
<td>594</td>
<td>601</td>
</tr>
<tr>
<td>595</td>
<td>602</td>
</tr>
<tr>
<td>596</td>
<td>603</td>
</tr>
<tr>
<td>597</td>
<td>604</td>
</tr>
<tr>
<td>598</td>
<td>605</td>
</tr>
<tr>
<td>599</td>
<td>606</td>
</tr>
<tr>
<td>600</td>
<td>607</td>
</tr>
<tr>
<td>601</td>
<td>608</td>
</tr>
<tr>
<td>602</td>
<td>609</td>
</tr>
<tr>
<td>603</td>
<td>610</td>
</tr>
<tr>
<td>604</td>
<td>611</td>
</tr>
<tr>
<td>605</td>
<td>612</td>
</tr>
<tr>
<td>606</td>
<td>613</td>
</tr>
<tr>
<td>607</td>
<td>614</td>
</tr>
<tr>
<td>608</td>
<td>615</td>
</tr>
</tbody>
</table>

**Inquiry Numbers 1238-1294**

<table>
<thead>
<tr>
<th>Inquiry Numbers 1238-1294</th>
<th>Inquiry Numbers 648-1122</th>
</tr>
</thead>
<tbody>
<tr>
<td>1238</td>
<td>648</td>
</tr>
<tr>
<td>1239</td>
<td>649</td>
</tr>
<tr>
<td>1240</td>
<td>650</td>
</tr>
<tr>
<td>1241</td>
<td>651</td>
</tr>
<tr>
<td>1242</td>
<td>652</td>
</tr>
<tr>
<td>1243</td>
<td>653</td>
</tr>
<tr>
<td>1244</td>
<td>654</td>
</tr>
<tr>
<td>1245</td>
<td>655</td>
</tr>
<tr>
<td>1246</td>
<td>656</td>
</tr>
<tr>
<td>1247</td>
<td>657</td>
</tr>
<tr>
<td>1248</td>
<td>658</td>
</tr>
<tr>
<td>1249</td>
<td>659</td>
</tr>
<tr>
<td>1250</td>
<td>660</td>
</tr>
<tr>
<td>1251</td>
<td>661</td>
</tr>
<tr>
<td>1252</td>
<td>662</td>
</tr>
<tr>
<td>1253</td>
<td>663</td>
</tr>
<tr>
<td>1254</td>
<td>664</td>
</tr>
<tr>
<td>1255</td>
<td>665</td>
</tr>
</tbody>
</table>

**1. Circle the Numbers on Your Direct Link Card**

Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

**2. Print Your Name and Address**

Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

**3. Product information will be rushed to you from the selected companies!**
YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card
Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address
Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!
REVIEWS

HARDWARE

A New LaserJet, a New Standard

SHELLEY CRcyan

With its new LaserJet 4M printer, Hewlett-Packard proves a central computer industry maxim: If you wait long enough, features will soar and prices will plummet. While that's bad news if you've got money tied up in expensive, aging equipment, it's good news if you're currently in the market for a solid, feature-rich printer.

Last year, for example, 600-dot-per-inch PostScript printers fetched upward of $4000. Multiple-platform connectivity cost extra. So did automatic emulation switching and decent speed. Yet the LaserJet 4M offers all this and more for $2999.

As you might expect, this boosts HP's former powerhouse, the LaserJet III, into retirement. In its place are the 4M and the upgradable LaserJet 4, which lacks PostScript and Macintosh connectivity and retails for $2199.

New Specs

With the LaserJet 4 series printers, HP should set a new standard in desktop printing. The workhorses of the desktop set have been 300-dpi laser printers since the introduction of the original HP LaserJet in 1984. It wasn't that long ago that you had to pay $3000 for a 300-dpi PostScript printer, and HP is betting that consumers will still be willing to spend that kind of money if offered enhanced features.

The LaserJet 4M makes that gamble compelling, especially with its 600-dpi output. Seeing the higher resolution is akin to getting a stronger pair of glasses: You may have been happy with your old ones, but the new ones show you what you were missing, and you don't want to go back.

The crisp output of the LaserJet 4M owes much to HP's Resolution Enhancement Technology, introduced with the LaserJet III. This smooths the edges of letterforms and graphics and, along with smaller toner particles, boosts the apparent resolution. Photographs, shading, and hairline rules look especially sharp.

But the LaserJet's exceptional output is not merely a trick of software algorithms and toner technology. The printer is based on a new 8-page-per-minute Canon engine, the P270. The new design produces true 600-dpi output. Of course, this also means that the LaserJet 4 will not accept the old Canon toner cartridges. While the newly designed cartridges will cost more than the old cartridges ($150 as opposed to $125), they will also pump out more sheets (6000 sheets, up from 4000), resulting in lower cost per page, HP says.

Because of the LaserJet's traditional market share, you can expect immediate third-party support for the 4M. Extended Systems has already announced a family of add-on products for the LaserJet 4, including a fax module.

PostScript Performance

Tests prove that the 4M is indeed a respectably speedy printer. I put it through BYTE's standard suite of Genoa Technology tests, which have been run on comparable printers (see "PostScript's Middle Class," August BYTE).

In the first-page index, which measures how long it takes to print a standard business letter, the HP LaserJet 4M ranked right up there with 300-dpi printers and bested units with higher resolution (see the benchmark graph). The LaserJet 4M lagged slightly behind the NEC Silentwriter 2990 but was faster than the rest of the pack, including the 300-dpi Texas Instruments microLaser Plus, the Apple LaserWriter IIg, and the 600-dpi IBM LaserPrinter 10.

In the second set of tests, consisting of printouts from a variety of word processing, drawing, and spreadsheet applications, the LaserJet 4M finished in the middle of the pack. Of the models faster than the LaserJet 4M, however, all deliver lower resolution. When you consider that a 300-dpi printer handles only a fourth as much data as the 4M, the new LaserJet's performance is all the more notable.

A few factors account for the printer's impressive speed: Most important, the LaserJet 4M uses an Intel 960KA 20-MHz RISC processor. Additionally, the LaserJet 4M comes packaged with PostScript Level 2, which is speedier than Level 1. (The LaserJet 4 lacks PostScript but can be upgraded for $495.) PostScript is built right in, so you no longer need a speed-choking cartridge, as was required for the LaserJet II and the LaserJet III. An enhanced

The LaserJet 4M from Hewlett-Packard includes built-in PostScript and AppleTalk. The new look includes a paper tray that tucks completely into the unit, a more readable control panel, and a true 600-dpi Canon engine.

DECEMBER 1992 • BYTE 209
A NEW LASERJET, A NEW STANDARD

The performance of the LaserJet 4M is impressive, especially given its higher resolution. For other comparisons, see “PostScript’s Middle Class,” August BYTE.

HP PCL 5 printer control language (HP claims to have optimized the language for faster graphics performance) and a 156-KBps parallel port also contribute to its speed.

Automatic Emulations
People who work in departments with both Macs and PCs will appreciate the 4M’s built-in parallel, serial, and LocalTalk ports. Best of all, when you send print jobs from any source, in PostScript or PCL, the printer will automatically identify the source language and proceed with the print job. There’s no need to get up and manually switch the printer yourself.

I put this feature to a rigorous test. With a 386 PC hooked to the parallel port, and a Mac IICx on the other end of the LocalTalk cable, I repeatedly sent a barrage of alternating PostScript and PCL files. From the Mac, I sent QuarkXPress files with text and photos, as well as Aldus FreeHand drawings. The 386 sent detailed drawings from AutoSketch for Windows, as well as text-laden pages from DOS-based WordPerfect 5.1. Despite my best efforts, I was unable to trip up the printer. The automatic emulation switching worked perfectly.

Although you can expect extensive driver support for the new LaserJets, it’s inevitable that not all applications will be supported by updated printer drivers. You could use LaserJet III drivers, but you may not have access to all the 4M’s advanced features from your software application. HP has addressed this inconvenience in two ways.

First, the new LaserJet includes an easy-to-read, vacuum-fluorescent display on the printer’s control panel, making it easier to manually select features. Second, HP’s PC Remote Control Panel software greatly minimizes the need to touch the printer’s front control panel. Just load this free utility and a functional representation of the control panel appears on-screen.

Paper Pusher
Gone is the protruding paper tray of LaserJets past. The new model tucks a 250-sheet tray under the printer itself. Unfortunately, that’s not the case with the printer’s 100-sheet multipurpose tray, where you load odd-size paper, including up to 10 envelopes at a time. When opened, this tray hangs off the front of the unit and feels rather flimsy. A built-in tray extender helps steady longer sheets of paper, but it doesn’t glide in and out smoothly. It does the job, however, as envelopes fed through without a hitch.

Replacing the toner cartridge is a snap—literally. You hear a satisfying click when you slide it in correctly. A protective tape, as well as a clever overall design, makes replacing a cartridge a clean, spill-free operation. The drum and toner cartridge come packaged as a unit, so replacing one means that you have to replace the other. While this is convenient, it can also be more expensive than purchasing a drum and toner separately.

The LaserJet 4M comes standard with 6 MB of RAM, expandable to 22 MB. An optional $225 paper tray can be attached underneath to expand the paper capacity by 500 sheets. A power envelope feeder that holds 75 envelopes is available for $295. The 4M includes 10 TrueType, 35 Intellifont (HP), and 35 PostScript typefaces, as well as a cartridge slot.

If the past is any indication of the future, you’ll be able to get better features at a lower price next year. But don’t torture yourself. The LaserJet 4M today offers an impressive combination of features at a reasonable price.

Shelley Cryan runs a consulting business that helps companies incorporate computer-based technologies to boost productivity. She holds an M.B.A. in finance and marketing from the University of Chicago. She can be reached on BIX c/o “editors.”
Essential Development Tools At Your Fingertips.

MKS Toolkit — All the Tools of the Trade for Professional Programmers and Application Developers.

MKS Toolkit puts a powerful suite of easy-to-use development utilities within your grasp. MKS Toolkit was designed by developers for developers. That’s how we knew precisely which programming instruments to give you — and how to make them work together so you can achieve levels of productivity you’ve only dreamed about — until now!

Developers working on DOS can now get the extraordinary power of tools that were once available only on UNIX. Only MKS Toolkit delivers a full suite of these essential tools on your PC, and allows you to switch quickly back to your DOS applications. For multi-platform environments, MKS Toolkit is fully compatible with UNIX systems, and tracks both POSIX and z/Open standards.

Now it’s easy to take hold of all the tools of your trade. MKS Toolkit enables you to develop the technology of tomorrow — today.

Start shaping the applications of the future! Call now to order your copy of MKS Toolkit.

Some of the 170+ utilities in MKS Toolkit 4.1:

- A new, easy-to-use, efficient UUCP communications package that connects you to the world.
- MKS AWK, the fast prototyping and report generating language, now with a new AWK compiler.
- MKS KornShell, the full-featured programming language that allows you to interchange scripts with UNIX and POSIX systems.
- MKS Make, the software construction utility that lets you update files automatically.
- MKS VI, the full-screen editor.
- New Windows icons for frequently used commands.
- Interoperability with Open VMS, CTOS and MPE/iX.
- A full array of commands for profiling, compression, archiving, file processing and customizing your PC environment.

MKS
35 King Street North
Waterloo, Ontario, Canada
N2J 2W9

Price: $299, Upgrade $99. Call for multi-user pricing. 30 day money back guarantee.

For information on how to order, call MKS at: 1-800-265-2797 (US and Canada) or (519) 894-2251 • Fax (519) 884-8861. International customers please call:

AUSTRALIA +61 03 988 1333 • BRAZIL +55 83 333 1904 • DENMARK +45 87 72 00 • FRANCE +33 1 48 77 22 11 • GERMANY +49 0721 988 280 • JAPAN +81 3 5702 0351 • NETHERLANDS +31 020 6 14 24 63 • SWEDEN +46 013 111588 • SWITZERLAND +41 061 421 32 01 • UK +44 064 53 1599 • USA +1 410 580 1333

MKS and MKS Toolkit, MKS KornShell, MKS AWK, MKS Make, MKS UUCP and MKS VI are trademarks of Mortice Kern Systems Ltd. UNIX is a registered trademark of UNIX System Laboratories, Inc. All other trademarks are acknowledged.

Circle 121 on Inquiry Card.
Allow us to crank up the volume on your PC.

Just when you thought you had us pegged for building fiery-hot graphics cards we decide to throw a curve ball. And this one’s aimed directly at your ears: the new Orchid Sound Producer Pro. An easy-to-load board that features a phenomenal 20-voice synthesizer, delivers sampling rates up to 44.1 KHz and is 100% compatible with SoundBlaster Pro, along with three other sound standards—Disney Sound Source, AdLib and Covox Speech Thing. MIDI support, joystick port, microphone, speakers and our exclusive Voice Notes (for audio post-its) are bundled for an absurdly low $199. For more details, call 800-7-ORCHID. Or fax: 510-490-9312. And prepare to sample true audio ecstasy.

©1992 Orchid, Sound Producer and Voice Notes are trademarks of Orchid Technology. All other trademarks are owned by their respective manufacturers.
TypeReader Takes OCR Toward Better Recognition

D. Barker

ExperVision claims that TypeReader’s OCR (optical-character-recognition) technology is “virtually” 100 percent accurate. Just think: An OCR package that can read a scanned page and correctly understand “virtually” every single character would let you drop text into your word processor or spreadsheet and not have to fix a thing.

It would be great if that claim were true. But while TypeReader is more accurate than many other OCR programs on the market, its accuracy rate falls short of perfection, especially with second-generation documents and ornate typefaces. However, with clean, laser-printed output, TypeReader’s accuracy is the closest I’ve seen yet to 100 percent.

TypeReader, available in Macintosh and Windows versions, uses what ExperVision calls machine-learned fragment analysis. Other programs, like Caere’s OmniPage and Calera’s WordScan, use feature extraction. They look at each text character and identify features such as lines and loops, and then they use that information to try to deduce what the letter is. They know that a letter composed of a vertical stroke and three parallel horizontal strokes appended to it is probably an E.

Machine-learned fragment analysis, a pattern-recognition technology, uses geometric models. A font is a set of coordinates in that model. When the program looks at a character, it analyzes each fragment—the stroke coming out of a d, for example—and breaks it down into a numerical model. The program also looks at the relative lightness and darkness of a character; only the fragments that are very dark or very light are reliable indicators of what a character is. The program takes the good fragments and maps them geometrically.

Like other packages that use lexical context, the program then takes its best guess at what a word might be and checks its dictionary to see if that word is there. If it finds jack and not jeck, for instance, it figures that second letter is probably an a rather than an e. According to ExperVision, TypeReader algorithms consist of code to learn to recognize characters rather than code to recognize characters.

Fragment analysis sounds good, but does it really make a difference? With certain types of output, it does. TypeReader proves to be excellent—virtually 100 percent accurate—at interpreting 10-point text from a daisy-wheel printer and good-quality output from a laser printer. But take that same page, fax it, and then feed it to the OCR software and the accuracy rate declines, as it would with any OCR program. The big difference with TypeReader is that the accuracy rate declines less.

Besides its innovative OCR technology, TypeReader has other impressive attributes. The program is simple to learn and use. For basic operation, you probably won’t even have to crack open the manual. The interface, very similar in both the Mac and Windows versions, is straightforward (see screen 1). All the controls you’re likely to need are located on a bar along the top of the screen. The button you’ll use most often, Auto, is big and obvious. Click on it and the program goes to work; it scans the page (or pages), locates all the text regions, and then starts the recognition process. It draws lines from one block to the next to show the order in which it will process the text; if you want to change that order, you can do so graphically by clicking on and dragging the lines from one region to another.

When done processing, the program displays a bit-mapped image of the page. Any characters the program doesn’t understand are highlighted; any illegible characters are replaced with a tilde. You can then work through the page as you would with a word processor, jumping from suspect to suspect by pressing the Tab key and changing them if need be.

TypeReader will handle deferred processing, so you can scan in a big batch of pages, queue them up, and then have the program do its recognition chores after you’ve gone home. This is a nice timesaver that not all OCR packages allow.

After TypeReader has digested a scanned document, you can save it as an image or a text file. The program will export the text to any format you’re likely to need, including standard ASCII and Rich Text Format, most PC and Mac word processors, and Lotus 1-2-3 and Excel. The package comes with drivers for most scanners. If you have a scanner that the program doesn’t work with, you can save your scanned file in TIFF, PICT, or PCX format and then send that through TypeReader. The program can handle resolutions from 200 to 600 dots per inch.

Screen 1: TypeReader’s push-button interface is neat and straightforward. After reading a scanned page, it highlights characters it doesn’t recognize.
How Good Is It?
To test the accuracy of TypeReader, I fed it a 17-page document, output from a variety of devices: laser printer, daisy-wheel printer, dot-matrix printer, photocopier, and fax machine. Once the scanned text was saved as an ASCII file, I ran that file through a custom comparison program developed by the BYTE Lab (see "Tame the Paper Tiger," April 1991 BYTE). The program compares the original ASCII text to the OCRRed version and generates a report showing every error and the overall accuracy rate. The BYTE comparison program counts wrong words rather than wrong characters (the latter approach is what most OCR vendors use in arriving at their accuracy claims). Words, rather than individual characters, are a more meaningful index. Words are the standard currency of communication, and if you take an OCRRed document and run it through a spelling checker, it will look for suspect words rather than incorrect characters.

Given a page of Courier text from a daisy-wheel printer set at 12 characters per inch, TypeReader's accuracy rate is an impressive 99.4 percent. This kind of output is an OCR program's dream, however. What happens when the type isn't so clean? When that same document was faxed, the accuracy rate fell to 93.1 percent. The photocopied version was worse, turning in an accuracy rate of 91.1. The program handled a light but fairly typical dot-matrix document with considerable aplomb, yielding an accuracy rate of 92.1 percent. In our tests, TypeReader registered its best score with a laser-printed document set in 12-point Palatino. The accuracy rate was 99.9 percent. Most excellent.

While anything near 90 percent is a great score in most situations, it's not such a good batting average for an OCR program. Look at it this way: A 99 percent accuracy rate means one wrong word out of every 100.

All these tests were run at the program's default settings. You can adjust the scanner's brightness levels within TypeReader. Getting the right brightness level results in a more accurate reading. After I raised the brightness used to scan a faxed page, the accuracy rate changed from 93.1 percent to 95.3 percent.

TypeReader consistently scored higher in our accuracy tests than almost any other OCR software the BYTE Lab has reviewed. The only program to top it, and that was only in the daisy-wheel test, was Calera's WordScan Plus, which scored 99.6 percent compared to TypeReader's 99.4 percent. The runners-up were Caere's OmniPage, at 99.3, and Hewlett-Packard's AccuScan, at 99.2 percent. In the other tests, TypeReader was a clear winner. The nearest competitor in the laser-print test was OmniPage, which scored 97.2 percent compared to TypeReader's 99.9. In the rest of the tests, no package came close to TypeReader's accuracy ranking. With the dot-matrix document, the closest score was OmniPage's 88.9.

Reading Ransom Notes
ExperVision says TypeReader can handle any type size from 5-point to 64-point. Six-point type is what most other programs claim as the smallest they can read, and anywhere from 26 to 72 (OmniPage) as the largest. In order to check the program's ability to handle multiple point sizes and fonts—the company says the package can understand 1700 typefaces—I gave it the ransom-note test: a page of mixed typefaces in randomly selected sizes, from 5...
There is a good reason why your database language was developed in C. In fact, there are many good reasons.

- **C code is small.** C code is fast. C code is portable. C code is flexible. C is the language of choice for today's professional developer. With the growing complexity of database applications, C is a realistic alternative. Now with CodeBase 5.0, you can have all the functionality, simplicity and power of traditional database languages together with the benefits of C/C++.

- **C speed - fast code, true executables.** FoxPro, Clipper, and dBASE were written in C primarily for speed. But those compilers don't really compile, they combine imbedded language interpreters into your .EXE. Now that's slow. For dazzling performance you need the true executables of **C**.

- **With CodeBase you get the real thing, C code.**

- **Consider the following statistics, from the publisher of Clipper:**

  **1200**

  **1000**

  SLOWER

  "Sieve of Erastothenes"

  Benchmark for Prime Number Generation

  Shows C to be incredibly faster!

- **C portability – ANSI C/C++ on every hardware platform...**

  No other language exists on more platforms than C/C++. Why rewrite your entire application for DOS, Windows, Windows NT, OS/2 or UNIX? With CodeBase the complete C source code is included, so you can port to any platform with an ANSI C or C++ compiler. Now and in the future.

- **dBASE Compatible data, index and memo files...**

  You want the industry standard. You need compatibility. Sure, dBASE is the standard, but every dBASE compatible DBMS product uses its own unique index and memo file formats. Only CodeBase has them all:

  - FoxPro (.cdx), Clipper (.ntx), dBASE IV (.mdx) and dBASE III (.ndx).
  - Now it's your choice, we're compatible with you.

### Announcing CodeBase 5.0

The power of a complete DBMS, the benefits of C

### NEW - Multi-user sharing with FoxPro, Clipper and dBASE...

Now your multi-user C/C++ programs can share data, index and memo files at the same time as concurrently running FoxPro, Clipper and dBASE programs. No incompatibilities. No waiting.

### NEW - Queries & Relations 1000 times faster...

CodeBase 5.0 now lets you query related data files with any logical dBASE expression. Our new Bit Optimization Technology (similar to FoxPro's Rushmore technology) uses index files to return a query on a 1/2 million record data file in just a second. Automatically take advantage of this query performance by using our new CodeReporter:

To use CodeReporter, simply draw your report, then include it in any program you write. Call 403/437-2410 now for your FREE working model of CodeReporter.

### New - Design complex reports in just minutes...

Our new CodeReporter takes the painstaking work out of reports. Now simply design and draw reports interactively under Windows 3.1, then print or display them from any DOS, Windows or UNIX application.

### SPECIAL - FREE CodeReporter

Order CodeBase 5 before Feb. 28, 1993 and receive CodeReporter for free! This offer includes our no-risk, 90-day money back guarantee, so order today!
JetLAN lets you plug your HP LaserJet printers directly into your network...anywhere!

Here's how you can connect your HP LaserJet printers where you want them: near your network users. Without sacrificing centralized file servers for LAN maintenance and network security. Without the expense of dedicating a PC as a print server. And without software that degrades performance and hogs memory on a user's workstation.

Simply slide ASP's JetLAN™ print server card into the 'Optional I/O' slot of your HP LaserJet II, IID, III, or IUID. Connect it to the existing twisted-pair or thin-wire cabling anywhere on your Ethernet LAN, the same way you'd add an additional PC. It's that easy! The JetLAN installs in less than five minutes. There's no need to shut down the network for installation, and your existing Novell software is all you need.

JetLAN Speeds Up LAN Printing!
The JetLAN enhances LAN performance and improves printing speed for graphics and complex documents. And because JetLAN plugs directly into your printer and your existing network cabling, there are no individual PC-to-printer cables, external boxes or power supplies to clutter your office. Your system security is enhanced because there's no keyboard or monitor for access to the network.

To order your JetLAN, or for further information, fax ASP at:

1-800-9 LAN ASP
Dept B2140
International 408-746-2965

ASP COMPUTER PRODUCTS, INC.

Australia, Springer Products Pty Ltd
2977-8115 • France, Livingstone Technologie 1-6907-8769, Numetronic 1-4709-3636 • Germany, Dantronic Vertriebs GmbH 8382-76043 • Hong Kong, Tech Pacific (HK) Limited 569420 • Malaysia, First Tech Pacific Distributors Sdn Bhd 244-7300/7266 • Mexico, Divitel SA De C.V. 5-393-8744 • Singapore, Tech Pacific (S) Pte Ltd 278-8686 • Taiwan, Tech Pacific Limited - Taiwan Branch 2-7038561 • UK, Printware 705-877111, Peripherique 252812249

Typereader

to 64 points. TypeReader does remarkably well with Courier and Times at very small sizes. Other fonts, such as Geneva, give the program some trouble when tiny; it reads a Geneva $ as an S, which is understandable enough, and point as print, which is not too far off but makes you wonder about the lexicon (since there is no English word print). But in a total miss, it interpreted line as M I ae. This is disappointing, considering that Geneva isn't exactly an ornate typeface.

If you raise the type size to 7 points, TypeReader does much better, although it isn't completely accurate. In one line of 7-point text, it mistook an M for a 4, resulting in a score of one wrong character out of 28. The program also chokes on big type sometimes. For example, it thought a 24-point Times Roman n was a b and guessed that the word was ib.

I know of no other OCR package that can do any better with very small type. TypeReader does remarkably well, but ExperVision does claim it can handle 5-point text, and that claim, as our tests prove, is not completely accurate.

TypeReader aims to preserve the formatting of a document when poured into another program. To test this, I scanned in some multicolumn pages from magazines, saved the text, and opened them up in different word processors. For the most part, styles and layouts were intact (see screen 2). The software ignores any graphics on the page. The Mac version does a better job retaining format information. It correctly interpreted drop caps (large capital letters at the beginning of a column), while they sometimes mysteriously disappeared in the Windows version. Still, problems surfaced between the conversion from bit-mapped to word processor file. Some lines turned to gibberish.

Nobody's Perfect

An OCR program has to be at least as accurate as a good typist to be worth its price. With clean output and simple typefaces, TypeReader is accurate enough to make the grade. By surpassing the 99 percent accuracy rate when handling daisy-wheel and laser output, it earns high marks. And you can yield a higher accuracy rate by learning which settings work best.

Some OCR developers say total accuracy will never be attained; some say it will take something like neural networks to make the programs smarter. TypeReader isn't perfect, but in the evolution of OCR, it's a big step toward perfection.

D. Barker is a BYTE Lab editor covering applications software. You can reach him on BIX as "dbarker."

Typerreader...
Why are professional graphic artists so excited about dye-sublimation printers? One color printout tells the story. Instead of using halftoning or dithering processes to create colors on paper, a dye-sublimation printer uses heated dyes that diffuse into a special paper and mix to form continuous-tone color images. The output has a near-photographic color quality and appearance (see the photo on page 219).

Of course, you pay for the quality, but the costs are coming down. Currently, prices start at about $15,000 for the printers, and the output costs $5 to $10 per page. Tektronix’s Phaser II SD is a 300-dot-per-inch dye-sublimation color printer that costs $10,000; the cost per page is roughly $3.

Interiors

The Phaser II SD looks remarkably similar to the Phaser II PXi thermal-wax printer, and for a reason: It borrows heavily from the PXi’s proven thermal-wax design. Inside the Phaser II SD, a transfer roll impregnated with three or four process colors moves past a printer head embedded with heating elements. When hot, these elements flash the solid dyes into vapor (the sublimation process), driving the colors onto the paper. This mechanism is similar to thermal-wax printing, but the dye chemistry, paper type, and precision control of the heating elements differ for dye-sublimation printing. For additional information on dye-sublimation technology, see “Hot Colors” in the October 1991 BYTE.

The Phaser II SD’s 24-MHz AMD RISC processor powers an Adobe PostScript Level 2 interpreter. The main logic board has 16 MB of RAM mounted on it, expandable to a maximum of 64 MB. The printer’s firmware has 39 resident Type 1 PostScript fonts, and a 50-pin Centronics-style SCSI port offers additional font storage on an optional hard drive.

A Sharp printer engine, built to Tektronix specifications, prints on letter (8½ by 11 inches), legal (8½ by 14 inches), A4 (200 by 238 mm), and A4 special (200 by 297 mm) paper or transparency sheets. The dye-sublimation process requires a special polyester paper. Total cost per page depends on the number of dyes used (three or four colors), the paper size (letter or legal), and the media type (paper or transparency). At the low end, a three-color letter-size page paper costs $2.75, while the cost of a four-color legal-size transparency jumps to $4.25.

The printer has several standard interfaces: DB-25 serial, Centronics parallel, and mini-DIN-8 LocalTalk. The printer firmware switches automatically among the ports as jobs are sent to it by various computers.

For those folks who need to print multi-megabyte image files, an optional Ethernet interface board ($695) that boosts throughput plugs into a socket on the logic board. On the outside, the Ethernet interface uses Apple’s AUI (Attachment Unit Interface) port, which lets you connect the appropriate Ethernet transceiver to match your office network cables. This Ethernet interface supports AppleTalk Phase 2 protocols, allowing the printer to communicate on large networks. On the downside, AppleTalk is the only protocol this interface supports. Unix users will need a Tektronix 4511A network interface unit ($1495) to provide TCP/IP support or will have to use AppleTalk drivers on their workstations to print to the Phaser II SD.

Putting It to Work

The BYTE Lab tested a Phaser II SD with 48 MB of RAM and a 110-volt, 60-Hz power supply. Printers are available for countries that use different line voltages and frequencies. Unfortunately, I discovered that adding the Ethernet interface board (or extra RAM) isn’t as convenient as the presence of SIMM sockets implies. It’s definitely not a user-installable project: You loosen several sets of screws at the top and bottom of the printer’s cover to remove it, unplug a cable, and unhook the RF shield to get at the logic board. This seems unnecessarily complicated (especially in contrast to the Phaser II PXi, where two thumbscrews release a plate on the printer cover’s back).

The bundled software includes drivers and printer utilities for Windows 3.0 and the Macintosh, along with software for Sun Sparcstations. For printer timing tests, I used a Mac Quadra 950 (running System 7.0.1) on a “network” composed of just the computer and the printer. I also
INTRODUCING MICRO-CAP IV.™
MORE SPICE. MORE SPEED.
MORE CIRCUIT.

PC-based circuit analysis just became faster. More powerful. And a lot easier. Because MICRO-CAP IV is here. And it continues a 12-year tradition of setting CAE price/performance standards.

Put our 386/486 MICRO-CAP IV to work, and you'll quickly streamline circuit creation, simulation and edit-simulate cycles — on circuits as large as 10,000 nodes. In fact, even our 286 version delivers a quantum leap upward in speed. Because, for one thing, MICRO-CAP IV ends SPICE-file-related slowdowns; it reads, writes and analyzes SPICE text files and MC4 schematic files. It also features fully integrated schematic and text editors. Plus an interactive graphical interface — windows, pull-down menus, mouse support, on-line HELP and documentation — that boosts speed even higher.

Now sample MICRO-CAP IV power. It comes, for example, from SPICE 2G.6 models plus extensions. Comprehensive analog behavioral modeling capabilities. A massive model library. Instant feedback plotting from real-time waveform displays. Direct schematic waveform probing. Support for both Super and Extended VGA.

And the best is still less. At $2495, MICRO-CAP outperforms comparable PC-based analog simulators — even those $5000+ packages — with power to spare. Further, it's available for Macintosh as well as for IBM PCs. Write or call for a brochure and demo disk. And experience firsthand added SPICE and higher speed — on larger circuits.

1021 S. Wolfe Road
Sunnyvale, CA 94086
(408) 738-4387 FAX (408) 738-4702
THE PHASER II SD PRINTS DAZZLING DYES

This image was acquired using the Kodak DCS 200ci camera. On the left is a sample of the Phaser II SD's output. On the right is a thermal-wax print made from the same image data. (Photo courtesy of Howard Eglowstein)

BYTE ACTION SUMMARY

- WHAT THE PHASER II SD IS
  A continuous-tone, dye-sublimation color printer with PostScript Level 2.

- LIKES
  Near-photographic-quality output for scanned images; printer firmware produces crisp edges on text and PostScript graphics.

- DISLIKES
  It's difficult to add RAM or an Ethernet interface; no TCP/IP support for Ethernet.

- RECOMMENDATIONS
  Good for those who output scanned images or work with graphics that use many color blends or gradations.

- PRICE
  $9995 (includes 16 MB of RAM)
  Ethernet interface, $695
  4-MB RAM SIMM, $395
  16-MB RAM SIMM, $1995

- FOR MORE INFORMATION
  Tektronix, Inc.
  P.O. Box 1000
  Wilsonville, OR 97070
  (503) 685-3067
  fax: (503) 685-3063
  Circle 1228 on Inquiry Card.

printed with a Compaq LTE Lite/25 (in Windows 3.1) connected to the printer's parallel port.

The BYTE PostScript benchmark test, which uses several color operators to time the PostScript interpreter's color-imaging speed, posted a time of 22 seconds, making it one of the fastest interpreters on the market. (See "Color at a Reasonable Price" in the June BYTE for comparative times of thermal-wax-transfer color printers.) This value varied upward by as much as 20 seconds, depending on the printer mode.

Printing a 3.7-MB scanned image from Adobe Photoshop required 671 seconds through the LocalTalk interface, of which 218 seconds were spent by the print engine using a three-color roll to output the image. Using the Ethernet interface trimmed the output time to a total of 419 seconds. That's barely half the time taken by printing via the LocalTalk port.

At Tektronix's suggestion, I printed images to PostScript files and downloaded them to the printer. Using the Ethernet interface this way to print huge TIFF images, I cut printing times by one-third or one-fourth the LocalTalk printing times. Printing directly from an application causes poor Ethernet performance, because the data is processed before being sent to the printer.

Outstanding Output

I got marvelous output from this printer. I got rich blacks with just the three-color transfer roll, where the blacks are reconstructed by mixing the cyan, magenta, and yellow dyes. Scanned images that were printed from either Adobe Photoshop on the Mac or Aldus PhotoStyler on the Compaq notebook resembled photographs (see the photo).

The best results occurred when I set Photoshop to convert the images to the CMYK color model and used SWOP (Specifications Web Offset Publications) coated paper for the ink settings. Also, I disabled the halftoning screens, because, as a continuous-tone device, the Phaser II SD doesn't need them.

Because the dye mixing occurs inside the paper, these images are permanent and won't scratch or flake like thermal-wax materials that just adhere to the paper's surface. I had access to Kodak's DCS 200ci electronic camera and used a Photoshop plug-in to download images from it into the Quadra. From there, I made color adjustments and created a photo-quality print in a matter of minutes. Imaging technology hasn't replaced film yet, but a system comprising the Kodak DCS 200ci, a Quadra 950, and the Phaser II SD comes close.
<table>
<thead>
<tr>
<th>1</th>
<th>Exxon</th>
<th>25</th>
<th>Standard Oil (Ohio)</th>
<th>49</th>
<th>Consolidated Foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>General Motors</td>
<td>26</td>
<td>AT&amp;T Technologies</td>
<td>50</td>
<td>Lockheed</td>
</tr>
<tr>
<td>3</td>
<td>Mobil</td>
<td>27</td>
<td>Boeing</td>
<td>51</td>
<td>Georgia-Pacific</td>
</tr>
<tr>
<td>4</td>
<td>Ford Motor</td>
<td>28</td>
<td>Dow Chemical</td>
<td>52</td>
<td>Monsanto</td>
</tr>
<tr>
<td>5</td>
<td>IBM</td>
<td>29</td>
<td>Allied</td>
<td>53</td>
<td>W.R. Grace</td>
</tr>
<tr>
<td>6</td>
<td>Texaco</td>
<td>30</td>
<td>Eastman Kodak</td>
<td>54</td>
<td>Signal Companies</td>
</tr>
<tr>
<td>7</td>
<td>E.I. du Pont</td>
<td>31</td>
<td>Unocal</td>
<td>55</td>
<td>Anheuser-Busch</td>
</tr>
<tr>
<td>8</td>
<td>Standard Oil (Ind.)</td>
<td>32</td>
<td>Goodyear</td>
<td>56</td>
<td>Nabisco Brands</td>
</tr>
<tr>
<td>9</td>
<td>Standard Oil of Cal.</td>
<td>33</td>
<td>Dart &amp; Kraft</td>
<td>57</td>
<td>Johnson &amp; Johnson</td>
</tr>
<tr>
<td>10</td>
<td>General Electric</td>
<td>34</td>
<td>Westinghouse Elec.</td>
<td>58</td>
<td>Coastal</td>
</tr>
<tr>
<td>11</td>
<td>Gulf Oil</td>
<td>35</td>
<td>Philip Morris</td>
<td>59</td>
<td>Raytheon</td>
</tr>
<tr>
<td>12</td>
<td>Atlantic Richfield</td>
<td>36</td>
<td>Beatrice Foods</td>
<td>60</td>
<td>Honeywell</td>
</tr>
<tr>
<td>13</td>
<td>Sun</td>
<td>37</td>
<td>Union Carbid</td>
<td>61</td>
<td>Charter</td>
</tr>
<tr>
<td>14</td>
<td>Occidental Petroleum</td>
<td>38</td>
<td>Xerox</td>
<td>62</td>
<td>General Mills</td>
</tr>
<tr>
<td>15</td>
<td>U.S. Steel</td>
<td>39</td>
<td>Amerada Hess</td>
<td>63</td>
<td>TRW</td>
</tr>
<tr>
<td>16</td>
<td>Phillips Petroleum</td>
<td>40</td>
<td>Union Pacific</td>
<td>64</td>
<td>Caterpillar Tractor</td>
</tr>
<tr>
<td>17</td>
<td>Sun</td>
<td>41</td>
<td>General Foods</td>
<td>65</td>
<td>Aluminum Co. of Amer.</td>
</tr>
<tr>
<td>18</td>
<td>United Technologies</td>
<td>42</td>
<td>McDonnell Douglas</td>
<td>66</td>
<td>Sperry</td>
</tr>
<tr>
<td>19</td>
<td>Tenneco</td>
<td>43</td>
<td>Rockwell Int.</td>
<td>67</td>
<td>Gulf &amp; Western Ind.</td>
</tr>
<tr>
<td>20</td>
<td>ITT</td>
<td>44</td>
<td>PepsiCo</td>
<td>68</td>
<td>Continental Group</td>
</tr>
<tr>
<td>21</td>
<td>Chrysler</td>
<td>45</td>
<td>Ashland Oil</td>
<td>69</td>
<td>Bethlehem Steel</td>
</tr>
<tr>
<td>22</td>
<td>Procter &amp; Gamble</td>
<td>46</td>
<td>General Dynamics</td>
<td>70</td>
<td>Weyerhaeuser</td>
</tr>
<tr>
<td>23</td>
<td>R.J. Reynolds Ind.</td>
<td>47</td>
<td>3M</td>
<td>71</td>
<td>Ralston Purina</td>
</tr>
<tr>
<td>24</td>
<td>Getty Oil</td>
<td>48</td>
<td>Coca-Cola</td>
<td>72</td>
<td>Colgate-Palmolive</td>
</tr>
</tbody>
</table>

**The Phaser II SD**

I had no trouble printing drawings made in either Adobe Illustrator 3.2 or Aldus FreeHand 3.1. Graduated color fills were smooth, without a trace of dithering. Both text and fine lines were crisp and clean in any direction. The Phaser II SD's firmware uses Tektronix's Photofine image-processing software to perform edge enhancement. These Photofine algorithms do look-ahead searches in the printer's image buffer. As the print head approaches the edge boundary, Photofine adjusts the heater temperatures to sharpen the transition. I made a mock-up of a BYTE cover in Aldus PageMaker 4.2 that merged two contrasting output types: a scanned image and colored text. Photofine handled this output capably. The image looked vibrant, and yet the text still looked sharp.

