Apple redefines top of the line with the 40-MHz

Mac IIfx

Lotus 1-2-3/G
Toshiba T1200XE
Mylex EISA Triple Play
Emerging Architectures: IBM's SAA, DEC's NAS, Others

REVIEWS
23 386-Clone Motherboards
NEC Prospeed CSX
Low-Cost Color Scanner
HP NewWave
Ami Pro vs. Windows Word vs. Legend
FoxPro
MPW C++ vs. Think C 4.0
THE DELL SYSTEM* 386

**THE DELL 386SX**

The perfect low price maximum performance and compatibility with unprecedented value and support.

**STANDARD FEATURES:**

- Intel 80386 microprocessor running at 25 MHz.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM** expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
- Advanced Intel 82386 Cache Memory Controller with 32 KB of high speed RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 25 MHz Intel 80386 or 25 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controllers.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).
- 12-month On-Site Service Contract provided by Xerox.

*Commercial Lease Plan, Lease for as low as $121/month...

**Xerox Extended Service Plan pricing starts at $375**

40 MB TTL Monochrome System $1,299

40 MB VGA Color Plus System $1,999

100 MB VGA Color Plus System $2,699

50 MB Super VGA Color System (800x600) $2,899

Prices listed reflect 1 MB of RAM, 80, 150 and 322 MB hard drive configurations also available.

**THE DELL SYSTEM** 25 MHz 386S.

An even better value at these low prices.

**STANDARD FEATURES:**

- Intel 80386 microprocessor running at 25 MHz.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM** expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
- Advanced Intel 82386 Cache Memory Controller with 32 KB of high speed RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 25 MHz Intel 80386 or 25 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controllers.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).
- 12-month On-Site Service Contract provided by Xerox.

**Commercial Lease Plan, Lease for as low as $121/month...

**Xerox Extended Service Plan pricing starts at $375**

40 MB TTL Monochrome System $1,299

40 MB VGA Color Plus System $1,999

100 MB VGA Color Plus System $2,699

50 MB Super VGA Color System (800x600) $2,899

Prices listed reflect 1 MB of RAM, 80, 150 and 322 MB hard drive configurations also available.

Ask about our high resolution graphics.

*Performance Enhancements: Within the first magistrate of memory: 128 KB (386SX, 386XT and 280), 384 KB (128 and 300) of memory is assumed for use by the system to enhance performance. Can be optionally disabled on 386SX and 280, with configurations available on all systems. Call for pricing. All systems are subject to change without notice. Dell cannot be responsible for errors in typographical or photographic errors.**
Before the Dell System 325 was named the top 386 personal computer by the rest of the world, it had quite a following at home.

Winning both the PC Magazine Editor's Choice and PC World's Best Buy awards.

And most recently, it was rated number one for overall customer satisfaction, in a PC Week poll of corporate volume buyers.

One reason for this unprecedented popularity is that Dell deals directly with every Dell customer in the world.

Custom configuring each computer. Responding to the needs of each user. So when you call Dell for a System 325, you get more than the exhilaration of running the world's top rated 386 computer, you get something called satisfaction.

With a 30-day money-back satisfaction guarantee, self-diagnostic software and toll-free expert technical support.

As well as next day on-site service provided by Xerox Corporation.

And you can get it starting at $4,199. With leasing plans as low as $153 a month.

Call us toll-free. And Dell will custom configure a System 325 for you.

After all, that's what the world is coming to.
When computer publications from nine countries got together and voted for the best 386" computer, it marked a major shift in power.

They chose the Dell System® 325 head and shoulders over every other system in the world.

Turn the page and find out why.

800-283-1170

FOR NETWORK OR UNIX INFORMATION, CALL 800-678-UNIX.
For Dell in Canada, call 800-387-5752.
PC MAGAZINE, January 1989, "In a field of powerhouse machines there can only be one winner, and ALR’s FlexCache is it."


PC WEEK, July 1989, "Based on a series of benchmarks run last week on Advanced Logic Research, Inc.’s prototype 486 desktop system, ALR will enter the 486 market with a bang."

At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we’ve designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR’s custom ASIC chips which deliver the fastest processing speed ever.

More important, PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing better than zero wait state performance as compared to the i386. Furthermore, the ALR PowerCache 4 is 100% IBM® PS/2™ Micro Channel™-compatible supporting bus mastering devices and giving

<table>
<thead>
<tr>
<th>ALR M130 Desktop</th>
<th>ALR M150, M350 M650 Floor-Standing</th>
<th>IBM M70-A21 Power Platform™</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>25 MHz i486</td>
<td>25 MHz i486</td>
</tr>
<tr>
<td>Bus</td>
<td>MCA</td>
<td>MCA</td>
</tr>
<tr>
<td>External Cache</td>
<td>128 KB cache Read and Write-Back</td>
<td>128 KB cache Read and Write-Back</td>
</tr>
<tr>
<td>Video Opt. on board</td>
<td>640x480 1024x768</td>
<td>640x480 1024x768</td>
</tr>
<tr>
<td>I/O Slots</td>
<td>6 expansion slots</td>
<td>6 expansion slots</td>
</tr>
<tr>
<td>Storage Expansion</td>
<td>4-3 1/2&quot; 1-full-height 2-1/2&quot;-height 2-3 1/2&quot; drives</td>
<td>3-3 1/2&quot; drives</td>
</tr>
<tr>
<td>Disk Capacity</td>
<td>130 MB-260 MB 150 MB-650 MB 110 MB</td>
<td>Starting at $11,490  $12,990</td>
</tr>
<tr>
<td>Price</td>
<td>$9,990</td>
<td>$11,490</td>
</tr>
</tbody>
</table>
California Anza-Borrego Desert State Park
(Classic-etched sandstone. These concretions are formed of onion-skin layers of minerals resistant to erosion.)

i486™ system in the world.
from the leader in 386™ technology.

you a more efficient system for a variety of multi-user and fileserver applications. Like most ALR computers, the PowerCache 4 is a truly balanced system. The fastest power is achieved by enhancing our PowerCache 4 design with the industry's fastest disk drives and interface. The PowerCache 4 systems come standard with a high-speed 15MHz ESDI and 32 KB hard disk cache on the disk controller. What more could you possibly need.

It's no wonder ALR remains ahead of the pack with our innovative design expertise. As far back as 1986, we've been recognized in the industry as a leader in performance. Recently, the highly acclaimed 386/220 won us "Best of 1987" from PC Magazine. 1988 brought us the honor of receiving the PC Magazine Award for Technical Excellence for designing the industry's most advanced cache architecture. As for 1989 we've already begun to excite the industry with the PowerCache 4.

Now, what else would you expect from a company who is so committed to innovation and high-performance technology that we take you a step beyond. At ALR, we are concerned with your processing needs. Our technical support staff is available to assist you by one simple phone call. All our systems are backed by a one year warranty. Call today for more information on the new PowerCache 4 and the name of an authorized reseller nearest you.

1-800-444-4ALR
COVER STORY
Apple's Special f x
page 111

Apple redefines
top-of-the-line
with the
speedy II fx.

NEWS
19 MICROBYTES
36 WHAT'S NEW

FIRST IMPRESSIONS
102 SHORT TAKES
LaserJet III,
HP's trailblazing printer
Photoshop,
Adobe eases image manipulation
Toshiba T1200XE,
impressive notebook computing
R:base 3.0,
many new features from Microrim
Lotus 1-2-3/G,
three dimensions for PM

REVIEWS
130 PRODUCT FOCUS:
The Heart and Soul
of a PC Compatible
The BYTE Lab examines 23
25-MHz 80386 motherboards.

145 Color Hits the Streets
NEC brings color to a laptop,
but is it worth it?

151 Svelte Scanner Is No
Fistful of Dollars
Sharp's low-cost scanner delivers
high-quality color images
to those who can afford to wait.

157 Word Processing in Windows
Ami Professional, Legend,
and Word for Windows are the first
WYSIWYG word processors
for Microsoft Windows, but
are they fast enough?

163 A Better dBASE
FoxPro may have outdone
all other dBASE systems,
including dBASE IV.

171 Windows Rides a New Wave
With NewWave, Hewlett-Packard
expands Windows, but it's
not easy.

179 C Compilers Have
Different Strengths
Apple and Symantec bring object-
oriented C compilers to the Mac.

193 Reviewer's Notebook
A compilation of brief reviews
and updates to previously
published evaluations.

STATE OF THE ART
196 APPLICATIONS
ARCHITECTURES
Introduction

199 Transparent and Portable
By providing a consistent
framework, applications
architectures let software
run on different machines
and operating systems.

205 From TTY to VUI
Frank Hayes discusses the past,
present, and future of user-
interface design.

215 Behind the Scenes
Understanding your programming
interface can help you decide
which user interface to support
in a heterogeneous environment.

225 Bridging Troubled Waters
Thriving in a diverse computing
environment is a lot easier if
you have the right tools.

237 Blueprints for the 1990s
IBM's SAA versus DEC's NAS—
how do they compare?

246 An Open Approach
With its new Distributed
Applications Architecture,
Data General challenges
IBM and DEC.

248 Building Blocks
A sampling of products and
organizations involved in
applications architectures.
FEATURES

252 Time and Money
A program called Spawn uses auctions to fairly allocate precious computer time.

261 New Objects for Old Structures
Using object-oriented techniques to convert existing applications has its advantages.

269 Who Owns the Copyrights?
Who owns the copyrights on independently developed programs? An attorney discusses recent developments.

275 Managing the Well-Tempered LAN
ISO standards signal that network management help is on the way.

HANdS ON

287 UNDER THE HOOD
Gateways to Protected Mode DOS extenders deliver 16-bit compatibility and 32-bit performance.

297 SOME ASSEMBLY REQUIRED
Flirting with Assembly
Armed with a few general concepts, you can make assembly language improvements without knowing assembly.

DEPARTMENTS

6 Spotlight

10 Editorial: Mylex Struts
EISA’s Stuff

32 Letters, Ask BYTE, and Fixes
A 286/386SX/386 debate goes on.

PERSPECTIVES

349 CHAOS MANOR MAIL

350 1.5 Decades of April Fools
This is a serious business, but it has had its funny side.

352 PRINT QUEUE
Advise and Compute
The tortuous evolution of copyright law in the computer world.

356 STOP BIT
To Boldly Benchmark
New meaning for the term “high-level benchmarks.”

READER SERVICE

343 Editorial Index by Company
344 Alphabetical Index to Advertisers
346 Index to Advertisers by Product Category
Inquiry Reply Cards: after 348

PROGRAM LISTINGS

From BIX: See 284
From BYTEnet: call (617) 861-9764
On disk: See card after 336

EXPERT ADVICE

53 COMPUTING
AT CHAOS MANOR
Chaos Manor Awards
by Jerry Pournelle
Find out if your favorite product has been honored.

71 THE UNIX/bin
Getting UUCP Running, and Other Stories
by David Fielder
Our columnist details how to set up UUCP communications.

77 DOWN TO BUSINESS
CD-ROM to the Rescue
by Wayne Rash Jr.
CD-ROM databases can provide your business with valuable information in a hurry.

81 MACINATIONS
Two Sides of the Same Coin
by Don Crabb
A bright side with education, a darker side with software development.

85 OS/2 NOTEBOOK
Living with OS/2 1.2
by Mark J. Minasi
Life with OS/2 1.2 is a lot like life with version 1.1, with some welcome changes.

97 NETWORKS
Faraway LANs
by Mark L. Van Name and Bill Catchings
You don’t have to be in the office to take advantage of the office LAN.

BYTE (ISSN 0360-5280) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $31.95 per year. Single copies $3.50 in the U.S., $3.95 in Canada. Executive, Editorial, Circulation and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 5923. Printed in the United States of America. Postmaster: Send address changes, USPS Form 3379, and subscription questions to BYTE Subscriptions, P.O. Box 561, Hightstown, NJ 08520.
Design screens and menus with PAINT™, placing input fields and messages precisely where you want them to appear in your final application. PAINT stores screen definitions in a single file — which can be modified without recompiling or relinking your application. Your program manages screen display and I/O through the POWER SCREEN Runtime Library. All essential features are supported, including:

- Block multi-field or single-field I/O
- Automatic range checking
- Configurable editing/menu key definitions
- Application context-sensitive, cross-referenced help
- Virtual/automatic scrolling screens within viewports
- Multiple, overlapping viewport display
- Plus much, much more

The Runtime Library can be linked directly with Turbo Pascal applications, or installed as memory resident.

All this for just $149.00

Includes complete sample programs, a comprehensive reference manual, and the Norton Instant Access program and guides to assist you during program development. And, we offer a 30-day money back guarantee.

Supports Microsoft C/QuickC, Turbo C, Turbo Pascal, QuickPascal and QuickBASIC.

The trials and tribulations of testing 25-MHz 386-based motherboards

At first, it seemed simple: Set up a standard system configuration that would let us plug in and benchmark 25-MHz 386-based motherboards. We would run both MS-DOS and Unix tests, compare features and price, and assess expandability. In the end, we accomplished our goal: to tell you which motherboards make the best PC clones (see “The Heart and Soul of a PC Compatible” on page 130). Our mistake was thinking that it would be easy.

Technical editor Rob Mitchell and testing editors Steve Apiki and Stan Wszola wrestled with one problem after another. The PC market is changing as fast as the technology. Consequently, several vendors revised their motherboards in the midst of the review, forcing us to duplicate work already done.

Not every vendor supplied a math co-processor, so the BYTE Lab had to install one 25-MHz 80387 chip into a number of machines. While we placed the math chip in a special carrier to minimize wear and tear, and used special chip-pulling tools, by the end of testing we had somehow cracked the math chip, making it into the most expensive tie clip BYTE has ever purchased.

Assembling and disassembling systems from the ground up was more time-consuming than we had expected and brought more than a few surprises. Several boards failed, some spectacularly, when powered up in the BYTE Lab. One failure trashed the hard disk drive containing our Unix benchmark code.

We wanted to look at motherboards available through dealers and distributors for those of you who want to build or upgrade a machine yourselves. We also wanted products that you can’t buy directly, but that you are likely to find in popular PC clones. Sorting out how each company markets its motherboards required a great deal of phone work.

But if you find any part of our effort useful when you shop for your next PC clone, we’ll consider it work well done.

—Michael Nadeau
Introducing HiWIRE® Plus

Wintek's smARTWORK® pioneered low-cost printed-circuit-board CAD. Then HiWIRE set the standard for productivity and ease-of-use in schematic capture. Now Wintek introduces HiWIRE-Plus, integrating HiWIRE's schematic features with a powerful printed-circuit-design facility.

Creating Schematics

With HiWIRE-Plus, simply connect library symbols with wires and buses. Creating and changing symbols is fast and painless. Produce your drawing using a dot-matrix printer, laser printer, or pen plotter.

Circuit-Board Design

HiWIRE-Plus gives you all the design freedom you want: you choose the grid size, trace widths, and pad shapes. The board size and number of layers are virtually unlimited. HiWIRE-Plus is perfect for surface-mount, microstrip, and ECL applications.

HiWIRE-Plus Advantages

- One tool for schematics and printed-circuit artwork
- Easy-to-learn menu-driven operation; complete documentation and tutorial
- Schematic libraries with TTL, CMOS, ECL, ladder, microprocessor, and discrete components
- Netlist and bill-of-materials utilities included
- Circuit boards up to 60x60 inches and 256 layers
- Variable grid size, trace width, and pad size (.001" resolution)
- PCB library with DIPs, SIPs, SMDs, PGAs, TOs, and edge and D connectors
- Schematic-to-layout cross-checking
- Design-rule checker
- 800 number for free support

System Requirements

- IBM PC, XT, AT, or PS/2 with 512K RAM, printer port, color monitor, and CGA, EGA, or VGA graphics card
- Microsoft Mouse
- IBM ProPrinter or Epson dot-matrix printer, and/or
- Houston Instrument or Hewlett-Packard pen plotter

Higher Performance
Better Value

Still only $895, HiWIRE-Plus delivers quality schematics and PCB artwork. You don't need to guess if HiWIRE-Plus is right for you—we guarantee it! Try it for 30 days at absolutely no risk. Call toll free today and put HiWIRE-Plus to work for you.

Wintek Corporation
1801 South Street
Lafayette, Indiana 47904-2993
(800) 742-6809 or (317) 742-8428
FAX: (317) 448-4823
Telex: 15-624-6480

Europe: RIVA Ltd., England, Phone: 0420 22666, FAX: 0420 23700
Australia: Wintek Software
Phone: (08) 2720028, FAX: (08) 3733145

Circle 400 on Reader Service Card

Current Versions
HiWIRE-Plus V 1.3e
smARTWORK V 1.4r6

*HiWIRE, smARTWORK, Wintek, and the Wintek logo are registered trademarks of Wintek Corporation.
In order to facilitate the many changes that must take place, we have assigned international SWAT teams to each of our regional offices. This organization will be in place until such time as all operations can be coordinated out of the central office.

Assignment follows:

<table>
<thead>
<tr>
<th>Lead/Assistant</th>
<th>Field Office</th>
<th>Program Description</th>
<th>Headcount</th>
</tr>
</thead>
<tbody>
<tr>
<td>D. Mary/K. Geng</td>
<td>Chapel Hill</td>
<td>Food Service: All food requirements, including purchasing, promotion, and menu preparation</td>
<td>12</td>
</tr>
<tr>
<td>J. Klein/G. Greenberg</td>
<td>Toronto</td>
<td>Scheduling: Implementation of new flight and crew scheduling methodology</td>
<td>8</td>
</tr>
<tr>
<td>M. Laddis/E. Karlson</td>
<td>Buffalo</td>
<td>Baggage/Flight Services: Baggage handling plus all flight attendant services</td>
<td>24</td>
</tr>
</tbody>
</table>

Needless to say, the most important work lies ahead of us.

They're here... Intuitive icons on the Ribbon make those everyday tasks, like formatting, as easy as ABC. Or, more precisely, see, point, do.

Save a tree. WYSIWYG editing shows what each page will look like, before it's printed, a feature that's easy on paper. Not to mention your patience.

We offer outstanding table service. Now, creating a table is easier than dining out. The Word for Windows table feature allows you to organize numbers, text, and graphics in a spreadsheet-like array of cells. And there's no tab.

Help wanted. Word for Windows context-sensitive, on-line help gets you up and running quickly. And keeps you there.

Chances are, those simple, everyday memos you've been creating aren't so simple to create anymore. What with the time-consuming process of mess with formatted paragraphs, typefaces, and tables.

And even if your documents aren't formatted, there's probably someone in your office who wishes they were. You, perhaps.

Enter Microsoft® Word for Windows. The word processor that compares to predecessors like the correction key compares to white-out.

Word for Windows' intuitive graphical user interface makes the most annoying and mundane parts of everyday memos as easy as ABC.

Or, more precisely, see, point, do.

Its computer-based training program and
Our guide will lead the way. Document Templates give you transparent access to sophisticated features like macros, glossaries and Styles, guiding you through the creation of a document.

Achieve the right consistency. Style sheets allow you to name character and paragraph formats. Then apply them quickly, easily, and most important of all, consistently. So it's simple to maintain corporate standards or establish your own.

Context-sensitive, on-line help make getting started every bit as natural as using it. In addition, Word for Windows allows you to make the quantum leap into graphical word processing without losing the equity you have in your current program. It reads and writes files from virtually all word processing applications.

In twenty years of office automation, you've never experienced anything like Word for Windows. But you can. Just call (800) 541-1261, and ask the people in Dept. K42 to send you a $9.95* Working Model. You'll discover that switching to Word for Windows means you won't be making any mistakes.
The most complete EISA offering to date clearly shows EISA's performance edge

As we were going to press, Mike Nadeau, associate managing editor for reviews, and the BYTE Lab got to test the most complete Extended Industry Standard Architecture (EISA)-based product line to date—an i486-based motherboard, a caching SCSI disk drive controller, an Ethernet adapter, and a prototype Texas Instruments Graphics Architecture (TIGA) graphics coprocessor, all from Mylex.

Mike reports that these EISA products are fast and that they suggest that we've just scratched the surface of EISA's power. For example, the disk drive controller is by far the fastest SCSI device that we have seen, approaching the performance of the best ESDI caching controllers. The GXE020A TIGA board—incidentally, it is the first 34020-based board that we have tested—scored a significant 45 percent higher on our low-level benchmark tests than any other TIGA board evaluated: This board could well be the year's TIGA performance leader. The other components in the demonstration system are equally impressive.

Motherboard
The prototype MAE 486-25 motherboard looked like a finished product, except for the firmware (an early Phoenix EISA BIOS), which needed some help from device drivers to configure the EISA boards.

It has six 32-bit EISA slots and two 8-bit slots, a 128K-byte write-back external cache, and a socket for a Weitek 4167 math coprocessor. It will accept up to 32 megabytes of RAM in two single-in-line-memory-module memory banks.

The Mylex scored well on the BYTE CPU and FPU benchmarks, with indexes of 6.21 and 27.44, respectively. Mylex has designed this board for use in file servers, Unix/Xenix systems, and engineering and scientific workstations. This explains why the designers added an external RAM cache and the FPU socket when the i486 already has a small cache and an FPU integrated on the chip.

Graphics
The GXE020A TIGA bus-mastering board was in an earlier stage of development. It had preliminary AutoCAD and TIGA drivers, with X Window System, Presentation Manager, and Windows/386 drivers in the works. The company expects to ship the board sometime during the second quarter, which is noteworthy since no one at this time has yet produced even an Industry Standard Architecture (ISA) 34020 board, much less an EISA version.

With 1280-by 1024-pixel resolution (a 1600-by 1280-pixel version is planned), the GXE020A runs at 32 MHz (up to 40 MHz is planned) and supports 256 colors on-screen from a palette of 16 million. Our test unit came with 4 MB of RAM.

Disk Drive Controller
The DCE376 caching SCSI disk drive controller, based on the Intel 80376 processor, was designed for service in networking or multituser environments. It comes with drivers for MS-DOS 3.3 and 4.0, OS/2 1.1, Novell NetWare 3.0, and 386/i386 V.3.2. Our unit came with 1 MB of cache RAM, expandable to 8 MB. The bus-mastering DCE376 supports up to seven SCSI devices, and you can program it for use with optical disks, scanners, tape drives, or CD-ROM drives.

Ethernet
The Mylex LNE390A Ethernet adapter is not a bus-mastering device. Nevertheless, Mylex claims an impressive host-to-adapter data transfer rate of 32 megabytes per second. The adapter is built around a National Semiconductor DP8390 Network Interface Controller, which takes over data buffer and communications management from the system's CPU. It supports both thick and thin Ethernet interfaces, and Mylex provides software support for Novell NetWare 2.15 and 3.0.

Pricing
The downside to all this is the price: The motherboard lists for a steep $7600, including a 128K-byte RAM cache and 4 MB of memory. The TIGA controller goes for $5100—expensive, but only about $500 more than the most expensive 34010-based TIGA boards. The SCSI controller and Ethernet adapters are more reasonable at $1700 (with 1 MB of RAM) and $500, respectively, and the DCE376 is comparably priced with ISA ESDI controllers.

Mylex is perhaps best known for its high-performance motherboards. The company does not sell complete systems to end users, but you can buy the EISA boards for your own system, and at least one vendor, Samsung Electronics, will sell systems using the Mylex motherboard and other EISA products. All the products except the TIGA board should be available by the time you read this.

EISA proponents have bet that bus's future on early availability of EISA-capable products and compatibility with the ISA standard. Mylex has addressed three key areas where bottlenecks occur: disk I/O, graphics, and network communications. The company will be among the first to actually sell EISA boards to end users. So far, EISA is well ahead of Micro Channel at its early stages, and all indications say that this trend will continue. Stay tuned.

—Fred Langa
Editor in Chief
(BIX name "flanga")
Turbo Pascal,® the world-standard Pascal compiler, adds Object-Oriented Programming with our new version 5.5. We combined the simplicity of Apple’s Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

It’s easy to extend yourself
If you’re already programming with Turbo Pascal, it’s easy to extend yourself from structured programming to object-oriented programming. And, Turbo Pascal 5.5 is the only compiler that is 100% source-code compatible with your existing Turbo Pascal 4.0 and 5.0 programs.

A fast object lesson
Object-oriented application programs more closely model the way you think. Objects contain both data and code. As in a spreadsheet cell, the value and the formula are together. Objects can inherit properties from other objects. For example, a Porsche Carrera inherits most attributes from the base model 911, but it also sports a whale tail.

Turbo Pascal 5.5’s object-oriented extensions give you code that’s easier to change, extend, and support.

Turbo Pascal 5.5 Professional with Turbo Debugger® and Turbo Assembler®
The award-winning Turbo Debugger now includes an object inspector and hierarchy browser. And Turbo Debugger can debug any size program.

Upgrade objectively
Pascal owners: Upgrading from Turbo Pascal 5.0 to 5.5 is only $34.95 plus $5 shipping and handling ($75 plus shipping and handling for owners of Turbo Pascal 4.0 or earlier). And upgrading from Turbo Pascal 5.0 and earlier to Turbo Pascal 5.5 Professional is only $99.95 plus $10 shipping and handling. To order, CALL (800) 331-0877.

Turbo Pascal 5.5 Features
- Inheritance
- Static & dynamic objects
- Constructors & Destructors
- Object constants
- Compiles @ > 34,000 lines/minute
- New integrated environment tutorial
- Hypertext Help with copy and paste
- Enhanced smart linker & overlay manager
- Support for 8087/80287/80387
- Integrated source-level debugging

Turbo PASCAL

BORLAND
We make a super VGA monitor

NEC presents the MultiSync® 2A, the best VGA monitor you can buy.

It’s the first monitor from the leader in the color monitor industry that’s been customized to the needs of the VGA user.

The MultiSync 2A is affordable and uncompromised. And compatible with all VGA modes. In short, it performs brilliantly. But what’s equally important, it allows you to move effortlessly to the next major graphics standard: SuperVGA. That’s something fixed-frequency monitors like IBM and Compaq can’t do.

All this in a monitor that gives you a 14" non-glare screen on a tilt-swivel base, for nearly 30% more viewing area than standard 12" screens, as well as a new, ergonomically designed cabinet.

MultiSync 2A. One super VGA monitor.
that's also a SuperVGA monitor.

But that's only part of the story. NEC also presents the best SuperVGA monitor you can buy. MultiSync® 2A.

The monitor that senses the software you're using and makes the switch from a VGA monitor to SuperVGA, the new standard developed by NEC and recognized by VESA. SuperVGA delivers a maximum resolution of 800 x 600, which is 56% higher than VGA.

After all, since you're most likely buying a board that goes beyond VGA, your monitor should too.

The MultiSync 2A is also available in a gray-scale version called the MultiSync GS2A monitor, with a 14" paper-white flat surface screen.

Either way, it's one super SuperVGA monitor. For literature call 1-800-826-2255. For information call NEC at 1-800-FONE-NEC.

MultiSync 2A. One SuperVGA monitor.
"Zortech C++ is one of the best MS-DOS products I’ve had the luck to use. I can highly recommend Zortech V2.0"


NEW! AT&T C++ V2.0 SPECIFICATION

NEW! MS WINDOWS COMPATIBILITY

NEW! C++ SOURCE LEVEL DEBUGGER

NEW! EXPANDED C++ TOOLS

NEW! OS/2 COMPILER UPGRADE

NEW! EASIER PORTABILITY FROM MSC

Zortech is first again with the release of its new C++ V2.0 Developer's Edition featuring the AT&T C++ V2.0 specification.

New V2.0 features like Multiple Inheritance and Type Safe Linkage make this the most advanced compiler available today.

You get 1500 pages of clear, high quality, professional documentation.

Zortech C++ V2.0 makes it really easy for you to move code over from most other leading C compilers.

Zortech C++ V2.0 Developer's Edition comes with a great new environment that lets you edit, compile and debug with ease.

Zortech present another "World's First" with its new C++ Source Level Debugger for MS-DOS. Once you've used our debugger you will never want to go back to any other.

The Developer's Edition also includes a 99% ANSI compatible C compiler, seamless LIM/EMS support, C++ Graphics Shell, TSR functions, C++ Tools, Optimizer, SAA/CUA style user interface, and full standard library source code.

Please call for our color brochure.

PRICES
C++ Compiler $199.95
C++ Debugger $149.95
C++ Tools $149.95
Library Source $149.95
Save $200 - Get the Developer's Edition for only $450 (includes all the above items).
OS/2 Compiler $CALL
C++ Video $499.95

USA: Zortech Inc.
1165 Massachusetts Ave.
ARLINGTON MA02174
Voice: 617-646-6703
Fax: 617-643-7969

EUROPE: Zortech Ltd.
106-108 Powis Street
LONDON SE18 6LU
Voice: 44-1-316-7777
Fax: 44-1-316-4138

HOTLINE 1-800-848-8408
Circle 302 on Reader Service Card
Smalltalk/V® PM.
Think of it as a bold, "seat-of-the-pants" solution that cuts to the heart of the OS/2 Presentation Manager complexity challenge. Thus unlocking the potential of this powerful operating system.

With the introduction of Smalltalk/V PM, object-oriented programming moves out of the realm of mystery and into a new era of breakthrough applications that promises to be of legendary proportions.

OS/2 PM is designed to push "user friendly" to a whole new level of sophistication. If you compare it to an orchestra, OS/2 has capabilities no ordinary assemblage of instruments has ever dreamed of possessing. Yet to tap its potential, OS/2 PM demands a conductor capable of true genius. That conductor is Smalltalk/V PM.

You'll find Smalltalk/V PM a perfect language for representing and manipulating high-level information. Because you go from designing to prototyping to delivering a completed application in one seamless step, you cleanly avoid the old costly "crash and burn" delays so common with languages born in the age of mainframes.

UNLEASHING THE AWESOME POWER OF OS/2 PM

Smalltalk/V PM. It helps stop the natural drift toward vaporware so common in software development today. It lets you dive right in and get to the creative parts without the usual grunt work. For example, if you want to ignore the complexities of understanding OS/2 PM details you can immedi-
fast, seat-of-the-pants way

THE FIRST
FULLY-COMPiled
SMALLTALK.
Because Smalltalk/V
PM is fully compiled
it provides you with a
more responsive envi­
ronment than ever
before. Now you'll be
able to generate
stand-alone applica­
tions (.EXE).

debugger simplifies ap­
lication development
and gives you instant
response when you im­
plement an idea. Our
extensive user manuals
and tutorials have
earned us high praise.

SMALLTALK/V PM. 
THE TALKING HAS
ALREADY STARTED.

"Digitalk's Smalltalk/V PM is a
masterful implementation of a clas­
sical object-oriented programming
language and a state of the art
graphical user interface. Any pro­
grammer struggling with the com­
plexities of Presentation Manager
should take a close look at this
product."

Charles Petzold, Contributing Editoi;
PC Magazine

"Digitalk's Smalltalk/V PM is
dazzling! This product makes Pre­
sentation Manager pay off."

Jeff Duntemann, Contributing Editoi;
Dr. Dobbs Journal

"Smalltalk/V PM from
Digitalk is the greatest! This is an
incredible product."

J.D. Hildebrand
Editor-in-Chief, Computer Language

THE BEST PM INVESTMENT
YOU'LL EVER MAKE
Smalltalk/V PM $499.95

Prices and information on these and
other Digitalk products are available
on request:
Smalltalk/V, Smalltalk/V 286,
Smalltalk/V Mac

Smalltalk/V. A product of Digitalk Inc.
9841 Airport Blvd., Los Angeles, CA
90045. For information or to find a dealer
near you call:
1-800-922-8255
1-213-645-1082
Compuserve 71361,1636
FAX 1-213-645-1306

Smalltalk/V is a registered trademark of Digitalk Inc.
Prices subject to change without notice.
Other product names are trademarks or registered
trademarks of their respective holders.

Circle 91 on Reader Service Card
Scalable Fonts
What they are and how to get them free.

For hundreds of years, metal font typefaces were stored by printers in typecases—to be set by hand on printing presses. This system was modernized by machines that set type in paragraphs at a time—which created a revolution for the publishing industry.

The nine scalable fonts built into Canon Laser Beam Printers represent the same kind of advance for PC users. Scalable fonts are actually mathematical formulas that allow you to create the exact size font you want—from fine print to type too large to fit on a single page.

What's more, they can be rotated, and filled with patterns or shadows for effect. Gone are the days of juggling font cartridges, or filling up scarce disk space with soft fonts.

And now through June 30, 1990, Canon Laser Beam Printers are an even better buy: you'll receive a free SC-1™ IC card with 22 more scalable fonts (seven typefaces). A $19.5 value, free.

Call 1-(800)-767-4300 to receive our free brochure with instructions on how to take advantage of this free offer—and start improving your image right now.

Circle 36 on Reader Service Card

A printer driver kit is provided free with each printer containing all printer definition files currently available on diskette, plus complete installation instructions.

Canon
LASER BEAM PRINTERS
Working to improve your image.
Optical Computer No Longer Light Years Away

Researchers at AT&T Bell Labs have successfully demonstrated what they call the world’s first digital optical processor, an experimental device that performs calculations using optical switches and beams of light instead of transistors and electricity. The processor holds the promise of future computers that are much faster than current machines and more adept at handling multiple tasks simultaneously.

The tabletop processor bears little resemblance to a silicon chip; in fact, it looks like a Rube Goldberg contraption. Measuring about 2 feet on a side, the processor is made up of lenses, mirrors, prisms, light-sensitive chips, and laser diodes stripped from commercial compact disk players (the scientists hope to someday fit all this into 3 square inches). Four video cameras read the “output” and display a matrix of dots on large TV screens.

At the heart of the processor are tiny optical switches, called S-SEEDs (Symmetric Self-Electro-Optic Effect Devices). Each S-SEED contains two mirrors whose reflectivity to infrared light can be controlled by a separate optical input. The processor contains four arrays of 32 S-SEEDs, and each S-SEED acts as a NOR logic gate. Bell Labs estimates that the area occupied by one conventional electrical path could hold 256 optical gates.

The processor calculates by sending light beams from the laser diodes through a series of lenses and masks to the S-SEEDs, which either reflect or absorb the light, depending on logic. Each array then cascades its output to the next array as input. In this way, the processor is able to count, at an execution speed of about 1 million cycles per second. Since S-SEEDs can switch at up to 1 billion cycles per second, the processor might someday be able to run hundreds of times faster than it does now. Among the impediments to building a speedier version: Researchers can’t debug it with conventional computers because they’re too slow.

While the optical processor is far from a functional computer, the Bell Labs researchers, led by Alan Huang, hope to challenge skeptics who question whether a completely optical computer is several years away, their experimental device is a major step toward computing at the speed of light.

They do it with mirrors. And prisms, lenses, light-sensitive chips, and laser diodes. Bell Labs staff member Maralene Downs and consultant Nicholas Craft with the digital optical processor they helped build. Although the researchers caution that an optical computer is several years away, their experimental device is a major step toward computing at the speed of light.
Open Look, AT&T and Sun's answer to the OSF/Motif graphical user environment, has been upgraded. An AT&T representative said that Open Look 2.0 includes bug fixes and performance enhancements, as well as utilities that used to be options.

Intel (Santa Clara, CA) has formed a joint venture with the Japanese company NMB Semiconductor to manufacture and market high-speed DRAM chips. The new Intel/NMBS DRAM Fabrication Co. plans to make 1- and 4-megabit chips at NMBS' site in Tateyama City, Japan, and eventually in the U.S. NMBS will handle the manufacturing, and Intel, the marketing.

Prometa USA (Gainesville, FL) showed at UniForum a Motorola 88000-based coprocessor card that plugs into Micro Channel-based computers. Using bus-mastering techniques, the board handles its own I/O, freeing the host processor to run DOS or OS/2 applications without additional overhead. The board runs Unix System V release 3.2. Prometa has built extensions to Microsoft Windows and Presentation Manager to allow execution of Unix programs from within DOS and OS/2. Prometa subscribes to the 88open Binary Compatibility Standard, so applications built for other 88000 platforms should run unmodified on Prometa's card.

Graphic Software Systems (Beaverton, OR) now has a version of its XVT (Extensible Virtual Toolkit) graphical interface library that runs under OSF/Motif. Previously, XVT allowed programmers to create interface modules in C that can be compiled with minimal changes across Microsoft Windows, Presentation Manager, Macintosh, and nongraphic character displays. GSS has enhanced XVT with color support, dynamic menu modification, text editing, and child windows. A Universal Resource Language specification and compiler allow interface elements to be textually described and transported across various platforms, GSS says.

Computer can ever be built. Some computer scientists maintain that optics will be restricted to system I/O and connections between electronic components. And some say that optical gates will never be a practical alternative to transistors.

A fully optical computer is more than five years away, according to the Bell Labs group. The most viable use now for optical technology is in hybrid systems that combine optics and electronics. The researchers are now focusing their work on optical interconnects between chips, which could be practical in as little as three years. Optical interconnects could vastly increase the amount of data moving in and out of chips.

A big problem with electronic chips is their data I/O bottleneck: Signal lines need a critical mass to carry data and must be kept far enough apart to prevent cross talk. By contrast, light is very resistant to interference and has a huge bandwidth. Streams of photons can even cross one another without causing any distortion.

Optics and computers will likely converge gradually. The Bell Labs processor is a significant step toward an optical computer, but there are other hurdles, including developing techniques for programming an optical machine. By 1995, AT&T says, supercomputers and telecommunications computers could contain 20 percent to 30 percent optical components; by the year 2000, as many as half the components could be optical. But it will be quite a while before you'll be running your favorite application program on your desktop optical computer.

—Andy Reinhardt

Have They Been Doing It Wrong? Discovery Could Help Chip Makers, Researcher Says

In the process of designing a device for monitoring peak voltages on silicon surfaces, a Stanford University researcher says that he accidentally made a discovery that could greatly improve manufacturing yields and the reliability of ICs. Contrary to a basic assumption governing silicon chip design and production, Dr. Wieslaw Lukaszek says that he discovered that the process of depositing electrical charge on silicon surfaces (called doping, it's used to introduce voltage differentials into a semiconductor) tends to distribute the charge evenly over the surface, rather than concentrating the charge in proportion to the area of the surface. Until this discovery, Lukaszek says, chip manufacturers have assumed that ion implanters and other charging devices act as a current source and deposit their charge on the silicon wafer in proportion to the size of its area. On the basis of this assumption, manufacturers have believed that they could prevent excessive electrical charge simply by limiting the size of the polysilicon wafer.

With this same assumption in mind, Lukaszek set out to design a peak voltage monitor that could measure and store in memory the voltage levels of a wide range of silicon structures subjected to electrical charge. Lukaszek says he found that "no matter what the size of the polysilicon structure, it sees the same voltage given the same electrical charge." In other words, explains Lukaszek, "the ion implanter behaves more like a voltage source than a current source." Or, in still other words, a basic assumption of making semiconductors is wrong, he claims. Until now, there has been no way of verifying the assumption, Lukaszek says. "It was based on looking at the residual damage in chips, sort of like doing an autopsy."

Lukaszek hopes to work with semiconductor companies to refine his voltage monitor so that the manufacturers can gain a better understanding of what's going on. Lukaszek told Microbytes Daily that he thinks this new insight could lead to better control of manufacturing conditions and less electrical "stress" on silicon wafers, thus resulting in higher yields. His finding could possibly enable manufacturers to understand better how silicon wafers behave in response to doping and then to redesign their equipment without worrying about wafer area, but focusing instead on other factors. "Manufacturers have been getting clobbered, and they didn't know about it," he says.

—Nick Baran

continued
Until now there was only one way to integrate C and Assembler.

While C and Assembler give you power to burn, switching back and forth between them can leave your brain feeling a little fried. All that stopping. And starting. And constantly retracing your steps.

Well, relax. Now there's Microsoft® QuickAssembler. Available with our clever QuickC® Compiler in one location: the first integrated environment for C and Assembler.

For the first time, you can save time with an integrated editor, compiler, assembler and debugger that let you create C programs, mixed C and Assembler programs, or Assembler programs that stand alone.

To make sure you feel at home in your new environment, we've designed Microsoft Quick Advisor, a hypertext electronic manual that coaches, coaxes and guides you on screen.

Quick Advisor gives you access to information on all ROM BIOS and MS-DOS® calls. And it even lets you cut and paste sample programs, so you can make both C and Assembler subroutines part of your routine in no time.

For more details on the incredible integrated power of QuickAssembler and QuickC Compiler, call (800) 426-9400. If you own QuickC Compiler version 2.0 already, we'll tell you how to add on QuickAssembler quick. And take a load off your mind.

Microsoft®
Making it all make sense:

Customers inside the 50 United States, call (800) 426-9400. In Canada, call (416) 673-7538. Outside the U.S. and Canada call (206) 882-8661. © Copyright 1989 Microsoft Corporation. All rights reserved. Microsoft, the Microsoft logo, MS-DOS and QuickC are registered trademarks and Making it all make sense is a trademark of Microsoft Corporation.
Whether you're considering one computer or 1000, you've got a friend in the business at Gateway 2000. You're assured of getting fully loaded machines for the same price as the competition's stripped down models. The standards in your new system will be second to none. From painstaking assembly by Gateway technicians to rigorous quality controls, the system you receive will be the best value in the industry.

Here's what the experts have to say about Gateway 2000:

"With Gateway's low price, you get plenty of power for your money." - PC Magazine

"Let me save you a lot of legwork; one of the strongest candidates around is the Gateway 2000..." - Computer Shopper

"...the Gateway 2000 386/33 is an amazing value...for top price and performance, there's no beating Gateway..." - PC World

"The leader in support policies is Gateway..." - Infoworld

"...Gateway 2000 isn't sacrificing quality to deliver a low-priced 386." - PC Resource

Every Gateway computer purchase includes:
- 30 Day Money Back Guarantee
- 1 Year Warranty
- Lifetime Toll-Free Technical Support
- Free Federal Express Shipment of Replacement Parts
- Bulletin Board Technical Support Service
- Free On-Site Service (to most locations if support by phone, BBS or Federal Express shipments doesn't correct a problem.)

Of course a good source of information about any company is its customers. Here's a small sampling of what Gateway 2000 customers have to tell you:

"I have purchased about 20 computers by mail order and your company has been the most courteous I have dealt with. Thanks for fine products, very good service, and fair pricing..." - J. Keith Sharp

"I have performed an exhaustive search and study as to the price and performance of comparative systems on the market. Gateway 2000 has emerged to the top of my evaluation by a wide margin." - Kenneth P. Battista

"Rarely do you find a company who will REALLY stick by the customer AFTER the purchase. I can honestly say, Gateway 2000 is one of these rare breeds." - Charles Paul Hsey

"I am most impressed thus far with my new Gateway 2000 20 Mhz, 80386 computer. I am also impressed with your company. Your people are knowledgeable and friendly. Your prices are the best I have seen for a quality product line." - Hobart K. McDowell III

"We've standardized on Gateway 2000 systems in our department. Your prompt service and technical support has kept our sales operation running better than ever. Based on the quality and performance of your systems, I would strongly recommend them to other corporations." - Elizabeth Coyman, McGraw-Hill
## 12 MHz - 286 VGA
- 80286-12 Processor
- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$1995.00

## GATEWAY - 386SX
- 2 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2195.00

## 20 MHz - 386 VGA
- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2695.00

## 25 MHz - 386 VGA
- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$3395.00

## 33 MHz - 386 VGA
- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$4395.00

## 25 MHz - 486 VGA
- 4 Megs RAM
- 1.2 Meg 5¼" Drive
- 1.44 Meg 3.5" Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14" 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

Call For Price

*This device has not been approved by the Federal Communications Commission. This device is new, and may not be offered for sale or lease, or sold or leased until the approval of the FCC has been obtained.*
IBM Will Offer NeXT Environment to Unix Users

It came as no surprise, but it's good news for NeXT. IBM announced officially that it will offer NeXT's NextStep user interface and development environment on its workstations and PS/2 personal computers running AIX, IBM's version of Unix. IBM licensed NextStep from NeXT in 1988 but then made no public commitment to using it. While it's not yet clear that users of IBM's new RT will want to run NextStep on top of AIX, the fact that it's an option gives NeXT's environment the official seal of approval from the world's biggest computer company.

NextStep is a graphical user interface layer for Unix. NeXT uses a version of Unix called Mach, developed primarily at Carnegie Mellon University. IBM's AIX version of Unix is not compatible at the binary level with Mach; therefore, programs developed on NeXT Computers will have to be recompiled to run under AIX, and IBM programs developed with NextStep will have to be recompiled to run on NeXT Computers. While it is likely that little, if any, code modification will be necessary because NextStep uses a consistent graphics model on either NeXT or IBM systems, neither company has publicly demonstrated the portability of NextStep applications.

IBM will also support the Open Software Foundation's Motif interface, which can be considered a competitor of NextStep. NextStep has advantages over OSF in that it offers an excellent development environment for programmers with its Interface Builder and Application Kits, which facilitate software design. NextStep's possible disadvantage is its use of a proprietary windowing system, while most of the Unix market has settled on the X Window System. While the Window Server doesn't have the acceptance that the X Window System has gained, some NeXT users have said that they think it's superior.

Some major software companies have already said that they're developing applications to run under NextStep, including Lotus, Informix, WordPerfect, and Adobe. IBM's decision to offer NextStep is good news for developers working on NextStep applications. It gives them the opportunity to market their programs on IBM PS/2s and workstations that run AIX.

—Nick Baran

Group Proposes Decorum for OSF

In an effort to set an industry standard for distributed computer networks that contain software and hardware from different vendors, the Open Software Foundation (Cambridge, MA) has been evaluating responses to its "request for technology." Although the OSF has received 50 proposals for a standard distributed computing environment, observers say that one of the front-runners is Decorum, backed by a group that includes IBM, Microsoft, DEC, Apollo, Locus Computing, and Transarc.

Decorum defines tools that developers can use to more easily create applications for distributed environments. Although obviously aimed primarily at Unix-based environments, the proposal also defines ways of connecting with other operating systems, including DOS and OS/2. Other main components include remote procedure calls using Apollo's Network Computing System protocol; process transparency, provided by the Transparent Computing Facility, jointly developed by IBM and Locus; and a distributed file system, based on Transarc's AFS (formerly the Andrew File System of Carnegie Mellon). These provide support for uniform file systems across networks, as well as for integrating DOS and Unix file systems.

Rounding out the complex proposal are threading facilities based on POSIX, time services using the Network Time Protocol (NTP), distributed access to remote devices, administrative services for managing and monitoring networks, and capabilities for diskless systems.

A spokesperson for the Decorum group says that each of the major components of the proposal are designed as independent layers that can be combined into a complete distributed computing environment.

continued
Introducing FoxPro. The only relational database management system that combines astonishing performance with a sleek interface of amazing power and beauty.

- FoxPro offers all the elegance and accessibility of a graphic-style interface, yet operates at the stunning speeds possible only with character interfaces.
- FoxPro is so easy to learn and use, even beginners can become productive immediately; yet it’s powerful and sophisticated enough to satisfy the needs of the most demanding developers and power-users.
- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it’s able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don’t even need a graphics card or special windowing software.

**Nothing is Faster**

Fox Software products are famous for their unmatched execution speed. FoxPro extends that tradition.

FoxPro is up to eight times faster than dBASE IV—more than 15 times faster than dBASE III PLUS! And that blazing speed translates into unprecedented power. Now you can efficiently process gigantic databases with hundreds of thousands—even millions—of records.

**Protecting Your Investment**

With FoxPro, your existing FoxBASE+ or dBASE III PLUS programs will run perfectly—first time, every time, no excuses. And FoxPro is language-compatible with dBASE IV.

But FoxPro doesn’t stop there. It has over 140 language enhancements not found in any version of dBASE. We’ve outdone ourselves by adding more than 200 language extensions you won’t find in FoxBASE+.

Best of all, FoxPro opens up whole new worlds for your applications by letting you move them onto a variety of different platforms.

**The Tradition Continues**

Fox Software is committed to excellence—our products prove it. We’ve been producing superb database management software since 1983. And our products for both the PC and the Macintosh continue to win awards worldwide.

We’ve taken everything we know about software engineering, databases and interface design, and focused it into one remarkable product—FoxPro.

**FREE Demo Disk**

But don’t just take our word for it. Try FoxPro for yourself, and see what the higher standard of database management can do for you.

Call (419) 874-0162 now to get your free demo disk. Or ask for the FoxPro dealer nearest you. One look, and we think you’ll agree: Nothing Runs Like The Fox.

**FoxBASE+ Users: Call About Our Liberal Upgrade Offer!**

_SYSTEM REQUIREMENTS:_ FoxPro operates in 512K RAM (640K recommended) with MS/PC-DOS 2.0 or greater and an 8086/8088, 80286 or 80386 microprocessor. For optimum performance, FoxPro takes complete advantage of any available EMS (expanded memory) or a math coprocessor.

**Trademark/Owner:** FoxPro, FoxBASE+; Fox Software; dBASE III PLUS, dBASE IV/Ashton-Tate.
Most VGA monitors this colorful,
The Monarch butterfly is one of Mother Nature's most splendid creations. And as you can see, Samsung's new high resolution VGA color monitor vividly brings to life its rich colors and striking contrasts.

Capable of displaying an unlimited palette of colors, the VGA-Graphic Master's™ 14-inch screen with 640 x 480 resolution creates images of superb quality. The tight .31mm dot pitch keeps everything from graphics to type super-clear and razor sharp.

Add to that convenient, up-front controls, a non-glare screen and tilt-swivel base for comfortable viewing, and you've got an array of features that add up to a monitor costing hundreds more.

But this, of course, should come as no surprise. Because along with outstanding performance, Samsung has for years enjoyed a reputation for unmatched value and reliability. All of which have gone a long way toward making Samsung the world's largest monitor maker, with over 8 million units sold.

So if you're looking for high performance, for a lot less, take a good look at Samsung.

For literature or the name of your nearest Samsung distributor, call 1-800-446-0262.
The Soviet software industry isn't much of an industry just yet, according to Alexey Pajitnov, developer of the popular Tetris computer game and probably the USSR's most famous programmer. "We have practically no software products, only programs. We have a very small number of computers, and usually we use them only for scientific or research applications," he said during a recent tour of the U.S. to promote his new game, Welleris (distributed by Spectrum Holobyte). Soviet programmers work "in the same style" as Western ones, Pajitnov said. As for computers in the Soviet Union, Pajitnov doesn't expect to see a PC on every desktop in the near future. He said that his country has "a lot of serious problems" like food shortages and civil unrest that need greater attention.

Meanwhile, ComputerLand is opening the first computer store in the Soviet Union. The new Moscow franchise will sell systems from IBM, Compaq, AST, Epson, and Hewlett-Packard. The store will not sell Macintoshes yet because Apple is currently developing a Cyrillic keyboard for the Russian market, according to ComputerLand spokesperson Brian Okun. The Moscow store will be owned by Michael Tseytin, a Russian immigrant who owns ComputerLand franchises in Secaucus, New Jersey, and Dresher, Pennsylvania.

Are you lonesome tonight? UUNET Communications (Falls Church, VA), an independent company directly connecting 130 Unix sites around the world, has started a telephone-based service through a 900 number. At a rate of 40 cents per minute (telephone toll charges included), users of the 900 number can send E-mail to any machine in the worldwide network of some 100,000 computers and can also pull public files off the UUNET machine, which is the repository for most free Unix software, including the source code for the X Window System from MIT and GNU compilers and editors.

Each layer is designed to operate with the others, yet remain independent. Another prominent proposal comes from Sun Microsystems and involves Sun's Network File System, which is a standard of sorts in the Unix world and is more mature than most of the components in the Decorum model.

Even though Sun is an industry rival of the OSF, the group has shown a remarkable ability to cut through politics and meld technologies from competing companies. A decision on the distributed computing environment could come this month.

Stan Miastkowski

**Ethernet-on-a-Chip Will Save PCs a Slot**

Turning an IBM PC or compatible into an "Ethernet-ready" system usually involves plugging a network card into a valuable expansion slot. But now U.S. Sage (Longwood, FL) has developed a chip that incorporates most Ethernet hardware functions. The company hopes that PC makers will use the Ethernet Needing Zero Overhead (ENZO) chip on their motherboards.

ENZO combines most of the Ethernet hardware functions on a single chip, according to U.S. Sage president Alex DuBrow. The LAN controller and Manchester encoding/decoding functions, which often require two chips on Ethernet boards, are included in the chip. ENZO is compatible with the IEEE 802.3 Ethernet network standard and supports both Novell's NetWare and U.S. Sage's MiniLan operating systems, the company says.

Building an Ethernet-ready motherboard really isn't a new concept (witness the NeXT Computer). But it's an idea that hasn't been exploited by manufacturers of IBM compatibles. DuBrow thinks that PC makers (and, in turn, users) can benefit from the LAN-on-a-chip technology; ENZO sells for only $10 to $25 (in OEM quantities), and it frees up a slot. DuBrow claims that U.S. Sage has received "strong inquiries" about ENZO and has sent out about a dozen evaluation kits, some to PC manufacturers.

Jeffrey Bertolucci

**Mike Will Replace Mouse, Apple Exec Says**

The "ask and tell" interface will eventually replace the mouse and keyboard for many applications, and the microphone will play an important role in this new interface, says Apple Computer vice president of advanced technology Lawrence Tesler.

Newer, more advanced personal computer applications will require better interfaces, including speech input. "When you're not sure about something, you'll be able to ask, and when your system has some advice about how you can do something better, it will tell you," Tesler says. Interacting with your personal computer will change to "more of a dialogue, like what you might have with a colleague or assistant," he says. The microphone will become a standard feature of personal computers as speech input technology improves.

Apple says that's two or three years away. "It's pretty easy now to do single-speaker, limited-vocabulary recognition," says marketing director Michael Homer. "It's a lot more difficult to do a larger vocabulary—say, 2000 words of connected speech—where the system isn't trained to the particular speaker."

Jeffrey Bertolucci

Send us your microbytes. Neural networks? Groupware? New laptop technology? New chips? If you, your company, or your research group is working on one of these exciting technologies or developing products that will significantly affect microcomputers and the way people work with them, please let us know. Phone us at (603) 924-9281. Or send a fax to (603) 924-2550. Or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. Or send E-mail to "microbytes" on BIX or to "BYTE" on MCI Mail. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.
Your customers expect software that works. All the time. The key to software quality is exhaustive testing. It’s also an engineer’s worst nightmare. But it doesn’t have to be. Because now you can automate your software testing.

Introducing the Atron Evaluator. The first and only non-intrusive automated PC-based software testing tool.

The Atron Evaluator automatically runs your software regression testing programs. All of them. All day. All night. Giving you thoroughly tested, higher quality software.

The Atron Evaluator is hardware-based. And since it’s non-intrusive, software behavior is tested without the risk of alteration. Once your tests have run, you can refer to automatically generated test reports to double-check test results.

The Atron Evaluator saves time. And time makes you money. Development cycles are shortened, so your software gets to market sooner. And while your test programs are running, you can be more productive. Start a new project. Or go home.

For more information about the Atron Evaluator, call us at 1-800-283-5933. And put an end to your worst nightmares. Automatically.

Circle 31 on Reader Service Card

In Europe, contact:
Everex Limited, Enterprise House
Floor Technology Park, Limerick, Ireland
Phone: 061-338177

QA Training Limited, Cecily Hill Castle
Gloucester, Gloucestershire, GL7 2EF, England
Phone: (0385) 5888

Now available in VGA.
Daily Schedule
Thursday
8:30 Review Proposal with Lon
10:00 Finalize presentation
11:30 Lunch with Keith, Laura, Carl
2:30 Catch flight
4:08 Scheduled arrival
4:45 Meeting with WWS Inc.

Quarterly Sales
We've pulled the plug on 386SX technology.

The top of a desk is no longer the only place 386-based computing gets done. That's because we've come up with a battery-powered alternative that works anywhere. It's known simply as the T3100SX.

First of all, we gave it a powerful 386SX processor. So it can handle multitasking operating environments like Windows 386 and OS/2 with ease.

Next, we devised an ingenious display system unlike anything you've ever seen on a battery-powered portable. It combines both VGA and gas plasma technology, boasts a 100:1 contrast ratio and can support both an internal display and an external monitor simultaneously.

Finally, we gave it a 40MB hard disk, a 1.44MB 3.5" floppy disk drive and 1 megabyte of RAM, which you can expand up to 13MB. All in an easy-to-carry, 14.9-pound package that goes wherever your work is.

So now you can put the latest 386 computing power to work for you, even if there isn't a plug anywhere in sight. The Toshiba T3100SX. Take it. See how far you can go.

T3100SX: 14.9 pounds, 16MHz 386SX with 80387SX math coprocessor socket, 40MB hard disk with 25msec access, two removable, rechargeable batteries; three dedicated Toshiba memory slots, one dedicated Toshiba modem slot, one Toshiba general purpose slot, 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales and 100:1 contrast ratio; 1.44MB 3½ " diskette drive. For more information call 1-800-457-7777.
286 vs. 386SX vs. 386

The issue of the 386SX is not one of speed, but one of future compatibility and protecting your investment (Editorial, “The Last Word on the SX?,” December 1989). Given a choice between an 8-MHz 386SX and a 25-MHz 286, I would put my money on the 386SX every time, because a fast 286 executes 386 code at precisely 0 MHz.

The 386SX, 386, and i486 CPUs have a common working environment and code that will finally give software a chance to catch up with the hardware, at least for a few years before the i586 hits the scene. While there might not be much 386-specific software now, the installed base is large enough to be worth the effort of developing it.

Bob Keates
Guelph, Ontario, Canada

Until recently, I would have agreed completely with editor in chief Fred Langa about the 386SX chip. As part of my job, I specify a lot of LAN workstations, and the one place where I suddenly find myself choosing the 386SX is for running Microsoft Windows. The reason is memory management. With the 386SX, I can use plain old extended RAM and the Quarterdeck Expanded Memory Manager to get what would otherwise require expensive hardware-enhanced EMS.

The 386SX machines I end up with aren’t as fast as similarly priced 286s, but the memory handling makes up for it, at least under Windows. However, I continue to specify 286 systems, too.

Jeff Sloman
Boston, MA

If you substitute 386 for 386SX in your letter, I will agree completely. There are many valid reasons for opting for a 386 over a 286—memory management being one of them. My editorial was not anti-386—not at all. But it was anti-386SX. If you need 386 capabilities (and it sounds like you do), then “real” 386 is usually the way to go. The 386SX is a crippled 386. Why buy it, especially when many vendors still charge a premium for it?

—Fred Langa

Hugh's Reviews Reviewed

Hugh Kenner's column on A. K. Dewdney's The Turing Omnibus (Print Queue, December 1989) carries much more punch than that of a review. Kenner offers a historical perspective that could only come from one who has a broad background in both computer science and mathematics.

John M. Ward
Augusta, GA

I'd like to make a few comments on Hugh Kenner's review of The Turing Omnibus. First, 3 is not the first prime number. Unfortunately, 2 is. Many theorems begin with, “For all odd primes. . . .”

Second, G. H. Hardy's use of the word useless to describe number theory was a very restrictive use of the term. Useless, in Hardy's sense, meant that one couldn't use number theory as a tool of war. How wrong he was.

Finally, I wonder what Kenner meant by the phrase, “what universities fund as 'mathematics.'” Perhaps Kenner works in a department that universities fund as “English.”

Wayne Moore
Gaylord, MI

Don't Forget Amiga

Regarding Don Crabb's “A Tale of Two Operating Systems” (December 1989), I would rewrite the last part of the second sentence to read, “You can pick and choose from a variety of powerful computer systems—IBM PC or Macintosh or Amiga—and at prices less than a king's ransom.” I would add that if you want high-resolution color graphics, true multitasking, and more than a nickel left in your bank account, you should choose the Amiga. The Mac will display a bazillion colors more than the Amiga 4096, but you'll pay dearly for it. And the Mac does not really perform multitasking. OS/2 does, but, again, you pay a great price for what you get.

Barry E. Holsinger
Sunnyvale, CA

Flap over Kurzweil's Flap

I was surprised by Raymond Kurzweil's use of the term “alveolar flap” in his article on automatic speech recognition (ASR) (“Beyond Pattern Recognition,” December 1989). He states that we all have an alveolar flap that turns on and off nasality in human speech.

An alveolar flap is an acoustic event, not a piece of anatomy. An alveolar flap is the sound made by tapping or flapping the tip of the tongue against the alveolar ridge behind the top front teeth while the vocal chords are vibrating, producing the sound represented by “di” in “ladder.”

The anatomical part that opens and closes the air passage between the oral and nasal cavities is the nasal side of the velum (also called the “soft palate”).

In addition, phonemes are not speech sounds, as Kurzweil says. A phoneme is an abstraction, a symbol for a category of one or more speech sounds (phonetically similar if more than one) called “allophones.” A phoneme represents a minimal sound difference that can signal a meaning difference. Substitution of one allophone for another of the same phoneme may sound peculiar, but it does not signal a change of meaning.

I found Kurzweil's article and the continued
"It's great to have a 386SX system that's ready for the future.

"And it's even more appealing when I can save $200 right now."

ZENITH DATA SYSTEMS INNOVATES AGAIN™

The SX Appeal deal—$200 instant savings on our Flat Technology Monitor when you buy our Z-386SX or SupersPort® SX.

Why does the Intel386SX™ microprocessor have so much appeal? It not only handles today's advanced applications, but assures compatibility with emerging software designed for graphical user interfaces—all with the affordability of a 286-based PC. And now for a limited time only, you can take advantage of our special SX Appeal deal.

Choose our Z-386 SX desktop PC that maximizes 386SX performance for ultra-fast processing speed. Or our SupersPort SX laptop PC with its Page White VGA display. Then for each system purchased, you’ll receive $200 savings on our award-winning Flat Technology Monitor—the revolutionary non-glare VGA color monitor with unsurpassed clarity that's the perfect match for graphical interfaces. This offer also applies to all our 386-based desktops and VGA laptops.

Just bring the attached $200 Savings Certificate to your participating Zenith Data Systems Medallion Reseller before June 1, 1990. Additional certificates are available at each location. For the location nearest you, call:

1-800-227-4617
U.S. and Canada

© 1990 Zenith Data Systems

Graphics simulate Microsoft® Windows, a trademark of Microsoft Corp. Intel386 is a trademark of Intel Corp.
others in the In Depth section on sound and image processing very interesting. I once predicted that someday we’d reform our spelling in English to accommodate natural language processing (that prediction is as yet unfulfilled, of course). Now that commercial ASR systems require pauses between words, I suggest (but not predict) that we might change our manner of speech, pausing briefly between words, to accommodate ASR.

James L. Wyatt, Chairman
Dept. of Modern Languages
and Linguistics
Florida State University
Tallahassee, FL

Helping the GUI User
If William Lee (“Heard It Through the Help Line,” December 1989) thinks that giving customers advice over a help line is a nightmare with a textual interface, he should appreciate what I heard outside an office that had just installed Macs.

“Just a minute. I’ll put you on the speakerphone. I can’t balance a headset, type, and run the mouse at the same time!”

Voice on the phone: “Run the little mousey over the thing that looks like a praying mantis that got ironed in your shirt pocket. Go clicky, clicky. Did he turn into a new menu or that old flatiron thing again?”

“Neither. I think it’s a shot glass.”

“That’s just wishful thinking. Could it be a wastebasket? One of those old wire ones?”

“What does a wire wastebasket look like?”

“Are you under 30? Did you ever see an old movie with a reporter’s office? They always had one by the desk.”

“Yeah, so what? Do you have to be over 40 to work this thing? It took me 15 minutes to figure out that the clockface wasn’t a pie. I own a digital watch, like everyone else. Now I gotta know all about old movies to recognize these stupid pictures!”

“Go clicky, clicky on the shot glass and tell me if it turned back into the flatiron thing. If not, look for a real shot glass after work.”

Joe Celko
Los Angeles, CA

You’re Welcome
Thanks for starting David Fiedler’s Unix/bin column. With Unix coming into play more and more in the workplace, it’s a much-needed, gentle introduction to the subject. Keep it up.

Louis M. Pecora
Washington, DC

ASK BYTE

Too Much Protection
I am trying to run a program that I received with my Penman plotter almost two years ago, but a special security feature built into it has prevented me from doing so.

The name of the program is PEPLOT.EXE. The documentation failed to mention that I could make only one backup copy. It was clear, however, that the program had to be executed on the original disk. In the process of trying to reemerge the situation, I also overwrote the original file (or else it automatically locked itself when I made a second backup copy).

Having looked at the executable file with my PCTOOLS file editor, I know that it is an unpublished work by the Vault Corp. I have been unable to find an address for the company, and Penman has gone out of business. Is it possible for me to defeat the backup security? It displays “Unauthorized Duplicate” any time I run Penplot on the original disk or either of the backups.

Larry D. Elliott
Moscow, ID

You’re not the first person to have this problem, and I doubt that you’ll be the last. Yes, it’s possible to defeat the copy protection on your software, but making pirated copies of software is illegal and a practice that we at BYTE disapprove of. But with Vault’s copy protection, it is often unnecessary.

Vault’s scheme uses a physical mark on the floppy disk. You can use a magnet to copy your software back onto it (from your backup), and the disk should be as good as new.

For obvious reasons, I won’t tell you how to break Vault’s scheme here, but I can tell you that several software utilities are available that will make copies of your disks. Before you spend your money, I suggest that you contact Vault’s technical-support department (505 West Olive Ave., Suite 330, Sunnyvale, CA 94086, (408) 737-8474). The people there are very nice, and as long as you’re holding a legitimate copy of the software, I’m sure that they’ll be glad to help you out.

-H. E.

The Educated Computer
I am studying educational administration, and the theme for my upcoming thesis is “Computer-Assisted and Support Instruction—Its Planning, Implementation, and Evaluation.” Could you suggest any source of information on this topic (including any computer software that is available)?

Oralia Eugenia Machuca Vaca
Mexico City, Mexico

First, I suggest that you explore your university library to see if it carries the Journal of Research on Computing in Education. If not, you may be able to obtain a subscription (either through your department or the library) by contacting the International Association for Computing in Education, 1230 17th Street NW, Washington, DC 20036.

As far as software goes, the public domain world is filled with educational and educational-support (which I take to mean record-keeping, student tracking, and so on) software. Try the Buyer’s Mart at the back of BYTE and order a few catalogs.

Finally, here is a list of some books you can look for that describe specific instances of using computers in upper-level courses: APL Programs for the Mathematics Classroom by Norman Thompson (Springer-Verlag, New York, 1989); Calculus and the Computer by William F. Oberle (Addison-Wesley, Reading, MA, 1986); and Using Computers in Physics by John R. Merril (Houghton Mifflin, Boston, MA, 1976).—R. G.

Speaking of Speech Recognition
In the December 1989 Ask BYTE, David R. Brammer wrote asking about speech recording and playback hardware for the PC. Shortly afterward, we received a press release describing SofiSpeak, a software product from Quantech Ltd. SofiSpeak allows a 10-MHz PC (or any AT or PS/2) to produce speech through the standard speaker; no additional hardware is required. Mr. Brammer, if you’re reading this, contact Quantech Ltd., 2a West View, Forest Hall, Tyme & Wear, NE12 0LJ, UK, 091-266-7007.

—Lab Staff

FIXES
- The mapping algorithm shown in “Configuring Parallel Programs” (December 1989) was developed by Shahid B. Hokhari for the Finite Element Machine, which was an early microprocessor array at the NASA Langley Research Center.
- The correct telephone number for Zenith Data Systems (“Zenith’s EISA Does It,” February) is (800) 553-0331.
"It's a jungle in there," said the programmer looking at the code for the user interface of an application. "Every year it gets worse."

Don't despair. Finally, there is a way out. Vermont Views™ 2.0.

From Complexity to Simplicity
Vermont Views 2.0 replaces the complexities of interface coding with the simplicity of the Vermont Views Designer. This powerful interactive forms designer works in concert with our comprehensive library of over 550 functions to make interface development and management quicker and easier than ever before.

Development Will Never Be the Same Again
With the Vermont Views Designer you will quickly create operational prototypes of an application interface — and enjoy doing it! Because design is fast and visual, you will involve your clients actively from the beginning. Last-minute change requests will be accepted without battles or escalating costs. No longer will you throw away months of prototype code — the prototype will become the implementation. And, integration and final testing will go faster, because all Designer objects are tested for validity as they are created.

No More Maintenance Blues
Software maintenance typically accounts for over 50 percent of total lifecycle programming effort — and a higher percentage of headaches. With the Vermont Views Designer, you will always be able to revise the interface quickly and easily, seeing the changes as you make them.

The Vermont Views Difference
Screen generators for most libraries require you to modify generated source code to create fully functional forms — after which you can no longer use the screen generator. Not so with the Vermont Views Designer. Designer forms and menus can incorporate any of the special capabilities of Vermont Views — such as nested menus, scroll bars, tickertape fields, scrollable form regions, choice lists, and memo fields — and still be revised interactively.

Message from the Jungle
"At a recent field staff meeting, we were able to get a consensus on what forms should look like by using the Designer on a big screen TV. Changes can be posted real-time, and a functioning prototype results from the exercise. The form designer is GREAT."

— Randy Jones, Beta Tester

Globally Applicable
Use Vermont Views with any database or file manager with a C-language interface, such as Oracle, Informix, dBase, Clipper, dbVista, Brieve, and C-tree. Maintain the same interface with the same source code under DOS, OS/2, UNIX, XENIX, and VMS. Create interfaces for any roman-based language. Truly a global solution for your interface needs.

100% No-Risk Guarantee
We believe in our product. Try Vermont Views for as long as you want. No limits. If not fully satisfied, return for a full refund.

Free Test Drive
Call now for a free DOS working copy of the Designer, lacking only the ability to save forms. Get out of that jungle!

Call 800-848-1248
Fax 802-848-3502
WHAT'S NEW

A 386SX for Less Than $1000

The generically named 80386SX from Acma Computers includes a 16-MHz CPU, 1 MB of RAM (expandable to 8 MB), an American Megatrends BIOS, a 5¼-inch 1.2-MB or 3½-inch 1.44-MB floppy disk drive, a floppy/hard disk drive controller, and five 16-bit and two 8-bit expansion slots.

The chassis is either the small-footprint or standard AT size, respectively measuring 6½ by 17 by 6½ inches and 6½ by 21 by 6½ inches. The small-footprint version can hold one 3¼-inch and three 5¼-inch half-height floppy disk drives. The standard-size system has room for five half-height 5¼-inch drives.

The VGA Executive Package includes color VGA graphics necessities, a printer, and printer accessories. Inside the computer, Acma supplies a 40-MB 28-ms hard disk drive and a 16-bit color VGA card. The package also includes a color VGA monitor and a Panasonic 1191 printer. Printer accessories include a cable, a stand, a surge protector, 10 disks, and computer paper.

Price: $995; VGA Executive Package, $2245.


Inexpensive Desktops and a Laptop

Emerson Computer has introduced three inexpensive ATs: two desktops and a laptop.

The 8200 is a 12.5-MHz 286 small-footprint desktop system. It has 640K bytes of RAM (expandable to 4 MB on the motherboard), five 16-bit full-length slots, a CGA controller, two 3½-inch disk drive bays (one internal), an Integrated Drive Electronics (IDE) hard disk drive controller, a 101-key keyboard, a 5¼-inch 1.2-MB floppy disk drive, and bundled software.

The 16-MHz 826ECV desktop ups the ante with 1 MB of RAM and a VGA controller but has only three full-length expansion slots.

The 550LTV laptop has a 12-MHz 286 CPU, a monochrome VGA controller, a 10-inch backlit VGA monitor, 1 MB of RAM (expandable to 4 MB), a socket for an 80287 math coprocessor, a 3½-inch 1.44-MB floppy disk drive, and a 20- or 40-MB hard disk drive. The laptop weighs 14 pounds without the hard disk drive but with the battery (which is good for 3 hours between charges).

Price: 8200, $1349; 8200 with 20-MB hard disk drive, $1669; 826ECV, $1699; 550LTV with 20-MB drive, $2499; 550LTV with 40-MB drive, $2699.


Inquiry 1120.

386SX Portables Come with Cellular Phones

Intelligence Technology has introduced two 386SX-based portables with removable cellular telephones that you can use for voice communication or for 2400-bps data communications.

The ITC 386 CEL and XCEL (for extra-lightweight cellular) systems both feature a built-in keyboard and monochrome VGA display, an MNP modem, and standard I/O ports. Power on both models comes from a removable 7.2-V rechargeable battery pack or any 12-V connection.

Weighing 9¼ pounds (with telephone), the XCEL has 2 MB of RAM and a 20- MB hard disk drive. It measures 2¾ by 12 by 11¼ inches.

The 15-pound (with telephone) CEL offers 4 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, a 40-MB hard disk drive, one 16-bit expansion slot, a full-size keyboard with a numeric keypad, and a built-in speakerphone. It measures 3½ by 13 by 12¾ inches.

Price: XCEL, $7495; CEL, $8695.

Contact: Intelligence Technology Corp., 16526 Westgrove, Dallas, TX 75248, (800) 356-3493 or (214) 250-4277.

Inquiry 1122.

Acma's 80386SX has all the basics and is expandable.

Cellular phones let you talk from your ITC laptops.
The Shape of Monitors to Come

The Finlux ELM 640.350 is a compact flat-panel monitor that gives you yellow-on-black EGA (640- by 350-pixel) graphics and three levels of gray with electroluminescent display technology.

The ELM weighs only 3 pounds, measures 9 3/4 by 7 3/8 by 2 1/2 inches (with a display area of 4 3/4 by 7 3/8 inches), and has a movable arm and table stand. Finlux says that the monitor emits no magnetic or electrical radiation and that it uses only 25 W, which is about one-fourth the power consumption of a normal CRT.

Price: $1595.

Contact: Finlux, Inc., 20395 Pacifica Dr., Suite 190, Cupertino, CA 95014, (408) 725-1972.

Inquiry 1128.

Two-Page Display for a Mac or PC

The Radius TPD/21 is a high-resolution 21-inch two-page monochrome/gray-scale display system for your PC compatible or Mac SE, SE/30, or II.

The flat-screen monitor features a maximum Macintosh resolution of 1152 by 882 pixels (effectively, 74 dpi) and a 71-Hz refresh rate. If you’re using a PC, the refresh rate is 65 Hz and resolution is 1280 by 960 pixels.

Included in the price of the monitor is RadiusWare software for menus and drivers for DOS applications and for VGA-compatible applications. The video-controller card is optional.

Price: $1795; TPD/PC controller, $795; TPD/Mac controller, $595; GS/C controller for Mac II, $1895.

Contact: Radius, Inc., 1710 Fortune Dr., San Jose, CA 95131, (408) 434-1010.

Inquiry 1127.

Epson’s New Wide-Carriage 24-pin Printer

The LQ-1010 is an inexpensive 24-pin letter-quality printer with a carriage wide enough for 136-column printing.

Features include print speeds of 180 cps in draft mode and 60 cps in letter-quality mode, bidirectional printing in text mode, a slot for optional font modules, an 8K-byte buffer, built-in push-tractor feed, and automatic single-sheet loading. There’s also a SmartPark paper-handling feature and 360- by 360-dpi graphics resolution.

Standard equipment also includes five resident fonts, four print speeds, and six character sets. The printer has a parallel interface, measures 57 1/2 by 23 1/2 by 13 7/8 inches, and weighs 18 pounds.

Price: $699.

Contact: Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505, (800) 922-8911.

Inquiry 1129.

Mondo Storage for Unix Fans

The MO Floppy drive for Unix systems features rewritable and removable 640-MB magneto-optic cartridges and is implemented on The Santa Cruz Operation’s Unix 386/V operating system.

MO Floppy is based on Sony’s SMO-8501 magneto-optic drive. You plug it into the host system via the included 1542A 16-bit SCSI controller by Adaptec.

Each MO Floppy includes a SCSI driver and operating software. The user interface has commands for formatting new cartridges and for copying files.

Price: $7999.

Contact: Software Horizons, Inc., 501 McDonald Rd., Aptos, CA 95003, (408) 684-1375.

Inquiry 1130.

This Keyboard Is Designed for 3270 Applications

The 122-key KB 3270 Plus keyboard from Key Tronic has an 8K-byte RAM chip for IBM 3270 terminal emulation. It’s plug-compatible with PCs, and an adapter is available for PS/2s.

Two main features are ScanEdit and ScanLoad, with which you can reprogram all 122 keys. Supported applications include Attachmate, Attachmate Extra, IBM 3270 Workstation, IBM 3270 Emulation, IRMA, IRMA/2, IRMAX Multisessions, Novell NetWare 3270, and PCOX.

Price: $349.

Contact: Key Tronic, P.O. Box 14687, Spokane, WA 99214, (509) 928-8000.

Inquiry 1131.
Plus Development's Hardcard II Features 64K-byte Cache

Plus Development has announced a revamped version of its hard-disk-on-a-card product, Hardcard. The company says that the Hardcard II offers better performance but is designed to work only with 286- and 386-based systems.

Hardcard II comes in two models: the Hardcard II 80 and the Hardcard II 40, holding 80 and 40 MB of data, respectively. Both cards are full-length, single-slot cards that do not obscure other slots.

Both cards use 3½-inch hard disk drives and integrate a full 16-bit drive controller on the card. In addition, both use 1-to-1 interleaving and have an on-board 64K-byte cache to give them an effective access time of 19 ms, according to the company.

Hardcard II also features Plus Development's firmware to transparently trap bad sector information and map data elsewhere on the disk to minimize data loss.

Price: Hardcard II 40, $849; Hardcard II 80, $999; the company has also reduced prices of the original Hardcards to $749 (20-MB model) and $849 (40-MB model).

Contact: Plus Development Corp., 1778 McCarthy Blvd., Milpitas, CA 95035, (408) 434-6900.

Inquiry 1132.

Controller Doubles Your Hard Disk Capacity

Perstor says that its new ADRC-9008 hard disk drive controller, a half-length 8-bit card, almost doubles the capacity of modified frequency modulation (MFM) hard disk drives and significantly increases the capacity of run length limited (RLL) drives.

To achieve such dramatic increases in capacity, the controller writes to 32 sectors per track (MFM usually uses 18 sectors, and RLL, 26). To keep errors from occurring more often, Perstor uses a proprietary 56-bit error-correction code that doesn't increase flex reversals.

The ADRC-9008 supports two hard disk drives. Any ST506/ST412 drive type with up to 1024 cylinders and 15 heads will work. For installation, Perstor provides a BIOS-resident autoconfigure setup and low-level formatting program.

The controller supports variable interleaving and operates at 9 Mbps. It has an 8-bit bidirectional bus-host interface but will operate in 286 and 386 systems.

Price: $199.

Contact: Perstor Systems, Inc., 1335 South Park Lane, Tempe, AZ 85281, (602) 894-3494.

Inquiry 1133.
Major disasters, like the Exxon Valdez spill, require quick response based on careful data analysis. Fortunately, an easy-to-use database was already being created which would help.

The Application

The Alaskan Marine Contaminants Database lets oceanographic chemists easily access 60 megabytes of data covering the past decade. The database is provided free of charge on CD-ROM, and the Windows interface means they can get right to work, assessing damage to the ecosystems of Prince William Sound and other Alaskan waters.

The Solution

db_VISTA III is the only DBMS with the features this project required: C language support, Windows compatibility, royalty-free runtime distribution, quick performance in large databases, quality documentation and support. With the Alaskan Marine Contaminants Database, the difficult job of calculating the long-term effects of the Exxon spill is a little easier.*

db_VISTA III™
Database Management System

Specifications:
- Complete C source code available. No Royalties
- C Language Portability & High performance
- Complete revision capability. Supports: MS-DOS, MS Windows, UNIX, QNX, SunOS, XENIX, VMS, Macintosh. OS/2 compatible. Most C Compilers supported.
- LANs: 3COM, Novell, Banyan, Appleshare. Call for other environments.

Your DBMS problems may not make the headlines, but they are no less important and often no less challenging. If you develop applications for MS-DOS, MS Windows, UNIX, VMS, QNX, OS/2, Macintosh, and other environments, db_VISTA III is your solution.

Call 1-800-db-RAIMA (1-800-327-2462)

* Reprints of the story, as published in PC Week and Data Based Advisor, are available from Raima.

Power Tools For C Programmers

db_VISTA III DBMS rated number #1

FOR $1899, YOU CAN GET A LOT OF COMPUTERS.
OK. So you don't have the biggest budget in the world. But that doesn't mean you have to think small.

Introducing the Dell System® 316SX, 16 MHz 386"SX.

Now you can get into 32-bit computing with this complete 20 MB system. Including 512 KB of RAM, a VGA Monochrome monitor, and three 16-bit industry standard expansion slots. With a 5¼" or a 3½" diskette drive.

More important, it's built by Dell. The computer company rated number one for overall customer satisfaction in the last four PC Week polls of corporate volume buyers.

Over IBM. Over Compaq.
And every Dell System comes with a one-year warranty, toll-free technical support and next-day desk-side service provided by the Xerox Corporation. So for $1899, you don't have to buy a cookie cutter clone and go it alone.

Call Dell. You'll get a lot of computer. With a lot of company.

800-283-1190

FOR NETWORK OR UNIX INFORMATION, 800-678-UNIX
For Dell in Canada, call 800-387-5752

Circle 87 on Reader Service Card
A Mouse in Disguise

The MousePen is a Microsoft Mouse-compatible input device with two input buttons and ballistic control, yet you hold it like a pen and you don’t need a mouse pad.

Inside the head of MousePen is a miniature mouse. The buttons are positioned for clicking with your index finger; the bottom button is the “point” or traditional “left” button. Resolution is 50 to 1000 dpi, and tracking speed is 18 inches per second.

MousePen measures 7/8 by 3/4 by 6¾ inches. Without the PS/2 cable or the serial cable for XT’s and AT’s, MousePen weighs 32 ounces.

Pop-up TSR menus for Lotus 1-2-3, dBASE III, and WordPerfect are included in the 10K- to 30K-byte main program. Also included is TelePaint, a color paint program with VGA support.

Price: $129.

Contact: International Machine Control Systems, Inc., 1332 Vendels Cir., Paso Robles, CA 93446, (800) 448-1184 or (805) 239-8976.

Inquiry 1138.

Da Vinci Graphics Creates Penless Plotter

Da Vinci Graphics’ new RasterPro 720 “penless plotter” looks much like a laser printer and operates eight to 10 times faster than conventional pen plotters. The RasterPro 720 uses a bidirectional print head and a four-color fabric ribbon.

Inside the plotter is a 68000 microprocessor and technology for converting vector-based plotter instructions to a raster printing format. Print resolution is 720 dpi, and the interfaces are parallel and serial.

The RasterPro 720 produces A-size (8½ by 11-inch) or B-size (11 by 17-inch) images. Unlike conventional plotters, the RasterPro 720 offers a high-speed draft mode at either 180 or 360 dpi in color or monochrome.

The RasterPro 720 weighs 27 pounds and measures 4½ by 22½ by 13¾ inches.

Price: With 512K bytes of RAM, $3495; with 2 MB of RAM, $3995.

Contact: Da Vinci Graphics, Inc., 870 Hermosa Dr., Sunnyvale, CA 94086, (408) 737-8800.

Inquiry 1137.

Measure Horizontal Frequencies on CRTs

Scan-Mate is a hand-held device that measures your monitor’s horizontal frequency or the horizontal frequency of a video projector, using the magnetic fields that CRTs emit. It can measure monitors with screens as small as 9 inches or as big as 35 inches and display frequencies from 0 to 70 kHz. Power comes from a standard 9-V battery.

Price: $250.

Contact: Inline, Inc., 625 South Palm St., La Habra, CA 90631; (800) 882-7117 or (213) 690-6767.

Inquiry 1142.

Spoken to Your Spreadsheet Lately?

The Voice Master Key System II is a small external box that lets you add voice commands to DOS applications, thus replacing repetitive keystrokes or extensive mouse movements with macro voice commands. The interface is your parallel printer port, and there’s a pass-through function that lets you keep your printer attached.

A TSR program is included that occupies about 64K bytes of RAM (or you can order an EMS version that requires only 6K bytes of main memory). It’s compatible with such programs as Lotus 1-2-3, AutoCAD, WordPerfect, dBASE III, and SideKick.

You teach it words by saying them twice and typing the prompt and the desired response. Other users can subsequently repeat the list of macros in their own voices and save additional voice templates to memory.

The program is divided into 16 levels, which can correspond to 16 different software packages. You can store up to 16 macros in each level, with a macro as short as one keystroke or as long as 250. Any one of the maximum 64 voice commands can be assigned to activate a macro in any of the 16 levels, so a single voice command can have different meanings in different software applications, for example.

Other features include adjustments for recognition modes and sensitivities, testing sequences to adjust for background noise, display of your macros within applications, and recording and sending voice memos over networks (with Voice Master Systems on each voice-memo workstation).

Also included is developer software for speech and sound recording and editing. Editing software lets you edit sounds for use in software programs or in external EPROMs. It allocates 64K bytes of RAM for input, variable to 576K bytes of RAM with data file links.

Price: $219.95.

Contact: Covox, Inc., 675-D Conger St., Eugene, OR 97402, (503) 342-1271.

Inquiry 1140.
You've come to depend on SCO™ for the latest UNIX® System software solutions for PCs. Industry standards such as SCO™ XENIX® 386 and SCO UNIX System V/386 Release 3.2. World-famous applications such as SCO Professional®, the 1-2-3® workalike, and SCO™ FoxBASE+™.

And now Microsoft® Word 5.0, the same full-featured word processing system that has defined power, speed and flexibility for MS-DOS® and OS/2™ users, is also available for SCO XENIX and UNIX Systems!

It's multiuser and multitasking. And it's ready to give you true workgroup benefits while maintaining keystroke and file compatibility with Word for MS-DOS and OS/2, preserving your investments in Word training and data.

With Microsoft Word 5.0 for UNIX Systems, you can share a single copy of Word — on a single PC — with an entire workgroup of 16, 32, or even more users on inexpensive terminals.

And your workgroup can share documents, style sheets, forms, macros, glossaries, and outlines — plus group review and editing features such as annotations and redlining — while sharing expensive printers and other resources as well.


And since it's compatible with SCO Portfolio™, Microsoft Word 5.0 for UNIX Systems supports the SCO Portfolio Clipboard, letting you copy and paste data to and from other popular applications such as SCO Professional and SCO FoxBASE+.

Call ext. 8605 at SCO today for the SCO Authorized Reseller nearest you. And see for yourself that if you want your SCO XENIX or UNIX System running the best multiuser word processing available today, you'll have our Word on it.
Active Objects and Graphics Added to KBMS for OS/2

Two tools included in AI-Corp's new version of its Knowledge Base Management System (KBMS) for the OS/2 Presentation Manager let developers use graphics during the application development process and incorporate graphics in the resulting application.

Developer Graphics, a tool for designing, developing, and analyzing KBMS applications, has a graphical editor facility that lets you select an object, see the attributes defined for that object, and view the relationships among objects during the development process, AI-Corp says.

Active Objects lets you link rules with graphics, building knowledge-base applications with a graphical user interface. For example, you can use Active Objects to develop a course registration application in which users see a map of the U.S., click on a city where they want to take a course, and automatically register and update the underlying database, instead of filling out forms or using a text menu.

The Active Objects editor lets you choose shapes, colors, fonts, and other elements. You can also use bit-mapped images from other sources.

Price: $7500.

Contact: AI-Corp, 100 Fifth Ave., Waltham, MA 02254, (617) 890-8400.

Inquiry 1143.

Better IPC for Unix, OS/2

IPC (for Extended Interprocess Communications Facilities) is a software library designed to augment the interprocess communications facilities of Unix, OS/2, and VMS. In the area of software engineering, XIPC supports on-line monitoring of all IPC activities of a live system, multiple views of the same system, interactive debugging, and browsing of message queues and shared memory of an active system. It also lets you configure and use multiple instances of XIPC without modifying the operating-system kernel, Momentum says.

The package adds a message queue facility that offers atomic multiple-queue operations by multiple processes, individual queue slicing, automatic overflow spooling, and many other functions.

XIPC provides for automatic portability of source code among operating systems, while supporting a superset of the functionality of all supported operating systems.

The package will be available for OS/2, SCO Xenix, Unix System V, AIX, SunOS, Ultrix, and VAX/VMS.

Price: $1495 and up.


Inquiry 1146.

Spelling Checker for Programmers

SpellCode, a customizable spelling checker for programmers, can check both the text that end users will see and the contents of program files. SpellCode checks variable and constant names, reducing the number of compiler or interpreter errors, says Geller Software.

SpellCode comes with an English dictionary and a dictionary of computer terms. The program knows the keywords used in dBASE languages and can check Ada, COBOL, PL/1, FORTRAN, and other languages. It can check the contents of character and memo fields in DBF data files or Lotus 1-2-3 worksheets.

SpellCode runs on the IBM PC with 256K bytes of RAM and DOS 2.0.

Price: $99.95.


Inquiry 1144.

CUA Compliance for DOS

With Layout/CUA for DOS, a software development tool that works with Interactive Images' Easel/DOS graphical development tools, you can create applications that automatically comply with IBM's Common User Access guidelines. With Layout/CUA, you can add action bars and scroll bars, pull-down menus, and secondary windows to your DOS application.

Layout/CUA for DOS runs as an application under the OS/2 Presentation Manager. Once you've defined how the application will look, Layout/CUA automatically generates the necessary DOS code.

To run the system, you need an IBM PC with at least 640K bytes of RAM.

Price: $1900; Easel/DOS Development System, $7500.

Contact: Interactive Images, Inc., 600 West Cummings Park, Woburn, MA 01801, (617) 938-8440.

Inquiry 1147.

FORTRAN Subroutines for the Mac

MSL has released three FORTRAN libraries for the Macintosh that provide more than 800 subroutines for solving mathematical problems, analyzing statistics, and special functions.

Features of the libraries include standard calling sequences, sophisticated error handling, and automatic allocation of workspace.

The libraries require a Mac II or SE/30 running Language Systems' FORTRAN compiler 1.2.1 and System 6.0.3.

Price: $3250.

Contact: MSL, 2500 Park-West Tower One, 2500 City-West Blvd., Houston, TX 77042, (800) 222-4675 or (713) 782-6060.

Inquiry 1145.

continued
New, the next generation editor at Programmer's Paradise

Announcing the Sage Professional Editor - the editing environment for the 90's. The product of two years work by one of the most talented programming teams in the business. Right out of the box you'll be more productive with this editor than any you use today.

The instant installation, elegant mouse support, advanced user interface, and point-and-shoot help get you running immediately. If you prefer the commands and keystrokes of a popular editor, the turnkey emulations duplicate them precisely, and you still gain the Sage Professional Editor's advanced features, windowing capabilities and powerful engine.

Later you'll make this editor truly yours by configuring the interface as you prefer. Every feature can be turned on or off as you like - from a clean screen, to tiled windows, to overlapping windows in various colors, pulldown menus, rulers, scroll bars, and line numbers - choose any or all and place them as you like.

Use the editor with or without a mouse - all functions are available without lifting your fingers from the keyboard.

Pop open the DOS window and the editor shrinks to just 4K. So you can back-task to compilers and other tools without leaving the editor.

This package is stuffed with value. It includes MS-DOS, OS/2 and Dual Mode versions, templates for popular languages, and you can buy it with or without a bundled Microsoft® Mouse.

The core of the Sage Professional Editor is a powerhouse virtual memory system that allows you to edit huge files (up to 100MEG) in as many as 256 windows - over two billion lines. It makes maximum use of all available memory. All higher level services use this powerful VM scheme. Consequently, there are no size constraints on the macro library and no limit to Undo/Redo. You can have 1000 bookmarks, anchors and saved positions per buffer.

And then there's the extension language. The Sage Professional Editor uses a C-like extension language and compiler/debugger that programmers find immediately intuitive. You can build the environment you want with the editor as the front end to your favorite tools. The seamless integration of the Polytron Version Control System (PVCS) is a sterling example of how cleanly you can hook external programs.

Emulations of Vi, Brief, EMACS, and WordStar, were written with the extension language. The source code for emulation is included. Enter a new generation today by calling Programmer's Paradise.

Make our interface what you prefer, from clean screen to multi-window with drop-down menus and icons.

The editor environment provides seamless integration to the Polytron Version Control System (PVCS) or any other tool you care to connect.

1-800-445-7899

Programmer's Paradise

List Ours
Single User Version $295 $249
With a Microsoft Mouse $395 $335

Both packages include: MS-DOS, OS/2 and Dual Mode versions on 3 1/2" and 5 1/4" disks.

Circle 226 on Reader Service Card
WATCOM C 7.0/386
ASMTool
AdvantEdge Disassembler
VM/366
Paradox/386
MS Macro Assembler
GraphPak Professional
Graph Pak
OPTASM
P.D.Q.
MS BASIC Prof. Development System
DESQview 386 190 169
LaserPak
db/LIB
Dialogic
ProBas
ProBas HyperHelp Toolkit
BASIC LIBS/UTILITIES
QuickPak Professional
QuickPak
QuickWind Windows Advanced Corp.
C COMPIlERS
Microsoft C 6.0
MS QuicC w/QuicAssembler
Top Speed C
DOS Professional
OS/2 Professional
Turbo C
Turbo C Professional
WATCOM C 7.0
OS/2 TOOLs
Brief
CASEFM
Greenleaf DataWindows
MKS Lex/Acc (DOS)
MKS Toolkit (DOS & OS/2)
MS OS/2 Prm. Mgr. Softw.
MS OS/2 Prm. Mgr. Toolkit
MultiScope
Panel Plus
PC-link
PCYACC
Smalltalk/V PM
GRAPHTOOLS
Acton PLUS
FileView
MS QuickPascal
OS/2 Professional
Power Tools PLUS/OS/2
Turbo C 5.5
Turbo Pascal 5.5 Professional
Turbo-Plus 5.5
Turbo Pascal 5.0
PROTOTYPEING
Dan Bricklin's Demo II
Instant Reply III
Presto Ink
Show Partner FIX
Soft Demo
TRANSLATORS
Barc, C, Commercial
dbl Translator
FOR_C
PROMUL/FORTRAN
NEW RELEASES
SECOM by Secure
Communication Technologies
SECOM is a secured encryption
communications solution for PCs.
SECOM supports IBM and IBM
compatibles and gives you the ability
to securely exchange mail, files and
taxi while communicating bidirectionally.
SECOM is DES approved and includes
an Auto Session Key System.
List: $300 Ours: $269
Norton Backup
by Peter Norton Computing
Speedy, reliable and easy to use; Reads
the hard disk and writes to a floppy
simultaneously. Norton Backup
restores from severely damaged disks.
Saving and restoring can be done
quickly by pointing and clicking through
organized pop-up windows.
List: $99 Ours: $99
Actor 2.0
by The WhiteWater Group
Create windows applications in
significantly less time than it takes in
C. Actor 2.0 adds three new features:
object binding, class variables and
class initialization.
List: $699 Ours: $599
### Borland Spring Sale

**APPLICATION SOFTWARE**

<table>
<thead>
<tr>
<th>Product</th>
<th>List</th>
<th>Ours</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGC</td>
<td>245</td>
<td>199</td>
</tr>
<tr>
<td>VM/386</td>
<td>245</td>
<td>199</td>
</tr>
<tr>
<td>VM/386 Multi-User</td>
<td>819</td>
<td>819</td>
</tr>
<tr>
<td>VM/386 Multi-User Starter</td>
<td>359</td>
<td>359</td>
</tr>
<tr>
<td>MS/Netpack</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>MICROSOFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS BASIC Prof. Devel. System</td>
<td>349</td>
<td>349</td>
</tr>
<tr>
<td>MS C</td>
<td>495</td>
<td>495</td>
</tr>
<tr>
<td>MS COBOL</td>
<td>900</td>
<td>629</td>
</tr>
<tr>
<td>MS FORTRAN</td>
<td>450</td>
<td>450</td>
</tr>
<tr>
<td>MS Macro Assembler</td>
<td>105</td>
<td>105</td>
</tr>
<tr>
<td>MS OS/2/386 Mgr. Toolkit</td>
<td>349</td>
<td>349</td>
</tr>
<tr>
<td>MS OS/2 Soft</td>
<td>130</td>
<td>105</td>
</tr>
<tr>
<td>MS Pascal</td>
<td>300</td>
<td>209</td>
</tr>
<tr>
<td>MS Programmer's Library</td>
<td>275</td>
<td>275</td>
</tr>
<tr>
<td>MS QuickBasic 4.5</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>MS Quick 2.0</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>MS QuickC w/QuickAssembler</td>
<td>139</td>
<td>139</td>
</tr>
<tr>
<td>MS/QuickPASCAL</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>MS Windows</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>MS Windows/386</td>
<td>139</td>
<td>139</td>
</tr>
<tr>
<td>MS Windows Development Kit</td>
<td>349</td>
<td>349</td>
</tr>
<tr>
<td>MORTICE KERN SYSTEMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MKS AWD</td>
<td>99</td>
<td>79</td>
</tr>
<tr>
<td>MKS LEXYACC</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>MKS MAKE</td>
<td>149</td>
<td>119</td>
</tr>
<tr>
<td>MKS Programming Platform</td>
<td>666</td>
<td>666</td>
</tr>
<tr>
<td>MKS RCS</td>
<td>130</td>
<td>140</td>
</tr>
<tr>
<td>MKS Software Mgmt. Team</td>
<td>239</td>
<td>239</td>
</tr>
<tr>
<td>MKS SQP</td>
<td>479</td>
<td>479</td>
</tr>
<tr>
<td>MKS Toolkit</td>
<td>249</td>
<td>197</td>
</tr>
<tr>
<td>MKS Trilogy</td>
<td>115</td>
<td>105</td>
</tr>
<tr>
<td>MKS VI</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>POCKET SOFT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTLlink</td>
<td>266</td>
<td>266</td>
</tr>
<tr>
<td>RTLlink PLUS</td>
<td>495</td>
<td>495</td>
</tr>
<tr>
<td>SAGE SOFTWARE/POLYTRON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Beauti8r</td>
<td>50</td>
<td>42</td>
</tr>
<tr>
<td>Can Bricklin's Demo II Program</td>
<td>159</td>
<td>159</td>
</tr>
<tr>
<td>PF/Finish</td>
<td>259</td>
<td>259</td>
</tr>
<tr>
<td>PF/fixPlus</td>
<td>259</td>
<td>259</td>
</tr>
<tr>
<td>PlinkfixPlus</td>
<td>395</td>
<td>395</td>
</tr>
<tr>
<td>PolyAVK</td>
<td>99</td>
<td>85</td>
</tr>
<tr>
<td>OS/2 Version</td>
<td>179</td>
<td>179</td>
</tr>
<tr>
<td>PolyBoost II</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>PolyDisc</td>
<td>199</td>
<td>199</td>
</tr>
<tr>
<td>PolyLibrarian</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>PolyLibrarian II</td>
<td>149</td>
<td>125</td>
</tr>
<tr>
<td>PolyMake 3.0</td>
<td>149</td>
<td>125</td>
</tr>
<tr>
<td>PolyShell</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>PolyXRef</td>
<td>99</td>
<td>99</td>
</tr>
<tr>
<td>Professional PVCs (Corporate)</td>
<td>495</td>
<td>495</td>
</tr>
<tr>
<td>ZORTECH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zortech C Video Course</td>
<td>309</td>
<td>269</td>
</tr>
<tr>
<td>Zortech C++ Compiler V2.0</td>
<td>200</td>
<td>166</td>
</tr>
<tr>
<td>Zortech C++ Developer V2.0</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>Zortech C++ Developer’s Edition</td>
<td>399</td>
<td>399</td>
</tr>
<tr>
<td>Zortech C++ Tools V2.0</td>
<td>150</td>
<td>129</td>
</tr>
<tr>
<td>Zortech C++ Video Course</td>
<td>449</td>
<td>449</td>
</tr>
</tbody>
</table>

### LIST OURS

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
<th>APPLICATION SOFTWARE</th>
<th>SCIENCE &amp; ENGINEERING</th>
<th>UTILITIES</th>
<th>PRODUCTS BY VENDOR</th>
<th>DIGITALINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLAST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Copy Plus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeskLink</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laplink IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC Anywhere III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ProComm Plus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SideTalk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESKTOP PUBLISHING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adobe Illustrator</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corel Draw!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CorelDraw</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIGITALK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo Assembler/Debbugger</td>
<td>150</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo C 2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo C Professional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo Debugger &amp; Tools</td>
<td>CALL</td>
<td>CALL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo Pascal 5.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turbo Pascal Professional</td>
<td>150</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAGLe Color Extension</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodies #1, #2 or #3</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodies #1, #2 or #3</td>
<td>50</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smalltalk/V 386</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smalltalk/V MAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smalltalk/V PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RETURN POLICY**

30-day no hassle return policy. Most manufacturer’s products cannot be returned once disk seals are broken.

For more information, call or write for our FREE catalog.
Accounting with Database Orientation

A low-end accounting program called AXS (pronounced "access") Accounting Solutions features a database orientation that lets you work with accounting data interactively. The program's database structure lets you enter, edit, scroll, find, select, and take action on a data file, all from the same form, Computer Trends says.

When you write a check or make a deposit, you can use the payee, vendor, or customer name. If you're not sure of the exact name, you can enter the first few letters and scroll through the companies in the database that match.

AXS Level 2 includes general ledger, accounts payable, accounts receivable, a check writer, and a mail manager. AXS Level 1 includes only accounts receivable, accounts payable, and inventory control.

The AXS Accounting Solutions' database structure lets you perform a number of operations on a data file from the same form.

Four Accounting Modules for the Mac

Pro Plus Accounting consists of four modules that you can use as stand-alone programs or link to form an integrated system. The system features multiple-level password protection and can export reports in ASCII text, SYLK, and Excel format, its developer reports. The four modules are general ledger, accounts receivable, accounts payable, and inventory control.

To run the program, you need a Mac II or higher with a hard disk drive.

Price: Level 1, $59.95; each module, $350.


Inquiry 1149.

Forms Software Does More Than Create Blanks

In addition to its ability to create fill-in-the-blank forms, a forms completion and management program called Blankity Blank works with your word processor's mail-merge capabilities to create hundreds of forms and documents from databases and questionnaires. When used with the separate Blankity Blank DB-Link, you can import information needed to complete forms from up to five other external databases created by Blankity Blank or another DBMS.

The latest version, 3.0, features point-and-shoot screens, multiple simultaneous document and form completion, and one-pass laser printing, where a form and its associated data are printed at the same time.

Blankity Blank's math capabilities let you do addition, subtraction, rounding, and other basic mathematical operations automatically in a form. It can also convert the numeric form of a number to text.

The program runs on the IBM PC with 640K bytes of RAM.

Price: $99.50; four-user network version, $249.50; DB-Link, $199.50 and $449.50, respectively.


Inquiry 1151.

Streamline Organizational Writing with One Voice

Scandinavian PC Systems, publisher of the style-checking program Readability Plus, has released a new program that lets businesses create their own style models. An organization can thus establish and enforce writing standards based on its own best-written products. With Corporate Voice, you identify your company's stellar proposals, briefs, reports, and other documents; the program then uses these documents to create corporate style models that help staff writers replicate outstanding written products.

Corporate Voice uses the style models to evaluate similar documents. It identifies inappropriate sentences and determines the percentage of sentences that fit the selected style model. In addition, the program guides the writer through the revision process, after which the document will closely resemble its original style model.

Corporate Voice works directly with WordPerfect (including version 5.1), Microsoft Word, and WordStar. It can also read ASCII files. The program requires 256K bytes of RAM and will run on any DOS 3.0–compatible LAN.

Price: $119.95.

Contact: Scandinavian PC Systems, Inc., 51 Monroe St., Suite 1101, Rockville, MD 20850, (800) 288-7226 or (301) 294-7450.

Inquiry 1150.
And It Runs ...
And Runs ...
And Runs .

The fastest serial dot matrix printer on the market today! The all new **850XL** offers a world of benefits!

- Lightning fast at 850 cps (240 lpm throughput)
- Continuous printing capabilities with no overheating or unnecessary downtime!
- Over 300 local service centers nationwide to keep your jobs running day and night!*

The waiting game is over, as the **850XL** takes on mountains of data, round the clock, with no duty cycle restrictions! Any printing application you need is handled with rapid-fire reliability:

- Data Processing
- Financials
- Bar Codes
- Spreadsheets
- Labels
- Graphics
- 5 to 18.2 Pitch Printing
- Front Panel Menu Programming (No DIP Switches)
- Quietized Enclosure
- EPSON, DEC, and IBM ProPrinter XL Emulations
- 8K Data Buffers
- Serial & Parallel Ports
- Convenient Front & Bottom Paper Feed
- Full International Character Set

**OTC ... An American Winner!**
Call today for more details.

**1-800-4-OUTPUT** (8 am - 5 pm PST)
(468-8788)

Call me, I'm interested: Circle 208

---

**OUT PUT TECHNOLOGY CORPORATION**

Output Technology Corporation BV  •  Saturnusstraat 25  2132 HB Hoofddorp  •  The Netherlands
Telephone: (31) 2503 32599  •  Telefax: (31) 2503 39555  •  Telex: (844) 20000 REF: MMC27-NLX505

---

Call now. You Can Lease OTC printers For As Little As $52/mo.
Engineering Database for the Earth Sciences

Techbase, a relational DBMS for earth science engineering projects, combines graphics, modeling, and statistics with the ability to handle the large numeric data sets often encountered in mining, petroleum, and similar industries.

You can add or delete database fields at any time; files and tables within a database can vary in size; and you can store data in flat, polygon, cell, layer, or block format.

All Techbase modules have filtering capability to selectively retrieve data or regroup it in subsets for further analysis and graphing. The program can calculate common statistics such as mean and standard deviation, plus chi-squared and two-tailed t-distribution hypothesis statistics. It can also calculate correlation coefficients.

Techbase can generate four kinds of statistical plots: cumulative frequency plots, scatter plots, histograms, and ternary diagrams. You can annotate the graphs with text, lines, and graphics. Graphics capabilities include contouring, cross sections, digitizing, plotting, three-dimensional perspective, and vector.

You can include up to 128 customized markers on a graph or plot.

Techbase runs on PCs and workstations from IBM, Sun, DEC, Hewlett-Packard, Silicon Graphics, and others. It requires a minimum of 640K bytes of RAM and a hard disk drive.

Price: Single-user, $2840 and up; multiuser, $5190 and up.

Contact: MINESoft Ltd., 1801 Broadway, Suite 910, Denver, CO 80202, (303) 292-6449.

Inquiry 1160.

Data Acquisition with Graphing, OOP Language

LabOBJX combines data acquisition with math, statistics, and graphing. According to Scientific Software Tools, LabOBJX's programming language combines the object-oriented capabilities of Smalltalk with syntax similar to that of Pascal and Modula-2, letting you modify routines to fit your requirements in the laboratory.

The compiler, linker, editor, analysis, and interface tools are integrated in the run-time application environment, and at any time during execution you can create and integrate new commands or displays of data.

The program lets users work from the command line (for advanced lab personnel) or with pull-down menus (for novices). LabOBJX supports three-dimensional axonometric and mesh plots and several other types of graphs, including real-time display of signal traces.

To run LabOBJX, you need an IBM PC with 640K bytes of RAM; a math coprocessor is recommended.


Inquiry 1161.

Nonlinear Curve Fitting Added to Plotting Program

SigmaPlot 4.0, a scientific graphing program, lets you define almost any equation, or sets of equations, with up to 25 parameters and 10 independent variables, and fit the equation to your own data. In addition to the nonlinear curve-fitting capability, the company has added a pull-down menu interface and more graph types and has increased the program's worksheet capabilities.

Jandel Scientific says that it has expanded the SigmaPlot worksheet to 16,000 columns by 65,000 rows. The program directly supports Lotus spreadsheet files, including named ranges. It also supports GIF files and ASCII. SigmaPlot 4.0 runs on the IBM PC with 640K bytes of RAM and a hard disk drive.

Price: $495.

Contact: Jandel Scientific, 65 Koch Rd., Corte Madera, CA 94925, (800) 874-1888 or (415) 924-8640.

Inquiry 1164.

Electromagnetic Analysis Added to FEA Program

A new version of Cosmos/M, a finite-element analysis system for IBM PCs, Mac IIs, and Unix workstations, includes a module for performing FEA of electromagnetic problems. Called EStar, the new module features nonlinear analysis and includes B-H material and permanent magnet demagnetization curves, its developer reports. (A B-H material curve refers to the magnetic flux density [B] versus magnetic field intensity [H] curve that's used to solve nonlinear material curve design problems.) The module can handle force calculations on ferromagnetic objects under externally applied fields and supports two- and three-dimensional magnetostatic modeling while including the current effects for the 2-D and axisymmetric cases under study.

In all, the program has 11 modules, including fluid, nonlinear static, heat transfer, linear dynamic, and linear static analysis. Cosmos/M 1.60 can solve problems of up to 15,000 nodes and 60,000 degrees of freedom. It requires a hard disk drive with at least 10 MB.

Price: $995 and up.

Contact: Structural Research and Analysis Corp., 1661 Lincoln Blvd., Suite 200, Santa Monica, CA 90404, (213) 452-2158.

Inquiry 1163.
Open Server.

Runs on every vendor’s operating system:
OS/2™, VINES®, UNIX®, VAX® VMS, IBM® MVS, etc.

Supports every vendor’s local area network protocol:
Novell’s® SPX/IPX®, NetBIOS, Named Pipes®, etc.

Transparent access to data in other vendor’s databases:
IBM’s DB2™ and SQL/DS, and Digital’s RMS.

Transparent data sharing between all your computers:
PCs, minis and mainframes.

Lotus 1-2-3® spreadsheets and dBASE® applications work with ORACLE Server today.

Developers have a complete and integrated family of portable tools for CASE,
applications generation, report writing, etc.

Programmers can use interfaces from C,
COBOL, and FORTRAN.

Certified by Codd and Date to run at 11.0 TPI transactions per second.

Call to register for the Oracle Client/Server Forum nearest you. Or order ORACLE Server for OS/2 for only $2499 and get six months of phone support and upgrades for free (a $500 value). Or try our Developer’s Version (limited to 3 users) for only $699.

Call 1-800-ORACLE1, ext. 4965. We’re always open.
Animate Building Sites with VideoScapes

A video library for land planning professionals that works with Autodesk's Animator lets you take an image of a planned building site that's bereft of buildings, trees, people, and cars and create a full-color, animated presentation for a client.

Using the animation capabilities of Animator, VideoScapes' cars can move across the screen, trees can grow, and people can walk through a building site.

With the VideoScapes library and Animator, cars can move, trees can grow, and people can walk through a building site.

VideoScapes comes in Animator and Targa formats.

Price: $495.

Contact: LandCADD, Inc., 7519 East Highway 86, Franktown, CO 80116, (303) 688-8160.

Inquiry 1152.

Access COGO Reference Points Through Database

The AutoCAD release 10 add-in E.S. (for expert system) COGO lets you access COGO reference points through an external database instead of having to select the point on-screen. According to Applications Publishing, this feature is useful for engineers who need the hidden data and attributes of many reference points in a large drawing. You can use more than 100 commands while working on the external database to retrieve information such as the distance between two reference points.

A new Universal Data Collector converts raw field data into a representative drawing, and the Master Symbol Library performs symbol insertion for each COGO reference point that you've entered via a description code.

E.S. COGO and E.S. COGO Contour (for contour mapping, plan and profile modeling, and other representations of data) each require extended AutoLisp and AutoCAD running on an IBM AT with 640K bytes of RAM and a hard disk drive.

Price: $2500; E.S. COGO Contour, $1000.

Autodesk Ships PM Version of AutoCAD

Autodesk's version of AutoCAD release 10 for OS/2 Presentation Manager (PM) is the latest in the company's introductions of AutoCAD for high-end platforms, including one for Unix (specifically, the SCO Xenix and SCO Unix System V/386 operating systems), and a DOS-extended, 386-specific version.

Autodesk says that the multitasking capabilities of OS/2 make it a natural platform for AutoCAD. As is the case with other DOS programs ported to OS/2, many new features of AutoCAD for OS/2 are OS/2 features, such as multitasking, the PM graphical user interface, and Dynamic Data Exchange. Another feature is the ability to port AutoCAD files for OS/2 to any other platform running AutoCAD release 10, without file conversion. (However, this is a standard feature of all versions of AutoCAD release 10.)

AutoCAD for OS/2 requires at least 4 MB of memory and an 80287 or 80387 coprocessor. It is compatible with either the Standard or Extended Edition of OS/2.

Price: AutoCAD for OS/2 and Unix, $3000; for extended DOS, $3300.


Inquiry 1153.

Ad Hoc Reporting, New Attributes Added to EASIMAP

EASIMAP (Equipment and Systems Installation Management and Planning) 3.0, a data-center facility-planning add-in for AutoCAD, features true ad hoc reporting capabilities and more than 60 new attributes per symbol. New attributes include leasing and maintenance, square footage of each machine, airflow in cubic feet per minute, operating temperature and relative humidity tolerances for each machine, and more.

With the ad hoc capabilities, you can sort up to three attributes and search up to four attributes concurrently. Some of the other EASIMAP attributes include British Thermal Units to air and water, weight, machine type, and serial number.

EASIMAP comes standard with three-dimensional symbol libraries for IBM, multilayered/multicolored symbol libraries, and a DXF file translator. Additional symbol libraries are available for DEC, Cray, and other systems. EASIMAP runs on the IBM AT, Mac II, and Sun and Apollo systems with AutoCAD release 9 or higher, a math coprocessor, and a hard disk drive with 3 MB of available space.

Price: $2750 and up; additional libraries, $275 each.


Inquiry 1158.
Where's more power and speed when you need it?
Introducing the IBM RISC System/6000™

With the ultimate desktop

Whatever job you’re setting off to conquer, from pioneering new electrical circuitry to getting a new airplane design off the ground, if you’re always wishing your workstation could help you do it better and faster, you’re a Power Seeker. And the new IBM RISC System/6000 family of POWERstations and POWERservers is for you.

Take our new POWERstation 320. It puts more than 7 MFLOPS of double-precision performance and over 27 MIPS right on your desk—more power than most floor-standing workstations. And those numbers soar as high as 13 MFLOPS and 41 MIPS in other models.

A processor that’s ages ahead of its time. What makes all this possible? POWER Architecture—Performance Optimization With Enhanced RISC—IBM’s second
generation of RISC technology, and the heart of the RISC System/6000 family. POWER Architecture gives you up to four instructions per cycle, and it has a CMOS microprocessor built right in that leaves others in the dust. Plus, there's massive memory (up to 256MB) linked to the processor by high-speed internal bandwidth that handles data up to 480MB per second—so the POWER processor is free to attack larger tasks. All of which means solving a complex problem doesn't mean a long wait anymore.

Micro Channel" conquers throughput barriers. This much raw processing power needs lots of data transfer muscle, too. So we gave all these systems a new implementation of the Micro Channel bus with I/O throughput of up to 40 megabytes per second. And that's just the beginning. There'll be future implementations of Micro Channel that can double and even quadruple that data transfer capability, making the traditional, nonexpandable architectures seem primitive by comparison.

Add to all this the ability to take advantage of Micro Channel cards and adapters, IBM's new 320MB and 857MB high-performance disk drives and high-speed POWER processing, and throughput bottlenecks are ancient history.
3D graphics performance

Rock-solid support for all UNIX® applications. All members of the RISC System/6000 family are industry-standard UNIX operating system processors all the way, with the AIX™ system, IBM's version of the UNIX operating system. And they'll run hundreds of applications in such diverse fields as engineering design, fluid dynamics, molecular modeling, structural analysis, securities trading, technical publishing and geophysical modeling, plus a wide selection of commercial applications.

Your complete graphics arsenal. Every POWERstation in the family is built to give you high-speed, high-resolution graphics. Each can come complete with its own graphics processor, freeing up the driving speed of the POWER processor to rapidly create and analyze your designs. And all have screen resolution of 1,280 x 1,024 pixels for sharp, crisp, detailed images.

When it's time to call in the heavy artillery, there's our new Supergraphics POWERstation 730. It features IBM's new Supergraphics Processor Subsystem that's a lot of processors in one: a graphics control processor, a drawing processor and a shading processor, to let you smoothly shade and rotate complex 3D images.
The POWERstation 730 is an awesome combination of speed and performance. It can do nearly one million 3D vector transformations and 120,000 Gouraud Shaded Triangles per second, for realistic shading effects done amazingly fast. Great news for Power Seekers who work on animation, scientific visualization, medical imaging, applications using IBM graPHIGS and CAD applications like CADAM™ and CATIA™.

All these beautiful performance numbers yield even more beautiful results. You get an almost unimaginable palette of 16 million colors to work with, which gives you 3D images so realistic, they fairly leap off the screen. And POWER processing lets you view even complex creations in fast, fluid motion from any angle. With any POWERstation, you'll be catapulted into a whole new arena of graphics performance.
...and a whole lot more.

A network with power to spare. And to share. The RISC System/6000 family is designed to connect to everything from big IBM mainframes to PS/2®, as well as the full range of non-IBM systems. That means great connectivity and more open systems, so all users have the full power of the network at their command.

AIX brings different worlds together. Hardware this powerful deserves an operating system to match. So every system in the family can come preloaded with AIX, IBM's version of the UNIX operating system, which runs across the broadest range of platforms in the industry. And it supports major industry standards, as well as the programming languages C, FORTRAN, COBOL and PASCAL. And AIX has additional enhancements, like Advanced Optimizing Compilers, that give you the maximum benefits of POWER Architecture, enriched file system capabilities and support for real-time processing. To make things even easier, we've included on-line publications with hypertext search capabilities. Plus, you get leading industry graphical user interfaces: AIXwindows™—based on the popular X Windows System™ and OSF/MOTIF™—and NextStep™. AIX lets the RISC System/6000 family fit right into your installed UNIX base as well as your IBM SAA® environments, giving you, quite literally, the best of both worlds.

A lot more power for a lot less loot. Power Seekers will be pleased with the surprisingly low price of our entry desktop POWERstation 320—with over 27 MIPS and 7 MFLOPS—as well as our floor-standing POWERservers. And the booty doesn't stop there. Included in the price of every system are software service and a full one-year warranty, plus the best documentation in the business. It's enough to satisfy even the most demanding.
The RISC System/6000 family. Choose your weapon.

There's a RISC System/6000 POWERstation or POWERserver to conquer any need, from a single user's desktop requirements to the demands of an army of concurrent users. Each member of the family comes in a wide variety of configurations, so you can choose among display sizes and disk storage and graphics processing capabilities. For low cost-per-user LAN solutions, there's even a new, high-performance IBM Xstation 120.

<table>
<thead>
<tr>
<th>Package</th>
<th>RISC System/6000 POWERstations</th>
<th>RISC System/6000 POWERservers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>320</td>
<td>520</td>
</tr>
<tr>
<td>MFLOPS (DP)†</td>
<td>7.4</td>
<td>7.4</td>
</tr>
<tr>
<td>MIPS†</td>
<td>27.5</td>
<td>27.5</td>
</tr>
<tr>
<td>Internal DASD Capacity</td>
<td>640MB</td>
<td>2.5GB</td>
</tr>
<tr>
<td>Total Memory Slots</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Total Micro Channel I/O Slots</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Graphics 3D Vectors (K/sec)</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Shaded Polygons (K/sec)</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

†MFLOPS are the results of the double-precision, all FORTRAN Linpack test.  ††The Dhrystone version 1.1 test results are used to compute RISC System/6000 integer MIPS values, where 17.57 Dhrystones/sec. is 1 MIPS (VAX 11/780).

Project Performance
The strong support of IBM.

The RISC System/6000 family gives Power Seekers the raw power they want, the awesome graphics performance they love and the superb connectivity they need, plus one more very important and very exclusive feature: the unparalleled worldwide support of IBM. Service when you need it, 24 hours a day, 365 days a year.

An IBM customer engineer can even come to your site and configure your network, install your machines and make sure all your systems are integrated, whether they’re manufactured by IBM or not.

To find out more, call your IBM marketing representative or Business Partner. For literature, call 1 800 IBM-2468, ext. 224.

And find the power you’ve been seeking, and more.

For the Power Seeker.
Chicago Group Sponsors Computer Show

The Chicago Computer Society (CCS) is sponsoring the first of what the group hopes will become an annual computer show in the Chicago area. The event, to be held from 9:00 a.m. to 4:00 p.m. on March 31 at the Rosemont O’Hare Exposition Center in Rosemont, Illinois, will feature workshops, vendor expositions, seminars, and raffles.

CCS now has six chapters and 18 special interest groups (new SIGs include graphics and communications). The group mails about 2500 copies of its newsletter each month and runs its own BBS.

Contact: The Chicago Computer Society, P.O. Box 8681, Chicago, IL 60680, (312) 794-7737; BBS: (312) 942-0706. For show information, call (312) 942-1265.

Denver Group to See Quattro Pro

The Mile High Computer Resource Organization (MICRO) will feature Quattro Pro, Borland’s latest spreadsheet, at its general meeting in April. The group is also scheduled to see Act, the contact management program from Contact Software International.

