

New: 32-bit Color on the Mac (page 99)

PRODUCT FOCUS



Head-to-Head Tests: LAN OSes

REVIEWS

- IBM PS/2 Model 70-A21
- Phar Lap 386|VMM
- HOOPS
- Folio Views
- WingZ
- A Color PostScript Printer

BYTE

JULY 1989

A McGRAW-HILL PUBLICATION

THE 12 TOP GUIs

Your Guide to State-of-the-Art Graphical User Interfaces

IN DEPTH

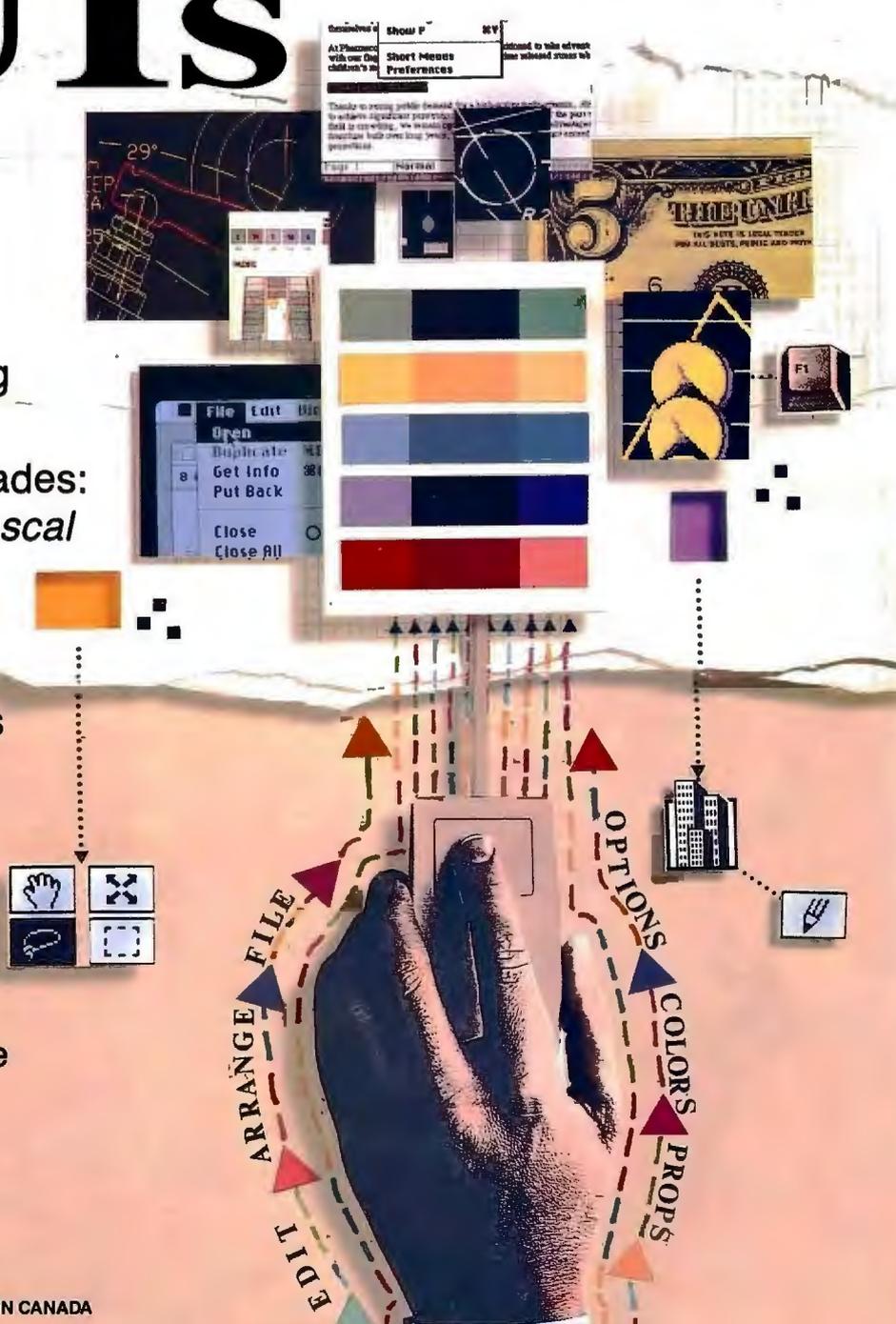
Distributed Processing

Object-Oriented Upgrades:
Microsoft's Quick Pascal vs. Borland's Turbo Pascal 5.5

2 Brand-New Columns

PLUS

- Optical LAN Standards
- HP DeskJet Plus
- PixelPaint 2.0
- HyperPAD
- Mitsubishi's Smart Mouse



ARRANGE
FILE
EDIT

OPTIONS
COLORS
PROPS



\$3.50 U.S.A./\$4.50 IN CANADA
0360-5280

JULY 1989

BYTE

12 GUIs • LAN OSes • DISTRIBUTED PROCESSING

Volume 14, Number 7

DOT MATRIX PRINTERS.

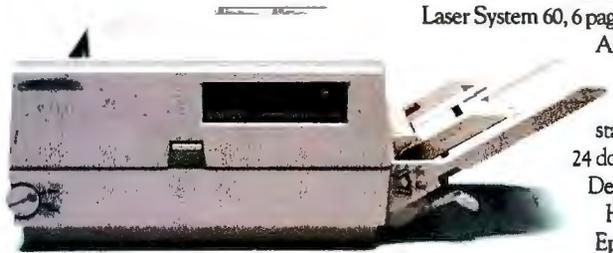
Printer System 800: \$699.95
Our highest resolution text and graphics, 24-pin dot matrix printer. Draft quality at 200 cps. Letter quality at 66 cps. Parallel and serial interfaces. Wide carriage.

Printer System 600: \$499.95
9-pin dot matrix. Draft quality at 240 cps. Near-letter quality at 60 cps. Parallel interface. Wide carriage.

Printer System 300: \$199.95
9-pin dot matrix. Draft quality at 144 cps. Near-letter quality at 36 cps. Four standard fonts. Parallel interface. Narrow carriage.

LASER PRINTERS.

Laser System 150, 15 pages
Laser System 80, 8 pages
Laser System 60, 6 pages



All C
I
I
stand
24 dow
Dell la
Hew
Epson
Diabl

SO HOW COME YOU NEVER CALL?

THE NEW DELL SYSTEM 316 16 MHz 386SX

STANDARD FEATURES:

- Intel 80386SX microprocessor running at 16 MHz.
- Choice of 1 MB, 2 MB, or 4 MB of RAM* expandable to 16 MB (8 MB on the system board).
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- LIM 4.0 support for memory over 1 MB.
- Socket for 16 MHz Intel 80387SX math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface and diskette controller on system board. (ESDI based systems include a hard disk controller.)
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots.

OPTIONS:

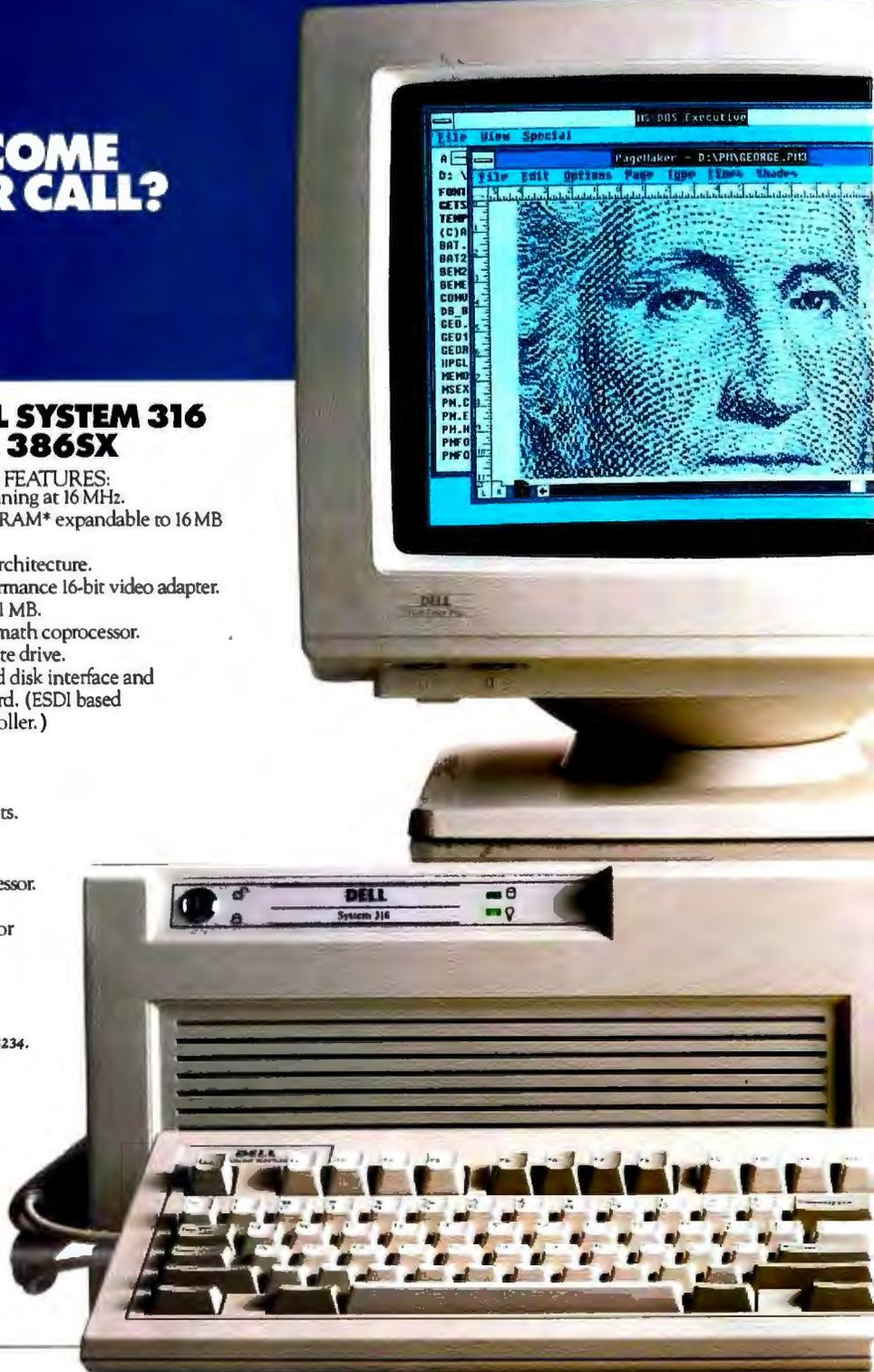
- 40 MB or 150 MB tape backup.
- 16 MHz Intel 80387SX math coprocessor.
- 1 MB or 4 MB RAM upgrade kit.
- Graphics Performance Accelerator GPX-1024.
- Graphics Performance Display GPD-16C, GPD-19C.

*Lease for as low as \$112/Month.

◇ Extended Service Plan pricing starts at \$234.

System 316	With Monitor & Adapter			
Disk Drives	VGA Mono 1MB RAM	VGA Mono 2MB RAM	VGA Color Plus 1MB RAM	VGA Color Plus 2MB RAM
40 MB- 29 ms IDE	\$2,999	\$3,198	\$3,499	\$3,698
100 MB- 25 ms IDE	\$3,599	\$3,798	\$4,099	\$4,298
150 MB- 18 ms ESDI	\$4,099	\$4,298	\$4,599	\$4,798
322 MB- 18 ms ESDI	\$5,099	\$5,298	\$5,599	\$5,798

Disclaimer: All systems are photographed with optional extras that some computer retailers won't even recognize.



per minute: \$5,995
 er minute: \$3,295
 er minute: \$2,195
 All laser printers come with
 MB RAM, full-page 300
 l graphics, and have 31
 d fonts (7 resident and
 oadable from diskette).
 er printers also provide
 art-Packard LaserJet Plus,
 FX, IBM Proprinter* and
 630* emulations.



THE DELL SYSTEM 325
25 MHz 386.

When you need the highest-performance 386 computer, this is it.

STANDARD FEATURES:

- Intel 80386 microprocessor running at 25 MHz.
- Choice of 1 MB, 2 MB or 4 MB of RAM* expandable to 16 MB using a dedicated high speed 32-bit memory slot.
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 25 MHz Intel 80387 or 25 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard disk drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots.

OPTIONS:

- 40 MB or 150 MB tape backup.
- 25 MHz Intel 80387 math coprocessor.
- 25 MHz WEITEK 3167 math coprocessor.
- 1 MB or 4 MB RAM upgrade kit.
- 2 MB or 8 MB memory expansion board kit.
- Graphics Performance Accelerator GPX-1024.
- Graphics Performance Display GPD-16C, GPD-19C.

*Lease for as low as \$199/Month.

o Extended Service Plan pricing starts at \$370.

System	325	With Monitor & Adapter	
Hard Disk Drives	VGA Mono	VGA Color Plus	
40 MB-29 ms IDE	1 MB RAM	4 MB RAM	\$5,999 \$5,698
	1 MB RAM	4 MB RAM	\$5,799 \$5,998
100 MB-25 ms IDE	\$5,999	\$6,198	\$6,299 \$6,498
150 MB-18 ms ESDI	\$6,499	\$6,698	\$6,799 \$6,998
322 MB-18 ms ESDI	\$7,299	\$7,498	\$7,599 \$7,798



THE DELL SYSTEM 310
20 MHz 386.

The best combination of performance and value available in its class.

STANDARD FEATURES:

- Intel 80386 microprocessor running at 20 MHz.
- Choice of 1 MB, 2 MB or 4 MB of RAM* expandable to 16 MB using a dedicated high speed 32-bit memory slot.
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 20 MHz Intel 80387 or 20 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard disk drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots.

OPTIONS:

- 40 MB or 150 MB tape backup.
- 20 MHz Intel 80387 math coprocessor.
- 20 MHz WEITEK 3167 math coprocessor.
- 1 MB or 4 MB RAM upgrade kit.
- 2 MB or 8 MB memory expansion board kit.
- Graphics Performance Accelerator GPX-1024.
- Graphics Performance Display GPD-16C, GPD-19C.

*Lease for as low as \$135/Month.

o Extended Service Plan pricing starts at \$251.

System	310	With Monitor & Adapter	
Hard Disk Drives	TTL Mono	VGA Color Plus	
40 MB-29 ms IDE	1 MB RAM	4 MB RAM	\$3,699 \$3,898
	1 MB RAM	4 MB RAM	\$4,199 \$4,398
100 MB-25 ms IDE	\$4,199	\$4,398	\$4,699 \$4,898
150 MB-18 ms ESDI	\$4,699	\$4,898	\$5,199 \$5,398
322 MB-18 ms ESDI	\$5,499	\$5,698	\$5,999 \$6,198



THE DELL SYSTEM 220
20 MHz 286.

It's fast as most 386 computers. But at less than half the price. The footprint is small, too.

STANDARD FEATURES:

- 80286 microprocessor running at 20 MHz.
- 1 MB of RAM* expandable to 16 MB (8 MB on system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 1 MB.
- Integrated diskette and VGA video controller on system board.
- Socket for Intel 80287 math coprocessor.
- One 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports (integrated on system board).
- 3 full-sized industry standard expansion slots available.

OPTIONS:

- 40 MB or 150 MB tape backup.
- External 5.25" 1.2 MB diskette drive.
- 3.5" 1.44 MB diskette drive.
- Intel 80287 math coprocessor.
- 1 MB or 4 MB RAM upgrade kit.

*Lease for as low as \$109/Month.

o Extended Service Plan pricing starts at \$264.

System	220	With Monitor & Adapter	
Hard Disk Drives	TTL Mono	VGA Color Plus	
40 MB-29 ms IDE	1 MB RAM	2 MB RAM	\$2,999 \$3,198
100 MB-25 ms IDE	\$3,599	\$3,798	\$3,899 \$4,098



THE DELL SYSTEM 200
12.5 MHz 286.

This full-featured 286 computer runs at 12.5 MHz, and is completely Microsoft MS-DOS and MS OS/2 compatible.

STANDARD FEATURES:

- 80286 microprocessor running at 12.5 MHz.
- 640 KB of RAM expandable to 16 MB (4, 6 MB on system board).
- Socket for Intel 80287 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard disk drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 6 industry standard expansion slots.

OPTIONS:

- 40 MB or 150 MB tape backup.
- Intel 80287 math coprocessor.
- 512 KB RAM upgrade kit.
- 2 MB RAM upgrade kit.

*Lease for as low as \$64/Month.

o Extended Service Plan pricing starts at \$466.

System	200	With Monitor & Adapter	
Hard Disk Drive	VGA Mono	VGA Color	
40 MB-40 ms	\$1,699	\$2,099	
40 MB-28 ms	\$1,999	\$2,399	
100 MB-25 ms IDE	\$2,599	\$2,999	
150 MB-18 ms ESDI	\$3,099	\$3,499	
322 MB-18 ms ESDI	\$3,899	\$4,299	

*Performance enhancements (Systems 325, 310, 316 and 220) Within the first megabyte of memory, 384 KB of memory is reserved for use by the system to enhance performance.

4 MB configurations available on all systems. Call for pricing.



OPERATING SYSTEM SOFTWARE.

- Dell Enhanced Microsoft® MS-DOS® 3.3: \$99.95
- Dell Enhanced Microsoft MS-DOS 4.0: \$119.95
- (Both MS-DOS versions with disk cache and other utilities.)
- Dell Enhanced MS® OS/2 Standard Edition 1.0: \$324.95
- Dell UNIX® System V/386, Release 3.2:
- Now available. Call for details.

APPLICATION SOFTWARE.

We offer a complete line of software. Everything from complex CAD/CAM applications to fun flight simulator programs. All at extremely competitive prices.

All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. *Figments based on a 36-month open-end lease. †Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices will vary. Microsoft, MS and MS-DOS are registered trademarks owned by Microsoft Corp. UNIX is a registered trademark of AT&T. Dell UNIX System V is based on INTERACTIVE Systems Corporation's 386/ix. Intel, 386 and 386SX are trademarks of Intel Corporation. *Signifies trademarks of entities other than Dell Computer Corporation. †Service in remote locations will incur additional travel charges. o Provided by Xenix Corporation. © 1989 DELL COMPUTER CORPORATION.



THE \$3500 DELL 386SX SYSTEM COMES WITH SELF-DIAGNOSTIC SOFTWARE, TOLL-FREE TECHNICAL SUPPORT, 30-DAY MONEY-BACK GUARANTEE AND NEXT-DAY, DESKSIDE SERVICE.

Right away, it's easy to see what makes the new Dell System 316 different from the Compaq[^] 386s.

While they both utilize Intel's new 386SX™ chip, the System 316 is a full featured system designed to give you uncompromising 386SX/16 MHz performance.

But for a price that's somewhere in the neighborhood of a 286-based system.

Now, cynics might be inclined to think we achieved this at the expense of expandability.

Obviously these people own the 4-slot Compaq.

The System 316 has a total of seven open slots. Leaving you enough room to add modems or

network cards, fax boards, high-performance graphics cards or tape backups. Not to mention all the bells and whistles that'll be coming out next year. And the year after that.

And the year after that.

Point is, the Dell System 316 was designed for the long haul.

Not as a passing fad.

IT'S YOUR CALL.

If the System 316 is beginning to sound like the perfect business computer, it's because it is.

How perfect though is entirely up to you. Because every 316 is custom configured. To give users

exactly what they need.

For example, the System 316 comes standard with your choice of 1 MB or 2 MB of RAM. If you'd like more, we can add as much as 8MB to the system board. Okay, we can add another 8MB by installing a memory expansion board.

What about storage? We can set your 316 up with a 40, 100, 150 or 322 MB hard drive. And a 40 or 150 MB tape drive.

Tell us, what type of monitor do you prefer? VGA mono with paperwhite screen, or VGA Color Plus for high resolution colors displayed on a larger screen? Or perhaps you'd like even larger monitors, capable of displaying 1024 by 768 pixel

resolution? You've got your choice. You've got your choice of operating systems, too. The 316 can run MS-DOS[®], OS/2[®], or UNIX[®] systems. Making it extremely versatile, as well as extremely powerful.

Once you've told us what you want, we'll make sure what you want works, by burning-in the system unit.

And even though each and every 316 we build is individually configured, they're all guaranteed dependable just the same.

DON'T GET STUCK IN THE MIDDLE.

Have you noticed how most computer retailers seem to know far too much about sales techniques and far too little about computer technology?

Ask even the simplest of questions and the answer will undoubtedly involve the highest margin item in the store.

And heaven forbid you should ever have to go back there for service.

Well, when you buy from us,

you never set foot in a store.

Because we've eliminated it.
Along with the retailer.

Instead, you talk directly with
a computer expert.

Someone who can help you
configure a system that not only
meets your needs, but meets
them for about 35% less than
you'd pay a retailer.

**WE COME
WHEN WE'RE
CALLED.**

One of the things that very
clearly sets a Dell system apart
from other computers is not
just how they're sold but how
they're supported.

Overkill was one description
used in a PC Week article.

Perhaps.

But then, we think you'll
agree, when something goes
wrong, you want as much help
as possible, right?

Which is why every Dell
system comes with self-
diagnostic software and a toll-
free technical support line.
We're able to solve 90% of all
problems right over the phone.

The other 10% receive
next-day, desktide service.
Thanks to our new alliance
with Xerox Corporation.

And you get all this help
for a full year—whenever you
need it—at no extra charge.△

You've probably guessed,
by now, one of the things
that drives us most is
customer satisfaction.

So we'd like to give
you the ultimate guarantee:
Try a System 316 in your office
for a month. Run your toughest
applications. Put it through its
paces, at your pace. If you're
not completely satisfied, send it
back anytime within 30 days.
And we'll refund your money.
No questions asked.

**I HAVE
MY OWN
COMPUTER
COMPANY**



**THE \$4900 COMPAQ 386S
COMES WITH A GUY IN A SUIT.**

**MAYBE YOU
SHOULDN'T BUY
ONE AFTER ALL.**

No matter how many reasons
we give you to buy a Dell system,
sometimes it makes more
sense to lease one instead.

Whether you need a
single computer, or an
entire office full, a leasing
plan is just like 100% financing.
So you don't tie up working capital.
Or credit lines. Of course, there
can also be tax advantages as well.

And just as we can custom
configure your computers, we can
see to it you get a custom designed
lease plan to fit the exact needs
of your business. †

Maybe that explains why
over half the companies in the
Fortune 500 now own or lease
Dell computer systems. And why
in the last four PC Week polls,
corporate buyers rated Dell
number one in overall customer
satisfaction, by a landslide.

Because we give people exactly
what they want.

No more. No less.



TO ORDER, CALL

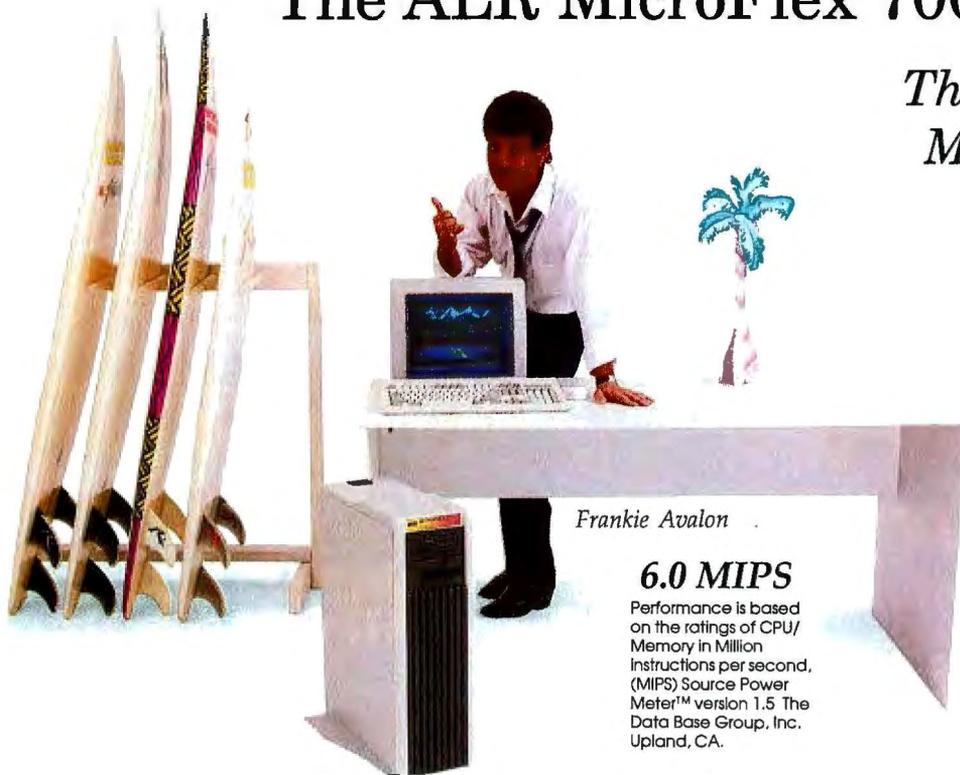
800-426-5150

IN CANADA, CALL 800-387-5752
IN GERMANY, CALL 06103/701100
IN THE U.K., CALL 0800 414535

Now we're making waves with IBM®

The ALR MicroFlex 7000

*The first 25MHz
Micro Channel®
compatible*



Frankie Avalon

6.0 MIPS

Performance is based on the ratings of CPU/Memory in Million Instructions per second, (MIPS) Source Power Meter™ version 1.5 The Data Base Group, Inc. Upland, CA.

ALR
California
Home of the World's First 386 PC
Advanced Logic Research, Inc.

At ALR, we thrive on opportunities to beat our competitors. Our 25MHz 80386® based MicroFlex 7000 is no exception.

Unmatched performance

Our proprietary "pre-fetch" FlexCache™ design delivers the most efficient form of microcomputer processing. By combining a true 64-bit cache bus with 64-KB cache memory, performance increases 30% when compared to other 32-bit computers. And 64KB of high-speed cache memory enables you to experience the fastest

throughput for sophisticated applications. For those seeking large storage capacities, the MicroFlex 7000 gives the option of 120 or 300MB of disk storage using high-speed ESDI controllers with 1:1 interleave.

The most built-in features

The MicroFlex 7000 includes our super VGA controller with 800 X 600 graphics resolution and the sleek tower chassis offers the most internal expansion capabilities of any Micro Channel system available. Our one-

year warranty with unlimited technical support and on-site servicing available from Intel® can't be beat.

So make some waves of your own at the office with ALR's MicroFlex 7000 or any of our 33MHz systems. For more information and the name and number of your local authorized ALR reseller, please call:

1-800-444-4ALR

Advanced Logic Research, Inc.
9401 Jeronimo, Irvine, CA 92718
(714) 581-6770 FAX:(714) 581-9240

For our Canadian office: 1-800-443-4CAN
For our UK office: 44-1-399-4897
For our Singapore-Asia/Pacific office:
(65) 258-1286 FAX: (65) 258-1285

FlexCache is a trademark of Advanced Logic Research, Inc. 80386 is a registered trademark of Intel Corp. IBM and Micro Channel are registered trademarks of International Business Machines Corp. Shown with optional monitor. Prices and configurations subject to change without notice. Certified FCC class A, for business use only. Copyright 1989 Advanced Logic Research.

We're making some big waves in California

Introducing ALR's FlexCache™ 33/386Z

33MHz 80386™
*performance for
as little as \$3995!*



Frankie Avalon

7.5 MIPS

Performance is based on the ratings of CPU/Memory in Million instructions per second, (MIPS) Source Power Meter™ version 1.5 The Data Base Group, Inc. Upland, CA.

ALR
California
Home of the World's First 386 PC
Advanced Logic Research, Inc.

Wipe out!

Hang on because ALR's latest addition to the FlexCache 386™ Z-family is cruising at an amazing 33MHz. That's a 20% increase in processing speed when compared to the award winning FlexCache 25386.

Fast Cache

With 32KB of cache memory, award-winning FlexCache architecture and our enhanced 16-bit super VGA controller you better be ready to move.

At prices starting as little as \$3995*, the FlexCache 33/386Z delivers the most performance for all power hungry desktop applications like CAD/CAM, desktop publishing or financial modeling at a very modest price. Of course the FlexCache 33/386Z is OS/2® compatible for tomorrow's latest generation of applications. The FlexCache 33/386Z as with all of the Z-Family comes packaged with PC-Kwik®, the award-winning disk caching utility.

With ALR's FlexCache 33/386Z you'll receive unbeatable support backed by an unprecedented three year factory warranty on the main system board, a one-year system warranty, unlimited technical support and optional on-site servicing from Intel.



For more information on the FlexCache 33/386Z call:
1-800-444-4ALR.

FlexCache is a trademark of Advanced Logic Research, Inc. 386 is a registered trademark of Intel Corp. OS/2 is a registered trademark of IBM Corp. PC Kwik is a registered trademark of Multisoft Corp. Shown with optional monitors. Certified FCC Class A, for business use only. Prices and configurations subject to change without notice. Copyright 1989 Advanced Logic Research, Inc.

PRODUCTS IN PERSPECTIVE

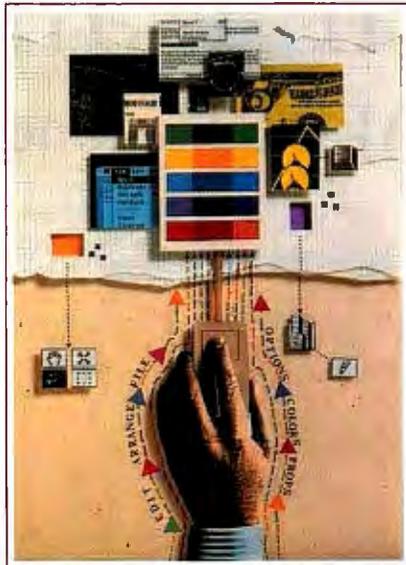
57 What's New

89 Short Takes

DeskJet Plus, Hewlett-Packard improves a winner
PixelPaint 2.0, big improvements from SuperMac Technology
HyperPAD, Brightbill-Roberts' desktop manager with hypertext power
Mitsubishi Smart Mouse, useful for specialized applications
Counterpart, a security device from Fifth Generation Systems

FIRST IMPRESSIONS

- 99 **Apple's 32-Bit QuickDraw** Covers the Spectrum
by Tom Thompson
Color imaging for the Mac II and SE/30 takes a leap forward with this new program.



COVER STORY

A Guide to GUIs

by Frank Hayes
and Nick Baran
page 250

Your complete guide to 12 state-of-the-art graphical user interfaces.

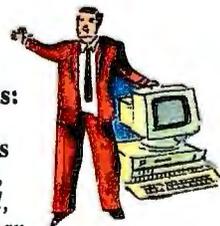
104 Clash of the Object-Oriented Pascals

by Jon Udell
Quick Pascal and Turbo Pascal 5.5 are both friendly environments for object-oriented programming.

REVIEWS

154 Product Focus: Battle of the Network Stars

by Steve Apiki, Stanford Diehl, and Rick Grehan
The BYTE Lab takes a look at five different PC-LAN operating systems.



173 IBM's New Speed King

by Caroline Halliday
The Model 70-A21 is the fastest of the PS/2s, but it's slower than its competition.

177 Color by Numbers

by Kent Quirk
The Tektronix Phaser CP slashes the cost of PostScript-compatible color output.

EXPERT ADVICE

109 Computing at Chaos Manor: Computers vs. Taxes

by Jerry Pournelle
Jerry wages his annual battle with taxes and breaks in a new Northgate computer.

125 Applications Plus: Is Bigger Better?

by Ezra Shapiro
Is the industry paying too much attention to bells and whistles and not enough to simplicity?

129 OS/2 Notebook: Figuring Out CONFIG.SYS

by Mark Minasi
A discussion of how to set up a typical CONFIG.SYS file under OS/2.



137 Down to Business: Dawn of the Dead Disk

by Wayne Rash Jr.
When your hard disk suddenly crashes, all is not necessarily lost.

143 Macinations: Learn on Me

by Don Crabb
The Mac is changing the face of computer-aided instruction.

148 NetWorks: The LAN Road to OSI

by Mark L. Van Name and Bill Catchings
The OSI reference model is the framework within which international communications standards are developed.



Distributed Processing/212

181 EMS with a Cache
by Jeff Holtzman
 The Elite 16 Plus HyperCache board from Profit Systems boosts EMS 4.0 performance.

187 Breaking the Memory Barrier with 386VMM
by Martin Heller
 This 80386-based virtual memory manager from Phar Lap lets you build large applications.

193 Powerful Portable 3-D Graphics
by Bradley Dyck Kliewer
 Develop portable three-dimensional graphics with Ithaca Software's HOOPS.

201 Text Retrieval with a Twist
by Dennis Allen
 Folio Views advances text management technology with a new indexing scheme.

207 The Flying Spreadsheet
by Don Crabb
 Informix Software's WingZ for the Mac is stiff competition for Excel.

IN DEPTH

212 Introduction: Distributed Processing

215 Take Your Pick
by Gilbert Wai
 From client/servers to parallel processing, distributed processing uses a variety of methods to share resources.

225 A Transparent Environment
by Bruce J. Walker and Gerald J. Popek
 With transparency, you can have a distributed and heterogeneous environment without making big changes to your existing software.

235 Remote Control
by Carl Manson and Ken Thurber
 Remote procedure calls offer a solution to the problem of distributed processing over a network.

241 The Paperless Office
by Dean Hough
 You no longer need a superminicomputer to use document image processing.

248 Distributed Processing Roundup
 Some products that distribute processing over different architectures, operating systems, or networks.

FEATURES

250 Cover Story: A Guide to GUIs
by Frank Hayes and Nick Baran
 Your complete guide to 12 state-of-the-art graphical user interfaces.

259 The Qsim Simulation Toolkit
by Roy E. Kimbrell, Linda Correll, and Robert Bass
 Qsim lets you use your personal computer to model all kinds of systems, from banks to breweries.



HANDS ON

269 Under the Hood: The Light at the End of the LAN
by L. Brett Glass
 The new FDDI standard lets optical LANs move more data more efficiently.

277 Some Assembly Required: Object-Oriented Mac Windows
by Jonathan Amsterdam
 Software that protects you from some of the hassles of Macintosh windows programming.

DEPARTMENTS

- 8 Editorial: New Unix Benchmarks
- 17 Microbytes
- 34 Letters and Ask BYTE
- 55 Chaos Manor Mail
- 331 Coming Up in BYTE
- 340 **NEW** Print Queue
- 344 **NEW** Stop Bit

READER SERVICE

- 330 Editorial Index by Company
- 332 Alphabetical Index to Advertisers
- 334 Index to Advertisers by Product Category
- Inquiry Reply Cards: after 336

PROGRAM LISTINGS

- From BIX: See 84
- From BYTEnet: call (617) 861-9764
- On disk or in print: See card after 240

BYTE (ISSN 0360-5280) is published monthly with an additional issue in October by McGraw-Hill, Inc. Postmaster: Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520. Second-class postage paid at Peterborough, NH 03458, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America.

Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.

Copyright © 1989 by McGraw-Hill, Inc. All rights reserved. Trademark registered in the United States Patent and Trademark Office.



Subscription questions or problems should be addressed to: BYTE Subscriber Service, P.O. Box 551, Hightstown, NJ 08520.

Microsoft profession something other lang



Professional languages give you leverage. Professional languages don't. Leverage.



In an industry that evolves practically overnight, it's tough to stay ahead of the crowd.

You need tools that not only give you an edge day-to-day, but open up endless possibilities.

Tools that can only come from Microsoft.

Combine Microsoft® C and Macro Assembler and you've got enough power to create programs for MS-DOS®, Windows and OS/2 systems.

What's more, you can do it all in record time because our renowned CodeView® Debugger, Linker, Microsoft Editor, and MAKE utility work ingeniously and seamlessly together.

In other words, you've got the leverage of the most inventive and comprehensive tools around.

When you develop under OS/2 systems, you've got options no one else can touch. Like multi-tasking. And blasting through the 640K barrier.

In addition, Microsoft C and Macro Assembler can accommodate more third party add-ons than any other PC professional languages.

Maybe that's why the most popular applications on the market today were developed through the unique power of our C and Assembler: Lotus® 1-2-3®, WordPerfect® 5.0, Microsoft Excel. And Aldus® PageMaker®.

So drop by your nearest Microsoft dealer soon. And start turning out the most airtight, fine-tuned code ever to touch a disk.

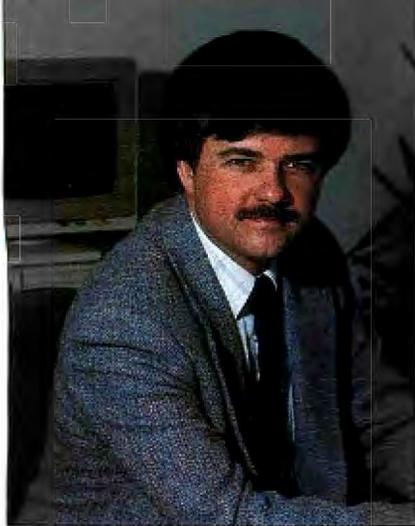
After all, you've got the leverage.



Microsoft
Making it all make sense.

Circle 182 on Reader Service Card (DEALERS: 183)

Customers in the U.S., call (800) 426-9400. In Canada, call (416) 673-7638. Outside North America, call (206) 882-8661. © Copyright 1989 Microsoft Corporation. All rights reserved. Microsoft, MS-DOS and the Microsoft logo are registered trademarks and *Making it all make sense* is a trademark of Microsoft Corporation.



NEW UNIX BENCHMARKS

The SPEC group and the BYTE Lab have both been busy creating a new suite of Unix benchmarks

You probably haven't heard a lot about SPEC, the Systems Performance Evaluation Cooperative, but you shouldn't feel bad. It's a pretty exclusive club, featuring companies like IBM, Apollo, Hewlett-Packard, Sun Microsystems, Digital Equipment Corp., Data General, Motorola, and other "heavies" in the field of workstations and high-performance personal computers. SPEC is attempting to standardize and improve Unix benchmarking.

Why New Unix Benchmarks?

Dhrystones, Whetstones, and the old benchmarks still used by many computer publications can't accurately measure the performance of high-end personal computers and workstations. These machines increasingly take advantage of mainframe and supercomputer design concepts like instruction pipelining, multiple execution units working in parallel, large caches, fast memory systems, and optimizing compilers—things these old benchmarks just weren't designed to test. Also, test suites that seek to isolate and benchmark the individual system components and subsystems, or (on the other extreme) the entire system as a "black box," give you incomplete and misleading results.

Most benchmarks in use today fail on at least one of these counts; several of the most heavily promoted computer magazine benchmarks fail on *all* counts. Tests originally designed for small systems simply are inadequate for today's hard-

ware and software. SPEC's new benchmarks will be decidedly heavy-duty, aimed at machines using processors like the 68030/68040 and 80386/80486 and equipped with 16 megabytes of system memory.

The SPEC tests combine low-level and applications-level evaluations. The low-level tests will show the strengths and weaknesses of individual elements in the system; the high-level elements of the suite will give a profile of the entire system working as an integrated unit for different applications.

The only major problem with the SPEC benchmarks is that they are very large and complex. The source code of the entire suite will likely exceed 100 megabytes; many of these benchmarks simply won't run on smaller or less-powerful machines.

BYTE's Unix Benchmarks

The SPEC benchmarks are conceptually almost identical to the second-generation BYTE benchmarks we've been using for about a year now. (BYTE's benchmarks were the first second-generation benchmarks in the industry; the first benchmarks to work across different operating systems and platforms; and the first to combine both high- and low-level testing for a truly complete picture of system performance.)

BYTE Lab's new Unix benchmarks were designed and built on a smaller and more manageable scale than SPEC's; ours can be used to benchmark not only pricey, ultrahigh-performance machines, but also the kinds of machines most of us (and most of our businesses) can afford to use every day.

Some specifics: Our low-level Unix benchmarks are carefully designed not to be defeated by some of the tricks used by new compilers. Our high-level tests are actually custom versions of real database engines and fully implemented standard Unix programs (e.g., editors and compilers). And our benchmarks are

designed explicitly to test both single-user and multiuser systems.

For multiuser testing, we adapted techniques from the latest version of the internationally accepted Monash University Suite for Benchmarking Unix Systems (MUSBUS), developed in Australia. The benchmarks feed interactive applications clocked streams of activities from simulated users on each port. The system is then exercised with an increasing load of simulated concurrent users. This lets you see how system performance is affected by an ever-increasing concurrent workload.

For your convenience and ease of use, our new Unix benchmarks (like all our benchmarks) are in the public domain. The new Unix benchmarks should be available for downloading about the time you read this. You can get the benchmarks from BIX or BYTEnet. Information on accessing both systems appears under "Program Listings" in the table of contents.

With our new Unix benchmarks in place, we'll soon be benchmarking new systems on every appropriate major operating system: We'll test new 80386 and 80486 machines, for example, under DOS and OS/2 and Unix. We'll test new high-end Macs under the Mac operating system and A/UX. And so on.

The idea is to multiply your options. Today's mixed computing environment means that each of us has to know more about more machines than we ever did before. BYTE is committed to giving you the comparative, unbiased information that you will need to sort through the welter of options and to make solid decisions about whatever new hardware and software comes down the pike—regardless of brand, architecture, or operating system.

In a nutshell: Single-platform and single-operating-system solutions are passé.

—Fred Langa
Editor in Chief
(BIX name "flanga")

At last, an assistant that follows your directions



Wouldn't it be great to delegate your routing?

You can! We know your time is valuable. That's why Wintek pioneered comprehensive and affordable CAD packages for IBM personal computers. HiWIRE-Plus continued that tradition, integrating schematic-capture features and printed-circuit-artwork capabilities into one versatile package.

New autorouter.

The Autorouter for HiWIRE-Plus is powerful enough to handle the most demanding design problems, yet simple enough for a casual user. Just turn it loose on your design. It's hassle free because it works long hours, without supervision or errors.

100% autorouting.

The autorouter for HiWIRE-Plus rips-up, reroutes, and with appropriate design rules, racks up 100% completion.

- Forget gridded routers. This autorouter places vias and traces anywhere your design rules allow. With 1-mil resolution.
- Vary trace width and spacing for individual networks. Route 1, 2, 3, or more tracks between IC and connector pins.
- Set up boards from 1 to 250 layers, up to 60" x 60".
- Specify shape, size, and type of vias, layer-by-layer: through-hole, blind, buried, micro. Specify via types for individual networks.
- Use fewer vias and layers than comparably priced autorouters.
- For use on your IBM PC, XT, AT, PS/2, or compatible with 640K RAM.

Why pay more for a 100% autorouter?

Compare the features and performance to packages costing five times more. HiWIRE-Plus and the Autorouter for HiWIRE-Plus sell for \$895 each. Both have a no-nonsense, 30-day money-back guarantee. With unlimited, toll-free, no-charge technical support.

Let HiWIRE convince you that it makes a great assistant. Call us toll-free at (800) 742-6809 today and put HiWIRE-Plus and the Autorouter for HiWIRE-Plus to work for you tomorrow.



Wintek Corporation
1801 South Street
Lafayette, IN 47904-2993
Fax: (317) 448-4823
Phone: (317) 742-8428 or

(800) 742-6809

GATEWAY 2000

The Company

Gateway 2000 has consistently led the pack of competitors in this highly competitive field. We have the most aggressive pricing in the industry, the most aggressive support policies, and lead the pack in quality. So shop around, then call Gateway 2000 to discover just how far ahead of the competition we really are.

The Products

Your Gateway 2000 computer system will arrive thoroughly tested and ready to run. All of our top quality systems come standard with our own *Crystal-scan 860* monitor and a 16 bit VGA card that is expandable to 512K. We have a variety of options available to suit anyone's needs. So call Gateway 2000, and we'll custom configure a system just for you.

12 Mhz 286 VGA

80286-12 Processor
2 Megas RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2295.00

16 Mhz 286 VGA

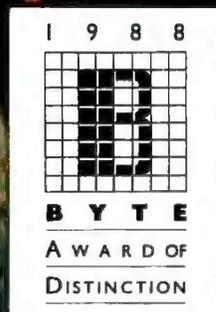
80286-16 Processor
2 Megas RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2395.00

20 Mhz 286 VGA

80286-20 Processor
2 Megas RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2495.00



Due to the Volatility in the DRAM Market all prices subject to change.

LEADS THE PACK

The Service

Gateway 2000 backs its computer systems with a full one year warranty and 30 day money back guarantee. If a problem does arise, you will promptly receive a solution over the phone or via *Federal Express* at our expense. In addition to this, we offer *lifetime toll-free support*, even after the warranty expires. So call Gateway 2000 for the best overall value on the market today.



20 Mhz 386 VGA

1 Meg RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
80 Meg 28ms Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$2995.00

(Upgrade to 4 Megs \$500)

25 Mhz 386 VGA

4 Megs RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
150 Meg 16.5 ms ESDI Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$4495.00

(64K Cache Add \$500)

33 Mhz 386 VGA

64K Cache RAM
4 Megs RAM
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
150 Meg 16.5 ms ESDI Drive
16 Bit VGA Board
14" VGA COLOR Monitor
1 Parallel/2 Serial Ports
101 Key Keyboard
MS DOS 3.3 or 4.01

\$5995.00

Gateway 2000  **GATEWAY**
P.O. Box 2000
Sgt. Bluff, IA 51054
800-779-2000
712-943-2000

BYTE

EDITOR IN CHIEF
Frederic S. Langa

PUBLISHER/GROUP VICE PRESIDENT
J. Burt Totaro

OPERATIONS
Glenn Hartwig *Associate Managing Editor*

REVIEWS (Hardware, Software, Product Focus)
Michael Nadeau, *Associate Managing Editor*, Dennis Allen *Senior Technical Editor, Software*, Richard Grehan *Director, BYTE Lab*, Stephen Apiki *Testing Editor, BYTE Lab*, Stanford Diehl *Testing Editor, BYTE Lab*, Howard Eglowstein *Testing Editor, BYTE Lab*, Stanley Wszola *Testing Editor, BYTE Lab*

NEWS AND TECHNOLOGY (Microbytes, What's New, Short Takes)
Rich Malloy *Associate Managing Editor*, D. Barker *Senior Editor, News and Technology*, Anne Fischer *Leit Senior Editor, New Products*, Andrew Reinhardt *Associate News Editor*
Peterborough: Roger Adams *Associate News Editor*, David Andrews *Associate News Editor*, Martha Hicks *Associate News Editor*
West Coast: Gene Smarte *Bureau Chief*, Costa Mesa, Nicholas Baran *Senior Technical Editor*, San Francisco, Frank Hayes *Associate News Editor*, Marlene Neary *Associate News Editor*, Jeffrey Bertolucci *Editorial Assistant*, San Francisco

SENIOR TECHNICAL EDITORS
Ken Sheldon *Features*, Jane Morrill Tazelaar *In Depth*, Tom Thompson *At Large*

TECHNICAL EDITORS
Janet J. Barron, Robert Mitchell, Robert M. Ryan, Ben Smith, Jon Udell

SENIOR CONTRIBUTING EDITOR
Jerry Pournelle

CONTRIBUTING EDITORS
Don Crabb, David Fiedler, L. Brett Glass, Hugh Kenner, Mark Minaasi, Wayne Rash Jr.

CONSULTING EDITORS
Jonathan Amsterdam, Laurence H. Loeb, Trevor Marshall, Stan Mlastkowski, Dick Pountain, Phillip Robinson, George A. Stewart, Mark L. Van Name, Peter Wayner

COPY EDITORS
Lauren Stickler *Chief*, Cathy Kingery *Copy Administrator*, Susan Colwell, Jeff Edmonds, Judy Grehan, Nancy Hayes, Margaret A. Richard, Warren Williamson

EDITORIAL ASSISTANTS
Peggy Dunham *Office Manager*, Linda C. Ryan, June N. Sheldon, Lynn Susan Valley

ART
Nancy Rice *Director*, Joseph A. Gallagher *Assistant Director*, Lisa Nardacchia *Assistant*, Jan Muller *Assistant*, Alan Easton *Technical Artist*

PRODUCTION
David R. Anderson *Director*, Virginia Reardon *Senior Editorial Production Coordinator*, Barbara Busenbark *Editorial Production Coordinator*, Denise Chartrand *Editorial Production Coordinator*, Michael J. Lonsky *Editorial Production Coordinator*

TYPOGRAPHY
Sherry Flake *Systems Manager*, Donna Sweeney *Applications Manager*, Christa Patterson

ADVERTISING/PRODUCTION (803) 924-6448
Lisa Wozmak *Director of Advertising Services*, Linda Fluhr *Customer Service Supervisor*, Lyda Clark *Senior Account Coordinator*, Dale Christensen, Karen Cilley, Roxanne Hollenbeck, Rod Holden, Wai Chiu Li *Quality Control Manager*

ADMINISTRATION
Donna Nordlund, *Publisher's Assistant*

MARKETING AND PLANNING
Michele Perron, *Director*
Pamela Petrakos-Wilson *Marketing Communications Manager*, Wilbur S. Watson *Marketing Services Manager*, Dawn Matthews *Public Relations Manager*, Lisa Jo Steiner *Assistant Promotion Manager*, Stephanie Warnesky *Marketing Art Director*, Sharon Price *Associate Art Director*, Julie Perron *Senior Market Research Analyst*, Faith Kluntz *Copyrights Coordinator*, Cynthia Damato *Sands Reader Service Coordinator*

FINANCIAL SERVICES
Phillip L. Penny *Director of Finance and Services*, Kenneth A. King *Business Manager*, Marilyn Parker, Diane Henry, JoAnn Walter, Jaime Huber

CIRCULATION
Dan McLaughlin *Director*
Vicki Weston *Assistant Manager*, Karen Desroches *Distribution Coordinator*, Louise Menegue *Back Issues*

PERSONNEL
Patricia Burke *Personnel Coordinator*, Beverly Goss *Receptionist*

BUILDING SERVICES
Tony Bennett *Manager*, Cliff Monkton, Mark Monkton, Agnes Perry

BIX BYTE INFORMATION EXCHANGE

DIRECTOR
Stephen M. Laliberte

EXECUTIVE EDITOR
George Bond

MANAGING EDITOR
Tony Lockwood

MICROBYTES DAILY
D. Barker *Coordinator*, Peterborough, Rich Malloy *New York*, Gene Smarte *Costa Mesa*, Nicholas Baran *San Francisco*, Rick Cook *Phoenix*, Frank Hayes *San Francisco*, Martin Heller, Boston, Jason Levitt *Austin, TX*, Laurence H. Loeb *Wallingford, CT*, Brock N. Meeks *San Francisco*, Stan Mlastkowski *Peterborough*, Wayne Rash Jr., Sue Rosenberg *Washington, DC*, David Reed *Lexington, KY*

GROUP MODERATORS
David Allen *Applications*, Leroy Casterline *Other*, Marc Greenfield *Programming Languages*, Jim Howard *Graphics*, Gary Kendall *Operating Systems*, Steve Krenek *Computers*, Brock N. Meeks *Telecommunications*, Barry Nance *New Technology*, Donald Osgood *Computers*, Sue Rosenberg *Other*, Jon Swanson *Chips*

EXCHANGE EDITOR
Laurence H. Loeb, *Macintosh Exchange Editor*

BUSINESS AND MARKETING
Patricia Bausum *Secretary*, Denise A. Greene *Customer Service*, Brian Warnock *Customer Service*, Tammy Burgess *Customer Credit and Billing*

TECHNOLOGY
Clayton Lisle *Director*, *Business Systems Technology*, ISCo., John Spadafora *Programmer/Analyst*, Wayne Power, *Senior Business Systems Analyst*

ADVERTISING SALES
Steven M. Vito *Associate Publisher*, *Vice President of Marketing*
Sara Lyon *Administrative Assistant*
Arthur H. Kossack *Eastern Regional Sales Manager*, (312) 751-3700
Jennifer L. Bartel *Western Regional Sales Manager*, (214) 844-1111
Susan Vernon *Sales Assistant*

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO, CANADA & EASTERN CANADA
John C. Moon (617) 262-1160

ATLANTIC
NY, NYC, CT, NJ (NORTH)
(212) 612-2645

EAST
PA, KY, NJ (SOUTH), MD, W.VA, DE, DC
Thomas J. Brun (215) 498-3833

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA, MS
Thomas H. Tolbert (404) 252-0626

MIDWEST
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH
Kurt Kelley (312) 751-3740

SOUTHWEST, ROCKY MOUNTAIN
CO, WY, OK, TX, AR, LA
Karl Heinrich (713) 462-0757

SOUTH PACIFIC
SOUTHERN CA, AZ, NM, LAS VEGAS, UT
Ron Cordek (714) 657-6292
Tom Harvey (213) 480-5243

NORTH PACIFIC
HI, WA, OR, ID, MT, NORTHERN CA, NV (except LAS VEGAS), WESTERN CANADA
Bill McAfee (408) 879-0371
Christine Kopec (415) 362-4600

TELEMARKETING
L. Bradley Browne *Director*
Susan Boyd *Administrative Assistant*

NATIONAL SALES
Liz Coyman (603) 924-2518
Dan Harper (603) 924-2599
Eliisa Lister (603) 924-2598

BYTE BITS (2x3)
Mark Stone (603) 924-6930

THE BUYER'S MART (1x2)
Brian Higgins (603) 924-3754

REGIONAL ADVERTISING SECTIONS
Scott Gagnon (603) 924-4380
Larry Levine (603) 924-4379
Barry Echavarría (603) 924-2674

BYTE POSTCARD DECK MAILINGS

BYTE DECK
Ed Ware (603) 924-6166

COMPUTING FOR DESIGN & CONSTRUCTION
COMPUTING FOR ENGINEERS
Mary Ann Goulding (603) 924-9281

INTERNATIONAL ADVERTISING SALES STAFF
See listing on page 333.

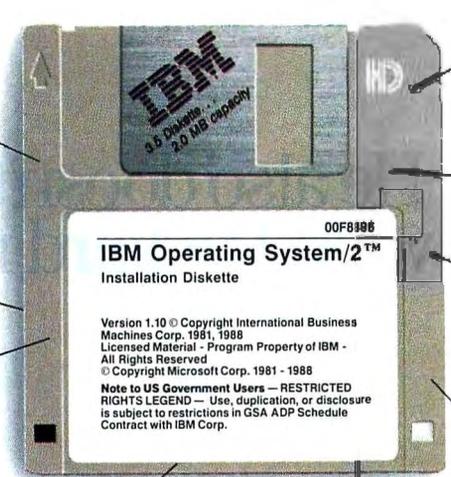
EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
West Coast Branch Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-6292.
New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
BYTEnet: (617) 861-9754 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).
Editorial Fax: (603) 924-2550. **Advertising Fax:** (603) 924-7507. **Telex:** (603) 924-7881.
SUBSCRIPTION CUSTOMER SERVICE: Outside U.S. (609) 426-7070; inside U.S. (800) 525-5003.
For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520.

Officers of McGraw-Hill Information Services Company: President: Walter D. Serwatka. Executive Vice Presidents: Kenneth E. Gazzola, Aerospace and Defense; Ira Hersenstein, Computers and Communications; Russell C. White, Construction; Robert P. McGraw, Healthcare; Brian H. Hall, Legal. Senior Vice Presidents—Publishers: Laurence Altman, Data Communications; David J. McGrath, Engineering News-Record. Senior Vice Presidents: Robert D. Daleo, Finance; Michael J. Koeller, Human Resources. Group Vice Presidents: J. Burt Totaro, BYTE; Norbert Schumacher, Energy/Process Industries. Vice Presidents: George Elsing, Circulation; Julia Leonard, Systems Planning and Technology. Officers of McGraw-Hill, Inc.: Joseph L. Dionne, Chairman, President, and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel, and Secretary; Robert J. Bahash, Executive Vice President and Chief Financial Officer; Frank D. Penigale, Senior Vice President, Treasury Operations.

Founder: James H. McGraw (1860-1948). Executive, editorial, circulation, and advertising offices: One Phoenix Mill Lane, Peterborough, NH 03458, phone (603) 924-9281. Office hours: Monday through Thursday 8:30 AM-4:30 PM, Friday 8:30 AM-1:00 PM, Eastern Time. Address subscriptions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520. Subscriptions are \$29.95 for one year, \$54.95 for two years, and \$74.95 for three years in the U.S. and its possessions. In Canada and Mexico, \$31.95 for one year, \$59.95 for two years, \$79.95 for three years. \$75 for one-year air delivery to Europe. \$28,800 for one-year air delivery to Japan, \$14,400 for one-year surface delivery to Japan, \$45 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is \$3.50 in the U.S. and its possessions, \$3.95 in Canada, \$4.50 in Europe, and \$5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue. Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any article herein for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 29 Congress St., Salem, MA 01970. Specify ISSN 0360-5200/83, \$1.50. Copying done for other than personal or internal reference use without the permission of McGraw-Hill, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London WC1R 4EJ, England.

BYTE and **BYTE** are registered trademarks of McGraw-Hill, Inc.

Everything OS/2 can do for you...



OS/2™ includes a built-in graphical interface so it's easy to use.

OS/2 lets you run your DOS programs plus hundreds of programs DOS can't.

OS/2 lets you run programs larger than 640K, so you can use more powerful applications.

OS/2 lets you take full advantage of Micro Channel!™

OS/2 provides an optional Communications Manager which allows easy networking.

OS/2 lets you keep two or more programs running at the same time, so you can do more.

OS/2 lets you take advantage of 386™ power.

OS/2 provides an optional Database Manager to make managing information easy.

IBM Operating System/2™
Installation Diskette

00F8396

Version 1.10 © Copyright International Business Machines Corp. 1981, 1988
Licensed Material - Program Property of IBM - All Rights Reserved
© Copyright Microsoft Corp. 1981 - 1988

Note to US Government Users — RESTRICTED RIGHTS LEGEND — Use, duplication, or disclosure is subject to restrictions in GSA ADP Schedule Contract with IBM Corp.

This offer lets you do for less.

Right now, when you choose OS/2, you can get from \$100 to \$1,600 back on the kind of heavy duty memory that only OS/2 can handle. With this offer, the more memory you buy (up to 8Mb), the bigger your rebate.

Plus you can get thousands of dollars in rebates on over 100 different OS/2 programs. You can also get hundreds of dollars back on modems, accessory cards and hardware—all the things that help you do more work in less time with OS/2.

So if you're ready to move up to all the real advantages of OS/2, ask your IBM Authorized Dealer about these rebates today. To find the dealer nearest you call 1 800 IBM-2468, ext 128.



He also doesn't realize
Hewlett-Packard makes PCs.

That's unfortunate. Because Hewlett-Packard has a line of eight high-performance personal computers, PCs which range from desktop and floor-mount Intel386™-based powerhouses to entry-level 8086-compatibles. PCs which offer you a better way of doing business.

Hewlett-Packard personal computers give you plenty of opportunity for expansion. As



The HP Vectra QS/20 PC. One in a line of eight PCs from Hewlett-Packard.

386 is a trademark of Intel Corporation
©1989 Hewlett-Packard Company CP-PC903



well as plenty of options. At the high end, you can get up to 8 accessory slots, 620 Mbytes of hard disk storage, and 16 Mbytes of RAM. And on all models, you get a choice of video solutions and the flexibility of using either 5.25" or 3.5" disks.

Beyond this, an investment in Hewlett-Packard PCs allows you to choose confidently from thousands of software applications and peripherals. HP's strict

adherence to industry standards insures compatibility. Now, and into the future.

But the most important feature, the one you won't get with any other personal computer, is Hewlett-Packard reliability. For 50 years, HP has promised, and delivered, exceptional quality in everything from calculators to HP LaserJet printers.

Finally, every PC made by

Hewlett-Packard is backed by an extensive network of trained, authorized dealers. For more information and the name of your nearest dealer, call 1-800-752-0900. You'll soon realize what an HP personal computer can do for you.

There is a better way.





Creative License.

If you've ever tried to combine windows, menus, forms, and text entry to create an effective user interface, you know how challenging it can be.

Perhaps you've turned to a third-party library for help. Only to run into restrictions, limitations, and dead ends. So you had to compromise your design. Or modify the library source code. Or start over.

Which is precisely why we designed Vermont Views™, the new generation of Windows for Data®, the best-selling C library for user interfaces.

Vermont Views offers unbridled, unrestricted creative license.

The Human Interface Of Your Dreams

Vermont Views offers an unparalleled set of interface building blocks that you can combine in unlimited ways:

- Menus can be created in any style you choose, made scrollable vertically and horizontally, and nested to any level. Features include n-th character selection, checkmarks, and unavailable items.

- Data entry forms can be bigger than their display windows, have scrollable regions for the entry of variable lines of items, lists of choices for data entry, context sensitive help, and special decimal, date, time, and toggle fields.

- A mini word processor can be attached to a field window in a form or

used as a pop-up note taker.

You're In Charge

Because you can write and attach functions to the beginning and end of menus, forms, fields, and to keys, you're always in control.

Use these control functions to call up subsidiary forms and menus, change field values and the active field, exit or abort a form, do almost any task you can imagine.

All interactive capabilities of Vermont Views use a unique system of accessible keytables, so you can easily change or disable key assignments - even add to the functions provided for menus, forms, text entry, and windows.

One For All

Vermont Views is available for DOS, OS/2, UNIX, XENIX, and VMS. Maintain the same user interface on all of these operating systems with the same source code.

Vermont Views provides international portability as well, with full support for IBM international characters, flexible date and time formats, and changeable decimal and thousands separators.

Novice Or Expert

Despite its depth and flexibility, Vermont Views is easy to learn and use. Each major facility is covered in a single, self-

contained section of the manual, so you only need to learn capabilities as you use them.

To help you become an expert in no time, we include a free copy of the Norton Guides™ Engine and our own comprehensive Pop-Up Reference™. You'll have immediate, on-line access to function names, reference pages, structures and tables.

No-Time-Limit Guarantee

We've only touched on a fraction of what makes Vermont Views special. The only way to know it is to use it.

Try Vermont Views on your hardest problems.

For as long as you want. At no risk.

If not fully satisfied, return for a full refund. Anytime.

To Order Today Call 1-800-848-1248

Call to order Vermont Views today. And we'll send your "creative license" right away.

Prices: DOS \$395; with Source \$790. UNIX, XENIX, VMS, OS/2 please call.



Vermont
Creative
Software

Pinnacle Meadows, Richford, VT 05476

800-848-1248, 802-848-7731 Fax: 802-848-3502 Telex: 510-601-4160 VCISOFT

MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry, compiled from Microbytes Daily and BYTEweek reports

Optical Broadcast Could Break Access Bottleneck

Three scientists at the University of California at Davis are trying to bypass bottlenecks of computer architecture with a hybrid system that combines electronics and optical technology. They're working on something they call Optimul (Optical Interconnect for Multiprocessor Systems), which makes use of "wireless" lasers and a special coating for computer chips. The UCD team thinks its design can solve problems caused by memory contention in shared-memory systems and network bottlenecks in separate-memory systems. With sufficient funding, a crude working prototype of Optimul could be built "in about six months," says Steven Kowel, a materials scientist on the UCD team.

Optical computers would overcome the ultimate speed limits faced by traditional computer designs. But people who have tried to build more or less completely optical computers (as Kowel says, "no silicon except maybe the input/output components") have encountered "startlingly difficult" hardware problems, he adds. Systems that are mostly optical remain "primitive" and expensive, he says.

Within the last five years, though, research has shifted toward a focus on hybrid systems. These systems handle logic, memory, and I/O electronically but use ostensibly faster optical fibers for interconnecting chores. "People have taken chips and glued them board-to-board via fiber," Kowel says. At the far reaches of this approach, some scientists are attempting "intra-chip" optical connections using

holographic techniques.

Kowel and cohorts Norman Matloff and Charles Eldering think their idea is more practical than "holographic interconnects." Basically, they want to coat memory chips with a thin polymer film treated for sensitivity to electrical charges and light, producing a result somewhat like an LCD, says Kowel.

A laser beam illuminates the coated memory chip and "broadcasts" a picture of the entire contents of memory at that instant. The broadcast can be picked up by multiple processors at once, and the beam demodulated back into electrical charges and stored as such. This constitutes a kind of "double parallelism," according to Kowel, "across processors and across bits in memory."

In a tightly coupled or shared-memory system, a wireless broadcast solves the problem of contention for memory access, Kowel says.

Another kind of bottleneck arises with networked systems where there is no central memory. Even with high-bandwidth channels like fiber optics in place, a limited number of data pins feed memory contents to the optical channel; Optimul bypasses that constraint by broadcasting rather than channeling data, Kowel says. Writing to memory in Optimul would still be done, at least initially, using electronics, so a data bus would remain part of the overall system. It will likely be many years, the USD designers admit, before coated Optimul-type interconnects might be a standard part of the backbone.

NANOBYTES

If OS/2 had a theme song, it could possibly be the old Sam and Dave number, "Hold on, 'Cause I'm Coming." Even Microsoft officials admit that the operating system lacks applications to lure users. "Today, there isn't a truly compelling reason to go to OS/2, especially if you want to run a single DOS application," said Microsoft vice president Scott Oki during the recent IBM PS/2 Forum in Boston. "But there will be in the next few months." Oki said the public doesn't see the development going on in corporations, which are converting their own mainframe programs to run under OS/2 on PS/2s. A lot of companies are developing full-blown Presentation Manager versions of in-house applications, using the Common User Access (CUA) interface, which is the name of the "look" that IBM wants across all its systems, from mainframes to microcomputers, via the Systems Application Architecture.

IBM, like any humongous corporation, has gotten a reputation for being somewhat inflexible. But during the PS/2 road show, Big Blue executives said the company is now taking a different approach. "We recognize that, in order to meet your needs, we need to become much more flexible," said Paul Palmer, New England regional vice president for IBM, during a session with computer dealers. Asked to translate, another IBM official said, "It means that we're going to become even more market-driven; we're going to go out and ask our customers what they want, and then deliver that."

Senator John Glenn (D-Ohio) is calling for the U.S. to establish the **Advanced Civil Technology Agency** to coordinate commercial science and technology projects. "The time is right for the creation

continued

Virtual Memory, "Hot Links" Coming to the Mac OS

Apple Computer has been promising a new operating system that will swing the Macintosh into the 1990s, but some Mac users have wondered if they'd be left behind in the 1980s when the new System arrives. Based on information dispensed by Apple officials at the spring edition of the developers'

conference, the company is trying to maintain continuity in the Mac family. System 7.0 will have some impressive capabilities, but perhaps its most important characteristic is that it's supposed to run on everything from a Mac Plus to a Mac IIcx (as long as they have at least 2 megabytes

continued

NANOBYTES

of a civilian counterpart" to the Defense Advanced Research Projects Agency (DARPA), Glenn told *Microbytes Daily*. Glenn stressed that ACTA is not meant to "step on the toes" of private industry; instead, the agency would augment "projects not adequately addressed by the private sector." Glenn's bill calls for three-year, \$300 million funding of a "lean" agency staffed by about 35 "top-level" researchers, scientists, and engineers. Currently, about 100 congressional committees deal with science and technology issues, Glenn said.

The Object Management Group has formed to promote a standard object-oriented environment. The OMG environment, which will be based on Hewlett-Packard's NewWave, will run on DOS, OS/2, and Unix systems, and, according to the backers, it will allow new applications from diverse hardware platforms to work together easily. Members of the OMG, based in Westborough, Massachusetts, include HP, Sun, Unisys, Prime, Data General, 3Com, and Gold Hill Computers.

National Instruments (Austin, TX) has a new specification for a 32-bit instrumentation bus interface that it says is faster and more flexible than the GPIB (IEEE-488) spec, which some users say is poky. MXI (Multisystem Extension Interface) is a bus-on-a-cable, a protocol extender that will allow systems using the VXI (VMEbus Extensions for Instrumentation) bus to be connected to microcomputers. National has released the spec and hopes it will become a standard.

Toshiba (Irvine, CA) is now sampling a new line of 256K-bit CMOS static RAM chips that offer access times of 20, 25, or 35 ns. Toshiba also has a new video RAM that it claims will "spur development of next-generation high-resolution graphics systems." The VRAMs will be offered in 4- and 8-bit-wide versions with

continued

of memory). "There is no break or discontinuity in our System software," said Apple Products president Jean-Louis Gasse.

Apple said its new System will include virtual memory management, an improved Finder, "hot links" between applications, a new but backwardly compatible type and font model, a new Communications Toolbox, and a Database Access Toolbox for accessing host mainframe databases. In other words, System 7.0 will be Apple's answer to OS/2 and Unix.

Virtually all current Mac applications will run under System 7.0, Apple said. Those "ill-behaved" applications that have used the upper 8 bits of the Motorola 680x0 32-bit address space may not run under System 7.0 (these are applications that are not "32-bit clean").

The only feature of System 7.0 that will not work on the 68000-based Mac SE and Mac Plus is the virtual memory capability, which will allow a portion of the hard disk to appear as an extension of the machine's system memory (RAM). The virtual memory capability will require the paged memory management unit (PMMU) that's built into the 68030 or can be installed on the logic board of the 68020-based Mac II.

For Mac users, one of the big breakthroughs in System 7.0 will be the Interapplications Communications Architecture (IAC), which will support interprocess communications similar to what will be offered by Hewlett-Packard's NewWave environment. IAC's "live copy/paste" will allow multiple applications to share data and dynamically link and update the data. For example, you might use a chart from a charting program in a desktop publishing package. By specifying a "live copy/paste" link, the desktop publishing document will automatically include any subsequent changes you make to the chart using the charting program. This capability is often called "hot links" or "dynamic linking."

While live copy/paste is something for Mac users to look forward to, existing applications will have to be modified to take advantage of it. Most developers of new applications will certainly build in the live copy/paste function. The live copy/paste feature will also work across an AppleTalk network, Apple said, so that data can be shared and hot-linked among

multiple machines.

Part of System 7.0 will be Apple's new font format, which will give the Mac a WYSIWYG imaging model comparable to that of Display PostScript (used on the NeXT computer). However, Apple's new font model is in some ways better than Display PostScript—it doesn't require a license, and it will be an open, published specification. Apple's new type fonts simply replace the current QuickDraw bit-mapped fonts with a new library of fonts represented mathematically using a quadratic equation algorithm.

Since the new fonts are represented mathematically rather than by bit maps, they are completely scalable from one resolution to another. They will work on any output device from screens to printers to typesetters. Current Macintosh bit-mapped fonts will still be supported under System 7.0. But new applications will take advantage of the new fonts, which appear crisp even on an Imagewriter printer. Adobe Systems announced that it will offer a utility that converts Apple's new fonts to PostScript so that PostScript printers (e.g., the Apple LaserWriter NT and NTX) will be able to print the new fonts. However, the new fonts are independent of PostScript and will therefore also print well on less-expensive laser printers that don't support PostScript (the LaserWriter SC, for example).

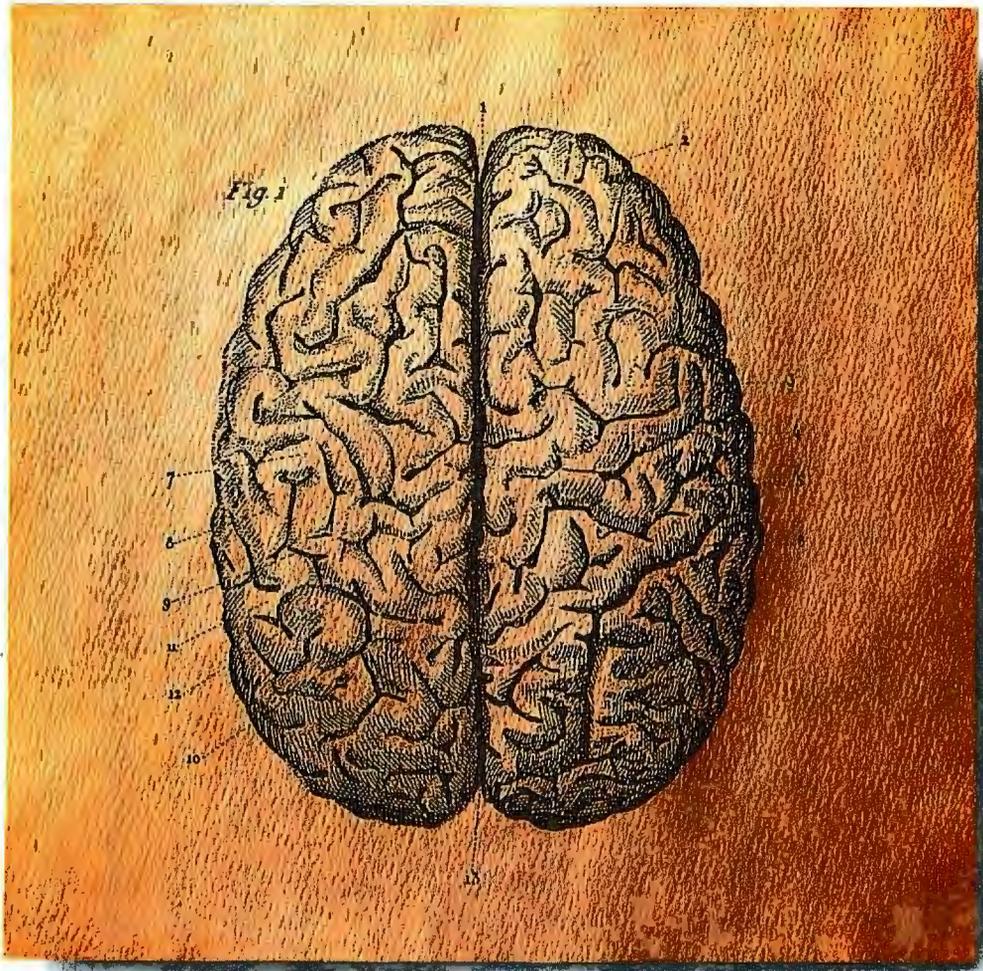
Like System 6.0, System 7.0 will support the MultiFinder multitasking system, which allows multiple tasks to execute simultaneously (e.g., a communications program running in the background and a word processor in the foreground). Because System 7.0 will offer virtual memory, the current memory limitations on MultiFinder will disappear since you'll be able to allocate additional memory on the hard disk.

However, System 7.0 will not support memory protection or preemptive execution of applications. These features, which are offered by Unix and OS/2, protect simultaneously executing applications from interfering with each other or causing the entire system to go down if one application crashes. Without these protection features, there is some risk involved in using MultiFinder, and this risk will remain in System 7.0.

Some of System 7.0's other features include an improved Finder with file

continued

Now QuickPascal makes this software go even faster.



Even the quickest minds tend to brake suddenly when confronting new languages.

Enter new Microsoft® QuickPascal Compiler.

The first Pascal that is not only powerful but easy, intuitive and 100% headache-free.

For example, our new hypertext QuickPascal Advisor offers on-the-job training: by cutting and pasting sample code you can learn to program in Pascal from scratch. And if you do hit a snag, the Quick Advisor can straighten everything out right on the spot.

To accelerate your thought processes even more, all of our processes are seamlessly integrated; no other Pascal offers you easier

access to your editor, debugger and compiler.

What's more, QuickPascal is the first PC Pascal to offer Object Oriented Programming, or OOP. With objects, you can easily assemble whole programs from modular building blocks of code and data. And once you know Pascal, OOP is a snap. Which means, you get maximum productivity with minimum effort.

Naturally, our Pascal is also fully source compatible with Turbo Pascal®.

So stop by your Microsoft dealer soon.

You'll find our software is on the same wavelength as yours.

Microsoft
Making it all make sense.

Customers in the U.S. call (800) 426-9400. In Canada, call (416) 673-7638. Outside North America, call (206) 882-8661. © Copyright 1989 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo are registered trademarks and *Making it all make sense* is a trademark of Microsoft Corporation. Turbo Pascal is a registered trademark of Borland International.

Circle 184 on Reader Service Card (DEALERS: 185)



Epson LQ-510. Narrow-carriage 24-pin printer, 180 CPS/draft, 60 CPS/letter quality, built-in push tractor, auto single sheet load, bi-directional printing for both text and graphics, four resident fonts. **Epson LX-810.** Narrow-carriage, 9-pin printer, 200 CPS/SuperDraft, 180 CPS/draft, 30 CPS/near-letter-quality, built-in push tractor. One year limited warranty on both printers. Epson is a registered trademark of Seiko Epson Corporation. SmartPark is a trademark of Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505. (800) 922-8911.

Even If It's Your First Printer

Don't Give It A Second Thought



The new Epson LX-810

This is one of the easiest decisions you will ever make. Introducing the near letter quality LX-810 and letter quality LQ-510 from Epson.



The new Epson LQ-510

To begin with, the inexpensive LX-810 is the most full-featured printer in its class—perfect for printing everything from term papers to personal finances. The LQ-510 is Epson's most affordable letter quality printer. Producing crisp, dark text and graphics, it lends a more professional look to any printed page.

Each offers features ordinarily reserved for more expensive printers. For example, Epson's advanced SmartPark™ paper handling lets you change between different types of paper almost instantly. The convenient SelecType panel makes for one-touch selection of timesteps, pitch and print modes.

Most important, both models are backed by two decades of Epson reliability, quality and value. Coming from the world's #1 printer company, that means a great deal.

Epson printers. They're first because they last.

**WHEN YOU'VE GOT AN EPSON,
YOU'VE GOT A LOT OF COMPANY.™**

NANOBYTES

access times of 100 ns and 120 ns.

Need to give your traveling computer some high-speed networking capability? **Xircom** (Woodland Hills, CA) has a new device that the company says will allow any IBM-style computer with a parallel port to hook into an Ethernet network. The \$695 Pocket Ethernet Adapter, about the size of a pocket modem, comes in versions for thick and thin Ethernet or twisted-pair wiring.

Elographics (Oakridge, TN) has developed a touchscreen driver that emulates mouse commands. Mousetrapp for Windows lets you execute mouse commands by touching the appropriate part of the company's touchscreen (e.g., slide your finger across the screen instead of dragging the mouse across the desk). Elographics says the emulator lets you perform all Microsoft Windows functions, such as moving objects, resizing windows, and activating commands. Mousetrapp intercepts the mouse interrupt calls before they reach the application program and directs them to the touchscreen driver, according to an Elographics engineer.

A new survey indicates that **Japan** is not the utopian high-tech-automation society depicted by some people on this side of the Pacific. According to the latest survey by the Japan Institute for Office Automation, there's been a drop since 1987 in the number of Japanese workers who think that office automation is making them more efficient at their jobs. The JIOA questionnaire results were more negative than in the past, with fewer respondents saying that personal computers and word processors were "creating a richer work environment" or making them more interested in their jobs.

Adding yet another acronym to the lexicon of personal computer communications, the **Crosstalk** division of Digital Communications Associates (Roswell, GA) has developed what it calls an

continued

search capabilities and an integrated Font DA/Mover, allowing you to activate fonts and desk accessories simply by dragging them into the System folder. A Communications Toolbox will provide functions for designing Mac-like interfaces to other networks and host computer systems. System 7.0 will also have a Database Access Toolbox, which will allow SQL queries to host databases using the CL/I interface language (which Apple acquired when it bought

Network Innovations last year).

While Apple officials provided a lot of technical details, they wouldn't say when System 7.0 will be ready. The company told developers they would see beta software sometime this fall. Randy Battat, Apple's vice president of product marketing, said the company hopes to ship final versions of System 7.0 a few months after the release of the beta software. Apple declined to release prices but indicated that there would be a "nominal fee."

New DOS Will Be Quicker, Smaller, Gates Says

Microsoft will release a new version of DOS that will be faster and will require less memory than DOS 4.0, according to Microsoft CEO Bill Gates, who said he didn't know "exactly when" this new version would be ready. In a question-and-answer session sponsored by the Boston Computer Society's IBM special interest group, Gates also said that OS/2 1.2, due later this year, will have a more powerful file manager and that the awaited version of OS/2 for the 80386 will arrive next year. A version for the 80486, which Gates called a "significant" chip, won't

require many software changes. "There never will be an application that's '486-specific,'" he said.

Gates predicted that a high percentage of DOS machines, "80 to 90 percent," will become Windows machines.

Despite his assurances that Microsoft will continue to support DOS, Gates made it clear that he feels the direction of desktop computing is in graphical applications. In fact, Microsoft decided not to endorse DOS extenders primarily because "It's like telling people to write more character-based applications," Gates said.

Computer Makers to Release Unix-Based Benchmarks for Motorola, Intel Machines

The Systems Performance Evaluation Cooperative, a group of computer makers better known for competing with each other than for cooperating, plans to release its Unix-based suite of computer benchmarks in September. Computers targeted by SPEC include 68000- and 80386-based machines with about 16 megabytes of system memory, said Jerry Nelson, chairman of the steering committee and R&D manager for Hewlett-Packard's Ft. Collins (Colorado) Workstation Laboratory. "Many of these benchmarks simply won't run on 80286-based machines because some images are 15- to 30-megabyte images."

The porting of the first benchmarks onto other popular operating systems will be encouraged, SPEC members said. "But the more systems-oriented things we get, the harder it will be to move away from Unix," according to John Mashey, a steering committee

member and vice president of systems technology at MIPS Computer Systems.

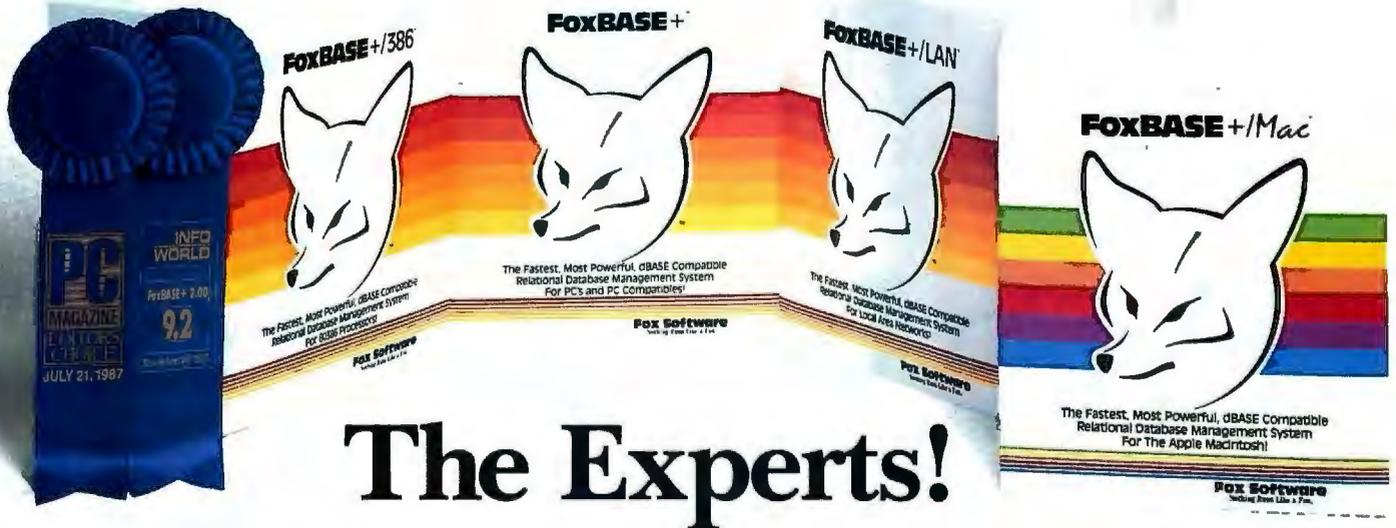
Most of the SPEC benchmarks will measure performance in engineering and scientific applications, but the group expects to also someday release business application benchmarks as well as multiuser, multiprocessing, and parallel processing benchmarks.

Dhrystones and Whetstones don't accurately measure workstation performance, SPEC says, because today's high-performance microcomputers often take advantage of mainframe and supercomputer design concepts. "Today's workstations and servers deliver high performance by using heavy instruction pipelining, multiple execution units working in parallel, large caches, fast memory systems, and optimizing compilers," said Nelson.

A possible shortcoming of the SPEC

continued

Who Says FoxBASE+ is Better than dBASE®?



The Best Just Got Better—Now Shipping New FoxBASE+ Version 2.10!

Nicholas Petreley, InfoWorld Review Board:

"FoxBASE+ has outdone itself. Once again, FoxBASE+ earns an "excellent" in performance, with kudos for responding to user suggestions. For sheer productivity, there is no other choice." *InfoWorld* "Editor's Choice" for 1987 and 1988!

P.L. Olympia, Founder & President, National Dbase Users Group / Government Computer News:

"FoxBASE+ is a supercharged dBASE, with all the features Ashton-Tate forgot. If you're into serious dBASE development and have not tried FoxBASE+, you are living in the dark ages and wasting your company's money."

George F. Goley IV, Cont. Editor, Data Based Advisor:

"The product is fast, very compatible, fast, easy to use, fast, relatively inexpensive, and very fast. In every test, FoxBASE+ outperformed the other products. And people who answer the phone at Fox know what they are talking about."

David Irwin, Former President/CEO, Data Based Advisor:

"From the dBASE compatibility standpoint, FoxBASE+ is flawless. From the speed standpoint, FoxBASE+ is unbelievable. From the "lazy factor" standpoint, FoxBASE+ is perfect."

Glenn Hart, Contributing Editor, PC Magazine:

"Initial tests of FoxBASE+ were simply stunning. In many ways, FoxBASE+ gives you the best of both worlds: all the benefits of interactive development and debugging, plus the speed and code protection of a compiler."

Adam Green, Contributing Editor, Data Based Advisor, dBASE Author:

"For the PC, FoxBASE+ has consistently set the performance standard for dBASE compatible languages. For the Macintosh, FoxBASE+/Mac will set standards for innovation and leadership in a new dBASE implementation."

Don Crabb, Contributing Editor, InfoWorld:

"You can expect blazing speed on the Mac. FoxBASE+/Mac breezes past tests that have proven stumbling blocks for Macintosh databases in the past. FoxBASE+/Mac combines complete dBASE compatibility with a genuine Macintosh user interface."

This is what they said about Version 2.00 of FoxBASE+.

Imagine what The Experts will say about New Version 2.10 with these added features: Menu-Driven Interface, Program Documentor, Screen Painter and Template-Based Application Generator . . . and Version 2.10 is even faster than 2.00!

Join The Experts. Get your copy of the New FoxBASE+ Version 2.10 today! Now available at your nearest, quality software retailer, or directly from us by calling (419) 874-0162 Ext. 320.

Because, when it comes to speed, compatibility and value, nothing runs like the New FOX—Version 2.10!

See us at COMDEX/Spring '89, Booth #7830

Fox Software

Nothing Runs Like a Fox.

Fox Software
118 W. South Boundary
Perrysburg, OH 43551

(419) 874-0162 Ext. 320.
FAX: (419) 874-8678
TELEX: 6503040827 FOX

Circle 112 on Reader Service Card

FoxBASE and FoxBASE+ are trademarks of Fox Software. dBASE and dBASE III PLUS are trademarks of Ashton-Tate. Macintosh is a trademark of Apple Computers, Inc.

Spreadsheet Rivalry Heats Up

Things are getting down and dirty, a computer analyst observes.

Dealers who have seen what will be a new drama...



RACE OF VS. POS

We Interrupt T War For This Im

To all those unlucky enough to be stuck smack in the middle of the current spreadsheet confusion, take heart.

There is, at last, a viable alternative to war: revolution.

One that delivers even more performance than you have (ahem) been waiting for, but without demanding expensive new hardware or extensive retraining. And without abruptly cutting you off from any user in your company, even those on mainframes.

The name of the spreadsheet is SuperCalc®5.

And what it can do for you is, frankly, quite revolutionary.

Let's begin at the end. Stand-alone quality graphic capabilities have been built in.

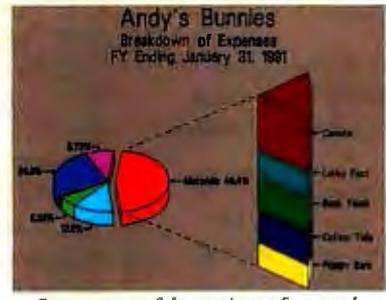
Offering hundreds of presentation treatments from word charts to three-dimensional bar, pie, scatter, and polar graphs.

And with SuperCalc5, you select fonts, lines, boxes, grids and shading. All of which can be used to produce the highest quality customized reports.

Plus, SuperCalc5 actually makes productivity easier. An integrated Undo feature simply reverses unwanted commands. And a truly comprehensive system of debugging highlights costly errors and analyzes macro logic.

Perhaps even more impressive

is the way SuperCalc5 can link spreadsheets. Up to 255



Present a state-of-the-art picture of your work.

Andy's Bunnies					
Mid-Year Consolidation					
	North	South	East	West	Total
Line	\$24,390	\$201,445	\$288,551	\$46,317	\$2,088,422
Grand Total	\$141,614	\$193,249	\$192,463	\$194,222	\$643,164

Andy's Bunnies					
Quarter 1 Results					
	North	South	East	West	Total
Line	\$29,444	\$274,061	\$144,198	\$281,438	\$1,029,165
Grand Total	\$14,167	\$78,324	\$97,413	\$99,558	\$198,162

Andy's Bunnies					
Quarter 2 Results					
	North	South	East	West	Total
Line	\$14,165	\$99,442	\$144,461	\$143,199	\$1,051,657
Grand Total	\$7,109	\$28,444	\$198,842	\$96,222	\$56,597

Link just about everything in sight.



Catch bugs before they come back to bite you.

© 1989 Computer Associates International, Inc. 1240 McKay Dr., San Jose, CA 95131. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. Excel is a registered trademark of Microsoft Corporation.

**POWER
TION**

the field had been ranked and the odds
personal computer spreadsheet software

**New program
es to fend off
spreadsheet war**

...GE, Mass. — Lo-
red to fight the
war with sweep-
its reseller pro...

• A restructuring
MIF plan. The
aining com
ophant

**Spreadsheet
Ready to Pounce**

January 28, 1989

**Gain
on Riv**
...creating a spreadsheet
...distortion...

The Spreadsheet portant Update.

to be precise. Linking either in memory or on disk, either pages of the same spreadsheet or independent, either SuperCalc5's files or Lotus® 1-2-3®'s.

and compatible computers but also takes full advantage of 286 and 386 machines when *you* decide to make that transition.

And if all that isn't enough to make you run out today and join the revolution, there's even more incentive.

Like our free demo disk offer through July 31, 1989. And our \$100 upgrade offer for just about any spreadsheet you're using. Call 1-800-531-5236. In Canada call 1-800-663-6904.

Which finally brings us to our admittedly biased outlook for the much touted spreadsheet war. With SuperCalc5, peace is at hand.

Andy's Bunnies

Income Statement
FY Ending January 31, 1989
Unaudited

Revenue	Vol	Rev Per
Sales		
Live	\$5,778,433	\$1,200,000
Theatrical	\$1,444,775	\$170,000
Sales Discounts	\$624,760	
Sales-Related Fees	\$279,981	
Other	\$748,259	
Cost of Sales		
Operating Inventory	\$9,662,251	
Production	\$109,814	
Freight In	\$26,727	
Shipping Inventory	\$9,232,885	
Cost of materials	\$2,324,133	
Other	\$2,097,981	
Direct Labor	\$1,647,261	
Employee Benefits	\$286,390	
Rental expense	\$275,444	
Travel Cost of Sales	\$4,811,252	
Gross Profit	\$2,596,642	
Less selling, general and admin expenses	\$469,382	
Depreciation (Good assets amortization)	\$2,284,273	
Other income and expense		
Interest income	\$11,209	
Other income	\$17,399	
Gain (Loss) on sale of fixed assets	\$221	
Provision for income taxes	\$28,829	
Current income taxes	\$1,043,382	
Deferred income taxes	\$1,014,553	
Net earnings (Loss) for period	\$3,625,387	

Produce annual-report quality output everyday

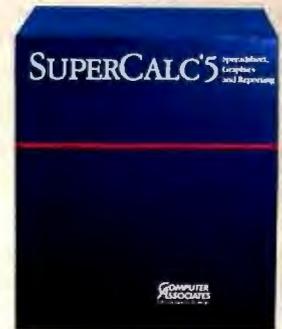
Letting you easily move 1-2-3 macros into SuperCalc5 and back again. Even toggling between menus is a snap for SuperCalc5.

But not for Excel®

Which now brings us to the "E" word. Unlike Excel, SuperCalc5 runs on all IBM®

Microsoft, IBM is a registered trademark of International Business Machines.

Circle 63 on Reader Service Card



NANOBYTES

Asynchronous Communications Server, generally called a modem pooler. A modem pooler allows users on a LAN to share asynchronous devices, such as modems, without each personal computer needing to have its own modem card. The basic ACS software will support as many as four serial devices and sell for \$795, said Jeff Garbers, director of software development, at the recent CITEX show in Atlanta. At that time, the software was in final beta testing.

Asked for his reaction to Hewlett-Packard's acquisition of Apollo Computer, which would make HP the world's biggest vendor of Unix workstations, **Sun Microsystems CEO Scott McNealy** said, "That's one less OSF member. It's kind of a nonevent." Both HP and Apollo are members of the Open Software Foundation, which hopes to challenge AT&T and Sun with its own rendition of Unix. McNealy speculated that the merger came about because "one company couldn't go it alone, and the other couldn't catch up."

Speaking of OSF, the group's schedule for releasing components of OSF/1 is as follows: The Vendor Kit, for members to port the OSF kernel to their platforms, is supposed to be ready in October; the Application Kit, which will provide software developers with the OSF application environment, is slated for March 1990; the University Platform, which will be a functionally complete OSF/1, will be given to universities and other beta sites for testing starting in May 1990; and the Commercial Platform, the OSF/1 for the rest of us, is slated for July 1990.

Avid Technology (Burlington, MA) has a new Mac IIx-based system for editing film and video. The Avid/1 Media Composer digitizes full-motion, 30-frames-per-second National Television System Committee video onto the Mac's hard disk. An editor can then directly manipulate and assemble the digitized "clips" into finished sequences using a dual editing

continued

benchmarks is their size and complexity. The source code of the entire suite will likely exceed 100 megabytes. Each of the hardware-specific applications (compilers, multiprocessor applications, graphic design applications) requires extensive work to port them to new hardware.

The SPEC steering committee represents both sides of the campaign for a standard user interface for Unix, with members that belong to the Open Software Foundation (most notably, HP and Apollo) and members from

Unix International (the AT&T loyalist faction). Apollo, HP, MIPS, Digital Equipment Corp., and Sun Microsystems all have representatives on the steering committee. Other SPEC members include Data General, Motorola, Multiflow Computer, and Stellar Computer. IBM, a late addition to the group, will not be on the steering committee until after release of the first suite, according to Nelson. Any company can join SPEC, provided it can afford the \$10,000 initial fee and dues of \$3000 per year.

Weitek Pushing Its Own Math Chip for Intel's 80486

Intel's 80486 chip will have its own built-in version of the 80387 math coprocessor, so some industry watchers say there won't be much of a market for add-on math coprocessors for the 80486. But that's not so, according to Weitek (Sunnyvale, CA), maker of high-speed FPUs. Weitek has developed its own math coprocessor for the 80486, called the Abacus 4167, that the company claims offers two to three times faster numeric performance than that offered by the 80486.

Despite the built-in 80387 coprocessor on the 80486, Weitek hopes to convince OEMs to provide the 142-pin socket on their 80486 logic boards. Such a socket is required to accommodate the new 4167 coprocessor. According to Weitek product manager Mauro Bonomi, Weitek already has lined up several OEMs to support the new chip. The 4167 offers full binary compatibility with Weitek's 3167 coprocessor, which can be used in several major 80386-based systems, including the Compaq Deskpro 386, the HP Vectra, and the Sun386i.

Compatibility with the older 3167 coprocessor is important because it will allow the chip to run a growing number of applications that support the 3167. These applications include VersaCAD, CADKEY, Mathematica, Ansys, the HOOPS graphics package, and many other products for scientific, engineering, and statistical analysis. Several major vendors of DOS and Unix compilers offer C, FORTRAN, and Pascal compilers for the 3167 (Green Hills, Silicon Valley Software, MetaWare, Lahey, and MicroWay).

The new Weitek chip could fill a need in the market, but industry

observers see good news and bad news ahead. The good news is that the 80387 is probably inadequate for some serious number-crunching applications; it's simply not in the same league as RISC processors like the i860 or R3000. This is where Weitek sees an opportunity.

The bad news is Intel's i860, a RISC chip that not only is a fast math coprocessor but also contains an on-chip graphics engine. This is significant since most number crunchers will probably be used in some way with graphics, which basically kills two birds with one stone. Add to that the fact that IBM seems firmly planted behind the i860 (it already has shown an experimental graphics card based on the i860), and you see some rough going for the Weitek chip.

The existing base of software that will work with the 4167 will give that chip at least a temporary advantage over the i860; software that works with the Intel RISC chip is at least a year away. And, according to Bonomi, the 4167 compares favorably to the i860 in scalar numeric operations. Although the i860 is optimized for vector operations, most applications are still designed to perform scalar numeric computations. (Vector calculations involve a scheme in which multiple calculations are performed simultaneously, rather than sequentially as in the scalar computational model.)

The Weitek 4167 will be priced at \$565 in 1000-unit quantities, adding between \$1000 and \$1500 to the retail cost of 80486 systems that include the 4167. The new Weitek chip is supposed to ship in sample quantities in September.

continued

PC EXPERTS AGREE:

Proteus® offers the fastest for the least, and supports them the most.



Proteus® sells the fastest personal computers you'll find. But as experts from BYTE, InfoWorld, Personal Computing, and others have discovered, our computers are more than just fast.

"The Proteus is an excellent value for the performance it offers potential buyers. Its speed, expansion capability, and service contract put it in a class with the big boys."

Personal Computing Magazine

"You get... fifteen months of service coverage – and onsite at that. Even without the warranty, we highly recommend this machine."

Computer Buyers Guide

"A remarkable range of performance and operational capabilities."

Ed McNierney, BYTE Magazine

For custom configurations and new low prices, call Proteus Toll-Free.

"This IBM-compatible is so fast I have had trouble measuring its speed."

Business Computer Digest

"Proteus is markedly faster than any other personal computer we've worked with, including Deskpro 386/20."

Personal Computing Magazine

"The Proteus is one of the fastest desktop computer systems we tested, a zero-wait-state hot rod."

InfoWorld Magazine

"...a complete multi-user solution that arrives with all peripherals and operating systems installed and tested... a very powerful machine that does what it claims."

Computer Shopper Magazine

PROTEUS 286-16

- 16MHz, ZERO WAIT STATE
- 80286 CPU running at 16MHz
- 640K RAM
- 8 expansion slots
- 5 drive bays
- 2 serial & 1 parallel port
- 1:1 interleave
- Hard disk & floppy controller
- 200W power supply
- 101-key enhanced keyboard
- 15-month on-site service free
- Made in U.S.A. **\$1,495**
- 30-day money back guarantee

COMPLETE SYSTEMS:

- Monochrome System \$1,656
- EGA Color Plus System \$2,112
- VGA 16-bit 800x600 System \$2,407



PROTEUS 386-20

- 20MHz, ZERO WAIT STATE
- Intel 80386 CPU at 20MHz
- 1MB RAM – Expandable to 16MB
- Intel 82385 EE cache ctlr
- 32K fast cache
- 2 serial & 1 parallel port
- 1.2MB floppy drive
- Dual HD & floppy controller
- 1:1 interleave
- 200W power supply, 110/220V
- 101 key tactile keyboard
- 15-month free on-site service
- Made in U.S.A. **\$2,595**
- 30-day money back guarantee

COMPLETE SYSTEMS:

- Monochrome System \$2,839
- EGA Color Plus System \$3,295
- VGA 16-bit 800x600 System \$3,595



PROTEUS 386-25

- 25MHz, ZERO WAIT STATE
- Intel 80386 CPU at 25MHz
- 1MB RAM expandable to 16MB
- Intel 82385EE cache ctlr
- 32K fast cache
- 387 coprocessor support
- 2 serial & 1 parallel port
- Dual HD & floppy controller
- 1:1 interleave
- 200W power supply, 110/220V
- 1.2MB floppy drive
- 15-month free on-site service
- Made in U.S.A. **\$3,495**
- 30-day money back guarantee

COMPLETE SYSTEMS:

- Monochrome System \$3,695
- EGA Color Plus System \$4,070
- VGA 16-bit 800x600 Multiscan System \$4,595



PROTEUS SYSTEM 3400ME UNIX & DOS

MULTIUSER SYSTEM

- 80386-25 CPU, 25 MHz opt. 33 MHz
- 8-User system support
- 4MB 32-bit RAM
- Intel 82385 ctlr
- Cache Memory
- 150MB ESDI fast hard disk
- 1.2MB 5.25" or 3.5" 1.44MB fd
- Upright server Case
- 250W 110/220v power supply
- SCO XENIX/PC MOS operating sys.
- High res. 14" console/monitor
- Graphics controller
- Parallel & serial ports
- 15-month free on-site service

COMPLETE SYSTEM: \$8,795

- Choice of optional terminals & Proteus Lightwave graphics term.



Circle 229 on Reader Service Card

To order, call us direct. 1-800-782-8387

In N.J. call 201-614-7000

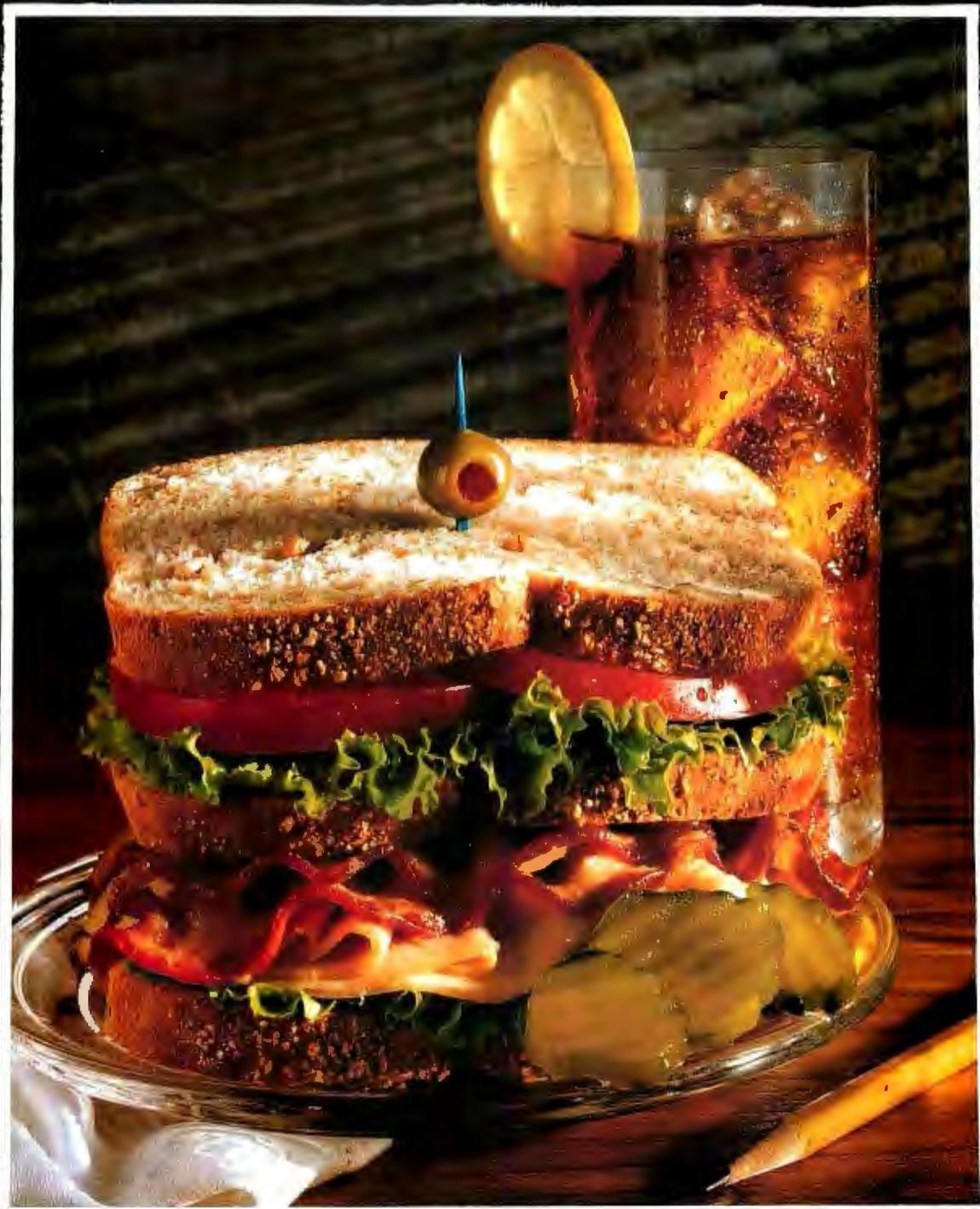
For 24 hr catalog, call 1-800-548-5036 using your modem set at 1200B or 2400B/N/8/1.

Technical Support Hotline: 1-800-541-8933 Reseller/VAR programs available.

Custom configurations available.

All trademarks recognized. © Proteus is a registered trademark of Proteus Technology Corp. All prices, terms, specs subject to change.

proteus
THE INTELLIGENT CONCLUSION
75 Kingsland Ave.,
Clifton, N.J. 07014



The least a local area network can give you is time for lunch.

Some food for thought.

Getting all the information from all your equipment to all your people can occupy all your time.

That's where the IBM Token-Ring Network can help.

With our new 16-megabit bandwidth, it provides remarkable new speed in moving everything from bulk data to mail to graphic images.

IBM's Token-Ring Network fits into most existing environments. It's compatible with today's popular software, connecting your workstations, including PCs and PS/2s®, midrange computers, mainframes and peripherals.

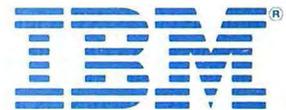
We've also designed it for reliability. With IBM software, it's easy to diagnose, isolate and correct problems, without affecting the rest of your network.

It's another reason why no other company connects more companies with more equipment to more people than IBM.

For more information on IBM local area network solutions, contact your local IBM Advanced Product Dealer or your IBM marketing representative.

We can help your entire organization run more smoothly and productively. And that means you can devote your time to other important matters.

Bon appétit.



NANOBYTES

window that puts source and edited material onto the screen. The basic Avid/1 sells for about \$50,000 with an 8-megabyte Mac IIx and a 600-megabyte hard disk drive, which can hold about 25 minutes of video.

Meta-Software (Campbell, CA) has ported its **HSPICE** program for simulating analog circuits to 80386-based personal computers. The \$4000 software requires an 80387 coprocessor and at least 4 megabytes of RAM.

Microsoft has started shipping version 5.0 of its **FORTRAN** Optimizing Compiler. This one will support OS/2's 16-megabyte addressing capability and dynamic link libraries. It's also designed to support a wide variety of VAX and VS syntax, the company said. Besides a new graphics library, the \$450 compiler package comes with a new version of CodeView for working with OS/2 programs as big as 128 megabytes.

The Instrument Society of America (Research Triangle Park, NC) has a new quarterly magazine, *Industrial Computing*, covering the use of computers on the factory floor.

Informix (Lenexa, KS) says it will develop a version of **WingZ**, the very graphical spreadsheet program that runs on the Mac, for Apollo's line of Unix-based workstations. The program will use OSF/Motif as its user interface, a spokesperson said.

Database for chemists: The National Institute of Standards and Technology is offering a new database of 2000 chemical reactions and more than 5000 data entries compiled by NIST scientists. The agency says the database (NIST Standard Reference Database 17, Gas Kinetics) is a good tool for modeling combustion systems or chemical processes taking place in the atmosphere. (Contact the Office of Standard Reference Data, NIST, A320 Physics Building, Gaithersburg, MD 20899, (301) 975-2208.)

ATs Get Boost from IIT's New Coprocessor

Owners of AT-type systems who rely on a math coprocessor are in for a boost, and it isn't coming from Intel. A young company called Integrated Information Technology (Santa Clara, CA) plans to start shipping a chip that will serve as a direct, and speedier, replacement for Intel's 80287 FPU.

The IIT chip, which can run at up to 20 MHz, will plug into sockets that are designed for the Intel 80287, and it is designed to work with exactly the same software. IIT officials told *Microbytes Daily* that they plan to match their chip's pricing with that of Intel's (80287s currently average on the street in the \$200 to \$250 range) while offering several improvements.

The IIT chip is virtually a superset of the Intel 80287, but it differs in several important ways. The company says its chip can run all current software that works with the Intel 80287 but also has special matrix instructions, which speed up certain kinds of math operations, including

manipulating three-dimensional graphics. (These instructions, however, won't be useful unless software developers design their programs to make use of them.) Perhaps most important, the IIT chip, even at the same clock speed, performs floating-point math "two to three times as fast" as Intel's 80287, IIT officials said. If you have an 80287 in your computer, you could pull it out, pop an IIT 80287 into the socket, and get better performance, IIT engineers claimed.

According to Chi-Shin Wang and Y. W. Sing, the engineers who cofounded the company, they've been able to come up with a faster chip by completely redesigning the coprocessor. Instead of trying to "reverse engineer" Intel's chip, IIT took Intel's specifications and designed the new chip from the ground up, they said. As a result, the IIT chip has a much larger percentage of its area devoted to actually performing floating-point math, and four times as many registers as the Intel chip.

Agilis Squeezes Workstation into Hand-Held Unit

Advances in miniaturization and electronic packaging have yielded the first truly hand-held workstation. The new Agilis System, designed by engineers formerly with GRiD, 3Com, and NeXT, is a modular, battery-powered, 8088- or 80386-based computer that's about the size of a notebook and weighs from 4 to 10 pounds. It has a touch-screen interface connected to Microsoft Windows, which allows the user to operate the system with one hand. There's also built-in Ethernet and an optional radio Ethernet module, which allows wireless Ethernet networking at a range of up to 1 kilometer.

The Agilis System, made from ruggedized plastic, is built on the concept of modular slices, with each slice providing a component of the system. There's a CPU component, or

"processor slice," a communications slice, a data storage slice, and a battery-power slice. Data can be stored on memory cards, floppy disks, or the new Prairie Technology 2½-inch hard disk drives. An adapter allows the system to run on 12-volt direct current. The device is designed specifically for use in the field. The wireless networking capability allows the user (say an airplane mechanic) to connect to a host mainframe to retrieve maintenance procedures, for example.

An 80C88 processor slice with display and battery power will cost over \$4000. An 80386 system starts at about \$8000 and goes up from there depending on the configuration. (Contact Agilis Corp., 1101 San Antonio Rd., Mountain View, CA 94043, (415) 962-9400.)

NEWS STAFF SEEKS NEWS. DIAL (603) 924-9281.

The BYTE news staff is always interested in hearing about new developments that might affect microcomputers, the way they work, or the way people work with them. If you know of a project that could shape the state of the art, please give us a call at (603) 924-9281 or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.



NOW YOUR SOFTWARE CAN TEST ITSELF.

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.



Saratoga Office Center
12950 Saratoga Avenue
Saratoga, California 95070

In Europe, contact:
Elverex Limited, Enterprise House
Plassey Technology Park, Limerick, Ireland
Phone: 353-61-338177

QA Training Limited, Cecily Hill Castle
Cirencester, Gloucestershire, GL7 2EF, England
Phone: (0285) 655888

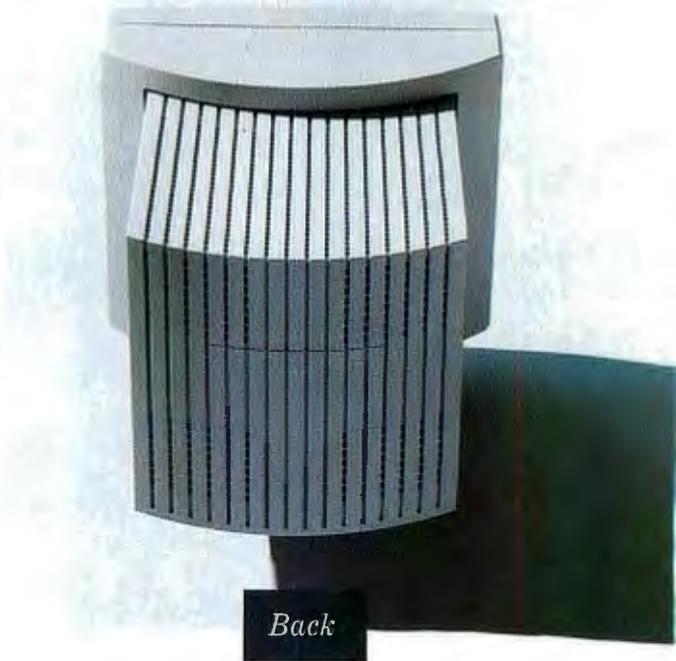
Some views on why the NEC MultiSync

There's a lot more to the new MultiSync® 3D monitor from NEC than meets the eye. Because instead of making one monitor for each



graphics board, we've developed a monitor that enhances

the performance of the modes on practically any board.



With its new microprocessor-controlled digital tuning system, MultiSync 3D can adjust to a given video standard with a precision matched only by a few high-end single-frequency monitors.

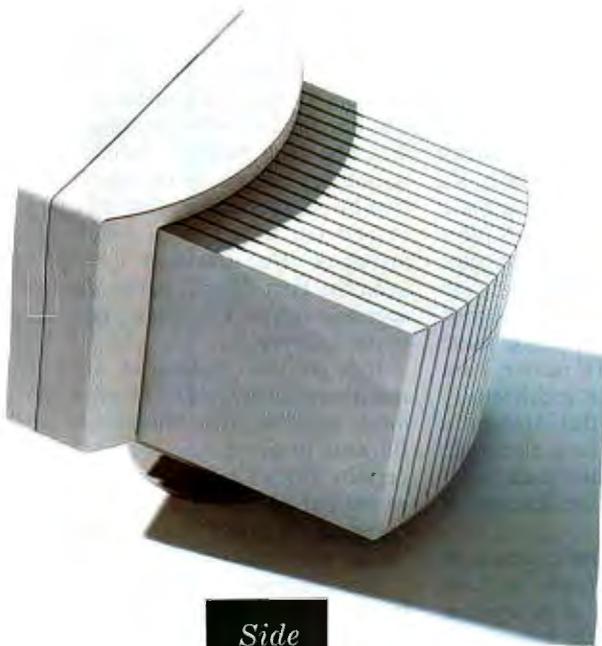
Making it perfectly compatible with virtually all systems and boards. From 8514A, SuperVGA and Mac II to VGA, EGA, MDA and

3D is the new monitor standard.

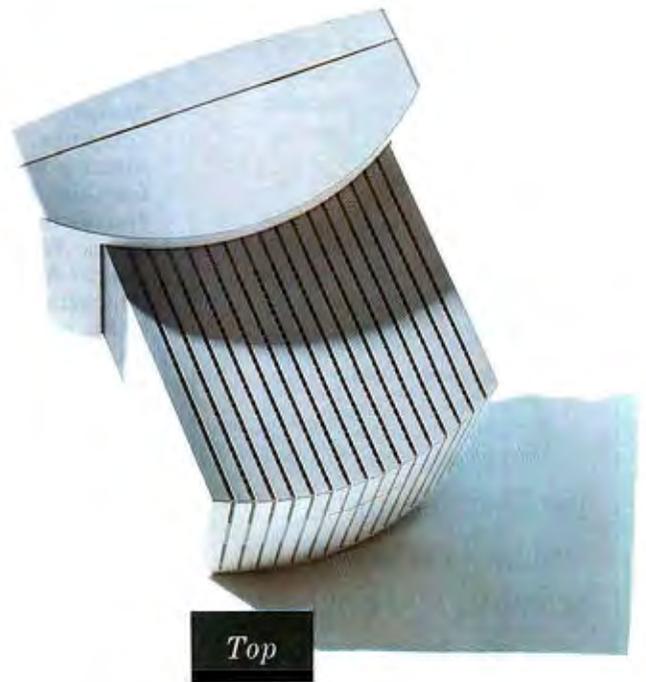
CGA. For an incredible maximum resolution of 1024 x 768.

What's more, MultiSync 3D is equally compatible with you and your workplace. There are upfront controls, for easier access. A 14" non-glare screen on a tilt-swivel base, for more comfortable viewing. And, as you can see, there's even a full 360 degree design.

The way we see it, MultiSync 3D



Side



Top

has dramatically raised the

standards by which all other color monitors will be judged.

MultiSync is a registered trademark of NEC Home Electronics (USA) Inc

For literature, call 1-800-826-2255. For technical details call NEC

Mac II is a registered trademark of Apple Computer, Inc

Home Electronics (USA) Inc. 1-800-FONE-NEC.

©1989 NEC Home Electronics (USA) Inc

NEC

JULY 1989 • BYTE 33

DADiSP..

/EX/EX/EX/EX/EX

Now Available!—DADiSP/EX
Runs 80286 and 80386-based PCs
in protected mode.
Up to 16MB addressability.



Talk to your instruments with **DADiSP-488**. Use over 150 functions to display and analyze your waveforms, as easy as typing a name. Run external data acquisition software, or *your own analysis programs*. Create new functions with *DADiSP Macros*.



the First Spreadsheet
designed exclusively for
Scientists and Engineers.

(617) 577-1133

Ask about DADiSP for IBM-PC/XT/AT, DEC MicroVAX, HP9000, Masscomp 5000, and Sun Workstations. For further information write DSP Development Corporation, One Kendall Square, Cambridge, MA 02139, (617) 577-1133

Mention this magazine and receive an Evaluation Disk FREE. A \$20 value.



LETTERS

and Ask **BYTE**

Setting the Record Straight

A book that attempts to rewrite history should be reviewed with much more skepticism than G. Michael Vose showed in his review of *The First Electronic Computer: The Atanasoff Story* by Alice R. Burks and Arthur W. Burks (September 1988). A reviewer, especially in the pages of **BYTE**, should acknowledge that this "story" is not just a deeper look at an interesting machine but also a concerted effort to discredit my father, Dr. John W. Mauchly, who is the coinventor of the ENIAC.

In their book, Alice and Arthur Burks make two huge claims—first, that J. V. Atanasoff invented "the first electronic computer," and second, that John Mauchly stole the idea of the computer from him. Both are false, as virtually the entire computer history community agrees. Why didn't Vose question these claims? As a typical **BYTE** reader, I am well versed in computer architecture, and it is obvious to me that Atanasoff's machine was not "the first electronic computer." You can examine each word, one at a time, to see if the description fits.

To be the "first" machine means to be the first machine that actually worked. Surely "the first airplane" is the one that flew, not the one that could have flown had all the bugs been worked out. The ABC computer never ran; it never solved the problem for which it was designed.

Was the machine "electronic"? Well, it did indeed use vacuum tubes for the adding circuit, so it was, in part, electronic. The other part, the memory, was

electromechanical. It was a rotating drum, and it took one whole revolution of the drum to read one number—it took one second. Any advantage of the electronic part was negated by the speed of the memory: It was slower than the relay machines of the day.

Claiming today that something is a "computer" should require that it meets the minimal definition of a computer. This means that it be *digital*, *automatic*, and *programmable*. The ABC was digital. But it was not general-purpose; it was designed to solve only one problem. Running that problem would have required several weeks of constant attention by an operator feeding punch cards in and out in a special order—hardly automatic. Had it worked, it would have been the first digital, partly electronic, special-purpose calculator; however, it never did work.

It is not the elevation of Atanasoff's machine to a new title that bothers me the most, however. It is the attempt by the Burkses to prove that Mauchly stole a certain "idea" from Atanasoff, which would put Atanasoff at the base of the computer's family tree. This is the "idea" of computing electronically.

Now, just the "idea of computing electronically" sounds like "the idea of building a flying machine"; many tried it before someone succeeded. John Mauchly worked and experimented on electronic computing for years before meeting Atanasoff. The wisdom of the day was that vacuum tubes were too unreliable to use in quantity. It took the genius of J. Presper Eckert to make 18,000 of them work in the ENIAC. But to make their "story" work, the Burkses have to make us think that Mauchly stole this unpopular idea from Atanasoff. They attempt to prove that Mauchly never thought about digital calculation in the years before he met Atanasoff.

Unfortunately for them, there is ample evidence to the contrary. There is a letter from Mauchly that states his intention to build a keyboard-operated electronic digital calculator; there is an experimental

continued

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. We can print listings and tables along with a letter if they are short and legible. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

Because of space limitations, we reserve the right to edit letters. Generally, it takes four months from the time we receive a letter until we publish it.

If You Want To Talk Fast DBMS Call 1-800-db_RAIMA And Start Screaming

You'll be screaming, all right. db_VISTA III from Raima Corporation combines the flexibility of a relational DBMS and the lightning speed of the network database model.

C db_VISTA III is written for C Programmers.

Source code available. The interactive database utilities and outstanding documentation make db_VISTA III easy to learn. All applications are portable to VMS, UNIX, OS/2, MS-DOS, even Macintosh. No royalties.

db_VISTA III is *Fast*. Using benchmarks originated at PC Tech Journal Laboratories, db_VISTA III measured 3 to 12 times faster than the average relational database! Call us and we'll send you the results.

Relational and Network Model Technology for Programming Flexibility.
Retrieve a record fast using the relational keyed access method

db_VISTA III Database Development System		
Features	Yes	No
db_VISTA 3.1 High Performance DBMS:		
Single and Multi-User available	✓	
Relational B-tree Indexing	✓	
Network Database Model	✓	
Multiple database access	✓	
Referential integrity	✓	
Automatic recovery	✓	
Record & File locking	✓	
RAM resident		✓
db_QUERY 2.1 SQL-based Query:		
Relational Query & Report Writer	✓	
db_REVERSE 1.0 Database Restructure Program:		
Total database redesign/restructuring	✓	
Operating Systems*: VMS, ULTRIX, UNIX	✓	
BSD 4.2, SunOS, XENIX, MS-DOS	✓	
Macintosh and MS Windows, OS/2 compatible	✓	
C Compilers*: Most compilers supported	✓	
C++ compatible	✓	
LANs*: 3COM, Novell, Banyan, AppleShare	✓	
WKS Library:		
Read & Write WKS, WK1 & DBF files	✓	
SOURCE CODE AVAILABLE:	✓	
ROYALTIES: (Absolutely not!)		✓✓

*Other environments are supported; call for complete list.

and all related records can be immediately available using the network model. You decide how to combine these for best application performance.

SQL Support with SQL-based db_QUERY, db_VISTA III's relational query and report writer.

db_VISTA Puts You in Some Fast Company. Thousands of C programmers in over 50 countries worldwide use db_VISTA III, including APPLE, ARCO, AT&T, EDS, Federal Express, Hewlett-Packard, IBM, NASA...

Don't wait. Call Raima for more information about how you can build applications that are *screaming-fast!*

Call 1-800-db_RAIMA
(That's 1-800-347-7246)

db_VISTA III™
Database Development System

Prices start
at \$695

RAIMA™
CORPORATION

USA: (214) 231-3131 • International Distributors:
 Belgium: 31(02159)46 814 • Sweden: (013)124780 Italy: 045/584711 Norway: 47 244 88 55
 Denmark: (2)887249 Singapore: (02)511 3277 Mexico: (83) 57 35 94 Central America: (506) 28 07 64
 Caribbean: (809) 834 4069 Colombia: (57) 362 696-4308 Uruguay: 92 19 37 Brazil: (0192) 52 9770 © 1989

BYT 7/89

counter that he built using vacuum tubes; and there are Mauchly's students at Ursinus College who remember his interest in digital electronic calculators—all this before he ever met Atanasoff. The Burkses bring up these issues and claim to refute them. But they really only pick away at little details and can only cloud the facts, not deny them. A careful reader with a little computer background can see that they are attempting a smoke screen.

The Burkses commit large sections of their book to proving what a great guy Atanasoff was and what a forgetful, un-inventive man Mauchly was. This is supposed to make it look more likely that their accusations are correct. What it actually does is turn what could have been a respectable book into a cheap shot at Arthur Burks's old rival, John W. Mauchly. No wonder the major computer publishers refused to print it.

The Atanasoff Story is extremely well written and well researched. One would assume that it is correct in its conclusions. But the history of computers is still a living, controversial subject. G. Michael Vose should have looked a little

deeper before he assumed that history had suddenly been "corrected."

John William Mauchly Jr.
Berwyn, PA

When Is a Desktop Not a Desktop?

I have used the desktop metaphor in several incarnations—on the Macintosh, on the NeXT computer, and under Microsoft Windows. I think that the designers of these environments could significantly improve the genre by simply looking at their own *real* desktops and modeling their metaphors after the real thing.

I am most familiar with the Mac Desktop, so let me use it as an example. The way I use the Mac Desktop isn't anything like the way I use my real desktop. For example, I don't have a bunch of file folders on my desk—I keep them in a filing cabinet. On my desk is a pad of paper or a notebook. I can put anything I want on a piece of paper. On the Mac, however, everything is broken up into incompatible "documents" (i.e., spreadsheet, word processor, drawing, painting, and compiler documents are all completely incompatible and can be combined only in special cases).

With my real desktop, I might take a piece of paper and put some text on it with my writing tools. Then I might get out a set of drawing tools and draw on the same piece of paper. I can also jot quick notes in the margin. I might put a table of numbers on the paper and do math calculations on them using a math tool such as a calculator. I might have a book on the desk that I'm reading from as a reference while I'm writing. All the tools are out at the same time, and all of them are working on the same piece of paper. If I need more tools, I reach into a drawer and put those tools on the desktop, too.

Operating-environment designers don't need to limit themselves to real tools. For example, desktop publishing systems have made us all familiar with the idea of "pouring" text into a frame, although none of us has ever seen a real "text pourer." A text-pouring tool might be very interesting.

All I want is an operating environment that I can draw and write on at the same time, just as I do on my real desktop.

Marshall Brain
Zebulon, NC
continued

Compact Desk.



This pocket-sized box instantly turns a portable computer into a laptop office. Introducing the WorldPort 2496™ portable fax and data modem.

If your business is like most, fax is a way of life. The WorldPort 2496 is the fax of life on the road.

Weighing less than 8 ounces, with battery, it also runs on AC power and connects to RJ11s or optional acoustic couplers for public phone

use anywhere. Via Bell or CCITT standards. It even sends and receives fax and data messages unattended or while you run other applications.

Suddenly, a laptop in the field is a full communications center. With up-to-the-minute incoming from your host. Overnight outgoing to the branches. And on-the-run faxes to any client. Over pay phones, hotel phones and PBXs worldwide.

Get the WorldPort 2496. It adds the power of your office to the portability of your laptop. And the advantages of a fax to the convenience of your desktop.

Call us today at 800-541-0345 (in New York, 516-261-0423) for more on the WorldPort line and the dealer nearest you.



Touchbase Systems, Inc.
160 Laurel Avenue
Northport, NY 11768
(516) 261-0423
Fax (516) 754-3491

WorldPort 2496 is a trademark of Touchbase Systems, Inc. © 1989 Touchbase Systems, Inc.



No Other Company We Know Imprints a Seal of Quality on Every Piece of Equipment it Ships. This Seal Guarantees Our Customers that Every Component has been Hand Inspected and Electronically Tested for 72 Consecutive Hours or More.

Samsung amber high res 14" flat screen monitor with tilt and swivel base.



All buttons and status lights easily accessible on front panel.

Modern, small footprint case with power supply.

Keytronic enhanced 101 keyboard.

The deal is straightforward. Every system is complete, tested and 100% guaranteed, built to meet the industry's highest standards. The components are from the most respected manufacturers and the system is future oriented to easily upgrade and expand.

MULTIMICRO
386/20 for \$1889

The same features and high quality components.

MULTIMICRO
Custom Computers

We'll build whatever you need to the same exacting standards.

Our Warranty Is Simple

If anything goes wrong with your MultiMicro computer, we will repair or replace it for one year from date of purchase.

Circle 196 on Reader Service Card (DEALERS: 197)

We're Proud of Our Components

Compare our 386/25mhz features before you purchase any other system:

- Intel 25mhz CPU chip is at the heart of our computer.
- Our chip set is from Chips and Technology.
- 80387/Weitek co-processor socket for future upgrade.
- The best diagnostic and set up software from AMI.
- 1mb of memory easily expandable to 8mb on the board.
- Western Digital 1:1 interleave mfm controller for fast data transfer.
- Seagate 32mb mfm hard disc with auto park provides substantial storage capacity at a fast 26ms access time.
- Your choice of Teac high density 1.2mb 5.25" or 1.44mb 3.5" floppy drive.
- Hercules compatible monographics card has 132 column capability. You also get color emulation and screen saver software.

Our phone number is 415.979.0140
or Fax 415.979.0142.

Call us anytime to place an order or discuss your computer needs.

All orders shipped COD.



We Want to be Your Computer Company

582 Folsom Street
San Francisco, CA 94105

All brand names are registered trademarks of their respective companies.

JULY 1989 • BYTE 37



CSR 286/14



CSR 286/20 SL

After years of fi we built

Introducing the best built, best backed 286- and 386-based systems.

Since 1983, CSR has been a leading microcomputer maintenance provider. We repair all major brands - IBM[†], Compaq[†] and the best-known peripherals - for the largest dealer networks and third-party service companies nationwide. So when we decided to build our own 286- and 386-based systems we knew how to make them even better.

With CSR, you can put your confidence in a company that has it all - the service, support, performance and IBM compatibility you expect - but at prices that will surprise you.

The industry's best 2-YEAR warranty.

For the first full year we provide complete on-site service on all parts and labor. During the second year we'll repair or replace any parts that fail. This revolutionary warranty demonstrates the high degree of confidence we have in the quality and reliability of our computers.

Plus, when you call our toll-free Technical Support Hotline you'll be connected to a highly-skilled Customer Engineer (CE). Your CE will either fix the problem over the phone or dispatch a Service Engineer to your site - within 24 hours of your call - for prompt, professional problem resolution.

And what's best about this CSR-exclusive is that everything is included in the price of your computer!

High performance, not a high price.

CSR delivers high performance in every machine we make. Our 286/20 uses an Intel[†] based 80286 chip that runs at a blazing 20 MHz and outperforms most 386-based machines.

And unlike some of our competitors, we don't imbed the VGA or disk controllers on the mother board - that can just lock you out of future innovations. Instead, we provide a high-speed VGA controller which supports all VGA modes. And a totally IBM-compatible disk controller which features the latest in track-buffer technology to boost drive performance by an amazing 30% to 50%.

Compatible with reality.

You've invested a lot in software. That's reality. So we designed our machines to be 100% compatible with all your MS-DOS[®] and OS/2[®] software.

And we know you have software on both 3 1/2" and 5 1/4" media. That's why *all* CSR computers have both size drives - even the low profile, small footprint 286/20 SL. It's a convenience we've added without adding to the price.

Plus you'll find our high resolution high contrast VGA monitors and "clickable" keyboard to be consistent with your definition of how a computer should look and feel.

Compatible with your budget.

You may have computing needs that are incompatible with what *other* computer companies would like you to spend. Tell *us* the details of your needs. Then tell *us* your budget. And we'll build *you* a system that's compatible with both.

So if you want a better built, better backed computer system, compare warranties. Compare specifications. Then pick up the phone and call us at 800-366-1277. We'll deliver what you need at prices that will surprise you.

Full leasing options available. Rates begin as low as \$60/mo. We accept MasterCard, VISA and certified checks.

[†]The brands or product names mentioned are trademarks or registered trademarks of their respective holders. MS-DOS and OS/2 are registered trademarks of Microsoft Corporation. Made in the USA.

CSR 386/20



CSR 386/25c



Doing their best, Ours better.

CSR 286/14 CSR 286/14 SL

- 80286 Intel based microprocessor running at 14 MHz.
- 1 MB RAM expandable to 16 MB (8 MB on the system board).*
- Page mode interleave memory architecture.
- High speed VGA controller.
- Dual Diskette/Hard Disk Controller.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- Socket for Intel 80287 or Witek math coprocessor.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 8 industry standard expansion slots. **
- Power reset switch.
- Security keylock.
- AMI bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

1 MB to 16 MB of high speed memory.
80287 math coprocessor.
Slim line case with one 5.25" and two 3.5" drive bays accessible.

NOTE: *Up to 8 MB in SL case. ** 5 expansion slots in SL case.

CSR 286/14 Hard Disk Drives	Monitors / Adapters		
	Monochrome	VGA Mono	VGA Color
20 MB 40 MS ST506	\$1,699	\$2,099	\$2,399
40 MB 40 MS ST506	\$1,899	\$2,299	\$2,599
40 MB 22 MS ST506	\$1,999	\$2,399	\$2,699
90 MB 18 MS ESDI	\$2,599	\$2,899	\$3,299
150 MB 18 MS ESDI	\$3,099	\$3,299	\$3,699

CSR 286/20 SL CSR 286/20

- 80286 Intel based microprocessor running at 20 MHz.
- 1 MB RAM expandable to 16 MB (8 MB on the system board).*
- Page mode interleave memory architecture.
- High speed VGA controller.
- Track buffered high speed dual diskette/hard disk controller.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- Socket for Intel 80287 or Witek math coprocessor.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 8 industry standard expansion slots. **
- 3 speed selectable 8 MHz, 16 MHz or 20 MHz speed.
- Power reset switch.
- Security keylock.
- AMI bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

2 MB to 16 MB of high speed memory.
20 MHz math coprocessor.
Slim line case with one 5.25" and two 3.5" drive bays accessible.

NOTE: *Up to 8 MB in SL case. ** 5 expansion slots in SL case.

CSR 286/20 Hard Disk Drives	Monitors / Adapters	
	VGA Mono	VGA Color
3.5" 1.44 MB Diskette Drive	\$1,999	\$2,299
40 MB 22 MS ST506	\$2,599	\$2,799
60 MB 22 MS ST506	\$2,799	\$2,999
100 MB 29 MS ST506	\$3,499	\$3,799

CSR 386/20

- Intel 80386 Microprocessor running at 20 MHz.
- 1 MB RAM expandable to 16 MB on the system board.
- Page mode interleave memory architecture.
- Socket for 20 MHz Intel or Witek math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Track buffered high speed diskette/hard disk controller.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- High speed 16 bit VGA controller.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 200 watt power supply.
- 8 industry standard expansion slots.
- Power reset switch.
- Security keylock.
- AMI bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

2 MB to 16 MB expansion memory options.
25 MHz Intel coprocessor chip.
Internal or external tape backup.

CSR 386/20 Hard Disk Drives	Monitors / Adapters			
	VGA Mono 1MB RAM	VGA Mono 4MB RAM	VGA Color 1MB RAM	VGA Color 4MB RAM
40 MB 22 MS ST506	\$3,399	\$4,399	\$3,699	\$4,699
60 MB 22 MS ST506	\$3,499	\$4,499	\$3,799	\$4,799
90 MB 18 MS ESDI	\$3,799	\$4,799	\$4,099	\$5,099
150 MB 18 MS ESDI	\$4,199	\$5,199	\$4,399	\$5,399
322 MB 18 MS ESDI	\$4,499	\$5,499	\$4,799	\$5,799

CSR 386/25c

- Intel 80386 Microprocessor running at 25 MHz.
- 1 MB RAM expandable to 16 MB on the system board.
- Advanced Austek Cache memory controller with 32K of high speed static RAM Cache.
- Page mode interleave memory architecture.
- Socket for 25 MHz Intel or Witek math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Track buffered high speed diskette/hard disk controller.
- Enhanced 101 tactile "click" keyboard with copy holder and dust cover.
- High speed 16 bit VGA controller.
- 1 parallel, 1 serial port and a Microsoft compatible bus mouse port.
- 200 watt power supply.
- 8 industry standard expansion slots.
- Power reset switch.
- Security keylock.
- Award bios.
- Real time clock with battery backup.
- MS-DOS and MS-OS/2 compatible.

Popular Options

2 MB to 16 MB expansion memory options.
25 MHz Intel coprocessor chip.
Internal or external tape backup.

CSR 386/25c Hard Disk Drives	Monitors / Adapters			
	VGA Mono 1MB RAM	VGA Mono 4MB RAM	VGA Color 1MB RAM	VGA Color 4MB RAM
90 MB 18 MS ESDI	\$4,799	\$5,799	\$5,199	\$6,199
150 MB 18 MS ESDI	\$5,299	\$6,299	\$5,699	\$6,699
322 MB 18 MS ESDI	\$5,699	\$6,699	\$6,099	\$7,099

To order,
please call **800-366-1277**

Circle 65 on Reader Service Card



Computer Systems Research
We build ours better.

Punish Virus Spreaders

I was disturbed by John Baltzer's letter (April). He seems to suggest that people will stop creating computer viruses if we just pat them on the head and show them what a wonderful world it would be if they would leave our computers alone. Hogwash!

How long will it be before a virus infects a computer system at a hospital, a police department, or a military installation? Will Baltzer be willing to forgive

the person responsible for causing a patient to be given the wrong medication? For an innocent person being jailed? For live rounds being used during training exercises? It's bad enough to lose several months' worth of work to a virus that trashes your disks, but to have someone killed by some misanthrope's idea of a little joke is intolerable.

Viruses and other forms of computer tampering are not just a threat to the free flow of information, as Baltzer suggests.

They have the potential to inflict enormous harm, and the people who are responsible for them should be subject to criminal prosecution. They are engaging in malicious destruction of property as surely as if they had walked into someone's office and tossed a match into a file cabinet. It's only a matter of time before something much more serious happens as a result of their antics.

I suggest that computer manufacturers, users groups, and magazines like BYTE establish a fund to be used in the vigorous prosecution of anyone responsible for the creation and distribution of malignant code. Furthermore, a portion of this fund should be set aside as a reward to anyone who provides information leading to a conviction in such a case. Education certainly has its place, but deterrence and punishment are necessary for those who refuse to learn.

Paul M. Carlisle
Royal Oak, MI

IF DESKTOP PUBLISHING WERE A BUICK, PCT_EX WOULD BE A LAMBORGHINI.

You'd expect us to say PCT_EX is hot—so don't take our word for it. In their desktop publishing systems category, INFO WORLD rated PCT_EX #1. They said:



"...No non-*T_EX*-based program has such typological aesthetics...enormously flexible and offers complete control over the output of your printer..."

And from PC MAGAZINE: "...PC *T_EX* offers ample rewards. You can achieve incredible precision in formatting text, especially mathematical expressions."

TRY THIS 

with a standard desktop system and you'll see that for complex scientific and mathematical formulation and notation, PCT_EX leaves the others back in the dust.

FORMATTING with textbook quality, and unsurpassed placement of

TYPE that rivals professional typesetting: all yours. Pick the type you like from 30+ Bitstream font families.

FLEXIBILITY Camera-ready, publisher-ready manuscripts are fast and easy. Author to printed piece time reduces, author control increases.

That's flexibility—that's PCT_EX.

$$\int_{-\infty}^{\infty} \frac{X^y \cdot Z}{X - tY} dt = \sum_{i=1}^n \left(\frac{(x^4 - i)^3}{\sqrt{Z^3 + y^{10}}} \right) \left(\frac{1}{Z - X^5 Y} \right)$$

A,
b,
c,

TEST DRIVE IT.

For a free PCT_EX demo diskette, the new PCT_EX 88 product catalog and information on a PCT_EX configuration for your system, give us a call at **415-388-8853**

PERSONAL

T_EX

INC

12 Madrona Ave. Mill Valley CA 94941

VOR O O O O O M !

PCT_EX is a registered TM of Personal T_EX, Inc. T_EX is an American Mathematical Society TM. Manufacturer's product names are their TMs. Inquire about PTI distributorships. Site licenses available to qualified organizations. This ad was typeset using PCT_EX and Bitstream fonts.

Optimizer Problems

I am writing to bring attention to a problem with versions 5.0 and 5.1 of Microsoft's C Compiler under MS-DOS. The problem appears to be with the optimizer. Consider the following source code:

```
#define items 10

double Ua [items], Va [items],
       Ub [items], Vb [items],
       Su [items], Sv [items],
       Ru [items], Rv [items],
       a;
void calculate(1)
int i;

{
  double temp;

  temp = Ua [i] - Ub [i];
  Ru [i] = temp * temp;

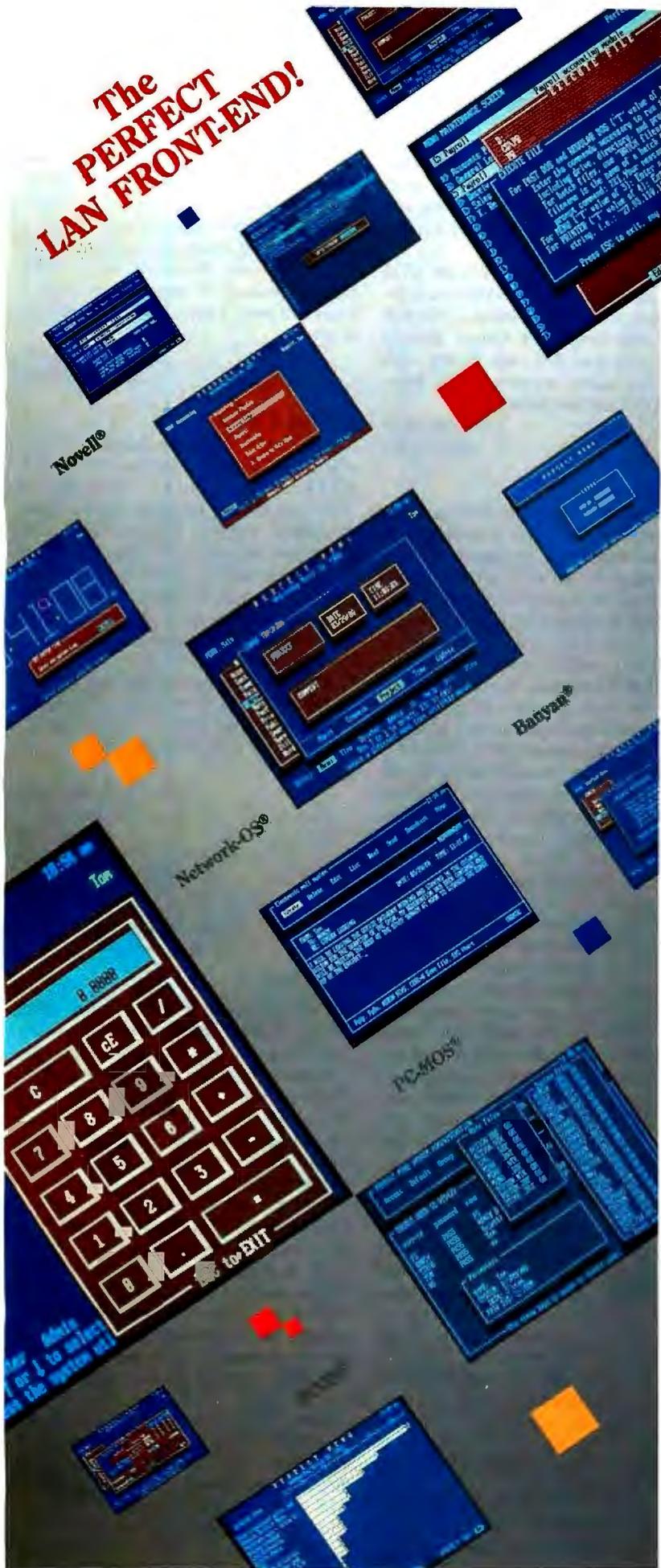
  temp = Va [i] - Vb [i];
  Rv [i] = temp * temp;

  Su [i] = Ru [i] * a;
  Sv [i] = Rv [i] * a;
}
```

When the above code is compiled with the default options of the c1 command (time optimization on), the resulting code calculates the Ru [i] and Rv [i] correctly. However, in order to calculate the Su [i], it does not use the value of Ru [i] as specified by the program but instead uses the value of temp * temp.

continued

The PERFECT LAN FRONT-END!



Meet Perfect Menu. The Perfect LAN Front-End.

Menu Program, System Administrator, Electronic Mail System, Usage/Project Tracker, Security Watchdog, and much more, all in one program for your DOS LAN or stand-alone.

Perfect Menu is a total LAN Front-end solution—compatible with ALL DOS LANs (Novell, 3COM, PC-MOS, Network-OS, Banyan, you name it). For all its power, **Perfect Menu is completely Non-Memory Resident**, and self-installs across any network, to any local, redirected and virtual drive of any size.

Perfect Menu gives you access to 640 individual menu selections with over 10,000 command options for each user. Menus can even be nested up to 32 levels deep! Perfect Menu lets you create a Common Integrated User Interface—tailor it to your specifications and needs.

Perfect Menu gives you System Administrator sophistication, power and ease-of-use with features like advanced security control, innovative usage and project tracking, handy PIM tools and much more. Perfect Menu's autonomous System Administrator program sports more tools than we have room to explore. Suffice to say—it defines power and convenience.

And, if all of the above is not enough, Perfect Menu comes with a full feature E-mail system! You have to see Perfect Menu to believe it, check it out today!

PERFECT MENU Family

◆ LAN PAK/UNLIMITED Users Per File Server.

If you're looking for best value in network front-end, menu, E-mail, usage/project tracking, security and productivity software—then this is the perfect selection! Easy to setup, administer and use, yet completely customizable and extremely powerful and sophisticated. It's simply perfect.

Retail Price: \$349.95

◆ LAN PAK/FIVE User Network.

If you have a PC-based network or applications, then our five user version sets the standard for small networks! Not only is it easy-to-use, it's easy-to-administer and has all the power of its Unlimited Big Brother. Of course, if you have growth in mind, all versions are fully upgradeable.

Retail Price: \$195.95

◆ BUSINESS PAK/Stand-alone.

With our single user BUSINESS PAK, many users share one stand-alone computer. You can have all the power of the PERFECT MENU network versions as you administer productivity—not headaches!

Retail Price: \$84.95

◆ BASIC SYSTEM/Single User.

Want perfection at home? PERFECT MENU BASIC SYSTEM is as powerful as it is easy to use. At a \$49.95 suggested retail, it's one of the best values in its class.



International Computer Group, Inc.
18520 Office Park Drive
Gaithersburg, MD 20879
(800) 833-2324, (301) 670-7007 in MD,
(301) 330-7274 fax

Trademarks are registered to their respective manufacturers.

which is incorrect, since the contents of temp have been overwritten during the calculation of Rv [1].

This bug results in numerical errors in the executable code. If all optimization is turned off, the produced code is correct. I wrote a letter to Microsoft about this bug in June 1988. A couple of months later, I received a call from Microsoft's product-support department, saying that the people there were able to reproduce the bug and advising me not to use the optimizer!

Contrary to Microsoft's advice, I keep using the optimizer, but I have stopped using one temporary variable to store different intermediate results, especially results from indexed variables. I just let the optimizer handle the optimizations, and I have no problems, but now I compare the results of the program that have been produced with the optimizer to the results of the same program produced with all the optimizations turned off.

Fotios J. Kehayias
Bohemia, NY

Manzana's Good Enough for Me

Jeff Holtzman's review of advanced floppy disk drive controllers (March) came about a month too late for us, but my wife and I must disagree strongly with some of his findings.

My wife and I have a CompuAdd 80286 IBM AT clone with a hard disk drive and two (1.2-megabyte and 360K-byte) floppy disk drives. Naturally, when I got a PS/2 at the office, it was time to install a third (1.44-megabyte) floppy disk drive in the vacant drive bay to give me convenient work/home compatibility.

We're on a tight budget, so after getting descriptions of the Manzana Mux Card, we decided to cheap out with that card (\$99.95 includes the driver software) and a 1.44-megabyte floppy disk drive (Chinon) that CompuAdd sells for \$89.

The bottom line to all this is that installation was really no problem. In marked contrast to Holtzman's experience, we found the 1988 version of the Manzana Mux Card manual well written, clear (with pictures of the card and the proper connections), and reasonably easy to follow, even for a non-computer expert like me. We installed the drive and then carefully followed the Mux Card hardware installation procedures. My wife capably handled the software end, and we were up and running in an afternoon. Here, we agree with Holtzman: It has performed flawlessly ever since. We can now read, write, and for-

mat both 720K-byte and 1.44-megabyte disks as drive D and can even copy from drive D to drive E. We haven't had any compatibility problems so far with either my office PS/2 or software.

So if your readers with ATs (or XTs) need a cheap but clearly effective solution to the problem of adding a 3½-inch floppy disk drive to a system already loaded with two 5¼-inch floppy disk drives, we highly recommend the Manzana Mux Card and software.

Gene Baizman
Albany, NY

Ideal Keyboard Design

For 13 years, I've been waiting for a computerized keyboard to replace the modified typewriter keyboards of current computers. An ideal computer keyboard would have programmability, several preprogrammed keyboard arrangements, blank keys, and several type-through soft "skins" that contain all the symbols of a particular keyboard. There should be four standard keyboard arrangements preprinted on four separate soft skins: the conventional QWERTY arrangement; the Dvorak keyboard; the Dvorak left-hand keyboard; and the Dvorak right-hand keyboard. The latter two would be for handicapped persons using only one hand. There should also be extra blank skins for personal keyboard arrangements.

I use the Dvorak keyboard arrangement, but, as an author, I want all the keys to be infinitely programmable, so they should be blank. I want to program a blank skin for my own customized keyboard, relocating oft-used keys (e.g., quotation marks, question mark, and exclamation point) under my fingers.

Pharmacists, word processors, accountants, statisticians, engineers, and others could program their own unique keyboards. Changing keyboard arrangements would be as simple as switching soft skins and selecting one of the standard or customized keyboard codes.

The ideal keyboard would be an 8-bit computer with 65K bytes of memory for programming. The four standard keyboards should reside permanently in ROM, and other keyboards could reside in EEPROM. The remaining memory would hold long and involved keystroke sequences, activated by a function key. For some people, especially those who work with graphics, such programming could use all of what remains of the 65K bytes of memory.

The keyboard should be portable and therefore as simple to attach and detach from the computer as a lamp is to line

current in a wall jack. On the right and left sides of the keyboard, you could attach—as, when, and if needed—a trackball, a joystick, and a mouse, all by a standard input attachment. All the above is possible and practical, and I think many thousands of persons need such a keyboard now. I hope we'll soon be able to get one.

Edward L. Tottle
Baltimore, MD

Up with UPS

Thank you for the fine editorial coverage afforded ITT PowerSystems in the April BYTE Product Focus, "Curing the Brownout Blues" by Steve Apiki, Stanford Diehl, and Rick Grehan. The article as a whole was extremely impressive. As one outside source said to me yesterday, "When you have a color photo of an oscilloscope screen showing the waveform at the actual moment of cutover—that's in-depth!"

Also, the text box "What Is a UPS?" by Mark Waller is the best explanation I've seen on that subject. I hope you receive many fine compliments on the article.

Charles B. Ballinger
ITT PowerSystems Corp.
Galion, OH

ASK BYTE

Grep This

For the past year, I've been using DOS on my 12-MHz IBM AT with great success. However, since I use Unix at work, I've always had the notion that someday I would get Unix for the AT also. Well, my fascination with DOS has just about run out. It's a reasonable operating system, but I long for multitasking and virtual memory.

I started looking around for a small Unix port—no, I don't want networking; no, I am not rich; no, I have only 1 megabyte of RAM on my machine. The choices seem to be very limited. There is Microport's System V and SCO Xenix, but they are far too memory-hungry and far too expensive (2.5 megabytes for Microport System V, and SCO Xenix costs \$1500!).

Isn't there a small Unix kernel out there that will allow the millions of AT owners to use Unix without draining their bank accounts? I've heard of IBM's AIX and a couple of others, but I know nothing about them. My last resort is to

continued

THE FIRST GRAPHIC SPREADSHEET.
THE LARGEST, FASTEST AND MOST VERSATILE SPREADSHEET EVER.

WINGZ™

“If you use Excel, you'll be up and running with the \$399 Wingz almost immediately—the learning curve is not an obstacle to upgrading to it.”

“You get total control over visual elements of the spreadsheet... it produces graphs that are nothing short of awesome.”

“Wingz has more features than any Macintosh or DOS spreadsheet on the market, but is easy to use and learn.”

—MacGuide

“Wingz towers over Excel.”

“Wingz is fast. Faster than Excel or Full Impact in recalculation speed as well as in opening and saving files.”

“The most extensive graphing capability of any current Mac program.”

—MacWeek

INGRAM
MICRO D
BEST SELLERS LIST
MAY 1989
based on actual units shipped
APPLE/MACINTOSH PRODUCTS
BUSINESS
1 | 5 **WINGZ • INFORMIX • (MAC)**

“The most exciting piece of software I've ever used on the Macintosh... Wingz opens up virtually the whole of the Macintosh box of tricks.”

“Wingz is as significant in its own way as MacPaint and HyperCard.”

—MacUser U.K.

“Philip Welt, group product manager for Microsoft's analysis business unit, conceded that the newest upgrade to Mac Excel is partly the result of competitive pressures coming from Informix. ‘Wingz has focused on output and graphics. They've hit us in a place where we haven't moved our product ahead.’”

—Computerworld

“Wingz is a nice replacement for Excel.”
“Go for the gold and purchase Wingz.”

—InfoWorld

MACUSER RATING
WINGZ ★★★★★

Available now for Apple® Macintosh® computers.

TO FIND A WINGZ DEALER NEAR YOU CALL (800) 331-1763, EXT. 1000

INFORMATION MANAGEMENT SOFTWARE FROM INFORMIX®

Copyright © 1989 Informix Software, Inc. Informix and HyperScript are registered trademarks and Wingz is a trademark of Informix Software, Inc. Apple, Macintosh, MacPaint and HyperCard are registered trademarks of Apple Computer, Inc. Microsoft is a registered trademark of Microsoft Corporation. Full Impact is a trademark of Ashton-Tite Corporation.

Circle 141 on Reader Service Card

ZEOS[®]

Systems of Choice



296/SS

Complete 12MHz 286
with 32MB Hard Drive!
Only \$1395.00

It's the fastest 286-12 you can buy. Workhorse of the industry. Rugged from the ground up. This true Zero-Wait state system features a fast Seagate auto-park hard drive. Nothing can touch it!

- 80286-12 CPU, 6/12MHz Dual Speed keyboard/hardware selectable. Reset and Turbo buttons right up front.
- Zero-Wait State DRAM, 512K expandable to 4MB on the motherboard (16MB System Total). EMS capability!
- Fast 32MB Seagate 138R Hard Drive with auto-park, 1.2MB Floppy Drive.
- Ultra high speed Hard/Floppy controller. I.I interleave, 300 KB/sec transfer rate.
- High-Res Amber Display. Tilt/Swivel Base.
- ZEOS Enhanced 101 Key Keyboard, with Pleasant Tactile/Click Feel.
- Serial and Parallel Printer Ports.
- Clock/Calendar with Battery Backup.
- 6-16 and 2-8 bit expansion slots.
- 80287 support, up to 12MHz.
- Heavy Duty Case complete with Security Lock and LED indicators.

20MHz 286 HARD DRIVE SYSTEM
286/20—At 20MHz, the fastest 286. Complete with our 32MB, 33ms Hard Drive and 1MB RAM. This is what Dazzling Speed is all about. Only \$2095.00

"Out of 104 machines from 58 companies...for overall excellence in both the 16- and 20MHz categories we selected ZEOS International's 386-16 and 386-20" PC Magazine, May 30, 1989

In the May 30th issue PC Magazine reviewed 104 machines from 58 manufacturers. Virtually every '386 in production was tested. The systems were grouped into three speed categories, 16, 20 and 25MHz. In two of the three categories only one company was selected for "overall excellence."

That company is ZEOS International.

We appreciate the recognition. It speaks directly to the goals and objectives of our company. Simply, to deliver to you the very best value in computing today. To further quote PC Magazine:

"Price is always a consideration. So are benchmark results.

But both factors can be deceiving, which is why we consider other aspects that will make the difference months and years down the road. Things like quality of construction, reliability, expandability and ease of service."

We couldn't have said it better. These are the qualities we build into every ZEOS system. That's our commitment. To quality. To performance. To reliability and support. To Value. When compared to virtually every other manufacturer in the world PC Magazine called it "overall excellence."

In all areas ZEOS systems are top performers. Take our guarantee for instance. We offer every customer a 30 day Full Refund Satisfaction Guarantee. And that's backed up by our Full One Year Limited Warranty and our Express Parts Replacement policy.

And there's Technical Support. At ZEOS, Technical Support is not only free, it's Toll Free. Seven days a week, 365 days a year.

Quality, Performance, Reliability and Support. Overall Excellence. These qualities make ZEOS systems your best choice. So pick out your dream machine today and order it now with confidence. Your choice of ZEOS excellence is, in a word, Guaranteed. Order now by calling 800-423-5891.

All prices and specifications are subject to change without notice. Please call for current pricing and warranty details. ZEOS is a publicly traded company; MPLS/St. Paul Local OTC. ©1989 ZEOS International, Ltd., 530 5th Avenue, N.W., St. Paul, MN 55112



386SX

The New ZEOS 386SX Hard Drive System. Below '286 Prices!
Only \$1895.00

The future is now!

PC Magazine says "386SX-based machines are the right choice..." the new ZEOS 386SX is why. The future is yours now with the new ZEOS 386SX. It's even priced below comparable '286 systems!

- 80386SX-16 CPU, 8/16MHz Dual Speed Keyboard Selectable. Reset/Turbo buttons.
- 512K DRAM, expandable to 8MB on board (16 MB System Total).
- Shadow RAM and EMS capability.
- Fast 32MB Seagate 138R Hard Drive, 1.2MB FDD
- Ultra high speed Hard/Floppy controller. 1:1 interleave, 800 KB/second transfer rate.
- High-Res Amber Display, Tilt/Swivel Base, compatible graphics controller.
- ZEOS Enhanced Tactile/Click keyboard.
- High Speed Serial and Parallel ports.
- 6-16, 2-8 bit expansion slots. 80387SX Math coprocessor support.
- ZEOS space saver case. Including Security Lock and LED indicators.

Options Galore: As PC Magazine said, "more options than even the most configuration hungry hound could possibly need." Including 14" VGA, add only \$595. An incredible selection of hard drives: SCSI, RLL, ESDI and MFEM! Virtually any other add-on you could want. Corporate leasing plans are available, too. Call Toll Free for details 800-423-5891.



386DT

Complete ZEOS 20MHz '386 System. 80MB SCSI Drive!
Only \$2995.00

16 MHz systems from \$2295!



The new '386 desktop standard. Featuring our 64K CACHE (twice that of most competitors) providing Zero-Wait State performance vastly superior to page/interleave memory schemes. Incredible value.

- High speed Zero-Wait 64K SRAM CACHE.
- Genuine 32-bit Intel 80386-20MHz CPU.
- 1MB of Zero-Wait DRAM Expandable to 16MB System Total.
- Fast 80MB, 28ms SCSI Seagate Hard Drive, 1.2MB Floppy Drive.
- High speed HDD/FDD SCSI Host Adapter with Software.
- Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.
- 101 Key ZEOS Tactile/Click keyboard.
- High speed Serial and Parallel Ports.
- 1-32, 6-16 and 1-8 bit slots.
- 80387 math coprocessor support.
- ZEOS 5-bay case. Including Security Lock and LED indicators.



386V

Complete 25MHz '386 Vertical System. 80MB SCSI Drive!
Only \$3995.00

Complete 33MHz systems only \$4995!

ZEOS 25MHz and 33MHz 80386 systems are the fastest, most advanced available anywhere. Review after review, these ZEOS systems are selected as the best price/performance buys. A power-user's dream.

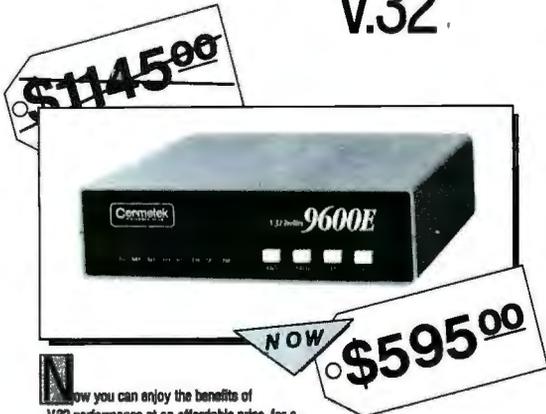
- High Speed Zero-Wait 64K CACHE.
- Genuine 32-bit Intel 386-25 or 33MHz CPU.
- 1MB Zero-Wait 32-bit DRAM expandable to 8MB on board plus 16MB 32-bit expansion (24MB total).
- Fast 80MB, 28 ms SCSI Seagate Hard Drive, 1.2MB Floppy Drive.
- High speed HDD/FDD SCSI Host Adapter with software.
- Genuine Hercules® brand graphics controller. High-Res Amber Display with Tilt/Swivel.
- 101 Key ZEOS Tactile/Click keyboard.
- High Speed Serial and Parallel Ports.
- 1-32, 6-16 and 1-8 bit slots.
- 80387 and Weitek 3167 support.
- Heavy Duty 6-bay Vertical Case. Desktop configurations deduct \$150.00!

Order Now Toll Free
800-423-5891



FAX Orders Dial: 612-633-2310
In Minnesota Call: 612-633-4591
MasterCard, VISA and COD
Open days, evenings and weekends
Se habla Español.

AFFORDABLE V.32



Now you can enjoy the benefits of V.32 performance at an affordable price, for a limited time only. The Cermetek 9600E is a CCITT V.32 compliant modem featuring full duplex communications from 4800-9600Kbps. It offers trellis encoding, backward error correction, near-end/far-end echo cancellation, adaptive equalization, asynchronous or synchronous, 2- or 4-wire leased line with leased line dial back-up, 1 year warranty and MORE.....

You too can own the modem of choice. Hurry and place your order now while quantities last. Call or write us today: Tel: 800-862-6271 / 408-752-5000 Fax: 408-752-5004

Cermetek Microelectronics, Inc.
1308 Borregas Avenue
Sunnyvale, CA 94088



buy the source for a small kernel and put virtual memory into it myself.

Paul A. Merrill
New South Wales, Australia

We share the same desire for an affordable Unix for ATs. I make do by using the MKS Toolkit Unix shell and utilities for MS-DOS on my AT. I connect to the Unix minicomputer here at BYTE for doing serious Unix work. Although this does not fulfill my desire for a 10-MIPS workstation on my desk, it does serve the need to keep the working environment familiar from machine to machine. Real Unix requires real resources: memory, processor, licenses, and usually money.

The thought of modifying an operating system to use virtual memory in a dependable way makes me shudder. Don't forget that you have to change the compiler libraries as well as the kernel. However, if you are extending a popular operating system like Minix, the effort will not be a waste of time. Others would love to benefit from your efforts. There's a large community of Minix hackers, but Minix was written primarily for learning operating-system design concepts, and many of the enjoyable features of Unix are missing. Unless you like writing and porting utilities more than you like using them, you should buy a commercial Unix.

Because all real Unix licenses require the developer to license source code from AT&T, they all cost more than \$100. The most for the least is probably a Bell Technologies two-user license discounted to about \$300. Don't expect much printed documentation, however. (TRC in California, (213) 937-8822, is a source.)

Another excellent way of purchasing Unix is to buy an AT&T 7300 Unix PC. Although the machine is no longer manufactured, support for it continues. I'll grant that the Unix PC is not a high-performance computer, but it is very functional. (Contact Discovery Electronics, 775 Franklin Rd., Suite 100, Marietta, GA 30067, (800) 346-8243.)

Incidentally, the August issue of BYTE will begin a new Unix column by David Fiedler, who has a dragon's lair of public domain programs for Unix. He'll be able to help you keep things inexpensive once you've decided which direction to take.

—B. S.

Temperature-Sensitive

Could you tell me why my three-year-old IBM PC clone doesn't like cold weather? It's a Leading Edge Model D with 640K bytes of RAM, a 20-megabyte Seagate hard disk drive, and a floppy disk drive.

continued

Call us for a free AnthroCart catalog: 800-325-3841



**Anthro®
Technology Furniture®**
3221 N.W. Yeon St.
Portland, Oregon 97210
(503) 241-7113

Anthro, AnthroCart and Technology Furniture are registered trademarks of Anthro.

The MAXI RD45:

Blazing Speed.
Low Cost/Megabyte.
Convenient 45MB
Portable Cartridges.
SCSI Flexibility.
For PC, PS/2, Mac.

Need We Say More?

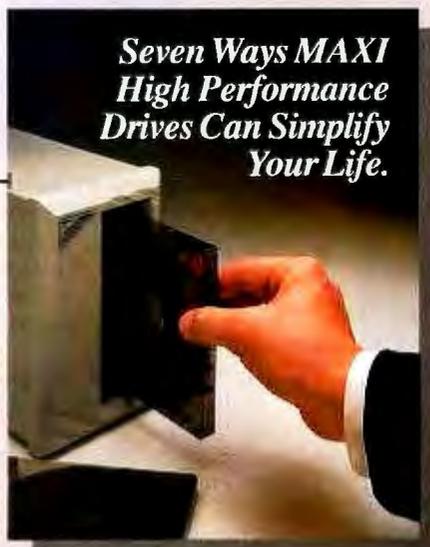
Then call for this
free brochure.

We'll also give you the name
of your nearest Sysgen MAXI™
dealer, and an application for
a free evaluation unit.

Hotline: 1-800-821-2151

SYSGEN
INCORPORATED

556 Gibraltar Drive, Milpitas, CA 95035



All registered and unregistered trademarks indicated above are the sole property of their respective holders.

Circle 272 on Reader Service Card

It works fine in warm weather. But when room temperature is below 50°F, this machine cannot be booted. After the power-on self test, it tries to find something from the hard disk with no success. This may be a ROM scan, or perhaps the system's searching for the hidden files. The hard disk light is constantly on. The same thing happens in booting with the floppy disk. But if I turn it off after a few minutes of machine warm-up and boot again, the machine is normally bootable. After that, no problems whatsoever occur for the whole day. Was this machine made for the southern country or something?

Jae K. Lee
Fremont, OH

I don't know whether your disk controller board is one of the hard disk/floppy disk combination boards. If so, my guess is that you have a temperature problem on that board—specifically, a loose solder joint or (heaven help you!) a hairline crack on one of the circuit traces. When your machine is cold, contraction of components causes an open circuit. As the machine warms up and parts expand,

the broken connection closes and the machine boots.

Go for the easy fixes first. Try reseating all the circuit boards and data cables. Then try (carefully!) reseating any socketed chips on the hard disk/floppy disk controller board. If those tricks don't cut it, try reseating socketed chips on the system motherboard—again, carefully.

If you're still dead in the water, the next step is to play the continuity game, which may be out of the question if you don't have a logic probe (or at least a volt-ohm-milliammeter). I suggest you locate a trustworthy repair shop or see if anyone in your local PC users group does repair work on the side.—R. G.

Filled to the Gills

I own a 1983 model IBM PC. I recently added a hard disk drive, 384K bytes of memory, and a math coprocessor. I'm out of expansion slots, but I'd like to add even more things. Are there any controller cards that can handle a 30-megabyte hard disk drive and one or more floppy disk drives?

Martin L. Smith
Fairbanks, AK

Plenty of controller cards can handle multiple hard disk drives and floppy disk drives. I suggest that you check the back of BYTE for ads from companies like JDR Microdevices.

However, if all you're looking at is adding an extra hard disk drive, the board you already have can probably support two hard disk drives as it is. I'm guessing that you're using an ST-506-compatible interface, and most controllers of that variety already have the extra connector for an additional drive. All you need is the proper cabling and an external drive housing. Again, do some mining in the back of BYTE.—R. G.

Senility Sets In

An academic friend of mine has a venerable Kaypro CP/M luggable with a 10-megabyte hard disk drive literally stuffed to the brim with various text files written with a program called Perfect Write. He has never made any backup of this valuable information (he's not what you'd call a power user). I attempted to make a backup for him, but the disk utility somehow got overwritten. All documen-

continued

The most powerful expanded memory software available.

TURBO EMS



Turbo EMS now includes "Automatic Spillover" and special support for Windows, Excel, DESQview, and Ventura.

- Provides "Automatic Spillover" between any combination of expanded memory, extended memory and disk file space
- Simulates LIM 4.0 expanded memory with LIM 3.2 hardware
- Allows customized individual configuration files for multiple software applications
- Supports the LIM XMS 2.0 specification for extended memory
- Provides up to 32 megabytes of LIM 4.0 expanded memory
- Totally network compatible and relocatable to RAM between 640KB and 1 megabyte

Turbo EMS \$99.95 Suggested retail

For the name of the dealer nearest you or for more information call Lantana.

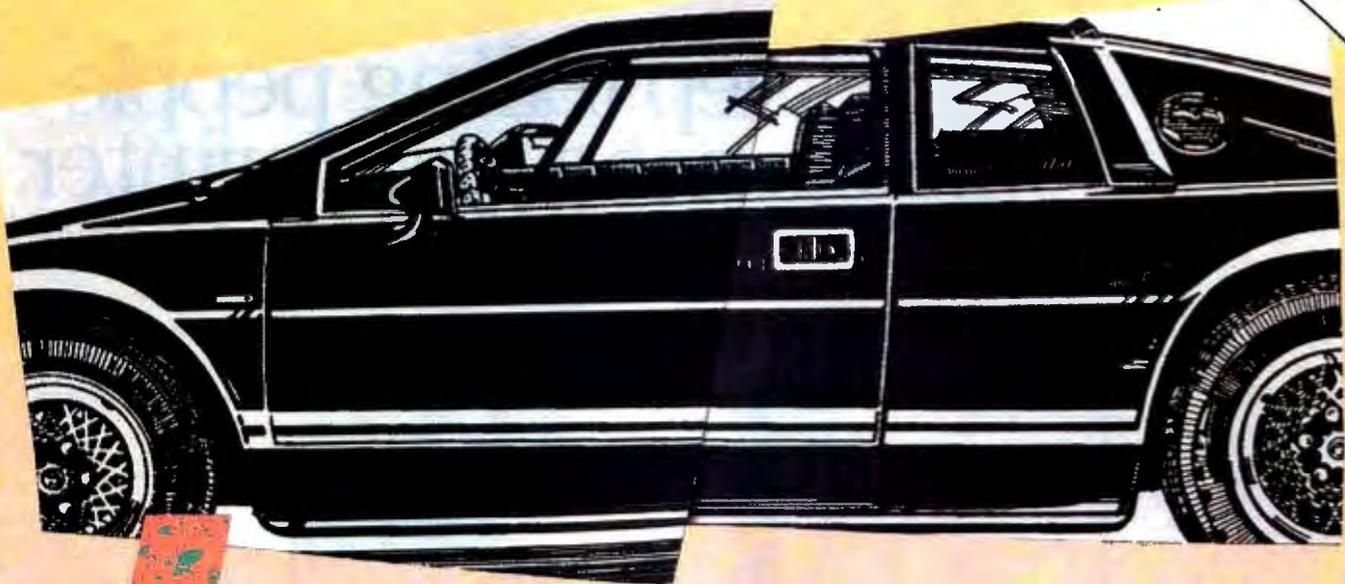
4393 Viewridge Avenue, Suite A • San Diego, CA 92123 • 619/565-6400 • FAX 619/565-0798



These unretouched print samples show the superior print quality of QMS-PS 810 over printers using first-generation print engines.



Now \$4995!
Suggested Retail Price.



Introducing the PostScript laser printer that blacks out at high speeds.

The new QMS-PS® 810 can compose and print the most complex pages in record times, with richer, more saturated blacks than ever before. All with the desktop publishing power of Adobe PostScript®, and the superior print know-how of QMS, an industry leader.

Under the hood QMS ASAP™ (Advanced System Architecture for PostScript) is proprietary technology that helps eliminate the hardware bottlenecks that hinder other PostScript printers. As a result, QMS-PS 810 boasts processing speeds remarkably faster than other PostScript printers in its class. And faster output means greater productivity. In addition, the QMS-PS 810 laser

printer's new Canon® SX® print engine covers solid areas and prints fine detail better than previous-generation engines.

Fast start, strong finish You can adorn your documents with one or all of the 35 Adobe typefaces. Thanks to PostScript, there's an infinite number of font variations available. You can also make type as large or as small as you want. And put it anywhere on the page. In fact, with PostScript you enjoy total control over the design of your page. It gives you the complete desktop publishing power to do things that would otherwise be virtually impossible. So you get high-quality output exactly how you want it.

Along with PostScript, the HP LaserJet+™, Diablo® 630 and HP-GL™ printer emulations are added for your non-PostScript software.

The QMS-PS 810 laser printer is easy to use, maintain, and comes with a one-year warranty. It's available from Laser Connection dealers. Laser Connection is a sales and marketing subsidiary of QMS. For the dealer nearest you call **1-800-523-2696**.

**The new
8-page/minute
QMS-PS 810
laser
printer**



LASER CONNECTION™

A QMS® company

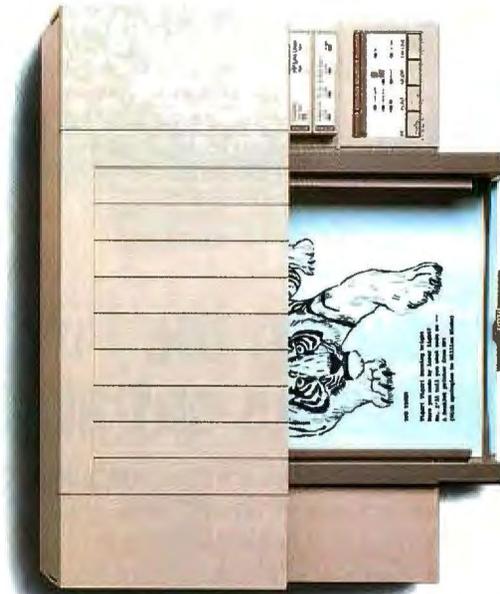
The following are trademarks of their respective companies: QMS, QMS-PS, ASAP, Laser Connection of QMS, Inc. PostScript of Adobe Systems, Inc. Canon, Canon SX of Canon, U.S.A. LaserJet+, HP-CL of Hewlett-Packard, Diablo of Xerox Corp.

©1987 Laser Connection

Circle 230 on Reader Service Card

JULY 1989 • BYTE 49

We keep telling people
this is not a laser printer.



The new \$995 HP DeskJet PLUS Printer.

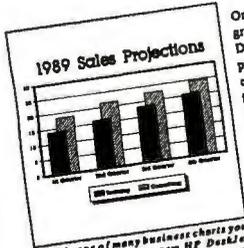
But they keep looking at the evidence.



Mr. Arnold R. Jones
220 Bush Street, Suite 845
San Francisco, CA 94104

Dear Reader:

Imagine being able to put out merged text and graphics that look like a laser printer. In fact, that your clients will think you're using a laser printer. Yet you're using the \$995 HP DeskJet PLUS printer instead.



This is one of many business charts you can print out on the new HP DeskJet PLUS printer. Software for this text and graphics demonstration by Harvard Graphics.

Sincerely,

Alan Grube
Alan Grube

One reason you can't get around so many graphs around so fast is that the HP DeskJet PLUS printer can create your most popular software programs and your favorite programs and graphics beautifully.

We call it a price that's small, price, that's right.

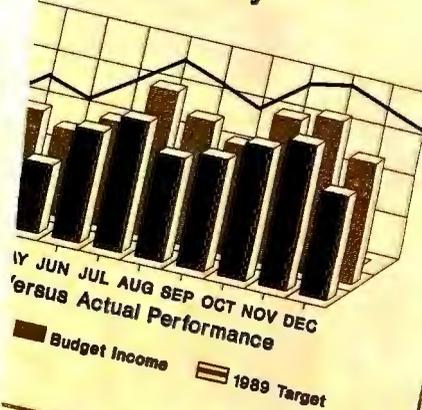
Of course, you know how good it is. It's a real trip to you for yourself.



THE TIGER

Tiger! Tiger! burning bright
Were you made by laser light?
No, I'll tell you what made me —
A DeskJet PLUS printer from HP!
(With apologies to William Blake)

MegaCorp 1988 Sales History



You won't believe your eyes (or ears), either. The HP DeskJet PLUS printer gives you the same crisp, black lettering. Clean, sharp graphics. And whisper-quiet operation. But it uses advanced inkjet technology to supply these laser-like qualities for the price of a 24-wire printer.

For just \$995, you get 300 dpi in a trim 15-pound package that's twice as fast as the original. What's more, it has built-in landscape and improved font selection. Including ten built-in fonts and over 100 optional fonts, with sizes up to 30 points. And its 20,000-hour MTBF

assures a long, happy life.

So call 1-800-752-0900, Ext. 276J for the name of your nearest authorized HP dealer. Then judge the HP DeskJet PLUS printer for yourself.



tation and associated floppy disks have long since vanished.

To worsen matters, the machine is getting a little senile. Sometimes it will write to disk, sometimes not. Wild cards seem to exacerbate the glitch. I think that, in order to make a backup, I will have to copy each file to a floppy disk, one by one.

My friend will shortly be purchasing an IBM AT-class laptop with a hard disk drive. My question is this: Do you know

of any public domain software that will get his files over to DOS? He'd like to be able to preserve the formatting, if this is possible.

B. J. Lachance
Rochester, NH

The least-expensive way to get files from the Kaypro to the PC is to locate some good public domain communications software packages for each machine and transfer the files via a serial port. This

can be somewhat time-consuming, but it gets the job done with a minimal investment in dollars. Check the Public Domain section of the Buyer's Mart at the back of BYTE.

Another possibility that you might look into is Uniform from MicroSolutions (125 South Fourth St., DeKalb, IL 60115, (815) 756-3411). This allows a PC disk to read from and write to disks in virtually all the CP/M formats, and it would certainly be less painful than the serial transfer route.—R. G.

Visual Aid

I am interested in exploring certain Lisp-based AI projects that involve computer "recognition" of objects and people. Inevitably, this involves capturing a frame of video pixels and storing them in memory somewhere so that pattern-recognition techniques can be applied to find out what the camera/computer is "looking at."

Since I already have a Phillips VKR 6850 video camera, it would be nice if I could find some sort of interface card that would permit this camera to feed video information into my PC. Otherwise, I realize that I might have to buy a new camera designed to work with a specific interface card.

Is there an appropriate interface card on the market for this purpose?

David J. Steele
Singapore

Dig out your May through August 1987 issues of BYTE. The Circuit Cellar ImageWise video digitizer may be just what you're looking for. You won't need any expensive interface boards, just a composite output from your camera and an RS-232C port on your computer.

—R. G.

SUNDAY 10-5

GRAPHIC CARD
ATI VGA 200 249.99
ATI VGA 200 249.99

FACSIMILE
Canon Fax 15 599.99
Canon Fax 15 599.99

PRINTERS
Dymo 100 205.99
Dymo 100 205.99

LAPTOP
Compaq Laptop 1000 2999.99
Compaq Laptop 1000 2999.99

COMPAQ
Compaq 386 499.99
Compaq 386 499.99

NEC
NEC 386 499.99
NEC 386 499.99

TOSHIBA
Toshiba 386 499.99
Toshiba 386 499.99

INTEL CO. PROC.
Intel 386 499.99
Intel 386 499.99

HAND SCANNERS
OCR Software 179.99
OCR Software 179.99

LASER PRINTERS
Apple Laser II X 349.99
Apple Laser II X 349.99

MODEMS
Hayes 149.99
Hayes 149.99

SOFTWARE
Microsoft 149.99
Microsoft 149.99

MONITORS
NEC MultiSync 300 499.99
NEC MultiSync 300 499.99

MOUSE
Logitech Mouse 49.99
Logitech Mouse 49.99

EXECUTIVE ORGANIZER
Executive Organizer 49.99
Executive Organizer 49.99

GUARANTEED LOWEST PRICES

COMPUTERS & ELECTRONICS
West 21 Street, New York, N.Y. 10011
Tel: (212) 463-8330
Fax: (212) 463-8335
Toll Free: 1-800-874-1235
Toll Free: 1-800-223-6779
In N.Y.S.: (800) 223-6779
In Canada: Toll Free 1-800-666-1668

ALL MERCHANDISE SHIPPED IN FACTORY SEALED CARTONS. 100% GUARANTEED

FIXES

- Our March What's New item on Flexi-CAD (page 94) listed an incorrect phone number for Amiable Technologies. The correct number is (215) 222-9066.
- The price of a μ DACS was incorrectly reported in the May What's New (page 78). The price is \$10,000, which includes an XT clone, four four-port transceiver cards (\$1495 each), and one switching card (\$2495). The XT add-in cards can also be purchased separately. Contact Frederick Engineering, Inc., 10200 Old Columbia Rd., Columbia, MD 21046, (301) 290-9000. ■

THE SIVA 386 20MHZ SYSTEM

delivering superior Quality, Performance & Value!

VNS includes many important options as standard: **\$1995**
 40MB Hard Disk, 1MB Memory and more! Priced at

Meet us at



June 20-22, '89
 Booth 2028



"20 MHz SIVA 386
 makes an excellent file server..."
 Bruce Brown



Complete System Features:

- 32-bit Intel 80386-20 CPU
- 1MB of 32-bit RAM on board expandable to 16MB
- 16/20 MHz keyboard selectable
- ST-251-1 Seagate 40MB formatted 28ms high speed, with ultra high speed controller 1:1 interleave
- 1.2MB high capacity floppy drive
- Super deluxe heavy duty tower case with 7 half-height drive bays
- High-resolution 12" non-glare amber display; Tilt and swivel base, Hercules-compatible Adapter
- 101 key enhanced keyboard; pleasant "Tactile-Click" feel
- 80287/387 math co-processors optional
- Fully compatible with virtually all XT/AT and 386 software

System Upgrades:

- VGA color upgrade — add only \$495
- EGA upgrade — add only \$395
- 80 MB — \$395
- Call for all other options and upgrades

Please call us for information on the great XENIX Software/SIVA 386 System offer.

NEW SIVA 286 20MHZ SYSTEM

\$1595



Complete System Features:

- CPU 80C286 at 16/20 with Zero Wait RAM
- Expandable to 4MB on board (STD 1MB)
- Award BIOS with built-in setup
- 40MB hard drive; 1.2MB floppy drive with high speed floppy/hard disk controller 1:1 interleave
- High resolution 12" monochrome monitor with tilt and swivel base
- Real time clock calendar with battery back-up
- On board 80287 co-processor socket
- 4-16 bit and 1-8 bit expansion slots available
- 2-Serial, 1-Parallel and 1-Game port
- 101 keyboard fully AT-compatible
- DOS, OS/2, XENIX-compatible

Call us for delivery details on the popular 12MHZ SIVA 286 Model 210 System at \$1295

*We Welcome Inquiries
 from OEMs and VARs*

VNS America Corp.

*Order Now Toll-Free
 1-800-252-4212*

910 Boston Post Road • Marlboro, MA 01752 U.S.A. • In MA 508-481-3726 • FAX: 508-481-2218

All prices subject to change without notice.

Circle 293 on Reader Service Card

Working Hours: 9 a.m. - 6 p.m. E.S.T. Monday - Friday



—Fred Molinari, President

Introducing QuickCapture™ for the PS/2. The first and only frame grabber that's tailor made for the MCA.

QuickCapture is a real breakthrough for the Micro Channel.™
Add it to your PS/2 and you'll be able to capture, store, and display images directly from video cameras, VCRs, or still-video devices *in real time.*

Then, your images can be displayed continuously or in freeze frame on an RGB analog video monitor.

Imagine it.
Real-time image capture and display, square-pixel resolution, and 256 shades of gray on a single, plug-in board.

Image processing tailor made for the MCA.

Call (508) 481-3700
In Canada, call (800) 268-0427

FREE 1989 Image Processing Handbook.



DATA TRANSLATION®

World Headquarters: Data Translation Inc., 100 Locke Drive, Marlboro MA 01752-1192 USA, (508) 481-3700 Tlx 951646
United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG11 2QJ, U.K. (0734) 793838 Tlx 94011914
West Germany Headquarters: Data Translation GmbH, Stuttgarter Strasse 66, 7120 Bietigheim-Bissingen, West Germany 01742-54025
International Sales Offices: Australia (2) 662-4255; Belgium (2) 466-8199; Canada (416) 625-1907; China (1) 868-721 x4017, (408) 727-8222; Denmark (2) 274511; Finland (0) 372144; France (1) 69077802; Greece (1) 951-4944, (31) 527.039 (1) 361-4300; Hong Kong (5) 448963; India (22) 23-1040; Israel (3) 5401524; Italy (2) 82470.1; Japan (3) 502-5550, (3) 348-8301, (3) 355-1111; Korea (2) 756-9954; Netherlands (70) 99 6360; New Zealand (64) 9-545313; Norway (2) 53 12 50; Portugal (1) 545313; Singapore (65) 7797621; South Africa (12) 8037680/93; Spain (1) 455-8112; Sweden (8) 761-7820; Switzerland (1) 723-1410; Taiwan (2) 7020405

QuickCapture is a trademark and Data Translation is a registered trademark of Data Translation, Inc. All other trademarks and registered trademarks are the property of their respective holders.

CHAOS MANOR MAIL

*Jerry Pournelle answers questions about his column
and related computer topics*

Auto Analogy

Dear Jerry,

Your column was a good read, but the analogy was faulty—the Macintosh an automatic and the IBM PC a stick shift (“Stick Shift or Automatic?” October 1988). This analogy subtly favors MS-DOS systems. I don’t own a Mac, and I’m quite satisfied with my IBM PC XT clone, so I’m not a Mac nut trying to convert you.

I don’t think you appreciate the things that make the Mac so appealing to so many people. For starters, I’d modify your analogy. The Mac is like any car you buy at a dealer. It’s a stick shift with some options, but it has a lot of standard features.

The IBM PC, on the other hand, is a car kit that has zillions of options, and you can’t even move the thing unless the nice salesperson does a crude assembly. On your way home, you realize that you have to steer by typing in the angle of each turn and accelerate by specifying the proper rate and proportions of gas and air. Needless to say, you immediately stop—not that you were going anywhere—and phone a friend who passes as an expert mechanic. You have to put up with an incessant gush of technical explanations from this person, who hopes that one day you will understand. This friend also leaves you with the impression that you are mentally deficient if you don’t learn auto mechanics.

Everything in the IBM has to be installed! Sure, you can buy a steering wheel, but there are so many—you can’t just buy one, plug it in, and then go. You have to install it. This means hours, sometimes days, of reading and trying it out. Sometimes it won’t even work with the particular model you bought. Then when you finally get a simple system ready and you learn how to make a small trip, you find that you have to go through the misery for every trip because the car works differently for every destination.

Steve Jobs summed up the original Mac philosophy of computers when he said, “Now we know what they use them for.” If you want a racing car, build one

from scratch or buy a Ferrari—don’t buy a Chevette with options. Like a car, the most functional designs are integrated around a known purpose. Windows may seem like the Mac interface, but the most significant difference is that it is an option that will be bypassed or discarded by everyone who thinks he or she has a better way.

The last bastion of IBM’s “philosophy” is that the Mac is a mental crutch—if you use one, you’ll never learn computing. Engineers see it as a disease and will often not allow one on their premises. Bosses are particularly susceptible to the IBM sales pitch, since many of them believe that employees are half-wits to begin with. “THINK” is hung lovingly on the wall.

André Roussil

Quebec, Montreal, Canada

Well, I'm not sure I agree, but you do have a point.—Jerry

Truth Stranger Than Fiction

Dear Jerry,

Do you remember the good old days when IBM ruled over the whole micro-computer market? Order and peace were everywhere, and users were happy.

Look around you nowadays. What you see is chaos. Why? Because the subjects revolted against Big Blue—their Emperor—and don’t agree with its new proposal: PS/2, which, good or bad, must become a de facto standard for everybody, both user and manufacturer, dealing with the Intel 80x86 CPU. Otherwise, we shall all be left orphaned with no more safe landmarks either on the software or the hardware side. (Of course, something of the ancient order is still in place. But just how long will it

continued

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 "jerryip."

situation:

**Puzzled over
which Pascal
compiler is best
for you?**

solution:

**BLAISE
COMPUTING
INC.**

**Our tools support both
QuickPascal and Turbo Pascal.**

POWER TOOLS PLUS/5.0 \$149

Full featured function library

- ◆ Features context sensitive help screens
- ◆ window oriented pick lists
- ◆ multiple-line edit fields with fully configurable edit keys
- ◆ moving bar pull-down menus and windows
- ◆ in-memory sort routines
- ◆ EMS support
- ◆ TSRs and ISRs
- ◆ and much more!

ASYNCH PLUS \$129

Asynchronous communication manager

- ◆ Features speeds to 19.2K baud
- ◆ XON/XOFF protocol
- ◆ support for up to 4 comm ports
- ◆ hardware handshaking
- ◆ XModem file transfer
- ◆ I/O buffers up to 64K
- ◆ and much more!

POWER SCREEN \$129

Screen I/O manager

- ◆ Features screen painter
- ◆ virtual screens
- ◆ data validation
- ◆ context sensitive help
- ◆ unlimited screens
- ◆ definable keys
- ◆ and much more!

Fast, flexible and affordable!

Blaise Computing offers programming tools that are fast, flexible and affordable. Call now to order or to ask for a free brochure on our full line of products for C and Pascal.

FREE with these products!

Source code, complete sample programs, a comprehensive reference manual with extensive examples, the Norton Guides Instant Access Program, and a comprehensive online database.

Supports QuickPascal and Turbo Pascal!

All of these products support Turbo Pascal 4.0, 5.0, and 5.5 and Quickpascal 1.0.

Put Blaise tools to the test!

If at any time during the first 30 days you are not completely satisfied with their speed and flexibility, we'll refund your money.

Call (800) 333-8087 today!

FAX: (415) 540-1938

BLAISE COMPUTING INC.