**Color with a difference**

So who needs such a printer? Anyone who manipulates scanned images for output to film could use the Phaser II SD to preview the results. An artist requiring fast photographic-quality output will be satisfied. Someone making overheads for a business presentation can now integrate images—say, the picture of a factory behind a sales chart—on his or her transparencies. A professional artist using object-based drawing packages with lots of color blends or gradations should check out this printer as well: My color-packed PostScript diagrams have never looked better.

Since the Phaser II SD is a continuous-tone device, you can’t use it to check images for possible moiré effects. Certain color proofing can be done with a lower-priced thermal-wax printer. Also, accurate color matching is problematic unless you invest in expensive color-calibration equipment. Tektronix's TekColor software performs some color adjustments, but it's not adequate for jobs requiring serious color accuracy from monitor to printer.

If you want to buy this printer to print scanned images—and who wouldn’t, with its superb output—plan to include extra RAM and the Ethernet interface for better throughput. A Phaser II SD with Ethernet and 12 MB of additional RAM (for a total of 28 MB) costs $12,475. This is still less than high-end dye-sublimation printers, and the cost per page is one of the lowest. One look at the Phaser II SD’s output tells you the printer is worth it.

Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. from Memphis State University. He is an associate Apple developer. You can reach him on BIX as “tom_thompson,” on AppleLink as “T.THOMPSON,” or on the Internet at tomt@bytepb.byte.com.
INTRODUCING THE ALR PROVEISA

Utilizing ALR's fastest i486DX™ and i486DX2™ CPUs, the ALR PROVEISA™ has the power to breeze through today's most advanced applications. Built-in SuperVGA graphics let Mark view his latest sail designs quickly and clearly, while a 32-bit EISA bus provides the ultimate in PC data throughput.

And wait until you see what this system can do in a networking environment. Utilizing standard IDE drives, the ALR PROVEISA's available MULTUS™ "multi-seek" controller delivers better performance than expensive SCSI subsystems.* Five levels of system security protect valuable network data from tampering. And let's not forget about expandability -- the ALR PROVEISA offers ten EISA expansion slots, twelve drive bays, and room for up to 256-MB of memory.

Of course, the ALR PROVEISA's most unique feature is its upgrade path to dual processing. When you need even more performance, you can simply plug in a second i486 processor. Imagine having the power of two 66-MHz i486DX2 processors at your fingertips. Now that's world-class speed!

To become a part of the winning ALR tradition, call:

1-800-444-4ALR

Advanced Logic Research, Inc.
9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9290
ALR Canada Ltd.: 800-465-5979
ALR U.K. Ltd.: 44-635-521922
ALR Deutschland GmbH: 49 69 33 38 11
ALR International (Singapore): 65-742 0866

*Optional larger secondary read/write back cache.
**Requires multiple IDE disk drives and a multithreaded operating system such as Novell® NetWare™.

*Prices and configurations subject to change without notice. Systems shown with optional equipment. Verify exact specifications with ALR. Prices based on U.S. Dollars. ALR is a registered trademark of Advanced Logic Research, Inc. All other brand and product names are trademarks or registered trademarks of their respective owners. Intel Inside is a trademark of Intel Corp. In order to take full advantage of the ALR MULTUS Controller multiple drives and multithreading operating systems such as Novell NetWare are necessary ©1992 by Advanced Logic Research, Inc.

Circle 244 on Inquiry Card (RESELLERS: 245).
To a software developer, this is what heaven looks like.

Most people wouldn't know what to make of a screen like this. But developers like you know a screen like this can help make all kinds of applications. With OS/2® 2.0, you can develop the DOS, Windows®, OS/2 and host-based apps end users need. And you can do it faster and easier than ever before. Because OS/2 2.0 can make the most of your 386 or 486 processor.

Now you can edit in one window, compile in another, profile in a third and test in a fourth. Preemptive multitasking makes everything run smoothly and responsively. And OS/2 Crash Protection® helps shield running applications from each other, so if one goes down it won't affect the others. Instead of rebooting, you just restart the affected app and continue.

And since OS/2 2.0 is a 32-bit operating system, programs are easier to write and run faster, too. Which all adds up to improved productivity and reduced development cycle time.

But maybe the best part is that for less than the cost of DOS and Windows, OS/2 gives you a whole lot more. And to keep your cycle rolling, a full range of services and support are available, like on-line help through OS/2 Support line, Bulletin Board and IBM Link. Or you can join the IBMOS2 and OS2DEV conferences on CompuServe where you can meet IBMers, users and developers who can find fast answers to your questions. For an IBM authorized dealer near you, or to order OS/2 2.0 from IBM, call 1 800 3-IBM-OS2:

- OS/2 Crash Protection helps shield applications from each other
- The integrating platform of choice for DOS, Windows and OS/2.
- Preemptive multitasking for responsive, reliable execution.
- 32-bit flat address space for productive programming.
- A full range of IBM services and support.
Stepping Up to XVT 3.0

RAYMOND GA CÔTÉ

Last July, BYTE rated XVT 2.12 as the best all-around library for porting custom graphics applications to a variety of platforms (see "Code on the Move," July BYTE). The best way to summarize the newest release of XVT is to say it's still the best and getting better. It still supports the widest range of platforms: Macintosh, Microsoft Windows, Presentation Manager (for OS/2 1.3 and 2.0), Motif, and Open Look. Character-mode versions are available for DOS, various flavors of Unix, and VMS. XVT Software promises Windows NT support by year's end.

I looked at the XVT 3.0 library, XVT-Design 1.1, and XVT++ for the Mac and Microsoft Windows 3.0 and 3.1. The most significant change to the library is its use of operating-system improvements. On the Mac, for example, XVT applications are now aware of the standard suite of Apple events. Within Windows, XVT applications use common file and print dialogs.

In previous releases, all window definitions were stored in a fixed resource file, and window parameters could not be changed dynamically. Version 3.0 lets you make dynamic window alterations in a portable manner. Creating international applications is much easier, since all system messages are now available as external string resources. Previously, many messages were compiled directly into the library source code.

One feature that XVT still lacks is full file-system support. For example, you can change directories or create and erase files, but you can't create a directory.

Two Tools

Not reviewed in July were two optional XVT tools: XVT++ and XVT-Design. XVT++ provides a thin interface layer between the XVT libraries and your C++ compiler. This layer is so thin that the majority of function calls are not changed at all; they're merely provided in a header that declares them as C functions.

XVT++ defines a set of base classes. BaseXVT is an abstract base class from which all other classes are derived. Control, for creating and manipulating controls, and BaseWin, for windows and dialogs, derive directly from BaseXVT. The last four classes derive from BaseWin and support dialog boxes and standard window sources like windows and dialogs. XVT provides all the prototyping tools you expect, without a lot of frills. You can design windows, modal and modeless dialog boxes, and menus.

Once the prototype is complete, XVT-Design generates both the C code for a sample application and a portable file containing the Universal Resource Language definition of your resources. URL is not a new feature, but it's one of the most powerful features of the entire XVT environment. It defines a portable format for resources like windows and dialogs. XVT provides a URL compiler (CURL) on each platform. CURL translates resource information, not into binary format, but into the standard resource format for that platform.

XVT is a fairly expensive solution and still has some minor deficiencies. However, with standard library improvements and especially with XVT++ and XVT-Design, XVT Software has succeeded in improving a great environment for developing portable applications.

XVT-Design, a new option available with XVT 3.0, is a screen prototyper that generates code and resources that are portable between platforms.
The Windows File Shuffle

STANFORD DIEHL AND DANA HUDES

Windows file-conversion software solves some basic problems we all encounter when working with graphical images. These compact tools accept a wide range of graphics files, allowing you to display them, print them, or convert them to the file format you need.

Although limited in scope, the programs are easy to use and deliver a convenient method for performing some routine image management chores. If you work with image files under Windows, one of these utilities will be a handy tool to have around. You'll probably end up wondering how you ever got along without it.

The Field

We looked at three of these products: HiJaak for Windows 1.0 from Inset Systems, Conversion Artist 1.1 from North Coast Software, and Image Pals 1.0 from U-Lead Systems. All three perform basic file conversion among the most popular graphical file formats. They also support Windows screen captures, color reduction (e.g., converting a 24-bit color image to 8 bits), and a convenient way to print your images. These basic functions and a few extra perks add up to a general-purpose utility that anyone who works with a lot of images will come to depend on.

The accompanying table lists the file formats supported by the programs. While some other formats are supported by HiJaak for Windows and Conversion Artist, the list covers the most popular formats you are likely to run into.

If you work with a specific format not appearing in the table, you should call the vendors for a complete list of supported formats.

The benchmark graphs show how the programs perform on routine tasks such as loading files and converting files to various formats. For the first test, each program pulled in a large (2.4-MB) 24-bit TIFF file from a Bernoulli Transportable cartridge. The second test gauges conversion speeds: a 24-bit Windows bit map was converted to the TIFF format; a TIFF file was then converted to a 24-bit PCX file; and, finally, a Targa file was converted to TIFF. To test the speed of color reduction, each program took a true-color (16 million colors) TIFF image and reduced it to 256 colors. Each program offers user-selectable algorithms for color reduction (e.g., dithering and diffusion); thus, for each package, we selected the algorithm that resulted in the highest-quality image possible. The last test shows how long it takes to scale an 8-bit gray-scale image and send it to the printer.

Artist with a Broad Brush

Of the three programs reviewed here, Conversion Artist ($149) is the strongest entry for nuts-and-bolts file conversion. File support is extensive, and the interface takes a no-nonsense approach to the task at hand. When you open a file, a dialog box displays vital information on the file—format, size, color depth, compression status—as it is loaded. Once the image loads, file information is listed at the bottom of the screen.

Image conversions are triggered from the Save As option of the File menu. In addition to the rich complement of supported formats, Conversion Artist offers you a choice of color depth for almost every file it supports. You can quickly convert a 24-bit TIFF image to a 256-color or bit map, performing conversion and color reduction in one easy step.

Screen capture options let you decide which portion of the screen to capture: the active application, the entire screen, any open window, or a rectangle you set up with a click and drag of the mouse.

Conversion Artist is quick and convenient. The basic program offers a handy, uncluttered utility for those needing only to convert files and capture screens. But if you need more functionality, the program supports optional “plug-in” modules. By simply copying DLLs into Conversion Artist’s working directory, you can upgrade the program to include image-manipulation features such as rotation and cropping (the image-preparation module sells for $69).

Other modules include support for color separations ($149), JPEG compression ($99), and the Dycam digital camera ($5). You can add new modules as they become available while paying only for what you need. Let’s hope that philosophy also guarantees that the basic version of Conversion Artist is always available for those who need a simple, fairly inexpensive Windows file-conversion utility that gets the job done.

With Image Pals, you can collect thumbnail versions of your selected images, along with an optional title and description, into a simple image database.
Circle 106 on Inquiry Card.

THE WINDOWS FILE SHUFFLE

A DOS Mainstay Comes to Windows
HiJaak for Windows ($249) is a GUI version of the DOS graphics-file-conversion utility that has been around for a number of years. At first glance, HiJaak for Windows looks like an impressive offering. The program supports a broad range of file formats, including the most extensive support of vector formats among the programs we reviewed. It also claims some powerful image-processing features:

### FILE FORMATS SUPPORTED

While some other formats are supported by HiJaak for Windows and Conversion Artist, this list covers the most popular formats you are likely to encounter in the Windows environment. (● = yes; ○ = no.)

<table>
<thead>
<tr>
<th></th>
<th>HiJaak for Windows</th>
<th>Conversion Artist</th>
<th>Image Pals</th>
</tr>
</thead>
<tbody>
<tr>
<td>File formats (raster)</td>
<td>$249</td>
<td>$149</td>
<td>$249</td>
</tr>
<tr>
<td>TIFF 5.0</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Windows BMP</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Targa (TGA)</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>PCX</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>GIF</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>JPEG</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>WPG (raster)</td>
<td>●,●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>IFF (including HAM)</td>
<td>○</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>MacPaint Mac</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Macintosh PICT2</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>CCITT Group 3 and 4 fax</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>HP PCL</td>
<td>○,●</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Vector formats**

- HPGL Read only ○ ○ ○
- AutoCAD DXF Read only ○ ○ ○
- EPS (PostScript) Write only ○ ○ ●
- DRW (Micrografx) ○ ● ○
- WMF (Windows metafile, vector) ● ○ ○
- WPG (vector) ○ ○ ○

1. Offers sub-sample control for the RGB-to-YUV color-space conversion.
2. 24-bit WPG not supported.
3. Support claimed, but testing showed it did not work.
4. Only EPS files it creates.

### BYTE ACTION SUMMARY

- **WHAT GRAPHICS FILE-CONVERSION PROGRAMS DO**
  These utilities convert files to and from a wide range of file formats. They also capture screens and provide tools to display, enhance, and print graphical images.

- **LIKES**
  The tools are easy to use and solve the complex problem of converting among divergent file formats under Windows.

- **DISLIKES**
  HiJaak for Windows is slow and somewhat unstable. Image Pals supports a limited set of file formats.

- **RECOMMENDATIONS**
  Conversion Artist supports a wide variety of file formats at a reasonable price. It’s quick, easy to use, and convenient.
XVT's Portability Toolkit™ is a powerful C development environment that allows you to build a single application, then re-compile to every major GUI without rewriting code. XVT solutions also include an interactive design tool and a class library for C++ developers.

- Supports Macintosh, Microsoft Windows, Windows NT, OS/2 Presentation Manager, OPEN LOOK, OSF/Motif, and Character Systems
- Native look-and-feel to all target GUIs
- Portability to 26 hardware systems
- Access to the complete functionality of every windowing system
- Easier to use than native development toolkits
- Minimal size and performance overhead
- Shorter development cycles
- No royalties or runtime fees
- Clear documentation and responsive technical support

Now in its third generation, XVT is recognized as the industry leader in portable GUI development solutions and is the base document for the emerging IEEE standard. It is used by world-class software developers like Novell, HP, AT&T, Digital, Lockheed, Kodak, Grammatic/Reference Software, because it allows them to take their applications to the widest market, quickly and cost effectively.

Don't write another line of code without gearing up to develop your application simultaneously for all GUIs. Call for technical materials and a demo.

The portable GUI development solution.

1-800-678-7988
XVT Software Inc. 4900 Pearl East Cr., Boulder, CO 80301
(303) 443-4223 FAX (303) 443-0969

Circle 167 on Inquiry Card (RESELLERS: 168).
Subscription Problems?
We want to help!

If you have a problem with your BYTE subscription, write us with the details. We'll do our best to set it right. But we must have the name, address, and zip of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.

BYTE Magazine
Attn. Subscriber Service, P.O. Box 555
Hightstown, NJ 08520

THE WINDOWS FILE SHUFFLE

a range of color-reduction methods, cropping and resizing, and controls for adjusting brightness, contrast, and gamma.

The program has some unique features. For example, you can customize your file conversions for specific applications. Let's say you have an image file that displays particularly well in Ami Pro. HiJaak for Windows can use the optimized image file as a model, using the same parameters to convert other images for use in your Ami Pro documents.

Screen capture is also impressive. You can capture an entire screen, an active window, or an object such as an icon or a pull-down menu. If you need more flexibility, HiJaak lets you draw a rectangle on the screen for customized captures.

There's also some nice convenience features. For instance, you can convert files from the Save As menu option, or you can go directly to the Convert menu and perform conversions without having to load the files into memory. A command-line option even allows you to use wild-card designators to batch up conversion jobs.

For all that's right with HiJaak for Windows, the program is hampered by some serious flaws. First of all, the program is slow. Our benchmarks tell only part of the story. With a 24-bit TIFF image loaded, it sometimes took up to 30 seconds just to call up a dialog box. To get a feel for each of the reviewed programs' operation, we called up a large TIFF image and did some work with it: converting it, changing its color depth, cropping it, and the like. With the other two programs, we faced some minor delays in loading files and making changes, but the software was generally responsive. Not so with HiJaak for Windows. Its performance was downright irritating, taking two to three times longer than the other programs to do almost every operation.

On top of that, the program proved unstable. For each of the reviewed programs, we loaded up five different files of various formats to see how they performed with multiple files on the desktop. HiJaak for Windows was the only program that ran out of memory during the test. That's not so bad, but it handled the problem with a total lack of grace, tossing out a warning and then dropping back to the program manager.

To test the program's ability to read Hewlett-Packard Printer Control Language (LaserJet command codes), we converted a color image to gray scale in Aldus PhotoStyler and used the Windows HP LaserJet printer driver to print the file to disk. HiJaak loaded the resulting file as solid black. When printing, we took the printer off-line and caused all sorts of havoc,
Inside Out

The Best Choice: SupraFAXModem

Inside or Out, now you can choose the hot-selling SupraFAXModem technology that best fits your computer. Either way, Supra can turn your PC into a communications powerhouse!

SupraFAXModems come in a wide range of models, from our budget-minded SupraFAXModem 24/96i to the fastest fax modem available: the SupraFAXModem V.32bis. Whichever model you choose, you will get Supra's proven technology and reputation for high-quality, reliable modems. Supra modems are designed for novice and expert communicators alike. Whether you use DOS™, Windows™, or a Macintosh™, we’ve got a package for you — and our packages include everything you need. Plus our easy-to-follow Getting Started manuals will help you install your modem and start using it in just a few minutes! Imagine sending and receiving perfect faxes, exploring the world of on-line databases, or retrieving an important work file — all from the convenience of your desk. And advanced users will appreciate the error-correction and data-compression features that can save you money!

No matter what your needs, a Supra modem is your best choice. Call us today at 1-800-727-8647, and find out why!

<table>
<thead>
<tr>
<th>Model</th>
<th>INT/EXT</th>
<th>Fax</th>
<th>Data</th>
<th>V.42bis &amp; MNP S</th>
<th>Max Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>SupraFAXModem V.32bis</td>
<td>E</td>
<td>14,400</td>
<td>14,400</td>
<td>100</td>
<td>57,600</td>
</tr>
<tr>
<td>SupraFAXModem V.32</td>
<td>E</td>
<td>9600</td>
<td>9600</td>
<td>100</td>
<td>38,400</td>
</tr>
<tr>
<td>SupraFAXModem Plus</td>
<td>E</td>
<td>9600</td>
<td>9600</td>
<td>3600</td>
<td>38,400</td>
</tr>
<tr>
<td>SupraFAXModem V.42bis</td>
<td>E</td>
<td>5000</td>
<td>4800</td>
<td>3600</td>
<td>9600</td>
</tr>
<tr>
<td>SupraFAXModem Plus</td>
<td>E</td>
<td>9600</td>
<td>9600</td>
<td>100</td>
<td>9600</td>
</tr>
</tbody>
</table>

DOS Package includes modem, FaxTalk™ Plus, COMT™, cables, manuals • Windows Package includes modem, WinFax™, cables, manuals

All trademarks belong to their respective companies. 7101 Supra Drive S.W., Albany, OR 97321 USA • 503-967-9710 • Fax: 503-967-9401

Circle 175 on Inquiry Card.
THE WINDOWS FILE SHUFFLE

WINDOWs PERFORMANCE

<table>
<thead>
<tr>
<th></th>
<th>Conversion Artist</th>
<th>HiJaak for Windows</th>
<th>Image Pals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load large TIFF file</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
</tr>
<tr>
<td>Convert formats</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
</tr>
<tr>
<td>Color reduction</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
</tr>
<tr>
<td>Scale and print</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
<td>Better/Worse</td>
</tr>
</tbody>
</table>

Benchmark tests show the kind of performance you can expect from these programs when running routine operations. First, we loaded a large (2.4-MB) 24-bit TIFF file. The second test gauges conversion speeds. To test the speed of color reduction, each program took a true-color (16 million colors) TIFF image and reduced it to 256 colors. For the last test, we scaled an image and sent it to the printer. Overall, Image Pals was the top performer.

ending in a “General Protection Fault.”

Clicking the Cancel button at an inopportune moment during file loading causes the same result, as does loading a Micrografx Windows Draw (DRW) file.

HiJaak for Windows has a broad set of features, but performance and reliability are too suspect to warrant a recommendation.

An Old Pal Comes Back Around

Image Pals ($249) comes from U-Lead, the company that originally produced PhotoStyler, one of the first image-editing programs for Windows 3.0. Image Pals shares some of PhotoStyler’s low-end functionality, but image-editing features are not the program’s strong suit. Image Pals provides a set of utilities for doing the quick-and-dirty jobs we all face when working with graphical images. Some useful modules support image enhancement and adjustment, screen capture, file conversion, and image cataloging.

Image Pals does not enjoy the same breadth of file-format support as Conversion Artist; instead, U-Lead has settled on a strategic set of popular formats often encountered under the Windows interface. On the other hand, Image Pals has the strongest set of image-manipulation features among the products tested. You can flip an image or rotate it to any degree specified. The dimensions of an image can be changed along with the image resolution. There’s a whole range of image adjustments, and you can subtly blur or sharpen an image to suit your needs. Some special-effects filters (e.g., mosaic and emboss) are also included.

Scanner support is strong. A host of input devices is supported through the TWAIN driver, and stitching is offered from within Image Pals, allowing you to piece together an image from a number of separate scans. The Capture module lets you capture a full Windows screen, any open window, or a rectangle you specify by clicking and dragging.

The Album module helps set this program apart from the others. You collect thumbnail versions of your selected images, along with an optional title and description, into an “album” (see the screen on page 225). Multiple albums can be open as individual document windows, and each can be searched on various criteria, including the label and the description. Drag-and-drop is supported for quickly loading your images into other Windows programs.

Image Pals offers a set of handy utilities for managing and manipulating graphical images. It falls short of providing some high-end features such as color separations, but it fulfills some of the simple needs most of us have. It was also very snappy; overall, it performed the best on our benchmark tests. This is a handy program to turn to when a full-fledged image-editing application is overkill.

A Click Away

Image Pals has some nice perks not found in Conversion Artist. The Album module could be an effective way to catalog your image files, and it should work nicely with the new Kodak Photo CD. As long as you can live with the limited number of file formats supported by Image Pals, you should go with it. But for those of us trying to cope in the diverse world of multiple file formats, Conversion Artist is a solid solution. It doesn’t have some of the image-editing features of Image Pals, but it covers a broader range of file formats.

Conversion Artist is the best choice for handling a large assortment of file flavors. It’s quick, easy, and convenient. Next time your graphical application balks at an incompatible file format, you’ll appreciate having Conversion Artist a click away.

Stanford Diehl is a technical editor for the BYTE Lab. You can reach him on BIX as “sdiehl.” Dana Hudes is a freelance software engineer, writer, and photographer. You can reach him as “dhuines” on BIX, where he moderates the photo conference, or at dhudes@mcimail.com on the Internet.

COMPANY INFORMATION

Inset Systems, Inc.  
(HiJaak for Windows 1.0)  
71 Commerce Dr.  
Brookfield, CT 06804  
(203) 740-2400  
fax: (203) 775-5634  
Circle 1222 on Inquiry Card.

North Coast Software, Inc.  
(Conversion Artist 1.1)  
18A Shipley Rd.  
P.O. Box 459  
Barrington, NH 03825  
(603) 332-9363  
fax: (603) 332-9398  
Circle 1223 on Inquiry Card.

U-Lead Systems, Inc.  
(Image Pals 1.0)  
970 West 19th St., Suite 520  
Torrance, CA 90502  
(310) 523-9393  
fax: (310) 523-9399  
Circle 1224 on Inquiry Card.
Four reasons to buy a TI microLaser™ printer.

Now there's a way for you to put the power of Microsoft® Windows™ on paper — microLaser from Texas Instruments.

Designed to be Windows-compatible, there's a microLaser just right for your needs, whether you need a personal or shared printer. Here's why:

1. Compatibility With HP LaserJet emulation and Adobe® PostScript® software, microLaser easily supports your demanding applications. And with our Microsoft Windows driver, set it and forget it with all Windows applications.

Not only does PostScript give you scalable outline fonts and graphics, it also means that your microLaser works in computing environments like Windows, DOS®, Apple® Macintosh®, OS/2® and UNIX®.

2. Performance
When it comes to printing high-quality documents fast, microLaser really makes you look good. At either nine or 16 pages-per-minute, microLaser printers speed you through documents in a hurry. Plus PostScript means what you see on your screen is what you get on paper. You can even turbocharge your microLaser with a RISC processor for blazing fast graphics.

3. Reliability
When you buy a printer, you want it to print. And print. And print. That's just what the microLaser does.

Take our personal microLaser Plus for example. With its high duty cycle of 10,000 pages-per-month* and a standard one-year limited warranty †, you can rely on your microLaser to work the first time, every time, for years.

4. Value
Starting as low as $999‡, there's a microLaser designed to fit any budget. From the single user all the way up to a network. Consider this, too: microLaser's average cost per page is only 1.9 cents, while some laser printers average around 3.3 cents.

The microLaser not only makes sense, it saves you money, too.

For details on the right microLaser for you and the name of the nearest dealer, call 1-800-527-3500.

The microLaser PS17 has earned the 1990 PC World Best Buy award; microLaser PS35 has earned the 1990 InfoWorld Excellent Value award and 4½ mice from MacUser, October 1990.

*Based on estimated optical usage. **For more information on service upgrade options, call 1-800-847-5757 in the U.S. and 1-800-268-6314 in Canada. §Suggested retail price — dealer prices may vary. †Based on suggested retail price of consumables and approximate page coverage rating for each consumable at 4% black (toner, developer and OPC). microLaser is a trademark of Texas Instruments Incorporated. Microsoft and DOS are registered trademarks, and Windows is a trademark of Microsoft Corporation. Adobe, PostScript and the PostScript logo are registered trademarks of Adobe Systems Incorporated which may be registered in certain jurisdictions. LaserJet is a registered trademark of Hewlett-Packard, Inc. Apple and Macintosh are registered trademarks of Apple Computer, Inc. OS/2 is a registered trademark of International Business Machines Corporation. UNIX is a registered trademark of AT&T. © 1992 TI 76543

Circle 160 on Inquiry Card.
A Real-World Notebook Battery Test

HOWARD EGLOWSTEIN

BYTE's laptop battery tests used to be simple—turn on the laptop, wait until the battery dies, and record the elapsed time. Although BYTE was among the first to begin a formal battery-testing program as part of its portable-system review process, we realized that the battery test just didn't reflect the way people actually used the systems. For example, while sitting in an airplane, people may type for a bit on a machine, turn it off when they're served that sumptuous airline food, and then turn the power back on afterward.

Along Came Thumper II
The prototype for Thumper II, BYTE's automated battery tester, was finished in early 1991. Self-contained closed-loop servo motors, attached to multijointed flexible wooden arms, press on the laptop's keys via flexible cables. The control circuitry provided the pulse-width modulation the motors required and support for an optical-sensor head to read screen status. The Thumper II prototype could handle four motors at the same time and was designed to test two machines simultaneously. (Thumper II first appeared in the text box "Testing Battery Life" on page 252 of the December 1991 BYTE.)

For the production version, I replaced the prototype's dedicated pulse hardware with a microprocessor and increased Thumper's capacity from two machines to eight. The controller cabinet is a rackmountable box with 33 front-panel connectors and an LCD (see the photo). Thumper II's heart and soul is an 8-MHz 6809 processor with nine serial ports and interface circuitry to control 16 servo motors and read from eight optical sensors. The muscle to press the keys comes from 16 redesigned arms.

During testing, one arm handles the notebook's Enter key, and one or two more arms use the standby/power function to reactivate the notebook if it shuts itself off. The system determines the notebook status by watching the screen with one of the optical sensors. Power for the arm's mechanical finger comes from a closed-loop servo motor linked through a flexible cable.

The notebook being tested runs a control program that simulates the load a word processor puts on a computer during normal use. Thumper II is fully platform-independent; if you can program a portable and it has a serial port, it can be thumped.

Getting There
Thumper's new controller is a full-blown microcomputer, and putting it together required some special tools. Once I had designed the 6809 system board, I called Huntsville Microsystems, Inc. (Huntsville, AL, (205) 881-6005), and borrowed a 6809 emulator. Its system uses a PC for interface and control and connects to the target system with a ribbon cable. One critical feature of the HMI emulator is the 6809's MRDY line. MRDY is a processor input that allows a slow peripheral to extend the system clock—similar to the way IBM PCs use wait states. I needed this input to handle Thumper's slow LCD. The HMI emulator also provides multiple hardware breakpoints, symbolic debugging, and a user interface.

Universal Cross Assemblers (Saint John, New Brunswick, Canada, fax (506) 847-0681) makes a great table-driven cross assembler (Cross-32) that supports code of different processors. The processor support is a series of ASCII files with the processor instruction sets. If they don't support the processor you need, it's an easy matter to write your own table.

Thumper's controller cabinet is a modified version of the DataPad cabinet from Interface Systems (Williamsville, NY, (716) 634-0492). Building data acquisition hardware (like Thumper) can be tricky, so I brought Interface Systems onto the design team. I contracted the system board layout and mechanical development to the company's engineers. I uncovered only one serious problem during Thumper's shakeout testing. The original design used a self-clocking circuit to mimic the function of the dedicated pulse generators I used in the Thumper II prototype. The idea was to have the processor load up a memory array with the pulse-width information and then let dedicated hardware take over. It was obvious there was a timing glitch in the system, but I didn't have a clue where to look first. I turned to BYTE's HP 16550 Logic Analyzer. I connected 60 of its logic probes to key parts of the system board and told the analyzer to look for problems. Five minutes later, the HP 16550 stopped and displayed the culprit.

A Design for the Future
Thumper II is about as close as anyone has been able to get to a real-world battery-life test. It allows for notebooks of any size and shape and for efficient use of standby mode on 386SL processors. It does all this with a single control computer for eight notebooks.

As pen-based computers become available, I'll design new battery-life tests for these machines. I've got an actuator design on the drawing board with three motors for x, y, and z control, and Thumper's firmware already supports it. You won't see effective pen-based testing from any solenoid-based designs. We also plan to use Thumper's optical sensors for further automating Windows and other GUI-applications testing in the Lab.

Howard Eglowstein is a BYTE Lab testing editor who has developed microprocessor systems and firmware since the 1970s. You can contact him on BIX as "heglowstein."
STATISTICA/W® (for Windows) Complete Statistical System with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures • Complete Windows 3.1 support, DDE, OLE, TT-fonts, multiple toolbars, right mouse button support • Unlimited numbers of data, results, and graph-windows • Inter-window integration: data, results, and graphs can be treated as objects and converted into one another in a number of ways • The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques; multiway tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit, general ANOVA/MANOVA; stepwise discriminant analysis; log-linear analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; time series modeling; forecasting; lag analysis; quality control; process analysis; experimental design (with Taguchi); and much more • Manuals with comprehensive introductions to each procedure and examples • Hypertext-based Stats Advisor expert system • Extensive data management facilities (spreadsheet with long formulas, block operations, advanced clipboard support, DDE hot links, relational merge, data verification, powerful programming language) • Batch command language and macros also supported, "turn-key system" options • All output displayed in Scrollsheets™ (dynamic, customizable, presentation-quality tables with toolbars, pop-up windows, and instant 2D, 3D and multiple graphs) • Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) • Megafile Manager with up to 32,000 variables (8 Mb) per record • Unlimited size of files; extended ("quadruple") precision; unmatched speed • Exchanges data and graphs with other applications via DDE or an extensive selection of file import/export facilities • Hundreds of types of graphs, including categorized multiple 2D and 3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs • Facilities to custom design new graphs and add them permanently to menu • On-screen graph customization with advanced drawing tools, interactive stretching and resizing of complex objects, interactive embedding of graphs and artwork, special effects, icons, maps, multi-graphics management, page layout control for slides and printouts; unmatched speed of graph redraw • Interactive rotation, perspective and cross-sections of all 3D and 4D graphs • Extensive selection of tools for graphical exploration of data: fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets • Price $995.

Quick STATISTICA/W® (for Windows) A comprehensive selection of basic statistics and the full graphics capabilities of STATISTICA/W® • Price $495.

STATISTICA/DO$® (for DOS) A STATISTICA/W-compatible data analysis system • Price $795.

Quick STATISTICA/DO$® (for DOS) A subset of STATISTICA/DOS statistics and graphics • Price $295.

Domestic sh/$10 per product; 14-day money back guarantee. Circle 151 for DOS. Circle 152 for MAC.

StatSoft, Inc.
2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149 Fax: (918) 583-4376


StatSoft, STATISTICA® Quick STATISTICA®, STATISTICA/Mac, Quick STATISTICA/Mac®, STATISTICA/DOS, Quick STATISTICA/DOS, and Scrollsheets are trademarks of StatSoft, Inc.
HUGH KENNER

The camera, they used to tell us, could not lie; something new, because the painter certainly could. Its optical laws assured accurate scale and placing, compliant with the geometry of space. But man’s heart differs from the Leica’s in being a dark forest indeed, and when Leon Battista Alberti in 1436 outlined the algorithm for doing true perspective by hand, clever painters were quick to spot merely a recipe for faking what never was.

Getting rid of the human agent: about 1840 that was like the newfangled scientific method, with its sentences devoid of people—“The rabbit was sacrificed by a blow to the cranium.” Once you let humans in, you’re mired in fudging, messiness. Sure enough, humans soon learned to judge even photos; a print, for instance, might draw on more than one negative. Still, page-turners kept the faith. For “a photograph is fossilized light,” William J. Mitchell reminds us in The Reconfigured Eye: Visual Truth in the Post-Photographic Era.

The reconfigured image exists as a grid of numbers, each naming the state (i.e., hue, brightness) of 1 pixel. Those numbers can make anything possible. The digitized image can be sure is simply a photograph?

Short Subject

A while back I reviewed Jeff Duntemann’s Assembly Language from Square One, an exemplary book that in the way of things exemplary became, almost overnight, unavailable (something to do with publishers buying up publishers). Wiley has now reissued it as Assembly Language Step by Step. It’s been cleaned up and tightened throughout, and it sports two additional chapters: on string functions, and on the “brave new world” of 286, 386, and 486 instructions. There’s still no better introduction to assembly language.

The reconfigured eye is there any longer. For (thanks to the computer) is there anything left you can be sure is simply a photograph?

THE COMPLETE TCP/IP

TCP/IP Network Administration, Craig Hunt, O’Reilly & Associates, $29.95, ISBN 0-937175-82-X.

Craig Hunt’s TCP/IP Network Administration is the most complete TCP/IP book I’ve seen. Despite its technical depth, it doesn’t do too much knowledge. You’ll have to know Unix (the book uses SunOS for most examples, but it also refers to SCO Unix fairly frequently), but beyond that, the author doesn’t even assume you currently have a network.

TCP/IP Network Administration reads like the condensation and analysis of every Unix network manual ever written. There’s plenty of reference material; every Unix network administration command introduced, for example, has its own reference manual–style entry. And unlike Unix documentation, which often stops at the basics, this book details everything from applying for connection to the Internet to the format of various TCP/IP packet headers. Of particular note is the section that makes sense out of the convoluted configuration files used by the BSD E-mail daemon sendmail. This book makes it clear through its use of copious explanations and clear figures.

Whether you’re putting a network together, trying to figure out why an existing one doesn’t work, or wanting to understand the one you’ve got a little better, TCP/IP Network Administration is the definitive volume on the subject.

—Tom Yager
THE ARTIST'S NEW TOOLS


I've spent many hours of work on computer-generated drawings, only to discard them and start over. Why? Because along the way I discovered an easier and better way to accomplish the same result. At times it's quite tricky re-thinking artwork into Bézier curves, PostScript curves, and clipping paths.

Design Essentials gathers such electronic tricks and techniques into one volume that covers drawing, painting, and printing. The drawing section shows you how to create offset outlines (for a drop-shadow effect), draw a five-pointed star, produce 3-D charts, make smooth blends, and generate color gradations within letters. The printing section teaches you how to add drop shadows or an embossing affect to objects; create glowing, shadowed, or recessed text; generate custom textures; and add a stipped appearance to images. The printing section offers a brief explanation of color trapping and overprinting. It also tells you how to halftone an image and create stereoscopic images. Numerous photos and diagrams show explicitly how to achieve a certain effect or result.

If you send drawings to a typesetter for output, the section on creating smooth color blends includes formulas that explain how to calculate the minimum number of gradient steps required to create a smooth blend on the typesetter. This information prevents you from creating artwork that prints on a laser printer but results in costly typesetter crashes. While these tips are oriented around Adobe's Illustrator and Photoshop applications, you can easily apply the techniques in other drawing and painting applications. Even if you're a design expert, you'll find timesaving shortcuts in this book.

—Tom Thompson

GENIUS AT WORK


Richard Feynman’s best-selling as-told-to autobiography, Surely You’re Joking, Mr. Feynman, portrays the renowned theoretical physicist as a wisecracking, safecracking prankster, an aw-shucks prodigy who just happened to have been on hand to help build the atom bomb and then, over the next few decades, steer the course of quantum physics. Through the lens of James Gleick’s superb biography, a more complex and more human Feynman comes into focus. His often childlike behavior reflected a conscious commitment to retain the clean perceptual slate “that was what made every child a physicist.”

Never wholly comfortable with the fashionable physics of probability, strangeness, and charm, Feynman returned again and again to first principles and worked toward an understanding of nature rooted in physical, not just mathematical, intuition. The legendary, near-mystical insights that he regularly produced more than justified Feynman’s willful rejection of the techniques and dogmas of his professional peers. Gleick shows us, as Feynman himself could not, that such iconoclastic methods might as easily terrify as inspire. Some colleagues’ egos and careers were permanently sabotaged by encounters with the slashing Feynman intellect.

But Gleick also shows us a private Feynman whose first wife, Arline Greenbaum, suffered a long and ultimately fatal bout of tuberculosis. Even while engrossed in the Los Alamos project— theorizing about implosion effects, organizing a roomful of calculator-wielding volunteers to form a human-powered computer, analyzing the risks of storing increasingly pure supplies of uranium 235, and all the while upholding his reputation as an irreverent practical joker—Feynman spent every weekend at an Albuquerque sanatorium with his dying lover. An anguished love letter that was written to Arline two years after her death reveals a private torment and sensitivity wholly at odds with Feynman’s brash public image.

We learn too of Feynman’s occasional yet fruitful excursions outside physics. His computational work at Los Alamos scratched the surface of parallel processing. Thinking about miniaturization, he offhandedly invented the field we now call nanotechnology. During a brief stint as an amateur geneticist, Feynman stumbled across a phenomenon called intragenic suppression, which, discovered independently soon after, led Francis Crick to an understanding of how the genetic code is expressed.

Finally, wracked with cancer, Feynman served on the commission investigating the space shuttle Challenger’s catastrophic end. His dramatic experiment with a chunk of O-ring rubber, a C clamp, and a glass of ice water caught the NASA bureaucrats flat-footed. “The public saw with their own eyes,” Gleick reports Freeman Dyson to have said, “how a great scientist thinks with his hands, how nature gives a clear answer when a scientist asks her a clear question.”

—Jon Udell

CD-ROM SMORGASBORD

Nautilus, $137.40 per year (13 issues) from Metatec Discovery Systems, 7001 Discovery Blvd., Dublin, OH 43017, (800) 637-3472 or (614) 766-3165; fax (614) 761-4110.

Nautilus offers a potpourri of information in a monthly format that includes news, shareware programs, demonstration software, images, and sounds for Windows users. The content, regrettably, is a bit weak.