In May, the general meeting will focus on Autodesk’s Animator. Tentatively scheduled for May or June is Lotus 1-2-3/G.

MICRO holds its general meetings on the last Thursday of the month at the Glendale Community Center on 999 South Clermont, near Mississippi and South Colorado Blvds. February’s general meeting covered the IBM Micro Channel architecture.

Contact: Mile High Computer Resource Organization, 3311 West 92nd Place, Westminister, CO 80030, (303) 286-7455, (303) 426-6669, or (303) 798-5435.

Smalltalk/V Users Groups

Two users groups that support Smalltalk/V, Digitalk’s version of the object-oriented programming language, are forming in the Midwest, one in Columbus, Ohio, and the other in Chicago.

Contact: Ron Schultz, Network Solutions, 7450 Horizon Dr., Columbus, OH 43235, (614) 841-4103; or Aubrey Jackson, Commonwealth Edison, 72 West Adams St., Room 922, Chicago, IL 60690, (312) 294-2945.

Computer Show in Lexington, Kentucky

On April 14, the Central Kentucky Computer Society will sponsor the CKCS Computer Show and Seminars at the Lexington Hilton Inn Convention Center. The group expects to hold two sets of...continued

---

Excellent prices with:

- Fast service and one-year parts/labor warranty
- 30 Day money back guarantee (less shipping)
- Free shipping and no surcharge for VISA/MC

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>80386-33 MHz</td>
<td>$3999</td>
<td></td>
</tr>
<tr>
<td>80386-20 MHz</td>
<td>$1699</td>
<td></td>
</tr>
<tr>
<td>80386-25 MHz</td>
<td>$2899</td>
<td></td>
</tr>
<tr>
<td>80386-20 MHz</td>
<td>$2399</td>
<td></td>
</tr>
<tr>
<td>80286-12 MHz</td>
<td>$1499</td>
<td></td>
</tr>
</tbody>
</table>

Orders: (708) 628-0344  
Tech-Support: (708) 628-0304  
Order Status: (708) 628-0323  
Fax Orders: (708) 543-1859  
Telex: 590369

Micro Image International Inc.  
1010 W. Fullerton, Unit G  
Addison, Illinois 60101  
Call for custom configurations. Prices subject to change.

Circle 510 on Reader Service Card (DEALERS: 511)
MYODA computers are manufactured by PAO-KU Group, a highly respected, public-held corporation. The MYODA product line includes a full selection of desktop and laptop computers. Myoda is the one source supplier for costumer looking for quality, service & price.

**SALE!**

**MYODA 16Bit VGA Card**
512K, Res. 800x600
**$149**

**SPECIAL ON MOTHERBOARD**

**MD3410** $685

- INTEL 80286-12cpu
- 0 wait state
- 8087 coprocessor socket
- 1MB on board (expandable to 4MB on motherboard)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1 serial, 1 parallel, 1 game port
- 8 expansion slots
- 1:1 Interleave HFDC
- Baby AT case

**MD2000** $319

- 8088-1(10MHz) Microprocessor
- 4.77/10 MHz Clock Speed
- 256KB installed, Expandable to 640KB on Board
- One 360 KB Floppy Drive with Controller
- Four 1/2 Height Drive Bays
- Turbo Switch & LED
- Reset Switch
- Hard Drive Access LED
- 150W Power Supply
- 101 key enhanced Keyboard

**MD5030**

- INTEL 80386SX-16cpu
- 80387 coprocessor socket
- 1MB on board (expandable to 8MB on motherboard)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1 serial, 1 parallel, 1 game port
- 8 expansion slots
- 200W power supply
- 1:1 interleave HFDC

**MD7240**

- INTEL 80386-25cpu
- 0 wait state
- 80387 coprocessor socket
- 1MB on board (expandable to 8MB)
- 101 key enhanced keyboard
- 1.2 MB Floppy Drive
- 1 serial, 1 parallel, 1 game port
- 8 expansion slots
- 220W power supply
- 1:1 interleave HFDC

For Regional Distrib, Centers, please call: 1-800-562-1071
Illinois: (708) 860-2290 Fax: (708) 860-7760

*Volume Buyers Welcome*
seminars each hour during the show, which will also include product demonstrations. CKCS recently moved the location of its general meetings to the Lexington Community College on Cooper Dr. General meetings are held on the third Monday of the month. Contact: Central Kentucky Computer Society, Inc., 2050 Idle Hour Center, Suite 160, Lexington, KY 40502, (606) 266-7446; BBS: (606) 293-0154.

Technology Conference Nanobytes

On April 9–12, Chicago's McCormick Place East will be the site of the 1990 AIIM Show and Conference. Sponsored by the Association for Information and Image Management, the show will cover the latest in technologies for document imaging.

Contact: Association for Information and Image Management, 1100 Wayne Ave., Suite 1100, Silver Spring, MD 20910, (301) 587-8202.

Columbus, Ohio, will be the site of the sixth annual Academic Microcomputing Conference. The conference deals with all aspects of microcomputing and workstation use in the academic setting.

Contact: John Schar, Instruction and Research Computer Center, The Ohio State University, 1971 Neil Ave., Columbus, OH 43210, (614) 292-4843.

The 1990 IEEE International Conference on Robotics and Automation, including exhibits, will be held at the Hyatt Regency Cincinnati on May 13–18.

Contact: IEEE Robotics and Automation Society, P.O. Box 3216, Silver Spring, MD 20901, (407) 483-3037.

St. Paul, Minnesota, will host the Midwest Electronics Exposition. The show addresses management and technical issues in electronics, including design, production, and test engineering.

The exposition will be held at the St. Paul Civic Center on May 15–17.

Contact: MG Expositions Group, 1050 Commonwealth Ave., Boston, MA 02215, (800) 223-7126 or (617) 232-3976.

Wisconsin Group to Sponsor MacWorld Talk

For those Wisconsinites who can't make it to San Francisco for MacWorld, the Madison Macintosh Users Group is sponsoring a report by Dan Neesley, owner of North Shore Computers in Milwaukee, on the convention. Neesley will speak at the Edgewood High School on April 17.

The group usually holds its general meetings at the high school, located at 2219 Monroe St., on the third Wednesday of the month.

Contact: Madison Macintosh Users Group, P.O. Box 1522, Madison, WI 53701, (608) 251-2885.

Customer Support BBS

...for the IBM PS/2, XT, AT and compatibles.

Support your customers via modem. Electronic mail between your customers and you gives them the answers they need, 7 days a week!

- They can upload questions and problem reports to you
- You can download updates and product information to them
- Multiple users may be online at once, on one computer
- SIGs, teleconferencing, and questionnaires too
- Very easy to install and configure, works under MS-DOS
- Works with COM1/COM2/COM3/COM4, or multi-port serial cards or multi-modem cards

Only $59 for the complete 2-line software!

Call our “demo” system with your modem: (305) 583-7808

GALACTICOMM

© 1990 Galacticomm, Inc. • 4101 S.W. 47th Avenue, Suite 101, Fort Lauderdale FL 33314 • Voice: (305) 583-5990

Circle 509 on Reader Service Card
## Resource Concepts Computer Outlet

### Monitors

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8088/10 MHz XT</td>
<td>(PIM-TB10)</td>
<td>$83.00</td>
</tr>
<tr>
<td>8087-3 (5MHz)</td>
<td>$85.00</td>
<td></td>
</tr>
<tr>
<td>8087-2 (8MHz)</td>
<td>$119.00</td>
<td></td>
</tr>
<tr>
<td>159K 16MHz</td>
<td>$129.00</td>
<td></td>
</tr>
<tr>
<td>8068-7 (8MHz)</td>
<td>$199.00</td>
<td></td>
</tr>
</tbody>
</table>

### Accessory Cards

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>64K RAM CARD XT</td>
<td>(PIM-129)</td>
<td>$20.00</td>
</tr>
<tr>
<td>386 MB CARD XT/AT</td>
<td>(PIM-201)</td>
<td>$160.00</td>
</tr>
<tr>
<td>NO SLOT CLOCK ON CHIP XT</td>
<td>$20.00</td>
<td></td>
</tr>
<tr>
<td>FDC XT/W/CABLE</td>
<td>$19.00</td>
<td></td>
</tr>
<tr>
<td>XT/AT DEN 4 DRIVES</td>
<td>$43.00</td>
<td></td>
</tr>
</tbody>
</table>

### Specials

- IBM 512 MEMORY EXP BOARD $50.00
- MICROSOFT WINDOWS/386 $59.00
- XT FLOPPY CONTROLLER OEM PK $14.00
- KEYTRONICS 101 KEYBD XT/AT $50.00
- KEYTRONICS 101 KEYBD PS/2 $50.00
- COMPUTER CLOCK BATTERY, RAYOVAC 4.5V $3.00
- 200W POWER SUPPLY AT $50.00
- WD 1007A ESDI CONTROLLER, OEM PK $125.00
- MONITOR TILT & SWIVEL BASE $3.65
- HARD DRIVE MOUNTING KIT 3.5 TO 5.25 $7.90
- AT HARD DRIVE RAILS $12.95
- MITSUBISHI 1.2 W/Y | $65.00 |
- SONY 1.44 FLOPPY W/5.25 MOUNTING BRACKET $75.00

### CoProcessors

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-30 REPLACES 8086</td>
<td>$50.00</td>
<td></td>
</tr>
<tr>
<td>8087-3 (5MHz)</td>
<td>$85.00</td>
<td></td>
</tr>
<tr>
<td>8087-2 (8MHz)</td>
<td>$119.00</td>
<td></td>
</tr>
<tr>
<td>159K 16MHz</td>
<td>$129.00</td>
<td></td>
</tr>
<tr>
<td>8068-7 (8MHz)</td>
<td>$199.00</td>
<td></td>
</tr>
</tbody>
</table>

### Graphic Boards

- DTK-1000, 8086/10 MHZ, 0 WAIT STATES, OK RM, 150 WATT P/S, AT STYLE CASE, 1 YR. WARRANTY $180.00

### Switches

- AB PARALLEL (CE362) $15.93
- AS CABLE (CE25L) $22.50
- AA/BB SERIAL (CE25L) $22.00

### Stands

- CPU STAND W/CASTERS METAL (PIM-C) $23.93
- CPU STAND (UNIVERSAL) PLASTIC (CPUPJ) $7.33
- PRINTER STAND 2PC.PLASTIC (PSTM132) $10.60

### mother boards

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>256K x 4 DIP</td>
<td>$3.00</td>
<td></td>
</tr>
<tr>
<td>256K x 1 DIP</td>
<td>$2.00</td>
<td></td>
</tr>
<tr>
<td>286/12MHZ AT MINI (PTM-1233C)</td>
<td>$260.00</td>
<td></td>
</tr>
<tr>
<td>286/10MHZ XT (PIM-TB10)</td>
<td>$83.00</td>
<td></td>
</tr>
<tr>
<td>286/10MHZ XT (PIM-TB10)</td>
<td>$83.00</td>
<td></td>
</tr>
<tr>
<td>286/10MHZ XT (PIM-TB10)</td>
<td>$83.00</td>
<td></td>
</tr>
<tr>
<td>286/10MHZ XT (PIM-TB10)</td>
<td>$83.00</td>
<td></td>
</tr>
</tbody>
</table>

### Accessory

- JACOBBON MINITABLET KB (JGB) $19.95
- COPY CUP PLASTIC (CHSAJ) $3.93

### Accessories

- MONITOR EXT CABLE (MR 0906) $3.93
- MONITOR/ CPU POWER EXT $2.87
- HARD DRIVE (XTHDJ 2 PC 3.95
- MINI VACCUM CLEANER (VAC) $7.00
- LAPTOP COMPUTER CARRY CASE $44.00
- DISK BOX W/LOCK (54100L) $7.33

### cables

- CEF-12300, 80286/12 MHZ, 0 WAIT STATES, OK RM, 2 SER/1 PAR, 200 WATT P/S, TOWER CASE, 1 YR. WARRANTY $1500.00
- DTK-1230C, 80286/12 MHZ, 0 WAIT STATES, OK RM, 2 SER/1 PAR (full size), 200 WATT P/S, AT CASE, 1 YR. WARRANTY $395.00

### GENDER CHANGER


### IMAGE START

- CALL OR WRITE FOR FREE CATALOG
- WE BUY EXCESS AND OVERSTOCK INVENTORIES!!! SEND LIST OR CALL!!!

### Graphic Boards

- EGA I - HERC, COMP, AUTO, SWITCH, XT/AT $79.00
- EGA M12 - 640X480, 16 COLORS, 132 COL, HERC, COMP. $91.00
- VESA - 640X480 W/256K 8 BIT $103.00
- AVGA - AUTOSWITCHING VGA 800X600 W/256K 8 BIT $129.00
- EVGA-16/256K - 800X600 W/256K, 16 COLOR UPGRADE TO 512K & 1024X768 $176.00
- EVGA-16/512K - 1024X768 W/512K, 16 COLOR $212.00
- ML-VS1 - 800X600 W/256K-EXP TO 512K & 1024X768, 168BIT $210.00
- ML-ADV - 640X480 FASTEST BIT AVAILABLE XT/AT/P52 $130.00

### DTK Barebone Systems

- DTK-1000, 8086/10 MHZ, 0 WAIT STATES, OK RM, 150 WATT P/S, AT STYLE CASE, 1 YR. WARRANTY $180.00
- DTK-1230C, 80286/12 MHZ, 0 WAIT STATES, OK RM, 2 SER/1 PAR, 200 WATT P/S, AT CASE, 1 YR. WARRANTY $395.00
- DTK-2000, 80386/20 MHZ, 0 WAIT STATES, OK RM, 2 SER/1 PAR, 200 WATT P/S, TOWER CASE, 1 YR. WARRANTY $1060.00
- DTK-2030, 80386/20 MHZ, 0 WAIT STATES, OK RM, 2 SER/1 PAR, 200 WATT P/S, MINI 386 CASE, 1 YR. WARRANTY $1000.00

### 90 Day Warranty

- $54.95
- $59.95
- $49.95

### Terms

- TERMS: COD, CASH. MC/VISA OR PRE·PAID

### Price

- PRICE MAY VARY FROM RETAIL STORE
- PRICE SUBJECT TO CHANGE WITHOUT NOTICE
- SOME ITEMS LIMITED TO STOCK ON HAND

### Add 909

- 52MW-5 April 1990

---

Circle 519 on Reader Service Card (DEALERS: 520)
GUARANTEED FOR 6 YEARS!
The Best Performances & Services
Cause We Care...

THE GREATEST PRINTERS...

KX-P1150 - 128 CPS. 9 PIN $ 179
KX-P1191 - 240 CPS, 9 PIN $ 235
KX-P1242 - 192 CPS, 24PIN $ 295
KX-P1680 - 390 CPS, 9 PIN, 120.COL $ 430
KX-P1624 - 272 CPS, 24PIN, 120.COL $ 485
KX-P4420 - 8PM, LFSER JET PRINTER $ 955
KX-P4450 - 11PM, LASER JET PRINTER $1400

FIUJ
Floppy
Disk
SPECIAL

MF2HD 3.5" HDD $18.50
MF2DD 3.5" DDS $ 9.50
MD2HD 5.25" DD $ 7.50
MD2DD 5.25" DDS $ 5.50

FIU
Floppy
Disk
SPECIAL

- Prices Subject to Change Without Notice—Return Item Add 15% Restocking Fee

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX
One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983

Microcomputer News On-Line

In this fast-paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. It if concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

Microcomputer News On-Line

In this fast-paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Microcomputer News On-Line

In this fast-paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Call now and subscribe today.

BIX
One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983

Microcomputer News On-Line

In this fast-paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX
One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983

Microcomputer News On-Line

In this fast-paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX
One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983
**PC ENTERPRISE IBM COMPATIBLE SYSTEMS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>286-12</td>
<td>80286-12 cpu, 6/12 MHz, 1 Meg RAM</td>
<td>$225</td>
</tr>
<tr>
<td></td>
<td>(4 Meg max.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 Meg or 1.44 Meg FD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 serial/1 parallel port</td>
<td></td>
</tr>
<tr>
<td></td>
<td>101 keys keyboard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18 months warranty</td>
<td>$699</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>386SX-16</td>
<td>80386SX-16 cpu, 8/16 MHz, 1 Meg RAM</td>
<td>$349</td>
</tr>
<tr>
<td></td>
<td>(6 Meg max.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 Meg or 1.44 Meg FD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 serial/1 parallel port</td>
<td></td>
</tr>
<tr>
<td></td>
<td>101 keys keyboard</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18 months warranty</td>
<td>$879</td>
</tr>
</tbody>
</table>

**MISC. & ACCESSORIES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel 80286-10</td>
<td>$225</td>
</tr>
<tr>
<td>Intel 80386-20</td>
<td>$349</td>
</tr>
<tr>
<td>Intel 80387-25</td>
<td>$469</td>
</tr>
<tr>
<td>Intel 80387-33</td>
<td>$579</td>
</tr>
<tr>
<td>Curtis Data Switch (2 printer/pc)</td>
<td>$39</td>
</tr>
<tr>
<td>Curtis Data Switch (2 cpu/printer)</td>
<td>$39</td>
</tr>
<tr>
<td>Ext. modem cable</td>
<td>$12</td>
</tr>
<tr>
<td>Kraft game port w/Y cable</td>
<td>$35</td>
</tr>
<tr>
<td>Data Guard surge protector</td>
<td>$18</td>
</tr>
</tbody>
</table>

**INPUT DEVICES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summasketch 12x12 tablet</td>
<td>$369</td>
</tr>
<tr>
<td>Summasketch 12x18 tablet</td>
<td>$619</td>
</tr>
<tr>
<td>Microsoft Mouse (Serial)</td>
<td>$15</td>
</tr>
<tr>
<td>Microsoft Mouse (bus)</td>
<td>$115</td>
</tr>
<tr>
<td>Keytronic 101 KB</td>
<td>$109</td>
</tr>
<tr>
<td>Mitsumi 101 KB</td>
<td>$59</td>
</tr>
</tbody>
</table>

**MONITORS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Star EGA/VGA</td>
<td>$339/$359</td>
</tr>
<tr>
<td>Samsung EGA/VGA</td>
<td>$339/$369</td>
</tr>
<tr>
<td>Samsung multisync</td>
<td>$449</td>
</tr>
<tr>
<td>NEC multisync 2A/3D</td>
<td>$499/$625</td>
</tr>
<tr>
<td>NEC multisync 4D/5D</td>
<td>$1149/$2299</td>
</tr>
<tr>
<td>Packard Bell amber</td>
<td>$89</td>
</tr>
<tr>
<td>Panasonic multisync</td>
<td>$469</td>
</tr>
</tbody>
</table>

**VIDEO CARDS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic EGA/VGA</td>
<td>$109/$135</td>
</tr>
<tr>
<td>Generic MGP/GGP</td>
<td>$39/$45</td>
</tr>
<tr>
<td>Paradise EGA 480</td>
<td>$89</td>
</tr>
<tr>
<td>Paradise VGA 4/5/16</td>
<td>$179/$209</td>
</tr>
<tr>
<td>ATI VGA Wonder w/mouse 256K/512K</td>
<td>$250/$319</td>
</tr>
<tr>
<td>ATI VGA Wonder no mouse 256K/512K</td>
<td>$200/$269</td>
</tr>
<tr>
<td>ATI basic VGA 640x480</td>
<td>$155</td>
</tr>
</tbody>
</table>

**DRIVES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy Drives Toshiba 360K/1.2 Meg</td>
<td>$60/$74</td>
</tr>
<tr>
<td>Toshiba 720K/1.44 Meg</td>
<td>$75/$86</td>
</tr>
<tr>
<td>TEAC 1.2 Meg/1.44 Meg</td>
<td>$69/$89</td>
</tr>
<tr>
<td>Hard Drives Seagate ST-225/kit</td>
<td>$190/$259</td>
</tr>
<tr>
<td>Seagate ST-238R/kit</td>
<td>$200/$269</td>
</tr>
<tr>
<td>Seagate ST-251</td>
<td>$349</td>
</tr>
</tbody>
</table>

**VIDEO CARDS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic EGA/VGA</td>
<td>$109/$135</td>
</tr>
<tr>
<td>Generic MGP/GGP</td>
<td>$39/$45</td>
</tr>
<tr>
<td>Paradise EGA 480</td>
<td>$89</td>
</tr>
<tr>
<td>Paradise VGA 4/5/16</td>
<td>$179/$209</td>
</tr>
<tr>
<td>ATI VGA Wonder w/mouse 256K/512K</td>
<td>$250/$319</td>
</tr>
<tr>
<td>ATI VGA Wonder no mouse 256K/512K</td>
<td>$200/$269</td>
</tr>
<tr>
<td>ATI basic VGA 640x480</td>
<td>$155</td>
</tr>
</tbody>
</table>

**DRIVES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy Drives Toshiba 360K/1.2 Meg</td>
<td>$60/$74</td>
</tr>
<tr>
<td>Toshiba 720K/1.44 Meg</td>
<td>$75/$86</td>
</tr>
<tr>
<td>TEAC 1.2 Meg/1.44 Meg</td>
<td>$69/$89</td>
</tr>
<tr>
<td>Hard Drives Seagate ST-225/kit</td>
<td>$190/$259</td>
</tr>
<tr>
<td>Seagate ST-238R/kit</td>
<td>$200/$269</td>
</tr>
<tr>
<td>Seagate ST-251</td>
<td>$349</td>
</tr>
</tbody>
</table>

**MONITORS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Star EGA/VGA</td>
<td>$339/$359</td>
</tr>
<tr>
<td>Samsung EGA/VGA</td>
<td>$339/$369</td>
</tr>
<tr>
<td>Samsung multisync</td>
<td>$449</td>
</tr>
<tr>
<td>NEC multisync 2A/3D</td>
<td>$499/$625</td>
</tr>
<tr>
<td>NEC multisync 4D/5D</td>
<td>$1149/$2299</td>
</tr>
<tr>
<td>Packard Bell amber</td>
<td>$89</td>
</tr>
<tr>
<td>Panasonic multisync</td>
<td>$469</td>
</tr>
</tbody>
</table>

**VIDEO CARDS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic EGA/VGA</td>
<td>$109/$135</td>
</tr>
<tr>
<td>Generic MGP/GGP</td>
<td>$39/$45</td>
</tr>
<tr>
<td>Paradise EGA 480</td>
<td>$89</td>
</tr>
<tr>
<td>Paradise VGA 4/5/16</td>
<td>$179/$209</td>
</tr>
<tr>
<td>ATI VGA Wonder w/mouse 256K/512K</td>
<td>$250/$319</td>
</tr>
<tr>
<td>ATI VGA Wonder no mouse 256K/512K</td>
<td>$200/$269</td>
</tr>
<tr>
<td>ATI basic VGA 640x480</td>
<td>$155</td>
</tr>
</tbody>
</table>

**DRIVES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy Drives Toshiba 360K/1.2 Meg</td>
<td>$60/$74</td>
</tr>
<tr>
<td>Toshiba 720K/1.44 Meg</td>
<td>$75/$86</td>
</tr>
<tr>
<td>TEAC 1.2 Meg/1.44 Meg</td>
<td>$69/$89</td>
</tr>
<tr>
<td>Hard Drives Seagate ST-225/kit</td>
<td>$190/$259</td>
</tr>
<tr>
<td>Seagate ST-238R/kit</td>
<td>$200/$269</td>
</tr>
<tr>
<td>Seagate ST-251</td>
<td>$349</td>
</tr>
</tbody>
</table>

**MONITORS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold Star EGA/VGA</td>
<td>$339/$359</td>
</tr>
<tr>
<td>Samsung EGA/VGA</td>
<td>$339/$369</td>
</tr>
<tr>
<td>Samsung multisync</td>
<td>$449</td>
</tr>
<tr>
<td>NEC multisync 2A/3D</td>
<td>$499/$625</td>
</tr>
<tr>
<td>NEC multisync 4D/5D</td>
<td>$1149/$2299</td>
</tr>
<tr>
<td>Packard Bell amber</td>
<td>$89</td>
</tr>
<tr>
<td>Panasonic multisync</td>
<td>$469</td>
</tr>
</tbody>
</table>

**VIDEO CARDS**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic EGA/VGA</td>
<td>$109/$135</td>
</tr>
<tr>
<td>Generic MGP/GGP</td>
<td>$39/$45</td>
</tr>
<tr>
<td>Paradise EGA 480</td>
<td>$89</td>
</tr>
<tr>
<td>Paradise VGA 4/5/16</td>
<td>$179/$209</td>
</tr>
<tr>
<td>ATI VGA Wonder w/mouse 256K/512K</td>
<td>$250/$319</td>
</tr>
<tr>
<td>ATI VGA Wonder no mouse 256K/512K</td>
<td>$200/$269</td>
</tr>
<tr>
<td>ATI basic VGA 640x480</td>
<td>$155</td>
</tr>
</tbody>
</table>

**DRIVES**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floppy Drives Toshiba 360K/1.2 Meg</td>
<td>$60/$74</td>
</tr>
<tr>
<td>Toshiba 720K/1.44 Meg</td>
<td>$75/$86</td>
</tr>
<tr>
<td>TEAC 1.2 Meg/1.44 Meg</td>
<td>$69/$89</td>
</tr>
<tr>
<td>Hard Drives Seagate ST-225/kit</td>
<td>$190/$259</td>
</tr>
<tr>
<td>Seagate ST-238R/kit</td>
<td>$200/$269</td>
</tr>
<tr>
<td>Seagate ST-251</td>
<td>$349</td>
</tr>
</tbody>
</table>

We have provided our valuable customers with excellent service and support for the past five years. Call us and tell us what you need. We can configure our computer the way you need.

We accept VISA/Mastercard. Terms available to qualified customers. Please call us for lowest cost on shipping and fastest service.

We accept defective software will be replaced with the same item. Hardware will be replaced or repaired at our discretion within terms and limits of the manufacturer's warranty. We cannot guarantee compatibility. All sales are final and returned shipments are subject to a restocking fee. Prices and availability subject to change.

PERSONAL COMPUTER ENTERPRISE, INC.
2433 W. 75th St., Woodridge, IL 60517
Tel: (708) 910-3737 Fax: (708) 910-4179
Create Expert Systems with DBMS

A program for application developers called Guru FirstStep combines a relational DBMS, a fourth-generation programming language, and Structured Query Language support with the ability to create expert systems. The program, developed by Micro Data Base Systems (mdbs), combines all the capabilities of KnowledgeMan/2 2.6, the company's information management system, with an expert-system development platform that supports up to 30 rules with one level of nesting.

Other features of the program include a forms manager, natural-language interface, custom report generator, color graphics, text processor, remote communications, and spreadsheet. A debugger lets you view source code through pop-up windows.


NCR's PC486/MC Exploits Micro Channel

A bus-mastering SCSI controller and 128K bytes of cache memory are just two of the high-performance features of NCR's new top performer, the PC486/MC.

The heart is an Intel i486 CPU. The motherboard can accept up to 16 MB of RAM and offers four Micro Channel architecture slots. The cache is contained in a pair of custom application-specific IC cache chips that permit read-and-write-back operation.

NCR will offer an optional bus-mastering graphics coprocessor board made by GSS (and based on a Texas Instruments 34010) that provides high-speed 1024- by 768-pixel graphics independently of the CPU. The PC486/MC comes standard with Super VGA (800- by 600-pixel) graphics.

NCR will deliver the PC486/MC in four configurations. The base system has 1 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, and the Super VGA. The most powerful system has 8 MB of RAM and a 200-GB SCSI hard disk drive.

Price: $9995 to $16,995.

Enhance, an image-enhancement program that offers 256 levels of gray support for filtering operations, lets you create up to three versions of the same image so that you can experiment with image filters without corrupting the original image. MicroFrontier says that the program offers real-time filters for brightness/contrast, gamma, gray-scale toning, and color/gray-scale thresholding.

With the program's cut-and-paste function, you can copy among the different versions of an image. Once you cut from one image, you can align it automatically or display it as a semitransparent overlay. An undo feature allows you to convert an altered image to its original state.

The program supports 256 colors for painting and drawing, offering airbrush, pencil, smudge, and smooth tools. Enhance runs on the Mac II with 2 MB of RAM, an 8-bit video card, and a gray or color monitor. It supports TIFF, EPS, and PICT image formats.

Price: $375.

Contact: MicroFrontier, Inc., 7650 Hickman Rd., Des Moines, IA 50322, (515) 270-8109.

Inquiry 1021.

Image Manipulation Times Three on the Mac

Enhance runs on the Mac as well as on the Mac or the Mac. Price: $795.

Contact: Orange, S. Corp., 1700 South Patterson Blvd., Dayton, OH 45479, (800) 225-5627 or (513) 445-5000.

Inquiry 1022.

Retrieve BBS Documents with Graphics

With BulletFax, you can access documents from a DOS-based BBS and have those documents sent to any fax machine, Nuntius reports. The program works on any BBS that has drop to DOS (doorway) capability. Callers to the BBS can search, scan, tag, and fax out documents. If the BBS is single-line, the document is faxed as soon as you hang up; dual-line BBSes can fax documents while you're still on-line.

With BulletFax, a BBS can transmit a document created using desktop scanning equipment, Aldus PageMaker, or Ventura Publisher with graphics intact (the program also supports ASCII). BulletFax supports batch processing, the ability to create documents from existing databases. For example, while you're on-line, you can create an inventory list with the most up-to-date information and then transmit it to any fax machine immediately.

BulletFax works with single-line versions of TBBBS, FIDO, OPUS, RBBS, Wildcat, and WWTV, and it supports BBSes that run under the DESQview/DoubleDOS environment. It requires an IBM PC with DOS 3.0 or higher and a 40- MB hard disk drive. If an Intel Connection CoProcessor 2400-bps modem is used, the BBS can receive faxes as well.

Price: BulletFax only, $249; with Intel board, $950.

Contact: Nuntius Corp., 1904 Merrill Dr., St. Charles, MO 63301, (314) 768-0109.

Inquiry 1018.
IBM Compatible Computers assembled by a highly experienced team of top quality engineers since mid '87 in USA now introduces RACER series for the nineties.

RACER 286 & 386SX

**BASIC FEATURES OF RACER 286 SYSTEMS:**
- INTEL 80286-12 MHz CPU (Landmark 15 MHz on 0 wait)
- AMI-BIOS with built-in Setup & Diagnostic
- 1mb RAM expandable to 4mb on 6-layer Motherboard + 8mb on 32-bit Card
- 1 or 1.2 wait state setting
- 8 expansion slots
- Realtime Clock/Calendar
- 1 Parallel, 2 Serial & Game I/O
- Math Co-Processor socket(s)
- Enhanced Keyboard
- 200 watts

**BIOS Support within BIOS on 286-16MHz & 386sx Systems**

<table>
<thead>
<tr>
<th>System</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACER ATM BAREBONE</td>
<td>$445</td>
</tr>
<tr>
<td>RACER AT-JUNIOR 1.2mb FD</td>
<td>$1045</td>
</tr>
<tr>
<td>RACER AT-SENIOR 1.2mb FD</td>
<td>$1245</td>
</tr>
<tr>
<td>RACER AT-DJUNIOR 1.2mb FD</td>
<td>$1545</td>
</tr>
<tr>
<td>RACER AT-JUNIOR 1.2mb FD</td>
<td>$1645</td>
</tr>
</tbody>
</table>

**UPGRADE ON ANY OF THE ABOVE SYSTEMS**

- with 286-16 MHz Motherboard  add $180
- with 386sx-16 MHz Motherboard add $250
- Additional 1.2 or 1.44 Floppy Drive add $85

RACER 386 SYSTEMS

**BASIC FEATURES OF RACER 386 SYSTEMS:**
- INTEL 80386-25 MHz CPU (Landmark 34 MHz on 0 wait)
- AMI-BIOS with built-in Setup & Diagnostic
- 1mb RAM expandable to 8mb on 8-layer Motherboard + 8mb on 32-bit Card
- 0 or 1 wait state setting
- 8 expansion slots
- Realtime Clock/Calendar
- 1 Parallel, 2 Serial & Game I/O
- Math Co-Processor socket
- Enhanced Keyboard
- 200 watts

**BIOS Support within BIOS on systems**

<table>
<thead>
<tr>
<th>System</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACER 386 BAREBONE</td>
<td>$995</td>
</tr>
<tr>
<td>RACER SOLO 386-25/68 1.2mb FD</td>
<td>$1840</td>
</tr>
<tr>
<td>RACER GRAND 386-25/68 As above</td>
<td>$2240</td>
</tr>
</tbody>
</table>

**UPGRADE ON ANY OF THE ABOVE SYSTEMS**

- INTEL 82385 Cache Controller and 32k SRAM integrated on Motherboard add $700
- INTEL 80386-33MHz CPU (Landmark 64 MHz) Motherboard with Cache Controller and 32k SRAM add $1300

RACER 486-25 MHz TURBO LANDMARK 114 MHz

**$4630**

**BASIC FEATURES:**
- INTEL 80486-25 MHz CPU incorporated with 8k Cache Memory
- 80387 Math Coprocessor, 82385 Cache Controller (Landmark 114 MHz on 0 wait state)
- 2mb RAM expandable to 8mb on 8-layer Motherboard + 8mb on 32-bit Card + 1024x768-512k VGA Controller with 512k 1 Parallel, 2 Serial + 250 watts Power Supply + 8 drive DC outlets, 2 Fans in Heavy Duty Steel Case
- 2 Fans in Heavy Duty Steel Case with wheels, 5 open bays + space for 6 more 5.25" H/H Drives and 16 serial port holes, Front dust cover swing open/close door
- 1.2mb 5.25" Floppy Drive with MFM or RLL Controller for 2nd any capacity Floppy & 2 Hard Drives + 101 Enhanced High Quality Keytronic Keyboard.

All Systems Fully IBM Compatible. Operates under DOS/Unix/Xenix/OS2 Novell & other Net-working Environments (IBM/Lotus-123 & Dbase-III are registered marks of other Corporations).

**FREE WITH EVERY SYSTEM**

Each system comes with Software packages that include DOS 3.3 or 4.01, DOS Help, Tutorial, Word Processor, Spreadsheet (like Lotus 123) Data Base (like Dbase-III) Communications, Graphics, Desk Top Organizer (Memo Pad, Do-List, Address Book, Dialer, Labels, World Clock)

**ONE YEAR FULL PARTS & TWO YEAR LABOR WARRANTY ON EVERY RACER UNIT**
**Canvas Adds Enhanced Bézier Curves**

A new version of Canvas, the drawing program for the Macintosh Plus or higher, features enhanced Bézier curve editing, the ability to create four-color separations, and a 100,000-word spelling checker.

New editing features of the Bézier curve tool include adding control points anywhere on the curve, creating sharp edges without adding control points by manipulating the control handles independently, and splitting curves at any location.

**Price:** $299.95.

**Contact:** Deneba Software, 3305 Northwest 74th Ave., Miami, FL 33122, (305) 594-6965.

**Inquiry 1015.**

---

**Dynamic String Handling for C**

For programmers who want to build dynamic strings in C, KBM Communications has released the bStrings Library, which provides dynamic string-handling capabilities similar to BASIC, without the difficulties of heap management and without fragmenting memory, the company says.

The library provides more than 130 string-manipulation routines that KBM says duplicate almost every string function available in BASIC.

**Price:** $89.95.

**Contact:** KBM Communications, 2401 Lake Park Dr. NW, Suite 160, Atlanta, GA 30080, (404) 333-0303 or (800) 227-0303.

**Inquiry 1017.**

---

**Hyper-Word Processor**

**Hyper-Word,** a hypertext word processor for the IBM PC, contains a number of features that may interest programmers. In addition to

- The program's ability to interconnect documents by linking a calendar, memos, contracts, and outlines; it can link related source files to display a function or subroutine from any reference.
- Zaron Software says that Hyper-Word can use its hypertext ability to make quick work of a program mock-up or a set of interrelated screens that show how a proposed program will look and flow.
- First, individual screens are drawn and then interlinked using Hyper-Word's link function. You can jump to a screen that shows the next logical display in program operation.
- Of course, Hyper-Word is not just for programmers. Other features include a readability index and an integrated spelling checker. You can search multiple files with words, symbols; automatic labeling of calls; copy, move, and rotate functions; and a font editor.
- The library provides more than 130 string-manipulation routines that KBM says duplicate almost every string function available in BASIC.

**Price:** $249.95.

**Contact:** Zaron Software, 13100 Dulaney Valley Rd., Glen Arm, MD 21057, (301) 592-3334.

**Inquiry 1016.**

---

**Property-Mapping Software**

LAN/SCAN’s L-Plot 5.0 is a property-mapping program for title attorneys, real estate companies, and anyone else involved with property descriptions. It lets you automatically generate a map of a property by typing in a description of the land. You can plot any legal description by metes and bounds, township and range, or a combination of both, LAN/SCAN reports.

Each file can include up to 250 closed tracts. The program includes a library of mapping symbols; automatic labeling of calls; copy, move, and rotate functions; and a font editor.

**Price:** $299.

**Contact:** LAN/SCAN, Inc., 3305 Northwest 74th Ave., Miami, FL 33122, (305) 594-6965.

**Inquiry 1015.**

---

**CAD Display Controller Zooms Four Times Faster**

N th Graphics’ Nth Engine/550 display controller zooms and pans up to four times faster than the company’s previous Nth Engines and comes with 4 MB of onboard display list RAM, expandable to 8 MB.

The AT-bus-compatible board comes with Hydra, the company’s visualization software that reads in three-dimensional wire frames produced in AutoCAD directly from your hard disk drive, the company reports. It then uses the controller’s 20 MIPS and 3 MFLOPS of processing capability to shade and rotate models. You can use Hydra to “walk through” wire-frame and surface-shaded models.

The board is also bundled with Nth View, a stand-alone program that lets you view, plot, and save two-dimensional wire-frame drawings without having the CAD software that created the drawing (for distribution of drawings across networks and via modem). Some of the other free software includes a GIF file-exchange utility, an interactive palette editor, and enhanced display list drivers.

**Price:** 1024- by 768-pixel, $4995; 1280- by 1024-pixel, $5995; extra RAM, $350 per MB.

**Contact:** Nth Graphics, Ltd., 1807-S West Braker Lane, Austin, TX 78758, (800) 624-7552 or (512) 832-1944.

**Inquiry 1013.**

---

**Hypertext Word Processor**

**Hyper-Word,** a hypertext word processor for the IBM PC, contains a number of features that may interest programmers. In addition to

- the program's ability to interconnect documents by linking a calendar, memos, contracts, and outlines; it can link related source files to display a function or subroutine from any reference.
- Zaron Software says that Hyper-Word can use its hypertext ability to make quick work of a program mock-up or a set of interrelated screens that show how a proposed program will look and flow.
- First, individual screens are drawn and then interlinked using Hyper-Word’s link function. You can jump to a screen that shows the next logical display in program operation.
- Of course, Hyper-Word is not just for programmers. Other features include a readability index and an integrated spelling checker. You can search multiple files with words, symbols; automatic labeling of calls; copy, move, and rotate functions; and a font editor.
- The library provides more than 130 string-manipulation routines that KBM says duplicate almost every string function available in BASIC.

**Price:** $249.95.

**Contact:** Zaron Software, 13100 Dulaney Valley Rd., Glen Arm, MD 21057, (301) 592-3334.

**Inquiry 1016.**

---

**Property-Mapping Software**

LAN/SCAN’s L-Plot 5.0 is a property-mapping program for title attorneys, real estate companies, and anyone else involved with property descriptions. It lets you automatically generate a map of a property by typing in a description of the land. You can plot any legal description by metes and bounds, township and range, or a combination of both, LAN/SCAN reports.

Each file can include up to 250 closed tracts. The program includes a library of mapping symbols; automatic labeling of calls; copy, move, and rotate functions; and a font editor.

**Price:** $299.

**Contact:** LAN/SCAN, Inc., 3305 Northwest 74th Ave., Miami, FL 33122, (305) 594-6965.

**Inquiry 1015.**

---

**Dynamic String Handling for C**

For programmers who want to build dynamic strings in C, KBM Communications has released the bStrings Library, which provides dynamic string-handling capabilities similar to BASIC, without the difficulties of heap management and without fragmenting memory, the company says.

The library provides more than 130 string-manipulation routines that KBM says duplicate almost every string function available in BASIC.

**Price:** $89.95.

**Contact:** KBM Communications, 2401 Lake Park Dr. NW, Suite 160, Atlanta, GA 30080, (800) 227-0303 or (404) 333-0303.

**Inquiry 1017.**
POWER-USER SPECIAL!

THE SQUARE³ EXTRA

25 MHz 80386 PROCESSOR, 8 MB RAM
SUPER VGA GRAPHICS WITH COLOR MONITOR
200 MB-15 MSEC HARD DRIVE, 1.2 MB FLOPPY

$3,695

For more than three years, we've been a major supplier of PC-compatible computers to OEM and European markets. Earlier this year, we introduced a new line of 80386-based business computers. Because of the positive response our introductory SQUARE³ system received, we are now offering a specially priced system for power-users: The SQUARE³ EXTRA. The 200 MB/15 MSEC hard drive features a data transfer rate greater than 1000 Kb/sec. This blazing hard disk combined with a full 8 MB of RAM, and a Super VGA color monitor will ensure that you can meet the demands of the most sophisticated applications—today and tomorrow. When you're looking at high-performance systems make sure that's what you'll get—not just a fast processor in a chain of weak links. As with every SQUARE, custom configurations are available to address your specific needs. Every SQUARE is backed by a 1-year warranty and a 30-day money-back guarantee. Call today to order your SQUARE system, or for more information on the entire line of SQUARE computers.

REASON TECHNOLOGY
The solution...Reason.

NOW CALL TOLL-FREE
1-800-542-2049

290 Coon Rapids Blvd., Minneapolis, Minnesota 55433 • 612-780-4792 FAX 612-780-4797

Circle 518 on Reader Service Card

APRIL 1990 • BYTE 52MW-11
Integrated Software for Small Businesses

Enable/BP integrates word processing, a spreadsheet, a relational database, business graphics, and telecommunications with the ability to open up to eight windows at once, Enable Software reports. The program, available in single-user and LAN versions, lets you copy data and graphics among windows and supports more than 20 formats for importing and exporting files.

The 65,000-cell spreadsheet, compatible with Lotus 1-2-3, includes a macro facility. You can update and display graphs and spreadsheets simultaneously. The word processor supports mail merge and graphics and includes an 80,000-word spelling checker.

Enable/BP requires 384K bytes of RAM for DOS 2.1 and 448K bytes for DOS 3.0 and higher.

Price: Enable/BP, $199; Enable/BP LAN (four-user version), $495.

Contact: Enable Software, Northway Ten Executive Park, Ballston Lake, NY 12019, (518) 877-8600.

Inquiry 1007.

Desktop Publishing for Under $60

Spinaker Software has released version 5.0 of its BetterWorking Word Publisher. It lets you work in text or graphics mode, allowing you to edit text in a WYSIWYG environment. The program combines word processing with the ability to create documents using fonts, columns, boxes, lines, and clip-art images.

Other enhancements include the ability to scale documents to large, distorted, normal, reduced, and other sizes. You can also pick any column height and the program automatically reformats the text, the company says. The program includes a spelling checker, outliner, and cut-and-paste capabilities. To run the program, you'll need an IBM PC with 512K bytes of RAM and a hard disk drive.

Price: $59.95.

Contact: Spinaker Software Corp., One Kendall Sq., Cambridge, MA 02139, (617) 494-1200.

Inquiry 1008.

Create 32 Graphs and Charts

With QuickGraph, you can create 32 types of charts and graphs from data you've imported from Lotus 1-2-3, dBASE III, ASCII, and ASCII delimited files. QuickGraph lets you chart up to 2250 data points (up to 15 columns wide and 150 rows deep) in one chart. You can hot-link a chart to data, and once you create a chart, you can export it directly to a word processor.

The program supports standard bar, column, line, and other charts. Variations include clustered, overlapped, stacked, and unstacked. Chart styles include pie-column, scatter, table, pie-pie, and others. You can also create comparative charts with dual y-axes.

Other features include text annotation, automatic scaling, and a variety of line styles and colors.

QuickGraph consumes about 415K bytes of RAM and runs on the IBM PC.

Price: $99.95.

Contact: Sumak Enterprises, 39 Dawson Dr., Sudbury, MA 01776, (508) 443-0205.

Inquiry 1012.

Graph-in-the-Box for Executives

New England Software's newest version of Graph-in-the-Box supports 15 different types of charts and uses disk swapping, so that the program requires only 10K bytes of RAM when not activated. The Executive version, a TSR program that captures data and text directly from the screen, lets you manipulate, display, and print it as a graph or chart.

In addition to three-dimensional effects and nine fonts, the program offers 57 data manipulation functions and 16 statistics. The program automatically detects the graphics standard in your IBM PC and supports the EMS specification. When active, Graph-in-the-Box requires about 300K bytes of RAM on a PC.

Price: $299.95.


Inquiry 1011.

continued
2 YEAR WARRANTY.

12Mhz 286
- 1MB RAM
- 1.2MB 5¼" or 1.44MB 3½"
- 40MB/28MS Drive
- High-Res Amber Display
- 2 Serial/1 Parallel Port
- Key Tronic 101 Keyboard
- MS-DOS 3.3 or 4.01

$1,395.00

16Mhz 386 SX
- 1MB RAM
- 1.2MB 5¼" or 1.44MB 3½"
- 40MB/28MS Drive
- High-Res Amber Display
- 2 Serial/1 Parallel Port
- Key Tronic 101 Keyboard
- MS-DOS 3.3 or 4.01

$1,495.00

20Mhz 386
- 1MB RAM
- 1.2MB 5¼" or 1.44MB 3½"
- 65MB/28MS Drive
- High-Res Amber Display
- 2 Serial/1 Parallel Port
- Key Tronic 101 Keyboard
- MS-DOS 3.3 or 4.01

$1,995.00

25Mhz 386
- 1MB RAM
- Optional 32K to 256K Cache
- 1.2MB 5¼" or 1.44MB 3½"
- 65MB/28MS Drive
- High-Res Amber Display
- 2 Serial/1 Parallel Port
- Key Tronic 101 Keyboard
- MS-DOS 3.3 or 4.01

$2,195.00

33Mhz 386
- 1MB RAM
- 32K Cache up to 256K
- 1.2MB 5¼" or 1.44MB 3½"
- 65MB/28MS Drive
- High Res Amber Display
- 2 Serial/1 Parallel Port
- Key Tronic 101 Keyboard
- MS-DOS 3.3 or 4.01

$2,995.00

The Omega Difference
- 2-Year Warranty
- 1-Year Upgrade Policy
- 30-Day Satisfaction Guarantee
- Express Parts Shipment
- 100% IBM Compatibility
- Cache Advance Program
- Corporate and Personal Leasing Available
- All Systems 100% QC. Checked and 48-Hour Burn-In Tested

Visa, MasterCard, Discover Card no surcharge. American Express add 3%. All prices and specifications subject to change without notice. On-site service available in most locations and subject to restrictions; optional on 286 and 386SX systems.

Fax Orders and Quotes
219-289-0847

800-543-5044
(In Indiana call 219-289-6688)
Please call for current prices and warranty details.
10:00 a.m. to 8:00 p.m. EST Mon.-Fri.
10:00 a.m. to 2:00 p.m. EST Sat.

GE On-site Service.

Corporate, university and dealer inquiries are welcome.

Circle 512 on Reader Service Card (DEALERS: 513)
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
Rapid Systems' Waveform-Averaging Software

With Rapid Systems’ R2 software and multichannel waveform digitizers, you can display up to 16 channels at once and average from two to 1000 waveforms per channel, the company says.

Digitizers that R2 supports can handle one to 16 independent channels, sample rates from 0.01 Hz to 20 Hz, data buffers of 128K bytes per channel, and 8 or 12 bits of A/D resolution.

Some of the features of R2 include digital scope display and the ability to display amplitude in engineering units of your choice. You can control acquisition and display parameters from pull-down menus.

R2 runs on the IBM XT or higher with 640K bytes of RAM. It is included with a Rapid Systems digitizer.

Price: $1995 to $6495, depending on the hardware.

Contact: Rapid Systems, Inc., 433 North 34th St., Seattle, WA 98103, (206) 547-8311.

Inquiry 1025.

Front-Line Security for the Mac

Magna’s scaled-down version of Empower II, a security system for the Macintosh, limits access to your machine by accepting registered users only. Unlike its predecessor, however, Empower I doesn’t provide for levels of access privileges.

Once inside the system, you can open any folder, but you still need a password to get into the system (that’s what Magna means by “front line”). Empower I can optionally prevent start-up of the Mac from a floppy disk and control the use of floppy disks after start-up.

Security administrators are the only users who can add or delete registered users and change security options, the company says. A key icon can immediately blank the screen from prying eyes when you’re dealing with sensitive data, and a timed lockout feature lets you blank the screen after a period of inactivity. The program can also log activity.

Empower I runs on the Mac Plus or higher.

Price: $169.

Contact: Magna, 2540 North First St., Suite 302, San Jose, CA 95131, (408) 433-5467.

Inquiry 1024.

Manage PROM Programming on the PC

The PROM Master Support Program 1.10, an interface between the IBM PC and a PROM programmer unit, lets you edit and display PROM images in terms of the addresses the target machine sees, so that you don’t have to do manual address conversions.

The program allows direct serial data transfers between PROM Master and Bytek PROM programmers of 19,200 bps and 9600 bps and the PC.

PROM Master Support Program 1.10 can automatically program PROMs for multiple PROM word lengths of any multiple of 8 bits. The program verifies PROMs end to end. It directly loads Intel object files produced by Intel (Santa Clara, CA) or Systems and Software (Costa Mesa, CA) locaters.

Price: $99.95.

Contact: Roth Enterprises, 925 H Kirsten Court, Rohnert Park, CA 94928, (707) 586-9237 or (707) 762-2703.

Inquiry 1026.

Better Function Testing Through Talis

Auto Function Tester is a structured testing tool for C that Talis Computer Service says is designed to eliminate random testing and throwaway test cases. AFT supports relative timing, regression testing, and any function that takes parameters, the company says. With the tool, you can run hundreds of tests on your function with only one compile/link cycle. The program is self-documenting, saving all test data, output, and code. Test case coverage reports help you design better test cases, Talis says.

With the Source Code Catalog (SCAT), you can organize your functions in a database so that you can find functions by category, external reference, or description. The database is language-independent and supports Auto-Add functions in batch or interactive modes from C or dBASE source code and Microsoft-compatible libraries. The program comes with stand-alone and TSR versions. You can also search or view any file and paste function calls and paths.

Price: AFT, $199; SCAT, $99; SCAT network version, $199.

Contact: Talis Computer Service, Inc., P.O. Box 1539, Nevada City, CA 95959, (916) 265-5777.

Inquiry 1027.
Look through the tower of our SIA 386/33—or our new 486/33C (Convertible)—and you'll find a few of the reasons why BYTE said:

"The 'world's fastest PC' is one that lets you finish your work in the least amount of time. Since this is what the BYTE application index measures, the SIA 386/33 has the most right to the claim." *

Thanks, BYTE. But we're a lot more than just fast. We provide our resellers with a full line of PC platforms that consistently beat the "big guys." Custom configurations delivered in weeks rather than months. And American-made components, 50+ hour burn-in, AT hardware interchangeability, and AMI BIOS to ensure compatibility and reliability.

And we support our resellers. With exclusive channels, excellent margins, five-color brochures, double boxing, and 12-month warranties.

Our complete line of four 386 and five 486 high-performance PCs fits your serious VAR applications in CAD, imaging, publishing and networking.

So if you and your clients worry about performance, reliability and speed, call SIA today at (312) 440-1275.

Jerry presents his annual awards for the best products of 1989

Well, it's year's end and time for the annual Chaos Manor Awards. Of course, this is the April issue, but there's no help for that; by me, a year ends in December when I write this column.

First the ground rules: these are my awards. This year for the first time we'll be giving out certificates—the basic design was done by Mrs. Pournelle with considerable help from the BYTE editorial staff—that bear the BYTE logo; what that means is that BYTE approves of my giving awards; however, they remain my choices, not those of the BYTE staff.

There are two award categories: the Chaos Manor Best of the Year User's Awards, which go to products that I consider the best in their respective categories and that are in use at Chaos Manor, and the Chaos Manor User's Choice Awards. In both cases, the awards go to products I use myself.

In addition to the awards, there's the Chaos Manor Orchid and Onion Parade for products, companies, and deeds that I think deserve praise or opprobrium.

Languages
I have for years said that small computers will come of age when programming languages are at the point where they can be used to do. I tend to look for developments that move us in that direction.

One of those is object-oriented programming, of which a prime example is Borland's Turbo Pascal 5.5, which provides the simplest introduction to OOP that I know of. I've said enough about Turbo Pascal that I needn't repeat it here; I really had no trouble deciding that Turbo Pascal 5.5 has earned the Language of the Year User's Choice Award.

There's a significant development in languages that I know of. Microsoft BASIC 7.0 Professional Development System, didn't get here until mid-December, and while that's technically in 1989, it hasn't been around long enough to be in this year's running. However, I have had it long enough to know I like it.

BASIC 7.0 is based on BASCOM with a world of new features. It's thoroughly integrated with CodeView, the Microsoft debugger. My late mad friend Dan MacLean really hated BASIC as a programming language because of its lack of structure, but I'm sure he'd share my enthusiasm for the new BASIC 7.0. He would, however, insist that it isn't really BASIC. BASIC in his day required line numbers, had few control structures and no declarations, and generally required liberal use of GOTO statements to build useful programs. Now, not one of those criticisms applies.

Microsoft's BASIC 7.0 compiler has a lot of interesting features. For one thing, it breaks the 64K-byte string space limit. For another, it can automatically use EMS memory, which means that on a 386 with a memory manager such as Quarterdeck's QEMM-386, you can have very large programs without k ludges. There are already several commercial games that are written in compiled BASIC; now there will be even more. Microsoft BASIC 7.0 looks very good indeed as a language for developing large and complex programs quickly and easily.

There's a significant development in the other direction, as well. I described Crescent's P.D.Q. library for Microsoft QuickBASIC 4.5 in the February column: with P.D.Q., you can build small, fast programs in BASIC, including TSR programs; P.D.Q. has already earned its User's Choice Award. Equally important, Crescent is revising their entire line of professional BASIC tools and routines to work with the new Microsoft BASIC 7.0; those should be out by the time you read this. The result is a truly professional capability that provides a highly friendly and productive environment.

Microsoft and Crescent have taken several giant steps toward the world I envisioned 10 years ago, in which anyone could write and debug decent programs. A world in which you concentrate on what you want the computer to do, rather than how to persuade it to do it. True, behind that kind of "user programming" there have to be some very sophisticated people writing software tools in assembly language—which is fine by me. I don't really know how my books are printed and bound, either.

Follow the Dots . . .
When I got my very first computer, about half the cost was for a Diablo daisy-wheel printer. Later I upgraded to an NEC Spinwriter. It's faster than the Diablo and uses a ribbon rather than a daisy wheel, but otherwise it's not a lot different from the old Diablo: big, clunky, loud, and pretty slow.

I solved the whole problem by going to the Hewlett-Packard LaserJet; I got one of the very first ones, and I loved it. I'm told my raving about the thing helped HP's sales a lot, and I sure hope so. Incidentally, I still have it and still use it. It was upgraded to a LaserJet Plus, but that's the only service or maintenance it ever got, and it will be used to print out this column when I'm done.

I do use the old NEC Spinwriter once a month: when it comes time for the ritual known as The Paying of the Bills. I have an accounting program (I wrote it) that lets me enter the checks and credit-card expenditures and such into my General Journal; after which another program reads the Journal and writes the checks. The checks themselves come printed on
tractor-feed paper, so there's no way they can be fed into the LaserJet. As a consequence, every month I drag the Spinwriter out of a closet and fire it up for the half hour it takes to write checks, and then I stuff it away again.

Then last fall I met someone from the printer division of Seikosha. "I need a little printer," I said. "The smallest tractor-feed printer you have?"

"That's no problem," he said, making a note, "but don't you want a real dot-matrix printer as well?"

I'd never thought about it; what I really wanted was freedom from the Spinwriter, out of a closet and fire it up with small computers is almost nil.

Don has used that printer to print out sell enough stories that it's not really a fair test: Don has much experience as a copy editor and proofreader, and he knows a good bit about typography and typesetting; but his hands-on experience with small computers is almost nil.

Don has used that printer to print out sell enough stories that it's not really accurate to call him an apprentice any longer. He got the printer to work with Q&A and a roll of Avery labels to make up the labels for our Christmas greetings list; he does a good bit of my correspondence with it; and in general, he uses the printer daily. No glitches.

Dot-matrix printers have come a long way in the past few years. The SL-230AI is fast and relatively quiet, and best of all, the output doesn't look like dot matrix. Italic is italic, boldface comes out boldface, and so forth. They're quieter, too, not much louder than most office equipment.

I still prefer laser printers for both speed and print quality, but I have to say, modern dot-matrix printers are plenty good enough. Incidentally, hooking up the SP-2000 so it would do the NEC Spinwriter's job took about 5 minutes; and it sure takes up a lot less room. Now my only problem is, what do I do with an old NEC Spinwriter?

Clearly, the Seikosha dot-matrix printers have earned their User's Choice Award.

UPS of the Year

Ever since the Great Power Spike (see my August 1989 column), I have been sensitized to the need for power conditioning; in fact, not only have I had all my systems connected to surge protectors, but my major systems are connected to uninterruptible power supplies, usually called UPSes.

I have come to the conclusion that if you are serious about the value of the work you do on your small computer, you simply must get a UPS; it's as important as backing up your hard disk. If you run Unix, it's even more important, because Unix talks to the disk from time to time even if you're not around, and if

---

**Frequent Flyers.**

If a portable computer has improved the way you do business away from the office, think what a portable modem can do for you. With it, you'll be able to send and receive data, and even faxes, anytime you want. In or out of the office.

The WorldPort family gives you a choice of four portable modems, including an MNP* error-correcting modem and an electronic fax/data modem.

Each is no more than 8 ounces and can fit in a shirt pocket. They're small but tough and capable, built for the rigors of business on the road.

They connect to practically any telephone, public or private, via standard RJ-11 jacks or an optional acoustic coupler. They adhere to Bell and CCITT standards world-wide so you can connect to other modems (or fax machines) almost anywhere. They're powered by a single 9-volt battery or through an AC outlet, whichever is more convenient. And, they're easily shared as external peripherals among co-workers.

The WorldPort family of modems. They're built for travel, whether it's to extreme environments, to exotic locations or just down the hall.

Call us today for the dealer nearest you: 800-541-0345.

(In New York, 516-261-0423.)

---

MNP is a registered trademark of Microcom, Inc. WORLDPORT and TOUCHBASE SYSTEMS are trademarks of Touchbase Systems, Inc. © 1989 Touchbase Systems, Inc.
Erasable Optical
Or Write-Once,

The Right Ones
Are Right Here.

Today, there are important places for both erasable and write-once optical storage. But Storage Dimensions is the one place to find the right optical solution for you. Erasable and write-once. Plug-and-play. For every popular PC environment—DOS, Macintosh* and Novell*

Applications such as image management, database distribution and back-up are naturals for high performance erasable optical storage. It's no coincidence that our new LaserStor™ Erasable Optical subsystem, with its nearly one gigabyte cartridge capacity and 35 ms average seek time, is the industry performance standard.

For archiving, document storage/retrieval and microform replacement, write-once optical clearly makes the most sense. And the clear winner again is LaserStor, the number one desktop seller. That position will only get stronger with our newest write-once offerings. First, a 940-megabyte subsystem that combines high capacity with impressively high-speed throughput. And second, our compact, internally mountable half-high, 786-megabyte package.

The right optical products—Erasable and Write-Once—are right here, right now. So give us a call, right now. 408/879-0300. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.
there's a power glitch while Unix is doing whatever mysterious things it does, you can lose everything.

Anyway, we've been collecting and testing UPS systems for several months now. Naturally, the only kind I'd even consider testing do power conditioning as well as provide emergency power. That eliminated several. Some we tried didn't work properly. I'd plug the Zenith Z-248 (286) computer into the UPS, get Q&A Write going, and yank the UPS power cord. If the computer had any problems at all, that UPS went back to its manufacturer. Then I plugged the UPS into a Variaic and ran the voltage down; if the UPS didn't kick in before the computer noticed, we got rid of it. That got rid of a lot more UPS boxes.

Eventually we were down to just two brands of UPS. Both had come through the initial tests all right.

One surviving UPS is a small desktop unit, a cute little thing with convenient switches and flashing lights, a lot prettier than its Clary competition. It's also quieter; the Clary desktop UPS has a fan sound squarely in a frequency I'm sensitive to. Mind you, that's not a real flaw for most people; I have a condition commonly known as "artillery man's ear," which means serious hearing losses in scattered frequencies, no losses at all in others. The result is that I don't hear my own voice very well, and many conclude I'm deaf as a post; but in fact I hear high frequencies better than most people, so that things that sound normal or quiet to my friends are sometimes loud to me.

In any event, I chose the Brand X UPS (I don't name it for reasons I'll give later) to sit on my desk, and Don Hawthorne got the little desktop Clary, which, incidentally, he loves, but that's getting ahead of the story.

I plugged Big Cheetah, a 386/387 with a Distributed Processing Technology disk drive controller, a Priam 330-megabyte hard disk drive, and 4 MB of memory, into the UPS. I plugged in the Zentih Flat Technology Monitor (FTM). Then into the outlet labeled "printer" I plugged in an in-outlet box, into which I plugged the USRobotics modem, a CD-ROM drive, and the Maximum Storage WORM (write once, read many times) drive. That's three items, leaving the fourth outlet on the strip empty. The UPS fired up, and everything seemed to be working properly.

It was that way for weeks; then one day the housekeeper plugged a vacuum cleaner into that empty fourth outlet on the power strip. For about 2 minutes nothing happened; then, Whammo!, the system sounded horrible warnings, and everything shut down. Clearly, overloading that UPS was not the thing to do. I unplugged the vacuum cleaner and restarted. Nothing. A glass cartridge fuse had blown, and until it was replaced, the UPS was dead. Once the fuse was replaced, everything seemed all right—Until a couple of weeks ago. We've been having rain in Los Angeles. Rain does odd things here. Power spikes. Miniblackouts in which lights flicker. And every time the lights flickered, Big Cheetah reset. He came right back up OK, but he had reset. Fortunately, my habit is to save early and often, so nothing was lost; but this clearly was not why you want a UPS!

Time for some investigation. I had Don Hawthorne bring the little Clary UPS from his room and plugged Big Cheetah into it.

The Clary UPS has fewer switches and continued
Series 4 Assemblers/Simulators/Compilers

Assembler:
Full listing control, conditional
assembly and built-in cross-reference. User-defined
sections. Linker & Librarian.
Listings can be relocated by
the Linker to reflect actual run-
time addresses.

Outputs:
IntelHex, Extended IntelHex,
Motorola s19, s28 and s37 file
formats. Supports the most
commonly used symbol table
formats.

Simulator-Debugger:
Address, memory and register
breakpoints with optional pass
count. Read/write and write-
only memory trapping. Single
step, trace, undo, and multiple
scrollable hex windows.
Supports all symbol table and
file formats output by 2500
A.D. Linker.

Compiler:
Supports in-line assembly
language, ROM-able code
and full floating point. Includes
Macro Preprocessor, Assem-
bler, Librarian, Librarian, C and
Assembly Libraries, and
Simulator-Debugger (except
Z280 & 68020). C-Library
source extra.

Memory:
Series 4 products require a
640K MSDOS system.

<table>
<thead>
<tr>
<th>Processor</th>
<th>Macro Assemblers</th>
<th>Simulator-Debuggers</th>
<th>C Compilers</th>
<th>Library Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super 8</td>
<td>200.00</td>
<td>150.00</td>
<td>600.00</td>
<td>250.00</td>
</tr>
<tr>
<td>Z-8</td>
<td>200.00</td>
<td>150.00</td>
<td>600.00</td>
<td>250.00</td>
</tr>
<tr>
<td>Z-80</td>
<td>200.00</td>
<td>150.00</td>
<td>600.00</td>
<td>250.00</td>
</tr>
<tr>
<td>Z-280</td>
<td>300.00</td>
<td></td>
<td>500.00</td>
<td>250.00</td>
</tr>
<tr>
<td>Z-8000</td>
<td>300.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1802</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6301</td>
<td>200.00</td>
<td>150.00</td>
<td>600.00</td>
<td>250.00</td>
</tr>
<tr>
<td>64180</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6501/02/C02</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65816</td>
<td>300.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6800,2,8</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6801,3</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6804</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6805</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6809</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68C11</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68000,8,10</td>
<td>300.00</td>
<td>200.00</td>
<td>700.00</td>
<td>250.00</td>
</tr>
<tr>
<td>68020</td>
<td>400.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8400/C00</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8044/51/52</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80410/710</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80451</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80515</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8080</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8085</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8086/88</td>
<td>100.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8096</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80186/286</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80386</td>
<td>300.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8748</td>
<td>200.00</td>
<td>150.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>87751</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>740</td>
<td>200.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSC800</td>
<td>200.00</td>
<td>150.00</td>
<td>600.00</td>
<td>250.00</td>
</tr>
<tr>
<td>PDP-II</td>
<td>300.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Product _______ Operating System _______
Series _______ Amount $ _______
Shipping $ _______ Total $ _______
Signature _______ COD (U.S. Only) □
MC/VISA/AMEX # _______
Expiration Date _______

Educational discount available.
To order, call toll free in U.S. (including HI, PR and VI):
1 800 843-8144
In Colorado: (719) 395-8683
TELEX: 752659/AD FAX: (719) 395-8206
For more details, ask for a free brochure.

(Shipping is $31.00 per unit for overseas orders. Toll Free number does
not apply to overseas. 2500AD pays COD charges.)

Circle 8 on Reader Service Card
controls than the other one does; but it also has one thing the others lack, a line of lights, first green, then red. As you draw more current from the UPS, more and more of the green lights come on, until you overload it, and you get one green and one red; then, no green and two red, at which point it simply cuts things off and tells you in no uncertain terms that you can't overload it this way.

It did that with Big Cheetah. The interesting part is that it is rated for as much power as the UPS I'd been using on Big Cheetah—which let me use it but wasn't reliable. The Clary UPS, in other words, knew it was overloaded and was not about to fool me into thinking it was doing its job when it wasn't.

"You've had your Tandon 286 plugged into this Clary during the bad weather, haven't you?" I asked Hawthorne.

"Sure have. Never noticed a thing."

"Even when the lights blinked?"

"Nothing. I remember once I was writing and I'd just finished something and was saving it when the lights blinked. The Clary box screamed for a second, but then the lights came on, and no problem. I just went on working."

He just went on working, while Big Cheetah, supposedly protected by the other UPS, reset itself.

So, as I write this it's raining outside, and I have a lash-up. Big Cheetah is still plugged into the other UPS, but that is plugged into a big, hairy extension cord, which runs across the Great Hall to the soundproofed electronics closet; and in that closet the big extension cord is plugged into the big Clary UPS, their 1.25-kVA OnGuard system. As I wrote this, I deliberately did not save the last paragraph.

I walked over to that closet and yanked the cord that plugs the Clary UPS into the wall. It howled. I waited a moment and plugged it back in. Then I stood there and jiggled the plug, plugging it in and out as fast as I could about nine times. Came back here. As you see, the paragraph remains intact. Things plugged into a Clary UPS never know that you're torturing the poor thing.

The Clary 1.25-kVA UPS is in a closet because it is much louder than its little brother; it puts out a high-pitched sound that even my wife finds too much to be close to. That's all right. It doesn't need attending, and we'll never hear it in the cable closet. It would be all right in almost any kind of cabinet for that matter, but it's pretty big and convenient to have it remotely located. Tomorrow, I'll string a power cable under the floor.

continued
THE NEW STANDARD FOR HIGH PERFORMANCE STATISTICAL SOFTWARE

CSS

A powerful, comprehensive, elegant, and super-fast statistical package for IBM (PC, AT, PS/2) and compatible computers. The CSS optimized user interface with fast hierarchical menus incorporates elements of artificial intelligence; even complex analyses require only a few keystrokes (batch processing is also supported). CSS features comprehensive, state-of-the-art implementations of:

- Basic statistics,
- Multi-way frequency tables,
- Nonparametric statistics,
- Exploratory data analysis with analytic graphs,
- Multiple regression methods,
- Time series analysis with modeling and forecasting (incl. full ARIMA),
- General ANOVA/ANCOVA/MANOVA,
- Contrast analysis,
- Discriminant function analysis,
- Factor analysis,
- Principal components,
- Multidimensional scaling,
- Item analysis/Reliability,
- Log-linear analysis,
- Cluster analysis,
- Non-linear estimation,
- Logit/Probit analysis,
- Canonical analysis,
- Survival and Failure Time analysis (Censored data),
- Quality Control analysis,
- and much more.

All statistical procedures are integrated with fast data base management and instant, presentation quality graphics (over 100 types); full support for all mono and color graphics boards (incl. VGA) and over 100 plotters and printers (incl. the HP and Postscript standards). All CSS screen output is displayed via customized Scrollsheets™ (i.e., dynamic, user controlled, multi-layered tables with cells expandable into pop-up windows); all numbers in a Scrollsheet™ can be instantly converted into a variety of presentation quality graphs; contents of different Scrollsheets™ can be instantly aggregated, combined, compared, plotted, printed, or saved.

The flexibility of the CSS input/output is practically unlimited: CSS offers an intelligent interface (read/write) to all common file formats (Lotus, Symphony, dBase, dBase II, dBase III+, DIF, SYLK, ... ) and special utilities to easily access data from incompatible programs; graphics can be saved in files compatible with desktop publishing programs (Aldus, Ventura). CSS data files can be as large as your operating system (DOS) allows; OS/2 version coming soon.

CSS precision exceeds the standards of all common precision benchmarks.

Technical note: The CSS user interface and all I/O were written in Assembler and bypass DOS; graphics and data management were written in Assembler and C; the computational algorithms were written in Assembler and optimized Fortran.

$495 (plus $5 sh/h); 14-day money back guarantee.

Circle 267 on Reader Service Card

StatSoft

2325 East 13th Street • Tulsa, OK 74104 • (918) 583-4149
Fax: (918) 583-4378

As to why the other UPS is still on my desk, I have deadlines and it’s a perfectly good power-distribution box. Besides, the monitor is sitting on it and I like the height. I’ll change that tomorrow, too. I don’t name this box because it’s a perfectly good UPS if you don’t overload it. After all, it did pass my preliminary tests. Its only real problem is that it doesn’t tell you when it’s overloaded.

But the clear winner of the Chaos Manor UPS of the Year User’s Award is Clary. I have no hesitation in trusting my work to Clary.

**Dance of the Planets**

There isn’t much science education software, and a lot of it isn’t very good, which is surprising, since computers are getting faster and their graphics better. Once in a while, though, comes a program that will simply blow you away. Dance of the Planets is like that. It has an infuriating user interface that’s hard to learn unless you know a lot about astronomy. The view it gives you when you first fire it up isn’t very intuitive. Even after you use it for a while, it will do things you didn’t expect, and you’ll have vexing problems trying to get it to do something simple. But none of that matters at all.

Dance of the Planets simulates the solar system. Once you’ve mastered it, you can move around from one viewpoint to another. Stand well back and watch all the planets go about the Sun. Set a date, past or future, to see where the planets are. Add the asteroids, and look again. This part of the program alone makes it an absolute must for me: I have several science fiction stories set in the asteroid belt, and it used to drive me nuts calculating where the various flying mountains were relative to each other and to the major planets. Now I just crank up Dance of the Planets.

Once you’ve looked at the solar system, zoom in on a planet, Jupiter, for instance, and see all the moons, plus the great bands on Jupiter itself. Now go look at Saturn as it appeared from Voyager. And on. It’s not the easiest program to learn, but it’s sure worth learning it.

Dance of the Planets works on EGA systems, but it’s prettier on VGA. We’ve had it up on a Tecmar VGA card with a Zenith FTM, and a Samna VGA card with the 19-inch Electrohome monitor; you haven’t lived until you’ve seen Saturn’s rings on a 19-inch color monitor! A fast 386 with no coprocessor will run it fairly well, but a slower 286 with an 80287 math chip will be faster: this is a simulation program, and it has to calculate where all those objects are. A 33-MHz 386 with an 80387 really screams.

If you have the slightest interest in astronomy and the solar system, get this program, which I’m giving the Best Science Education Program of the Year User’s Choice Award. Try it. You will love it.

**Games**

There are two kinds of games: those that you think you ought to enjoy, and those you just plain like. Chess falls in class 1 for me: I used to be a good chess player and even played successfully for money when I was in the army. I still follow the tournaments, and I guess I still think of myself as a chess player; but the fact is that I haven’t played much in the past few years. I’m not sure why.

But, if I do play chess against a computer, the game to beat is Chessmaster 2100 from The Software Toolworks, continued
The point is: today's applications require a great pointing device. PC-TRAC, our newest advanced-design trackball, gives you precision control over every move your cursor makes. Without cramping your desk, your style or your hand.

PC-TRAC is the most comfortable pointing device you'll ever lay a hand on. Relax your entire hand, while your fingertips master the power of touch with incredible ease. Control the ball and buttons with your fingertips. If mice ever made you feel like you're all thumbs, wait till you try PC-TRAC.

Just plug PC-TRAC in and perform. Minimal set up. No waiting. PC-TRAC is 100% Microsoft* Mouse or PS/2* Mouse compatible. For Lotus*, dBASE*, or WordPerfect*, use the included software utilities that come in the box.

Click with your thumb or fingertips on PC-TRAC's wrap-around buttons. They're easy to locate and unexcelled on response, with built-in drag lock.

Any way you use PC-TRAC, you're on a roll with more agility, more precision, and resolution up to 1,000 dpi—automatically. And since the trackball gives you direct fingertip control, there's never any mouse cursor creep.

PC-TRAC fits beside your keyboard in less than 4 inches. And, unlike a mouse, it stays put in one spot. PC-TRAC gives you back the desk space your mouse and mouse pad took away from you. Now no mouse pad, no mouse rowing, no mouse cleaning.

PC-TRAC. A great pointer. Check it out for performance, style and an unbeatable price. PC-TRAC available in Serial, Bus, PS/2 and InPort versions. Suggested Retail Price $119, bus version slightly higher.

MicroSpeed
1-800-232-7888
International and California call (415) 490-1403 FAX (415) 490-1665

Circle 188 on Reader Service Card (DEALERS: 189)
only I don’t win very often. Old-time readers will remember that The Software Toolworks was Walt Bilofsky’s company distributing really nifty utility programs in ZipLoc bags back in S-100 CP/M days. The company has gotten a bit larger, and the packaging is slicker nowadays. There’s been no drop in quality of products, either. Chessmaster 2100 is as good as chess programs come.

Go is intermediate between the games I think I ought to like and the games I like. I play more go than I play chess, and I like it more; indeed, if I were condemned to play only one game for the rest of my life, I’d choose either contract bridge or go, depending on who I’d get in my bridge foursome.

There are two major go programs: Cosmo Go and Nemesis, the Go Master. Both are awfully good, and each has beaten the other in a computer go tournament. I believe that Nemesis is ahead this month. Overall it’s hard to choose between them, but I find that when I play go against a computer, I almost always choose Nemesis, which tells me something. There are versions for both the Macintosh and the PC. I generally play on the Mac, but I keep the PC version on my Zenith 286 SupersPort laptop.

Finally, there’s a game of no redeeming social value at all; it was just plain fun, and I played a lot of it last year: Sword of Aragon from Strategic Simulations. This is a game of medieval fantasy. The fantasy elements are good, but that’s not what I really liked about this game. What I really liked was that you could quite realistically simulate medieval warfare, build combined-arms armies and use them properly, and win the game without letting magic dominate it at all.

Anyway, on reflection, I’m giving

continued
Can your compiler meet the challenge?

We invite you to take an existing program and compile it using TopSpeed C. Then, compare the overall performance with the compiler you now use. If you are not 100% satisfied, return the entire package to us, and we will refund all of your money.
New Version 2.0

FINALLY. A debugging tool tough enough to handle the DOS Nasties.

How Soft-ICE Works

Soft-ICE uses the power of the 80386 to surround your program in a virtual machine. This gives you complete control of the DOS environment, while Soft-ICE runs safely in protected mode. Soft-ICE uses the 80386 to provide real-time break points on memory locations, memory ranges, execution, I/O ports, hardware & software interrupts. With Soft-ICE you get all the speed and power of a hardware-assisted debugger at a software price.

Don't want to switch debuggers?

You don't have to! Soft-ICE can run stand-alone or it can add its powerful break points to the debugger you already use. Use your favorite debugger until you require Soft-ICE. Simply pop up the Soft-ICE window to set powerful real-time break points. When a break point is reached, your debugger will be activated automatically.

MagicCV with Soft-ICE

Using Soft-ICE with CodeView gives you the features necessary for professional level systems debugging. MagicCV and Soft-ICE can work in concert with CodeView to provide the most powerful debugging platform you will find anywhere.

"These may be the only two products I've seen in the last two or three years that exceeded my wildest expectations for power, compatibility and ease-of-use."

—Paul Mace
Paul Mace Software

Soft-ICE $386
MagicCV $199
MagicCV for Windows $199
Buy Soft-ICE & MagicCV(W) —Save $86.
Buy MagicCV and MagicCVW —Save $100.
Buy All 3 —Save $186.

New Product/New Idea

Finds overwrites and un-initialized pointers automatically
All the protection of a protected OS under DOS

Bounds Checker - $249

RUN CODEVIEW IN 8K

MagicCV

CodeView is a great integrated debugger; but it uses over 200K of conventional memory. MagicCV uses advanced features of the 80386 to load CodeView and symbols in extended memory. This allows MagicCV to run CodeView in less than 8K of conventional memory on your 80386 PC.

NEW—Version 2.0 includes EMS 4.0 driver. Attention Windows Developers! Version available for CVW.

P.O. BOX 7607 NASHUA, NH 03060-7607

CALL TODAY (603) 888-2386
or FAX (603) 888-2465

30 day money-back guarantee
Visa, MasterCard and AmEx accepted

Nu-Mega TECHNOLOGIES

Circle 207 on Reader Service Card
Chaos Manor User’s Choice Awards to Chessmaster 2100 and Nemesis, the Go Master; but the 1989 Chaos Manor Game of the Year User’s Award goes to Sword of Aragon.

Monitors
The all-around best monitor in the business is Zenith’s FTM, which has already got plenty of awards, including mine as monitor of the year two years running. It’s crisp and clean and has no flicker. You can see it in all conditions of ambient light, from late night with other lights in the room to a bright, sunny afternoon with a window behind you. It’s the monitor of choice for VGA systems.

However, it’s also big, bulky, and comparatively expensive. Moreover, some people don’t need color. I’ll argue that if you can possibly afford it, the Zenith FTM is worth the money in what it saves you in eye strain, even if you use it only as a monochrome monitor; but I also know that some won’t agree.

We’ve looked into a lot of low-cost monitors this year, and one was outstanding: the Goldstar Paper White VGA Monochrome Monitor. It’s about as low in cost as you’ll find for anything of decent quality. It has crisp, clear images and no flicker. It’s light in weight and cool-running. I used monochrome for years before I thought color was sharp enough to stare at all day; and the monitor I had then wasn’t anywhere near as good as the Goldstar Paper White VGA monitor, which gets a Chaos Manor User’s Choice Award.

Backup System
A lot of people seem to think that when I say something is “good enough” I am damning it with faint praise. Not so. In my judgment, “good enough” is high praise: it means I can use it without worrying about it; that it has all the features I need to get the job done.

There’s one problem with starting off with hardware or software systems that are good enough: there’s little incentive to experiment with anything else. This is fine when I’m thinking like a user, but it’s not so hot when I’m looking for something new to write about. It’s even worse for the people trying to get me to look at something new.

Most of you know that I’m partial to WORM drives in general, and the Maximum Storage WORM drive in particular. I’ve had a Maximum Storage WORM drive for a couple of years now, and it’s more than good enough. I’ll recommend the Maximum Storage WORM drive to anyone; and I’ve often said that if you’re serious about the value of what you do on your computer, you’ll get a UPS and a WORM drive, because anything less is gambling in ways you’ll regret. The Maximum Storage WORM drive got a year’s best award last year, and it has improved considerably since; it more than deserves its User’s Choice.

A WORM drive is great for a single user. It’s pretty good when a couple of users share it, for instance through an Applied Creative Technology Systematizer. As the number of users goes up, though, while it’s important to have at least one WORM drive—it’s still the absolutely best way to be sure you have kept and can retrieve every version of your work—using a single WORM drive to back up the work of many people becomes difficult, while setting up and enforcing a centralized plan for ensuring that all valuable work is saved and cataloged becomes nearly impossible.

Last year was supposed to be the Year of the LAN. I don’t think it was, and I don’t think this year will be, either, but it does seem clear that networked microcomputers are getting more important as time goes by, and they already are stealing large portions of a market that used to be the private preserve of the minicomputers, including VAXen. Now, one of the strengths of VAX systems was the ability of the MIS to set up and enforce backup plans whereby, like it or not, everyone’s work was systematically copied off and archived. It was something you couldn’t do with linked microcomputers.

That’s no longer true. Comes now Palindrome, a network-archiving system for Novell and Novell-compatible LANs, which will do just about everything a VAX backup system can do. Palindrome is software and firmware to run an automated 2.2-gigabyte Exabyte tape cartridge backup system.

Palindrome first goes out and backs up everything; depending on the size of the network, this could take all night the first time you run it. Once it has done that, Palindrome then works iteratively, copying anything that changed since the last backup. It uses a sophisticated tape-changing scheme so there’s no chance of losing everything; and, of course, you can periodically send tape cartridges off-site so that you have a choice to revive your company even if the place burns to the ground. It also records what it has done and catalogs the files it has archived.

Palindrome comes as a complete system with an Exabyte tape drive, or, if you already have an Exabyte tape drive but...
don’t have software as good as Palindrome—and I don’t know of any that is—you can get the firmware and software alone. Either way, if you are running a Novell network system or contemplating one, I strongly recommend Palindrome, the Chaos Manor Data Backup System of the Year User’s Choice.

MNP and ARQ
Sometimes I think I have the noisiest telephone lines in the U.S.; at least when it rains in Los Angeles, I get world-class line noise. There is, however, a remedy. Not all communications networks have it. Tymnet doesn’t, for instance, and BIX has it on only a few direct-dial lines. MCI Mail has it, though, as does GE’s GENie. I refer to a hardware error-correcting protocol system called MNP and ARQ. I confess I haven’t the remotest idea of what those stand for, and what, if any, is the difference between them.

What I do know is that the new USRobotics modems can be set to use these protocols automatically. Once properly set, the modem sends a special signal to any modem it connects with. If it gets the proper return, the two go into communications in error-correcting mode—and you are not bothered by line noise no matter how bad the lines are. Moreover, when the lines are not noisy, the data transmission is much faster.

I don’t have space for the technical details. But as a user, I find that MNP and ARQ pretty well solve the line-noise problems and speed up data transmission as well; and the USRobotics Courier HST Dual Standard modem wins hands down the Chaos Manor Modem of the Year User’s Award. I love this thing.

Gadgets
I love gadgets; there’s even a “gadgets” topic in the new technology conference that’s part of my new exchange on BIX. There were a lot of really neat gadgets last year: the Atari Portfolio, a pocket-size DOS computer that I really like except that I can’t get mine away from my son Alex; the Sharp Wizard; the Casio Boss; the Selectronics Word Finder; and a number of other dedicated special-purpose computers developed by Mike Weiner at Microlytics.

On reflection, though, one stands out: the Spectre OCR. Add this to an Atari ST, and you have, for all practical purposes, a Mac Plus. Add it to Atari’s neat full-function portable ST, and you have a low-cost portable Mac Plus. The Chaos Manor Gadget of the Year User’s Choice Award goes to Dave Small of Gadgets by Small for the Spectre GCR.

Mice
Like it or not, a good pointing device is becoming a necessity. I make no secret that I keep searching for new substitutes for the mouse. One product I mightly wanted to support was Logitech’s TrackMan trackball system. Alas, for me it didn’t quite make it. It was a good step in the right direction, but I find that the pointing device I prefer, and use at Chaos Manor, is not the TrackMan but Microsoft’s “Dove-bar-shaped” Mouse. It fits the hand, looks nice, is easy to use, and gets this year’s Chaos Manor User’s Choice Award.

Orchids
Every year on BIX I ask for nominations for the Chaos Manor Orchids and Onions Parade: people, events, and things...
When something becomes a standard, using it becomes second nature. That's true about LapLink. It's so effective that it has become the most popular laptop-to-desktop and desktop-to-desktop file transfer program ever.

And now Release III improves on the original with added power—while preserving the simple design that has made LapLink the choice of more major corporations.

LapLink III offers both serial and parallel file transfer, and you can take advantage of parallel transfer speeds of 500,000 baud or higher. It comes with a "six headed" universal cable that provides you with everything you need to use both serial and parallel modes.

And LapLink III will even install itself automatically on a remote computer.

That's in addition to ease-of-use and productivity features like our popular split screen design, flexible transfer options, and disk and printer sharing.

For the same fast, error-free file transfers between PCs and Macintoshes, get LapLink Mac. And for more information about any Traveling Software product, call us at (800) 662-2652.

LapLink III. The standard in file transfer software.
C Programmers choose db_FILE because it's fast and flexible.

The combination of relational B-tree indexing and network database technology delivers better performance than file managers using relational technology alone. Build simple B-tree/ISAM applications or complex database applications. You decide how to optimize runtime performance.

SQL Support included.
db_RETRIEVE – the SQL-based relational Query and Report Writer is now included in this special offer.

Applications completely portable. Free lifetime phone support.

C source code is now included! No royalties.

SPECIAL LIMITED OFFER
db_FILE, db_RETRIEVE and source code for each - at one low price!

Single-User Package $295.00
A $2780 value.

Multi-User Package $595.00
A $2890 value.

File Manager 2.2
File Structure: Relational B-tree indexing and network database model. Use independently or in combination for real power.

Transaction processing supported
Not RAM resident
Operating Systems: MS-DOS, UNIX, XENIX
C Compilers: UNIX, XENIX, Microsoft, Lattice, TurboC
Major LANs Supported

For your nearest distributor call:
1-800-db_RAIMA (1-800-327-2462).

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 'jerriy'.
Pinnacle Micro is the world's leader in removable, erasable, optical storage systems.
The expanding line of Pinnacle drives offers real solutions to mass storage problems and a whole new set of data handling capabilities.

**Removable, Erasable, Opticalabilities.**

**Access-archivability.**
Access your archives quickly and easily. Why wade through stacks of floppies or miles of tape to find a single file?

**Platform-compatibility.**
Interface kits are available for Macintosh, Sun, DEC, HP, IBM-XT, AT, PS/2 and compatibles, plus advanced applications such as Unix, A/UX, Xenix and Novell NetWare.

**Infinite-storability.**
Store huge files-CAD/CAM, multi-media, pre-press, 32-bit color. Each cartridge holds up to 650 megabytes. If one isn't enough, add another.

**Data-securability.**
Carry your world wherever you go. Put your operating system, applications, and data files on a single cartridge. Keep your data safe and secure or move it from place to place.

**Upscale-ability.**
Start with a single or dual-disk system for your network today. Move up to a 25 disk, 16 gigabyte system tomorrow. Your cartridges and your data will easily move up with you.

**Crash-avoidability.**
Eliminate crash anxiety, with laser technology there are no heads to crash. If your hard drive goes down your optical system will put you back on-line immediately.

**Mass-movability.**
Distribute massive amounts of data in limited quantities. CD-ROM's are great, but not if you need a reduced amount.

**Problem-solvability.**
Learn how to put these and other opticalabilities to work for you, call today for the name of your nearest authorized dealer.

(800) 553-7070

---

Pinnacle Micro is the world's leader in removable, erasable, optical storage systems. The expanding line of Pinnacle drives offers real solutions to mass storage problems and a whole new set of data handling capabilities.
"The MKS Toolkit is an amazingly faithful replication of a System V UNIX™ environment." - UNIX Review

KST;...is an amazingly

"MKS software is absolutely the best in its
class. Don't mix environments without it."
Grover Righter Director Hybrid Systems,
Novell Netware Product Division

Site Licences

MKS Toolkit reflects its users' needs. Organizations such as AT&T, H-P, ITT, and NCR - all heavily committed to the UNIX system - use MKS Toolkit to create a standard operating environment. Universities, from Harvard to UCLA, use MKS Toolkit to enrich personal research computing environments and double the bandwidth of their PC teaching labs. The National Institute of Standards and Technology uses MKS Toolkit as a standard operating environment for experts and as a POSIX training tool for neophytes.

Interconnectivity

MKS Toolkit interacts well on standard PC and PS/2 networks. Combined with Novell Netware™, the most popular LAN for PCs, MKS Toolkit creates a UNIX time sharing system in DOS or OS/2 environments. UNIX shops can now hook up all their PC's using PC-NFS™ and MKS Toolkit, enabling you to use a PC as a UNIX workstation and off-load your mini mainframe. With Macintosh or IBM's PS/2, MKS Toolkit is the perfect training tool for moving from DOS to UNIX. MKS Toolkit is the perfect transition tool for DOS environments.

POSIX Training

Government departments and organizations choose MKS Toolkit as a cost-effective means of familiarizing personnel with the POSIX environment - now a Federal government standard for computing.

Cost-effective Learning Tool

If your organization is committed to moving into the UNIX environment, then MKS Toolkit is the perfect learning path. DOS or OS/2 users retain the familiar world of the PC keyboard and programs and move effortlessly to a UNIX environment on their desktop. Exposure to new commands and functionality now becomes an integral part of the novice's working day.

"With this package, you can become familiar with the UNIX environment on your microcomputer, with DOS only a keystroke away."
Byte Magazine, May 1989

MKS Programming Platform

MKS Toolkit is the heart of the MKS Programming Platform. MKS Platform helps smooth out the details of programming and software development by adding time-saving utilities such as: MKS RCS (Revision Control System), MKS Make™ (automated program builder), MKS LEX & YACC™ (compiler learning and construction tools). Also available is MKS SQPS™ an enhanced version of the Documentator's Workbench™ with complete troff typesetting capabilities.

In all, you simply cannot find a more complete set of commands and utilities to get you from DOS or OS/2 to UNIX or POSIX. With MKS Toolkit or Platform, you get there fast, stress-free, and with no extra investment in hardware.
The details of setting up Unix communications can be overwhelming without a little direction.

There's a good reason for the wry title of this month's column. Trying to set up UUCP (Unix-to-Unix copy) has gotten many people running—as far away as they can get from even the thought of Unix!

Luckily, things are better these days. Many systems have automatic UUCP setup scripts or menus that make the process a lot easier. But without automatic setup, it's still an intricate mechanism of tables and daemons (background programs).

This month, I'll go over some of the inner workings of the UUCP subsystems, with particular reference to the mundane aspects of setting it up and getting it running. I will assume, for this column, that a setup script is not available; it doesn't often do what you want, anyway.

Hard Facts
The first hurdle to clear in your race for intersystem communications is hooking up your modem. While most modems will work (at a minimal level) with factory configurations on most computers, this is not what you want, except perhaps when you initially test the modem.

On single-tasking operating systems, you generally operate the modem manually by dialing out, using a telecommunications program. This gives you direct control over what the modem is doing. But a Unix system will place and receive its own calls whether you're there or not. So the full complement of modem-control signals must be used, especially Data Terminal Ready (DTR) and Data Set Ready. These correspond to pins 20 and 6, respectively, on a standard DB-25 connector. If this is not done, your modem may stay on-line for hours after a call has failed, running your phone bill way up.

Generally, the pins that should be connected (straight through from one end to the other) are pins 1 through 8, and pin 20. Some modem/computer combinations have to be cross-wired: 2 on one side to 3 on the other, 4 crossed with 5, and 6 with 20. This is known as a "null-modem" cable and can be used to connect two computers directly, back-to-back. But test your regular cable first.

If all this talk of pins confuses you, just make sure you use a modem-to-computer cable with at least nine internal wires. Test the connection as described below; if your modem operates satisfactorily, all is well.

Talking to the Modem
You need both read and write permission on the modem port to test the connection.

On some systems, you may have two different names for the same physical port: one with the modem-control signals and one without. If so, test both, but use the modem-control device for "real" work whenever possible.

In the following examples, I've used the actual entries from my own SCO-based system; be sure to substitute the correct port names and data transfer rates for your machine.

On my system, I've found through trial and error that the only way to get my modem to operate correctly with all my communications programs is to allow dial-ins on the modem-control port (/dev/ttylA) and to perform dial-outs on the non-modem-control port (/dev/ttyla). The uudemon.hour shell script (the one that performs UUCP dial-outs) disables log-ins until UUCP is done and then reenables them. It may not be standard, but it works on my machine!

continued
Getting to Know cu

It's time to edit some files in the /usr/1ib/uucp directory. In the current HoneyDanBer (HDB) version of UUCP, the file that describes what port to use for dial-outs is called Devices (previous UUCP versions called it L-devices). A typical entry in this file might be Direct ttyla - 2400 direct. This lets you talk directly to the modem port via the cu program. Except for the port number and data transfer rate, it should look the same on your machine. If you want to talk to the modem at different speeds, make similar entries at different speeds.

Test your Devices entry by typing $ cu -l /dev/ttyla. You should get a connected message from cu, indicating only that you've reached the modem port. Now type AT (it may not echo), and if all goes well, you should receive an OK from the modem if it's been set up to respond with status messages (and it should have been).

You can now type ATDT5551234 (replace the digits with the telephone number of an operating, answering computer) to connect to another machine. Once you connect, you're acting as a remote terminal to that computer. When you're done, type \ (a tilde followed by a period) to end the cu session. The modem should hang up, and its DTR light should go out, showing that your modem control (at least from the DTR side) is working.

For UUCP, as well as dialing by name from cu, you will have to make another entry in the Devices file to tell the system about dialing capabilities. Mine looks like this:

ACU ttyla - 300-19200 dialTBIT \D

This signifies that I have an automatic calling unit (ACU) on port /dev/ttyla. The first dash takes up space for a field naming a separate dialer port (an antiquated method). The usable data transfer rate (or range, in this case) follows. The next field, dialTBIT, references the name of the modem for dialing purposes. This can be a separate program but is usually an entry in the Dialers file, which describes the protocol involved in getting a phone number to the dialer. The \D simply means, "Use the system phone number exactly as found in the Systems file." A \T would mean to translate the number passed to the dialer, using information found in the Dialcodes file (I've never personally had any luck using Dialcodes files).

Finally, We're Getting Somewhere

From here to full UUCP capabilities is only a short step. The Systems file (..sys in previous versions of UUCP, with a slightly different format) tells UUCP the names of the systems you can call, plus their phone numbers and log-in information. A typical entry looks like this:

lizard Any2300-0700 ACU 2400
19165551234 \D
" \D|r gln:-gln:-BREAK-gln:
\uucp sword: foolouy
\n
This lets my system call the "lizard" system on any day from 11 p.m. to 7 a.m. (when the phone rates are lowest); that it dials out (ACU) at 2400 bps; and that lizard's phone number is 1-916-555-1234.

Secure software and data with reliable, effective protection products that won't burden honest users.

Glenco is a world leader in the area of software security products and services. Our copy protection products and data security products are second to none. They are designed to function on a wide variety of third party hardware. We have over 3500 satisfied software firms utilizing our products. We also have a full line of disk based protection systems.

- MACHINES SUPPORTED - IBM PC/XT/AT & PS/2, Macintosh
- OPERATING SYSTEMS - MS-DOS, XENIX, Network, Finder, & Multifinder.
- LANGUAGES/COMPIILER - Over 50, including runtime packages, data bases and spread sheets. We have a non-programmers interface as well.

Call or write for more information.

GLENCO
ENGINEERING INC.
SERVING THE SOFTWARE INDUSTRY SINCE 1979
721 W. Algonquin Road, Arlington Hts., IL 60005, (312) 364-7638, FAX 364-7698

In Europe contact: SOC Security Systems, The Netherlands
Tel: +31-45-445335, FAX: +31-45-444744

Circle 128 on Reader Service Card

Circle 128 on Reader Service Card
NOW THE CHOICE IS SIMPLE.

USE THE FAIRCOM® TOOLBOX AND GET BOTH 4GL SPEED AND C SOURCE CODE POWER.

Whether you need the development speed and convenience of 4GL programming or the low-overhead power capabilities of C source code, the FairCom ToolBox can meet the requirements of any professional developer!

INDUSTRIAL STRENGTH TOOLS

Develop applications the way you want with The ToolBox's industrial strength tools.

Development Environment by d-tree®
- Prototype generation
- Data dictionary
- Dynamic resource swapping
- Screen management
- Overlapped windows
- File restructuring
- Runtime portability
- Menu management

File Management by c-tree®
- Variable length records
- Key compression
- Client/Server architecture
- Ascending/Descending key segments
- Dynamic space reclamation

- Portable. Used in over 100 environments
- Variable length key fields
- High speed B+ trees

Report Generation by r-tree®
- Complex multi-line reports
- Multi-file access
- Complete layout control
- Conditional page breaks
- Nested headers and footers
- Unlimited control breaks
- Dynamic format specifications
- Horizontal repeats
- Powerful set functions

POWER AND FLEXIBILITY

Now you can create applications using the methods you like — whether it's 4GL convenience or C source code power. You can have it all with FairCom's introduction of The ToolBox Special Edition. And at $695 you get this power at a price you can afford.

ORDER TODAY

Order the FairCom Development ToolBox and use it for 30 days. No risk. If the FairCom ToolBox doesn't meet your development needs, just return the entire package for a full refund.

CALL 1-800-234-8180 TODAY FOR YOUR FAIRCOM TOOLBOX

The ToolBox,
Professional Edition ........ $1,095.00
DOS, Unix, Xenix, VMS, OS2 Full source, single and multi-user support.

The ToolBox,
Special Edition ............... $695.00
Microsoft, Borland, Xenix, OS2 Object Libraries, single user only.

Upgrade to
Professional Edition ........ $400.00
Includes overnight delivery.

FAIRCOM CORPORATION
4006 West Broadway
Columbia, Missouri 65203
(314) 445-6833
FAX (314) 445-9698

Circle 113 on Reader Service Card
The rest of the line is a so-called "chat script" that alternates between strings to be expected from the other system and strings sent to the other system. The chat script begins executing once connection strings sent to the other system. The chat script "that alternates between strings to call a system using cu, the chat script is made to the remote system. When you other null string (i.e., the pair of quotes) means to initially expect nothing. It serves as a placeholder. The \|\d\r, meaning "Delay one second, then carriage return," is then sent out to the remote system. This expect/send pair is useful for goading systems that would otherwise wait too long to send their login prompt.

The next string, gin:--gin:-BREAK-gin:, anticipates the last characters of the log-in prompt from the remote machine. The double dashes request that an essential for debugging chat scripts, and it's interesting when you're just getting started.

If these three tries fail, then the chat script fails. However, if the other system is running properly, one of these combinations should elicit the desired login: prompt, at which time the script knows to send out the UUCP log-in name of your computer (in this case, nuucp). Then, you expect to get a Password: prompt (again, you just look for the last few characters), at which time your system sends the message foolyou.

Then the fun begins, as UUCP connects to the other system and begins exchanging any mail and news that each system may have queued up for the other. To watch all this happen, run /usr/lib/uucico -rl -Slizard -x9. You won't want to do this all the time, but it's essential for debugging chat scripts, and it's interesting when you're just getting started.

UUCP will block calls to systems if certain lock or status files exist, so you should remove them before testing. In HDB, these are /usr/spool/uucp/LCK* and /usr/spool/uucp/Status/system (where system is the name of the system you're trying to call). Status files in earlier versions of UUCP are named /usr/spool/uucp/STST.system.

Finally, to make sure pending mail, news, and UUCP requests get processed, you must ensure that the uucico program executes once or twice an hour. The shell script /usr/lib/uucp/uudemon.hour should run from the cron task scheduler by the user uucp. Either /usr/lib/uucp/uudemon or /usr/lib/uucp/uudemo -r1 should be in the uudemon.hour script.

Next month, I will finish up the UUCP discussion with some more hints and tricks, and delve into some public domain programs that help make E-mail and UUCP a bit more interesting, if not easier.

David Fiedler is publisher of the Unix Video Quarterly and the journal Root, as well as coauthor of the book Unix System Administration. He can be reached on BIX as "fiedler."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
Ten Channels: four parallel and six serial, all can be software configured as either input or output; automatic conversion from parallel to serial, serial to parallel, or serial to serial parameters; automatic switching and queuing of jobs

115,200 bps: our software allows virtually all PC applications to send data serially to the SL twelve times faster than normal 9,600 bps serial

PC to PC Serial File Transfer Utility: available free

Pop-up Menu via Hotkeys: keyboard selection of printers, macros and many other control functions

Simple Installation: just plug in the cables and run the menu-driven installation software for the Pop-up Menu

User Upgradable Memory: from 0 to 4MB buffer

The SL Saves Money By Sharing Resources
Using the SL™ is the inexpensive way to let everyone share lasers, printers, plotters and modems. Greater access by more users reduces unproductive idle time and the need to purchase more of these expensive peripherals. An SL with memory improves PC productivity by allowing all users to simultaneously send their print jobs and quickly release their PCs to continue working. The SL is an alternative to a LAN at a fraction of the cost.
The new DigiCHANNEL series of multi-user communications boards sets the new performance standard for terminal response time, especially under heavy user-load conditions. The key to this performance is the synergy between our hardware and our new Front End Processing real-time Operating System (FEP O/S 5.4) software.

The proof is in the numbers, and a good example is the DigiCHANNEL PC/16i. In benchmark tests, it beats every other leading board in the two critical areas that determine board performance: data throughput and processor overhead.

Data throughput is calculated by measuring the total amount of data that a board can handle per port and per system. The higher the data throughput, the faster the response time for each user on the system.

Processor overhead is the amount of additional processing imposed on the CPU to handle the data input/output being controlled by the communications board. The less time the CPU needs to spend on I/O chores, the more time it can spend processing applications for terminal users.

Call for our FREE technical white paper with all the details on our benchmark testing. While you’re at it, ask for our FREE booklet, How to Do Multi-User Right.

No matter how simple or complex your multi-user systems, you can trust DigiBoard to put you at the head of the pack. And keep you there.
CD-ROM TO THE RESCUE

If your business needs complete and accurate information in a hurry, databases on CD-ROM may fill the bill.

Jim had a problem. A new client wanted to talk to his boss about a project that was being relocated to a remote site in the Pennsylvania mountains. Unfortunately, his boss was in a small hotel in Zambales in the Philippines, and it was now 3 a.m. there. Jim knew that overseas telephone calls are not always reliable and are not always answered in the wee hours. He also knew that his boss was leaving soon to see the new client, but at the old site.

Fortunately, Jim also knew that the international telex networks are quite reliable and immune to the interruptions that plague voice telephone traffic overseas. He knew that nearly every hotel in the world that caters to business travelers has a telex number. All he had to do was find the telex number for the hotel in the Philippines and send a message.

Unfortunately, this is easier said than done. While telex directories do exist, they are expensive; they normally cover only a few of the many networks in any area; and the thorough, accurate ones are massive, due to the hundreds of thousands of listings they must contain. Few businesses want to deal with the bulk, the expense, and the uncertain coverage of paper telex directories.

Jim's boss, of course, had no idea his client had a new site or where it was located. Thus, Jim knew he would have to find a source that would tell him about Pennsylvania and locate the new site's proper county and town.

Jim grabbed a copy of Time-Space Research's Supermap disk, inserted it into the CD-ROM drive on his PC clone, and loaded a list of the counties in Pennsylvania. This source provides information on localities and the demographic business and physical information about them. When he found the correct county, he looked at a map of the state, which had the county highlighted. It was clear from the map that the site had to be near Pittsburgh. With that in mind, Jim turned to the problem of the telex number.

Finding the telex number was even easier. Jim used the Jaeger-Waldmann worldwide CommDisc package, which provides every telex and teletex number and many fax numbers. Despite the vast quantity of information it contains—it takes two CD-ROMs to hold it all—the J+W CommDisc allows speedy search and retrieval. You can search by the name of the telex subscriber (or a portion of the name), its address, or its city or country. If you know only part of the information (e.g., the hotel name but not the city), you can search on what you do know. You will have to look at a few more entries, but it can be surprisingly few if you're careful what you ask for.

The CD-ROM telex directory includes the capability to display company logos, advertisements, and information beyond the telex number. Many companies also include a fax number, for example. The telex number listing includes the name of the telex network as well as the subscriber's answerback.

Within minutes, Jim was able to compose a message to his boss explaining the change in plans. With the information he had obtained from the CD-ROM, Jim gave his boss particulars about the new site, the name and location of the airport he needed to fly into, and the specifics of the meeting arrangements. Without the information on the disk, Jim's task would have been difficult, if not impossible.

Not every business needs a listing of...
ITEMS DISCUSSED

CDU-510 .................................... $895
Sony Corp. of America
Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000
Inquiry 1101.

Day-Timers Quick Trip
Carryall ................................... $135
Day-Timers, Inc.
One Day-Timers Plaza
Allentown, PA 18195
(215) 395-5884
Inquiry 1102.

J+W CommDisc telex and fax
directories .................................. $1850
Universal Media Division,
Shamgar, Inc.
212 Broadway
Bethpage, NY 11714
(516) 433-6767
Inquiry 1103.

or

Jaeger + Waldmann GmbH
P.O. Box 11 14 54
Birkvenweg 8-10
1600 Darmstadt 11, West Germany
49 (6151) 3302-0
Inquiry 1104.

Supermap U.S. Census Data and
Mapping Companion .................. $4500
Chadwick-Healey, Inc.
1101 King St.
Alexandria, VA 22314
(703) 683-4890
Inquiry 1105.

or

Time-Space Research Pty Ltd.
668 Burwood Rd.
Hawthorn, East Victoria, 3123
Australia
61 3813-3211
Inquiry 1106.

longer have the luxury of looking up information at your leisure, unless you want the competition to get there first.

One answer to this need for immediate access to great quantities of information is the CD-ROM. The demand for more and more information has resulted in significant growth in the quantity and variety of information available in this format. Where once reference material was limited to Microsoft Bookshelf, CD-ROMs are now available with contents ranging from the CIA's World Factbook to facts about additives in fast food. Many of these items are public domain information that has been packaged on CD, so the cost is surprisingly low.

Horizontal and Vertical Markets

The CD-ROM marketplace contains a great deal of vertical-market software and information. For reasons that I'll cover next month, this area of information is becoming very attractive to companies that need to provide large quantities of information for their customers.

Information for the horizontal market is aimed at a variety of businesses. Companies that publish horizontal-market packages on CD-ROM try to provide information that many types of businesses will use, and then they try to sell it to businesses in general. A CD-ROM reader similar to the Sony unit I looked at for this column now costs about $600. If you think that your business needs this type of resource more than a few times a year, you can probably justify the cost in terms of the staff time you will save and the accuracy you will achieve.

CD-ROMs intended for business use normally include search software optimized for the data on the CD-ROM. Frequently, this is in the form of a full-text database package that supports flexible queries with partial information. These packages are usually based on menus and are quite easy to use.

Are They for You?

Whether your business needs CD-ROMs depends on several factors. Some packages are quite expensive, although usually less so than their paper counterparts would be. They do require the installation of an additional drive and the addition of another internal circuit card. Most CD-ROM drives can play music with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash, or in the to.wayne conference.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
A class at Microsoft® University will go straight to your head.
Reason being, your course instructors work for us, Microsoft. The country's leading developer of software.
Better still, they do their teaching in a laboratory setting that gives you two big advantages: Hands-on experience. And software you've developed that's yours to keep.
It's the fastest way to learn the latest technology being utilized in today's popular programs. Giving you, and your corporation, a big jump in developing software.
Courses are offered in several powerful systems platforms, including Microsoft OS/2, Microsoft OS/2 Presentation Manager and Windows. And innovative networking technologies like LAN Manager and Microsoft SQL Server.
To get more information and a free copy of the Microsoft University catalog, call (800) 541-1261, Dept. K88.
As a graduate, you'll soon be writing better applications, faster.
Making your career, and your company, grow by leaps and bounds.

Microsoft University®
Multiple choice.

1. VIRTUALLY UNLIMITED SYSTEM CONFIGURATIONS: Our popular MultiMicro 386/25 and 386/33 systems provide economical, yet powerful computer solutions. Our MultiMicro Tower VGA 386/25 and Super Tower VGA 386/33 systems offer memory, hard drive and display options with unmatched pricing and performance.

2. MULTIMICRO CUSTOM COMPUTERS: Virtually any system configuration will be created to your exacting standards, with the assurance of MultiMicro quality.

3. COMPARISON OF OUR COMPONENTS: Major names like Intel, Weitek, AMI, Western Digital, Maxtor, Imprimis, TEAC and Seiko. All providing top quality components with maximum reliability.

4. MULTIMICRO SEAL OF QUALITY. This seal guarantees that every piece of equipment has been hand inspected and electronically tested for 72 hours or more.

5. A POWERFUL WARRANTY. We will repair or replace your system for one year from date-of-purchase, with parts shipped overnight express. 24 hour turn around.

The multiple choice begins with a simple selection: Choose MultiMicro.

582 FOLSOM STREET
SAN FRANCISCO, CA 94105
(415) 979-0140 FAX (415) 979-0142
(800) 848-4256 Outside California

Circle 196 on Reader Service Card (DEALERS: 216)

We Want to be Your Computer Company.

MULTIMICRO INCORPORATED

ALL BRAND NAMES ARE REGISTERED TRADEMARKS OF THEIR RESPECTIVE COMPANIES.
Apple takes one step forward with education and one step back with software development

I work closely with Apple. Some of you have suggested that I work too closely and sometimes am too critical of Apple, because I feel for this company. I plead guilty to that charge. I know this company well, probably better than any other technology company I deal with. While I count many of its employees as my close friends, I do tend to take things that Apple does with at least some personal grain of salt. If I sometimes lose sight of Apple and its role in the bigger picture of commercial computing technology, I apologize. It’s hard to watch a close friend make an error without spouting off about it.

But I also know when to praise Apple. This is one of those times. Most large hardware vendors have some kind of programs in place to encourage education, especially higher education. Most of these programs are simple grant or extended loan programs, where the vendor donates hardware to a school for use in its classes or research, sometimes with topical areas targeted for the grants. Thus, we’ve seen grants for developing courseware, teaching English, research in software engineering, and others.

While these programs are certainly worthwhile, they’re really not much more than thinly disguised soft-sell marketing efforts. If a vendor can get faculty, staff, and especially students exposed to its machines on campus, the marketing theory says that they’ll be enamored of that equipment and want to buy more (or buy it for their companies after graduation).

There’s certainly nothing wrong with these tit-for-tat grant programs, but they don’t go far toward helping schools in the business of teaching and research. Also, they don’t build strong long-term buying constituencies for the computer companies. Apple has been a tit-for-tat company with its education grants for years, but recently it has branched out with new programs that don’t have equipment donation as their primary interaction with the schools.

The Bright Side
One of these programs, Apple’s Academic Marketing Competition, is two years old. The idea behind AAMC is to create a program within a group of targeted universities where students develop and execute their own marketing program. Not surprisingly, the marketing program has to be about Apple products generally, and the Macintosh specifically. And to keep that focus in mind, Apple donates two Mac SEs to each participating school and provides a fully equipped Mac lab to the winners (after all, this is a competition).

The way AAMC has worked so far is that Apple has identified some universities with a large or growing Mac presence and others where the Mac is just beginning to emerge as the machine of choice. Once these are identified, Apple uses its higher education marketing people already working with those schools to find a group of students on each campus willing to take part. Uniformly, this has meant working with a class of marketing students and their instructor (and other allied faculty). Significantly, not all the classes Apple has worked with in AAMC are business school marketing classes. Others have been journalism classes, graphics design classes, and those studying the sociological implications of technology marketing.

continued
The rules for AAMC are fairly clear and reasonably flexible. Each team works with its Apple higher education representative and has a $2000 budget (also supplied by Apple, and separate from the donated hardware). The team plans, puts together, and executes a specific marketing plan at its school. Each team uses the budget as it sees fit to buy advertising. Similarly, the teams can use the Mac SEs any way they choose. Most teams use the computers to design ads, plan schedules, write ad copy, produce radio commercials, and create storyboards for TV ads. Some choose to give away one or both of the SEs as part of the plan; others barter or sell one or more of the SEs to increase their budget.

Results of the competition are judged in a single-day presentation in front of a group of 10 judges selected from the computer industry. Each team spends 20 minutes presenting its campaign in any way it chooses, trying to convince the judges that its plan has been created and executed to perfection, and relying on Mac-generated multimedia to enhance the presentations. I recently spent a very enjoyable two days judging an AAMC in Canada. My memories of the whole process are clear.

The winner of the Chicago competition, the University of Missouri-Columbia, blew away the judges with the completeness of its campaign, how well it integrated the Mac into its campaign, and its preparation. On top of that, this team was a wonder at its presentation. In short, it was the only team to convince me and the other judges that we should hire it as our ad agency. And it did so by subtly influencing us with the technology of the Mac, its interface, and the ease with which the team pulled the whole thing off.

These kinds of competition change the way that personal computers are thought about and used in a broader range of careers. Apple deserves kudos for this, as well as our encouragement for future AAMC-style programs. If personal computing is ever going to live up to the promises made for it, such programs will have to become the standard, not the exception.

Personal computing is not about making a lot of money, nor about buying and using all the latest gear. Personal computing is about people using a malleable machine that can fit their work patterns theoretically better than any Swiss Army knife ever made. Apple has begun something significant with the Mac that goes way beyond user interfaces. Its revolutionary view of how personal computing is conceived is just now starting to take off and spread to others in the industry with a parallel vision. With programs such as AAMC, Apple has proven that it still maintains the conceptual lead over its competitors.

A Darker Side

Having said all that, you still can’t lose sight of the building blocks that make up the revolution. The personal computing revolution started by the Mac and fostered by Apple each year (much better this year than in previous years) is based on the Mac’s user interface. Without that now-familiar Mac Desktop, we wouldn’t be worrying about stuff like Motif, X Window System, Presentation Manager, Open Look, NewWave, and others.

The problem with the Mac has always been the paradox of software development. While the Mac user interface can be seen as the first ease-of-use win for personal computing users, it has been a royal pain for software developers. People who have been developing for the Mac since 1984 still complain about twiddling with the Mac’s esoteric Toolbox ROM calls (which get more complex with each new CPU), its complex development system (MPW), and its arcane user-interface guidelines (which Apple regularly violates while nearly terrorizing developers into adhering to).

The problem of software development on the Mac is going to get worse. As System 7.0 rolls out this year, and Apple gets close to a CPU with 1 megabyte of ROM code, developers will be screaming for help. Apple should take a serious look at overhauling its developers’ tools, probably by scrapping MPW (or rewriting it) and refining its MacApp-oriented programming (OOP) tools.

Apple also needs to produce a lower-level developers’ system that could be built on the ideas popularized in HyperCard and announced in AppleScript. It should include some of the nice prototyping features of Plus and SuperCard, with structure and language editors on a par with Prograph and QUED. It wouldn’t even have to be all Apple. The company could license parts of other systems for both the lower-level system (I call it the Mac User’s Software Kit [MUSK]) and the professional system (I’ll call it the Mac Professional Developer’s Software Kit [MPDSK]).

Regardless of how Apple breaks these out and how it puts them together, the need is certainly there. Apple must make it easier for pros, semipro, and power users to roll their own applications and to distribute them to other Mac aficionados. Apple also needs to give MPDSK users the ability to cross-develop their software for other platforms. The “not invented here” syndrome won’t do at all. Other graphical user interfaces (GUIs) are here to stay, no matter how many lawsuits get filed. Applications need to be developed with more than one computer in mind, and the translation between environments needs to be made as transparent as possible for developers.

Here is another one of those golden opportunities for Apple to take the lead in the personal computing revolution that it started. Just as it has recaptured the higher education market with innovative cooperative programs like AAMC, an Apple-developed cross-GUI programming system would set the pace for others to follow.

Tip of the Month

Speaking of development systems, I’ve been using a new one lately, called Prograph, from TGS Systems. So far, this graphically oriented OOP system lacks a compiler, but that should be completed by the time you read this. The Prograph system combines an OOP environment with a GUI programming environment that relies on visual programming metaphors (e.g., HyperCard). To this interesting mix, TGS Systems adds familiar data-flow diagrams.

While Prograph 1.2 won’t replace MPW or even Symantec’s Think compilers, it’s an important new kind of development system. If you’ve toyed with the idea of Mac software development before, but you were put off by the weaknesses of HyperCard and the complexities of MPW, look at Prograph.

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as “decrabb.”

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
Even to the experienced observer, a disc drive is a technological marvel. With discs spinning at 60 revolutions per second, the mechanics involved are astounding. It takes a company with a unique level of skill and experience to produce drives in volume that perform reliably year after year. A company like Seagate.

Our 3.5" ST1096 family is a great example of Seagate craftsmanship. Featuring a choice of 42, 60 or 83 formatted megabytes, these high performance (24 msec average access time) drives are ready for demanding PC and Apple® applications. The family offers ST412/MFM and SCSI interfaces for application flexibility. And they all feature a 50,000 hour mean-time-between-failure rate.

Like the artist who spends years perfecting his craft, Seagate has spent the past decade mastering the fine art of disc drives. For more information on our multi-faceted product line, contact your authorized Seagate distributor, or call Seagate directly at 800-468-DISC, or 408-438-6550.
Power Packed & Built To Last.

STANDARD 150 $69
Economical This UL approved, fully tested unit is one of the best generic 150s available. Ideal for basic systems.

SILENCER 150 $129
Ultra-Quiet Stop that irritating whine with the Silencer 150. Its large, low speed, West German fan keeps your system 5° to 15° cooler and 84% quieter. Virtually inaudible! Great in the executive suite or home office.

TURBO-COOL 150 $149
High Performance Upgrade your PC/XT with our popular, UL approved Turbo-Cool 150. Its patented twin fan, sloped-cover design keeps your system 25° to 40° cooler and 50% quieter. Prevents intermittent data errors and other heat-related problems. Meets the demands of a fully loaded system.

STANDARD 220 $99
Economical This UL approved, fully tested unit is one of the best generic 220s available. Ideal for basic systems.

SILENCER 220 $149
Ultra-Quiet Unrattle your nerves with the Silencer 220. Its high-efficiency, adjustable-speed fan offers 69% less noise with standard cooling. Quieter than most hard drives. Great in the executive suite or home office.

TURBO-COOL 250 $189
High Performance Protect your investment! Upgrade your AT/386 with our powerful, UL approved Turbo-Cool 250. Its high-capacity, adjustable-speed fan keeps expansion cards, hard drives, and other valuable components 20° to 35° cooler for up to three times longer life. Perfect for a fully loaded system.

TURBO-COOL 200 $189
Maximum Performance Put AT power and 200% more cooling under the hood of your PC/XT with our UL approved Turbo-Cool 200. Its twin fans keep your system 30° to 45° cooler for maximum expandability. Perfect for hot rod PCs and Mini ATs!

TURBO 375/450 $299-$369
Maximum Performance The choice of PC professionals, our Turbo 375 and Turbo 450 feature built-in line conditioning, autoselect input, independent regulation, external DC voltage adjustment, remote switch option, enhanced cooling, UL/CSA/TUV approval, 50,000 Hr MTBF, and 2-year warranty! Ideal for workstations and network file servers.

CP160 $169
Original Portable Upgrade Give your Portable greater reliability and 100% more power with our direct replacement CP160. Allows 286, 386, and hard disk upgrades.

CD270 $249
Deskpro Upgrade The power user's power supply! Our direct replacement CD270 gives your 8086/286/386 Deskpro up to 70% more power and the reliability it deserves. Prevents nuisance rebooting. Advanced design includes autoselect 110V/220V. 2-year warranty.

---

Our power supplies feature:
• Full-rated power
• UL/FCC compliance
• 110V/220V input
• 4 drive plugs (min)
• Heavy-duty components
• Low output ripple
• OVP, OCP, SC protection
• Installation instructions
• Rigorous testing
• 1-year immediate replacement warranty

“Could you buy cheaper no-name power supplies almost anywhere, but don't. PC Power and Cooling's units are better made and more reliable than anything in the field.”

PC Computing
January, 1989

Most orders shipped same day. We accept Visa, MC, COD or PO on approved credit.
Incremental improvements are a sign that OS/2 is maturing

I told you about using the High Performance File System (HPFS) last month. Now I'll look at OS/2 1.2 in general. I've been living with this new version for a while, and for those of you who are still thinking of taking the plunge, here are some of the things you'll find.