2500 Ninth Street, Suite 310 Berkeley, CA 94710 (415) 540-5443

Turbo Pascal is a registered trademark of Borland International.
QuickPascal is a registered trademark of Microsoft Corporation.

survive? A quarter? A year perhaps. And later on?)

Worse, I heard that the rebels' league is pregnant and will give birth to a child soon. The name of this crossbreed is EISA (Extended Industry Standard Architecture).

I cannot live with this thought in mind, because I'm sure that if division in the microcomputer world starts, it will never end. And it's easy to figure out where that will lead: to a new chaotic era.

So tell me, Jerry, that IBM is going to make use of its dark side of the Force to bring order into the microcomputer galaxy one more time. Tell me that the Empire will strike back again. Tell me all this is not science fiction.

L. Zambotti
Milano, Italy

I fear things will remain chaotic. The Empire will strike back, but the rebels have a lot of strength and power on their side; who knows, we may see the Return of the Jedi, with decentralization and a lot of choices for the user. . . .—Jerry

Q&A Technical Support

Dear Jerry,

I enjoyed "The Revenge of the File Formats" (Computing at Chaos Manor, November 1988), especially when you discussed the file-conversion tribulations and eccentricities of Q&A. I have been doing battle with Q&A technical support over the printing foibles of version 3.0 for six months.

Printing a succession of reports or purchase orders on single sheets in the file mode leads to the same creeping top margin effect you experienced. The so-called workaround is the inclusion of an ASCII formfeed symbol on the last header line in print options. This is easily done with a macro, but printing premodification forms means my data overlaps onto two pages. I also shortened my page length to 61 lines. Shortening all my forms will, of course, destroy data. I plan to redesign my forms and begin the new style on a clean slate soon. Q&A does not truly print three full screen pages of data forms in any case.

I am using the most common of printers, an Epson LQ 1050, so I know that the problem is an omission in the design of the program. I've found some people at Symantec to be very cooperative, but my impression of the company is that there's a lack of internal communication, some confusion in accounts and record keeping, and a black hole when it comes to response from the technical-support people.

It's nice to know there is someone out there who has enough influence to get things moving at Symantec. I hope that a future version of the Q&A database will incorporate all the features of WRITE and repair these small but maddening glitches.

When you get around to testing DESQ-view, try loading a TSR program in the same window as an application. I've been using Q&A 3.0 with the Microlytics thesaurus, but I can't fit the combination into the available 420K-byte space. The batch-file trick is, of course, moot with a too-small memory segment. Maybe some of the new enhancements (e.g., Phar Lap) for the 80386 will help.

Bill Copenhagen
Richmond, CA

I don't quite understand: I'm writing this with Q&A Write with the Microlytics thesaurus in memory. We have our DESQ-view jiggered up to give me a 540K-byte maximum window (it takes an 80386 to do that).

Symantec has done several revisions of its print drivers and, I believe, has taken care of all the problems you mentioned; certainly we were able to print with the Kyocera printer set to emulate various others.—Jerry

Furlongs per Fortnight

Dear Jerry,

As an ex-aerospace scientist, I don't remember encountering the whimsical speed unit, furlongs per fortnight (furl/fort), that you mentioned in Computing at Chaos Manor (October 1988). Nevertheless, I couldn't help reaching for my calculator, which came up with a number for the speed of light about a quarter of a million furl/fort lower than yours. Since the difference is a fraction of a part per million (ppm), I suspect you might have inserted an out-of-date value for the velocity of light (c).

Assuming that you applied the international SI Units (SIU) conversion factor of exactly 2.54 for inches to centimeters (and not the U.S.-approved factor of 1/0.3937), I deduced that you used 299,792,500 meters per second (m/s) for the value of c. This is the value given in references (e.g., *Encyclopaedia Britannica*) in tables of physical constants using the 1969 least-squares adjustments: c = 299,792,500 m/s with 0.33 ppm uncertainty.

Knowing that you strive to be in the vanguard, I remind you that the meter (formerly based on the wavelength of krypton 86) was redefined in 1983 as the distance in meters that light travels in a

vacuum in 1/299,792,458 of a second. This defines c as 299,792,458 m/s.

With the meter so defined, you must therefore use with the above-noted SIU equivalence (1 inch = 2.54 centimeters (cm), or 1 foot = 0.3048 meter) the value of 299,792,458 for the velocity of light.

The calculation, then, is as follows:

$$\text{m/furl} = 660 \times 0.3048 = 201.168$$

$$\begin{aligned} \text{s/fort} &= 3600 \times 24 \times 14 \\ &= 1,209,600 \end{aligned}$$

$$\begin{aligned} \text{light speed} &= \text{m/s} \times \text{s/fort} \times \text{furl/m} \\ &= 299,792,458 \\ &\quad \times 1,209,600 \\ &\quad \times 1/201.168 \\ &= 1,802,617,499,790 \\ &\quad \text{furl/fort} \end{aligned}$$

The number you gave in your discussion of the Lascaux program displayed the result to a fraction of a trillion furl/fort, viz., 1,802,617,752,326.41. Since the experimental value for c used in the calculation had an accuracy of no more than nine significant digits, the 15 digits of the result are not justified. It should have been truncated to the following: 1,802,617,750,000.

You will observe, however, that the result calculated above is correctly expressed in 13 digits, since no rounded-off numbers entered into the computation.

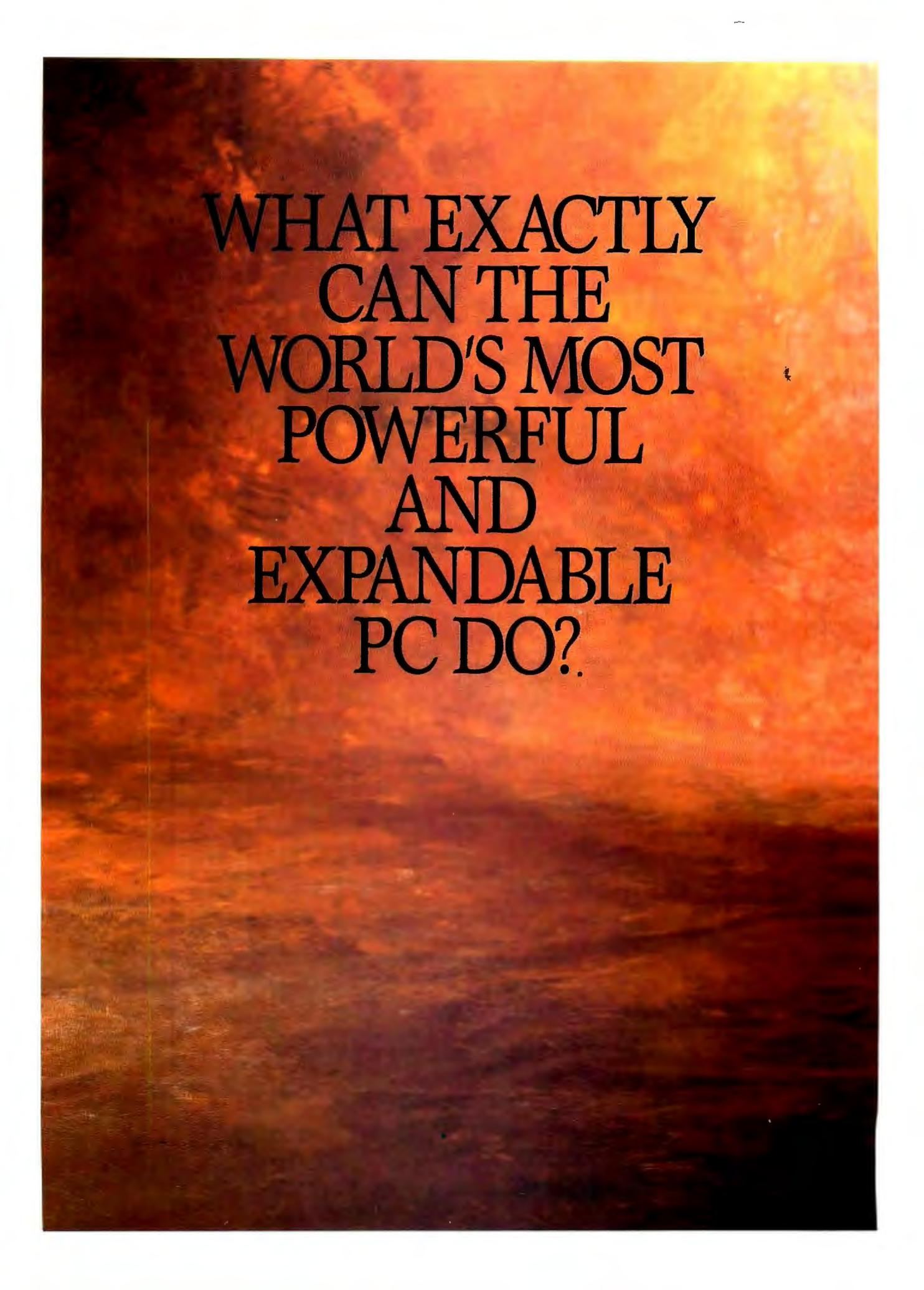
As you know, the U.S. is the only major country that has not adopted the SIU system. The *Wall Street Journal* reported recently that the National Bureau of Standards and the National Oceanographic and Atmospheric Administration recommended that the U.S. stay with its definition of the foot instead of the SI unit. Rather than using 2.54 like the rest of the world, the U.S. uses 1/0.3937 = 2.5400508, which differs from the SI unit by about 2 ppm. This is ridiculous, especially since we have already adopted selected SIUs. For example, in 1959 the U.S. abandoned the old definition of the nautical mile (nm) and adopted the international unit, 1 nm = 1852 meters exactly (no longer 6080.2 feet).

William Matheson
Friday Harbor, WA

Well, thank you. Of course, you're right, and I do hope no one experienced navigation errors as a result of my oversight!

—Jerry ■

Editor's note: *We have calculated that c = 1,802,617,499,785.254116 furl/fort, rounded off to 19 digits of precision.*



WHAT EXACTLY
CAN THE
WORLD'S MOST
POWERFUL
AND
EXPANDABLE
PC DO?

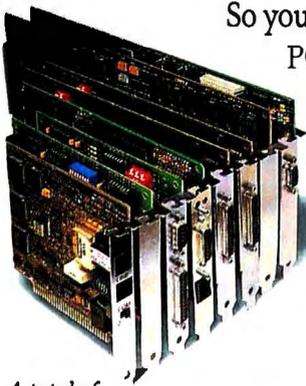
ANYTHING
IT WANTS.



Now it's possible to do just about anything you can think of, faster than you can think.

Introducing the COMPAQ DESKPRO 386/33 Personal Computer. Never before has so much performance, expandability and storage been put into one desktop PC. And never before has one PC been capable of so much.

Inside its new system unit, you'll find that our engineers have redesigned just about every component to deliver a minicomputer level of power with unmatched PC flexibility.



A total of eight expansion slots let you customize the system to your needs by expanding memory and choosing from thousands of industry-standard expansion boards.

So you can use it as a stand-alone PC, putting its power to work on the most demanding CAD/CAE, financial analysis, database management and other personal productivity applications.

Or you can spread the power around, using the COMPAQ DESKPRO 386/33 as the driving force for a network or multiuser system. At the heart of the system is the Intel 386™ microprocessor. Running at a blazing 33 MHz, it works in concert with a series of technological advancements. Like a 33-MHz cache memory controller with 64K of high-speed static RAM. Interleaved memory architecture. And the exclusive COMPAQ Flexible Advanced Systems Architecture.

This high-performance combination delivers a 35% performance improvement in

CPU-intensive applications over 25-MHz 386 cache-based PC's.

Or said another way, nothing will slow you down. No matter what you want to do.

You can expand the 2 MB of standard RAM up to 16 MB using the high-speed 32-bit slot. That leaves up to six industry-standard slots free to customize the system to the demands of

the application you're using.

If your job is particularly demanding, you can use up to five high-performance internal storage devices to hold up to 1.3 gigabytes of data. And if that's not enough, bring

total system storage to 2.6 gigabytes with the optional COMPAQ Fixed Disk Expansion Unit.



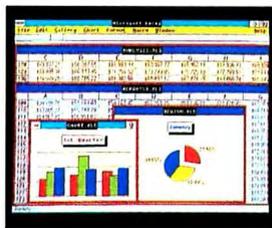
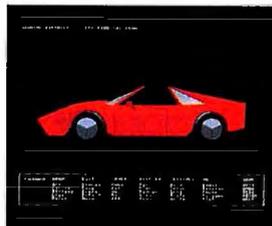
Built-in interfaces make it easy to connect pointing devices, printers, plotters or other peripherals without using an expansion slot.

There's more. You can run MS-DOS®, MS® OS/2, Microsoft® Windows/386 and the XENIX® and UNIX® operating systems. Access memory over 640K under DOS with the COMPAQ Expanded Memory Manager that supports Lotus/Intel®/Microsoft (LIM) 4.0. And speed through calculations with 33-MHz Intel 387™ and Weitek 3167 coprocessor options.

All the new advancements engineered into the COMPAQ DESKPRO 386/33 deliver an unmatched level of power, expandability and storage.

To do anything you want.

INTRODUCING THE COMPAQ DESKPRO 386/33



High-speed VGA graphics are built in. And for greater graphics capabilities, add the optional COMPAQ Advanced Graphics 1024 Board.

COMPAQ

It simply works better.®



IN 386 PERSONAL COMPUTING, YOU'RE LOOKING AT THE MOST WANTED LIST.

In 1986, Compaq introduced the world to personal computers based on the 386 microprocessor.

Since then, we've made it possible for every level of user to work with this powerful technology. In fact, more people work with COMPAQ 386-based PC's than any other 386's worldwide.

Today, Compaq offers the broadest line of these high-performance personal computers. Each delivers significant technological advancements developed by Compaq engineers. Each delivers optimum performance for the needs of different users. And each is built to the highest standards for compatibility and reliability.

For power-hungry users who want 386 performance to go, the COMPAQ PORTABLE 386 Personal Computer does things normally reserved for a desktop 386 PC. Without compromise.

For people considering 286 desktops, the COMPAQ DESKPRO 386s Personal Computer is an affordable way to move up to 386 performance. And if you have a 286 that you've outgrown, the COMPAQ DESKPRO 386/20e Personal Computer

is an easy step up to the power and capabilities of a 20-MHz 386 machine.

For the increasing needs of today's 386 users, the COMPAQ DESKPRO 386/25 Personal Computer offers advanced performance. And for those who desire the most power and expandability available in a desktop PC, the COMPAQ DESKPRO 386/33 stands alone.

For a free brochure on COMPAQ 386-based personal computers and the location of your nearest Authorized COMPAQ Computer Dealer, call 1-800-231-0900, Operator 93. In Canada, 1-800-263-5868, Operator 93.

COMPAQ® COMPAQ DESKPRO 386s® COMPAQ PORTABLE 386®. It simply works better.® Registered U.S. Patent and Trademark Office. Intel® Intel 386 and Intel 387 are trademarks of Intel Corporation. Microsoft®, MS®, XENIX® and MS-DOS® are trademarks of Microsoft Corporation. MS® Windows/386 and MS® OS/2 are products of Microsoft Corporation. UNIX® is a registered trademark of AT&T.® Registered U.S. Patent and Trademark Office. Product names mentioned herein may be trademarks and/or registered trademarks of other companies. COMPAQ DESKPRO 386/25 graphics ©1988 Accent Software, Inc. ©1989 Compaq Computer Corporation. All rights reserved. Printed in the U.S.A.

COMPAQ

It simply works better.®

WHAT'S NEW

HARDWARE • SYSTEMS

U.S. Newcomer Introduces First PS/2 Portable

The Darius ProPortable from Mission Cyrus is the first PS/2-compatible "portable," the company says.

But since it weighs in at a hefty 20 pounds, it's better characterized as in the "transportable" category. Mission Cyrus says the product will be 100 percent compatible with the IBM PS/2 Models 70 and 80. It also includes two Micro Channel slots.

Based on an 80386 processor running at 25 MHz, the ProPortable uses a static RAM cache and has sockets for both 80387 and Weitek math coprocessors. One megabyte of RAM is standard, expandable to 16 megabytes on the motherboard.

Both SCSI and modified frequency modulation hard disk drive controllers are also included, as is a 10-Mbps Ethernet controller. There's even a built-in ink-jet printer that a company spokesperson says is based on Hewlett-Packard's "drop on demand" technology.

The VGA monitor displays a 16-level gray scale, or you can use a standard hookup for an external VGA monitor. Options include 40-, 100-, and 200-megabyte hard disk drives and a 2400-bps internal modem. A built-in tape backup drive is also an option. Mission Cyrus promises fax and cellular options soon. Price: About \$10,000.

Contact: Mission Cyrus Group, 1505 South 192nd St., Seattle, WA 98148, (604) 432-7727.

Inquiry 1129.



Mission Cyrus's portable PS/2 clone.

One-Pound MS-DOS Laptop Makes Debut

The personal computer has reached a new level of miniaturization, according to Atari. The company now has a QWERTY-keyboard-based, 1-pound, MS-DOS personal computer.

The Portfolio has most of the standard features you've come to expect in a laptop. For transferring files to your full-size system, you can use an optional expansion chassis with serial and parallel ports.

The 4.92-MHz 80C88 microprocessor supports 128K bytes (expandable to 640K bytes) of system memory. For the BIOS and a half-dozen applications, each Portfolio has at least 256K bytes of ROM in a cartridge that's connected to the bottom of the

computer through a 64-pin connector.

The keyboard, with tiny calculator-size keys, fits easily into the 8- by 4- by 1-inch chassis, as does the monitor with its resolution of 240 by 64 pixels. The LCD display produces an 8-row by 40-column platform, except in Lotus 1-2-3 mode, when figures are displayed in a 255-row by 127-column platform.

Battery power comes from three AA batteries and is rated at 48 hours of continuous use or four to six weeks of casual use. Bundled applications that run off MS-DOS 2.11 include a basic word processor, a spreadsheet that's Lotus 1-2-3 compatible, an address book, a calendar, and a calculator.

Price: \$399.

Contact: Atari Computer, 1196 Borregas Ave., P.O. Box 3427, Sunnyvale, CA 94088, (408) 745-2000.

Inquiry 1127.

SEND US YOUR NEW PRODUCT RELEASE

We'd like to consider your product for publication. Send us full information, including its price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE has not formally reviewed each product mentioned. These items, along with additional new product announcements, are posted regularly on BIX in the microbytes.sw and microbytes.hw conferences.

Kiss a Portable 80386

There's a new display option in the fast-changing world of portable computers: Kiss Computer has incorporated a flat-panel, DC electroluminescent (EL) screen into a new 20-pound 80386 "tower" portable called the PX386.

The tilting amber screen, which measures only 4 inches high, 9 inches wide, and three-fifths of an inch deep, uses the same amount of power as a backlit LCD, yet it is faster, more rugged, and longer lived, Kiss claims.

The PX386 is available in several configurations. The motherboard supports a 16-, 20-, or 25-MHz CPU, with or without a math coprocessor, and it can include up to 8 megabytes of RAM (2 megabytes is standard).

Mass storage options include hard disk drives ranging from 20 to 383 megabytes and half-height 5¼- or 3½-inch floppy disk drives.

Kiss says the DC EL screen, made by Cherry Electric, is an improvement over older AC EL screens, which were fragile and suffered from flicker and an audible buzz. The new screen offers advantages over LCD as well, Kiss says. It can be read easily from the side and is very fast, with no visible ghosting.

The display has 640- by 200-pixel resolution using the CGA standard. Support for Hercules and VGA is planned for late summer.

Price: Base system, \$3995.

Contact: Kiss Computer Corp., 2604 Washington Rd., Kenosha, WI 53140, (800) 438-5477 or (414) 652-5477. Inquiry 1128.

continued

Kodak's Portable Printer Gets Fortified

The office-dictionary-size (10½ by 6½ by 2 inches) Diconix 150 portable printer, which doesn't exactly tip the scales at just over 3 pounds, now has even more features. The Diconix 150 Plus is a new version with several improvements that make it an even more useful companion for your laptop computer.

First among the improvements is that the Diconix 150 Plus doesn't need special thermal paper anymore. The print mechanism has been changed from thermal to ink-jet, so you can use plain single-sheet or continuous-form paper. The speed has been improved, too. The 150 Plus now prints at 180 cps in draft mode, about 30 percent faster than its predecessor.

The Diconix 150 Plus comes with ink-jet-optimized pica and elite type styles, as well as draft, near-letter-quality, quality, condensed, and superscript/subscript modes. Kodak has also increased international character set support from eight to 14.

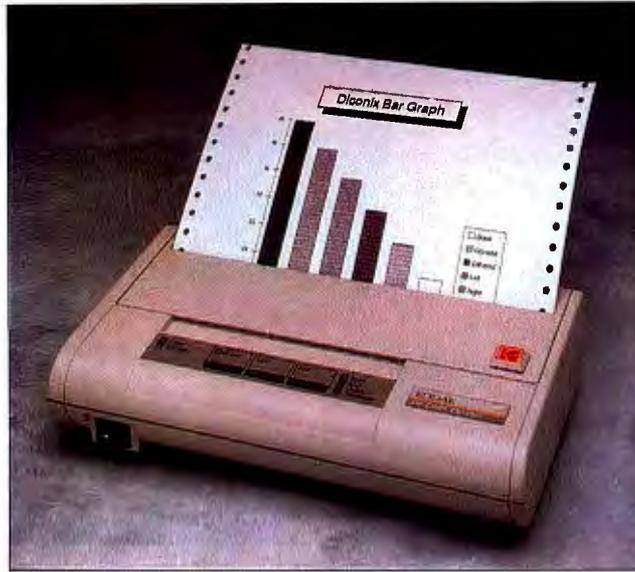
The printer is powered with standard C-cell rechargeable batteries, which Kodak claims will print about 150 pages per charge. Another new feature is that you can recharge the printer while it's in use. Software senses when data is being received from the computer, and charging gets temporarily stopped.

The Diconix 150 Plus emulates the IBM Proprinter and the Epson FX series and prints graphics at up to 192 dpi. It's available in both serial and parallel versions.

Price: Parallel, \$519; serial, \$499.

Contact: Eastman Kodak Company, 343 State St., Rochester, NY 14650, (716) 724-4000.

Inquiry 1132.



The Diconix 150 Plus: a featherweight that doesn't need thermal paper.

A Monstrous Monitor for Desktop Publishing

Tatung's Model MM-1580 monitor screen measures 15 inches diagonally and features a flat, square CRT to eliminate glare and distortion. It has a paper-white phosphor display for gray-scale graphics and a resolution of 1024 by 736 pixels. Its

horizontal scanning frequency is 74 kHz, the vertical scanning frequency is 70 Hz, and the maximum bandwidth is 108 MHz.

According to Tatung, you can drive the MM-1580 with any IBM PC-compatible graphics card.

Price: \$599.

Contact: Tatung Company of America, Inc., 2850 El Presidio St., Long Beach, CA 90810, (213) 979-7055.

Inquiry 1135.

Low-Cost Page Scanning

The Complete PC has rounded out its product line of microcomputer peripherals with The Complete Page Scanner, which the company claims is the lowest-cost full-fledged page scanner on the market. The unit's image resolution is either 200 or 300 dpi, and it uses a simulated 16-level gray scale with three dithering patterns.

The Complete Page Scanner handles originals up to a full 8½ inches wide and 14 inches long. It comes with a quarter-size add-in card that fits any standard 8-bit slot on an IBM PC or compatible.

SmartScan software, included with the scanner, scales your images from 10 percent to 200 percent of their original size and lets you crop, rotate, scale, and pixel edit. You can also convert images to a wide variety of graphics formats, including PC Paintbrush Plus (.PCX), Microsoft Windows Paint (.MSP), Dr. HALO II and III (.CUT), TIFF (.TIF), GEM (.IMG), and fax.

An optical-character-recognition (OCR) program is also available for use with The Complete Page Scanner. Developed by Computer Aided Technology

Add Storage to Your Mac

If your Mac II's hard disk drive isn't up to the capacity you need, Micropolis has a new series of internal hard disk drives that offer a variety of storage options.

The MacPAK (for Macintosh performance advantage kits) are available in capacities ranging from 76 to 668 megabytes. Micropolis claims the 668-megabyte model is the highest-capacity 5¼-inch hard disk drive available for the Mac.

These kits contain the Micropolis SCSI disk drive, cables, mounting hardware, installation/formatting software, and a complete installation manual.

Price: 76-megabyte drive, \$1250; 150-megabyte drive, \$1795; 340-megabyte drive, \$2995; 668-megabyte drive, \$4495.

Contact: Micropolis Corp., 21211 Nordhoff St., Chatsworth, CA 91311, (818) 709-3300.

Inquiry 1134.

continued

specifically for the scanner, The Complete PC claims that Complete OCR/Page reads virtually all monospaced, proportionally spaced, and typeset material.

To use The Complete Page Scanner, you need an IBM PC, PS/2, or compatible with at least 512K bytes of RAM, a hard disk drive, a graphics adapter, and MS-DOS 2.1 or higher.

Price: \$899; Complete OCR/Page, \$495.

Contact: The Complete PC, 521 Cottonwood Dr., Milpitas, CA 95035, (408) 434-0145.

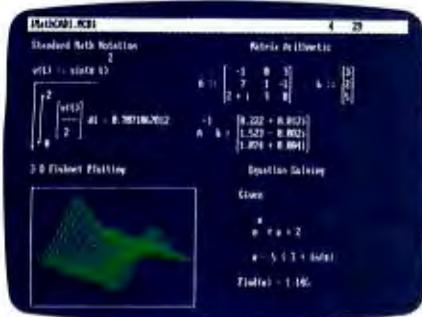
Inquiry 1133.

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.

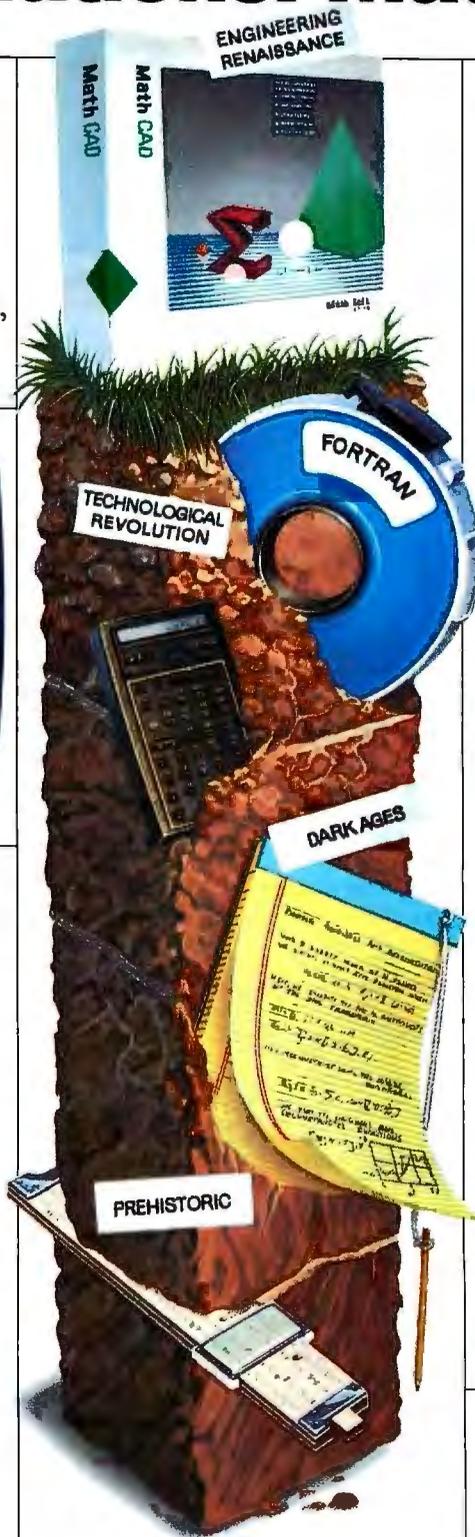


MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

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 50,000 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).

**If you purchased MathCAD 2.0 between 5/1/89 and 6/16/89, you can get a FREE upgrade to version 2.5 (otherwise, the upgrade cost is \$99.00 until June 30, 1989; afterwards, the cost will be \$149.00).*



March 14, 1989 issue.
Best of '88
Best of '87

MathCAD®

MathSoft, Inc. One Kendall Square, Cambridge, MA 02139

A Speedy Analog Board for the Mac II

For data acquisition applications on the Mac II, National Instruments has a new solution. The NB-A2000 is a high-speed board that uses a precision 12-bit converter and analog input circuitry to monitor multiple channels at up to 1 MHz.

The board uses four independent circuits to simultaneously track and hold multiple analog signals. The NB-A2000 can sample one channel at 1 million samples per second, two channels simultaneously at 500,000 samples per second, or four channels concurrently at 250,000 samples per second.

Once you've acquired your data, you can transfer it directly to Mac II memory or to National Instruments' NB-DMA2800 block-mode direct-memory-access board. The NB-DMA2800 can approach the upper NuBus bandwidth limit of 37.5 megabytes per second.

National Instruments says it has enhanced its LabDriver software to control the NB-A2000. The driver uses high-



The NB-A2000 Mac II board monitors channels at up to 1 MHz.

level software routines that you can call from any programming language that can make Macintosh Device Manager Toolbox calls.

Another unique feature of the NB-A2000 is that you can use it to emulate a digital oscilloscope using its built-in digital triggers, pretrigger/posttrigger modes, and programmable AC/DC coupling. **Price:** NB-A2000, \$2995; LabDriver software, \$295; coaxial adapter board, \$225; 1-meter coaxial adapter cable, \$175.

Contact: National Instruments Corp., 12109 Technology Blvd., Austin, TX 78727, (800) 433-3488 or (512) 794-0100.

Inquiry 1136.

A Disparate Pair of AT Motherboards

While many computer users need or want the speed or power of a state-of-the-art computer system, not everyone wants (or can afford) to start from scratch. For these folks, a motherboard upgrade is a logical choice. Here are two recently introduced cases in point:

DTK has a new 16-MHz 80286-based motherboard with several unique features.

The PTM-1660C puts all major system functions on the motherboard. Besides the

usual contingent of AT-clone features, DTK has built a monochrome graphics controller, a floppy disk drive controller, and a 16-bit AT bus header into the motherboard. Also on the board are a PS/2-like mouse port, two serial ports, and a parallel port.

Using Chips & Technologies' NEAT chip set, the PTM-1660C also has on-board support for EMS 4.0. The board supports page-interleave memory and has space for 5 megabytes of on-board RAM (100-ns RAM is required for 16-MHz operation).

The board directly replaces all standard and reduced-size AT motherboards. DTK says the PTM-1660C will be available as a complete computer by the third quarter of this year.

Price: \$725 (without memory).

Contact: DTK Computer, Inc., 15711 East Valley Blvd., City of Industry, CA 91744, (818) 333-7533.

Inquiry 1137.

At the other end of the spectrum, the Hauppauge 386 Motherboard/33 will make even the most processor-intensive applications fly.

As its name implies, the 386 Motherboard/33 is built around an 80386 processor running at 33 MHz. But applications don't live on fast processors alone, so the folks at Hauppauge have added a 64K-byte static RAM cache and a full 4 megabytes of 32-bit main memory.

The Hauppauge 386 Motherboard/33 is a direct replacement for any standard AT board. The company claims the board gives you 7-MIPS performance.

Price: \$4495.

Contact: Hauppauge Computer Works, Inc., 175 Commerce Dr., Hauppauge, NY 11788, (516) 434-1600.

Inquiry 1138.

Board Upgrades PC to 80386SX

Sota Technology has what it claims is the first available add-in board that upgrades IBM PCs and compatibles to 80386SX-processor power. The company says the Sota 386si board is optimized for use with all 8088- and 8086-based systems, including the IBM PC XT, IBM PS/2 Models 25 and 30, the AT&T PC 6300, and the Compaq Portable and Deskpro.

The board comes standard with an 80386SX running at 16 MHz. There's also 16K bytes of zero-wait-state

cache RAM and a socket for an optional 80387SX math coprocessor. It's a half-length add-in card that fits in any standard 8-bit slot.

The 386si also has a standard 16-bit local bus connector to which you can attach Sota's Memory/16i, an optional memory card that supports both extended memory and the EMS 4.0 specification. You'll need this board if you want to run OS/2. There's also a connector on the 386si for the Floppy I/O Plus, a controller that supports up to four floppy disk

drives in capacities up to 1.44 megabytes. The Floppy I/O Plus also has both serial and parallel ports.

Sota claims that when you install the 386si in a PS/2 Model 30, the system will run 18.7 times faster than an IBM PC and 2.5 times faster than an AT.

Price: 386si, \$645; Memory/16i (with 0K), \$295; Floppy I/O Plus, \$149.

Contact: Sota Technology, Inc., 559 Weddell Dr., Sunnyvale, CA 94089, (408) 745-1111.

Inquiry 1139.

continued

Be Objective.

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.

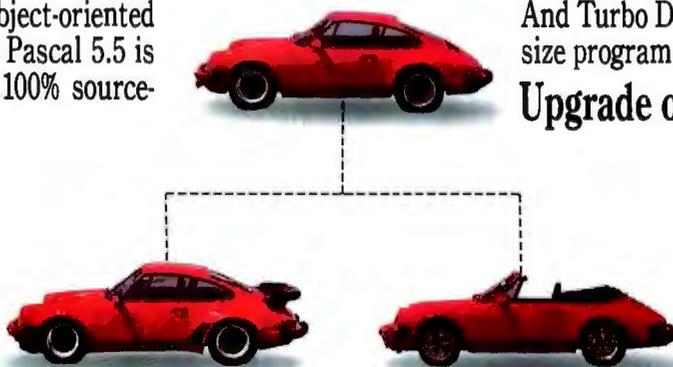
Turbo Pascal 5.5 Professional with Turbo Debugger[®] and Turbo Assembler[®]

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.



Inheritance provides powerful modeling capabilities by allowing objects to inherit attributes from other objects.

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



B O R L A N D

Code: MA14

Mail upgrade orders to: Borland, P.O. Box 660001, Scotts Valley, CA 95066-0001. For orders outside the U.S., call (408) 438-5300. Turbo Pascal, Turbo Debugger, and Turbo Assembler are registered trademarks of Borland International. Copyright ©1989, Borland International, Inc. All right reserved. BI 1324

Circle 46 on Reader Service Card (DEALERS: 47)

Programmer's Paradise offers an



WE'LL MATCH NATIONALLY ADVERTISED PRICES.

386 PRODUCTS

	LIST	OURS
386 ASMLINK	495	395
386MAX	75	66
386MAX PROFESSIONAL	129	115
F77L-EM/32	895	829
High C 386	895	799
NDP C-386	595	529
NDP FORTRAN-386	595	529
Professional Pascal 386	895	799
VM/386	245	199

ASSEMBLY LANGUAGE

Advantage Disassembler	295	279
Incra	180	159
MS Macro Assembler	150	99
OPTASM	125	105
SOURCER w/ BIOS source	140	125
Turbo Assembler/Debugger	150	105
Visible Computer: 80286	100	89

BASIC LANGUAGE

db/LIB	139	121
Facelt	99	90
GraphPak Professional	149	127
MS BASIC/6.0	295	199
ProBas	135	125
ProBas Telecomm. Toolkit	75	70
ProBas Toolkit	99	94
ProScreen	99	94
QuickBASIC	99	69
QuickComm	139	119
QuickPak Professional	149	129
QuickPak Scientific	79	70
QuickWindows Advanced	139	125
SoftCode	79	70
True BASIC	100	69
Turbo Basic	100	69

C COMPILERS

AZTEC C Commercial	499	CALL
High C	595	549
Lattice C 6.0	250	199
Microsoft C	450	299
QuickC	99	69
Turbo C	150	112
Turbo C Professional	250	175
WATCOM C 7.0	395	CALL
Zortech C	90	79
Zortech C++	150	129
w/ source	250	209
Zortech C++ Tools	100	89

C CODE GENERATORS

DATABO55 Applic. Generator	399	379
Logic Gem	198	179
Matrix Layout	150	129
PRO-C	495	449
w/ Workbench	675	569

C COMMUNICATIONS

BreakOut II	125	99
C ASYNCH MANAGER	175	129
Essential Communications	185	159
Greenleaf Comm Library	229	165
Greenleaf ViewComm	495	CALL
Lattice Comm. Library	250	189

C LIBRARIES/UTILITIES

C TOOLS PLUS/5.0	129	99
C Utility Library	199	139
CxPERT	395	335
Greenleaf Business Mathlib	239	169
Greenleaf Functions	209	155
Greenleaf Superfunctions	265	199
Multi-C	249	229
PCVACC	395	359
PC-lint	139	101
PforCe	395	229
TimeSlicer	295	279
w/ source code	1000	899
Turbo C TOOLS/2.0	149	109
vLIB	99	89
WKS Library	195	189
Zip	295	265

C SCREENS/WINDOWS

C-Scape	299	282
w/ Look & Feel	399	379
C-Worthy w/ forms and source	495	439
Greenleaf DataWindows	295	219
Greenleaf MakeForm	125	90
HALO Window Toolkit	495	CALL
HI-SCREEN XL	149	129
HI-SCREEN XL Prof. Series	325	275
JAM	595	529
JAM/DBI	395	339
JYACC FORMAKER	395	339
Panel Plus	495	395
Vermont Views	395	CALL
w/ source code	790	CALL
Vitamin C 3.2	225	162
VCScreen	149	109

COBOL LANGUAGE

Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
COBOL/2 Toolset	900	749
Personal COBOL	149	129
MS COBOL	900	599
Realia COBOL	995	849
w/ RealMENU	1145	979
SCREENIO	400	375
XDB-COBOL (Realia)	395	359
XDB-COBOL (Microsoft/Focus)	595	509

DATABASE DEVELOPMENT

Clarion	695	589
Clear +	200	169
Clipper	695	439
dBASE III Plus	695	CALL
dBASE IV	795	CALL
dBASE IV Devel. Edition	1295	109
dBFast/DOS	195	179
dGE	195	169
Flipper	395	249
FoxBASE+	595	399
FoxBASE+/386	99	90
Friendly Finder	395	259
Genifer	149	129
Integrated Devel. Library	299	249
Magic PC	299	249
Paradox 3.0	725	525

PC/Focus	1295	778
QuickSilver	599	369
R&R	150	119
w/ Clipper/FoxBASE module	199	179
R:Base for DOS	725	529
SilverComm Library	189	135
Silver Paint Library	100	90
Tom Rettig's Library	100	75
UI Programmer 2	595	CALL

DEBUGGERS

386 DEBUG	195	145
Optebug	125	109
Periscope I/ST2K	795	675
Periscope III 10 MHz	1395	1119
Periscope IV	CALL	CALL
Sherlock	195	179
Softprobe II/IX	395	345

DOCUMENTATION

C/Analyst	150	135
Clear + (C)	150	135
C.Lines/C.Tree	80	75
EasyFlow	150	115
FLOW CHARTING II+	229	207
Source Print	97	80
Tree Diagrammer	77	70

DOS SHELLS

Magellan	139	CALL
Norton Commander	89	56
ViewLink	150	129

EDITORS

BRIEF	195	CALL
w/ dBRIEF	275	CALL
Ed, The Programmer's Edition	365	315
Epsilon	195	151
KEDIT	150	120
Me w/ source	189	169
MKS Vi	149	135
Multi-Edit	99	90
Norton Editor	75	70
NROFF/PC	99	85
PC/EDT+	295	269
Pi Editor	149	129
SLICK Editor	195	155
SPF/PC	245	185
VEDIT PLUS	185	115
Vq	270	CALL

FILE MANAGEMENT

Btrieve	245	185
Btrieve/N	595	455
CBTREE	195	169
C-Index for M5C	195	175
C-Index for Turbo C	100	90
C-Index Plus	395	329
C-ISAM	225	209
c-tree	395	309
d-tree	495	395
r-tree	295	239
c-tree/r-tree	650	523
CQL	225	199
w/ PASS	395	349
dBC III	250	179
dBC III PLUS	500	349
db_FILE	395	322
db_RETRIEVE	395	322
Essential B-Tree	99	89
w/ source	198	149
FABS VISION	595	172
Informix Products	CALL	CALL
Netware SQL	595	489
pBase	149	135
Turbo Programmer/C	549	449
XDB-C	395	359
XQL	795	599
Xtrieve PLUS	595	459

FORTRAN LANGUAGE

F77L	477	429
F77L-EM/32	895	829
GRAFLIB	175	159
Grammatic	135	119
Grammatic/Plotmatic	240	219
GRAFLIB	50	45
Lahey Personal FORTRAN.77	95	89
MS FORTRAN	450	299
PLOTHI	175	159
PLOTHP	175	159
Plotmatic	135	119
Printmatic	135	119
RM/FORTRAN	595	499
SPINDRIFT Library	149	125
TEKMAR Graphics Library	195	169
WATFOR FORTRAN	375	337

GRAPHICS LIBRARIES

Essential Graphics	299	229
GFX Fonts and Menus	99	89
GraphicC	395	322
GraphicC	595	509
GSS Graphics Devel. Toolkit	325	229
HALO '88	595	399
HALO '88 for MS Devel.	99	90
PCX F/X	125	115
PCX Programmer's Toolkit	99	90
PCX Text	150	135
Turbo Geometry Library	150	135

LIST OURS

LINK & LOCATE ++	395	349
OPTLIB	49	45
OPTLINK	125	113
Plink86plus	495	279
PolyLibrarian II	149	131
.RTLink	195	185

LINKERS/LIBRARIANS

LINK & LOCATE ++	395	349
OPTLIB	49	45
OPTLINK	125	113
Plink86plus	495	279
PolyLibrarian II	149	131
.RTLink	195	185

MODULA-2

LOGITECH Modula-2:		
Compiler Pack	99	81
Development System	249	199
TopSpeed Modula-2:		
Compiler Kit	100	89
DOS 3-Pack	200	159

OBJECT-ORIENTED PROGRAMMING

ACTOR	495	423
Language Extension I	99	95
C_talk	150	137
C_talk/Windows	450	399
Smalltalk/V	100	85
Communications	50	45
EGAVGA Color Extension	50	45
Goodies #1, #2 or #3	50	45
Smalltalk/V Mac	200	169
Smalltalk/V 286	200	169
Zortech C++	150	129
w/source	250	209
Zortech C++ Tools	99	89

OPERATING SYSTEMS/ CONTROL PROGRAMS

Concurrent DOS 386 (3 users)	395	335
10-User System	495	419
DESQview 386 (w/ QEMM)	190	169
QEMM 386	60	55
MS Windows/386	195	130
PC-MOS 386 (single user)	195	179
5 Users	595	539
VM/386	245	199
VM/386 Multi-user	895	759
VM/386 NetPak	150	129

PASCAL LANGUAGE

B-tree File	125	99
DATABO55	395	359
MS Pascal	300	189
Pascal ASYNCH MANAGER	175	129
POWER SCREEN	129	99
Professional Pascal	595	549
QuickPASCAL	99	69
Turbo Analyst	99	79
TurboMAGIC	199	179
Turbo Pascal 5.0	150	105
Turbo Pascal 5.0 Professional	250	175
Turbo-Plus 5.0	100	80
Turbo Power Tools Plus	149	109
Turbo Professional 5.0	125	99

PROFILERS

Codesifter	119	85
Inside!	125	109
Pfinish	395	229
Turbo Analyst 5.0	99	79

NEW RELEASES

HALO WINDOW TOOLKIT

New from Media Cybernetics, a windowing system for building sophisticated user interfaces for graphics-based programs. Designed for use with Microsoft C Compiler. Supports extensive list of graphics display devices.

List: \$495 Ours: \$359

VITAMIN C 3.2

Popular C library for developers seeking an easy way to integrate windows, data entry, menus, and text editing. The new version offers support for EGA and VGA modes, an improved User's Guide and enhancements for context-sensitive help development.

List: \$225 Ours: \$162

MS OS/2 PRESENTATION MANAGER TOOLKIT

Development Toolkit that includes a collection of graphical tools for Presentation Manager, extensive documentation, more than 3 megabytes of sample code, complete hypertext MS OS/2 Programmer's Reference Library on-line, and two hours of Microsoft OnLine electronic support.

List: \$500 Ours: CALL

Unbeatable Selection 1-800-445-7899

FREE DEMO!!!

Lotus Magellan, the ultimate utility for finding, viewing and using all the information on your hard disk, has arrived in Paradise!

To learn more about **Lotus Magellan**, call us today and ask us to send you a free demo.

Or order now at our special introductory price.

LIST OURS

PROTOTYPING

Dan Bricklin's Demo Program II	195	179
Grasp 3.5	149	129
Instant Replay III	150	131
Proleus	149	125
Show Partner FX	350	319
Soft Demo	69	59

REFERENCE GUIDES

Command Tips	90	80
Norton Guides	100	75
Tom Rettig's HELP	120	105

TRANSLATORS

Bas_C (Commercial)	375	323
Bas_Pas (Commercial)	280	242
BASTOC	495	399
dBx TRANSLATOR	550	469
FOR.C	750	679
Heap Expander	80	75
PROMULA.FORTRAN	450	425
TP2C	249	199

UTILITIES

1 DIR Plus	95	75
BACK-IT	129	120
Command Plus	80	70
w/ Programmer's Toolkit	130	115
Copy II PC	40	35
Copy II PC Option Board	159	139
Disk Technician Advanced	190	149
Disk Technician Plus	130	119
Fast!	99	89
FASTBACK Plus	189	142
HELP ME	99	90
hTest:hFormat	90	80
MACE GOLD	149	129
MACE Utilities	99	90
MKS Toolkit	199	169
Norton Utilities	100	61
Norton Utilities Advanced	150	101
Pathfinder	70	65
PC Fullback	70	59
PC/Tools Deluxe	80	70
V OPT	50	47
Vfeature Deluxe	120	111
Vtools	50	47
XENOCOPY-PC	80	70
XTree	70	60
XTree Pro	129	111

VERSION CONTROL SYS.

MKS RCS	189	161
PVCS (Corporate)	395	332
PVCS (Personal)	149	131
Seidl Version Manager	300	269
TLIB	100	90
TLIB 5 Station LAN	300	259

OTHER LANGUAGES

C-terp	298	219
Janus/Ada C Pak	129	115
muLISP-87 Interpreter	300	219
PC Scheme	95	79
PC /FORTH +	250	225
Personal Rexx	150	129
Turbo Prolog	150	112

XENIX/UNIX SOFTWARE

Aspen Korn Shell	125	109
Basmark QuickBASIC (386)	695	629
db_FILE	CALL	CALL
DOS-alike	89	79
EDIX	275	222
Epsilon	195	152
Informix Products	CALL	CALL
Micro Focus COBOL/2 (386)	3500	2995
Microport Sys. V/386 (comp.)	899	759
Microport Sys. V/AT (comp.)	649	549
Microsoft FORTRAN	695	CALL
Microsoft Pascal	695	CALL
MKS Trilogy	119	105
PANEL PLUS	795	675
SCO 386 XENIX Sys. V (comp.)	1495	1195
SCO XENIX System V (comp.)	1295	999

BORLAND

Paradox 3.0	725	525
SideKick Plus	200	149
Turbo Assembler/Debugger	150	112
Turbo Basic	100	75
Turbo C 2.0	150	112
Turbo C 2.0 Professional	250	175
Turbo Pascal 5.0	150	112
Turbo Pascal 5.0 Professional	250	175
Turbo Prolog	150	112
Turbo Prolog Toolbox	100	75

IGC

VM/386	245	199
VM/386 Multi-User	895	759
VM/386 NetPak	150	129

LAHEY

F77L	477	429
F77L-EM/16	695	649
F77L-EM/32	895	829
Lahey/Al OS/386	95	179
Personal FORTRAN w/ Toolkit	119	105

LATTICE

Lattice C Compiler 6.0	250	199
Lattice (C) Amiga Compiler	300	199
Lattice Comm. Library	250	189
Curses	100	59
dBC III	250	179
dBC III Plus	500	349
RPG 3.0	1600	1279
SecretDisk II	79	59
SideTalk	120	99
SSP/PC	350	279

MEDIA CYBERNETICS

HALO Window Toolkit	495	359
Publisher's Partner	495	359
Dr. HALO IV	140	101
HALO '88A	325	229
HALO '88A for MS Developers	595	399

MICROSOFT

MS BASIC/6.0	295	199
MS C	450	299
MS COBOL	900	599
MS Excel	495	299
MS FORTRAN	450	299
MS Macro Assembler	150	99
MS OS/2 Present. Mgr. Toolkit	500	CALL
MS OS/2 Programmer's Toolkit	350	229
MS Pascal	300	199
MS QuickBASIC 4.5	99	69
MS QuickC 2.0	99	69
MS QuickPASCAL	99	69
MS Sort	195	139
MS Windows	99	69
MS Windows/386	195	130
MS Windows Development Kit	500	319
MS Word 5.0	450	285

ZORTECH

Zortech C	90	79
w/ Debugger	150	129
Zortech C Debugger	90	79
Zortech C Training Video	300	269
Zortech C ++	150	129
w/ source	250	209
Zortech C ++ Tools	99	89
Zortech C ++ Training Video	CALL	CALL

PROGRAMMER'S POLICIES

Phone Orders

Hours 9 AM-7 PM EST. We accept MasterCard, Visa, American Express. Include \$4.00 per item for shipping and handling. All shipments by UPS ground. Rush service available.

Mail Orders

POs by mail or fax are welcome. Please include phone number.

International Service

Phone number required with order. Call or fax for additional information.

Dealers and Corporate Accounts

Call for information.
Unbeatable Prices
We'll match nationally advertised prices. (Subject to same terms and conditions.)

Return Policy

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

LIST OURS

VM/386

"VM/386 should be considered mandatory software as important as MS-DOS." ... Computer Language 10/88



VM/386, PC Magazine Technical Excellence Award Winner, lets you create "virtual machines," each running its own MS-DOS application so you save valuable time while maximizing the performance of your 386 PC. Time consuming tasks like compiling code and running bulletin

boards no longer tie up your PC, because they run simultaneously. VM/386 offers the highest level of data integrity and software compatibility available in a multi-tasking operating environment. Order your copy today!

Special Price: \$199

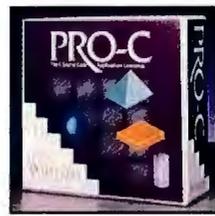


LAHEY 386 FORTRAN

NEW VERSION 2.0

F77L-EM/32 is a fast and powerful 32-bit FORTRAN compiler that lets users write and port programs up to 4 Gigabytes on 80386s. EM/32 was the winner of PC Magazine's 1988 Technical Excellence Award for Compilers/Languages. New 2.0 features: Weitek support for faster processing, easier mainframe porting with DO WHILE & END DO statements, and built-in graphics. Other features include: Full 77 Standard, VAX and IBM VS mainframe extensions, fast compilation, excellent diagnostics, and a powerful debugger. Another outstanding product from the FORTRAN experts. (Requires Lahey/Al OS/386.)

Special Price: \$829



PRO-C

PRO-C is the database applications generator that produces professional quality C source code in a fraction of the time it would take to write the same code by hand. PRO-C features an integrated screen generator, report generator, menu generator, data definition tool, update program generator, and an extensive context-sensitive help utility. Unlike 4GL applications, PRO-C generated applications run at 3GL speed and do not require additional run-time modules. Use PRO-C Workbench to completely customize your applications.

Special Price: \$449



LATTICE C 6.0

Lattice C is back on top and the benchmarks show it!! Due to a new optimizer and many performance improvements in the library, Lattice C 6.0 for DOS and OS/2 is again outperforming its competitors. And Lattice C now includes a full-screen symbolic debugger, CodeProbe, that will enable you to easily debug family mode programs, Presentation Manager applications, and OS/2 multi-thread applications. And it can be used with a mouse.

The already comprehensive library has been expanded to include the curses screen manager, graphics, and communications libraries.

Best of all, Lattice support comes free with Lattice C. Lattice's bulletin board and telephone support are the best in the business. Lattice C 6.0's new list price is \$250.

Special Price: \$199



Lattice

In NY: 914-332-4548
Customer Service: 914-332-0869
International Orders: 914-332-4548
Telex: 510-601-7602

Fax: 914-332-4021
Call or Write for
Latest Free Catalog!

1-800-445-7899

Programmer's Paradise



A Division of Voyager Software Corp
55 South Broadway, Tarrytown, NY 10591

Circle 226 on Reader Service Card

Is It a Mouse or a Trackball?

Kensington Microware, whose Turbo Mouse ADB trackball substitute for the Macintosh rodent has saved many a cramped desktop, now has a version for IBM PS/2s. Even though it's called the Expert Mouse, the relationship is in name only. It's a true trackball that sits quietly next to your PS/2. The Expert Mouse has the same two-button configuration as the IBM and Microsoft mice, and it has what Kensington calls an "ergonomic design" that's arranged for both right-handed and left-

handed users.

The Expert Mouse plugs directly into your PS/2's mouse port and uses optical technology that the company claims has virtually eliminated moving parts—except for the trackball itself. Kensington says its rodent is 100 percent compatible with all PC applications designed with a mouse in mind. And for non-mouseable applications, Expert Mouse comes with programmable pop-up menus that let you use the trackball with many popular PC applications. **Price: \$169.95.**

Contact: Kensington Microware, Ltd., 251 Park Ave. S, New York, NY 10010, (212) 475-5200. **Inquiry 1142.**

Portable Power for Laptops

The portability of your laptop doesn't do you much good if your computer's battery is dead or dying and you're nowhere near an AC socket. But if you use your laptop in your car (not when you're driving, of course), PowerTrip might help.

It's a 4¼-by 2¼-by 1¼-inch box that turns your car's 12-VDC power into 115 VAC.

You can plug in your laptop's charger or any other electrical equipment that draws less than 100 W. Zirco claims that PowerTrip's circuitry

protects your equipment from the comparatively "dirty" power (low-battery, overloading, and overheating) of automobile electrical systems.

Price: \$179.95.

Contact: Zirco, Inc., 10900 West 44th Ave., Wheat Ridge, CO 80033, (303) 421-2013.

Inquiry 1145.

Gray-Scale VGA for Desktop Publishing

If you want the advantages of a matched gray-scale monitor/graphics card for desktop publishing and the capability to use color-based applications, Relisys has a solution. Its bundled VGA monitor/board system is optimized for serious desktop publishing users.

Dubbed the RA1541X Graphics Subsystem, it includes a half-length add-in card for IBM PCs and compatibles that uses Gemini Technology's application-specific ICs, along with special software drivers for popular desktop publishing packages (like Ventura Publisher and PageMaker). These push the system resolution up to 1280 by 1024 by 4 shades of gray.

Although the board can be used with any analog multifrequency or fixed-frequency monitor, it's optimized for the Relisys 1541 15-inch multi-scan, a full-fledged color monitor. But it also features a gray scale for high-resolution monochrome applications.

You can use the Relisys Graphics Subsystem with any IBM PC or compatible that has a free half-length slot. Software drivers are included.

Price: \$995.

Contact: Relisys Corp., 320 South Milpitas Blvd., Milpitas, CA 95035, (408) 945-9000.

Inquiry 1143.

continued

VDT Filter Does It All

The scare stories about the potential adverse health effects of your harmless-looking CRT are enough to make you think more than twice about sitting down in front of that tube. Whether or not you believe the stories about harmful CRT radiation, you have other hassles to deal with: glare, reflection, eyestrain, and overall fatigue.

In an effort to solve many of these problems in one fell swoop, Sunflex offers its

VDT Environmental Control (VEC) filter. For glare and reflection control, the VEC filter is constructed from a pattern of matte black microfibers. Sunflex says it minimizes diffused glare and mirror-like reflections while effectively sharpening the CRT's focus, increasing contrast, and eliminating dust buildup on the glass.

Chief among radiation concerns is VLF (very low frequency) emissions, which are blamed for a num-

ber of potentially dangerous side effects. Sunflex claims that because the VEC's microfibers are conductive and connected to a common ground point, the VEC filter eliminates up to 99 percent of VLF emissions before they hit your face.

Then there's that pesky buildup of static electricity in dry weather or dry air-conditioned internal climates. While seldom dangerous, it's annoying, and a large-enough static charge can damage computer components. The VEC has a grounding touch panel that discharges static charges to ground. There's even an indicator that lights as your personal static charge gets grounded.

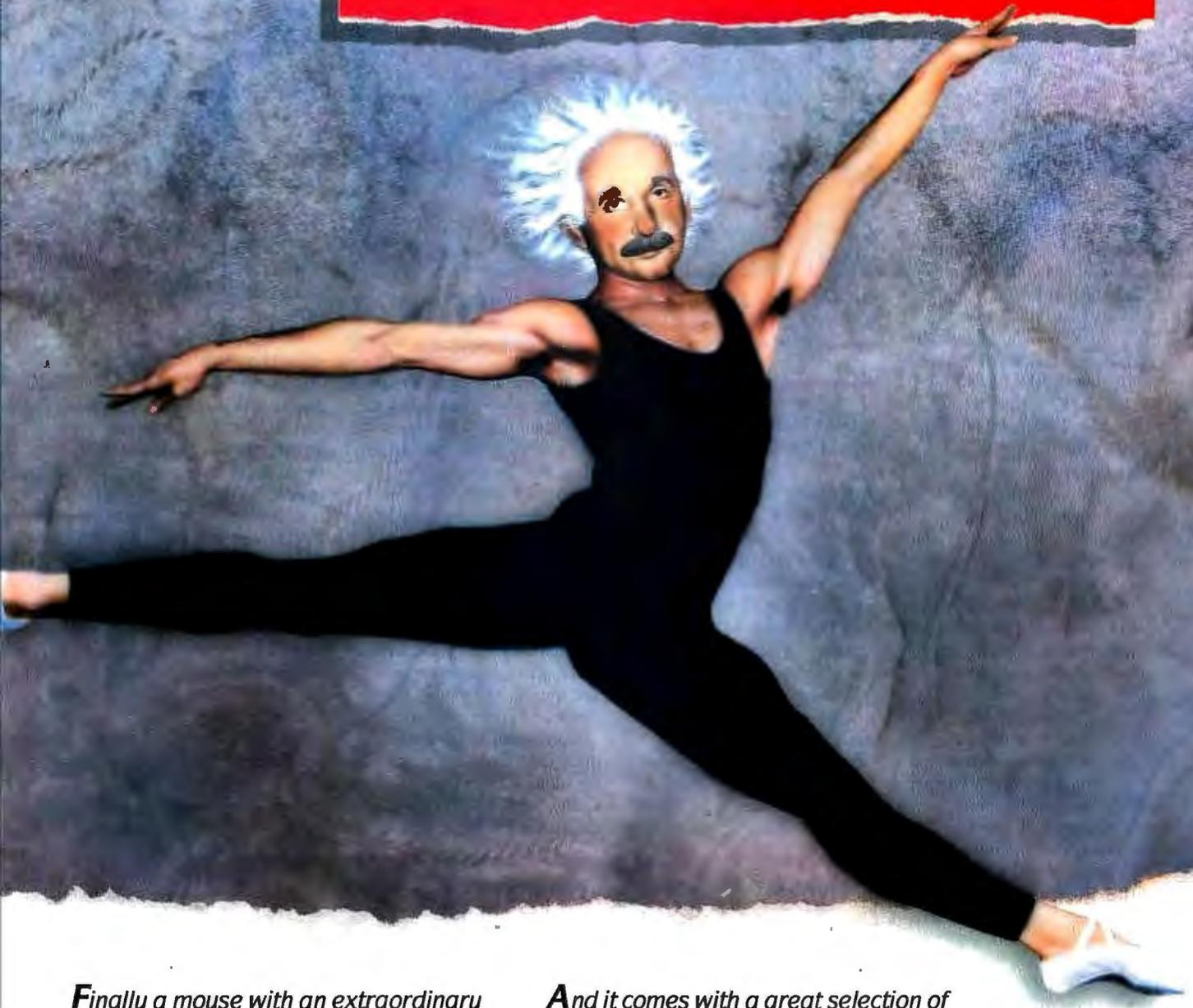
Sunflex says the VEC filter is available in models for most computer monitors.

Price: \$69.95.

Contact: Sunflex, 73 Digital Dr., Novato, CA 94949, (800) 321-1659 or (415) 883-1221; in California, (800) 458-3539. **Inquiry 1144.**



Announcing a big leap in mouse technology.



Finally a mouse with an extraordinary body and a mind to match.

The Logitech Mouse is tuned to accelerate your cursor across any screen with the mere flick of a wrist. And slow it down on arrival for pixel-point control.

It's guaranteed to work with all IBM personal computer applications.



And it comes with a great selection of MouseWare™ including Pop-Up DOS™—the ultimate DOS handler; the Mouse-2-3™ shell; 35 menus for popular keyboard-based applications; and unlimited Product Support.

For your nearest dealer, call Logitech at: 800-231-7717

In California: 800-552-8885

In Europe: ++41-21-869-96-56

Circle 162 on Reader Service Card (DEALERS: 163)



Use Epson Printers with Your Mac

Epson America's LQ printer software is a package of two floppy disks and a cable that lets you connect your Macintosh to Epson 24-pin LQ-series printers. The package works with the Mac Plus, SE, II, and IIx, and it connects with the LQ-500, LQ-800, LQ-850, LQ-950, LQ-1000, LQ-1050, LQ-2500, and LQ-2550. (The LQ-500 requires a serial interface board.)

With the software, you can access up to eight resident fonts and up to four bit-mapped fonts, depending on the LQ model you're using. Graphics resolution is up to 360 by 180 dpi. Epson says the printer software is compatible with most Mac applications, including WordPerfect, Microsoft Excel, Aldus PageMaker, and HyperCard.

The printer software will work with minimally equipped Macs, but for maximum system performance, Epson recommends a minimum of 2 megabytes of RAM, a hard disk drive, and an 800K-byte floppy disk drive. If you have an LQ-850, LQ-950, LQ-1050, or LQ-2550, the printer software will let you use those printers' built-in Smart-Park paper handling, as well as their landscape and envelope printing capabilities.

Besides a custom cable for mating your Mac and LQ, the LQ printer software includes a chooser, installer, fine-tuned bit-mapped fonts, and a spool adjustment disk. The whole package takes about 1.6 megabytes of disk space.

Price: \$69; serial interface board for LQ-500, \$59.

Contact: Epson America, Inc., 23530 Hawthorne Blvd., Torrance, CA 90505, (213) 539-9140.

Inquiry 1147.



With Epson's LQ printer software, your Mac can print to your Epson 24-pin LQ series printer.

Co/Session Gets an Upgrade

Version 4.0 of Co/Session, Triton Technologies' remote-access software package, has several major enhancements, according to the company. They're designed to make it easier and more efficient to take control of remote personal computers over the telephone lines.

Co/Session now has several user-interface options. The new menu system lets you use function keys, arrow keys, or even single letters to call up program features. There's also

a command-line-only version for experienced users. The result, according to Triton, is that you need fewer keystrokes to control the program.

Another improvement in Co/Session is that the installation process has been enhanced, with no changes needed to your AUTO-EXEC.BAT or CONFIG.SYS files. You can also enter additional user information on serial ports, modem types and speeds, and phone information for remote systems.

Co/Session 4.0 now supports EGA and VGA graphics (in addition to text and CGA). It has what Triton claims are the fastest screen

updates in the remote-access software category. The program uses a "global" approach that updates only screen areas that have changed.

Also new is a proprietary sliding-window error-correcting file transfer protocol. Triton says it's a full-duplex protocol that's similar to SDLC and X.25.

Co/Session 4.0 is made up of two programs: Support and Application. Support is installed on the remote computer and requires 125K bytes of RAM. Application is installed on the local computer that's used to access the remote system. It requires 51K bytes of RAM. Both programs run on the IBM PC, PS/2s, and compatibles and require DOS 2.0 or higher.

Price: Support, \$175; Application, \$125; bundled, \$249; upgrade for registered owners, \$50.

Contact: Triton Technologies, Inc., 200 Middlesex Essex Turnpike, Iselin, NJ 08830, (201) 855-9440.

Inquiry 1151.

continued

Hyper Comm Package Covers DOS and OS/2

Hilgraeve has introduced the HyperACCESS/5 communications program. Designed for Presentation Manager under OS/2, it also ships in a character-based configuration for the MS-DOS world.

According to the company, HyperACCESS/5 is the first full-featured communications program that takes full advantage of OS/2's multitasking capabilities. Running in protected mode under PM, the program supports multiple concurrent communication sessions, true background operation, child processes (to the HyperACCESS/5 parent process), and detached operation.

It's compatible with four different manufacturers' digital telephones for support of the multiple, simultaneous sessions afforded by ISDN telecommunications. Hilgraeve says HyperACCESS/5 was designed for ISDN in particular and allows your computers serial access to digital telecommunications (versus access to analog telecommunications through modems) with these telephones.

While supporting all standard file transfer protocols, HyperACCESS/5 also has its own proprietary method. HyperProtocol uses on-the-fly adaptive compression that Hilgraeve claims gives effective

throughput that's up to five times the line speed.

The package has its own script language and uses a unique user interface with sliding windows that let you "point and fire" to make your selections.

HyperACCESS/5 runs on any IBM PC, PS/2, or compatible and uses 350K bytes of RAM. You'll also need either OS/2 1.0 or higher or DOS 2.0 or higher. Both 5¼- and 3½-inch floppy disks are included.

Price: \$199.

Contact: Hilgraeve, Genesis Centre, 111 Conant Ave., Suite A, Monroe, MI 48161, (800) 826-2760 or (313) 243-0576.

Inquiry 1149.

GO AHEAD, MAKE YOUR DAY

Point-and-Pick Your Applications

Choose the application you need quickly and easily directly from the menu—or even another application!

Run Several Tasks at Once

Switch instantly between active tasks in different applications at the touch of a keystroke!

Move Data Between Applications

Share data easily between applications like SCO™ Lyrinx,® SCO Professional,® and SCO Integra™ with the electronic Clipboard!

Link Up Your Business with Electronic Mail

Exchange messages and files—even spreadsheets and graphics—across the office or around the world!

Locate Business Contacts Instantly

Store, update, find, and sort addresses and phone numbers quickly and easily with the time-saving Directory!

Calculate Within Any Application

Put the four-function, “running-tape” capabilities of an online Calculator right at your fingertips!

Add Only the Applications You Need

Build your own customized solution by adding individual applications as you need them!

Print While You Work

Move on to your next job while your last one is printing out—on a local or shared workgroup printer!

Talk Across The Office

Instantly converse with other system users, screen-to-screen, with the handy Intercom!

Schedule Meetings and Resources

Check others' Calendars online for available times—then schedule and notify them automatically!



WITH THE SCO PORTFOLIO WORKGROUP SOLUTION

Get the competitive edge with the SCO Portfolio™ integrated workgroup solution!

Teamed with the world's most popular UNIX® System—SCO System V—the SCO Portfolio solution turns the 386™ personal computer into a workgroup powerhouse.

What's more, users only need to know how to use their familiar applications in order to put the amazing power of the UNIX System to work immediately.

With SCO Portfolio and the SCO Portfolio family of business applications, everyone in a workgroup can perform virtually any business task—from writing reports and creating financial analyses, to scheduling meetings and exchanging messages—far more productively than ever. And all using a single, standard—and cost-effective—386-based PC!

Get started today with SCO Portfolio Suite, and get all the advantages of a fully-integrated office system without compromising the functionality of full-featured business applications—all in one economical package.

SCO Portfolio Suite integrates the powerful SCO Lyrinx word processing system, the SCO Professional 1-2-3® workalike, and the SCO Integra industry-standard-SQL database, with SCO Portfolio's convenient desktop tools, customizable menu system, and electronic clipboard—and lets you add any other software of your choice under its easy-to-use menu, as well.

Contact your SCO authorized supplier or call (800) 626-UNIX (626-8649) for more information about SCO Portfolio and SCO Portfolio Suite and find out how easy it is to make your day—today!



(800) 626-UNIX (626-8649)

(408) 425-7222

FAX: (408) 458-4227

E-MAIL: ...!uunet!sco!info info@scocom

SCO, the SCO logo, and SCO Portfolio are trademarks, and Lyrinx and SCO Professional are registered trademarks of The Santa Cruz Operation, Inc. Integra is a trademark of Comandant Industries. UNIX is a registered trademark of AT&T in the USA and other countries. 386 is a trademark of Intel Corporation. 1-2-3 is a registered trademark of Lotus Development Corporation. © 1989 The Santa Cruz Operation, Inc. All Rights Reserved. The Santa Cruz Operation, Inc., 400 Encinal Street, P.O. Box 1900, Santa Cruz, California 95061 USA

The Santa Cruz Operation, Ltd., Crowley Centre, Hazlers Lane, Watford WD1 8YN, Great Britain, +44 (0) 923 816344, FAX: +44 (0) 923 817781, TELEX: 917572 scozow G

Upgrading?

If your computer needs have grown, we understand completely—ours have too! The On-Line Store has expanded and is now serving an active network of over 100,000 dealers, resellers, and end users worldwide. To handle all this growth without compromising the quality of our service, we decided to “upgrade.”

We've added a *Software Showcase* to our comprehensive on-line catalog to let you “try before you buy”—making it easier for you to decide which package will suit you best—and easier for us to meet your needs.

We are distributing our on-line catalog to major bulletin board systems

such as CompuServe and GENie, so you can reach us to review products, download sample software, and order from the convenience of your home or office, at any time of the day or night.

And last, but not least, we've installed a multi-line version of PCX, our award-winning voice/mail telemarketing system to handle the increased phone traffic—so you'll get service when you call, not a busy signal.

If your computer needs are growing too, get in touch with the On-Line Store. We've put our products to work and provide even better service than before—and that's the true meaning of “upgrade,” isn't it?

PC/WORKS



New!
PCX
MULTI-LINE
VOICE/MAIL
SYSTEM

Everyone's talking about the new multi-line version of PCX Voice/Mail Telemarketing System.

The single line version of PCX was just awarded PC Magazine's *Editor's Choice* in January (under its parent name, Bigmouth) and we fully expect the multi-line version to carry on the family tradition of earning top honors for high flexibility and low price.

With hundreds of features such as call routing, in- and outbound telemarketing and private mailboxes, PCX can be customized to fit your particular needs.

With the multi-line version, you can increase your capabilities as your needs grow. Upgrade from one to two lines (ask about full value trade-ins) and add on additional units to accommodate up to 16 phone lines.

Single Line Version: Multi-Line Version:

\$ 269

\$ 799

AWARD WINNING SYSTEMS

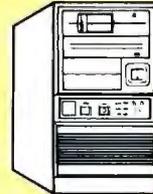


30 MB
HARD DRIVE SYSTEM
286/AT

\$ 795 Full Cash Price

- 80286 Processor • IBM/OS2 Compatible
- 80287 Co-Processor Slot • Monitor Optional

386 MICRO
TOWER
IBM/OS2 COMPATIBLE



\$ 995 Full Cash Price

While Special Supply Lasts!

PORTABLES TO GO

PORTABLE 286/386



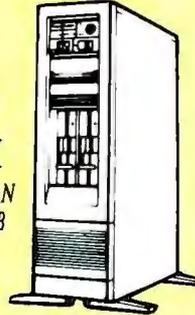
- 6 Expansion Slots
- 640 x 400 Backlit LCD
- Handsome Carry Case

286 Processor, 40 MB Hard Disk, 640K \$1595
386 Processor, 65 MB Hard Disk, 1 MB 1995

65 MB
386/TOWER
CASE SYSTEM

- Novell/UNIX/XENIX/LAN
- 1 MB RAM Expand to 16 MB

\$ 1995 Full Cash Price



20 MB HARD DISK
PC/XT

- 8088 Processor
- IBM Compatible

\$ 595 Full Cash Price

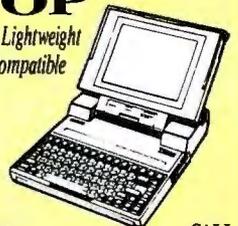


Limited Stock—Call Now!

TOSHIBA T-1000
LAPTOP

- 1 Floppy • 3 Slots • Lightweight
- Battery/AC • IBM Compatible
- LCD Display

\$ 695 Full Cash Price



20 MB Hard Drive Option CALL

SYSTEM ENHANCEMENTS

PRIAM 292 MB
HARD DRIVE AND
CONTROLLER KIT

- Novell Compatible
- Unix Compatible
- 24 MS Access

\$ 1995 Full Cash Price

154 MB
MINISCRIBE DUAL
HARD DRIVE AND
CONTROLLER KIT

- High Quality
- Advanced Technology

\$ 879 Full Cash Price

TOSHIBA 110 MB
HARD DRIVE AND
CONTROLLER KIT

- H/F Controller
- E1 Interleave
- 25 MS Access

\$ 849 Full Cash Price

INSTANT
WORKSTATIONS
Just Add Our OA-Link
XT/AT Co-Processing
Stations to Your 286/386

- FAST Installation
- XT or AT Processors
- Color Available

\$ 650 Full Cash Price

Just Say When.

QUADRAM

JT/FAX

Now Only **\$199***

JT/FAX has features such as pull-down windows, multiple scheduling and Broadcast FAX.

Runs unattended. Input: scanner or word processor. Output: dot matrix or laser printer. Group III FAX compatible. External Stand-Alone Version \$349*



LOGITECH

SPECIAL PURCHASE MOUSE

With Paint Show Plus

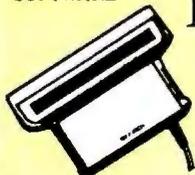
Graphics and Desktop Publishing Software

\$69*



ASK ABOUT
OCR/ASCII
SOFTWARE

LOGITECH HAND SCANNER



Now Only **\$169***

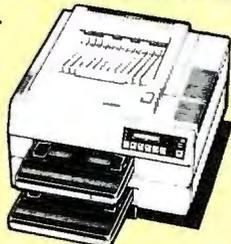
Including Software
Call About Our Full Page Scanners!

LASERJET

FAMOUS BRAND LASER PRINTER II

\$1399*

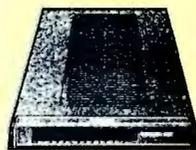
With
Jet
Font
Cartridge
Bundle



HIGH SPEED

US Robotics HST

\$539*



HAYES COMPATIBLE

V.32 External Modem \$669*
USR Dual Standard CALL
USR 2400 Baud Modem 129*

SOFTWARE SHOWCASE

Try Before You Buy!

The On-Line Store's new Software Showcase allows you to download the demo versions of many great software products. Just call the bulletin board number listed below.

DLX is a commercial multi-line multi-user database and BBS System capable of supporting up to 24 users under nothing more than MS-DOS.

RBASE DOS is a highly acclaimed database that allows scores of custom applications with true multi-user support. A compiler is also available.

TELEMAGIC is a telemarketer's dream come true. This product will organize the most unorganized telephone salesperson and is available in a multi-user version.

DESIGN CAD 3D is a 3 dimensional CAD/CAM program for under \$300 with features that exceed systems costing over \$5,000. Also ideal for engineering and architectural applications.

DOWNLOAD FROM OUR BBS
24 HOURS A DAY: 8/1/N

805/650-0193

MODEMS

4800 BAUD HAYES COMPATIBLE MODEM USING MICROCOM LEV 5 MNP

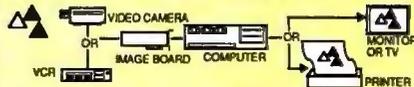
• Software included • Auto Dial • Auto Answer

• Supports 300-1200-2400
Baud TOO!

\$129* \$99*
• 2 Year Warranty Ext. Int.

PC/WORKS

INTEGRATED IMAGE BOARD



Tap the rich graphics sources of your TV, VCR or video camera with the push of a button. In less than 10 seconds you can make high resolution video snapshots and turn them into sharp halftone graphics. The program's quick editing utilities let you retouch, crop, and rotate images for use in virtually any graphics or desktop publishing application.

• NTSC/PAL Input and Output
• High Resolution 512 x 480

\$169*

Call About Our Genlock Version!

FILE TRANSFER

LAPLINK FILE TRANSFER KIT

• Includes 35" and 5.25" Disks and Universal Cable
• FAST File Transfer
• Easy-to-Use Menus—
No Commands to Learn

\$89*

While Special Supply Lasts!

ALL *PRICES SHOWN ARE WHOLESALE AND REFLECT AN ADDITIONAL 3% CASH DISCOUNT. THE ON-LINE STORE'S WHOLESALE + 7% PURCHASERS PAY JUST 7% ABOVE THE WHOLESALE PRICE, PLUS SHIPPING AND HANDLING. Minimum shipping: \$5 per order. International orders: call for rates. Prices subject to change. Products subject to availability and may be private label versions. WE ALSO SERVE LARGE CORPORATE ORDERS: call for information. This ad supersedes all previous.

CALL NOW! 24 HOUR ORDER LINE:

805/650-0188



BBS 805/650-0193

FAX 805/650-0195

CUSTOMER SERVICE: 805/650-0188

3037 Golf Course Dr., Ventura, CA 93003



Your Data Communications System Specialist

LANstation Brings You (Desk) Space

For reasons of security, management control, and price, diskless workstations are increasingly popular in many LAN installations. Some are also popular for their small footprint.

Having redesigned the case and removed the bulky CRT, Emerald Computers says its diskless AT-compatible LANstation I is now as small as, or smaller than, the rest.

The LANstation I uses an electroluminescent flat-screen display that is 95 percent smaller than a CRT. The EL display is EGA-compatible, displaying monochrome graphics in resolutions of up to 640 by 350 pixels. It also doesn't generate heat or emit radiation like a CRT.

With the elimination of a fan and the space needed for disk drives, the entire LANstation I measures just 14½ by 5¾ by 9¾ inches. It weighs 9 pounds. Each unit comes with 2 megabytes of RAM, a single full-length 16-bit expansion slot, plus two serial ports and a parallel port. There's also a front-panel slot for a ROM card option that lets you add special functions or custom programs to your LANstation.

In keeping with the compact design of the LANstation, its keyboard is also reduced in size. With 85 full-size keys, it measures 14½ inches wide. The LANstation I comes with 80286 clock speeds of 8, 10, 12, or 16 MHz.

Price: \$2195 to \$2495.
Contact: Emerald Computers, Inc., 7324 Southwest Durham Rd., Portland, OR 97224, (800) 321-5711 or (503) 620-6094.
Inquiry 1152.



Save desk space with the LANstation I, a diskless networking system.

A Security Man for Your UPS

Uninterruptible power supplies can be lifesavers for critical computer systems, especially LANs. Para Systems' Network Manager software works with its Minuteman UPSes.

When power fails, Network Manager works with the UPS to perform an orderly shutdown of the system. Para Systems says Network Manager distinguishes between brief interruptions and hard

power failures. If power is restored within 10 seconds, the power shutdown sequence doesn't start.

Network Manager works with the IBM PC or compatibles running SCO Xenix 2.2.3 or Novell 2.1 or higher. In Novell networks, you set the Interrupt Filter delay during installation. In SCO Xenix, you can set the delay at any time.

Price: Network Manager, \$199; Minuteman 1000 UPS, \$2249.

Contact: Para Systems, Inc., 1455 LeMay Dr., Carrollton, TX 75007, (800) 238-7272.
Inquiry 1148.

Low-Cost Board Adds Micro Channel Serial Quartet

Adding extra serial ports to Micro Channel-equipped versions of the IBM PS/2s can be an expensive proposition. But NeoTech has come to the rescue of those without bottomless wallets with the low-cost CM/4 multi-channel serial board.

The IBM-registered card adds four standard RS-232C serial slots to your PS/2 and takes up just a single slot in your computer. Since all serial connections are via standard 25-pin connectors (cabled from the rear of the card), there's no need to fool with 9-pin adapters.

All serial ports on the card have the full complement of handshaking lines on every channel to support all standard serial devices. NeoTech says you can use the CM/4 with Xenix, Unix, and OS/2.

Price: \$395.
Contact: NeoTech, Inc., 30295 Solon Industrial Pkwy., Solon, OH 44139, (800) 552-1552 or (216) 248-4114.
Inquiry 1154.

continued

LAN Uses Expanded Memory

Although Invisible Software's newest LAN product is called the Invisible Network, it's a very visible line of three different LAN boards for the IBM PC and the Micro Channel bus. Using dual twisted-pair wiring, the system transfers data at up to 3 Mbps.

Invisible Software claims that the Invisible Network is the only LAN that supports expanded memory. On systems equipped with EMS 4.0, your DOS memory overhead can be as little as 3K bytes for a workstation

and 13K bytes for a server. This can leave you up to 630K bytes of free DOS memory while you're running the network. (Without expanded memory, the overhead is 60K bytes for a workstation and 80K bytes for the server.)

The Invisible Network comes with the company's NET/30 Network Operating System. It includes facilities for file sharing, print spooling, E-mail, security, and an on-line help system. The Invisible Network is also compatible with NetBIOS, the

IBM PC LAN, and Novell NetWare.

Three boards are available: The Model 200 is a low-cost board that transfers data at 1.8 Mbps; the Model 300 increases that speed to 3.0 Mbps; and the Model 200/A is a 1.8-Mbps Micro Channel board.

Price: Model 200, \$215; Model 300, \$315; Model 200/A, \$399.

Contact: Invisible Software, Inc., 1165 Chess Dr., Suite D, Foster City, CA 94404, (415) 570-5967.
Inquiry 1153.

IN ALL FAIRNESS, YOU SHOULD READ WHAT ASHTON-TATE® IS SAYING BEFORE YOU PURCHASE ORACLE.



Ashton-Tate Fights SQL Bugs

Same Query Run Twice Can Result in Different Replies

Ashton-Tate last week acknowledged that the Structured Query Language (SQL) portion of dBASE IV can produce inconsistencies and inaccurate results. The crux of the SQL problems lies with three anomalies that occur when data is structured in a specific way, according to Knorr Richardson, a spokesman for the Torrance, Calif. firm. As a result, the same query run two different times can result in two different replies, for example, or a query can retrieve incomplete information from the database. (See Chart, Page 8.)

Ashton-Tate does not plan to issue a diskette to fix the problem; it is, however, offering work-around solutions to users through its support lines and bulletin board, and on CompuServe, Richardson said.

Though Ashton-Tate is characterizing dBASE IV's SQL problems as "minor" and confined to specific circumstances, database experts claim their impact is more serious.

"The SQL in dBASE IV is unstable, unreliable and unpredictable," said Richard Finke, president of Performance Computing Inc., a database consulting firm in Chicago.

"I don't see how anyone can use it," he added. "They'd have to know the answer to the SQL query ahead of time."

Surprisingly, the majority of dBASE users were unaware by dBASE IV's SQL glitches.

"The drawbacks in SQL are an

See DBASE Page 8

PC Week, January 9, 1989

Oracle developed the first commercial SQL database over 10 years ago.

And the first SQL database for the PC over 4 years ago.

It's called Professional ORACLE®.

It has the most up-to-date, most powerful and most complete set of application development tools available.

Like SQL*Forms® SQL*ReportWriter™ SQL*Menu® And SQL*Plus®.

It's based on ANSI standard SQL and runs on PCs, minis and mainframes.

And it works.

To order Professional ORACLE for the PC, call 1-800-ORACLE1, ext. 4947.

It's \$1,299, and comes with a 30-day, money-back guarantee.

ORACLE®
Compatibility • Portability • Connectability

UNIVERSALLY ACKNOWLEDGED TO WORK JUST FINE.

Copyright ©1989 by Oracle Corporation. Article reprinted from PC Week January 9, 1989. Copyright ©1989 Ziff Communication Company. dBase, dBase IV and Ashton-Tate are registered trademarks of Ashton-Tate Corp. ORACLE, SQL*Forms, SQL*Menu, and SQL*Plus are registered trademarks and SQL*ReportWriter is a trademark of Oracle Corporation.

AppMaker Eases Mac Interface Programming

AppMaker, an application generator for the Macintosh, lets programmers and nonprogrammers shorten development time by generating source code for creating or changing menus, windows, dialog boxes, and alerts in the application interface.

With AppMaker, you point and click or type to arrange the user-interface elements on-screen; the program then generates source code in Pascal or C.

With AppMaker, you can concentrate on your application's unique features instead of programming the standard user-interface elements. Nonprogrammers can also use the program to create a prototype of the application and then turn the rest of the application over to a programmer. Bowers Development also reports that programmers unfamiliar with the Macintosh environment can use AppMaker as a study tool.

To compile and link the C or Pascal source code that AppMaker generates, you need MPW or Think. AppMaker works on all Macs with System 5.0 or higher (6.02 on the Mac II), Bowers reports. It uses 400K bytes of memory and is MultiFinder-compatible.

Price: \$295.

Contact: Bowers Development Corp., P.O. Box 9, Lincoln Center, MA 01773, (617) 259-8428.

Inquiry 1107.

Expert-System Tree

A non-rules-based expert-system tool that uses multipath decision trees capable of handling 100,000 rules per application was announced by CAM software. LogicTree was designed for classification, decision making, logic and software documentation, and diagnostics applications.

During development, you enter your logic to a decision tree without having to enter code as you would in a standard AI language.

LogicTree runs on IBM PCs with 640K bytes of RAM, a hard disk drive, and DOS 2.0 or higher.

Price: \$495.

Contact: CAM Software, Inc., Westpark Building, Suite 208, 750 North 200 West, Provo, UT 84601, (801) 373-4080.

Inquiry 1108.

The Programmable Editor

Infinitor lets you emulate any other editor and actually change the way the editor works to suit your needs, according to Agranat Systems. The program is an ASCII file editor and text-processing utility.

Included with the program is TPL (for Text Processing Language). You can run or compile TPL programs while editing a file without leaving Infinitor. TPL programs can retrieve text from a file, manipulate it, and add new text. They can also generate code, act as code utilities, and serve as on-line references. The program comes with 17 TPL programs.

Infinitor also includes a windowing system called Nimble Windows, which lets you edit 10 files at once, each with its own window.

To run Infinitor, you need an IBM PC with 384K bytes of RAM and DOS 2.0 or higher.

Price: \$150.

Contact: Agranat Systems, P.O. Box 4415, Brockton, MA 02401, (800) 526-5368.

Inquiry 1110.

dBASE Compiler for Interactive 386/IX Unix

WordTech Systems' Quicksilver for Unix lets you compile your dBASE III Plus applications as stand-alone .EXE files to run under Interactive's 386/IX. Quicksilver for Unix is compatible with dBASE III Plus and WordTech's dBASE III Plus interpreter, dBXL. The compiler supports automatic record and file locking and will allow any multiuser dBASE application written for DOS LANs to execute on Unix, WordTech reports.

The compiler requires version 1.0.6 of 386/IX or higher. Each stand-alone application running in Unix will require 512K bytes of memory plus 256K bytes per person, the company reports.

Price: \$1399.

Contact: WordTech Systems, Inc., P.O. Box 1747, Orinda, CA 94563, (415) 254-0900.

Inquiry 1106.

Generating C for PM

Winpro/PM 2.1 is a Presentation Manager application prototyping tool for use with the Microsoft OS/2 Software Development Kit 1.06.

The program enables you to create C source code from a standard PM resource definition file. The C code supports menu bar items, pull-down menus, dialog boxes, and accelerator keys. You can also compile the code with Microsoft's C 5.1 to create an executable PM application prototype.

Winpro/PM 2.1 runs on any IBM PC or compatible running Microsoft OS/2 Software Development Kit 1.06.

Price: \$350.

Contact: Xian Corp., 625 North Monroe St., Ridgewood, NJ 07450, (201) 447-3270.

Inquiry 1109.

Dis.Doc Upgraded

The Dis.Doc interactive disassembler and patcher from RJ Swantek is now available in version 3.0.

The program cuts programming time by immediately making and displaying changes you make to a disassembled listing.

With version 3.0, you can load files through the command line. Other enhancements include the ability to edit segments and data types, an improved outline format, and uppercase and lowercase features.

Dis.Doc 3.0 runs on the IBM PC with DOS 2.0 or higher and at least 384K bytes of RAM.

Price: \$125.

Contact: RJ Swantek, P.O. Box 1032, Hartford, CT 06111 (203) 953-0236.

Inquiry 950.

continued



QNX vs. OS/2 UNIX

QNX®: Bend it, shape it, any way you want it.

ARCHITECTURE If the micro world were not so varied, QNX would not be so successful. After all, it is the operating system which enhances or limits the potential capabilities of applications. QNX owes its success (over 75,000 systems sold since 1982) to the tremendous power and flexibility provided by its modular architecture.

Based on message-passing, QNX is radically more innovative than UNIX or OS/2. Written by a small team of dedicated designers, it provides a fully integrated multi-user, multi-tasking, networked operating system in a lean 148K. By comparison, both OS/2 and UNIX, written by many hands, are huge and cumbersome. Both are examples of a monolithic operating system design fashionable over 20 years ago.

MULTI-USER OS/2 is multi-tasking but NOT multi-user. For OS/2, this inherent deficiency is a serious handicap for ter-

minal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 32 terminals and modems to connect to any computer.

INTEGRATED NETWORKING Neither UNIX nor OS/2 can provide integrated networking. With truly distributed processing and resource sharing, QNX makes all resources (processors, disks, printers and modems anywhere on the network) available to any user. Systems may be single computers, or, by simply adding micros without changes to user software, they can grow to large transparent multi-processor environments. QNX is the mainframe you build micro by micro.

PC's, AT's and PS/2's OS/2 and UNIX severely restrict hardware that can be used: you must replace all your PC's with AT's. In contrast, QNX runs superbly on PC's and literally soars on AT's and PS/2's. You can

run your unmodified QNX applications on any mix of machines, either standalone or in a QNX local area network, in real mode on PC's or in protected mode on AT's. Only QNX lets you run multi-user/multi-tasking with networking on all classes of machines.

REAL TIME QNX real-time performance leaves both OS/2 and UNIX wallowing at the gate. In fact, QNX is in use at thousands of real-time sites, right now.

DOS SUPPORT QNX allows you to run one PC-DOS application at each computer on a QNX network. With OS/2, 128K of the DOS memory is consumed to enable this facility. Within QNX protected mode, a full 640K can be used for PC-DOS.

ANY WAY YOU WANT IT QNX has the power and flexibility you need. Call for details and a demo disk.

THE ONLY MULTI-USER, MULTI-TASKING, NETWORKING, REAL-TIME OPERATING SYSTEM FOR THE IBM PC, AT, PS/2, THE HP VECTRA, AND COMPATIBLES.

Multi-User	10 (32) serial terminals per PC (AT).	C Compiler	Standard Kernighan and Ritchie.
Multi-Tasking	64 (150) tasks per PC (AT).	Flexibility	Single PC, networked PC's; single PC with terminals, networked PC's with terminals. No central servers. Full sharing of disks, devices and CPU's.
Networking	2.5 Megabit token passing. 255 PC's and/or AT's per network. 10,000 tasks per network. Thousands of users per network.	PC-DOS	PC-DOS runs as a QNX task.
Real Time	4,250 task switches/sec (AT).	Cost	From US \$450. Runtime pricing available.
Message Passing	Fast intertask communication between tasks on any machine.		



For further information or a free demonstration diskette, please telephone (613) 591-0931.

Quantum Software Systems Ltd. • Kanata South Business Park • 175 Terrence Matthews Crescent • Kanata, Ontario, Canada • K2M 1W8

QNX is a registered trademark of Quantum Software Systems Ltd.

The UNIX Operating System is a registered trademark of AT&T. IBM, PC, AT, XT and PS/2, PC-DOS and OS/2 are trademarks of International Business Machines. HP and Vectra are registered trademarks of Hewlett-Packard Company.

Circle 233 on Reader Service Card

BIX CALENDAR

JULY

Display this month's
BIX activities

J

U

Y

SUNDAY, 7/2, 9 PM EST. "Computer Babel: Which language is best for your project?"

Which programming language should you use for which project? Why shouldn't you use one language for all projects? The BIX Language Group conference moderators are joined by some of BIX's best programming experts as they try to define language needs. (Join the CBix topic of the Other.lang conference)

THURSDAY, 7/6, 8:30-9:30 PM EST. "Just what is Ada, anyway?"

Randy Brukardt and Dan Stock of R.R. Software discuss the Ada language, why it isn't "just another programming language," and the difficulties of using it in distributed processing. (Join the CBix topic of the Janus.ada conference)

WEDNESDAY, 7/12, 9-11 PM EST. "Emerging trends in the microcomputer industry"

Join BYTE Editor in Chief Fred Langa and BYTE columnist Wayne Rash, Jr. in a discussion of the future of this industry. (Join main CBix area, Band A, Channel 1)

All-Month Conference

"Getting Ready for the Boston MacWorld Expo: What to look for in upcoming products" is the theme of the month in the Macintosh Exchange. In addition, Macsbug 6.1 will be this month's focus utility. It has been changed dramatically since version 6.0, so there's a lot to talk about—including user-extensible-D commands that can let the debugger carry out preset commands or code.

Uploads/Downloads

One of the major features of BIX is its Listings areas—the place to find and share program code for your computer. Here's a small sampling of some of the newest files.

Amiga Listings Area

colorlab.arc—A program for studying the Amiga's color capabilities. You can look at all the colors of the Amiga computer by clicking into gadgets or by sliding the R,G,B proportional gadgets.

jrcomm93.zoo—A terminal program that supports ANSI graphics, and XMODEM, YMODEM, and ZMODEM protocols. Other features include macros, scripts, an intelligent dialer and telephone book manager, and a review buffer.

mandvrn.arc—A Mandelbrot generator kit.

IBM AT Listings Area

diskflag.zip—A utility that checks your disk for free space.

egaedit.arc—An EGA font editor that lets you create custom EGA character fonts, such as special or multilingual character sets. Features include pixel-by-pixel editing of all 256 characters in the EGA character set and such editing features as invert, flip backwards, and flip upside-down. Fonts can be loaded and saved.

rom2ram.zip—A utility that moves your EGA's ROM BIOS into extended memory, which increases speed.

IBM PC Listings Area

alias421.com—Alias is a resident program that provides command aliasing, parameter recall, and command completion.

inflat.exe—An inflation calculator that helps you watch your money's value erode.

MS-DOS Listings Area

tsarc.exe—The TimeStar time-management system includes schedules for recurring activities, archives completed tasks, shows your week at a glance, pops up calendars and alarms, and includes a text and graphics database manager with an auto-dialer. Shareware; requires Microsoft Windows.

Macintosh Listings Area

address17.sit—Address Book 1.7, an address and phone book application. Described by the uploader as "the best I have seen." Features include a modem dialer, a Desk Accessory and Application form of the program with complete documentation, and a merge program to combine two files.

separate.sit—Adds a separation line to your menu between Desk Accessories.

Telecomm Listings Area

atexcodes.txt—Description of ATEX typesetting system's file structure and a code set based on research done by the author on an ATEX system. The program's author uses this information to submit files to ATEX.

elink20.arc—EAZilink is a shareware terminal package that includes support of external protocols for error-free downloads and a number of interesting emulations, including ViewData and ANSI-BBS. It also supports a mini-BBS mode.

Ti Listings Area

c99mdos.ark—Clint Pulley's C99 C Compiler for the Ti.

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 blow 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, 8 bits, no parity, 1 stop bit, or 7 bits, even parity, 1 stop bit. Now dial BLX at 617-861-9767, hit the return key, and respond as follows:

Prompt:	You Enter
login (enter "bix"):	bix
Name?	bix.flatfee

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 \$15 per month, or \$2 per off-peak hour.

For additional information, including your local Tymnet access number, call 800-227-2983 (in New Hampshire 603-924-7681).

**Based on a \$156 annual fee, billed quarterly — a subscription which you may cancel at any time without future quarterly charges. If you prefer, you may subscribe for a 3-month trial at just \$59.*

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983 • In NH 603-924-7681
Circle 450 on Reader Service Card



Finite-Element Modeling on the Mac

LapCAD3 is a Macintosh finite-element preprocessor that creates models for MacNeal-Schwendler's MSC/pal and MSC/Nastran.

The MacNeal-Schwendler programs perform stress, vibration, and heat transfer analysis of structures and mechanical components. MSC/pal runs on the Mac, and MSC/Nastran runs on workstations and mainframes.

LapCAD3 is a graphics preprocessor that creates the geometry, element mesh, element and material properties, and loads and constraints. You can also create models for MSC/Nastran on the Mac and upload them to a mainframe.

The program can import geometry from VersaCAD and AutoCAD. And the latest version of LapCAD3 can create models of up to 2500 nodes.

LapCAD3 runs on the Mac Plus, SE, II, IIx, or IIcx.

Price: \$395.
Contact: LapCAD Engineering, 885 Lees Ave., Long Beach, CA 90815, (213) 594-5878.

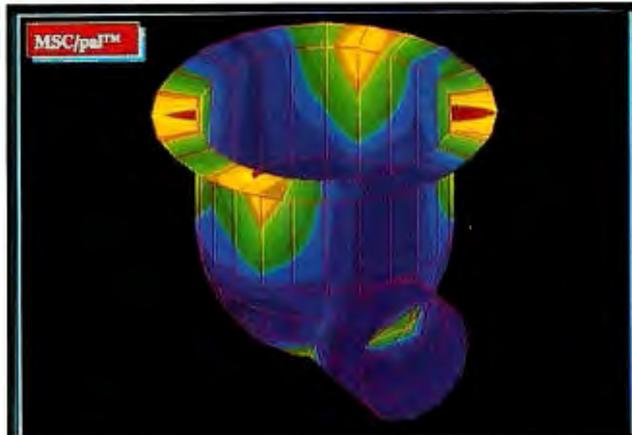
Inquiry 1112.

Numerical Computing

Matfor, an interactive system for numerical computations, lets you perform matrix arithmetic, matrix manipulation, various matrix decompositions, fast Fourier transforms, linear programming, and more.

The program supports two- and three-dimensional plots and produces graphics files in PostScript format.

You can also use Matfor as a programming language by making use of functions with



LapCAD3 simplifies finite-element modeling for MSC/pal and MSC/Nastran.

multiple output and optional input arguments, lists, user-defined data types, and overloading of operators and functions.

Matfor runs on the IBM PC AT with 640K bytes of RAM, on the Mac II, and on Sun and other workstations.

Price: \$75.

Contact: Computational Engineering Associates, 4252 Cordobes Cove, San Diego, CA 92130, (619) 259-8863.
Inquiry 1115.

Studying Chaos

You've heard a lot about chaos, or nonlinear dynamics, but you might not know all you want to about the topic. Chaos in the Classroom is a teaching program that offers an introduction to nonlinear systems and chaos.

The first module of the program, Maps and Bifurcations, is currently available. It lets you explore the behavior of eight systems of equations, including logistic and seasonal logistic growth equations. Features include bifurcation diagram construction, visualization of time series and phase portraits, and sequential magnification.

A second module on fractals and Julia sets is planned for midsummer, according to Dynamical Systems.

The program runs on the

IBM PC with 512K bytes of RAM and a CGA or EGA card.

Price: \$49.95.

Contact: Dynamical Systems, Inc., P.O. Box 35241, Tucson, AZ 85740, (602) 825-1331.

Inquiry 1113.

Mainframe Math Program Now on 80386-Based PCs

MACSYMA, a symbolic and numerical math program jointly developed by MIT and Symbolics for mainframes, is now available for 80386-based DOS machines. Besides automating numerical problem solving, the program can automate symbolic operations, including differential equation solving, Laplace and Fourier transform computations, and vector and tensor calculus. The program includes a library of methods for computing perturbation and series solutions for problems with unknown exact symbolic solutions.

Written in Lisp, the program runs in CLOE, a Lisp application delivery package for 80386 PCs. CLOE provides two advanced memory management features, virtual memory and garbage collection.

The PC version of the program will feature two- and three-dimensional graphing capabilities, a debugger and compiler, and code generators for C, FORTRAN, and TEX.

PC MACSYMA requires an 80386-based PC running DOS 3.1 or higher with 4 megabytes of main memory and a 40-megabyte hard disk drive.

Price: \$2900.

Contact: Symbolics, Inc., 8 New England Executive Park E, Burlington, MA 01803, (800) 622-7962 or (617) 221-1251.

Inquiry 1111.

Parameter Manager Plus Upgrade

GW Instruments recently upgraded its Parameter Manager Plus data acquisition software that runs on the Macintosh. Version 3.0 offers more powerful data-smoothing features, larger graph sizes (up to 400 by 400 inches), and the ability to handle up to 32,767 graphs from a single data set.

The new version is also faster and lets you move and sort graphs of data as individual slides. Slides can also be up to 400 by 400 inches, with a maximum of 32,767 per document.

Version 3.0 includes the MacADIOS TurboDrivers and SCSI hardware I/O drivers, enabling you to run the program with MacADIOS II and SCSI-compatible data acquisition hardware.

The program runs on the Mac Plus, SE, and II.

Price: \$990.

Contact: GW Instruments, Inc., 35 Medford St., Somerville, MA 02143, (617) 625-4096.

Inquiry 1114.

continued



How to match the best front end with the best back end.

You've invested in the best hardware, operating system and database products. You have a staff of programmers ready to go. But to build great looking applications with the sophisticated features today's users demand, you need a powerful front end development tool—JAM.™

JAM, the most advanced user interface management system on the market, does it all—from prototyping to implementation. And, because it works with any database



Create colorful screens and nested windows easily.

or file manager, you get the best front end and the best back end.

JAM is hardware independent, so it isn't limited to one computer, database or operating system. In fact, JAM runs on everything from PC's to super-minis, works under 7 operating systems and provides access to a host of database products. Using JAM you can create a consistent user interface across multiple systems and hardware platforms.

JAM works under the following operating systems:

- UNIX®
- VMS®
- RMX™
- MS-DOS®
- XENIX®
- VOS™
- AOS/VS™

JAM makes it easier than ever to design and revise complex applications. Using features like context-sensitive help, procedural command language (JPL), shifting and scrolling fields, extensive data validations, on-line testing, and a variety of visual attributes, you'll be amazed how quickly your applications spring to life.

JAM is fast, as well as flexible. Development time is reduced significantly thanks to JAM's powerful screen drawing utilities and comprehensive library of sub-routines. You can easily create and link together screens, windows, and menus to develop an application shell. Then simply attach the processing routines, and your application is complete.

Plus, if your back end is an SQL-compatible relational database like Oracle,® SQLbase,® Informix,® or Britton Lee,™ you'll really appreciate JAM/DBi, JAM's optional database interface. With JAM/DBi, you can develop entire applications using only industry-standard SQL statements and JAM's authoring tools.

So if you're programming in a 3GL like C or FORTRAN, follow the lead of the many Fortune 1000 companies who have already discovered JAM.

JAM from JYACC. It gives you the best at both ends.

Call for more information about JAM and our demo diskette. **800-458-3313**
 JYACC, Inc.
 116 John Street
 New York, NY 10038
 212-267-7722 FAX No. 212-608-6753



Use SQL to retrieve and display data.

JAM

JYACC Application Manager. *The Composer for Sophisticated Applications.*

NEW FOR TURBO C PROGRAMMERS

**Three Serious Tools
at a ridiculously low price.**

Your time is valuable! Now you can reduce your programming time like you never imagined, using The Working Toolbox Software program by Be Aware Inc. Our program comes with an extensive, easy-to-use manual that is loaded with examples. Also included is a 30-day money back guarantee. Here are some of the features of these three great timesaving tools.

THE WORKING TOOLBOX

THE WORKING ISAM

- Stores data in B+ Trees.
- Maximum of 256 indexes.
- RAM buffers for high speed.
- 6 types of indexes available.
- Multi-field indexing.
- All indexes stored in one file.
- Automatic Recovery.
- **FREE SOURCE CODE**

THE WORKING SCREEN PAINTER

- Friendly interactive environment.
- Data entry and display.
- Box & line drawing supported.
- Multi color screens at a glance!
- **SUPER FAST SCREENS**
- Writes C source code ready to be compiled under any memory model.

THE HANDY LIBRARY

- Great functions for easier programming and professional results.
- Intelligent data entry and display.
- Overlapping windows
- Pop Up, Pull down and bar menus with one function call!
- All memory models supported.
- Date conversion functions.

So don't waste any more time, order now! Only \$79.99 plus shipping and handling. Call (our toll-free number) or fax your order.

Be Aware Inc.

1443 Banks Road, Margate, FL 33063

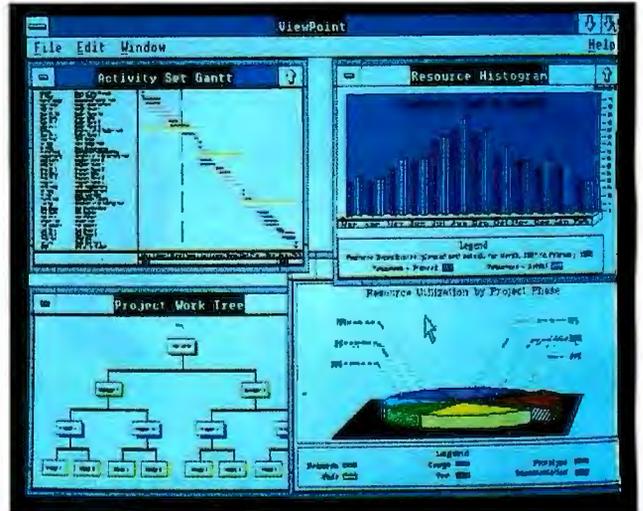
No Royalties! ORDER NOW ONLY \$79.99

1 800-423-1611 or 305-970-0372
or FAX 305-735-3459

Turbo C is a registered trademark of Borland International.

WHAT'S NEW

SOFTWARE • BUSINESS



A logic diagram of work flow done with ViewPoint OverView.

Management Software Links Multiple Projects

ViewPoint OverView, a LAN-based multiuser program, lets you manage scheduling, resource, and budget requirements among several departments working on more than one project. It determines how an event affects its own and other projects, present and future.

OverView's security system, based on password access, determines which projects are available to line managers and program managers, and which projects can be saved after revisions.

Computer Aided Management, the program's publisher, also released graphics modules that support Windows under DOS and Presentation Manager under OS/2. You can use the modules to make Gantt charts, logic diagrams, bar charts, histograms, and the like. The new modules let you attach notes and scanned logos to a chart. (Both programs are scheduled to ship this summer.)

ViewPoint OverView works on the IBM PC XT with 512K bytes of RAM, a mouse, and a CGA, EGA, or VGA card.

Price: \$2000 per user;

graphics module, \$995.
Contact: Computer Aided Management, 1318 Redwood Way, Suite 210, Petaluma, CA 94952, (800) 635-5621 or (707) 795-4100.
Inquiry 854.

Add-in Reduces Spreadsheet Chaos

Sorting through a spreadsheet's screens or printouts full of numbers can be difficult. Symantec's solution to this problem, an add-in for Lotus 1-2-3 called Budget Express, is a two-dimensional "outline processor" that can hide numeric detail and bring it back when you touch a key.

Budget Express lets you shrink spreadsheets to a format where you see the labels, sub-totals, and cell formulas only. You can manually specify the area to be collapsed into outline form, or the program can do it for you automatically by detecting indented ranges, labels, and cell formulas. The program adds a plus sign to rows in the spreadsheet that summarize hidden detail. When you move the cursor to a summary row and press a key, you can expand or reduce the spreadsheet.

Budget Express can also generate automatic quarterly

continued

NEW! REAL-TIME MONITORING & CONTROL

MENU-DRIVEN, EASY-TO-USE STAND-ALONE COMPUTER

The stand-alone SOLUS™ computer connects to an IBM PC's RS-232 port, and provides 36 digital/analog I/O channels.

Menu-driven operation and a large graphics library make it easy to create monitoring and control applications. Use modems to remote locations. And daisychain up to 256 SOLUS computers.

For details or to order, call toll-free.

(800) 247-5712
In Oregon
(503) 635-3966

Only **\$895**

VISA/MC/AMEX accepted. Software additional.

SOLUS™
PERSONAL CONTROL COMPUTER™

TMI, inc.
4000 Kruse Way Place, 2-120
Lake Oswego, OR 97035
FAX (503) 635-3004



OUR μ P DEVELOPMENT TOOLS HELP PROJECTS GET ON THEIR FEET.

The "creature" shown above doesn't depict a futuristic lunar landing. Rather, it represents a *polar* landing of a sophisticated weather monitoring device. A new parachute-deployed device that instantly transmits vital environmental data to waiting scientists. And whose Antarctic installation and erection now happen automatically, in a matter of minutes, allowing critical data collection in remote areas that were impossible to reach before.

This "Self-Erecting Weather Station," sponsored by the National Science Foundation and designed and developed by Polar Research Lab, was made possible by Avocet and AVSIM™, Avocet's unparalleled simulator/debugger.



The AVSIM Full-Screen Display

Unequaled capability

Polar Research needed AVSIM's sophistication to control the sensors in the weather station's "legs" and to create its transmitter. AVSIM's detailed on-screen CPU simulation, unlimited breakpoint facility, and unique "undo" capability gave their engineers the ease of use and flexibility that allowed them to *execute and test the software even before the hardware was ready*. Saving crucial time and frustration in both the programming and testing phases of development. And money, too; at only \$379, AVSIM is a fraction of the cost of additional hardware.

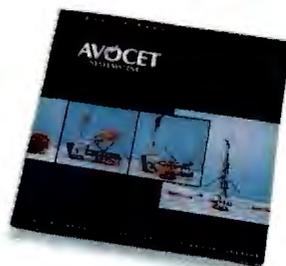
Complete compatibility: from the ground up

Best of all, AVSIM is completely compatible with our AVMAC™ macro assemblers and AVOCET C™ cross compilers — the ideal combination of tools which gives you a comprehensive development solution.

Get your own project off the ground; try before you buy

Try the AVSIM demo yourself for 30 days. If you're not satisfied for any reason, return the unopened program disk for a full refund — less \$35 for the demo disk and manual, which are yours to keep.

Free Catalog



Call Toll-Free 1-800-448-8500*

For your free catalog, to order, or for more information about AVSIM and other Avocet products.

Call Avocet today and ask about our complete line of affordably priced software and hardware μ P development tools. Discover how we can help you get *your* next project on its feet, too.

AVOCET

SYSTEMS,® INC.

©1988 Avocet Systems, Inc. All rights reserved.

THE SOURCE FOR QUALITY μ P DEVELOPMENT TOOLS

Microsoft® is a U.S. registered trademark of Microsoft Corp. ©1980 Hewlett-Packard Company PE12915

HOW TO MAKE P
How to make points.
HOW TO MAKE PO
How to Make Poi
How to Make Po
HOW TO MAKE P
How to make points
How to make points.
How to make poi
How to Make Points.
HOW TO MAKE
HOW TO MAKE POIN

How to Make

HOW TO MAKE

How to make points.

How to Make Points
HOW TO MAKE POIN *How to Make Points*
HOW TO MAKE PO *HOW TO MAKE PO*
How to make points. *How to make points*
How to make points *How to Make P*
HOW TO MAKE POIN. **HOW TO MAKI**
How to Make Points *How to Make Point*
How to make p *How to make poin*
How to make **HOW TO MAKE P**
HOW TO MAKE POINTS.
How to make point
HOW TO MAKE POINTS
How to make point
HOW TO MAKE POIN
How to make points.
HOW TO MAKE POINTS
How to make p
HOW TO MAKE POINT
HOW TO MAKE POINTS.
HOW TO MAKE POINT
How to make points.
How to make point
How to make poi

How to HOW TO MAKE POIN
How to make *How to make point*
How to make p HOW TO MAKE POI
How to Make Point' How to make po
How to make p How to Mak
How to make points. *How to Mc*
HOW TO MAKE POINTS **HOW TO**
HOW TO MAK **How to**

Now you can impress them like never before with your HP LaserJet printer. Because HP and Compugraphic have developed a new selection of disk-based scalable typefaces. And with our Type Director software, each face can be scaled from 4 to 200 points in 1/2 pt. increments. Of course, our new faces work with your favorite software. Including WordPerfect, Microsoft® Word and Windows, Ventura Publisher and Aldus PageMaker. Best of all, we're adding more faces all the time. So now your documents are limited by only one thing. Imagination. Call 1-800-752-0900, Ext. 711Q for your nearest authorized Hewlett-Packard dealer.



There is a better way.



Unique New Service Keeps Telecommunications Costs Under Control

No matter how complex your voice communications services are, no matter how many locations you manage, TRACKER™ from CCMI/McGraw-Hill can now give you the information you need to contain costs and save money.

Drawing on years of experience gathering and analyzing rate and tariff data, CCMI/McGraw-Hill created TRACKER to provide you with an instant look at your current services by location... and then compare your alternatives. Through this unique database, you can quickly identify where to reduce costs at a price that more than pays for itself.

TRACKER has proven itself to be the answer to lower costs in the increasingly complex telecommunications environment. To learn more, call today.

1 800 526-5307 Ext. 249



CCMI/McGraw-Hill
500 North Franklin Turnpike
Ramsey, New Jersey 07446

Complete 386 Compiler Package for \$895 SVS FORTRAN-386

- Runs in 32-bit Protected Mode
- Accesses all Available Memory
- Supports VAX and IBM Extensions
- Supports the Intel 287/387 and Weitek 1167/3167 Co-processors
- Applications run up to four times faster than those created with other compilers
- Compiles at High Speed



Package Includes:

- SVS FORTRAN Compiler
- LINK-REX Linker
- 100% Royalty Free License on Distributed Software
- DOS Extender
- DOS Support Library
- Librarian
- Debugger
- Technical Support

"The SVS compiling and linking is extremely fast, and the compiler produces nicely compact code." - *Micro/Systems Journal*

"The LOADS module in DOE-2 is about 14,000 lines of code. I used SVS FORTRAN-386 since it was the only compiler that would swallow the source code (VAX extensions)." - *Programmer's Journal*

Software Conversion Services are also available for converting FORTRAN mainframe source code to the 80386. This service includes conversion, code optimization, user I/O, and more. Call SAIC for more information.



PRICES:
SVS FORTRAN-386.....\$895
SVS PASCAL-386.....\$895
Scitech Scientific Library.....\$325
Scitech Plotting Library.....\$325
Maintainability Analysis Tool....\$895

For More Information Call: 1-800-346-5159 In CA Call: (415) 960-5931

and annual reports. The Goal Tracking function lets you keep a running scoreboard of current and target values. The program's virtual memory scheme lets you store closed or shrunken portions of the spreadsheet on disk, and you can also use it to consolidate dissimilar spreadsheets.

Budget Express works with Lotus 1-2-3 versions 2.0, 2.01, and 2.2, uses 64K bytes of RAM, and can be removed from memory while you're in Lotus 1-2-3.

Price: \$149.
Contact: Symantec, 10201 Torre Ave., Cupertino, CA 95014, (800) 635-6887 or (408) 253-9600.
Inquiry 1116.

Expert Software Creates Employee Handbook

KnowledgePoint's Personnel Policy Expert covers more than 50 policy subjects to help you create a legally appropriate policy for your business. The program gives you an overview of the critical issues that must be addressed when developing a policy on smoking, pay, termination, drugs, or nondiscrimination. It then leads you through a question-and-answer process and, based on the answers you provide, creates the policy.

The program is available in single-user and consultant versions. The consultant version allows you to create a questionnaire from the knowledge base that an employer completes, helping you write a manual for that company.

Personnel Policy Expert includes a built-in word processor that allows you control over the final wording of the document.

Personnel Policy Expert runs on the IBM PC with DOS 2.11 or higher and 512K

bytes of RAM.

Price: \$495; consultant version, \$1495.

Contact: KnowledgePoint, 1311 Clegg St., Petaluma, CA 94952, (707) 762-0333.
Inquiry 1117.

Accounting Database for the Mac

Written in 4th Dimension, a⁴ is an integrated accounting, communications, and sales tracking database for companies with sales in the \$1 million to \$10 million range.

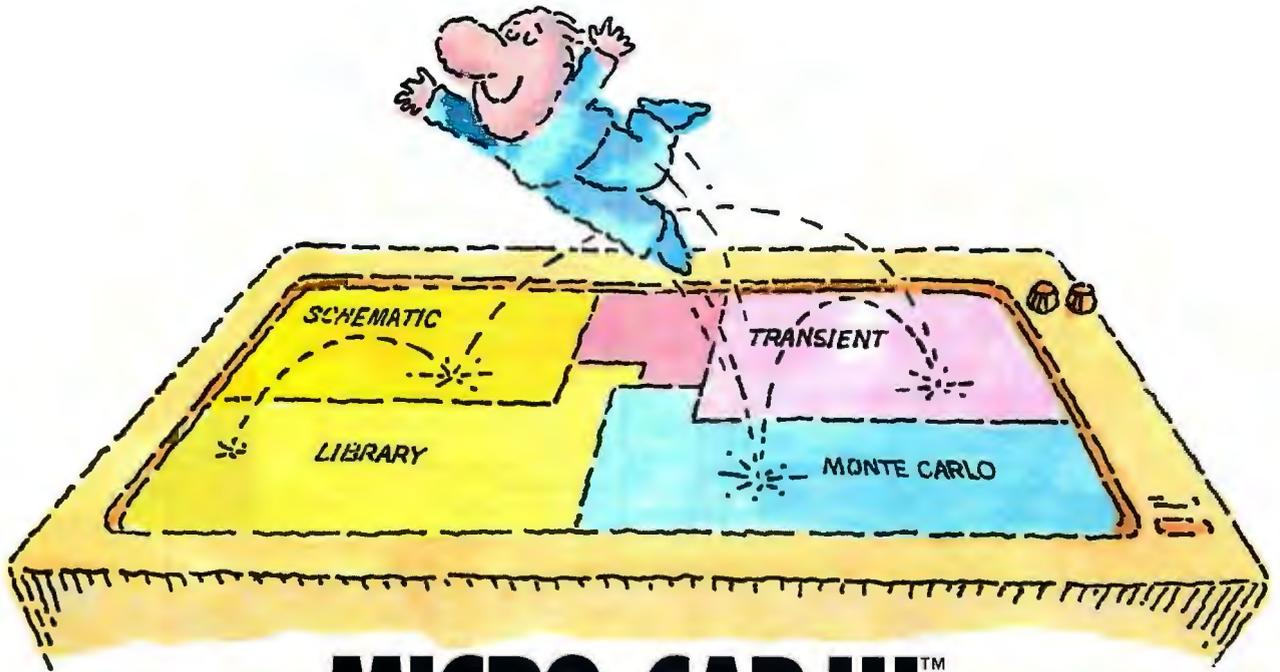
Accounting functions of the program include accounts receivable and payable, general ledger, order entry/invoicing, and inventory. Accounts payable or receivable invoices can be aged by calendar month, or you can define your own aging period. Partial payment can be applied to both client and server invoices.

The program's communications functions include a memo pad, calendar, specialized menus that you can create for departmental passwords, and quick report, letter, and mailing label capability.

Softek recommends that you use the program with a 68020- or 68030-based system such as a Mac II, IIX, or SE/30, or a Mac SE with an accelerator card. The program requires 2 megabytes of RAM, a hard disk drive, and 4th Dimension or 4D Runtime. Softek reports that the program works on any Macintosh-compatible network except TOPS. For 10 or more users, the company recommends a Macintosh-compatible Ethernet solution.

Price: \$1000; a⁴ Open (includes source code), \$2000.
Contact: Softek Design, 882 Calgary Way, Golden, CO 80401, (303) 526-0606.
Inquiry 1118.

continued

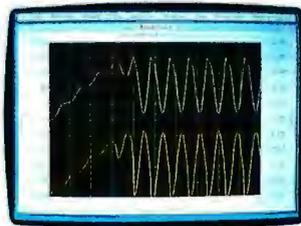


MICRO-CAP III.™ THIRD-GENERATION INTERACTIVE CIRCUIT ANALYSIS. MORE POWER. MORE SPEED. LESS WORK.

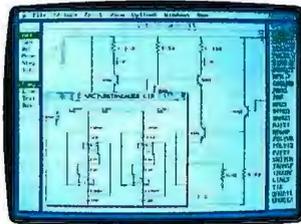
MICRO-CAP III,™ the third generation of the top selling IBM® PC-based interactive CAE tool, adds even more accuracy, speed, and simplicity to circuit design and simulation.

The program's window-based operation and schematic editor make circuit creation a breeze. And super-fast SPICE-like routines mean quick AC, DC, Fourier and transient analysis — right from schematics. You can combine simulations of digital and analog circuits via integrated switch models and macros. And, using stepped component values, rapidly generate multiple plots to fine-tune your circuits.

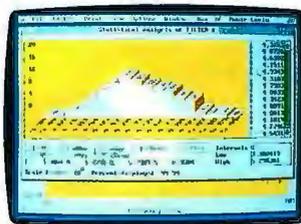
We've added routines for noise, impedance and conductance — even Monte Carlo routines for statistical analysis of production yield. Plus algebraic formula parsers for plotting almost any desired function.



Transient analysis



Schematic editor



Monte Carlo analysis

Modeling power leaps upward as well, to Gummel-Poon BJT and Level 3 MOS — supported, of course, by a built-in Parameter Estimation Program and extended standard parts library.

There's support for Hercules® CGA, MCGA, EGA and VGA displays. Output for laser plotters and printers. And a lot more.

The cost? Just \$1495. Evaluation versions are only \$150.

Naturally, you'll want to call or write for a free brochure and demo disk.

spectrum

1021 S. Wolfe Road,
Sunnyvale, CA 94086
(408) 738-4387

MICRO-CAP III is a registered trademark of Spectrum Software.
Hercules is a registered trademark of Hercules Computer Technology.
IBM is a registered trademark of International Business Machines, Inc.

CMO... Your Nationwide Source

PC/TOO



PC/TOO 80286 SYSTEM CONFIGURATION

- 12.5 MHz Intel Processor
- 512K, Expandable to 4MB
- 1.2MB Floppy Disk Drive
- Built-in Floppy & Hard Disk Controller
- Phoenix Bios, Clock & Calendar
- 101 Key Enhanced Keyboard
- 2 Serial, 1 Parallel & PS/2 Mouse Ports
- Built-in EGA/CGA Controller.
- Four Expansion Slots

MONITOR:

- 14" Color RGB Display
- Tilt & Swivel Base
- 80 x 25 Display
- Green Text Switch

SYSTEM PRICE \$1099

AMIGA

Anakin Research	
Easyl Drawing/2000	\$349
Easyl Drawing/500	319
C.LTD	
Keyboard w/Macros	99
Laser Xpress	2149
Digital Creations	
Supergen	709
Great Valley Products	
A2000 - 2/2	759
A2000 HC/40M	719
A2000 HC/40Q	859
A500 HD/30	799
A500 HD/40M	969
Megatronics	
3 1/2" External Air Drive	149
3 1/2" Internal Air Drive	119
Microbotics	
Starboard II w/512K	449
Upperdeck	45
Progressive Peripherals	
Pro-Gen Genlock	389

Frame Grabber	\$319
Spirit Technology	
1.5MB Bd. w/OK (A1000)	245
1.5MB Bd. w/OK (A500)	245

MACINTOSH

Olympia	
NP-30 Mac 150cps	289
Qume	
ScripTen Laser	3395
Crystal Print Publisher	3299
Seikosha	
SP-1000AP Mac	239
Dolphin	
Integra 20 External	559
Integra 40 External	799
Everex	
EMAC 20 Deluxe 20MB	579
EMAC 60T 60MB Backup	799
Cornerstone	
SinglePage Display SE	759
DualPage Display SE	1259
Magnavox	
9CM080 14" VGA Display	499

Sigma Designs	
PageView SE	\$849
LaserView II	1899
Practical Peripherals	
Mac 2400 Stand Alone	239
Shiva	
NetModem V2400	429
TeleBridge	349

MONITORS

Amdek	
Video 210+ 12" Amber	99
Video 410 TTL Monochrome	145
Video 432 VGA Monochrome	149
Color 732 VGA Color	399
Cornerstone	
SinglePage Display	699
Magnavox	
7BM623 12" TTL Amber	89
CM8762 14" Comp/RGB	235
9CM053 14" HiRes EGA	369
9CM062 14" VGA Display	349
9CM082 14" VGA Display	399
Mitsubishi	
DiamondScan 13" Display	499
Packard Bell	
PB-1272 12" TTL Mono	80
PB-1472 14" TTL 132 Col.	109
PB-1422EG 14" HiRes EGA	359



NEC
JC-1403 Multisync IIA
\$489

Polaroid	
Palette EGA Plus	2199
Seiko Instruments	
CM-1430 14" VGA	559
Taxan	
119 12" Composite Amber	89
Wyse Terminals	
WY-30, 50, 60	Call
Zenith	
ZFM-1490 14" VGA Analog	619

MULTIFUNCTION

ATD-ZuckerBoard	
Color Half Card	69
Monochrome Graphics Adpt.	79

AST	
Six Pak Plus Board	\$125
VGA Plus Adapter	389
Boca Research	
TopHat 128K Expansion	119
BocaRam/AT 0-4MB Board	149
Boca Dual Graphics Adapter	69
Boca MultiEGA	169
DCA	
Irma 2 3278 Board	699



ORCHID TECHNOLOGY
ProDesigner VGA
\$299

Emerald	
3XTwin 5251 Local Emulat.	549
Everex	
Magic I/O AT Par/Ser	59
Ram 3000 Deluxe 0-3MB Bd.	89
Micro Enhancer EGA	169
5th Generation	
Logical Connection 256K	429
Hercules	
Graphics Card Plus	179
Intel	
AboveBoard 2 Plus w/OK	319
AboveBoard PS/286 w/512K	419
AboveBoard Plus w/512K	429
AboveBoard Plus I/O 512K	579
Inboard 386/PC 80386 CPU	589
8087 IBM PC/XT CoProc.	95
80287-8 IBM XT 8MHz CoP.	219
80387-16 16MHz 80386	399
Orchid Technology	
TinyTurbo 286	269
Renaissance	
RVGA2 800x600 256K-PAL	259
Video 7	
Vega VGA Adapter	279
FastWrite Video Adapter	319
V-RAM VGA Adapter	469

STORAGE DEVICES

American Power	
450AT + UPS Backup	439
Everex	
Floppy Stream 40 40MB Int.	359
Excel Stream 40T 40MB Int.	529



Your Source for Hardware, Software & Peripherals

For Quality Computer Products.

Miniscribe	
8425 20MB 3 1/2" 40Msec	\$259
3650 40MB 5 1/4" 61Msec	329
3053 44MB 5 1/4" 25Msec	469
6085 70MB 5 1/4" 28Msec	599
Mountain Computer	
TD-4340 40MB Int. Tape	319
TD-8000 80MB Ext. Tape	445



PLUS DEVELOPMENT
20MB HardCard
\$529

Seagate	
ST-225 20MB w/cont	249
ST-238 30MB w/cont	279
ST-251 40MB 1/2 height	349
Sysgen	
Bridge-File 5 1/2" External	249
Bridge-Tape 40MB External	479
SmartImage 60MB Internal	479
QIC-File 60MB External	599
Omni Board Controller	80

COMPUTERS

AST	
Premium 286 Model 70	1299
Compaq	
Deskpro & Portable 286/386	Call
IBM	
PS/2 Model 30 w/20MB	1599
NEC	
Multimate Laptops	Call
PC-TOO	
256K 12MHz 8088 Dsktp	449
512K 12MHz 80286 Desktop	899
Sysgen	
ProSystem 12MHz w/40MB	1999
Toshiba	
T1000 8088 Laptop	779
T1200 Floppy/Hrd Lptp	Call
Zenith	
80286/386 Desktops	Call
SuperSport & Superspt 286	Call



AST
Bravo 82086 Model 5
\$849

COMMUNICATIONS

Anchor	
2400 Baud Lightning f/i	109

2400 Baud External	\$169
Atari	
XMM301 XL/XE 300 Baud	45
SX-212 ST Modem	90
Avatex	
1200 HC External	99
2400 Baud Internal	129
Everex	
Evercom 12 1200 Baud Int.	80
Evercom 24 2400 Internal	149
Evercom 24E+ 2400 Bd. Ext.	189
Hayes	
Personal Modem 1200 Ext.	129
SmartModem 1200 Baud	289
SmartModem 2400 Baud	429
Intel	
2400EX External	299
Murata	
M1200 Facsimile	699
Panasonic	
UF-140 Panafax Facsimile	899
FX-89 Fax Board	699
FX-505 Hi-Res Scanner	1049
Practical Peripherals	
1200 Baud Internal	69
1200 Baud Stand Alone	85
2400 Baud Stand Alone	139
2400 Baud Internal	189



COMPLETE PC
Complete HandScanner
\$149

Sharp	
FO-220 Facsimile Machine	899
Supra	
2400AT 2400 Baud Atari	169
The Complete PC	
Complete FaxBoard 4800	269
Complete Answ. Machine	239

PRINTERS

Alps	
ASP-1000 9-Pin Flatbed	159
Allegro 24 24-Pin Flatbed	319
Brother	
M-1709 240cps, 132 Col.	369
M1724L 24-Wire, 132 Col.	569
HR-20 20cps Daisywheel	329
HR-40 40cps Daisywheel	589
Epson	
LX-810 200cps, 80 Col.	189
FX-850 264cps, 80 Col.	Call
FX-1050 264cps, 132 Col.	Call
LQ-510 180cps, 24-Wire	339
LQ-850 330cps, 24-Wire	Call
LQ-950 264cps, 24-Wire	Call
LQ-1050 330cps, 132 Col.	Call
Hewlett-Packard	
2225 Thinkjet	329
NEC	
P2200 Pinwriter 24-Wire	359
P5200 Pinwriter 265cps	549
Okidata	
ML-172 180cps, 80 Col.	199
ML-182 Trbo 220cps, 80 Col.	245



PANASONIC
KX-P1180 192cps,
80 Col. \$179

ML-320 300cps, 80 Col.	\$359
ML-390 270cps, 24-Wire	499
Panasonic	
KX-P1191 280cps, 80 Col.	249
KX-P1124 192cps, 24-Wire	349
KX-P1524 24-Wire, 132 Col.	559
Seikosha	
SP1600A1 160cps, 9-pin	185
SK3000A1 300cps, Color	365
Star Micronics	
NX-1000 144cps, 80 Col.	159
NX-1000 Rainbow Color	229
NX-2400 24-Wire, 80 Col.	369

PLOTTERS/DIGITIZERS

Chinon	
DS-3000 FlatBed Scanner	549
Houston Instruments	
9012 HIPAD+ 12"x12" Tblt	399
PC695A 4-Pen A&B Plotter	599
Seiko	
DT-3503 11"x11" Digitizer	379
Summagraphics	
SummaSketch +12"x12"	399

MS-DOS SOFTWARE

Ashton-Tate dBase IV	459
----------------------	-----

Ashton-Tate MultiMate II	\$289
Bloc PopDrop	32
Bloc Form Tools	55
Borland Paradox R-Database	439
Borland Quattro	149
Central Point PC Tools	50
DAC EASY Accounting	60
Delrina Per FORM	159
5th Generation FastBack Plus	99
Fox Base + Development	199
IMSI OptiMous w/Dr. Halo III	79
IMSI Turbo CAD	59
Intuit Quicken	33
Logitech PS/2 2-button	59
Lotitech ScanMan Scanner	189
Lotus Lotus 1-2-3	299
MECA Managing Your \$	119
Meridian CarbonCopy +	119
MicroPro Wordstar Pro 5.0	199
Microsoft Mouse	109
Nolo Press WillMaker	35
Peter Norton Adv. Utilities	80
Peachtree Accounting	169
Quarterdeck DESQView	80
Server Technology EasyLan	179
SPC 1st Choice 3.0	90
SPC 1st Publisher 2.0	80
SPC Professional Write 2.0	179
TOPS for DOS	119
Traveling Lap-Link +	85
WordPerfect 5.0	219
Xerox Ventura Publishing 2.0	459



MSC
OmniMouse
\$35



Your Source for Hardware, Software & Peripherals

In U.S.A.

800-233-8950

In Canada call: 800-233-8949

All Other Areas call: 717-327-9575 Fax call: 717-327-1217

Educational, Governmental and Corporate Organizations

Call toll-free: 1-800-221-4283

CMO, 101 Reighard Ave., Dept. A1, Williamsport, PA 17701

Over 400,000 SATISFIED CUSTOMERS • MAJOR CREDIT CARDS ACCEPTED

POLICY: Add 3% (minimum \$7.00) shipping and handling. Larger shipments may require additional charges. Personal and company checks require 3 weeks to clear. For faster delivery, use your credit card or send cashier's check or bank money order. Credit cards are not charged until we ship. Pennsylvania and Maryland residents add appropriate sales tax. All prices are U.S.A. prices and are subject to change. All items are subject to availability. Defective software will be replaced with the same item only. Hardware will be replaced or repaired at our discretion within the 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. We are not responsible for typographic or photographic errors.

MMC
MICROCOMPUTER
MARKETING COUNCIL
www MMC.org

A107



A better line driver over the short haul!

Introducing the Model 201 auto-powered line driver. Better because it requires only TD, RD and signal ground for full duplex operation up to 19,200 baud.

The 201 is also equipped with both screw terminals and a RJ-11 connector to accommodate future changes in site wiring, plugs directly into the RS-232 port without cabling and includes a DTE/DCE switch to allow reversing of pins 2 and 3 for computers, terminals and printers. There's even a built-in surge suppressor.

Call today for more information and our free catalog, "The Datacom Cookbook #5", a handy guide to products that solve your toughest datacom problems.

FREE CATALOG

Datacom solutions **TELEBYTE**

270 E. Pulaski Rd., Uniontown, NY 11740
 Tele: 1-800-835-3298 • NY (516) 423-3232 • Fax: (516) 385-8184

WHAT'S NEW

SOFTWARE • OTHER



ReadStar Ex-Press optical-character-reader software has page-analysis capability.

Keeping an Eye on the Page

Inovatic's ReadStar Ex-Press is an optical-character-recognition (OCR) program that analyzes character shapes and assigns them to mathematical models instead of using matrix-matching or feature-extraction recognition methods. The program is entirely software-based and works with standard IBM PCs and desktop scanners, Inovatic reports.

ReadStar Ex-Press can differentiate among text, graphics, headlines, and multiple columns in one pass and suppresses images and logos automatically. The software's semiautomatic mode allows the system to recognize characters about which the automatic expert system is unsure.

The program can also recognize typewritten and typeset text as small as 4 points. The program includes an editor with lexicon for correcting OCR text files. ReadStar Ex-Press runs on the IBM PC AT and PS/2s with 640K bytes of RAM. Price: \$995.

Contact: Inovatic, 1911 North Fort Myer Dr., Suite 708, Arlington, VA 22209, (703) 522-3053. Inquiry 1125.

Reference Adds Utility to Grammatik

The Utilities Pak from Reference Software is an add-on set of programs for the company's Grammatik III grammar checker. It's a standard feature of the latest release of Grammatik; current Grammatik users can purchase it separately.

The Utilities Pak adds four new tools to Grammatik. You used to have to exit from your application to use Grammatik, but one utility now gives you the option of making Grammatik RAM-resident. You can call up grammar checking with the touch of a hot key and then use your word processor to make the suggested corrections. Grammatik's RAM-resident option takes up a whopping 200K bytes of RAM, but Reference says a version that uses expanded memory will be available soon.

Also new is a Grammar Rules Editor that lets you tap Grammatik's parsing information and customize the

continued

We do Windows

Finally, full-featured communications software for Microsoft's Windows

ape (A Programmable Emulator)

- Powerful! Easy-to-use scripting
- Multiple scripts can run concurrently
- Multi-national character set support
- A wide variety of terminal emulations
- Can act as an information switch using DDE
- XModem, XModem1K, YModem, and Kermit protocols
- Built-in line monitor and data capture facility

HI-Q INTERNATIONAL

1142 Pelican Bay Drive, Daytona Beach, Florida 32019
 1-904-756-8988
 Site licensing & dealer inquiries welcome
 In Europe call TeleSIGMA AB 46-8-735-8560



ScanMan™. Turning imaginations loose everywhere.

Pop any image up to 4" x 11" straight into any IBM personal computer or Apple Mac™!

Select one, two, three or four hundred D.P.I. Resize, rotate, flip and edit it. With the IBM version, use PaintShow Plus™ (included free) for coloring and shading, then port into any popular publishing program.

With the Mac ScanMan use the Clipboard™ to transfer the image to virtually any application — the Mac ScanMan works just like any Desk Accessory!

- ScanMan for the PC — \$339
- Multi-Channel version — \$399
- Macintosh version — \$499

For your nearest dealer, call: 800-231-7717

In California: 800-552-8885

In Europe: ++ 41-21-869-96-56

Circle 164 on Reader Service Card (DEALERS: 165)



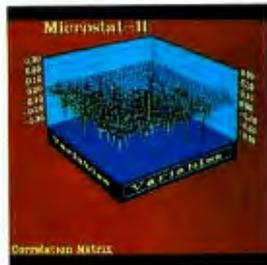


Now you can use YOUR favorite graphics package with Microstat-II.

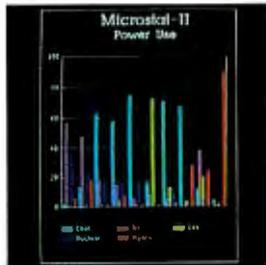
Just some of the packages covered include *3-D Perspective Jr.*, *Harvard Graphics*, *Microsoft's Chart*, *Grapher*, and others.

Microstat-II also includes new procedures for:

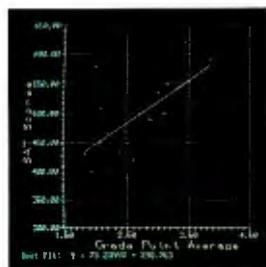
- Canonical Correlation
- Factor Analysis
- MANOVA
- Discriminant Analysis
- Principal Components Analysis
- Cluster Analysis
- Covariance Analysis



3-D Perspective Jr.



Harvard Graphics



Grapher

While Release 1.0 was good:

"... one of the fastest IBM PC statistical packages we have tested... using Microstat-II is a breeze."

Infoworld

"Installation of Microstat-II is simple... The user interface is clean... a pleasant package to use..."

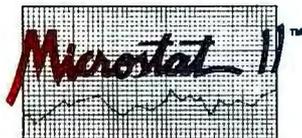
PC Magazine

Microstat-II Release 2.0 is even better!

For a limited time, you can purchase Microstat-II Release 2.0 for \$395.00. Microstat-II requires an IBM PC, XT, AT, PS2 or compatible with 512K memory or more with either a hard disk or two floppy drives. For more information, contact your local computer dealer or call:

Ecosoft, Inc.

6413 N. College Ave.
Indianapolis, IN 46220
Orders: 1-800-952-0472
Info: 1-317-255-6476
FAX: 1-317-251-4604



ECOSOFT

3-D Perspective Jr., Harvard Graphics, Grapher, Microsoft's Chart and IBM are all registered or unregistered trademarks of the following companies respectively: 3-D Graphics, Inc., Software Publishing Corp., Golden Software Inc., Microsoft Inc., IBM Inc.

A Word Publisher for OS/2

Lennane Advanced Products announced Describe Word Publishing (DWP), a program that combines word processing and desktop publishing features.

Lennane claims that the program is a "start from scratch" Presentation Manager application that makes full use of OS/2's graphical user interface to allow you to create graphical pages without having to use a full-fledged desktop-publishing application. The program also has WYSIWYG capabilities and makes extensive use of point-and-shoot mouse commands, multiple windows, and pull-down menus.

DWP lets you control columns, windows, and typography (including leading, kerning, and letter spacing). It also has a variable undo feature that uses a sliding

window to let you choose how much to undo, all the way back to when you first opened the document.

The program includes several standard stylesheets and gives you the option of customizing your own. It also imports and exports documents and graphics from and to a variety of standard applications. It outputs pages on any PM-supported printer and includes a driver for PostScript printers.

Lennane includes Proximity's dictionary and thesaurus with DWP. There's also a built-in customizable hyphenation dictionary.

Price: \$595.

Contact: Lennane Advanced Products, 4047 North Freeway Blvd., Sacramento, CA 95834, (916) 646-1111.

Inquiry 1121.

program's rules to reflect your personal or company-specific rules. There's also a Grammar Help Editor that lets you customize Grammatik's pull-down grammar help screens. Using this feature, you could include a corporate style guide in Grammatik.

Last but not least, Grammatik's Utility Pak adds a customizable compare function that lets you include up to three custom documents that Grammatik will compare to any other document. This gives writers a graphical comparison of their documents with the standard.

The Grammatik III Power Pak includes both Grammatik and the Utilities Pak. If you're already a Grammatik user, you can buy the Utilities Pak by itself. **Price:** Utilities Pak, \$59; Power Pak, \$149.

Contact: Reference Software, 330 Townsend St., Suite 123, San Francisco, CA 94107, (800) 872-9933 or (415) 541-0222.

Inquiry 1122.

Take the Cache and Run

Intelligent Devices has introduced Power Cache and Power Cache Plus, two new disk-caching products. Power Cache is designed for those who want a program that uses very little conventional memory (less than 5K bytes).

You can install Power Cache Plus in conventional, expanded, or extended memory. It includes an assist utility that lets you change the size and configuration of the cache on the fly without having to reboot your machine.

Both versions run on the IBM PC and PS/2s with DOS 2.0 or higher and at least 512K bytes of RAM.

Price: Power Cache, \$69.96; Power Cache Plus, \$99; both packages, \$139.95.

Contact: Intelligent Devices Corp., 245 East Foothill Blvd., Suite 297, Upland, CA 91786, (714) 946-4959.

Inquiry 1123.

SHORT TAKES

BYTE editors' hands-on views of new products

DeskJet Plus

PixelPaint 2.0

HyperPAD

Smart Mouse

Counterpart



The DeskJet Gets Hotter

It's not hard to see why Hewlett-Packard's DeskJet has been a hot seller since its introduction last year. The printer uses "drop-on-demand" thermal ink-jet printing on plain paper, and its output is virtually indistinguishable from that of a laser printer (and it sells for about half the price).

How do you beat a winner? You do something better. The DeskJet Plus, which has the same quirky appearance as its predecessor, adds a raft of new features and still sells for \$995. (The original DeskJet is still available, with its price reduced to \$795.)

The design and documentation of Hewlett-Packard products remain some of the best in the business. About 10 minutes after I expectantly ripped open the box, I had the DeskJet Plus up and running. It was actually easier than setting up most dot-matrix printers, and it has both parallel and serial interfaces.

Because it uses a new motor and new drive electronics that move the paper through the printer at twice the speed of the original, the DeskJet Plus prints a page of text in half the time. But by laser-printer

standards, it's still slow, taking about 45 seconds to print a full page (55 lines) of single-spaced text. So if you plan to use a DeskJet Plus to print some copies of your 1000-page Great American Novel, you might be better off considering an alternate possibility.

For graphics, the DeskJet Plus is impressive indeed. It prints them up to five times faster, at the same 300- by 300-dot-per-inch resolution. After I added graphics to my standard page of text, the DeskJet Plus took about 45 seconds to finish the job. This is considerably faster than the original DeskJet, which took almost 3 minutes.

In keeping with Hewlett-Packard's reputation for well-

built hardware, the DeskJet Plus is actually rated for a very respectable 12,000 pages per year. But I'd hate to be the person sitting next to the printer waiting for those pages to finish printing.

Another new feature that I found useful is a standard landscape mode. I printed out spreadsheets without having to resort to the special (and expensive) cartridge that the original DeskJet needed.

The DeskJet Plus comes with 10 built-in fonts: six portrait and four landscape. If you want to do funky desktop publishing, you'll still need font cartridges. Hewlett-Packard has 10 available, with fonts up to 30 points. One improvement that I found pleasing is

that the company has fine-tuned the spacing tables on proportional fonts, making them look much more natural than the originals.

Although the DeskJet Plus comes with an impressive list of features, it still has some limitations. With only 128K bytes of RAM, I couldn't use soft (downloadable) fonts without plugging in an additional RAM cartridge. But this is another area where Hewlett-Packard has added some versatility to the DeskJet's new incarnation. You could expand the original DeskJet's RAM to only 256K bytes (not exactly a useful amount). However, in the DeskJet Plus, I added both a 128K-byte and a 256K-byte RAM cartridge, to bring the total internal memory up to half a megabyte.

But that adds a whopping \$350 to the price tag. And although prices of font cartridges have been reduced by an average of 30 percent, they'll still set you back \$75 to \$95 each.

You'll also need special printer drivers for your applications in order to take advantage of the DeskJet Plus's features. Drivers for WordPerfect, Lotus 1-2-3, WordStar, Microsoft Word, Harvard Graphics, and MultiMate were the only ones available when I wrote this. But more should be quickly on the way.

Still, even a fully loaded DeskJet Plus costs considerably less than a comparably equipped laser printer, and I needed a magnifying glass to tell the difference in the output. It's not designed for a stressed-out production environment, but I found the DeskJet Plus a logical step up from my elderly dot-matrix printer. And I never want to go back.

—Stan Miestkowski

continued

THE FACTS

Desk Jet Plus
\$995

Options:

Font cartridges, \$75 to \$95; 128K-byte RAM cartridge, \$150; 256K-byte RAM cartridge, \$200; Epson FX-80 emulation cartridge, \$40;

HPGL plotter software, \$129; dustcover, \$35; additional print cartridges, \$18.95.

Hewlett-Packard Co.
P.O. Box 10301
Palo Alto, CA 94303
(800) 752-0900
Inquiry 1025.

Painting on the Mac Takes a Step Forward

PixelPaint, a color graphics application distributed by SuperMac Technology, first demonstrated that the Macintosh II's color capabilities could be put to use by the professional artist. It did this with a set of intuitive MacPaint-style painting tools and easy-to-use but powerful color special effects. Early this year, **PixelPaint 2.0** arrived with significant enhancements to existing features, improved color-output-device support, and a scanning module that lets you import images from a scanner.

PixelPaint 2.0 has improved color dithering techniques that eliminate most of the *banding* or *fringing* effects that usually occur when working with a limited set of 256 colors. This new version of PixelPaint imports and exports TIFF images. Unfortunately, you're limited to working and saving only gray-scale information for TIFF files.

The special-effects capabilities of the painting tools have been beefed up. For example, the Brush tool has a Paint with Clipboard feature that lets you use the image captured in the Clipboard as the Brush shape and color. This feature, which is identical to the one in Photon Paint, lets you select a portion of a forest, or a Martian crater, to paint with.

Mask is a new addition to the Menu bar. This lets you select an arbitrary region on a picture to be rendered unalterable; that is, if you use the SprayCan tool on the image,



THE FACTS

PixelPaint 2.0
\$395

Requirements:
Mac II family or Mac SE/30 with at least 2 megabytes of RAM, an 8-bit video board, a color

or gray-scale monitor, and a hard disk drive.

SuperMac Technology
485 Potrero Ave.
Sunnyvale, CA 94086
(408) 245-2202
Inquiry 1026.

everything inside the Mask region is not affected by the spraying operation, and everything outside the Mask is altered. This is similar to the frisket that airbrush artists use to protect parts of a picture as they apply another layer of paint to it.

However, what looks good on the screen isn't worth much if you can't get it onto paper. PixelPaint 2.0 addresses this problem with its support of Pantone 747XR colors. It does this with a custom spot color picker, and a Pantone color

formula guide comes in the package. PixelPaint 2.0 can output an image as PostScript, color PostScript, or CYMK (cyan-magenta-yellow-black) process color separations.

Additional dialog boxes let you set undercolor removal, ink buildup, and density range for process colors. You can also set line resolution for output on high-resolution devices (e.g., a Linotronic printer). You can print directly to color PostScript devices like the QMS Color Script 100. Color printers like the Tektronix

Model 4693D, Hewlett-Packard's PaintJet, and the Mirus FilmPrinter are also supported by special drivers.

I tried PixelPaint 2.0 on a Mac IIcx running System 6.0.3 and alpha versions of Apple's 32-Bit QuickDraw and the LaserWriter 6.0 driver. The system had 4 megabytes of RAM, an 80-megabyte hard disk drive, and a full-chunky SuperMac Spectrum/24 video board driving a 19-inch color monitor. For the scanning of images, I used the Howtek Scanmaster color scanner.

PixelScan 2.0, the scanning module, is a big improvement over the version I reviewed in the April BYTE, with a much-needed preview mode. PixelPaint 2.0's results are still eye-catching. Performance is improved in some areas. However, it's degraded in other areas. PixelPaint 2.0 seems particularly sluggish catching keyboard commands: You have to really hold down, say, the Command-Q keys to get the application to quit. PixelPaint 2.0 printed a color image as a gray-scale print on the BYTE Lab's LaserWriter IINT without difficulty, even though it was using Apple's preliminary driver.

Overall, PixelPaint 2.0 is a worthy heir to its predecessor. The big improvements are the masking for detailed artwork and the ability to drive sophisticated color output devices. This latter feature alone is reason enough to upgrade.

—Tom Thompson

Desktop Manager with Hypertext Power

Are you one of those IBM PC-compatible users who mills around the Apple booth at trade shows, gazing wistfully at the Macintoshes running HyperCard? Or perhaps you're looking for a colorful mouse-and-windows DOS shell that doesn't require

gobs of memory. **HyperPAD** delivers an easy-to-use character-based hypertext environment on DOS PCs.

HyperPAD is a sophisticated package that emulates most of HyperCard's features and provides a user-configurable "push-button" DOS shell

for desktop management and program launching. Although it uses different terminology than HyperCard—stacks are called PADs (short for personal application designs) and cards are called pages—it uses the same logical hierarchy as its Apple ancestor and offers

similar objects, tools, and menus.

As a desktop manager, it competes with other new offerings like Magellan and ViewLink. But HyperPAD is not just a file manager with a friendly face: It's an object-

continued



Embedded systems designers have already used CrossCode C in over 413 different applications.

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 47 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 \$1595, 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: 1-312-971-8170
FAX: 1-312-971-8513

SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 23
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

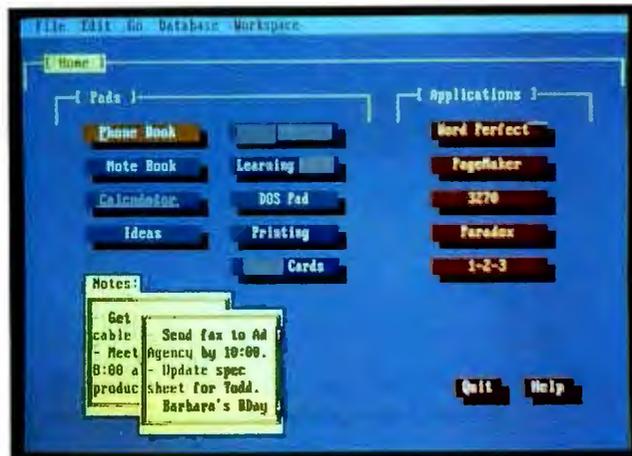
CrossCode™ is a trademark of SOFTWARE DEVELOPMENT SYSTEMS, INC. MS-DOS® is a registered trademark of Microsoft. UNIX® is a registered trademark of AT&T. XENIX® is a registered trademark of Microsoft.

oriented, free-form database with drawing, painting, and form-generating capabilities. At its heart are authoring tools and a scripting language called HyperScript, which is strikingly similar to Apple's HyperTalk. Yet it is character-based, not bit-mapped, which means it will run on any PC, and it will run faster and with less memory consumption than HyperCard.

HyperPAD will be shipped with 25 preconfigured PADs, including a "home" screen, assorted desktop functions (e.g., an appointment calendar, notepad, and Rolodex), and a DOS PAD that allows push-button disk formatting, directory management, file copying, and other tasks.

You can easily reconfigure the canned PADs, or you can lock them with passwords. When installed, HyperPAD uses 384K bytes of RAM; after your applications are launched, a 2K-byte stub is left behind that reloads HyperPAD upon your exit from an application.

HyperPAD struck me as an elegant implementation of hypertext for a PC. It includes a windowing system that looks and behaves remarkably like Microsoft Windows, with pull-down and pop-up menus, dialog boxes, and scroll bars. It's fast—the slowest part was waiting to load new PADs from the hard disk. Designing



THE FACTS

HyperPAD
\$99.95

Requirements:
IBM PC with 512K bytes of RAM, at least 720K bytes of mass storage, and DOS 2.1 or higher. A color monitor and a mouse are strongly recommended.

Brightbill-Roberts & Co., Ltd.
120 East Washington St., Suite 421
Syracuse, NY 13202
(315) 474-3400
Inquiry 1027.

new buttons and pages is a snap, and the menus of options offer considerable aesthetic flexibility. The package includes snazzy graphics features like tear-away and fade-out screen segues, a character paintbrush, and three-dimensional shading. And the underlying HyperScript language is very impressive,

although most people won't need to use it.

Not everything about HyperPAD was gratifying, however. Bearing in mind that I ran an early, buggy version of the product that included only seven working PADs, I found its power and flexibility to be marred by some questionable design decisions. For exam-

ple, it's easy to create buttons and fields with literally dozens of combinations of border colors and text, yet to change the background color for a page requires an oddly unintuitive process. Some of the menus were strangely arranged, and I occasionally got lost or had difficulty navigating between levels, especially the foreground and background of a page.

I tried HyperPAD on both a color-monitor system with a mouse and a monochrome system with only cursor arrow keys. The mouse was helpful, but I could have survived without it because keyboard movement was fast and logical. On the other hand, HyperPAD in monochrome was almost unusable. I couldn't tell where I was, and the normally communicative screens became disorienting and muddled. I strongly advise color capability as a precondition for using HyperPAD. Incidentally, I also had to unload all my TSR programs before it would run.

In short, HyperPAD is an exciting, richly detailed program with great potential, assuming the bugs get fixed and a few conceptual lapses are cleaned up. Whether you just need an easy-to-use PC desktop manager or you want to develop products using a hypertext platform, you should consider buying HyperPAD.

—Andrew Reinhardt

Smarter Than Your Average Mouse

You can get there from here. Quite easily, in fact, if "there" is some area on a computer screen and you have a mouse. But on a very large screen, it may take some time. You may have to move the mouse, pick it up, and repeat the process a few times. To make the trip a little easier, Mitsubishi has designed a mouse that it claims can almost jump to the other side of the screen. But can it?

The new **Mitsubishi Smart Mouse** reportedly has special

hardware that lets it vary its resolution from 200 dots per inch to 800 dpi. According to the company, the actual reso-

lution depends on how fast you move the mouse. Note that this increased resolution is not for fine graphics work, but to let

you quickly traverse large sections of the screen.

In appearance, this mouse looks much like most other two-button mice. It seems well made and has a nice feel. Its two buttons are large and easy to access. The mouse is about a quarter of an inch wider than the sleek Microsoft Mouse. Personally, I would prefer the Mitsubishi device to be a little narrower.

Installation is easy. You can plug it into any 9- or 25-pin

continued

THE FACTS

Mitsubishi Smart Mouse
\$194.50; with EGA Paint, \$239.50; with Drafix CAD, \$264.50

Requirements:
IBM PC with a serial port.

Mitsubishi International Corp.
520 Madison Ave.
New York, NY 10022
(212) 605-2000
Inquiry 1028.

FENDER RENDER vs.



BUMPER-TO-BUMPER.

Whether you're designing the next generation of a product or drafting the plans for a new building, you need to keep the whole project in mind. And now you can keep it in view as well, thanks to the Truevision HR Graphics card. The HR card lets your Mac® II display a sharp 1280 x 960 pixel image, 400% more than a standard Apple® monitor and 56% more than other 'high resolution' 1024 x 768 displays. Its 256 colors (from a 16.7-million color palette)

give you tremendous flexibility for engineering drawings, scientific visualizations, or 3D modeling for prototypes. And the HR supports a virtual desktop up to 2048 x 2048 pixels, allowing you to pan over large drawings in real-time, horizontally and vertically.

The HR card is QuickDraw™ compatible*, which means that you can run with virtually all Macintosh® software. And you may select the monitor of your choice from

manufacturers like JVC, Philips and SONY®. There are two Truevision HR cards available: the HR 2M (\$3995) addresses a virtual desktop of up to 2048 x 1024 pixels, and the HR 4M (\$5995) addresses up to 2048 x 2048 pixels. Get precise images and view large format drawings with the Truevision HR Graphics card. Take a test drive soon by visiting your Authorized Truevision Reseller, or call us at 800/858-TRUE for more information.



The HR Graphics Card works with the Macintosh II, IIx and IIcx.



Truevision, Inc.
7351 Shadeland Station, Indianapolis, IN 46256

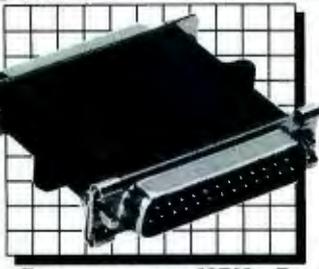
Circle 286 on Reader Service Card

INTERNATIONAL: Canada 416/499-9400 France 33-13-952-6253 Italy 39-2-242-4551 Switzerland 41-1-825-0949 U.K. 44-1-991-0121 West Germany 49-89-612-0010
Other International 617/229-6900. Suggested retail price is US domestic price, and is subject to change.

Unretouched screen displays of an Apple RGB monitor at 640 x 480 and an HR-compatible monitor displaying the same image at 1280 x 960 pixel resolution.

*All graphics cards with more than 1MByte of memory require 32-bit QuickDraw. QuickDraw is a trademark and Apple, Macintosh and Mac are registered trademarks of Apple Computer, Inc. SONY is a registered trademark of Sony Corporation of America. Image courtesy of Electric Image. PageMaker is a registered trademark of ALDUS Corp. AutoCAD is a registered trademark of Autodesk Inc.

PROTECT INTELLIGENCE WITH INTELLIGENCE



SOFTWARE PROTECTION KEYS BY PROTECH

PROTECH KEYS:

- are totally transparent to the end user
- allow unlimited back up copies
- free up disk drives
- do not interfere with peripheral operations
- are easy to install
- protect software developers' revenues
- assembler based routines (not drivers)
- encrypted routines
- physically unique hardware KEYS
- sophisticated software installation advice
- provide the highest level of protection available

THE KEY
The KEY provides effective software protection while insuring customer satisfaction. The KEY is a random response device which is designed for identically reproduced software packages.

THE MEMORY KEY
The MEMORY KEY is a programmable software protection device. Each byte of memory can be addressed in groups or individually. Possible applications for the MEMORY KEY include:

- modular package control
- serialization
- customization
- access control to PCs
- demo control
- software leasing
- updating modules in the field
- any "counter" operation

For a demonstration package or additional information, please write or call: **1-800-843-0413**

PROTECH MARKETING, INC.
4905 Pine Cone Drive • Building 10
Durham, North Carolina 27707
(919) 490-4970 FAX (919) 490-4974

WE HAVE THE KEY TO SOFTWARE COPY PROTECTION

serial port on an IBM PC. Since the Smart Mouse is software-compatible with the Microsoft Mouse, programs like Microsoft Windows are all ready for it. It also includes TSR programs that let it work with applications that do not directly support mice, like XyWrite III Plus and Lotus 1-2-3.

To get a feel for the varying resolution of the new mouse, I did some simple tests using Microsoft Windows. At a very slow speed (about 1 inch per second), it took about 3.2 inches of mouse movement to traverse the screen. Moving the mouse as fast as I could, it took only about 1.2 inches, or about 38 percent as much space as before. This is impressive, but not quite the ratio you would expect going from 200 to 800 dpi.

Out of curiosity, I tried the same test using the Microsoft Mouse. With slow movement, the mouse needed about 3.1 inches to traverse the screen. When I moved it quickly, it needed only about 1.6 inches, or only 52 percent as much space. This is almost as impressive as the results for the Smart Mouse. Evidently, Windows has its own mechanism for speeding up cursor movement.

The Smart Mouse worked quite well with Windows and fairly well with other non-

mouse-oriented applications. In the nonmouse applications, the mouse movements substitute for cursor key presses, and a menu of keyboard macros can be called up.

The mouse worked pretty well with Lotus 1-2-3, XyWrite III Plus, and SideKick. But I noticed a curious phenomenon: The speed change seemed to go in reverse. Fast mouse movement caused slower cursor movement, while slower mouse movement caused faster cursor movement. This seemed a bit strange, but this mouse is not intended for these types of applications.

Although the Mitsubishi Smart Mouse performed quite well, it was not as impressive as I'd expected. The lower-priced Microsoft Mouse offered a perceived resolution increase that was almost as good as that of the Smart Mouse.

I'd use the Smart Mouse only as a second mouse for certain specialized applications. If you are using PageMaker on a portrait-style monitor, or AutoCAD on a 19-inch screen, the Smart Mouse will save some wear and tear on your mouse pad. But for most other applications on normal-size screens, an ordinary garden-variety rodent should work just fine.

—Rich Malloy

RADs™

works the way you think.

Rapid Application Development System

We take you from Concept to Prototype to Finished Program to Demo to Tutorial

Read our little scenario and check off where appropriate:

<p>"So, Your</p> <ul style="list-style-type: none"> <input type="checkbox"/> Boss <input type="checkbox"/> Client <input type="checkbox"/> Market <p>says: "I need a:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Program <input type="checkbox"/> Prototype <input type="checkbox"/> Demo <input type="checkbox"/> Tutorial <input type="checkbox"/> Presentation <input type="checkbox"/> All The Above <p>"with:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Nested Menus <input type="checkbox"/> Pop-up windows <input type="checkbox"/> Pull-down Menus <input type="checkbox"/> Light Bars <input type="checkbox"/> Original User Interface <input type="checkbox"/> Music <p>"Oh, and in the prototype, demo, and tutorial could you make it:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Interactive <input type="checkbox"/> Self Running <input type="checkbox"/> Both <p>"And it needs:</p> <ul style="list-style-type: none"> <input type="checkbox"/> User Input <input type="checkbox"/> Simulated Report Generation <input type="checkbox"/> Active Screen Areas for User Input <input type="checkbox"/> Dialogue Boxes <input type="checkbox"/> Variable Math Calculation <input type="checkbox"/> GO SUB Routines <input type="checkbox"/> and much more 		<p>"Oh, and one more thing, I need to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Make as many copies as I want with no license fees <p>"And:</p> <ul style="list-style-type: none"> <input type="checkbox"/> No screen in front promoting the product it was developed in. <p>"And:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Free 800 # telephone support <p>"Oh, and just one more thing, I'd like to use the screens from the prototype in the program we're writing in:</p> <ul style="list-style-type: none"> <input type="checkbox"/> C <input type="checkbox"/> Basic <input type="checkbox"/> Pascal <input type="checkbox"/> dBase <input type="checkbox"/> Clipper <p>"And the routines should also do:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Screen Handling <input type="checkbox"/> File Handling <input type="checkbox"/> Mouse Support <input type="checkbox"/> Serial Port Control
---	---	--

EASY **NEW**

"And could I have that in two days please?"
Sound familiar?

NO Problem, if you've got RADs!

COMPLETE SYSTEM: \$299.95
Demo Available

To Order or For Product Information Call
1-800-777-1437

GENESIS
GENESIS DATA SYSTEMS
8415 Washington Place N.E.
Albuquerque, NM 87113 (505) 821-9425

Counterpart Mirrors Your Drives

Counterpart is an add-in card security device for the IBM PC and compatibles. It acts as a mirroring controller that continuously and transparently backs up data from a primary hard disk drive to a second drive.

In keeping with today's concern for security, Counterpart also gives you the option of adding several levels of access control to your system. You can add multiple user passwords, as well as control access to drives and directories. And if you're really

paranoid about the company secrets, you can also add automatic password-controlled encryption and decryption of all data on your disks. Counterpart lets you use either the industry-standard Data Encryption Standard or a proprietary standard.

Counterpart doesn't replace your existing hard disk drive controller. Instead, it works with it. Since my controller, like most, handles two drives, all I had to do was install the second drive and the

continued



Natural selection provides unique passive protection for the porcupine.

The Activator - Natural Selection For Software Protection



Inventor and entrepreneur Dick Erett explains how "The Activator" provides sane protection for your intellectual property.

"In any industry, just as in nature, the process of natural selection raises one solution above another. Natural selection is the most elegant of engineers.

In the area of software protection The Block has been selected by the marketplace as the solution that works. Over 500,000 packages are protected by our device.

For the past 4 years our philosophy has been; *'You have the right and obligation to protect your intellectual property.'*

A New Ethic For Software Protection

In allowing end-users unlimited copies of a software package and uninhibited hard disk and LAN operation, The Block has created a new ethic for software protection.



By removing protection from the magnetic media we remove the constraints that have plagued legitimate users.

They simply attach our key to the parallel port and forget it. It is totally transparent, but the software will not run without it.

A New Technology For Software Protection

Our newest model, The Activator, builds on our current patented design, and establishes an unprecedented class of software protection.

We have migrated and enhanced the circuitry of The Block to an ASIC (Application-Specific Integrated Circuit) imbedded in The Activator.

This greatly improves speed and performance, while reducing overall size. Data protection can also be provided.

Programmable Option

The Activator allows the software developer the option to program serial numbers, versions, or other pertinent data known only to the developer, into the circuit, and access it from the program.

Once you program your part of the chip, even we have no way to access your information.

The ASIC makes emulation of the device
Circle 260 on Reader Service Card

virtually impossible. It also presents an astronomical number of access combinations.

Full 100% Disclosure

Since The Activator is protected by our patent we fully disclose how it works. Once you understand it, endless methods of protection become evident.

Just as no two snowflakes are the same, no two implementations of The Activator are identical. And like the snowflake the simplicity of The Activator is its greatest beauty.



We never cramp your programming style or ingenuity. Make it as simple or complicated as you desire.

Let us help safeguard what's rightfully yours. Please call today for additional information or a demo unit. *It's only natural to protect your software."*

1-800-333-0407 ext.105
In Connecticut 203-329-8870
Fax 203-329-7428



870 High Ridge Road
Stamford, CT 06905

NEW FROM **NOVAS**



HONORED BY PC MAGAZINE

"...It gave better performance than ALL the machines of this group on most of the processor benchmark tests..."

"...Working my way down the tower, I found a 'NOVAS SUPER TURBO 286X MOTHERBOARD'..."

"...It's so flexible that it makes living without a big name no chore at all..."



NOVAS
286-14MHz System
Starting at ... \$1195

NOVAS
286-20MHz System
Starting at ... \$1595.

NOVAS
386-25MHz System
Starting at ... \$2295

NOVAS 386 MOTHERBOARD Available in 25/20/16MHz versions
 • 80386 by Intel, AMI Bios, EMS Support
 • Chips & Technologies 386 CHIPset, sockets for 80287 & 80387/Weitek
 • Expandable to 16MB (Simm) on board, Interleave/page mode memory 0 wait state
 • Shadow RAM, Independent Clock, On board battery, 8 I/O expansion slots
 • 1 serial & 1 parallel port on board (optional 2nd serial port). **STARTING AT ... \$895**

NOVAS 286 NEAT MOTHERBOARD available in 20/16/14MHz versions
 • 80286 CMOS by Harris, AMI Bios, EMS 4.0 support
 • Chips & Technologies 286 NEAT CHIPset, socket for 80287
 • Expandable to 8MB (Simm) on board, Interleave/page mode memory 0 wait state
 • Shadow RAM, Independent Clock, On board battery, 8 I/O expansion slots
 • 1 serial & 1 parallel port on board (3 more optional serial ports). **STARTING AT ... \$345**

NOVAS 4000 SUPER VGA 16 BIT CARD
 • 100% IBM compatibility at register plus gate level, Shadow RAM
 • Expandable to 1MB of display memory, Supports 132 columns for Lotus 1,2,3
 • Chips and Technologies 450 VGA product line chips, Analog & Digital Outputs
 • 640 x 480 in 256 colors, 800 x 600 in 16 colors, 1024 x 768 in 4 colors
 • Backward capability to EGA, CGA, Hercules, and MDA. **NEVER MORE THAN ... \$395**

NOVAS 386-20MHz w/64k CACHE CONTROLLER
 • Increases performance up to 25% **NEVER MORE THAN ... \$1495.**

"...FULLY LICENSED TO UTILIZE **IBM** PATENTS..."



Quality Products From
COMPUTRADE CO.
780 MONTAGUE EXPRESSWAY,
SUITE 501, SAN JOSE, CA 95131

OEM, VARS, & DEALERS WELCOME
Corporate & University Discounts

*Service in USA

*VGA, XT, AT & IBM are trademarks of International Business Machines
*Prices & specs subject to change

U.S. SALES: (408) 435-2662
U.S. FAX: (408) 435-5458



THE FACTS

Counterpart
\$495

Requirements:
IBM PC with two hard disk drives and DOS 2.1 or higher (DOS 3.3 or higher for multiple logical drives).

Fifth Generation Systems, Inc.
11200 Industriplex Blvd.
Baton Rouge, LA 70809
(504) 291-7221
Inquiry 1029.

Counterpart card. And thankfully, the second drive doesn't have to be identical to the primary drive, as long as it has at least the same capacity.

I found installing the second drive the most difficult part of the process. I had to track down a cable that would handle two drives and then puzzle over setting the disk-select jumpers on the drive. But once that chore was finished and the new drive was formatted and partitioned, I ran a preinstallation program that checked the interrupts in my system and told me how to set the jumpers on the Counterpart card. Then I plugged in the card (there's nothing to connect to it).

Fifth Generation Systems' automatic installation utility made the final steps a breeze. I set up password protection for my system but chose not to encrypt all data on the drive. After rebooting the system, Counterpart went quietly to work, backing up all the data on my primary drive to the new drive. Then I performed the ultimate test, pulling the

power connector on my primary drive while it was doing a database sort. The system didn't miss a beat, automatically switching to the second drive. The card also started beeping, telling me that there was a problem with my primary drive.

Disk mirroring has been used in large computer systems for many years, especially for critical applications like on-line banking, where system downtime or data loss can be an unmitigated disaster. Counterpart brings this level of security down to the world of PCs. Best of all, it's easy to install.

Counterpart isn't for everyone. I think that its \$495 price is a bit high. And when you add the cost of the required second drive, the total cost of adding disk mirroring and security to your system can easily top \$1000. And I still back up my data to tape. But if you use your system for critical applications, Counterpart will surely give you that hard-to-find peace of mind.

—Stan Miastkowski ■

The smart buy for PC Power Protection is now . . .

The Smart UPS For LAN's

. . . Reliable Protection From Data Loss

MINUTEMAN
UNINTERRUPTIBLE POWER SUPPLIES

**INTRODUCING
1KVA
ON-LINE UPS**

TOTAL POWER PROTECTION:

- BLACKOUTS
- BROWNOUTS
- OVERLOADS
- OVERVOLTAGE
- SURGES/SPIKES
- EMI / RFI

"For All Sensitive Electronic Equipment"



- A unique software package that interfaces your LAN's and Minuteman UPS system for an automatic and orderly network shutdown due to power failures . . . before data loss occurs!
- Compatible with SCO XENIX 2.2.3
- Compatible with Novell Systems:
ELS 2.12 and above
Advanced Netware 2.10 and above
SFT Netware 2.10 and above
- Selectable power loss warning times and shut-down times
- Instantaneous user notification
- Also Interfaces to Wide Area Networks
- Auto Shutdown of UPS for unattended operation
- The only software available that supports ELS Level II
- No Novell monitoring hardware required
- Network Manager Suggested Retail Price when purchased with a Minuteman UPS Model: \$199

Power Output	120 Volt Models	230 Volt Models
250 WATT	\$ 379.00	\$ 429.00
300 WATT	\$ 549.00	N/A
500 WATT	\$ 699.00	\$ 799.00
600 WATT	\$ 899.00	\$1049.00
900 WATT	\$1249.00	N/A
1000 WATT *	\$2249.00	\$2549.00
1200 WATT	\$1499.00	\$1749.00
1600 WATT	\$1999.00	\$2299.00

FOR L.A.N.
NOVELL LABS
TESTED AND
APPROVED
NetWare Compatible



* On-line model Suggested Retail

- One millisecond transfer time *
- Synchronized sinewave *
- Full one year warranty
- Order-Ship same day

* 250 watt and 500 watt units offer 4 msec transfer time, PWM waveform



PARA SYSTEMS, INC.

1455 LeMay Drive
Carrollton, TX 75007

Telephone:
(214) 446-7363

1-800-238-7272

FAX: (214) 446-9011

TELEX: 140275 OMEGA

Maxon MVGA-16 adapter works with flying colors



**providing VGA[®]
compatibility equal
to IBM's own VGA adapter**

That's right . . . Maxon's MVGA-16 adapter is 100% IBM[®] compatible. So, if you're using one of the standard IBM modes (up to 640x480 with 16 colors), you don't need a special driver at all.

When extended resolution* is required, Maxon still comes through with flying colors. The MVGA-16 includes drivers for AutoCAD[®] - ADI[®] versions 2.1 and 3.1, Lotus[®] 1-2-3[®] - release 2.x, Framework II[®] - releases 1.0 and 1.1, GEM[®] Desktop[™] - version 2.x, Ventura Publisher[®] - releases 1.1 and 2.0, MS[®] Windows[®]/286 - versions 2.03 and 2.1, WordPerfect[®] - releases 4.0 and above, and WordStar[®] - release 3.xx. And that's not the whole story . . . additional drivers are being added constantly.

Circle 171 on Reader Service Card

*High-res drivers offer different resolutions for different software packages.

**with features
that make it
unequaled by any
other VGA adapter**

- Operates up to 400% faster than IBM VGA adapter
- Extended modes (require 512K of RAM): 1024x768 - 16 colors; 640x480 - 256 colors
- Full BIOS and REGISTER compatibility with MDA[®], CGA[®], MCGA[®], EGA[®], VGA[®] and Hercules[®]
- Works with either XT[™] or AT[®]: 16 bit design - auto-detects and adapts to 8 bit slots
- High-res drivers for popular software

**For more information about Maxon's
16 bit VGA adapter, phone (415) 377-0269,
FAX (415) 377-0236 or write to Maxon Systems, Inc.,
One Waters Park Drive, Ste. 117, San Mateo, CA 94403.**

maxon[®]
SYSTEMS INCORPORATED

A Wholly Owned Subsidiary of Maxon Electronics Co. Ltd. of Korea

The following are trademarks or registered trademarks of the companies listed: IBM, XT, AT, VGA, MDA, CGA, MCGA and EGA - International Business Machines Corp.; Hercules - Hercules Computer Technology, Inc.; MVGA-16 - Maxon Systems, Inc.; AutoCAD and ADI - Autodesk, Inc.; Lotus and 1-2-3 - Lotus Development Corp.; Framework II - Ashton-Tate Corp.; GEM and Desktop - Digital Research Inc.; Ventura Publisher - Ventura Software, Inc.; MS and Windows - Microsoft Corp.; WordPerfect - WordPerfect Corp.; and WordStar - MicroPro Int'l. Corp.

© 1989 - Maxon Systems, Incorporated

Apple's 32-Bit QuickDraw Covers the Spectrum

An update to the Mac's
System software advances
color imaging
for microcomputers

Editor's note: *What follows is a hands-on appraisal of 32-Bit QuickDraw. Tom Thompson has written a follow-up article that will appear in a subsequent issue. It provides technical background and describes in greater detail how 32-Bit QuickDraw works.*

With the introduction of 32-Bit QuickDraw, Macintosh II and SE/30 users are now able to produce photo-quality images with a virtually unlimited choice of colors. Several graphics board vendors already have products available that take advantage of 32-Bit QuickDraw's capabilities. Unfortunately, there is a downside to this newfound power: It's expensive to fully exploit.

When Apple upgraded Color QuickDraw, the Mac II family's core graphics primitives, the company needed to extend the capabilities of existing routines while retaining compatibility with existing Mac applications. Many of these new extensions had to handle 32-bit addresses or data values—hence the name 32-Bit QuickDraw.

The most important of these extensions is that 32-Bit QuickDraw routines can now operate with pixels larger than 8 bits: Color pixels can now be 16 bits (with 15 bits of color information) or 32 bits (with 24 bits of color information). This means that the Mac is no longer limited to 256 on-screen colors; it can display thousands of colors (32,768 for 15 bits) or its entire color palette

(16,777,216 colors for 24 bits) on-screen with the appropriate video hardware. With this range of colors, a Mac can generate photo-quality images. The data for these images could come from a scanner or from the output of a complex simulation, such as the exhaust flow in a rocket nozzle.

However, displaying high-quality images by itself is not enough. These new features must fit into the day-to-day graphics operations that many a Mac user relies on. Other 32-Bit QuickDraw extensions let you cut and paste these images into other application windows or documents, and a revision to the color picture definition format allows you to save these images to a disk file. A new LaserWriter 6.0 driver now supports color PostScript devices, such as the QMS ColorScript 100 and the Tektronix

Phaser CPS printers. The new driver also allows color images to be printed as halftones on monochrome PostScript printers. Finally, even the typical user benefits: Performance in the 2-, 4-, and 8-bit screen modes has been improved.

The Components of Color

The new QuickDraw runs on any 68020- or 68030-based Mac running System 6.0.3. To install it, you simply copy the files in the 32-Bit QuickDraw package to the System Folder and restart the computer. The package consists of a disk with seven files. You can obtain this disk from your Apple dealer, or the files will be included with products that require 32-Bit QuickDraw.

The 32-Bit QuickDraw file contains the QuickDraw extensions. It is not an

continued

Photo 1: *32-Bit QuickDraw in action. The image has 24 bits of color information that was captured using a Howtek Scanmaster scanner.*

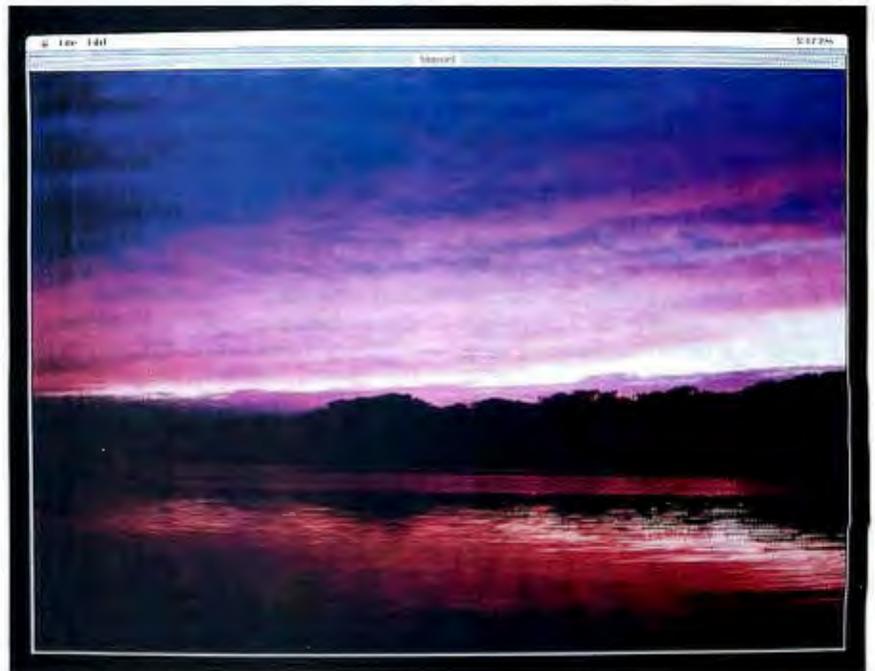


Table 1: The BYTE Small-C video benchmark test results. All times are in seconds. All tests were conducted on a system where there were no INITs or special cdevs, MultiFinder was not in use, and AppleTalk was disabled; (32) indicates that 32-Bit QuickDraw was in use. The CPU's code cache and, where applicable, data cache, were disabled. See the text for a discussion of the results.

Mac II				
Mode	Text		Graphics	
	TextEdit	DrawString	Slow Graphics	QuickDraw
32-bit	42.94	33.06	33.33	0.72
8-bit (32)	15.73	9.42	34.81	0.57
8-bit	14.45	8.4	134.02	0.61
4-bit (32)	11.17	5.52	35.0	0.55
4-bit	10.45	4.95	99.3	0.57
2-bit (32)	9.13	3.77	35.31	0.53
2-bit	8.5	3.23	82.29	0.58
1-bit (32)	9.8	4.28	31.27	0.48
1-bit	7.32	2.26	58.89	0.5

Mac IIcx				
Mode	Text		Graphics	
	TextEdit	DrawString	Slow Graphics	QuickDraw
32-bit	38.80	30.07	30.42	0.62
8-bit (32)	13.99	8.57	31.63	0.48
8-bit	12.87	7.67	116.48	0.51
4-bit (32)	9.79	4.96	31.86	0.47
4-bit	9.17	4.51	76.94	0.49
2-bit (32)	7.92	3.35	32.12	0.47
2-bit	7.37	2.87	70.67	0.49
1-bit (32)	8.44	3.63	28.65	0.42
1-bit	6.27	2.01	50.59	0.43

INIT: Instead, it contains several "ptch" resources you use to patch System resources and the Mac Toolbox, and a "PACK" resource with a new version of the Color Picker designed to handle the wider range of colors. These patches replace parts of Color QuickDraw and the Slot Manager and take up about 120K bytes of RAM on the system heap. The Mac must be running System 6.0.3, which detects the presence of the 32-Bit QuickDraw file and installs the patches. If this process succeeds, the file's black-and-white icon turns into a colored one.

The Monitors cdev file now supports video boards that handle the new large-pixel formats. If your system has a 32-bit-deep video board in it, you use this cdev with the Control Panel to select a screen depth ranging from 1 bit deep (dull aesthetically since the screen is black-and-white, but blazingly fast on screen redraw) to 32 bits deep (magnificent colors, but with slower screen redraw). Or you can select screen depths between these two extremes (2, 4, 8, and

16 bits, depending on the video board) to achieve a reasonable compromise in color fidelity and display speed. While this might seem like a simple enhancement, it wasn't, because the method of displaying large pixels differs from that of 8-bit or smaller pixels.

The changes to the General cdev file are internal and not accessible to the user. Specifically, a bug has been fixed, and this cdev now interacts with the Mac color environment in a way that doesn't disturb the current palette of colors.

The modifications to the laser printer files let you print deep images on monochrome or color PostScript devices. The LaserWriter 6.0 file has a new pop-up menu in its Page Setup dialog box that lets you select custom page sizes. This is handy for those color PostScript printers that have a page-image area different from that of Apple's printers.

The LaserWriter dialog box has two new radio buttons: Color/Grayscale and Black & White. The first button indicates that the output device supports

color or gray-scale PostScript printing. If the second button is selected, the driver resembles the older LaserWriter 5.2 driver. You would use this selection to maintain compatibility with those applications that assume a black-and-white graphics port (grafPort) during printing operations, or to speed the printing process for those situations that would benefit by it (line drawings or text-only documents).

You don't need a 16- or 32-bit video board to make use of 32-Bit QuickDraw. As mentioned earlier, the display speed at the "shallower" (2-, 4-, and 8-bit) modes has been improved. You can also view "deep" or "true color" (16- or 32-bit) images with just an 8-bit board: 32-Bit QuickDraw renders these images at the current screen depth, using either best-match or dithering algorithms.

However, if you plan to use a graphics package that manipulates true colors, you'll want a video board that can display the full range of colors. Apple currently does not offer such a board, but several third-party vendors do: Radius, SuperMac Technology, and RasterOps. The cost of viewing true color is not cheap: Prices for this type of video board start at about \$3500 and can go over \$5000.

All these new features use memory. The patches consume space on the system heap. And the larger pixels themselves use more memory: double the RAM over an 8-bit image for 16-bit pixels and four times the RAM for a 32-bit-deep image. Apple recommends that a Mac running 32-Bit QuickDraw have a minimum of 2 megabytes of RAM. If you work with deep images on a large display, plan on needing more.

Seeing Colors

Apple provided an alpha version of 32-Bit QuickDraw. SuperMac Technology loaned us a full-chunky Spectrum/24 board that displays 32-bit, but not 16-bit, pixels. This board drove one of its 19-inch color monitors. To evaluate the software, I used a Mac II with 2 megabytes of RAM and a Mac IIcx with 4 megabytes of RAM, both running System 6.0.3. At times, I also connected an Apple Portrait Display monitor using its 16-color video board to see how well the software handled depth conversions of images as they were moved across screens.

Connectix's virtual memory INIT broke right away, and I had to disable it to get the system to boot. This was expected, since Connectix had informed me that its product was not 32-bit clean and that the company plans a fix.

The rest of the INITs worked just fine.

I was pleasantly surprised to find that most screen-saver INITs, such as Black-out and Moire, functioned. Most applications worked with no problems, although there were a few exceptions.

SuperPaint 2.0 crashed if I shuttled a window between screens unless I set it to only the Preferences to use QuickDraw operations. Some graphics applications write directly to the screen to boost performance, but for the sake of compatibility, they ought to use QuickDraw functions when required. It's a nice option for an application to have, and I'm glad to see it in SuperPaint. MacDraw 1.1 could use it: In the 32-bit mode, it draws the windows and the controls properly, but the window's content region is a blizzard of parti-colored snow.

Drawing activities on the screen were noticeably slower, but not sluggish. The drawing operations are certainly faster than those on a 24-bit chunky/planar board I've worked with. The drawing speed is influenced by the size of the area to repaint: Menus snapped down smartly enough, but large images took several seconds to draw. Remember that I was working with a large screen with a large area to paint, however.

To generate 32-bit-deep color images, I used a Howtek Scanmaster color scanner and SuperMac Software's PixelScan 2.0 application. You simply clap a photo to the scanner's bed, tell the PixelScan application to scan, and in several minutes a breathtaking image as detailed as the photo itself appears on the screen. Images seem to jump off the screen at you with their realism (see photo).

PixelScan lets you save these images to PICT files, and they're about three times the size of PICT files storing the same image as 8-bit indexed pixels. (32-Bit QuickDraw has a packing scheme that clips that fourth alpha channel byte from the pixels when the image is saved to disk.) But even with this type of packing, a small 32-bit-deep image takes about half a megabyte or more of disk space, and I easily made files that were several megabytes in size. Nevertheless, this combination of scanner hardware and the Mac definitely makes for plug-and-play imaging technology.

I had no problems using the Mac IIcx with 4 megabytes of RAM. But on the Mac II with 2 megabytes of RAM, certain applications wouldn't load because there wasn't enough memory. If you want to use 32-Bit QuickDraw with graphics applications, plan on having 4 or more megabytes of RAM in the system.

To accurately gauge the performance of the deep display, I ran version 1.2 of

BYTE's low-level graphics and text benchmarks (see table 1). In the shallow screen modes, the graphics tests indicate a performance boost at every screen depth with 32-Bit QuickDraw installed. The Slow Graphics benchmark indicates that pixel manipulation is certainly faster. The small spread in the times using 32-Bit QuickDraw for this benchmark indicates that the application has become CPU-bound: It's the code execution and not graphic I/O that takes most of the execution time. The QuickDraw test shows that 32-Bit QuickDraw operations are faster in the shallow modes. This benchmark also shows that these operations take longer in the 32-bit mode, but not by a large margin.

Both text benchmarks indicate that the speed of drawing text has slowed in 32-Bit QuickDraw. This won't be a problem for typical word processing tasks, since you'd normally perform such work using a shallow screen setting anyway. But it might be a problem for color prepress applications that typically display a page with a combination of deep color images and text. However, at this stage of 32-Bit QuickDraw's development, I can understand that the software engineers would want to optimize QuickDraw's graphics speed first and concentrate on text performance later.

There are some caveats to these numbers. First, the software and the board's firmware were both undergoing changes. I got several software updates and one configuration ROM during the course of this article. Second, the code cache (and data cache on the 68030) were disabled, so these numbers can be considered worst-case figures.

My overall impression is that 32-Bit QuickDraw is slower in the deeper screen modes, but not prohibitively so, even with a large screen. While you might not do real-time animation in the 32-bit mode, its response time makes it quite usable for graphics design or painting applications. It's an impressive piece of software when you consider the amount of data the Mac works with just to draw the deep screen.

Over the Rainbow

With 32-Bit QuickDraw, the Mac II family and the Mac SE/30 can serve as serious image-processing engines. They can now tackle complex graphics simulations performed routinely on high-end workstations or mainframes, such as processing medical or satellite imagery or electronically retouching and adjusting the color of photos for darkroom work or

continued

Circle 145 on Reader Service Card

IEEE 488

for PC/AT/386 & PS/2

Compare the features!

Iotech Personal488

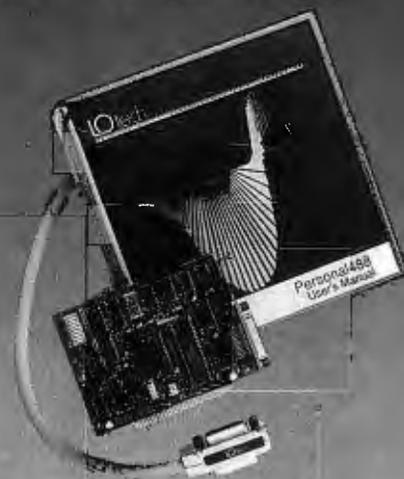
National Instruments PCIIA

\$395	\$395	IEEE 488 board with Quick BASIC & BASIC A driver for PCs and compatibles
✓	✓	BASIC ON SRQ GOSUB capability
✓	✓	IEEE printer/plotter redirection utilities
✓	✓	Compatible with Windows 286 & 386
✓	✓	Compatible with IBM GPIB board
✓	N/A	DMA beyond 64K segment boundaries
✓	N/A	BASIC ON ERROR GOSUB capability
✓	N/A	Instrument control directly from DOS
✓	N/A	Borland Quattro spreadsheet support
✓	N/A	DADISP waveform spreadsheet support
✓	+\$495	Lotus 1-2-3 spreadsheet support
✓	+\$495	Lotus Symphony spreadsheet support
✓	+\$100	On-board crystal oscillator
✓	+\$50	Turbo BASIC support
✓	+\$50	True BASIC support
✓	+\$50	Microsoft C support
✓	+\$50	Microsoft Quick C support
✓	+\$50	Aztec C support
✓	+\$50	TURBO C support
✓	+\$50	Microsoft FORTRAN 4.0 support
✓	+\$50	TURBO Pascal support
✓	+\$50	8086 assembler support

\$395 \$1,935 Total

Add \$100 to each for IBM Micro Channel PS/2 support.