In the three editions I saw, the news items consisted of rehashed press releases with little analysis or objective reporting. Most of the games were bland, and the educational essays consisted of limited scope and depth. A listing of CDs was so full of marketing hype that I found it impossible to separate the good products from the bad. And the educational programs consisted mainly of demonstration programs.

Nautilus has potential but needs a focus. It falls into the old trap of trying to please everyone and comes up short all around.

—Stanford Diehl
If you are an OS/2 or Windows NT developer and you are porting an application that needs robust 32-bit support, your wait is over. Microway is currently shipping NDP Fortran-386/486 for OS/2 or NT, along with our CIC++ and Pascal. Our products work with the IBM and MS linkers and can directly access their respective APIs, taking full advantage of the 386/486 gigabyte address space. The biggest advantage of these new 32-bit operating systems over DOS is their ability to pre-emptively multitask, which dramatically improves the speed of hard disk I/O and multitasking in general.

Microway has also engineered a complete line of 486 workstations which are ideal platforms for both developers and users who are into number crunching. Using removable hard disks, we can set up a system for you that can be used for DOS, OS/2 and UNIX development! Scientists and engineers will appreciate the fact that our top of the line 486 boxes use industrial strength power and cooling—that's one of the reasons why half of our Number Smasher-860s have gone out in a 50 MHz 486 B+ workstation. Another important reason is the fact that the 800 can save you thousands of dollars per month in Cray or 3860 rentals. For more information, please call Microway's Technical Support Department at (508) 746-7341.

### 386, 486 and i860 Compilers

Our NDP family of compilers generate globally optimized, mainframe quality code that runs on the 386, i486, or i860 in protected mode under Windows NT, DESQview, UNIX, OS/2, or extended DOS. The compilers address 4 gigabytes of memory while supporting the 287, 387, Weitek, and Cyrix EMC coprocessors. Applications can mix code from all three compilers and assembly language. To simplify your ports, we offer ClearView, our full-featured, windowing symbolic debugger that works with DOS versions of NDP 386 and 486 compilers.

**NDP Fortran™** is a full F77 with F66 and DOD extensions that is 95% VMS compatible. Also contains new F90 features & MS compatibility.

**CIC++™** runs in three modes: K&R with Sys V and MS C extensions; 100% ANSI C; and C++ Release 2.1 compatible.

**Pascal™** is a full ANSI/IEEE Pascal, with extensions from C and BSD 4.2 Pascal.

### NDP Language Pricing

**NDP Fortran**, CIC++, or Pascal — DOS products include NDP Tools and Extender, 486 DOS version includes Weitek support, royalty-free binder, and ClearView-386. All DOS compilers come with GRESX, Microway’s library of 160 MS C compatible lower level graphics and hardware interface routines.

<table>
<thead>
<tr>
<th><strong>OS/2</strong></th>
<th><strong>DOS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>$695</td>
<td>$695</td>
</tr>
</tbody>
</table>

**386/486 Compilers**

<table>
<thead>
<tr>
<th><strong>386</strong></th>
<th><strong>486</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>$295</td>
<td>$495</td>
</tr>
</tbody>
</table>

**386/486 Pascal Compilers**

<table>
<thead>
<tr>
<th><strong>486</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>$495</td>
</tr>
</tbody>
</table>

**386/486DOS Compilers**

<table>
<thead>
<tr>
<th><strong>386</strong></th>
<th><strong>486</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>$1995</td>
<td>$1995</td>
</tr>
</tbody>
</table>

**NDP Language Pricing**

- **Basic Library** $500
- **DSP** $500

<table>
<thead>
<tr>
<th><strong>i860 Vectorizers and Libraries</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NDP NAG/860™ is a Microway port of the NAG workstation library to the 860.</strong></td>
</tr>
<tr>
<td><strong>NDP HALO-660 includes HALO Professional and an interface library which makes HALO directly callable by the 860.</strong></td>
</tr>
<tr>
<td><strong>860 Vectorizer includes PSR VAST-2 which converts a C or FORTRAN program into a new program which calls the Intel Vector Library.</strong></td>
</tr>
<tr>
<td>**860 Vector Library - <strong>Written for Intel, includes over 400 vector primitives that take advantage of the 860’s cache, dual instruction mode, and pipelined multiplier accumulator.</strong></td>
</tr>
<tr>
<td><strong>IGL - 3-D Graphics Pipeline that performs geometry and rendering using routines which use the 860’s built-in graphics hardware.</strong></td>
</tr>
<tr>
<td><strong>Kuck &amp; Associates CLASSPACK—Hand-coded, pipelined libraries for the 860.</strong></td>
</tr>
<tr>
<td><strong>Basic Library</strong> $500</td>
</tr>
<tr>
<td><strong>DSP Over 100 routines including 1 and 2-D convolutions and convolutions.</strong></td>
</tr>
<tr>
<td><strong>Dense Array solver package.</strong></td>
</tr>
</tbody>
</table>

**Math Co-processors/Oversize**

| **WEITEK: 4167-25/33** | **$350/$595** |
| **3167-29/33** | **$520/$850** |

**mW65167 Micro Channel-25/33 from $700**

**mW65167/80387 Board from $200**

**INTEL: 287XL**

| **387SX $80** |
| **387 16-33: $90** |

**Overdrive 20 MHz: $425 25 MHz: $545**

**dCAD** $350

**Cyrix:**

| **F3387-25: $79** |
| **F3387-33: $99** |

**Math Co-processors/Oversize**

<table>
<thead>
<tr>
<th><strong>Target</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FASTCache-SX/Plus™</strong>—The “Windows Solution.” Converts your 286 into a powerful 25 MHz 386SX. Combines Microway’s award-winning FASTCache-SX accelerator with up to 16 meg of extended memory. Features an Intel 486-style 16k internal cache and 386SX coprocessor socket. Use a 16-bit slot, outperforms most SX systems. Installs in minutes in over 100 AT systems including AST, Compaq, Epson, HP, IBM, NCR, NEC, Sperry, Tandy, Zenith and more.**</td>
</tr>
<tr>
<td><strong>FASTCache-SX/Plus-25</strong> $495</td>
</tr>
</tbody>
</table>

**Math Co-processors/Oversize**

<table>
<thead>
<tr>
<th><strong>Target</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DE-804</strong>- ISA 64K cache 250W $295</td>
</tr>
</tbody>
</table>

**DE-804**- ISA 25K cache 250W $249

**DE-804**- ISA 50 ISA 25K cache 250W $396

**DE-804**- ISA 25K cache 350W $449

**Math Co-processors/Oversize**

<table>
<thead>
<tr>
<th><strong>Target</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DE-804</strong>- ISA 64K cache 250W $495</td>
</tr>
</tbody>
</table>

**Math Co-processors/Oversize**

<table>
<thead>
<tr>
<th><strong>Target</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DE-804</strong>- ISA 25K cache 250W $295</td>
</tr>
<tr>
<td><strong>DE-804</strong>- ISA 50 ISA 25K cache 250W $396</td>
</tr>
</tbody>
</table>

**Math Co-processors/Oversize**

<table>
<thead>
<tr>
<th><strong>Target</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DE-804</strong>- ISA 25K cache 350W $449</td>
</tr>
</tbody>
</table>

**Circle 119 on Inquiry Card.**
Advancing technologies have driven the development of a new generation of notebook and subnotebook systems that boast a longer battery life, faster processors, more memory, greater mass-storage capacity, and better displays. These systems pack desktop-level performance, but they have lacked the standard expansion slots common to desktop systems. The relatively new PCMCIA (Personal Computer Memory Card International Association) standard is changing that, opening the door to placing add-ins such as modems, network adapters—even disk drives—on a device approximately the size of a credit card.

The PCMCIA was born out of the need for a removable mass-storage alternative to the relatively large and power-hungry floppy drive for notebook and subnotebook computers. Memory cards were a viable, low-power alternative to floppy disks for such applications, so the PCMCIA developed an interface specification to standardize the electrical, mechanical, and functional interfaces for these cards. Shortly thereafter, the PCMCIA enhanced its PC card standard to look more like a memory and peripheral expansion slot.

The PCMCIA standard has been widely accepted by a long list of established computer-industry vendors, including IBM, AT&T, Intel, NCR, and Toshiba. As you read this, a deluge of new PCMCIA-compatible systems and add-in cards should be hitting the market. Modern and network-interface cards are already available, and disk drives on a card are sure to appear in 1993. The first systems to include PCMCIA slots are already here: AST’s PowerExec 386SL/25 and Dell’s 320SLi are two such systems introduced earlier this year.

The First Release
Release 1.0 of the PCMCIA standard, introduced in August 1990, supported all standard memory types except for DRAM. The list included ROM, OTPROM (one-time programmable ROM), UV-EPROM (ultraviolet EPROM), EEPROM, flash memory (a newer, more economical type of EPROM), SRAM (static RAM), and PSRAM (pseudo-SRAM, a type of DRAM that acts like SRAM). PCMCIA has worked closely with JEIDA to introduce standards documents in Japan that correspond to those issued in the U.S.

The release 1.0 interface was adequate for supporting memory cards, but the PCMCIA went on to include many general-purpose enhancements in release 2.0 in September 1991. Enhancements included support for I/O devices, additional support for flash-memory devices, support for dual-voltage (5-volt/3-V) cards, and an XIP (execute-in-place) mechanism. The dual-voltage card support allows for the next generation of subnotebook computers, which will use 3-V IC technology to minimize power consumption. The XIP mechanism allows applications to execute directly from the PC card.
to preserve system memory.

Along with the release 2.0 standard, the PCMCIA developed the Socket Services Interface Specification to establish a standard set of system calls for PC card operations. Socket Services forms a BIOS of sorts that allows a system to maintain hardware independence and ensure software portability. The PCMCIA introduced the first Socket Services specification (release 1.0) in August 1991; it released a slightly modified version (release 1.01) one month later. The PCMCIA has since made an effort to better define and enhance Socket Services functions and has beefed up support for protected-mode operation. Work on a higher-level software layer, called Card Services, commenced in early 1992 and was to be ratified as this article went to press.

Physical Definition

The PCMCIA standard defines a 68-pin connector that interconnects a PC card with a PCMCIA interface port in the host computer. The PC cards have a socket (female) connector, while the system interface ports use mating pin (male) connectors. The standard defines three different pin lengths for the system side of the interface. This design ensures that power is applied first and removed last when cards are inserted into and removed from a PC card port. This is necessary to guarantee reliable operation when inserting and removing PC cards in an electrically live socket.

The release 2.0 specification defines Type I and Type II card sizes (see figure 1). All cards measure 2.12 inches wide by 3.37 inches deep, but thickness varies. Type I cards are 0.533 millimeters thick. Type II cards measure 5.0 mm in the center but maintain a 3.3-mm thickness around the outer edges to remain compatible with system interface ports designed for Type I devices.

The PCMCIA recently defined a Type III card as an extension of the release 2.0 standard. This card is the same width and length but is 10 mm thick to accommodate large devices that cannot fit on Type I or II cards, such as Hewlett-Packard's new 1.3-inch hard drive. Like the Type II card, the Type III card maintains a 3.3-mm thickness at the outer edges, but it nonetheless requires a double-height slot.

Additional release 2.0 extensions stretch the length of Type I and II cards to 5.733 inches, leaving almost 2 inches protruding from the PCMCIA slot, and extend the height for the overhanging section to a maximum of 0.38 inch. This design is intended to support modern cards, which must include an RJ-11 jack and telephone-line transformer on-board.

The PCMCIA standard goes beyond mechanical dimensions to dictate the location of the write-protect switch, internal backup battery, vendor's label, and PCMCIA/JEIDA logos, if these items are present. Compliant PC cards must accept programming of specific types of memory chips, but the host system can reconfigure it to be an IREQ (interrupt request) line when it detects the presence of an I/O card.

Electrically, all PC cards look like a memory card until the host system initializes them. The host system then changes the appropriate pin functions as necessary. Signals that were specifically added for I/O operations include IREQ, IORD (I/O read), IOWR (I/O write), INPACK (input acknowledge), SPKR (audio output), IOIS16 (16-bit I/O select), and STSCHG (status change). The PCMCIA specification also defines several signals for memory chip support, including Vpp1 and Vpp2 (two programming supply voltages), RDY/BSY, BVDA1 and BVDB2 (battery voltage detects), WP (write protect), WE/PGM (write enable/program), and RFSH (refresh).

For memory accesses, the OE (output

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Standard function (alternative function)</th>
<th>In/out?</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Ground</td>
<td>Data-bus bit 3</td>
</tr>
<tr>
<td>2</td>
<td>D3</td>
<td>I/O</td>
<td>Data-bus bit 4</td>
</tr>
<tr>
<td>3</td>
<td>D4</td>
<td>I/O</td>
<td>Data-bus bit 5</td>
</tr>
<tr>
<td>4</td>
<td>D5</td>
<td>I/O</td>
<td>Data-bus bit 6</td>
</tr>
<tr>
<td>5</td>
<td>D6</td>
<td>I/O</td>
<td>Data-bus bit 7</td>
</tr>
<tr>
<td>6</td>
<td>D7</td>
<td>I/O</td>
<td>Card enable</td>
</tr>
<tr>
<td>7</td>
<td>-CE1</td>
<td>I</td>
<td>Address-bus bit 10</td>
</tr>
<tr>
<td>8</td>
<td>A10</td>
<td>I</td>
<td>Output enable</td>
</tr>
<tr>
<td>9</td>
<td>-OE</td>
<td>I</td>
<td>Address-bus bit 11</td>
</tr>
<tr>
<td>10</td>
<td>A11</td>
<td>I</td>
<td>Address-bus bit 9</td>
</tr>
<tr>
<td>11</td>
<td>A9</td>
<td>I</td>
<td>Address-bus bit 8</td>
</tr>
<tr>
<td>12</td>
<td>A8</td>
<td>I</td>
<td>Address-bus bit 13</td>
</tr>
<tr>
<td>13</td>
<td>A13</td>
<td>I</td>
<td>Address-bus bit 14</td>
</tr>
<tr>
<td>14</td>
<td>A14</td>
<td>I</td>
<td>Write enable</td>
</tr>
<tr>
<td>15</td>
<td>-WE/PGM</td>
<td>O</td>
<td>Ready/busy or interrupt request</td>
</tr>
<tr>
<td>16</td>
<td>+RDY/-BSY (+IREQ)</td>
<td>O</td>
<td>Power</td>
</tr>
<tr>
<td>17</td>
<td>Vcc</td>
<td>1</td>
<td>Address-bus bit 16</td>
</tr>
<tr>
<td>18</td>
<td>Vpp1</td>
<td>I</td>
<td>Address-bus bit 15</td>
</tr>
<tr>
<td>19</td>
<td>A16</td>
<td>I</td>
<td>Address-bus bit 12</td>
</tr>
<tr>
<td>20</td>
<td>A15</td>
<td>I</td>
<td>Address-bus bit 7</td>
</tr>
<tr>
<td>21</td>
<td>A12</td>
<td>I</td>
<td>Address-bus bit 6</td>
</tr>
<tr>
<td>22</td>
<td>A7</td>
<td>I</td>
<td>Address-bus bit 5</td>
</tr>
<tr>
<td>23</td>
<td>A6</td>
<td>I</td>
<td>Address-bus bit 4</td>
</tr>
<tr>
<td>24</td>
<td>A5</td>
<td>I</td>
<td>Address-bus bit 3</td>
</tr>
<tr>
<td>25</td>
<td>A4</td>
<td>I</td>
<td>Address-bus bit 2</td>
</tr>
<tr>
<td>26</td>
<td>A3</td>
<td>I</td>
<td>Address-bus bit 1</td>
</tr>
<tr>
<td>27</td>
<td>A2</td>
<td>I</td>
<td>Address-bus bit 0</td>
</tr>
<tr>
<td>28</td>
<td>A1</td>
<td>I</td>
<td>Data-bus bit 0</td>
</tr>
<tr>
<td>29</td>
<td>A0</td>
<td>I</td>
<td>Data-bus bit 1</td>
</tr>
<tr>
<td>30</td>
<td>D0</td>
<td>I/O</td>
<td>Data-bus bit 2</td>
</tr>
<tr>
<td>31</td>
<td>D1</td>
<td>I/O</td>
<td>Write protect</td>
</tr>
<tr>
<td>32</td>
<td>D2</td>
<td>O</td>
<td>or I/O port is 16-bit</td>
</tr>
<tr>
<td>33</td>
<td>+WP (IOIS16)</td>
<td>O</td>
<td>Ground</td>
</tr>
<tr>
<td>34</td>
<td>GND</td>
<td>Ground</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Table 1: The signals assigned to the PCMCIA 68-pin connector all initially support memory-specific functions, but they can be switched to alternative functions for other types of cards.
UNDER THE HOOD

**PCMCIA PC CARD PIN ASSIGNMENTS**

<table>
<thead>
<tr>
<th>Pin number</th>
<th>Standard function (alternative function)</th>
<th>In/out?</th>
<th>Function description</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>-CD1</td>
<td>O</td>
<td>Card detect</td>
</tr>
<tr>
<td>37</td>
<td>D11</td>
<td>I/O</td>
<td>Data-bus bit 11</td>
</tr>
<tr>
<td>38</td>
<td>D12</td>
<td>I/O</td>
<td>Data-bus bit 12</td>
</tr>
<tr>
<td>39</td>
<td>D13</td>
<td>I/O</td>
<td>Data-bus bit 13</td>
</tr>
<tr>
<td>40</td>
<td>D14</td>
<td>I/O</td>
<td>Data-bus bit 14</td>
</tr>
<tr>
<td>41</td>
<td>D15</td>
<td>I/O</td>
<td>Data-bus bit 15</td>
</tr>
<tr>
<td>42</td>
<td>-CE2</td>
<td>I</td>
<td>Card enable</td>
</tr>
<tr>
<td>43</td>
<td>RFSH</td>
<td>I</td>
<td>Refresh</td>
</tr>
<tr>
<td>44</td>
<td>RFU (reserved) (-IORD)</td>
<td>I</td>
<td>Reserved or I/O read</td>
</tr>
<tr>
<td>45</td>
<td>RFU (reserved) (-IOWR)</td>
<td>I</td>
<td>Reserved or I/O write</td>
</tr>
<tr>
<td>46</td>
<td>A17</td>
<td>I</td>
<td>Address-bus bit 17</td>
</tr>
<tr>
<td>47</td>
<td>A18</td>
<td>I</td>
<td>Address-bus bit 18</td>
</tr>
<tr>
<td>48</td>
<td>A19</td>
<td>I</td>
<td>Address-bus bit 19</td>
</tr>
<tr>
<td>49</td>
<td>A20</td>
<td>I</td>
<td>Address-bus bit 20</td>
</tr>
<tr>
<td>50</td>
<td>A21</td>
<td>I</td>
<td>Address-bus bit 21</td>
</tr>
<tr>
<td>51</td>
<td>Doc</td>
<td>I</td>
<td>Power</td>
</tr>
<tr>
<td>52</td>
<td>Vpp2</td>
<td></td>
<td>Programming supply voltage 2</td>
</tr>
<tr>
<td>53</td>
<td>A22</td>
<td>I</td>
<td>Address-bus bit 22</td>
</tr>
<tr>
<td>54</td>
<td>A23</td>
<td>I</td>
<td>Address-bus bit 23</td>
</tr>
<tr>
<td>55</td>
<td>A24</td>
<td>I</td>
<td>Address-bus bit 24</td>
</tr>
<tr>
<td>56</td>
<td>A25</td>
<td>I</td>
<td>Address-bus bit 25</td>
</tr>
<tr>
<td>57</td>
<td>RFU (reserved) (-RESET)</td>
<td>O</td>
<td>Reset</td>
</tr>
<tr>
<td>58</td>
<td>RFSH</td>
<td>I</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>59</td>
<td>RFU (reserved) (-WAI T)</td>
<td>O</td>
<td>Extend bus cycle</td>
</tr>
<tr>
<td>60</td>
<td>RFU (reserved) (-IN PACK)</td>
<td>O</td>
<td>Reserved or input port acknowledge</td>
</tr>
<tr>
<td>61</td>
<td>REG</td>
<td></td>
<td>Register select</td>
</tr>
<tr>
<td>62</td>
<td>BVD2 (-SPKR)</td>
<td>O</td>
<td>Battery voltage detect 2 or audio-digital waveform</td>
</tr>
<tr>
<td>63</td>
<td>BVD1 (STCHG)</td>
<td>O</td>
<td>Battery voltage detect 1 or card statuses changed</td>
</tr>
<tr>
<td>64</td>
<td>D8</td>
<td>I/O</td>
<td>Data-bus bit 8</td>
</tr>
<tr>
<td>65</td>
<td>D9</td>
<td>I/O</td>
<td>Data-bus bit 9</td>
</tr>
<tr>
<td>66</td>
<td>D10</td>
<td>I/O</td>
<td>Data-bus bit 10</td>
</tr>
<tr>
<td>67</td>
<td>-CD2</td>
<td>O</td>
<td>Card detect</td>
</tr>
<tr>
<td>68</td>
<td>GND</td>
<td></td>
<td>Ground</td>
</tr>
</tbody>
</table>

enable) signal becomes the read strobe, while the WE/PGM signal operates as the write strobe. For I/O operations, separate IORD and IOWR signals exist for the read and write strobes. Two card-enable signals, CE1 and CE2, provide access to PC cards by enabling bytes at even-numbered and odd-numbered addresses respectively. A multiplexing scheme, based on A0, CE1, and CE2, enables 8-bit host systems to access all data on D0–D7, if desired.

PC cards include a separate 64-MB memory-space area called *attribute memory*, which the host system accesses by asserting the REG (register select) signal. This special section of memory is distinct from main memory. In general, it’s used to record card- and vendor-specific information such as card capacity and other configuration and attribute data. It’s also used to access standardized card-configuration registers. The host system also asserts REG for I/O accesses.

While 3-V operation will become increasingly valuable as more systems based on 3-V IC technology appear on the market, PC cards placed into a 3-V system must start out operating with a 5-V interface. The system then configures the card for 3-V operation if the card supports it.

### The Software Interface

To permit software access to PC card functions in a hardware-independent manner, the PCMCIA developed a set of system functions that applications can call by way of Card Services (see figure 2). At the most fundamental level, this consists of a group of functions called Socket Services. In a PC environment, you access Socket Services by way of interrupt 1Ah. Table 2 shows the Socket Services available in the current release 1.01 specification.

Socket Services views its resources in terms of adapters and sockets. An adapter is the hardware that connects the local computer bus to PCMCIA-compatible sockets, while a socket is the 68-pin interface connector into which you insert a PC card. A host system generally has only a single adapter, but it can support multiple adapters, and a single adapter can have multiple sockets.

The concept of memory-space windows is integral to the design of Socket Services. An area of a PC card’s memory or I/O space is mapped into system memory or I/O space through a window—a reserved addressing range—that consists of zero or more pages. If a window is paged, all the pages within the window must be contiguous and of equal size. I/O-spaced windows are not paged.

Error detection is another important area. Some memory cards are EDC (error-detection code) generators, which means that they can detect memory errors. This is important for applications that want to ensure data integrity.

Socket Services reports the number of sockets, windows, and EDC generators for each adapter in a system. It can also report and alter the configurations of installed PC cards. While Socket Services provides access to all PC card features, it does not include all possible types of write/erase routines. Since there are many of these functions (called memory technology drivers), and since they are specific to the memory type and manufacturer, a higher-level software layer usually handles them.

In order to handle numerous data-recording formats and data organizations, the release 2.0 standard defines a metaformat that consists of a hierarchy of layers: physical (layer 0), basic compatibility (layer 1), data-recording format (layer 2), data organization (layer 3), and systemspecific (layer 4).

The physical layer specifies the interface signals and electrical characteristics described above. The basic compatibility layer describes a minimal level of organization of the data on a PC card. All PC cards must support this layer by including a CIS (card information structure), which starts at location zero of the attribute memory space. The information in the CIS describes the card’s organization, including memory type, size, speed, and other information. The data-recording format layer specifies the PC card’s data organization at the lowest level. The data-organization layer, one level higher, describes the logical organization of the data. The systemspecific layer defines operations or interfaces specific to a particular operating environment.

Socket Services comprises six function categories. The nonspecific functions
The PCMCIA specifies three basic PC card sizes. All measure 2.12 inches wide by 3.37 inches deep. However, Type I PC cards are 3.3 mm thick, while Type II and Type III cards have thicknesses of 5 mm and 10 mm, respectively. The Type II card fits into any PCMCIA slot; the Type III card requires a double-height slot.

Card Services
Socket Services is the lowest software layer of a multilayer software hierarchy. Higher layers may be operating-system specific and may allow the creation of virtual Socket Services, so that any PC card can be shared by multiple processes. Seeing the need to specify the next layer above Socket Services, the PCMCIA working group began work on the Card Services specification in early 1992 and was to present the specification’s first release in September. Card Services controls the operation of individual cards by sending transactions over the bus via Socket Services.

The PC card architecture consists of one or more implementations of low-level (hardware-dependent) Socket Services, which interact directly with PC card adapters. Card Services provides PC card access to programs (clients) running in the system and coordinates PC card resource use between clients.
UNIX is changing the world of computers, the world of business – quite simply, changing the world. It’s revolutionizing office automation. It’s required for U.S. government computer contracts. It’s the backbone of information strategies worldwide.

That’s why you need **UNIXWorld** — the magazine that keeps you up to date on the rapidly changing world of open systems computing. Each issue brings you the latest product trends and technical advances that can affect your business. The inside story on some of the biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

**UNIXWorld**’s in-depth features go beyond dry technical facts to show how the pieces fit together — to tell you what’s important about the advances and strategies that are changing your world. And **UNIXWorld** consistently offers the freshest, most down-to-earth writing that you’ll find in any computer publication.

Subscribe today and receive the next 12 issues of **UNIXWorld** for just $18.00 — half the regular newsstand price. Save even more by ordering for two or three years. You can’t lose—every subscription to **UNIXWorld** comes with a no-risk guarantee*.

If you’re into UNIX, you need **UNIXWorld**

---

*UNIXWorld’s no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.

UNIX is a registered trademark of UNIX System Laboratories, Inc.
UNDER THE HOOD

Card Services acts as the liaison between multiple clients (tasks running in the system) and PC cards, sockets, and other system resources. All client tasks must make calls to Card Services to access PC card functions, which in turn make the necessary Socket Services calls to effect the requested operations. While a system can have multiple distinct implementations of Socket Services to accommodate multiple adapters in a system (Socket Services is hardware-dependent), only a single implementation of Card Services can be present in a system. Card Services coordinates all requested PC card operations when multiple Socket Services implementations are present.

Intel, an active PCMCIA participant, has defined its own software interface environment that replaces Card Services. The exchangeable card architecture, or ExCA, predates Card Services and was the model on which much of the Card Services was based. ExCA remains a superset of the defined PCMCIA functions and, with certain modifications, may at some point become a more integral part of the PCMCIA standard.

Compatibility Snags
The PCMCIA standard is proving its importance in the development of subnotebook systems. The push for so much functionality has not, however, been without its problems.

The definition of the PCMCIA software interface lagged behind the relatively solid physical-interface definition. As this article went to press, the dust was still settling on the latest revisions to Socket Services and Card Services. Several companies, including Phoenix Technologies and SystemSoft, had already developed Socket Services code for use in PCs. With over 50 suppliers preparing to rush PCMCIA-compatible products into production in time for Fall Comdex, the potential for PC card compatibility problems loomed.

PCMCIA executive director Brendan McGuire dismissed such speculation. He claimed that these concerns are overblown, that the software is mature, and that most vendors have designed their systems to easily accommodate any upgrades that are made to the Socket Services and Card Services. Any problems that arise should be short-lived, as vendors quickly revise their software.

PCMCIA cards are considerably more expensive than standard PC card add-in boards. For example, a 2400-bps data/fax modem card was selling for approximately $300 at press time, versus about $99 for a typical AT-bus card. And solid-state memory costs quite a bit more per megabyte than...
Here's How To Organize Your Finances And Have Time To Relax!

**Balance.** Gives you current balance after every transaction.

**Payee.** Remembers every check you've ever written. Never enter a payee twice.

**Address.** Prints it on your check and remembers it.

**Category.** Assigns your transaction to one or more budget categories.

**Date.** Automatic. You never have to re-enter it.

**Check Number.** Remembers last check number and inserts the next one.

**Memo.** Enter a brief description or a memo of any length.

**By.** Pay bills by check or electronically via CheckFree?

---

**New Andrew Tobias' Managing Your Money® Version 9.0**

Takes care of everything. With it, you'll pay bills, balance your checkbook, track your investments, keep all your records, phone numbers and calendar, print reports, and more.

**Gain New Confidence**

Managing Your Money helps you analyze and plan your finances. You'll feel better knowing you've taken care of your responsibilities and can meet your commitments.

**Well Within Your Grasp**

Managing Your Money takes minutes to install, learn and use. You'll enjoy almost instant control over your finances. If it has more than you need right away, the tools are there when you're ready.

**Here's A Quick Tour**

- Organize and track all your expenses by Category and Subcategory. See where your hard-earned money is going.
- Print out your checks automatically. Reminds you of your recurring payments (mortgage, car loan, insurance bills, etc.).
- Import data from Quicken for more complete analysis and download financial data from PRODIGY's® BillPay USA™ and PCF™ with the separate Import Capability utility disk. Check box on order form to get it free.
- Figure your net worth anytime.
- Maintain an up-to-date portfolio valuation.
- Print out reports: check register, net worth statement, portfolio status, and more.
- Set up monthly budgets for up to five years. Compare your expenses against budget.
- Estimate your tax bill anytime. Form 1040, Schedule C, and six more.
- Analyze insurance, children's education and retirement needs, loan amortization, mortgage refinancing decisions, lots more.
- Run your small business. Maintain complete payables and receivables, profit and loss statements, cash forecasting, and balance sheets. Print invoices.
- Update portfolio prices directly from CompuServe® and Dow Jones.

**Try Managing Your Money FREE**

Just pay $8.50 for shipping billed to your credit card (non-refundable), and we'll send you Managing Your Money to try for 30 days. If you're not more organized, with more time to relax, return the "No Thank You" card enclosed with the package. We won't charge you anything more. Don't even return the software.

But, if you're pleased, do nothing. Thirty-five days after we ship, we'll bill your credit card the balance of $49.95, and also send you a Free Software Bonus: Home Lawyer® (a $49.95 value). Take this opportunity to get organized and relax. You've got nothing to lose. But you must respond to this unique offer by January 31, 1993.

**To Order Call:** 1-800-284-1546 ext. 313 (24 hours a day)

**Or Fax To:** 1-800-944-6322 (24 hours a day)

**Or Mail Your Order Form To:** MECA Software, Inc. Box 912, Fairfield CT 06430-0912

**Free Software Bonus**

We'll send you a copy of Hyatt Legal Services' Home Lawyer® (a $49.95 value) absolutely free when we receive full payment for Managing Your Money. It gives you living will, last will and testament, residential lease, power of attorney, bill of sale, request for credit report, and much more. (Macintosh users get MacUSA™, a $69.95 value.)

---

**NEW Version 9.0. Now Import Data From Quicken®**

---

**Yes! Send me Andrew Tobias' Managing Your Money and charge my credit card $8.50 for shipping (not refundable). If not happy, I'll return the included "No Thanks" card and that will be it. Otherwise, in 35 days, you'll bill my credit card the balance of $49.95 and send Home Lawyer, a $49.95 value. (Credit cards only for Free Trial Option.)

**Media (if no box checked, we'll ship 5½" DOS)**

- DOS 5½" (MMIT5)  
- DOS 3½" (MMIT3)

**Early Decision Option!** My check is enclosed or charge my credit card the full $49.95. Send me everything now, including Home Lawyer (MECA pays shipping). If I'm not completely happy, I'll return Managing Your Money and Home Lawyer within 30 days for a full refund.

**Payment Method:** (CA, CT, FL, TX residents add sales tax)

- Check or Money Order Payable to MECA Software, Inc. (Early Decision Option Only — Save Shipping Cost)
- Please charge my:  
  - VISA  
  - MasterCard  
  - Am. Express

**Card #:**

**Exp. Date:**

**Signature:**

**Daytime Phone:**

**Name:**

**Address:**

**City:**

**ST:**

**Zip:**

**Mail to:** MECA® Software, Inc. Dept. 313  
Box 912, Fairfield, CT 06430-0912
Table 2: Socket Services consists of a set of low-level system functions that application programs can call. PCs access Socket Services by way of interrupt 1Ah. Resources appear as adapters (the hardware that connects the system bus to a PCMCIA socket) and sockets (the 68-pin interface connector into which you insert a PC card).

<table>
<thead>
<tr>
<th>Category</th>
<th>Function Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nonspecific functions</strong></td>
<td></td>
</tr>
<tr>
<td>Get number of adapters</td>
<td>Returns the number of adapters supported by Socket Services.</td>
</tr>
<tr>
<td>Register status callback</td>
<td>Registers a callback routine to be invoked at status changes.</td>
</tr>
<tr>
<td>Register card technology callback</td>
<td>Registers a callback routine to be invoked at write request to a card that doesn't support Write multiple.</td>
</tr>
<tr>
<td><strong>Adapter functions</strong></td>
<td></td>
</tr>
<tr>
<td>Get Socket Services version number</td>
<td>Returns version number of current Socket Services handler.</td>
</tr>
<tr>
<td>Inquire adapter</td>
<td>Returns information for a particular adapter.</td>
</tr>
<tr>
<td>Get adapter</td>
<td>Returns the current configuration of the specified adapter.</td>
</tr>
<tr>
<td>Set adapter</td>
<td>Sets the configuration of the specified adapter.</td>
</tr>
<tr>
<td><strong>Window functions</strong></td>
<td></td>
</tr>
<tr>
<td>Inquire window</td>
<td>Returns information for a particular window.</td>
</tr>
<tr>
<td>Get window</td>
<td>Returns the current configuration of the specified window.</td>
</tr>
<tr>
<td>Set window</td>
<td>Sets the configuration of the specified window.</td>
</tr>
<tr>
<td>Get page</td>
<td>Returns the current configuration for a particular window page.</td>
</tr>
<tr>
<td>Set page</td>
<td>Sets the status for a particular window page.</td>
</tr>
<tr>
<td><strong>Socket functions</strong></td>
<td></td>
</tr>
<tr>
<td>Inquire socket</td>
<td>Returns information for a particular socket.</td>
</tr>
<tr>
<td>Get socket</td>
<td>Returns the current configuration for the specified socket.</td>
</tr>
<tr>
<td>Set socket</td>
<td>Sets the configuration for the specified socket.</td>
</tr>
<tr>
<td><strong>Card functions</strong></td>
<td></td>
</tr>
<tr>
<td>Get card</td>
<td>Returns the status of a particular socket.</td>
</tr>
<tr>
<td>Reset card</td>
<td>Resets a particular card.</td>
</tr>
<tr>
<td>Read one</td>
<td>Reads 1 byte/word from a particular socket.</td>
</tr>
<tr>
<td>Write one</td>
<td>Writes 1 byte/word to a particular socket.</td>
</tr>
<tr>
<td>Read multiple</td>
<td>Reads multiple bytes/words from a particular socket.</td>
</tr>
<tr>
<td>Write multiple</td>
<td>Writes multiple bytes/words to a particular socket.</td>
</tr>
<tr>
<td><strong>EDC functions</strong></td>
<td></td>
</tr>
<tr>
<td>Inquire EDC</td>
<td>Returns the capabilities of specific EDC hardware.</td>
</tr>
<tr>
<td>Get EDC</td>
<td>Returns the configuration of an EDC generator.</td>
</tr>
<tr>
<td>Set EDC</td>
<td>Sets the EDC configuration.</td>
</tr>
<tr>
<td>Start EDC</td>
<td>Starts a previously configured EDC generator.</td>
</tr>
<tr>
<td>Pause EDC</td>
<td>Pauses EDC generation on an operating EDC generator.</td>
</tr>
<tr>
<td>Resume EDC</td>
<td>Resumes EDC generation on a paused EDC generator.</td>
</tr>
<tr>
<td>Stop EDC</td>
<td>Stops EDC generation on an operating EDC generator.</td>
</tr>
<tr>
<td>Read EDC</td>
<td>Reads a calculated value from the EDC hardware.</td>
</tr>
</tbody>
</table>

standard rotating media. However, prices are expected to come down as products begin to ship in volume. PC cards are a simple, easy-to-carry alternative to floppy disks, and they’re more appropriate for the small size and power-consumption requirements of subnotebook and handheld computers.

You can expect to see more PCMCIA "drives" in more desktop machines as the PCMCIA interface standard gains in popularity and as users demand easier data transfers with their subnotebook and pocket-size computers. Thanks to the PCMCIA standard, it’s no longer necessary to give up expandability and easy network interfacing to have a small portable computer.

ACKNOWLEDGMENT

Thanks to Brendan McGuire, executive director of the PCMCIA, for his help in preparing this article.

Roger C. Alford, a BYTE consulting editor, is president of Programmable Designs, a Michigan-based electronics design services firm. You can reach him on BIX as "rogera."
Decisions, decisions, decisions.

Decider, decider, decider.

Down-sizing, upgrading, multi-platform environments. Today’s computer hardware issues are more numerous, more difficult, more critical than ever. So how do companies make decisions?

According to a new IntelliQuest study, they turn to the only person qualified to decide: Someone like Bob Barrett. A person with 18 years in computers. Who oversees a technical staff of 75. And whose buying decisions and approvals affect nearly 3,000 users worldwide.

In other words, they turn to the BYTE reader. A full 92% of whom control the products and brands their companies buy.

If you want to reach an audience as influential as this, then yours is an easy decision—advertise in BYTE.

BYTE reader Robert N. Barrett, Vice President Management Information Systems, M/A-COM, Inc.

It doesn’t get bought without

Flatly Refuse to Compromise on Graphics!

Today's graphics cards bulldoze you into a compromise, sacrificing speed for resolution, or resolution for realistic color. ATI's new GRAPHICS ULTRA cards give you all-round performance... speed, color and resolution all at the same time.

Resolution and Color Support

<table>
<thead>
<tr>
<th>1024 x 768 / 65,000</th>
<th>ATI</th>
<th>S3</th>
<th>SVGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>256</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Up to three times faster than competing S3 solutions and even local-bus products, our mach 32 graphics processor propel Windows to an amazing 25 million WINMARKS.*

resolved with 2.0MB of video memory, ATI lets you run 1024x768 with 65,000 colors at accelerated speed or work in 24-bit color. All at flicker-free refresh rates up to 76Hz. Our single Windows driver supports painless mode switching, displays a virtual desktop, and provides hardware-accelerated True Type font scaling and smoothing via exclusive ATI CRYSTAL Font technology.