Compatibility
It appears that just about anything that ran version 1.1 will run version 1.2. As before, one of my OS/2 workstations has a DTK motherboard with the Phoenix BIOS 3.06 (you may recall that the DTK BIOS doesn't seem to work with OS/2). My Micronics 386 motherboard, as before, will not boot version 1.2. That's probably because this early Micronics motherboard required a daughterboard to use an 80387, and something about the daughterboard upsets OS/2, or so I am told.

I don't have a later motherboard to test this claim on because Trillian Computer, the company I bought the system from, has washed its hands of this particular computer—you see, the company doesn't sell Micronics motherboards anymore. Micronics has no suggestions, either, alas, so for now I've got to advise caution when buying Micronics motherboards for use with OS/2.

Of course, 1.2 runs on the IBM machines that I've tested it on, although running it on either the PS/2 Model 30 286 or the 50 Z is a joke: version 1.2 takes about 10 megabytes of disk space, about the same as 1.1, and both computers ship with 20-MB drives. I suppose that means that the official low-end IBM OS/2 machine will be the Model 50 Z, but most folks I know who are doing real work on OS/2 end up with the 386SX-based PS/2 Model 55 SX or the 386-based PS/2 Model 70.

If you're a Big Blue-only person, I'd suggest (reluctantly, as it's expensive) that you look at the PS/2 Model 80. It is built around a 386, can be gotten with the large hard disk drives that OS/2 really needs, and has numerous slots. You'll want the slots for the 8-plus MB of RAM that is needed for the Extended Edition or some other communications/database product.

Performance
I hate to say it, because I love the features that I get from OS/2 (e.g., large memory and multitasking), but it's still slow. For example, I do a lot of work with three object-oriented graphics packages: Generic CADD, a regular DOS application that creates its own graphical environment; Micrografx Designer, one of the best (if not the best) Windows-based object-oriented drawing programs; and Designer/PM, a beta version of Micrografx Designer for use with the Presentation Manager (PM).

The difference in speed of screen handling is remarkable and instructive. Because it does its own screen management, Generic CADD runs respectably on an 8-MHz 8088 machine. It's built around a 386, can be gotten with the large hard disk drives that OS/2 really needs, and has numerous slots. You'll want the slots for the 8-plus MB of RAM that is needed for the Extended Edition or some other communications/database product.

The benefits of Windows are counterbalanced by its overhead. That's why...
Windows was renamed Windows/286; you can certainly run Windows/286 on an 8088 machine, but you really don’t want to. However, Windows looks positively snappy compared to PM: Everything takes forever on a 286. PM’s overhead must be tremendous. And 1.2 has not solved the problem. I suppose it’s an

I just wonder how long it will be before OS/2 runs without delays.

Next-generation video hardware should solve the problem.

other argument for not buying below 386 machines if you’re running OS/2.

Don’t get me wrong, I’m not beating up on OS/2. I’m just wondering how long it will be before it runs without delays. Next-generation video hardware will solve the problem, if PC vendors can get together on a standard.

The problem stems from the basic approach to putting graphics on the screen. Suppose a program wants to put a circle on the screen. With the popular graphics boards (i.e., CGA, Hercules, EGA, and VGA), the program describes the circle as a series of commands to place dots, or pixels, on the screen. Basically, it does a pile of calculations that are familiar to students of trigonometry: sines, cosines, and the like. (That’s why a numeric co-processor improves the performance of most graphics programs.)

This pixel-by-pixel approach is, as you’d imagine, quite compute-intensive. It’s also video-board-type-specific: You have to know how many pixels exist on a VGA to write a VGA driver, how many on an EGA for an EGA driver, and so on.

The newest video boards take high-level graphics commands independent of board resolution. The width and height of the screen are defined as 1.0, and a point can be placed anywhere from (0.0, 0.0) to (1.0, 1.0). For example, the center of the screen would be (0.5, 0.5).

NOR must the program direct the board to place pixels in order to define a circle.

Instead, the program just tells the video board to place a circle on the screen, centered on a given point and extending for a given radius. It’s a more efficient system because the last video board has a microprocessor on-board that’s been optimized for this kind of work.

Texas Instruments and Intel make chips that are intended for just this kind of thing; the problem is that no big PC vendor has popularized the idea enough to make it cheap. The TIT34010 graphics chip isn’t exactly new and untried at this point. Why not embrace it? Perhaps someday soon. If the slowness of the PM’s screen handling isn’t enough to spur the development of such products, I don’t know what is.

Needed Fixes: Fonts and the Spooler

Two really annoying features of 1.1 were the buggy spooler and the hidden fonts. The spooler, as I’ve mentioned in previous columns, was pretty useless under 1.1. Version 1.2’s spooler seems better, and now there are printer drivers for PostScript and Epson printers, Hewlett-Packard plotters, and a number of IBM printers.

The Times Roman and Helvetica fonts are now also preloaded into the PM, so there is no more wandering through the Control Panel. With 1.1, you got (in addition to the usual monospace Courier font and the proportional Helvetica-like System font) those ever-popular mainstays of desktop publishing, Times Roman and Helvetica.

Unfortunately, the fonts were copied to the hard disk by the automatic installation procedure, but not installed—the two actions are separate under both Windows and PM, and it takes some digging in the manuals to figure out what must be done and how to do it. You probably needn’t worry about it here, however, as 1.2 preloads the fonts—a nice touch, and a needed one.

Improvements

Here are some more welcome changes that I found in version 1.2.

Command history. Many of you no doubt use a program like DOSEDIT or CED under DOS to remember previous commands. Such a program lets you recall the last 20 or so commands, edit any command, and reissue it just as if you’d typed the whole line.

For those who don’t use something like that now, let me tell you, it’s indispensable, because it saves retyping lines entered in error and simplifies repetitive tasks. A public domain “command continued
Today's computer graphics require a new way of looking at things. For the latest in leading-edge displays, look to Microvitec.

Our new CAD-Scan monitor shows every detail from edge-to-edge through its unique 17" flat square, .26mm dot pitch screen. It scans from 48 to 64 kHz for compatibility with high-end graphics cards. And its small-footprint, tilt/swivel stand saves precious space on the desktop.

In fact, our entire range of displays provide features for applications from financial trading and the factory floor to the office, school and home. For all types of PCs and workstations, interactive video systems, Uniplex and ANSI operating environments.

Whether you need one display or one thousand, take a look at Microvitec. What you see might surprise you.

MICROVITEC

Circle 190 on Reader Service Card
(DEALERS: 191)

Our new CAD-Scan monitor displays your sharp ideas through its high-resolution 17" flat square screen. It's compatible with high-end 48 and 64 bit

graphic cards for IBM* and Apple* PCs and leading graphics workstations.

Microvitec Plc, Bolling Road, Bradford, West Yorkshire, BD4 7TU, UK. Tel: (+44) 274-390011
Microvitec, Inc., Atlanta, USA, Tel: (+1) 404 991 2246
Microvitec GmbH, West Germany. Tel: (+49) 211 24 30 81

MICROVITEC

Circle 190 on Reader Service Card
(DEALERS: 191)
history” program for OS/2 named Alias has been around for a while, but it’s nice not having to hunt around for Alias every time I set up a system. Thanks, Microsoft and IBM. How about putting this feature in DOS?

On-line documentation. Rather than having to hunt around for the manual to look up some obscure syntax, there is now an on-line command reference that is installed (optionally) by the Install program. Take my advice and install it. You see, you don’t get a manual with IBM OS/2 1.2 that completely describes the commands. You must install the command reference on-line or buy the separate command reference book from IBM (lesson number 457,199 in “how to annoy customers”).

The command reference is as complete as the old OS/2 manuals. Since there are new options for several commands, take a look at the on-line reference before going too far with OS/2. Oh, and a hint on using the reference: You’ll see a command syntax tree showing each option, but no description of what each option does. What you must do to get more information is to click, hypertext-like, on the option itself—you’ll get the whole story then.

No more unnecessary disk checks. Version 1.1’s file manager had an incredibly annoying habit. When it started up, it checked each floppy disk drive to see if there was a disk in the drive. As there generally is not a disk in the drive, the file manager waited a minute or two for each drive to time-out, and believe me, that minute got longer every time you loaded the file manager. No more.

Dual boot. Dual boot has been needed for some time, and it’s a welcome addition. One problem with dual boot was setting up the directories for both DOS and OS/2: OS/2 left the root directory a real mess, with some basic system device drivers required to be in the root directory. But that’s all fixed.

The change from 1.1 to 1.2 was more evolutionary than revolutionary (save, of course, for the HPFS), but perhaps that’s because OS/2 is starting to mature. We’ll see just how mature when the 386 version appears.

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
## STANDBY UPS MODELS

<table>
<thead>
<tr>
<th>Power Output</th>
<th>120 Volt Models</th>
<th>208-240 Volt Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 WATT</td>
<td>$379.00</td>
<td>$429.00</td>
</tr>
<tr>
<td>300 WATT</td>
<td>$549.00</td>
<td>N/A</td>
</tr>
<tr>
<td>500 WATT</td>
<td>$699.00</td>
<td>$799.00</td>
</tr>
<tr>
<td>600 WATT</td>
<td>$899.00</td>
<td>$1049.00</td>
</tr>
<tr>
<td>900 WATT</td>
<td>$1249.00</td>
<td>N/A</td>
</tr>
<tr>
<td>1200 WATT</td>
<td>$1499.00</td>
<td>$1749.00</td>
</tr>
<tr>
<td>1600 WATT</td>
<td>$1999.00</td>
<td>$2299.00</td>
</tr>
</tbody>
</table>

## TRUE ON-LINE UPS MODELS

<table>
<thead>
<tr>
<th>Power Output</th>
<th>120 Volt Models</th>
<th>208-240 Volt Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 WATT</td>
<td>$2249.00</td>
<td>Available</td>
</tr>
<tr>
<td>3000 WATT</td>
<td>$5495.00</td>
<td>Available</td>
</tr>
<tr>
<td>5000 WATT</td>
<td>$8950.00</td>
<td>Available</td>
</tr>
</tbody>
</table>

## ON-LINE UPS MODELS

- 1000 To 5000 VA Sinewave Output
- True On-Line — Total Isolation
- Static Bypass Switch Standard

## SHUTDOWN SOFTWARE

- Auto Shutdown of Local Area Networks for Unattended Operation
- Compatible with SCO XENIX 2.2.3 and above
- Novell ELS 2.12 and above
  - Advanced Netware 2.11 & above
  - SFT Netware 2.11 and above

---

**Para Systems, Inc.**

1455 LeMay Drive
Carrollton, TX 75007

Phone: (214) 446-7363

Fax: (214) 446-9011

Telex: 140275 OMEGA

---

Circle 213 on Reader Service Card
April 1st is funny.

Adobe Systems ... NCP
Streamline Windows 1.0—Converts your bitmapped images to PostScript format. Imports TIFF, PNT, and PCX formats. Exports to EPS, Illustrator, Corel Draw and Micrografx Designer. ......... $229.

Adobe Systems ... NCP
Illustrator Windows 1.0 .... $279.
Streamline Windows 1.0 .... 229.
Aldus ... NCP
PageMaker 3.0 .......... 499.
Alpha Software ... NCP
Alpha Four 1.1 ......... 319.
Alpha Works 2.0 ...... 89.
Application Techniques ... NCP
Pizzazz Plus 1.3 ....... 69.
AutoTate ... NCP
Dbase IV 1.0 .......... 499.
Autodesk ... NCP
Autocad 2.0 ........... 95.
Autodesk Animator 1.0 .. 189.
Avery ... NCP
Label Pro 1.0 ........... 49.
Bitstream ... NCP
Fundamentals: Reports and Proposals, Presentations or Spreadsheets .... each 159.
Headlines (1 to 6) ....... each 99.

Alpha Software ... NCP
Alpha Four 1.1—The award-winning, fully relational database management & application development system for business people, not programmers. Offers sophisticated reports and customized applications .......... $319.

Bloc Publishing ... NCP
FormTool 2.01 ........... 55.
PopDropPLUS 1.0 ......... 59.

Borland International ... NCP
Turbo C Professional Pack 1.0 .... 175.
Turbo Pascal Professional Pack 1.0 .... 175.
Quattro Pro 1.0 ........... 289.
Paradox 3.0 ............... 469.

Brightbill-Roberts ... NCP
Hyperpad 1.0 ............. 89.

Broderbund ... CP
New Print Shop (NCP) .... 39.
Memory Mate 3.01 (NCP) .... 45.

ButtonWare ... NCP
PC-File 5.0 ............... 75.

Caere ... NCP
Omnipage 386 2.1 ....... 599.
Central Point ... NCP
PC Tools Deluxe 5.5 ...... 77.
Copy II PC 5.0 ........... 27.

Chipsoft ... NCP
TurboTax for 1989 Taxes 7.0 .... $45.
Individual States ........ each 34.

Chronos Software ... NCP
Who What When 1.08 .. 119.
Concentric Data Systems ... NCP
SQL R & R Relational Report Writer 3B ... 109.

Corel Systems ... NCP
Corel Draw 1.1 ........... 329.

CrossTalk Communications ... NCP
Crosstalk XVI 3.7 ... 109.

DacEasy ... NCP
DacEasy Accounting 4.0 .... 89.

Data Storm ... NCP
PROC COMM PLUS 1.1 .... 52.

Delrina Technology ... NCP
nForm 2.0 .... 169.

Delta Technology ... NCP
Direct Access 4.1 ....... 52.

Digital Composition Systems ... NCP
Bob Publisher Report Maker 2.0 .......... 185.

Dow Jones ... NCP
News/Retrieval Membership Pkg. 24.

5th Generation ... NCP
MacUtilities 1990 .... 89.
Fastback Plus 2.09 .... 109.

FoxWorx ... NCP
FormWorx File & File 2.5 .... 85.

Fox Software ... NCP
FoxPro 1.0 ............... 489.

Funk Software ... NCP
Sideways 3.21 .......... 42.
Allways 1.0 ............... 85.

Generic Software ... NCP
Generic CAD Level 3 1.13 .... 169.

Great American Software ... NCP
One Write Plus Accounting Sys. 2.0 .... 179.

Harvard Associates ... NCP
PC Logo 3.0 .............. 59.

Hayes ... NCP
Smartcom II 3.0 ........ 89.

Microcom ... NCP
CarbonCopy Plus 5.2—Links two PCs, their keyboards, screens, and disks. You can have complete control of a remote PC's application software from your own PC. .... $115.
Aprill 15th means money.

Hilgraeve ... NCP
2323  HyperACCESS 1.0 (DOS & OS2) ... $115.
IBM ... NCP
6187  Storyboard Plus 2.0........ 239.
6599  Current 1.0........... 239.
Individual Software ... NCP
2408  Professor DOS 4.0........ 27.
6222  Resume Maker 1.0........ 29.
Intuit ... NCP
2426  Quicken 3.0........... 39.
Lord Publishing ... NCP
5191  Ronstadt's Financials 1.02... 145.
Lotus ... NCP
5417  1-2-3 3.0........... 3.
call
5653  1-2-3 2.2........... 2.
call
5134  Magellan 1.0........... 149.
4311  Agenda 1.0........... 275.
2660  Freelance Plus 3.0........ 31.
MECA ... NCP
4603  Andrew Tobias' Tax Cut 1989... 45.
2798  Managing Your Money 6.0...... 119.
Microfax ... NCP
2775  CarbonCopy Plus 6.2 (2 req.)... 115.
2694  Draw Plus 1.0........... 289.
Micro Logic ... NCP
2968  1-2-3 3.0........... 3.
call
2731  QGIF 2.0 (new version).... 45.
Microsoft ... NCP
2860  Learning DOS 2.0........ 35.
2869  Windows 286 2.1........ 69.
2904  Works 2.0........... 39.
2900  Windows 386 2.1........ 129.
2901  Word 5.0........... 209.
6195  Word for Windows........ 329.
2856  Excel 2.1 (reg. 80286/80386) ... call
6133  Excel for OS/2 1.0....... 339.
5188  QuickPascal 1.0........ 69.
2894  QuickBASIC 4.5........ 69.
6195  Word for Windows........ 329.
2853  QC Compiler 5.1........ 299.
Multisoft ... NCP
4925  PC-Kwik Power Pak 1.5...... 79.

New England Software ... NCP
4337  CG8-Stat 1.5........... 159.
Nolo Press ... NCP
2982  WillMaker 3.0........... 35.
Norton-Lambert ... NCP
4928  Close-Up Customer 0.0...... 135.
4929  Close-Up Support 3.0...... 165.
5420  Close-Up Lan (User)....... 529.
Paperback Software ... NCP
6358  VP-Planner 3D 1.0....... 169.
PC Globe ... NCP
5902  PC Globe 3.0........... 39.
5900  PC USA 1.1........... 39.
Perspectives ... NCP
3126  SeeMORE 2.0........... 54.
4328  Look & Link 1.1......... 59.
Peter Norton ... NCP
3152  Norton Commander 3.0...... 89.
3148  Advanced Utilities 4.5..... 89.
6397  The Norton Backup 1.0..... 89.
Precision Software ... NCP
6600  Superbase 4 for Windows... 459.

Quarterdeck ... NCP
3221  Expanded Memory Mgr. 386 5.0 .... 59.
3220  DESQView 2.26........ 79.
4588  DESQView 386........ 129.
6400  Manifest 1.0........... 39.
6422  QRAM 1.0........... 49.
Reality Technologies ... NCP
6572  WealthBuilder 1.1....... 145.
Reference Software ... NCP
4396  Grammatik IV 1.0......... 52.
Revolution Software ... NCP
4480  VGA Dimmer 2.01 (screen saver) ... 19.
RightSoft ... NCP
4155  RightWriter 3.1......... 54.
1-800/776-7777

1-800/776-7777

ButtonWare ... NCP
3570  PC-File 5.0--The most friendly, comprehensive database available. It includes letterwriting with mail merge, business graphing, and a powerful report writer. It also works directly on dBase files .... $75.

Hilgraeve ... NCP
2323  HyperACCESS 1.0 (DOS & OS2) ... $115.
IBM ... NCP
6187  Storyboard Plus 2.0........ 239.
6599  Current 1.0........... 239.
Individual Software ... NCP
2408  Professor DOS 4.0........ 27.
6222  Resume Maker 1.0........ 29.
Intuit ... NCP
2426  Quicken 3.0........... 39.
Lord Publishing ... NCP
5191  Ronstadt's Financials 1.02... 145.
Lotus ... NCP
5417  1-2-3 3.0........... 3.
call
5653  1-2-3 2.2........... 2.
call
5134  Magellan 1.0........... 149.
4311  Agenda 1.0........... 275.
2660  Freelance Plus 3.0........ 31.
MECA ... NCP
4603  Andrew Tobias' Tax Cut 1989... 45.
2798  Managing Your Money 6.0...... 119.
Microfax ... NCP
2775  CarbonCopy Plus 6.2 (2 req.)... 115.
2694  Draw Plus 1.0........... 289.
Micro Logic ... NCP
2968  1-2-3 3.0........... 3.
call
2731  QGIF 2.0 (new version).... 45.
Microsoft ... NCP
2860  Learning DOS 2.0........ 35.
2869  Windows 286 2.1........ 69.
2904  Works 2.0........... 39.
2900  Windows 386 2.1........ 129.
2901  Word 5.0........... 209.
6195  Word for Windows........ 329.
2856  Excel 2.1 (reg. 80286/80386) ... call
6133  Excel for OS/2 1.0....... 339.
5188  QuickPascal 1.0........ 69.
2894  QuickBASIC 4.5........ 69.
6195  Word for Windows........ 329.
2853  QC Compiler 5.1........ 299.
Multisoft ... NCP
4925  PC-Kwik Power Pak 1.5...... 79.

New England Software ... NCP
4337  CG8-Stat 1.5........... 159.
Nolo Press ... NCP
2982  WillMaker 3.0........... 35.
Norton-Lambert ... NCP
4928  Close-Up Customer 0.0...... 135.
4929  Close-Up Support 3.0...... 165.
5420  Close-Up Lan (User)....... 529.
Paperback Software ... NCP
6358  VP-Planner 3D 1.0....... 169.
PC Globe ... NCP
5902  PC Globe 3.0........... 39.
5900  PC USA 1.0........... 39.
Perspectives ... NCP
3126  SeeMORE 2.0........... 54.
4328  Look & Link 1.1......... 59.
Peter Norton ... NCP
3152  Norton Commander 3.0...... 89.
3148  Advanced Utilities 4.5..... 89.
6397  The Norton Backup 1.0..... 89.
Precision Software ... NCP
6600  Superbase 4 for Windows... 459.

Quarterdeck ... NCP
3221  Expanded Memory Mgr. 386 5.0 .... 59.
3220  DESQView 2.26........ 79.
4588  DESQView 386........ 129.
6400  Manifest 1.0........... 39.
6422  QRAM 1.0........... 49.
Reality Technologies ... NCP
6572  WealthBuilder 1.1....... 145.
Reference Software ... NCP
4396  Grammatik IV 1.0......... 52.
Revolution Software ... NCP
4480  VGA Dimmer 2.01 (screen saver) ... 19.
RightSoft ... NCP
4155  RightWriter 3.1......... 54.
1-800/776-7777

1-800/776-7777

ButtonWare ... NCP
3570  PC-File 5.0--The most friendly, comprehensive database available. It includes letterwriting with mail merge, business graphing, and a powerful report writer. It also works directly on dBase files .... $75.
We've got what it takes

Timeslips ... NCP
□ Timeslips III 3.4—Track every minute's efforts, then print the invoice and log the receivable
all from the convenience of Timeslips III. Menu-driven and memory resident, this is a
must for your service business ........ $169.

Timeslips ... NCP
□ Timeslips III 3.4 .......................... 169.
Timeworks ... NCP
6253 □ Publish-It! 1.1 .......................... 115.
TOPS ... NCP
3726 □ TOPS Network Bundle 3.0 ........ 159.
3720 □ Flashcard 2.1 (Apple Talk network card; 1 year warranty) .......... 179.
Traveling Software ... NCP
4190 □ Battery Watch 2.0 (31/2" only) ........ 35.
5179 □ LapLink III 3.0 .......................... 85.
True BASIC ... NCP
3561 □ True BASIC 2.1 ...................... 52.
3765 □ SoftBytes 2.0 .......................... 35.
WordPerfect Corp. ... NCP
3799 □ WordPerfect Library 2.0 ........... 75.
3804 □ WordPerfect 5.1 ....................... 265.
WordStar USA ... NCP
2825 □ WordStar Prof. Release 5.5 ....... 229.
5000 □ Upgrade to Release 5.5 .......... 89.

Xerox ... NCP
3812 □ Ventura Publisher 2.0 .................. $529.
6505 □ Formbase 1.0 ......................... 319.
XTREE ... NCP
6161 □ XTreePro Gold 1.3 ................. 75.
YQUEST ... NCP
4393 □ XYWrite III Plus 3.55 .......... 229.

RECREATIONAL/EDUCATIONAL.

Broderbund ... CP
1417 □ Where/Europe Carmen San Diego? .... 32.
5701 □ Where/Time Carmen San Diego? .... 32.
Electronic Arts ... NCP
6436 □ Hunt for Red October ............... 35.
4659 □ Chessmaster 2100 (CP) ............ 35.
5804 □ Deluxe Paint II (Enhanced) ......... 89.
Microprose ... CP
4454 □ CF-19 Stealth Fighter ............... 39.
5923 □ Red Storm Rising ..................... 39.
Microsoft ... NCP
2958 □ Flight Simulator 4.0 ................ 39.

Microsoft ... NCP
□ Word for Windows—Combines the power of Word for the PC with ease of use and WYSIWYG accuracy
of Microsoft Windows. Integrate graphics and data from Windows applications into your documents ........ $329.

Parlor Software ... CP
3159 □ Bridge Parlor 2.3 ..................... 49.
Sierra On-Line ... CP
5695 □ Manhunter: San Francisco ......... 33.
4456 □ Police Quest II ...................... 39.
5106 □ Space Quest III ..................... 39.
6022 □ Colonel's Bequest ................... 39.
Spectrum Holobyte ... NCP
5993 □ Welltris (Tetris sequel) ........... 22.
Spinnaker ... CP
5580 □ Sargun IV ............................. 32.
3435 □ My Letters, Numbers, Words (2 to 6) .... 22.
3438 □ 1st Math (ages 5 to 6) .......... 22.
3439 □ 2nd Math (ages 7 to 16) ....... 27.
5231 □ Phonics Plus ....................... 22.
Sublogic ... NCP
6190 □ Air Transport Pilot .................. 33.
True BASIC, Inc. ... NCP
□ Kemeny/Kurtz Math Series: 10 titles ............... each 45.

Reality Technologies ... NCP
□ WealthBuilder by Money Magazine 1.1—Save &
invest wisely. Set financial goals & achieve
them. Plan for retirement, a child's educa-
tion, a home. Optimize your portfolio &
track all of your investments ........ $145.

Intel ... 5 years
Connection CoProcessor—Award winning fax-modem includes a free copy of Fax-it software from Intel. Send and receive information in the background from within many popular applications. New low price ........ $529.

HARDWARE
Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

AST Research ... 2 years
1299 SixPakPlus 384K CISP .................. 189.
4107 RAMpage Plus 286 512K ............... 419.
Brother International ... 1 year
5787 HL-8e Laser Printer ..................... 1799.
5788 HL-8Ps PostScript Laser Printer .... 2948.
Compuable ... 2 years
1604 2-Position switch box ............... 25.
1605 3-Position switch box ............... 35.
Corvus ... 1 year
6184 ReadyNet Starter Kit ................. 319.
6183 ReadyNet Add-On Kit ............... 165.
Cuesta ... 1 year
1608 Datasaver 400 Watt (power backup) ...... 429.
Curtis ... lifetime
1690 Diamond Plus SP-1+ ................. 41.
1694 Emerald SP-2 ....................... 36.
1707 Ruby 56F-2 (6 outlets) ............. 55.
1708 Ruby-Plus 56F-2 Plus ............... 65.
Diconix ... 1 year
5655 150 Plus Printer (Parallel) ......... 359.
Epson ... 1 year
We are an authorized Epson Service Center.
1906 FX-650 (80 col., 264 cps, 9 pin) ...... 369.
1904 FX-1050 (136 col., 264 cps, 9 pin) ... 479.
5183 LG-510 (80 col., 180 cps, 24 pin) .... 349.
1930 LO-850 (80 col., 264 cps, 24 pin) .... 519.
1917 LO-1050 (136 col., 264 cps, 24 pin) ... 725.
4116 LG-2550 (136 col., 333 cps, 24 pin) ... 989.
5184 LX-810 (80 col., 180 cps, 24 pin) .... 199.
1052 Printer-to-IBM cable (6 feet) ........ 15.
5th Generation ... 1 year
3952 Logical Connection 512K .......... 529.
Hayes ... 2 years
2307 Smartmodem 2400 ................. 349.
2308 Smartmodem 2400B (w/Smartcom II) 249.
Silicon salad days.
(Or, how we mind our Peas & Cukes.)

Way up north in the fertile crescent of Marlow, NH (pop. 562), we know how to dig down deep. Which is pretty difficult (even for our celebrated 20 mole team) since the bedrock's just inches below the surface and the growing season's shorter than the day is long. But, with the winds of change blowing non-stop through the micro fields, you can't just scatter your seed any which way. You have to put down roots! We ought to know—we were the first company to sell peripherals and software exclusively for IBM personal computers. So when customers call us for product specs, prices, or technical assistance, they're dealing with a company that has its paws (and peas) planted firmly in the ground.

A window-based system you can grow with.

Up here in Marlow, our imagination isn't the only thing that's fertile. In fact, it's small potatoes compared to our PC Connection Mint Garden which comes complete with soil and seeds for growing a luscious crop of Spearmint, Peppermint and Lemon Balm right on your favorite window. Put a fresh sprig in your favorite beverage and we're sure it will add a delightful je ne sais quoi (which means that we have no idea what it will add—but it'll taste good). It's free to everyone who places an order of $500 or more between now and June 30.

Grow your own in a PC Connection Mint Garden. Offer not available outside the Continental U.S. or to accounts on net terms. One per customer.
IOMEGA ... 1 year
5116 Bernoulli II Single 44 Meg Internal $995.
5117 Bernoulli II Dual 44 Meg External 1969.
5113 44 Meg Cartridge Tripak (10/4") 249.
2499 PC Card (controller required) .. 169.

Mountain Computer ... 1 year
2917 40-60 Meg Internal Tape Drive . 379.
5502 83-152M Ext. Tape Drive . 759.
5500 83-152M Int. Tape Drive . 629.
6153 DC2120 Cartridge (5 pack). 135.
5190 DC2000 Pre-formatted Cartridges ea. 35.

Pacific Rim ... 1 year
5010 1.2 Meg External for PS/2's. 215.
6602 1.44 External (for PC/XT/AT) . 239.

Plus Development ... 2 years
3105 Hardcard 20 Meg (49 ms) . 529.
3106 Hardcard 40 Meg (28 ms) . 599.
6424 Hardcard II 80 Meg (19 ms) . 699.

Seagate ... 1 year
FREE PCTV® Hard Drive Installation
Tape with purchase of 20, 30 or 40 Meg Seagate drive for the IBM PC (not for AT, Beta or VHS).
2285 20 Meg Internal Hard Drive ST2205 (w/control and cables, 65 ms) . 275.
2286 30 Meg Internal Hard Drive ST238 (w/control and cables, 65 ms) . 289.

XTREE ... NCP
XTREEPro Cold 1.3—A treasure of advanced disk management features—Directory Tree Display, Application Menus, Archive Management, AutoView & Enhanced View. Single keystroke commands for all operations. $75.

Cables ... lifetime
1019 Smartmodem-to-AT cable (10 feet) $15.
5511 Right Angle Printer cable (6 feet) . 15.
1050 Parallel Printer cable (15 feet) . 19.

DISKS
All disks have a lifetime warranty.
5 1/4" DS/DD Disks (360k)
3291 Sony (10 disks per box) . 12.
2789 Maxell MD2-D (10 disks per box) . 13.

Intel ... 5 years
Interested 386/PC—Brings advanced computing power to your PCXT system. Includes 16Mhz 80386 processor and 1Mb RAM. Flexible 32-bit memory expansion options are also available. $579.

5 1/4" DS/HD Disks (1.2 Meg)
3292 Sony (10 disks per box) . 19.
2790 Maxell MD2-HD (10 disks per box) . 19.

3 1/2" DS/DD Diskettes (720k)
3297 Sony (10 disks per box) . 14.
2792 Maxell (10 disks per box) . 15.
3 1/2" DS/HD Diskettes (1.44 Meg)
3298 Sony (10 disks per box) . 29.
2793 Maxell (10 disks per box) . 29.

WordPerfect Corp. ... NCP
WordPerfect 5.1—Mix both text and graphics with this “high-end” word processor. Publisher. Multiple new features including "hot links" to 1-2-3, Excel, and PlanPerfect along with networking—all built in. $265.

WordPerfect Corp. ... NCP

Shipping
Note: Accounts on net terms pay actual shipping. Continental US:
• For heavy hardware items such as printers, monitors, Bernoulli Boxes, etc. pay actual charges. Call for UPS 2nd-Day & Next-Day Air.
• For all other items, add $3 per order to cover UPS Shipping. For such items, we automatically use UPS 2nd-Day Air at no extra charge if you are more than 2 days from us by UPS ground.

Hawaii:
• For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add $3 per order.

Alaska and outside Continental US:
• Call 603/446-3383 for information.

Our Policy:
• We accept VISA and MASTER CARD only.
• No surcharge added for credit card orders.
• Your card is not charged until we ship.
• If we must ship a partial order, we never charge freight on the shipment(s) that complete the order (in the U.S.).
• No sales tax.
• All U.S. shipments insured; no additional charge.
• APO/FPO orders shipped 1st Class Mail.
• International orders U.S. $950 minimum.
• Upon receipt and approval, personal and company checks now clear the same day for immediate shipment of your order.
• COD max. $1000. Cash, cashier's check, or money order.
• 120 day limited warranty on all products.
• To order, call us Monday through Friday 9:00 AM to 5:30 PM. You can call our business offices at 603/446-3383 Monday through Friday 9:00 AM to 5:30 PM.

Practical Peripherals ... 5 years
2400SA MNP—Fully supports error-free MNP Level 5 data transmission, giving you more confidence in your communications. Also supports Hayes compatible 2400 bps standard operation. . . . . . . $209.

4554 40 Meg Int. HD ST2S1-1 (28 ms) . 359.
2287 40 Meg Int. HD for PC ST2S1-1 (w/control and cables, 28 ms) . 419.
4624 80 Meg Int. HD ST4096 (28 ms) . 619.
TEAC ... 1 year
4950 PC, XT 360k Drive (5 1/4") . 79.
4951 720k Drive (specify XT or AT, 3 1/2") . 79.
4870 1.44 Meg Drive for XT (3 1/2") . 99.
4328 1.44 Meg Drive for AT (includes Basitech software utilities, 3 1/2" copy prot.) . 119.

WordPerfect Corp. ... NCP

Copyright 
PC CONNECTION, INC., 1990. PC CONNECTION and PCTV ARE REGISTERED TRADEMARKS OF PC CONNECTION, INC., MARLOW, NH. THE RACOON CHARACTERS ARE TRADEMARKS OF PC CONNECTION, INC.
to make the best of both.

Intel ... 5 years
2400EX MNP Modem—The newest member of Intel's modem family. MNP/Level 5 provides error-correction for reliable communications, as well as data compression for faster data throughput ........ $229.

Hercules ... 2 years
2318 Graphics Card Plus .................................. 189.

Hewlett-Packard ... 1 year
6583 LaserJet II (w/toner) ................................ 1739.
6582 LaserJet IIIP (w/toner) ............................... 1039.
6581 DesignJet II Plus (w/tint cartridge) .......... 719.

Intel ... 5 years
4966 2400B Internal Modem ............................... 159.
2352 2400B Internal Modem 2 (for PS/2) 294. ....... 179.
5119 2400 Baud External Modem ....................... 179.
6420 2400EX MNP Modem ................................. 229.
2346 Inboard 386PC w/1 Meg (wfrees Ami) .... 579.
4269 Above Board Plus 512k ............................. 419.
4267 Above Board Plus I/O 512k ....................... 449.
5336 Above Board Plus 8 2 Meg ........................ 599.
5342 Above Board Plus 8 I/O 2 Meg .................... 629.
4272 Above Board 2 Plus 512k ............................ 469.
5396 Above Board MC 32 0k ............................... 359.
4275 Connection CoProcessor (w/Fax-it) .......... 529.
4857 Visual Edge (graphics enhancement for the HP LaserJet II) ........................................ 449.

Hugraev ... NCP
@HyperACCESS 1.0—Blasts data through your modem faster than any other program. Fontent, agile, civilized. An automation breakthrough—it learns your work! Contains versions for DOS and OS/2. .......................................................... $115.

Huygens ... 5 years
2897 Mouse with Paintbrush ............................. 109.
2898 Mouse with Windows 286 2.1 ..................... 139.

Microsoft ... lifetime
6007 PC-TRAC Trackball serial ........................ 75. bus 85.

Mouse Systems ... lifetime
5845 White Mouse (bus or serial) ....................... 69.
5997 Trackball (1 yr. w/gu) serial 75. bus 85. .......... 89.
4306 PC Mouse II w/PC Paint+ .......................... 89.

NEC ... 2 years
1979 Multysync 2A (VGA Monitor) ................. 499.
5085 Multysync 3D Monitor ............................... 699.

Oracle Technologies ... 4 years
4690 ProDesigner VGA (800 x 600) ................. 249.

PC Power & Cooling Sys. ... 1 year
3202 Turbo Cool 150 (25°-40° cooler) ................ 129.
3200 Silencer 150 (84% noise reduction) ............ 115.

Practical Peripherals ... 5 years
3101 1200 Baud Internal Modem ....................... 69.
3100 1200 Baud External Modem (mini) ............. 77.
3103 2400 Baud Internal Modem ....................... 139.
3102 2400 Baud External Modem ....................... 179.
5286 2400 Baud Int. MNP Modem (Lev. 5) ........ 175.
5285 2400 Baud Ext. MNP Modem (Lev. 5) .......... 209.
4542 2400 Baud Internal Modem for PS/2 ............ 229.

Safe Power Systems ... 2 years
4561 Safe 250W (standby power break) ............. 249.
4562 Safe 425W (standby power break) ............... 369.

SOTA Technology ... 2 years
5111 SOTA 286i-12 (12 MHz acceler) ................. 269.
5402 SOTA 386i-16 (16 MHz acceler) ................. 389.

Targus ... lifetime
4899 Nylon Laptop carrying case ...................... 55.
6037 Premier leather carrying case ................. 199.

1-800/776-7777
PC Connection 6 Mill Street
Marlow, NH 03456
SALES 603/446-7721 FAX 603/446-7791

The Complete PC ... 2 years
5598 TheComplete Half Pg. Scanner 400 ............. 189.
5140 TheComplete Page Scanner ....................... 549.
4887 TheComplete Fax 9600 ............................. 429.
5828 TheComplete Communicator ..................... 559.

Toshiba ... 1 year
3694 T1000E Laptop (800286, 6.4 lbs.) 699.
6332 T1000SE Notebook Laptop (5.9 lbs.) 1269.
4958 T1600 Laptop (12 MHz, 20 Meg) ............... 3249.

Tripp Lite ... 2 years
6201 Isobar 6 (8 outlets, 12 ft. cord) .................... 69.
6019 LS 600 Line Stabilizer .............................. 85.
6018 LC 1200 Line Conditioner ......................... 159.

Video 7 ... 7 years
5883 1024i VGA (includes 512k) ................. 289.
4931 VRAM VGA 512k .................................. 449.

DRIVES

DTC ... 1 year
6248 At Floppy-Hard Drive Controller ............. 129.

Targus ... lifetime
Premier Leather Carrying Case—Establishes a new standard of quality for business related luggage. This dual purpose case combines a luxurious, feature rich, leather briefcase together with a functional laptop carrying case ........ $199.
There are plenty of places to get information in this industry. Too many. But if you want the best quality information, there’s only one that rises to the top: BYTEWEEK.

BYTEWEEK is a weekly newsletter from the same professionals who produce BYTE Magazine. Each week, the most important news and information from the previous week is presented in a readable and concise manner. BYTEWEEK offers you what no other publication can: timely news on the rapidly-evolving computer industry as it happens with the interpretation and evaluation that only BYTE’s experienced editorial staff can provide.

Subscribe now and take advantage of a special subscription rate of $395 ($495 outside the U.S. and Canada). Your subscription to BYTEWEEK also includes a free subscription to BIX, BYTE’s exclusive on-line conferencing system. Don’t miss this opportunity!

For fastest service, call toll-free 1-800-258-5485 [in N.H., call 603-924-9281] and charge to a major credit card or we’ll bill you.

BYTEWEEK offers a money-back guarantee if you are not completely satisfied.

YES! Sign me up as a subscriber to the Cream of the Crop, BYTEWEEK at the special subscription rate of $395 a year for 50 issues ($495 a year outside the U.S. and Canada).

Name ______________________
Title ______________________
Company ____________________
Mail Address _________________
City/State/Zip ________________
Business Phone ______________

Card # ______________________
Exp. ______________________
Signature __________________

One Phoenix Mill Lane, Peterborough, NH 03458

BYTEWEEK offers a money-back guarantee if you are not completely satisfied.
LAN remote-access schemes are the next-best thing to being there

The last few years have tugged many of you in two directions at once. LANs have drawn you to central locations, while the growing use of portable computers and the move toward people working at home have pushed you geographically apart. We're suffering from this dilemma ourselves. Our main LAN, with its crucial data and applications, is in our lab at Mark's house. We currently run NetWare on that LAN because it lets us link the 20 or so Macintoshes and PCs in the lab to the same servers. The problem is that, while we often work together in the lab, Bill also often works in his home office. We also spend a lot of time traveling, usually armed with one of the eight or so Mac and PC portables in the lab.

A recent bout of travel, coupled with some bad weather, forced us to consider ways to get to the lab's LAN from other locations. While our situation is admittedly unusual (few organizations have a 10-to-1 computer-to-employee ratio), the solutions that we found will work for any group that needs to provide remote access to its LANs.

Move the Mountain
The most obvious solution is to move any LAN data you need to a remote system. Just run a communications program and a modem on a machine on the LAN, and use that machine to transfer files. All you need is a reasonable file transfer protocol, such as ZMODEM, XMODEM, or Kermit. Until fairly recently, this was our answer: Kermit in server mode on a PC.

But this approach has several drawbacks. It ties up a PC, it doesn't let the remote user run important LAN applications like E-mail, and it abandons the whole notion of sharing live LAN data.

Create Two Mountains
The disadvantages of moving data to a remote system suggest another obvious solution: Make the remote computer a full participant in the LAN, so that it can share LAN data in the usual ways. Basically, you extend the LAN over telephone lines by using a LAN spanning product such as a bridge or router. Then neither the remote system nor any of the other machines on the LAN, including the server, are aware that the LAN is not all in one location.

On the remote side, you connect a PC to a null Ethernet (or another network), which in turn connects to the bridge or router. On the LAN side, you connect another bridge or router to the Ethernet. Many vendors now offer remote bridges and routers for both PCs and Macs.

Unfortunately, these products are impractical for single PCs, because they require a pair of bridges and high-speed modems, as well as a leased line or its equivalent. That will cost from $5000 to $10,000 up front and hundreds of dollars a month in line charges.

Bridges become cost-effective when you need to connect a remote group of PCs to a central LAN because you can spread the cost over all the remote PCs. Bridges work best when most of the LAN traffic is on the two separate LAN segments, with only occasional messages passing between them.

Move Mohammed
The final solution is to leave the data where it is. You just dedicate a local PC to the remote user and run a remote-access program on that PC. Those programs run the LAN applications on the...
MapInfo software can find, display and analyze your data geographically. See your prospects, customers, facilities—anything in your database. Find addresses by street, ZIP code, city, etc. (We can even supply the maps.) MapInfo software can find, display and analyze your data window to view, edit, and print. Draw your own presentations. MapInfo is a trademark of MapInfo Corp. dBASE is a trademark of Ashton-Tate.

ITEMS DISCUSSED

- NETRemote+ .................. $350 per server Brightwork Development, Inc. 766 Shrewsbury Ave. Jerral Center West Tinton Falls, NJ 07724 (800) 552-9876 (201) 530-0440 Inquiry 1071.

- QL 1002 (for the PC) ........ $645 QL 2201A (for the AT) .......... $1125 Cubix Corp. 2800 Lockheed Way Carson City, NV 89706 (702) 883-7611 Inquiry 1072.


local PC and send to the remote PC only the screen output of those applications. The idea of transferring only screen information is not new to LANs; PC and Mac remote-access programs have been around for years.

One interesting LAN remote-access product is NETRemote+ from Brightwork Development of Tinton Falls, New Jersey. NETRemote+ adds LAN capabilities to Co/Session, a PC remote-access package from Triton Technologies of Red Bank, New Jersey.

NETRemote+ runs as a TSR program on the slave PC on the LAN. It detects screen changes as they happen and sends them to the remote PC. The remote PC runs a special, complementary terminal emulator that uses those changes to update the screen. That emulator also sends any keystrokes from the remote PC to the LAN slave PC, making it appear as if you had typed them in on the slave. The program can even send graphics screens, albeit slowly.

Co/Session provides most of these features. NETRemote+ goes a step beyond normal remote access by letting the slave PC control any other PC on the LAN.

The result of running NETRemote+ is that the remote PC acts as if it were the slave PC on the LAN. While fewer remote-access products exist for the Mac than for the PC, the Mac products work in basically the same way. Timbuktu/Remote, from Farallon Computing of Emeryville, California, is a popular Mac remote-access program. Because it works with Macs, Timbuktu/Remote sends mouse commands as well as keystrokes to the slave Mac. It transfers screen images as QuickDraw commands; this approach speeds graphics transfers and lets the remote and slave Macs use different-size monitors.

One More Wrinkle

The above approach still requires a dedicated PC or Mac, with a modem, to handle the telephone connection. That’s fine for folks who need to get to their office systems from a home computer or a laptop on the road, but it means buying another whole system if the remote user doesn’t normally have an office PC. That additional slave PC costs extra money and consumes precious space.

Cubix Corp. addresses this problem by putting a dedicated PC into a PC-based server. The firm’s PC-on-a-card product requires only a standard AT bus slot and is available in both NEC V40 and 286 versions. It lets you put up to four PCs on a card and up to four such cards in one server—so you can have as many as 16 PCs hiding in your server. This approach can save a lot of desk space.

We put one of Cubix’s QL 1002 cards, which contains two V40 processors, in our Samsung NetWare server. (The card will also work with Network OS.) The server’s standard AT bus acts as the “network” between the server’s CPU and the CPU on the card. The QL 1002 includes NetWare drivers for this “bus” network, so neither the server nor the PC can tell that it’s not just another system on the LAN. (The server sees the bus as just another LAN medium, much as a single NetWare server can contain and work with both Ethernet and Token Ring cards.)

The PCs on the card use a NetWare shell that also comes with the card. You also have to create a boot-image file for these PCs, such as we described in our December 1989 column “When One Drive Is Enough.” You then boot the PC-on-a-card from the server. By attaching a terminal to it, you can operate that PC just as if it were a diskless workstation.

You also can use the PC-on-a-card to solve our problem by running a remote-access package on it. You can make the entire process automatic by starting that program in the PC-on-a-card’s AUTOEXEC.BAT file in the boot image. Attach an external modem to the card (which has the necessary serial ports), and you can access the PC-on-a-card...
Systemizing
The truly universal LAN alternative...

NEW Slot Card Systemizer SC!

Up to 31 users can...
- Share Printers
- Share Plotters
- Share a Modem
- Exchange E-MAIL
- Transfer Datafiles

Systemizing has become the connectivity standard at many of the world's largest corporations and throughout the federal government. Ten's of thousands are already in use. The new Systemizer SC is the latest model in Applied Creative Technology's line of Systemizing products, and it delivers what 95% of corporate computer users want from a Local Area Network—at far less cost and complexity, and yet with much more versatility.

Corporate computing managers prefer Systemizing over other connectivity methods because it offers:
- Guaranteed software/hardware compatibility.
- Ability to mix PC's, LAN's, mainframes, laptops.
- Easy owner installation. Low cost cabling.
- 5 min. user training with no support needed after.
- Flexibility; readily accommodates growth and changes.
- Distributed processing for high speed and reliability.
And with the new SC, everyone can afford to Systemize!

Call 1-800-433-5373 to get a FREE demo!
NETWORKS

From Five to Three in nothing flat

megamate

2.8 MB version also available

Megamate includes everything you need to add tomorrow's disk drive to today's computers. Installation is a snap, just plug in the card, plug in the drive, and run the setup software (4 keystrokes and you're done). Megamate is easy to use, just like a 3.5 inch drive. It works with PCs, XTs, and ATs, and you can add it to any computer because it's external.

Megamate gives your customers compatibility with IBM computers that use 3.5 inch diskettes, both the 720KB laptop diskettes and the 1.4MB PS/2 diskettes. It automatically determines which type of diskette is being used.

- Installs in minutes
- Handles any 3.5 inch IBM disk, 20KB or 1.4MB automatically
- Complete package — for any PC, XT, AT, or compatible
- Attractive and compact, barely bigger than a diskette
- One year warranty

The PC-on-a-card approach saves both physical space and network bandwidth. You can use it whenever you would use a dedicated PC on the LAN; for example, it makes a nice asynchronous modem pool server. But there are some drawbacks to using a PC-on-a-card. These cards can't work with any other boards in the server because they see the server's bus as a network, not a normal bus. These boards cannot, therefore, work with such important server resources as 3270 gateways. The PC-on-a-card also isn't particularly cheaper than a dedicated inexpensive PC clone—Cubix's AT-on-a-card lists for more than $1100.

Line Problems

The solutions that we have described should sound familiar: We've just reinvented the minicomputer, complete with terminals (graphics terminals for Macs).

It shouldn't be surprising, then, that these techniques also suffer from the biggest problem plaguing minicomputer terminals—the speed of telephone lines. If you've ever used a minicomputer or an on-line service like BIX, you know that 2400 bps is slow. The problem is even worse for PCs and Macs, where applications update the screen constantly.

Higher-speed 9600-bps modems help quite a bit. CCITT V.32-class modems with V.42 data compression are even better. Still, even the best modem yields screen performance far below what you have come to expect from PCs. The 65,536-bps speed of ISDN will help even more, but remote access will probably never be as nice as being there.

The bottom line is that you sacrifice PC responsiveness to gain remote LAN access. As a result, for the foreseeable future, remote LAN access is best for occasional use for applications such as E-mail and data exchange. Save the heavy database work until you're in the office and can either sit down at your desktop LAN system or plug your laptop into a Xircom external Ethernet adapter or an AppleTalk connector.

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvannam e" and "wbc3," respectively.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
Our Printer Sharing Unit Does Networking!

An Integrated Solution
Take our Master Switch™, a sophisticated sharing device, combine it with MasterNet™ networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

Versatile
Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The MasterLink™ utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

Other Products
We have a full line of connectivity solutions. If you just want printer sharing, we've got it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

Commitment to Excellence
At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.

Call now for literature or more information.
(800) 333-9343
The No-Compromise Notebook Computer

For laptop systems—perhaps the most personal of personal computers—everybody seems to have strong opinions on what features ought to be included. We all have our own notions of the ideal display type, processor, hard disk size, weight, and, of course, price. In the past, the small size and weight required that you make some significant compromises. This has been particularly true for the lightweight notebook computers that have appeared recently. But fortunately, as time goes on, new systems exhibit fewer and fewer compromises. And the new Toshiba T1200XE is perhaps the first notebook system that frees you from any major compromise.

At first glance, it looks as if Toshiba has crammed all the goodies of its T1600 laptop into a notebook format. This is quite a feat, since the T1600 weighs almost 12 pounds, and the new T1200XE weighs in at less than 8 pounds, including a battery pack. Despite this rather low weight, the system includes a 12-MHz 286 processor, a 20-megabyte hard disk drive, a 3½-inch floppy disk drive, and a high-contrast LCD screen. There is even room inside for up to 5 MB of memory (1 MB is standard); this is important for OS/2 users. And while most companies charge more for their smaller systems, Toshiba has bestowed upon the T1200XE a price that is significantly lower than that of its older, larger relative, the T1600.

Of course, the new Toshiba computer does not set any records for low weight. Lighter laptops are available, notably the impressive Compaq LTE/286, which has the same features as the Toshiba system but weighs in at a full pound less. Nevertheless, the T1200-XE has a larger screen, a more comfortable key-board, and a lower price tag.

In my test of a prototype T1200XE, the system performed quite well. Its large 640-by-400-pixel CGA-style backlit LCD is almost exactly like that of the T1600 and is a real pleasure to view. Likewise, the keyboard is almost an exact copy of that on the T1600 and is very easy to become accustomed to. The many T1000 users out there—including myself—should have no trouble at all easing into this system.

A somewhat hidden feature of the new system is a 100-pin connector on the back panel. Toshiba has stated that it will soon offer a "base station" for the T1200XE that will include, among other things, room for two full-size expansion slots. Another nice feature of the back panel is an RGB monitor connector—important for those who need to make presentations or demonstrations.

Other hidden features of the system include Toshiba's traditional assortment of laptop frills. These include AutoResume, a feature that lets you turn the system on and immediately resume what you were doing when you last powered the computer down. Toshiba has a number of interesting new laptops available. The new T1000SE and the T1000XE (with a hard disk drive) deserve particular note. I found these systems to be excellent, but some users may prefer a bit more power.

Eventually, we will probably see notebook systems based on the 386SX microprocessor. But until then, if you're going to hit the road and can't compromise on power—or anything else, for that matter—the T1200XE seems to be an excellent choice.

—Rich Malloy

R:base Goes for the Gold

Ever since its first appearance, R:base's forte has been ease of use coupled with power. In its newest incarnation, R:base 3.0 from Microrim, it is even easier to use and more powerful and comes with a raft of new features.

It's nearly impossible to list even a small fraction of the features available in an application package as sophisticated as R:base 3.0. Its menu interface is improved and now looks like those in other database packages. But overall, the software makes creating, editing, and doing real work with data much less of a chore than other database managers I've used.

While QBE (Query By Example) is a customary (and necessary) feature in all relational databases, R:base 3.0 adds a number of handy bells and whistles to it. In competing high-end packages, the all-too-necessary ability to browse through existing data—to mark, edit, or print needed information—isn't always easy. But R:base 3.0 has made browsing chores easy to do with just a few keystrokes.

Another time saver is R:base's ability to do global search and replace. By way of comparison, in Borland's Paradox 3.0, the only way to do a search and replace is by writing a custom utility using the package's proprietary language.

Most of the people who actually use databases in their day-to-day work aren't technically sophisticated. So in order to be truly powerful, a database manager must provide the ability for the resident database expert to create easy-to-use finished applications with custom forms and menus. R:base 3.0's application-generation facilities are some of the...
Our Printer Sharing Unit Does Networking!

An Integrated Solution
Take our Master Switch™, a sophisticated sharing device, combine it with MasterNet™ networking software for PCs, and you've got an integrated solution for printer and plotter sharing, file transfer, electronic mail, and a lot more. Of course you can also share modems, minis, and mainframes or access the network remotely. Installation and operation is very simple.

Versatile
Or you can use the Master Switch to link any computer or peripheral with a serial or parallel interface. The switch accepts over 20 commands for controlling the flow of data. It may be operated automatically, by command, or with interactive menus. Its buffer is expandable to one megabyte and holds up to 64 simultaneous jobs. The MasterLink™ utility diskette for PCs comes with every unit and unleashes the power of the switch with its memory-resident access to the commands and menus.

Other Products
We have a full line of connectivity solutions. If you just want printer sharing, we've got it. We also have automatic switches, code-activated switches, buffers, converters, cables, protocol converters, multiplexers, line drivers, and other products.

Commitment to Excellence
At Rose Electronics, we're not satisfied until you're satisfied. That's why we have thousands of customers around the world including large, medium, and small businesses, factories, stores, educational institutions, and Federal, state, and local governments. We back our products with full technical support, a one-year warranty, and a thirty-day money-back guarantee.

Call now for literature or more information.
(800) 333-9343
Hewlett-Packard’s Laser Counterattack

With the introduction of the LaserJet III, Hewlett-Packard has thrown down the gauntlet, making it clear to competitors that it’s not about to sit back and give others the advantage in the hot battle for laser-printer market share. The long-awaited successor to the venerable LaserJet Series II, the LaserJet III brings new meaning to the term “more for less,” and it’s sure to make users sit up and take notice. I certainly did.

HP claims that the LaserJet III is completely compatible with the Series II. So what’s the big deal, besides a sleek new look? Well, there’s plenty of cutting-edge technology under the hood. If you’ve purchased a laser printer recently, you’ve probably found that few are very useful without a bunch of options. It’s like buying a stripped-down car.

But HP has packed enough standard features into the LaserJet III to make it immediately useful. With a megabyte of RAM, I could print out a full page of graphics. Even more useful is the LaserJet III’s selection of fonts. The 14 internal bit-mapped fonts are just the beginning. It also comes with CG Times and CG Univers typefaces from AGFA Comptographic. Both typefaces come in regular, boldface, italic, and boldface italic. You can scale these eight fonts from 1/4 point (too small to read) to 999.75 points (larger than a standard sheet of paper).

Thanks to the III’s new PCL (Printer Control Language) 5, which incorporates vector graphics, those fonts can be stretched, rotated, and overlaid in addition to being scaled. All these features are impressive, but what places the LaserJet III in a solitary spotlight is a proprietary feature called resolution enhancement. Yes, it is still a 300- by 300-dot-per-inch printer, but HP has put a patented circuit before the print engine that makes all the difference. Resolution enhancement performs the tricky task of modulating the laser beam in the print engine, varying both the size and placement of the individual dots. It works strictly on the edges of graphics and characters, and it does a superb job of eliminating jaggies, the stair-step edges that are particularly noticeable on graphics and large fonts.

I noticed the difference on the first sheet I printed; the III’s output has a pronounced crispness that’s lacking on the output from other laser printers. Since resolution enhancement is also switchable (in case you’re using add-in cards that depend on an unmodified print engine), I turned it off and printed a page of unenhanced graphics. The difference is striking, and, under a magnifying glass, the III’s ability to produce what’s effectively the look and feel of typeset quality is even more discernible.

While many laser printers are rated at 8 ppm, that’s a theoretical maximum for plain text. The reality—especially for printing graphics—is often considerably less. But in the LaserJet III, HP has tweaked the hardware and software to make the data really move. The company claims overall I/O performance has been increased by nearly 50 percent. And although I didn’t use any formal benchmarks, my subjective impression is that the LaserJet III gave my computer back to me (and started printing) considerably faster than the Series II. It was very noticeable when I printed graphics.

At $300 less than the LaserJet II, the LaserJet III’s price is impressive. You can use all the add-ons designed for the Series II plus some new ones. Add a 2-MB memory board, a PostScript-emulation cartridge, and an AppleTalk interface, and for $4355, you have a full-fledged Macintosh laser printer for considerably less than Apple’s own. In addition, you get resolution enhancement.

I was disappointed that the LaserJet III lacks a second paperfeed tray. But when you couple the printer’s standard features, resolution enhancement, and rock-bottom price, the LaserJet III comes out as not only an unbeatable deal, but a truly trailblazing product. And since other laser-printer manufacturers will be burning the midnight oil to answer HP’s challenge, the LaserJet III’s ultimate feature may turn out to be “competition enhancement.”

—Stan Miastkowski
Photoshop Is Picture-Perfect

With the advent of 32-Bit QuickDraw and a variety of 24-bit color boards, Macintoshes can view and work with large images that contain millions of colors. This opens the door for Mac applications like Adobe's new Photoshop, which can perform the electronic equivalent of darkroom manipulation on your Desktop.

Photoshop comes well-equipped to import, process, and export images from various computers. It reads PICT2, TIFF, MacPaint, PixelPaint, and the preview image in EPS files. Other files that it can handle are TGA (TARGA format), GIF, PIXAR, and Amiga IFF/ILBM files. For the hard cases, there's also a "Raw" option that lets you specify certain file characteristics so that Photoshop attempts to generate an image from the data. And Photoshop's list of image-saving formats is equally exhaustive. It has its own Photoshop format, plus PICT2, PICT2 resource, TIFF, EPS, Amiga IFF/ILBM, GIF, MacPaint, and PIXAR formats.

Photoshop supports black-and-white bit-mapped, grayscale, RGB, HS1 (hue, saturation, and brightness), HSB (hue, saturation, and brightness), and CMYK (cyan, magenta, yellow, and black) images. You can convert images between each image type, within limits.

A variety of tools on a floating palette window provides all sorts of ways to work with an image. You can paint, view, edit, and select tools. You can also make color corrections to an image by adjusting its brightness, contrast, and color balance. You can flip, rotate, and skew images. There's a host of filtering functions that blur or sharpen an image, apply high-pass filtering, diffuse and de-speckle it, or add noise. These changes are applied to the entire image or just the portion that you select with one of the selection tools.

Photoshop can print an image using CMYK-process colors or Color PostScript, or as a halftone, where you can specify the screen frequency, dot shape, and screen angle. Images can be printed as composites (all the colors together) or as separations. Photoshop can send the pixel data either as ASCII hexadecimal (the standard PostScript method) or in binary form for speed.

I used a beta version of Photoshop 1.0b6 on a Mac II equipped with 4 megabytes of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a 19-inch SuperMac monitor and Spectrum/24 Series III video board. I worked with an assortment of scanned images, ranging from 8 to 24 bits deep and 75 to 300 dots per inch, that I acquired from either Howtek or Sharp color scanners.

Photoshop's user interface is very slick and clean: Adobe used Apple's MacApp object-oriented libraries to implement it. You can have multiple windows open, and each window's title describes what's inside. Photoshop can send the entire image rapidly to an image; it worked with an assortment of scanned images, ranging from 8 to 24 bits deep and 75 to 300 dots per inch, that I acquired from either Howtek or Sharp color scanners.

Photoshop's user interface is very slick and clean: Adobe used Apple's MacApp object-oriented libraries to implement it. You can have multiple windows open, and each window's title describes what's inside. Photoshop can send the entire image rapidly to an image; it worked with an assortment of scanned images, ranging from 8 to 24 bits deep and 75 to 300 dots per inch, that I acquired from either Howtek or Sharp color scanners.

Photoshop is fast. It does not take long to open 24-bit PICT2 images. And it applies color modifications and rotations rapidly to an image; there was none of the dawdling that I've come to expect with PhotoMac 1.1. Photoshop had no problems importing a TIFF file from a NeXT Computer, and it accepted Amiga IFF and HAM files that I downloaded from BIX. For the HAM file, a dialog box informed me that the original image's pixels were rectangular and asked if it should rescale the image for the Mac's square pixels. It's small but significant touches such as these that save designers and illustrators headaches and that makes Photoshop a superior product.

I used Apple's LaserWriter 6.0 driver with a LaserWriter and a QMS-PS 810 Turbo laser printer to print images, with good results. Printing with binary encoding reduced the printing times by a third. Certain networks and printer chokes on binary PostScript data, in which case you'll have to check ASCII encoding in the printer dialog box. Photoshop also implements its own virtual memory system so that you can work with files larger than physical memory.

This version of Photoshop looks excellent. The tools worked smoothly, and the virtual memory let me work on 6-MB files easily. If your work runs to heavy-duty image processing or color prepress, then Photoshop promises to be a must buy for the job.

—Tom Thompson

continued
The No-Compromise Notebook Computer

For laptop systems—perhaps the most personal of personal computers—everybody seems to have strong opinions on what features ought to be included. We all have our own notions of the ideal display type, processor, hard disk size, weight, and, of course, price. In the past, the small size and weight required that you make some significant compromises. This has been particularly true for the lightweight notebook computers that have appeared recently. But fortunately, as time goes on, new systems exhibit fewer and fewer compromises. And the new Toshiba T1200XE is perhaps the first notebook system that frees you from any major compromise.

At first glance, it looks as if Toshiba has crammed all the goodies of its T1600 laptop into a notebook format. This is quite a feat, since the T1600 weighs almost 12 pounds, and the new T1200XE weighs in at less than 8 pounds, including a battery pack. Despite this rather low weight, the system includes a 12-MHz 286 processor, a 20-megabyte hard disk drive, a 3½-inch floppy disk drive, and a high-contrast LCD screen. There is even room inside for up to 5 MB of memory (1 MB is standard); this is important for OS/2 users. And while most companies charge more for their smaller systems, Toshiba has bestowed upon the T1200XE a price that is significantly lower than that of its older, larger relative, the T1600.

Of course, the new Toshiba computer does not set any records for low weight. Lighter laptops are available, notably the impressive Compaq LTE/286, which has the same features as the Toshiba system but weighs in at a full pound less.

Nevertheless, the T1200XE has a larger screen, a more comfortable key-board, and a lower price tag.

In my test of a prototype T1200XE, the system performed quite well. Its large 640-by-400-pixel CGA-style backlit LCD is almost exactly like that of the T1600 and is a real pleasure to view. Likewise, the keyboard is almost an exact copy of that on the T1600 and is very easy to become accustomed to. The many T1600 users out there—including myself—should have no trouble at all easing into this system.

A somewhat hidden feature of the new system is a 100-pin connector on the back panel. Toshiba has stated that it will soon offer a "base station" for the T1200XE that will include, among other things, two full-size expansion slots.

Another nice feature of the back panel is an RGB monitor connector—important for those who need to make presentations or demonstrations.

Other hidden features of the system include Toshiba's traditional assortment of laptop frills. These include AutoResume, a feature that lets you turn the system on and immediately resume what you were doing when you last powered the computer down.

Toshiba has a number of interesting new laptops available. The new T1000SE and the T1000XE (with a hard disk drive) deserve particular note. I found these systems to be excellent, but some users may prefer a bit more power.

Eventually, we will probably see notebook systems based on the 386SX microprocessor. But until then, if you're going to hit the road and can't compromise on power—or anything else, for that matter—the T1200XE seems to be an excellent choice.

—Rich Malloy

THE FACTS

<table>
<thead>
<tr>
<th>Toshiba T1200XE</th>
<th>$3999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toshiba America Information Systems Computer Systems Division 9740 Irvine Blvd. Irvine, CA 92718 (714) 583-3000 Inquiry 987.</td>
<td></td>
</tr>
</tbody>
</table>

R:base Goes for the Gold

E ver since its first appearance, R:base's forte has been ease of use coupled with power. In its newest incarnation, R:base 3.0 from Microrim, it is even easier to use and more powerful and comes with a raft of new features.

It's nearly impossible to list even a small fraction of the features available in an application package as sophisticated as R:base 3.0. Its menu interface is improved and now looks like those in other database packages. But overall, the software makes creating, editing, and doing real work with data much less of a chore than other database managers I've used.

While QBE (Query By Example) is a customary (and necessary) feature in all relational databases, R:base 3.0 adds a number of handy bells and whistles to it. In competing high-end packages, the all-too-necessary ability to browse through existing data—to mark, edit, or print needed information—isn't always easy. But R:base 3.0 has made browsing chores easy to do with just a few keystrokes.

Another time saver is R:base's ability to do global search and replace. By way of comparison, in Borland's Paradox 3.0, the only way to do a search and replace is by writing a custom utility using the package's proprietary language. Most of the people who actually use databases in their day-to-day work aren't technically sophisticated. So in order to be truly powerful, a database manager must provide the ability for the resident database expert to create easy-to-use finished applications with custom forms and menus. R:base 3.0's application-generation facilities are some of the continued
CrossCode C has twelve important features to help you program your 68000-based ROMable applications

It's the one 68000 C compiler that's tailor-made for embedded systems development

CrossCode C is designed specifically to help you write ROMable code for all members of the Motorola 68000 family. It comes with these twelve special features to help you get your code into ROM:

1. **A 100% ROMable Compiler:** CrossCode C splits its output into five memory sections for easy placement into ROM or RAM at link time.

2. **Integrated C and Assembler:** You can write your code in any combination of C and assembly language.

3. **Readable Assembly Language Output:** The compiler generates assembly language code with your C language source code embedded as comments, so you can see each statement's compiled output.

4. **Optimized Code:** CrossCode C uses minimum required precision when evaluating expressions. It also "folds" constants at compilation time, converts multiplications to shifts when possible, and eliminates superfluous branches.

5. **Custom Optimization:** You can optimize compiler output for your application because you control the sizes of C types, including pointers, floats, and all integral types.

6. **Register Optimization:** Ten registers are reserved for your register variables, and there's an option to automatically declare all stack variables as register, so you can instantly optimize programs that were written without registers in mind.

7. **C Library Source:** An extensive C library containing over 70 C functions is provided in source form.

8. **No Limitations:** No matter how large your program is, CrossCode C will compile it. There are no limits on the number of symbols in your program, the size of your input file, or the size of a C function.

9. **68030 Support:** If you're using the 68030, CrossCode C will use its extra instructions and addressing modes.

10. **Floating Point Support:** If you're using the 68881, the compiler performs floating point operations through the coprocessor, and floating point register variables are stored in 68881 registers.

11. **Position Independence:** Both position independent code and data can be generated if needed.

12. **ANSI Standards:** CrossCode C tracks the ANSI C standard, so your code will always be standard, too.

There's More

CrossCode C comes with an assembler, a linker, and a tool to help you prepare your object code for transmission to PROM programmers and emulators. And there's another special tool that gives you symbolic debugging support by helping you to prepare symbol tables for virtually all types of emulators.

CrossCode C is available under MS-DOS for just $1995, and it runs on all IBM PCs and compatibles (640K memory and hard disk are required). Also available under UNIX, XENIX, and VMS.

CALL TODAY for more information:

1-800-448-7733
(ask for extension 2003)

Outside the United States, please dial

PHONE: 1-708-971-8170
FAX: 1-708-971-8513
Lotus Goes Graphical

Lotus's snazzy new three-dimensional Lotus 1-2-3/G spreadsheet for Presentation Manager (PM) takes full advantage of OS/2's power, yet manages to retain compatibility with earlier character-based versions of 1-2-3. It also upholds an OS/2 truism: If you want multitasking, large memory, and the ease of use of a graphical user interface (GUI), you must be prepared to pay a price in hardware and performance.

Many of the program's advantages (i.e., WYSIWYG screens and live links to external files) accrue from OS/2 and PM. To make the transition to OS/2 even more appealing, Lotus greatly improved graphics and added 20 levels of undo. A utility called the Solver lets you model equations for optimal results based on a defined set of inputs and criteria.

Lotus 1-2-3/G is based on the feature set and 3-D model used in 1-2-3 release 3.0. A single spreadsheet file can contain up to 256 layers, and normal @ functions and ranges can stretch along the z-axis.

In addition, you can open up to 16 spreadsheet and graphics windows on the desktop at the same time. Because OS/2 is multitasking, you can recalculate a spreadsheet in one window while printing from another and editing in a third.

One of 1-2-3/G's strengths is that it conforms to PM standards while preserving the keystroke sequences that are familiar to current 1-2-3 users. To mimic 1-2-3's hierarchical menu in the GUI environment, Lotus devised enhancements to PM, including cascading menus and multiple-choice dialog boxes.

Among the new graphics features are 3-D bar graphs and the user's ability to directly manipulate graphs with the mouse. Most of the new features are in the Graph Tool, a separate part of the program from the main menu.

With the powerful Solver utility, you can model problems backward to obtain a desired output. Instead of trying repeated what-if scenarios, you enter variables and constraints into the spreadsheet and let the 1-2-3/G Solver feature optimize an output like profit or resource utilization.

I was very impressed with most capabilities of 1-2-3/G. My only reservation concerned a conceptual clash between the 3-D model of release 3.0 and the windowing model of PM. In maintaining file and keystroke compatibility, I don't think 1-2-3/G makes the best use of the mouse. This is clearest when a window contains stacked sheets in the style of release 3.0.

While PM lets you click between windows, resize them, and so forth, sheets within a window don't follow the same rules—of fact, you can't even zoom in on them as you can in release 3.0. As a result, you spend more time with the keyboard than the mouse, but for 1-2-3 traditionalists, this is probably preferable anyway.

—Andrew Reinhardt

THE FACTS

Lotus 1-2-3/G

Requirements:
A 386 computer with 4 megabytes of RAM, OS/2 1.1 or 1.2 Standard or Extended Edition, a hard disk drive with at least 10 MB of free space, and EGA, VGA, or 8514A graphics.

Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Inquiry 989.
Here's How We Protect Your Software And Profits Better.

Because our key-interrogation routines are encrypted, and our hardware is custom-wired to distinguish each of our clients' keys, our clients have the highest degree of security available.

Unlike other manufacturers, our routines assume responsibility for all hardware, software and timing issues. And what this means is that your engineering time and money won't be wasted reinventing protection schemes.

We offer two high security products for copy control: the KEY™ and the MEMORY KEY™. Our protection devices can also be used for serialization techniques, software leasing, modular software management, creative revenue collection, demo control and a path for future upgrades.

The information stored in the MEMORY KEY can be conveniently reprogrammed by your application software or at the end user's site via software disk or modem. All our products attach conveniently to the printer port, and are transparent and allow for unlimited back up copies.

For serious software protection, call now. And start protecting your profits. Hands down, we're better.

We'll Never Tell.

/MICROPHAR

In EUROPE:
Microphar, 42, Ave. Sainte Foy 92200, Neuilly Sur-Seine FRANCE
Tel: 33-1-47-38-21-21 Fax: 33-1-46-24-76-91
Call to obtain distributor addresses in:
BELGIUM, IRELAND, ITALY, NETHERLANDS, PORTUGAL, SPAIN, SWITZERLAND, U.K. & W. GERMANY.

In the U.S., the AMERICAS & the PACIFIC:
ProTech, 9600-J Southern Pines Blvd. Charlotte, NC 28217
Tel: 704-523-9500 Fax: 704-523-7651
Hours: Mon-Thurs: 8:30-7:00 ET, Fri: 8:30-5:30 ET
FOR A DEMONSTRATION PACKAGE OR ADDITIONAL INFORMATION, PLEASE WRITE OR CALL.

Macintosh is a registered trademark of Apple Computer, Inc.

For Europe Circle 230 on Reader Service Card
For Americas & Pacific Circle 231 on Reader Service Card
Get One Of These Blockbuster Movie Hits FREE When You Buy A Video Seven VGA Graphics Card.

What a great way to introduce you to three of the very best VGA cards: The VEGA VGA for personal and business applications; the VGA 1024i for advanced business applications; and the V-RAM VGA for CAD/CAM and graphics applications. All three give you razor sharp resolution and guaranteed software compatibility, plus Video Seven's 7-year warranty and exclusive support package. Buy any of them between March 1st and May 15th and we'll send you one of these all-time favorite movie videos, free.
Just fill out the coupon and send it along with your receipt and the completed product registration card to: Seven Videos From Video Seven, P.O. Box 24527, San Francisco, CA 94124. For information: Inside CA 800-962-5700; outside CA 800-238-0101; Canada 800-548-0624.

Send me my free movie video. Here's my receipt and completed registration card from my new VEGA VGA, VGA 1024i or V-RAM VGA card. Please send me:

TITLE
VHS _______ Beta _______
Name ____________________________
Address (no P.O. boxes, please) ____________________________
City _______ State _______ Zip _______
Dealer name and address ____________________________
City _______ State _______ Zip _______
Date of purchase ___________ =B-4/90


VIDEO SEVEN
Best of Seven
A Headland Technology Inc. brand

Circle 296 on Reader Service Card
Everything You Ever Wanted In UNIX.
And Less. $99.95.*

OK. We know it's hard to believe. So just consider this. Coherent™ is a virtual clone of UNIX. But it was developed independently by Mark Williams Company. Which means we don't pay hundreds of dollars per copy in licensing fees.

What's more, Coherent embodies the original tenet of UNIX: small is beautiful. This simple fact leads to a whole host of both cost and performance advantages for Coherent. So read on, because there's a lot more to Coherent than its price.

SMALLER, FASTER...BEITER.

Everybody appreciates a good deal. But what is it that makes small so great?

For one thing, Coherent gives you UNIX capabilities on a machine you can actually afford. 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. You can also have it running faster, learn it faster and get faster overall performance. All because Coherent is small. Sounds beautiful, doesn't it?

But small wouldn't be so great if it didn't do the job it was meant to do.

EVERYTHING UNIX WAS MEANT TO DO.

Like the original UNIX, Coherent is a powerful multi-user, multi-tasking development system. With a complete UNIX-compatible kernel which makes a vast world of UNIX software available including over a gigabyte of public domain software.

Coherent also comes with Lex and Yacc, a complete C compiler and a full set of nearly 200 UNIX commands including text processing, program development, administrative and maintenance commands.

And with UUCP, the UNIX to UNIX Communication Program that connects you to a world-wide network of free software, news and millions of users. All for the cost of a phone call.

We could go on, but stop we must to get in a few more very important points.

EXPERIENCE, SUPPORT AND GUARANTEES.

Wondering how something as good as Coherent could come from nowhere? Well it didn't. It came from Mark Williams Company, people who've developed C compilers for DEC, Intel, Wang and thousands of professional programmers.

We make all this experience available to users through complete technical support via telephone. And from the original system developers, too!

Yes, we know $99.95 may still be hard to believe. But we've made it fool-proof to find out for yourself. With a 60-day money-back no-hassles guarantee.

You have to be more than just a little curious about Coherent by now. So why not just do it? Pick up that phone and order today.

You'll be on your way to having everything you ever wanted in UNIX. And for a lot less than you ever expected.

1-800-MARK WMS
(1-800-627-5967 or 1-708-689-2300)
60-DAY MONEY BACK GUARANTEE!

*Special introductory price good through July 31, 1990. Coherent is a trademark of Mark Williams Company. UNIX is a trademark of AT&T. XENIX is a trademark of Microsoft.

---

LENS IS MORE!

<table>
<thead>
<tr>
<th></th>
<th>Coherent For the IBM-PC/AT and compatible XENIX 286, 286 or 386 based machines.</th>
<th>Santa Cruz Operations Version 2.3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Manuals</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>No. of Disks</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Kernel Size</td>
<td>64K</td>
<td>198K</td>
</tr>
<tr>
<td>Install Time</td>
<td>20-30 min.</td>
<td>3-4 hours</td>
</tr>
<tr>
<td>Suggested Disk Space</td>
<td>10 meg</td>
<td>30 meg</td>
</tr>
<tr>
<td>Recommended Memory</td>
<td>640K</td>
<td>1-2 meg</td>
</tr>
<tr>
<td>Performance*</td>
<td>38.7 sec</td>
<td>100.3 sec</td>
</tr>
<tr>
<td>Price</td>
<td>$99.95</td>
<td>$1495.00</td>
</tr>
</tbody>
</table>

*Byte Exec benchmark, 1000 iterations on 20 MHZ 386.
The code name for Apple's new Mac IIfx was "Fl9," which sounds like a name for a jet fighter plane or rocket. Indeed, the Mac IIfx is one "wicked fast" computer, as the machine's product manager, Frank Casanova, describes it. Powered by a 68030 CPU and a 68882 math coprocessor operating at a clock speed of 40 MHz, this new Mac leaves its predecessors in the dust.

Apple's two most recent machines in the Mac II product line, the IIcx and IICl, were compact models with only three NuBus slots. The Mac IIfx, however, is a six-slot machine like the Mac II and Mac IIx. In addition, the Mac IIfx includes a Processor Direct Slot that is similar to the slot used in the Mac SE/30, which operates independently of NuBus and therefore offers a direct and higher-performance interface for third-party peripherals such as graphics and network controllers. The 120-pin PDS is a superset of the Mac SE/30 PDS and accepts add-in cards designed for the SE/30. Use of the PDS disables one of the six NuBus slots on the logic board, so six slots remain.

Not only does the Mac IIfx have a much faster clock speed than its Mac II cohorts, it has new features specifically designed to boost performance. To help minimize main memory and disk accesses, the Mac IIfx comes with a cache memory consisting of 32K bytes of 25-nanosecond static RAM. To ease the burden of the main processor, the IIfx has a new controller for DMA to SCSI devices like the hard disk drive, and two Peripheral Interface Controllers (PICs) for controlling the floppy disk drives, the Apple Desktop Bus, and the system's two serial ports.

Each PIC controller consists of a 10-MHz 6502 processor surface-mounted to the logic board. You might recall that the 6502 is the CPU of the Apple IIe. In this new machine, two of those IIe processors are used as peripheral controllers. The photo on page 112 shows the new logic board of the IIfx.

The purpose of the SCSI DMA and PIC controllers is to take over tasks that previously were performed by the central processor. Coupled with these I/O and SCSI controllers, the increased clock speed and cache memory of the machine result in a dramatic improvement in system performance, with faster disk access and processing during serial and floppy disk drive operations. Based on some benchmarks that I ran on a preproduction machine, the Mac IIfx is two to four times faster than its IIci predecessor and sets new Macintosh speed records.

□ Nick Baran
The Mac IIfx's logic board represents a new design. Although it has new functions such as cache memory and peripheral controllers, the IIfx board has the same chip count as the IIci logic board. Note the empty real estate on the board, suggesting that a compact model with fewer slots could also be produced.

Preliminary benchmark results reveal the speed advantage offered by Apple's new Mac IIfx.

<table>
<thead>
<tr>
<th>Low-level test</th>
<th>Mac IIx</th>
<th>Mac IIcx</th>
<th>Mac IIci</th>
<th>Mac IIfx</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matrix</td>
<td>17.1</td>
<td>16.2</td>
<td>10.4</td>
<td>6.4</td>
</tr>
<tr>
<td>String move</td>
<td>81.7</td>
<td>51.3</td>
<td>31.9</td>
<td></td>
</tr>
<tr>
<td>Byte-wide</td>
<td>42.1</td>
<td>26.5</td>
<td>16.1</td>
<td></td>
</tr>
<tr>
<td>Word-wide</td>
<td>22.8</td>
<td>14.2</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>Doubleword-wide</td>
<td>31.3</td>
<td>19.6</td>
<td>12.1</td>
<td></td>
</tr>
<tr>
<td>Sieve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math</td>
<td>151.5</td>
<td>93.2</td>
<td>45.0</td>
<td></td>
</tr>
<tr>
<td>Sine(x)</td>
<td>72.7</td>
<td>45.2</td>
<td>21.6</td>
<td></td>
</tr>
<tr>
<td>e^x</td>
<td>96.6</td>
<td>60.8</td>
<td>29.1</td>
<td></td>
</tr>
<tr>
<td>Disk I/O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Finder seek</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-sector read</td>
<td>13.9</td>
<td>14.2</td>
<td>14.3</td>
<td></td>
</tr>
<tr>
<td>32-sector read</td>
<td>35.6</td>
<td>25.4</td>
<td>24.7</td>
<td></td>
</tr>
<tr>
<td>Video</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Text</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TextEdit</td>
<td>4.7</td>
<td>3.3</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>DrawString</td>
<td>1.6</td>
<td>1.1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Graphics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matrix test</td>
<td>52.8</td>
<td>18.5</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>QuickDraw</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

Preliminary benchmark results reveal the speed advantage offered by Apple's new Mac IIfx.

Times faster than the Mac SE/30 or Mac IIX, depending on the operation. On the average, the Mac IIfx is about 60 percent faster than the Mac IIci (see the table). With the SCSI DMA controller, disk seeks of 32 blocks are about seven times faster on the Mac IIfx than on the Mac SE/30. In a briefing at Apple, the IIfx executed a complicated spreadsheet and graphics routine, involving recalc and cut-and-paste operations and scrolling graphics, almost twice as fast as the Mac IIX did.

Along with its new superfast Macintosh, Apple announced a new version of its flavor of Unix, A/UX 2.0 (see the text box "A/UX 2.0: Unix with Mac Interface Not Ready Yet" on page 113), and a new series of 24-bit color graphics boards (see the text box "24-bit Graphics with a Bang" on page 114). Clearly, Apple planned these announcements together with the rollout of the Mac IIfx to position the machine as its main platform for the high-end engineering and CAD workstation markets, where the two key components are Unix and high-speed graphics.

The Mac IIfx comes with either 4 or 8 megabytes of RAM. However, these are nonstandard 80-nanosecond, 1-megabit single inline memory modules. Rather than standard off-the-shelf 32-pin SIMMs, the Mac IIfx uses 64-pin-wide SIMMs, which are designed to support a memory-access technique called latched read/write. Basically, the phrase means that read and write accesses to memory can overlap, with a "holding area" in the form of 64-bit words for managing the overlapping read/write operations. According to Casanova, Apple is patenting its latched read/write technique. While the technique was designed to improve performance, the drawback is that users who wish to upgrade their systems will have to buy these 64-pin SIMMs from Apple at Apple's premium prices. Perhaps worse, current Mac IIX or IICi users will not be able to reuse their memory if they decide to upgrade their machines to the IIfx logic board. But that's the price of high performance, I guess. It should also be noted that Apple will eventually offer 4- and 16-Mb SIMMs, allowing memory expansion of up to 16 and 32 MB, respectively.

While the logic board has been completely redesigned (it has the same chip count as the Mac IIci in spite of new cache chips, the I/O and DMA processors, and some new custom application-specific ICs), the IIfx looks just like the Mac IIX or the Mac II, and many of its...
Although Unix is one of the oldest of the operating systems in use today, there is little doubt as we enter the 1990s that it is the operating system of choice for scientific and engineering applications. Any computer manufacturer who wants to compete in the federal and technical markets has to offer a version of Unix—one that has a good graphical interface.

Apple sees an opportunity to make major inroads into the Unix market by offering a version of Unix that looks to the user just like the Macintosh interface, which is probably still the premier graphical interface on the market today. Except for the NeXT computer's NextStep interface, no full-fledged, Unix-based graphical interface exists that is completely integrated with the operating system like the Macintosh interface. The Open Software Foundation's Motif and Sun's Open Look are the other major Unix graphical interface contenders, but neither of them is a complete end-user interface at this point. They are still developers' tools that will lead to end-user interfaces in the next year or two.

In conjunction with the introduction of the Mac IIx, Apple has introduced A/UX 2.0, which is indeed a version of Unix (System V release 2 with BSD 4.3 extensions) with the Mac desktop interface. As you can see from the photo, A/UX 2.0 lets you run Unix and Macintosh applications simultaneously and exchange data between them from the Clipboard. You can configure the hard disk drive with two partitions—one for Unix and one for the Macintosh System—and applications are transparently accessed from either partition. Note, however, that multiple tasks under MultiFinder will not run reliably in conjunction with A/UX. According to Apple's product managers for A/UX, the Unix preemptive scheduler can "bring down MultiFinder."

You use the Macintosh Chooser to select printers and file servers. A dialog box called the Commando provides a point-and-click interface for issuing Unix commands, which are automatically routed to the Unix console window. The Apple menu is used to hide running applications that you can recall with a simple mouse-click. In addition, A/UX comes with a mouse-driven text editor and support for TCP/IP networking protocols and the X Window System. Using the Macintosh Toolbox, programmers can develop "hybrid applications" that run under Unix but take advantage of Macintosh desktop features. It's all very elegant.

Nonetheless, A/UX 2.0 isn't ready. According to A/UX product managers, it won't be ready until mid-1990. The version that was demonstrated at the press briefing looked like early alpha software, and it crashed repeatedly. Although Apple demonstrated A/UX 2.0 on a 4-megabyte Mac, it was clear that you need 8 MB of memory to run any significant applications simultaneously.

There are other concerns. While it is undoubtedly an elegant interface that lets you execute Unix and Macintosh applications simultaneously, A/UX 2.0 needs third-party applications. Some off-the-shelf Unix character-based applications may run under A/UX, but Apple supports only the QuickDraw screen-imaging model. Although the X Window System is supported in A/UX 2.0 and can run in a separate window, Unix software developers will still have to port graphics-based applications to run under QuickDraw. At this time, Apple does not support any three-dimensional graphics standards, such as PHIGS, GKS, or RenderMan. As a result, third-party developers can't write three-dimensional applications for A/UX using those standards.

On the other hand, the major appeal of A/UX 2.0 is that you can run both Unix and all the third-party Mac-based applications at the same time. An obvious use of A/UX 2.0 would be for a Unix network such as NFS (Network File System) with simultaneous access to Macintosh software, or for the development of vertical-market Unix-based applications with links to standard Mac software.

Another question is price. At the time of this writing, Apple declined to disclose its price for A/UX 2.0; but A/UX 1.0 costs about $400, and Product Manager Carol Clettenberg stated, "We have lots of additional value in this." That implies that it will cost substantially more than $400. And the price of the software is only the beginning. A/UX takes up most of an 80-MB hard disk drive. That means that you need at least an additional 80-MB hard disk drive or, preferably, an even larger hard disk drive, to store your applications and data. Add to that the cost of a fully configured 68030-based Mac II with high-resolution graphics and 8 MB of RAM, and you're looking at a very expensive system, probably in the neighborhood of $15,000 or more.

Although it's expensive when you add it all up, A/UX 2.0 looks very impressive. Now, the question is whether Apple can deliver a working product and whether software developers will write applications for A/UX 2.0.
24-bit Graphics with a Bang

If you're going after the workstation markets, you need Unix and high-speed graphics. A/UX 2.0 is one side of the equation. The other side is Apple's new 24-bit graphics accelerator board (see the photo). Called the Macintosh Display Card 8/24 GC, the board is powered by an AMD29000 RISC processor running at 30 MHz. The accelerated version is part of a new family of color cards based on Apple's new "custom color chip," which is a single-chip replacement of the series of digital-to-analog converter chips that were used in previous Apple color boards. The board requires one NuBus slot, 2 megabytes of main memory, and version 6.0.5 of the Mac OS.

The 8/24 GC board comes with 2 MB of video memory and can be expanded to 4 MB of RAM. In color mode, the board can display images with 8 or 24 bits per pixel and has a screen resolution of 640 by 480 pixels. In gray-scale mode, the board supports 1, 2, 4, or 8 bits per pixel at a resolution of 1152 by 870 pixels. The board supports a refresh rate of 66.7 to 75 Hz depending on the resolution of the display. It also supports the RS-170 timing standard for interlaced video devices such as TVs and VCRs. However, the 8/24 GC does not have a video input port. The board automatically configures its display mode and resolution according to the display to which it is connected.

With the AMD 29000 processor, which is rated at about 20 million instructions per second at the 30-MHz clock speed, the 8/24 GC provides excellent performance for complex and colorful graphics applications. In a demonstration at an Apple press briefing, the board offered blazing speed for everything from text scrolling to movement and refreshing of 24-bit images on the screen. Apple claims that the 8/24 GC accelerates color display from five to 30 times the normal speed of color applications. The company declined to give a definite price for the 8/24 GC but said that it would cost approximately $2100.

In addition to the 8/24 GC, Apple announced less powerful color boards called the Display Card 4/8 and the Display Card 8/24. The 4/8 version is an 8-bit color board that you can upgrade to a 24-bit 8/24 card by adding video memory to it. These cards have essentially the same features as the 8/24 GC but without the accelerator board. The boards will be priced at about $700 and $1000 for the 8-bit and 24-bit versions, respectively.

The 8/24 GC is an impressive top-of-the-line graphics board; the other new entries are more conventional color cards, although they support 24-bit color. However, Apple faces stiff competition from such third-party graphics board suppliers as Radius, RasterOps, and SuperMac, all of which offer 24-bit color graphics accelerators at very competitive prices.

The AMD29000 RISC processor, which operates at 30 MHz. The board comes standard with 2 MB of video RAM and includes a 64K-byte static RAM instruction cache.

COMPANY INFORMATION
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 1090.

Nick Baran is BYTE's West Coast bureau chief. You can contact him on BIX as "nickbaran."
Other laser printers play with one standard dot size.
Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

The rules have changed. Now the name of the game is Resolution Enhancement technology. You'll call it the best thing to happen to laser printing since the very first HP LaserJet printer. It gives you clearer resolution. Curves that really curve. And edges that are never jagged.

Instead of a “one-size-fits-all” dot, HP's built-in intelligence varies dot sizes. So they can fill areas where they could never go before. For clearer, more professional-looking documents.

©1990 Hewlett-Packard Company PE12003
whole new ball game.

But there's more than better print quality. 14 bit-mapped fonts and 8 internal scalable typefaces provide thousands of options. And enhancements to our PCL5 printer language, including our HP-GL/2 graphics language, let you print portrait and landscape on the same page. Reverse and angled type. Spirals. Even shaded text. You can also plug in Adobe PostScript® software.

For all its new features, the $2,395* list price of the HP LaserJet III is a good deal less than the HP LaserJet Series II printer it replaces. With the same hardware compatibility, wide range of applications, 8 ppm print speed, and software compatibility, including WordPerfect 5.1 and WordStar® 5.5. And the same reliability as the rest of the HP printer family.

So call 1-800-752-0900, Ext. 1007. Ask for our booklet on Resolution Enhancement technology and where to find your nearest authorized HP dealer. We'll put you in a whole new league.

There is a better way.


Circle 135 on Reader Service Card
FREE UPGRADE TO WINDOWS 3.0 COMPATIBILITY! CALL FOR DETAILS.

Multiple viewports allow you to work on up to four views of your drawing at the same time.

Status line gives you instant access to colors, linetypes, layers, snaps and 'quick zooms'.

Color-coded prompts guide you through the design process.

Mouse prompts tell you exactly what each mouse button does.

FINALLY, CAD FOR WINDOWS.
DRAFIX® WINDOWS CAD.

At last the power of true, high performance CAD is available for Windows. Drafix Windows CAD. With features that take you far beyond any Windows drawing package you currently use.

Powerful CAD. Windows CAD is the first and only Windows software to provide all of the designing and editing functions demanded by engineers, drafters, architects and other serious CAD users. It offers multiple interactive viewports, allowing you to work in four views simultaneously. Associative dimensioning, associative crosshatching and a powerful macro programming language are just a few of its features—and that's just the beginning.

Quick to learn, easy to use. Windows CAD lets you take full advantage of your Windows experience. If you already use Excel, Pagemaker, Micrografx Designer, or any Windows package, Windows CAD will have you doing precise, accurate CAD design in no time. And of course you can use all of the plotters, printers and video devices that work with Windows.

From a proven line of CAD products. Windows CAD is the latest in a full line of highly rated CAD software that includes Drafix CAD Ultra, Drafix CAD QwikStart and Drafix 3-D Modeler.

Order your copy of Drafix Windows CAD today!
Now if you have Windows you can have the full power of true CAD. Drafix Windows CAD. Only $695. For more information call us today at 1-800-231-8574 or (816) 891-1040.

Drafix Windows CAD has features you usually find in packages costing 5 times as much!

- Item Attributes [256 layers, 8 colors]
- 8 linetypes
- Up to 60 database attributes to any entity
- Multiple line widths

- Drawing Features [Lines: single, double, tangent, parallel, perpendicular, multiple width]
- Arc/Circle
- Curve/Line
- Polygons and Polylines
- Ellipses
- Pointers
- Freeshading

- Input Methods [Windows menu system]
- Keyboard equivalents
- On-line help system
- Multiple font styles

- System Requirements [286 or '386 processor, Windows 2.1 or later, 1MB internal memory or greater, Microsoft Windows-supported mouse, Windows-supported mouse]

- File Compatibility [AutoCAD, HPGL, COF, SDF for database information]

DRAFIX® WINDOWS CAD

Foresight Resources Corp.
1-800-231-8574

“Drafix Windows CAD packs many of the features of such top-notch programs as AutoCAD and CADkey at a fraction of the cost” - PC Magazine

Circle 118 on Reader Service Card (DEALERS: 119)
32-bit OS/2 forges ahead, with DOS and Windows in tow

Jon Udell

I t's going to be a flat world after all. Microsoft's long-awaited 32-bit OS/2 2.0 joins the list of 386 operating systems—Unix, NetWare 386, 386|DOS-Extender—that have abandoned segments in favor of the flat model. Of course it isn't a flat world yet. Thirty-odd million DOS systems, several million Windows systems, and a few hundred thousand OS/2 systems run segmented programs today and will continue to do so for a long time to come.

Can OS/2 2.0 inherit the features of its three 16-bit predecessors and still realize its 32-bit destiny? I don't see why not. OS/2 2.0 runs 1.x binaries and offers both 16- and 32-bit application programming interfaces (APIs). More important, it features DOS support that far outperforms the 1.x compatibility box. OS/2 2.0 can multitask DOS and even Windows sessions, each in an OS/2 screen group or Presentation Manager (PM) window and scheduled as a normal OS/2 process.

The Unix-style memory model and DOS multitasking add up to a "hit 'em high, hit 'em low" strategy. At the high end, OS/2 can now compete strongly as a server platform. LAN Manager 2.0's HPFS-386 (High Performance File System) is a crucial ingredient, but OS/2 2.0's ability to run 32-bit applications on the server with paged virtual memory completes the picture. Microsoft can't realistically expect to dominate the server market. Today, nearly half of the server-class machines that cost between $15,000 and $350,000 run Unix; the other half run IBM, DEC, or other proprietary operating systems; less than 1 percent run OS/2. Still, an OS/2 freed from its 16-bit shackles should be able to carve out a significantly bigger piece of the midrange pie.

Farewell to Segments
In view of that goal, Microsoft's choice of the flat memory model is a strategic decision, not merely a technical one. Segments, per se, aren't evil. What gave them a bad name was that, on the 286 with its 16-bit registers, segments were too small—just 64K bytes. On the 386, with 32-bit registers, a segment can span 4 gigabytes. An operating system can organize kernel and process-address spaces as one or several of those segments. That choice determines whether segment-oriented or just page-oriented mechanisms can protect the kernel from user processes, and processes from one another.

Experts differ on what's best, but segments have advantages, notably limit-checking, that OS/2 2.0 forgoes. Why toss them completely? Technically, they're inconvenient. Even with fewer, larger segments, there's inefficiency associated with loading selectors. Programmers are just plain tired of them, but strategically, they're a disaster. Competitive Intel-based operating systems don't use the segmentation hardware, and most other 32-bit processors don't even have segments. Although the flat model won't make OS/2 applications portable to other operating systems and processors, at least it will make them less nonportable. It makes reverse migration feasible as well. The prophesied union of OS/2 and the FORTRAN/COBOL code base may yet come to pass.

Battle for the Desktop
At the low end, it's a different story. Here, OS/2 contends for desktop supremacy in a market that Microsoft already dominates. Although the Macintosh finds wide favor, and the romance between Unix and 386 PCs continues to heat up, these systems, like OS/2 itself, compete mainly with DOS and Windows. To judge OS/2 a failure because users still cling to DOS, or because there aren't more OS/2 applications, begs the question. The DOS desktop market is huge; its inevitable upward migration will be glacially slow. As users do move, they'll have to make a choice. OS/2 2.0's competitive 32-bit capabilities and strong DOS support will make it a likely candidate. Microsoft wins to the extent that users will choose OS/2.

The imminent Windows 3.0, which Microsoft acknowledges will run Windows applications in protected mode and so give them access to large memory, clearly complicates matters. Those who have used OS/2 know that memory management is just one of its advantages over Windows. Windows rests on a shaky foundation, namely DOS, and it won't ever match the multitasking, multi-threaded capabilities of OS/2. Nevertheless, users who don't yet see OS/2's superiority will, in the short term, almost...
certainly make Windows 3.0 a successful applications platform. More trouble for OS/2? Again, only if users, when they migrate, don’t choose it.

OS/2 and Windows: An Applications Strategy

Although OS/2 2.0 won’t run Windows binaries, its ability to run Windows in a DOS session will help keep users in the family. Even more helpful would be a way to simplify porting Windows applications to PM. Despite their conceptual similarity, the two programming environments differ radically in their implementation. Today, a port from Windows to PM can be a painful exercise. Microsoft is therefore at work on a “mapping layer,” analogous but unrelated to Micrografx’s Mirrors, designed to ease the Windows-to-PM transition. Microsoft hopes to add the still-unnamed tool to a future release of the 2.0 Software Development Kit (SDK). It’s not version-specific, though; Microsoft expects it to work for current and future versions of Windows and OS/2.

Developers will, in theory, be able to port Windows applications in gradual stages. Minimally, they’ll have to touch perhaps 10 percent of their code in order to meet the requirements of the mapping layer’s interface. Mainly, that means converting interrupts to system calls. The emulator would then enable OS/2 to run the Windows application, with an estimated 5 percent to 10 percent performance penalty. The Windows program could even exploit features of the kernel—threads, interprocess communication, scalable fonts, and HPFS. Ultimately, of course, a full PM port is best, but the emulator should lower the threshold of resistance and help OS/2 capture the still-burgeoning Windows applications market.

The 2.0 SDK

Microsoft announced shipment of the 2.0 SDK on the last day of last year and began filling orders in quantity about six weeks later. It’s the usual deal. This time, developers will have to pony up $2600 to get the series of releases leading up to the final 2.0. What are they paying for? In Microsoft’s view, tools, on-line support, and a head start on building 32-bit applications. In the eyes of some developers who have already invested thousands of dollars in previous OS/2 SDKs, the opportunity to alpha-test yet another new operating system. Obviously, the big players won’t blink. To what extent this policy alienates the “little guy,” and so impedes the flow of OS/2’s lifeblood applications, we may never know. In any event, when a final version of 2.0 ships sometime this year, everyone can join the party—for the price of a compiler upgrade and an OS/2 toolkit.

The SDK version of the operating system, fat with debugging instrumentation, wants 6 megabytes of RAM. Microsoft expects the final version to run in 4 MB, and, given that 2.0’s more efficient virtual memory system will make more of the kernel swapable, that seems attainable. In its current incarnation, the system looks and feels just like OS/2 1.2. The SDK includes 32-bit versions of Microsoft C and MASM (Microsoft Macro Assembler). The C compiler, called Microsoft C 5.2, isn’t the new 6.0 compiler that was in beta test at the time of this writing, but rather a 32-bit adaptation of Microsoft C 5.1. However, the SDK does include a prerelease version of CodeView 3.0, the debugger that’s bundled with Microsoft C 6.0. Eventually, 6.0 and its Programmer’s Workbench should work with OS/2 2.0, but Microsoft hasn’t yet committed to a release date.

In other respects, the SDK is a typical OS/2 toolkit. It includes the resource and help compilers; icon, dialog box, and font editors; and sample code. Like the 1.2 toolkit, which began shipping around the time of the 2.0 announcement, it will also include the Dialog Manager, which supports COBOL- and FORTRAN-generated screens in the PM environment, and IBM’s CUA (Common User Access) style guide. These components testify to OS/2’s key role in IBM’s plan to integrate applications across platforms, which is known as SAA (Systems Application Architecture).

The New Memory Model

OS/2 2.0 accomplishes the shift to a 32-bit programming model gracefully. Developers familiar with version 1.x needn’t worry about API shock. The vast majority of kernel and PM functions don’t change. Dual 16- and 32-bit support takes the form of 16- and 32-bit dynamic link libraries (DLLs) and header files that control parallel name spaces. You will still write DosOpen and DosCreateThread; when compiling for 32-bit mode, those names will become DosOpen2 and Dos32CreateThread. Those functions that manipulate segment selectors, such as DosAllocSeg and DosAllocHuge, are gone. But few programmers will shed many tears for them.

The new unit of memory allocation is called a “memory object” and is simply a contiguous set of 4K-byte pages in the linear address space. Flags to the allocation routines specify access permissions: read, write, execute, or guard. Guard pages facilitate the use of “spare memory objects.” OS/2 2.0 distinguishes between allocating and committing memory. To allocate memory means to reserve linear address space; to commit it means to map physical pages into that reserved space and possibly trigger page swapping. Guard pages enable the system (or the programmer) to commit memory dynamically to an allocated region; stacks are the most obvious use for the technique. When there’s a reference to a guard page, the processor generates a guard-page fault; a system- or user-defined exception handler can then commit a physical page and make the next page a guard page.

Since there’s no way to defragment the linear address space or reallocate memory, spare memory lets programmers allocate ridiculously large chunks—limited only by the backing store—without involving the virtual memory subsystem until it is actually needed.

Threads, Semaphores, and Other Enhancements

OS/2 threads, or “lightweight processes,” offer huge advantages to the applications that use them; they also support multitasking.

120 BYTE • APRIL 1990

---

**OS/2 threads**, or “lightweight processes,” offer huge advantages to the applications that use them; they also support multitasking. With OS/2 2.0, everyone can join the party—for the price of a compiler upgrade and an OS/2 toolkit.
How to plan your LAN.

You'll need a pencil.

That's to write down the telephone number on the bottom of this page. Which will connect you with Samsung's nationwide network of resellers. And the Samsung/Novell co-labeled line of LAN hardware.

With one call you can plan on substantial savings over the big name computers which, despite high clock rates and even higher price tags, are not really optimized for networking.

And you can plan on 100 percent compatibility with all versions of Novell's NetWare®, because Samsung's LAN hardware was co-designed by Novell.

THE TESTING WENT IN BEFORE THE LABEL WENT ON.

Samsung's 386AE and PCTerminal/286 have been tested exhaustively and certified by Novell for compatibility with all popular networking products. In fact, Samsung's 386AE is one of 3 file servers certified by Novell to run NetWare 386.

Novell's engineers successfully tested the PCTerminal/286 in 1200 network configurations...with 50 units running at once! No other computer manufacturer can make that claim.

NETWORKING VS. NOTWORKING.

What's the difference? Take our 386AE Fileserver. It includes Novell's Advanced BIOS and 8 expansion slots to accommodate multiple network interface cards and disk controllers. Plus an oversize power supply for driving dual high capacity hard disks and tape backup system. Plus 4 megabytes of memory for disk caching.

Then there's Samsung's PCTerminal/286 Diskless Workstation with a built-in Ethernet interface and Remote Boot EPROM.

And not to be overlooked is our 16-bit SE2100 Ethernet Interface Card which provides up to twice the throughput for the price of an 8-bit card.

CALL TODAY.

For the name of the Samsung reseller nearest you, call us today at 1-800-624-8999, ext. 851.

The 386AE and PCTerminal/286. More than affordable.
The system now dynamically allocates stack memory for threads using the guard-page feature. The semaphore functions are new and are incompatible with the 1.x functions. Semaphores in 2.0 come in three flavors: event, mutual exclusion (mutex), and multiple wait (muxwait). Event semaphores provide a basic interthread signaling mechanism. The mutex semaphores work similarly but are designed for serializing critical sections of code in multiple threads. The muxwait semaphores permit a thread to wait on multiple semaphores, all of which must be of either the event or mutex variety. All semaphores are now handle-based and reside outside an application's address space.

Other enhancements include built-in floating-point emulation (a DLL that's not loaded on an i486 or if an 80387 is present), improved exception-handling capabilities that language extensions can make available to users, new device helpers (DevHlps) to enable device drivers to communicate with the linear address space, and a general relaxation of system limits. OS/2 2.0 supports more threads (4000, versus 1.2's 512 and 1.1's 256), and vastly more semaphores—64,000 per process.

There's one major omission. OS/2 2.0 does not support the VIO/KBD/MOU packages, which bypassed PM to give 1.x developers direct control of the keyboard, screen, and mouse. So there's no middle ground anymore. It's either PM or printf (primitive teletype-style I/O).

**MVDM: Multiple Virtual DOS Machines**

There's no shortage of 386 DOS multitaskers these days. DESQview, VM[386], and VP/ix are notable examples of programs that use the V86 mode of the 386 to good effect. But OS/2's MVDM facility exploits an advantage that is uniquely Microsoft's. Other DOS multitaskers run off-the-shelf MS-DOS. MVDM's designers grabbed the DOS 4.0 source code, threw away the file system and other nonessentials, and ended up with an OS/2 2.0-specific version of DOS that leaves more than 620K bytes of RAM free for real-mode applications.

It's eerie to see DOS programs like Lotus 1-2-3, WordPerfect, and even Flight Simulator running in overlapped PM windows, side by side with PM applications. A DOS program can run in the background as an icon. DOS programs can even use the PM clipboard. For example, you can cut a block of numbers out of 1-2-3 using PM's mouse and paste the numbers into WordPerfect or the PM version of Excel. MVDM will allow a full-screen DOS program to write straight to the display. And it supports EMS memory. Tunable parameters, such as task priority and idle detection, aren't in the first SDK version of OS/2 but will be made available.

MVDM comes with "virtual device drivers" for the standard character devices: video, keyboard, printer, and communications port. There won't be VDDs for block devices (at least initially), so DOS programs won't be able to talk directly to network adapters, CD-ROM readers, tape drives, and the like. You'll have to depend on OS/2's support for such devices—and that's been a sore point with OS/2 thus far. There aren't many OS/2 network drivers available yet, and, despite Microsoft's commitment to CD-ROM publishing, there's no OS/2 CD-ROM driver yet.
You won't be able to run DOS-extended programs, such as the DOS versions of Lotus 1-2-3 release 3.0, AutoCAD 386, Mathematica, and IBM Interleaf Publisher, under 2.0's MVDM. OS/2 2.0 doesn't, and won't, support VCPI (Virtual Control Program Interface). Options are to use dual-boot or wait for PM versions of these programs—which, in the case of 1-2-3 and AutoCAD, have already appeared. Although Microsoft acknowledges a need for DOS programs under MVDM to use extended memory better than EMS memory allows, there’s no announcement yet of a plan to accomplish that.

Royal Fonts
Although Royal fonts aren't included in the first SDK release of 2.0, Microsoft has demonstrated the technology. Apple licensed the Royal font format to Microsoft. In the near term, this means that OS/2 2.0 and the forthcoming Macintosh System 7.0 will be able to exchange and use identical, high-quality, scalable display fonts. When Royal printers appear, both operating systems will be able to operate with them as well.

Royal is especially well suited to OS/2's GPI (Graphics Programming Interface). OS/2 defines its own vector-font API, which need not change to accommodate Royal. OS/2 features a unified imaging model that makes virtually no distinctions between screen and printer graphics. OS/2 2.0 defines no new APIs for Royal, because it doesn’t need to. From an application writer's perspective, the necessary tools are already in place.

It’s (Almost) the Real Thing
OS/2 is finally growing up. Flat addressing, paged virtual memory, an extremely powerful and flexible file system, an excellent graphical user interface, DOS multitasking, and a unified imaging model: It all adds up to certain success in the long run. How long? That may not matter; Microsoft can afford to wait. So long as there isn’t a mass exodus to alternate platforms—and the next couple of years admittedly will be critical—2.0 will be there to greet users who grow weary of wrestling with DOS and its extensions.

But the picture isn't completely rosy. OS/2 2.0 is still wobbly; a final release is many months away. OS/2 device driver support remains spotty—in some cases, such as printer control language and CD-ROM, unconscionably so. Applications are few. Development tools aren’t what they should be. And the proliferation of Microsoft systems—DOS, Windows, 16-bit OS/2, and now 32-bit OS/2—fragments the finite pool of programming talent to an alarming degree. We’ll see how it all plays out. But I’ve seen the system that I want to install on my 386 PC. It’s OS/2 2.0.

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."
Last year saw an explosion of interest in Unix workstation computing, but IBM's position in the market remained a big question. How would the company upgrade its lackluster RT system? In December, BYTE was invited to preview the answer, the RISC System/6000 family of high-performance workstations and servers. Codeveloped by IBM's Yorktown, New York, and Austin, Texas, research labs under the code name "RIOS," these machines are IBM's new Unix flagships.

The RISC System/6000 sets a new performance standard, boasting speeds of 28 million instructions per second on the desktop and over 40 MIPS in the fastest models. Preliminary benchmarks for the entry-level system appear to show performance 2.5 times that of the Sun SPARCStation 1; the machines have enough power to emulate an Intel 8086 in software and still run DOS applications faster than an AT. Most important, the RISC machines are designed not just for technical users but also for multiuser commercial applications, which speaks volumes about IBM's commitment to the Unix market.

The pricing is also very aggressive. An entry-level machine sells for $12,995 and includes a 120-megabyte hard disk drive, 8 MB of RAM, a 19-inch 1280-by-1024-pixel monochrome display, an Ethernet card, a keyboard, a mouse, AIX and OSF/Motif software, and a one-year warranty. A desktop server model has a 240-GB hard disk drive and sells for $14,945.

Variations on a CPU
The product line includes nine RISC machines based around a common CPU architecture, plus an array of add-ins and a low-cost X terminal (see the table). IBM is also releasing a new version of AIX—its home-grown Unix variant—with the machines.

The new AIX 3 has a file system that can span physical devices and change in...
IBM's new family of RISC-based Unix systems offers tremendous power.

The systems are packaged in three basic models: desktop, deskside (or tower), and rack-mount. The desktop and desk-side units are available as workstations or servers, while the cabinet-size rack-mount model is a server only. Many subsystems, including memory boards, mass storage, and graphics and communications cards, are common across the product family. In this article, we will focus on the entry-level platforms.

The 32-bit superscalar CPU is constructed of seven to nine CMOS chips containing more than 6 million transistors. Its architecture, which IBM calls "second-generation RISC," includes separate fixed-point, floating-point, and instruction/branch units that operate in parallel, for a total execution rate of up to five operations per cycle. In addition, the chip set includes separate data cache, storage control, and I/O control units. Depending on the model, the CPU operates at 20, 25, or 30 MHz. (See the figure.)

The new processor can access a vast amount of memory. Full 32-bit memory addressing allows it to directly address up to 4 gigabytes of real memory, and 52-bit virtual address generation permits access to a whopping 4 petabytes (i.e., 4 million gigabytes) of virtual memory. Real memory is located on a special high-speed synchronous bus that passes data to the cache on a 64- or 128-bit wide path, depending on the model, at speeds of between 160 and 480 megabytes per second.

All the systems include an enhanced version of IBM’s Micro Channel bus that uses data streaming to allow burst-mode transfers at up to 40 MBps, twice the speed of the bus in the PS/2s. The sustained throughput is 25 to 30 MBps. The new Micro Channel also specifies a 77 percent larger card size to allow more complex designs, and it performs parity checking on all data; however, it still accepts the smaller boards engineered for PS/2s. All the new high data-rate cards available for the systems, such as graphics, SCSI, and network interfaces, have on-board I/O processors and are bus-mastering.

To boost system reliability, all members of the family include error-detection and correction capabilities unprecedented in workstations, including a suite of 80 to 100 power-on self tests, parity checking on all buses and boards, bad-bit-swapping, and memory scrubbing.

The RISC CPU is a uniprocessor and isn't designed to allow closely coupled multiprocessing like many minicomputers. However, with an eye to distributed computing, IBM has built-in support for a 20-MBps optical link that lets systems share data in clusters. This technology will be implemented in the future.

**Desktop POWERhouse**

The entry-level RISC systems are called the POWERstation 320 and POWERserver 320. (POWER is an acronym for performance optimization with enhanced RISC.) Both use the same polycarbonate.

---

**SYSTEM CONFIGURATIONS FOR THE RISC SYSTEM/6000 FAMILY**

*IBM’s new RISC System/6000 consists of six models, all of which use essentially the same proprietary RISC CPU.*

<table>
<thead>
<tr>
<th>Model</th>
<th>Packaging</th>
<th>CPU/cache</th>
<th>Memory slots</th>
<th>Standard RAM</th>
<th>Maximum RAM (1-Mb/4-Mb SIMMs)</th>
<th>Micro Channel slots available</th>
<th>Storage bays (full-/half-height)</th>
<th>Standard storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>320</td>
<td>Desktop</td>
<td>20 MHz/32 KB</td>
<td>2</td>
<td>8 MB</td>
<td>32/128 MB</td>
<td>4</td>
<td>0/2</td>
<td>120 MB</td>
</tr>
<tr>
<td>520</td>
<td>Desk-side</td>
<td>20 MHz/32 KB</td>
<td>8</td>
<td>8 MB</td>
<td>128/512 MB</td>
<td>7</td>
<td>3/6</td>
<td>355 MB</td>
</tr>
<tr>
<td>530</td>
<td>Desk-side</td>
<td>25 MHz/64 KB</td>
<td>8</td>
<td>16 MB</td>
<td>128/512 MB</td>
<td>7</td>
<td>3/6</td>
<td>355 MB</td>
</tr>
<tr>
<td>540</td>
<td>Desk-side</td>
<td>30 MHz/64 KB</td>
<td>8</td>
<td>64 MB</td>
<td>128/512 MB</td>
<td>7</td>
<td>3/6</td>
<td>640 MB</td>
</tr>
<tr>
<td>730</td>
<td>Desk-side</td>
<td>25 MHz/64 KB</td>
<td>8</td>
<td>16 MB</td>
<td>128/512 MB</td>
<td>6</td>
<td>3/6</td>
<td>355 MB</td>
</tr>
<tr>
<td>930</td>
<td>Rack-mount</td>
<td>25 MHz/64 KB</td>
<td>8</td>
<td>16 MB</td>
<td>128/512 MB</td>
<td>6</td>
<td>4/8 per drawer</td>
<td>670 MB</td>
</tr>
</tbody>
</table>

1Storage, internal hard disk drives: 120- MB (desktop only), 320- MB (3½-inch); 355- MB, 670- MB, and 857- MB (5¼-inch); backup: 8-millimeter digital audio tape-recording system (internal/external), and 4½-inch and 5½-inch tape (external); other: External 5¼-inch floppy disk drive and internal CD-ROM drive.

Japanese only.

Notes: All systems include one 3½-inch 1.44- MB floppy disk drive and the following ports: keyboard, mouse, tablet, external floppy disk drive, parallel, and two serial.

Desk-side systems include one 4-Mbps SCSI adapter; the 930 has two. The 730 includes a two-slot graphics card.
SECOND-GENERATION RISC SYSTEMS

Instruction bus (2 words)

Fixed-point unit

Floating-point unit

Instruction/branch unit (with 8K-byte cache)

Instruction cache reload (2 words)

Cache address

Data cache

32K or 64K bytes

Two chips or four chips

Initial program load EPROM

Storage I/O control unit

System I/O bus (2 words)

Memory bus (4 words/2 words)

Memory cards

Native I/O controller

Optical link

Micro Channel interface

Block diagram of RISC CPU architecture. Note the separate units for fixed-point, floating-point, and instruction/branch operations. All memory access flows through the data-cache unit, while the storage I/O control unit and I/O “combo” chip control Micro Channel and bus access.

plastic enclosure, but the server version will sport more storage.

The desktop unit is a little larger than an IBM AT: It measures 6½ inches tall, 18 inches wide, and 20½ inches deep, and it weighs between 28 and 34 pounds. Inside the unit are a system planar (the motherboard [see photo 1]) and a CPU planar (see photo 2) that plugs into the unit perpendicularly. Both boards use an advanced eight-layer construction, with four signal and four power/ground layers; the CPU board is virtually devoid of passive components.

The desktop CPU uses a seven-chip complex that operates at 20 MHz and includes two 16K-byte data-cache chips, or 32K bytes of cache. (Larger systems use a nine-chip set that has 64K bytes of data cache.) In addition to the CPU slot, the system planar has two memory slots, four Micro Channel slots, a “direct attach” hard disk drive connector, 192K bytes of self-test and boot EPROM, and an assortment of I/O ports. Rounding out the interior are a quiet cooling fan and a 265-watt, auto-sensing power supply with its own fan.

The standard memory allotment is 8 MB of 80-nanosecond RAM, configured as eight 1-MB single-in-line memory modules on a single memory board. Double-sided 2-MB SIMMs are also available that would allow each memory board to hold 16 MB, for a total system memory of up to 32 MB. When 4-megabit DRAM chips become available in the future, the desktop unit will be able to hold 128 MB of real memory. For mass storage, the desktop includes two 3½-inch 120-MB hard disk drives mounted in a special carrier and plugged into the hard disk drive slot, and a 3½-inch 1.44-MB floppy disk drive.

For commercial installations, IBM provides a range of multport asynchronous cards to connect ASCII terminals. For graphics applications, IBM offers four cards: gray-scale and color two-dimensional boards and two three-dimensional color options, which will be discussed later in the article. You can choose from 13 displays that range from a 12-inch, 640- by 480-pixel monochrome model to a 23-inch, 1280- by 1024-color unit, or you can use previously purchased displays.

The deskside systems, which look like small minicomputers, share similar packaging and internal design, but they vary in performance and configuration. In these models, the system and CPU boards are on the same plane, attached end to end (see the table for specifications).

Reestablishing the Lead in RISC

IBM invented RISC in 1975 with the 801 processor. The 801 was almost used as the heart of the IBM DisplayWriter, but, instead, it evolved into the CPU for the IBM RT, which was introduced in 1986.

The RT’s anemic floating-point and graphics performance prompted IBM to design a new-generation CPU. The RIOS project had a major design objective: to achieve an execution rate of less than one cycle per instruction. Hand-in-hand were commitments to use 1-micron VLSI CMOS technology for low-power and cooling requirements, to offer large virtual memory and real-time interrupt handling, to develop optimized Unix compilers, to use industry standards, and to provide the best price/performance ratio on the market.

IBM’s definition of RISC relies less on a small instruction set than on optimizing them to execute in a single cycle or less. To achieve this, the RISC CPU uses parallelism and pipelining. At the heart of the CPU are three separate processor chips: the instruction/branch unit (ICU), the fixed-point unit (FXU), and the floating-point unit (FPU).

The ICU is responsible for doling out
instructions to the FXU and FPU and for resolving branch conditions. Instructions are pulled from an 8K-byte cache located on the same chip, which is in turn fed from memory through the data cache in 64-bit increments. The ICU can execute two operations internally while at the same time issuing orders to the FXU and FPU.

The ICU has two particularly powerful capabilities. First, it contains a special 32-bit register that is used to track the status of up to eight branch conditions. Using this register and instruction look-ahead, the ICU can *pre* solve branches and execute them as soon as conditions permit. This so-called “zero-cycle” branching is more efficient than the methods that are used in other RISC architectures.

Second, the ICU contains special registers into which the complete machine state is stored in the event of an interrupt. This allows the system to vector quickly to an interrupt service routine without using a time-consuming stack operation that would tie up the FXU address generation and memory access.

The FXU is less remarkable in its design, but it plays an important role in generating and translating addresses and controlling the data cache. What is significant is that these tasks have been off-loaded from the usual RISC CPU. The FXU performs all integer arithmetic and logical operations and contains the segment registers for memory addressing. One unusual feature for a RISC system is that the FXU supports special string instructions for handling null-terminated strings (used in C) or length-specified strings (used in Pascal) with minimal overhead.

The key to RISC performance is that the FPU receives instructions concurrently with the FXU and executes them at the same rate. The FPU has a 64-bit path from the data cache and conforms to IEEE floating-point standards. A pipelined design lets it spit out a double-precision result every cycle with only a two-cycle latency.

The FPU also has one special instruction (multiply/add) that executes in the same time required for simple adding or multiplying. This single instruction permits the system to execute the equivalent of five operations per cycle, even though only four are dispatched at a time.

All the chips in the CPU are implemented in VLSI CMOS using 1-micron technology. The packages, roughly 1 inch on a side, have between 184 and 293 pins each and are socketed for easy replacement. For reliable cooling, each chip is topped with an aluminum heat sink. Most of the rest of the components in the system are surface-mounted.