If you already own a National Instruments PCII or PCIIA, IBM GPIB, or any NEC 7210-based IEEE board, Driver488 from Iotech provides the software features above for only \$195. Also, our GP488B IEEE board at \$295 is an economical replacement for any of the IEEE boards listed above.



Call or send for your
FREE Technical Guide

Iotech

(216) 439-4091

Telex 6502820864 • Fax (216) 439-4093

Iotech, Inc. • 25971 Cannon Road • Cleveland, Ohio 44146

London (0734)861287 • Paris (1348)0178 • Milan (02)4120360 • Brussels (02)3848082

Zurich (01)8219444 • Vienna (022)252626 • Copenhagen (01)9303333

Linköping (0133)10140 • Helsinki (0251) • Munich (089) 710020 • Oslo (02)540070

Copenhagen (02)804200 • Madrid (91)4027000 • Lisbon (01)4103420 • Seoul (02) 678 7457

Tel Aviv (03) 491 822 • Melbourne (03)3793622 • Toronto (416)8740444

Products listed are trademarks of the respective manufacturer.
Comparisons based on product information available January 1, 1989.

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



color prepress applications.

However, the cost of this capability is quite steep. SuperMac's Spectrum/24 video board alone costs \$3999. This is on top of the cost of the Mac, a color monitor, and the additional RAM and disk space you'll need. If this cost seems prohibitive, remember that Apple has put a lot of effort into making 32-Bit QuickDraw serve up respectable imagery on an 8-bit-deep screen. Even if you're a typical Mac user, you might use 32-Bit QuickDraw to get a performance boost at the shallower screen modes.

Do you really need thousands or millions of colors? After all, if you lit every pixel with a different color on a 19-inch 1024- by 768-pixel display, you could display only 786,432 colors at once. To display all 16.8 million colors at 72 dots per inch, you'd need a screen that's nearly 4¾ feet to a side. But that's missing the point: What it means is that a 19-inch monitor can show thousands of colors, not just 256. It makes a big difference in how images look on-screen.

This capability becomes crucial when you consider printing the image. While Mac monitors have a resolution of 72 dpi, PostScript printers start at 300 dpi and go up to 2540 dpi. With these output densities, even a standard 8½- by 11-inch page at 300 dpi comes close to holding the range of colors possible using 16-bit pixels, and, at 2540 dpi, the color range possible requires the use of 32-bit pixels. Color printing certainly needs the capabilities of 32-Bit QuickDraw, and it's no surprise that Apple introduced a printer driver to support it.

Apple's 32-Bit QuickDraw extends imaging technology for microcomputers. It takes the manipulation of photo-quality images out of the darkroom and puts it onto the desktop. The new LaserWriter driver ensures that these images reach a printer when necessary and makes it useful for color prepress or other color printing technologies. It does so, however, by making large demands on the Mac's resources in terms of RAM, storage, and display. But for those people whose work needs the full spectrum of colors, 32-Bit QuickDraw now lets them accomplish it on a

ACKNOWLEDGMENT

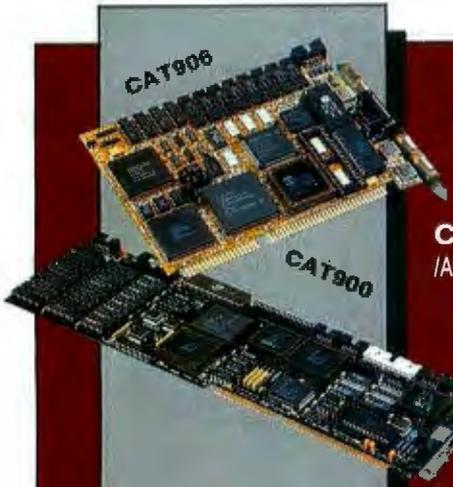
The author wishes to thank Laurie Girand, product manager of Apple's graphics system software, whose contributions helped in the preparation of this article.

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."

FAST

286 16MHz

The 386 Alternative



CAT906 — "Upgrade your /XT"

/AT 80286 "half board" computer running at 8, 10 or 16MHz at 0 or 1 wait state, with up to 1Mb of DIP RAM, real time clock w/battery, BIOS shadowing, speaker port and reset port. Optional 80287 co-processor. 4.7" x 6.7" form factor.

CAT900 — "Upgrade your /XT"

/AT 80286 computer running at 8, 10, 12, or 16 MHz at 0 or 1 wait state with up to 64KB EPROM memory, 2Mb of on-board DIP RAM, 2 serial and 1 parallel port, mouse port, speaker port, keyboard port, reset port, BIOS shadowing, page mode DRAM. Optional 80287 co-processor. 3.85" x 13.4" form factor.



USA
TECHNOLOGY
AT
ASIAN
PRICES



Diversified
Technology

112 E. State St. • Ridgeland, MS 39158
(601)856-1121

1-800-443-2667

Designed and Manufactured by DTI in the USA. G-1

/AT is a trademark of the IBM Corp.

GE Information Services GE[™]nie

A summary of your monthly charges:

Description	Time	Cost
Download 3 Files	1:00	6.00
Read messages on 2 bulletin boards	0:15	1.50
Check 10 stock quotes	0:05	.92
Read today's news	0:10	1.00
Play Stellar Emperor	0:30	3.00

Total hrs. non-prime/
1200 baud 2:00

Total Cost . . . \$12.42

CompuServe[®] Monthly Summary

A summary of your monthly charges:

Item	Hours	Cost
Download 3 Files	1:00	12.50
Read messages on 2 bulletin boards	0:15	3.13
Check 10 stock quotes	0:05	1.24*
Read today's news	0:10	2.08
Play MegaWars III	0:30	6.25

Total hrs. non-prime/
1200 baud 2:00

Total Cost . . . \$25.70

Network surcharge \$.50 *\$.02/quote surcharge non-prime

It doesn't take a computer to figure out the difference.

The difference between the GE[™]nie[™] service and CompuServe[®] could make a big difference to you. Here's why. GE[™]nie's rate for 1200 baud access is just \$6 per non-prime hour*. There's more than twice as much. Which means that with GE[™]nie you can stay online longer for a whole lot less.

And that means more time to enjoy more of GE[™]nie's services. Like valuable computer Round Tables.

Exciting multi-player games. Useful financial information and much more. All at hourly rates designed to allow you to spend more time online. Not more money.

-And with GE[™]nie signing up is as easy as one, two, three.

- (1) Set your modem for local echo (half duplex), 300 or 1200 baud.
- (2) Dial 1-800-638-8369. When connected, you just enter HHH.
- (3) At the U#= prompt simply enter

XTX99660, GE[™]nie then RETURN. And have a major credit card or your checking account number ready. For information in the U.S. or Canada, call 1-800-638-9636. Or write GE Information Services, 401 North Washington, Rockville, MD 20850.



We bring good things to life.

Clash of the Object-Oriented Pascals

Quick Pascal and Turbo Pascal 5.5—fast, friendly Pascal compilers with object-oriented extensions

Microsoft's and Borland's new Pascal products took me completely by surprise. Both start where Turbo Pascal left off to create a true object-oriented language.

Quick Pascal from Microsoft (\$100), scheduled to ship last May, closely follows Apple's Object Pascal. Turbo Pascal 5.5 from Borland (\$150), also scheduled to ship in May, likewise draws on Object Pascal, but it adds some ideas from C++ and some original features.

Why my surprise? Well, I thought that the language giants' first OOP (object-oriented programming) products would test the C++ waters into which other vendors, such as Zortech, have ventured. C++ projects are probably on the drawing boards at Microsoft and Borland, but in the meantime the new Pascals are nice environments in which to explore OOP. It seems appropriate that Pascal, the language that taught one generation of programmers about structured programming, may in a new guise teach another generation about OOP.

A true object-oriented language must support both encapsulation and inheritance. Encapsulation means that the language provides a way to combine data and the code that operates on that data into reusable structures. But that's not enough. Although Ada's packages and Modula-2's modules support encapsulation, these are not object-oriented languages in the modern sense. Inheritance, which is the ability to derive a specialized structure from a more general one,

is the crucial ingredient.

Like Object Pascal, Quick Pascal and Turbo Pascal 5.5 implement inheritance by means of a new Pascal type called *object*. Like a Pascal record, an object can hold data of varying types. But an object can also contain *methods*—Pascal procedures or functions—that operate on the object's data. Moreover, an object can inherit data and methods from another object, add new data and methods, and (if necessary) override the inherited methods.

Although subtle differences exist between the object-oriented dialects that the two products implement, they are comparable in scope and power. They don't offer the generality and conceptual wholeness of a pure object-oriented language like Smalltalk, in which everything is either an object or a message. But these are in no sense toy languages. The benefits of the object-oriented extensions will be immediate and tangible.

Consider a family of objects that define files of various types and operations on files. A root object, *File*, might define data (*Position*, *Length*, *CreateDate*) and methods (*GetByte*, *PutByte*, *SetCreateDate*) that are common to all files. Derived objects *MagDiskFile* and *NetworkFile* might then inherit *File*'s data but redefine its methods in a manner appropriate to the medium at hand.

Suppose now that all these objects are compiled (using Quick Pascal or Turbo Pascal 5.5) and distributed as a standard unit called *Files*. Suppose further that you purchase the *Files* unit and want to add support for a new kind of file, an *OpticalDiskFile*. You can, without access to the *Files* unit's source code, acquire its data and methods, define the object *OpticalDiskFile*, and implement the new object with a minimum of effort by overriding only the methods concerned with specific characteristics of an optical drive.

A system like this has two remarkable properties. First, you don't need to write

any code to implement *SetCreateDate*. Since *SetCreateDate* concerns itself with an abstract property of *File*, it's not necessary to change *File*'s *SetCreateDate* method. *OpticalDiskFile* can simply inherit it. Second, although you'd have to write a new implementation of *GetByte* and *PutByte*, because these methods talk to a physical device, you wouldn't have to change any programs that use the interface to the *File* unit. Programs that call *GetByte* and *PutByte* can continue to do so, blissfully unaware that they might now be talking to an optical drive rather than to a magnetic disk or network pipe.

Quick Pascal: Turbo Pascal with Objects

If you're familiar with Turbo Pascal, you'll experience a sense of déjà vu when you fire up Quick Pascal's integrated environment. The two products look and feel strikingly similar. A text editor dominates the environment; from it you access the compiler and debugger. When you're editing Pascal source code, help is context-sensitive. If the cursor is on the word *Crt*—the name of a library of utility routines—the help key brings up a list of the routines in that library.

When you activate the compiler and it encounters an error, Quick Pascal puts the cursor at the right spot to fix it. If the current file refers to other units (the Turbo Pascal equivalent of packages or modules), you can transitively compile the whole network of units. Once a program compiles cleanly, you can either run it or debug it. With the debugger you can step line by line through the source code and see the values of selected variables in a watch window.

Like Turbo Pascal, Quick Pascal provides an escape from the sometimes overwhelming embrace of its integrated environment in the form of a command-line version of the compiler. That's fortunate for me because I'm much more productive with my own text editor and a

stand-alone compiler than with any of the integrated environments I've seen. The command-line versions of Turbo Pascal 5.5 and Quick Pascal offer a virtually identical set of switches for controlling stack checking, debugging information, and floating-point arithmetic. However, Quick Pascal doesn't provide a stand-alone debugger (as Turbo Pascal does), so if you want to debug a program, you have to use the integrated environment.

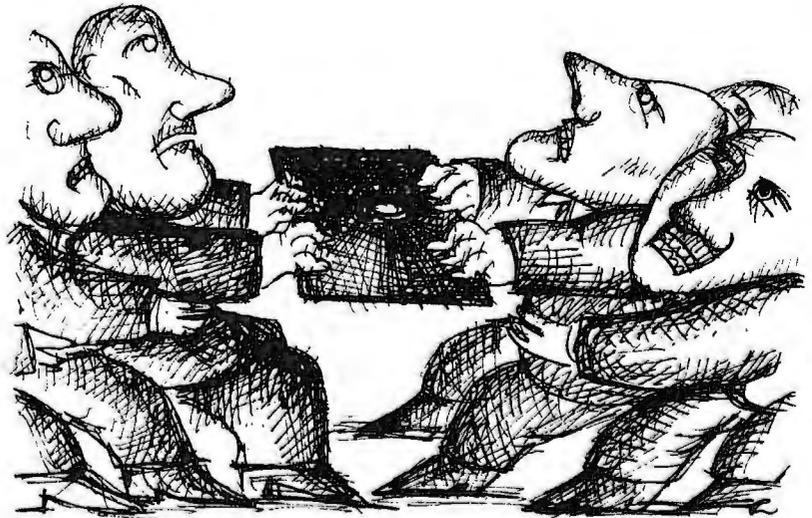
Quick Pascal supports the keywords `unit`, `interface`, `implementation`, and `uses`. This syntax, which Borland introduced with Turbo Pascal 4.0, encourages the construction and use of libraries (units) that export the definitions of useful routines (the interface) to any program that acquires (uses) these libraries, while hiding the details of the code (the implementation). Quick Pascal offers most of the standard units that Turbo Pascal does: `Crt` (screen and keyboard routines), `Dos`, `Printer`, and `Graph`.

Although there's also an `MSGraph` unit that provides an alternate interface to the graphics routines, Quick Pascal's `Graph` unit is, essentially, the `BGI` (Borland Graphic Interface). And sure enough, Quick Pascal compiled and ran Borland's graphics demo, `BGIDEMO.PAS`, almost flawlessly. Microsoft has clearly launched a frontal assault on Borland's flagship product.

Quick Pascal's Windows-like behavior relieves the sense of sameness. Unlike Turbo Pascal, Quick Pascal—although character-based—sports windows with mouse-sensitive drag bars, scroll bars, grow boxes, and close boxes. At a resolution of 80 columns by 25 rows, the visual effect is less than spectacular, but the mechanism nonetheless can be useful. If you don't have a mouse, you can, of course, do everything by way of the keyboard; the program supports the normal Microsoft Windows conventions.

Turbo Pascal 5.5: The New Generation

Although I've owned a copy of Turbo Pascal 2.0 since 1985, it's been years since I took it out of mothballs. For this review I dusted it off and compared it to Borland's latest offering; the changes are impressive. Over the years, Turbo Pascal has acquired a number of important features—separately compiled units, a graphics toolkit, a multiwindow interface, and an extremely powerful debugger. Borland has now added object-oriented extensions that are quite similar to the ones offered by Microsoft but in several respects more useful.



Borland's OOP implementation encompasses Microsoft's and adds static methods, more flexible dynamic allocation of objects, and implicit access to objects' data and methods. Each of these features takes a bit of explaining.

Methods like the `Files` unit's `GetByte` and `PutByte` exemplify what's called late binding. When the unit compiles, the addresses of these routines can't be known because, as I explained in the case of `OpticalDiskFile`, the code may not yet exist. In Turbo Pascal 5.5, you declare such methods with the special keyword `virtual`; a call to a virtual method binds late—that is, at run time. You've seen the flexibility this technique confers. There are costs as well. Objects must store pointers to their methods, and the run-time system has to use those pointers to locate and execute methods. Moreover, all virtual methods that share the same name (e.g., `File.GetByte`, `Network.GetByte`, and `OpticalDiskFile.GetByte`) must declare the same number and types of arguments.

In Quick Pascal, all methods are virtual; there's no other alternative. In Turbo Pascal 5.5, methods are static, or early-bound, unless you specifically request otherwise. Because they're embedded in objects, static methods should be a little slower than normal Pascal procedures and functions, but because their addresses are known at compile time, they should be a little faster than virtual methods. In fact, that's just what I found when I timed 1 million Turbo Pascal 5.5 procedure calls (4.1 seconds), static method calls (5.7 seconds), and virtual method calls (6.1 seconds). Equivalent times for Quick Pascal were as follows: procedures, 4.1 seconds; static methods,

not applicable; virtual methods, 6.7 seconds.

Although Turbo Pascal 5.5's static methods are more efficient than virtual methods, they are not overwhelmingly so, and speed isn't a compelling reason to use them. Convenience is. Suppose the `File` object has an `Initialize` method. The objects you derive from `File` may require different quantities and types of data in order to initialize themselves. For example, in one case you might want to call

```
MagDiskFile.Initialize(name,
    bufsize)
```

and in another case,

```
OpticalDiskFile.Initialize(name,
    buf1size, buf1address,
    buf2size, buf2address)
```

Turbo Pascal 5.5's static methods permit that.

Subtle Differences

In Quick Pascal, objects behave like dynamic variables. To get hold of an instance of `MagDiskFile`, you first declare a variable of that type, then call `new` to allocate storage for it:

```
var
    MyFile : MagDiskFile;
begin
    new(MyFile);
```

In Turbo Pascal 5.5, objects behave like static variables. To create an instance of `MagDiskFile`, you only need to do this:

continued

```
var
  MyFile : MagDiskFile;
```

You can also choose to allocate an instance dynamically, using Pascal's normal pointer syntax:

```
var
  MyFilePtr : ^MagDiskFile;
begin
  new(MyFilePtr);
```

Moreover, Borland has extended the syntax of `new` so that it works with another keyword, constructor. Constructors (and their counterparts, destructors) come from C++. In that language, you can write code that will automatically execute at the beginning and the end of an object's lifespan. An object typically requires dynamic memory to fulfill its mission; constructors and destructors are convenient places in which to localize the allocation and release of that memory.

Turbo Pascal 5.5's extensions to new are threefold: You can pass `new` a pointer type rather than a pointer variable; you can pass an optional second argument that is a constructor; and you can return the pointer value that `new` creates:

```
type MagDiskFilePtr =
  ^MagDiskFile;
var MyFilePtr : MagDiskFilePtr;
begin
  MyFilePtr := new
    (MagDiskFilePtr, Initialize
     ("myfile", 1024));
```

The equivalent operations in Quick Pascal are as follows:

```
var MyFile : MagDiskFile;
begin
  new (MyFile);
  MyFile.Initialize("myfile",
    1024);
```

So what's the big advantage? In this case, there is none. But consider what happens when you want to manipulate more than one object of type `MagDiskFile`. In Turbo Pascal 5.5, `MyFilePtr` refers to an object only indirectly. The object that it points to is anonymous. Therefore, you can dynamically allocate and initialize a list of object instances like this:

```
for i := 1 to FileCount do
  FileList.Add (New
    (MyFilePtr, Initialize
     (FileName[i], 1024)));
```

where `FileList` is an object that takes a

pointer to an object of type `File` (or to any of `File`'s descendants) and adds it to a list of such pointers.

In Quick Pascal, though, `MyFile` refers directly to an object. To create and initialize three instances, you'd have to do this:

```
var MyFile1, MyFile2, MyFile3 :
  MagDiskFile;
begin
  New(MyFile1);
  New(MyFile2);
  New(MyFile3);
  MyFile1.Initialize("myfile1",
    1024);
  MyFile2.Initialize("myfile2",
    1024);
  MyFile3.Initialize("myfile3",
    1024);
```

Turbo Pascal 5.5 also provides a parallel extension to `dispose`. You can pass `dispose` a destructor, so in a single call you can activate an object's shutdown method and then free its memory.

Another convenience that Turbo Pascal 5.5 provides has to do with how an object accesses its own data. Here's what `Initialize` would look like in Quick Pascal:

```
procedure Initialize (InitName :
  string; InitBufsize :
  integer);
begin
  Self.Name := InitName;
  Self.Bufsize := InitBufsize;
  Self.SetCreateDate;
end;
```

`Initialize` assigns values to the object's `Name` and `Bufsize` slots and calls its `SetCreateDate` method. But in order to gain access, `Initialize`, even though it already belongs to the object, must qualify everything with `Self`—which simply affirms, "yes, go ahead and operate on *this* object." Turbo Pascal 5.5 makes `Self` implicit, so the equivalent method is just:

```
procedure Initialize (InitName :
  string; InitBufsize :
  integer);
begin
  Name := InitName;
  Bufsize := InitBufsize;
  SetCreateDate;
end;
```

It's a small thing, but once you've spent some time with Turbo Pascal 5.5, it's annoying to move to Quick Pascal and have to type "Self" constantly.

Choose Your OOP

The release of these two excellent products will do much to advance the cause of OOP. I'd recommend either of them over C++ for a gentle introduction to what is in many ways a bewildering subject. But which one? For me, it's no contest: I'd pick Borland's Turbo Pascal 5.5.

Points in Quick Pascal's favor include excellent speed, graphics, a Windows-like environment, an integrated debugger, on-line help, and the object-oriented extensions. Of these, the only feature unique to Quick Pascal is the Windows-like environment. That doesn't weigh heavily with me, though; since I don't depend on a mouse for my daily work, I find Turbo Pascal's keyboard-driven windowing environment just as useful.

Turbo Pascal 5.5 matches or betters Quick Pascal in all other respects. It's faster—though you'll need a very big program before either of these products will make you wait long. Its on-line help is better organized. Where Quick Pascal just displays the interface part of, for example, the `Crt` unit, Turbo Pascal 5.5 gives you a list of names of routines in that unit. When you select a name, you get another screen with the procedure header and descriptive documentation.

Although the two integrated debuggers match one another on a feature-by-feature basis, Turbo Pascal 5.5 also comes with Borland's justly renowned stand-alone debugger. Unlike either of the integrated debuggers, the Turbo Debugger can trace a mixture of source and assembly code and can inspect complex variables (e.g., unpack nested records and follow chains of pointers). Borland has now added a new OOP-related feature—an object hierarchy inspector. This tool displays and traverses a family of objects. It can inspect data belonging to an object and identify the object's methods. It's very impressive and gives Turbo Pascal 5.5 the feel of a Smalltalk system.

Finally, although the two OOP dialects are roughly equivalent, Borland's encompasses Microsoft's and adds several quite useful conveniences. The battle isn't over. Object-oriented technology is on the march and will doubtless soon appear in other forms. There's little hope of mastering the complexities of modern graphical environments without the leverage that OOP provides. But while there's no telling what surprises the two companies may have in store, this round goes to Borland. ■

Jon Udell is a BYTE technical editor. He can be reached on BIX as "judell."



The Persistence Of Time.

Your computer doesn't have to become obsolete. You can protect yesterday's investment. Work with today's more powerful programs. Be ready for the future. Now there is the Mitsubishi® MP386s with a 16 MHz, 386SX™ processor and 2 MB RAM standard.

The MP386s works with existing PC programs and expansion cards, new multi-tasking and multi-user environments and emerging 386 software.

You can receive a free poster of "The Persistence Of Memory" by Salvador Dalí by seeing the MP386s demonstrated at your nearest Mitsubishi dealer. Call 1-800-556-1234, ext. 25 in the U.S. and Canada (in California 1-800-441-2345, ext. 25).

The Mitsubishi MP386s. Now, past is present and the future is easier to define.



 **MITSUBISHI
ELECTRONICS**

Mitsubishi Electronics America, Inc., Information Systems Division, 291 Kondo St., Torrance, CA 90502.

Mitsubishi Electric Sales Canada, Inc., 8885 Woodbine Ave., Markham, Ontario L3R 5G1.

© 1989 Mitsubishi Electronics America, Inc. Pentium is a registered trademark of Intel® Corp., Tokyo. 386SX is a trademark of Intel® Corp.

Circle 100 on Reader Service Card (DEALERS-101)

The Only Character Recognition System



That Outperforms Ours

Nature's character recognition system can be trained to read any language. Flagstaff Engineering's **SPOT OCR Text Reader** is also trainable. It has read text printed in thousands of typefaces in over 130 different languages!

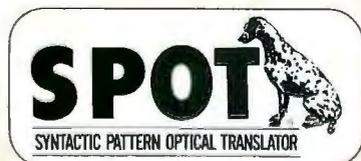
The SPOT OCR Text Reader works just like a typist who reads a page, then uses a keyboard to transfer the information on the page into a computer file—except SPOT uses a scanner for eyes and outputs the text directly into standard text files. SPOT is also faster. It can read up to 35 characters per second on a 16MHz AT, and up to 65 characters per second on a 25MHz machine (that's 780 words per minute). SPOT supports most major makes of scanners.

Using sophisticated statistical techniques, SPOT recognizes characters like the brain does: by examining their shape and context. Like nature's original, SPOT is very flexible. It can glance over an entire page or zoom in on a few lines of text. SPOT can read newspapers,

magazines, books, manuals, invoices, contracts, government documents, columns, tables . . . just about any printed text. And SPOT keeps getting better. The **new Version 3.0** is faster, more accurate, easier to use, and better documented than its predecessors.

Since 1982, Flagstaff Engineering has provided visionary data conversion solutions for thousands of companies worldwide. SPOT is already increasing productivity and making life easier for many publishers and researchers, accountants and telemarketers, medical and legal offices, archival and transcription services.

Wouldn't *your* business benefit from fast, accurate, and low-cost OCR software? Give us a call and let our application specialists explain how you can save time and money with SPOT, *the* OCR text-entry solution.



Join Flagstaff Engineering's
BIX conference: flageng

Circle 96 on Reader Service Card for
S.P.O.T. 3.0 Version
97 for 9 Track Tape
98 for Disk Conversion Systems Up-Date
99 for DEALERS only



Helping People Read a World of Information

1120 Kaibab Lane • Flagstaff, AZ 86001
602-779-3341 • FAX 602-779-5998



COMPUTERS VS. TAXES

Jerry wages his annual battle with taxes and breaks in a new Northgate computer

Well, I survived doing my income tax. It wasn't easy. Because of trips and deadlines and a touch of Chicago flu, I found myself *starting* on Friday, April 14, with not all my income, cash, and credit card expenditures *entered* into my accounting system, much less posted off into their proper ledger pages. Worse, just about everything I did have entered was on 8-inch disks—and I didn't have an 8-inch drive.

Of course, it was all my fault. For years I have kept my accounts on the Golem, a big CompuPro Z80/8086/80286 machine running Concurrent CP/M. The Golem has an integral 8-inch floppy disk drive as well as a 360K-byte 5¼-inch DOS drive; you can easily see which one I got into the habit of making backup files on.

As it happens, the Golem was shipped up north to CompuPro for a complete upgrade. He's getting an 80386 CPU card, a new hard disk drive, and a number of other features, and will be, in the words of some of the kids who hang out around here, "just awesome." I carefully copied all the important files onto 8-inch disks and sent the machine away. It took longer to get him back than I'd figured, so there I was.

Transferring the files wasn't much of a problem. Barry Workman offers that service, and he's only half an hour away. Then I had to recompile all my accounting programs.

For some of them, those written in CBASIC2 for CP/M, it was trivial. Just compile (type CB86 FILENAME) and link (LINK86 FILENAME), and you're

done. There are various compiler toggles I don't remember—one suppresses sending the listing file to the screen—but none of that mattered. The programs recompiled and ran flawlessly.

Others weren't so simple, since I had, for unaccountable reasons, written them in Microsoft BASCOM for CP/M, and Microsoft QuickBASIC isn't quite compatible with that. In particular, you'll want to pay a lot of attention to any IF...THEN statements with multiple consequences. There were also a bunch of odd errors: programs would compile, but they had errors when run. I'd eventually trace those down, but the error often didn't relate at all to the error message. In one case, I was trying to read in a file as "D:Filename" while logged onto a subdirectory in D. I should have got a "Bad File Name" error, but instead I got "String Space Corrupt." There were others of that kind.

A warning to QuickBASIC 4.5 users: if you get what you think are impossible error messages, they probably are. Look for something else entirely. It will probably be silly.

I also noticed something else. CBASIC2 executable files are much smaller than those produced by QuickBASIC 4.5. As an example, the CBASIC2 source file for JOURNAL is 31K bytes; it's certainly the most complicated program in the entire accounting suite. The .EXE file produced by CBASIC2 is only 36K bytes long. ALLOC, a much simpler program that uses a small subset of the same code as JOURNAL (it reads in a big composite journal file and allocates the entries to smaller files sorted by date), is 8.5K bytes in source code, but QuickBASIC 4.5 makes an .EXE file 65K bytes long!

QuickBASIC 4.5 has records (although I don't use them in the accounting programs) and a few other such features, but if I were going to write many more programs in BASIC, I'd seriously consider ignoring both QuickBASIC 4.5 and

Turbo Basic and working in CBASIC2; it's still a real contender, especially if it's augmented by CBC Tools from Minnow Bear Computers.

On the other hand, I did get all my files converted, except for some whose source code I had foolishly never saved off the Golem's hard disk. Actually, I do have the code, but it's in one or another box of 8-inch disks that are stored away; it wasn't saved onto the disk that I thought it was on.

The upshot was that I did not have the code for my depreciation programs; all I had was a memory of what they did. Starting from scratch, I was able to recreate those programs in QuickBASIC 4.5 in about 2½ hours. Of course, I had samples of the input and output to them from my past years' tax returns; I wasn't designing the program. Even so, it's an impressive testimonial to the power of the QuickBASIC 4.5 environment. I know I couldn't have done it anywhere near that quickly with CBASIC2, especially late at night with fatigue poisons slowing me down.

MacInTax and TaxView

By working through the night, I was able to get nearly all the accounting part of my tax reports done. I still had a few hours of work entering stuff, but since April 15 fell on a Saturday this year, I had until midnight April 17 to get the things done. (I know about extensions. All I can say is that I'm compulsive.)

I figured the hard part was over.

True, Monday morning's paper was full of stories about people going mad over the new tax code, but I wasn't worried. I had a secret weapon: an unopened box from SoftView. I've used SoftView's MacInTax for several years now, enough so that I have enormous confidence that no matter how complex your tax returns—and mine are *very* complex, what with limited partnerships that make small profits but require an amazing

continued

amount of paperwork, and stuff like that—MacInTax will take care of it. I've said often enough that it's worth getting a Mac if all you do with it is run MacInTax; and I have a Mac complete with the LaserWriter IINTX. MacInTax not only figures your tax returns, it also prints the forms for you.

I didn't even hurry. Consequently, it wasn't until after dinner that I opened the box—and discovered to my horror that what I had wasn't MacInTax for the Mac

but TaxView for the IBM PC.

OK. My fault, of course. SoftView has no obligation to send me their products year after year. I know they work, and I jolly well could just go *buy* a copy of MacInTax, and indeed I would have if I hadn't had a big box prominently marked "Jerry's 1988 Tax Programs" put off in the "Don't anyone *ever* touch this" area. The point was, though, I hadn't, Egghead and Priority One were closed, and the deadlines were coming.

There was nothing for it but to try TaxView.

TaxView is SoftView's Windows implementation of MacInTax. To get it running, you must first install the run-time portion of Microsoft Windows. Therein lies the first rub: Windows isn't easy to install.

First, you must prepare. If you use DESQview, dump it. Get rid of every TSR program you have. Later, you may want to add them, but when you're first installing Windows—even the run-time package—the last thing you need is complications. Make your system as vanilla as possible.

Be warned. The instructions look as if they're clear. They look as if they were written for rank beginners. Alas, they aren't really. For example, at one crucial point, the system tells you what it thinks it's looking at. In particular, it says it thinks you have a Microsoft Mouse. Well, I don't have a Microsoft Mouse in Big Cheetah. I have a Logitech Mouse, with a Microsoft Mouse emulator. I read the screen report as saying that Windows had tested the system and decided my mouse was acceptable, and I told Windows to proceed.

It did proceed, for quite a long time, and eventually locked the system so thoroughly that I had to use the hardware reset button. Next time, I told it I had a Logitech Mouse. It accepted that and trundled along. I forget what went wrong that time.

I went through several more iterations. In between I was, I fear, rather impolite to SoftView's answering service. Eventually, I got put through to a SoftView technician. (I shamelessly pulled rank; look, I was desperate.) After that, things went swimmingly. In 7 minutes, I was talked through the installation complexities—all of them due to Windows, not TaxView—and was looking at a screen nearly indistinguishable from the MacInTax I know and love.

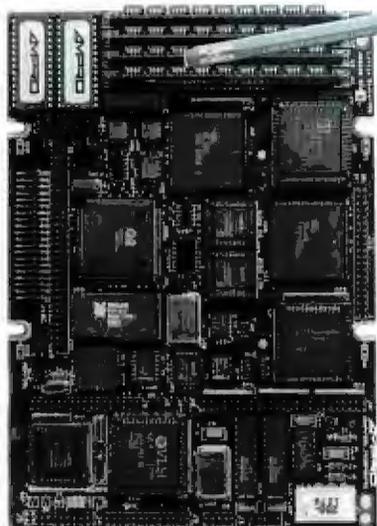
There are a few other anomalies. A few things don't work the same way in TaxView as in MacInTax; once again, it's entirely due to Windows. More important, they *do* work. In about 2 hours, I had the silly tax forms filled out and told TaxView to print them on my (quite vanilla) LaserJet Plus. There were no problems at all. It does take quite a while before printing begins—TaxView thinks to itself for several minutes before sending even the first byte to the printer—but eventually out they came, page after page of tax forms and schedules.

So, as I said, I survived my taxes. I'd

continued

WHY DESIGN YOUR PRODUCT AROUND A COMPUTER?

Design the computer in.



Little Board™/286

Built-in vs. built-around. External systems mean boxes, boards, backplanes, cables, and reliability problems. Ampro's Little Boards give you a complete system on a single board you can build right into your product.

Small size. Big power. Eliminate the bulk and constraints of multi-board, backplane-based systems. Embed a Little Board that requires just 2/3rds the power and volume of a 5 1/4" floppy drive. But with the full power of a PC or AT®.

Fully compatible. Little Board/286 and Little Board/PC are functionally identical to multi-board PCs and ATs. They run PC-DOS™ 2.0 to 3.X. They run DOS languages, compilers and applications. You'll be standing on a proven foundation of hardware and software.

Ampro's Single Board Systems. It's all there. Up to a Megabyte of RAM. RS-232C and Parallel ports. AT/PC-compatible controllers and bus expansion. EGA/CGA/MDA and Hercules™.

Reps: Australia—81 3 720-3298; Austria—43-222/45 45 01; Canada—(604) 438-0028; Denmark—45 3 66 20 20; Finland—358 0 585-322; France—331 4502-1800; Germany, West—49 89 811-8151; Israel—972 3 49-16-95; Italy—39 6 811-9408; Japan—81 3 257-2630; Netherlands—010-411 85 20; Spain—M34 3 204-2099; Sweden—46 8 55-00-65; Switzerland—41 1 740-41-05; United Kingdom—44 2 964-35511; USA—contact AMPRO

Trademarks: IBM, AT—IBM Corp.; Hercules—Hercules Computer Technology, Inc.; Little Board—Ampro Computers, Inc.; DR-DOS—Digital Research, Inc.



Little Board/PC

compatible video options. Even optional solid-state disk. Plus SCSI support for hard disk, tape, optical drives, bubble drives... you name it. And, low power consumption (+5VDC, less than 8W) and a wide operating temperature range (0 to 60°C). Perfect for standalone operation and harsh environments. Anywhere that reliability is a critical consideration. Available worldwide. For information and the name of your nearest U.S. or international Ampro representative, call us at the number below. Or write for Little Board Product information.

Now includes DR-DOS™

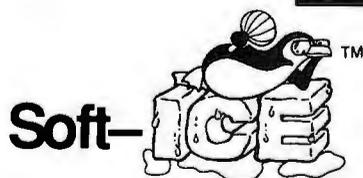
408-734-2800

Fax: 408-734-2939 TLX: 4940302

AMPRO
COMPUTERS, INCORPORATED
1130 Mountain View/Alviso Road
Sunnyvale, CA 94089

FINALLY. A debugging tool tough enough to handle the DOS Nasties.

New Version 2.0



Nasty over-write? No sweat!

Soft-ICE memory range break points help you track down memory over-write problems whether you are doing the over-writing or another program is over-writing you.

Hung program? No problem!

When the system hangs, you now have hope. With Soft-ICE you can break out of hung programs no matter how bad the system has been trashed. And with Soft-ICE's back trace ranges you can re-play the instructions that led up to the crash.

Program too large? Not with Soft-ICE!

Soft-ICE runs entirely in extended memory. This means you can debug even the largest DOS programs. And since your program runs at the same address whether Soft-ICE is loaded or not you can find those subtle bugs that change when the starting address of your code changes.

System debugging? Soft-ICE is a natural!

Soft-ICE is ideal for full source level debugging of TSRs, interrupt service routines, self booting programs, DOS loadable device drivers, real-time kernels, non-DOS O/Ss and ROMs. Soft-ICE can even debug within DOS & BIOS.



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.

30 day money-back guarantee
Visa, MasterCard and
AmEx accepted



New Soft-ICE 2.0 features

- Back Trace Ranges
- Symbolic & Source level debugging
- EMS 4.0 support with special EMS debugging commands
- Windowed user interface



CALL TODAY (603) 888-2386
or FAX (603) 888-2465

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

THE PROGRAMMER'S SHOP

helps save time, money, and cut frustrations. Compare, evaluate, and find products.

FREE! Summer '89 Catalog
75+ New Products. Revised expanded descriptions make product selection even easier.
Mention "BY789"

Assemblers

	List	Ours
MS Macro Asm	150	109
Turbo Assembler/Debugger	150	115
Visible Computer 80286	100	89

C Language - Compilers

AZTEC C86 - Commercial	499	Call
High C-286 - by MetaWare	595	559
Instant C/16M	795	719
Lattice C - V3.4	450	289
Microsoft C 5.1 - w/CodeView	450	Call
Microsoft QuickC 2.0	99	Call
Turbo C - by Borland	150	Call
Turbo C Professional	250	Call
Watcom C7.0 - highly optimized	295	279

Dbase & Tools

Buzzwords Toolboxes	295	269
CLEAR+ for dBASE	200	169
Clipper Summer '87	695	469
dBASE IV	795	Call
Dbase Online - 6 pop-up references	99	89
dBMAN V	190	179
dBRIEF w/BRIEF	275	Call
dBug - source debugger	195	179
dBX - dBASE III to C	550	529
DBXL Interpreter	199	149
FoxBASE + - V2.1	395	249
Genifer - code generator	395	259
QuickSilver Diamond	599	369
R&R Relational Report Writer	149	129
Scrimmage by IDL - screen menu	149	119
SoftCode w/dBASE templates	80	69
UI Programmer - Dev's Version 2.0	595	479
UI Programmer - User's Version 2.0	295	239

New Discovery

R:BASE Compiler
by Microm, Inc. Complete debug R:BASE applications. Includes application generator. Call MS C or MASM routines. Allows UDFs using R:BASE commands. Microsoft C or MASM. Supports most R:BASE System V and R:BASE for DOS Commands. Menu driven debugger provides separate screens for viewing source and output. \$749

Debuggers/Disassemblers

	List	Ours
Periscope II - breakout switch	175	139
Periscope III - 10 MHz version	1395	1259
SoftProbe II TX - debug Sourcer	395	359
	100	89

Editors

BRIEF	195	Call
Edix	195	159
Epsilon - like EMACS	195	169
KEDIT - like XEDIT. V.4	150	125
Personal Rexx	150	129
MKS VI	149	129
PI Editor	195	Call
SPF/PC - V2.0	245	185
Vedit Plus	185	129

Text Screen Addons

AE Windows	225	209
C scape	399	379
C Windows Toolkit	100	95
C Worthy w/forms	295	Call
Curses - by Aspen Scientific	159	139
Greenleaf DataWindows	295	229
JAM by JYAC	595	469
Vitamin C - source, menus	225	169
Vermont Views - replaces WFD with source	395	Call

Note: Mention this ad. Some prices are specials. Ask about COD and POs. Formats 3" laptop now available, plus 200 others. UPS surface shipping \$4/per normal item. Prices subject to change without notice.

Established 1983. We carry over 1,100 different products. Call today for complete technical information and advice, our free catalog, literature, and solid value.

800-421-8006

HOURS
M-F 9:30 - 8:00
Sat 10:00 - 4:00

5-B Pond Park Road
Hingham, MA 02043
Main: 800-442-8070
or 617-740-2510 5:89
Telex: 671-5348
FAX: 749-2018

CHAOS MANOR

still rather use MacInTax than TaxView, but that's mostly due to the problem of getting the Windows run-time package installed. The real bottom line is that TaxView gets the job done on time, even if you started far later than you should have.

Highly recommended, for the fourth straight year. And I do apologize to the receptionist at the answering service.

SIMNON

Last month I talked about Extend, the simulation program for the Mac. Even as I wrote about it, I vaguely remembered I'd been sent a program of the same sort for the PC, but I couldn't recall what it was. I was also in a hurry.

Yesterday, we were trying to clear off the table in the Great Hall, and I ran across SIMNON, an MS-DOS simulation program developed at the Department of Automatic Control, University of Lund, Sweden, and distributed in the U.S. by Engineering Software Concepts. I hate cleaning up, and I like simulation programs, so...

Like Extend, SIMNON consists of a box of tools for setting up, solving, and graphing solutions to differential and difference equations. You can build models of a variety of situations, both orderly and chaotic.

SIMNON's cover features the now-familiar butterfly graph of a Lorenz "strange attractor." You needn't feel bad if that term means nothing to you; it's part of chaos theory. In the past dozen years, the study of chaos has moved from academically disreputable to intellectually respectable. No one is quite sure what discipline it belongs to. It isn't mathematics: mathematicians thrive on rigorous proofs, the notion being that you can count on the previous work to be absolutely sound, and chaos theory consists in large part of computer programs. It's too theoretical to be engineering or computer science.

No matter. The study of chaos seems to throw light on a number of academic disciplines, from hydraulics to population biology. In essence, it's the mapping and modeling of systems in which tiny changes in the initial conditions can produce wildly different and unpredictable results. If you want to know more, a good place to start is *Chaos: Making a New Science* by James Gleick (Viking, 1987).

After you've read that book, get SIMNON if you have a PC, or Extend if you have a Mac, and you'll be ready to play your own chaos simulation games.

Even without chaos theory, SIMNON

continued

People are talking about us.

When professional FORTRAN programmers develop or port large programs they use Lahey's F77L-EM/32 and F77L-EM/16, *PC Magazine's 1988 Technical Excellence Award Winners*. F77L-EM/32 is a fast 32-bit protected-mode compiler that accesses up to 4 gigabytes of memory on 80386s. F77L-EM/16 gives 80286 users the power to create 15 megabyte programs. These protected-mode FORTRANs include the features that have made them, and our F77L and Lahey Personal FORTRAN, market leaders: full ANSI 77 Standard, VAX and IBM VS extensions, fast compilation, comprehensive diagnostics, and a powerful debugger.



When people talk about FORTRAN
the name mentioned most often is

Lahey
Computer Systems Inc.

Contact us to discuss our products and your needs. (800) 548-4778
Lahey Computer Systems, Inc. P.O. Box 6091, Incline Village, NV 89450
Tel: (702) 831-2500 FAX: (702) 831-8123 Tlx: 9102401256

Compuclassics

ACCOLADE	
Test Drive	22.00
ADOBE	
Illustrator/Windows	409.00
ALDUS	
PageMaker	499.00
ALPHA	
Alpha/4	329.00
AMERICAN SMALL BUSINESS	
Design Cad	159.00
Design Cad 3D	209.00
APPLAUSE	
Perfect Addition	29.00
APPLICATION TECHNIQUES	
Pizzazz Plus	69.00
ASHTON-TATE	
DBase IV	509.00
Framework III	455.00
DBase III Plus	455.00
Mastergraphics	295.00
Multimate Advantage II	295.00
ASK SAM	
Ask Sam	179.00
AUTODESK	
Autosketch Enhanced	65.00
BANNER BLUE	
Org Plus	55.00
BLOC PUBLISHING	
Formtool	59.00
BLAISE	
Turbo C Tools	85.00
Turbo Power Tools Plus	85.00
BORLAND	
Turbo C	99.00
Turbo Pascal	99.00
Turbo C Pro	169.00
Turbo Pascal Pro	169.00
Quattro	165.00
Sidekick Plus	135.00
Turbo Assembler/Debugger	99.00
Paradox	439.00
BOURBAKI	
1 Dir Plus	50.00
BRIDGEWAY	
Fast Trax	35.00
BRODERBUND	
Print Shop	39.00
Memory Mate	45.00
BUMBLEBEE	
DB Fast/DOS	60.00
BUTTONWARE	
PC File DB	69.00
CALIFORNIA SCIENTIFIC	
Brainmaker	79.00
CENTRAL POINT	
PC Tools Deluxe	79.00
Copy II PC	25.00
CHANNELMARK	
Quick Schedule Plus	49.00
CHRONOS	
Who-What-When	119.00
CLARION	
Professional Developer	409.00
COMPUTER ASSOCIATES	
Supercalc 5	319.00
Superproject Expert	455.00
CONCENTRIC DATA	
R & R Report Writer	109.00
CORE	
Corefast	79.00
CROSTALK	
Crosstalk Mark 4	129.00
Remote 2	99.00
DAC	
Lucid 3D	62.00
DAC Easy Bonus Pack	119.00
DAC Easy Accounting	59.00
DATAEASE	
Dataease 4.0	509.00
DATASTORM	
Procomm Plus	52.00
DELIRIA	
Perform	155.00
DELTA TECHNOLOGY	
Direct Access	55.00
DIGITAL RESEARCH	
Gem Artline	289.00
Gem Draw Plus	179.00
DIGITALK	
Smalltalk V286	145.00
DYNAMIC MICROPROCESSOR	
PC Anywhere III	80.00
ELECTRONIC ARTS	
Mavis Beacon Teaches Typing	35.00
Deluxe Paint II	69.00
EPYX	
California Games	25.00
FIFTH GENERATION	
Fastback Plus	109.00
FORMWORX	
Formworx w/Fill & File	89.00
FOX	
Foxbase Plus	199.00

FUNK	
Sideways	42.00
Allways	89.00
GAZELLE	
QDOS II	39.00
GENERIC	
Generic CADD Level 3	169.00
GIBSON	
Spinrite	52.00
GOLDEN BOW	
V Cache	45.00
HAVENTREE	
Interactive Easy Flow	115.00
IBM	
DOS 4.01	125.00
Displaywrite IV	289.00
INDIVIDUAL	
101 Macros For WordPerfect	45.00
INSET	
Inset Plus	109.00
INSIGHT DEVELOPMENT	
Laser Control	85.00
Print-A-Plot	109.00
INTUIT	
Quicken	35.00
LASERGO	
Go Script	155.00
Go Script Plus	205.00
LEARNING COMPANY	
Reader Rabbit	25.00
LOTUS	
Agenda	289.00
Other Products	Call
MATHSOFT	
Mathcad	215.00
MECA	
Managing Your Money	125.00
MERIDIAN	
Carbon Copy Plus Special	129.00
MICROGRAFX	
Windows Graph Plus	329.00
Designer	449.00
MICROLOGIC	
Tomado	55.00
MICROLYTICS	
Gofer	45.00
MICROPRO	
Wordstar Professional 5.0	229.00
MICROPROSE	
F19 Stealth Fighter	39.00
MICRORIM	
RBase For DOS	499.00
MINDSCAPE	
Balance of Power	30.00
MULTISOFT	
Super PC Kwik	65.00
MICROSOFT	
Quickbasic	67.00
Quick C	67.00
Windows 286	67.00
Windows 386	129.00
Excel	239.00
Macro Assembler	99.00
C Compiler	299.00
Word	229.00
Word Simulator	35.00
MICROTEK	
Softbytes 286	35.00
NANTUCKET	
Clipper	429.00
NEW ENGLAND	
Graph-In-The-Box	75.00
NOLO	
Willmaker	35.00
NORTH EDGE	
Timeslips III	115.00
NOVELL	
Advanced Net 2.15	1959.00
Other Products	Call
OWL	
Guide	169.00
PAPERBACK	
VP Planner Plus	129.00
PATTON & PATTON	
Flowcharting II Plus	139.00
PAUL HACE	
Mace Utilities	55.00
PEACHTREE	
Complete Acting W/Data Query	235.00
PERSOFT	
Ize	265.00
Smartem 240	209.00
PERSONICS	
Ultravision	79.00
See More 1-2-3	49.00
PETER NORTON	
Norton Utilities	59.00
Norton Commander	55.00
Norton Utilities Advanced	89.00
POLARIS	
Packrat	265.00
PRECISION SOFTWARE	
Superbase 4	499.00
PRIME SOLUTIONS	
Disk Technician Advanced	119.00
PROXIMITY TECHNOLOGY	
Choice Words	65.00

PUBTECH	
File Organizer	145.00
QUAID	
Copywrite	55.00
QUALITAS	
386 To The Max	60.00
QUARTERDECK	
Desoview	79.00
QEMM 386	37.00
REFERENCE	
Grammatik III	52.00
RIGHTSOFT	
Rightwriter	52.00
RIX	
Colorix VGA Paint	109.00
ROYKORE	
Opus One	275.00
SAMNIA	
AMI	99.00
SANTA CRUZ OPERATIONS	
SCO Operating System 286	405.00
SCITOR	
Project Scheduler 4	429.00
SIERRA ON-LINE	
Leisure Suit Larry #2	32.00
Kings Quest IV	32.00
Space Quest III	39.00
SIMON & SCHUSTER	
Webster Prof Thesaurus	79.00
SOFTKLONE	
Mirror III	55.00
SOFTLOGIC	
Disk Optimizer	45.00
SOFTWARE DIRECTIONS	
Print Q	69.00
SOFTWARE MASTERS	
Flash	49.00
SOFTWARE PUBLISHING	
Harvard Graphics	299.00
PFS 1st Publisher	79.00
PFS 1st Choice	99.00
PFS 1st Graphics	89.00
Professional Write	145.00
SOLUTION SYSTEMS	
Brief	169.00
SPECTRUM HOLOBYTE	
Tetris	24.00
Falcon-AT	32.00
STSC	
Statgraphics	589.00
STORAGE DIMENSIONS	
Speedstor	39.00
SUBLOGIC	
Jet	32.00
Scenery Disks	Call
SYMANTEC	
O & A	229.00
Timeline	369.00
Grandview	189.00
SYMSOFT	
Hotshot Graphics	149.00
SYSTEMS COMPATIBILITY	
Software Bridge	79.00
THREE D GRAPHICS	
Perspective Jr.	109.00
TIMEWORKS	
Publish It!	125.00
TRAVELING SOFTWARE	
Laplink III	85.00
Viewlink	69.00
TURBO POWER	
Turbo BTree Filer	79.00
Turbo Professional	79.00
UNISON WORLD	
Printmaster Plus	32.00
VERSASOFT	
DB Man V	139.00
WHITE CRANE	
Brooklyn Bridge	75.00
WISEWARE	
Prmetime	69.00
WOLFRAM RESEARCH	
Mathematica 386	599.00
WORDPERFECT	
Word Perfect	239.00
Word Perfect Library	69.00
Word Perfect Network	355.00

FAX YOUR ORDER!
(818) 347-9977

► IMMEDIATE SHIPMENT ON PURCHASE ORDERS FROM GOVERNMENT AND STATE AGENCIES, CITIES, COUNTIES, SCHOOL AND UNIVERSITIES.
► Prices subject to change without notice and while stocks last. ► We Ship the latest versions. ► We accept Visa, MasterCard, American Express ► 2% Surcharge on American Express
► Please call (818) 347-9400 for an Authorization # for defective goods on your return will not be accepted. ► Due to copyright laws we cannot take back any software where the seal has been broken. ► \$5 minimum shipping per item, less on bulk orders. ► *9 Blue Label shipping, \$3.50 C.O.D. charge
► Heavier items are charged accordingly. ► We do not guarantee compatibility
► Call for prices for any software item not included in this ad. ► Order desk open 7 a.m. to 5 p.m. (PST), Saturday 10 a.m. - 2 p.m. (PST). ► P.O. Box 10598, Canoga Park, CA 91309
Showroom: 7959 Deering Ave., Canoga Park, CA 91304 ► Customer Service 818 347 9400
General Office 347 7500

INTERNATIONAL ORDERS 818-347-2444

We ship to APO & FPO PO Boxes

WE WELCOME CORPORATE ACCOUNTS AND INTERNATIONAL ORDERS

ORDERS CALL 800 733 3888

Circle 60 on Reader Service Card

JULY 1989 • BYTE 113

isn't for the fainthearted. The manual assumes you know what differential and difference equations are; it also assumes a general familiarity with programming. There are even syntax diagrams in the back of the book.

However, there are examples, and the manual, while terse, is at least clear; it has been a long time since I did any serious mathematical work, and while I can't say I understand everything in the manual, I was able to get started playing around with a wide variety of simulations. I'm now working on a difference-equation model to predict the number of grendels you might find on the mainland. If you haven't read *Legacy of Heorot*, that won't make sense, but it's a situation you might find in extraterrestrial biology.

For more on the fun—and the importance—of simulation tools, see the "Models of Doom" section in my June column. I won't say SIMNON on the PC is as easy to use as Extend on the Mac, but it will do the job if you'll take the trouble to learn it. Recommended.

Last-minute reflection: SIMNON will teach you a lot about nonlinear simulations, but I think \$695 is severe overpricing; for that, you ought to get a whole course on simulation.

More Chaos

Another program for studying chaotic behavior is Chaos in the Classroom from Dynamical Systems. CITC runs in color and generates bifurcation diagrams. Bifurcation diagrams are explained in Gleick's book; they're fundamental to the study of chaos. CITC has a lot of neat demonstration programs. It's pretty slow, but that's to be expected given the nature of what it's modeling. The manual is meant for those dedicated to using the program, but it does explain a bit of what's going on. If you're seriously interested in chaos, this is another program that's worth having.

The CITC package probably came with a letter that has been lost. On that score: Please, always make sure that your name, address, and phone number (if you've sent something you want reviewed) are on everything you send me. I have probably a hundred letters I can't answer because the address was only on the envelope. Envelopes get lost here. So, alas, do cover letters.

Northgate 80386

I think I first heard of Northgate at the 1987 Comdex in Las Vegas. They were in a booth over in Caesar's Palace, and while they probably had clones, the interesting thing on display was the keyboard,

which had a decent (but not superb) layout and an excellent feel. I recall making some suggestions about key layout.

A few months later, I was startled to find they'd listened to my advice and revised the keyboard. It still had a few bugs, but then they fixed those. They've been improving ever since, and as I reported last month, the Northgate Omni Key/102 has become the standard keyboard at Chaos Manor; my only problem is that I don't have enough of them. What with the Backspace key in the right place and that great keyboard feel, I just hate having to use anything else.

Anyway, I was talking with Northgate president Art Lazere about keyboards, and he pointed out that they sell computers, too; in particular, they sell a vanilla 80386. "I think it's a shame that people get touted onto fast 80286s," Lazere said. "The 80386 doesn't cost that much more, and you get a lot more machine."

Since that squares 100 percent with my view, we got on famously. He suggested that I take one of his standard 80386 systems and give it a workout. I thought of protesting that I have more than enough machinery around here and darned little time; but it really was a reasonable proposition.

I do most of my work on fairly advanced equipment. I don't really need all that speed and power, but I appreciate it. Every now and then, I get a letter suggesting I ought to work with equipment readers can afford. My general reply is that I'm trying to stay *ahead* of the industry, and what's exotic today is vanilla next year. Still, it's an argument I'm sensitive to. Then too, I keep vanilla XT and AT clones as test-beds. I certainly ought to have a standard 80386. "OK," I said.

There followed an odd comedy of errors: the next thing I knew, I had a call from BYTE in Peterborough. They said that a chap in Orange County had received several boxes of computers with my name on them shipped to his address. He had no idea why, but could he have an address or phone number? They'd come Air Express, and he was worried that I needed them for a deadline, which was in fact true.

It took a while to get that sorted out. What happened was that while I was on the phone to Lazere, I mentioned a program called System Sleuth (see my May column). Lazere jotted down the company's name and address. Then he sent a memo to his people instructing them to ship me a standard 80386 from stock. Guess what address was attached to the memo?

Eventually, the Northgate 80386 arrived, just as Roberta and I were leaving on one or another trip. When we got back, the poor machine was buried under *more* mail. Sigh. Finally I got it cleared off and invited my son Alex over to play with it.

There's this about Alex: he carries a Murphy field wherever he goes. If a computer can be crashed, he can crash it. Sometimes, he only has to be in the same room. Exhibitors at trade shows hate to see him coming.

First thing was to unpack the system. Northgate packs these machines very well, indeed. Everything was in good shape, despite the brief diversion to Orange County.

The keyboard was Northgate's newest model, advanced enough that I grabbed it off for my own workstation; I'm using it to write this now. I put my old Northgate keyboard on the new machine, and we fired it up.

So far, so good. The Northgate 80386 comes with MS-DOS 4.01. I'm not familiar with it, but I figured it hardly mattered—DOS is DOS.

When we get in new machines, we have standard procedures. First thing is to install some essential programs: the Norton Editor (for big editing jobs, I prefer BRIEF or Logitech's Point, but for an all-around general utility, you just can't beat the Norton Editor), Norton Utilities, Mace Utilities Gold, Coretest, Norton Commander, and Golden Bow's Vopt.

The next thing is to set up the machine environment the way I like it. We use the Norton Editor to set the prompt (I use 'PROMPT \$P \$T\$H\$H\$H\$G '—note the space—which displays the directory path and the time in hours, minutes, and seconds, but without the hundredths of seconds), add DEVICE=ANSI.SYS into the CONFIG.SYS file, and generally make the display a bit more informative and attractive. All that worked as expected, which was a relief; the last time I'd tried MS-DOS 4.01, the Norton Utilities wouldn't work with it. Norton has since revised the Utilities, and they work fine.

Now it was Alex's turn.

I'm an admitted DESQview user; indeed, one reason I like 80386 machines so much is the way DESQview works with them compared to 80286 machines. The trick is to use QEMM-386 properly so that a number of essential TSR programs get loaded up above the 640K-byte DOS barrier; with care, you can get DESQview windows greater than 550K

continued

"TOPSPEED IS ONE GREAT COMPILER!"

— Jerry Pournelle
 BYTE Information Exchange



"Everything about this product exudes quality...it is one of the most complete and powerful development systems available today."

Scott Robert Ladd
 Computer Language

"...TopSpeed™ is surely one of the finest new products introduced to date in the PC arena...DDJ doesn't give unqualified raves very often, but there's no question about it in this case; JPI's TopSpeed Modula-2 is first-rate."

Kent Porter
 Dr. Dobbs Journal

"JPI Modula-2 looks like another classic in the making. It generates code as good as or better than leading C compilers and the programming environment is a genuine pleasure to use."

Dick Pountain
 BYTE Magazine

In England and Europe contact:

Jensen & Partners UK Ltd., 63 Clerkenwell Road, London EC1M 5NP. Phone: (01)253-4333. DOS Compiler: £59.95, TechKit £34.95, VID £34.95. DOS 3-Pack £119.95, OS/2 Compiler £124.95.

Handling charges: In UK please phone for VAT & P&P. In Europe, add £6 for up to 3 products, £2 for each add'l product.

TopSpeed Modula-2 is a high-speed optimizing compiler (3,000-5,000 lines/min. on a PC AT 8MHz), integrated menu-driven environment with multi-window/multi-file editor, automatic *make*, fast smart linker. All Modula-2 sources to libraries included. **BONUS:** Complete high-speed window management module included with source. 258-page User's Manual and 190-page Language Tutorial.

OS/2 version now available: Runs in protected mode under OS/2 Standard or Extended Edition 1.0 or 1.1. Generates standard .OBJ files and .DLLs. Comes with fast, smart linker, built-in assembler. Modula-2 and assembly source code for libraries included (and fully compatible with DOS version). Full support of all OS/2 calls. Same integrated configurable environment as the DOS version.

VID (Visual Interactive Debugger): An integrated multi-window symbolic debugger for DOS. View source code as it executes. Single-step and trace through multiple modules. Qualify breakpoints with expressions. Examine & modify variables in symbolic form, including arrays, records & pointers. Automatic trace of variables accessed. Includes symbolic disassembler, execution profiler. 78-page manual. (DOS only)

The TechKit™ includes: Assembler source for start-up code and run-time library, JPI TopSpeed Assembler (30,000 lines/min.), TSR module, communications driver, PROM locator, dynamic overlays, and technical information. 72-page manual. (DOS only)

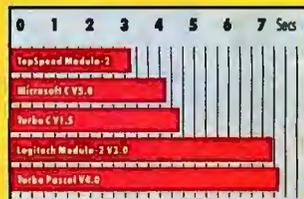
System Requirements: IBM PC or compatible, 384K available RAM, two floppy drives (hard disk recommended).



TopSpeed's seamlessly integrated environment.



VID (Visual Interactive Debugger): power without complexity.



Sieve benchmark measured by the British Standards Institution (BSI)—25 iterations on an 8MHz AT.

DOS Compiler \$99.95
TechKit \$59.95
VID \$59.95

DOS 3-Pack \$199.95
 (Compiler, TechKit & VID)

OS/2 Compiler \$195.00

To Order:

In the US, call:
1-800-543-5202

In Canada, call:
1-800-543-8452

Or mail us your order with a check, money order, or VISA/MC information. 30-day unconditional money-back guarantee.

Shipping & handling charges:

In North America: add \$5 for each product ordered. CA residents please add applicable sales tax. Overseas: Add \$20 for EACH compiler and \$8 for each other product. 3-pack s & h is \$36.00.



Jensen &
 Partners
 International

1101 San Antonio Rd.
 Suite 301
 Mountain View, CA 94043
 Phone: (415)967-3200

TopSpeed and TechKit are trademarks of Jensen & Partners International. Other brand and product names are trademarks or registered trademarks of their respective holders.



Diamond Scan 14
Auto-Tracking
800 x 600 pixels (digital, analog, monochrome)
330 x 500 pixels (composite NTSC)

Diamond Scan 20A
Auto-Tracking
800 x 600 pixels (digital, analog, monochrome)
1024 x 800 pixels (maximum)

Diamond Scan 16L
Auto-Tracking
1024 x 768 pixels (typical)
1280 x 1024 pixels (maximum)

Diamond Scan 20L
Auto-Tracking
Up to 1280 x 1024 pixels

Actual unretouched screen images
Monitors shown with optional bases

A Clear View To Monitor Quality

CHAOS MANOR

bytes and still have lots of files and buffers, a mouse driver, and either a WORM (write once, read many times) drive or CD-ROM. Alex has got this down to an art. It's an art I don't quite understand, since much of it is based on undocumented features of QEMM-386 that he's ferreted out somehow; but it's sure effective on Big Cheetah.

There was only one problem: it didn't work. QEMM-386 would not load properly. Now what, I wondered. My suspicion was that MS-DOS 4.01 was at fault, but I couldn't be sure. Alex went over to Quarterdeck, while I sent E-mail to Lazere.

That worked wonders: Lazere called Quarterdeck while Alex was there, so I got the whole story. It seems that Northgate's BIOS chips come from American Megatrends. In assembling the Northgate BIOS, they left in some identifiers that make the system believe it's a Compaq Deskpro 386. QEMM-386, meanwhile, looks into the BIOS to see if it's dealing with a Compaq. If it is, it knows that certain memory areas are available; only those areas are *not* available on the Northgate 80386.

"There's a simple remedy," Alex told me. "Use DEBUG on QEMM.SYS to find the ASCII message 'COMPAQ.' Change that to 'COMPAL' or 'COMPAT' or anything else with exactly six letters. Then everything will work."

It didn't sound all that simple to me. Sure, I could dig out the DEBUG manuals and do the job, but then I'd have two versions of QEMM-386 floating around, and sure as anything they'd get mixed up and confused. Of course, an 80386 without DESQview is a crippled 80386, and I did want to be fair. . . .

Fortunately, there was another trip coming up, so I didn't have to do anything at all. When I got back, there was a package from Northgate: new ROMs, which were now standard for future Northgate 80386s. American Megatrends had fixed the problem. All I had to do was install these two chips in the machine. I needed to look inside the machine anyway, so that didn't figure to be a problem.

The Northgate 80386 opens up like most other AT machines. I noted that the case is sturdy, and the motherboard construction is clean and neat. The boards

are thick; I've seen some clones with boards so thin they wave in the breeze. There are no extraneous jumper wires. It's assembled inside and out with good-quality screws so that the heads don't get munged up by my power screwdriver. Everything is mounted properly, and the drive cages are all sturdy. There are two serial ports and one parallel port on the motherboard. The solder joints look clean, no telltale discolorations. The power supply is 220 watts, more than enough for an 80386. The fan is strong and quiet. Definitely a solidly made machine, quality materials throughout.

The BIOS ROMs were in the middle of the motherboard, just underneath the disk drive controller board. They were labeled "high" and "low," while the new ones were labeled "odd" and "even."

It happens there was a note enclosed with them explaining that "even = low," but it had got mixed in with other papers before I saw it. I wasn't worried. Provided you get the chips installed properly in their sockets, you can't hurt them by swapping two ROMs. The machine wouldn't work with them in the wrong

Only one supplier of color monitors offers the widest selection of features and operating flexibilities in the market today.

That company is Mitsubishi Electronics.

Mitsubishi® delivers the reliability and performance that can meet your color information display requirements today as well as tomorrow. Larger screen sizes, truer colors, and optimum resolutions make your work easier—and far more productive.

Whether your requirements call for fixed-frequency graphics standards, like EGA and VGA, or multiple-frequency performance, Mitsubishi has the color monitor

with the resolution and size to fit *your* specific needs. This includes the Diamond Scan Series of 14", 16" and 20" auto-tracking monitors, some with microprocessor-enhanced programmable display settings. All at very competitive prices.

To get a clear view of monitor quality and value, look to Mitsubishi.

For product information or nearest authorized Mitsubishi Electronics sales representatives, please call 1-800-556-1234, ext. 54M. In California, call 1-800-441-2345, ext. 54M. Mitsubishi Electronics America, Inc., Computer Peripherals Division, 991 Knox Street, Torrance, CA 90502, (213) 217-5732.



XC1429C
VGA Compatible
640 x 480 pixels

XC1410C/XC1430C
EGA Compatible
640 x 350 pixels

Mitsubishi Model	Screen Size (Inches)	Horizontal Scan Frequency (kHz)	Mask Pitch (mm)	Compatibility/Resolution							
				NTSC	CGA	EGA	VGA		Apple Mac II	1024 x 768 (48 kHz)	1024 x 1024 (64 kHz)
							Std.	Ext.			
Diamond Scan 14 (AUM1381A)	14/13V	15.7 ~ 36 auto-tracking	0.31	•	•	•	•	•	•		
Diamond Scan 16L* (HL6605TK)	16/15V	30 ~ 64 auto-tracking	0.31				•	•	•	•	•
Diamond Scan 20A (HA3905ADK)	20/19V	15.7 ~ 36 auto-tracking	0.31		•	•	•	•	•		
Diamond Scan 20L* (HL6905TK)	20/19V	30 ~ 64 auto-tracking	0.31				•	•	•	•	•
XC1429C	14/13V	31.5	0.28				•				
XC1410C	14/13V	22 or 15.75	0.40		•	•					
XC1430C	14/13V	22 or 15.75	0.31		•	•					

*Microprocessor-enhanced programmable display settings



And Value.

© 1988 Mitsubishi Electronics America, Inc.
Mitsubishi is a registered trademark of Mitsubishi Electric Corp., Tokyo.

Screen images produced with permission from the following companies (trademarked software package name follows company name): Autodesk, Inc. (AutoShade); ComputerVision Corporation (Personal Designer); Computer Friends, Inc. (Modern Artist); SuperMac Software (PixelPaint); Three D Graphics, Inc. (Perspective); Microsoft Corporation (Excel Version 2.0).

CHAOS MANOR

sockets, but nothing would be harmed.

I got out the chip extractor. Mine is labeled "Burndy," and I probably got it at Radio Shack. It sure beats using a screwdriver. There was only one problem. One of the chips came out smoothly and easily, but the other is mounted extremely close to one of the bus sockets. It's so close that the chip extractor can't get a proper grip, and for that matter, you can't even get a screwdriver under the end of the chip closest to the bus. Eventually, I pulled the chip out, but in doing it I broke off a pin.

Nothing for it now: either the new BIOS chips worked, or this machine was dead. I got out another chip tool, bent the pins to the proper angle—all chips apparently come with the pins spread out too far for insertion—and stuck them in. On with the power switch.

The machine came right up. QEMM-386 loaded properly. All of Alex's strange little tricks to pack high memory worked fine. We were in business.

Video

The Northgate 80386 comes with a 16-bit VGA board and a Princeton Graphic Sys-

tems' Ultra-14 monitor. The video is *fast*, considerably faster than what I'm at present getting from either Big Cheetah or the Zenith Z-386. The colors are bright. I somewhat prefer the Zenith ZCM-1490 Flat Technology Monitor—which works quite well with the Northgate 80386's VGA board—but there's really very little difference. It's hard to complain about the video output of the Northgate 80386.

I don't really have a way to measure it, but compared to the Z-386 with an 8-bit Video Seven VGA board or Big Cheetah with a vanilla VGA, the Northgate 80386 is noticeably faster on graphics images. Empire, which is all graphics, is almost twice as fast on the Northgate 80386 as on my other machines. So is Windows, once you get that working.

TrackerMouse

One of the things I saw at Comdex in Chicago was TrackerMouse from Penny and Giles Computer Products. This isn't really a mouse; it's a small trackball device set onto a stand that includes, of all things, a small solar-powered calculator. Why a calculator in your mouse? Why

not? It costs little more to add it, and it's often very convenient to have a calculator handy.

However, the real feature of TrackerMouse is that it's small: the trackball is more the size of an extra-large marble than the orange-size things you generally see. The case, calculator and all, is low profile, standing not much higher off the table than your keyboard.

The end of the TrackerMouse cable is a 9-pin plug suitable for AT serial ports, but just in case you've got a machine with DB-25 connectors, the company supplies an adapter. All quite elegant.

Installing TrackerMouse is simple: just plug it into a serial port and transfer the software to your hard disk. The driver goes in CONFIG.SYS. TrackerMouse is supposed to emulate a Microsoft Mouse, and in general it does, but see below.

Using TrackerMouse is an odd experience. The buttons—two of them—are on each side of this calculator-size box. Thus, you tend to use your thumb for the left button, middle finger for the right button, and forefinger for manipulating

continued

ITEMS DISCUSSED

Annals of Rome \$34.95 The Software Toolworks 19808 Nordhoff Place Chatsworth, CA 91311 (818) 885-9000 Inquiry 1031.	MacInTax\$119 TaxView\$119 SoftView, Inc. 4820 Adohr Lane, Suite F Camarillo, CA 93010 (805) 388-2626 Inquiry 1036.
APX-4200 \$4450 Maximum Storage, Inc. 5025 Centennial Blvd. Colorado Springs, CO 80919 (719) 531-6888 Inquiry 1032.	Northgate 80386 \$4248 Northgate Computer Systems, Inc. 13895 Industrial Park Blvd., Suite 110 Plymouth, MN 55441 (800) 548-1993 Inquiry 1037.
Chaos in the Classroom \$49.95 site license..... \$100 Dynamical Systems, Inc. P.O. Box 35241 Tucson, AZ 85740 (602) 825-1331 Inquiry 1033.	QuickBASIC 4.5 \$99 Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073 (800) 426-9400 (206) 882-8080 Inquiry 1038.
DESQview/386\$189.90 Quarterdeck Office Systems 150 Pico Blvd. Santa Monica, CA 90405 (213) 392-9851 Inquiry 1034.	SIMNON\$695 Engineering Software Concepts 436 Palo Alto Ave. Palo Alto, CA 94301 (415) 325-4321 Inquiry 1039.
Empire \$49.95 Interstel P.O. Box 57825 Webster, TX 77598 (713) 486-4163 Inquiry 1035.	TrackerMouse\$169 Penny and Giles Computer Products, Ltd. 35 Reynolds St. Attleboro, MA 02703 (508) 226-3008 Inquiry 1040.

the "thumbball." I think I'd find it simpler to put both buttons on one side of the TrackerMouse box, so that the thumb would be used for guidance; but I'm not sure.

I experimented with TrackerMouse for about an hour, testing it with various programs; eventually, I fired up Empire, since it's completely mouse-driven. You can play Empire without a mouse, but it's sure not easy. Anyway, because it's mouse-intensive, it's as good a way to practice using a mouse as any.

I didn't have any problems; indeed, it was simple enough to use that I'm seriously thinking of stowing TrackerMouse in the kit with my Zenith SupersPort 286 portable; I don't often need a mouse on the road, but then I haven't really thought about it much. TrackerMouse should work just fine, once I transfer the driver to a 3½-inch disk.

I don't think I'm tempted to change to TrackerMouse for everyday use. It does get easier to use with practice, though, and it takes less room than a normal rodent. If you're a mouse hater in a world that's increasingly moving to mice, you might want to investigate trackballs, and this is a pretty good one.

Compatibility

Back in the early days, you tested system compatibility with Flight Simulator; if that ran, almost anything would. Nowadays, the acid test is Windows.

I didn't want to install full Microsoft Windows on the Northgate 80386 because I'm not sure I have the latest version; but I had something nearly as good: TaxView with the Windows run-time package.

Installing Windows, whether the real thing or just the run-time package, is te-

dious. There are five 1.2-megabyte disks; you insert the first one, log onto the floppy disk drive, and type INSTALL. After that, the program guides you through screen after screen and disk after disk. The whole process seems to take forever.

I went through it the first time, letting Windows think TrackerMouse was a Microsoft Mouse. There didn't seem to be any glitches until the installation was over; then the program informed me that it was improperly installed and died. There were no other error messages, and my only remedy was to start over.

I did. This time, I told the Windows INSTALL program that I had a strange mouse. The program asked for the disk containing the MOUSE.SYS driver. I put that in. Windows trundled awhile, then asked for its own disks back and continued with no problems. Ten minutes later it was done, and it wouldn't work. No error messages, just "It don't work, Turkey!" (Actually, it says "Windows Improperly Installed!," forces you to click on "OK," and dies, but the effect is the same.)

I now had a genuine quandary: was it the mouse, the Northgate 80386, or MS-DOS 4.01 that was causing the problem? It was simpler to change mice than operating systems. Since I'd recently received an update of Microsoft's MOUSE.SYS (many previous versions do *not* work with Windows), it seemed reasonable to install a Microsoft Mouse and have done with it. Then I started the installation process all over again.

Ten minutes later I was done, and this time it worked. There was TaxView in all its glory, and with the Northgate's 16-bit VGA video driver, it was *fast*—blindingly fast compared to Big Cheetah with his 8-bit VGA.

I make no doubt that the Logitech Mouse would have worked as well (since that's what I have on Big Cheetah); but the Penny and Giles MOUSE.SYS needs some revision before it will work with Windows.

First Report

Next thing was to test the Northgate 80386 for speed. I'm not a big fan of benchmarks, which I think are misleading; but people do like numbers. The Northgate 80386 has a Norton SI of 17, meaning that it's supposed to be 17 times as fast as a standard IBM PC XT. For the hard disk drive, the Coretest throughput index is 6.5, which compares favorably with any machine I have except Big Cheetah with his Distributed Processing

continued

COMPUTER DISCOUNT WAREHOUSE™



ZENITH data systems
Supersport 88, 2 drive
Supersport 88, 20 Meg
Supersport 286, 20 Meg
Supersport 286, 40 Meg
TurboSport 386, 40 Meg
TurboSport 386, 40 Meg w/modem



EPSON
EX800 LQ500
FX1050 LQ510
LX800 LQ850 LQ1050
LX10 LQ950 LQ2550

CDW™ has the lowest prices on all EPSON products.

WHY PAY RETAIL?

CDW™ Sells For Less

AND SERVICES YOU MORE

S-330 4.77/10 MHz, 640K, 6 Slots, Built-in CGA, DOS 3.3, Enhanced Keyboard
S-330, 1 Floppy \$745.50
S-330, 20 Meg/40 Meg \$94.95/1019.52
S-550 AT Compatible 8/12 MHz, 8 Slots, 25/PC, Built-in EGA, DOS 3.3, Enh. Keyboard
S-550, 1.2M Floppy \$1220.45
S-550, 20 Meg/40 Meg \$1569.80/1695.45
S-800, 386 20 MHz, 8 Slots, 1 Meg, 1.2 & 720 Floppies \$2570.69
S-800, 40 Meg/80 Meg \$2990.01/3280.00
S-800, 80 Meg (28 me) \$3050.50



SAMSUNG
ML 182 Turbo NEW ML 321 \$478.25
ML 172 OKIte ML 390 \$75.80
ML 182IBM \$222.50 ML 391 \$36.48
LASERLINE 6 \$282.69 ML 393 \$69.99
ML 320 \$39.63 ML 393 Color \$167.50



OKIDATA
ML 182 Turbo NEW ML 321 \$478.25
ML 172 OKIte ML 390 \$75.80
ML 182IBM \$222.50 ML 391 \$36.48
LASERLINE 6 \$282.69 ML 393 \$69.99
ML 320 \$39.63 ML 393 Color \$167.50

HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

COMPUTERS
AST SPECIALS
MDL 80 CALL CDW™ MDL 340C IN STOCK
MDL 140 FOR ALL MDL 390C & READY
MDL 170 AST MDL 3150C TO SHIP
MDL 300C PRICING

IBM PS2
MDL 30, 20 Meg \$1655.17 MDL 50Z, 60 Meg \$2756.70
MDL 60, 40 Meg \$3401.15 MDL 70, 60 Meg \$3471.20
MDL 60, 70 Meg \$3644.32 MDL 70, 121 Meg \$2529.84
MDL 80, 111 Meg \$4937.83 MDL 80, 40 Meg \$4374.40
MDL 30286, 1 dr \$142.10 MDL 80, 70 Meg \$6069.37
MDL 30286, 20 Meg \$1929.50 MDL 80, 315 Meg \$2641.19
MDL 50Z, 30 Meg \$2889.60

COMPAQ™
286, Mdl 1 \$1699.55 386-20E, 40 Meg \$4565.12
286, NEW 386-20E, 100 Meg \$5564.22
386, 25 MHz, 130 \$718.33 Port. II, Mdl 2 \$1958.10
386, 25 MHz, 60 \$683.90 Port. II, Mdl 4 \$2697.42
386S, Mdl 1 \$2324.49 Port. III, Mdl 20 \$3495.85
386S, Mdl 20 \$2783.12 Port. III, Mdl 40 \$3998.35
386S, Mdl 40 \$3992.84 Port. 386 Mdl 40 \$4262.24
386, 25 MHz, Mdl 110 \$6995.95 Port. 386 Mdl 100 \$6689.74
386, 25 MHz, Mdl 300 \$8898.99

LASER TURBO
XT 1/20 \$699.19 XT w/40 Meg \$1095.74
XT w/20 Meg \$999.25 XT w/70 Meg \$1395.36

TOSHIBA
T1000 \$799.55 T3000 \$3497.20
T1200, 2 Drive \$175.55 T5100 \$4885.88
T1200, 20 Meg \$2362.22 T5200, 40 Meg \$2189.60
T3100e \$2742.32 T5200, 100 Meg \$7195.17

WYSE
MDL 2108 \$895.50 MDL 2214 \$1921.30
MDL 2112 \$271.20 MDL 3216 \$2060.37

WORKSTATIONS
AST 105X ALL AST
AST 386SX Model 5/ Model 4S WORKSTATIONS
AST Bravo IN STOCK
EARTHSTATION V40 or 286, Arcnet or Ethernet CALL

DRIVES, TAPES & CARDS
FLOPPIES, DRIVES & TAPES
CONNER 40 Meg / 110 Meg \$572.34 / \$955.80
GENDA 60 Meg int. tape / ext. tape \$689.60 / \$1919.10
GENDA 150 Meg int. tape \$1078.85
OMEGA 20 + 20 External 8" \$658.22
OMEGA 8120X \$929.80
OMEGA 8220X, External 5 1/4" \$1619.40
IRWIN 20 M/40 M Internal Tapes \$399.10 / \$539.20
MOUNTAIN 4440 int. / ext. \$385.80 / \$557.75
MOUNTAIN 150M Filisafe \$398.39
PLUS Passport 20 / 40 \$476.10 / \$479.78
PLUS 2 & 40 System Kit \$489.75
PLUS PS2 MC System Kit \$585.58
PRIMA 40 Meg / 80 Meg \$669.57 / \$749.95
SYSTEM 5 1/4 Ext. Floppy \$225.25
WELTEC 5 1/4 External Floppy \$207.77

MINISCRIBE
MIN-8425 \$239.40 MIN-3085 \$729.40
MIN-8438 \$293.85 MIN-6085 \$592.52
MIN-3053 \$469.52 MIN-9380 \$859.58

SEAGATE
SEAGATE 20 Meg \$269.58 SEAGATE ST-251-0 \$369.30
SEAGATE 30 Meg \$287.32 SEAGATE ST-251-1 \$399.23
SEAGATE 4096 80 \$599.95

STORAGE DIMENSION
AT-155E \$1995.52 AT-650E \$4580.80
AT-655E \$2725.26

HARD DRIVE CARDS
PLUS DEVELOPMENT 20 Meg \$539.28
PLUS DEVELOPMENT 40 Meg \$779.80
WESTERN DIGITAL 30 Meg \$399.37

PRINTERS
EPSON
LX800/LX810J CALL LQ500/LQ510 ALL EPSON
EX800 CDW™ LQ850/LQ950 MODELS
FX850 FOR BEST LQ1050 READY
FX1050 PRICE OVER LQ2550 TO SHIP
CDW™ stocks all cut sheet feeders and ribbons

IBM
Pro Printer III \$499.95 Quickwriter III \$295.62
Pro Printer IV XL \$533.68 Pro Printer III XL24E \$311.62

brother
M-1724L \$579.64 M-1709 \$384.47
HR20 \$440.50 HR40 \$25.12

OKIDATA
ML 182 Turbo NEW ML 321 \$478.25
ML 172 OKIte ML 390 \$75.80
ML 182IBM \$232.50 ML 391 \$36.48
LASERLINE 6 \$282.69 ML 393 \$69.99
ML 320 \$39.63 ML 393 Color \$167.50

PANASONIC
1124 \$351.76 1592 \$412.44
1595 \$453.45 3131 \$318.30
1180 \$193.95 1524 \$582.10
1191 \$44.12 CALL FOR ACCESSORIES

CITIZEN
1200 \$190.55 1800 \$174.11
MSP45 \$386.58 MSP55 \$244.30
MSP50 \$304.10 Premiere 35 \$15.17

ALPS
Allegro 24 \$342.50

LASER PRINTERS
BROTHER HL-86 \$1869.90
H-P Laser Jet Model 2 / 110 \$719.40 / \$2835.95
H-P Deskjet \$599.90
NEC LC890 \$895.60
PACIFIC DATA 25 in 1 cartridge \$296.86

INTEL BOARDS & COPROCESSORS
INTEL Inboard 386PC \$569.53
INTEL Visual Edge \$448.39
INTEL Connect Co-processor \$122.43
INTEL 8087-2 / 8087-3 \$149.80 / \$112.20
INTEL 80287-6 / -8 \$154.30 / \$235.55
INTEL 80287-10 \$236.56
INTEL 80387-16 / 80387-27 \$399.69 / \$455.65
INTEL 80387-25 / 80387-8X \$639.92 / \$390.82
INTEL 80387-33 \$75.20
INTEL 80386-A \$395.50

TERMINALS
WYSE 50, Amber or Green \$373.40
WYSE 60, Amber or Green \$306.16
WYSE 85 / 90 Amber \$759.90 / \$94.10
WYSE 99CT \$94.82

PLOTTERS, DIGITIZERS & SCANNERS
CALCOMP
1023 \$3745.38 12 x 12 \$358.12
1043 \$477.15 12 x 18 \$719.10
1044 \$915.06 36 x 48 \$2326.15

KURTA
1212S1 \$349.06 36x48 \$2891.51
12x17 \$499.35 4 Button Cursor \$75.90

SUMMASKETCH
12x12 \$383.30 12x18 \$599.50

HEWLETT PACKARD
HP7440A \$968.30
HP7475A \$1389.89
HP7550 \$2926.56
HP7570 LOWEST PRICE
HP7576-EXL \$4546.40
HP SCANJET SAVE

HOUSTON INSTRUMENTS
HI DMP-52 / DMP-52MP
HI DMP-56A
HI DMP-61
HI DMP-62
Image Maker

SHARP FO-220 \$854.48 TOSHIBA FO-310 IN STOCK
SHARP FO-300 \$1199.10 TOSHIBA 300 \$1199.44

NOVELL NETWORKING
SOFTWARE & STARTER KITS
Entry-level 286 Starter Kit, 4 Users \$429.90
Entry-level 286 Starter Kit, 8 Users \$89.89
NOVELL 286 Software V. 2.15 \$1839.65
NOVELL SFT Netware V2.15 \$2486.60
NOVELL NETPRO \$1120.50

INTERFACE CARDS
3COM ETHERLINK \$417.29
ARCNET PC110 LANboard PS2 \$39.40
ARCNET PC120 LANboard \$169.27
ARCNET PC220 LANboard \$199.50
ARCNET SMC 16-Bit File Server Bd. \$437.85
ARCNET SMC 16-Bit Workstation Bd. \$59.25
ETHERNET Interface Connector (NE1000) \$38.00
ETHERNET Plus Board (for 286) (NP600) \$335.35
G-NET Interface Card w/cable \$288.52
NOVELL NE2000 \$394.15
THOMAS CONRAD 6042 \$29.22
THOMAS CONRAD 6045 \$299.88
WESTERN DIGITAL Ethernet Cards \$249.19

ACCESSORIES
ARCNET Passive Hub \$74.00
ARCNET Active Hub \$95.10
ARCNET SMC Turbo Kit \$89.95
ARCNET SMC Active Link \$84.70
Ethernet Terminators \$9.50
Novell trained and authorized sales and support.
See WORKSTATIONS under Computers

MODEMS & COMMUNICATIONS
COMPLETE Fax 9600 \$399.50
EVEREX 1200B \$79.90
EVEREX 2400B \$84.75
EVEREX 2400 Ext / 2400 PS2 \$99.90 / \$99.40
MEGAHERTZ 2400C \$229.20
PACKARD BELL 2400 Int / 2400 Ext \$89.90 / \$109.22

Hayes
HAYES 1200 \$269.20 2400B \$370.45
1200B \$269.20 2400PS2 \$307.15
2400 \$165.89

Robotic
Counter 1200 \$174.80 1200 External \$129.10
Counter 2400 \$279.60 2400S \$199.70
1200B \$108.45 9600 HST \$645.20

BATTERY BACKUP & SURGE
AMERICAN
AME-1200VX \$529.45 AME-520EX \$449.48
AME-3300T \$279.72 AME-800RT \$699.19
AME-450AT \$95.82

DATASHIELD
500 Watt \$560.05 S3700 + \$669.80
800 Watt \$634.56 1200 Watt \$94.76
S100 \$99.85 6 Outlet Surge \$27.85

DURANT TECHNOLOGIES
BPS-300 \$324.10 BPS-550 \$506.02
BPS-500 \$77.31 BPS-1200 \$716.66

MHZ MEGAHERTZ CORPORATION
2400 for ZENITH \$107.16 1200 for COMPAQ S1T \$258.80
2400 for NEC \$25.68 2400 for TOSHIBA \$83.74

TRIPPLITE
BC-450 \$367.50 4 outlet \$44.25
BC-1200 \$95.85 LC-1200 \$64.85
BC-2000 \$179.80 LC-1800 \$36.80

MISC. & ACCESSORIES
A-B Switching Box (par or serial) \$30.85
800 & Par or 10 DSD/DD wireless \$30.00
INTELLICOM Long Link \$29.70
KENSINGTON Masterpiece \$99.99
KENSINGTON Masterpiece Plus \$23.40
KEYTRONICS 5151 IBM or AT&T \$149.95
KEYTRONICS 101 \$79.95
5TH GEN Logical Connection 256K / 512K \$47.72 / \$154.38
Electronic 4-Way Switchbox \$4.85
XT Power Supply 150 Watt \$9.00

SOFTWARE
WORDPERFECT 5.0 5 1/4 / 3 1/2 \$229.90 / \$38.90
ASHTON TATE dBase III+ / dBase IV \$24.00 / \$78.10
ASHTON TATE Multimate Advantage II \$28.12
LOTUS 1-2-3 5 1/4 / 3 1/2 \$299.95 / \$95.95
ANSI Paradox 3.0 \$39.17
BORLAND Quattro / Side Kick \$149.50 / \$31.50
MICROSOFT EXCEL / WINDOWS 386 \$262.50 / \$29.00
MERIDIAN Carbon Copy \$119.57
SYMANTEC Q&A \$217.40
XEROX Ventura Software Version 2.0 \$478.00

MONO MONITORS & CARDS
CDW™ color / mono cards w/p \$99.00 / \$93.00
HERCULES color / mono cards w/p \$46.14 / \$79.84
AT&T Monochrome Monitor \$90.48
AMDEK 410A / 1208 \$48.99 / \$78.76
COMPAQ Mono / VGA Mono \$77.90 / \$38.95
IBM PS2 8502 \$109.95
GOLDSTAR Amber \$4.10
NEC Monograph \$227.25
PGS MAX 12E / MAX 16 \$126.40 / \$28.70
PACKARD BELL Green or Amber \$8.95

COLOR GRAPHIC MONITORS
IBM PS2 8512 / 8513 \$439.40 / \$29.28
SAMSUNG RGB Color \$238.00
TAXAN 720 \$272.30
MAGNAVOX 8762 \$299.05

VGA & EGA PRODUCTS
VGA & EGA MONITORS
COMPAQ VGA monitor \$548.68
MAGNAVOX 9436GA / 9436MG \$65.40 / \$72.52
MITSUBISHI 1409 / 1410 \$282.44 / \$385.50
MITSUBISHI 1331 Diamond Scan \$179.20
NEC Multisync II / PLUS \$59.76 / \$48.10
NEC Multisync XL 19 inch \$208.40
NEC Multisync 2A / Multisync 30 \$57.20 / \$95.85
PACKARD BELL 8541 VGA \$36.20
PACKARD BELL 8524 Enhanced VGA \$69.95
PACKARD BELL 8526 Multisync \$77.40
PS2 Ultramagic 12 \$63.53
PSS Ultramagic 14 / 18 \$19.66 / \$87.77
SONY Multisync 1302 / 1303 \$19.85 / \$48.82
ZENITH 21490 \$27.80

VGA DISPLAY CARDS
ATI VGA Wonder 256 \$289.89
ATI VGA VIP \$28.24
GENOA 5200 / 6300 \$330.95 / \$293.20
RENAISSANCE RIVA II / VGA I \$289.89 / \$119.05
PARADISE VGA / VGA + 16 \$262.88 / \$296.33
VIDEO-7 VGA \$29.15
VIDEO 7 Fast Writer / VRAM VGA \$72.15 / \$84.25

CAD MONITORS & CARDS
MITSUBISHI 6905, 19 inch \$3229.90
MITSUBISHI 3905180K \$1835.62
MITSUBISHI 3905180K \$64.85
SIGMA LaserView \$687.18
VERMONT Cobra \$297.76
METHUES 1104 \$639.80

MICE
LOGITECH C9 Serial / PS2 \$89.95
LOGITECH BUS \$49.99
MICROSOFT Mouse (Bus Version) \$109.34
MICROSOFT Mouse (Serial Version) \$17.25
MICROSOFT MOUSE windows \$38.27
MOUSE SYSTEMS (Serial Version) \$9.95
MOUSE SYSTEMS (Bus Version) \$108.77

MOST ORDERS RECEIVED BY 4:00 P.M. C.D.T. SHIP SAME DAY. **HIGH VOLUME BIDS INVITED** 2840 Maria Avenue, Northbrook, IL 60062 FAX-A-BID (312) 291-1737 **If you find a better price call us before you buy.**

WHY WAIT? CALL COMPUTER DISCOUNT WAREHOUSE™ NOW!
Open terms available to approved credit
(800) 233-4426

SPECIAL EXTENDED HOURS
Sales 7:30-7:30 CDT Mon-Fri.
9:00-3:30 CDT Sat.
Tech. Support 9:00-5:00 CDT Mon-Fri.

In Illinois FAX **(312) 498-1426 (312) 291-1737**
Credit Card charges are not permitted until time of shipment. Shipping and handling additional. Do not hold other orders and orders under \$200.00 please add \$5.00 handling fee. Non-defective returns subject to restocking fee. All prices reflect 3% discount for cash. All 10 business days for shipping when paying by personal check. Software, chips and other electronic components are not returnable. All pricing subject to change. IBM - Registered trademarks of IBM and COMPAQ



Technology controller and Priam hard disk drive, which is a bit like comparing a Chrysler LeBaron with a Ferrari.

I tend to use criteria like "slow," "good enough," and "wow!" rather than numbers anyway; and I rate the Northgate 80386 as better than good enough on CPU and disk speed and wow! on video speed.

When Northgate first started shipping machines, I had reports of some problems with quality control; but I haven't

seen any of those for months. I have good reason to believe the early problems were caused by the rapid growth of the company. Meanwhile, let me repeat that I am impressed with this machine's construction. Of course, I expect any machine sent to me will work—although some haven't—but I also have reports from other people who have Northgate computers, and they're happy.

I still recommend that utter novices will be better off going through a reliable

dealer rather than ordering by mail, but I have to add that reliable dealers aren't all that easy to find; and there sure wasn't any installation required for this system. I just turned it on, and it came up in MS-DOS 4.01.

I'll hang onto the Northgate 80386 for a while and let you know how it wears; but my preliminary report is that I like this machine a lot. The configuration I have is the 80386 computer running at 16 MHz with 4 megabytes of RAM, two serial ports, and one parallel port; a 70-megabyte hard disk drive with MS-DOS 4.01 installed to segment the drive into 5-megabyte and 65-megabyte logical drives; two floppy disk drives, one 1.2-megabyte 5¼-inch and one 720K-byte 3½-inch; a 16-bit VGA card; the Ultra-14 monitor; tons of documentation; and the wonderful Northgate Omni Key/102 keyboard. This is a very good configuration.

If you ever run out of hard disk drive space, there's room for a second drive inside the case. The workmanship is superior. Changing BIOS ROMs is close work because of the way the sockets are situated, but clearly I was able to do it all right.

All in all, the Northgate 80386 looks like one of the best deals in town. It would certainly do as the only machine I had if I were in another line of business. More as we use it more.

Objects!!!

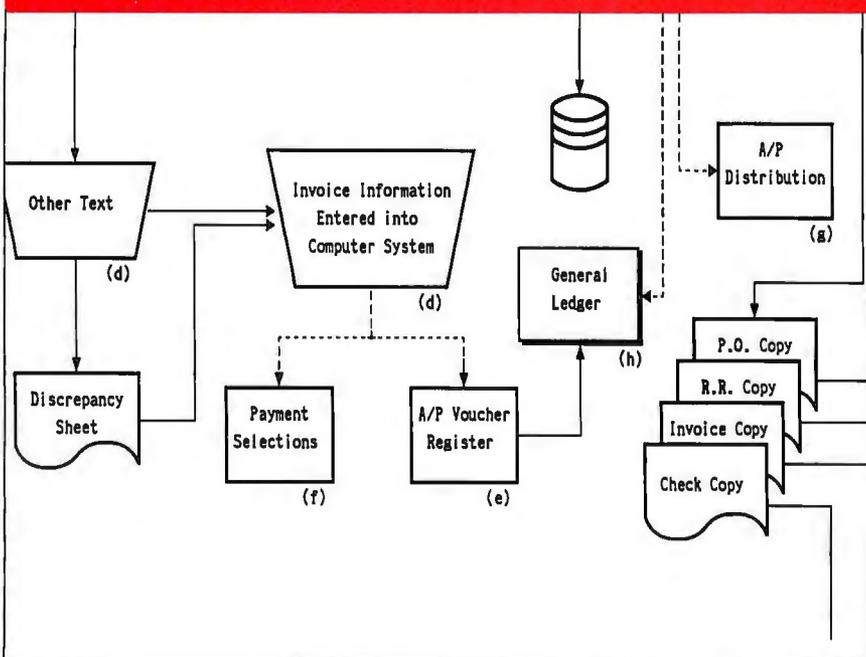
The most exciting thing this month just came in: a beta copy of Borland International's Turbo Pascal 5.5. It has *objects*, and Borland swears that by the time you read this it will be shipping.

Objects, for those who have been hiding out in the North Woods for the past year, are all the rage as programming tools. The notion is that you build a complex structure—say, a window with colors, graphics, text, and dialog boxes—and define it as an object, after which you can manipulate it as you would any other data structure in your program.

In the Turbo Pascal 5.5 implementation, objects are similar to records, but they can contain procedures. The new compiler has syntax for object construction and destruction (thus releasing all their memory) and various ways to manipulate the objects. I've had almost no time to run this, but I like it enough already that I am seriously contemplating converting Mrs. Pournelle's Reading Program to Turbo Pascal 5.5; it certainly would be easier to modify and maintain.

continued

ARE YOU STILL DRAWING FLOWCHARTS BY HAND?



FLOW CHARTING II+

Flow Charting II+ will *amaze* you with its speed, power and simplicity.

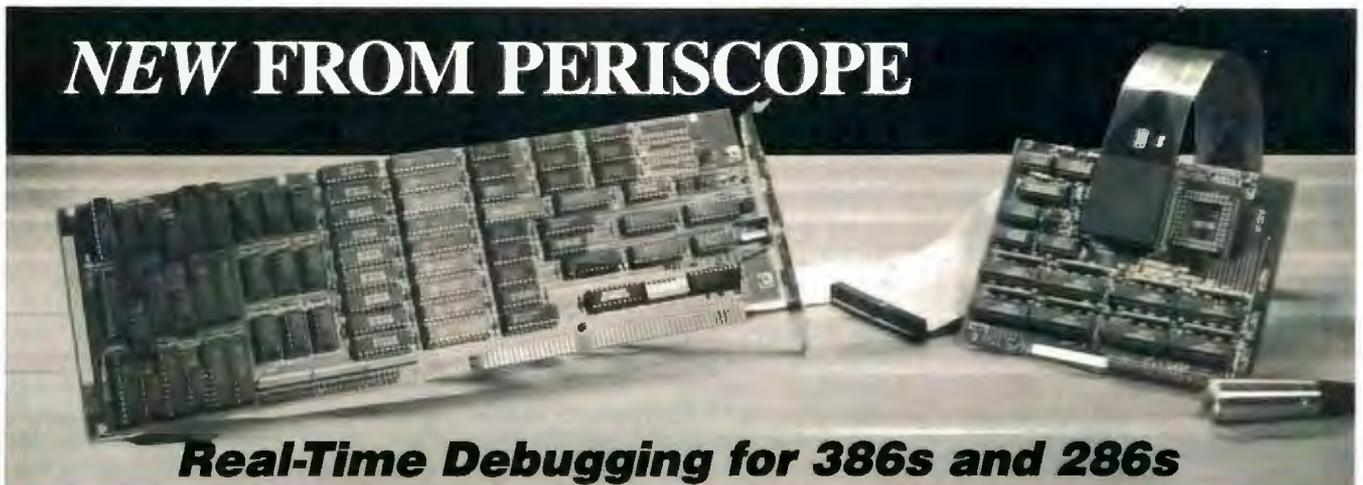
- Update and print charts as fast as the situation changes
- See your revisions right away—no long wait for charts to be hand drawn
- Select 26 standard shapes; 10 text fonts
- Tutorial manual makes learning easy
- Runs on IBM or compatibles
- Produces excellent organizational charts!
- Only \$229!

PATTON & PATTON

Software Corporation
Excellence in charting the flow of ideas

For more information, see your local retailer or call
 1-800-525-0082, ext. 47 (outside Calif.) 408-629-5376 (Calif./Int'l.)
 81 Great Oaks Blvd., San Jose, CA 95119

NEW FROM PERISCOPE



Real-Time Debugging for 386s and 286s

User Jeff Garbers, Crosstalk Communications' Director of Software Development, has been debugging with Periscope® Model IV and says, "The hardware really makes Periscope shine, especially when you've got timing-related problems. I can now track down changing pointers and altered buffers on my 386. I've been using it to debug Crosstalk® Mk. 4 and there's just no better way to do it."

Periscope IV gives you the ability to debug time-sensitive programs, hardware-interrupt routines, and programs with intermittent errors. You can run your program at full speed while tracking down unwanted memory overwrites. You can use the information captured in Periscope IV's real-time trace buffer to see EXACTLY what the system is doing, and to improve its performance.

Periscope manual, disk, quick-reference card, and 512K Plus board that provides write-protected RAM for Periscope Models I, III, and IV.



A New Generation of Hardware-Assisted Debugging

Compatible with virtually any 286 or 386 with an AT-style bus, Periscope IV works on machines running up to 25MHz with any number of wait states. Because it gets information directly from the CPU, instead of from the system bus, Model IV is not sensitive to bus compatibility issues.

Periscope IV collects CPU information in its hardware trace buffer while the CPU runs at full speed. Whether you tell Periscope IV to capture just selected information or to capture everything, you can use its powerful trace buffer commands to search for and display the execution history the way you need to see it. And you can use the CPU cycle count information to get the last bit of performance out of your code.

With Periscope IV you can set hardware breakpoints on memory accesses (within the first 16MB), I/O ports, and data. You can also set breakpoints on the occurrence of specific sequences of events, such as "watch for the routine FOO to begin executing, then while it is, watch for the variable BAR to be written." This capability, called sequential triggering, enables you to define complex conditions, then stop your program and examine what has happened when these conditions occur.

If you're developing a large application that needs all of the lower 640K, you can use the optional Plus board to keep Periscope totally out of normal DOS memory. The Plus board requires the use of a second slot.

The Periscope IV software is an extension of the software that comes with all models of Periscope. So, along with Periscope IV's powerful hardware, you get a full-function software debugger with source and symbol support for most popular PC compilers and linkers, Microsoft® Windows support, PLINK overlay support, dual monitor support, support for debugging device drivers and TSRs as well as regular programs, DOS independence, crash recovery, ease-of-use, and much more.

Prices on Periscope range from \$145 for software-only Model II-X to \$2,995 for a 25MHz 386 hardware-assisted Model IV. Call 800/722-7006 for pricing details, free information, to talk about your debugging needs, or to order your Periscope.

**Order Your Periscope, Toll-Free,
Today! 800-722-7006**

MAJOR CREDIT CARDS AND QUALIFIED
COMPANY PURCHASE ORDERS ACCEPTED



"No matter what your debugging needs, a single call to the Periscope Company has always sufficed..."

Ross Greenberg
"Best of 1988" (Development Tools)
PC Magazine, January 17, 1989

The
Periscope
Company, Inc.

1197 PEACHTREE ST.
PLAZA LEVEL
ATLANTA, GA 30361
404/875-8080
FAX 404/872-1973

Debug Your Program BEFORE You Write It!

"Deep bugs", the kind that show up after you ship the product, are usually the result of logic flaws. Such bugs include redundancies, contradictions, unique conditions without specified actions, etc.

Logic Gem, a proven programmer's tool, helps you avoid these bugs in three ways:

- ◆ Catches logical errors before you code the program. Saves hours of debugging time.
- ◆ Automatically produces written documentation of your logic, which assures good communications between designer and coder. (And helps remind you of the logic from one work session to the next.)
- ◆ Automatically produces flawless code for the "guts" of your program... in C, BASIC, Pascal, FORTRAN, and dBASE.

Logic Gem works with whatever compiler you are using. The only change: with **Logic Gem** you catch and correct the logic bugs before you write the program.

Jerry Pournelle says (Chaos Manor, BYTE, March 1989), "*It has already saved me several hours, and I haven't had it a week. Highly recommended.*"

Avoid hours and days of needless debugging time. Call 1-800-722-7853 now for details about **Logic Gem**. Or put **Logic Gem** to work for you immediately: Order a copy (it costs only \$195) and use it for 90 days at our risk. You can return it for any reason within 90 days for a complete refund.



Sterling Castle, Inc.
702 Washington Street
Suite 174
Marina del Rey, CA 90292
1-800-722-7853
1-800-323-6406 (in CA)

Prediction: object-oriented Pascal will be *the* language development of the year. Second prediction: the first prediction is an understatement.

Big WORMs

The other important development I don't have much room for is Maximum Storage's newest APX-4200 monster WORM drive, which now stores some 380 megabytes on each side of a WORM disk cartridge. The new drive reads all your old WORM cartridges. If it sees that the cartridge has been initialized in the old format, it writes to it that way.

Because of all the traveling I've been doing, I've had little chance to wring out the new WORM, so this won't be the last report on it. I do want to emphasize that in almost a year of working with Maximum Storage WORM drives, I have yet to lose one bit of data, and several times they've really saved my bacon, like the time when the Project X software completely munged my hard disk drive file allocation tables.

I haven't tested the new WORM software with MS-DOS 4.01; last time I tried, it wouldn't work. I'm willing to bet that by the time you read this, Maximum Storage will have fixed that problem. Meanwhile, I remain a real WORM enthusiast, and it's sure nice to have 380 megabytes a side on those cartridges. The doubled data density has also speeded up the WORM something wonderful.

If you're in the software development business and you don't have a WORM, you really ought to rethink your situation. WORMs are better than streaming tape because WORM drives get *used*, and this is especially true now that QEMM.SYS can load the WORM drivers into high memory (on an 80386) so that the WORM drive is available in every DESQview window.

Winding Down

Tomorrow I'm off to the Lowell Observatory for the annual board meeting. I'll get to see how they're using the big 80386 that Cheetah International assembled from parts donated by Maximum Storage, Intel, Logitech, Priam, and Cheetah itself. Then I catch a plane to New York for a United Nations symposium on the future. Given the excitement over the Fleischmann and Pons cold-fusion experiments, that ought to be quite a discussion.

As usual, there's a huge mound of stuff I haven't been able to get at, including a pile of CD-ROMs we collected at the annual Microsoft CD-ROM confer-

ence. There are now hundreds of CD-ROMs available, with over a hundred of general interest. For a good catalog of what's available, contact the Bureau of Electronic Publishing, P.O. Box 43131, Upper Montclair, NJ 07043, (201) 746-3031. Despite the official-looking logo, this outfit has less relationship with the government than did my mad friend Gary, who 40 years ago camped out on the grounds of what would become the UN and issued his Citizen of the World passports (still accepted in India and Ceylon, by the way; Gary wasn't *that* mad). If you're interested in CD-ROM, the "Bureau's" free product guide is worth the "list price" of \$4.95.

The computer book of the month is Chris DeVoney's *DOS Tips, Tricks, and Traps* (Que, 1988); it's one reference work that can save you quite a lot of time and trouble. The book of the month is *Parallel Universes* by Fred Allen Wolf (Simon and Schuster). Wolf is a physicist who really takes seriously quantum physics with its paradoxes and anomalies. Parts of the book are repetitious, and some of it is plain silly, but there's more than enough substance to keep you interested if you like far-out speculative science. My own interest was in research: I'm working on *Wrath of God*, a postapocalypse novel, and I needed some arguments to make limited time travel sound respectable. Wolf managed that.

The game of the month (other than Empire, which promises to be the game of the decade) is Annals of Rome. This is a strategic-level game in which you play the ruling faction of the Senate of Rome and try to keep the Republic/Empire alive through the centuries. It's frustrating and you're eventually guaranteed to lose, but the scope is magnificent, and more often than you'd think, there's a chilling resemblance to real history.

It's late, and I have to pack for Flagstaff, Arizona, and New York City on one trip. Larry Niven says a dark suit is always appropriate. I may have to test that hypothesis. ■

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 "jerry."

THE NEW STANDARD FOR HIGH PERFORMANCE STATISTICAL SOFTWARE

CSS

COMPLETE STATISTICAL SYSTEM

WITH DATA BASE MANAGEMENT

AND GRAPHICS

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 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 263 on Reader Service Card



StatSoft

2325 East 13th Street ■ Tulsa, OK 74104 ■ (918) 583-4149

Fax: (918) 583-4376

Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph: 040/4200347, StatSoft UK (London, UK), ph: 0438/310056 or 316561, StatSoft Pacific (Melbourne, Australia), ph: 613-663-6580
Available From: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Benelux: Lemax BV 02968-94210; France: Conceptel 45669700; Sweden: AkademiData 696201;

Korea: Geul Bang 272-1973.



Aw...What the Heck!

EXTREMELY POWERFUL

DesignCAD 3-D version 2.0 is as powerful as most CAD systems costing \$5000-\$10,000! Features like: Complex Extrusions-linear, scalar, and circular, Blending of Surfaces, Shading, Cross Sectioning, Complex Sweeps and Translations, and Boolean operations make DesignCAD 3-D one of the most powerful 3-D CAD systems available... at any price! Engineers, Architects and Consultants constantly tell us that they use CAD systems costing thousands of dollars which are not as powerful as DesignCAD 3-D.



VERY EASY TO USE

Just because DesignCAD 3-D is powerful doesn't mean it is difficult to use. Single keystroke commands and side-bar menus which give short directions on how to proceed make DesignCAD 3-D a snap to use! While not required, DesignCAD 3-D supports all popular digitizers and mice.

Many of the older, more cumbersome CAD systems require weeks of training before a user can be productive. DesignCAD 3-D users find they can be producing useful drawings in a matter of minutes! In a recent CAD contest only one contestant was able to match our drawing time. The package sold for \$3000.00. The other CAD packages took up to twice as long to perform the same drawing and cost up to \$5000.00!

Still don't believe us? The goblet pictured below required only 16 keystrokes and 3 commands to create! The top, front, side, and isometric views were created simultaneously... in less than one minute!

VERY LOW PRICED

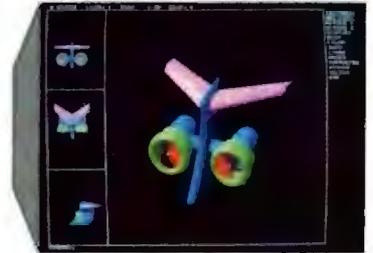
The first question asked by many people is, "Why is DesignCAD 3-D priced so low?" The answer? After developing DesignCAD 3-D version 2.0, we were unable to decide how the product should be priced. We consulted experts. We used the finest spreadsheets on the market. We took employee polls. Finally, in the great American Tradition, we said, "Aw... What the Heck! Let's see the other guys beat this price!" DesignCAD 3-D version 2.0 sells for \$399.



DesignCAD 3-D only \$399!

WHY BUY THIS ONE?

There is a very important reason to buy DesignCAD 3-D. **PERFORMANCE.** No other CAD system can match our price/performance ratio. Many people make the serious mistake of thinking that it is necessary to spend thousands of dollars to obtain "a good 3-D CAD system." This is not true! We talk to people everyday that are sadly disappointed with their "expensive" CAD systems. Don't be one of them! Call us and we will send you a complete set of literature and a free slide show demo disk. Once you compare DesignCAD 3-D version 2.0 with other CAD systems we know you will choose DesignCAD 3-D.



DON'T TAKE OUR WORD FOR IT

Here is what other people have to say about DesignCAD 3-D:

"After you've worked with DesignCAD, the single keystroke commands are simple to remember and it becomes easy to "flick one key" to execute a command. An extremely ergonomically designed program."

HENRY LEVET, Levett & Daigle Architects - New Orleans, LA
Designed a 65,000 sq. ft. nursing home using DesignCAD

"Recently I worked with a firm that builds decks. They purchased your product on my recommendation. I sat down with them and in two hours they were very proficient in DesignCAD. Now they are more effective; and we can communicate... it's wonderful to be able to do a block repeat 42 times and there are 42 2x4's to make the deck!"

J. TURNER, Architect, TAD Ltd. - The Woodlands, Texas

"Allows scientists and engineers to expend minimum time learning and using CAD software so that their time can be expended on the project at hand. It also allows scientists and engineers to quickly present to management all views of a subject. (3-D)."

DR. STEVENS, NASA Space Scientist/Engineer

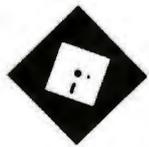


HOW DO I GET ONE?

DesignCAD 3-D version 2.0 is available from most retail computer stores, or you may order directly from us. DesignCAD 3-D is available in a number of foreign languages from distributors throughout the world. All you need to run DesignCAD 3-D is an IBM PC Compatible and 640K RAM. DesignCAD 3-D supports most graphics cards, printers, plotters and digitizers. Free information and a demo diskette are available by contacting us at:

American
Small Business Computers, Inc.

327 South Mill Street
Pryor, OK 74361
918/825-4844
FAX: 01-918-925-6359
TELEX: 9102400302



IS BIGGER BETTER?

Recent upgrades raise the question: When do bells and whistles overwhelm a product and its users?

I have been railing against the computer industry's penchant for constant upgrades for many months; we're caught in a spiral of bigger and bigger products designed to solve smaller and smaller problems. Spreadsheets, word processors, database managers, and such were tremendous boosts to productivity and creativity when they first appeared on microcomputers; any of the later enhancements to the basic concepts are trivial by comparison.

Generating an automatic table of contents or deriving an internal rate of return with one command is all very fine, but these niceties don't change our lives the way our first personal computers did. Yet each minor improvement, no matter how inconsequential, is hailed as a major revolution, and we rush like check-writing lemmings to jump on the bandwagon.

Simple programs have grown to include the equivalent of indoor plumbing and electric appliances, which we may or may not need; few, if any, of us will ever use all the bells and whistles of every product we own. But as each of us requires different features, it all works out for the best in the end. Or does it?

Here's a fact: Manufacturers abandon old products when new versions come out. No way can you buy a copy of SuperCalc2, a nice introductory spreadsheet, or WordStar 3.x, or any of the forerunners of today's megaprograms. If you want a limited but comfortable set of features, you're forced to look into odder and odder corners of the market. Laptop owners trying to avoid the weight penalty



of hard disk drives are at peril, as are users with meager needs and/or little interest in becoming power users.

I'm really dismayed by what all this means for those people new to computing. Those of us who have been around for a while accept the welter of new functions with an occasional sigh, but we can handle it. We're capable of ignoring unnecessary kitchen-sink features or deciding when an upgrade makes sense and when to pass. However, the feature wars have created programs that can be pretty daunting to the neophyte. Yes, software is easier to learn today than ever before, but there's a lot more to learn.

So what are the repercussions? Is the computer industry inadvertently setting up barriers that block its own growth? Is too much attention being paid to sophisticated doodads and not enough to simplicity and elegance? It's been so long since I was a novice that I'm not sure anymore. But I do notice that whenever an absolute beginner asks me what programs to buy,

I keep wishing that some of the products of a few years ago were still available.

Some companies (distressingly few) solve this dilemma by providing down-scaled variants of their powerhouse products or by developing junior-level programs. These are good moves. I'd also like to see some older products remain on the shelves, even after they've been superseded by newer, hotter, and bigger versions. We need more tiers of software functionality, particularly at the simple, user-friendly level. Without the software equivalent of a welcome mat, the industry will risk turning away those making their first tentative steps into computing.

Some Examples

More II for the Macintosh and WordStar Professional 5.0 in the MS-DOS world bring this phenomenon into sharp focus. More II is a brilliant package, combining outlining with presentation graphics and word processing. I stand in awe of the

continued

programming skills of the Winer brothers, Dave and Peter, who took the basic idea of an outlining tool and refined it into this amazing product.

But it has become so powerful, so flexible, and so enormous that you can spend weeks trying to figure out everything it can do. More II is the slickest tool I've ever seen for creating and organizing a slide show with graphics, whether you output it as 35mm slides or project it as computer screens. There are built-in tree and bullet charts with draw-style graphics, editing capabilities, installable style libraries, dissolves and wipes, and a timed execution facility for unattended presentations. On the text-handling side, More II has added style sheets, a spelling checker, true headers and footers, page breaks, and a print-preview feature.

Also, More II no longer restricts outline headlines to one line of text, effectively freeing you from the constraints of the indented outline format. And, of course, the program retains its predecessors' outline-manipulation features: cloning, mark and gather, time stamping, calculation, and so on. As I said, it's wondrous stuff.

However, using More II to cobble up a little outline, perhaps to organize your thoughts before sitting down to write a report, is like using low-yield nuclear weapons to rid your house of termites. The screen is awash with new teeny cryptic symbols. Endless menus lead to endless submenus. Understanding the More II library format and how to use it is an afternoon in itself. The scope of this program has vastly outstripped the scale of the job it was originally intended to do.

I wrote about WordStar Professional 5.0 in January, so I'll skip some of the gory details. Suffice it to say that my old standby now has the best print-preview screens in MS-DOS, a variety of interfaces (including pull-down menus), automatic reformatting, direct import of spreadsheet and database files, windows, macros, a selection of new commands for font control on laser printers, and much more. Although it is still identifiable as a word processor, it's a far cry from the familiar product I first began using many years ago.

Both More II and WordStar Professional 5.0 are excellent programs, highly recommended. Yet after a few months with each of them, I went back to the previous versions, More I.1c and WordStar 4.0. I found I had little use for most of the new stuff, and it got in the way more than it helped. Further, both programs had lost the indefinable feel that had characterized their ancestors.

ITEMS DISCUSSED

BirdSongs! \$45
 Corrales Software
 P.O. Box 2730
 Corrales, NM 87048
 (505) 897-4024
 Inquiry 1021.

More II.....\$395
 Symantec Corp.
 10201 Torre Ave.
 Cupertino, CA 95014
 (408) 253-9600
 Inquiry 1022.

Plain Paper Ink
 Cartridge..... \$11.95
 Diconix, Inc.
 343 State St.
 Rochester, NY 14650
 (800) 848-9977
 Inquiry 1023.

WordStar Professional 5.0....\$495
 MicroPro International Corp.
 33 San Pablo Ave.
 San Rafael, CA 94903
 (415) 499-1200
 Inquiry 1024.

Now, the good folks at Symmetry will point out that Acta Advantage has everything I need in a Macintosh outliner, and they're probably right. If it's command-set compatibility with old versions of WordStar that I want, I have only to look to Sprint, PC-Write, SideKick's Notepad, or half a dozen other MS-DOS word processing programs that can be configured to emulate the old classic.

But I don't merely want similar functionality to, or close emulation of, the original programs, and there's more than nostalgia to my complaint. The originals had a cohesiveness—integration, if you will—lacking in the new versions. It's that sense of "rightness" that causes me to favor one program over another. And the new ones, no matter how spectacular, don't have it.

On the Jet Stream

OK, I admit it, I feel a little dumb. It's taken me over a year to discover a wonderful product, and I wish I'd known about it when it began shipping in April 1988. It's one of those seemingly trivial items that attract little attention but can completely change the way you work. What's this magic bullet that's got me so excited? It's the Diconix Plain Paper Ink Cartridge for portable ink-jet printers, that's what.

The rap on low-cost ink-jet technology has always been that you can't get good print quality without special paper. As ink-jet ink is still technically a liquid when it hits the paper, it has been recommended that you use stock with high absorption characteristics. Until the introduction of the Diconix cartridge, you had only two choices: clay-coated paper, which absorbs ink without much spreading at the edges of the dots, or ultra-cheap, highly absorbent paper that allows so much spreading that printouts look like the lines on the eye chart below the last one that you can read. Ordinary paper was out of the question; unabsorbed ink remaining on the surface would smudge the instant you touched it.

I fell in love with Hewlett-Packard's ThinkJet printer before it was officially unveiled (and Hewlett-Packard insiders were still calling it "Vesuvius"). It was small and quiet. Also, it didn't shake the table like a subway train passing under the building at full throttle. But the paper question kept me from adding a ThinkJet to my printer collection.

When the Diconix 150, a yet smaller portable printer based on the same disposable-cartridge technology, was introduced, I continued to raise a skeptical eyebrow. Clay-coated printer paper is not exactly a common household item.

Last month, however, I decided to take the plunge, seduced by advertisements calling the Diconix unit a "plain paper printer." It arrived with one ink cartridge and an ominous sample pack of clay-coated paper. I used a few sheets, and the output looked marvelous. When I used plain paper, however, it was Smudge City. Irritated, I began a long series of phone calls.

What I eventually learned was that Diconix has a cartridge filled with a quick-drying ink formulation that the company calls "plain paper ink." This item is, of course, not mentioned anywhere in the materials provided with the printer. I ordered a sample, and, wonder of wonders, it worked.

It worked on every type of paper I could find in my office. It even worked on my personal letterhead, which is bright white and slick, a rough test for any printer. No smudging, period. So far, I've encountered only one type of stock that can't handle the ink: those clear plastic labels designed for photocopiers. As of yesterday, the machine-gun daisy-wheel printer and the chain-saw dot-matrix printer have been banished to their original cartons in the back of the garage. I'm in printer heaven.

continued

ESTABLISHED
1988

MONTGOMERY GRANT

BYTE
7/89

OUTSIDE USACALL
(718)692-0071

For Customer Service
Call Mon-Fri: 9:30am-4:30pm
(718) 692-1148

Retail Outlet: Penn Station, Main Concourse
(Beneath Madison Square Garden) New York City, NY, 10001
Store Hours: Mon-Thurs, 8:30am-8pm Fri, 8:30am-6:30pm Sat, Closed / Sun, 9:30am-7pm
FOR ORDERS & INFORMATION CALL TOLL FREE

1-800-759-6565

OR WRITE TO:
Montgomery-Grant Mail Order
Department, P.O. Box 58,
Brooklyn, N.Y., 11230

FAX NO. 7186923372
TELEX 422-132 MGRANT

ORDER HOURS: Monday-Friday, 9:00am-7:00pm Saturday CLOSED Sunday, 9:30am-6:00pm
NO SURCHARGE FOR CREDIT CARD ORDERS / WE INVITE CORPORATE AND EDUCATIONAL CUSTOMERS
CORPORATE LEASING AVAILABLE / DISCOUNTS FOR QUANTITY ORDERS

LAPTOPS

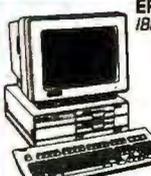
TOSHIBA 1000.....	\$749
TOSHIBA 1600.....	\$3269
TOSHIBA 3100 e.....	\$2759
TOSHIBA 1200 H.....	\$1999
TOSHIBA 1200 HB.....	\$2299
TOSHIBA 3200.....	\$3549
TOSHIBA 5100.....	\$4599
TOSHIBA 5200.....	\$5999
NEC MULTISPEED H.D.....	\$1999
NEC ULTRALITE 1MB.....	\$1899
NEC ULTRALITE 2MB.....	\$2299
NEC PROSPEED 386 w/40MB.....	\$4599
ZENITH 184 w/TWO FLOPPIES.....	\$1469
ZENITH 184-2 w/20MB.....	\$2199
ZENITH 286 w/20MB.....	\$2999
SPARK EL.....	\$999
COMPAQ SLT 286-20.....	\$3899
QUADRAM J.T. FAX FOR LAPTOPS.....	\$259
EPSON LT w/20MB (BACKLIT).....	\$1799

MODEMS, EXTERNAL DRIVES & ACCESSORIES AVAILABLE FOR ALL LAPTOPS

AMIGA™

AMIGA 500 w/Built-in 5.25" Drive.....	\$529
AMIGA 500 w/1084S Monitor.....	\$799
AMIGA 2000 w/Built-in 3.5" Drive.....	\$1359
AMIGA 2500.....	\$3149
AMIGA 2000 H.D.....	\$1999
AMIGA 1084S RGB MONITOR.....	\$279.95
AMIGA 1010 DISK DRIVE.....	\$159.95

ALL AMIGA PERIPHERALS AND ACCESSORIES IN STOCK!!



EPSON EQUITY 1+
IBM XT COMPAT. PKG.
• 640K RAM w/Clock
• Calendar
• 360K Drive
• Keyboard
• Serial and Parallel Ports
• 12" High Resolution Monitor
• MS DOS / GW Basic
\$799

SAME W/20MB HARD DRIVE.....	\$1059
SAME W/30MB HARD DRIVE.....	\$1099
SAME W/40MB HARD DRIVE.....	\$1149
SAME W/TWO 360K FLOPPIES.....	\$879

EPSON EQUITY 1e.....\$789



EPSON EQUITY II+
IBM AT COMPATIBLE
HARD DRIVE PACKAGE
• Keyboard
• 640K RAM
• 80286 Microprocessor
• 1.2MB Floppy Drive
• 20MB Hard Drive
• 12" Monitor
• MS DOS/GW Basic
\$1499

SAME W/30MB HARD DRIVE.....\$1549
SAME W/40MB HARD DRIVE.....\$1599

FINAL EPSON PRICES! NO WAIT FOR REBATE!



NEC
POWMATE 1
HARD DRIVE PKG.
• 640K
• Keyboard
• 10 MHz
• 1.2MB Floppy Drive
• 20MB Hard Drive
• Serial/Parallel Ports
• 12" Monitor
• 80286 Processor
\$1399

SAME W/30MB.....	\$1449
SAME W/40MB.....	\$1499

NEC POWERMATE 1+.....\$1549



NEC POWERMATE 386 SX
• 2MB RAM
• 16 MHz
• 1.2MB Floppy Drive
• 42MB Hard Drive
• 12" Monitor
• Windows 386
• MS DOS 3.3
\$2599

POWMATE 386-20
2MB RAM
20 MHz
42MB Hard Drive
1.2MB Floppy Drive
12" Monitor
Windows 386
MS DOS 3.3
\$3699



commodore COLT
IBM XT COMPATIBLE
PACKAGE
• 640K RAM - Keyboard
• 360K Floppy Drive
• Serial & Parallel Ports
• 12" Monitor
• MS DOS/GW Basic
\$499

SAME W/TWO 360K FLOPPIES.....\$549
W/1 FLOPPY & 20MB HARD DRIVE.....\$749



ASTRAID PC-1640
• Keyboard
• 640K RAM Turbospeed
• Two 360K Drives
• 12" Monitor
• FREE Mouse & Software
• MS DOS/GW Basic
\$729

W/ONE FLOPPY AND 20MB.....\$1029
EGA AND CGA MODELS IN STOCK!



IBM XT
HARD DRIVE PKG.
• IBM XT Computer
• IBM Keyboard
• 256K RAM
• Expandable to 640K
• 360K Disk Drive
• 20MB Hard Drive
• (Monitor Optional)
\$1049

IBM XT PACKAGE w/TWO FLOPPY DRIVES.....	\$849
IBM AT w/30MB.....	\$1649
IBM AT w/40MB.....	\$1699



IBM PERSONAL SYSTEM 2
PS/II MODEL 25 Color.....\$1099
PS/II MODEL 30 w/20MB.....\$1699
PS/II MODEL 30/286-021.....\$2749
PS/II MODEL 50Z w/30MB.....\$2749
PS/II MODEL 50-061.....\$2999
PS/II MODEL 55.....\$2999
PS/II MODEL 70-561.....\$3795
PS/II MODEL 70-121.....\$3299
PS/II MODEL 80-071.....\$4799

5.25" 360K External Drive for IBM PS/II-30.....\$129
PACIFIC RIM 5.25" 1.2MB External Drive for IBM PS/II 5060/7080.....\$259
ALL OTHER PS/II MODELS AVAILABLE

IBM PERSONAL SYSTEM II MONITORS
8503 MONOCHROME.....\$239
8512 COLOR.....\$449
8513 COLOR.....\$539

WE RECONFIGURE ANY OF OUR COMPUTER PKGS. TO FIT YOUR SPECIFICATIONS. CALL FOR INFORMATION. WE CARRY MODEMS, DRIVES, CARDS, COLOR MONITORS, MEMORY UPGRADES & ALL OTHER ACCESSORIES FOR YOUR COMPUTER



EVEREX
EVEREX STEP 386 IS.....\$1999
EVEREX 386 25 MHz.....\$3499



COMPAQ
DESKPRO 286
• 640K
• 12MHz
• 1.2MB Floppy Drive
• 20MB Hard Drive
• 12" Monitor
\$1899

SAME PACKAGE W/30MB.....\$1949
SAME PACKAGE W/40MB.....\$1999

COMPAQ 286e.....\$1849



AST BRAVO 286
HARD DRIVE PKG.
• 80286 Processor
• 1.2MB Floppy Drive
• 20MB Hard Drive
• Keyboard
• 12" Monitor
• Video Card
\$1249

SAME PACKAGE W/20MB.....\$1349
SAME PACKAGE W/40MB.....\$1399
AST PREMIUM 386/16 MHz.....\$2199



APPLE
APPLE IIGS w/Floppy Drive & 12" Monitor
\$599

APPLE IIGS COMPUTER PACKAGE
• Apple IIGS Computer
• 512K Upgrade
• RGB Color Monitor
• Apple 3.5" Disk Drive
\$1449

IMAGEWRITER II PRINTER.....\$449
MAC SE COMPUTER W/DUAL DRIVE.....\$2299
MAC SE COMPUTER W/20MB.....\$2749
APPLE MAC II.....\$3499
APPLE MAC II w/40MB.....\$4299
APPLE MAC.....\$1399
APPLE MAC II CX.....\$3399
APPLE MAC II CX w/40MB.....\$3749
MAC SE 30.....\$3199
MAC SE 30 w/40MB.....\$3499



COMPAQ DESKPRO 386 S
• 1MB RAM
• 16 MHz
• 1.2MB Floppy Drive
• 40MB Hard Drive
• VGA Adaptor
• 12" VGA Monitor
\$2999

DESKPRO 386-20e
• 1MBRAM
• 20MHz
• 1.2MB Floppy Drive
• 40MB Hard Drive
• VGA Adaptor
• 12" VGA Monitor
\$4199

COMPAQ 386/25 MODEL 60.....\$5895



AST PREMIUM 286
MODEL 70
HARD DRIVE PKG.
• 80286 Processor
• Keyboard
• 1.2MB Floppy Drive
• 20MB Hard Drive
• 12" Monitor
• MS DOS/GW Basic
\$1499

SAME PACKAGE W/30MB.....\$1549
SAME PACKAGE W/40MB.....\$1599



Panasonic FX-1750
IBM AT COMPATIBLE HARD DRIVE PKG.
80286 Processor • 640K RAM
3.5" 1.44 MB Floppy • Keyboard
20MB Hard Drive • 12" Monitor
MS DOS/GW Basic
\$1149

SAME W/30MB.....\$1199
SAME W/40MB.....\$1249



SHARP PC-7100 PORTABLE
IBM XT COMPATIBLE COMPUTER PKG.
• Detachable Keyboard
• Backlit Screen
• 8 MHz Turbospeed
• 5.25" Floppy Drive
• 20MB Hard Drive
• Serial/Parallel Ports
\$999

PC 7000 W/TWO FLOPPY DRIVES.....\$699



VENDEX HEADSTART III
• 8-12 MHz
• 1MB RAM
• 5.25" 1.2MB Floppy
• 3.5" 1.44MB Floppy
• 30MB Hard Drive
• VGA/EGA/CGA/MDA Included
• Parallel/Serial Ports
• Mouse
• MS DOS
• 12" VGA Monitor
\$2399

SOFTWARE INCLUDED

MAGNAVOX EGA Monitor.....	\$330
MAGNAVOX EGA Monitor w/EGA Card.....	\$499
MAGNAVOX VGA Monitor.....	\$399
MAGNAVOX VGA Monitor w/VGA Card.....	\$599
NEC MULTISYNC IIA.....	\$320
PARADISE VIDEO CARDS.....	IN STOCK!

SEAGATE 20, 30, 40, 60, 80MB HARD DRIVES IN STOCK!

PRINTERS

STAR NX-1000.....	\$164.95
STAR NX-1000 RAINBOW.....	\$219.95
STAR NX-2400.....	\$294.95
CITIZEN MSP-15E.....	\$315.95
CITIZEN MSP-40.....	\$269.95
CITIZEN MSP-45.....	\$359.95
CITIZEN MSP-50.....	\$299.95
CITIZEN T8016-124.....	\$359.95
EPSON FX-1050.....	\$489.95
EPSON FX-850.....	\$339.95
EPSON LO-500.....	\$279.95
EPSON LO-510.....	\$329.95
EPSON LO-850.....	\$529.95
EPSON LO-950.....	\$589.95
EPSON LO-1050.....	\$729.95
EPSON LO-2550.....	\$919.95
EPSON LX-810.....	\$179.95
EPSON FX-286E.....	\$399.95

COLOR OPTION KIT FOR MSP-50 AND T-124.....\$49.95

NEC P2200.....	\$339.95
NEC P5200.....	\$489.95
NEC P5300.....	\$649.95
OKIDATA OKIMATE 20.....	\$139.95
OKIDATA OKID 180A.....	\$219.95
OKIDATA OKIDATA 320.....	\$349.95
OKIDATA OKIDATA 321.....	\$459.95
OKIDATA OKIDATA 390.....	\$459.95
OKIDATA OKIDATA 391.....	\$629.95
SANYO PR-3000A DAISY WHEEL.....	\$59.95
HP DESKJET PRINTER.....	\$599
HP DESKJET PLUS.....	\$699
HP PAINTJET PRINTER.....	\$1079

LASER PRINTERS

HP HEWLETT LASERJET SERIES II PACKARD.....	\$1629
1 MB EXPANDER.....	\$349
2MB EXPANDER FOR LASERJET II.....	\$399
HP LASERJET II.....	\$299
PANASONIC KXP-4450.....	\$1349
BROTHER HL-8E.....	\$1859
NEC LC 860.....	\$1999

RUSH SERVICE AVAILABLE. CALL FOR DETAILS.

Centric Check Bank Checks Money Orders Approved P.O.s Visa Mastercard Am-Ex Diner's Club Carte Blanche & C.O.D.'s accepted Please call before submitting P.O.s No additional surcharge for Credit Card orders Non-certified checks must wait 4-6 weeks for clearance N.Y. residents add applicable sales tax Prices and availability subject to change without notice Not responsible for typographical errors Return of defective merchandise must have prior return authorization number Returns will not be accepted IBM PC XT are registered trademarks of International Business Machines Corp. Please add \$7 shipping & handling APO FPO orders please add 10% shipping and handling All APO FPO orders are shipped first class priority air All orders can be shipped Air Express Call for details DCA #00213

Introducing the Smallest 80386 based PC Compatible Single Board Computer Only 4" x 6"



Quark/PC® II

- VGA® VidedColor LCD Controller
- SCSI Hard Disk Control
- Up to 4 Mbytes Memory and more

To order or enquire call us today.
Megatel Computer Corporation
(416) 745-7214 FAX (416) 745-8792

174 Turbine Drive, Weston, Ontario M9L 2S2

Distributors

Germany — Tech Team (06074) 98031 FAX (06074) 90248
Italy & Southern Europe — NCS Italia (0331) 256-524 FAX (0331) 256-018
U.K. — Densitron (0959) 76331 FAX (0959) 71017
Australia — Asp Microcomputers (03) 500-0628 FAX (03) 500-9461
Denmark — Ingeniørfirmaet (02) 440488 FAX (02) 440715
Finland — Digipoint (3580) 757 1711 FAX (3580) 757 0844
Norway — AD Elektronikk (09) 877110 FAX (09) 875990
Sweden — (040) 97 40 90 FAX (040) 13 90 38

Quark is a registered U.S. trademark of F. & K. MFG. Co. Ltd. VGA is a registered trademark of IBM Corp.

megatel

OS/2 ^{and} ~~or~~ DOS? MultiBoot is the answer.

From *BYTEWEEK*/Feb. 6, 1989

"... Bolt Systems has come out with a program that does away with the dual-boot problem. And at \$49, MultiBoot will be an essential utility for any OS/2 user ...

MultiBoot is simple, foolproof, and it works flawlessly. It's an example of a much-needed utility that fills a niche, a niche that will widen as more users take up OS/2. We recommend it."

Not all DOS programs work in the OS/2 compatibility box. MultiBoot lets you install both systems in your computer. MultiBoot works with DOS version 3.0—4.01 up. And OS/2 versions 1.0 and 1.1

TO ORDER:

Send \$49.95* + \$3.00 shipping and handling (check or money order) to:

MultiBoot, Bolt Systems, Inc.
4340 East-West Highway
Bethesda, Maryland 20814

*Maryland residents add 5% sales tax.

or call 1-301-656-7133.
FAX: 1-301-907-8736 to order by Visa/Mastercard. Specify 3.5" or 5.25" diskettes. Ask about our volume discounts

A Product of **BOLT** Systems, Inc.

These Diconix cartridges cost \$11.95 a pop, produce about 500 pages in draft-quality mode, and work in the ThinkJet, the Diconix 150 and 300, and the General Computer WriteMove printer for Macintosh users. Reproduction is not quite as glorious as you'll obtain with clay-coated paper or with a 24-pin near-letter-quality dot-matrix printer, but for routine work, this arrangement can't be beat.

For the Birds

The odd product of the month—possibly of the year—is BirdSongs! from Corrales Software. It's a Macintosh package, and the name says it all. For \$45, you get a resource file of digitized birdcalls and two programs with which to play them—a stand-alone application and a desk-accessory version. BirdSongs! is designed to let you play sounds in the background, either with MultiFinder or without it. When you adjust sliders to set maximum and minimum intervals for playback and choose an assortment of songs from the menu, you can have a bunch of birds merrily twittering while you work.

Author Loren Cobb explains that the sound-generation capabilities of the Mac are ideally suited for reproducing high-frequency noises. A quick check with an impartial panel of experts (my cats) certifies the validity of this claim; these judges responded to BirdSongs! with noticeable interest and ear-twitching. The songs are quite attractive to human ears as well. I heard none of the unpleasant clicks and hissing that characterize many other collections of digitized sounds; the overall effect is delightful.

BirdSongs! contains the sounds of 17 North American birds, mostly thrushes, wrens, and catbirds. If you're so minded, you can build your own resource files for the program using any digitized sounds; simple instructions are included in the short manual. Or for \$15 each, Corrales Software will sell you other sound files, including Southwestern birds and animals, birds and monkeys of Madagascar, and (my favorite) arctic wolves. Just the thing to perk up a dull day at the office.

Recommended if you fancy this sort of thing. ■

Ezra Shapiro is a consulting editor for BYTE. You can contact him on BIX as "ezra." Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



FIGURING OUT CONFIG.SYS

The file that configures your OS/2 system has grown up since its DOS days

You're witnessing computer journalism history. Up until now, I did much of my work under OS/2 but wrote my columns with a DOS-based text editor. This month's column was produced entirely under OS/2.

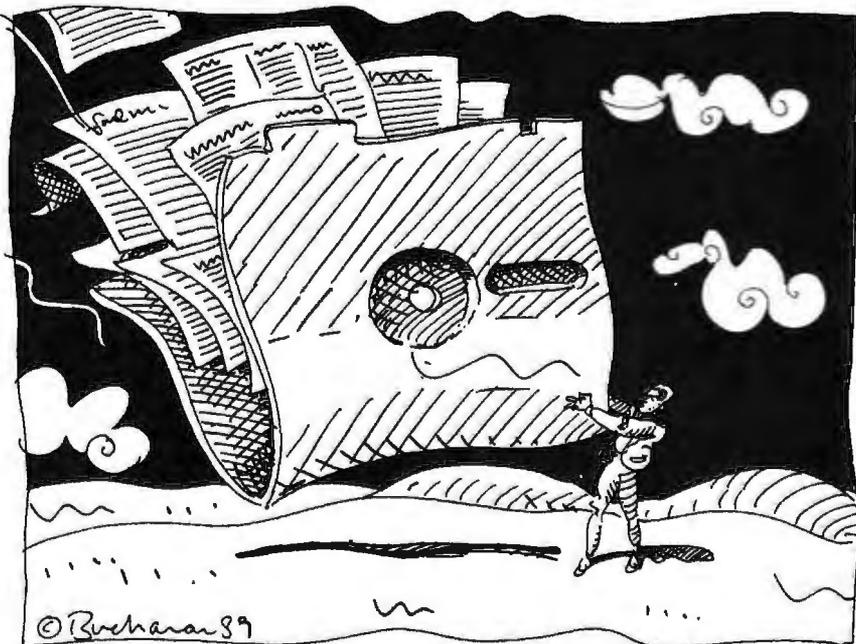
I'm writing it with the SideKick Notepad. This isn't my editor of choice, but I'm sure the Borland people would be the first to say that it's not intended for writing a 1500-word document. The speed is not great, but Notepad seems to keep up with my typing unless virtual memory is activated—then it can take seconds for what I've keyed to show on the screen.

This is just another example of something I've said before: Avoid the virtual memory feature of OS/2, if you can. Here's how to tell if you've activated virtual memory: An action that should not affect the disk drive causes the drive light to go on. Consider the drive light your "buy some more memory now" light.

Another oddity about Notepad is that it uses a large monospace Courier font. Courier is easy to read, but the 55 columns remind me of the 1981 IBM programs that were all written to run on the lowest common denominator of the time—a 40-column screen.

This month, I'll finish the discussion of building and setting up a Presentation Manager-ready system.

In previous columns, I've discussed how to assemble the hardware that you'll need to run IBM's PM. Then I discussed how to install OS/2 and what files are on your disk once the installation has been completed. In this column, I'll show you



how to set up CONFIG.SYS.

Listing 1 shows a typical CONFIG.SYS file under OS/2. Many of these commands will look familiar to the knowledgeable DOS user. PROTSHELL tells the system where to find the user shell program (COMMAND.COM under DOS, PM under OS/2 1.1).

SHELL does the same thing that it did under DOS. In fact, it affects only the DOS mode session (what used to be called the compatibility box). As under DOS, you may have to modify SHELL if you face "out of environment space" errors. Just add the /e:nnn option, where nnn is the size in bytes of space to allocate for environment strings, which are short pieces of information put in an area called the environment. The environment is accessible from a program.

SET PATH and SET DPATH show that, under OS/2, you can put your environment strings in CONFIG.SYS. For example, to tell Microsoft Word that you have a VGA display, you could put the

following line in your AUTOEXEC.BAT file under DOS:

```
SET VGA=YES
```

The SET command places values in the environment string space. In this case, of course, the VGA=YES doesn't mean anything to any other program but Word (and, perhaps, some other Microsoft programs).

Finding the Path

PATH and DPATH refer, as in DOS, to the sequence of subdirectories searched to find programs and data, respectively. PROMPT is essentially the same as in DOS. The fourth SET command, COMSPEC, will also be familiar to the DOS technician. COMSPEC gives the path of the command-line interpreter. Under DOS, the command-line interpreter is COMMAND.COM. Under OS/2, it's called CMD.EXE.

continued

BBS Sysops

Are you looking for ways to improve your board? Something that will set you apart from other boards in your area? Are your subscribers interested in Microcomputers? Listen to this!

Announcing the Bulletin Board EXchange

The Bulletin Board Exchange allows you to become a publisher of MicroBYTES Daily, an on-line news service from BYTE. Bulletin Board Exchange/MicroBYTES is a custom package of news and features designed especially for local BBSes, and is available only to sysops.

Every Monday through Friday you get articles about developments in microcomputing, telecommunications and selected new product announcements. Get the latest news about MS DOS machines, Macintoshes, Unix workstations, Amigas, Atari STs, peripherals and software. All the stories are reported, written, and edited by the staff of BYTE Magazine, BYTEweek and BIX, and our world-wide network of reporters and editors.

Not only do you get a great resource for your subscribers, but you also get access to BIX which will cut your cost of exchanging information and conducting BBS network business.

All this is just \$49 a quarter.

Your one-year subscription to the Bulletin Board Exchange (billed quarterly) may be cancelled any time without further charge; just notify us. If you prefer, you may subscribe for three months only, at just \$69.

If you call BIX direct, you pay no hourly telecommunications charge. If you call using Tymnet, the rates are only \$2/hour on evenings and weekends and \$8/hour on weekdays. You may also purchase unlimited off-peak Tymnet for just \$15 a month.

Subscribe today.

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983
In NH 603-924-7681

LIBPATH, an important new command, tells OS/2 where to find its dynamic link libraries. In the case of my CONFIG.SYS, I have the usual OS/2 DLLs, which, you will recall from last month, are placed in the \OS2\DLL subdirectory by the IBM installation program. The \OS2\DLL subdirectory comes first on my LIBPATH. SideKick requires DLLs, so LIBPATH must point to the C:\SIDEKICK subdirectory.

Finally, I have some utilities—I've mentioned ALIAS, a command-line editor, for example—that require DLLs. Those DLLs all go in my \XOS2 (extra OS/2) subdirectory. There is no environment string for LIBPATH, because Microsoft doesn't want you confusing the operating system by changing LIBPATHs in midsession. Just imagine the confusion if you inadvertently took, say, the DLLs for the video driver off the LIBPATH.

BUFFERS is the same as in DOS. DISKCACHE creates and sizes a hard disk drive cache, a function similar to BUFFERS.

Allocating Memory to Resources

MAXWAIT and THREADS control the multitasking environment. I discussed MAXWAIT in my November 1988 column. THREADS just sets the maximum number of simultaneous threads of execution. The IBM installation procedure sets them at 128, but 64 will work just fine. Strangely enough, even the minimum value, 32, seems to work, despite

claims from several sources that 48 is the practical minimum. Lowering the number of threads frees up 2K bytes per thread. Dropping THREADS to 64 will recover 128K bytes of RAM.

PROTECTONLY tells OS/2 whether or not to create a DOS mode session. PROTECTONLY=YES means *don't* run real-mode (DOS) programs (i.e., don't create a DOS mode session). Confused? Me, too. Just remember that PROTECTONLY=YES means *no* DOS mode session, and PROTECTONLY=NO means go ahead and set one up. The default is NO.

RMSIZE tells OS/2 how much memory to allocate to the DOS mode session. The default is 640K bytes.

MEMMAN and SWAPPATH control the memory manager under OS/2. MEMMAN's first parameter is either SWAP or NOSWAP, which controls virtual memory. As you'd expect, NOSWAP says, "Don't do virtual memory." SWAP, the default, allows virtual memory to be activated when real memory overflows.

The second parameter is either MOVE or NOMOVE. It does for your RAM what a product like Disk Optimizer or Norton SpeedDisk does for your hard disk drive: eliminates fragmentation. Because OS/2 is a multitasking operating system, it must allocate and deallocate areas of memory to specific tasks as they are created and destroyed. MEMMAN=MOVE or NOMOVE is used to tell OS/2

continued

Listing 1: A typical CONFIG.SYS file under OS/2.

```
SET PATH=C:\OS2;C:\OS2\SYSTEM;C:\;c:\xos2
SET DPATH=C:\OS2;C:\OS2\SYSTEM;C:\;
SET PROMPT=$1[$p]
SET COMSPEC=C:\OS2\CMD.EXE
PROTSHELL=C:\OS2\PMSHELL.EXE C:\OS2\OS2.INI C:\OS2\CMD.EXE
SHELL=C:\OS2\COMMAND.COM /P
LIBPATH=C:\OS2\DLL;C:\;C:\SIDEKICK;c:\xos2
BUFFERS=30
DISKCACHE=128
MAXWAIT=1
THREADS=64
PROTECTONLY=NO
RMSIZE=640
MEMMAN=SWAP,MOVE
SWAPPATH=C:\OS2\SYSTEM 10000
BREAK=OFF
FCBS=16,8
COUNTRY=001,C:\OS2\SYSTEM\COUNTRY.SYS
DEVINFO=SCR,EGA,C:\OS2\VIOTBL.DCP
DEVICE=C:\OS2\EGA.SYS
DEVICE=C:\OS2\POINTDD.SYS
DEVICE=C:\OS2\MOUSEA04.SYS
DEVICE=C:\OS2\PMDD.SYS
DEVICE=C:\OS2\COMO1.SYS
```

There are more impressive transfer systems. But not on this planet.

Now you can boldly go where no IBM compatible laptop to desktop file transfer system has gone before.

With FastLynx, the new file transfer system from the developers of the highly acclaimed Fastwire II. FastLynx conveniently and accurately copies files, directories, and complete disks at warp speed (up to more than 500,000 baud in parallel mode or 200,000 baud in serial mode).

Discover FastLynx and our new FastLock file protection system at a special introductory price. Call 1-800-852-RUPP for your nearest dealer.

What's more, FastLynx offers a simple point-and-shoot split screen mode, a form mode to create routine macros, and a command mode to write batch files and execute advanced commands.

No matter what planet you're from, FastLynx is easy to use. Just connect the cable, load the software, and you're ready to go. A convenient upload feature even transfers FastLynx to remote systems without the use of diskettes.

FastLynx. There's not a more impressive transfer system in the world. That is, this world.

Call 212-517-7775 Fax 212-249-8243

FastLynx, and FastLock are trademarks of the Rupp Corporation. IBM is a registered trademark of International Business Machines Corporation.



**The file transfer system
that really moves.**

whether it's kosher to move memory blocks in order to keep all the allocated regions together and all the deallocated regions together.

Imagine what a problem this must be for the operating-system designer: You've got to move memory blocks while the programs are running without damaging these programs. That's like trying to tune a car while it's traveling down the highway. Most of us will use `MEMMAN=MOVE`, although if you've got

lots of memory to burn and don't start and stop many applications, you might squeeze some extra performance from your machine with `NOMOVE`.

`SWAPPATH` does two jobs. First, it tells the swapper where to put the temporary virtual memory storage files. `SWAPPATH=C:\OS2\SYSTEM` just names the subdirectory in which to put the swap files. Under OS/2 1.1 only, it also restricts the growth of the swap files. Now you can tell the swapper to

leave some room free with the second parameter of the `SWAPPATH` command. `SWAPPATH=C:\OS2\SYSTEM 10000` tells OS/2 that it can use the disk for virtual storage, but that it must leave 10,000K bytes free at all times. If you don't do that, the swapper's temporary files can grow to fill the disk, as I've discussed in previous columns.

Finishing Up

The remaining commands are fairly straightforward. `BREAK` and `FCBS` behave exactly as under DOS. `COUNTRY` is the same as under the later versions of DOS—an international device-support command. It tells OS/2 things like what character is used to prefix currency amounts, what format currency is reported in (e.g., in the U.S., it's floating point with two decimal places), and collation sequence.

It also covers date format. For example, in the U.S., we report month/day/year. Set the country for the United Kingdom, and you get the more logical day/month/year. Unlike other `.SYS` files, `COUNTRY.SYS` needn't be in the root directory. If you live in the U.S. or English-speaking Canada, you needn't even include the statement.

`DEVINFO` is another international support command. It supports foreign-language character sets for the screen, keyboard, or printer. The example here is a support command for the screen.

Finally, there are the device drivers. The first one, `EGA.SYS`, matters only for the DOS mode session. The next three—`POINTDD.SYS`, `MOUSEA04.SYS`, and `PMDD.SYS`—supply mouse support. The last one, `COM01.SYS`, drives the serial ports. And remember not to put the `COM01.SYS` driver before the mouse drivers if you have a serial mouse. If OS/2 sees the serial driver first, it allocates all the serial ports to COM-port status. By the time OS/2 sees the serial mouse driver, the serial ports are all taken, and it can't recognize the mouse.

Believe it or not, that's a basic OS/2 `CONFIG.SYS` file. That will get you started; you can dig into the IBM manuals for more. ■

Mark 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.

GRASP is clearly
the hands-down winner
in terms of sheer power,
flexibility, and speed.
—PC Magazine

Program in the
4th Dimension...
ANIMATE!

Get unlimited action and interaction with the
most powerful PC animation system available,
by calling Grasp routines from your programs
in C, Pascal, Basic, and other languages.

Or develop your graphics applications
directly in Grasp! Take advantage of:

- 74 animation & effects commands
- 25 predefined fades
- single-command animation
- all major graphics modes
- screen capture and graphics printing utilities

Includes Pictor, a full-featured
paint program, completely
integrated with Grasp for
fast development and
editing of programs
and graphics.

GRASP 3.1
\$149

**Graphic
Animation
System for
Professionals**

Convince yourself!
Send us \$2.00 for Episode I
"The Adventures of Ferguson Floppy"

Paul Mace
SOFTWARE

400 Williamson Way
Ashland, OR 97520
800-523-0258

Discover Parallel Processing!



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 the 20 MHz T414 or T800 or the new 25 MHz T425 or T800.

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 our own Prolog. We also stock the NAG libraries for the T800 and Rockfield's structural and thermal finite element package. 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?

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 together with ribbon cables to build large systems. One MicroWay customer reduced an 8 hour mainframe analysis to 15 minutes with five Quadputers, giving him realtime control of his business.

Micro Way

World Leader in PC Numerics

P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 617-934-2414 Australia 02-439-8400 Germany 069-75-1428

Quarterdeck

DESQview 2.2 and DESQview 386. The multitasking, windowing environments that work with your favorite software.

DESQview™ is the operating environment that brings OS/2™ power to DOS. And it lets you, with your trusty 8088, 8086, 80286, or 80386 PC, leap into the next generation in PC productivity. For not much money. And without throwing away your favorite software.

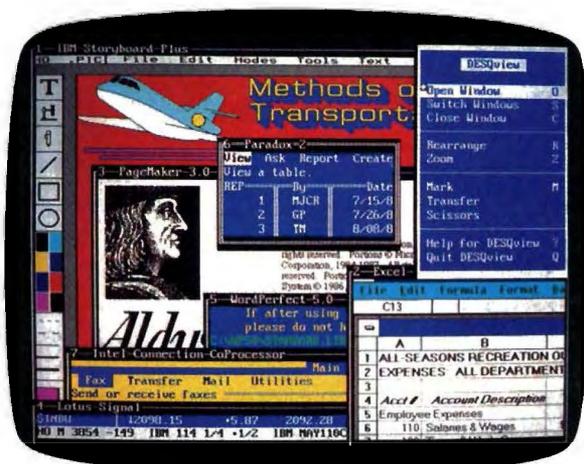
Introducing DESQview 2.2

And now, DESQview 2.2 adds capabilities, performance, and compatibility enhancements you've been asking for:

Like being able to fine tune DESQview performance "on the fly." Run Lotus Express and Metro. And the Intel Connection Co Processor. Even use the DOS 4.0 shell with DESQview. Have DESQview automatically install Quattro, Sprint, Aldus PageMaker, Microsoft Excel, Word Perfect, Dataease and as many as 80 other programs. And using the DESQview API, be able to dynamically link them.

More bang; less bytes

While other programs get bigger, we've worked to make DESQview smaller. And we've succeeded in a big way on PCs and PS/2's with extended, EMS 3.2 (AboveBoard), EEMS and EMS 4.0 memory—as well as on 386 PCs and



DESQview lets you run your favorite programs in windows side-by-side.

PS/2s. For example, DESQview overhead on EMS 4.0 and 386 PCs can be as low as 10K on EGA/VGA PCs. And DESQview actually increases memory 30K on CGA PCs; 20K on monochrome and Hercules PCs. That's good news for users of big desktop publishing, CAD and database programs.

Introducing DESQview 386

For users of 80386 PCs and PS/2s (or PCs with 80386 add-in boards, such as the Intel Inboard 386), there's DESQview 386 (a combination of DESQview 2.2 and the new QEMM-386

Quarterdeck Expanded Memory Manager, version 4.2).

DESQview 386 gives you extraordinary power. Run text, CGA, EGA, VGA, and Hercules programs in windows and in the

background. Run 32-bit 386 programs, like Paradox 386, and IBM Interleaf simultaneously with your favorite DOS programs. All with the speed and performance you expect out of your 386. And with protection against 'misbehaved' programs.

Promise and performance

And, of course, both DESQviews have all the features that made prior versions the popular choice in operating environments. The ability to multitask in 640K and beyond. View programs in windows or full screen. Transfer data. Access DOS via menus. Dial your phone. And create key-stroke macros within and between programs.

Our story gets better and better

If there's any doubt about our commitment to your PC and PS/2 productivity, just look at our accomplishments over the years. We think you will understand why GE, Ford, Aetna, Monsanto, and so many other major corporations use DESQview.

And why PC Magazine twice gave DESQview its Editor's Choice Award for "The Best Alternative to OS/2," why readers of InfoWorld voted DESQview "Product of the Year" three times. Why, by popular vote at Comdex Fall for two years in a row, DESQview was chosen "Best PC Environment" in PC Tech Journal's Systems Builder Contest, and just won their "Professional Solutions" Award.

DESQview lets you have it all now.



ek Delivers.

QEMM. Break the 640K barrier for \$59.95

Your 80386 PC, IBM Personal System/2 Model 80, PC or AT with 80386 add-in board, as well as your IBM Personal System/2 Models 50 or 60 can all break through the DOS 640K barrier. Now you can have maximum use of your memory—whether you have one megabyte or 32—with the Quarterdeck Expanded Memory Manager. All without having to purchase special expanded memory boards.

QEMM uses hidden features within your existing memory to make it compatible with the Lotus-Intel-Microsoft Expanded Memory Specification (EMS) version 4.0.



Now you can run colossal spreadsheets, databases, and CAD models designed for expanded memory, using Lotus 1-2-3, Symphony, Framework, Paradox, AutoCAD, Excel and more.

And if you'd like to use these programs all together—multitasking beyond 640K—QEMM works with our popular DESQview multitasking environment.

If you are one of the 12 million or so 8088, 8086 or 80286 PC users who feel left out, don't despair. We have options that let you keep your computer and favorite programs and give you today what the newest PCs and operating systems are promising for the future.

Visit your dealer for more information on barrier-breaking Quarterdeck products.

DESQview API Toolkit. New C and Pascal Libraries, Debugger, Panel Designer. And more.

**DESQview API
Conference '89**
Coming in August
Write for details

API Reference Manual

The key to the power of the DESQview API, our Reference Manual contains all you need to know to write Assembly Language programs that take full advantage of DESQview's capabilities. And there's an 'include' file with symbols and macros to aid you in development.

API C Library

Here are C language interfaces for the entire set of API functions. It supports the Lattice™ C, Metaware™ C, Microsoft® C, and Turbo C compilers for all memory models. Included with the C Library package is the API Reference Manual and source code for the library.

API Pascal Library **NEW!**

The Pascal library provides interfaces for the entire set of API functions. It supports Turbo Pascal V4.0 and V5.0 compilers. Included are the API Reference Manual, source code for the library, and example programs.

API Debugger

The DESQview API Debugger is an interactive tool enabling the API programmer to trace and single step through API calls from several concurrently running DESQview-specific programs. Trace information is reported sym-

bolically along with the program counter, registers, and stack at the time of the call. Trace conditions can be specified so that only calls of interest are reported.

API Panel Designer

This interactive tool helps you design windows, menus, help screens, error messages, and forms. It includes an editor that lets you construct an image of your panel using simple commands to enter, edit, copy, and move text, as well as draw lines and boxes. You can then define the characteristics of the window that will contain the panel, such as its position, size, and title. Finally, you can specify the locations and types of fields in the panel.

The Panel Designer automatically generates all the DESQview API data streams necessary to display and take input from your panel. These data streams may be grouped into panel libraries and stored on disk or as part of your program.

More Tools are Coming

Quarterdeck is committed to adding tools as needed by our users. To that end we have been working with Ashton Tate and Buzzwords International on dBASE III and dBASEIV translators. And in the works, we have BASIC and DOS Extender libraries.

Quarterdeck

Quarterdeck Office Systems, 150 Pico Blvd., Santa Monica, CA 90405 (213) 392-9851
FAX: (213) 399-3802

For additional information, please use the following Reader Service numbers: DESQview: # 234 QEMM: # 235 API Tools: # 236 API Conference: # 237

UNIX WORLD
Reader's
Choice

VOTED #1 BEST OF
UNIX COMMUNICATIONS SOFTWARE

ONE COMMUNICATIONS PROGRAM THAT MAKES ALL OF OUR INCOMPATIBLE COMPUTER SYSTEMS COMPATIBLE?

I CALL THAT UNLIKELY.

They call it TERM.

TERM runs identically under DOS, UNIX, XENIX, VMS, BTOS and MAC?

TERM is keystroke-for-keystroke compatible across all of our different computer systems and offers features like automatically restartable file transfers, data compression and CRC error detection.

But, can it be customized?

TERM's built-in script language is so sophisticated that it allows exact solutions to be tailored to our specific needs. In fact, there are over 25 pre-built scripts provided for solving problems like unattended file transfers, remote system polling, and error logging. TERM script allows building customized menus, data entry screens and pop-up windows designed for your unique applications.

And it talks to non-TERM systems?

Fluently. TERM comes with nine protocols and thirteen terminal emulations... that's enough to communicate with a wide variety of different systems.

DEC Terminal Emulation?

Wait till you see it. TERM's VT220 emulator meets the needs of all of our divisions by providing exact VT220 and VT102 emulation on all terminals. We've got full graphics character support even under Unix...not to mention Televideo, SCO color console and the other emulations.

Where did you find it?

I called: 801-268-3088

Circle 54 on Reader Service Card
(DEALERS: 55)

All orders shipped 2nd Day Air

TERM. Powerful Communications.

Features:

- ✓ Automatically restartable file transfers
- ✓ State-of-the-art Lempel-Ziv-Welch data compression
- ✓ Exact VT220, VT102, and VT100 Emulation on ALL systems
- ✓ Fully remappable keypad support
- ✓ Full color support
- ✓ 38.4K file transfers
- ✓ KERMIT Protocol for mainframes
- ✓ XMODEM and YMODEM Protocols for bulletin boards
- ✓ Remote PC execution
- ✓ Powerful script language for customized applications
- ✓ Wildcard file send/receive capability
- ✓ Auto-login, dial/redial modem control
- ✓ Unlimited autodial directory
- ✓ Performs unattended file transfers
- ✓ Remote maintenance capability
- ✓ Online User's Manual for instant help
- ✓ Electronic mail/TELEX/FAX
- ✓ Easylink/MCI Gateway

TERM is available now on Altos, Apple Macintosh, Ariz/Arete, AT&T, British Telecom, Bull, Burroughs, CCI, Celenity, Convergent Technologies, Counterpoint Systems, Cubix, DEC VAX, Fortune, Gould, Harris, Heunikon, Hewlett Packard, Honeywell, IBM, ICL, ICON, IMP, Integrated Solutions, Intel, Jargon, Lanier, Masscomp, Momentum, Motorola, NCR Tower, Nixdorf Targon, Northern Telecom, Plexus, Prime, Pyramid, Ridge Computer, Sequent, Sigma Designs, Sun Workstation, Tandy, Unisys, Victor, Wang PC, Zenith and Zilog. Find out how easy it is to get your VMS, UNIX, XENIX and MSDOS machines all together.

TERM

COMMUNICATIONS SOFTWARE

Call or write for complete information

 **CENTURY**
SOFTWARE

5284 South 320 West, Suite C134 Salt Lake City, Utah 84107 (801) 268-3088



DAWN OF THE DEAD DISK

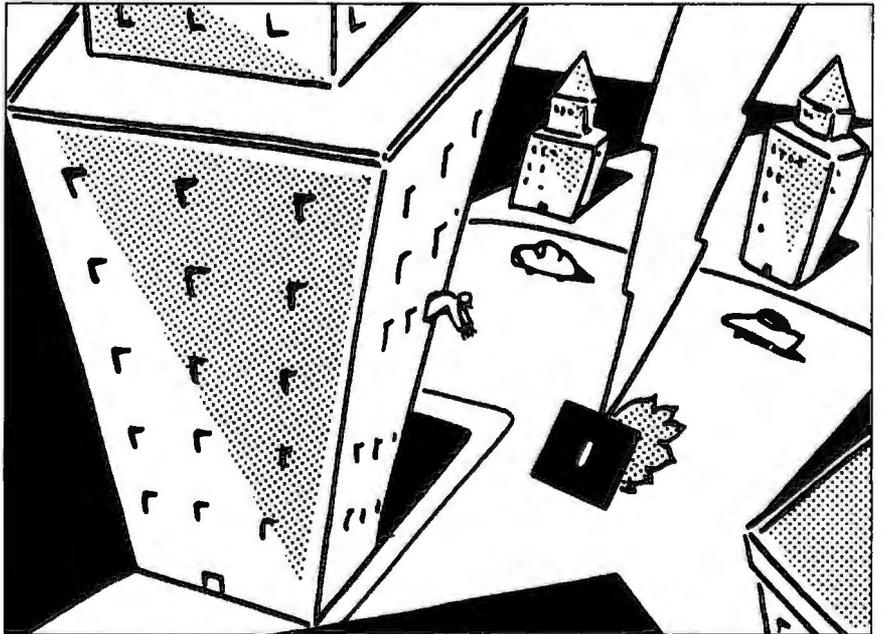
What do you do when your hard disk goes down and takes your data with it?

If I asked you to name the element of your computer system that is worth the greatest amount of money to your business, what would you say? Most people would pick an expensive CPU or perhaps a network file server. And they'd be wrong. In any business that depends on a computer, the most valuable component is the information contained in the computer's storage, not the hardware itself. If you have your business and accounting records on the computer, the operation of your business depends on your having access to the information. This is compounded if your product also exists on the computer, as it well might if you have a consulting company or programming shop.

Whether your company depends on a mainframe or on a personal computer doesn't matter. What does matter is that mainframe users usually have a full-time staff assigned to keep the information safe and available. Businesses that depend on personal computers usually don't have such a staff. As a result, data backups don't always happen, and when they do happen, they may be defective or stored improperly.

Without timely, complete backups, your business may well depend on the mechanical health of a \$200 hard disk. One day you may find that a thunderstorm the night before fried the electronics in your disk. Or you may find something less dramatic, such as drive C suddenly not being available any more.

Coping with the message "Invalid drive specification" when you try to use your hard disk is no fun. It's no fun even if you have complete backups, but it's a



lot less fun if you haven't been as faithful as you should have been. Fortunately, help is available.

Depending on the nature of the problem, you can send your hard disk to a company that specializes in data recovery, or you can buy software and try to do it yourself. Some problems, such as a hard disk that's been fried by lightning or dropped, or that seems to have suffered some mechanical or electronic failure, will require you to send the drive out. Others, including scrambled directories and file structures, can be done by you or sent out. The choice there depends on your skill and confidence.

Major Surgery

When something really awful happens—your computer catches fire or falls from a window or something—you have little hope of recovering the data yourself. In times like these, you will need to call a professional data recovery service that can actually rebuild a hard disk to the ex-

tent necessary to remove the information that's on it. One of the clear leaders in this field is Ontrack Data Recovery.

Ontrack has been known to extract data from disks that have been in fires, have had their electronics fried, or have simply suffered from mistakes on the part of their operators. Because it has a clean room, Ontrack Data Recovery can take your hard drive apart to repair it, if necessary. Ontrack can even move the hard disk platters from one drive to another to get the data off.

Of course, most failures are not quite so catastrophic, and most of Ontrack's business comes from problems with head alignment and from failure in the electronics. Ontrack says that it will turn a data recovery job around in as few as three days.

Workman & Associates, long a respected supplier of software for personal computers, has recently expanded its services to include data recovery. It takes

continued

ITEMS DISCUSSED

DOSutils \$99.95
 NetUtils \$99.95
 Ontrack Computer Systems, Inc.
 6321 Bury Dr., Suites 16-19
 Eden Prairie, MN 55346
 (800) 752-1333
 (612) 937-1107
Inquiry 1101.

Mace Gold.....\$149
 Paul Mace Software, Inc.
 400 Williamson Way
 Ashland, OR 97520
 (503) 488-0224
Inquiry 1105.

Norton Utilities Advanced
 Edition 4.5\$150
 Peter Norton Computing, Inc.
 2210 Wilshire Blvd., Suite 186
 Santa Monica, CA 90403
 (213) 319-2000
Inquiry 1104.

Ontrack Data Recovery, Inc.
 Initial estimate:
 hard disk \$200
 floppy disk \$100
 Recovery \$300-\$800
 (See Ontrack Computer Systems,
 Inc.)
Inquiry 1102.

Workman & Associates
 Initial estimate \$90
 Recovery \$45/hr.
 Rush \$65/hr.
 1925 East Mountain St.
 Pasadena, CA 91104
 (818) 791-7979
Inquiry 1103.

disks that are not physically damaged but have lost their data through electronic or operator problems.

Both Ontrack and Workman & Associates use a variety of commercial and proprietary software tools to recover the information from a disk. For competitive reasons, neither company will reveal what those tools are, but they do agree on

one item: Patience is the most important part of the process.

While I couldn't find out exactly what Ontrack and Workman & Associates do to recover scrambled or lost data from disks, I could at least get some ideas about Ontrack. Ontrack Computer Systems, the parent company of Ontrack Data Recovery, sells a set of data recov-

ery and disk management tools called DOSutils, which combines data recovery with hard disk diagnosis, formatting, and optimization.

Unfortunately, DOSutils was thrown off by the hard disk and controller combination I had in the Cheetah 386. This is an ESDI controller with 4 megabytes of cache from Distributed Processing Tech-



With the ever-growing list of mass storage vendors, how do you choose the company that will best meet *your* mass storage needs?

Consider this: Storage Dimensions has specialized engineering and marketing teams dedicated to designing comprehensive mass storage solutions for *your* operating environment. Whether it's DOS, NetWare® or Macintosh® —hard disk or optical.

In fact, we design, build and support the broadest range of high-performance mass storage subsystems in the industry.

A Complete Solution From Start To Finish.

Many so-called storage subsystems are really no more than a collection of third party components thrown together in a box. At Storage Dimensions, we design our plug-and-play subsystems using a "total systems" approach.

We start by developing our own software, firmware and host adapters. Which lets us achieve the highest performance and reliability in the industry. We also engineer and test all components to

ensure they work together in *your* application environment.

And we finish the job with responsive service and knowledgeable technical support.

What Makes A Total Storage Solutions Company?

- Completely Integrated Solutions
- High-Quality Disk Drives
- Software Support for Novell®, DOS & Macintosh®
- In-House Controller Design
- All Components Tested as a System
- Responsive, Knowledgeable Technical Support
- Comprehensive, Easy-To-Use Documentation
- Full One-Year Systems-Level Warranty
- Financially Strong Company
- Support for AT™ Bus, Micro Channel™ & Macintosh

Total Storage Solutions.

nology. It works well with the Cheetah and its Priam drive, but DOSutils was convinced that the drive had an average seek time of less than 1 millisecond. Meanwhile, the Disk Look utility refused to look at all.

Ontrack also makes a utility called NetUtils for managers of Novell LANs. While I didn't have the chance to wring this package out, it offers many of the utilities found in the DOS version. One potential problem is that NetUtils is designed for standard IBM PC AT controllers, while the Novell-branded file server normally uses a SCSI disk interface. Still, this is about the only set of disk utilities available for use with NetWare, so if you're a system administrator, you should check it out.

Norton Expands

One of the original sets of packaged utilities for disk management was the Norton Utilities. Over the years, this set of programs has been improved and expanded. Once, its most popular feature was its ability to restore a file that had been erased. It still does that, but now it will restore a hard disk that has been for-

Clearly,
there are many ways
to recover your data
if you need to.

matted, let you edit the file allocation table or the directory, and do direct editing on any other portion of the hard disk, including the boot record.

The new version of Norton Advanced Utilities is a powerful set of programs indeed. Fortunately, it is accompanied by a complete set of three manuals. It also includes an excellent book on troubleshooting and a slim volume that tells how a hard disk works with MS-DOS. If anything is missing, it is explicit coverage for types of DOS beyond those supplied by IBM and Compaq. Fortunately, there are very few differences among the types of DOS, but there are some.

Unlike the software from Ontrack, the

Norton Utilities were not thrown off by the Cheetah 386 and its Priam disk and ESDI controller. For some reason, though, the package did seem temporarily confused by the existence of a second hard disk in my Zenith Z-248, although I was able to overcome the problem.

The Norton Utilities are designed to allow easy access to any spot on your hard disk. This is good in that you can correct anything, but you do have to know what you're doing. It's easy to make a mistake, but that's the price you pay for the power you need to recover your data. The Norton Utilities also have a solid selection of disk management software that will reduce file fragmentation, check for sectors that are going bad, and the like.

Of course, these capabilities are also in Mace Utilities, which have been around nearly as long as Norton. Paul Mace was the first to market a program that would restore a hard disk that had been formatted. This used to be a common problem until the format programs were changed to make it harder to do. The Mace Utilities also include a data

continued



Complete Subsystems For DOS, NetWare And Macintosh.

With Storage Dimensions' extensive line of storage solutions, you get the performance and capacity you need, and the choices you want. No matter what your desktop application.

Our field-proven families of high-performance subsystems deliver a broad range of options—from 45 megabytes, to 2.6 gigabytes, in both internal and external configurations. With support for all popular interfaces.

Plus, our subsystems install easily in minutes, are 100% compatible with your operating environment, and deliver exceptional reliability.

Hard Disk And Optical Subsystem Families.

Product Family	Application	Capacity Range	Interfaces Supported
SpeedStor™	PC/MS-DOS	120 MB to 2.6 GB	ESDI, SCSI, ST412, RLL
LANStor™	Novell NetWare	115 MB to 2.6 GB	ESDI, SCSI, ST412, DCB
LaserStor™	Write-Once Optical PC/MS-DOS & Mac	786 MB (DOS) 732 MB (Mac)	SCSI
MacinStor™	Apple Macintosh	45 to 650 MB	SCSI

Get Your Mass Storage Needs In Line. Call (408) 879-0300.

Don't trust your valuable data—or your business—to an incomplete storage solution. Call the company that does it right from the start.

More In Store.™



2145 Hamilton Avenue, San Jose, CA 95125

Across The Line.

©1989 Storage Dimensions. SpeedStor, LANStor, LaserStor and MacinStor are trademarks of Storage Dimensions.



A Brand New Resolution The Handy Scanner HS-3000

Free HALO DPE™

The handiest little scanner in the world just got even better! The Handy Scanner 3000 from DPI offers you clarity and versatility in a little package. Like our other Handy Scanners, the Handy Scanner 3000 for the IBM PC, PS/2, and compatibles can handle almost all the jobs the desktop models can, but it's smaller and easier to use.

We give you the features you need the most in a Handy Scanner. The new 4-bit scanning width makes short work of the heaviest pictures. You can watch the scanner operate. The adjustable DPI For those really important pictures, the Handy Scanner 3000 lets you have it all with 400 DPI resolution. The real-time screen display lets you manually set your scan, so you can quickly make scanner adjustments as necessary. With adjustable half-tones and contrast, you get a clean, clear picture. Two out-

of-the-way, get more in size and originality. No extra work or extra time. No extra cost for scanned without being asked!

The Handy Scanner 3000 comes complete with full-featured professional software for scanning, editing, and saving text with your graphics. Scan over 100 different compatible with almost all graphics software, including PageMaker, SmartDraw, WordPerfect 7.0 and many others. The package includes the scanner, an interface card, the HALO DPE desktop publishing software package (worth \$195), a utility diskette and an instruction manual.

The Handy Scanner 3000 is a little scanner that does a lot and does it even better.

ADDED SPECIAL NOW OCR SOFTWARE AVAILABLE

Converts scanned images from scanner into ASCII text for use with word processors, data bases, etc.

Reg. \$199.95
If purchased with HS-3000 ONLY

\$79.95

LOGITECH SCANMAN

- 200 dpi
- 4" scanning width
- IBM, PC, XT, AT, PS/2 (25 & 30)



Complete with Logitech® "Scanware"™ software

\$189.95

QUALITY CUSTOMER SERVICE 800-278-8545
TECHNICAL ASSISTANCE 800-278-8548

TOLL FREE ORDER LINE
1-800-635-0300

TRUE DATA PRODUCTS
115 MAIN ST., P.O. BOX 347
UXBRIDGE, MA 01568
508-278-8555
HOURS: MON-FRI 9-4, SAT 10-4 (EST)

CORPORATE P.O.'S WELCOMED

ALL PACKAGES SHIPPED UPS EXCEPT CANADA AND A.P.O.'S C.O.D.'S ADD \$2.30 MASTER CHARGE/VISA ADD 3% 1 YEAR WARRANTY UNLESS OTHERWISE NOTED PRICES TERMS CONDITIONS SUBJECT TO CHANGE WITHOUT NOTICE

DOWN TO BUSINESS

recovery program for dBASE files, and a program that saves the contents of memory to disk periodically, so that you can even recover from a power outage.

The Mace Utilities disk management software helps ensure against hard disk failure by allowing sectors that are going bad to be locked out before they actually destroy data. In addition, there's a text-file data recovery program that works with disks that DOS may not recognize.

Eliminating the Problem

Clearly, there are many ways to recover your data if you need to. Unfortunately, even the best of recovery services or recovery software can't recover data that's destroyed. "When it really heads for the weeds," Motorola's Bill Lucas told me, "a little software isn't going to stand in the way of total destruction." He's right, and there are still several ways for total destruction to happen. A software development project gone amok is fairly common, but so is the physical destruction of the magnetic surface of the disk. When these things happen, you're out of luck.

The real solution, then, is the one that the mainframe staffs already use. It's called backup. If the information on your computer is important to the operation of your business, it should be backed up daily, unless you can afford to lose a day's work. The backup data should not be stored in the office with the computer. A backup is of little value if it burns in the same fire that gets the computer. Many companies simply send the daily backup home with a trusted employee.

With the advent of networks and large hard disks on microcomputers, floppy disks have become less attractive as a backup medium. A logical alternative is a tape drive, which can be found inexpensively. I'll be looking at tape backup units soon. Meanwhile, you may have recourse if your hard disk suddenly disappears from view. The range of services available makes it likely that someone will find a way. Unfortunately, it won't be cheap. But replacing your company's information wouldn't be cheap, either. ■

Wayne Rash Jr. is a consulting editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults 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.

Finally . . . a low cost, high speed copier for 5¼ and 3½ inch diskettes!

Attach a Victory V3000 Autoloader to your IBM/PC or Apple/Macintosh, enter one or more copy jobs, and walk away! The system automatically copies 5¼ or 3½ inch diskettes—up to 140 per hour. Switching the copy drive takes less than a minute.

Copy Formats Flawlessly. Victory's Auto-Dup™ software copies different formats or you can

build your own format. Auto-Dup tests the quality of each copy, sorting diskettes into one of two output bins.

Do-It-Yourself Servicing. The Autoloader's simple component design and diagnostics for checking drive alignment and speed allow you to maintain the system without outside service.

Call (800) 421-0103. And ask about Victory's family of affordable Autoloaders that support

Hard Drive Back-Up, Serialization, and Custom Label Printing.



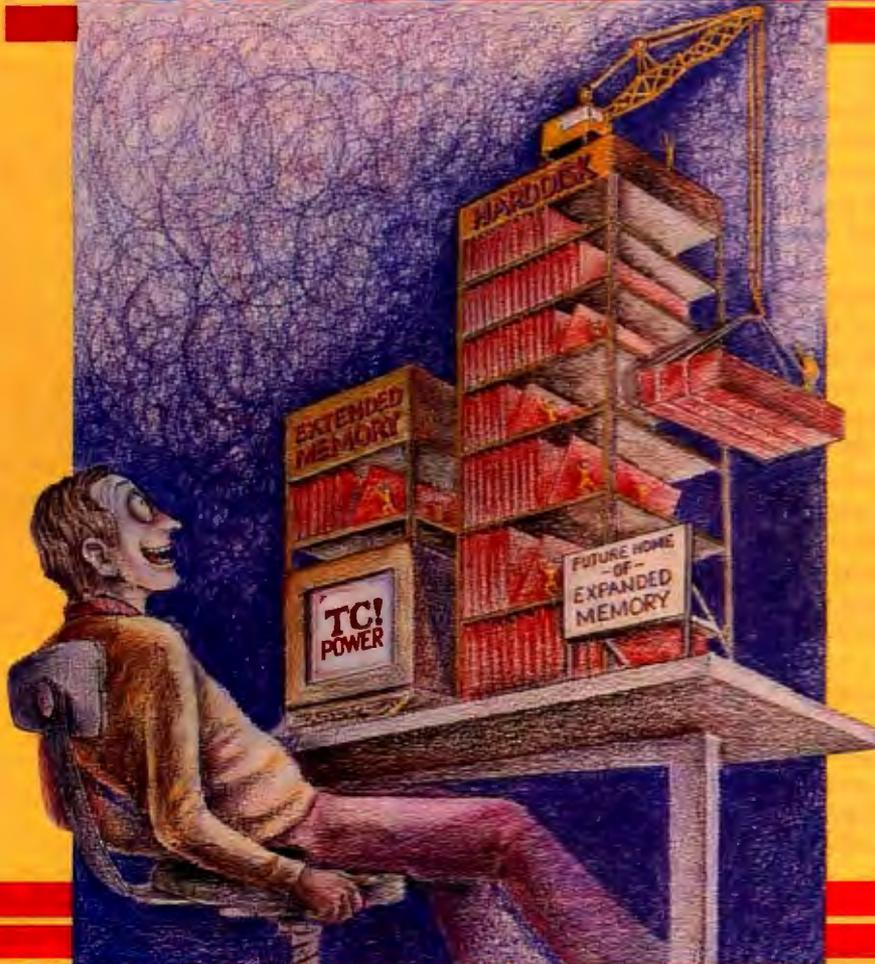
VICTORY ENTERPRISES
Technology, Inc.
Victory Plaza
1011 E. 53½ Street
Austin, TX 78751-1728
(512) 450-0801

Internationally call BFI: Paris (33-1) 45330137, Frankfurt (49-6974) 40980, London (44-622) 882467, Milan (39-2) 33100535, Stockholm (46-8) 6269900, or Madrid (34-1) 2529503, or LOADPLAN: London (44-1) 2007733 or Melbourne (61-3) 5254088.



THE EXPANDED MEMORY BUILDER

TC! POWER



EXPANDED MEMORY SOFTWARE

Now you can build Expanded Memory that MS-DOS can use, from your unused extended memory, free hard disk space or both. Eliminating the need for expensive expanded memory boards.

TC!Power lets you gain more memory on your PC and portable computer for today's larger programs. Don't let your unused extended memory or free hard disk space in your computer go to waste. Let TC!Power convert it into Expanded Memory that MS-DOS can exploit.

This new and exciting product, TC!Power, will let you add enormous amounts of memory to your system, thereby optimizing the use of your machine's hidden resources.

TC!Power breaks the 640kb DOS barrier and eliminates the out of memory and memory full messages when running today's bigger programs that use the Lotus / Intel / Microsoft EMS specifications like Lotus 123,

Symphony, Quattro, SideKick Plus, Auto Cad and Harvard Graphics.

TC!Power accomplishes the task of building EMS memory for computers with only 640K of RAM by turning free hard disk space into expanded memory. Memory that DOS can use.

TC!Power also senses unused extended memory on AT 286 and 386 computers and converts this extended memory into useable expanded memory. If needed, additional expanded memory can be built from free hard disk space and added to the already converted memory.

TC!Power is easy to use and easy to learn, designed for the non-experienced and intermediate user. Its installation and configuration program are com-

pletely automatic and menu driven with context sensitive help always available at the touch of a key.

As more and more programs grow in size, expanded memory will almost become a necessity. TC!Power has been developed to create all the expanded memory you will need at an affordable price, thereby eliminating the need to purchase an expanded memory board costing \$500.00 to \$1,000.00 dollars or more.

A TAKE CHARGE!® PRODUCT

\$79.95 Plus \$5.00 Shipping and Handling

Major Credit Cards Accepted

Tel 201-786-6878 / FAX 201-786-5868

All product names are trademarks of their manufacturers copyright 1989 Compufix. All rights reserved.

FLEXSCAN™ 9070S, PC Hi-Res That Looks Like a Million.

The FLEXSCAN 9070 Multiple Scan monitor is of course compatible with other multi-scans, but includes improvements that will give you the professional edge which is the mark of a good investment.

You can extend your multi-scan range from 20kHz to 50kHz in practical terms. This means that, at the 48-50 kHz range, you can make use of PC CAD/CAE capabilities at a resolution of up to 1024 dots × 768 lines. The FLEXSCAN 9070 takes advantage of non-interlace high resolution signal as high as 1024 × 768 to provide you with a flicker free display at much brightness. You can also use the 9070 with IBM PS/2 or VGA compatible boards at a high resolution mode like 800 × 600 and 1024 × 768 (non-interlace).

The FLEXSCAN 9070 provides a 16-inch screen, large enough for CAD/CAE and 3-D projections, yet small enough to fit comfortably into your home work space.



1024 dots × 768 lines Graphics (Non-interlace)
AutoCAD



Also, for your convenience, all controls and switches, including the alternate video input, are located within easy reach on the front panel. The FLEXSCAN 9070 is compatible with a wide range of IBM, Apple, and other products, allow you to use all of today's popular programs---at a resolution that looks like a million.

FLEXSCAN™ MODEL 9070S

- IBM VGA(PS/2), 8514/A, PGC, EGA compatible and CAD/CAE use.
- Apple Mac. II and SuperMac Spectrum compatible
- Max. 1280 dots × 800 lines high resolution
- 1024 dots × 768 lines display on Non-Interlace signal delivers flicker-free high-res graphics
- 20kHz to 50kHz horizontal scan automatic adjustment. 50Hz to 80Hz vertical scan automatic adjustment
- 16 inch, 0.31mm dot pitch and newly developed XF(Extended Field) Gun to obtain both brightness and sharp focus.
- Front mounted controls including the input signal select switch between 2 video input.
- Selecting white or Amber displays colored application in shades of gray or amber
- Tilt-Swivel stand standard

NANAO®

NANAO USA CORPORATION

23510 TELO AVE., SUITE 5 TORRANCE, CA 90505
PHONE (213) 325-5202 FAX (213) 530-1679

Specifications are subject to change without notice.

APPLE, Macintosh II are registered trademarks of Apple Computers Inc. ARTIST, ARTIST I Plus, ARTIST 10, ARTIST 10/16 are trademarks of Control Systems Inc. IBM, IBM PC, XT, AT and PS/2 are registered trademarks of International Business Machines Corporation. SuperMac is a trademark of SuperMac Technology. SuperEGA HP/EM, SuperVGA and SuperVGA HiRes are trademarks of Genoa System Corporation. Orchid Designer VGA, Orchid Designer VGA-2, TurboEGA and TurboVGA are trademarks of Orchid Technology. Paradise VGA Professional Card, Paradise VGA Plus Card and AutoSwitch EGA are trademarks of Paradise Systems, Inc. Paradise Systems is a registered trademark of Paradise Systems, Inc. VEGA Deluxe and VEGA VGA are trademarks of Video-seven Inc. Mathaus is a registered trademark of Mathaus Corporation. Imaginix is a trademark of Imaginix Corporation. AutoCAD is a registered trademark of Autodesk, Inc. GEM is a registered trademark of Digital Research Inc. Lotus and 1-2-3 are registered trademarks of Lotus Development Corporation. SigmaVGA and SuperEGA are trademarks of Sigma design, Inc. FLEXSCAN is a trademark of NANAO CORPORATION. NANAO is a registered trademark of NANAO CORPORATION.



LEARN ON ME

The Mac provides new ways to handle engineering and scientific courseware

Courseware (or computer software that helps you learn) used to be called computer-aided instruction (CAI) or computer-enhanced instruction (CEI). That's because courseware used to mean mostly drill and practice—learning by rote. Pretty simple stuff, really. Even well-developed CAI software, like the main-frame-based Plato system from the University of Illinois, relied heavily on drill and practice to drive home its lessons.

However, in the last couple of years, what defines courseware has broadened considerably, as techniques borrowed from AI, multimedia, and learning research have been increasingly applied to this field. The Macintosh has helped accelerate these changes, especially in science and engineering courseware, where software that takes an exploratory approach to teaching has emerged from colleges and universities.

Almost from the beginning, the Macintosh has been a natural platform for the development and use of computer courseware. The Mac has always had the basic capabilities that courseware demands: a high-resolution screen and excellent graphics primitives that permit a user interface with icons, windows, and scroll bars; a mouse; and decent sound facilities. With the emergence of the modular Mac II family, Apple has further improved its courseware platform. The Macs in this family provide color, as well as bigger screens, more memory, faster processors and FPUs, and better sound than their compact cousins. These new features, plus NuBus slots that let you plug in peripheral cards suitable for data



acquisition and real-time control, make them suitable for science and engineering courseware.

The Medium Is the Message

Most Mac science and engineering courseware is written strictly for the Mac. In other words, the Mac forms a single-medium learning platform for the courseware student. Over the next few years, however, you'll see a greater use of multimedia-based science and engineering courseware. Such software will incorporate visual and acoustic information from nontraditional sources like videodisk (laser disk), videotape, interactive video (CD-I), compact disk video (CD-V), CD-ROM, and 35mm slides.

One of the strongest boosters of multimedia-based courseware has been Apple. Almost from the start, Bill Atkinson and others at Apple envisioned HyperCard as having many uses in courseware authoring and development. Because HyperCard and HyperTalk are reasonably easy

to learn and are bundled with every Mac, there has been a considerable incentive among potential science and engineering courseware authors to take advantage of them. With HyperCard 1.2's CD-ROM control facilities, science and engineering courseware developed using HyperCard now has a suitable medium for the storage of large files often needed by simulations and analysis programs.

CD-ROM may also prove to be an excellent medium for the distribution of ambitious and large-scale courseware in medicine, electrical engineering, and biological sciences. Some courseware has already been developed for these disciplines, but one problem has always been including enough descriptive data to teach a detailed technical discipline.

CD-ROM could also solve the data- and software-dissemination problem for interdisciplinary science and engineering courseware, where techniques from these fields are applied to the analysis

continued

and understanding of subject matter from the humanities and social sciences. Often, the knowledge base for good interdisciplinary software are lexicons or concordances of millions of words or the original texts themselves. Before CD-ROM, the solution was to build such courseware around very small textual or visual samples. Since a CD-ROM disk has a capacity of over 650 megabytes, science and engineering interdisciplinary courseware authors can create applications based on the real data, not on some sketchy samples or tiny extracts.

While the Mac is being used in junior high schools and high schools, most of the science and engineering courseware already developed for the Mac is pitched at the college student. Courseware under development at most universities also starts with the college student in mind.