GRAPHICS ULTRA+
- Fast 21.0 million WINMARK* performance
- Accelerated 1024x768 at 65,000 colors
- True color (16.7 million) at 800x600
- Accelerate multimedia applications**
- Available in 2.0 MB or 1.0 MB versions
- Priced from $399.00***

GRAPHICS ULTRA PRO adds:
- Fast 25.5 million WINMARK* performance
- Accelerated 1280x1024 at 256 colors non-interlaced at 74 Hz refresh rate
- Available in ISA, EISA or Micro Channel versions
- Priced from $599.00***

Avoid crushing disappointment. Get ATI GRAPHICS ULTRA cards for No Compromise Graphics.
Most of the principles of the dynamically linked library are as old as computing itself. For example, in the early days of computing, commonly used routines on mainframes were grouped into core libraries, so called because they resided in the magnetic core of the computer. These libraries decreased the amount of program storage space needed and boosted execution speed. Even today, many mainframe operating systems, such as Prime’s PRIMOS, maintain vast virtual-storage libraries that can be modified and enlarged by both end users and authorized support personnel. Unix, too, has adopted shareable libraries, which serve a purpose similar to that of Windows DLLs.

Windows (along with OS/2 and Windows NT) offers a flexible and elegant form of dynamic linking that has key advantages for software development and product support. Unfortunately, until recently, writing a Windows DLL was a complicated and mentally taxing exercise. DLLs require some fancy footwork in terms of static and dynamic data. Moreover, since you can call a DLL from a different language than that used to write it, you may need to think about two sets of calling conventions—one for functions within the DLL and a possibly different one for functions exported to the DLL’s clients. These design and coding considerations make DLLs much trickier than traditional statically linked libraries.

As “dynamically linked” implies, the code for a DLL is not bound to an executable file at the time the program is linked. Rather, a program called an *import librarian* extracts a pseudolibrary from the DLL for use by the linker. This pseudolibrary is used to resolve library calls from another module at link time. The actual DLL file, which comes into play at run time, must reside in the current directory, or in the current directory, or in Windows’ SYSTEM subdirectory.

In this article, I’ll develop a simple DLL that exports printf-like functions. Clients can use these functions to post messages to a listbox maintained by a listbox server program working with the DLL. Before I dive into the code, though, I’ll review some Windows programming basics from a DLL perspective.

**Module Definition Files**

Most development environments, including the Borland and Microsoft C/C++ products, use module definition files to describe key characteristics of ordinary programs and DLLs. Like Intel assembly pseudo-ops, these .DEF files produce no code directly. They tell the linker and run-time operating-system loader about the DLL’s requirements. Some statements in the .DEF file just name and describe the module. Others inform the linker about segment names and properties (e.g., the size of the stack and heap, whether to preload code and data, and whether to tag code and data as movable or discardable). Still others enumerate and define entry and exit points (i.e.,
SOME ASSEMBLY REQUIRED

imports and exports).

DLLs share many of the same .DEF statements as normal Windows programs. The most notable exception is the STACKSIZE parameter, which should not be specified, since a DLL uses its caller’s stack.

Whether you are writing a Windows program or a DLL, the information in the module definition file is vital. For the novice Windows programmer, a few hours studying the special syntax and layout of the .DEF file will be well spent.

Resources and DLLs

Like ordinary Windows programs, DLLs can have resources attached to them via the resource compiler. Resources are static data that your program uses—icons, bit maps, cursors, and strings. Although most DLLs don’t include resources, some (e.g., Windows 3.1’s MOREICONS.DLL) exist solely as resource containers. Even though you may never need to write a DLL that maintains its own static resources, it’s still interesting to note that DLLs can do so if required.

Early and Late Binding

Late binding—the ability to link to code at run time—is often cited as a key advantage of object-oriented environments. While most DLL clients bind early by linking against an import library, there is an alternative mechanism that supports late binding. A program can call LoadLibrary to pull a DLL into memory and then call GetProcAddress, which dynamically acquires a function exported by the DLL.

This technique is especially useful when multiple versions of a library exist and the user chooses a particular version at run time. Microsoft Word for Windows’ file-import filters, for example, are a set of DLLs that implement a set of common routines used to import text from a variety of foreign file formats into Word (see “Object-Oriented DLLs” in this issue).

Quirks and Oddities

DLLs can be more than a little quirky. As I’ve noted, a DLL uses the stack segment of its caller. This arrangement has some curious ramifications.

continued
Year after year you Interleaf users have hoped for a newer, friendlier, better publishing solution—and what you got were promises.

- What you ought to get is FrameMaker.
- With FrameMaker you'll get a document publishing program that's powerful, fully featured, and fully integrated—like Interleaf. But not fully frustrating—like Interleaf.
- You'll get a familiar, well-behaved user interface that increases your productivity; instead of a proprietary interface that increases your confusion. You'll get accessible, intuitive tools like FrameMaker's Conditional Text, instead of cumbersome, procedure-intensive nightmares like Interleaf's "Effectivity."
- You'll finally get files that are truly compatible—across all the major desktops and across future upgrades. Instead of Interleaf version 5 on your Sun* that can't be handled by Interleaf version 3 on your Macintosh.
- You'll get the same compatibility with FrameViewer, Frame's leading edge viewing technology that lets you distribute FrameMaker documents—or even converted Interleaf documents—electronically. So everyone in your organization can receive up-to-the-minute, accurate information on-line.
- And if you act quickly you'll get an even easier upgrade deal: a free Interleaf-to-FrameMaker file conversion filter*—a $995 value** Call 1-800-U4-FRAME Ext. 233 today for more information. And this time upgrade for good.
Like normal Windows programs, DLLs are subject to segment-size limits for both code and data. Although that limit is 64 KB, a 4-KB or 16-KB segmentation policy may be preferable in 386 enhanced mode. Using 4-KB segments can help the Windows memory manager work more efficiently, since its paging mechanism is also based on 4-KB units. Although segregating code and data into 4-KB segments may seem like a mundane exercise, it is one way to squeeze performance out of a large Windows application.

Functions that a DLL will export to clients (or to Windows itself) must be defined using the keywords FAR and PASCAL: FAR because the function can be called from any point in the Windows code space, and PASCAL because that calling convention is the lingua franca of Windows. (The PASCAL calling convention is that function parameters pass left to right and that the callee, not the caller, cleans up the stack.)

Once in the DLL's code space, you can use any calling convention you like for internal (nonexported) functions. This convention is typically either that of C or Pascal, but others are possible. Windows will allow any convention within your own code space, but FAR PASCAL (known as CALLBACK in the Windows 3.1 header file) must be specified for functions Windows will call. To reference data and code in the DLL itself, both far and near pointers to local data can be used as required. Far pointers are preferable, mainly because they fully qualify an object without the need to refer to the ever-shifting CS (code segment) or DS (data segment) registers.

Segmentation Issues
I'd like to clear up some of the mist surrounding what kind of memory is used for which types of data in a Windows DLL. Typically, the SS register points to the stack segment of the caller. The data placed on the caller's stack includes parameters to DLL functions, as well as automatic data allocated by DLL functions, as well as automatic data allocated by the DLL functions.

Unlike in a regular Windows program, a second stack area is granted to DLLs by Windows. Known as the local heap, this second stack area is referenced from within a DLL via the DS register. Windows puts all DLL resources and static data here, as well as memory allocated by way of calls to malloc or LocalAlloc.

Having two separate data segments for automatic and static data allows for some more breathing room in a Windows DLL, but it greatly complicates matters when the DLL must call other libraries or statically linked support routines. Those routines typically assume the SS (stack segment) register points to the same place as the DS register—a traditional assumption for both DOS and Windows code. Because DLLs violate that assumption, early Windows DLL developers often had to write their own unique library routines to work inside DLLs. These routines typically used far pointers to fully qualify an object without the need to refer to any of the segment registers, or they merely assumed that they were to use the DS register rather than SS.

Fortunately, Borland and Microsoft (and other vendors) now offer complete, robust, standard libraries for Windows. These libraries work adequately under both DLLs and standard Windows applications. Consequently, the DS = SS problem surfaces only when DLLs are used for certain activities, like interprocess communication or mixed-memory-model programming.

Resource Ownership
When memory is being allocated from within a Windows DLL, the question of...
resource ownership arises. Since a DLL can be shared by many Windows applications, who actually owns the data once it’s allocated? In the case of LocalAlloc (or malloc), the answer is straightforward: Since LocalAlloc returns pointers relative to DS, the DLL itself owns this data. That means that any handles returned from calls that allocate resources within the DS stack of the DLL will be valid only when processed by the DLL itself.

In the case of GlobalAlloc, however, the argument for ownership is less clearcut. Suppose you are allocating global memory for a callback function or other Windows application. If the newly allocated DS were to belong to a DLL, it would be freed when the DLL was unloaded. This could be disastrous if the callback function or Windows application attempted to use memory that was no longer available. Conversely, if that same DS belonged to the program that called the DLL, then the DLL would crash if its first caller (and the owner of the segment in question) freed the memory while the DLL was still using it to service the requests of another Windows application. If memory is not to be locked at all times, how do you allow it to be shared properly?

To address this problem, the GlobalAlloc call supports two special flags, GMEM_SHARE and GMEM_DDESHARE. As their names imply, these flags allow any allocated DS to be shared with other programs without risking a protection violation. When used from within a DLL, these flags also solve the ownership dilemma. If neither flag is specified in the call to GlobalAlloc, then the resulting handle to the DS in question belongs to the currently active instance of the application that called the DLL. When that instance terminates, the memory is freed automatically. However, when either GMEM_SHARE or GMEM_DDESHARE is specified, the newly allocated DS will belong to the DLL, not to its caller.

Inside DBPUTS

Given this background, look at the sample DLL application, DBPUTS.DLL (see listing 1). The library exports versions of the puts and printf functions, in collaboration with a server application that provides a scrolling, resizable listbox in which messages accumulate. DBPUTS exports six functions: LibMain, SetHandle, DbPuts, DbSprintf, CheckDLL, and WEP. Two of these appear in every DLL: LibMain, the standard DLL entry function, and WEP, the standard exit function. The others are the meat of DBPUTS.

SetHandle’s job is to synchronize DBPUTS with DBSERVER, the standard Windows application that provides the listbox in which clients of DBPUTS insert their debugging messages. Although a DLL can operate its own user interface (typically in the form of dialog boxes), I found it more convenient to let DBPUTS parasitically exploit the user-interface machinery of a full-fledged Windows application. To this end, DBPUTS exports SetHandle, which, when called by DBSERVER, enables DBPUTS to acquire a handle to DBSERVER’s application window. The DLL can then use that handle to pass data received from its clients to the listbox server. Using the Windows EnumWindows routine within SetHandle enables the DLL to confirm that the handle passed to it belongs to a top-level window—it’s just a sanity check.

DBPUTS launches DBSERVER by calling WinExec. If the server fails to launch, it alerts you by means of a message box. How can DBPUTS, a DLL that doesn’t maintain its own window, supply the MessageBox call with an appropriate

```
Listing 1: The exported library routines.
#include <windows.h>
#include <stdio.h>
#include <stdarg.h>
#include <string.h>
#include "dbserver.h"
#include "dbputs.h"

BOOL FAR PASCAL EnumFunc(HWND hWnd, LONG); hWnd = (HWND) NULL; // DBSERVER's window
HANDLE hli; WORD wSS, wHeapSz; LPSTR lpParam; int FAR PASCAL LibMain(HANDLE hLi, WORD wSSw, WORD wHszw, LPSTR lpCmdLine) { WORD wParam = WMDestroy(); hWnd = hWnd; // Save instance handle wSS = wSSw; // Save SS of caller wHeapSz = wHszw; // Local heap sz
lpParam = lpCmdLine; return(TRUE); }
int FAR PASCAL WEP(int EventCode) { return 1; }
HWND FAR PASCAL SetHandle(HWND hWndIn) {
if(hWnd != (HWND) hWndIn) return hWnd; }
int FAR PASCAL DbPuts(LPSTR message) {
size_t sLength;
if(hWnd) return NULL;
if(message) return NULL;
sLength = strlen(message); if(sLength)
PostMessage(hWnd, WM_COMMAND, MSG_SIG1, (LONG) GlobalAddAtom((LPSTR) message));
return (int) sLength; }
int FAR PASCAL DbSprintf(LPSTR message,...) { static char chBuffer[1024]; WORD sLength; va_list pArguments;
if(hWnd) return NULL;
if(!message) return NULL;
va_start(pArguments, message);
sLength = vsprintf(chBuffer, message, pArguments);
va_end(pArguments);
sLength = strlen(chBuffer);
if(sLength)
PostMessage(hWnd, WM_COMMAND, MSG_SIG1, (LONG) GlobalAddAtom((LPSTR) chBuffer));
return (int) sLength; }
BOOL FAR PASCAL EnumFunc(HWND hWnd, LONG lpParam) { if(hWnd == (HWND) lpParam) hWnd = hWnd; return FALSE; }
return TRUE; }
void FAR PASCAL CheckDLL() { char buf[80]; // Example of a DLL resource being used;
LoadString(hli, IPL_MESSAGE, buf, 80); // We, too, can use our own DLL functions;
DbPuts(buf); DbSprintf("DLL instance \", hli); }
```

DECEMBER 1992 • BYTE 251
handle? The solution I've used is to call `GetFocus` in order to "borrow" the handle of the active window. After `SetHandle` has stored the handle to the listbox server locally, any Windows program that binds statically or dynamically to DBPUTS can issue calls to its two service routines, `DbPuts` and `DbSprintf`. DBSERVER calls `DbPuts` to announce its successful initialization, like this:

```c
DbPuts("DbServer started.*");
```

`DBCLIENT`, a sample client of DBPUTS, uses the `DbSprintf` call

```c
DbSprintf("message %d
\tinstance %ld\n", times++, hInst);
```

to relay two numbers: a count of its calls to `DbSprintf`, and its instance handle. (Since messages from all clients appear interleaved in DBSERVER's listbox, the instance handle differentiates multiple instances of `DBCLIENT`.)

Finally, DBPUTS.DLL can call its own functions to place messages in DBSERVER's listbox. Its `CheckDLL` function does this in response to DBSERVER's corresponding menu option; this enables a user of DBPUTS to verify that the library is available and working properly. On the screen on page 248, DBSERVER displays messages from itself, from DBPUTS, and from two instances of `DBCLIENT`.

DBPUTS relays its client's string to DBSERVER by creating a `global atom` (an entry in a special table of strings available to all Windows programs) and then posting a `WM_COMMAND` message to DBSERVER. The first parameter of the message instructs DBSERVER to retrieve and display the string that DBPUTS attached to the atom; the second is the atom itself. When it receives that message, DBSERVER extracts the string, deletes the atom, and then in turn sends messages to its own listbox that cause the string to be inserted and highlighted. In fact, DBSERVER does most of the hard work; DBPUTS merely relays messages to DBSERVER. Yet, as a DLL, DBPUTS provides the crucial link between DBSERVER and a host of potential clients.

If you call the `DBPUTS` functions in rapid-fire succession from inside a loop, you'll find that DBSERVER displays no more than eight of them. That's because DBPUTS uses the asynchronous `PostMessage`, rather than the synchronous `SendMessage`, to send its messages to the server. PostMessage drops messages in the target application's queue and returns immediately. But that application can't process the messages until the sender yields the CPU, and the queue fills up after eight messages. One solution is to have DBPUTS call `Yield` periodically. Another is to use `SendMessage` to synchronize the communications. In that scenario, each call to `DBPUTS` would halt the calling program until DBSERVER had processed the message.

For performance, I chose the asynchronous approach using `PostMessage`. If you want to call `DBPUTS` repeatedly from within loops, switch to `SendMessage`.

**DLL Constructors and Destructors**

It's time to explain the two obligatory DLL support routines, `LibMain` and `WEP`. Like `WinMain` (the entry point to a standard Windows program), `LibMain` returns either `TRUE` or `FALSE`, depending on the success or failure of initialization. As such, it's analogous to a `C++` or Object Pascal constructor. The four parameters to `LibMain` are a little bit unusual, even for a Windows callback function. They are the
Odyssee lets you avoid the punishment of programming development.

Creating applications doesn't have to hurt

The extraordinarily complex process of writing software applications is time-consuming and repetitive. And can get you into a lot of trouble.

If after months of writing in excess of thousands of lines of code a client decides to change the specs or platform, the punishing procedure begins all over again.

Introducing Odyssee from Case Design, a new concept in programming development software that eliminates the need for editors or a high degree of technical skill. Odyssee is a fully integrated tool that features DBMS support, WYSIWYG user interface design and reporting.

In the development cycle, you can access a wide variety of helpful features including a data dictionary, physical and logical independence, tasks, actions, events and expressions. Resulting applications can run on a variety of OS platforms with no change.

Call for a free demo disk and try it yourself

(IDOS, WINDOWS, UNIX) with no change. Creating the data structure and manipulating the database are features of Odyssee that are transparent to the developers. Odyssee can simultaneously access and simplify the use of many different DBMS, including XBASE, ORACLE, UNIFY, SYBASE and DB RAIMA.

Call Case Design to learn how truly edifying Odyssee can be.

FREE INTRODUCTORY OFFER

Purchase Odyssee now and you'll receive a free introductory offer valued at $400.

THE ODYSSEE STARTER KIT — $1299

MS-DOS, XBASE for single user. Other platforms available. Call today for more details.

30-DAY MONEY-BACK GUARANTEE

CASE DESIGN

RESULTS ORIENTED

CALL 1-800-880-1100

9111 Jollyville Road • Suite 207 • Austin, Texas 78759
Phone (512) 346-8991 • Fax (512) 346-7920

All other products and brand names are trademarks and registered trademarks of their respective companies.

Circle 183 on Inquiry Card (RESELLERS: 184).
library's instance identifier, its DS, the size of its own local heap, and the command-line buffer used to invoke the DLL.

That's right—the command line. It's a little-known fact that DLLs can load actively, just like normal Windows programs. In fact, Informix Wingz 1.1 and 2.0 use a form of this "active loading" feature to allow users to write their own C functions and libraries, which can be called from the built-in Wingz command language, Hyperscript. This feature of Wingz (and Windows) is another form of late binding, as no .DEF or .LIB files are required for calling external, user-provided libraries.

The first two parameters—the value of the DS register and the size of the DS (in bytes)—are passed to LibMain. Since LocalAlloc uses this local heap segment, it's a good idea to compare its size to the DLL's estimated run-time requirements before returning TRUE to Windows. The module definition directive HEAPSIZE can manipulate the number of bytes allocated to the local heap, as can Windows' LocalInit function.

The values of DS and hInstance could be useful when supporting multiple DLL invocations. Currently, though, Windows is highly serialized and supports activation of only one instance of any DLL.

When examining the size of the local stack (i.e., DS), don't forget about resources your DLL may need to load. Make sure that everything you need will fit into the DS heap area. Once control reverts to Windows, of course, Windows can swap out any unneeded resources, just as it does for ordinary Windows applications. If, for some reason, LibMain returns FALSE to Windows, the library will not load, and the calling application will terminate gracefully—in other words, the user will be notified by means of a message box.

The WEP function serves as the DLL's destructor—a mechanism for releasing memory and other resources before exiting. If you don't have cleanup to perform, you may not have to include a WEP, since compilers like Borland's will automatically include a generic one for you. I've included one in DBPUTS just for completeness.

**DLLs in Perspective**

Most of the headlining features of Windows 3.1 are packaged as DLLs and, as such, can be retrofitted to Windows 3.0. Registered users of Windows 3.0 aren't required to upgrade their version of Windows; they can take advantage of advanced 3.1 features by merely adding the 3.1 DLLs, which vendors are actively encouraged to redistribute. Common dialog boxes, DDEML, and OLE are just a few of the recent 3.1 innovations that can be retrofitted into Windows 3.0 by merely copying the required DLLs into Windows 3.0's SYSTEM directory.

Though a simple example, DBPUTS nicely illustrates the power of DLLs. For the price of a few function prototypes and an extra link argument (or a call to LoadLibrary and GetProcAddress), any Windows application can post simple or formatted debugging messages to a convenient on-screen bulletin board.

**Editor's note:** The complete listings described in this article are available in electronic format. See page 5 for details.

Randall A. Nagy is a principal software development engineer for Informix in Lenexa, Kansas. He develops Windows, Unix, and OS/2 software. You can reach him on BIX c/o "editors" or on the Internet at rnagy@informix.com.

---

**Attention U.S. BYTE Subscribers**

Watch for the next BYTE DECK mailing that will be arriving in your mailbox soon!

Use this as a fast, convenient tool to purchase computer products and services. It's loaded with essential hardware and software products that you should be aware of when making your buying decisions... and it's absolutely FREE!

If you have a computer product or service, and would like to reach 275,000 influential BYTE magazine subscribers, please give Ed Ware a call today at (603) 924-2596.

Here's what a BYTE Deck advertiser has to say:

"Ten years ago we advertised in the very first BYTE Deck—the number of sales leads we received was enormous! The BYTE Deck was so successful for us, that we have continued to use it over the past ten years!"

Lisa Tarpoff, Marketing Manager, Heath Company, Benton Harbor, MI

---

254 BYTE • DECEMBER 1992
TRUTH OR CONSEQUENCES
IN THE DATA STORAGE BUSINESS.

You've heard it all before:
“Let’s have lunch.”
“I'll call you tomorrow.”
“The check is in the mail.”

Now it’s the same story in the data storage business. Backup systems that can’t back up their claims. And along with compatibility issues and nonstandard tape media, the user is left to suffer the consequences.

Truth is, our digital helical scan products are universally accepted and reliability tested in the most demanding environments on more than 100 platforms worldwide. And we’ve shipped over 450,000 units to prove it.

Each EXABYTE product builds upon another, providing capacities and transfer rates that complement preceding products. Backward compatibility enables users to take advantage of technology advances yet protects their archival data investment.

Standard, readily available data grade tape makes high-capacity storage easy and affordable.

For more information on the leading role of digital helical scan data storage products, call us today at 1-800-EXABYTE.

It’s OK to do business with companies selling backup systems lacking formal standards, compatibility, and OEM acceptance. Just as long as you keep your fingers crossed.
**Audit Your LAN**

Users call upon network administrators to solve problems, even if those problems are only tangentially related to the network. The first step in resolving such issues is to take an inventory to determine where conflicts may lie. You can do this by walking from workstation to workstation, recording configuration files, and running diagnostic utilities, but you won’t want to do it often—and configuration information is most valuable when you track it on a regular basis.

I wrote two LAN inventory programs to make the recording of user configurations more automatic. The programs are called PROBE and LANDB. Both run on each workstation on the LAN, writing configuration information to files in a shared network directory. They record processor type and speed, the amount of RAM installed, free disk space, user IDs, CONFIG.SYS and AUTOEXEC.BAT contents, and other useful parameters.

PROBE produces a unique file for each workstation. The file contains text entries that describe the workstation in detail. PROBE names its output files according to the unique node address burned into the network adapter, with an extension consisting of the first three characters of the user ID for the person who uses that workstation.

LANDB writes to a single shared file (i.e., LAN.CSV), no matter what workstation it runs on. Each line of LAN.CSV is a comma-delimited series of fields that describe a particular workstation. You can import this text file into a database manager such as Borland’s Paradox. LANDB creates a new record in LAN.CSV each time it’s run.

PROBE and LANDB recognize both IPX-based (i.e., NetWare) and NetBIOS-based (e.g., LAN Manager, LAN Server, and LANtastic) LANs, providing information about both kinds of environments. LANDB contains file-sharing logic to prevent LAN.CSV collisions if two or more instances try to write to the shared database at the same time.

You can run PROBE or LANDB in the batch file that gets a workstation onto the LAN, but that means visiting each workstation to update batch files. There’s an easier way: You just invoke PROBE or LANDB in the system log-in script for your network. On my network, I set up the log-in script to run PROBE and LANDB every Tuesday.

With command-line parameters, you can tell both LANDB and PROBE which shared directory to use, so they’ll write output files to a central location on the file server. (Make sure all your users have full rights to that directory.) After you run PROBE for a day, you’ll accumulate a directory of files with one file for every workstation that logged in. Or, if you run LANDB, you’ll have a single file with entries for each log-in.

I used Microsoft C 6.00A to write these programs. The C code is totally generic—you could use almost any C compiler—but the logic that determines CPU speed is compiler-dependent. I used a timing loop to measure CPU speed, and the number of loops obviously depends on the machine code emitted by the compiler. You’ll need to recalibrate the CPU speed table if you use a different compiler.

---

**Trimming the Fat from System 7.0**

One of the best talismans you can use to keep the Bomb Beast at bay is a crash disk—a bootable floppy disk with disk-recovery utilities. When your Mac refuses to start after a crash, you just poke in the floppy disk, restart, and begin recovery procedures. Unfortunately, this strategy falls apart with System 7.0, which requires 1.3 MB of storage on a bootable volume. This leaves you only 100 KB left to pack anything else on a 1.44-MB bootable floppy disk.

Frank Probul has created a shareware Installer script (available for $15) that trims nonessential resources (e.g., color icons, Balloon Help, SANE [Standard Apple Numeric Environment], and network drivers) from the System file, freeing an extra 200 to 300 KB of space. I’ve used this script to make a bootable floppy disk that includes Disinfectant 2.9. This works reliably on the Mac II, Mac Iici, PowerBooks, and Quadra 950.

---

**Saving Face**

For several years now, the Usenix organization has been encouraging attendees at its conferences to save face—to have the image of their face recorded for the faces database. The project is geared to humanizing communication around the worldwide Unix network and to adding graphics to appropriate Unix utilities.

The face-image viewer is a program named xface, an X Window System client program. The collection of utilities, called faces, is maintained by Rich Burridge of Sun Microsystems (Australia) and is available on most Unix archive servers and BIX.

Faces works like this: You store your character-based compressed image in your home directory and instruct your mail-composing program to include a pointer to this file. Whenever you send an E-mail message, your image is included.

---

Editor’s note: Software Corner highlights public domain, freeware, and shareware programs. The programs are available electronically. See “Program Listings” on page 5 for details. We solicit your contributions. We pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
OBJECT-ORIENTED DLLS

Some say that Windows’ architecture is less than elegant, but I still marvel at the transformation from Windows 3.0 to 3.1. A host of new functions and data types appeared: DDE management, OLE, common dialog boxes, and more. DLLs made the complexity manageable. Each new library added a group of APIs and, more importantly, a new object, class, or abstract data type. As a result, Windows, in the midst of growth, remained organized and comprehensible.

Of course, the design of operating-system software is an ambitious and difficult undertaking, so it makes sense that Windows’ engineers would take the time to partition their problem space in a tasteful manner. But what of the ordinary Windows applications programmer? Is the extra effort really required?

Consider Microsoft Word for Windows’ import filters, which are organized as a set of DLLs. Don’t be fooled by the .CNV filename extensions. If you run EXEHDR (the Microsoft C .EXE snooper) against Word’s filters, you’ll find that they’re really DLLs that export functions. Even more interesting, you’ll find that each filter exports a consistent set of functions: GETINIENTRY, INITCONVERTER, FOREIGNTORTF, RTFTOFOREIGN, and ISFORMATCORRECT.

When you ask Word to import a file whose format is foreign, it enumerates the filters listed in WIN.INI. When you pick one, Word loads the library and stuffs the addresses of its functions into a table of function pointers, neatly TYPEDEFed to enforce strict type checking. Knowing nothing of the filter’s inner workings, Word simply asks it to perform a file conversion. After kicking things off with a call to INITCONVERTER, Word might then use ISFORMATCORRECT to verify the contents of the foreign file as an appropriate match for the DLL and FOREIGNTORF to create an intermediate representation of the data in the RTF (Rich Text Format) that Word can use.

Once the requirements for a file converter are defined and documented, any Windows programmer can write an import filter. Because Windows itself defines parameter passing and calling conventions for DLLs, a filter can be written as easily in Pascal as in C. Interface elements such as dialog boxes, menus, and bit-map files can be bound into the module. Initialized, static data lives in its default data segment. If data packets are rigorously abstracted to HANDLE types, the private workings of the DLL and host application become opaque to one another.

From this perspective, a DLL is more than just a code repository. It’s a distributable, reusable object. In the case of the WinWord import filter, that object abstracts the type foreign file represented by a file handle and wrapped with a template of method definitions that describe the operations on the type foreign file. The variation in type of the foreign file (i.e., its subclasses) is represented by instantiations of the DLL description—the individual .CNV files. Because the requirements of the interface between the converter and Word have been formalized, and the relationship between them conveniently decoupled via dynamic, run-time linking, any number of converters can be independently produced, tested, and distributed.

To the delight of software engineers and academics alike, effective software design with DLLs shifts the emphasis toward early specification, abstraction, and interface design. Just any old DLL won’t do. A correct interface is of paramount importance, because it governs how application components interact. A large software project may be designed and implemented as a collection of DLLs. With a rigorous specification, teams or individuals can work independently.

Designing DLLs

Designing a first DLL interface can be a daunting task. One approach is to study what other developers have done. All you need is the EXEHDR utility and a working version of the applications software. Even a crippled demonstration program retains the peculiar architecture of its commercial counterpart and, as such, makes for a low-cost study tool suitable for spelunking with EXEHDR. The Windows API, in all its splendor, is another suitable avenue for exploration.

For the ultimate in late binding, you can exploit run-time dynamic linking, as Word’s import filters do. That means the calling application doesn’t even discover the name of the DLL—let alone resolve its entry points—until run time.

Alternatively, you can bind the DLL’s name into your program and resolve the
DLL's entry points in advance, using the linker. In this model, you can alter your program's behavior by swapping in any DLL that has the right name and exports the right set of functions. The name of the module becomes an attribute of the formal definition of the interface. This technique is less flexible than the run-time approach, but it's also simpler. You don't have to build and maintain a list of function pointers, because the linker does that for you. Use this approach to distribute incremental software updates or to outfit an application for multiple versions. Consider, for example, a network-aware application that can run over NetBIOS, SPX/IPX, or TCP/IP protocols. You might choose among protocol modules during installation and never again need to change that DLL.

In larger projects, you'll have to make a basic design decision. Should your DLL export a few complex functions or many simple ones? I've just lent a helping hand to an application design that required such a decision. I helped the architect weigh the pros and cons of each approach. In this case, it was necessary to design a DLL that would expose nearly every aspect of the application's behavior to modification by the user. We decided that a single polymorphic entry point would serve our needs best.

This entry point would take just two parameters: an integer representing an event and a 32-bit word whose meaning depended on the event passed in the first parameter. At every stage in the execution of the application, we would arrange to send events to the DLL by way of this polymorphic entry point. The definition of each event would include a definition of the data passing through in the 32-bit parameter.

We chose this method so we'd be able to add and remove events without continuous modification to a group of DLLs dispersed geographically among the future installed base, potentially (we hoped) thousands of users. Another benefit was that trivial implementations of the DLL, ones that handled only a subset of the application's events, wouldn't be burdened with the responsibility of providing a list of unused function entry points. The point is that there's a productivity penalty associated with changing a DLL interface once you've designed it. That penalty is proportional to the number of DLLs written to the interface.

Polymorphism and Parameter Packing

A polymorphic interface, although it's admittedly cryptic, limits the cost of evolution while preserving the flexibility of dynamic linking. With some careful plumbing, the door to the closet of polymorphic anxieties can be kept tightly closed, even at night. Polymorphic parameters, fundamental to Windows itself, simply imply weak typing, the Wirthian anxiety.

To begin, the type of the parameter must be established and agreed on by the sending and receiving parties. The sending party must shoehorn its data into the 32-bit space by means of a compiler cast or bit-shifting sleight of hand. Similarly the receiver, collecting what seems to be an unsigned DWORD value, must prod, nudge, and dissect the value into its respective components.

Notice that the reason for creating strongly typed languages was to relieve programmers of the burden of handling this sort of data typing mentally. Conversely, notice that a great deal of excellent software predates the availability (read: preferred use) of strongly typed language.

A Message to Our Subscribers

FROM TIME TO TIME WE MAKE THE BYTE subscriber list available to other companies who wish to send our subscribers material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to the following address.

BYTE Magazine
Attn: Subscriber Service
P.O. Box 555
Hightstown NJ 08520
compilers. You can certainly create robust software using polymorphic entry points, but you have to really want to. Failing to properly cast a 16-bit pointer before passing it into a 32-bit integer parameter can result in the compiler incorrectly filling the upper 16 bits of the parameter with a sign extension. Even if the receiving party is able to dereference this new and interesting data type, we can be assured that it does not point to the intended value.

If you’re unfortunate enough to be implementing a DLL for which you have no knowledge of the calling application, you’ll be able to get some mileage from the new parameter-validation routines that are available in the Windows 3.1 API. Such routines can be used to ensure that a pointer to writable memory is actually so. Alternatively, by establishing some clever design standards for parameter passing, additional typing knowledge can be imparted on polymorphic parameters.

Notice how most of the new data structures in Windows 3.1 require that you initialize the first DWORD of the structure with the size of the structure. My guess is that this information makes implementing a thunk-layer (e.g., Windows 3.1 running on Windows NT) that much easier. The thunk can examine the first field of the structure and determine whether a 16- or 32-bit compiler created the structure. I call this approach “better than nothing” or “strong most of the time” typing.

Choosing the other alternative—separate named entry points for each function—solves these problems. Or does it solve them? Essentially, the big problem you face with polymorphic parameters is ensuring that the proper values are packed into parameters (primarily during compilation). If either side of the interface changes without both entities (application and DLL) being aware, problems at run time persist with either solution. If the application adds a new parameter to a function call and the DLL entry point is expecting the old stack frame, the system will die an ugly death.

Creating individual entry points does, of course, make for more readable code. Consider how much more cryptic the Word filters would be with a single entry point. Achieving maximum benefit from multiple entry points is a result of stabilizing the names and/or ordinal identifiers of the exported DLL functions. This allows the specification to be “grown” without affecting earlier incarnations of the DLLs.

Basically, the difference between fewer polymorphic entry points and more numerous typed entry points is the amount of information about the interface that is packaged with the DLL itself. The presence of more information means greater understandability and more opportunities for querying the DLL package (at run time) about its capabilities. Maintaining this extra information means a proliferation of module definition file entries and methods, resulting in a greater “change ripple” when parts of the interface evolve. But perhaps this required effort will shift our emphasis toward getting the interface right the first time, focusing our attention on the value of good software engineering and design.

Gen Kiyooka is the founder of Electron Image. He creates Windows software and is the inventor of the RoboHelp Windows help authoring tool and the BugMan debugging agent from Blue Sky Software. You can reach him on BIX c/o “editors” or on CompuServe at 76376,43.

---

**Girl Scouts Care for the Earth**

When was the last time you looked at the color of a rainbow or listened to a chorus of spring frogs? Lucky for us millions of girls still do—in the Girl Scouts. This year, to celebrate our 80th birthday, Girl Scouts nationwide are working to help care for our environment through a national service project called “Girl Scouts Care for the Earth.”

Won’t you join us? Call your local Girl Scout council to learn how.
Time Flies

Recently had my 16-MHz 386DX chip replaced with a 20-MHz 386DX chip. Everything works fine except for the system clock. Immediately after I turn on my computer, running the DOS TIME command gives the correct time (e.g., 3:00 p.m.). Running the command a minute later gives the incorrect time of 3:02 p.m. The problem is apparently in software, because if I switch the computer off and on, the DOS TIME command again yields the incorrect time. What's the problem, and how can I fix it?

Samuel L. Park
Alexandria, VA

The source of your problem is hardware, not software. Your computer actually has two clocks. The battery-backed CMOS real-time clock maintains the correct time even when your system is off. The system timer controls the speed of the CPU and related peripheral chips. When you replaced the CPU with a faster chip, the technician also replaced the system-timer crystal with another, probably rated at 40 MHz. (System-timer crystal signals are divided by 2: 40 MHz/2 = 20 MHz.)

When you boot up, the BIOS reads the time from the CMOS real-time clock and stores the values in a set of memory locations that it uses as a counter. The BIOS uses the CPU system timer to update the counter 18.2 times per second and does not look at the real-time clock until you reboot the computer.

Unfortunately, your BIOS still assumes that you are running the CPU at 16 MHz, not 20 MHz, and updates the registers more quickly. Both time and your CPU run 25 percent faster.

Short of going back to a 16-MHz system clock, the only solution is to use a TSR program that looks at the real-time clock and updates the DOS time and date. One such program is ATCLOCK, available on BIX in the IBM.AT listings area. This clock device driver uses the CMOS real-time clock for all DOS timekeeping functions.

—Stan Wszola

Weather by Shortwave

In September, Ask BYTE answered a question from Pascal Gilles about receiving weather maps via shortwave radio transmissions and displaying them on his PC. Our advice was to go to a commercial service. Several readers responded that it is indeed practical to receive weather maps by shortwave radio. Here's one reader's explanation of how to do so.—Stan Wszola

I write a monthly column called RTTY: The Exciting World of Radioteletype Monitoring for Popular Communications. The column covers radioteletype and radiofax stations that can be heard on shortwave radio. All Gilles needs is a radiofax demodulator to connect to his computer's serial port and to the external speaker or earphone jacks on a shortwave radio, and the software to drive the interface.

Numerous weather stations on all continents, including Antarctica, use shortwave radio to send weather maps of all types, which are used by the military and maritime/aviation stations. Many weather stations broadcast 24 hours a day, including the U.S. Navy's. Gilles can easily monitor the radiofax weather station located in Rome over shortwave radio.

Companies that supply radiofax demodulators and software include Advanced Electronic Applications (P.O. Box C2160, 2006 196th St. SW, Lynwood, WA 98036, (206) 774-5554), MFJ Enterprises (P.O. Box 494, Mississippi State, MS 39762, (601) 323-5869; fax (601) 323-6551), OFS Weatherfax (6404 Lakecrest Court, Raleigh, NC 27612, (919) 847-4545), Software Systems Consulting (615 South El Camino Real, San Clemente, CA 92672, (714) 498-5784; fax (714) 498-0568), and Hoka Electronics (Telko Clockstraat 31, NL-9665 BB Oude Pekela, The Netherlands).

All products require a high-quality shortwave receiver that covers the range of 2 to 30 MHz and that can receive SSB (single sideband) transmissions.

Robert Margolis
Lake Forest, IL

Loopback Tests

Can you tell me the pin configuration for the 25-pin serial and parallel loopback plugs?

Joseph A. Inguaggiato
Matawan, NJ

Most diagnostic software packages perform loopback tests on serial and parallel ports. To perform the test, you must attach a loopback or wrap plug that connects the output signal pins to the input signal pins. Running test signals through these ports is more effective than merely accessing the internal diagnostic mode of the UART (universal asynchronous receiver/transmitter) chip to see if it is active.

If you are handy with a soldering iron, the loopback plugs are easy to make. On a serial RS-232 nine-pin port, use a female DB-9 connector and connect pins 1 to 7 to 8; 2 to 3; and 4 to 6 to 9. For serial RS-232 25-pin ports, you'll need a female DB-25 connector with pins 1 to 7; 2 to 3; 4 to 5 to 8; 6 to 11 to 20 to 22; 15 to 17 to 23; and 18 to 25 connected. To test a Centronics 25-pin parallel port, you'll need to connect pins 1 to 13; 2 to 15; 10 to 16; 11 to 17; and 12 to 14 in a male DB-25 connector.

—Stan Wszola

Boot Differences

I know that resetting my computer with the Ctrl-Alt-Del keys doesn't do the same thing as turning the power off and on again, but what about using the reset button? I assume that its actions fall somewhere in between the two extremes.

Joe S. Herring
Rockport, TX
Most business and government professionals view and analyze data with spreadsheets, databases and occasionally in business graphics packages. While these types of software work well when displaying statistical data, they are blind to important geographical information -- such as market potential by sales territory, distribution coverage by product, or customer locations by ZIP code or street address.