### Data Paths

The cache is the interface to the main memory, and it feeds instructions to the ICU and data to the FXU and FPU. Instead of off-the-shelf static RAM components, IBM uses a custom cache design that is two- or four-way associative. The company claims that this design permits a hit rate that is equal to a direct-mapped static RAM cache twice as large.

The entry-level desktop and deskside continued...
First Impressions
Sizzling RISC Systems from IBM

Company Information
IBM
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 890.

systems have 32K bytes of two-way associative cache and a 2-word, or 64-bit, path width from main memory. (The actual data bit width from each memory card is 80-bits— including error-correction and redundant bit lines— while there are 50 lines for 32-bit addresses plus control and parity.) With a CPU speed of 20 MHz, the memory bus bandwidth is 160 MBps.

The nine-chip systems have a 64K-byte four-way associative cache and a memory path width of 128 bits, or 210 bits including addressing and error-correction. The 25-MHz models have a memory bandwidth of 400 MBps, and the 30-MHz model transfers at 480 MBps.

The systems use a segmented memory architecture and support memory locking to prevent processes from interfering with one another. Physically, memory is four-way interleaved and scattered so that no more than 1 bit of each word is located in a single DRAM chip. Logically, memory is split into 4K-byte pages, and real addresses are calculated using a translation look-aside buffer and a page-frame table.

Graphic Evidence
Any of the systems can accept one of several 2-D and 3-D graphics adapters announced with the RISC family. The “entry-level” board is available in two flavors: 4-bit gray-scale (16 shades) or 8-bit color (256 colors from a palette of 16 million). This card uses a single frame buffer and can draw 75,000 2-D vectors per second.

The High-Performance 3-D Color Graphics Processor, codeveloped by IBM and Silicon Graphics, uses technology from the Personal Iris system. The two-slot card is available in 8-bit or 24-bit color versions to allow, respectively, 256 or 16 million colors from a palette of 16 million. It can draw 90,000 2-D vectors and 95,000 3-D vectors per second, and with an optional daughtercard, it can draw 10,000 Gouraud-shaded triangles per second. A second daughtercard option provides z-buffering.

Impressions
To go from the back of the Unix pack to being a leader requires more than snappy hardware. Users want standards, and they need applications. IBM has poured a vast effort into the compiler technology that lets applications take advantage of the RISC CPU. But the company has also chosen to sidestep the popular movement toward a common Unix by enhancing its nonstandard AIX.

To encourage wary third-party developers to port applications to the RISC System/6000, IBM has set up a special porting lab in Austin and will establish others in the U.S. and all over the world. The laboratories are staffed by trained engineers dedicated to each port, and developers are given ample equipment and security. Hundreds of Unix applications have already been ported. The costs of running the centers is no doubt staggering, but they are indicative of IBM’s commitment to this product line and to the Unix market.

IBM’s previous venture in workstations was unsuccessful, and the company knows it is at least two years behind in the marketplace. To catch up, IBM has thrown everything into the RISC System/6000, including years of engineering, extensive training, and what promises to be a major marketing effort. From our early look, we think the RISC System/6000 stands a good chance of success.

Our technical reservations are few. Will the Micro Channel, even with its improvements, be fast enough for large multiuser applications or very data-intensive graphics? Will AIX suffer in the market for its incompatibility with Unix System V release 4 and lack of multiprocessing support? Will there be enough applications available soon enough? The main concern is whether IBM will be sufficiently nimble to succeed in the fast-paced workstation market. The RIOS project has been marked from the beginning by vacillation and delays. To compete in the RISC market against Sun, Hewlett-Packard, MIPS, and Digital Equipment, IBM can’t afford to be risk-averse.

IBM has hinted at less-expensive members of the RISC System/6000 family in the future, the price/performance ratio by 2 to 1. Since IBM has hinted at less-expensive members of the RISC System/6000 family in the future, the price/performance ratio will continue to challenge not only competing workstations but high-end PCs as well.

Andy Reinhardt is a BYTE associate news editor. Ben Smith is a BYTE technical editor. You can contact them on BIX as “areinhardt” and “bensmith,” respectively.
Now you can grab, store, and process 16 images in Real Time on the PC AT.

The DT2861 Arithmetic Frame Grabber can process 4 times as many images as any other frame grabber built for the PC AT.

With a built-in processor, the DT2861 also lets you process 4 images in parallel, or switch display instantaneously from as many as 16 images. The DT2861 grabs images off virtually any video source, including CAT scanners, scanning electron microscopes, line-scan cameras, as well as ordinary video cameras and VCRs. It even ships with IRIStutor™ software—free!

For more information about the Frame Grabber that’s 4 times better than anything else made for PCs, give us a call today.

Call (508) 481-3700.
In Canada, call (800) 268-0427.

FREE 1990 Image Processing Handbook

The many faces of Fred Molinari, President of Data Translation, Inc.
The right motherboard provides the foundation for high-performance, 25-MHz 386 systems

Steve Apiki, Rob Mitchell, and Stan Wszola

With all the emphasis these days on high-performance storage and video subsystems, it's easy to forget that the ultimate performance enhancement is a new system board. The fastest SCSI drive won't give your applications the boost you expect if the real culprit is a slow CPU or memory architecture.

Virtually all 386 motherboards are designed to run at or close to zero wait states. But the presence of cache memory, or support for interleaving or fast-page-mode DRAM chips, can make a big difference in how a motherboard performs. Of course, performance isn't the only factor separating 386 motherboards. Other features, such as pricing and expandability, vary considerably.

Why do the different 386 motherboard designs stack up? To find out, we examined 23 motherboards from 16 different vendors (see tables 1 and 2). All the motherboards support a 25-MHz CPU and include a 25-MHz Intel 80387 math coprocessor. Last year's cutting-edge performers, systems built around the 25-MHz 386, have dropped in price to become an attractive high-performance 386 platform.

Why Test Motherboards?
Replacement motherboards are an appealing alternative to budget-conscious users of XT- and AT-class machines who are looking for an inexpensive way to move up to a 386. Depending on your existing hardware, you could save substantially over the cost of a new system. But you might have some problems integrating the new motherboard into a system with components that are designed for older, slower systems.

If you plan to build a system from the ground up, the savings will probably be disappointing. Major PC clone vendors buy components by the truckload and can offer assembled systems for less than the retail cost of all the parts. The main advantage of assembling your own system isn't monetary; it's an intimate understanding of what's in your machine and how it fits together. You can build your system to your exact specifications using the components that will produce the best performance or greatest economy.

But the relative merits of 386 motherboards aren't just topics for the do-it-yourselfer. If you're thinking of buying a system, you will find that third-party motherboards offer an excellent basis of comparison among clone machines. Many PC clone vendors pride themselves on using name-brand graphics adapters, monitors, and hard disk drives. But the motherboard isn't as likely to be from a well-known manufacturer—and even when it is, information about a given motherboard is often hard to find.

We tested both cached and noncached designs and both XT- and AT-size motherboards. You won't find all these motherboards at the corner computer store, or even in the back pages of BYTE. Intel and Mylex, for example, sell only to value-added resellers (VARs). But other vendors, such as Jameco and JDR Microdevices, sell both directly to end users and through dealers.

Most vendors offer a bare-bones motherboard configuration that includes a 25-MHz Intel 866 CPU and no DRAM. If the motherboard includes a cached-memory system, it includes at least 32K bytes of static RAM.

List prices vary, depending on configuration, vendor reputation, and distribution channel. Cache motherboards cost more than noncached models, and name-brand motherboards like Mylex's MWS 386-25 and Jameco's JE3026 (which is actually made by American Megatrends, Inc. and is identical to 25-MHz AMI motherboards found in many compatibles) cost substantially more than lesser-known brands. Motherboards sold through dealers and VARs have higher list prices than boards available directly from the manufacturer, but they generally sell at a discount.

To make comparisons easier, we've made two features tables: table 1 for caching motherboards, and table 2 for noncaching motherboards. Most of those with a cache ranged in price from $1100 to $2000 with no RAM. The least-expensive cached product was Nascent's NT-386-25 ($1049), and the most expensive was Intel's Model 302 ($4091), which included 2 megabytes of RAM. Noncaching boards started at $765 and went up to $2095 for the Seattle STD 386XT, which comes standard with 1 MB of RAM.

The Proving Ground
We tested each motherboard for two things: performance and physical compatibility. Determining the latter merely meant installing each motherboard in a generic AT-size case to check for correct size and proper lo-
cation of the holes for mounting standoffs and screws. Every board fit into the case, although some just squeaked by our AT’s disk drive housing.

To test performance, we set up a test system consisting of the following peripherals: a 250-watt power supply, a Western Digital WD1006V-MM1 hard disk drive controller card, a 40-MB hard disk drive, a Jameco JE1077 floppy disk drive controller/serial/parallel card, a TEAC FD-55GFR 5½-inch 1.2-MB floppy disk drive, an AST VGA Plus video card, a Key Tronic KB 101 keyboard, and one of several color VGA monitors.

We hooked each motherboard into this test-bed in turn. We tested each board under DOS 3.3 with an Intel 80387 coprocessor and at least 2 MB of memory installed. If the minimum interleaved configuration required 4 MB, we installed 4 MB. The BYTE benchmark results in table 3 show the CPU, FPU, and video benchmark indexes and ratings from the conventional Dhrystone and Livermore Loops tests.

To gauge the effectiveness of these boards when running large, protected-mode applications, we also put them through a run of the BYTE Unix benchmarks. We installed 8 MB of memory in each board to provide a realistic Unix environment and then ran the benchmarks using Interactive’s 386/ix 3.2. The indexed results of these benchmarks and of our standard CPU, FPU, and video benchmarks are graphed in the figure.

**Cache Machines**

Motherboard designers use several tricks to improve performance. While a few techniques (e.g., video-BIOS shadowing or increasing the bus speed) affect peripherals, most are aimed at shortening the time that the CPU spends exchanging data with system memory. Over the last few years, as PC processors began outrunning available DRAM, cached memory has proved the continued
### Table 1: Features of caching 25-MHz 386 motherboards. Boards are differentiated by nonperformance features (e.g., expandability and flexibility of configuration) as well as by performance-enhancing features (● = yes; ○ = no).

<table>
<thead>
<tr>
<th>Motherboard</th>
<th>Manufacturer</th>
<th>List price</th>
<th>Board size (inches)</th>
<th>CPU speeds (MHz)</th>
<th>System bus speed (MHz)</th>
<th>Expansion slots</th>
<th>Math coprocessors</th>
<th>ROM BIOS</th>
<th>BIOS Shadow RAM</th>
<th>Video Shadow RAM</th>
<th>386 chip set</th>
</tr>
</thead>
</table>
| Atronics AT1-386B | Atronics International | $1295$ | 18½ × 12 | 8, 25 | 2-8-bit, | 616-bit, | 2-8-bit, | 616-bit, | 80387-25, 1167-25 | AMI EC&T 5286 (4-20-88) | ○ | ·
| CF M-386-25 | C² Micro Systems | $1300$ | 12 × 13½ | 6, 8, 25 | 2-8-bit, | 5-16-bit, | 16-32-bit | 80387-25, | 1167-25 | Award M386-25/33 (8-25-89) | ○ | ○ | 'Discrete logic |
| DTK Cache 386-25 | DTK Computer | $1649$ | 12 × 13½ | 10, 25 | 6, 12 | 1-8-bit, | 616-bit, | 5-16-bit, | 16-32-bit | 80387-25, 3167-25 | DTK 4.25 (6-12-89) | ○ | ○ | Discrete logic |
| Jameco JE3026 | AMI | $1900$ | 12 × 13½ | 8, 25 | 1-8-bit, | 616-bit, | 5-16-bit, | 32-bit | 80387-25, 3167-25 | AMI DAMI 3607 (4-25-89) | ○ | ○ | Discrete logic |
| Jameco JE3525 | Elite Group | $1200$ | 8½ × 13 | 8, 25 | 1-8-bit, | 4-16-bit, | 32-bit | 80387-25, 3167-25 | AMI EC&T 1131 (8-30-89) | ○ | ○ | C&T |
| JCS 386c | JC Information Systems | $1100$ | 8½ × 13 | 8, 25 | 1-8-bit, | 616-bit, | 5-16-bit, | 16-32-bit | 80387-25, 3167-25 | Phoenix 1.10.02 (1-15-88) | ○ | ○ | C&T |
| JDR C386-25 | Modular Circuit Technology | $1199$ | 8½ × 13 | 16, 25 | 3-8-bit, | 4-16-bit, | 1-32-bit | 80387-25, 3167-25 | AMI EC&T 1131 | (2-25-89) | ○ | ○ | C&T |
| Micronics 80386-1 Cache | Micronics Computers | $1500$ | 12 × 13½ | 6, 8, 25, 8.3, 12.5 | 2-8-bit, | 5-16-bit, | 32-bit | 80387-25, 3167-25 | Phoenix 1.10.10A (1-15-88) | ○ | ○ | Discrete logic |
| Monolithic MicroFrame 386CT | Monolithic Systems | $1845$ | 8½ × 13 | 10, 25, 8.3, 10, 12.5 | 6-16-bit, | 32-bit | 2-8/16-bit, | 32-bit | 80387-25, 3167-25 | Qualitex CS8231 | (8-09-89) | ○ | ○ | C&T |
| Mylex MWS 386-25 | Mylex | $2100$ | 12 × 13½ | 8, 25 | 6.25, 8.33, 12.5 | 1-8-bit, | 616-bit, | 5-16-bit, | 32-bit | 80387-25, 3167-25 | Phoenix 1.10.10 (11-15-88) | ○ | ○ | Discrete logic |
| Orchid Privilege 386/Cache | Orchid Technology | $1398$ | 12 × 13½ | 8, 25 | 2-8-bit, | 616-bit, | 5-16-bit, | 32-bit | 80387-25, 3167-25 | AMI DC&T 5025 (4-30-89) | ○ | ○ | C&T |

Note: Base price includes CPU.
1 All motherboards support only one math coprocessor at a time unless footnoted.
2 Tested type listed first.
3 Base price includes 1 MB of RAM.
4 Supports both coprocessors simultaneously.
5 Uses 64K-byte-cache version.
6 Uses 256K-byte-cache version.

Most effective method for enhancing high-speed board performance.

Not surprisingly, cached boards in our tests décidely outperformed their non-cached counterparts. On both DOS and Unix CPU tests, the 16 caching models finished well ahead of the seven that did not use caches. The trend continued for our Drystone tests as well.

While some cache is always better than no cache, a clear winner among implementations differs, however, in how they organize data, when they write to main memory, and how large a cache they require.

About one-half of the cached boards (nine) used a direct-mapped cache organization; the remainder used two-way set-associative caches. Although other types exist, these two are by far the most common in current PCs.

Direct-mapped caches assign a dis-
**PRODUCT FOCUS**

**386 MOTHERBOARDS**

<table>
<thead>
<tr>
<th>Memory Cache</th>
<th>Controller</th>
<th>Cache organization</th>
<th>SRAM speed (ns)</th>
<th>Tested size (bytes)</th>
<th>Other size (bytes)</th>
<th>Warranty (years)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>256K x 9 SIMM 80 RAS/CAS, static-column</td>
<td>Proprietary</td>
<td>Direct-mapped write-through</td>
<td>25</td>
<td>64K</td>
<td>32K</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>1Mb x 9 DIP 100 Page-mode, RAS/CAS</td>
<td>Intel 82385</td>
<td>Two-way set-associative write-through</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9 SIMM 80 RAS/CAS, static-column</td>
<td>C&amp;T 82C307</td>
<td>Two-way set-associative posted-write</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>256K x 9 SIP 80 RAS/CAS</td>
<td>Proprietary</td>
<td>Direct-mapped write-back</td>
<td>25</td>
<td>64K, 256K</td>
<td>None</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 4 DIP 100 Page-mode</td>
<td>C&amp;T 82C307</td>
<td>Two-way set-associative write-through</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>256K x 1 DIP 60 RAS/CAS</td>
<td>Intel 82385</td>
<td>Two-way set-associative write-through</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9 SIMM 80 RAS/CAS, static-column</td>
<td>Intel 82385</td>
<td>Direct-mapped write-through</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>VARs</td>
</tr>
<tr>
<td>1Mb x 9 DIP 70 Page-mode</td>
<td>Intel 82385</td>
<td>Two-way set-associative write-through</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9 SIP 80 RAS/CAS</td>
<td>Intel 82385</td>
<td>Direct-mapped write-back</td>
<td>25</td>
<td>64K</td>
<td>None</td>
<td>1</td>
<td>VARs</td>
</tr>
<tr>
<td>256K x 1 DIP 80 RAS/CAS, static-column</td>
<td>C&amp;T 82C307</td>
<td>Two-way set-associative posted-write</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>256K x 9 SIMM 80 RAS/CAS, static-column</td>
<td>Intel 82385</td>
<td>Direct-mapped write-through</td>
<td>25</td>
<td>32K</td>
<td>None</td>
<td>1</td>
<td>VARs</td>
</tr>
</tbody>
</table>

**Promo Package**

<table>
<thead>
<tr>
<th>Geometry</th>
<th>Package Speed</th>
<th>RAM Interleave</th>
<th>Maximum on-board RAM</th>
<th>Maximum 32-bit RAM</th>
<th>Warranty (years)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>256K x 9</td>
<td>SIMM 80 RAS/CAS, page-mode, static-column</td>
<td>O</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td>DIP 100 Page-mode, RAS/CAS</td>
<td>O</td>
<td>4</td>
<td>16</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIMM 80 RAS/CAS, static-column</td>
<td>O</td>
<td>16</td>
<td>16</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIP 80 RAS/CAS, static-column</td>
<td>O</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIMM 100 Page-mode, RAS/CAS, static-column</td>
<td>O</td>
<td>8</td>
<td>40</td>
<td>1</td>
<td>VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td>DIP 70 RAS/CAS, page-mode, static-column</td>
<td>O</td>
<td>8</td>
<td>24</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIMM 80 RAS/CAS, static-column</td>
<td>O</td>
<td>0</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIP 80 RAS/CAS</td>
<td>O</td>
<td>0</td>
<td>32</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 4</td>
<td>DIP 100 Page-mode</td>
<td>O</td>
<td>0</td>
<td>32</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 1</td>
<td>DIP 60 RAS/CAS</td>
<td>O</td>
<td>0</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIMM 80 RAS/CAS, static-column</td>
<td>O</td>
<td>0</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIP 100 Page-mode</td>
<td>O</td>
<td>0</td>
<td>32</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>256K x 9</td>
<td>SIMM 80 RAS/CAS</td>
<td>O</td>
<td>0</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>1Mb x 1</td>
<td>DIP 70 Page-mode</td>
<td>O</td>
<td>0</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
</tbody>
</table>

**Notes:**

- Base price includes 2 MB of RAM.
- Motherboard will support 4-megabit chips when available.
- Memory board required, not included ($99).
- Optional daughtercard supports both Intel 80387 and Weitek 3167 coprocessors.
- Can be configured as two-way set-associative with additional static RAM.
- 80-nsec chips are standard.

---

tinct set of memory locations to each cache line (a line is 4 bytes long for these boards). The main memory locations mapped to each cache slot are grouped by the least significant part of their addresses; the effect is that each cache location has only one corresponding cache slot, the processor need only check one location to determine if a hit or a miss has occurred. This fast hit/miss determination is the strength of the direct-mapped method. Unfortunately, because each memory location must share a cache slot with several other main memory addresses, it's possible that some useful data will get bumped out, forcing the CPU to access main memory.

Two-way set-associative cache designs reduce the likelihood of this problem by having two slots available for each memory location. A cache of this kind is like two direct-mapped caches in parallel. This system has two disadvantages: First, each set is only half the size of an equivalent direct-mapped cache; and second, the processor must look in two places to determine whether a hit or a miss has occurred.

Memory-write methods also affect continued
cache performance. A cache can follow a simple write-through policy, in which each write operation is carried out to both cache and main memory. A more sophisticated approach, \textit{postwrite-through}, frees the main processor after the cache write; the main memory write is carried out independently by the cache controller. Write-back, the most complex scheme, updates main memory only when a modified entry is dumped from the cache.

Cache size is the last critical factor. Large caches mean better performance, but there is a very steep diminishing-returns curve after a certain size. That critical size differs for each application, but several manufacturers statistically estimate a 95 percent cache hit rate for 32K-byte caches.

Six of the boards that we tested used Intel's 82385 cache controller. Although the 82385 can be configured for either direct-mapped or two-way set-associative operation, only the Micronics board ran the unit in direct-mapped mode. Micronics lets you set the cache organization as an option, but you must double the standard static RAM to 64K bytes to use a two-way set-associative cache.

JC Information Systems' JCS 386c, the Monolithic MicroFrame, and the Cache 386-25 used Chips & Technologies' 82C307 cache/memory controller instead. The 82C307 also allows two-way set-associative cache control of up to 32K bytes.

The other boards went with proprietary cache designs, all of which were direct-mapped. Intel, ironically, passed over its 82385 in favor of a proprietary cache controller design for the Model 302. DTK's board lets you install a cache of up to 256K bytes, and it and the Nasc are the only models to implement a write-back cache.

Our benchmarks show some correlation between cache type and effectiveness, but the presence or absence of a cache is still a much stronger indicator of performance. DOS tests, which are related closely to the Sieve of Eratosthenes almost as well as other cached boards.

The Dhrystone test showed more of an affinity for cache size than for cache type. DTK's 256K-byte board finished on top, and the two next highest performers had 64K-byte caches. These three also shared a write-back cache.

Under Unix, large, direct-mapped caches seemed to fare better than they did under DOS. All the cached boards clustered very tightly on these tests, however, and the difference in scores between the best and the worst cached boards is far less than the gap between the slowest caching unit (the Mylex MWS 386-25) and the best noncached board (the JDR 386-MB-255).

The Interleave Alternative

Noncached boards are an attractive alternative to the pricier cached models, if top performance isn't your driving requirement. The least expensive of these boards can be had for $765, and, of course, any of these boards will still run rings around an AT.

The seven noncached boards that we tested all make use of memory-bank interleaving to strengthen memory performance. Several of the cached boards also use interleaving to back the cache.

One of the critical delays in accessing DRAM is recharge time, which must occur between successive accesses to the same chip. The interleave solution puts
one-half of the addresses (even) in one
bank and the other half (odd) in another;
if reads or writes occur sequentially, one
bank can be recharging while the other is
being accessed. Unfortunately, boards
that use this scheme require that you fill
the memory banks in pairs. On many
boards, this means that you must have
either 2 or 8 MB of memory to get rea-
sonable performance. In some prelimi-
nary tests, we found that the difference
between interleaved and noninterleaved
performance was 15 percent to 20 per-
cent.

Pioneer's VMB 386/25, Seattle Tele-
comm's STD 386XT, and the JCS 386i
use page-mode DRAMs for added speed.
Normal (row address strobe/column ad-
dress strobe, or RAS/CAS) DRAM chips
require that both row and column select
lines be strobed for each access. Page-
mode DRAMs can skip the RAS pre-
charge time when making successive
reads or writes to memory locations with
the same row address (i.e., in the same
"page"). Pages are 2K bytes in size for
256K-byte DRAMs; this gives you a 2K-
byte range of consecutive addresses that
can be accessed much more quickly than
with normal DRAMS. Boards that inter-
leave page-mode DRAMS interleave not
addresses but entire pages, for a much
higher probability of fast access.

Some of the cached boards also use, or
can also accept, page-mode DRAMS.
C²'s MB386A+ board and several
cached models will also accept static-
column RAM, which is like page-mode
memory but doesn't require a column ad-
dress strobe between successive reads.
Intel claims a 7 percent improvement for
static-column over page-mode DRAM
and a 7 percent performance difference
between page-mode and normal DRAM.

Our benchmarks show little correla-
tion between use of page-mode DRAMS
and superior performance. The seven
noncaching boards, page-mode or not,
performed very much alike under Unix.
Under DOS, five of the motherboards
were nearly identical, while the (page-
mode) STD 386XT and (standard) C²
MB386A+ boards were disappoint-
ingly slow.

Beyond the CPU
Fast memory architecture could not
make as much of a contribution to our
floating-point and video benchmarks.
As a result, the cached/noncached dis-
tinction is not nearly as severe.

DOS FPU benchmarks showed a
smooth transition between cached and
noncached units, with cached models
still somewhat faster. The two results
that stand apart are negative: Atronics'
ATI-386/B was surprisingly weak for a
cached board, and the noncaching C²
Baby 386 Mainboard, which could run
its 80387 at only 20 MHz, finished dis-
mally far behind the rest of the pack.
Unix Float benchmark results confirmed
the DOS numbers.

The Livermore Loops test, which
doesn't concentrate on pure 80387 in-
structions quite as much as our FPU
benchmark does, showed a similar but
slightly broader spread. Again, C²'s
Baby 386 Mainboard lagged.

Our final test was BYTE's video suite.
Originally, we intended it to be a mea-
sure of bus throughput, but instead it
pointed out the effectiveness of video
BIOS shadowing.

The graphics portions of our test ran
similarly on all the boards. Since all
buses were configured at or near 8 MHz,
there was little room for variation.

But our text tests, which rely heav-
ily on the BIOS, showed drastic differ-
ences from board to board. The benchmark
uses cursor-positioning BIOS calls to
move the cursor around the screen; on
this test, the difference between shaded
and not-shadowed performance was on
the order of 2 or 3 to 1.

Installation Basics
All the motherboards that we test-
came preconfigured with each vendor's
recommended memory configuration.
But since most boards don't include any
memory as standard, you'll face a vari-
ety of memory options. A 25-MHz
motherboard requires fast RAM, typi-
cally with access times of 60 to 100
nanoseconds. Your best bet is to stick
with the vendor's recommendations
here. You can use slower, less expensive
RAM chips, but that adds CPU wait
states, which defeats the purpose of buy-
ing a fast computer. If you're upgrading
to a board that will accept dual-in-line
package (DIP) DRAMS, don't give in to
the temptation to reuse 150-nS RAM
from that old AT—the cost savings isn't
worth the performance penalty that you
will pay.

A few motherboards, such as C²'s
386-25 and the JCS 386c, require page-
mode DRAMS. Other motherboards ac-
cept standard RAS/CAS or page-mode
DRAMS, but the slight increase in per-
f ormance that you'll get by buying page-
mode DRAMS probably isn't worth the
extra cost. Several vendors also support
even faster—and more expensive—static-
column DRAMS as an option.

Most of the motherboards that we
tested support 16 MB of 32-bit memory
through a combination of on-board RAM
and 32-bit memory boards. That is no
coincidence. Most manufacturers used
continued

<table>
<thead>
<tr>
<th>Geometry x Package</th>
<th>Speed (ns)</th>
<th>RAM types</th>
<th>Interleave</th>
<th>Maximum (MB)</th>
<th>Maximum (MB)</th>
<th>Warranty (years)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>256K x 4 DIP</td>
<td>80</td>
<td>RAS/CAS, page-mode</td>
<td>*</td>
<td>10</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>1Mb x 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256K x 9 SIP</td>
<td>80</td>
<td>RAS/CAS, page-mode</td>
<td>*</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256K x 4 DIP</td>
<td>80</td>
<td>Page-mode</td>
<td>*</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>Direct, dealers, VARs</td>
</tr>
<tr>
<td>1Mb x 4 SIMM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256K x 9 SIP</td>
<td>80</td>
<td>RAS/CAS</td>
<td>*</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256K x 9 SIP</td>
<td>80</td>
<td>RAS/CAS</td>
<td>*</td>
<td>16</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256K x 9 SIMM</td>
<td>60</td>
<td>Page-mode</td>
<td>*</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>Dealers, VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>256K x 9 SIP</td>
<td>60</td>
<td>Page-mode</td>
<td>*</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>Direct, VARs</td>
</tr>
<tr>
<td>1Mb x 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

APRIL 1990 • BYTE 135

PRODUCT FOCUS

386 MOTHERBOARDS

Continued
**PRODUCT FOCUS**

**386 MOTHERBOARDS**

**DOS AND UNIX BENCHMARK RESULTS**

<table>
<thead>
<tr>
<th>DOS</th>
<th>Unix</th>
</tr>
</thead>
<tbody>
<tr>
<td>C² M-386-25</td>
<td>JDR M386-25</td>
</tr>
<tr>
<td>Orchid Privilege 386/Cache</td>
<td>DTK 386-25 (64K cache)</td>
</tr>
<tr>
<td>JCS 386c</td>
<td>Monolithic MicroFrame 386CT</td>
</tr>
<tr>
<td>Cache 386-25</td>
<td>Jameco JE3525</td>
</tr>
<tr>
<td>OEM 386-25MX</td>
<td>Myllex MWS 386-25</td>
</tr>
<tr>
<td>Jameco JE3026</td>
<td>JDR M386MB-25S</td>
</tr>
<tr>
<td>DTK 386-25 (256K cache)</td>
<td>Pioneer Vantage 386/25</td>
</tr>
<tr>
<td>Micronincs 80386-I Cache</td>
<td>C² Baby 386 Mainboard</td>
</tr>
<tr>
<td>Nascent NT-386-25</td>
<td>C² MB 1386A+</td>
</tr>
<tr>
<td>Intel Model 302</td>
<td>Seattle STD 386XT</td>
</tr>
<tr>
<td>Atronics AT-386/B</td>
<td>Everex Step 386/33</td>
</tr>
<tr>
<td>DTK 386-25 (64K cache)</td>
<td>IBM PC AT</td>
</tr>
</tbody>
</table>

**Note:** Indexes show performance relative to baseline machines at the bottom of the graph. For the DOS benchmarks, the baseline machine is an 8-MHz IBM PC AT; for Unix, the baseline machine is an Everex Step 386/33 running Xenix 2.3. Cumulative system performance is indicated by the length of the stacked bar.

DOS and Unix benchmark performance for each motherboard, shown here ranked by DOS CPU index. While Unix test results showed less difference than DOS tests, both clearly indicate the value of cached memory.

Chips & Technologies' 386/AT chip set, which can address up to 16 MB of 32-bit RAM. While Chips & Technologies' 82C307 cache/memory controller can address up to 64 MB of RAM, none of the motherboards that used it supported that much memory. The Cache 386-25 accepted 16 MB, while the Monolithic MicroFrame and JCS 386c supported 24 MB and 32 MB, respectively. Intel's Model 302 had the largest memory capacity. It used two 32-bit expansion slots to support up to 40 MB of RAM. Pioneer's VMB-386/25 motherboard, on the other hand, didn't have any 32-bit expansion slots and supported only the 8 MB that will fit on-board. Other boards that put all the system memory on the motherboard—the Orchid Privilege 386/Cache and the Cache 386-25—accommodated 16 MB of on-board RAM.

The most common memory ceiling on the boards that we tested was 8 MB of on-board RAM and 8 MB on a 32-bit add-in card. But some manufacturers put all system memory on add-in cards and used 256K-byte or 1-MB single in-line memory modules (SIMMs) or single in-line package (SIP) modules to save space. Jameco and JC Information Systems included an empty memory card with their base systems. Micronics' base model also had a memory card, but if you need more than 8 MB, you have to pay a piggyback card (which comes with 4 MB of RAM) for $795. JDR Microdevices charges an additional $99 for its memory board with no RAM.

Unfortunately, when it comes to 32-bit memory cards, there is no standard; you can't use one company's 32-bit memory card in another motherboard's 32-bit memory slot. With the rapid advances in motherboard technology and the high turnover in new versions of motherboards, you should consider getting a 32-bit memory card when you purchase your motherboard. Delaying the purchase may make getting an expansion card difficult or impossible.

Most boards accepted some combination of DIPs and either SIMMs or SIPs. Both of C²'s full-size entries, JDR's...
INTRODUCING HAUPPAUGE'S 33MHz SYSTEM BOARDS.
If your computer feels slow, we know where it hertz. For a fast cure, get our new 386 MotherBoard/33MHz. We've built in 4 Megabytes of high speed RAM, 64K of RAM cache, and both 387 Weitek math coprocessor sockets. This board makes your 386 computer the fastest PC available!

Network Savvy. With the 386 MotherBoard/33MHz, you can build a file server or workstation that makes Novell networks scream. Enjoy compatibility with Token Ring, Arcnet, Ethernet, and other network cards.

The UNIX Engine. Great for VARS, Systems Integrators and UNIX OEMs, the Hauppauge 386 MotherBoard/33MHz runs SCO Xenix, Interactive 386/ix and AT&T's UNIX System V. With its PC/AT compatible I/O system, our 33MHz board accommodates the latest in disk control, graphics, and network I/O cards.

CAD Capability. Do your AutoCAD and other CAD programs seem slow? The 386 MotherBoard/33MHz boosts your math and graphics applications, and supports the high speed 387-33 and 33MHz Weitek math coprocessors.

Technical Features. The 386 MotherBoard/33MHz includes:
- 4 Megabytes of high speed 32-bit memory, expandable to 64 Megabytes
- 64K of 20 nsec cache memory
- Six 16-bit expansion slots, one 8-bit and one 8-bit/32-bit slot
- PC/AT compatible I/O system for support of OS/2 and UNIX.

Yes, send me your product information!

Name ____________________________  Company ____________________________
Address __________________________  Address ____________________________
City, State, Country, Zip Code ______
Telephone _________________________  Zip Code _________________________
Mail Coupon to:
Hauppauge Computer Works, Inc. or: Hauppauge Computer Works, GmbH
175 Commerce Drive Hansaallee 201
Hauppauge, New York 11788, U.S.A. 4000 Dusseldorf 11, West Germany
Tel: 01-516-434-1600  Tel: 0211-594320
Fax: 01-516-434-3198  Fax: 0211-593908

For more information call Hauppauge, (516) 434-1600. In Europe: (49) 211-594320.

Hauppauge Computer Works
Your high performance 386 Supplier
Circle 132 on Reader Service Card
Convertible DIP sockets allow some boards, like those from DTK and OEM, cached model, and the OEM and Micronics boards accepted only DIPs. Convertible DIP sockets allow some boards, like those from DTK and OEM, to accept either 256K by 4-bit or 256K by 1-bit DRAMs. Except for the OEM 386-25MX, all the boards that we tested could be configured for either 256K or 1-Mb DRAMs. (There's a $25 charge for the upgrade, and you have to return the old PALs.) And, most critically, one bank of SIPs on JDR's 386-MB-25 motherboard wouldn't fit in cards such as caching hard disk drive controller cards or Ethernet LAN cards. DTK's PEM 2500 Cache 386-25 motherboard didn't offer an 8-MHz bus speed: it ran at 6 or 12 MHz. Unfortunately, if your add-in cards won't run faster than 8 MHz, you will have to run them at 6 MHz—25 percent slower than normal.

### System Logic

Some vendors used discrete chips to implement the 386 system logic, and one vendor—Atronics—had its own VLSI chip set. But the majority opted for Chips & Technologies' 386/AT chip set. Continued
A 486 With Zero Wait.
If you’ve been waiting for the right 486 system to come along, wait no more.

Configured with either the Industry Standard (ISA) bus or the Extended Industry Standard (EISA), CSS Laboratories MaxSys® systems are the right choice in multi-user file servers.

- 12 slot motherboard for maximum expandability, longer return on investment
- Systems with 5 or 10 half-height drive bays - enough for the most storage-intensive applications
- 400 watt power supply and two cooling fans for reliable performance under the heaviest workloads
- Proven-to-runNovell® Netware®, SCO Xenix®, ISC Unix®, IBM® OS/2®️️, Microsoft® OS/2™️, "Quarterdeck®️️ DESQview™️️"
- Exclusive CSS Silent Memory Bus®, triple-grounded for maximum reliability
- Up to 64 MB RAM*
- On-board support for the Weitrick 4167 math co-processor
- Zero wait static cache memory access - plus a special 32-bit Hires Mode memory transfer that outperforms zero wait state in sequential applications
- 25 or 33 MHz available**

With features like these available today, why wait? Call a CSS representative today for more information on the MaxSys line as well as all our other product families, including network B&W and color laser printers, desktop workstations, and more.

CSS LABORATORIES, INC.
A Solid Investment.
In the U.S.A. (714) 852-8161
In Canada (416) 882-0260

*64 MB with EISA, 35 MB with ISA.
**33 MHz availability based on Intel chip release.


AT is a registered trademark of International Business Machines. Silent Memory Bus, MaxSys and the CSS logo are registered trademarks or trademarks of CSS Laboratories, Inc. All other brand or product names are trademarks or registered trademarks of their respective companies. © 1990 CSS Laboratories, Inc.
Implemented in seven VLSI chips, the CS8230 chip set lets manufacturers build smaller 386 motherboards with as few as 40 additional chips (excluding memory). By contrast, the Intel Model 302 motherboard, which uses LSI parts for most of its system and cache controller logic, has well over 150 ICs. Chips & Technologies’ CS8230 chip set, which includes the 82C307 monolithic, used Chips & Technologies’ CS8231 set, which includes the 82C307 cache/memory controller and does not compensate for pipelining problems in earlier 386s. Other boards required a special daughtercard that included decode logic to compensate for pipelining problems in earlier 386s. Some motherboards, including the Mylex and Jameco’s JE3026, had one board—Seattle’s STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn’t much of an issue.

Most motherboards also supported the 25-MHz Weitek 3167 or 1167 FPU. A few specifically claim to support the Intel 80387. But one board—Seattle’s STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn’t much of an issue.

Most motherboards also supported the 25-MHz Weitek 3167 or 1167 FPU. A few specifically claim to support the Intel 80387. But one board—Seattle’s STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn’t much of an issue.

Most motherboards also supported the 25-MHz Weitek 3167 or 1167 FPU. A few specifically claim to support the Intel 80387. But one board—Seattle’s STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn’t much of an issue. 

A few have one or two wire numbers with software written for both coprocessors, you may want to look into this option.

Expanding Your Horizons
Whether XT or AT size, all motherboards offered either seven or eight expansion slots. The type and usability of the slots, however, varied. Most motherboards had one or two 8-bit slots, four or five 16-bit slots, and one 32-bit slot that also accepted an 8- or 16-bit card. The Cache 386-25 had seven 16-bit slots—the most on any board. Several products, including two of the JDR Microdevies boards and the Seattle STD 386XT board, had eight 8-bit slots. None of the motherboards exhibited any bus compatibility problems during our tests. But some slots weren’t optimally designed. For example, ROMs positioned just behind the two 8-bit slots in JDR Microdevies’ CS862-25 prevented them from accepting some 8-bit cards or some video boards designed to fit in either 8- or 16-bit slots.

Fit and Finish
All the motherboards appear to be designed well. A few have one or two wire
continued
You don't have to be a rocket scientist to program in BASIC.

Granted, with Microsoft's BASIC Professional Development System, rocket scientists can work wonders every day of the week.

But if you want to work better in this stratosphere, Microsoft® QuickBASIC is all you need. Instead of an I.Q. test, you get a step-by-step printed tutorial that guides you through a complete working program. And our handy on-line electronic manual lets you put your finger on anything you want to know instantly, or copy and paste sample code into your program window.

Meanwhile, our on-line training and Easy Menus make you feel at home in your new environment in minutes—not hours. And to simplify things even more, our intuitive interface offers context-sensitive help. Plus a debugger that gets your program up and running in record time.

Naturally, this BASIC also turns out code at record speed—150,000 lines per minute. Not surprisingly, PC Magazine called it "...perhaps one of the greatest software programs ever written" and gave it their Editor's Choice Award.

All of which only goes to prove one thing: you don't have to be a rocket scientist to conquer new frontiers. Just smart enough to get a hold of our Microsoft QuickBASIC.
PRODUCT FOCUS
386 MOTHERBOARDS


traces. All are logically laid out and are relatively easy to set up and configure. One vendor, Monolithic, mounts its SIP modules between expansion slots on the motherboard, which makes them tough to install or remove—but once they're in, they work just fine. The SIP problem on JDR's 386-MB-25S, on the other hand, is a limitation that we could live without.

The Seattle STD 386XT's FPU setup is also a little awkward. It runs without any problems, but the daughtercard just clears the drive bay housing in our AT case and is an uncomfortably close fit.

Other details are relatively minor. All the boards except the Seattle STD 386XT and C²'s MBI386A+ and M-386-25 offer a connector for a turbo-mode LED, and all the boards have connectors for keyboard lock and hard reset switches and for an external speaker. Many motherboards have a soldered battery for CMOS memory but also include a connector for an external battery as a back-up. Two boards—the Atronics and DTK models—have a soldered battery only, but DTK claims a 10-year life for the module. As often as not, vendors with external battery connectors don't include a battery with their motherboard.

Other Considerations
If you're planning to install one of these motherboards yourself, don't count on learning the finer points of assembly from the manuals. Most of the documentation that we received was disappointing. The text often consists of loose, photocopied pages that you are expected to insert into your own three-ring binder. OEM and JDR sent documentation that was written for previous versions of their motherboards. In one case, the motherboard described didn't look anything like the motherboard we received. Other vendors don't document jumper settings or other specifications. Most of the manuals seem unable to keep up with the rapid design changes that are made to these boards.

On the whole, bigger-name manufacturers provide better documentation: Mylex and AMI (via Jameco) provide readable, informative manuals, and Micronics' bound book is especially good. The standout was Intel's Model 302 manual. This 228-page paperback was professionally printed and exhaustive in detail. It included a full description of all specifications, a glossary, an index, and plenty of illustrations. Not even this excellent document, however, is immune to being a few revisions out of step with the product.

If you have trouble with a motherboard and can't find the answers in the manuals, the vendor may have a help line. Some companies, such as JDR Microdevices and Jameco, offer technical assistance over the phone. Others, including Intel and Mylex, refer you to a local dealer or VAR. None of the manufacturers has a toll-free help line.

Most vendors guarantee their motherboards against defects for one year. Unlike the case with fully assembled PC clones, on-site service is not an option. The user must pay shipping costs to the manufacturer. Orchid, Pioneer, and Na-scent all offer a two-year warranty, but Monolithic's five-year warranty is the longest offered by far. One vendor, Atronics, will let you extend its warranty from one to two years as an option. As with most nonmechanical devices, failures tend to come early in the product's life, so a one-year warranty is probably sufficient.

First Choice
It's hard to pick one winner from this group. Several boards came out on top in our DOS tests. The Unix benchmark results were consistent with the DOS benchmark results, but the numbers were much closer. The one exception was DTK's PEM 2500 Cache 386-25 with a 256K-byte cache. Moving from 64K bytes to 256K bytes of cache memory didn't make much difference under DOS, but it produced a marked improvement under Unix. Unfortunately, the extra static RAM also makes the board one of the most expensive that we tested.

Of the five best-performing motherboards on our DOS benchmark tests (see the photo at left), the JCS 386c and Cache 386-25 offered the most bang for the buck. The Cache, a full-size board, was our favorite overall. It was about as fast as the C² M-386-25 and JCS 386c on the CPU test, but it did much better than either on the video tests and had seven 16-bit slots instead of the usual five or six. If you're looking for an XT-size board, the JCS 386c is just $1100 and accepts up to 32 MB of 32-bit memory. The Orchid Privilege 386/Cache and JDR C386-25, the two other top performers, were slightly more expensive.

If $1100 sounds like more than you're willing to spend, consider one of the noncaching boards. JDR Microdevices' XT-size M386-25, the fastest noncaching motherboard that we tested, is $799. The Pioneer VMB-386/25 was on par with the JDR Microdevices M386-25's performance and was slightly less expensive. It was, however, limited to 8 MB of 32-bit RAM. The other noncaching boards had certain drawbacks. The C² Baby 386 Mainboard ran its FPU at 20 MHz instead of 25 MHz, JDR Microdevices' 386-MB-25S wouldn't fit into our AT case with all its SIP sockets filled, and the Seattle STD 386XT board was relatively slow and expensive.

Steve Apiki and Stan Wszola are testing editors for the BYTE Lab. Rob Mitchell is a BYTE technical editor. They can be reached on BIX as "apiki," "stan," and "rob_mitchell," respectively.
FasMath
Your 386!

Running in our Number Smasher-386/25 AT accelerator, the FasMath delivers 5.5 megahetztones of numeric throughput.

CYRIX CX83D87
FasMath™
Coprocessor

This new numerics coprocessor from Cyrix Corporation is a high performance CMOS 80387 compatible device. Its features include a 91 bit wide architecture that results in improved speed and accuracy and an idle cutoff that reduces power consumption, making it ideal for laptops. Long running operations such as square root, division, transcendental, exponents and logs run between 2 and 4 times as fast as identical functions on an 80387. The improved accuracy results in faster convergence when used with error sensitive routines. Driven by NDP Fortran-386, the FasMath delivers 3.72 Megahetztones at 25-MHz and 5.05 Megahetztones at 33 MHz.

Number Smasher 386/25™

The new Number Smasher is the fastest PC accelerator brought to market to date. It replaces the 80286 in any AT or compatible with an 80386 running as an asynchronous emulator (see BYTE “PC Accelerators” Nov. 1986 Stephen Fried).

Unlike the Inboard, which only accelerates 8 MHz ATs, the Number Smasher runs in 6, 8, 10 and 12 MHz 286 motherboards! Standard production is currently available at 20 or 25 MHz, with a list of options that include sockets for up to 8 megabytes of 32 bit RAM, Intel, Cyrix and Weitek Coprocessors, a 64 Kbyte Cache and interface cables for any of the 3 possible 80286 sockets. Running at 25 MHz with the CX83D87, the number Smasher generates 3.7 Megahetztones, which is a factor of 30 improvement over an 80287 running in an 8 MHz AT.

NDP 386 Compilers

MicroWay’s NDP Fortran, C and Pascal are available in 386, 386SX and 486 versions. They are all mainframe quality globally optimizing compilers that have been specially optimized for the 386/486 family using Intel, Cyrix or Weitek coprocessors. They support the most common dialects, such as UNIX System V or ANSI C with Microsoft extensions, Fortran 77 with VAX VMS extensions, and ISO Pascal. All include the MicroWay GREX graphics library and run under UNIX, XENIX and the popular 386 DOS Extenders.

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, UK, 01-541-5466
USA FAX 508-746-4678 Italy 02-74930749 Holland 40 8964555 Germany 069-75-2023
DTK 386 systems deliver superior performance at prices that are hard to beat. **33MHz.** Take our KEEN-3300 Series for example. Its innovative high speed write-back cache memory and 80386-33 microprocessor combine to deliver zero wait state performance and a MIPS rating of 8.2.

PC Magazine said: "The excellent processor performance and expansion capability of the KEEN-3304 make it a very good network file server."

**25MHz.** The KEEN-2500 Series has the same lightning fast cache memory scheme as the 33MHz and delivers 6.2 MIPS. It's Novell Certified for use with NetWare, and XXCAL Labs certified for compatibility with a long list of hardware, operating systems and, of course, the latest high-performance software.

Personal Workstation said: "The caching strategy and overall cache and board design undoubtedly affect system performance, boosting the DTK (KEEN-2500) to one of our top performers... one of the best high-performance bargains we've seen."

DTK also offers you a choice of dependable, top-performing 20MHz 386 and 16MHz 386SX models. They're among the fastest and most flexible systems in their class.

All systems are backed with DTK's one year parts and labor warranty.

So when you're looking for a top-rated 386 with "take it to the bank" dependability and savings to match, look to DTK.

Call or write DTK Computer Inc., 15711 E. Valley Blvd., City of Industry, CA 91744. Tel: (818) 333-7533 Fax: (818) 333-5429 BBS: (818) 333-6548

Branch Offices:
- City of Industry, CA (818) 333-7533
- Miami, FL (305) 477-9440
- Elk Grove Village, IL (708) 593-3080
- Edison, NJ (201) 417-0300
- Houston, TX (713) 568-6688

DTK, Intel 386, Novell, NetWare and XXCAL are registered trademarks of DataTech Enterprises Co., Ltd.; Intel Corporation; Novell, Inc. and XXCAL, Inc. respectively.
Color Hits the Streets

NEC’s pioneering ProSpeed CSX brings color to portables for the first time, but at a steep price

Mark L. Van Name and Bill Catchings

Last October, NEC delivered its ProSpeed CSX, the first commercially available laptop with a color liquid crystal diode (LCD) display. Although it’s nice to see a color laptop, the CSX’s price and display quality leave much to be desired.

Our evaluation unit was a standard ProSpeed CSX, with a 16-MHz 386SX, a socket for a 16-MHz 80387SX math coprocessor, 2 megabytes of memory, a 42-MB hard disk drive, a 3½-inch 1.44-MB floppy disk drive, one serial and one parallel port, an external floppy disk drive connector, an external VGA monitor connector, and an 8-color VGA LCD screen with 256K bytes of video RAM. The CSX requires AC power. Bundled with the system were MS-DOS 3.3, GW-BASIC 3.3, and Windows/386 2.1.

This package costs a hefty $8499. You can also get a model with a 100-MB ESDI hard disk drive for $9499.

The Wide World of Color

At these prices, you really have to want color. The system’s display supports all EGA options but only some VGA display models. In VGA text mode, you get a full 25-row by 80-character display. The CSX’s 640- by 400-pixel resolution, continued
the color screen costs you a great many things. Two immediately obvious costs are the system’s size and power requirements.

however, hurts you on VGA graphics, where you lose 80 pixels off the bottom of the display. You also get only 8 colors, although 16 colors are available on an external monitor, courtesy of a Chips & Technologies 82C455 flat-panel video controller.

The image quality of the LCD display isn’t great. The colors are true, but they are washed out. Large areas of the same color tend to be mottled, and the screen bleeds when it scrolls. You can lose a mouse if you move it too quickly, as NEC warns you in a product release bulletin. The screen ghosts vertically a great deal.

Also, while we were testing the system, two vertical lines (one green and one red) appeared on the left side of the screen. They eventually vanished, but not immediately and not when we initially turned off the machine. An NEC spokesperson had not heard of this problem but was not surprised by it. (For more details on the display, see the text box “Competing Color LCD Display Technologies” on page 148.)

The Cost of Color

The color screen also costs you a great many things. Two immediately obvious costs are the system’s size and power requirements. It’s larger than most laptops by an inch or two in all dimensions, thanks primarily to the thick display and the 70-watt power supply necessary to support the color screen.

Another obvious cost is money. The CSX runs $1904 more than NEC's own monochrome $6995 lunchbox PowerMate SX. Worse, a comparable Dell System 316LT monochrome 386SX portable, which can run off batteries, costs $3999—$4500 less than the CSX. To be fair, the CSX will probably have a street price well below its list, while the Dell will not, but the price difference between the two systems is still likely to be large.

You also pay a performance premium, because the CSX’s display is slow. The CSX was nearly three times slower on the BYTE video benchmarks than the desktop IBM PS/2 Model 55 SX, a reasonable but not particularly fast 386SX system.

The CSX’s anemic video performance also hurt the system’s overall application index, which was about 8 percent below the Model 55’s. That’s too bad, because the CSX performed reasonably well in other areas, including the CPU and hard disk drive tests, where it beat the Model 55 by 11 percent and 15 percent, respectively.

Spotless Compatibility,

Good Keyboard

You may give up performance with the CSX, but you lose nothing in compatibility. The system successfully ran all our test programs, including Borland’s Paradex/386 2.03, Quattro Pro 1.0, SideKick Plus 1.00A, SuperKey 1.16A, Turbo C 2.0, and Turbo Pascal 4.0; DigitalTalk’s Smalltalk/V 1.2; Foresight’s DraftCAD Ultra 3.03C; Lotus 1-2-3 release 4.0; MicroPro’s WordStar 4.0; Novell’s NetWare 2.15; the Norton Utilities 3.00; the public domain Kermit 2.32/A; Quarterdeck Office Systems’ DESQview 2.00 and QEMM-386 1.10; Symantec’s Q&A 1.1; and WordPerfect 5.0. The CSX also worked with our test hardware, which included a Microsoft Serial Mouse and an external Xircom Pocket Ethernet Adapter.

You also sacrifice little with the ProSpeed CSX’s keyboard, which has a good feel and 89 full-size keys, including a modified separate numeric keypad. The keyboard basically follows the AT Enhanced keyboard layout, minus the central arrow and cursor-position clumps, and with two keys ([ and Enter) missing from the numeric keypad.

Going Inside

Open the CSX, and the first thing you notice is its power supply, a collection of analog parts and circuits that spans the rear of the machine. There’s also a fan, one of the few we’ve seen in a clamshell portable. The disk drives sit in front of the power supply—the hard disk drive on the left, and the floppy disk drive on the right. The 3¼-inch NEC hard disk drive has a 28-millisecond average access time. It runs off a National Computer ST506 controller that sits on a small
### NEC ProSpeed CSX

**APPLICATION-LEVEL PERFORMANCE**

<table>
<thead>
<tr>
<th>WORD PROCESSING</th>
<th>DATABASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>XyWrite III+ 3.52</td>
<td>dBASE III+ 1.1</td>
</tr>
<tr>
<td>Load (large)</td>
<td>Copy</td>
</tr>
<tr>
<td>Word count</td>
<td>Index</td>
</tr>
<tr>
<td>Search/replace</td>
<td>List</td>
</tr>
<tr>
<td>End of document</td>
<td>Append</td>
</tr>
<tr>
<td>Block move</td>
<td>Delete</td>
</tr>
<tr>
<td>Spelling check</td>
<td>Pack</td>
</tr>
<tr>
<td>Microsoft Word 4.0</td>
<td>Count</td>
</tr>
<tr>
<td>Forward delete</td>
<td>Sort</td>
</tr>
<tr>
<td>Aldus PageMaker 1.0a</td>
<td></td>
</tr>
<tr>
<td>Load document</td>
<td></td>
</tr>
<tr>
<td>Change/ Bold</td>
<td></td>
</tr>
<tr>
<td>Align right</td>
<td></td>
</tr>
<tr>
<td>Cut 10 pages</td>
<td></td>
</tr>
<tr>
<td>Place graphic</td>
<td></td>
</tr>
<tr>
<td>Print to file</td>
<td></td>
</tr>
</tbody>
</table>

**DATABASE**

<table>
<thead>
<tr>
<th>dBASE III+ 1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copy</td>
</tr>
<tr>
<td>Index</td>
</tr>
<tr>
<td>List</td>
</tr>
<tr>
<td>Append</td>
</tr>
<tr>
<td>Delete</td>
</tr>
<tr>
<td>Pack</td>
</tr>
<tr>
<td>Count</td>
</tr>
<tr>
<td>Sort</td>
</tr>
</tbody>
</table>

**SCIENTIFIC/ENGINEERING**

<table>
<thead>
<tr>
<th>AutoCAD 2.52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load SoftWest</td>
</tr>
<tr>
<td>Regen SoftWest</td>
</tr>
<tr>
<td>Load StPauls</td>
</tr>
<tr>
<td>Regen StPauls</td>
</tr>
<tr>
<td>Hide/redraw</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STATA 1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphics</td>
</tr>
<tr>
<td>ANOVA</td>
</tr>
<tr>
<td>MathCAD 2.0</td>
</tr>
<tr>
<td>IFS 800 pts.</td>
</tr>
<tr>
<td>FFT/IFFT 1024 pts.</td>
</tr>
</tbody>
</table>

**COMPILERS**

<table>
<thead>
<tr>
<th>Microsoft C 5.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>XLisp compile</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Turbo Pascal 4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pascal 5 compile</td>
</tr>
</tbody>
</table>

**LOW-LEVEL PERFORMANCE**

<table>
<thead>
<tr>
<th>CPU</th>
<th>DISK I/O</th>
<th>VIDEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matrix</td>
<td>Hard Seek</td>
<td>Text</td>
</tr>
<tr>
<td>String Move</td>
<td>Outer track</td>
<td>Mode 0</td>
</tr>
<tr>
<td>Byte-wide</td>
<td>33.0</td>
<td>17.03</td>
</tr>
<tr>
<td>Word-wide</td>
<td>Inner track</td>
<td>Mode 1</td>
</tr>
<tr>
<td>Odd-bnd.</td>
<td>32.6</td>
<td>17.03</td>
</tr>
<tr>
<td>Even-bnd.</td>
<td>Half platter</td>
<td>Mode 2</td>
</tr>
<tr>
<td>Doubleword-wide</td>
<td>Full platter</td>
<td>Mode 3</td>
</tr>
<tr>
<td>Odd-bnd.</td>
<td>Average</td>
<td>Mode 7</td>
</tr>
<tr>
<td>Even-bnd.</td>
<td>29.4</td>
<td>N/A</td>
</tr>
<tr>
<td>Seek</td>
<td>DOS Seek</td>
<td>Graphics</td>
</tr>
<tr>
<td>36.36</td>
<td>1-sector</td>
<td>CGA:</td>
</tr>
<tr>
<td>Read</td>
<td>32.33</td>
<td>Mode 4</td>
</tr>
<tr>
<td>0.21</td>
<td>32-sector</td>
<td>2.58</td>
</tr>
<tr>
<td>Write</td>
<td>0.83</td>
<td>Mode 5</td>
</tr>
<tr>
<td>0.92</td>
<td>35.09</td>
<td>2.58</td>
</tr>
<tr>
<td>5.47</td>
<td>Mode 6</td>
<td>2.88</td>
</tr>
<tr>
<td>Read</td>
<td>3.86</td>
<td>Mode 7</td>
</tr>
<tr>
<td>5.77</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**FLOATING POINT**

<table>
<thead>
<tr>
<th>Math</th>
<th>FPU</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>Read</td>
</tr>
<tr>
<td>N/A</td>
<td>Write</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**CONVENTIONAL BENCHMARKS**

<table>
<thead>
<tr>
<th>LINPACK</th>
</tr>
</thead>
<tbody>
<tr>
<td>2918.41</td>
</tr>
</tbody>
</table>

For a full description of all the benchmarks, see “Introducing the New BYTE Benchmarks,” June 1988 BYTE.
Competing Color LCD Display Technologies

There are currently two major basic color liquid crystal diode (LCD) display technologies. NEC's ProSpeed CSX uses a technique known as direct (or passive) matrix addressing. The competing approach is called indirect (or active) matrix addressing or, sometimes, thin film transistor (TFT). (We will explain these terms below.)

These two color LCD display technologies have much in common, as well as a few key differences. The easiest way to understand them is to follow the light through the many layers that both types of displays typically contain (see the figure).

The rearmost layer is the light source. In the CSX, four cold cathode fluorescent tubes provide the display's backlighting.

Directly in front of the light source is the rear polarizer, which lets through only light that is oriented perpendicularly to the LCD display's crystals. This linearly polarized light passes to the third layer, a sandwich with two panes of glass surrounding a matrix of LCDs. In their natural, twisted state, these LCD elements pass through the polarized light. If you apply current to them, however, they straighten and block the light. The LCD sandwich contains three elements for every screen pixel.

Follow the bouncing light rays. From its original source, the light passes through a rear polarizer, which allows properly oriented light to pass to the LCDs. The LCDs react to the light, blocking some of it. What passes goes to the RGB polarizer, which has red, green, and blue filters that combine to form one of the eight available colors. Another layer blocks "leaked" light, and the remaining light passes through a final polarizing layer and to the viewer.

POACH (for "PC on a Chip") application-specific ICs.

The ProSpeed CSX's standard 2 MB of 80-nanosecond DRAM are soldered to the motherboard in 1-megabit single inline memory modules. The system uses a paged/interleaved architecture to avoid wait states most of the time.

The 386SX CPU and the socket for the 80387SX are on a small card under an expansion area cover on the bottom front of the machine—a nice touch that makes it easy to add a math coprocessor. Also under that expansion cover are two proprietary expansion slots, one for a 2400-bps modem and one for an additional 2 MB of DRAM.

Odds and Sods

It's almost easier to add those expansion options than it is to set up the machine. First, you must run the Setup program to make sure that the system's CMOS accurately reflects its configuration. Then you must do a high-level disk format, and, finally, you install DOS. Fortunately, both the Setup program and the system's documentation are good, so this process isn't hard.

If you do run into problems, the CSX...
The next layer, the RGB polarizer, houses one filter for every LCD element. Each screen pixel gets one red, one green, and one blue filter for its three LCD elements. By using all possible combinations of these three filters, you get the eight colors possible with the CSX: black, white, red, green, blue, cyan, magenta, and yellow.

You could produce 16 colors by using a fourth LCD element for each screen pixel. The filter in front of that element would be white and would function much like the intensity signal of some color monitors.

LCD displays tend to "leak" some of the light they're trying to block, so the CSX next uses a compensated twisted nematic layer that removes much of the leaked light. Finally, the light passes through another polarizing layer and then out to the viewer.

This design has a problem: Much as dots on CRT screens fade after they are activated, LCD elements relax and begin to lose intensity after they are charged. Direct and indirect addressing displays deal with this problem differently.

In direct matrix addressing, the driver circuit connects directly to each LCD element. The driver circuit then addresses one row of LCD elements at a time, in sequence from top to bottom on the screen (much as the electron gun scans a CRT screen). Unfortunately, as soon as the driver circuit leaves a row, that row's LCD elements begin to relax to their inactivated state. The result is bleeding, or ghosting, as well as a lower contrast ratio.

Indirect matrix addressing produces better images and avoids most of the ghosting by keeping current supplied to every LCD element. To do so, it inserts a memory transistor between the driver circuit and each LCD element. The driver connects only to the transistors (hence the "indirect" in the name), which supply the LCD elements with current while the driver scans the display.

Active matrix sounds so much better that you have to wonder why NEC didn't use it in the CSX. The reason is cost.

An active-matrix display requires one transistor per element. To get eight colors and the full VGA 640-by-480-pixel resolution, it would need at least 640 by 480 by 3 (3 pixels per element) transistors—that's 921,600 transistors in a continuous, thin 10-inch layer. (That's the source of the "thin-film transistor" name.) No one can yet mass-produce such a dense screen with high enough yields to make the manufacturing process cost-effective. An NEC spokesperson estimated that a TFT display today would cost buyers at least $2000 more than the CSX's already expensive display.

These technologies also require much more power than monochrome LCD displays need. In part because of the many filters, the color panel transmits only about 20 percent to 25 percent as much light as a typical paper-white LCD display would. The many transistors of a TFT display demand even more power.

Both technologies are, at least for now, considerably more expensive to produce than standard monochrome LCD displays. We must hope that future developments will make good color LCDs affordable.

At least for now, it's the only color laptop around.

If you've absolutely got to have a color laptop, go for the NEC ProSpeed CSX. Otherwise, you should wait for the day when color laptop technology matures enough to give us vibrant, quick displays at reasonable prices.
Just Being Fast Isn't Good Enough...
Micronics 25 MHz and 33 MHz motherboards allow you to maneuver in the 386 fast lane!

Some manufacturers push components and designs to improve performance and reduce their costs. Pushing components, even a little bit, creates the kind of heat and stress that cause systems to crash and data to be lost forever.

Micronics refuses to give in to this practice. We recognize there is nothing more valuable than your data. Our motherboards are designed and manufactured with the kind of reliability demanded by today's high performance computers. These computers require devices such as: cache memory, fast static RAM and coprocessors originally used only in mainframes. Advanced operating systems including UNIX and OS/2 require high levels of design sophistication. Large databases, spreadsheets and multiuser applications also have complex critical timing requirements. Micronics motherboards are built to meet these needs.

Advanced engineering, high quality, and unequalled reliability: motherboards created by Micronics to help keep you in the 386 fast lane!

Call now for more information and the Micronics supplier nearest you.

National WATS
(800) 234-4386
California
(408) 732-0940
FAX
(408) 732-6048
Svelte Scanner Is No Fistful of Dollars

Sharp’s low-cost scanner delivers high-quality color images to those who can afford to wait

Tom Thompson

T he Sharp Electronics Personal Color Scanner’s svelte size gives the impression that it’s a hand-held scanner. It’s not. It’s a diminutive (6½ by 12½ by 1½ inches) flatbed scanner about the size of an add-in board’s carton, and its weight is equally modest at just over 3½ pounds. There is a serial interface for communicating with a computer, so no interface boards are required to connect it to a Mac II, a PC, or an Amiga.

The $995 JX-100 produces high-quality images at several resolutions and in a variety of modes (black and white, grayscale, and color). But this convenience has a price. Because of its small size, the scanner handles only small images, and color scanning can be time-consuming.

A Hardware Tour

The JX-100 is a stationary flatbed scanner, unlike its much larger cousin, the JX-450, whose bed moves from side to side. Transparent panels make up most of the JX-100’s top and bottom. A white rectangle on the bottom panel delineates the scanning area. Original images must be no greater than 3.93 by 6.29 inches; thus, the scanner is suitable for typical 4- by 5-inch snapshot prints.

A compact scanning head with a sensor strip travels inside the transparent panels to acquire image data. For color images, the scanning head must make three passes over an original, which explains why color scanning can take so long (see the text box “Inside the Personal Scanner” on page 152).

To hook the scanner to a Mac, you’ll need the DB-9-to-mini-DIN-8 adapter cable supplied with the Mac scanning software. The scanner’s serial cable ends in a DB-9 serial connector for an IBM AT. The scanner works with a PC, a Mac II, or an Amiga, but only the Macintosh software was available as of press time.

Power comes from a 12-volt powersupply brick. An adapter cable from this brick plugs into a special connector on the serial cable. The scanner has no on/off switch; you handle that detail by plugging in or unplugging the power supply.

Scanning Software

The JX-100 handles Mac II scanning with Imagenesis’s ChromaScan 100 application software, a modified version of the Sharp JX-450 scanner application. ChromaScan requires 32-Bit QuickDraw, so you can use the software and scanner only on the Mac SE/30 or Mac II-family computers. ChromaScan saves the captured image data in memory, so your Mac needs at least 4 megabytes of RAM; Imagenesis recommends 8 MB.

ChromaScan lets you scan an image in black and white with a user-selectable threshold (a brightness value that determines whether a pixel is white or black). You can also do color scans either as indexed colors (256 colors maximum, using a byte value that corresponds to a color table entry) or as direct colors (the pixel holds the actual color data and can be 16 or 32 bits in size). Indexed colors can be based on the default system color table or on a custom color table sorted by ChromaScan for the best-fit 256 colors. While direct color scans can display more colors, they also take up more memory and more disk space. All captured images are saved in the Mac’s PICT2 format, which allows other applications to use them.

ChromaScan’s preview mode makes a fast gray-scale scan of the original and then presents it in a special preview window. Here you can drag slider bars over

continued
Sharp JX-100 Personal Color Scanner

**Company**
Sharp Electronics Corp.
Systems Division
Sharp Plaza
Mahwah, NJ 07430
(201) 829-9500

**Hardware Needed**
Mac SE/30 or Mac II-family computer
with at least 4 MB of RAM and a hard disk drive (SE/30s must have a color monitor set up as the main screen); versions for the IBM AT and Commodore Amiga are planned

**Software Needed**
System 6.0.3 or higher with 32-Bit QuickDraw

**Price**
$995

**Inquiry** 851.

---

**Inside the Personal Scanner**

How did Sharp cram so many capabilities into such a small unit as the JX-100? The scanner’s compact size and weight result from a combination of tiny components and a clever design that builds on techniques used in Sharp’s JX-450 color scanner.

However, the JX-450 acquires an image by moving its bed from side to side, which moves the original over a stationary sensor strip built into the housing (see “Full-Spectrum Scanners,” April 1989 BYTE). By contrast, the JX-100 lies atop the original image and remains stationary during the capture process. Inside the JX-100’s housing, a scanner head rides on two rails. A precision stepper motor drives a wire pulley that moves the head in precise steps across the image. As the scanner head travels from one end of the housing to the other, a sensor strip inside it captures the image a line at a time (see the figure).

A minuscule fluorescent lamp inside the scanner head illuminates the image. Four mirrors route light reflected from the image through color filters and a lens and then onto a charge-coupled-device sensor strip with 1024 elements.

Each element samples the light intensity that corresponds to a spot on the image. While each element can detect 256 different light levels, the accuracy of the sample is good only to 6 bits.

The scanner head samples monochrome image data. With the use of color filters, color scans are possible. The original is scanned three times to collect red, green, and blue information. A clever lever mechanism switches a filter strip inside the scanner head from one color to the next. Each time the scanner head returns to start a new scan, a shaft engages a projection inside the housing that advances the filter strip to the next color.

Inside the Mac, software combines the data from each scan into a color image. For indexed color images, the information is reduced to the 256 best-fit colors. For direct color images, the information is assembled into pixels. For 16-bit scans, a pixel contains 15 bits of color information that can represent 32,768 colors. For 32-bit scans, a pixel contains 24 bits of color information that can represent a possible 16.8 million colors. However, since the accuracy of each color pass is limited to 6 bits, the actual number of colors captured by the JX-100 is 262,144. Nevertheless, this range of colors should be adequate for most color desktop publishing work.

---

**Field Test**

I put the JX-100 scanner to work on a variety of snapshots, magazine covers, and photos from books. I used a Mac II running System 6.0.3 and equipped with 5 MB of RAM, a Rodime Cobra 210e 210MB hard disk drive, and a SuperMac 19-inch monitor and Spectrum/8 video board. Installation takes only about 3 minutes: You plug the serial cable into the Mac’s modem port, plug in the scanner’s power supply, and copy the software to the Cobra drive.

The scanner’s viewfinder and ChromaScan’s preview window made scanning a snap. I selected what I wanted to scan and what type of scan with just a few mouse-clicks. Previews took only a minute, and 100-dpi gray-scale scans took 2 minutes, 10 seconds. The quality of the color images was excellent, even at 200 dpi. I hadn’t expected such quality in the continued
Introducing a better way to protect your whole family.

New network savers from Emerson UPS.

However you use your network, a file server power problem can really cost you. In downtime. Lost data. And frustration.

That's why we've introduced two new Novell-compatible uninterruptible power systems (UPS) designed specifically to protect your file server, your whole network and your data.

They're compact enough to fit under a desk. Powerful enough for a file server or your entire LAN—even those with multiple drives and terminals.

And they're priced less than even one hour of downtime.

Most important, the UPS 600 and UPS 1250 come from Emerson, the most reliable name in computer power protection. Backed by a network of support from local dealers and distributors. And nationwide service from the leading supplier of UPS systems.

See how easy it can be to protect your whole family. Just call us at 1-800-Back-UPS today.

EMERSON UPS
We protect the ones you love.

© 1989 Emerson Computer Power, a division of the Emerson Electric Co.

Circle 105 on Reader Service Card (DEALERS: 106)
REVIEW

SVELTE SCANNER IS NO FISTFUL OF DOLLARS

The quality of the JX-100's color images was excellent, even at high resolutions where mechanical misalignment problems can occur.

high-resolution color scans because of the inevitable mechanical misalignment that occurs when the scanner head makes three trips over an image. I saw slight color fringing in the fast scanning mode, but in the slow scanning mode the 100-dpi images were superb.

The scanner always performs 200-dpi imaging in the slow mode, and the quality is as good as that of the 100-dpi scans (see the photo above). PhotoMac 1.1, PixelPaint Professional, and a beta version of Photoshop easily read 8-, 16-, and 32-bit pixel image files created by ChromaScan. I had no trouble printing images on a Tektronix ColorQuick color inkjet printer. But when I printed to a LaserWriter printer using the color driver (version 6.0), my results were hit-or-miss: Many of the indexed color scans looked good, while direct color scans conked out with a PostScript error before the print job was completed.

The hardware's biggest flaw is the time it takes to scan in color. A 100-dpi dithered scan using the slow mode and indexed colors took nearly 12 minutes to complete. At 200 dpi, the same image took about 35 minutes. The scanning process takes so long because ChromaScan sorts through the image data for the best-fit 256 colors. By contrast, some 16-bit direct color scans at 200 dpi in the slow mode took only 20 minutes.

The biggest scanning-software problem is that every color-scan pass is stored in memory. This requires lots of RAM. Even with 5 MB, I often ran out of memory when I tried to make a direct color scan larger than a snapshot. I tried using Connectix's virtual memory INIT to gather more memory, but under virtual memory ChromaScan became erratic, sometimes working, sometimes freezing the system. I'd like ChromaScan to spool each pass to disk during a color scan, to ease up on memory requirements. For now, if you plan to make direct color scans using the scanner's entire imaging area, you'd best have 8 MB of RAM.

Do You Need One?

Make no mistake, the JX-100 works admirably, producing quality color images in the slow mode at the highest resolution. Its low price is attractive, especially for small businesses, and its direct color capabilities will be useful for certain color prepress jobs, as long as the work fits in the scanner's small scanning area.

However, be aware of the trade-offs: You'll need all the RAM you can get, as well as a color graphics package to touch up and print some images. Producing a high-resolution color scan is definitely a start-it-and-leave-for-lunch operation. If you can live with these limitations, then Sharp has a scanner for you.

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."
See the Future.

NANAO fully appreciates the importance of monitor selection to the business professional. The FLEXSCAN® 9060S has been specially designed for today's complex world of windows and graphics applications.

Unlike other 14" monitors, the FLEXSCAN® 9060S uses its Dynamic Focusing Circuit to deliver sharp, bright images to all corners of the screen. This makes it the ideal display for VGA and SuperVGA (800 x 600) applications.

The FLEXSCAN's ergonomic design minimizes static, glare, and magnetic radiation, to provide the most user-friendly environment possible, even during extended operation. Other monitors meet the standards. FLEXSCAN® sets them.

NANAO USA CORP.
23510 Telo Ave., Suite 5
Torrance, CA 90605 USA
Phone (213) 325-5622
Fax (213) 630-5799

Circle 198 on Reader Service Card
(DEALERS: 499)

FLEXSCAN 9060S
14" (137) V.G.26Mm dot pitch CRT
Scan Frequency: Automatic Adjustment
H: 16.5KHz - 30.9KHz
V: 50Hz - 80Hz
Front-mounted controls for easy access.
VGA, SuperVGA (600 x 800), EGA, CGA, MDA, and Mac II compatible.
Word Processing in Windows

Ami Professional, Legend, and Word for Windows provide WYSIWYG editing in Microsoft Windows

Lamont Wood

The PC world has long awaited full-featured WYSIWYG word processing software that could also take a swing at desktop publishing. Now, thanks to Microsoft Windows, there are three such packages: Ami Professional 1.0 from Samna, Word for Windows 1.0 from Microsoft, and Legend 2.0 from NBI. Each is priced at $495.

All three offer a wealth of WYSIWYG functionality such as the budget-minded PC user could only have dreamed of a few years ago. But all three packages paid for it—to varying degrees—with performance problems. Printing speeds are particularly troublesome, and in some situations, you have time to get up and make a sandwich while waiting for a page to be drawn on the screen.

I tested the three Windows-based word processors on a 16-MHz Club American 386 with 3 megabytes of RAM, a 30-millisecond hard disk drive, and a Hercules display. I ran them under Windows/386 and printed them on a QuadLaser 1 that emulated a Hewlett-Packard LaserJet.

The Two Worlds

Previously, conventional word processing concentrated on helping you generate text, with spelling checkers, search-and-replace and cut-and-paste functions, and scads of other useful tricks. But any formatting beyond fancy typewriter emulation was not to be expected. Meanwhile, page-layout systems turned your computer into a typesetting machine—but they had no facility for word processing. You were expected to write the material with a word processor and then import it into desktop publishing.

Having both worlds in one package makes sense. The problem is that true WYSIWYG word processing assumes the use of a graphical screen, but composing text on a graphical screen that has to format itself as you type can be a slow and disorienting experience.

These three packages get around the problem by having a draft and a layout mode. You type in draft mode with only text on the screen and switch into layout mode for formatting. (Under many conditions, however, it is possible to type directly into the layout mode. For eye relief, I often edited raw text in layout mode using a 14-point font, without any continued...
**Review**

**Word Processing in Windows**

<table>
<thead>
<tr>
<th>Ami Professional 1.0</th>
<th>Legend 2.0</th>
<th>Word for Windows 1.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Company</strong></td>
<td>Samma Corp.</td>
<td>NBI, Inc.</td>
</tr>
<tr>
<td></td>
<td>5600 Glenridge Dr.</td>
<td>3450 Mitchell Lane</td>
</tr>
<tr>
<td></td>
<td>Atlanta, GA 30342</td>
<td>Boulder, CO 80301</td>
</tr>
<tr>
<td></td>
<td>(404) 851-0007</td>
<td>(303) 444-5710</td>
</tr>
<tr>
<td><strong>Hardware Needed</strong></td>
<td>IBM or compatible 286-based or higher system with a hard disk drive and Hercules, CGA, EGA, or VGA graphics</td>
<td>IBM or compatible 286- or 386-based system with 640K bytes of RAM, a hard disk drive, a mouse, and Hercules, EGA, or CGA graphics</td>
</tr>
<tr>
<td><strong>Software Needed</strong></td>
<td>MS-DOS 3.0 or higher</td>
<td>MS-DOS 3.0 or higher</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>$495</td>
<td>$495</td>
</tr>
<tr>
<td><strong>Inquiry</strong></td>
<td>881</td>
<td>882</td>
</tr>
</tbody>
</table>

Real formatting, and changed to another font just before the final printout.)

Then, there is the problem of positioning things on the page. Both Ami Pro and Legend use the “frame” approach, where you place frames (rectangles) that contain the graphics or text that you want in a certain spot on the page. You can only edit the text in a frame after you have selected that frame. You can move frames about on the page or from page to page as you would scrap paper.

Word for Windows uses a text-based approach in which you “position” individual paragraphs, sections, or tables. You can position by hand to a certain extent, as with the frame approach, but you are expected to give the system a few rules and let it format the material by itself.

But all three packages stop short of giving you the kind of visual control that a true desktop publishing system like, say, Xerox’s Ventura Publisher gives—where you define margins and line thicknesses to a thousandth of an inch. Instead, they give you a cookbook selection of line thicknesses and border patterns. This is probably just as well—most folks would rather produce documents, not experiment with typographic elements.

All three packages come with an optional single-application environment version of Windows, but if you run them under a full version of Windows, you can take advantage of the clipboard and import text or graphics from other applications. Thanks to Windows, you can also have those applications running in the background, flipping back and forth between them. (With Windows/386, you can even leave MS-DOS programs running in the background and gridding out data analyses or file conversions or whatever.) Also, an interesting Windows feature called Dynamic Data Exchange (DDE) lets you link data in one application to data in another, and as one changes, the other will also. (Both applications have to be loaded, of course.)

Keep in mind that Windows is responsible for the screen, printer, and mouse drivers, and third-party fonts are installed in Windows, not in any particular application. Having these details handled by the environment itself (i.e., Windows) has led to Windows’ increasing popularity with software developers, who are spared the effort of handling such matters themselves.

**Ami Professional**

Of the three, Ami Pro has the most features. It has the basic word processing and desktop publishing features found in Ami “nonprofessional,” which came out last year, but with numerous additions. It has a drawing facility for doing simple graphics, and a charting facility for making bar, line, or pie charts. In fact, Ami Pro comes with about a hundred examples of clip art in Ami Pro’s own line-drawing format.

You can create and name styles (a combination of typeface and formatting features) through a series of dialog boxes that give you previews of what you have selected—on-screen representations of the font or format you’ve picked, before it’s applied (see photo 1).

The program uses DDE, so, for example, you could link an entry in an Ami Pro document to a cell in a Windows Excel spreadsheet and change the entry as the cell changes. There are a sophisticated macro language, context-sensitive help screens, and a thesaurus as well as a spelling checker.

Ami Pro tries to embody the whole rationale behind Windows: integration, across or within applications. Thus, your computer becomes your personal assistant, capable of greatly magnifying and enhancing your efforts, rather than a balky tool that demands as much from you as you do from it.

However, Ami Pro has some problems. Loading the drawing or graphing modules can be so slow that you might as well exit and go to another system. Ami Pro would not import PCX (Publisher’s Paintbrush) files, and other pictures that it did load were slightly distorted vertically, so that smiling people looked like vampires. I also kept getting meaningless “internal error” messages when performing search-and-replace procedures. And Ami Pro crashed a couple of times when I tried to move text through the Windows clipboard.

None of this, however, got in the way, since Ami Pro has something the other two lack—in fact, something rarely seen in full-featured word processors: It saves your text automatically at intervals in the background.

**Legend**

Legend might best be described as a simplified version of Ami Professional. It uses the same frame-based approach and includes a drawing function, but it lacks...
a graphing function, plus some “bells and whistles” such as formatting previews, document descriptions, and a word counter.

Its chief advantage is its draft mode, which does not use the (tiny) default Windows screen text that Ami and Windows Word use, but instead employs a larger, custom typeface (see photo 2). It saves your eyes from having to squint, and since it shows special tokens for carriage returns, it’s easier to format E-mail and database downloads. But the use of the larger text also means that, under ordinary conditions, Legend’s draft mode scrolls more slowly than its layout mode.

Legend also distinguishes itself by letting you define properties for frames. Therefore, instead of starting from scratch each time you create a frame, you can select from a list of frame types that you’ve already created.

Legend has no macro language, nor any use of DDE, a thesaurus, or context-sensitive help. While it still embodies more features than most users will probably ever want, it seems overpriced compared to Ami Pro.

**Word for Windows**

This program is really a superset of Microsoft Word, translated to Windows. Everything is text-oriented—graphics are embedded in the text, rather than placed in frames on the page. You can place text and graphics in “tables” and get some of the effect of frames, but the precision is not there—you can’t, for example, wrap a poem around an irregular graphic. You can only move things around on the page while in print preview mode; you get a full page view, but the detail is lost (see photo 3). And there are no drawing or graphing functions.

But if all you need is to spice up a report with some proportional fonts, a logo, and maybe an occasional chart, Word for Windows is great. It offers that spice, plus a complete checklist of features typical of a high-end word processor—document version comparisons, an outliner, a thesaurus, variables you can embed in the text, and a document summary telling how many times the document was edited, for how many minutes, and by whom.

It even has a macro language that is actually a Microsoft QuickBASIC interpreter, allowing a word processing manager to not only customize, but actually change the appearance of Word for Windows. The program supports bidirectional DDE; for example, data that you type in through Word for Windows could affect a Windows Excel spreadsheet cell, which in turn could change another cell and update another section of the original Word for Windows document.

**Slow Performance**

So much for the good news. The bad news is that while all three programs show passable performance while doing straightforward, one-column, text-based word processing tasks (see the table), further demands bring them to their knees rather quickly.

It can take a full minute to import a graphics file, and scrolling horizontally across a graphic can be torture as the picture is redrawn a section at a time. Especially with Legend (but the others are not far behind), you can get to the point where pushing one key will set off 30 seconds of hard disk activity before control returns. With the slow response and jangling hard disk, I felt I was operating a crane in a shipyard.

At first, Word for Windows seemed to be by far the fastest of the three. Invoking a screen menu does not trigger any disk activity, as it does with the other two programs. One might suspect that Microsoft, which surely knows all Windows’ programming tricks, has used some of them. Alas, it hardly matters, continued...
because after you add some pictures and formatting to a page, Word for Windows becomes as slow as the others. Its layout mode can be glacial.

Meanwhile, printing speeds for all the packages were sometimes three to five times slower than those for Ventura Publisher (see the figure). Remember that all three packages did fine with straight word processing tasks—it's when you start making graphics-oriented demands that they wilt. But what's the point in going to the trouble of installing Windows and switching to a graphics-based word processor unless you can actually make use of the graphics? You might as well just stick to the old method of creating the text any way you want—any shareware word processor will do—and then importing the text into a desktop publishing package.

The culprit, of course, is Windows. While Windows gives each application automatic access to RAM above the PC's traditional 640K-byte barrier, that extra memory is really just disk emulation. What counts is the "conventional" memory below 640K bytes, where program modules are swapped in and out as they are needed. Basically, you have a large object (the code of these programs) being crammed into a small space (the RAM that Windows can allot to each is below 640K bytes). Of course, things aren't going to work as well as they might.

Ami Professional comes with unpublished Windows settings to change the way Windows allocates memory and thus, you hope, improve performance under certain circumstances. The other two vendors also have plenty of advice to offer. (Windows/286, for instance, may be faster than Windows/386, and it's best to use as much memory as you can for the disk buffer.) Using their suggestions did help somewhat.

But there's hope. Noises emanating from Microsoft indicate that Windows 3 is in the works and will make up for everything. It promises to do away with the 640K-byte barrier and give each application its own "virtual machine" with its own protected range of RAM. Everything will run faster because the applications won't be distracted by the constant need to juggle fragments of code in and out of slivers of RAM. Meanwhile, we remain stuck in the present, with three software packages offering much potential, shackled to the performance problems of the current versions of Windows. If you control the data processing in a large organization, then Word for Windows with its document production features and its macro language will appeal to you—assuming you're already using Windows. If you're a professional who's interested in coaxing the maximum use out of your personal computer, then Ami Professional will appeal to you. It offers a wealth of features, and the integration possible with Windows is just what a self-reliant professional needs.

If you want something simpler—if you just want correspondence with "high impact"—or if your glasses are getting too thick, you might consider Legend. It lacks DDE and a macro language, but if you're more interested in using your computer than configuring it, you may never notice. Either way, these three packages prove that PC word processing has an exciting future—as soon as it can escape from its past.

Lamont Wood is a computer journalist, desktop publisher, and data broker living in San Antonio, Texas. You can reach him on BIX as "lwood."
Introducing the Hercules Graphics Station Card. With more features than any card in its class. And more power. The company that took the monotony out of monochrome now puts more zip into analog monitors.

Fast Graphics

In today’s competitive business world, time is more precious than ever. But Windows applications like PageMaker, Excel, and Corel Draw can make you wait while they work. Not with the Hercules Graphics Station Card—it’ll run Windows up to five times faster than a regular VGA card. At higher resolutions, too.

The secret is the on-board Texas Instruments 34010 graphics processor. It frees the CPU from the drudgery of graphics functions and screen memory control so you won’t have to wait for your screen to catch up with you.

From VGA on UP

A whole megabyte of video memory lets the Hercules Graphics Station Card offer a full range of modes—from VGA up to 1024 x 768 resolution with 256 colors, and plenty in between. So it will run all your software—from general business to complex design programs. And as your software needs become even more sophisticated, you won’t need to shop for a new video card.

Life-like Images

Computer images can look realistic when software can access more colors. The 16- and 24-bit color modes on the Hercules Graphics Station Card allow any standard analog monitor to display up to 16.7 million colors for high quality photo-realistic images.

And best of all, you can have all these features for less than you’d think. Call us at 800 532-0600, ext. 190 (U.S.) or 800 323-0601, ext. 191 (Canada) for the quickest way to your Hercules dealer.
WHETHER REPORT.

Whether you’re a software developer writing new applications for the IBM or Mac, or a PC user securing proprietary data files, software and data protection has never had a brighter silver lining. For a number of very good reasons.

Beginning with the ‘whether-expert’ Rainbow Technologies. And ending with its Software Sentinel family of hardware keys. Starring five models that fit virtually any software program or data file you need to protect.

There’s the best-selling SentinelPro for the IBM PC/XT/AT, PS/2 and compatibles, and even the Atari ST. Known worldwide for its virtually unbreakable security. And its ASIC technology. And its invisible operation. A close relation, the Sentinel-C stands at-the-ready for custom configurations and multiple software packages.

In the Apple market, security-minded Mac software developers turn to Eve. For completely transparent operation and world-class security of the protected software. Just by plugging Eve into the Mac ADB connector.

PC users wanting a low cost, user-friendly solution to the problem of securing sensitive data can call on the DataSentry. Using a proprietary Rainbow algorithm or DES, the DataSentry encrypts data files on individual PCs, protects modem transmissions and secures data on local area networks.

Rainbow’s latest protection strategy is the SentinelShell—that lets users place a ‘shell’ around existing, off-the-shelf programs. Because access can be limited to those issued a key, libraries, universities and corporations can very simply guard their software investments.

Whatever your whether, Rainbow Technologies has the software and data protection products that make the difference. For more information, call 714-261-0228 in the U.S., or contact Rainbow Technologies Ltd. in the United Kingdom for the distributor nearest you. Whethecasters are standing by.
FoxPro pushed the dBASE language to its limits

Steven J. Vaughan-Nichols

For many years, despite determined competition, Ashton-Tate has been the dominant player in the dBASE game. Now, that could change. Fox Software's newest entry in the race is a clear winner over the other challengers.

FoxPro 1.00 is not just the latest bid to trump Ashton-Tate's troubled dBASE IV. Fox Software's $795 package has far more going for it than shaving a few milliseconds off indexing or adding a few dozen more procedures or commands, although it does do all that. Besides providing a high-performance superset of dBASE III Plus and IV commands, FoxPro brings a character-based windowing interface to the PC by way of the well-received FoxBASE+ Mac. As a result, dBASE programming will never be the same.

FoxPro also comes with a nonprocedural, object-oriented front end for its database manager. You can still use the keyboard with the new interface, but the program works best when you use a mouse. The FoxPro interface is about as far removed as you can get from the dot prompt and still be dBASE compatible.

The new interface isn't just for DOS-phobic users, though. Even the most dyed-in-the-wool command-line programmers will be impressed by FoxPro's ability to dynamically move, resize, and temporarily erase windows. It is possible to have an editing, a trace, a debugging, and an output window all either on-screen or a mouse-click away. Combine this with the ability to dynamically set breakpoints, a source code-level debugger, blazingly fast speed, and compatibility with both its own and Ashton-Tate's products, and you have a state-of-the-art dBASE development environment.

That is all very nice in theory, but dBASE IV 1.0 was also supposed to be the greatest thing since sliced bread until the bugs started popping up. To get my feet wet with FoxPro and to see how well it really worked, I performed a major overhaul on a 3000-line application that had started life in dBASE III Plus, and whose code had been expanded during a brief fling with Clipper.

Code Repair Made Easy
Installing FoxPro was a snap. The program, weighing in at more than 3 megabytes, comes in compressed form on merely five 360K-byte floppy disks. The installation program works automatically and, with a minimum of fuss and bother, transfers the program to your hard disk and then expands it without trying to rewrite your AUTOEXEC.BAT or CONFIG.SYS files. You probably will need to change your CONFIG.SYS file, though, because FoxPro needs every file handle it can get. The company recommends that your CONFIG.SYS be set to at least 40 files.

The documentation that comes with the program is well written. It's arranged in such a way that it's easy to use whether you're a novice learning the program or a grizzled dot-prompt veteran looking for examples of obscure command syntax. Unfortunately, the program it's written about isn't quite the same as the one you get. The release notes include no fewer than 47 pages of errata and additions to continued
I had never seen my project's code before, so the first thing I did was sic FoxPro's integrated documenter, FoxDoc, on it to see what it could make of the hundred or so procedures and 50 programs. About 3 minutes later, I was looking at a system summary that included a complete tree structure, a variable cross-reference list, and summaries of indexes, formats, labels, procedures, and report files. FoxDoc prettied up the code and added comments that included file and procedure calls and listings of all called data and format files. This was a world of improvement over the documentation that came with my program—none. For this alone, I can highly recommend FoxPro to the legion of dBASE code repairers.

After going through the code, I then began tuning it up and adding the new programs required to expand the system's capacities. Again, FoxPro proved to be a godsend. It let me easily jump from watching the program's output to tracing the code and then to watching my debugging routines while dynamically setting variables and breakpoints.

Compared to previous FoxBASE releases, FoxPro has expanded support for user-defined functions. It's still not the equal of Clipper in this respect, though. You can't directly link C or assembly code for that extra performance edge. For this application, however, I could live without that ability.

FoxPro's internal editor is a good one, but I missed the WordStar-compatible commands of Ashton-Tate's editor. Still, it has one outstanding feature that I wish more true word processors had: It lets you retrieve any text deleted during an editing session. On the minus side of the balance, while the editor lets you move and copy text from window to window, it requires an extra step to do it. In theory, FoxPro allows you to call an outside editor in place of its internal editor. In practice, there wasn't enough memory left over for WordStar 5.5, my editor of choice.

Quick and Compatible

Despite its graphical user interface, FoxPro is impressively quick. A first look at FoxPro might make you think that it would be as slow as many Microsoft... continued
Check out
HI's new DL series

Large format, Big features, Small price.

- Eight-pen changer
- LCD user interface display
- One-year warranty
- Plot optimization
- "Quick scale" feature
- Standard media up to 36" × 48"
- Sizzling speed up to 40 ips
- High resolution of 0.0005 inch
- Roll-feed option
- Scanner option
- 1 Mb buffer option

These are just some of the many standard features packed into HI's new DMP-60 DL series of pen plotters. Based on the popular DMP-60 line, the new DL series delivers a blend of proven performance and state-of-the-art innovation. At a surprisingly low price.

Top of the line. Heavy duty. Large format. Loaded with standard features. Priced as low as $4,895.*

Check it out by calling 1-800-444-3425 or 512-835-0900.

HOUSTON INSTRUMENT™
A DIVISION OF AMETEK
8500 Cameron Road, Austin, TX 78753

* U.S. suggested retail price. Subject to change.

Houston Instrument is a trademark of AMETEK, Inc.

Circle 111 on Reader Service Card
Windows-based programs. That's because its text-mode windows require only a fraction of the display memory that a true GUI requires. The end result is one of the smoothest and fastest windowing interfaces around.

The Browse command is also better than previous implementations. It now has two types of window formats. The first is the usual spreadsheet-like format, while the other corresponds to an Edit window. You can toggle between the two layouts at will. The real strength of the new-and-improved Browse is the ability to dynamically choose what fields or subsets of fields will be displayed, their size, and the order in which they will be displayed.

Despite some difficulties, mostly with Clipper commands that FoxPro doesn't support, I was able to finish the project in about half the time it would have normally taken me—and that includes learning time. There is one caveat to this. I was using a mouse. If I had relied on the keyboard alone to get my work done, it would have gone much more slowly. It's not that the program's key selections are poor, it's just that the program is at its best when mouse-driven.

FoxPro proved to be perfectly compatible with the dBASE III Plus dialect of dBASE. A series of tests on a number of dBASE IV programs that I had lying about revealed no problems with the newer language variant. Unlike its Ashton-Tate predecessor, FoxPro proved to be bug-free.

The program also has no trouble dealing with dBASE IV's database and index structures, with the exception of dBASE IV's master index format (.MDX). Make no mistake about it, though, FoxPro is a superset of dBASE. Its indexes and its memo formats are not backward compatible with Ashton-Tate's products.

In particular, FoxPro's new memo format is not like anything seen before in dBASE. New memo fields are unlimited in length. If you want to have a megabyte-size memo, you can. To make these monstrous memos more manageable, they can be searched and manipulated by several of the more important string functions, including the AT( ) and SUBSTR( ) subroutines. This goes a long way toward making memos more tractable for serious applications. FoxPro can also store binary data in string or memo fields. You can keep digitized images, sounds, and executable files all within the database. Putting binary data to use in the system isn't easy. For this release, the feature is more of a neat trick than a useful tool.

Pluses and Minuses

One thing you can always count on in any new dBASE program is that its makers will claim that their new index structure is smaller and faster than its forerunners. The makers of FoxPro are no exception. But while it may have the fastest indexing routines, they're not always the most efficient in terms of space. FoxPro indexed my files as much as 47 percent faster than dBASE IV with only a minimal amount of expanded memory (see table 1). However, file size was more of a toss-up. For simple index expressions, FoxPro made files an average of 10 percent smaller than dBASE IV's. When an index was based on a long, compound string key, dBASE IV was marginally more efficient.

I based my comparisons on eight indexes—six for a database with 837 records (Database 1) and two for a database continued
A PROMOTION THAT PROVES WE DON'T MAKE ALL PAPERWORK OBSOLETE.

Now when you buy BASF diskettes you can win up to $10,000 in our Keyboard Kash Sweepstakes. You'll find a scratch-off card in every specially marked box. You have a better than 1 in 10 chance to win cash.

And BASF diskettes offer unsurpassed data protection. So you can take a chance at $10,000 without taking a chance with your data. This offer is for a limited time only. Call your BASF dealer today.

Try it. Depend on it. ~ BASF
with 1470 records (Database 2). The names, types, and lengths of the fields used are shown in table 2.

I ran the tests on an Austin 286 AT compatible running at 12.5 MHz with 640K bytes of conventional memory and 384K bytes of expanded memory. The system also had an 80-MB Plus Development Hardcard II disk drive with a BIOS disk access speed of 28 milliseconds and a 128K-byte hardware disk cache.

There are two points where dBASE IV still has the edge. The first is automatic screen generation—Ashton-Tate's product is easier to handle. The second is the report generator. I rate FoxPro's as equal to dBASE's except for one significant shortcoming. The other dBASE variations let you directly edit a report's code; you can't do this with FoxPro.

The company claims that its report generator is so complete that you'll never need or want to meddle directly with the code. Wrong. Expert dBASE programmers will still want to get their hands dirty working directly with the report's format. Still, for the computerphobes in the office, the nonprocedural, object/event-oriented front end of FoxPro's report generator is easier to approach than dBASE's.

One of the more remarkable things about FoxPro is that it manages to perform its tricks in as little as 512K bytes of RAM and on your typical 70-ms, slow-as-death, XT-class hard disk drive. It's not fun, mind you, and the program really slows down, but you can do it.

FoxPro sings, however, when used with a fast chip and EMS 4.0 memory—the more of the latter, the better. FoxPro will also put any 80x87 math coprocessors in your PC to good use. One thing to be noted, though, is that FoxPro is very sensitive to its environment. Even a small reduction in RAM, either normal or expanded, can make a big difference in its performance.

Of course, FoxPro isn't perfect. The program claims to “compile” files, but it doesn't. FoxPro creates and runs object code faster than it runs source code. You can create true run-time programs only with the purchase of the not-yet-available FoxPro unlimited run-time package, which will set you back an additional $500. You can't simply buy a professional developer's package.

The current package isn't ideal for LAN use, either. However, Fox Software says that it is working with Novell to produce FoxPro/LAN for NetWare.

FoxPro is not a relational database manager and doesn't support Structured Query Language. This is a problem. The relational database model is the wave of the future. SQL, the language of the relational database management system, provides fundamentally stronger query and manipulation tools than dBASE, but good microcomputer SQL implementations are still hard to find. The company says that the next major release of FoxPro will include a SQL interface, but it will take more than that to make a DBMS relational. It is a step in the right direction, though, and I look forward to seeing the revision.

If you just want to get at your data quickly or whip up a simple report, you will be very happy with Fox Software's new product. FoxPro brings more than just a Mac look to the DOS environment. You can master the bread and butter of simple database design (i.e., data entry and report generation) quickly and easily in FoxPro. The program would make a fine choice for most offices.

FoxPro stretches the single-user, single-machine flat-file database model about as far as it can go. I wish it included SQL and improved LAN suitability, but despite these reservations, I plan to use FoxPro for most of my dBASE applications development.

Steven J. Vaughan-Nichols is a program/analyst for Bendix (Lanham, MD) whose work currently includes designing a database that takes data from a Goddard Space Flight Center telephone digital switch. You can contact him on BIX as “sjvn.”
Cheetah Gold 425/D™

- INTEL 25MHZ 486 CPU/FPU
- FULL 16MB of 70NS System Memory
- Tower Case with 450/W Power Supply
- ESDI Caching Disk Controller with
  Dedicated Processor and 512K Memory
- Super Fast 383 MB ESDI Hard Drive
- 1024 x 768 Premium VGA Card
- 14" Premium VGA Color Monitor
- 1.2MB & 1.44Mb Floppy Drives
- 2 Serial & 2 Parallel Ports
- 101 Key Keyboard
- Cheetah Gold 425/D $9,995!

(Other models from $5,995)

- Price subject to change
- 20% Refundable deposit required
- Subject to availability of INTEL 25MHZ 80486 chips. A surcharge may apply if Cheetah’s cost of i486 chips exceeds $950 each.
- Visa, MasterCard and American Express add 4%
- Delivery date subject to the availability of i486 chips.

BENCHMARKS
LOW NUMBERS INDICATE SUPERIOR PERFORMANCE

| Benchmark       | Seconds
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 20x</td>
<td>115.8</td>
</tr>
<tr>
<td>MM Word Processing MM</td>
<td>140.3</td>
</tr>
<tr>
<td>Graphic Drawing 20x</td>
<td>154.0</td>
</tr>
<tr>
<td>Graphics Drawing 20x</td>
<td>176.4</td>
</tr>
</tbody>
</table>

Cheetah International, Inc.
1003 West Cotton Street
Longview, TX 75604

1-800-CHEETAH
(1-800-243-3624)
1-214-757-3031
1-214-753-0529 FAX

1989
BYTE
AWARD
OF
DISTINCTION

Cheeta Gold 425™ with 8 years of memory and DRAM capacity can support a wide range of graphic and data processing applications. Cost-effective and efficient in its design.
ACMA offers "...performance, expansion possibilities, better-than-average warranty, and reasonable prices. This is an impressive machine..." our favorite is the ACMA 386/25 Business System. *PC Magazine 11-28-89

Urgent News:

**Acma Slashes Prices**

45 Day "Risk Free" Money-Back Guarantee -- Two Year System Warranty* -- Unlimited Lifetime " Toll-Free" Technical Support -- Replacement Parts Shipped Air Express FREE! -- Fastest Delivery In The Industry -- Flexibility Makes Ownership Easy -- Hearing And Speech Impaired TDD Service -- Commercial Leasing -- On-Site Service Available!

Get all the hardware you need to start computing today!

---

**Complete 286 Business Package**

**Now! $1,265**

**FREE Surge Protector and Printer Stand**

ACMA's 286/12 with Intel's 80286/12MHz CPU - New Enhanced AT CHIPSet - AMI BIOS - 0 wait state - page mode interleaving - 512K RAM expandable to 1MB - math coprocessor support - ROM-based setup - shadow RAM - 2MB or 4MB floppy drive - 20MB hard drive - dual high-speed floppy controller - parallel and serial ports - eight expansion slots - 200MB UL approved power supply - enhanced 101-key keyboard - mono/multimonitor - monochrome monitor and video card - Panasonic 1180 printer - 1024printer (1920x100) - MS-DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

**Complete 386SX Package**

**Now! $1,799**

**FREE Surge Protector and Printer Stand**

ACMA's 386SX with Intel's 80386SX-16MHz CPU - AMI BIOS - Intel ChipSet - 0 wait state - page mode interleaving - 1MB RAM - 512K/1MB math coprocessor support - eight expansion slots - 200MB UL approved power supply - 40MB/80MB hard drive - 2MB or 4MB floppy drive - parallel and serial ports - enhanced 101-key keyboard - mono/multimonitor with 8MB/16MB/32MB mono/stereo monitor and video card - Panasonic 1180 printer/2400/cpx) - 6 parallel printer cable - 1 desktop computer paper - User's Guide and "Easyview stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Choice of MS-DOS, Unix or Novell systems. 2 year warranty. Two year system warranty - 1st year labor. 2 year system warranty - 1st year labor. 2 year system warranty. 2 year warranty.

**Complete 386/20 Power Package**

**Now! $2,650**

**FREE Surge Protector and Printer Stand**


---

**NEC SV-810 Monitor, & ATI Video Card With Monochrome Option**

$199

**Hyundai Color VGA Monitor & Acma VGA Video Card**

$49

Only $95

Now, for a limited time, get PFS Free! First Choice for $35 when you purchase any Acma computer. You save almost 40% off the regular retail value of $149.

---

**Open 7 Days A Week!**

**800-456-1818**

Hearing & Speech Impaired TDD 800-456-8689

Mon - Fri 7am to 6pm, Sat - Sun 9am to 5pm PST

---

*We accept Visa, Mastercard (no surcharge), American Express, C.O.D. (via guaranteed check only), qualified P.C.'s, money orders, wire transfers, and personal checks (after 7 days to clear). Cash, check or wire transfers entitles 10% discount. Add 5% for shipping and handling (83 lbs.), or 5% for 2nd day air on systems. A minimum of $100.00 per order is required. Call for shipping charges if not indicated here. Price are subject to change without notice, and all listed taxes are included in quoted price. *Money-Back Guarantee Does not include monitors, accessories, return shipping and handling. Software, accessories, monitors, printers and shipping are not refundable. Replacement parts are cross-shipped by 3rd day air of Acma's expense with an approved RMA. Customers assume all responsibilities and costs for returning defective parts to Acma. We are not responsible for data or software errors or damage. We strongly suggest you back up your data before shipping to Acma. We offer a 2 year warranty on parts and labor, the first year. Products not made by Acma are covered by the manufacturer's warranty. "Commercial leasing is for qualified businesses only, and the amount listed is based on a 36 month, zero down, 10% purchase option lease on basic configurations." Free shipping of Video Combs, Ship Free. *"Free shipping of Video Combs is by UPS ground, and covers the monitor and video card when purchased separately from any other products.

Circle 11 on Reader Service Card

---

PC MAGAZINE

117 Foothill Ave., Fremont, CA 94539 (415) 623-1212 (415) 623-0818 Fax
Hewlett-Packard’s NewWave is nice, but is it too hard to use?

John Lussmyer

When Microsoft Windows was first introduced, it started people thinking about the potential of a DOS-based graphical user interface. Still, even now, it seems that something is missing. While Windows provides a programming interface and a platform for graphics-based applications, it offers little in the way of amenities to users. Furthermore, while object-oriented paradigms apply well to GUIs, Windows’ programming interface does not include many hooks that allow interface elements to be handled as objects.

NewWave, Hewlett-Packard’s layered enhancement for Microsoft Windows, promises to change all that. Announced over two years ago, NewWave is supposed to bring a more robust feel to Windows. The goal was to make Windows easier to use and expand the range of functionality available to Windows applications. In this review, I’ll examine NewWave, both the user interface and the programming tools, and weigh the benefits it brings against the hardships it creates.

NewWave is much more demanding than Windows. My system, an NEC PowerMate 386/20 with 4 megabytes of RAM and a 40-MB hard disk drive, just barely met the requirements of NewWave. On a 386 system, you need at least 4 MB of RAM and 8.5 MB of disk space. That’s a tall order, but moving some files to the Novell network cleared up enough disk space.

The NewWave installation program decided that my system was not set up correctly, wrote out a lengthy error file, told me to read it, and quit. I would have preferred an explanation of the failure on the screen. The error file listed several problems with the way my system was set up. The error messages were fairly verbose and contained references to various application notes; I had a little trouble finding those notes. According to the error messages, my system didn’t have any EMS bank pages above 640K bytes, it didn’t have enough EMS RAM, it didn’t have enough EMS RAM (installation had found only 80K bytes), the proper version of Windows was not installed, I did not specify a TEMP directory in my environment, and I did not have enough free disk space. If you didn’t already know, NewWave is a very demanding, finicky environment.

I fixed the first problem by changing my 386Max installation. I never understood why NewWave saw only 80K bytes of EMS RAM, so I ignored the error. Decreasing the size of the disk cache gave me enough EMS RAM for banking. I had Windows 2.10 in my path; NewWave requires version 2.11, so I installed a newer copy. I then set up a TEMP directory. Finally, I made room on my hard disk drive, and NewWave was satisfied.

I had some questions about NewWave’s use of EMS and called the HP NewWave support hotline. After a few levels of voice-mail recordings, I got another recording telling me that all the support people were busy and to please leave a message. I did, but no one returned my call.

continued
The Trouble with Windows

I had just finished installing Microsoft Windows 2.11 when I found the READ-ME file on the NewWave installation disk 1. Some of the instructions in this file tell you to replace certain files on the Windows installation disks with ones supplied by HP. So I made the changes and reinstalled Windows. If you ever have to reinstall Windows after you have installed NewWave, you must make some minor changes to the Windows installation.

This time when I ran the NewWave installation, everything seemed to run properly. A Windows/NewWave program performs a large part of the NewWave installation. This means that the installation runs slowly with long delays between disk swaps.

Problems began almost immediately after starting NewWave. Most of the Windows utility functions (e.g., Calc, Notepad, and HeapWalker) would not run. They aborted with a "not enough memory to run" message. One of the NewWave tools, Agent (an object that records and plays back user actions), just told me "Agent tool can't be opened in this release." Why was it installed? Every now and then, my NewWave session would inform me that it couldn't find one of its system files and to put it in drive A. Right. I didn't even know which distribution disk it was on. I knew that it was on the hard disk drive, but NewWave couldn't find it. I had to either put it on a disk in drive A or use the three-finger salute to reboot (losing any work in progress).

I called the NewWave technical-support line again, and this time I was quickly connected to a person. It turns out that the company has a new phone system and has had some problems with it, but the technical-support person was surprised to hear that no one had called me back. She was quite helpful and answered a few questions I had but couldn't figure out what was going on. The manuals had left me with the impression that NewWave worked only with EGA and VGA, which is wrong; it should work with any Windows-compatible video card, although NewWave has only been tested with EGA and VGA. She also verified that NewWave won't work with Windows/386. This was never explicitly stated in the manuals.

Within a couple of hours, the technical-support person called me again to get more information on my system. An hour or so later, she called and had another person there to help. We finally found that Windows 2.11 doesn't work with my Novell network. So I got on Microsoft's On Line support service and found that Microsoft had a fix for the problem, a new KERNEL.EXE (On Line knowledge base message Q44660). After downloading this and reinstalling Windows, everything started working fine.

Converting Applications for NewWave

A couple of days after getting NewWave running, I received the HP NewWave developer's pack. This is a set of disks with five binders' worth of manuals and another copy of the application notes.

The manuals are not especially helpful. HP really needs a book similar to Charles Petzold's Programming Windows (Microsoft Press, 1988) for NewWave. The most helpful manual is the HP NewWave Environment Programmers Guide. It describes how to convert an existing Windows application into a NewWave application, although it explains only a minimal conversion.

I did a minimal conversion of my Windows-based BIX conference viewer. My goal was to create a BixWin object that is a view of a specific portion of the message database. The changes required to even minimally convert an existing Windows application to work in the NewWave office are extensive. If your application makes use of the command line, you will have problems. NewWave has its own internal use for the command line, and, as far as I can tell, you cannot invoke an application from the DOS command line. It really wouldn't make sense in the NewWave object environment to do so. Any special command-line options you have will need to be implemented in some other fashion.

You must change two main functional groups of program code: those groups that use the Object Management Facility (OMF) and those that use the NewWave application programming interface (API). The NewWave OMF consists of a group of messages and functions that you must work with to handle NewWave objects. NewWave will invoke your application when the user (or another program) activates an object belonging to your application. This makes for some changes to the normal menu structure. The normal File menu is renamed Action, and some of the functions are changed. You will no longer have a New item; that function is handled by OMF. You can select Objects and then create a New from the Office Window. The function Save As will also create a new object.

Your application will also have more possible states of execution. A stock Windows application is either running or it isn't. Under NewWave, it can be inactive (not running at all), active, or open. When it's active, it creates its window but doesn't display it. A window is only displayed when the application is brought up to open status. This additional state requires changes to the application's initialization functions. You will always create the window, but you don't perform the ShowWindow or UpdateWindow function calls until NewWave sends you an OMF_OPEN message (which it may never do). To create a window, the NW_CreateWindow function is called, which replaces the existing CreateWindow. The initialization code also has to call the OMF_Init function to tell OMF what your window handle is. NewWave makes extensive use of property lists to maintain information about a window.

After you have called OMF_Init, you start getting OMF messages, and you must modify your main window procedure to properly handle them. The first thing your Window procedure must do with each message is call NW_MessageFilter. If this function returns True, you must immediately return to Windows with a value given to you by this function. You will also have to process some of the various WM_SYSCOMMAND messages. For SC_MAXIMIZE and SC_RESTORE, NewWave provides special functions that should be called. All other WM_SYSCOMMAND messages should be passed on to DefWindowProc.
HOW TO COMBINE SPEED, POWER AND GRACE WITH BRUTE FORCE.

**AUTOCAD® 386.** Zoom faster. Pan faster. Draw faster. AutoCAD 386 combines world-standard CAD performance with full-force 32-bit workstation power—right on your 80386®-based PC.

AutoCAD 386 is built for speed. It loads, redraws, and saves drawings up to 62% faster than before. It accesses up to 16 megabytes of RAM and 4 gigabytes of virtual memory, making more room available for larger AutoLISP® and other applications programs, memory-resident drivers, network interfaces and other utilities—which translates directly into more speed.

Quick! Call Autodesk now to arrange a power-demo at the authorized Autodesk reseller nearest you. And upgrade your present version of AutoCAD for as little as $300.

Autodesk, the Autodesk logo, AutoCAD and AutoLISP are registered in the U.S. Patent and Trademark Office by Autodesk, Inc. 80386 is a registered trademark of Intel Corporation.

Circle 32 on Reader Service Card
PostScript®
Just
Got
More
Affordable!

GoScript
PostScript® Language Interpreter
for the IBM PC

NEW
PRICING:
GoScript: $19
(13 fonts)
is now only $149
GoScript Plus: $33
(35 fonts)
is now only $299

GoScript allows you to print PostScript language text and graphics on the most popular laser, ink jet and dot matrix printers.

NEW VERSION 3 FEATURES:
- EGA and VGA screen drivers give you screen preview capabilities.
- GOPRINT™printing utility allows you to use our scalable fonts to print plain text files.
- An expanded Bitmap Save option allows the bitmap image to be saved in TIFF or PCX format.
- Send back the registration card to receive 4 extra fonts.

For Catalogs, Brochures, Benchmarks, Compatibility Lists, Print Samples & Ordering Information, contact us at:
1-800-955-FONT
or
LaserGo, Inc.
Attn: New Products
9369 Carroll Park Drive
Suite A
San Diego, CA 92121

PostScript is a registered trademark of LaserGo, Inc. GoPrint is a trademark of Executech Systems, Inc. Adobe Systems, Inc. All other product names are trademarks of their respective manufacturers.

In addition, you must set up a function to handle the OMF HAS_METHOD messages. This simply returns True or False, depending on whether your application supports that particular NewWave method. A method is just a name for a particular type of NewWave message. I do not understand why the company didn’t provide a standard Window subclassing function to handle the NW MessageFilter, WM_SYSCOMMAND, and HAS_METHOD handling. It looks like these handlers might be identical for all applications. The OMF already has all your HAS_METHOD information from your .INS file (a file similar to the Windows .DEF file).

HP has given quite a few style guidelines for NewWave developers to follow, one of which is that during activation, you get the title of the object being activated and display it in the title bar of the application. You also must obtain the filename and path from OMF and load the file. For BiXWin, my objects are just a minimal specification of which conference, topic, and message are to be viewed. Since I wasn’t doing this in the original Windows version, I had to add a menu item and code to read and write to the files. The menu that was most affected by this was the Conference View menu. I added Remember, which creates a NewWave object. When this object is activated, it starts a view of the message that was remembered. It is not an easy task to create a new object from within a program. You can only invoke the NewWave dialogue that the user normally uses. The user still has to fill in the blanks in the dialogue. There doesn’t seem to be a way to simply create a new object of the same type that is executing.

In addition, do not use the undocumented Windows function ExitWindows from your application. NewWave will prompt with a message box that asks whether you really want to exit (which is probably what you were trying to avoid). It will also end up confused about the state of any objects on the screen. I had several objects just disappear until I told NewWave to straighten up the screen and realign by rows.

By the time you do a minimal conversion, your code will look considerably different. Your normal Windows initialization won’t actually display the window. You will have added several new functions to process OMF messages, along with a bunch of calls to OMF function for initialization and termination.

HP recommends that you add the line EXETYPE WINDOWS to your .DEF file for proper operation. You also have to create an .INS file that gives NewWave some environment-specific information about your program. This includes a list of files that make up the executable file, whether default data files get copied when a new object is created, what methods are supported, and the name of your application.

Going All the Way
At this point, your application will be more NewWave tolerant, but it won’t yet fully exploit the new features. The second part of conversion will bring you up to a full NewWave application. This is the heart of the NewWave API: It supports the on-line help facility, Computer Based Training (CBT), and the Agent. I did not have time to perform a full conversion on my large BiXWin application. I read the manuals and worked with the supplied sample programs. Each of the sections of the API requires extensive changes to the average application. HP tells you that setting up the Help facility requires no programming; then, a few pages later, there is a list of messages that you must process for Help to work. The Help facility looks nice when it is done. The major problem is writing Help text that makes sense.

Adding the last bit of NewWave functionality to an application renders it even more unrecognizable. You must add calls to quite a few API functions to determine if you are going to process the message, and if so, what to do with it. HP provides sample code sections that can be copied verbatim into your code. These are more correct, you hope, than the usual Windows sample code. Again, it looks like HP could have performed many of these functions by just subclassing the window when you create it. Most of these changes are to support a task language that should continued
Death
Taxes
Software Piracy

We can save you from one of them.

Sorry. Death we can’t do anything about. As for taxes, when you use our product you’ll probably wind up paying more. But software piracy: there we offer some help. Our family of software protection devices (dongles) have improved unit sales for over 2,000 companies around the world. Our products can be used in the MS-DOS, OS/2 and Macintosh environments.

Build Your Own Custom Protection Environment

Use our patented “dual-locking” ASIC chip as the basic building platform. Next, add options like: on-the-fly read/write memory, write-once or multiple-write locking codes, and encryption shells. Then add your own programming creativity to build a protection environment best suited to your product.

Users attach the device to their parallel port, and programs won’t run without it. Back-up copies, hard disk and LAN operation are not interfered with.

Your Intellectual Property Belongs To You

And if you don’t protect it, who will? Our products offer the most equitable way to protect your interests without sacrificing the rights of your customers. Call us today for information and demonstration units.

Software Security

1011 High Ridge Road - Stamford, CT 06905
1-800-333-0407 ext. 101
203-329-8870 Fax 203-329-7428 BBS 203-329-7253
AppleLink™ D2379

Macintosh is a trade mark of Apple Computer Inc., Activator, Macintosh are trade marks of Software Security Inc.; illustration: detail from Michelangelo’s Last Judgement

Circle 265 on Reader Service Card
Rack & Desk PC/AT Chassis

Integrand's new Chassis/System is not another IBM mechanical and electrical clone. An entirely fresh packaging design approach has been taken using modular construction. At present, over 40 optional stock modules allow you to customize our standard chassis to nearly any requirement. Integrand offers high quality, advanced design hardware along with applications and technical support all at prices competitive with imports. Why settle for less?

Integrand's new Chassis/System is not another IBM mechanical and electrical clone. An entirely fresh packaging design approach has been taken using modular construction. At present, over 40 optional stock modules allow you to customize our standard chassis to nearly any requirement. Integrand offers high quality, advanced design hardware along with applications and technical support all at prices competitive with imports. Why settle for less?

NewWave isn't easy to port to, but then, nothing worth doing should come easily.

Not written with a command language in mind, creating a complete one can be a difficult job in itself. HP suggests that you use its YACC (a spin-off from the Unix Yet Another Compiler Compiler, for which HP includes an advertising flyer) to generate the parser for the language. The manuals give examples of task languages and what to do with them, but using the examples causes some basic structural changes to your program. All commands can be processed by the same function. If you use dialog boxes—and who doesn’t—you will have to make a number of changes. The dialog boxes should just return command codes for the main command processor to execute. You will not be performing much other than entry validation in the dialog box functions.

The CBT support lets you write automated tutorials for your program. Again, it requires changes to your main window procedure so that it can monitor what the user is doing and supply actions when necessary. HP supplies a limited animation capability for CBT that helps make things a little more interesting. Creating the animation is a tedious job at best, though. I didn’t have time to do more than look at the code changes necessary to support this, and they are considerable.

One of the more interesting features of NewWave is the data sharing, with which a view of your applications data can be pasted into another application. This view is wholly maintained by your application, but support is implemented by handling another set of messages that HP has defined. Again, the code to support this can be rather large. The examples given in the NewWave documentation were not very clear on what it takes to do this.

Another area in your application that will require modifications is the print support. NewWave objects print themselves using a different technique than is normally used by a Windows program. NewWave performs all printing by way of metafiles. The window procedure receives a message indicating that it should print a single page to the given metafile. After each page is done, the window procedure sends a message back to NewWave asking for the next page’s metafile, and another message is sent when printing has completed. Since you are printing to metafiles, the normal Windows spooler isn’t needed, and NewWave's installation disables it by default. A side effect of this is that your normal Windows applications will print more slowly. If you are going to be doing much printing from a normal Windows application, you will probably want to reenable the spooler. Make sure you disable the spooler afterward; otherwise, the (effectively) doubled spooling will make the system seem slow.

Likable, but a Lot of Work
Overall, I liked using the NewWave interface. The icon/object-oriented interface is easy to use and learn. When more applications are available, it should be a nice environment. I like the idea of sharing views of data between programs. This could make some of my normal bookkeeping a lot easier. However, modifying an existing program to use is difficult at best. If you don’t perform a complete conversion, there is no real advantage to the environment. If you do a complete conversion, you must rewrite major portions of your application. If you are planning to convert your application to the NewWave environment, you should sit down and figure out just what portions of it you need to or can support. The HP NewWave Environment Programmers Guide gives a good (although incomplete) description of how to convert an existing application.

The manuals need some help. If you run into a snag, the support line is good. In any case, expect to spend a lot of time reading the manuals and testing what you’ve written. NewWave isn’t easy to port to, but then, nothing worth doing should come easily.