Courseware Developers

Although some science and engineering courseware is developed and sold by commercial software vendors, most of the courseware used in higher education comes from within the schools. The reasons that both the developers and the consumers of this type of courseware come from the same institutions are simple. First, only the universities truly know their pedagogical needs, especially in the technical disciplines. Second, home-grown software can be developed under the auspices of federal grants (especially from the National Science Foundation) and local university grants, which pay for the development costs. Once the software has been developed for a local university market, it's easy to sell to other universities through mechanisms provided by the Apple University Consortium (AUC) and Kinko's Academic

Most courseware is developed by the universities that use it.

Courseware Exchange.

The AUC now consists of 30 institutions. Among its other functions, it shares information and development efforts on courseware development and the use of multimedia within courseware units as an instructional aid. Information about current AUC science and engineering courseware developments can be found in the quarterly journal *Wheels for the Mind*, which is available to anyone interested in educational computing. *Wheels* does a good job of chronicling the individual courseware development efforts at AUC schools, while also focusing on special courseware-related topics. The Fall 1988 issue, for example, incorporated articles on multimedia in education, hypertext in teaching, medical instruction on the Mac, and software engineering courseware.

Authoring Systems

As I mentioned earlier, much of the early CAI software belonged in the drill-and-practice category before the introduction of the Macintosh. Part of the reason was that the programmers who created CAI software were often not subject-matter or pedagogy specialists. They got the job by virtue of their programming exper-

tise. This scenario started to change a year or so after the introduction of the IBM PC (1981), when several software vendors introduced computer courseware authoring packages that did not require specialized programming knowledge for their effective use. One of the most popular of these early courseware authoring programs was McGraw-Hill's Course Authoring System, running under DOS.

On the Mac, the availability of authoring systems like Telerobotic's Course Builder has helped push the development of science and engineering courseware. Course Builder uses a flowchart metaphor to allow scientists and engineers, who may not be familiar with CAI teaching techniques or know much about courseware creation, to create stand-alone courseware in their fields.

Course Builder is really a visual language (not unlike Mainstay's V.I.P. language) that is incorporated into a full-blown system encompassing a graphics editor, animation capabilities, sound-presentation tools, real-time calculation abilities, and a true Mac interface for all courseware created. Automatic branching facilities make it easy for authors to keep their lessons interesting without getting sidetracked into CAI model testing. Course Builder also generates a record for each student who uses a created application, so you can track students' progress.

A companion product to Course Builder, called Video Builder, allows the courseware author to control full-motion video or 35mm slide sources for display on appropriate Mac II color screens, separate video monitors, or slide projection screens. Video Builder can control videotape player/recorders, laser disk players, or slide projectors to introduce additional visual or sound elements into a course created with Course Builder. Video Builder is especially useful for providing ancillary visual material to support the main points of any courseware lesson.

A good example of this might be a courseware program that teaches students about the basic techniques for VLSI design. While it's necessary for students to master the symbols, electronic methods, and logical basis for VLSI design (which your courseware would presumably facilitate), you can add tremendously to the learning experience by including video selections of the actual fabrication of VLSI chips or a discussion by professional VLSI engineers about the practical problems of the field.

continued

REPRESENTATIVE COURSEWARE

Calculus \$99.95
Physics \$99.95
Sensei/Broderbund Software
17 Paul Dr.
San Rafael, CA 94903
(415) 492-3200
Inquiry 1183.

DesignScope\$249.95
MathView Professional....\$249.95
Brainpower, Inc.
30497 Canwood St., Suite 201
Agoura Hills, CA 91301
(800) 345-0519
In California, (818) 707-1712
Inquiry 1185.

Mathematica
Mac Plus/SE version\$495
Mac II version\$795
Wolfram Research, Inc.
P.O. Box 6059
Champaign, IL 61826
(800) 441-6284
Inquiry 1186.

Tarski's World \$16.50
Turing's World \$15
Kinko's Academic Courseware
Exchange
255 West Stanley Ave.
Ventura, CA 93001
(800) 235-6919
Inquiry 1184.



PS/2 model 30/286	1949
PS/2 model 50/30 meg	2695
PS/2 model 70/60 meg	3895
PS/2 model 80/40 meg	4395
PS/2 model 70/120 meg	5595
PS/2 model 80/115 meg	Call
Call for other models	



386 S 40 meg	Call Call
386 20E - 40 meg	4595
286E 40 meg	Call
386 110 meg/25 MHz	7395
386 60 meg/25 MHz	5895
Portable III 40 meg/12 MHz	4095
CARD & MONITOR EXTRA	
Call for other models	

Macintosh

Mac-SE/20 Meg	2795
Mac-II/40 Meg	4249
Mac-SE-2 DR	2295
Call for 60 and 100 Meg	
Lazer NT	3595
Lazer NTX	Call

LOW PRICE LEADER

SINCE 1983

LAP-TOP

Compaq SLT 286-20	Call
SLT 286-40	Call
Toshiba T1000	Call
T1200F	Call
T1200HB	Call
T1600	Call
T3100E	Call
T3200-40 Meg	Call
T5100	Call
Zenith Supersport	
286-20 Meg	3195
286-40 Meg	Call
8088-20 Meg	Call
Epson LT	Call
NEC Lap-Top	Call
Mitsubishi 286-20	2595

Toshiba Sale! Call for all!

Everex

Step 286 - 12 & 16 MHz & 20 MHz
1 Meg RAM
Set up utility in ROM
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call! for your configuration

Everex

Step 386-20 MHz & 16 MHz & 25 MHz
Up to 256K cache of very high speed RAM
2 Meg RAM, expandable to 16 Meg
S/P, C/C
Enhanced keyboard
1.2 MB floppy
DOS/BASIC

Call



AST 286 model 140X	2350
AST 286 model 80	1495
AST 386 model 300c	Call
AST 386 40 Meg	3195

CARD & MONITOR EXTRA
CALL FOR OTHER MODELS

WE STOCK

CITIZEN
OKIDATA
EVEREX
GOLD STAR

TOSHIBA
NEC
WYSE
HITACHI

PRINCETON GRAPHICS
SONY
ACER
HOUSTON INSTRUMENTS

AMDEK
HAYES
SAMSUNG
CALCOMP

PC MOUSE
MICROSOFT MICE
LOGITECH
MITSUBISHI

IRWIN & ARCHIVE
TAPE BACK
TAXAN
MAGNOVOX

BOARDS

Paradise VGA +	285
Vega VGA	299
Everex EVGA	265
Everex EGA	179
Tatung 16 bit	265

SOFTWARE SPECIALS

dBase IV	455
Wordperfect	239
Aldus Pagemaker	479
Ventura Publisher	495
Clipper	415
Quatro	145



PRINTERS

EPSON	
LX-800/LQ-500	195/315
LQ-850/1050	535/735
OKIDATA	
320/321	359/490
390/391	490/649

LASER PRINTERS

HP Laser II	1695
HP Desk Jet ±	695
Panasonic 4450	1549
Brother HL-8	1949
Nec LC 890	3195
PageLaser 12	\$\$\$\$
Canon Laser	Call

MONITORS

Nec Multisync IIA	525
Nec Multisync 3D	649
Nec Multisync Plus	899
Nec Multisync XL-19"	2295
Samsung EGA	359
Goldstar VGA	375

FAX MACHINES

Sharp FO 220	875
Sharp UX 350	1249
Canon	Call
Brother	Call
Richo	Call
Murata	Call

Intel Coprocessors

8087-3	105
8087-2	145
80287-8	235
80287-10	275
80387-16	409
80387-20	499
80387-25	599

TOSHIBA

321-SL/341-SL	439/595
351-SX 350 CPS	895
BROTHER	
1709-9 PIN	425
1724-24 PIN	595

MODEMS

Everex 1200 Int	89
Everex 2400 Int	159
Hayes 1200 B	289
More in Stock	Call

WE ACCEPT LC, CASHIER CHECKS, MONEY ORDERS, VISA, MC, AmEx
3% charge on VISA, MC & 5% on American Express

EXPORTS Available

COMPUTERLANE

HOURS:
M-S 9-6

1-800-526-3482 (Outside CA)
(818) 884-8644 (In CA)
(818) 884-8253 (FAX)

22107 ROSCOE BLVD.
CANOGA PARK
1/2 BLOCK W. OF TOPANGA
CA 91304

CORPORATE ACCOUNTS WELCOME
CALL FOR VOLUME DISCOUNTS
CONSULTANTS CALL FOR PRICING

Prices subject to change without notice

Compaq is a Registered Trademark of Compaq
IBM is a Registered Trademark of International Business Machines

Hardware and Software Requirements

The minimum hardware and software requirements for courseware authoring systems like Course Builder and Video Builder aren't too demanding, and typically a Mac Plus and a hard disk drive will suffice. However, the actual learning station requirements (i.e., the computer system where students use the science and engineering courseware) are typically much greater.

Because you'll want to give students the best sound and visual presentation possible (especially critical in conveying the complex symbolic content of many science and engineering topics), a Mac II, IIx, or IIcx with a large hard disk drive and large-format color monitor is a requirement. And, naturally, to really develop courseware effectively for this platform, courseware authors need the same hardware.

If you decide to add full-motion video

This space represents the potential memory available in your Mac.

But this is all you've got.

Until now. But now there's a way to take full advantage of the Macintosh operating system's 8 megabyte capacity—without shelling out megabucks for expensive memory chips.

Introducing VIRTUAL—the virtual memory software for the Macintosh II, IIx, IIcx and SE/30. By putting information normally stored in RAM on your hard disk—and retrieving it transparently as required—VIRTUAL allows you to run multiple “memory hogs” concurrently under Multifinder. And at just \$295 (or \$695 for the Macintosh II), VIRTUAL not only helps with memory that's too full... it also helps keep your checkbook from getting too empty.

To order, call 415/324-0727.

MEGABYTES NOT MEGABUCKS CONNECTIX

Connectix Corp. 125 Constitution Dr. Menlo Park, CA 94025



ITEMS DISCUSSED

Course Builder\$395
 color version\$695
 Telerobotics International, Inc.
 8410 Oak Ridge Hwy.
 Knoxville, TN 37931
 (615) 690-5600
Inquiry 1181.

Wheels for the Mind
 1-year subscription (4 issues) ... \$12
 Peter Olivieri, publisher
 Apple Computer, Inc.
 P.O. Box 1834
 Escondido, CA 92025
Inquiry 1182.

to your courseware, you'll need a compatible videodisk or tape player (costing upwards of \$1000) for each student and developer, plus a color monitor to view the video (or a special National Television Systems Committee NuBus board that allows NTSC video to appear on a Mac II color monitor). For ambitious science and engineering courseware, these kinds of hardware requirements can be a severe burden to already-tight laboratory budgets. That's one reason why courseware that takes this kind of multimedia approach has been slower to develop and get disseminated than courseware that needs only a Mac.

The state of science and engineering courseware art can be summarized by two words: solid and growing. The Mac has solidified the development of this software with all the user-interface innovations for which Apple should be regularly applauded (even as I've groused at the company for its failings in some other areas).

The buzzwords for the next round of science and engineering courseware development will probably be hypermedia and multimedia. With more and more developers using HyperCard, CD-ROM, and laser disks, and the price of video peripherals dropping, the garden-variety science and engineering courseware that will be popular in the 1990s will have a very different look from the courseware of today. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. 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.

Not only does Telebit make the world's fastest modems, we also endorse your checks.

If you're looking for a high-speed, dial-up modem that endorses industry standards and more, check out the Telebit® T2500.

As well as transmitting data error-free at a lightning-fast 19,200 bps with Telebit's PEP™ modulation, the T2500 also adds V.32 to its modulation list. That means you can automatically use the CCITT V.32 standard for synchronous or asynchronous connections.

So, for large-volume or interactive transmissions, you won't find a better modem than the Telebit T2500. It supports all major modem standards, and is ideal for connecting micros to LANs or mainframes. Plus it easily handles international transmissions. And speaks fluently with more dial-up modems than any other.



In addition to the industry's highest data rate, Telebit's multicarrier PEP technology makes hang-ups and bad line problems a thing of the past.

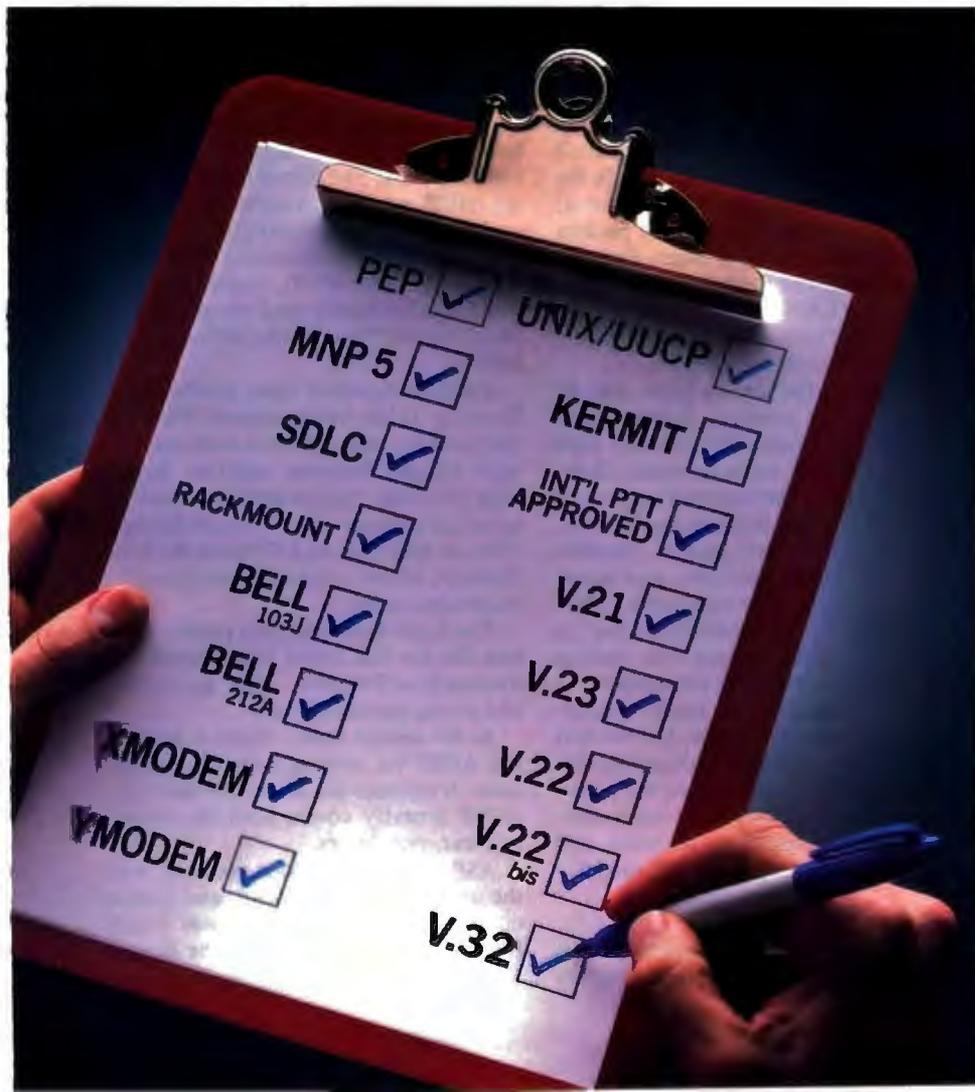
To find out more about the world's fastest modem, call 1-800-TELEBIT today. Or write us at 1345 Shorebird Way, Mountain View, CA 94043-1329. Phone: (415) 969-3800.

Learn why no one gets the message through like Telebit.



© 1989 Telebit is a registered trademark and PEP is a trademark of Telebit Corp. MNP is a registered trademark of Microcom, Inc. Other product names are trademarks of their respective holders.

In Europe call Luxembourg +352-31-96-45





THE LAN ROAD TO OSI

Here's how three LANs stack up against the Open Systems Interconnection model

The world of LANs is rife with inconsistent terminology. Most LAN vendors, however, pay at least lip service to the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) reference model, the framework within which international communications standards are developed. Conformance to the OSI structure, and to the standards within its layers, ensures connectivity between heterogeneous computing environments. We'll examine that framework and see how some important LANs stack up against it.

The OSI reference model consists of seven layers, each of which communicates only with the layers directly above and below it. The model describes only each layer's basic capabilities, not the exact interface between those layers.

At the bottom is the physical layer, layer 1. It defines how the data bits get onto the physical medium. It includes the connector to that medium and the electrical signaling convention.

Above the physical layer is the data link layer, which assures reliable data transmissions. If it receives a packet that contains an error, it requests another transmission. While the data link layer doesn't guarantee that a transmission succeeds, it passes only correct packets to the next higher level.

A set of data link layer protocols, the IEEE 802 LAN standards comprise two functions: Media Access Control (MAC) and Logical Link Control (LLC). Each 802 LAN protocol—such as 802.3 (Ethernet), 802.4 (Token Bus), and 802.5 (Token Ring)—has its own MAC

component, which determines whether the LAN uses tokens or CSMA/CD logic to manage packets. Above the MAC, IEEE 802.2 defines the LLC, which is the same for all the 802 MAC protocols. LLC handles error control, acknowledgment, and flow control.

OSI's layer 3, the network layer, establishes, maintains, and terminates connections and routes packets through the network. Since all nodes can communicate directly with all other nodes in a LAN, no routing through intermediate nodes is necessary. In a wide-area network, on the other hand, a packet may be routed through many intermediate nodes before it reaches its destination.

So far, the OSI model guarantees the delivery of accurate packets but doesn't ensure each packet's arrival. That's the function of the transport layer, layer 4, which also ensures that all data packets are delivered in the right order. Because LANs transmit one packet at a time, data packets on a LAN can't get out of order and are rarely lost, so a LAN's transport layer has little to worry about.

OSI layer 5, the session layer, sets up communication sessions between two computers. Its functions include such common network verbs as open, close, read, and write. The next two layers give the user the final network application. The presentation layer, layer 6, provides the services that a particular application needs, such as the file command OPEN FILE. Layer 7, the application layer, is the application that the user sees, such as a file server's remote file commands.

The OSI model, like many abstractions, is reasonably elegant, but the real world of LAN protocols is altogether different. The figure shows how the protocols supported by three major microcomputer LANs—AppleTalk, NetWare, and LAN Manager—map to the OSI model.

AppleTalk

Apple's AppleTalk architecture is the only one of these LAN environments that

has separate protocols that correspond to all seven layers of the OSI model.

Apple currently provides two options at the physical layer, LocalTalk and EtherTalk (Apple's implementation of Ethernet). At the data link layer, AppleTalk has a Link Access Protocol (LAP) for each option. LocalTalk is built into the Mac.

Apple's equivalent to the OSI network layer is its Datagram Delivery Protocol. DDP manages "socket-to-socket" delivery. (A socket address is the unique identifier of a particular service on a given node.) DDP sends and receives datagrams.

AppleTalk actually has several different components at the transport layer; we have omitted some of them from the figure for clarity. The Name Binding Protocol (NBP, not shown) converts names to socket addresses. Several different higher-level protocols—including the Printer Access Protocol (PAP), AppleTalk Session Protocol (ASP), and the AppleTalk Data Stream Protocol (ADSP)—can call NBP.

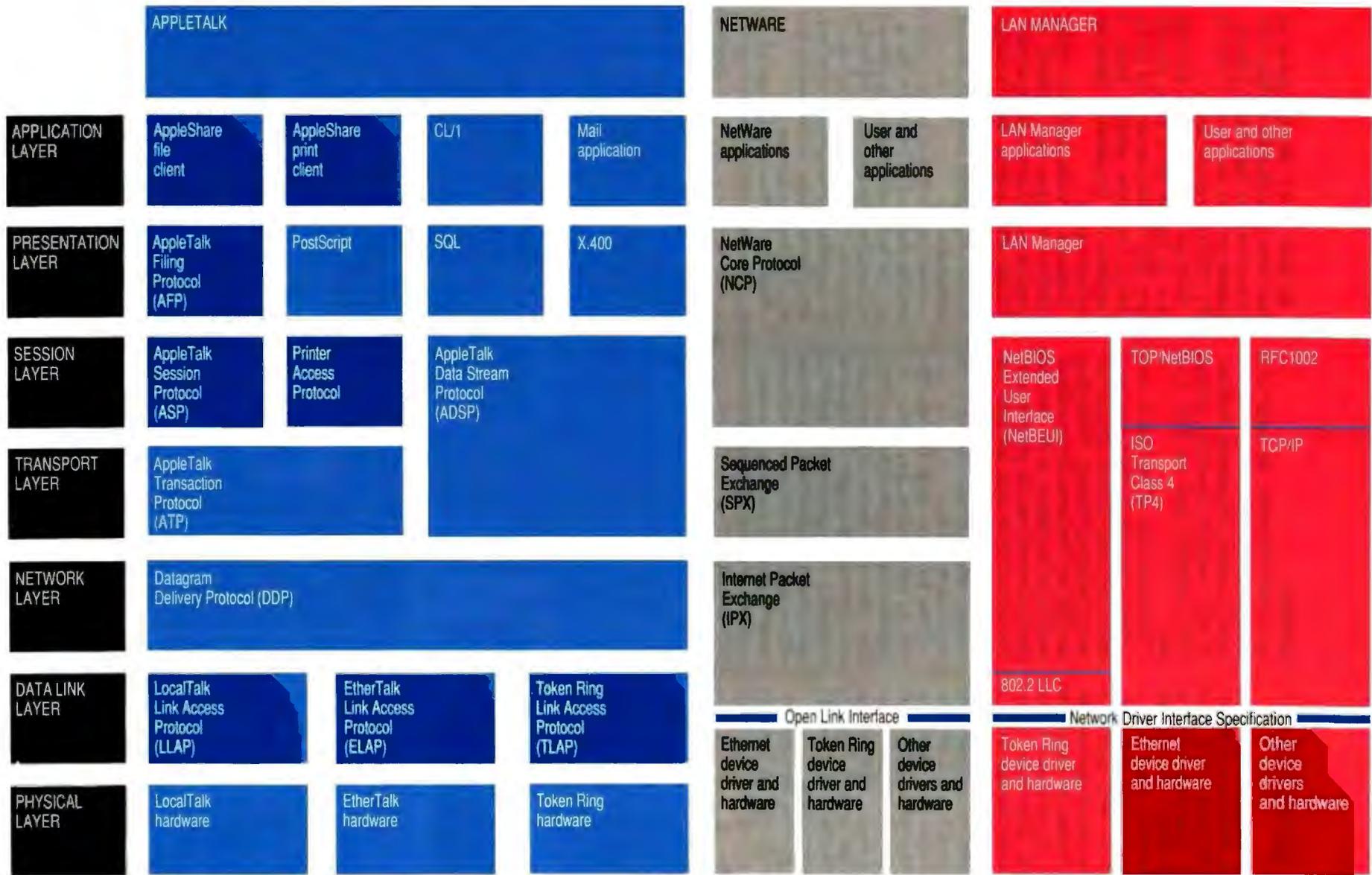
Another transport layer protocol, the Routing Table Maintenance Protocol (not shown), uses a table to route packets over bridges between separate AppleTalk networks. Both it and the Echo Protocol (also not shown) are accessible only from another system. DDP uses the Echo Protocol, which echoes packets to see if a node is accessible.

The AppleTalk transport protocol that best fits the OSI model is the AppleTalk Transaction Protocol. ATP guarantees end-to-end packet delivery.

At the session layer, Apple is promoting ADSP for writing network applications. It replaces the older ASP and ATP. ADSP actually covers both the session and transport layers.

ASP is a typical session protocol, with the usual open, close, send, and receive operations. AppleTalk now uses it only for older applications and as the Session

continued



= planned

The protocol stacks of Apple's AppleTalk, Novell's NetWare, and Microsoft's LAN Manager mapped to the Open Systems Interconnection reference model. LAN Manager and NetWare run on additional hardware platforms.

Protocol for the AppleTalk Filing Protocol (AFP).

The other two transport protocols, Zone Information Protocol (not shown) and PAP, are specialized. ZIP helps track the users in a particular subset, or zone, of an AppleTalk LAN. PAP lets AppleTalk interact with a LaserWriter.

AppleTalk's presentation- and application-level protocols work together to provide a few basic network applications. One network application, the AppleShare Print Client, lets you print on a LaserWriter. While the LaserWriter understands the PostScript language, APC is the actual printing application.

Another Presentation Layer protocol, the AppleTalk Filing Protocol, provides the primitives necessary for remote file services. On a Macintosh, AFP serves only the AppleShare File Client at the application layer. However, AFP can also talk to several other servers, including the AppleShare File Server and Novell's new NetWare for Macintosh.

Apple also is planning two new network applications that will use ADSP: an E-mail package and its CL/1 distributed database language.

NetWare

In the MS-DOS world, the major LAN packages don't map so nicely to the OSI model. Consider, for example, NetWare, Novell's network operating system, which currently leads the DOS LAN pack.

The lowest layer of NetWare's architecture contains the hardware and device drivers for many different physical networks, including Ethernet, Token Ring, and ARCnet. The device driver and hardware lie in the bottom of the data link layer and extend into the physical layer. The top half of the data link layer contains part of IPX (Internet Packet Exchange), which is also NetWare's network layer protocol.

These two parts of the data link layer need to communicate, and a fairly new NetWare interface, the Open Link Interface, tells how device drivers should communicate with higher-level protocol stacks (i.e., any group of protocols that spans multiple OSI layers). By obeying OLI, a single device driver can work with multiple protocol stacks; conversely, a single protocol stack can work with many device drivers.

By offering OLI, Novell hopes to get other firms to develop for NetWare both device driver and higher-level industry-standard protocol stacks like TCP/IP or ISO's TP4 (Transport Class 4).

While part of IPX is in the data link layer, its biggest role is at the network layer. IPX handles internetwork packet routing. Like other network layers, it guarantees that the packets it hands upward are correct.

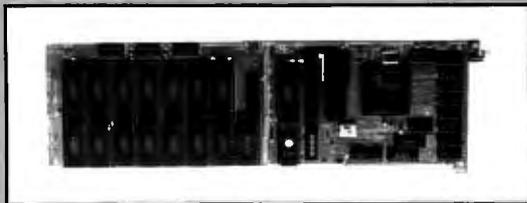
Sequenced Packet Exchange (SPX), NetWare's transport layer protocol, ensures that packets arrive and are in order. SPX and IPX compose Novell's proprietary protocol stack. Protocol stacks that obey the OLI could substitute for this combination.

Above this combination is another NetWare interface (not shown in the figure) that defines the interactions between the transport layer and NetWare's higher layers. NCP, the NetWare Core Protocol that provides client/server services, obeys that interface. NCP spans the session and presentation layers.

Finally, NetWare applications sit on top of the whole stack. They include the

continued

PERFORMANCE FOR EVERYONE!!



PCSS-8IM

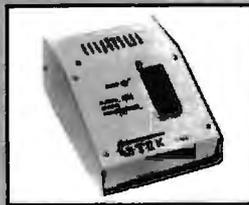


- PCSS-8IM** For IBM PC/AT compatible bus
- Serial Communication Co-processor with 8 channels per card.
 - Up to 2 Megabytes of dynamically allocated buffer memory.
 - Baud rates up to 57,600 baud.
 - Upward compatible with the PCSS-8I.

- MCSS-9IM** For IBM Micro-Channel compatible bus
- Serial Communication Co-processor for Micro-Channel with 9 channels/cards.
 - Up to 1 Megabyte of dynamically allocated buffer memory.
 - Baud rates up to 57,600 baud.
 - Upward compatible with PCSS-8I.

- MCSS-8T** For IBM Micro-Channel compatible bus
- Serial I/O card adds 6 channels to a Micro-Channel machine.
 - Compatible with the PCSS-8T, PCSS-8TX, and the PCSS-8TH.

PC/AT and Micro-Channel are registered trademarks of IBM Corp.



MODEL 9000

- Fastest programmer on the market.
- Quick and Intelligent programming algorithms.
- Supports megabit eproms.
- Programs largest variety of chips.



MODEL ROMX-2JKL

- Emulates 2716-27010 eproms.
- 256 kbit to 1024 kbit models.
- Battery backed up, auto emulate on power-up.
- Low-cost, pays for itself on first project.
- Free 19.2K Serial Communications Software included.



DEVELOPMENT HARDWARE & SOFTWARE
 P.O. Box 2310; Bay St. Louis, MS 39521-2310 U.S.A.
 ORDER TOLL FREE 1-800-255-GTEK (4835) FAX: 1-601-467-0935
 MS & Technical Support 1-601-467-9048



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

Give a Rose to your computer

basic file services that many users see as an integral part of NetWare.

LAN Manager

The hottest newcomer in the PC LAN world is Microsoft's OS/2 LAN Manager, an OEM software product that provides the core functionality of 3Com's 3+Open, IBM's LAN Server, and many other network operating-system products. LAN Manager supports several protocol stacks.

The LAN Manager network operating system sits at the presentation layer. It supports an application layer that contains both LAN Manager built-in applications and applications that others develop. The SQL Server may be the most important new application.

Underneath LAN Manager can sit any of several different protocol stacks. While Microsoft offers only one today, it will support two others. In addition, LAN Manager licensees offer their own

protocol stacks for LAN Manager.

Both NetWare and LAN Manager are moving toward a modular, OSI-compliant model that provides clean interfaces between layers so that they can plug in popular protocol stacks, such as TCP/IP.

All the underlying LAN Manager protocol stacks must provide a NetBIOS interface between their session layer components and the LAN Manager software. The one currently available protocol stack uses IBM's NetBIOS Extended User Interface (NetBEUI). 3Com and Madge Networks Limited jointly developed this protocol stack, which also includes an IEEE 802.2 LLC-compatible portion of the data link layer.

Other underlying protocol stacks are under development. 3Com, using code from Retix, is building one that will support ISO's TP4, with a TOP/NetBIOS session-layer protocol as its NetBIOS interface to the presentation level. Excelan is developing a TCP/IP stack that will speak to the presentation layer via the ARPA RFC1002 session-layer protocol, which maps NetBIOS to TCP/IP.

Just as all these protocol stacks present a NetBIOS interface at the top, they obey another interface at the bottom. This interface, Microsoft and 3Com's Network Driver Interface Specification, defines the way device drivers communicate with the higher-level protocol stacks. NDIS essentially splits the data link layer between the IEEE MAC and LLC layers.

The hardware on which LAN Manager runs—which may be Token Ring, Ethernet, or a variety of other configurations—fills the data link layer's MAC portion and the physical layer.

Clear Direction

The greatest benefit of the OSI model is not the levels it defines, but that it argues strongly for well-defined levels.

All three of these LAN architectures are developing clean interfaces between their levels. The reward is the ability to plug in different protocol stacks while retaining the controlling LAN operating system and its features. As more people need to link heterogeneous networks, this ability will prove crucial to the success of LAN vendors and users alike. ■

Mark L. Van Name and Bill Catchings are independent computer consultants based in Raleigh, North Carolina. You can reach them on BIX c/o "editors" and as "wbc3," respectively.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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, BYTE-week, and BIX, MicroBYTES gives you access to our worldwide 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
800-227-2983
In NH 603-924-7681



Pack extra power into your PC.

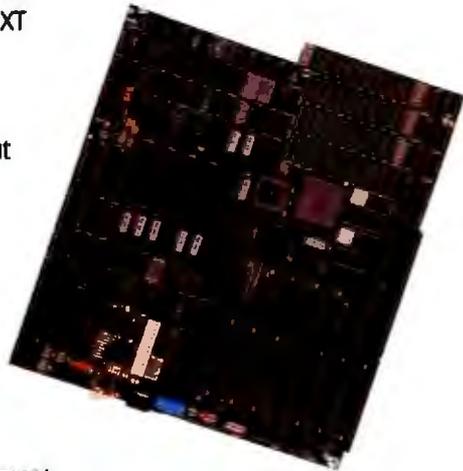
Make it over into a '386.

DTK's new PEM-2000 dual-speed 8/20 MHz 80386 motherboard gives you 100% PC/AT compatibility at speeds up to 27.3 MHz. It also offers some very elegant engineering, like eight expansion slots including two for 32-bit memory expansion, two serial ports and one parallel port, a DTK BIOS with built-in diagnostics, and the socket for an optional 80387 coprocessor.

DTK means value in PC-compatible motherboards, add-on and networking cards, and bare bone systems, including FCC Class B-certified 10 and 12 MHz '286 computers. Which is why the two high-speed XT clones named "Best Buys" in *PC World's* August, 1988 issue, both use DTK motherboards.

The PEM-2000 is a good example—but by no means the only example—of the DTK difference. To get the full story on all our high-performance XT, '286 and '386-based products, contact the DTK office nearest you for specifications and pricing.

And find out how to pack some extra power into your PC.



® Where price and performance meet.

DTK COMPUTER INC.

15711 E. Valley Blvd. • City of Industry, CA 91744
Tel: (818) 333-7533 • Fax: (818) 333-5429

DTK Computer Inc. of Florida
7245 Corporate Center Dr., Suite B
Miami, FL 33126
Tel: (305) 477-7440
Fax: (305) 477-8322

DTK Computer Inc. of New Jersey
300 Columbus Circle, Raritan Center
Edison, NJ 08818
Tel: (201) 417-0300
Fax: (201) 417-0307

DTK Computer Inc. of Texas
10535 Wilcrest Dr., Suite 120
Houston, TX 77099
Tel: (713) 568-6688
Fax: (713) 568-5688

DTK Computer GmbH
Wahlerstr 16
4000 Düsseldorf 30
West Germany
Tel: 011-49-221-656031
Fax: 011-49-221-655753

AT and XT are registered trademarks of International Business Machines Corporation. DTK is a registered trademark of Datatech Enterprises Co., Ltd.



Battle of the Network Stars

Readers searching for the right LAN operating system face three confusing choices. DOS-based systems are a common, relatively inexpensive solution, but their performance is limited, and their security and user-interface features lag behind those of more modern products. Proprietary network operating systems like NetWare offer exceptional speed, but at the expense of a server software configuration compatible with any other vendor's. Now, OS/2-based LAN operating systems promise a new alternative: performance coupled with support for common protocols and a common development environment.

This roundup focuses on five LAN operating systems, representing all three categories: Novell's SFT NetWare 286, 3Com's 3+Open LAN Manager and 3+Share, and IBM's PC LAN Program and OS/2 LAN Server. All these networks support workstations running PC-DOS. 3+Share and PC LAN represent the tried-and-true MS-NET-based environment; NetWare has its own proprietary multitasking operating system. Finally, 3+Open and LAN Server represent the new wave of OS/2-based network operating systems.

We installed each operating system on a dedicated 20-MHz IBM PS/2 Model 80 server cabled to six workstations, including five IBM PC AT-class machines and one 16-MHz Model 80. We used the most popular networking hardware for each operating system: Ethernet for 3+Share, NetWare, and 3+Open, and Token Ring for IBM's PC LAN and LAN Server software.

Our evaluations included performance testing and running through the key features of each program (see table 1). We also established a suite of common procedures; these included installation, network management, configuration, mail, print queue, accounting, and security tasks. An overview of each product follows.

IBM's PC LAN 1.30

IBM's PC LAN is unique for a couple of reasons. First, it doesn't support Ethernet—it runs only on IBM's Token Ring or PC Network hardware. Also, PC LAN allows peer-to-peer resource sharing; any workstation on the network can act as a server, making its disk drives or other local resources available to any workstation on the network. By contrast, server-based LAN software, such as NetWare, allows resource sharing only from a central file server. (For purposes of testing, we configured each LAN to be server-based.)

PC LAN workstations run PC-DOS 3.3 or 4.0. Each workstation has a special subdirectory, drivers for the Token Ring adapter card mentioned in CONFIG.SYS, and some additional lines in the AUTOEXEC.BAT file. All workstations use the redirector, a 46K-byte TSR program that ties itself into the standard DOS INT 21H system requests. The redirector watches requests that application programs make to DOS and determines whether to send the request to the network or to handle it locally.

When you install PC LAN, you have two choices. With Base Services, all network commands take the form NET <command> <options>, and you enter them from the DOS command prompt. This typically drives you to create a tool chest of batch files to reduce streams of NET commands to a single file.

The alternative to Base Services, Extended Services, replaces the NET commands with a menu-driven system that issues the commands for you. Whereas Base Services leaves most of the administrative work in the hands of network users, Extended Services lets you designate a network administrator who has sole control of the resources available on the network. Extended Services also pro-

vides some security; the administrator can attach passwords to network-available disks, directories, and printers.

PC LAN includes an installation disk and a retinue of five file disks. The installation utility first asks you to choose between Base and Extended Services, and then it asks whether the station you're setting up will use the redirector and whether you want it to be a receiver (receive messages only) or a messenger (send and receive messages). Finally, you must indicate whether the station will be a server.

Shared subdirectories and files are called *filesets*, and under Extended Services the system automatically creates names for them. PC LAN does this for security reasons. For example, if you create a fileset named ROOT that points to the server's drive D, an unauthorized user who overhears that the company's balance sheet is in the ROOT fileset can't creep back to his or her machine and access ROOT with a NET USE command. First, ROOT is probably known to the network as something like IBMX001; second—and most important—Extended Services automatically attaches a password to the fileset.

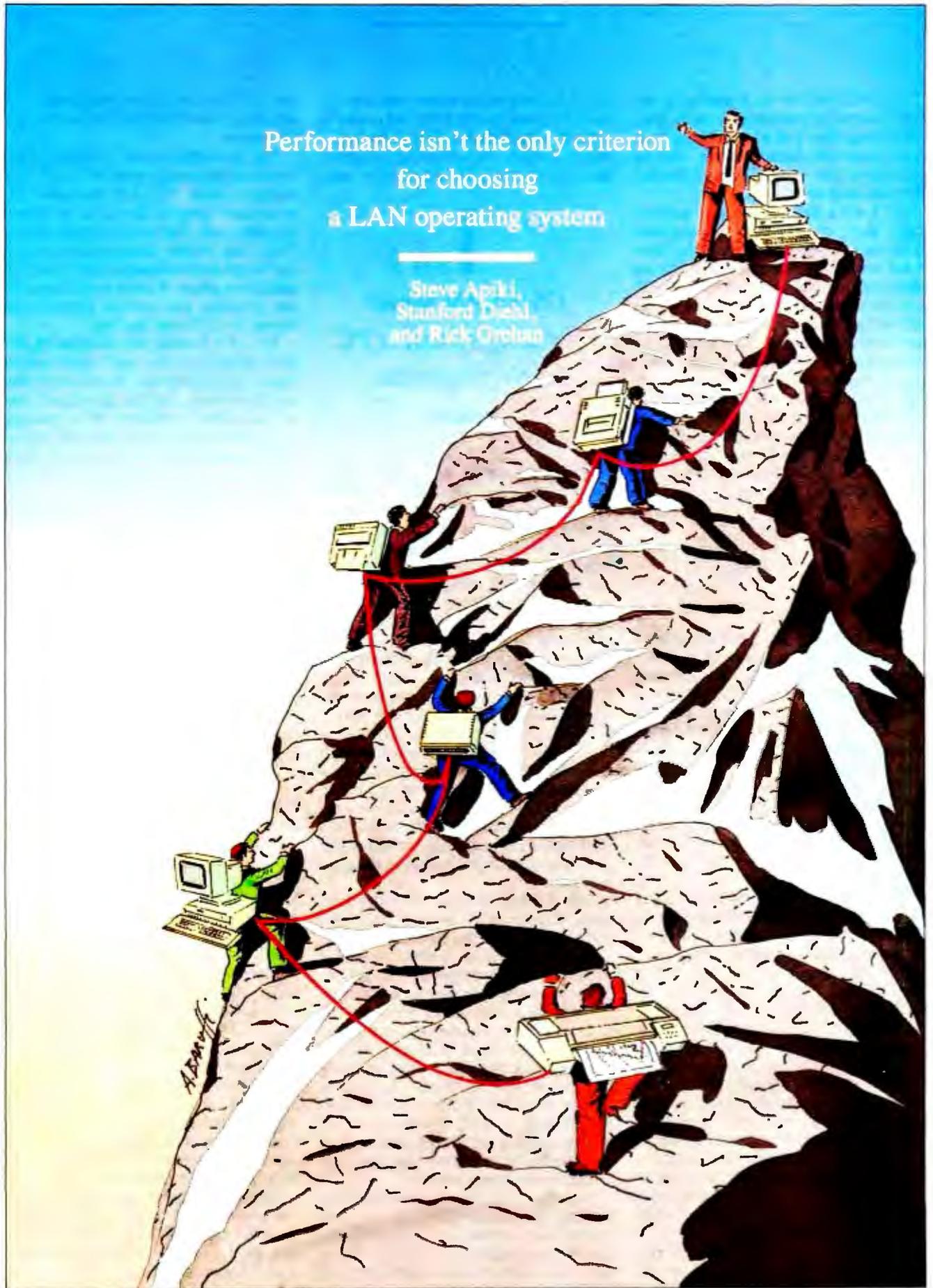
During installation, we made a mistake in assigning user names to filesets and so had to delete some users. But we discovered that deleting a user is much more difficult than adding one. Not only do you have to locate all the filesets that the user has access to and remove those accesses, but you must also locate all the other users with access to the first user's home directory and detach *those* connections as well.

The Extended Services menus easily automate the process of mapping filesets to logical drives. Thus, you can select fileset ROOT to appear on your system as drive M, fileset DBASE to appear as drive N, and so on. Extended Services will even record the settings and automatically invoke them when you log on.

continued

Performance isn't the only criterion
for choosing
a LAN operating system

Steve Apiki,
Stanford Diehl,
and Rick Orphan



PC LAN includes an E-mail program that's about as rudimentary as it gets. Under Base Services, a message can be at most about 100 characters long, with no provisions for attachments. Extended Services adds an editing screen.

PC LAN's documentation is surprisingly slim, compared to the megavolumes we received from some of the other LAN vendors. A single three-ring binder about the same size as IBM's PC-DOS manual takes care of it all. Since we set all the stations to run Extended Services, we found ourselves referring to the documentation only during installation. If you decide that you'd prefer Base Services, the manual includes a functional guide to the NET commands; all you need to know is what you want to do, and the manual points you to the appropriate command. Under Extended Services, help is just an F1 key away.

IBM's OS/2 LAN Server 1.00

LAN Server is a PC LAN-compatible operating system that enjoys all the benefits of running on OS/2. The chemistry between LAN Server and PC LAN is so good that you can replace server software on a PC LAN network with LAN Server without having to reinstall any workstation software; you need only inform LAN Server that there are DOS-based PC LAN stations out there. (IBM does, however, recommend making some modifications to the defaults for running PC LAN workstations together with LAN Server.)

LAN Server offers a few features that PC LAN workstations can't use. For example, PC LAN workstations can't act as network administrators. Other commands are unavailable to PC LAN users because they require OS/2. These include NET RUN and NET USE. NET RUN lets you run programs remotely. Programs that you activate via NET RUN execute in the memory of the server's machine, and you can redirect the output of the program to a file. You also can't execute NET USE in conjunction with shared serial devices. Under LAN Server, you can make a serial device (a modem, for example) available to the network. LAN Server doesn't spool data sent to and from the device and its user, but transfers it directly.

LAN Server also adds usage record keeping. (The best you can do on PC LAN is NET ERROR, which gives you a

list of the most recent errors that have occurred at your station.) Not only can the network administrator view error logs—which include the offending program, the error number, and a full error mes-

IBM's OS/2 LAN Server operating system is PC LAN-compatible.

sage—but the system keeps ongoing statistics of the server's activities. Available figures include the number of sessions started, the number of files and print jobs opened, and the total number of system errors. Finally, the administrator can flag selected resources to record usage in an audit trail file, so you can keep track of who requested access to a certain directory, whether the request was granted, what time the request was made, and the duration of usage.

While we were creating the user and fileset configurations, we came across one of LAN Server's faults. The menu that an administrator must crawl through to define users and shared resources are a veritable maze—and without a mouse, the process is maddening. Activating a pull-down menu from the keyboard is a confusing combination of Arrow and Return keys that is guaranteed to generate mistakes.

Our problem was that we had forced some directories to become shareable and also had specified that they be available on user demand. It wasn't apparent that the two might be mutually exclusive. We were unable to deduce the connection between the fileset names we had given to the directories and the alias names that should have appeared on the network. We prowled every menu and pulled up every help screen we could find. The manual was no help. We finally stumbled onto the answer; in a fit of frustration, we stopped sharing the filesets, reattempted to log onto one of the workstations, and suddenly everything worked.

A similar situation occurred when we tried to alter a user's profile. We were unable to log on that user while updating the user's information. However, even after the administrator completed the modifications and had logged off, the

user still couldn't log on. Eventually, the situation cleared itself up, for no discernible reason.

The installation also revealed some welcome advantages over PC LAN. For example, under PC LAN, the system administrator governs file access on a user-by-user basis. For small setups, this is fine, but it gets cumbersome when you've got a multidepartmental system in which one group of users needs access to one database and another group needs access to a different database.

PC LAN handles this situation by letting you model a new user's profile after that of an existing user, so that when you add a new user, you can give him or her all the access privileges of an existing user with a single keystroke. But it's up to the administrator to remember who's in what group. LAN Server lets you define a conglomerate of users as a group and give that group access privileges that all members instantly inherit.

LAN Server's documentation is more substantial than PC LAN's, and the on-line help is an improvement over that for PC LAN. Not only is help context-sensitive, but if the help message isn't complete enough, you can go to an on-line manual.

Novell's SFT NetWare 286 version 2.15

The sheer number of manuals included in the distinctive red Novell NetWare packaging conveys the software's complexity and richness. The *Guide to Manuals* runs 75 pages by itself, and a small library of spiral-bound supplements details the nuances of installing various interface cards.

With NetWare, Novell has taken a proprietary approach to networking. By not basing its networking software on DOS, Novell traditionally has been able to outperform its rivals. Novell offers a product that does the job and does it well.

Perhaps the scariest thing about a network is its vulnerability. A disk crash on a network server can shut down an entire organization. Novell has the best set of features for protecting data. NetWare automatically checks for bad data blocks on your disk by comparing each block written to disk against the same block in memory. If the two blocks don't match, NetWare takes the block from memory and stores it to a special area of the disk. It also saves the address of the defective

continued

Share Printers, etc...



**NOW
38,400
BAUD**

Why Use The SL Sharing Device?

Saves Money By Sharing

When you can't afford to buy a laser for each PC, using the SL™ is the inexpensive way to let everyone share - not just your lasers, but printers, plotters and modems as well. You will get more efficient use of your peripherals because greater access by more users reduces unproductive idle time and the need to purchase more of these expensive devices.

Increases Office Efficiency

An SL with memory improves PC productivity by allowing all users to simultaneously send their print jobs and release their PCs to continue working without being delayed by other users or slow printers. Memory in the SL is a more sensible investment than additional memory in each printer since SL memory is shared by all users and all peripherals.

More For Your Money

If you don't need E-mail or access to shared files, the SL is an alternative to a LAN at a fraction of the cost. When you compare the price and capabilities of the SL with any similar devices, we believe you will agree with thousands of well-informed professionals that the SL is the best value available anywhere!

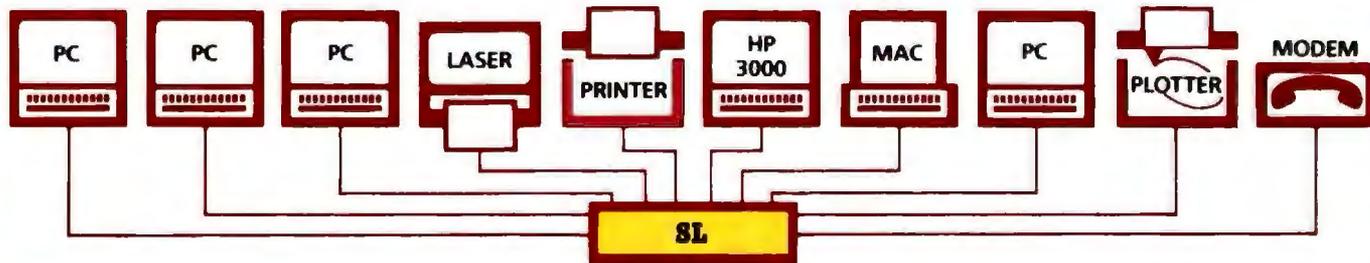
SL

Only \$500
plus \$100 per 256KB
up to 4MB

Some SL Features

- **Ten Channels:** four parallel and six serial, all can be software configured as either input or output.
- **Pop-up Menu:** keyboard selection of printers, macros and many other control functions.
- **Automatic Switching:** no software needed if always sending data to only one printer.
- **Interface Conversion:** automatic parallel to serial, serial to parallel, or serial to serial parameters.
- **Simple Installation:** just plug in the cables and run the menu-driven installation software.
- **Compatible With Minis Or Mainframes:** any RS-232-C asynchronous serial or parallel connection.
- **User Upgradeable Memory:** from 0 to 4MB buffer.
- **45 Day Money Back Satisfaction Guarantee**

Cables and Telephone Adapters



Smaller Buffers



All Parallel Ports

AS-31 3 inputs to 1 output automatic switch without buffer for only \$200.

XL 2 automatic inputs to 2 electronic switch selectable outputs with from 256KB up to 2MB buffer from \$400.

CP 1 input to 1 output with from 256KB up to 4MB buffer from \$300.

EW 1 input to 2 software selectable outputs with from 256KB up to 4MB buffer from \$325.

Serial and Parallel Ports

MI 1 parallel or 1 serial input to 1 parallel or 1 serial output with from 256KB up to 2MB buffer from \$425.

CALL TOLL FREE TODAY and talk to one of our friendly and knowledgeable application technicians for solutions to your connectivity problems.

Buffalo Products
2805 19th Street SE
Salem OR 97302

Dealer Inquiries Welcome

Sales (800) 345-2356
FAX (503) 585-4505

PRODUCT FOCUS
PC-LAN OPERATING SYSTEMS

Table 1: Features of five LAN operating systems (● = yes; ○ = no).

	IBM PC LAN Program 1.30	IBM OS/2 LAN Server 1.00	3Com 3+ Open 1.0	3Com 3+Share 1.3.1	Novell SFT NetWare 286 version 2.15
Price	\$245 per user	\$1040 for server \$830 per OS/2 workstation \$245 per DOS workstation*	\$995 for 5 users \$2995 for unlimited users	\$595 for 5 users \$2495 for unlimited users	\$4695 for up to 100 users
Minimum server requirements					
Hardware	80286 or 80386	80286 or 80386	80286 or 80386	80286 or 80386	80286 or 80386
Software	DOS 3.3 or 4.0	OS/2 EE 1.1	OS/2 1.0	DOS 3.1 or higher	
Memory	640K for extended services 350K for basic services	5 Mb	4 Mb	640K	1 Mb ¹
DOS workstation memory used by the network operating system	81-190K	81-190K	NBP: 25K XNS: 100K	NBP: 25K XNS: 100K	45-60K
Peer-to-peer resource sharing	●	●	○	●	○
Disk caching	●	●	●	●	●
E-mail	●	●	[●]	[●]	○
Disk diagnostics	○	○	○	○	●
Supports multiple file servers	●	●	●	●	●
Server can act as a workstation	●	●	●	●	○
Administrator access from remote station	●	●	●	[●]	●
Traffic monitoring					
Reports current log-ons	●	●	●	●	●
Reports shared resources	●	●	●	○	●
Error log	●	●	●	●	●
Audit trail	○	●	●	○	●
User chargeback accounting	○	○	○	○	●
Security					
Passwords attached to users	●	●	●	●	●
Passwords attached to resources	●	●	●	●	●
Time restrictions	○	○	●	○	●
Station address restrictions	○	○	○	○	●
Network hardware supported					
Ethernet	○	○	●	●	●
Token Ring	●	●	●	●	●
ARCnet	○	○	●	○	●
Connectivity options					
AppleTalk	○	○	●	●	●
LU 6.2	●	●	●	●	●
SNA	●	●	●	●	●
DECnet	○	○	●	●	○
TCP/IP	○	○	●	●	○ ²
X.25	○	○	●	●	●

*Requires IBM PC LAN Program.

¹1024K bytes (1 megabyte) if attaching a 70-megabyte hard disk drive or less; 2048K bytes (2 megabytes) if attaching a 70-megabyte or larger hard disk drive.

²TCP/IP gateway available from third-party vendors.

[] = Optional.

block to prevent further writes to that area. For added insurance, NetWare stores duplicate copies of the directory table and the file allocation table (FAT) to two different locations on disk.

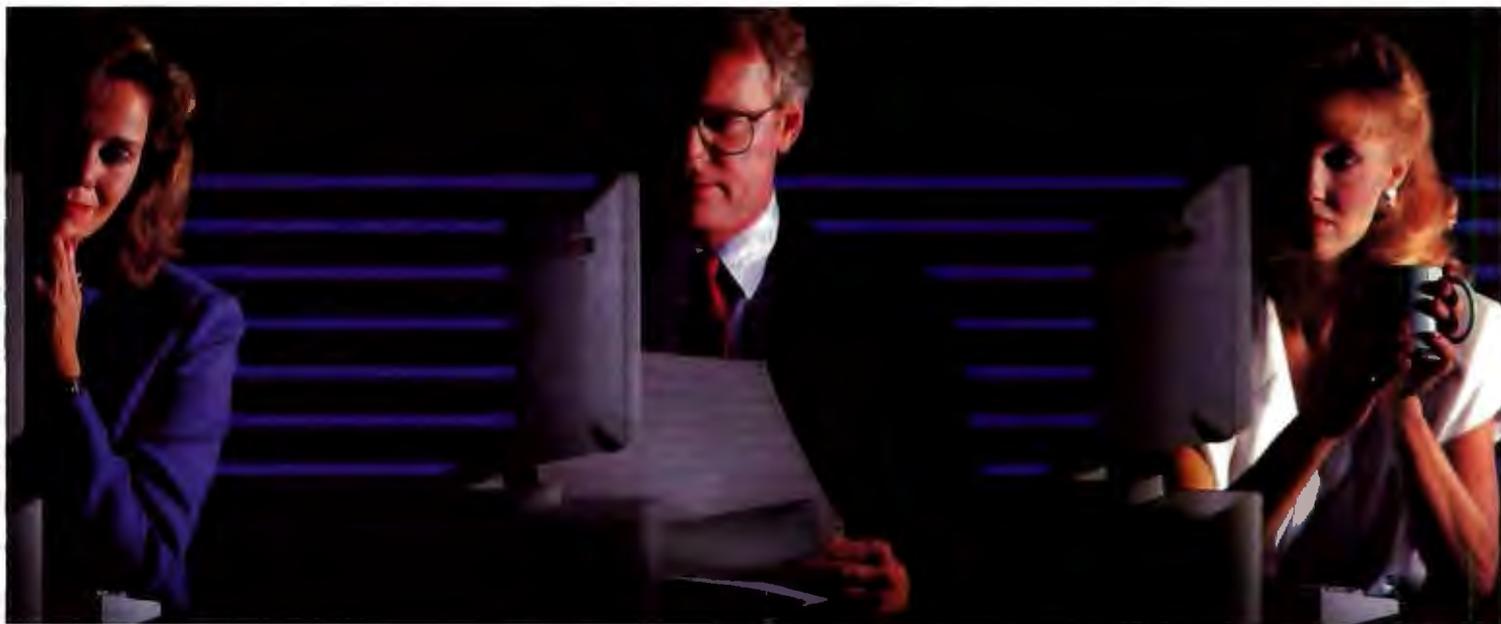
The SFT (System Fault Tolerant) version of NetWare can maintain a duplicate of the entire server disk. You can either set up two disks on the same controller to eliminate problems caused only by data

corruption and disk errors, or you can save to a second disk on a separate channel (controller, interface cable, and power supply) to provide greater security. Setting up two disk channels speeds backup by enabling parallel transfers. Disk reads also become more efficient, since the fastest disk services a given read request, and both disks can service multiple read requests.

Even with all this protection, you can still face sudden shutdowns. The biggest problem occurs if the system fails when it has written data to disk but before it has updated the transaction in the application's underlying index. NetWare treats an entire write sequence as a single transaction, saving none of the data unless the entire sequence is completed.

continued

SOME COMPANIES MAKE ALL THE RIGHT CONNECTIONS.

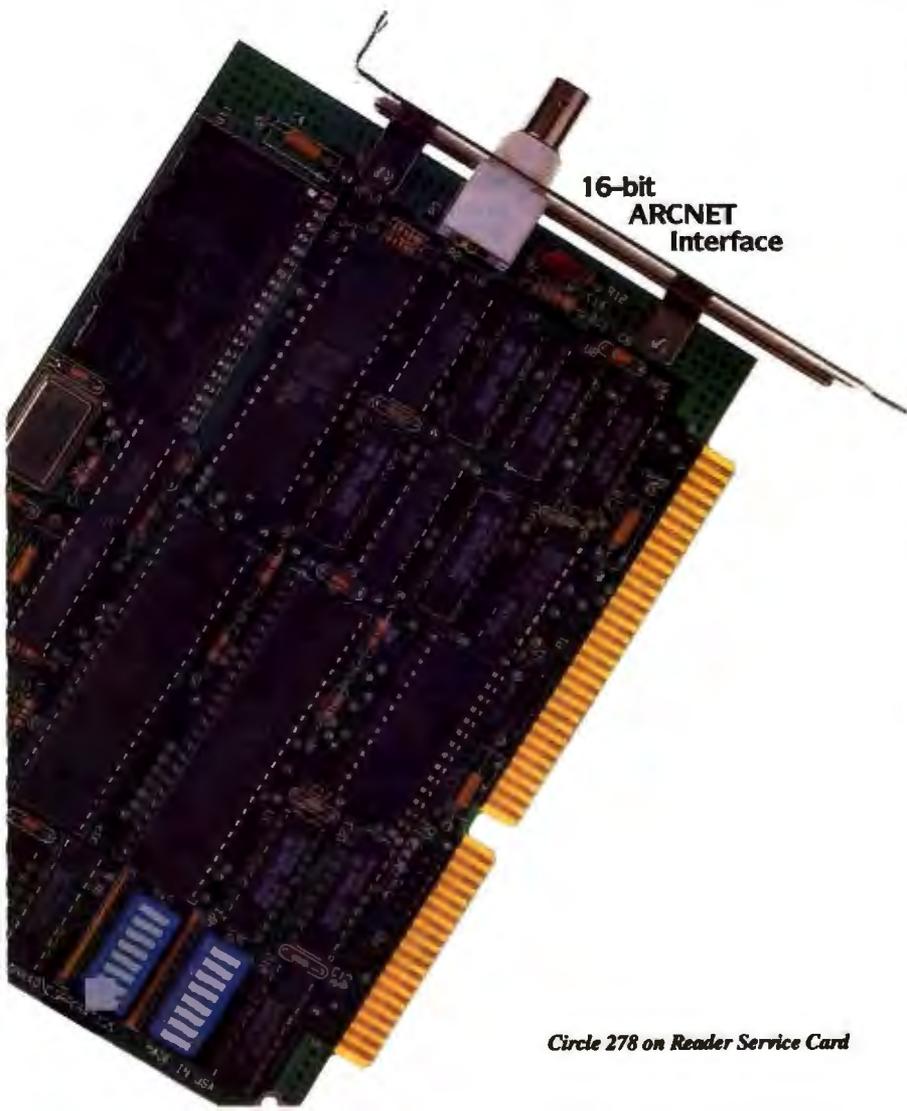


THEY CONNECT WITH 16-BIT ARCNET® CARDS.

Face it. Some companies are better connected than others. Success often depends on who can deliver. Successful businesses are turning to Thomas-Conrad for reliable ARCNET networking products.

- **GET 12 HOURS OF WORK IN AN 8 HOUR DAY.** Our 16-bit interface gives you up to a 50% increase in network throughput.
- **COAX, TWISTED-PAIR, FIBER OPTICS** – Whatever you want to work with, we work with.
- **DELIVERABLE HARDWARE** – While others are talking, Thomas-Conrad is shipping.

To find out how you can connect with ARCNET products that have the networking world talking, call Thomas-Conrad today.



16-bit
ARCNET
Interface


THOMAS • CONRAD
CORPORATION

800-332-8683

1908-R Kramer Lane
Austin, Texas 78758, (512) 836-1935

Arcnet is a registered trademark of Datapoint Corporation.

Circle 278 on Reader Service Card

If NetWare can't detect a full transaction, it "rolls back" the data to its former state.

Given NetWare's size and complexity, installation is fairly painless. The documentation clearly addresses planning issues up front, and then it steps you through menu selections and configuration options according to your requirements. NetWare requires a dedicated

NetWare

is a proprietary network operating system that requires a dedicated server and a special server disk format.

server and uses its own proprietary format on the server disk. You can still run DOS, but NetWare acts as the host operating system. A dedicated network operating system offers additional security, since users can't boot directly from the server disk; they must pass through the network to access server files. There is a downside to this, though: If anything goes wrong, you can't call on familiar DOS utilities such as FDISK.

Novell strictly enforces the server-client model for network operations. A centralized server retains network resources, while each of the client sites accesses the server through the NetWare shell. The shell intercepts all DOS calls processed by interrupt 21H. It turns local operations over to DOS and translates network calls to the NetWare Core Protocol (NCP) for the server to process.

The NetWare shell is surprisingly compact, requiring only 45K to 60K bytes of precious workstation RAM. This is less than any of the other products we reviewed—in fact, NetWare's is the only shell to leave enough room in DOS memory for RAM-hungry applications like dBASE IV.

A series of menus and a set of command-line utilities form the NetWare User Interface. The SYSCON menu drives the most common operations. From this menu, the supervisor can add new users, delete old ones, join users to a group, modify file permissions, set log-

in restrictions and other security features, maintain the error log, track charge/user status, and even establish group rates for network services. The entire user interface is logical and consistent. For instance, from the screen display that lists network users, you press the Insert or Delete key to add or delete users, respectively. NetWare retains this basic interface structure throughout each configuration screen and menu option.

As a supervisor, or as a trustee with parental rights in a directory, you can assign different file permissions (e.g., read, write, create, delete, open, modify, search, or parental) to each user. You can also assign attributes to individual files (e.g., read/write, read only, and shareable/nonshareable) that then apply to all users, despite the permissions they have within the directory. A trustee can change file permissions within a directory, allowing the supervisor to delegate administrative responsibilities to other users. The supervisor can still retain security control by modifying the "Maximum Rights Mask." The mask specifies which permissions the trustee can assign. If the supervisor removes delete permission from the Maximum Rights Mask, the trustee can't let any other user delete files, although he or she still retains that permission.

Special log-in features highlight NetWare's security arsenal. You can systematically purge inactive accounts by setting an account expiration date. You can also set password expiration dates to force users to make periodic password changes. Concurrent access restrictions limit the number of stations a user can log onto while still logged on somewhere else. Station restrictions let the user log onto only one specific station address. You can also designate time blocks, limiting user access to certain time intervals. Other utilities—console monitoring, error logs, and usage statistics—help track user activity. You can temporarily disable suspicious accounts and set an account to automatically disable itself after a preset number of failed password attempts. A NetWare utility will evaluate your security system, pointing out any deficiencies that it finds (such as an account without a password assigned to it).

Special utilities help the supervisor face the arduous task of adding large numbers of new users. This can be especially trying when the administrator first establishes the network. The MAKE-USER utility accepts a listing of names and adds them to the network. The file can also specify permissions and restrictions, or you can set up one user with a

generic set of permissions and assign equivalent security status to any other user or group of users.

Administrators will quickly appreciate NetWare's accounting functions. You can apply charges for time logged onto the network or for server disk storage. Rates can fluctuate according to the time of day. Even if your organization doesn't charge for network usage, the accounting module creates an audit trail for tracking user log-ons, session durations, and resource use.

3Com's 3+Open LAN Manager 1.0

3Com has played the compatibility game patiently. While Novell impressed users with a fast, dedicated network operating system, 3Com stuck with DOS and the limited services of MS-NET, opting for the standard despite its limitations. Now, with the introduction of 3+Open LAN Manager, 3Com's time may have come. All the pieces of 3+Open have yet to come together, although the overall structure is in place.

Novell has stuck with its proprietary IPX protocols, which have made it one of the fastest LANs on the market. But Novell doesn't directly support other protocols, such as industry-standard TCP/IP, within its architecture. 3Com has introduced a protocol-switching shell to support various combinations of protocols. This shell, which should be available by press time, will let the company build and dynamically install an assortment of compatible transport stacks.

3+Open initially loads the NetBIOS Protocol (NBP), a slimmed-down (25K-byte) version of the Xerox Network Standard (100K bytes) with limited file and print services. It loads XNS for other services like E-mail. However, when an application requires a different protocol, such as TCP/IP or ISO TP/4, the resident protocol manager swaps it in automatically. Since 3+Open will directly support multiple alternate transport stacks, it won't require gateways or creative kludges for internetwork communications. Although 3Com is now shipping the protocol-switching shell and NBP, we didn't receive them in time for inclusion in this review. We performed our tests using XNS.

As 3Com implements TCP/IP and other alternative transport stacks and as OS/2 catches on, 3+Open should prosper.

continued

SOME COMPANIES MAKE ALL THE RIGHT CONNECTIONS.



FOR THOSE WHO DIDN'T . . . THERE'S THE SMART HUB.

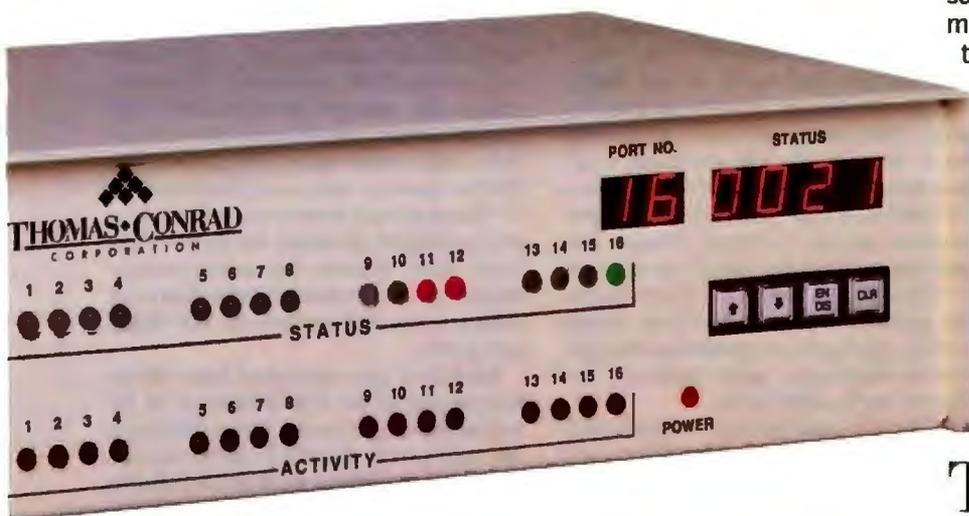
The Smart Hub:

- ◆ Helps you find the problem . . . fast.
- ◆ Lets you disable a port at the touch of a button.
- ◆ Includes all the features of a Thomas-Conrad Active Hub.
- ◆ Works on *any* ARCNET LAN.

Even the best-maintained ARCNET® LANs sometimes develop a glitch. That's when it pays to have the Thomas-Conrad Smart Hub help locate problems on the network.

With a Smart Hub in place, you can detect the culprits immediately. Or you can monitor each port and get a readout that pinpoints where the trouble is. Then you can instantly disable the port and repair the problem . . . loose cables, bad boards, same node IDs, whatever. You can even move the Smart Hub to a different location to test out a separate set of workstations and interfaces.

The ARCNET Smart Hub is available in both 8 and 16 port versions for coax, twisted pair or fiber optic ports. Call Thomas-Conrad today and we'll show you how the Smart Hub sees to it that your problem ports are spoken to.




THOMAS • CONRAD
CORPORATION

800-332-8683

Circle 279 on Reader Service Card

1908-R Kramer Lane, Austin, Texas 78758 (512) 836-1935

ARCNET is a registered trademark of Datapoint Corporation.

A cousin of LAN Server, 3+Open is a good choice for an OS/2-based server. As other major vendors port to LAN Manager, it should become a de facto standard for OS/2 networks, and 3Com should be in an enviable position.

Installation is simple. You need to know a few basic facts, such as the amount of server memory, the type of security to implement, and whether you want a dedicated server. From then on, it's smooth sailing. The routine is fully menu-driven, and the documentation guides you along step by step. Workstation installation is just as easy. An automated program sets up your directories and modifies your boot-up batch files.

3+Open uses the familiar MS-NET command structure. Workstation users access server resources by entering the NET SHARE command. The server resource is then available to the workstation as a logical drive or as an addressable resource name. This makes resource sharing transparent to the client station. Users simply map logical drives to server directories. You can reference other shared resources by a simple resource name, so users never need to know complicated path names or cryptic system labels.

Entering the NET command without parameters generates a menu system at an OS/2 workstation. DOS stations can use only the command-line interface. 3Com bundles a menu-driven DOS extender that can log users onto network drives, but it's not a 3+Open menuing interface. This shouldn't be a problem, though. The NET command structure is easy to master, and the NET HELP command delivers on-line assistance.

From the View menu, you can share resources or monitor print and communications device queues. The Message menu lets you send and receive messages, as well as review your message log. You can set or change configuration options, including passwords, from the Config menu, and you can check statistics from the Status menu.

The NET ADMIN command calls the Administration menu. It retains the same structure as the User menu but includes additional options. The Accounts menu lets you establish user accounts and set permissions for shared resources. Statistics such as errors, session starts and disconnects, files used, spooler status, and password violations help the administrator monitor network activity.

If 3+Open detects a problem, the Alerter broadcasts a warning to the administrator. For instance, when we were navigating through the network and tried

too many unauthorized actions, the server screen flashed "8 access denied errors in the last 5 minutes—recommend you view the server's audit trail." The audit trail meticulously tracks all pertinent network activity. Administrators can use the information to properly configure the network and to identify problem areas.

3+Open recognizes two types of net-

3 Com's 3+Open LAN Manager recognizes two types of network security: share-level and user-level.

work security: share-level and user-level. Share-level security assigns a password to a specified resource. The user then shares the resource by issuing the correct password, and all users who issue the resource password have identical permissions.

With the more sophisticated user-level security, the user owns a unique password. The administrator can then assign resources to specific users or user groups, giving users specific access permissions for each resource. File permissions include read, write, create, delete, change attributes, or change permissions. The change attributes permission lets a user change file attributes (e.g., read-only, hidden, and system). These file attributes take precedence over permissions set by 3+Open. Change permissions permits the user to modify the 3+Open access rights for the resource. An optional product, 3+Open Secure (\$195), can force user password changes, provide additional audit tracking, and analyze audit information.

3Com's E-mail option, 3+Open Mail (\$1190), allows forwarding, filing, and binary attachments. 3Com also bundles the 3+Name Service with 3+Open Mail. This lets remote hosts recognize local network names. Large LANs can become unmanageable without a functional naming service. If you're serious about internetwork communication, this function is essential.

3Com's 3+Share 1.3.1

3+Share, the MS-NET-based precursor to 3+Open, is a slower, less expensive alternative that provides a migration path to 3Com's OS/2 LAN product. To manage the underlying DOS operations, 3+Share employs the Microsoft Redirector to evaluate system calls and route network requests to the server. The program lets you use the server as a workstation, but 3Com recommends a dedicated server. A powerful naming service and a suite of optional support programs make 3+Share a worthy product.

If you're installing the operating system on a network built around one of 3Com's proprietary servers, the documentation is clear and logical; if not, the documentation is poorly organized. We got the system up and running through trial and error. The operating system comes in different versions, depending on whether it's bundled with 3Com hardware. In its software-only incarnation, the system doesn't include disks for bringing up workstations. You may find workarounds, but keep the technical-support number close by if you're new to networks.

You control 3+Share by issuing instructions from the command line or by accessing the 3+Menus interface. The menu options are clear and comprehensive, but if you don't like the menu structure, you can customize it.

3+Share recognizes three types of users: network users, administrators, and server-users. The network user can use network resources, run applications, and execute DOS commands. Administrators can manage network activities, establish users, and modify user restrictions. The server-user can control only devices attached to a specific server. The 3+Name service stores all user names as well as named resources on the network. Each name follows the name:domain:organization structure. Applications reference users and servers by the three-part name.

Each new user receives a home directory on the server disk. Not even an administrator can access a home directory, the user's root directory on the server. Any user can share a subdirectory that he or she owns by assigning a Sharename to it. A user can then link a logical DOS drive to the Sharename and access the directory as if it were a local disk. Each Sharename retains a set of access rights that let the owner dictate the conditions of

continued



Terminal emulation doesn't have to be this way.

We've all been there. Trying to remember whether the "Do" key is really <Ctrl-F1>. Or was it <Alt-F1>? And the editing keypad. Can you be absolutely sure you're about to press the "Select" key and not the "Remove" key? The results can be disastrous.

That's why KEA developed the PowerStation. The PowerStation, an exact VT200 layout keyboard bundled with VT240 or VT220 terminal emulation software, turns your IBM PC or compatible into a key-by-key replica of a DEC terminal - without messy labels!

But what does that get you?

Peace of mind. The PowerStation keyboard takes the frustration out of switching between a DEC terminal and a PC *because each key is right where you'd expect it to be.* And our "Gold Key" version makes ALL-IN-1 and WPS a breeze.

Savings. If you think you can't afford both emulation software *and* a keyboard, think again! The PowerStation can actually save you money by eliminating the time you waste every day translating between VT and PC keystrokes. And with the PowerStation, *startup training costs are virtually eliminated.*

Consistency. The PowerStation keyboard provides a consistent interface for both VT emulation and regular PC applications. In emulation mode you get the 105-key functionality of a real DEC keyboard and in PC mode you get a super enhanced keyboard. *And* you can use the PowerStation on virtually any PC! Move between an XT, AT, PS/2, AT&T PC and a DEC terminal *without missing a keystroke.*

PowerStation and ZSTEM are trademarks of KEA Systems Ltd. All other brand and product names are trademarks or registered trademarks of their respective holders.

Circle 152 on Reader Service Card

The best in terminal emulation software. With the PowerStation keyboard you get the fastest, most precise, DEC terminal emulation software available: ZSTEM. You have the choice between two popular software packages: ZSTEM 240, our VT241/VT340 graphics emulator and ZSTEM 220, our VT220 text emulator. Both packages will impress you with their speed and feature-by-feature accuracy.

To top it off, the PowerStation gives you all this at a surprisingly low price. But find out for yourself why Digital Review Labs says "the PowerStation 240 is a godsend" Call us at 800-663-8702.



KEA Systems Ltd., 2150 West Broadway, Suite 412
Vancouver, B.C., Canada V6K 4L9
Telephone: 604-732-7411 Fax: 604-732-0715

JULY 1989 • BYTE 163

We back up what we don't sell.



sharing. A directory can have more than one name, and each name can have a unique combination of access rights. You can further protect the directory by giving it a password. Access rights include private, public, read, write, read/write, write/create, read/write/create, and shareable. A single user controls a private directory, though he or she may share it by giving it a password. A public directory allows file reading but refuses file writes or file creation.

Printing functions are similarly configured. The 3P SHARE command assigns a printer Sharename and password. You then link the printer to a port. Users can change the priority of their print jobs, which are sent to a queue; the administrator can change the priority of any job. 3+Remote PC (\$295) enables modem dial-ins, and 3+Route (\$1500) connects two 3+Share networks by dial-up or direct connections. 3+Net Connect (\$1500) links dissimilar networks. Other optional programs from 3Com include disk mirroring (\$1595), support for OS/2 workstations (\$995), and 3+ for the Mac (\$495).

The optional mail service is surprisingly strong. User functions include forwarding, filing, replying, and help. Server functions route the mail across the network as well as to and from other networks. If the server can't deliver a message, it returns the message to the sender. The 3+ naming service enables this efficient communication scheme. 3+Mail administrative functions allow easy management of the mail system.

3+Share lacks a strong administrative module. It maintains a status log and reports rudimentary usage statistics, but it falls well short of what NetWare offers. Functions include 3+Backup, which supports an automatic backup routine that triggers transfers to cartridge tape or disk. You can run backup and restore operations from any workstation.

Network Testing

No single number, or even a set of numbers, can describe operating-system performance across the vast spectrum of possible network configurations. Almost every installation will have some hardware features that make it unique—the type of servers, the number and type of workstations, and bridges or gateways to other networks can dramatically affect network response time.

Our tests sought to determine the relative throughput of each system on a common test platform. The absolute numbers that are given for each test are not meant

continued

POWERsave™ is the first generic tape backup and restore facility for MS®-DOS compatible PC networks. Whether your disks belong to workstations or servers — POWERsave backs them all up.

Big. Unattended, it supports up to 16 tape drives of mixed types, including 2.2 GB cassettes, for "an incredible 32.704 GB of data...without changing tapes" using POWERstreamer IV™. And if that's not enough, an operator can feed POWERsave up to 100 tapes in succession.

Fast. PC Magazine benchmarks "...the POWERstreamer IV roughly twice as fast as The VAST™ Device (from Emerald Systems™) on all tests."

Highly reliable. PC Magazine "...tried to torment the software, with little success." Replicated directories, tape overwrite protection, dual validation, and other safeguarding features are built in.



POWERsave with POWERstreamer IV

Easy to use. Simple menu options allow quick and selective restore by file, directory, or volume.

Flexible. POWERsave supports Exabyte 2.2 GB 8mm cassettes, IBM 3480 HI/TC cartridges, and 150 MB tapes, all with SCSI controllers; plus 60, 125, or 150 MB tapes using QIC-36 or QIC-02 standards.

By the way, we do back up and sell one of the networks shown here — POWERLan!



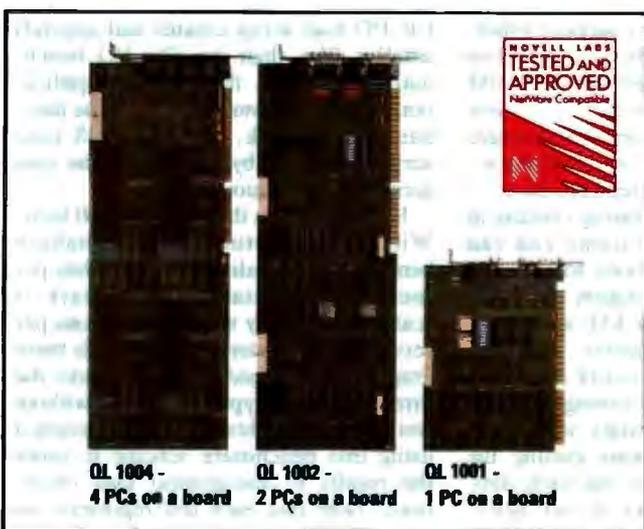
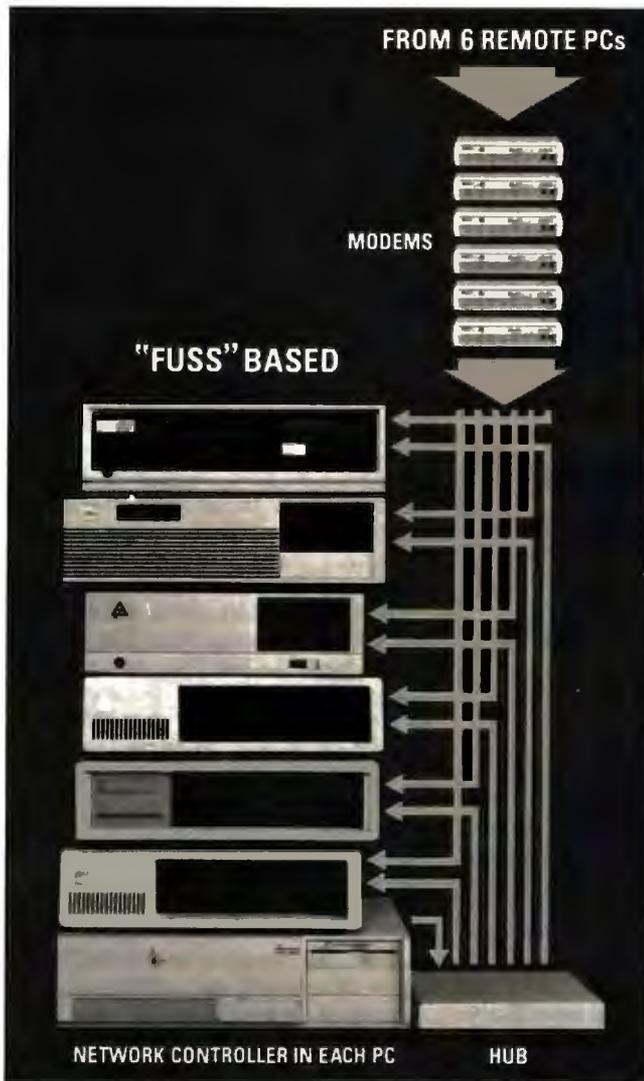
Call 1-800-825-LANS

Reseller inquiries invited.

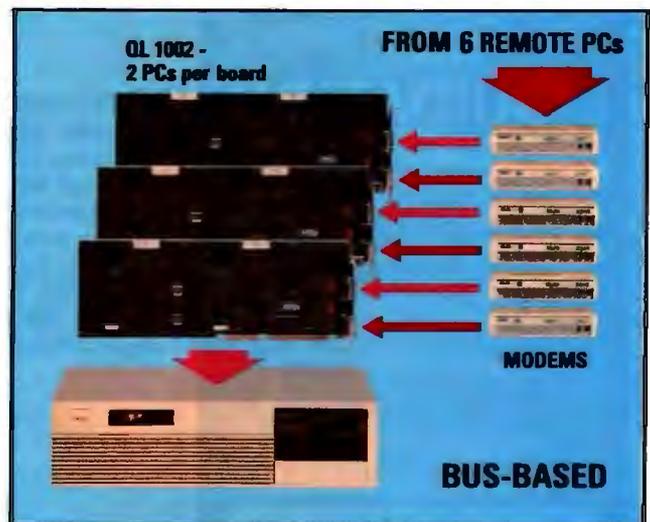
800 Lincoln Center • 7800 IH-10 West • San Antonio, Texas 78230

* Frank J. Deller, Jr. and C.G. Milligan, "2-Gigabyte Low Server Backups," PC Magazine, Jan. 17, 1989 (Volume 8, Number 1). POWERLan, POWERstreamer, POWERsave, POWERstreamer, and POWERstreamer IV are trademarks of Performance Technology, Inc. All other products mentioned are trademarks of their respective manufacturers.

IN SOME WAYS WE DON'T STACK UP



Novell NetWare is a trademark of Novell, Inc.
 CBIS Network-OS is a trademark of CBIS, Inc.
 CompuServe is a trademark of CompuServe, Inc.
 MCI is a trademark of MCI Telecommunications Corporation.
 WordPerfect is a trademark of WordPerfect Corporation.
 Lotus 1-2-3 is a trademark of Lotus Development Corporation.



IN SOME WAYS WE DO!

Remote Communications Made Easy

The QL 1000 PC-on-a-board Series is the elegant, low-cost alternative to standalone communication servers for Novell NetWare and CBIS Network-OS network environments.

Instead of dedicating noisy, bulky standalone PCs to specific network tasks, QL 1000 Series computers-on-a-card install neatly inside the fileserver chassis — not visible, but ready to process tasks upon demand.

Each user's processor, memory and I/O are on an AT bus based add-in board. Data travels at bus speed. That's as fast as it'll go!

QL boards are:

- **DIAL-IN MODEM SERVERS** — dial into your network from home or remote offices. Read your E-mail, run diagnostics, conduct business remotely.
- **DIAL-OUT MODEM SERVERS** — dial out from any network node to receive information from on-line bulletin boards like CompuServe and MCI.
- **BATCH SERVERS** — maximize network efficiency by offloading work to an idle processor. Run reports, compiles, long print jobs, database consolidations in background mode.
- **APPLICATION WORKSTATIONS** — run popular PC network applications like WordPerfect and Lotus 1-2-3 on low cost terminals. Each 8 MHz PC processor has 768K RAM.

By using QL 1000 boards, you don't need a stack of money AND a stack of PCs to install remote communications and high speed networking.

Call 1-800-648-2130 or (702) 883-7611 to order.

The leader in bus-based PC networking



Cubix Corporate Offices • 2800 Lockheed Way, Carson City, Nevada 89706 • Tel (702) 883-7611 • Fax (702) 882-2407
 Europe • Unit 4 Colonial Business Park, Watford, Hertfordshire, WD2 4PR, England • Tel (44) 923 51150 • Fax (44) 923 37021

Circle 78 on Reader Service Card (DEALERS: 79)

JULY 1989 • BYTE 165

CRAFTSMAN
PC XT-2 TURBO IBM
COMPATIBLE PERSONAL
COMPUTER
LIQUIDATION
FACTORY NEW! FACTORY PERFECT!



Bring the power of the office computer to your home! Our buyer made a fantastic deal with the distributor on these XT-Turbo Computers! Now we can offer them to you at HUGE SAVINGS!! Compute information quickly with this fast-handling, affordable turbo machine!

- 512K memory expandable to 640K.
- Two 360 KB 5-1/4" floppy drives.
- 8088 micro processor with hardware & software selectable system clock for 4.77 MHz & 10 MHz. • 100% IBM compatible.
- Eight—8-bit expansion slots.
- 8087 math co-processor socket, speaker.
- MS DOS/GW Basic.
- Mono/color graphics card.
- Tilt swivel amber monitor.
- Turbo switch on front panel.
- Key lock front panel. • Zero weight state.
- One Year Warranty!

20 MB Hard Drive w/ Single Drive

Mfg. Sugg. Retail: \$1,595.00

DAMARK PRICE:

\$799

Item No. B-1312-122721
Insured Ship/Hand.: \$39.00

Dual Disk Drive

Manufacturer's Suggested Retail

\$1,295.00

DAMARK PRICE:
\$599

Item No. B-1312-122672
Insured Ship/Hand.: \$39.00

FOR FASTEST SERVICE
CALL TOLL FREE

1-800-950-9090



DAMARK INTERNATIONAL, INC.
6707 Shingle Creek Parkway, Minneapolis, MN 55430
Customer Service • 1-812-568-4940

CRAFTSMAN Personal Computer(s)
@ \$599 each, plus \$39.00 s/h each.
Item #: B-1312-122672.

CRAFTSMAN 20MB Hard Drive
Computer(s) @ \$799 each, plus \$39.00
s/h each. Item #: B-1312-122721.
MN res. add 6% sales tax.

Name _____

Address _____

City, State, Zip _____

Check/MO VISA MasterCard Discover

Card No. _____

Exp. Date _____

Ph. # () _____

DELIVERY TO 48 U.S. STATES ONLY

to reflect performance in any other configuration; they serve only as a basis of comparison from one system to another.

Our test lab setup included six workstations and one server. Five of the workstations were AT-based systems: two 12.5-MHz Dell machines, two 12-MHz Everex ATs, and one 12-MHz Compaq Deskpro. We used these machines to create different network load conditions.

Our tests
determine relative
throughput on a
common test platform.

We made all our throughput measurements from the sixth workstation, a 16-MHz IBM PS/2 Model 80. For a server, we chose a 20-MHz Model 80 set up with a 110-megabyte ESDI hard disk drive and 8 megabytes of RAM. The setup couples a popular, general-purpose server with typical workstations.

In order to test these products on the substrate upon which they'll most likely be installed, we ran 3Com's and Novell's products on thin-wire Ethernet cabling using 3Com's EtherLink II and EtherLink/MC network adapter cards. IBM's two LAN products don't support Ethernet and would most likely be installed on Token Ring hardware. We set up an IBM Token Ring network using IBM's new 16-megabit-per-second network adapters and an IBM concentrator (multiple access unit, or MAU) for these products.

We set up all the operating systems in their default configurations and ran scripts on the workstations to measure throughput. Each workstation ran DOS. There are four tests: file I/O, a database application, a DOS transfer, and NetBIOS. All the tests consist of running a script or program on the timing workstation and taking readings with zero through four workstations loading the network. In addition, we ran each complete test with three types of load: again, file I/O, a database application, and a DOS transfer. With these readings, we were able to generate a matrix of results showing how each operating system performed when running a given test under a given load.

The file I/O test is a modified version

of our file I/O system benchmark. It creates a group of files on the server drive, appends additional data to each file in turn, and then performs a series of random reads and writes (in a 3-to-1 ratio). The result is a series of fragmented files that model those created by applications that randomly access a series of small files.

Database applications typically need random access to small chunks of very large files. Our database test, a script for the network version of Microrim's R:base, does a series of seeks and single-column writes to a 1-megabyte file. It makes multiple writes to each column that fits the seek criteria, so the read-to-write ratio is approximately 1-to-1 and little time is spent locking each column.

The DOS transfer test is a batch file that copies a 1-megabyte file on the server, reads the file from the server to local storage, and writes it back to the server. It tests the network's effectiveness at moving large groups of data in response to DOS INT 21H read and write calls.

The final benchmark in the suite tests throughput at the NetBIOS level. It's a simple, workstation-to-workstation transfer of a 1-megabyte file using NetBIOS calls. Since the test requires two workstations, we ran it on two Dell 210s; it's an exception to our running all timing tests on the Model 80. We didn't use the Model 80 to generate load, however, so each load step remained linear.

Each loading script is a scaled-down version of the equivalent timing test. Our file I/O load script creates and appends smaller files than the file I/O benchmark. Similarly, the database application load does fewer writes than the database benchmark, and the DOS load script moves 1K-byte files. All the load scripts are continuous loops.

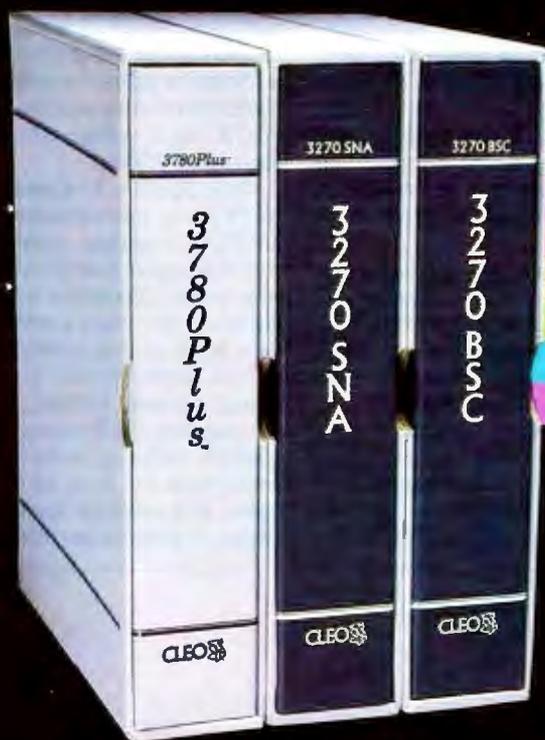
Figure 1 shows the results for all tests. With the exception of the database benchmark, all values are in kilobits per second. The database benchmark is scaled in arbitrary write transactions per second for consistency. To compile these graphs, we averaged the results under the three different types of loads without weighting. Weights could be assigned using this benchmark scheme to tailor the results to less-general load conditions. Note that each test represents an average of three complete runs.

Performance

No matter what security or compatibility features a network operating system may support, most customers will also

continued

CLEO is your SNA, BSC and Coax Gateway



VMS
UNIX
XENIX
PC-DOS
Macintosh
NetBios LAN

Sharing Information

Whatever your industry, your computers need to share information with your mainframe. Or, they need to exchange data with other computers. In either case, you need a total communications solution. You need software, hardware interfaces and modems that all work together smoothly. You need CLEO!

CLEO software products allow your computer to communicate with mini-computers and mainframes, and to emulate their workstations. Since 1981, CLEO has provided communications between micros, minis, and mainframes for the automotive, insurance, medical and banking industries. Today over 78,000 CLEO users worldwide are running on all major computer brands. The greatest number of these users run CLEO software on IBM Personal Computers and NETBIOS LANs.

Complete Software/Hardware Package

Every CLEO package contains all the software and hardware accessories you'll need. Your selected CLEO SNA, BSC, or Coax software is packaged with 1) an internal modem card for dial-up applications, or 2) an interface card and cable for use with your existing modem, or 3) a Coax card for local connectivity. There's no waiting for non-CLEO add-ons. And, you get prompt, single-source service.



Package prices range from \$795.00 for most stand-alone packages, up to \$1,995.00 for the 32-user SNA gateway.

Call us today to discuss your application.

CLEO Software
2652 Eastrock Dr.
Rockford, IL 61109
FAX 815/397-6535

Headquarters:

USA: 1-800/233-2536
Canada: 514/484-8787
International: 815/397-8110

Sales and Distribution:
Canada, East: 800/361-3185
Canada, West: 800/361-1210
Canada, Montreal: 514/737-3631
Colombia, S.A.: 12172266
Denmark: 02 94 81 19
England: (0993) 776543
Italy: (0331) 634 562
Mexico City: 550-8033
Sweden: 4687405070
W. Germany: 06151 55095

CLEO 

demand that it respond to requests for data without noticeable delay. If every user is to have the illusion that his or her area on the server is simply another local drive, then the network needs to provide data at local-disk speed.

We used a comparison with single-user drive performance as our throughput yardstick. The shaded area in each figure (except figure 1a) represents performance below that of our PS/2 server when taken off the network and run as a stand-alone machine. Figure 1a, NetBIOS test results, doesn't have a single-user equivalent.

The flat load response of our NetBIOS test, which doesn't access the server drive, led us to conclude that most of the load delays shown by the other tests represent a server bottleneck. Traffic on the physical layer and the effectiveness of the

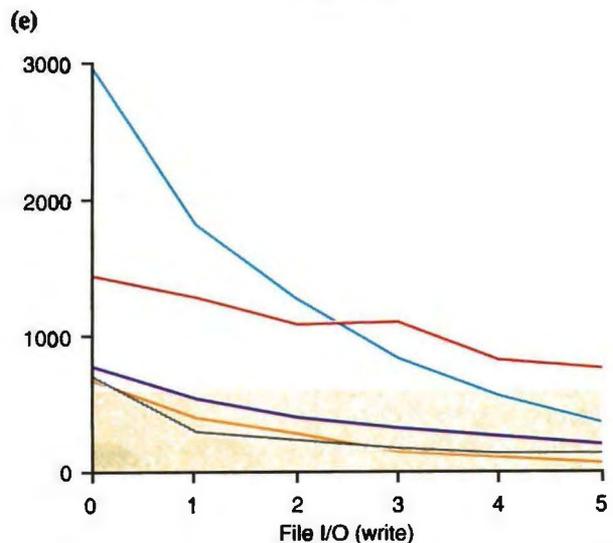
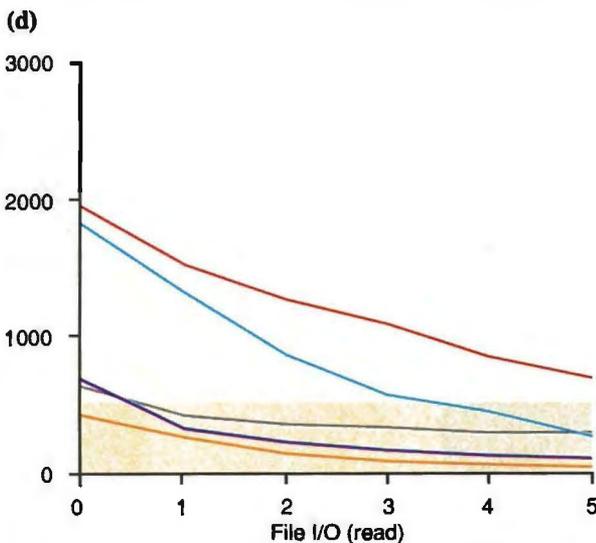
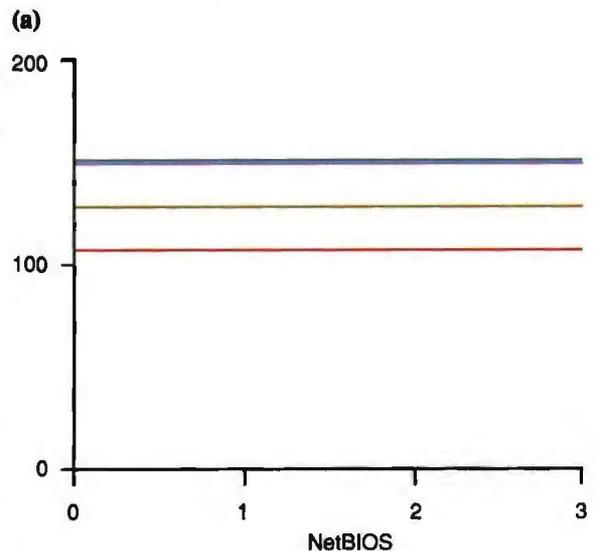
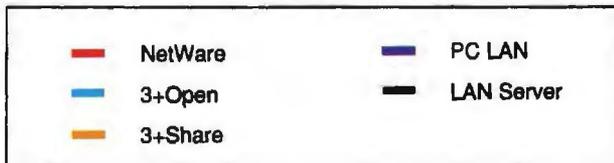
protocol stack had little to do with overall throughput. Most of our tests measured how well a given operating system handled server disk access and the quality of the software's network adapter driver. In practice, these are the factors most likely to degrade performance on any server-based system. Some tests, like file I/O, also seemed sensitive to workstation caching.

Novell's NetWare had a spectacular showing. Novell's disk optimizations include a server cache made up of 4K-byte buffers, limited in number only by available memory. Directories are also cached, making for rapid disk searches. NetWare's disk format features larger logical blocks than the 512-byte sectors of DOS and OS/2, which enhances performance on large file transfers. The one weak spot was NetWare's NetBIOS test

result, which was the lowest of the tested packages. NetBIOS is the native session protocol for the other systems, while IPX is Novell's native session protocol. Its NetBIOS is an emulation layered on top of IPX, so it suffers when compared to native NetBIOSes.

Only 3Com's 3+Open came close to NetWare's performance. We tested 3+Open running under Microsoft's server adaptation of OS/2, a special version normally bundled with the 3+Open package. The main performance difference between this version and standard-edition Microsoft OS/2 is the inclusion of a sophisticated caching utility. Unlike the standard OS/2 cache, the server adaptation cache is write-behind, can be configured for sizes of up to 14 megabytes, and employs scatter-gather algorithms to enhance performance. The sys-

Figure 1: Results of the BYTE benchmark suite for five LAN operating systems. All graphs represent network throughput; higher numbers mean better performance. Part (a) shows the NetBIOS test results. The yellow-shaded areas in parts (b) through (g) represent the levels of performance you could expect from a single-user system operating on the same file server. Points in the shaded areas mean response delays you wouldn't see in a dedicated system, and points above the areas indicate better operation than a single-user machine. All values are in kilobits per second except for the database benchmark, which is in write transactions per second.



tem used a 384K-byte cache on our server. 3+Open also buffers the server disk with three 64K-byte buffers. All of 3+Open's parameters can be adjusted to further fine-tune performance.

Although 3+Open turned in good benchmark results, it outdid NetWare only on our file I/O write test. 3Com says that its new NBP protocol will substantially improve performance, and the company claims especially good performance for 3+Open over linked networks. Its transport protocol, unlike Novell's IPX, can send multiple packets before requiring receiver acknowledgment.

3+Open proved to be a much more responsive system than its older sibling, 3+Share. OS/2's multitasking capability and very high memory ceiling make it much more effective than DOS at handling the strain put on a network server.

3+Open, like NetWare, handles multiple client requests as multiple processes. Because it can handle requests concurrently, 3+Open is able to intelligently buffer up requests that refer to adjacent areas on the disk. This enables it to satisfy the largest number of requests with the fewest disk accesses.

3+Share caches the server disk, directories, and FAT. While performance with the system set up in its default configuration was disappointing, 3+Share is completely configurable and devotes an entire manual to network tuning.

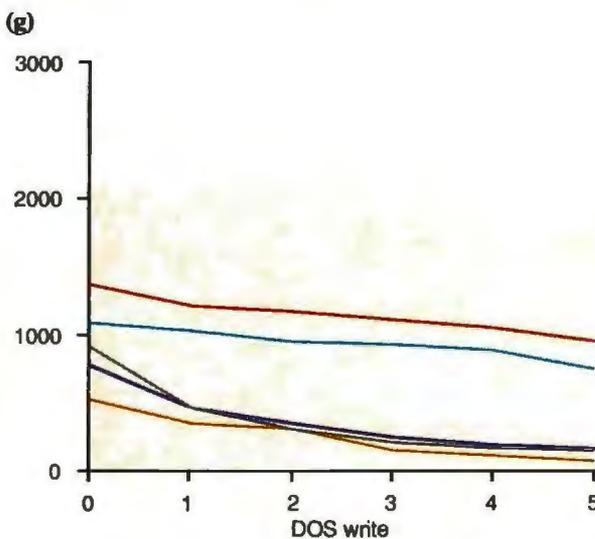
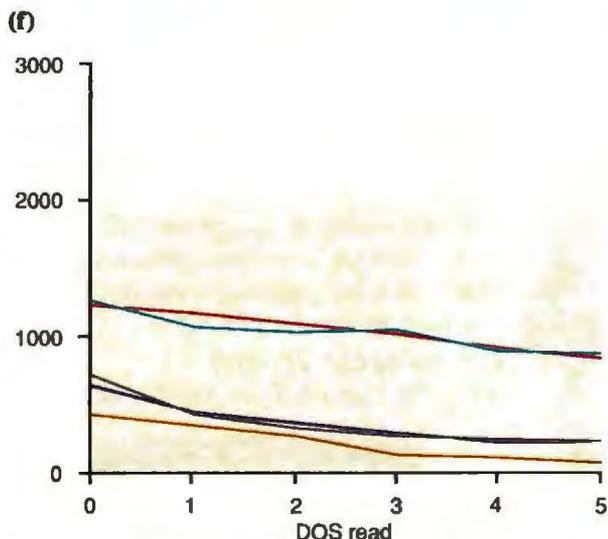
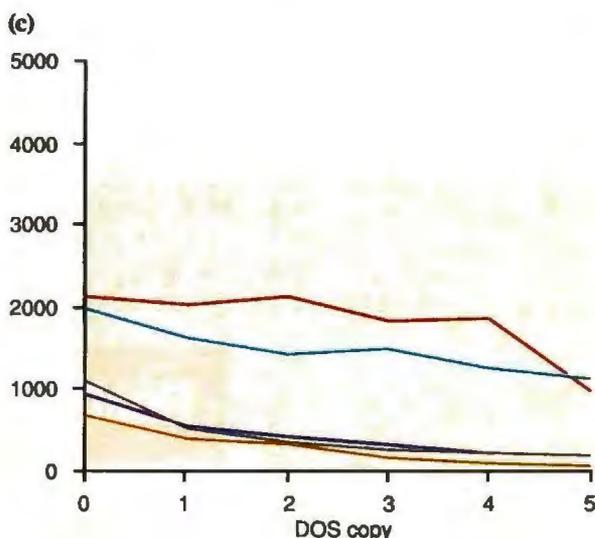
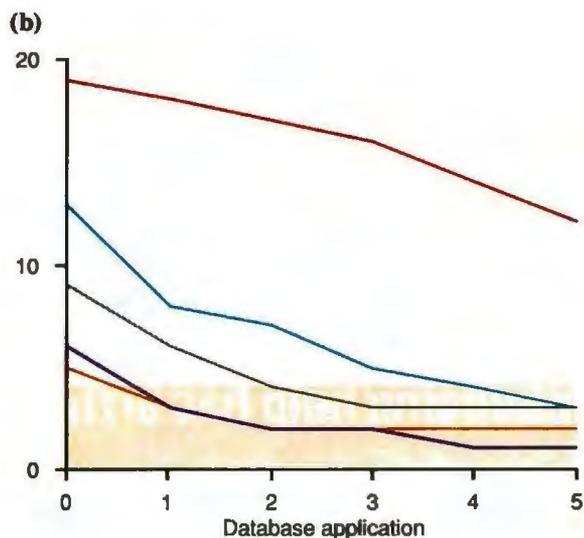
IBM's two entries, both running in a Token Ring environment, showed surprisingly similar performance. While the throughput levels are about where we'd expect for PC LAN, LAN Server's numbers are surprisingly weak.

Since it's sold as a stand-alone pack-

age, we ran LAN Server under IBM OS/2 Extended Edition 1.1, not the server-optimized version packaged with 3+Open. As a result, OS/2's server caching was limited to the 64K-byte cache to which OS/2 defaults as part of the installation. Though it wasn't part of the formal benchmarks, we did tweak the cache up to 384K bytes to see whether it was the only factor limiting LAN Server's performance. The server responded with slightly better throughput, but the numbers were still significantly worse than those for 3+Open. The rest of LAN Server's disk buffer parameters default to the same values as 3+Open's.

You should keep in mind that we tested LAN Server with DOS workstations that were running the PC LAN redirector software. Any workstation contributions

continued



COMPANY INFORMATION

IBM Corp.
Armonk, NY 10504
Contact local representative.
Inquiry 1071.

Novell, Inc.
122 East 1700 South
P.O. Box 5900
Provo, UT 84601
(801) 379-5900
Inquiry 1072.

3Com Corp.
3165 Kifer Rd.
Santa Clara, CA 95052
(408) 562-6400
Inquiry 1073.

to performance were identical for PC LAN and LAN Server. This is not like the relationship between 3+Open and 3+Share, because 3+Open DOS workstations aren't compatible with 3+Share.

In testing the OS/2 networks, LAN Server and 3+Open, we ran into a few

performance oddities: We were able to run tests repeatedly and get results varying by as much as 40 percent from run to run. Often the test results would fall within a narrow window from a long series of tests and then suddenly degrade with no apparent changes to the configuration. Microsoft representatives speculate that the performance quirks may be due to using up all the clear blocks in the server cache.

Final Decision

Even with Extended Services, PC LAN is fairly basic. It appears to have no fault-tolerant provisions and no auditing capabilities. If most of the systems in your workplace are IBM PC XTs, then PC LAN is worth a look. But most users in this situation would probably find 3+Share more full-featured.

LAN Server has many of the features that PC LAN lacks. Since LAN Server is built on top of OS/2, it carries with it advantages beyond performance: a common set of application programmer interfaces and an open, modular communications architecture mean excellent compatibility. If you've already got PC

LAN installed in your office, the easy upgrade path to LAN Server (provided you've got machines that can run OS/2) bears scouting.

Clearly, the heavyweights here are NetWare and 3+Open. With Novell still solidly entrenched at the top, 3Com has now embarked on a new offensive. No longer locked in the limited confines of DOS, 3+Open should evolve into an impressive product. Ultimately, for large networks with numerous internetwork bridges and gateways to other environments, 3+Open, with its planned support for multiple transport stacks and efficient naming conventions, will hold the edge. But while we're impressed by the promise of 3+Open, NetWare still offers the strongest product overall. It handles network chores with ease, and its management, accounting, and security features are well ahead of the pack. ■

Steve Apiki and Stanford Diehl are testing editors for the BYTE Lab. They can be reached on BIX as "apiki" and "sdielh."
Rick Grehan is the director of the BYTE Lab. He can be reached on BIX as "rick_g."



Finally. OS/2 debugging help has arrived.

Introducing MultiScope™, an OS/2, multi-language, CodeView™-compatible debugger, like nothing you've seen before.

For a start, it provides 13 views of your program: Source—Data—Graphic Data—Assembly—Thread—Breakpoint—Watch—Register—Module—Call—Memory—Log—and Output.

Other unique features include: run-time and post-mortem debugging options; OS/2 text mode and Presentation Manager user interfaces; and even a graphical representation of your data structures! All for \$299.

Call toll free 800-231-7717.

In CA 800-552-8885. Fax 415-792-8901.

MULTISCOPE™
DEBUGGER

From LOGITECH Software

Circle 166 on Reader Service Card (DEALERS: 167)

An offer from CDP for PC users who have always wanted to try CD-ROM, but never had the drive.

For a limited time, we're offering a special NEC CD-ROM/Microsoft software package that lets you take this exciting new technology out for a spin—at a price that even the most prudent PC user will find affordable.

This one-of-a-kind package includes:

•Your choice of NEC CD-ROM drives—Choose from a NEC internal or stand-alone unit.

•Microsoft Bookshelf—A comprehensive collection of 10 renowned reference works for writers on one disk. PLUS you'll receive a coupon to purchase Microsoft's Stat Pack and Small Business Consultant bundled—for only \$100.

All for over \$700 off the regular retail price!

"I believe more than ever that CD-ROM products will be a major force in the expansion of the information industry..."

Bill Gates, Chairman, Microsoft

When you use CD-ROM with your PC you'll be able to access—and speed through—more information than you ever dreamed possible. What's more:

•A single 4.72" CD is capable of holding up to 1,500 floppy disks (or 250,000 text pages).

•CD-ROM is compatible with existing IBM PC/XT/AT/386 and PS2 computers.

•Information encoded on a CD is virtually indestructible.

Inexperienced users can't harm data.

•And most importantly, CD-ROM is growing! Over 25 new titles are being published every month!

A unique offer from CDP—the largest specialized supplier of CD-ROM products in the U.S.

CDP (Compact Disk Products, Inc.) distributes a complete range of CD-ROM, WORM and Erasable optical memory drives and software. For over two years, we've provided our customers with prompt service...expert advice...and the most competitive prices possible. Most importantly, we've established a commitment to bringing this exciting, new technology to PC users like you. There's no better time than right now to get in on CD-ROM. Here's what you'll get when you take advantage of our special offer:

•NEC CD-ROM Drive—Your unit comes complete with an interface card for PC/XT/AT/386 compatibles (specify if you require a PS2 Microchannel card), connection cable, MS-DOS Extensions and Instructions. Choose from the NEC CDR-77 stand-alone unit, or CDR-80—an easy-to-install, half-height internal drive.



•Microsoft Bookshelf—A comprehensive reference collection for writers on a single disk including: *The World Almanac*, *Chicago Manual of Style*, *Bartlett's Familiar Quotations*, *Roget's II: Electronic Thesaurus*, *American Heritage Dictionary*, *Business Information Sources*, *The U.S. Zip Code Directory*, *Houghton Mifflin Spell Checker and Usage Alert*, and *Forms and Letters*. PLUS you'll receive a coupon allowing you to purchase the two following programs bundled for only \$100!

•Microsoft Stat Pack—Databases on this disk include Statistical Abstracts, Area Wage Surveys, Business Statistics, agricultural and land management statistics from the federal government, plus Microsoft Excel and Lotus 1-2-3 Spreadsheet files for each statistical table.

•Microsoft Small Business Consultant—The most popular publications of the Small Business Administration and the accounting firm of Deloitte, Haskins & Sells on running a small business. Find tips on writing a business plan, obtaining credit, personnel issues, import-export regulations, and more.

•In addition, you can order Microsoft Programmer's Library. Over 15,000 pages of Microsoft's technical reference manuals, covering OS/2, Windows, MS-DOS, C, Basic, MASM, Pascal Fortran and assorted hardware products.

Place your order now and receive these free gifts. Order your NEC/Microsoft package from CDP now and receive:

•A free subscription to CD-ROM End User magazine.

•A free CD-ROM quartz clock—valued at \$24.95 (clock offer available for mailed or faxed orders, only) Note: Free gift offer limited to first 500 orders.

TO ORDER, CALL TOLL-FREE:
1-800-MEGABYTE (1-800-634-2298),
FAX YOUR ORDER TO
(212) 737-8289, OR RETURN THE
COUPON TO:

Compact Disk Products, Inc.
223 East 85th Street
New York, New York 10028
(For inquiries, call
(212) 737-8400.)

GUARANTEE

1) If you are unable to install a NEC drive purchased from CDP in your computer system within 30 days of receipt, we will issue you a complete refund, including shipping.

2) If, by June 30, 1991, you believe the NEC drive you receive is incompatible with prevailing CD-ROM technology, we will provide you with a new, compatible drive at 50% of the listed retail price of the new drive.

3) All hardware is backed by a full 90-day manufacturer's warranty. If you receive a defective unit, CDP will replace it at any time during the warranty period.



Please send the package I've checked below.

Microsoft Package "A"—Complete CD-ROM drive kit (internal or external) plus Bookshelf (includes a coupon to purchase Stat Pack/Small Business Consultant bundle for \$100) for only \$695!

Microsoft Package "B"—Complete CD-ROM drive kit (internal or external) plus Bookshelf and Programmer's Library (includes a coupon to purchase Stat Pack/Small Business Consultant bundle for \$100) for only \$1189!

Please send the following drive configuration with my order:

Stand-alone Internal

NEC CDR-77 Stand-alone drive, select PC/XT/AT/386
 Microchannel

(NEC CDR-80 Internal drive for PC/XT/AT/386 only)

Circle 59 on Reader Service Card

Compact Disk Products, Inc.
223 East 85th Street, New York, New York 10028
(212) 737-8400

Please send me a free catalog of all your products.

Corporate / personal check / money order enclosed
Charge my (circle one) American Express Optima VISA
MasterCard Diner's Club

Acc. # _____ exp. date _____

Signature _____

Name _____

Company _____

Address _____

City/State/Zip _____

Prices include shipping and handling. New York residents add 8.25% sales tax.

“...I don't know any other computer I could have used in a White House briefing.”

CAMBRIDGE
Z88

Jerry Pournelle
BYTE, June 1989, page 119

When he visited the White House recently, Jerry Pournelle used his 2 pound Cambridge Z88 ultralight portable computer to document the event.

No larger than this magazine, the Z88 fits easily into your briefcase or backpack and runs 20 hours on 4 AA batteries.



The Z88's silent keyboard can be used in the classroom, meetings, libraries. 8 x 106 supertwist LCD display has a page map that shows the "shape" of each page.



With built-in word processor, spreadsheet, diary, calendar, calculator, clock and alarms, the Z88 operates stand-alone and can transfer files to a desktop PC or Mac using optional cables and software. Memory is expandable from 32KB up to 1.5MB. Base unit price \$549. Link software, cables and memory sold separately. Call us for more details and a 21 day no obligation test drive.

West & Midwest East Coast
800-366-0088 800-888-3723

Dealer inquiries call 207-761-3700

Cambridge North America, 424 Cumberland Avenue, Portland, Maine 04101

Mac and Macintosh are trademarks of Apple Computer Inc.
Copyright 1989 Cambridge North America



IBM's New Speed King

The Model 70-A21 is the fastest PS/2, but it's slower than its competition

Caroline Halliday

You'd think they're selling computers by the pound these days. Almost all the recent crop of 25-MHz 80386-based personal computers are large desktop or floor-standing units with a lot of expansion slots and room for storage devices. IBM's PS/2 Model 70-A21 is also a 25-MHz 80386-based personal computer, but it is packaged into a small form factor with only three expansion bus slots. At first glance, the Model 70 may seem to be an ideal machine if you don't need all those expansion slots—but its comparative performance is not stellar.

Essential Features

The Model 70-A21's system board memory architecture includes an 82385 memory cache controller with 64K bytes of static RAM (SRAM). The system board comes with 2 megabytes of 80-nanosecond RAM, expandable to 8 megabytes. One 1.44-megabyte 3½-inch floppy disk drive is standard, and there's room for a second. The 120-megabyte ESDI hard disk drive is similar to the hard disk drive in the 20-MHz Model 70-121. A basic Model 70-A21 costs \$11,295.

The 101-key IBM Enhanced keyboard comes with the system unit, but you must purchase the display separately. As with its siblings, this computer's VGA adapter subsystem, serial port, parallel port, and mouse port are integral parts of the sys-



tem board. The Micro Channel architecture (MCA) expansion bus includes two 32-bit slots and a 16-bit slot for PS/2 expansion boards. The system I reviewed had 8 megabytes of system board RAM (\$1495 for each 2 megabytes beyond the standard), the 25-MHz 80387 math coprocessor (\$2395), and the 8513 color monitor (\$750), for a total price of \$18,925. [Editor's note: *After this review was written, IBM announced that it had temporarily stopped production of the 70-A21 to correct an undisclosed problem on the motherboard. Units made since March have the revised motherboards.*]

PS/2 Lineage

The Model 70-A21's styling is similar to that of the other Model 70s and the Model 50s. (I reviewed the previous

Model 70s in "Strengthening the Lineup," January BYTE.) From the front, the desktop unit looks very small, occupying over 35 percent less space than an IBM PC AT, but it is almost as deep.

The power switch and floppy disk drive are on the front of the unit. You can install a second 3½-inch floppy disk drive (\$425) in the bay between them. All connectors are on the rear panel, as is the keylock for locking the case. The keyboard locks via the password protection facility supplied with all the PS/2s.

The keyboard and mouse port connectors are 6-pin mini-DIN connectors that are physically similar but (unlike their counterparts on the Model 30) not interchangeable. The display is connected via a miniature DB-15 VGA connector

continued

IBM PS/2 Model 70-A21

Company

IBM Corp.
900 King St.
Rye Brook, NY 10573
(800) 426-2468

Components

Processor: 25-MHz 32-bit 80386; socket for optional 25-MHz 80387 math coprocessor
Memory: 2 megabytes of 80-ns RAM, expandable to 8 megabytes maximum on the system board and 16 megabytes maximum in the system; 82385 memory cache controller with 64K-byte SRAM zero-wait-state memory cache
Mass storage: One 1.44-megabyte 3½-inch floppy disk drive (optional second floppy disk drive); optional 120-megabyte hard disk drive
Display: VGA as integral part of system board; optional 8513 color VGA monitor
Keyboard: 101-key IBM Enhanced
I/O interfaces: One female DB-25 parallel port; one male DB-25 serial port; miniature DB-15 VGA connector; one 6-pin DIN mouse port; two 32-bit MCA expansion slots and one 16-bit MCA slot

Size

5½ × 14½ × 16½ inches; 21 pounds

Software

Reference Diskette

Documentation

Quick reference guide

Price

Model 70-A21: \$11,295
System as reviewed: \$18,925

Inquiry 852.

rather than the CGA's and EGA's DB-9 connector. The extra pins are necessary, in part, to enable the computer to identify the type of monitor attached.

Inside Story

The Model 70-A21's interior is similar to that of the other Model 70s and the Model 50; no cables are used. The power supply runs from front to back on the right side, and the system board lies in the base of the unit. A platform arrangement above the system board supports the disk drives. The hard disk drive is mounted on the platform behind the floppy disk drives. All disks are linked to the system board via a printed circuit board that effects the right angle connection.

The system board occupies the whole bottom of the case to the left of the power

supply. The processor, math coprocessor, and cache controller are on a piggyback board under the floppy disk drives. The main system RAM modules are on the main system board. You need to remove the drive support platform to add system memory modules. You can reach the math coprocessor socket through a hole in the platform under the second floppy disk drive (if installed).

Three MCA expansion slots are in the left rear of the system board. The 16-bit slot on the far left includes the video extension portion of the bus, which allows you to use video boards, such as IBM's 8514/A, in place of the VGA. The two 32-bit slots do not include this extension.

Banning DIP Switches

On the PC and AT, DIP switches and jumpers set the interrupt levels and starting addresses for the expansion board. The PS/2s attempt to rectify this annoyance with an automatic configuration system, standard across the machines and achieved through software rather than just hardware. IBM thereby discourages third-party vendors from adding any jumpers or switches to boards. (But it breaks its own rule on the 8514/A video board memory-expansion module.)

This configuration standard is called Programmable Option Select. Each PS/2 expansion board has a unique ID, set in software-writable latches, that POS uses. When any option is added, taken out, or even moved around in a PS/2, the supplied Reference Diskette is used to reset the configuration.

For most situations, the automatic configuration utility on the Reference Diskette is adequate. The utility determines the type of adapter in a particular slot, the adapter's desired interrupt level, and the adapter's starting address. For many adapters, alternate interrupts and starting addresses are also specified. The configuration utility sets the interrupt levels and starting addresses so as to avoid conflicts, selecting alternates if possible, or disabling an adapter board if conflicts cannot be resolved. The current configuration information is stored in the battery-backed CMOS RAM, where the operating system can access it.

In addition to the software-writable latches on an adapter board, a board manufacturer can supply a floppy disk that includes adapter description files, diagnostic tests, and power-on self test error messages. These are added to the Reference Diskette prior to configuration. The Reference Diskette includes other configuration utilities that you use for more specialized applications when

you don't want to use the settings from the automatic configuration.

Also on the Reference Diskette is the password protection utility, which offers two levels of password protection: power-on and keyboard. You must type the correct password, which can be up to seven characters long, before you can use the computer. The keyboard password program lets you lock the keyboard from the DOS prompt until the password is typed. You set the passwords initially via a utility on the Reference Diskette.

Reading Reference

The Model 70-A21 comes with a quick reference manual and disk cache instructions. The reference manual gives a basic introduction to the Model 70, information on installing options into the computer, and some troubleshooting tips.

The instructions are clear and concise, with adequate graphics. For example, the instructions for installing the math coprocessor start with checking the type of coprocessor and turning off the computer and continue through orienting the chip and reconfiguring the computer.

Measuring Up

As expected from the company that set the standard, IBM's Model 70 is fully software-compatible. I did not have any problems with application software.

The BYTE benchmarks, with no disk-caching software installed, rated the 25-MHz Model 70-A21 lower than the 20-MHz Compaq Deskpro 386/20, the Dell System 310, and Advanced Logic Research's FlexCache 20386. This is due to the Model 70's slower hard disk drive.

With a disk cache added, the various machines perform more evenly. A good disk-cache program operates out of RAM most of the time, only accessing the disk when a cache miss occurs. Arguably, the supplied disk cache compensates for a lower-performance disk drive. If you are using DOS and typical application programs, the hard disk with disk-caching software installed won't present a performance problem. But for applications that access data randomly from the disk, there is a performance penalty.

At the CPU level, the Model 70-A21 is faster than the Compaq Deskpro 386/25, even though both machines use the Intel 82385 as the memory cache controller (not to be confused with the disk-caching software). IBM's implementation is a 64K-byte, two-way associative cache; Compaq's is a 32K-byte cache.

When a cache miss occurs on the Model 70, 8 bytes, rather than 4, are

continued



IBM PS/2 Model 70-A21

APPLICATION-LEVEL PERFORMANCE

IBM PS/2 Model 70-A21 **16.4***

WORD PROCESSING

XyWrite III + 3.52	Medium/Large
Load (large)	:13
Word count	:02:13
Search/replace	:03:17
End of document	:01:11
Block move	:08:08
Spelling check	:06:38

Microsoft Word 4.0

Forward delete	:18
----------------	-----

Aldus PageMaker 1.0a

Load document	:09
Change/bold	:19
Align right	:14
Cut 10 pages	:13
Place graphic	:03
Print to file	1:54

■ **Index:** **3.20**

SPREADSHEET

Lotus 1-2-3 2.01

Block copy	:02
Recalc	:01
Load Monte Carlo	:15
Recalc Monte Carlo	:03
Load rlarge3	:04
Recalc rlarge3	:01
Recalc Goal-seek	:02

Microsoft Excel 2.0

Fill right	:03
Undo fill	1:09
Recalc	:01
Load rlarge3	:17
Recalc rlarge3	:01

■ **Index:** **3.75**

DATABASE

dBASE III + 1.1

Copy	:51
Index	:19
List	1:26
Append	1:50
Delete	:02
Pack	1:46
Count	:17
Sort	1:18

■ **Index:** **1.52**

SCIENTIFIC/ENGINEERING

AutoCAD 2.52

Load SoftWest	:32
Regen SoftWest	:22
Load StPauls	:08
Regen StPauls	:04
Hide/redraw	7:09

STATA 1.5

Graphics	:23
ANOVA	:10

MathCAD 2.0

IFS 800 pts.	:09
FFT/IFFT 1024 pts.	:09

■ **Index:** **5.33**

COMPILERS

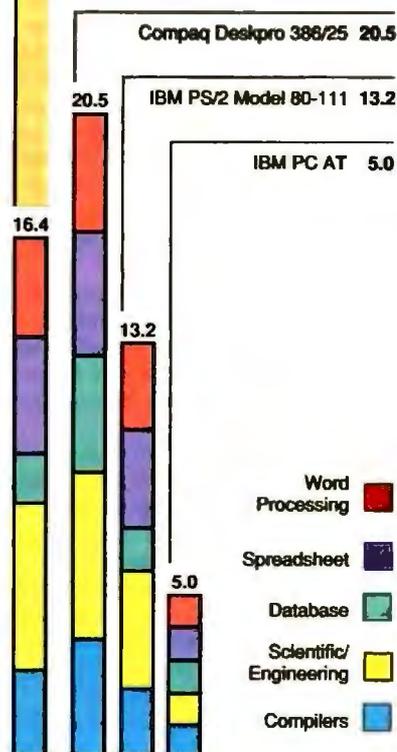
Microsoft C 5.0

XLisp compile	3:07
---------------	------

Turbo Pascal 4.0

Pascal S compile	:05
------------------	-----

■ **Index:** **2.62**



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT=1.

LOW-LEVEL PERFORMANCE¹

IBM PS/2 Model 70-A21

CPU

Matrix	2.69
String Move	
Byte-wide	18.95
Word-wide:	
Odd-bnd.	23.73
Even-bnd.	9.50
Doubleword-wide:	
Odd-bnd.	16.49
Even-bnd.	4.76

Sieve	14.22
Sort	10.64

■ **Index:** **4.71**

FLOATING POINT

Math	5.06
Error ²	

Sine(x)	1.59
Error	

e^x	1.86
Error	

■ **Index:** **10.23**

DISK I/O

Hard Seek³	
Outer track	5.00
Inner track	5.00
Half platter	7.14
Full platter	8.60
Average	6.43

DOS Seek	
1-sector	12.67
32-sector	26.88

File I/O⁴	
Seek	0.09
Read	1.06
Write	1.14

1-megabyte	
Write	5.25
Read	4.96

■ **Index:** **1.64**

VIDEO

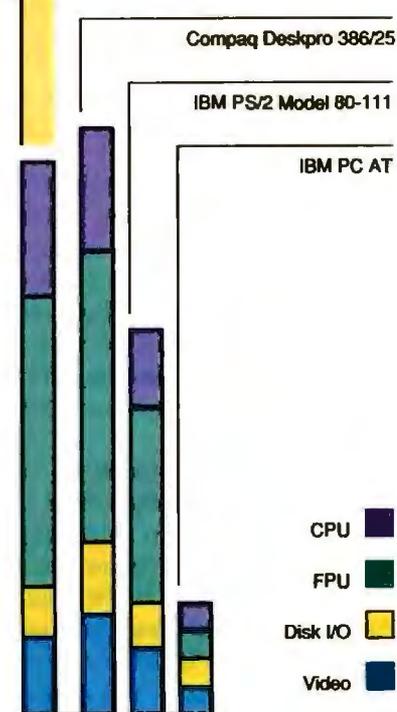
Text	
Mode 0	3.13
Mode 1	3.13
Mode 2	3.41
Mode 3	3.41
Mode 7	N/A

Graphics	
CGA:	
Mode 4	1.26
Mode 5	1.21
Mode 6	1.38

EGA:	
Mode 13	2.47
Mode 14	2.96
Mode 15	N/A
Mode 16	2.93

VGA:	
Mode 18	3.06
Mode 19	1.26
Hercules	N/A

■ **Index:** **2.96**



N/A=Not applicable.

¹ All times are in seconds. Figures were generated using the 8088/8086 and 80386 versions (1.1) of Small-C.

² The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

³ Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

⁴ Read and write times for File I/O are in seconds per 64K bytes.

⁵ For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

CONVENTIONAL BENCHMARKS

LINPACK	142.05
Livermore Loops ⁵ (MFLOPS)	0.20
Dhrystone (MS C 5.0) (Dhry/sec)	7974

fetched from memory. When cache misses occur one after another in groups, this method improves the machine's performance. Typically, applications access memory sequentially, which makes using a cache worthwhile; however, once a cache miss occurs, several more cache misses are likely, making IBM's method efficient. The ALR 25-MHz 25386 outperformed the Model 70 on all the CPU tests because its proprietary cache controller has superior performance.

The Model 70's video performance, while completely compatible with IBM's own standard, is not as good as that of the Compaq machine because of its 8-bit architecture. Compaq's 16-bit VGA architecture gives it the edge here.

As expected, the disk I/O tests show the weakness of the Model 70's hard disk drive. The results are similar to those of the IBM PS/2 Model 80-111; however, the index of 1.64 indicates a performance only 1.64 times faster than the hard disk drive in the 8-MHz AT. Pitted against competitors, IBM's hard disk drives do not fare well. For example, the 25-MHz Compaq has a hard disk index of 2.55.

The application-level benchmarks

show the effect of the hard disk drive and graphics in typical applications. As expected, the database results are the most affected by the hard disk drive. The Model 70 takes 50 percent longer to perform the database tests than the Deskpro 386/25. In the scientific and engineering tests, the superior memory architecture shows when calculations are significant, but its effect is tempered by the 8-bit VGA when graphics are important.

Wrap-Up

The 25-MHz Model 70 offers full software compatibility with the AT class of machines and a fast speed. It is hardware-compatible with the PS/2 family, incorporating 32-bit MCA expansion slots. The MCA expansion bus and the 3½-inch floppy disk standard may be a barrier to some purchasers, but the IBM label may be important to others.

Machines comparable to the Model 70-A21, such as Compaq's Deskpro 386/25 (\$11,447) and ALR's FlexCache 25386 (\$9499), are larger, but they incorporate other features (e.g., faster hard disk drives and VGA boards) that enable them to perform substantially

faster. In fact, some 20-MHz machines perform the BYTE benchmarks faster than the Model 70-A21. This shortcoming is mostly attributable to a slower hard disk drive and an 8-bit VGA system. However, the hard disk performance can be improved to acceptable standards with the supplied disk-caching software.

With the disk caching, the Model 70-A21 is a reasonably fast machine, and you can have up to 8 megabytes of memory on the system board before needing one of its three expansion slots. If you need more than three expansion slots along with the speed, opt for a Compaq Deskpro 386 or an ALR 80386 computer. Otherwise, this, or one of the slower, lower-priced versions of the Model 70 (the Models 70-E61 and -121), may fit your needs cost-effectively. ■

Caroline Halliday is an electrical engineer and freelance writer living in the Chicago area. Her recent books are: IBM PS/2 Technical Guide with James A. Shields (Howard W. Sams and Co., 1988) and Using OS/2 with Mark Minasi and David P. Gobel (Que Corp., 1989). She can be reached on BIX c/o "editors."

Quality In... Quality Out

No matter how well acquainted you are with making important personal computing decisions—decisions that may involve hundreds of thousands of dollars—the value of those decisions is only as good as the value of your information. Without quality information—it's hard to make quality decisions.

BYTEweek, McGraw-Hill's new weekly newsletter for professionals in the personal computer industry, is devoted to giving you that quality information through its timely and compact one-stop news format. And BYTEweek interprets this news with in-depth commentary and analysis.

Subscribe to BYTEweek for quality information. Remember, quality in... quality out.



Take advantage of the special one-year charter subscription rate of \$395 (\$495 outside the U.S. and Canada)—a savings of \$100 off the regular rate. Your subscription includes 50 issues plus a free three-month subscription to BIX—a \$49 value.

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: 1-603-924-9281.

BYTEweek offers a money-back guarantee if you're not completely satisfied.

BYTEWEEK 

News and Analysis for Professionals in the
Personal Computing Industry
One Phoenix Mill Lane, Peterborough, NH 03458

IF YOU LIKED OUR AD, YOU'LL LOVE THE BOOK.

On the front gatefold of this magazine, you'll find a 4-page ad about our 386™ systems, 286 systems, laser printers, and low direct-from-the-manufacturer prices. And if you



like what you see, we have a 28-page catalog you'll like even more. Just send the card below, and we'll send you a free copy.

Or call (800) 426-5150. In Canada, call (800) 387-5752.

© 1988 DELL COMPUTER CORPORATION. 386 is a trademark of Intel Corporation.

GET OUR FREE 28-PAGE CATALOG OF DELL COMPUTER SYSTEMS.

This new catalog is the best place to shop for high performance 386 and 286 systems. We also offer a full line of software, peripherals, enhancement products, and networking solutions. Just send this card, and we'll send you a copy.

Name: _____

Title: _____

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____

Please have a Dell representative call me.

- | | |
|---|---|
| 1. Are you a (select one): | 4. How many PCs do you have installed now? |
| A <input type="checkbox"/> End user | A <input type="checkbox"/> 1-10 |
| B <input type="checkbox"/> Consultant | B <input type="checkbox"/> 11-20 |
| C <input type="checkbox"/> Reseller | C <input type="checkbox"/> Over 21 |
| D <input type="checkbox"/> Corporate Purchaser | |
| E <input type="checkbox"/> DP/MIS Manager | 5. How many PCs do you (your company) plan to purchase in the next twelve months? |
| 2. Which products are you most interested in? | A <input type="checkbox"/> 1-10 |
| A <input type="checkbox"/> 286 architecture | B <input type="checkbox"/> 11-20 |
| B <input type="checkbox"/> 386 architecture | C <input type="checkbox"/> Over 21 |
| 3. Are you interested in computer products for: | 6. Is your requirement: |
| A <input type="checkbox"/> Home | A <input type="checkbox"/> Immediate |
| B <input type="checkbox"/> Business | B <input type="checkbox"/> 1-3 Months |
| | C <input type="checkbox"/> Over 3 Months |
| | D <input type="checkbox"/> Info only |

AD CODE NO. 51EG9

GET OUR FREE 28-PAGE CATALOG OF DELL COMPUTER SYSTEMS.

This new catalog is the best place to shop for high performance 386 and 286 systems. We also offer a full line of software, peripherals, enhancement products, and networking solutions. Just send this card, and we'll send you a copy.

Name: _____

Title: _____

Company: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: _____

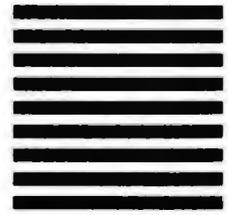
Please have a Dell representative call me.

- | | |
|---|---|
| 1. Are you a (select one): | 4. How many PCs do you have installed now? |
| A <input type="checkbox"/> End user | A <input type="checkbox"/> 1-10 |
| B <input type="checkbox"/> Consultant | B <input type="checkbox"/> 11-20 |
| C <input type="checkbox"/> Reseller | C <input type="checkbox"/> Over 21 |
| D <input type="checkbox"/> Corporate Purchaser | |
| E <input type="checkbox"/> DP/MIS Manager | 5. How many PCs do you (your company) plan to purchase in the next twelve months? |
| 2. Which products are you most interested in? | A <input type="checkbox"/> 1-10 |
| A <input type="checkbox"/> 286 architecture | B <input type="checkbox"/> 11-20 |
| B <input type="checkbox"/> 386 architecture | C <input type="checkbox"/> Over 21 |
| 3. Are you interested in computer products for: | 6. Is your requirement: |
| A <input type="checkbox"/> Home | A <input type="checkbox"/> Immediate |
| B <input type="checkbox"/> Business | B <input type="checkbox"/> 1-3 Months |
| | C <input type="checkbox"/> Over 3 Months |
| | D <input type="checkbox"/> Info only |

AD CODE NO. 51EG9



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



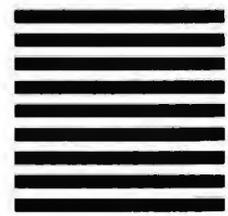
BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 6745 AUSTIN, TEXAS

POSTAGE WILL BE PAID BY THE ADDRESSEE

DELL COMPUTER CORPORATION
Dept. ME
9505 Arboretum Boulevard
Austin, Texas 78759-9969



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



BUSINESS REPLY MAIL
FIRST CLASS MAIL PERMIT NO. 6745 AUSTIN, TEXAS

POSTAGE WILL BE PAID BY THE ADDRESSEE

DELL COMPUTER CORPORATION
Dept. ME
9505 Arboretum Boulevard
Austin, Texas 78759-9969



IF YOU CAN'T CALL, WRITE.

On the front gatefold of this magazine, there's a 4-page ad for Dell Computer Systems. It invites you to call our toll-free number, so you



can get our free 28-page catalog. But if you'd rather send this card, that's fine with us. Just fill it out, and we'll get a catalog to you right away.



Color by Numbers

Tektronix takes the cost of PostScript-compatible color output to a new low

Kent Quirk

If you're working with color images on your PC and need to get color hard copy, you have few options. Plotters are generally limited to drawings. Dot-matrix printers offer limited colors and mediocre resolution. Film recorders support many colors and are flexible, but they require additional processing to get a full-size image and usually require special driver software. A more attractive alternative may be color thermal-transfer printers. The Tektronix Phaser CP is the newest and lowest-cost entry in this field.

The Phaser CP takes the impact of full-size, high-resolution, color hard copy and adds to it the power of a PostScript-compatible page description language. The result is a color thermal-wax-transfer printer that generates brilliant color hard copy from a wide variety of applications (see figure 1). And at \$12,995, it's several thousand dollars cheaper than its nearest competitor, the QMS Color Script 100 Model 20.

An AppleTalk-compatible version of the Phaser for the Macintosh should be available by the time you read this. The \$15,995 Phaser CPS supports Color PostScript only. It includes a separate controller box with a 40-megabyte hard disk drive and ports to support the LaserWriter and Phaser CP driver cards.

The Tektronix Phaser CP's print engine is a hefty 95-pound unit that resembles an old-style Xerox copier. Opening the front panel reveals lots of green han-



dles and levers; the paper path is unusually complicated, compared to current single-color laser printers.

The printer mechanism is based on a Kyocera thermal print head, which doesn't move. The head prints a complete horizontal line at once, and the paper moves past it at a constant vertical speed. The printer boasts 300-dot-per-inch resolution along both axes.

Between the print head and the paper is a film ribbon that's composed of alternating bands of yellow, magenta, and cyan wax on a transparent plastic substrate. The print head melts the wax, transferring it from the plastic ribbon to a special coated paper. Each band of color on the ribbon is the width of a page; the ribbon and the paper move together past the print head, once for each color printed. Tektronix also sells four-color or all-black ribbons.

Because printing a single color image requires three or four passes past the print head (depending on the thermal-transfer ribbon used), the printer clamps the paper tightly to ensure accurate positioning. Unfortunately, the clamping

process takes up space on both ends of the page, leaving a usable area of just 8 $\frac{1}{10}$ by 8 $\frac{3}{4}$ inches on an 8 $\frac{1}{2}$ - by 11-inch page. Thus, you must use legal-size paper to print a full page of text.

Phaser Driver

The Phaser CP actually comprises two components: the CP printer (\$6000) and the Phaser Card (\$6995). The add-in card contains a 12-MHz 68020 processor with 8 megabytes of RAM, and it has connectors to drive Tektronix color and monochrome laser printers, when they become available. Tektronix says that future printers will be able to use this card without modifications. It supports a wide variety of interfaces. You can set up the system to emulate (in hardware) any COM or parallel port.

The first 3 megabytes of RAM is located on the main card; another 5 megabytes is on a full-length daughtercard. You can add another 3 megabytes of RAM to the daughtercard, for a total of 11 megabytes. Tektronix says this additional memory improves printing time

continued

Tektronix Phaser CP

Company

Tektronix, Inc.
Graphics Printing and Imaging Division
P.O. Box 1000
Wilsonville, OR 97070
(800) 835-6100

Features

Compatible with PostScript and HPGL; supports 35 standard PostScript fonts; prints letter- or legal-size documents (English and metric sizes) on transparencies or thermal paper

Size

12¾ by 22 by 21½ inches; 95 pounds (paper cassette adds 13 inches to width)

Hardware Needed

IBM PC or AT with an 8-bit slot, a floppy disk drive, and a hard disk drive

Documentation

Printer manual; Phaser Card manual; Symbol and Dingbats font reference cards; Phaser Interpreter reference manual available

Price

Phaser Card: \$6995
Phaser CP printer: \$6000
Complete package: \$12,995

Inquiry 851.

and increases bit-map space for images.

Tektronix went out of its way to acquire rights to all the same type families that Adobe uses. The fonts are adjusted to look good at all point sizes. Although the character widths are identical to Ado-

be's, there are tiny but noticeable differences in character outlines, particularly in the shape of serifs. This may be the result of the difference in printing technology. The Phaser CP also supports PostScript downloadable (Type 3) fonts.

The Phaser CP comes with plenty of documentation, including user's guides for the printer and the Phaser Card. A reference manual is available for \$45.

Most PostScript printers include information about statusdict, the dictionary of printer-specific operators for the language, and the limitations imposed by the implementation. That's even more critical in this case, because this is not name-brand PostScript—although the language implementation is fully compatible with Adobe PostScript version 49, including the color extensions.

Tektronix has implemented several extensions to the PostScript language without affecting the base operators. Most of the implementation limits are the same as those on the Apple LaserWriter, with a few extensions (like total number of path segments) that Tektronix thought were too limiting. I did not discover any PostScript compatibility problems in testing with output from various PostScript application drivers, nor when I wrote PostScript code. Since the PostScript interpreter resides on the host system disk, any compatibility problems that might occur could be fixed with a software release.

The software for the Phaser Card is enormous. It comes on 15 360K-byte 5¼-inch disks or eight 720K-byte 3½-inch disks. The setup software is courteous enough not to modify your AUTOEXEC.BAT file unless you give it permission. Once you've downloaded

the software to the Phaser Card, it doesn't use any system RAM, although it does take up nearly 3 megabytes of disk space.

On my 20-MHz AST Premium/386 running DOS 3.3, the Phaser Card consistently refused to load properly at initial power-on. It emitted an error message and aborted. Tektronix was unable to explain this behavior. However, the card loaded properly when the system was rebooted, taking approximately 28 seconds to download 2.3 megabytes of software. You can also set up the software to emulate the Hewlett-Packard Graphics Language (HPGL).

Performance

With a three-color ribbon installed, the print engine can generate about one legal-size page every 50 seconds. It prints each color layer individually and then backs up and reprints on the next color for the same page. According to Tektronix, a four-color ribbon should print a legal page in about 70 seconds, and a black ribbon should print the page in about 30 seconds.

Despite the 68020 processor, the PostScript interpreter is fairly slow compared to some of the newer laser printers. Even ignoring the speed of the actual print engine (which is also very slow, compared to laser engines), image generation takes a long time. A Mandelbrot set routine (which is calculation-intensive) ran for 1 hour on a QMS PS-810 Plus laser printer and would have run for over 16 hours on the Phaser CP if I had let it finish. On the other hand, bit-map generation continues in the Phaser Card while the print engine is printing, so the effective throughput on multipage jobs is fairly good.

The Phaser Card has an application-specific IC designed to implement color halftoning at high speed in hardware. Images where this is used seemed to print quickly, although I didn't use any objective color benchmarks to test this.

I did run the benchmark tests that Steve Apiki and Stan Diehl used in "PostScript Printers Come of Age" (September 1988 BYTE). When compared to the QMS Color Script 100 Model 30, the large text file took significantly less time on the Phaser CP; the time for the other files was roughly comparable (see table 1).

True Resolution

The Phaser CP advertises 300-dpi "positional resolution," but the size of those dots can vary with the medium used and the density of the print. As a test of printer resolution, I printed 1-pixel verti-

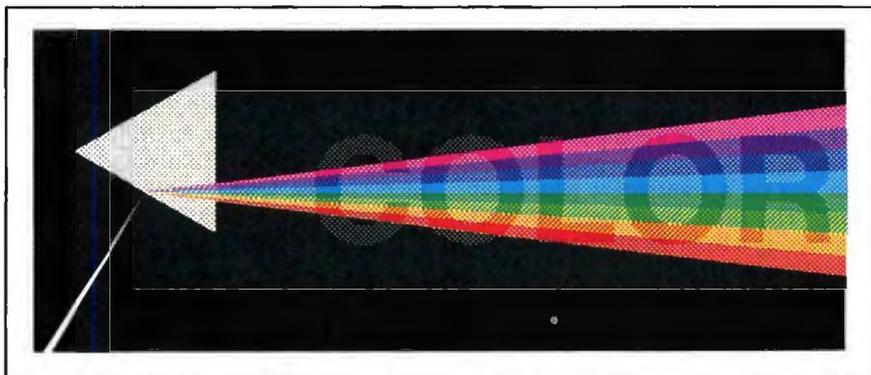


Figure 1: This sample output from the Phaser CP shows the printer's color quality and resolution. To ensure accurate reproduction, I created this sample image using PostScript and then used a PostScript program to break down the image into its cyan, magenta, yellow, and black components and to print each separation. The resulting image, printed here without additional processing, appears at the same resolution as the original and maintains color consistency with it.

cal lines over a range of different colors and spacings using the standard three-color ribbon.

At 300 lines per inch, the dots merged (as they should). At 100 lpi, they were clearly separated. At 150 lpi, however, they were separated for the first quarter inch of vertical distance and then blurred together as the print head heated up. The black area was particularly bad, because the yellow wax seems to melt at a lower temperature than the others. It therefore bleeds more, and the 150-lpi area ends up as a rather sick-looking shade of brown. When printed on a transparency, the dots spread even more, but this improved the appearance nearly everywhere.

Although the resolution is the same as that of a laser printer, the difference in printing technology is noticeable. Jaggies are obvious on diagonal lines, lending a low-resolution appearance, particularly at smaller point sizes.

Not for Everyone

The Phaser CP should prove popular in the presentation departments of large companies, in the graphic arts industry, or as an output device for three-dimen-

Table 1: PostScript printer benchmark tests. In the large-text-file benchmark, the Phaser CP was significantly faster than the more-expensive Color Script 100 Model 30. Times are in seconds.

Benchmark	Phaser CP	QMS Color Script 100 Model 30
Large text file	640	1582
Small text file	380	362
PostScript graphics file	285	297

sional mechanical renderings. Other users will find that both the Phaser CP's purchase price and its cost per page are too high for most applications. Printing costs range from 38 cents per page using a three-color ribbon on thermal paper to \$1.50 per page for color transparencies using a four-color ribbon. Compare this to an average cost of just 8 cents per page for a monochrome laser printer.

Although the images are stunningly bright, the resolution isn't good enough to use them as color originals for four-color work, nor should you count on the Phaser CP to generate accurate colors for printing proofs. However, those who

need a color printer for presentation graphics should strongly consider this one, particularly in a workgroup situation. The image quality is terrific, the PostScript compatibility is high, and as this review went to press, its price made it an excellent buy. But competition in this market is heating up. If you can afford to wait, prices should continue to tumble as QMS and other vendors introduce competitive products. ■

Kent Quirk is president of Totel Systems, a software development company in Westford, Massachusetts. You can reach him on BIX as "kquirk."



REAL-TIME MULTI-TASKING KERNEL

for protected mode 80386

- No royalties
- C language support
- Preemptive scheduler
- Time slicing available
- Configuration Builder
- List Manager
- 20 us task switch at 16 MHz (no waits)

- Intertask messages
- Message exchanges
- Dynamic operations
 - task create/delete
 - task priorities
 - memory allocation
- Event Manager
- Semaphore Manager

Source Code Included

Manual only **\$75 US**
AMX 386 **\$3995 US**
(shipping/handling extra)

Also available for 8086, 80286, 8080, Z80, 68000.

KADAK Products Ltd.
206 - 1847 W. Broadway
Vancouver, B.C., Canada
V6J 1Y5
Telephone: (604) 734-2796
Fax: (604) 734-8114



Industrial Control Systems
Intelligent Terminals
Diskless Systems



For the IBM
PC, XT, AT, PS/2
and PC DOS* or MS DOS*

SOLID STATE DISKETTE AND DRIVE EMULATORS

New Dual Disk Models

- NEW PCE/2 Dual disk model—up to 1.2MB of read only EPROM memory or 770K of EPROM as the primary "boot" diskette with a secondary diskette with up to 770K of SRAM of read/write memory.
- NEW PS/2 Dual disk model—up to 1.44MB of read only EPROM memory as the primary "boot" diskette and a secondary diskette with 128K of SRAM read/write memory.

ROMDISK PCE MODEL STANDARD FEATURES

- In-board and interchangeable Cassette models using EPROM, Flash EPROM and SRAM technology.
- On-board EPROM programmer—simply copy a diskette to program the EPROMs.
- Two Autoboot modes, a File (read) and a Programming mode—automatic disk drive designation set-up during booting.
- Flash EPROM models are electrically erasable. SRAM models are battery backed. EPROM models are ultraviolet erasable.
- List prices with memory ICs from \$295, OEM prices and models available OEM with or without memory ICs.



CURTIS, INC.
2837 North Fairview Ave. • St. Paul, MN 55113
612/631-9512 Fax 612/631-9508



* IBM PC, XT, AT, PS/2 and PC DOS are trademarks of IBM; MS DOS is a trademark of Microsoft

MicroWay Means Numerics!

MicroWay is your best source for the software and hardware you need to get true 32 bit performance from your 386. These include 32-bit tools, such as NDP Fortran, C, and Pascal, and the 32-bit applications that were developed with them (see last paragraph). These products run in protected mode under Unix, Xenix, or Phar Lap extended MS-DOS.

Starting with release 1.4VM, NDP Fortran, C and Pascal not only access 4 gigabytes of memory, but run with Phar Lap's new VMM extension which provides 386 protected mode virtual memory. Now you can run a program with a 30 MB array on a 2 MB system simply by having 30 MB of space on your hard disk.

MicroWay also offers transputer based parallel processing boards and languages that run on an XT, AT, or 386. Each of the T800 RISC processors on these boards packs the power

Dr. Robert Atwell, leading defense scientist, calculates that NDP Fortran-386 is saving him \$12,000 per month in rentals of VAX hardware and software while doubling his productivity!

Fred Ziegler of AspenTech in Cambridge, Mass. reports, "I ported 900,000 lines of Fortran source in two weeks without a single problem!" AspenTech's Chemical Modeling System is in use on mainframes worldwide and is probably the largest application to ever run on an Intel processor.

Dr. Jerry Ginsberg of Georgia Tech reports, "My problems run a factor of six faster using NDP Fortran-386 on an mW1167 equipped 386/20 than they do on my MicroVAX II."

of a 20 MHz 386/1167. Our best selling board, the Quadputer2™, has four T800s and boasts 40 MIPS/6 megaflops of processor throughput.

MicroWay manufactures Weitek 1167 and 3167 coprocessor cards that run with the 80386. Both cards include an 80387 socket. The 1167 is 2 to 4 times faster than the 80387. The 3167 runs 30% faster than the 1167 in double precision. The key to achieving this speed increase is our NDP Fortran or C and the new 32-bit applications that offer Weitek support. Either process or provides a dramatic increase in throughput for graphics intensive applications. These include VersaCad and Hoops 3D graphics, ANVIL 5000 CAD/CAM, SRAC and Swanson Analysis finite element packages, Mathematica and a host of other packages that were recently ported to the 386 using our NDP Fortran and NDP C. Please call (508) 746-7341 for more information.

32-Bit Compilers and Tools

NDP Fortran-386™, NDP C-386™, and NDP Pascal-386™ compilers generate globally optimized, mainframe quality code. Each runs in 386 protected mode under Unix, Xenix or Phar Lap extended MS-DOS. The memory model employed uses 2 segments, each of which can be up to 4 gigabytes. They generate code for the 80287, 80387, mW3167 or mW1167 and include high speed EGA graphics extensions written in C that perform BASIC-like screen operations. NDP Fortran-386™ is a full implementation of FORTRAN-77 with Berkeley 4.2 and Fortran-66 extensions. NDP C-386™ is a full implementation of AT&T's PCC with MS and ANSI extensions. NDP Pascal-386™ is a full implementation of ANSI/IEEE Pascal, with extensions from C and Berkeley 4.2 Pascal. NDP Fortran/C/Pascal-386/DOS each \$595 NDP Fortran/C/Pascal-386/VM. \$695 NDP Fortran/C/Pascal-386/UNIX. \$795

Phar Lap 386/VMM extensions are supported by the VM releases of NDP Fortran, C, and Pascal, making it possible to compile and run programs as large as the free space on your hard disk.

Phar Lap Virtual Memory Manager . . \$295
Phar Lap Development Tools \$495

NDP Windows™ — NDP Windows includes 80 functions that let you create, store, and recall menus and windows. It works with NDP C-386 and drives all the popular graphics adapters Library: \$125, C Source: \$250

NDP Plot™ — Calcomp compatible plot package that is callable from NDP Fortran. It includes drivers for popular plotters and printers. Works with CGA, MDA, EGA and VGA . . . \$325

NDP/FFT™ — Includes 40 fast running, hand coded algorithms for single and double dimensioned FFTs which take advantage of the 32-bit addressing of the 386 or your hard disk. Callable from NDP Fortran with mW1167 and 80387 support \$250
387FFT for 16-bit compilers. \$250

NDP to HALO '88 Graphics Interface — Enables you to call graphics routines in HALO '88 from NDP Fortran, C or Pascal. \$100

Parallel Processing

Videoputer™ — The highest performance graphics card on the market. Uses a T800 and TI 34010 in conjunction with a 130 MHz BrookTree DAC. Includes one MB of system RAM, one meg of video RAM and a library of graphics primitives. Runs standalone or in conjunction with a transputer network and drives 32 and 64 KHz analog monitors \$4995

Monoputer™ — The world's most popular PC transputer development product now extends the memory available for developing transputer applications from 2 to 16 MB. The board features a DMA bus interface for fast I/O.

Monoputer with T414 (0 MB) \$995
Monoputer with T800 (0 MB) \$1495

Quadputer™ — This board for the AT or 386 can be purchased with 2, 3 or 4 transputers and 1 or 4 MB of memory per transputer. Two or more Quadputers can be linked together to build networks of up to 100 or more transputers providing mainframe power from \$3495

Linkputer™ — Uses four Inmos C004 programmable cross bar switches. It allows the user to dynamically change the topology of the processors in a network. Using this board, it is possible to get 100% linkage among eight Quadputers and design larger, custom topologies. CALL

Transputer Compilers and Applications
These Parallel languages are designed for use with Monoputer2 and Quadputer2.

Logical Systems Parallel C \$595
3L Parallel C or 3L Parallel Fortran . . \$895
COSMOS/M - Finite element analysis .CALL
ParaSoft: Parallel Environment . . . \$500
Performance Monitor . . . \$500
C Source Level Debugger \$500
T800/NAG™ (See NDP/NAG) \$2750

387BASIC™ — Our 16-bit MS compatible compiler introduces numeric register variables to produce the fastest running 80x87 code on the market. \$249

386 Your AT

386/387 Turbo™ AT — This board plugs into your 80286 socket, allowing your IBM AT to run 32-bit protected-mode code written for the 80386. Includes an 80387 socket. The most cost-effective AT upgrade!

386/387 Turbo AT/16MHz \$495
386/387 Turbo AT/25 MHz \$695

Weitek-Based Coprocessor Boards

mW1167™ and mW3167™ coprocessor boards are built at MicroWay using Weitek components. Each includes an 80387 socket.

mW1167-16 \$895
mW1167-20 \$1095
mW1167 Microchannel-16/20 CALL
3167-20 \$995
3167-25 \$1295
3167-33 \$1695
mW3167/80387 Board \$150

Intel Coprocessors and RAM

8087 \$84	8087-2 \$120
80287-8 \$195	80287-10 \$220
80387-16 . . . \$350	80387-16SX . . . \$310
80387-20 . . . \$400	80387-25 . . . \$500
80C287A (CMOS) \$280	287Turbo-12 (for AT compatibles) . . . \$350
RAMpak™ - one meg 32-bit memory module for Compaq 386 20/25 \$495	
RAMpak™ - four meg \$1995	
256K 80ns DRAM \$8.00	256K 100ns DRAM \$6.50
256K SIMMs 100ns \$99	1 meg SIMMs 100ns \$300

(All of our Intel coprocessors include 87Test.)

Multi-User Accelerators

MicroWay's AT8™ and AT16™ intelligent serial controllers run 8 to 16 terminals under Unix or Xenix without bogging down your AT, 80386 or PS/2 PC. AT8: \$895 AT16: \$1295

12 MHz PC Accelerators

FastCACHE-286 12 MHz \$299
SuperCACHE-286 12 MHz \$399
FastCACHE-286 9 MHz \$199

NUMERICS HOTLINE
(508) 746-7341

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 Germany 069-75-2023



EMS with a Cache

The Elite 16 Plus HyperCache boosts EMS 4.0 performance

Jeff Holtzman

The Elite 16 Plus HyperCache is an EMS 4.0 board with a twist. It provides capabilities similar to those of other boards, such as the Intel Above Board Plus and AST Research's RAMpage Plus/286, but it distinguishes itself with an on-board 16K- or 32K-byte memory cache that gives it a performance edge. It's also a cost-effective way to bring modern memory design techniques to older 8-MHz 80286-based systems. And in systems with faster bus speeds, the board's memory cache lets you use slower, less-expensive DRAMs.

You can configure the HyperCache with up to 16 megabytes of memory on the card; it includes one parallel and one serial port and a 16K-byte RAM cache. The board boasts switchless installation, full EMS 4.0 compatibility, and an extremely versatile memory-allocation scheme. Options include an extra 16K-byte RAM cache (\$189) and a second serial port (\$50). A Micro Channel architecture version of the board should be available by the time you read this.

As with other EMS boards, you can allocate memory on the HyperCache among conventional, extended, and expanded memory. You can allocate extended memory 16K bytes at a time, which is more efficient than the 512K- and 128K-byte increments that the Intel Above Board Plus and AST RAMpage Plus/286 use, respectively. The HyperCache can also backfill conventional memory and swap that memory in 16K-

byte pages according to the EMS 4.0 specification.

The HyperCache has only a single EMS alternate-mapping register set, an optional feature of EMS 4.0 that lets you swap entire memory-mapped contexts with a few I/O instructions. Like paged conventional memory, alternate-mapping registers also let operating environments such as Windows and OmniView operate more efficiently. By contrast, the RAMpage has 32 alternate mapping registers; the Above Board Plus has none.

To set up the Intel Above Board Plus and AST RAMpage Plus/286, you must run a utility that programs an on-board EEPROM. To set up the HyperCache, your machine just loads the AUTORAM.SYS driver during boot-up (a \$158 EEPROM-based setup is available for running OS/2 and Unix environments).

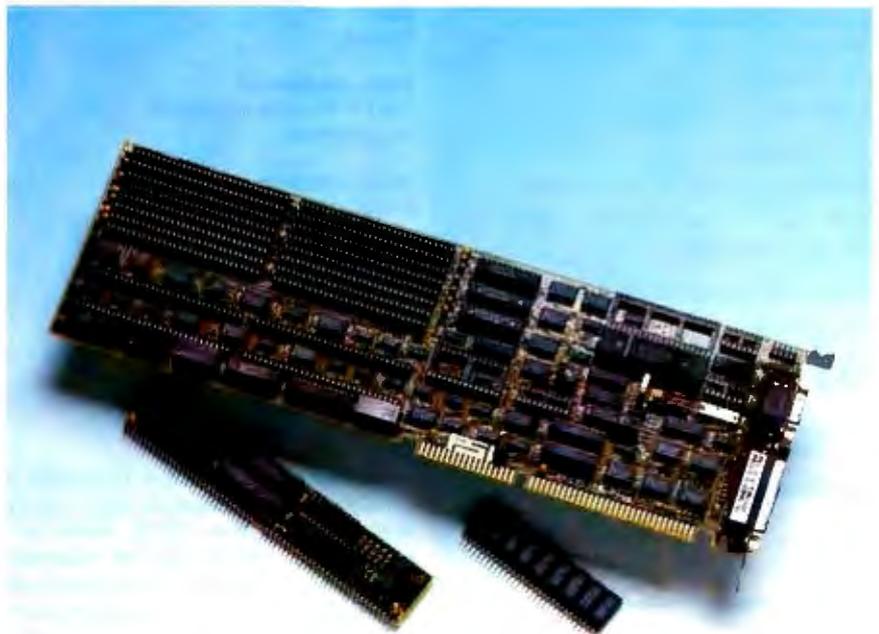
Arguments to AUTORAM.SYS let

you specify operating parameters, including memory allocation and ranges of memory to include and exclude for EMS page mapping. In addition, several parameters let you specify operational aspects of the board, including DRAM speed, number of wait states, bus timing, and whether you want 8- or 16-bit access to EMS memory above A0000.

Installation Decisions

Before installing the HyperCache, you must decide what you want to do with motherboard memory. The HyperCache can backfill from as low as the 128K-byte boundary (20000h). It's best to disable as much motherboard memory as possible, since the HyperCache won't cache it. You also can't swap system memory, because the motherboard lacks EMS 4.0 mapping hardware.

continued



EZ-DOS

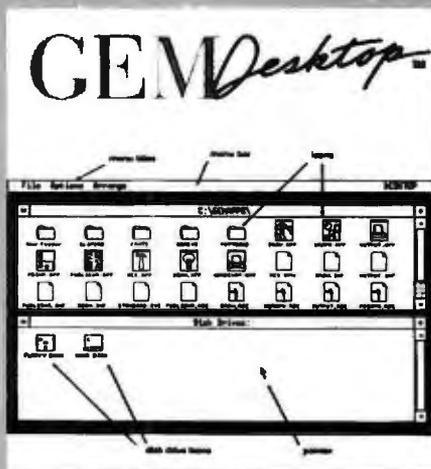
Break the stranglehold on your PC.

Digital Research & 2001 Sales have developed EZ-DOS as an enhanced replacement for your current DOS.

Now you can use the sophistication of EZ-DOS instead of accepting the limitations of another DOS.

The main features of EZ-DOS are:

- * DOS compatibility
- * Multiple 512 megabyte partitions - quit dissecting your hard disks
- * Password protection of files and directories
- * Full screen text editor
- * On-line HELP for command syntax
- * Command history
- * LIM 4.0 Extended memory driver
- * Menu based installation that works with all compatibles



- * A true graphic, windowing operating environment - GEM/3 Desktop is our user interface.
- * Inexpensive - compare costs

EZ-DOS 4.1 Deluxe..... \$79.00
 plus True BASIC..... \$99.00
 plus serial Mouse..... \$139.00
 plus T.BASIC & Mouse.. \$159.00

2001 Sales, Inc.

16580 Harbor Blvd., Ste. D
 Fountain Valley, CA 92708.

Tel: (714) 531-6551

Fax: (714) 531-8546

Dealer, Distributor & OEM inquiries welcome.
 VISA and Master Card accepted.

REVIEW

EMS WITH A CACHE

Elite 16 Plus HyperCache

Company

Profit Systems, Inc.
 30150 Telegraph Rd.
 Birmingham, MI 48010
 (313) 647-5010

Features

EMS 4.0 board with 16K- or 32K-byte cache; 512K bytes to 16 megabytes of RAM allocatable among conventional, expanded, and extended memory; includes serial and parallel port; switchless setup

Size

Full-length

Hardware Needed

IBM PC AT or compatible with 16-bit expansion slot

Documentation

Instruction guide

Price

With 512K bytes of RAM: \$895
 With 2 megabytes of RAM: \$1895
 As reviewed: \$2084

Inquiry 853.

Memory modules are available in 256K-byte and 1-megabyte sizes; you install them in pairs (512K bytes or 2 megabytes), which you can intermix. You can install up to seven HyperCache boards in one system; a miniature rotary switch determines the board's ID and I/O port address range. The software handles multiple boards automatically; it also maps out bad blocks, detected at boot time, in 16K-byte increments.

The board should operate in most systems, regardless of bus speed or timing, but you may need to tweak several parameters in the driver software to optimize performance, especially if the machine's bus doesn't adhere strictly to IBM timing standards. The instruction guide is insufficient for doing this; it says to call the company for assistance.

In the default configuration, the board backfills conventional memory to 640K bytes, if necessary, and allocates the rest to expanded memory. If you want extended memory, you must specify the amount to the driver. Even with all memory allocated as extended memory, the version of the software that I tested left the EMS driver, needlessly, in memory.

Another annoyance is that the driver consumes about 20K bytes more of conventional memory than either the AST or the Intel drivers. Also, a bug in the soft-

ware driver prevented Lotus 1-2-3 from executing properly out of swappable conventional memory; Profit Systems should have this fixed by the time this review reaches print.

Overall, the board is well built. It uses single in-line memory modules (SIMMs) with pin connections rather than edge card connections. The modules extend out from the board into the next expansion slot; however, a half-length card will still fit in the adjacent slot.

Performance

I tested a HyperCache with 2 megabytes of 100-nanosecond DRAM (main memory) and 32K bytes of 45-ns static RAM (cache memory) in an 8-MHz IBM PC AT with a 20-megabyte hard disk drive and a Hercules Graphics Card Plus.

Profit Systems built the HyperCache around the IDT7174 cache-tag RAM chip from Integrated Device Technology. This chip supports a direct-mapped cache in which multiple locations in main memory correspond to a single location in the cache. When the upper bits of the address bus equal the value in the tag RAM, a cache hit occurs, and the CPU can read the desired data with zero wait states. Otherwise, the board runs with one wait state. (For more on cache memory, see "Caching in on Memory Systems" by Brett Glass, March BYTE.)

Profit Systems says that the board can run with zero wait states (during cache hits) in buses running as fast as 12 MHz, and with one wait state in 12- to 20-MHz buses, no matter what the speed of the board's DRAMs. But this means only that the board itself will generate zero or one additional wait state; if you have a system bus that's designed, say, for two-wait-state operation, the bus delay will at least partially negate the gain in performance from the HyperCache.

I ran BYTE's CPU benchmarks and several high-level tests on the AT's motherboard memory by itself, and on the backfill memory provided by an AST RAMpage Plus/286, an Intel Above Board Plus, and an Elite 16 Plus HyperCache with a 32K-byte cache. The results appear in table 1.

To test the memory boards, I disabled the AT's upper 256K bytes of memory so each board could backfill memory. To ensure that the tests ran in expansion memory, I wrote EATMEM.EXE, a program that allocates a specified block of memory and executes the DOS TSR function, and used it to eat up memory to a point just above the 384K-byte boundary; this ensured that the tests ran just

continued



**"How did I find out
about the number one
selling 286 laptop?
My competition was
killing me with it."**

ZENITH INNOVATES AGAIN™

**Today's leading 286 battery-powered portable* gives you the edge
you need to be number one on the road.**

Turning miles into dollars. That's business as usual with SupersPort 286™. Another Zenith Data Systems innovation to let you work the way you want...*where* you want.

With the lightweight SupersPort 286, hard-driving AT desktop performance is yours. Anywhere your business takes you. To crunch the numbers. And the competition.

And we mean *crunch*. SupersPort 286 is loaded with unrelenting speed and power to tackle huge spreadsheets, files and databases. It even lets you extend your productivity through Zenith's *Intelligent Power Management System,*™ which puts power usage in *your* control. For more than four hours of non-stop battery life.

SupersPort 286 also features a dazzling backlit *Supertwist* LCD screen for superior readability. It also has one of the widest viewing angles of any portable, and can be used in virtually all lighting conditions.

So put Zenith Data Systems' SupersPort 286 in the driver's seat. And start letting your competition know who's number one on the road.

For the name of your nearest Zenith Data Systems authorized dealer, call
1-800-842-9000, ext. 1.



Graphics simulate Microsoft® Windows, a product of Microsoft Corporation. Microsoft® Windows is included with all hard disk models of Zenith Data Systems' advanced desktop systems.

*Source: Dataquest

ZENITH | data systems

THE QUALITY GOES IN BEFORE THE NAME GOES ON®

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?*



Rack & Desk Models

Accepts PC, XT, AT Motherboards and Passive Backplanes

Doesn't Look Like IBM

Rugged, Modular Construction

Excellent Air Flow & Cooling

Optional Card Cage Fan

Designed to meet FCC

204 Watt Supply, UL Recognized

145W & 85W also available

Reasonably Priced

Now Available
Passive Backplanes



INTEGRAND

RESEARCH CORP.

Call or write for descriptive brochure and prices:
8620 Roosevelt Ave. • Visalia, CA 93291

209/651-1203

TELEX 5106012830 (INTEGRAND UD)

FAX 209/651-1353

We accept Bank Americard/VISA and MasterCard

IBM, PC, XT, AT trademarks of International Business Machines. Drives and computer boards not included.

REVIEW

EMS WITH A CACHE

Table 1: Benchmark tests using the standard IBM PC AT configuration, the Intel Above Board Plus, the AST RAMPAGE Plus/286, and the Profit Elite 16 Plus HyperCache. I tested the HyperCache using a 32K-byte cache. All times are in seconds.

	IBM PC AT	Intel Above Board Plus	AST RAMPAGE Plus/286	Profit Elite 16 Plus HyperCache
Low-level tests				
Matrix	11.7	11.6	11.7	9.7
Move (byte)	80.4	80.4	80.5	80.6
Move (word odd)	80.4	80.5	80.5	80.6
Move (word even)	40.3	40.3	40.3	36.3
Sieve	73.7	73.4	73.4	56.3
Sort	84.4	84.6	84.6	62.4
High-level tests				
AutoSketch redraw	42.2	42.3	42.2	33.4
VP-Planner recalc	7.7	7.6	7.6	6.4
WordStar scroll	28.1	28.0	28.1	24.3

For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE

from the expansion-board memory.

As shown in the table, the HyperCache had the fastest times in the low-level benchmarks. (It lost its edge on the byte and odd-aligned string-move tests because of the way the motherboard hardware converts 16-bit memory accesses into 8-bit accesses.)

The high-level tests consisted of re-drawing a vector graphics screen in AutoSketch 1.04 Standard Edition, recalculating a 100K-byte spreadsheet under VP-Planner 1.0, and scrolling a 30K-byte file in WordStar 5.0. Here again, the HyperCache performed 15 percent to 20 percent faster than the other boards.

Not shown in the table are the effects of running a 16K-byte cache versus the optional 32K-byte cache. The low-level benchmarks ran about the same because they're small programs; most fit within a 16K-byte cache. However, the application benchmarks ran 6 percent to 12 percent slower with the 16K-byte cache.

Investment Potential

A 2-megabyte HyperCache costs \$1895; comparable setups from AST and Intel cost \$1940 and \$2095, respectively. Not only is the Profit HyperCache cheaper, it provides better performance. But you get the most from the HyperCache on machines with an 8-MHz bus; relative performance increases diminish as the machine's bus speed increases.

For example, I installed the board on an AST Premium/286 and changed the bus speed from 6 to 8 to 10 MHz. Moving from a 6- to an 8-MHz bus, the relative increase in bus speed and board per-

formance was about 30 percent. But moving from an 8- to a 10-MHz bus, the 10 percent increase in board performance doesn't keep up with the 25 percent increase in bus speed. The board must insert more wait states because the bus is faster than its 100-ns memory.

On systems with faster buses, the board's attraction is that it lets you save money by using slower DRAMs. For example, if your machine requires 80-ns DRAMs, the HyperCache's memory cache should let you use 120-ns DRAMs while maintaining nearly the same performance as with the 80-ns chips.

In terms of future upgrades, the HyperCache has a big advantage over the Above Board Plus because it uses more-economical SIMMs. It also holds 16 megabytes of RAM in 1½ slots, while the RAMPAGE and Above Board require two and four slots, respectively. The RAMPAGE does have more alternate mapping registers, an advantage where efficient multitasking is important, but the HyperCache has more-flexible memory allocation, which is important if you want to conserve memory while running Windows with HIMEM.SYS.

If you're looking for a memory upgrade or for a way to increase the performance of an older AT-class machine, this board is an excellent buy. ■

Jeff Holtzman owns Publishing Concepts, a firm in Ann Arbor, Michigan, that specializes in evaluation, verification, and documentation of high-technology products. You can reach him on BIX as "jholtzman."

Reach for ultimate portability

Systems Start at
\$790.00!



120 MBytes of power, speed and security in a revolutionary, removable hard drive.

At last, the Disk Pack gives you everything you've always wished for in a data storage system. The speed and high storage capacity of a hard drive. The ease and convenience of a floppy diskette. And the safety of a tape backup. All wrapped up in a state-of-the-art rugged unit, about the size of a paperback book. Designed to make your life a lot simpler and more secure.

True portability is here

Just picture this: With the Disk Pack you carry your whole work environment with you, wherever you go. All your files, all your data stay organized and configured just the way you created them. Between your office and remote sites. Or home. Or another department. You can even mail a Disk Pack. It's that rugged.

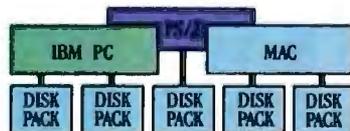


The Disk Pack frees you from the constraints of fixed computers. Your whole work environment fits in the palm of your hand.

Total security for your data

Simply slide out a Disk Pack module and lock away your entire business customer base and payroll figures in a drawer or safe. Same for lawyer,

banker or accountant sensitive data and Uncle Sam confidential information. All fully secured in a snap.



Get full data portability and security on the computer of your choice. Macintosh, PC-Compatible or PS/2.

Blazing speed Rock-solid reliability Limitless expansion

Breakthrough technology makes the Disk Pack four to five times more reliable than other removable products. Access times as low as 13 ms make it one of the fastest hard drives on the market. The Disk Pack doesn't limit you to a single storage capacity either. You can interchange 20-, 40-, 80- or 120-MByte modules in your

system and between systems. Link modules up for a whopping Half-GByte + of on-line data. Store them for unlimited off-line data. And do lightning-fast data backups.

That's not all. The Disk Pack turns a shared computer into your fully personal machine within seconds. It's ideal for space grabbing applications such as color graphics, CAD, or music. One Disk Pack module does the job of 100 diskettes.

Ten times faster. And with a lot less hassle.

And thanks to the Disk Pack's unique architecture, you'll use it equally well on any Mac, Apple, PC-compatible or PS/2 computer. It's that advanced.

Outside the USA, contact IEF, Tel: (33) 1 45 57 14 14
217 Quai de Stalingrad 92134 Issy, France



The Disk Pack is ideal for data security. Lock it away and forget about accidental or intentional data loss.

For more information call

1-800-322-4744

IEF DISK PACK®

The new standard in data storage technology

MEGADRIVE

S Y S T E M S
11693 San Vicente Blvd, Suite 370
Los Angeles, CA 90049
Disk Pack is a trademark of IEF



YES! I want to know more about Mega Drive Systems' new data storage technology. Please rush me more information about the Disk Pack and your free booklet "20 Valuable Facts About Hard Disk Care and Maintenance" today.

Name _____
Company _____
Address _____
City _____ State _____ Zip _____
Phone (____) _____

Mega Drive Systems, Inc.
11693 San Vicente Blvd, Suite 370
Los Angeles, CA 90049 (213) 556-1663

Number of Micros _____ Mac _____ PC _____

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.

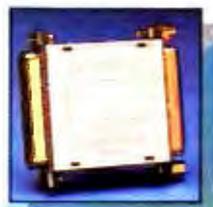
In the Apple market, security-minded Mac software developers turn to Eve. For completely transparent operation and world-class security of the protected software. Just by plugging Eve into the Mac ADB connector.

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. Whethercasters are standing by.

SentinelPro™



- Runs under DOS, OS/2 and Xenix • Algorithm technique (Never a fixed response) • External parallel port installation • Minimal implementation effort • Higher level language interfaces included • 100 times faster than fixed-response devices (1 ms) • ASIC design for reliability

Sentinel-C™



- Protects multiple packages with one device • 126 bytes of non-volatile memory programmed before shipment of the software • Rainbow supplies a unique adapter for programming the unit • Higher level language interfaces included • Runs under DOS, OS/2 and Xenix • External parallel port installation

Eve™



- For the Macintosh SE and II • Complies with Apple Desktop Bus Interface requirements • Rainbow-assigned developer passwords to prevent tampering by other developers or sophisticated "hackers" • 7 locks per key, usable individually or in combination, on one or up to seven applications

DataSentry™



- Completely user-installable • Pocket-sized external device • Menu-driven, user-friendly interface • Single- or multi-user security system • Audit trail, log-on identifiers and automatic encryption/decryption of entire directories • Secures data transmitted by modems • Prevents recovery of data by utility programs

SentinelShell™



- Runs under DOS on IBM PCs and compatibles • Protects without requiring access to the source code • Completely transparent to the end user • User-friendly software • Pocket-size key attaches quickly to any standard PC parallel port • ASIC design for reliability

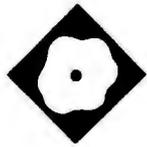


RAINBOW TECHNOLOGIES

18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY, U.K., Tel: 0753-41512, Fax: 0753-43610

© 1989 Rainbow Technologies. All product names are trademarks of their respective manufacturers.

Circle 240 on Reader Service Card (DEALERS: 241)



Breaking the Memory Barrier with 386|VMM

Phar Lap transparently
adds virtual memory
to extended-DOS
programs

Martin Heller

The 386|VMM ads say "Think Big." And indeed, thinking big is what this 80386-based virtual memory manager is for. If you want to build large applications with megabytes of code and megabytes of data, and you don't care that they run only on pricey 80386-based computers, Phar Lap's 386|VMM will help you do the job.

By itself, the developer's version of 386|VMM is a mere \$295. But that's the least of your costs. You will also need Phar Lap's 386|ASM/LINK (\$495); a Phar Lap-compatible compiler, like MetaWare's 80386 High C (\$895) or MicroWay's NDP FORTRAN-386 (\$595); and Phar Lap's 386|DEBUG symbolic debugger (\$195). All this just lets you develop code. To distribute programs with 386|VMM, you can buy out the royalties for \$10,000 or pay \$20 to \$50 per copy, depending on quantity.

What It Does

Phar Lap's extended-DOS environment puts the 80386 CPU into *flat* memory mode (i.e., it uses the 32-bit capabilities of the 80386 chip to address large amounts of memory). With 386|VMM, the extended-DOS environment also includes demand-paged virtual memory, another 80386 capability that operating systems such as Unix and Xenix exploit.

If your program is running with

386|VMM, then, instead of hitting a wall at 640K bytes of conventional memory (as it would under DOS) or at the end of extended memory (as it would under normal extended DOS), the program just starts swapping 4K-byte chunks of memory (i.e., pages) to and from your hard disk until you run out of disk space or reach the maximum virtual memory size of 4 gigabytes. When your program tries to use a piece of code or data that is paged out to disk, it causes a *page fault*, and 386|VMM restores the necessary page. Of course, another piece of memory has to be written to disk to make room. You can instruct 386|VMM to swap out the least-frequently used page (that's the default) or a page that was not used recently. You control the details of the swapping mechanism by means of command-line switches.

Most of this technical detail is not important. From a user's point of view, a program built with 386|VMM uses up all the memory in the machine and goes to the hard disk if it needs more. It does it efficiently and without much fuss.

A Lengthy Process

You don't test a system like this by timing the Sieve of Eratosthenes. I tested it by experimenting with MicroEMACS, a freely distributed programmer's editor. The DOS incarnation of this program can't read a file that's bigger than available RAM. Under extended DOS with 386|VMM, that limitation goes away, theoretically without changing any code. After about 60 sleep-deprived hours, three telephone calls, and a half-dozen BIX messages, I had MicroEMACS 3.9 running under 386|VMM. And yes, without ever writing any code to handle virtual memory, I got the program to read and edit multimegabyte text files.

What took all the time and effort was getting the program to compile under MetaWare's High C Compiler, link with the MetaWare library, and operate properly in Phar Lap's protected-mode envi-

ronment. Once I'd ported MicroEMACS to the Phar Lap environment, adding virtual memory took only a few minutes.

To begin with, I spent time reading the manuals: The three binders from Phar Lap along with the MetaWare manual make up a formidable library. Then I had to install six disks from Phar Lap and six disks from MetaWare. And, of course, I configured and validated everything. One somewhat unusual aspect of the installation involved modifying the MetaWare initialization code (INIT.ASM) to recognize the Phar Lap memory management scheme, reassembling it with the Phar Lap assembler, and using the Phar Lap librarian to put the new module back into the MetaWare library. At this point, you'd think that all I had left to do was to compile MicroEMACS with MetaWare's High C Compiler and link with Phar Lap's 386|LINK. Not so.

If you have a program that uses only K&R C and has no machine, system, or compiler dependencies, you might get away with just compiling and linking. But I picked a real-world program that directly accesses video RAM, calls the IBM PC BIOS, and calls DOS. I also tripped on a few good C "gotchas," like the size of an *int*. It was, shall I say, educational.

A Few Snags

MetaWare's High C Compiler has to be the fussiest C compiler I've ever used. The original philosophy of C was that it should be a *loose* language. For fussy examination of your code, you would use a lint utility.

MetaWare doesn't subscribe to this theory. The company has made its C compiler more like a Pascal compiler—it makes few allowances. Even on perfectly good code, the High C Compiler tends to generate pages of warnings.

MicroEMACS is already full of conditional code geared to different compilers and environments. To adapt the editor

continued

386|VMM

Company

Phar Lap Software, Inc.
60 Aberdeen Ave.
Cambridge, MA 02138
(617) 661-1510

Format

One 360K-byte floppy disk

Hardware Needed

80386-based PC

Software Needed

DOS 3.x or higher; 386|ASM/LINK;
386|DEBUG; Phar Lap-compatible
compiler (MetaWare 80386 High C,
NDP FORTRAN-386, or NDP C-386)

Price

Developer's version: \$295
Run-time version: \$20 to \$50 per copy,
depending on volume, or a \$10,000
one-time fee for unlimited distribution

Inquiry 881.

for High C and the Phar Lap 386|VMM environment, I started out in the file `ESTRUCT.H`:

```
#if MSDOS & HIGHC
/* M. Heller: for
BYTE review */
#include <msdos.cf>
/* DOS calls, interrupts,
and registers */
#include <system.cf>
/* c_unlink, etc. */
#include <string.h>
#define movmem(a,b,c)\
memcpy(b, a, c)
#define int86(a,b,c)\
callint(a)
#define bdos(a,b,c)\
Registers.AX.LH.H=a;\
Registers.DX.R=b;\
Registers.AX.LH.L=c;\
callldos()
#define intdos(a,b)\
callldos()
#define NULLFP\
(int (*) ()) 0
#define unlink(a)\
c_unlink(a)
#endif
```

MS-DOS C mavens will note that High C's definitions for access to the 80x86 registers are different from most. But what appears in `ESTRUCT.H` is only the good news. The bad news shows up inside C routines as conditional code. For instance, in the file `IBMPC.C`, which

contains the system-dependent code for the IBM PC architecture, you have

```
#if HIGHC
short int _far *scadd;
struct overlay {int off;
short seg;};
short int _far *scptr[NROW];
short unsigned int sline[NCOL];
#else
long scadd;
/* address of screen ram */
int *scptr[NROW];
/* pointer to screen lines */
unsigned int sline[NCOL];
/* screen line image */
#endif
```

Note the keyword `_far` rather than `far` in the definitions of `scadd` and `scptr` for High C. Also note that these are short integers; that's necessary because MetaWare's `int` type is 4 bytes long. You're looking at the result of quite a bit of coal mining in the manuals and help files, with assistance from the folks at Phar Lap. Here's more of the code to directly address the screen:

```
#if HIGHC
((struct overlay *)&scadd)->
seg=0x1c;
((struct overlay *)&scadd)->
off=0;
#endif
```

This code initializes `scadd` to a magic screen-segment selector provided in the Phar Lap environment. It took more spelunking to find out about that selector.

After straightening this out, I still had trouble getting MicroEMACS to write to the screen. Recall that in `ESTRUCT.H`, I defined `movmem` to use the `memcpy` macro. Unfortunately, MetaWare's library code for `memcpy` uses a REPE MOVDS block-move instruction, which ignores our carefully set `_far` segment selector. Instead of writing to the screen, MicroEMACS wrote over parts of itself. The solution to this problem would have been to write a `_far` version of `memcpy`.

Despite the massive 32-bit address space for which the MetaWare compiler generates code, the memory model has one code segment and one data segment. MetaWare quaintly refers to the memory model as the *small* model, although it's clearly anything but small. Nevertheless, MetaWare provides libraries only for the small model. To get `memcpy` to work across segments, you'd need the equivalent of a large-model version of the routine. I abandoned the idea of doing a memory-to-memory copy; I simply

looped through each line, poking characters individually to the screen.

But the overwriting of my program's code took me by surprise. I've grown used to debugging my C code under OS/2 using the large model in protected mode. In the OS/2 protected-mode environment, code segments are read-only, and that's what I expected in the Phar Lap environment. Unfortunately for me, Phar Lap chose not to write-protect the code segments "to be more compatible with DOS." The company did help me find the problem, though—the key was to use the watchpoint command in Phar Lap's 386|DEBUG product.

This debugger is similar to Microsoft's SYMDEB. It's a symbolic debugger that displays assembly code made somewhat more readable by the insertion of variable and function names from your source code. The Phar Lap watchpoint is better than Microsoft's, because it takes advantage of the 80386 hardware debug registers. That means that you can set watchpoints without slowing down the execution of your code. However, 386|DEBUG is definitely not a source-level debugger. If I hadn't been able to read assembly language, I wouldn't have found the problem. I never thought that I'd miss CodeView—but I did.

Finally, I had to convert all the keyboard and screen BIOS calls to conform to MetaWare's unique register structure. Here's one example:

```
ibmmove(row, col)
{
#if HIGHC
Registers.AX.LH.H=2;
Registers.DX.LH.L=col;
Registers.DX.LH.H=row;
Registers.BX.LH.H=0;
#else
rg.h.ah = 2;
/* set cursor position
function code */
rg.h.dl = col;
rg.h.dh = row;
rg.h.bh = 0;
/* set screen page number */
#endif
int86(0x10, &rg, &rg);
}
```

Ugly, isn't it? There's a whole lot more of this, unfortunately. I just wasn't clever enough to come up with a macro that would make this conversion transparent.

The 386|VMM Solution

I expected to add calls to Phar Lap's 386|VMM to activate and control it. I

continued

OS/2 NEWS

Volume 1, No. 5.

A continuing report on advanced software for personal computers.

Get money back on OS/2 memory, options and software.

Right now IBM and its business partners are offering thousands of dollars in rebates on over 110 available applications. IBM is also offering up to \$1,600 back on memory plus hundreds of dollars back on modems, accessory cards and hardware. Ask your IBM Authorized Dealer about these special savings today, or call 1 800 627-2492.

Easel makes it easy to migrate applications from hosts to programmable workstations.

Easel® for OS/2 Extended Edition is a full-featured development tool for creating programmable workstation-based graphical interfaces that can communicate with existing host 3270 applications. This lets you develop workstation applications without having to change host applications. It provides high-level language support (and WYSIWYG graphics) for developing EE applications that support Presentation Manager™ and Communications Manager. For more information contact your IBM representative.

DeScribe gives OS/2 users WYSIWYG word processor.

DeScribe™ conquers the gap between word processing and desktop publishing. DeScribe gives you advanced word processing combined with style sheets, flexible page layout and typographic controls. Since it runs under Presentation Manager, you benefit from the multi-tasking, multi-windowing environment. The WYSIWYG mouse-and-menu interface makes it easy to create professional quality documents. For additional information on DeScribe, call Lennane Advanced Products at 1 916 646-1111.

Lotus 1-2-3 Release 3 delivers advanced spreadsheet power to OS/2 users.

1-2-3® Release 3 delivers a new dimension of power and performance to OS/2 users. Release 3 integrates true 3D worksheets, powerful data base capabilities and high-impact business graphics. Of course, it's fully compatible with your existing 1-2-3 data and macros. Release 3 supports leading OS/2 networks and PostScript® output devices. For more information, see the Lotus® Authorized Reseller nearest you.

Maximize semiconductor manufacturing process with AIM—Advanced Interface for Micralign®

As part of Perkin-Elmer's commitment to provide the semiconductor industry with ways to improve productivity, they've developed an OS/2 version of Advanced Interface for Micralign (AIM™). This integrated system interfaces with the Perkin-Elmer Micralign 500/600 HT series and utilizes OS/2's advanced multitasking capabilities to monitor 50,000 processes for maximized machine utilization. AIM reduces the time semiconductor manufacturers spend on system setup and diagnostics, and it enables flexible storage and real-time information retrieval. For more information on how AIM can help dramatically improve your productivity, call Perkin-Elmer at 1 203 834-4725.



OS/2 software vendor rebate participants.

Advanced Business Microsystems, Inc.
Advanced Graphics Applications, Inc.
ASI Application Specialists, Inc.
Borland International, Inc.
California Software Products, Inc.
Cawthon Software Group
Computer Associates International, Inc.
Consumers Software, Inc.
Data Wright, Inc.
DCA Corporation
Dodson Programming Service
Enable Software, Inc.
Eryart Development Corporation
GBA Systems
Graphic Software Systems, Inc.

Gupta Technologies, Inc.
IBM Corporation
Information Builders, Inc.
Infomix Software Systems, Inc.
Intelligent Environments
Key Software, Inc.
Laboratory Microsystems, Inc.
Lattice Corporation
Logitech, Inc.
Lotus Development Corporation
Lugaru Software, Ltd.
mdbs, Inc.
Micro Focus, Inc.
Micrografix

Microm, Inc.
Microsoft Corporation
Novell
Para Research, Inc.
Symantec Corporation
3COM Corporation
T/Maker Company
TPS Systems
WordPerfect Corporation
ZSoft Corporation

Free OS/2 Application Guide available.

You can receive a 340-page OS/2 Application Guide that lists and describes over 800 identified applications for OS/2. For a free copy of this guide call 1 800 IBM-2468, ext. 120.