Atlas Software® is changing that. By linking data from spreadsheets, databases and even other applications – on your PC or Macintosh® – you can now add the important geographical dimension to your information system.

And when we say important, we mean mission critical. For example, Atlas Software can help business professionals answer “what if” and “show me where” questions for optimizing sales territories, targeting customers, and selecting ideal site locations. Government professionals can use Atlas Software for everything from political redistricting to land-use planning and public safety analysis.

Without Atlas Software, decision makers often overlook important geographic information and allocate resources ineffectively.

Atlas Software programs come equipped with built-in data management capabilities, map file importing and a generous base map and data sampler from our comprehensive library containing over 75 gigabytes of geographic files, business statistics and demographic data.

Atlas Software comes in a variety of “flavors” to suit your specific needs and supports MS DOS®, MS Windows® and Macintosh operating systems.

So if you’re ready to add a dynamic new dimension to the way you use information, like 25,000 other Strategic Mapping customers, call us for a Free Desktop Mapping Guidebook and demo disk. We’d be happy to map out a plan for you.

Phone: (408) 970-9600
FAX: (408) 970-9999
Turning the computer off and on again is referred to as a cold boot. When you turn on a computer, the inrush of power stresses the semiconductor components in the system. The Ctrl-Alt-Del combination, or “three-finger salute,” is called a warm boot. It resets the system but skips the POST (power-on self test) routines and memory test.

The reset button is an intermediate way to restart the system. Technically, it's a cold boot: It clears all memory locations and performs the POST routines and memory test. It doesn't, however, cut off power to the semiconductor components. The reset button is a convenient way to restart your computer when an ill-behaved piece of software has locked up the system.—Stan Wszola

Megabyte Math

In the August Ask BYTE, Jeffrey A. Sawyer complained that his new Seagate STJ 144A JDE hard drive was advertised as having a capacity of 130.7 MB but formatted to only 124.7 MB. Our response notwithstanding, there is nothing wrong with Mr. Sawyer's hard drive. As alert readers quickly pointed out, Seagate calculates 1 MB as 1 million bytes (10^6) instead of the actual 1,048,576 bytes (2^20) per megabyte when formatted. This effectively turns Seagate's “130.7-MB” hard drive into a 124.7-MB device.—Stan Wszola

Software Publishers and C Books

I am a software programmer trying to market a product, and I am looking for companies who will market my product and pay me on a royalty basis. CJ Software Publishing used to offer such services, but I'm unable to contact it. Has it gone out of business?

Another problem that I have is with the lack of information on C programming. Many techniques and methods are not covered in any texts I've seen. For example, how do you call another program, run it, and return back to the mother program?

Another problem is memory allocation. Every text shows you how to allocate memory for a single-dimensional array, but never for the more commonly used multi-dimensional array. Where can I find the answers to such questions?

Daryl F. Watson
Calgary, Alberta, Canada

I don't know what has happened to CJ Software Publishing, but other companies will help you market your product. Look in the classified sections in your favorite computer magazines under “software packaging” and “software marketing.”

Many books have been written about C and C++ programming. The problem is finding the correct book. One place to start is with a programming periodical such as the C Users Journal (R&D Publications, 1601 West 23rd St., Lawrence, KS 66046, (913) 841-1631).

As to your programming questions, the method of accomplishing some of the tasks depends on the compiler and libraries you use and the operating system in which you're running. In the Unix environment, you usually invoke a separate program with a call to one of the family of exec system function calls. The MS-DOS environment has the spawn library functions. The Macintosh environment has a process manager that can launch, track, and control other programs. Launching programs and many other tasks are system-dependent. That's why general books on programming in C don't adequately cover these issues.

Your question concerning multidimensional arrays and memory management is of a much more general nature. When you declare a fixed-size multidimensional array, you must also specify the size of each dimension when you declare the array. (It is not necessary to specify the size of the first dimension in certain situations.) As an example, a list of words might be defined as char wordlist [80][80];

But if you plan on allocating the memory dynamically, as needed within a function, you will need more sophisticated operations. You will want your array to act as a contiguous block, but separate calls to memory allocation functions don't ensure that this will happen. Therefore, you must either create your own structure of block lists or use a heap management library such as Rick Grehan's routines in "If Memory Serves..." (August 1989 BYTE).

As you are aware, dynamic arrays are not a trivial problem.—Ben Smith

Keyboard Guardrails

I'm a careless typist. Sometimes I accidentally hit two keys at once, or my finger slides off the edge of one key onto the next. Why can't someone make guardrails between the keys to prevent this? Can you picture a sort of grillwork level with the top of the key to protect the i when I almost missed the o? Has anyone ever made such a keyboard, or could a manufacturer produce such a grillwork that could simply be laid over a standard keyboard to help me avoid these silly errors?

Sam I. Lerman
Southfield, MI

You can get such devices for most computer keyboards through a distributor of occupational-therapy equipment such as Enrichments (P.O. Box 579, Hinsdale, IL 60521, (800) 323-5547 or (708) 325-1700). Readers outside the U.S. should ask for Joanne Dorris.

BYTE testing editor Howard Eglowstein has written a one-key rollover (i.e., the number of keystrokes made active at a time) keyboard driver for MS-DOS. If you use this as your interface to your PC, you can limit the rollover to one and prevent the double letters that often result from pressing more than one key at a time. You can find similar programs in many keyboard utility packages. Eglowstein's version, called rollover.com, is available on BIX in the FROMBYTE92 listings area.

—Ben Smith and Howard Eglowstein
COPY SOFTWARE ILLLEGALLY
AND YOU COULD GET THIS HARDWARE ABSOLUTELY FREE.

Software piracy isn't just a crime. It's a shame. Because most people who do it aren't even aware that it's illegal. If you copy software that's protected by copyright, you could lose your job, face a civil suit, pay a $100,000 fine and possibly be imprisoned. So get the facts now. To request more information, contact the Software Publishers Association at 1-800-388-7478. Because in a court of law, ignorance is one thing you won't be able to plead.

Don't Copy That Floppy

Macintosh is a registered trademark of Apple Computer, Inc.
If your board doesn't say Quatech Inc., you may be missing something...

Ask a Quatech sales Engineer to show you the value of quality, service and support.

- Quatech manufactures a complete line of data acquisition, communication, and Micro Channel boards for the PC AT/XT, PS/2 and compatible computers.
- Quatech's user friendly software drivers enable our full featured adapters to support most popular operating systems.
- Quatech's adapters are backed by our free on-line technical support.

For a free catalog call: 800-553-1170

Buy it Through BYTE

BUYER'S GUIDE

Mail Order
The latest offerings from vendors supplying products of all leading manufacturers at extremely competitive prices.

Hardware/Software Showcase
This categorized four-color display section makes it easy to find Hardware and Software products from a wide variety of manufacturers and suppliers.

Buyer's Mart
From Accessories to Laptops to Word Processors, you can easily find the dealers you are looking for in this directory of products and services.

266 304 312
The Cost of 486 Power is Falling Fast.

AND LODESTAR'S VALUE KEEPS GOING UP:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAM</td>
<td>4 MB last RAM expandable to 32 MB</td>
</tr>
<tr>
<td>Hard Drive</td>
<td>85 MB IDE hard drive w/cache</td>
</tr>
<tr>
<td>IDE Controller</td>
<td>1:1 interleaved 21/27 IDE controller</td>
</tr>
<tr>
<td>Floppy Drives</td>
<td>1.2 MB 5.25&quot; &amp; 1.44 MB 3.5&quot; floppies</td>
</tr>
<tr>
<td>Floppy Drives</td>
<td>16-bit 1024x768 SVGA card w/1MB RAM</td>
</tr>
<tr>
<td>Floppy Drives</td>
<td>14&quot; 1024x768 SVGA color monitor</td>
</tr>
<tr>
<td>Ports</td>
<td>2 serial, 1 parallel &amp; 1 game port</td>
</tr>
<tr>
<td>Operating System</td>
<td>MS DOS 5.0 &amp; MS Windows 3.1</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Enhanced 101-key keyboard</td>
</tr>
<tr>
<td>Monitor</td>
<td>High resolution serial mouse</td>
</tr>
<tr>
<td>Case</td>
<td>Mini-vertical case</td>
</tr>
</tbody>
</table>

$1259 486-SX/25 $1299

$1559 486 ISA Datquest

$2029 486-LB WINstation

$2969 486 EISA CADStation

Some of our most astute customers are buying today, upgrading tomorrow.

To maximize the useful life of their systems, our customers depend on us. No need for them to unplug an obsolete system. They're using the power they need today and, with their LODESTAR StarFlex Series, they'll be upgrading simply, painlessly. LODESTAR's unique StarFlex CPU sockets are built right into the system. Upgradable all the way from 386DX to 486SX or 486DX, at any clock speed.

They keep coming to us because most other "upgradable" systems require purchase of a special CPU module board. This causes some performance loss due to speed adjustment. And they couldn't rely on those vendors being there when they needed to upgrade. Nor could they rely on sky-rocketing prices. So they've been calling LODESTAR.

Now Our Customers Are Getting It All — Value, Features and Price.
How thousands of our customers are BUYING DIRECT

When they buy from us, they’re buying directly from the factory. So they get more value with each purchase, and are always assured their system is backed directly by the people who assembled it.

386-SX Workstation
- 2MB RAM expandable to 32MB
- 80MB IDE hard drive w/cache
- 1.1 Interleave 2H/2F IDE controller
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 16x 1024x768 0.28mm pitch SVGA color monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Mini-vertical case

386-SX/25 $1139

386-DX Workstation
- 4MB RAM expandable to 32MB
- 130MB 15ms IDE hard drive w/64K cache
- 1.1 Interleave 2H/2F IDE controller
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 16-bit 1024x768 SVGA card w/1MB RAM
- 14x 1024x768 non-interlaced 0.28mm pitch SVGA color monitor
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0 & MS Windows 3.1
- Enhanced 101-key keyboard
- High resolution serial mouse
- Desktop or mini-vertical case

386-DX/25 $1399

StarFlex 3/486C
- CPU upgradable to 386DX, 486SX, 486DX, 486DX2. Up to 66MHz
- 4MB ultrafast write-back cache SRAM expandable to 256K
- 4MB fast RAM expandable to 32MB
- 130MB 15ms IDE drive w/64K cache
- 1.2MB 5.25" & 1.44MB 3.5" floppy drives
- 1MB SVGA non-interlaced color card
- 14x 1024x768 non-interlaced 0.28mm pitch SVGA monitor
- VGA 72Hz flicker-free display
- 2 serial, 1 parallel & 1 game port
- MS DOS 5.0, Windows 3.1 & mouse
- Enhanced 101-key keyboard
- Desktop or mini-vertical case

386-DX/33 $1429

386-DX/40 $1459

486-DLC/33 $1669

486-DX2/50 $1929

486-DX/66 $2039

486-DX 2/66 $CALL

Your Assurance of Complete Satisfaction

OUR RISK-FREE GUARANTEE

Look for your comprehensive, written guarantee when you take delivery of any LODESTAR system. This industry-acclaimed, FIVE WAY Personal Warranty proves our willingness to stand behind everything you buy from LODESTAR.

CALL FOR YOUR FREE COPY; we’ll fax or mail it immediately. Use the LODESTAR FIVE-WAY GUARANTEE as your shopping guide; compare and question the others before ordering.

1-800-875-3818

GOVERNMENT, SCHOOL, AND CORPORATE ORDERS WELCOME. TO RECEIVE YOUR FREE COPY OF OUR PRODUCT CATALOG, JUST CALL.

All specifications subject to change without notice. 3-Year Parts Warranty applies to advertised LODESTAR systems only. Money Back Guarantee does not include shipping & handling, and all returns must be shipped prepaid & in original condition. Please call to confirm all warranty details. Photography is for illustration only. No substitution on VISA, MasterCard & Discover. Purchase orders are accepted on approved cards. California orders add 8.25% sales tax. All product names, trademarks and registered trademarks are the property of their respective companies. © 1992 LODESTAR Computer Corp.

Circle 220 on Inquiry Card.
MEMORY...
YOU JUST CAN'T DO WITHOUT IT.

Picture this:
You bought a new software package. You try it out on your computer and soon find yourself working for hours on a sophisticated graphic design. While scrolling through your worksheet, it feels like you are moving through pudding. Your hard disk has a tough time trying to catch up. You then try to print, but the laser printer's buffer is full. You reset it, try again, and find that it spits out only part of your beautiful graphic....

No problem!
We'll take it from here. With our JetRam™ line that supports the leading brands of laser printers and PcRam™ line that upgrades your Notebook, Laptop or Desktop computers, Transcend can help solve your memory problems.

What you get from our memory upgrades
- Life time warranty on all our products
- Full memory lines support a variety of brand names of laser printers and PCs
- High quality at a reasonable price
- Easy-to-install

Office hours: 6:00 a.m. to 6:00 p.m. Mon. to Fri.
“You order in the morning, we will ship in the afternoon.”

Transcend
Your Supplier, Your Partner, Your Friend.

Transcend Information Inc.
104 Exchange Place,
Pomona, CA 91768 U.S.A.
TEL: (714) 598-5500
FAX: (714) 598-5050, (714) 598-6050

3Fl., No. 465, Chung Hsiao East Road,
Sec. 6, Taipei, Taiwan, R.O.C.
TEL: (886) 2-7881000
FAX: (886) 2-7881919, 7889191

* All brand names are registered trademarks of their respective owners.
Isn’t It Time You Played David Leadbetter’s Greens?

If water hazards are becoming too hazardous for you, then play David Leadbetter’s Greens. It’s the 3-D golf simulation that improves your game.

The golf instructor who helped Ian Baker-Finch, Nick Faldo, and Nick Price become champions can help you rise from course duffer to club pro.

Under his guidance, you’ll adjust stance, swing, tee, and ball positions. You’ll view shots from seven different angles. And you’ll even review your performance through slick instant replays and graphic hole-by-hole analysis.

David Leadbetter’s Greens from MicroProse. It’s the computer golf game you’ve been wading for.

Visit your local retailer, or for a free catalogue, dial 1-800-877-PLAY.
**Super Selection. Super Service. Super Direct!**

**Insight's 24 hour shipping:**
Need a fully-loaded, value-packed '486 right now? No problem! We've specially configured and pre-built our hottest selling systems and they're ready to ship today! Place your order before 5 P.M. (MST) and we'll ship your computer within 24 hours!

*The fine print.*
- This offer is good as long as these pre-built systems are in stock.
- Order by 5 P.M. (MST) Monday thru Friday.
- Order is subject to credit approval. P.O.'s subject to additional conditions.
- You must order a 486 ISA as listed here (Custom orders take a tad longer).

---

**CD-ROM**

- **Talon**
  - TA-100
  - Internal, 380ms access time, 32KB buffer, fast transfer rate.
  - $279

- **Sony**
  - S-535
  - Internal, 340ms access time, 8KB buffer, 150KB/second transfer rate.
  - $399

- **Talon High Performance TA-200**
  - Internal, 280ms access time, 64KB buffer, 300KB/second transfer rate.
  - $599

**Free with any CD-ROM drive**
- 1992 Multimedia Encyclopedia
- Stereo Headphones
- Reference Library
- Game Pack

**CD Software—Pick any 5 for $99**
- Aircraft Encyclopedia
- Bible Library
- Career Opportunities
- CIA Factbook
- Civil War
- European Monarchs
- Guinness Disc
- Great Cities (MM)
- Interactive Storytime
- Korea
- Mavis Beacon
- Interweaving
- N. American Indians

*With purchase of a CD-ROM Drive

---

**Insight 486 ISA**

- Fully Upgradable Intel 80486 CPU
- 4MB RAM - 256K Cache
- 210MB 12ms Hard Drive w/cache
- 420MB with Stackertm
- Non-Interlaced 14" Super VGA Color Monitor
- 24 Bit 1MB Graphics Accelerator
- Super VGA Video Card - Up to 16 Million Colors
- 1.2MB 5.25" Floppy Drive
- 1.44MB 3.5" Floppy Drive
- 2 Serial Ports, 1 Parallel, 1 Game Port
- Enhanced 101 Key Keyboard
- MS-DOS 5.0
- Mouse
- Desktop Case, Full Vertical Available
- Stackertm and Dr. Solomon's Anti-Virus™ Software

**486sx-25MHz**
- $1,599

**486-33MHz**
- $1,899

**486sx-50MHz**
- $1,999

**486-50MHz**
- $2,099

**486sx-66MHz**
- $2,299

---

**24 HOUR WORRY FREE CHARGE IT!**

---

**GET IT ALL WITH INSIGHT**

- 486 ISA, EISA & Local Bus Computers
- Multimedia Kits
- Notebooks
- Hard Drives
- Removable Drives
- Monitors
- Printers
- CD-ROM Drives & Software
- Power Drives
- Tape Backups
- Memory
- Networking Products
- Uninterruptible Power Supplies
- Fault-Tolerant Disk Arrays
- Software

---

**Insight Buy the Super Direct way!**
120MB to 2100MB Hard Drives

120MB IDE
- Talon TA3020A, 10ms, 3.5" 1"H
  Bare $329 8 Bit Kit $319
  16 Bit Kit $399

520MB IDE/SCSI
- Fujitsu FJ2624S, 12ms 3.5" HH
  Bare $899 16 Bit Kit (IDE) $1,019
  16 Bit Kit (SCSI) $1,149

1350MB SCSI
- Micropolis MC1528-15, 14ms 5.25" FH
  Bare $1,799 16 Bit Kit $1,949

Tape Backups
Standard QIC 80 attaches to existing floppy controller or dedicated unit, w/ data compression, 2-3MB/min.

Talon
- 120MB includes one tape $189
- 250MB includes one tape $249

Colorado
- 120MB $199
- 250MB $259

Printers
Canon
- BJ-10ex Bubble Jet $289
- BJ-20 Bubble Jet $379
- BJ-300 Bubble Jet $389
- BJ-330 Bubble Jet $579
- BJC-800 Color Bubble Jet $1,899
- BJC-820(SCSI) Color Bubble Jet $1,999
- LBP-4LITE Laser Beam $759
- LBP-4Plus Laser Beam $899
- LBP-8 MARK III Laser Beam $1,499

Monitor
TVM
- MediaScan 4A+ 14" $319
- Low Radiation 5A+ 15" $459
- MediaScan 6A 17" $1,039

NSA/Hitachi
- SuperScan™ 15 (CM15B4) $579
- SuperScan™ 17 (CM17B5) $1,099
- SuperScan™ 20 (CM20B5) $1,499

IBM
- MultiSync 3FGx 15" $639
- MultiSync 4FG 15" $749
- MultiSync 5FG 17" $1,349
- MultiSync 6FG 21" $2,359

WangDAT Tape Backups
- 2GB 3100 Internal Kit $1,199
- 2GB 3100 External Kit $1,299
- 4GB 3200 Internal Kit $1,399
- 4GB 3200 External Kit $1,499

Software
- Automap $49
- Lotus SmartSuite for Windows $419
- Microsoft Excel 4.0 $295
- Microsoft Word 2.0 $295
- Paradox 4.0 $499

Networking
- L.A.Nastic® AE-2™ Ethernet Starter Kit (ISA) $479
- L.A.Nastic® AE-3™ Ethernet Starter Kit (ISA) $549

Bernoulli
Removable media, offers a 90 Pro internal drive, SCSI adapter by Rancho Technology 360MB of storage, 2.90MB cartridges and Stacker® disk compression software.
- Internal Kit $499
- Extra Cartridges $149
- 3 Pack of Cartridges $419

Super selection.
Super service.
Super Direct™ way to have it all - direct to your door faster than a speeding bullet.

Hard Drives International and Insight have joined forces to bring you a superstar in your mailbox. We offer the ultimate selection of today's most popular hardware and software, with the most affordable prices. Get Insight's superior service and support, plus 1000's of products to choose from. It's the Super Direct™ way to have it all - direct to your door faster than a speeding bullet.

Super service.
- 30-Day "Worry-Free" Money Back Guarantee
- Federal Express Delivery
- Toll-Free Technical Support 7 Days a Week
- Payment Options Galore
- Order 24hrs a Day
- One Year Parts & Labor Warranty/Replacement Policy
- Special National Accounts Department for Larger Customers

Super Direct™
Order 24 Hours a Day
800-998-8040
National Accounts - P.O.'s 800-998-8041
FTP 602/350-1128
Fax 602-350-1188
Insight Distribution Network Inc.
1912 W. Fourth St.
Tempe, AZ 85281
FH 602-350-1128
Fax 602-350-1150
Source Code CAW

800-998-8040
Insight
Buy the Super Direct™ way!
Whether this is your first experience at networking or you are a certified engineer, the professionals at Network Express are ready to help. Call or fax us your requirements.

Over 5,000 proven NETWORK PRODUCTS from more than 200 manufacturers.

Novell, IBM, and Artisoft trained sales consultants to serve you.

The following list of products represents a small portion of the selection available. Please call for any networking needs...we’ll try to help.

**FILE SERVERS**

- **INTERNATIONAL**
  - IBM 9290 MAU Multi Access Unit...
  - IBM 1660 TES Ring 16MB Internal...
  - IBM 4 MB Token Ring Adapter...
  - PROTOCOL 16/4 Token Ring Adapter...
  - PROTOCOL EISA BusMaster 34/4 Adapter...

- ** domestic**
  - Panther P.O. 125 1.0GB 13MS...
  - Panther P.O. 110 1.5GB 13MS...

**TOKEN RING**

- **IBM**
  - Token Ring 16/4...

**SCSI HARD DRIVES**

- ** domestic**
  - Seagate ST37401B 360MB 68MS ...
  - Seagate ST37502B 520MB 68MS ...
  - Seagate ST37401B 520MB 68MS ...

**SCSI CONROLLERS**

- ** domestic**
  - Adaptec 1520RA 32-bit ISA Adapter...
  - DPT Cache Plus EISA SCSI ...
  - UltraStar 24F EISA SCSI ...
  - UltraStar 16F EISA SCSI ...

**LAN SERVER DEVICES**

- ** domestic**
  - Castelle FAX Server...
  - Castelle Print Server...
  - Castelle 1995...
  - Castelle 1995...
  - IBM NetBridge 4000...
  - IBM NetBridge 4000...
  - IBM 500MBA ...
  - IBM 500MBA ...

**REPEATERS-TRANSCEIVERS**

- ** domestic**
  - AUI/BNC Transceiver...
  - AUI/10 Base T Transceiver...
  - Dual Port Thin Coax Repeater...
  - IBM Quad Port Repeater...
  - IBM 802.3 Fast Ethernet...
  - IBM Optical Transceiver...

**BUSINESS HOURS**

- M-F 8:30AM-5:30PM
- Saturday 10AM-4PM
- Closed Holidays

**NETWORK EXPRESS**

- **P.O. BOX 125**
- **Sarasota, FL 34272**
- **FAX 1-813-355-2876**
- **VOICE 1-813-355-5841**

**POWER BACKUP**

- **Smart UPS 600**
- **Retail $449**

**NEW LOWER PRICES**

- **NE**
  - SMART UPS 400...
  - SMART UPS 600...
  - SMART UPS 1200...
  - SMART UPS 2200...
  - SMART UPS 3200...

**ETHERNET COAX PRODUCTS**

- **ALTA 16 BIT BNC & 10BaseT Combination Adapter**
  - **$129**

**MCIC98! 1.0GB 16MS 3.25"...
  - **$1,899**

**MICROPOLIS**

- **Fujitsu**
  - 2 Year - 24 Hours Warranty...
  - 5 Year Warranty from Manufacturer...

**ARGENT PRODUCTS**

- **Arcnet Adapter 16 Bit Star/BUS Twisted Pair & Coax**
  - **$79**

** CABLING**

- **Network Express**
  - **1-800-846-9899**
  - **24 HOUR TOLL FREE**

**OPTICAL STORAGE**

- **Pinnacle PMO**
  - **650MB Optical Hard Disk**
  - **$3,295**

**NETWORK EXPRESS POLICIES**

- **30 Day Satisfaction Guaranteed**
- **Evaluation Period. Sorry, but no refund can be made after 30 days from invoice date. Products must be in new condition with all manuals, boxes, and received materials. Opened software packages not returnable. RMA required.**
- **Full Manufacturer’s Warranty on all products.**
- **Same Day Shipping & Overnight Delivery available on most orders.**
- **Government, Education, and Corporate Purchase Orders welcomed, subject to approval.**
- **Shipping Charges Not Refundable.**
- **Prices, Specifications & Availability subject to change without notice.**
- **We Export.**

Novell, Novell, and “N” are trademarks of Novell. All other brand names and trademarks are the property of their respective companies. Smart people read the fine print and try to do business with Network Express. 

**Circle 236 on Inquiry Card (RESELLERS: 237).**
So the novelty of flying wore off a long time ago. Cancel those reservations and strap yourself into the cockpit of the F-15 Strike Eagle® III jet fighter computer game. This is flying as it should be. Slicing through war theaters around the world. Blasting enemy fighters to smithereens with high-tech missiles.

Devastating strategic targets in dangerous bombing runs.
Performing fantastic aerial aerobics.
And dogfighting against a friend via modem. All brought to life by dazzling, state-of-the-art graphics. Sure, it's not like flying first class.

But when's the last time you had fun flying first class?

F-15 Strike Eagle III from MicroProse.
To get your copy, visit your favorite computer game retailer today.
Get More Performance From Your PC System

**RMB MOTHERBOARDS**

Buy Smart...Buy RMB Upgradable Motherboards

<table>
<thead>
<tr>
<th>Model</th>
<th>No Memory</th>
<th>2 Mb</th>
<th>4 Mb</th>
<th>8 Mb</th>
<th>16 Mb</th>
<th>32 Mb</th>
</tr>
</thead>
<tbody>
<tr>
<td>386 SX-25</td>
<td>139</td>
<td>215</td>
<td>291</td>
<td>463</td>
<td>719</td>
<td>NA</td>
</tr>
<tr>
<td>386 SX-33 16k cache</td>
<td>159</td>
<td>1235</td>
<td>1311</td>
<td>1463</td>
<td>1739</td>
<td>NA</td>
</tr>
<tr>
<td>386 DX-33 (upgradable to 486DX)</td>
<td>245</td>
<td>NA</td>
<td>197</td>
<td>254</td>
<td>425</td>
<td>1405</td>
</tr>
<tr>
<td>486 SX-25 Local Bus Slot</td>
<td>139</td>
<td>NA</td>
<td>471</td>
<td>623</td>
<td>899</td>
<td>1479</td>
</tr>
<tr>
<td>486 DX-33</td>
<td>499</td>
<td>NA</td>
<td>751</td>
<td>903</td>
<td>1179</td>
<td>1759</td>
</tr>
<tr>
<td>486 DX-50 Local Bus Slot</td>
<td>675</td>
<td>NA</td>
<td>822</td>
<td>979</td>
<td>1255</td>
<td>1835</td>
</tr>
<tr>
<td>486 DX-50 EISA w/Overdrive</td>
<td>1075</td>
<td>NA</td>
<td>1239</td>
<td>1403</td>
<td>1655</td>
<td>2235</td>
</tr>
<tr>
<td>486 DX-66 EISA Local Bus Slot</td>
<td>1250</td>
<td>NA</td>
<td>1414</td>
<td>1578</td>
<td>1830</td>
<td>2410</td>
</tr>
</tbody>
</table>

*64k Cache Memory *128k Cache Memory ***256k Cache Memory

Future Upgradability: 486 DX-33 to 486DX-2/66 MHz or 486 DX-50 to 486DX-2/100 MHz

**DRIVES**

Floppy Drives
- Epson*: 1.2M 5.25" half height drive $69.00
- Epson*: 1.44M 3.5" in a 5.25" frame $69.00
- Teac*: 1.44M 3.5" drive $59.00
- Epson*: 2.88M 3.5" in a 5.25" frame with controller card $169.00

Hard Drives
- Conner*: CP-3000 40 Meg IDE with 28ms access time $169.00
- Maxtor*: 7030A 80 Meg IDE with 17ms access time $229.00
- Maxtor*: 7120A 120 Meg IDE with 15ms access time $289.00
- Maxtor*: 7231A 213 Meg IDE with 13ms access time $399.00
- Maxtor*: LXT-340A 340 Meg IDE with 13ms access time $799.00

**TAPE BACKUPS**

- Colorado*: DJ-30 Jumbo 120 Mb QIC-40 internal $197.00
- Colorado*: DJ-30 Jumbo 250 Mb QIC-80 internal $257.00

**VIDEO PRODUCTS**

14" Super VGA Displays (interlaced)
- Magnavox* CM3079 SVGA w/0.39 dot pitch $259.00
- Amaizing* CM4849SX SVGA w/0.39 dot pitch $213.00
- CTX* CV3-5439A SVGA w/0.39 dot pitch $229.00
- Magnavox* CM3089 SVGA w/0.28 dot pitch $289.00
- Amaizing* CM4848SX SVGA w/0.28 dot pitch $266.00
- CTX* CV3-5468A SVGA w/0.28 dot pitch $269.00

14" Super VGA Displays (non-interlaced)
- Amaizing* CM4828MX SVGA w/0.39 dot pitch $298.00
- CTX* CV3-5468NI SVGA w/0.28 dot pitch $306.00

15" Display (Ralin's choice for Windows users)
- CTX* CTS-1560 Flat Square Tube SVGA w/0.28 $475.00

17" Display (for the serious Windows user)
- CTX* CTS-1760 Flat Square Tube 1280 x 1024 w/0.28 $665.00

20" Display
- Magnavox 20CM64 1280 x 1024 w/0.31 dot pitch $1275.00

**VIDEO CARDS**

- RMB Trident 9000C w/1Mb up to 1024 x 768 $75.00
- RMB Windows Accelerator $75.00

Call 1-800-752-9512 today and talk to the

**CASES**

- Desktop Case
  - 5-bays (3) 5.25", (2) 3.5" 16.3"x16.6"x7.7" $87.00
  - 170 watt power supply $75.00

- Mini Tower
  - 4-bays (2) 5.25", (2) 3.5" 7"x16.6"x13.6" $139.00
  - 200 watt power supply $75.00

- Full Tower
  - 9-bays (6) 5.25", (3) 3.5" Digital Display, 230 watt power supply $115.00

- Mid Tower Version

Ralin Policies

- Prices and availability subject to change.
- Purchase orders are accepted, subject to approval.
- We do not charge your card until order is processed.
- Incomplete returns are subject to a service charge.
- All returns other than exchanged items incur a 10% re-stocking fee.
- Not responsible for compatibility problems and types.
- 30 day guarantee does not apply to software. Defective software exchanged only.
- APO and FPO's please call for shipping charges or for credit card orders.
- All returns other than exchanged items incur a 10% re-stocking fee.

To ensure your shipment arrives when you need it, Ralin uses only the most reputable modes of transportation available.
For a Lot Less Than You Think.

MODEM UPGRADES

Zoom Telephonics

Zoom modems rate at the top of their class for compatibility and performance. The recipient of numerous Editors' Choice awards, Zoom modems offer the quality and dependability that you require at a price that makes them a true value. All Zoom modems are backed by a 7 year warranty and are made in the USA.

- 2400 bps w/ RPI compatible v.42bis and MNP 2-5
  - (AMC) internal $49.00
  - (AMX) external $65.00
- 2400 bps w/ v.42bis and MNP 2-5
  - (AMC) internal $59.95
  - (AMX) external $79.95
- 9600 send & 4800 receive Fax
  - (PC 9624) internal $79.95
  - (FX 9624) external $95.00
- 9600 bps modem w/ v.32, v.42bis, MNP2-5
  - (VP-V32) internal $199.00
  - (VF-V32) external $199.00
- 14,400 bps modem w/ v.32, v.42bis, MNP 2-5 and 9600 bps send/receive Fax
  - (VF-V32bis*) internal $229.00
  - (VF-V32bis*) external $269.00
- 2400 bps modem w/ v.42 bis and MNP 2-5 and 9600 bps send/receive Fax
  - PKT Pocket/Fax Modem $89.95

*WINFAX software option available for $15 if purchased with VFP-V32bis or VF-X32bis modem.

PRINTERS

EPSON®

The solution to all your home and office printing needs. Crisp, clean 24-pin print quality that you expect from Epson and a unique 50 sheet tray that makes continuous feed paper a thing of the past.

- AP-3250 24 pin LQ
  - $191.00
  - 200 cps draft / 72 cps LQ
  - 11k buffer
  - 5 letter quality fonts & 2 scalable fonts
  - Two year warranty

9-Pin Printers

- LX-810 240/48 cps $133.00
- FX-850 264/54 cps $288.00
- FX-1050 264/54 cps $377.00
- DFX-5000 533 cps $1265.00
- DFX-8000 1066 cps $2145.00

24-Pin Printers

- LQ-570 252/84 cps $259.00
- LQ-870 330/110 cps $435.00
- LQ-1070 252/84 cps $369.00
- LQ-1170 330/110 cps $575.00
- LQ-2550 400/133 cps $849.00

Math Co-processors

Cyrix® S25 for 386 SX-16, 20 or 25 MHz $69.00
Cyrix® D33 for 386 DX-16, 20, 25 or 33 MHz $87.00
Cyrix® D40 for 386 DX-16, 20, 25, 33 or 40 MHz $110.00

Upgrade Specialists.

Hours: 8:00 am to 7:00 pm Monday-Friday
Customer Service: 716-674-6267
Fax: 716-674-2108

WE ACCEPT: VISA

Circle 229 on Inquiry Card (RESELLERS: 230).
### Notebook 386SLC-120MB
- CALL

### Notebook 486SLC-120MB
- CALL

### PS/2-486-33-400MB
- CALL

### 95 Server 1GB
- CALL

### Monitor Extra

#### MEGACUBE EISA BUS
- 486-33 MHz System
  - 8 meg, 128K Cache, SCSI.................. 3695
- 486/33 MHz System
  - 4 meg, 256K Cache, 1.2 & 200 meg drives, SVGA Combo...... 2995
- Carrier 386sx/25 MHz Notebook
  - 4 meg, 120 meg Hard Drive, VGA........... 2195

#### POWERCUBE
- 486-33 MHz System
  - 8 meg, 128K Cache, SCSI.................. 3695

#### 486/33 MHz System
- 4 meg, 256K Cache, 1.2 & 200 meg drives, SVGA Combo...... 2995

#### 386SX/25 with 40 meg HD
- 950

#### 386SX/25 with 40 meg HD
- 950

### ASimetary

#### Notebook 386SLC-120MB
- CALL

#### Notebook 486SLC-120MB
- CALL

#### PS/2-486-33-400MB
- CALL

#### 95 Server 1GB
- CALL

### Note: LOW PRICES LEADER SINCE 1983
- We export to Europe, Asia & the Far East
- We Honor Manufacturer's Warranties
- Call for details

### WE STOCK TOSHIBA

#### CD ROM/Multi Media
- NEC CD ROM 37M-Gallery...................... 570
- NEC CD ROM 74M-Gallery..................... 680
- Sound Blaster Pro.......................... 205

### ACS Computers

#### Made in USA
- Intel CPU with 4 meg RAM
- Desktop or tower case
- 2 serial, 1 parallel, 1 game (joystick) ports
- 101 AT enhanced keyboard
- 1.2 (5.25") & 1.44 (3.5") TEAC floppy drives
- SVGA card w/1 meg & SVGA 0.28mm monitor
- MS DOS 5.0 (complete w/manuals)
- MS Windows 3.1 (complete w/manuals) & mouse

#### 486/50 with 200 meg HD
- 2150

#### 486/33 with 120 meg HD
- 1860

#### 386/40 with 120 meg HD
- 1390

#### 386SX/25 with 40 meg HD
- 950

### Corporate Accounts Welcome

### Call for Discounts on Volume

### And Consultant Orders

### Exports Available

### Computerlane inc.

#### Outside California: 1-800-526-3482

#### Inside California: 818-884-8644 • FAX: 818-884-8253

#### Hours: Monday - Friday 9 -6, Saturday 10-6

Compaq is a Registered Trademark of Compaq. IBM is a Registered Trademark of International Business Machines.
TRAVEL LIGHT, TRAVEL NEAT, TRAVEL SMART...

ABC BICOM B260i

- Weight less than 1 kg
- PCMCIA 2.0 Interface
- 60 Mb Hard Disk
- 2 Mb RAM
- No adapters needed

- Weight 2.2 lbs. (Bicom and Battery)
- Dimension 8.78" x 6.36" x 1.22"
- True 16 bit AMD Lonestar Processor, 386SX Class Performance
- 5 "AA" size NiMH Batteries
- 60 MB Hard Disk Drive
- 2MB RAM expandable to 4MB on board and 16MB with memory card
- PCMCIA 2.0/JEIDA standard port for memory card and I/O card
- 640 x 400 resolution LCD screen supports CGA, AT&T mode and all Windows graphics
  - 64-key keyboard
  - 1 parallel (bi-directional)/ 1 serial
  - External FDD port for optional Floppy Drive
- DR-DOS 6.0, File Transfer Software & Serial Download Cable
- Built-in Personal Data Manager software
- Built-in Programmable Power Management Software
- Universal AC/DC adaptor
- Carrying Case

Options: External Floppy Drive, SRAM Memory Cards, 9624 IC Card
Fax/Modem, Mini-trackball, External Keyboard, extra batteries.

Christmas Special

$995

30-Day Money Back Guarantee
All brand names are registered trademarks of their respective owners.

DECEMBER 1992 •BYTE 277

Circle 231 on Inquiry Card (RESELLERS: 232).
ALL SYSTEMS INCLUDE:
• 4MB RAM on 32MB Motherboard
• 2 Serial, 1 Parallel, 1 Game Port
• 2 Floppies, 1.44 & 1.2 MB (3-1/2" & 5-1/4")
• DynamicScan, Super VGA Monitor .28 DOT, 1024x768, Tilt & Swivel
• 1MB, Super VGA Card
• 101 Keyboard, Non-Click or Click
• Min. 200W Noiseless Power Supply
• 8 Expansion Slot
• Windows 3.1 and Mouse (2600DPI), DOS 5.0

Synchronous 32Bit Local Bus
66, 50 and 33MHZ available now!
• 486-DX66MHZ, 256K Cache, w/Local Bus...Call Price
• 486-DX50MHZ, 256K Cache, w/Local Bus...$1,589.00
• 486-DX50MHZ, 256K Cache, w/ISA Bus...$1,499.00
• 486-DX33MHZ, 256K Cache, w/Local Bus...$1,349.00
• 486-DX33MHZ, 256K Cache, w/ISA Bus...$1,259.00
• 386-DX40MHZ, 64K Cache, AMI BIOS
  Upgradeable to 486-66MHZ..............................$998.00
  "Made in USA Motherboard"

OPTION:
NonInterlaced DynamicScan 72 SPVGA Monitor.
1024 x 768, .28 DÔT, 72HZ, Add..............................$49.00

HARD DRIVES: – Call For Best Price
<table>
<thead>
<tr>
<th>SIZE</th>
<th>80MB</th>
<th>100MB</th>
<th>120MB</th>
<th>200MB</th>
<th>300MB</th>
<th>600MB</th>
<th>1.2GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>80MB</td>
<td>16MS</td>
<td>16MS</td>
<td>14MS</td>
<td>14MS</td>
<td>14MS</td>
<td>14MS</td>
<td>14MS</td>
</tr>
</tbody>
</table>

The Fastest PC. Configurations:

• 300MB IDE Hard Drive plus 32Bit Local Bus
• Comes with 4MB RAM Write Back Cache
• Speed Up Windows or AutoCAD
• 32Bit Local Bus

• 16MB RAM INSTALLED
• 256K Write Back S.RAM Cache
• Dual local Buses

Dual Synchronous 32Bit Local Buses
The Fantasy Combinations/VGA & IDE Caching

$3,789.00

• 15" Flat Screen
• Flicker Free
• .28 DÔT, 1024 x 768
• Low Emission

The Best Application for File Server, CAD Station, Graphic Art, Data Base

• Click or Soft Touch
101 Keyboard

30 Days Money Back Guarantee
On site service to Most Locations

DynamicScan

The Price is changed without notice
The Fastest PC?