John Lussmyer is a software developer living in Troy, Michigan. He can be reached on BIX as “jflussmyer.”
IPLIB is a transputer based image processing library written in C. The library consists of over 200 of the most common and useful image processing functions available. The functions supplied range from simple row, column and pixel manipulation to complex line extraction and component and texture recognition. The supplied routines are able to run in parallel with the commonly available transputer high level languages such as Pascal and Fortan and with Occam in the D705/D711 compiler versions.

As an added advantage, the full source code of every function is supplied with detailed documentation of how the system works. This allows the user great flexibility to adjust the IPLIB functions to their own requirements and to expand the library with their own routines.

As well as providing large numbers of functions for image processing IPLIB also provides a parallel processing harness which operates transparently to the user. Functions are supplied that will automatically allocate data packets to the individual processors and then reassemble the resulting image after processing is complete. These functions allow high performance parallel systems to be constructed quickly and easily.

For details of availability and application please contact: Steven J. Doyle
National Engineering Laboratory  East Kilbride, Glasgow G75 0QU ,U K
Telephone: East Kilbride (03552) 20222  Telex: 777888  Fax: (03552) 36930

Circle 202 on Reader Service Card
In the 1990s, code will be generated by the click of a mouse or a tap of a key. With Matrix Layout 2.0 you can do that now. And the results will surprise you.

**Preview the 1990s with Layout**

In Layout, you create programs by designing an object-oriented flowchart, with all the options of traditional programming. It's a technology we call desktop programming.

Once you're done, simply choose the language you want for the finished program. There's Microsoft C, Lattice C, and Turbo C, as well as Turbo Pascal and Microsoft QuickBasic. You can even create a .EXE file that's ready-to-run on any IBM PC or compatible.

**1990s Power without 1980s Pain**

Because Layout works with today's standards, you can painlessly take advantage of the power behind Layout - object oriented programming, CASE (Computer Aided Software Engineering) technology, hypertext databases, and graphical user interfaces. All without giving up your favorite computer language.

**An Architecture for the 1990s**

Layout comes with objects that produce real code for everything traditional computer languages can do - math, branching, variable management, complex data structures - and it extends each language to include powerful user interface and hypertext database capabilities. But best of all, you can extend Layout past the 1990s by building your own objects - BlackBoxes - that can do anything you imagine. Added together, Layout cuts your development time by up to 70%.

**Welcome to the 1990s**

Ready to jump into the 90s? Get Layout today. It's available for just $199.95. Or for a glimpse of the 90s, see the Layout video tape for just $9.95. Give us a call at 1-800-533-5644.

In Massachusetts call (617) 567-0037.

---

In the 90s, this is how you'll write code.
Two compilers bring object-oriented power to the Mac

Matt Mashyna

Apple has been dedicated to object-oriented programming—so dedicated that a substantial portion of System 7.0 is being developed in it. Object-oriented code is easier to control, from a software engineering point of view, and the Macintosh’s interface suits it very well. Objects that respond to your actions with little dependency or knowledge of other objects free you from worrying about which window or area received a mouse-click or keystroke. The objects know what to do because the framework tells them when to handle an event and when to pass it on.

Apple started by adding object extensions to its Pascal compiler. Then Apple developed an application framework called MacApp. MacApp provided Pascal programmers with a fast development system that gave the programmer all the basic functions—text editing, scrolling lists, and views, to name a few—in self-contained objects. None of the objects required changes to be fully functional, and they were easily changed to meet new needs.

Now C objects are accessible to Mac programmers in two varieties: Symantec’s Think C 4.0 and Apple’s MPW C++. Both compilers offer objects, but they are very different animals. Think C is a complete environment that meets the needs of the majority of programmers, while C++ is a more robust, powerhouse language for the MPW Shell.

A C compiler has different strengths

A Closer Look: Think C

The Think C environment is inviting, and it is streamlined for C development. The object extensions (make no mistake, Think C is not C++) provide you with tools to tame the Macintosh. The program offers a number of improved features, along with the object extensions, over version 3.0.

The new ANSI library supports all the ANSI standard functions. This is nice for portability. It replaces the Unix libraries from earlier versions. It also eliminates some odd, peculiar functions in favor of more standard ones. Functions like clalloc and mmalloc and non-standard string-to-number conversions are gone.

ANSI prototyping is now supported. This makes for better programs by forcing the compiler to check arguments in function calls and by forcing programmers to properly cast variables. In-line assembly is available, too, and it now accepts all MC68020 and MC68881 instructions and addressing.

A nice feature is the “Once only headers” that lets you define a preprocessor symbol at the top of your header files to prevent multiple inclusion. The rule is that if you define a symbol beginning with _H_, followed by the name of your include file, without the .h extension, it will not be processed a second time if it is included by other header files. For instance, the statement

```
#define _H_foo
```

within the file foo.h stops it from being included again, in case other header files also include foo.h.

Think C makes it easy to build multi-segment code resources for desk accessories and device drivers and provides the ability to address globals using register A4 without affecting other applications’ A5 addressing.

Another feature that I like is cdev debugging. Symantec has implemented a cdev object. The basic methods are already done, which means you only need to worry about the specifics of your cdev. An example with two projects is included. One project builds a real cdev, and the other builds an application with which you can use the debugger.

continued
Review

C Compilers Have Different Strengths

<table>
<thead>
<tr>
<th>Company</th>
<th>MPW C++ 3Bt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
<td>Think C 4.0</td>
</tr>
<tr>
<td>Apple Computer</td>
<td>Symantec Corp.</td>
</tr>
<tr>
<td>Programmers and Developers Assoc.</td>
<td>10201 Torre Ave.</td>
</tr>
<tr>
<td>20525 Mariani Ave, Mail-Stop 33G</td>
<td>Cupertino, CA 95014</td>
</tr>
<tr>
<td>Cupertino, CA 95014</td>
<td>(408) 253-9600</td>
</tr>
</tbody>
</table>

Hardware Needed
- Mac Plus, SE, SE/30, or II with 2 MB of memory and a hard disk drive

Software Needed
- System 6.0.2 or higher; MPW Shell and C Compiler Bundle 3.0 ($400); MacApp 2B is optional ($100)

Price
- $175

Inquiry 888.

Switching Channels: MPW C++

Apple calls MPW C++ "beta," but it is shipping the product unrestricted to end users, nonetheless. It consists of Apple's port of AT&T's Cfront preprocessor 2.0 (the latest) coupled with the standard MPW C compiler. As a bonus, the C++ package also includes version 3.1 of the C compiler, which has bug fixes over 3.0. This is a nice compiler with detailed warnings and error messages that tell you what went wrong and what it expected for arguments. Converting files from version 2.0 to 3.0 or 3.1 requires several changes, but Apple throws in a conversion tool that takes most of the pain out of converting.

A lot of the glue has been changed with respect to using call-by-reference versus call-by-value. You can count on making calls-by-reference, now, when Inside Macintosh says that the Pascal call uses a VAR. I also like the fact that it gives you many errors, depending on the severity, before it quits. I hate having to do fixes and then compiling the code over and over to catch each error.

To compare these products more evenly, I've combined C++ with MacApp. MacApp is Apple's object library. C++ does not come with a Mac-specific object library. MPW C++ is a complete C++ implementation, and it packs more punch than other object-oriented compilers. Think C comes with its own Think Class Library. TCL is close to an older version of MacApp (1.1).

Both TCL and MacApp provide you with the basic objects that you'll need to get started, but MacApp is more refined. For example, setting up a scrolling region is effortless using MacApp, but using TCL, it can be a trying experience, at least the first time. MacApp has a Scroller object that takes care of scrolling any view that is embedded in it. TCL uses the older style of windows, scroll panes, and scroll bars that can be a hassle to coordinate. TCL also lacks some of the deluxe features that Think App provides, like TextListView, which displays scrolling lists of nearly any number of lines.

Stacking Them Up

These two products diverge after their object-orientedness. Think C has some features that I love. It's so easy to create INITs in C. It's also great to make inline assembly calls rather than link another assembled object module, because you can reference your C variables more easily in the assembly code. Another helpful item is Think C's console interface. It allows you to directly port Unix (and other) code that routes I/O calls through stdin, stdout, and stderr. MPW still doesn't do this outside of an MPW tool, and even then, it doesn't work well.

The Think C compiler is also very fast. The ability to include precompiled headers greatly reduces the time needed to read all the header files that are regularly included in your source files. I'm also a big fan of the symbolic debugger. You can't write debugging shell scripts, but it's nice to simply debug applications and cdevs. (It's a straightforward debugger with twin windows—one for source and another for data [see photo 1]. You can watch data and easily set breakpoints, with or without conditions. It reminds me of Microsoft's CodeView.)

The(Symbolic Application Debugging Environment (SADE) debugger has scripting and other powerful features, but its primitive interface is more difficult to master (see photo 2).

Besides the TCL shortcomings, Think C lacks the ability to create code segments over 32K bytes. It also pales in comparison to MPW's resource compiler. I also don't care for the giant project sizes that it creates. Since the compiler keeps all the object code handy in the project file, the compile/link time is fast, but I think I'd rather share object code between projects and keep them small. When you initially compile a project that uses the TCL, it takes a long time. After your project has been compiled once, though, the TCL doesn't need to be compiled again, and compile time dramatically decreases thereafter.

The TCL can't be compiled into its own object-code library, because you would lose the ability to use the debugger on TCL classes.

The MPW editor has features that the Think C editor lacks (e.g., searching backward and marking text for quick reference). Most Unix C++ professionals will not like the fact that it is not C++. It is more akin to MPW's Pascal with object extensions.

As for MPW C++, its biggest feature is that it is real C++. You can take Unix C++ programs and expect them to compile. You gain C++ 2.0's multiple inheritance—the ability to combine components of different objects into one—the standard C++ I/O streams, and function and operator overloading (defining multiple functions with the same name). The features of C++ are many, and its power is great. I can't stress enough that these two products are not the same language.

A great virtue of MacApp is its debugging mode. MacApp creates executable files in two modes: debug and nondebug. In debug mode, you can examine your objects and browse through them via an Inspector window. This can be a big help when your object relationships are complex. The Think C debugger allows you to examine your objects, but it's not as handy. With just a few mouse-clicks and without cluttering the screen with data windows, the MacApp inspector gives you a lot of useful information based on the type of object that you're interested in.

When you get a lot of power in a product, you pay a price. The price for using C++ is time, space, and dollars. The compile time using MacApp can hurt. I continued
The Pocket LAN Adapters for Token Ring, Ethernet and Arcnet.

Innovation comes in all shapes and sizes. At Xircom we believe it should fit in your pocket. Our Pocket LAN Adapters are revolutionary products developed for PC users who want the most convenient access to Token Ring, Ethernet or Arcnet networks.

What makes the Pocket LAN Adapters revolutionary? They require no internal slots, connecting through the parallel port of any IBM-compatible PC. All come supplied with certified drivers for a trouble-free solution that will have you connected in less time than it takes you to read this ad!

The Xircom approach has left the press full of praise: "The image of perfection—the way computers should be," wrote Steve Gibson in InfoWorld; "Incredibly easy to use... easy to install, easy to carry... a very clever device," according to Aaron Brenner at LAN Magazine.

You may think that all this "perfection" and convenience comes with a hefty price tag. It doesn't—in fact the Xircom family of LAN adapters costs about the same as the more traditional methods which it is quickly rendering obsolete.

It's living proof that with innovation on your side or in your parallel port, a little can take you a very long way.

Call Xircom today at (818)884-8755.

Xircom
LAN solutions for laptops.

22231 Mulholland Hwv., Suite T14
Woodland Hills, CA 91364
(818)884-8755 - FAX (818)884-1719

Arcnet is a registered trademark of Datapoint Corp.
count on an overhead of almost 2 minutes for each file that must include the MacApp headers. The folder that contains my MacApp files is around 7 MB in size. The price of C++ does not include the cost of the MPW Shell, MPW C, MacApp, or the SADE debugger. Perhaps by the time you read this, Apple will have a much faster version of MPW C++ that uses precompiled headers. That should diminish the compile time penalties for using MacApp.

If it sounds like I’m discouraging you from using C++, I’m not. Sure, it’s expensive, but when you have all the required elements, the MPW shell with all its tools and flexibility is second to none. Those people who are used to working in a Unix environment will like it. The shell can be bent into the shape that suits you. You can even define shell scripts and variables. The Make facility is also much like Unix. Combining object code from different source languages is a snap. You can create your own tools to help you in your development. If you need a grep (pattern match) utility, just write your own and make it a part of the shell.

The Need for Speed
I don’t think that speed is very important. It’s more useful to know how the products compare as development tools. I took the basic, empty shells from Think C and MacApp and created an application with a scrolling, sizable, and zoomable window that did open, close, and save documents—all the basic things you’d want—and built an application with only these lines in the Draw methods:

```
MoveTo(10,10);
DrawString("Hello, world!");
```

The first time, Think C took 4 minutes, 50 seconds to compile on my Mac II. When I recompiled my application, document, view, and main files, the program took 29 seconds. Linking the project into an executable file took 12 seconds. The executable file size came out to be 57K bytes.

With MPW C++, the first compile, Rez, and Link took 2 minutes, 22 seconds. The next compile took 2 minutes, 7 seconds. The executable file size came out to be 92K bytes in nondebug mode and 254K bytes in debug mode. Note that the C++ source program was in a single file that was considerably smaller than the Think C source files, but the point of the comparison is to show the minimal source compile times using the basic frameworks of each class library. Because the integration of C++ and MacApp is not in its final state, Apple recommends that you include all source files in the main file so that, by including them only once rather than in many source compilations, you reduce the time to load the MacApp headers.

As for documentation, MPW C++ includes the standard AT&T C++ product manual, library manual, and selected...
Enter the picture...the BayTech H-Series Multiport Controllers—stand-alone multiplexers that connect one host computer to as many as 23 peripheral devices. By cascading, the number of devices you can connect is practically unlimited. Full duplex transmission of asynchronous data is provided at speeds up to 38,400 bps. These intelligent multiports will operate with any RS-232C serial computer or peripheral device. (Optional RS-422A).

The H-Series models have been used extensively in each of these areas:

- security and environmental sensing, to improve monitoring capabilities for large and small businesses
- industrial robotics—control environments, where multiple numerical or assembly-line machines can be centrally controlled
- medical data monitoring environments, where speedy responses are vital and critical information must reach the host computer immediately
- data exchange among point-of-sale devices, through which a myriad of business equipment can be operated from one computer

BayTech offers unlimited hotline technical support before and after you purchase a unit. Designed and manufactured in the USA, the reliable H-Series is UL- and CSA-listed and fully covered by a one-year warranty.

So put yourself into the picture...call us today to learn about the many ways the H-Series Multiplexer-Controllers can benefit your business.
C COMPILERS HAVE DIFFERENT STRENGTHS

I like the Think C manuals. They are very clean, and it’s easy to find what you need. The Class documentation lists each TCL class with its ancestors and descendants. Each method is listed with its parameters. A complete manual of standard C library functions is also included.

What do you need to harness these tools? For Think C, you’ll need 1 MB of memory (2 MB to use the symbolic debugger), 1.5 MB of hard disk storage or two 800K-byte floppy disks, and Finder 4.2/System 6.0 or higher.

MPW C++ requires the MPW Shell, MPW C 3.1, SADE for debugging, at least 2 MB of memory (realistically, you’ll need 5 to 8 MB), an additional 2 MB of disk space over what the MPW Shell uses, and, again, Finder 4.2/System 6.0 or higher.

Objectively Speaking
As I’ve pointed out, these are two different languages. They can both function to merely compile C code, but that’s not what should compel you to buy one over the other. I think of Think C as the Swiss Army knife of compilers. It does so many nice things. I can’t imagine wanting to write an INIT in assembly language when I can use Think C. Think C makes building cdevs easy, too, and you can use the debugger on them. It’s quick and simple for writing printfs to a window. For the price, you can’t beat it. When I need to get something done in a hurry, I turn to Think C. In some cases, I use it to prototype methods of large C++ applications because of its sheer speed.

Why use C++ with MacApp? If you really want to exploit object-oriented programming, there’s no substitute. MPW C++ is the real McCoy, and the MacApp library is very complete. They have been under development for over five years. They can save you from unexpected crashes and will manage memory segments. C++ comes with ViewEdit for creating everything from simple to extravagant and complex views.

I like both these products very much. If Think C had an improved class library, I’d be tempted to use it for everything, in spite of my dislike for its limited subset of C++, its editor, and its Rmaker resource compiler. I tend to use it more for its non-object-oriented features, but I do use the TCL for “light” applications. If you’re on a budget, Think C is the way to go. You can get everything out of it that you would get from MacApp with a little more work.

For product development, I rely on MPW C++ and MacApp. In concert with their tools, I feel pampered. They are slower than Think C, but I don’t run into problems building views because ViewEdit lets me create predictable results. For Macintosh interfaces, views are everything, and MacApp gives you much to work with. The MacApp library is very stable and has evolved past the TCL.

No matter which one you choose, I think you will be pleased. These are modern tools for modern times. This is your chance to get a jump on the next wave of programming trends.

Matt Mashyna is a software developer living in Pittsburgh, Pennsylvania. He can be reached on BIX c/o "editors."
In Our Business, the most important thing is Your Bottom Line.

You're reading a magazine with hundreds of "look-alike" ads for IBM Compatible Computers, they all claim similar performance, outstanding quality, low price and great support. How do you make your choice?

Price: Some show unusable entry level or giant overkill units, and sock it-to-you on the drives, monitors and video cards you really need. Some add outrageous freight, handling and customization charges. We don't. We advertise the industries largest selection of complete drive and video configurations all unbelievably priced. All priced delivered to your door.

Quality: Some claim quality but offer only a 30, 60 or 90 day warranty. Our 5 year program is the best and longest in the business...

PC Magazine, PC Buyers Guide, Computer Shopper, Byte, and Personal Computing all say the same thing about PC Brand in their reviews: "Outstanding quality... Rock Bottom Price." We couldn't have said it better ourselves.

Support: Everybody claims it, but check our facts: 30 Day Money Back Guarantee (no RMA's required), Toll Free Technical Support, Toll Free Customer Service, On-Site Service, On-Site Installation, Leasing and Customized "Built to your Specs" configurations. Even our FAX's are on Toll Free Lines. Our support is so good it wins us Awards.

Put it all together and it spells our commitment to you, the Bottom Line, the Best one in the Business. Call us at 1-800-PC Brand Today.

PC BRAND OFFERS A FULL RANGE OF COMPUTER SYSTEMS
NAME BRAND PERIPHERALS AT THE LOWEST PRICES
FREE FREIGHT TOLL-FREE SERVICE & SUPPORT 5-YEAR WARRANTY 7
30-DAY MONEY BACK GUARANTEE ON-SITE SERVICE BY TRW* 24-36 MONTH LEASING

[Turn page for PC Brand Systems...]

PC BRAND COMPUTERS...

UNTOUCHABLE QUALITY,
UNBELIEVABLE PERFORMANCE,
OUTSTANDING SUPPORT,
AT ROCK BOTTOM PRICES.
### Find Out Why We're Rated No. 1 for Service & Support.

"PC Brand is the LL Bean of personal computer mail order...PC Brand wants no unhappy customers...it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies, Feb. 1989

---

### 286 SYSTEMS FROM $599

<table>
<thead>
<tr>
<th>PCBRAND 286/12</th>
<th>$599</th>
</tr>
</thead>
<tbody>
<tr>
<td>12MHz Clock, Zero Wait Operation, Norton SI 15.5 Landmark™ Speed 15.1MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PCBRAND 286/16</th>
<th>$749</th>
</tr>
</thead>
<tbody>
<tr>
<td>16MHz Clock, Zero Wait Operation, Norton SI 19.0 Landmark™ Speed 20.6MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PCBRAND 286/20</th>
<th>$899</th>
</tr>
</thead>
<tbody>
<tr>
<td>20MHz Clock, Zero Wait Operation, Norton SI 23.0 Landmark™ Speed 26.7MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports</td>
<td></td>
</tr>
</tbody>
</table>

#### Standard System Features:
- 80286-12, 80286-16, 80286-20 operating at 12 MHz, 16MHz, or 20MHz w/Zero Wait
- 512K RAM expandable to 8MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25” or 1.44MB 3.5” Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaved Hard/Floppy Drive Controller, 1MB/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101 Key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports on all configurations
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS w/Full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0BMS hardware
- User Configurable I/O timing permitting compatible operation w/older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 RBit)
- Medium foot print case w/6 Disk Drive bays

#### Options:
- Low profile Slim Line Case w/3 Disk Bays available at no extra charge (pictured above)
- Mini Size desk top Tower @ Case w/4 bays
- LCD or Plasma Portable
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice

---

### PC BRAND 286/12

w/512k, Hard Disk Drive, Monitor & Video Card

<table>
<thead>
<tr>
<th>Hard Drives</th>
<th>MHz/MB</th>
<th>20/40</th>
<th>40/64</th>
<th>66/25</th>
<th>100/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Video</td>
<td>$1029</td>
<td>$1099</td>
<td>$1209</td>
<td>$1399</td>
<td></td>
</tr>
<tr>
<td>Mono</td>
<td>$1049</td>
<td>$1149</td>
<td>$1329</td>
<td>$1699</td>
<td></td>
</tr>
<tr>
<td>VGA-Mono</td>
<td>$1129</td>
<td>$1329</td>
<td>$1509</td>
<td>$1889</td>
<td></td>
</tr>
<tr>
<td>VGA-Color</td>
<td>$1499</td>
<td>$1559</td>
<td>$1739</td>
<td>$1979</td>
<td></td>
</tr>
<tr>
<td>SVGA/Color</td>
<td>$1569</td>
<td>$1669</td>
<td>$1849</td>
<td>$2189</td>
<td></td>
</tr>
</tbody>
</table>

### PC BRAND 286/16

w/512k, Hard Disk Drive, Monitor & Video Card

<table>
<thead>
<tr>
<th>Hard Drives</th>
<th>MHz/MB</th>
<th>20/40</th>
<th>40/64</th>
<th>66/25</th>
<th>100/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Video</td>
<td>$1079</td>
<td>$1179</td>
<td>$1399</td>
<td>$1699</td>
<td></td>
</tr>
<tr>
<td>Mono</td>
<td>$1199</td>
<td>$1299</td>
<td>$1479</td>
<td>$1699</td>
<td></td>
</tr>
<tr>
<td>VGA-Mono</td>
<td>$1399</td>
<td>$1499</td>
<td>$1669</td>
<td>$1879</td>
<td></td>
</tr>
<tr>
<td>VGA-Color</td>
<td>$1699</td>
<td>$1799</td>
<td>$1889</td>
<td>$2029</td>
<td></td>
</tr>
<tr>
<td>SVGA/Color</td>
<td>$1799</td>
<td>$1899</td>
<td>$1999</td>
<td>$2139</td>
<td></td>
</tr>
</tbody>
</table>

### PC BRAND 286/20

w/512k, Hard Disk Drive, Monitor & Video Card

<table>
<thead>
<tr>
<th>Hard Drives</th>
<th>MHz/MB</th>
<th>20/40</th>
<th>40/64</th>
<th>66/25</th>
<th>100/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Video</td>
<td>$1229</td>
<td>$1329</td>
<td>$1509</td>
<td>$1649</td>
<td></td>
</tr>
<tr>
<td>Mono</td>
<td>$1349</td>
<td>$1449</td>
<td>$1629</td>
<td>$1769</td>
<td></td>
</tr>
<tr>
<td>VGA-Mono</td>
<td>$1529</td>
<td>$1629</td>
<td>$1809</td>
<td>$1949</td>
<td></td>
</tr>
<tr>
<td>VGA-Color</td>
<td>$1759</td>
<td>$1859</td>
<td>$2039</td>
<td>$2179</td>
<td></td>
</tr>
<tr>
<td>SVGA/Color</td>
<td>$1869</td>
<td>$1969</td>
<td>$2149</td>
<td>$2289</td>
<td></td>
</tr>
</tbody>
</table>

®Tower is a registered trademark of NCR Corporation
30-DAY MONEY BACK GUARANTEE
FREE FREIGHT TOLL-FREE SERVICE AND SUPPORT
ON-SITE SERVICE BY TRW*
24 or 36 MONTH LEASING
AND A 5-YEAR WARRANTY

Best "Executive Decision" System.

"The PC Brand 386/SX-16 performed at least as well as the far costlier Compaq... We simply began marveling at what is surely the biggest bargain in personal computing."

PC BRAND 386/SX-16 $899
16 MHz Clock, Zero Wait Operation • Norton SI 18.7 Landmark™ 18.3Mhz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keybord, 2 Serial and 1 Parallel Ports

Standard System Features:
• 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
• 512K RAM expandable to 8MB on the System board using 256K and/or 1MB RAM
• 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
• FCC Class "A", Intended for business use
• High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
• 1:1 Interleaved Hard-Flappy Drive controllers, 1 Mbyte disk transfer rates on all 100MB drives or larger
• Enhanced 101-key Click/Tactile Keyboard
• 2 Serial & 1 Parallel ports on std-configurations
• High Capacity 200 Watt System Power Supply
• Real Time Clock/Calendar with 5 Year Battery
• 8087/SX Co-Processor Support
• AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
• 8 Slot motherboard design (2 16bit & 3 8bit)
• Medium foot print case w/ 6 Disk Drive bays (Shown in optional Mini Size Tower ® Case)

Options:
• Low profile Slim Line Case w/3 Disk Drive bays at no extra charge
• Mini Size desk top Tower ® Case w/4 Disk Drive bays (as pictured above)
• LCD or Plasma Portable
• Factory Installed RAM Upgrades
• Custom configurations w/Name Brand peripherals of your choice

PC BRAND 386SX-16
w/512K, Hard Disk Drive, Monitor & Video Card

Call 1-800-PC BRAND

PC Brand, Inc. 920 W Washington St., Chicago, IL 60607 Canadian Fax 312-633-2888 Canadian Voice 312-226-5200
We are open Mon. thru Fri. 9am to 6pm Central Time. MasterCard, Visa, Discover, Checks and Approved P.O.'s are Accepted. Prices and specifications subject to change.
The Best Low-Cost Alternative Around!

PC BRAND'S
386/20
386/25...
"FASTER THAN A SPEEDING BULLET!"
-Computer Shopper: Cover Story
November, 1988

20MHz FROM $1349
25MHz FROM $1499

PC BRAND 386/20 $1349
20 MHz Clock, Zero Wait Operation,
Norton SI 3.0 Landmark Speed 26.1MHz,
1048K RAM, 1.2MB or 144MB Drive, 101-Keyboards,
2 Serial and 1 Parallel Ports

PC BRAND 386/25 $1499
25 MHz Clock, Zero Wait Operation,
Norton SI 2.6-Landmark Speed 33.6MHz,
Norton SI 3.6-Landmark Speed 45.5 w/Cache,
1024K RAM, 1.2MB or 144MB Drive, 101-Keyboards,
2 Serial and 1 Parallel Ports

"The PC Brand 386/25 is a fascinating machine.
It offers flexible configuration...at a bargain price..."
"and the company backs it all with what may be the
longest warranty on the market...PC Brand makes
it possible to buy two complete systems for less than
most competitors charge for just one."

-PC Magazine, 25MHz 386 PC's, Feb, 14, 1989

Standard System Features:
- True 20MHz or 25MHz Z Intel 80386 CPU
  Operating with Zero Wait States
- 1024K RAM standard expandable to 16MB
  using 256K and/or 1MB RAM
- 1.2MB or/and 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with
  1024x768 capability on all VGA systems
- 11 Interface Hard Drive/Floppy Drive
  controllers, 1MB/Second disk transfer rates
  on all 1000mb drives or larger
- Enhanced 10-key Click/Tactile Keyboard
- 2 serial & 1 parallel ports on std-configurations
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387, or Weitek Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX,
  UNIX, NOVEL, 3COM compatibility
- 8 Slot motherboard design
- High Capacity 200 Watt System Power Supply
- Medium foot print case w/6 Disk Drive bays

Options:
- Low profile Slim-Line Case w/3 Disk Drive
  bays available at no extra charge
- Full Size Tower Case w/6 Disk Drive bays
- Mini Size Tower Case w/4 Disk Drive bays
- LCD or VGA Plasma Portable Case
- Custom configurations w/Name Brand
  peripherals of your choice

PC BRAND 386/20
with Hard Disk Drive, Monitor & Video Card

<table>
<thead>
<tr>
<th>Hard Drives</th>
<th>Mb/Mb</th>
<th>40/25</th>
<th>66/25</th>
<th>100/25</th>
<th>200/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Video</td>
<td>$1779</td>
<td>$1959</td>
<td>$2099</td>
<td>$2549</td>
<td></td>
</tr>
<tr>
<td>Mono</td>
<td>$1899</td>
<td>$2079</td>
<td>$2219</td>
<td>$2669</td>
<td></td>
</tr>
<tr>
<td>VGA-Mono</td>
<td>$2079</td>
<td>$2259</td>
<td>$2399</td>
<td>$2849</td>
<td></td>
</tr>
<tr>
<td>VGA-Color</td>
<td>$2399</td>
<td>$2489</td>
<td>$2629</td>
<td>$3079</td>
<td></td>
</tr>
<tr>
<td>SVGA/Color</td>
<td>$2419</td>
<td>$2599</td>
<td>$2739</td>
<td>$3189</td>
<td></td>
</tr>
</tbody>
</table>

PC BRAND 386/25
with Hard Disk Drive, Monitor & Video Card

<table>
<thead>
<tr>
<th>Hard Drives</th>
<th>Mb/Mb</th>
<th>40/25</th>
<th>66/25</th>
<th>100/25</th>
<th>200/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Video</td>
<td>$1929</td>
<td>$2109</td>
<td>$2249</td>
<td>$2699</td>
<td></td>
</tr>
<tr>
<td>Mono</td>
<td>$2049</td>
<td>$2229</td>
<td>$2369</td>
<td>$2819</td>
<td></td>
</tr>
<tr>
<td>VGA-Mono</td>
<td>$2229</td>
<td>$2409</td>
<td>$2549</td>
<td>$2999</td>
<td></td>
</tr>
<tr>
<td>VGA-Color</td>
<td>$2459</td>
<td>$2639</td>
<td>$2779</td>
<td>$3229</td>
<td></td>
</tr>
<tr>
<td>SVGA/Color</td>
<td>$2599</td>
<td>$2749</td>
<td>$2899</td>
<td>$3339</td>
<td></td>
</tr>
</tbody>
</table>
386/33 CACHE $2299
33 MHz Clock, Zero Wait Operation,
Norton SI 45.9 • Landmark 58.7 MHz,
1024K RAM, 1.2MB or 1.44MB Drive, 101-Keyb oard,
2 Serial and 1 Parallel Ports

"Here's a price $2799... [Now $2299] Must be
stripped to nothing, Right?
Wrong... You don't sacrifice
quality for low price either.

The PC Brand machines
are an efficient com­
ination of in-house en­
geniering and top-notch
off-the-shelf Parts."

-PC Magazine, 33MHz 386 PCs,
October 31, 1989

"... excellent price performance ratio; high quality."

-Computer Buyers Guide,
Product Review, February, 1990

Call 1-800-PC BRAND
(213-226-5200) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607
Canadian Fax • 312-635-2888 Canadian Voice • 312-226-5200
We are open Mon thru Fri: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and
Approved P.O.'s are Accepted. Prices and specifications subject to change: BYTE 15-4
Portables With More Power than Desktops.

512K (286, 386/6x) or 1024K (386) RAM Serial and Parallel Ports, L.2MB or 1.44MB Floppy, 86-key keyboard

The power, reliability and performance of our desktop systems combine with our portable casing to make our system technically unique! We support 3 built-in, externally accessible disk drives, enabling dual (3.5" and 5.25") floppy drives for total media compatibility, including tape CD-ROM drives or other devices to deliver desktop functionality in a Portable Unit.

Simultaneous Internal AND external monitor support, VCA functionality, 2 open card slots and our unique 3 drive support, permit this family to be used as a complete "in-the-office system" which you can pick up and take anywhere.

Standard System Features:
- All performance and compatibility features as in desktops featured on previous pages
- 16 Grey Scale, 640x480 VGA Plasma or 4 Grey Scale, 640x400 CGA/Mono Graphics
- VYGA Gas Plasma Portables
- LCD Backlit Portables
- NEC
- Complete PC
- Monitors
- Fax Cards
- Modems
- Tape Backups
- Floppy Disk Drives
- Hard Disk Drives
- Video Cards

Actual VGA PLASMA Screen Image

PC BRAND VGA Cards

VGA 256K (8 bit) $599
VGA 256K (16 bit) $912
VGA 512K (16 bit) $1989

"an outstanding device... compared with the 15 high performance VGA cards tested in PC Magazine's July 1989 issue."


Video Seven

1040 VGA with 256K $549
VRAM VGA with 512K $999
### CD-ROM
- **Amdek** Laserdeck 2000/50MB External Kit $619
- **Microsoft** Bookshelf 1.0 $195, Stack Pack $99
- **Programmer's Library** $295
- **NEC** CD-ROM External $539, CD-ROM Internal $499
- **Clintex** 3D Image Flex $285
- **Sony** CD/1501 External Kit $1655, CD/1701 External Kit $779

### Networking Hardware

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Getway G/External A: $335 for 512</td>
<td>$335</td>
</tr>
<tr>
<td>Getway G/External B:</td>
<td>$165</td>
</tr>
<tr>
<td>Standard Micro</td>
<td>$393</td>
</tr>
<tr>
<td>PS110 Board for M/ polys</td>
<td>$439</td>
</tr>
<tr>
<td>PS509/16 Bit B for Server</td>
<td>$393</td>
</tr>
<tr>
<td>PS509/16 Bit Twisted Pair for PS 1935</td>
<td>$393</td>
</tr>
<tr>
<td>PS509/16 Bit Twisted Pair for Server</td>
<td>$393</td>
</tr>
<tr>
<td>PCI/300 Twisted Pair</td>
<td>$135</td>
</tr>
<tr>
<td>PCI 300 twisted board</td>
<td>$320</td>
</tr>
<tr>
<td>ARINC 429 passive hub</td>
<td>$300</td>
</tr>
<tr>
<td>ARINC intelligent hub coax</td>
<td>$450</td>
</tr>
<tr>
<td>ARINC intelligent twisted pair coax</td>
<td>$690</td>
</tr>
<tr>
<td>Synectics</td>
<td>$318</td>
</tr>
<tr>
<td>DigiTechs</td>
<td>$279</td>
</tr>
<tr>
<td>Topo</td>
<td>$2123</td>
</tr>
<tr>
<td>Western Digital</td>
<td>$1439</td>
</tr>
<tr>
<td>Pocket ARINC Adapter Case</td>
<td>$295</td>
</tr>
<tr>
<td>Pocket Ethernet Adapter Twisted Pair</td>
<td>$289</td>
</tr>
</tbody>
</table>

### Printers

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizen 4 port hubs</td>
<td>$49</td>
</tr>
<tr>
<td>Citizen 8 port hubs</td>
<td>$285</td>
</tr>
<tr>
<td>Traveling Software Datastonn</td>
<td>$52</td>
</tr>
<tr>
<td>Conon 2500 Workgroup Concentrator</td>
<td>$839</td>
</tr>
<tr>
<td>Disk Manager N</td>
<td>$99</td>
</tr>
<tr>
<td>Norton Utilities</td>
<td>$59</td>
</tr>
<tr>
<td>Norton-Lambert Close-up Support A/C</td>
<td>$170</td>
</tr>
<tr>
<td>Ontrack Disk Manager - $99</td>
<td>Nettlision - Call</td>
</tr>
<tr>
<td>Tops</td>
<td>$215</td>
</tr>
<tr>
<td>Traveling Software</td>
<td>$112</td>
</tr>
<tr>
<td>Unix/Xenix Multiuser Products</td>
<td>$596</td>
</tr>
</tbody>
</table>

### LaserJet Accessories

<table>
<thead>
<tr>
<th>Category</th>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laserjet I</td>
<td>$105</td>
<td></td>
</tr>
<tr>
<td>Laserjet II</td>
<td>$120</td>
<td></td>
</tr>
<tr>
<td>Laserjet II N</td>
<td>$99</td>
<td></td>
</tr>
<tr>
<td>LaserJet LX</td>
<td>$89</td>
<td></td>
</tr>
</tbody>
</table>

### Supplies

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sony 5.25&quot; 360K (box)</td>
<td>$59</td>
</tr>
<tr>
<td>Sony 5.25&quot; 1.2M (box)</td>
<td>$16</td>
</tr>
<tr>
<td>Sony 3.5&quot; 720K (box)</td>
<td>$15</td>
</tr>
<tr>
<td>Sony 3.5&quot; 1.44M (box)</td>
<td>$25</td>
</tr>
<tr>
<td>5.25&quot; Diskette Case</td>
<td>$9</td>
</tr>
<tr>
<td>3.5&quot; Diskette Case</td>
<td>$13</td>
</tr>
<tr>
<td>Toner cartridge for HP DeskJet Plus</td>
<td>$499</td>
</tr>
<tr>
<td>LaserJet II and Tp</td>
<td>$240</td>
</tr>
<tr>
<td>Data Cartridges</td>
<td>$199</td>
</tr>
<tr>
<td>DC/500 (each)</td>
<td>$37</td>
</tr>
<tr>
<td>DC/600X (each)</td>
<td>$29</td>
</tr>
</tbody>
</table>

### PC Brand Internal Modem (100% Hayes Compatible)

<table>
<thead>
<tr>
<th>Modem Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKS Spike Bar</td>
<td>$999</td>
</tr>
<tr>
<td>IBM 4 Outlet Isobar</td>
<td>$99</td>
</tr>
<tr>
<td>CCP Isobar</td>
<td>$85</td>
</tr>
<tr>
<td>LC2000 Link Conditioner</td>
<td>$49</td>
</tr>
<tr>
<td>BC325 Battery Back up</td>
<td>$279</td>
</tr>
<tr>
<td>BC450 Battery Back up</td>
<td>$349</td>
</tr>
<tr>
<td>Omnisonic 60 or 6580 Battery Back up</td>
<td>$119</td>
</tr>
<tr>
<td>BC750LAN Battery Back up</td>
<td>$79</td>
</tr>
<tr>
<td>OMNI1200 Battery Back up</td>
<td>$79</td>
</tr>
</tbody>
</table>

### Software

<table>
<thead>
<tr>
<th>Software</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlas Pagemaker</td>
<td>$999</td>
</tr>
<tr>
<td>AFI for Windows</td>
<td>$129</td>
</tr>
<tr>
<td>ANSI Professional</td>
<td>$319</td>
</tr>
<tr>
<td>Autosketch Animator</td>
<td>$179</td>
</tr>
<tr>
<td>Bull IV</td>
<td>$499</td>
</tr>
<tr>
<td>Boland Control 40</td>
<td>$279</td>
</tr>
<tr>
<td>CARE Conspire 386</td>
<td>$619</td>
</tr>
<tr>
<td>CAD Draw</td>
<td>$199</td>
</tr>
<tr>
<td>Dataspace ProComm Plus</td>
<td>$96</td>
</tr>
<tr>
<td>Delphi Perform 2.0</td>
<td>$159</td>
</tr>
<tr>
<td>Delta Technology SureSync</td>
<td>$49</td>
</tr>
<tr>
<td>Deskview 386</td>
<td>$115</td>
</tr>
<tr>
<td>Fifth Generation Feedback Fast</td>
<td>$102</td>
</tr>
<tr>
<td>Filebase</td>
<td>$189</td>
</tr>
<tr>
<td>Generic CADD Level 3</td>
<td>$155</td>
</tr>
<tr>
<td>Harvard Graphics</td>
<td>$249</td>
</tr>
<tr>
<td>IBM Displaywriter</td>
<td>$249</td>
</tr>
<tr>
<td>Lotus Freelance</td>
<td>$329</td>
</tr>
<tr>
<td>Lotus 123 v. 2.2</td>
<td>$395</td>
</tr>
<tr>
<td>Microsoft Excel</td>
<td>$499</td>
</tr>
<tr>
<td>Microsoft Excel 2.1</td>
<td>$29</td>
</tr>
<tr>
<td>Microsoft Works</td>
<td>$125</td>
</tr>
<tr>
<td>Microsoft Works</td>
<td>$325</td>
</tr>
<tr>
<td>Microsoft Works</td>
<td>$99</td>
</tr>
<tr>
<td>Northedge Timeliness 11</td>
<td>$1199</td>
</tr>
<tr>
<td>Norton Utilities Adv.</td>
<td>$79</td>
</tr>
<tr>
<td>Panovis v. 3.0</td>
<td>Call</td>
</tr>
<tr>
<td>Peacebase 5.5</td>
<td>$145</td>
</tr>
<tr>
<td>Peachtree Complete III w/ Data Query</td>
<td>$225</td>
</tr>
<tr>
<td>Professional Writer</td>
<td>$145</td>
</tr>
<tr>
<td>Quickword</td>
<td>$35</td>
</tr>
<tr>
<td>Symantec Q&amp;A 3.0</td>
<td>$255</td>
</tr>
<tr>
<td>Timezone 3.0</td>
<td>$75</td>
</tr>
<tr>
<td>Timeslows Publish II</td>
<td>$125</td>
</tr>
<tr>
<td>Word Perfect 5.1</td>
<td>$249</td>
</tr>
<tr>
<td>Wordbase Pro 5.2</td>
<td>$225</td>
</tr>
<tr>
<td>Ventura Publisher 2.0</td>
<td>$499</td>
</tr>
</tbody>
</table>

### Call 1-800-PC BRAND

(1-800-772-7263) In All 50 States FAX: 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607. Canadian FAX: 312-653-2088 Canadian Voice: 312-226-5200. We are open Mon. thru Fri. 8:00 am to 6:00 pm Central Time. MasterCard, Visa. Discover, Checks and approved P.O.'s are accepted. Prices and specifications subject to change.

**BYT**E 15-4

### APRIL 1990

**Free Freight* 30-Day Money-Back Guarantee**

**No Credit Card Surcharge**

**Call for Prices on Other Peripherals**
Even This Is More Confining Than Clipper.

Just as the vast expanse of the American West gave its settlers a new perspective on opportunity, Clipper's open architecture lends unprecedented freedom to application development.

Unlike fixed systems, Clipper never forces you to "make do". Its language is fully extensible with user-defined functions and new user-defined commands. You can extend the language with routines written in Clipper itself, or integrate code from other languages like C, Assembler, dBASE® and Pascal. Odds are, you already have knowledge you can use with Clipper!

But if a customizable language isn't enough, there's even more elbow room. Database and I/O drivers can be supplemented or replaced. Even Clipper's linker knocks down barriers by allowing you to develop applications larger than available memory, without defining overlays! And when you're done, Clipper's compiler generates stand-alone, executable files for cost-free, unrestricted distribution.

So, don't let the bounds of fixed systems fence you in. Unleash your imagination in the wide-open spaces of Clipper. To find out more, give us a call today.

Clipper® 5.0
The Application Development Standard
213/390-7923
Dot-Matrix Printers Rise Again

Dot-matrix printers may sound unexciting these days, especially with all those low-cost laser printers hitting the market. But Panasonic's new KX-P1624 24-pin entry is an intriguing, low-priced, full-featured workhorse that fills an important niche.

Panasonic designed the printer for offices that use dot-matrix printers day in and day out for such mundane (albeit necessary) tasks as printing reams of reports, multipart forms, or mailing labels—in short, for jobs where laser printers don't particularly shine.

The KX-P1624 takes forms up to 15 inches wide. It has five built-in letter-quality fonts: Courier, Prestige, Bold PS, Script, and Sans Serif. All are available in 10 different character sizes ranging from 5 to 20 characters per inch. There are also two draft-quality fonts.

Few dot-matrix printers match the KX-P1624's list of standard features. You can feed paper from four different directions (front, back, bottom, or top). A neat flat-belt tractor feed swivels to act as either a push or pull tractor. The push tractor (used with a built-in perforation-cut feature) is particularly handy for eliminating waste of continuous forms.

You will also find the usual paper-parking feature, which lets you print a single sheet without removing continuous forms. For those worried about software compatibility, the printer emulates the IBM Proprinter XL24E and the Epson LQ-2500. A 12K-byte buffer (expandable to 44K bytes) is standard.

At first glance, I found the printer's "EZ-Set" front panel difficult to understand. You work through several switches (there are no DIP switches) and a panel full of indicator lights to set up the KX-P1624. In the end, I figured out the switches in a short time, and the panel let me set up three macros for my most frequently used combinations.

With a print speed of 160 pica-size characters per second for draft and 53 cps for letter-quality text, the KX-P1624 isn't the fastest 24-pin printer available. But it's speedy enough for all but the most demanding environments. Panasonic could have made it faster, but that would have added to the bottom line, which may be the printer's most surprising feature: At $700, the KX-P1624 is hundreds of dollars less expensive than similar printers.

The KX-P1624's output doesn't match what you get from a laser printer, but I wouldn't be shy about sending out a manuscript, letter, or report printed on this printer to my most important readers. The printer does what it's designed to do and does it well. What's more, it's part of an encouraging trend toward feature-packed printers that won't clear out your wallet.—Stan Młastkowski

KX-P1624
Panasonic Communications and Systems Co.
Office Automation Group
Two Panasonic Way
Secaucus, NJ 07094
(201) 348-7000
$699.95
Inquiry 853.

Superbase 4
Windows Outshines GEM Version

In the March 1989 BYTE, I reviewed Precision's Superbase 4, a full-featured database that ran on the GEM graphical user interface but could access only 640K bytes of memory. The program boasted the capability to incorporate graphics and text files as external database fields and had powerful relational capabilities. However, the 640K-byte memory limit and a number of bugs severely hampered the product. In addition, Superbase 4 suffered from inadequate documentation. I concluded that continued
the program had great potential but needed additional memory, the elimination of several bugs, and improved documentation.

Precision seems to have addressed all my complaints in its recently introduced Superbase 4 for Microsoft Windows. Superbase 4 Windows supports both extended and expanded memory, allowing the display of bit-mapped graphics as database fields.

In addition, Superbase 4 Windows includes an external data type that can point to either a bit-mapped graphics file or a text file that can be searched for and queried. The product also includes a comprehensive programming language, a built-in text editor, a telecommunications facility for transferring files, and a powerful Structured Query Language query facility, as well as full-featured forms and report writers.

I checked the program for the bugs that I had found in the earlier GEM version, and all of them had been eliminated. In addition, the documentation has been upgraded and is easier to follow. The communications facility has been greatly improved, and the VCR-like control panel, which controls the database, works much better than the one in the GEM version. The text-field search feature now works as advertised, and I found it much easier to manage multiple open database files than in the GEM product.

In spite of all these improvements, Superbase 4 Windows is not a product for the casual database user or for the faint of heart. The product has powerful capabilities for database application developers, but you can expect to encounter a steep learning curve before understanding how to really take advantage of those capabilities.

For example, the forms designer presents the user with two rows of more than 30 icons, the functions of which are by no means intuitive and which require a certain amount of effort to learn. The query and file-linking facilities are also complex, and they, too, take some diligence to understand.

Nevertheless, serious database developers for Microsoft Windows should find Precision’s Superbase 4 Windows to be an excellent candidate for their development work.—Nick Baran

Superbase 4 Windows
Precision, Inc.
8404 Sterling St., Suite A
Irving, TX 75063
(800) 562-9909
(214) 929-4888
$695 with run-time version of Microsoft Windows
$995 for five-user LAN extension (total of six users)
Inquiry 856.

Making Smalltalk with OS/2

D igitalk has taken a large stride with Smalltalk/V PM, a version of its Smalltalk/V environment for OS/2’s Presentation Manager. This new release holds great promise for those looking to step up to OS/2 from Digitalk’s 286 version, as well as for developers seeking an easier method for developing PM applications.

Smalltalk/V PM makes it easy for OS/2 developers to build, in hours or days, complete applications that are indistinguishable from those built the hard way—with compilers, linkers, and so forth. Smalltalk/V PM hides the complexity of dealing with windows, input events, and the like until you’re ready for them. I produced several applications with Smalltalk/V PM before I knew anything at all about PM. The result was that I could focus on the development problem at hand rather than on the user interface.

Although Smalltalk can be a self-contained, self-sustaining environment, Smalltalk/V PM produces real PM programs, with access to all of OS/2’s advanced features, including Dynamic Link Libraries and Dynamic Data Exchange. Since any resource available under OS/2 and PM is available to Smalltalk/V PM, integrating V PM programs with those produced in conventional languages is simple.

For those who are already familiar with Smalltalk, Smalltalk/V PM offers some surprises. A new, simpler application model consists only of Models and Windows. A cleaner approach to graphics makes using custom graphics in an application much easier than before.

The changes from previous releases of Smalltalk are significant enough that porting to Smalltalk/V PM could be time-consuming, particularly if your application is graphics-intensive. If the application is loaded with homegrown Panes and Dispatchers that are not simple subclasses of the standard set, you may find it necessary to rebuild large portions of the program.

However, even with all the changes, the environment is still recognizable to users of Smalltalk/V 286 and Smalltalk/V Mac (the 286 and Macintosh versions). All the familiar user interface components remain available, and a few more have been added. Users of other Digitalk products will also feel right at home with the programming tools that come with Smalltalk/V PM. The browsers, debugger, and inspector work much as they did before.

Another key change that Smalltalk/V PM brings to the Smalltalk world is compilation. Instead of keeping track of the classes you define and objects you create in a set of data files, Smalltalk/V PM incrementally produces an .EXE file. This file, together with a single Dynamic Link Library, is all that’s needed to run the application on any PM system. The resulting executable file is quite large, but Digitalk plans a Developer’s Kit to address the problem.

On the whole, Smalltalk/V PM represents a significant new direction in Smalltalk environments. Its close integration with the host system, together with its much-improved application and graphics models, makes this environment far better than what has gone before. The power that it provides to OS/2 developers is valuable. Even if Smalltalk/V PM is used only for rapid prototyping, no OS/2 development team should be without it.—Eric Smith

Smalltalk/V PM
Digitalk, Inc.
9841 Airport Blvd.
Los Angeles, CA 90045
(213) 645-1082
$499.95
Inquiry 855.
Securing your data is as fast as one, two!

When you use DPT's

SmartCache

the caching controller with disk-mirroring.

Speed and security in one package.
SmartCache with disk-mirroring ensures uninterrupted operation in the event of disk failure by simultaneously writing data to your PC's primary drive and a secondary, "mirror" drive. SmartCache increases system speed and eliminates down time and data loss due to drive failure, thus providing true disk fault tolerance for all PCs.

When we say fast...
Unlike software disk-mirroring that actually slows your PC down, SmartCache dramatically boosts system speed, thanks to its state-of-the-art disk-caching technology. The on-board processor and expandable cache RAM allow the controller to simultaneously manage the primary drive and the mirror drive and still process data at 0.5ms for unprecedented speed and security.

Picture-perfect compatibility.
SmartCache needs no special ROM BIOS or software drivers and is fully compatible with all 286/386 PCs and all operating systems. Because SmartCache looks exactly like a standard disk controller to your computer, installation is quick and easy.

So smart, it can repair itself.
SmartCache actually repairs all disk errors automatically. Even catastrophic drive failures will not cause the system to crash.

Backed by the best: DPT.
Distributed Processing Technology was the first to develop caching disk controllers for microcomputers and is the recognized leader in the industry. Our products have been at work for over a decade, speeding up minis and mainframes. We offer a 1-year warranty, clear documentation, and outstanding technical support.

Look into SmartCache!
You'll like what you see. Call today and find out how you can add speed and security to your PC system—with SmartCache, from DPT.

132 Candace Drive • Maitland, FL 32751 • (407) 830-5522
When you plan to construct a house, one of the first things you need is a set of blueprints. Until you have those, you don’t know where to begin, how big a hole to dig, or what materials to buy.

In the past, writing applications software has been more like making bricks than building something with them. The developers each made their own bricks, some red, some brown, and some blond, some rectangular, some square, and some hexagonal. The end result has been lots of piles of bricks that don’t always fit together the way you’d like them to.

The time has come to step back, make a blueprint of what you want to create, trying to incorporate as many of the pieces you already have as possible, and start construction. One name for this blueprint might be applications architecture, a framework for creating order out of the chaos of applications today.

This first State of the Art section begins with “Transparent and Portable” by Mark L. Van Name and Bill Catchings. In it, they describe the types of applications architectures available that provide a consistent framework across different machines. Currently, the Macintosh is the leader in this area in the personal computer field, but over the next few years, you can expect others to appear. Portable, transparent applications make life easier for all of us who use desktop computers.

Then, in “From TTY to VUI,” Frank Hayes discusses user interfaces, their pluses and minuses, and how they compare. Many people today prefer a graphical user interface to the command-line interface, but how do the available GUIs compare with each other? Is it really safe to say “when you’ve seen one, you’ve seen them all”?

When you go behind the user interface, you come to the application programming interface. In “Behind the Scenes,” Howard Eglowstein explores the next level of detail to consider when you choose a user interface: the capabilities behind it as reflected in the API.

Next, in “Bridging Troubled Waters,” Jon Udell describes several cross-platform tools that let you use the same software on different machines. This concept and the products that use it solve the problem of which machine and which operating system to support. An application can be written once and then simply ported to a variety of machines.

In “Blueprints for the 1990s,” Sheila Osmundsen provides a comparison of the two major applications architectures available today: IBM’s Systems Application Architecture and Digital Equipment’s Network Applications Support. More and more companies are exploring the advantages of these consistent frameworks: interoperability and greater portability across dissimilar platforms. New players are entering the field at a growing rate. The text box “An Open Approach” looks at Data General’s recent entry, Distributed Applications Architecture.

As these architectures proliferate, will Big Brother be watching? Will you lose your independence? I don’t think so. Rather, you will gain the freedom to move from one machine to another and from one operating system to another, without retraining. Knowing an applications architecture will broaden your usefulness and your sales appeal. Individually, you can still march to the beat of a different drummer, but, together, you can harmonize.

—Jane Morrill Tazelaar
Senior Technical Editor
State of the Art
If you need disk performance, PSI's got your number...

**GigaBytes of Storage**

The hyperSTORE supports an incredible 50.4 GigaBytes of high performance on-line storage using today's drive technology. As drive standards and capacities improve, the unique controller plus Mediadapter™ design protects your investment by allowing you to add new drive interfaces.

**Hard Disk Drives**

The hyperSTORE controls up to 8 MFM, RLL, or ESDI drives, up to 28 SCSI drives, or any combination of drives, each mass on an independent interface for improved performance through true simultaneous operation. All drives are cached in the hyperSTORE's on-board cache memory.

**MegaBytes of Cache**

Add as little as 512KBytes of RAM to a zero-K hyperSTORE and enter the fast lane of computing. As your needs increase, simply plug in standard SIMM memory to add to the cache. After filling the 4MByte on-board capacity, our 16MByte expansion card brings the total to 20MBytes.

**MegaBytes per Second**

Data transfer rates of 4MBytes/second burst and over 2.5MBytes/second sustained make your disk-intensive applications run amazingly fast. Imagine jobs that used to take an hour, now taking as little as seven minutes. That's the kind of real-world performance the hyperSTORE delivers.

**Interface Standards**

Mediadapters allow the hyperSTORE to concurrently control MFM, RLL, ESDI, and SCSI drives. So you can mix and match to build the ideal controller for your application. And when you add a new drive, you can upgrade to the latest technology without throwing away your old drives.

**Compatibility Modes**

Select WD-1003 mode for 100% compatibility with standard operating systems like Unix, Xenix, and Netware-386. Or switch to native mode and take advantage of the benefits provided by our SSP (Standard Storage Protocol) interface under DOS, PC-MOS, Windows, and Netware-286.
STATE OF THE ART
APPLICATIONS ARCHITECTURES

Transparent and Portable

Applications architectures provide compatible access to incompatible machines

Mark L. Van Name and Bill Catchings

Sometimes a single solution can remedy several problems. Consider applications software. Users want programs that are easy to use and consistent across different machines. Developers want to produce bug-free software as efficiently as possible for as many machines as possible. And vendors want to provide a broad range of systems to attract as many buyers as possible. Applications architectures can satisfy the needs of all three groups.

An applications architecture is a set of tools for developing applications. By providing a consistent framework on different machines, it lets you get the most out of your equipment and training budgets. It's also a way out of the dilemma that plagues anyone who uses a computer: compromise.

Newer, faster machines promise improved productivity, but often at the cost of learning a whole new way of working. Existing systems let you work in familiar, comfortable ways, but often at the cost of living with less than optimal performance. An applications architecture solves this conflict. It ensures that your new system works the same way as your current one, or at least close enough so that the cost of learning the new system is bearable.

Such a framework also lets software developers make the most of limited resources. No one has the time or money to support all the interesting and commercially viable systems in use today. Even if you consider just personal computers, you must write software to run under DOS, Windows, OS/2, and the Mac OS to support the major platforms.

In addition, vendors develop applications architectures to bridge multiple environments. While they may strive for compatibility across product lines, time and changing technologies eventually force vendors to offer systems that are incompatible with previous hardware and operating systems. An architecture allows them to provide users and developers with a smooth migration path from the older to the newer systems.

Laying the Foundation
Most of the benefits of a good architecture stem from two basic features: transparency and portability. Not surprisingly, these terms have slightly different, albeit related, meanings for users and developers.

To a user, transparency is the degree to which a new system resembles the existing one. To put it another way, a new system is transparent if you can't tell the difference between it and your current system.

A transparent system should have the same look and feel as the system you use continued.
now. Its appearance, command structure, and menu structure—in other words, its user interface—should be familiar. Typing the same command, for example, should produce the same result on both systems, as should double-clicking on an icon.

The new system should also offer all the applications you currently use. Basically, if you can walk up to a display attached to a new system and feel as if you're working on the same old system, it is transparent.

To a developer, transparency means that a new system's structure is basically the same as the one on the previous system. The new system must provide a consistent set of abstractions, from the application programming interface (API) to the data, file, database, and network organizations. For example, application programs must be able to call memory-allocation, record-retrieval, and record-locking routines that work the same way on both old and new systems. (For a more-detailed discussion of APIs, see "Behind the Scenes" on page 215.)

Portability, while related to transparency, addresses slightly different concerns. For most users, the crucial part of a system's portability is its ability to handle existing data and procedures. When you walk up to a new system, you want to be able to load your working data—whether on disk, tape, or other media—and get down to business. If you have any automated procedures, which may range from keyboard macros to full-fledged programs, you want to be able to run them, too.

Portability is similar for developers, who need to be able to move current source code and development tools to the new system with as little hassle as possible. To meet this requirement, the new system must provide not only a consistent API, but also a consistent set of such development tools as text editors, compilers, linkers, and debuggers.

A complete applications architecture includes specifications and tools that address all these needs. It runs on several different platforms. It includes development guidelines, a consistent API for every aspect of development, and a complete set of development tools. Its user interface is consistent across systems, and, if it is successful, the resulting applications are also available on all systems.

Arguably, the most successful example of such a structure to date is the one offered by the Macintosh. Applications that follow Apple's user-interface and internal programming guidelines—so-called "well-behaved" applications—will run on any Mac, from the least to the most powerful, and with any size monitor and any Mac printer. They will also be relatively easy for experienced Mac users to learn, because they will have the familiar Mac look and feel.

Erecting the Framework
The Mac's applications architecture, like any other, consists of tools and specifications that address many issues. While no two approaches are the same, they all have to deal with the same basic problems.

To gain a broad view of the various architectures, we'll construct a framework within which to analyze them. Within this framework, we'll concentrate on the problems that the architectures must help a developer solve. If they solve those problems well, and if they provide a consistent user interface, then they will also meet the needs of the users.

An applications architecture is basically a set of tools with written guidelines for using them. The tools must be powerful enough to let developers build user interfaces that are consistent with the user interfaces of other products that follow the same approach.

The goal of these tools is to free you from having to deal directly with certain external elements. We'll take a look at each of these elements and the tools that these architectures must provide to deal with them.

Insulation Requirements
An applications architecture on any machine must deal effectively with the underlying hardware and system software. This is the area that usually gets the most attention, largely because it is the area where system vendors tend to have the most problems.

Consider, for example, the problems of IBM. This giant firm has customers running such different platforms as its mainframes (with the firm's several different mainframe operating systems), System 38s, System 36s, System 34s, AS/400s, AIX RISC machines, and both DOS and OS/2 PCs. IBM is trying to unite some of these systems with its Systems Application Architecture (SAA), a mammoth task.

To let you work on such different hardware and operating-system combinations, an architecture must insulate you from the complexities of the underlying system. To do this, several key services must be provided.

One is memory management. All applications need to allocate and free memory, a problem that most systems address differently. The underlying architecture must provide tools for static and dynamic memory allocation, memory freeing, and a consistent way to deal with out-of-memory errors.

Another crucial service is task management. Applications must be able to communicate with one another, exchange data, and, ideally, spawn subtasks. To attain these ends, an architecture must provide good interprocess communication facilities, data-sharing tools (such as a clipboard), and a multitasking/multithreading facility. Sometimes, it must forbid certain facilities on some systems, such as multitasking on PCs, but then you must either write to the lowest-common-denominator system or abandon support for some systems entirely.

Another necessary function is hiding low-level aspects of the system or providing transparent ways to take advantage of those features that are present. Some systems, for example, have floating-point and graphics accelerators, while others do not. Ideally, an applications architecture lets programs automatically take advantage of those accelerators when they are present and remain unchanged on systems without them. Another approach is to provide a set of APIs that either passes calls to the accelerators or, when the system has none, emulates their function in software.

Similarly, as more and more systems begin to offer multiple processors, a good architecture must let applications benefit from them when they are present. At the simplest level, this means only hiding the existence of those processors from the applications. A better answer, however, is to provide tools, such as special compilers, that produce code that can take advantage of multiple processors when they are present.

Finally, such a structure must come with a set of rules for developing applications that distance themselves from the underlying system. These rules range from such simple ones as "Don't call the operating system directly; use the standard toolbox instead," to more complex ones, such as "Don't assume a given byte contains the most significant digit in any word." In essence, the applications architecture must become the underlying system. Writing portable applications means learning to live with the features of this "virtual system."

The Flexible Facade
Moving up a level in hardware, these architectures must let applications work with many different types of monitors.
The problems in this area depend in part on whether the system comes with text or graphics displays.

There are two basic problems with text displays: screen sizes and control codes. Applications must be able to work with different size screens so that text can expand to fill the available space. They also must be able to handle the different control codes demanded by displays from different manufacturers. The latter problem is particularly acute for ASCII display terminals, where a Digital VT220 uses different display codes than a TeleVideo 925, which differs from the next, and so on.

Although these problems are answered in different ways, there are just two basic approaches. One is to provide a template file that contains a set of generic display commands and mappings for those commands for different terminals. This is the approach that Unix typically uses, with its Termcap and Terminfo files. The other approach is to use an insulating software layer. That layer can be anything from a simple receptacle for display drivers, such as those supported by Windows, to a complete set of controlling procedures, such as the Mac’s QuickDraw software.

The notion of an insulating layer of software also works for graphics displays, although the problems are more complex. Graphics displays differ in everything from size to resolution to the ways programs must control them. The best solution is to have a set of controlling procedures and an accompanying set of development specifications, such as the Mac’s QuickDraw or the X Window System (referred to as X Window for the remainder of this article).

You can, of course, just write drivers for each different graphics standard. This has long been the DOS approach. The differences between the results of this approach and the results of having a layer of graphics software are, however, profound.

Hook a PC up to a high-resolution 21-inch monitor and most PC applications will still run as if they are on a 12-inch display.

Hook a PC up to a high-resolution 21-inch monitor and most PC applications will still run as if they are on a 12-inch display.

The screen's size and resolution don't matter, because QuickDraw deals with those features at a level below the applications. In fact, QuickDraw goes so far as to let the Mac work with multiple monitors simultaneously, all with no programming effort other than following the development guidelines.

X Window defines a similar set of insulating functions for Unix graphics workstations. Applications that are designed to use these functions can run on any X Window workstation without the specifics of the different displays causing problems.

X Window can also take advantage of the hardware features of a particular display system. If, for example, the display hardware can draw a filled polygon on the screen, X Window maps that feature to one of its own functions. (X Window itself calculates the pixels to activate for display systems that don't have such a polygon-fill function.) X Window applications look basically the same on different displays, no matter how each screen draws pixels.

Entrances and Exits

Keyboard specifics can also be a problem. The easiest way to handle that problem, of course, is to force every keyboard to emit the same codes. That's essentially the answer for PCs, where keyboards have to be PC-compatible for anyone to buy them.

Another approach is to define a basic set of keycodes for the architecture and a way to provide drivers that map the codes from various keyboards to the basic ones. The coming standard for a Streams-based Unix terminal driver will include this type of abstraction. This keyboard driver lets keyboards with different national key sets and layouts work with Unix applications.

Printer codes can also cause difficulties. Historically, applications have required special drivers to support the various printers that are popular for a specific machine. This approach, while expensive, at least lets applications take full advantage of the features of different printers.

To minimize development costs, many vendors built their own internal printer-template files. These files mapped the control codes of different printers to a basic set of printer functions. The problem with this approach, of course, is that the basic set has to be very rich in features or it won't be able to take full advantage of some of the printers.

Sometimes printer pseudostandards, such as the Xerox Diablo 630 or the Hewlett-Packard LaserJet, emerge. These pseudostandards typically are the control codes of printers that became so popular that many other printers emulate them.

Today, the trend is toward sophisticated page-definition languages. A PDL provides you with a standardized way to define the appearance of a printed page. A PDL interpreter then turns PDL commands into something that a particular printer can understand. By far the most widely used PDL is PostScript.

Grist for the Mill

The final piece of the external environment of any program is its data. There are several aspects of data that can vary from one system to another, including its machine representation (e.g., which byte in a word contains the most significant bit), file format (e.g., flat or indexed file), and network location. While we won't go into detail on these topics, an applications architecture must nonetheless address them.

Further, as more and more applications rely on databases for their data, the architectures must provide insulating layers for database functions. Apple's CL/1, for example, is a standard toolbox that lets you work with many different types of databases on many different, possibly remote, systems.

Ergonomic Engineering

The sum of all these insulating layers of software is a set of programming abstractions, or tools, for building applications. Programs developed with these tools will work in many external environments. That's a great step forward, but it's not continued
the end of the journey.

The next step is to ensure that all applications employ the same user-interface style. Key issues here include consistent visual layouts, the way in which you work with the keyboard (and, typically, a mouse), and menu and command structures.

An architecture should do two basic things to help create applications with "acceptable" user interfaces. The first is to provide a set of specifications that defines exactly what "acceptable" means: Developers must have a goal. The other is to provide a set of tools that makes it easy to reach that goal.

The Mac's Toolbox is one example of such tools. A newer and, according to most reports, more powerful answer is the NeXT Interface Builder, which helps build consistent user interfaces quickly.

Early user interfaces were simple command-line interpreters like the one in DOS. These interfaces left you on your own, forcing you to learn many arcane operating-system commands and different working styles for each application.

Then the Mac popularized the graphical user interface (GUI), a system based on graphical icons, pull-down menus, and other devices designed to free you from having to memorize lots of commands. The Mac's interface standards also gave a standard look and feel to Macintosh applications.

Today, GUIs are all the rage. Windows and NewWave are vying for the GUI title on PCs, with such other players as GEM also in the fray. OS/2 has its own GUI, the Presentation Manager.

The Unix world is perhaps the most complicated one currently, with such major GUI contenders as the Open Software Foundation's Motif and Unix International's Open Look, as well as NeXT's NextStep, and others. The goal of all these systems is to free users from the need to learn cryptic Unix commands, so that Unix can become popular with many of the same people that today work happily with Macs. (For further details on GUIs and other user interfaces, see "From TTY to VUI" on page 205.)

**Building Overhead**

If by now you're thinking that applications architectures sound like a lot of software, you're right. Complete ones include a substantial amount of code and documentation, and they have some costs as well.

Perhaps the most obvious cost is performance overhead. If you want to squeeze the last drop of performance from a system, you write directly to the hardware, preferably in hand-crafted assembly code designed to take advantage of every feature of the processor and display. These architectures are at the other end of the spectrum: They cover every aspect of the system with a thick, CPU-draining blanket of software.

The standard argument in their favor, however, is that the results justify the performance costs. Besides, ever-faster hardware will handle the CPU requirements easily. We support that argument, but we also think it's important to realize that these architectures have a considerable performance overhead. The more sophisticated the applications architecture that you want to embrace, the more powerful the system you are likely to need.

These architectures can also be complex. The learning time for DOS developers, for example, is far less than the learning time for Mac developers. This is a problem. The best solution to date seems to be using higher-level toolboxes, such as NeXT's Interface Builder, that hide the nitty-gritty under another layer of software.

A final potential cost is in innovation. No architecture can cover everything; no architecture can cover everything; no architecture can cover everything; no architecture can cover everything; no architecture can cover everything. The only answer here is to design them to grow easily, so that things like user-interface style can evolve to reflect new technologies.

**Expansion Plans**

Despite the costs, applications architectures are clearly hot. In fact, this is one area where it's easy to make general predictions with confidence.

For one thing, you can expect each of the major vendors to standardize on one applications architecture or, at most, a few. IBM and Digital Equipment Corp. (DEC) are already doing it, and most Unix system vendors are either already standardizing or ready to do so as soon as the Open Software Foundation versus Unix International conflict is resolved.

Another safe bet is that object-oriented programming will play an increasingly important role. Object-oriented systems let you define abstractions that have well-known specifications and are well insulated from the outside world. Objects are the latest and greatest ways to express abstractions in programming, and that's much of what these architectures are all about. The object-oriented approaches of the NeXT system and HP's NewWave are almost certainly just the first of many.

You can also expect to see more high-level cross-system development tools, from large sets of toolboxes built around objects to still-higher-level fourth-generation languages. (For a discussion of some of the various cross-system development tools available, see "Bridging Troubled Waters" on page 225.)

Finally, as the industry learns more about how to build multimedia systems, you can expect to see user interfaces and other aspects of these architectures that take advantage of those systems. Voice and video are likely to become far more common in the future as vendors strive to make computers more accessible.

**The Ground Floor**

Most of all, you can expect applications architectures to continue to rise in importance. Consistent approaches have proven benefits.

Look, for example, at DEC's success in recent years. While DEC did not have a stated applications architecture a few years ago, it did offer the same basic machine (VAX) and network (DECnet) architecture from its smallest system to its largest. IBM, by contrast, had to support many different system types. The result was a huge increase in DEC's user base, often at IBM's expense.

Even DEC, however, has had to bow to the performance of other machine architectures and now offers workstations based on MIPS Computer's RISC chips. These workstations are not compatible with DEC's VAX products, so now the company is building an applications architecture called Network Applications Support (NAS) to link these two systems and Unix workstations, DOS PCs, and Macs as well. (For a comparison of IBM's and DEC's applications architectures, see "Blueprints for the 1990s" on page 237.)

Over the next few years, you can expect other architectures to join the Mac's as leaders in the personal computer arena. Vendors of other large systems will also strive to offer total architectures on their systems (see the text box "An Open Approach" on page 246). Who will come out ahead is anybody's guess. The only sure thing is that increased portability and transparency will be a plus for everyone who uses desktop computers.

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvname" and "wbc3," respectively.
Compared to Plotter in a Cartridge, everyone else is behind the times.

For fast HPGL output, there really is no comparison. Pacific Data Product's *Plotter in a Cartridge™* is up to 100 times faster than pen plotters or PC-based software emulations.

Simply plug it into your LaserJet Series II or Canon LBP-8II printer and it's ready to print precise, high-quality graphics. And we also have a version for the HP LaserJet IIP and IID printers. *Plotter in a Cartridge™* is compatible with all of the major CAD/CAM, engineering and graphics software packages.

For your nearest authorized dealer, or for more information on our full line of laser printer enhancement products, call Pacific Data Products at (619) 552-0880.

**Pacific Data Products—Plug into Power**

---

*Plots run at 8 Mhz with parallel interface. Times quoted reflect PC processing time. Plotter in a Cartridge is a trademark of Pacific Data Products, Inc. All other company and product names are trademarks of the company or manufacturer respectively. © 1990 Pacific Data Products, Inc.*
Using 16 Ports Is Easier Than Ever

You told us what you're looking for from your multiuser communication controller. We listened and gave you exactly what you asked for. The ULTRA 16 and ULTRA 8 — designed to make your life easier.

Now you can have...

- A Powerful 80286 Processor
- Streams Drivers
- Field Upgradable From 8 To 16 Ports
- New “Quick Connect” Cabling
- A Universal Interface Box and “Dual Lock” Mounting
- Easy To Install Drivers For SCO XENIX System V, SCO UNIX System V, Interactive 386ix, IBM AIX, Sun OS, IBM OS2 and PC-DOS
- Transparent Print

- Multiple Sessions
- Easy To Use Documentation

When you need a basic multiuser communication controller, give our HOSTESS SERIES a try. Count on our people to give you the support and extra effort you deserve and have come to expect from us since 1982.

Call Us Toll Free
800-9-COMTROL

The ULTRA SERIES logo, COMTROL ULTRA SERIES, ULTRA 8, ULTRA 16, Universal Interface Box, HOSTESS SERIES, and the COMTROL logo are trademarks of COMTROL CORPORATION. Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies. © COMTROL CORPORATION. All rights reserved.

Circle 71 on Reader Service Card
As computers become more complex, using them becomes easier and easier

Frank Hayes

What makes a good user interface? That is not a simple question. Designers have been struggling for decades to create architectures that let you get the most from your software. There are questions of priorities. Should the user interface maximize performance for experts or shorten the learning curve for beginners? Is safeguarding data more crucial than efficiency? And which should take priority: flexibility or throughput?

Not surprisingly, the quality of a user interface depends on the level of technology represented in the underlying hardware. The first interactive computer systems communicated with you through teletypewriters (TTYs)—character-based terminals that could accept only typed input and could print only on paper, one character at a time. As technology improved, video display terminals (VDTs) became widely available. These "glass TTYs" could position a character anywhere on the screen. They quickly became the norm in computing. Then came high-resolution graphical displays that could support graphical user interfaces (GUls), complete with mice.

In the Beginning Was the TTY

The original interactive user interface was the command-line interface. The most familiar CLI today is probably the DOS A> prompt, but the heritage of CLIs goes further back than the IBM PC. They came by way of the TTY's that served as the first terminals for mainframes.

TTYs had a bottleneck problem: Each command you typed had to be sent to the computer across a relatively slow serial link, and once the command arrived, the computer had to decode it. A typical CLI had to minimize the amount of information making its way from the TTY's keyboard to the mainframe. This is part of the reason why all CLIs have inherited a tendency toward short and cryptic commands. The only way around the bottleneck was to limit the amount of information that had to pass through it. Thus, in those early days, every keystroke counted.

TTYs were limited in what they could print out as well. A TTY printed one character at a time, typewriter style. As the TTY gave way to the VDT, something new was added: the ability to alter the position of the cursor. That made it possible to print information anywhere on the screen. Using special keystrokes and a character-based VDT, software allowed you to move a cursor around the screen. You could go back and correct mistakes and update information. It's hard to grasp today what a profound improvement the electronic VDT was over the paper-based TTY.

continued
It’s even harder to grasp that the “glass TTY” still defines the limits of CLIs, even on high-powered PCs. Although desktop computers have all but eliminated the bottleneck between the computer and the screen, character-based PCs behave as though the bottleneck still exists. CLI commands are still short and cryptic, and every single keystroke still counts. With a CLI, one wrong key can wipe out a day’s work. However, CLIs remain popular because they work with almost any kind of operating-system architecture that can accept or print one character at a time. But they certainly show their age.

Fortunately, when desktop computers eliminated the CPU-to-display bottleneck, they also made graphics practical, and with them, GUls.

The Mac Standard
The Macintosh user interface was the first GUI to appear on a popular desktop computer. It became a model for almost all the GUls to follow. By comparison to the one-character-in, one-character-out simplicity of CLls, GUls are immensely difficult to program. The goal, however, is to make life easier and more productive for users. Three standard features distinguish almost any Macintosh screen from a non-GUI screen: a mouse pointer, a menu bar, and one or more windows (see photo 1).

The mouse pointer, which you move around the screen by moving the Mac’s one-button mouse, is typically an arrow. A program can change it to one of a number of graphical icons, however, each with its own meaning. For example, to indicate that you’re supposed to wait while the computer does its work, the software will typically change the pointer to a watch.

There are several standard mouse actions. Clicking selects an item or an action, double-clicking simultaneously selects an item and starts an action, and dragging moves objects on the screen or selects groups of objects.

The menu bar runs across the top of the screen. Clicking on an item on the menu bar causes the menu to drop down. Each menu item is associated with an action, which you can select by clicking on it. You can also select some menu items by using keyboard equivalents (i.e., using key-based commands instead of the mouse and menu).

Other menu items pull down submenus. A submenu appears to the right of the original menu. The items on the submenu can themselves have submenus, so it’s possible to work your way deeper and deeper into the command structure and see all the menus as you do. Any item, no matter how deep in the menu structure, can have a keyboard equivalent, which would make it unnecessary to go through the entire menu structure to initiate the action.

A window is a rectangle on the screen that lets you work within a program. On a Mac, you may be able to move the window around on the screen, change its size and shape, open it to fill the screen, close it entirely, or change how much of its contents shows. Windows can also contain buttons, menus, sliders, and other objects.

Outside the window, there can be other icons, such as disk drive icons or a Trashcan. Just as every menu item is associated with an action, every icon is associated with an object, whether that object is a file, a program, a group of files, or a storage device such as a disk drive or a network server.

Apple has made an extraordinary effort to control the Mac GUI, with guidelines that aren’t merely suggestions—they have the force of law. The payoff has been that Macintosh applications all look and act very much alike—a consistency that, until the Mac, was almost nonexistent in software.

But the Mac’s reputation for ease of use consists of equal parts reality and myth. While almost all Mac applications are similar, they can require extraordinary calisthenics to operate. A mouse-click is used to select and deselect items. Some software requires complex user actions, such as triple-clicking or dragging while a key is held down. And with keyboard equivalents, there are often several different ways to accomplish the same thing.

What’s wrong with that? It’s not consistent—and it’s certainly not simple to learn. Jef Raskin, the Apple designer who originally created the Macintosh project and gave the machine its name, argued that every action should always have the same result, and that every result should have just one action associated with it. For example, there should be only one way of erasing a file.

Raskin’s argument is compelling: Efficiency and ease of use come from habit, and if you have one way of erasing a file, you’ll become very fast at erasing files that way. The GUI designer’s task, Raskin believed, was to find good, easy, efficient ways for you to perform your work. Once those ways have been developed, all software should follow them.

Needless to say, Raskin’s design changed after he left the project, and the Mac you see today bears little resemblance to his original plan. The result is a plethora of ways to do almost anything on a Mac—which makes it flexible, but much more complex than its reputation implies.

Although the Mac has demonstrated in business settings that it is easier to learn than CLI-based systems, it’s still a far cry from a truly easy-to-use system. This is part of the reason that, while Macintosh software was a huge improvement over the software available in 1984, it has not catapulted the Mac into spectacular success.

The Macintosh is certainly not a failure—its consistency across applications is unsurpassed, and Apple’s programming guidelines produce software that rarely has trouble coexisting. (By contrast, you often find yourself playing “TSR roulette” when you try to add yet another pop-up program to your collection of DOS utilities and drivers.) And if the Mac hasn’t kept the faith of Raskin’s original, friendly user-interface design, it still seems like the Holy Grail of interface design compared to DOS.

DOS Opens a Window
While the Macintosh was originally designed with a GUI, the PC was designed with CLIs. PCs get their CLI from a file called COMMAND.COM, which is actually a program that runs when no other programs are running. COMMAND.COM provides the A> prompt and executes simple built-in DOS commands such as ERASE, COPY, and DIR. COMMAND.COM also loads and executes applications and batch files.

Early versions of DOS required that the original COMMAND.COM be in place, but more recent versions allow you to replace COMMAND.COM with other command interpreters, including GUls. However, there’s a fundamental problem in adding a GUI to a PC: DOS lacks many of the building blocks of a GUI,

continued
For every PC that has dreamed of becoming a CAD workstation.

Call for your FREE HP ME10d videotape. 1-800-526-1036.

A workstation CAD package can give you all the functionality you need. But you work on a PC. And you're concerned that it's putting limitations on your designs.

Hewlett-Packard has a better way. HP ME10d. A mechanical design and drafting system that brings workstation performance to your PC.

Our videotape will show you that it only takes a few steps to complete complex, precise designs. This added efficiency can be yours with a minimum of training. No matter what system you're using today.

HP's ME10d works with ME30 and other industry solutions on IBM, Compaq, and HP Vectra PCs. It can easily accept existing files and designs can be output to other CAD/CAM applications.

With HP's ME10d you'll get the complete PC CAD solution. And all the assurances that come with the Hewlett-Packard name. Engineering expertise. Commitment to standards. And reliability.

Call 1-800-526-1036. Get the video. And get more from your PC.

There is a better way.
such as a windowing system, mouse support, and screen drivers, to handle objects that appear, disappear, change size, and move. Creating a windowing system for DOS requires building all these elements and then piling them atop DOS's command-oriented structure. The result tends to make PC-based GUIs memory-hungry and slow.

Despite the basic problems, there have been several attempts to bring windowing environments to DOS. The most notable have been GEM from Digital Research, Inc. (DRI), Microsoft Windows, and Quarterdeck's DESQview.

GEM was originally designed as a full mouse-and-menus windowing system. It ran into legal trouble with Apple very early, and DRI had to make significant changes to GEM's desktop. Windows was another early contender that ran into trouble with Apple. Microsoft's solution was to sign a license for some of the Apple technology.

But other problems stood in the way of the success of Windows and GEM. Users complained that both systems were slow and required too much memory. In addition, both GEM and Windows require that programs be designed explicitly for them, thus slowing their acceptance. GEM finally found a niche as the shell for Xerox's Ventura Publisher desktop publishing software. It has taken years for Windows to build a significant following.

While DESQview qualifies as a windowing system and supports a mouse, it was not designed primarily as a Mac-competitive GUI. Instead, DESQview was intended to allow several ordinary DOS programs to run simultaneously in separate on-screen windows. As a result, it became the first successful multitasking system for the PC, although it doesn't really fall into the GUI category.

But Windows is a GUI, and a substantial number of programs have now been designed to work with it. Like the Mac's GUI, Windows and its visually similar cousin, OS/2's Presentation Manager (PM), use a mouse pointer, a menu bar, and movable windows. However, some superficial differences quickly become apparent.

For example, menus drop down immediately when the mouse points to an item on the menu bar. (Windows has drop-down menus as opposed to the Mac's pull-down menus.) The windows themselves share only some of the standard features of Mac windows. For example, you can move a Windows or PM window by its title bar, but you can change its shape by dragging any of the other three sides.

Windows and PM also have boxes to minimize a window, allowing a program to continue running in the background and remain visible on-screen only as a small icon (see photo 2). That feature—part of their support for multitasking—is their most recognizable advantage over the standard Macintosh GUI.

But something else sets Windows and PM apart: They are designed to conform to IBM's Systems Application Architecture. SAA is part of IBM's plan to bring a level of standardization to some of its operating systems, from mainframes to PCs. The fundamental idea is to design an architecture in which the same software can be used on a terminal connected to a mainframe, a workstation connected to a minicomputer, and a desktop microcomputer—with only minimal changes to support the wide range of hardware involved.

That task is difficult, because the lowest common denominator, character-based terminals, does not support graphical displays or mice. To allow software to run on both terminals and PCs with GUIs, SAA mandates that every menu item or mouse-based action in an SAA-compliant system must have a keyboard equivalent.

As a result, there will be a certain level of consistency across all SAA applications. Function key Fl, for example, is always the help key under SAA (a standard that has been picked up by many non-Windows and non-PM applications). And most Windows applications, for example, generally function like other Windows applications.

However, Microsoft's style guidelines are not nearly as rigorously enforced as Apple's. Given the PC's history of incompatibilities, it's hard to believe that Windows and PM will ever achieve the level of consistency of Mac software.

Windows and PM offer some advantages over the Mac, however, including the ability to minimize a window, but neither Windows nor PM offers a GUI that is as smooth or attractive as the Mac's, or as consistent. Also, Windows and PM, with their mandatory keyboard equivalents, stray even further than the Mac from the principles of ease of use. Ultimately, even more than the Mac does, Windows and PM may suffer from programmers who would rather substitute a windowing system for careful, friendly program design.

**X Marks the Spot**

Unix poses its own problems for GUIs. Like DOS, Unix was designed as a character-oriented system; any graphical elements must be built on top of the original system. But Unix has another problem: Unlike DOS or OS/2 systems, in which the display is closely tied to the CPU, a Unix system can have a display terminal...
If these images didn't catch your eye, then why are you reading this ad?

Images that leap out at you, especially in a magazine like this, have to be powerful. And whether you need to present your business information more effectively or you want to expand into multi-media, you need strong visuals. Together with Truevision, you can develop that power for presentations, CAD, training, video production and more. And it's easier than you think. You can bring photo-realism and multi-media to your presentations by using a TARGA board with compatible software and peripherals from over 200 companies.

With a TARGA videographics board and your PC*, XT* or AT*-class machine, you can capture images in real-time from a video source, merge them with other images or add text and graphs, even create stunning broadcast-quality animations, and then output the result to video, tape, slides or paper prints. That's how to maximize your presentation efforts into multi-media.

Truevision videographics cards are ready for you today. Contact us at 800/858-TRUE for more information, or visit your local Authorized Truevision Reseller for a demonstration. We'll show you how to visualize your data in a way that no one else can.
that’s far from the central computer. It’s the bottleneck problem all over again: How can you send large amounts of graphical information through a conventional communications link?

The commonly accepted solution is MIT’s X Window System (referred to as X Window for the remainder of this article). X Window is a standard way of describing graphically oriented displays and sending the information from one X Window system to another. X Window also provides the ability to send keystrokes and mouse-movement information, so you can interact fully with the program. X Window doesn’t completely solve the bottleneck problem, but it’s a great improvement over sending a GUI display to a terminal one pixel at a time.

However, X Window is not a GUI. You might say it’s just a graphical communications interface. Several X Window-based GUis have been built (including proprietary systems, such as DECwindows, which runs only on DEC computers). But the two X Window-based Unix GUis that promise to become the most widespread are Unix International’s Open Look and the Open Software Foundation’s (OSF) Motif.

Open Look was designed by Sun in close association with AT&T. In fact, it was originally designed to be the GUI for the new version of Unix (System V release 4), which is scheduled to appear this year. However, Open Look has both technical and political peculiarities. It can use some of the X Window System, but it also depends heavily on Sun’s own operating-system features.

One of the reasons for a hybrid approach was X Window’s notorious slowness in updating some screens. This slowness is more than a minor annoyance. It’s the most obvious characteristic of many X Window implementations. Users complain that they can move a mouse and wait seconds before the on-screen mouse pointer moves. However, a new version of X Window was recently released, and it’s said to be much more responsive.

Another reason may have been Sun’s long investment in its own non-X Window GUis. The Sun alliance with AT&T was directly responsible for the creation of Open Look’s main competitor, Motif, which is fully X Window-based.

As you’d expect, Open Look resembles the Mac and PC windowing systems. The usual windows and mouse pointer are there, and, as with Windows and PM, a window can be reduced to an icon while its program continues to run.

But Open Look has some different features as well. You can move a copy of a menu around on-screen, for example, or hold it in position with a pushpin (see photo 3). Even more significant is Open Look’s mouse. It has three buttons, each of which has a specific purpose. The left button is for selecting items from menus; the middle button is for moving and resizing windows; and the right button is for pulling up so-called invisible windows and menus, which appear separately from any menu bar.

Open Look’s unusual use of the mouse is both its greatest weakness and its greatest strength. If you’re accustomed to using other GUis, the three-button approach is unfamiliar. But it’s also much more consistent—a particular mouse button always serves the same function. As a result, although the learning curve is somewhat steeper, some users say Open Look is ultimately much more efficient than other GUis.

OSF/Motif has its own political and technical history. OSF was formed by several Sun competitors who feared that Sun’s close relationship with AT&T would produce a version of Unix that would be especially well suited to Sun’s workstations—giving Sun a head start in getting products to market. OSF’s first project was a competition to design an X Window–based GUI that would compete with Open Look. The result was Motif (see photo 4)—a blend of the look of Hewlett-Packard’s NewWave, the feel and behavior of OS/2’s PM, and the toolkit from DEC’s DECwindows system.

Motif looks very much like Windows or PM, except that it has the characteristic three-dimensional look of NewWave. It works very much like the PC-oriented GUis and has the ability to minimize a window. However, Motif doesn’t come with its own file manager—the portion of the GUI that actually allows you to copy and delete files. Some current implementations of Motif (including The Santa Cruz Operation’s Open Desktop) use IXI’s X.desktop as the file manager. However, X.desktop can be jarring to some users, since it and Motif don’t
share the same visual style.

Both Open Look and Motif have extensive specifications for conforming to a standard style, but it's too soon to tell whether either system will approach the Mac's consistency across applications. In fact, both GUIs have just been introduced, although several different software vendors have demonstrated their products using early versions of the interfaces. At the moment, Open Look seems almost ready to go. Meanwhile, Motif, with its conventional use of X Window and the mouse, seems to be a more familiar and popular choice, but it isn't yet ready for users.

With either system, it may take a long time before much Unix software makes the jump from a character-based interface to a GUI. However, it does have some things going for it. For example, more powerful workstations that traditionally run Unix have useful advantages over PCs or Macs. On a Macintosh screen, dragging a window is indicated by a dotted outline; in Motif and Open Look, the entire window moves. But the complexity of X Window and the remaining communications bottleneck will continue to keep it substantially slower than its non-Unix competitors. Still, for communicating across networks with a GUI, X Window is far ahead of its competition (see the table).

Coming Attractions?
If GUIs present a far more complex architecture than CLIs, will the next generation bring still more complexity to programmers in the search for easier-to-use software? Probably not. The most innovative systems for desktop computers today are racing toward object-oriented programming.

Apple's MultiFinder, a multitasking operating system for the Macintosh, replaces conventional time-sliced preemptive multitasking with event-oriented, cooperative multitasking. This is a step in the direction of the Smalltalk environment that gave birth to modern GUIs. NeXT's NextStep provides tools designed explicitly to speed up programming. NewWave and applications such as ViewLink and Magellan move much of what was once programming into the hands of users.

Meanwhile, hardware is no longer a critical barrier for better user interfaces. While low-speed TTYs once forced you to deal with CLIs, today fiber optics and inexpensive video technology are making an entirely new set of views possible for your desktop windows. In the Knowledge Navigator, the imaginary future computer that Apple president John Sculley likes to describe to his audiences, an animated talking head answers your questions.

But, in the real world, video images are already part of some GUI systems. The images are what might be called semi-interactive video: You can change the contents of the video, but you can control how to view the images—in what order and at what speed. The combined GUI/video interface even has a name: the video user interface, or VUI.

One use of semi-interactive video, as part of Japan's TRON project, is in software designed for education and running on a modified PC. In one demonstration, you can watch a short video image of the African grassland and then click with a mouse on various animals or plants within the picture to see close-ups, get information, or run a related video. The video images are stored on a videodisk but appear within windows on the computer screen.

Another use of video in a windowed user interface is in networking, particularly in groupware. Researchers at the Xerox Palo Alto Research Center—home of the first GUIs—have experimented with continuous remote video conferencing between the PARC and a facility near Portland, Oregon. With improving video (and networking) technology, the approach could eventually put the faces of every member of your workgroup on your screen—along with a project, document, or spreadsheet the group is working on.

The VUI is an important step in the evolution of user interfaces for desktop computers. Just as the move from CLIs to GUIs made working with a computer less abstract and more "real," VUIs hold the promise of combining graphical, video, and audio information to bring the real world into the computer.

Frank Hayes, a former BYTE news editor, is a writer for UnixWorld and lives in Portland, Oregon. You can contact him on BIX as "frankhayes."
Memory is gold.
And like gold, some of it is hidden away inside your computer. For years, we’ve been working toward putting it all under your control. And now we can.

Now you can make today’s more powerful programs run without giving up network and mouse drivers and TSRs.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest

Manifest guides you deep inside your PC. It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Manifest shows you how your memory works. Here’s the first megabyte of RAM, showing unused areas.

Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and ‘map’ memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V.2.x.

If your PC has ‘shadow RAM,’ there’s even

QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K — freeing it up for your programs to use.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It’s a productivity breakthrough from the memory experts at Quarterdeck.

Manifest shows you the contents of AUTOEXEC.BAT and CONFIG.SYS files. That can be a big help when diagnosing problems. Manifest tells you all about your hardware, too—from your CPU type to what boards you have installed. Manifest even tests memory speed. And it runs benchmark tests on expanded memory boards so you can make informed buying decisions.

You won’t need a PhD to understand what you’re doing. Manifest has an interactive ‘manual’ that tells you how to use the program and what benefits you’ll get.

Administering a number of PCs? Manifest’s diagnostic and reporting capabilities reduce technical support time. It not only identifies problems but helps to solve them.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It’s a productivity breakthrough from the memory experts at Quarterdeck.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest

Manifest guides you deep inside your PC. It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Manifest shows you how your memory works. Here’s the first megabyte of RAM, showing unused areas.

Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your

memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and ‘map’ memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V.2.x.

If your PC has ‘shadow RAM,’ there’s even

QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K — freeing it up for your programs to use.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It’s a productivity breakthrough from the memory experts at Quarterdeck.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest

Manifest guides you deep inside your PC. It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Manifest shows you how your memory works. Here’s the first megabyte of RAM, showing unused areas.

Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your

memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and ‘map’ memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V.2.x.

If your PC has ‘shadow RAM,’ there’s even

QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K — freeing it up for your programs to use.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It’s a productivity breakthrough from the memory experts at Quarterdeck.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest

Manifest guides you deep inside your PC. It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Manifest shows you how your memory works. Here’s the first megabyte of RAM, showing unused areas.

Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your

memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and ‘map’ memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V.2.x.

If your PC has ‘shadow RAM,’ there’s even

QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K — freeing it up for your programs to use.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It’s a productivity breakthrough from the memory experts at Quarterdeck.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest

Manifest guides you deep inside your PC. It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Manifest shows you how your memory works. Here’s the first megabyte of RAM, showing unused areas.

Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your

memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and ‘map’ memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V.2.x.

If your PC has ‘shadow RAM,’ there’s even

QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K — freeing it up for your programs to use.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It’s a productivity breakthrough from the memory experts at Quarterdeck.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

That’s why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It’s called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck’s seven years of memory expertise made Manifest

Manifest guides you deep inside your PC. It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Manifest shows you how your memory works. Here’s the first megabyte of RAM, showing unused areas.

Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your
Introducing QEMM 50/60
Version 5.0

QEMM (Quarterdeck Expanded Memory Manager) 50/60 is the gold standard in memory management for the IBM PS/2' series 50 and 60. It works with IBM's Memory Expansion Option, Expanded Memory Adapter/A and compatible memory boards. It supports all three specifications for expanded memory: EMS 4.0, EMS 3.2 and EEMS memory so you can run all expanded memory programs. And it also works with Microsoft's XMS specification, in case you want to use Windows. QEMM lets you use memory locations between 640K and 1024K to run TSRs, mouse and network drivers, DOS resources and MCA adaptors. That means you can gain up to 130K of memory space below 640K for your programs. Best of all, QEMM is designed to be easy to use—even for those new to the PC. Just install it and type 'optimize,' and it looks at your AUTOEXEC.BAT and CONFIG.SYS files and loads whatever it can in high memory. Automatically. QEMM 50/60 is priced economically. It's the biggest boost you can give your PS/2 for under $100.

QEMM 386 can expand the memory of all 386-based computers, including PCs with 80386 upgrade boards. It makes your memory compatible with EMS 4.0, EMS 3.2 and EEMS memory without having to add special hardware. It's compatible with protected-mode programs (like 1-2-3 Release 3, IBM Interleaf and Paradox 386) using DOS extenders compatible with the Quarterdeck/Pharlap VCPI spec. QEMM also works with Microsoft's XMS spec to extend memory for Windows users. QEMM gives you maximum control over your memory between 640K-1024K. It can find unused memory nuggets as small as 4K and use them to free up room for programs to use. QEMM 386 even monitors how your programs use memory while they're running. Then it shows you where there's additional memory you can use. It even measures which parts of your memory are fastest and 'decides' how to use them for better performance. In action, it's easy and fun—almost like having an artificial intelligence program to help tune up your PC.

QEMM and DESQview let you multitask and window with the programs you know and use today. Introducing QEMM 386
Version 5.0

DESQview's recent awards.

Yes! I need increased productivity on my current PC!

Payment Options: Visa, MasterCard

Shipping & Handling: $5 in USA/$10 outside USA

California Residents add 6.5%

Circles 238 on Reader Service Card

©1989 Quarterdeck Office Systems
The best.

BYTE said it in 1984.
The American Statistician said it in 1985.
PC Magazine said it in 1989.
SYSTAT is the only statistics software to have won both InfoWorld's Best in Class award and
PC Magazine's Editor's Choice award.
SYSTAT is the only statistics package ever to win
InfoWorld's prestigious Top 100 award.
For five consecutive years, SYSTAT has won every
major review in every major publication.

Users agree.
SYSTAT received the top rating in PC Week's
1988 user satisfaction poll.
No other statistics company's microcomputer user
base rivals the more than 100,000 users of
SYSTAT products worldwide.
Find out for yourself why no other company comes
close to our record.

MS-DOS®, MACINTOSH®, UNIX®, VMS®
For more information and a free poster of this map,
call 708 864.5670 or write SYSTAT, Inc. 1800 Sherman Ave.,
Evanston, Illinois 60201
Behind the Scenes

A good API makes development a piece of cake, and a bad one can drive you bananas

Howard Eglowstein

Providing a user interface that you can learn to use quickly and easily has been a driving force in the computer industry since the Macintosh made "ease of use" a religion in 1984. The major interfaces—DOS and Unix command interpreters, Macintosh Finder, Windows, Presentation Manager, and the X Window System—provide different levels of functionality and comprehensibility.

Deciding which user interface to support in a multiple-machine environment requires more than a simple examination of the different interfaces. It requires an understanding of the programming interface that underlies what you see on your computer screen.

The application programming interface is what gives your program access to the system's resources. A good API will make it easy to concentrate on the task at hand, and a bad one can drive you bananas.

The API lets your program communicate with the operating system, which is responsible for managing all the resources available in the system. At a minimum, this involves managing the keyboard, display, disk drives, and file system. Most personal computers extend operating-system support to include the management of printer ports, serial I/O ports, and memory.

Giving all programs unrestricted access to all system resources would result in chaos. The operating system needs to be in control to sort out conflicting requests for scarce resources. You need a way to tell the operating system what your program needs to do. That's what the API is for.

A Bushel of APIs

At the simplest level, the API is just the definition of the raw operating-system calls. CP/M or DOS programmers who work in assembly language use such calls exclusively.

At the next level, a high-level language like BASIC, C, or Pascal incorporates operating-system calls into its own language primitives and standard libraries, making it easier to use the operating system and providing some level of code portability. The high-level-language approach also cuts down radically on learning time; the language designers have programmed the hardest routines for you.

Perhaps the most interesting API is an event-driven windowing environment. From the outside, a windowing program normally has menu bars and movable windows and uses some sort of pointing device to control a free-roaming cursor. These elements constitute a graphical user interface (GUI). Microsoft Windows and the Mac interface are the most common examples.

A windowing interface combines basic continued
operating-system calls with special libraries that control the graphics display, pointing device, memory allocation, and (if it is supported) multitasking. A high-level language normally ties it all together.

Listing 1: Programming DOS in assembly language involves manipulating the registers directly and triggering specific interrupts. This code fragment opens a file.

```
Fname db 'FACE.DMG',0
Fhandle dw ?
;
    mov DX,offset Fname           ; DX register points to the filename
    mov AX,3000h                   ; All the 'open' function (DOS)
    int 21h                        ; Software interrupt 21h is the
    je Open_error                  ; Standard MS-DOS file system interrupt.
    ; When DOS returns, check the Carry bit to see
    ; if the operation was successful. If it didn't
    ; work, jump to our error-handling routine.
    ; Since we didn't jump, it must have worked.
    ; DOS returned the file "handle" in AX. Save it.
    mov Fhandle,AX

    ; Go on and do more stuff
```

Listing 2: This piece of code demonstrates how to open a DOS file using C. The high-level language shields you from the complexities of the assembly API.

```
#include <stdio.h> /* Standard DOS information, stored in an include file. */
char name[] = "FACE.DMG";       /* The file we want opened. */
FILE *fp, *fopen();            /* Open the file, store the 'handle' in fp. */
if ((fp = fopen(name,"r") != NULL))
    {                               /* Do some stuff with the file. */
      cout(fp);
      /* Close the file. */
    }
else
    {                               /* We couldn't open the file. */
      cout("FILE \n
closeDoing any low-level programming.

APIs Speak Your Language

If assembly programming isn't to your liking, you can program CP/M and DOS machines in a high-level language. BASIC and C are probably the most commonly used high-level languages. They completely shield you from having to manipulate CPU registers directly.

Listing 1 shows an assembly DOS program opening a disk file. Listing 2 contains the same function, written in C. The C compiler handles all the DOS functions and remaps them into a standard ANSI C format. BASIC performs a similar function, except that the standard BASIC implementation on DOS machines is Microsoft's GWBASIC, which is not an ANSI standard. Listing 3 shows how you open a file using GWBASIC.

In these sample listings, note that the filename is designated using the DOS naming conventions. While high-level languages give you some degree of code portability, the operating system always determines the file-naming convention.

Screen control in DOS is not nearly as flexible as file access. DOS uses the system BIOS to give you simple teletypewriter emulation. By outputting characters to a standard file handle, DOS can pass them through the BIOS to the screen. This handle does not support cursor commands, colors, or any display attributes—just characters. (CP/M implementations at least provided some

continued
After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.
What the historians will call it, only time will tell.
Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.

MathCAD 2.5 includes 3-D plotting, HPGL sketch imports, and PostScript output.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

And now we've made the best even better. MathCAD 2.5 is a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, and the ability to import HPGL files from most popular CAD programs, including AutoCAD. And now you can print on PostScript compatible printers.

And like before, MathCAD's live document interface™ lets you enter equations anywhere on the screen, add text to support your work, and graph the results. Then print your analysis in presentation-quality documents.

It has over 120 commonly used functions built right in, for handling equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 60,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists, and economists.

But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."

And for Macintosh users, we present MathCAD 2.0, rewritten to take full advantage of the Macintosh interface. Entering operators and Greek letters into equations is pure simplicity!

Look for MathCAD 2.5 at your local software dealer, or give us a call. For more information, a free demo disk, or upgrade information, dial 1-800-MATHCAD (in MA, 617-577-1017).

Available for IBM® compatibles and Macintosh computers.

MathCAD®
MathSoft, Inc. One Kendall Square, Cambridge, MA 02139

form of terminal emulation, normally with VT52 or similar escape sequences.) However, an IBM-compatible machine gives you control over display attributes, such as cursor location and text colors, through calls to the system BIOS.

In assembly language, you set screen attributes using the INT 10h BIOS interrupt and access the display-file handle through the INT 21h DOS interrupt. GW-BASIC provides its own interface to the BIOS. Sadly, standard C libraries provide only the teletypewriter emulation of DOS—C does not support BIOS calls. To correct that omission, most compilers can be fitted with function libraries that give you full control over the screen. In some cases, these libraries come with the compiler. They are also available from numerous third-party developers.

DOS and Don'ts
DOS is essentially a collection of device-control functions waiting to be called by your application program. Writing for DOS is simply a matter of working in the standard definition of a language, making the appropriate function calls as needed. This limits your program to the functions that DOS defines. (It also restricts your programs to a maximum of 640K bytes of memory.)

Thus, DOS programs tend to be very keyboard-oriented and often have a sparse look about them. Perhaps the most common complaint from DOS users is the lack of a standard user interface. Because DOS handles only basic screen output or keyboard entry, your program is free to use any keystrokes you wish. You can also make the screen look any way you please. However, if you choose to use the DOS API, you should strive to be consistent.

The Nonstandard Standard
Unix has been around much longer than DOS, but it wasn’t a practical operating system for desktop equipment until the arrival of fast processors, cheap memory, and high-capacity hard disk drives. Unix is semiportable, and it has been adapted to many different processors and architectures. In the world of Unix, however, there’s no such thing as standard hardware, never mind a standard machine-instruction set.

Unix systems usually have more memory than DOS machines—lots more. Unix system libraries have built-in support for terminal control and true multitasking.

Preemptive multitasking can make programming a complex system much easier on a Unix machine than it is on a DOS machine. For example, say you’re writing the ultimate word processing package and you want to run under both DOS and Unix. One feature you want to add is background printing, where the software can print one file while editing another.

DOS provides two ways to accomplish this, neither of them terribly elegant. Because a word processor spends most of its time waiting for keystrokes, you can perform limited multitasking within the code by writing a keyboard-sampling routine that prints out a few characters, then samples the keyboard, and then prints a few more characters. Since your program polls the keyboard at regular intervals, this approach works well for a word processor. It is not appropriate for most programs, however.

Another facility available under DOS is the background “multiplex” interrupt, which will perform simple background tasks as a part of DOS’s overhead. A standard DOS utility, PRINT, uses this interrupt to handle file printing in the background. A number of DOS word processing packages send output to a temporary file and then have DOS use PRINT to output the file. Elegant? No, but it is functional.

On a true multitasking operating system such as Unix, you can spawn a separate task to handle printing. In fact, this task could be a separate copy of the same word processor. The spawned task handles the printing as needed and then destroys itself. The operating system handles task switching and resource conflicts automatically, making the code much simpler.

Terminal Affairs
Screen I/O under Unix isn’t much better than it is under DOS. When Unix was developed, bit-mapped graphics screens were an oddity. Until the advent of the microcomputer, all output screens were part of data terminals, some of which featured better functionality than others.

Unix handles a terminal by treating it like a file and using standard file I/O commands to spew characters back and forth. Simply sending ASCII characters wouldn’t give you any cursor control, and it’s impractical to write support for every possible terminal type into your program. (This is not a problem under DOS, however, because all PCs look alike to DOS.)

To get around this problem, Unix systems provide you with a standard terminal-interface package. A terminal is assumed to support a standard set of functions, driven by escape sequences. A table of all possible terminals is stored in the Termcap file, and the system variable TERM will tell your program which kind of terminal it’s on. It’s not nearly as convenient as the single DOS machine type, but it’s a good compromise and is one step toward a device-independent interface.

A Sashay Through the Windows
Imagine adding one layer of graphics support between you and the operating system. Further, give this layer complete control over the system memory, keyboard, and file system. Then, have the graphics support offer a wide variety of window types and support any type of screen (within reason). What you wind up with is an API that supports a GUI.

Apple calls its GUI API the Toolbox and puts it into the system ROM of every Macintosh it makes. DOS users can buy something similar (in the guise of Windows/286 or Windows/386). Those running OS/2 have access to similar technology with Presentation Manager. In the following discussion, I use Mac termi-
The ARC Proturbo 386™ Blows The SX Away

It doesn't make sense to buy a 386™SX based personal computer. They say you can get a 386 SX system at a 286 system price. We'd like to know where!

Realistically, if your applications have outgrown your 286 and you've decided to get a 386, you already know you have to spend more money. So why compromise performance?

Get an ARC Proturbo 386/20.

It's a true 32-bit 386. It costs the same as many 386 SX systems but blows them all away. If you need 386 power with a painless price tag, don't settle for a wimpy SX.

Get the ARC Proturbo 386/20 and the muscle to handle your growing needs.

Where? At your local ARC dealer.

In California: (213)265-0835
Elsewhere:(800)FIND-ARC
(800)423-3877

ARC
AMERICAN RESEARCH CORPORATION

ARC Products are Sold Worldwide

Argentina 1-469518
Australia 252-935212
Bahamas 973-531177
Bangladesh 2-44179
Belgium 2-2418784
Denmark 42-951895
England 1-6844164
Finland 52-619100
Hong Kong 3-7420007
Hungary 1-1667666
Iceland 1-667659
Italy 2-2776232
Kuwait 2-5421912
N. way 42-15500
o. Istan 21-521599
P. nya New Guinea 675-257477
Peru 14-19840
Phippines 2-8189320
Portugal 1-577760
Saudi Arabia 3-3265007
Singapore 65-329-2111
Spain 1-3203470
Switzerland 46-315895
Sweden 22-7925075
Thailand 2-4996065
Turkey 901-190930
United Arab Emirates A-232061
USA 213-258033
West Germany 40-6505
Yemen Arab Republic 2-207721

Circle 23 on Reader Service Card (DEALERS: 24)
Listing 4: A sample Macintosh event event loop. Most of the code has been removed to show the file structure better.