Microsoft™

IBM®

was pleasantly surprised. All I had to do was load 386|VMM along with the program—everything else was transparent. Here is the one-line batch file I used to run the virtual memory version of MicroEMACS:

```
run386 -vmfile vmmdrv memacs %1 %2
      %3 %4 %5 %6 %7 %8 %9
```

All the magic is in run386 and vmmdrv. The run386 environment puts the 80386 into 32-bit protected mode, launches a 32-bit application, and handles the switching between protected and real modes that's required when the application requests DOS services. In this case, the application is MicroEMACS (i.e., run386 loads and executes a file called MEMACS.EXP). The .EXP extension characterizes protected-mode programs that were built by Phar Lap's 386|LINK and that can run only in the run386 environment.

If you were to type run386 memacs, you would run a protected-mode MicroEMACS without virtual memory. If you then add the command-line argument -vmfile vmmdrv, you activate

VMMDRV.EXP, the virtual memory driver. It's that simple—once you've got a protected-mode MicroEMACS to work with.

Phar Lap's 386|VMM works as advertised. You may have some trouble getting your code converted to 80386 pro-

There may be people with a need to solve 20-megabyte financial models.

ected mode, but once you've done that, adding virtual memory is a snap.

Who will benefit from 386|VMM? Anyone who has programs bigger than 1 or 2 megabytes destined to run on 80386-based computers under DOS. The first program to ship with 386|VMM was

Mathematica 386—certainly a good candidate since it needs at least 2 megabytes of RAM to run and 4 megabytes to run well; with more RAM, it can solve large problems.

I know of many engineering and scientific programs that have been too large for PCs up until recently. Programs specialized for reentry physics, hydrodynamics, solid modeling, and chemical process simulation are a few that spring to mind. Some of these are being ported to Xenix, others to OS/2, and some to DOS extenders like Phar Lap's. These large programs intended for vertical markets are the prime candidates for the VMM treatment.

But who knows what tomorrow will bring? While I can't imagine needing virtual memory to solve a spreadsheet, there may be people out there with a real need to solve 20-megabyte financial models. Anyone care to build a global economic model on a PC? ■

Martin Heller develops software and writes about technical computer applications. He holds a Ph.D. in physics. He can be reached on BIX as "mheller."



Protect the one you love.

Yours is not just any computer. It's your friend. Your confidant. Your business partner. You wouldn't be without it.

But it can happen in a flash. A sudden storm, distant ditch digger, motor, or even a toy metallic balloon can send data-killing, component-killing electric surges and sags smack into your computer. Even knock it out altogether.

It's a matter of time before this happens to you. So protect your friend with Emerson's

new low-cost SW1000 Uninterruptible Power System. Only 2¼ in. high, it fits smartly right under your PC's monitor for less than \$700.

In a brownout or blackout, a battery will instantly take over giving you ten minutes or more to shut down your computer.

Call 1-800-Back-UPS for the Emerson dealer nearest you. Before it's too late.

EMERSON
Computer Power
Computers Won't Run Right
On The Wrong Fuel.

*Limit 1 per customer. Offer expires September 30, 1989. Dealer: For reimbursement, forward copy of sales slip, UPS serial No., and customer name, address and phone number to: Marketing Services, Emerson Computer Power, 3300 S. Standard Street, Santa Ana, CA 92705.

© 1989 Emerson Electric Co.

We'll never try to sell you a laser printer.

We will, however, try to sell you on a laser printer language.

The PostScript[®] language from Adobe Systems.

You see, there are two kinds of printers and typesetters in the world. Those that support PostScript. And those that do not.

The ones that do—at last count there were 46—are completely compatible. That means, when you print a file on a PostScript printer from one manufacturer, you can print the same



file on a PostScript typesetter from a completely different manufacturer. And that's good to know, since more than 25 different O.E.M.'s have adopted the Adobe PostScript language.

On the other hand, when you print a file on a printer that doesn't support PostScript, that's virtually the only place you can print it. Forever.

Since there are so many different PostScript printers and typesetters, you can pick the one that

meets your specific needs. For paper handling options. Printing speeds. Choice of resolutions. And black & white or color output.

And only Adobe PostScript gives you absolute freedom to select the best hardware and more than 3,000 software programs for virtually every application, platform and budget.

Isn't it time you bought into the PostScript language?

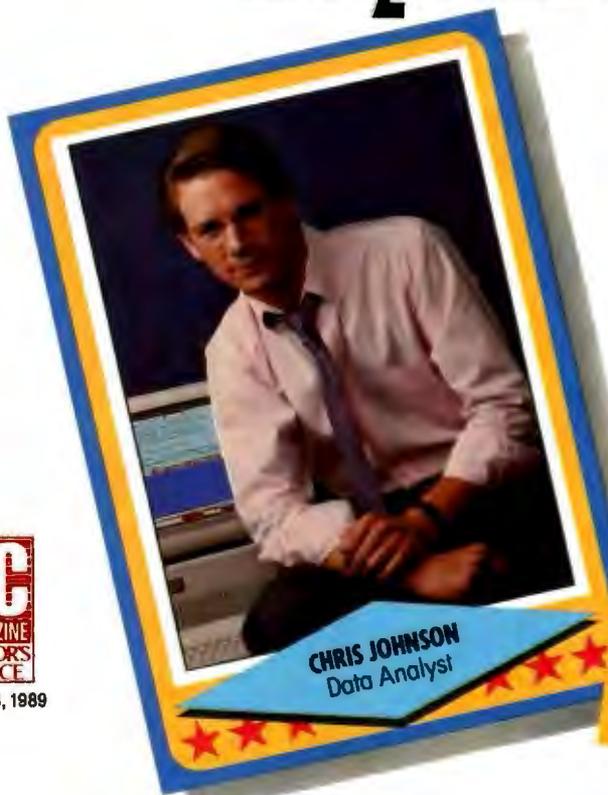


Look for the PostScript symbol on computers, printers and other products that support PostScript software from Adobe Systems; it's your guarantee of quality and compatibility. Adobe, the Adobe logo and PostScript are registered trademarks and the PostScript logo is a trademark of Adobe Systems Incorporated. ©1989 Adobe Systems Incorporated. All rights reserved.

We'll take your stats and make you the most valuable player in your league.



March 14, 1989



CHRIS JOHNSON Data Analyst

CAREER HIGHLIGHTS

1983
Proposed remap of sales territories based on SPSS analysis of economic and consumer trends. Increased new-customer revenues 38% in 2 years.

1985
Used SPSS data entry/tabulation system to administer employee benefits more efficiently. Eliminated outside costs of more than \$75,000.

1986
Identified current customers likely to need added services, increasing average billings by more than 20%.

1988
Rewarded with special corporate recognition and bonus.

Another Story in the SPSS SUCCESS SERIES

Data analysis software from SPSS® gives your PC a winning advantage.

It doesn't matter which field you play hardball in. With the right equipment and ability, you can be a hero.

You get that ability with SPSS. Whether your equipment runs on MS-DOS™, PC-DOS™ or OS/2™. So you turn raw data into useful facts. And yourself into a smarter decision maker.

With SPSS and its options, you can interface directly with data from your database, spreadsheet or other appli-

cation software. Then manipulate it in countless ways. From data entry to advanced statistics, mapping, forecasting, graphics and more.

Voted #1 by the fans.

When the readers of *PC Week* chose the top statistical software for "user satisfaction" (12/5/88), their choice was SPSS. And no wonder.

SPSS is designed not only for your computer's operating system, but also for its operator. With menu and help systems, plus an on-line statistical glossary. So you're always in control. For market research, sales analysis,

quality control and more.

And you can always count on the training, support and ongoing upgrades of SPSS. The team that's come through for over 1 million users since 1968.

Find out how SPSS can make you first in your micro league by calling

(312) 329-3315

We'll give you the numbers to really stand out in your field.

SPSS inc.

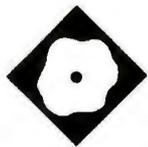
Best in the final analysis.

444 North Michigan Avenue • Chicago, Illinois 60611

SPSS International BV: Avelingen West 80, P.O. Box 115, 4200 AC Gorinchem, The Netherlands

SPSS is a registered trademark of SPSS Inc. PC-DOS and OS/2 are trademarks of International Business Machines Corporation. MS-DOS is a trademark of Microsoft Corporation. Not all options are available on all operating systems.

Powerful Portable 3-D Graphics



HOOPS provides
the tools, you supply
the imagination

Bradley Dyck Klierer

At the heart of every CAD program there's a database of geometric objects, a display manager, and an event manager. That's HOOPS 2.03 in a nutshell. HOOPS (Hierarchical Object-Oriented Picture System) is a library that provides support for three-dimensional imaging to C or FORTRAN programs.

HOOPS can add three-dimensional objects to a database. It can display the contents of the database in one or more viewports, from any point of view, using orthographic or perspective projection, as a wireframe or shaded solid; and it can determine what database object a pointing action (such as a mouse-click) indicates. Because versions of the HOOPS library exist for DOS, Phar Lap's DOS-Extender, the Macintosh operating system, Unix, and VMS, a HOOPS application developed under any of these operating systems will port readily to any other.

Several HOOPS-based three-dimensional CAD programs are in the works. That's not surprising; developers of commercial CAD software desperately need the portability that HOOPS confers. But HOOPS appeals to a larger audience, too. All sorts of applications could profitably use three-dimensional imaging. For example, you might create a graphical front end to an automotive database, using HOOPS routines to manipulate a three-dimensional representation of the parts.

HOOPS requires a powerful system to run properly. Space is tight on a 640K-byte DOS machine. Working on an IBM AT with an Intel Inboard 386 and Microsoft C 5.1, running under DOS, I frequently ran out of memory. When I added a powerful graphics coprocessor—the 3D Engine from Nth Graphics—the situation improved greatly. In that configuration, HOOPS executes on the 3D Engine's transputer, leaving plenty of space for programs. I also tried HOOPS on a Sun386i, with good results.

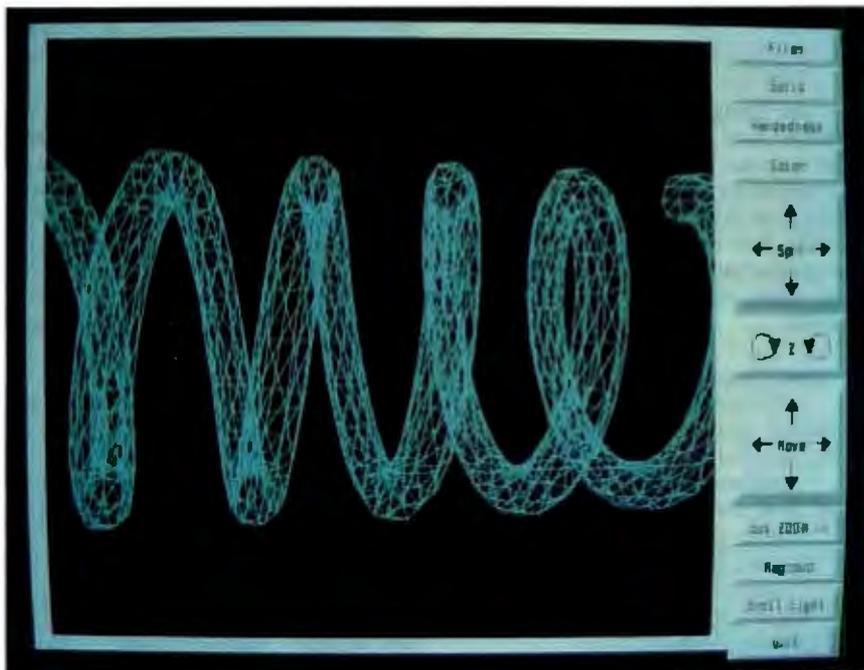
Ithaca Software acknowledges that workstations are the natural domain of HOOPS and intends to support all sufficiently powerful platforms. The 640K-byte DOS machine just barely makes the grade; in fact, the company may not continue to support it. But that same 80286- or 80386-based machine with extended memory, a graphics coprocessor, and DOS-Extender or Unix makes a fine HOOPS platform.

A Tree-Structured Graphical Database

The graphical entities that HOOPS works with are polylines (multisegment lines described by a series of three-coordinate points), polygons (closed, coplanar polylines), pixel arrays, and text strings. The program organizes all graphical data as a hierarchical database. Entities belong to named segments; segments can nest. It's like a hierarchical file system. The root is known as / (as in Unix) and has the alias ?home. HOOPS maps the display to a special segment called ?picture. Here's part of a segment tree you might define to represent a car:

```
?picture/car
?picture/car/rf_wheel
?picture/car/rf_wheel/hubcap
?picture/car/lf_wheel
?picture/car/lf_wheel/hubcap
```

continued



HOOPS 2.03

Company

Ithaca Software
902 West Seneca St.
Ithaca, New York 14850
(607) 273-3690

Hardware Needed

IBM PC or compatible with 80286 (640K bytes of RAM) or 80386 (640K bytes of RAM under DOS, 1 megabyte of RAM under DOS-Extender, and 3 megabytes under OS/2), and 80x87 or Weitek coprocessor; Mac II with 2 megabytes of RAM; Sun-3, -4, or 386i; DEC VAXstation; Silicon Graphics 4D Series (including Personal Iris); Sony News; Apollo Domain; and HP 9000

Software Needed

IBM PC and compatible: DOS, OS/2, DOS-Extender, Microsoft C 5.1 or MetaWare High C, Microsoft FORTRAN 4.0
Mac II: Finder 6.0, MPW C 3.0
Sun: SunOS 3.5 (Sun-3) or 4.0 (Sun-4 and 386i), cc
DEC: VMS or Ultrix, VAX C or cc, VAX FORTRAN or f77
Silicon Graphics: Unix, cc, or f77
Sony: Unix, cc, or f77
Apollo: Unix (SR 10), cc, or f77
Hewlett Packard: Unix, cc, or f77

Price

IBM PC compatible (DOS and OS/2) version: \$495
IBM PC compatible (DOS-Extender) version: \$575
Mac II version: \$575
Sun386i version: \$1150
For all other systems: \$3450

Inquiry 886.

You can navigate a structure like this with the `Open_Segment` and `Close_Segment` routines. While a segment is open, you can modify the geometry contained within it or change the *attributes* that tell HOOPS how to display that geometry. You might build the body and the right front wheel of your hypothetical car as follows:

```
HC_Open_Segment
  ("?picture/car");
insert_part (body);
HC_Set_Color("lines=black,
  faces=mulberry");
HC_Open_Segment ("rf_wheel");
insert_part (wheel);
HC_Set_Color("lines=white,
  faces=midnite blue");
HC_Set_Visibility("off");
HC_Close_Segment ();
HC_Close_Segment ();
```

The `HC_` names are HOOPS routines; in FORTRAN, they'd begin with `HF_`. The `insert_part` function represents a user-written routine that might read in or fabricate the necessary three-dimensional data, then call HOOPS routines to insert that data into the current segment. When this code fragment executes, HOOPS adds two graphical objects—the body and the wheel—to the database, then displays the database. Because the wheel's visibility attribute is turned off, only the body appears. Note that the second call to `Open_Segment` need only supply a partial name, because `?picture/car` is the current segment (analogous to the current directory in a file system).

Believe it or not, you're looking at a nearly complete HOOPS program. All you need to do to make something happen is to open segments and add geometry. You *don't* have to ask HOOPS to draw this scene; that happens automatically whenever you change the database. All HOOPS attributes have default values, so you'll get the standard colors, line width, camera location, and so on.

Because HOOPS uses descriptive path names and function names, and because the parameters to functions are mainly textual, HOOPS programs are easy to read—though all the lengthy names can be tedious to type. The names of the colors (e.g., mulberry or midnite blue) are a whimsical touch—they're from the Crayola 64 crayon set. You can rename these, or you can create your own color maps using your choice of techniques: HLS (hue, lightness, saturation), HSV (hue, saturation, value), HIC (hue, intensity, chromaticity), or RGB (red, green, blue).

Organizing the Picture

Maintaining the hierarchical database takes effort, but it's worth the trouble. A child segment inherits the attributes of its parent, and those attributes control its color, scale, orientation, and rendering. This scheme gives the HOOPS programmer enormous leverage. You can modify an entire scene by changing attributes in the root segment, or you can change selected parts of a scene by operating on subsidiary segments. For example, you could create an exploded view of the car by translating the coordinates of the wheel segments. The hubcap belonging to each wheel segment would inherit the new coordinates.

What seems very different from a user's perspective—viewports, menus, buttons—look alike to HOOPS. They're just segments with associated windows. Any segment under `?picture` can belong

to one or more windows. A menu segment's window might occupy a portion of the display and contain subsidiary segments (representing buttons) with window coordinates relative to the menu's window. So, you could move or even re-scale the entire menu by modifying its top segment; the same concept applies to segments containing windows that display database geometry. This uniform handling of different kinds of objects is a great strength of HOOPS.

HOOPS assigns a key (i.e., a long integer) to every segment and to every object within a segment. Routines that insert objects come in two flavors. For example, there's `Insert_Polygon` and also `KInsert_Polygon`. The non-K routines simply insert things; the K routines insert and return a key. Why two versions? You use the former when your application doesn't need to explicitly track objects, and the latter when it does. Of course, if you let HOOPS track things for you, that doesn't mean you can't query the database. You can use HOOPS search routines to traverse the database and return the keys of segments or objects that match a search specification composed of a segment name (which can contain wild cards) and a list of object types.

The wild-card facility makes the search mechanism extremely powerful; for example, the string `"/...#hubcap"` specifies all the hubcap segments. You can then apply a filter so that HOOPS will find only, say, the polygons in those segments. Additional routines use the keys of the found objects to extract their geometric data. When you can't predict an application's pattern of database access, it's probably best to let HOOPS manage the keys, and to ask HOOPS (by way of the search routines) to locate objects when you need them. If you know your application will be using particular segments or objects intensively, you might want to handle the keys explicitly so you always have immediate access.

I've mentioned the special segment `?picture`, which HOOPS associates with the display. Think of it like video RAM on a PC—whatever you write to it appears on the screen. Although you can insert geometry into segments within `?picture`, as I illustrated above, there is a more elegant solution. HOOPS provides two other special segments: `?Include Library` and `?Style Library`. These aren't visible, but you can establish links between them and `?picture` in a manner analogous to Unix file linkage.

Multiple views show this technique to good advantage. You wouldn't want to

continued

You know
exactly what
your company
wants in a
color printer.

replicate segments within ?picture to show front, top, side, and isometric views. Better to manipulate geometry and attributes off-screen in ?Include Library and ?Style Library. You can then reserve ?picture for menus and view windows. The segment that defines each viewport need only refer to geometry in ?Include Library and attributes (e.g., orientation and projection) in ?Style Library.

The HOOPS Repertoire

HOOPS provides more than 150 functions; the manual categorizes them as geometry, attributes, segments, input, and system routines. You've already seen examples drawn from the first three categories (i.e., routines that insert geometry, control its presentation, and navigate the structured database).

The geometry routines insert or retrieve the basic HOOPS entities: lines, polylines, polygons, pixel arrays, and text strings. The HOOPS programmer must build more complex geometry from these primitives. For example, to add a spline or a cylinder to the database, you have to compute the component line segments or polygons and insert them individually. There's no way to add direct database support for new user-defined primitives. Such extensibility, while clearly desirable, would require that users solve the rendering problems associated with those new primitives. By restricting the core set of primitives to those that HOOPS itself can render, users can rest assured that more complex objects they construct from those primitives will render properly.

Although the database is not, strictly speaking, extensible at the lowest level, HOOPS does provide one "back door" function called `Set_User_Value`, which embeds a single long integer within a segment. You might use that value to store a pointer to your data—or code, for that matter. It's your responsibility to access the data or activate the code; HOOPS just provides a slot into which you can place the hook. The mechanism offers a convenient way to link graphical data managed by HOOPS with nongraphical data specific to an application.

Attribute-related routines control the orientation and presentation of objects. HOOPS can scale a segment, rotate it about its own axis or another axis, or translate it to new coordinates. For special applications, you can add your own transformation matrices to the pipeline of matrices through which HOOPS data passes enroute to the screen.

You can render an image as a wire-

frame or a solid. In the latter case, you can vary the location and color of one or several distant sources of light. The interplay of colored lights on colored surfaces yields fascinating effects. View control is very flexible. HOOPS provides reasonable defaults for the camera (location of the viewpoint within a scene), target (location at which the camera points), field of view (the camera's lens), and method of projection; you can vary these attributes as required. Depending on the effect you want, the camera can dolly (slide left, right, up, down, in, or out); pan (rotate with respect to a fixed target); orbit (move around a fixed target); or zoom.

To simplify the modification of a segment's attributes, HOOPS provides *quick* versions of several functions; these versions automatically open and close the named segment. Suppose you want to switch from an orthographic to a perspective projection. The long version looks like this:

```
HC_Open_Segment ("?Style
Library/car_style");
HC_Set_Camera_Projection
("perspective");
HC_Close_Segment ();
```

The quick version does the same thing in one line:

```
HC_QSet_Camera_Projection
("?Style Library/car_style",
"perspective");
```

The most basic and useful input function is `Get_Selection`; it waits for a mouse-click and returns the segment associated with the location of the click. That's all you need to implement a menu system with mouse-sensitive buttons. `Show_Selection_Item` tells you which piece of geometry within a segment the user indicated. Other functions acquire individual keys or text strings from the keyboard. These high-level input functions are implemented in terms of low-level ones that manage input devices and event queues.

The system-related routines are a mixed bag of extras. There are functions that define error handlers, parse strings, examine environment variables, and inquire about the characteristics and status of devices.

On the Output Side

Output to the screen is the default, of course. But for hard copy, the system provides another special segment called ?hardcopy. To print the display, you

open ?hardcopy, force a display update, then close and delete the segment. That takes about eight lines of code. Curiously, the only place to find this information is in the installation manual under the PostScript and Hewlett-Packard Graphics Language (HPGL) driver descriptions. A sample print routine would be a welcome addition to the otherwise excellent tutorial. And although HOOPS's support of PostScript and HPGL gives it a broad base of support, the library could use a driver for the HP LaserJet and perhaps a few other plotters or dot-matrix printers.

A significant new feature in version 2.03 is `Set_Metafile`. Metafiles are ASCII dumps of the contents of segments; you can store metafiles to disk and read them back. And since metafiles work with segments, you can save as much or as little data as you need by selecting a segment at the appropriate level in the tree structure. Metafiles have several optional attributes that control the information saved. Normally HOOPS saves just geometry and attribute data, but you can store the entire state of the system if required—including things like color maps and aliases. You can store just the names of included segments or its names and contents, as well.

The ASCII format works nicely for reviewing (or even editing) the database, and of course, it makes metafiles readily portable. It does consume a lot of disk space, though; according to the company, a forthcoming version of HOOPS will support a binary metafile format that will alleviate that problem. HOOPS automatically converts the name of a metafile to something that will work with the host operating system, retaining the original name within the metafile. For example, a Unix-like name, such as `test.hps.file.1`, might turn into `TEST.HPS` under DOS.

Learning the Ropes

HOOPS comes with a 50-page tutorial. Using clear and concise examples, the tutorial shows you how to build a simple application that creates a cylinder, displays it in two viewports, and presents a menu that enables the user to rotate and zoom the image. One of the installation disks contains the complete source code for the tutorial application, along with the code for GEOS, a more ambitious program. GEOS can retrieve and display more complex images. These are stored on disk in an ASCII format that GEOS can interpret. They include some of the three-dimensional CAD standards—a

continued

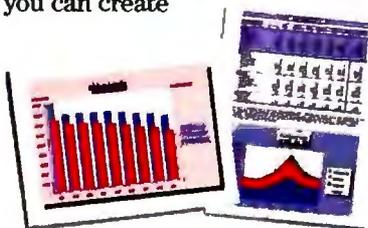
Monet, not money.



The HP
PaintJet.
\$1395*

Who says fine art is out of reach? The HP PaintJet color printer produces brilliant color for a price any business can afford.

So now there's no limit to what you can create



with your business communications. Surprise your audience with thousands of colors. Beamed up on an overhead. Or tucked neatly into a report. Persuading people up to 85% more effectively than black and white.

The PaintJet works with all your favorite graphics, presentation, spreadsheet and word processing software. Just hook it up to your IBM-compatible or Macintosh computer and start painting.

For only \$1395 (add \$125 for the Macintosh interface).

Call 1-800-752-0900 Ext. 711K for your nearest authorized HP dealer and a free sample output. The HP PaintJet. It's what artists are starving for.

There is a better way.

 **HEWLETT
PACKARD**

Circle 128 on Reader Service Card

POWERFUL PORTABLE
3-D GRAPHICS

**Protects
while you
type!**



- Remains In Place while you use your computer.
- Avoids Costly Repairs. Protects delicate electronics from dust, spills, smoke, ashes, staples.
- Soft, Flexible, retains normal keyboard feel.
- Washable, Durable High-Tech Polymer lasts years.
- Hundreds of Models. SafeSkin is available for most PCs, laptops, workstations and clone keyboards.
- Office • Home • Factory • Classroom • Laboratory

List Price \$29.95. Please call or write for free color brochure. Dealer inquiries encouraged.

SafeSkin
KEYBOARD PROTECTOR

Merritt Computer Products, Inc. 5565 Red Bird Center Drive
Suite 150, Dallas, Texas 75234/(214) 339-0753 • FAX (214) 339-1313
In Canada call 1-800-663-1061

Volkswagen beetle, a wine glass, and a teapot. GEOS gives a great demonstration of HOOPS's features: You can pan, rotate, or zoom an image; resize the window that contains it; change its color using red, green, and blue sliders; and move the light sources that surround it.

I felt comfortable with HOOPS after a few hours. I did take some wrong turns when first working with the hierarchical database. You need to understand its architecture well, because everything else flows from it. In short order, though, I enhanced the tutorial, adding a new object (a box) and several features (save, load, and print). I discovered how easy it is to make significant structural changes in an object-oriented environment.

I also ported my modified tutorial to a Sun386i. After recompiling the code, it ran without problems. I even loaded metafiles that I had created on my AT. Performance on the Sun386i was roughly comparable to my AT with a 3D Engine aboard. Of course, the \$7000 3D Engine from Nth Graphics is an expensive way to cram HOOPS into a 640K-byte DOS environment. If you have or are willing to acquire Phar Lap's DOS-Extender and the MetaWare High C Compiler, the 32-bit DOS version of HOOPS is a good bet for PC compatibles. Since HOOPS supports EGA and VGA output, you won't need a graphics coprocessor. Still, you'll want one (HOOPS supports, among others, the Pixelworks Clipper and VMI Cobra) to see the program at its best. Of course, HOOPS is most comfortable on high-end Sun, Apollo, and Silicon Graphics workstations. Any way you look at it, serious HOOPS development requires serious hardware.

Developers of custom CAD applications for manufacturers, scientists, and engineers will appreciate the power and portability of HOOPS. Such applications often require real-time data analysis. I'd rather add graphics to an existing analytical application, by way of HOOPS, than try to integrate the analysis into a stand-alone graphics or CAD program. HOOPS will help move three-dimensional graphics outside traditional CAD markets. If your application requires or could benefit from three-dimensional imaging and must run on a variety of platforms, take a close look at HOOPS. ■

Bradley Dyck Kliever is the author of EGA/VGA: A Programmer's Reference Guide (McGraw-Hill, 1988) and owner of DK Micro Consultants, a microcomputer consulting business in Bloomington, Indiana. He can be reached on BIX as "bkliever."

IEEE-488

'488 (GP-IB, HP-IB) control for your PC/XT/AT

Control instruments, plotters, and printers.
Supports BASIC, C, FORTRAN, and Pascal.
Fast and easy to use. High-speed DMA.
Software library included so you spend less time programming.
Thousands sold. Risk free guarantee.
Hardware and software - \$395.

Product literature 1-800-234-4CEC
Technical assistance 617-273-1818



cec Capital Equipment Corp.
Burlington, MA. 01803

1024X768 IBM COMPATIBLE VGA VIDEO CARD

VGA W O N D E R™

T H E S E C O N D W O N D E R

1024X768

Plus: VGA, EGA, CGA, MDA & Hercules on Standard MULTISYNC monitors

Yes! the Phenomenal VGAWONDER does it all at IBM Hardware level compatibility with automatic monitor detect and no dip switches or jumpers to set. A HOT CARD for the 286/386 POWER USER with AUTO BUS DETECT for 8 or 16 bit slots, running with a 16 bit datapath with 1:1 interleave. 100% IBM HARDWARE LEVEL COMPATIBILITY means that ALL software and operating systems designed for IBM systems will run. 1024 WILL BE DISPLAYED IN COLOR ON STANDARD MULTI-FREQUENCY MONITORS. Although these features are expected from ATI they are NOT AVAILABLE from other manufacturers. EGA on all monitors including RGB & TTL means a perfect card for networks. MOUSE ON BOARD! ATI built the mouse right in to this one, why not? No extra charge! VGAWONDER is available in both 512K and 256K Versions. Ask your dealer for more information.



TECHNOLOGIES INC.

Technology you can Trust.

ATI Technologies Inc.
3761 Victoria Park Ave., Scarborough, Ontario
Canada M1W 3S2 Telex: 06-968640 (ATI TOR)
Tel: (416) 756-0718 Fax: (416) 756-0720



Circle 24 on Reader Service Card

ATI, VGA W O N D E R — ATI Technologies Inc.; Multisync — NEC Home Electronics Inc.;
AUTOCAD — Autodesk Inc.; WINDOWS — Microsoft Inc.; GEM — Digital Research Inc.;
VENTURA — Xerox Corp.; HERCULES — Hercules Computer Technology Inc.;
IBM, VGA, EGA, CGA — International Business Machines Corp.



The New
804
Series

AFFORDABLE CONNECTIVITY



A VERSATILE LAN-ALTERNATIVE FOR \$395



THREE MODELS TO MEET YOUR APPLICATIONS

The Print Master® II 804 Series is BayTech's newest intelligent controller with four ports and a 256KB dynamically allocated buffer. Available in your choice of four serial ports (RS-232C or RS-422A), four parallel ports, or two serial and two parallel ports, the 804 Series offers affordable connectivity.

The 804 Series provides a cost-effective solution for users who want to maximize their resources. Each four port model allows you

to connect any combination of computers, printers, and plotters for:

- ▶ printer sharing
- ▶ plotter sharing
- ▶ buffering of data
- ▶ LAN printer expansion

Models with serial ports allow you to also connect modems or any other RS-232C device for computer-to-computer communication and modem sharing.

The 804 Series allows simultaneous data input from computers, output of print data and full duplex communication between pairs of computers.

LAN APPLICATIONS

The 804 Series is ideally suited for expanding the printing capabilities of a LAN system. By acting

as a printer server, it can off-load network traffic and provide port expansion and extra buffering.

BayTech products are covered by a one-year warranty and are supported toll-free by a team of application engineers.

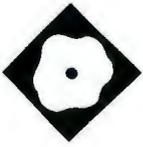
Call us today to learn how the new Print Master® II 804 Series can become your connectivity solution.

BayTech

Bay Technical Associates, Inc.
Data Communications Products Division
200 N. Second Street, P.O. Box 387
Bay St. Louis, MS 39520 USA
FAX: 601-467-4551
Telex: 910-333-1618 BAYTECH
Phone: 601-467-8231 or toll-free

800-523-2702

Circle 34 on Reader Service Card (DEALERS: 35)



Text Retrieval with a Twist

Folio Views advances text management technology with a new indexing scheme

Dennis Allen

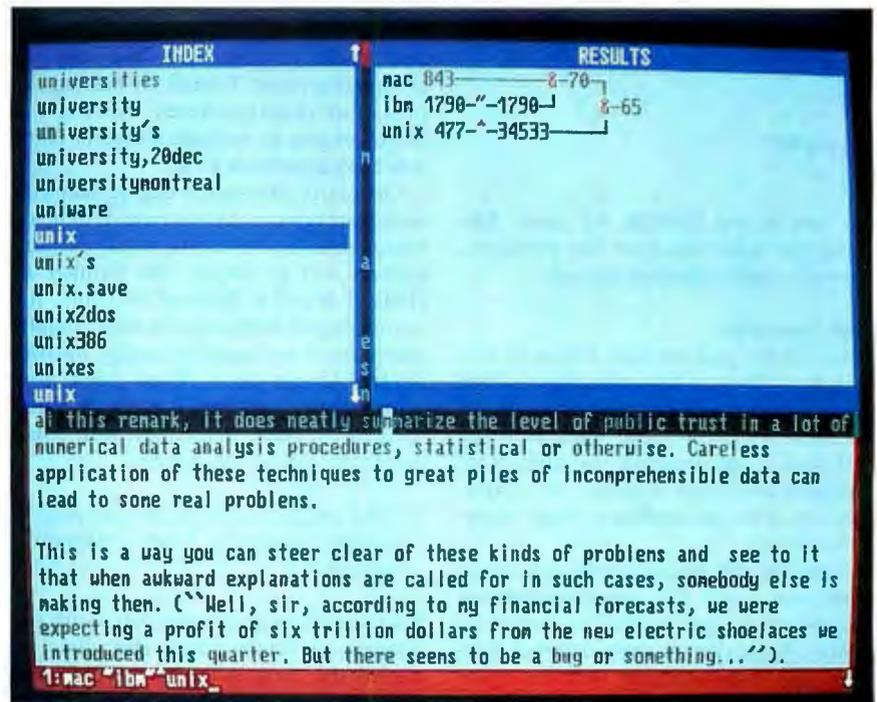
In some ways, Folio Views 1.0 is a whole new ball game; in other ways, it's nothing new. It's a synthesis of several applications for DOS machines—text retrieval, hypertext linking, word processing, directory management, and electronic publishing. None of those applications is particularly new, but you've never seen them together before.

Folio Views is more than just a marriage of old ideas. It takes text management technology a step further. Through a proprietary scheme called "under-head," Folio Views indexes every word of your text files and compresses the lot—text and index—into as little as half the space of the original ASCII file. (Its index limit is 10 million unique words, but I can't imagine generating a database that uses that many.)

Folio Views also lets you organize your text in *views*, which you can quickly recall. You can conduct amazingly fast searches and even change the database on the fly without reindexing it.

View Processing

Using logical views to recall text makes sense. If you've ever had to go through several documents, you know what I mean. For example, say you've accumulated a couple megabytes of information—mail, internal memos, proposals, and so forth—and you keep all your mail in one directory (or file), memos in an-



Folio Views helps you find the right search word by displaying its index and highlighting the first match in its list as you type each letter. The program also lets you use wild cards.

other, and so on. Just finding all the references to, for instance, red-striped widgets in those files is like trying to find a needle without knowing whether to look in the barn or the haystack.

Folio Views lets you keep information physically intact. It also lets you group just the pieces of information about those red-striped widgets. You might have a paragraph from a memo, three paragraphs from a proposal, and the bodies of two letters in the view. By pressing the Enter key, you can see the complete source of any one of the view entries in a separate window, and you can have as many as 10 windows open at once.

Each logical piece of information in a view is called a *folio*. Typically, each paragraph in a document constitutes a

folio. However, you can define a folio to be any amount of information, provided you have EMS memory installed in your system (you're limited to up to 10,000 characters without EMS memory).

Markers show where each folio begins, and you can jump from one marker to the next with a single keystroke. You can also jump to the next page (screen) or go directly to any folio you specify. And you can scroll through the text using the cursor keys. Just don't be in a hurry, though. The way Folio Views handles screen updates is atrocious.

Folio Views' slow scrolling is its biggest weakness. Speed is critical when you're dealing with huge amounts of text, and scrolling in the program is just

continued

Folio Views 1.0

Company

Folio Corp.
2155 North Freedom Blvd., Suite 200
Provo, Utah 84604
(801) 375-3700

Hardware Needed

IBM PC or compatible with 512K bytes of RAM and a hard disk drive

Software Needed

MS-DOS 2.0 or higher

Documentation

User's manual; quick reference guide

Price

\$495

Inquiry 885.

too slow on my 10-MHz AT clone. The company acknowledges the problem, however, and promises a remedy.

Fast Searches

Folio Views' real strength lies in its text searches. They're fast enough to offset the scrolling problem, and you can do searches from any view—including the full view of the database. Because of its unique index, most searches are instantaneous, even on databases many megabytes in size.

Searches can be as simple as a single word—any word. The program does not use so-called "stop words" to shorten its index. Typically, a text-retrieval program that does indexing will not index words such as *the* and other frequently used articles of speech; it's too costly in both disk space and CPU time.

But Folio Views adds a new—and very efficient—twist to how it indexes text (see the text box "The Trouble with Indexing" on page 204). If you do a search of *the* in a 10-megabyte text file, the program completes the search almost instantly.

I tested that idea on just such a file. I used the text from all BYTE issues in 1988, totaling about 9.6 megabytes in ASCII and about 6 megabytes in Folio Views' compressed format. I typed *the* on the search line; by the time I released the Enter key, the program had completed its search—9824 folios contained the word *the*. Another tap of the Enter key, and 2 seconds later I was looking at a view containing four folios (all that fit on the screen) with *the* highlighted in 32 places.

That was too easy. So for grins, I tried a little Boolean logic. I did a search for

all folios that did not contain *the*, and just as quickly I got my answer—8060 folios.

Of course, you can do more complicated searches using full Boolean logic with nesting, wild cards, exact phrases, and proximity matching. About the only kind of search you can't do with Folio Views is one using fuzzy logic. However, if you're not quite sure of a word, the program helps by displaying its word list (the index), highlighting the first match in its list as you type each letter (see photo). You can also use wild cards (* and ?), just as you would in DOS.

The search engine gives highest priority to NOT operations, followed by OR and AND, respectively. You can get around that order, though, by nesting expressions in parentheses, forcing the search engine to evaluate whatever is inside the parentheses first.

Generally, the search engine keeps up with your typing. As you type, it builds a search tree on-screen to verify search criteria and to display the number of finds. I found it difficult to choke the search engine with even the most complicated Boolean searches using nesting several layers deep. What does slow things down, however, is a search using wild cards. Still, the longest wait I had was for the following search:

```
(???86 intel/intel's ibm(pc/pcs)
compaq/compaq's^(amd/("second
source"1)
```

That search located every folio with the mention of 80x86 chips that also included the companies Intel, IBM, and Compaq but contained no reference to AMD or the phrase "second source." (The spaces represent logical AND, the slashes represent logical OR, and the caret represents logical NOT.) Because I'm not a fast typist (Folio Views processes the search as you type), my wait was only a couple of seconds. A faster typist might have waited 5 seconds.

One of the best things about doing searches in Folio Views is that you don't have to do them twice. Every search results in a view, and to retain that view, you just name it. The additional views always use text in the existing database, conserving space on your hard disk. You can even confine your searches within specific views.

Links and Dynamic Data

You can create explicit links to views from anywhere in the database and even set up menus to make selecting views easy. You can also use links to create hypertext-like jumps. An attorney, for ex-

ample, could use a link to directly tie a reference in a brief to the text of the cited court case.

Each link is represented by a token. Viewing the linked view is just a matter of moving the cursor to the link token and pressing Enter. Links are particularly useful for footnotes. You can have up to 200 million links in a database.

Perhaps even more important than Folio Views' links is its ability to be modified. Most other text-retrieval software usually requires you to import all the data just as though you were starting anew once you've appended or changed the original ASCII data file. At the very least, you have to wait for the software to completely reindex the database, which could take hours.

Because of the way Folio Views organizes its index, you can easily add, delete, or edit a database from within it. It even has its own built-in word processor that, while it's no WordPerfect, is adequate for making minor corrections or annotations to the database.

You can also do cut-and-paste imports and exports of the database. You can direct output to your printer or a file in either ASCII format or one that includes the program's folio markers and attribute codes.

If you don't want your database changed, Folio Views lets you lock a database with passwords so that an end user can only view information and not change it.

Electronic Publishing Perils

My trials using Folio Views included creating databases of two years' worth of BYTE text (about 20 megabytes), one month of the *Washington Post* downloaded from The Source (about 6 megabytes), the *King James Bible* (about 4.5 megabytes), about 1.2 megabytes of BIX conference messages, and all my E-mail on file (about 1.9 megabytes).

I learned that electronic publishing is not necessarily easy. Unfortunately, Folio Views does not make a database automatically. First, I had to insert folio markers (Control-E) in appropriate places in the text. For example, I figured I'd just tell my word processor to go through the 20 megabytes of BYTE text and insert a folio marker wherever two hard carriage returns occurred. But it wasn't that easy. Paragraphs in some articles were separated by only one carriage return and an indentation of one or more spaces or tabs. I also had to strip out some of the editing codes that BYTE uses.

continued

DR DOS. THE CHOICE IS OBVIOUS, MORE OR LESS.

DR DOS

- Full DOS application support
- Large disk partitions - greater than 32 megabytes
- LIM 4.0 expanded memory support
- Graphical icon-based user interface
- Fully executable from ROM
- Quick and easy installation
- Password protection for files and directories
- Full screen text editor
- Multiple command line recall
- Built-in help for utilities
- Backed by the Digital Research commitment to quality service and support

THE OTHER DOS

- Full DOS application support
- Large disk partitions - greater than 32 megabytes (DOS 4 only)
- LIM 4.0 expanded memory support (DOS 4 only)
- Graphical character-based user interface (DOS 4 only)

You don't have to look too closely to see how DR DOS stacks up against the competition. With an added set of features and capabilities, DR DOS gives you proven capability *and* flexibility in a superior alternative for any system. Whether you use a hand-held computer, a laptop, a diskless workstation,



a portable or a powerful full-sized system with specialized applications, DR DOS gives you everything you need to make the right choice. Obviously.

For more information: Systems Integrators and OEMs call Digital Research at 800-443-4200.

 DIGITAL RESEARCH®

DR DOS™
THE BEST CHOICE.

Digital Research and the Digital Research logo are registered trademarks, and DR DOS is a trademark of Digital Research Inc. Copyright © 1989, Digital Research Inc. All rights reserved.

The Trouble with Indexing

Although Folio Views is not the first program to try to manage large text files, it does it with a new twist in indexing technology. Most developers recognize the *inverted index* as the best and fastest form of indexing. But an inverted index has some serious limitations: namely, that the index is typically 30 percent to 100 percent the size of the original text file, and changing the text file requires the time-consuming chore of reindexing the entire file.

Here's how an inverted index works. Say you wanted to build an inverted index for a 100-word text file. You would extract all the unique words and alphabetize them. Then you would use that list of words, which would be nearly as big as the text file itself, as the basis of the index. Beside each word, you would write the location of each occurrence of the word in the text. That's typically done by counting how many bytes from the top of the file each occurrence sits. What you end up with is a list of words and, beside each word, a string of numbers that represent the locations for every time the word appears in the text.

That seems simple, but what if you change, say, the fiftieth word in the text? You have to update the locations of every word that follows it. That may not be so hard with a 100-word file, but if

you have several megabytes, it becomes a difficult chore. That's why some text-retrieval programs reindex the entire file after an update or don't allow updates at all.

Folio Views uses what its developers call "sparse inversion." Rather than storing a list of precise byte offsets to point to word occurrences, it stores a list of the *folios* that contain the word. For example, even if the word "the" appears 20 times in a folio, the program stores a single pointer for that folio. When a search brings up a folio, the program highlights the search words or phrases. To save more space, it uses a proprietary method for compressing the folio pointers.

All the indexing is done during the second of two passes over the text. During the first pass, Folio Views compresses the text, again using a proprietary method. The program's developers say that they steered away from the space-efficient Huffman encoding in favor of a scheme that could decompress more quickly.

Together, the text compression, pointer list compression, and sparse inversion give Folio Views its speed. Those techniques also give it the ability to store a complete database in as little as half the space of the original file.

Now none of this is particularly difficult—I used XyWrite's macro language to automate the process. But when you're dealing with 20 megabytes of text, the process takes a long, long time. My system ran constantly for days while I prepared all the files. I wish Folio Views did some of this work for you. For example, the Create program, which converts the ASCII files to a database, should have an option to insert folio markers on the fly based on parameters that you set.

After I had prepared all the data, I ran the Create program, which does two things: First it compresses the text, and then it indexes it. You can convert a single file into a Folio Views database or set up a parameter file that gives the Create program a list of files and existing Folio Views databases to convert into one big database.

All this works well, provided there are no errors or extraneous characters in your parameter file. I set up a parameter file that listed the BYTE text files (each

file contained one issue). The problem I had was that XyWrite embedded an invisible (null) character at the beginning of the file that the Create program interpreted as a delimiter. I didn't know that at first. I just got an error message saying that I needed to specify an output file, which I had in fact done.

Even when I loaded the parameter program into the Folio Views word processor, the extraneous character causing the problem did not appear. Later, when I had removed that character, I had a similar problem with the end-of-file marker placed by XyWrite. This time I got an "Unable to open" message. Surely the error checking can be made more precise.

It would have helped if the program had told me how much disk space I needed to do a conversion. For the BYTE text, which the program compressed into about 13 megabytes (including the index), I thought 17 megabytes of free disk space would be enough. I was wrong. After the Create program ran for about 4

hours, it aborted with an "Insufficient disk space" message. Eventually, I was successful, and my 10-MHz Hyundai 286c took 5½ hours to create the BYTE text database. The process made me want an 80386 system. Creating a smaller database is quicker; I converted my 1.2-megabyte file in less than 9 minutes.

Even if you're not interested in creating your own Folio Views database, you may still come face to face with Folio Views. Several large publishing houses plan to publish text databases in the Folio Views format using a run-time version of the program called Preview. Preview gives you all the search capability, but not the customization, of Folio Views. Preview is also distributed with Novell's NetWare.

If you want to publish electronically, Folio sells Views Publish, which is a developer's kit for putting Folio Views databases together. If you just want to distribute your database internally, you can use Folio Views' Chop and Load programs. Chop breaks a database into floppy disk-size pieces, and Load puts it together again.

Folio Views comes with one database, America, that will probably help you settle some bets in the office. It contains The Constitution, the Declaration of Independence, and several important Supreme Court case rulings.

The Big View

Folio Views has its faults, the biggest of which is the slow text scrolling. I'd like to see the error trapping improved, too. And while I'm making out a wish list, I'd like the Create program to provide an estimate of how much time it will take to make a database and how much disk space it will need. Moreover, it would be nice to have some of the creation process automated.

Yet even with those shortcomings, I've found Folio Views very useful. It's made organizing large amounts of information practical for me. Because of the compression, I didn't have to buy another hard disk drive. Because of the speed, I don't have to take a coffee break when I initiate a search. The good far outweighs the bad.

I see Folio Views as a breakthrough product. Its indexing and compression techniques have pushed that technology to the point of being truly useful. If you've been looking for a way to manage large amounts of text, this is it. ■

Dennis Allen is a BYTE senior technical editor. He can be reached on BIX as "dallen."

THERE ARE FOUR WAYS TO MEASURE THE SPEED OF A LAN.



Ours only wins in three of them.

1. How fast does it install.

We have no competition in this category. LANLink 5X installs in about fifteen minutes, and it doesn't take a technician to do it. Since LANLink 5X uses standard parallel or RS-232 serial ports, installing a network means little more than connecting the cable and loading the software.

With hardware LANs, installation can easily take two days—one to set it up and one to tweak it. And it also takes someone who really knows what he's doing. That is, someone expensive.

2. How fast does it transmit.

Okay, this is the category we don't win: the hardware LANs are generally a little quicker. At least, they are under optimal conditions, which is how they rate themselves.

But LANLink 5X is pretty quick, too. At half a megabit per second, it's way out ahead of any other software LAN, and right at the heels of the hardware types. Which, of course, are far more expensive.

3. How fast does it maintain.

The real cost of a network is not so much the initial price as it is the continuing outlay for maintenance—adapting it to changing needs. That's something LANLink 5X does practically on its own.

Running under PC-MOS/386™ or PC-DOS, it turns your server PC into a multi-tasking controller, driving a truly expandable LAN that is easily and quickly upgradable.

A hardware LAN, on the other hand, becomes obsolete as new technology is introduced. And, to keep the network up and running as applications change, you need the attentions of a technician, on a continuing basis. A very well-paid technician.

4. How fast can you pay for it.

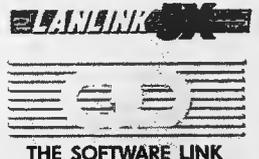
Now we've arrived at the bottom line, where LANLink 5X is toughest to beat. You can install a five-user LANLink network for about the same cost as the LAN board in a board-driven network. On top of that, factor in what you save on installation and maintenance time, and the difference is pretty dramatic.

LANLink 5X is available immediately, and it comes with a money-back guarantee. Its price of \$595 includes a server and a satellite module plus the network operating system. Additional satellites are available for \$125.

For complete details on the fastest software-driven network available, call 800-451-LINK.

LANLink 5X. Because three out of four ain't bad.

3577 Parkway Lane, Norcross, GA 30092 (404) 448-5465 FAX (404) 263-6474



NO ADDED CHARGE ON CREDIT CARDS

FOR COMPUTER & ACCESSORIES

CALL TOLL FREE: 1-800-882-2802

FOR FAX, TYPEWRITERS & DICTATION EQUIPT.

CALL TOLL FREE: 1-800-223-7323

IN N.Y. STATE CALL: 1-212-947-5290

HOURS: Mon. Tru. Thurs. 9AM Till 6PM, Fri. 9AM Till 1:30PM, Sun. 9:30AM Till 5PM, Closed On Sat.

EXECUTIVE PHOTO & SUPPLY CORP.

LAPTOPS

EPSON



Equity LT
10MHz, 640K, 2-3.5 720K Drives,
Supertwist Backlit Display
w/Free Laplink
1044.95

Equity LT w/20MB Hard Drive 1487.00*

DESKTOPS

COMPAQ



**DESKPRO 286, 12MHz, 1.2 Floppy Drive,
Seagate 40MB Hard Drive (40ms) 2085.00**
COMPAQ SLT7286 Portable w/40MB Hard
Drive..... CALL

PRINTERS

EPSON



LQ-510
24 Pin, Narrow Carriage, 180 CPS
Draft, 80 CPS NLQ, Advanced
Smartpark Paper Handling
CALL

HARDWARE

intel

INTEL 80287-8..... 205.00
NEW INTEL Above Board Plus..... 386.00
INTEL 386PC Piggback w/1MB..... 387.00
AST Rampage Plus..... 399.75
Laser Connection Jetscript..... 1635.75
NEW! Logitech Mouse..... 84.95
NEW! Logitech Scanman..... 189.00
DFI HS-3000 Scanner..... 187.75
HP Pro Collection..... 235.00
IQ Engineering Cartridge..... 375.00
MICROSOFT Mach 20..... 315.75
MICROSOFT Mouse..... 99.95
PLUS 20MB Card..... CALL
TOSHIBA 3 1/2" 720K Drive w/KIT..... 85.00

SOFTWARE

WORDPERFECT..... 224.95
APPLAUSE Perfect Addition..... 28.75
AVERY List & Mail..... 37.95
NEW! SAMNA AM..... CALL
NOTA BENE 3.0..... 235.00
NY Write w/4 A Cards..... 214.75
WORDSTAR Legal..... 249.95
WORDSTAR Pro 5.5..... 184.75
GRAMMATIK III..... 48.99
LASER GO..... 159.75
MATH CADD..... 197.00
ADOBE Fonts..... CALL
BITSERAM Fonts..... CALL
GENERIC Dot Plot..... 25.75
PER: FORM by Delrina..... 139.00
MICROGRAFX Designer..... 425.00
XEROX Prof. Extension..... 374.00
ALDUS PageMaker..... 445.00
HARVARD Graphics..... 266.75
LASER TORQ..... CALL
ZENOGRAPH Pixie..... 107.95
PFS First Publisher..... 69.00
PROCOM Plus..... 42.95
NEW! LUCID 3D..... 50.00
IMPRESS..... 79.95
LOTUS 1-2-3..... CALL
LOTUS Agenda..... 247.75
2-D GEM..... 33.00
ASK Star..... 165.00
D'Base IV..... CALL
GENIFER by Bytel..... 169.95
DATAEASE 4.0..... 479.00
FOXBASE Plus..... 187.75
PARADOX 3.0..... CALL
FRAMEWORK III..... 399.00
INTUIT Quickran..... 31.85
DAG Easy Accounting 3.0..... 57.00
BPI General Accounting..... CALL
GLOX Personal Ledger..... 125.00
NOLO Will Maker..... 36.95
BACK II..... 58.75
FASTBACK Plus..... 97.00
SPINRITE..... 48.99
385 MAX..... 54.75
TRAVELING Software Viewlink..... 85.75
NORTON Advanced Utilities..... 78.95
BORLAND Turbo Pascal..... 93.80
BORLAND Turbo C Pro..... 167.00
GLOX Personal Ledger..... 34.95
DESKVIEW..... 75.00
TOPS for DOS..... 103.95

SPARK by Datavue
Spark-EL, 640K, 2-3.5 Drives..... 997.00
Spark I-Floppy Drive, & 1-20MB H.D. 1789.95
1200 Modem I/Datavue..... 149.75

MITSUBISHI
286L w/20MB Hard Drive..... 2359.50
286L w/40MB Hard Drive..... 2888.75

TOSHIBA (sold in Store Only)
T-1000..... CALL T-1200/FFB..... CALL
T-1200HB..... CALL
NEW! T-1600..... CALL
NEW! T-5200..... CALL
T-3200/T-5100..... CALL

ZENITH
184-1..... 1499.00 184-2..... 2145.00
Supersport 286 Model 20 w/20MB Hard
Drive..... 2865.75
286 w/40MB Hard Drive..... 3367.75
386 w/40MB Hard Drive..... 4199.75

NEC
PROSPEER 386..... CALL
ULTRALIGHT 286..... CALL
Multispeed HD..... 1069.75

SHARP
PC-4502 w/640K, 2-Floppy Drives & Backlit
Monitor..... 819.75

*Price after mfr. rebate
Up To \$200

AST



AST PREMIUM 286
10 MHz, 512K, 1.2 Floppy Drive,
Seagate 40MB Hard Drive (40ms)
1597.75

**NEW! AST BRAVO 286 8 MHz, 1.2 Floppy,
40MB Hard Drive (40ms)..... 1229.75**

EPSON
EQUITY 1+, 1-380K Floppy Drive, 1-20MB
Hard Drive..... CALL

COMPATIBLES
IBM-XT Compatible, 1-380 Floppy Drive,
1-20MB Hard Drive..... 709.95
IBM-AT Compatible, 12MHz, 512K, 1.2
Floppy Drive, Seagate 40MB Hard Drive
(28ms)..... 1219.00
VENDEX Headstart II..... CALL

Laptop Accessories
WORLD PORT 2400 Modem/Fax..... CALL
New! DICONIX 150 Plus Printer..... CALL

PANASONIC
KX-P 1181.175.75 KX-P 1191.214.75
KX-P 1124..... CALL
PANASONIC Laser Printer..... 1277.00

TOSHIBA (sold in Store Only)
NEW! Expresswriter 301..... CALL

NEC
NEC 2200..... 339.00
NEC P3200..... 499.95
NEC P3300..... 649.95
NEC P9..... CALL
NEC LC-890 Postscript Laser..... 3099.00

OKIDATA
320..... 339.00 390..... 469.95
OKIDATA 393..... 1019.00

STAR
NX-1000..... 189.90 NX-1000C..... 189.00
NX-1000 Rainbow..... 229.00

PRINTER SALE!
DICONIX 300 Wide Printer..... 408.75
NEW! H.P. Deskjet Plus..... CALL
H.P. Laserjet II w/Toner..... CALL
APPLE Imagewriter II..... 439.00

Display Cards & Monitors
PARADISE VGA Plus..... 224.75
NEW! PARADISE VGA Plus 16..... 299.90
PARADISE VGA Professional..... CALL
NEW! HERCULES VGA Card..... 179.00
ATI VGA Wonder 256K..... 277.00
NEW! NEC Multitync IIA Monitor..... CALL
NEC Multitync 3D..... 899.78
SEIKO 1433 Monitor..... 855.75
SONY 1302 Monitor w/Stand..... 633.80
PRINCETON Ultrasync..... 493.00

Modems/Fax Cards
NEW! HAYES Personal Modem..... 135.00
EVEREX 1200B Modem..... CALL
US Robotics 9600..... 879.75
COMPLETE PC Fax 4000..... 235.00
QUADRAM Jt Fax Internal 4800 194.75

PRINTER RIBBONS
NEC P7/P3 Ribbon..... 4.99
OKIDATA 292 Ribbon..... 5.99
EPSON Original EX-300/1000 Color/1.59

DISKETTES



EXECUTIVE MD-2D..... 6.75
EXECUTIVE MD-2H..... 14.99
EXECUTIVE MF/DD..... 16.49

FAX MACHINES

PANAFAX



UF-140..... CALL UF-150 IN STOCK
UF-250 IN STOCK UF-280 IN STOCK

SHARP
FO-220..... CALL FO-300..... CALL
FO-330..... CALL FO-420..... CALL
FO-550..... CALL FO-700..... CALL

TYPEWRITERS

& Word Processors

SMITH CORONA



WORD PROCESSORS
PWP-2000..... CALL PWP-3000..... CALL
PWP-5000..... CALL PWP-100C..... CALL
PWP-7000LT Laptop..... CALL

TYPEWRITERS
XL-1500..... CALL XL-4900..... CALL
XD-8600..... CALL XD-7600..... CALL

WP & Typewriter Access.
PWP Start-Rite Kit..... 39.95
Printerless..... 10.95
Multi Strike Film..... Dz. 74.95
Correctable Film..... Dz. 34.95
Lift-Off Correcting Cassette..... Dz. 44.95
Cover-Up Correcting Cassette..... Dz. 46.95
Data-Disks..... Dz. 34.95
CoronaCalc..... 44.95
Sheet Feeder w/PWP-3000..... 139.90

Panasonic
KX-W1000 Word Processor..... CALL
KX-W1500 Word Processor..... IN STOCK
KX-W1510 WP w/Sheetfeeder..... CALL
KX-R430..... CALL KX-R440..... CALL
KX-R800 Word Processor Typewriter..... CALL

brother

WP-80 Word Processor..... CALL
WP-75 Word Processor..... CALL
WP-80 Word Processor..... CALL
AX-28..... CALL AX-28..... CALL
Accessories..... CALL

Dictation Equipment

OLYMPUS Pearlorder

L-200..... 129.90 S-907..... 35.90
S-911..... 59.90 S-930..... 99.90
T-1010 Transcriber..... 189.90
S-804..... 119.95 S-810..... 189.95
T-100..... 289.95 T-2020..... 229.90

PANASONIC
RN-15..... 129.90 RN-35..... 176.90
RN-99..... 79.90 RN-105..... 29.90
RN-115..... 39.90 RN-125..... 53.90
RR-900..... 176.90 RR-970..... 249.90
RR-980..... 279.90

SANYO
TRC-6100..... CALL TRC-5680..... 79.90
TRC-2550..... 149.90
TRC-5200..... 229.90 TRC-5020..... 179.90
TRC-4300..... 227.90 TRC-4030..... 179.90
TRC-6000A..... 227.90 TRC-6010A..... 185.90
TRC-6700..... 239.90 TRC-6070..... 185.90
TRC-9100..... 239.90 TRC-9010..... 199.90

SONY
M-100B..... 219.90 M-740..... 35.90
M-750V..... 49.90 TM-5000EV..... 369.90
BM-12..... CALL BM-17..... CALL
BM-560..... CALL BI-500..... CALL
BM-75..... CALL BM-90..... CALL
BM-815T..... CALL BM-820..... CALL

NORELCO
585..... 99.90 592..... 119.90
NT-1le..... 134.85 NT-V..... 199.95
NT-VI..... 219.90 NT-VII..... 247.90
MC-III..... 184.95 MC-IV..... 189.95
2595..... 119.90
205..... 287.90 505..... 319.90
510..... 399.90 805..... 629.90
MC-3000..... 299.90 MC-4000..... 379.90
2525..... 369.90 2510..... 334.95

COPIERS

Canon (PC))



PC-3 II..... 399.90 PC-5 II..... 499.90
PC-9 II Legal Size..... CALL
PC-9..... 799.90 PC-9RE..... 999.90
NEW! PC-7 Zoom Copier..... 639.90
Black Cartridges..... 79.95
8 1/2x11 Paper (5000 sheets)..... 49.50

CALCULATORS & DATABANKS

HEWLETT PACKARD

HP-10B Business..... 38.45
HP-12C Financial..... 69.90
HP-14B Business..... 90.90
HP-17B Business..... 79.90
HP-19B Business Consultant II..... 125.90
HP-20S Scientific..... 39.95
HP-22S Algebraic Scientific..... 43.90
HP-27S Scientific..... 74.95
HP-28S Advanced Scientific..... 162.90
HP-32S RPN Scientific..... 52.95
HP-41CV..... 119.90 HP-41CX..... 199.95
HP-42S RPN Scientific..... 69.90
HP Infrared Printer..... 99.90

PSION

ORGANISER II-XP..... 198.90

SHARP
OZ-7000 WIZARD..... IN STOCK
WIZARD Accessories..... CALL
EL-8230 Auto Dialer..... 39.90
EL-8250H Dial Master..... 89.90

CASIO
SF-4000 32K Digital Diary..... 89.90
SF-7000 I.O.S.S. 32K Digital Diary 169.90
SF-7500 I.O.S.S. 84K Digital Diary 199.90
SF-8000 I.O.S.S. 64K Digital Diary 209.90
FC-1000 Financial Consultant..... CALL

TELEPHONES

Panasonic

Feature Telephones
KX-T 2335..... 32.90 KX-T 2365..... 58.95

Multi-Line Phones
KX-T 3122..... 56.90 KX-T 3145..... 67.90
KX-T 3155..... 79.90 KX-T 3170..... 139.90

INTEGRATED PHONES
KX-T 2345..... 82.90 KX-T 2330..... 105.90
KX-T 2429..... 135.90 KX-T 2430..... 108.90
VA-9045..... 149.90

Answering Machines Specials
KX-T 1412..... 59.90 KX-T 1418..... 69.90
KX-T 1423..... 65.90 KX-T 1424..... 69.90
KX-T 1427 LCD w/Time Announce 109.90
KX-T 1600..... 69.90 KX-T 1720..... 109.90

CORDLESS PHONES
KX-T 3000..... 119.90 KX-T 3807..... 59.90
KX-T 3823..... 70.90 KX-T 3824..... 99.90
KX-T 3832..... 93.90 KX-T 3880..... 125.90
KX-T 3900 w/2-Keypads..... 123.90
KX-T 4200 w/Answering Machine..... 145.90

Freedom Phone
FF-1700 Cordless "Top Rated" 100.90

Business Key Systems
PANASONIC

2 Line Integrated Intercom System
VA-8200 System (1-8210, 2-8230) 899.90
VA-8210 Electronic Controller..... 124.90
VA-8230 2 Line Phone w/Speaker 124.90

VA-614 4-Line System
VA-61410 Key Service Unit..... CALL
VA-61421 Phone w/Speakerphone..... CALL
VA-61422 Speakerphone w/LCD..... CALL
VA-61423 Speakerphone w/BLF..... CALL

VA-208 2-Line System
VA-20810 Key System Unit..... CALL
VA-2082..... CALL

KX-T81610 Control w/Key System
KX-T81620 Phone w/Speaker..... CALL
KX-T81630 Speakerphone w/LCD..... CALL

FREEDOM PHONE
FS-246 6-Line Service Unit..... CALL
FS-900 Basic Station..... CALL
FS-900 Executive Station..... CALL

VISA, MASTERCARD, AMERICAN EXPRESS, OPTIMA & DISCOVER CARDS ACCEPTED

OUR GUARANTEE: Defective goods will be replaced or repaired if returned within 10 days in original packing, mint condition, blank warranty card, detailed letter of explanation & copy of invoice. No return privilege on software. If found defective, We will advise customer how to consult manufacturer for warranty service. For Customer Service: Please Call (212) 847-5295. Not Responsible for typographical errors. We reserve the right to limit quantities.

TO ORDER by MAIL: Please send money order or certified check for UPS shipment on most items. Personal check delays your order by 15 days.

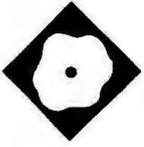
Shipping & Handling: Handling Charge; 2% plus 5.95. Shipping Charge; 0.65 per lb. Estimate minimum shipping 5.95. Items charge at time of order. Shipping & Handling charges are not refundable.

INQUIRE about NEXT DAY AIR or 2nd DAY AIR Shipment. N.Y. State Residents add TAX.

EXECUTIVE PHOTO & SUPPLY CORP.

MAIL ORDER: Dept BY, 120 West 31st Street, N.Y., N.Y. 10001 (Tel. 1-212-947-5290)
MANHATTAN STORE: 120 West 31st Street, N.Y., N.Y. 10001 (Tel. 1-212-964-3592)
SCARSDALE, NY STORE: 455 Central Ave. (Scarsdale Plaza) SCARSDALE, N.Y. 10586 (Tel. 1-914-723-1331)
N.Y.C. Consumer Affairs License Number: 800193

Circle 109 on Reader Service Card



The Flying Spreadsheet

Put WingZ on your numbers for presentation graphics, customization, and high speed

Don Crabb

Think of WingZ as a *presentation spreadsheet* for the Macintosh. Sure, it does what all the other spreadsheets do, but it also provides flexible, presentation-quality charts based on your worksheets.

WingZ is also fast. It can speed through recalculation so quickly that it's liable to give Microsoft's Excel and Ashton-Tate's Full Impact a serious run for the money.

WingZ runs on the Mac Plus, SE, or SE/30, or members of the Mac II family. The program comes with a getting-started video (VHS format) called "Learn to Fly." The package also includes two manuals: a user's manual, which includes a tutorial (tutorial files are also included on a separate disk), and a reference manual. If you've used a Macintosh spreadsheet program before, you won't have any problem learning to use WingZ.

But WingZ is different from the other major spreadsheet programs. It is really an integrated program that consists of a basic worksheet, a presentation worksheet, and a custom worksheet.

Three Faces of a Worksheet

The basic worksheet includes the kind of powerful number-crunching features that you find in other Macintosh spreadsheet programs, such as Excel, or in spreadsheets for the PC. To help you

build financial, budgetary, or analytical models, WingZ includes more than 140 arithmetic, logical, database, algebraic, financial, statistical, trigonometric, and other functions that you can incorporate into any cell formula.

The basic worksheet also includes the usual flat-file database commands that let you use the program as a rudimentary column (representing fields) and row (representing records) database. Besides numbers, WingZ commands can manipulate worksheet text, logical values, dates, and times. Like other spreadsheet programs, it includes automatic recalculation when formulas change, but you can also switch this feature off to make it easier to edit a large worksheet.

WingZ's basic worksheet includes multisheet capability. You can link as many sheets together as you want (within the limits of available memory) to help organize information better or to distribute your analysis into logically separate sheets. Updating one sheet automatically updates those sheets that are linked, so they always maintain their parallel structures.

The presentation worksheet includes a graphics layer that sits on top of the basic open worksheets. It includes two- and three-dimensional color charts, a drawing environment for customizing those charts and creating others from scratch, and presentation aids for creating on-line slide shows, reports, overhead foils, and 35mm slides. You can create an interactive worksheet with WingZ for building demos for novices.

The program includes five drawing tools for annotating existing charts and creating new ones: line, arc, rectangle, oval, and polygon. Besides these tools, it includes many fill patterns, 24-bit color support (for more than 16 million colors), multiple line widths, arrowheads, and borders.

Charts in the presentation layer are linked dynamically to a cell or a range of cells in a corresponding worksheet.

When you update the worksheet, you also update the charts. WingZ has 20 different built-in chart types, including bar, line, pie, combination three-dimensional, and scatterplots.

The custom worksheet gives you the ability to customize the program to suit your work. WingZ is built on a scripting language called HyperScript, and the basic scripts that define the preset user interface are included with the package. You can alter these scripts to work like any other spreadsheet on the market or to create a custom application. This customization capability sets WingZ apart from the likes of Excel, Full Impact, Trapeze, and MacCalc.

The program can also record scripts directly, akin to the way that Excel records macros. Once a script is recorded, you can edit it just like any programming language.

The worksheet screen looks a lot like most other Mac spreadsheets, dominated by the ever-present Macintosh menu bar. Below the menu bar, you'll find the title bar for the worksheet that's open, an entry bar that shows the contents of the current cell, a tool box on the left side that holds the drawing and graphics tools, some special quick-scroll navigation arrows, the worksheet grid, and the usual horizontal and vertical scroll bars. For the most part, it's pretty standard stuff.

The graphics layer (when invoked) sits on top of the worksheet grid, as does the editing window for HyperScript. You can also have on-line help windows open while the worksheet remains active.

Programming in HyperScript

HyperScript is a complete worksheet-based programming language. It includes complex data structures, such as matrices and records; functional abstraction, such as user-defined functions; HyperTalk-style ON-handlers, messages, and objects; loops (WHILE

continued

WingZ

Company

Informix Software, Inc.
16011 College Blvd.
Lenexa, KS 66219
(800) 331-1763

Format

Two 800K-byte 3½-inch floppy disks

Hardware Needed

Mac Plus, SE, or SE/30, or Mac II family

Documentation

User's manual, reference manual, quick reference card, and videotape tutorial

Price

\$399

Inquiry 882.

and FOR constructions); selection structures, such as IF...THEN and CASE; assignment statements; regular expressions; and local and global variables.

To support the HyperScript language, WingZ provides an editing window, the ability to record script commands by *watching* the actions that take place on the screen (like the macro recorder in Excel), and a script compiler that does extensive syntax and error checking.

HyperScript looks something like a cross between Pascal and HyperTalk, although it also has some extensions for handling WingZ objects. But HyperScript is not for the faint-hearted. Even with its handy recording function, building a WingZ application requires previous experience at program design, algorithm construction, and coding. Hy-

perScript's similarity to Pascal and HyperTalk will help experienced programmers get started, but the differences will have to be learned—something that's not easy if you're a regular Pascal and HyperTalk coder.

Nonetheless, HyperScript is powerful, and it provides more computing capability than the macro language of Excel or the Full Talk language of Full Impact. In many ways, HyperScript breaks new programming ground for the Mac by providing the tools to create a self-modifying application.

Snazzy Graphics

There's no doubt you can create snazzy graphics using WingZ. Even someone with zero artistic capability, like me, can pump out basic graphical information, even dazzling charts, of just about every variety. The three-dimensional graphics types will remind you of those available in Wolfram's Mathematica (see "Symbolic Math on the Mac" by Peter Wayner, January BYTE).

Creating charts and linking them to a worksheet is simple—much simpler, in fact, than doing so in Excel. WingZ charts are not separate documents like those in Excel, so the graphics environment is always available as a layer that can be placed on top of any worksheet.

The program is not as handy, however, for producing general-purpose presentations. It's not as powerful as More II, Cricket Presents, Persuasion, or PowerPoint when it comes to making presentations, since it lacks many of their organizational capabilities. For example, while More II is based on the proven More outliner, WingZ lacks such an outliner (although you could conceivably create one using HyperScript).

Given that WingZ's presentation capabilities are built into an already first-rate spreadsheet, the compromises made to keep the program small enough to be fast and reasonably priced are good ones. If your presentation needs are basic or primarily consist of charts, WingZ does the job nicely.

Top-Gun Performance

To give WingZ a fair shake, I used it as my everyday spreadsheet, converting my Excel worksheets for use in the program and creating new ones using the program. I kept careful track of the calculations WingZ made, to verify its accuracy. None of the checking I did (using a hand calculator) revealed any calculation errors.

Two things struck me while using WingZ: First, it's easy to use for basic worksheet calculations and for charting, but the HyperScript language is not as easy to master as I thought it would be. Second, the program's Go menu is too condensed—it contains too many sub-menus. A better strategy would have been to add one more menu-bar listing, perhaps splitting out the important Select command (with its list of 22 subcommands).

Besides general-usage tests, I ran a series of benchmark tests on WingZ to establish its basic performance level. I ran the same tests on a copy of Excel 1.5 for comparative purposes. I used a Mac SE with 1 megabyte of RAM and a 20-megabyte hard disk drive, and a Mac II with 8 megabytes of RAM and a 40-megabyte hard disk drive.

In addition to the standard BYTE spreadsheet benchmark tests, I also timed the recalculation of my departmental budget. That worksheet keeps track of my laboratory operating and capital costs, costs for graduate student stipends, and related instructional costs for my department. The model consists of a sheet that is 24 columns by 250 rows. The worksheet contains mixed calculations, with the bulk consisting of multiplication and addition.

Given all that WingZ can do, I expected sluggish performance, at least on the Mac SE. As the benchmark results indicate (see table 1), nothing could be further from the truth. These tests corroborate what my daily usage tests already told me—that WingZ is substantially faster at everything it does than Excel. Even on mundane tasks, such as horizontal and vertical scrolling, WingZ is much faster than Excel. In fact, WingZ is so much faster than Excel at the

continued

Table 1: Benchmark test results. WingZ performs notably faster than Microsoft's Excel.

	Mac SE ¹		Mac II ²	
	WingZ 1.0	Excel 1.5	WingZ 1.0	Excel 1.5
Savage	3.1	14.1	1.9	6.9
Recalc	3.5	7.1	1.4	3.2
Scroll right	30.5	63.8	15.3	39.2
Load file	3.3	14.8	1.6	6.8
Save file	2.0	18.3	0.9	9.9
Budget recalc	37.3	68.6	18.4	29.9

¹ Standard Mac SE with 1 megabyte of RAM, a 20-megabyte Apple internal hard disk drive, minimal System, Finder (no MultiFinder), minimal fonts, cdevs, and INITs; no RAM cache.

² Standard Mac II with 8 megabytes of RAM, a 40-megabyte Apple internal hard disk drive, minimal System, Finder (no MultiFinder), 8 fonts, 7 cdevs, and no INITs.

Note: Each test was repeated 10 times; the results reported are the means. Times are in seconds.

BIGGER.

BETTER.



Have you seen the latest versions of these PC databases yet?

Open them up and you may wonder if they weren't put together on the principle of "no pain, no gain."

Not to mention what it's going to cost in time and money for learning, conversion, training and support.

Open R:BASE® and you can start taking care of business immediately, without learning a single command.

You'll be using the business database management system that's so powerful that it topped all the major industry ratings in 1988 (even beating dBASE IV) and walked away with top honors from Datapro for four years running.

And you'll quickly find that managing your business data is easier than ever before. You can do it yourself with menus, or have R:BASE write complete programs for you. Then customize your applications with an English-based language made for managing data, not for twiddling bits. And use our true compiler to create even faster solutions.

NOTE TO SPEED DEMONS AND VARS: *The R:BASE Compiler™ is shipping now.*

You can share data with software like dBASE, Lotus and Excel. And just "plug-and-play" on any of the popular networks (3 users free, 6-Pack and Unlimited add-ons available).

R:BASE is providing over 600,000 end-users worldwide with the information they need in large businesses and small. On stand-alone PCs and in networks sharing data with minis and mainframes. In insurance and real estate companies, factories and universities, government offices and the storefront down the street.

It's better.

MICRORIM®

CALL 1-800-624-0810 TODAY. DEPT. BY0789

Please send me the fully-functional* R:BASE Trial Pack on 5 1/4" floppy disks for just \$19.95 plus \$3.50 shipping. Check payable to Microrim enclosed Visa Mastercard

Card Number _____ Expires _____

Name _____ Phone () _____

Company _____

Shipping Address _____

City/State/Zip _____

Mail to: Microrim, Inc., ATTN: NMC, P.O. Box 97022, Redmond, WA 98073-9722.

*Does everything R:BASE does with 50 or fewer records

8/0789

Microrim, R:BASE and R:BASE Compiler are trademarks of Microrim, Inc. Other products and services mentioned are not. ©Microrim, Inc. 1989

Circle 178 on Reader Service Card (DEALERS: 179)

JULY 1989 • BYTE 209

GURU THE ONLY COMPLETE UNIX™ DRIVER TUTORIAL

Whether you write UNIX Drivers
or just want a better understanding of them,
Driver Guru is for you!

De-mystifies UNIX Drivers forever!
Provides expert assistance in driver modification
Hypertext Environment

For the experienced UNIX
programmer:

- Detailed source code written in "C"
- Complete explanation of kernel interaction
- Hypertext access to specific information

For the programmer new
to UNIX:

- Years of experience at your fingertips
- Broad explanation of UNIX driver theory
- Segmented for quick and complete education

Driver Guru • \$ 149.95 U.S.

CALL TODAY

USA 1-800-433-9711 FAX 206-627-5934

UK 05436-71699 FAX 05436-75093

Empirical Research

P.O. Box 583 • Tacoma, WA 98401 • (206) 627-8511
A Public Corporation (OTC)

Requires Dos 2.0 or higher UNIX is a registered trademark of AT&T

basics—opening and closing files, saving files, copying and deleting blocks of cells, and scrolling—that it makes Excel seem downright pokey.

WingZ is also faster than Excel at the not-so-mundane stuff, such as sorting, file importing and exporting, updating linked charts, updating the worksheet display when recalculating, and the like. Although I had never thought of Excel as having performance handicaps, WingZ reminded me of just how irritating it is to wait for any software to finish a task. In fact, I found the speed improvement reason enough to convert all my personal Excel worksheets over to WingZ and keep them there.

Adding Up

Is WingZ the best Macintosh spreadsheet? That's hard to say. If all you need is a spreadsheet, without fancy presentation graphics or programming capabilities, then you are better off with a product like MacCalc, which costs under \$200. If you need to build complicated display models, you might want to consider Trapeze. But if you are a potential Excel or Full Impact user, then WingZ deserves to be on your short list.

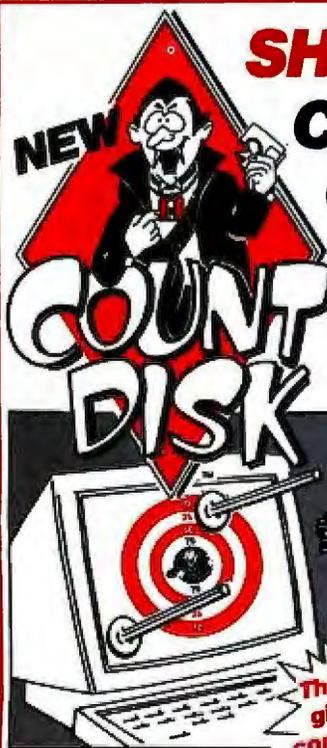
For my money, WingZ is superior to current versions of Full Impact and Excel. It's significantly faster than Excel, and it offers more features than either Excel or Full Impact. It also includes excellent presentation-graphics capabilities that neither of the other programs can touch. Indeed, to get the kind of presentation capabilities that WingZ has, you must export your Excel or Full Impact graphics into a desktop presentation program, which will cost you an additional \$200 to \$400. WingZ also breaks new ground with its HyperScript programming environment.

At \$399, WingZ is only \$4 more than the list prices (\$395) for Excel and Full Impact. And when you add up all the pluses—speed, lots of worksheet functions, great graphics, fancy programming capabilities, and competitive price—WingZ is a bargain. ■

Editor's note: At press time, Microsoft announced an upgrade to Excel that it says will have improved speed performance and "presentation-quality output."

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 consulting editor for BYTE. He can be reached on BIX as "decrabb."

SHOOT TO THRILL!



NEW

**Count Disk
Computer Dart
Gun Game**

**Count
Disk**

*The perfect
gift for any
computer user*

**Relieve stress and
have hours of fun
with your computer!**

\$19.95

INCLUDES:
 *45 Caliber Dart Gun
 *6 Soft Darts (Suction Type)
 *5.25" Game Disk With:
 Bullseye Darts
 Championship Darts
 Baseball Game
 Count Disk Target
 Executive Decision-maker
 Boss Panic Screen
 And FREE membership to
 the Count Disk Club

1-800-344-1996

Supports: IBM, & Compatibles, CGA, EGA, VGA and Hercules

*To order call our toll-free order line or send \$19.95 + \$3.00 (S & H) Check or Money Order to Count Disk, 2601-38 South Military Trail, Suite 164, West Palm Beach, FL 33415. Florida residents add 6% sales tax. Dealer inquiries welcome at (407) 241-6050.



SINCE 1979,
servicing our PC buyers
with low pricing,
technical experience—
and reliable service.

WAREHOUSE DATA

PRODUCTS

Order Status,
Technical & Other
Info: (602) 246-2222
Fax: (602) 246-7805
Call for programs
not listed.

1-800-421-3135 WITHIN THE USA AND CANADA TOLL-FREE

S O F T W A R E

SPREADSHEETS

Lotus 1-2-3	\$305
Lucid 3D	78
Microsoft Excel	224
Plan Perfect	189
Quattro	162
SuperCalc 5	305
Twin Advanced	69
VP Planner Plus	125

DATA BASE MANAGERS

Clarion Personal Developer	\$95
Clarion Pro Developer	379
Clipper	429
D Base IV	469
D Base IV Developers Ed	819
DB-XI Diamond 1.4	145
Data Perfect	283
Fox Base Plus 2.1	199
Genifer	189
Paradox 3.0	469
PFS: Professional File 2.0	165
Powerbase 2.3	169
Q&A 3.0	215
Revelation Advanced	469
R Base Compiler Ver. 1.0	580
R Base For DOS 2.1	463
Reflex	95
Relate & Report	99
VP Info	63

CAD & ENGINEERING

Autosketch Enhanced	\$61
DesignCad 2D 3.0	219
Easy Cad 2.05	119
Generic Cad Level 3	159
MathCad 2.0	245

COMMUNICATION PROGRAMS

Brooklyn Bridge Universal	\$75
Carbon Copy Plus	106
Crosstalk XVI	99
Desklink	99
Lap Link 3	79
PC Anywhere III	69
Pro Com. Plus	44
Relay Gold	149

GRAPHICS

PFS First Graphics	\$87
Grasp	82
Harvard Graphics 2.12	269
Mapmaster	219
Printmaster Plus	29
Printshop	36
Printshop Companion	29
Snow Partner Fx	199

INTEGRATED

Enable OA	\$389
PFS First Choice	89
Microsoft Works	95
Smart Software	469
Symphony 2.0	410

PROJECT MANAGER

Super Project Plus	\$255
Timeline Pro Ver. 3.0	364
Total Harvard Manager 3.01	369

WORD PROCESSING

Grammatik III	\$49
Microsoft Word 5.0	In Stock
Multimate Advantage II	285
PFS Professional Write 2.1	119
Right Writer	55
SPF/PC 2.0	165
Will Maker 3.0	37
Word Perfect 5.0	225
Word Perfect Library 2.0	65
Wordstar Pro 5.5	229
Wordstar 2000 Plus	273
Xywrite III Plus	216

LANGUAGES

Brainmaker	\$79
Microsoft C 5.1	299
Microsoft Fortran	295
Microsoft Macro Assembler	99
Microsoft Quick Basic 4.5	65
Microsoft Quick C 2.0	65
Borland	
Turbo C 2.0	95
Turbo C Professional	165
Turbo Pascal 5.0	99
Turbo Prolog 2.0	90
Turbo Prolog Toolbox	59

UTILITIES

Allways	\$85
Battery Watch	25
Copy II PC	23
Copywrite	55
Core Fast	65
Desqview 2.2	79
Direct Access	49
Disk Manager	59
Disk Technician Advanced	108
Fastback Plus 2.01	104
Fasttrax	25
Formtools	56
Formworx	85
Gopher	39
H-TEST	69
Mace Gold	81
Microsoft Windows 286	63
Microsoft Windows 386	129
Norton Advanced 4.5	83
Norton Commander 2.0	45
Norton Utilities 4.5	49
Org Plus Adv	79
PC Tools Deluxe 5.0	44
Q DOS II	49
QEMM 386	39
Sidekick Plus	125
Sideways	39
Software Carousel	43
Spirrite	49
XTree	35
XTree Pro	64

DESKTOP PUBLISHING

Adobe Illustrator Window	\$409
Bitstream Fonts	119
Pagemaker Ver. 3.0	459
PFS: First Publisher 2.0	73
Ventura Publisher 2.0	509
Ventura Pro EXT	377

EDUCATION/GAMES

688 Attack Sub	\$33
Chuck Yeager Flight Simulator	35
Gunship	35
Leisure Suit Larry II	28
Kings Quest IV	30
Formworx	85
Mavis Beacon Teaches Typing	30
Microsoft Flight Simulator 3.0	35
Typing Tutor IV	30
Where in the World	29
Many More Titles Available	Call

ACCOUNTING

Bedford Accounting	\$145
Check Write Plus	30
Dac Easy Acct, Ver 3.0	59
Dac Easy Light	42
Dollars & Sense	99
Managing Your Money 5.0	119
Peachtree Business Acct.	149
Peachtree W/PDQ	220
Quicken	30

DOS

MS-DOS 3.3	\$102
MS-DOS 4.01	115

H A R D W A R E

ACCESSORIES

Curtis Ruby Plus	69
Emerson Surge Protector	69
Keytronics KB101	99
Logical Connection 256K	479
Mach III Joystick	300
Masterpiece	85
NTC 101 Keyboard	89
Targus Laptop Bags	Call
150 Watt Power Supply	69

HARD DRIVES

Bernoulli B120X	\$1049
Bernoulli Carts	In Stock
Core Hard Drives	Call
MiniScribe	Special
Seagate 20 MB w/Cont	259
Seagate 30 MB w/Cont	279
Seagate 251-1 40MB 28 Mil.	409
Seagate PS/2/25.30 20MB	339
Seagate ST 125 w/Cont	319
Seagate ST 138 w/Cont	369
Seagate ST 251	369
Seagate ST 4096	585

CO-PROCESSOR

INTEL	
80287	\$161
80287-8	229
80287-10	259
80387-16	399
80387-20	439
8087-2	139
8087-3	95
EMERSON UPS	
UPS 200	\$289
UPS PC ET 700 WATT	499

VIDEO BOARDS

AST VGA Plus	\$349
ATI EGA Wonder 800	239
ATI VGA Wonder	285
Everex Viewpoint 256K	249
Orchid Designer 800	232
Orchid Pro Designer w/256K	299
Paradise Autoswitch EGA 480	159
Paradise VGA Plus	259
Paradise VGA Pro	449
Vega Fastwrite	349
Vega V-RAM	509

MICE/SCANNERS

Complete Hand Scanner 400	\$143
Data Copy 730 GS	930
DFI Scanner	189
Logitech Bus NEW	79
Logitech Scanman Hi-Res	189
Microsoft Bus w/Paintbrush	105
PC Mouse II w/Paint	79

COMPUTERS

AST	
Bravo 5	889
Model 140	2739
Model 140X	2409
ARC	
Pro Turbo 88	739
Pro Turbo 286 w/512	1209
Pro Turbo 286, 1 MB	1319
386 Skyscraper	2729

Hyundai (18 Month Warranty)	
Super 16TE w/Video Card	699
Super 16X 3.5 Floppy w/Microsoft Works and Video Card	669
Super-286C, 640K, 1 Floppy	859

BOARDS

AST Rampage 286 Plus, 512K	\$529
AST Sixpac Plus w/64K	129
ATI Wonder VGA	433
Copy II PC Deluxe Board	109
Everex RAM 3000	89
Everex 2MB Above Board	61
Everex I/O	65
Intel Inboard 386 PC	799
Intel Above 286, Plus w/512K	419
Intel Connection Co-Processor	739
Orchid Tiny Extra Turbo	Call

MONITORS

Monochrome	
Samsung White	95
Samtron Amber	89
CGA	
Samtron RGB SC 452	\$235
Magnavox 8762 RGB	255
EGA	
Samtron 14" EGA	369
Magnavox CM 9053	370
VGA	
NEC Multisync 2A	529
Seiko 1430	599
Zenith Flat ZCM 14	629
Multisync	
Mitsubishi Diamondscan	509
NEC Multisync 3D	679

LASER PRINTERS

NEC LC 890	\$3195
Panasonic 4450	1399
Personal Laser Printer	1549
Personal Laser Plus	1699

PRINTERS

Epson	
All Models	Call
NEC	
P5200	\$519
P5300	669
3550 Spinwriter	399

OKIDATA

OKI 182 Turbo	235
OKI 320	355
OKI 321	499
OKI 391	669
PANASONIC	
1124	339
1180-I	189
1191-I	254

STAR MICRONICS

NX1000	179
NX1000 Color	238

HARD CARDS

Plus Hardcard 20 MB	\$529
Plus Hardcard 40 MB	669

DIGITIZERS

Kurta Tablets IS/One 12 x 12	\$295
Summa Graphics 12 x 12	349

LAPTOP COMPUTERS

Toshiba T-1000	\$699
Toshiba T-1200FB	1579
Toshiba T-1600	3359
Toshiba T-3100E	2839
All Other Models	Call

MODEMS

Everex 300/1200	\$69
Everex 2400 INT	139
Everex 2400 MNP INT	159
Everex 2400 MNP EXT	189
Hayes 1200	289
Hayes 2400	435
U.S. Robotics	
1200 Internal w/Software	130
2400E	335
9600 HST	609
Sportster 1200 INT	79
Sportster 2400 INT	133

FLOPPY DRIVES

Teac 5 1/4" 360K	\$79
Toshiba 3 1/2" 1.44 MB	129
Toshiba 3 1/2" 720K	109

CALL FOR ITEMS NOT SHOWN

1-800-421-3135 • 1-602-246-2222
2727 W. Glendale Ave., Phx., AZ 85051

USER FRIENDLY TERMS & CONDITIONS:

- We welcome international accounts, please call for special pricing.
- Volume discounts for corporate and institutional orders.
- We do not charge your credit card until your order is shipped.
- Shipping minimum is \$5.00. Arizona orders + 6.7% sales tax.
- Personal/company checks allow fourteen (14) days to clear.

- All shipments insured at no extra cost.
- All prices are subject to change without notice.
- We do not guarantee compatibility.
- No charge for Visa or MasterCard

Technical Support: (602) 246-2222
FAX (602) 246-7805

Phone Hours: Monday thru Friday 5:30 a.m. - 6:00 p.m. MST
Saturday 9:00 a.m. - 5:00 p.m. MST

BY 07

Distributed Processing

- 215 Take Your Pick**
by Gilbert Wai
- 225 A Transparent Environment**
by Bruce J. Walker and Gerald J. Popek
- 235 Remote Control**
by Carl Manson and Ken Thurber
- 241 The Paperless Office**
by Dean Hough
- 248 Distributed Processing Roundup**

What is distributed processing? Surprisingly, there are many answers to this question. Everything from shared databases to process migration claims a foothold in this field. This popularity indicates that the advantages of the teamwork inherent in distributed processing are significant, but what are they?

Bear with me. Let's assume a friend of ours has a pizza party every Tuesday night. A group of varying size gets together to make and eat pizza and to talk. If four people show up, one person can probably make the pizza without much trouble, but if 10 people come, we'll need several pizzas. If one person makes them all, it takes a while. It works better if several people go to the kitchen and divide up the tasks: rolling the dough, cutting the toppings, grating the cheese. Sometimes the real fun is in the kitchen, so everyone's out there, cutting and chopping and talking.

Believe it or not, this is distributed processing. When there's only a little work to do, one person, or processor, can handle it fairly easily. But when the work multiplies, the more hands, or processors, the merrier. In fact, you may find that some people, and processors, are better at some tasks than others. The benefits add up quickly in terms of cost effectiveness, more efficient use of resources, and quicker response times.

The term "distributed processing" covers client/server systems with distributed transactions; systems that distribute various processes across a network for execution; parallel processing systems, which distribute various processes among their own processors; and distributed applications. Common usage dictates that all these definitions apply.

Our special In Depth coverage of distributed processing begins with "Take

Your Pick" by Gilbert Wai. In addition to providing a look at what is—and isn't—distributed processing, he looks in detail at the client/server architecture. In contrast to the loosely coupled LAN environment used for most distributed systems, the text box "The Opposite Tack" by Michael L. Smith and George White delves into a major concern of tightly coupled multiprocessor systems—cache coherency.

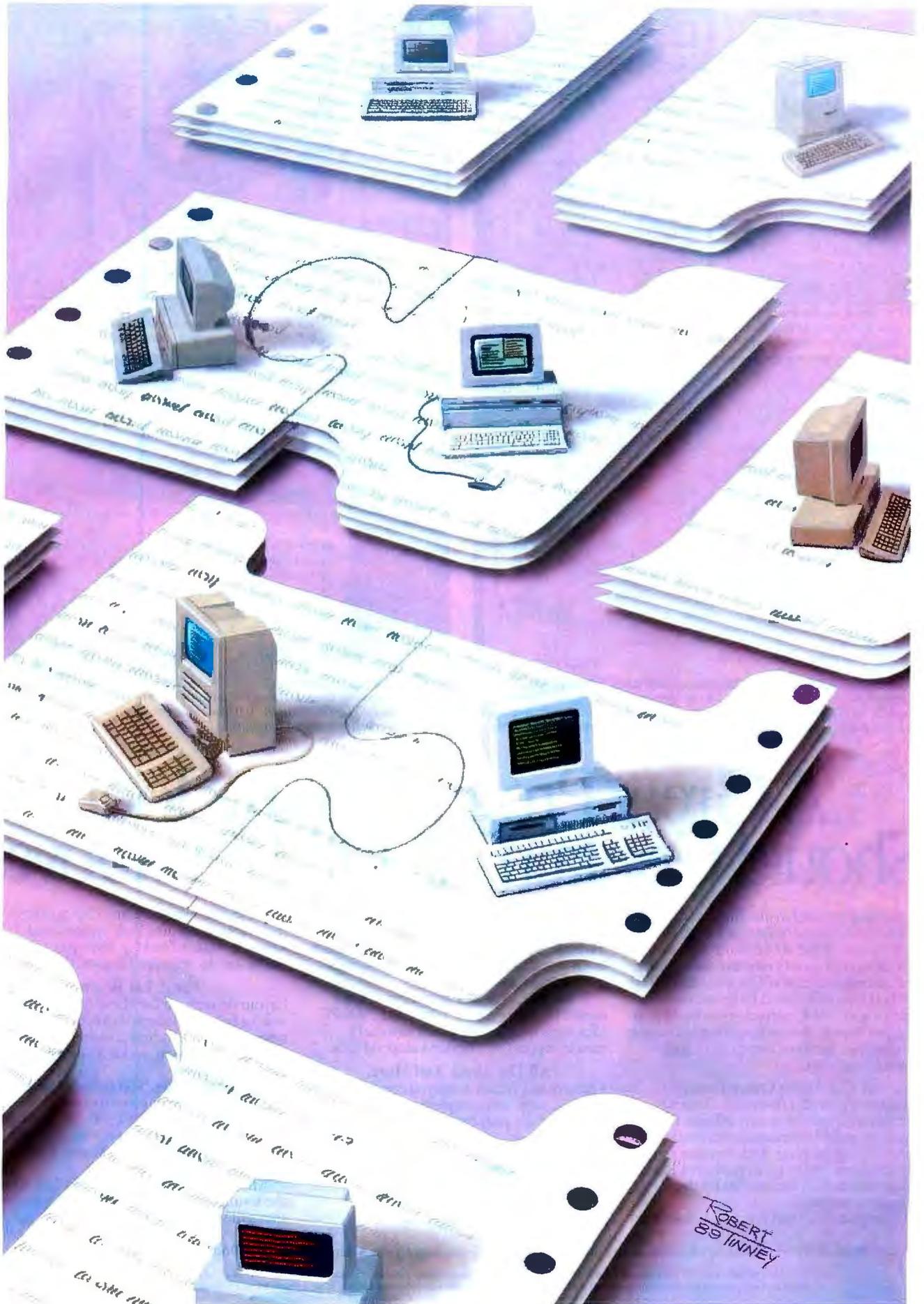
Then, in "A Transparent Environment," Bruce J. Walker and Gerald J. Popek detail the concept of transparency in a distributed system. This approach lets you use the resources of other machines on the network without concern for caring where they are. You don't even need to know that you're on a network. How is this done? It's a fascinating subject.

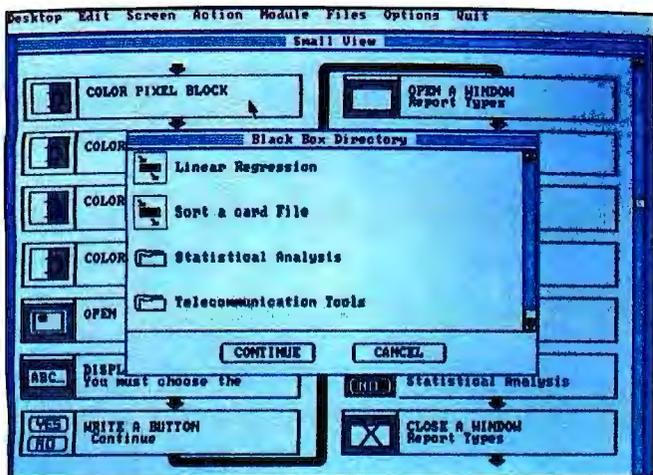
The remote procedure call provides another means of initiating distributed processes on remote machines. In "Remote Control," Carl Manson and Ken Thurber discuss how RPCs work in theory and in practice.

And in "The Paperless Office," Dean Hough looks at a new—to microcomputers—distributed application: document image processing. DIP itself is not new; it has been available on traditional workstations for some time. However, this capability on a PC-based LAN is indeed innovative and is likely to have a strong impact on office automation.

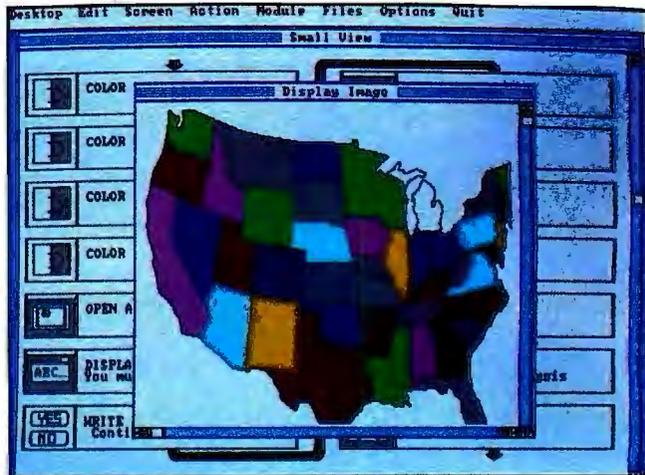
If it sounds like anything goes in distributed processing, I think it does. Any time you have simultaneous, coordinated work or resource sharing, you have distributed the processing you are trying to accomplish. In doing so, you have made your system more effective, more efficient, and probably quicker. Anything goes, indeed. Anchovies, anyone?

—Jane Morrill Tazelaar
Senior Technical Editor, In Depth

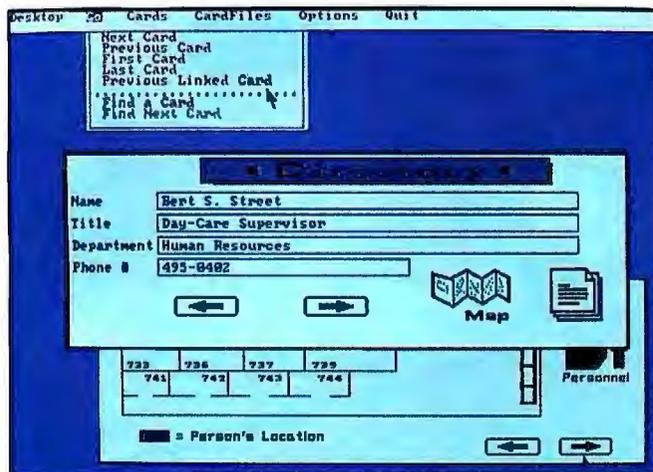




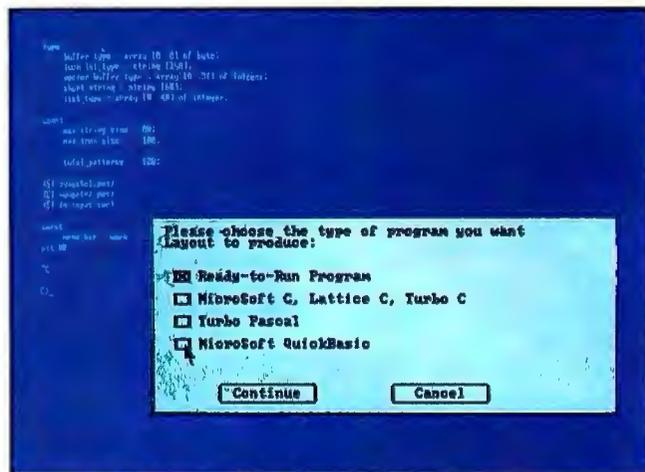
OOPS. Using sophisticated Object-Oriented Programming, Matrix Layout gives you the power to build complete applications faster than you thought possible. And that's just the beginning.



CASE. Layout's Computer Aided Software Engineering functions let you design programs using an intuitive flowchart model. Then, Layout can automatically turn your flowchart into source code or even an .EXE file.



Hypertext. Layout puts all the features of Hypercard® on your PC and in your programs. Use Layout's graphical user interface to create documents with action links to related documents in any file. Or to create hyperlink applications.



Plus, your favorite programming language(s). Using Layout's tools, you can cut your coding time up to 70 percent, and still produce ready-to-run programs in your choice of languages.

A Great Programming Tool Should Contain All Of The Above.

Presenting Matrix Layout, the first full software development system for the PC to promise you all the above. And deliver.

Sit down to Layout's intuitive user interface and in minutes you'll be using advanced OOPS (Object-Oriented Programming System) and CASE technology to build your program. Simply draw a flowchart indicating the windows, buttons, menus, text, and graphics you want.

A Cut Above Other Tools.

Layout also provides flowchart elements for Hypertext data base capabilities, math functions, variable management, conditional branching and looping. And, its open architecture allows you to build your own Black Box elements — to create exactly the program you want.

When your flowchart is ready, Layout uses

artificial intelligence technology to automatically turn it into code — Turbo Pascal, Turbo C, Microsoft C, QuickBasic or Lattice C. Or create a ready-to-run .EXE file right from within Layout.

It's so efficient, your programs will run incredibly fast, even on a standard 256K PC. Plus, they'll include Layout's automatic mouse support and device independence.

All The Above And More.

- *Matrix Helpmaker* helps you create context-sensitive help and complete on-line documentation for your programs.
- *Matrix Paint* offers a full set of graphics

tools, scanner support, and clip-art files to make your programs look professional. • Finally, *Matrix Desktop* gives you a simple, visual way to organize files and disks.

For A Lot Below.

Layout delivers all the above for just \$149.95 — a lot below what you'd expect. Especially when you throw in free customer support, no copy protection, and a 30-day, money-back guarantee.

Video Tape Offer. Still not convinced? Call for a copy of our Matrix Layout VHS demonstration video at 1-800-533-5644 (just \$9.95 for shipping and handling, credited against your purchase). In Massachusetts, call (617) 567-0037.

Any way you look at it, Matrix Layout is the ultimate PC programmer's tool. And that's the bottom line.

M A T R I X
L A Y O U T

Matrix Software Technology Corporation • One Massachusetts Technology Center • Harborside Drive • Boston, MA 02128 • (617) 567-0037

Matrix Software/UK • Plymouth, England • 0752-796-363 • Matrix Software/Belgium • Geldenaaksebaan 476 • 3030 Leuven • 016202064
The following are registered and unregistered trademarks of the companies listed: Matrix Layout, Matrix Paint, Matrix Helpmaker, Matrix Desktop,
Matrix Software Technology Corporation; Macintosh, Hypercard, Apple Computer, Inc.

Take Your Pick

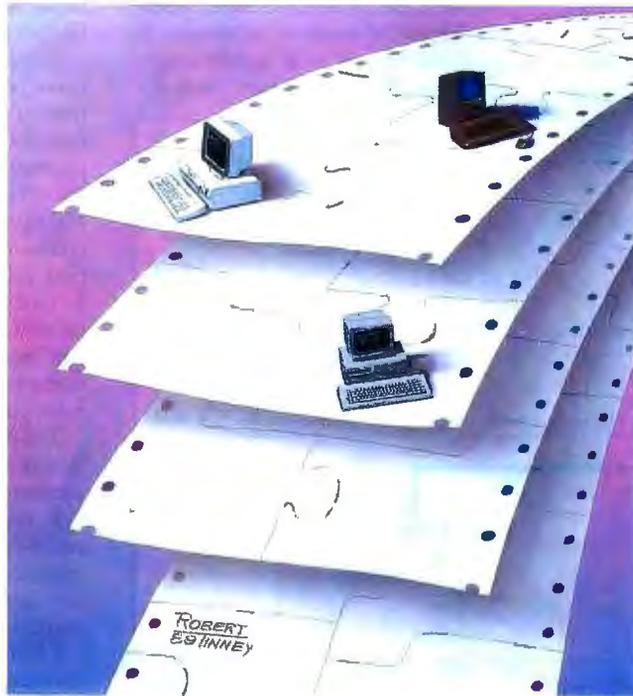
From client/servers to transparency to parallel processing, distributed processing uses a variety of methods to share resources

Gilbert Wai

Not long ago, the choices you had in configuring a computer system were limited. The speeds of the processors, the interconnections possible between different machines, and the capabilities of the software all contributed to a finite range of flexibility.

Now, with the 68030 and 80386 processors operating at 25 MHz and above, LANs available in many locations, and more open and accessible software, you can use almost any combination of software and hardware you want to create an optimum environment. Information that used to exist in one person's word processing, spreadsheet, and database applications can now be shared among an entire workgroup. The value of this information increases with its availability.

Once restricted to the realm of mainframes and minicomputers, distributed processing has now become available in the microcomputer world as well, with midrange systems linked to personal computers and LANs of personal computers. One major source of confusion, however, seems to be exactly what constitutes a distributed processing system.



What Is Distributed Processing?

One school of thought considers the client/server model (which uses Structured Query Language [SQL] and transactions from a variety of users) to be a form of distributed processing. Another insists that distributed processing applies only to those systems that attempt to distribute the various tasks or processes of a program across a network to the systems

best suited for them. Still another group considers a parallel-processing system to be distributed, because it distributes various parts of a program among its own different processors. And then there are the distributed applications and databases.

One approach that holds great promise for distributed processing is transparency, the ability to access the resources of other machines without knowing where they are (see "A Transparent Environment" by Bruce J. Walker and Gerald J. Popek on page 225). In a truly transparent environment, you don't even know you're on a network. You can run some parts of an application on one machine while other parts execute on other machines, which might be of different architectures.

Besides the user-interface advantages of this approach, it also lets you spread the workload among processors.

A similar approach is achieved with the remote procedure call (see "Remote Control" by Carl Manson and Ken Thuber on page 235). It is a self-defining term: An RPC calls a procedure that resides on a remote machine. It also lets you use a variety of processors that may

continued

The Opposite Tack

Michael L. Smith and George White

In LAN-based distributed processing, you tie processors together to share resources, not to increase speed. However, multiprocessing systems connect processors using a high-speed bus to enhance system performance. But, like LAN systems, multiprocessing systems must overcome obstacles to achieve transparent operation. Some of the obstacles are the same—process scheduling and load leveling, for example. Others are unique to processors that share a common bus and common memory.

For example, the Zenith Z-1000, which is based on an architecture designed by Corollary, connects up to six Intel 80386 processors with a 32-bit high-speed bus called the C-bus. In addition, the bus connects the processors to system memory. The Z-1000 also contains a standard IBM PC AT bus that lets you use standard AT cards for I/O.

Preventing Bus Overload

Each processor on the Z-1000 has a 64K-byte memory cache. With chips

rated between 15 and 25 nanoseconds, cache memory is significantly faster than system memory. Thus, each processor can quickly access its most frequently used data. Without the caches, the processors would saturate the bus with memory accesses.

The system's ability to keep the various cache memories in sync is critically important to data integrity. The Z-1000 depends on cache coherency to allow the various caches to work in tandem when collecting and dispensing frequently accessed data from the system memory. Cache coherency provides each processor with an identical view of memory. Since a data value can exist in more than one cache, the system must be able to tell when duplicate data in one cache is modified and to invalidate the stale data in all other caches.

The most common cache-coherency scheme is called *write-through*. Under this scheme, if a data value changes in one cache, the new value is immediately written to main memory (see figure A).

Thus, main memory always has the correct value. If the data also exists in another cache, that cache must access main memory to get the updated value. Write-through maintains coherency, but it requires a bus transfer every time a value changes. This can bog down the entire system.

To keep bus access to a minimum, the Z-1000 uses a different scheme, called *write-back*. With write-back, a processor reads or writes to its own cache as much as possible, accessing the system memory only when necessary. The different cache controllers monitor the system bus to ensure that duplicated data always has the correct value.

To implement the write-back scheme in the Z-1000, each line in a cache has a tag that contains the high-order address for the data location and a set of access bits. The access bits mark the data in the cache as either shared, exclusive, modified, or invalid.

When a processor requests data that is not present in its own cache, it puts a request onto the system bus. If no other processor has a copy of the data, the processor moves it from system memory into its cache and marks it as exclusive. If the processor later writes over the exclusive data, it marks the data as modified. Because the processor is accessing its own cache, it can write the data any number of times without using the system bus (see figure B). Thus, the bus doesn't become saturated as you add more processors.

The individual cache controllers constantly monitor the system bus. When another processor tries to access a data item marked as modified, the owning cache controller intercepts the memory request and places the valid data on the bus (see figure C). The data is then marked as shared.

Processors cannot write to data that is marked as shared. A processor can write only to data marked as exclusive. Consequently, when a processor needs to write to shared data, it first tells all

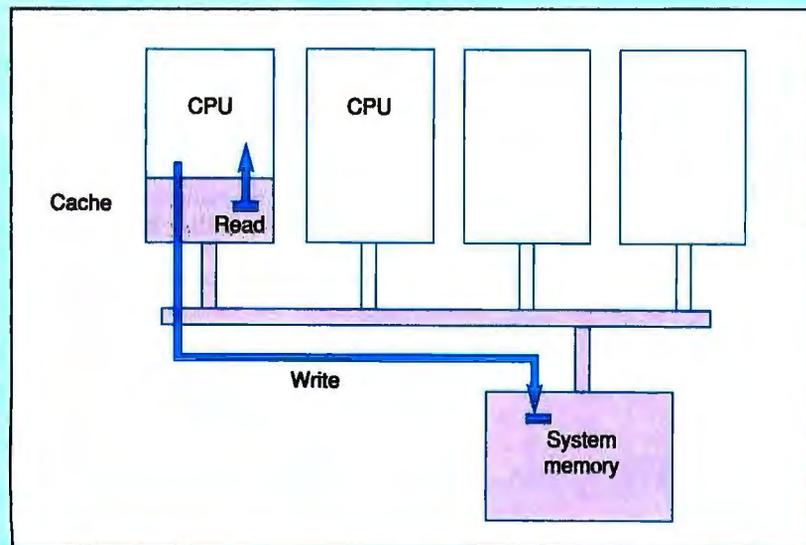


Figure A: With a typical write-through coherency scheme, data can be read many times from the processor cache, but data can only be written across the bus to the system memory.

be geographically separate to perform the various tasks of a single application, often concurrently.

Distributed applications are emerging as well. The higher speed and lower cost of today's microprocessors enable tradi-

tional workstation applications to become both PC-based and distributed. For example, document image processing (DIP) was traditionally available only on much larger machines, often dedicated to the application. It is now available in dis-

tributed form on PCs attached to a LAN (see "The Paperless Office" by Dean Hough on page 241).

Then there are some people who categorize parallel processing as a form of distributed processing. And who's to say

other caches to mark their copies of the data as invalid. After this operation, the data is marked as exclusive, allowing the write to proceed. After the write, the data is marked as modified.

In general, the use of status bits combined with the automatic monitoring of the bus for applicable addresses ensures that duplicated data items are kept in sync without using the system bus excessively.

Processor Scheduling

In addition to keeping data synchronized, a multiprocessing system must be able to divide the workload among the processors. To keep this function transparent to users and applications, it must be done by the operating system.

The Z-1000 uses The Santa Cruz Operations' (SCO) Xenix operating system, which is compatible with AT&T's Unix System V. Corollary modified the kernel to use multiple processors. On the Z-1000, any processor can run the Xenix kernel.

The individual processors schedule themselves from a common run list, which is a modified version of the usual Xenix run list. It contains an added field that indicates which processes must run on the base processor connected to the AT bus and which can run on the other processors.

Load balancing on the Z-1000 is essentially automatic. When a processor finishes a task, it searches the common run list and schedules itself to execute the process with the highest priority. Implementing this scheme involves locking the run list and other common data structures to serialize access to them, but these details are transparent to the processes.

Multiprocessing Transparency

The C-bus cache-coherency system and the modifications to the operating-system kernel that detect and utilize the multiple processors are transparent to both users and applications. The cache

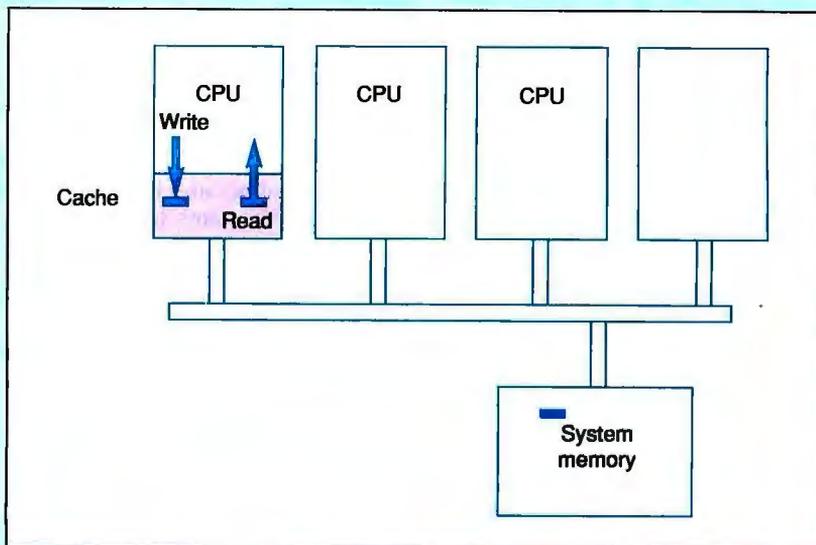


Figure B: Using a write-back cache, data can be written any number of times so long as no other cache contains a copy of the data. The system bus is never used in this situation.

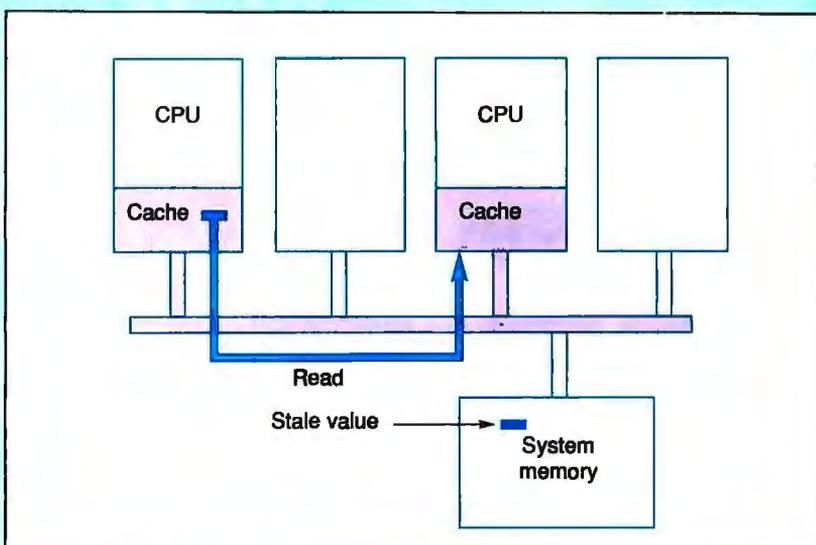


Figure C: If a processor requests data stored in another cache, the owning cache detects the request and satisfies it by placing the data on the bus.

system gets around the problem of having multiple processors use the same bus, while the kernel modifications handle scheduling and load balancing. Together, they create on the Z-1000 a transparent, tightly coupled distributed processing environment.

Michael L. Smith is director of advanced systems for Zenith Data Systems in Glenview, Illinois. George White is president of Corollary, Inc., in Irvine, California. You can reach them on BIX c/o "editors."

they're wrong? The two bear some marked similarities. Both must distribute tasks among various processors, coordinate any necessary interaction between them, handle errors that didn't occur with a single processor in control,

and level loads among the available processors. The difference, of course, is obvious: In a parallel-processing machine, all the processors are in close geographic proximity; over a distributed network, they are much more likely to be remote

from each other, physically as well as logically. In other respects, though, parallel processing does resemble distributed processing.

The client/server architecture also

continued

embodies a model for distributed processing, the one I will discuss. The client machines contain the user interface, while the server machine holds the database. Requests for data traverse the network from client to server, and only the appropriate data makes the return trip.

With all these new options, designing an architecture for distributed processing has become a complex and often confusing undertaking. In choosing a distributed processing configuration, you need to keep two major factors in mind: the cost-effectiveness and the responsiveness of the solution. Sharing computer resources can have a huge impact on the cost-effectiveness of a system. It's also important to take full advantage of new technology. For example, using sophisticated workstations simply as dumb terminals is a waste of their capabilities. But as a part of a distributed processing system, their processing power can be more fully utilized.

LANs

The basic element of all but one of these distributed processing designs (the ex-

ception being parallel processing) is the network, usually a LAN. LANs are considered loosely coupled systems, since the individual processors are located in separate machines and communicate at relatively low speeds. Parallel processing, on the other hand, is considered tightly coupled because it usually refers to multiple processors in a single machine, communicating over a bus at high speeds. Coordinating multiple processors in a single machine is a different challenge (see the text box "The Opposite Tack" by Michael L. Smith and George White on page 216).

The LAN is the means by which distribution takes place, regardless of what you're distributing. For example, the file-server option provides one LAN approach to distributed processing. PC LANs allow you to store data on a central PC server (see figure 1). You can control and manipulate data locally without the duplication of effort and resources found in replicated systems. You can put files on a disk to be shared, or you can share databases between workstations. And you can access files on remote file

servers as easily as you can access information on your own machine.

While the file-server option lets you share information without duplicating data or applications, it can create heavy network traffic. Furthermore, each access to a large file can potentially lock a block of the file, slowing the system down considerably under heavy use and making large amounts of information temporarily unavailable to other users.

Client/Server Model

One common way to employ distributed processing is with a client/server architecture, which splits the application processing into two components: client and server. The relational database, for example, takes advantage of this model. In this case, the user interface resides on the client machines, PCs or workstations, and includes screen display, reports, and data requests. The server machine stores and manipulates the actual data and provides security, locking functions, transaction logging, and recovery capabilities. Data requests in the form of SQL

continued

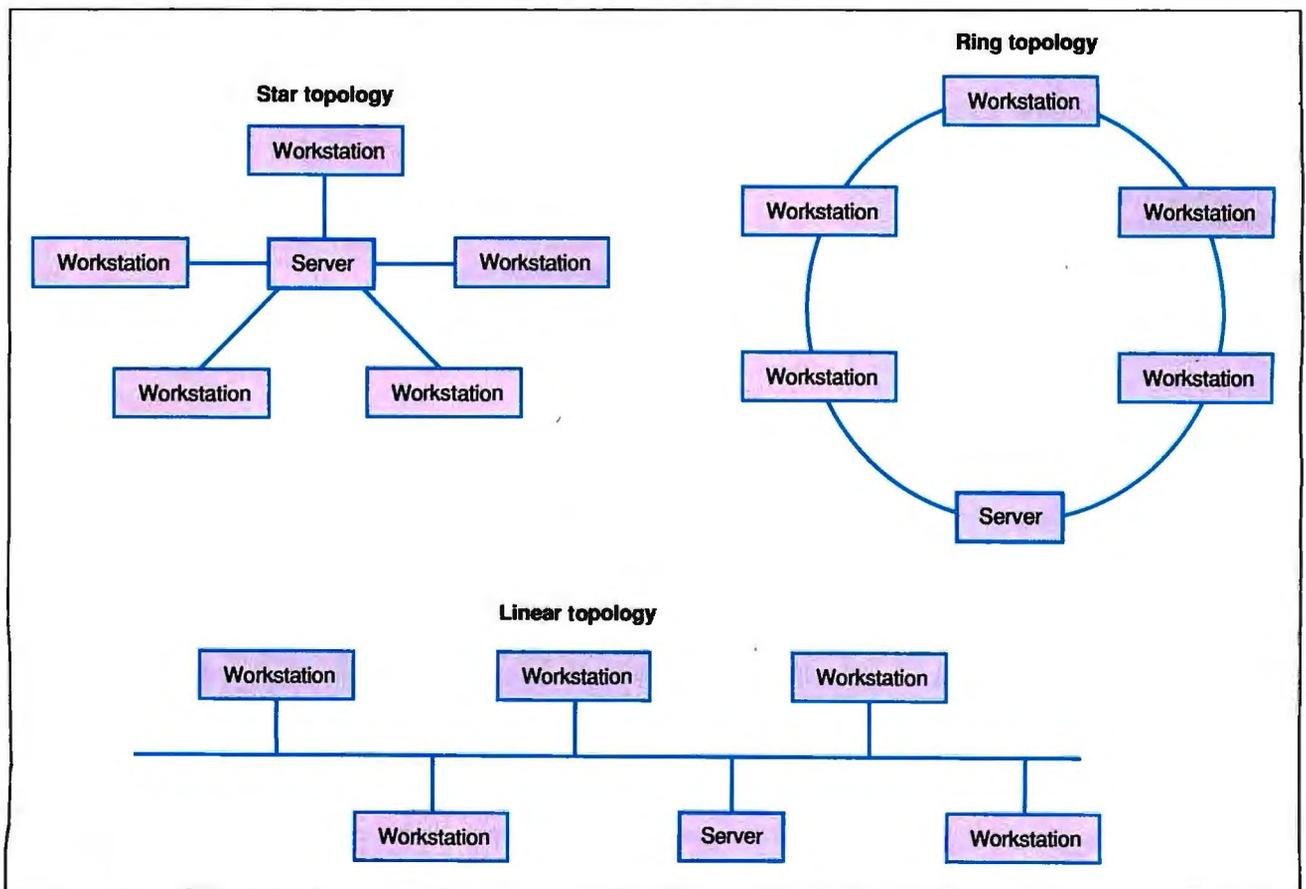
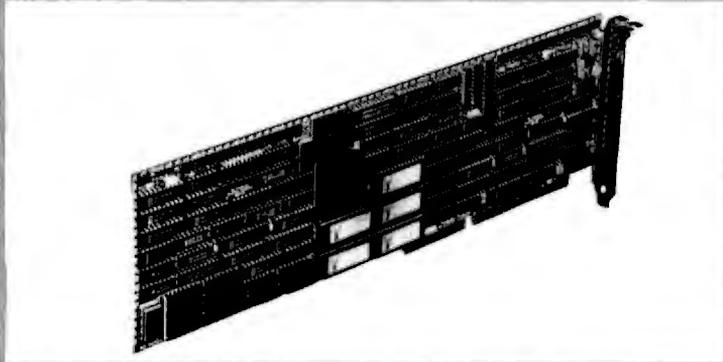


Figure 1: Three common LAN topologies. The file-server option lets you store data on a central PC server. You can share disk files or whole databases and access remote files as easily as local ones.

Rupp Corporation Presents

Power Products Showcase No. 19



PM3011 CACHING CONTROLLER

Up to 16MB of hardware implemented cache for ESDI, RLL of ST506 drives.

Product Profile: The PM3011 caching controller is the single most effective performance improvement tool available for disk-intensive applications. The PM3011 accesses data in as little as 0.5ms; that's 50 to 150 times faster than a random disk access.

Advanced Caching Algorithms: Such advanced caching features as disk read ahead and elevator sorting during cache write-back increase disk performance to levels unattainable by non-caching controllers. The controller's on-board 68000 microprocessor enables it to access the disk

drive at the same time as the computer reads or writes to the controller cache.

Compatibility: Since PM3011 caching controllers operate transparently to the operating system, special software drivers or ROM BIOS changes are not required.

Up to 16MB of Cache: The PM3011 Cache RAM is expandable from the on-board 512KB to 16MB with the optional Cache Expansion board. The cache is totally independent from system memory and does not require device drivers.

PM3011/70 Caching Controller With 512KB cache. **\$1150**

Circle 326 on Reader Service Card

DPT Introduces Hardware Disk Mirroring

Distributed Processing Technology, the leader in the field of Caching Disk Controllers, has announced a long-awaited addition to its product line—Hardware Disk Mirroring.

Hardware Disk Mirroring provides true fault tolerant disk storage for PC/AT systems regardless of the application and operating system environment. It is available for all DPT PM3011 Caching Disk Controllers supporting ST506, RLL, and ESDI drives.

Disk mirroring is important in environments where disk data integrity is vital, such as network file servers, multiuser systems, and CAD workstations. Since the DPT caching disk controllers operate without special software drivers, the mirroring feature is transparent.

The Hardware Disk Mirroring can be added to PM3011 controllers as a field upgrade by installing a DM3011 Key Card directly onto the controller.

DM3011 **\$795**

Circle 325 on Reader Service Card



XIRCOM

The Xircom Pocket Ethernet Adapter allows you to conveniently connect any IBM compatible personal computer to an Ethernet or IEEE 802.3 local area network. This adapter connects externally to any parallel printer port, eliminating the hassles of installing an internal Ethernet adapter.

It's the only adapter that can easily be used with laptop computers and is also an ideal choice for workstations where board slots or power are at a premium.

The Pocket Ethernet Adapter is also an economical choice for a group of in-

requent network users because it can be quickly and easily moved from computer to computer. It contains no configuration switches, completely avoiding the problems of address and interrupt conflicts common with other Ethernet adapters. Drivers for Novell Netware version 2.0 and 2.1 are included.

Features:
Uses LPT port.
For all IBM compatibles.
Netware 2.x compatible.
IEEE 802.3 standard.

PRICE

*Circle 327
on Reader
Service Card*

\$695

*For pricing on RLL, ST506 controllers and other options please call

Call 212-517-7775
Fax 212-249-8243

Dealer Inquiries Welcome

Charge Cards Accepted: Amex, Visa, MC
Hours (EST) 9:00 to 5:00



Exceptional Computer Products

Rupp Corporation
835 Madison Avenue
New York City, NY 10021

commands travel across the network from the client machine to the server, and only the records matching the request criteria are sent back.

Although the client/server model seems like an updated version of a PC LAN, its advantages are numerous. Each server can support more users with this model, since the client machines manage the user interface. Database information is locked for shorter periods of time. More users can obtain concurrent access to data. More sophisticated locking mechanisms are available. And a number of users can share the data without hampering system performance; this is a definite improvement over file sharing.

In addition, with the increasing connectivity available among so many machines and operating systems, you can choose as client systems the software and hardware environments you are most comfortable with—say an IBM PC. Then you connect these client machines to a more powerful server system, such as a

Unix system. No matter where the data is, you can access it without having to learn the server environment.

File Sharing vs. Client/Server

Both the file-sharing and client/server models provide distributed processing capabilities by allowing client machines to share information. In the file-sharing model, PCs can share application software and databases stored on a LAN file server (see figure 2). One DOS computer can handle both the application-tool process and the database-engine process on a LAN operating system. A client computer specifies a file system on the server and can then use its resources as if it were a local file system. Thus, you can access remote files as if they were local.

The client/server model splits the process between the front end, which handles the user interface and interaction, and the back end, which processes your requests. Only SQL queries and commands are sent across the network to the

server. The back end on the server processes the request, selects the data that matches the selection criteria, and sends only the appropriate data back over the network to the client machine (see figure 3). SQL lets you manipulate entire sets of data at once instead of one record at a time, speeding up the process.

To see how the client/server and file-sharing methods differ in practice, assume you are using file sharing and you want to find all employees with salaries over \$25,000. The employee-records database is stored on another computer on the network. The application process on the client machine requests the file server to send the appropriate database table across the network. The client machine receives the table, checks to see which records meet the selection criteria, and then keeps the appropriate records.

If you were using a client/server architecture, the database server would send across the network only the information that fulfills the request; it wouldn't send the entire file. This form of distributed processing minimizes network traffic and doesn't unnecessarily prevent other users from accessing data.

Distributed Database Technology

Distributed database technology takes you a step further. With distributed databases, you can access data that is located among a number of physically separate servers (see figure 4). The key advantage of this technology is that it provides you with a global view of the data.

For example, a regional office could view and update its own local records, while the corporate office could access data from all regions to monitor activities. You could make a request like "How many software packages were sold in March?" and the answer might correlate information from the western region, located on a remote machine, with data from the eastern region, located on another remote machine. All you see is the final result; you don't have to know where the information came from. Any updates you add are immediately available throughout the network, so you can't have out-of-date or duplicate data.

Problems with implementing distributed database technology do exist. The technology is still evolving, and all the components of a completely distributed database are not yet in place. A few proprietary systems offer distributed capabilities, but according to a definition put forth by Chris Date, executive vice president of the Codd & Date consulting group, no relational DBMS based on

continued

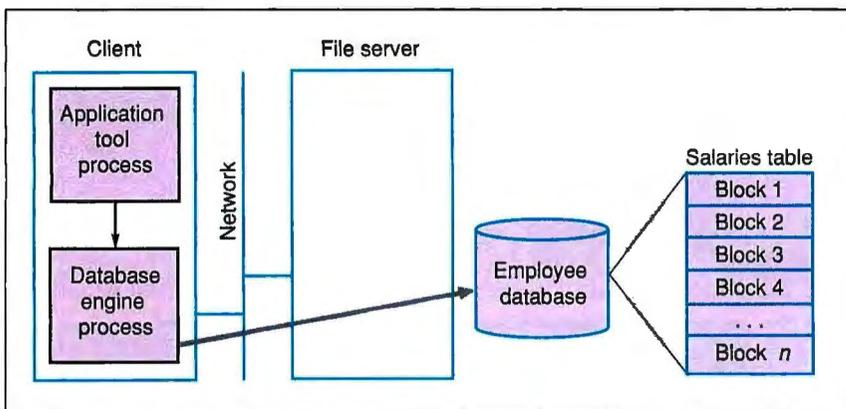


Figure 2: The file-sharing model. Client machines can share application software and databases stored on the LAN file server as if they were local. The server sends entire files back over the network to the client machine.

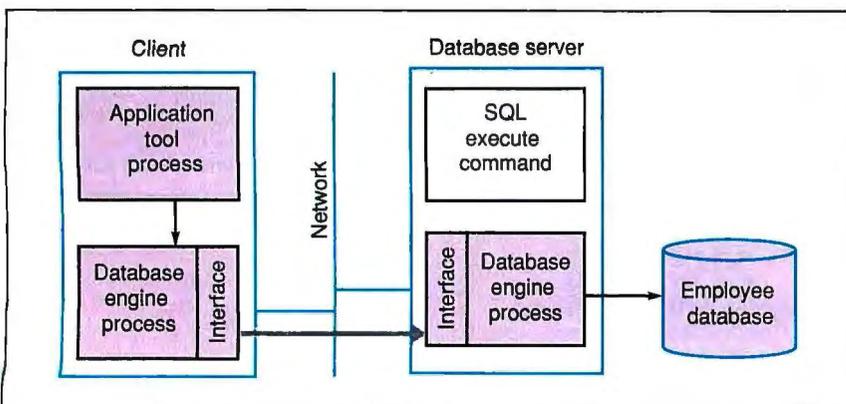


Figure 3: The client/server model. The front end handles the user interface and interaction, and the back end processes requests. The server sends only the appropriate data back over the network to the client machine.

Workstations no longer have to be stationary.



At Toshiba, we don't just concentrate on making computers, but on answering the specific needs of business.

Like how to get the power you expect from a workstation out of a portable computer.

That's what led us to design the new T5200.

We gave it a 386 processor, 2MB RAM internal (upgradable to 8MB) and a high resolution VGA display clear enough for the most sophisticated graphics.

We make it available with either a 40 or 100 megabyte internal hard disk and with two IBM-compatible expansion slots that you can fill with many different kinds of add-ins, such as mainframe communications boards and LAN cards.

And we got it all into a machine that weighs only 18.7 pounds.

Which means you can use it as a very powerful PC or as a very portable workstation.

After all, we believe portability is more than just an issue of where you do your work.

It's also what you can do there.



T5200: 20MHz 386 processor, 2 internal IBM compatible expansion slots, VGA display with external VGA monitor port, 40MB or 100MB hard disk, 2MB RAM standard expandable to 8MB, 1.44 MB 3 1/2" diskette drive.

Toshiba is the world leader in truly portable PCs and manufactures

a complete line of high quality dot-matrix and laser printers. For more information call 1-800-457-7777.

**Circle 281 on Reader Service Card
(DEALERS: 282)**

In Touch with Tomorrow
TOSHIBA

Toshiba America Information Systems, Inc., Computer Systems Division

Under Unix

Distributed transaction processing under Unix has generated a great deal of interest. Unix has wide appeal because of its ability to migrate applications across hardware environments and to utilize development skills across them. Since you can handle a large amount of the processing locally, response time is better, and the bandwidth for a higher-quality user interface is available.

Despite the interest, however, there are three major barriers to distributed transaction systems under Unix: its lack of applications development tools, the constraints of its file system, and current distributed database technology.

The constraints of the Unix file system that impact transaction processing are its limited ability to provide sustained performance with many concurrent users, its inability to guarantee data integrity (i.e., in the event of a system failure, you can lose data), and its limited database capacity (i.e., file sizes are limited by the capacity of individual disk drives).

One of the companies tackling these problems is Informix Software of Menlo Park, California. In the Informix architecture, two procedures handle the processing: A database tool provides the user interface, and a database en-

gine manages the data. They can exist on the same processor, on different processors in the same machine, or in different machines.

One problem to overcome is Unix's lack of applications development tools. Informix-4GL is a fourth-generation language that includes nonprocedural syntax to speed up development and maintenance, procedural syntax for flexibility and control, and a source-level debugger. Fourth-generation languages provide significant improvement in programmer productivity over conventional languages.

The constraints of the Unix file system are dealt with by an on-line transaction processing (OLTP) database engine, Informix-Turbo, which balances system resource allocation among multiple users. Through direct I/O, it provides virtually unlimited database capacity. You can add disk space, and tables can exceed the capacity of an individual disk drive. In the event of a system failure, the database is automatically restored to its last state.

In the near future, Informix plans to release the first phase of its distributed database, which will enable you to perform multisite reads and single-site updates, including remote queries and multitable joins across the network.

industry standards provides a complete distributed package.

Developing a distributed database application requires extensive planning to anticipate the many complex possibilities. The potential for a large number of transactions traveling over wide-area networks means that you must consider the capacity of the communications lines and the possible impact on system speed.

Distributed Transaction Systems

Transaction processing involves many on-line users who are simultaneously accessing and updating a common database. The database plays an essential role. Traditionally, transaction processing applications have been centralized using proprietary hardware solutions. The demanding requirements of transaction systems could be handled only by certain proprietary hardware environments. Now, however, such systems have migrated into the minicomputer and microcomputer worlds (see the text box "Under Unix" at left).

Several approaches or models for providing distributed transaction processing exist. The simplest model uses replicated applications. Although these are not truly distributed applications, they provide similar benefits: A single large transaction-processing application is broken down into smaller, independent applications. For example, the benefit of a point-of-sale system with a single computer in each store is that the systems are easily deployable and scaled to local pro-

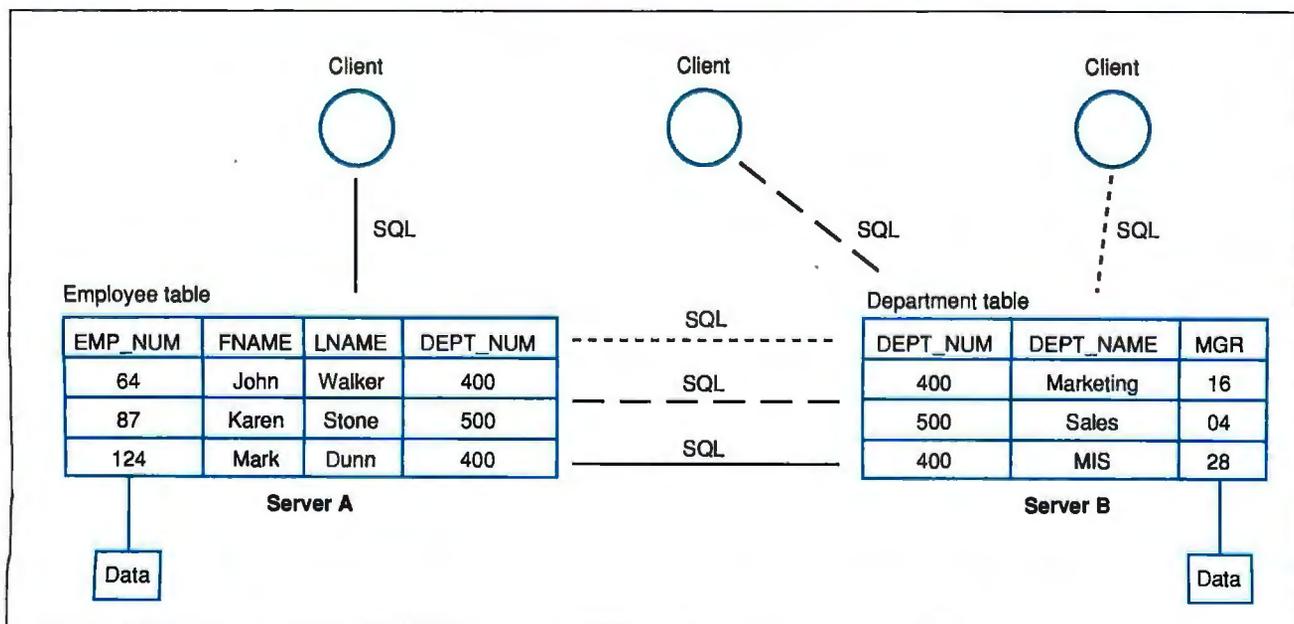


Figure 4: A distributed database. You can access data dispersed among several physically remote servers. This technology provides you with a global view of the data.

cessing requirements.

The next model uses a front-end processing system that handles a subset of the processing. Then the transaction is sent to the main system. For example, in a system responsible for credit-card authorization, the front-end system does a quick check for lost or stolen cards before routing the transaction to the main system. This approach is more flexible than a single central system and lets the main system handle more transactions.

The third model employs peer-to-peer applications. Again, it breaks a large problem into smaller tasks. The difference is that, here, the individual applications work together. An example would be an inventory-control system in which each warehouse has its own inventory levels but also has access to data at other warehouses. Inventory information can be shared. This model lets transactions process locally for speed while retaining access to remote information.

For distributed transaction systems to be possible, the distributed database must be able to run on all the machines you have in your environment. In addition, the distributed database is more complex to manage than the central database. However, the biggest barrier to deploying distributed technology is probably the perceived loss of control by the owners of the data. Once the data is no longer in a single room, people believe that they lose control of it. Distrust of the system, uneasiness about the lack of control over the data, and the possibility of data contamination may be the strongest deterrents to implementation. Recent computer virus scares have done nothing to assuage these fears.

Options Up, Limitations Down

Improved options for distributed processing continue to develop. The wide range of server machines and choices for data location have increased the flexibility of the client/server options available. The ability to offload processing to low-cost machines and the improved response time of various distributed processing models have made anticipated cost advantages a reality.

As distributed processing evolves, it will continue to take advantage of the technology available today while reducing the limitations with every advance. ■

Gilbert Wai is director of product marketing for Informix Software in Menlo Park, California. He has a B.S. in electrical engineering and computer science from the University of California at Berkeley. He can be reached on BIX c/o "editors."

MINIX®

Inspired by the UNIX®* Operating System
Including 60,000 lines of SOURCE CODE!

For only \$116!

MINIX® 1.3 system is a new operating system that is functionally comparable to Version 7 of the AT&T UNIX® operating system. It was written by world-famous author and computer scientist Andrew S. Tanenbaum. For the unbelievably low price of \$116 you get not only the executable (binary) programs, but also more than 60,000 lines of SOURCE CODE (in C) for the operating system and utilities.

MINIX 1.3 SYSTEM FEATURES (IBM® and ATARI® ST versions):

- System call compatible with V7 of the UNIX® operating system
- Full multiprogramming (many programs can run at once)
- Kernighan and Ritchie compatible C compiler
- Shell that is functionally identical to the Bourne shell
- Emacs-style, multi-window, full-screen editor
- Over 120 utilities (cat, cp, ed, grep, ls, make, roff, sort, etc.)
- Over 140 library procedures (atoi, fork, malloc, read, stdio, etc.)
- IBM and Atari ST hard disks supported (but not required)
- Contains programs to read and write DOS/TOS diskettes

ADDITIONAL MINIX 1.3 SYSTEM FEATURES (IBM® version only):

- Spelling checker with 40,000 word English dictionary
- Support for extended memory above 1M (AT only)
- Up to 3 simultaneous users on one machine
- RS-232 serial line support with terminal emulation
- Distributed computing on Ethernet® (remote login, etc.)

The documentation comes as a 500 page reference manual that also discusses the internal operation of the MINIX system in complete detail, procedure by procedure.

To order, send coupon to Prentice Hall, Book Distribution Center, Route 59 at Brook Hill Drive, West Nyack, NY 10995. For orders please call **(201) 767-5937**, or **FAX (201) 592-2785**.



PRENTICE HALL

Simon & Schuster
Higher Education Group
Englewood Cliffs, NJ 07632

*UNIX® is a registered trademark of AT&T. MINIX® is a trademark of Prentice Hall.

Rush me The MINIX® Operating System (PC requires 640K, AT and Atari ST require 512K min.).

(Check appropriate box)

IBM Software + Manual (\$116) IBM PC (58442-6), PC-AT (58441-8).

Atari ST Software Only, without Manual (\$79.95) _____ (58439-2).

MINIX® Operating System Reference Manual Only (\$28) _____ (58440-0).

Shipping and handling to be paid by publisher (please include your state's sales tax where applicable).

Name _____

Address _____

Payment: Check Enclosed MasterCard VISA

Card # _____ Exp. Date _____

Signature _____

D-MMUO-BR(O)

**By popular demand, we've extended
this program to June 30, 1989.**

FREE* SIVA 386 SYSTEM

*with the purchase of \$3295++
of software or \$4995++ of
hardware.*

Standard 386 Features:

- 32-bit Intel 80386-16 CPU,
- 1MB of 32-bit RAM on board. System expandable to 16MB.
- 8/16/20 MHz Keyboard selectable.
- ST-251-1 Seagate 40MB Formatted 28 ms high speed, with ultra high speed Controller 1:1 interleave.
- 1.2MB High Capacity Floppy Drive.
- Super deluxe heavy duty tower case with 6 half-height drive openings.
- High-resolution 12" Non-Glare Amber Display. Tilt and Swivel base, Hercules-compatible Adapter.
- 101 Key Enhanced Keyboard, Pleasant "Tactile/Click" Feel.
- 80287/387 Math-Coprocessors optional.
- Fully compatible with virtually all XT/AT and 386 software.

Upgrades for your FREE 386 System:

- VGA Color Upgrade — add only \$495.
- 20 MHz CPU Upgrade — add only \$195.
- Call for all other options and upgrades.

Choose Your Hardware

A hardware purchase of \$4995 or more is required to receive the SIVA 386 System FREE.

- | | |
|---|--------|
| • QMS PS 810 Postscript Laser Printer | \$5495 |
| • CDC WREN IV 300MB SCSI Hard drive with Controller | \$2595 |
| • CDC WREN III 155MB SCSI Hard drive with Controller | \$1795 |
| • CDC WREN II 86MB ST506 Hard drive with HD/FD Controller | \$ 895 |
| • Eight Port RS232 Intelligent Card with Xenix Driver | \$ 995 |
| • 32-Bit 8MB Memory Expansion Board | \$2997 |
| • Intel 80387 — 16 Coprocessor | \$ 495 |

Software

- | | |
|---|--------|
| • Complete SCO Xenix System (including Operating System, Developing System and Text Processing System for 80386-based System) | \$1595 |
| • SCO Lyrix System | \$ 595 |
| • SCO Professional | \$ 895 |
| • SCO Integra | \$1295 |
| • SCO Foxbase Plus | \$ 995 |
| • SCO VP/IX (integrated DOS environment — two users) | \$ 495 |
| • Language & Development Tools | CALL |
| • Networking & Communication Packages | CALL |

A software purchase of \$3295 or more is required to receive your FREE SIVA 386 System. Mix and match to meet your needs!



Ask about our Professional Services:

- Data Processing and Network Consulting
- Application Development and Training
- System Administration
- Hardware and Software Installation & Support

1-800-252-4212

VNS America Corp.

Suite 270, 910 Boston Post Road
Marlboro, Massachusetts 01752 U.S.A.
In Massachusetts 508-481-3726
FAX: 508-481-2218

All prices subject to change without notice.

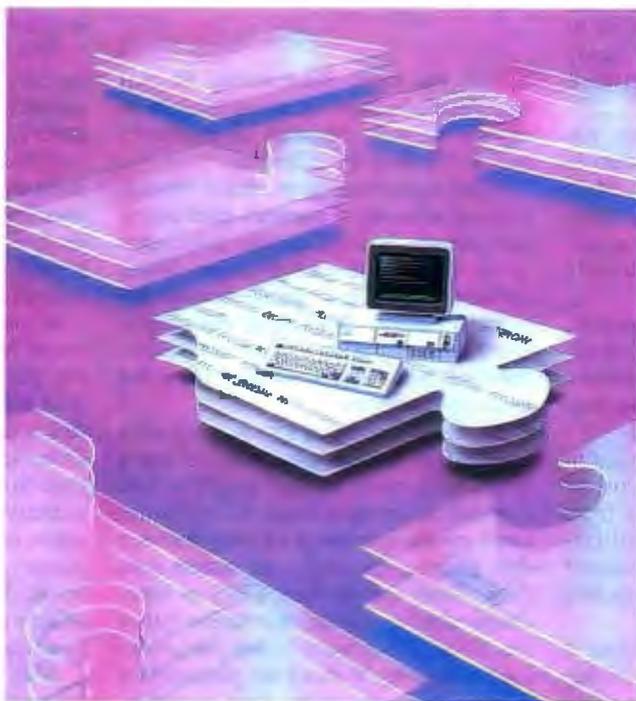
A Transparent Environment

You never need to know—or worry about—where your programs execute, where your data is, or even whether you're on a network

Bruce J. Walker and Gerald J. Popek

In today's mixed computing environment, transparent access to resources of other machines has become increasingly desirable. With a high degree of transparency, you can take advantage of a distributed and heterogeneous environment without making significant changes to your existing software. You can run some existing applications so that parts of them execute on one machine while other parts execute on other machines of possibly different architectures. For example, a display-oriented function could execute on the machine that has the display, while the data-acquisition portion of the same application executes near where the data is stored.

Transparency can allow inherently parallel tasks to take advantage of multiple CPUs without losing the autonomy of each. In an environment where you see the same view of system resources regardless of the machine you're working on, you can make processes execute on less-loaded CPUs and even relocate them during execution, without modifying the application. You can also grow or shrink the underlying computing environment without disrupt-



ing ongoing activity. You simply add or remove processors or storage. In addition, you can use specialized machines for particular tasks without building specialized communications software.

What Is Transparency?

Transparency is a widely used term with many facets. The first, *access transparency* (which applies to files, devices,

processes, and interprocess-communications entities), means you can use the same system calls regardless of the resource's location.

Device transparency is a subset of access transparency but is distinguished from it because some companies claim access transparency when only the data file access is transparent. *Process transparency* is also a subset of access transparency, but it takes the concept far beyond the remote-mount distributed file-system products available today.

The next two facets deal with naming your resources, particularly the files. *Location transparency* means that the name of the CPU where the resource resides is *not* embedded in the path name; this means that the resource can be moved without changing

its name. *Name transparency* means that the same name used on different CPUs will access the same resource. In other words, within a distributed environment, each resource must have a globally unique name that is accessible from all the CPUs.

Performance transparency means that the overhead referencing involved in

continued

remote resources is so small when compared to local access that you can ignore it. These six transparency components combine to make up *network transparency*, a concept embodied in the LOCUS Distributed System Architecture.

Network Transparency

What does a transparent environment look like, and how does transparency make that environment more productive? Here are the characteristics of transparency and the benefits that each of them provides.

Hidden underlying network. First, as much as possible, the existence of a network and the division of resources between processing nodes should be hidden from you. This operates in the same way that virtual memory relieves you from dealing with the boundary between primary and secondary storage.

LANs make this radical departure from traditional networking possible with their high capacity, low delay, low error rate, and low cost. Each of these attributes plays a role in facilitating transparency. High capacity helps avoid queuing delays and frees you from needing to know where data is stored. Low delay allows intimate interactions between nodes.

High bandwidth alone can allow the time required for large data transfers to approach local disk-access times. Most other types of interaction can't be pipelined, so you can consider them transparent only if the round-trip delay is suitably small.

A low error rate is always desirable, and it's important in hiding the network, reducing delay, and simplifying network interactions, thereby reducing transparency's CPU-cycle overhead.

The low cost of LANs is important in two ways. First, it reduces the cost of transparency. Second, it frees you from trying to maximize bandwidth utilization. As a result, you can achieve lower delays and provide more performance transparency.

Hiding the network and providing a seamless interface to a collection of distributed resources is the key to a more productive environment, just as data independence is the key in the database world. Hiding the way in which the data is organized allows a simpler interface and lets you rearrange the data as your needs change without disrupting existing programs. Regardless of initial performance considerations, data independence is now widely accepted.

Network transparency will follow a similar pattern. Where data is stored and

where programs are executed will be of little day-to-day concern. However, it will be useful to have tools that let you look "under the covers" to see and control the details of resource location and execution, especially if transparency is not complete.

The virtual memory analogy also applies. Few new systems are built without

As much
as possible, the location
of your data, the
allocation of resources,
and even the existence
of a network should be
hidden from you.

it, and you rarely have reason to deal with detailed control of the virtual memory mechanism. Network transparency may well end up the same way.

Single user name space. A key component to attaining a network-transparent environment is to present the same view of all resources to each machine. Thus, account names and numbers must be globally unique. Benefits include simplifying administration and access protection and providing a simpler view for users and programs.

Name transparency. A globally unique file-naming space ensures that a given path name on any machine will translate to the same data. This requirement means consistent naming for user data files, commands, and system data files. Thus, you can treat CPUs as interchangeable resources and attain better availability, more parallelism, and easier load balancing. Without the guarantee of a consistent view from each machine, you can only attain these objectives in limited circumstances or with case-specific specialized adaptations.

Location transparency. Resources don't have a site's location built into their names. Embedding the site defeats transparency in two ways. First, you can't transparently relocate the data. As with data independence in databases, you should not expose the underlying layout in a way that prevents changing it. Sec-

ond, encoding the name of the storage site makes it difficult to replicate the resource so that you can use the replicas to attain performance improvements or higher availability.

Consistent file-access semantics. Preserving file access, modification, and synchronization semantics in the face of processes executing on several different machines simultaneously is also important to a transparent environment. It is not often achieved today.

Sun's Network File System (NFS) doesn't meet this goal, partly because, when it was created, there was no remote-process capability. Thus, since processes on different machines couldn't cooperate, synchronizing their accesses to a file wasn't important. To provide synchronization, you must keep the state at the storage site, and NFS is specifically designed to be stateless.

IBM's Distributed Services (DS) and the Transparent Computing Facility (TCF) both retain the state at the storage site to provide file-access synchronization, mask machine boundaries, and provide an environment closer to that of the single machine.

Process transparency. Process transparency is key to overall network transparency. Each process should see all the other processes as if they were executing on the same CPU. This implies that there must be a cluster-wide unique process-naming space. It also implies that the underlying system can reliably send signals to and get process status from processes executing on any CPU.

A parent process shouldn't have to know where its descendants are executing and shouldn't need any extra code to deal with remote processes. This means that a process created on a remote machine must inherit all the same objects that those created on the local machine inherit—open files and offsets, open pipes and terminals, current working directory, process ID, process group, and so on. These objects must have the same effects when used remotely as they would have had locally.

With such an environment, you could take software written with only a single machine in mind and run part of it on one CPU and the rest on another, even if the architectures differ.

Device transparency. Device transparency implies several design constraints. First, devices should have globally unique names, like files. This would mean that a device could be accessed by the same name, no matter which machine it is actually attached to and no

continued

NOW YOU CAN DESIGN JUST ABOUT ANYTHING... INCLUDING YOUR OWN CADD SYSTEM!



Anyone can produce a computer-aided drafting and design package that sells for thousands of dollars. But creating one that's fast, powerful, and affordable takes real ingenuity.

That's exactly what we've done at Generic Software.™ We sell the most widely used CADD program in the world for under \$500.



PC Magazine ranked it "Editors Choice" in a face off with 17 low-cost CADD packages. "This product is an outstanding value from every point of view and is highly recommended." "A paperback version of AutoCAD", stated PC Week.

And our CADD programs are just part of what we offer.

You can start with Generic CADD Level 1,™ then advance to other levels as your needs—and skills—expand.

And you can use our CADD add-ons, Utilities, and symbols libraries to design the CADD system that fits your needs.

You only pay for the functionality you need, and the functionality you get has depth.

Critic tested, market approved. Generic Software offers price, quality, and support. Match our customer support against anyone!

- Unconditional 60-day guarantee on most products
- Unlimited free technical support
- Free monthly newspaper
- Regular updates at modest prices. All adding up to prove that the only thing generic about us is the price.

Call us for a free CADDalog™ or for the name of your local dealer: 1-800-228-3601.

© Generic Software Inc., Level 1 and Generic CADD are trademarks of Generic Software Inc., 11911 North Creek Parkway South, Bothell, WA 98011. Macintosh is a trademark of Apple Computer Inc.

Generic

S O F T W A R E

Transparency Today

The Transparent Computing Facility (TCF) clustering service for IBM's AIX operating system is an interesting example of network transparency today. It contains most of the important characteristics of transparency in a distributed system. TCF is primarily a set of enabling code that is included in the kernel of each computer in the cluster. As such, each machine is a full-function Unix system and yet can cooperate with other systems, even those with different architectures, to provide a multia-machine single-system image.

A Global Hierarchy

A cluster-wide file-system hierarchy is the key to allowing users and processes to execute on any CPU as if it were the local CPU. To achieve it, the kernels at each site keep the local tables of mounted file systems identical to one another. Anything mounted at any site becomes visible to all the other sites.

The global file-system hierarchy provides *name transparency*; each file has a globally unique name, so no matter which site calls that name, it leads to the same data.

To achieve *location transparency* in TCF, only the global mount table (a kernel data structure) records the location of files. Because the kernels all agree where file systems are mounted, TCF can expand path names efficiently without needing explicit location information.

The global hierarchy also extends to the root-file system. An independent root-file system for each machine would violate name transparency since you couldn't guarantee that the same name would access the same data on different machines. A single root stored at one site would work, but performance transparency and availability would be likely to suffer.

File replication lets you have one *logical* root, while a copy of the root exists at each cluster site. Then, TCF must ensure that all the copies are kept up-to-date. It should also guarantee that any open request receives the latest version of the file, whether or not it has been propagated to all sites yet. In addition, TCF must synchronize file access: After a process writes a byte to a given file on one machine, any subsequent read from other machines should see the new byte.

File Replication

The TCF replication scheme differs for system and user files. For example, the root-file system must contain, for each command, binaries for each machine type. Replicating 370 binaries on an IBM PS/2 disk seems unnecessary, so, for each file in a system-replicated file system, you can mark what machine type, subtype, or set of machine types should store the file. For user-replicated file systems, you typically specify precisely which machine or machines will store the file.

TCF replication differs substantially from shadow disks (where you simultaneously write the same data to two disks on one machine), primarily in that replication can be controlled on a file basis. Also, different copies exist on different CPUs and may be physically quite far apart. Each machine that agrees to store a file in a given file system has a disk structure for it. The various file-system structures need not all be the same size; not all files will be stored at each eligible site.

To avoid the possibility of conflicting updates during network partitioning or a sequence of failures, TCF designates one storage site as primary for a file system, and all updating occurs on that copy. The system then propagates the changes to the other copies.

You can use these copies for read access as long as they are current and no one is modifying the file. The operating system is responsible for maintaining copies and ensuring that an open request always receives the current copy; it substitutes another copy if the storage site crashes or for any reason leaves the cluster.

Hidden Directories

The root-file system must store a binary for each command and each machine type. However, if only one machine type has a binary, the system will run the command transparently on that type, regardless of which machine invoked the command.

When there is more than one binary type for a given command, how do you store the various representations? Users and programs expect to reference commands by specific names. Thus, the TCF implementation stores a slightly modified directory in the name hierarchy where you would expect to find a

binary load module. Inside these "hidden" directories are the binaries, with names like "i370" and "i386."

If you attempt to execute or open a hidden directory, the kernel will "slide through" to the appropriate component. You can treat the hidden directory like a regular directory through an escape mechanism, so you can replace load modules in it or look at its complete contents.

Tokens for Synchronization

To synchronize file access in a single-system-image manner, TCF uses two *token* schemes. The first uses file or data tokens. Multiple reading sites or a single writing site can hold a token at any time, and you can keep caches of remote data at sites holding a token. Fairness strategies exist to ensure that sites receive a given token in the requesting order.

File-offset tokens support the remote execs and forks. In Unix, a child process shares file offsets with its parent; thus, if the parent reads a byte and then the child issues a read, the child sees the bytes following those that the parent has read. With parents and children on different CPUs, you still need to maintain these semantics; the offset token accomplishes this.

The token mechanisms also synchronize cluster-wide named and unnamed pipes. In some Unix implementations, pipes are a special form of file, using file information structures (*i-nodes*) and disk data blocks. Providing simultaneous and synchronized read/write access around the cluster is natural.

Pipe semantics dictate that readers read in the order that writers write, and writers can't get too far ahead of readers. Also, readers naturally wait in the kernel read call for writers to write. Dealing with remote waiting and remote wake-ups requires an extra mechanism. Remote waiting also occurs when you use remote devices; it is supported similarly.

Remote Process Support

The kernel provides remote-tasking support, which is transparent to processes and users. You don't need to change application code to take advantage of it. The exec system call can execute the requested code on a CPU other than the one that made the call.

The remote process inherits the entire state that a local `exec` inherits. That state includes process identification (ID); process group; parent process group; user ID; current working directory; signal and environment information; and open files, devices, and pipes, and the current offsets into each. A kernel-to-kernel protocol transfers the required information, so neither process is aware of the network.

Keeping the process and process-group IDs the same is essential for transparency. Without it, signaling and general control would be either cumbersome or impossible. TCF supports globally unique process IDs, and it doesn't change them when migration occurs but still permits each site to allocate them rapidly without a global agreement protocol.

To do this, TCF uses some of the high-order bits in the process ID for the ID of the site that created the process. That ID then stays with the process even after a remote `exec`. Examining an ID tells you only where a process originated, not where it is currently executing. Knowing the current execution site is important in guaranteeing signal delivery, so part of the remote-process creation protocol maintains process and process-group tracking information.

Process Migration

If you try to invoke a load module that will run only on a hardware architecture different from the one you have, the kernel will choose the right type of CPU as the execution site and migrate the task. You can set up a profile to help the system choose an appropriate machine if you wish, or you can just leave it up to the system. For explicit control, TCF provides a new remote `exec` call with all the functions of `exec` plus an extra site argument.

TCF also includes a remote system call (`rfork`) that is the same as `fork` except for an additional site parameter. Remote `fork` shares much of the code of remote `exec`. However, `rfork` must also provide a copy of the process data space. You don't need a copy of the text, since the child process will just "page-fault" the image as needed, either from a local copy or across the network. The `rfork` capability lets you take a parallel task and spread it across several CPUs.

You can also move a process in the

middle of execution and continue to run it on another CPU. Migration uses much of the same code that `rfork` does; the difference is that the new process keeps the ID of the old process, and the old process image is destroyed. When TCF transfers control, it takes special care to ensure that signals are seen only once—not lost and not duplicated.

Migration can be initiated in one of two ways. A process can issue the `migrate` system call or the new `SIGMIGRATE` signal. `SIGMIGRATE` takes a site number as an added argument (via a `kill3` system call, which has all the protection rules of `kill`). The operating system services the signal, so the migration can proceed without the process's knowledge.

The standard command shells have been enhanced to include a built-in `migrate` command so you can use this tool for dynamic load balancing. Migration can be useful if you have to take a given CPU down for service.

Graceful Addition of CPUs

To make adding or deleting CPUs as transparent as possible, the kernels in the cluster run a distributed protocol when any of them notices a change in the topology. This protocol determines which machines exist in the cluster and the locations of available file systems. During most of the reconfiguration protocol, normal activity can proceed.

Executing the algorithm or protocol cleans up after resources that are no longer available, handles resource substitution, and cleans up after processes that have left the cluster. That dynamic reconfiguration doesn't require any user or operator intervention. The act of taking a CPU to multiuser mode causes it to join the cluster. The new CPU, its devices, and its mounted file systems become available to the rest of the cluster, and their CPUs, devices, and mounted file systems become available to the local machine.

Exceptions to Transparency

TCF includes some exceptions to transparency, however. While the environment provides a high level of transparency, it doesn't completely meet a few of the ideal characteristics.

The first exception concerns error transparency. While TCF will substitute a replicated copy of an open file in

the event of a failure, it keeps no *hot shadows* (where you simultaneously update the same data on two disks on two different machines) of files that would permit updating to continue if the storage site were to fail. It also includes no process checkpointing to restart a process that didn't complete due to processor failure. Adding support for hot shadows will be easier due to the already existing file replication. Adding process checkpointing is an extension of the process-migration facility.

The second exception involves CPU-specific accounting files. These files, stored outside the kernel, help to maintain system operability even when the CPU is unable to join the cluster. While a special form of symbolic link is used to minimize the effect of this change, it's visibly different from normal operations.

Another problem lies with the `/tmp` directory, typically used in Unix for transient temporary storage and occasionally for exchanging user information. A copy of `/tmp` should reside on each site for performance and availability. In TCF, `/tmp` is a local file system, although each `/tmp` does have another globally unique name. You can become confused if you use the local name.

Device names are handled the same way. Each device has a globally unique name. In addition, you can use the local name `/dev/tty00`, for example, to refer to a local terminal.

Another general class of exceptions involves some interprocess-communications mechanisms. The semaphore, message queues, and shared-memory mechanism of Unix System V are not supported cluster-wide, so processes on different CPUs cannot communicate via these mechanisms. This is an example of incomplete implementation of transparency, and it can be addressed within the framework of the overall architecture.

Most Objectives Provided

TCF, which will be available soon from IBM for 370-class machines and PS/2-386 machines, provides most of transparency's objectives: the global file-system hierarchy, transparent file access, file replication, remote pipes and signals, and transparent heterogeneous process execution. The exceptions are few and largely unnoticed.

matter which machine you access it from. While necessary for complete transparency, this is not always as important as the globally unique names for data files and directories; access to devices is more stylized and accomplished with fewer commands.

Second, the functions you can apply to devices should be uniformly available from all machines. Uniform access includes not only open, read, and write, but also the catch-all Unix system call for manipulating devices, `ioctl`.

There are several different classes of devices in Unix, and uniform access is more practical for some of them than for others. For terminal devices that are buffered through kernel data structures, it is critical and feasible. For memory-mapped screen manipulation, however, it is considerably harder to get good performance. For block-mode devices, which are implemented by way of the kernel file I/O buffer cache, providing device transparency is reasonably straightforward.

You can provide device transparency for so-called *raw mode* devices like magnetic tape, but the performance degrada-

tion can be significant. It may prompt you to use process transparency and run the process on the machine local to the device.

User transparency. Uniform access to devices is important in accessing the terminals of users attached to other CPUs. Current loosely coupled systems use specialized programs and a variety of Unix daemons to determine where other users are logged in.

For example, in Berkeley Unix, the `rwho` daemon broadcasts information about who is logged on locally and collects information about who is logged onto other machines; the `talk` daemon supports a conversation with a remote user; the `rsh`, `rlogin`, and `telnet` daemons provide a command interpreter on a remote machine; and so on.

None of these fragile application-specific daemons should be necessary in a transparent environment. The standard single-machine utilities should operate correctly.

"Under the covers" access. Sometimes, it's worthwhile to move a processing component to the data rather than move the data to the process. Semanti-

cally, such an action should have no effect on the execution of the application, but it may be useful nonetheless. You can improve both availability and performance by, for example, anticipating site failures and taking advantage of replicated data.

Control of process-execution sites. Processes need some criteria to know where to execute. You should at least be able to specify where to run a process. However, the method shouldn't require altering existing software to use it.

One alternative would have you supply information external to the specified program: an ordered list of machines to try to execute on, or criteria like the least-busy site, the machine nearest the data, or the one without a communications bottleneck.

In another situation, you could attach information to the program so that particular processing units could act as cycle servers for particular programs. What is important is that the underlying machine allows you to start processes on specific machines.

Process relocation during execution. To fully attain the goal of load balanc-

How to think of the New DigiCHANNEL PC/Xi Intelligent Multi-Channel Communications Board.



Think of the DigiCHANNEL PC/Xi as the cutting edge of flexibility. The new state-of-the-art in intelligent multi-channel communications boards.

A 12.5 MHz 80186 subsystem, featuring DigiBoard's Front End Processor real-time Operating System (FEP O/S), works in concert with whatever operating system you're using to ensure efficient I/O handling. Plug-in I/O Mate™ modules give you a



choice of 8 or 16 asynchronous ports to make it extremely flexible. You can specify from 128K to 512K of RAM, plus a variety of interfaces such as RS-232 and RS-422. There's even an optional synchronous channel.

So if your multi-user or multi-channel applications call for the last word in speed, configuration flexibility and programmability, the new DigiCHANNEL PC/Xi will put you at the cutting edge. Where you belong.

DigiBoard
Plugging you into tomorrow

Call 1-800-344-4273. In Minnesota, (612) 922-8055.

ing, you need to be able to do more than just start a task on a given machine. You also need to be able to change the execution site of all or part of the task during execution. This is a rigorous test of how transparent the environment is. If, in general, you can move a process from processor to processor and still accomplish the same task unaware of the change, then CPUs really are just interchangeable resources, and the environment is network-transparent.

But this functionality is important for more reasons than just to prove how transparent the environment is. You can use process migration to spread loads evenly and improve availability. A user, system administrator, program, or load-leveling daemon should be able to direct a process to change its execution site. In addition, the process itself may want to move during the execution, either to get closer to the data or a device or to spread the load.

You can also increase availability if you move processes off a CPU before you take it down for maintenance. However, this may not always be successful, because the process may need other re-

sources on the CPU in question.

While process migration may seem like an ambitious requirement, it's not a significant extension to remote execution if the required context is maintained. It appears more difficult than it is, because the common remote-job facilities typically in use don't extend easily.

Process creation on other CPUs. Process migration and transparent remote execution help you run processes on a collection of CPUs, but the standard Unix way of setting up parallel activity is to use the fork mechanism. (The Unix fork creates another process that is largely identical to the one that issues it.) With remote execution and migration, implementing remote forking is straightforward.

You need various criteria to determine the execution site. You could either choose a site at random or base your decision on load, as in the multiprocessor environment. The user's environment might also provide hints. In any case, given that communication is more expensive in this network environment than in the multiprocessor environment, you need a way to explicitly state which CPU

you want fork to create a process on. Thus, even if the underlying system can't perfectly spread out a highly parallel function, the program or compiler can.

Cost benefits, particularly with local resources. One way to assess whether network transparency would be valuable to you is to use the yardstick frequently applied to multiprocessor systems. As you add processing elements, what fraction of an additional processor is performing useful work? In addition, the cost of having network-transparency capabilities in the system should be low for a single-site operation.

Resource addition without disrupting ongoing work. The system should be able to use added resources automatically. Similarly, you should be able to create file replicas during normal operation and use them immediately. Adding printers and tape drives should also be transparent. Adding users should simply require integrating them into the whole cluster, subject only to protection and resource-management controls. Installing a software package once should make it available everywhere. You should need to

continued

How to think of the New DigiCHANNEL PC/Xe Intelligent Multi-Channel Communications Board.



Think of the DigiCHANNEL PC/Xe as the cutting edge of economy. You asked for an intelligent multi-channel communications board to fit applications that don't need a host of "extra" features, and we listened.

An 8MHz 80186 processor gives you speed and power that basic boards can't match, yet its cost is surprisingly...well...basic. You can choose between 4 or 8 asynchronous channels, and you'll find that its

64K of RAM is plenty for such straight forward multi-user and multi-channel applications as data collection and office automation.

Best of all, the DigiCHANNEL PC/Xe is engineered and built to the same impressive standards as our DigiCHANNEL PC/Xi. So, no matter how simple or complex your system, you can trust us to get you up and running. And keep you there.

DigiBoard
Plugging you into tomorrow.

Call 1-800-344-4273. In Minnesota, (612) 922-8055.

Seven ~~Six~~ easy ways to boost your BASIC



UPDATED

PROBAS™ Basic Programming Library

So who cares that BYTE magazine calls PROBAS a "Supercharger for QuickBASIC" or that PC Tech Journal says that PROBAS is a "high-quality, high-quantity package"? Who buys a product just because Jerry Pournelle said "Anyone doing serious QuickBASIC programming would do well to get [PROBAS]"? And who cares that Wayne Hammerly calls PROBAS "The greatest thing since sliced bread"?

Who?—Only those who want to write better, faster, slicker programs and save hundreds of programming hours in the process. With all of that hoopla out of the way, we are formally announcing the momentous release of PROBAS Version 3.1, now with over 400 assembly routines to make BASIC programs faster and more powerful than you ever dreamed with features like:

- A 1,000-page two-volume manual
- Full mouse support
- Extended and EMS memory support
- Full-featured windowing
- Moveable, resizable windows
- Screen snapshots (text & graphics)
- Virtual screens in memory
- Lightning-fast file I/O
- Critical error handling
- String, array, and pointer sorts
- Search directories and archives

Create dazzling screens in text, CGA, EGA, VGA, and Hercules graphics modes with windows that can overlay one another and be moved and resized on the fly. Store megabytes of string, data, or screen snapshots in extended or EMS memory. Draw complex text or graphic screens to memory and snap them on in an eyeblink. The PROBAS file I/O routines allow you to read or write huge chunks of data at a clip, far faster than with BASIC.

PROBAS also has over 300 other essential services, including handy string, date, time, directory, and array manipulation routines; string, screen, and data compression routines; valuable equipment and input routines; and faster replacements for many BASIC commands.

Whether you are a professional or a novice, PROBAS will boost your BASIC in ways you never thought possible. PROBAS allows the professional to write faster, tighter code in much less time and allows novices to quickly and easily write professional-quality programs that would be impossible with BASIC alone. The bottom line is PROBAS adds power and saves time. After all, how much is a few hundred hours of your time really worth?

For all DOS versions of QuickBASIC and BASCOM. **Just \$149.00!**

UPDATED

PROREF™ On-Line Help For PROBAS

PROREF provides on-line help for the routines in the PROBAS library. This hypertext manual links directly to the QB Advisor in QuickBASIC 4.5 so that the PROBAS reference becomes an integral part of your QuickBASIC on-line manual. Includes information and examples on PROBAS routines and helpful hints on programming in BASIC. **Just \$50.00!**

UPDATED

PROSCREEN™ Screen Management

PROSCREEN is a full-featured screen generator/editor that will save you more design and coding time than you ever thought possible. PROSCREEN treats screens like a word processor treats text to provide complete control over characters, colors, and placement. Design input screens with up to 130 fields, 19 pre-defined and 2 user-defined masks. Save screens to screen files or .OBJ files and use the tight BASIC/Assembly code that comes with PROSCREEN to access the screens. There's no kludgy code generator here! Access hundreds of input screens with less than 25k of total code. **Just \$99.00!**

PROMATH™ Mathematics Library

PROMATH is a collection of over 150 high-level routines that provide mathematical functions and operations for programmers who often work in mathematics, science, or engineering. Complex variables, real and complex matrices, real and complex trigonometric and hyperbolic functions and their inverses, solution of linear equations, integration, differential equations, Fast Fourier transforms, graphics support, and many other useful routines are provided.

For years Fortran has been the language of choice for scientific and engineering applications, but it lacks many of the useful features of QuickBASIC. PROMATH contains most of the Fortran mathematical and numeric functions and allows you to easily translate Fortran code to BASIC or write new programs in BASIC, while retaining Fortran's numerical prowess.

The PROMATH manual is over 200 pages and provides a complete description of each routine, including any algorithm and the mathematical formula the routine uses, shown in standard notation. For QuickBASIC 4 and BASCOM 6 only. **Just \$99.00!**

UPDATED

PROBAS™ TOOLKIT

The TOOLKIT is a collection of high-level BASIC and assembly modules that use the routines in the PROBAS library to save you even more hours of grunt work. Why spend hundreds of hours re-inventing the wheel when you can just plug in TOOLKIT modules like:

- Super-fast B-Tree indexing
- Ring, Bar, Pop-Up, Pull-Down menus
- Scroll-bar tag windows
- Dialog boxes with radio buttons
- Two mini-editors with word wrap
- BCD math routines
- Julian date & calendar routines
- Patch .EXE files
- Protected memory storage area

The TOOLKIT now supports EGA and VGA graphics modes for menus, windows, editors, calendars, and more. Complete with BASIC source code and an all-new comprehensive manual. The TOOLKIT requires the PROBAS library and helps conserve your greatest asset of all—time! **Just \$99.00!**

PROBAS™ TELECOMM TOOLKIT

The PROBAS TELECOMM TOOLKIT is a collection of high-level communications modules that you plug into your code to provide popular file transfer protocols, terminal emulations, login scripts and baud rates up to 115,200 baud. You get:

- Xmodem/Modem7/Xmodem-1k
- Ymodem (single and batch)
- CRC-16 and Checksum
- VT52, VT100, ANSI, BBS etc.
- Auto Dialer & data base
- Documented BASIC source

Why use clumsy SHELLs to complex terminal programs when you can plug just the communications routines you need into your code? Implement just the features and commands you want. Requires PROBAS. **Just \$75.00!**

Our thirty-day, money-back guarantee assures you the highest quality and our technical support staff is always ready to help.

HAMMERLY
COMPUTER SERVICES, INC.

9309 JASMINE COURT • LAUREL, MD 20707

(800) 343-7484

INT'L. ORDERS: (301) 953-2191 FAX: (301) 725-8147
BBS: (301) 953-7738

Add \$5.00 per item (\$8.00 Canada) for shipping per order. Europe: \$39.00 for 1st item plus \$5.00 for each additional item. Visa, M/C, C.O.D. (US Only) checks and approved. POs accepted. Trademarks PROBAS, PROREF, PROSCREEN, PROMATH, Hammerly Computer Services, Inc., QuickBASIC, BASCOM, Microsoft Corp.

perform software-maintenance activities only once; the system should propagate any changes to all replicas.

Resource removal without loss of service. Removing resources can be either a planned or an unplanned event. With error transparency, you shouldn't notice in either case, except perhaps for degraded performance. Several interesting, but not absolute, degrees of error transparency exist.

First, activities that don't involve the lost resource shouldn't be disrupted. Second, the system should automatically substitute equivalent resources. File substitution should be possible if copies exist, and process transparency should allow CPU substitution. However, these substitutions may be difficult in ongoing operations.

For example, if a file was partially updated and some of the changes were cached, losing the site with the cache may preclude a simple substitution and require more extensive checkpoint/restart facilities. Similarly, if a process is partway through execution on a CPU that fails, the process can be restarted from the beginning on another CPU. But, in general, that won't be completely transparent to other processes and users who may have already seen partial results.

A Significant Step Forward

Designing a system to provide this collection of characteristics and requirements is an ambitious endeavor, but the result would be a significant step forward in Unix functionality and in distributed computing. "Single-system image" may be a buzzword, but it's certainly descriptive of the goal of network transparency. IBM's TCF implementation of the LOCUS Distributed System Architecture demonstrates that most of the transparency requirements outlined are feasible, even while maintaining single-machine Unix semantics (see the text box "Transparency Today" on page 228).

Transparency as a concept has many degrees and dimensions. Single-machine Unix users who have struggled with limited cross-machine services generally are excited by it and find the transparent environment greatly superior. We expect that interactive terminal-intensive tasks will naturally run near the keyboard and screen, while back-end machines will get file- and CPU-intensive assignments.

System administration will be much easier than for n individual machines. However, more is involved in managing a transparency cluster than a single machine because of the opportunities to im-

prove performance and availability by relocating or replicating data and by allocating CPUs. The ease with which you can run tasks in parallel on different CPUs will probably result in a flurry of engineering and scientific applications.

Due to the high level of transparency, you should be able to smoothly expand the environment by adding front-end terminal machines, file-server-type machines, cycle-server machines, or combinations of these without disturbing the existing installation and with immediate integration. We expect that a high level of transparency will open many doors. ■

BIBLIOGRAPHY

- Hurwitz, J. S. "Transparent File Systems: The LOCUS Model for DNC." *Patricia Seybold's Network Monitor*, vol. 3, no. 7, July 1988.
- IBM Corp. AIX announcement, March 15, 1988. Sections 288-130 and 288-132.
- Sun Microsystems. NFS - VAX documentation, part no. 800-1427-01.
- Popek, Gerald, Bruce Walker, et al. "LOCUS: A Network Transparent, High Reliability Distributed System." In *Proceedings of the Eighth Symposium on Operating Systems Principles*, Pacific Grove, CA, December 1981.
- Popek, Gerald, and Bruce J. Walker. *The LOCUS Distributed System Architecture*. Cambridge, MA: MIT Press, 1986.
- Walker, Bruce J. "Issues of Network Transparency and File Replication in Distributed Systems: LOCUS." Ph.D. dissertation, UCLA, 1983.
- Walker, Bruce J. "The LOCUS Distributed Computing Environment." In *1984 IEEE Aerospace Applications Conference Digest*, IEEE cat. no. 84TH0108-1.
- Walker, Bruce J., and R.W. Matthews. "Process Migration in AIX's Transparent Computing Facility (TCF)." *IEEE Corp. Soc. Tech. Comm. on Operating Systems*, vol. 3, #1, Winter 1989.
- Walker, Bruce J., Gerald Popek, et al. "The LOCUS Distributed Operating System." In *Proceedings of the Ninth Symposium on Operating Systems Principles*, Bretton Woods, NH, October 1983.

Bruce J. Walker is chief architect at Locus Computing Corp. in Inglewood, California. He has a Ph.D. in computer science from UCLA. Gerald J. Popek is chairman of Locus. He has a Ph.D. in computer science from Harvard University and has been a director of the Center for Experimental Computer Science at UCLA. Walker and Popek have co-authored several books. They can be reached on BIX c/o "editors."



Unleash the BASIC Power of Hypertext!

Our latest BASIC-booster includes the first hypertext engine designed to be called from BASIC. With the **PROBAS HYPERHELP TOOLKIT** you can use the hypertext engine to put one or more manuals on-line with full hypertext search facilities. Imagine having one or more manuals on-line with all of the fantastic hypertext abilities in the QuickBASIC 4.5 compiler and then some:

- Choose single- or multi-window display
- Specify window colors and placement
- Move and resize windows with mouse or keys
- Sophisticated mouse and keyboard interface
- Up to 40 bookmarks to move between hyperlinks

In less than a dozen lines of code you can pop-up context-sensitive help at any time. Your users can then jump to related help, examples, or just browse the manual(s) in one or more windows that they can move or resize at will. The text will automatically wrap within the window to stay fully visible!

Create HyperCard Applications

Use the **HYPERHELP** engine to create full-blown hypercard applications. Create sophisticated multi-window, multi-thread hypercard stacks. Mix cards and manuals for total data integration. Moving from link-to-link or card-to-card is instantaneous and the speed will amaze you.

Adding hypertext to your applications takes less than about a dozen lines of BASIC code. Converting ASCII text to hypertext is just as easy—just put delimiters around keywords, hyperlinks, and items you want to display in boldface.

Multiple Help Subsystems

The hypertext engine is just a part of the **HYPERHELP TOOLKIT**. There is a wide selection of help subsystems with various displays, user interfaces, and memory requirements to suit almost any need. Want a small, window-oriented, keyword help system? It's in there! Need a Terminate & Stay Resident help system? It's in there! How about a lightbar indexing system that then pops-up the selected text? It's in there!

The **HYPERHELP TOOLKIT** gets its blinding speed by using the low-level routine in our **PROBAS** Professional Basic Programming Library. **HYPERHELP** requires the **PROBAS** Library. See our ad on the opposite page for information on **PROBAS**, shipping rates, and our thirty-day money-back guarantee.

Special Introductory Price—For a short time this powerful hypertext engine and collection of help subsystems is available for **just \$99.00!**

HAMMERLY
COMPUTER SERVICES, INC.

9309 JASMINE COURT • LAUREL, MD 20707

(800) 343-7484

INT'L. ORDERS: (301) 953-2191 FAX: (301) 725-8147
BBS: (301) 953-7738

Add \$5.00 per item (\$8.00 Canada) for shipping per order.
Europe: \$30.00 for 1st item plus \$5.00 for each additional item. Visa, M/C, C.O.D. (US Only) checks and approved POs accepted. Trademarks **PROBAS**, **PROHELP**, **PROSEARCH**, **PROMATCH**: Hammerly Computer Services, Inc. Quick-BASIC, BASCOM: Microsoft Corp.

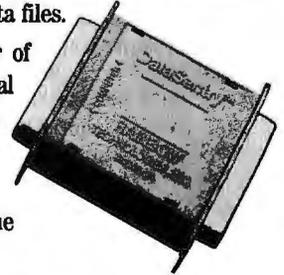
Ask The Doctor Your Most Important Questions About PC Data Security.



Escalating instances of PC data theft and misuse affecting both government and industry have shown the need for an effective yet easy-to-use data security product. U.S. Public law 100-235 now mandates that government agencies protect sensitive data files.

In response, Dr. Alan K. Jennings, Ph.D., inventor and co-founder of Rainbow Technologies, has designed the DataSentry™, an external hardware key that provides data file security without the problems associated with internal hardware and software-based protection.

In this first of a series of informational bulletins, Dr. Jennings answers some of the more frequently asked questions on PC data security and the DataSentry system from Rainbow Technologies.



Data Sentry

- Completely user-installable
- Pocket-sized external device
- Menu-driven, user-friendly interface
- Single- or multi-user security system
- Audit trail, log-on identifiers and automatic encryption/decryption of entire directories
- Secures data transmitted by modems
- Prevents recovery of data by utility programs

Dealer Inquiries Welcome.

Q. What is the DataSentry system?

A. The DataSentry protection system consists of a combination of a hardware encryption device – Personal Access Key – and associated software that runs on an IBM or compatible PC having a parallel printer port and a floppy disk drive. The DataSentry provides three types of security: mandatory use of the access key to open a file, encryption and password protection.

Q. What is inside the Personal Access Key?

A. Inside each pocket-sized Personal Access Key is a proprietary custom-designed integrated circuit, often referred to as an Application Specific Integrated Circuit (ASIC). This ASIC was designed by engineers at Rainbow Technologies specifically for the DataSentry system. The full capabilities of the ASIC are known only to Rainbow. In operation, the proprietary ASIC implements a special function called an algorithm, chosen from many thousands of possible algorithms when the key is being manufactured at the Rainbow factory.

Q. What is the disadvantage of password-only software protection?

A. The main disadvantage of password-only protection is that users find it difficult to remember a password unless it is something quite familiar to them – like their spouse's name, their dog or the street they live on. It was recently estimated that about 75% of ARPANET passwords could be discovered by trying these three choices. Choosing a less familiar name requires that it be written down. This, of course, is a security risk. As a result, password-only protection is fairly easy to defeat.

Q. What is the advantage of external hardware keys over internal security boards?

A. Some protection systems depend on circuit boards being installed inside the PC. In addition to objection to the expense of installation and training, many users are reluctant to open their PCs. IBM PS/2s and laptop PCs do not accept the standard add-in boards. As a result, nearly all PC users have a strong preference to the addition of low-cost external hardware to achieve the desired protection.

Q. Is the DES (Data Encryption Standard) government-specified algorithm available with the DataSentry system?

A. Yes. The DES algorithm as defined by U.S. government standard FIPS 46 is implemented in the DataSentry system.

Q. Can the DataSentry system be used on local area networks?

A. Yes. It can be used on LANS as long as the automatically protected files are stored on a local computer. It does not matter if the application is stored on the local PC, on a shared file server or on any other PC.

Q. Can a DataSentry system be used to secure mainframe data files?

A. Yes. The mainframe could send files to the PC for encrypting or decrypting.

Q. What are some of the new special features of the DataSentry system?

A. Audit trail, log-on identifiers, and automatic encryption/decryption of entire directories.

To consult Dr. Jennings and the DataSentry sales staff about your personal data security questions, call Rainbow Technologies today.



RAINBOW TECHNOLOGIES

18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260
Rainbow Technologies, Ltd., Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY, U.K., Tel: 0753-41512, Fax: 0753-43610

© 1989 Rainbow Technologies. All product names are trademarks of their respective manufacturers.

Remote Control

*Distributing computing tasks over a multivendor network
is a lot easier if you know your RPCs*

Carl Manson and Ken Thurber

The basic limitation of all single-processor systems is that they execute only one instruction at a time. There are a couple of ways around this limitation. One is parallel processing. Parallel processors can achieve super-computing speeds at near microcomputing prices by combining varying numbers of tightly coupled CPUs.

The network offers another way around the one-instruction limitation: distributed processing. On a network, you can integrate multiple, loosely coupled processors into a single computing environment by using remote procedure calls.

Spreading the Work Around

As the name implies, a remote procedure call (RPC) invokes a procedure on a machine that is remote from where the call originates. In its basic form, an RPC identifies the procedure to be executed, the machine it is to be executed on, and any arguments required. The application of this RPC model results in a client/server arrangement where the client is the application that issued the call and the server is the processor that handles the call.



An early implementation of the RPC model, Courier, was developed by Xerox as part of the Xerox Network System. Courier is defined as a three-layer protocol that uses virtual circuits for communication (see figure 1). At the top layer, the Courier protocol consists of a message stream that includes the call and return information. The bottom layer consists of a block stream for data transfer.

The middle layer—the object stream—defines the data types that can be used in transferring information. The idea behind Courier was to allow distributed systems to use the higher-level abstractions it provides.

Using RPCs, Courier made it possible to distribute the processing of a job over the network. However, it lacked a way to match processing requests to processors—the Courier model required that you specify the server as part of the call. Other issues not addressed by Courier: load balancing, resource naming, reliability, error handling, process blocking, and data translation.

Currently, the two RPC implementations receiving a lot of attention are Sun Microsystems' RPC, which is part of the Network File System (NFS), and Apollo Computer's RPC, which is a component of its Network Computing System (NCS).

RPCs in the Sun

The Sun RPC mechanism is relatively simple (see figure 2). Like Courier, it executes a process on a remote machine as if the process were being executed

continued

locally. A major difference, however, is the requirement that the Sun RPC system work in multivendor environments. This led to the inclusion of a data-translation mechanism called the External Data Representation (XDR) protocol.

The Sun RPC is a library of routines you can use to develop distributed applications. It consists of three layers. The highest is a set of routines that perform network functions such as determining how many users are logged onto a remote machine. The lowest layer involves direct network manipulation.

You use the middle layer of routines to construct the higher-level functions. These are the routines that actually invoke remote procedures.

For example, `callrpc()`, the simplest RPC in the library, requires eight parameters that illustrate the Sun RPC model. The first parameter is the name of the remote machine that will handle the call. The next three are the program, version, and procedure numbers. The fifth parameter is an XDR routine that is used to convert the arguments being passed to an intermediate data representation defined by the XDR protocol. This is followed by the actual arguments to the remote procedure. The last two parameters, an XDR routine and the return arguments, are for the return call. Thus, with the exception of the data conversion that ensures processor independence, the Sun RPC uses the same model used by Xerox for its Courier protocol.

The NFS Idea

Based on the Sun RPC, NFS provides transparent file access among computers of different architectures over one or

more networks. NFS keeps different file structures and operating systems transparent to users. Access techniques also remain invisible to users. In addition, file access performance with NFS is comparable to local file access.

NFS is an open approach to solving the problems inherent in networking in today's heterogeneous world of computers. Important design goals include machine and operating-system independence, simple crash recovery, transparent file access, and good performance. Sun also wanted NFS to provide a Unix-like way of making remote files available to local programs without having to modify, or even recompile, them. To achieve these goals, Sun designed the NFS protocols independently of the operating system and transport network. Thus, NFS is not a network operating system but an independent network service.

Implementing NFS

NFS extends the standard Unix mount command, allowing system administrators and network users to mount remote files and directories on their machines for local use. Under NFS, you can mount files immediately when you bring a network server or computer on-line, or later as you need them. Access to these files follows the same operating-system procedures as local file retrieval. With Unix, for example, you locate a file with the `cat` command plus the appropriate path name to the file. As long as the client and server share the same network, this doesn't change under NFS, regardless of the file's location. NFS automatically determines whether a request for a file should take place locally or over the

network. For performance reasons, NFS is integrated with the kernel of Sun's operating system.

NFS perceives machines on a network as being servers, clients, or both. Any system with a disk can function as both a server and a client. Diskless nodes operate only as clients, and dedicated servers only as servers.

Because NFS is used with multiple operating systems, servers on the network are stateless. They do not maintain tables relating to each file being served. Each file request is shipped across the network with exactly the parameters (such as read/write privileges) that are attached to it locally. This makes for simple recovery in the event of a system or network crash. For example, the system doesn't have to reconstruct file-locking tables.

The NFS Protocol

NFS starts with a remote-execution system protocol. This defines the operations available (the remote procedures), the arguments passed to them, and the results returned. The principal operation in the protocol is `START`, which initiates a remote program. The `START` procedure takes the name of the command and its arguments, the working directory (including the name of the server providing it), a list of environment variables with their values, and port numbers for the standard input, output, and error channels. `START` returns the status of the initial execution in both machine-readable and human-readable form.