**MOTHERBOARD**
- 486-50MHZ, Local Bus w/S3 VGA Card Set $889.00
- 486-EISA or ISA Please CALL
- 386-40MHZ, 64K AMI Bios $229.99
- Upgradable to 486-60
- 386-SX25MHZ $139.00
- 386-SX16MHZ $119.00

**FLOPPY DRIVES**
- Teac 1.44MB $52.00
- Teac 1.2MB $58.00
- JPN 1.44MB $51.00
- JPN 1.2MB $57.00

**MONITORS**
- 1024 x768 Non-interlaced SuperVGA Package $368
  - 28 DOT Pitch
  - 16 bit Spvga Card w/1MB RAM
  - 256 Colors at 1024x768
  - 14” Monitor
  - Drivers support on major programs
  - Monitor Only $289

**GRAPHIC CARDS**
- Trident, 1MB $69.00
- SpeedStar Stealth, 1MB $249.00
- Renoir Hi Color, 1MB $189.00
- Tseng Lab, 1MB RAM, 32K Colors $119.00

**HARD DRIVES**
- Maxtor CALL
- Seagate CALL
- Conner CALL
- Western Digital CALL

**CASES & POWER SUPPLIES**
- AT Mini Tower w/200W PS $59.00
- AT Medium Tower w/200W PS $89.00
- AT Big Tower Case w/230W PS $129.00

**DYNAMICS CAN 486-33MHZ DX NOTEBOOK**
- 4MB RAM
- 130MB Hard Drive

**SALES/ORDERS** 314-423-0044
**FAX** 314-426-4014
**EXPORTING** 314-428-7734
**TECH SUPPORT AND RMA** 800-852-3273

DynamicScan Systems
10824 Page Avenue
St. Louis, Missouri 63132

We Offer Any Custom Configuration. Lanastic, Novell Lan System.
All Systems Include The Following Software Package That Even The Novice Can Use.
- Easy Menu
- Lotus Tutor
- Bible
- Accounting
- DOS Tutor
- Word Processing
- Data Base
- Real Estate
- Variety of Games and Educational Programs

Test a DynamicScan System yourself with a 30-day money back guarantee.
With the purchase of any DynamicScan System, you will have access to unlimited technical support with our “800” DynamicScan Users Number.
Warranty—1 Year On-Site Service to most locations.

DynamicScan Systems
10824 Page Avenue
St. Louis, Missouri 63132
**Chip**s and SIMM's

- **RAM Chips**
  - 41250-100 256 100 ns DP  1.49  1.35
  - 41250-120 256 120 ns DP  1.49  1.35
  - 41250-140 256 140 ns DP  1.49  1.35
  - 41250-160 256 160 ns DP  1.49  1.35
  - 41250-180 256 180 ns DP  1.49  1.35
  - 41250-200 256 200 ns DP  1.49  1.35

- **SIMM Modules**
  - A21308-04 8mb 10 ns  1.35
  - A21250-36 4mb 10 ns  1.35
  - A21250-37 8mb 10 ns  1.35
  - A21250-38 16mb 10 ns  1.35
  - A21250-39 32mb 10 ns  1.35
  - A21250-40 64mb 10 ns  1.35

**Conner Peripherals**

- 1920 100 ns IDE Call
- 1920F 133 100 ns IDE Call
- 2440 100 ns IDE Call
- 2440F 133 100 ns IDE Call
- 2440FX 166 133 ns IDE Call

**Diagnostics**

- Prophet 205 100 ns IDE Call

**Hard Drives**

- Western Digital
  - "Caviar" series with 1" height, 100% full pay and 30% buffer.
  - 41250-100 256 100 ns DP  1.49  1.35
  - 41250-120 256 120 ns DP  1.49  1.35
  - 41250-140 256 140 ns DP  1.49  1.35
  - 41250-160 256 160 ns DP  1.49  1.35
  - 41250-180 256 180 ns DP  1.49  1.35
  - 41250-200 256 200 ns DP  1.49  1.35

**Math Coprocessors**

- AMD 286/7, increases your 286 PC performance.

**Memory Upgrades**

- Notebooks
  - Compaq LifeBook, 144mb...
  - Toshiba 32mb...
  - IBM 64mb...

**Modem Bundle**

- 2400 MODEM and 9600 FAX (Int.)

**Motherboards**

- Compaq DP386/33.

**Multimedia**

- Sony
  - 7200 Laser Library w/6x CD's...

**Modems**

- Hayes Optima 33.6k
  - Novotem, a high performance modem with V.22bis speed and throughput up to 9600 bps.

**Notebooks**

- IBM ThinkPad...

**Software**

- Microsoft Excel...

**Sound Blaster**

- Pro Audio Spectrum 16...

**Telecom**

- Hayes Optima Modem...

**Video Graphics Cards**

- ATI
  - TruType fonts with Flintstone

**Microchip**

- Micronics, Inc.

**Motherboards**

- Advanced Computer Products...

**Monitors**

- Micronics...

**Software**

- Norton AntiVirus...

**Telecom**

- Hayes Optima Modem...

**Memory Upgrades**

- RAM Chips
  - A21308-04 8mb 10 ns  1.35
  - A21250-36 4mb 10 ns  1.35
  - A21250-37 8mb 10 ns  1.35
  - A21250-38 16mb 10 ns  1.35
  - A21250-39 32mb 10 ns  1.35
  - A21250-40 64mb 10 ns  1.35
ARES GIVES YOU ONLY

Many will follow a familiar path. Others feel compelled to set their own distinct course. Those who choose ARES place themselves firmly in the second category. The new ARES VL-Bus motherboard represents a new beginning in PC performance by incorporating the compatibility of the VESA (Video Electronics Standards Association) Local Bus along with the unprecedented power of the Intel 80486 line of processors. Our steadfast goal is to make you an ARES customer for life by offering you guarantees and support policies that our competitors dare not match. ARES takes the time to do things right...recognized throughout the industry for our many design accomplishments, such as:

- 72 hour burn-in, followed by a rigorous 4-hour 100-point quality certification test, documented by a personalized 4-page printed report signed by a skilled ARES technician.
- ARES unpacks and tests ALL plug-and-play components like keyboards and monitors. No other company does that.
- ARES systems are custom-packed in sturdy cartons surrounded by 360-degree solid foam packing. This protects your unit from even the most brutal pounding during shipment.
- ARES cabinets are 1.5mm steel: thicker than anyone else's. This, along with an FGQ approves reflective finish, reduces interference to a minimum.
- ARES seals all component screws in place for maximum security.

Innovative Motherboards, Award Winning Video Cards, Superior Hard Drives... Uniquely Combined To Carry On The ARES Trademark of Excellence.

It's The HEART OF ARES

With greatness of heart comes strength of body. And our strength lies in the multitude of ARES systems owners who express their enthusiasm and appreciation to us every day in customer satisfaction letters, follow-up calls, and on PRODIGY.

A personal computer company should do many things... it should inspire confidence and a sense of freedom. It should have a reputation that earns respect. It should, from day one, provide exactly what you need - both hardware and applications solutions. And do so without costly "free" software that you'll never use. It should offer a boundless horizon with the flexibility to grow and expand in limitless directions. THIS IS ARES! If you're looking for everything a personal computer should be, there is only one choice... AND ARES WAS THE CHOICE OF:

- Dunn & Bradstreet
- Honeywell
- U.S. Air Force
- Ziff-Davis Publishing
- General Battery
- U.S. Navy
- J.D. Power
- U.S.D.O.A.
- U.S. Dept. of Defense
- NASA
- PPG

Come Experience The Exhilaration Of Excellence.
Join The Growing Family Of Satisfied Customers...
It's The BODY OF ARES
The soul of an ARES is found in the people that stand behind it. Our standards are the same as yours: quality first. Our technology may be envied and emulated throughout the industry, but our people, proud and dedicated, are our greatest asset.

Our objective is customer satisfaction. We begin with the highest quality product, and couple it with unparalleled service. We build a reliable product with dependable and responsive people to back it up. From the onset of design to the final process of packaging and delivery, quality is paramount.

**ARES 486-33EISA**
- Intel 80486-33DX Processor
- Intel 80487 Math Co-Processor
- 256K External Cache
- 8MB RAM expandable to 64MB on board
- Quantum 240MB IDE Hard Drive
- SCIS Hard Drive Controller
- Teac 1.44 and 1.2 MB Floppy Drives
- Viewsonic 686 VGA Non-Interlaced Monitor
- 28 Dot Pitch
- Diamond SpeedStar 24X Graphics Accelerator Video Card
- Your choice of ARES Platinum Series Keyboards
- 2 Serial and 1 Parallel port
- DOS 5.0, Windows 3.1 pre-installed
- ARES FixUp Disk
- Authentic Microsoft Mouse

**Price:** $3,175.00

**Quality Product.**

**Quality Software.**

**Quality People.** It's the SOUL of ARES.

**ARES 486-25WX**
- Intel 80486-25WX Processor
- 4MB RAM expandable to 64MB on board
- Quantum 128MB IDE Hard Drive - 64 READ AND Write Cache
- Teac 1.44 and 1.2 MB Floppy Drives
- Viewsonic 686 VGA Non-Interlaced Monitor
- 28 Dot Pitch
- Diamond SpeedStar 24X Graphics Accelerator Video Card
- Your choice of ARES Platinum Series Keyboards
- 2 Serial and 1 Parallel port
- DOS 5.0, Windows 3.1 pre-installed
- ARES FixUp Disk
- Authentic Microsoft Mouse

**Price:** $1,995.00

**ARES 486-33DX**
- Intel 80486-33DX Processor
- Intel 80487 Math Co-Processor
- 4XK External READ AND WRITE Cache
- 4MB RAM expandable to 64MB on board
- Quantum 170MB IDE Hard Drive or Maxtor 213MB IDE Hard Drive
- Teac 1.44 and 1.2 MB Floppy Drives
- Viewsonic 686 VGA Non-Interlaced Monitor
- 28 Dot Pitch
- Diamond SpeedStar 24X Graphics Accelerator Video Card
- Your choice of ARES Platinum Series Keyboards
- 2 Serial and 1 Parallel port
- DOS 5.0, Windows 3.1 pre-installed
- ARES FixUp Disk
- Authentic Microsoft Mouse

**Price:** $2,395.00

Your package is a class act. I have 8 computers, and this one's packaging, sales, and attention to detail are by far the best of them all.

-Susan Stevens

**DECORATIVE TEXT:**

**Problems?** Forget it.

The ARES 386 Mini Tower gave relentless, quality performance.

- Rebecca Roben

**I called 11 different companies to research my purchase. The ARES sales rep. was by far the most knowledgeable and courteous. He got my order.**

-Douglas A. Gifford

**U.S. Embassy, Madrid**

**ARES sold me the first time on quality and performance; but more importantly, I was sold the second time on customer support.**

-John W. Messina

**In short, ARES just checked every quality throughout, from the sales rep. to the follow-up letters, to the system itself and the documentation. I was more pleased with ARES.**

-Prof. Jim Wade

**ARES has assembled an organization to be proud of and equipment that compares most favorably with any that I have been exposed to. I have worked with both Dell and IBM.**

-E. Marvin Freeman

**Syosset, New York**

**Your Package is a class act. I have 8 computers, and this one's packaging, sales, and attention to detail are by far the best of them all.**

-Susan Stevens

**Memphis, Tennessee**

**CALL TODAY... We'll Ship Today...**

800-322-3200

Circle 235 on Inquiry Card.
CMCS 222A

PC-based motion control may seem like science fiction to many people. Here at CyberResearch, it’s one of our specialties. It can also cost a lot less than you think. Complete motion control systems from CyberResearch include all of the components you need to set up an intelligent yet powerful, high-speed motor control system, which includes:

- Regulated DC Power Supply
- Screw Terminal Panel with Cabling
- 40V, 3.5A Bipolar Chopper Drivers
- Two High-Torque Stepping Motors, Size 23
- 2-Axis Stepping Motor Controller Board
- Maximum holding torque of 125 oz-in. Rated for speeds of up to 7,000 steps/second
- 8 Channels of Precision D/A
- 16 Analog inputs, 2 analog outputs, 32 digital I/O lines, 3 counter/timers
- Programmable gains • Demand-mode OMA • Burst-mode timing
- 10" VGA High-Resolution Color Monitor, with VGA Card included at no extra charge.
- Eight Expansion Slots.
- Utilize components from our extensive product line and set up your own motion control system, at no extra charge at our world headquarters in Branford, CT before shipping the complete system to you.

Keithley Metrabyte Sets the Standard — AGAIN

The DAS 16 analog converter board has always set the standard for PC-based data acquisition. Keithley Metrabyte has now set a new standard for price and performance. A total redesign using ASCII architecture has resulted in complete backwards compatibility, reduced size, weight, and power consumption, and the addition of many new features, including:

- Burst-mode timing
- D/A Channels may be sequentially or simultaneously updated, with all channels resetting to zero
- Maximum holding torque of 125 oz-in. Rated for speeds of up to 7,000 steps/second
- Utilize components from our extensive product line and set up your own motion control system, at no extra charge at our world headquarters in Branford, CT before shipping the complete system to you.

Motion Control Systems make Motor Control Easy

PC-based motion control may seem like science fiction to many people. Here at CyberResearch, it’s one of our specialties. It can also cost a lot less than you think. Complete motion control systems from CyberResearch include all of the components you need to set up an intelligent yet powerful, high-speed motor control system. Featured here is our CMCS 222A high-speed motor control system, which includes:

- 2-Axis Stepping Motor Controller Board
- Two High-Torque Stepping Motors, Size 23
- 40V, 3.5A Bipolar Chopper Drivers
- Regulated DC Power Supply
- Screw Terminal Panel with Cabling
- Maximum holding torque of 125 oz-in. Rated for speeds of up to 7,000 steps/second
- 8 Channels of Precision D/A
- 16 Analog inputs, 2 analog outputs, 32 digital I/O lines, 3 counter/timers
- Basic drivers and pop-up control panel software included free.

19" Rack-Mount Keyboards just 1 Rack Unit High

If you use a standard keyboard with your rack-mount system, you know what a nuisance and a hazard it can be. These industrial keyboards are designed to fit easily into any DIA 19" rack. Rugged and reliable, these keyboards are made in the U.S.A. for use in many different applications. Each keyboard is carefully equipped with a Swiss electronic company to demonstrate classic Swiss craftsmanship.

- 101-key layout & full-travel keys; unit pulls out & locks with a solid, tactile feel for comfortable touch-typing
- DIX 3010 drawer-mounted (drawers slide out with locking door)
- Occupies only 1 rack space (1.75" high)
- DIX 6010 Slide-out, Rack-Mounted Drawer (not shown)...

PC Systems Handbook for Scientists & Engineers

This Combination Tutorial/Catalog Includes Many Examples of PC-based Systems

The CyberResearch PC Systems Handbook for Scientists & Engineers describes over 1000 unique and hard to find items for PC-based engineering. Packed with useful technical information and easy-to-read diagrams, this invaluable reference should be part of every engineer’s library.

Fax, Call, or Write for a complimentary copy.
SmartCache™ Plus: the grow-as-you-go approach to SCSI controllers

START WITH THE BEST...
DPT's entry level SmartCache Plus board offers unrivaled price/ performance for single-user systems. It features ISA or EISA bus mastering, and universal SCSI disk compatibility for all PC operating systems. SmartDriver software supports SCSI-2 peripherals like tape and optical drives.

NOW ADD CACHING!
Get DPT's award-winning caching technology in a plug-in module! Move up to disk caching speed without investing in a new controller. With an integral 512K cache, the module provides up to 5X performance gains for workstations, power users, and small multiuser systems.

ADD MORE USERS, ADD MORE CACHE!
Plug in a 2 MB or 4 MB memory module and accommodate up to 18 users from a single card slot. Ideal for medium-sized networks or multiuser systems.

HOW ABOUT DISK MIRRORING?
DPT's SmartCache mirroring module provides 100% disk fault tolerance by simultaneously writing all data to a second "mirrored" drive. No more data loss or costly system down-time due to disk failures. And unlike software mirroring schemes, fault tolerance is achieved with no performance penalties.

PLUS STILL MORE CACHE, AND THEN SOME...
Cable over to DPT's 4 MB Cache Expansion Card, then grow your system to 16 MB by adding more plug-in memory modules—enough power for 64 plus users!
DPT has your solution—no matter how you grow. Performance, compatibility and upgradability make SmartCache Plus the only SCSI controller you'll ever need. For details, contact Distributed Processing Technology, 140 Candace Drive, Mailand, FL 32751. Phone (407) 830-5522. FAX (407) 260-5366.
## Network

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3COM 3C250 Etherlink IV 5-pack</td>
<td>$189/259</td>
</tr>
<tr>
<td>3COM 3C905T 10 Base T</td>
<td>$259</td>
</tr>
<tr>
<td>3COM 3C905T 115 Base T</td>
<td>$395</td>
</tr>
<tr>
<td>3COM 3C905T 115 Base T</td>
<td>$429</td>
</tr>
<tr>
<td>3COM 3C905T 100 Base T</td>
<td>$529</td>
</tr>
<tr>
<td>3COM 3C905T 100 Base T</td>
<td>$599</td>
</tr>
</tbody>
</table>

## Notebooks

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas Instruments</td>
<td>$300/600/1200</td>
</tr>
<tr>
<td>Texas Instruments</td>
<td>$2025/2125/2925</td>
</tr>
<tr>
<td>8000 Win</td>
<td>$850/1500/2310</td>
</tr>
<tr>
<td>9000 Win</td>
<td>$1750/2950/3950</td>
</tr>
</tbody>
</table>

## Printers

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canon LBP+</td>
<td>$910/1499</td>
</tr>
<tr>
<td>Canon B J</td>
<td>$399</td>
</tr>
<tr>
<td>Canon 8320/330</td>
<td>$499</td>
</tr>
</tbody>
</table>

## Bulldog Systems

Bulldog's Standard Configuration - Double Floppy Drives + Super VGA Card with 1 MB RAM + 14 Color VGA Card Monitor (1024 x 768) + CITI 5.0 + Windows 3.1 + Mouse + 1 year

- 386/25/25 w/ 2 MB w/ 50 MB HD | $329
- 386/40 (64K CACHE) 2 MB w/ 120 HD | $139
- 386/60 (56K CACHE) 2 MB w/ 210 MB HD | $269
- 386/60 (56K CACHE) 2 MB w/ 210 MB HD | $269

## Drives

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD-ROM</td>
<td>$292/499</td>
</tr>
<tr>
<td>IBM</td>
<td></td>
</tr>
<tr>
<td>Iomega</td>
<td></td>
</tr>
</tbody>
</table>

## Software

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>WordPerfect Office - 5 User</td>
<td></td>
</tr>
<tr>
<td>Norton Utilities 6.0</td>
<td>$94</td>
</tr>
<tr>
<td>Microsoft Ball Point Mouse</td>
<td>$11</td>
</tr>
</tbody>
</table>

## Monitors

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC MultiSync</td>
<td>$89/239</td>
</tr>
<tr>
<td>Panasonic</td>
<td></td>
</tr>
<tr>
<td>Samsung</td>
<td></td>
</tr>
</tbody>
</table>

## Tape Drives

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOPPY DISK 360/720</td>
<td>$59/639</td>
</tr>
</tbody>
</table>

## Memory Boards

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST</td>
<td></td>
</tr>
</tbody>
</table>

## Chips

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual 16.8 HST ext w/ fax</td>
<td>$799</td>
</tr>
</tbody>
</table>

---

**After 9 years, We're Still Doggedly Determined to Give the Best Doggone Service and Prices to PC Users!**

**1-800-438-6039**
CONTROL UP TO 96 PC FILE SERVERS WITH 1 KEYBOARD AND MONITOR USING...

COMMANDER

by cybex

- Select via Keyboard
- Dual access up to 250 feet away (optional)
- No external power
- Mix PC, PC/XT, PC/AT and PS/2
- "AutoBoot™" Feature boots attached computers without operator intervention
- Shows PC power status

- PS/2 Mouse support available
- Each unit accommodates from 2 to 8 PCs
- Up to 12 units can be cascaded
- Mounting kit available for 19" and 24" rack installation

Dealer Program Available

Cybex Corporation
2800-H Bob Wallace Ave.
Huntsville, Alabama 35805
(205) 534-0011
Fax (205) 534-0010
INTERNATIONAL MISSING CHILDREN'S FOUNDATION
A PUBLIC NON-PROFIT ORGANIZATION
MISSING CHILDREN

VICTORIA RENEE STEPHENS
DOB: 01/23/85 AGE: 7
DATE MISSING: 12/16/90

RODNEY KEITH STEPHENS
DOB: 06/24/89 AGE: 3
DATE MISSING: 12/16/90

STOLEN FROM: ANNINSTON, ALABAMA BY RHONDA RENEE STEVENS
AKA: VICKIE STEPHENS AK: RHONDA RONEY
DOB: 10/08/68 CALL 714-850-9164 INTERNATIONAL MISSING CHILDREN'S FOUNDATION
3050 Madison Avenue • Costa Mesa, California 92627

AC1 has been helping corporate America with its computing needs for over a decade. We would like to offer you an opportunity to join us in helping others with a greater need than ours. Please, take a moment and study the children in these pictures. When you purchase an AC1864-40, AC1 will make a donation to The International Missing Children's Foundation on your behalf so that they may continue their much needed work and support for missing children worldwide.

### 386DX-40
- 64K Cache
- 4 Meg RAM
- 1.2 & 1.44 Teac Floppy Disk Drives
- 120 Meg Maxtor Hard Disk (Connor or Seagate Available Upon Request)
- SVGA 14" Color Monitor 1024x768 28 dp CTX
- SVGA Card 1024x768 w/1 Meg Trident
- Hard & Floppy Disk Controller
- 2 Serial, 1 Parallel, 1 Game Port
- Mini Tower Case w/LED Display/200 Watt PS
- Alps 101 Enhanced Keyboard w/Template
- MS DOS 5.0 or Dr. DOS 6.0 w/Manuals
- MS Windows 3.1 w/Mouse, or Quatro w/Mouse & Manuals, or Sidekick w/Mouse & Manuals

$1,322

### 486DX-33 Local Bus
- 64K Cache
- 4 Meg RAM
- 1.2 & 1.44 Teac Floppy Disk Drives
- 120 Meg Maxtor Hard Disk (Connor or Seagate Available Upon Request)
- SVGA 14" Color Monitor 1024x768 28 dp CTX
- ET-4000 Local Bus Video Card w/1 Meg
- Hard & Floppy Disk Controller
- 2 Serial, 1 Parallel, 1 Game Port
- Mini Tower Case w/LED Display/200 Watt PS
- Alps 101 Keyboard w/Template
- MS DOS 5.0 or Dr. DOS 6.0 w/Manuals
- MS Windows 3.1 w/Mouse & Manuals, or Quatro w/Mouse & Manuals, or Sidekick w/Mouse & Manuals

$2,066

### 486DX-50
- 256K Cache
- 4 Meg RAM
- 1.2 & 1.44 Teac Floppy Disk Drives
- 120 Meg Maxtor Hard Disk (Connor or Seagate Available Upon Request)
- SVGA 14" Color Monitor 1024x768 28 dp CTX Non Interlaced
- SVGA Card 1024x768 w/1 Meg Trident
- Hard & Floppy Disk Controller
- 2 Serial, 1 Parallel, 1 Game Port
- Full Tower Case w/LED Display/230 Watt PS
- Alps 101 Keyboard w/Template
- MS DOS 5.0 or Dr. DOS 6.0 w/Manuals
- MS Windows 3.1 w/Mouse & Manuals, or Quatro w/Mouse & Manuals, or Sidekick w/Mouse & Manuals

$2,305

### 486DX-33
- 64K Cache
- 4 Meg RAM
- 1.2 & 1.44 Teac Floppy Disk Drives
- 120 Meg Maxtor Hard Disk (Connor or Seagate Available Upon Request)
- SVGA 14" Color Monitor 1024x768 28 dp CTX
- SVGA Card 1024x768 1 Meg Trident
- Hard & Floppy Disk Controller
- 2 Serial, 1 Parallel, 1 Game Port
- Mini Tower Case w/LED Display/200 Watt PS
- Alps 101 Enhanced Keyboard w/Template
- MS DOS 5.0 or Dr. DOS 6.0 w/Manuals
- MS Windows 3.1 w/Mouse & Manuals, or Quatro w/Mouse & Manuals, or Sidekick w/Mouse & Manuals

$1,866

### Hewlett Packard Laser Printers And Memory Upgrades

**LASER PRINTERS**
- DeskJet 500 .................................. $385
- DeskJet 500C ................................ $659
- HP 11P Plus w/Toner ........................................ $820

**Cases & Power Supplies**
- Desk 10 Case w/20 Watt Power Supply .................. $62.00
- Mini Tower Case w/20 Watt PS, 4 Drive Bays w/LED Display ........ $65.00
- Mini Tower Case w/20 Watt PS, 5 Drive Bays w/LED Display ........ $89.00
- Full Tower Case w/20 Watt PS, 7 Drive Bays w/LED Display ........ $125.00

**Motherboards w/CPU**
- 386DX-40/2Mb 68443A Cache/A80SX ......................... $225.00
- 486DX-33/64Mb Cache/64 Meg ISA ....................... $225.00
- 486DX-33/64Mb Cache/64 Meg ISA ....................... $225.00
- 486DX-40/80Mb Cache/64 Meg ISA ....................... $225.00

**Monochrome Cards**
- Monochrome Graphic w/pp .................................. $14.00
- Trinitron 1 Meg VGA 1024x768 .......................... $67.00
- ET-4000 VGA Card 1280x1024 w/1 Meg .................. $119.00
- ET-4000 Local Bus Video Card w/1 Meg .................. $185.00

**Graphics Cards**
- Monochrome VGA Paper White ......................... $135.00
- 14" SVGA 28 dp 1024x768 CTX .......................... $295.00
- 14" SVGA 28 dp 1024x768 Non Interlaced CTX .......... $345.00
- 14" SVGA 28 dp 1024x768 Proton ....................... $345.00
- 14" SVGA 28 dp 1280x1024 Proton Non Interlaced .... $345.00

**Modems**
- 2400 Baud Int ............................................. $30.00
- 9600 S/R FAX w/2400 Baud Modem ...................... $65.00
- 9600 S/R FAX w/9600 Baud Modem ...................... $65.00
- 9600 Baud Internal Modem ............................ $65.00

**Floppy Drives**
- 1 Meg ............................................ $129
- 2 Meg ............................................ $155

**Hard Disk**
- 40 Meg Hard Disk ........................................ Call
- 60 Meg Hard Disk ........................................ Call
- 80 Meg Hard Disk ........................................ Call
- 120 Meg Hard Disk ...................................... Call
- 200 Meg Hard Disk ...................................... Call
- 360 Meg Hard Disk ...................................... Call

**Accessories**
- 256K Cache ........................................ Call
- 4 Meg RAM ........................................... $199

**HP MEMORY UPGRADES**
- HP III w/Toner ........................................ $99.00
- HP III w/Toner ........................................ $199.00
- HP IV w/Toner ........................................ $199.00
- HP IV w/Toner ........................................ $199.00
- HP 486 DX-33/Local Bus/64K Cache/64 Meg ............. $199.00
- 4 Meg RAM .................. . ................. $199

**Motherboards w/CPU**
- 386DX-40/2Mb 68443A Cache/A80SX ......................... $225.00
- 486DX-33/64Mb Cache/64 Meg ISA ....................... $225.00
- 486DX-33/64Mb Cache/64 Meg ISA ....................... $225.00
- 486DX-40/80Mb Cache/64 Meg ISA ....................... $225.00

**Motherboards w/CPU**
- 386DX-40/2Mb 68443A Cache/A80SX ......................... $225.00
- 486DX-33/64Mb Cache/64 Meg ISA ....................... $225.00
- 486DX-33/64Mb Cache/64 Meg ISA ....................... $225.00
- 486DX-40/80Mb Cache/64 Meg ISA ....................... $225.00

**Monitors**
- Monochrome VGA Paper White ......................... $135.00
- 14" SVGA 28 dp 1024x768 CTX .......................... $295.00
- 14" SVGA 28 dp 1024x768 Non Interlaced CTX .......... $345.00
- 14" SVGA 28 dp 1024x768 Proton ....................... $345.00
- 14" SVGA 28 dp 1280x1024 Proton Non Interlaced .... $345.00

**Terminals & Accessories**
- 30 day money back guarantee on all systems. 2 year parts warranty. 5 year labor warranty. Prices & availability subject to change without notice. Visa, MC & Discover accepted with no surcharge. 72 hour burn on all systems. Prices do not include shipping & handling. Corporate & Government purchase orders accepted upon approval. Toll free tech support. Free computer stand & cover with each system. All systems are standard configurations, if our configurations advertised do not suit your needs, just give us a call & our experienced sales representatives will help you with your custom configuration.

Circle 554 on Inquiry Card (RESELLERS: 555).
People come to KINGLI for prices, and stay with KINGLI for... QUALITY and SERVICE

We focus on Quality and Service, because you're demanding.

All systems are Windows, CAD, OS/2, Unix, and Novell ready.

Our WIN*CAD stations come with 32-bit LOCAL BUS to provide EISA speeds at ISA prices.

Call for our VESA-standard local bus to enhance your investment!

WIN*CAD 486dx50 EISA $2238
WIN*CAD 486dx-50 L.B. $2039
WIN*CAD 486dx2-50 L.B. $1898
WIN*CAD 486dx33 L.B. $1809
WIN*CAD 486sx25 L.B. $1468
386dx40 upgrade 486/50 $1399

Great bargains for upgraders!!

- Main board 486/33, 2x loc.bus $628
- Main board 486/33 EISA loc.bus $859
- Main board 486/33,64K, Cyrix $359
- Main board 386/40,upgrade 486 $229
- Modem data-fax,5R,57K baud $308
- Hard drive 84M,WD,Conner $235
- Windows accelerator.Svga,Fahr.1280 $238
- Windows accelerator.Svga,1-2M,nur $139

All systems include the quality parts:

- 4MB RAM, 64K cache, AMI BIOS
- 1.2M & 1.44MB Teac floppy drives
- 130MB hi-speed hard drive
- SVGA 1280 w/1MB 32-bit L.B. or equil.
- 1024x768,28 dp Non-Interl. monitor
- desktop or tower case w/230W
- DOS 5, hi-res. mouse, 4/1/O ports
- Enh. Keyboard, On-site service

To order: (800)788-0622 (7am-6pm PST)

KINGLI Technology, Inc.
1140 Centre Drive, Suite #S
City of Industry, CA 91789
Phone: (714) 468-2722
Fax: (714) 468-2721 bbs: (714) 468-2725

30-day money back guarantee
1 year warranty on parts,3 years on labor, 5 years free tech support
Major credit cards accepted
Dealer, VAR inquiries welcome
Prices reflect cash discount 2.8%

Run a full- or half-page 4-color ad reaching a portion of BYTE's U.S. readers at unbelievably low rates — right here in this section!

Call today to learn more about BYTE's unique Regional Advertising Section, located in our prominent Buyer's Guide.

(603) 924-2651 or (603) 924-2637
Your Source For Industrial PC Systems

New Rackmount Computers with built-in Monitors

System Includes
- 33Mhz 80386DX Motherboard
- 1 MB RAM
- 9" Mono/10"VGA/14"SVGA Monitor
- 1.2MB 5.25" Floppy Disk Drive
- Socket for Math Coprocessor
- 8 Expansion Slots - 6 15-bit and 2 8-bit
- 2 Serial & 1 Parallel Port
- Hard Disk / Floppy Disk Cont.
- Video Graphic Card
- Rack-mounting slide rails
- Heavy-duty aluminum case
- Rackmount Keyboard
- MS-Dos 5.0

14" Hi-Res. Color Monitor
- One front & Two internal 1/2 height drives
- Space for 4 full & 4 3/4 length cards

19" Hi-Res. Color Monitor
- Three front & one internal full height drives
- Space for 8 full length cards

Call for Your Configurations !!!

Do You Need More Slots In Your Computer ??

Now you can expand your PC-AT system without timing or noise problems and without time-consuming system reconfiguration with the new ETRC-AT active Expansion Bus Interconnect Kit from APPRO International.

TERMS & CONDITIONS
- 30 Day Money Back Guarantee for IBM Incompatibility
- All other returns subject to 15% restocking fee
- All returns require RMA Number
- Government, School PO's welcome
- 1 Year Parts and Labor warranty

To Order Call:
408-732-6091
Fax: 408-732-6095
APPRO International, Inc.
3687 Enochs St., Santa Clara, CA 95051

Circle 551 on Inquiry Card.
In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- How long has the company been in business?
- Does the company offer technical assistance?
- Is there a service facility?
- Are manufacturer's warranties handled through the company?
- Does the seller have formal return and refund policies?
- Is there an additional charge for use of credit cards?
- Are credit card charges held until time of shipment?
- What are shipping costs for items ordered?

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

- State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.
- Establish that the item is in stock and confirm shipping date.
- Confirm that the price is as advertised.
- Obtain an order number and identification of the sales representative.
- Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.

If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:
the MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.
6 E. 43rd St.,
New York, NY 10017

© Direct Marketing Association, Inc. 1988
**Buffalo SL Series Features:**

- **Two Models:**
  - SLmk11 - 4 parallel and 6 serial ports.
  - SLP - 8 parallel and 2 serial ports.

- **Flexible Configuration:**
  Any port of your SL Series box may be set as either input or output.

- **Rapid Data Transfer:**
  The SL Series software allows PCs to transmit up to 8,000 characters per second parallel and up to 115,200 bits per second serial, much faster than the DOS serial limit.

- **Automatic Switching:**
  SL Series Buffalo boxes will automatically buffer data, convert between parallel and serial, and route data from your PC to the device of your choice. No commands are needed when sharing only one printer.

- **User Upgradable Memory:**
  SL units are available with installed buffer memory from 256KB to 4MB. Buffer modules can be added later to expand any unit to the full 4MB.

- **Easy Installation & Use:**
  Connect one cable for each PC or output device to the SL Series box. Run the SETUP program to configure the Buffalo box and to install the pop-up menu. Then, simply select your printer and print as you did before you installed the box.

- **Pop-up Menu Option:**
  Select printers, macros, and other control functions using the cursor or a mouse. The pop-up menu appears over other applications and desktop publishing.

- **Network Server Support:**
  Connected to a network server port, the SL Series can direct data to a variety of shared output devices.

- **Windows Support:**
  Buffalo hardware and menu software are Windows compatible.

- **Toll-Free Technical Support:**
  Skilled technicians will answer your call and help you achieve the best performance from your system.

- **Cost-Effective Solutions:**
  Prices for the SLmk11 and the SLP range from just $595 with 256KB of memory to $995 with a full 4MB installed.

- **Smaller Alternatives:**
  The Buffalo H Series is also available priced from $245 for the HXP with 4 parallel ports and 256KB of buffer. The H Series buffers offer expandability to 16MB of buffer and parallel data transfer at up to 180,000 characters per second.

- **Toll-Free Application Advice:**
  Our knowledgeable staff will help you select products to fit your needs.

- **One Year Warranty**

- **45 Day Money-Back Guarantee**

US and Canada Toll-Free
**1-800-345-2356**
(503) 585-3414
FAX (503) 585-4505
Buffalo Products, Inc.
2805 19th St. SE, Salem, OR 97302
Response Code: C2SL3

BUFFALO is a registered trademark of Meleo, Inc. Other brands and product names are trademarks or registered trademarks of their respective owners.

Australia Miden
Belgium Vivien
CSIR
Denmark JPS
Finland Cy Ansil
France LPE
Germany Graphics
Hong Kong AE
Israel Unver
Italy SPH
Netherlands Compadata
New Zealand Cable Plus
International Notea
FAX(503) 585-6417

DECEMBER 1992 • BYTE 289
When it comes to high-speed EISA performance, Comtrade is furiously blowing away the competition. "A very swift graphics machine," says Computer Shopper (May 1992). And this hurricane EISA power is finally available to you at a price that won't blow you away. These EISA systems feature a powerful 32-bit EISA hard disk controller that provides real 32-bit access to the hard drive. The result is a 350% faster data transfer rate (DTR). Comtrade 486 EISA systems—the ultimate machine that lets you take your workload by storm.

"Performance is the Comrade's strong point."
"Excellent Design"

Comtrade Local Bus Wins Big!

In Comparison With Other Leading High Performance Super VGA.

Introduced Comtrade's 32-bit Local Bus. Traditionally, 486 ISA machines could only support 16-bit video cards and run at standard 8MHz bus speed. That would result in a bottleneck regardless of how fast the CPU could run. Now you have an alternative. Comtrade's Local Bus system uses a 32-bit video card which not only provides double the data path, but also the video bus runs at true CPU speed. The result is video speed up to 5x faster than regular SVGA and up to 50x faster with our Local Bus 3 VRAM Graphics Accelerator.

Overview: Windows Performance Test (WinMark)

<table>
<thead>
<tr>
<th>Comtrade Local Bus</th>
<th>486/33 DX</th>
<th>1280x1024 Local Bus</th>
<th>ATI Graphics Ultra ISA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Windows</td>
<td>11,912RBS</td>
<td>5,940,033</td>
<td></td>
</tr>
<tr>
<td>Performance Test</td>
<td>7.29/864</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Circle 213 on Inquiry Card (RESELLERS: 214).