```
repeat
  if (theInput <> nil) then  
    TEId (theInput);  
  SystemTask;
  if GetNextEvent(everyEvent, myEvent) then
    begin (Start handling the event)
      case myEvent.what of
        MouseButton : Mouse button pressed
          begin (handle the pressed button)
            if (code = inMenuBar) then
              [See if a menu selection]
            begin (Handle the menu-handling stuff here)
              [Edit the menu selection and handle it]
            end;  
          [Do the menu-handling stuff here]
          end;  
        MouseDrag : Mouse button dragged
          begin (In a grow area of the window)
            [Set which window the event happened in]
            FindWindow(myEvent.where, whichWindow);
            [Get which window the event happened in]
            InDrag
              [If event then...]
          end;  
      end;  
      GetNextEvent returns the next event
    end;  
    end;  
  end;
end.  
```

In the queue. The case statement isolates MouseDown and KeyDown events, calls the necessary routines, and then loops until doneFlag is set. In a complete program, doneFlag is set by clicking the close box, selecting Quit from the System menu, or some other action. SystemClick passes a MouseDown event off to activate desk accessories.

Microsoft Windows uses a similar scheme. Listing 5 is an excerpt from SHOBITS, a program in C that displays arbitrary graphics on the screen and wraps text around them. WinMain is the main procedure that displays the graphics window and polls for messages from the event queue. Note the structural similarity between the Windows program and the Macintosh program. In this example, GetMessage serves the same purpose as the Macintosh’s GetNextEvent.

Share and Share Alike

Windowing systems are often multitasking, so it’s possible that other programs will be vying for the same resources. Thus, the windowing system normally manages memory, as well as screen I/O, which requires special calls to send text to the active window. Keyboards come in through the event queue. File I/O, on the other hand, is usually handled directly by the operating system.

Multitasking is handled in various ways. Nonpreemptive systems such as the Macintosh use cooperative multitasking, which takes advantage of the fact that programs have to query the system for events. By asking for an event, the program indicates to the event handler that it is waiting for something to do. Another program can then get control of the processor for a while and return control when it is waiting for an event.

If all the programs on such a system are well behaved, then everyone gets a turn. Of course, there are always a few programs that don’t play fair and never relinquish control. On the Macintosh or under Windows, there simply is no way for an application to regain control from these ill-behaved ones.

On the other hand, OS/2 is truly a preemptive operating system, and PM can simply take control whenever it wants. Whether you have a preemptive or nonpreemptive environment, it’s best to make sure your applications can coexist with other programs in a multitasking system.

A Standard

Windowing interfaces depend on high-resolution graphics displays. In this continued
The ViVa24 Modem knocks 'em dead with style and convenience.

Finally! An affordable, state-of-the-art modem designed to maximize any work station or desktop and take up minimal space. The new 2400 baud modem from Computer Peripherals, Inc. is a 100% Hayes compatible external modem which boasts more high-tech features than its competition at an unbelievable price tag.

The compact, distinctively sleek tower design simplifies placement, and it's easily accessible, front panel power switch eliminates fumbling around the back of the unit. The handsome weighted base holds the ViVa24 firmly in place, and sharp LED indicator lights are aligned for comfortable viewing, utilizing international graphic icons that make the ViVa24 simple to understand.

The small tower design creates a natural flow of air over the surface of the board, allowing the ViVa24 to run cooler and affording you 24-hour, worry-free operation. The ViVa24 modem provides the user compatibility with IBM PC, XT, AT, IBM PS/2, Apple Macintosh computers and any computer that supports RS-232C.

The ViVa24 modem represents innovation from its footprint up with features such as: use of the Hayes "AT" command set, asynchronous data format, auto-dialing, auto answer, adaptive equalization, non-volatile memory, automatic tone and pulse dialing, remote access while your computer is unattended, self-test and built-in diagnostics. Best of all, the ViVa24 is fully backed with a five-year limited warranty.

Before investing in an ordinary modem, be sure to investigate the ViVa24.

Call your nearest dealer or call us for details.

Circle 66 on Reader Service Card (DEALERS: 67)
The Cream.

The Crop.

There are plenty of places to get information in this industry. Too many. But if you want the best quality information, there's only one that rises to the top: BYTEWEEK, a weekly newsletter from the same professionals who produce BYTE Magazine.

Subscribe now and take advantage of a special subscription rate of $395 ($495 outside the U.S. and Canada). Don't miss this opportunity!

In the U.S. call BYTEWEEK's toll-free number: 1-800-258-5485. In N.H. and outside the U.S. call 603-924-9281.

BYTEWEEK offers a money-back guarantee if you are not completely satisfied.

BYTEWEEK
One Phoenix Mill Lane
Peterborough, NH 03458

Listing 5: A main procedure and event loop from Microsoft Windows.

/* The Source file: shobits.c */
#include "windows.h"
#include "shobits.h" /* There's no bits like SHOBITS */
int PASCAL WinMain( hInstance, hPrevInstance, lpszCmdLine, cmdShow )
{
msg.wParam = 0;
if ( hPrevInstance ) {  /* Copy data from previous instance */
  if
  else
    /* Call initialization procedure - this is the first instance. */
  if ( hWnd = CreateWindow((LPSTR)szAppName,
                             (LPSTR)msgMessage,
                             WS_TILEDWINDOW,
                             0, 0, 0, 0, 0, 0, (HWND)NULL,  /* no parent */
                             (HWND)NULL,  /* use class menu */
                             hWnd, (LPSTR)NULL, ) ) { /* no parameters to pass on */
    hinst = hInstance; /* Save instance handle for DialogBox. */
    while ( GetMessage((LPMSG)&msg, NULL, 0, 0) ) { /* Polling messages from event queue. */
      TranslateMessage((LPMSG)&msg);
      DispatchMessage((LPMSG)&msg);
    }
    return (int)msg.wParam;
  }
}

/* Procedures that make up the window class. */
long FAR PASCAL ShoBitsWndProc ( hWnd, message, wParam, lParam )
switch (message)
{
case WM_SYSCOMMAND:
  switch (wParam)
  {
    case IDSABOUT:
      DialogBox( hinst, MAKEINTRESOURCE(ABOUTBOX), hWnd, lpprocAbout ) ;
      break;
    default:
      return DefWindowProc( hWnd, message , wParam, lParam ) ;
  } 
  break;
case WM_DESTROY: /* Quit was selected from the File menu */
  PostQuitMessage( 0 ) ;
  break;
case WM_MOUSEMOVE: /* Any time the mouse moves */
  if (bMouseDown) ( /* Erase old line and draw a new one */
  break;
case WM_LBUTTONDOWN: /* If either mouse button is pressed */
  if (bMouseDown) {
    /* snag a starting X and Y coord */
  break;
case WM_LBUTTONUP:  
case WM_RBUTTONDOWN:
  if ( ! bMouseDown ) ( /* The button was down and has just been released */
  break;
case WM_PAINT:  /* Windows has just asked us to repaint the screen */
  BeginPaint( hWnd, (LPPAINTSTRUCT)&ps );
  if ( fPlsAddTxt ) ( /* Wrap two columns of text */
    Column1 ( hWnd, GetDC ( hWnd ) );
    Column2 ( hWnd, GetDC ( hWnd ) );
  )
  fPlsAddTxt = FALSE ;
  ReadClipboard ( hWnd, GetDC( hWnd ) );
  xorBox ( hWnd, startx, starty, endx, endy );
  EndPaint( hWnd, (LPPAINTSTRUCT)&ps );
  break;
default:
    return DefWindowProc( hWnd, message , wParam, IParam ) ;
  break;
}
return(OL);
All the power of The Software Link's PC-MOS operating system. All the benefits of both individual and networked PCs.

All in one high-performance, low-cost, multi-tasking system. With no terminals and no additional PCs — unless you want to optionally use your old XTs or ATs.

**The UnTerminal™ UnNetwork.**

It's the ideal multiuser system for personal computer users.

UnTerminal monitor-keyboard workstations cost less than terminals. Less than text-only "intelligent I/O" solutions. Less than fiber-optic graphics solutions.

An independently operating UnTerminal workstation outperforms them all. With faster screen refresh — text and graphics. Instant switching between single and multiuser screens. Running popular DOS applications. And making every user feel like the only user.

**Just add PC-MOS, monitors & keyboards.**

The Software Link's PC-MOS multiplies the power of your PC. Why pay extra just to get the boxes? You can run up to eight color or 16 monochrome UnTerminal workstations per system — and save thousands.

Distributed by The Software Link, Inc.

For more information, call: The Software Link, Inc. at (800) 451-LINK or (404) 448-5465.

---

**The PC-MOS UnTerminal**

PC-MOS MULTIUSER SYSTEMS WITHOUT TERMINALS

The Software Link, Inc., 3577 Parkway Lane, Norcross, GA 30092.

Phone: (800) 451-LINK or (404) 448-5465, FAX: (404) 263-6474, Telex: 4996147 SWLINK.

PC-MOS is a trademark of The Software Link, Inc. UnTerminal, UnNetwork, Video Network Adapter, Video Connect Card Adapter and Video Graphics Network Adapter are trademarks of Advance Micro Research, Inc.

Circle 263 on Reader Service Card (DEALERS: 264)
regard, the Mac Toolbox enjoys the advantage of always running on a Macintosh. There are no problems with non-standard displays. The Toolbox can run any program on any type of display that conforms to Apple's standard. In fact, you can have your program ask the Toolbox about the color and resolution of the display and use this information in your program. Device independence on the Macintosh is excellent.

The PC, however, has few standards, and life with Windows becomes interesting because of it. Microsoft has built in support for the usual screen displays: CGA, EGA, and VGA. Because of the popularity of the monochrome Hercules graphics board, recent versions of Windows now support that card as well. But that's about it. If you want to use one of the new full-page displays with Windows, you will have to make sure that the manufacturer supplies a Windows driver. PM is limited to standard Windows devices.

Cooking Up an Application

APIs are not all sweetness and light. Those who work with Windows or the Macintosh probably consider the DOS API half-baked. Conversely, the eyes of those involved with DOS tend to glaze over when they first investigate Windows. Happily, the recipe for picking the right API is an easy one.

If you work on the Macintosh, you have no choice. The standard Mac operating system is programmed solely through the Toolbox and event-loop programming. A/UX, the Unix port for the Mac II family, combines the multitasking of Unix with the best of the Toolbox functions.

The X Window System is a standard that is beginning to show up on Unix workstations. However, the GUIs built on top of it are not yet generally available on desktop machines and are incompatible with one another. Until the X Window System-based GUIs make greater inroads into the desktop arena, Unix hackers will have to be content with their true multitasking and Termcap screen control.

If you work on an IBM-compatible machine, you have a few options. Programming conventional DOS applications is easy, and the new crop of DOS extenders allows access to memory beyond the standard 640K bytes. You can choose between two GUI environments: Windows running under DOS, and PM running under OS/2. All three of these APIs have appeal.

If your applications rely heavily on multitasking, OS/2 is probably the correct choice. However, it may be a long time before OS/2 becomes the standard operating system for IBM compatibles, if it ever does.

If you need to be able to port your application to other machines, straight C under DOS or Unix would be a good choice. If ease of use is a primary concern, then Windows may well be your best choice.

Examining user interfaces is only part of the picture in determining which system to support. Understanding the strengths and weaknesses of each API and matching the right API to the job at hand will make your efforts much more fruitful.

Howard Eglowstein is a testing editor for the BYTE Lab. He can be reached on BIX as "heglowstein.

CAPTURE THE POWER OF QUINTUS PRODUCTS IN YOUR SOFTWARE DEVELOPMENT

Quintus' premier Prolog-based software engineering products provide tools that enhance object-oriented programming, rapid prototyping, debugging, windowing and database interface development.

Quintus proudly offers support for:

UNIX  Quintus Prolog, Runtime Generator, Runtime Licenses, Quintus ProWINDOWS, Database Interfaces

MAC  *MacProlog, MacObject, Prolog ++, Flex

MS-DOS  *DOSProlog, Prolog, ++ Flex

Available across a wide variety of platforms including SUN, Digital VAX/VMS, VAX Ultrix and DECstation, HP, Sony, Apollo Domain, IBM RT/PC (AIX) and IBM PS/2 (AIX), 80386 UNIX, Sequent Symmetry and Intergraph Clipper.

Visit our booth at MACWORLD April 11-13, San Francisco.

The companies and products mentioned are trademarks and registered trademarks of their respective companies. * Registered trademarks of Logic Programming Associates

For more information contact sales:

Quintus Computer Systems Inc.
An Intergraph Company
1310 Villa Street, Mt. View, CA 94041
Phone: (415) 965-7700; 800-AILOGIC
FAX: (415)-965-0551

Quintus
Only NRI teaches you to service all computers as you build your own fully AT-compatible micro—now with 1 meg RAM and 20 meg hard drive!

Jobs for computer service technicians will almost double in the next 10 years according to Department of Labor projections, making computer service one of the top 10 growth fields in the nation.

Now you can cash in on this opportunity—either as a full-time industry technician or in a computer service business of your own—once you've mastered electronics and computers the NRI way.

Get inside the powerful, fully AT-compatible West Coast computer system

To give you hands-on training with the absolute in state-of-the-art computer technology, NRI includes the powerful new West Coast 1010 ES computer as the centerpiece of your training. You build this 1 meg RAM, fully IBM AT-compatible computer from the keyboard up, plus you now go on to install a 20 megabyte hard disk drive to complete your total computer system.

Understanding you get only through experience

You need no previous background in electronics to succeed with NRI. You start with the basics, rapidly building on the fundamentals of electronics with bite-size lessons. You perform hands-on experiments with your NRI Discovery Lab® and then move on to master such advanced concepts as digital logic, microprocessors, and computer memories.

Learn at home in your spare time

With NRI, you learn at your own convenience in your own home. No classroom pressures, no night school, no need to quit your present job until you're ready to make your move. And all throughout your training you've got the full support of your personal NRI instructor and the entire NRI technical and support staff. They're always ready to answer your questions and help you whenever you need it.

Get all the facts from NRI's free 100-page catalog. Send today!

SEND CARD TODAY FOR FREE NRI CATALOG

Check one FREE catalog only.

Computers and Microprocessors
TV/Video/Audio Servicing
Robotics
Computer Programming

Security Electronics
Electronic Music Technology
Telecommunications Technology
Basic Electronics

For career courses approved under GI Bill © check for details. 169-040

Accredited by the Accrediting Commission of the National Home Study Council
Get In-Demand Computer Servicing Skills With NRI "Hands-On" Training

Total Computer Systems Training, Only From NRI
No computer stands alone... it's part of a total system. So if you want to learn to service and repair computers, you have to understand today's computer systems. And only NRI builds meaningful training around just such a powerful computer system—the new West Coast 1010 ES Series Computer, complete with monitor, floppy disk drive, hard disk drive, and valuable software—all yours to train with and keep.

The 1010 ES features full IBM AT compatibility, the breakneck speed of an advanced 80286 CPU, and big-system raw power: 1 meg RAM and full expandability for future system growth.

Mastery Is "Built-In"
You assemble the West Coast 101-key "intelligent" keyboard, install the power supply and 1.2 meg, 5¼" floppy disk drive, and attach the high-resolution monitor. You then go on to install a powerful 20 meg hard drive—today's most wanted computer peripheral—now included as part of your NRI hands-on training.

The many demonstrations and experiments you perform as you build your computer system give you a total mastery of computer operation, based on a thorough knowledge of the intricacies of computer theory.

Total Computer Systems Training, Only From NRI
No computer stands alone... it's part of a total system. So if you want to learn to service and repair computers, you have to understand today's computer systems. And only NRI builds meaningful training around just such a powerful computer system—the new West Coast 1010 ES Series Computer, complete with monitor, floppy disk drive, hard disk drive, and valuable software—all yours to train with and keep.

The 1010 ES features full IBM AT compatibility, the breakneck speed of an advanced 80286 CPU, and big-system raw power: 1 meg RAM and full expandability for future system growth.

Mastery Is "Built-In"
You assemble the West Coast 101-key "intelligent" keyboard, install the power supply and 1.2 meg, 5¼" floppy disk drive, and attach the high-resolution monitor. You then go on to install a powerful 20 meg hard drive—today's most wanted computer peripheral—now included as part of your NRI hands-on training.

The many demonstrations and experiments you perform as you build your computer system give you a total mastery of computer operation, based on a thorough knowledge of the intricacies of computer theory.

SEND CARD TODAY FOR FREE NRI CATALOG

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 10008 WASHINGTON, D.C.
POSTAGE WILL BE PAID BY ADDRESSEE

NRI School of Electronics
McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW
Washington, DC 20077-3543

100-Page Free Catalog Tells More...Send Today!
Send the postage-paid card today for NRI's free 100-page catalog that gives all the facts about NRI computer training, plus career training in robotics, TV/video/audio servicing, electronic music technology, and many other fields. If the card is missing, write to NRI at the address below.

IBM is a registered trademark of International Business Machines Corp.
Subscribe to BYTE now and
SAVE up to 52%
PLUS,
get the annual IBM PC
Special Issue as an
EXTRA BONUS!

Enjoy
MORE SPEED!
SAVE up to $66.05
PLUS
get the extra IBM PC Special Issue

Send me BYTE for:
☐ 1 year (12 issues) for $24.95
   (Save 40% off the newsstand cost)
☐ 2 years (24 issues) for $44.95
   (Save 46% off the newsstand cost)
☐ 3 years (36 issues) – $59.95
   SAVE 52% off the newsstand cost
   (20% off the basic subscription price)

Name ____________________________
Company __________________________
Address __________________________
City/State/Zip ______________________
Payment enclosed ☐ Bill me ☐

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it!
Single copy $3.50. The basic annual subscription rate is $29.95.

Profit from
MORE POWER!
SAVE up to 52%
PLUS
get the extra IBM PC Special Issue

Send me BYTE for:
☐ 1 year (12 issues) for $24.95
   (Save 40% off the newsstand cost)
☐ 2 years (24 issues) for $44.95
   (Save 46% off the newsstand cost)
☐ 3 years (36 issues) – $59.95
   SAVE 52% off the newsstand cost
   (20% off the basic subscription price)

Name ____________________________
Company __________________________
Address __________________________
City/State/Zip ______________________
Payment enclosed ☐ Bill me ☐

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it!
Single copy $3.50. The basic annual subscription rate is $29.95.

Gain
MORE APPLICATIONS!
SAVE up to 52%
PLUS
get the extra IBM PC Special Issue

Send me BYTE for:
☐ 1 year (12 issues) for $24.95
   (Save 40% off the newsstand cost)
☐ 2 years (24 issues) for $44.95
   (Save 46% off the newsstand cost)
☐ 3 years (36 issues) – $59.95
   SAVE 52% off the newsstand cost
   (20% off the basic subscription price)

Name ____________________________
Company __________________________
Address __________________________
City/State/Zip ______________________
Payment enclosed ☐ Bill me ☐

No-Risk Guarantee: If dissatisfied, cancel anytime for a full 100% refund. Your subscription will start in 6-8 weeks. Watch for it!
Single copy $3.50. The basic annual subscription rate is $29.95.
Detach and mail card now to
SAVE up to
52%
on BYTE . . .

PLUS,
get the annual IBM
PC Special Issue as an
EXTRA
BONUS!

Order even faster by
phone:
Call
Toll-Free
1-800-257-9402
weekdays 9-5 EST.
In NJ, call
1-609-426-5535.
As desktop computing "standards" proliferate like wildfire, both users and software developers face a similar question: Which machine, and which operating system, should they support? DOS continues to dominate the installed base of microcomputers and thus has the greatest software support, but the Mac has many attractive features, and Unix and OS/2 are coming on strong.

All this results in four operating systems (lumping together the many Unix variations); five major graphical user interfaces—Microsoft Windows, OS/2's Presentation Manager (PM), the Mac, and the X Window System-based Motif and Open Look; many more minor GUls; and an uncounted number of different machine architectures.

The choice comes down to limiting your prospects by supporting one machine or facing the daunting prospect of supporting multiple, complex computing environments and application programming interfaces (APIs).

New tools, however, can provide a third alternative. What if you could write an application once to a universal API and move it to a variety of popular systems? This would make it easy to support multiple standards and to use the same software on different machines.

I will discuss five toolkits that allow this kind of portability. XVT and Smalltalk/V (both of which are general-purpose toolkits), HOOPS and Design/OA (two graphics libraries), and FoxBase (a DBMS) each provide a common API across multiple platforms. These toolkits—and others like them—can make it easier for users and programmers to support multiple environments.

Solving a Sticky Problem
XVT (for Extensible Virtual Toolkit) from the Advanced Programming Institute is a set of libraries, one for each graphical environment that it supports. Each library maps a set of common XVT function calls to equivalent system-specific calls. For example, XVT's new_window turns into NewWindow on the Mac and CreateWindow under Microsoft Windows.

But XVT is more than a Rosetta stone. Although Windows, PM, and the X Window System (referred to as X Window for the remainder of this article) owe much to the event-driven style of programming that the Mac has popularized, they differ from the Mac and from one another in ways that go beyond a one-for-one translation of function names.

For example, each GUI system defines a different set of events. There are 11 Mac events, 24 X Window events, and more than 100 Windows messages. XVT continued
The Mac in native mode, however, requires more work to make that window behave properly. Say you indicate, by clicking the mouse, your intention to drag a window across the Desktop. The programmer must ask the Toolbox which window received the mouse-click, determine that the click happened in the window’s inDrag region, and then explicitly call the Toolbox’s dragWindow function. XVT, like Windows, handles these details automatically.

Vive la Difference!
Although XVT smooths out the differences among platforms, it doesn’t stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application’s window to clear space for other applications; on the Mac, the application joined MultiFinder’s round-robin.

XVT’s method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily systemspecific, a portable program can’t refer directly to the contents of that menu.

XVT’s solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as “12-point Times Roman.”

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for “big,” “normal,” and “small” sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It’s important to understand what XVT isn’t, as well as what it is. It isn’t intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don’t have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Vive la Difference! Although XVT smooths out the differences among platforms, it doesn’t stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application’s window to clear space for other applications; on the Mac, the application joined MultiFinder’s round-robin.

XVT’s method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily systemspecific, a portable program can’t refer directly to the contents of that menu.

XVT’s solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as “12-point Times Roman.”

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for “big,” “normal,” and “small” sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It’s important to understand what XVT isn’t, as well as what it is. It isn’t intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don’t have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Vive la Difference! Although XVT smooths out the differences among platforms, it doesn’t stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application’s window to clear space for other applications; on the Mac, the application joined MultiFinder’s round-robin.

XVT’s method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily systemspecific, a portable program can’t refer directly to the contents of that menu.

XVT’s solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as “12-point Times Roman.”

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for “big,” “normal,” and “small” sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It’s important to understand what XVT isn’t, as well as what it is. It isn’t intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don’t have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Vive la Difference! Although XVT smooths out the differences among platforms, it doesn’t stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application’s window to clear space for other applications; on the Mac, the application joined MultiFinder’s round-robin.

XVT’s method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily systemspecific, a portable program can’t refer directly to the contents of that menu.

XVT’s solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as “12-point Times Roman.”

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for “big,” “normal,” and “small” sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It’s important to understand what XVT isn’t, as well as what it is. It isn’t intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don’t have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Vive la Difference! Although XVT smooths out the differences among platforms, it doesn’t stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application’s window to clear space for other applications; on the Mac, the application joined MultiFinder’s round-robin.

XVT’s method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily systemspecific, a portable program can’t refer directly to the contents of that menu.

XVT’s solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as “12-point Times Roman.”

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for “big,” “normal,” and “small” sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It’s important to understand what XVT isn’t, as well as what it is. It isn’t intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don’t have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Vive la Difference! Although XVT smooths out the differences among platforms, it doesn’t stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application’s window to clear space for other applications; on the Mac, the application joined MultiFinder’s round-robin.

XVT’s method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily systemspecific, a portable program can’t refer directly to the contents of that menu.

XVT’s solution is fascinating. It defines a new event, called the font event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as “12-point Times Roman.”

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for “big,” “normal,” and “small” sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It’s important to understand what XVT isn’t, as well as what it is. It isn’t intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don’t have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.
Monoputer/2™
The World’s Most Popular
Transputer Development System

Since 1986, the MicroWay Monoputer has become the favorite transputer development system, with thousands in use worldwide. Monoputer/2 extends the original design from 2 to 16 megabytes and adds an enhanced DMA powered interface. The board can be used to develop code for transputer networks or can be linked with other Monoputers or Quadputers to build a transputer network. It can be powered by a 20 or 25 MHz T800 and is priced from $1295.

Parallel Languages
Fortran and C Make Porting a Snap!

Microway stocks parallel languages from 3L, Logical Systems and Inmos. These include one Fortran, two Cs, Occam, Pascal, and Ada. We also stock NAG libraries for the T800 and ParaSoft’s debugger, profiler, and Express Operating Environment. A single T800 node costs $2,000, yet has the power of a $10,000 386/1167 system. Isn’t it time you considered porting your Fortran or C application to the transputer? It’s easier than you think!

For further information, please call MicroWay’s Technical Support staff at (508) 746-7341.

Quadputer™
Mainframe Power For Your PC

MicroWay’s Quadputer is the most versatile multiple transputer board on the market today. Each processor can have 1, 4 or 8 megabytes of local memory. In addition, two or more Quadputers can be linked to build large systems. One MicroWay customer reduced an 8 hour mainframe analysis to 15 minutes with five Quadputers, giving him real time control of his business. Quadputer is priced from $1995.

COSMOS™/M

Finite Element Analysis Running on the Quadputer

One of the most fruitful areas for parallel processing is finite element analysis. Problems which can be broken into small pieces run naturally on systems built up of many processors. COSMOS/M running on a Quadputer took just 300 seconds to solve a problem which ran in 12,000 seconds on an AT. Even very large mainframe problems run fast on the Quadputer: a system with 12,000 degrees of freedom took just 806 seconds while another that had 23,000 DOF ran in just 40 minutes. Contact MicroWay for information on COSMOS/M.

Attend a MicroWay-sponsored Parallel Processing Seminar: Munich, FRG May 29-30, 1990

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023
that's locally appropriate. Either way, you get a machine-independent programming toolkit.

Digitalk’s host-sensitive approach, coupled with the improved performance and packageability that the new Smalltalk/V PM supports, has recently ignited something of a Smalltalk revival. Leading the charge, Microsoft’s Bill Gates delivered the ringing endorsement that Smalltalk/V PM is “the right way to develop PM applications.”

An Object Lesson
Smalltalk’s all-encompassing object orientation takes some getting used to. Listing 1 shows a snippet of Smalltalk/V code—a method—to read a text file and write a sorted list of the different words it contains to a scrollable window.

The short code does quite a bit of work. The TextEditor and File objects respond to the “messages” they receive according to the Smalltalk message pass system. For example, when I moved the word-cataloging code from the Mac to PM, I decided to add a fancy way to choose the input file. The Smalltalk/V PM environment has a nifty “Browse Disk” menu option. It activates a multipane window that works like PM’s own File Manager. The browser is an instance of a Smalltalk class called DiskBrowser. So I created another instance,

```
DB := DiskBrowser new open.
```

I selected a directory and a file and then asked the Smalltalk object inspector to unpack DB. It showed me that two instance variables, selectedDirectory and selectedFile, held the information. I needed the Class Hierarchy Browser, so I selected them from the Class Browsers. The Class Browser’s messages asset (return yourself without selectedDirectory and selectedFile) was, at the other end of the window, the Class Browser’s message editor, which looks to Smalltalk like just an ordinary window class. The checkmark selects multiple items. It replaces the traditional interpreted “image” with a true OS/2 executable file, into which methods incrementally compile. That executable file, along with dynamic-link libraries containing necessary runtime support, constitutes a stand-alone PM program—and a pretty fast one at that.

Finally, the traditional scheme for organizing an application’s windows, the “model-Pane-Dispatcher” class triad, has evolved into a more natural system based on a new class, ApplicationWindow. The new PM class hierarchy compromises Smalltalk/V’s portability to a degree. If you rely on the new classes (although you don’t have to), your code won’t be guaranteed total transportability to other Smalltalk/V platforms until the new system becomes standard across the product line.

There is no magic bullet. Modern graphical programming is a tricky business, and programming for multiple platforms is even trickier. The results, however, are worth the effort, particularly to the user community. I think that the latest incarnation of Smalltalk/V will spark renewed interest in Smalltalk as an appropriate technology for building portable, user-interface-intensive programs.

There are still more surprises to come. At the 1989 OOPSLA show, an object-oriented database company called Servio Logic showed a Smalltalk application coupled to its GemStone server. What looked to Smalltalk like just an ordinary database was, at the other end of a network cable, an industrial-strength database. Now there’s an architecture for the 1990s.

Jumping Through HOOPS
Now that desktop hardware can do reasonable three-dimensional graphics, there’s a large and growing demand for software that can work with 3-D models. The ability to display and manipulate representations of landscapes, machinery, furniture, buildings, and anatomy is revolutionizing a number of engineering and medical disciplines.

One approach to creating portable software for these markets is to build on top of a commercial 3-D CAD package. Most of the leading ones come with tools that you can use to build customized applications. Several, including AutoCAD, MicroStation, and VersaCAD, run on multiple platforms. Or you could use HOOPS (Hierarchical Object Oriented Picture System) from Ithaca Software. It is a general-purpose 3-D graphics library, with both C and FORTRAN bindings. It runs on all
the high-end Unix workstations, as well as the Macintosh and (with the help of a DOS extender) 386 PCs (a PM version should be available by the time this article sees print). Several leading PC CAD vendors have incorporated HOOPS into the 386 versions of their products to take advantage of its fast rendering capabilities. So it's clear that HOOPS doesn't trade performance for portability.

I've worked with the 386 and Macintosh versions of HOOPS. Central to its architecture is a database of 3-D geometry—points, lines, and polygons—organized as a hierarchy of named segments.

A typical HOOPS program creates a bunch of segments and inserts geometry into them. Then it sets attributes to control things like the size and location of the display window, the orientation of the model, and the method of rendering (wire-frame or solid). HOOPS automatically makes the screen represent the current state of the database, so there's no redraw function to call.

The hierarchical database means that HOOPS programs can be much more flexible than most CAD programs are. The layers that CAD programs typically use to organize models are nothing more than electronic transparencies. While that approach yields the outputs that architects and engineers professionals require, a hierarchical scheme can better represent complex structure and interrelationships. For example, because a subordinate segment in a HOOPS database inherits the orientation of its parent, a model is implicitly animatable.

This method of organization is the basis of HOOPS's claim to be object-oriented. The program is mainly declarative: It classifies and describes physical structures and lets HOOPS worry about how to display and render them. It must also contain user-interaction code so you can tell the database things like "Turn the model 30 degrees to the left."

**HOOPS and You**

HOOPS handles the user interface in a fairly heavy-handed way. It wraps its own event loop around the screen, keyboard, and mouse. When you perform a mouse-click, HOOPS provides the name of the segment you pointed to. You can implement a menu by creating segments with names such as $picture/menu/file, displaying appropriate text in them (e.g., "File Options"), and setting up the program to react to hits in those segments.

Ithaca Software realizes that it underestimated the GUI juggernaut when it designed HOOPS this way. Although most commercial graphics and CAD programs create their own user interfaces, people really do want standards. There's no shortage of standards to choose from, but it's reasonable to expect a PM, Mac, or X Window program to obey the local conventions.

So, although it's easier to let HOOPS run the show, you can arrange for it to share screen space and event processing with the host's GUI. Fair warning: This is easier said than done. Nevertheless, HOOPS is a remarkable toolkit. If you want to incorporate 3-D geometry into portable applications, you will want to investigate it.

**Design Away with Design/OA**

MetaDesign, from Meta Software, is an innovative graphical editor that is available on the Macintosh and under Windows and X Window. The editor helps you to build intelligent diagrams made of nodes and connectors. Nodes automatically maintain their connections when they are moved, making hierarchical networks of nodes easy to create and navigate. In fact, a node hierarchy with attached chunks of text acts like a hyper-text document.

These features are often found in computer-aided software engineering tools, and MetaDesign is in fact marketed as a cross between a graphical outline processor and an entry-level CASE tool. But that's really just the tip of the iceberg.

MetaDesign grew out of long-term research into systems analysis. The company's founders, experimenting with a formal technique for analyzing concurrent systems, built the graphical toolkit that they needed to create representations and executable models of such systems. That toolkit has two manifestations: MetaDesign, a basic graphical editor, and Design/OA, the open-architecture version for building specialized applications on top of the basic editor.

Meta Software has used Design/OA for vertical-market applications that analyze transaction processing in, for example, the banking industry. Other applications include a graphical interface to a relational database, and a hypertext word processor for programmers.

**The R Factor**

Design/OA thoroughly insulates you from the underlying operating system and its GUI. Working with the toolkit is a lot like working with a programmable text editor. You're given a fully functional program and access to its primitives, which you can deploy to specialize the program.

The Design/OA kernel handles the main event loop and manages the display of the current diagram. An application can intercept and react to menu choices and other events (such as the double-click) and then pass them along to the kernel (or not). With calls to $Dsmenu_delete and $Dsmenuadd, the kernel can customize the default menu system, so an application need not look just like MetaDesign.

Two particularly interesting events that an application might want to capture are the node-creation and node-connection operations. The demonstration program that comes with Design/OA captures them to implement an editor that handles a kind of formal diagram called a predicate/transition net.

The modified editor enforces a graphical syntax: It associates types with nodes, requires you to label nodes and connectors, and implements rules like "a transition node can't be connected to another transition node." Dialogues triggered by the creation of a node gather and store information about the node. Syntax-checking routines monitor all requests to connect the node.

With Design/OA, it's pretty straightforward to add interesting and useful extensions to MetaDesign, and easy to move the results from one platform to another. As with any full-blown programming environment, there's a lot to be learned, and the Design/OA documentation (which essentially consists of a couple of sample programs and an alphabetical list of functions) isn't as much help as it should be. But if an application requires intelligent diagramming and has to be portable, Meta Software is a place to look for one.
Mixed-Network Data Management

With all the fanfare surrounding the new generation of server-based database software, it's easy to sneer at the old-fashioned, workstation-based programs. However, for many applications, it's not necessary to locate processing and data in the same box.

Multuser databases that rely on simple file- and byte-range locking to synchronize access to shared data can be quite effective. It's true that a server-based application transmits fewer packets, but how many databases used in typical office situations sustain a transaction intensity that is likely to choke a network?

The reality is that multuser dBASE and dBASE-compatible like FoxBase, though hardly leading-edge, are nonetheless effective toolkits for building applications that manage shared data. When the toolkit spans the PC-to-Macintosh gulf (as FoxBase does), and when you have both PCs and Macs hanging off your network (something that Novell, 3Com, and TOPS all support), things can become pretty interesting.

My XVT project yielded a simple multuser database that ran almost identically on PCs and Macintoshes. The problem was that it was too simple: It had no indexing, keyed-searching, or data-definition capabilities. One solution would have been a portable database library. But the ones I investigated didn't support locking on mixed PC and Macintosh networks. So I looked into FoxBase, which does.

Environmentally Fit

If you've never seen FoxBase on the Macintosh, you'll be amazed at what the Mac interface does for the stodgy "dot prompt" that the PC FoxBase inherits from dBASE. With multiple browse windows, you can see linked databases side by side. Horizontal and vertical scroll bars make browsing easy. To freeze columns (i.e., make them immune to horizontal scrolling), you just drag a divider from the left margin. The view window displays icons for open databases, and arrows for the relational links between databases. You can even set up links by clicking and dragging.

A typical FoxBase application opens databases and index files and then deploys a couple of tools—the browser and the record editor—under program control. In a multuser situation, an application should do an RLOCK (record lock) on your behalf if you ask to edit a record, notify you of the success or failure of the lock request, and take the appropriate action in either case.

Fox claims that the code required to do these things ports transparently from the PC to the Macintosh. That's basically true, but I did end up making some adjustments to the application I wrote. The APPEND command on the Macintosh didn't quite work as advertised (although there's an acceptable workaround), and PC-style pop-up menus don't retain their look and feel on the Mac (although you can use the Mac's menu bar instead). Fox's newest PC product, FoxPro, emulates (in character mode) FoxBase/Mac's interface. So the forthcoming multuser FoxPro should work even more smoothly with FoxBase/Mac.

I'd have preferred the simplicity of identical source code, but the changes were minimal and the end result—PC and Mac users sharing a common database—was well worth the trouble. Imagine the convenience. Whether you're using a Mac or a PC, you have access to the exact same data from both machines. No copies, no keeping multiple versions updated.

In Praise of Diversity

Walk into a typical office, and you're likely to find an eclectic mix of computers. The fact is, different machines excel at different things. I use a PC and a Mac and wouldn't want to give up either one. I prefer most Mac applications to their PC counterparts, but for writing and programming I'll take the PC with its faster character mode. When X Window-based applications become common, I'm sure they will have their advantages and disadvantages, too.

Using portable toolkits, developers don't have to target one market at the expense of all others, and users can run similar or identical applications on dissimilar machines. This is important now, and will become more important as networks that encompass diverse machines continue to flourish. It enables you to maintain your choice of hardware while staying fully functional within your work environment. Freedom of choice survives.
The Highly Decorated General Northgate

A bit pushy? Not at all. General George Patton would, on occasion, walk around with all of his medals in place. So would Generals Douglas MacArthur and Dwight D. Eisenhower when the spirit grabbed them.

And Samuel F.B. Morse, father of an earlier form of communications, before the world became computerized. (If you think we're making this up, check out Morse's be-medaled photo on the back page of this special Northgate insert.) In the meantime, we could go on and on with the reasons to buy a Northgate system, but we thought the awards said it better than we could.

5. Computer Shopper “Best Buy” awards, three years in a row, based on a vote of the magazine’s readers. Best Buy — complete computer system • Best Buy — overall (all products advertised in the magazine) • Best Buy — Input device: Northgate Omnikey Keyboard.
6. Infoworld. In April of 1989, they saluted Northgate’s Elegance 386/25 with the headline: “The Elegance 386/25 among the fastest 25-MHz systems” (Infoworld, April 10, 1989). In November, in their review of our Elegance 386/33, they said the following: “Northgate’s Elegance 386/33/2000 computer is a top product in most of our scoring categories including value, where it earns just the second excellent mark we’ve awarded to 33 MHz systems.” Overall rating 9.1, their highest ever.
7. PC Magazine “Editors’ Choice” award: Northgate’s Omnikey Keyboard. 8. “The Northgate Humility award” given to the most modest computer company in Plymouth, Minnesota. So there you have it. And the year is still young. Northgate: “Semper Humilis.” (Forever Humble).
*“1a. Refinement and grace in movement, appearance or manners.
b. Tasteful opulence in form, decoration or presentation.
2. Something that is elegant.” (American Heritage Dictionary)
You said it.

Since at least three of the medals garnered by General Northgate were for our highly acclaimed Elegance series (triple Editors’ Choice awards from PC Magazine, for example), we thought we’d show you what the machine looks like and give you a few specs in case you might be inclined to buy this elegantly designed state-of-the-art computer.

First of all, to photograph an elegant machine... you need an elegant photographer. So we went to the most highly respected lensman in Hollywood: Harry Langdon. He normally lights and shoots such famous faces as Linda Evans, Victoria Principal, Cher, Arnold Schwarzenegger and Diana Ross, to name just a few. So shooting a different pretty face like a Northgate Computer is all in a day’s work for Harry. For one thing, Northgate doesn’t need a hairdresser.

The Elegance series to your left comes in three versions: The 20 and 25 MHz models, and our top of the line/highest performance Elegance: the 33 MHz which earned a 9.1 rating in InfoWorld.

The price of the complete 386™ 33 MHz Elegance system pictured: $5995.00. (Of course, you can buy a fully configured Elegance system starting at $3395.00.)

The only thing more impressive than the price is the tech support which comes along with our usual 1 year parts and labor warranty. Did we mention that we also ship you replacement parts, should they be needed, overnight at our expense? And that our tech support people are actually here for you 24 hours a day, every day, every night?

Put us to the test: give us a call some night at midnight. Or 3:00 AM.

Now to the specs:

Technobabble™

*Seemingly endless Technical specifications, without which you aren’t about to buy this machine no matter how many awards it’s won.

Not only that...would this look like a real computer ad without them? Probably not. Here they are:

STANDARD CONFIGURATION
- 33 MHz Intel 80386 processor
- 150 MB ESDI Hard Drive 16MS.
- 4 MB Ram.
- 64 KB Read-Writeback Cache
  (Optional 256 KB Cache available)
- Zero wait state performance.
- 1.2 Mb—5.25” floppy drive (also reads, writes and formats low density diskettes).
- 1.44 Mb—3.5” floppy drive (also reads, writes and formats low density diskettes).
- Eight expansion card slots
- 80387 or Weitek coprocessor support
- Two serial ports and one parallel port (two with monographics systems)
- 14” Multifrequency VGA Color Monitor
  1024x768 resolution with 16 bit controller.
- Sleek new Elegance 7 drive-bay custom vertical cabinet pictured.
  (Desktop style optional, save $150.00.)
- Exclusive award winning Omnikey Keyboard.
- 24 Hr 7-days a week tech support: unlimited toll free phone.
- Additional Technobabble available upon request

NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North
Plymouth, Minnesota 55441-4100
1-800-548-1993
Northgate, OMNIAVY, OMNIKEY PLUS, and the Northgate™ logo are trademarks of Northgate Computer Systems, Inc. All other product and brand names are trademarks and registered trademarks of their respective companies.
CREATED & PRODUCED BY FREDERG LTD.
© NORTHGATE COMPUTER SYSTEMS, INC. 1990.
ALL RIGHTS RESERVED.
386 IS A TRADEMARK OF INTEL CORPORATION
Slimmer. Trimmer. The world's smallest 386, standing not even as tall as America's favorite diet cola. Obviously Northgate has lost a few pounds.

At least in the 386/20 pictured above. But it hasn't lost anything else. How do we pack a 20 MHz real 386 system with a 40 MB hard drive into this space saving, smallest 386 ever introduced?

We do it.

It comes with a VGA monitor and all the usual Northgate guarantees.

Slim price too: $2,499.00 for the entire system. Let's see the competition match this.

Come to think of it...there is no competition. This is one of a kind. A Northgate original. If you're thinking of slimming down, call 1-800 548 1993, and we'll tell you more about it.

Of course we still make the bigger 386. It's up to you.

Northgate Computer Systems: regular or diet.
DID WE MENTION

24

HOURS/7 DAYS A WEEK
TOLL-FREE TECHNICAL SUPPORT

NORTHGATE COMPUTER SYSTEMS, INC.
1-800-548-1993
The Three Greatest Myths:

1. The world is flat.
2. If humans were meant to fly, they'd have wings.
3. All 3780 software is alike.

The fact is, there's one 3780 PC-to-mainframe solution that stands apart.

It's 3780Plus, from CLEO Communications.

Our 3780Plus software is the leading 2780/3780 PC-to-mainframe connectivity solution for EDI, IRS electronic filing, and other data transfer applications.

Our 3780Plus software is the leading 2780/3780 PC-to-mainframe connectivity solution for EDI, IRS electronic filing, and other data transfer applications. 

Supports MS-DOS, VMS, and UNIX/XENIX operating systems.

Users prefer 3780Plus for one simple reason: It works. With over 35,000 worldwide installations, it's guaranteed to connect to any major network.

With 3780Plus, you get complete IBM 2780/3780 terminal emulation for IBM PCs, PS/2s, and compatibles. It also works with VAX, HP9000, NCR Towers, and lap-top systems, among others. It supports MS-DOS, VMS, and most leading UNIX operating systems.

Users find 3780Plus easy to install and use. In one fully integrated package, it provides forms control, auto dial/auto answer, attended or unattended operation, and a communications line monitor. You also get our Scripting Command Language (SCL) and Application Program Interface (API).

We offer 3780Plus on high-speed modem boards, high-performance co-processor boards, and economical synchronous interface boards, as well as our intelligent SYNCable, which links to your host through your PC's serial port.

To learn the facts — just the facts — about our unique, proven 3780Plus solutions, call us today at 1-800-233-2536. Or write to us at 3796 Plaza Drive, Ann Arbor, Michigan 48108. FAX: 313/662-1965.

CLEO Communications
A Division of Interface Systems, Inc.
Total applications architectures that create a single environment across multiple platforms don’t apply to microcomputers—or do they? They do if the choice of such an architecture affects whether or not you can keep your favorite microcomputer. They do if that choice affects what operating systems you can use. And they do if you’re trying to create a more productive environment where changing jobs doesn’t involve retraining computer skills.

Currently, two total applications architectures are available, one each from IBM and Digital Equipment Corp. A third one is also in the works (see the text box “An Open Approach” on page 246). IBM, with its Systems Application Architecture, and DEC, with its Network Applications Support, are the major players in this arena. The similarities and differences between SAA and NAS are endlessly debated and will continue to be, for they are IBM’s and DEC’s software blueprints for the 1990s.

**Systems Application Architecture**

When SAA was introduced in 1987, IBM was suffering from increasing demands among its customers for compatibility across its divergent platforms. DEC underlined that pressure with its now famous “one operating system” message. DEC could claim a common programming environment across an entire hardware line: the VAX. IBM could not. In addition, the VAX’s range of performance was rapidly encroaching on the range that IBM covered with its microcomputer, minicomputer, and mainframe platforms.

SAA is an attempt to provide common ground for a selection of IBM’s platforms with the structure shown in figure 1. The platforms are OS/2 Extended Edition (for microcomputers), OS/400 (for minicomputers), and, within its S/370 (mainframe) hardware architecture, the VM/SP and MVS operating systems (subsystems TSO/E, CMS, CICS, and IMS). CICS and IMS, as transaction-processing monitors, are participating systems; only the relevant elements are supported for these.

SAA is divided into three parts: Common Communications Support (CCS), Common User Access (CUA), and Common Programming Interface (CPI).

CCS identifies the following communications options to be implemented across SAA’s platforms: Data streams—3270, Document Content Architecture (now MO:DCA [mixed-object DCA]), Intelligent Printer Data Stream; Applications services—System Network Architecture’s distributed service, Document Interchange Architecture office system, SNA Network Management...
Architecture; Session services—LU 6.2; Network control—Low-Entry Networking (Type 2.1 nodes); and Data-link controls—Synchronous data-link control, Token Ring network.

The inclusion of IBM’s LU 6.2/APPC (advanced program-to-program communications) interface provides SAA’s solution for program-to-program connections between IBM computers. This is the major reason IBM people and others sometimes characterize SAA as an extension of SNA.

CUA identifies the elements of the user interface that must be supported across the various platforms, including keyboard, mouse, stream layouts and palettes, applications flow, and user interaction with applications.

CPI provides a common programming environment for all SAA operating systems. This includes specifying and using an identical set of language implementations. The chosen ones are C, COBOL, and FORTRAN (being implemented in that order), and RPG and PL/I (added to SAA in 1989). In addition, CPI specifies the use of the IBM Cross System Product applications generator and the REXX command-procedures language.

CPI also provides common application programming interfaces (APIs) that specify how to access key services (i.e., programming support), shown in the center of the standard SAA diagram in figure 1. This support includes Presentation Manager (PM), which is the OS/2 Extended Edition implementation toolkit for the Presentation Interface API, and the relational DBMS of each system that supports the Database Interface.

The system services currently announced are as follows:

• Common Programming Interface (Communications): CPI to LU 6.2/APPC on the various platforms, initially implemented in the CMS subsystem of MVS only.

• Presentation Interface: device-independent APIs for CUA-compliant windowing, keyboard, mouse, fonts, and graphics support based on the S/370 Graphical Data Display Manager (GDDM).

• Dialog Interface: CPI for setting up menus, help functions, data requests, and message selections on user screens.

continued

Figure 1: SAA attempts to provide common ground for OS/2 Extended Edition, OS/400, and certain operating systems within IBM’s S/370 line. This diagram shows the standard colors for the different layers. These layers are often referred to by their colors: the yellow layer, the blue layer, and so on.
THE NEW MICRO-CAP III™
SO YOU CAN TEST-FLY
EVEN MORE MODELS.

It wasn’t easy. But we did it. Made the long-time best-selling IBM® PC-based interactive CAE tool even better.

Take modeling power. We’ve significantly expanded math expression capabilities to permit comprehensive analog behavioral modeling. And, beyond Gummel Poon BJT and Level 3 MOS, you’re now ready for nonlinear magnetics modeling. Even MESFET modeling.

Analysis and simulation is faster, too. Because the program’s now in “C” and assembly language. That also means more capacity — for simulating even larger circuits.

As always, count on fast circuit creation, thanks to window-based operation and a schematic editor. Rapid, right-from-schematics analysis — AC, DC, fourier and transient — via SPICE-like routines. The ability to combine digital/analog circuit simulations using integrated switch models and parameterized macros. And stepped component values that streamline multiple-plot generation.

And don’t forget MICRO-CAP III’s extended routine list — from impedance, Nyquist diagrams and BH plots to Monte Carlo for statistical analysis of production yield. The algebraic formula parsers for plotting virtually any function. The support for Hercules, CGA, MCGA, EGA and VGA displays. Output for plotters and laser printers.

Cost? Still only $1495. Evaluation versions still only $150. Brochure and demo disk still free for the asking. Call or write for yours today. And see how easily you can get ideas up and flying.

1021 S. Wolfe Road
Sunnyvale, CA 94086
(408) 738-4387
• Database Interface: implemented in Structured Query Language (SQL).
• Query Interface: query and report-writing facilities.
• Repository Interface.
• Distributed Data Management (DDM).

As platform-specific implementations of SAA generally support additional functions, you must use the CPis with CCS and CUA specifications to ensure applications portability. For example, IBM is redesigning many applications to conform with SAA and may still support some of their original functions as well.

If you use nonconforming functions, your application might not be portable to other SAA platforms.

On the other hand, IBM ensures that source code written to the "ordered subset" of functions that SAA supports in the CPis will endure, whatever enhancements may be made in the future.

IBM has not yet implemented all the elements of SAA: Internal guidelines state that SAA support on one platform must be followed with support on all the other platforms within two years. But SAA is not static. Repository Interface was announced in September 1989, and IBM is planning its first implementation on the MVS operating system for June.

Network Applications Support
While IBM is providing applications integration for its own systems, DEC is going ahead with integrating Unix and providing interoperability with desktop platforms—VMS, its proprietary operating system, and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. SAA does not address this mission at all.

As IBM's development of its Unix environment (AIX) has been on a separate track for the first three years of SAA's existence, DEC's Unix support may be an advantage that will stand for some time. But then, strong in technical computing where Unix has its bedrock, DEC

Figure 2: AIA provides the architectural categories for NAS. NAS attempts to integrate Unix and provide interoperability with VMS and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. The colors used group like elements together but do not have the significance of the colors in figure 1.
has had more reason to focus on Unix.

The NAS scheme provides applications on the five platforms mentioned with access to common services that run under VMS and Ultrix. Those services may exist on larger machines or on the VMS or Ultrix workstations. (VMS and Ultrix workstations can perform as servers as well as clients. The other three desktop computers are clients only, although a server role may be in the future for OS/2.)

In addition, DEC claims greater openness for NAS because it is based on de facto and de jure industry standards. SAA's ingredients may or may not adhere to standards: It's not in the charter. However, many of them do, and whatever IBM does is often so widely implemented that it becomes a de facto standard, anyway. Both companies are trying to drive relevant standards in their respective strategies, especially in integrating new technologies for which standards are just emerging.

DEC uses the label Applications Integration Architecture (AIA) to describe NAS architecturally, according to the structure shown in figure 2. However, NAS is the overall term used. The NAS implementations deliver that architecture and map directly to it. The table on page 242 contains the generic designations AIA supplies for the various pieces of the environment followed by the current names of NAS implementations. Due to NAS's basis in standards, the pieces often match up with various standardization efforts.

Like SAA, NAS reflects much intention as well as reality. For example, DEC's electronic document interchange (EDI) services, although they have been outlined, will not show up until late this year. The slot for Repository services is filled by DEC's Common Data Dictionary/Plus for VMS. Last spring, DEC announced that it will support an API for CDD/Plus based on a draft standard jointly developed with Atherton Technology. The proposed standard is now before standards-review committees.

The API, an Ultrix version of CDD/Plus, and client support for DOS and OS/2 are forthcoming, probably beginning later this year. LiveLinks and Builder in the NAS list are data-link technologies currently offered by DEC in compound-document-architecture (CDA) based applications; DEC plans to make them generic services for NAS.

The System access category also requires explanation. POSIX provides an interface to System services in contrast to the high-level services in the other categories. DEC now supports it in Ultrix, with VMS support to come. This will provide a common portable development environment. The use of POSIX is a possible route to further integration of OS/2 into the NAS scheme, since Microsoft has stated that OS/2 will support POSIX.

Finally, with the sole exception of POSIX, NAS's base in standards does not mean that standard functionality is synonymous with the NAS service functionality. Standardized function is a rarely important component of full-function NAS services, depending on how far a standard has progressed. For example, DECwindows was developed on an X Window System (referred to as X Window for the remainder of this article) base and incorporates a look and feel that is slated to migrate to conformance with the Open Software Foundation's Motif, both fully fleshed-out standards.

On the other hand, DEC's CDA implementation incorporates existing document architecture/open document interchange format standards, as does IBM's MO:DCA, in fact. But those standards are minimal so far, DEC hopes its work in the relevant standards processes will lead to incorporating its technology for tabular data handling and live links, for example, into the standard.

Adherence to industry standards creates an additional dimension to portability and interoperability under NAS that can be significant. The X Window underpinnings of DECwindows, for example, allow DECwindows users to run programs that support X Window even if it was written for another system with a different user interface. In addition, the X Window base is portable.

**Similarities**

SAA and NAS share some generic characteristics. Both provide CPIs that address heterogeneous collections of computing resources. These CPIs allow applications to access the various services that different operating systems deliver. They provide interoperability and greater portability across dissimilar platforms.

In addition, both SAA and NAS are emerging concurrently with new technologies—graphical interfaces, repositories, compound document architectures, and distributed databases. The architectures are important elements in their companies' respective development efforts around new technologies as well as in rewriting programs to bring existing products into line.

Each is a Chinese puzzle of components in various states of conformance.
Computers for the Blind

Talking computers give blind and visually impaired people access to electronic information. The question is how and how much?

The answers can be found in The Second Beginner's Guide to Personal Computers for the Blind and Visually Impaired, published by the National Braille Press. This comprehensive book contains reviews, written by blind users, of software that works with speech.

Send orders to:
National Braille Press Inc.
88 St. Stephen Street
Boston, MA 02115
(617) 266-6160

$12.95 for braille or cassette
$14.95 for print

NBP is a nonprofit braille printing and publishing house

---

### NAS FUNCTIONALITY LIST

The Applications Integration Architecture describes Network Applications Support architecturally. The NAS implementations deliver that architecture. Notice that the pieces of the environment are the same as the services shown in figure 2.

<table>
<thead>
<tr>
<th>Pieces of environment</th>
<th>Generic AIA designations</th>
<th>Current NAS implementations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications access</td>
<td>Windowing services</td>
<td>DECwindows (for VMS, Ultrix)</td>
</tr>
<tr>
<td></td>
<td>Forms services</td>
<td>MS-DOS Display Facility</td>
</tr>
<tr>
<td></td>
<td>Terminal services</td>
<td>DECforms</td>
</tr>
<tr>
<td></td>
<td>Graphics services</td>
<td>DEC GKS</td>
</tr>
<tr>
<td></td>
<td>Application control services</td>
<td>DEC PHIGS</td>
</tr>
<tr>
<td>Communications and control</td>
<td>Messaging services</td>
<td>LiveLink</td>
</tr>
<tr>
<td></td>
<td>EDI services</td>
<td>Builder</td>
</tr>
<tr>
<td>Information/resource sharing</td>
<td>Compound document services</td>
<td>CDA Toolkit</td>
</tr>
<tr>
<td></td>
<td>Data access services</td>
<td>CDA Viewers</td>
</tr>
<tr>
<td></td>
<td>Repository/dictionary services</td>
<td>CDA Converter Library</td>
</tr>
<tr>
<td></td>
<td>File-sharing services</td>
<td>DECimage Applications Services</td>
</tr>
<tr>
<td></td>
<td>Print services</td>
<td>SQL Services</td>
</tr>
<tr>
<td></td>
<td>System access</td>
<td>CDD/Plus</td>
</tr>
<tr>
<td></td>
<td>System services</td>
<td>VMS Services for PCs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NFS for Ultrix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VMS/Ultrix Connection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DECprint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POSIX interface</td>
</tr>
</tbody>
</table>

---

separate implementation that allows the DOS desktop to use a DECwindows application, even though its lack of multitasking prevents it from running as a true DECwindows workstation.

When comparing the lists of functions as definitions of an applications environment, some other differences pop up. SAA's specification of many protocols for communications has no parallel in the NAS list. DEC has provided all NAS platforms with support for DECnet and TCP/IP protocols, and applications built on top of NAS services are network-independent. Also, communications functions in the NAS list are built on the underlying network mechanisms.

### Apples, Oranges, and Sequels

At this stage in their development, even when equivalent NAS and SAA functions have been implemented, a 1-to-1 comparison is elusive and difficult to generalize from. A close look at one case offered in both frameworks, however—SQL database access—illustrates some of the differences between them. It also shows how similar SAA and NAS can be when they both conform to the same standard.

Two comparisons are relevant for clarity. The first addresses DEC's evolving integration of VMS and Ultrix under the NAS umbrella, comparing the current VAX SQL interface for VMS's relational database to SAA's SQL CPI.

The VAX SQL interface is slated to present a common API to the relational DBMS for Ultrix, which DEC is expected to release this year, based on technology licensed from Ingres. As such, VAX SQL is the strict apples-to-apples comparison to SAA's SQL CPI. Listings 1 and 2 show the almost identical steps required to retrieve payroll information in a C application using the VAX SQL and SAA SQL interfaces.

Notably, IBM has been talking about extending the SAA SQL CPI umbrella to embrace its relational DBMS for AIX, for which it initially licensed technology from Oracle. Although this extension would entail communications issues, continued
FOR SALE: DRAWING BOARD, T-SQUARE, DRAFTING PENS...BARELY USED.

It's time to consider computer-aided design and drafting (CADD). Join over 200,000 users who create better drawings faster with Generic CADD. From simple floor plans to detailed engineering drawings, there's a Generic CADD solution to all your drawing needs.

Get started quick with The CADD Starter Kit. Computerized drawing is easier than you think. Create your own drawings and designs in just hours using the Starter Kit's step-by-step tutorials, sample drawings and pre-drawn design symbols.

Draw like a pro with CADD Level 3. Draw blueprints, floor plans and schematics just once... then revisions are just a "stretch," "move" or "copy" away. You can enhance your image while saving time with this precision drawing tool.


It's a real bargain. See your local software dealer to buy the right Generic CADD product for you. Or call us at 800-228-3601, ext. 703 (U.S. and Canada) for the dealer nearest you.


Generic SOFTWARE
A better way to draw.
Listing 1: This C code shows the programming required for NAS’s SQL Services to access data in DEC’s Rdb relational database. Compare this to listing 2. Both programs are in dynamic SQL but use quoted strings to replace user input.

1. To set up program for SQL communications
   ```c
   #include <sqlsrvds.h>
   #include <sqlsrvca.h>
   #include <sqlsrv.h>
   ```

2. To declare SQL variables
   ```c
   char *assoc_id, *stmt_id;
   struct SQLDA *sel_list;
   char name[20], ssn[10];
   int hours_worked
   ```

3. To prepare select statement
   ```c
   sqlsrv_prepare(assoc_id, 0, ”SELECT * FROM PAYROLL WHERE PAY = 0”, stmt_id, 0, &sel_list);
   ```

4. To open cursor
   ```c
   sqlsrv_open_cursor(assoc_id, ”C1”, stmt_id, 0);
   ```

5. To fetch
   ```c
   sel_list->SQLVARARY[0].SQLDATA = &name;
   sel_list->SQLVARARY[1].SQLDATA = &ssn;
   sel_list->SQLVARARY[2].SQLDATA = &hours_worked;
   sqlsrv_fetch(assoc_id, ”C1”, 0, 0, sel_list);
   ```

Listing 2: This C code uses SAA’s CPI to access a relational database. It differs from the VAX SQL in the stmt.len statement, which reformats the input string from C to COBOL format in the IBM case.

1. To set up program for SQL communications
   ```sql
   EXEC SQL INCLUDE SQLCA;
   ```

2. To declare SQL variables
   ```sql
   EXEC SQL BEGIN DECLARE SECTION;
   char name[20], ssn[10];
   int hours_worked;
   struct {short len ;
   char stg[36];
   }stmt;
   EXEC SQL END DECLARE SECTION;

3. To prepare select statement
   ```sql
   stmt.len = 35;
   stmt.stg[”SELECT FROM PAYROLL WHERE PAY = 0”,35];
   EXEC SQL PREPARE SELECT1 FROM :stmt;
   ```

4. To open cursor
   ```sql
   EXEC SQL DECLARE C1 CURSOR FOR SELECT1;
   EXEC SQL OPEN C1;
   ```

5. To fetch
   ```sql
   EXEC SQL FETCH C1 INTO :name, :ssn, :hours_worked;
   ```

necessitating an interface for LU 6.2 and TCP/IP, it may be one of the first steps IBM takes to merge the separate path of AIX development with SAA. NAS provides database access from the desktop platforms via SQL Services as client/server software. The emphasis is on relieving the client of as much processing as possible due to the memory and processing limitations of DOS.

As the primary results, NAS’s SQL Services omits the use of precompilers and supports only dynamic SQL (rather than dynamic and static SQL, as in both VAX SQL and SAA). Dynamic SQL software analyzes statements at runtime, the function that permits ad hoc queries. The server can perform this analysis in the NAS scheme, so you don’t have to run a precompiler locally.

Programming for OS/2 Extended Edition queries under SAA is somewhat simpler than programming for DOS using NAS’s SQL Services. Still, SAA does not support DOS. In addition, code written to the NAS API for DOS is portable to other supported NAS platforms. So far, DEC supports SQL Services for VMS, Ultrix, and DOS clients.

However, the DOS deficiencies arbitrate unnecessary restrictions on the other two platforms. When DEC provides a common SQL for Ultrix and VMS relational DBMSes, it will probably introduce an unrestricted optional version of SQL Services for those systems as clients. They will remain clients, however. The other ingredient of SQL Services is establishing a session between the desktop and the remote host that has the database.

In SAA, the remote connection is established transparently. IBM plans to incorporate LU 6.2 communications capabilities into its relational DBMSes on all SAA platforms; that is, into Database Manager on OS/2 Extended Edition, into the integral relational DBMS of OS/400, into SQL/DS for VM, and into DB2 for MVS. A catalog and optimizer in each system determine where remote data is located.

In this transparent distributed database-access scheme, a query goes to the local database, which determines the location of the remote database being accessed. At the present time, transparent access is supported only between like systems. From an OS/2 Extended Edition system, the program in listing 2 could retrieve data from a database on another OS/2 Extended Edition system, but not from DB2.

DEC plans to provide a SQL Services API for OS/2 this year. In addition, DEC
and Apple are jointly developing Mac support for NAS. Last May, Apple announced that a SQL Services product supplying a VMS server and an API for the Macintosh will be forthcoming.

Both IBM and DEC support the ISO/ANSI X3.135 standard for SQL, each with its own extensions. However, NAS supports some 54 functions compared to 19 in the SAA CPI.

**Current Directions**

This year, DEC is likely to move a remote procedure call into its lineup. Program-to-program applications have been held back in the past because DEC never provided an easy-to-use API for the sophisticated bidirectional communications services in DECnet. As IBM backs up its new LU 6.2 CPI with more support, such applications will become more attractive, and DEC is expected to jump ahead to incorporate the RPC as a service in NAS.

As the flow of DECwindows and PM implementations from third-party sources increases to more than a trickle, it will be interesting to see if IBM comes out with high-level communications support. This would allow applications on remote systems to open windows on the PS/2s, fulfilling one of IBM’s aims: to off-load mainframes from having to do screen management.

It will also be interesting to see how open IBM’s protocols will be. Right now, DECwindows, with the X Window base providing that capability across a network, is far more attractive. While SAA leaves you on your own for high-level support, DECwindows allows you a variety of options. In addition to building DECwindows applications, you can build compatible workstations, alternative network services, and applications with a look and feel suited to custom environments.

**Keeping Score**

How do NAS and SAA stack up in the microcomputer arena? Clearly, at this time and for plans currently in place, DEC has the edge. NAS supports DOS; SAA does not. NAS supports the Macintosh; SAA does not. NAS supports Unix; SAA does not. The tally is not entirely one-sided, however. Both NAS and SAA support versions of OS/2, and both support forms of SQL.

In addition, both IBM and DEC claim adherence to standards, although DEC seems to be more serious about it. IBM is accustomed to being able to influence the setting of standards by brute force: If IBM does it, then it will probably become a de facto standard. DEC is also trying to influence standards in its favor: DEC is intensifying its participation in the industry processes for standards setting.

NAS and SAA show transformations in DEC’s and IBM’s approaches to the 1990s as the two vendors who most loudly claim the ability to mastermind enterprise-wide computing. They are only just beginning to make their marks. New players are entering the field, and IBM and DEC are still jockeying for position. Keep your scorecards handy.

**ACKNOWLEDGMENT**

Thanks to Harold Lockhart, senior consultant at Technology Concepts, Inc. (Sudbury, MA), for writing the listings. Sheila Osmundsen is an industry analyst in Boston, Massachusetts, who specializes in tracking DEC and IBM. She can be reached on BIX c/o “editors.”

---

**HAVING TROUBLE FINDING ALL THE INFORMATION YOU NEED ON UNIX®?**

**TAKE THE FIRST STEP... CALL DATAPRO TODAY!**

If you’re looking for detailed analysis of the critical issues surrounding UNIX... if you need timely information on the products and key players in the industry... then turn to Datapro Reports on UNIX Systems & Software.

Updated monthly, this unique new information service is designed to help you discover the opportunities UNIX offers... decide how UNIX fits in your organization... optimize results while minimizing risk.

UNIX® is a registered trademark of AT&T.

Each month, Datapro Reports on UNIX Systems & Software brings you in-depth analyses of everything new and noteworthy in the UNIX market. You receive the most up-to-date, thoroughly researched information available. Information you can put to use in planning your own UNIX strategies.

Find out how much of a difference Datapro can make to your decision-making: call us today at 1-800-DATAPRO (1-800-328-2776) or use the reader service card.

---

Circle 312 on Reader Service Card
An Open Approach

Herb Osher

In today's multivendor environments, it is difficult, if not impossible, to completely integrate information artifacts—a Macintosh desktop, a Unix mail message, a Lotus 1-2-3 spreadsheet—without trade-offs.

A technical writer, for example, may value the Mac's user-friendly interface, but struggle when accessing data on DOS-based PCs over a Token Ring LAN. A CAD/CAM expert may prize a high-performance Unix workstation for mathematical analysis, but hit a brick wall when trying to include data residing on an IBM mainframe. Although there are many ways to share data in mixed environments, little progress has been made in integrating applications across proprietary systems.

Major innovations in the microcomputer world of the 1990s will most likely come from the development of distributed architectures based on industry standards. In recent years, Data General has been creating such an architecture that targets open systems: Distributed Applications Architecture (DAA).

The Architecture

DAA is a set of written specifications and software products that allows you to integrate distributed applications across mixed environments. It gives you a consistent view of data, applications, and services no matter what machine or operating system you use. DAA is based on the client/server computing model. It's not limited to one hardware or software environment. Clients are portable to a range of operating systems, and servers to new hardware architectures that support Unix V release 3.

The architecture provides an integrated environment for those who write applications to a variety of standards. It also integrates popular shrink-wrapped applications. The standard environments that DAA supports include DOS, OS/2, Unix, POSIX, and the Motorola 88000 Binary Compatibility Standard.

Data General began announcing products based on DAA in 1989. In February, it launched the AViiON family of computers—servers and workstations based on the 88000 RISC chip and a version of Unix called DG/UX. The AViiON systems comply with the

<table>
<thead>
<tr>
<th>DAA'S DISTRIBUTION OF LAYERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-powered workstation (Unix, OS/2, Macintosh)</td>
</tr>
<tr>
<td>User Interface</td>
</tr>
<tr>
<td>Operating system</td>
</tr>
<tr>
<td>Backplane</td>
</tr>
<tr>
<td>Unix V.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Low-powered workstation (DOS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Interface</td>
</tr>
<tr>
<td>Operating system</td>
</tr>
<tr>
<td>Backplane</td>
</tr>
<tr>
<td>Unix V.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nonintelligent workstation (Terminal, X Window terminal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Interface</td>
</tr>
<tr>
<td>Operating system</td>
</tr>
<tr>
<td>Backplane</td>
</tr>
<tr>
<td>Unix V.3</td>
</tr>
</tbody>
</table>

Figure A: The applications-access point (AAP) and service-access point (SAP) are industry-standard remote procedure calls that allow you to configure DAA for different workstations. Notice how the distribution of layers depends on the sophistication of the workstation used. (The red shows the portion residing on the server; the blue shows that on the clients.)
Software backplane allows you to plug in services such as mail, calendar, and database components, and object-management services are provided at the presentation, function, and data management levels.

In addition, DAA is a complete implementation of a distributed architecture. This encompasses a backbone of software services (e.g., object database, communications link, name, authentication, notification, and systems management services). Similar to a hardware backbone design, DAA's software backbone allows you to plug in services such as mail, calendar, and print, and to expand to other services when necessary. DAA also provides a set of application programming interfaces (APIs) based on remote procedure calls (RPCs) used to integrate distributed applications across networks.

The Clients
The DAA platform is organized into user communities. It connects clients across LANs and wide-area networks to geographically dispersed servers. This environment can consist of various heterogeneous computing components using a mix of operating systems such as Unix, DOS, OS/2, and the Mac OS.

Clients are logical workstations that can run on RISC-based Unix workstations, Macs, PS/2s, PCs, and ANSI and X Window System terminals. The DAA platform provides you with a common user environment across workstation clients using any of the following: Microsoft Windows and Hewlett-Packard's NewWave for PCs; Open Software Foundation's Motif for Unix workstations; Presentation Manager for PS/2s; and text-based menu interfaces for ANSI and X Window terminals. A Mac implementation will preserve the traditional Mac look and feel.

Based on an object-oriented paradigm, the logical workstation includes functional objects, such as an in-box object and related methods like read, reply, and forward. Functional objects provide functionality at the application level and interact with presentation objects, which provide a view of the functional objects. In addition, clients can integrate popular shrink-wrapped software as applications-level objects to run on PCs and workstations. A local object manager manages these objects.

The client also has access to two powerful mechanisms that leverage functions and services scattered across multiple clients and servers (see figure A). An applications-access point (AAP) allows presentation objects to transparently invoke functional objects that may reside on a client or server. The service-access point (SAP) interface connects the functional objects on the logical workstation with service objects in the object database. The SAP defines the place where the functional objects plug into a DAA server backbone. You can build custom-integrated applications using the SAP interface.

The Servers
The DAA servers consist of communications links, service-providing shared computers, and their peripherals. The server is composed of a service backbone with service objects built on it. It can span more than one physical computer.

At the heart of the object-oriented computing platform is the object database. A component of the service backbone, this database stores all objects, including services. Objects are self-contained units that encapsulate the data and the methods that manipulate it. Object orientation enables DAA to define its objects using high-level abstractions. The database is based on an extension of the SQL model and operates with a range of SQL relational database systems, such as Informix, Oracle, Ingres, and Sybase.

The API available to clients, the SAP, makes RPCs to methods in objects in the database. The DAA platform provides a library of basic objects. It also provides a library of presentation objects that supports a common user interface based on a HyperCard-like model.

The service backbone also houses additional services. An X.500-based name service keeps track of all user names, workstations, and services. Communications links, to allow workstations and services to communicate transparently, are based on industry-standard RPCs, like NetWise. An authentication service enables client and server to authenticate themselves and guarantee secure sessions. A notification service notifies you of changes in status, like new mail. The backbone also houses systems management services for distributing software and managing networks, users, and objects.

The Networks
Users, clients, servers, and the objects associated with them are organized geographically into groups called domains and communities. Domains and communities provide a home, or address, for these entities and an organization that is the basis for system management.

A domain is a group of users, a list of clients and servers, and all the objects that these clients and servers own. The system can authenticate, register, and centrally manage all users and services within it. A community is a collection of interconnected domains. No central authority controls its members. Rather, a loose federation of domains exists.

As an open architecture based on industry standards, DAA can communicate with other environments. For example, it embraces Data General's Systems Application Architecture communications strategy, which is aimed at compliance with SAA protocols. This architecture allows a meaningful subset of SAA applications to execute in DAA client/server environments. It also provides extensive support for cooperative processing and data distribution between SAA and DAA applications.

At the transport level, the platform is based on Data General's Open LAN architecture, which allows integration over TCP/IP, Novell NetWare, LAN Manager, Token Ring, Open Systems Interconnection, and AppleTalk networks. OSI standards are used as the basis for DAA's naming and management services.

A Single-System Image
DAA presents an open approach to computing in the 1990s. The architecture significantly reduces the trade-offs commonly experienced when you integrate popular operating systems, workstations, interfaces, and applications in today's multivendor environments.

DAA provides much information-processing power, with network-based applications distributed optimally throughout the system. It creates a unified single-system image among heterogeneous computing environments.

Herb Osher is division director of the Office Systems and Distributed Computing Group at Data General Corp. (Westborough, MA). He can be reached on BIX c/o "editors."
Building Blocks

The future course of applications software depends on the interplay of diverse concepts, standards, products, and market forces. For more information on the elements discussed in this section, contact the organizations listed below.

ANSI X3.135 (SQL)
American National Standards Institute (ANSI)
1430 Broadway
New York, NY 10018
(212) 354-3300
Inquiry 1051.

CL/1
Finder
MultiFinder
QuickDraw
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 1052.

DECnet
DECwindows
Network Applications Support (NAS)
Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(508) 493-5110
Inquiry 1053.

Design/OA
MetaDesign
Meta Software
150 Cambridge Park Dr.
Cambridge, MA 02140
(617) 576-6920
Inquiry 1054.

DESQview
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9851
Inquiry 1055.

Distributed Applications Architecture (DAA)
Data General Corp.
4400 Computer Dr.
Westborough, MA 01580
(508) 366-8911
Inquiry 1056.

88open Binary Compatibility Standard
88open Consortium, Ltd.
8560 Southwest Salish Lane,
Suite 500
Wilsonville, OR 97070
(503) 682-5703
Inquiry 1057.

FoxBASE+
FoxBASE+/Mac
Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162
Inquiry 1058.

GEM
Digital Research, Inc.
Box DRI, 70 Garden Court
Monterey, CA 93940
(408) 670-3866
Inquiry 1059.

GemStone
Servio Logic Development Corp.
1420 Harbor Bay Pkwy., Suite 100
Alameda, CA 94501
(415) 748-6200
Inquiry 1060.

HOOPS
Ithaca Software
902 West Seneca St.
Ithaca, NY 14850
(607) 273-3690
Inquiry 1061.

Interface Builder
NextStep
NeXT, Inc.
900 Chesapeake Dr.
Redwood City, CA 94063
(415) 366-0900
Inquiry 1062.

LU6.2/APPC
OS/2 Extended Edition
Presentation Manager
Systems Application Architecture (SAA)
IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 1063.

MS-DOS
OS/2
Presentation Manager
Windows
Windows/286
Windows/386
Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
Inquiry 1064.

NewWave
Hewlett-Packard Co.
3000 Hanover St.
Palo Alto, CA 94304
(415) 857-1501
Inquiry 1065.

Open Look
Unix International, Inc.
Waterview Corporate Centre
20 Waterview Blvd.
Parsippany, NJ 07054
(201) 263-8400
Inquiry 1066.

OSF/Motif
Open Software Foundation
11 Cambridge Center
Cambridge, MA 02142
(617) 621-8700
Inquiry 1067.

Prototyper
SmethersBarnes
520 Southwest Harrison St.,
Suite 435
Portland, OR 97201
(503) 274-2800
Inquiry 1068.

Smalltalk-80
ParcPlace Systems, Inc.
1550 Plymouth St.
Mountain View, CA 94043
(800) 882-7880
(415) 691-6700
Inquiry 1069.

Smalltalk/V Mac
Smalltalk/V PM
Digitalk, Inc.
9841 Airport Blvd., Suite 604
Los Angeles, CA 90045
(800) 922-8255
(213) 645-1082
Inquiry 1070.
In DEPTH
APPLICATIONS ARCHITECTURES

TRON
TRON Association
Tomoe-cho Annex 2
5F, 8-27, Toranomon 3 Chome
Minato-ku, Tokyo 105
Japan
81-3-433-6741
Inquiry 1181.

X desktop
IXI, Ltd.
62-74 Burleigh St.
Cambridge CB1 1OJ
England
44-0223-462131
Inquiry 1182.

XVT
Advanced Programming Institute, Ltd.
Box 17665
Boulder, CO 80308
(303) 443-4223
Inquiry 1183.

X Window System
MIT Software Distribution Center
Technology Licensing Office
Room E32-300
77 Massachusetts Ave.
Cambridge, MA 02139
(617) 258-8330
Inquiry 1184.

This resource guide lists information sources for the major concepts and products listed in the section. 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 of the guide.

Intuitive Mathematics
and Equations Made Easy

Have you ever wished for a symbolic algebra program that was easy to use and powerful, but only required 1 MB of memory? A program where you didn't have to learn how to program, memorize syntax rules, or read a large manual? A program that solves equations the way you normally do, symbolically and numerically - step by step. How about using those solved equations, answers, and graphs and placing them into your word processing and page layout documents, with typeset quality results? What about graphs? How about 2-D graphs, 3-D solids, contour plots, animation, and more, all saved as PICT, PICS, or Encapsulated PostScript for quality output. Well if this is what you want, then please give us a call, or write for some detailed information and how to order Theorist and Expressionist.

Theorist will solve and graph your equations, Expressionist produces typeset quality equations for your documents! And best of all, the programs can work together importing and exporting equations back and forth. Both are simple enough for the student, yet powerful enough for the professional educator, scientist and engineer. Prescience (pronounced PRE-shenns) brings you the complete mathematical solution for the Macintosh. Our programs enable you to concentrate your time investigating and presenting your work, not learning how to!
Data General’s AViiON lets you run both.

When you’re looking for solutions, choose the UNIX® system-based RISC platform that scores of industry leading software vendors have already chosen: Data General’s AViiON™ Family!

There's a deep set of proven utilities, databases, and 4GLs that make developing or porting your own programs as easy as can be. And there’s a broad range of applications for industries like banking, insurance, hospital management, accounting and more.

Data General supports the 88open BCS, the industry’s only binary standard for multivendor interoperability. That means AViiON is open to the most important networking, communications, and software standards.

Call 1-800-DATAGEN and we’ll send you a brochure listing hundreds of third-party software programs available for Data General’s AViiON Family.

Name ____________________________

Company ____________________________

Address ____________________________ Phone ____________________________

City __________________ State ______ Zip Code ____________________________

Call 1-800-DATAGEN and we’ll send you a brochure listing hundreds of third-party software programs available for Data General’s AViiON Family.
In the world of mainframe computers, time is quite often money. The system administrators often allocate the company computer's time by charging the users more for using the machine in the hours of high demand and less at times when demand is low (like in the middle of the night). Most personal computer users are hardly familiar with this concept because they never have to share their machines. This situation is changing, though, as networks connect many machines.

People with overloaded computers will soon realize that there might be an idle computer on the network that could handle some of the work and lessen the load on their own. The only problem is building an operating system for the network that makes it easy, quick, and efficient to share time.

In the Beginning . . .

At Xerox's Palo Alto Research Center (PARC), one team of researchers is borrowing the metaphor from the old mainframe system and putting a price on computer time. Their new network, called Spawn, is not just a collection of wires for transferring files; it is a miniature auction economy where machines trade time for a computerized version of cash.

The one big difference between these new networks and the mainframes is the structure of the "economy." The mainframes sell computer time to users at fixed prices and guess how the pricing will control demand. This new system for managing a distributed system of computers is a pure market filled with many buyers and sellers who set prices by bidding for computer time. The result seems to be an ideal way to allocate resources and also, incidentally, to study how markets work.

The basic Spawn system operates on a network of Unix computers running Sun Microsystems' protocols for Remote Procedure Calls (RPC) and accessing a Network File System (NFS). The designers chose Unix and C because they make up the core of an almost universal operating system that can handle multitasking and network computing. They also chose this combination in spite of the fact that much of Unix's power wasn't necessary and a smaller, finely tuned distributed operating system would be more efficient. But they gained ease of implementation and universality in the trade-off.

The structure of Spawn is easy to understand. Each computer runs a resource-managing process that keeps track of the work being done on the machine. If the computer is idle, the resource manager holds an auction to sell a slice of the spare time to another machine on the network. If one of the jobs running on the machine needs more computer time, the resource manager watches for auction announcements and bids at the auctions until it finds the necessary computer cycles. The manager also keeps track of the amount of electronic "cash" that each process has to spend, although the current implementation makes no attempt to guard against fraud or counterfeiting. (Other researchers are developing secure cash systems relying on clever cryptography, but these ideas are outside the scope of this article.)

Finding the Parallelism

Under Spawn, each application must call up the resource manager when it has a task that could be spun off to run on another machine. The programmer must build the intelligence into the application itself so the application can know when it has a bit of computation that can be "spawned" and executed in parallel.

The process is not automatic. Once the application makes the decision, it hands off the procedure to Spawn, which finds another machine to do the work. The program must know how to integrate the information when it comes back.

For example, ray tracing is an application suited for parallel processing (see "The Art of Ray Tracing," February BYTE). The programmer might set up a program, break it up into 100 different sections, hand those 100 different sections to Spawn, and ask it to bid for time on 100 different machines. If 100 different machines are free, the information will come back very quickly. If fewer machines are free, the resource manager will bid on the available time and continue looking until all 100 jobs...
are finished. (Note that even if there are 100 free machines holding auctions for their free time, the whole job will not get done 100 times faster. The overhead of communication and bidding prevents perfect efficiency. Preliminary test results show overhead has ranged from 7 percent to 10 percent.) The ray-tracing program then reassembles the data into final results.

The jobs Spawn sets up on different machines can vary in intelligence. The simplest subapplications act like black boxes and only report their results after they’ve finished their work. The more sophisticated ones send information regarding their partial progress to their manager, which examines all their reports and will often send back instructions to the subapplications regarding the best way to proceed.

Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

This interaction is especially useful for solving problems such as the traveling salesman problem—finding the fastest, shortest route to many locations. Different processes could search different routes and, through the manager, keep track of the current best solution.

The subapplications can also recursively create their own subapplications by splitting their part of the problem into small sections. The entire structure of applications and subapplications can form a big tree-like structure in the network. These subapplications get the money to bid for new time from the process, this managing process in turn obtains money from the entire structure of applications and subapplications by splitting their part of the problem into small sections. The entire structure of applications and subapplications can form a big tree-like structure in the network. These subapplications get the money to bid for new time from the process, this managing process in turn obtains money from the network. Though, they are running auctions on their machines and have enough to buy time.

The strategies used by the top applications to guide their subapplications can be simple or complex. Equal funding is easy to implement, but it’s only efficient if all subapplications are performing an equivalent amount of work. The top application, for example, might create several different applications that would each explore a different approach to the same problem. More funding, though, could be allocated to the solution that is more likely to succeed. A better but more complex heuristic for allocating the currency would reward the more successful sub-processes with more cash to spend on more computer cycles. Of course, this method relies on the existence of some measure of relative progress and success.

Bad Code in the Node?
A major advantage of the economic model is its ability to survive disasters such as other computers crashing on the network. A centralized allocation scheme not only must devote a large amount of time maintaining an active list of machines but must not fail itself. If it stopped, every job would be lost. Some other complex distributed systems have provisions for electing a new central processor in the event of a crash. These protocols are complex and time-consuming because the new central processor must either discover the status of the jobs or restart them.

In the Spawn environment, the resource manager does not need to know the operating status of all the machines. When it wants to buy time, it just watches for announcements of new auctions. However, the application itself must watch for trouble. If a machine running a subprocess crashes in the middle of the job, the top process must notice that no results were returned and restart the subprocess by buying time at the next auction. Fault tolerance can be built in by starting subapplications simultaneously on different machines and accepting the results of the first successful subtask. Obviously, if the top manager halts, the entire job will crash as well. The rest of the network, though, will not be affected.

The Auctions
Spawn conducts closed auctions that are clever combinations of open auctions and sealed-bid auctions. Open auctions aren’t efficient on a computer network because they can run indefinitely and flood the network with messages. Spawn requests sealed bids and sells the computer time to the top bidder, but at the price offered by the second-place bidder. Using sealed bids reduces the network load, since they consist of only one message. Setting the price at the second-place bid results in almost exactly the same price as if there were an open auction. (The difference between taking the first and the second price is important. A normal sealed-bid auction charges the winner just what the time is worth to the top bidder alone. Consequently, the price paid is always the largest amount the top bidder is willing to spend—not the equilibrium price obtained when supply balances demand. The second-place bid is the price at which the second-place bidder would have dropped out of an open auction.) Interestingly enough, if there is only one bidder, the slice of computer time is given away gratis because the effective second-place bid is 0.

Each process must use some strategy to decide what to bid. Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. In the meantime, they received a constant trickle of money from their manager. The effect of this system is simple and fair. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

How Spawn Performs
The best measure of the system, of course, is its performance. The team at the Xerox PARC has tested Spawn with a number of different experiments. These tests have revealed a great deal about the fairness, adaptability, and chaotic behavior of the system.

Some experiments parceled out parts of a Monte Carlo simulation to the various machines. (A Monte Carlo process is a testing method for analyzing large, complex simulations by generating random initial conditions and checking the results. For example, a Monte Carlo simulation of a craps game would roll the dice enough to show that the house has a distinct advantage.)
INTERCON IS RAINING
FONTS! NOW WATCH YOUR CREATIVITY GROW!

It's a "PERFECT" spring day. And you now have all the right tools to make your word processing flourish. The result: professional, eye-catching documents that burst with style! Blossom with creativity! Bloom with impact!

THE "PERFECT" FONT CARTRIDGE FOR WordPerfect!

Like bees with flowers, "PERFECT" is made especially for WordPerfect 5.0/5.1 with a technically advanced design. You take full advantage of WordPerfect's capabilities. No waiting for download fonts. No additional printer memory needed.

- MORE TYPE SIZES
- Three Popular Faces
- Portrait and Landscape
- Extensive Symbols

Century 702 and Swiss 721 (Bitstream's® Schoolbook® and Helvetica®) in 6 to 30 point medium, bold, italic.

Prestige Elite in 10 point (12 pitch) to match typewriter style and 7 point 16.66 pitch for spreadsheets.

126 symbols for commercial, legal, scientific, mathematical, and linguistic usage. Symbols are the same size as the font you select.

Operational with the HP® II, IID, IIP, and Canon® LBP 8 II laser printers.

If you're not satisfied, send it back within 30 days for a full refund!

For immediate service using MasterCard or Visa

1-800-422-3880 outside New York State
(716) 244-1250 in New York State

FAX: (716) 473-4387

Order 10 "PERFECT" cartridges and Intercon will incorporate your logo into your cartridge for FREE!

INTERCON
1850 Winton Rd. S., Rochester, NY 14618

Intercon's font cartridge line includes: Pro IIP for the HP IIP printer; Phont + for the Epson® EPL 6000, Toshiba® PageLaser 6 and AT&T® 593 printers; C3 for Data General® CEO/WordPerfect 4.2 users.
The simulations are very easy to split into many sections and run in parallel. The researchers experimented with various funding strategies. Figure 1 shows the results of connecting six Sun workstations and running three tasks that are given 30 cents, 20 cents, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs begin, the price quickly increases until it oscillates around an equilibrium price of 1 cent per second.

Because there are six machines, and therefore six auctions conducted, the total money spent per second is, on average, equal to the money flowing to the processes. The fluctuations in the prices shown in the figure are just the first evidence of the random nature of the system. If the same set of programs is restarted, the price graph will be different. The average price will remain the same, but the shape of the price oscillating randomly around this average will be different. The chaos enters the system because the bidding is not linear: Each auction is priced at the value of the second-largest bid.

Team members Bernardo Huberman and Tad Hogg studied a similar system of equations that are easier to analyze theoretically. They discovered that the chaos was often unavoidable when there were delays in communication between computers and each computer's knowledge about the status of the others was incomplete.

The noisy, erratic behavior of the price should be familiar to anyone who plays the stock market. The process is fair, at least to those who subscribe to free-market doctrines, which form the axioms at the foundation of the system. The processes that receive the highest priority are the ones with the most money. In the simulation shown in figure 1, where the ratio of capitalization was 3 to 2 to 1, the allocation of computer cycles was roughly 2.79 to 2.00 to 1.00. The chaotic behavior is probably the cause of the discrepancy between the two ratios.

**High-Priority Jobs**

The effects of high-priority jobs are easy to see in figure 2. The system begins and ends with two processes (with 1 cent and 2 cents to spend per second). In the middle of the graph, a process starts with 7 cents per second. It quickly begins winning about 60 percent to 80 percent of the auctions, and the price soars. When the job finishes, the price quickly returns to normal. This effect should be familiar to people who watch real markets perform in the same way. (The price of homes in the

*continued*
Up to date.
Down to earth.

**Changing the world.** 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.

**The information you need.** That's why you need *UNIXWORLD*—the magazine that keeps you up to date on the rapidly changing world of opensystems computing. Each issue brings you the latest product trends and technical advances that can affect your business. The inside story on some of the world's biggest high-tech companies. Easy-to-understand programming tips and tutorials that can help you and your company use UNIX to its fullest. And unbiased hardware and software reviews to help you invest wisely when you buy.

**The whole UNIX-verse.** *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 the strategies that are changing your world. And *UNIXWORLD* consistently offers the freshest, most down-to-earth writing you'll find in any computer publication.

**Subscribe and Save.** Subscribe today, and receive the next 12 issues of *UNIXWORLD* for just 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.*

1 year $18.00 (save 50%)
2 years $32.00 (save 55%)
3 years $42.00 (save 60%)

**Subscribe now! Call toll-free:**
1-800-341-1522

*UNIXWORLD*

---
*UNIX* is a registered trademark of AT&T. UNIX WORLD is not affiliated with AT&T.

*UNIXWorld's no-risk guarantee: If not satisfied, cancel and receive a full refund for the balance of your subscription.*

A McGraw-Hill publication.
San Francisco Bay area, for instance, soared over the last 20 years as the computer industry brought more and more spending money into the area. The price of homes in Houston, on the other hand, collapsed after the price of oil dropped, cutting the flow of money into the region.

If there are two different machines in the network with different capabilities, different prices will develop. Figure 3 shows the prices of the auctions run on a network of three Sun-4/260s (top line) and six Sun-4/110s (bottom line). The 4/260 is roughly 40 percent faster than the 4/110, and the average prices are quite different. The 4/260 gets more work done, so it is more valuable.

The most important part of the economic model is its support of an easily scalable, very diverse system. A large network will almost certainly not be made up of equivalent machines. Some will be faster than others. Some will have access to special data, and others may have numerical processors suited only for special problems. The value of these systems to all the users will change as they run different programs. If everyone is interested in inverted matrices, then the price of time on the systolic array will be high. On another day, with users running different applications, the time might be free. Dynamic pricing strategies ensure that the network will adapt.

Tying It Up

The chaotic nature of Spawn may seem a bit disconcerting, but, unfortunately, theoretical analysis seems to imply that the chaos is unavoidable. A system with built-in delays and imperfect knowledge seems to lead to chaos. This noise makes it difficult to predict exactly what the network will do. Spawn, though, always seems to behave as intuition might predict. The difficult problem is finding a strategy for bidding that can attempt to watch auction prices and plan intelligently.

Other systems for trading cycles between machines and balancing the network load often behave quite similarly when the Spawn applications bid naively. These other systems are often just economies that use terms like priority quotient instead of economic terms. The difference is usually largely semantic.

Setting up a distributed network of computers to share their cycles is a difficult problem that must be solved as networks become more prevalent. The free-market metaphor is not only easy for the mind to understand, but truly useful. Spawn effectively and flexibly allocates computer cycles with a small amount of interaction.

For further reading on the subject, try The Ecology of Computation (edited by B. A. Huberman, Elsevier Science Publishing, 1988). This book contains articles about distributed networks, including a piece about a system built at MIT called the Enterprise. In this system, instead of bidding money, the computers bid estimated finishing time.

ACKNOWLEDGMENTS

My thanks to Carl Waldspurger, Bernardo Huberman, Jeffery Kephart, Tad Hogg, and Scott Stornetta, members of the Spawn team at the Xerox PARC, for providing background material.

Peter Wayner is reading toward a Ph.D. in computer science at Cornell University. He can be reached on BIX c/o "pwayner."

THE FIRST NAME IN TRUE OEM COMPATIBILITY
NATIONALWIDE
1-800-292-6272
FAX
1-301-561-4659
MARYLAND LOCAL
1-301-561-0200

WE ACCEPT PURCHASE ORDERS & CHECKS
Use of Equipment manufacturer's names is for identification only. NCRC is in no way affiliated with the OEMs listed.

CARTRIDGE RIBBONS (NYLON)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price Ea. (Black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>Apple Imagewriter II 4/C</td>
<td>$9.75</td>
</tr>
<tr>
<td>114</td>
<td>Apple Imagewriter 3/D</td>
<td>$9.35</td>
</tr>
<tr>
<td>127</td>
<td>Brother M 150/170D</td>
<td>$9.55</td>
</tr>
<tr>
<td>104</td>
<td>Canon A-1200</td>
<td>$5.65</td>
</tr>
<tr>
<td>109</td>
<td>Centronics 253/352/353</td>
<td>$10.75</td>
</tr>
<tr>
<td>118</td>
<td>Citizen LSP 1200/1800</td>
<td>$5.65</td>
</tr>
<tr>
<td>101</td>
<td>Citizen MSP 10/20</td>
<td>$3.15</td>
</tr>
<tr>
<td>117</td>
<td>Citizen MSP 15/25</td>
<td>$4.45</td>
</tr>
<tr>
<td>123</td>
<td>Compaq 400</td>
<td>$5.65</td>
</tr>
</tbody>
</table>

90 DAY NCRC GUARANTEE
We have always believed that no sale is complete until the customer has received total satisfaction from our products. We will never, knowingly, disappoint you. If for any reason your purchase does not give you complete satisfaction, the full purchase price will be cheerfully refunded upon return of the merchandise.

By buying from the manufacturer you are guaranteed the freshest ribbons, highest quality and fastest service.

The most important part of the economic model is its support of an easily scalable, very diverse system. A large network will almost certainly not be made up of equivalent machines. Some will be faster than others. Some will have access to special data, and others may have numerical processors suited only for special problems. The value of these systems to all the users will change as they run different programs. If everyone is interested in inverted matrices, then the price of time on the systolic array will be high. On another day, with users running different applications, the time might be free. Dynamic pricing strategies ensure that the network will adapt.

Tying It Up

The chaotic nature of Spawn may seem a bit disconcerting, but, unfortunately, theoretical analysis seems to imply that the chaos is unavoidable. A system with built-in delays and imperfect knowledge seems to lead to chaos. This noise makes it difficult to predict exactly what the network will do. Spawn, though, always seems to behave as intuition might predict. The difficult problem is finding a strategy for bidding that can attempt to watch auction prices and plan intelligently.

Other systems for trading cycles between machines and balancing the network load often behave quite similarly when the Spawn applications bid naively. These other systems are often just economies that use terms like priority quotient instead of economic terms. The difference is usually largely semantic.

Setting up a distributed network of computers to share their cycles is a difficult problem that must be solved as networks become more prevalent. The free-market metaphor is not only easy for the mind to understand, but truly useful. Spawn effectively and flexibly allocates computer cycles with a small amount of interaction.

For further reading on the subject, try The Ecology of Computation (edited by B. A. Huberman, Elsevier Science Publishing, 1988). This book contains articles about distributed networks, including a piece about a system built at MIT called the Enterprise. In this system, instead of bidding money, the computers bid estimated finishing time.

ACKNOWLEDGMENTS

My thanks to Carl Waldspurger, Bernardo Huberman, Jeffery Kephart, Tad Hogg, and Scott Stornetta, members of the Spawn team at the Xerox PARC, for providing background material.

Peter Wayner is reading toward a Ph.D. in computer science at Cornell University. He can be reached on BIX c/o "pwayner."

THE FIRST NAME IN TRUE OEM COMPATIBILITY
NATIONALWIDE
1-800-292-6272
FAX
1-301-561-4659
MARYLAND LOCAL
1-301-561-0200

WE ACCEPT PURCHASE ORDERS & CHECKS
Use of Equipment manufacturer's names is for identification only. NCRC is in no way affiliated with the OEMs listed.

CARTRIDGE RIBBONS (NYLON)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price Ea. (Black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>175</td>
<td>Apple Imagewriter II 4/C</td>
<td>$9.75</td>
</tr>
<tr>
<td>145</td>
<td>Hewlett Packard 2631A</td>
<td>$13.85</td>
</tr>
<tr>
<td>161</td>
<td>IBM 3263S615 SD Loop</td>
<td>$2.25</td>
</tr>
<tr>
<td>155</td>
<td>IBM 3263S615 SD Crl</td>
<td>$3.15</td>
</tr>
<tr>
<td>188</td>
<td>IBM 4201 ProPrinter II</td>
<td>$4.75</td>
</tr>
<tr>
<td>170</td>
<td>IBM 4202 ProPrinter X4</td>
<td>$5.65</td>
</tr>
<tr>
<td>177</td>
<td>IBM 4207 ProPrinter X24</td>
<td>$5.95</td>
</tr>
<tr>
<td>186</td>
<td>IBM 2534</td>
<td>$10.95</td>
</tr>
<tr>
<td>184</td>
<td>IBM 2533</td>
<td>$20.35</td>
</tr>
<tr>
<td>266</td>
<td>Mannesmann Tally 85</td>
<td>$8.65</td>
</tr>
<tr>
<td>265</td>
<td>Mannesmann Tally 80</td>
<td>$8.35</td>
</tr>
<tr>
<td>201</td>
<td>Mannesmann Tally 120/250</td>
<td>$3.85</td>
</tr>
<tr>
<td>204</td>
<td>Mannesmann Tally 140/80</td>
<td>$4.45</td>
</tr>
<tr>
<td>660</td>
<td>NEC Printer P1/P2/P3/P4</td>
<td>$5.65</td>
</tr>
<tr>
<td>661</td>
<td>NEC Printer P5/5P</td>
<td>$5.65</td>
</tr>
<tr>
<td>662</td>
<td>NEC Printer P5/5</td>
<td>$5.65</td>
</tr>
<tr>
<td>663</td>
<td>NEC Printer P5/5</td>
<td>$5.65</td>
</tr>
<tr>
<td>210</td>
<td>NEC 5200/5200 Nyx</td>
<td>$6.45</td>
</tr>
<tr>
<td>211</td>
<td>NEC 5202/5202 Nyx</td>
<td>$6.45</td>
</tr>
<tr>
<td>209</td>
<td>Okidata 262/192/303/332</td>
<td>$4.55</td>
</tr>
</tbody>
</table>

90 DAY NCRC GUARANTEE
We have always believed that no sale is complete until the customer has received total satisfaction from our products. We will never, knowingly, disappoint you. If for any reason your purchase does not give you complete satisfaction, the full purchase price will be cheerfully refunded upon return of the merchandise.

Philip E. Belling, President

By buying from the manufacturer you are guaranteed the freshest ribbons, highest quality and fastest service.

We manufacture our products with the best worst matrix inks, premium high density nylon, precision engineered plastics and "Rem" air refrigerated loading equipment.

Minimum Order 6 Ribbons

CARTRIDGE RIBBONS (FILM)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price Ea. (Black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>307</td>
<td>Brother EM200 HR15/SMS</td>
<td>$4.75</td>
</tr>
<tr>
<td>152</td>
<td>Diabo Hyper II M3</td>
<td>$3.75</td>
</tr>
<tr>
<td>202</td>
<td>NEC 3500/5800 SMS Fip</td>
<td>$6.75</td>
</tr>
<tr>
<td>320</td>
<td>IBM Selectric I Y H .705</td>
<td>$2.95</td>
</tr>
<tr>
<td>171</td>
<td>IBM Autostar Cat</td>
<td>$4.50</td>
</tr>
<tr>
<td>3348</td>
<td>Olivetti ET 121/351 M5</td>
<td>$5.55</td>
</tr>
<tr>
<td>227</td>
<td>Ricoh 1300/1600 M5</td>
<td>$3.75</td>
</tr>
</tbody>
</table>

TWIN SPOOL (NYLON)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price Ea. (Black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>454</td>
<td>Decision Data 5087/671/694</td>
<td>$1.5</td>
</tr>
<tr>
<td>458</td>
<td>Dec writer LA 303/6</td>
<td>$3.35</td>
</tr>
<tr>
<td>456</td>
<td>IBM 3263S615 TES</td>
<td>$4.55</td>
</tr>
<tr>
<td>454</td>
<td>IBM 5229S529S529</td>
<td>$19.15</td>
</tr>
<tr>
<td>457</td>
<td>Printing 150/500/600</td>
<td>$5.55</td>
</tr>
<tr>
<td>457</td>
<td>Star Micronics Gemini 10/10x</td>
<td>$1.65</td>
</tr>
</tbody>
</table>

"CALL US FOR VOLUME DISCOUNT PRICING"
Introducing software that thinks. There has never been personal computer design and drafting software this powerful, this fast or this intuitive. Vellum thinks. Its radical new technology automatically pinpoints and aligns geometry as you draw. Built-in intelligence allows you to draw virtually freehand, yet set precise dimensions at any time. Finally, the days of complex commands and weeks of training are gone. Vellum has made industrial-strength design click on the Macintosh. For a demonstration see your Ashlar dealer or call (408) 746-3900.
Introducing DADiSP 2.0

DADiSP — interactive graphics and data analysis software for scientists and engineers. DADiSP 2.0 delivers unprecedented power, through easy-to-use menus. Choose from hundreds of analysis functions and graphic views — from tables to 3-D. Simultaneously display multiple windows, each with different data or analyses, for unlimited perspective on your toughest data analysis problems.

Build your own analysis worksheets — build and display an entire data analysis worksheet, without programming. And DADiSP's powerful graphic spreadsheet automatically recalculates and updates the entire worksheet if you change your data or an analysis step.

Do serious signal processing...the way you always pictured it! FFTs, digital filter design, convolutions, waterfall plots, and more — all at the press of a key.

Let your instruments do the talking — use DADiSP-488 to bring data from your instruments directly into a DADiSP window for immediate viewing and analysis.

Flexible, expandable, customizable — annotate your graphs and send them to printers, plotters, or publishing packages. Create your own macros, automate routine tasks, and run any program written in any language from within DADiSP. DADiSP even lets you build your own menus.

A proven standard — already used by thousands of engineers and scientists worldwide, in a whole range of applications like medical research, signal processing, chemistry, vibration analysis, communications, manufacturing quality control, test & measurement, and more. DADiSP supports the IBM PC and PS/2, SUN, DEC VAX, HP 9000 and Concurrent families of personal computers and workstations.

GET THE PICTURE!
CALL TODAY 617-577-1133

Ask for our Evaluation Disk. For more information, write to DSP Development Corporation, One Kendall Square, Cambridge, MA 02139, or FAX: 617-577-8211.

Australia: Interworld Electronics, 03 521-2662; England: Adept Scientific, 0462 480665; Biscoft (0223) 89822;
France: SM21, (1) 34810178; Sacasa, 69077802; West Germany: Didalog, 02166 4218; Stemmer Electronic, 089-896 62-0; Israel: Racom Electronics, 03-491-922; Italy: BFS Computers, (02) 61290221; Japan: Astrodesign, 044-761-1011; Netherlands: Computer Engineering Roosendaal, 01650-57417;
New Zealand: GTS Engineering, (09) 392 464; Sweden: Systek, 013 11040; Switzerland: Urech & Harr AG, 61 611325; Taiwan: Advantech, 2-351-2117.
NEW OBJECTS FOR OLD STRUCTURES

Converting existing applications to object-oriented applications is possible and often very advantageous

Jeff Duntemann and Chris Marinacci

hen you forge ahead to apply new language technology to new projects, existing applications usually get left behind. Writing new applications is fun; converting old ones is just drudgery. Besides, existing applications work already. If they're not broken, why spend the time to fix them?

This last question is actually another question in disguise. Is the benefit to be gained from new language technology worth the risk in "lifting the hood" on a completed application? The answer, of course, is that it all depends on the value of the technology.

Ring out the Old; Ring in the OOP

New technology shows up with great regularity in the programming tools business. Still, it's been a long time since anything has generated the excitement that's been created by object-oriented programming (OOP) systems—probably not since the appearance of structured methods in the 1960s. (See "Object-Oriented Programming," February BYTE.)

Is OOP worth the bother?

The answer is almost certainly yes, and the same reasons that apply to new applications also apply to converting old applications:

- Maintainability—OOP programs are more easily read and understood (and hence changed) than traditional structured programs. OOP techniques provide a highly effective means of controlling program complexity by imposing a functional hierarchy on program details and hiding whatever details the programmer doesn't have to face at any given time.
- Reusability—It is possible for programmers to write objects so loosely coupled that they can be considered "black boxes" that can be dropped into programs with little disruption of unrelated code. If they design them well, programmers can use these same black boxes as standard software parts in future applications, and often with no changes whatsoever.
- Extensibility—One benefit of OOP's inheritance concept is that objects can be easily extended with new features without any unnecessary duplication of code. A child object is declared that inherits everything its parent object has and defines only those things that differ from (or must be added to) the parent object.

Weigh Costs and Benefits

Converting an application involves several important decisions regarding the shape of not only that application, but of applications that will be written or converted in the future. Actually, before developers convert any old applications to object-oriented applications, they should put a

continued
strategy in place for designing object orientation into future applications. This way, they can spread costs between future development projects and current applications. Developers should, in fact, be thoroughly familiar with these costs before they begin any conversion project. The main costs involve time, tools, talent, and inconvertible applications.

Viable big-picture planning is time-consuming, difficult, and expensive. Without a well-designed hierarchy, there’s no way to take advantage of the powers of late binding and polymorphism. But designing the hierarchy isn’t easy and can require a level of coordination of efforts among individuals that has never been achieved. The application’s architects and support personnel need to be part of the process. Object-oriented conversion is not a small matter to be left to the programmers in the trenches who have been maintaining the code.

In addition, existing development tools may be incompatible with OOP techniques. Older code libraries may not link with new object-oriented modules. Debuggers may not be able to trace object-oriented code, especially where there is heavy use of late binding.

In this early stage of OOP’s acceptance, too, OOP talent is still fairly hard to come by, and object-oriented design and programming skills may be a little rough. Training programmers is costly, and staff turnover may greatly retard—or even halt—an important conversion project.

Finally, it’s always possible that an existing application may require so much effort to convert that it is better to rethink, redesign, and recode it from scratch using an OOP language that may be completely different from the language currently in use. Applications not written in a structured fashion to begin with, for example, are nearly impossible to recode along OOP lines without a total rewrite.

In general, the higher the coupling between application components—modules, procedures, or whatever—the harder it will be to recode for OOP. Also, code that takes full advantage of system-level resources such as interrupts is hard to meld with true object-oriented code. Some applications convert more easily than others. It’s a good idea to know which ones are easier to convert before you begin the conversion process.

**Structured Pascal vs. Object-Oriented Pascal**

People long assumed that OOP would require new and radically different languages, such as Smalltalk. But over the last few years, major object-oriented extensions to both Pascal and C have shown this concept to be false. Apple published its Object Pascal specification in the mid-1980s. Soon after, Bjarne Stroustrup defined the C++ object-oriented extension to the C language. Since then, effective and efficient object-oriented extensions to structured languages—most notably Objective C, used in the NeXT workstation—have appeared on the scene.

In mid-1989, Borland International extended its Turbo Pascal implementation of Pascal to incorporate objects. The techniques that we’ll describe assume the use of Turbo Pascal 5.5, but in broad terms they apply to any language bridge between a traditional language and its object-oriented extensions.

Turbo Pascal implements all three key object-oriented concepts: polymorphism, encapsulation, and inheritance. Polymorphism is the ability of objects to respond appropriately to directives from routines that do not know the objects’ exact type. It is accomplished through late binding, which is the de-
Encapsulation is the melding of code and data into a single structure. It is embodied in the object structure, which is defined very much like a record:

```pascal
type
  Point = object
    X, Y : Integer;
    Visible : Boolean;
  end;

  Circle = object (Point) { Inherits from Point }
    Radius : Integer;
    procedure Grow (GrowBy : Integer);
    procedure Shrink (ShrinkBy : Integer);
  end;
```

A circle differs from a point only in that a circle has a radius. The Grow and Shrink methods are provided to change the radius without directly accessing the Radius data field. All of Point’s definitions are directly accessible from Circle as though Circle had defined them itself. In other words, given an instance of Circle named ACircle, the inherited Show method is called by the statement ACircle.Show.

Turbo Pascal objects can override inherited methods simply by redefining them. The compiler knows that an identifier has been redefined when it parses an identifier’s second definition; Object Pascal’s OVERRIDE reserved word is therefore redundant and unnecessary.

Late binding is implemented by declaring a method as virtual using the new reserved word VIRTUAL. Objects that are descended from one another in an object hierarchy can all share a single virtual method name (like Show), but each can implement that method differently as its individual needs require. Which implementation is actually executed for a given invocation of a virtual method is not decided until run-time—hence the term late binding. Traditional Pascal procedure calls are bound (i.e., the calling logic is given the address of the procedure) at compile time.

Late binding in Turbo Pascal 5.5 makes possible polymorphism (from the Greek for “many shapes”). A single virtual method call can have many shapes, depending on which object type is being called at the moment.

**Can You Convert This Application?**

Before we discuss how to do a conversion, it’s worthwhile to consider which applications may be difficult or impossible to move toward object orientation. You should ask several important questions of any conversion prospect.

Is it structured to begin with? Unstructured applications should be left as they are or totally rewritten. Unstructured Pas-cal applications make little use of procedures and data structures. Data is scattered across dozens or hundreds of global variables. The main program is large, and loops are often implemented with GOTOs and labels. Many line-for-line ports from older versions of BASIC and FORTRAN end up looking like this, and they tend to be as flexible as concrete.

Object orientation is in one sense a structure of structures. If fundamental program structures such as procedures and records are missing, making it object-oriented might as well be considered a complete rewrite from scratch. Even the specifications may have to be rewritten, as an unstructured spec will be more hindrance than help in writing object-oriented code.

A lesser but related question should be asked of any application. Does anyone in-house really understand it? Old, rarely used, and poorly commented applications should be left alone, or else respecified and rewritten by someone who has never even seen the old application.

The second question is less plain and more troublesome. Does the application or any major part of it depend on non-object-oriented tools? Screen generators that create Pascal code for data-entry modules fall into this category, as do toolbox products consisting of many interrelated procedures and functions that must be linked into the program code. These products are “object-ignorant” and require the application to perform procedure calls and set up data structures in certain ways.

While you can, to a degree, make applications that use such tools object-oriented, the tools will eventually become a source of considerable frustration and will limit the evolution of the object-oriented application along natural object-oriented lines. Furthermore, reusability and extensibility of modules that incorporate non-object-oriented tools will be severely limited or rendered impossible.

**First Steps Toward Conversion**

Unlike with totally object-oriented languages such as Smalltalk, Turbo Pascal programmers have a lot of choice regarding to what degree an application will be object-oriented. Furthermore, you can convert a traditional Pascal application incrementally without degrading the performance of the application.

The first steps are easy. Remove conflicts with reserved words and predefined identifiers. Turbo Pascal 5.5 adds only four new reserved words to the language: OBJECT, VIRTUAL, CONSTRUCTOR, and DESTRUCTOR. If the application contains any use of any of these words, you must choose new identifiers. There are only two new predefined identifiers that, if at all possible, you should not redefine: Self and Fall.

Note that there is nothing in Turbo Pascal’s overlay scheme that hinders object orientation. Objects can exist in overlays without modification or special considerations.

**Looking for Near-Objects in Old Applications**

Programmers are often surprised at how easily they can recast certain portions of an application in object form. The surprise comes from the fact that they sometimes unwittingly create libraries of procedures and functions along object-oriented lines without thinking of them as object-oriented. Often, then, by this time, they have performed everything but encapsulation.

Such “near-objects” usually consist of a data structure or family of data structures and several procedures and functions that act on those data structures. The whole is often defined within a unit, which reduces coupling with other program code and further facilitates “objectification.”

One common example of a near-object is a unit that defines a calendar date record and several routines for manipulating...
dates. The date record generally contains the date expressed as a month, day, and year value:

type
  Date =
  record
    Month, Day, Year : Integer;
  end;

Other expressions of the date, such as the DOS time stamp, a slash-delimited string form such as “6/29/89,” or a fully spelled-out string form such as “June 29, 1989,” are usually calculated and returned by routines defined in the unit. Other to the current date in the system clock, or to calculate the days between two date values.

useful routines might include a procedure to set a date variable (it is assumed that the object's date data) and place their headers within an object type definition.

type
  Date =

Listing 1: A long string object type definition produced by encapsulation.

const
  MaxLStringLength = 65521;  { The maximum amount that can be allocated to a pointer }

type
  LStringRange = 0..MaxLStringLength;
  LString = array [1..MaxLStringLength] of Char;
  LStringData = record
    Data : LString;
    Len : LStringRange;  { Current length }
    MaxLen : LStringRange;  { Length that has been allocated. This is always allocated in blocks of 16 bytes so that the long string's data doesn't have to be reallocated every time the long string grows. }
  end;

procedure SetToToday(When : Date);
function AsDOSStamp : Word;
function AsShortString : String;
function AsLongString : String;
function AsJulian : Longint;
function DayOfTheWeek : Integer;
function DaysBetween(Date1,Date2 : Date) : LongInt;

The DaysBetween method retains one parameter and returns the number of days between its own date value and the value of the Date2 object passed as a parameter.

Long Strings as Objects

One of Borland's ongoing research projects during the development of Turbo Pascal's object extensions was the creation of the TurboCale spreadsheet program. One near-object identified during the specification process was the long string type (capable of storing up to 64K-byte characters) used by the spreadsheet.

In a way similar to the date example presented earlier, a long string was originally implemented as a record containing the string length and a pointer to an array of characters containing the string data. A suite of functions and procedures performed the necessary manipulations on the string record: insert, append, copy, return length, and so on. Encapsulating the data from the original record with the procedure definitions of the routines that acted on the data produced the long string object type definition shown in listing 1.

Recasting utility libraries as objects provides some immediate benefits. In almost all cases, the resulting objects are more loosely coupled than the original library. This reduction in coupling allows their reuse in other applications that are either being converted or under development. Creating objects from utility libraries confers future benefits, as well. Long after their creation, objects can be easily and efficiently extended by creating child objects from these objects. Inheritance confers all the parent's code and data on the child object while allowing the child object to change only that code and data that differ from the parent type.

Identifying the Central Object Within an Application

At the core of most applications of any consequence is a large and often complex data structure representing the work that the application does. For a word processor, this is the document that is often created as a linked list of text lines on the heap. For a database, it may be a binary tree or some other system of records and indexes tied together through pointers. For a spreadsheet, it is usually some kind of sparse array held together with pointers.

This data structure is the essence of what goes on in a program, and all the rest of the code in the program serves it in some way. However the data structure is represented, it should become an object during conversion. The trick here is knowing what code belongs to this central object and what code belongs elsewhere in the program. The identification process is one of "drawing a line around the object," including the code that works with the data structure directly and excluding the code that performs other tasks.

This process sounds simpler than it is, especially when you consider that large objects can (and should) manage their own complexity by containing other smaller and simpler objects. A word processor document is a good example. Most word pro-
NEW OBJECTS FOR OLD STRUCTURES

successors express a document as a linked list of text lines. Each line is a string, and strings are excellent candidates for objectification. The string object should contain the methods for managing string data within the string. The document object should leave manipulation of data within the strings to the string objects themselves and concentrate on managing the relationships of the strings to one another. These relationships include data that flows among strings, say, during the reformating of a paragraph.

Obviously, drawing this line becomes a lot easier when you have some plan for an object hierarchy in mind. One of the knottiest problems is that of drawing the line between the data structure and the user interface. In order to achieve speed in displaying data to the screen, the central data structure is often very tightly coupled to the display routines. This tight coupling makes isolating the user-interface objects as a separate (and easily reusable) hierarchy much more difficult.

One way around this problem is to make the central data structure a child object of the user-interface hierarchy (see the text box “An Object’s Heritage” on page 262). The browser object would presumably have a redraw method, which could be overridden by the data structure object with a method that displays the data structure to the screen or window. Don’t be afraid to make the central object of the application a descendant of the user interface: The object inherits the ability to present itself to the user according to the rules you have established for your applications.

There are nonobvious benefits to this procedure, as well. If you have a windowing system in which you can create and display a new window at will, making the document or spreadsheet object a descendant of the window object means that splitting the screen into as many documents or spreadsheets as you need is as easy as instantiating a second document or spreadsheet object. The screen-splitting code is right there, inherited from the parent user-interface object.

Incremental Conversion
As you develop object-oriented subsystems for new applications, try grafting them onto old applications under conversion. The tremendous advantage of an object-oriented subsystem is that it is completely decoupled from the application itself. Assuming it doesn’t conflict with any existing subsystems within the application, you can add a proven object-oriented subsystem as easily as linking it in and calling its methods.

The hardest part of such a graft might in fact be stubbing out or removing procedures and functions made obsolete by the new subsystem. Watch out for any and all unexpected side effects. Coupling is a snake with an infinite number of heads.

The Application as Object
As you work with OOP, you might get used to thinking of applications as containers for objects. But why not design applications that are objects? The entire application then becomes reusable as a component part of larger systems. Such an application-object might have only two methods: Activate, which initializes and executes the application, and Deactivate, which "cleans up" any resources used by the application and returns control to the execution platform, which might be a DOS shell. Additional methods to export data to a clipboard for exchange with other applications would be right in line with the object philosophy.

Paradoxically, this forward-thinking conversion strategy is one that you might apply to old applications that are too unstructured or too poorly understood to be converted any other...
way. Putting an object “wrapper” around the entire application might be considerably easier than attempting to convert its tangled innards.

If you use this scheme, a word processor becomes a document object, and an accounting application becomes a ledger object. A hidden benefit of this scheme is that the ledger object could become a field in a database, as could a spreadsheet object or document object. Similarly, a document might become a cell in an object-oriented spreadsheet, subject to formulas that might return the document’s size or time stamp or even a Boolean flag indicating whether the document contains certain patterns.

Guidelines for Conversion
Converting a traditional application into an object-oriented one is not an all-or-nothing proposition. You can convert incrementally and go as far as time and energy—and the design of the original application—allow. Here is a simple strategy for conversion:

- Find the near-objects in the application and make them objects, ideally set off in a separate module. These near-objects would include string objects, time and date objects, and so on. Performing this procedure is a good way to learn object-oriented techniques when starting from scratch.
- Establish an object-oriented hierarchy plan for future applications. This process involves high-level planning of a user interface, a help system, on-line tutorials, and other relatively application-independent and reusable subsystems.
- With the hierarchy in mind, return to the application being converted and identify the central data structure. Recast the data structure as an object, separating it as much as possible from the other subsystems, such as the user interface and help system.
- As you develop other object-oriented subsystems for future applications, try to add them to the application being converted. This step may involve a lot of rewriting if the original application is object-unfriendly. The amount of programming time you can reasonably allow for the project will dictate the amount of rewriting that takes place.

Watch out for some pitfalls. First, don’t get overzealous and try to turn simple data types into objects. Leave characters, enumerations, numeric types, and Booleans as they are. Simple types are treated specially by the language in numerous ways, most of which are lost when the simple types are surrounded by an object framework. The benefits gained by turning simple types into objects are not worth the complication and loss of flexibility.

Don’t use virtual methods unless late binding is necessary. Static method calls are identical in speed and overhead to ordinary procedure calls. Moreover, Turbo Pascal’s smart linker will strip out any static methods that are never called within an application, reducing the application’s code size. Because calls to virtual methods are not known to the compiler at compile and link time, they cannot be stripped out.

Don’t design an object hierarchy to accommodate the quirks of a non-object-oriented application. Reusing such a hierarchy in future development will carry those quirks into all your future applications. Instead, wipe the slate clean and design your hierarchy for the future, and then put as many resources as you can afford to into rewriting the old application to adhere to the principles of a fully object-oriented design.

Keep in mind that change for the sake of change isn’t the goal. You make an application object-oriented to obtain certain benefits, but the process involves trade-offs. After taking a good hard look at your existing application, you may correctly decide that the benefits aren’t worth the costs. The danger here is that you may base your decision on too little information and have too little experience in OOP.

Write at least one fully object-oriented application before you attempt to convert an existing application. Give the conversion process a chance. The compelling benefits of object-oriented techniques turn up in surprising places.

Jeff Duntemann is the former editor of Turbo Technix, the Borland language journal. Currently, he is a freelance writer focusing on the programming industry. Chris Marinacci is development coordinator for Turbo Debugger and Turbo Assembler at Borland International. They can be reached on BIX c/o “editors.”

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
The Aurora 1024™ brings the graphics user into the new age of graphics processing. By adding the Aurora 1024 high resolution graphics card to your XT or AT, you will have unparallel processing power with 100% IBM 8514/A compatibility. The Aurora 1024 is a full-featured TI 34010-based board that runs at resolutions up to 1024 x 768 x 256 colors.

HIGH SPEED
The Aurora 1024 is fast! It runs 20-50 times faster than VGA and 10-50% faster than IBM's 8514/A. But that's not all! With the specially designed ADI driver, you will see AutoCAD redraw 20 times faster than IBM's 8514/A and other industry-leading boards (as shown below).

WIDE COMPATIBILITY
With the Aurora 1024, you also get industry-wide software compatibility. That's because IBM's new graphic standard, the Adapter Interface (AI) used for the 8514/A, is included with every board. And for AutoCAD users, we also include our specially designed ADI driver—as well as the hottest performing Windows and VENTURA driver available. These interfaces give ready access to a wide range of important non-CAD application programs, such as Lotus 1-2-3®, Wordperfect®, Quattro®, PS/RIO®, PS/TOPAS®, EXCEL®, EnerGraphics™ and Pagemaker®...plus hundreds of other titles.

AFFORDABLE PRICE
The Aurora 1024 sets a new standard of value and performance at about half the price of most comparable high-resolution graphic boards. You simply won't find a better price anywhere! $995

ORDER TODAY
CALL TOLL FREE
1(800) 325-0174

ENERTRONICS
Innovator in Graphic Solutions

Enertronics Research, Inc. • #5 Station Plaza • 1910 Pine Street • St. Louis, MO 63103 • (314) 421-2771

Circle 107 on Reader Service Card
Spring Has Sprung... And So Have Our Deals!

Please call us for products not listed. We ship to any state. Please call 818-347-2444.

DigitaL's Smalltalk/V PM combines the power of the industry's leading object-oriented programming with the richness of OS/2 Presentation Manager. Fully compiled, giving a PM application developer an extremely responsive environment. Contains a manual which is consistently reviewed as the best introduction to object-oriented programming available. Source code compatibility with DigitaL's other Smalltalk products.

Smalltalk/V PM $295.00

ACCOUNTING & PERSONAL FINANCE
Dac Bonnie Park 4.0 $175.00
C3 Financials $259.00
QuickBooks $289.00
Quick 3.0 $39.00
Quicken 2.0 $125.00
Turbo Tax Personal $45.00
Turbo Tax Professional $75.00

COMMUNICATIONS
Carbon Copy Plus 3.5 $55.00
Check Up Support 3.5 $115.00
PC Anywhere III $69.00
PowerPaX $129.00
SmartCom 2400 $199.00

DATABASE
Claron Professional Developer $399.00
Database 4.2 $495.00
FoxPro Single User $109.00

DESKTOP PUBLISHING
Bennin's Design $59.00
Broderbund AuthorIT $109.00
Business Composer $89.00
Expressive Publisher $69.00
Freestyle Publisher $129.00
UltraPage $119.00
UltraPublisher II $219.00
Vendor Publisher $65.00

EDUCATION & ENTERTAINMENT
ATI Teach Yourself Series $59.00
1979 SightPhrak $45.00
Flight Simulator 4.0 $45.00
Individual Training Series $40.00
King's Quest II $55.00
Leslie Hallary III $79.00
Lindy $25.00
Velos $32.00
Wiz $20.00

GRAPHICS
Adobe Illustrator $199.00
Macromedia FreeHand $349.00
Geography II $399.00
Horizon Paint II $119.00
InkPlus (w/Track) $199.00
PC PaintPlus IV $199.00
Picasa Plus $99.00
ShowPressFX 3.5 $209.00

HARDWARE & PERIPHERALS
Copy II Option Board Deluxe $115.00
Hot Page Board Plus 5.0 $145.00
Logitech Mouse Mouse III $85.00
Logitech Lead Mouse $115.00
Logitech Serial Mouse $65.00
Logitech Trackman Serial or Bus $89.00
Masterpiece Plus $155.00
Monitor Mouse with Mouse $189.00
Orbit Payload Plus $325.00
Pacific Data Page $209.00
Parade Vis taboo 128 $205.00
Precision Plus $229.00
Preci Penc 2400 En/w/MMP $229.00
Preci Penc 2400 TW/w/MMP $175.00
Scriba 2400 Acrastor $399.00
Scriba 3800 Acrastor $399.00
Scriba 2400XQ $399.00
Scriba 3800 Acrastor $399.00

NETWORKING
Laminant Starter Kit $409.00
NetWare 310 $199.00
NetWare 386 $359.00
NetWare 386 Plus $239.00
Oregon Standard Edition 1.2 $265.00

OPERATING ENVIRONMENT
DOS/360 $97.00
Desqview 386 1.1 $65.00
IBM DOS 6.3 $65.00
IBM OS/2 2.0 $199.00
IBM Windows 286 $89.00
INFOSYS DOS/360 $199.00

PERSONAL FINANCE
Dac Bonnie Park 4.0 $175.00
C3 Financials $259.00
QuickBooks $289.00
Quick 3.0 $39.00
Quicken 2.0 $125.00
Turbo Tax Personal $45.00
Turbo Tax Professional $75.00

SOFTWARE
 Alias | Project 3.0 $309.00
Adobe Illustrator $349.00
Agenda $275.00
Alphamak $175.00
Astronomy $79.00
ATA Teach Yourself Series $59.00
1979 SightPhrak $45.00
Flight Simulator 4.0 $45.00
Individual Training Series $40.00
King's Quest II $55.00
Leslie Hallary III $79.00
Lindy $25.00
Logitech PaintDriver $97.00
Logitech Trackman Serial or Bus $89.00
Macromedia FreeHand $349.00
Geography II $399.00
Horizon Paint II $119.00
InkPlus (w/Track) $199.00
PC PaintPlus IV $199.00
Picasa Plus $99.00
ShowPressFX 3.5 $209.00
Copy II Option Board Deluxe $115.00
Hot Page Board Plus 5.0 $145.00
Logitech Mouse Mouse III $85.00
Logitech Lead Mouse $115.00
Logitech Serial Mouse $65.00
Logitech Trackman Serial or Bus $89.00
Masterpiece Plus $155.00
Monitor Mouse with Mouse $189.00
Orbit Payload Plus $325.00
Pacific Data Page $209.00
Parade Vis taboo 128 $205.00
Precision Plus $229.00
Preci Penc 2400 En/w/MMP $229.00
Preci Penc 2400 TW/w/MMP $175.00
Scriba 2400 Acrastor $399.00
Scriba 3800 Acrastor $399.00
Scriba 2400XQ $399.00
Scriba 3800 Acrastor $399.00
Laminant Starter Kit $409.00
NetWare 310 $199.00
NetWare 386 $359.00
NetWare 386 Plus $239.00
Oregon Standard Edition 1.2 $265.00
DOS/360 $97.00
Desqview 386 1.1 $65.00
IBM DOS 6.3 $65.00
IBM OS/2 2.0 $199.00
IBM Windows 286 $89.00
INFOSYS DOS/360 $199.00

to further enhance the user interface. Smalltalk/V PM is extremely responsive, reviewed as the best introduction to object-oriented programming available.

GraphWriter II Plus 5.2 $199.00
Copy II PC 5.0 $229.00
Copy II Oplion Board Deluxe $115.00
Hot Page Board Plus 5.0 $145.00
Logitech Mouse Mouse III $85.00
Logitech Lead Mouse $115.00
Logitech Serial Mouse $65.00
Logitech Trackman Serial or Bus $89.00
Masterpiece Plus $155.00
Monitor Mouse with Mouse $189.00
Orbit Payload Plus $325.00
Pacific Data Page $209.00
Parade Vis taboo 128 $205.00
Precision Plus $229.00
Preci Penc 2400 En/w/MMP $229.00
Preci Penc 2400 TW/w/MMP $175.00
Scriba 2400 Acrastor $399.00
Scriba 3800 Acrastor $399.00
Scriba 2400XQ $399.00
Scriba 3800 Acrastor $399.00
Laminant Starter Kit $409.00
NetWare 310 $199.00
NetWare 386 $359.00
NetWare 386 Plus $239.00
Oregon Standard Edition 1.2 $265.00
DOS/360 $97.00
Desqview 386 1.1 $65.00
IBM DOS 6.3 $65.00
IBM OS/2 2.0 $199.00
IBM Windows 286 $89.00
INFOSYS DOS/360 $199.00

PROJECT MANAGEMENT
Adv. Project Manager Workbench 3.0 $845.00
AboveDisk 3.1 $3,099.00
AboveDisk 3.2 $3,299.00
AboveDisk 3.3 $3,499.00
AboveDisk 3.4 $3,699.00
AboveDisk 3.5 $3,899.00
AboveDisk 3.6 $4,099.00

SCIENTIFIC STAT
Brainmaker $199.00
Brainware $130.00

WE WELCOME CORPORATE ACCOUNTS AND INTERNATIONAL ORDERS.

Circle 62 on Reader Service Card
WHO OWNS THE COPYRIGHTS?

All those involved in creating a computer program should make sure to determine their copyright interests

William T. McGrath

With the proliferation of computer usage in the business world, the importance of copyright ownership in computer programs can no longer be overlooked. A copyright owner obtains an array of valuable rights, including the exclusive right to sell copies of an original work and to sell new works based on or derived from the original work.

As a general rule, the author of a work is the owner of the copyright. However, if the author is an employee of a corporation or other business entity, and the work is created within the scope of employment, then the employer is the owner of the copyright.

More difficult questions arise if the author of the work is an independent contractor. In a typical situation, a company contracts with a freelance programmer to create software for a particular business application. The program is successful, and the company starts marketing the software commercially. The programmer also begins marketing the software or a modification of it.

Litigation is bound to follow—each party claiming that it has the exclusive right to sell the software. Much hangs in the balance, since the copyright owner not only can prevent the other party from selling the software but may also recover an award of damages, including any profits the infringer made from marketing the program.

The ownership question has been veiled in confusion for several years. The problem arose from conflicting interpretations given by courts to the "work-made-for-hire" rule of the Copyright Act.

Supreme Court Ruling
A recent decision by the U.S. Supreme Court, Community for Creative Non-Violence v. Reid, will eliminate much of the confusion. In the Reid case, involving ownership of a copyright to a sculpture, the Court for the first time addressed the issue of who owns the copyright to works created by independent contractors. The Court resolved the conflicting interpretations of the lower courts in a decision that greatly expands the rights of independent contractors.

For independent contractors, the decision is a boon. For hiring parties, the decision is a clear indication that certain contractual measures should be taken if the party wants to obtain ownership of a program's copyright.

The decision is a departure from the way the ownership issue has been analyzed in the past. It should cause computer professionals to reexamine the status of copyright ownership in the programs they have created or commissioned.
Considered an employee even though he was by most standards an independent contractor. The courts reasoned that if the hiring party exercised supervision and control, the creator of the work could be considered an employee even though he was by most standards an independent contractor. This seemingly clear dichotomy between works by employees and works on commission became hopelessly clouded when some lower courts held that commissioned works could be works-made-for-hire even though there was no signed agreement. The courts reasoned that if the hiring party exercised “supervision and control,” the creator of the work could be considered an employee even though he was by most standards an independent contractor.

Since the independent contractor was viewed as an employee, the courts said that the employer owned the copyright, regardless of the type of work or whether there was a signed agreement. Several court cases applied this analysis and ruled that computer programs were owned by the commissioning party. The courts gave little guidance as to the type or degree of supervision and control necessary to give copyright ownership to the hiring party rather than the creator.

The Reid case has entirely changed the analysis for determining copyright ownership. The Supreme Court has eliminated the fiction that an independent contractor can be considered an employee merely as a result of supervision by the hiring party.