When `START` concludes, the remote program executes. Its standard input is read from, and standard output written to, the indicated network ports (with an optional third network port for standard error). The `WAIT` operation waits for the command to terminate, and it returns the exit status, also in both machine-readable and human-readable form.

NFS protocol procedures use this mechanism to provide the basic functionality of the Unix file-system routines. For example, under NFS you can use Unix functions such as `read`, `write`, `create`, and `mkdir` even if the server is running some other operating system.

In addition to the protocol procedures themselves, the NFS design also deals with the problems inherent in both the server and the client side of a transparent distributed processing network.

Servicing NFS Requests

Because servers are stateless under NFS, any modified data must be committed to stable storage before the system returns the results of an NFS service request.

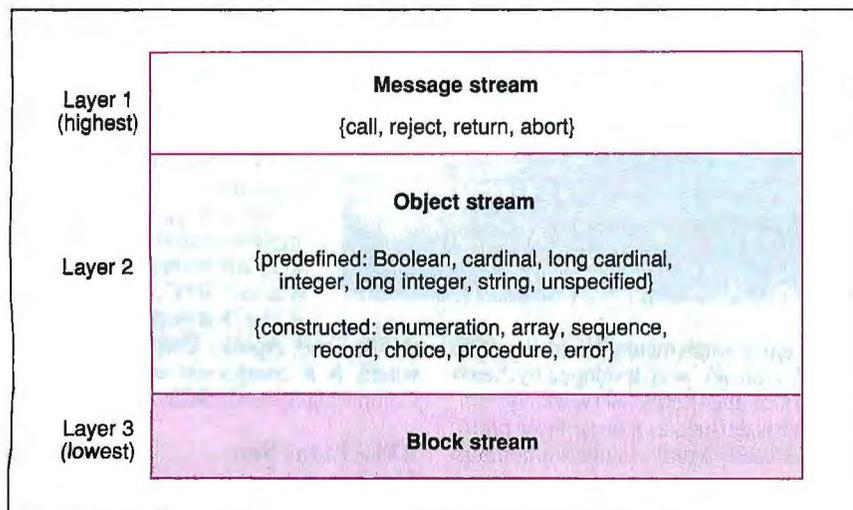


Figure 1: The protocol layers of XNS Courier show the built-in data types supported by the remote procedure call (RPC) mechanism.

The implication for Unix-based servers is that NFS requests that modify the file system must flush all modified data to disk before returning. For example, when NFS performs a write operation, the server must flush not only the data block but also any modified indirect blocks and the block containing the system file descriptor (the *i-node*).

Another modification to Unix necessary to make the server work properly is the addition of a generation number in the *i-node* and a unique file-system ID for the file system on the server. These extra numbers make it possible for the server to use the *i-node* number, the *i-node*-generation number, and the file-system ID together as the network ID for a file. The *i-node*-generation number is necessary because the server may hand out a network ID with an *i-node* number for a file that is later removed and the *i-node* reused. When the original network ID comes back, the server must be able to tell that this *i-node* number now refers to a different file. The generation number has to be incremented every time the *i-node* is freed.

Client Worries

The client side provides the transparent interface to the NFS functions. To ensure transparent access to remote files, NFS uses a method of locating remote files that does not change the structure of path names. Some Unix-based remote-file-access schemes use `host:path` to name remote files. This "late binding" does not allow true transparent access since it requires the modification of existing programs that parse path names.

Sun's solution is to perform the host-name lookup and file-address binding once per file system. The NFS mount command accomplishes this by allowing you to attach a remote file system to a directory. The advantage to this system is that you deal with host names only once, at mount time. It also allows the server to limit access to file systems by checking client credentials. The disadvantage is that remote files are not available to the client until a mount is done.

Transparent access to different types of file systems mounted on a single machine is provided by different file-system interfaces in the kernel. Each file-system type requires two sets of interface operations. The virtual file-system (VFS) interface defines the procedures that operate on the file system as a whole. The virtual node (*v-node*) interface defines the procedures that operate on an individual file within that file-system type.

The VFS interface's structure con-

tains the operations that can be done on the file system as a whole. Likewise, the *v-node* interface's structure contains the operations that can be done on a file or directory within the file system. There is one VFS structure in the kernel for each mounted file system and one *v-node* structure for each active file or directory. This use of abstract data types allows the kernel to treat all file systems and nodes the same way without having to know the details of the underlying file system. The *v-node* and VFS interfaces ensure that programs that parse Unix path names will be able to find remote files on many different file systems.

Locks and Open Files

Being stateless, NFS does not support remote record and file locking. It contains separate lock managers that handle file and record locking. Lock managers are provided at both the client and the server. Lock requests from the client are forwarded to the server lock manager using RPC routines. The network status monitor service then notifies the lock managers of any change in status of either the server or the client.

If the status monitor detects the failure

of a client, it notifies the server, which then releases the failed client's lock. If the status monitor detects the failure and recovery of a server, the client-lock manager retransmits any client-lock requests.

In addition to record and file locking, NFS attempts to obey Unix file-system semantics without modifying the server or the NFS protocol. In some cases, this is difficult. For example, Unix allows the removal of open files. A process can open a file, remove its directory entry, and still read and write to the file. This procedure defines temporary files.

Of course, not all operating systems or file systems support the removal of open files. To provide this capability, NFS checks the client VFS during a removal operation. If the file is open, NFS renames the remote file instead of removing it. This makes the file "sort of" invisible to the client and still allows reading and writing to the file. The new name is not removed until its *v-node* becomes inactive. NFS calls this the "three-quarter solution" because, if the client crashes between the rename operation and the remove operation, a garbage file is left on the server.

continued

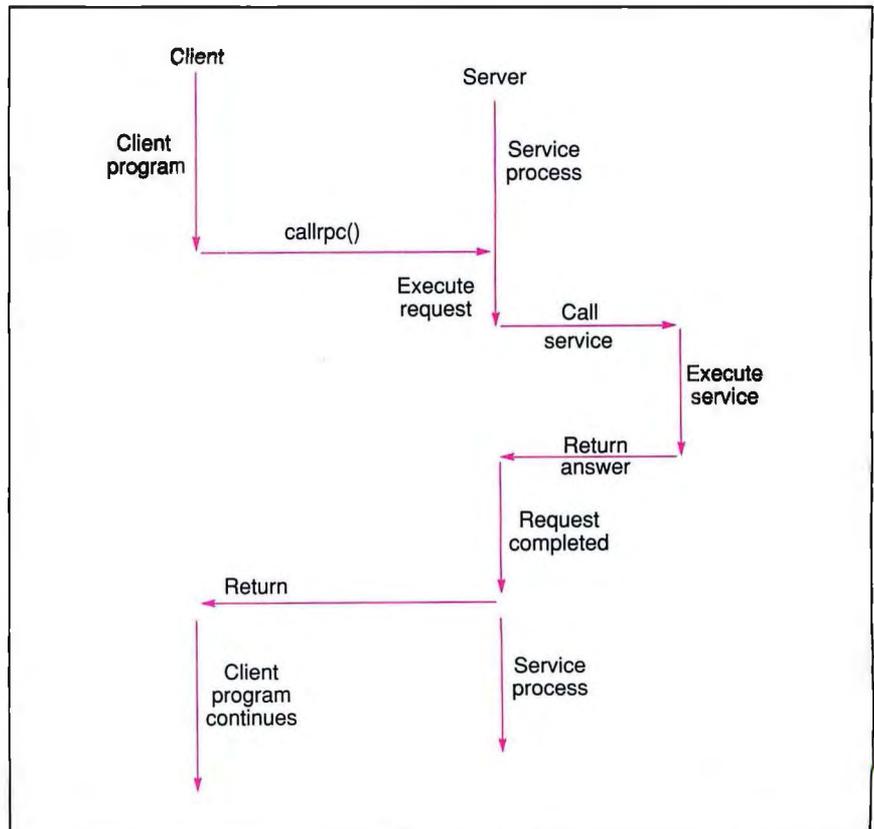


Figure 2: A typical call using the Sun RPC shows the flow of control from the client to the server and back again.

However, NFS does not preserve all the Unix open-file semantics because interactions between two clients using the same remote file cannot be controlled on a single client. For example, if one client opens a file and another client removes that file, the first client's read request will fail even though the file is still open.

Another source of difficulty for NFS is time skew. Time skew between two clients or between a client and a server can cause the time associated with a file to be inconsistent. For example, the Unix command `ranlib`, which converts archives into libraries, saves the current time in a library entry. The Unix dynamic linker `ld` checks the modify time of the library against the time saved in the library. When `ranlib` is run on a remote file, the modify time comes from the server, while the current time saved in the library comes from the client. If the server's time is far ahead of the client's, it appears to `ld` as if the library is out of date. This problem can be handled by taking the network-status-monitor approach with file and record locking. Time requests would then be implemented as remote procedure calls.

NFS is a good example of a distributed processing application that uses RPCs. It remains dependent, however, on clients mounting remote file systems. Apollo Computer's RPC-based system automates the selection of servers to a greater degree than NFS.

The Apollo Approach

Apollo's approach to RPCs is to provide a set of routines that look like standard, stand-alone subroutines to client applications. These stand-in routines are called *stubs*. Likewise, servers also use stubs

that stand in for the applications calling a subroutine. The client application invokes remote procedures using standard calling conventions, as if the procedures were part of the local program. The client stub acts as the "local representative" of the procedures, organizing the data into a format that can be meaningfully transmitted to the server. The stub then uses the Apollo RPC Runtime library routines to communicate with the server. Within the server, a similar chain of events occurs. The RPC Runtime routines pass the request to a server stub that stands in for the calling program and invokes the requested procedure. After execution, the server stub passes return information to the RPC Runtime routines, which in turn communicate with the client (see figure 3).

The RPC Runtime library is an integral part of Apollo's RPC strategy. It provides the system calls required to implement both calling clients and called servers. These calls provide the mechanisms for transferring requests from the clients to the servers and transmitting and receiving responses.

Characteristics of RPC Runtime

The Apollo RPC Runtime system contains most of the facilities required to implement distributed processing. It includes error-handling capabilities and is robust in the face of lost, duplicated, or long-delayed messages, messages arriving out of order, and server crashes. RPC Runtime ensures that no call ever executes more than once. Because the error handling is built into RPC Runtime, the application can call for only as much error correction as is needed. For example, if you can execute a subroutine more

than once without side effects, you can eliminate the overhead required to guard against this.

The RPC Runtime environment includes conversion routines for changing byte order and converting floating-point representations. You can use the source code provided for these routines to create run-time procedures that handle data conversion between different machines.

System-level support for RPC operations is also provided. In most cases, you don't use RPC Runtime calls directly. Instead, you create an interface definition in the Network Interface Definition Language. The NIDL compiler automatically generates the stub code, including RPC calls, for both the server and client from a single interface definition. This layered design simplifies and isolates the operations required to make a remote procedure call work.

RPC Runtime is as independent of particular network layer protocols as possible. It is written in portable C and uses the Berkeley Unix socket abstraction, which masks the details of various protocol families so you can write protocol-independent networking code.

Networking facilities designed to move long byte streams reliably, such as TCP/IP, are not suited to handling the way an RPC system exchanges messages because the cost of setting up and maintaining a connection using such facilities is quite high. RPC Runtime implements exactly the reliability it needs on top of a connectionless network service such as the User Datagram Protocol. Because they lack sophisticated handshaking protocols, datagram services have less overhead than connection-oriented services and are thus ideal for RPC systems.

Less overhead, however, also means less reliability in error recovery. RPC Runtime makes up for this by providing its own error checking and recovery procedures on top of the datagram service. This approach has the additional advantage of reliably handling those systems—embedded microprocessors, for instance—that supply a less-than-reliable service when connected to a network.

The protocol that RPC Runtime implements on top of a datagram service is lightweight yet robust in the face of problems with messages. The user is not required to switch to a standard transport layer like TCP/IP in order to achieve reliable network service.

Programming RPC Runtime

The NIDL compiler automatically generates the stub procedures that stand in

continued

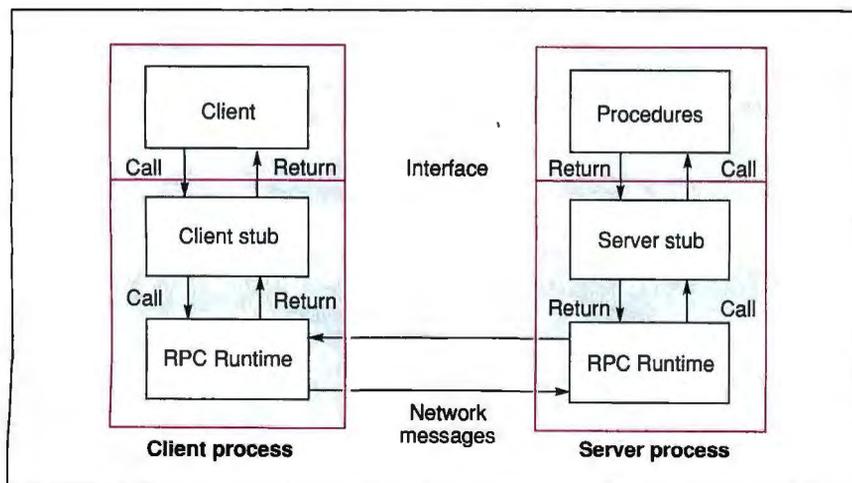


Figure 3: The Apollo RPC facility uses stubs on both the client and server side to stand in for the called procedure and the calling application, respectively.

It Will Forever Change The Way You View Your Existing Software And Data!



Here's What The Critics Are Saying About ViewLink...

"The most significant new product of the late DOS era ... a visionary solution - a beacon of good sense and productivity."

Jeff Angus, INFOWORLD
-Feb. 6, '89

"In a computer market that's overflowing with 'me-too' products, ViewLink is potentially one of the most important products to appear in the past year."

BYTEWEEK -Jan. 30, '89

"ViewLink provides a welcome new way of managing applications."

Jimmy Guterman, PC WEEK -Jan. 30, '89

"What a great idea... ViewLink is an idea that's long overdue for any DOS computer."

Don Crabb, CHICAGO-SUN TIMES-Feb. 19, '89

"ViewLink performs the type of service users should expect of their operating system..."

Jeffrey Tarter, SOFT•LETTER



Now that you've heard what the critics are saying about ViewLink ... imagine how much more efficiently you could work if all of your files were organized according to the way you use them. And not limited by their DOS directory or subdirectory structures.

Think of how much quicker you could get things done if you could load both the file you want to work with and its program at the same time—with a single keystroke.

Visualize how much more effective you could be if you could search an entire hard disk for related files—and group them together automatically.

That's the powerful idea behind ViewLink. A new easy-to-use method in connecting you with your software and data. It works with over 50 of today's most popular software applications. And it's only **\$149.95**.

From Traveling Software, the people who brought you LapLink, DeskLink and Battery Watch.

Available at your local computer store today.

For more information about ViewLink, call **1-800-343-8080** or in Washington state **206-483-8088**.

Traveling Software



18702 North Creek Parkway • Bothell, WA 98011

Circle 284 on Reader Service Card

for the remote procedure on the call side, and for the caller's procedure on the server side (see figure 4). You describe the stub routines in an interface specification (written in NIDL) that describes the procedures that can be called remotely, as well as the numbers and types of their arguments.

NIDL contains constructs for describing the data types, functions, and procedures associated with a remote interface. It is a declarative language and contains no executable constructs. It comes in two flavors: NIDL/C with a C-like syntax, and NIDL/Pascal with a syntax like the Pascal/Modula-2 family of languages.

All RPC Runtime calls are tagged with a description of how the calling machine represents basic data such as integers, characters, and floating-point numbers. The representation of aggregates does not differ across machine types because aggregates are defined by the stubs (which actually pack the components of the aggregates), not the underlying machine architecture. All stubs are thus capable of converting data to the appropriate type. The compiler also lets you write separate procedures to handle

pointers. Thus, you can pass complex data structures between machines.

The NIDL compiler generates stubs that can employ the following data types: signed and unsigned integers, single- and double-precision floating-point numbers, characters, strings, fixed- and varying-length arrays, enumerations, sets, records, discriminated unions, and simple pointers. The compiler supports three types of binding for the RPC and the remote procedure to be executed: explicit, implicit, and automatic.

Explicit binding means that the NIDL specification states exactly which server to use whenever the application is run. In implicit binding, the client defines the server in a variable before making any remote procedure calls, thus deferring binding to run time. Automatic binding is provided as a service of the *location broker*. The binding options available allow greater flexibility than systems that use explicit binding exclusively.

The Location Broker

To be truly distributed, an application should not contain hard-coded information about its execution environment. For

example, if you add an array processor to a network, you shouldn't have to modify applications to have them recognize and use the new machine. The Apollo NCS uses a location broker to automatically match tasks to servers. Servers register their capabilities with the location broker, and clients query the location broker at run time to determine which servers to use for particular RPC calls.

The location broker maintains a replicated database that contains the identities and locations of server objects available on the network. Client programs can access different resources through the location broker without knowing the location of each object beforehand. The location broker provides a forwarding facility and invocation facility. Forwarding provides an address to the objects on a server. Invocation can start the server if it is not running at the time the location broker receives a request for the object.

Other location-broker components include a client agent, called by programs that want to use location-broker facilities; local brokers, which manage information about resources on the local host; replicated global brokers, which manage information about resources available to all clients; and administrative tools that update the location broker.

The location broker is a large step toward providing transparent distributed processing on a network. Using a broker, applications can dynamically bind to resources in the network without any changes in their source or object code.

Distributed Applications

Although networks can never achieve the raw processing speed of a tightly coupled parallel processor, distributed processing using RPCs offers many of the advantages of parallel processing.

Presently, there is not a lot of commercial work in the area of building a distributed processing network to perform a particular function. This area is wide open for applications development. With the availability of distributed processing tools based on RPCs, you will see the development of such applications. ■

Carl Manson is a senior systems engineer at Architecture Technology Corp., in Minneapolis, Minnesota. He has an M.S. in computer science from the University of Minnesota. Ken Thurber is president of Architecture Technology Corp. He has a Ph.D. in electrical engineering from Montana State University and is the author of 14 books on computer science. They can both be reached on BIX c/o "editors."

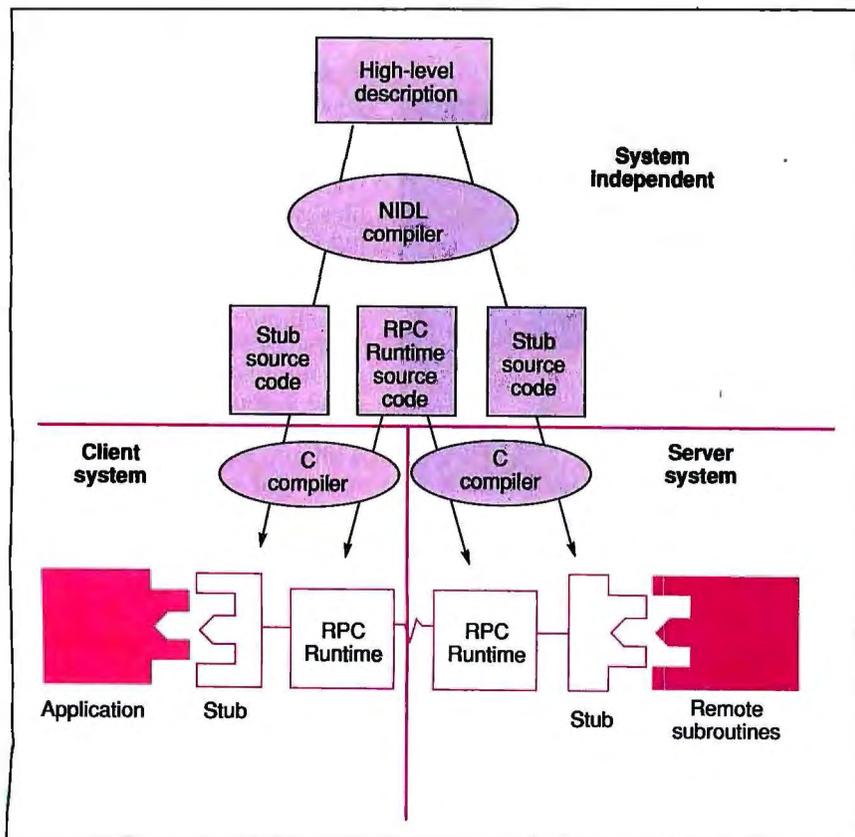


Figure 4: The NIDL compiler generates complementary stubs that are used on both the client and the server side. The declarations produced by the NIDL are used by native compilers on both the client and server to produce the actual stub code.

Order **BYTE** and **BIX** on disk Today!

Full Text of **BYTE** on Disk

Now you can order disks containing the full, machine-searchable text of articles. You can read and search the text with any word processor. Excellent for reference and research! Disks can be ordered singly or by annual subscription. Full text of **BYTE** is available starting from September 1988.

BYTE Program Listings on Disk

BYTE listings on disk are the right choice if you want to compile or read the complete source code listings of programs. BYTE listings are available from December 1985 to present at the prices stated below.

Best of BIX on Disk

Receive highlights of each month's activities on **BIX**—**BYTE**'s world-class on-line conferencing system. You can read and search the text with any word processor. Each disk contains the most interesting and informative recent discussions specific to the machine you own. For example, order the **IBM** disk, and get the highlights from **IBM**-specific conferences. Disks can be ordered singly or by annual subscription.

BYTE also offers listings in print form. Order bound versions of the complete source code listings of programs excerpted from our articles. Handy for quick reference. Order singly or by annual subscription; with or without accompanying diskette version.

Call toll-free for more information: 800-258-5485.

ORDER FORM: To place your order, fill out the card and mail.

	IN USA		OUTSIDE USA	
	Single Month (1 disk)	Annual Subscription (13 disks)	Single Month (1 disk)	Annual Subscription (13 disks)
5-1/4 Inch: <input type="checkbox"/> IBM PC <input type="checkbox"/> Atari ST Other disk formats available. Call toll-free.	<input type="checkbox"/> Full Text of BYTE \$9.95 <input type="checkbox"/> BYTE Listings \$9.95 <input type="checkbox"/> Best of BIX \$9.95	<input type="checkbox"/> Full Text of BYTE \$79.95 <input type="checkbox"/> BYTE Listings \$79.95 <input type="checkbox"/> Best of BIX \$79.95	<input type="checkbox"/> Full Text of BYTE \$12.95 <input type="checkbox"/> BYTE Listings \$12.95 <input type="checkbox"/> Best of BIX \$12.95	<input type="checkbox"/> Full Text of BYTE \$99.95 <input type="checkbox"/> BYTE Listings \$99.95 <input type="checkbox"/> Best of BIX \$99.95
3-1/2 Inch: <input type="checkbox"/> Apple Macintosh <input type="checkbox"/> Atari ST <input type="checkbox"/> Amiga <input type="checkbox"/> IBM PS/2	<input type="checkbox"/> Full Text of BYTE \$10.95 <input type="checkbox"/> BYTE Listings \$10.95 <input type="checkbox"/> Best of BIX \$10.95	<input type="checkbox"/> Full Text of BYTE \$89.95 <input type="checkbox"/> BYTE Listings \$89.95 <input type="checkbox"/> Best of BIX \$89.95	<input type="checkbox"/> Full Text of BYTE \$13.95 <input type="checkbox"/> BYTE Listings \$13.95 <input type="checkbox"/> Best of BIX \$13.95	<input type="checkbox"/> Full Text of BYTE \$109.95 <input type="checkbox"/> BYTE Listings \$109.95 <input type="checkbox"/> Best of BIX \$109.95

FOR DIRECT ORDERING
CALL TOLL FREE:
800-258-5485



Call: M-F, 8:30 a.m. to 4:30 p.m. Eastern Time
(603-924-9281 for New Hampshire residents)

For credit card orders only.

BYTE

PLEASE COMPLETE IN FULL

JULY

Name _____

Address _____

City _____

State _____

Zip _____

County or Parish _____

Country _____

Credit Card # _____

Exp. Date _____

Signature _____

Date _____

Please allow 4-8 weeks for delivery.

• Please indicate the issue date below. If you are beginning an annual subscription, note the starting issue.

Full Text of **BYTE**

Month _____ Year _____

BYTE Program Listings

Month _____ Year _____

Best of **BIX**

Month _____ Year _____

Check enclosed

MasterCard

VISA

U.S. funds enclosed
(If ordering from outside the U.S. please remit in U.S. funds drawn on U.S. bank. Thank you.)

Order **BYTE** and **BIX** on disk Today!

Full Text of **BYTE** on Disk

Now you can order disks containing the full, machine-searchable text of articles. You can read and search the text with any word-processor. Excellent for reference and research! Disks can be ordered singly or by annual subscription. Full text of **BYTE** is available starting from September 1988.

BYTE Program Listings on Disk

BYTE listings on disk are the right choice if you want to compile or read the complete source code listings of programs. **BYTE** listings are available from December 1985 to present at the prices stated below.

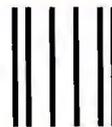
Best of **BIX** on Disk

Receive highlights of each month's activities on **BIX**—**BYTE**'s world-class on-line conferencing system. You can read and search the text with any word processor. Each disk contains the most interesting and informative recent discussions specific to the machine you own. For example, order the **IBM** disk, and get the highlights from **IBM**-specific conferences. Disks can be ordered singly or by annual subscription.

BYTE also offers listings in print form. Order bound versions of the complete source code listings of programs excerpted from our articles. Handy for quick reference. Order singly or by annual subscription; with or without accompanying diskette version.

Call toll-free for more information: 800-258-5485.

ORDER FORM: To place your order, fill out the card and mail.



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 10 PETERBOROUGH, NH

POSTAGE WILL BE PAID BY ADDRESSEE

BYTE & BIX on Disk

One Phoenix Mill Lane
Peterborough, NH 03458-9990



The Paperless Office

*Distributed PC-based document image processing
may change the way you do business*

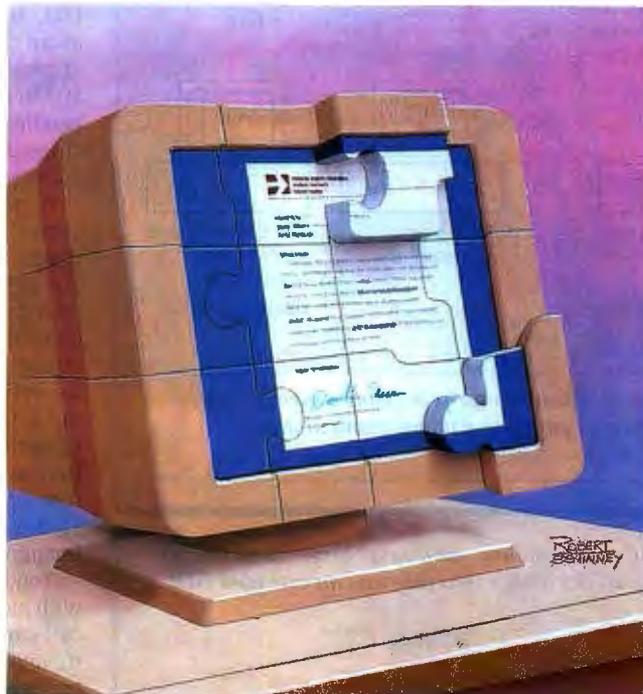
Dean Hough

For years you've heard how computer technology was going to create an office environment where paper would be obsolete. It appears, however, that computers have had the opposite effect: Offices now create more paper than ever before. The difficulties in creating a paperless office are in getting real-world documents into and out of a computer system, and in working with them once they have been acquired. One solution is document image processing.

DIP is the storage, management, and retrieval of images on a computer system. Once the exclusive domain of large dedicated systems, it is emerging as a bona fide personal computer-based office-automation application. It may change the way you do business.

Elements of a DIP System

DIP systems consist of page scanners, database managers, and mass storage devices that capture and manage original documents as images. You use standard or high-resolution displays to view these images, and laser printers to generate hard copy. Specialized DIP functions are



controlled by dedicated image-processing hardware and software.

DIP is most useful when you integrate it into a LAN that provides access to shared laser printers, scanners, optical disks, and databases. Such a distributed environment lets your DIP system automate and manage the flow of documents electronically. If you're on the network, you can access thousands of documents

without ever leaving your own machine. Further, the same document can be viewed simultaneously at different workstations. You can also integrate DIP with applications such as fax, forms, and desktop publishing to help manage the distribution and output of graphics information.

The computers on your DIP system must perform some or all of the following functions: image compression and expansion, scanning, printing, retrieving, and scaling and rotating. The machines that function as print and scan servers should be specialized to speed these processes. Specialized hardware can handle image compression and manipulation. Finally, the systems you use as DIP workstations to retrieve and view images require a retrieval engine and may need enhanced

graphics capabilities.

The ideal DIP network configuration contains many elements (see figure 1). A file server stores the database application and image data. A DIP server provides image compression and decompression, and I/O via the attached scanner and printer. The workstations, running either DOS or Windows, have either a

continued

hardware or software retrieval capability, which includes image decompression and manipulation.

The Software Side

As usual, DIP hardware technology has progressed faster than the software, which must catch up before DIP can gain wide acceptance. Fortunately, the necessary software pieces are beginning to fall into place.

The increasing acceptance of Windows marks a long overdue shift from character-based applications to a standard graphics interface. This is particularly important to a graphics-intensive

application such as DIP. Windows represents a major step toward integrated image-processing systems, but it has some limitations.

The major obstacle in using standard Windows as the front end to a DIP application is that it lacks free-form image capabilities. This is illustrated by the absence of Windows support for scanners. Existing Windows applications deal primarily with structured data such as fonts, patterns, and vector graphics. This is fine for standard word processing, database, and spreadsheet applications, but not for graphics-intensive ones. Structured graphics definitions

can't handle handwriting, photographs, and free-form drawings. By contrast, raster representation can describe all types of image and graphics information, since it makes no assumptions about image content.

Opening Windows

For DIP applications, one solution is to extend Windows so it can work more easily with raster images. You can accomplish this by providing extensions to the graphics device interface (GDI) that forms the foundation of Windows.

The Windows GDI provides the font and graphics resources that enable applications to display and print structured data. GDI functions operate on a device context that can be a memory bit map or a display window. Due to memory limitations and performance considerations under Windows, device contexts are usually limited to less than 64K bytes. This limitation creates problems. For example, when displaying a 300-dot-per-inch scanned page, many iterations of standard GDI operations are required to process the entire 1-megabyte image. In fact, it takes standard GDI commands about 2½ minutes to read, scale, and display a 1-megabyte image on a 20-MHz 80386 machine. By extending the GDI to handle large raster images, the same machine displays the image in about 2 seconds (see listing 1).

A part of the speed improvement comes when you compress the scanned image using the same CCITT standard compression techniques used in fax communication. Compression is a necessary component of DIP systems because raster images are bigger than structured graphics definitions. For example, compressing a CCITT Group 4 two-dimensional image results in about a 15-to-1 savings in disk storage space. The image, therefore, can be read from a disk or a network 15 times faster than an uncompressed image.

You can also use extended GDI calls with page scanners and printers. A single call can scan a page, compress it, format it, and write it to disk. If specialized hardware is available, the compression, formatting, and disk operations can take place concurrently with scanning and printing. Concurrency lets scanners and printers that are controlled by library extensions operate at "rated speed." For example, an HP LaserJet printer can print images at 8 pages per minute without any delays between pages.

Because image files can be formatted in a variety of ways with a variety of file

continued

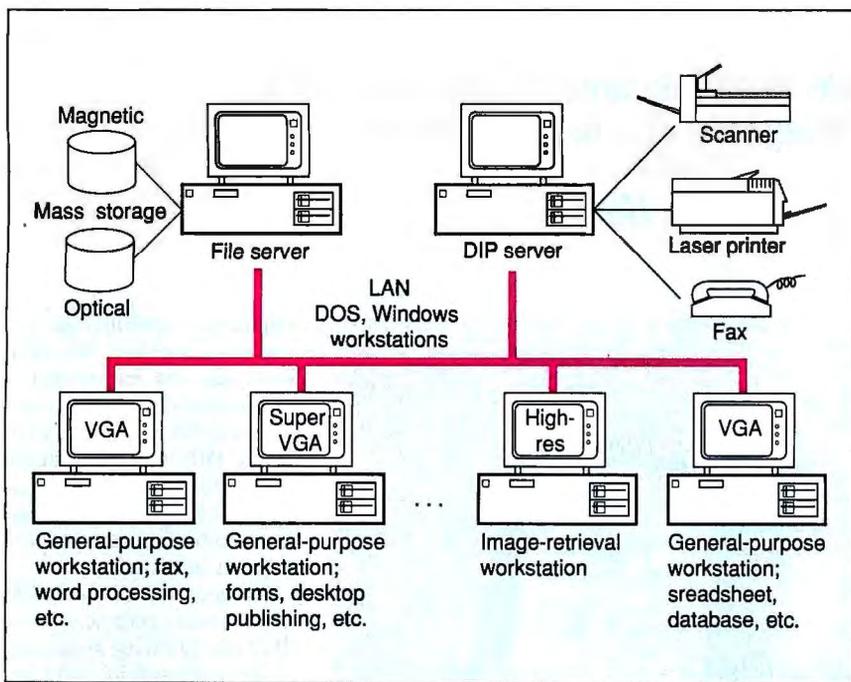


Figure 1: An idealized distributed document-image-processing system provides specialized imaging services, such as scanning and image manipulation, in addition to standard network services.

Listing 1: These code fragments contrast how you display large raster images using the standard Windows' graphics device interface and an extended GDI.

STANDARD GDI	EXTENDED GDI
<pre> get window do { create compatible bitmap read into map create memory DC select bitmap stretch blt DC to window deselect bitmap delete bitmap delete memory DC } while(not end of image) return </pre>	<pre> get window DISPLAYIMAGE return </pre>

Automation For The 90's From The Heartland

CORPORATE COMPUTERS OF IOWA provides the nation's most aggressive prices on all TOSHIBA®, EPSON®, NEC® and PANASONIC® printers, FAX machines, laptops and cellular phones.

Call one of our account executives today and experience the performance and quality you'd expect from the "Heartland."



CORPORATE COMPUTERS OF IOWA 386 PERFORMANCE AT THE NATIONS LOWEST 286 PRICING!!!

CCI AT 286/20 MHZ

80286 Processor Running At 20/10	14" Multisynch Monitor
Phoenix Bios/Digital Speed Display	EVGA Graphics Card
80287 Math Co-Processor Socket	1 - Parallel - 2 Serial - Game Port
8 Expansion Slots	101 Key AT Keyboard w/Dust Cover
1 Meg RAM (Expandable to 8 Megs)	DOS 4.01 w/GW Basic
1.2 Meg Floppy	Surge Suppressor
1.44 Meg Floppy	1 Year Parts and Labor Warranty
80 Meg Seagate ST-4096 (28MS)	30 Day Money Back Guarantee
WD Controller	2nd Year Warranty \$49.95

**CORPORATE COMPUTERS OF IOWA PRICE
\$2,799.00**

1 Year On Site Service Contract \$79.00
Corporate Computers of Iowa Policies

- C.O.D. Cashier Checks
- 30 Day, Money Back Guarantee With 10% Restock Fee
- Prices Subject To Change In Manufacturers Pricing
- Allow 10 Days For Personal Checks To Clear
- Call For Corporate Purchase Orders
- Dealer Inquiries Invited

1-800-533-0948

TOSHIBA LAPTOPS

MODEL	RETAIL	CCI PRICE
T-1000	\$1249.00	\$ 760.00
T-1200F	\$2099.00	\$1299.00
T-1200FB	\$2399.00	\$1485.00
T-1200H	\$3499.00	\$2159.00
T-1200HB	\$3699.00	\$2275.00
T-1600	\$4999.00	\$3000.00
T-3100E	\$4299.00	\$2599.00
T-5100	\$7199.00	\$4300.00
T-5200	\$9499.00	\$5700.00

FREE box of 3.5 Diskettes with every Toshiba

EPSON PRINTERS

MODEL	RETAIL	CCI PRICE
LX-800	\$ 299.00	\$167.00
FX-850	\$ 549.00	\$339.00
FX-1050	\$ 799.00	\$449.00
LQ-500	\$ 529.00	\$299.00
LQ-850	\$ 859.00	\$519.00
LQ-950	\$ 949.00	\$589.00
LQ-1050	\$1199.00	\$699.00
LQ-2550	\$1499.00	\$925.00

Corporate Computers of Iowa offers a "FREE" 6 foot cable with every Epson Printer Purchased!!

CCI STATE OF THE ART COMMUNICATIONS PRODUCTS

MODEL	RETAIL	CCI PRICE
Cobra Porta Fax	\$1295.00	\$ 875.00
GE XR 3500 Cellular Phone	\$ 795.00	\$ 625.00
NEC M3700 ES Cellular Phone	\$ 895.00	\$ 649.00
Mitsubishi Model 800 Transportable	\$1495.00	\$ 975.00
Mobira P-30 Hand Held Phone	\$1395.00	\$ 935.00
NEC 9100 Hand Held Phone	\$1495.00	\$1110.00
Panasonic UF-150 Fax	\$1795.00	\$ 980.00
Panasonic UF-260 Fax	\$2795.00	\$1499.00

**386 25MHz
Tower
\$3399.00**

**286 12 MHz
CALL FOR PRICING**



CORPORATE COMPUTERS OF IOWA

Box 784
North City, Iowa 51301
715-257-2981
Call Toll Free: 1-800-533-0948
Corporate Computers of Iowa
500 5th Street
North City, Iowa 51301

Circle 74 on Reader Service Card (DB) 8/85-85

KoFax Delivers

Founded in 1985, KoFax Image Products in Irvine, California, brings personal computer-based solutions to bear on the problems of creating document-image-processing systems. Its latest solution is an integrated series of products that you can use to create customized DIP applications.

The KoFax 9200 Document Image Processing Series consists of a number of hardware and software products that enable you to create a DIP system of any size or complexity. The heart of the 9200 Series is the developer's toolkit. It includes device-independent DOS and Windows libraries that support vital DIP functions such as image retrieval, display, and manipulation; document scanning and printing; and file compression and decompression. Also included are support for 4GL and object-oriented development environments, and a DIP application.

The KoFax library extensions use storage filters to import and export files. These aid the library extensions in

decoding file data into raster information. The storage filter module allows the graphics device interface (GDI) extension to utilize the concurrency features built into the libraries.

Printer Driver Emulations

Another component of the developer's toolkit is the GDI printer driver emulation. Installed like a standard Windows printer driver, this emulation provides many important benefits, one of which is a significant increase in printing performance.

For example, printing with the HP LaserJet under Windows requires many steps (see figure A). First, the printer driver translates GDI printer functions into equivalent HP PCL (printer-control language) commands. These are transmitted via a serial or parallel connection to the printer where the PCL formatter creates the raster image for printing. The laser engine then prints the raster image.

KoFax eliminates much of this over-

head. The KoFax driver creates a raster image of the page inside the computer. It then transmits the raster image directly to the laser-printer engine, which produces the page. Pages are printed in about half the time it normally takes with a LaserJet. All Windows applications benefit from this accelerated image-printing approach.

Another benefit of the printer driver emulation is not so apparent. You can route the raster produced by the driver not only to the printer but to a fax board or disk (as an image file) as well. Thus, all Windows applications gain the ability to transmit directly to fax machines.

A third feature of the emulation applies to forms and database applications. The driver can print text over an image background with no performance degradation. Thus, a complex form containing graphics can be spooled out to disk as a raster image file and merged later with text from a database application. The forms production effort is reduced to processing the limited amount of character data required to fill in the blanks of a form template.

Engines That Can

Complementing the developer's toolkit are the hardware and software products that provide the image-processing engines required by the library extensions. The basic hardware engine is the KF 9100 Image Retrieval Engine. Available on both IBM PC AT and Micro Channel boards, the 9100 provides basic functions such as expand, scale, and rotate. In a distributed environment, it also retrieves and decompresses images from the network for display on its host computer. The functions of the 9100 are also available from the KF 910 Software Image Retrieval engine, which is a low-cost solution for occasional network viewing.

The most important hardware component of the 9200 Series is the KoFax 9200 Multifunction Document Processor (see figure B). It provides many vital services to a distributed DIP system. (It can also act as a complete single-station system.) Like the 9100, it comes in both AT and Micro Channel flavors and performs basic image manipulation using custom application-specific IC chips. The Advanced Micro Devices Am95C71 performs compression and decompression. Finally, the 9200 pro-

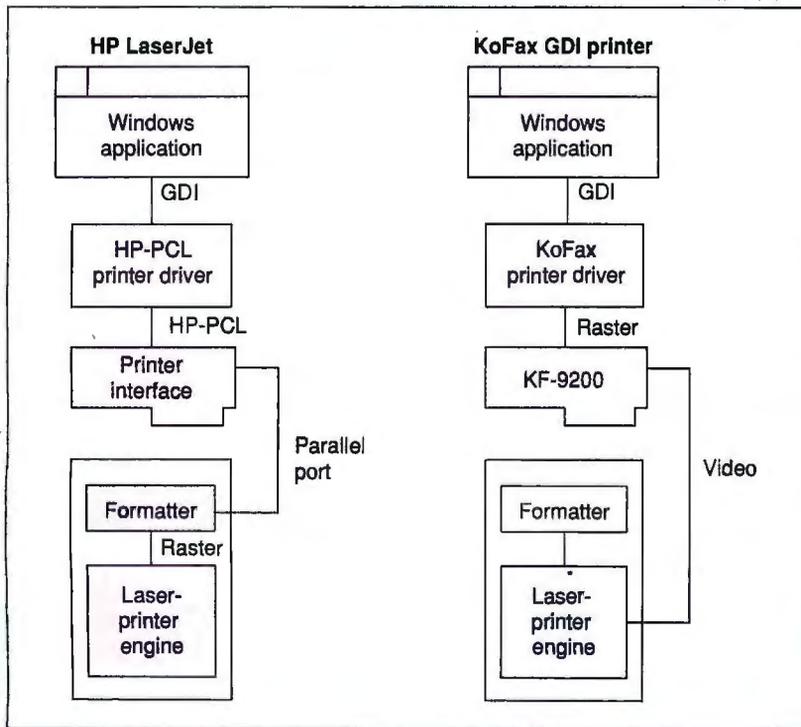


Figure A: Using the standard Windows LaserJet driver, a raster image must be translated into HP printer-control language commands, transmitted to the printer, and re-created by the formatter before it can be printed. The KoFax emulator eliminates the PCL coding and decoding by sending the raster image directly to the laser engine.

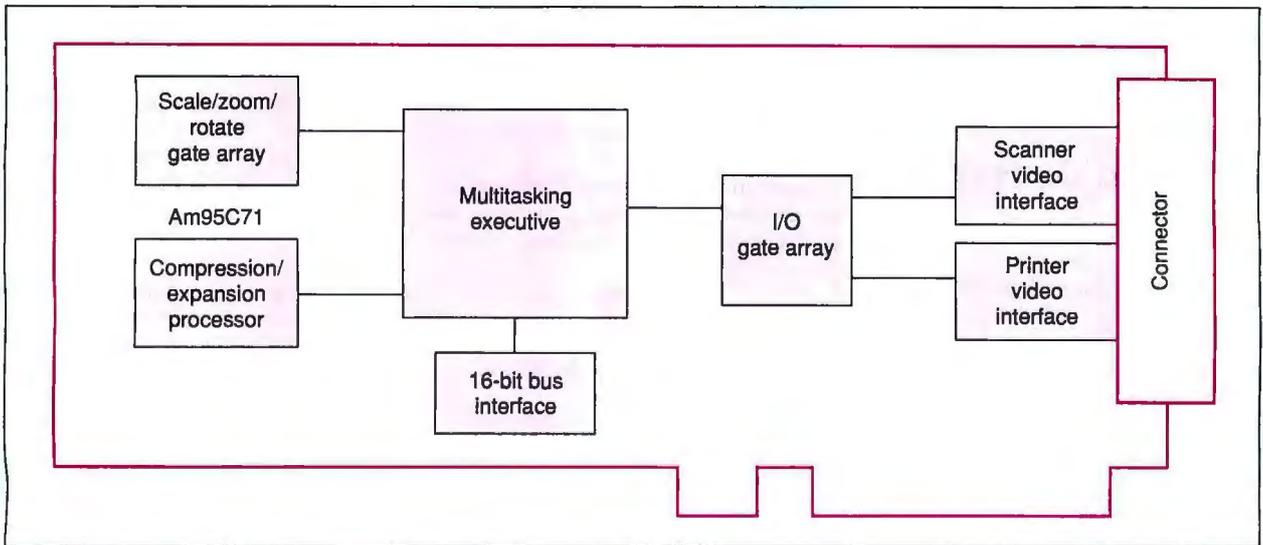


Figure B: The block diagram of the KoFax 9200 Multifunction Document Processor shows how both the image-manipulation functions and the I/O ports can access images stored in the on-board memory cache.

vides direct support for both a scanner and a printer. It is the basic I/O server for a DIP system.

A Custom Fix

The components of the 9200 Series work together to give you access to all the specialized functions required by a DIP application (see figure C). At the lowest level, you find the hardware and software DIP engines that handle all scanning, printing, retrieval, and image-manipulation functions. Above the engines are the image libraries and drivers provided by the developer's toolkit.

You access the components of the Image Library Layer in many different ways. You can write a C application to use the KoFax libraries directly through dynamic link library calls. You can also have any Windows application use the KoFax printer drivers directly for printing or fax transmission. Or, you can develop at the Windows Application Support Layer, where you have two options. First, you could use 4GL development tools to develop a Windows application with DIP capabilities. Second, by direct calls to the KoFax libraries, you could use an existing Windows application, such as Excel, to access the QuickApp high-level image application module using dynamic data exchanges.

The KoFax 9200 Series gives you the hardware and software tools you need to create powerful DIP applications. In a network environment, it also gives you the means to create a paperless office.

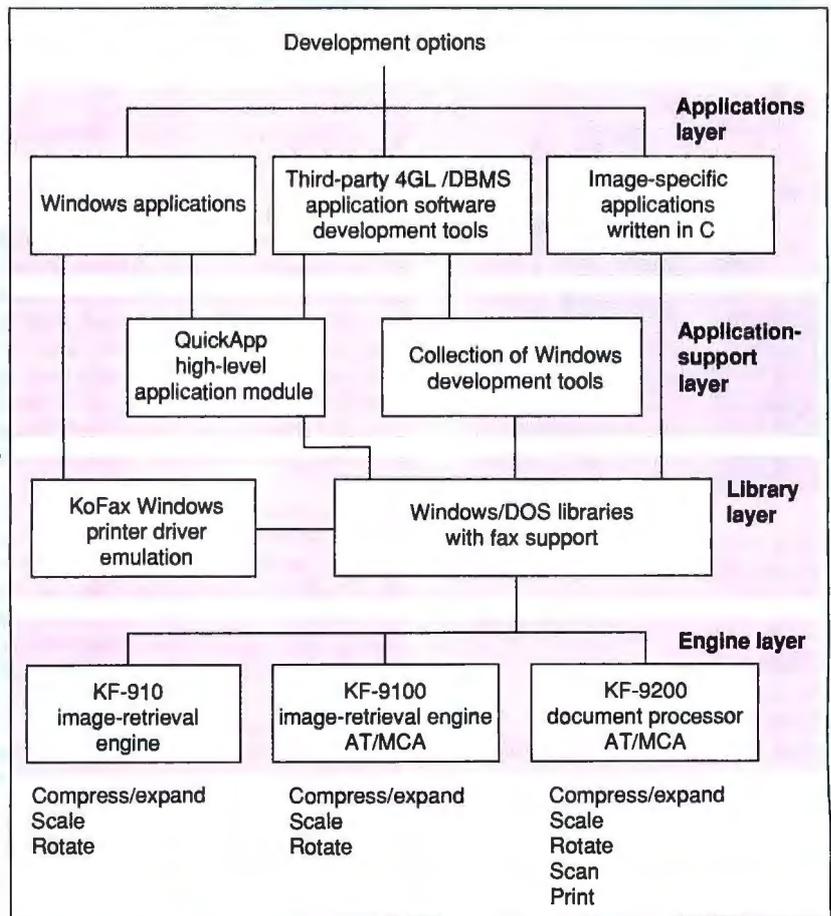


Figure C: The KoFax 9200 Document Image Processing Series uses a layered approach in delivering DIP solutions. You have two options to systems development: You can write an application that accesses the image libraries directly, or you can employ a Windows-based front end.

Industrial Rack PC/AT Chassis

SETTLE FOR THE BEST From The Leading Manufacturer of PC Based Chassis

BEST IN

- **Quality** - Product Reliability
- **Delivery Time** - Off The Shelf Delivery
- **Price** - OEM Pricing
- **Support** - Application and Technical Support



- *Rack & Table Top Available*
- *Supports PC, XT, AT Motherboards and Passive Backplanes*
- *250 Watt Power Supply, 110/220 Volt Operation*
- *High Output Cooling Fans*
- *Rugged, All Steel Chassis*
- *Special Designs are Available!*

Industrial Computer Products

For more information call or write:

(619)279-3642

FAX (619)541-1138
4837 Mercury Street
San Diego, CA 92111

The Leading Manufacturer
of PC Based Chassis...

headers, GDI extensions must be able to generate and interpret different types of file formats. File filters allow you to display different types of images, such as scanned documents, fax pages, and raster images that are generated by other applications.

In addition to extending Windows' imaging functions, you can also extend the standard GDI printer functions to speed

P*C-based
DIP in a distributed
environment is not
limited by technological
barriers, but by lack of
creative development.*

up printing and to directly support devices like fax machines.

Image-Processing Engines

Library extensions to the GDI require either a hardware or a software image-processing engine. Hardware accelerators for decompressing and scaling images are naturally faster than any software solution. They are also naturally more expensive. By working in the background, they allow concurrent image processing to overlap disk I/O and screen paints.

Image compression coupled with concurrent image processing provides significant performance improvements to the Windows environment. This is true for standard Windows applications as well as DIP applications. Hardware retrieval engines are often used with high-resolution (1664 by 1200 pixels) displays on image-retrieval workstations.

Software solutions provide the same image-processing features as hardware accelerators do. They are cheaper, but they lack the concurrency and performance of hardware. However, because not everyone on a network requires rapid image retrieval, the software solution is a cost-effective way to let all network users access an image database.

Developing DIP Applications

To make a DIP system useful, you need to develop a tailored DIP application that

meets your requirements and the specifications of your system. DIP vendors provide a significant amount of application support to assist you in adding imaging to existing applications. This support takes two forms: direct support using high-level image library routines, or remote support using a high-level application module with Dynamic Data Exchange (DDE).

High-level applications can use image script language commands to invoke image operations. For example, a command such as DISPLAY_IMG might pop up a window on the screen and display a specified image within it. These superimposed images appear as child windows from within the application. You could move this window around and manipulate the images within it. Image manipulation capabilities include panning, scrolling, rotating, and zooming up or down within the image window.

Existing Windows applications with DDE command capability can use the extended GDI to access and display image information. For example, you can use the macro, database, and DDE capabilities of Microsoft Excel to build custom imaging procedures. Thus, Excel can act as a simple applications builder. You can use Excel's macro language to issue commands directly to Windows extensions, or you can use its DDE capability to issue commands to a higher-level application module.

Windows development packages, such as Bridge from Softbridge, generate custom image applications quickly. DBMS-based development packages, such as SQL Windows and SQLBase from Gupta Technologies, provide a relational database foundation to manage image filing. You can construct powerful storage and retrieval systems with a multiuser networked version of SQLBase.

DIP on the Horizon

Microcomputer-based DIP in a distributed environment holds great potential for the world of office automation. It is no longer limited by technological barriers, but by the paucity of creative development for tailored applications.

The release of developer toolkits and libraries, however, herald the arrival of sophisticated personal computer-based DIP applications and, with them, the fulfillment of the paperless office. ■

Dean Hough is vice president of engineering at KoFax Image Products. He holds a BSEE from San Diego State University and can be reached on BIX c/o "editors."

Faster computers sooner... from FORTRON.



NetSet™ 286
12, 16, 20 MHz

NetSet™ 325, 333 Desktop or Power

Desktop 286 or 386
12, 16, 20 MHz

As fast as products are designed, that's about how fast you can get them from Fortron. In early 1987 we were one of the first to ship an Intel 386™ based personal computer.

Now we're ready to dazzle you with speed again: the NetSet™ 325 and NetSet™ 333 personal computers, based on Intel 386™ 25 MHz and 33 MHz microprocessors. Designed for optimum performance of CAD/CAM, UNIX, XENIX, and network server applications.

Like all our other personal computers, these come with **one full year of service, free, at your site (USA)**. We're that sure of the reliability. And because we manufacture the computers ourselves, right here in California, you know exactly who to call with any technical questions; and if they do need service, we can fix them fast. **Speed, service, and savings. That's Fortron.**

BASIC SYSTEM PRICES START AT:

NetSet 286-12	386-16	386-20 Plus	NetSet 386-325	NetSet 386-333
\$995	\$1950	\$2400	\$3290	\$5450
512K	2MB	1MB	1MB	4MB

To Order Call Toll Free
1-800-821-9771

In CA 415-373-1008

Leasing Program Available
International Distributors Wanted

386™ is a trademark of Intel Corp.
NetSet™ is a trademark of Fortron/Source Corp.

FORTRON

Fortron/Source Corp.
6818-G Patterson Pass Road
Livermore, CA 94550
Tel: 415-373-1008
FAX: 415-373-1168 TELEX: 559291

- Please have a sales representative call me.
- Please send me more information.
- 1. I am most interested in
 - A. 286-based systems
 - B. 386-based systems
- 2. I am a
 - A. End User
 - B. VAR
 - C. Corporate Purchaser
 - D. DP/MIS.

Name _____
Title _____
Company _____
Address _____
City _____
State _____
Zip _____
Phone No. _____

7/89

BECAUSE YOU CAN SAVE A HUB !

Our ARCNET BUS is designed to eliminate the need for HUBS in a small (up to eight nodes) installation with segments that extend up to 1,000 feet.

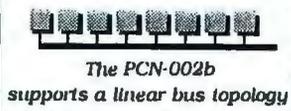
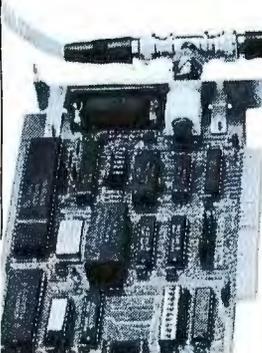
Other Network Products:

- 8-PORT ACTIVE HUB
- TWISTED PAIR ETHERNET BOARD
- TWISTED PAIR ETHERNET CONCENTRATOR
- 16-BIT ETHERNET BOARD
- DISKLESS PC
- CHEAPERNET REPEATER
- INTELLIGENT ETHERNET BOARD
- INTELLIGENT ARCNET BOARD
- MICRO CHANNEL ETHERNET BOARD

NOVELL LABS
TESTED AND APPROVED
NETWARE COMPATIBLE

WHY TAKE A BUS?

8-PORT ACTIVE HUB/TWISTED PAIR ETHERNET BOARD/TWISTED PAIR ETHERNET CONCENTRATOR/16-BIT ETHERNET BOARD/DISKLESS PC



HEADQUARTER
5830 E WASHINGTON BLVD.
CITY OF COMMERCE, CA 90040
TEL:(213) 724-0643
FAX:(213) 724-5453

EAST COAST OFFICE
307 WEST CENTRAL ST.
NATICK, MA 01760
TEL:(508) 820-1102

601 West 112 Ave.
New York, NY 10025
(212) 865-5030

MCA is a trademark of IBM

Distributed Processing Roundup

The list below contains the names and manufacturers of some products that distribute processing over different architectures, operating systems, or networks. The focus is on products that provide distributed processing services to personal computer and workstation users. A listing of distributed database applications is planned as part of the September In Depth.

NetWare RPC from \$950
Lets you develop distributed applications for NetWare implementations. It consists of the RPC Compiler, which produces client and server source code, and the Network Library, which manages the execution of RPCs. NetWare RPC supports Microsoft C and Turbo C, produces International Standards Organization-compatible code, and supports DOS and OS/2 (OS/2 support with Microsoft C 5.1 only).
Novell, Inc.
Novell Development Products Div.
6034 West Courtyard Dr., Suite 220
Austin, TX 78730
(512) 346-8380
Inquiry 1188.

Netwise RPC Tool from \$1250
Supplies C and Ada tools to develop RPC applications. The Netwise RPC Tool supports many architectures (including PC, PS/2, Sun, and VAX), operating systems (including DOS, OS/2, Unix, and VAX/VMS), and networks and protocols (including TCP/IP, Touch OSI, NetWare, LAN Manager, and DECnet).
Netwise, Inc.
2477 55th St.
Boulder, CO 80301
(303) 442-8280
Inquiry 1189.

Network Computing System from \$500
Network software that implements transparent distributed processing using RPCs, a descriptive compiler, and a location broker. Supports Ultrix, VAX/VMS, and SunOS, and Pascal and C compilers.
Apollo Computer, Inc.
330 Billerica Rd.
Chelmsford, MA 01824
(508) 256-6600
Inquiry 1190.

Network File System
(bundled with SunOS)
Allows remote file access over a network. NFS supports many architectures, operating systems, and networks.
Sun Microsystems
2550 Garcia Ave.
Mountain View, CA 94043
(415) 960-1300
Inquiry 1191.

PCILIB \$995
An applications programming interface used to create distributed DOS and Unix applications. PCILIB works in conjunction with other Locus connectivity products such as PC-Interface and Merge 386.
Locus Computing Corp.
9800 La Cienega Blvd.
Inglewood, CA 90301
(213) 670-6500
Inquiry 1192.

TCF for AIX from \$400
Creates a transparent distributed processing environment using TCF LAN under AIX (IBM's Unix). Provides load leveling, shared resources, parallel processing, redundancy, data integrity, and a global file system.
IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 1193.

ZORTECH

T · E · C · H · N · O · L · O · G · Y

C DEBUGGER \$89.95

Zortech's Debugger is the most sophisticated source level debugger now available. Because it is fully compatible with Codeview you can use it to debug Zortech or Microsoft programs.

Single step through source in one window while watching the variables (inc. automatics) change value in another window. You can even alter variables dynamically while the program executes.

Much better than Codeview, and full of advanced features like dual monitor, EMS memory and Mouse support. Call for data sheet.

BOTH FOR \$149.95

C COMPILER \$89.95

The most advanced C compiler money can buy. No junk – just pure performance.

Magazines are too embarrassed to print our optimized benchmark results – they don't want to upset the big guys!



The 600 page manual comes with a great introductory section and lots of solid technical data and examples. Fully compatible with Codeview and the new Zortech C Debugger. You get over 400 functions and the Flash Graphics package with drivers for Hercules, CGA, EGA and VGA – the fastest graphics library available! Context Sensitive Help, an advanced editor/environment, make, touch, five memory models, linker & librarian. Library Source only \$89.95 – Call for data sheet.

C VIDEO \$299.95

Learn C Now! When you buy our C Course the first lesson you learn is in economics. You will save yourself or your company hundreds of dollars in seminar tuition fees.

You get ten one hour tapes containing 36 lessons ranging from the beginners introduction through to more advanced features.

Great for learning C! Any compiler and any operating system. Complete with 365 page workbook (additional copies available at \$29.95) and free Zortech C compiler – Call for data sheet.



HELP!

TECHNICAL HOTLINES

All our products are covered by an extensive FREE technical support hotline which is open five days a week from 9.00 till 5.00 (EST)

USA HOTLINE
617-646-6703
Fax: 617-648-9340

OUTSIDE USA
44-423-501552 (England)
Fax: 44-423-530746 (England)

ZC/TC/MSC TOOLKITS from \$49.95

Please state which compiler you have.

COMMS – \$99.95

Full Communications library with support for up to 8 ports, Xmodem, Kermit, ANSI, VT52, VT100, up to 38,400 baud, etc. 120 page manual.

BTREE – \$79.95

A database function library for C, complete with example program and over 50 functions. Easy to use with 92 page manual.

WINDOWS – \$69.95

Enhance your application with easy to use multiple text windows. Full demo program including 90 page manual.

PROSCREEN – \$69.95

Generates C source code for your application from screens that you draw. Too many features to list.

NEW! C++ VIDEO AVAILABLE NOW!

Please request full data sheets.

C++ COMPILER \$149.95

This is the world's only true C++ compiler for MS-DOS machines – there is no choice. Not to be confused with 'translators' which are slow, expensive, inefficient and not real C++ compilers.

More people use Zortech's C++ than any other C++ on any operating system. Zortech strives to ensure full compatibility with AT&T C++.

Zortech C++ contains all the features of Zortech C including the C compiler itself at no extra cost. Everything is in one neat package. Compatible with Codeview and the new Zortech Debugger. C++ Library Source only \$149.95 – Call for data sheet.



C++ TOOLS \$99.95

Zortech's toolkit of base C++ classes covering a wide range of common programming tasks such as bit vectors, singly and doubly linked lists, dynamic and virtual arrays, binary search tree, hash table, BCD maths, time/date/clock, directory lists, filenames, interrupt and critical error handlers, string editing, text windows and editing.

The 450 page manual also acts as a C++ tutorial which introduces the C programmer to the world of C++. Call for data sheet.

BOOKS



C Primer (Sams) – \$23.95
Advanced C Primer (Sams) – \$23.95
C++ (Stroustrup) – \$29.95
Oops & C++ (Wiener) – \$27.95

ORDER HOTLINE
1-800-848-8408

VISA/MC/COD

Prices do not include shipping

Circle 310 on Reader Service Card



A GUIDE TO GUIs

*Graphical user interfaces make computers easy to use;
keeping them all straight is the hard part*

Frank Hayes and Nick Baran



he world of graphical user interfaces (GUIs) seemed pretty simple in 1984, when Apple introduced the Macintosh. Back then, the genealogy was straightforward: Researchers at Xerox's Palo Alto Research Center begat the Xerox Star; Steve Jobs visited PARC, saw the Star, went back to Apple, and begat the Mac.

But five years later, the begats have become bewildering. The Mac begat Windows—or was it just a cousin? Windows begat Presentation Manager—which doesn't look much like the Mac at all, thanks to IBM, which begat Systems Application Architecture (SAA). MIT begat X Window, which crossbred with PM and NewWave to give birth to Motif. Tandy begat DeskMate, Japan, Inc., begat BTRON, Steve Jobs—back again for a second try—begat NextStep, and Apple has filed a paternity suit against Microsoft. What a mess.

But though there seem to be dozens of GUIs today, it's clear that they all still share similarities that reach below the surface.

Just One of the GUIs

Turn on a Macintosh, and you'll come face to face with the original definition of a GUI for desktop computers. The Mac defined the parts we've come to associate with a GUI:

- a pointing device, typically a mouse
- on-screen menus that can appear or disappear under pointing-device control
- windows that graphically display what the computer is doing
- icons that represent files, directories, and so on
- dialog boxes, buttons, sliders, check boxes, and a plethora of other graphical widgets that let you tell the computer what to do and how to do it

Of course, today's GUIs come in many varieties—not everything that's called a GUI has all these features. For example, some GUIs don't use icons. On others, the icons are optional or

available only sometimes. Some require a mouse, while others will let you work from the keyboard.

GUIs are more similar beneath the surface. Although there are some hybrids, most GUIs consist of three major components: a windowing system, an imaging model, and an application program interface (API). (See figure 1.)

The windowing system is a set of programming tools and commands for building the windows, menus, and dialog boxes that appear on the screen. It controls how windows are created, sized, and moved on-screen, and how the user moves from one window to another, among other functions.

One example of a windowing system is X Window. X Window is *not* a complete GUI—it's just the windowing system shared by a group of different GUIs. Because all the X Window GUIs share the same windowing system, they can also share programming tools for developing applications. (By contrast, Microsoft Windows, for example, is a complete GUI with its own windowing system, imaging model, and API.)

The imaging model defines how fonts and graphics are actually created on-screen. For example, the typeface and size of text in a word processor or desktop publishing program is specified through the imaging model; so are the lines and curves of a CAD program. PostScript may be the best-known imaging model, familiar from laser printers; Display PostScript is a screen version of the PostScript imaging model. The Macintosh imaging model is QuickDraw, and Microsoft's PM for OS/2 uses an imaging model called GPI (for Graphic Programming Interface).

Some GUIs support more than one imaging model. For example, while Sun's NeWS (for Network Extensible Window System) is similar to the PostScript imaging model, it can also turn the screen over to a complete graphics imaging system (such as PHIGS or GKS) for controlling a CAD program.

The API is a set of programming-language function calls—it's how the programmer specifies which windows, menus, scroll bars, and icons will appear on the screen. Both PM and

continued

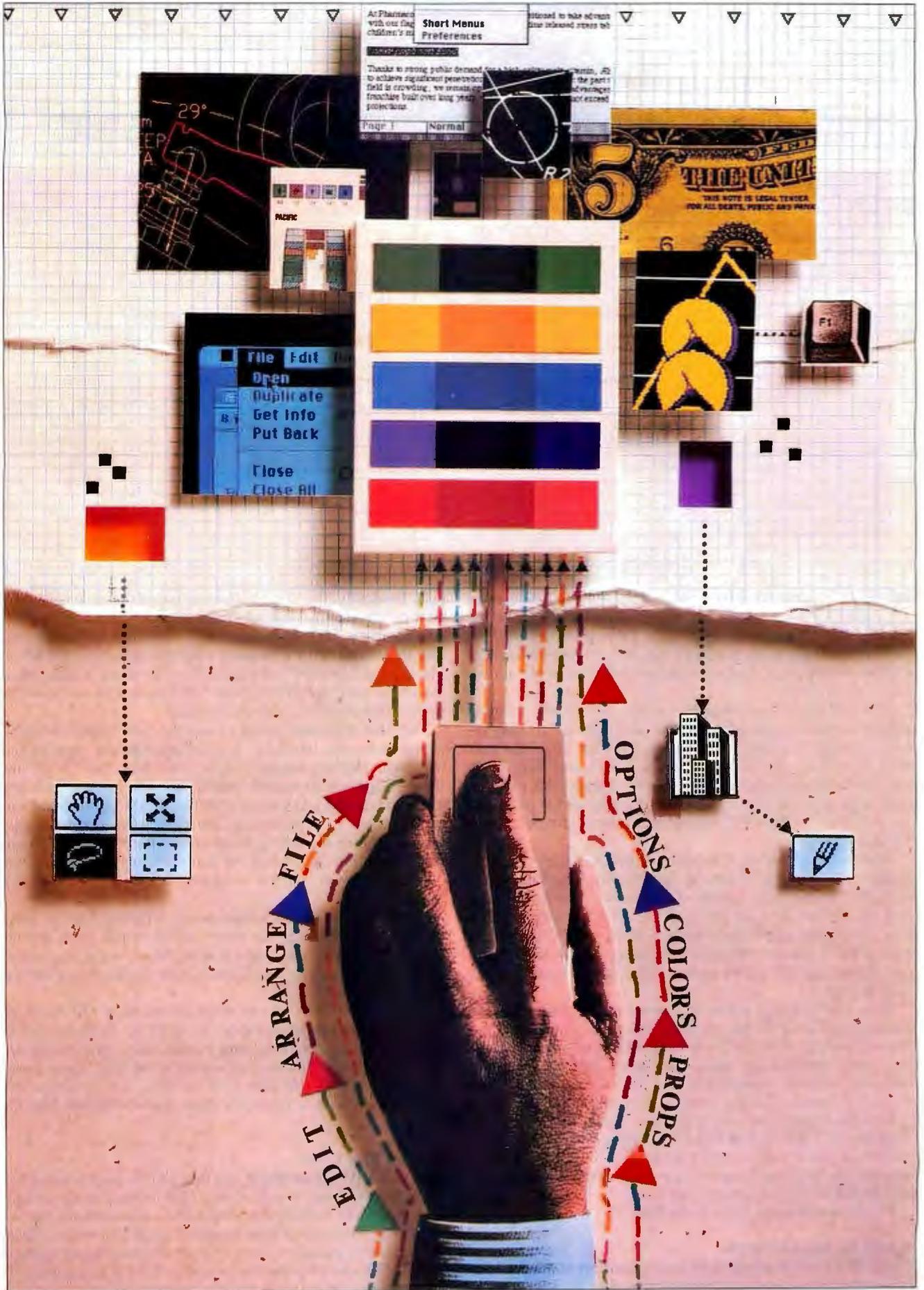


Figure 1: Graphical user interfaces tend to fall into a few camps: those based on IBM's Systems Application Architecture (primarily Windows and Presentation Manager), Unix systems generally built around X Window, and Mac-like systems

	NewWave	Windows	Presentation Manager	CXI	Motif	DEC-windows
API	*		User Interface Controls API	HP X Widgets	XUI	
Windowing system	Graphics Device Interface		Windows API	X Window		
Imaging model	GDI output functions		Graphics API (GPI)	*	Not yet decided	Display PostScript
Operating system	MS-DOS		OS/2	Unix		
CPU	Intel 8086/80286/80386					

Microsoft Windows have their own APIs. DECwindows uses an API called XUI (for X User Interface), which includes function calls for the X Window System. Open Look is the new API for Sun's operating system. NextStep uses its own API (defined by a library of objects called *kits*) and its own windowing system (the *window server*).

On top of these three elements—windowing system, imaging model, and API—some systems also have tools for creating interfaces and developing integrated applications. Hewlett-Packard's NewWave, for example, is not a user interface, but a method for integrating applications and objects from multiple applications—it's a development tool for application programmers. Similarly, NextStep includes a set of tools for object-oriented programming.

Another characteristic that varies widely is the level of integration between the GUI and the operating system. Some GUIs are tightly bound to the system—turn on a Mac, an Amiga, or a NeXT computer, and the GUI appears automatically. By contrast, you must specifically choose Microsoft Windows and most of the X Window GUIs that run under Unix—which could be a hindrance for Unix-based systems trying to appeal to a mass market.

Some GUIs provide access to a conventional command-line interface that lets you, for example, pass arguments to applications or view the text of a file without using the mouse, menus, and icons. NextStep has a console window that lets you get at the command line, whereas the Mac makes you use a desktop accessory to examine files, manipulate them, and so on.

With the similarities and differences defined, it's easier to break the GUI family tree into a few large groups: those based on the distinctive look of IBM's SAA; those built upon X Window and the Macintosh and its apparent offshoots; and a few hard-to-define hybrids and special cases.

We'll begin by going back to the Mac.

A GUI for the Rest of Us

The idea of a standard user interface, regardless of the machine the user is facing, was part of the dream that built the Macin-

tosh. Ironically, the Mac has become one of the most isolated of GUI-based machines, largely because of Apple's litigiousness. Any company that even looked like it might be copying the Mac was threatened with a lawsuit. (See the text box "Of Mice, Menus, and Lawyers" on page 256). The result is that, while the whole world has followed the Macintosh in its use of GUIs, most of that world has gone its own way.

The Mac GUI (see photo 1) was the first widely available mouse-and-menu interface. It established several conventions that have reached beyond GUIs, including the "point and shoot" approach to menus. Before the Mac, you'd look at a menu and choose a key to type. After the Mac, your selections were limited to contextually correct answers—you simply couldn't choose something meaningless. Point-and-shoot interfaces—whether graphical or character-based—eliminated "wrong" answers, since it's impossible to select a choice that isn't available.

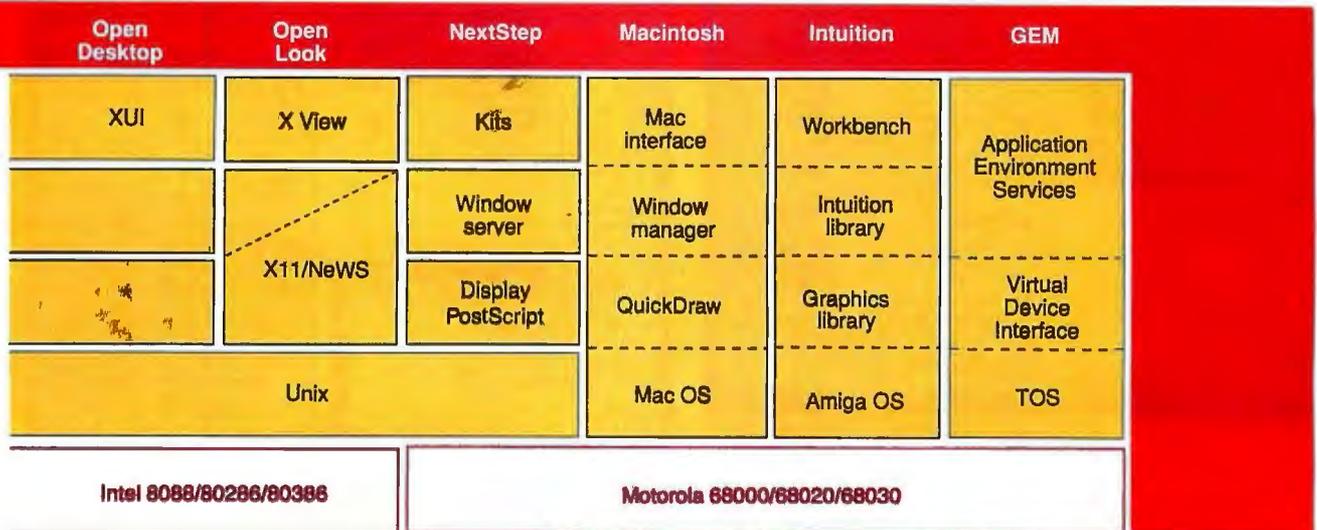
Although its stylistic guidelines are certainly heavily documented, the Mac interface really specifies just three distinct operating systems: the single-tasking Mac Finder, the multi-tasking MultiFinder, and Apple's own Finder clone for the Apple IIGS, ProDOS-16.

The Mac GUI combines all the functions of an API, windowing system, and imaging model in its ROM Toolbox, QuickDraw graphics primitives, and Finder, and these pieces are tightly integrated. The stark efficiency of the QuickDraw imaging model allows the Mac GUI to have reasonable performance, even with a relatively slow microprocessor like the 68000.

The Big Blue Look

IBM's SAA is both more and less than a GUI. SAA is actually a whole family of user interfaces that IBM defined two years ago. SAA interfaces include everything from ground-level character-only systems up to high-powered graphical workstations, and they span machines from PCs up to mainframes running IBM's MVS and VM operating systems. SAA is a complete system architecture, and as a result it covers things that most user

that tend to be tightly integrated and distinctive. In this figure, a dotted line indicates some overlap between the objects on either side of it. An asterisk indicates that the technology is proprietary or that the company has no specific name for it.



interfaces don't—including a standard for networking called the Systems Network Architecture (SNA), and one for database queries, the Structured Query Language (SQL). It also specifies, but doesn't rigorously define, the user interface. An SAA user interface isn't necessarily a GUI, complete with mouse and graphics. Remember, SAA is a standard for everything from glass teletypes on up, so SAA GUIs are really just a subset of SAA user interfaces.

SAA seeks to let any terminal handle any SAA application. Thus, while all SAA applications use the same style of drop-down menus, character-only systems will display only characters—and send only characters back to the application—while mouse-based graphics systems will let the user point and click. However, SAA does create a least-common-denominator situation: The application software ultimately has to choose what the minimum configuration for the SAA terminal is going to be. Fortunately, SAA applications that use terminals are much more likely to involve transaction processing—things like airline ticket reservation systems—rather than CAD systems or paint programs.

The PC-level GUIs that implement SAA are Windows for MS-DOS systems (see photo 2) and PM for OS/2 (see photo 3). Several GUIs based on X Window, including CXI, Motif, and PM/X (discussed below), have an SAA/Windows/PM look and feel designed to let users adapt easily from DOS-based systems to Unix-based systems. (In its original version, Windows was much more Mac-like in its appearance, but between a threatened lawsuit by Apple in 1985 and IBM's definition of SAA in 1987, it has come to look and act like the rest of its close brethren.)

The critical and most distinctive element of SAA GUIs is the fact that they don't depend on a mouse at all. You can do anything in an SAA GUI without a mouse, and, in fact, the system leans heavily on keyboard equivalents, including function keys. (You can gauge the pervasiveness of SAA's influence in the PC world by counting the number of DOS applications that now use the F1 key as the Help key.)

A characteristic element of the mouse-independent nature of

SAA GUIs is the menu bar, which in SAA-speak is called the Action Bar. While the Mac interface requires a mouse-click to pull down a menu, you can do it in an SAA GUI by pressing a key instead.

Another characteristic of SAA GUIs is the style of windows they use. Unlike the Mac window, the size and shape of which you change by dragging the box in the lower right corner, an SAA window can be stretched by any of its borders. And under OS/2, there's an added feature: You can "minimize" a window down to an icon, and the program running in the window will continue to run. (You can also minimize a window under Microsoft Windows, but since Windows is not a multitasking operating system, the program in the window suspends operation until you "maximize" it again.)

While the DOS-based Windows and OS/2's PM share the SAA look and feel, each has its own API, imaging model, and windowing system. Although these parts are similar, they are not directly compatible, and porting an application from Windows to PM is not necessarily an easy task.

The emergence of powerful 80386 machines and the increasing acceptance of Unix as an operating system for them has led to a curious convergence between PM and Unix-based GUIs.

The Unix Brand: X

X Window user interfaces are a wide-ranging group—but underneath it all, X is X. The current version, X11, has become the most popular windowing system for Unix workstations, for two reasons. First, software that's written for the X Window System can (at least in theory) use any X Window display. The application program sends calls to the X Window library, which packages the display requests as X packets and sends them along to the X Window server, which decodes the X packets and displays them on the screen.

If that sounds a little complicated, it's because of X Window's second advantage: Since X Window is designed to work with networks, the software (called a *client application*) and the display may be on different computers. For example, the

continued

A GUI Gallery

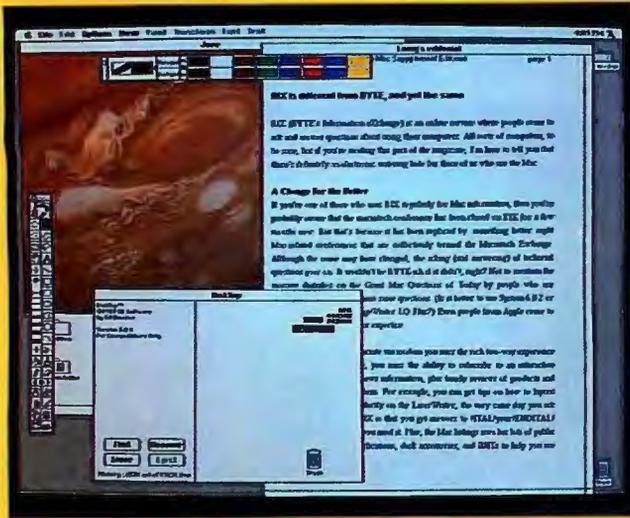


Photo 1: The familiar Macintosh interface, with its windows, icons, and pull-down menus, launched a thousand graphical user interfaces—which promptly took off in their own directions.

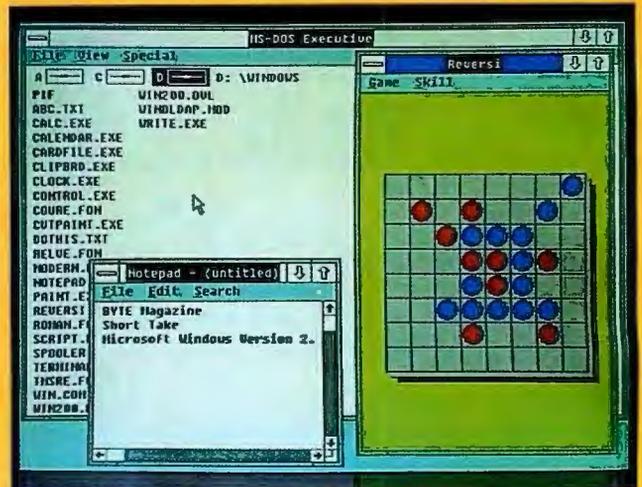


Photo 2: In its original incarnation, Microsoft Windows looked more like the Macintosh interface; a threatened lawsuit from

Apple, as well as IBM's solidification of its Systems Application Architecture, forced a shift to what is now the standard SAA look.



Photo 5: The Common X Interface (CXI), developed by Hewlett-Packard and Microsoft, features a Presentation Manager look on an X Window platform.

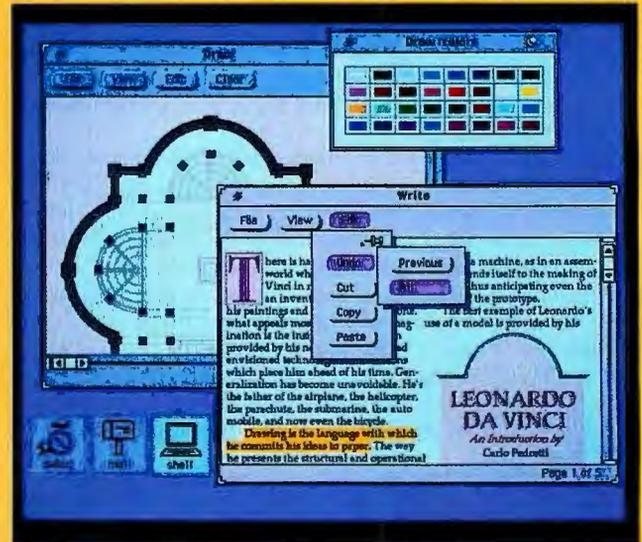


Photo 6: Open Windows, from Sun Microsystems, features the Open Look interface, which provides

several enhancements to the classic windows, icons, and pull-down menus interface.

display can be on a workstation, while the application itself can be running on a mainframe or supercomputer. That's why the display requests have to be put into packets, so they can go zipping along the network as quickly as possible.

Exactly how those packets will be displayed on a workstation depends on the set of *widgets*, or predesigned window elements, the workstation uses. A radically different set of widgets could

make the same program appear different on two separate workstations. But even if the look is different, the behavior of the program will be the same. For example, one workstation might have windows with a Close box in the upper left corner, while another might include it in a pop-up submenu. They'll look different—but whether you click on the Close box or select Close, the window will still close.

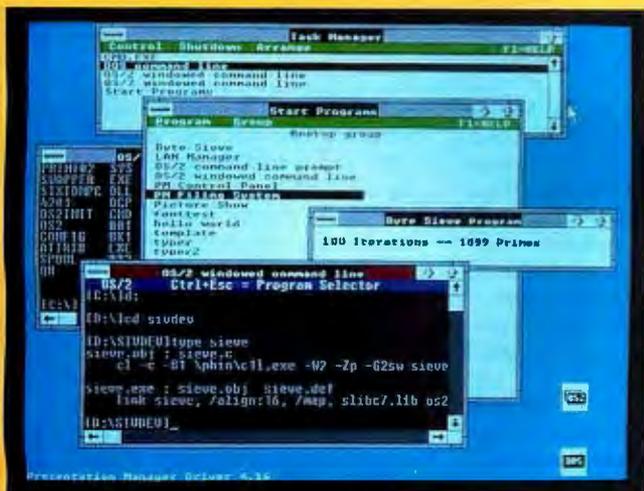


Photo 3: OS/2's Presentation Manager is heir to the Microsoft Windows look and feel, although application developers have found that some similarities are only

skin deep. Currently, several developers of graphical user interfaces for Unix systems are licensing the PM look for X Window-based interfaces.

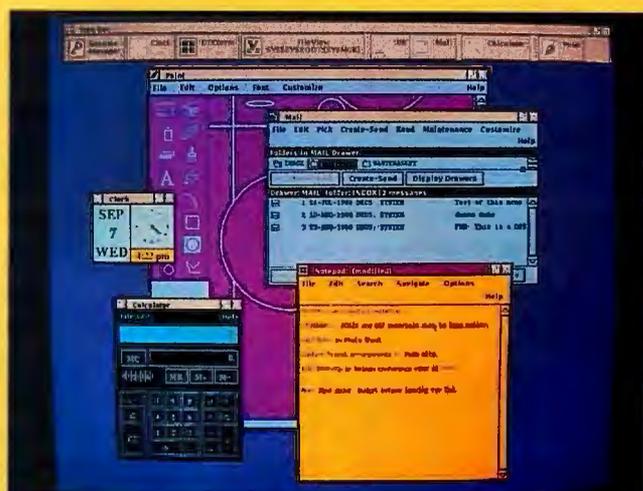


Photo 4: DECwindows, Digital Equipment Corp.'s graphical user interface, was recently licensed by SCO for its integrated Open Desktop product.



Photo 7: Motif, the graphical user interface designed by the Open Software Foundation, combines DEC's XUI and HP's X Widgets with a

Presentation Manager look and NewWave's three-dimensional windows on an X Window platform.



Photo 8: NextStep, the user interface for Steve Jobs's NeXT machine, includes a set of tools for object-oriented programming.

Because X Window is so widespread on Unix workstations, hybrids have cropped up—on some systems, not all display operations are routed through it. For example, Sun's Open Windows system runs on NeWS in parallel with X Window; some display functions go through X Window, while others are handled by NeWS.

Currently, the "look" of X Window GUIs is divided into

several camps: Hewlett-Packard uses an API called HP X Widgets. DEC based its DECwindows interface (see photo 4) on its XUI. Recently, Hewlett-Packard and Microsoft developed the Common X Interface (CXI) (see photo 5), with the look and feel of PM but working within an X Window environment. The Open Windows system from Sun Microsystems (see photo 6)

continued

Of Mice, Menus, and Lawyers

In 1985, Apple Computer threatened legal action against Digital Research, for its GEM operating environment, and Microsoft, for Windows. It claimed that the products infringed on Apple's copyright for the visual display of the Macintosh. Both companies signed agreements with Apple to resolve the disputes out of court.

According to the Apple-Microsoft agreement, Apple was willing to tolerate Windows 1.0 and several other programs (such as Excel) as long as Microsoft acknowledged that the displays of those programs were "derivative works of the visual displays generated by Apple's Lisa and Macintosh graphic user interface programs."

Then, in March 1988, Apple Computer filed a lawsuit against Microsoft and Hewlett-Packard, claiming that Microsoft Windows 2.03 and Hewlett-Packard's NewWave (which runs on top

of Windows) infringed on the Macintosh's copyrighted visual display. Although versions 1.0 and 2.0 of Windows are not all that different (version 2.0 has overlapping windows, fatter screen borders, minimum/maximum icons for sizing windows, and mnemonic keyboard selections in menus and dialog boxes), Apple apparently thought that the program was beginning to look too much like the Mac interface.

Microsoft—mindful of its role as a major provider of Mac software—responded that the latest versions of Windows were covered by the 1985 agreement. Hewlett-Packard, which sells very little software for the Mac, went further, filing a countersuit against Apple. According to the Hewlett-Packard suit, the Macintosh copyrights were invalid because Apple didn't originate its displays but copied them from the work of windowing-interface pioneers

such as Xerox's Smalltalk and Star interfaces. The suit also claimed that Apple had coerced Microsoft into signing the 1985 agreement and was trying to illegally prevent competition in the market for window-and-icon user interfaces.

While many observers thought that Apple could not win the suit, the judge in the case surprised them: In March, he ruled that version 2.03 of Windows was *not* covered by the 1985 agreement. (A ruling that it was covered would have ended the case in Microsoft's favor.)

At this writing, the case is headed for trial to determine whether or not Windows and NewWave infringe on Apple's copyrights. While an out-of-court settlement is again a possibility, some industry observers are concerned that a victory for Apple could spell trouble for other user interfaces and developers of software for those interfaces.

uses Sun's Open Look interface (see "Face to Face with Open Look" by Tony Hoerber, December 1988 BYTE).

Now, however, there is some movement toward a consensus, thanks in part to the Open Software Foundation. Last year, the OSF asked major software developers to submit GUI technologies for consideration as part of a standard operating environment for Unix. To most people's surprise, the OSF chose pieces from three companies—DEC, Hewlett-Packard, and Microsoft. Motif, as the OSF GUI is called, looks like PM, uses parts of the DEC and Hewlett-Packard APIs (as well as the three-dimensional windows from Hewlett-Packard's NewWave), and is based on X Window (see photo 7). The imaging model for Motif has not yet been selected.

Following the announcement of Motif, many companies announced support for the OSF standard and began tweaking their GUI software to be compatible with it. Hewlett-Packard and Microsoft are working on a version of PM for Unix (PM/X), with pieces similar to CXI and Motif. (While CXI merely *looks* like PM but is still based on X Window, PM/X will have its own windowing system. The idea is that PM/X will make it easy for application developers who have created applications under OS/2 to port those programs to Unix.)

Then, in February, The Santa Cruz Operation (SCO), which supplies Xenix, announced Open Desktop. This is a complete user interface for 80386-based Unix systems that incorporates the Motif GUI, DOS compatibility, SQL database facilities, and network support. Even IBM has announced support for Motif, despite the fact that it had earlier licensed the NextStep interface from NeXT. Although it's unlikely that IBM will support two different and incompatible user interfaces on its Unix platform, it could use some of the NextStep technology, such as the development toolkit and object-oriented programming features. Or IBM may have just been hedging its bets when it licensed NextStep, in case OSF failed to come up with an accepted standard interface.

Yet another GUI for X Window is X.Desktop, from IXI,

Ltd., of Cambridge, England (see the text box "Managing the X Window Desktop" by Dick Pountain, page 356, January BYTE). X.Desktop incorporates its own API, although the company is working on implementations that use the Motif and Open Look APIs.

The multitude of SAA GUIs for Unix points up one of the major problems in trying to sort out GUIs—these things don't belong to simple categories. For example, CXI and Motif are X Window GUIs with an SAA look and feel. From the programmer's point of view, they belong to the X camp; from the user's standpoint, they've clearly got the PM look and feel.

Because X Window works on networks, it makes distributed computing a real possibility with mouse-and-menu GUIs. Unfortunately, anything that is graphics-intensive requires a lot of information to pass along a network, which can really slow down response time. X Window users complain that when you move the mouse, you have to wait several seconds for its on-screen pointer to catch up. On the other hand, X Window is the only GUI system that really does work in a multiuser, multi-computer, networked environment. For now, if you want to run windowing software on a Cray supercomputer and see the result on your personal desktop machine, X marks the spot.

The Mac-Like GUIs

Although the Macintosh essentially stands on an island in the GUI world, there are at least two other Mac-like GUIs. One is the original version of GEM from Digital Research (which survives on the Atari ST). Another is the user interface for Intuition, the operating system for the Commodore Amiga.

GEM was originally intended to be highly Mac-like, and so it was; so much so that in 1985, Apple threatened to sue Digital Research for copyright infringement. Digital Research responded by removing the offending features (including overlapping and movable windows) from the PC version of GEM, but the Atari ST version still has a Mac-like GUI. However, the ST lacks many of the Mac Desktop's niceties of implementation,

such as long filenames, the ability to remove things from the Trashcan, proportional typefaces, and automatic saving of the desktop.

While the Amiga's Intuition wasn't threatened with an Apple lawsuit when it first appeared, it too shared many Mac-like characteristics. But Intuition added a feature that Apple didn't include until several years later: It was the first widely used multitasking GUI. Unlike X Window and SAA, Intuition isn't really designed for remote applications—it's a single-user multitasking system. But if the Finder is the father of desktop computer GUIs, Intuition is arguably the father of MultiFinder.

The Next Wave

NextStep (see photo 8) represents the high end of GUIs for single-user computers. NextStep itself is a huge piece of the operating system of the NeXT computer, including a number of utilities that would probably be viewed as applications on most systems. More than any other GUI, NextStep resembles the Mac in its ambition—it wants to change the world. But it also scrupulously avoids being too Mac-like. Unlike the Mac, where a file-selector box can display the files of only one directory at a time, the NeXT GUI can display files in multiple hierarchical pop-ups. It's sort of an improved version of the Mac file-selector box.

NextStep does have application icons; in fact, you can drag an icon out of a window and onto the desktop for convenient use. The idea is to keep regular-use items handy.

The other way NextStep resembles the Mac philosophically is in its rejection of anyone else's standards. In the Unix world, the windowing standard is X Window—but NextStep doesn't use X Window. In fact, nothing in the networking world works with NextStep except NextStep—in many ways, it is designed for a powerful single-user PC running Unix rather than for a fully networked machine.

Another hard-to-classify system is Hewlett-Packard's NewWave, which the company likes to call a "software applications environment." Currently built upon Windows, NewWave features an Object Management Facility that lets you incorporate pieces from different types of applications—word processor, spreadsheet, graphics program, whatever—into NewWave documents. A task manager, called the Agent, acts as a kind of supermacro processor to let you automate repetitive tasks involving a number of different applications. As such, NewWave is part GUI, part "super-application." Hewlett-Packard is developing one version of NewWave that will run on top of PM and another that will run on Unix using the Motif GUI.

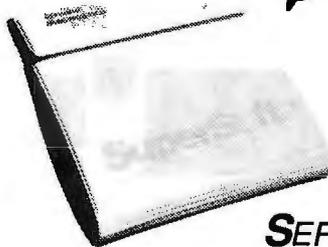
Windows of Opportunity

In the months and years to come, you can expect to see even more interesting things popping up in the windows on your screens: extremely high-resolution images, multimedia applications, full-motion video, and new ways of interacting with data. Programs like NextStep and NewWave point the way to the future, where intelligent interfaces may not only help you to automate everyday tasks, but may even anticipate your actions and thereby increase productivity.

The real question is no longer the one the Macintosh raised in 1984—whether to use a GUI. Today the issue is what *sort* of GUI: which elements are most important, and which you can sacrifice in favor of things like better network performance or low cost. ■

Frank Hayes is an associate news editor and Nick Baran is a senior technical editor for BYTE. They can be reached on BIX as "frankhayes" and "nickbaran."

Want to save Time, Money,
& Headaches?



GET SUPERSOFT'S
SERVICE DIAGNOSTICS

All the software, alignment diskettes, parallel/serial wrap-around plugs, ROM POSTs and extensive, professional documentation to provide the most comprehensive testing available for IBM PCs, XTs, ATs and *all compatibles* under DOS or Stand Alone. No other diagnostics offers such in-depth testing on as many different types of equipment by isolating problems to the board and chip level.

NEW: SuperSoft's ROM POST performs the most advanced Power-on-Self-Test available for system boards that are compatible with the IBM ROM BIOS. It works even in circumstances when the Service Diagnostics diskette cannot be loaded.

NEW: 386 diagnostics for hybrids and PS/2s!

For over nine years, major manufacturers have been relying on SuperSoft's diagnostics software to help them and their customers repair microcomputers. End users have been relying on SuperSoft's Diagnostics II for the most thorough hardware error isolation available. Now versions of Service Diagnostics are available to save everyone (including every serious repair technician) time, money, and headaches in fixing their computers, even non-IBM equipment.

All CPUs & Numeric Co-processors	All Color Graphics & Monochrome Monitors
System Expansion & Extended Memory	Parallel & Serial Ports
Floppy, Fixed & Non-standard Disk Drives	Mono, CGA, Hercules & EGA Adapters
Standard & Non-standard Printers	All Keyboards & the 8042 Controller
System Board: DMA, Timers, Interrupt, Real-time Clock & CMOS config. RAM	

Join the ranks of XEROX, NCR, CDC, SONY, PRIME, ... who have bundled SuperSoft's diagnostics with their microcomputers at no risk because of our 30 day money back guarantee.

Service Diagnostics for PC, PC/XT, and compatibles only.....	\$169
Alignment Diskette for PC, PC/XT and compatibles (48 tpi drives).....	\$ 50
Wrap-around Plug for PC, PC/XT and compatibles (parallel and serial).....	\$ 30
Service Diagnostics for AT and compatibles only.....	\$169
Alignment Diskette for AT and compatibles (96 tpi drives).....	\$ 50
Wrap-around Plug for AT (serial).....	\$ 15
ROM POST for PC, PC/XT and compatibles only.....	\$245
ROM POST for AT and compatibles only.....	\$245
Service Diagnostics: The KIT (includes all of the above—save \$502).....	\$495
Service Diagnostics for 386 or V2, V30, or Harris, etc. (please specify).....	\$195
Diagnostics II is the solution to the service problems of users of all CP/M-80, CP/M-86 and MS-DOS computers.....	\$125
ROM POST for PS/2 and compatibles only.....	\$245
Alignment Diskette for PS/2 and compatibles (3.5 inch).....	\$ 50

To order, call 800-678-3600 or 408-745-0234
FAX 408-745-0231, or write SuperSoft.

your microcomputer repair solution

SuperSoft

FIRST IN SOFTWARE TECHNOLOGY P.O. Box 611328, San Jose, CA 95161-1328 (408) 745-0234 Telex 270385

SUPERSOFT is a registered trademark of SuperSoft, Inc.; CDC of Control Data Corp.; IBM PC, AT & XT of International Business Machines Corp.; MS-DOS of MicroSoft Corp.; NEC of NEC Information Systems, Inc.; PRIME of PRIME INC.; Sony of Sony Corp.

Digitizers

18" x 24" thru 9' x 9' x 9'



We'll cover your digitizer needs with twelve different active areas to choose from. From the GP-7 Grafbar Mark II, ("Flexible, Precise, and Elegant . . .", PC Magazine), all the way through the 60" x 72" GP-8, and of course the user adjustable active volume, (up to 9 ft. cube), of the GP-8-3D. And you can digitize on any work surface.



All our digitizers come complete with RS-232 output format, power supply, two-way communications, a stylus, optional one button and four button cursors, a five function menu, and are IBM-PC compatible. So no matter what your size requirements are, we've got you covered; (at low cost too!).



OEM versions available. Directly supported by AutoCAD, ProDesign II, Generic CADD, CADVANCE, CADKEY, Easy Digit, etc. Also, compatible with Lotus Measure.

For more information contact:
Skip Cleveland (203) 255-1526

We've got your size.

SAC[®] SCIENCE
ACCESSORIES
CORPORATION

970 Kings Highway West, P.O. Box 550

Southport, CT 06490

(203) 255-1526 • Telex 964300

FAX (203) 254-7271

THE QSIM SIMULATION TOOLKIT

*Qsim lets you simulate the behavior of everything
from atomic particles to galaxies*

Roy E. Kimbrell, Linda Correll, and Robert Bass

With the right simulation tools, you can create a model of the universe or of the computer used to model the universe. You can answer questions that would be impractical or impossible to answer otherwise. With the right tools, simulation can be enlightening. With the wrong tools, it can be exasperating.

Some of the tools that modelers have developed are as specialized as a surgeon's, others as general as a hammer. The kind that you might use depends on what kind of model you're making. Some of these models describe and predict the behavior of the atmosphere, or fluids, or plasmas, or the earth during seismic activity. The stresses and strains on a structure, such as a bridge withstanding traffic and wind, require a special-purpose program called a finite-element model and often use a lot of computer power to complete the simulation. Simulations that use sets of partial differential equations to describe the models use custom programs on high-powered machines such as the Cray. Engineers use models of complex VLSI circuits to design and develop the chips. They use special-purpose programs and, perhaps, special-purpose machines to run them.

But we designed our own toolkit, Qsim, for using per-

sonal computers to model systems and LANs. Here, we will provide the Qsim Toolkit, with which you can also model factories, highways, banks, fast-food restaurants, mail rooms, magazine offices, and many other human endeavors.

Two manufacturers that make general-purpose modeling toolkits for the IBM PC are Pritsker & Associates (makers of Slam) and CACI (makers of Simscript). You can expect to pay \$1500 for Slam or (gasp!) \$8600 for Simscript. Either will give you a good start on creating many kinds of models. The documentation and training offered with either package might be just what you need.

By developing Qsim, we found we had better control over the modeling process because of our intimate understanding of the operations of the model. Model development became easier because we used a common programming language, C. Also, we were able to model many difficult processes because we could modify and add to the tools in the toolkit.

The Qsim tools are for creating queuing system models, but you can combine them with various modeling techniques to create other kinds of system models. Examples of queuing systems are everywhere. In the customer line for bank tellers, the customers are the *entities*, the line is the *queue* (the structure holding the entities awaiting

continued



service), and the tellers provide the *service*. Mathematical models of simple queuing systems can describe the lengths of the queues, the waiting time in the queues, and other details quite well. But whenever a few complications enter the picture, the mathematical models fail miserably, and a more direct modeling method is needed. You have to build a simulation of the system with model parts: queues, services, and entities. With the simulated system, you want to find the average behavior and the amount of variation in the system.

You may want to specify both the rate of arrival of entities and the time to service an entity as random variables with specified distributions (time variables that have a probability associated with each possible value). For example, the time you have to wait in line at McDonald's for lunch on Wednesdays will vary from zero (if no one else is in line at the counter) to several minutes (if you came in behind a crowd). There is an average wait at McDonald's on Wednesdays, and the probability of having to wait a longer time decreases the longer you wait.

The relationship between the length of time and its associated probability is a distribution. The interval between customer arrivals might be modeled by an exponential distribution. In a normal distribution, the values near the mean are more probable than those far from the mean. Both the mean and the standard deviation describe the particular normal distribution. Modelers use random distributions to describe the arrival rates of entities, the time to service an entity, and other features of a model.

The Model as an Interpreter

A model developed using the Qsim Toolkit is like an interpreter—similar to a BASIC, APL, or Pascal interpreter. Compiling a program results in machine language instructions that the computer performs to take on the programmer's design. But a program interpreter only models the design. It actually executes many machine language instructions while interpreting (modeling) each program command.

A system is to its model as a compiled program is to its interpreted counterpart. In order to answer questions about throughput and saturation of an Ethernet network at different work loads, we could build a network, run traffic over it, and measure the various details. This is similar to a compiled program. But if we build a model of a network that simulates its actions, we have something similar to an interpreted program. A model built using the Toolkit is interpreted. The scheduler, the create, the queue, and other tools perform the native functions. The data produced by the model approximates the data produced by the real system, just as the interpreted program approximates the actions of a compiled program.

Building a Model

To build a model, first you identify the basic processes in the system, and then you select the tools for modeling each process. You identify which processes create entities, which ones hold entities waiting for service, which ones service the entities, and which ones make decisions about what to do with the entities. You will have to design tools to model the processes that don't fit into these categories. For example, in modeling the low-level contention-backoff mechanisms in the Ethernet protocols, we had to add a tool we called a *trigger*. (We've seen other kinds of tools used to good effect, such as gates, collectors, and event detectors. Their names hint at their functions.)

When designing a new tool, try to keep it simple. If you can, break it down into several tools. This will simplify your design, make it easier to build the model, and, in the process, ensure that you really understand what you are trying to model.

You will also need one or more processes to terminate the entities you create unless you intend them to circulate through your network for the whole simulation. You may also need a process to stop the simulation. However, this service can be performed by a termination process, which counts the number of entities it terminates and then stops the simulation at a threshold. If you have indefinitely circulating entities, use a service routine to count them and terminate at an appropriate time. This service need not take any time; it just counts.

A Simple Example

Figure 1 illustrates a simple computer system. The system consists of a host computer, two operator workstations, and an analyst workstation connected by a LAN. (In this example, the transmission medium is not important, although the actual system modeled was an Ethernet LAN.)

The host receives messages from an outside source and performs an automated analysis of the messages. After the analysis is complete, the host sends the messages to one of the operators. The operator verifies the message and checks for sanity. If a message is garbled or contains questionable information, the operator flags it for review by the analyst. If the message appears to be in order, the operator sends it to the database and processing of the message is complete.

The analyst attempts to restore garbled messages, complete incomplete messages, and verify questionable data. If the message is hopeless, the analyst may terminate the message. Otherwise, it corrects the message and resends it to an operator for processing and entry into the database.

To make this example interesting, we've assumed that 40 percent of the messages need to be sent to the analyst, and, after analysis, 85 percent of those terminate. The other 15 percent go back to operators. We've also assumed that the host releases a message every 15 minutes, and each message spends 20 to 30 minutes with an operator. The analyst may take less time to process a message than the operator does, but the analyzed message might have to sit waiting to get the operator's attention. If a message has to go to the analyst first, the whole process can take an additional 45 minutes. The system administrator wants to know how long a message is in the system.

A run of the simulation for an 8-hour day using 27 messages showed that each message was in the system for an average of 62 minutes. The average wait to get to an operator was 29 minutes, and the average wait to get to the analyst was 8 minutes. Some messages went back and forth between the operators and the analyst—a typical problem in any bureaucracy.

We conducted the simulation using a model constructed with the Qsim Toolkit. This kit contains C language functions and data structures, and macros to help define them. A little "glue" code binds the model together. The functions and data structures are in five basic device groups: creates, queues, decisions, services, and terminates. The packets of data passed from one device to another are called *entities*. Figure 2 diagrams this example.

We selected three different random-number distributions for this model. Messages come in about every 15 minutes using an exponential distribution, a good choice for any kind of arrival distribution, such as customers, messages, and jobs. The operators take from 20 to 30 minutes using a uniform distribution, which delivers equally probable numbers falling into its range. Finally, the analyst needs about 45 minutes using a normal distribution, which produces random numbers grouped about a mean (average). After a simulated 8 hours, the scheduler stops the simulation and prints the results (see listing 1). The simulation takes between 3 and 4 seconds to run on an IBM PC.

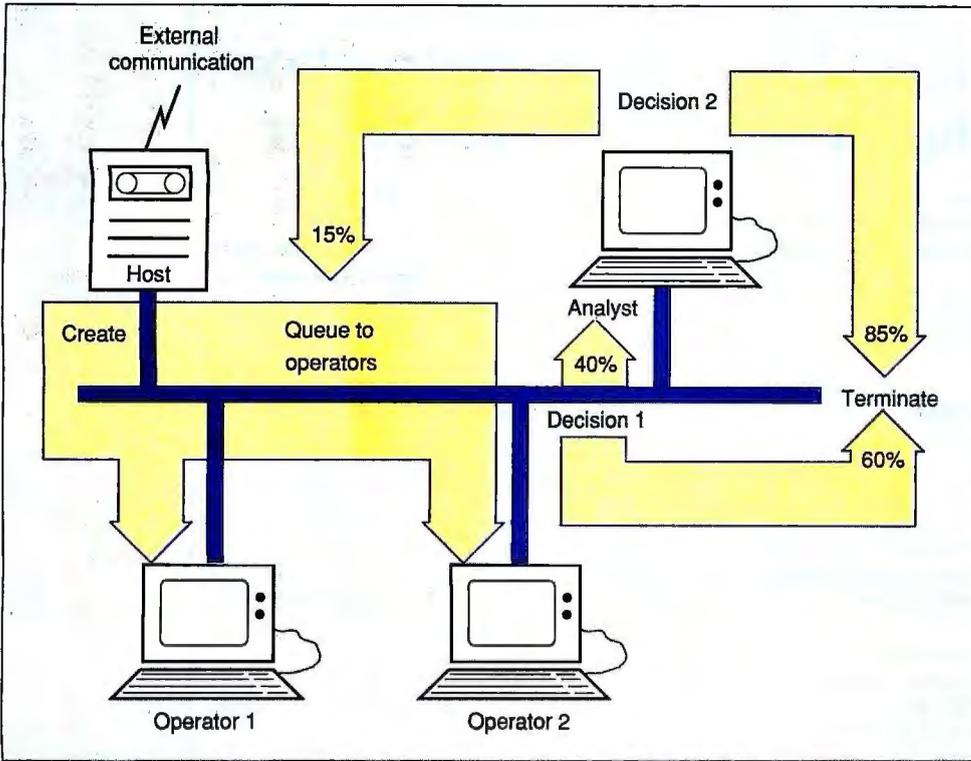


Figure 1: We used Qsim to model an Ethernet LAN with a host computer, two operator workstations, and an analyst workstation.

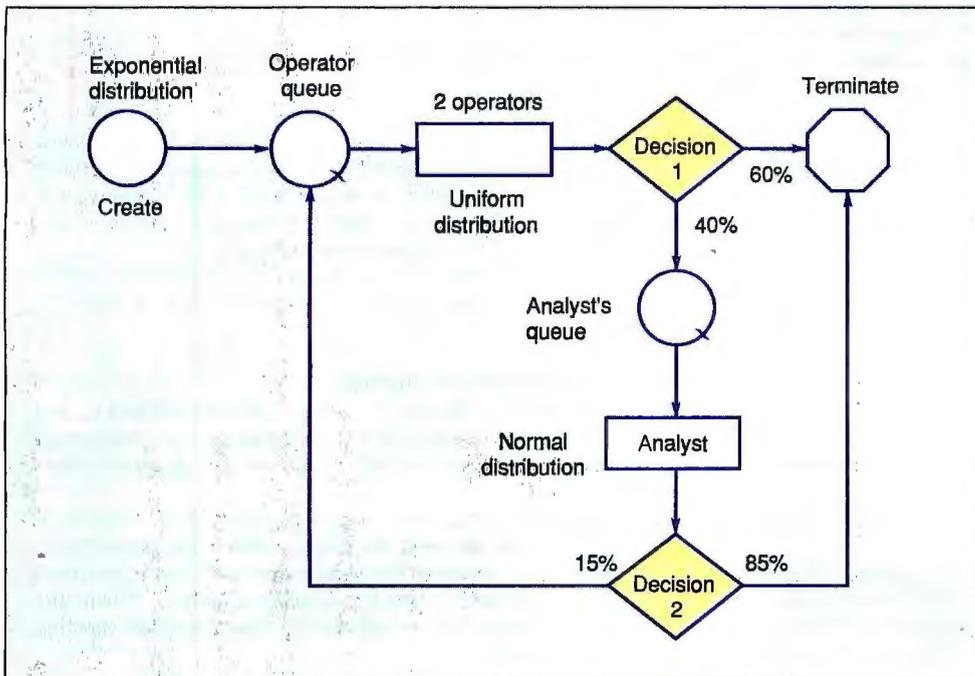


Figure 2: The simulation model is a queue system: Entities (messages) are created by the host every 15 minutes or so and wait in the operator queue until one of the operator servers is free. After waiting from 20 to 30 minutes in the service, the entity enters a decision. The decision sends 60 percent to the terminate device and 40 percent to the analyst. The analyst queue holds each entity until the analyst service is free. After a random time (average 45 minutes), the entity enters the second decision, which sends 85 percent to the terminate device and 15 percent back to the operator queue to await a free server.

The Scheduler

The scheduler operates behind the scenes and coordinates the activities of all the devices; it actually transfers entities among some devices. The scheduler has two parts: the event calendar and the engine. The various devices place data on the calendar by calling a Toolkit library function. The records placed on the calendar contain a pointer to a function, an optional pointer to an entity, and a time. When that simulated time arrives, the engine calls the function and passes an entity, if there is one.

Here is how it all works: The initialization device places

calls to the create device in the model and a call to the stop function on the event calendar. Then, initialization calls the engine, which takes the next record from the event calendar and calls the function indicated by the pointer in the record, handing over any entity that is pointed to in the record. Suppose this is a call to create. The create device allocates memory for an entity and calls the operator queue, handing over the entity.

The operator queue puts the entity on its own internal queue and calls the operator service. The service looks at a local static

continued

String and Variable Construction Using an ANSI C Preprocessor

Before ANSI C, C programmers used peculiarities of their particular C preprocessors to facilitate code writing. A generation of C programmers established these tricks as an unwritten set of rules.

Two special features of the preprocessor seemed most vulnerable to this abuse: parameter substitution in strings, and comment elimination.

Parameter Substitution in Strings

The expansion of `baker(foo)` by

```
#define baker(X) "X"
```

might be either "X" or "foo" depending on the implementation of the preprocessor. In the first case, the preprocessor protects strings from parameter substitution. In the second, the substitution is made.

The ANSI X3J11 committee specified the # operator to accomplish the equivalent of substituting parameters into strings within the macro's body. With this, the programmer can build up strings consisting of substituted parameters and explicit strings. The preprocessor looks for a parameter name following a #. When it finds one, it creates a string consisting of the substitution argument. When all strings have been created, those separated only by white space are joined. For example,

```
#define fubar(able, baker) \
    #able " and " #baker " or " #able #baker \
    " or " #able#baker
```

would expand `fubar(foo,bar)` to

```
"foo" " and " "bar" " or " "foo bar" " or "
"foobar"
```

which, after string concatenation, becomes

```
"foo and bar or foo bar or foobar"
```

(The # and the parameter name can be separated by white space, as in #able.)

Comment Elimination

When the preprocessor eliminates comments after parameter substitution but before passing the program text on to the compiler, programmers can use the comment delimiters /* and */ to create variable names. /**/ is a signal to other programmers that parameter concatenation is intended. Take, for example, the statement

```
#define able(X,Y) X/**/Y
```

The statement `able(foo,bar)` would expand to `foobar`. Suppose you wanted to create a debug statement to print the values of a couple of variables. Further suppose that the variables you are printing all start with `dog` but end in a unique string. You might write the preprocessor statement like this:

```
#define debug(first, second) \
    printf("first = %f, second = %d\n", dog/**/first, \
    dog/**/second)
```

But, depending on how your preprocessor works, `debug(1,2)` might expand to

```
printf("1 = %f, 2 = %d\n", dog1, dog2);
```

or

```
printf("first = %f, second = %d\n", dog1, dog2);
```

or, if comments are removed before parameter substitution, it might expand to

```
printf("first = %f, second = %d\n", dogfirst, \
    dogsecond).
```

The ## operator is used to join parameters with other text or with parameters in the macro's body. It is a concatenation operator. For example, `#define fubar(X,Y) X ## Y` expands `fubar(foo,bar)` to `foobar`; `#define snafu(Y) printf("%d\n", rhythm_ ## Y)` expands `snafu(aces)` to `printf("%d\n", rhythm_aces)`; and `#define secret(X) printf("%d\n", Y ## _o_mine)` expands `secret(pal)` to `printf("%d\n", pal_o_mine)`.

ANSI Standard C Compilers

We use the latest versions of Lattice C, Microsoft QuickC, and Borland Turbo C on an IBM PC. At the present, the only one of the three that can successfully support these operators is Borland Turbo C.

Microsoft claims QuickC supports the full draft ANSI standard, but a bug prevents the preprocessor from properly expanding the ## operator. Perhaps this will be fixed soon. However, the standard is quickly nearing approval. When this happens, there will be a mad rush to issue compilers meeting the full standard.

Until that time, it is well to be aware of the new things in the draft standard and to attempt to write code using them.

variable to see if it's busy. (Since the service has two servers, the busy variable is really an array of two.) The variable contains the time at which the server expects to be free. If the current time is earlier than the scheduled time, the server is assumed to be busy. But if a server is free, the service calculates a service time and sets the server's variable. It then places a call to the first decision on the event calendar. The time in the call record is the time the service expects to be done with the entity.

The service also places a pointer to the entity in the record. Then it returns the service time to the queue.

If the service rejects the entity because it's busy, it returns a -1. If the service accepts the entity, queue removes it from the queue and places a call (back to itself, but without an attached entity) on the event calendar. The time in the call is the current time plus the service time. When the service time has passed, the queue can try to pass another entity off the top of its queue

Listing 1: The output from Qsim Toolkit.

```
Total time in system = 1670.2085, count = 27
Average time in system = 61.8596
Max time in system = 132.1292
Min time in system = 20.1056
```

SERVICES:

name	total	total busy	utilization
s_operator	30	745.3597	1.5844
s_analyst	4	158.3463	0.3280

QUEUES:

name	max_len	cur_len	total_wait	count	avg_wait
q_operator	5	0	871.8822	30	29.0627
q_analyst	2	2	46.4740	6	7.7457

to the service.

The queue now returns to the create device, which computes the next time it should create an entity, places a call to itself on the event calendar with that time, and then returns control to the engine. The engine takes the "soonest" record off the event calendar and calls the function pointed to. Eventually, it will call the first decision and pass the entity stored there by the service. The first decision will generate a random number between 0 and 1. If this number is less than 0.65, it will call the terminate passing the entity. Otherwise, it calls the analyst's queue. The analyst's queue, the analyst's service, and the second decision all behave as previously described. The terminate device tallies the counts and times associated with the entity.

Eventually, the engine will call the stop function placed on the event calendar by initialization. The stop function will print statistics and exit, thereby ending the simulation.

The Qsim Toolkit

We designed the Toolkit with two principles in mind:

- All the programming should be in ANSI C (or as close to the proposed standard as we can make it), thereby obviating the need for a special preprocessor to create modeling code or the need for a "simulation" language such as Simscript or Slam.
- The programming should be as simple as possible.

We tested the simulation Toolkit by coding both simple and complex models in Slam and with a combination of Qsim and Turbo C. The results were somewhat different because of the different random-number-generation techniques.

However, we ran all the models for extended periods to assure ourselves that the statistical results were valid. Averages and standard deviations, for example, approached the same values for the same model in both Slam and C. Finally, using mathematical techniques, we computed the results of the simplest models and found the Toolkit to give the proper values.

Coding the Example

Listing 2 contains the macros that generate the code describing the devices. The three DEFINE macros declare function prototypes and allocate storage for queue and service structures. The queue structure holds the top of a queue, as well as performance data such as maximum and minimum numbers in the queue. The service structure holds performance data only. The type of

Listing 2: The macros that are used to define function prototypes and allocate storage to queues and service structures. (The #s and ##s internal to the define statements are ANSI C extensions to the C preprocessor directives. See the text box "String and Variable Construction Using an ANSI C Preprocessor.")

```
#define DEFINE_CREATE(c_name) \
void c_name();\
#define DEFINE_QUEUE(q_name) \
void q_name(ENTITY *);\
QUEUE_STRUCT q_name ##_q={#q_name};\
#define DEFINE_SERVICE(s_name) \
systime_t s_name(ENTITY *);\
SERV_DATA s_name ##_s={#s_name};\
#define SCHEDULE(name, entity, time) \
schedule(name, (ENTITY *)entity, \
(systime_t)(time));\
#define CREATE(c_name, create_time, feature, \
create_freq, next_device)\
void c_name(){\
extern systime_t now;\
next_device(create((systime_t)create_time, \
(double)feature));\
SCHEDULE(c_name, 0, now+create_freq);\
}\
#define QUEUE(q_name, next_device) \
void q_name(ENTITY *entity){\
systime_t srvertime;\
ENTITY * top;\
if (entity) nq(&q_name ##_q, entity);\
if ((top = topq(&q_name ##_q)) &&\
srvertime=next_device(top)) >= 0){\
dq(&q_name ##_q);\
SCHEDULE(q_name, 0, srvertime);\
}\
/* increment counters (if desired) */\
}\
#define SERVICE(s_name, number_servers, \
service_time, next_device)\
double s_name(ENTITY *entity){\
static systime_t srvertime[number_servers],\
wait_time;\
extern systime_t now;\
unsigned short i;\
for (i=0; i<number_servers; i++) \
if (srvertime[i] <=now)\
break;\
if (i == number_servers) return -1;\
/* note: service_time may be a function call */\
wait_time = service_time;\
srvertime[i] = now + wait_time;\
SCHEDULE(next_device, entity, srvertime[i]);\
/* increment counters */\
q_name ##_s.total++;\
q_name ##_s.total_busy += wait_time;\
q_name ##_s.srvertime = srvertime[i];\
return srvertime[i];\
}
```

data in these structures is up to the modeler.

The SCHEDULE macro is just an easier way of calling the schedule function. The casts are necessary when constants (such as 0) are used as parameters.

CREATE calls the create() library function to make a new entity. It then passes an entity pointer to the device named in

continued

Listing 3: A simple example of Qsim's decision devices, terminate devices, and the stop function.

```
void decision_1(ENTITY *entity){
    if (drand() < .6) term(entity);
    else q_analyst(entity);
}

void term(ENTITY *entity){
    /* increment counters then ... */
    free(entity);
}

void stop(void){
    /* compute and print statistics then ... */
    exit(0);
}
```

Listing 4: The C language source code using the Qsim Toolkit for the example in figure 1.

```
#include <stdio.h>
#include "sim.h"
#include "sim_lib.h"
#include <float.h>

DEFINE_CREATE(messages);

DEFINE_QUEUE(q_operator);
DEFINE_QUEUE(q_analyst);
QUEUE_STRUCT
    *q_array[]={&q_operator_q,&q_analyst_q,NULL};

DEFINE_SERVICE(operator);
DEFINE_SERVICE(analyst);
SERV_DATA *s_array[]={&operator_s,&analyst_s,NULL};

void decision_1(ENTITY *);
void decision_2(ENTITY *);
void term(ENTITY *);
void stop(void);

void main(int ac,char **av) {
    SCHEDULE(messages,0,0);
    SCHEDULE(stop,0,8*60.0*10);
    engine();
}

CREATE(messages,now,0,expon(15.0),q_operator)

QUEUE(q_operator,operator)
SERVICE(operator,2,unfrm(20.0,30.0),decision_1)

void decision_1(ENTITY *entity){
    if (drand() < .6) term(entity);
    else q_analyst(entity);
}
```

```
QUEUE(q_analyst,analyst)
SERVICE(analyst,1,normal(45.0,10.0),decision_2)

void decision_2(ENTITY *entity){
    if (drand() < .85) term(entity);
    else q_operator(entity);
}

static systime_t total_time, max_time, min_time
    =FLT_MAX;
static unsigned count;

void term(ENTITY *entity){
    systime_t tis;

    count++;
    tis = now - entity->time;
    total_time += tis;
    if (max_time < tis) max_time = tis;
    if (min_time > tis) min_time = tis;
    free(entity);
}

void stop(void){
    int i;

    printf("Total time in system = %f, count =
        %d\n",total_time,count);
    printf("Average time in system =
        %f\n",total_time/count);
    printf("Max time in system = %f\n",max_time);
    printf("Min time in system = %f\n",min_time);
    printf("\nSERVICES: name|total|total busy|total
        |utilization|\n|-----|-----|
        -----|-----|\n");
    for (i=0;s_array[i];i++)
        printf("%15.s\t%d\t%f\t%f\n",
            s_array[i]->name,
            s_array[i]->total,
            s_array[i]->total_busy,
            (s_array[i]->srvtime)
            ? s_array[i]->total_busy/s_array[i]->srvtime
            : 0
        );
    printf("QUEUES\n");name|max_len|cur_len|total wait|\
        count|average_wait|\n|-----|-----|
        -----|-----|-----|\n");
    for (i=0;q_array[i];i++)
        printf("%15.s\t%d\t%d\t%d\t%f\t%d\t%f\n",
            q_array[i]->name,
            q_array[i]->max_len,
            q_array[i]->cur_len,
            q_array[i]->total_wait,
            q_array[i]->count,
            (q_array[i]->count)
            ? q_array[i]->total_wait/q_array[i]->count
            : 0
        );
    exit(0);
}
```

the macro's parameter list. Finally, it schedules a call to itself. Notice that the function makes no provision for rejecting the entity. The device must be a service with a short service time, a service with plenty of servers, or a queue. If the device is not a queue, there is room here for a subtle bug when it rejects entities and the create doesn't test for it.

QUEUE defines a function that accepts a pointer to an en-

tity. When an entity pointer exists, QUEUE calls nq() to place the pointer on its queue. Then, if an entity pointer is on the top of its queue, it calls the service s_name, passing on the entity pointer. The service returns a positive number (or 0) when it has accepted the entity. QUEUE removes it from the queue and schedules a call to itself with a null entity pointer. When this call to itself is made, the queue attempts to pass another entity

off the top of its queue to the service. The call is scheduled even if no entity is presently on the queue, because an entity may arrive before the service is ready to accept another. The `nq()` and `dq()` functions maintain some counters in the queue's `QUEUE_STRUCT`, but you may want to add to the `QUEUE` macro.

`SERVICE` accepts an entity pointer. This function allocates a static array of counters for the service times. `DEFINE_SERVICE` could include this array in the `SERV_DATA` structure in the same way that `DEFINE_QUEUE` builds its queue structures. It's a matter of preference. The `now` variable contains the virtual simulation time and is updated by the engine. The service function looks at the time remaining in all the slots in the `srvtime` array; if all servers are still busy, the service function rejects the entity. Otherwise, it computes a `wait_time` (the time the server will be free again) and schedules a call on the next device. The `SCHEDULE` call contains a pointer to the entity. When the engine calls the device, it passes this pointer.

Listing 3 is a simple example of decision devices, terminate devices, and the stop function. We used these macros in coding the example shown in listing 4.

We didn't use macros to define the decision and terminate devices and the stop function because these definitions seem to vary from model to model. These devices could make their choices based on anything in the model—on counts, calculated values, or events—not just on random numbers. The stop function only needs to display the simulation statistics.

In the example in listing 4, the engine calls `decision_1()`, passing an entity pointer. Sixty percent of the time, `decision_1()` calls `term()`; 40 percent of the time, it calls `q_analyst`. In both cases, control over the entity is passed. This is an example of a simple decision. In other models, the decision could be made based on a value carried by the entity (perhaps in `feature`) or based on something else in the model—the number of entities in a queue, for example.

The `terminate`'s main job is to update counters that keep track of the number of entities successfully traversing the model and the time they take doing so. It is also responsible for freeing the memory allocated to the entities. The `term()` function could, if desired, call `stop()` when a certain number of entities arrive. The stop, whether called by `term()` or by the engine, prints the statistics and exits.

While analyzing your system and identifying the various processes, you will also decide how each process passes the entities on to the next process. In the same way, the tools will pass entities from one to another. In listing 2, we list the code for `CREATE`, `QUEUE`, and `SERVICE` macros and show a sample decision. In each of these, there is a `next_device` specified. The names here are used to connect one device to another.

Suppose you want to model a workstation that spools print jobs to a queue and a printer server. The workstation is modeled by the `CREATE` and the `QUEUE`, the printer server by the `SERVICE`. You would connect a `CREATE` named `c_workstation_1` to a `QUEUE` named `q_workstation_1` to a `SERVICE` named `s_printer_server`. The code would look like this:

```
CREATE(c_workstation_1,0,0,normal(10,5),
      q_workstation_1);
QUEUE(q_workstation_1,s_printer_server);
SERVICE(s_printer_server,1,unfrm(10,15),
        terminate_1);
```

Here, the distributions (`normal` and `unfrm`) describe how often a new entity is to be created or how long it will take to service the entity. The `terminate_1` is another device used—in this case, to terminate the entity and free the allocated memory.

You can give it other uses. Some of the tools are macros; others are C code. All assume the presence of a background scheduler activating tools and, perhaps, passing entities to them.

Coding a Model

When coding your own model, place the tools in the following order:

- *Includes.* Be sure to `#include` "sim.h" and "sim_lib.h". `Sim.h` contains the macros that `#define` some of the tools, as well as type definitions for various data structures. `Sim_lib.h` contains function prototypes for the scheduler, for some of the queuing primitives (`nq`, `dq`, and `topq`), for the random number generator (`drand`), and for some distributions (`expon`, `normal`, `unfrm`, and so on).
- *Prototypes.* These are C language function prototypes. However, there are macros to help write the `create`, `queue`, and `service` prototypes. You will need to write your own prototypes for `decision`, `terminate`, and `stop` functions.
- *Service data array.* If you use our style of coding, the following will work:

```
SERV_DATA *s_array[]={&service_name_s, &service
                      name_s, ... , NULL};
```

Each service collects data on the number of entities it processes and the time it takes to process them. When the `DEFINE_SERVICE` macro creates a prototype service function, it also creates a data structure to hold this data. The `s_array` holds pointers to these structures (the reason for the `_s` at the end of each service name). At the end of the simulation, the stop routine prints out the data from the service data structures. The `NULL` at the end of the list of service names controls looping.

- *Queue data array.* Like the service data array, the queue data array holds data about the number of entities on the queues and how long they stay there. The definition and syntax is similar to that of the service data array:

```
QUEUE_STRUCT *q_array[]={&queue_name_q, &queue
                          name_q, ... NULL};
```

- *Main function.* The main function just schedules starts for all the `create` devices, schedules a call to the stop function if you want the simulation stopped at a specific time, and then calls `engine()` to start the simulation. It should look like this:

```
void main(){
    SCHEDULE(create_name,0,start_time);
    SCHEDULE(create_name,0,start_time);
    %
    %
    %
    SCHEDULE(stop,0,stop_time);
}
```

The `create_names` are the names of the creates declared in the prototypes above. The `start_times` are the times you want each create to start producing entities; if you want this to take place at the beginning of the simulation, use zero. `Stop` is the name of the stop function. (A stop function is any function that exits the program without returning to the calling function.)

- *Create, queue, service, decision, terminate, stop, and other functions.* The `create`, `queue`, and `service` functions are created by using the macros. When invoked, these macros define entire

continued

functions. The functions differ as their parameters differ. For example, create functions differ in their names, their start times, their frequency of creates, and the device to which they pass their created entities.

If decision devices are used, these functions will form an interconnected network. Place the macro calls and other function definitions in whatever order you please. (If you faithfully use prototype definitions of the functions, the order isn't important to C.) We usually start at one side of our picture of the system and continue across the picture to the other side. (Grouping functions by type makes it difficult to debug the model because its form is not as clear.)

Extending the Toolkit

The Toolkit has primitives for queuing system models. But what about other kinds of models? Can the Toolkit be extended to enable it to build others? In general, it can, though for some complex models the tools are specific to the particular model. But general-purpose techniques tend to be slow.

Aside from these exceptions, models are generally based on systems of mathematical equations. Often the model can be stated briefly, in less than a page of code. Other aspects of the model (such as routines for computing special mathematical functions, input routines, and display routines) may add many more pages of code to the model. The equations are difficult or impossible to solve exactly (otherwise, there would be no need for the model), and their solutions are approximated by using iteration. Systems of equations might model something as simple as the inventory in a store or as complex as a chemical reaction.

A mathematical model and a queuing model can interact through an event and a reaction. An event occurs in a queuing system when something in the system causes one or more variables to change value. A reaction is a decision made on the basis of the value of a variable.

Some Examples

The inventory level for an item in a store decrements when a customer buys one. The event is the change in the quantity in stock; the reaction is the decision to order more stock. This decision is usually based on an inventory threshold: The reaction occurs when the inventory level falls below the threshold. The same thing happens in a fast-food restaurant: The cook makes more hamburgers when the ready level falls below a threshold. The threshold may depend on the time of day or the season.

Customers might change lines (queues) based on the number in each queue or on the perceived service rate of each server. The events are the service variables or queue-length variables; the reaction is the jockeying from one line to another.

The number in a queue could cause the service rate to change. For example, in a crowded hospital, the arrival of more patients in dire need than the hospital can support might cause the decision to release patients who are nearly well.

The completion of a disk operation in a computer system might be modeled as an event and a reaction.

Some Methods of Modeling

All these examples have in common the change of state of a variable and a possible reaction to this change. Code to change these variables can be placed anywhere in the model. In the case of the inventory model previously mentioned, the inventory variables might be changed in a service module. The reaction to the change might also be in the same module.

One way for it to occur elsewhere is by writing a special service module. To model an inventory control person, you could

write a module that periodically checks the inventory levels. You could then schedule an initial call to this module by calling the scheduler and passing the module's name during initialization. The module could schedule subsequent calls to itself. When called, the module would check the inventory levels and take appropriate action. In this situation, there is no direct connection between the event (the decrement of the inventory level) and the reaction (the ordering of more items), except through the value of the inventory variable.

In the inventory model, the variable changes by discrete amounts. In other models, the changes are continuous and can be complex. For example, in models of kinetic systems (e.g., solar systems and economic systems), there are several interdependent variables. Models of these continuously variable systems are usually stated in a few mathematical equations, though the equations are such that exact solutions are difficult or impossible. The SCoP modeling system (produced by the National Biomedical Simulation Resource of Duke University Medical Center in Durham, North Carolina) can be used to create continuous models of many kinds of systems, although it, too, has its limitations.

One way to solve complex systems of equations is to assign values to the variables and then iteratively increment the independent variable (or variables) by a small amount or feed back the results of the first computation into the second. The values assumed by the dependent variables eventually approximate the solutions. These can be plotted against the independent variables to show their relationship. These methods are used by SCoP and Borland's Eureka. The SCoP package contains examples of continuous models and their methods of solution.

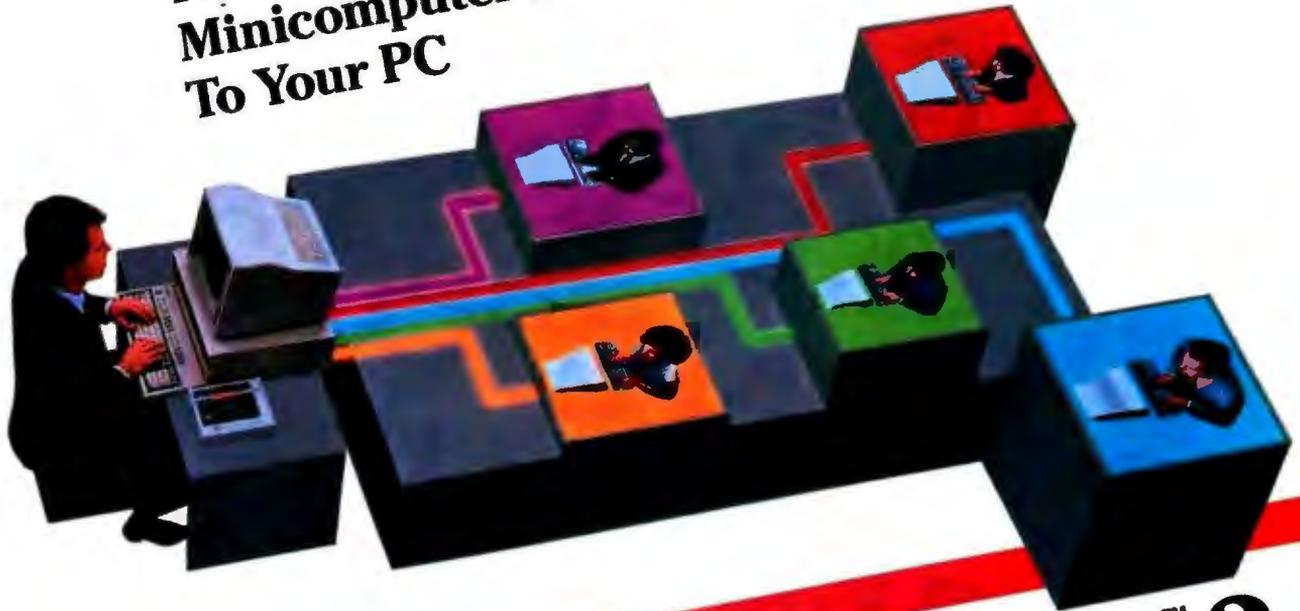
You can make the changes in the independent variables (which drive the continuous model) using the independent service model described above. But the increments to the independent variables usually must be quite small (to keep the model sane). A variable that takes on values from 0 to 1 might be incremented by 0.001. Calling the service module to make each increment is inefficient. It is a good idea to call the service module the first time, let it iterate a fixed number of times or until it reaches an intermediate threshold, and then have it schedule the next call to itself. On the next call, it will iterate a maximum number of times or until it reaches a threshold. And so on.

Most models use only a few tools. But models of factory operations typically combine continuous-event, discrete-event, and queuing systems. For example, in a brewery, the concentration of alcohol in the beer or wine depends on both biological and chemical factors. The time to reach a threshold concentration would be modeled by a system of equations. Other factors of the brewing operation cause the beer or wine to be moved to various tanks and processes. These factors might also be modeled by systems of equations. The factory model will contain discrete variables: the inventory of bottles, carloads of raw product, and so forth. Finally, the model will have queuing elements: the conveyer system for the bottles, the cases of product, and the staging of the brewing process itself. All these elements must be integrated in a complete model. The elements are integrated through the events (variable changes through thresholds) and responses (reactions to the crossing of a threshold). ■

Editor's note: The source code for Qsim is available in a variety of formats. See page 5 for further details.

Roy E. Kimbrell is a computer systems scientist, and Linda Correll and Robert Bass are assistant programmer/analysts at the Planning Research Corp. in Bellevue, Washington. They can be reached on BIX c/o "editors."

How To Bring Minicomputer Power To Your PC



Introducing PC-MOS™ 3.0

A multiuser system no longer means only a mainframe or minicomputer. Today's 386- and 286-based PCs are more powerful than the minicomputers of just a few years ago. And they often provide more desktop power than one person can use effectively.

That's why you need PC-MOS 3.0. It harnesses the power of your 386- or 286-based PC and turns it into a powerful multiuser, multitasking computer. PC-MOS is the multiuser operating system that lets you run popular DOS applications such as Windows™, Lotus 1-2-3™, dBase IV™ or WordPerfect™—without modification.

PC-MOS is the perfect solution for a small business or a department of a large company that needs users to easily and affordably share programs, databases or peripherals. It takes full advantage of the hardware's power—and saves you money in the process! For example, instead of replicating PCs, each user can have an inexpensive terminal or monitor that acts like a PC.

DOS Compatibility Means Minimal Training And Support

Since PC-MOS is DOS compatible—unlike UNIX™ or OS/2™—there's no need for users to learn a "new" operating system or be retrained on the application programs they already know. And unlike most LANs, PC-MOS is easy to install and even easier to maintain. No hassle, no expensive wiring and no network management headaches.

There are now more than 100,000 users of PC-MOS worldwide, but if you haven't seen it lately, take another look. We've broadened our base of compatible applications and added multi-level security, faster disk performance and larger task sizes. Version 3.0 also interfaces with Novell LANs, 3270 mainframe communications products and The Software Link's LANLink™ local area network.

Call us today for more information about PC-MOS 3.0 and the location of your nearest multiuser dealer. We'll show you how to easily and affordably turn your PC into a powerful multiuser system.

Terminals and Workstations Supported
Wyse 150™, Link MC5™, Kimtron KT-70™, IBM 3151™,
AT&T 605 Business Communications Terminal™, Sun
River Cygna/386™, Video Network Adapter™ and others.



THE SOFTWARE LINK

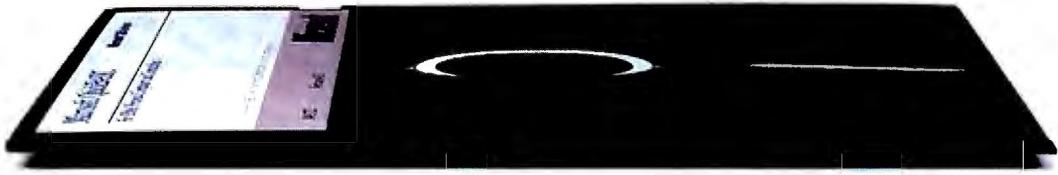
3577 Parkway Lane Norcross, GA 30092
1-800-451-LINK (404) 448-5465
Fax: (404) 263-6474 Telex: 4996147 SWLINK

PC-MOS and LANLink are trademarks of The Software Link, Inc.
All other products referenced are trademarks of their respective companies.

**Your connection to
advanced technology**

Reader Service Card (DEALERS: 259)

To learn Microsoft QuickBASIC, you only need a manual this thick.



You're looking at something you won't see anywhere else.

It's called QB Advisor. A remarkable new hypertext electronic manual that can make you instantly more productive, even if you don't know the first thing about programming. QB Advisor actually lets you experiment by cutting and pasting useful sample programs right into your programming window. Only Microsoft has it. Only Microsoft could. And it's just one of the things you'll learn about new Microsoft® QuickBASIC version 4.5 for IBM® PCs and compatibles.

Another is the step-by-step tutorial that actually takes you through every stage of programming by working you through a complete program.

And QB Express—the interactive way to learn all about your programming environment in a matter of minutes—not hours.

Microsoft QuickBASIC also comes with Easy Menus that let you develop programs with

a minimum number of menu choices. Context-sensitive Help for immediate help with error messages and variables by simply punching a key, or clicking a mouse. And a built-in debugger that lets you see exactly what your program is doing, as it's doing it.

Best of all, Microsoft QuickBASIC is packed with enough power to handle whatever problems drove you to programming in the first place. Fact is, it translates your program into executable code at an incredible 150,000 lines per minute.

Microsoft QuickBASIC version 4.5. If programming is the only way out, this is the easiest way in.



Microsoft
Making it all make sense.

THE LIGHT AT THE END OF THE LAN

A new standard lets optical LANs move more data more efficiently

The era of the LAN is now here. Ethernet, ARCnet, and Token Ring adapters are available for virtually every type of computer. You can walk into a computer store and walk out with a complete, easy-to-use kit that will interconnect an entire room (or building) full of machines. Still, some users require more speed and reliability than current LAN standards provide. The Fiber Distributed Data Interface (FDDI) standard addresses these needs.

Most current LAN standards (see table 1) have data rates in the range from 1 to 20 megabits per second. ARCnet, sporting a low clock rate but dependable and efficient, runs at 2.5 Mbps. Ethernet operates at 3 or 10 Mbps, Token Ring at 4 or 16 Mbps. But these speeds are not always fast enough.

Diskless Unix workstations, for instance, can slow to a crawl when they swap blocks of virtual memory to mass storage across a LAN. Database applications often "lock" areas of a file to preserve internal consistency; if a LAN isn't fast enough, every user may have to wait for a transaction to complete. A few channels of digitized audio and video—even with the best compression and decompression techniques—can strain a network to the breaking point. The bandwidth of a single ESDI hard disk drive, which can retrieve data at 10 to 15 Mbps, can swamp most current LANs.

The need for faster LANs was anticipated in the early 1980s, when ANSI assembled the X3T9.5 working group to develop higher-speed LAN standards. The first standard to come out of this

group was the Locally Distributed Data Interface. LDDI was a broadband system that could span only 1 kilometer and connect only seven nodes, making it unsuitable for many applications where LANs are used today.

In 1986, ANSI published a draft of the most recent standard: FDDI. It supports up to 500 nodes distributed over a loop of up to 100 kilometers in circumference, and it runs over optical fiber at a signaling rate of 125 million baud, delivering 100 Mbps of data. (See the text box "Why Fiber?" on page 271.) The topology is a token-passing ring similar to the IEEE 802.5 Token Ring (see my column in the January BYTE). While the FDDI standard makes use of lessons learned in the development of the Token Ring standard, the signaling schemes and token-passing protocols are different.

FDDI and the OSI Model

Figure 1 shows the components of the FDDI standard, as well as the relationship of those components to the International Standards Organization's Open

Systems Interconnection (OSI) model.

The Physical Medium Dependent (PMD) standard specifies the characteristics of the fiber-optic medium, the connectors used to attach the medium to each station, the wavelength used for transmission, the power requirements for the transmitters, and methods for optically bypassing inactive nodes.

The Physical (PHY) standard defines the 125-MHz clock speed, the clocking scheme, the data-encoding scheme, and the control symbols used in the network.

The Media Access Control (MAC) standard handles token passing, frame formation, addressing, error detection and recovery, and bandwidth allocation among the nodes.

Finally, the Station Management (SMT) standard handles station insertion and removal, ring configuration, error logging, and other network management services. Strictly speaking, SMT falls outside the OSI model; however, it is the "glue" that helps all the other layers play together.

continued

Table 1: How the Fiber Distributed Data Interface standard stacks up against two other popular LAN standards: Token Ring and Ethernet.

	FDDI	Token Ring	Ethernet
Medium	Fiber	Twisted-pair or fiber	Coaxial cable
Data rate	100 Mbps	4/16 Mbps	3/10 Mbps
Encoding efficiency	80%	50%	50%
Maximum station	2 km	300 m to medium-access unit	500-m separation
Maximum coverage	100 km	Varies with configuration	2.5 km
Maximum nodes	500	260	1024
Topology	Dual-ring	Single-ring	Bus
Access	Token passing	Token passing	CSMA/CD protocol

Perhaps this is the reason that SMT has been the slowest area of the standard to come together. It has the most global effect on how FDDI systems work. No link-level protocol is specified by FDDI. Most systems will probably use the IEEE 802.2 link-layer-control protocols or their equivalent.

The Physical Layer

According to the PMD standard, FDDI nodes transmit light at a wavelength of 1300 nanometers. FDDI uses multimode fiber. Single-mode fiber, while it has lower loss per unit distance, is more expensive and very tricky to couple. The core of the fiber can be either 62.5 or 85

microns thick; the outer cladding must be 125 microns thick. When assembled properly, an FDDI fiber link has a worst-case bit error rate of 1 in 1 billion.

FDDI nodes can include an optical bypass switch, which lets light pass through up to three consecutive inactive nodes unhindered. While FDDI has redundant loops that let data be routed around a disabled node, a bypass switch reduces the need to rely on these loops.

The standard FDDI connector is a duplex plug with incoming and outgoing fibers. A node can have either one or two of these connectors. If it has two connectors, it's called a Class A node. One fiber on each connector is used for normal operation; the other one is part of a backup ring that routes traffic around disabled nodes (see figure 2).

The backup ring runs in the opposite direction from the main ring; in the initial standard, it doesn't normally carry data (although proposals to let it do so are being considered). Its two main purposes are to aid in ring configuration and to route data around faults (see figure 3).

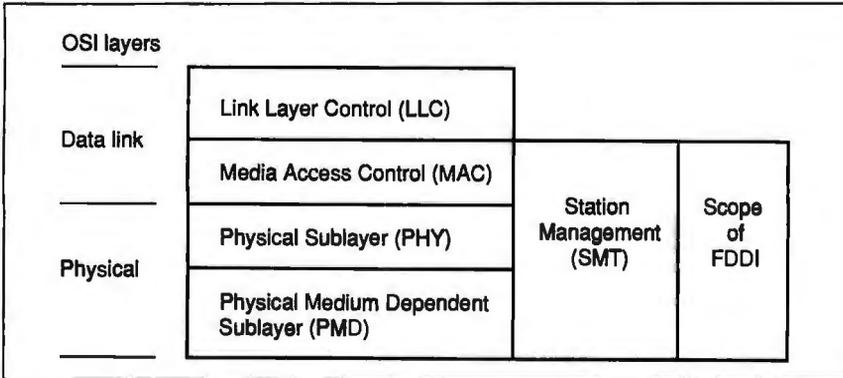


Figure 1: The four key documents of the Fiber Distributed Data Interface specification include PMD, PHY, MAC, and SMT. FDDI does not specify a standard LLC protocol, but the IEEE 802.2 protocol is a likely candidate.

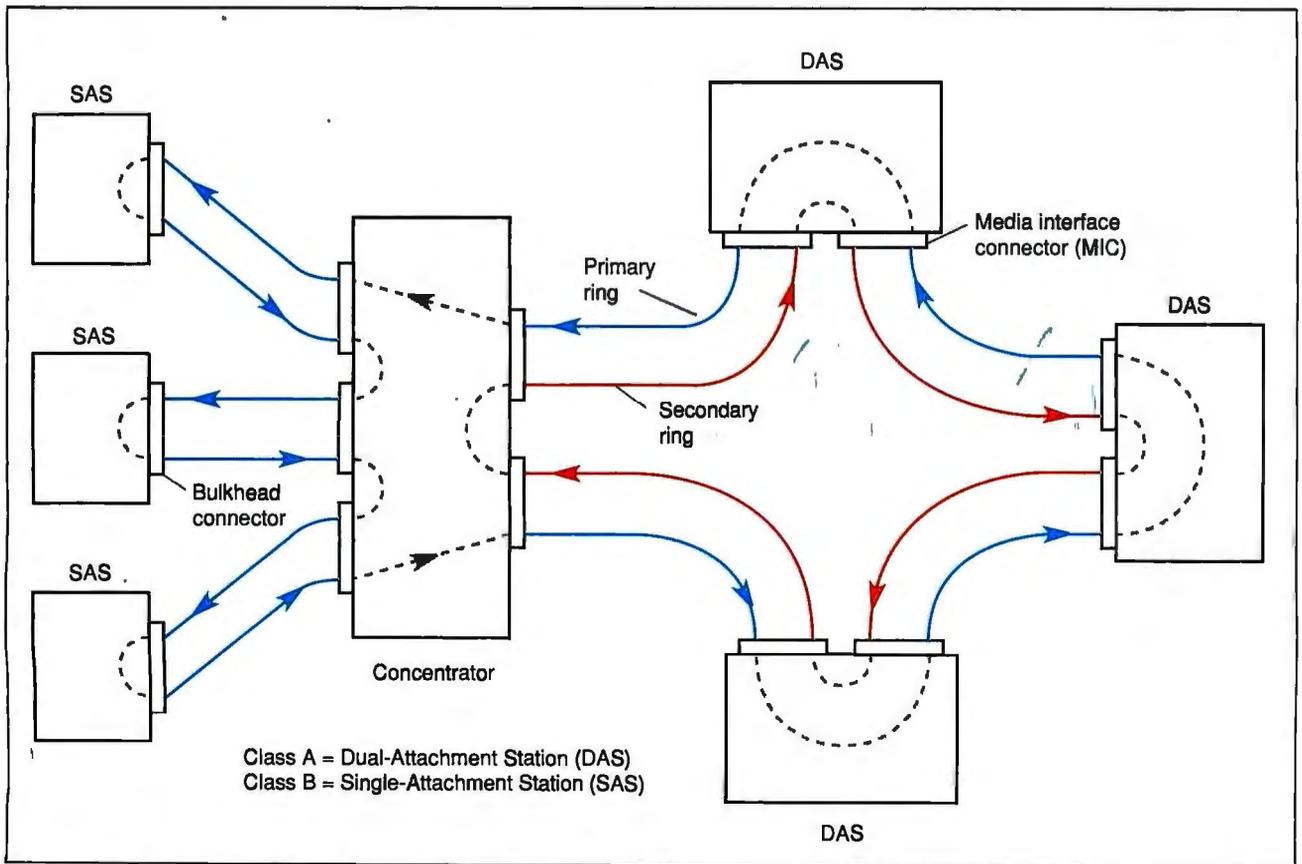


Figure 2: A Fiber Distributed Data Interface network may consist of Class A or Class B nodes, or a mixture of the two types. Class B nodes must connect to the network through a wiring concentrator; Class A nodes can connect directly to the main ring and have provisions to reroute traffic around faults. Since Class B nodes attach only to the primary ring, they may not be able to continue working when certain kinds of faults occur.

Token Ring and Ethernet both use Manchester encoding for data; in these schemes, it takes 2 transition times, or baud, to represent a single bit. FDDI is more efficient. It uses 5 baud to represent every 4 bits (see the text box "Group Encoding and FDDI" on page 272). The clock speed at each node is 125 MHz, resulting in a data rate of 100 Mbps.

Unlike the IEEE 802.5 Token Ring, where the active monitor provides the clock signal for the entire ring, FDDI uses a distributed clocking scheme. When a station repeats data, it reclocks it with an accuracy of ± 50 parts per million. Every bit is decoded, checked, and reencoded at every station. An *elasticity buffer*—a first-in/first-out buffer that can compensate for differences between the input and output clock speeds—absorbs the jitter that may result from signal distortion in the multimode fiber. And a *smoother* adds "idle" bytes between frames to make sure that they are separated by a gap of at least 6 bytes. (This gap increases the chances that a

continued

Why Fiber?

Fiber-optic media are desirable for use in high-speed LANs. Fiber has high bandwidth (hundreds or even thousands of megabits per second), and it can carry signals for long distances without repeaters. Noise levels are up to a million times lower than those for coaxial cable, and fiber is difficult (although not impossible, as some believe) to tap.

Many of fiber's unique advantages are due to the facts that it's not metallic and it won't conduct electricity. Fiber is not affected by electromagnetic radiation, nor does it generate any—thus, no shielding is required to meet FCC requirements. You can't get a shock from an optical fiber, nor can it cause ground loops. (Most LANs must have isolation transformers to meet UL requirements; fiber-optic LANs don't need them.) Lightning won't send a deadly charge

down a fiber to cripple all the stations on a network at one stroke. In addition, fiber can't corrode, which means that it's likely to last a long time in harsh environments.

The highest-performance fibers are made of glass and are no thicker than a human hair. However, the more common and economical varieties used in the Fiber Distributed Data Interface are about 10 times thicker. It's easier to handle and manufacture thicker fibers, but they have lower bandwidth and greater signal loss per unit distance.

Plastic fibers are more robust, but they are lower in performance than their glass counterparts. However, all varieties of fiber outperform conductive media by a wide margin, and they all are smaller and lighter than the coaxial cable or twisted-pair medium that they replace.

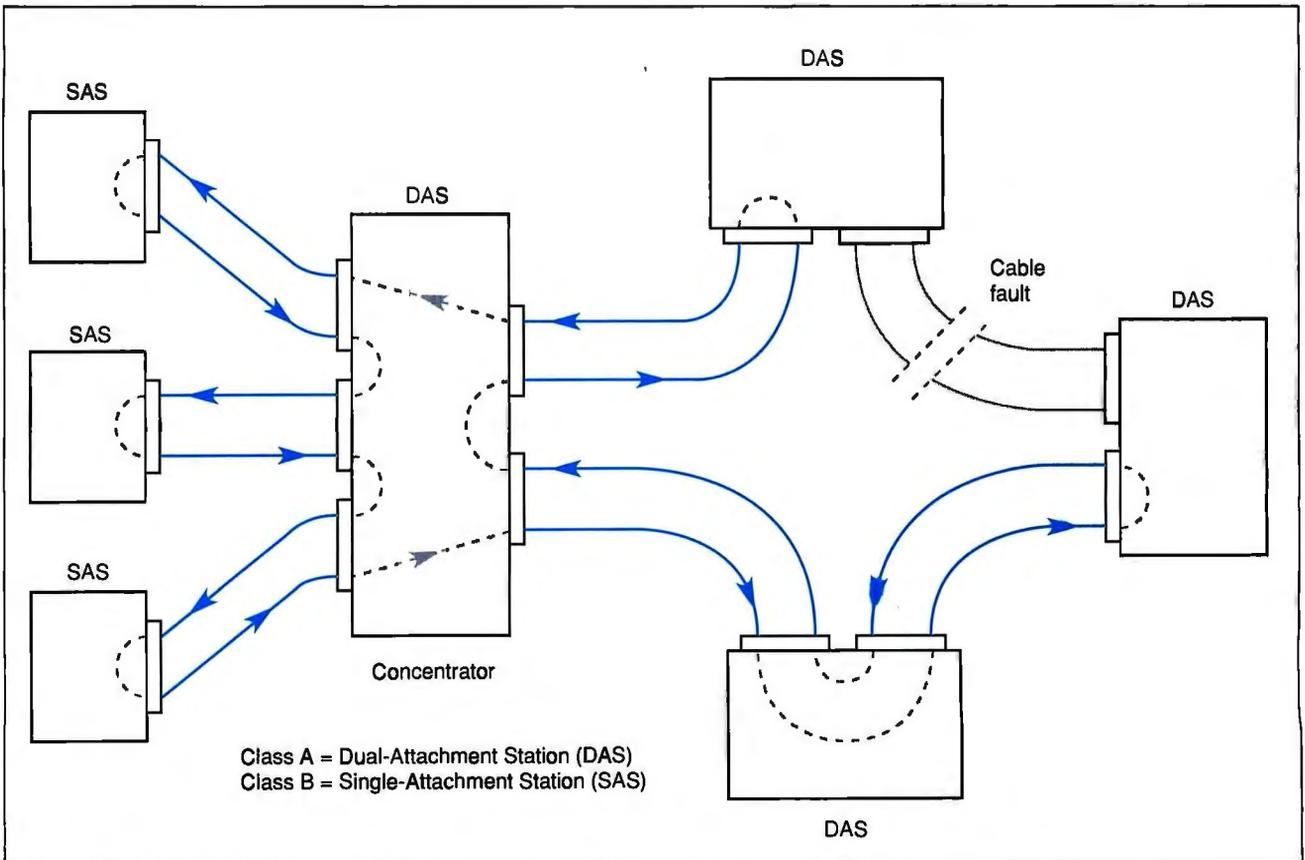


Figure 3: The secondary ring in a Fiber Distributed Data Interface system is used to keep the network intact during a single-point fault. Here, the ring wraps to avoid a damaged section of cable.

Group Encoding and FDDI

In the Manchester encoding schemes used by Ethernet and Token Ring, it takes 2 bauds—or potential transitions—to represent a single bit (see the text box “Encoding” on page 366 of the

January BYTE). Thus, a 10-megabit-per-second Ethernet must send 20-MHz signals over the wire, and a 16-Mbps Token Ring must send 32-MHz signals. If the Fiber Distributed Data Interface

standard used the same scheme, the fiber would need a bandwidth of 200 MHz to carry FDDI’s 100 Mbps.

To make the best use of lower-cost fiber, FDDI uses *group encoding* instead. Group encoding is to Manchester encoding what run-length-limited encoding is to modified-frequency-modulation encoding in the world of hard disk drives (see the text box “RLL Encoding” on page 296 of the February BYTE). Like RLL, FDDI’s 4b/5b group code gets more use out of the same bandwidth by allowing fewer transitions but limiting run lengths; no more than 3 bauds without a transition are allowed. The 4b/5b designation means that every 4 bits are represented by 5 bauds; some special groups of bauds are used to carry control information. The FDDI group codes are shown in table A.

This encoding scheme has sufficient symmetry between ones and zeros that the average value of the signal varies by less than 10 percent while the ring is functioning normally. This makes it easier to design the analog circuitry that recovers the data from the fiber.

Table A: The Fiber Distributed Data Interface standard group codes. Some of the symbols in the second column, either alone or in combination, can violate the run-length constraints; this occurs only when something has gone wrong.

Symbol	Encoded bits	Symbol	Encoded bits
0	1 1 1 1 0	C	1 1 0 1 0
1	0 1 0 0 1	D	1 1 0 1 1
2	1 0 1 0 0	E	1 1 1 0 0
3	1 0 1 0 1	F	1 1 1 0 1
4	0 1 0 1 0	Q (Quiet)	0 0 0 0 0
5	0 1 0 1 1	I (Idle)	1 1 1 1 1
6	0 1 1 1 0	H (Halt)	0 0 1 0 0
7	0 1 1 1 1	J (Start 1)	1 1 0 0 0
8	1 0 0 1 0	K (Start 2)	1 0 0 0 1
9	1 0 0 1 1	T (Terminate)	0 1 1 0 1
A	1 0 1 1 0	R (Reset)	0 0 1 1 1
B	1 0 1 1 1	S (Set)	1 1 0 0 1

node will be able to receive two consecutive frames addressed to it.)

The MAC Layer

The MAC layer of FDDI is very similar to that of the IEEE 802.5 Token Ring. Figure 4 shows the FDDI frame format, and figure 5 shows an FDDI token. Unlike the Token Ring, FDDI manipulates data as 4-bit symbols (i.e., nibbles) or as bytes, rather than as individual bits. This technique makes it easier to change parts of a frame, like an error indicator, on the fly. More can be done in parallel.

Another difference is that the token isn’t changed into a frame on the fly. An FDDI node that wishes to transmit captures the token and sets up to transmit a frame. Because it never has to receive and transmit at the same time, an FDDI node can have a single half-duplex data path internally, instead of two paths, as a Token Ring node must.

FDDI also builds in a feature that is optional in most Token Ring systems: early token release. In ETR, a transmitting station can send a token before the data it sends can circulate completely around the ring and return. This feature greatly reduces ring latency, especially in large rings. FDDI frames, unlike

Token Ring frames, have a fixed maximum size of 4500 bytes. This ceiling prevents a station from monopolizing the network.

Another difference is the presence of *fragments* on the ring. An FDDI station often repeats the beginning of a token or frame (i.e., sends it on to the next station) and then decides that it wants to capture the token or strip the frame from the ring. By the time the station makes this decision, it’s too late to “catch” the data that has already been repeated. The downstream nodes must recognize and strip fragments of tokens and frames from the ring.

Neither the FDDI frame nor the FDDI token contains an AC (access control) field, as do their Token Ring equivalents. No token has a specific priority (although use of the token may be restricted, as I’ll show shortly), and there is no reservation process. Instead of arbitrating for ring access as the token circulates, FDDI stations share ring bandwidth via the Timed Token Protocol.

The Timed Token Protocol

FDDI divides the bandwidth of the ring into two pools: *synchronous* bandwidth, devoted to communications that *must*

happen at certain regular intervals, and *asynchronous* bandwidth, devoted to other communications. The allocation is performed by limiting the amount of time during which any station can hold the token and attempting to cause the token to return to each station within a certain amount of time (the target token rotation time, or TTRT).

As the ring is configured, each node asks for the amount of synchronous bandwidth it needs by specifying the minimum TTRT it will require to meet its needs for synchronous transmission. The node requiring the shortest TTRT wins the bidding. From this point on, time is divided between the nodes in such a way that

1. each node knows how long it can safely hold the token before passing it on;
2. the sum of these maximum holding times is less than or equal to the TTRT; and
3. the token is guaranteed not to take more than twice the TTRT to return to any node on the ring.

Each node may transmit a certain
continued

Our MAJOR ADVANTAGE-Supplying you with the Broadest Range of Software Ammunition.



ADVANTAGE SOFTWARE

BACKUP UTILITIES		LIST OURS
Copy II PC	240	20
DS Backup 4.0 (MAC)	70	46
FASTBACK/MAC	129	73
FASTBACK Plus	189	109

CAD		LIST OURS
AutoCAD Release 10	3000	CALL
AutoSketch	80	65
DesignCAD	300	159
DesignCAD 3-D	399	219
Drafix CAD Ultra	395	259
Generic CADD Level 3	249	149
Generic CADD 3-D Solids	349	195
TurboCAD	100	59

COMMUNICATIONS		LIST OURS
Carbon Copy plus	195	115
Crosstalk Mk.4	245	132
Crosstalk XVI	195	95
Mirror III	100	90
Procomm Plus	75	49
Red Ryder (MAC)	80	59
RELAY Gold	295	130
Remote 2	195	101
Smartcom III	249	151

DATA ACQUISITION/ANALYSIS		LIST OURS
Asystant	495	429
DADISP	795	719
LABTECH Notebook	995	799

DATABASE		LIST OURS
Clipper	695	439
dBASE III Plus	695	429
dBASE IV	795	519
dBASE MAC	495	322
dBXL	169	119
FoxBASE+	395	249
FoxBASE+/MAC	395	210
McMax	295	199
Paradox 3.0	725	479
PC/Focus (5-1/4")	1295	809
PFS:Professional File	249	149
QuickSilver	599	369
Q&A	349	213
R&R	150	109

DESKTOP PUBLISHING		LIST OURS
Adobe Illustrator '88 (MAC)	495	359
ClickArt	CALL	CALL
Draw Applause	495	303
Finesse	179	CALL
GEM Artline	495	289
GEM Desktop Publisher	299	178
PageMaker	695	489
Publisher's Paintbrush	285	155
Ready, Set, Go (MAC)	495	320
Ventura Publisher	895	469

DISK/FILE UTILITIES		LIST OURS
1 DIR Plus	95	52
Command Plus	80	68
diskdoubler II	99	85
Disk Technician Advanced	190	117
Mogellan	139	CALL
MKS Toolkit	199	155
Norton Commander	89	41
ViewLink	150	99
XTreePro	129	69

FILE TRANSFER		LIST OURS
Laplink Plus	140	64
Laplink (MAC)	140	85
Software Bridge	149	121
Brooklyn Bridge	140	85

INFORMATION ORGANIZERS		LIST OURS
Agenda	395	CALL
askSam	295	209
GOTer	80	43
GrandView	295	179
Guide	275	218
Memory Lane	149	127
Memory Mate	70	43
PackRat	395	284
SlideKick Plus	200	149
Tomado	100	75
Who-What-When	189	119
Zyindex Professional	295	159

INTEGRATED SOFTWARE		LIST OURS
Enable/OA	695	445
Framework III	695	455
Lotus Symphony	695	CALL
Microsoft Works	149	99
Microsoft Works (MAC)	295	203
SmartWare	895	476

LANGUAGES		LIST OURS
Lahey FORTRAN F77L	350	319
Lattice C 3.4	450	289
Lightspeed C (MAC)	249	179
Lightspeed Pascal (MAC)	229	165
Micro Focus COBOL/2	900	CALL
w/Toolset	1800	1499
Microsoft C	450	299
Microsoft COBOL	900	599
Microsoft FORTRAN	450	299
Microsoft Macro Assembler	150	103
Microsoft Pascal	300	199
QuickBASIC	99	69
QuickBASIC (MAC)	99	69
QuickC 2.0	99	69
QuickPASCAL	99	69
Turbo Assembler/Debugger	150	112
Turbo Basic	100	75
Turbo C 2.0	150	112
Turbo C Professional	250	185
Turbo Pascal 5.0	150	112
Turbo Pascal Professional	250	187

MATHEMATICAL TOOLBOXES		LIST OURS
Derive	200	166
Eureka: The Solver	167	125
MathCAD 2.0	349	215
Mathematica (MAC)	795	675
Mathlab	695	659
TK! Solver Plus	395	277

MULTIPURPOSE UTILITIES		LIST OURS
MACE GOLD	150	79
Norton Utilities	100	55
Norton Utilities Advanced	150	79
PC Tools Deluxe	79	40
PC Tools (MAC)	79	40
Symantec Utilities (MAC)	100	63
V feature Deluxe	120	117

OBJECT-ORIENTED LANGUAGES		LIST OURS
Actor	495	423
C_talk	150	137
Smalltalk/V	100	85
Smalltalk/V 286	200	145
Smalltalk/V Mac	200	169
Zortech C++	150	129
w/ source	250	209
Zortech C++ Tools	99	89

OPTIMIZING UTILITIES		LIST OURS
Disk Optimizer	70	42
Fast!	99	79
V CACHE	60	51

PCB ARTWORK/SCHEMATICS		LIST OURS
Micro-CAP III	1495	1269
PSpice (MAC)	1450	1327
smARTWORK	895	824
Tango-PCB Series II	595	569

PRESENTATION GRAPHICS		LIST OURS
Chart-Master	375	205
Concorde	695	509
Corel Draw	495	349

SPREADSHEETS		LIST OURS
20/20	500	301
Ability Plus	199	139
Javelin Plus	395	CALL
Lotus 1-2-3	495	CALL
Lucid 3-D	100	CALL
Microsoft Excel	495	249
Microsoft Excel (MAC)	395	CALL
PFS:Professional Plan	249	CALL
PlanPerfect	395	193
Quattro	248	186
Silk	150	CALL
Smart Spreadsheet	399	CALL
SuperCalc5	495	319
Trapeze (MAC)	295	190
Wingz (MAC)	495	CALL

SPREADSHEET ADD-INS		LIST OURS
4Views	150	119
4Word	100	61
@ Liberty	99	92
Hal	150	CALL
Impress	139	89
Inword	100	55
Look & Link	100	63
Note-It Plus	80	49
Noteworthy	80	49
R&R (Lotus)	149	109
SeeMore	80	43
Sideways	70	43
SmartNotes	80	43
SpellIt!	80	49
Worksheet Utilities	100	63

STATISTICS		LIST OURS
CSS	495	482
GAUSS Math & Stat System	395	350
GB Stat	300	185
Microstat II	395	328
NWA StatPak	399	366
SPSS/PC+	795	727
StatGraphics	895	CALL
StatPac Gold	595	545
SYSTAT	595	488
SYSTAT (MAC)	595	421
SYSTAT (w/ SYGRAPH)	795	709

PRIMARY TARGET

Smalltalk/V 286

Object-oriented programming. Everybody's talking about it as the way all software will be written. Now you can master this leading-edge technology at a budget oriented price.

Smalltalk/V 286 offers a complete high performance development environment for your 286 or 386 computer. The manual includes a twelve chapter tutorial, considered by reviewers to be "the best way to learn object-oriented programming."

Smalltalk/V 286 is backed by the leader in object-oriented technology, Digitalk. Technical support is unlimited and free.

List: \$200 Ours: \$145



digitalk inc.

Freelance Plus	495	CALL
GEM Graph Present. Team	495	289
Graph-in-the-Box	140	108
Harvard Graphics	495	279
Micrografix Designer	695	449
Pinstripe Presenter	200	139
PIXIE	195	117
Xerox Presents	495	325

PROJECT MANAGEMENT		LIST OURS
Harvard Project Manager	695	446
MacProject II	495	379
Micro Planner	595	419
Microsoft Project	495	33
Project Scheduler 4	685	489
Project Workbench 3.0	1275	995
SuperProject Plus	495	267
Time Line v. 3.0	595	345

WORD PROCESSING		LIST OURS
Ami	199	99
Choice Words	99	60
DisplayWrite IV	495	342
FullWrite Prof. (MAC)	295	236
Microsoft Word	450	235
Microsoft Word (MAC)	395	275
Multimate Advantage II	565	CALL
Q & A Write	199	119
RightWriter	95	51
Sarna Word IV	595	313
Sprint	200	149
Timeslips III	200	115
Volkswriter 4	199	109
Word Perfect 5.0	495	245
Word Perfect (MAC)	395	237
WordStar Professional 5.0	495	245
XyWrite III Plus	445	284

Terms & Policies

All prices subject to change without notice. We accept Visa, MC, AMEX (2% surcharge on AMEX). Shipping \$4 per item sent UPS Ground. Allow 14 days for personal/company check clearance. Returns subject to 15% restocking fee. RA # required. PO's welcome from Fortune 1000 and other qualified organizations.



ADVANTAGE SOFTWARE

A Division of Voyager Software Corp

In the U.S. call:

1-800-333-3141

N.Y. / International 914-332-0756

Fax: 914-332-4021

55 South Broadway, Suite B, Tarrytown, NY 10591

Circle 11 on Reader Service Card

amount of synchronous data whenever it receives the token. Then, if there's time to keep the token longer without causing the TTRT to be exceeded, the node may transmit asynchronous traffic. Finally, when there is no more data to transmit, or when the token must be sent on its way to meet the TTRT, the token is passed to the next node. This strategy has the effect of making sure that every node gets its share of the synchronous bandwidth, while allowing the remaining time to be taken up by asynchronous transmissions.

All synchronous transmissions get top priority in FDDI, but asynchronous transmissions, which share the bandwidth that remains, are grouped into

eight priority levels. Each level is associated with a time value inversely related to its importance. If the node can hold the token for at least the specified length of time, frames at that priority level can be transmitted. The result: Asynchronous bandwidth is fairly allocated to each level as needed.

FDDI adds one final twist to the protocol to support high-speed transactions between stations on the ring—a host and a disk drive, for instance. An FDDI token can be marked as restricted. In such a case, only certain nodes can use it for asynchronous transmissions (any node can still use it for synchronous transmissions). By temporarily devoting

all the asynchronous bandwidth of the ring to one key exchange, FDDI can expedite that exchange and keep certain systems (e.g., distributed databases) running smoothly.

FDDI Today and Tomorrow

The FDDI standard, while well on the way to approval, is not entirely complete. Table 2 shows the status of the parts of the standard as of January.

FDDI's creators expected that it would be used in one of three ways: as a front-end network, to connect workstations to file servers; as a back-end network, to connect peripherals to machines in computer rooms; or as a backbone, to connect computers over a campus-size area. All these are useful and desirable applications, but adoption may be initially limited by cost, typically \$8000 or more per station. (To put things in perspective, it helps to remember that Ethernet was equally expensive when it was first developed.)

FDDI will probably appear first in large corporate and campus networks, but I hope it will only be a matter of time before FDDI adapters are as inexpensive and readily available as Ethernet and ARCnet are today. ■

BIBLIOGRAPHY

- Draft Proposed American National Standard. "FDDI Token Ring Media Access Control (MAC)." ANCS X3T9.5, February 28, 1986.
- Draft Proposed American National Standard. "FDDI Token Ring Physical Layer Medium Dependent (PMD)." ANCS X3T9.5, July 10, 1986.
- Draft Proposed American National Standard. "FDDI Token Ring Physical Layer Protocol (PHY)." ANCS X3T9.5, October 10, 1986.
- Draft Proposed American National Standard. "FDDI Token Ring Station Management (SMT)." ANCS X3T9.5, September 5, 1986.
- McCool, John F. "FDDI: Getting to Know the Inside of the Ring." *Data Communications*, March 1988.

ACKNOWLEDGMENT

Thanks to AMD for providing many of the tables and figures used in this article.

L. Brett Glass is a freelance programmer, author, and hardware 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.

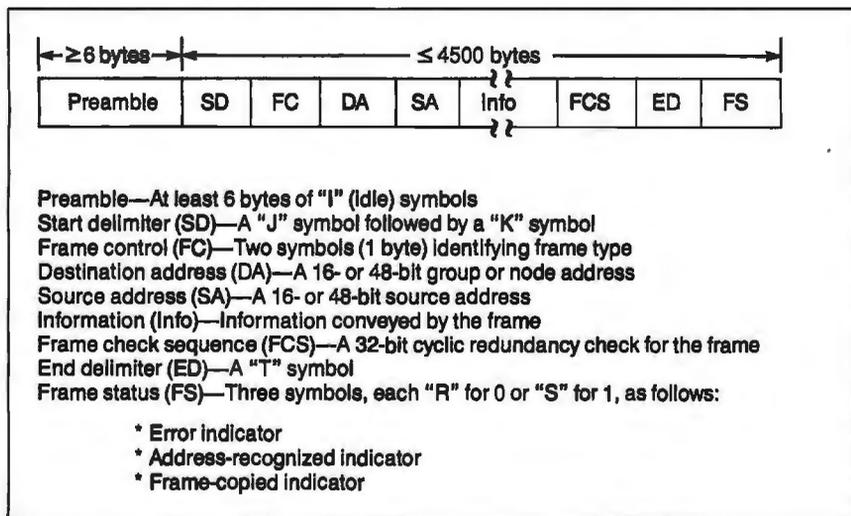


Figure 4: The Fiber Distributed Data Interface frame format.

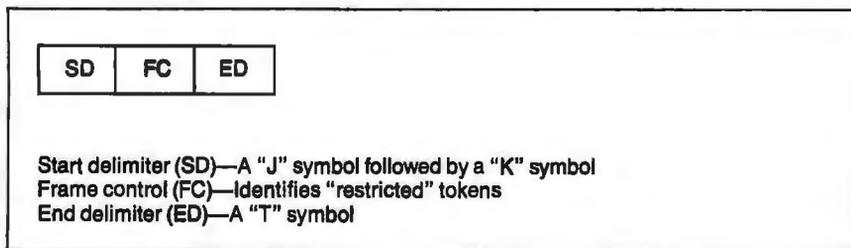


Figure 5: The Fiber Distributed Data Interface token format.

Table 2: The Fiber Distributed Data Interface standard, while well on the way to approval, is not entirely complete. In particular, some aspects of the Station Management protocol need to be fleshed out, and other sections are still up for approval. (Table courtesy of AMD)

	PMD	PHY	MAC	SMT
X3T9.5 (FDDI)	Approved	Approved	Approved	In committee
ANSI	Second public review	Published	Published	Not forwarded
ISO	Letter ballot	Approved	Approved	Not forwarded



CompuStar II



IT EATS IBM'S LUNCH... AND SERVES DELL FOR DINNER!

Introducing Wells American's CompuStar II. It's one *hungry* machine. Feed it the toughest applications you can dish out and it's ready for "seconds" before IBM, Dell and all the others even get started.

IT FEEDS ON THE COMPETITION.

CompuStar II's enormous appetite for devouring the competition comes from its unique, modular design. Interchangeable, plug-in CPU "modules" are available in 80286, 80386SX and 80386 configurations.



The modules are remarkably inexpensive — as little as \$750 for a '286 module, and incredibly powerful.* The 33MHz '386 module achieves a stunning MIPS rating! Best of all, for up to one full year after purchase, you can trade in the module you originally select toward the purchase of any of the other more powerful modules.

IT DEVOURS OTHER COMPACTS.

Unlike other small footprint micros, CompuStar II won't put your computer expansion needs on a diet. Each system features an amazing six bus slots — four of them available in a fully configured VGA system. That's 25% more than IBM or Dell gives you. Better yet, you can have up to 11 slots with CompuStar II's exclusive bus expansion chassis. No other compact system available offers this much room for growth. And no other comparably sized system can accommodate that growth better than CompuStar II.



BUS EXPANSION CHASSIS

Its whopping 200 watt power supply gives you more than twice as much reserve power as IBM or Dell.



And CompuStar II has more room for disk/tape drives — *four* compartments in all; three accessible from the front panel. IBM and Dell give you just three compartments and only two are accessible from the front. CompuStar II also accommodates 5 1/4" and 3 1/2" disk drives. IBM and Dell restrict you to 3 1/2" drives only.

IT'S ALSO WELL-MANNERED.

Worried about quality and reliability? Don't! Wells American has been making PCs longer than IBM or Dell! Each CompuStar II is money back guaranteed for 31 days, factory warranted for a full year and can be field serviced from hundreds of locations worldwide.

When you think about it, buying an IBM or Dell system instead of our new CompuStar II is sort of like eating hamburger when you could have had steak — and paid less for it. CompuStar II... from Wells American. It makes "mincemeat" of everything else.

To receive a CompuStar II product information kit, call 1-803-796-7800. VAR inquiries also welcome.



Corporate Headquarters: 3243 Sunset Boulevard • West Columbia, South Carolina 29169 • 803/796-7800 • FAX 803/796-7029

IBM is a trademark of International Business Machines Corporation. Dell refers to Dell Computer Corporation. *CompuStar II's CPU performance is so incredible you won't believe it! Call or write for complete benchmark information. Certified FCC Class A. For business use only.

HARDCORE SOFTWARE

Stop fooling around. It's time to get hardcore about software. With Microsoft.

We'll give you all the resources you want. Tens of millions in R&D funding. Along with one of the most elementary tools for thinking — a door, which leads to your own private office. All backed by management that truly does speak your language, because they probably helped write it.

We're serious about software design. If you are too, then apply right now for one of these opportunities.

Software Design Engineers

We're working on everything from operating systems, sophisticated graphics, award-winning applications products and networking, to compilers, powerful productivity software and more. In fact we're working on some truly visionary ideas we can't even reveal yet. You could be too, if you have programming experience and a background that includes micros, "C", 8086, 68000, Macintosh® Toolbox, Windows™, OS/2, or MS-DOS®.

Program Managers

Instant responsibility. You select the features, you shape the product, you design the user interface for new generations of software. Guide product development from programming through documentation and testing. Keep your product at the forefront of technology by knowing your competition and product

trends. Convince us you're bright, motivated and knowledgeable of the microcomputer software industry. Project management experience and a BS in Computer Science or related degree desirable.

Project Leads

We're looking for expert designers with project lead experience to take charge of a team of experienced developers and have full responsibility for the design and implementation of leading edge software in either our OS/2, Networking or Powerful Applications Software groups. You should have a BS or MS in CS or related degree and preferably 4 or more years of software experience, with 1 or more years as a successful project lead.

Microsoft offers you an opportunity to live and work where the quality of life is high and the cost of living is low — the beautiful Pacific Northwest. Along with amenities such as a health club membership, workout facilities and parcourse, plus an array of benefits.

Begin by sending your resume to MICROSOFT CORPORATION, Human Resources, Dept. SSBYTE-0789, 16011 N.E. 36th Way, Box 97017, Redmond, WA 98073-9717. We are an equal opportunity employer. No phone calls, please.



Microsoft®

Trademarks are registered to their respective companies.



OBJECT-ORIENTED MAC WINDOWS

Programming with Macintosh windows is a little less painful if you insulate with an object-oriented layer

Macintosh windows are wonderful to use, but programming them can be downright painful. Although the Macintosh Toolbox provides a wealth of powerful programming goodies, its complexity makes it hard to use.

I was writing a medium-size program that required more than one or two kinds of windows. With each new type of window I added, I found myself repeating the same cryptic incantations, modifying the same bloated procedures, and slowly going nuts. So the following invention was born out of necessity.

A Layer of Insulation

I put a layer of code between myself and the Mac window system, code that makes it possible to add and modify window behavior without complex, nonmodular fiddling about. The code supports a roughly object-oriented style of programming: You define various window types, create windows that instantiate those types, and send the windows messages to get them to perform. This is a simple idea that requires some delicacy of execution. To appreciate some of the subtleties, you need to understand the Mac window system.

If you do some digging, you'll find that a Macintosh window is a data structure containing a `GrafPort`, the window's size, its position on the screen, visibility, and other important data fields. There's also a pointer-size field called the `refcon` (reference constant) for use by programmers.

The Macintosh operating system is event-driven: Anytime you press a key, click the mouse button, or insert a new disk, the system records the activity in an *event record* data structure and places the record in a queue (the *event queue*). As you'll see, the system also records other, less-obvious activities on the event queue. Fundamentally, Macintosh programs remove records from the event queue and use them to determine which code to dispatch. For example, pressing a key might cause the program to vector to a routine that reads the character and displays it on the screen.

Three events that bear directly on the window's behavior but are generated internally by the Mac's Window Manager are *activate*, *deactivate*, and *update*. The frontmost window on the Mac screen is known as the *active* window. It looks different from other windows on the screen: Among other things, its title bar is highlighted with horizontal stripes.

Most applications that allow multiple windows treat the active window specially. For example, a word processor will usually display any characters you type in the active window. Since keeping track of the active window is important, the Mac uses two events to orchestrate its maintenance. Whenever you activate a window, the Mac's Window Manager generates a deactivate event for the currently active window and an activate event for the newly active window. Whenever you move, resize, or hide a window, the action may reveal parts of other windows. To maintain the illusion that you're really looking at a desktop with pieces of paper on it, the newly revealed windows need to be redisplayed. To this end, the Window Manager generates an update event for each window that should be redrawn.

Keeping to the Guidelines

The Macintosh user guidelines specify that clicking on a deactivated window should activate it; clicking and dragging

on a window's title bar should move the window; and clicking on the close box, zoom box, and resize box should produce the appropriate responses. Much of a program's event-handling code involves managing windows. And most of the time, the code will do the same thing for every window.

On occasion, however, the program might need to do something other than the default behavior. For example, when a window is activated or deactivated, the program may need to update certain global variables that track the currently active window. It's frustrating to have to rewrite the code for each program even though the code to handle typical behavior is common to almost every application. You end up distributing this code among nonwindow events such as menu selection and key presses. Worse, minor variations on the usual behavior require that you modify this code, and these modifications are typically nonmodular.

I Did It My Way

One solution to the problem would be to just write a new window system from scratch, but it would be a shame to junk all the existing Toolbox code. My solution is less revolutionary: First, separate each window operation—activating, updating, moving, and so on—into its own function. Second, collect these functions in a single place, called a `WindowType`.

A `WindowType` is a data structure containing an array of pointers to functions, one for each window operation. A `WindowType` is associated with every window created by the program. When your program performs an operation on a window, this system retrieves the appropriate function from the `WindowType` and invokes the function. Listing 1 gives you some idea of what it's like to use my window package.

To conform to object-oriented programming terminology, I call the individual functions that perform window

continued

operations "methods," and the process of selecting a function "sending a message." You actually select the function by calling the `send_window` function

with `WindowPtr` (a pointer to a window) and a message (an integer) as arguments. Since I included the ANSI C facility for a variable number of arguments (see list-

ing 2), you can pass any additional arguments of any type to `send_window`. It retrieves the `WindowType` data structure and uses the message (index) to select the function. `Send_window` then calls the function with the `WindowPtr` and the remaining arguments (see listings 3 and 4).

Listing 1: *An example of how to use my utilities. This program creates a new `WindowType` with new facilities; it does little else. (Listing 3 is of `window.h`.)*

```
#include "window.h"
WindowType qcw_struct;
WindowType *quit_on_close_window = &qcw_struct;
int do_free(), do_draw();

main()
{
    InitGraf(&thePort);
    InitFonts();
    InitWindows();
    FlushEvents(everyEvent, 0);
    InitCursor();

    init_windows(0);
    new_window_type(quit_on_close_window, 0, standard_window);
    put_method(quit_on_close_window, Free, do_free);
    put_method(quit_on_close_window, Draw, do_draw);
    test();
}

int do_free()
{
    ExitToShell();
}

int do_draw()
{
    MoveTo(0, 0);
    LineTo(thePort->portRect.right,
           thePort->portRect.bottom);
}

test()
{
    Rect r;

    SetRect(&r, 40, 40, 200, 150);
    ShowWindow(create_window(quit_on_close_window, &r, "Test", 0));
    for (;;)
        handle_event();
}

handle_event()
{
    EventRecord event;
    int doKeyDown(), doMenuBar();

    SystemTask();
    if (GetNextEvent(everyEvent, &event))
        handle_window_event(&event, doKeyDown, doMenuBar);
}

doKeyDown(event)
EventRecord *event;
{
}

doMenuBar(event)
EventRecord *event;
{
}
```

Built-in Messages

My window package has 13 defined messages that take care of all the operations you'll usually perform on windows. You can define as many additional messages as you wish. The 13 I've defined are as follows:

- **Init:** Sent when a window is created. The default implementation does nothing.
- **Activate:** Sent when an activate event occurs.
- **Deactivate:** Sent when a deactivate event occurs.
- **Update:** Sent when an update event occurs. In the default implementation, this calls the Macintosh `BeginUpdate` procedure, sends a `Draw` message to the window, and then calls the `EndUpdate` procedure.
- **Grow:** Sent when the mouse is pressed in the window's grow box.
- **Move:** Sent when the mouse is pressed in the window's title bar.
- **Close:** Sent when the mouse is pressed in the window's close box.
- **ZoomOut:** Sent when the mouse is pressed in the window's zoom box and the window is in its initial state.
- **ZoomIn:** As above, but when the window has already been zoomed out.
- **Content:** Sent when the mouse is pressed in the content region of an active window.
- **InactiveContent:** As above, but for an inactive window. In the default implementation, this merely brings the window to the front, activating it.
- **Draw:** Sent when the window's contents should be redrawn. This does nothing in the default implementation.
- **Free:** Sent when the window should be destroyed. In the default implementation, this just releases storage for the window.

Note that a single event can result in more than one message. This provides you with finer control over window behavior. For example, a mouse-click in the content region of an active window can result in a variety of behaviors, de-

pending on what the window is being used for. But a click in the content region of an inactive window will nearly always result in the activation of that window. Since I've separated these two behaviors into separate messages, if you want to change one behavior, you needn't worry about reimplementing the other as well.

New Windows and Types

My window package has two window types defined: `vanilla_window` and `standard_window`. The first is just a rectangle on the screen: You can't move, close, grow, or zoom it, but it will handle activate, deactivate, and update events correctly. The second is the usual Macintosh document window, with a title bar and close, zoom, and grow boxes. Its methods implement the behaviors usually associated with mouse-clicks in those areas.

You create a new window by calling `create_window`, which returns a `WindowPtr`. The function takes four arguments: a window type, the window's title, the rectangle to be occupied by the window, and the number of bytes for the window's `refcon` (I'll discuss this last argument later). Using `create_window` is far simpler than using the Mac's NewWindow procedure with its bewildering eight arguments. The simplification is achieved by containing some of the information required by `NewWindow`, such as whether the window has a close box, in the `WindowType`. Also, `create_window` does not display the window, and it always puts the new window in the back of the window list.

The `vanilla_window` and `standard_window` types are useful starting places, but neither is fully functional because they lack a method for the `Draw` message. It's necessary to create a new `WindowType` in order to do anything really useful. If you create a new type that inherits from an old type, you need only define the differences in the types' behaviors.

For example, to create a `WindowType` that has the facility to actually draw, you create a new type that inherits from `standard_window` and add a method for the `Draw` message. To do this, you call the `new_window_type` procedure with three arguments: a pointer to the storage for the new `WindowType`, an integer denoting the number of bytes of local storage to reserve for each window, and a pointer to the old `WindowType`.