DEALER DISCOUNTS ON MOST ITEMS

**NEW! COMPAQ LAPTOP MEMORY**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOSHIBA LAPTOP MEMORY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T2200SX, T2000SX, T2000SX</td>
<td>2MB</td>
<td>$77</td>
</tr>
<tr>
<td>T2000SX, T2000, T2000, T1600</td>
<td>4MB</td>
<td>$156</td>
</tr>
<tr>
<td>T1600, T1200XE, T1000XSESE</td>
<td>6MB</td>
<td>$218</td>
</tr>
<tr>
<td>T1000X, T1600, T1800, T1800C</td>
<td>8MB</td>
<td>$290</td>
</tr>
</tbody>
</table>

**CALL FOR PRICES ON MODEMS & FAX/MODEMS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.

**SUN SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>EPSON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>SONY ECLIPSE 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>CANON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>ZENITH Z8000 4MB</td>
<td></td>
<td>$127</td>
</tr>
</tbody>
</table>

**MAGNUS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.

**SUN SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>EPSON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>SONY ECLIPSE 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>CANON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>ZENITH Z8000 4MB</td>
<td></td>
<td>$127</td>
</tr>
</tbody>
</table>

**MAGNUS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.

**SUN SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>EPSON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>SONY ECLIPSE 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>CANON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>ZENITH Z8000 4MB</td>
<td></td>
<td>$127</td>
</tr>
</tbody>
</table>

**MAGNUS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.

**SUN SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>EPSON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>SONY ECLIPSE 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>CANON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>ZENITH Z8000 4MB</td>
<td></td>
<td>$127</td>
</tr>
</tbody>
</table>

**MAGNUS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.

**SUN SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>EPSON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>SONY ECLIPSE 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>CANON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>ZENITH Z8000 4MB</td>
<td></td>
<td>$127</td>
</tr>
</tbody>
</table>

**MAGNUS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.

**SUN SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>HP VECTRA TX SERIES 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>EPSON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>SONY ECLIPSE 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>CANON EPS240 4MB</td>
<td></td>
<td>$127</td>
</tr>
<tr>
<td>ZENITH Z8000 4MB</td>
<td></td>
<td>$127</td>
</tr>
</tbody>
</table>

**MAGNUS**

- **NEW! TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**
- **TOSHIBA LAPTOP MEMORY**
- **TOSHIBA MEMORY**

**TERMS AND CONDITIONS:** All sales final. We charge a 20% restocking fee on all new, sealed, shrink-wrapped and pre-approved returns. Please be sure to charge without notice, and returns for damaged goods. We reserve the right to refuse any returns, unless previously agreed upon and stated in our policies. All goods with out of stock items, are not returnable for credit, and are subject to an exchange only. We accept purchase orders from credit-worthy institutions, although please be advised that we will not ship to any account with a credit balance. Purchase prices at the time of sale are final. Memory upgrades guaranteed 100% compatible.
ACER 486sx - 16MB SIMM (4M X 36) $ 529.00
32MB SIMM (8M X 36) $ 1,599.00
AMI EZ-FLEX - 64MB KIT (4 SIMMS) $ 2,799.00
AMIGA 2000 - 16MB SIMM $ 469.00
AST BRAVO 486LC - 16MB SIMM $ 469.00
COMPAQ SystemPro - 32MB MODULE $ 1,199.00
DELL 486's - 16MB KIT (2 SIMMS) $ 538.00
32MB KIT (2 SIMMS) $ 1,088.00
MAC IIfx - 16MB SIMM $ 479.00
MAC QUADRA 950 - 16MB SIMM $ 469.00
MAC IIcx,IIci,IIci,QUADRA 900 - 16MB SIMM $ 469.00
MAC QUADRA 700 & SE/30 - 16MB SIMM $ 529.00
NeXT TURBO - 16MB SIMM $ 469.00
SUN IPX,ELC - 16MB SIMM $ 499.00
SUN SPARC SERVER - 256MB KIT CALL

OTHER MEMORIES AVAILABLE...

IBM
PS/1 - 2MB $ 68
M30 - 2MB $ 79
M50,500x,150x,70 - 1MB $ 45
M53x,155x,70 - 2MB $ 79
M70-A21,451,121 - 2MB $ 79
M40s,35x - 8MB $ 359
M67x,90,95 - 4MB $ 359
M80-401 - 1MB $ 65
M80-111,121,31 - 2MB $ 180
16-BIT 8KB Exp Board $ 128
32-BIT 8KB Exp Board $ 128

AST
PREM. 386/20C - 1MB KIT $ 65
PREM. 386/25 - 1MB $ 45
PREM. 386/25 - 1MB $ 45
PREM. II 486 - 1MB $ 41
PREM. II 486 - 8MB KIT $ 139
PREM. II 1MB Exp Board $ 469

COMPAQ
DP 386/20,20E,25 - 1MB $ 65
4MB $ 169
DP 386/16 - 1MB $ 66
4MB $ 169
DP 286N,386N,20 - 4MB $ 135
M-SYSTEMS - 2MB $ 79
4MB $ 135
DP 386/33,486/25 - 2MB $ 96
SystemPro - 8MB $ 269
OK Exp Brd $ 355
DP 386/16/1MB Exp Card $ 105
DP 386/20,20E,25,25E $ 105

HP
Vectra Q5-16 - 2MB KIT $ 129
Vectra 486 - 2MB KIT $ 70
4MB $ 169
8MB $ 269
X-Station 700 Ser. - 2MB $ 149
2MB $ 299
9000/400X,425 - 8MB KIT $ 496
16MB KIT $ 999
9000/425e - 8MB KIT $ 428
16MB KIT $ 828

APPLE
LISE/SE/30 - 1MB $ 32
Classic - 1MB Exp. Board $ 54
SE/30,J.I,LC,LC, & Quad. 700/900 - 4MB $ 118
Quad. 700/900 - 32MB KIT $ 1120
68K - 1MB KIT $ 499
68K - 32MB KIT $ 1156
Quadri 256K V-RAM $ 27
LC 512K V-RAM $ 44

CitiTronics Inc.

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

OTHER MEMORIES FOR:
ACER, ALTIMA, APPLE, AST, CHAPLET, COMPAQ, DELL, EPSON, EVEREX, HP, LEADING EDGE, IBM, NEC, NCR, OKIDATA, PACKARD-BELL, PANASONIC, PHILIP, SAMPO, SHARP, SILICON GRAPHICS, SUN MICROSYSTEMS, TANDON, TI, TOSHIBA, TULIP AND ZENITH.

CALL FOR OUR COMPLETE CATALOG

TERMS: C.O.D., CASH, VISA OR MASTERCARD.
COMPANY AND UNIVERSITY P.O.'S ACCEPTED UPON CREDIT APPROVAL.

414 CLOVERLEAF DR., UNIT B, BALDWIN PARK, CA 91706
TEL. (818) 855-5688 FAX (818) 855-5687

CitiTronics Inc.

Circle 222 on Inquiry Card.

ALL PRODUCT NAMES, TRADEMARKS AND REGISTRED TRADEMARKS ARE THE PROPERTY OF THEIR RESPECTIVE COMPANIES.

CALL FOR OUR COMPLETE CATALOG

414 CLOVERLEAF DR., UNIT B, BALDWIN PARK, CA 91706
TEL. (818) 855-5688 FAX (818) 855-5687

CitiTronics Inc.

Circle 222 on Inquiry Card.

ALL PRODUCT NAMES, TRADEMARKS AND REGISTRED TRADEMARKS ARE THE PROPERTY OF THEIR RESPECTIVE COMPANIES.
Rack Mount Computers - Motherboard or Passive Backplane

- Use external monitor
  Up to 6 drives

  8.75" high

- Mono or color monitor
  Up to 5 drives

  8.75" high

- 14" color monitor
  Up to 3 drives

  12.25" high

Rack Mount Monitors

- 10" mono or color monitor

  8.75" high

- 14" mono or color monitor

  12.25" high

- Enclosure for most desk top monitors

  14.0" high

Rack Mount Keyboards

- Drawer mounted keyboard

  1.75" high

- Drawer for desk top keyboards

  3.5" high

- Vertical-mount, sealed membrane keyboard

  5.25" high

Rack Mount Printer

- Dot matrix printer with industrial rating

  12.25" high

Complete '286, '386 and '486 systems

RECORTEC, INC.

1290 Lawrence Station Road, Sunnyvale, CA 94089
Tel. (408) 734-1290 Fax: (408) 734-2140

1-800-729-7654
### SOFTWARE LIQUIDATION

**WORDSTAR**

<table>
<thead>
<tr>
<th>WordStar 6.0 or WordStar 2000 Basic 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$99</strong></td>
</tr>
</tbody>
</table>

For Sale! New Edition of StarSoft 1.0 for only $99. 35% in deals with original manuals. All original manuals. Sold as new. **$99** only.

**COMPUTER PERIPHERALS, INC.**

**CPU UPGRADES**

- **Intel**
- **AMD**
- **Cyrix**

**HARD DRIVE SALE**

<table>
<thead>
<tr>
<th>Model</th>
<th>Size</th>
<th>Speed Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2120</td>
<td>80MB</td>
<td>7200 rpm</td>
<td>$199</td>
</tr>
<tr>
<td>35C</td>
<td>120MB</td>
<td>5400 rpm</td>
<td>$199</td>
</tr>
<tr>
<td>5282</td>
<td>40MB</td>
<td>7200 rpm</td>
<td>$199</td>
</tr>
<tr>
<td>34C</td>
<td>10MB</td>
<td>7200 rpm</td>
<td>$199</td>
</tr>
</tbody>
</table>

**IBM PS/2 Memory**

- **Vega Memory**
- **Laser Printer Memory**
- **TOSHIBA Laptop & Notebook Memory**

**More Laptop Memory**

- **COMPAQ Portable**
- **PORTABLE MEMORY**
- **Toshiba P5000**
- **Deaver**

**SPECIAL SALE!**

**Chinon**

- **CD-ROM, 60GB/20MB**
- **DVD-ROM, 60GB/20MB**
- **DVD-ROM, 60GB/20MB**

**CPU UPDATES**

- **Intel**
- **AMD**
- **Cyrix**

**Floppy Drives**

<table>
<thead>
<tr>
<th>Model</th>
<th>Interface</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.44 MB</td>
<td>3.5&quot; drive</td>
<td>$98</td>
</tr>
<tr>
<td>2.88 MB</td>
<td>3.5&quot; drive</td>
<td>$98</td>
</tr>
<tr>
<td>1.2 MB</td>
<td>5.25&quot; drive</td>
<td>$98</td>
</tr>
</tbody>
</table>

**Modems for Your Computer**

- **COMPUTER PERIPHERALS, INC.**

**Call Today!**

**800-982-2925**

**TOLL FREE FAX NUMBER**

**DOES NOT APPLY TO FAX, PHONE, OR POSTAL MAIL**

**SAVINGS: WE HAVE BIGGER POWER NO SURCHARGES TOLL FREE CALLING**

**SAFETY: IN BUSINESS FOR 6 YEARS 1 YEAR WARRANTY NEVADA'S LARGEST WHOLESALE**

**SOFTWARE LIQUIDATION**

- **WORDSTAR**
- **COMPUTER PERIPHERALS, INC.**
- **CPU UPGRADES**
- **HARD DRIVE SALE**
- **IBM PS/2 Memory**
- **SPECIAL SALE!**
- **CPU UPDATES**
- **Floppy Drives**
- **Modems for Your Computer**
- **Call Today!**

**Modems for Your Computer**

- **COMPUTER PERIPHERALS, INC.**

**Call Today!**

**800-982-2925**

**TOLL FREE FAX NUMBER**

**DOES NOT APPLY TO FAX, PHONE, OR POSTAL MAIL**

**SAVINGS: WE HAVE BIGGER POWER NO SURCHARGES TOLL FREE CALLING**

**SAFETY: IN BUSINESS FOR 6 YEARS 1 YEAR WARRANTY NEVADA'S LARGEST WHOLESALE**
EXTRAORDINARY! Local Bus

Buy Today - Upgrade Tomorrow.

Basic Systems Features:
- Upgradable Local Bus MB
- Intel CPU / 64K Cache / 4MB Memory
- 32 Bit Local Bus SVGA Card / 1MB
- 1.2 & 1.44MB F/D, 120MB IDE H/D
- 2 Serial / 1 Parallel / 1 Game Port
- 14" SVGA Monitor, 28 dp
- 101 Enhanced KB w/Serial Mouse
- Minitower w/Display

ADVANCED Systems Highlights:
- 14" VESA Monitor, 1280 x 1024
- IDE Cache H/D Controller / 512k (0.3ms)
- 2.88MB F/D w/Controller

486DX2/66 & 50 LOCAL BUS
Basic ● $2049 / $1699
Advanced ❑ $2299 / $1949

486DX/50 & 33 LOCAL BUS
Basic ● $1779 / $1679
Advanced ❑ $2029 / $1929

386DX/40 & 33 LOCAL BUS
Basic ● $1239 / $1229
Advanced ❑ $1489 / $1479

Buy "One" gets "All" Free:
- Novell DR Dos 6.0
- Super Stor - Disk Compression
- Super Pak - Disc Cache
- File Link - File Transfer Utility
- EMM 386 - Memory Manager
- GEM - Window Manager

LANKMARK SPEED V2.0 BENCHMARK TEST

<table>
<thead>
<tr>
<th>Model</th>
<th>Characters Per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDI LOCAL BUS</td>
<td>13,100</td>
</tr>
<tr>
<td>DIAMOND SPEED STAR</td>
<td>4,593</td>
</tr>
<tr>
<td>ATI-XL WONDER</td>
<td>3,223</td>
</tr>
</tbody>
</table>

P.C. MAGAZINE BENCHMARK

<table>
<thead>
<tr>
<th>Model</th>
<th>Pixels Per Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDI LOCAL BUS</td>
<td>23558.4</td>
</tr>
<tr>
<td>DIAMOND STEALTH</td>
<td>6067.2</td>
</tr>
<tr>
<td>S3 CHIPSET</td>
<td>4584.96</td>
</tr>
</tbody>
</table>

DHT Associates, Inc.
7411-B East Gale Ave., City of Industry, CA 91748 • Tel: (818) 810-0552 • FAX: (818) 810-4555
WEST COAST REGION —Tel: (714) 483-5351 • FAX: (714) 989-1488
EAST COAST REGION —Tel: (713) 789-4775 • FAX: (713) 789-9146

Circle 198 on Inquiry Card (RESELLERS: 199).
With Backpack, several computers can share a single tape drive. Backpack connects quickly and easily to the parallel printer port of any PC compatible or portable—without interface cards or tools! The Backpack tape drive is also easy to transport, making it ideal for transferring data from one computer to another. QIC-40 (40/120MB) and QIC-80 (80/250) tape, diskette and hard drive models are available. So share and share alike! Call today for more information.

backpack

MicroSolutions
Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115  815-756-3411  Fax 815-756-2928
Don't settle for 386SX performance. With 386DX and 486DX power, external keyboard and VGA ports, it is the only computer you will ever need.

## HCP Power Notebook Standard Features

- VGA graphics with 32 gray-scale supertwist back-lit LCD screen
- 4 MB RAM installed, total memory capacity is 16 MB
- 120 MB hard disk, 15 ms access time
- 1.44 MB floppy drive
- Three-hour battery
- Carrying case
- Licensed DR-DOS 6.0
- Two serial, one parallel port
- External numeric keypad included
- External VGA and keyboard connections

## Optional Features

- Docking station with 2 x 16 bit slots $160
- Auto cigarette adapter $40
- Memory upgrade to 16 MB $380
- Memory upgrade to 8 MB $160
- Hard drive upgrade to 210 MB $200
- Additional battery set $90
- Additional battery charger $30
- Additional AC power adapter $50

---

Micro-International, Inc.
10850 Seaboard Loop
Houston, Texas 77099

National Sales 800/967-5667 Houston 713/495-9096

Hours: 9:00 a.m. to 5:00 p.m. M-F, 11:00 a.m. to 1 p.m. Sat. (Central Time)

All systems and components include a one-year warranty; 30-day money-back guarantee.
Price reflects cash or credit card payment. Major corporation purchase orders accepted.

Circle 224 on Inquiry Card (RESELLERS: 225).
Pick A Card

Volante

Draw your winning card from National Design's Volante Series of high speed graphics boards.

All Volante high speed graphics boards offer:
• Built on ISA, MicroChannel or VME bus
• Video memory upgrades to 4 MB
• Program memory upgrades to 4 MB
• Razor sharp resolutions from 1024x768 up to 1600x1280
• Blazing color selection from 8-bit to 24-bit true color
• Optional TI TMS34082 floating point processor for enhanced 3D acceleration
• Superior speed of the TI TMS34020 graphics engine paired with National Design's advanced ASIC technology
• LIFETIME WARRANTY - no gamble here!

Whether your game is CAD, Microsoft Windows, graphic arts, multi-media or medical imaging, Volante has a card for you at a fraction of the cost charged by the competition.

Call 800-253-8831 now for information on the breathtaking Volante series.

NATIONAL DESIGN, INC.
1515 CAPITAL OF TEXAS HWY., SD.
5TH FLOOR
AUSTIN, TEXAS 78746

Circle 208 on Inquiry Card (RESELLERS: 209)
**“Fa La La La La La La Lapine.”**

**POWERTOOL OPTIONS**

**POWERTOOL PLUS!**
8MB base memory, 200MB hard drive and 256K Cache ....................... add $292

**POWER CACHE!**
4.5MB caching hard drive controller for 10X faster processing .......... add $292

- 15” flat screen SVGA monitor upgrade ..$199
- 17” flat screen SVGA monitor upgrade ..$520
- Low radiation monitors
- CD ROM and multi-media
- Tape backups and MORE!

**POWERTOOL STANDARDS**

- 4MB (60ns/70ns) RAM 64K Cache
- 125MB fast IDE hard drive with Cache
- 16-bit 1MB SVGA card with 32,000 color Sierra® DAC chip
- 280 watt power supply
- TEAC® 1.2 and 1.44MB floppy drives
- LAPINE 101-key tactile keyboard
- 14” non-interlaced 28 1024x768 SVGA monitor
- 2 serial/1 parallel/1 game port
- MS-DOS 5.0 and WINDOWS® 3.1 with hi-resolution mouse
- Your choice of standard desktop, mini-upright or standard upright

**POWERTOOLSTANDARDS**

**LAPINE SERVICE**

- 1 year parts and 3 years labor
- Toll free technical support unlimited
- Federal Express replacement parts
- Intensive 72 hour burn-in and test
- 30-day money back guarantee

**Business Hours:** Mon. - Fri. 7am-5pm (PST)
8025 Deering Ave. Canoga Park, CA 91304
818/884-3685 FAX 818/884-3670
1-800-927-3772
All major credit cards accepted. Net 30 day credit terms to qualified government, educational & commercial accounts. All prices subject to change. Prices do not include shipping.

**GRAND POWERTOOLS**

**486-33 Local Bus**

- 16MB (60ns) RAM 256K Cache
- 1.2 Gigabyte fast SCSI hard drive
- 32-bit local bus 53 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- Programmable 101-key LAPINE keyboard

**486-50 Local Bus**

- 16MB (60ns) RAM 256K Cache
- 1.2 Gigabyte fast SCSI hard drive
- 32-bit local bus 53 graphics accelerator for 50x faster graphics with up to 1280x1024 resolution and 32,000 colors
- Programmable 101-key LAPINE keyboard

**POWERTOOLS For Christmas**

*Circle 227 on Inquiry Card (RESELLERS: 228).*

**LAPINE**

**Personal. Professional. Powertools.**
Righton® patented Spot® Anchors, with their special adhesive, are the best theft deterrents you can buy. Our versatile variety gives you options, easy access, and are easy to use. Spot-Link 5®, unlike competitors, is not dependent on the adhesive strength of a laminated top. Factory-direct prices from $8.20 to $32.50 save you money. Request our free brochure B with prices. Thank you.

5755 SW WILLLOW LANE, LAKE OSWEGO OR 97035-5340
(503) 636-6831 • FAX (503) 636-9642
Made in U.S.A.

Circle 223 on Inquiry Card.

ADVERTISERS

Run a full- or half-page 4-color ad reaching a portion of BYTE's U.S. readers at unbelievably low rates — right here in this section!

Call today to learn more about BYTE's unique Regional Advertising Section, located in our prominent Buyer's Guide.

(603) 924-2651 or (603) 924-2637
Serving you since 1979

BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

UPRIGHT CASE
$99.95
- Mounts 5 floppy and 4 hard drives
- Accommodates std. & mini motherboards
- 2 digit LED display

MOTHERBOARDS
25MHz 386SX $199.95
- 25MHz Intel 80386SX CPU
- Expandable to 16Mb on-board
- Uses 256K, 1M or 4M 9.9V SIMMs (5V8K installed)
- Six 16-bit and two 8-bit slots

CONNER
84Mb DRIVE HARDWARE $289
- CP-30084 84Mb, 19ns IDE hard drive, 16-bit floppy/IDE disk controller, cables and instructions

IDE HARD DRIVES
CP-3000 Center 40Mb 28mm 3.5" IDE $189
CP-3044A Side 44Mb 28mm 3.5" IDE $199
CP-3050 Center 50Mb 28mm 3.5" IDE $199
CP-3096A Side 80Mb 28mm 3.5" IDE $269
CP-3106A Center 100Mb 3.5" IDE $349
CP-3200F Center 210Mb 3.5" IDE $499

FLOPPY DRIVES
FDD-1.2 1.2Mb, 3.5", Beige $79.95
FDD-1.4 1.44Mb, 3.5", Black $79.95
FDD-3.5 3.5" IDE, 2.88Mb, Beige $89.95
FDD-2.88A 2.88Mb, 3.5" drive, Beige $149.95
FDD-505 5.25" & 3.5" combo drive, Beige $149.95

MULTI I/O CARD WITH IDE FLOPPY/HARD CONTROL $69.95
- 16-bit 256KB/386/486 compatible
- Supports 2 IDE hard drives or 2 floppy drives (360K-1.44MB)
- 2 serial, 1 parallel & 1 game port

POWER SUPPLIES
MCT-M286-12 12MHZ 286 $129.95
MCT-M286-16 16MHZ 286 $149.95
MCT-C386-33 33MHZ cache 386 $349.95
MCT-C386-40 40MHZ cache 386 $379.95
MCT-M386SX-25 25MHZ cache 386 $199.95
MCT-M486-50E 50MHZ EI SA w/cache $955.00

NON-INTERLACED
VGA-MON-1024 1024x768 monitor $249.95
VGA-MON-2048 2048x768 monitor $499.95
VGA-MON-32768 32768x2048 monitor $999.95

FAX/PHONE/SWITCH
FAX-SWITCH Without modem connection $59.95
FAX/SWITCH With phone line $89.95
PORTABLE IC TESTER
- Tests the following 14 to 20-pin devices: 74 series TTL, 7400 & 74 series CMOS, 4001 series DIPs up to 1M
- Identifies unknown part numbers
MOD-BIC $149.95

DYNAMIC RAM
PART # SIZE SPEED TYPE PRICE
45328-80 512Kx8 @ 8Kx8 80ns 3.3V $1.49
454256-80 256Kx8 @ 8Kx8 80ns 3.3V $5.49

MATH CO-PROCESSORS
CALL FOR YOUR FREE JDR CATALOG TODAY!
FOR PC'S, SOFTWARE, MONITORS, DISK DRIVES, KEYBOARDS, MODULARS, CABLES, CONNECTORS, ICS, COMPONENTS, PROGRAMMERS, TEST EQUIPMENT, TOOLS & MORE!
| Processor     | Model          | Price  
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel 486 SX</td>
<td>25MHz</td>
<td>$200.00</td>
</tr>
<tr>
<td>IBM PS/2</td>
<td>Model M300</td>
<td>$180.00</td>
</tr>
<tr>
<td>Toshiba</td>
<td>Model T2400</td>
<td>$189.00</td>
</tr>
<tr>
<td>RAM</td>
<td>1MB 80ns</td>
<td>$180.00</td>
</tr>
<tr>
<td>Simm Modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IBM PS/2</td>
<td>Model M320</td>
<td>$250.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Prices are in USD.
- All prices are for the items listed.
- Shipping and handling costs are not included.
- Contact Ultima Electronics Corp. for more information.

**Ultima Electronics Corp.**
3074 Landess Avenue, San Jose, CA 95132
Tel: (408) 942-9695 · Fax: (408) 942-5509

**Lowest Prices**
Same Day Shipping
High performance graphics for the PC. 1600 × 1280 resolution gives 6 times the visual information of standard VGA. Dedicated graphics processor handles graphics commands up to 100 times faster. All TEXANs are supplied with drivers for TIGA and MS-Windows, and a display list driver for AutoCAD® 386 rel. 10-12. X Window System® Interactive and SCO UNIX is optional. T1® TMS34020 processor, TMS34082 optional, VGA passthrough for single monitor operation, software selectable resolutions, 256 colors.

THE TEXAN 1600
1600 × 1280 display resolution, 256 colors, 60Hz noninterlaced, VGA passthrough and cables. $1450.00

THE TEXAN 1280
1280 × 1024 display resolution, 256 colors, 72Hz noninterlaced, VGA passthrough and cables. $1250.00

THE TEXAN 1024/16
1024 × 768 display resolution, 16 colors, 72Hz noninterlaced, VGA passthrough and cables. $1100.00

NEW M&M PRO

M&M Basic Frame Grabber puts live video in a window on existing VGA display. NTSC and PAL.

VIDA Video, VGA, and Audio mixer converts VGA to video, and outputs as an overlay on an input video signal. NTSC Composite Video $550.00 PAL Composite Video $650.00

VIDA Basic VGA to Video Converter outputs VGA to composite and S-Video with flicker-free filters. NTSC Composite Video $300.00

SWEET 16 Real-Time Frame Grabber displays 32K colors with full TARGA® 16 compatibility. S-Video and Composite $775.00

WE ACCEPT VISA, MASTERCARD AND AMERICAN EXPRESS Direct From Manufacturer 12-Month Warranty F.O.B. Houston

Omnicomp Graphics Corporation...The Texas Graphics Company 1734 W. Sam Houston Pkwy. N. Houston, Texas 77043 DECEMBER 1992 • BYTE 303

Circle 246 on Inquiry Card (RESELLERS: 247).
**Add-In Boards**

**Communications/Networking**

**Accessories/Supplies • Add-In Boards**

**YOU CAN SAVE $1000s OF DOLLARS By Making One Easy Phone Call**

**Savings Line**

**900 Discount Shopper**

We have shopped over 500 Direct vendors and our price information is the most up-to-date anywhere.

The charge is $1.95 per minute and the average call lasts 4 minutes. You can receive your information by Voice Announcement on the same call or the information can be faxed to you within 2 minutes. Call us if you are a vendor and want to be listed or have any suggestions on how we can improve at 1-800-952-5280. Sponsored by The National Discount Shopping Advisory Board.

---

**Call NOW**

1-900-680-DEAL
(1-900-680-3325)

We have shopped over 500 Direct vendors and our price information is the most up-to-date anywhere.

The charge is $1.95 per minute and the average call lasts 4 minutes. You can receive your information by Voice Announcement on the same call or the information can be faxed to you within 2 minutes. Call us if you are a vendor and want to be listed or have any suggestions on how we can improve at 1-800-952-5280. Sponsored by The National Discount Shopping Advisory Board.

---

**Add-In Boards**

**Disk and Drive Emulators**

**Communications & I/O Specialists**

**New**

**PCE/2-SR SRAM Emulator**

- Multiple models, EPROM, Flash, battery backed SRAM technologies
- Capacities from 180K to 14MB, Single and Dual disk emulation under MS DOS
- Autobooting—on-board programming

**Curtis Inc.**

416 West County Road D
St. Paul, MN 55112
MS DOS is a trademark of Microsoft

FAX 812/631-6588

---

**PC/AT Four Port Com. Coprocessor**

**GMM Sync4/CCP**

- High Performance 16 MHZ 16 bit CPU.
- 80X86 code compatible.
- 4 Sync/ Async Ports (2 Serial Ports with Full Duplex DMA).
- Uses Zilog 85C30, 85240 SCC chip.
- 512K Dual Ported Ram (STD)
- 8k or 16k, 32k, 64k Window Size (Programmable).
- 8k, 16k, 32k, 64k Window Size (Programmable).
- 8 Soliware Selectable and Shareable Interrupts.
- RS232/RS422/RS485
- Source Code Debugger Kit Available.

**GMM Products Are Made in USA.**

PC/AT Dup Port Com. Coprocessor also available

Extremely competitive pricing.

(714)752-9447 Fax (714)752-7335

18092 Sky Park South - Unit E, Irvine, CA 92714

---

**Gtek Inc.**

**PCSS-8FX Ultra High Speed Serial Coprocessor**

- 1 Megabyte/Sec transfer speed.
- No load on Host Processor.
- I/O mapped - No host memory used.
- 8 ports per card.
- RS-422, RS-485

Order Toll-Free
800-282-4835

---

**Complete Solution In One Card**

**SIGMA SIX™**

96/24kpbs send
Receive Fax/Data Modem

**Flash Disk™ (Flash Eeprom)**

256K or 512K

**IDE/Floppy Controller**

1024x768 Non-Interlaced Supports 24Bit True Color with 16.8 Million Colors

**Windows™ Accelerator**

- Windows 3.1/3.0 Compatible
- Software configurable interrupt lines (IRQ) - No hardware interrupts required. All functions can be enabled and disabled via software.
- Avoids Multi-board incompatibilities.
- Saves time and money.
- 30 days money back guarantee.
- 2 years warranty-board replacement.
- **MADE IN USA**

Advanced Micro Technology
123 University Pkwy
Pomona, CA 91768
Tel: (714) 598-6120 Fax: (714) 598-7716

Circle 331 on Inquiry Card.

---

**Circle 332 on Inquiry Card (RESELLERS: 333).**

**Circle 333 on Inquiry Card.**

**Circle 334 on Inquiry Card.**

**Circle 335 on Inquiry Card.**

**Circle 336 on Inquiry Card.**

**Circle 337 on Inquiry Card.**
**Integrated Voice/Fax Mail**

Integrates major voice/fax applications plus program control into one full-featured high performance software. PC or AT 386/486 based. Menu driven. Easy to use. Full support for Rhettex, New Voice, Dialogic, TTD and Intel. Supports up to 24 voice lines and up to 8 fax lines. Hardware + Software $950

Tel: (818) 368-6132  Fax: (818) 368-7895

**SigmaTech Software**

SigmaTech Software provides Party/Chat lines and Telemarketing voice and fax hardware. Supports up to 24 menu driven software. PC-AT/386/486 based. SigmaTech Software offers Auto-Attendant, Unlimited Audiotex, Call Processing, Telemarketing, Fax Mail, Fax-on-Demand, Fax Broadcasting, Party/Chat lines, and Talking Yellow pages. Resellers/Dealers/OEMs/Private labels are welcome.

Tel: 617-938-8020  Fax: 617-938-8037

**LET YOUR COMPUTER DO THE TALKING!**

Auto-Attendant

Unlimited Audiotex

Call Processing

Telemarketing

Fax Mail

Fax-on-Demand

Fax Broadcasting

Party/Chat lines

Talking Yellow pages

**Circle 339 on Inquiry Card.**

**SSD-2HD Intelligent Solid-State Disk**

- 1.44MB max. FLASH/EPROM Disk w/erase-protect
- 1.44MB max. SRAM Disk w/battery backup
- Auto-sense installed FLASH/EPROM/CRAM memory types
- Auto-configure Solid State Disk Drive
- Software protection key (PARAKEY) designed to protect a specified software application from unauthorized use.

**ACI**

1.800-886-ACI-3

U.S.A.  TEL:617-938-8020  FAX:617-938-8039

International  TEL:310-230-7220  FAX:310-230-7240

**Circle 341 on Inquiry Card.**

**Rackmount Solutions**

- RACKMOUNT COMPONENTS — 1U 59.75
- RACKMOUNT Chassis 19"x17"  $183
- Rackmount VGA Monitor  $531
- Rackmount Monitor Shelf  $113
- Rackmount Keyboard Shelf  $68

**Circle 342 on Inquiry Card.**

**The Intelligent Solution For Data Acquisition**

- Digital Signal Processing at 16 MIPS
- 20 MHz CPU with DRAM to 1048K
- 32 MHz DSP with DRAM to 96K
- TLL/I Improved Operating System
- 100% standard commands
- Custom commands in C

Send for FREE catalog and demo diskette. Or call us at (206) 453-2345.

**Circle 370 on Inquiry Card.**
Connect with the Parallel Universe

SIGEN 250MB PORTABLE PARALLEL PORT TAPE BACKUP

No controller card required. Connects to parallel port. Installs in less than 3 minutes. Great for Laptops. To 9.5 MB/min transfer rate.

Capacity
20 MB Parallel Port Floppy
90/250 MB 1/4" cartridge 4.5 MB/min
60/200 MB 1/4" cartridge 9.5 MB/min
250/700 MB 3/4" cartridge 9.5 MB/min
1.3 GB 1/4" cartridge SCSI 18 MB/min
1.2 / 2 GB 4mm DAT SCSI 10 MB/min

Supports
DOS, OS/2
Novell, 286, 386
UNIX, XENIX

Industry standard SYTOS PLUS, or CENTRAL POINT BACKUP software and for file server based NLM and VAP TAPWARE.

PHONE (408) 737-3904 • FAX (408) 737-3910

Circle 347 on Inquiry Card.

STAND ALONE DISKETTE DUPLICATOR

OVER 300 DISKS PER HOUR

5.25" and 3.50" Models

SIMPLE AND FAST FROM $1699

TEL: (416) 503-3335
FAX: (416) 252-4084

Circle 348 on Inquiry Card (RESELLERS: 349).

Laptops & Notebooks

Universal Keypad for Portable Computers

Available in Ivory or Black

Boost data entry speed, accuracy and convenience with Genovation’s Micropad,™ the innovative numeric keypad for portable computers.

Is the unhandy numeric section of your portable computer’s keyboard dragging you down?...Give your productivity a boost by using our Micropad. The ergonomically designed Micropad is ideal for spreadsheet and accounting applications that require fast and accurate entry of numeric data.

The Micropad attaches to the parallel port of any MS-DOS computer while providing a clean pass through connection to the printer.

Power usage is negligible. Lightweight and compact, the Micropad is fully programmable and is also available with connectors to fit keyboard and serial ports.

Circle 350 on Inquiry Card.

Let your "true colors shine through" when you advertise your computer products in BYTE's HARDWARE/SOFTWARE SHOWCASE

our newest, affordable, 4-color advertising section!

Call for more details:
(603) 924-2695
or (603) 924-2598
Prevent 486 CPUs From Overheating

This new patented series of products is available for the latest powerful CPU specifications. Each model is designed for easy installation and removal.

**Model** | **Target CPU** | **Dimensions** | **Price**
--- | --- | --- | ---
HSF4013ALI | 486DX·33 | 49.5x49.5x23 | $49.50
HSF41110DLI | 486DX·33 DX·511 | 49.5x49.5x13.7 | $49.50

TEL: 886-2-2996930-32 FAX: 886-2-2996929
Taipei Hsien, Taiwan, R.O.C.

**AVC**

**ASIA VITAL COMPONENTS CO., LTD.**

Magazine Promotion

**Video Packer, 30:1 Image Compression Software for Windows 3.0**

- Dynamically Saves Precious Hard Disk Space by 30:1 with Minimum Image Quality Loss
- Supports Windows 3.0, Windows 3.1 and MS-DOS 5.0
- Adapts to JPEG Standard
- Complete with All Major Graphic File Formats: TIFF, TARGA, PCX, GIP
- Money-Resident Program
- Operates Transparently within Popular Applications
- All-in-One Program
- User-friendly Picture Publisher
- Auto-access and Decompression

**WinPrinter, Cost Effective 800 DPI Laser Printing**

- Made for Windows Printing
- Printing Versatility - 3 Ways: Windows Direct Drive, Postscript Emulator, PCL
- 800 DPI Laser Printing, 4 Pages Per Minute
- Upgrade Kit for Your HP LaserJet Series Printers Available

**For Order, Catalog And Price Quotes Call:**

1-800-446-1967 Empire Computech
9906 Henness Ave.
Rancho Cucamonga, CA 91730
Tel: 714-448-1400 Fax: 714-446-1401

All trademarks are trademarks of their respective owners.
Programmable Hardware

IEEE 488.2 for Notebook PCs

- Attaches to the PC's parallel printer port
- Controls up to 14 IEEE Instruments
- Transfers data at up to 170 kbytes/sec
- Includes DOS or Windows software drivers
- Graphics & analysis software available
- Allows parallel & IEEE devices to be connected simultaneously.

Call or fax for more information:
Tel (216) 439-4091
Fax (216) 439-4093

TUP-400 $745.00 NEW
TUP-300 $575.00

I New Improved hardware and software.
I The most complete PC-based Universal Programmer, Programs PLD (PAL, GAL, FPL, EPLD, PEEL, MAX, MACH...), EPROM, EEPROM, Flash EPROM, Bipolar PROM, Small PROM, and TGA with 8 to 64 pins.
I New Programming adapters available.
I EPROM EMULATION capability.
I Tests digital ICs and DRAM/SDRAM/SIMM adapters available.
I Free software update and new device added upon request.
I IC Manufacturers' approval.
I 1-year warranty, 30-day money-back guarantee.

Call TODAY for MORE INFORMATION.

9-Track for PCs
Mainframe to PC data interchange

Rock solid solutions, rock bottom prices.
Direct from the manufacturer. 1600 & 6250 bpi.
Subsystems include drives and software.

9 Track/3480 Tape Subsystems
1/4" DAT 8mm Optical
New Windows Software Available

- Best Quality
- Lowest Prices

800/600/3200/6250 BPI
CALL 1-800-859-8856

Laguna Data Systems
23151 Alcalde Drive, Suite 8-3, Laguna Hills, CA 92653
Tel: 714-586-3010, Fax: 714-586-5538

Circle 367 on Inquiry Card.

Tape Drives • Business

Over 2,000 devices, desktop programmer for your IBM PC with high speed & reliability

- Easy to use menu driven software
- Universal programming for EEPROM, flash EEPROM, bipolar PROM, small PROM, microcontroller, etc.
- Test TTL/CMOS logic I/Os & memory (DRAM/SRAM)
-life time free software updates on BBS & technical support.
- 1 year Hardware warranty & 30 day money back guarantee.
- Developed & made in U.S.A.
- Call for demo discs.

Distributors are welcome!

Little PLC™
Program It In C

Our new Little PLC™ measures only 4.33 x 2.85 inches! This miniature controller costs only $195, including 8 optically isolated inputs and 8 relay driver outputs. Low cost expansion cards allow you to add multiple I/O digital and analog. It has dual RS-485 serial I/O, battery backed memory and time/date clock, programmable timers, watchdog, and can mount on a standard DIN rail. Our easy to use Dynamic™ integrated development system also costs $195. You can write simple programs in an hour, or develop major applications with 20,000 lines of C language.

Z-World Engineering
1724 Piccaso Ave., Davis, CA 95616 USA • (916) 757-3737
Fax: (916) 753-5141 • 24 hr. Automatic Fax: (916) 753-0618
(For automatic fax call from your fax, request catalog #18)

Circle 369 on Inquiry Card.
Dealers Wanted

MicroBiz, the nation's leading POS software developer, is currently looking for 200 additional dealers to supplement its nationwide dealer network. The MicroBiz Controller Series is available for the following markets: Retail • Video • Auto Repair • Liquor • Rental • Hair/Nail Salon • Restaurant, Dry Cleaner and more...

Dealer Inquiries Welcome • Call for a FREE catalog
French and Spanish versions available

800-637-8268
Fax: (914)425-4598 Ph: (914)425-9500
BBS: (914) 425-6440

Circle 372 on Inquiry Card (RESELLERS: 373).