The Court ruled that an independent contractor owns the copyright to any work he or she creates unless there is an express signed agreement that the work is for hire and the work falls into one of the nine categories specifically identified in the Copyright Act. If there is no written agreement or if the work is not one of the types mentioned in the Act, the independent contractor retains ownership of the copyright.

In Reid, the Court ruled that the artist was an independent contractor, not an employee. Since there was no written agreement and sculpture did not fall into one of the nine categories, the artist owned the copyright.

**Who Is an “Employee?”**

The Court ruled that the determination of whether a hired party is an employee or independent contractor should be made according to traditional principles of agency law. Since there was no written agreement, several factors distinguish independent contractors from employees. In order to determine which is which, courts look at the skill the job requires, who owns the instruments and tools used in the job, the location of the work, the duration of the relationship between the parties, whether the hiring party has the right to assign additional projects to the hired party, and the extent of the hired party’s discretion over when and how long to work.

The courts take into consideration additional factors, such as the method of payment, the hired party’s role in retaining and paying assistants, whether the work is part of the regular business of the hiring party, whether the hiring party is in business, the provision of employee benefits, and the tax treatment of the hired party. No one of these factors is determinative.

**What Qualifies as Work-Made-for-Hire?**

As previously noted, a work by an independent contractor can only become a work-made-for-hire if it falls into one of nine categories of works listed in the Copyright Act. These categories are an odd conglomeration of different types of works. They are the result of lobbying efforts and compromises made during the legislative process.

Computer programs are not specifically identified. However, some of the categories are arguably broad enough to encompass programs under some circumstances. The scope of these categories is unclear, and they are sure to become the next battlefield in litigation over copyright ownership.

Courts have thus far provided no guidance as to whether they will be construed broadly or narrowly. If the courts interpret these categories broadly, a computer program could arguably fall into one of the following categories: contribution to a collective work, translations, supplementary works, and compilations.

- **Collective works:** A collective work is a work in which a number of contributions, constituting separate and independent works in themselves, are assembled into a collective whole. Typical collective works are periodicals, anthologies, and encyclopedias. It is not uncommon, however, for separate and independent software modules to be assembled into a collective whole. A recent court case involved a software system consisting of 236 separate programs. These independent modules could arguably be considered contributions to a collective work.

- **Translations:** Programmers often translate a program from one form written for one type of computer to a form suitable for another. A program can also be translated from one programming language to another. These arguably could be considered “translations” under the statute.

- **Supplementary works:** A supplementary work is a work prepared as a secondary adjunct to a work by another author for the purpose of illustrating, explaining, or assisting in the use of the other work. Examples are forewords, afterwords, pictorial illustrations, charts, tables, and indexes. In the computer indus-
try, the user documentation and manuals accompanying the programs will often constitute supplementary works.

- **Compilations**: A compilation is a work formed by a collection of preexisting materials or data, arranged and selected so as to constitute an original work. Typical examples include telephone books, directories, and catalogs. But some computer programs could arguably be considered compilations, as in cases, for example, where subroutines from different programs are combined into a new program.

It is unlikely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire, and it remains to be seen how the courts will treat software in connection with these categories.

**Joint Authorship of Computer Programs**

Since the concept of “supervision and control” alone is not enough to create a work-made-for-hire, commissioning parties sometimes claim copyright ownership by virtue of being joint authors of the software.

The Copyright Act defines a joint work in true lawyer-like language as “a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole.” To be a joint work, it is essential that at the time the work is created, the authors intend that their respective contributions will be merged into an integrated unit.

An author of a joint work is a co-owner of the work’s copyright and is entitled to modify, reproduce, or distribute copies of the work. A joint author’s protection extends to the entire work, not just the portion he or she contributed. Each author has the independent right to sell or license the joint work but has a duty to account to the co-owners for any profits earned.

Several cases have recently addressed the question of requirements to qualify as a joint author in the development of software. It is clear from these cases that a commissioning party who merely describes to the programmer what the software should do or look like is not a joint author.

In *Whelan v. Jaslow Dental Laboratory*, a case decided by the federal appeals court in Philadelphia, a dental laboratory owner commissioned the creation of software for use in his business. The owner gave the programmer a detailed description of the operation of the computer, dictated the functions to be performed by the computer, and even helped design the language and format of some of the screens that would appear on the computer’s visual displays.

The court nonetheless found that the programmer was the sole author of the software. The court’s principal focus was on the creation of the source and object codes. The owner’s general assistance and contributions to the fund of knowledge of the author did not make him a creator of any original work. The court made an analogy to an owner explaining to an architect the type and functions of a building the architect is to design. The owner is not a coauthor of the architectural drawings no matter how detailed the ideas or instructions he or she provides.

**Obtaining Copyright by an Assignment**

The Supreme Court’s work-made-for-hire decision does not leave commissioning parties entirely out in the cold, however. A party can still obtain ownership of a copyright by a written agreement transferring the copyright. The ownership of the copyright simply becomes a matter of contract negotiation.

There are some pitfalls, though. To be valid, the transfer of copyright ownership must be in writing and signed by the copyright owner. Further, the Copyright Act provides that after 35 years, the copyright ownership will revert to the original author. While most software would be obsolete long before the reversion, it is conceivable that some systems could have a life that long.

**Copyright Importance to Programmers**

The importance of copyright ownership cannot be overstated. The copyright owner controls reproduction, modification, and sale or licensing of a computer program. The financial benefits of ownership, too, are very real, especially where the software is unique or has high marketability.

The Supreme Court’s decision resolves some issues, but it leaves many questions unanswered. Consequently, all parties involved in a computer program (even those programs that are already implemented) should exercise care in determining their copyright interest. As for future transactions, programmers should negotiate up front the matter of copyright ownership, and hiring parties should obtain a written assignment if they want to be sure they own the copyright to programs created by freelancers.

William T. McGrath is a partner at the law firm of Burke, Wilson, and McIlvaine Ltd., Chicago, Illinois. He practices primarily in the areas of copyrights, trademarks, and computer-related matters. He can be reached on BIX c/o “editors.”
Take any 3 books for only $1.00 each

when you join BYTE Book Club®
VALUES UP TO $141.45!

- Your one source for computer books from over 100 different publishers
- the latest and best information in your field
- discounts of up to 40% off publishers' list prices

OS/2 PROGRAMMER'S GUIDE. By E. Iacobucci. 1100 pp., illus., softbound. "Byte" magazine called it "a necessity." This giant reference explains all the basic functions you'll need, with emphasis on such new or different functions as multitasking and memory management.
881300-X Pub. Pr., $29.95

INTRODUCING PC-DOS & MS-DOS, illus., softbound. This Second Edition covers all releases through 4.0, as well as Microsoft Windows and DOS-SHELL. Features the same hands-on tutorial format of the First Edition, with expanded coverage of batch file techniques that can dramatically increase your computing speed.
565/651 Pub. Pr., $27.95

LOCAL AREA NETWORKS: Architectures and Implementations. Second Ed. covers all releases through 4.0, as well as Microsoft Windows and DOS.
881257-7 Pub. Pr., $22.95

ADVANCED TURBO C. By J. T. Smith. 256 pp., illus., softcover. Mastering Turbo C has never been easier. Crystal-clear answers to all your questions are supplemented by fully-documented programming examples. Coverage includes string processing, screen handling with Turbo C Tools, keyboard input, line handling, memory management, interrupt services, and much more.
587/078 Pub. Pr., $24.95

THE NEW DOS 4.0. By K. W. Christopher, Jr., B. A. Fegrenbaum, and S. O. Saliga. 353 pp., illus., softbound. Practical advice from IBM's own DOS 4.0 developers to help you harness more PC power and versatility. Covers SELECT, the DOS Command Prompt, batch filing, Command Line Redirection, the EDLIN Line Editor, and much more.
584889-9 Pub. Pr., $22.95

EGV/VGA: A Programmer's Reference Guide. By B. D. Kliewer. 269 pp., illus., softbound. All the practical guidelines are right here for learning the ins and outs of the Enhanced Graphics Adaptor—one of the most popular PC add-on boards available—and its PS/2 counterpart, the Video Graphics Array. It's filled with innovative programming techniques tips for working around the bugs in the BIOS...and EGV/VGA BIOS calls not available elsewhere.
350/892 Pub. Pr., $29.95

THE PAUL MACE GUIDE TO DATA RECOVERY. By P. Mace. 352 pp., illus., softbound. An indispensable guide to restoring vanished files and coping with virtually every type of data loss emergency. You get clear, step-by-step instructions for restoring deleted files or directories, recovering lost or damaged Lotus 1-2-3 files, what to do when your disk won't boot, and much, much more.
584926-7 Pub. Pr., $21.95

DATABASE SYSTEM CONCEPTS. By H. E. Korth and A. Silberschatz. 546 pp., illus. From fundamental concepts to advanced problem solving, this book provides a clear understanding of the design and use of database systems. Also demonstrates the best ways to protect data from unauthorized access and malicious or accidental alteration or destruction.
447/527 Pub. Pr., $46.95

SECURITY IN COMPUTING. By C. P. Pfleeger. 338 pp., illus. Here are the best ways to maintain the confidentiality and integrity of your computer system. This insightful guide helps you evaluate the security risks inherent in the computer tasks you perform and shows you exactly what you must do to make your operations secure.
584941-0 Pub. Pr., $44.00

ARTIFICIAL INTELLIGENCE USING C: The C Programmer's Guide to AI Techniques. By H. Schildt. 412 pp., illus., softbound. This hands-on guide shows you how to create your own applications and systems using C. After an introductory overview it provides coverage of expert systems, logic, natural language processing, machine learning, pattern recognition, and more, with ready-to-run programs illustrating each topic.
881255-0 Pub. Pr., $21.95

PROGRAMMING USING THE C LANGUAGE. By R. C. Hutchison and S. B. Just. 519 pp., illus. Whether you want to understand programs in C written by others, or write better C programs of your own, this practical, authoritative book gives you the tools and guidance you need. Coverage includes program organization, sorting algorithms, recursion, linked lists, and more—with many sample programs.
315/418 Pub. Pr., $29.95

LIFE WITH UNIX: A Guide for Everyone. By D. Libes and S. Reusser. 346 pp., illus., softbound. A practical, readable sourcebook that gives you the information you need to use UNIX effectively. Provides a thorough examination of its advantages and disadvantages...and beyond the view point of tutorial viewpoints, users, programmers, and administrators...and even a complete guide to UNIX books, periodicals, users' groups, and shareware.
585016-7 Pub. Pr., $29.95

Take any 3 books for only $1.00 each
Any 3 books for $1.00 each... if you join now and agree to purchase two more books—at handsome discounts—during your first year of membership.

**New! BYTE LARGE SYSTEMS Books**

- **MVS: Concepts and Facilities**, By R. H. Johnson. 613 pp., illus. This comprehensive overview of IBM's mainframe operating system provides you with a crucial edge in MVS programming, management, and systems development. Covers processor complexes, MVS/XA and MVS/ESA, DASD's, the I/O subsystem, and much more.

- **CICS: Debugging, Dump Reading, Problem Determination**, By P. Donofrio. 176 pp., illus. A long-needed, step-by-step troubleshooting guide for CICS programmers. Provides invaluable information on problem determination, interactive debugging, terminal autoinstall, service strategies, the new dump formatting routine, and dump reading procedures that will have you clearing up failures in no time.

**Here’s how BYTE Book Club® works to serve you:**

- **Important information... we make it easy to get!** Today, professionals who perform best are those who are best informed. For reliable, hands-on information, turn to the BYTE Book Club. Every 3 or 4 weeks (12-15 times a year), members receive the Club Bulletin offering more than 30 books—the best, newest, most important books from all publishers.

- **Dependable service... we're here to help!** Whether you want information about a book or have a question about your membership, just call us toll-free or drop us a line. To get only the books you want, make your choice on the Reply Card and return it by the date specified. If you want the Main Selection, do nothing—it will be sent to you automatically. (A small shipping and handling charge is added to each shipment.)

- **Club convenience... we do the work!** You get a wide choice of books that simply cannot be matched by any bookstore. And all your books are conveniently delivered right to your door. You also get 10 full days to decide whether you want the Main Selection. (If the Club Bulletin ever comes late and you receive a Main Selection you don't want, return it for credit at our expense.)

- **Substantial savings... and a bonus program too!** You enjoy substantial discounts—up to 40%—on every book you buy. Plus, you're automatically eligible for our Bonus Book Plan which allows you savings up to 70% on a wide selection of books.

- **Easy membership terms... it's worthwhile to belong!** Your only obligation is to purchase two more books during your first year of membership. (If the Club Bulletin ever comes late and you receive a Main Selection you don't want, return it for credit at our expense.)

Fill out the card and mail today! If the card is missing, write to:

**BYTE Book Club**, P. O. Box 582, Hightstown, New Jersey 08520-9959

For faster service in enrolling, call 1-800-2-MCGRAW
Now There's a Periscope Board for Your IBM PS/2

With the new Periscope® Model I/MC, you now have the same robust Periscope Model I debugging capabilities using a PS/2 with Micro Channel® architecture that you already have using a PC, XT, AT, or AT-compatible 80386 machine.

Just like the current Periscope Model I, Periscope Model I/MC has a 32K footprint in system memory, above 640K but in the first megabyte. The board stores the Periscope software and all debugging information (symbols, etc.) in its write-protected RAM.

Designed for use in machines with the IBM Micro Channel bus architecture, the board allows you to add chips to extend the 512K of write-protected RAM to a full two megabytes, if need be. (Most developers find 512K to be quite enough, however.)

Don't worry about trashing your debugger, debugging large programs, or erratic bugs.

With this new board in your IBM PS/2 or compatible, Periscope uses zero memory in the lower 640K. So you don't have to worry about things like a runaway program trashing your debugger, or not being able to debug a very large program, or having bugs appear or disappear when you load your debugger.

Use the break-out switch, which plugs into the board, to break in to your system safely any time. It keeps you from having to power down and back up when your system hangs. You can just press the little red "panic" button to find out exactly what is going on.

Real-time hardware-assisted debugging of programs running on PS/2s is now possible! The remote feature of the new Version 4.3 Periscope software enables Periscope IV to support real-time debugging of programs running on DOS-based machines, including those with Micro Channel architecture. The open architecture remote debugging feature will support OS/2® and other protected-mode environments in the near future. Call for details.

Choose from a full line of professional software and hardware-assisted models.

All models include Version 4.3 software, manual, and:

- **Periscope I** has 512K PC- and AT-compatible board & break-out switch .......... $595.
- **Periscope II** has break-out switch ...... $175.
- **Periscope II-X** has no hardware ...... $145.
- **Periscope III** has PC- and AT-compatible real-time board (to 10MHz) & break-out switch ........ $1395.
- **Periscope IV** has 80286 and 80386 AT-compatible real-time hardware (to 25MHz) & breakout switch .......... $2195-$2995.
- **PLUS board** is Model I board (no software), optional with Models III & IV .......... $500.

Call Toll-Free Today For More Information 800-722-7006

MAJOR CREDIT CARDS AND QUALIFIED COMPANY PURCHASE ORDERS ACCEPTED

IBM, PS/2, OS/2, and Micro Channel are registered trademarks of the IBM Corporation.
MANAGING THE WELL-TEMPERED LAN

Network management can be a daunting task, but new tools and emerging standards can help

William Stallings

A recent survey of Fortune 500 companies by a market research firm, Infonetics (Santa Clara, CA) revealed that these firms are suffering an average of two local network outages per month, with an average outage time of 5 hours. About 5 percent of the companies averaged more than two such outages per week. Company executives estimate the average annual costs per firm at $3.5 million in lost productivity and over $600,000 in lost revenue. These are Fortune 500 companies with the budget and technical staff to handle local network installations, so how can this be? The answer is their lack of effective network management. Networks have grown in many ways—physical extent, number of users, amount and diversity of traffic, and complexity of supporting communications software. In addition, in too many companies, network management tools and procedures have not kept pace with these factors.

One University’s Experience
LAN administrators who follow the industry’s product offerings are aware that software tools can help to keep a LAN or set of LANs running smoothly. For example, a large university (which, for security reasons, will remain nameless) has developed an effective networking strategy based solely on Ethernet products. It began with a very simple architecture based on the use of a central backbone Ethernet. Attached to this central backbone were repeaters to 35 of the 110 on-campus buildings. Each remote site, designated a minihub, serviced equipment in a single building or a cluster of buildings. Thus, the architecture was a star arrangement, with a central backbone network and a number of minihub networks attached to the backbone.

With the use of repeaters, the entire system functioned as a single Ethernet providing a total capacity of 10 megabits per second. With growth in the number of users and in the amount of time average users utilize the network, however, this capacity soon became insufficient. As the load on the network increased, the university was able to keep pace by splitting the backbone into two backbones connected by an Ethernet bridge. Effective use of this configuration requires thoughtful load balancing to minimize the traffic through the bridge and avoid a bottleneck. With the aid of a traffic-monitoring package, the university was able to observe the traffic between pairs of stations and make an effective split.

At present, this architecture is sufficient to serve the needs of the main campus. However, there are also five...
Circle 122 on Reader Service Card

C for the 8051: Compare:

Benchmark Results - Sample program: Eratosthenian sieve
Program from BYTE (1/83) expanded with I/O and interrupt handling.

<table>
<thead>
<tr>
<th></th>
<th>Archimedes</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICC51 v2.20A</td>
<td>MCC51 v1.2</td>
<td>FRANKLIN C51 v1.2</td>
</tr>
<tr>
<td>Compilation time</td>
<td>12 sec</td>
<td>18 sec</td>
<td>17 sec</td>
</tr>
<tr>
<td>Linkage time</td>
<td>29 sec</td>
<td>9 sec</td>
<td>6 sec</td>
</tr>
<tr>
<td>Execution time</td>
<td>11.45 sec</td>
<td>9.00 sec</td>
<td>0.88 sec</td>
</tr>
<tr>
<td>Total code size</td>
<td>5318 bytes</td>
<td>3798</td>
<td>1726</td>
</tr>
<tr>
<td>Sieve module size</td>
<td>736</td>
<td>1021</td>
<td>541</td>
</tr>
</tbody>
</table>

Call now for your free DEMO disk.

FRANKLIN SOFTWARE INC.
888 Saratoga Ave. # 2 • San Jose, CA 95129
(408) 296-8051 • FAX (408) 296-8061

Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture.

regional campus and among all the campuses.

Each regional campus is served by a minihub. Each minihub is connected to the main campus by means of a pair of remote bridges. At installation, each pair of remote bridges is connected by a 56,000-bps link provided by a university-owned private microwave system.

For emergency backup, an alternative path via 9600-bps modems using dial-up telephone lines is in place. Thus, if the microwave system fails, by using the public telephone network, the university still has a limited amount of connectivity. If the single 56,000-bps link becomes saturated, it is possible to install an additional 56,000-bps link between the same two bridges. The bridges use multiple links simultaneously, load-balancing between them automatically.

This scheme extends the transparent, seamless interconnection of devices to the regional campuses. In effect, the regional networks and the central system perform as a single Ethernet.

Every station on the expanded network has a unique address, and any station can address any other station with no knowledge of its physical location. The consistent use of repeaters and bridges guarantees this transparency. Furthermore, the regional campuses are poised for expansion with no disruption or reconfiguration of the overall network. Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture. Indeed, any of the regional campuses can establish a two-segment backbone in the same manner as the central campus. The same seamless interconnection exists no matter how much the remote network expands.

Automated Tools Help

The network management group uses several software control tools. These tools support the institution’s ability to configure devices remotely, to diagnose problems, and to reboot terminal servers. The university uses utilities for automating password changes, collecting server usage statistics, and reviewing server-PROM revision levels.

The university also uses network management software to
produce audit trails for all connections, disconnections, occurrences of queues, network faults, and other network events of significance. The audit trail helps determine future needs for additional host computer connections, identify common client mistakes, and study other usage trends.

Also obtainable is a LAN-monitoring package that provides cumulative information on overall Ethernet traffic. Reports, available in real time, supply information regarding peak throughput and long-term utilization trends. The information helps determine expansion requirements, assists in deciding how to load-balance the two halves of the core network, and generally provides a good picture of overall use and performance of the Ethernet.

The software is deficient in one area, however: fault isolation. Initially, the university mixed Ethernet components from two different vendors. Each of these products had strong points. However, this mix created chronic problems. Each manufacturer, of course, credited the other manufacturer's equipment as the source of the intermittent (but severe) network disruptions. Finally, for the sake of standardization, the university eliminated all LAN equipment except that of a single vendor. The improvement in network reliability was dramatic.

Prior to the standardization, there was an average of three user-perceivable Ethernet disruptions per day. After standardization, the rate settled down to fewer than one disruption per month. This improvement resulted not because the remaining vendor was the only reliable one, but because there was a single point of responsibility for errors.

Configuration Assistance Welcome

As another example, consider the difficulties of a government research center that was relying on a broadband LAN to tie together mainframes, minicomputers, personal computers, and terminals located in over 100 buildings spread across a 350-acre site. As the traffic on the LAN grew, it became impossible to accommodate all the equipment on a single 5-Mbps, 6-MHz channel. As a result, the center opened up five channels on the LAN with channel-to-channel bridges to allow any device to talk to any other device.

The center tried to cluster groups of users on the same channel, but, even so, users occasionally reported slow responses. Also, there were instances when connections seemed to lock up and require cancellation. To manage the network properly and plan for growth, the center installed performance-monitoring software that provided a profile of connections across bridges versus connections on the same channel, traffic per connection, traffic per bridge, and other useful statistics. Thus, the center was able to continually adjust channel assignments to maintain proper load balancing.

This software, however, was insufficient to diagnose a new problem that cropped up. At random times, a surge of traffic would drastically reduce response time. This situation would occur without any noticeable change in the number of connections or active users. The center decided to add software that could count the number of retransmissions of packets by source and by channel. As a result of the installation, a clue emerged. The slow response time coincided with high retransmissions on two particular channels involving a terminal cluster on one channel and a large minicomputer on the other.

The monitoring software was set to generate an alarm when this condition occurred. When the alarm sounded, a network administrator checked the jobs running on the minicomputer and eventually traced the problem to a high-volume graphics job that would dump large volumes of data onto the LAN. After continued
Elements of a Network Management System

Each system includes a network management entity package that performs local functions. It can communicate with a network control center that has the same software as other nodes, plus network control software that provides a user interface for managing the entire network.

Network Management Systems

Most personnel responsible for network management appreciate the value of network management software. But two problems confront the manager. First, the variety of tools needed can lead to the procurement and use of a number of packages with different user interfaces and different hardware platform requirements. Second, if the facility includes equipment from a number of vendors, it is difficult to find software that works effectively across all vendor brands.

From the user’s point of view, the best approach would be to obtain a set of tools for network management that provides several features. It would contain a single-operator interface with a powerful but user-friendly set of commands for performing most or all network management tasks. It would require a minimal amount of separate equipment. That is, most of the hardware and software required for network management would be incorporated into the existing user equipment.

A system that supplies this type of integration is generally referred to as a network management system. It consists of incremental hardware and software additions implemented among existing network components. The software used in accomplishing the network management tasks resides in the host computers and communications processors (e.g., front-end processors and network interface units). A network management system is designed to view the entire network as a unified architecture, with addresses and labels assigned to each point and the specific attributes of each element and link known to the system. The active elements of the network provide regular feedback of status information to the network control center.

The figure illustrates the architecture of a generic network management system. Each network node contains a collection of software devoted to the network management task, referred to in the diagram as a network management entity. Each NME collects statistics on communications and network-related activities and stores statistics locally. Each NME also responds to commands from the network control center, including those that transmit collected statistics to the network control center, change a parameter (e.g., a timer used in a transport protocol), provide status information (e.g., parameter values and active links), and generate artificial traffic to perform a test.

At least one host in the network is designated as the network control host. In addition to the NME software, the network control host includes a collection of software called the network control center. The NCC includes an operator interface to allow an authorized user to manage the network. The NCC responds to user commands by displaying information and/or by issuing commands to NMEs throughout the network. This communication is carried out using an application-level network management protocol that uses the communications architecture in the same way as any other distributed application.

continued
The Book is dead. Long live the CD-ROM.

An exaggeration? Remember what the automobile did to horse drawn carriages. OK, books aren’t buggy whips, but CD-ROM will forever change the way we store, distribute and access information.

CD-ROM NEWS

You’ve probably read a lot about this exciting technology recently. At Compact Disk Products we were early believers in the benefits of CD-ROM and formed an entire company to promote its use. Look to this column each month for CD-ROM news and new product information. Then look for our special offers of the most popular CD-ROM hardware and software. This month we’ve joined with two CD-ROM industry heavyweights, Microsoft and Hitachi, to offer packages that will convince you to join the information revolution now.

HITACHI CDR-3600 EXTERNAL AVAILABLE

Since its September, 1989 debut, the third generation CDR-3600 has become the leading internal CD-ROM drive. Many owners of earlier drives are upgrading to the CDR-3600 with its look ahead cache, linear pickup head motor and compact design. Now CDP is pleased to offer the CDR-3600’s superior speed and reliability to users who need an external model (available for either domestic or international voltages).

Dealer Inquiries Welcome

CDP SPECIAL OFFERS

PACKAGE A - $899 ($1290 value)

Microsoft Bookshelf and HITACHI CDR-3600 INTERNAL drive kit (complete)! Make your writing more precise and more interesting with this indispensable collection of references. Includes The World Almanac and Book of Facts, Chicago Manual of Style, Bartlett’s Familiar Quotations, Roget’s II: Electronic Thesaurus, American Heritage Dictionary, Forms and Letters. RAM resident. Search a complete reference work from within your document. Powerful cut and paste features for use with popular word processing and spreadsheet programs.

PACKAGE B - $999 ($1390 value)


BONUS OFFER: Until April 30, order package A or B and buy any of the following for only $49 each.

- CD-PLAY: Give your CD-ROM drive more features than top-of-the-line home audio CD-Players. Ram resident.
- Food Analyst CD-ROM: The complete nutritional analysis software.
- Programmer’s ROM: Useful source code in Pascal, Assembler, Modula 2, OS/2 and 8 other languages.
- Sherlock Holmes on Disk: The complete unabridged works with graphic woodcuts.

OTHER PACKAGES AVAILABLE

ORDERS
(800)-MEGABYTE (634-2298)

UNCONDITIONAL GUARANTEE

If for ANY REASON you are unhappy with your purchase, return it within 30 days for a FULL REFUND of your purchase price (not shipping and handling).
You've heard all about those "Super-Big-Number-One" cartridges.

We've heard all about you wanting Solutions, not numbers.

Introducing the Solution II™ series of font cartridges, featuring the quality, hand-tuned fonts, most requested by demanding laser printer users.

For those special needs, the Custom Solution II™ cartridge is custom engineered for your unique requirements. Your Custom Solution II™ cartridge will include fonts, logos, signatures or other graphic images.

Mitchell Pacific
Suite 1050, 10303 Jasper Avenue
Edmonton, Alberta Canada T5J 3N6
Phone (403) 425-0100 Fax (403) 420-0900
MANAGING THE WELL-TEMPERED LAN

As depicted in the figure, the NCC communicates with and controls what are essentially software monitors in other systems. The architecture can be extended to include technical control hardware and specialized performance-monitoring hardware as well.

To maintain high availability of the network management function, it makes sense to use two or more NCCs. In normal operation, one of the centers idles or simply collects statistics while the other performs control functions. If the primary NCC fails, the backup system should still function.

Network Management Standards

As LANs for personal computers expand to become networks of LANs, the need for network management becomes increasingly important. Until now, LAN users have had to rely on a simple network control facility provided by the LAN hardware vendor, or a set of proprietary software, such as IBM’s NetView or the Novell software. These approaches will ultimately be inadequate for several reasons.

Users want the freedom to mix equipment from different vendors and yet retain a unified network management architecture with a single interface. Also, tools developed to deal with single-LAN management are inadequate for dealing with an internet consisting of multiple LANs and wide-area networks.

What is needed is a standard for network management that would function as the basis for multivendor and multinetwork management tools. The International Standards Organization (ISO) has developed a standard for network management referred to as the Open Systems Interconnection (OSI) management framework. It specifies the functions to be performed by a network management system and defines protocols for the exchange of commands, responses, and measurement data.

This standard is relatively new, and no products are yet available. However, it is serving as the basis for network management systems being developed by computer and LAN vendors and, as such, will assume increasing importance in the marketplace.

Functional Areas

The ISO document divides the network management task into five functional areas (see table 1). These areas provide a useful checklist for assessing any network management offering.

Fault management facilities allow network managers to detect problems in the communications network and the OSI environment. These facilities include mechanisms for the detection, isolation, and correction of abnormal operation in any network component or any of the OSI layers.

Fault management facilities detect and report the occurrence of faults. These procedures allow a managed system to notify its manager of the detection of a fault, using a standardized event-reporting protocol. Other facilities log the received event report. This log can then be examined and processed. In addition, there are fault management procedures that schedule and execute diagnostic tests, trace faults, and initiate correction of faults. These procedures can be invoked as a result of analyzing the event log.

Accounting management facilities allow a network manager to determine and allocate costs and charges for the use of network resources. They provide procedures that inform users of costs incurred, using event reporting and data manipulation software, and enable accounting limits to be set for the use of managed resources. They also enable costs to be combined where multiple resources are used to achieve needed communication.

continued
MANAGING THE WELL-TEMPERED LAN

Configuration and name management facilities allow network managers to exercise control over the configuration of the network components and OSI layer entities. Configurations can be changed to alleviate congestion, isolate faults, or meet changing user needs. Configuration management provides procedures to collect and disseminate data concerning the current state of resources. Locally initiated changes or changes due to unpredictable occurrences are communicated to management facilities by means of standardized protocols.

These facilities also provide procedures that set and modify parameters related to network components and OSI layer software, as well as initialize and close down managed objects. They also change the configuration and associate names with objects and sets of objects.

Performance management facilities enable the network manager to monitor and evaluate the performance of network and layer entities. Performance management provides procedures to collect and disseminate data concerning the current level of performance of resources, and maintain and examine performance logs for purposes such as planning and analysis.

Security management facilities allow a network manager to manage those services that provide access protection for communications resources. Security management provides support for the management of authorization facilities, access control, encryption and key management, authentication, and security logs.

OSI Management Architecture
The key elements of the architectural model of an OSI system are as follows:

- Network management application. This application provides the mechanism for the network manager, a human, to read or alter data, control the network, and access reports. Residing in the NCC, this application could be a very simple command interpreter or an expert system requiring very little interaction with the network manager.
- System management application process (SMAP). This application is the local software within a system responsible for executing the network management functions on a single system (e.g., host and front-end processor). It has access to an overall view of system parameters and capabilities and can, therefore, manage all aspects of the system and coordinate with the network management application and SMAPs on other systems.
- System management application entity (SMAE). This application is responsible for communication with other nodes, especially with the network management application in the NCC host. Standardized application-level protocols are used for this purpose.
- Layer management entity (LME). Software is embedded into each layer of the OSI architecture to provide network management functions specific to that layer.
- Management information base (MIB). This is a collection of information at each node pertaining to network management.

By defining these five items, ISO has created a structure within which developers can create standards relating to network management.

Related ISO Standards
The OSI management framework document (ISO 7498-4) is part of the overall specification of the OSI architecture. It supplies a general structure for network management. In addition, ISO is developing specific standards for various aspects of network management (see table 2).
These ISO standards are important to the user who is planning a future network management strategy. Although the standards have not been finalized, several vendors are positioning themselves to provide ISO-compliant network management products. Furthermore, the products being developed will operate not only on the OSI architecture, as you would expect, but also on the TCP/IP protocol suite.

This latter communications architecture, developed as a set of military standards, is widely used in LAN products. Thus, whether your installation uses TCP/IP or OSI-based products, the ISO standards offer the means for developing a vendor-independent network management capability.

The ISO standards are based on three key concepts: the management information base (MIB), the Common Management Information Protocol (CMIP), and the Common Management Information Service (CMIS).

The MIB is a list of items that can be managed by the network management system. The network management specifications developed for TCP/IP make use of the same formats and include a subset of the objects defined in the ISO standard.

The CMIP is the protocol by which various management entities communicate. The use of the term "common" refers to the fact that the protocol is used to support work in all five functional areas of OSI network management (those listed in Table 1). This application-level protocol is part of the OSI protocol suite and is intended to work with systems that implement the OSI architecture.

In the TCP/IP community, the current draft version of CMIP is used in CMOT (for CMIP over TCP/IP). This is the same protocol; the difference is that the protocol is specified to run over TCP/IP rather than the OSI protocols. A number of TCP/IP vendors are working on CMOT implementations. In the meantime, the TCP/IP community is relying on the Simple Network Management Protocol (SNMP), which provides a rudimentary network management capability that can be used in the near term. SNMP and CMOT share the same management information base, which will make migration easier.

Finally, the CMIS defines the services that can be supported by CMIP.

Network Management Solutions
The need for network management grows with the complexity and scale of the networks to be managed. Although it is possible to acquire software and hardware tools that address specific areas individually (e.g., fault detection and security), a full-fledged integrated network management system is the most effective way to satisfy the spectrum of network management requirements.

As in other aspects of computer communications, proprietary approaches to network management create difficulties in the areas of flexibility and vendor independence. Accordingly, the ISO network management framework and evolving standards offer hope for resolution of the network management problems facing those with substantial network installations. Both TCP/IP and OSI-based products that conform to this set of standards are beginning to appear. Now is the time to plan for the use of this effective network management system.

Editor's note: This article is based on material in the author's new book, Business Data Communications (Macmillan, 1990).

William Stallings is president of Comp-Comm Consulting in Prides Crossing, Massachusetts, and the author of 14 books on data communications and computer systems. He can be reached on BIX c/o "editors."
Interactive Games Exchange offers two new conferences.

If you've ever felt you were in a time warp, join SCA (Society for Creative Anachronisms) and swap stories with other people who know the feeling. Right now, SCA is exploring the medieval experiences of contemporary people.

And if you have children under age 14, introduce them to BIXing. It's fun for kids, encourages social interaction, and promotes computer literacy. (join bix.kids)

For other information about IGX, see below.

Exchange Updates

Real-time on the Interactive Games Exchange — The IGX continues to offer real-time fun — such as role-playing game techniques in the fun conference and on-line backgammon and trivia in the fun.n.games conference. If your idea of fun is a serious debate on social issues, you'll want to join the gazebo conference every Monday night. If you want to meet with IGX management and talk about whatever is on your mind, join the gazebo conference on Thursdays. For freeform role-playing games that take you back to the Middle Ages — and sometimes far into the future — check into the Meade & Mirth Inn every night at 9 PM EST. (join mm/m Inn)

IBM Exchange — In concert with the April BYTE's focus on GUIs and 80386 motherboards, this month's IBM Exchange will feature discussions on both Microsoft Windows and OS/2 Presentation Manager GUIs. The topics will be explored from the perspectives of both the user and the programmer. We'll also discuss the ways in which other companies, such as Lattice and Borland (both of which have vendor conferences on BIX) support Windows and PM programming. (join microsoft and ibm.os2)

If you're considering replacing an 80386 motherboard, you'll want to join either the ibm.at or ibm.pc conference. We'll discuss what you should look out for when buying one, prices, speed/performance, compatibility with Unix and OS/2, and how to fit them into XT/AT cases. We'll even drop a few names of suppliers and their prices, and invite other conference attendees to describe their experiences with motherboard replacements.

Mac Exchange — This month, the Mac Exchange will provide coverage of the MacExpo in San Francisco, with several reports from the floor on what to see, what's hot, and what's on the way. If you plan to attend the show, we'll help you plan your time wisely. If you're not coming, the Mac Exchange promises to be the next best thing.

Other offerings in the Mac Exchange during April include our continuing on-line tutorial, product critiques, and question-and-answer sessions about every facet of the Macintosh world.

BIX Conference News — The Oakland Group, makers of the C-scape object-oriented interface management system for DOS, Unix and Look&Feel (a screen design tool), has joined the BIX vendor Support Exchange. (join oakland.group)

Video Associates Labs (VAL) has opened a conference to support users of its Microkey Mark 10 video overlay (genlock) hardware. (join val)

Hot and cold fusion, interstellar travel, and electronic gadgets are some of the discussion topics in the new Technology Conference. (join technology)

The 7th Annual Contact Conference, where anthropologists, physicists, science-fiction writers, sociologists, and xenobiologists explore their common ground, was held during March in Phoenix, Arizona. BIXen prepared for this annual meeting and will continue its spirit of cooperation all year long in the Contact Conference. (join contact)
Finally. An on-line service that doesn't nickel and dime you.

It's BIX's flat-fee service

BIX is short for BYTE Information Exchange. The on-line information service that's yours for an unheard-of flat fee of just $39 for three months*—an amount you could easily waste in just two to four hours with an hourly rate, on-line service. (Not to mention the fact that you'd be nickel-and-dimed for its monthly minimums.)

And here's another distinction: BIX is strictly for microcomputer pros; it contains no "fluff." As a subscriber, here's what you've got coming to you:

- All the information and ideas exchanged in more than 150 microcomputer-related conferences—a give-and-take in which you can participate.
- Microbytes Daily—up-to-the-minute industry news and new product information.
- Plus support from hardware vendors and software publishers, access to extensive software libraries, and the use of our electronic mail service—which allows binary attachments.

Subscribe to BIX right now—using your computer and modem

Set your telecommunications program for full duplex, 7 bits, even parity, 1 stop bit. Call BIX directly on our special registration-only number: 800-225-4129 (in Massachusetts, call 617-861-9767). Then hit the return key, and respond as follows:

<table>
<thead>
<tr>
<th>Prompt:</th>
<th>You Enter:</th>
</tr>
</thead>
<tbody>
<tr>
<td>login (enter &quot;bix&quot;):</td>
<td>bix</td>
</tr>
<tr>
<td>Name?:</td>
<td>bix.flatfee</td>
</tr>
</tbody>
</table>

You can charge your BIX subscription to major credit cards, or have it billed to your company.

You may also purchase unlimited off-peak access via Tymnet for just $20 per month, or $3 per off-peak hour, in the continental US** For more information, and your local Tymnet access number, call 800-227-2983 (in NH and outside the US, call 603-924-7681).

*Based on a $156 annual fee, billed quarterly. You may cancel at any time. If you prefer, you may subscribe for a 3-month trial at just $59. Fee does not include Tymnet connect charges.

**No extra charge for 2400-baud access. Tymnet prices are subject to change. International networks access BIX at NUI 310690157800.

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983. In NH 603-924-7681.
Go Beyond 640K DOS.

Build multi-megabyte programs with Phar Lap's 386|DOS-Extender.™

If the DOS 640K limit is driving you nuts, get all the memory you want with 386|DOS-Extender from Phar Lap.®

Large-scale benefits. By turning DOS into a true 32-bit operating system, 386|DOS-Extender shatters the 640K barrier. It lets you create protected mode applications that use all the memory in the machine — up to 4 gigabytes. You work within a flat, 32-bit address space. No more suffering with overlays, bank-switched EMS, or segmentation.

With full 32-bit memory and power, you can finally build workstation-class applications for the PC. Your Extended-DOS programs will run considerably faster, have room for more features, and be more responsive than those in 16-bit DOS.

And if that's not enough, add Phar Lap's 386|VMM™ virtual memory manager. With true demand-paging, 386|VMM enables your application to grow bigger than available RAM. Both code and data are automatically swapped to disk as needed.

Total compatibility. Because 386|DOS-Extender is embedded into your program, it is invisible to the end-user. Your program looks exactly like any other DOS application. There's no new operating environment for your end-users to buy or learn.

Every 80386 PC that can run MS-DOS or PC-DOS can run 386|DOS-Extender. It is completely compatible with all DOS-based software, including TSRs and network managers.

386|DOS-Extender is backed by a full complement of 32-bit languages. Choose your favorite from among C, Fortran, Pascal, Ada, Assembler, and others. And with Phar Lap, you'll be using the finest, most widely used 386 software development tools in the world.

Proven success. AutoCAD 386, IBM Interleaf Publisher, and Paradox 386 are just a few of the hundreds of Extended-DOS applications already being shipped with 386|DOS-Extender. Utilizing this exciting new technology, industry leaders are keeping their competitive edge by delivering the speed and power that 386 users have been waiting for.

So if DOS is looking smaller than ever, call Phar Lap today.

And see what it's like beyond 640K.

Phar Lap 386|DOS-Extender:
We open a world of memory.

Phar Lap Software, Inc.
60 Aberdeen Avenue
Cambridge, MA 02138
617-661-1510
FAX 617-876-2972

DOS extenders offer the best of two worlds: DOS compatibility and access to protected mode.

For programmers and users of Intel-based microcomputers, the architectural legacy of the IBM PC is a blessing and a curse. No other industry-standard architecture enjoys as wide a variety of polished prepackaged software, useful utilities, and high-powered development tools.

However, few architectures have as many restrictions and limitations. The most hobbling of these are the formidable 640K-byte barrier, which prevents programs, data, and DOS from using more than 640K bytes of directly accessible memory, and the 64K-byte limit on memory segment size, which requires programs to perform special gymnastics to manipulate large data objects.

Both limitations arise from the design of the original PC and its CPU, the Intel 8088. The 8088’s address space contains only 1 megabyte, and only 640K bytes of this was made available for programs and data on the PC. Despite the introduction of the 286, which can address up to 16 MB of RAM, and the 386, which can perform 32-bit arithmetic and address up to 4 gigabytes in a single segment, the need for downward compatibility and lack of a standard operating environment that supports the new features force most users to run these microprocessors as fast 8088s, in what is called real mode.

Seeking to extract more performance from today’s faster clones, clever engineers have come up with numerous ways to circumvent these two limitations. Among these are EMS, add-on program switchers and multitaskers, completely new operating systems, and DOS extenders. Each has advantages and disadvantages vis-à-vis features, compatibility, performance, development techniques, and hardware requirements. In this installment of Under the Hood, I’ll discuss how DOS extenders work and how they compare to other methods of getting around the PC’s limitations.

Why a DOS Extender?
A DOS extender lets a program run in the protected mode of the 286 or 386, while maintaining access to DOS, DOS device drivers, TSR programs, and the IBM PC BIOS. DOS-extender programs can use all the memory in the machine, including extended memory (i.e., the region above the 1-MB address reach of the original 8088). Protected mode costs some speed, typically 5 percent to 10 percent for the enhanced security of “sanity checking” on accesses to memory and I/O devices, but large memory and—on the 386—full 32-bit addressing and arithmetic usually offset that performance hit by a wide margin.

The user of a DOS-extender program starts it from the DOS prompt the same way he or she would run any other program. There’s no new environment to learn, and the user need not even be aware that the extender is at work. DOS-extender makers have gone out of their way to ensure that an ordinary DOS application must be modified only in very minor ways to work with the extender; it might even take just a recompilation.

The downside of DOS extenders is that they run only on systems that use 286, 386, and i486 microprocessors. Users of 8088- and 8086-based machines are left out in the cold. And because the machine must switch back to real mode to handle many system interrupts (including timer ticks and keystrokes), some operations are actually slower, especially on the 286. It’s possible, in fact, to drop incoming characters when doing serial I/O at 9600 bps. Fortunately, this problem can
be circumvented with special programming techniques.

What are the other options for getting around the PC’s limitations, and how do they compare? While a complete discussion of this topic could fill an entire column by itself, I’ll now summarize the key methods.

**Other Possibilities**

**Expanded memory** is a bank-switching scheme that switches memory in and out of the PC’s address space in 16K-byte blocks. Its key advantage is that it’s available on most PC compatibles, including those with 8-bit CPUs.

Expanded-memory emulator programs are available to turn the extended memory on an AT clone into expanded memory, and memory managers (e.g., CEMM, QEMM-386, and 386Max) can use the 386 paging unit to do the bank switching.

Expanded memory’s main disadvantages are lack of speed (it takes time to switch banks) and the awkwardness of dealing with RAM that’s been broken up into 16K-byte chunks. Expanded memory does not provide access to protected mode or the enhanced addressing and math facilities of the 386 chip.

386 operand and address size overrides let a program running on the 386 in real mode use 32-bit arithmetic and enhanced addressing modes. This simple but little-known feature of the 386 can be used to speed up key parts of a computation. I’ve seen one program that uses operand size overrides to compute the Mandelbrot set five times faster than it could otherwise.

However, this technique may cause compatibility problems with some OEMs’ versions of OS/2, specifically those that don’t preserve the full 386 registers during a task switch.

Address size overrides let real-mode programs use powerful array-addressing modes with 32-bit offsets and built-in “shift and add” operations. They can also be used to address segments larger than 64K bytes and memory above 1 MB. However, the techniques for doing so are undocumented (and hence unsupported) by Intel; they may disappear in later chips. And, of course, the 286 supports none of these features.

**Other operating environments**—notably Unix, OS/2, Concurrent DOS, PC-DOS, and QNX—have been developed to support the enhanced architectural features of the newer chips, but users have been loath to migrate to them. Why? Because they’re expensive, require large investments in RAM and hard disk space, and lack DOS’s phenomenal software base. Rewriting your own code to run under these new environments can be expensive and incredibly time-consuming.

Fortunately, many of these systems have facilities to run DOS programs—or even several at once—as tasks, but they often do it slowly and with limited compatibility. And the DOS programs they do run are still limited to 64K bytes within their individual “virtual machines” or “compatibility boxes.”

**Add-on multitaskers** (e.g., DESQview and VM/386) let multiple DOS applications run simultaneously and offer good DOS compatibility, but they don’t offer a full-up enhanced operating-system environment. And the individual programs they run are still subject to the same limitations they’d encounter under DOS.

Note, though, that many of these environments now support DOS-extender
Weitek Your 386/486!

The new 4167 delivers up to 10 Megaflops when driven by NDP Fortran-486 and is supported by dozens of scientific, engineering and CAD applications. MicroWay provided the tools to develop many of these applications and supplies the interface cards required to use Weitek coprocessors in conjunction with with an 80387, in both standard AT bus and MicroChannel machines.

Number Smasher 386/25™

Our newest AT accelerator board replaces your 80286 with an 80386 clocked at 20 or 25 MHz. It is socketed for 8 Megabytes of 32 bit RAM, an 80387 or 3167 and a 64K SRAM cache. The NDP Fortran-386 driven 3167 throughput at 25 MHz is 5.5 Megawhatstones.

mW3167/387

This popular daughterboard (shown on the Number Smasher 366/25) lets you plug a 3167 and an 80387 into a 386 system that has a single EMC socket.

3167/4167 Numeric Performance

<table>
<thead>
<tr>
<th></th>
<th>3167/MCA</th>
<th>NS 386/25</th>
<th>NS/486/25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Megawhatstones</td>
<td>3.4</td>
<td>5.5</td>
<td>12.2</td>
</tr>
<tr>
<td>Megawhatstones</td>
<td>1.6</td>
<td>3.1</td>
<td>9.9</td>
</tr>
</tbody>
</table>

mW3167/MCA

Our MCA Weitek card runs in the IBM Model 70 and 80. At 20 Mhz, its performance is 2 to 3 times that of an 80387.

NDP Fortran-486 and C-486 are globally optimized main-frame compilers that have been fine tuned for the 80486 and 4176.

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, UK, 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90 40
Germany 069-75-2023

Weitek 3167 and 4167 are trademarks of Weitek Corp., MicroWay and Number Smasher are registered trademarks of MicroWay, Inc., 80386, 80286, 80486 are trademarks of Intel Corp.
Inside a DOS Extender
A DOS extender's job is a tricky one. DOS and the BIOS run in real mode. Thus, they perform operations that are illegal in a protected-mode system. The DOS extender filters requests from the application program to the system, as well as any information that comes back. The result: DOS and the BIOS "look" like protected-mode system software to the application, and it looks like a real-mode application to them.

Microcomputer News On-line
In this fast-paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MSDOS machines, Macintosh, Unix workstations, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy
Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

See our ad on pages 284, 285 of this issue.
Call now and subscribe today.

BIX
One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983 • In NH (603) 924-7681

The figure shows, schematically, where the DOS extender fits into the scheme of things. The DOS extender manages and filters communications between the program and other system software. It also performs mode switches as necessary and sets up the descriptor tables (i.e., GDT, LDT, and IDT) that control how memory is used.

Care and Feeding of DOS and the BIOS
To make the BIOS and DOS useful to a protected-mode program, the DOS extender must run the system software in real mode and make it think it's dealing with an ordinary real-mode program. This can require a good deal of work.

For one thing, DOS and the BIOS don't know how to handle protected-mode addresses. If a DOS or BIOS call requires a pointer to a parameter (as is often the case with disk functions), the protected-mode address furnished by the application (which contains an abstract segment selector and an offset) must be converted to a real-mode address (which contains a physical segment number and an offset).

What's more, since DOS and the BIOS can't access memory above FOO0:FFFF hexadecimal (the 1-MB limit), any parameters passed in high memory must be either copied down into the lower part of RAM or mapped into it with the 386's paging unit. Likewise, results must often be copied back up to high memory after a call.

Not all DOS extenders have a full repertoire of DOS and BIOS calls, however. For instance, Phar Lap Software's 386/DOS-Extender does not support DOS functions that use file-control blocks, and none automatically supports NetBIOS (although Rational Systems supplies sample source code that can be used to make NetBIOS calls from the DOS extender). Eclipse Computer Solutions' DOS extenders do buffer copying, but they limit it to 16K bytes on many calls.

A DOS extender must handle interrupts in both real and protected modes. Interrupts can arise from three sources: software interrupts (like the ones used to call DOS and the BIOS), hardware interrupts (usually generated by peripherals), and processor exceptions (usually caused by errors in the application). Furthermore, because the IBM PC BIOS disregards Intel's recommendations and uses some "reserved" interrupt vectors for BIOS functions, the extender must also figure out the cause of each interrupt and call the proper routine.

continued
The Altec Collection—Pillars of Success

"ALTEC Zip 386s are solid machines featuring brand-name parts. A good buy, they are clearly affordable."  
PC Magazine May 30, 1989

The ALTEC-286 turned in some of the best performance times of all the machines tested."  
PC Magazine Feb. 14, 1988

Fast Release
We do same-day shipping.

Policy:
- Same day shipments with standard configurations for orders before 3:00 pm EST.
- Shipping and handling extra. Personal and company checks require 10 days to clear. Prices are subject to change and all items are subject to availability. All orders must be shipped prepaid, insured, in original condition and complete with documentation. All returns must have RMA #.

Altec's Another Standout-Service
- 30 Day Money Back Guarantee
- 1 Year Warranty for Parts and Labor
- Free 4 Months On-Site Service
- Lifetime Toll-Free Technical Support

1-800-255-9971

Circle 18 on Reader Service Card
A DOS extender accepts DOS and BIOS calls from a protected-mode application, processes the parameters, and reissues the request in real mode. It also fields interrupts in protected mode (and some in real mode as well), performing mode switches and reissuing interrupt requests as necessary. A DOS-extender application can also have a portion that runs in real mode (not shown), usually for the purpose of handling interrupts without a mode switch.

Turning Off the Engine

One problem that the DOS extender must overcome in each machine is that of switching quickly and nondestructively between real and protected modes. The technique varies with the microprocessor involved. The 286 can be switched from real mode to protected mode in a few instructions. Unfortunately, Intel, in its zeal to make sure that the protection mechanisms on the 286 were secure, provided no way to switch it back! The only way to do so is to reset the microprocessor via a hardware reset line or a particularly nasty sequence of erroneous instructions.

When IBM designed the AT, it noted this problem and provided a hardware workaround for it. An output from the keyboard controller was connected to the main CPU’s reset line. The CPU could “commit suicide” by ordering the keyboard controller to toggle the line. The keyboard controller could also be ordered to mask or unmask the 286’s A20 address line to simulate the 8088’s behavior in real mode.

Some compatibles—including many Compaq machines, systems that use application-specific IC chip sets, and the PS/2s—provide more direct ways of forcing resets and toggling A20. The 386 can be returned to real mode quickly without a reset, and the i486 even provides a pin to notify the internal cache controller that A20 is masked, so that the address used by the cache corresponds to the physical address that appears on the machine’s data bus. The bottom line: The time to switch back to real mode can be as short as 30 microseconds on a fast 386 or as long as half a millisecond on a 6-MHz 286.

Protected-Mode Constraints

While the DOS extender is doing its job, the application program must cooperate with it by following the architectural guidelines for protected mode.

As I mentioned in the December 1989 Under the Hood, the most important of these restrictions have to do with memory addresses. A program can access only the memory for which it has a memory selector, and then only in a way that corresponds to the type of the segment. You cannot write to a code segment or execute a data segment (although it is possible to create an alias—a writable data segment that overlaps a code segment—if you must).

You can only perform an intersegment jump or call to a “safe” entry point through a call gate. You can’t read or write beyond the end of a segment. And you can’t trash the operating system by mistake—unless, of course, it chooses to let you do so. If you try to do any of these things, you will get a GP (General Protection) fault, and your program will stop running.

Generally speaking, protection is a good idea. It tends to catch program bugs like wild pointers and out-of-bounds array indexes. Different DOS extenders provide different degrees of protection, however, as you’ll see shortly when I look at some actual products.

Virtual Memory

Another advantage of protected mode is the possibility of virtual memory. If you like writing programs that use 64 MB of RAM, and you don’t happen to have that much handy, a DOS extender can help. Virtual memory in the 286 must be implemented by swapping whole segments, up to 64K bytes at a time. On the 386, however, the paging unit works with 4K-byte pages.

In either case, a simple least-recently used algorithm is usually sufficient to keep the system from thrashing. All the manufacturers of DOS extenders I’ve seen either have virtual memory or plan to have it in the near future.

Four DOS Extenders

To gain experience with DOS extenders, I obtained copies of four products: two for the 286 and two for the 386. These included Rational Systems’ DOS/16M (the DOS extender that Lotus picked for 1-2-3), Eclipse Computer Solutions’ OS/286 and OS/386, and Phar Lap Software’s 386/DOS-Extender. To familiarize myself with the development process for each one, I wrote a simple program—the ever-popular “hello world”—in assembly language. It made only two DOS calls: one to function 9 (Write String), and another to function 4C hexadecimal (Terminate Program).

I then built and executed each program, using my own AT clone for the 286 extenders and a 20-MHz 386 system to me by Arche Technologies for the 386 extenders. All the programs generated by the 286 extenders also ran on the 386 with no changes, as you might expect.

Although the source code used with both of the 286 extenders was the same, DOS/16M required me to assemble and link an additional module into my code. The purpose of this module was to set up a series of segments for descriptor tables and video screens and to make sure the segments were in the right order.

Building a DOS-Extender Program

For each 286 DOS extender, I used the Microsoft Macro Assembler (MASM)
by John C. Dvorak and Nick Anis • Foreword by Peter Norton
5.10 and the Microsoft Overlay Linker 3.65 to generate the initial .EXE files and associated .MAP files. (The .MAP files are very important, because they let the postprocessors set up call gates for intrasegment calls.) Both .EXE files ran as ordinary real-mode programs from the DOS prompt. I then passed each through a postprocessor (.EXPress for OS/286 and MAKEPM for DOS/16M), which converted them to a protected-mode format.

To execute the OS/286 program, I loaded the OS/286 kernel as a TSR program by simply typing OS286 at the DOS prompt; I could then execute the "hello world" program by typing UP HELLO. (OS/386 will also run 16-bit protected-mode programs created for OS/286, so you can keep one kernel loaded for both.) Phar Lap provides a loader that’s called RUN386 to run its programs. All three DOS extenders came with debuggers. None was of the quality of Code View or Turbo Debugger, but they all seemed adequate for simple debugging jobs.

Run-Time Environments
Each of the DOS extenders I used presented a slightly different run-time environment to the program. Phar Lap’s is the simplest: The code, data, and stack are all mapped into a single large program segment. This segment is normally aliased so that all the segment registers point to it. (Unfortunately, this means that it’s very easy for a buggy program to clobber its own code.)

The other three extenders allow multiple segments. The Phar Lap and Rational Systems extenders run all protected-mode code at PL 0, but the Eclipse extenders run the kernel at PL 0 and the user program at PL 3. The latter seems to me to be a wise decision; it’s a good idea to take as much advantage as possible of the facilities of protected mode.

High-Level Languages and DOS Extenders
All the DOS extenders I tested came with lists of high-level-language compilers that they supported. (There’s no room here to list them all; contact the manufacturers for the most current lists.) Some compiler manufacturers (e.g., Metaware) work with the DOS-extender manufacturers to make their products compatible; others (e.g., Microsoft) aren’t as cooperative and are supported through third-party patches to the run-time libraries. Almost all the patches are workarounds for areas where the run-time libraries access absolute addresses directly, create self-modifying code, or do segment-address arithmetic.

To see what it was like to work with a high-level language under a DOS extender, I tried Meridian Software Systems’ AdaVantage Ada compiler and environment, which work with OS/286. Once I got the system installed, I could hardly tell the difference between developing for real and protected modes. The environment “knew” about the DOS extender and behaved appropriately. I was able to get some simple Ada programs running in about an hour.

I tried one more experiment. Eclipse claimed in its manual that the .EXPress program would convert many real-mode programs to run in protected mode, as long as there was no segment arithmetic and the program was reasonably well behaved. I decided to test this by writing a simple Turbo Pascal “hello world” program, generating a .MAP file, and then running the output through .EXPress.

That didn’t work, as .EXPress complained that it couldn’t find a “Name” section in the .MAP file (there wasn’t one) and quit without producing any output. Daringly, I used a text editor to add the required heading to the .MAP file and tried again. This time—Io and behold!—the conversion worked, and the program ran in protected mode.

Eclipse says that it will soon support Turbo Pascal’s patched run-time library that allows the heap and overlays to work completely.

Compatibility Problems
DOS extenders work hard to make your hardware perform unusual stunts—and
sometimes the hardware doesn't cooperate. Before you can run Eclipse's OS/286 kernel, you must run a program called Tune, which checks the characteristics of your machine and sets the kernel up to work with it. The documentation warns that Tune may crash the machine a few times as it works, so when this happened on my trusty 8-MHz 286 clone, I calmly rebooted and tried again.

Alas, Tune hung the machine more than 20 times before I stopped trying. It couldn't figure out how things needed to be configured. I therefore called Eclipse, and its technical-support people were very helpful. They gave me a command that forced Tune to configure the kernel as if my machine were a standard AT. The resulting kernel ran with no problems.

What Price Speed?
Each of the DOS extenders I tested lets you "bind" the extender to the loader program to create an .EXE file that can be run directly from the DOS prompt. However, only Rational Systems' package actually included such a utility. The other vendors required you to buy a license before you could use it.

Suppose you're now sold on the idea of using a DOS extender in your application. How much can you expect to pay in royalties? If you have a successful product, you will probably pay a great deal, regardless of which vendor you choose.

Phar Lap charges $1995 for the first 1000 copies and 2 percent of the list price of your program for each copy thereafter.

Rational Systems' DOS/16M, which has a $5000 price tag to start with, comes with a license that lets you distribute 200 copies of your programs. After that, you pay $30 per copy up to the 999th copy and $15 per copy thereafter. If you wish to purchase some larger number of copies or buy a blanket license, you need to negotiate directly with the company.

Eclipse lets you distribute 2500 copies of your application(s) for a single $10 registration fee, but after that you must pay more, up to a maximum of $15,000.

These prices may be sufficiently daunting to developers that they are inspired to roll their own DOS extenders. While this is a tricky business, it's certainly possible—and even likely—that some will do so. And compiler developers, eager to cash in on the DOS-extender market, may develop extenders exclusively for their own products.

I asked each vendor if its agreement made provisions for distribution of products as shareware; so far, none had. Unfortunately, without special terms for this mode of distribution, it's unlikely that we'll see protected-mode programs written with these DOS extenders in the shareware arena.

The Right Choice?
With OS/2, Windows, Unix, DESQview, DOS extenders, and DOS replacements all competing for pieces of the operating-environment marketplace, DOS extenders have two key advantages.

First, they don't require you to run out and buy an expensive piece of software (and possibly hardware to match); second, they provide better performance than most (perhaps all) of the other environments. The 386 DOS extenders run consistently ahead of Unix and OS/2 on virtually all benchmark tests, probably because they eliminate the overhead of a multitasking kernel and scheduler.

I plan to experiment further with DOS extenders as a way of getting more out of my systems and honing my protected-mode programming skills. While vanilla DOS and real mode will surely be around for a long time to come, it's clear that protected-mode programming will play an important role in the future of the Intel-based world.

ACKNOWLEDGMENT
Many thanks to Arche Technologies for the loan of a 386 system for use with the 386 DOS extenders.

L. Brett Glass is a freelance programmer, author, and hardwar designer residing in Palo Alto, California. He can be reached on BIX as "glass."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
If you own or are about to buy a 386, 386SX, or 486-based system, you are losing 50% or more of your system’s speed if you are still running 16-bit code or have not installed a coprocessor. To date, hundreds of mainframe applications have been ported to the 386 that take advantage of the real power of the 386. Many of these applications were developed with MicroWay NDP Fortran and C. Our compilers break the 640K barrier wide open, making it possible to run programs up to 4 gigabytes in size. They also run in virtual memory under DOS, UNIX or XENIX, generating mainframe quality, globally optimized code capable of driving every coprocessor on the market, including the latest high performance devices from Weitek and Cyrix. If you have a question about coprocessor performance, call for a free copy of an article by Stephen Fried, “The State of PC Numerics in 1990.”

For Model 70 and 80 owners, we offer a Weitek Micro Channel card that runs 200% faster than an 8087. For Compaq Deskpro owners, our Weitek daughterboard takes a 3167 and Cyrix CX83D87. We also offer RAMpak one and four megabyte Deskpro RAM upgrades.

NDP Fortran-386 is as close to VM FAC AS/400 as you can get in non-VAX environment, while our C conforms to both the UNIX System V and ANSI standards and includes MicroWay and Microsoft extensions. If you plan to mix FORTRAN with C or Pascal, our languages are the only choice. Our compilers include GREX, a library of 135 character and pixel oriented graphics routines that automatically detect and support CGA, Monochrome, Hercules, EGA and VGA. We complement our compilers with a complete line of 386 tools listed below.

Please call (508) 746-7341 for more information.

386 Compilers and Tools

NDP Fortran-386™, NDP C-386™, and NDP Pascal-386™ compilers generate globally optimized, mainframe quality code that runs on the 386 or 486 in protected mode under UNIX, XENIX, or Cyrix or Phar Lap extended DOS. The compilers support the 80287, 80387, Weitek and Cyrix coprocessors. Applications can mix code from all three compilers and assembly language. The DOS versions allow the user to write his own numeric error handlers and interface 386 real mode programs from protected mode. The VM versions use Phar Lap’s Virtual Memory Manager to run programs which exceed the size of your system memory. NDP Fortran-386 is a full FORTRAN 77 with FORTRAN 66, BSD 4.2, DOD, and VMS extensions. NDP C-386 is a full K&R C with both MS and ANSI extensions. It is 100% compatible with UNIX C and is substantially faster than the C which comes with UNIX. NDP Pascal-386 is a full ANSI/EESA Pascal, with extensions from C and BSD 4.2.

The product comes with an example of how to solve complicated mathematical calculations, generate statistics and regression analysis, do statistics and regression analysis, generate differential equations and eigenvalue problems. perform matrix operations, fit curves, and parallel applications under the Microsoft Windows environment. Our compilers include GREX, a library of 135 character and pixel oriented graphics routines that automatically detect and support CGA, Monochrome, Hercules, EGA and VGA. We complement our compilers with a complete line of 386 tools listed below.

Please call (508) 746-7341 for more information.

NEW! Cyrix FasMath™

Cyrix CX83D87 FasMath™ - Fastest 80-bit Intel compatible coprocessor. Performs transcendental calculations up to 3 times faster than the 80387. 20 MHz. $499 25 MHz $649 33 MHz $799

Weitek-Based Coprocessor Boards

mW1167™ and mW3167™ coprocessor boards are built at MicroWay using Weitek components. Each includes an 80387 socket.

mW1167-16 $595
mW1167-20 $795
mW1167 Micro-Channel-16/20 from $995
mW1167 Micro-Channel-25/33 from $1195
mW1167-20 $795
mW1167-25 $995
mW1167-33 $1295
mW1167/80387 Board $200

Intel Coprocessors and RAM

NUMBER SMASHER-386™ - A full-sized card that replaces the 80286 microprocessor on your IBM PC or compatible motherboard with an 80386 that runs at 20 or 25 MHz. It runs numerically intensive applications up to a factor of 60 times faster, while maintaining full hardware and software compatibility when running all 386 applications. It includes sockets to optionally add up to 16 megabytes of 32-bit memory, an Intel 8087, Weitek, or Cyrix numeric coprocessor, and 64K or 256K of high speed cache memory...

SuperCACHE-286 12 MHz $399
FastCACHE-286 12 MHz $299

12 MHz PC Accelerators
When in Finland, do as the Finnish do; when in assembly, try the same

In The Mythical Man-Month, Frederick P. Brooks Jr. estimates that replacing 1 percent to 5 percent of high-level-language code with machine language is the best fix for any speed problem. For many hackers, that's true, a number of high-level languages, notably the ones in Borland's Turbo family, do provide machine language interfaces; but wasn't your reason for mastering one of those languages precisely that you'd be spared a byte-by-byte copying with assembly? If so, then (like me) you may have no grasp of assembly at all, and the luscious fruit Brooks dangles is just out of reach.

All need not be lost. Although I'll not be denying that the more you know the better, I'll offer a case history of how enlightened ignorance can sometimes lead to useful work. A Turbo Pascal program I'd written got speeded by a factor of six when I replaced two short procedures with assembly equivalents. One of them, yes, I copied from a book, but the other I devised on the principle by which a non-speaker of Finnish might manage to order breakfast in rural Finland: Observe the natives and imitate their ways.

Ignorance can be enlightened by two things: by the fact that all computer languages have structural analogies that the very nature of the computer enforces, and by the fact that once you find a skeleton to flesh out, a few hints from a good book may suffice.

A Dark and Stormy Night
It all started when I needed a program that would locate text strings (words and phrases) in large text files and then tell me where and how often it had found them. Well, don't the MS-DOS utilities offer FIND.EXE? Yes, yes; but FIND doesn't tell you how often it found its quarry; it can tell you on how many distinct lines, which may be quite a different number. Also, for my purposes, FIND has at least two trouble areas.

The first is awkwardness. Each and every search requires a complex command line, where you specify the file to be searched, the string to be sought, refinements like "Ignore letter case" and "Display line numbers," instructions about where the output should go (disk? printer?): in short, much finicky key-pushing per search. And I envisaged perhaps dozens of searches per session.

The other trouble with FIND is that you can't make it disregard punctuation. That can cause no end of trouble. Say you want all instances of the word up in a file that contains, among other items, the following:

1. go up to 
2. Up there 
3. puppy 
4. Get up! 
5. Upset

The instances you want are 1, 2, and 4. FIND's search will locate 1, 3, and 4, overlooking "Up" and including an unwanted "puppy." The same search with the /i switch set (to ignore case distinctions) will locate not only the three items you do want, but also two you don't—items 3 and 5. By prefixing a space to the search string, you could exclude "puppy," and spaces both before and after would exclude "Up" too; but then the trailing space would make the search miss "Get up!" So can't you somehow suppress punctuation as well as case?

Not, so far as I can see, with the DOS version of FIND. So my next step was to write a Turbo Pascal program, called SEEK, with the following specifications:

1. Just once, at the start, you name the file you plan to search.
2. The program asks you where you want the output: Printer? Disk file? Screen?
3. After that, it asks you for something to find (the Quarry), and each time you supply a Quarry it offers you two options: Ignore case distinctions? <Y/N>
Ignore punctuation? <Y/N>
4. Output consists of numbered lines containing the Quarry.

If the Quarry appears twice on a line, the line is shown twice. At the end, the program tells you that the Quarry was found n times, or else it tells you, "I didn't find [Quarry]." It then asks you for a new Quarry; by answering "--" you can exit to DOS.

Like most no-fuss programs, SEEK devotes much code to getting filenames, error-checking, and other such housekeeping. But once under way, it spends most of its time as follows:

1. Read the next line of text to a string;
2. On a working copy of the string, (a) attach a leading and a trailing space; (b) swap case differences if required; (c) kill punctuation if required;
3. Search the modified CopyString for Quarry; (a) If found, write the original line (numbered) to Outfile. (b) Search further along the string for a recurrence. (c) Found another? Back to 3a. No more? Back to 1.

The Game Is Afoot
I didn't need to write a search algorithm; Turbo Pascal has a very fast POS function to return an integer designating the first appearance of your Quarry in a line. A zero means "not found," so only when

POS (Quarry, CopyString) <> 0

continued
do you have to do anything more. (What you do is print LineNumber and Line, then.head CopyString right up to the end of the Quarry you’ve found, and then search what’s left anew, just in case your Quarry is present more than once.)

That worked—not as fast as FIND but agreeably fast—so long as I didn’t request it to “Ignore case differences” or “Ignore punctuation.” In particular, the latter mired SEEK’s feet in molasses.

The obvious way to “Ignore case differences” was to put both the Quarry and the working copy of each input line into uppercase. That meant, for each of perhaps many hundred input lines, a FOR loop that ran from 1 to the length of the line, uppressing characters as necessary. Turbo’s UPPCASE function made that go a lot faster than it might have; the procedure increased SEEK’s run times by some 30 percent, ascribable mostly to loop overhead. Without UPPCASE—well, read on.

And the obvious way to “Ignore punctuation” meant a similar FOR loop, to ask each character in the line if it’s contained in the set [0 . . .9 , a . . .z , A . . .Z] and replace it by a space if it isn’t. (Quarry also gets a space appended if it hasn’t one already; this, a search for “up” with both options set becomes a search for “UP,” and lo, you find “Get Up!” because it’s been transformed into “GET UP”; meanwhile, the space guards us against distraction by “PUPPY.”) Neat, yes. But you’ve built-in Turbo function to help you, and that loop increases run time by an intolerable 650 percent.

I’ve since replaced the search function itself with an assembly version derived from Robert Jourdain’s book Turbo Pascal Express. As published, it had a bug, which Dan Mick fixed for me via BIX. Moreover, so efficient is the Turbo Pascal POS that the speed gain proved unspectacular. Still, it was there.

Closing In on the Quarry

So back to The Mythical Man-Month’s rule of thumb: When a program spends most of its time doing one thing over and over, then optimize that routine and watch the sparks fly. Obvious candidates for optimization were perhaps the Line Uppercase and certainly the Punctuation Killer. To optimize a Turbo Pascal routine, you’d rewrite it in assembly language. But I didn’t know assembly.

I did, though, chance to remember a detail from the Turbo Pascal 3.0 manual. To illustrate Turbo’s in-line assembly code, it offered a sample procedure that did just what “Ignore case” wanted: converted entire strings to uppercase. So I replaced my Pascal Procedure Uppercase with a careful copy of what the manual listed. The assembly version ran so fast that for files of, say, 25K bytes, the difference between ignoring case differences and not ignoring them was nearly unmeasurable. The Mythical Man-Month was right; I was on to something.

But could I also deal with punctuation in assembly? How long would it take to learn what I’d need? Weeks, likely, with luck. The payoff, savings measured in seconds, seemed insufficient.

But then two things dawned on me in rapid succession. First, when you need code in a language you don’t know, best get it from a book, which was what I’d just done with Procedure Uppercase. Second, if you can’t find it in a book, look for something structurally similar and work out just the modifications. And that is the secret of flirting with assembly (or any other) language. Let a wizard handle the grunt work. Save your own attention for the details you need.

Something structurally similar? Well, I needed to read in a string, check it character by character, and replace anything that wasn’t a numeral or letter with a space. And what does Procedure Uppercase do? It reads in a string, checks it character by character, and replaces any lowercase characters with uppercase. That seemed close enough to be promising. Possibly, just by retouching Procedure Uppercase, I could come up with machine code for a Procedure DePunct. I finally did, and here’s a play-by-play.

All Is Revealed

The first step was to gain some understanding of how Procedure Uppercase worked. It is listed in full in listing 1. I’ll be scrutinizing those mysterious assembly statements toward the right. Any reader fluent in MS-DOS assembly can either look away or relive the struggle.

First to catch the eye is that pair of labels, L1: and L2:. And since assembly items are supposed to jog human memories, an instruction beginning with J is probably a jump. (Yes, a book confirmed that.) Examining the code more closely, you find three jumps up to L1: and one jump clear out to L2:. Coming right after a counter has decremented, that JZ likely means “jump if zero” and jumps you to the exit point. Yes, L2:, at the very bottom, does look like an exit. If so, then the business part of the procedure, its repeated looping and testing, is confined to L1: and below. So the lines down to L1: are doing setup, and you can likely take them over as they stand. (All that turned out to be true.)

Now, how does the testing work? It looks as though the range a through z is being tested, since a character within that range wants uppressing. A way to uppress is to subtract decimal 32 (20 hexadecimal) from the character’s ASCII value, and that must be what’s happening in the second-to-last line of code, which begins with SUB and ends with 20H. Thereafter, a JMP takes us back up to L1:, which must be where a new character starts getting fetched.

Another detail: Our character is evidently not being checked against all 26 of the letters a through z. The routine is just looking at boundary conditions. An assembly manual confirms the guess that JA means “jump if above” and JB means “jump if below.” “Above” and “below” confused me for a while. “Below” means “lower in value”—that is, nearer the top of the ASCII table. So if the character’s ASCII value is less than hexadecimal 61 (a), or if it’s higher than hexadecimal 7A (z), it’s not a lowercase letter, and the jump takes us back to L1: to fetch the next candidate.

You can see how this is getting promising: Checking for membership in a range seems quick. Now recall the coarse structure of the ASCII table, where the alphanumeric characters come in just three blocks: decimal 48–57 (the numerals 0 through 9), 65–90 (the uppresses A through Z), and 97–122 (the lowercased a through z). You might check your character for membership in each block; keep it if it qualifies or have a space quash it otherwise.

So envisage a label SP: where that space gets substituted, and (as before) label L1: where you get the next character. An automatic jump to L1: should follow SP:. Using “below” the way assembly jargon uses it—to mean “nearer the top of the ASCII table”—pseudocode might look like this:

```plaintext
Initialize.
L1: Get a character.
Below 97 Jump to SP:, then to L1:.
Below or equal to 9? Jump to L1:.
Below AT Jump to SP:, then to L1:.
Below or equal to Z? Jump to L1:.
Below aJ Jump to SP:, then to L1:.
Below or equal to Z? Jump to L1:.
```

Notice that when you’ve descended as far as A, you’ve already eliminated the numerals, leaving it safe to exclude anything above A. Likewise, when you’ve reached a, you’ve eliminated all capitals as well as all numerals. And the place to put SP: is under the z test. That’s because continued
A Refreshing Idea....
A New Standard....
Computing Goes Better With CARRY-I

FLYTECH TECHNOLOGY CO., LTD.
HEAD OFFICE:
2 FL., NO. 8, LANE 50, SEC. 3,
NAN-KANG RD., TAIPEI, TAIWAN, R.O.C.
TEL: (02)785-2556 FAX: (02)785-2371
TELEX: 22233 FLTCO

U.S.A.:
3008 SCOTT BLVD., SANTA CLARA, CA. 95054 U.S.A.
TEL: (408)727-7373, 727-7374 FAX: (408)727-7375

WEST GERMANY:
MENDELSSOHNSTRASSE 53,
6000 FRANKFURT AM MAIN 1, WEST GERMANY
TEL: (069)746-081, 746-453 FAX: (069)749-375

HONG KONG:
B12, 8 FL., BLOCK 3, TONIC INDUSTRIAL CENTRE,
19 LAMING ST., KOWLOON BAY, KOWLOON,
HONG KONG
TEL: 302-1256 FAX: 796-8427

The Book Size Computer
The Book you’ll read over and over again

CARRY-I 8088
10MHZ XT/AMI BIOS/256K RAM expandable to 640k/One to two 720KB 3.5” FDD/
Serial/Parallel/Game/CGA/MGA/Standard keyboard connector/16Watt Power adapter
Dimension: 240mm x 185mm x 45mm Weight: 1.9kg-2.4kg

CARRY-I 80286
12MHZ, 0 Wait State AT/AMI BIOS with Diagnostic/1MB RAM/20MB Hard Disk
Drive optional/One to two 1.44MB 3.5” FDD/2 Serial/1 Parallel/CGA/MGA/Standard
keyboard connector/30Watt Power adapter
Dimension: 240mm x 185mm x 45mm Weight: 2.1kg-2.8kg

CARRY-I KEYBOARD
82 Key/XT-AT Autoswitch
Dimension: 310mm x 145mm x 27mm

It’s priced lower than you’d expect for a PC with this kind of power and portability.
But don’t take our word for it. Call us today for more information.

Circle 117 on Reader Service Card
unsuited characters still lurk below z, and a descent that gets as far down as those can safely fall through to Sp: without further testing.

A Necessary Confrontation

And now it’s time to confront the need to write that Turbo Pascal in-line code in hexadecimal. Help is needed here, and the most suave and savvy help around is Jeff Duntemann’s Turbo Pascal Solutions (Scott Foresman, 1988). After Duntemann has done everything he can to discourage you from even attempting Turbo Pascal in-line code, he offers ample hints, backed up by an invaluable 70-page “Eyeball Assembler.”

His most salient hint is this: Unlike real assembly, Turbo Pascal in-line code cannot just jump to a label. It must supply the number of steps in the jump, and “if you miss it by even a single byte, you could be reaching for the power switch.” Moreover, backward jumps mean negative steps, supplied in two’s-complement format. For short jumps, that means just subtracting the number of backward steps from decimal 256, although Duntemann offers a handy hexadecimal table.

The sole thing he doesn’t stress sufficiently is that Turbo Pascal in-line code does not demand hexadecimal. Converting a decimal count to hexadecimal (or worse, trying to count in hexadecimal) is one more thing that’s likely to baffle nonexperts. But it needn’t be done. Instead of, say, $2C (Turboese for 2CH), you can just insert plain decimal 44. Blessedly, the compiler won’t care. (And how might you obtain decimal 44? As I’ll be explaining in a moment, you simply count, kindergarten-style.)

Counting the Steps

Now look at listing 2, which is what I arrived at after some hours. The top five lines are copied straight from Procedure UpperCase in the Turbo 3.0 manual.

Next, you’ll easily spot the checks for the three ranges: 0 through 9, A through Z, and a through z. Once more, their syntax is lifted from the parent program; all I did was supply decimal numbers to mark where the ranges begin and end.

When the character’s ASCII number is smaller than the number at the start of the range, then you jump (JB) down to Sp:, where a MOV instruction substitutes a space. If you’ve taken that jump, you’re done with this character, and you head back up to L1: to fetch another. If you haven’t, you next try a match with the number at the end of the range. This time, if it’s equal or smaller, you’re within the range, and a jump-if-equal (JBE) takes you back up to L1:, where you pull in the next candidate from your string, or else you exit to L2: if no more string is left. And if both of those tests have failed, you move to the next range and repeat the process.

It all works perfectly. And fast! An unencumbered search clear through the 42,000 characters in a 750-line text file takes about 10 seconds. Depunctuating every line the Pascal way adds 55 seconds more. But depunctuating by this assembly procedure adds exactly 1 second: a stunning 55-to-1 improvement.

The Final Clue

Now for a few last details. Where did I get the code for JBE, which is not to be found in that parent program? I looked it up in Jeff Duntemann’s “Eyeball Assembler,” which spells out the hexadecimal codes for every useful assembly combination. That’s also where I got the continued
Don't take our word for it, take theirs...

"Do you know what the underground bargain C compiler of this year is? It's the Mix Power C compiler. For under $25 with shipping, it is one heck of a good compiler."

Victor Schneider
Dr. Dobb's Journal, June 88 (Letter to the editor)

"Overall, Power C's performance is remarkable for the price. Quite compatible with the Microsoft C and Turbo C standards, Power C is a heavyweight contender in the educational, hobbyist, and perhaps even the professional market — at a bantamweight price."

Stephen Davis
PC Magazine, September 13, 88 (Review)

"Power C is an unbelievable product for $19.95, and is very competitive with Turbo C, Microsoft C, and Microsoft's new Quick C in both features and performance. It is excellent for the beginner who wants to learn C, or for the experienced programmer who wants to develop professional applications. The manual alone is worth the price of this package, and the generous library source code and assembler offer adds to the value of it. If you have any desire to program in C, or want a more powerful C compiler, get a copy of Power C!"

Michael Cortese
Computer Shopper, August 88 (Review)

"The Ctrace debugger is where Mix really shines. It is magnificent. It's not only better than the stripped down debugger Microsoft includes with Quick C, it's better than the full debugger Microsoft provides with its high-end compiler (Codeview)."

David Weinberger
Computer Shopper, November 88 (Review)
SOME ASSEMBLY REQUIRED

code for the key command

MOV ES:BYTE PTR [DI],'

which moves a space into the slot in memory that some unwanted character is occupying. (And no, I did not know that assembly command. I hunted through Duntemann’s long list of MOV commands for one that looked like the SUB command I was replacing. You see what I meant about imitating the natives.)

And what about the lengths of all those jumps? The length is inserted as the last element in each jump instruction, and for forward jumps you just count how many elements are to be jumped over. Thus, the code for the last JB SP: ends with a 6, because to get to the start of SP: you must jump over the six machine-code elements in the next two lines. As I mentioned earlier, Turbo Pascal’s compiler understands decimal numbers, although purists would prefer that you convert to hexadecimal.

The backward jumps to L1: are a little trickier. Examine the JBE L1:, just after the comparison with 9. Count the jump counter itself as 1, and count backward along each line of machine code until you reach the first instruction ($FE) for L1:, and you’ll get 17. Subtract that from 256 to get its two’s-complement value, 239. That’s your jump counter.

Assembly, My Dear Watson

So, lo, without any real grasp of MSDOS assembly, you’ve acquired in-line machine code for a fast DePunct procedure. Let me repeat that I’m making no claims for ignorance. I’m certainly prepared to learn that a better assembly version of DePunct is possible. But I’m still asserting that a little patience, a little luck, a little analytic effort, and one good book can take you further with an unfamiliar language than you may have imagined you could go.

Editor’s note: The Turbo Pascal source code and a compiled version of SEEK are available in a variety of formats. See page 5.

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times and Harper’s. His recent books include A Sinking Island and Mazes. He can be contacted on BIX as “hkenner.”

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
BYTE

PRODUCT SHOWCASE

- BUYER'S MART
- BYTE BITS
- PRODUCT SPOTS
- MICRO PRODUCT CENTER

ILLUSTRATION: JULIE E. MURPHREE © 1989
THE BUYER'S MART is a monthly advertising section that enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers. Effective January 1, 1990. RATES: 1x—$590, 3x—$550, 6x—$525, 12x—$475, 24x—$450. Prepayment must accompany each insertion. VISAMAC/Accessed. AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must furnish typewritten copy, Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork. 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 Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Brian Higgins at 603-524-3754.

---

**ACCESSORIES**

SIMMS DIRECT FROM MFG.

*HP LASERJET SERIES II MODULE*PS/2 70 & BO MODULES
*LASEAR JET SERIES II MODULE*MACINTOSH MODULES
*IBM COMPATIBLE MODULES*AST MODULES
1 2 YEAR WARRANTY
SAYS 60% BUYING DIRECT AND RECEIVE A FREE FLOPPY DISK
HOLDS 3.5 OR 5.25 DISKETS. IS ALSO AVAILABLE USING YOUR MEMORY CHIP. CALL NOW FOR MONEY NEEDS.

BEPHYR INDUSTRIES, INC.
Ph: (714) 951-5103 FAX: (714) 551-5141

---

**NEW! WET RIBBON RE-INKER**

Stop discarding expensive printer ribbons. Our Wet Ribbon Re-inker gives you more than 50 better-than-new ribbons for each one you buy:
- Easy to use
- Accommodates most cartridges
- High quality synchronous motor
- Automatic timer
- Satisfaction guaranteed

BLUE RIBBONINK, LTD.
6500 E. 47th Ave. Dr., Unit D, Denver, CO 80216
(303) 333-8889

---

**PRINTERS**

Finally a Better Toner Cartridge for your Canon PC Copier: HP® or Apple Laser Printer 15% at 10,000 sheets or orange 3 1/2 times more ink in one cartridge than HP or Canon

PAINT CARTRIDGE MESS HP & Apple Series I, II, III, IV, V, VI, VII, VIII, IX, X

PC 15 Cartage 3995 many other Laser Printers that are Canon Compatible

Three year cartridges are matched to blend in with your existing programs. With our replacement disc you can put your own special cartridges in exactly the same position as your existing ones. Our cartridges are fast, easy to use, and save you money!

Car Morack, Inc.
901 W. Pioneer Pkwy, Suite 9, Bldg. D
(513) 644-2230

---

**ACCESSORIES**

*FABULOUS CATALOG*

A complete source for all your computer supplies—inners, paper, cables, furniture, software, ribbons, laser, cleaning, & FAX supplies, accessories & much more.

Bulk Discounts — Minimum Order $50

5.25" DS/DD 25¢ 3.5" DS/DD 65¢

5.25" DS/DD 99¢ 3.5" DS/DD $1.19

GAAN COMPUTER SUPPLIES
186 S. E. 60th Street, Columbus, OH 43219
(614) 252-2376, In Collect: (406) 370-2747

---

**ARTIFICIAL INTELLIGENCE**

NANO LISP

An MS-DOS Common LISP interpreter that supports most Common LISP operations and string adherence to the standard. Numerous advanced and extra features, excellent debugging facilities, sample AI programs, fully-indexed manual, free trial disk.

Microcomputer Systems Consultants
P.O. Box 6844, Santa Barbara, CA 93105
(805) 967-2270

---

**CUT RIBBON COSTS!**

Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one inker! For crisp, black cartridge ribbons with just one inker! For crisp, black

CARTRIDGE INKERS $94.50

INK MASTER (Electric) $189.00

Electric E-Zee Inker $94.50

Ink Master (Electric) $189.00

World's best E-Zee Inker gives you more than 50 better-than-new ribbons for each one you buy.

E-Zee Ink $94.50

Ink Master (Electric) $189.00

Electric E-Zee Inker $94.50

Ink Master (Electric) $189.00

E-Zee Ink $94.50

Ink Master (Electric) $189.00

E-Zee Ink $94.50

Ink Master (Electric) $189.00

E-Zee Ink $94.50

Ink Master (Electric) $189.00

---

**RISKY FORTUNE**

POKER—BLACKJACK—CRAPS

TRY YOUR LUCK AGAINST "TIM, DICK & HARRY" Play any...POKER, BLACKJACK OR better, 3 CARDS OUT, 5 CARD NO PEEK, 5 CARD STICK, and many more!

899 WITHOUT—$199 WITH EPROM

CUSTOM SOFTWARE AVAILABLE

---

**AMUSEMENT**

**ARTIFICIAL INTELLIGENCE**

NATURAL LANGUAGE C LIBRARY

Increase your market share! Use JAKE to add a natural language front end to your application. JAKE translates English commands and converts C function calls and data structures. JAKE offers context-sensitive semantic processing; Interfaces easily: <O/A mem.

ENGLISH $495

INTERACTIVE DEMO $10

ENGLISH KNOWLEDGE SYSTEMS, INC.
5525 Scotts Valley Dr. #22, Scotts Valley, CA 95066
(408) 439-6922

---

**PORTABLE READER**

Better equipped, handheld reader with 804 data RAM, 2x16 LCD display, 32-key keyboard, Real-Time Clock. Want or laser scanner. Program prompts and data checking through its own keyboard. Easy data transfer by RS-232 port or PC, FSK keyboard. Doubles as Online Reader. 30-day back. Year warranty on software. 30-day back.

---

**BEBHYR INDUSTRIES, INC.**

AD: 8x$550, 6x$525, 12x$475, 24x$450 PREPAYMENT MUST ACCOMPANY EACH INSERTION. VISANMAC ACCEPTED.

---

**COMPANION AND EXTENDER**

Place a keyboard and monitor up to 600' from your CPU with COMPANION and EXTENDER. Place a second Keyboard/Monitor at the CPU with COMPANION and EXTENDER. Supports MDA, CGA, EGA, VGA, PS2. Use simple 16 volt DC. Prices start at $149.00 for EXTENDER and $219.00 for COMPANION 25 ft. and complete.

---

**SOFTWARE**

**SOFTWARE**

**SOFTWARE**

**SOFTWARE**

**SOFTWARE**

**SOFTWARE**

**SOFTWARE**

**SOFTWARE**

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---
The Buyer's Mart

Print Bar Codes/Big Text From Your Program

Add bar codes and big graphics characters to your program. Print from any MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 93, Epson, Iki. IBM dot matrix type set up to 1.4". LaserJet up to 2", Font cartridges not required. $199-$239. 30-day $5 back.

Wortington Data Solutions

Inquiry 587.

Print Bar Codes/Big Text From Your Program

Add bar codes and big graphics characters to your program. Print from any MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 93, Epson, Iki. IBM dot matrix type set up to 1.4". LaserJet up to 2", Font cartridges not required. $199-$239. 30-day $5 back.

Wortington Data Solutions

Inquiry 587.

Bar Code Readers Only $285

• Complete Bar Code Systems Available
• Now like a bar keypinger for IBM XT/PS2 and Clones. Macromeshes and any RS232C terminal
• Wired/Laser scanner/PC-compatible system and user connectivity
• POS Special Keyboard with Bar Code/Magnetic Card Readers
• No software or hardware modification needed
• Shiny Monopak-Back guarantee

Kasco Technology, Inc.

Inquiry 591.

Cables and Accessories

Parallel Printer Cables $3.59 and Up
Serial Cables $4.95 and Up
Switchboxes $11.95 and Up
We can supply all your cabbing needs. Master-Card and Visa Accepted. Dealer pricing available.

Connect-IT

Inquiry 601.

Bar Code Readers

BAR CODE READERS

AMERICAN MICROSYSTEMS

One-year warranty. Reseller discounts available.

5.25" or 3.5" formats.

Same day shipping. 30-Day money-back guarantee.

$59.95. No Royalties. Specify UNIX V/386 or MSDOS, AMERICAN MICROSYSTEMS

WAND, LASER, MAGNETIC READERS. Same

UPC bar codes. Label printing program for HP, OKI, and

clones and any RS-232 Terminal. Transparent to

gram. Print from ANY MS-DOS language. Bar codes: Keyboa-

rd emulation for PC/XT/AT & PS/2's, all

UPC, EAN, 2 of 5, MSI, Code 39. Epson, Oki, IBM dot

What makes you want spend one cent replacing your PERCON bar

code decoder for five years. That's reliability you can count on.

PERCON

2910 W. 11th Ave, Eugene, OR 97402

Phone: (800) 873-7269 FAX: (503) 344-1399

Re-run ad on page 107.

Inquiry 593.

Bar Code Specials

PC Bar Code Specialists

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data entry. Choose from standard keyboard or interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems

Inquiry 594.

Business Opportunity

Turn your computer into a family wage earner

Learn how some people are making over $3000/wk with their computer. Each month receive a new and fascinating method of making money with your computer—each opportunity completely detailed—subscribe to ComputerProfs$\textdollar; now ONLY $229. VISA/MC call (603) 880-3991 or send to

ComputerProf$\textdollar; 41 Carlene Dr., Nashua, NH 03062 (satisfaction guaranteed)

Inquiry 598.

Cables and Accessories

Bar Code Readers

BAR CODE READERS

AMERICAN MICROSYSTEMS

One-year warranty. Reseller discounts available.

5.25" or 3.5" formats.

Same day shipping. 30-Day money-back guarantee.

$59.95. No Royalties. Specify UNIX V/386 or MSDOS, AMERICAN MICROSYSTEMS

WAND, LASER, MAGNETIC READERS. Same

UPC bar codes. Label printing program for HP, OKI, and

clones and any RS-232 Terminal. Transparent to

gram. Print from ANY MS-DOS language. Bar codes: Keyboa-

rd emulation for PC/XT/AT & PS/2's, all

UPC, EAN, 2 of 5, MSI, Code 39. Epson, Oki, IBM dot

What makes you want spend one cent replacing your PERCON bar

code decoder for five years. That's reliability you can count on.

PERCON

2910 W. 11th Ave, Eugene, OR 97402

Phone: (800) 873-7269 FAX: (503) 344-1399

Re-run ad on page 107.

Inquiry 593.

Bar Code Specials

PC Bar Code Specialists

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data entry. Choose from standard keyboard or interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems

Inquiry 594.

Business Opportunity

Turn your computer into a family wage earner

Learn how some people are making over $3000/wk with their computer. Each month receive a new and fascinating method of making money with your computer—each opportunity completely detailed—subscribe to ComputerProfs$\textdollar; now ONLY $229. VISA/MC call (603) 880-3991 or send to

ComputerProf$\textdollar; 41 Carlene Dr., Nashua, NH 03062 (satisfaction guaranteed)

Inquiry 598.

Cables and Accessories

Parallel Printer Cables $3.59 and Up
Serial Cables $4.95 and Up
Switchboxes $11.95 and Up
We can supply all your cabbing needs. Master-Card and Visa Accepted. Dealer pricing available.

Connect-IT

Inquiry 601.

Cables and Accessories

Parallel Printer Cables $3.59 and Up
Serial Cables $4.95 and Up
Switchboxes $11.95 and Up
We can supply all your cabbing needs. Master-Card and Visa Accepted. Dealer pricing available.

Connect-IT

Inquiry 601.

Case

Finite State Program Compilers

State programs develop quicker, run faster and use less memory than sequential programs. A few keystrokes can replace hundreds of instructions. The Competition, a CASE software development tool, forms source state programs in Ada, BASIC, COBOL and Pascal for IBM DOS.

Price $200 per lang. (With Primer and Debugger)
Sampler $99.50 (With all manuals & credit)
AYECO
5025 Nassau Circle, Orlando, Florida
INCORPORATED
FL 32208 (407) 295-0930

Inquiry 602.

CD-ROM

Alde Corporation

CD ROM players as low as $499 plus selected disc. Choose from many titles. Alde does consulting, joint venture and/or royalty projects for qualified parties. Write, call or fax for complete information. New Acta release.

Box 1086, Glen Lake, MI 55346
1-800-727-9724 FAX: 1-612-934-2824

Inquiry 603.
THE BUYER'S MART

CD-ROM

Large Selection and Best Price
Microsoft Programmers Library & Drive $94.50.
Computer Library $88.50 • Public Domain SW $49.
NEC PC or Mac Drive Kit $76.50 • Book+Drive Best Price.
Drives from $49.50. Hundreds of titles from $29.
MOVIES/AMX/CCD, Money-back Guarantee.
Write or call for free 150-page catalog.
Bureau of Electronic Publishing
141 New Road, Pamplinly, NJ 07054
THE SOURCE FOR CD-ROM

Inquiry 604.

Inquiry 605.

Inquiry 606.

Inquiry 607.

Inquiry 608.

Inquiry 609.

Inquiry 610.

Inquiry 611.

Inquiry 612.

Inquiry 613.

Inquiry 614.

Inquiry 615.

Inquiry 616.

Inquiry 617.

Inquiry 618.

Inquiry 619.

Inquiry 620.

COMMUNICATIONS

PC SDL CLR SUPPORT
Use Sangoma hardware and software to provide a cost effective, easy to use and easy to link DCC link from MS-DOS, XENIX, AIX, PICK, PC-MOS, etc.
All real time communication functions performed by intelligent co-processor card.
X.25 support also available.
Sangoma Technologies Inc.
(416) 472-1990
770 Warden Avenue F2, Markham, Ontario, Canada L8J 6B2

Inquiry 610.

COMPUTER INSURANCE

INSURE YOUR COMPUTER
SAFEWARE provides full replacement of hardware, media and purchased software. As little as $45 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 a.m.-10 p.m. ET. (Sat. 3 a.m. to 10 p.m. ET)
TOLL FREE 1-800-848-3469
(Inland 814-262-0599)
SAFEWARE, The Insurance Agency Inc.

Inquiry 611.

COMPUTER UPGRADE

THE COMPLETE XT UPGRADE
The K-811 Kit upgrades your XT to full 386, 20MHz 80386 CPU and high speed disk performance. The K-811 Kit includes 28MHz 80386 with RAM, 16-bit Adapter 111 control card, 66MHz 80386 Mitsubishi disk drive, choice of 1.2 or 1.44MB disk drives, Ken Tonic 101 Plus keyboard, 200 IN PS, new drive cables. Matches or exceeds the performance of a new system but at far lower cost. Top quality, every item tested, 1 year warranty, $1,795.
5G Corporation
4131 Spicewood Springs Rd. Austin, TX 78759
800-333-4131 512-345-9843 Fax 512-345-9575

Inquiry 612.

CROSS ASSEMBLERS

MACINTOSH CROSS ASSEMBLERS
"ASM"—New Version 3.01 integrated text editor, assembler, and terminal package. 5 or 16 character output to all EPROM programmers. Macros, cond's, and local, & auto labels, mnemonic symbol cross-ref. $46.95 each plus S/H.
MOVIE. Tech. bulletin avail. Most 386 MPU's. 30 day money back guarantee.
MICRO DIALECTS, INC., Dept B
PO Box 50623, Cincinnati, OH 45230
(513) 271-9100

Inquiry 616.

CROSS ASSEMBLERS

RELOCATABLE, VERSATILE DEBUG SIMULATORS • DISASSEMBLERS • EPROM PROGRAMMERS
MICRO COMPUTER TOOL CO.
Phone Toll Free (800) 443-0779
In CA (415) 825-4200
912 Hastings Dr., Concord, CA 94518

Inquiry 617.

CROSS COMPILERS

6800 Family Development Software
Our C Compilers for the 6800, 6801, 6802, and 68011 feature a complete implementation (excluding bit fields) of C as described by K&R and yield 30-70% less code than other compilers. Our Assemblers feature macros and conditional assembly. Listing and Terse Assembler Included.
Windek Corporation
1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428

Inquiry 618.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION
More than just a straight dump or format transfer
Word Processing, DMRIS, and Spreadsheet data on Disks or Teletype transferred directly into applications running on Mainframes, Minis, Micros, Dedicated Word Processors, Typewriters, and Electronic Publishing systems.
IBM PS/2 & Macintosh supported
Buy Dip in the translation industry!
CompuData Translators, Inc.
3235 Wilshire Blvd., Suite 120, Los Angeles, CA 90010
(213) 387-4477 1-800-825-8251

Inquiry 619.

DBMS/COPY

CONVERTS YOUR DATA INTO INFORMATION
Now your favorite text package can access any database.
DBMS/COPY can directly convert any database or spreadsheet file (ORACLE, PARADOX, Btrieve, Lotus etc.) into any text package (WRITE, SPESS, WORDSTAR, etc.). The full version allows sorts, selections, and calculations. $95. 30-day guarantee.
VISANICS/EXPOCOSCO Call for free limited version.
CONCEPTUAL SOFTWARE INC.
PO Box 35627, Houston, TX 77256
(713) 667-4222 FAX: (713) 667-3FAX 1-800-STATWOW

Inquiry 620.

EXECUTIVE, INC.

SOFTWARE MART, INC.

CD-ROM/PUBLISHERS/ASSEMBLERS
WE BEAT ANY PRICE
CALL FOR LOW, MONTHLY SPECIALS
CD-ROM Drives: HI-TECH • NEC • SONY • TOSHIBA • PHILLIPS • DENON • CHINON
Write Drives: MAXTOR • PARAGON • PHILIPS • TOSHIBA
Ensembl Drives: MAXTOR • CANON • SONY
SPECIAL STOCK of CD-ROM discs. unmatched anywhere!
Erasable Drives: MAXTOR • CANON • SONY
1168 Elm Terrace 24-hr auto order line
CD-ROM SHOPPER

Inquiry 606.

CD-ROM Publishing Services
Complete CD-ROM publishing services including custom soft­
ware interface. Reasonable rates, fast turnaround. Call for details.
Toll Free 1-800-848-3469

Inquiry 607.

CD-ROM Developer's Lab
Multimedia production resource for Mac & PC developers & managers. Focused design, management, data prep, program­
ing, proof reading, and manufacturing techniques & specs from front leading companies. Doms of all-the-shelf tools for imaging, audio, animation (2D). Real applications using Media—Mixer source tools. CD-ROM XA, PC or Mac 8525; Transportable 841. Visa or MasterCard; 7 days a week.
Software Mart, Inc.
4131 Spicewood Springs Road 1-A, Austin, TX 78759
512-346-7887

Inquiry 608.

CD-ROM/WORKER/SABLE

YOUR SALES MESSAGE
about the special computer product or service that you provide belongs in print.
THE BUYER S MART

The Buyer's Mart

CROSS ASSEMBLERS

Universal Linke r, Librarian
Targets for 36 Microprocessors
Hosts: PC/MS-DOS, micro vAX, VAX 8000
ENERTEC, INC.
BOX 1012, 1811 W. 57th St.
Cantil, CA 93514
Tel: 213-362-0966 Fax: 213-345-9575

Inquiry 613.

CROSS ASSEMBLERS

COMPUTER ASSEMBLERS

SANGOMA TECHNOLOGIES INC.

CROSS ASSEMBLERS/SIMULATORS

BEST COMPILERS: Embarcadero's MX-144 Compiler supports the 80386, including MMU's of intensity plus the 8086, 80186, and Serial features with full debugger; 120 for many cross compilers for the 8086, 80386, and 286 for S&H. Our list of 80186 and 386 for S&H. Our list of 80186 and 386 for S&H.

Inquiry 617.

LEAR COM COMPANY

3440 Kipling St. ISie. 206, Lakewood, CO 80215

Inquiry 614.

CROSS COMPILERS

68000 $C Compiler
Available under MS-DOS, UNIX, and VAX
CrossCode $C generates ROMable code for all members of the Motorola 68000 family. It comes with an optimising compi­ler, Motorola-compatible assembler, linker, librarian, symbol table, and terminal package. S or Hex output downloads to most EPROM programmers. Macros, conditionals, local & auto labels, symbol table cross-ref. S149.95 each plus S/H.

Inquiry 615.

CROSS COMPILERS

68000 Family Development Software
Our C Compilers for the 68000, 6801, and 68011 feature a complete implementation (excluding bit fields) of C as described by K&R and yield 30-70% less code than other compilers. Our Assemblers feature macros and conditional assembly. Listing and Terse Assembler Included.

Inquiry 616.
FREE COMPUTER MAGAZINES
To More Than 200 Magazines
Don't spend a fortune on computer, communications or business magazines. The Satellite Directory lists over 200 titles you can get free and runs on any IBM PC.
For more info. and FREE DEMO DISK, call:
1-800-782-0194 or fax to: 617-863-8844
Inquiry 643.
The $25 Network
Try the truly lowest cost LAN
• Connect 2 or 3 PCs, XTs, ATs
• Uses serial ports and 5-24 wire cable
• Runs at 15K bps
• Runs in background, totally transparent
• Share any device, any file, any time
• Needs only 14K RAM
Skeptical? We make believers!

LAPTOP SAVINGS
Laptops: Toshiba • Zenith • NEC • Sharp
• Epson • Mitsubishi • Compaq
Also Laptop Accessories: Modems, Fax Modems, External Drives, Portable Printers, Memory, Key Pads, Hard Drives, Batteries, and Auto Adapters.

Computer Options Unlimited
16 Madison Lane
Phone: 201-465-7676
Fax (201)-465-7544
8 hours: 9am/10pm 7 days
Worldwide sales

LAPTOP BLOWOUT SALE!!!
MITSUBISHI • SHARP • PANASONIC • TOSHIBA
Laptops are now at their lowest prices ever. We buy direct from the factory, unlike our competition. We guarantee the lowest net prices in the entire country and stock every item specific to global. We ship in 24 hours. We also stock over 1 million in laptops always Buy from a factory-direct dealer. For your protection we check for stolen credit cards & ship only to your billing address. No COD's Please.

TOTE-A-LAP
1501 El Camino Real, Belmont CA 94002
(415) 591-1663 ext. 600

LAPTOP BACKLIGHTS
Factory Installed • 30-day Warranty
Toshiba, Amstrad, Sanyo, DG, Kaypro, IBM, HP, etc. $295
The Portable Peripherals People
Axonix Corporation
(801) 466-9797

TOSHPIC LAPTOP ENHANCEMENTS
PAKAGES: 98/90/740 tips, software, acoustic port
MODEMS, INTERNAL: 2400 bps, acoustic or serial port
MODEM, DEDICATED: 2400 bps (14400, 19200, 24000)
SERIAL IO CARDS: PC/PS/RS, 8088, 80286, NPI, Rambone
BATTERY PACKS: 12v external battery + vehicle adapter
Contact us for more information:
PRODUCT & R&D Corporation (Catalif)
800/829-5584, Fax: 805/646-5716
RID YOUR SYSTEM OF VIRUSES FOR EVER VIRUSLOCK®

The most effective anti-virus system available.
- Recognizes over 35 viruses — regularly updated.
- Protection against existing and future viruses.
- Saves, identifies and renames known viruses resident in memory and programs.
- Checks integrity of specified programs for virus related changes.
- Boot-Operated memory replication protects your hard disk against new virus attacks.

Price $92. Visa/MC. 30-day money-back guarantee.
EllaShim Microcomputers Inc.
528 N. High St., Gahanna, Ohio 43230
Phone: (614) 888-9990

SOFTWARE/ACCOUNTING

BIT-LOCK® SECURITY

PC Time Clock
AutoTime is an Employee Management System that allows you to turn any PC into an Electronic Time Clock. AutoTime provides Time & Attendance, Job Costing, Payroll Interface, and Labor Distribution reporting. Network compatible. Prices start at $495.

Other Business Products: Network Fax, Absence Call-in, db-Edition

Chase Technologies
1617 Kingman Rd., Fairlawn, OH 44126
(408) 998-2971

SOFTWARE/BASIC

QuickBASIC 4.5 TOOLS!
Our FREE CATALOG features:
NEW, UPDATED FINAL! Library with over 400 routines for QB 4.5: XGRAP, the complete graphics package for QB 4.5. Other top-line products from all major vendors.
Call 1-800-423-3400 or (412) 782-0384
KOMPUTERWERK, INC.
861 Parkview Blvd., Pittsburgh, PA 15215

SOFTWARE/BUSINESS

SECURITY

HANDS OFF THE BOARD® (32 SIZE SECURITY BOARD)
Stop boot bug — Require password to boot PC
disk read error — prevent boot sector virus
Passw ord prevents DOS FORMAT and low-level formats
Set hard disk READ ONLY or turn ON/OFF
Turn DOS and.COM files OFF
IBM XT, AT Bus — DOS v3.x — $149.95 + $5.00 SH
SYSTEMS CONSULTING INC.
PO Box 11500, Pittsburg, PA 15238
(412) 761-5280

DATA ENTRY

KeyEntry II$, a complete Data Entry System that provides all the capabilities for designing data entry applications, controlling data flow, and monitoring/operating reporter activity & performance. Supports LAN and stand-alone environments. Evaluation copy (all programs & documentation) available. Call today for information!

Eastern Software Products, Inc.
PO Box 15303, Alexandria, VA 22309
(703) 365-7600

SOFTWARE/ENGINEERING

EASE GRADING BLUES!
Now in its 6th year, GRADEBOOK II can: rank students, easy edit, calculate student and class averages, add grades, delete grades, assign letter grades, calculate course grades plus 10 more functions. 30 day trial & print reports with 69 options. You get: software, support, and manual for only $495.00. MOVISTA. Specify IBM PC or Apple II. Order now.

WREN SOFTWARE, INC.
PO Box 1138, Dept. B, Castle Rock, CO 80104
303/660-0649

SOFTWARE/BUSINESS

SECURITY

PC Security “Password”
With All the Complete Security, Password is the Perfect Security Lock.
Password is a software program providing security for your PC. Password is Easy to understand and Simple to install, requires no reformatting. The boot time crypt security password provides for up to 100 users with the supervisory controlling access to protected directories. Password is compatible with popular window and help screens. The program provides on each user of users, and a screen blinking feature.

Nasdec International Inc.
203-43 Serry Street, Winnepeg, MB Canada, R3C 4J5
Phone: (204) 666-2788 FAX: (204) 643-2762

SOFTWARE/ENGINEERING

Boolean Logic Simulator
- LogicGEM: 100% compatible
- Make your logic equation work onable
- Graphic window stimulator editor
- Single, multiple, simple & complex devices
- Multiple circuits: You get the circuit, AT & up, CD, CDa, VISA
- $89/0 includes 1 year upgrade support
- VISA, MC, CHQ

ARCTOS SYSTEMS CORP.
29 Sandwell Cr., Kanata, Ontario, Canada K2K 1V3
(613) 922-3947

SOFTWARE/BASIC

COPY PROTECTION
The world's largest software ware manufacturers depend on Softguard copy protection systems. Your FREE CATALOG features:
- Hard disk supported
- No source code changes
- Customized versions
- LAN support
- New upgrades available

SOFTWARE/ACCOUNTING

AUTO-POST
It's here! A totally integrated business management system for $495. Invoices, statements, payroll, inventory general ledger, proposal, job cost and payables. It runs compiled with dBASE III compatible Mac. A 100-page manual is included. Demo $985 with manual $29.95

New Serv
1615 Galgo Dr, Suite 34, Farleld, OH 45014
Phone: (513) 829-1585

SOFTWARE/ENGINEERING

SCADA SYSTEM DESIGN
IBM PC or compatible
Supervisory Control And Data Acquisition modular design software includes interactive screens for setting RTU parameters, modern speed, etc., extensive toolbar, precision for engineering analysis modules, addressing stability and control and advanced networks for communication subsystems. $450 Engineering modules priced individually, and described in free catalog.

AURASTAR INFORMATION SYSTEMS, INC.
Suite 100, 5050 George Avenue, Bethesda, MD 20814
(301) 770-1950 Fax (202) 770-1954

SOFTWARE/ACCOUNTING

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE

DATA ENTRY SOFTWARE
**SOFTWARE/ENGINEERING**

**MASS & VOLUME CALCULATOR WITH MATERIALS DATABASE**
Calculate the volumes of dozens of shapes easily with MassCalc. Weights are calculated for over 700 materials. Differential and proportional comparisons made automatically. Flexible input system accepts Decimal, Fractional, and Exponential notation. For IBM PCs & Compatibles with 384K.

$59

DEMPSEY'S FORGE, Software Division
2th B Box 408, Shelton, WA 98312

Let us FAX you a flyer. CALL (206) 282-4602

Inquiry 709.

**RUTHLESS SIMULATION**
A new approach to logistics
TAYLOR, THE DYNAMIC ANALYST

Taylor is the fully menu-driven factory simulation package that combines ease of use with great flexibility. Taylor offers interactive graphical modeling, numerous modeling options, animation, in-depth result analysis and the Taylor Language Interface (TLI). Version 4.2 of the analysis and professional simulation on the market is now available.

FH jr., Logistics and Automation BV Spoorstraat 424, 5938 CG Tilburg, The Netherlands

Phone: +31 13 368344 Fax: +31 13 427516

Inquiry 710.

**Circuit Analysis — SPICE**
Non-linear DC & Transient; Linear AC.

*Version 3H1 with BSDM, GAAM, IFET, MOSFET, BJT, diode, etc. models, screen graphics, improved speed and convergences.* PC: PC Plus and above.

Call, write, or check Inquiry # for more info.

Northern Valley Software
25277 Rothrock St., Rancho Palos Verdes, CA 90274

(213) 341-3677

Inquiry 715.

**FREE ENGINEERING MAGAZINE**
Personal Engineering is a monthly magazine sent free of charge (USA only) to scientists/engineers who use PCs for technical applications. Topics each month include Instrumentation • Data Acquisition • Design Automation. To receive a free sample issue and qualification form call or write on letterhead to:

Personal Engineering Communications
2300, Brookline, MA 02146

Inquiry 716.

**SOFTWARE/GEOPHYSICS**

**MULTIPURPOSE GRAPHICS SOFTWARE**

The Desktop Fractal Design System will be an indispensable educational and scientific tool for students, engineers, and scientists. This software (which runs on IBM and compatibles/PCs with an enhanced graphics board, 64K and 16K screen memory) helps to connect theoretical concepts with on-screen geometric models.

9099, 70-5015821. 01-7005673

Includes Directory Fractal Handbook and one floppy disk

Academic Press
ATTN: Book Marketing Dept. 950900

1150 Bush Ave., San Diego, CA 92108

Inquiry 721.

**CAD/CAM Developers**
You save thousands of hours of programming and debugging time and the thousands of dollars this time costs you when you use the CAD/CAM math and DFX routines in the QuickGeometry Library.

All the routines you need for any type of CAD/CAM/CAE project - 2D needs-use/real-time that construct, intersect, and offset lines, arcs, circles, ellipses and even splines

$195 includes C source code and telephone support.

Call (617) 624-5217 today for information or to order!

Building Block Software, PO. Box 1270, Somerville, MA 02144

Inquiry 722.

**NEW GRAPHICS SOFTWARE**

**THE ULTIMATE CAD/CAM ENGINE**

TurboGeometry Library 3.0. The most complete tool box of 2D & 3D routines available today! Over 300 routines. SURFACE, SOLIDS, Hidden line, Volume, Areas, Transformations, Perspective Viewing, Shading, Tapers and more. 30 day guest, $199.88 w/works S&H incl. Foreign $235.80. MSPC DO.2-0. Turbo Pascal, Turbo C, MSW C, Zortec C++. VISA/MC, PO, Chk. USA funds only.

Disk Software, Inc.
2116 E Arapaho Rd., #487, Richardson, TX 75081

(214) 433-7388, (800) 835-7765, FAX (214) 423-4465

Inquiry 723.

**PERSONAL SOFTWARE FOR ENGINEERING**

Cedar fuses mathematics and Intelligent geometric modeling and works with geometries the same way a spreadsheet works with numbers. Now you have the power of a smart drawing system integrated with a scientific calculator and formula solver within one easy-to-use software package.

Requires Microsoft Windows. $895

MCAE Technologies Inc.
Tel: 408-748-0334 Fax: 408-748-1915

Inquiry 724.

**SOFTWARE/GRAPHICS**

**RAINDROP**


ECLECTIC SYSTEMS
806 E. Arapaho Rd., #92, Richardson, TX 75081

(214) 433-7388, (800) 835-7765, FAX (214) 423-4465

Inquiry 724.

**SIMULATION WITH GPSS/PC**

GPSS/PC is in a class by itself. A new simulation tool for the popular mainframe simulation language GPSS. Graphic animation and an extremely interactive environment allow a totally new view of your models. If you are contemplating the creation or modification of a complex system you need GPSS/PC to help you predict it's behavior. Call now.

MINUTEMAN SOFTWARE
PO. Box 1NY, Stow, Massachusetts, U.S.A.

(617) 652-6523 ext. 543 (603) 222-1420 ext. 540

Inquiry 744.

**SOFTWARE/PORTAN**

**ELECTRONIC CATALOG**

Electronic software for log plotting, photodetector analysis, hydrology, digitizing, 3D solid modeling, systems estimation, fracture analysis, image processing, and process control. For more information, circle or write for Free Catalog.

RockWare, Inc.
4051 Kipling St., Suite 500, Wheat Ridge, CO 80033 USA

(303) 423-5645 Fax (303) 423-5171

Inquiry 720.
SOFTWARE/GRAPHICS

**DoDOT for Microsoft Windows**

With DoDOT, you can:

- Capture screens, windows, dialog boxes, and pull-down menus.
- Convert between various file formats: TIFF, PostScript, PCX, GIF, BGR, PIC, PCL, MSF, Clipboard, bitmaps, and more.
- View and edit images with full color support.
- Print images in wide range of formats: Laserjet, Postscript, and more.

For IBM PC, AT, AT & compatibles, you receive free upgrades and support. Only $49.95 + S&H

**Inquiry 726.**

**POPPULAR HGRAPH**

**SCIENTIFIC 2D & 3D graphic routines for IBM PC, AT, AT & compatibles.**

- Linkable/OEM of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards.
- 240 page manual. No royalties.
- Supports 
  - Video, Painters & Printers.
  - Linear, log, polynomial, bar & pie charts.
  - Scalable fonts, line types, markers.
  - Multiple plots on a page.
  - Over 100 routines with full source code.
  - Supports VIDEO, PRINTERS & PLOTTERS.

**Inquiry 727.**

**GRAPHICS PRINTER SUPPORT**

- AT & compatibles.
- We support a
  - 301 Prelude Or. , Dept. 8, Silver Spring, MO 20901 USA
  - Hoffman Estates, IL 60195 FAX 708-882-4173

**Inquiry 728.**

**FORTRAN PROGRAMMER SUPPORT**

At LAST! Use the PHIC key to make quality labeled B&W or color reprodutions of your display on any dot matrix, inkjet, or laser printer (including Postscript) in up to 50 shades of gray or 256 colors. PHIC supports all versions of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards. Lineable/OEM versions available. $48.95

**Jewell Technologies, Inc.**

476 E. Front St. 80901 USA
(900) 350-9500 x257 (206) 537-1501

**Inquiry 729.**

**GRAPHICS LIBRARIES for C, FORTRAN, PASCAL & QUICKBASIC**

- Supports VIDEO, PRINTERS & PLOTTERS.
- Linear, log, plot, smith, bar & pie charts.
- Scalable fonts, line types, markers.
- Multiple plots on a page.
- Over 100 functions with full source code.
- $295.00

**Inquiry 730.**

**PRINTED GRAPHS**

- The Graphlink® Printer Grapher toolkit lets you use your Turbo Pascal programs build and print graphs at the printer's resolution! 60+ routines emulate Borland Graphics Interface. Supports the most popular color and dot matrix printers. Only $125 ($250 for Professional version) Soon for TOS, MS, CG, Quick C.

**Inquiry 731.**

**SOFTWARE/INKJET/PAGE PRINTERS**

**DRUMA FORTH**

Break the 64K barrier without speed/space penalty. Powerful, efficiently printed, 163 Standard:
- 16K automatic memory management
- Full DOS interface, extensive utilities
- On-line documentation, ASCIINewHelp
- Other product features: graphic processor, modems, printers
- IBM PC/XT/AT & all compatibles

For IBM PC, AT, AT & compatibles. Free learnability disk available.

**Inquiry 735.**

**SOFTWARE/INVESTMENT**

**IMAGE TOOLS LIBRARY**


**Inquiry 736.**

**SOFTWARE/MATHEMATICS**

**MATH EDITING FOR THE PC**

- MathEdit constructs math equations to be inserted into WordPerfect, WordStar, and others.
- WYSIWYG interface—no codes need to be learned.
- MathEdit—INSTANT MATH EASY!

**Inquiry 737.**

**SOFTWARE/MEDICAL**

**PC HOLTER/ECG SOFTWARE**

Provides automated ECG data acquisition, analysis, and report generation. FDA approved for medical applications. Complete report review, edit, and print features. Includes best superimposition and laser printer support. Utilizes tape cassette or solid-state memory data collection devices. Custom versions for OEMs, VARs and dealers.

**Diagnostiic Medical Instruments, Inc.**

654 Thomas St., Syosset, NY 11791
(800) 544-5500 Ext. 20
(914) 437-2005

**Inquiry 738.**

**SOFTWARE/PRINTERS**

- HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS
- C64 binders &apolis the IBM, IBM binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity in quantities. We supply what you need to bring your software to market. Disk and binder sleeves. Much more! Low priced fast service. Call us for a FREE GOAHEAD.

**Inquiry 739.**

**SOFTWARE/PACKAGING**

**SAVE SAVE SAVE LET'S TALK PACKAGING**

From disk labels to manuals to shipping boxes—We are a complete packaging service. Everything you need to market your software. Call us for our free catalog.

**Inquiry 740.**

**SOFTWARE/SCANNERS**

**Optical Character Recognition**

Stop relying. PC-OPT software will convert typed or printed pages into editable text files for your word processor. Works with HP Scanjet, Panasonic and most other scanners. Supplied with 16 popular fonts. User friendly: teach you to read virtually any typestyle, incl. foreign fonts. Proprietary text, printer output. Kensei, Japanese, ENS, Chigyo/2A/2BDC, Kana/2A/2BDC.

**Essex Publishing Co.**

PO. Box 231, Cedar Grove, NJ 07009
(201) 783-8190

**Inquiry 742.**

---THE BUYER’S MART---

Inquiry 726.

Inquiry 727.

Inquiry 728.

Inquiry 729.

Inquiry 730.

Inquiry 731.

Inquiry 732.

Inquiry 733.

Inquiry 734.

Inquiry 735.

Inquiry 736.

Inquiry 737.
**SOFTWARE/SCIENTIFIC**

Chaos/Nonlinear Dynamics

DYNAMICAL SOFTWARE I and II $250
ordinary and partial differential equations, bifurcation diagrams, basin boundaries, 2- and 3-D plotting, principal solutions, return maps, special analysis, fractal dimensions, lyapunov exponents

CHaos IN THE CLASSROOM Instructional Programs Maps and bifurcations $1455. software and Jills $55.50

DYNAMICAL SYSTEMS, INC.
PO Box 3524, Tucson, AZ 85702 (520) 294-1932

**SOFTWARE/SORT**

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Geslct utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including BrEve and eBASE. Unlimr.d file sizes, multiple keys and statistical proces.s $19?$.