New methods are then added by calling the `put_method` function with the `WindowType`, the message name, and the new method. Say that `my_draw_func` is a function for drawing on a window, and

`my_window_type` is a pointer to a `WindowType`. The following two lines will then create the new `WindowType` and install the drawing function:

```
new_window_type(my_window_type,
0, standard_window);
```

```
put_method(my_window_type, Draw,
my_draw_func);
```

Event Dispatching

The main loop of a typical Macintosh program removes the front event from *continued*

Listing 2: This include file provides the ANSI C variable argument functionality to development systems that don't have it.

```
/* varargs.h */
/* This file defines the ANSI C standard
   macros for variadic functions. Put it in the
   same directory subtree as the Lightspeed C application. */

typedef char *va_list;
# define va_dcl int va_alist;
# define va_start(list) list = (char *) &va_alist
# define va_end(list)
# define va_arg(list,mode) ((mode *) (list += sizeof(mode)))[-1]
```

Listing 3: The file `window.h` defines the structures and lists the global functions of my package. You must reference it in any files that use my routines.

```
/* window.h */

#ifndef _window_
#define _window_

#include <WindowMgr.h>
#include <EventMgr.h>

#define zoomDocProc 8
#define zoomNoGrow 12

typedef int (*intfuncp)();

typedef struct {
    int defProcID;
    Boolean closable, growable;
    int min_width, min_height;
    int inst_vars_size;
    intfuncp *method;
} WindowType;

typedef struct {
    WindowType *type;
    char inst_vars;
} WindowData;

typedef WindowData **WindowDataHandle;
extern WindowType *vanilla_window, *standard_window;
#define WITH_PORT(x) {GrafPtr _sp; GetPort(&_sp); SetPort(x);}
#define END_PORT SetPort(_sp);}
#define W_DATA_HANDLE(w) ((WindowDataHandle)((WindowPeek) w)->refCon)
#define W_TYPE(w) ((*W_DATA_HANDLE(w))->type)
#define W_REFCONP(type,w) \
    ((type*) (&((*W_DATA_HANDLE(w))->inst_vars) \
    + W_TYPE(w)->inst_var_size))
#define W_REFCON(type,w) (*W_REFCONP(type,w))
#define W_INST_VARP(type,w,offset) \
    ((type*) (&((*W_DATA_HANDLE(w))->inst_vars) + offset))
#define W_INST_VAR(type,w,offset) (*W_INST_VARP(type,w,offset))
```

continued

```

/***** functions *****/
void init_windows(int);
/* number of user-defined messages */
WindowPtr create_window(WindowType*, Rect*, char*, int);
/* type, rect, title, refConSize */
void free_window(WindowPtr);
int send_window(WindowPtr, int, ...);
/* window, message, args */
int vsend_window(WindowPtr, int, char*);
/* window, msg, args */
int send_window_event(WindowPtr, EventRecord*);
Boolean handle_window_event(EventRecord*, intfunc, intfunc);
/* event, key proc, menu proc */
int new_window_type(WindowType*, int, WindowType*);
void put_method(WindowType*, int, intfunc);
/* window type, message, method */
void add_grow(WindowType*);
void add_close(WindowType*);
void add_zoom(WindowType*);
#define N_SYS_MESSAGES 13
enum {Init = -N_SYS_MESSAGES, Activate, Deactivate, Update, Draw, Move,
      Grow, Content, InactiveContent, Close, Free, ZoomIn, ZoomOut};
#endif

```

Listing 4: Functions from my Macintosh window package.

```

#include <WindowMgr.h>
#include <EventMgr.h>
#include <varargs.h>
#include "window.h"

#define W_MESSAGE_OFFSET N_SYS_MESSAGES
#define SCREEN_MARGIN 5
#define DEFAULT_MIN_WIDTH 5
#define DEFAULT_MIN_HEIGHT 5

#define COPY(type,old,new) BlockMove((old), (new), sizeof(type))
#define MENU_BAR_HEIGHT 20
#define NULL 0L
#define SCREEN_WIDTH (screenBits.bounds.right - screenBits.bounds.left)
#define SCREEN_HEIGHT (screenBits.bounds.bottom - screenBits.bounds.top)

int w_init(), w_activate(), w_deactivate(), w_update(),
    w_move(), w_grow(),
    w_content(), w_close(), w_free(), w_inactive_content(),
    w_draw(), w_zoom_in(), w_zoom_out();

intfunc basic_methods[] = {w_init,
                          w_activate,
                          w_deactivate,
                          w_update,
                          w_draw,
                          w_move,
                          w_grow,
                          w_content,
                          w_inactive_content,
                          w_close,
                          w_free,
                          w_zoom_in,
                          w_zoom_out};

WindowType vanilla_window_struct, standard_window_struct;
WindowType *vanilla_window = &vanilla_window_struct;
WindowType *standard_window = &standard_window_struct;

static int last_window_message, n_messages;

```

continued

the event queue and dispatches on the event type. Most events involve windows in some way, but key presses and menu selections do not. For event dispatching, I have a single function, `handle_window_event`. It takes three arguments: a pointer to the event, pointers to the function to be called when a key is pressed, and the function to be called for menu selections.

You might wonder why key presses and menu selections are involved in window events. Conceptually they aren't, of course, but their presence is strongly suggested by the structure of the event dispatch code. You could divide `handle_window_event` into two functions, one that merely checks to see if the event involves a window and another that actually does the dispatch, but you'd be duplicating code and doing a little extra work. Not my style.

The program in listing 1, which just puts a standard window on the screen, should now be comprehensible. It first calls `init_windows` to set things up. This function takes one argument, the number of user-defined messages. In this case, there are none. I then define a new `WindowType` that behaves just like `standard_window`, except for the addition of a `Free` message (for exiting the program) and a `Draw` message. The test routine uses `create_window` to create a window and displays it with the Toolbox procedure `ShowWindow`. It then enters the event-dispatching loop, using `handle_window_event` to take care of all the work. The key press and menu functions do nothing.

In Depth

In my description of the system, I've glossed over several important implementation decisions. How, for instance, is a `WindowType` associated with a window?

One method is to define a new data structure that has a window and type information embedded in it. This is probably not a good idea. The Mac has many procedures that expect pointers to windows as arguments, and using them might become complicated, requiring at least casts and possibly glue routines. Also, embedding a window in another structure would make it difficult to extend the window system to handle dialog boxes, which already have a window embedded inside them.

An alternative, the method I have adopted, uses the `refcon` field of the Macintosh `WindowData` structure. Recall that this pointer-size field is available for programmer use. I use it to hold

a handle to a structure, called a window data record, that contains the WindowType.

Since I've used the refcon, you won't be able to if you use my routines, but that's why I have included room for another refcon in the WindowData structure. I've even improved somewhat on the original by allowing this refcon to be of any size: You specify the number of bytes you want as the fourth argument to create_window.

The WindowData structure also has room for data that is local to each window. The size of this local area is given as an argument to new_window_type.

Inheritance

Another important implementation issue involves inheritance. In some object-oriented languages, like Smalltalk, the methods that type A inherits from type B are stored only in B, and the inheritance chain is searched when a message is sent. This is a reasonable space/time trade-off for a system with many messages, which is an unlikely situation with my window system. So I chose the simpler and faster

continued

```

/*****/
void init_windows(n_msgs)
int n_msgs;
{
    last_window_message = n_msgs-1;
    n_messages = N_SYS_MESSAGES + n_msgs;
    new_window_type(vanilla_window, 0, NULL);
    new_window_type(standard_window, 0, vanilla_window);
    add_grow(standard_window);
    add_close(standard_window);
    add_zoom(standard_window);
}

WindowPtr create_window(type, rect, title, refcon_size)
WindowType *type;
Rect *rect;
char *title;
int refcon_size;
{
    WindowPtr w;
    WindowDataHandle wd;

    wd = (WindowDataHandle) NewHandle(sizeof(WindowType*)
        + type->inst_vars_size + refcon_size);
    (*wd)->type = type;
    CtoPstr(title);
    w = NewWindow(NULL, rect, title, FALSE, type->defProcID, -1L,
        type->closable, (long) wd);
}
    
```

continued

Turbo Pascal Tools to Help You Program Faster and Easier

A Multi-User B-Tree Toolkit



Write powerful network compatible databases faster and easier using **B-Tree Filer 5.0**. You'll have the fastest, safest, most flexible databases—no rigid structure, no TSR hassles, no running out of files. And they're compatible with Novell, 3Com, MS-NET, and others.

You get: ■ Fixed and variable length records ■ Two billion records per data base ■ Up to 100 indexes per file ■ Flexible record locking ■ Fail-safe mode with journaling ■ Units for sorting, browsing, reindexing, and network control.

B-Tree Filer includes full source code, documentation, technical support, and you pay NO royalties.

B-Tree Filer 5.0 is only \$125. (single user)
With network support, only \$175.

"A Superbly Crafted Toolbox"



Turbo Professional 5.0 is a library of more than 600 state-of-the-art routines optimized for Turbo Pascal 5.0. It includes complete source code, comprehensive documentation, and powerful and useful demo programs.

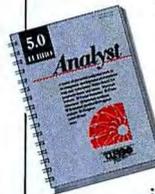
You get: ■ TSR management ■ Menus and windows ■ BCD ■ Large arrays and more. *New Routines!* Complete mouse support ■ Window-oriented text editor ■ Scrolling data entry screens ■ Versatile pick lists ■ On-line reference guide, and more.

"Turbo Professional...a superbly crafted toolbox... [makes] the hard stuff so easy."

Kent Porter, Dr. Dobb's Journal, 4/88

Turbo Professional 5.0 is only \$125.

Analytical Tools to Help You Write Better Programs



You'll write better Turbo Pascal 5.0 programs easier and faster using the powerful analytical tools of **Turbo Analyst 5.0**. You get an integrated development environment with: ■ File Browser ■ Mouse support ■ Hotkey access to the compiler, debugger and the analytical tools.

The tools include: Pascal formatter, Program structure analyzer, Program lister, three Execution profilers, and Unit disassembler.

"Turbo Analyst...a valuable tool for every Turbo Pascal programmer. The Program Structure Analyzer...a timesaver. The integrated environment...impressive."

Namir Shammas, Turbo Tech Report, 7/88

Turbo Analyst 5.0 is only \$99.

Satisfaction guaranteed or your money back within 30 days. Turbo Pascal 4.0 or 5.0 is required. Shipping and taxes prepaid in U.S. and Canada. Elsewhere add \$15 per unit. For more information call (408) 438-8608.



TurboPower Software P.O. Box 66747 Scotts Valley, CA 95066-0747

Call toll-free for credit card orders.

1-800-333-4160

Continental U.S. and Canada

```
PtoCstr(title);
vsend_window(w, Init, NULL);
return(w);
}

void free_window(window)
WindowPtr window;
{
    DisposHandle((WindowDataHandle) GetWRefCon(window));
    DisposeWindow(window);
}

Boolean handle_window_event(event, keyProc, menuProc)
EventRecord *event;
Int (*keyProc)(), (*menuProc)();
{
    WindowPtr window;

    switch (event->what) {
        case keyDown: return(keyProc? (*keyProc)(event): FALSE);

        case activateEvt:
        case updateEvt:
            return((Boolean) send_window_event((WindowPtr)
                event->message, event));

        case mouseDown:
            switch (FindWindow(event->where, &window)) {
                case inMenuBar:
                    return(menuProc ? (*menuProc)(event) : FALSE);
            }
    }
}
```

alternative—having `new_window_type` copy the methods. The semantics of the two schemes are subtly different; in my system, unlike in Smalltalk, a changed method in a parent type will not propagate to the already-created children of that type.

For the sake of simplicity and speed, I implemented messages as integers. The hashed-string method used by Smalltalk requires additional code to do the hashing and searching. It cannot compete in speed with my scheme, which is a simple array index. To its credit, the hashed-string approach allows new messages to be added incrementally, while the integer scheme does not, and it saves space when objects of different types use very different messages.

The Bad News

I'd like to be able to say that my window method provides a simple, efficient, and fully modular way of adding different pieces of functionality to Macintosh windows, but that is not entirely true. Although it's easy enough to create a type that provides one feature, things begin to

continued

How to make 2 plus 2 equal 1.

Get the DSDP-402 communication board, from Qua Tech. Along with two independent parallel ports, it has two optional serial port modules that can support any combination of RS-232, RS-422, or RS-485 at the same time.

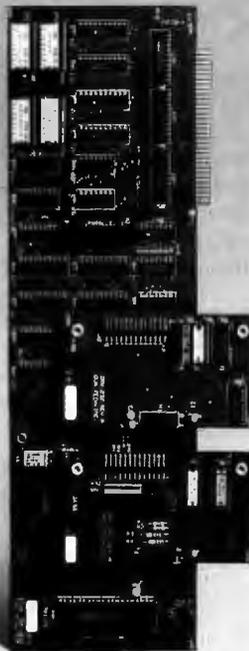
The DSDP-402's parallel ports offer the convenience of connecting two printers to your PC-AT workstation or file server.

The serial ports have selectable and sharable interrupts. And all ports are address

selectable, so they won't interfere with existing serial or parallel hardware.

All on one board, all in one slot.

For order info, call:
1-800-553-1170.



QUA TECH, INC.
478 E. Exchange Street
Akron, OH 44304

SUBSCRIPTION PROBLEMS?



We want
to
help!

If you have a problem with your BYTE subscription, write us with the details. We'll do our best to set it right. But we must have the name, address, and zip of the subscription (new and old address, if it's a change of address). If the problem involves a payment, be sure to include copies of the credit card statement, or front and back of cancelled checks. Include a "business hours" phone number if possible.

BYTE MAGAZINE

ATTN: SUBSCRIBER SERVICE
P.O. Box 555
HIGHTSTOWN, NJ 08520

Power

Incredible Value!

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)

Circle 194 on Reader Service Card



Technical Specifications

Power C includes: Power C compiler with integrated Make, Power C Linker, Power C Libraries (450 functions), the Power C book (680 pages), and support for ..

- ✓ ANSI standard
- ✓ IEEE floating point
- ✓ 8087/80287 coprocessor
- ✓ auto-sensing of 8087/80287
- ✓ automatic register variables
- ✓ unlimited program size
- ✓ mixed model (near & far pointers)
- ✓ graphics on CGA, EGA, VGA, & Hercules

Optional Products:

- ✓ Power Ctrace debugger
- ✓ Library source code
- ✓ BCD business math

Order now by calling our toll free number or mail the coupon to Mix Software, 1132 Commerce Drive, Richardson, TX 75081.

1-800-333-0330

For technical support call: 1-214-783-6001
Minimum System Requirements:
DOS 2.0 or later, 320K memory, 2 floppy drives or hard drive.
Runs on IBM PC, XT, AT, PS/2 and compatibles.

60 day money back guarantee

Name _____
Street _____
City _____
State _____ Zip _____
Telephone _____
Paying by: Money Order Check
 Visa MC AX Discover
Card # _____
Card Expiration Date _____
Computer Name _____ Disk Size 5¼" 3½"
Product(s) (Not Copy Protected)
 Power C compiler (\$19.95) \$ _____
 Power Ctrace debugger (\$19.95) \$ _____
 Library Source Code (\$10.00) \$ _____
(includes assembler & library manager)
 BCD Business Math (\$10.00) \$ _____
Add Shipping (\$5 USA - \$20 Foreign) \$ _____
Texas Residents add 8% Sales Tax \$ _____
Total amount of your order \$ _____

NEW! Innovative PC Products**WORDPERFECT DREAMER®**

Over 80 single-stroke commands for WordPerfect 5.0, plus 30 additional user macros. "One of the more innovative products at Comdex/Spring'88".—InfoWorld. Also for Lotus 1-2-3, Enable, etc. **\$199.95**

PROGRAMMABLE DREAMER®

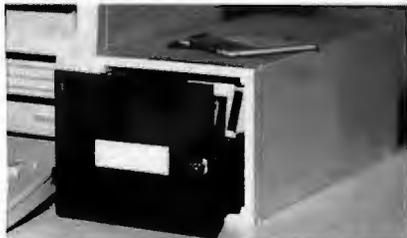
Great for VARs—for use in POS, machine control, process control, custom applications. Many models to choose from. Custom options available. **\$199.95**

WINNING WORDPERFECT 5.0

This best-selling 20-lesson interactive tutorial includes a disk containing lesson demo files. **\$29.95**

FANCARD™

Extend the life of your PC and components. No additional power supply needed. Available with one or two fan units. FanCards are quiet! Patent pending. **from \$79**

BANX®

Stacks vertically and horizontally. Holds over 75 3.5" disks. Easy access via slide out drawers. Four color-coded dividers included. Security lock and key. Manufactured from high quality plastic. **\$29.95**

Dealer/Distributor/OEM Inquiries Welcome!

T. S. MICROTECH, INC.

12565 Crenshaw Blvd. Hawthorne, CA 90250
(213) 644-0859 • FAX (213) 644-0567

284 B Y T E • JULY 1989

H A N D S O N
S O M E A S S E M B L Y R E Q U I R E D

```

        case inSysWindow:
            SystemClick(event, window); return(TRUE);
        case inDesk: return(TRUE);
        default: return(send_window_event(window, event));
    }

    default: return(FALSE);
}

int send_window(window, message, va_alist)
WindowPtr window;
int message;
va_dcl
{
    va_list args;
    int result;

    va_start(args);
    result = vsend_window(window, message, args);
    va_end(args);
    return(result);
}

int vsend_window(window, message, args)
WindowPtr window;
int message;
char *args;
{
    WindowType *type = W_TYPE(window);

    return(*type->method[message+W_MESSAGE_OFFSET])(window, args);
}

int send_window_event(window, event)
WindowPtr window;
EventRecord *event;
{
    switch(event->what) {
        case activateEvt:
            if (event->modifiers & activeFlag)
                vsend_window(window, Activate, (char*) event);
            else
                vsend_window(window, Deactivate, (char*) event);
            return(TRUE);

        case updateEvt:
            vsend_window(window, Update, (char*) event);
            return(TRUE);

        case mouseDown:
            switch(FindWindow(event->where, &window)) {
                case inDrag:
                    vsend_window(window, Move, (char*) event); return(TRUE);
                case inGrow:
                    vsend_window(window, Grow, (char*) event); return(TRUE);
                case inGoAway:
                    vsend_window(window, Close, (char*) event); return(TRUE);
                case inZoomIn:
                    vsend_window(window, ZoomIn, (char*) event);
                    return(TRUE);
                case inZoomOut:
                    vsend_window(window, ZoomOut, (char*) event);
                    return(TRUE);
                case inContent:
                    if (window == FrontWindow())
                        vsend_window(window, Content, (char*) event);
                    else
                        vsend_window(window, InactiveContent, (char*) event);
                    return(TRUE);
            }
    }
}

```

continued

?

How can I manage and maintain different code, documentation and software products?



MKS Make and MKS RCS manage projects from the simplest to the most complex with unsurpassed efficiency!

It is easy to see why business leaders have chosen this MKS "dynamic duo." MKS RCS and MKS Make provide all the features needed by anyone, from the smallest to the largest user. MKS RCS manages multiple versions of text files such as program source code, manuscripts, and catalogs. MKS Make automates the building of programs and supports a wide range of industry standard compilers, librarians, and linkers.

Retrofit Your Projects

The MKS advantage can be obtained by incorporating RCS and Make into existing projects. You eliminate missed deadlines by building a history and version base from files already developed. The complete reference and tutorial guides included in the packages allow you to immediately incorporate these valuable tools into demanding development environments.

Critical LAN Tools

In geographically separated software development environments, multiple authors can change the same source code or document file. With MKS RCS, changes made by multiple authors are sorted out and merged in separate change paths. MKS RCS also provides security over IBM PC networks, Novell NetWare, PC NFS, and other networking software systems. A project leader can even have a portion of the development team pursue an independent development stream, with that stream reintegrated at a later time.

The Development Manager's Team

For the managers of software development, MKS RCS and MKS Make generate the needed reports to keep multi-programmer projects on target. File versions may be retrieved by date, release number or user-assigned name. With the MKS management team, there is no system degradation in handling the most complex tasks.

MKS RCS

Portability — the easy transfer of development files among DOS, OS/2, Xenix, & UNIX environments

Prevention — programmers no longer overwrite each other's work

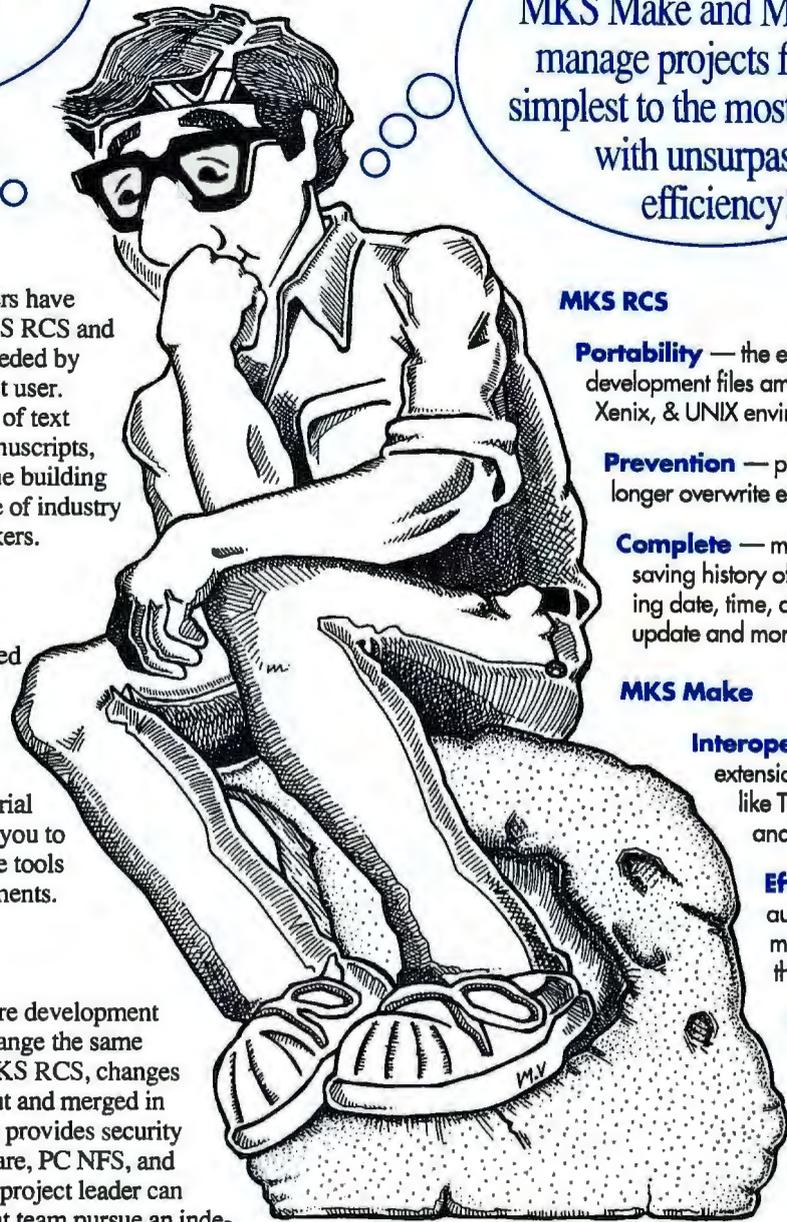
Complete — maintains a time-saving history of changes including date, time, author, reason for update and more.

MKS Make

Interoperability — extensions for compilers like Turbo C, MCS, and Watcom C.

Efficiency — automatic management of updates for the user

Complete — comes with an object code librarian (AR) so there are no additional costs



MKS RCS & MKS Make The Unbeatable Software Management Team

Products	List Price for DOS	List Price for OS/2
MKS RCS	\$189	\$395
MKS Make	\$149	\$249
Combined both packages	\$299	\$575

For attractive LAN, Site and combination pricing please call for details.

30-day money-back guarantee



1-800-265-2797 (continental U.S. calls only)
1-519-884-2251 (outside continental U.S.)
1-519-884-8861 (FAX)

35 King Street North, Waterloo, Ontario N2J 2W9 Canada

MKS, MKS Make, MKS Toolkit Korn Shell, and MS RCS are trademarks of Mortice Kern Systems Inc. UNIX is a trademark of AT&T.

Circle 195 on Reader Service Card



Power, price, and performance

JULY 1989 • BYTE 285

```

        default:
            return(FALSE);
    }

    default:
        return(FALSE);
}

/***** Window Types *****/

int new_window_type(wt, inst_vars_size, inherit_from)
WindowType *wt, *inherit_from;
int inst_vars_size;
{
    intfuncp *methods;
    int i;

    methods = (intfuncp*) NewPtr(n_messages*sizeof(intfuncp));
    if (inherit_from == NULL) {
        wt->defProcID = noGrowDocProc;
        wt->closable = FALSE;
        wt->growable = FALSE;
        wt->min_width = DEFAULT_MIN_WIDTH;
        wt->min_height = DEFAULT_MIN_HEIGHT;
        wt->inst_vars_size = inst_vars_size;
        wt->method = methods;
        for (i = 0; i < n_messages; i++)
            wt->method[i] = basic_methods[i];
        return(0);
    } else {
        BlockMove(inherit_from, wt, sizeof(WindowType));
        BlockMove(inherit_from->method, methods,
            n_messages*sizeof(intfuncp));
        /* must do this after BlockMove, so that it is not overwritten
           by inherit_from's method array */
        wt->method = methods;
        wt->inst_vars_size = inherit_from->inst_vars_size +
            inst_vars_size;
        return(inherit_from->inst_vars_size);
    }
}

void put_method(wt, message, method)
WindowType *wt;
int message;
intfuncp method;
{
    wt->method[message+W_MESSAGE_OFFSET] = method;
}

void add_grow(type)
WindowType *type;
{
    if (!type->growable) {
        type->growable = TRUE;
        switch (type->defProcID) {
            case noGrowDocProc: type->defProcID = documentProc; break;
            case zoomNoGrow: type->defProcID = zoomDocProc; break;
            default: fatal("add_grow: can't add to this doc type");
        }
    }
}

void add_close(type)
WindowType *type;
{
    type->closable = TRUE;
}

void add_zoom(type)
WindowType *type;

```

continued

get messy when you start trying to combine types with different features. The different types tend to step on each other's toes.

Some of the problems can be remedied with a little effort, and some are inherently challenging, but none are mere idiosyncrasies of the Mac or of window systems—they are endemic to the object-oriented style of programming. A modest attempt to prettify a programming interface can generate some serious research problems, demonstrating once again that programming is sometimes like picking your way through a mine-field.

The least problematic interaction between window types involves messages. I've explained why I chose to implement messages as simple integers, but using integers does make it difficult to combine messages.

Another interaction occurs between types' local storage areas. My save_window type inherits from vanilla_window, which itself uses no local storage, so the save_window methods assume that their local storage begins at offset 0 of the window's local storage area. But if there is some other type that also has local storage beginning at offset 0, how could the two types ever be used together? The problem is similar to that of messages, though more difficult to solve.

The final and most challenging problem concerns the methods themselves. Sometimes the only modification that's required for a method to be suitable for use with a new type is to perform some action after, or before, the original method. The only way to combine methods in my system is to copy and modify the source code, or to invoke methods from within other methods. It would be better if I could say, "Use the same method you usually would, but run this piece of code afterward." But to implement such an idea would require a great deal of work, and it would inevitably be messy to use.

The Flavors system, an object-oriented programming facility that runs on Symbolics Lisp machines, attempts to get around this problem. Flavors allows you to define methods that go before, after, or around other methods, and it provides a protocol that allows the passing of arguments and return values.

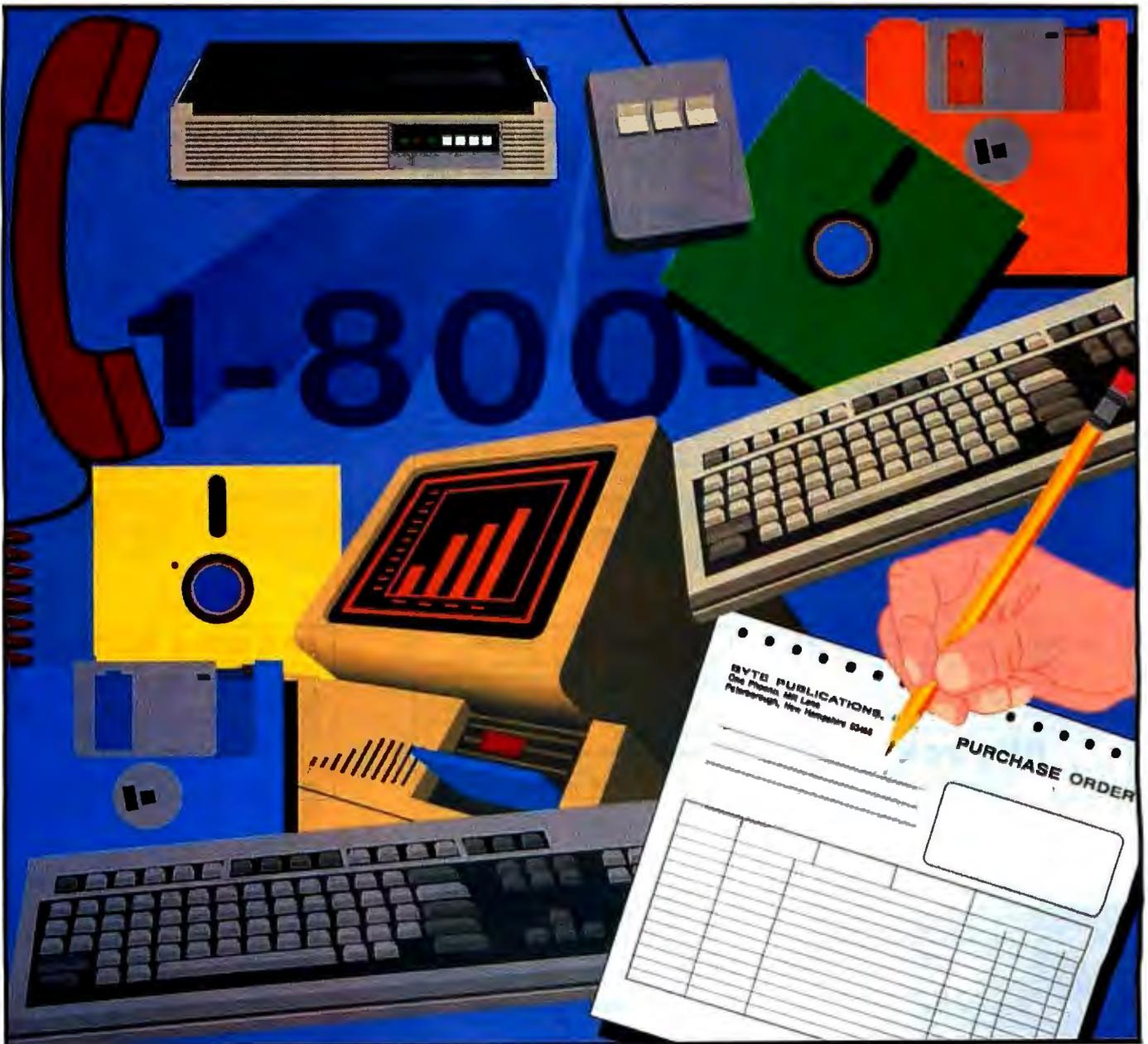
But Flavors is somewhat messy and complex, and subtle interaction bugs can still occur. It seems that the combining of methods remains an open research problem.

continued on page 339

PRODUCT SHOWCASE

■ BUYER'S MART
■ BYTE BITS

■ PRODUCT SPOTS
■ MICRO PRODUCT CENTER



THE BUYER'S MART

A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which 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.

RATES: 1x—\$525 3x—\$500 6x—\$475 12x—\$425
Prepayment must accompany each insertion. VISA/MC Accepted.

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 603-924-3754.

ACCESSORIES

CUT RIBBON COSTS!

Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one inker! For crisp, black professional print since 1982. You can choose from 3 models:

Manual E-Zee Inker — \$39.50

Electric E-Zee Inker — \$89.50

Ink Master (Electric) — \$189.00

1000's of satisfied users in 5 years. Money-back guarantee.

BORG INDUSTRIES

525 MAIN ST., JANESVILLE, IA 50647

1-800-553-2404

In IOWA 319-887-2976

Inquiry 576.

ACCESSORIES

COMPUTER CLOCK \$39

Clock/calendar for PS/2 & PC/XT compatibles, automatically enters time & date without wasting valuable I/O slot. Inserts transparently between a 28-pin ROM & its socket. Even works in BIOS or HD controller ROM. 10-yr. lithium battery. Software included. 30-day money-back guarantee. All orders shipped within 1 business day.

Time-Master part #111TM \$39.00 + \$2.50 S&H

800 432-9174 (24 hr.)

Talus Engineering, Inc.

Inquiry 581.

BAR CODE

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM

Add bar codes and big graphics text to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39. Epson, OKI, IBM dot matrix text up to 1/2". LaserJet up to 2". Font cartridges not required. \$179-\$239. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060

(800) 345-4220

In CA: (408) 458-9938

COMPANION AND EXTENDER

Place a keyboard and monitor up to 600' from your CPU with EXTENDER and COMPANION products. Keep a second Keyboard/Monitor at the CPU with COMPANION. Supports MDA, CGA, EGA, VGA, PS2. Uses single 1/2" cable.

Prices start at \$149.00 for EXTENDER and \$219.00 for COMPANION 25 ft. unit complete.

CYBEX CORPORATION

2800-H Bob Wallace, Huntsville, AL 35805

205-534-0011

International Fax # 205-837-9212

Inquiry 577.

RIBBONS • RIBBONS • RIBBONS

Fast, Professional, Friendly Service. Over 1,100 Printer & Typewriter Ribbons Available. One Call For All Your Ribbon Needs!

—THE RIBBON SOURCE—

SATISFACTION GUARANTEED!

U.S. So. Cal. San Diego

(800) 354-7744

(800) 453-6688

(619) 259-6800

Inquiry 582.

PORTABLE READER

Battery-operated, handheld reader with 64K static RAM, 2x16 LCD display, 32-key keyboard, Real-Time-Clock. Wand or laser scanner. Program prompts and data checking thru its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Direct from USA manufacturer. 30-day \$\$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060

(800) 345-4220

In CA: (408) 458-9938

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 queries and commands into C function calls and data structures. JAKE offers context-sensitive semantic processing; interfaces easily; <64K mem.

JAKE \$495. INTERACTIVE DEMO \$10

ENGLISH KNOWLEDGE SYSTEMS, INC.

5525 Scotts Valley Dr. #22, Scotts Valley, CA 95068

(408) 438-6922

Inquiry 583.

PRINT BAR CODES AND BIG TEXT

On EPSON, IBM, OKI dot matrix or LaserJet. Design any format/size on ONE easy screen. 1-120 fields/label. 13 text sizes to 1" — readable at 50 ft. AIAG, MIL-STD, 2 of 5, 12B, UPC/EAN, Code 39. File Input, FAST—\$279. Logos, Product Symbols. Other menu-driven bar code programs from \$48. 30-day \$ back.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060

(800) 345-4220

In CA: (408) 458-9938

Hi-Tech Noise Killer

SONEX Acoustical Treatment

Isolates, dampens and absorbs annoying noise. Proven effective in thousands of computer, industrial and audio applications. Call or write for more information.

Illbruck

5155 E. River Road N.E., Suite 413, Minneapolis, MN 55421

(612) 521-3555

Inquiry 579.

NanoLISP \$99.99

An MS-DOS Common LISP interpreter that supports most Common LISP operations and strictly adheres to the standard. Numerous advanced and extra features, excellent debugging facilities, sample AI programs, fully-indexed manual, free technical support.

Microcomputer Systems Consultants

P.O. Box 8646, Santa Barbara, CA 93180

(805) 967-2270

Inquiry 584.

BAR CODE READERS

For PC, XT, AT, & PS/2, all clones, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—\$399. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. One-year warranty. 30-day \$ back. Direct from USA manufacturer.

Worthington Data Solutions

417-A Ingalls St., Santa Cruz, CA 95060

(800) 345-4220

In CA: (408) 458-9938

REFILL LASER PRINTER & COPIER CARTRIDGES

Don't throw away that used laser printer or copier cartridge. Refill it and save over 75%. It's easy. For use with Canon EP & EPS cartridges, HP LaserJet & LaserJet II, Apple Laserwriter & Laserwriter II, Canon LPB, FAX, and many others. Also kits for Canon Copiers.

COMPLETE REFILL KIT \$29.95

Includes toner, felt pad, and instructions.

VIDEO TAPE PROGRAM \$45.00

Shows disassembly, cleaning, and remanufacture.

MORACK INC.

8647 W. 87th St., Hickory Hills, IL 60457

For order or information (312) 598-0580

Inquiry 580.

muLISP™ 87 for MS-DOS

Fast, compact, efficient LISP programming environment. muLISP programs run 2 to 3 times faster & take 1/2 to 1/3 the space of other LISPs. 450 Common LISP functions, multi-window editing & debugging, flavors, graphics primitives, lessons & help, demo programs, comprehensive manual.

Soft Warehouse, Inc.

3615 Harding Ave., Suite 505, Honolulu, HI 96816

(808) 734-5801

Inquiry 584.

BAR CODE SOLUTIONS

Bar coding is so easy with our complete line of readers. Our PC-Wand readers emulate your PC keyboard or ASCII terminal, and are carried around taking inventory, entering road sales and clocking time. Our bar code label printing software packages work with DOS and most matrix or laser printers. We also sell pre-printed labels. Our hardware can work with nearly every computer in the world.

International Technologies & Systems Corp.

635-C North Berry St., Brea, CA 92821

(714) 990-1880 FAX: 714 990-2503 TLX 6502824734 MCI

Inquiry 585.

THE BUYER'S MART

BAR CODE

BAR CODE SOFTWARE SOLUTIONS

ISD has software solutions that allow you to use bar codes for most anything. Like identifying products. Labeling packages. Or even managing assets and paperwork. You'll be able to speed and simplify data collection. Track products dock-to-stock. Streamline inventory control. And more.

Integrated Software Design, Inc.
171 Forbes Blvd., Mansfield, MA 02048
TEL: (508) 339-4928 FAX: (508) 339-2257
© 1989 Integrated Software Design, Inc.

Inquiry 586.

WHEN EASE-OF-USE COUNTS

Reading bar codes should be as easy as a "quick flick of the wrist." But many bar code readers require you to flick and flick and Flick and FLICK until the bar code label is finally read. PERCON designed bar code readers that *really* are as easy as a "quick flick of the wrist."

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

PERCON: THE BAR CODE SPECIALISTS

If you have questions about bar code technology, it's nice to know an experienced, friendly bar code specialist is only a phone call away. Want to know where to start or where to find hard-to-find bar code accessories? Call PERCON for answers.

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

5-YR. WARRANTY AT PERCON

PERCON decoders are now covered by a five-year limited warranty. That means you won't spend one cent replacing your PERCON bar code decoder for five full years. That's reliability you can count on!

PERCON

2190 W. 11th Ave., Eugene, OR 97402
Phone: (800) 873-7266 FAX: (503) 344-1399

PC BAR CODE SPECIALISTS

Bar code readers designed for fast, reliable, cost effective data entry. Looks just like keyboard data! Choose from stainless steel wand or laser interface. Also, powerful Bar Code and Text printing software. Great warranty. Dealer inquiries welcome.

Seagull Scientific Systems

15127 N.E. 24th, Suite 333, Redmond, WA 98052
206-451-8966

BAR CODING SOURCE CODE

UPC, EAN, CODE 39, 2 of 5, and Codabar. Ready to run programs with source codes. Toolkit for 'C' programmers. Do barcodes from your own programs. Supports HP LJ and Epson printers. Includes disk, manual, and symbology documentation. No royalties. 30-day money-back guarantee.

SymbCG - \$79.00 Complete

Symbologic

17019 Jeanette Ave., P.O. Box 4749B, Carritos, CA 90703
(CA res. add \$4.81 tax) (213) 926-2823

Inquiry 587.

BAR CODE

DATA INPUT DEVICES

Bar Code, Magnetic Stripe Readers & SmartCard Encoder/Reader for microcomputers & terminals, including IBM PS/2 & others, DEC, Macintosh, AT&T, CT, Wyse, Wang. All readers connect on the keyboard cable & are transparent to all software. UPC & 39 print programs, magnetic encoders, & portable readers are also available.

TPS Electronics

4047 Transport, Palo Alto, CA 94303
415-856-6833 Telex 371-9097 TPS PLA
FAX: 415-856-3843

Inquiry 588.

VARIANT MICROSYSTEMS

BAR CODE READERS DELIVER

WAND/LASER/MAGNETIC CARD CONNECTIVITY

- Keyboard wedges (Internal/External) for IBM PC/XT/AT, PS/2 and portables.
 - RS232 wedges for WYSE, Link, Kimtron terminals
 - Bar code and label printing software
 - Full two-year warranty
 - 30-Day Money-Back Guarantee
 - Extensive VAR/Dealer Discounts
- 3140 De La Cruz Blvd., Suite 200/Santa Clara, CA 95054/(408) 980-1880
FAX: 415-823-1372

Inquiry 589.

CAD/CAM

PHOTO PLOTTING

from your Smartwork Edit file or any RS-274 Gerber Photo Plot file. Raster type Photoplotting supplied on .007" thick Kodak Ultraline film. Plot data accepted by modem, 5 1/4", 3 1/2" MS-DOS format disks or 9-track mag tape. Gerber plot file 8"x10" plots start from \$15.00. Call for details.

KEPRO CIRCUIT SYSTEMS

Fenton, MO

1-800-325-3878 / 1-314-343-1630 in MO.

Inquiry 590.

P-C-B ARTWORK MADE EASY!

Create and Revise Printed-Circuit-Artwork on your IBM or Compatible

- Help Screens • Dip & Sip Library
 - Printer and Plotter Artwork • Supports Mice
 - Auto-Router available • ICON Menus
- Requirements: IBM or Compatible PC, 384K RAM, DOS 3.0 or later. PCBoards: \$99.00 DEMO: \$10.00

PCBoards

2110 14th Ave. South, Birmingham, AL 35205
(205) 933-1122

Inquiry 591.

CALENDAR SCHEDULING

PC-CAL

- Versatile Calendar and Event Scheduler
- Personal and Group Scheduling • Familiar Displays • Simple Setup and Operation • Side-by-Side Viewing • Repeating Appointments
- Copy, Move, Modify • Available for DOS, OS2, Xenix, HP3000 • Many useful Display and Printed Reports • DOS & OS2 for \$95

BRADFORD BUSINESS SYSTEMS

25301 Cabot Rd. #201, Laguna Hills, CA 92653
(714) 859-4428 FAX: 859-4508

Inquiry 592.

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 Compiler, a CASE software development tool, forms source state programs in: Ada, BASIC, C, FORTRAN and Pascal. FOR IBM DOS.

Price \$200 per lang. (With Primer and Debugger)
Sampler \$50.00 (With all manuals & credit)

AYECO 5025 Nassau Circle, Orlando
INCORPORATED FL 32808 (407) 295-0930

Inquiry 593.

CD-ROM

CD-ROM BUILDERS OMNIBUS

Provides the complete computer system and software prerequisites needed for a fast, productive DOS-based CD-ROM development environment. AMI 80386 25MHz, 4 MB RAM; 338MB Wren; Hitachi CDR-3500 w/audio; 800 MB WORM, AUM-1381A VGA. Other high performance, capacity, and reliability developer platforms/file servers also available. Send for catalog.

5G Corporation

4131 Spicewood Springs Road A-4, Austin TX 78759
800/333-4131 FAX 512/345-9575

Inquiry 594.

CD-ROM Drives & Titles

Largest selection for PC & Mac. Microsoft Programmers Library & Drive \$995 Computer Library \$695 • Public Domain S/W \$99.

Drives from \$699. Hundreds of titles from \$29.

MC/VISA/AMEX, Money-back Guarantee.

Call or write for free 100-page catalog.

Get it all from "The Bureau"

Bureau of Electronic Publishing

121 Norwood Ave., Upper Montclair, NJ 07043
(201) 746-3031

Inquiry 595.

Food/Analyst CD-ROM

Analyze foods, meals, and recipes for any number of persons based on the complete USDA food nutrient database. 4700+ foods, 80+ nutrients. See graphs, printed reports, summaries. Other titles and CD-ROM publishing services available.

Hopkins Technology

CD-ROM Publisher

421 Hazel Lane, Suite 104

Hopkins, MN 55343

(612) 931-9376 Compuserve 74017,614

Inquiry 596.

CD-ROM Developer's Lab

Multimedia production resource for Mac & PC developers & managers. Proven design, management, data prep, programming, pre-mastering, and manufacturing techniques & specs from 18 leading companies. Demos of off-the-shelf tools for imaging, audio, animation (Mac). Real applications using Media-Mixer source tools. CD-ROM XA. PC or Mac \$795; Transportable \$845. Visa or MasterCard.

Software Mart, Inc.

4131 Spicewood Springs Road I-3, Austin, TX 78759
512-346-7887

Inquiry 597.

COMPUTER INSURANCE

INSURE YOUR COMPUTER

SAFEWARE provides full replacement of hardware, media and purchased software. As little as \$39 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am-10 pm ET. (Sat. 9 to 5)

TOLL FREE 1-800-848-3469

(Local 814-282-0559)

SAFEWARE, The Insurance Agency Inc.

Inquiry 598.

CROSS ASSEMBLERS

CROSS ASSEMBLERS

Universal Linker, Librarian

Targets for 36 Microprocessors

Hosts: PC/MS DOS, micro VAX, VAX 8000

ENERTEC, INC.

BOX 1312, 811 W. Fifth St.

Lansdale, PA 19446

Tel: 215-362-0966 Fax: 215-362-2404

Inquiry 599.

THE BUYER'S MART

CROSS ASSEMBLERS

68000 CROSS ASSEMBLER

Assembles 68000/68010 code on a PC Compatible

- Very High Speed—2MB source code assembled per minute • Macros
- S-Records

Knowledge Based Systems, Inc.

2746 Longmire • College Station • Texas • 77840
Phone: (409) 696-7979 • Fax: (409) 696-7277
BBS: (409) 696-7055

Inquiry 600.

Professional Series

PseudoCode releases its PseudoSam professional Series of cross assemblers. Most popular processors. Macros, Conditional Assembly, and include Files. Virtually unlimited size. For IBM PCs, MS-DOS 2.0 or greater. With manual for \$50.00. (MI res. 4% tax). Simulators and disassemblers also available. Shipping \$5, Canada \$10, Foreign \$15. Visa/MC.

KORE Inc.

6910 Patterson, Caledonia, MI 49318 616-987-1444
30-Day satisfaction guaranteed or purchase price refunded.

Inquiry 601.

FANTASTIC SIMULATORS

For the 8048, 8051, 8080, 8085, & Z80 families. Full function simulation including ALL MODES of interrupts. Built-in disassembler. Better than expensive I.C.E.'s.

CROSS ASSEMBLERS

We support the 8048, 8051, 8080/8085, 8096 & Z80 families. Just \$75 each.

Lear Com Company

2440 Kipling St./Ste. 206, Lakewood, CO 80215
303-232-2226

Inquiry 602.

CROSS ASSEMBLERS

Macros, PC Compatible, Relocatable, Conditionals, Fast, Reliable from \$150

also: Disassemblers

EPROM Programmer Board

MICROCOMPUTER TOOLS CO.

Phone (800) 443-0779

In CA (415) 825-4200

912 Hastings Dr., Concord, CA 94518

Inquiry 603.

680X0 Cross Assemblers

Now, inexpensive quality 680X0 Cross-Assemblers that use your IBM PC or compatible. All versions support up to 32 char labels, INCLUDE files, PATH names, extensive list output, sorted symbol tables, many common directives, printed manuals. Basic versions create S-records. Linking versions include a librarian & linker, create either S-records or relocatable modules linked to create S-records or binary files. Minimum requirements are 320K, DOS 2.XX, & 1-5 1/4" 5DD.

Basic 68000/68010—\$49.95 Basic 68020—\$69.95

Linking 68000/68010—\$39.95 Linking 68020/68021—\$129.95

Linking 68030/68031—\$149.95

Checks, VISA, MC accepted. MN residents +8% sales tax.

No PDs or CODs please.

RAVEN Computer Systems

Box 12116, St. Paul, MN 55112 (612) 638-0365

Inquiry 604.

6800-Family Development Software

Our C Compilers for the 6800, 6801, 8809, & 68HC11 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. Linker & Terminal Emulator included.

Wintek Corporation

1801 South St., Lafayette, IN 47904

(800) 742-6809 or (317) 742-8428

Inquiry 605.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION

More than just a straight dump or ASCII transfer! Word Processing, DBMS, and Spreadsheet data on Disk or Tapes transferred directly into applications running on Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters, and Electronic Publishing systems.

IBM PS/2 & Macintosh supported

#1 in the translation industry!

CompuData Translators, Inc.

3325 Wilshire Blvd., Suite 1202, Los Angeles, CA 90010

(213) 387-4477 1-800-825-8251

Inquiry 606.

DATA/DISK CONVERSION

RESULTS

You Can Depend On!

- Data Conversion
- Disk Duplication
- Optical Scanning

Computer Conversions

9580 Black Mountain Rd., Suite J, San Diego, CA 92126

619-693-1697

Inquiry 607.

DISK CONVERSIONS

Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Microm, NBI, CT, also WP, WS, MS/WRD, DW4, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.

FREE TEST CONVERSION

CONVERSION SPECIALISTS

531 Main St., Ste. 835, El Segundo, CA 90245

(213) 545-6551 (213) 322-6319

Inquiry 608.

DISK & TAPE CONVERSIONS

AUTOMATICALLY

SAVE TIME AND MONEY

Over 1000 formats from Mini, Micro Mainframe, Word Processors, & Typesetters.

TAPE Conversions as low as \$23.00 MB

DISK Conversions as low as \$15.00 per Disk

Call or write TODAY for a cost-saving quotation.

CREATIVE DATA SERVICES

1210 W. Latimer Ave., Campbell, CA 95008

(408) 866-6080

Inquiry 609.

FROM MACs TO MAINFRAMES . . .

Our 12 conversion systems support over 1000 formats

DISK INTERCHANGE SERVICE COMPANY

2 Park Drive • Westford, MA 01886

(508) 692-0050

Inquiry 610.

THE #1 CHOICE

In disk & tape conversion

for many leading corporations, government agencies, law firms, and companies in every industry—world-wide.

Free test • Satisfaction guaranteed

Call the helpful conversion experts . . .

Graphics Unlimited Inc.

3000 Second St. North, Minneapolis, MN 55411

(612) 588-7571

Inquiry 611.

DATA/DISK CONVERSION

IBM PC ← to → HP

FILE COPY

IBM PC to HP File Copy allows IBM PCs, PS/2, compatibles to read, write files written by Hewlett-Packard Series 70, 80, 200, 300, 1000, 9000's. We offer custom work using our file copy utilities and program translators. Call for estimate, catalog, data sheet.

Oswego Software 312/554-3567

507 North Adams St. Fax 312/554-3573

Oswego, Illinois 60543 Telex 858-757

Inquiry 612.

CONVERSION SERVICES

Convert any 9-track magnetic tape to or from over 1000 formats including 3 1/2", 5 1/4", 8" disk formats & word processors. Disk-to-disk conversions also available. Call for more info. Introducing OCR Scanning Services.

Pivar Computing Services, Inc.

165 Arlington Hgts. Rd., Dept. #B

Buffalo Grove, IL 60089 (312) 459-6010

Inquiry 613.

DEMOS/TUTORIALS

INSTANT REPLAY III

Build Demos, Tutorials, Prototypes, Presentations, Music, Timed Keyboard Macros, and Menu Systems. Includes Screen Maker, Keystroke/Time Editor, Program Memorizer, and Animator. Rect. Great Reviews! Simply the BEST. Not copy protected. No royalties. 60-day satisfaction money-back guar. IBM and Compatib. \$149.95 U.S.Chk/Cr. Crd. Demo Diskette \$50.00.

NOSTRADAMUS, INC.

P.O. Box 9252

Salt Lake City, Utah 84109 (801) 272-0671

Inquiry 614.

DISASSEMBLERS

80x86 .EXE/.COM to .ASM

- Accurately reconstruct, study & modify [8K+] programs with a minimum of input or editing of output.
- Assembly language output is MASM 5.1-compatible.
- Exhaustive flowtrace distinguishes code from data.
- Best formats for each. Commented BIOS calls/OOS functions. SEGMENT/PROC/other vital pseudo-ops.

PC-DISnDATA (5 1/4" disk & manual) \$165

PRO/AM SOFTWARE

220 Cardigan Road, Centerville, OH 45459

(513) 435-4480 (9 A.M.—5 P.M. EST M-F)

Inquiry 615.

SOFT-X-PLORE

See "BYTE's May '88 Issue pg. 78" Disassemble 500 kb (*) program at 10,000/min. (*) in any file, ROM/RAM memory up to 80386 instruction set (*). SOFT-X-plore:

- * is for MS/DOS 2.0+ systems
- * uses 20 algorithms and seven passes (*)
- * only \$99.95 plus S&H w/30-day guarantee.

To order call (800) 446-4656 or info (203) 953-0236

Or write: RJSWANTEK INC.

178 Brookside Rd., Newington, CT 06111

* best on the market MC/VISA accepted

Inquiry 616.

DISK COMPATIBILITY

IBM PCs USE Mac DISKS

MatchMaker lets you plug any Macintosh external floppy drive into an IBM PC. Half-size card and software lets you copy to/from, view directory, initialize, or delete files on the Mac diskette. Works with PCs, XT's, AT's, and compatibles. The easy way to move information!

\$149.00 Visa/MC/COD/Chk.

Micro Solutions Computer Products

132 W. Lincoln Hwy., DeKalb, IL 60115 815/756-3411

Inquiry 617.

THE BUYER'S MART

DISK DRIVES

PS/2 DRIVES FOR PCs ATs

CompatiKit/PC \$279
CompatiKit/AT \$219

Built-in floppy controllers—no problem. Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes *plus more!* Call for further information or to place an order. *VISA/MC/COD/CHECK.*

Micro Solutions Computer Products
132 W. Lincoln Hwy., DeKalb, IL 60115 815/756-3411

Inquiry 618.

DISK DUPLICATION

SOFTWARE PRODUCTION

- Disk duplication
- All formats
- EVERLOCK copy protection
- Label/sleeve printing
- Full packaging services
- Warehousing
- Drop Shipping
- Fulfillment
- 48-hour delivery
- Consultation & guidance

Star-Byte, Inc.

2880 Bergey Rd., Hatfield, PA 19440
215-997-2470 800-243-1515

Inquiry 619.

DUPLICATION SERVICES

SOFTWARE DUPLICATION

- One-Stop Shopping
- Custom Packaging
- Copy Protection
- Technical Support
- Drop Shipping
- Fast Turnaround
- Competitive Pricing

SATISFACTION GUARANTEED
800-222-0490 NJ 201-462-7628

MEGAsoft

P.O. Box 710, Freehold, NJ 07728

Inquiry 620.

EDUCATION

B.Sc. DEGREE IN PROGRAMMING

The American Institute for Computer Sciences offers an in-depth correspondence course which allows you to earn your Bachelor of Science degree in computer programming at home. Subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating System Concepts.

AMERICAN INST. for COMPUTER SCIENCES
1704-BY 11th Ave. So., Birmingham, AL 35205
TOLL FREE 1-800-872-AICS

Inquiry 621.

ENTERTAINMENT

BEAT THE LOTTERY

with GAIL HOWARD'S SMART LUCK COMPUTER SYSTEMS
\$23.4 Million Florida Jackpot Just Won With Computer Wheel!!
COMPUTER WHEEL™—An absolute MUST for every serious lottery player.
5/4 * \$29.95 + \$2 sh. (Add \$3 for 3/4*)
COMPUTER ADVANTAGE™—Proven to be the most successful number selection system ever devised for Lotto. 5/4 * \$39.95 + \$2 sh. (Add \$1 for 3/4*)

SMART LUCK COMPUTER SYSTEMS
Dept. B8, P.O. Box 1519, White Plains, NY 10802
1-800-876-G-A-I-L (4245)

Inquiry 622.

NEMESIS™ Go Master®

Go, a game of strategic elegance, has been a way of life in the Orient for over four thousand years. Many consider Go to be the secret of the Japanese business-man's success. "While chess is a game of war, Go is a game of market share" (President of Nikko Hotels).

"If you are interested in Go, buy this program."
Game of the Month J. Pournelle BYTE 7/87
Toyogo, Inc. The Leader in Computer Go.
76 Bedford St. #34-Y, Lexington, MA 02173, (617) 861-0488

Inquiry 623.

FLOW CHARTS

Flowchart/State Diagram for Engineers

Draw flowcharts or state diagrams with this MacDraw-like program on your IBM PC/AT/PS2 or compatible. All flowchart symbols are prebuilt and can be stretched to any size. Add your own symbols to the symbol library. Ellipses, curves with ending arrowheads, cut/paste, enlarge/reduce, drag, zoom out, undo... etc. Output to most printers, plotters, and desktop publishing software. Complete with Logitech Mouse for \$89. See our larger ad every other month.

Daytron Electronics Inc.

610 S. Sherman #104, Richardson, TX 75081 214-669-2137

FLOW CHARTING II+ HELPS YOU!

Precise flowcharting is fast and simple with Flow Charting II+. Draw, edit and print perfect charts: bold and normal fonts, 26 shapes — 95 sizes; fast entry of arrows, bypasses & connectors; Fast Insert Line; shrlnk screen displays 200-column chart; 40-column edit screen for detail work, much more!

PATTON & PATTON

81 Great Oaks Blvd., San Jose, CA 95119
1-800-525-0082 Ext. 42 (Outside CA)
408-629-5376 Ext. 42 (CA/Int'l)
See our ad on page 120.

Inquiry 624.

WINDOWS FLOWCHARTER \$79

RFFlow is a drawing tool designed specifically for flowcharts. Easy to learn, easy to use. 75 shapes automatically adjust in size. Move, copy, or delete groups of objects. 7 levels of zoom. Use mouse or keyboard. On-line user's manual. Supports Windows printers, plotters, and fonts. \$5 trial disc. RFFlow requires Microsoft® Windows.

RFF ELECTRONICS

1053 Banyan Court, Loveland, CO 80538
(303) 663-5767

Inquiry 625.

STRUCTURED FLOW CHART

NSChart creates Nassi-Shneiderman (structured) flowcharts from a simple PDL. Key words define structures & text strings appear in the chart. Easy to create, even easier to revise! Automatic chart sizing, text centering. Translators from many languages available. For Mac and IBM PC.

SILTRONIX, INC.

P.O. Box 82544, San Diego, CA 92138
1-800-637-4888

Inquiry 626.

FORTRAN TOOLS

Tame Your Fortran Code!

Make your Fortran source more readable, portable, and maintainable.

- PRETTY** cleans up code: indents, relabels, changes GOTOs to IF-THEN-ELSEs, etc.
- OUTLINE** graphically highlights IF and DO nesting.
- PREP** supports conditional compilation, include files.

Plus four more, MS-DOS. All for \$129.

Quibus Enterprises, Inc.

106 N. Draper Ave., Champaign, IL 61821
(217) 356-8878

Inquiry 627.

GRAPHICS

RAINDROP™

FAST, compact PrtScr Utility for end users AND developers. Hardcopy as fast as 10 secs. Average binary size - 8 kbyte. 12 video graphic standards. Scale, rotate, colorize and more. "CALL" from user-written programs. Complete 9- & 24-pin dot-matrix, inkjet, and laserjet library \$39.95+\$3 s/h.

RAINBOW TECHNOLOGIES

8106 St. David Ct., Springfield, VA 22153
(703) 440-0064

Inquiry 628.

GRAPHICS LIBRARIES

GRAPHICS LIBRARIES

Very Fast 2D/3D Autoscaling Graphics for Microsoft Languages. 3D Lines Use Color. Fast Polygon Fill, Solid/Wireframe. Color/Blinking Text. XY, Bar, Smith Contour & 3D Fishnet Graphs. Supports CGA/EGA/VGA/Herc & Dot Matrix/Laser/Plotters @ Full Resolution. Print Screen. Port. \$140 NO ROYALTIES. FORTRAN Source + \$30.

CHIRP TECHNICAL SERVICES

P.O. Box 551, Del Mar, CA 92014-0551
(619) 632-9510

HARD DRIVE REPAIR

HARD DRIVE REPAIR

WE WILL REPAIR YOUR HARD DRIVE AT A FRACTION OF THE COST OF REPLACING IT. FAST TURNAROUND!!! CALL FOR DETAILS.

H & W micro, Inc.

528-C FOREST PARKWAY
FOREST PARK, GA 30050
(404) 366-1600

Inquiry 629.

HARDWARE

CHIP CHECKER

- 74/54 TTL + CMOS
- 14/4000 CMOS
- 14-24 Pin Chips
- 8000 Nat. + Signetics
- 8000 TTL
- 3" + .8" IC widths

Tests/identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM-compatible version \$259. C128 + C64 version \$159.

DUNE SYSTEMS

2603 Wills Dr., St. Joseph, MI 49085
(616) 983-2352

Inquiry 630.

Equipment Monitor And Control

Ideal cost-effective computer can be used to perform data acquisition and control using a dumb terminal or create data files on a PC. Features 16 chan. A/D, 64 digital I/O lines, 4 timer/counters and 4 serial ports. Options 4 chan. D/A, clock, CMOS, Forth OS, and networking.

E-PAC 1000 + \$249.00 E-PAC 2000 + \$449.00

EMAC INC.

P.O. Box 2042, Carbondale, IL 62901
Phone: 618-529-4525 Fax: 618-457-0110

Inquiry 631.

FREE CATALOG

Protect your computer power from black-outs, brown-outs, audio/video hash and surges! Complete line of low-cost Emergency Power Supply units, Line Conditioners and Surge Suppressors prevent damage and loss of valuable data. Prevent errors, malfunctions and false printouts! Send for money-saving catalog today.

INDUS-TOOL

730 W. Lake St., Chicago, IL 60606
Phone 312-648-2191

Inquiry 632.

PC CARDS/BREADBOARDS

- AD8-1, 8 bit A/D, digital osc. software . . . \$99
- 8 bit fast A/D, 8CH, GAIN 1,10,100 . . . \$199
- 12 bit A/D, 8CH, S/H, GAIN 1,10,100 . . . \$279
- DIO24, 24 TTL I/O, 8255 PPI . . . \$89
- Driver, 21-(50V, 300mA) OC outputs . . . \$99
- Printer Port or RS232 Breadboard . . . \$129

JB COMPU-TRONIX

P.O. Box 27717, Lakewood, CO 80227
(303) 987-3239

Inquiry 633.

THE BUYER'S MART

HARDWARE

AWARD BIOS UPDATE!

PC/XT Version 3.1
Now Supports 1.44 Mb 3.5" Floppies
288/386 Version 3.04
Revised Drive Tables, EGA & VGA Support
Authorized AWARD Distributor

1-800-423-3400 or (412) 782-0384
KOMPUTERWERK, INC.

851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 634.

Apple • Service Parts
• Accessories • Systems •
BUY ★ SELL ★ TRADE
PRE-OWNED Electronics, Inc.
30 Clematis Avenue, Waltham, MA 02154
800-274-5343 FAX 617-891-3556
Service Centers and Dealers welcome

Inquiry 635.

HARDWARE/ADD-ONS

The World's First Highest Density Module!

- 18 Meg on the smallest surface
- Organization: 2x1024Kx9 bit
- Package: DIL 64 pin Jedec-Standard
- Technology: CMOS, hybrid, 18xHMS1100JP-10
- Compatibility: With two Hitachi HB56A 19-10
- Suitable for extension of basic memory
- Engineers take notice. This product can be manufactured on large scale.

For more information please write or call:

TermoTrol Corp.

1888 Century Park East, Suite 1900, L.A., CA 90067
Tel: 213-284-3242

Inquiry 636.

HARDWARE/COPROCESSOR

DIGITAL SIGNAL PROCESSOR

DSP products for the IBM PC/XT/AT based on the TI TMS32010 and TMS320C25 up to 12 MIPS operation. Designed for applications in communications, instrumentation, speech, and numeric processing. Offered with 12 bit 110 KHz A/D and D/A and continuous-to-disk data acquisition & playback option. From \$650.

DALANCO SPRY

89 Westland Ave., Rochester, NY 14618
(716) 473-3610

Inquiry 637.

SC/FOX™ PARALLEL COPROCESSOR

PC/XT/AT/386 plug-in board with Forth software. 10 MIPS operation, up to 50 MIPS burst. 64K to 1M byte memory. Uses Harris RTX 2000™ RISC real-time CPU with 1-cycle multiply, 1-cycle 14-priority interrupts, two 256-word stacks, three 16-bit timer/counters, 16-bit I/O bus. Ideal for real-time control, signal and image processing, and multiple board operation. From \$2,295.

Optional SC/FOX Single Board Computer version for stand-alone operation. Eurocard size with software, starting at \$1,495.

SILICON COMPOSERS, INC. (415) 322-8763
210 California Ave., Suite K, Palo Alto, CA 94306

Inquiry 638.

68000/68020/68881

COMPLETE DEVELOPMENT AND EDUCATIONAL TRAINING SYSTEM for the 68000, 68020, 68881 chips — includes the chips, power supply, serial interface with software, 68000/68020 cross assembler (hosted on a PC), documentation, schematic, Operating System, cables. Special Price — \$1100.00

Phone URDA, Inc.
1-800-338-0517

Inquiry 639.

INVENTORY MANAGEMENT

STOCK-MASTER 4.0

Commercial grade inventory management software at micro prices.

- Supports all 12 transaction types
- Trend Analysis
- Quality Control
- Multiple Locations
- Purchase Order Tracking
- Open Order Reporting
- Serial/Lot # Tracking
- Stock Status Reporting
- Activity History Analysis
- Bill of Materials
- Purchase Order Writing
- Order Entry
- Material Requirements
- On Line Inquiry

Applied Micro Business Systems, Inc.
177-F Riverdale Ave., Newport Beach, CA 92863 714-759-0582

Inquiry 640.

dFELLER Inventory

Business inventory programs written in modifiable dBASE source code.

dFELLER Inventory \$150.00

Requires dBASE II or III, PC-DOS/CPM

dFELLER Plus \$200.00

with History and Purchase Orders

Requires dBASE III or dBASE III Plus (For Stockrooms)

Feller Associates

550 CR PPA, Route 3, Ishpeming, MI 49849
(906) 486-6024

Inquiry 641.

LANS

The \$25 Network

Try the 1st truly low-cost LAN

- Connect 2 or 3 PCs, XTs, ATs
- Uses serial ports and 5-wire cable
- Runs at 115K baud
- Runs in background, totally transparent
- Share any device, any file, any time
- Needs only 14K of ram

Skeptical? We make believer!
Information Modes

P.O. Drawer F, Denton, TX 76202
817-387-3339

Inquiry 642.

LAPTOP COMPUTERS

LAPTOP SPECIALS

TOSHIBA • Zenith • NEC • SHARP LAPTOPS

• Hard drives for Tandy 1400 LT & Toshiba 1100+

• AFFORDABLE 5¼" or 3½" DRIVE UNITS for

LAPTOPS & DESKTOPS • DICONIX PRINTERS •

768 card for T1000 • 2400 BAUD MODEMS for Lap-

tops • Fast reliable and friendly service. For Low Pric-

ing call **World wide sales**

COMPUTER OPTIONS UNLIMITED

201-469-7678 (7 Days, 9 am-10 pm Eastern time)

Inquiry 643.

Laptop Connection

2PC — THE File Transfer Utility

- Lap to Lap, Lap to Desk
- Super Easy to Use
- Breaks the "Bridge-Link" Price Barrier - 115 K Baud

\$55 w/universal cable, \$45 w/o cable

See Jan. 89 Issue—"What's New" Column—p.94

PLUS . . . Quality Cables at FAIR Prices:

• Null Modem (8) . . . \$12

• Kbd Ext (6) . . . \$12

• Par Print (6) . . . \$10

• Centronics (8) . . . \$12

• Mon Ext (8) . . . \$12

• Serial (8) . . . \$10

MANY MORE CABLES AVAILABLE. Mac & PC (VISA MC)

Thompson Computing—587 F. N. Venlu Park Rd., Ste. 306,
Newbury Park, CA 91320, (805) 498-7653 FAX (805) 498-6104

Inquiry 644.

LAPTOP PERIPHERALS

TOSHIBA PERIPHERALS	T1000	T1200	T3100	T3100e
	T1600	10/20	10/20	T5100
Battery AdapterPAK (12V)	FX2ST	FX2T	P80	P80+
Vehicle Battery Adapter	X2.5		A80	A80+
Built-in 2400bps Modem	M24BI	M24BI	M24EC	M24ES
Internal 2400bps Modem	M24IC		S232E	
Single COMMS Port Card	S232T		D232E	
Dual COMMS Port Card				SCSIE
SCSI Interface Card				

PRODUCT R&D Corporation

1194 Pacific St., Suite 201, San Luis Obispo, CA 93401

(805) 546-9713 or 800-234-5584

Inquiry 645.

MAC PROGRAMMING TOOLS

MAC DEVELOPMENT TOOLS

Professional Programmers Extender: Standard Mac interface, lists, printing, graphics, tiling. Extender GraphPac: Quality color graphs. Line, bar, semi-log, customizable symbols.

INVENTION Software

(313) 996-8108

Inquiry 646.

MAILING LIST PROGRAMS

YOURS FREE!

"How to Manage Your Mailing List" ArcList® & AccuMail® are two powerful programs for your IBM or compatible PC:

- Duplicate Recognition
- Postal Discount Presorts
- Label Design & Printing
- Carrier Route and Zip+4 Insertion
- Address Correction
- dBase® Compatible

Call 800-368-5806 for a FREE GUIDE

Group 1 Software, Inc.

8404 Ivy Lane, Dept. BIT-7, Greenbelt, MD 20770-1400

Inquiry 647.

MEMORY CHIPS

MEMORY CHIPS

41256-15-12-10	Call 51000 (1 Meg)	Call
4164-15	Call 51258 for Compaq 386	Call
4164-12	Call 8087-3-2	Call
41128 Piggy Back for AT	Call 80287-6-8-10	Call
41464-12 (64Kx4)	Call 80387	Call
414256 (256Kx4)	Call NECV-20-6	Call
2764, 27128, 27256, 27512	Call Mouse	Call

Prices subject to change

ESSKAY 718-353-3353

Inquiry 648.

MEMORY

64-15 P \$125 ONE MEG. ZIP

256-15 P \$595 SIP AVAILABLE

256-12 — \$695 INTEL CPU IN STOCK

MODEM \$69

VOICE CARD \$199

ITC

(714) 730-1121 FAX: (714) 730-3837

PRICES SUBJECT TO CHANGE WITHOUT NOTICE
MasterCard VISA

Inquiry 649.

MONITOR INTERFACE

DRIVE MULTIPLE MONITORS

with one PC using our VOPEX video port expanders. Featuring no loss of resolution or color, presentations are more dramatic. We have a VOPEX for PC, PS/2, MAC II & workstations. Units are available from 2 to 10 output ports.

NETWORK TECHNOLOGIES INC.

800-RGB-TECH or 216-543-1646 MC/VISA/AMEX

19145 Elizabeth St., Aurora, OH 44202

Inquiry 650.

MUSIC

LAPTOP PS/2 PC/XT/AT

MIDI-Serial I/O \$119.95

MIDIATOR™, Music Interface with Serial I/O, MIDI In, MIDI Out, & Real-Time clock. Use any PC compatible RS-232 Port without ext. power, card slot, system mods. Software avail. Add \$5.00 S&H USA. MC, VISA, COD, Check (10 days), TX res. add 7.5% tax.

KEE • Key Electronic Enterprises • KEE

9112 Hwy. 80 W., Suite 221-B, Fort Worth, TX 76116

Order 1-800-KEE-MIDI Tech (817) 560-1912

THE BUYER'S MART

NETWORKING

NETWORK BUSINESS SYSTEMS

Keypad Eliminator.....\$99.
 D C B Eliminator.....\$99.
 ELS Utilities.....\$59.
 Netcrack (lose password?).....\$99.
 Getdisk (get BIOS drives).....\$59.
 BIOS Networks (patch drive tpls).....\$99.

NETWORK BUSINESS SYSTEMS

1215 Woodhollow Drive, Suite 1104, Houston, TX 77057
 (713) 783-4457

Inquiry 651.

MP SERVER

MP SERVER — Software Toolbox enabling to create any purpose Network Server. With MP SERVER programmer can create servers as communication server, file server or any other server that can simultaneously support up to 100 stations in a single network. MP SERVER includes a "requests receiver" process (that stores station's requests in a queue), a "tasks executor" process (that schedules requests stored in the queue) and a "transmitter" process (that transmits result to stations).

Shany Computers Ltd.

Rechter Building, 4 Smilansky st., Natanya, Israel 42304
 Tel: (972) (53) 333931 Fax: (972) (53) 342418
 (972) (53) 821905

Inquiry 652.

MP MASTER

MP MASTER — End user utility, used for submitting programs to remote available slave while remote execution (eg. compilation, printing etc...) user can use local station for other tasks (eg. word processing, editing etc...). User can submit to slave a DOS batch file, DOS EXE or COM file or any internal DOS command (as DIR). MP MASTER enables also to list all available slaves in network and for each hardware configuration, so a user can select a slave according to its performances.

Shany Computers Ltd.

Rechter Building, 4 Smilansky st., Natanya, Israel 42304
 Tel: (972) (53) 333931 Fax: (972) (53) 342418
 (972) (53) 821905

Inquiry 653.

OBJECT ORIENTED TOOLS

OBJECT-ORIENTED TOOLKIT

TRIPLE your productivity with Complete C™
 The only C object-oriented development utility with precompiler, foundation classes (source code included), make, integrated debugger, documentation generator, profiler, streamliner, and full technical support.

Introductory Price: \$269

Complete Computer Corporation

111 West 57th St., NY, NY 10019
 212-582-2635

Inquiry 654.

PROGRAMMERS TOOLS

HYPERINTERFACE™

Menu Creator™ — A program generator for menu-driven user interface. Excellent for complex menu systems. \$99.95. **Advanced Library** — Extended capability for data entry and advanced text-display control from your programs. \$99.95. **FORTRAN, Pascal, C, BASIC** supported. **HYPERMATH™** — An application of Menu Creator™ and the Advanced Library. FREE

Avanpro Corp.

P.O. Box 989, Pacific Palisades, CA 90272
 (213) 454-3866

Inquiry 655.

TLIB™ 4.12 Version Control

"TLIB" is a great system" — *PC Tech Journal 3/88*. Full-featured configuration mgmt for software professionals. All versions of your code instantly available. Very compact, only changes are stored. Check-in/out locks, revision merge, branching, more. Mainframe deltas for **Pansophic, ADR, IBM, Unitys**. Only \$99.95 + S&H, or 5-station LAN \$299.95 + S&H. MS-DOS VISA/MC

BURTON SYSTEMS SOFTWARE

P.O. Box 4156, Cary, NC 27519 (919) 856-0475

Inquiry 656.

PROGRAMMERS TOOLS

Have Same 'C' Source for UNIX and DOS

D-LSAM—Unix standard indexed file management library for UNIX DOS and NETWORKS. Manages all locking. UNIX/DOS source \$595 (for both), DOS lib's* \$145.

'W'—Character windowing with COLORS, Line Graphics, Bells and more. You need not modify DOS code to work WELL on any UNIX terminal. UNIX/DOS source \$285 (for both), DOS lib's* \$95.

BYTE DESIGNS

P.O. Box F195-78, Blaine, WA 98230
 1-800-663-8547 or (604) 278-5200

*DOS lib's available for Microsoft or Borland 'C' compilers

Inquiry 657.

Async Executive™ & Tutorial

Interrupt driven transmit & receive. Supports up to eight ports. Buffered I/O to 64K. 50 to 19200BPS. XON/XOFF. DTE/DCE. Modem controls. Transfer characters or blocks. Millisecond timing. Universal language interface. BIOS/DOS extension capabilities. XMODEM w/CRC. 200+ page comprehensive manual. Sample programs include a spooler written in C. For IBM PC/XT/AT & all compatibles. Software Developer's Kit: \$195. Additional drivers \$50.00

Shipping \$5. Canada \$10. International \$15

CA residents must add sales tax. Checks/MO only.

CIRRUS SOFTWARE, INC.

P.O. Box 51924, Dept. B, Palo Alto, CA 94303

(415) 949-1470

Inquiry 658.

WINDOWS APPLICATION PROGRAMMING ENVIRONMENT (WAPE)

WAPE is an INTERACTIVE CODE GENERATOR for over 450 MS-Windows system calls. Set of LIBRARY FUNCTIONS for windows, menus, dialog boxes, list boxes, and clip board. Provides typical function TEMPLATES. Allows IMPORT of CODE from other files. Windows Application Development Tools can be invoked from within WAPE. Context-sensitive ONLINE HELP available.

INTERSOFT INC.

5285 S.W. Meadows Rd., Lake Oswego, OR 97035

(503) 639-3555

Inquiry 659.

TURBO PLUS \$149.95

Programming tools for Turbo Pascal 5.0 Screen Painter, Code Generator, I/O Fields, Dynamic Menus, Programming Unit Libraries, Sample Programs, 280-Page Illustrated Manual. 60-Day Satisfaction Guarantee! Brochures & Demo Diskettes avail. Highly Favorable Reviews! IBM & Compatibles.

Nostradamus Inc.

P.O. Box 9252, Salt Lake City, UT 84109

(801) 272-0671

Inquiry 660.

Get INSIDE!

The best PC software performance tool is now better than ever with source line timing, caller timing and arbitrary event timing—all with microsecond accuracy and without source modification. The expanded DOS analysis mode identifies I/O bottlenecks. \$125

Call today for a free brochure and the latest list of supported compilers. 30-day guarantee. VISA/MC/COD

Paradigm Systems

P.O. Box 152, Milford, MA 01757
 (800) 837-5043 In MA: (508) 478-0499

Inquiry 661.

FREE BUYER'S GUIDE

Programmer's Connection is an independent dealer representing more than 300 manufacturers with over 800 software products for IBM personal computers and compatibles. We have serviced the professional programmer since 1984 by offering sound advice and low prices. Call or write today to receive your FREE comprehensive Buyer's Guide.

Programmer's Connection US 800-336-1166

7249 Whipple Ave, NW Canada 800-225-1168
 North Canton, OH 44720 International 216-494-3781

Inquiry 661.

PROGRAMMERS TOOLS

'C' DOCUMENTATION TOOLS

- C-CALL \$59 Creates graphico-tree of caller/called structures, and files-ve-procedure table-of-contents
- C-HDR \$59 Creates/inserts/updates headers for each procedure showing caller/called and identifiers
- C-LIST \$39 List, action-diagram, reformat programs
- C-REF \$49 Local/global/parameter cross reference
- SPECIAL \$149 All 4 plus integrated C-DOC version

SOFTWARE BLACKSMITHS INC.

6064 St. Ives Way, Mississauga, ONT Canada L5N-4M1
 (416) 858-4466

Inquiry 662.

PUBLIC DOMAIN

\$3.00 SOFTWARE FOR IBM PC

Hundreds to choose from, word processors, databases, spreadsheets, games, lotto, communications, business, music, bible, art, education, language and useful utilities for making your computer easier to learn. Most programs have documentation on the disk.

Free 125-page catalog.

BEST BITS & BYTES

P.O. Box 8245, Dept. E, Van Nuys, CA 91409
 In CA: (818) 784-8803 800-245-BYTE

Inquiry 663.

\$1 per DISK SALE

20 TOP IBM PC PD/SW DISKS
 (360K) ONLY \$20 + \$3 S&H

QubeCalc, EDRAW, AutoMenu, Math Tutor, PC-DOS Help, Baker's Dozen, Languages, EZ-Form, PC-Style, PackDisk, PC-Stock, KidGames, Best Games, Home Inventory, PC-Outline, Form Letters, ImagePrint, SideWriter, PC-Prompt, Best Utilities.

BRIGHT FUTURES INCORPORATED

P.O. Box 1030, East Windsor, CT 06088
 FREE CATALOG (\$1.25 per disk)

Inquiry 664.

FREE CATALOG PUBLIC DOMAIN/SHAREWARE

• 400 IBM PC & compatibles disks •
 • 200 Amiga disks • 125 Atari ST disks
 PC disks as low as \$1.25 each, Amiga & ST as low as \$1.60 each! Rent or buy. Free shipping! Call toll free, write or circle reader service for FREE BIG CATALOG with full descriptions. Please specify computer—48-hr. turnaround!

Computer Solutions

P.O. Box 354—Dept. B, Mason, Michigan 48854
 1-800-874-9375 (M-F 10-6 EST) 1-517-828-2943

Inquiry 665.

- CLIP ART
- GRAPHICS
- LASER FONTS
- CAD
- ELECTRONICS
- GAMES
- TRAVEL
- AUDIO/VIDEO
- SECURITY
- EDUCATION

For FREE CATALOG write to:
CWI Information Services

P.O. BOX 4851, Anaheim, CA 92803
 800-777-5836

Or telephone (714) 879-7917 24 HOURS!

Inquiry 666.

RENT SOFTWARE \$1/DISK

Rent Public Domain and User Supported Software for \$1 per diskfull or we'll copy. IBM (3 1/2" also). Apple, C-64, Sanyo 550 and Mac. Sampler \$3. VISA/MC. 24-hr. info/return line. (619) 941-3244 or send #10 SASE (specify computer) Money-Back Guarantee!

FutureSystems

Box 3040 (T), Vista, CA 92083
 office: 10-6 PST Mon-Sat. (619) 941-9761

Inquiry 667.

THE BUYER'S MART

PUBLIC DOMAIN

No Shipping Charges USA

Disks: \$1.50 (5 1/4) — \$2.50 (3 1/2) \$5.00 Min Order

Applications, Utilities, Games for PCs

Send \$3.00 for 4 MDS, INC. Programs PLUS Shareware & Public Domain Catalog

Programs are: Label printer, Text editor, Menu System & DOS Shell, & Graphics.

MDS, INC.

218 Quinlan, #304; Kerrville, TX 78028

Inquiry 668.

PUBLIC DOMAIN SHAREWARE

1000's OF SELECTIONS Highest Quality

PD SOFTWAREHOUSE

CALL FOR A FREE CATALOG

1-800-548-7360

Inquiry 669.

FREE SOFTWARE

We send you 15-20 new IBM programs a month on 5 disks—FREE! You pay only \$5. shipping/handling. Annual membership req. \$29.95. Join today for only \$9.95 and we'll send you over 30 programs on 10 disks as a bonus—FREE! No gimmicks—no catches!

toll-free 800 669-2669 ext 348

SOFTWARE OF THE MONTH CLUB we take visa/mastercard/amex

Inquiry 670.

FREE IBM SOFTWARE

FREE CATALOG also contains SHAREWARE. 5 1/4 and 3 1/2-inch. All categories. ENGINEERING, CAD, DESKTOP PUBLISHING, LANGUAGES, UTILITIES, BUSINESS, GRAPHICS, SPREADSHEETS, WORD PROCESSORS, CHURCH, MEDICAL, HEALTH, EDUCATION, HOME!

SECTOR SYSTEMS COMPANY, INC.

Dept. B-6, 416 Ocean Avenue, Marblehead, MA 01945 (617) 639-2625

Inquiry 671.

FREE CATALOG

\$1 IBM SOFTWARE

For your free 32-page Master Edition catalog featuring the best of IBM Shareware from just \$1 each, call or write today!

1-800-338-2118

SOFSOURCE

Box 828, East Lansing, MI 48826

Inquiry 672.

FREE SOFTWARE CATALOG

Low as \$1.20/disk

Over 1000 quality IBM software

On 5.25" and 3.5" format

From outside U.S.A., except Canada, please send US \$2.00 refundable with order.

For fast service, write to

SOFTSHOPPE

P.O. BOX 709, Ann Arbor, MI 48105

(313) 763-8721

Inquiry 673.

294 B Y T E • JULY 1989

SECURITY

EVERLOCK COPY PROTECTION

- * Thwarts ALL Bit-copy Software
- * Protect any COM/EXE w/o Source changes
- * Shut down Debug Tracing & Disassemblers
- * Install to Floppy, Hard Disk, or LAN
- * Remotely reset Program Install-Count, Expire-Date or #Executes
- * No damaged media or I/O plugs

For IBM and clones. \$195 & up. Free Info.

Az-Tech Software, Inc.

305 East Franklin, Richmond, MO 64085

(800) 227-0644 FAX: (816) 778-2700

(816) 778-2700

Inquiry 674.

THE ULTIMATE COPY PROTECTION

- Completely Menu Driven
- Defeats all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk Support
- Unlimited Metering
- FREE Demo Disk

Quite Simply

The Best

Way To

Protect

Your Valuable

Software Investment

STOPCOPY™ \$325.00 STOPCOPY PLUS™ \$460.00

BBI COMPUTER SYSTEMS® (301) 871-1094

14105 Heritage Ln., Silver Spring, MD 20906 FAX: (301) 460-7545

Inquiry 675.

BIT-LOCK® SECURITY

Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port-transparent security device. PARALLEL or SERIAL port. Complemented by economical KEY-LOK™ and multifaceted COMPU-LOCK™ including countdown, timeout, data encryption, and multiproduct protection.

MICROCOMPUTER APPLICATIONS

3167 E. Otero Circle, Littleton, CO 80122 (303) 922-6410/770-1863

Inquiry 676.

PC Security "Password"

With All the Computer Security Talk, 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 limit option secures your hard disk. Password provides for up to 100 users with the supervisor controlling access to protected directories. Password is menu-driven with pop-up windows and help screens. The program provides an audit trail of users, and a screen blanking feature.

PASSWORD \$98.00 US Visa, M/C, Amex

Nasdec International Inc.

2704-85 Garry Street, Winnipeg MB Canada R3C 4J5

PH: (204) 956-2786 FAX (204) 943-3702

Inquiry 677.

COPY PROTECTION

The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.

- Hard disk support
- Customized versions
- No source code changes
- LAN support
- New upgrades available

(408) 773-9680

SOFTGUARD SYSTEMS, INC.

710 Lakeway, Suite 200, Sunnyvale, CA 94088

FAX (408) 773-1405

Inquiry 678.

SOFTWARE/ACCOUNTING

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-EDI.

Chase Technologies

1617 Kingman Ave., San Jose, CA 95128

(408) 998-2917

Inquiry 679.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORD/INVENTORY
- ACCOUNTS RECEIVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

\$99 ea. + S&H

DATAMAR SYSTEMS Cred. Card-Check-COD

4878-B Santa Monica Ave.

San Diego, CA 92107

(619) 223-3344

Inquiry 680.

SOFTWARE/BASIC

Save time, money, & brain cells!

QuickWindows Advanced user-interface library supports windows, menus, dialog boxes, help, mouse, and more. For text and graphics modes thru VGA. Fast and intuitive! QuickComm communications library supports up to 16 comm ports, Hayes modems, xmodem and ymodem file transfer, and more. All interrupt driven. Easy to use!

Each library written in assembly and comes with complete manual. \$129 each. For Microsoft QuickBasic or BASCOM.

Software Interphase, Inc.

5 Bradley Street, Suite 106, Providence, RI 02908 (401) 274-5465 Call now for FREE terminal/demo program. Fax # 401-272-1273

Inquiry 681.

SOFTWARE/BUSINESS

DATA ENTRY SYSTEM

Heads-down data entry with two-pass verification for the IBM PS/2-PC/XT/AT & compatibles. Features include: Auto dup/skip, verify bypass, range checks, table lookups, a complete edit language. Fully menu driven. Price \$395

Call for our free 30-day trial period.

COMPUTER KEYS

21929 Makah Rd., Woodway, WA 98020

Tel: 206/776-6443 USA: 800/356-0203 Fax: 206/776-7210

Inquiry 682.

MILP88—MIXED-INTEGER LP

A general-purpose system for solving mixed-integer linear programs with up to 800 constraints and 4000 general integer or nonlinear variables. Build MILP88 into your own programs with compiled Turbo Pascal units. MILP88 reads/writes Lotus worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Other features include interactive and batch operation, spreadsheet LP display and editing, an equation processor, problem/branch list storage, file I/O, download/reload, report generator, and sensitivity analysis. \$149 with manual and 8087 support. \$299 with Turbo Pascal units.

Eastern Software Products, Inc.

P.O. Box 15328, Alexandria, VA 22309

(703) 360-7600

Inquiry 682.

SOFTWARE/ENGINEERING

Affordable Engineering Software

FREE APPLICATION GUIDE & CATALOG

Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Engineering Graphics • Signal Processing • Active/Passive Filter Design • Transfer Function/FFT Analysis • Logic Simulation • Microstrip Design • PC/MSDOS • Macintosh • VISAMIC

BV Engineering Professional Software

2023 Chicago Ave., Suite B-13, Riverside, CA 92507 (714) 781-0252

Inquiry 683.

Digital Control Intro \$200
Digital Filter Tutor \$450
Kaiman Filter Tutor \$925

Practical hands-on training courses that run on the IBM PC. Ideal alternative to text books, seminars, and university courses. FREE demo disk available.

Engineering Tutorial Software

22338 Lull Street, Canoga Park, CA 91304

(818) 716-0816

Inquiry 684.

THE BUYER'S MART

SOFTWARE/ENGINEERING

SOURCE CODE SOFTWARE

Mechanical, Civil, Electrical, Aerospace Engineering
All programs supplied with sourcecode in BASIC, C or FORTRAN. Written by professionals and educators from leading industries and universities. Educational discounts available. Send for Free catalog.

Kern International, Inc.

100 Weymouth St., Dept. B1, Rockland, MA 02370
(617) 871-4982

Inquiry 685.

SIMULATION WITH GPSS/PC™

GPSS/PC™ is an IBM personal computer implementation of the popular mainframe simulation language GPSS. Graphics, animation and an extremely interactive environment allow a totally new view of your simulations. Simulate complex real-world systems with the most interactive and visual yet economical simulation software.

MINUTEMAN Software

P.O. Box 1717Y, Stow, Massachusetts, U.S.A.
(508) 897-5662 ext. 540 (800) 223-1430 ext. 540

Inquiry 686.

Circuit Analysis — SPICE

Non-linear DC & Transient; Linear AC.
• Version 3B1 with BSIM, GaAs, JFET, MOSFET, BJT, diode, etc. models, screen graphics, improved speed and convergence.
• PC Version 2G6 available at \$95.
Call, write, or check Inquiry # for more info.

Northern Valley Software

28327 Rothrock Dr., Rancho Palos Verdes, CA 90274
(213) 541-3677

Inquiry 687.

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 Acq/Control • Design Automation. To receive a free sample issue and qualification form either circle below or send request on letterhead to:

Personal Engineering Communications

Box 300, Brookline, MA 02148

Inquiry 688.

radiolink-Profile

A software package for line-of-sight radio systems. Will calculate antennae heights, reflection points, diversity heights and availability. Plots profile to screen; Epson, OKI, NEC and Laser printers; HP/GL and DM/PL plotters. US \$450 inclusive of Airmail.

Q8 Pty Ltd.

8 Yardam Court, Ocean Reef, WA 6027, Australia
Fax (09) 246-1749

Inquiry 689.

ECA-2 ELECTRONIC CIRCUIT ANALYSIS

Full nonlinear, interactive, analog circuit simulation with built-in, real-time graphics.

- 2 to 50 times faster than SPICE.
- Worst-case, Monte-Carlo.
- AC, DC, Transient, Fourier, Temperature.
- Now with multiple plots!

ECA-2 2.40 IBM PC or MAC \$775 FREE DEMO.

Tatum Labs, Inc.

3917 Research Park Dr., B-1, Ann Arbor, MI 48108
313-663-8810

Inquiry 690.

SOFTWARE/FORECAST

FORECASTING PC/SIBYL™

The classic collection of business forecasting software. Fully revised & expanded: • 19 forecasting models • Faster • Easier to use • Full statistics • By Spyros Makridakis, internationally recognized forecaster. Two-disk set now \$495 plus \$25 postage & handling; or \$20 for demo disk (credited toward purchase).

APPLIED DECISION SYSTEMS

33 Hayden Ave., Lexington, MA 02173
Call: (617) 861-7580

Inquiry 691.

SOFTWARE/FORTRAN

EXPAND & EXTEND LIBS

122 FORTRAN callable routines. EXPAND allows DOS compilers access to LIM/EMS 3.2 or 4.0 expanded memory. EXTEND provides CGA, EGA, VGA, Hercules, HP, Tektronix, AutoCAD DXF graphics, access to BIOS/DOS functions plus additional utilities. EXPAND \$119, EXTEND \$149, both \$218.

DESIGN DECISIONS, INC.

P.O. Box 12864, Pittsburgh, PA 15241
(412) 941-4525

Inquiry 692.

SOFTWARE/GEOLOGICAL

GEOLOGICAL CATALOG

Geological software for log plotting, gridding/contouring, hydrology, digitizing, 3-D solid modelling, synthetic seismogram, fracture analysis, image processing, scout ticket manager, over 50 programs in catalog. Macintosh tool! Please call, or write, for Free Catalog!

RockWare, Inc.

4251 Kipling St., Suite 595, Wheat Ridge, CO 80033 USA
(303) 423-5645 Fax (303) 423-6171

Inquiry 693.

SOFTWARE/GRAPHICS

PC TECHNICAL GRAPHICS

TEKMAR is a graphics library for the EGA or Tecmar Graphics Master. Similar to PLOT-10, includes WINDOW, VIEWPORT, AXIS. Support for HP, HI plotters. Curve fitting, complete plotting program. Log, semi-log, multi-axis, 3-D, contours. Jerry Pournelle (Aug 86 Byte): "As good as any I have ever seen..." Demo disks, literature available.

Advanced Systems Consultants

21115 Devonshire St. #328, Chatsworth, CA 91311
(818) 407-1059

Inquiry 693.

QuickGeometry Library

Many powerful math subroutines for CAD/CAM and graphics; LINES, ARCS, CIRCLES, ELLIPSES, NON-UNIFORM RATIONAL B-SPLINES WOFFSET (NURBS); INTERSECTION (even splines), ROTATE, SCALE, TRANSLATE, MIRROR, OFFSET, BREAK, TRIM; ENDPOINTS, TANGENTS, CURVATURE; DXF I/O; lists. IBM PC comp MS-DOS 2+ • \$199.00 + no S&H; incl C source, manual, support, 30-day guarantee.

Building Block Software

P.O. Box 1373, Somerville, MA 02144
(617) 628-5217

Inquiry 694.

PROFESSIONAL GRAPHICS FOR SCIENTISTS AND ENGINEERS PC/MS-DOS • Macintosh

FREE 48-page Catalog

Linear/Log Scaling • Graphs with error bars • AUTO PLOT • BATCH Mode • Multiple Y-axes • Multiple data files • Auto/Forced Scaling • Full labeling • Built-in editor • 1-2-3 Interface • Curve fitting • Statistics • CGA, EGA & Hercules Compatible. 40 pen plotters supported.

BV Engineering Professional Software

2023 Chicago Ave., Suite B13, Riverside, CA 92507
VISA/MC (714) 781-0282

Inquiry 695.

SOFTWARE/GRAPHICS

CADpacs

Software Development Tools
For CAD and Graphics Programmers

- MATHpac • SPLINEpac • PLOTpac
- GEOMETRYpac • VIEWpac • SHAPEpac
- MATRIXpac

General 2D & 3D graphic and utility libraries for C. Each CADpac includes complete C source code, programmers' manual, and sample programs. \$35 each CADpac + \$2 s/h.

DesTek, Inc.

Design Technology
P.O. Box 176, Kenmore, NY 14217

Inquiry 696.

Technical Report Graphics

Edit data and graphics with EDTECH for \$65

- Database, worksheet-style data editing
- Technical X-Y plots from data for reports
- Graphics editing on screen, drawing, text
- 180x180 dots/inch output, 24-pin ptr req'd
- Log axes, Greek, symbols, Lotus implex

DIGITAL ANALYTICS

P.O. Box 31430, Houston, TX 77231
(713) 721-2069

Inquiry 697.

TurboGeometry Library

Over 150 2&3 dimensional routines, includes intersections, Transformations, Equations, HiddenLines, Perspective, Curves, Areas, Volumes, Clipping, Planes, Vectors, Distance, Polydecomp, IBM PC and Comp. MAC, MS-DOS 2+, Turbo Pascal, Turbo C, MSC & Turbo Pascal MAC, 400-pg. manual, source code, \$149.95 + 5.00 S&H. Foreign add \$18.00. VISA, MC, Chk, P.O. 30-Day guarantee.

Disk Software, Inc.

2116 E. Arapaho Rd., #487, Richardson, TX 75081
1-800-635-7760
(214) 423-7288 FAX: 214-423-4465

Inquiry 698.

TECHNICAL GRAPHICS

FROM ANY LANGUAGE

- Logarithmic, Time/Date & Linear Axes.
 - Easy Curve Fitting and Data Smoothing.
 - Supports all Video & Device Standards.
 - 10 Curves with up to 8000 points each.
- Only \$95 Call Today 800-284-3381

Edmond Software, Inc.

5900 Mosteller Dr. #1125, Oklahoma City, OK 73112

Inquiry 699.

PEN PLOTTER EMULATOR

FLOT turns your dot matrix or laser printer into an HP pen plotter. Fast hi-res output. No jagged lines. Vary line width, color. Works with Autocad, Drafrix, etc. Supports NEC P5/P6, IBM Printer, Epson LQ/FX, Toshiba, HP Laserjet, Hercules/CGA/EGA/VGA for preview. \$84 check/m.o.

FLOT CORPORATION

24-16 Steirway St., Suite 605, Astoria, NY 11003
212-418-8469

Inquiry 700.

POPULAR HGRAPH

SCIENTIFIC 2D & 3D graphic routines for IBM PC, VAX, SUN and Macintosh. Powerful, easy to use. Multiple fonts, device and machine independent. Uses max resolution. Links with FORTRAN, Pascal, C, Module-2 and QuickBasic. \$119.00

Custom software development.
UGraph—the graphics editor available now!

Heartland Software, Inc.

234 S. Franklin, Ames, IA 50010
(515) 292-8216

Inquiry 701.

THE BUYER'S MART

SOFTWARE/GRAPHICS

GRAPHICS PRINTER SUPPORT

AT LAST! Use the *PrtSc* key to make quality scaled B&W or color reproductions of your display on any dot matrix, inkjet, or laser printer. GRAFPLUS supports all versions of PC or MS-DOS with IBM (incl. EGA, VGA), Tecmar, and Hercules graphics boards. \$49.95.

Jewell Technologies, Inc.

4740 44th Ave. SW, Seattle, WA 98116
800-628-2828 x527 (206) 937-1081

Inquiry 702.

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program.

GRAFATIC: screen routines \$135.
PLOTATIC: plotter driver 135.
PRINTATIC: printer driver 135.

For the IBM PC, XT, AT & compatibles. We support a variety of compilers, graphics bds., plotters and printers.

MICROCOMPATIBLES

301 Prelude Dr., Dept. B, Silver Spring, MD 20901 USA
(301) 593-0683

Inquiry 703.

STANDARD GRAPHICS

NOVA XGLIB: Optimized. Window/viewport, arcs, splines, figure fill, borders, text (scale, rotate, align), bitmaps, bitblt, keyboard, mouse, image capture. Over 150 functions. \$75. PC_VDI: Outline fillable text, includes Segmentation. Free Demo Disk. \$395.

Both products ANSI CGI compatible. Drivers for printer, plotter, HP laser, CGA/EGA/VGA. For most "C" compilers, MS FORTRAN, QuickBASIC. Demos, manual.

NOVA INC.

P.O. BOX 68978, Schaumburg, IL 60168
312-882-4111

Inquiry 704.

SOFTWARE/INVESTMENT

Compare over 1,300 Mutual Funds with Business Week's Mutual Fund Scoreboard and your IBM PC or compatible. Use simple menu commands to search and sort on over 25 information fields. No additional software required. Data transport easily to Lotus 1-2-3. Search, total, average, rank, display and print reports—at the touch of a key!

Only \$69.95 each for an Equity or Fixed Income Diskette
\$199.95 per subscription for either the Equity or Fixed Income version
\$319.90 for a subscription to both versions (a savings of \$80!)

Order now or receive more information by calling 1-800-553-3576
(In Illinois, call 1-312-250-9292)

Or write to: **Business Week Diskettes**
P.O. Box 621, Elk Grove, IL 60009

Inquiry 705.

STOCKS OPTION FUTURES

Turn Your PC Into A

MARKET QUOTATION MONITOR

85-page book covers satellite and radio data reception of financial news and quotes for your PC, \$19 (Includes demo diskette). Free informative catalog of

- Data receivers and kits
- Quote processing and display software
- Descrambling software utilities

303-223-2120 \$2 Shipping & Handling

DATArx

111 E. Drake Rd, Suite 7041, Fort Collins, CO 80525

Inquiry 706.

SOFTWARE/LANGUAGES

FORTH with DRUMA FORTH-83

Break the 64K barrier without speed/pace penalty. Well designed, attractively priced. '83 Standard.

- 1Mb+ automated memory management
- On-line documentation, ASCII/block files
- Many powerful and useful features
- Other products: windows, modules, profiler
- IBM PC/XT/AT & all compatibles

Write or call for FREE example diskette.

DRUMA INC.

6448 Hwy. 290 East E103, Austin, TX 78723

Orders: 512-323-0403 BBoard: 512-323-2402

Inquiry 707.

SOFTWARE/LANGUAGES

FORTRAN for Macintosh

Language Systems FORTRAN is a full-featured FORTRAN 77 compiler integrated w/MPW. Full ANSI FORTRAN 77 plus VAX-type extensions. SANE numerical calculations & data types incl. COMPLEX*16, 68000, 68020 and 68881 object code. Arrays greater than 32K. Link with Pascal, C, MacApp. \$359 w/MPW via air. MC/VISA/Check. MAC+, SE, Mac II. HD req.

Language Systems Corp.

441 Carlisle Drive, Herndon, VA 22070
(703) 478-0181

Inquiry 708.

TO: ARABS in America/Canada/Europe/Australia/Etc.

Arabic Software & Manuals

We are the largest shippers of the above etc. at the cheapest prices ever to any part of the world!!!

HURRY! Call Us Now and ask for our free list!

MY COMPUTER

TEL 00971 (2) 335030 Box 7168 Abu Dhabi, U.A.E
TLX 23490 MYCOMP EM, FAX 00971 (2) 342871

Inquiry 709.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^2 = \sum_{k=0}^{\infty} x_k^{2n} (q) + \left(\frac{1}{\sqrt{\alpha \pm \beta x}} \right)$$

- MathEdit constructs math equations to be inserted into WordPerfect and manuscript documents.
- User-friendly interface—no new word processor needs to be learned.
- MathEdit—\$149

K-TALK COMMUNICATIONS

50 McMillen Ave., Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 710.

MATHEMATICIANS—ENGINEERS

Have you ever seen functions of a complex variable? Would you like to really understand differential operators like div, grad and curl? How about a peek into the fourth dimension? Call or write for information on our latest PC and Macintosh software.

Lascaux Graphics

3220 Steuben Ave., Bronx, NY 10487
(212) 654-7429

Inquiry 711.

SOFTWARE/MUSIC

COMPLETE MUSIC SELECTION

Songwriters, arrangers, teachers and musicians. Explore the options of a MIDI set-up. All computers supported with the largest selection of software and hardware for various applications.

- Recording/Sequencing • Sound Editors
- Publishing • Cables • Computer-Aided Composition
- Education • Interfaces • Voices

Write for free catalog or call for free consultation.

MIX BOOKSHELF

6400 Hollis St., #12, Emeryville, CA 94608 (415) 653-3307
1-800-233-9604

Inquiry 712.

The ENTER-tainer Clip Music & Utility

300 Songs & Sound Effects • FUN & Educational!

By far the biggest & best collection on the market for DOS machines. Play like a jukebox through your PC speaker or clip & distribute in your own programs. BASIC source code included—no royalties required. Info-packed 172-page manual. 5.25" or 3.5" disks. Requires BASIC 2.0 or later. \$29.95+\$3.50 S&H w/VISA/M.C. Money-Back Guarantee!

PDI Music Software

P.O. Box 18655, Boulder CO 80308
(800) 727-4140 In Colorado (303) 440-4140

Inquiry 713.

SOFTWARE/PACKAGING

HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS

Cloth binders & slipcases like IBM's. Vinyl binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity imprinting. Bulk disks. Everything you need to bring your software to market. Disk and binder mailers. Much more! Low Prices! Fast service. Call or write for a FREE CATALOG.

Anthropomorphic Systems, Limited

378-B E. Saint Charles Rd., Lombard, IL 60148
1-800-DEAL-NOW 312-629-5160

Inquiry 714.

SAVE SAVE SAVE SAVE LET'S TALK LABELS

We do disk labels (5 1/4" & 3 1/4")

- Better • Faster • Cheaper •

Because we specialize in disk labels... Let's Talk

We also have Tyvek Sleeves

Mailers • Binders • Vinyl Pages

We are a complete software packaging service.

Hice & Associates

8303 Cincinnati-Columbus Rd., West Chester, OH 45069
513-777-0133

Inquiry 715.

SOFTWARE/PRINTING

PRINTER GENIUS

Powerful memory-resident printer management • Control printer features from menus or within documents • Print spool-to-disk files or memory • Background print • File & directory browse • Edit small text • and more... • User friendly pop-up screens • 92-page manual • Preset for all printers • Completely flexible • PC MS-DOS • \$89 + \$4 S/H • VISA/MC

Nor Software Inc.

527 3rd Ave., Suite 150, New York, NY 10016
(212) 213-9118

Inquiry 716.

SOFTWARE/SCANNERS

Optical Character Recognition

Stop retyping: PC-OCR™ 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 18 popular fonts. User trainable: you can teach PC-OCR™ to read virtually any typestyle, incl. foreign fonts. Proportional text, matrix printer output, Xerox copies OK. \$385. Check/VISA/MC/AmExp/COD

Essex Publishing Co.

P.O. Box 391, Cedar Grove, NJ 07009
(201) 783-6940

Inquiry 717.

SOFTWARE/SCIENTIFIC

DATA ACQUISITION & ANALYSIS ON PCs

- Free application assistance. Tell us about your DSP, process control, AD or DA needs. Our expert engineering staff will provide you with a system solution to fit your needs and budget.
- AD & IEEE 488 boards from MetaBytes, Scientific Solutions and National Instruments.
- Analysis software including PRIME FACTOR FFT subroutine library, FOURIER PERSPECTIVE II advanced linear systems analysis, and menu-driven software from Unikal, Laboratory Technologies, Quinn-Curtis, and Golden. Scientific Engineering 2 & 3D graphics.

See "What's New" page 80, BYTE July 1988

LOW PRICES—Satisfaction GUARANTEED

ALLIGATOR TECHNOLOGIES

P.O. Box 9706, Fountain Valley, CA 92708
Tel. (714) 850-9984 FAX. (714) 850-9987 MC, ALLIGATOR

Inquiry 718.

POWERFUL EQN SOLVER

RISK-FREE \$99 OFFER With Top 10 Word Processor!

"Simple to differentiate or integrate." SCI.Soft Graph across singularities • Non Linear • Coupled (singular) diff eqn • Any order any number • Indefinite (singular) integrals • New functions/algorithms/solutions • Fit 60th order curves to imported data • COMPLEX/real roots • Programming • 47 predefinitions • 14 digit accuracy • More • "Devs. over 40 years" EETimes • MS-DOS, 640KB, graphics card • CURVES

CALL TODAY • 800-648-5353 x100

VISA/MC/COD/International

Curve Systems International

11693 San Vicente Blvd., Suite 350, L.A., CA 90049

Inquiry 719.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

Chaos/Nonlinear Dynamics

* Ordinary and Delay Differential Equation Solvers * Bifurcation Diagrams * 2- and 3-D Plotting, Sequential Magnification, Poincaré Sections * Next Maximum, 1-D & Circle Maps
* Phase Portraits with Multiple Initial Conditions * Spectral Analysis, Fractal Dimensions, Lyapunov Exponents

DS:I \$250.00 DS:II \$350.00

CHAOS IN THE CLASSROOM \$49.95

DYNAMICAL SYSTEMS, INC.

P.O. Box 35241, Tucson, AZ 85740, 602-825-1331

Inquiry 720.

C SCIENTIFIC LIBRARY

Extensive library of matrix, mathematical, and statistical routines. Developed and documented for use by technical specialists and C programmers in research, education, engineering, and scientific applications. Over 550 functions, superior documentation—four manuals, including Tutorial, Function Pages, and Example Programs. Includes Real and Complex Linear Algebra, Eigensystems, Differential Equations, Quadrature, Smoothing, Filtering and Prediction, MultiVariate Statistics, Multi-Dimensional Optimization, Linear Programming, Curve Fitting and Interpolations, etc. \$295 object only and \$395 with C source code.

EIGENWARE TECHNOLOGIES

13090 La Vista Dr., Saratoga, CA 95070 (408) 867-1184

Inquiry 721.

ORDINARY/PARTIAL DIFFERENTIAL EQN SOLVER

FOR THE IBM PC & COMPATIBLES

MICROCOMPATIBLES INC.

301 Prelude Dr., Silver Spring, MD 20901

(301) 593-0683

Inquiry 722.

OUR CATALOG WILL SAVE YOU TIME AND MONEY!

It describes (i) GRAPH, a \$79 scientific plotting program; (ii) MINSQ, a powerful \$179 package for curve fitting and model development; (iii) LAPLACE, a simulation program employing numerical inversion of transforms (\$249); and (iv) RSTRIP for exponential stripping (\$249). Call today for our free 16-page catalog with detailed technical application notes.

MicroMath Scientific Software

Salt Lake City, Utah 84121-3144

For orders or catalogs call: (800) 942-MATH

Inquiry 723.

Scientific/Engineering/Graphics Libraries Turbo Pascal, Turbo C, Microsoft C

Send for FREE catalogue of software tools for Scientists and Engineers. Includes: Scientific subroutine libraries, device independent graphics libraries (including EGA, HP plotter and Laserjet support), scientific charting libraries, 3-D plotting library, data acquisition libraries, menu-driven process control software. Versions available for a variety of popular languages.

Quinn-Curtis

1191 Chestnut St., Unit 2-5, Newton, MA 02164

(617) 965-5660

Inquiry 724.

DialSEARCH data transfer by phone; prestores search strategies for your literature and data searches on DIALOG, BRS, STN, or other data bases. Cuts down on-line time. Dialsearch saves your results automatically, eliminating the risk of losing your data.

The unique user interface allows even novices to perform on-line searches without special training. For \$85 on IBM PC 5¼", IBM 3½", CPM 5¼", and Apple Macintosh disks. 30-day \$ back. VISA/MC/PO.

Scientific LOGICS Inc.

21910 Alcazar Ave., Cupertino, CA 95014

(408) 446-3575 Compuserve 74017,6643

Inquiry 725.

SOFTWARE/SCIENTIFIC

POWER FFT

High performance FFT routine library for the IBM-PC Forward/Inverse FFT, Prime Factor, and General-N single and double precision f.p. routines. Over 6000 efficient lengths up to 64K points. Complex 1024 FFT in .142s on Compaq 20MHz 386/387 or 2840s on Compaq 12MHz 286/6MHz 287. Also includes integer FFT to 16K points. Complex 1024 in .080/144s on Compaq 20MHz 386/12MHz 286. Multidimension and real transforms, all routines. Use with most C, FORTRAN, Pascal, Basic products.

SOFFTEC

P.O. Box 2363, Westford, MA 01886

Introductory offer

\$85 plus \$3 shipping

Inquiry 726.

SP-4 Plotting Program

Linear, Log, Weibull, Normal, Lognormal Axes
• 60,000 data • Curve fitting • 20 symbols • Transformations • CGA/EGA/HP Plotters.

Send for our 32-page catalog of engineering/scientific software.

Software Consulting Group

P.O. Box 3298, Santa Clara, CA 95055

(408) 448-1008

Inquiry 727.

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

THE BUYER'S MART

can help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

603-924-3754

Inquiry 728.

SOFTWARE/SECURITY

CodeSafe™ Virus Protection System

Thousands of copies in use since 1986 • Protects all hard disks, any size
• Protects all COM, EXE, and associated OVL files. Not just the system files (like other products) • Detects corruption of Boot sector and DOS • Supports all PC/Ms-DOS machines • DOS 2.0 to 4.0 • Mono, Hmc, CGA, EGA
• Includes both 5¼" and 3½" disks • Transparent to user • Warning windows will open, with options if a problem occurs • Memory resident approx. 10 to 20 K, depending on the number of files.

TOLL-FREE TECH SUPPORT • 30-Day Money-Back Guarantee
NOT COPY-PROTECTED \$89.95 Visa and MasterCard accepted

ChrisWare, Inc.

15415 N. Eden Dr., Eden Prairie, MN 55348

24-HOUR SERVICE TOLL-FREE 1-800-325-8448
In Minnesota or International Call Collect (612) 948-1116

Inquiry 729.

SOFTWARE/SORT

OPT-TECH SORT/MERGE

Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including Briefcase and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS \$149. XENIX \$248.

(702) 588-3737

Opt-Tech Data Processing

P.O. Box 678 - Zephyr Cove, NV 89448

Inquiry 730.

STATISTICS

SX STATISTIX

PC Magazine Editors Choice!

• Easy to learn and use • Fast Free Support
• Money-Back Guarantee

At \$179 SX outperforms higher priced programs!

If you value your time and money, call today for FREE SX demo disk

612-631-2852

Analytical Software Box 13204, Roseville, MN 55113

Inquiry 731.

STATISTICS

The BASS System™

Why use up 8 meg and 640K just to run a data step on your PC? Now you can run your data step code and statistical procs with a system that takes only 1 meg and 400K (and costs only \$399)! Free information:

BASS Institute, Inc.

P.O. Box 349, Chapel Hill, NC 27514

(919) 933-7096 or BB: (919) 968-6755 (N,8,1)

Inquiry 732.

Go with SOLO

Statistics and graphics for the PC. Quick and easy to use. All the popular statistics plus the latest in graphics. For business professionals for occasional use, researchers for basic statistics, or students. Satisfaction guaranteed! \$149 complete with graphics. Call today. VISA or MC.

BMDP Statistical Software, Inc.

1440 Sepulveda Blvd., Suite 318, Los Angeles, CA 90025

(213) 479-7799

Inquiry 733.

STATA

NEW RELEASE NOW AVAILABLE. Even better graphics, expanded on-line help, and much more. Still only \$590. Quantity and Academic Discounts available. \$20 Demo. Call toll-free for more information. AX/VISA/MC.

1-800-STATAPC

Computing Resource Center

10801 National Boulevard, Los Angeles, CA 90064

(213) 470-4341

Inquiry 734.

THE SURVEY SYSTEM

An easy-to-use package designed specifically for questionnaire data. Produces banner format, cross tabs & related tables, statistics (incl. regression) & bar charts. Codes and reports answers to open-end questions. All reports are camera-ready for professional presentations. CRT interviewing option.

CREATIVE RESEARCH SYSTEMS

15 Lone Oak Cir., Dept. B, Petaluma, CA 94952

707-765-1001

Inquiry 735.

STATISTICS CATALOG!

Call for the catalog full of professional programs for general statistics, analysis of variance, regression, questionnaire analysis and quality control. Thoroughly tested and easy to use, the programs come with complete documentation. Programs available for PC or Apple II. Call toll free now for your free catalog.

HUMAN SYSTEMS DYNAMICS

9010 Reseda Blvd., Suite 222

Northridge, CA 91324

(800) 451-3030 (818) 993-8536 (CA)

Inquiry 736.

SIR/DBMS DEMO KIT (7.5 Mb) \$49.95

Since 1976, SIR/DBMS has PIONEERED Advanced DBMS Technology DESIGNED to handle the changing complexities of Scientific, Engineering, and Research Database Management. SIR/DBMS is also DESIGNED to Provide THE BEST DIRECT Interfaces to SAS, SPSS, BMDP, & SYSTAT. SIR/DBMS offers True Application Level Portability from PCs thru Supercomputers!

MAYBE YOU SHOULD TRY SIR/DBMS??

Order Now! Ref Buyer's Mart Special Offer!

SIR, A Division of Inter Systems Inc.

312-480-9270 (IL)

703-642-1600 (VA)

Inquiry 737.

THE BUYER'S MART

STATISTICS

MINITAB's a PC of cake!

MINITAB's intuitive commands are easy to use and remember. Features descriptive statistics, regression, time series, chi-square, hi-res graphics, much more. PC version incl. LOTUS interface, data editor, network pricing. Call for FREE brochure.

Minitab, Inc.

3081 Enterprise Dr., State College, PA 16801
(814) 238-3280

Inquiry 738.

NCSS

Professional, easy to use, menu-driven statistical system. Used by over 5,000 researchers.

- 5.0 Statistical System —\$99
- 5.1 Graphics (2D & 3D)—\$59
- 5.3 Power Pac Supplement—\$49
- 5.4 Exp. Design/CC—\$49
- 5.5 Survival Analysis—\$59
- 5.8 Forecasting—\$69

We accept checks, POs, Visa, MC. Add \$3 s/h.

NCSS-B 801-546-0445

885 East 400 North, Kaysville, UT 84037

Inquiry 739.

SCA STATISTICAL SYSTEM

The only statistical software encompassing Forecasting & Time Series Analysis Quality and Productivity Improvement General Statistical Analysis

Available on both DOS and OS/2 operating systems. Call today for more information

Scientific Computing Associates

4513 Lincoln Ave., Suite 106, Lisle, IL 60532, USA
Phone: (312) 960-1698 FAX: (312) 960-1815

Inquiry 740.

StatPac Gold™

StatPac Gold is the award-winning statistics and forecasting package that delivers. It's fast, flexible, easy to use and dependable. Time-tested and loaded with features. You be the judge. Get the facts! Call for your FREE brochure.

1-800-328-4907

Walonick Associates, Inc.

6500 Nicollet Ave. S., Minneapolis, MN 55423
(612) 866-9022

Inquiry 741.

UTILITIES

ALL FORMAT DISK UTILITY

This unique disk utility for the IBM-PC will automatically adapt to any disk format. Once adapted, you can vary all the disk parameters to adjust to all DOS file formats. It is a simple matter to then Edit, Copy the Alien disk or even transfer files to MS-DOS disks. Price US\$45, includes C source.

AME Computing Systems

16 Leyte Drive, Surrey Downs, Australia 5126
(618) 251-1008

Inquiry 742.

BETTER PRINTER CONTROL

PRINTSELECTOR provides a menu of printer functions & embeds printer control inside documents. It's better because menu-controlled menu generators allow you to customize embedded controls and menus for your printer and your needs. MS-DOS 5.25" only \$50.00-\$40.00 SH+6.5% sales tax in CA to order or receive info:

Brook King Systems

10084-7 Larwin Ave., Chatsworth, CA 91311
(818) 882-8451

Inquiry 743.

UTILITIES

COPY AT TO PC—BRIDGE-IT 3.5

"CPATZPC" RELIABLY writes 360KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape back-up tape. Only \$78.00 + SH "BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 3 1/2" 720KB/1.44MB drives for PCXTXT without upgrading DOS/BIOS. Only \$39.00 + SH BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT \$129.00 + SH VISA/MC/COD UPS B/R

MICROBRIDGE COMPUTERS

655 Sky Way Suite 113, San Carlos, CA 94070
1-415-593-8777(CA) 1-415-583-7676 (FAX)
1-514-845-0818 (CANADA) 1-800-523-8777

Inquiry 744.

PC-REFERENCE

The best computer publications on-line index. Find articles by keyword, date interval, author, title, publication, type (article, review, etc.) or any combination. Our packing method gets more info into smaller files. Written in optimized C and assembler for speed and compactness. Byte, PC Mag, Personal Computing, PC Computing, PC/TJ, more—get just the ones you want. As low as \$49.95 per year.

Nova Software

Box 37484 • Albuquerque, NM 87176
(505) 836-8400

Inquiry 745.

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, change or create formats, change a file's status, change data in any sector. MS-DOS \$75 U.S. Check/Credit card welcome.

QUAD SOFTWARE LIMITED

45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

Inquiry 746.

ARABISE YOUR PC!

The ARABKIT package converts your PC to a fully bilingual Arabic/Latin system. Run popular software (Lotus 1-2-3, dBase III+, etc.) in English AND/OR Arabic, with on screen Arabic characters and NLQ printing. ARABKIT comes with a free copy of ALBAYAN, a dedicated and powerful bilingual word processor.

EGA version-\$299 MONO version (inc Mono card)-\$349

Add 15% VAT if ordering in U.K.

ROCKETFIELD COMPUTER SYSTEMS

86 Birch Hill Lane, Manchester M13 0XZ, U.K.
Tel: 061-224 4032 FAX: 061-256-3279

Inquiry 746.

DATABASE UTILITIES

NORTAK Software Ltd. now offers a menu-driven ASSIST-like file utility for dBASE, Clipper, and FoxBASE. Self-contained (.EXE file), fast and simple to use.

SINGLE VERSION—\$35; 3-VERSION PACKAGE—\$60.
To order call:

SHOSHIN Systems Inc.

USA 1-800-267-0755 Canada 1-800-267-8856
Info Only 613-235-2310
VISA and MC accepted

Inquiry 747.

LOGGER®

Logger, for IBM-PC and compatibles, tracks and reports: User, Time on, Time off, Directories used, Programs used, Program start/end time, and calculates totals. Tracks directories/files: Opened, Created, Renamed, Deleted. Completely transparent. Retail for \$74.95 with quantity discounts available.

System Automation Software, Inc.

8555 16th St., Silver Spring, MD 20910
1-800-321-3267 or 1-301-565-8080

Inquiry 746.

UTILITIES

\$79.95!!

Order the RED Utilities now! Programs include: Disk cache speeds hard and floppy disks. Printer spooler. Batch file compiler speeds batch files. Path command for data files. Wild card exceptions. Sort directories. Over 10 more programs. IBM PC. Visa/MC. Send for free catalog.

The Wenham Software Company
5 Burley St., Wenham, MA 01984 (508) 774-7036

Inquiry 749.

WORD PROCESSING

FARSI / GREEK / ARABIC / RUSSIAN

Hebrew, all European, Scandinavian, plus either Hindi, Punjabi, Bengali, Gujarati, Tamil, Thai, Korean, Viet, or IPA. Full-featured multi-language word processor supports on-screen foreign characters and NLQ printing with no hardware modifications. Includes Font Editor. \$355 dot matrix; \$150 add'l for laser; \$19 demo. S/H in U.S. incl'd. Req. PC, 640K, graphics. 30-day Guarantee. MC/VISA/AMEX

GAMMA PRODUCTIONS, INC.
710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401
213/394-8822 Tlx: 5106008273 Gamma Pro SNM

Inquiry 750.

DuangJan

Bilingual word processor for English and: Armenian, Bengali, Burmese, Euro/Latin/African, Greek, Gujarati, Hindi, Khmer, Lao, Punjabi, Russian, Sinhalese, Tamil, Telugu, Thai, Ukrainian, Viet, . . . Only \$109+\$5 s/h (foreign + \$12 s/h). Font editor included. For any IBM compatibles with dot-matrix & LaserJet printer. Demo \$9+\$1 s/h.

MegaChomp Company

3438 Cottman Ave., Philadelphia, PA 19149-1806
(215) 331-2748 FAX: (215) 331-4188

Inquiry 751.

PC-Write 3.0 — Shareware

Fast, full featured word processor for IBM PC. Now edits large files & multiple columns. Also spell check, mailmerge, networking, ASCII, and macros. Easy-to-use, optional menus. Supports 500 printers incl. lasers. Software, guide and tutorial on disk: \$19. Registration with manual, support newsletter and 2 free updates: \$99.

90-day money-back guarantee. VISA/MC.

Quicksoft 1-800-888-8088

219 First Ave. N., #224-BYTC, Seattle, WA 98109

Inquiry 752.

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

THE BUYER'S MART

can help you reach computer professionals and produce valuable inquiries for your company!

Call

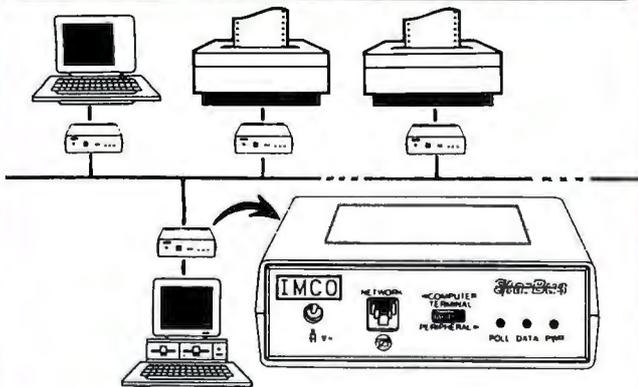
Brian Higgins

for more information

603-924-3754

Inquiry 753.

RS-232 NETWORKING



- Network up to 50 serial ports over a single pair of telephone wires in any topology . . . transparent to all software. Built in menus and help screens.
- Access any PC, printer, modem, plotter, or minicomputer from your keyboard!!
- Choose print destination from within spread sheet or word processor with POP UP communications utility. Includes background PRINT SPOOLING and X/Modem.
- Uses existing telephone wires in most offices. Easy to install, train and use.
- Add stand-alone BusDrivers, one at a time, at any point along the network, or use standard telephone splitters to add separate addressable ports to a single jack!
- SPECS: Distributed, packet-switched, full-duplex, asynchronous, RS-232 data network. Supports 50 devices, independent speeds up to 38,400 BPS (all devices may be simultaneously engaged in full-duplex conversation).

\$350 Per BusDriver (1 per port)
\$295 Each In Six-Packs

IMCO
(508) 898-2500

PC COMPATIBLE ENGINEERING

Annabooks gives you the hardware, software, and firmware information you need to design PC-compatible systems faster and better. And you have control of your design from the ground up -- our firmware and software products include **source code!** Plus all the utilities you need.

Do hardware design? **Doctor Design's 1M DRAM SuperSpec** is the first of a series of hardware books you won't want to miss. And a PC Bus timing book is on the way! Start by getting these books:

- AT BiosKit:** an AT Bios with source code you can modify. With setup & debug. 380 pages with disk, \$199
- XT BiosKit:** Includes a debug. 270 pages with disk, \$99
- Intel Wildcard Supplement** for XT BiosKit: Includes ASIC setup, turbo speeds, 60 pages with disk, \$49
- 1M DRAM SuperSpec:** Design your memory to all mfg's specs at once! Lots of timing diagrams & tables, \$79
- PromKit:** Puts anything in Eprom or SRAM; DOS, your code, data, you name it! With source on disk, \$179
- SysKit:** Here's a debug/monitor you can use even with a brand X Bios. Includes source, of course. \$69
- XT-AT Handbook:** The famous pocket-sized book jam-packed with hardware & software info. \$9.95 ea. or 5 or more for \$5 each.

Software tools: You need MS C & MASM 5.1 for modifying the Kit products.
FREE Mention this ad when you order and get a **free XT-AT Handbook** by Chelisser & Foster! Hurry before we come to our senses and change our minds.

Annabooks
 12145 Alta Carmel Ct Suite 250-262
 San Diego, California 92128 (619) 271-9526 Money-back guarantee

CONVERT 720K 3.5" DISKETTES TO 1.44M

You may already know that the difference between low and high density 3.5" floppies is in the plastic case. The 1.44 meg high density diskettes have a hole in the case not found in the 720K low density diskettes.

A low density 3.5" diskette can be formatted and used as a high density diskette after a small hole is placed in the plastic case. This hole should not be drilled because drilling may leave small particles that can corrupt the media.

We have developed a precision device that will place a clean hole in the proper location every time. Our diskette puncher is made in America of all steel and aluminum, no plastic. The punch mechanism is a combination of cold drawn tempered steel and hollow ground chrome steel that will make many clean, money saving punches.

SAVE MONEY. The high density 3.5" disks typically cost about 3 times what the low density disks cost. By buying the cheaper disks and converting them to high density, you can save 60% to 70% on floppies.

For more information on this money saving technique, see the related article in the April issue of *Computer Shopper* (page 322).

TO ORDER

ORDER TOLL FREE 1-800-446-5212 24 HOURS

VISA AND MASTERCARD ACCEPTED (no surcharge)

DISKETTE PUNCHER \$39.95
 SHIPPING & HANDLING \$3.50

OUTSIDE U.S.A., APO/FPO, \$10.00 SHIPPING
 ARKANSAS RESIDENTS ADD 5% STATE SALES TAX

Or Send Your Order To: **S & S Computer Products**
 P.O. Box 1486
 Little Rock, Arkansas 72203

24 HOURS

UNCONDITIONAL MONEY-BACK GUARANTEE.

IF, FOR ANY REASON, YOU ARE NOT COMPLETELY SATISFIED WITH THE DISKETTE PUNCHER, YOU MAY RETURN IT WITHIN TEN DAYS FOR A FULL REFUND.
 (Ten-day money-back guarantee does not include return freight, or shipping and handling.)

9600bps MODEM

+FAX **\$299**

2400 bps MODEM \$95 30 DAY FREE TRIAL
ECONOFAX™ OR MNP-5...CALL

Many low cost modems are faulty or very error prone....**Not ours!!!**
PERFORMANCE "I have recently had a lot of trouble getting 2400 BAUD MODEMS to work...this one is working perfectly." R.T., Moreno Valley CA. **SUPPORT** "I get the impression that your company, indeed, bends over backwards to provide service to its customer." M.F., Selma CA. **SUPERIOR TECHNOLOGY...**The phone connection is the main source of data errors. **DYNAMIC IMPEDANCE STABILIZATION™, DIS™** (invented by CompuCom) improves signal quality and reduces these errors by up to 95% compared to a standard modem. Model 2400 (without DIS) at \$95 outperforms the low cost alternatives, the 24DIS at \$119 outperforms the challengers, regardless of cost. IBM internal, Hayes compatible, made in USA, 6 COM ports, internal speaker, five year warranty, EasyCom software, dealers inquire. *If you aren't totally satisfied, return within thirty days for a full refund!*

CompuCom Corporation "Real deal...worked fine...quite a bargain!"
 March '89 p102 **BYTE MAGAZINE**
 CALL (408) 732-4500 (800) 228-6648

Save Your Data and Money, Too! Peripherals Sale!

Easy to Install!



Up to 150MB Capacity.

This is the fastest floppy interface tape drive around!
60MB TAPE DRIVES

Add \$10 for Shipping **\$279** 40MB Tape \$22
60MB Tape \$30

External model now available for only \$99 extra!

Works on PC, XT, AT's and 100% compatibles. Connects to the internal floppy (B:) connector or the optional adapter card (\$77). Comes complete with

installation instructions and data compression software that allows up to 100MB data storage on a 40MB tape — 150MB on a 60MB tape.



Total Power Protection!

UNINTERRUPTABLE POWER SUPPLY

As Low As **\$279** 250 Watt Model
Add \$23 shipping in the lower 48 states.

250 Watt	120 Volt	\$ 279
300 Watt	120 Volt	399
500 Watt	120 Volt	499
600 Watt	120 Volt	639
1200 Watt	120 Volt	1099
1600 Watt	120 Volt	1444*

230 volt units also available. *Shipped motor freight collect. Specify exact input voltage.

- Protects Against**
- Brownouts.
 - Blackouts.
 - Overvoltage.
 - Overload.
 - Spills/Surges
 - EMI

- Features**
- Two Audible Alarms.
 - LED Displays.
 - Optional Network Port.
 - Transfer Times As Fast As 1 Millisecond (Depends on Model).

Save on Low Cost Floppys!

Select the drive or drives you want, pick the enclosure and appropriate cable and we will assemble and test at no additional cost to you. All drives are brand new, not factory seconds, and carry a full one year parts and labor warranty. Add \$5 shipping and handling per drive.

360K 5.25" TEAC 55B bare.....	\$ 79
720K 5.25" TEAC 55F bare.....	.85
1.2M 5.25" TEAC 55FGH bare.....	.85
360K 3.5" TEAC 35B bare.....	119
720K 3.5" TEAC 35F bare.....	.85
1.44M 3.5" TEAC 35FGH bare.....	.85
5.25" mounting bracket for 3.5" drives.....	18

(Includes rails, signal & power adapter. Specify beige or black faceplate)

Dual 3.5" external case/power supply. Use with one or two 3.5" drives (horizontal).....\$49
Dual 5.25" same as above except vertical.....\$59
IBM external floppy cable for C/D. DB37 required.....\$39
(Add \$10 for brushed Stainless Steel cover)

Limited Time Only! Fantastic Prices Now On LOW COST HARD DRIVES For IBM and Tandy



Get the Best for Less!

5.2MB 95ms ST-506 MFM XT Kit **\$149**
21.4MB 65ms ST-225 MFM XT Kit **\$259**
32.7MB 65ms ST-238 12LL XT Kit **\$289**
42.8MB 40ms ST-251 MFM XT Kit 28ms Optional **\$399**

\$399 49.1MB 40ms ST-157R RLL Bare 28ms Optional
\$479 65.5MB 40ms ST-277R RLL XT Kit 28ms Optional
\$599 80.2MB 28ms ST-4096 MFM Bare
\$599 84.9MB 28ms ST-296N SCSI KH
\$699 122.7MB 28ms ST-144R RLL Bare

Add \$10 for shipping.

We provide the best low cost, high quality, fast access hard drives for your IBM, 100% compatible or Tandy computer. Our XT and SCSI kits are complete with drive, controller, cables and installation instructions. We use only brand new genuine Seagate drives so you can be assured of long trouble-free drive life. Data transfer rates as fast as 500KB per second MFM, 800KB RLL and 1MB using SCSI.

We provide software to park the heads (some drives self-park). Tandy 1000 requires DMA and ROM 1.01+. Not for EX/HX. Please specify the computer brand and model when ordering. ST 506, 4096 and 4144R are full size 5 1/2", ST 157R is 3 1/2". All others are half height 5 1/4". Sizes listed are after formatting. One year parts and labor warranty. Satisfaction guaranteed or your money back, less shipping.

Save on 32MB & 49MB Hard Cards



Hurry! Supply Limited

32.7MB 48ms RLL **\$329**
49.1MB 40ms RLL **\$489**

These units are completely assembled with brand new drives and come ready to install. For IBM XT's, 100% compatibles and Tandy 1000/1000A, SL, SX, TL, TX. Please specify the exact make and model of your computer. One year parts and labor warranty.

SOFTWARE SPECTACULAR! SENSATIONAL SAVINGS!

This list is only a small portion of our inventory! Call us for your software needs!

MS-DOS® BUSINESS SOFTWARE

Allways.....	\$ 92
Borland Quattro (1-2-3 Clone).....	169
Borland Sprint: The Work Processor.....	138
DAC Easy Accounting (all version 3).....	61
DAC Easy Bonus Pack.....	123
DAC Easy Payroll.....	61
dBase III Plus.....	439
dBase IV.....	499
Desqview.....	79
Desqview 386.....	116
Formtool.....	55
Framework III.....	399
Generic Cadd, Level 1.....	28
Generic Cadd, Level 2.....	55
Harvard Graphics.....	299
Lotus 1-2-3 2.01.....	319
Multiplan.....	134
Pagemaker 3.0.....	529
Peachtree Complete System II.....	174
ps: First Choice.....	99
ps: First Publisher.....	83
ps: Professional File with Report.....	169
ps: Professional Plan.....	62
ps: Professional Write.....	125
Printshop Bundle.....	37
Printshop Companion.....	31
Publish It!.....	122
Q & A.....	229

Quicken.....	\$ 31
Rightwriter.....	52
Ventura Publisher 2.0.....	529
WordPerfect 5.0.....	255
WordStar Pro Release 5.....	248

OTHER MS-DOS SOFTWARE

Chess Master 2100.....	\$32
F-19 Stealth Fighter.....	43
Kings Quest I, II, III or IV.....	31
Leisure Suit Larry.....	26
Leisure Suit Larry II.....	30
Managing Your Money.....	129
Mavis Beacon Teaches Typing.....	53
Math Blaster Plus.....	28
Microsoft Flight Simulator.....	37
Reader Rabbit.....	26
Test Drive.....	22
Typing Tutor IV.....	31
Where in Europe is Carmen San Diego?.....	28
Where in U.S.A. is Carmen San Diego?.....	28
Where in World is Carmen San Diego?.....	25

MS-DOS LANGUAGES/UTILITIES

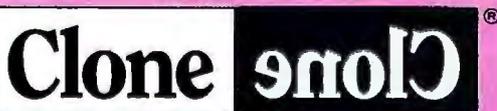
AutoSketch.....	\$ 53
Borland Sidekick Plus.....	138
Borland Turbo BASIC.....	69
Borland Turbo C.....	104
Borland Turbo PASCAL with 8087/BCD.....	103
Carbon Copy * (need two copies).....	119
Copy II PC.....	21

Copy II PC Option Board Deluxe.....	\$116
Fastback Plus.....	115
Grammarik III.....	54
Laplink Plus.....	84
Microsoft Macro Assembler 5.1.....	89
Microsoft Quick BASIC Compiler.....	67
Microsoft Quick "C" Compiler.....	67
Microsoft Windows 286.....	67
Microsoft Windows 386.....	133
Norton Utilities 4.5 Advanced.....	79
PC Tools Deluxe 5.0.....	45
Procomm Plus.....	46
Sideways.....	42
X Tree Pro.....	69

BOOKS

Take advantage of our volume discounts and save a bundle! Buy any 3 books and earn an additional \$3 discount. Buy 4 and deduct \$4. Buy 5, deduct \$5, etc.

Using 1-2-3, Special Edition.....\$19
dBase III Plus Handbook.....17
dBase IV Handbook.....16
Managing Your Hard Disk.....16
MS-DOS Users Guide 3rd Edition.....17
Running MS-DOS.....17
Using AutoCad.....21
Using Managing Your Money.....15
Using Paradox.....17
Using Q & A.....16
Using WordPerfect 4.2.....16
Using WordPerfect 5.....19



Reg. U.S. Pat. Off.



ORDER TOLL FREE!

Mon.- Fri. 9-7; Sat. 10-3

Call from anywhere in the lower 48 states and Hawaii.

1-800-527-0347

AD R9

HIGH QUALITY...LOW PRICE!

We've Built Our Reputation on This Premise for Almost a Full Decade.

Clone 286 With
LOW PRICE

\$1299 

10MHz, 30MB HARD DRIVE,
MONOCHROME MONITOR

Clone 286 With
MEDIUM SPEED

\$1969

12MHz, 40MB HARD DRIVE,
EGA MONITOR

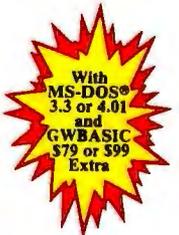
Clone 286 With
HIGH SPEED

\$2429 

16MHz, 65MB HARD DRIVE,
VGA MONITOR

Standard Features of All Clone 286 Computers:

- 640K/ 1MB RAM Standard (see chart).
- 1:1 Interleave, 2 Floppy/2 Hard Disk Controller (798 Kb/s RLL, 535 Kb/s MFM).
- 360K, 1.2M or 1.44M (3.5") Floppy Drive (your choice).
- 101 Key Enhanced Keyboard (Click-Tactile Option add \$20).
- 1 Parallel, 1 Serial, 1 Joystick Port.
- 200 Watt Power Supply.
- On-Board Clock/Calendar with Battery Backup.
- FCC Certified.
- System Reset Switch Located on the Front Panel.
- Setup in ROM.
- 80287 Math Coprocessor Socket.
- CPU Speed Switchable.
- Fully Expandable.
- Novell Compatible.
- One Year Parts and Labor Warranty.
- PC-Write - QModem - ExpressCalc AutoMenu - HomeBase - Money Master - Findex - Clone Utilities.


With MS-DOS® 3.3 or 4.01 and GWBASIC \$79 or \$99 Extra

GUARANTEED
One year parts and labor. 30 day money back guarantee (except software).

SERVING YOU SINCE 1980



CLONE VALUE CHART						
		HERC MONO	VGA MONO	CGA COLOR	EGA COLOR	VGA COLOR
12MHz 640K RAM 1 WATT STATE	32MB RLL 65ms	\$1299	\$1579	\$1459	\$1719	\$1879
	42MB MFM 40ms	1399	1679	1559	1819	1979
	65MB RLL 40ms	1499	1779	1659	1919	2079
	122MB RLL 28ms	1799	2079	1959	2219	2379
12MHz 1MB RAM 0 WATT STATE	32MB RLL 65ms	\$1449	\$1729	\$1609	\$1869	\$2029
	42MB MFM 40ms	1549	1829	1709	1969	2129
	65MB RLL 40ms	1649	1929	1809	2069	2229
	122MB RLL 28ms	1949	2229	2109	2369	2529
16MHz 1MB RAM 0 WATT STATE	32MB RLL 65ms	\$1649	\$1929	\$1809	\$2069	\$2229
	42MB MFM 40ms	1749	2029	1909	2169	2329
	65MB RLL 40ms	1849	2129	2009	2269	2429
	122MB RLL 28ms	2149	2429	2309	2569	2729



OPTIONAL EQUIPMENT FOR CLONE COMPUTERS

MODEMS & RODENTS

- Logimouse with software, Bus or Serial \$ 75
- Hi-REZ Logimouse with software, Bus 94
- Logimouse with First Publisher 108
- Hi-REZ Logimouse with First Publisher, CADD and Paint Show Plus 177
- Microsoft Mouse w/software, Bus or Serial 108
- Microsoft Mouse with Windows 286 149
- C/H Mach III Joystick 32
- C/H Flight Stick 60
- 1200 Baud internal modem with software 59
- 2400 Baud internal modem with software 99

- ATs. Comes with 512K RAM \$ 439
- Masterpiece Plus power director. Includes modem protection 119
- The Complete Fax 9600 449
- The Complete Answering Machine Board 227
- The Complete Hand Scanner (400 DPI) 182
- The Complete Hand-page Scanner 195
- Logitech ScanMan (400 DPI) 219

PRINTERS

- Star NX-1000 144cps, NLO \$179
- Star NX-1000 Rainbow, as above w/color 239
- Star NX-15 120/30 cps NLO, wide 319
- Star ND-15 180/45 cps 388
- Star NR-10 240/60 cps NLO 349
- Star NR-15 as above with wide carriage 449
- Star NB-15 300/100 cps NLO 759
- Star NB24-10 216/72 cps LQ 689
- Star NB24-15 as above with wide carriage 579
- Star NX-2400 170/57 cps LQ 24, pin 359
- Panasonic KX-P1124, 80/192 cps, 24 pin 359
- Panasonic KX-P1191i, 80 col/120 cps 289
- Panasonic KX-P1180i, 80 col/144 cps 219
- Panasonic KX-P1092i, 80 col/240 cps 329
- IBM parallel printer cable, molded ends 12

ADD-ONS & ACCESSORIES

- Autoswitching Hercules graphics/color graphics video card w/printer port, smooth scroll \$ 49
- Generic EGA card. 640 x 350 resolution 159
- Generic VGA card. 640 x 480 resolution 259
- Math coprocessors. All types, speeds in stock.
- Printer switch box, 2-position. 25 or 36 pin 29
- Printer switch box, 4-position. 25 or 36 pin 39
- 25 pin cable, 10'. Molded ends. MM or MF 16
- 36 pin cable, 10'. Molded ends. MM or MF 20
- Vertical CPU stand. Add \$9 for wheels 24
- AST Rampage 2MB EEMS memory board for

NO ORPHANED CUSTOMERS

We have been supplying customers with high quality hardware and software since 1980. Sound engineering, high performance, quality construction, outstanding warranties and a reputation for doing the right thing have been our way of doing business since Day One. As the manufacturer of Clone Computers, we stand behind each computer sold with a 100% commitment to our customer's satisfaction. Price, Performance, Value...Clone is the clear choice for serious computer users. Remember...YOUR BEST FRIEND MAY BE A CLONE.

Buy with Confidence! Our Guarantee Removes All the Risk from Your Buying Decision!

The Clone Guarantee is simple and straightforward. You have 30 days after receipt of your Clone to see if you and it are going to be compatible. If you are not satisfied with your Clone for any reason within that time, you may return it for a full refund, less shipping charges. Just don't write in the manuals and damage or lose anything that was in the original container, which also must be returned. You can void your warranty by failing to exercise normal care when hooking up or operating your Clone. Complete warranty details are available on request.



TURBO CLONE

AT Style Keyboard

\$749

Save Now!



Standard Features:

- 8088 @ 4.77 - 10MHz Turbo-speed Mainboard.
- 640K RAM standard.
- 8087 Socket.
- 150 Watt Power Supply.
- 360K Floppy Drive with Disk Controller.
- Hercules® Compatible Video Card.
- HiResolution TTL Monitor (choose green or amber)
- 2-Parallel Printer Ports.
- 1-Serial Port (2nd Optional at \$29).
- Game-Joystick Port.
- Clock Calendar with battery backup.
- 8 Slots.
- Fully Expandable.
- Mom's ROM BIOS.
- PC-Write - QModem - ExpressCalc - HomeBase - MoneyMaster - Findex - Clone Utilities - AutoMenu.
- FCC Class B Certified.
- Keyboard Lock.
- System Hardware Reset Switch on Front Panel.
- LED's for Power, Turbo and Hard Disk Access.
- One Year Parts and Labor Warranty.



**CLONE COMPUTERS • 2544 W. Commerce St. • Box 223957
Dallas, Texas 75222-3957 • Telex: 882761 • Fax: 214-634-8303**

For information or technical assistance call 214-637-5400

©1989 by Clone Computers. All rights reserved. Prices and specifications subject to change without notice. All prices are in U.S. Dollars. Payments must be in U.S. funds drawn on a U.S. bank.



Reg. U.S. Pat. Off.

Circle 56 on Reader Service Card

NEC V20 & V30 CHIPS

Replace the 8086 or 8088 in Your IBM PC and Increase its Speed by up to 30% Price

Part No.	1-9	10+	Part No.	1-9	10+
UPD70108-5 (5MHz) V20 Chip	\$6.49	\$5.95			
UPD70108-8 (8MHz) V20 Chip	\$6.49	\$5.95			
UPD70110-10 (10MHz) V20 Chip	\$13.26	\$10.95			
UPD70118-8 (8MHz) V30 Chip	\$6.96	\$7.95			
UPD70116-10 (10MHz) V30 Chip	\$16.96	\$15.49			

7400

Part No.	1-9	10+	Part No.	1-9	10+
7400	SALE	.15	7474	SALE	25
7402	SALE	.29	7475	SALE	39
7404	SALE	.15	7476	SALE	.35
7405	SALE	.35	7483	SALE	.59
7406	SALE	.39	7485	SALE	.45
7407	SALE	.25	7486	SALE	.29
7408	SALE	.35	7489	SALE	1.35
7410	SALE	.15	7490	SALE	.49
7411	SALE	.19	7493	SALE	.45
7414	SALE	.25	7495	SALE	.29
7416	SALE	.19	74107	SALE	.13
7417	SALE	.19	74121	SALE	.25
7420	SALE	.13	74123	SALE	.35
7427	SALE	.13	74125	SALE	.35
7430	SALE	.15	74147	SALE	1.49
7432	SALE	.39	74150	SALE	1.10
7438	SALE	.25	74151	SALE	.13
7442	SALE	.29	74154	SALE	1.35
7445	SALE	.59	74161	SALE	.69
7446	SALE	.89	74174	SALE	.35
7448	SALE	1.95	74175	SALE	.35
7473	SALE	.39	74193	SALE	.79

74LS

Part No.	1-9	10+	Part No.	1-9	10+
74LS00	SALE	.15	74LS139	SALE	.29
74LS02	SALE	.15	74LS151	SALE	.29
74LS03	SALE	.15	74LS153	SALE	.25
74LS04	SALE	.19	74LS154	SALE	1.19
74LS06	SALE	.19	74LS157	SALE	.35
74LS08	SALE	.59	74LS161	SALE	.29
74LS07	SALE	.59	74LS163	SALE	.35
74LS08	SALE	.28	74LS164	SALE	.35
74LS09	SALE	.15	74LS165	SALE	.65
74LS10	SALE	.19	74LS168	SALE	.69
74LS11	SALE	.29	74LS173	SALE	.35
74LS14	SALE	.29	74LS174	SALE	.29
74LS20	SALE	.15	74LS175	SALE	.29
74LS21	SALE	.19	74LS191	SALE	.39
74LS27	SALE	.19	74LS192	SALE	.69
74LS30	SALE	.15	74LS193	SALE	.59
74LS32	SALE	.19	74LS194	SALE	.59
74LS38	SALE	.25	74LS221	SALE	.49
74LS42	SALE	.49	74LS240	SALE	.45
74LS47	SALE	.89	74LS241	SALE	.49
74LS53	SALE	.25	74LS244	SALE	.49
74LS74	SALE	.19	74LS245	SALE	.59
74LS75	SALE	.29	74LS251	SALE	.69
74LS76	SALE	.29	74LS259	SALE	.89
74LS83	SALE	.59	74LS273	SALE	.89
74LS85	SALE	.59	74LS279	SALE	.49
74LS86	SALE	.29	74LS367	SALE	.29
74LS90	SALE	.19	74LS373	SALE	.59
74LS93	SALE	.29	74LS374	SALE	.29
74LS123	SALE	.35	74LS393	SALE	.69
74LS125	SALE	.49	74LS541	SALE	.99
74LS132	SALE	.29	74LS590	SALE	5.95
74LS138	SALE	.49	74LS588	SALE	2.39

74S/PROMS*

Part No.	1-9	10+	Part No.	1-9	10+
74S00	SALE	.19	74S188	SALE	1.49
74S04	SALE	.19	74S189	SALE	1.49
74S32	SALE	.19	74S240	SALE	1.39
74S74	SALE	.19	74S244	SALE	1.39
74S112	SALE	.29	74S259	SALE	1.49
74S124	SALE	1.25	74S288	SALE	1.49
74S138	SALE	.49	74S373	SALE	.99
74S153	SALE	.75	74S374	SALE	.99
74S174	SALE	.25	74S387	SALE	1.29
74S175	SALE	.25	74S472	SALE	2.49
74S175	SALE	.25	74S571	SALE	2.49

CD-CMOS

Part No.	1-9	10+	Part No.	1-9	10+
CD4001	SALE	.19	CD4051	SALE	.59
CD4002	SALE	.19	CD4052	SALE	.59
CD4007	SALE	.25	CD4053	SALE	.59
CD4011	SALE	.19	CD4060	SALE	.65
CD4012	SALE	.25	CD4066	SALE	.29
CD4013	SALE	.29	CD4069	SALE	.19
CD4015	SALE	.49	CD4070	SALE	.29
CD4016	SALE	.29	CD4071	SALE	.22
CD4017	SALE	.49	CD4072	SALE	.22
CD4018	SALE	.59	CD4073	SALE	.22
CD4020	SALE	.59	CD4081	SALE	.22
CD4021	SALE	.59	CD4082	SALE	.22
CD4024	SALE	.45	CD4094	SALE	.89
CD4027	SALE	.35	CD4095	SALE	.89
CD4028	SALE	.49	CD4503	SALE	.69
CD4029	SALE	.69	CD4511	SALE	.69
CD4030	SALE	.35	CD4518	SALE	.75
CD4040	SALE	.65	CD4520	SALE	.75
CD4042	SALE	.59	CD4522	SALE	.79
CD4043	SALE	.59	CD4528	SALE	.69
CD4046	SALE	.65	CD4538	SALE	.79
CD4047	SALE	.65	CD4543	SALE	.79
CD4049	SALE	.29	CD4584	SALE	.49
CD4050	SALE	.29	CD4585	SALE	.49

EEPROMS

Part No.	1-9	10+	Part No.	1-9	10+
2816A	2048x8	350ns (9V-15V) 5V Read/Write	5.25		
2816A-25	2048x8	250ns (9V-15V) 5V Read/Write	5.49		
2817A	2048x8	350ns 5V Read/Write	7.95		
2864A	8192x8	250ns 5V Read/Write (Pin 1, No R/B) 12.95			
2864A-30	8192x8	300ns 5V Read/Write (Pin 1, No R/B) 12.95			
2865A	8192x8	250ns 5V Read/Write	12.95		
52B13	2048x8	350ns (12V) 5V Read Only	1.49		

MICROPROCESSOR COMPONENTS

Z80, Z80A, Z80B, SERIES		8000 SERIES Continued		8000 SERIES Continued	
Part No.	Price	Part No.	Price	Part No.	Price
Z80	1.19	8155-2	3.49	8286	2.29
Z80A	1.29	81C55	3.99	8741	9.95
Z80A-CTC	1.65	8156	2.95	8742	17.95
Z80A-DART	4.96	8205	8.99	8748 (25V)	7.95
Z80A-P	1.66	8211	1.75	8749H (HMO5) (2V)	9.95
Z80A-SIO	3.66	8211	2.39	8749	9.95
Z80B	2.95	8216	1.39	8751H (3.5-12MHz)	36.95
Z80B-CTC	3.96	8224	1.75	8755	13.95
Z80B-P	3.95	8228	1.49	80286-10 (10MHz) UC	49.95
Z80B-PIO	3.95	8237-5	3.95	80287-3 (5MHz)	105.95
Z8681B1	8.96	8243	1.75	80287-10 (10MHz)	259.95

STATIC RAMS

Part No.	Function	Price
2016-2	2048x4 10ns	2.95
2102	2048x1 250ns	1.95
2111	2048x1 450ns	1.95
2144N	2048x4 450ns	.49
2144N-ZL	2048x4 20ns Low Power	1.49
21C 14	2048x4 200ns (CMOS)	2.49
2601	4096x1 CMOS	2.49
6116P 1	2648x8 10ns 1Mbit CMOS	3.99
6116P 2	2648x8 15ns 1Mbit CMOS	3.49
6116P 3	2648x8 100ns 1Mbit CMOS	3.49
6116P 4	2648x8 150ns 1Mbit CMOS	3.49
6264P 10	65536x1 10ns	8.49
6264P 15	65536x1 15ns	8.49
6264P 20	65536x1 20ns	8.49
6264P 25	65536x1 25ns	8.49
6264P 30	65536x1 30ns	8.49
6264P 35	65536x1 35ns	8.49
6264P 40	65536x1 40ns	8.49
6264P 45	65536x1 45ns	8.49
6264P 50	65536x1 50ns	8.49
6264P 55	65536x1 55ns	8.49
6264P 60	65536x1 60ns	8.49
6264P 65	65536x1 65ns	8.49
6264P 70	65536x1 70ns	8.49
6264P 75	65536x1 75ns	8.49
6264P 80	65536x1 80ns	8.49
6264P 85	65536x1 85ns	8.49
6264P 90	65536x1 90ns	8.49
6264P 95	65536x1 95ns	8.49
6264P 100	65536x1 100ns	8.49

DYNAMIC RAMS

Part No.	Function	Price
THM1000L 1L	1024x16x1 10ns	1.95
THM1000L 1H	1024x16x1 15ns	1.95
THM1000L 2L	1024x16x2 10ns	2.95
THM1000L 2H	1024x16x2 15ns	2.95
THM1000L 3L	1024x16x3 10ns	3.95
THM1000L 3H	1024x16x3 15ns	3.95
THM1000L 4L	1024x16x4 10ns	4.95
THM1000L 4H	1024x16x4 15ns	4.95
THM1000L 5L	1024x16x5 10ns	5.95
THM1000L 5H	1024x16x5 15ns	5.95
THM1000L 6L	1024x16x6 10ns	6.95
THM1000L 6H	1024x16x6 15ns	6.95
THM1000L 7L	1024x16x7 10ns	7.95
THM1000L 7H	1024x16x7 15ns	7.95
THM1000L 8L	1024x16x8 10ns	8.95
THM1000L 8H	1024x16x8 15ns	8.95
THM1000L 9L	1024x16x9 10ns	9.95
THM1000L 9H	1024x16x9 15ns	9.95
THM1000L 10L	1024x16x10 10ns	10.95
THM1000L 10H	1024x16x10 15ns	10.95
THM1000L 11L	1024x16x11 10ns	11.95
THM1000L 11H	1024x16x11 15ns	11.95
THM1000L 12L	1024x16x12 10ns	12.95
THM1000L 12H	1024x16x12 15ns	12.95
THM1000L 13L	1024x16x13 10ns	13.95
THM1000L 13H	1024x16x13 15ns	13.95
THM1000L 14L	1024x16x14 10ns	14.95
THM1000L 14H	1024x16x14 15ns	14.95
THM1000L 15L	1024x16x15 10ns	15.95
THM1000L 15H	1024x16x15 15ns	15.95
THM1000L 16L	1024x16x16 10ns	16.95
THM1000L 16H	1024x16x16 15ns	16.95
THM1000L 17L	1024x16x17 10ns	17.95
THM1000L 17H	1024x16x17 15ns	17.95
THM1000L 18L	1024x16x18 10ns	18.95
THM1000L 18H	1024x16x18 15ns	18.95
THM1000L 19L	1024x16x19 10ns	19.95
THM1000L 19H	1024x16x19 15ns	19.95
THM1000L 20L	1024x16x20 10ns	20.95
THM1000L 20H	1024x16x20 15ns	20.95

EPROMS

Part No.	Function	Price
TMS2516		

**Now Available...Jameco's NEW
Summer Sizzler Flyer #139 with 48 pages of
Computer Peripherals, Components & More!**

**15th ANNIVERSARY
YEAR
1974 - 1989**

TEST EQUIPMENT

Metex Digital Multimeters

Metex General Specs:
• Handheld, high accuracy
• AC/DC Voltage, AC/DC Current, Resistance, Diodes, Continuity, Transistor hFE • Manual ranging w/overload protection
M3650/B & M4650 only:
• Also measures frequency and capacitance
M4650 only:
• Data Hold Switch
• 4.5 Digit



M4650 Pictured

M3610	3.5 Digit Multimeter.....	\$49.95
M3650	3.5 Digit w/Freq. & Capacitance.....	\$69.95
M3650B	Same as M3650 w/Bargraph.....	\$79.95
M4650	4.5 Dig. w/Freq., Capacitance and Data Hold Switch	\$99.95

Metex Autorangeing Jumbo Readout DMM

• AC/DC Voltage, AC/DC Current, Resistance, Diodes, Continuity and Frequency
• 3.75 Digit (.8" High)
• Ruggedized, Water-resistant case • Easy-to-use pushbutton switches

M80.....\$59.95



COMPUTER ACCESSORIES

DFI Handy Scanner and 3 Button Mice for IBM PC/XT/AT

FREE DPE Software with HS3000!

The HS3000 offers a full 4 inch window at 400dpi resolution. Scan photos, logos, drawings, etc. Can be used with today's most popular applications.



HS3000 Pictured

HS3000	Handy Scanner.....	\$199.95
DMS200	200DPI 3-Button Ser. Mouse.....	\$39.95
DMS200S	200DPI 3-Button Ser. Mouse with Dr. Halo Software.....	\$59.95

IBM Compatible Cases and Power Supplies

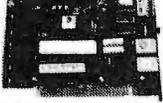


JE2010 Pictured

JE1030	Pictured	
JE1010	Flip-Top Standard PC/XT Case.....	\$39.95
JE1017	Flip-Top Baby AT Case.....	\$69.95 - \$54.95
JE1018	Slide Baby AT Case.....	\$69.95 - \$59.95
JE1030	150 watt PC/XT Power Supply.....	\$59.95
JE1032	200 watt Baby AT Power Supply.....	\$89.95
JE2010	Tower Case w/250 watt Pwr. Supply.....	\$279.95
JE2014	Flip-Top Baby XT Turbo Case.....	\$69.95

2400/1200/300 Baud Modems Dataronics

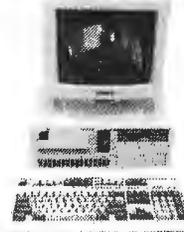
• Hayes command compatible
• Bell 103/212A compatible
• Auto-dial/auto-answer • FCC approved • 1-year warranty • Includes ProComm Communication Software



1200P	1200/300 Baud Pocket Size Modem.....	\$89.95
2400P	2400/1200/300 Baud Pocket Size Modem.....	\$149.95
1200H	1200/300 Baud Internal Modem.....	\$69.95
2400H	2400/1200/300 Baud Internal Modem.....	\$129.95
1200C	1200/300 Baud External Modem.....	\$99.95
2400C	2400/1200/300 External Modem.....	\$169.95

Jameco 12MHz IBM AT Compatible Kit With 512K RAM

- Free! QAPLUS Diagnostic Software Included!
- Free! PC Write Word Processing Software Included!
- 512K RAM Included, Expandable to 4MB
- AMI BIOS ROMs Included
- 8 or 12MHz Operation
- Regular \$840.20 value for only \$699.95!
- Flip-Top Case w/200 Watt Power Supply
- 1.2MB Disk Drive
- 13.7 Norton SI Rating
- 101-Key (Enhanced) Keyboard



Shown with EGA Option (not included)
JE1039 Monitor and Adapter Card \$499.95 (See Below)

JE3008	12MHz IBM AT Comp. Kit.....	\$799.95	\$699.95
EZDOS	Digital Research MS/PC-DOS Comp. Operating Sys.	\$49.95	
EZDOSP	Same as above with TrueBASIC.....	\$69.95	

IBM COMPATIBLE DISPLAY MONITORS

AMBER	12" Amber Mono.	\$99.95
HD55H	14" RGB 640x240	\$249.95
TM5154	EGA 14" 720x350	\$369.95
JE1059	EGA Monitor & Card	\$649.95
TM5155	14" Multiscan 800x560	\$499.95
QC1478	14" VGA 720x480	\$449.95
JE2055	VGA Monitor & Card	\$599.95



SALE

QC1478 Pictured

JAMECO IBM PC/XT/AT COMPATIBLE CARDS

JE1041	20/40MB Hard Disk Controller Card (PC/XT).....	\$79.95
JE1043	360K/720K/1.2MB/1.44MB Floppy Disk Controller Card (PC/XT/AT).....	\$49.95
JE1044	360K/720K/1.2MB/1.44MB Floppy/Hard Disk Controller Card (PC/XT).....	\$129.95
JE1045	360K/720K/1.2MB/1.44MB Floppy/Hard Disk Controller Card (AT).....	\$149.95
JE1050	Monochrome Graphics Card w/Parallel Printer Port (PC/XT/AT).....	\$59.95
JE1052	Color Graphics Card w/Parallel Printer Port (PC/XT/AT).....	\$49.95
JE1055	EGA Card w/256K Video RAM (PC/XT/AT).....	\$159.95
GC1500	Orchid 8-Bit VGA Card w/256K Video RAM (PC/XT/AT).....	\$269.95 - \$249.95
GC1501	Orchid 8/16-Bit VGA Card w/256K Video RAM (PC/XT/AT).....	\$349.95 - \$329.95
JE1080	I/O Card w/Serial, Game, Printer Port & Real Time Clock (PC/XT).....	\$59.95
JE1081	RS232 Serial Half Card (PC/XT).....	\$29.95
JE1082	RS232 Serial Half Card (AT).....	\$34.95
JE1085	I/O Card w/Serial, Game and Parallel Printer Port (AT).....	\$59.95
JE1071	Multi I/O Card w/Controller & Monochrome Graphics (PC/XT).....	\$119.95
JE1081	2MB Expanded or Extended Memory Card (zero-K-on-board) (AT).....	\$119.95

SEAGATE HALF-HEIGHT HARD DISK DRIVES

ST225	20MB Drive only (PC/XT/AT).....	\$224.95
ST225XT	20MB w/Controller (PC/XT).....	\$269.95
ST225AT	20MB w/Controller (AT).....	\$339.95
ST238	30MB Drive only (PC/XT/AT).....	\$249.95
ST238XT	30MB w/Controller (PC/XT).....	\$299.95
ST238AT	30MB w/Controller (AT).....	\$389.95
ST251	40MB Drive only (PC/XT/AT).....	\$379.95
ST251XT	40MB w/Controller (PC/XT).....	\$419.95
ST251AT	40MB w/Controller (AT).....	\$489.95
ST251-1	40MB Fast 28ms (Drive only).....	\$469.95

Your One-Stop Center for Hard Disk Drive Needs!



ST225XT Pictured

Seagate 60MB Hard Disk Drives Also Available!

IBM PC/XT/AT COMPATIBLE MOTHERBOARDS

JE1001	4.77/8MHz (PC/XT).....	\$89.95
JE1002	4.77/10MHz (PC/XT).....	\$109.95 - \$99.95
JE3005	Baby 8/12MHz (AT).....	\$229.95 - \$299.95
JE3010	Baby 8/16MHz NEAT (AT)	\$469.95 - \$399.95
JE3020	Baby 16MHz 80386 (AT)	\$1499.95 - \$999.95
JE3025	Baby 20MHz 80386 (AT)	\$1499.95 - \$1199.95
JE3026	Full-Size 25MHz 80386 (AT)	\$2299.95 - \$1999.95



JE3025 Pictured

IBM PC/XT/AT COMPATIBLE 3.5"/5.25" DISK DRIVES

352KU	3.5" 720KB (PC/XT/AT).....	\$109.95
356KU	3.5" 1.44MB (PC/XT/AT).....	\$129.95
JE1020	5.25" 360KB (PC/XT/AT) Black.....	\$89.95
JE1021	5.25" 360KB (PC/XT/AT) Beige.....	\$89.95
JE1022	5.25" 1.2MB (PC/XT/AT) Beige.....	\$99.95



JE1022 Pictured

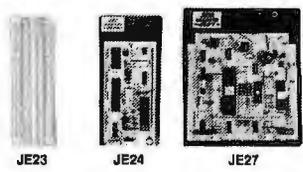
SUPER SONY SALE

720KB 3.5" Floppy Drive
• For use with IBM PC/XT/AT and compatible computers • Double-sided, double density • 135TPI • 160 tracks • Rotation speed: 300rpm • Size: 4"W x 6"D x 1"H
MPF11 720Kb Drive \$69.95
SMK 5.25" Mounting Kit ... \$14.95



PROTOTYPING PRODUCTS

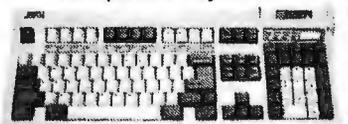
Jameco Solderless Breadboards



Part No.	Dim. L" x W"	Contact Points	Binding Posts	Price
JE21	3.25x2.125	400	0	\$4.95
JE23	6.5x2.125	830	0	\$7.95
JE24	6.5x3.125	1,360	2	\$12.95
JE25	6.5x4.25	1,660	3	\$19.95
JE26	6.875x5.75	2,390	4	\$24.95
JE27	7.25x7.5	3,220	4	\$34.95

COMPUTER ACCESSORIES

Jameco IBM PC/XT/AT Compatible Keyboards



JE2016 Pictured

JE1015	Standard AT Layout (PC/XT/AT).....	\$59.95
JE1016	Enhanced Layout (PC/XT/AT).....	\$69.95
JE2016	Enh. w/Solar Calculator (PC/XT/AT).....	\$79.95

Jameco Switch Boxes

• Female Connectors
• All Pins Switched



Part No.	Description	Price
JE1170	DB25-pin A/B Switch.....	\$22.95
JE1171	DB25-pin A/B/C Switch.....	\$27.95
JE1172	DB25-pin A/B/C/D Switch.....	\$29.95
JE1173	Centronics36-pin A/B Switch.....	\$24.95
JE1174	Centronics36-pin A/B/C Switch.....	\$27.95

30MB Hard Disk Card for IBM PC/XT



SA30.....	\$379.95
-----------	----------

Colorado Memory 40MB Tape Back-Up for IBM PC/XT/AT

DJ10	40MB Tape Back-Up and Tape...	\$349.95
TB40	40MB Tape Cartridge.....	\$24.95

ENGINEERING/DATA BOOKS

21035	Sams TTL Cookbook (88)	\$14.95
21398	Sams CMOS Cookbook (88)	\$19.95
22453	Sams Op-Amp Cookbook (88)	\$21.95
270645	Intel 8-bit Controller Hndbk. (89)	\$19.95
270646	Intel 16-bit Controller Hndbk. (89)	\$19.95
270647	Intel 32-bit Controller Hndbk.(89)	\$19.95
400041	NSC Linear Data Book Vol 1 (88)	\$14.95
400042	NSC Linear Data Book Vol 2 (88)	\$9.95
400043	NSC Linear Data Book Vol 3 (88)	\$9.95
ICM89	1989 IC Master (3 Volume Set)	\$129.95

1355 Shoreway Road
Belmont, CA 94002
24 Hour Order Hotline (415) 592-8097
FAX's (415) 592-2503 or (415) 595-2664
Telex 176043 - Ans. Back: Jameco Blmt
IC Data Sheets - 50¢ each
Send \$2.00 Postage for a FREE 1989 Catalog
© 1989 Jameco Electronics 7189
IBM is a registered trademark of International Business Machines



\$20.00 Minimum Order - U.S. Funds Only
CA Residents Add 6%, 6.5% or 7% Sales Tax
Shipping - Add 5% plus \$1.50 Insurance
(May vary according to weight)
Terms: Prices subject to change without notice.
We are not responsible for typographical errors.
We reserve the right to substitute manufacturers.
Items subject to availability and prior sale.
Products pictured may only be representative.
Complete list of terms/warranties is available upon request.

24-Hour Order Hotline (415) 592-8097 • The Following Phone Lines Are Available From 7AM - 5PM P.S.T.:
• Customer Service (415) 592-8121 • Technical Assistance (415) 592-9990 • Credit Department (415) 592-9983 • All Other Inquiries (415) 592-7108

COMPARE OUR NEW LOWER PRICES AND SUPERIOR QUALITY

PCI-286-12

- 80286-12
- 1.2 MB Floppy Drive
- 640K RAM
- Serial / Parallel / Game
- 101-Key Enhanced Key Board
- SI = 13.3 (1 Wait)
- SI = 15.2 (0 Wait \$100 Option)
- 6/12 MHz Key Board Switchable
- WA2 HD & FD Controller
- 80287 SOCKET
- 200W POWER SUPPLY

MONO SYSTEM

- W/Mono Monitor
- 20 MB Hard Disk

\$1195

VGA COLOR SYSTEM

- W/VGA Card & Monitor
- 20 MB Hard Disk

\$1795

EGA COLOR SYSTEM

- W/EGA Card + Monitor
- 20 MB Hard Disk

\$1580

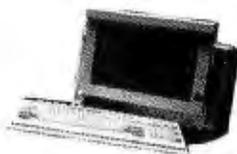


PCI-386-20

- 80386-20
- W/40 MB HD
- Mono System **\$2095**
- EGA **\$2495**
- VGA **\$2795**

GAS PLASMA 286-12 ___ \$1999

- 80286-12 CPU
- SI = 13.3
- 3 1/2" FD 1.44 MB
- 20 MB HD ST-138
- LCD Screen (640 X 400)
- I/O Card Parallel/Serial/Game
- 640K RAM



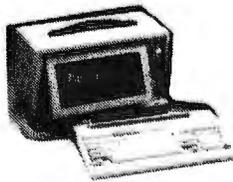
GAS PLASMA 286-20

- CPU 80286-20
- SI = 23

\$2295

LCD-286-10 PORTABLE ___ \$1395.00

- 10 MHZ 80286 SI=10.3
- 12 MHZ SI = 13.3 (Option \$50.00)
- 16 MHZ SI = 18 (Option \$250.00)
- 640K RAM
- LCD Screen 640 X 200 (Option 640 X 400 \$180.00)
- Super Twist & Back Lighting
- 86 Key Board
- External / Parallel / Game
- 1.2 MB Floppy drive
- 20 MB Hard Disk
- 80287 Socket
- 200 W Power Supply
- Side 15 1/4" X 9 1/2" X 8"
- 23 LBS



LCD-386-16 ___ \$2495

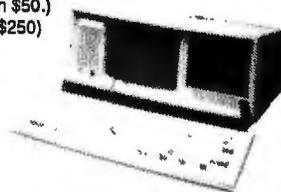
- 80386-16 MHZ
- 40 MB Hard Disk
- 80387 Socket

LCD-386-20 ___ \$2595

- 80386-20 MHZ
- 40 MB Hard Disk
- 80387 Socket

CRT-PORTABLE-286 ___ \$1295

- Compaq Type
- 80286 (10 MHZ or 12 MHZ)
- 12 MHZ SI = 13.3 (Option \$50.)
- 16 MHZ SI = 18 (Option \$250)
- One 1.2 MB Floppy Drive
- 200 W Power Supply
- TTL Display 9" Amber
- AT Key Board
- Serial / Parallel / Game
- WA2 HD & FD Controller
- 20 MB Hard Disk



CRT-386-16 \$2289

- 80386-16

CRT-386-20

\$2389

PCI PACIFIC COMPUTER

702 S. Del Mar Ave., #B,
San Gabriel, California 91776
(FAX) 818-286-8662

(818) 571-5548 (Technical support)

(800) 421-1102 (IN CA) ORDER ONLY

(800) 346-7207 (OUT CA)

*ALL SYSTEMS COME WITH ONE YEAR PARTS & LABOR WARRANTY

Mon - Sat
9:00 AM - 6:00 PM



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 a Buyer's Guide to talking microcomputers and large print display processors. More importantly it includes reviews, written by blind users, of software that works with speech.

This invaluable resource book offers details on training programs in computer applications for the blind, and other useful information on how to buy and use special equipment.

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. (\$3 extra for UPS shipping)

NBP is a nonprofit braille printing and publishing house.

BEST



Complete 386 SYSTEM

- 80386-20 MHz CPU
- Support 80287, 80387 & WEITEK processor
- Six 16 Bit, Two 6 Bit BUS
- 1 MB RAM (Expandable 2,4,8 MB on board), 32 Bit
- RAM Architecture (Interleaved Page Mode)
- AMI Bios
- Realtime Clock/Calendar
- 1.2 MB Floppy Drive
- Fast 1 to 1 Interleaved Hard Disk Controller
- VGA Adapter & VGA Monitor
- 80 MB Hard Drive (28ms)
- 101 Enhanced Keyboard
- Vertical Case
- MS-DOS 3.3 GW Basic
- 1 Year Warranty
- Support: NOVELL/3COM/PC NET/LanLink/OS/2

\$2990

NEW MINI PORTABLE BEST-286 LCD

- 10 MHz 0 WAIT (12 MHz Option)
- 512 K RAM
- 1.2 M. Floppy Drive
- 30 MB Hard Disk (Seagate 138 28ms)
- 200 W DC Fan Power Supply
- Serial & Parallel
- Non-Glare LCD Screen
- Super Twist
- Built-in Back Light
- 640 x 200 Dots
- Weight 22 lbs
- Padded Soft Carry Bag
- Dimension 16" x 8" x 9"

\$1600



286 BABY MOTHER BOARD

- 10 MHZ \$265
- 12 MHZ \$295
- Mono Monitor \$79
- Fujitsu 101 Enhance Keyboard \$45
- EGA PLUS 640 x 480 (Paradise Compatible) \$139

PORTABLE CASE

- 9" Dual Amber Monitor \$359
- 200 W Power Supply

LCD CASE

- 640 x 200 Dots \$549



VTI-33 SYSTEM

- 8088-2 10 MHz
- 640 K RAM
- 2 360K Floppy Drive
- Serial, Parallel Port
- Clock, Calendar
- AT Style Keyboard
- Built In Mono/Color Graphic
- MONO MONITOR
- MS-DOS 3.3, GW Basic

\$749

COLOR SYSTEM \$919

BEST-286 PORTABLE

- 10 MHz (12 MHz Optional)
- 512 K RAM
- One 1.2 MB Floppy Drive
- 7 Expansion Slots
- 200 W DC Fan Power Supply
- 9" Dual Amber Screen
- Mono or Color Graphic Card
- 2 Serial & 1 Parallel Port
- 84 Key Soft Tough Key Board

\$1115

BEST-88 PORTABLE \$845



VTI-55 SYSTEM

- 80286 8/12 MHz
- Award bios
- 640K-120 ns
- 1.2 MB Floppy Drive
- 40 MB Hard Disk Seagate ST-251 with NCL
- 2 Serial 1 Parallel
- Clock Calendar
- 101 Enhance Keyboard
- ATI EGA Wonder Card
- EGA MONITOR
- MS-DOS 3.3, GW Basic

\$1799

MONO SYSTEM \$1499

One Year Warranty

CALL FOR QUANTITY PRICE

BEST COMPUTER INC.
5017 Telegraph Road
Los Angeles, CA 90022

MON - SAT 8:00 - 5:00 PACIFIC TIME
PRICE & SPEC. ARE SUBJECT TO CHANGE WITHOUT NOTICE

Tel: (213) 265-0900
Tech: (213) 265-0300
Fax: (213) 265-4234
Toll: (800)634-7920
Outside Cal.



Circle 38 on Reader Service Card

Credit Card Purchase Subject to Service Charge.

WE HAD TO LEAVE OUT SOMETHING TO GIVE YOU ALL OF THIS

- AT Compatible 12 Mhz 80286 with 1 Meg of 0 Wait State Ram
- 8 ISA Expansion Slots (6-16 Bit, 2-8 Bit) 4 Full Length, 1 1/2 Length Slots free in standard model
- Expand up to 4 Megs on the motherboard, 16 Megs maximum Memory
- Includes EMS 4.0 driver for full 384K memory in 1 meg system (Most ATs limit this 384 K to useless shadow Ram)
- Advanced VLSI chip sets on motherboard and all I/O cards for enhanced reliability
- Runs with DOS 3.3, 4.01, OS/2, XENIX, Windows/286, Novel etc.
- Includes System User's Guide and Technical Reference Manuals

- Renaissance VGA card is 100% Hardware Register and BIOS compatible
- Packard Bell 640x480 256,000 color Analog Monitor with Tilt/Swivel Base
- VGA delivers up to 256 simultaneous colors at up to 640x480 resolution

- Choice of 64 Meg 28ms ST-277N SCSI or 40 Meg 28ms ST-251-1 1:1 MFM hard disk
- Choice of Top Quality Teac 1.2 or Teac 1.4 Meg floppy disk
- 3 5.25" and 2 3.5" drive slots, 3 free in standard system

- US Made Keytronics 101 key Keyboard has superior feel

- 2 Serial Ports, 1 Parallel Printer Port Standard
- 200 Watt Power Supply
- Real Time clock/calendar, ROM-based setup



\$1,895

PRICE:

Monochrome Graphics System, 60 Meg or 40 Meg
Diskless Network VGA Workstation

\$1,495
\$1,395

OPTIONS:

Teac 1.4 Meg 3.5" Floppy Drive

\$99

Microsoft MSDOS 3.3/4.01

\$79/\$89

OTHER OPTIONS

inquire

BitWise - Building and servicing PCs since 1985 - we understand what we sell! FREE SHIPPING to NY, New England, NJ, PA. Others, you pay UPS shipping ONLY, no surcharges. Full 1 Year Parts & Labor Warranty, 30 day money back guarantee. Personal Financing and Corporate Leasing Available. This is our price for cash in advance orders. VISA, MC, DISCOVER, COD welcomed (3% surcharge).

1-800-367-5906
or 518-274-0755
FAX 518-274-0764

297 River St.
Suite 501
Troy, NY 12180-9933

BITWISE
DESIGNS, INC.

Circle 41 on Reader Service Card (DEALERS: 42)

Compu\$ave



1-800-877-8855

Call about our Leasing Programs! Government P.O.'s are Welcome!

BOARDS

ADC/Alloy Slaves .. Save Orchid Pro Design 295
 Artist XJ10/16 1795 Paradise VGA + 252
 AST 5251/3270 Save Paradise VGA + 16 ... 292
 ATI VGA Wonder ... Save Sola VGA 16 512K ... 419
 Genoa 5300/5400 ... Save STB VGA EM 512K .. 358
 Intel Aboveboard+ ... 392 Tecmar VGA/AD 429
 Intel Inboard 386PC .. 615 Video 7 Fastwrite 318
 Metheus 1128 1899 Video 7 V RAM 459
 Adaptek, Boca, Hercules, Imagraph, Konan, Photon,
 Number Nine, Pixelworks, Quadram, Rasterops,
 Sigma Designs, Tops, VMI, Verticom, West Dig .. Call

DISK DRIVES

Archive 40Mb Tape ... 319 Miniscribe 676 Mb .. Save
 Maxtor 1140 1495 Panasonic Worm 1829
 Miniscribe 3085 549 Plus HardCard 40 638
 Miniscribe 157 Mb .. 1095 Seagate 30Mb Kit 272
 Miniscribe 3053 398 Seagate ST251-1 398
 Miniscribe 338 Mb .. 1695 Toshiba 1.44 Mb, 3.5" .. 92
 Miniscribe 40 Mb 289 Toshiba 720 K, 3.5" 75
 CDC, Core, Emerald, Genoa, Iomega, Maynard,
 Mountain, Priam, Storage Dimen. Sysgen, Teac Call

SOFTWARE

Adobe Fonts Save Microsoft PC Works 79
 Bitstream Fonts 105 Microsoft Word 5.0 215
 Carbon Copy Plus ... 107 PC Excel/Windows 245
 DBase IV Save Peachtree Dbl Bonus 219
 Desqview 386 105 Peachtree Complete .. 146
 Fastback Plus 104 Procomm Plus 47
 Grammatik III 54 Rightwriter 3.0 52
 Lotus 123 319 WordPerfect 5.0 228

COMPUTERS

Acer Computers Save Sharp Computers .. Save
 Altos Computers Save Televideo 286/386 .. Save
 Apple Computers Save Toshiba 1000 729
 AST Computers Save Toshiba T1200F 1359
 Cordata Computers Call Toshiba T1200FB .. 1545
 Compaq Computers .. Save Toshiba T1200HB .. 2345
 Everex Step 286/386 .. Save Toshiba T1600 3189
 IBM Computers Save Toshiba T3100E 2745
 Mitsubishi 20 Mb Lap .. 2298 Toshiba 3200 3489
 Mitsubishi 40 Mb Lap .. 2889 Toshiba 5200 Call
 NEC Computers Save Wyse 2108 929
 Packard Bell Systems .. Save Wyse 2112 1375
 Panasonic 286/385 Save Wyse 3216 2089
 Samsung Computers .. Save Zenith Supersports .. Save

CHIPS

Intel 80287 6/8/10 Mhz 139/212/242
 Intel 80387 16/20/25 Mhz 359/415/499

TERMINALS

IBM 3151 385 Wyse 30 285
 Kimtron KT-70 PC 339 Wyse 50 355
 Link MC-5 392 Wyse 60 399
 Televideo 905 299 Wyse 85 365
 Televideo 955 379 Wyse 99 GT 465
 Televideo 965 395 Wyse 150 369
 Adds, Ampex, HP, Sun River, & Other Models Call

MICE

Logitech C7 Serial 62 Microsoft w/ paint 98
 Logitech New HiRes 85 Microsoft w/Windows .. 132
 Keytronic Pro 79 Mouse Systems PC II .. 89

PLOTTERS

Calcomp 1023 3595 HP Draftpro DXL 3595
 Calcomp 1025E 4695 HP Draftpro EXL 4645
 Calcomp 1044GT .. 8595 Ioline 3500 2375
 Houston DMP 52 2295 Ioline 3700 2895
 Houston DMP 61 2995 Ioline 4000 3695
 Houston DMP 62 ... 4088 Roland 885 675
 HP 7475 A 1385 Roland 980 869
 HP 7550 A 2912 Roland DXY 1100 889
 HP 7570A 2898 Roland DXY 1200 .. 1295
 HP 7595 A 6795 Roland DXY 1300 .. 1695
 Enter, Numonics, Mural, Versatec, & Other Call

DIGITIZERS

Calcomp12 x12 342 Kurta 12x12 279
 Calcomp 44 x 60 3895 Kurta IS 3 Save
 GTCO 24 x36 1895 Kurta IS 12 x 17 479
 GTCO 36 x 48 2295 Scriptel Save
 Hitachi Puma Pros .. Save Summa 12 x 12 + ... 338
 Houston Hi Pad + ... Save Summa 12 x 18 568

MONITORS

Goldstar Composite ... 95 NEC Multisynch XL 1999
 Hitachi 20" Multil 2065 Packard Bell TTL 78
 Imtek Multiscan 425 PGS Ultra 16 629
 Mitsubishi 1381A 475 Samsung 14" RGB ... 209
 Mitsubishi HL6605 .. 1199 Samsung 14" VGA ... 359
 Mitsubishi HL6905 .. 2195 Seiko 14" 1024x768 .. 558
 Nanao 9070S 995 Sigma Laser + 19" 1695
 NEC Multisynch + 858 Sony 1302 629
 NEC Multisynch 2A .. 495 Taxan 1000 Ultra ... 2445
 NEC Multisynch 3D .. 639 Zenith 1490 589
 Amdek, Comerstone, Monitorm, Tatung, W yse .. Call

PRINTERS

Alps Allegro 24 318 NEC LC 890 3089
 Brother HL8E 2025 Okidata ML 320 328
 Canon BJ 130 725 Okidata ML 321 455
 Canon LBP-8II 1595 Okidata ML 390 455
 Citizen 120D 145 Okidata ML 391 635
 Citizen 180D 162 Panasonic 1124 Save
 Diconix D150 294 Panasonic 1180 179
 Fujitsu DL3400 508 Panasonic 1191 Save
 HP PaintJet 1025 Panasonic 4450 1299
 NEC P2200 319 Qume Script Ten ... 3199
 NEC P5200 498 Star NX-1000 168
 NEC P5300 654 Star NX-2400 298
 C.Itoh, Data Products, Data South, Epson, Genicom,
 OTC, Qume, Seikosha, TI, Varityper, & Other Call

MODEMS

Anchor 2400E 145 Okidata 2400 ext 209
 Avatex 1200 Ext. 65 Practical 1200i 65
 ATI 2400 ETC, InL 152 Prometheus 2400B/2 129
 Cardinal 2400 Ext. ... 129 Prometheus 2400G .. 149
 Hayes 1200 Ext. 278 Racal-Vadic 2400VP 388
 Hayes 2400 Ext. 415 USR Courier 2400E .. 328
 Megahertz Laptops Save USR HST 9600 588
 Multitech 224 EH ... Save USR Courier V.32 .. Save
 Multitech 9600 Save World Port Pocket .. Save
 Multitech v.32 9600 Save Zoom 2400 HC 119
 Penril, Pack. Bell, Telebit, Ventel, UDS Call

SCANNERS

Datacopy 730GS 819 PC Hand Scanner 157
 DFI Handy Scanner 219 Logitech Scan Man .. 195
 Chinon, Dest, Princeton Graphics, Panasonic Call

Mail Address: Compu\$ave - 4207 S. 37th Street - Dept B7 - Phoenix, AZ 85040. Order lines open: Mon.- Fri. 7 am - 6 pm, Sat.: 9 am - 2 pm. Prices reflect cash discounts and are subject to change without notice. We do not guarantee compatibility. DOA's are repaired or replaced, please call for a RMA. Major credit cards and selected PO's are accepted.

INTERNATIONAL SALES (602)437-4855 - FAX (602)437-9685 - CUSTOMER SERVICE (602)437-4856

BYTE BACK ISSUES FOR SALE

1987 1988 1989

January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Inside the IBM PCs Applications Software Today			

Issues Available

Rates (postage and handling included):

1987-'89 BYTE Issues	\$6.00*	BYTE 1988 Index	\$3.00
BYTE '83-'84 Index	\$3.00	1985 Inside The IBM PCs	\$4.00
BYTE 1985 Index	\$3.00	1986 Inside The IBM PCs	\$5.00
BYTE 1986 Index	\$3.00	1988 Inside The IBM PCs	\$6.00
BYTE 1987 Index	\$3.00	Applications Software	
*June 1988 (Benchmarks) \$3.00		Today Special	\$4.00

The above prices include postage in the US. Please add \$.50 per copy for Canada and Mexico; and \$2.00 per copy for foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

Please indicate which issues you would like by checking (✓) the boxes. Send requests with payment to:

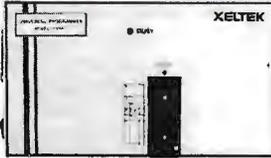
BYTE Back Issues, One Phoenix Mill Lane, Peterborough, NH 03458 (603) 924-9281

Check enclosed Charge: VISA MasterCard

Card # _____
 Exp. Date _____
 Signature _____
 Name _____
 Address _____
 City _____
 State _____ Zip _____

All orders must be prepaid. Please allow four weeks for domestic delivery and twelve weeks for foreign delivery by surface mail.

UNIVERSAL PROGRAMMER



- For E(E)PROM, PAL, BIPOLAR 8748/51Series PROGRAMMING & IC/Memory TESTING
 - High-Speed, Parallel Interface
- ONLY \$545 COMPLETE
Also Individual/Gang Units

XELTEK

473 Sapena Ct. Unit 24
Santa Clara, CA 95054

1-800-541-1975 (Toll Free Order)
Tel: (408) 727-6995, Fax: (408) 727-6996
COD, VISA, MC, AM EX Accepted

Circle 306 on Reader Service Card

HEAVY DUTY PC HARD CASES

MC & VISA	AIR FREIGHT HARD CASE	HEAVY DUTY HARD CASE	LT HARD CASE
EPSON EQUITY II CPU & KB	\$226	\$149	\$129
COMPAQ PORTABLE II	\$204	\$143	\$120
IBM AT CPU & KB	\$254	\$173	\$148
IBM MONITOR #5154001	\$226	\$154	\$129



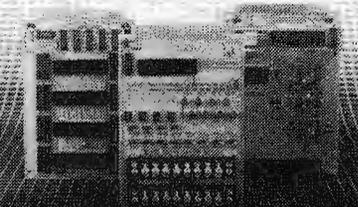
HEAVY DUTY FOAM LINED CASES WITH COMPARTMENTS FOR KEYBOARD & MOUSE

CASES ARE AVAILABLE FOR ANY COMPUTER, ALSO CUSTOM CASES

1-800-882-7112 In MI 616-374-7105
WESTERN CONTAINER & CASE
Box 125, Woodland, MI 48897

Circle 301 on Reader Service Card

6800/6809 Micro Modules



OEM 6800/6809 MICROCOMPUTER MODULES for dedicated control and monitoring, interfaces for sensors, transducers, analog signals, solenoids, relays, lamps, pumps, motors, keyboards, displays, IEEE-488, serial I/O, floppy disks.

Wintek Corp.
4801 South Street
Lafayette, IN 47904
317-742-8428



Circle 303 on Reader Service Card

Industrial Control Systems
Intelligent Terminals
Diskless Systems

ROMDISK™

For the IBM PC, XT, AT PS/2 and PC DOS* or MS DOS*

SOLID STATE DISKETTE and DRIVE EMULATORS
New Dual Disk Models

- NEW PCE/2 Dual disk model—up to 1.2MB of read only EPROM memory or 770K of EPROM as the primary "boot" diskette with a secondary diskette with up to 770K of SRAM of read/write memory.

ROMDISK PCE MODEL STANDARD FEATURES

- In-board and interchangeable Cassette models using EPROM, Flash EPROM and SRAM technology.
- On-board EPROM programmer—simply copy a diskette to program the EPROMs.
- Two Autoboot modes, a File (read) and a Programming mode—automatic disk drive designation set-up during booting.
- Flash EPROM models are electrically erasable, SRAM models are battery backed. EPROM models are ultraviolet erasable.
- List prices with memory ICs from \$295, OEM prices and models available OEM with or without memory ICs.

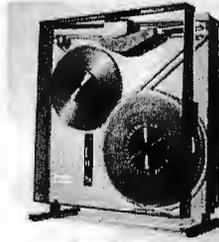
CURTIS, INC.