EM320

W I N D O W S

DEC VT320 Emulation for Microsoft Windows 3.X
• 132 column display
• Automatic window sizing
• Cut and paste
• Kermit file transfer
• Windows style help
• Local or ANSI color
• Multiple instances

Diversified Computer Systems, Inc. (303) 447-9251
FAX (303) 447-1066 Other products: EM320 DOS, Tektronix 4050 DGS

Circle 374 on Inquiry Card.

WINTERM

Terminal Emulation
Is Just the Beginning!
• The best DDE support in the business.
• Advanced scripting lets you integrate host-based applications with local programs in a flux.
• WinTerm's Unique Application Development Kit lets you write C-language DLLs to control WinTerm at a detailed level. The only truly extensible connectivity package on the market.
• Exceptionally faithful emulation of DEC VT Series terminals.
• Unidirectional connectivity: LAT, CTERM, TCP/IP (including WINSOCK), TES, INT14, NASI/NCIS, NETBIOS, and many more.

Markfield Software Development Corp.
71 West Main Street, Oyster Bay, NY 11771 • (800)733-1657 FAX (516)654-7890

Circle 375 on Inquiry Card.

B.S. & M.S. in Computer Science

Get the opportunity and earning power a college degree confers—without leaving home and without spending thousands of dollars.
• Approved for tuition reimbursement by leading corporations
• All Courses by Correspondence
• Most courses interactive
• Approved Ada course available
• Qualified instructors available on telephone help lines

Phone: 1-205-323-6191 • FAX: 1-205-326-2229
2101 BYX Magnolia Ave. • Suite 200 • B'ham, AL 35205

Circle 379 on Inquiry Card.

JMP® Statistical Discovery Software

“JMP is a leap forward in its overall approach. It combines graphics and statistics on a workstation better than any other existing product...The ease of use, low cost, and the context sensitive help system may do for statistics what spreadsheet software has done for accounting.”

Interface/Computing and Telecommunications Services News—Univ. of California, Santa Cruz

Call today for a free demo disk and Points of Interest from the leading name in data analysis software...SAS Institute Inc. 919-677-8000. Fax 919-677-8166.

JMP is a registered trademark of SAS Institute Inc. Copyright © 1992

Circle 379 on Inquiry Card.
APL
Complete APL system $60. PC, 386, WINDOWS.


Iverson Software Inc.
33 Major St., Toronto, Ontario, Canada M5S 2K9
Phone (416) 925-6096 Fax (416) 488-7559

Cross Assemblers, Simulators, Disassemblers
Processor Families:
8051 8096 8048
Z80 64180 6301
6805 6800 1802
6811 6502 68k
8085 6801 Z8
Join Thousands of Satisfied Customers Worldwide.
Call:
PseudoCorp
716 Thimble Shoals Blvd., Newport News, VA 23606
Tel: (804) 873-1947 • Fax: (804) 873-2154

Greenleaf Comm++ $199
The ONLY software program that can bypass DOS to recover your data.
Save hundreds, even thousands of dollars by doing your own data recovery.

Rescue can perform miracles!

Call Your Local Dealer Today!

Recover data from physically damaged disks!
PC Diagnostics and System Information

QAPlus™ Over 2 MILLION users

- Even novices can quickly solve common computer problems
- Review hardware configuration and performance benchmarks
- Now includes LAN features for network PC support and management

Also from DiaSoft: QAPlus/WIN™ for tuning and troubleshooting Windows and QAPlus/EF™ for power-users and service/support professionals.

Circle 336 on Inquiry Card (RESELLERS: 387).

Lost for the write word?
Get it right with

COLLINS ON-LINE v2

French, German, Italian & Spanish bilingual dictionaries for your PC.
Over 40,000 references, 70,000 translations drawn from contemporary use.

FEATURES INCLUDE:

- TSR - memory resident so it can be used with most word processors for MS-DOS.
- Look-up - enables you to find words in the dictionary, choose the appropriate translations and paste them into your document quickly and easily.
- Screen-read - reads words in your document automatically for quick and accurate translation.
- Annotate - allows you to create your own specialized glossaries for use with Collins' world renowned bilingual dictionaries.

English version (use with menu items in English)

Harpers Collins Computer 1113 South Creek Blvd.
Orem, Utah 84058 USA
Tel: +1 800 336 6312
Fax: +1 801 228 3795

For further information

French version (use with menu items in French)

LepageTech Int'l Inc
Via Aurelio Saft 10
2923 Milano MI
Italy
Tel: +39 2 4969001
Fax: +39 2 4969003

Circle 330 on Inquiry Card.

Circle 385 on Inquiry Card.

Circle 388 on Inquiry Card.

Circle 389 on Inquiry Card.
A DIRECTORY OF PRODUCTS AND SERVICES

THE BUYER'S MART

ACADEMIC COMPUTING

LEARN PARALLEL PROCESSING
Transputer Education Kit
1 Kit includes ready-to-use PC add-on board with T400 transputer, 1MB of RAM, and PC interface. Complete with Oceano and C compilers, assembler, source-level debuggers, example programs and 1600 pages of documentation (in 10 sections). Available

Computer System Architects
100 Liberty Plaza, 15 North 100 East, Provo UT 84600-3100
(801) 753-4524 (801) 379-3300 FAX (801) 379-3306

Inquiry 701.

ACCESORIES

RADIOACTIVE?
Plot it on your PC with The RPM-80 RADIATION MONITOR
Serial or printer port. Displays Alpha, Beta, Gamma, X-rays, Micror, 1000 times the resolution of standard geiger counters. Excellent for tracking TABLES/GRAPHs. Find sources, view radiation effects, WINDOWS/Plot/Background/Geiger Rain Clouds/Smoke Spills

Aware Electronics Corp.
17741 Mitchell North, Irvine, CA 92714
(800) 822-4333 (714) 333-3355 FAX (714) 333-9322

Inquiry 702.

CUT RIBBON COSTS
Re-link your printer ribbon quickly and easily. Do all cartridges, portable with just one unit! For crisp, black professional print since 1982. You can choose from 3 models.
Manual: E-Zeeinker $39.95
Electric: E-Zee-Ink $99.95
Ink Master (Electric) $199.00
1000s of satisfied users. Money-back guarantee.

BORG INDUSTRIES
583 MAIN ST., JAMESVILLE, NY 13087
1-800-253-2040 In IA: 319-897-2976

Inquiry 702.

KEYBOARD, VIDEO, MOUSE, AUDIO

Extend signals from PC with EXTENDER
Switch signals among PCs with COMMAND
Boosts signals up to 600 feet. Control up to 96 PCs with one keyboard, monitor and mouse.

CYBER CORPORATION
2600 North Wallace Ave., Muscogee, AL 36805
Phone: 205-535-0011 Fax: 205-535-0010

Inquiry 703.

CUSTOM KEYBOARDS AND TERMINALS

Engineering, Development and Production
Point-of-Sale Specials • HassCors • Access Control • Data Collection • Operator Input
Unique Industrial • Any Interface, key style or size • No minimum quantity limited

GENOVATION, Inc.
17741 Mitchell North, Irvine, CA 92714
(800) 822-4333 (714) 833-3355 FAX (714) 833-9322

Inquiry 704.

THE BUYER'S MART is a unique classified section organized by product category to help readers locate suppliers. Each ad has inquiry numbers to aid readers requiring information from advertisers.

AD FORMAT: Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers must furnish typewritten copy. 2." x 10" ads can include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. 2." x 12" ad has more space for descriptive text (550 characters is the maximum recommended).

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE, 2300 2nd Avenue South, Suite 500, Mill Lane, Peterborough, NH 03458. For more information call: Margot Gnade at 603-924-2656. FAX: 603-924-2663.

RATES (Jan. 1993)

<table>
<thead>
<tr>
<th>Issue</th>
<th>3 Ads</th>
<th>6-11 Issues</th>
<th>12-15 Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>20&quot; x 12&quot;</td>
<td>$663</td>
<td>$636</td>
<td>$557</td>
</tr>
<tr>
<td>2 ads/issue</td>
<td>$939</td>
<td>$912</td>
<td>$754</td>
</tr>
<tr>
<td>3 ads/issue</td>
<td>$1,236</td>
<td>$1,212</td>
<td>$991</td>
</tr>
</tbody>
</table>

Paying 2 ads/issue 5 weeks prior to issue date. For example: November issue 2 ads/issue 530 504 477 450

Battery operated, handheld reader with 64K RAM, 16-key keyboard and back light, 216 LCD display, and built-in calculator. Supports WAND, CCD, and LASER. Built-in program generator supports multiple programs and data files. Interfaces to PC & PS2 keyboards. RS-232 terminals, and HAYES compatible modems. 30-DAY MONEY-BACK GUARANTEE.

AMERICAN MICROSYSTEMS
2190 A Regent Parkway, Eustis, TN 38026
(800) 648-4452 (817) 751-9015 FAX (817) 685-6232

Inquiry 705.

READ BAR CODES!

PORTABLE BAR CODE READER
Battery operated, handheld reader with 64K RAM, 16-key keyboard and back light, 216 LCD display, and built-in calculator. Supports WAND, CCD, and LASER. Built-in program generator supports multiple programs and data files. Interfaces to PC & PS2 keyboards. RS-232 terminals, and HAYES compatible modems. 30-DAY MONEY-BACK GUARANTEE.

AMERICAN MICROSYSTEMS
2190 A Regent Parkway, Eustis, TN 38026
(800) 648-4452 (817) 751-9015 FAX (817) 685-6232

Inquiry 705.

CUSTOM KEYBOARDS AND TERMINALS

Engineering, Development and Production
Point-of-Sale Specials • HassCors • Access Control • Data Collection • Operator Input
Unique Industrial • Any Interface, key style or size • No minimum quantity limited

GENOVATION, Inc.
17741 Mitchell North, Irvine, CA 92714
(800) 822-4333 (714) 833-3355 FAX (714) 833-9322

Inquiry 704.

I. T. S. Bar Code Solutions
Bar codes are easy using our FULL line of readers & printers. They plug right into existing CPU/terminal/router/switchboard systems in your office, store, truck, factory or warehouse. 170 Bar code DOB printer print on matrix or laser printers. 30 day refund. 1 year warranty. OEM/VAR Dealer discounts.

International Technologies & Systems Corp.
655 K-North Berry St., Brea, CA 92621 - Western USA 13 Wren Court, Richmond, VA 23229 - Eastern USA
(800) 228-9447 (814) 690-1801 (800) 741-0725 (334) 606-2993

Inquiry 707.
Inquiry 712.

PC BAR CODE SPECIALISTS
Bar code readers designed for doctors, retailers, and financial institutions. They emulate your keyboard, so data looks just like it was typed in! Choose from stainless steel wall, laser gun, card slot, or magnetic stripe scanners. Also, powerful label printing software. Great warranty. Generous reseller discounts. 30-DAY MONEY-BACK GUARANTEE.
Seagull Scientific Systems
1517 H.E. 414th, Suite 333, Redmond, WA 98052
1-800-788-2001 206-451-8966

DATA INPUT DEVICES
Bar Code, Magnetic Stripe Readers & SmartCard Encoders/Readers for microcomputers & terminals, including IBM PS/2 & others, DEC, Macintosh, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. UPC & 39 print programs, magnetic encoders, & portable readers are also available.

TPS Electronics
4047 Transport, Palo Alto, CA 94303
415-856-8853 TPS PLX
1-800-526-5920 FAX: 415-856-3843

Inquiry 708.

VARIANT MICROSYSTEMS
BAR CODE READERS DELIVER WANDLASER/MAGNETIC CARD CONNECTIVITY
• Keyboard wedges (Internal/External) for IBM PC/XTAT, PS/2, and portables
• RS232 wedges for WYSE, Link, Kintron terminals
• Bar code and laser scanning software
• Full two-year warranty
• 30-Day Money-Back
• Extensive VAR/Distributor Discounts
4060 Freeborn Blvd., Suite 206/Fremont, CA 94538 (510) 440-3870 800-698-4818 FAX: (510) 623-1972

Inquiry 709.

Sirlin's CAD ++ ENGINE
• Read and Write AutoCAD DWG and DXF files.
• Chilled oriented, modular, database-like access to CAD data.
• View, Plot (Postscript), Plot (vectorize), and Pick (AutoCAD) modules.
• Available for DOS and Extended DOS. Windows, Sun, and other Unix systems.

Sirlin Computer Corporation
25 Orchard View Dr., Ste 14, Londonderry, NH 03053 Telephone (603) 437-0237 Fax: (603) 437-0733

Inquiry 711.

SCHEMATIX
• Integrated schematic environment
• Unlimited levels of design hierarchy
• 100% component/layer expandable
• Dot matrix, postscript, inkjet printers
• Board layout/Verifier software available

VAIL
Price: $195
Silicon Tools
305/570-5580

Inquiry 712.

CAD/CAM
CONTINUOUS MOTION CONTROL
FROM A PRINTER PORT: INEXPENSIVE UPGRADE SOFTWARE

NEW VERSION 3
• Controls up to six axes simultaneously
• Linear and Circular Interpolation.
• Easy-to-use DSS device software. User Manual
• CAD-CAM interface available.
Ability Systems
Cypress, CA 90601-6798 FAX: (213) 657-7813

Inquiry 713.

CD-ROM Products & Services:
CD-ROM, a world leader in the industry. WRITE for a FREE 100 page catalog.

C.P. Corporation
1657 Cole Blvd., Suite 400,
Golden, CO 80401, USA
Altos Deck 3

Inquiry 714.

High Performance Self Contained Portable CD-ROM Computing
ACCESS INFORMATION INC.
The information retrieval expert 1 - 800 - 847 - 3930

Inquiry 715.

SOFTWARE DISTRIBUTORS
Seagull Scientific Systems
1517 H.E. 414th, Suite 333, Redmond, WA 98052
1-800-788-2001 206-451-8966

Inquiry 716.

NEW
•・100% component/layer expandable
• Dot matrix, postscript, inkjet printers
• Board layout/Verifier software available

VAIL
Price: $195
Silicon Tools
305/570-5580

Inquiry 712.

COMMUNICATIONS
3780 • BSC • RJE
• UNIX, OS/2, MS-DOS, and Windows
• Single and Multi-channel options
• Script, API, Menu-Driven Interfaces
• Unattended and Interactive sessions
• Ideal for VARs, OEMs, and end-users!

Serengeti Systems Incorporated
Call (800) 634-3122 or FAX (512) 880-8729

Inquiry 717.

COMPUTER BOOKS
COMPUTER BOOKS at a discount
We specialize in ADVANCED books for developers, programmers, computer professionals, and academics. 15% discount. Latest books from over 50 publishers. Free catalog, UPS & international shipping. Popular service. 

MCV/SAI/AMX. Compiler Support 5000/1331, GO CBK Windows, C++, DOS 2.0, UNIX, Mac, OOP

CompuBooks
R. 1, Box 10-21, CA 97212 800-880-6918, 512-321-9652 voice & FAX

Inquiry 718.

INSURES YOUR COMPUTER
SAFECOMER Computer's coverage provides replacement of hardware, media and purchased software. As little as Theft, power surges and more. One call does all it.

TOLL FREE 1-800-848-3469
SAFECOMER, The Insurance Agency Inc.
PO Box 22111, 2929 N. Hill St., Columbus, OH 43202

Inquiry 719.

LOW-LOW-LOW
Computer Systems/Notebooks/Network Solutions
IBM-Apple-Compaq-AT-LX-486-AEPC-Atari-Microsoft
SURAH 385/466 ISA/ESA/AM/MX/M SOUND Boards
• CD ROM • Tape Backup • Packet Fax Modem LAN Card • Hard Drives/FlopPy Drives • Memory/Upgrades

DRAKE • MM Modules • Laser Printer/Solids
• Printers & Digitizers • Software
SERAUG inc.
1-800-543-1001 Nationwide Orders

Inquiry 720.

CROSS ASSEMBLERS
CROSS ASSEMBLERS
Fast, reliable with text search and source code. Conditional assembly, complete set of arithmetic and logical operators. Optimal listing for Turbo-assembler. Price $150.00 each.

SIMULATOR-DEBUGGERS/DISASSEMBLERS
We offer excellent high-function compilers with full in-circuit simulators for the 68040, 68030, 68020, 68010, and 68000 controllers, and now for the RISC and M68K, with their unique features fully supported. Prices from $200 to $900 each, with $50.00 discounts for XASM + SIM packages.

Lear Com Company
2440 Kipling St., Ste. 206, Lakewood CO 80215
303-392-2286 FAX: 303-392-8721

Inquiry 722.

CHRISTIAN BOOKS
CHRISTIAN BOOKS

Inquiry 723.

DECEMBER 1992 • BYTE 313
SOFTWARE/GRAPHICS

The Ultimate CAD/CAM/CAD Programming Engine
Black development tools with TD-Professional v.6.0, the most complete C++ toolbox of 2D & 3D graphic routines available today. Over 500 routines including NURBS, Diff, Graphics, Surfacing, Hidden Line, Transformations, Perspectives, Polygon (In/out/Cw/Ccw), Casing, Textures, Graphics routines for drawing using Bill or MCG Graphics and more. Full source, 30 day guarantee. USA $50.00, Foreign $56.00. Use MCG, Stencil C+++, WATCOM C++, or Network High C++. Call (703) 455-7702 or Fax 703-423-7755 for free technical information.

Disk Software Inc.
2118 E. James Rd., Suite 441, Richardson, TX 75081

Inquiry 767.

SOFTWARE/SCIENTIFIC

NEW! MathViews™ for Windows
MATLAB compatible interpreter for Windows • Matrix and Array Algebra • Complex Numbers and Signal Processing • 2D and 3D Graphics with Composite Clip • Written in C++ - Available for CEM • Introductory Price $495.00

The MathWizards
(619) 457-2971 FAX (519) 458-5849

Inquiry 773.

SOFTWARE/INSTRUCTIONAL

RAINDROP™
FAST, compact PrtScr Utility for end users AND developers. HandyCopy as fast as 10 sets. Average binary size = 6 bytes. 14 video graphic standards. Scale, rotate, colorize and more. "CALL" from user-written programs.

Protected mode version is only mouse & keyboard support, dialogues, and more. Includes Speed Learn. Read up to 3000 words per minute and Computer software shows you how to Speed Read and Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library.

$44.95 + S3

P.O. Box 580, Station A, Vancouver B.C. V6C 2N2
(703) 440-0064 Fax (703) 455-8695

Inquiry 778.

SOFTWARE/GUI

TEGL Window Toolkit lets you create DOS based GUI apps that are completely stand alone. Over 500 functions. Menu, secretsl Specily MAC or PC. Send the introductory day. Within 30 days you too can be a speed reader.

Protected mode version is only mouse & keyboard support, dialogues, and more. Includes Speed Learn. Read up to 3000 words per minute and Computer software shows you how to Speed Read and Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library.

$565.00US. Use MSC, Borland and more. Full source. 30 day guarantee. USA $500.00, Foreign free technical information.

1243 Rand Road, Des Plaines, IL 60016
(703) 440-0064 Fax (703) 455-8695

Inquiry 779.

SOFTWARE/SORT

MULTI-VOICE® TOOLS
Multi-Voice Tools is a complete development Toolkit for Pascal or "C" • Equations • Tables • Graphics • Scalable Fonts • Supports most printers • WYSIWYG previewer • Foreign Languages • Special Symbols • Font Effects • Indices • Most $299

"T" of Tomorrow"-Notices of AAEE, March 1991. Call now for a FREE DEMO DISK

MicroPress, Inc.
68-30 Harrow Street, Forest Hills, NY
Tel (718) 575-1816 Fax (718) 575-8038

Inquiry 774.

SOFTWARE/VOICE/FAX

OPT-TECH SORT/MERGE
Extremely fast Sort/Merge/Select utility. Runs as an MS-DOS command or CALL as a subroutine. Supports most speech processing boards available today. It helps you write Multi-Voice applications in minutes. A number of pre-packaged examples are provided. Applications and listings are delivered with source code.

"Call NOW" for a FREE PREVIEW DISK. Based in CAS specifications. WATCOM C++. Available.

ITI Logiciel
4263 Christophe-Colomb, Montreal, Quebec, Can. H2J 3G2
Tr.LIN (514) 697-8192 FAX (514) 692-3282

Inquiry 775.

SOFTWARE/PACKAGING

FREE SOFTWARE PACKAGING CATALOG
Every package will need to Package, Distribute, and Shio Your Software! From manuals and binders to mailers and shipping labels.

LABELS • LABELS • LABELS • For diskettes, pla or custom printed dot matrix or laser printer . free samples • FREE CATALOG•

Hice & Associates
6068 Monticello Dr., West Chester, OH 45069 Phone/Fax: (513)-777-8586

Inquiry 771.

STATISTICS

VISUALIZE YOUR DATA
MCA transforms most marketing and social science data to easily understood perceptual maps. Communicate complex relations with ease using presentation quality charts. Most printers supported. Demo available.

Breton-Clark
88 Headquarters Place, Montclair, NJ 07042
(201) 993-3135 FAX: (201) 993-1757

Inquiry 776.

WINSTAT™ Statistics for Windows
All the statistical methods you need, with all the convenience of Windows! Up to 65,000 variables and cases. Import/export Lotus, dBASE, etc. files. Copy & paste tables and graphs to word processor. Call for brochure and/or $10 demo. V/M/C/PC/NET

Kalmia Co. Inc.
Dept. 62, 71 Dudley St., Cambridge, MA 02140
Phone/FAX: (617) 864-5567

Inquiry 777.

Hours

THE BUYER'S MART

The Buyer's Mart announces a new double plus size ad. This larger ad will be available starting January 1993. Call Margot Gnade for details. 603-924-2656

Inquiry 782.

WALLPAPER

NEW}

88 WINDOWS® PROGRAMS
Buy this fantastic collection for only $9.95. Features games, business, utilities, education, home and graphics programs for use in Windows*. Price includes shipping and handling. (Please add $5.00 for foreign orders.) Credit Cards Only.

SMC SOFTWARE PUBLISHERS
(619) 931-8111 ext. 511

Inquiry 783.

DECEMBER 1992 • BYTE 317
YOUR DIRECT LINK

PRODUCT CATEGORY INDEX

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on Your Direct Link Card!

To receive information for an entire product category, circle the category number on Your Direct Link Card!

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HARDWARE**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ADD-IN BOARDS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMUNICATIONS/NETWORKING**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMPUTER SYSTEMS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DATA ACQUISITION**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISKETTES/DUPILCATORS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FAX BOARDS/MACHINES**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GRAPHICS TABLETS/MICE/ PENS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KEYBOARDS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LAPTOPS & NOTEBOOKS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MAIL ORDER**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MEMORY CHIPS/UPGRADES**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MICROSCHELAR**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MONITORS & TERMINALS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MULTIMEDIA**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PRINTERS/PLOTTERS**

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!
YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card
Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address
Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!
YOUR DIRECT LINK CARD

For free product information, mail your completed card today. For quicker response, fax to 1-413-637-4343!

See reverse side for card.

1. Circle the Numbers on Your Direct Link Card
Circle the numbers which are found on ads and articles in this issue or circle the product category number and receive information on all advertisers listed in that category.

2. Print Your Name and Address
Answer questions "A" through "E" and mail or fax card to 1-413-637-4343.

3. Product information will be rushed to you from the selected companies!
## YOUR DIRECT LINK

**PRODUCT CATEGORY INDEX**

For FREE product information from individual advertisers, circle the corresponding inquiry numbers on your Direct Link Card!

To receive information for an entire product category, circle the category number on your Direct Link Card!

<table>
<thead>
<tr>
<th>Category No.</th>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>PROGRAMMABLE HARDWARE</td>
<td>308</td>
</tr>
<tr>
<td>23</td>
<td>TAPE DRIVES</td>
<td>308</td>
</tr>
<tr>
<td>24</td>
<td>UPS</td>
<td>308</td>
</tr>
<tr>
<td>25</td>
<td>BUSINESS</td>
<td>308</td>
</tr>
<tr>
<td>26</td>
<td>CAD/CAM</td>
<td>308</td>
</tr>
<tr>
<td>27</td>
<td>COMMUNICATIONS/NETWORKING</td>
<td>308</td>
</tr>
<tr>
<td>28</td>
<td>DATA ACQUISITION</td>
<td>308</td>
</tr>
<tr>
<td>29</td>
<td>DATABASE</td>
<td>308</td>
</tr>
<tr>
<td>30</td>
<td>EDUCATIONAL</td>
<td>308</td>
</tr>
<tr>
<td>31</td>
<td>ENGINEERING/SCIENTIFIC</td>
<td>308</td>
</tr>
<tr>
<td>32</td>
<td>ENTERTAINMENT</td>
<td>308</td>
</tr>
<tr>
<td>33</td>
<td>GRAPHICS</td>
<td>308</td>
</tr>
<tr>
<td>34</td>
<td>MACINTOSH</td>
<td>308</td>
</tr>
<tr>
<td>35</td>
<td>MAIL ORDER</td>
<td>308</td>
</tr>
<tr>
<td>36</td>
<td>MATHEMATICAL/STATISTICAL</td>
<td>308</td>
</tr>
<tr>
<td>37</td>
<td>MISCELLANEOUS SOFTWARE</td>
<td>308</td>
</tr>
<tr>
<td>38</td>
<td>ON-LINE SERVICES</td>
<td>308</td>
</tr>
<tr>
<td>39</td>
<td>OPERATING SYSTEMS</td>
<td>308</td>
</tr>
<tr>
<td>40</td>
<td>PROGRAMMING LANGUAGES/TOOLS</td>
<td>308</td>
</tr>
<tr>
<td>41</td>
<td>SECURITY</td>
<td>308</td>
</tr>
<tr>
<td>42</td>
<td>SHAREWARE</td>
<td>308</td>
</tr>
<tr>
<td>43</td>
<td>SOFTWARE DUPLICATION</td>
<td>308</td>
</tr>
<tr>
<td>44</td>
<td>SPREADSHEETS</td>
<td>308</td>
</tr>
<tr>
<td>45</td>
<td>UNIX</td>
<td>308</td>
</tr>
<tr>
<td>46</td>
<td>UTILITIES</td>
<td>308</td>
</tr>
<tr>
<td>47</td>
<td>WINDOWS</td>
<td>308</td>
</tr>
<tr>
<td>48</td>
<td>WORD PROCESSING/DTP</td>
<td>308</td>
</tr>
<tr>
<td>49</td>
<td>BOOKS/PUBLICATIONS</td>
<td>308</td>
</tr>
<tr>
<td>50</td>
<td>GENERAL</td>
<td>308</td>
</tr>
</tbody>
</table>

## Category No. Inquiry No. Page No.

### BUSINESS

- ADVANCE PLUS DISTRIBUTORS, INC. 308
- COMPUTER ASSOCIATES 308
- MECA SOFTWARE, INC. 308
- PROGRAMMABLE HARDWARE 308
- TELECOMMUNICATIONS 308
- UPS 308

### SOFTWARE

- ADVANCE PLUS DISTRIBUTORS, INC. 308
- COMPUTER ASSOCIATES 308
- MECA SOFTWARE, INC. 308
- PROGRAMMABLE HARDWARE 308
- TELECOMMUNICATIONS 308
- UPS 308
| Inquiry No. | E 1302 | 1309 Electrical Engineering | 1274 Elitegroup 72, 114, 117 | 1314 Lines Information-tekhn 96 | 1316 Lucid 96 |
| Inquiry No. | F 1308 Farpoint Research 92 | 1295 First Byte Software 84 | 1310 LaserTools 88 | 1311 Advanced Relational 92 | 1312 Above Software 96 |
| Inquiry No. | G 1149, Gateway 2000 30, 60, 97 | 1331 Extended Systems 80 | 1321 Media Vision 30, 174 | 1327 Ralcal-Datacom 80 | 1328 Turtle Beach Systems 174 |
| Inquiry No. | L 1316 Lucid 96 | 1277 Liberty Systems 73 | 1328 Twelve Tone Systems 174 | 1329 VLSI Technology 137 | 1330 Xerox 142 |
| Inquiry No. | M 1312 Above Software 96 | 1314 Lines Information-tekhn 96 | 1328 Twelve Tone Systems 174 | 1330 Xerox 142 | 1331 XVT Software 224 |
| Inquiry No. | N 1286 Quantum 76 | 1316 Lucid 96 | 1329 VLSI Technology 137 | 1331 XVT Software 224 | 1332 Zenith Data Systems 137 |
| Inquiry No. | O 1293 Ralcal-Datacom 80 | 1327 Ralcal-Datacom 80 | 1332 Omni Labs and RTM 174 | 1332 Omni Labs and RTM 174 | 1332 Omni Labs and RTM 174 |
This Application Uses Over 100 Gigabytes of Memory!

BIX is the online service for people who know computing – it’s the collective computing power of thousands of hardware and software engineers, systems designers, independent consultants, technology buffs, and computer industry celebrities. With BIX and the people you’ll meet online, you’ll have access to literally gigabytes of information, software, source code, news reports, and advice. And BIX now offers an optional access program that lets you take advantage of Windows™ while you’re online.*

BIX is a Great Deal

Subscribe to BIX for only $13 per month. Connect to BIX locally via Tymnet for only $3 per hour in the evening and on weekends. Daytime rates are $9 per hour. Higher connect rates apply for access outside the mainland US.

Join BIX Now!

Using any communications program:
- Dial by modem: 1-800-695-4882
- At “login” enter bix
- At “Name?” enter bix.byte

Further details and complete rate information will be provided during the toll-free registration.

Questions? Call 1-800-695-4775 (voice)

*Optional access program — just $9.95!

- Get quick answers to tough coding questions
- Interact with top developers
- Download source code, utilities, & other programs
- Send & receive e-mail with binary attachments
- Chat with other BIX members in real time
- Track industry trends and announcements

Money-Back Guarantee: If for any reason you aren’t happy with BIX, simply cancel your account and request a refund of your first monthly fee.

Windows is a trademark of Microsoft Corporation.
BIX is a service of General Videotex Corporation
1030 Massachusetts Avenue, Cambridge, MA 02138. 617-491-3342

Circle 450 on Inquiry Card.
One of today's greatest and most enduring myths is that telecommunications and data processing have made this a shrinking world. In our lifetime, we expect to see a Europe stretching from the Urals to the Atlantic and a North American free-trade zone ranging from Hudson Bay to the Guatemalan border. Togetherness is the flavor of the millennium. It is beginning to be politically incorrect even to mention difference.

And yet, the more information technology and telecommunications bump us against each other, the more we see how different we are. When an Italian waves good-by, he or she means *come here*. The Greeks nod no. Angle of bow is critical in Japan. You can't express the conditional in Chinese. And there are differences in the way people everywhere do business.

The more technology opens up the planet, the more it becomes clear that you can't be given this new world in an entire lifetime, never mind 30 minutes.

The technology isn't bringing us all together; it's forcing us all apart. Politically, people are breaking loose from the old, centralized, monolithic way of doing things. We had a word for it in the last century, when the Austro-Hungarian Empire broke down: *Balkanization*. Ironically, the word has come back to haunt us in today's ex-Yugoslavia. And it's also happening in Scotland, Quebec, Nagaland, Azerbaijan, Georgia, Czechoslovakia, and too many other places to name.

This fragmentation is not only political. Minority groups everywhere are staking claim to their cultural heritage and their patch of territory. Corporations are restructuring decision-making processes to make them more distributed, less hierarchical. The workplace itself is fragmenting. In the 1940s, there were 80 kinds of jobs; today there are 800. More and more people are quitting the downtown office-block life in favor of telecommuting. Citizens are less satisfied than ever with the unrepresentative nature of our representative democracies.

As the comfortable certainties of the Cold War recede, is the place falling apart? No. We're seeing the first flowers of the information age. As the networks expand and become transparent and open, as software takes the gobbledygook out of the system, making it easy for ordinary people to operate, the technology is driving a trend toward increasing social complexity.

Throughout history, radical improvements in the ability to generate and share information have always triggered information surges, which in turn always generated bursts of innovation that brought into existence new entities, new kinds of people, new ways to live. The present information surge is no exception. It's just immeasurably more complex than anything that went before.

And complexity, ecological as well as human, makes life safer. The more heterogeneous an ecosystem, the more novelty it generates. In nature, where novelty is expressed in the variety of species, complexity enhances the likelihood of a species' survival in the event of radical environmental change.

The same process operates to protect human society. Information surges make it possible to bring more ideas together in novel ways. When that happens, the result is always more than the sum of the parts. An example from history: gasoline + perfume sprays = carburetor.

The complexifying of knowledge (from a couple of sciences 500 years ago to 20,000 specialist disciplines today) has enhanced our chances of survival and is responsible for generating the information technology that will take us to the next stage in our social evolution.

Information technology will offer the individual and the small community an unparalleled opportunity to survive as a viable entity, unconstrained by the rules and standards established in simpler times with simpler technologies, when nation states enforced conformity on communities as divergent as Scots and Maoris, when literacy was the only test of intelligence, when the political majority ruled unquestioned.

The new technology will shatter the mold. It will give us the means to tap the extraordinarily diverse talents of those billions of brains from thousands of cultures around the planet that up to now have been suppressed or ignored because we lacked the tools to manage anything but the lowest level of social complexity. And idiosyncratic, small-scale independence will benefit from other technologies, like renewable energy systems and genetic engineering.

But this Baskin-Robbins world will happen only if we bury the myth that it's good for us all to be the same. It's not. Survival and fulfillment are the products of diversity.

James Burke is a writer, producer, and host of BBC TV series such as Connections and *The Day the Universe Changed*. He is working on a 20-part series on the interactive nature of knowledge for the Discovery Channel. You can reach him on BIX c/o "editors."
NEW TECHNOLOGY IS ALWAYS PRICED JUST BEYOND YOUR BUDGET.

IF THAT’S THE LAW
THEN THIS IS A CRIME.

We didn’t get to be a FORTUNE 500® company by playing by the rules. Why start now?

Take our new Dell 486 66 MHz systems, for example. They’re all based on Intel’s incredibly fast 66 MHz i486 DX2 chip. They’re available in four platforms, and in hundreds of configurations. And you can get a complete system for just $2,499. (Sorry, Murphy.)

Likewise, you can’t find guarantees like ours with any other make of computer. That is, guaranteed response within five minutes to support phone calls. Guaranteed next-business-day service. And a guarantee to help you solve any compatibility issues. So, fact is, we broke quite a few of Murphy’s laws.

To us, it’s the perfect crime.

DELL 486P/66 i486 DX2 66 MHz SYSTEM
LEASE*: $92/MO.

• 4 MB RAM • 120 MB (72MS) IDE HARD DRIVE
• SUPER ACCELERATED VIDEO CONTROLLER
• SUPER VGA 1024X MONITOR
(14", 1024 X 768, .28mm) • ONE FLOPPY
DRIVE (3.5" OR 5.25") • MS-DOS 5.0

DELLE
800-433-3498
WHEN CALLING, PLEASE REFERENCE #11E86.
HOURS: 7AM-7PM CT MON-THR.
8AM-4PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 250-7111.
MANY OTHER CONFIGURATIONS AVAILABLE, ASK YOUR DELL REPRESENTATIVE.

BUSINESS PRODUCTIVITY BUNDLE, JUST $199
Available with purchase of Dell system and Windows.
- MS® OFFICE PRE-LOADED™ AND READY TO RUN INCLUDES:
  MS EXCEL 4.0 • MS WORD FOR WINDOWS 2.0
  MS POWERPOINT 3.0
  -2400 BPS MODEM WITH MTEZ™ SOFTWARE
  FOR JUST $10 MORE, MOVE UP TO 1400/9600 MODEM WITH FAX™ FOR WINDOWS
  **INTEREST RATES AVAILABLE**

GUARANTEED RESPONSE
One: We guarantee that when you call us, you’ll talk to a technical specialist within five minutes or less. Or if you prefer,
we’ll call you back within an hour.

GUARANTEED SERVICE
Two: We guarantee under your service contract that if you have a problem that requires on-site service, a technician will be at your desk the next business day.¹

GUARANTEED COMPATIBILITY
Three: We guarantee that in the unlikely event you have compatibility problems with your Dell system, we’ll do everything we can to help you solve them.

One more time: Great systems. Low prices. Real guarantees.²

For information, or to order, phone us. We can put an end to your worst nightmare.

Dell
800-433-3508
WHEN CALLING, PLEASE REFERENCE #11E87.
HOURS: 7AM-9PM CT MON-FRI,
8AM-4PM CT SAT, 10AM-3PM CT SUN.
in CANADA, CALL 800-668-3021.
in MEXICO CITY, 250-7111.
IF THE PRICE IS A DREAM, THEN THE SERVICE AND SUPPORT WILL BE A NIGHTMARE.

Such great systems. Such low prices. Add to that the legendary service and support that helped propel us into the FORTUNE 500 and earned us numerous international awards last year alone.

But, as is our style, we're going a step further by guaranteeing you'll rest easier.

NEW DELL 333SL/III86™ SX
33 MHz SYSTEM
NEW—ONLY $1,149
LEASE: $43/MO.

2 MB RAM • 80 MB (17 ms) IDE HARD DRIVE
3 EXPANSION SLOTS
VGA 800 MONITOR
(14", 800 x 600, 39mm)
ONE FLOPPY DRIVE (3.5" OR 5.25")
MS-DOS 5.0

*Sleeve included. Many locations: Leasing arranged by Leasing Group, Inc. 1986, #96 and the Intel Inside Logos are trademarks of Intel Corporation. MS-DOS and MS are registered trademarks and Windows is a trademark of Microsoft Corporation. Printed in USA on non-recycled paper. ©1992 Dell Computer Corporation. All rights reserved.
WE JUST FOUND
A WAY TO MAKE
WINDOWS 3.1
GO EVEN FASTER.

DELL 486P/33SX i486™ SX 33 MHz SYSTEM $1999

Free Windows™ 3.1,
Free Mouse and
Free Upgrades to:
UltraScan™
14C Monitor and
Super Accelerated Video
with 1 MB Video RAM.
Save $250
Standard system includes: 4 MB RAM
• 170 MB Hard Drive • Super VGA Monitor
• Super Accelerated Video with
512 KB Video RAM • MS-DOS® 5.0

DELL 486P/50 i486 DX2 50 MHz SYSTEM $2499

Free Windows 3.1,
Free Mouse and
Free Upgrades to:
230 MB Hard Drive,
UltraScan 15FS Monitor and
Super Accelerated Video with
1 MB Video RAM.
Save $350
Standard system includes: 4 MB RAM
• 170 MB Hard Drive • UltraScan 14C
Monitor • Super Accelerated Video with
512 KB Video RAM • MS-DOS 5.0

This is quite a deal, even by our standards.

For a limited time, when you buy one of these two Dell® 486 systems, we'll not only give you Windows 3.1 and a mouse, we'll also give you upgrades that make Windows work even better: a free monitor upgrade, and a free video RAM upgrade for twice the video performance.

Both systems come with Guaranteed Compatibility, Service and Response:

the only written guarantees of their kind in the industry.*

Call us to order your system. But you'd better call soon.
The window on this opportunity closes on December 31.*

800-433-3497
WHEN CALLING, PLEASE REFERENCE #11EM2.
HOURS: 7AM-9PM CT MON-FRI, 8AM-6PM CT SAT, 10AM-3PM CT SUN.
IN CANADA, CALL 800-668-3021. IN MEXICO CITY, 250-7111.