(702) 588-3737

Opt-Tech Data Processing
Rd. Box 678 — Zephyr Cove, NV 89448

**SOFTWARE/SPEECH**

SPEECH SYNTHESIS CHIP

Want the most advanced phonemes synthesis chip available? One flexible enough to generate spoken, music and sound effects... yet low cost and remarkably easy to use! The ARTIS-253 is all of this and more... a versatile, high-quality, phoneme-based, speech synthesizer circuit contained in a single, nonvolatile, 24-pin, CMOS, integrated circuit.

Artic Technologies
1050 Park Blvd., Troy, Michigan 48084
Phone: (313) 586-2770 FAX: (313) 586-2850

**SOFTWARE/UTILITIES**

PC Compatible File System

All "C", very portable, relocatable. Add floppy & winchester support to embedded systems, or transfer data to-from pc floppy or partitions from your OS. Full, high quality implementation. High quality CD-ROM interface software available too.

e tc bin systems

20 High Street, Nashua, NH 03060 (508) 448-9340

**SYSTEM SOFTWARE**

**UNINTERRUPTABLE POWER**

HOW TO PROTECT YOUR COMPUTER

And Make It Last Longer

FREE nonrenewable system. What you need to know about UPS- uninterrupted power supply. How to get complete protection from power failure. 300A through 1500A, worldwide. The largest manufacturer of single-phase UPS.

Best Power Technology, Inc.
PO Box 282, National City, CA 92051
800-565-2500 ext. 3933 TOLL FREE (606) 368-8764 ext. 3853

See our Ad on page 336.

**UTILITY SOFTWARE**

ACCUBACK—BACKUP SYSTEM

Program lets you back up all DOS Systems.

With 100% byte by byte read verification

Supports absolute file matching

Purges to DDS standards

DDS not needed.

Creates active archives that are directly accessible.

The most accurate backup system available. Special introductory price: $79.95 plus $4.00 shipping/handling.

ACER TECHNOLOGY SYSTEMS, INC.
DEPT D, 8170 SW 266th, Suite E, Portland Oregon 97219
(503) 245-2948 FAX (503) 245-0846 VISA/MC

**THE BUYER'S MART**

free catalog! 800-942-MATH

Micro Math Scientific Software

Inquiry 743.

Inquiry 744.

If you can find better sort/merge/select software, buy it!

Sor tech

Ultimate in performance and reliability

30-Day Money-Back Guarantee

Only $149.95

Systemat Corporation
211 N. Davenport Drive, Walnut, CA 91789
PHONE: 714 594-9567 FAX: 714 594-7984

**SOFTWARE/VOICE**

MULTI-VOICE® TOOLS

Multi-Voice Tools is a complete development tool for Turbo Pascal to access all the features of the W6JSON or DIALOGIC Speech Boards. It is also a high level library of procedures in BASS/VOICE RESPONSE system routines.

A powerful TERNPHONE ANSWERING program is given as an example with this book.

DIALOGIC 958, W6JSON 983, Voice/AC

ITI Logiciel
1705 St. Joseph E, Suite 4, Montreal, PQ, Can. H2J 1N1
(514) 881-9848

We can also write your Voice Response application programs.

Inquiry 748.

Inquiry 749.

The BASS System™

Why use up 8 meg and 640K to just run a data step on your 80386? Now you can run your data step code and statistical procedures with a system that takes only one meg and 40K (and costs only $399) for information.

BASS Institute, Inc.
PO Box 349, Chapel Hill, NC 27514
(919) 933-7096 or BB: (919) 966-8755 (N.A.1)

Inquiry 750.

Cover all the bases of design...

with Methodology Comprehensive package of five programs to aid in research design and analysis. Specifically, these programs offer assistance in sampling, data collection procedures, statistical analyses, experimental design, and measurement and scaling. $499.95 plus $4.00 shipping/handling.

BMTP Statistical Software, Inc.
1442 Segovia Beach Blvd., San Diego, CA 92105
(213) 479-7769

Inquiry 751.

Know where you’re going?

You will, by using Statistical Navigator®, an expert system that helps you select the best statistics for a problem. Statistical Navigator suggests appropriate analyses and explains how each fits your needs. Version 1.1 — $99.95 + s/h. VISA, MC, AMEX, PG, Checks accepted.

The Idea Works, Inc.
100 West Briarwood, Columbia, MO 65203
1-800-537-4866 FAX 314-445-4589

Outside USA 314-445-4584

Inquiry 752.

NCSS 5.x Series — $125


NCSS
825 East 400 North, Kaysville, UT 84037
Phone: 801-546-0445 Fax: 801-546-3907

Inquiry 754.

COPY AT TO PC—BRIDGE-IT 3.5

"COPY AT" RELIES on enough DOS to copy 1208 bytes of BIOS, or a disk in drive A. BRIDGE-IT 3.5 is a DEVICE DRIVER supplying 1208 bytes for BIOS, or native 340K BIOS, or native 1.44MB drives for DOS without upgrading D0G085. Only $39.95 + s/h.

BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT $129.95 + s/h VISA/AMEX/COD BIG UPS W/ BRIDGE-IT 3.5

MICROBRIDGE COMPUTERS
655 Sky Way Suite 220, San Carlos, CA 94070
1-415-593-8777 (CA) 1-415-593-7675 (FAX)
1-800-543-0610 (CANADA)
1-800-533-4777 (TOLL FREE)

Inquiry 759.

DELTA, the better text file comparison tool. Scorable windowed presentations of file or directory comparisons, with a built-in editor window. Ideal for programmers! Requires DOS 3.3 or higher with at least 384K RAM. A hard disk is recommended. Order now. $70. DEMO available on our BBS.

OPENNetwork
POWER TOOLS FOR POWER USERS

215 Berkeley Pl., (B-1), Brooklyn, NY 11217
718-638-2240 BBS: 718-638-2239

Inquiry 760.
Recover deleted files fast!
Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk: view, view or change format, change a file's size, change data in any sector. MS-DOS $75 U.S. Credit/ Check orders welcome.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

COPYWRITE
CopyWrite
Remove Copy Protection
No more diskettes, manuals or 
codematches. 100% of products copied.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl. Dept B
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243 Fax: (416) 961-8448

Remove Hardware Locks
Software utility allows for the hardware locks.
Don't wait for your lock or key device to fail or be stolen.

Safesoft Systems Inc.
191 Kipling Way, Winnipeg, MB, Canada, R3G 3A6

Inquiry 766.

Inquiry 767.

APPLEWORKS → IBM

Phone (919) 870-5694 for free info packet.
SoftSpoken Co., PO Box 18343, Raleigh, NC 27619

Inquiry 768.

FARSI / GREEK / ARABIC / RUSSIAN
Software includes over 500,000 foreign characters and NLC printing with no hardware modifications. Includes Font Editor. 3350 dot matrix: $155 edit/ run, $20 demo. SH in U.S. incl'd. Reg. PC. 840K, graphics. 30-day Guarantee.

Flagstaff Engineering
1120 Kebab Lane, Flagstaff, AZ 86001

Inquiry 769.

Why You Want BATCOM!
BATCOM is a batch file compiler that transforms your batch files to .exe files to make them faster. BATCOM extends DOS with many new commands so you can do the same commands in both batch or .exe files.

Wavenham Software Company
5 Burley St., Westham, MA 01884
(508) 774-7036

Inquiry 763.

Boot From Drive B:
YWSoft's B-Boot will boot a PCXT/AT, PS/2 or compatible from drive B. If you have a 3.5" and a 5.25" drive, you can now boot from disks of both sizes. Also works for external drives. Works for DOS and non-

YWSoft Co.
P.O. Box 2231, Bloomington, IN 47402
Tel: (812) 857-6772

Inquiry 764.

WE CAN READ 130 LANGUAGES FROM ARABIC TO ZULU
Use SPOT OCR Software with an image scanner and your 

Inquiry 761.

APPLEWORKS → IBM
CROSS-WORKS 2.0 transfers both ways between 

Apple IIe/IIgs and IBM PCXT/AT/PS/2 & compatibles. Exchange AppleWorks with 


Phone (919) 870-5694 for free info packet.
SoftSpoken Co., PO Box 18343, Raleigh, NC 27619

Inquiry 762.

YOUR SALES MESSAGE
about the 
special computer or 

your service 

that 

you provide 

in print.

To help you reach 

computer professionals and 

produce 

valuable inquiries 

for your company!

Call Brian Higgins for more information
603-924-3754
or Fax:
603-924-2683

Inquiry 765.

THE BOOKS
PASCAL 
PROGRAMMERS  
ARE ASKING FOR

Turbo Pascal® DiskTutor by Werner Fethel
(Includes 1 Book and 3 Disks)

"...The ideal tool for learning Turbo Pascal and object-oriented programming."
- Philippe Kahn, Borland CEO

This package contains 1 disk of programming examples, and an easy-to-follow book that guides you step-by-step to mastering Turbo Pascal and object-oriented programming.


Borland•Osborne/McGraw-Hill Programming Series

Turbo Pascal® 5.5: The Complete Reference
by Stephen K. O'Brien

The most complete single resource ever published for all Turbo Pascal 3.0 and 5.5 programmers. Covers every Turbo Pascal command, feature, and programming technique.


Borland•Osborne/McGraw-Hill Programming Series

Using QuickPascal®
by Steven Namoff

A practical get-up-and-go guide to Microsoft's Pascal with object-oriented programming. Covers object-oriented programming and produces valuable inquiries for your company!

Call Brian Higgins for more information
603-924-3754
or Fax:
603-924-2683

Inquiry 769.

NEW FROM OSBORNE/McGRAW-HILL

THE BUYER'S MART

UTILITIES

COPYWRITE
CopyWrite
Remove Copy Protection
No more diskettes, manuals or 
codematches. 100% of products copied.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl. Dept B
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243 Fax: (416) 961-8448

COPYWRITE
CopyWrite
Remove Copy Protection
No more diskettes, manuals or 
codematches. 100% of products copied.

QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl. Dept B
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243 Fax: (416) 961-8448

Remove Hardware Locks
Software utility allows for the hardware locks.
Don't wait for your lock or key device to fail or be stolen.

Safesoft Systems Inc.
191 Kipling Way, Winnipeg, MB, Canada, R3G 3A6

Inquiry 761.

AppleWorks → IBM
CROSS-WORKS 2.0 transfers both ways between 

Apple IIe/IIgs and IBM PCXT/AT/PS/2 & compatibles. Exchange AppleWorks with 


Phone (919) 870-5694 for free info packet.
SoftSpoken Co., PO Box 18343, Raleigh, NC 27619

Inquiry 762.

Why You Want BATCOM!
BATCOM is a batch file compiler that transforms your batch files to .exe files to make them faster. BATCOM extends DOS with many new commands so you can do the same commands in both batch or .exe files.

Wavenham Software Company
5 Burley St., Westham, MA 01884
(508) 774-7036

Inquiry 763.

Boot From Drive B:
YWSoft's B-Boot will boot a PCXT/AT, PS/2 or compatible from drive B. If you have a 3.5" and a 5.25" drive, you can now boot from disks of both sizes. Also works for external drives. Works for DOS and non-

YWSoft Co.
P.O. Box 2231, Bloomington, IN 47402
Tel: (812) 857-6772

Inquiry 764.
**VOICE MASTER KEY® SYSTEM II**

**VOICE RECOGNITION & SPEECH RESPONSE**

FOR IBM PC/XT/AT/386, PS/2, LAPTOPS, COMPATIBLES

---

FOR PRODUCTIVITY, PRESENTATIONS, SOFTWARE DESIGN, ENTERTAINMENT, LANGUAGE TRAINING, EDUCATION, MORE...

SPEECH/SOUND RECORDING AND PLAYBACK. Desktop Audio sound editing allows you to create custom sound applications. Variable sample rate (to 20 Khz) and compression levels. A four-voice music synthesizer is included also.

**VOICE RECOGNITION** TSR utility allows you to add voice command keyboard macros to your CAD, desktop publishing, word processing, spreadsheet, or entertainment programs. Up to 64 voice commands in RAM at once—more from disk.

**SOFTWARE** contains built-in speaker with separate volume and tone controls, external speaker and headphone jacks. Enclosure made of sturdy vinyl-clad steel. Attaches to parallel printer port without affecting normal printer operation (U.S. Patent 4,812,847). Headset microphone, printer cable. 9 volt AC adapter (1 to volt UUCSA listed). and comprehensive user manual included.

**QUALITY THROUGHOUT. MADE IN USA. ONLY $219.95**

**ORDER HOTLINE:** (503) 342-1271 Mon-Fri, 8 AM to 5 PM PST

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Special computer type when ordering. Add $5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C&F/CIF quotes. OEM configurations available.

**30 DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED.**

---

**BIOS SOURCE CODE**

The AT BiosKit gives you a complete BIOS with source code you can modify for your own applications! The BiosKit includes a BIOS on diskette ready for programming an Eprom, and includes the utilities you need to run the source code. The BIOS also has a ROM Monitor/Debug and Setup. At last you have control over the core of your system. Over 380 pages, with diskette, $199. The XT BiosKit is only $99, or get both for $279.

**FREE** We'll include a free copy of the pocket-sized XT-AT Handbook by Cholser and Foster with each BiosKit if you mention this ad when you order. Of course, this $9.95 value is also available by itself. Or buy five or more for only $5.00 each.

---

**DISC DRIVE REPAIR SPECIAL**

Formatted Cap. Flat Rate SPECIAL SHIPPING YOUR DRIVE FOR REPAIR $148

<table>
<thead>
<tr>
<th>Cap.</th>
<th>Flat Rate</th>
<th>SPECIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-19 mb</td>
<td>$99</td>
<td>$89.10</td>
</tr>
<tr>
<td>20-29 mb</td>
<td>$125</td>
<td>$112.50</td>
</tr>
<tr>
<td>30-39 mb</td>
<td>$150</td>
<td>$135.00</td>
</tr>
<tr>
<td>40-49 mb</td>
<td>$175</td>
<td>$157.50</td>
</tr>
<tr>
<td>50-65 mb</td>
<td>$210</td>
<td>$189.00</td>
</tr>
<tr>
<td>66-90 mb</td>
<td>$275</td>
<td>$250.00</td>
</tr>
<tr>
<td>91-129 mb</td>
<td>$325</td>
<td>$300.00</td>
</tr>
<tr>
<td>130-159 mb</td>
<td>$425</td>
<td>$400.00</td>
</tr>
<tr>
<td>160-199 mb</td>
<td>$495</td>
<td>$450.00</td>
</tr>
</tbody>
</table>

**TEST & EVALUATION $25**

VALID THROUGH 4/30/90

**DISC DRIVE SALES**

<table>
<thead>
<tr>
<th>Cap.</th>
<th>Flat Rate</th>
<th>SPECIAL</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Cap.</th>
<th>$185</th>
<th>NOVEL SUBSYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD/SCSI</td>
<td>$156 MB</td>
<td>$1,195</td>
</tr>
<tr>
<td>HD/SCSI</td>
<td>$156 MB</td>
<td>$1,195</td>
</tr>
</tbody>
</table>

**THOUSANDS OF DISC DRIVES IN STOCK**

We Feature Technical Support for Everything We Sell, We Specialize in Disc Drives — Ask for Our Brochure

---

**The TransTerm 5 is a work station data entry/display terminal for on-line shop floor data collection into PC/AT based systems. The unit is one of a family of such terminals which feature LC displays for operator prompting and data entry via a membrane keyboard or an optional barcode wand (Code 39). A multi-terminal polling controller (up to 250 stations) and a dBASE III+ compatible software package are also available. System costs below $300.00 per station. Call for info.**

Options—backlighting for display, RS-422 I/O, 20 Ma current loop I/O. dBASE is a registered trademark of Ashton Tate, Inc.

**COMPANION WISE, INC.**

302 N. Winchester • Olathe, KS 66062 • 913-829-0600 • Fax 913-829-0810
The **SPEEDMODEM**™ is a knock out for value and performance. It features **DYNAMIC IMPEDANCE STABILIZATION™ (DIS™)**, (patent pending). **DIS** improves signal quality, assuring maximum speed and data integrity. **DIS** is renowned for superior performance where other modems fail. All products are internal IBM cards, made in USA, 5 year warranty. If you aren't totally satisfied, return within thirty days for full refund!

- **SPEEDMODEM 300-9600-bps** $299
- **SPEEDMODEM+ FAX-9600** $399
- **FAX-9600 full featured high speed fax card** $299
- **2400-4800-bps MNP-5 MODEM** $193 $169
- **2400-bps MODEM with SEND ONLY FAX** $159
- **2400-bps MODEM** $119 $95
- **FREE $69 EASYCOM™ SOFTWARE with modem**

Only your imagination limits how you benefit from PERCON® keyless data collection.

Checking out books or checking in employees—input data quickly and accurately using bar codes or magnetic stripes. PERCON has proven bar code solutions for IBM®, DEC™, and Apple Macintosh®, Call 1-800-8-PERCON.

PERCON
2190 W. 11th Avenue, Eugene, Oregon 97402-3503
(503)344-1189 FAX(503)344-1399
©1989 Percon, Inc. PERCON, IBM, DEC and Apple Macintosh are trademarks.
### SIP & SIMM MODULES

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>74LS216</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS217</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS218</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS219</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS220</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS221</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS222</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS223</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS224</td>
<td>10</td>
<td>$0.49</td>
</tr>
<tr>
<td>74LS225</td>
<td>10</td>
<td>$0.49</td>
</tr>
</tbody>
</table>

### MICROPROCESSOR COMPONENTS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8080</td>
<td>$0.49</td>
</tr>
<tr>
<td>8085</td>
<td>$0.49</td>
</tr>
<tr>
<td>8086</td>
<td>$0.49</td>
</tr>
<tr>
<td>8087</td>
<td>$0.49</td>
</tr>
<tr>
<td>8089</td>
<td>$0.49</td>
</tr>
<tr>
<td>8098</td>
<td>$0.49</td>
</tr>
<tr>
<td>8099</td>
<td>$0.49</td>
</tr>
<tr>
<td>809A</td>
<td>$0.49</td>
</tr>
<tr>
<td>809B</td>
<td>$0.49</td>
</tr>
<tr>
<td>809C</td>
<td>$0.49</td>
</tr>
<tr>
<td>809D</td>
<td>$0.49</td>
</tr>
</tbody>
</table>

### STATIC RAMS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2114/16-1S</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-1S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-2S</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-2S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-4S</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-4S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-8S</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-8S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-16S</td>
<td>$0.39</td>
</tr>
<tr>
<td>2114/16-16S (16K)</td>
<td>$0.39</td>
</tr>
</tbody>
</table>

### DYNAMIC RAMS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1S4164-1S</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-1S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-2S</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-2S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-4S</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-4S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-8S</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-8S (16K)</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-16S</td>
<td>$0.39</td>
</tr>
<tr>
<td>1S4164-16S (16K)</td>
<td>$0.39</td>
</tr>
</tbody>
</table>

### EPROMS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2716/248-1S</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-1S (128K)</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-2S</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-2S (128K)</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-4S</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-4S (128K)</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-8S</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-8S (128K)</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-16S</td>
<td>$0.49</td>
</tr>
<tr>
<td>2716/248-16S (128K)</td>
<td>$0.49</td>
</tr>
</tbody>
</table>

### EPROMS

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>27C256-25-100</td>
<td>$0.89</td>
</tr>
<tr>
<td>27C256-25-100 (100ns)</td>
<td>$0.89</td>
</tr>
<tr>
<td>27C256-25-100 (100ns)</td>
<td>$0.89</td>
</tr>
</tbody>
</table>

### MISC. COMPONENTS

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tantalum Capacitors</td>
<td>$0.49</td>
</tr>
<tr>
<td>Potentiometers</td>
<td>$0.49</td>
</tr>
<tr>
<td>Transistors and Diodes</td>
<td>$0.49</td>
</tr>
<tr>
<td>Switches</td>
<td>$0.49</td>
</tr>
<tr>
<td>IC Connectors</td>
<td>$0.49</td>
</tr>
<tr>
<td>LEDS</td>
<td>$0.49</td>
</tr>
<tr>
<td>74HC HI-SPEED CMOS</td>
<td>$0.49</td>
</tr>
<tr>
<td>74HC CMOS TTL</td>
<td>$0.49</td>
</tr>
<tr>
<td>Commodore</td>
<td>$0.49</td>
</tr>
<tr>
<td>Latches</td>
<td>$0.49</td>
</tr>
</tbody>
</table>

415-592-8097

Jameco Electronics

Partial Listing • Over 4000 Components and Accessories in Stock! • Call for Quantity Discounts

Rams are subject to frequent price changes.

Circle 149 on Reader Service Card.
Jameco 20MHz 80386 Desktop Computer Kit

- Fully IBM Compatible
- Free! Concurrent 386 Disk Operating System Software Included!
- Free! CAPLUS Diagnostic Software Included!
- Free! WORDSTAR EASY Word Processing Software Included!
- 1MB RAM Included, Expandable to 8MB onboard, 16MB with optional expansion board
- 816/20MHz Keyboard Switchable Operation
- AMI BIOS ROM's Included
- FlipTop Case w/200 Watt Power Supply

Shown with VEGA Option (not included)
JE2003 VEGA Monitor and VEGA Card...$329.95

(See Below)

$1599.95

Jameco 32-Key Keypad for IBM PC/XT/AT & Compilables

- Ideal for use with Laptops!
- Great for use with laptop computers as well as original IBM AT layout keyboards
- 12 function keys • Separate cursor keys • Tactile touch keyswitches • Soft-wire and manual included

JE2018...

$59.95

EGA & Multisync Monitor Packages

Casper 14" EGA monitor and EGA card package (720 x 350 max. resolution)
JE1059 EGA Monitor & EGA Card

$459.95

Reliys 14" Multisync monitor and EGA card package (800 x 600 max. resolution)
JE2057 Multisync Monitor & EGA Card

$599.95

JAMECO IBM PC/XT/AT COMPATIBLE CARDS

JE1043 360K/720K/1.44MB 44Pin Floppy Disk Controller Card (PC/XT/AT)

$49.95

JE1050 Monochrome Graphics Card w/Parallel Printer Port (PC/XT/AT)

$49.95

JE1052 Color Graphics Card w/Parallel Printer Port (PC/XT/AT)

$49.95

JE1055 EGA Card w/256K Video RAM (PC/XT/AT)

$399.95

JE1500 Orca III VGA Card w/256K Video RAM (PC/XT/AT)

$199.95

JE1061 8 Bit/16 Bit VGA Card w/256K Video RAM (PC/XT/AT)

$399.95

JE1064 16 Bit VGA Card w/256K Video RAM (PC/XT/AT)

$599.95

JE1065 IO Card w/Serial, Game, Printer Port & Real Time Clock (PC/XT)

$399.95

JE1066 RS232 Serial Half Card (PC/XT/AT)

$39.95

JE1067 IO Card w/Serial, Game and Parallel Printer Port (AT)

$399.95

JE1071 Multi I/O Card w/Controller & Monochrome Graphics (PC/XT)

$119.95

JE1077 Multi IO Card w/256K/720K/1MB 44Pin Floppy Controller (AT)...

$74.95

JE1081 2MB Extended or Expanded Memory Card (zero-K on-board)...

$109.95

MiniScribe Hard Drives & CMS Tape Back-Ups

Part No.
MB425
MB425XT
MB425AT
MB425F
MB435
MB435XT
MB435AT
MG450
MG450XT
MG450AT
M3095
M3095AT
M3160E
M3130E
QFA500
Price
$299.95
$299.95
$299.95
$299.95
$299.95
$299.95
$299.95
$299.95
$299.95
$299.95
$60.00
$60.00
$60.00
$60.00
$299.95

Format
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM
MFM

Part No.
MB308 AT
QFA500

Price
$299.95
$299.95

Format
MFM
MFM

Part No.
JE3533 Jameco Baby 33 MHz 80386...
JE3525 Jameco Baby 25MHz 80386...
JE3010 Jameco Baby 8/16 MHz 80286...
JE3028 AMI Full-Size 33MHz 80386...
JE3026 AMI Full-Size 25MHz 80386...
JE3015 Jameco Baby 20/33MHz 80386...
JE3025 AMI Full-Size 20MHz 80386...
JE3032 AMI Full-Size 33MHz 80386...
JE3033 AMI Full-Size 33MHz 80386...
JE3018 AMI Full-Size 33MHz 80386...
JE3034 AMI Full-Size 33MHz 80386...
JE3035 AMI Full-Size 33MHz 80386...
JE3020 AMI Full-Size 25MHz 80386...
JE3019 AMI Full-Size 20MHz 80386...
JE3021 AMI Full-Size 25MHz 80386...
JE3012 AMI Full-Size 20MHz 80386...
JE3016 AMI Full-Size 20MHz 80386...
JE3027 AMI Full-Size 25MHz 80386...
JE3029 AMI Full-Size 25MHz 80386...
JE3005 AMI Full-Size 20MHz 80386...
JE3004 AMI Full-Size 20MHz 80386...
JE3003 AMI Full-Size 20MHz 80386...
JE3031 AMI Full-Size 25MHz 80386...
JE3030 AMI Full-Size 25MHz 80386...
JE3009 AMI Full-Size 20MHz 80386...
JE3008 AMI Full-Size 20MHz 80386...
JE3007 AMI Full-Size 20MHz 80386...
JE3006 AMI Full-Size 20MHz 80386...
JE3004 AMI Full-Size 20MHz 80386...
JE3003 AMI Full-Size 20MHz 80386...
JE3031 AMI Full-Size 25MHz 80386...
JE3030 AMI Full-Size 25MHz 80386...
JE3009 AMI Full-Size 20MHz 80386...
JE3008 AMI Full-Size 20MHz 80386...
JE3007 AMI Full-Size 20MHz 80386...
JE3006 AMI Full-Size 20MHz 80386...
JE3004 AMI Full-Size 20MHz 80386...
JE3003 AMI Full-Size 20MHz 80386...
JE3031 AMI Full-Size 25MHz 80386...
JE3030 AMI Full-Size 25MHz 80386...
JE3009 AMI Full-Size 20MHz 80386...
JE3008 AMI Full-Size 20MHz 80386...
JE3007 AMI Full-Size 20MHz 80386...
JE3006 AMI Full-Size 20MHz 80386...
JE3004 AMI Full-Size 20MHz 80386...
JE3003 AMI Full-Size 20MHz 80386...
JE3031 AMI Full-Size 25MHz 80386...
JE3030 AMI Full-Size 25MHz 80386...
JE3009 AMI Full-Size 20MHz 80386...
JE3008 AMI Full-Size 20MHz 80386...
JE3007 AMI Full-Size 20MHz 80386...
JE3006 AMI Full-Size 20MHz 80386...
JE3004 AMI Full-Size 20MHz 80386...
JE3003 AMI Full-Size 20MHz 80386...
JE3031 AMI Full-Size 25MHz 80386...
JE3030 AMI Full-Size 25MHz 80386...
JE3009 AMI Full-Size 20MHz 80386...
JE3008 AMI Full-Size 20MHz 80386...
JE3007 AMI Full-Size 20MHz 80386...
JE3006 AMI Full-Size 20MHz 80386...
JE3004 AMI Full-Size 20MHz 80386...
JE3003 AMI Full-Size 20MHz 80386...
JE3031 AMI Full-Size 25MHz 80386...
Microcomputer News On-Line

In this fast paced industry, can you afford to wait a week or a month for information that may affect you today?

MicroBYTES Daily is an electronic news service covering the latest developments in the microcomputer industry. If it concerns MS DOS machines, Macintosh, Unix workstations, Amigas, Atari STs, peripherals, networks or software, you will find it in MicroBYTES.

Fast and Easy

Read the items as they break or use the powerful search command to quickly locate your information. Best of all you can download the text and print it or use it in your favorite word processor.

Whether you are a developer, marketer, or researcher, you need reliable information and you can count on MicroBYTES. Backed by the combined resources of BYTE Magazine, BYTEweek, and BIX, MicroBYTES gives you access to our world-wide network of reporters and the integrity and experience of our editorial staff.

In your position as a leader in new technology, you cannot afford to be just one of the crowd. Get ahead with MicroBYTES.

Call now and subscribe today.

BIX One Phoenix Mill Lane, Peterborough, NH 03458
1-800-227-2983
HELP
THE AMERICAN FOUNDATION
FOR THE BLIND
HELP YOU!

The American Foundation for the Blind's National Technology Center (NTC) maintains a Job Index/User Network which features information from over 1,100 blind and visually impaired people who use adaptive equipment in a variety of jobs.

The NTC is looking for additional participants. Blind and visually impaired individuals of all ages who have hands-on experience with computers, low vision aids, talking products, or other adaptive devices are needed as resource people and/or evaluators.

As a resource person, other users may contact you to share your knowledge and experience. As an evaluator, you may be asked to evaluate both existing and newly developed or adapted devices. Evaluations are published in the “Random Access” section of the Journal of Visual Impairment & Blindness.

If you are interested, please fill out the form below or call our hotline, 1-800-232-5463 (New York residents call 212-620-2147). Tell the operator you wish to be part of the Job Index/User Network.

Your response will be followed by a brief, confidential telephone survey. The information you provide will be used for NTC purposes only and will include the equipment you use, your experience with it, training and employment.

Your assistance will enable the Job Index/User Network to continue as a major information and support system for blind and visually impaired people nationwide.

Mail to: American Foundation for the Blind, National Technology Center, 15 West 16th Street, New York, NY 10011, Attn: A. Hypolite

Name

Address

City __________________________ State ____________ Zip ____________

Best time to contact ___________________ Telephone ___________________
Fresnel Integrals

\[ C(z) = \int_0^z \cos(0.5t^2) \, dt \]
\[ S(z) = \int_0^z \sin(0.5t^2) \, dt \]

Cornu's Spiral

IBM® PC (with source code) $395
Circle 256 on Reader Service Card
Macintosh® (no source code) $295
Circle 257 on Reader Service Card
Licensed for personal use only

VTEK 4.3
DEC VT100/102/52 & Tektronix 4010/4014/4105 Terminal Emulator for IBM® PCs

“its ease of use, high resolution graphics, emulation, and price make it a more attractive purchase than the other products.” — MINI-MICRO Systems
$95
Circle 258 on Reader Service Card
*Full reprints on request
Scientific Endeavors
508 North Kentucky Street
Kingston, TN 37763 USA
(615) 376-4146 FAX:(615) 376-1571

RS-422/RS-485 Boards for AT, Micro Channel

RS-422/RS-485 asynchronous serial communication boards from Qua Tech available in 1 to 4 ports for PC-AT and compatibles and 1 to 4 ports for PS/2 Micro Channel.
Call for our free
PC Interface Handbook:
1-800-553-1170

Bird Tech synchronous/asynchronous serial boards for PC-AT and compatibles support RS-232, RS-422, and RS-485 communication.
Call for our free
PC Interface Handbook:
1-800-553-1170

5218 Printer Interface for PS/2 and AT

Qua Tech interface cards connect IBM 5218 Display-Writer printer to PS/2 and AT.* Available now. Hundreds installed.
For order info, call:
1-800-553-1170

Intelligent multiport, supports RS-422
SmartLynx AT™ intelligent 4-port serial adapter for PC-AT and compatibles supports RS-422 and most multi-user operating systems. On-board processor takes burden off CPU.
For order info, call:
1-800-553-1170

Joystick Adapter for PS/2
Qua Tech GPA-1000 works with IBM Micro Channel for PS/2 Models 50, 60, 70, and 80. Connect two joysticks or four paddles. Also compatible with IBM Game Control Adapter for PCXT and AT.
Call our toll free order line:
1-800-553-1170
900 Hz 4-Channel Simultaneous Sample/Hold with 12-bit Resolution Single Piece Price $995
- For IBM PCXTIA™ and compatibles
- 32K data buffer
- Pre-trigger or post-trigger data or any combination of both
- Stream data to disk
- Two 4-bit optically isolated output ports
- Event marker and auxiliary inputs
- Flexible and expandable

LAWSOM LABS, INC.
5700 Raibe Road
Columbia Falls, MT 59912
406-321-5955

3M DISKETTES

3M DATA CARTRIDGES

3M COMPUTER TAPES

3M HIGHLAND DISKETTES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

3M ACCESSORIES

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.

Ultracase: Completely User Friendly
BRANDOMSIZE presents ULTRA-CASE
Finally a database you can use without timing manuals, and have fun doing it! Features include: Help window, Mailing List, Calculator, Memo pad & alarm, Fax, Letters, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to printer, Global update and delete, Auto-data, Grand total, Running totals, List of matching records, Auto-fill-in of all deleted records, and records the last time the folder was used.
**Circle 291 on Reader Service Card**

**UNICORN-YOUR I.C. SOURCE**

**COLLIMATOR PEN**

A low power collimator pen containing a MOVPE grown gain guided GaAlAs laser. This collimator pen delivers a maximum CW output power of 2.5 mW at 25°C. These collimated laser sources are designed for industrial applications such as data retrieval, telemetry, alignment etc.

The non-hermetic stainless steel encapsulation of the pen is specifically designed for easy alignment in an optical read or write system, and consists of a lens and a laser device. The lens system collimates the diverging laser light. The wavefront quality is diffraction limited. The housing is circular and precision manufactured with a diameter of 11.0 mm and an accuracy between + and -11 µm.

**LIST PRICE $168.00**  **PRICE $39.99**

Quality Components — Low Prices Since 1983

**LASER DIODE**

Designed for general industrial low power applications such as reading optical discs, optical memories, bar code scanners, security systems, alignment etc.

The gain guided laser is constructed on a n-type gallium arsenide substrate with a Metal Organic Vapor Phase Epitaxial process (MOVPE)

**LIST PRICE $36.00**  **PRICE $9.99**

We Carry A Full Line of Components

**CALL FOR FREE CATALOG**

**EPROMS**

**Circle 352 on Reader Service Card**

**Professional**

**8086 ROM Development with C_thru ROM and ROM-DOS**

C_thru ROM works with Microsoft C or Turbo-C to comprise a complete ROM development package. Comprehensive debugger, remote debugging, startup code, full 80x86 library, ROMable library, etc.

**Circle 138 on Reader Service Card**

**LAZER TECHNOLOGY**

**Circle 185 on Reader Service Card**

**WELCOME TO THE 16 BIT WORLD**

Turn your Turtle into a Rabbit for only $189.00

You do not need to buy a new computer!!!

Trade in your slow XT mainboard for a new AT 80286, which includes:

- Microprocessor Intel 80286 CPU, socket for 80287.
- 12 MHz speed, selectable between 8 and 12 MHz.
- 0 to 512 MHz, clock, calendar, reset button.
- AT and -MBS mem. Upgrade, 8245/845 memory.
- Six 16-bit slots & two 8-bit slots, 10 level IRQ.
- Fis in the XT and AT cases.

with 512 KB...

$245.00...

$299.00...

**Circle 232 on Reader Service Card**

**Intelligent Solutions Network, DOS, OSI/2 & Xenix**

**SCSI CONTROLLERS FOR ISA & MCA**

Novell tested under NetWare 286

Use with NetWare 286 or 386

Use any size • SCSI disk drive

Handle large SCSI hard drives and erasable opticals

Phone: (216) 234-6387

FAX: (216) 234-2233

The SCSI Professionals

6801 ENGLE ROAD, CLEVELAND, OH 44130

**Circle 224 on Reader Service Card**

**Cross-Assemblers as low as $50.00**

**Cross-Disassemblers as low as $100.00**

**Developer Packages as low as $200.00**

**A New Project**

Our list of macro cross-assemblers and cross-disassemblers is extensive, including 8086, 8088, and 80386 processors.

Get in the Market—FAST

Don’t wait until the project is done. Use one of our developers now.

Call us, we’re here to help.

**Quality Solutions**

PseudoCorp has been developing and supporting environments for microprocessor development since 1983.

**BROAD RANGE OF SUPPORT**

- C support
- Fortran
- Assembly
- Source level debugging
- Source level debugging
- Source level debugging

**Set To Go**

Buy our development packages and the next time your boss asks “Get it to work,” you’ll have it ready.

**So What Are You Waiting For? Call us:**

PseudoCorp Development Products Group

1774 Three Lakes, Suite E

Staples, MN 55377

(800) 873-1547

FAX: (864) 873-2154

**Circle 224 on Reader Service Card**

**Circle 227 on Reader Service Card**
BACK ISSUES FOR SALE

BYTE
Limited Quantities — Order Now!

January 1987
February 1988
March 1989
April 1990
May
June
July
August
September
October
November
December
Inside the IBM PCs

Available Issues

Rates (postage and handling included):

1987–'90 BYTE Issues .................................................. $6.00*
BYTE '83–'84 Index .................................................. $4.00
BYTE 1985 Index .................................................. $4.00
BYTE 1988 Index .................................................. $4.00
1985 Inside the IBM PCs ........................................... $4.00
1986 Inside the IBM PCs ........................................... $5.00
1988 Inside the IBM PCs ........................................... $6.00
1989 Inside the IBM PCs ........................................... $6.00
*June 1988 (Benchmarks) $3.00
*December 1988 $3.00

The above prices include postage in the U.S. Please add $.50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

☐ Check enclosed. Payments from foreign countries must be made in U.S. funds payable at a U.S. bank.

Name______________________
Address _____________________
City ________________________ State ________ Zip ________

All orders must be prepaid. Please allow four weeks for delivery.

Charge: ☐ VISA ☐ MasterCard

Card # ___________________________
Exp. Date ___________________________
Signature ___________________________

Please indicate which issues you would like by checking (√) the boxes.

Send requests with payments to:

BYTE Back Issues
One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281
A-BUS™
Data Acquisition and Control
Low Cost A/D, Motion Control, Relays, D/A, Digital I/O...
Sample applications: - Read sensors, voltages, light levels, temperatures, keypads, touch-tones; - Switch electrical devices; - Automate experiments; - Test equipment.

A-BUS Cards
Analog Input: 8 inputs, 8 bit, 7500 conversions/second. AD-142: $142
12 Bit A to D: 1 input, bipolar, integrating 130ms conversion AN-148: $153
High-Speed 12-bit A/D
NEW converter: 8 inputs, 10µs conversion. FA-154: $179
Relay Card: 8 relays (3A at 120VAC contacts, SPST). RE-140: $142
Reed Relay Card: 8 relays (20mA at 6VDC, SPST). RE-156: $109
D/A Converter: Four 8-bit, DA-147: $149
24 line TTL I/O: 24 input and/or output signals, TTL 0/5V levels. DG-148: $72
Digital Input: 8 opt-isolated, Voltage levels or switch closures, IN-141: $65
Digital Output: 4 lines, 3A at 60VDC. SPSI: $109
Digital Output Driver: 8 lines, 250mA at 12V. For relays, solenoids... ST-143: $49

A-BUS Parallel Adapters for: IBM PC/XT/AT & compatibles. Uses one Smart Quad Stepper Controller: On/off. Note: supply 12V, 1A. 12V. For relays, solenoids... ST-143: $78

Clock with Alarm: CL-144: $98
Touch Tone Decoder: PH-154: $87
Prototyping card: 4x4.5" x 5" PR-152: $16
Counter Timer: Three 16 bit counter/timers. CT-150: $132
Smart Quad Stepper Controller: On board microprocessor controls four motors simultaneously. SC-149: $99

Other options available: Power Driver PD-123: $49
Remote keypad: RC-121: $54
A-BUS Parallel Adapters for: IBM PC/XT/AT & compatibles. Uses one short or long slot. AR-133: $69

Other cards available: Apple II, Commodore 64, 128, TRS-80.

Circle 15 on Reader Service Card

Circle 276 on Reader Service Card

Free Diskettes
3.5" SDSCD Bulk $0.47 ea.
3.5" SDSCD White Box $0.57 ea.
3.5" SDSCD Bulk $1.39 ea.
3.5" SDSCD White Box $1.49 ea.
5.25" SDSCD Bulk $0.20 ea.
5.25" SDSCD White Box $0.27 ea.
5.25" SDSCD White Box $0.49 ea.

Absolutely Free
Governments and Fortune 500 PD's acceptable MIC VIa PrePaid/0.D. Standard UPS charge for COD.
Add 5% for credit card orders.
No Handling Charge.
Free freight on orders of $200 or more.
Order less than $200 add: 3" 16 oz per 50ea. 25" 20 oz per 50ea. PA residents add 6% sales tax.

Toll Free 1-800-5FLOPPY
IQ BUSINESS PRODUCTS INC.

Circle 147 on Reader Service Card

EZ-ROUTE VERSION II
SCHEMATIC TO PCLAYOUT $500 INCLUDES AUTO ROUTER
EZ-ROUTE Version II from AMS for IBM PC, PS/2 and compatibles is an integrated CAE System which supports 256 layers, line widths from 0.001 inch to 0.5 inch, flexible grid, X/Y coordinate, M/D/Sm components and outputs on Plotters as well as Photo printers and printers.

SCHEMATIC TO PCLAYOUT $500 INCLUDES AUTO ROUTER
FREE EVALUATION PACKAGE
30 DAYS MONEY BACK GUARANTEE
1-800-972-3733 or (305) 975-9515
ADVANCED MICROCOMPUTER SYSTEMS, INC.
1221 N.W. 65 Place - Ft. Lauderdale, FL 33330
Circle 36 on Reader Service Card

IMAGING CARD
- Dual camera inputs
- Composite video in/out
- 256 x 240 resolution
- Digitize/display at frame speed
- 16 Meg. color palette out (DV02)
- External trigger input option
- PC/XT/AT compatible
- Complete with software & library

The premier system for retail store management. Supports cash drawers, barcode readers, receipt printers, customer displays, digital scales and complete online credit card authorization. Controls all types of retail stores both hardgoods and apparel with complete credit card dish and management and reporting. Easy to install and use. Field proven for speed and reliability. Provides all the features needed for today's retail merchant at a price far below comparable systems. Demo system available.

Accounts Receivable
Point of Sale
Inventory Control
Accounts Payable
General Ledger
Mailing List
$995 Complete system
Dealer inquiries invited.

Crichtlow Data Science, Inc.
(804) 471-0500
PO Box 75567, Richmond, VA 23256

Circle 74 on Reader Service Card

Circle 77 on Reader Service Card

E/EPROM & MICRO PROGRAMMER
$895
- EP/140 includes: software, cable, user's manual, 2 free software update coupons, toll-free technical support, one-year warranty & a unconditional 30 day money back guarantee.
- EP/24, 28, 32-40 pin E/EPROMs
- Supports 874X & 875X series microcontrollers
- Connects to a standard parallel port
- 32-pin model, EP/322, available for $495

The Engineer's Programmer
CALL TODAY 800-225-2102
### PS/2 Models

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/286</td>
<td></td>
<td>1895</td>
</tr>
<tr>
<td>50/300 meg</td>
<td></td>
<td>2395</td>
</tr>
<tr>
<td>70/60 meg</td>
<td></td>
<td>3695</td>
</tr>
<tr>
<td>80/40 meg</td>
<td></td>
<td>4395</td>
</tr>
<tr>
<td>70/120 meg</td>
<td></td>
<td>5595</td>
</tr>
<tr>
<td>80/115 meg</td>
<td></td>
<td>6395</td>
</tr>
</tbody>
</table>

**Call for other models**

### IBM

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>368 S 40 meg</td>
<td></td>
<td>2275</td>
</tr>
<tr>
<td>368 20E-40 meg</td>
<td></td>
<td>4195</td>
</tr>
<tr>
<td>366 40 meg</td>
<td></td>
<td>2795</td>
</tr>
<tr>
<td>366 110 meg/25 MHz</td>
<td></td>
<td>7295</td>
</tr>
<tr>
<td>366 60 meg/25 MHz</td>
<td></td>
<td>5895</td>
</tr>
</tbody>
</table>

**Portable**

### IBM

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>386 S 40 meg</td>
<td></td>
<td>2275</td>
</tr>
<tr>
<td>386 20 E-40 meg</td>
<td></td>
<td>4195</td>
</tr>
<tr>
<td>286E 40 meg</td>
<td></td>
<td>2275</td>
</tr>
<tr>
<td>386 110 meg/25 MHz</td>
<td></td>
<td>7295</td>
</tr>
<tr>
<td>386 60 meg/25 MHz</td>
<td></td>
<td>5895</td>
</tr>
</tbody>
</table>

### Macintosh

<table>
<thead>
<tr>
<th>Model</th>
<th>RAM</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mac IIx/80 Meg/40 Meg RAM</td>
<td></td>
<td>5995</td>
</tr>
<tr>
<td>Mac II/40 Meg</td>
<td></td>
<td>4095</td>
</tr>
<tr>
<td>Mac SE 30/40 Meg</td>
<td></td>
<td>3595</td>
</tr>
<tr>
<td>Lazer NT</td>
<td></td>
<td>4995</td>
</tr>
</tbody>
</table>

### We Stock

- Citizen
- Okidata
- Everex
- Gold Star

### Software Specials

- dbase IV
- Wordperfect 5.1
- Aldus Pagemaker
- Ventura Publisher
- Easy Extra

### Printers

- Epson
- Okidata
- Panasonic
- Samsung

### Monitors

- Nec Multisync
- Magnavox
- Samsung
- Sony

### Exports Available

- Prices subject to change without notice
- Quantities are limited

**Contact:**

- 1-800-526-3482 (Outside CA)
- (818) 884-8644 (In CA)
- (818) 884-8253 (FAX)

**Hours:**

- M-S 9-6

**Compaq is a Registered Trademark of Compaq
IBM is a Registered Trademark of International Business Machines**
Circle 146 on Reader Service Card

Circle 260 on Reader Service Card

Developers: Add TurboSound™

Orders: 800 • 969 • 4411

- Compact PC systems. Run 8088 code and
- Now Available! Systems that are functionally
- IEEE equivalent to large PC's, in compact
- Our CPU cards use V40N50 micros and drive
- DISCOVER the POWER of SOUND in 
YOUR IBM-PC /AT from $19.95!
- Analog 1/0. digital 1/0, RS-232, RS-422, SCSI.
- Easiest to use, for Complex Stand-Alone
- Digital Audio Software/Hardware.
- Emulator
- Memory Cards Programming Module (Seiko/Epson,Fujitsu) - $145
- Four socket GANG Programming Module - $145
- Optional built-in Erase/Unprogram module (SS0); Top cover conductive foam pad.
- $249 (Q25)
- $499 (Q1)
- Programs EPROMs, ZIFRAM, Intel Mem, Memory Cards.
- Sound-Alive Mode for Stand-Alone and Card Duplication /Verify.
- All 24/32/64 pin EPROMs in 4 MHz (upgradeable to 32 megahertz).
- Model UP100 ($345). Model UP200 ($495) accepts dedicated modules.
- Memory Cards Programming Module (Schlumberger/Flash/Flex) - $145
- Four socket GANG Programming Module - $145
- On-Board Programming option for ZIFRAM, ZIFROM, and Memory Cards.
- Can be operated with any compatible IBM-PC or compatible systems.
- Optional built-in Erase/Unprogram module ($50). Top cover conductive foam pad.
- Four one year software updates and Customer Support.
- Full 1 year warranty. Customer support via voice line, Fax & dedicated BBS.

Circle 129 on Reader Service Card

Complete PC Systems
For Complex Stand-Alone Applications

- New Available! Systems that are functionally equivalent to large PC's, in compact packages.
- Our systems are based on single board CPU's and include all hardware, software, and support
- Run DOS applications without a disk using our BIOS.
- BIOS DOS and user programs in EPROM's.
- Debug Monitor, BIOS for disk capability, utilities, and source code are available.
- Compatible with our systems. Run 8088 codes and DOS applications. Use standard PC/AT cards in
- Passive backplanes for expansion.
- Easiest to use, for Complex Stand-Alone
- Digital Audio Software/Hardware.

Circle 93 on Reader Service Card

EASTERLASS EDITING
between files —
across applications —

If you work with more than one file, you need i/2 —
the editor for multi-file processing.

OS/2 & DOS versions... both for $150
1-800-284-3269

GOLDEN BOW SYSTEMS
2665 ARIANE DRIVE, #207
SAN DIEGO, CA 92117
(619) 483-0901

Circle 38 on Reader Service Card

PC BASED UNIVERSAL
DEVICE PROGRAMMER

- Programs EE/EPROM, ZIFRAM, Intel Mem, Memory Cards.
- Sound-Alive Mode for Stand-Alone and Card Duplication /Verify.
- All 24/32/64 pin EPROMs in 4 MHz (upgradeable to 32 megahertz).
- Memory Cards Programming Module (Schlumberger/Flash/Flex) - $145
- Model UP100 ($345). Model UP200 ($495) accepts dedicated modules.
- Optional built-in Erase/Unprogram module ($50). Top cover conductive foam pad.
- Four one year software updates and Customer Support.
- Full 1 year warranty. Customer support via voice line, Fax & dedicated BBS.

Circle 36 on Reader Service Card

INTELLIGENT
ROM EMULATOR

- Emulator 2176 through 27128 EPROMs (2k to 64k bytes) with a single unit.
- Connects to the standard parallel printer port. Use standard printer cable.
- Intelligent "In-Circuit-Emulator" type features include: Address Comparator, Address Snag, Trigger Input, Hal-Drop, Progressivestep Operation, Powerful Memory buffer editor, selectable watch window.
- On-screen software support in English, Spanish, French, German and Italian.
- Powerful and reliable. All memory cards can be expanded to 40 pins.
- Custom interface modules available.
- Systems, Verilog, VHDL, Standard VHDL.
- Full 2 year warranty. Call today for datasheets!

Circle 39 on Reader Service Card

B&C MICROSYSTEMS INC.
325 WEST OAKLEY AVE., SUNNYVALE, CA 94086 USA
TEL: (408) 730-5501 FAX: (408) 730-5511 BBS:(408) 730-2117

APRIL 1990 • BYTE 333
Buy with

Confidence

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.

© Direct Marketing Association, Inc. 1988

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

MMC
MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.
How to Protect Your Computer
And Make It Last Longer
FREE money-making literature. What you need to know about UPS — uninterruptible power systems.
How to get complete protection from power line problems. 350 Va to 5 kW models from the world's largest manufacturer of single-phase UPS.
Best Power Technology, Inc.
P.O. Box 280, Necedah, WI 54646
Toll-Free (800) 356-5794, ext. 3864
Circle 167 on Reader Service Card

Circle 169 on Reader Service Card

Circle 169 on Reader Service Card (DEALERS: 170)

Circle 167 on Reader Service Card

Circle 170 on Reader Service Card

Circle 45 on Reader Service Card

Circle 109 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card

Circle 40 on Reader Service Card
Dynamic C

... is a real breakthrough for programming embedded microprocessor systems in the C language. Dynamic C is a complete menu-driven, PC-based compiler, editor, and source debugger. It compiles and downloads to your target at 25,000 lines per minute. Includes multi-tasking kernel. With Dynamic C you get the advantages of the C language without the problems. Only Z-World has Dynamic C.

Ask for our free demo disk.

Z180 / HD64180

Single Board Computer

The SBC100 single board computer has serial and parallel ports, jSBX ports, battery-backed RAM, EPROM, a battery-backed time-date clock, power fail detection, watchdog timer and LED display. Power supply included. A prototyping area lets you add up to 20 IC's. Single board computer only $395. Dynamic C programming system, including PC interface card, only $695.

In-Circuit Emulator C Development system

The IC180 is a total development system including in-circuit emulator, Dynamic C and all supporting software. Only $3,495 including pod for Z80, Z180/HD64180 or HD647180.

RS-232/485

Communications Coprocessor

The Z485 communications coprocessor for PC has 2 asynchronous, full duplex channels. 57k baud. Dynamic C available. Only $295. OEM discounts.

Z-World Engineering

1340 Covell Blvd., Davis, CA 95616
(916) 753-3722
Fax: (916) 753-5141

In-Circuit Emulator

C Development system

The IC180 is a total development system including in-circuit emulator, Dynamic C and all supporting software. Only $3,495 including pod for Z80, Z180/HD64180 or HD647180.

RS-232/485

Communications Coprocessor

The Z485 communications coprocessor for PC has 2 asynchronous, full duplex channels. 57k baud. Dynamic C available. Only $295. OEM discounts.

Z-World Engineering

1340 Covell Blvd., Davis, CA 95616
(916) 753-3722
Fax: (916) 753-5141
IMPORTANT
HIGH LEVEL
POSITION

Excellent opportunity for rewarding international career challenge. Candidate must have skills, motivation and interest in people for this self-actualizing job. All living expenses fully paid. Chance to travel. Age no barrier.
The toughest job you'll ever love.
Call Peace Corps.
1-800-424-8580, Ext. 93.

MANAGER.
Large national bank seeks
out-mind highly motivated.


SONY

3" DS
8.95
PER BOX

3" HD
17.95
PER BOX

Bulk
Diskettes

3.5" DS
4.9
PER E.A.

3.5" HD
14.9
PER E.A.

3M

5.25 DD
5.95
PER BOX

5.25 HD
10.95
PER BOX

3.5" DD
8.95
PER BOX

3.5" HD
17.95
PER BOX

maxell

5.25 DS
5.95
PER BOX

5.25 HD
10.95
PER BOX

3.5" DS
8.95
PER BOX

3.5" HD
17.95
PER BOX


Old Reliable
Diskette Connection

NORTHWEST
1-800-451-1849
PO BOX 10442, WILMINGTON, DE 19804

SOUTHEAST
1-800-940-4600
PO BOX 13902, COLUMBUS, OH 43216

MIDWEST
1-800-654-4058
PO BOX 1974, BETHANY, OK 73008

WEST
1-800-621-6221
PO BOX 12345, LAS VEGAS, NV 89112

Minimum Order $20.00. NO SURCHARGE on VISA/MC
COD orders add $3.00. UPS Surface shipping add $4.00
per each 100 Disks (First Class US Mail delivery extra)
Prices are subject to change without notice

FAX
(405) 495-4596
Circle 159 on Reader Service Card

Circle 125 on Reader Service Card

Circle 157 on Reader Service Card

Circle 88 on Reader Service Card

Circle 85 on Reader Service Card

Circle 143 on Reader Service Card

Circle 78 on Reader Service Card

Circle 22 on Reader Service Card

Circle 139 on Reader Service Card

Circle 158 on Reader Service Card

Circle 98 on Reader Service Card

Circle 34 on Reader Service Card

Circle 126 on Reader Service Card

Circle 121 on Reader Service Card

Circle 75 on Reader Service Card

Circle 77 on Reader Service Card

Circle 124 on Reader Service Card

Circle 136 on Reader Service Card

Circle 138 on Reader Service Card

Circle 137 on Reader Service Card

Circle 80 on Reader Service Card
YOUR MOTHERBOARD CONNECTION!

"OUR FASTEST" 33MHZ CACHE 368

- NORTON SI 43.9 • LANDMARK AT SPEED 80.8
- 33MHZ 80386 CPU • 84K ZERO WAIT STATIC RAM CACHE
- 1/4MHZ ON BOARD RAM USING 8085 SIMMS (DISK INSTALLED) • 1/4MB USING 48 256K SIMMS OR 4MB USING 48 1MB SIMMS
- CHIPS & TECHNOLOGY 82C208 DMA INTERFERENCE CONTROLLER • SOCKETED FOR 80387-33 MATH CO-PROCESSOR • EIGHT EXPANSION SLOTS (ONE 32-BIT, 64-BIT, OR 128-BIT) • ATI BIOS ADJUSTIBLE SPEEDS • INTERLEAVED MEMORY • NEAR 0 WAIT STATE

MCT-3386MC-33

$1495.00

25MHZ 386

- NORTON SI 29.7 • LANDMARK AT SPEED 32.5
- 25MHZ 80386 CPU • 1/10MHZ/25MHZ KEYBOARD
- SELECTABLE SPEEDS • 1/16MH ON BOARD RAM CAPACITY USING SIPS (DISK INSTALLED) • 1/16MB USING 36/72 256K SIMMS OR 1/16MB USING 1MBX1 DRAMs OR 4/16MB SIMMS OR 4MB USING 32 1MBX1 DRAMs OR 4/1MB SIMS OR 4/16MB SIMMS • 1MB USING 72 1MBX1 DRAMS AND 9 1MB SIMS • SHADOW RAM FOR BIOS & VIDEO • SOCKETED FOR WEITEK 3167 CO-PROCESSOR • EIGHT EXPANSION SLOTS (FIVE 16-BIT, THIRTEEN 8-BIT) • AMI BIOS ADJUSTABLE SPEEDS • INTERLEAVED MEMORY • NEAR 0 WAIT STATE

MCT-3086MB25

$1495.00

MINI 25MHZ CACHE 386

- NORTON SI 30.5 • LANDMARK AT SPEED 40.7
- 25MHZ-30 Marvin • Requires one of the RAM CARDS LISTED BELOW • SHADOW RAM FOR ROM BIOS • USES MEMORY CACHING FOR BEST PERFORMANCE • MEMORY INTERLEAVING FOR NEAR 0 WAIT STATE OPERATION • BANKS OF MEMORY CACHINGocketed FOR 8030 & 80387-33 MATH CO-PROCESSOR

MCT-C386-25

$1199.00

2/64MB USING 36/72 256K SIMMS OR 4/16MB 256K SIMMS (DISK INSTALLED)

MCT-C386-M4

$995.00

2/64MB USING 36/72 256KX1 DRAMS OR 4/16MB 256KX1 DRAMS (DISK INSTALLED)

MCT-C386-M8

$995.00

1/16MB USING 4//128MB SIMMS OR 4/16MB 256K SIMMS OR 4/16MB 1MBX1 DRAMs OR 1/64MB DRAMS OR 1/32MB DRAMS (DISK INSTALLED)

MCT-C386-M16

$995.00

MINI 20MHZ 386

- NORTON SI 22.0 • LANDMARK AT SPEED 26.1
- MEMORY INTERLEAVING FOR NEAR 0 ZERO WAIT STATES • SOCKETED FOR 8030 & 80387-33 MATH CO-PROCESSOR • USES DR0 OR 100NS, 256K SIMMS OR 1MB SIMS/DIP RAMS • 16MH RAM CAPACITY: 1MB ON BOARD RAM (INSTALLED) • ON BOARD RAM: 1/2MB USING 48 256K SIMMS OR 1MB SIMS/DIP RAMS • 16MH RAM CAPACITY: 1MB ON BOARD RAM (INSTALLED) • ON BOARD RAM: 1/2MB USING 48 256K SIMMS OR 1MB SIMS/DIP RAMS
- STANDARD XT HOLE SPACING • AMI BIOS • SIZE: 6.5" X 10" 1/2MB USING 4/8MB 256K SIMMS OR 1MB SIMS/DIP RAMS

MCT-386-28

$629.00

MCT-386S-25

$629.00

10MHZ 8088

- NORTON SI 21.1
- 10MHZ 8088 CPU • EXPANDABLE TO 4MHB ON BOARD; 1/32K & 1MB DRAMS SIMULATING 1MB SIMS
- AT-COMPATIBLE • 6/12.5MHZ KEYBOARD SELECTABLE SPEEDS • EXPANDABLE TO 4MHB ON BOARD; 1/32K & 1MB DRAMS
- AT-COMPATIBLE • 6/12.5MHZ KEYBOARD SELECTABLE SPEEDS • EXPANDABLE TO 4MHB ON BOARD; 1/32K & 1MB DRAMS
- AT-COMPATIBLE • 6/12.5MHZ KEYBOARD SELECTABLE SPEEDS • EXPANDABLE TO 4MHB ON BOARD; 1/32K & 1MB DRAMS

MCT-8088-13

$995.00

MCT-8088-10

$995.00

ORDER TOLL-FREE 800-538-5000
CUSTOMER SERVICE 800-538-5001
TECH SUPPORT 800-538-5002
MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)

APRIL 1990 • BYTE 339
• 14" NON-G LARE SCREEN • BOO X 560 MAX RESOLUTION
• CGN EGNVGA COMPATI BLE • TTU ANALOG MODE

VGA
PACKAGE

JOA-MULTI

$359.95

REL YSIS VGA MONITOR

$499 95

• 14" ANALOG VGA MONITOR • GLARE RES ISTANT SCREEN
• 720 X 480 MAXIMUM RESOLUTION • TILT/SWIVEL BASE

VGA COLOR AND
CLARITY AT AN EGA
PRICE ! • B·BIT VGA
CARD IS FULLY
COMPATIBLE WITH
IBM VGA • 720 X 540
MAXIMUM RESOLUTION .
640 X 480 IN 16 COLORS
• 528 X 480 IN 256 COLORS
• HIGH RESOLUTION ANALOG
MONITOR • EGNCGN MONO AND HERCULES COMPATIBL
• DR IVERS FOR WINDOWS, GEM, 1·2·3, SYMPHONY,
AUTOCAD & VE NTURA

VGA-PKG
MONO-VGA PAPERWHITE VGA MONITOR ............. $139.95
NEC-MULTl-30 NEC MULTl·3D MULTISYN C .......... $649.00
CM-1440 SEIKO DUAL FIXED FREQUEN CY ............. $599.00

VGA-MONITOR

$339.95

EGA MONITOR

•14" NON-GLARE SCREEN WITH 640 X 350 MAXIMUM
RESOLUTION · DISPLAY 16 COLORS SIMULTANEOUSLY

EGA-MONITOR

$1499

TAXAN DUAL PAGE MONITOR

• GLARE-RESISTANT 19" MONOCHROME ·SCREEN
• INCLUDES DISPLAY CARD • 1280 X 960 NON-INTERLACED

TAXAN·P

$139.95

14" SCREEN MONO

• GLARE -RESISTANT 14" SCREEN WITH AMBER DISPLAY
• 720 X 350 RESOLUTION • TILT/SWIVEL BASE

GM-1489
MONO-SAMSUNG SAM SUNG 12" FLAT SCR EEN $129.95
JOA-MONO 12" MONO WITH GREEN SCREEN ........ $69.95

ENHANCED KEYBOARD
WITH CALCULATOR
• NUMERIC KEYPAD DOUBLES AS A MULTI -FUNCTION
BUSINESS CALCULATORWITH MEMORY FUNCTIONS • 10 1
KEYS • 12 FUNCTION KEYS • XT/AT & PS/2 COMPATIBLE (PS/2
REQUIRES ADAPTOR GENDER 5·6 $4.95)

FC-3001

ENHANCED KEYBOARDS
BTC-5339 101 ·KEY WITH 12 FUNCTION KEYS ............ $69.95
BTC·5339R COMPACT 101-KEY , 30% SMALLER ........ $79.95
MAX-5339 101-KEY MAXI-SWITCH (286 ONLY) .......... $84.95
K103·A AUDIBLE "CLICK" 101-KEY KEYBOARD ........... $84.95

STANDARD KEYBOARDS

GENISCAN
SCANNER

FASTTRAP 3-AXIS
TRACKBALL
$109 95

$199 95

• UP TO 400 DPI • 32 LEVE LS
OF GRAY SCALE • SPEED
OVERRUN WARNING LIGHT
• AUTO MERGE FOR LARGE IMAGES
• INCLUDES INTERFACE CARD
• INCLUDES SCANEDIT II, & DR. GEN IUS SOFTWARE

GS-4500
PRODIGY-OCR OCR SOFTWARE

2 & 3·AXIS PO INTING CAPABILITY
• HIGH RESOLUTION 200 PULSE/INCH
• HARDWARE VARIABLE RESOLUTION
• STANDARD RS -232C SERIAL INTERFACE

FAST-TRAP
PC· TRAC 2-AXIS TRACKBALL $89.95

CABLES AND GENDER CHANGERS

~ LOGITECH MICE
,

·THREE -BUTTON SERIES 9

lOGiHCH:~~~?:~ ~~1~'i:Li~~~1BLE.
LOGC9
LOGC9·C
LOGC9·P
LOGC9-PC
LOGB9
LOGB9·P
LOGB9·PC

SERIAL MOUSE ....... .. .. ............. ................... $98.95
SER IAL MOUSE (NOT PS/2 COMPATIBLE) $79.95
SERIAL MOUSE WITH PAINTSHOW ...... .. $109.95
SER IAL MOUSE WITH PAINT/CAD .......... $154.95
BUS MOUSE ..
........................... $89.95
BUS MOUSE WITH PAINTSHOW ..... ..... ... $1 04.95
BUS MOUSE WITH PAINT/CAD .... .. .. $149.95

CBL-PRINTER
CBL·PRNTR-25
CBL·PRINTR· RA
CBL-DB25·MM
CBL-DB25·MF
CBL-9-SERIAL
CBL·KBD-EXT
CBL·CNT·MM
CBL·FDC·EXT
CBL·MNT·9
CBL· MNT-15
CB L-MODEM
GENDER-VGA

6 FT. PC PRINTER CABLE
9.95
25 FT. PC PRINTER CABLE
15.95
RIGHT ANGLE PRINTER CABLE
15.95
9.95
DB25 MALE· DB25 MALE 6 FT.
9.95
DB25 MALE· DB25 FEMALE 6 FT .
6.95
DB9 FEMALE- DB25 MALE 6 FT.
5 FT. KEYBOARD EXTENS ION
7.95
36-PIN CENTRONICS ·M/M
14.95
37-PIN EXT. FLOPPY CABLE
9.95
6.95
9-PIN MONITOR EXTENSION
15-PIN MONITOR EXTENSION CABLE 9.95
MODEM ·DB25· DB25 FEMALE
6.95
DB9·DB1 5 ADAPTOR
4.95

JDR caters to the developer with a full line of
prototyping and programming products.
Here are just a few examples, Request
our catalog for our complete line!

SIZE
204Bx8
4096x8
8192x8
8192x8

SPEED

8192x8
16384x8
16384x8
32768x8
32768x8
65536x8
131072x8

350ns
250ns
450ns
250ns
200ns
250ns
200ns
250ns
25Dns
250ns
200ns

Vpp
25V
21V
12.5V
12.5V
12.5V
12.5V
12.5V
12.5V
12.5V
12.5V
12.5V

EPROM PROGRAMMER

PINS PRICE
24
3.95
24
3.95
3.49
28
3.69
28
28
4.25
4.25
28
5.95
28
28
4.95
28
5.95
28
7.95
32
24.95

$129 95

• PROGRAMS 27XX AND 27XXX
EPROMS UP TO 27512 · SPLIT
OR COMBINE CONTENTS OF
SEVERAL DIFFERENT SIZED
EPROMS (VAR IOUS FORMATS AND
VOLTAGES) • READ , WRITE , COPY,
BLANK CHECK AND VERIFY • HEX
AND INTEL HEX FORMATS SOFTWARE

MOD-EPROM

DATARASE II EPROM ERASER $39 95
• SMALL SIZE! • ERASES ALL
SIZE EPROMS UP TO 4 AT A
TIME·· MOST IN 3 MIN UTES
• WALL PLUG POWER SUPPLY

DATARASEll

340

• FOR LASERJET SER IES II PRINTERS
• USER EXPANDABLE TO 1, 2 OR 4MB
(0K INSTALLED) · USES 256K 150NS OR
1MB 120NS DRAMS

RAM CARD FOR LASERJET llP
• ADDS 1MB TO 4MB RAM (1MB INSTALLED)

llP-RAM

JETFONT SUPERSET ·150 FONTS!

$29fl9 5

2 CARTRIDGES CONTAIN THE
EQUI VALENT OF 18 SEPARATE HP
CARTRIDGES WITHOUT DOWN­
LOADING ! · FOR HP LASERJET,
LASERJET + AND LASERJET II
• DR IVERS FOR WORDPERFECT,
WORD-STAR 2000, IBM DISPLAY
WR ITE 4, MS WORD , WINDOWS,
1·2-3, DBASE II AND MORE!

SUPERSET

PROTOTYPE CARDS
JDR·PR1
JDR· PR2
JDR· PR2-PK
JDR-PR10
JDR·PR10· PK

8-BIT WITH +5V AND GROUND PLANE
ABOVE WITH 110 DECODING LAYOUT
PARTS KIT FOR JDR-PR2 ABOVE
16-BIT WITH 110 DECODING LAYOUT
PARTS KIT FOR JDR-PR10 ABOVE

27.95
29.95
8.95
34.95
15,95

MODULAR PROGRAMMING SYSTEM

EPROMS
PART#
2716·1
2732A
2764
2764-250
2764-200
27128
27128A·200
27256
27C256
27512
27C101·20

RAM CARD
FOR HP LASERJET

MCT-RAMJET

MOLDED; GOLD-PLATED CONTACTS; 100% SHIELDED

I

BTC-5060 84-KEY WITH 10 FUNCTION KEYS ............... $59.95
MAX-5060 MAXI -SWITCH 84- KEY(286 ONLY) ............. $64.95

BYTE • APRIL 1990

EACH MODULE IN THIS SYSTEM USES A COMMON HOST ADAPTOR CARD, SO YOU CAN USE JUST ONE
SLOT TO PROGRAM EPROMS, PROMS, PALS & MORE!

EPROM MODULE

$119 95

• PROGRAMS 24-32 PIN EPROMS, CMOS EPROMS & EEPROMS
FROM 16K TO 1024K • HEX TO OBJ CONVERTER • AUTO,
BLANK CHECKIPROGRAMN ERIFY• VPP 5, 12.5, 12.75, 13, 21 &
25 VOLTS • NORMAL, INTELLIGENT, INTERACTIVE & QUICK
PULSE PROGRAMMING ALGORITHMS

• UNIVERSAL INTERFACE FOR ALL
THE PROGRAMMING MODULE !
• SELECTABLE ADDRESSE
PREVENTS CONFLICTS
• MOLDED CABLE

MOD·MEP
M00-MEP·4 4· EPROM PROGRAMMER ... ............... 1169.95
MOD-MEP-8 8-EPROM PROGRAMMER ... ............... 259.95
MOD-MEP-16 16-EPROM PROGRAMMER ........ ..... 499.95

MOD-MAC

UNIVERSAL
MODULE

PAL MODULE

• PROGRAMS EPROMS, EEPROMS, PALS, Bl-POLAR PROMS,
8748 & 8751 SER IES DEV ICES: 16V8 AND 20V8 GALS
(GENER ·IC ARRAY LOGIC) FROM LATTICE,
- ,....,
NS, SGS ·TESTS TTL, CMOS,
DYNAMIC & STATIC RAMS
;~
-·.,.
•LOAD DISK , SAVE DISK,

• PROGRAMS MMI, NS, Tl 20 & Tl 24 PIN DEVICES • BLANK
CHECK, PROGRAM, AUTO, READ MASTER. VERIFTY & SECUR­
ITY FUSE BLOW

\ .
EDIT, BLANK CHECK,
PROGRAM, AUTO, READ

MOD·MMP MICROPROCESSOR PROGRAMMER ..... 1179.95
MOD-MIC DIGITAL IC & MEMORY TESTER ...... .... . 259.95
MOD-MBP Bl-POLAR PROM PROGRAMMER .. . ... 499.95

MASTER, VERIFY AND
COMPARE • TEXTOOL
SOCKET FOR .3" TO
.6" WIDE C'S (8-40 PINS)

.• .­

......... . . . . . ...

MOD-MUP
MOD-MUP-EA 4-UN IT ADAPTOR ................................ $99.95

MOD·MPL

OTHER MODULES

PAL DEVELOPMENT SOFTWARE

$99 95

ENTRY-LEVEL PAL DEVELOPMENTFROM CUPL. FULL SUP·
PORT FOR 16L8, 16R4, 16R6, 16R8, 20L8, 20R4, 20R8 AND 20X8 .

MOD-MPL-SOFT

Circle 6 on Readl!r Service Card (DEALERS: 7,


**HIGH SPEED HARD DRIVES**

KITS INCLUDE: FAST FLOPPY DRIVE CONTROLLER, CABLES, INSTALLATION GUIDE & NOVELL NETWORK SOFTWARE

<table>
<thead>
<tr>
<th>SIZE</th>
<th>AVERAGE</th>
<th>INTERFACE</th>
<th>FACE PRICE</th>
<th>KIT PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G7MB</td>
<td>275MB</td>
<td>ESDI</td>
<td>$349</td>
<td>$699</td>
</tr>
<tr>
<td>1.7GMB</td>
<td>275MB</td>
<td>ESDI</td>
<td>$349</td>
<td>$699</td>
</tr>
<tr>
<td>3.2GMB</td>
<td>185MB</td>
<td>ESDI</td>
<td>$189</td>
<td>$199</td>
</tr>
<tr>
<td>3.2GMB</td>
<td>185MB</td>
<td>ESDI</td>
<td>$189</td>
<td>$199</td>
</tr>
<tr>
<td>6.4GMB</td>
<td>185MB</td>
<td>ESDI</td>
<td>$379</td>
<td>$779</td>
</tr>
<tr>
<td>6.4GMB</td>
<td>185MB</td>
<td>ESDI</td>
<td>$379</td>
<td>$779</td>
</tr>
<tr>
<td>12.8GMB</td>
<td>185MB</td>
<td>ESDI</td>
<td>$759</td>
<td>$1,519</td>
</tr>
<tr>
<td>12.8GMB</td>
<td>185MB</td>
<td>ESDI</td>
<td>$759</td>
<td>$1,519</td>
</tr>
</tbody>
</table>

**HARD DISKS**

<table>
<thead>
<tr>
<th>SIZE</th>
<th>AVERAGE</th>
<th>FORM</th>
<th>DRIVE</th>
<th>KIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1MB</td>
<td>ST-223</td>
<td>122MB</td>
<td>$199</td>
<td></td>
</tr>
<tr>
<td>2.7MB</td>
<td>ST-223</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>3.5MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>3.5MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>4.3MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>5.2MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
</tbody>
</table>

**DRIVE KITS**

<table>
<thead>
<tr>
<th>SIZE</th>
<th>AVERAGE</th>
<th>FORM</th>
<th>DRIVE</th>
<th>KIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1MB</td>
<td>ST-223</td>
<td>122MB</td>
<td>$199</td>
<td></td>
</tr>
<tr>
<td>2.7MB</td>
<td>ST-223</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>3.5MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>3.5MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>4.3MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
<tr>
<td>5.2MB</td>
<td>ST-235</td>
<td>122MB</td>
<td>$219</td>
<td></td>
</tr>
</tbody>
</table>

**MODULAR CIRCUIT TECHNOLOGY**

**DRIVE CONTROLLERS**

**MULTIFUNCTION I/O CARDS**

**DISPLAY CARDS**

**FAX SWITCHER**

**ORDER TOLL-FREE 800-538-5000**

**JIM'S BARGAIN HUNTERS CORNER**

---

**For shipping and handling in excess of $3.50 for UPS Ground and $6.50 for Air, Orders over $10 and foreign orders may require additional shipping charges, without the prior written authorization from the sales department for the amount. California residents must include sales tax.**

**Technicians:** Minimum order $15.00 for shipping and handling. Call 310-490-3880 for details. We reserve the right to limit quantities. A limited number of manufacturer's items are available at reduced prices. Item descriptions may only be representative of similar items available. Please call for details.

---

**Circle 6 on Reader Service Card (DEALERS: 7)**

---

**April 1990 • Byte 341**
**Magnetic Tape/Diskette Conversion**

Transfer data between 1600/3200/6250 9 track magnetic tapes and 5.25" or 3.5" diskettes. We specialize in Telephone Billing Tapes and other mainframe/minicomputer tape files. Transfers Low Costs.

Advanced Management Technologies, Inc.

691 South Irolo Street, Suite 1702
Los Angeles, CA 90005
213/389-7445

**QUARTERHORSE**

High Capacity Tape Subsystems for Disk Backup, Data Acquisition, and Archiving on IBM PC/XT/AT & PS/2.

- 150 Mb 1/4" CT. $1,395.
- 320 Mb 1/4" CT. $1,495.
- 1.2 Gb 4mm DAT.... $3,195.
- 2.3 Gb 8mm HS.... $3,695.

Optional Application Interface Library (in °C) available. Full Support.

**REWRITABLE/ERASABLE OPTICAL DISK DRIVE SYSTEM**

WRITE/ERASE/STORE and DIRECTLY ACCESS vast amounts of Information on a REMOVABLE disk!

- "REWRITABLE/ERASABLE" allows user to read & write over and over up to a million times. Direct or random access at speeds comparable to a hard disk.
- CAPACITY: 650 megabytes (1024 bytes/sector) or 594 megs (512 bytes/sector) of recordable data.
- High track density-15,000 tpi.
- DATA LIFE: 10 to 25 years with no degradation.
- Immune to EMI or RFI emissions.

Applications include: IBM-PC or compatible with ANY MODELS.

Only $5500

Includes software, disk drive and all cables.

Extended warranties available.

**AVPROM $295**

For IBM-PC's & compatibles, menu-driven EPROM programs

- Programs 2716 thru 27128A
- 4-6 and 18 socket gang versions too.

Call for prices.

For complete specs, free 32 pg. development tool catalog, call

800-448-8500.

**OCTACOMM®/IR**

Change TV channels from your PC. Control DOS programs from a hand-held remote. Use a PC to send and receive the infra-red signals used by hand-held remote controllers like those used with TVs, VCRs and other devices.

Maintains a database of IR signals learned from your own hand-held remote controller. Hardware attaches to the serial port of the IBM-PC. Software for DOS 2.0 and greater.

Price: $395.00

Houston Computer Services, Inc.

11331 Richmond Avenue/Suite 101/Houston, Texas 77092

(713)493-9900

Circle 277 on Reader Service Card

**JLaser$399**

Laser Printer Controller

Thinking of buying a

- LaserMaster
- Intel Visual Edge™
- Kofax board

JLaser 5 gives you the functions of all three boards combined into one, plus EMS:

- Fast laser printing
- Halftones on a laser printer
- Group 4 filing and display

**Circle 278 on Reader Service Card**
# Editorial Index by Company

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

<table>
<thead>
<tr>
<th>INQUIRY #</th>
<th>COMPANY</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1121</td>
<td>ACMA</td>
<td>36</td>
</tr>
<tr>
<td>986</td>
<td>ADOBE SYSTEMS</td>
<td>102</td>
</tr>
<tr>
<td>1083</td>
<td>ADVANCED PROGRAMMING INSTITUTE</td>
<td>248</td>
</tr>
<tr>
<td>1051</td>
<td>AMERICAN NATIONAL STANDARDS</td>
<td>248</td>
</tr>
<tr>
<td>888</td>
<td>APPLE COMPUTER</td>
<td>53, 81, 102, 111, 179, 199, 205, 248, 353</td>
</tr>
<tr>
<td>995</td>
<td>PRECISION</td>
<td>130</td>
</tr>
<tr>
<td>1052</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1090</td>
<td></td>
<td></td>
</tr>
<tr>
<td>994</td>
<td>ARC SOFTWARE</td>
<td>53</td>
</tr>
<tr>
<td>1074</td>
<td>ATRONICS</td>
<td>130</td>
</tr>
<tr>
<td>1006</td>
<td>BORLAND INTERNATIONAL</td>
<td>53, 102, 145, 261, 297</td>
</tr>
<tr>
<td>1071</td>
<td>BRIGHTWORK DEVELOPMENT</td>
<td>97</td>
</tr>
<tr>
<td>1075</td>
<td>C'MICRO SYSTEMS</td>
<td>130</td>
</tr>
<tr>
<td>1076</td>
<td>CACHE COMPUTERS</td>
<td>130</td>
</tr>
<tr>
<td>1105</td>
<td>CHADWICK-HEaley</td>
<td>77</td>
</tr>
<tr>
<td>998</td>
<td>CLARY</td>
<td>53</td>
</tr>
<tr>
<td>1140</td>
<td>COVOX</td>
<td>36</td>
</tr>
<tr>
<td>1072</td>
<td>CUBE LOOK</td>
<td>97</td>
</tr>
<tr>
<td>1056</td>
<td>DATA GENERAL</td>
<td>237, 248</td>
</tr>
<tr>
<td>1137</td>
<td>DAVINCI GRAPHICS</td>
<td>36</td>
</tr>
<tr>
<td>1102</td>
<td>DAY-TIMERS</td>
<td>77</td>
</tr>
<tr>
<td>1053</td>
<td>DELL COMPUTER</td>
<td>145</td>
</tr>
<tr>
<td>1059</td>
<td>DIGITAL EQUIPMENT</td>
<td>199, 205, 237, 248</td>
</tr>
<tr>
<td>855</td>
<td>DIGITALK</td>
<td>193, 225, 248</td>
</tr>
<tr>
<td>1070</td>
<td>DUNLOP</td>
<td>130</td>
</tr>
<tr>
<td>1077</td>
<td>DTK COMPUTER</td>
<td>130</td>
</tr>
<tr>
<td>982</td>
<td>ECLIPSE COMPUTER SOLUTIONS</td>
<td>287</td>
</tr>
<tr>
<td>1057</td>
<td>OPEN CONSORTIUM</td>
<td>248</td>
</tr>
<tr>
<td>1120</td>
<td>EMERSON COMPUTER</td>
<td>36</td>
</tr>
<tr>
<td>1129</td>
<td>EPSON</td>
<td>36, 193</td>
</tr>
<tr>
<td>1073</td>
<td>FARALLON COMPUTING</td>
<td>97</td>
</tr>
<tr>
<td>1128</td>
<td>FINLUX</td>
<td>36</td>
</tr>
<tr>
<td>886</td>
<td>FOX SOFTWARE</td>
<td>163, 248</td>
</tr>
<tr>
<td>1058</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1004</td>
<td>GADGETS BY SMALL</td>
<td>53</td>
</tr>
<tr>
<td>1001</td>
<td>GOLDSTAR TECHNOLOGY</td>
<td>53</td>
</tr>
<tr>
<td>887</td>
<td>HEWLETT-PACKARD</td>
<td>85, 102, 171, 199, 205, 237, 248</td>
</tr>
<tr>
<td>1065</td>
<td>IBM</td>
<td>85, 124, 145, 199, 237, 248, 275, 287, 353</td>
</tr>
<tr>
<td>1078</td>
<td>INTEL</td>
<td>275</td>
</tr>
<tr>
<td>1123</td>
<td>INTELLIGENCE TECHNOLOGY</td>
<td>36</td>
</tr>
<tr>
<td>1138</td>
<td>INTERNATIONAL MACHINE CONTROL SYSTEMS</td>
<td>36</td>
</tr>
<tr>
<td>1061</td>
<td>ITHACA SOFTWARE</td>
<td>248</td>
</tr>
<tr>
<td>1082</td>
<td>IXY</td>
<td>248</td>
</tr>
<tr>
<td>1104</td>
<td>JAEGER + WALDMANN GMBH</td>
<td>77</td>
</tr>
<tr>
<td>1079</td>
<td>JAMECO ELECTRONICS</td>
<td>130</td>
</tr>
<tr>
<td>1080</td>
<td>JC INFORMATION SYSTEMS</td>
<td>130</td>
</tr>
<tr>
<td>1081</td>
<td>JDR MICRODEVICES</td>
<td>130</td>
</tr>
<tr>
<td>1131</td>
<td>KEY TRONIC</td>
<td>36</td>
</tr>
<tr>
<td>886</td>
<td>LOTUS DEVELOPMENT</td>
<td>102</td>
</tr>
<tr>
<td>991</td>
<td>MAXIMUM STORAGE</td>
<td>53</td>
</tr>
<tr>
<td>1054</td>
<td>META SOFTWARE</td>
<td>248</td>
</tr>
<tr>
<td>1082</td>
<td>MICROPCOSM COMPUTERS</td>
<td>130</td>
</tr>
<tr>
<td>988</td>
<td>MICROTRONIC</td>
<td>102</td>
</tr>
<tr>
<td>883</td>
<td>MICROSOFT</td>
<td>53, 119, 145, 157, 193, 205, 225, 248</td>
</tr>
<tr>
<td>996</td>
<td>MIT</td>
<td>252</td>
</tr>
<tr>
<td>1184</td>
<td>MIT SOFTWARE DISTRIBUTION CENTER</td>
<td>248</td>
</tr>
<tr>
<td>1083</td>
<td>MONOLITHIC SYSTEMS</td>
<td>130</td>
</tr>
<tr>
<td>1084</td>
<td>MYLEX</td>
<td>130</td>
</tr>
<tr>
<td>1085</td>
<td>NASCENT TECHNOLOGY</td>
<td>130</td>
</tr>
<tr>
<td>882</td>
<td>NBL</td>
<td>157</td>
</tr>
<tr>
<td>852</td>
<td>NEC TECHNOLOGIES</td>
<td>145</td>
</tr>
<tr>
<td>1135</td>
<td>NEW SOFTWARE GRAPHICS</td>
<td>36</td>
</tr>
<tr>
<td>1062</td>
<td>NEXT</td>
<td>199, 248</td>
</tr>
<tr>
<td>1086</td>
<td>OME</td>
<td>130</td>
</tr>
<tr>
<td>1067</td>
<td>OPEN SOFTWARE FOUNDATION</td>
<td>248</td>
</tr>
<tr>
<td>1087</td>
<td>ORCHID TECHNOLOGY</td>
<td>130</td>
</tr>
</tbody>
</table>

## The BYTE On-Going Utility in Space (BOGUS) tests: APRIL FOOL

April Fool
To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.
BYTE ADVERTISING SALES STAFF:
Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281
Arthur Kossack, Eastern Regional Sales Manager, 645 North Michigan Ave., Chicago, IL 60611, tel. (312) 751-3700
Jennifer L. Bartel, Western Regional Sales Manager, 81111-BJ Freeway, Suite 136, Dallas, TX 75251, tel. (214) 644-1111
Liz Coymn, Inside Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-2518

International Advertising Sales Staff:
UNITED KINGDOM
Ros Weyman
34 Dover St.
London W1X 4BR
England
E-mail: rweyman@mcgraw-hill.com
FAX: 44 171 633 4069

GERMANY, BELGIUM
Pedro Tourinho
Frank Tanis
Pedro Teixeira, S.A.
Bovesplatz 5
90431 Nuremberg
Germany
FAX: 49 911 440 283

FRANCE, ITALY
Roger Siboulet
A. G. International Publications SA
4 Avenue de Tours
92850 Rueil Malmaison
France
E-mail: rsiboulet@mcgraw-hill.com
FAX: 33 1 39 92 32 39

SOURCE: ADVERTISING SUPPLEMENT TO BYTE, APRIL 1990
## Index to Advertisers by Product Category

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.
<table>
<thead>
<tr>
<th>Inquiry No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 DESCRIIBE,INC.,INC.</td>
<td>122,123</td>
</tr>
<tr>
<td>507 EKIM</td>
<td>MW-6</td>
</tr>
<tr>
<td>508 EKIM</td>
<td>MW-6</td>
</tr>
<tr>
<td>462 EKIM</td>
<td>PC-18</td>
</tr>
<tr>
<td>483 EKIM</td>
<td>PC-18</td>
</tr>
<tr>
<td>121 FOX SOFTWARE,INC &amp; 174</td>
<td>25</td>
</tr>
<tr>
<td>439 PROCEDURES,INC &amp; E&amp;W-49</td>
<td>MICROSOFT</td>
</tr>
<tr>
<td>220 NANTUCKET</td>
<td>192</td>
</tr>
<tr>
<td>192 NANTUCKET</td>
<td>192</td>
</tr>
<tr>
<td>192 NANTUCKET</td>
<td>192</td>
</tr>
<tr>
<td>192 NANTUCKET</td>
<td>192</td>
</tr>
<tr>
<td>212 PAPERMAK SOFTWARE</td>
<td>88</td>
</tr>
<tr>
<td>212 PAPERMAK SOFTWARE</td>
<td>88</td>
</tr>
<tr>
<td>212 PAPERMAK SOFTWARE</td>
<td>88</td>
</tr>
<tr>
<td>212 PAPERMAK SOFTWARE</td>
<td>88</td>
</tr>
<tr>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
</tr>
<tr>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
</tr>
<tr>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
</tr>
<tr>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
<td>321 SOLUTIONS SYSTEMS &amp; E&amp;W-61</td>
</tr>
</tbody>
</table>

### Advertising Supplement

- **Jade Computer (U.S. and Canada Subscribers)**
- **READER SERVICE**
- **Circle 316 011 Reader Service Card**
- **Correspond directly with company**

### SOFTWARE INDEX

#### Scientific/Technical
- **400 WINTEK CORPORATION**
- **823 IBM/MSDOS APPLICATIONS — UTILITIES**
  - **307 AMERICAN SMALL BUSINESS COMP 307**
  - **307 AMERICAN SMALL BUSINESS COMP 307**
  - **32 AUTODESK**
  - **36 A.M.S**
  - **127 GENERIC SOFTWARE**
  - **136 HEWLETT-PACKARD ENGRN**
  - **452 LANDCADD,INC**
  - **400 WINTEK CORPORATION**

#### Business/Office
- **278 TELEPHONE PRODUCTS CENTER**
- **291 UNICORN ELECTRONICS**
- **327 USA SOFTWARE**

#### MISCELLANEOUS
- **27 AMT,INC**
- **421 COSI SYSTEMS**
- **150 JB TECHNOLOGIES**
- **249 SAFEWARE,INC**

---

**APRIL 1990 • BYTE**
Want More Information About the Products and Advertisers Featured in this Issue?

1. Circle numbers on reply card which correspond to numbers assigned to items of interest to you.
2. Check all the appropriate answers to questions "A" through "C".
3. Print your name and address and mail.

Fill out this coupon carefully. PLEASE PRINT.

Name
Title
Company
Address
City
State Zip
A. What is your level of management responsibility?

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Senior-level Management</td>
</tr>
<tr>
<td>2</td>
<td>Other Management</td>
</tr>
<tr>
<td>3</td>
<td>Non-Management</td>
</tr>
</tbody>
</table>

B. What is your primary job function/principal area of responsibility? (Check one.)

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Personnel Architecture</td>
</tr>
<tr>
<td>2</td>
<td>Accounting/Finance</td>
</tr>
<tr>
<td>3</td>
<td>MIS/DP/Information Center</td>
</tr>
<tr>
<td>4</td>
<td>Computer Retail Stores</td>
</tr>
<tr>
<td>5</td>
<td>Administration</td>
</tr>
<tr>
<td>6</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>7</td>
<td>Marketing</td>
</tr>
<tr>
<td>8</td>
<td>Purchasing</td>
</tr>
<tr>
<td>9</td>
<td>Other Personnel</td>
</tr>
<tr>
<td>10</td>
<td>Education/Training</td>
</tr>
<tr>
<td>11</td>
<td>Other:</td>
</tr>
</tbody>
</table>

C. Please indicate your organization's primary business activity: (Check one.)

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Computer-Related Businesses:</td>
</tr>
<tr>
<td>2</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>3</td>
<td>Finance, Insurance, Real Estate</td>
</tr>
<tr>
<td>4</td>
<td>Retail/Wholesale</td>
</tr>
<tr>
<td>5</td>
<td>Government</td>
</tr>
<tr>
<td>6</td>
<td>Military</td>
</tr>
<tr>
<td>7</td>
<td>Professions (Law, Medicine, Engineering, Architecture)</td>
</tr>
<tr>
<td>8</td>
<td>Consulting</td>
</tr>
<tr>
<td>9</td>
<td>Other Business Services</td>
</tr>
<tr>
<td>10</td>
<td>Transportation, Communications, Utilities</td>
</tr>
</tbody>
</table>

Computer-Related Businesses:

<table>
<thead>
<tr>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Manufacturer (Hardware, Software)</td>
</tr>
</tbody>
</table>

Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.
Fill out this coupon carefully. PLEASE PRINT.

Name _______________________________ Phone _______________________________

Company _______________________________

Address _______________________________

City __________________ State ______ Zip _______

A. What is your level of management responsibility?
   1 □ Senior-level Management
   2 □ Other Management
   3 □ Non-Management
   (Check one.)

B. What is your primary job function/principal area of responsibility?
   (Check one.)
   0 □ Computer Retail Stores
   1 □ Consultants
   2 □ Service Bureau/Planning
   3 □ Distributor/Wholesaler
   4 □ MIS/DP/Information Center
   5 □ Finance, Insurance, Architecture
   6 □ Transport Ation, Service Bureau/Planning
   7 □ Manufacturing
   8 □ Government
   9 □ Military
   10 □ Sales/Marketing
   11 □ Purchasing
   12 □ Personnel
   13 □ Education/Training
   14 □ Other: ___________________________

C. Please indicate your organization's primary business activity:
   (Check one.)
   0 □ Computer-Related Businesses:
   15 □ Manufacturer (Hardware, Software)
   16 □ Computer-Related Businesses:
   17 □ Manufacturer (Hardware, Software)
   18 □ Other: ___________________________

Circle numbers on reply card which correspond to numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "C.

Print your name and address and mail.

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE
READER SERVICE
PO Box 5110
Pittsfield, MA 01203-9926
USA

Please indicate your organization's primary business activity: 

Computer-Related Businesses:
15 Manufacturer (Hardware, Software)
16 Computer-Related Businesses:
17 Manufacturer (Hardware, Software)
18 Other: ___________________________

Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.

□ Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.
WordStar Supporter

Dear Jerry,

Your comments on WordStar 5.5 have been great. I switched back to WordStar from WordPerfect 5.0 because WordStar 5.5 does so much more, works so well with other programs, and doesn't tax my memory. I keep hearing about other word processors and the things that they won't do, yet WordStar 5.5 does them. But I've wondered why other reviewers are so adamantly against WordStar 5.5 being so bad. I guess it's because they can't change, so they conduct a half-hearted review that makes the product appear ho-hum. WordStar does math; one "in depth" review never mentioned that or that it imports Lotus and dBASE files directly. Another said that the dot commands were outmoded, yet dBASE uses them, and no one is crying about that. I prefer the dot commands so I can see how important they are.

It's nice to read articles from someone who isn't into marketing. BYTE has not succumbed to being a sales catalog for Lotus 1-2-3 or WordPerfect. I'm not cheering for WordStar International; I'm cheering that someone finally looked closely enough at this product.

Mike Gautier
Woodbridge, VA

Thanks. We do try to look at everything. And chances are it will be a long time before BYTE is a sales catalog for anything—we can't get four editors to agree as it is!—Jerry

Orange Aid

Dear Jerry,

I commiserated mightily when I read of your orange-soda-in-the-disk experience in the October 1989 Chaos Manor. The same thing happened to me, to a disk that contained an already late paper I was due to deliver in Kyoto. That experience led me to conduct some experiments as reported in my paper, which is due to be published in Library HiTech. (Isn't it amazing what we spend our time doing in library schools?) Working with 5¼-inch 360K-byte disks, almost nothing—from Chinese food to rye to cat urine—destroyed data. Mess 'em up, wash 'em off, use 'em again. Your event led me to sacrifice more disks: some Dyan high-capacity 5¼-inches formatted in a 1.2-megabyte IBM drive, and some Verbatim 3½-inch ones, formatted double-sided in a Mac II. I didn't have any orange soda (we're hard-drinking buckaroos out here in Honolulu), but I did pour Pepsi over them, along with some other unpleasant substances. Result: no data loss. I actually had less trouble than I did with the 360K-byte samples (of course, the fact that these were new might have been significant).

The only difficulty that I experienced was in opening the 3½-inch case. I found that the best approach was to pry off the metal read-write slot protector (it's not really needed, anyway), slip a knife blade (tested to make sure it wasn't magnetized) into the edge away from the write-protect switch, and then twist it open like an oyster. I popped open three sides, leaving the left side (with the write-protect switch) attached. This did take a little effort—the things are glued together—but allowed the cookie (i.e., the floppy media proper) to be slipped out. After I washed the crud off the cookies, I dried them—first with a paper towel, then under hot air from the forced-air hand drier in the men's room. (I have never managed to get my hands dry under one of those things, but they work pretty well on disks.) Once the cookies were clean and dry, I put them into a new disk case. Every one of them read perfectly the first time.

I hope this little bit of advice helps you if you ever mess up a disk again. The secret is to take the cookie out before you wash it off, and then put it back in a clean case.

Larry N. Osborne
Honolulu, HI

Thanks. I'm not sure where to get new disk cases, although I suspect that I could find them with some effort. I also wonder if disk cases come with the little felt-like cleaner thing that goes between the cookie and the hard shell?

Mostly I hope it won't happen to me again, but it probably will.—Jerry

Dear Jerry,

Here's what to do when you pour orange soda over your irreplaceable 3½-inch floppy disks:

1. Carefully (so as not to damage the disk itself) disassemble the shutter assembly of the drenched disk and break open the case.
2. Do the same for a discarded disk, this time taking care not to damage the case too much.
3. Wash the drenched disk under running water with any mild dishwashing detergent, and dry with a clean, soft, lint-free cloth.
4. Reassemble the washed disk into the new case. Forget about the shutter unless you really can't copy the data off the disk.

I followed the four steps outlined above with complete success for a disk that I had been carrying in a pocket of my new stone-washed jeans; stone-washed denim contains a good deal of fine sand even after the first few washings, and the disk made unfortunate grating noises when I turned it by hand. Nonetheless, I managed to retrieve all the data.

In general, if a liquid is suited for human consumption (with the possible exception of tequila), it should leave the magnetic coating of the disk intact.

Christopher Ferebee
Konigstein, Federal Republic of Germany

Thank you for the instructions; next time I have a disk disaster, I'll be sure to try it!—Jerry

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. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."
1.5 DECADES OF APRIL FOOLS

All right, maybe you can fool some of the people some of the time

Kenneth M. Sheldon

hat do Hindsight Engineering, Soycure Systems, and the Famous Programmers’ School have in common? Well, for one thing, they’re all enterprises that have existed only in the minds of BYTE editors. Over the years, as we’ve wrestled to keep on top of the fast-moving microcomputer world, we’ve occasionally taken time out to poke a little fun at ourselves and the industry that we love.

The tradition started in our first April issue (1976), with a Technology Update on the first practical Touring Machine—a bicycle—with a unary relocatable-based operator (i.e., the person on the bike).

Later items detailed such arcane procedures as refolding the fanfold instruction card that came with the MC6809 microprocessor. In 1981, our What’s New column featured a new addition to the small components market, the 7N-∞ BHD (black-hole diode), useful mostly for GI (garbage-in) applications. Unfortunately, due to the light-absorption characteristics of the device, we were not able to provide a photograph of the BHD.

Sometimes, items that seemed funny at the time have become, over the years, amazingly prescient: Take the 5-megabyte hard disk drive for the tiny Sinclair ZX81 (marketed in this country as the Timex/Sinclair 1000) that we announced in our April 1982 issue. Hundreds of readers wrote to Hindsight Engineering in “Peanutbutter, New Hampshire” for more information. (Credit the local post office for figuring out where to send the wacky mail.) Nowadays, you can buy a portable as small as the Timex/Sinclair with hard disk drives of up to 100 MB!

Our April 1982 issue also saw the birth of an institution: the Famous Programmers’ School. In a full-page “advertisement” that asked, “Do you have a restless urge to program?” readers were offered the rare opportunity to study with such software greats as Bennett Lisp, Bruce Fortran, Red Basic, and the immortal Ignatious “Call Me Blaise” Pascal. Interested parties were asked to take a free aptitude test, with such challenging questions as, “Write down the numbers from zero to nine and the first six letters of the alphabet.” Numerous readers took the challenge and responded by sending the required $1000 in small unmarked bills. (Unfortunately, the bills were always Confederate, Monopoly, or homemade money.)

So successful was the Famous Programmers’ School that we offered, in the April 1983 issue, a follow-up seminar on pocket-computer local-area networks. The accompanying photo showed the school’s stellar staff with pocket computers in hand (and pocket), strung together by a wide ribbon cable.

That seemed pretty funny at the time, but now, with the advent of Xircom’s Pocket Ethernet Adapter—a device that lets you attach portable computers to an Ethernet LAN—it seems eerily prophetic. (Note that we considered filing a “look and feel” lawsuit against Xircom but opted instead to give them a BYTE Award of Excellence in our January issue. It’s still a good idea, even if we thought of it first.)

The Famous Programmers’ School (and most of its instructors) had a last gasp in April 1984, with a plea to “Help the Old Programmers’ Home.” Situated in a large brick building that looked oddly reminiscent of BYTE’s headquarters, the home was founded to provide a calm, tranquil shelter for programmers who were “too old or too burnt-out or have to pay too much alimony.” Residents were provided with “good hearty fast food, and an unlimited supply of cola and fanfold paper.” Age was of no concern; in fact, some of the residents were “over 35 years old.”

Continuing the tradition, our April 1985 issue featured a special “What’s Not” section that described several innovative products, such as MacKnifer, a peripheral that attached to the original single-disk Macintosh and let you sharpen knives, scissors, and lawn-mower blades while waiting for files to open.

After that issue hit the stands, we received a call from a woman who said that she’d checked every computer store in town trying to find the Parasoya Disks (made of processed soybeans) that we’d written about. The disks, which were supposedly readable, writable, and edible, were for people who were really concerned about protecting sensitive data. Needless to say, she was embarrassed when we explained that the disks (from Soycure Systems) were an April Fools’ item.

The very next day, a reporter from USA Today called us. He wanted more information about the Transporter, a portable computer that, with a few simple twists, transformed into a single-passenger automobile. They were thinking of running an article about it in their newspaper, but he thought he’d better call first, just to check. Needless to say, that item never appeared in the paper.

As a result of all this, you will find no bogus products in this issue of BYTE. Anything that looks odd or funny—intentionally or not—is thanks to the manufacturer of the product or its advertising agency.

We’ve learned our lesson.

Kenneth M. Sheldon is a senior technical editor for BYTE. He can be reached on BIX as “ksheldon.”
Get into Windows FAST!

Interested in a product for creating Windows applications very quickly?

Yes  No  Maybe

With intelligent applications

Need high-level access to:
- Hypermedia?
- Expert Systems?
- Object-Oriented Programming?

But without the hard work!

Order KnowledgePro (Windows) today!

Phone 518-766-3000

What if I said that this screen, including calling my video image was created by me, a non-programmer using just twenty instructions? Interested now?

Introducing the door into Windows!

Easy access to Windows
KnowledgePro (Windows) contains high-level commands for manipulating screen objects, lists, text, fonts, rules, external files and bitmap images. DLL and DDE support lets you integrate your own C routines with KnowledgePro and link your application directly to Excel and other Windows programs.

At a price you can afford
KnowledgePro (Windows) costs $695 with no runtime fees for applications. KnowledgePro for DOS costs $495. The systems run on IBM PC, XT, AT and PS/2 compatible machines with 640k of memory and a hard disk. KnowledgePro (Windows) requires Microsoft Windows 286 or 386 version 2.x or greater.

Call 518-766-3000 (FAX 518-766-3003) for more information or write to: Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123 USA. Amex, Visa or M/C accepted.

Another intelligent tool from KnowledgeGARDENInc.

KnowledgePro is a registered trademark of Knowledge Garden, Excel is a trademark of Microsoft Corp, IBM, XT, AT and PS/2 are trademarks of International Business Machines Corp.

*VideoWindows digital video overlay board by New Media Graphics.  Circle 158 on Reader Service Card
Thought is structured around certain absolutes: that light moves in vacuo at 299,792.458 kilometers per second; that the mean free path of molecules between collisions is 905 angstrom units; that the worst food in the known universe is on sale in the "A" terminal of the Newark airport.

Human interactions, though, are partly governed by law, and law's benchmarks tend to be prior legal decisions—that is, what someone once persuaded a judge to decide in a case that we are now litigating. Trace such a chain back to a primal decision, and behind that you'll expect to find statute law. However, some unclarity as to how the law applied necessitated a first decision.

Concerning software, law has been unclear from the start, as Anthony Clapes details in *Software, Copyright, and Competition: The "Look and Feel" of the Law* (1989, Quorum Books, Westport, CT, $39.95). On page 11 of his highly readable book, Clapes notes that the Founding Fathers in 1788 were at their deliberations nine years before J. M. Jacquard would unveil "the first programmable machine in history," the loom that took an artist's instructions from punched cards. So Article I, Section 8, Clause 8 of the Constitution had no programs in mind when it gave Congress power "To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

In 1790, Congress enacted the first copyright statute; it covered maps, charts, and books. In 1802, printmakers and graphic artists got included. In 1831, composers of music. In 1865, photographers. In 1870, makers of "paintings, drawings, chromos, statuettes, statuary, and models or designs of fine art." In 1912, the newfangled motion pictures. In 1971, sound recordings (tapes were getting pirated). You see the pattern. Technology kept pushing.

By 1976 it finally had pushed computer programs into the purview of Congress, and Congress was most unhappy. All Congress found itself able to say in 1976 was that computer programs were, yes, protected. But they were to have "no greater protection than they had enjoyed under prior law," which had never mentioned them.

Do not hasten to acclaim our Congresscritters. For by 1980 they'd enacted a most equivocal law, which (1) defined a "computer program"; (2) said that if you owned a copyrighted program you weren't infringing if you used it in a computer (!) or made an archival copy; and (3) deleted the "prior law" clause of 1976, which was meaningless anyhow. And that's where things stand today.

So we're back in the courts, where, says Clapes, lawyers fall very neatly into four categories: They either (1) haven't got time to learn what programming is all about, and don't; (2) decide not to take the time to learn, because judges and juries will never figure it out either, and don't; (3) being Luddites at heart, are constitutionally incapable of learning about programming, so don't; or (4) think they, yes, understand programming, but don't.

Which sets the stage for the generic case, *Apple v. Franklin*, 1982. The Franklin Ace, if you recall, was an Apple clone, back when Apple was synonymous with personal computing. And at Franklin, the company had simply copied the Apple operating system into ROM, so clumsily that one Apple programmer's name was left embedded in the code, as was the word Applesoft.

Franklin never denied the copying. The company's argument was this: For a machine to run existing Apple software, it needed to have continued
Announcing instant relief for LAN backup headaches.

The Network Archivist™ Software.

Now LAN Managers suffering from endless 2.2 gigabyte tape backup headaches can get instant relief.

Just replace your present system's software with Palindrome's Network Archivist. The retrofit is simple. The cost is nominal. And the result is complete management of your LAN backup files.

The Network Archivist retrofit uses the same software that powers all of Palindrome's impressive LAN backup tape systems. It's a smart, economical way to optimize virtually any 2.2 gigabyte system (or other selected systems), instantly.

Here's what you get:

**Automatic File Management**—Palindrome's expert system automates the backup process, keeping track of backup data, determining tape rotations and updates.

**Faster Backup**—Our automatic LAN archiving is two to five times faster than conventional backup systems. Tapes are updated—not overwritten.

**Easier Recovery**—Our on-line catalog lets you easily locate files from 2 minutes, 2 days or 2 years ago without even mounting a tape.

**Permanent Archiving**—The Network Archivist keeps a history of when files were modified, permanently capturing stable files; managing your entire tape library using 50% to 70% fewer tapes than competitive systems.

In a July 17 review of the Emerald, ARCServe and Palindrome systems, PC Week said, "for features and software design, the clear all-around choice is Palindrome's Network Archivist." See for yourself.

For a free demonstration disk and list of dealers, call us at (708) 505-3300 or send in this coupon.

The backup system that knows what it's doing.

Please send me my free Network Archivist LAN Backup Management Evaluator's Kit.

Name: ____________________________
Job Title: _________________________
Business: _________________________
Address: _________________________
City: _____________________________
State: __________ Zip: ___________
Phone: _________________________
Type of Network: __________________
No. of servers: ___________________
LAN capacity: ___________________

Send coupon to the Palindrome Corporation, 850 E. Diehl Road, Naperville, IL 60563. (708) 505-3300.
the operating system just about exactly as it was, since the operating system offered so many "entry points" that various software writers were using. The governing ideas, true, Apple couldn't copyright those; but compatibility with all that software—the only reason for a clone—had tied Franklin to nearly line-for-line specifics.

A Philadelphia judge named Newcomer nearly bought that; or rather, he bought something far more sweeping, the idea that software writers were using. The governing ideas, true, Apple programs, since their binary code isn't meant to be read by users, aren't covered by any statute governing "expression." He feared a step "into the world of Gulliver, where horses are 'human' because they speak a language that sounds remarkably like the ones humans use." Do such sequences as 00110000 00110000 merit the protections we accord to Moby Dick?

(Thought experiment: Pascal, for instance, is plainly meant to be read by humans. Might someone claim exemption from infringement after merely translating Pascal code, line by line, into C, a process so straightforward it's been automated? In 1978, a judge named Higginbotham ruled that no, someone couldn't. He even said it would "probably" be a violation to translate a flowchart into a computer language.)

Apple carried Judge Newcomer's ruling to the Court of Appeals, where on August 30, 1983, Judge Dolores K. Sloviter upheld Apple. She brushed aside what had given Judge Newcomer pause, the question whether a machine or a person was the destined reader of the code. Utilitarian! Aesthetic? The Copyright Act, she held, did not distinguish. What she did zero in on was whether Franklin could have simulated the Apple operating system without copying it line by line; for if idea and expression merge, Apple has no valid copyright, because that would amount to copyrighting an idea, which can't be done.

The line between the two, she said, must be "pragmatic," legalese for "what follows is a hunch." For "many of the courts which have sought to draw the line between idea and expression have found difficulty in articulating where it falls." Judge Sloviter wasn't presented with a case of "not copying except where necessary," hence didn't decide such a case. She was presented with a case of line-for-line copying, and Apple and Franklin took her hint to settle out of court. So "except where necessary" remains undefined, likely only addressable, says Clapes, "on a case-to-case basis." Case by case, though, Apple v. Franklin won't go away.

For here's another nugget from Judge Sloviter. There may be, as Franklin alleged, only a limited number of ways to write an Apple-clone operating system. Fine, that says there's more than one, so over at Apple idea and expression haven't merged, and copyright holds. But if Franklin got hemmed in by its desire for a clone that would run all available Apple software, that was "a commercial and competitive decision," and they should have had the wit to scale it down.

(Analogy, from me, not from Clapes: If you want a script that will produce in a theater exactly the effect of Shakespeare's Hamlet, then you've no recourse save to copy out Shakespeare's Hamlet. But you've made a commercial, not an artistic, decision. On the other hand, Tom Stoppard's Rosencrantz and Guildenstern Are Dead, though arguably parasitic on Hamlet, is a piece of artistry that infinges nothing.)

And Clapes argues throughout that programs "are literary works," and "not just in a copyright sense but as a matter of social taxonomy." They are literary works "in the way that a musical score or the 'shooting script' of a movie are literary works; One doesn't read them through like a novel, but they have the attributes common to all literary works." These include "structure, flow, logic, design, naming conventions, commentary, and resultant style."

Which brings us to look and feel, which apparently derives from the phrase "total concept and feel" in "a twenty-year-old case involving the copying of thematic and stylistic features of a line of greeting cards." The dashboard analogy has been popular lately; if you can drive one car you can drive them all, because controls and gauges are in pretty well standard locations. Judge Higginbotham even alleged 12 years ago that the gearshift H-pattern was "idea," not "expression," and hence not protected at all.

But the law doesn't work (as I've noted) from absolutes like the H-pattern gearshift or the velocity of light; it works tortuously, through a maze of decided cases, and chapter 20 of Clapes' book ("The 'Look and Feel' Cases") brings no easy comfort. Look-and-feel defendants will be spared liability "if, when everything is eliminated except the expression that may not be copied in the plaintiffs' user interfaces, it is found that they have not copied that expression." That seems to mean, if you take away everything except what looks like an elephant, and the elephant wasn't really copied, you're clear. Lawyer Clapes will perhaps forgive me if I say that the progress toward such a finding resembles the passage of a ball through a pinball machine (bounce, bounce; left? right? What did Judge A make of question X? Judge B of question Y?).

The man who stood up after a Clapes presentation to say "I disagree with everything you say" was understandably impatient. Your right in what you're doing seems very clear as you program. But you program out in a world where other programmers have been weaving trails that their employers may have protected. "Because the look and feel of a program is the part with which the user most clearly identifies, and the part that cannot be hidden from competitors, there would be absolutely no point in the development of innovative user interfaces if the results of those investments could be freely copied by others."

True. But the dashboard analogy? Is it simply that no one thought to sue when clutch left, brake right—the H-pattern for that matter—got copied and recopied? I've not been able to find a historian of these automotive matters. Clapes, I may well tell you, is "a Senior Corporate Counsel at IBM," although he's careful to deny giving things an IBM slant. What his book clarifies is why court decisions are not intuitive, the way programmers would like them to be. Law works its uneasy way through precedent, precedent. Software, Copyright, and Competition may, at the very least, teach us all patience.

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times and Harper's. His recent books include A Sinking Island and Mazes. He can be contacted on BIX as "hkenner."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.
They Left out Features....

We Left out the **COMMA!!**

The only thing missing...

is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. **DesignCAD 3D** sells for $399.00. Period. No Comma!

In order to draw the complex pictures shown below it is desirable to have the following 3D features:

- Interactive design with 3D cursor
- Blending of surfaces
- Boolean operations such as add, subtract, and intersection
- Complex extrusions
- Cross sectioning
- Block scaling
- On screen shading
- Shaded output to printers and plotters

All of these competitors left out one or more of these desirable features in their standard package. They didn’t forget the most horrible feature - the comma.

**DesignCAD 3D** offers ALL the listed features plus many more!

If **DesignCAD 3D** has the power to create the 3D objects shown below, imagine how it could help with your design project!

**DesignCAD 3D** sells for $399. We left out the comma. We didn’t think you would mind!

---

**BYTE MAGAZINE SAYS...**

“**At** $399, DesignCAD 3D was the least expensive package we saw, yet it was one of the more powerful. ...Don’t be fooled by the remarkably low price, this program can really perform.”

May, 1989, page 178

---

**COMPLETE 3-DIMENSIONAL design features make it easy for you to construct realistic 3-D models. With full solid-object modeling capabilities you can analyze your drawing to determine the volume, surface area or even center of gravity! DesignCAD 3-D even permits you to check for interference between objects! Aeronautical Engineers can now find the center of gravity for a new airplane design with a couple of keystrokes. The Architect can determine the surface area of a roof for decking in a matter of minutes. The Civil Engineer can calculate the volume of a lake or dam in seconds. The Mechanical Engineer will know for sure if certain parts fit together without interference. The uses for DesignCAD 3-D are only limited by your imagination!**

**HOW DO I GET ONE?**

DesignCAD 3-D and DesignCAD 2D are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. You all need to run DesignCAD 3-D is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free information and a demo disk are available by faxing (918) 825-6359 or telephoning:

1-(918) 825-4844

American Small Business Computers • 327 South Mill Street • Pryor, OK 74361 U.S.A.

---

**SOURCE: BYTE MAGAZINE**
A giant leap in our 15-year mission to seek out new means of testing computers

Over the years, BYTE has pioneered the use of benchmark tests as a means of evaluating which computer system is right for you. Just last month, we rolled out our latest suite of benchmarks, designed to test and compare Unix-based systems.

But our most exciting project to date is one that could change forever the way we evaluate computer systems. Beginning in September, we'll conduct the new BYTE benchmarks in a zero-gravity environment. To address these new considerations, we've designed a series of tests to be conducted on each new system reviewed in BYTE. Beginning in September, we'll report the results of the tests, which will be carried out through a special arrangement with mission specialists on regular flights of NASA's space shuttle. Developed with the assistance of Dr. Thomas Fulerly of the Wisconsin Institute of Technology, the tests will subject review systems to conditions that we can expect to be operating under in the days ahead.

The Final Frontier

In the days to come, exploiting new opportunities in space will become increasingly important to maintaining our economic position in the marketplace. Computers will become even greater part of business and technology. But present-day tests are useless for evaluating the kinds of conditions under which computers in space will have to operate.

To address these new considerations, we've designed a series of tests to be conducted on each new system reviewed in BYTE. Beginning in September, we'll report the results of the tests, which will be carried out through a special arrangement with mission specialists on regular flights of NASA's space shuttle. Developed with the assistance of Dr. Thomas Fulerly of the Wisconsin Institute of Technology, the tests will subject review systems to conditions that we can expect to be operating under in the days ahead.

The Tests

As we venture farther into space, we may find that gravity is a luxury that we can't always afford. How will this affect your new computer's ability to perform sensitive calculations? To test this, the BYTE null-grav benchmark will measure a system's ability to perform floating-point operations in a zero-gravity environment.

The hatch-activation-loop test will measure each system's ability to perform extensive repetitions of ordinary tasks. This HAL test will determine how many times the system can open and close the space shuttle's pod-bay doors in one hour and whether the system loses track of whether the door is open or closed.

Of course, not all computing will be done in a human-friendly environment. Thus, we have designed several benchmarks for extra-vehicular execution. The totality-rad test, for example, will measure the length of time that the review system can withstand exposure to cosmic radiation without producing computation errors.

Another extra-vehicular test will analyze a system's susceptibility to stresses and strains caused by breeches of security that might affect its operation and thereby present a threat to life-support systems. Based on our now-classic Sieve of Eratosthenes benchmark, the Strain of Andromeda test (named for the mythical goddess who was rescued from a monster) will analyze systems for possible infection by computer viruses.

During the (of necessity) final benchmark test, the review system will be ejected from the shuttle and allowed to reenter the earth's atmosphere. For this burn-in test, each unit will be equipped with a radio-transmitter modem and will transmit signals back to earth, where BYTE editors will record the exact time and height at which the system ceases to operate. Any system that continues to operate until it reaches the ground will automatically receive a BYTE Award of Excellence for endurance.

On the outside chance that a review system might blow up during a flight rather than come back to earth, we have written the new benchmark tests in BASIC. In the unlikely event that the system is intercepted by extraterrestrial life forms, we believe that BASIC is the language most likely to run on any given alien system.

Now It Can Be Told

As you might expect, developing the new BYTE benchmarks has required months of negotiation with the administration of our nation's space program. Unknown to the general public, the most recent flight of the space shuttle carried a preliminary test machine on which shuttle personnel conducted the new BYTE benchmarks. According to mission specialist Irving M. Kidden, the tests were almost a complete success. "The only problem came when one of the guys was making some Tang during the null-grav test," he said. "Some of the powder got into the disk drive and really gummed up the works."

This mishap, however, provided an opportunity for the new benchmarks to display their user-friendly, plain-English system of error messages: The affected machine promptly displayed the message, "He's dead, Jim."

It is with great pleasure that we announce the new BYTE On-Going Utility in Space tests. For more information on our new benchmarks or to receive a copy for your own use, please see the box on page 343.

Kenneth M. Sheldon is a BYTE senior technical editor. He can be reached on BIX as "ksheeldon."
If you haven't seen LabVIEW®, ask someone who has...

"Perhaps the new version of National Instruments' LabVIEW will emerge as a de facto standard."
- John M. Fluke, Jr., Chairman, John Fluke Manufacturing Co., Inc.

"LabVIEW 2 is the leader of data acquisition software, probably the most powerful product for data acquisition, analysis, and control on any microcomputer."
- John Rizzo, Technical Editor, MacUser Magazine

"The flexibility of LabVIEW 2 has prompted me to use it as the cornerstone of my future business."
- Steve Conquergood, Chief Design Engineer, CXT Limited

"LabVIEW has been the most valuable computer-based tool I have encountered in the past 10 years. I estimate the LabVIEW programming effort at two man-months, as opposed to the two man-years requested for our advanced workstation."
- Gary W. Johnson, Electronics Engineer, Lawrence Livermore National Laboratory

"We did it! LabVIEW 2 is everything we visualized when we set out over six years ago to create the next generation instrumentation software technology. Our free LabVIEW 2 upgrade program is our way of thanking the thousands of pioneering users who helped make this revolution possible."
- James Truchard, Ph.D., President, National Instruments

"Compared to the already excellent release 1.2, LabVIEW 2 is improved in virtually every way. Compared to ‘traditional’ software, it’s almost shocking. Worth the wait? You could say I’ve been waiting nearly a decade, since personal computers first came out, for something to bring it all together the way LabVIEW does."
- Scott Jordan, Product Line Manager, Newport Corporation

"With LabVIEW’s modular system, I can visualize my test systems as a hierarchy of individual, interchangeable components, resulting in shorter development time, increased functionality, and greater execution efficiency."
- Michael Porter, Test Systems Engineer, CODEX Corporation

"I give LabVIEW high marks for its conceptual ease and its ability to adapt. Using LabVIEW, I have developed a sophisticated process control system for our distillation laboratories that is comprehensive yet can be easily configured."
- Glenn Graham, Research and Development Engineer, Union Carbide Corporation

Nihon National Instruments K.K. (Japan) (3) 788-1921 • National Instruments of France (1) 4865 3370
National Instruments of Italy (2) 4830-1892 • National Instruments United Kingdom (06) 355-23-545

Circle 203 on Reader Service Card
Tandy®
Business
Systems

Step up to power planning.

What the future holds is in your hands . . . today. With a 386™-based Tandy Business System, you'll have the power you need to set—and reach—your strategic objectives.

Quickly transform raw data into useful information. Compile a spreadsheet to compare current and previous figures, then graph the results to see once-hidden trends.

Pinpoint those areas needing improvement, outline your plan and create PERT charts to support your formal proposal.

You won't be charting your course alone—Radio Shack offers the best support services in the industry.

Success? Plan on it with a Tandy Business System.