2837 North Feltrow Ave. • St. Paul, MN 55113
612/831-8512 Fax: 612/831-8688

*IBM PC, XT, AT, PS/2 and PC DOS are trademarks of IBM. MS DOS is a trademark of Microsoft.

Circle 81 on Reader Service Card

ALL NEW !!!
9 TRACK TAPE SUBSYSTEM
for IBM PC/AT/386
complete for only
\$2,595.00
1 YEAR WARRANTY



- IBM/ANSI compatible at 800*/1600/3200 bpi
- Controller, cables and software included
- Interfaces for PS/2*, Xenix* and DEC*
- SCSI*, AT or MCA* Bus I/O at 25/50/100 ips.
* optional

AKSystems Inc.
20741 Marilla St. Chatsworth CA 91311
TEL: 818/709-8100 FAX: 818/407-5889

Circle 12 on Reader Service Card

IN STOCK!
\$1995
1 MEG x 9 100 NS

BEST PRICES ANYWHERE!

Major electronics mfg.
17 yrs. industry exper.
will sell 1 or 1,000.

**XENTEK
SIMMS MART**

800-748-5505

Circle 308 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, trace width from 0.001 inch to 0.255 inch, flexible grid, SMD components and outputs on Penplotters as well as Photo plotters and printers.

Schematic Capture \$100, PCB Layout \$250, Auto Router \$250.

FREE EVALUATION PACKAGE

30 DAYS MONEY BACK GUARANTEE
1-800-972-3733 or (305) 975-9515

ADVANCED MICROCOMPUTER SYSTEMS, INC.
1321 N.W. 65 Place - Ft. Lauderdale, FL 33309

Circle 19 on Reader Service Card

TISAR-PC INVOICING



Keep records the way big business does...
(Hard drive required)

- FULLY INTEGRATED**
Remarkable Turn-Key System
- Data-base
 - Invoicing
 - Inventory control
 - 3,000 records per file
 - 12,000 invoices per file
 - Accounts received
 - Accounts receivable
 - Customer statements
 - Mailing labels

LIMITED OFFER
\$79.00

Now with point of entry pricing and user definable fields.

Search, cross-search, fast sorts, reports and much more.

Much easier than Dac-Easy, Peachtree, etc.

IDEAL for service or sales/mktg businesses. Easy, menu-driven, user friendly, fully tested. Up and running in under 3 minutes. Free customer support... Easy documentation.

CALL 1-800-537-LABS or ask your dealer.



Dealer inquiries invited

Circle 50 on Reader Service Card

MLC-XT™

SINGLE BOARD PC/XT COMPUTER FOR THE INDUSTRIAL WORLD

- * Solid State Disk
- * Watchdog Timer
- * 100% XT Compatible
- * Small Size

See June ad or call for more information:

(414) 639-1105

Micro Linear® Controls, Inc.
1713 Mount Pleasant St., Racine, WI 53404

Circle 176 on Reader Service Card

EX-SAMPLE+™

An expert system using AI strategies to compute sample size in statistical research. It provides a critique upon completion.

\$250.00

(plus shipping and handling)

VISA, MC, AMEX, PO and Personal Checks accepted.

The Idea Works, Inc.

Call toll-free

1-800-537-4866

Missouri residents call

314-445-4554

FAX 314-445-4589

IDEAWORKS

Circle 137 on Reader Service Card

IBM COMPATIBLE RS232/488 3 1/2 x 5 1/4" FLOPPY DATA STORAGE & TRANSFER SYSTEM



Information Transfer to/from Non IBM Compatible Systems to/from IBM & Compatibles: (Over RS-232 or 488 Interface).

- Reads & Writes MS DOS Disks
 - RS-232/488 I/O
 - Rugged Portable Package/battery option
 - MS DOS Driver for "Plug & Run" RS-232 External Operation
 - Baud Rate 110 to 38.4K Baud
 - 360K/720K RAM Cartridge Option
 - Price \$895 in Singles-OEM Qties. \$495.
- 28 other systems with storage from 100K to 42 megabytes.



ANALOG & DIGITAL PERIPHERALS, INC.
251 South Mulberry St., Troy, Ohio 45373
P.O. Box 499 TWX 810/450-2885
513/339-2241 FAX 513/339-0070

Circle 21 on Reader Service Card



DCI 286/12 IBM Compatible 30 Day Return 5 Year Extended Warranty! FREE FREIGHT!

- 80286 Processor Operating at 6 1/2 Mhz, 101 Keystation
- 512K RAM expandable to 1 Mb on board, 0/1 WS
- 1.2 Mb or 1.44 Floppy Drive
- Western Digital W42 HD/FD Controller
- Clock Calendar with 5 year battery
- 220 Watt Power Supply • 80287 FPP Support
- Either Full or Mini AT Case
- Made in USA, FCC A & B, True Phoenix BIOS

	20Mb	40Mb	40ms	40Mb	28ms	80Mb	28ms
Mono	1331"	1439"	1545"	1795"			
EGA	1760"	1867"	1974"	2224"			
VGA	1871"	1979"	2085"	2335"			

DCI - (409) 756-0094 • 3708B West Davis • Conroe, TX 77304
* All prices cash or check. City & Corp discounts available

Circle 83 on Reader Service Card

A HIGH QUALITY RS232-RS422 BIDIRECTIONAL CONVERTER AT A LOW PRICE

Changes RS232
Data Streams into
RS422 Compatible
Data Streams

Model
AA1709



Converts RS232
links to long distance
RS422 standards on cable
lengths to 4,000 feet, while having high noise immunity for use in
industrial environments. This module makes it possible for RS232
equipped devices, such as an IBM personal computer, to interface
with an RS422 equipped device. Included in the many uses of this
converter is the ability to communicate with Anaheim Automation's
own step motor motion controls. The unit includes a power supply.
Call or write for brochure.

List
\$89.00
(one to three)
over 100 \$59.90

ANAHEIM AUTOMATION
910 E. Orangefair Lane, Anaheim, CA 92801
(714) 992-6990 Telex: 2978217 MCI FAX: 714-992-0471

Circle 20 on Reader Service Card

Connectivity Solutions

Share - Switch - Speed

Leaders in connectivity devices since 1985, we manufacture a complete line of:

- Data converters
- Printer buffers
- Sharing devices
- Electronic switching
- Multiple port boards
- Data servers

Intelligent, high capacity, external/internal buffers, automatic serial/parallel data conversions. Connect multiple computers, printers, plotters, modems, etc. to a single management device.

Make your hardware investment pay off!



970 Terra Bella Ave # 3
Mountain View, CA 94043
(415) 968-8404

Over 120,000 sold since 1982



Never buy another ribbon !!!

\$68.50

Universal Cartridge Machine

Save thousands of dollars per year and always get a perfect printout, in black or with any of our colored inks. Universal Cartridge Machine is \$68.50. Multicolor adapters for multicolor cartridges. We support over 24,000 printer brands & have a complete range of accessories, color cartridges, OCR, heat transfer, and indelible inks. Customers vary from individuals to Fortune 500 companies. Ask for free catalog.

Computer Friends 1-800-547-3303

14250 NW Science Park Dr., Portland OR 97229
tel. (503)626-2291 -- fax (503)643-5379

Circle 64 on Reader Service Card



FREE! FLIP 'N' FILE
FORMATTED DISKS AT
UNFORMATTED PRICES!

DS-DD	Quantity Discounts Available	DS-HD
.63*	5.25" 3M Diskettes 10/box	*1.15
1.25*	3.50" 3M Diskettes 10/box	*2.95
1.89	SS/DD 8.00" 3M Diskettes 10/box	DS/DD 2.15

DC-2000	14.99	DC-600A	20.99
DC-300XLP	18.99	DC-6150(XTD)	21.99

3M Compac Tape 1/2" DEC TK50 Tape	25.95
3M/IBM 3480 Tape Cartridge	5.85
3M Mag Tape with seal 2400'	12.50

BASF *FREE Extra Quality Library Cases!!

DS-DD	Quality Discounts Available	DS-HD
.56*	5.25" BASF Diskettes 10/box	.80
1.09*	3.50" BASF Diskettes 10/box	*2.79

.35 BASF 5.25" DS/DD No-logs built with Tyvek sleeves, labels & w/p
.29 BASF Brand 5.25" SS/DD/48TPI Diskettes in BASF plastic library box 10/box



*FREE! 11th Disk!
*FREE Plastic Box

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.61*	1.15	1.29*	2.99*

maxell *FREE Plastic Library Box

5.25" DS/HD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.63*	1.15	1.19*	2.95*

Verbatim *FREE DataLifePlus with DISCUS 11th Disk!

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.63*	1.15	1.19	2.95

INCREDIBLE VALUE!!

.39	5.25" DS/DD 3M Highland	5.25" DS/HD .74
1.09	3.50" DS/DD Nashua	5.25" DS/HD .82
1.29	3.50" DS/DD SONY KAO	3.50" DS/HD 2.72

COLOR DISKETTES

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD
.39	.79	1.09

All 5.25" color diskettes in Tyvek sleeves, labels & w/p tabs

BULK DISKETTES

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.29	.55	.89	2.69

All 5.25" Bulk Diskettes in sleeves, labels & w/p tabs

RIBBONS STORAGE

-Please call for information-

TERMS: No surcharge on VISA, Mastercard or AMEX. COD only add \$3.00. Prepaid orders deduct 2% cash discount. PO's accepted from recognized institutions and corporations on net 30. Bank draft, T/T or L/C acceptable. Shipping: \$4/100 or fewer disks. Reduced shipping charges on large quantities. Price quoted for case (100 disks) quantities less than a case add 5%. (Min. order \$25.00. Min. order on PO's \$150.00.)

WE BEAT ANY PRICE!

Toll Free Order Line Information Line
1-800-523-9681 1-801-255-0080
TLX-9102404712 FAX-801-572-3327

DISKOTECH
DISKCO TECHNOLOGIES, INC.
213 Cottage Avenue
P.O. Box 1339 Sandy, Utah 84091

SIBEC II



The ideal solution for embedded control applications and stand alone development.

- 8052 Basic CPU
- PROM Programmer
- iSBX* Expansion Bus
- Highest Quality
- 1 Year Warranty

\$228.00 QTY 1

Call Now! (603) 469-3232

Inquire about our 8051 product development kit for the IBM PC/XT/AT.

Binary Technology, Inc.

Main St., P.O. Box 67 Mariden, NH 03770

*iSBX is a trademark of Intel Corporation.

Z80 HD64180 MICROPROCESSORS

C Compiler
Assembler/Linker
Remote Debug
Realtime Kernel
Emulator
PC Coprocessors
Proto Board

Integrated Software/Hardware Targeted
for Z80/64180 Development on PC/XT/AT

NEW! C-Compiler-Version 2-intro offer
Free Technical Brief on Request

Assembler/linker (only)	\$195.00
In-circuit Emulator	\$995.00
Source/symbolic debugger	\$195.00
Standalone Proto Board (64180µP)	\$295.00
PC Coprocessors--many versions, please inquire	

Z-World Engineering

1340 Covell Blvd, Suite 101

Davis, CA 95616

(916) 753-3722

fax: 753-5141



In Germany: 08131/1687

Complete Telephone Management System

TeleGenie™

Sophisticated Voice Mail and Call Processing
with High Quality REAL VOICE Digital Recording
for your PC, XT, AT or Compatible

VOICE MAIL

- Forwards to Extensions
- Beepers/Cellulars
- Individual Greetings and Passwords
- Multi-User-Box Capacity
- Remote Touch-Tone Access
- Replay/Delete/Record/Edit



Includes circuit board, software, phone cable and external speaker

ADVANCED CALL PROCESSING

- Unlimited Phonebook/Database
- Autodial/Redial/Search/Sort
- Caller/Computer Touch-Tone Interaction
- User-Definable Voice Prompted Menus
- Call Forward/Call Distribution
- In/Out Call Logging
- Outbound Timed Calls
- Automatic Attendant and More!

Enjoy the same benefits and features of systems costing thousands for only

\$279⁹⁵

800-637-3861

In CA 408/438-3883



Multiple Unit Discounts • Dealer Inquiries
250 Technology Circle, Scotts Valley, CA 95066

Circle 39 on Reader Service Card

Circle 311 on Reader Service Card

Circle 10 on Reader Service Card



SAME DAY SHIPMENT

D - RAMS

41256 - 06 ~ \$8.00	256 x 4 - 10 ~ \$18.50
41256 - 07 ~ \$7.50	64 x 4 - 10 ~ \$ 7.50
41256 - 08 ~ \$7.00	64 x 4 - 12 ~ \$ 7.00
41256 - 10 ~ \$6.20	1mg x 1 - 08 ~ \$18.00
41256 - 12 ~ \$5.70	1mg x 1 - 10 ~ \$16.00
41256 - 15 ~ \$5.25	1mg x 1 - 12 ~ \$15.00

ALSO AVAILABLE: SIMMS, SIPP, PLCC

MATH CO-PROCESSORS

8087-2 ~ \$118.00	80287 - 10 ~ \$215.00
8087-1 ~ \$168.00	80387 - 16 ~ \$315.00
80287-6 ~ \$128.00	80387 - 20 ~ \$375.00
80287-8 ~ \$188.00	80387 - 25 ~ \$470.00

CPU	80386 - 16 ~ 180.00
	80386 - 20 ~ 282.00
	80386 - 25 ~ 428.00

MODEM 2400 BPS Internal (with software) ~ \$69.00

CALL FOR QUANTITY PRICES

1-800-2-SABINA

SABINA INTERNATIONAL, INC.

657 Brea Canyon Road, #4, Walnut, CA 91789

(714)594-6336 • FAX (714)595-4008

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

Circle 248 on Reader Service Card

Circle 70 on Reader Service Card

Circle 224 on Reader Service Card

AVPROM™ \$295

For IBM-PC's & compatibles, menu-driven AVPROM programs EPROMs up to 8x faster than serially-connected units (20 sec. for 2764).

- Programs 2716 thru 27512A.
- 4- and 10 socket gang versions too. Call for prices.
- For complete specs, free 32 pg. development tool catalog, call

800-448-8500.
or 207-236-9055

AVOCET
SYSTEMS, INC.™

120 Union St., Rockport, ME 04856

Circle 27 on Reader Service Card

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)

QUANTITY ONE PRICES SHOWN (FOR MAY 21, 1988)

OUTSIDE OKLAHOMA: NO SALES TAX

(1) PS/2/70 (2) PS/2/80 (3) PS/2/80 (4) PS/2/80 (5) PS/2/80 (6) PS/2/80 (7) PS/2/80 (8) PS/2/80 (9) PS/2/80 (10) PS/2/80	DYNAMIC RAM		
	SIMM (1) 256Kx36	80 ns	\$450.00
	SIMM 1Mx9	80 ns	240.00
	SIMM (2) 1Mx9	85 ns	210.00
	SIMM 256Kx9	80 ns	99.00
	1Mbit 1Mx1	100 ns	17.75
	41256 256Kx1	60 ns	8.95
	41256 256Kx1	80 ns	7.40
	41256 256Kx1	100 ns	6.85
	51258 (3) 256Kx1	100 ns	7.00
41256 256Kx1	120 ns	6.15	
41264 (4) 64Kx4	120 ns	13.50	
EPROM			
27C1000 128Kx8	200 ns	\$28.50	
27C512 64Kx8	200 ns	12.95	
27256 32Kx8	150 ns	7.25	
27128 18Kx8	250 ns	4.50	
STATIC RAM			
62256P-10 32Kx8	100 ns	\$26.50	
6264P-12 8Kx8	120 ns	8.50	
6116AP-12 2Kx8	120 ns	5.50	

OPEN 6 1/2 DAYS, 7:30 AM-10 PM. SHIP VIA FED-EX ON SAT.

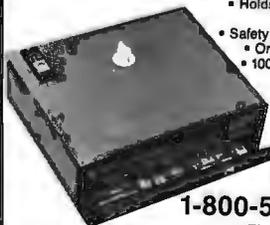
SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY: TR: \$6.00 AM '88; PR: \$1.25 '88. MasterCard/VISA or UPS CASH COD MICROPROCESSORS UNLIMITED, INC. 24,000 S. Florida Ave. BEGG'S, Ok. 74421 (918) 267-4961 No minimum order. Please note: prices subject to change! Shipping, insurance extra, up to \$1 for packing materials

Circle 177 on Reader Service Card

Erase or program EPROMs all in one site

Erasmogram-40™ MultiProgrammer™/UV Eraser

- PC Based Menu Driven Software.
- Supports 24, 28 & 32-pin (E)EPROMs.
- EPROMs: 2716 up to 27513, plus 27010, 27011, 27C301.
- EEPROMs: 2816 - 28C256.
- Fast Programming (2784 - 10 sec.) (27256 - 1 minute).
- 8, 16 & 32-bit word programming.
- 60 minute timer (auto shut-off).
- Holds up to 30 chips.
- UV indicator.
- Safety interlock switch.
- One year warranty.
- 100% U.S.A. made.



\$345.00

Call To Order

1-800-523-1565

FL: 1-407-994-3520

FAX: 1-407-994-3615 • TELEX: 4998369 BYTEK

BYTEK

BYTEK Corporation Instrument Systems Division
508 N.W. 77th Street
Boca Raton, FL 33487

Circle 49 on Reader Service Card

A-BUS™ MAGIC

Classroom to advanced industrial applications.

Be a Wizard in your Lab, Factory, College, Home...

It used to be difficult and costly to do process control, robotics, data acquisition, monitoring and sensing with your computer. Now the low-cost A-BUS system makes it easy to do almost any project you can imagine.

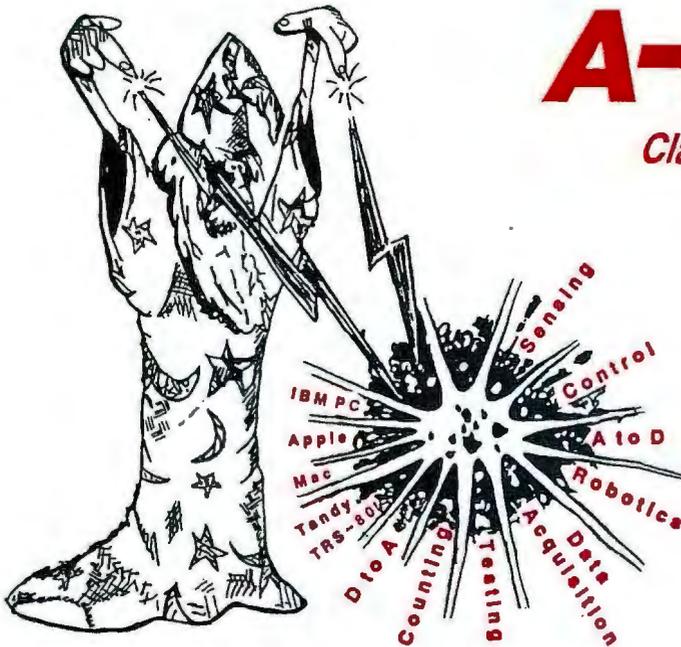
Versatility. A-BUS cards handle most interfacing, from on/off switching, to reading temperatures, to moving robot arms, to counting events, to sensing switches...

Adaptability. The A-BUS is modular, allowing expansion well beyond your needs. It works with almost any computer, or even as a remote data station with the new serial adapters.

Simplicity. You can start using the A-BUS in minutes. It's easy to connect, and software is a breeze to write in any language.

Reliability. Careful design and rugged construction make the A-BUS the first choice in specialized I/O.

An A-BUS system consists of: - An A-BUS adapter plugged into your computer - A cable to connect the adapter to 1 or 2 A-BUS function cards. - The same cable will also fit an A-BUS Motherboard for expansion to up to 25 cards in any combination.



NEW: REMOTE A-BUS! Use the new Serial (RS-232) Adapter or Processor to control any A-BUS system. Cards can be up to 500 ft away using phone type cable, or off premises using a modem. Call or send for the new A-BUS Catalog which covers all the products.

Important

All A-BUS Systems: ♦ Come assembled and tested ♦ Include detailed manuals with schematics and programming examples ♦ Can be used with almost any language (BASIC, Pascal, C, assembler, etc.) using simple "IN" and "OUT" commands (PEEK and POKE on some computers) ♦ Can grow to 25 cards (in any combination) per adapter ♦ Provide jumper selectable addressing on each card ♦ Require a single low cost unregulated 12V power supply ♦ Are usually shipped from stock. (Overnight service is available.)

About Alpha Products

Founded in 1976 for the purpose of developing low cost I/O devices for personal computers, Alpha has grown to serve over 70000 customers in over 60 countries. A-BUS users include many of the Fortune 500 (IBM, Hewlett-Packard, Tandy, Bell Labs, GM...) as well as most major universities. A-BUS products are U.S. designed, U.S. built, and serviced worldwide. Overseas distributors: England: Cady Science Assoc. Ltd., Merseyside, 051 342 7033. Australia: Brumby Technologies Pty. Ltd., NSW, 759 1638. France: Coserm, Rungis, 46 86 64 75

Inputs, Outputs, etc.

Analog Input: 8 analog inputs. 0-5.1V in 20mV steps (8 bits). 0-100V range possible. 7500 conversions/second. **AD-142: \$142**

12 Bit A to D: Analog to digital converter. Input range -4V to +4V, expandable to 100V. On-board amplifier. Resolution 1mV. Conversion time 130ms. 1 channel. (Expand to 8 channels with the RE-156 card.) **AN-146: \$153**

Relay Card: 8 individually controlled industrial relays each with status LED's (3A at 120VAC contacts, SPST). **RE-140: \$142**

Reed Relay Card: 8 reed relays (20mA at 60VDC, SPST). Individually controlled and latched, with status LEDs. **RE-156: \$109**

D/A converter: 4 Channel 8 Bit D/A converter with output amplifiers and separate adjustable references. **DA-147: \$149**

24 line TTL I/O: Connect 24 input or output signals (TTL 0/5V levels or switches). Variety of modes. (Uses 8255A) **DG-148: \$72**

Digital Input: 8 optically isolated inputs. Input can be 5 to 100V voltage levels or switch closures. **IN-141: \$65**

Digital Output Driver: 8 outputs: 250mA at 12V. Drive relays, solenoids, stepper motors, lamps, etc. **ST-143: \$78**

Clock with Alarm: Powerful clock/calendar. Battery backup. Timing to 1/100 sec. Alarm relay, LED and buzzer. **CL-144: \$98**

Touch Tone Decoder: Each tone is converted into a number which is stored on the board. **PH-145: \$87**

A-BUS Prototyping card: 4x4.5" card. Will accept up to 10 I.C.s. With power & ground bus. **PR-152: \$16**

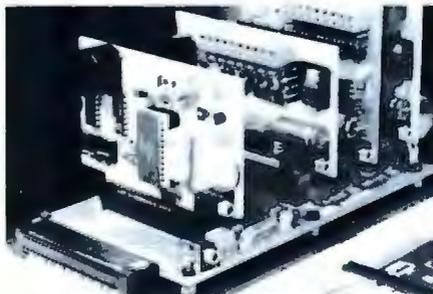
Counter Timer: Three 16 bit counters/timers. Use separately or cascade for long (48 bit) counts. **CT-150: \$132**

Call our application engineers to discuss your project.

Motion Control

Smart Quad Stepper Controller: The world's finest.

On board microprocessor controls four motors simultaneously. Uses simple English commands like "MOVE ARM 10.2 (INCHES) LEFT". For each axis, you control coordinates (absolute or relative), ramping, speed, units, scale factors, etc. Many inputs for limit switches, etc. On the fly reporting of speed, position... Built in drivers for small motors (such as MO-103 or 105). **SC-149: \$299**
Options: ▶ 5 amp/phase power booster for 1 motor: **PD-123: \$49**
▶ Remote "teach" keypad for direct motor control: **RC-121: \$54**



A large A-BUS system with two Motherboards
Adapter in the foreground plugs into PC.XT.AT type slot.

Stepper Driver Kit: For experimenting with stepper motors. Includes 2 MO-103 motors and a ST-143 dual driver **PA-181: \$99**

Stepper Motors: (4 phase, unipolar)
MO-103: 2 1/4" dia, 1/2" shaft, 7.5°/step, 12V, 5 oz-in torque. **\$15**
MO-104: 2" dia, 1/2" shaft, 1.8°/step, 5V, 60 oz-in torque. **\$45**
MO-105: 1.7" square, 2" shaft, 3.75°/step, 12V, 6 oz-in. **\$15**

A-BUS Adapters

▶ Can address 64 ports and control up to 25 A-BUS cards.
▶ Require one cable. Motherboard required for more than 2 cards.

A-BUS Parallel Adapters for:

IBM PC/XT/AT & compatibles. Uses one short or long slot. **AR-133: \$69**

Apple II, II+, IIe Plugs into any slot inside. **AR-134: \$52**

Commodore 64, 128 Plugs into Expansion Port on back. **AR-139: \$48**

TRS-80 Model 102, 200 Uses 40 pin "System bus". **AR-136: \$76**

Model 100 (Tandy portable) Plugs into socket on bottom. **AR-135: \$75**

TRS-80 Model 3, 4, 4D Y-Cable available if 50 pin bus is used. **AR-132: \$54**

TRS-80 Model I Plugs into 40 pin expansion bus. **AR-131: \$39**

Tandy Color Computers Fits ROM slot. Multiplex or Y-Cable **AR-138: \$49**

A-BUS Cable: Necessary to connect any parallel adapter to one A-BUS card or to first motherboard. 50 pin, 3 ft. **CA-163: \$24**
Special Cable for two A-BUS cards **CA-162: \$34**

Serial Adapter: Connect A-BUS systems to any RS-232 port. Allows up to 500 ft from computer to A-BUS. **SA-129: \$149**

Serial Node: To connect additional SA-129/A-BUS systems to a single RS232 serial port (max 16 nodes). **SN-128: \$49**

Serial Processor: same as above plus built in BASIC for off-line monitoring, logging, decision making, etc. **SP-127: \$189**
Use SA-129 or SP-127 with modems for remote data acquisition.

Motherboard: Holds up to 5 A-BUS cards in sturdy aluminum frame with card guides. A sixth connector allows (using cables CA-161: \$12) additional Motherboards to be added. **MB-120: \$108**

Power Supply: Power pack for up to 4 cards. **PS-126: \$12**

Complete Catalog Available
For Orders and Info call (203) 656-1806
Weekdays from 9 to 5 EST or FAX 203 656-0756

Ordering information: We accept Visa, Mastercard, Checks, and M.O. C.O.D. is \$4 extra. Purchase orders are subject to credit approval. CT residents add 7.5% sales tax. Shipping: \$4 per order (usually UPS ground). UPS 2nd Day Air: \$4 extra. Next Day service available. Canada: \$6 per order (Airmail). Outside US and Canada: Add 10% of order total.

Circle 14 on Reader Service Card



ALPHA Products

242-B West Avenue, Darien, CT 06820

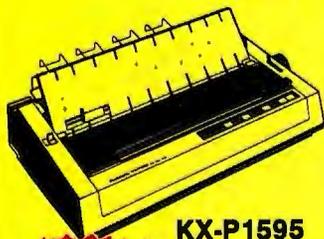
JULY 1989 • BYTE 311

YOU'LL

GO...APE!

FEDERAL EXPRESS SECOND DAY AIR! Ask Us About Special Low, Low Rates!!!

Panasonic Office Automation

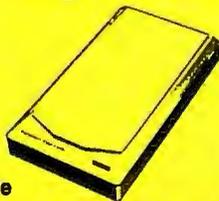


**KX-P1595
\$439**

**2 YEAR
WARRANTY**

- KX-P1180 \$179
- KX-P1191 \$249
- KX-P1592 \$429
- KX-P1595 \$439
- KX-P1524 \$539
- KX-P4450 \$1395
- KX-P1124 \$329

FX-RS505 Image Scanner



**Fax Partner
FX-BM89
Fax
Board
\$599
(List \$995)**



Also Available
FX-RS506

- Faster
 - Higher Resolution (List \$1899)
- \$1195**

With Interface
and Cable
(List \$1499)

SPECIAL OFFER



Laser Partner™ KX-P4450

\$1395 (List \$2595)

- Two 250-sheet paper cassettes
- 300 dot-per-inch resolution
- Five popular printer emulations
- Standard parallel and RS-232 serial interfaces
- Convenient front panel controls
- 512K RAM standard

Panasonic - Panafax THE LITTLE BIG FAX.



PANAFAX UF-250

IN STOCK NOW FOR SAVINGS!!

- UF-150 \$1075
- UF-250 \$1395
- UF-260 \$1695

H-P COMPATIBLE FONTS AND MEMORY

- NEW! NEW! Plotter. In A Font \$249
- The All In One
25 In 1 Font \$268
- For Lotus, Slik
Spreadsheet Font Special \$110
- Upgradable Memory Boards
 - 1MB \$275
 - 2MB \$545
 - 4MB \$895
 - 1MB (For Laser Jet 2D) \$345

PACIFIC DATA PRODUCTS

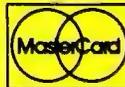


Orders: 800-272-9276
(National)
Inquiries and Technical: (508) 393-7220

1-800-332-0342
(Vermont)
(802) 334-5801

1-800-344-5648
(Canada)

HOURS: 9AM-8PM MON-FRI EASTERN STANDARD TIME
10AM-4PM SAT
• We Accept At No Additional Charge



APPLIED • PROGRESSIVE • ELECTRONICS • INC.

203 Southwest Cutoff Route 20, Northboro, MA 01532
FAX (508) 393-3124 • Phone (508) 393-7220

American Express Also Accepted

EXPIRES 7/3189

★ Order by FAX using a Credit Card and receive Free Freight!!
(UPS GROUND)

ALL ITEMS OFFERED WHILE STOCK LASTS
Ordering information: We ship anywhere in the continental United States via UPS. Prices are subject to change without notice. We accept VISA, MasterCard, personal, company checks and money orders subject to prior approval.

All returns must have prior authorization from our customer service department within 7 days of receipt. All returns must be in like-new condition, complete and in original packaging. Incomplete merchandise will not be accepted for return. All returns for merchandise credit only.

Defective products will be repaired or replaced at APE's discretion. We do not guarantee compatibility. Not responsible for typographical errors. ALL PRICES QUOTED ARE FOR PREPAY, C.O.D., OR CREDIT CARD ORDERS ONLY.

YOU'LL

GO...APE!

BE SURE TO ASK US ABOUT



**HEWLETT
PACKARD
ACCESSORIES**

EPSON®

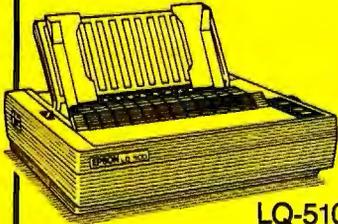


LX-810
Dot-Matrix Printer

- Full-featured, 80-column printer
- 180 CPS draft mode; 30 CPS NLO
- Automatic single sheet loading
- SelectType front control panel
- Compatible with most computers
- One year limited warranty

NOW ONLY \$179

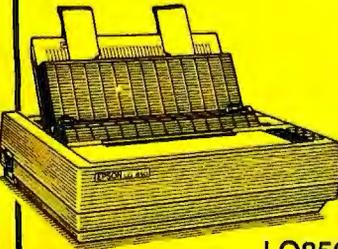
The LQ-500 combines the advantages of 24 pin Letter Quality printing with the benefits of affordable performance. With Epson's exclusive SelectType front control panel, the LQ-500 gives you push-button control of an array of impressive features. The LQ-500 also comes equipped with a pull tractor and friction feed with single-sheet auto load, which allow you to utilize a wide variety of paper.



LQ-510

NOW ONLY \$319

The LQ-850 combines SmartPark™ paper handling with 24-pin Letter Quality printing excellence. With SmartPark, you can quickly switch paper types without removing hardware or paper. And the LQ-850's SelectType front control panel gives you push-button control of an array of impressive features. For word processing and general office correspondence, this narrow-carriage printer is ideal.



LQ-850

CALL \$\$\$\$\$\$

Dramatic Savings On All Other Epson Printers

EX 800, FX 850 & 1050, LQ 850, 1050 & 2550

ALL EPSON RIBBONS 3 for 2

SHARP®

**FROM SHARP MINDS
COME SHARP PRODUCTS™**

- 10 MHz High Speed 80286 CPU (6/8 MHz switchable)
- Illuminated Supertwist Crystal Display with 4 gray scale levels
- Dual high density floppies (PC-7202) or single floppy and 20MB hard disk drive (PC-7221)
- 120 key detachable keyboard with separate numeric and cursor keypads
- 640 KB of RAM, expandable to 1.6 MB on the system board
- One internal expansion slot for full-size PC and AT compatible expansion cards
- Parallel, serial, and color/monochrome CRT ports
- One internal expansion slot for full-size PC and AT compatible expansion cards
- Optional internal modem card and expansion unit with four card slots

MODEL PC-7200 SERIES
The power of a desk-top AT in a compact portable unit



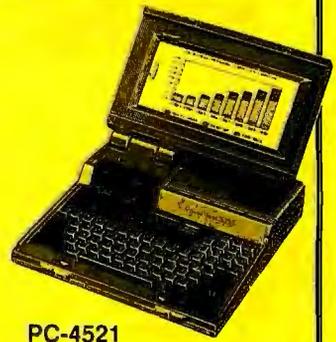
PC-7200

PC-7221 \$1495 PC-7241 \$2195

**Battery Powered
LAPTOPS from SHARP.**

- High contrast, illuminated supertwist display
- 20 MB hard disk drive and single 3.5 inch floppy drive
- High speed processor (7.16 MHz)
- 640K RAM
- Full-sized keyboard with 10 key numeric pad
- Software compatible with IBM PC
- Optional 300/1200 baud modem, CRT adapter, 1 MB EMS card, 788K EPROM card
- Also available with dual 3.5 inch floppy disk drives (Model PC-4502)

PC-4502 \$895
PC-4502M \$1095
PC-4521 \$1695
PC-4521M \$1895



PC-4521

NEW PC-4600 SERIES CALL



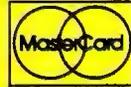
Orders: 800-272-9276
(National)

Inquiries and Technical: (508) 393-7220

1-800-332-0342
(Vermont)
(802) 334-5801

1-800-344-5648
(Canada)

**HOURS: 9AM-8PM MON-FRI EASTERN STANDARD TIME
10AM-4PM SAT
We Accept At No Additional Charge**



APPLIED • PROGRESSIVE • ELECTRONICS • INC.

203 Southwest Cutoff Route 20, Northboro, MA 01532
FAX (508) 393-3124 • Phone (508) 393-7220

American Express Also Accepted
EXPIRES 7/31/89

★ Order by FAX using a Credit Card and receive Free Freight!!
(UPS GROUND)

ALL ITEMS OFFERED WHILE STOCK LASTS

Ordering information. We ship anywhere in the continental United States via UPS. Prices are subject to change without notice. We accept VISA, MasterCard, personal, company checks and money orders subject to prior approval.

All returns must have prior authorization from our customer service department within 7 days of receipt. All returns must be in like-new condition, complete and in original packaging. Incomplete merchandise will not be accepted for return. All returns for merchandise credit only.

Defective products will be repaired or replaced at APE's discretion. We do not guarantee compatibility. Not responsible for typographical errors. ALL PRICES QUOTED ARE FOR PREPAY, C.O.D., OR CREDIT CARD ORDERS ONLY.

VOICE MASTER KEY[®]
VOICE RECOGNITION SYSTEM
FOR PC/COMPATIBLES & TANDY 1000 SERIES
 A FULL FEATURED VOICE I/O SYSTEM

GIVE A NEW DIMENSION TO PERSONAL COMPUTING. . .The amazing Voice Master Key System adds voice recognition to just about any program or application. Voice command up to 256 keyboard macros from within CAD, desktop publishing, word processing, spread sheet, or game programs. Fully TSR and occupies less than 64K. Instant response time and high recognition accuracy. Voice recognition tool-box utilities are included. A genuine productivity enhancer!

SPEECH RECORDING SOFTWARE. . .Digitally record your own speech, sound, or music to put into your own software programs. Software provides sampling rate variations, graphics-based editing, and data compression utilities. Create software sound files you can add to macros for voice recognition verification response. A complete, superior speech and sound development tool.

SOFTWARE CONVERSION CODES. . .The Voice Master Key System operates a growing list of third party talking software titles using synthesized phonetics (text-to-speech) or digitized PCM, ADPCM, and CVSDM encoded sound files. Voice Master Key System does it all!



EVERYTHING INCLUDED. . .Voice Master Key System consists of a plug-in card, durable lightweight microphone headset, software, and manual. Card fits any available slot. External ports consist of mic inputs and volume controlled output sockets. High quality throughout, easy and fun to use.

ONLY \$149.95 COMPLETE

ONLY \$89.95 FOR TANDY 1000 SL/TL MODELS—
 SOFTWARE PACKAGE ONLY.

Requires Tandy Brand Electret microphone.

ORDER HOTLINE: (503) 342-1271

Monday-Friday, 8AM to 5PM Pacific Time

Visa/MasterCard, company checks, money orders, CODs (with prior approval) accepted. Personal checks subject to 3 week shipping delay. Specify computer type and disk format (3 1/2" or 5 1/4") when ordering. Add \$5 shipping charge for delivery in USA and Canada. Foreign inquiries contact Covox for C & F quotes. 30DAY MONEY BACK GUARANTEE IF NOT COMPLETELY SATISFIED. ONE YEAR WARRANTY ON HARDWARE.

CALL OR WRITE FOR FREE PRODUCT CATALOG



COVOX INC. 675-D Conger St.
 Eugene, Oregon 97402 U.S.A.
 TEL: 503-342-1271 • FAX: 503-342-1283

SONY BULK **\$1.19**
 800K—IN LOTS OF 50

3.5" 1.44MB HD's...\$3.00

5.25" DD 25¢ IN LOTS OF 200
 DS/DD

5.25" 1.2MB HD...59¢

AMERICAN GROUP
800-288-8025
 12132 Sherman Way
 N. Hollywood CA 91604 • VISA-MC

Circle 17 on Reader Service Card

5.4 Gigabytes Unattended Backup

Store up to 5.4 Gigabytes of data on a single T-120 VHS video cartridge. Error rate is less than 1 in 10¹⁹ bits. High speed search gives average access time of three minutes.

Use GIGASTORE™ to backup your largest disk drive on off-hours without an operator.

GIGASTORE is a trademark of Digi-Data.

DIGI-DATA CORPORATION
 8580 Dorsey Run Road
 Jessup, MD 20794-9990
 (301) 498-0200
 Telex 87-580
 ... First In Value

Circle 91 on Reader Service Card

EPROM PROGRAMMER CROSS ASSEMBLERS

MODEL SX151

RS232C OR STAND ALONE (all models). Communication protocol: XMODEM, HEX, and BIN. Programs: EEPROMS, 2716 - 27512 and CMOS. Programs (w/adaptor): 25XX, 27101 (and above), 68701, 68705, 68764/6, 8741/2, 8744, 8748/9, 8751/2, 8755, 87252, and CMOS. More available soon. Model SX151 \$214 (assembled with case). Other models are available from \$49 (kit).

Cross assemblers by PseudoCode for IBM-PCs, \$50. Z80, 1802, 8502, 8600/12/3/5/8/9/11, 68000/8/10, 8048/9, 8051/2, 8080/5, 8096, and more soon. Simulators and disassemblers also available.

KORE, Inc.
 6910 Patterson S.E.
 Caledonia, MI 49316
 (616) 887-1444
 \$5 for shipping (USA), plus \$3.00 COD.

Circle 154 on Reader Service Card

ULTIBOARD COMPUTER AIDED PCB DESIGN

The ULTIBOARD PCB layout package featuring:

- Full SMI support
- 32 layer support with blind and buried vias
- Curved traces
- Real-Time Design Rule Check
- Powerful placement aids
- Trace Shove and Rotate/White Move
- Autoroute by window, component or net
- Backannotation to OrCAD, DASH, Schema, ViewLogic

ULTIMATE TECHNOLOGY
 15340 California MacCraw Dr., Chula Vista, CA 92015
 (619) 591-1000
 ASK FOR YOUR FREE DEMO DISK

Circle 290 on Reader Service Card

E/EPROM & MICRO PROGRAMMER

\$895

■ EP-1140 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

■ Programs 24-, 28-, 32- & 40-pin E/EPROMs

■ Supports 874X & 875X series microcontrollers

■ Connects to a standard parallel port

■ 32-pin model, EP1132, available for \$695

The Engineer's Programmer™

CALL TODAY 800-225-2102

BP MICROSYSTEMS
 10681 Haddington, #190, Houston, TX 77043
 713/461-9430 FAX 713/461-7413

Circle 29 on Reader Service Card

Advertise your computer products through

BYTE BITS
 (2" x 3" ads)

For more information call Mark Stone at **603-924-6830**

BYTE

One Phoenix Mill Lane
 Peterborough, NH 03458

Circle 330 on Reader Service Card

Complete Kit w/Controller **\$148** 1200 Baud w/Software **\$48**

Hard Disk Modem

Jade 10 MHz Turbo XT \$398
 640K Motherboard w/256K RAM
 Floppy Disk Controller
 140 Watt Power Supply
 101 Enhanced Keyboard

Monochrome Graphics System \$698
 640K RAM, 360K Disk Drive
 Printer Port, Amdek 310A Monitor
 30 MB Hard Disk System...add \$298
 CGA Color System...add \$188
 EGA Color System...add \$398
 VGA Color System...add \$568

Jade 12 MHz Turbo 286 \$898
 1 MB Motherboard w/512K RAM
 200 Watt Power Supply
 Clock/Calendar
 Enhanced 101 Keyboard

Mono Graphics System \$1098
 1.2 MB Floppy Drive & Controller
 Printer Port, Amdek 310A Monitor
 40 MB Hard Disk System...add \$438
 12 MHz, 1 MB of RAM...add \$148

Jade 20 MHz Turbo 386 \$1998
 1 MB of RAM on Motherboard
 1:1 Interleave FDD/HD Controller
 2 Serial, 1 Parallel, Clock, Calendar
 101 Enhanced Keyboard

40 MB Mono Graphics System \$2388
 1.2 MB Floppy Disk Drive
 40 MB Hard Disk Drive
 Amdek 310A Monitor

Disk Drives
 360K half height...\$68
 360K full height...\$118
 TEAC 55 BV...\$78
 1.2 MB for AT...\$88
 3 1/2" 720K...\$88
 3 1/2" 1.44 MB...\$118
 5 1/4" ext. 360K for PS/2...\$218
 5 1/4" ext. 1.2 MB for PS/2...\$258
 5 1/4" ext. for LapTop...\$298

Hard Disk Drives
 10 MB w/controller...\$148
 20 MB w/controller...\$238
 30 MB w/controller...\$288
 40 MB w/controller...\$398
 40 MB for AT...\$338
 ST 125 20 MB...\$248
 ST 138 30 MB...\$298
 ST 251 40 MB...\$368
 ST 251-1 40 MB...\$448
 ST 4096 80 MB...\$568

Tape Back-up
 CMS Jumbo 40 MB XT/AT...\$298
 XT/AT Kit External...\$128
 PS/2 Internal Kit...\$58
 PS/2 External Kit...\$128

Monitors
 Amdek 310A amber...\$98
 Amdek 410A amber...\$118
 14" amber flat screen...\$128
 RGB 640 X 240 color...\$258
 EGA 640 x 350 color...\$378
 VGA 640 x 480...\$398
 NEC MultiSync II...Call
 NEC MultiSync II 2A...\$528
 Mutsubishi Diamond Scan...\$498
 Zenith 1490 flat screen...\$618
 Sony 800 x 600 Multi Scan...\$488

Keyboards
 84 Key AT-style...\$68
 101 Key enhanced...\$78

Printers
 EPSON LX-800 9 PIN...\$188
 EPSON FX-850...Call
 EPSON FX-1050...Call
 EPSON EX-800...Call
 EPSON DFX-5000...Call

EPSON LQ-500 24 PIN...Call
 EPSON LQ-850...Call
 EPSON LQ-950...Call
 EPSON LQ-1050...Call

Okidata 320...\$348
 Okidata 321...\$498
 Okidata 390...\$498
 Okidata 391...\$648
 Okidata 393...\$948

Panasonic KX-P1180...\$178
 Panasonic KX-P1191...\$239
 Panasonic KX-P1124...\$318
 Panasonic KX-P1592...\$388
 Panasonic KX-P10921...\$318
 Panasonic KX-P1595...\$438
 Panasonic KX-P1524...\$538
 Panasonic KX-P4450...\$1548

Daisywheel Printer
 40 CPS Parallel and serial...\$199

Hewlett Packard DeskJet
 DeskJet...\$698
 EPSON emulation cartridge...\$68
 TMS RM/HELV Soft Font...\$98
 Ink cartridge...\$19

Hewlett Packard LaserJet
 LaserJet II...Call
 LaserJet IID...Call
 25 in One Font Cartridge...\$398
 4 MB card w/0 memory...\$188
 1 MB memory card...\$348
 2 MB memory card...\$648
 4 MB memory card...\$1148
 Toner cartridge...\$98

Terminals
 WYSE model 30...\$288
 WYSE model 50...\$368
 WYSE model 85...\$438

Joystick
 Kraft 3 button Joystick...\$19
 Dual Game Port...\$19

Plotter
 Roland DXY-980...\$698
 Houston Instruments...Call

Scanner
 Complete Hand Scanner...\$148
 Complete 4" Scanner...\$198
 Logitech Scan Man...\$248
 Diamond Flower 3000...\$198
 Hewlett Packard ScanJet...Call

Digitizers
 Summa Sketch 12 x 12...\$378

Mouse
 Opto-mechanical with Software...\$29

LogiTech
 LogiMouse Serial...\$68
 LogiMouse Bus...\$78
 LogiMouse Hi-rez...\$88

Mouse Systems
 PC Mouse with Paint...\$88

Microsoft
 Mouse w/Paintbrush...\$98
 Mouse w/CAD...Call
 Mouse w/Window...Call

Complete PC
 Complete FAX 4800...\$228
 Complete FAX 9600...\$388
 Complete Answering Machine...\$248

Switch Boxes
 Parallel or Serial (Specify)
 2 way AB...\$28
 3 way ABC...\$38
 4 way ABCD...\$58
 5 way ABCDE...\$68
 Crossover X...\$68
 AutoSwitch 3 way...\$198
 AutoSwitch 6 way...\$248

Modems
 1200 internal w/software...\$48
 2400 internal w/software...\$98
 1200 external...\$88
 2400 external...\$148
 2400 PS/2 internal...\$198
 Intel 2400B for PS/2...\$278

Intel
 8087...\$94
 8087-2...\$138
 8087-1...\$178
 80287-6...\$148
 80287-8...\$218
 80287-10...\$248
 80387-SX...\$348
 80387-16...\$378
 80387-20...\$398
 80387-25...\$528
 Above board 286 Plus 512K...\$418
 In board 386...\$1028

Cables
 6' printer...\$12
 10' printer...\$18
 25' printer...\$28
 9' serial...\$18
 25' serial...\$28
 50' serial...\$38
 100' serial...\$58
 Keyboard extender...\$12
 Monitor extender...\$16
 Printer extender...\$16

Boards
 Monographics w/Parallel...\$48
 Color Graphics w/Parallel...\$48
 Jade EGA card...\$158
 Jade VGA+...\$238
 Jade VGA+ 16...\$288
 Dual game port...\$19
 XT I/O Par/Ser/Clk/Game...\$58
 AT I/O Par/Ser/Game...\$58
 360/720K 1.2/1.44 MB FDC...\$48
 AT FDD/HD controller...\$98
 XT Hard Disk controller...\$58
 AST SixPak Plus...\$118
 AST XFormer...\$578
 Paradise auto EGA 350...\$168
 Paradise VGA+...\$268
 Paradise VGA+ 16...\$318

Surge Protector
 S. L. Waber 6 outlet...\$18
 Isobar 4 outlet...\$48
 Isobar 8 outlet...\$68
 Isobar modem protector...\$24

TrippLite Battery Back-up
 450 Watt UPS...\$398
 750 Watt UPS...\$498
 1200 Watt UPS...\$698

TrippLite Line Stabilizer
 600 Watt LC...\$98
 1200 Watt LC...\$158
 1800 Watt LC...\$188

Accessories
 Kensington Master Piece...\$88
 AC Master Control Center...\$48
 MicroSpeed PC-Trac Ball...\$78
 Vertical CPU stand...\$18
 Keyboard drawer...\$58
 Monitor Tilt-n-Swivel...\$18

4901 W. Rosecrans Ave. Box 5046
 Hawthorne, California 90251-5046



California

Torrance, Costa Mesa, Woodland Hills
 Kearny Mesa, Sunnyvale

Texas

Addison, Houston

Georgia Arizona
 Smyrna Phoenix

Not all items in stock at
 our nine retail locations.

JADE COMPUTER

Place orders and use our technical support toll free!

Continental U.S.A. 1-800-421-5500 Inside California 1-800-262-1710

Fax machine 1-213-675-2522/All others 1-213-973-7707



We accept checks, credit card or purchase
 orders from qualified firms and institutions.
 No surcharge on credit card orders. CA., TX,
 GA. & AZ. residents add sales tax. Prices and

availability subject to change without notice.
 Shipping and handling charges via UPS
 ground 50¢/lb. UPS air \$1.00/lb. Minimum
 charge \$4.00.

**NEW
LOW
PRICES**



Specials of the Month
IBM AT Memory Expansion Bd
 512K RAM ... \$129
Toshiba 1100+ Portable Expansion
 384K Memory Bd ... \$219

ESTABLISHED 1976

MEMORY EXPANSION BOARDS

**SIMM/SIPP
MODULES**

1 MG X 9 - for IBM TYPES
 1 MG X 9-120 NS .. \$199
 1 MG X 9-100 NS .. \$199
 1 MG X 9-80NS .. \$249
 1MG X9-70NS .. \$319

256 X 9 - for IBM TYPES
 256 X 9-120NS .. \$59
 256 X 9-100NS .. \$79
 256 X 9-80NS .. \$99
 256 X 9-60NS .. \$119

APPLE SIMM MODULES

1 MG X 8 - for APPLE
 1 MG X 8-120NS .. \$179
 1 MG X 8-100NS .. \$199

256 X 8 - for APPLE

256 X 8-120NS .. \$59
 256 X 8-100NS .. \$69

PS-2 SIMM'S

256 X 9 (FOR PS2)
 256 X 9-120NS .. \$99
 256 X 9-100NS .. \$109

MODEL 30-286

1 mg x 9-100 .. \$279

PS-2 MODEL 70&80 SIMM

1 MG X 9-100NS .. \$289
 1 MG X 9-80NS .. \$349
 2 MG X 9-80NS .. \$679

Daughter Bd Mod 70-80

1 mg (6450375) ... \$525
 2 mg (6450379) ... \$999



D - RAM

1 MG X 1
 1 MG X 1-120 NS \$15.00
 1 MG X 1-100 NS \$16.50
 1 MG X 1-80NS .. \$21.00

256 X 1
 256 X 1-150 NS .. \$5.50
 256 X 1-120 NS .. \$6.00
 256 X 1-100NS .. \$6.50
 256 X1-80NS .. \$7.50
 256 X 1-60NS .. \$9.00

256 X 4
 256 X 4-120 NS .. \$18.00
 256 X 4-100 NS .. \$19.00
 256 X 4-80NS .. \$23.50

64 X 1
 4164-150NS .. \$1.75
 4164-120NS .. \$2.35
 4164-100NS .. \$2.55

64 X 4
 4464-150 NS .. \$7.00
 4464-120 NS .. \$8.50
 4464-100NS .. \$9.50
 4464-80NS .. \$11.00

256 X 4 3C
 514258-10 .. \$25

256 X 1 3C
 51258-10 .. \$7.50
 51258-80 .. \$9.00
 51258-70 .. \$9.50

Compaq 386 Memory

1 mg-expansion ... \$399
 4 mg .. \$1399

**We accept
American Express**

MATH CO-PRO

8087-3(5MHZ) \$88
 8087-2(8MHZ) \$120
 8087-1 \$170
 80287-6 \$130
 80287-8 \$195
 80287-10 \$218
 80C287-12 \$299
 80387-16 \$320
 80387-20 \$380
 80387-25 \$475

CPU CHIPS

8088 \$5.00
 80386-16 \$189
 80386-20 \$289
 80386-25 \$439
 V-20 (8MHZ) \$7.50

**VIDEO RAM
FOR VGA CARDS**

64 x 4(150NS) \$10
 64 X 4(120ns) \$12
 64 X 4(100ns) \$18

RAM TESTER

only \$169
 Teste the following
 memory chips:
 64K X 1 256 X 1
 64K X 4 256 X 4
 4M X 1 1M X 4
 The RTI can help any-
 one come through the
 frustrating process of
 identifying bad (or good)
 D-RAMchips. The weight
 and durability of the
 tester, make portability a
 breeze, whether it be on
 site, in the lab or in your
 tool kit. Don't be caught
 without one!!

AST

Advantage 2 - Expands to 3MB with 512 K \$479
 has SER/PAR Software
 Uses 256K RAMS
Advantage 2-386 for PS2 Model 70/80 \$819
 Expands to 8 MG
 has SER/PAR
 Uses 256 or 1MG SIMMS
Rampage 286-For AT \$319
 Expands to 2 MG with 512 K
 Uses 256 RAMS
Rampage Plus 286-For AT \$589
 Expands to 8 MG with 512 K
6 PAK Plus-For PC/XT \$118
 Expands to 257K (with 64 K)
 Has PAR/SER/CLK Software \$248
 Uses 64K or 256K RAMS

BOCA RESEARCH

For PS2
Bocaram 38- with 8K RAM \$129
 Expands to 2MG
 Uses 1MG X 1 D-RAMS
Bocaram 50/60 with 8K RAM \$179
 Expands to 4 MG with Software
 Uses 1 MG X 1 D-RAMS
Bocaram MCA 50Z with 8K RAM \$189
 Expands to 2 MG
 Uses 1 MG X 1 D-RAMS
BOCA MCA Parallel Card \$99
BOCA MCA Serial/PAR \$189

EVEREX

Mini-Wagle - #EV138 - 576K Memory Card \$59
 for PC & AT with 0K
 Uses 64K & 256K D-RAM
RAMII 4000 - #EV-136 - 4MB EMS \$249
 Extended Memory card with 0 K
 Uses 1 MGD-RAMS

IBM

1497250 - For PS-2 MOD 50/60 \$499
 with 0K Expands to 8MB
 Uses 256K SIMMS (IBM only)
6450605 - For PS-2MOD 70/80 \$1329
 with 2 MG Expands to 8 MB
 Uses 2MG SIMMS (IBM only)
6450203 - For AT - Has 512K RAM \$129

IDEA ASSOCIATES

IDEA max 80 - for PS2 MOD 70/80 Call
 Expands to 8MB
 Uses 256K or 1MG SIMMS
IDEAsupermax/MC - for PS2 MOD 50/60 Call
 Expands to 8MB/2 Extended memory/2SER/EMS
 Uses 256 or 1MG SIMMS
IDEAmax/MC - for PS2 MOD 50/60 & 80 Call
 Expands to 12MB Extended
 memory with software
 Uses 1MG SIMMS

UNITEX

3MG Multifunction - for AT \$149
 Expands to 3MG - has SER/PAR PORT
 Uses 1MG D-RAMS
384 Multi-function Card for PC/XT \$99
 Expands to 384K
 has SER/PAR/CLK/Game port
 Uses 64K or 256K D-RAMS
PS-2 MEM for PS2-MOD 70/80 \$99
 Expands to 8 MB
 Uses 256 or 1MG SIMMS

VIDEO ADAPTER

ATI
EGA Wonder 800 \$249
 Supports EGA, MDA, CGA & Hercules
VIP VGA - 800 X 560 - \$275
 Supports VGA, CGA, MDA & Hercules
VIDEO 7
Fastwrite VGA \$349
 256 D-RAM, 800 X 600, 640 X 480
 Supports VGA/EGA/MDA/CGA & Hercules
V-RAM VGA \$519
 256 K V-RAM, 1024 X 768, 800 X 600
VEGA Deluxe \$239
 640 X 480 Multi-sync
VEGA Pro \$319
 800 X 600 Multi-Sync

ORCHID
Designer 800 VGA \$299
 800 X 600 - 16 Colors
Prodesigner \$339
 Supports 1024 X 768 - 16 Colors
Pro Designer Plus \$449
 Same as Prodesigner
 Has downloadable fonts
UNITEX
Monochrome Graphics Card \$46
 with par port - MDA/CGA/Hercules
Colorgraphics Card \$46
 RGB Color with Par Port - EGA/MDA/CGA/Hercules
EGA Card \$268
 640 X 480, 16 Colors, EGA/MDA/CGA/Hercules
VGA Card \$268
 800 X 800, 16 Colors - VGA/EGA/MDA/CGA/Hercules

TERMS AND CONDITIONS

No Surcharge for MC/VISA Terms: MC • VISA • COD • CASH • AMEX add 4%
 Purchase Orders from qualified firms 20% restocking fee on non-defective returns
 Prices Subject To Change

2852 F Walnut - Tustin, CA 92680

Phone: 714/730-5232 • FAX#: 714/838-8593

Customer Service #: 714/730-9527

TOLL FREE OUTSIDE CA: 1/800/533-0055



Circle 291 on Reader Service Card



Presto!
A Link to Mainframe Graphics

Find out how our whole family of EMU-TEK graphics terminal emulation software makes good sense for the work you do. Call today for more information.

FTG DATA SYSTEMS

(714) 995-3900
(800) 962-3900 (800) 972-3900 (Calif.)
10801 Dale St., Suite M-2
Stanton, CA 90680

Circle 113 on Reader Service Card

9-Track Tape For Your IBM PC/XT/AT/PS-2™

Read 1600 bpi 9-track tapes from a micro, mini or mainframe in EBCDIC or ASCII as mirror image or by individual files.

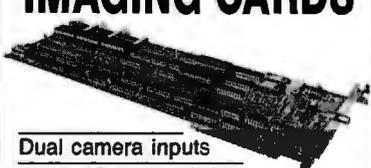
Use the 2000 PC™ for disk backup, data interchange or archival storage.

PC/XT/AT/PS-2 are trademarks of IBM. 2000 PC is a trademark of Digi-Data.

DIGI-DATA CORPORATION
8580 Dorsey Run Road
Jessup, MD 20794-9990
(301) 498-0200
Telex 87-580
... First In Value

Circle 90 on Reader Service Card

IMAGING CARDS



Dual camera inputs
Composite video in/out
256 x 240 resolution
Digitize/display at frame speed
16 Meg. color palette out (DV-02)
External trigger input option
PC/XT/AT compatible
Complete with software & library
DV-02 8-bit 256 gray levels. \$849
DV-03 6-bit 64 gray levels. \$549
VISA/MC Demo disk available

Control Vision
PO Box 596 Pittsburg KS 66762
800/292-1160 316/231-6647

Circle 73 on Reader Service Card

DYNAMIC RAMS

SIMM 80/100	\$CALL
1MBIT 100ns	\$16.00
514256 100ns	\$17.50
41464 150ns	\$ 6.25
41256 120ns	\$ 5.50
41256 150ns	\$ 4.95
51258 100ns	\$ 7.00
4164 150ns	\$ 2.65

* For high-speed, Zip, Picc, Simm Please Call!

PROCESSORS	EPROMS
80387-25 25MHz \$475.00	27C101 250ns \$ 23.00
80387-20 20MHz \$385.00	27C512 200ns \$13.00
80387-16 16MHz \$335.00	27S12 250ns \$ 8.50
80287-12 12MHz \$285.00	27C256 250ns \$ 5.25
80287-10 10MHz \$235.00	27256 250ns \$ 4.75
80287-8 8MHz \$208.00	27128A 250ns \$ 4.50
8087-1 10MHz \$178.00	27C64A 200ns \$ 4.25
8087-2 6MHz \$135.00	2764 250ns \$ 3.50
V-30 8MHz \$ 12.75	S. RAMS
V-20 8/10MHz \$ 8.5/15	43256 100ns \$ CALL
	4364 150ns \$ 8.95

I.C. EXPRESS

15358 Valley Blvd. City of Industry, CA 91746 Tel: 818-369-2688
ORDER TOLL FREE (Mon-Fri 9-5 PST)
(800) 892-8889 • (800) 882-8181
Outside California
CALL FOR CURRENT PRICES & VOLUME DISCOUNTS
Price Shown for Cash. MasterCard/VISA add 3%. Prices are subject to change.
Minimum order \$10.00. Shipping & Handling: UPS Ground \$5.00, Air \$7.00 (1 lb.)
ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

Circle 133 on Reader Service Card

PAL/EPROM PROGRAMMER for PC

VERSION 2 of Software and Hardware \$475

- Programs 20 and 24 pin MM, NS, TL, Altera, Cypress, Ricoh/ Pentec PALs, EPLD (UV erasable), polarity, and RA types.
- Functions Include: read, write, verify, protect, edit, print, and file load and save of program.
- JEDEC files supported.
- 2716-27512 EPROMs.
- Functions include: read, write, verify, blank check, H/LD split, edit in ASCII, HEX, or Decimal.
- INTEL Hex and Motorola 'S' Record file support.



200/100 MHz LOGIC ANALYZER for PC

LA27100	\$1299
LA27200	\$1899

- 24 Channel mode with 4K/channel • 6 Channel mode with 16K/channel
- Internal Rates from 200MHz(LA27200) or 100MHz(LA27100) to 250 Hz
- External Clock from DC to 50 MHz • 16 Level Triggering Sequence
- Threshold Voltage Level at TTL, ECL, or -5V to +14V variable • Data Display as Timing Diagram or State List • Seven-Load Data and Setup Info.

(201) 994-6669
Link Computer Graphics, Inc.
4 Sparrow Dr., Livingston, NJ 07039

Circle 159 on Reader Service Card

Cross-32 Meta Assembler

Table based macro cross-assembler using the manufacturer's assembly mnemonics.

Includes manual and MS-DOS assembler disk with tables for all of the following processors:

1802	64180	65C02	65816
6801	6805	6809	68HC11
680X0	80X86	COP400	COP800
8048	8051	8085	8096
TMS320	TMS370	Z8/Z80	...MORE

Users can create tables for other processors!

Generates listing, symbol table, and binary, Intel, or Motorola hexcode.

Free worldwide airmail shipping & handling.

Check, MO, VISA or MC: US\$199 or CNS249

Universal Cross-Assemblers
POB 384, Bedford, NS
Canada B4A 2X3
(902) 864-1873

Circle 292 on Reader Service Card

3M

Authorized Distributor - Magnetic Media Division

5 1/4" DD	5 1/4" HD
6²⁵ PER BOX	11³⁰ PER BOX
3 1/2" DS	3 1/2" HD
11⁹⁵ PER BOX	28⁹⁵ PER BOX

IBM

DISKETTES

5.25 DS	6023450	— 14.60
5.25 HD	6109660	— 32.50
3.50 DS	6404107	— 23.95
3.50 HD	6404078	— 45.95
2 D-1024	1669045	— 33.95

RIBBONS

PROPRINTER	(6328829)	— 5.60
PROPRINTER XL	(1040150)	— 7.99
PROPRINTER X24	(1040475)	— 8.10
PROPRINTER XL24	(1040414)	— 11.90
PROPRINTER II	(6328829)	— 5.60
MONO PRINTER	(1040440)	— 12.95
QUIETWRITER	(1299790)	— 9.45
QUIETWRITER III	(1299933)	— 13.95
DISPLAYWRITER	(1299463)	— 8.95

Dysan

3.5 DS	5 1/4" DS	3.5 HD
12⁷⁵ PER BOX	6⁸⁰ PER BOX	29⁹⁵ PER BOX
	5 1/4" HD	
	10⁹⁵ PER BOX	

the **Diskette Connection™**

- Delaware 1-800-451-1849
RQ BOX 10247, WILMINGTON, DE. 19850
- Oklahoma 1-800-654-4058
P.O. BOX 1674, BETHANY, OK. 73008
- Nevada 1-800-621-6221
P.O. BOX 12396, LAS VEGAS, NV. 89112

Minimum order \$2000. No Surcharge on Visa MasterCard. COD orders add \$300. Surface Shipping UPS add \$4.00 per 100 for 3 1/2" or 5 1/4". add \$4.00 per 100 for 8". U.S. Mail delivery add 9%. Prices subject to change without Notice.

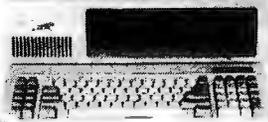
FAX (405) 495-4598

CAT™ 10MHZ

BASE SYSTEM

- 256K (Opt. 640K) • 150 Watt Power Supply • AT Style Keyboard & Case
- 4.77 or 8 MHz Keyboard Selectable • FDC
- 8087 Socket • 360K Floppy Drive • 1 Year Warranty

\$36900



CAT 386 SYSTEM

- 12" Amber Monitor with Graphics Interface Card
- 1.2 Meg Floppy Drive (expandable to 8 Meg)
- 1 Meg of Memory
- Parallel, Serial & Clock
- 70 Meg Hard Drive

20MHz **\$229700**

CAT™ 286-10MHZ

BASE SYSTEM

- 512K Exp. to 1 MEG • 200 Watt Power Supply • AT Style Keyboard
- Western Digital Controller • 1.2 Meg Floppy • Legal Bios w/manuals • Systems Documentation • 1 yr war. • Clock/Calc
- 10MHz DTK Motherboard

\$74900



11.3 MORTONS SL

8088 XT Compatible

640 K Upgrade	139 ⁰⁰	Clock Calendar	24 ⁰⁰
12" Amber Monitor w/Interface	139 ⁰⁰	Parallel & Serial Ports	39 ⁰⁰
DOS 4.01 w/GW BASIC	89 ⁰⁰	Additional Drives	See Below

SYSTEM OPTIONS

640 K Upgrade	49 ⁰⁰	14" EGA Monitor w/Interface	549 ⁰⁰
1 Meg Upgrade	159 ⁰⁰	Novell Network, Call 12 Mhz add	100 ⁰⁰
12" Amber Monitor w/Interface	139 ⁰⁰	14" Color Monitor w/Interface	289 ⁰⁰

WE WILL NOT BE UNDERSOLD

SEAGATE EVEREX INTEL WESTERN DIGITAL SAMSUNG ALL RAM UPGRADES

WE WILL BEAT ALL COMPETITORS QUOTES CALL (800) 654-7762

intel COPROCESSORS

If Your PC Uses the Intel	Running at..	Then You Need Intel	MEADS Price
8088	5MHz or less	8087	97 ⁰⁰
8088 or 8088	8MHz or less	8087-2	139 ⁰⁰
8086	10MHz or less	8087-1	199 ⁰⁰
80286	6-8MHz	80287	149 ⁰⁰
80286	8-10MHz	80287-8	229 ⁰⁰
80286	10MHz or more	80287-10	259 ⁰⁰
80386	16MHz	80387-16	379 ⁰⁰
80386	20MHz	80387-20	439 ⁰⁰
80386	25MHz	80387-25	549 ⁰⁰
386SX	16MHz	80387-SX	399 ⁰⁰

RAM UPGRADES

1 YEAR WARRANTY	64K	1 Meg.	WE BUY EXCESS RAMS PLEASE CALL OR FAX LIST
4464	100 NS, 64x4	1Meg x 1 120 NS	179 ⁰⁰
4464	120 NS, 64x4	1Meg x 1 100 NS	189 ⁰⁰
4464	150 NS, 64x4	1Meg x 1 80 NS	199 ⁰⁰
4184	150 NS, 64x1	64 x 9 150 NS	299 ⁰⁰
4184	120 NS, 64x1	256 x 8 150 NS	499 ⁰⁰
4184	100 NS, 64x1	256 x 9 80 NS	899 ⁰⁰
		256 x 9 100 NS	799 ⁰⁰
		256 x 9 120 NS	699 ⁰⁰
		1Meg x 9 120 NS	199 ⁰⁰
		1Meg x 9 100 NS	209 ⁰⁰
		1Meg x 9 80 NS	249 ⁰⁰
		1Meg x 8 120 NS	149 ⁰⁰

Seagate HARD DRIVES

ST125 20Meg 40 Mil 1/2 Ht 3 1/2" Drive only	279 ⁰⁰
ST138 30Meg 40 Mil 1/2 Ht 3 1/2" Drive only	339 ⁰⁰
ST225 20Meg w/cont. & Cables	269 ⁰⁰
ST238 30Meg w/cont. & Cables	289 ⁰⁰
ST251 40Meg 1/2 Ht 40 Mil w/software, Drive only	379 ⁰⁰
ST251-1 40Meg, 28 Mil Sec, Drive only	439 ⁰⁰
ST277R 60MB 40 Mil 1/2 Ht	469 ⁰⁰
ST4026 20Meg Full Ht 40 Mil	299 ⁰⁰
ST4038 30Meg 40 Mil Full Ht	399 ⁰⁰
ST4053 40MB 28 Mil Full Ht	519 ⁰⁰
ST4096 80Meg Full Ht w/software	639 ⁰⁰

MODEMS BY EVEREX

EV-923 EverCom 12 300/1200 bps Bitcom Software	69 ⁰⁰
EV-941 EverCom 24 2400 Baud Int. Bitcom Software	139 ⁰⁰
EV-945 External 2400 Baud	199 ⁰⁰
EV-942 2400 PS2	229 ⁰⁰
EX-955 FAX Card	349 ⁰⁰

COMPUTER PERIPHERALS — 5 YEAR WARRANTY

1200 Baud Internal w/Software	54 ⁰⁰
1200 Baud External Fully Hayes Compatible, Everex	99 ⁰⁰
2400 Baud Internal 1/2 card w/software	99 ⁰⁰
2400 Baud External Fully Hayes Compatible, Zoom	129 ⁰⁰

Imtec/SAMSUNG MONITORS

1256A 12" Amber w/Tilt & Swivel Base	99 ⁰⁰
1257 12" Amber Flat Screen 720 x 350	99 ⁰⁰
1464 14" Color 640 x 200, 16 colors	239 ⁰⁰
1453 14" EGA 640 x 350, 84 colors/31	369 ⁰⁰
1455N EGA 720x480 Multisync Compatible	449 ⁰⁰

EVEREX TAPE BACKUPS

40MB Mini Cartridge, 1.8MB/min, XT (DC 2000)	339 ⁰⁰
40MB Mini Cartridge, 3.6MB/min, AT (DC 2000)	339 ⁰⁰
40MB PS2 Model 50-60-70-80 (DC 2000)	419 ⁰⁰
60MB Streaming Cassette, 5MB/min w/cont (CT600)	649 ⁰⁰
60MB Streaming 600A, 5MB/min w/Full cont (DC600)	649 ⁰⁰
125MB Streaming Cartridge, 5MB/min w/Full cont.	1119 ⁰⁰
Excell 60 Model 60/80 (PS2)	999 ⁰⁰
Excell 125 Model 60/80 (PS2)	1269 ⁰⁰
DC2000 24"	External Add 195 ⁰⁰
	DC600 24"

WESTERN DIGITAL CONTROLLERS

WX-1 8 Bit 1/2 Sized for XT	79 ⁰⁰
WA-2 16 Bit Full Sized Hard/Floppy	119 ⁰⁰
WD-27X 8 Bit RLL 1/2 Size	89 ⁰⁰
WAH 16 Bit Hard Drive Controller	129 ⁰⁰
RAZ 16 Bit RLL Hard/Floppy for AT	159 ⁰⁰
MEAD Floppy Disk Controller for XT, controls 4 drives	299 ⁰⁰
MEAD 1.2 Meg & 360K Controller for XT	69 ⁰⁰
Cable Set for Hard Drive Only	59 ⁰⁰

Mitsumi FLOPPY DRIVES

360K 1/2 Ht. PC Compatible — Mitsumi	69 ⁰⁰
1.2 Meg Black Face — Mitsumi	89 ⁰⁰
720K 3 1/2" Drive w/5 1/4" mounting — Mitsumi	89 ⁰⁰
1.44 Meg 3 1/2" Drive w/5 1/4" mounting — Mitsumi	109 ⁰⁰
360K Tandon TM100-2 Full Ht (The Original IBM)	89 ⁰⁰
160K Tandon TM100-1 Full Ht	59 ⁰⁰
External Case w/Power Supply 2, 1/2 HTs or 1 Full	149 ⁰⁰

★ SPECIALS ★ SPECIALS ★ SPECIALS ★ SPECIALS ★ SPECIALS

MINISCRIBE HARD DRIVE 3130E, 112Meg, 17ms, 1/2 HT, Auto parking, cables, rails, Software ... List 1995 Mead 949⁰⁰
w/Controller add \$100
EVEREX EV659 EGA Auto Switch 640 x 350 ... 199⁰⁰
EVEREX Viewpoint 16 Bit VGA 256K exp. 512K ... 279⁰⁰

EVEREX TAPE BACKUP
40Meg for XT, Mini Cartridge 870A ... 279⁰⁰
COMPUTER PERIPHERALS MODEM
2400 Baud Internal, Hayes Compat, auto answer, auto dial, 5 Year Warranty PC-XT-AT Compatible ... 98⁰⁰

EVEREX MEMORY BOARDS
Base / Extended / Expanded 4.0 LIM Compatible
286 AT 0-3 Meg ... 149⁰⁰ 286 AT 0-10 Meg ... 199⁰⁰
Expanded / Extended EMS 4.0 com. uses 1 Meg 120NS chips
PS2 50/60 0-2 Meg ... 269⁰⁰ PS2 50/60 0-4 Meg ... 299⁰⁰

Liquidation Below Dealer Cost — New With Warranties

LETTER QUALITY PRINTER

DAISYWHEEL PRINTER MANUFACTURED BY C.I.TOH

Why pay \$1149 for a C.Itoh

STARWRITER™ F-10

When our 40 cps letter quality daisywheel printer from the same manufacturer is only

\$39900 ea.

REPEAT OF A SELLOUT



OPTIONS

- 6 ft. Serial Cable ... \$ 190⁰⁰
- Bidirectional Tractor ... 149⁰⁰
- Cut Sheet Feeder ... 199⁰⁰
- Serial to Parallel Converter ... 99⁰⁰

STANDARD FEATURES

- 40 CPS • Accepts Paper to 15 inches • Form Length and Pitch Set from Control Panel
- Industry compatible ribbon, printwheels and control commands • RS232 Serial Interface

MICROSOFT MOUSE



- In Port with Bus Interface
- Fully IBM Compatible (of course)
- Includes Showpartners and Paint Brush

List \$199 Mead **\$7900** 10 for \$740

KRAFT MONITOR



- FREE TILT SWIVEL BASE
- 14" Flat Screen • Paper White Phosphorus
- TTL Monochrome & Composite Interface

List \$199 Mead **\$9900** 10 for \$950

STATIC BUSTER

Attached to CRT face and keyboard, Static Buster works just like a sponge, dissipating static at a rated 20,000 volts in less than two seconds.



List 49⁰⁰ Mead 19⁰⁰ 10 for \$160

AT STYLE / XT CASE



- 2 Bay Standard AT Style Case
- Keypad Power and Hard Drive LED's

List 99⁰⁰ Mead 29⁰⁰ 10 for \$240

WESTERN DIGITAL

WD1003/RAH — RLL HDC For AT 16 Bit, Full Size RLL
List 199⁰⁰ Mead 99⁰⁰

WD1005-WAH — 16 Bit ESDI Controller for AT 2 to 1 Interleave
List 269⁰⁰ Mead 99⁰⁰

PARADISE

Auto Switch Monochrome EGA Card, 640x350 EGA, MDA, CCA, Herc. List 319⁰⁰ Mead 129⁰⁰

CLOSEOUTS QTY. LIMITED

CS 500 Cassettes	14 ⁰⁰
Epson Universal Printer Stand	9 ⁰⁰
Irwin Tape Backup	20Meg 199 ⁰⁰
Floppy Disk Controller 2 Drives	199 ⁰⁰
10Meg w/controller & cables	179 ⁰⁰
Real IBM AT Vertical Enclosure	49 ⁰⁰

800-654-7762

SALES: 7 a.m.—6 p.m. PST

702-294-0204

CUSTOMER SERVICE / ORDER STATUS:

9 a.m.—4 p.m. PST

FAX 702-294-1168

WE ALSO PURCHASE EXCESS INVENTORY—FAX LIST

*Best Quote applies to competitors advertised price with same terms, in this magazine.



- Quantity Pricing Available — CALL
- We Accept International Orders
- Purchase Orders from Universities, Government Institutions, Fortune 1000 and Qualified Firms.

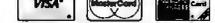
NO SURCHARGE FOR MC/VISA

TERMS: MC • VISA • COD • CASH

Purchase Orders from Qualified Firms

Personal Checks • AE add 4%

20% Restocking Fee on Non-Defective Returns within 15 days



SHIPPING: (min. 69⁰⁰) UPS

Super 386/25MHz \$3350

- Landmark 433, 6.2 MIPS
- High speed 0 wait 64K cache
- Genuine 32 bit Intel 386-25 CPU
- IBM ram expandable to 8MB on board plus 8MB 32-bit expansion (8MB)
- Fast 62MB Drive, 1.2 MB FDD
- Ultra High Speed Graphics contr.
- High Res. Amber Monitor
- '91 TactileClick KB
- High Speed Serial & Parallel port
- 1-32, 6-16 and 1-8 bit slots
- 60387 support USA MADE Vertical case also available

286	Full Line of Screen Products	
800	8 MHz 520K 1.2M (Large)	\$300
1700A	10MHz 510K 1.2M (Small)	\$850
1700C	10MHz 1M, 1.2M (Small)	\$1195
286		
3000A	10MHz, 1M, 1.2M (Large)	\$1895
3000D	20MHz, 1M, 1.2M (Large)	\$1995

MYLEX standard

286	386/25	4MB	63995	286 All Body Min	
	25MHz	1MB	62299	10MHz/2	\$389
	20MHz	1MB	61499	10MHz/1	\$359
	10MHz	1MB	61599	10MHz/1	\$399

Schwab Computer Center
"The Everest Store" - Authorized Everest Corp. VAR
3382 El Camino Real, Santa Clara, CA 95051
408-241-1920 Fax # 408-241-1919
M-F 9:30-7:00 11-4 VISAM/CAE
Daily UPS Please change without notice

Circle 252 on Reader Service Card

Dynamic Electronics

SIMMS

CALL FOR PRICES

INTEL	DRAMS	SIMMS
8087	64K	256 X 8
80287	256K	X9
80387	4464	1 Meg X 8
80387SX	1 Meg	1 Meg X 9
80C287A		

Phone 714-855-0411
Fax: 714-855-8504
23522 COMMERCE CENTER DR. #L
LAGUNA HILLS, CA 92653, USA

Circle 106 on Reader Service Card

TWIX COMPUTERIZED CASH REGISTERS



THE TWIX 3000 SERIES OF REGISTERS PROVIDE THE FLEXIBILITY OF A COMPUTER OR TERMINAL WITH THE LOOK AND FEEL OF A CASH REGISTER.

- 3010 "REGISTER HEAD" - REPLACES THE KEYBOARD, MONITOR, AND PRINTER OF ANY IBM XT/AT COMPATIBLE COMPUTER.
- 3040 "REGISTER TERMINAL" - TV 950 EMULATION PLUS DRAWER, MONITOR AND SCANNER CONTROL.
- 3070 "REGISTER COMPUTER" - STANDALONE IBM COMPATIBLE WITH 20 OR 40 MB HARD DISK DRIVES.

ALL MODELS AVAILABLE WITH A VARIETY OF RECEIPT PRINTERS, KEYBOARDS, MONITORS, CASH DRAWERS, BAR CODE SCANNERS AND MAG STRIPE

TWIX INTERNATIONAL CORP.
4401 S. BROADWAY, ENGLEWOOD, CO 80110
(303) 789-5333

Circle 288 on Reader Service Card

Terminal Emulation

TEK 4105/4010

- Tektronix 4105
- Tektronix 4010/4014
- VT220, VT102
- Picture files
- VGA and EGA support
- High resolution hardcopy

VT220

- VT220, VT102 emulation
- File transfer
- 132 column modes
- Color support
- Hot key

Diversified Computer Systems, Inc.
3775 Iris Avenue, Suite 1B
Boulder, CO 80301 (303) 447-9251
FAX 303-447-1406

Trademarks: VT102, VT220 - DEC, Tektronix - Tektronics Inc.

Circle 102 on Reader Service Card

PC MAGAZINE EDITOR'S CHOICE

MULTI-LINE POWER LINE VOICE MAIL

- ♦ Voice Mail System
- ♦ Call Processing
- ♦ Telemarketing
- ♦ Order Processing
- ♦ Call Distribution
- ♦ Programmers Tool Kit

Complete Systems
BIG MOUTH \$295
Starting at PLUS 6 SH
(415) 652-9600

TALKING TECHNOLOGY, INC. TTI
4383 PIEDMONT AVE., OAKLAND, CA 94611

Circle 275 on Reader Service Card

LOW-LOW-LOW

hp Laserjet Printer Series II \$1650

hp Scanjet Scanner + interface kit \$1355

IBM COMPAG APPLE ACER EVEREX AST & other

XT/AT Compatibles & 386 Computers
CALL for LOW PRICES

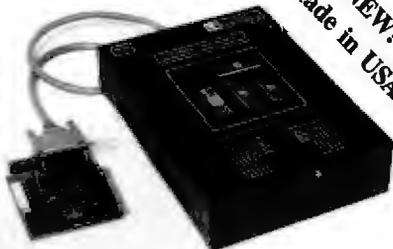
Gov't, Corporate, Schools, Dealers, & Export INQUIRIES WELCOME.

SURAK inc.

44862 Osgood Road, FREMONT, CA 94539
PH: (415) 651-5101 FAX: (415) 651-5241
1-800-543-1001
VISA, Master Card accepted. w/sc

Circle 270 on Reader Service Card

NEW! Made in USA!



PC BASED UNIVERSAL DEVICE PROGRAMMER \$595-895

- Programs EE/PROMs, PALs, GALs, IFLs, EPLDs, MICROS, BIPOLARS.
- Software driven pin drivers. D/A generated programming voltages.
- Upgradable for virtually any future programmable devices up to 40 pins.
- Self-sustistent operation. No additional modules or plug-in adapters required.
- Includes user friendly MEMORY BUFFER FULL SCREEN EDITOR.
- Friendly Menu-Driven Interface. Device selection by P/N and manufacturer.
- Supports 8/16/32 bit word, Intelligent I & II, Quick Pulse programming.
- Functional testing Register-Preload, FUSEMAP EDITOR for logic devices.
- File formats accepted: Intel Hex, 86/88, Tetronix Hex, Motorola S, JEDEC.
- Customer support via voice line, dedicated BBS or fax. Full 1 year warranty.
- Base price includes Interface card, cable, Memory device library and 1 year free updates. Additional Device Libraries (Logic, Micros, Bipolars) \$95 ea.
- Libraries updates available every 6 mo. and can be received via floppy or BBS.

PC BASED 8-SOCKET GANG PROGRAMMER \$595

- Handles all memory devices to 32 pins. (Upgradeable up to 8 megabit parts).
- FULL SCREEN BUFFER EDITOR plus all applicable features from above.
- Customer support via voice line, dedicated BBS or fax. Full 1 year warranty.
- Includes PC Interface card, Memory device library and 1 year free updates.

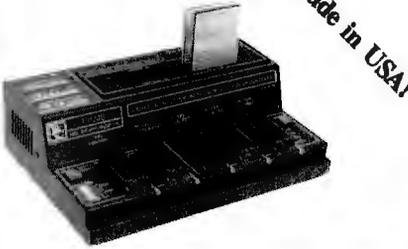
Made in USA!



UNIVERSAL RS-232 PROGRAMMER \$345-595

- Programs EE/Proms, FlashEproms, ZPRams, Intel Micros, Memory Cards.
- Stand-Alone Mode for EE/EProm and Memory Card Duplication / Verify.
- All 24/28/32 pin EE/EProms to 4 MBits (upgradeable to 32 megabits).
- Micros:8741/A, -2/A, -4, -8, -9, -51, -C51, -C51FA/B, -52, -55, -55, -C521, -C541, 9761.
- Memory Cards:Seiko/Epson,Fujitsu,Mitsubishi (Integrated Adapter Included)
- Modular design;Firmware easily upgradeable; 4 socket Gang module available
- On-Board Programming capability; Custom Interface modules available.
- User-Friendly Menu-Driven Interface Program for IBM-PC and Macintosh.
- Can be operated with any computer containing an RS-232 serial port.
- Optional built-in Eraser/Timer module (\$50);Top cover conductive foam pad.
- OEM open board programmer configurations available (from \$245).
- Customer support via voice line, dedicated BBS or fax; Full 1 year warranty.

Made in USA!



INTELLIGENT PC ROM EMULATOR \$395

- Emulates 2716 through 27512 EPROMs (2k to 64k bytes) with a single unit.
- Connects to the standard parallel printer port. Uses standard printer cable.
- Intelligent features include: Reset Output, Address Compare, Address Snapshot, Trigger Input. Memory buffer editing capability. Selectable word sizes.
- User friendly software. Command set includes: Load, Write, Display, Run, Type, Edit, Fill, Run-Command-File, Monitor, Port, Reset, Help, Calculator.
- FAST data loading via parallel printer port (65k bytes in less than 10 seconds).
- Caseable up to 8 units.Includes interface cable with Trigger and Reset clips.
- CMOS version with standard 9V battery backup available (\$495). After downloading the program from the host computer, the CMOS emulator version can be disconnected and used in stand-alone mode for firmware testing.
- File formats accepted: Binary, Intel Hex, Motorola S.

MC / VISA / AMEX Call today for datasheets!

B&C MICROSYSTEMS INC.
355 WEST OLIVE AVE., SUNNYVALE, CA 94086
TEL: (408) 736-5511 FAX: (408) 730-5521

3 1/2 INCH 1.4 MB DISKS FOR ONLY ONE DOLLAR!

New Invention Makes It Possible!

Do you use the new, high capacity, 3 1/2 inch disks? If so, you have paid four, five, even six dollars per disk! Byte for byte, that is as much as SIX TIMES the 'old' 360K floppies. Now you can convert all your programs, data, and files to the new format, WITHOUT PAYING THESE PRICES!

HOW IS THIS POSSIBLE? Have you ever tried to format a regular, 'low density' 3 1/2 inch disk to 1.44 MB? Of course you have! It doesn't work! The computer gives an invalid media error. Our company was putting in a large network of IBM Clones. We have grown from a small company to a million-dollar corporation in two short years, and we didn't do it by wasting money. So, of course, we tried to use the cheap, 720K disks. Total failure.

ENTER OUR CRACKPOT ENGINEER. Our Crackpot Engineer wondered what was the difference between the disks. He tore them apart, analyzed the media. He found NO DIFFERENCE WHATSOEVER! Yet, they would not format. Why? Then he started examining the plastic housing. And he found the difference. It is NOT in the media, IT IS IN THE PLASTIC CASE!

TOTAL FAILURE! Our Crackpot Engineer (among other things, he invented the Electronic Flea Collar) sent a brand-new 720K disk to our machine shop, and asked them to modify it. They did... and the DISK IMMEDIATELY FORMATTED! But, within 10 minutes of use, it totally failed. It lost data all over the place. Back to the drawing board. The disk was dis-assembled and examined. It was found that, in performing the conversion, a microscopic piece of plastic had entered the housing, and totally ruined the disk. It was obvious that, if the conversion could be done reliably, it required extreme precision.

ENTER OUR OTHER CRACKPOT ENGINEER. Our president is a mechanical engineer. One of the best in the country. While a research scientist at Colorado School of Mines, he completely revolutionized the field of water jet drilling. He tackled the problem. Finally he came up with a solution - a precision tool which could perform the modification EVERY TIME and leave no plastic particles which would damage the disk!

MONTHS OF TESTING. We then commenced on a testing program. We modified and formatted thousands of disks, and tested them for data integrity. Out of one thousand disks, one would not format, two had one bad track. NOT ONE LOST ANY DATA! We then put a disk on a computer with a bat file which copied data to a disk, read and checked every byte, then copied the data back to the disk. The program ran 24 hours a day, for TWO SOLID WEEKS without even one error! We were finally convinced that the procedure was reliable enough for a product.

OUR OFFER. Here is our irresistible offer. Purchase our DoubleDisk Converter for the price of \$39.95. If you are not COMPLETELY SATISFIED, return the DoubleDisk. You will receive a FULL REFUND! What is more, if a disk ever does not convert properly, send us the disk, and we will send you a 1.44MB disk from a major manufacturer in exchange!

YOU CAN'T LOSE! You will save MORE THAN THE PURCHASE PRICE IN CONVERTING ONLY YOUR FIRST TEN DISKS! From that point on, it is all profit. After converting only 100 disks, and after deducting the cost of the DoubleDisk, you will have saved AT LEAST \$425.00! Quite a return for an investment of only \$39.95!

CREDIT CARDS AND CHECKS ACCEPTED! Purchasing our DoubleDisk is easy! Simply call our 800 number. We accept all major credit cards. Or, return the coupon below, and we will ship you one immediately. We Will gladly accept your personal check.

24 HOURS **ORDER TOLL FREE - 1-800-537-4226** 7 DAYS
(In Colorado call 303-872-8945)

YES! I want to try your DoubleDisk on your UNCONDITIONAL MONEY BACK GUARANTEE! I enclose only \$39.95 plus \$3.50 Shipping and Handling (California residents add \$2.40 Sales Tax) for each DoubleDisk Converter. If I am not COMPLETELY SATISFIED, I will return the DoubleDisk for a FULL REFUND! If any disk ever fails to convert, I will send it to you and you will IMMEDIATELY send me a 1.44MB Disk in exchange!

Name _____ Address _____

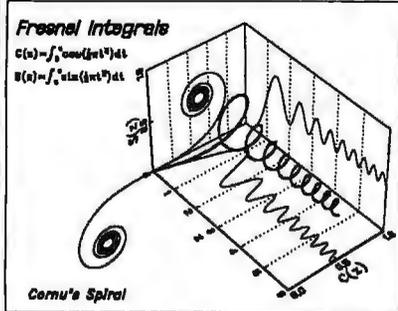
City _____ State _____ Zip _____ Telephone _____

Send To: Biological Engineering, Inc., DoubleDisk Offer
2674 Main Street, Ventura, CA 93003 Phone 805-644-1797

GraphiCTM

"gives you all the C language routines you need to write an impressive scientific graphing program of your own. Highly recommended."*

PC Magazine



IBM[®] PCs (with source code) \$395. Macintosh version (no source) \$295.
For personal use only.

VTEK 4.3TM

DEC[®] VT100/102/52 & Tektronix[®] 4010/4014/4105 Terminal Emulator

"its ease of use, high resolution graphics, emulation, and price make it a more attractive purchase than the other products."*

MINI-MICRO Systems

Only \$150

* Full reprints on request

Scientific Endeavors
 508 North Kentucky Street
 Kingston, TN 37763
 (615) 376-4146





of Discounting
Computers, FAX
& Cellular Phones

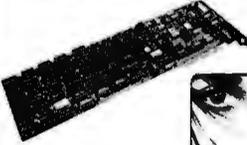
Radio Shack[®] SCO Tandy[®]

**We will meet or beat...
GUARANTEED LOWEST PRICES**

MARYMAC INDUSTRIES INC.
 22511 Katy Fwy.
 Katy (Houston), TX 77450
 1-713-392-0747 FAX (713) 574-4567
 Toll Free 800-231-3680

Circle 168 on Reader Service Card

VIDEO FRAME GRABBERS




MODEL	RESOLUTION	
HRT 256-4	256 x 256 x 4	495
HRT 256-8	256 x 256 x 8	795
HRT 512-8	512 x 512 x 8	995
HRT 512-24	512 x 512 x 24	1995

- IBM PC/XT/AT COMPATIBLE
- DIGITALIZE IN REAL TIME
- COMPOSITE VIDEO IN
- 24 BIT RGB OUT except model HRT 256-4
- 16 level gray scale out
- SOFTWARE LIBRARY OF IMAGE ANALYSIS ROUTINES
- FREE SOFTWARE UPGRADES TO REGISTERED OWNERS
- FULL CREDIT ON UPGRADE PURCHASE IN FIRST YEAR
- RETURN OLD BOARD AND JUST PAY DIFFERENCE



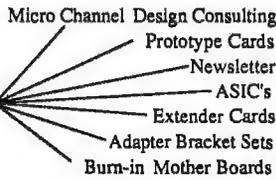
HRT HIGH RES TECHNOLOGIES
 P.O. BOX 78
 LEWISTON, N.Y. 14092
 PHONE 416-497-6493 FAX 416-497-1988

Circle 129 on Reader Service Card

ON TARGET ASSOCIATES

Products and Services
for Design and Manufacturing Engineers.

PS/2



- Micro Channel Design Consulting
- Prototype Cards
- Newsletter
- ASIC's
- Extender Cards
- Adapter Bracket Sets
- Burn-in Mother Boards

We will move your PC/XT/AT products to the Micro Channel, or create your new design.

CALL: (408) 980-7118
for our Free catalog

**ON TARGET
TARGET
TARGET**

...the PS/2 leaders.

PS/2 and Micro Channel are trademarks of IBM Corp.

Circle 208 on Reader Service Card

9-Track Tape Subsystem for the IBM PC/XT/AT



Now you can exchange data files between your IBM PC and any mainframe or mini-computer using IBM compatible 1600 or 6250 BPI 9-Track tape. System can also be used for disk backup. Transfer rate is up to 4 megabytes per minute on PCs and compatibles. Subsystems include 7" or 10 1/2" streaming tape drive, tape coupler card and DOS compatible software. For more information, call us today!

QUALSTAR[®]

9621 Irondale Ave., Chatsworth, CA 91311
Telephone: (818) 862-5822

Circle 232 on Reader Service Card

IEEE 488 Solutions

- Hardware & software interfaces for PC, AT, 386, PS/2, Macintosh, SUN, HP & DEC
- IEEE converters to SCSI, RS-232, RS-422, modem, Centronics, digital I/O & analog I/O
- IEEE extenders, expanders & buffers
- IEEE drivers for DOS, UNIX®, Lotus 1-2-3, Symphony & Quattro.

**Call or send for your
FREE Technical Guide**

Demo disks and application notes available

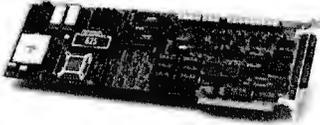
Please see our ad on pg. 101.



(216) 439-4091
 Telex 6502820864 • Fax (216) 439-4093
 Lotech, Inc. • 25971 Cannon Road
 Cleveland, Ohio 44146

Circle 146 on Reader Service Card

Data Acquisition ProcessorTM



Onboard Intelligence For IBM PC/XT/AT/386

- 16 MHz 80C186 for general processing
- 20 MHz DSP56001 for digital signal processing
- Sustained digital signal processing of 10 MIPS
- FFT and FIR filtering without programming
- Acquires analog and digital inputs to 235K s/s
- Buffers and processes input data as required
- Updates analog or digital outputs to 250K s/s
- Over 100 commands without programming
- Custom commands may be written in C

Call for FREE Demo Diskette

MICROSTAR
LABORATORIES

(206) 881-4286
 2863 152 Ave. N.E.
 Redmond, WA 98052
 FAX (206) 881-5494

Circle 186 on Reader Service Card

California Digital

17700 Figueroa Street • Carson, California 90248



\$539
CD-ROM Complete Kit

Doctor, lawyer, Indian chief... Virtually every industry and profession is disseminating information on CD-ROM. One compact disk, the same size as an audio disk, can store over 500 megabytes of data in High Sierra format.

Below is a listing of some of the CD-ROM drives currently available from California Digital. The best value is the Eclipse 430 external drive. The CDS/430 includes PC/XT interface, cables, sampler software and MS/DOS extension. It also offers an audio output feature for multimedia presentations. The system is Manufactured in Japan by one of the World's largest producers of magnetic storage equipment. A super value at only \$539.

clipse 430 external system	\$539	NEC interface kit for above	159
litachi 1503S External system	695	Sony CD/510 internal drive only	559
litachi 3500 Internal system	595	Sony 6101 external drive only	795
litachi internal drive only	519	Sony 230B interface kit	159
NEC CDR/77 External drive only	695	Panasonic LF5000 "write once"	1895
NEC CDR/80 Internal drive only	639	Panasonic interface kit for above	359

40 Meg. Tape Back-up
\$239

Head Crash, Power Spikes or just poor disk maintenance... Don't lose data because you didn't back up. The Alloy/40 is an inexpensive way to save and restore files in the event that your data has been destroyed. This 40 megabyte half height tape back is manufactured by Norm America's largest producer of data retrieval equipment.

No need to purchase a separate tape controller... The Alloy/40 attaches directly to your existing floppy disk controller. Supplied software allows your computer to back up any time Day or Night. Come back in the morning and 40 megabytes of irreplaceable data has been stored on one Scotch DC/2000 data cassette.

Back up entire hard disk, modified files only, or by file name. Loss of data is inevitable but when you are backed up on an Alloy/40 it's not a catastrophe.

Build Your Own Computer
\$35
AT Case Only

California Digital has all the components needed to customize your own computer. Buy as much computing power as you need now, and up grade when the need arises. Here are some examples of components available:

- 8 slot 10 MHz Motherboard
- 8 slot 12 MHz baby AT Motherboard
- Full size five drive AT case
- Four drive XT case
- 10/112 AT/XT German mfg. Keyboard
- 200 watt AT power supply
- Teac 360K/Byte disk drive
- Monochrome card, printer port
- MonoGraphics (hercules) printer port
- Color Graphics card
- EGA Color Multi Resolution II
- I/O card, serial & parallel
- I/O PLUS, Ser/Parl. clock, game
- Disk I/O, disk control, clock, game



	One	Two	Ten
TEC501 1/2 height sgl. side	39	29	25
TEC504 1/2 ht. double sided	59	55	49
TANDON 101/4 full ht. 96 TPI.	99	89	79
TEAC FD55BR half height	89	85	79
TEAC FD55FR 96 TPI, half ht.	119	109	105
TEAC FD55GFR for IBM AT	109	105	99
PANASONIC 455 Half Height	89	85	79
PANASONIC 475 1.2 Meg./AT	99	95	89
Dual enclosure for 5 1/4" drives			69

3 1/2" DISK DRIVES

SONY MP-73W, 1.44 Meg.	139	135	call
TEAC 235HF 1.44 Meg.	99	89	75
5 1/4" form factor kit			20

8" DISK DRIVES

QUME 842 double sided	189	179	175
QUME 841 single sided	99	89	79
SHUGART 851 R dbl. sided	319	309	299
REMEX RFD4000 dbl. sided	189	179	165

\$1299
Saba Scanner \$359

The Saba Scanner inputs a printed page in less than three seconds. OCR software allows your computer to transfer printed pages into ASCII files or directly to spreadsheets and word processing programs. Archival data, legal briefs... No problem. Simply insert the page into the Saba and in seconds the document is digitized into your computer and ready for editing. Also does line drawings that do not require gray tones. Limited quantities available. Original price \$1299; now only \$359.

SCANNERS

SABA SCANNERS		
page scanner with OCR software	1299	359
hand held scanner	799	159
OCR software for hand held		59
1000 flat bed page scanner		special pricing
2000 edge feed scanner	935	719
MICROTECHMSF300G 256 gray scales	2195	1759
DFI HandiScan 300 with Halo	359	239
PRINCETON GRAPHICS LS-300	1095	789
PANASONIC		
RS505 image page scanner	1499	999
RS506 Page scanner	1899	1259
DATACOPI		
730 flat bed scanner	1800	1159
840 flat bed scanner	6800	4159

SPECIAL PRODUCTS

XEROX Ventura PC Publisher	895	459
ALDUS PageMaker PC	795	455
COMPLETE PC FaxCard 4800	399	279
QUADRAM JT FaxCard 4800	395	259

MONITORS

MICROVITEC		
945CN, 20" 1freq. 31.5KHz. 1300x900	1895	659
1019, 20" autosec. 31 dot 1024x580	2395	1087
MITSUBISHI		
AUM 1381 13" diamond scan 800x600	889	519
HJ 6905ATK 20" multiscan	3650	2287
HITACHI		
4119 19" 1024x768, 31 dot, 48 KHz.	3480	2195
4115 15" 1280x1024, 65 KHz.	1890	1159
CONRAC 7250, 18" multi. 1024x1024	2895	1899
SONY MONITORS		
1303, 13" 37 dot, multiscan	825	595
1954, 19" 48 KHz.	4195	2993
MAGNIVOX 9CM082, 14" 640x480	849	459
NEC MultiSync II, 14" 800x560	949	597

NEC/890 \$3095 Laser

PC Magazine has chosen the NEC-890 best laser printer of the year. (Jan. 12, 1988). And its obvious why... the printer is Postscript, Hewlett Packard, and Apple compatible, and comes standard with three megabytes of memory. The 890 accepts data from parallel, serial and Apple-Talk devices.

PRINTERS

HEWLETT PACKARD		
Laser Printer II, 300x300	2595	1659
Laser Printer II/D double sided	3995	2995
QMS PS/810 2 Meg., 35 fonts, Post/S.	5495	3879
APPLE Laser Writer NT	4550	3559
NEC890 Postscript, 3 meg	4975	3095
TEXAS INSTRUMENTS		
2115 Postscript 15 pgs.	7995	5787
2108 Postscript ser., parl. & Apple.	5995	4295
DATAPRODUCTS		
LZR 1260 Postscript 12 pgs.	7995	6895
LZR 2600, 11" by 17" 26 pgs./min.	13,500	9887
MANNESMANN TALLY 905, HP/II	1995	1295
FUJITSU RX7100D w/ two paper bins	2550	1359

DIGITIZERS
As Low As \$279

HITACHI		
HDC 1212 Puma 12x12"	595	359
HDC 1515 15x15	869	659
Tiger 1111C, 12x12 stylus extra	727	487
HDC 3648, 36x48"	5357	3995
SUMMAGRAPHICS		
Summa 1201 plus 12x12"	599	379
TS 3648, 36x48"	4748	3728
KYE Genius Tablet w/4 but. mouse	599	279
CALCOMP		
25180, 12x18"	1275	999
91480, 36x48"	4118	3389
KURTA DIGITIZERS		
IS/ONE w/mouse 8x stylus	645	399
IS/THREE, 36x48"	4895	3799
HOUSTON INSTRUMENTS		
TG1011 11x11" stylus & power add.	685	519
HiPad 9012, 12x12 complete kit	495	399
HiPad 9018, 12x18 complete kit	795	599

Roland \$1795 980 \$695

The DXY 980 is an eight pen, size "B" flat bed plotter. This unit is fully HP 7470/7475 compatible and accepts both parallel and serial inputs. Digital LED coordinate display, .05mm step resolution and electrostatic paper holder are only some of the outstanding features on this quality plotter.

PLOTTERS

HOUSTON INSTRUMENTS		
DMP 41 single pen, 3 ips, C&D	2895	2289
DMP 52 single pen, 16 ips, C&D	2285	2485
DMP 56C size A-E, 16 ips	569	3095
DMP61 single pen, 32 ips, A-D	4285	3095
CP695A 4 pen, size "B" 3 ips	799	595
CALCOMP PLOTTERS		
1023 Arisan A-D, 8 pen, 30 ips	4895	3785
1043GT size A-E, 8 pen, 24 ips	7995	5495
HEWLETT PACKARD		
7475A 6 pen size "B"	1895	1495
7550A 8 pen size "B" 32 ips	3900	2995
7595A 8 pen, size A-E, 24 ips	9990	7595
HITACHI PLOTTERS		
872 XD 4 pen, size "B"	895	595
675 size "A-D" 8 pen	4895	3995
FUJITSU Imagergraph, 6 pen, 11x32	1295	895
INLINE PLOTTERS		
LP3700 size E, 10 ips	4195	3195
LP3700MP 8 pen, size "E" 10 ips	4695	3495
ROLAND PLOTTERS		
DXY980 flatbed size "B" 8 pen, 9 ips	1795	895
DPX2000 size "C" 8 pen with stand	2985	2195
DPX3300size "D" 8 pen with stand	4995	3495
ENTER COMPUTER		
SP600 size "B" 6 pen	695	659
SP1000 single pen size A-D	3995	2795
SP1800 8 pen, A-D, 32 ips	4895	3359
JDL 850, size "C" one meg. memory	3846	2789
VERSATEC 8524 Electrostatic	16,900	13789
NUMONICS		
5460 size "A-D"	2495	1659
5860 size "A-D" 8 pen	7495	6789

CAD SOFTWARE

AUTODESK		
AutoCAD version 10	2995	2195
AutoSketch Std & Enhanced 2.0	99	79
VERSACAD Designer	2995	1995
GENERIC CAD level 1	49	35
AMERICAN SM. BUS'N. Design Cad	299	179

EGA Color Monitor \$219

Ideal for CAD/CAM and Desk Top publishing applications. The Roland CD/240 color monitor has a resolution of 720 pixels by 400/480 lines on a .31mm dot pitch 12" non-glare screen. VGA specifications in text mode EGA in graphic mode. California Digital has made a special purchase and is able to offer the CD/240 EGA/VGA RGB color monitor for only \$219. Full featured, 132 column, multi-resolution video color adapter card available for only \$139 additional. Comparable card package would retail for \$105.

Amstrad \$1379 \$695

Two 720K/byte 3 1/2" drives • Supertwist LCD display
 640 K/byte DRAM memory • 16 color RGB/CGA output
 2400 baud internal modem • Full feature 101 keyboard

Take it to school, court, news events or anywhere that you require "computing power" on the go. Built in 2400 bps Hayes compatible modem allows you to transfer data files with your home office or any World wide data base.

A little large to be called a laptop but the Amstrad 640 is a true battery operated IBM compatible portable. (17 1/2" by 9" footprint).

40 Megabyte Hard Disk Kit \$397

Forty megabyte internal hard disk drive, controller and cables all for only \$397. The kit includes the of a 40 milisecond Miniscribe 3650 drive and a half slot Western Digital controller.

Five Inch Winchester Disk Drives

Price does not include controller. each two+

SEAGATE 225 20 Meg. 1/2 Ht.	239	229
SEAGATE 238 30 Meg. RLL	259	249
SEAGATE 251/1 51 M. 28mS.	459	445
SEAGATE 4096 96 M. 35mS.	559	539
MINISCRIBE 8425 25 M. 65mS.	239	227
MINISCRIBE 3650 50M 61 m. 319	319	309
MINISCRIBE 6085 90 meg.	459	435
MINISCRIBE 3053 25 ms. 1/2 ht.	359	339
FUJITSU 2242 55 M. 35mS.	1299	1229
FUJITSU 2243 86 M. 35mS.	1695	1619
RODME RD-204E 53 Meg.	895	859
MAXTOR XT1140 140 Meg.	1495	1459
MAXTOR XT2190 192 Meg.	1919	1875
TOSHIBA MK56 70 M. 30mS.	1289	1229
CONTROL DATA WREN "W" call		

Winchester Controllers for IBM/PC

XEBEC 1220 with floppy controller	159
DTC 5150CX	119
DMT 5527 RLL controller	99
ADAPTEC 2070 RLL controller	99
ADAPTEC 2372A 1/1 interleaf	159
WESTERN DIGITAL WD/1002WX2	89
WESTERN DIGITAL 1003WAH or WA2	139
WESTERN DIGITAL 1007/WA2 ESDI	239

SCSI/SASI Winchester Controllers

XEBEC 1418A 5 1/4" fast print	239
WESTERN DIGITAL 1002-05E 5 1/4"	229
DMT 20L	89

Winchester Accessories

Dual floppy enc. and powersupply	59
Winchester enclosure and supply	139
Switching power supply	49

MMC MICROCOMPUTER MARKETING COUNCIL DIRECT MARKETING ASSOCIATION

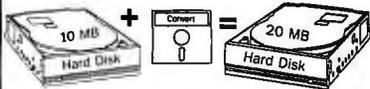
master charge VISA

8:00 AM to 5:00 PM Pacific Time

Every year since 1973, customers from virtually every nation in the free World have chosen California Digital for their data processing requirements. If **its computer, California Digital** has it... complete minisystem or just one microchip. California Digital offers over 10,000 unique computer products. Regardless of how specialized your data processing requirements... California Digital is your one stop shopping solution.

TECHNICAL & CALIFORNIA
(213) 217-0500
 TOLL FREE ORDER LINE
(800) 421-5041
 Telefax • (213) 217-1951

A Real Breakthrough—No Bull!



20 MB HARD DRIVE \$89

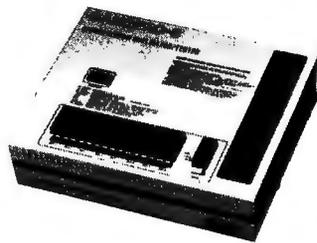
Turn your 10 MB Hard Drive into a real 20 MB Hard Drive! Our easy to use software is not a file compression program and it's not memory resident! Use it once. It actually changes the physical characteristics of your 10 MB Hard Drive and makes it a permanent 20 MB Hard Drive. No new hardware required. It's true—Money Back Guarantee! Order CONVERT® today! We pay S & H. Mail \$89 to:



3240 Dueber Ave. S.W. Canton, OH 44706
216-484-5320

Circle 271 on Reader Service Card

GANG PROGRAMMER Does 50,000 EPROMs A WEEK!



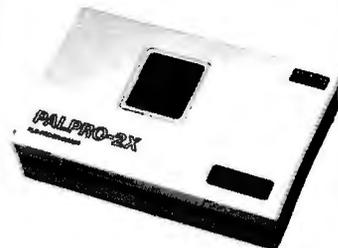
The only programmer under \$1000.00 that withstands heavy duty operation. Easy to use. Fastest possible programming speed: GANGPRO-8™ is a sure bet when reliability is what you want. All this plus a one year warranty and update for only \$995.00!

LOGICAL DEVICES, INC.

1201 N.W. 65th Place
Ft. Lauderdale, FL 33309
(305) 491-7404
1-800-331-7766

Circle 160 on Reader Service Card

STAND-ALONE UNIVERSAL PLD PROGRAMMER
Costs Less, Performs More



Palpro-2x™ is an intelligent programmer supporting PLDs from a wide variety of sources. Works with any PC or computer using a serial port. FREE one year device update and warranty. Price \$795.00.

LOGICAL DEVICES, INC.

1201 N.W. 65th Place
Ft. Lauderdale, FL 33309
(305) 491-7404
1-800-331-7766

Circle 161 on Reader Service Card

MIDI MUSIC

800 E. Campbell Road • Suite 199 • Richardson, TX 75081

Introducing...



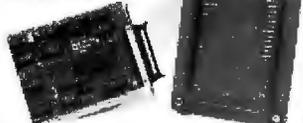
MIDI for PC Compatibles

Convert your standard serial card into a MIDI Card in less than an hour with our MIDI Kit. Kit includes easy-to-follow instructions, parts, MIDI cables, and a MIDI recording program with C source, for only \$39.95! Serial card add \$30. Assembled and tested add \$30. Professional sequencing and scoring software also available.

1-800-456-MIDI

Circle 189 on Reader Service Card

REAL WORLD I/O
For PC/XT/ATs



- DG24 • 24 line digital I/O; 10 MHz 8255. \$95
- AD500 • 8 channel 12-bit (plus sign) integrating A/D; prog. gains of 1, 10 & 100; 7 digital I/O lines. \$259
- AD100 • Single channel version of AD500; 10 digital I/O lines. Same programmable gains. 700 meg input Z. \$149
- AD1000 • 8 channel 12-bit A/D; 25 uS; sample & hold; 3.5 MHz timer/counters; 24 digital I/O lines. \$295
- ADA300 • 8 channel 8-bit 25 uS A/D; single D/A sample & hold; 24 digital I/O lines. \$239
- AD200 • 4 channel 12-bit 125 uS A/D; 3.5 MHz timer/counters; 24 digital I/O lines. \$239
- DA600 • Fast settling dual bipolar D/A. \$179
- PD200 • Prototype board w/ address decoder; manual \$99

All boards include BASIC, Pascal, C, and Forth drivers. 30 day return; 1 year warranty. Call for "Real World Interfacing" application notes.

Real Time Devices, Inc.
P.O. Box 906 State College, PA 16804
(814) 234-8087

Circle 244 on Reader Service Card

NEW DOSTAR™ NEW

TAR FOR MSDOS WITH UNIX/XENIX COMPATIBILITY

Read, write 16 different Unix formats including Altos, AT&T, IBM, NCR, Tandy & others

Multiple disk types — 3 1/2", 5 1/4" and 8"

Fully compatible with Unix tar — backup under MSDOS, restore onto Unix — backup Unix files, restore onto MSDOS

Menu-driven, using windows, function keys, on-line help

Only \$295.00

Bringing Unix & DOS together

New Generation Systems, Inc.
3609-B Chain Bridge Rd., Fairfax, VA 22030
Tel: (703) 691-0779 Fax: (703) 691-0397
In Canada please call:
New Generation Systems (Canada)
1110 Kamato Rd., Units 1B-19, Mississauga, Ont. L4W 2P3
Tel: (416) 238-1047 Fax: (416) 238-1039
Altos, AT&T, DOSTAR, IBM, MSDOS, NCR, Tandy, Unix, Xenix, are trademarks of their respective companies.

Circle 205 on Reader Service Card

8051 SIMulator

for the IBM PC/XT/AT \$99

The 8051SIM software package assists in the debug of 8051 family programs. A screen oriented, menu command driven program, 8051SIM speeds development by allowing program execution and debug without a target system. A great learning tool as well.

8031DryICE \$199

Dry ICE is a debugger/emulator that supports the development of hardware and software using the 8031 microcontroller. The DryICE provides powerful functions to assist in the integration, debug, and test phase. Hardware connects between your target 8031 IC socket and CRT terminal or PC COM port.

HTE HiTech Equipment Corporation
9400 Activity Road
San Diego, CA 92126

(619)566-1892

Circle 132 on Reader Service Card



Sure it's insured?

SAFWARE® Insurance provides full replacement of hardware, media and purchased software. As little as \$39/yr. covers:

- Fire • Theft • Power Surges
- Earthquake • Water Damage • Auto Accident

For information or immediate coverage call:
1-800-848-3469

In Ohio call 1-614-262-0559



SAFWARE, The Insurance Agency Inc.

Circle 249 on Reader Service Card

Memories for all COMPAQ Deskpro's 386/x

HANTZ & PARTNER offers all memory expansions for the COMPAQ DESKPRO 386/20/25/e/s Computers that are fully compatible with and are a direct substitute for add-on memory made by COMPAQ. The modules and boards are available with 1 + 4 MB.

PRODUCTS: Memory-Modules with 1 or 4 MB for the COMPAQ Deskpro's 386/20/25/20e/s + 286e.
Memory-Boards with 1 or 4 MB for the COMPAQ Deskpro's 386/20e and 386/s

All modules and Boards are 100% compatible in size, shape and performance. We guarantee most competitive prices! Sample orders are possible with Am. Express, MasterCard, Visa and Diners without surcharge. Just call!

DEALERS AND DISTRIBUTORS WANTED!!!

HANTZ & PARTNER
Herdweg 8 • D-7803 Gundelfingen
Germany Tel: (49) 761-581344
Fax: (49) 761-581354

Circle 200 on Reader Service Card

ACP Selected Top 10 Mail Order

Call ACP toll-free 1-800-FONE-ACP • 1-800-366-3227



LOW COST IBM/COMP BOARDS

- ACP Advanced Cards/IBM**
 ACP Mono/Color w/print port... 49.
 ACP Mono w/color emulation... 59.
 ACP SuperEGA/480... 169.
 ACP VGA/256... 199.
 ACP SuperVGA/1024 x 768... 249.
 DFI Multi I/O 2s.p.g.clk/XT... 139.
 ACP Six-Pak compatible/XT,OK... 89.
 ACP 286 Accelerator/XT... 249.
 ACP Multi I/O w/floppy contr./XT... 29.
 ACP Dual Floppy controller/XT... 29.
 ACP Serial I/O card/XT... 29.
 ACP Parallel I/O card/XT&AT... 29.
 ACP Serial I/O card/AT... 29.
 ACP Game adapter port/XT&AT... 29.
 ACP EPROM programmer/4port/43... 49.
 ACP 1.44Mb Floppy controller... 79.
 ACP AT Prototype card... 25.
 DFI 3.0Mb Multi I/O/10MHz/AT... 129.
 DFI 4.0Mb Megalith EEMS 4.0/AT... 199.
 DFI SuperMulti I/O/Wfloppy/AT... 69.
 DFI Megabit 2Mb uses 1Mb DRAM... 99.
 DFI NeoCD Enhance/Novell approv... 169.
 DFI Rambank 2/PS2 50,60... 149.

INPUT DEVICES-MICE

- Advanced PC Keyboards**
 5160 84key XT/AT/switchable... 59.
 5161 101key XT/AT/switchable... 79.
KEYTRONICS
 KB5151 Deluxe IBM w/99 keys... 139.
 KB101 101 key/AT... 110.
 MB101 101 key/XT,AT,PS2... 79.
LOGITECH
 Bus Mouse PC/XT/AT... 79.
 Serial Mouse PC/XT/AT... 75.
 Serial Mouse PS/2... 75.
MICROSOFT
 Bus Mouse w/PC Paintbrush... 99.
 Serial Mouse w/PC Paintbrush... 99.
 Serial PS/2 w/PC Paintbrush... 99.
MSC Technologies
 PC Mouse serial PC/XT/AT... 96.
 PS/2 Mouse serial... 96.
 PC Mouse bus PC/XT/AT... 96.

the Complete PC Half Page Scanner

Scans a 4" width with 200dpi resolution, includes the powerful SmartScan editing software and it's now available from ACP for under \$200.

COMPUTERS-CLONES

- Advanced 386 Clones save\$\$**
 Advanced386/16 bare bones... 995.
 Advanced386/16 base system... 1795.
Advanced 286 Clones save\$\$
 Advanced286/12 bare bones... 399.
 Advanced286/12 base system... 849.
 Advanced286/16 base system... 1049.
Advanced XT Clones save\$\$
 Advanced XT bare bones... 179.
 Advanced XT base system... 588.
call for options & details...
AST Research
 Premium 286 Model 80... 1495.
 Premium BRAVO... call.
 Premium386 Model 340... 3299.
call for all AST models...
HYUNDAI
 Hyundai286/Turbo16TE... call.
NEC
 Prospeed 286/Prospeed 386... call.
 Ultralite... call.
SHARP
 PC7241 Portable286, 40Mb... 1799.
TOSHIBA LAPTOPS
 T1000 Laptop... 749.
 T1200FB/1200HB... 1577/2395.
 T1600/3100e... 3295/2877.
 T3200 286 full keybd, 40Mb... 3495.
 T5100/5200... 4575/5988.
ZENITH
 Supersport Model2/Model20... call.
 Supersport 286... call.
 Model20/Model40... call.
 Turboport 386/386 w/modem call.

MOTHERBOARDS

- XT Turbo w/BIOS/8MHz... 89.
 XT Turbo w/BIOS/10MHz... 99.
 AT 286 w/BIOS/12MHz/XT size... 279.
 AT 286 w/BIOS/16MHz... 449.
 AT 386 w/BIOS/20MHz... 799.
I/O-GRAPHICS-PC BOARDS
AST Research
 Xtorm2/286 512K, 10MHz... 575.
 Advantage Premium/512K... 399.
 Advantage 286/512K... 374.
 Advantage 2/512K, PS2... 458.
 Rampage2/512K, EEMS, PS/2... 378.
 Rampage 286/512K, EEMS/2Mb... 388.
 Rampage Plus286/512K, EMS... 499.
 AST Sixpakplus, 64K... 118.
 AST Hotshot 286 accelerator... 324.

CHIPS - SIMM MODULES

- 256K 120ns... 7. 256K100ns... 8.
 1Mb 120ns... 20. 1Mb 100ns... 21.
 1Mb 80ns... 23. 1Mb 70ns... 25.
 256x9 120ns 79. 256x9 80ns... 99.
 256x9 100ns 89. 64Kx1... 2.
 1Mbx9 SIMM Module 120ns... 225.
 1Mbx9 SIMM Module 100ns... 245.
 1Mbx9 SIMM Module 80ns... 265.
ACP has full line of CHIPS!
386 PROCESSOR CHIPS-INTEL
 80387... 97. 80287-B... 225.
 8087-1... 196. 80287-10... 266.
 8087-2... 142. 80387-16... 395.
 80287-6... 155.
 80387-20... 476.
 Wietek... call 80387-SX... 395.

- 8438... 249.
 8450... 299.
 3130E... 98.
PLUS Development
 Plus20 Hardcard, 20Mb, 49ms... 529.
 Plus40 Hardcard, 40Mb, 39ms... 669.
 Passport20... 429.
SEAGATE
 20Mb ST225 (65ms) HH, MFM... 239.
 30Mb ST238R (65ms) RLL, HH... 269.
 40Mb ST251 (40ms) MFM, HH... 395.
 40Mb ST251-1 (28ms) MFM, HH... 438.
 60Mb ST277R (40ms) RLL, HH... 469.
 40Mb ST403 (28ms) MFM, FH... 519.
 80Mb ST409 (28ms) MFM, FH... 669.
 20Mb ST125 3.5" (40ms) MFM... 288.
 30Mb ST138 3.5" (40ms) MFM... 369.
WESTERN DIGITAL
 Filecard PS30 PS/2 model 30... 398.
 Filecard30... 398.
 1005V-MM1 1.6bit MFM 1:1... 149.
 1003V-SR1 RLL 3:1... 157.
 1006V-MM2 F14 MFM 1:1... 199.
 1002-27X 8bit RLL XT... 88.
 WX1 Controller MFM/XT... 88.
 WD286-WDM20, AT/286 MB... call.

Laptops for less

Why ACP sells more... TOSHIBA

- Pricing • Service • Availability

ACP won't be undersold for Toshiba laptops & printers.

- TAPE BACKUP/VIDEO**
ALPHAMICRO
 VCR Videotape backup card... 288.
 VCR Videotape tape backup PS2... 348.
IOMEGA
 Bernoulli B120X 5 1/4" internal... 983.
 Bernoulli B220X 5 1/4" ext'l... 1599.
 Bernoulli 20+20 8" ext... 1649.
 Tri-pak 20Mb cartridge, 5 1/4"... 189.
 Tri-pak 20Mb cartridge, 8"... 239.
 PC50 Adapter card... 149.
 PC3B/50 Adapter card... 299.
IRWIN
 2020 20Mb backup/internal... 325.
 2040 20Mb backup/internal... 425.
 445A 40Mb backup/external... 499.
TALLGRASS Technologies
 1040i 40Mb backup/internal... 338.
 1040e 40Mb backup/external... 549.
PRINTERS-LASERS
CITIZEN
 MSP400... 149. 180D... 189.
 MSP400... 299. MSP55... 578.
DICONICS/KODAK
 150Plus/300P... call/499.
EPSON
 DFX5000... call. L0510... 295.
 LX800... 189. L0850... 525.
 FX850... 349. L01050... 735.
 FX1050... 449. L0950... 595.
 EX800... 399. LD2550... 925.
Advanced Computer Products
...your full line Epson dealer
HEWLETT PACKARD fonts/etc.
 25 in 1 cartridge (comp.)... 345.
 Spreadsheet cartridge (comp) 169.
 Z cartridge (compatible)... 115.
 Jetware 1Mb upgrade memory call.
IBM PRINTERS
 Proprinter I, 240cps... 419.
 Proprinter X24, 240cps 24pin... 599.
 Proprinter XL24, 240cps 24pin... 799.
NEC
 P2200, 24pin (360x360dpi)... 379.
 P5200/5300... 569/719.
 LC890 Silentwriter... 3399.

- ATI Technologies**
 EGA Wonder 800... 235.
 VIP VGA... 299.
 VGA Wonder (1024x768) 256K... 329.
 ATI2400etc int. Modem... 199.
GENOA
 Super EGA/HI-Res Plus... 229.
 Super VGA/HI-Res... 389.
 Super VGA/256K... 339.
 Superspectrum mono /CGA... 149.
PARADISE
 Autoswitch EGA 480 /HI-Res... 199.
 VGA Plus/800X600... 274.
 VGA Plus 16/800X600... 298.
 VGA Professional/800X600... 459.
HERCULES
 Hercules VGA... 199.
INTEL
 Inboard386PC to/16MHz, 1Mb... 699.
 Inboard386/ATto386/16MHz... 1188.
 AboveBoard 2 Plus w/512KPS... 495.
 AboveBoard Plus w/512K... 387.
 AboveBoard Plus I/O w/512K... 467.

- FLOPPY DISK DRIVES**
SONY
 31/2" Micro Floppy 1.44Mb... 129.
TEAC
 558V 360K Floppy/PC/XT/AT... 77.
TOSHIBA AMERICA
 FDD4403 3 1/2" 720K w/kit... 86.
 3 1/2" 1.44Mb w/kit... 109.
 NDO4D 360K Floppy black bezel... 84.
 NDO4E-G 360K Floppy beige... 84.
 NDO8DE-G 1.2Mb AT beige... 109.
ADVANCED
 51/4" 360K Floppy-black bezel... 69.
 51/4" 1.2Mb Floppy-black bezel... 89.
 31/2" 1.44Mb Floppy w/kit... 99.
 31/2" 720K Floppy w/kit... 79.
External Floppy Drives
 51/4" 360K for PS2... 188.
 51/4" 1.2Mb for PS2... 228.
 Advanced Computer Products
 51/4" 360K for Laptop... 198.

- MONITORS-TERMINALS**
AMDEK
 410A/1280... 149/699.
IBM MONITORS
 8503/8512... 199/499.
 8513/8514... 549/1195.
NEC
 Multisync II/Multisync Plus 595/887.
 Multisync 2A/Multisync 3D 499/720.
 Multisync XL 20"(1024x768) 2099.
 Monograph sys (1024x1024) 1499.
SAMSUNG-IMTEC
 1256A 12" amber TTL mono... 88.
 1457A14" amber flat screen... 128.
 1457W14" white flat screen... 135.
 1464K 14" CGA/RGB Color... 248.
 1453 14" EGA Color... 375.
 1453 14" VGA Color... 375.
 1455 14" Multiscan Color... 439.
 5671 15" Fullpug white w/card... 699.
WYSE
 WY30/WY50 14" terminal... 329/399.
 WY60/WY150... 419/419.
...if you don't see what you want listed here or at the price you need... CALL US, WE'LL GET IT!

- ORCHID Technology**
 Designer 800 8-bit, VGA Card... 259.
 ProDesigner VGA 16-bit/256K... 319.
 ProDesigner Plus VGA 16/512K... 399.
 RAMQUEST 50/PS/2, 2Mb... call.
ORCHID
 MicrofazerII buffer w/64K... 269.
 Quadsprint XT accelerator... 79.
 Liberty EMS XT card, OK sale!... 79.
 Silver Quadboard Sixpak comp... 79.
VIDEO 7
 VEGA Deluxe EGA... 219.
 VegaVGA, 8-bit... 289.
 Fastwrite VGA, 16-bit... 379.
 VramVGA... 497.

- HARD DISK DRIVES**
Advanced DriveCard
 ACP 20Mb DriveCard... 288.
 ACP 30Mb DriveCard... 359.
MICROPOLIS
 1355/145Mb, ESDI, FH, 28ms... 1299.
 1335/70Mb, MFM, FH, 29ms... 669.
MAXTOR
 XT 1085/70Mb, FH, MFM, 27ms... 799.
 XT 1140/120Mb, MFM, 27ms... 1695.
 XT 4380E/330Mb, ESDI... 2995.
MINISCRIBE
 8425... 229.
 3053... 449.
 3085... 499.
OKIDATA
 ML390/391... 489/659.
 ML393/393C... 995/1095.

- SWITCH BOXES**
 ACP 2-position AB, 3636... 27.
 ACP 2-position AB, 2525... 24.
 ACP parallel/serial converter... 69.
 ACP serial/parallel converter... 69.
 Buffalo SX PC share (up to 7)... 499.
 Logical Connection 256K... 439.
INTELLI-COM
 Longlink-Parallel... 199.
TRIPLETE
 IsoBar4 surge supp w/4 outlets... 53.
 IsoBar8 surge supp w/8 outlets... 89.
 Line Conditioner w/4 outlets... 149.
 Backup Power Supply, 450w... 299.
 Backup Power Supply, 750w... 499.
 Backup Power Supply, 1200w... 649.
 Backup Power Supply, 2000w... 1199.
SOFTWARE
ALDUS
 Pagemaker/IBM... 478.
ALPHA SOFTWARE
 AlphaThree.0... 149.
ASHTON TATE
 dBase III plus... 249.
 dBase IV... 445.
 Multimate Advantage II 1.0... 149.
BORLAND
 FRAMEWORK III... 429.
 Quattro... 184.
 Paradox... 469.
COMPUTER ASSOCIATES
 Supercalc 5... 299.
 StarLANPLUS... call.
 Kit w/sw (3 users)... 877.
 network for less than \$300(mode)... 85.
 ViaNet LAN software... 85.
 Starhub... 329.
 Ethercard PLUS... 249.
 Ethercard PLUS TP (twisted pairs)... 319.
 Ethercard PLUS/A (microchannel)... 310.
PLOTTERS
HOUSTON INSTRUMENTS
 DMP52/52MP... call.
 SCANCALL... call.
 DMP56A/61/62... call.
CALCOMP
 1023... 3835. 1042... 7835.
 1040... 8475. 1044... 8910.
KURTA
 1212 IS1... 1499. 12x17... 499.
 36x48... 2888. 4 btn crn crd... 74.
SUMMASKETCH
 12x12... 375. 12x18... 629.
DISKETTES/ACCESSORIES
POLAROID
 5-1/4" DSDD 7... 39.
 5 1/4" DSDH 13... 3-1/2" DSDH 15... 39.
 3 1/2" DSDHD... 39.
3M
 5 1/4" DSDH 14... 3-1/2" DSDH 15... 39.
 3 1/2" DSDHD... 39.
BULK
 5 1/4" DSDD box of 100... 35.
 5 1/4" DSDH box of 100... 59.
Advanced PRINTER BUFFERS
 ACP 256K parallel buffer... 198.

- NETWORKS-LAN**
3COM
 Etherlink card... 418.
WESTERN DIGITAL
 StarLANPLUS... call.
 Kit w/sw (3 users)... 877.
 network for less than \$300(mode)... 85.
 ViaNet LAN software... 85.
 Starhub... 329.
 Ethercard PLUS... 249.
 Ethercard PLUS TP (twisted pairs)... 319.
 Ethercard PLUS/A (microchannel)... 310.
FOX SOFTWARE
 LotusBase r... 194.
LOTUS
 Graphwriter II... call.
 Lotus 123... call.
 Manuscript... call.
MICROPRO
 Wordstar Professional Rel 5... 229.
 Wordstar 2000 Rel 3... 199.
MICROFORM R-BASE DDS... 559.
ROSOFT
 Windows 286/386... 64/124.
 Word v4.0... 209.
 Excel... 224.
NORTON
 Utilities... 51.
 Commander... 46.
 Advanced Utilities... 75.
SOFTWARE PUBLISHING
 First Choice/First Publisher... 91/74.
 HARVARD GRAPHICS... 272.
SYMANTEC O & A... 212.
TRAVELING SOFTWARE
 Laplink Plus... 79.
XEROX
 Ventura... 499.

WESTERN DIGITAL

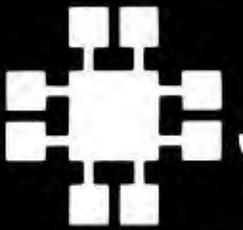
Everything you'd ever want in a motherboard...

- 12.5 MHz 80286
- Expandable to a Mb
- EGA on board
- IBM PS/2 286 compatible

Call ACP for case power supply and your custom configurations.

Advanced Computer Products, inc.

1310 E. Edinger, Santa Ana, CA 92705 • FAX 714-558-1603 • Customer Service 714-558-1356 • Sales 714-558-8813
 Since 1976 We accept MC/VISA/AMEX. No surcharge for credit card orders. Your card not charged until we ship. 100% guarantee, defective software replaced immediately, defective hardware repaired or replaced at our discretion. Items subject to availability. Prices subject to change without notice. Shipping \$3.00 per order 1st 10 lbs. UPS Ground. Federal Express next day available.



JDR Microdevices

MMC
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association, Inc.

• 30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

intel MATH COPROCESSORS

8-BIT COPROCESSORS

8087	5 MHz	97.95
8087-2	8 MHz	139.95
8087-1	10 MHz	189.95

16-BIT COPROCESSORS

80287	6 MHz	157.95
80287-8	8 MHz	219.95
80287-10	10 MHz	264.95

32-BIT COPROCESSORS

80387-16	16 MHz	397.95
80387-SX	18 MHz	389.95
80387-20	20 MHz	469.95
80387-25	25 MHz	589.95



5 YEAR
WARRANTY

STATIC RAMS **MEMORY SALE!** DYNAMIC RAMS

PART	SIZE	SPEED	PRICE
2112	256 x4	450ns	2.99
2114	1024x4	450ns	.99
2114L-2	1024x4	200ns	1.49
TMS4044-3	4096x1	300ns	2.49
TMM2016-200	2048x8	200ns	2.25
TMM2016-150	2048x8	150ns	3.95
TMM2016-100	2048x8	100ns	3.95
HM8116-4	2048x8	200ns	2.95
HM8116-3	2048x8	150ns	3.95
HM6116-2	2048x8	120ns	4.95
HM6116L-4	2048x8	200ns	3.95
HM6116L-3	2048x8	150ns	4.49
HM6116L-2	2048x8	120ns	5.49
HM6264LP-15	8192x8	150ns	8.95
HM6264LP-12	8192x8	120ns	9.95
HM43256LP-15	32768x8	150ns	24.95
HM43256LP-12	32768x8	120ns	29.95
HM43256LP-10	32768x8	100ns	34.95

PART	SIZE	SPEED	PRICE
4116-150	16384x1	150ns	.99
4164-150	65536x1	150ns	2.49
4164-120	65536x1	120ns	2.89
4164-100	65536x1	100ns	3.39
TMS4416	16384x4	150ns	8.95
41128-150	131072x1	150ns	4.95
TMS4464-15	65536x4	150ns	14.95
TMS4464-12	65536x4	120ns	15.95
HMS1258-100	262144x1	100ns	10.95
41256-150	262144x1	150ns	8.49
41256-120	262144x1	120ns	8.99
41256-100	262144x1	100ns	7.99
41256-80	262144x1	80ns	8.49
1MB-120	1048576x1	120ns	19.95
1MB-100	1048576x1	100ns	21.95
1MB-80	1048576x1	80ns	24.95
414256-100	262144x4	100ns	29.95
414256-80	262144x4	80ns	36.95

EPROMS

PART	SIZE	SPEED	Vpp	PRICE
2708	1024x8	450ns	25V	4.95
2716	2048x8	450ns	25V	3.40
2716-1	2048x8	350ns	25V	3.95
2732	4096x8	450ns	25V	3.85
TMS2532	4096x8	450ns	25V	5.95
2732A	4096x8	250ns	21V	3.95
2764	8192x8	450ns	12.5V	3.49
2764-250	8192x8	250ns	12.5V	3.69
2764-200	8192x8	200ns	12.5V	4.25
27C64	8192x8	250ns	12.5V	4.95
27128	16384x8	250ns	12.5V	4.26
27128A-200	16384x8	200ns	12.5V	5.95
27256	32768x8	250ns	12.5V	4.95
27256-200	32768x8	200ns	12.5V	5.95
27C256	32768x8	250ns	12.5V	5.95
27512	65536x8	250ns	12.5V	6.95
27C512	65536x8	250ns	12.5V	6.95
27C101-20	131072x8	200ns	12.5V	29.95

PARTIAL LISTINGS ONLY!
CALL FOR COMPLETE CATALOG

74 SERIES LOGIC

7400		74LS	
7400	.19	74LS76	.29
7402	.19	74LS93	.49
7404	.19	74LS95	.49
7408	.25	74LS96	.22
7406	.29	74LS90	.39
7407	.29	74LS92	.49
7408	.24	74LS93	.39
7410	.19	74LS109	.36
7411	.25	74LS112	.29
7414	.49	74LS123	.49
7416	.25	74LS125	.39
7417	.25	74LS132	.39
7420	.19	74LS138	.39
7432	.29	74LS139	.39
7447	.69	74LS151	.39
7473	.34	74LS153	.39
7474	.33	74LS154	1.49
7475	.46	74LS155	.49
7476	.35	74LS157	.35
7586	.35	74LS158	.29
7489	2.15	74LS161	.39
7480	.39	74LS163	.39
7493	.35	74LS164	.49
74121	.29	74LS165	.65
74123	.49	74LS166	.95
74151	.55	74LS175	.39
74154	1.49	74LS192	.69
74157	.55	74LS193	.69
74166	1.00	74LS197	.59
74LS00		74HC	
74LS00	.16	74LS221	.59
74LS02	.17	74LS222	.69
74LS03	.16	74LS224	.69
74LS04	.16	74LS225	.79
74LS05	.16	74LS226	.49
74LS08	.16	74LS227	.39
74LS10	.16	74LS228	.49
74LS11	.22	74LS229	.39
74LS14	.39	74LS230	.39
74LS19	.17	74LS231	3.95
74LS21	.22	74LS232	2.49
74LS27	.23	74LS233	2.49
74LS30	.17	74LS237	.39
74LS32	.16	74LS238	.79
74LS39	.28	74LS241	.79
74LS42	.39	74LS242	.79
74LS47	.75	74LS243	.79
74LS51	.17	74LS244	1.49
74LS73	.29	74LS245	.88
74LS74	.24	74LS246	3.20
74LS75	.29	74LS247	3.20

SIMM MODULES

PART	SIZE	SPEED	PRICE
41256A8B-15	256K x 8-BIT	FOR MAC	150ns \$69.95
41256A8B-12	256K x 8-BIT	FOR MAC	120ns \$74.95
41256A8B-10	256K x 8-BIT	FOR MAC	100ns \$84.95
42100A8B-10	1MB x 8-BIT	FOR MAC	100ns \$239.95
41256A9B-15	256K x 9-BIT	FOR PC	150ns \$79.95
41256A9B-12	256K x 9-BIT	FOR PC	120ns \$84.95
41256A9B-10	256K x 9-BIT	FOR PC	100ns \$94.95
41256A9B-80	256K x 9-BIT	FOR PC	80ns \$109.95
42100A9B-10	1MB x 9-BIT	FOR PC	100ns \$279.95
42100A9B-80	1MB x 9-BIT	FOR PC	80ns \$299.95



Derick's HIGH-TECH SPOTLIGHT

Here at JDR we are constantly reminded how difficult it is to keep up with new developments. Four years ago we could assure our customers that they needed 9 chips at a time to expand their PC. Then the AT became popular and we began saying 9 for PC's and 18 for 80286-based machines. Later we said that you added memory to an 80386 using 36 chips at a time.

When the available memory chips were designed so that one chip supported one bit on the data bus, it was easy to make rules like these. But the rules have changed, which can be very good as we shall shortly see. The number of chips is really determined by the width of the data bus AND the width of the Dynamic RAM memory chip.

For example, if you used a 1 Meg chip that is configured 256K by 4 bits wide, you could design an 80386 motherboard that is expandable in increments of 9 chips at a time. (256K by 4 = 256K by 1*36). The obvious advantage is the savings in board space, which makes room for more memory, and the lower cost for memory, since 1 Meg chips cost less.

Because the goal is to create products that are reliable, compatible, full featured and competitively priced, the new 1 Meg chips in both 1 Meg by 1 and 256K by 4 are very desirable. With that in mind, look for new products that take advantage of these more flexible memory options.

Derick Moore, Director of Engineering

EPROM ERASERS

DATASE II \$39.95

• SHIRT POCKET SIZE
• ERASES MOST EPROMS/
• EPLDS IN 3 MINUTES* ALL
SIZES UP TO 4 AT A TIME
DATASE II



SPECTRONICS CORPORATION

Model	Timer	# of Chips	Intensity (uW/Cm ²)	Unit Cost
PE-140	NO	9	8,000	\$88
PE-140T	YES	9	8,000	\$139
PE-240T	YES	12	9,600	\$189
PL-265T	YES	30	9,600	\$285



MICROPROCESSORS

8000		8200		6500	
8031	3.95	8284	2.79	6502	2.25
8036	1.49	8285	1.99	6502A	2.69
8039	1.95	8255-5	2.49	6502B	4.25
8032AH		8256	15.85	65C02*	7.95
BASIC	34.95	8259	1.95	6522	2.95
6080	2.49	8256-5	2.29	6526	13.95
8085	1.95	8272	4.39	6532	5.95
8085A-2	3.75	8274	4.95	6551	2.95
8088	5.99	8275	16.95	6581	14.95
9088-2	7.95	8279	2.49	* CMOS	
8155	2.49	8279-5	2.95	6800	
6155-2	3.95	8282	3.95	6800	1.95
8156	2.85	8283	3.95	6802	2.95
8741	9.95	8284	2.25	6809	2.95
8748	7.95	6285	3.95	6809B	5.99
8749	9.95	8287	3.95	6809E	2.95
8755	14.95	8288	4.95	6809E	5.49
8200		Z-80		6808	2.49
8205	3.29	Z80-CPU	1.25	6810	1.95
8212	1.49	Z80A-CPU	1.29	6821	1.25
8216	1.49	Z80B-CPU	2.75	68821	1.85
8224	2.25	Z80A-CTC	1.69	6840	3.95
8229	2.25	Z80B-CTC	4.25	6845	2.75
8237	3.95	Z80A-DART	5.95	6847	4.75
8237-5	4.75	Z80B-DART	6.95	6850	1.95
8238	4.49	Z80A-DMA	5.95	6883	22.95
8243	1.95	Z80A-PIO	1.89	V-20	
8250	8.85	Z80B-PIO	4.25	V20	6.95
8251	1.29	Z80A-SIO/0	5.95	V20-B	8.95
8251A	1.69	Z80A-SIO/1	5.95	V20-10	11.95
8253	1.59	Z80A-SIO/2	5.95	V30	13.95
8253-5	1.95	Z8671BASIC	9.95		

STANDARD CMOS LOGIC

4001	.19	4050	.29
4011	.19	4051	.69
4013	.35	4080	.69
4015	.29	4066	.29
4016	.29	4069	.19
4017	.48	4093	.49
4024	.48	14411	9.95
4040	.69	4511	.69
4048	.69	4538	.95
4049	.29	4702	9.95

SHORTING BLOCKS



5/\$1.00

DISCRETE

1N751	.49	2N3904	.10
1N4004	10/1.00	2N3906	.10
1N4148	25/1.00	2N4401	.25
KBP02	.55	4N26	.69
2N2222	.10	4N35	.88
2N2907	.25	JMBO RED	.10
2N3055	.79	JMBO GRN	.14

BYPASS CAPS

CERAMIC DISC:	
.01UF	100/5.00
.1UF	100/6.50
MONOLITHIC:	
.01UF	100/10.00
.1UF	100/12.50

MISC.

ADC0804	2.99
ADC0809	3.85
DAC0800	3.29
DAC0808	1.95
1793	0.95
8272	4.39
COM8116	6.95
UPD765	4.39
1691	8.95
2143	6.95
AT5-3600	11.95
PRO	11.95
AT5-1015	4.95
AT5-1013	3.95
MC146818	5.95
MM58167	9.95
MM58174	9.95
MSM5832	2.95
IM6402	3.95
IM6403	9.95
INS8250	6.95
NS16450	10.95

CRYSTALS

32,768 KHz	.95
1.0 MHz	2.95
1.8432	2.95
2.0	1.95
2.4576	1.95
3.579545	1.95
4.0	1.95
5.0688	1.95
6.0	1.95
8.0	1.95
10.0	1.95
10.0	1.95
12.0	1.95
14.31818	1.95
16.0	4.95
18.432	4.95
20.0	4

POWER SUPPLIES



135 WATT POWER SUPPLY

- UL APPROVED
- +5V @ 15A, +12V @ 4.2A, -5V @ .5A, -12V @ .5A
- PS-135 \$59.95
- PS-150 150W SUPPLY \$69.95



200 WATT POWER SUPPLY

- UL APPROVED
- +5V @ 20A, +12V @ 7A, -5V @ .5A, -12V @ .5A
- PS-200 \$89.95



APPLE TYPE SUPPLY

- WITH APPLE CONNECTOR
- +5V @ 6A, +12V @ 3A, -5V @ 1A, -12V @ 1A
- PS-A \$49.95



36 WATT POWER SUPPLY

- +5V @ 2.5A, +12V @ 1.5A
- 3 PIN INPUT, 6 PIN OUTPUT
- SELECTABLE 110V-220V
- PS-3045 \$12.95



SOLDER STATIONS

SOLDER/DESOLDER STATION

- OIL-FREE VACUUM PUMP
- TEMP ADJUSTS (212° F-900° F) & VACUUM (0-60 CM/HG)
- WITH GUN-REST, COOLING TRAY, WIRE BRUSH & TIP CLEANER ROD
- XY999SD \$399.95
- XY999D DESOLDER ONLY \$349.99



DELUXE SOLDER STATION

- ROTARY SWITCH TEMP CONTROL (200° F-978° F RANGE)
- LED TEMPERATURE READOUTS
- INCLUDES COOLING TRAY
- XY9-60L \$79.95



SOLDER STATION

- UL APPROVED
- HEAT SETTING ADJUSTS
- TIP TEMPERATURE READOUT
- REPLACEMENT TIPS @ \$2.95
- 168-3C \$59.95

WIREFRAP PROTOTYPE CARDS

FR-4 EPOXY GLASS LAMINATE WITH GOLD PLATED EDGECARD FINGERS AND SILK SCREENED LEGENDS



- JDR-PR1 WITH +5V AND GROUND PLANE \$27.95
- JDR-PR2 ABOVE WITH I/O DECODING LAYOUT \$29.95
- JDR-PR2PK PARTS KIT FOR JDR-PR2 ABOVE \$8.95

FOR AT

- JDR-PR10 16 BIT WITH I/O DECODING LAYOUT \$34.95
- JDR-PR10PK PARTS KIT FOR JDR-PR10 ABOVE \$12.95

FOR PS/2

- JDR-PR32 32 BIT PROTOTYPE CARD \$69.95
- JDR-PR16 16 BIT WITH I/O DECODING LAYOUT \$49.95
- JDR-PR16PK PARTS KIT FOR JDR-PR16 ABOVE \$15.95
- JDR-PR15V 16 BIT FOR VIDEO APPLICATIONS \$39.95

DATA SWITCH BOXES

TYPE	# OF POS.	PARALL.	SERIAL	PRICE
PUSHBTN.	2-WAY	AB-P	AB-S	39.95
ROTARY	2-WAY	RSP-2	RSS-2	24.95
ROTARY	3-WAY	RSP-3	RSS-3	27.95
ROTARY	4-WAY	RSP-4	RSS-4	29.95

EXTENDER CARDS

FOR PROTOTYPE DEBUGGING, TESTING AND TROUBLESHOOTING

- EXT-8088 XT COMPATIBLE \$29.95
- EXT-80286 AT COMPATIBLE \$39.95
- EXT-16 MICROCHANNEL 16-BIT \$69.95
- EXT-32 MICROCHANNEL 32-BIT \$99.95

JDR INSTRUMENTS--2 YEAR WARRANTY!

35 MHZ DUAL TRACE OSCILLOSCOPE

- WIDE BAND WIDTH • VARIABLE HOLDOFF
- MODEL-3500 (SHOWN) \$499.95

20 MHZ DUAL TRACE OSCILLOSCOPE

- TV SYNC FILTER • COMPONENTS TESTER
- MODEL 2000 \$389.95

3.5 DIGIT PROBE TYPE DMM

- AUTORANGING • AC/DC 2V - 500V, RESIS. 2K-2M
- DPM-1000 (SHOWN) \$54.95

3.5 DIGIT POCKET SIZE DMM

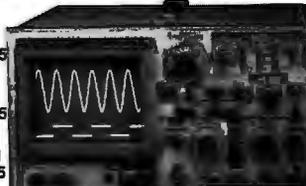
- BASIC DC ACCURACY ±0.5% • 14 RANGES
- DMM-100 \$29.95

3.5 DIGIT FULL FUNCTION DMM

- BASIC DC ACCURACY ±0.25% • 22 RANGES
- DMM-200 \$49.95

THE ULTIMATE 3.5 DIGIT DMM

- BASIC DC ACCURACY ±0.25% • 34 RANGES
- TEMP, TRANSISTOR & RESISTANCE FEATURES
- DMM-300 (SHOWN) \$79.95



RELIABLE, HIGH QUALITY TEST EQUIPMENT, REASONABLY PRICED

MOLDED COMPUTER CABLES

- GOLD-PLATED CONTACTS; 100% SHIELDED
- CBL-PRINTER PC PRINTER CABLE 9.95
 - CBL-PRINTER-25 AS ABOVE-25 FT. 15.95
 - CBL-PRINTER-RA RT. ANGL. PRINTER 15.95
 - CBL-DB25-MM DB25 MALE-MALE 9.95
 - CBL-DB25-MF DB25 MALE-FEMALE 9.95
 - CBL-9-SERIAL 9 PIN-25 PIN SERIAL 6.95
 - CBL-KBD-EXT KEYBOARD EXTEN. 7.95
 - CBL-CNT-MM 36 PIN CENTRON.-MM 14.95
 - CBL-HD-20 20 PIN HARD DISK 3.95
 - CBL-HD-34D 34 PIN DUAL HARD DISK 6.95
 - CBL-FDC-EXT 37 PIN EXT. FLOPPY 9.95
 - CBL-MNT-9 9 PIN MONITOR EXTEN. 6.95
 - CBL-MODEM DB25-DB25 FEMALE 7.95

SOLDERLESS BREADBOARDS

- NEW LOW PRICES!
- PDS-100 1360 TIE PTS \$12.95
 - PDS-200 1660 TIE PTS \$19.95
 - PDS-300 2380 TIE PTS \$24.95
 - PDS-400 3220 TIE PTS \$34.95



RS-232

BREAKOUT BOX

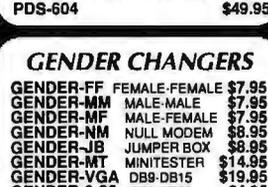
FOR TROUBLESHOOTING SERIAL COMMUNICATIONS

- OPEN/CLOSE INDIVIDUAL CIRCUITS • 20 JUMPERS
- CROSS-CONNECT ANY TWO CIRCUITS • 10 CIRCUIT ACTIVITY LEDS
- GENDER-BO \$34.95



PC BREADBOARD

- 62 CLEARLY LABELED BUS LINES
- ACCEPTS UP TO 24 14-PIN ICs
- 1940 TIE POINTS
- EXT FEMALE DB25 D-SUB CONNECT.
- PDS-604 \$49.95



GENDER CHANGERS

- GENDER-FF FEMALE-FEMALE \$7.95
- GENDER-MM MALE-MALE \$7.95
- GENDER-MF MALE-FEMALE \$7.95
- GENDER-NM NULL MODEM \$8.95
- GENDER-JB JUMPER BOX \$8.95
- GENDER-MT MINITESTER \$14.95
- GENDER-VGA DB9-DB15 \$19.95
- GENDER-9-25 DB9-DB25 \$4.95



LITHIUM BATTERY

- 6V FOR 286 AND 386 PCS
- MOTHERBOARD CONNECTOR
- ADHESIVE VELCRO MOUNTING STRIP
- LITHIUM 6.8V \$11.95



COIN TYPE BATTERY

- LONG-LASTING 3V LITHIUM
- 3V-MHW \$1.95
- HOLDER \$1.49



APPLE-COMPATIBLE PRODUCTS

- FLOPPY DRIVE FOR APPLE II SERIES AP-150 (W/CABLE, CONNECTOR) \$99.95
- REPLACEMENT KEYBOARD FOR APPLE II & II+ KEYBOARD-AP \$59.95
- EPROM PROGRAMMER, NOT REC. FOR CMOS. RP-525 (NO POWER SUPPLY REQ.) \$89.95
- 16K RAM CARD BOOSTS 48K APPLE TO 64K RAM-CARD (2 YEAR WARRANTY) \$39.95

"SNAPABLE" HEADERS

SNAP APART TO MAKE ANY SIZE HEADER, WITH .1" CENTERS

- 1 x 40 STRAIGHT LEAD \$9.99
- 1 x 40 RIGHT ANGLE LEAD \$1.49
- 2 x 40 STRAIGHT LEAD \$2.49
- 2 x 40 RIGHT ANGLE LEAD \$2.99

IDC CONNECTORS/RIBBON CABLE

DESCRIPTION	ORDER BY	CONTACTS					
		10	20	26	34	40	50
SOLDER HEADER	IDHxxS	.82	1.29	1.68	2.20	2.58	3.24
RIGHT ANGLE SOLDER HEADER	IDHxxSR	.85	1.35	1.76	2.31	2.72	3.39
WIREFRAP HEADER	IDHxxW	1.86	2.98	3.84	4.50	5.28	6.63
RIGHT ANGLE WIREFRAP HEADER	IDHxxWR	2.05	3.28	4.22	4.45	4.80	7.30
RIBBON HEADER SOCKET	IDSxx	.55	.55	.75	.75	1.19	1.19
RIBBON HEADER	IDMxx	-	5.50	6.25	7.00	7.50	8.50
RIBBON EDGE CARD	IDExx	.55	.55	.75	.89	1.29	1.69
RIBBON CABLE 10 FT.	RCxx	1.50	3.00	3.90	5.10	6.00	7.50

FOR ORDERING INSTRUCTIONS, SEE D-SUBMINIATURE CONNECTORS BELOW

D-SUBMINIATURE CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS						
		9	15	19	25	37	50	
SOLDER CUP	MALE	DBxxP	.45	.59	.69	.69	1.35	1.85
	FEMALE	DBxxS	.49	.69	.75	.75	1.39	2.29
RIGHT ANGLE PC SOLDER	MALE	DBxxPR	.49	.69	--	.79	2.27	--
	FEMALE	DBxxSR	.55	.75	--	.85	2.49	--
WIREFRAP	MALE	DBxxPWW	1.69	2.56	--	3.89	5.60	--
	FEMALE	DBxxSww	2.78	4.27	--	6.84	9.95	--
IDC RIBBON CABLE	MALE	IDBxxP	1.39	1.99	--	2.25	4.25	--
	FEMALE	IDBxxS	1.45	2.05	--	2.35	4.49	--
HOODS	METAL	MHOODxx	1.05	1.15	1.25	1.25	--	--
	PLASTIC	HOODxx	.39	.39	--	.39	.69	.75

ORDERING INSTRUCTIONS: INSERT THE NUMBER OF CONTACTS IN THE POSITION MARKED "xx" OF THE "ORDER BY" PART NUMBER LISTED. EXAMPLE: A 15 PIN RIGHT ANGLE MALE PC SOLDER WOULD BE DB15PR

MOUNTING HARDWARE .59

IC SOCKETS/DIP CONNECTORS

DESCRIPTION	ORDER BY	CONTACTS									
		8	14	16	18	20	22	24	28	40	44
SOLDERTAIL SOCKETS	xxST	.11	.11	.12	.15	.18	.15	.20	.22	.22	.30
WIREFRAP SOCKETS	xxWW	.59	.69	.69	.99	1.09	1.39	1.49	1.69	1.99	
ZIF SOCKETS	ZIFxx	--	5.95	5.95	--	6.95	--	7.95	7.95	10.95	
TOOLED SOCKETS	AUGATxx	.55	.59	.69	.79	.85	.85	.99	1.09	1.29	
TOOLED WW SOCKETS	AUGATxxWW	1.30	1.80	2.10	2.40	2.50	2.90	3.15	3.70	5.40	
COMPONENT CARRIERS	ICCxx	.49	.59	.69	.99	.99	.99	.99	.99	1.09	1.49
DIP PLUGS (IDC)	IDPxx	.95	.49	.59	1.29	1.49	--	.85	1.49	1.59	

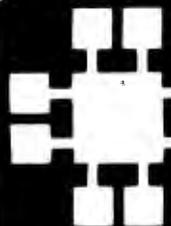
FOR ORDERING INSTRUCTIONS SEE D-SUBMINIATURE CONNECTORS ABOVE

JDR MICRODEVICES, 2233 BRANHAM LANE, SAN JOSE, CA 95124
LOCAL (408) 866-6200 FAX (408) 559-0250 TELEX 171-110

RETAIL STORE: 1256 SOUTH BASCOM AVE., SAN JOSE, CA
(408) 947-8881 HOURS: M-F 9-7 SAT. 9-5 SUN. 12-4

Terms: Minimum order \$10. For shipping and handling include \$3.50 for ground and \$4.50 for air. Orders over 1 lb and foreign orders may require additional shipping charges—please contact the sales department for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturers. All merchandise subject to prior sale. A full copy of our terms is available upon request. Items pictured may only be representative.

ORDER TOLL FREE 800-538-5000



JDR Microdevices

• 30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

MMC
MICROCOMPUTER
MARKETING COUNCIL
of the Direct Marketing Association, Inc.

2400 BAUD MODEM

\$89.95

- Hayes COMPATIBILITY
- 1/2 CARD • AUTO DIALANSWER
- SELF-TEST ON POWER UP
- FULL AND HALF DUPLEX
- TOUCHTONE OR PULSE DIALING
- 2ND PHONE JACK • CALL PROGRESS MONITORING
- ADJUSTABLE VOLUME

PRO-24I

PROMETHEUS MODEMS

INTERNAL MODEMS (MIRROR II SOFTWARE INCLUDED)

PRO-24I 2400 BAUD 1/2 CARD **\$99.95**
 PRO-12I 1200 BAUD 1/2 CARD **\$89.95**

EXTERNAL MODEMS (REQ. SERIAL PORT, CABLE, SOFTWARE)

PRO-24E 2400 BAUD **\$149.95**
 PRO-12E 1200 BAUD **\$89.95**

APPLE/MACINTOSH COMPATIBLE MODEMS

EXTERNAL MODEMS, AS ABOVE WITH CABLE & SOFTWARE

PRO-24EM MAC 2400 BAUD **\$199.95**
 PRO-24A APPLE II 2400 BAUD **\$179.95**
 PRO-12A APPLE II 1200 BAUD **\$139.95**

24-HR. ON-LINE ORDERING
(408) 559-0253

JDR's Bulletin Board offers technical support, conferencing and more!

"I will not hesitate to order ANYTHING from JDR—because I know your policy is to stand behind your products 100%"

—Robert Rindy, Grand Forks, ND

DFI SERIAL MOUSE

\$39.95

- 3-BUTTON OPTO-MECHANICAL
- 200 D.P.I.
- USES SERIAL PORT COM 1/2
- INCL. SOFTWARE DRIVERS
- 5-1/2' CABLE

DMS-200E MOUSE AND HALO-DPE SOFTWARE **\$59.95**
 DMS-200 **\$59.95**

NEW LOGITECH 3 BUTTON MOUSE

NEW SERIES 9 MICE FEATURE 320 DPI RESOLUTION. SERIAL MICE ARE ALSO PS/2 COMPATIBLE

LOGC9	SERIAL MOUSE	\$98.95
LOGC9-P	SERIAL MOUSE W/PAINTSHOW	\$109.95
LOGC9-PBL	SERIAL MOUSE W/PUBLISHER	\$149.95
LOGC9-PC	SERIAL MOUSE W/PAINT/CAD	\$154.95
LOGB9	BUS MOUSE	\$89.95
LOGB9-P	BUS MOUSE W/PAINTSHOW	\$104.95
LOGB9-PBL	BUS MOUSE W/PUBLISHER	\$139.95
LOGB9-PC	BUS MOUSE W/PAINT/CAD	\$149.95

NEW LOW PRICES!

VGA **\$499**

COMPATIBLE PACKAGE

- 720 X 540 MAX. RESOLUTION
- 640 X 480 IN 16 COLORS
- 528 X 480 IN 256 COLORS
- IBM STYLE MONITOR
- VGA, EGA, CGA, AND MGA COMPATIBLE

VGA-PKG (INCLUDES VGA CARD AND MONITOR)

VGA MONITOR **\$359**

- 14" ANALOG MONITOR • GLARE RESISTANT SCREEN
- TILT/SWIVEL BASE • FRONT MOUNTED POWER SWITCH

VGA-MONITOR

PAPER WHITE VGA **\$119.95**

14" GRAY SCALE MONITOR • 800 X 480 RESOLUTION MONO-VGA

JDR MULTI **\$429**

- FULL FEATURED MULTISCAN MONITOR WITH UNLIMITED COLORS • HIGH RESOLUTION, 14" NON-GLARE DISPLAY
- AUTO SWITCHING • TTL/ANALOG VIDEO INPUT

JDR-MULTI

EGA MONITOR **\$339**

- 840 X 200/350 RESOLUTION • 16 COLOR DISPLAY
- 14" BLACK MATRIX SCREEN • 9-PIN CABLE

EGA-MONITOR

RGB MONITOR **\$239.95**

- COLOR/GREEN/AMBER SWITCH • 14" NON-GLARE SCREEN
- 840 X 200 MONOCHROME RESOLUTION, 320 X 200 COLOR
- TILT AND SWIVEL BASE

JDR-RGB

FLAT SCREEN MONITOR **\$139.00**

- LOW DISTORTION, 14" GLARE-RESISTANT AMBER SCREEN
- 720 X 350 MAXIMUM RESOLUTION • IBM COMPATIBLE TTL INPUT • SWIVEL BASE

GM-1488

MONO-SAMSUNG WITH 12" SCREEN **\$129.95**

JDR-MONO 12" TTL MONOCHROME -GREEN **\$69.95**

JDR-AMBER 12" TTL MONOCHROME -AMBER **\$69.95**

TILT & SWIVEL MONITOR STANDS

MS-100 DURABLE PLASTIC **\$12.95**

MS-200 WITH 5 OUTLETS & SURGE SUPPRESSOR **\$39.95**

HIGH QUALITY KEYBOARDS

101 KEY ENHANCED, WITH SEPARATE CURSOR PAD:

BTC-5339 AUTOSENSE FOR XT/AT, AUTOREPEAT **\$69.95**

K103-A AUDIBLE "CLICK" STYLE **\$84.95**

MAX-5339 MAXI-SWITCH W/TACTILE FEEDBACK **\$84.95**

84 KEY STYLES:

BTC-5060 AUTOSENSE FOR XT/AT **\$59.95**

MAX-5060 MAXI-SWITCH W/TACTILE FEEDBACK **\$64.95**

HARD DISKS

20 MB **\$199**

30 MB **\$219**

40 MB **\$319**

28 MS **\$389**

60 MB **\$389**

80 MB **\$569**

KITS

20 MB **\$249**

30 MB **\$279**

40 MB **\$379**

28 MS **\$429**

60 MB **\$429**

80 MB **\$549**

Seagate

SIZE	MODEL	AVG. SPEED FACTOR	FORM ONLY	DRIVE KIT	XT KIT	AT F/H
20MB	ST-225	65 MS	5-1/4"	\$199	\$249	\$309
20MB	ST-125	40 MS	3-1/2"	\$269	\$299	\$379
30MB RLL	ST-238	65 MS	5-1/4"	\$219	\$279	\$379
30MB RLL	ST-138	40 MS	3-1/2"	\$289	\$339	\$429
40MB	ST-251	40 MS	5-1/4"	\$319	\$369	\$429
40MB	ST-251-1	28 MS	5-1/4"	\$389	\$439	\$499
60MB RLL	ST-277	40 MS	5-1/4"	\$389	\$449	\$549
80MB	ST-4096	28 MS	5-1/4"	\$569	—	\$679

80MB SCSI \$499

SCSI DRIVES ARE FASTER ST-296N BY SEAGATE
MCT-SCSI HOST ADAPTOR CARD **\$49.95**
ST-02 SCSI ADAPTOR W/FLOPPY **\$79.95**

1.44 MB 3-1/2" DRIVE

\$99.95

- ULTRA HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- FDD-1.44X BLACK FACEPLATE **\$69.95**
- FDD-1.44A BEIGE FACEPLATE **\$69.95**
- FDD-1.44 SOFT SOFTWARE DRIVER **\$19.95**

1/2 HEIGHT FLOPPY DISK DRIVES:

FD-55B	5-1/4" TEAC DS/DD 360K	\$99.95
FD-55G	5-1/4" TEAC DS/HD 1.2M	\$129.95
FDD-360	5-1/4" DS/DD 360K	\$69.95
FDD-1.2	5-1/4" DS/HD 1.2M	\$109.95
FDD-3.5X	3-1/2" 720K (BLACK)	\$97.95
FDD-3.5A	3-1/2" 720K (BEIGE)	\$97.95

ARCHIVE TAPE BACK-UPS

AR5240X	40 MB TAPE DRIVE FOR XT'S & AT'S	\$369.95
AR5540A	FAST 40 MB TAPE DRIVE AT'S ONLY	\$369.95
AR2020	EXTERNAL CHASSIS & INTERFACE	\$159.95
AR20A	ADDITIONAL INTERFACE CARDS	\$89.95
AR340	40 MB TAPE CARTRIDGE	\$24.95

UPRIGHT CASE **\$299.95**

SPACE SAVING DESIGN HOLDS ALL SIZES OF MOTHERBOARDS AND INCLUDES:

- 250W POWER SUPPLY • MOUNTS FOR 3 FLOPPY & 4 HARD DRIVES
- TURBO & RESET SWITCH • LED SPEED DISPLAY • POWER & DISK LEDS
- ALL HARDWARE, FACEPLATES & SPEAKER
- CASE-100 **\$39.95**
- CASE-FLIP FOR 8088 BOARDS **\$39.95**
- CASE-SLIDE FOR 8088 BOARDS **\$39.95**
- CASE-70 FOR 286 BOARDS **\$89.95**
- CASE-50 FOR 8088/286 BOARDS **\$59.95**
- CASE-JR MINI-286 W/150W PS **\$149.95**

EPROM PROGRAMMER **\$129.95**

- PROGRAMS 27XX AND 27XXX EPROMS UP TO 27512
- SUPPORTS VARIOUS PROGRAMMING FORMATS & VOLTAGES • SPLIT OR COMBINE CONTENTS OF SEVERAL EPROMS OF DIFFERENT SIZES
- READ, WRITE, COPY, ERASE, CHECK & VERIFY
- HEX/INTEL HEX SOFTWARE
- MOD-EPROM

MODULAR PROGRAMMING SYSTEM

OUR INTEGRATED MODULAR PROGRAMMING SYSTEM EASILY EXPANDS! ALL THE MODULES USE A COMMON HOST ADAPTOR CARD, SO YOU CAN USE JUST ONE SLOT TO PROGRAM EPROMS, PROMS, PALS & MORE!

HOST ADAPTOR CARD **\$29.95**

- UNIVERSAL INTERFACE FOR ALL THE PROGRAMMING MODULES!
- SELECTABLE ADDRESSES PREVENTS CONFLICTS
- HIGH QUALITY MOLDED CABLE
- MOD-MAC

UNIVERSAL MODULE **\$499.99**

- PROGRAMS EPROMS, EEPROMS, PALS, BI-POLAR PROMS, 8748 & 8751 SERIES DEVICES, 18V8 20V8 GALS (GENERIC ARRAY LOGIC) FROM LATTICE, NS, SGS
- TESTS TTL, CMOS, DYNAMIC & STATIC RAMS • LOAD DISK, SAVE DISK, EDIT, BLANK CHECK, PROGRAM, AUTO, READ MASTER, VERIFY & COMPARE
- TEXT TOOL SOCKET FOR .3" TO .5" W. IC'S (8-40 PINS)
- MOD-MUP

DFI 400 DPI SCANNER

\$199⁹⁵

• QUICKLY SCANS UP TO 4.1" W. IMAGES • 100, 200, 300, 400 DPI BOTH DIRECTIONS • B&W & 3 HALF-TONE MODES • 32 LEVELS OF GRAY SCALE • HERCULES, CGA, EGA & VGA COMPATIBLE • INCLUDES HALO DPE AND IMAGE EDITOR SOFTWARE HS-3000

OCR-SOFT SOFTWARE \$99.95



MOTHERBOARDS

25 MHZ 386 \$1049

LANDMARK AT SPEED 29.7MHZ NORTON SI 32.5

• 10/25 MHZ
• 16 MB RAM CAPACITY - 8MB ON-BOARD(OK), 8 MB RAM CARD
• USES 256K or 1MB DRAMS
• 8 SLOTS - 1X32 BIT RAM
2X 8-BIT & 5X 16-BIT
• SHADOW RAM FOR BIOS/VIDEO
• INTERLEAVED MEMORY
• ADJUSTABLE BUS SPEEDS
• AMI BIOS

MCT-386MB25

10/20 MHZ 386 LANDMARK 25.8MHZ/NORTON SI 23.0

MCT-386MB20

MCT-386-M 8MB RAM CARD FOR ABOVE(OK)\$149.95

MYLEX 386 - Landmark 29.5Mhz/Norton SI 23.5

20MHZ 386 - 1MB INSTALLED - 64KB CACHE - NEAR 0 WAITS

MI-386MB20-1 \$1499.00

MI-386MB20-4 MYLEX 386 20MHZ/4MB \$2399.00

MYLEX 386 - Landmark 23.5Mhz/Norton SI 18.7

16MHZ 386 - 1MB INSTALLED - 64KB CACHE - NEAR 0 WAITS

MI-386MB-1 \$1299.00

MI-386MB-4 MYLEX 386 16MHZ/4MB \$1999.00

MINI MYLEX 386 - Landmark 29.5Mhz/Norton SI 23.5

MYLEX MINI-386 20MHZ - 0K INSTALLED - 64KB CACHE

MY-386JR20 \$1299.00

MY-386JR MYLEX MINI-386 16MHZ/0K \$1099.00

20 MHZ 286 - Landmark 23.0Mhz/Norton SI 25.8

XT SIZE - UP TO 8MB 0 WAIT RAM W/MEMORY CARD(OK)

MCT-M286-20 \$599.00

MCT-M286-16 8/16 MHZ VERSION OF ABOVE \$489.95

12 MHZ 286 - Landmark 15.5Mhz/Norton SI 13.8

XT SIZE - 6/12 MHZ - TO 4MB ON-BOARD W/1MB DRAMS(OK)

MCT-M286-12 \$299.00

MCT-M286 6/10 MHZ MINI-286 \$269.95

10 MHZ SINGLE CHIP 8088 TURBO - Norton SI 2.1

4.77/10 MHZ K'BRD SELECTABLE - 8 SLOTS - 640K CAPACITY

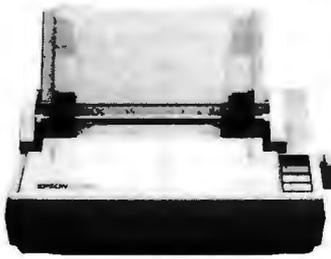
MCT-TURBO-10 \$99.00

8 MHZ 8088 TURBO - Norton SI 1.7

4.77/8 MHZ K'BRD SELECTABLE - 8 SLOTS - 840K CAPACITY

MCT-TURBO \$95.95

EPSON LX-810 \$179



• 9-PIN DOT MATRIX • 80 COL. • 200 CPS DRAFT, 30 CPS NLQ

We carry the full line of high-quality EPSON printers and accessories. Call us toll-free today to check our current pricing!

MODEL	PRINT HEAD	# COLS	DRAFT SPEED	LQ/NLQ SPEED
EX-800	9-PIN	80	300CPS	60CPS
FX-850	9-PIN	80	264CPS	54CPS
LQ-510	24-PIN	80	180CPS	60CPS
LQ-950	24-PIN	110	330CPS	88CPS
LQ-1050	24-PIN	136	330CPS	88CPS
LQ-2550	24-PIN	136	500CPS	133CPS

MODULAR CIRCUIT TECHNOLOGY DRIVE CONTROLLERS

FLOPPY DISK CONTROLLER \$29.95

• CONTROLS UP TO 4 FLOPPIES • DS/DD AND DS/DO MCT-FDC

1.2 MB FLOPPY CONTROLLER \$49.95

• SUPPORTS 2 FLOPPY DRIVES
• CAN MIX 360K, 720K, 1.2 MB & 1.44MB
• 1.44MB REQUIRES SOFTWARE DRIVER & DQS 3.2 OR ABOVE

MCT-FDC-1.2 FDD-1.44-SOFT 1.44MB SOFTWARE DRIVER \$19.95

HARD DISK CONTROLLER \$79.95

• SUPPORTS 16 DRIVE SIZES INCLUDING 10, 20, 30 AND 40MB
• DIVIDES 1 LARGE DRIVE INTO 2 LOGICAL DRIVES MCT-HDC

RLL CONTROLLER \$89.95

• SUPPORTS 2 RLL HARD DRIVES • 50% FASTER DATA TRANSFER • FOR XT-COMPATIBLES MCT-RLL

286/386 FD/HD CONTROLLER \$149.95

• 16-BIT DESIGN- SUPPORTS UP TO 2 FLOPPY DRIVES AND 2 HARD DRIVES • SUPPORTS 360K/720K/1.2MB/1.44MB MCT-AFH

286/386 RLL CONTROLLER \$199.95

• SUPPORTS 2 RLL HDD'S & 2 FDD'S (360K/720K/1.2MB 1.44MB) • FASTER DATA TRANSFER FOR AT-COMPATIBLES MCT-AFH-RLL

MULTIFUNCTION I/O

MULTI I/O FLOPPY CONTROL \$79.95

• SUPPORTS UP TO 2 360K FLOPPIES • SERIAL, PARALLEL, GAME PORT AND CLOCK/CALENDAR

MCT-MIO

MULTI I/O CARD \$59.95

• SERIAL PORT
• CLOCK/CALENDAR WITH BATTERY
• PARALLEL PORT IS ADDRESSABLE AS LPT1 OR LPT2 MCT-IO

286/386 MULTI I/O CARD \$59.95

• SERIAL, PARALLEL AND GAME PORTS • USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPERATION MCT-AIO

MONOGRAPHS MULTI I/O \$119.75

• CONTROLS 2 FLOPPIES • SERIAL, PARALLEL, GAME PORT • CLOCK/CALENDAR • RUNS COLOR GRAPHICS IN B&W MCT-MGMIO

MCT-MGAIO 286/386 MONOGRAPHS I/O \$99.95

DISPLAY ADAPTORS

16-BIT VGA CARD \$329.95

• REGISTER LEVEL COMPATIBLE VGA CARD
• RESOLUTION: 1024 X 768 TEXT: 132 COL. X 25 LINE
• SOFTWARE DRIVERS FOR LOTUS 1-2-3, AUTODESK, AUTOCAD, GEM AND WINDOWS.

MCT-VGA-16

MCT-VGA-8 8-BIT VERSION (ANALOG ONLY) \$199.95

MCT-VGA 8-BIT VGA (FOR ALL MONITORS) \$249.95

EGA ADAPTOR \$149.95

• IBM COMPATIBLE, PASSES IBM EGADIAGNOSTICS
• 256K OF VIDEO RAM FOR 640 X 350 IN 16 OF 64 COLORS MCT-EGA

COLOR GRAPHICS ADAPTOR \$49.95

• FOR RGB, COLOR AND COMPOSITE MONOCHROME
• 640/320 X 200 RESOLUTION • LIGHT PEN INTERFACE MCT-CG

MCT-CGP WITH PARALLEL PRINTER PORT \$54.95

MONOCHROME GRAPHICS \$59.95

• HERCULES COMPATIBLE • SUPPORTS LOTUS 1-2-3
• PARALLEL PRINTER PORT CONFIG. AS LPT1 OR 2 MCT-MGP

QUADRAM JT-FAX



\$279

INTERNAL



\$349

EXTERNAL

PC MAGAZINE'S "EDITORS CHOICE"! JUNE 1988 THIS FAX BOARD WON'T TIE UP YOUR COMPUTER! ITS MEMORY RESIDENT SOFTWARE WAITS IN THE BACKGROUND TO SEND OR RECEIVE FAXES. LETS YOU USE YOUR COMPUTER UNTIL A FAX IS ACTUALLY SENT OR RECEIVED. COMPATIBLE WITH SEVERAL PAGE SCANNERS.

- 4800 BPS COMMUNICATIONS RATE
 - RAM RESIDENT SOFTWARE
 - COMPATIBLE WITH PC/XT/AT
 - USES FAX, ASCII OR PC PAINT FILES
 - CHOOSE INTERNAL CARD OR EXTERNAL PORTABLE
- JT-FAX INTERNAL MODEL \$279.00
JT-FAX-PORT EXTERNAL MODEL \$349.00
JT-FAX-9600 9600 BAUD (FULL-SIZE CARD) \$549.00

intel

CONNECTION COPROCESSOR

\$795



"PRODUCT OF THE YEAR"—INFO WORLD
"BEST OF 1988"—PC MAGAZINE

SEND OR RECEIVE FAX'S "IN THE BACKGROUND" WITHOUT INTERRUPTING OTHER APPLICATIONS! COMPATIBLE WITH PC/XT, AT AND 386 COMPUTERS. INTEL 5 YEAR WARRANTY!

- ON-BOARD 10MHZ 80188 COPROCESSOR • 256K RAM
 - SUPPORTS DCA/INTEL CAS, 3600 BPS FILE TRANSFER, INCLUDING FAX AND E-MAIL • INSTALLATION SOFTWARE, GRAPHICS EDITOR AND DIAGNOSTICS INCLUDED.
- PCCB6000 \$795.00
PCC06010 2400 BAUD PIGGYBACK MODEM \$249.00
PCIB1200 INTEL INBOARD 386/PC \$649.00
PCMB4320 INTEL ABOVE BOARD PLUS \$499.95

576K RAM CARD \$59.95

• SHORT SLOT • USER SELECTABLE CONFIGURATION TO 576K • 64K AND 256K RAM CHIPS (OK INSTALLED).

MCT-RAM

EXPANDED MEMORY CARD \$139.95

• 2MB MEMORY(OK INSTALLED) • USER EXPANDABLE TO 2 MB USING 1MB DRAMS • CONFORMS FULLY TO LIM EMS 3.2.

MCT-AEMS



JIM'S BARGAIN HUNTERS CORNER

150 MB ESDI DRIVE KIT \$999

- THE MICROPOLIS ESDI PC FAX KIT INCLUDES:
- 150 MB FULL-HEIGHT 5-1/4" HARD DISK WITH ESDI INTERFACE AND 25MB AVERAGE SPEED
- WESTERN DIGITAL INDUSTRY-WAN/152 ESDI FLOPPY/HARD CONTROLLER WITH 1:1 INTERLEAVE & LOOK-AHEAD CACHING
- HARD DRIVE DATA CABLE AND CONTROL CABLE
- ALL MOUNTING HARDWARE
- REGISTRATION SOFTWARE INCLUDING DRIVE DIAGNOSTICS
- DRIVER SOFTWARE FOR NOVELL NETWORKS 286
- INSTALLATION GUIDE AND DOCUMENTATION

EXPIRES 4-30-89

Terms: Minimum order \$10.00. For shipping & handling include \$3.50 for ground and for \$4.50 air. Orders over 1 lb and foreign orders may require additional shipping charges—please contact the sales department for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sales. A full copy of our terms is available upon request. Items pictured may only be representative.

JDR MICRODEVICES, 2233 BRANHAM LANE, SAN JOSE, CA 95124
LOCAL (408) 866-6200 FAX (408) 559-0250 TELEX 171-110

RETAIL STORE: 1256 S. BASCOM AVE., SAN JOSE, CA
(408) 947-8881 HOURS: M-F, 9-7 SAT. 9-5 SUN. 12-4

ORDER TOLL-FREE 800-535-5000

COPYRIGHT 1989 JDR MICRODEVICES

CONTINENTAL US

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

INQUIRY #	COMPANY	PAGE	INQUIRY #	COMPANY	PAGE	INQUIRY #	COMPANY	PAGE
	ADVANCED MICRO DEVICES.....	241	1125	INOVATIC	72	1040	PENNY AND GILES COMPUTER PRODUCTS.....	109
	AGILIS	17		INSTRUMENT SOCIETY OF AMERICA	17	1104	PETER NORTON COMPUTING.....	137
1110	AGRANAT SYSTEMS	72		INTEGRATED INFORMATION TECHNOLOGY	17	881	PHAR LAP SOFTWARE	187
1190	APOLLO COMPUTER	17, 235, 248		INTEL.....	17	853	PRITSKER & ASSOCIATES	259
1182	APPLE COMPUTER ...	17, 99, 143, 148, 250	1123	INTELLIGENT DEVICES	72		PROFIT SYSTEMS	181
	AT&T.....	215		INTERNATIONAL ORGANIZATION FOR STANDARDIZATION	148	1034	QUARTERDECK OFFICE SYSTEMS.....	109
1127	ATARI COMPUTER.....	57	1035	INTERSTEL	109		RADIUS	99
	AVID TECHNOLOGY	17	1153	INVISIBLE SOFTWARE	57		RASTEROPS	99
	BORLAND INTERNATIONAL.....	104, 259	886	ITHACA SOFTWARE.....	193	1122	REFERENCE SOFTWARE	72
1107	BOWERS DEVELOPMENT	72		IXI	250	1143	RELISYS	57
1185	BRAINPOWER	143	1142	KENSINGTON MICROWARE.....	57		RETIX	148
1027	BRIGHTBILL-ROBERTS	89	1184	KINKO'S ACADEMIC COURSEWARE EXCHANGE	143	950	RJ SWANTEK	72
	CACI.....	259	1128	KISS COMPUTER.....	57		SANTA CRUZ OPERATION	215, 250
1108	CAM SOFTWARE	72	1117	KNOWLEDGEPOINT	72	1183	SENSEI/BRODERBUND SOFTWARE	143
1133	COMPLETE PC	57	1112	LAPCAD ENGINEERING	72	1118	SOFTTEK DESIGN.....	72
1115	COMPUTATIONAL ENGINEERING ASSOCIATES	72	1121	LENNANE ADVANCED PRODUCTS	72	1036	SOFTVIEW	109
854	COMPUTER AIDED MANAGEMENT	72	1192	LOCUS COMPUTING	225, 248	1031	SOFTWARE TOOLWORKS.....	109
	CONNECTIX	99		MADGE NETWORKS	148	1139	SOTA TECHNOLOGY	57
1021	CORRALES SOFTWARE.....	125	1032	MAXIMUM STORAGE	109	1191	SUN MICROSYSTEMS ...	17, 225, 235, 248, 250
	DEFENSE ADVANCED RESEARCH PROJECTS AGENCY	17	1134	META-SOFTWARE	17	1144	SUNFLEX.....	57
1023	DICONIX.....	125	1024	MICROPOLIS.....	57	1026	SUPERMAC TECHNOLOGY ...	89, 99
	DIGITAL COMMUNICATIONS ASSOCIATES	17	1038	MICROPRO INTERNATIONAL	125	1022	SYMANTEC.....	72, 125
	DIGITAL EQUIPMENT	250	1129	MICROSOFT	17, 104, 109, 148, 241, 250	1116	SYMBOLICS.....	72
	DIGITAL RESEARCH	250	1129	MISSION CYRUS GROUP	57	1111	SYSTEMS PERFORMANCE EVALUATION COOPERATIVE...	17
1137	DTK COMPUTER	57		MIT.....	250		TATUNG OF AMERICA.....	57
	DUKE UNIVERSITY	259	1028	MITSUBISHI INTERNATIONAL ...	89	851	TEKTRONIX	177
1113	DYNAMICAL SYSTEMS.....	72, 109		NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY	17	1181	TELEROBOTICS INTERNATIONAL.....	143
1132	EASTMAN KODAK	57	1136	NATIONAL INSTRUMENTS	17, 57	1073	3COM	148, 154
	ELOGRAPHICS.....	17	1154	NEOTECH	57		TOSHIBA.....	17
1152	EMERALD COMPUTERS.....	57	1189	NETWISE	248	1151	TRITON TECHNOLOGIES.....	57
1039	ENGINEERING SOFTWARE CONCEPTS.....	109	1037	NEXT COMPUTER	250		UNIVERSITY OF CALIFORNIA AT DAVIS	17
1147	EPSON AMERICA	57	1072	NORTHGATE COMPUTER SYSTEMS.....	109		WEITEK.....	17
1029	FIFTH GENERATION SYSTEMS...	89	1072	NOVELL.....	148, 154, 248	1186	WOLFRAM RESEARCH.....	143
885	FOLIO.....	201	1188	OBJECT MANAGEMENT GROUP	17	1106	WORDTECH SYSTEMS.....	72
1114	GW INSTRUMENTS	72		ONTRACK DATA RECOVERY	137	1103	WORKMAN & ASSOCIATES	137
1138	HAUPPAUGE COMPUTER WORKS	57	1101	OPEN SOFTWARE FOUNDATION.....	17, 250		XEROX	235
	HEWLETT-PACKARD	17, 89, 250	1102	PARA SYSTEMS.....	57		XEROX PALO ALTO RESEARCH CENTER	250
1149	HILGRAEVE.....	57	1105	PAUL MACE SOFTWARE	137	1109	XIAN.....	72
	HOWTEK.....	99					XIRCOM.....	17
852	IBM	154, 173, 225, 248, 250					ZENITH DATA SYSTEMS	215
1071						1145	ZIRCO	57
1193								
882	INFORMIX SOFTWARE.....	17, 207, 215						

COMING UP IN BYTE

PRODUCTS IN PERSPECTIVE:

How do the most powerful MS-DOS laptop computers stack up? Our August **Product Focus** on 80386-based laptops will provide the answer. Speaking of **laptops**, we review NEC's diminutive yet powerful UltraLite—PC power that weighs less than 5 pounds. For **PS/2 users**, we evaluate Pixelworks' Ultra Clipper graphics board and three Modula-2 compilers from JPI, Stonybrook, and Logitech.

On the **Macintosh side**, we'll report on Shiva's TeleBridge, which allows your network to access remote computers or other networks, and Virginia Systems' Sonar Professional 2.0, a text-search program.

Finally, a **software review** looks at Traveling Software's much-ballyhooed ViewLink, an information management program with a unique approach.

IN DEPTH:

What are **neural networks**? How is data represented in neural networks, and what major applications is this type of processing technology being used for? Why are they good for solving problems that traditional computing isn't, and what's hidden in their hidden layers? All this and more in the August focus on neural networks.

FEATURES:

The lead feature article for the August issue is a piece on **digital signal processors**. DSPs are finding their way into every aspect of personal computing—in areas from fax transmission, to data encryption and compression, to voice digitization—in fact, anyplace where analog signals become digitized.

Increasingly, the Unix operating system is becoming an option for power users of personal computers. Another August feature will take a look at the **Unix shell**, a command programming language that provides the user interface to the operating system. In addition, we'll have a special article on **very long instruction word technology**, a new architecture considered by some to be the heir to RISC.

Brett Glass looks **Under the Hood** at disk snoopers, software packages that look at and attempt to "repair" problem hard disks. What do these programs actually do, and how well do they do it?

In his **Some Assembly Required** column, Rick Grehan will discuss a set of tools for the IBM PC that mimics the memory management of the Macintosh and lets you overcome some pesky barriers.

In the **Expert Advice** section, our columns will include Computing at Chaos Manor, Down to Business, Macinations, OS/2 Notebook, NetWorks, and Unix /bin. Further, in the back of the book, our new book-review column by Hugh Kenner, Print Queue, and the op-ed-type Stop Bit will continue to enliven the format for those of us who like to read from back to front instead of the other way around.

In our August **Macintosh Special Edition**, we'll have a full-featured lineup that will include Short Takes, First Impressions, and features.

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 a Buyer's Guide to talking microcomputers and large print display processors. More importantly it includes reviews, written by blind users, of software that works with speech.

This invaluable resource book offers details on training programs in computer applications for the blind, and other useful information on how to buy and use special equipment.

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. (\$3 extra for UPS shipping)
NBP is a nonprofit braille printing and publishing house.

READER SERVICE

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.

Alphabetical Index to Advertisers

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	
8	2001 SALES	182	80	CURTIS INC	179	164	LOGITECH	87
9	2001 SALES	182	81	CURTIS INC	308	185	LOGITECH	87
10	ACS COMMUNICATIONS	310	*	DAMARK	166	188	LOGITECH	170
28	A.C.P.	325	82	DATA TRANSLATION	54	167	LOGITECH	170
*	ADOBE	191	83	DCI COMPUTERS	309	318	M2 LAB/MICRO	248
15	ADVANCED LOGIC RESEARCH	2,3	87	DELL COMPUTER	CII,1	168	MARYMAC INDUSTRIES	322
16	ADVANCED LOGIC RESEARCH	2,3	*	DELL COMPUTER	178A-B	189	MATHSOFT	59
11	ADVANTAGE SOFTWARE	273	89	DEPARTMENTAL TECHNOLOGIES	141	170	MATRIX SOFTWARE	214
12	AK SYSTEMS	308	90	DIGI-DATA CORP.	317	*	MAXCIMA	309
14	ALPHA PRODUCTS	311	91	DIGI-DATA CORP.	314	171	MAXON	98
17	AMERICAN GROUP	314	92	DIGIBOARD	230,231	172	MEAD COMPUTER	318
18	AMERICAN SMALL BUS. COMP.	124	94	DIGITAL RESEARCH	203	173	MEGA DRIVE	185
*	AMPRO	110	95	DIGITAL RESEARCH	203	174	MEGATEL COMPUTER	128
19	AMS	308	100	DISKOTECH	309	175	MERITT COMPUTERS	198
20	ANAHEIM AUTOMATION	309	101	DISKETTE CONNECTION	317	176	MICRO LINEAR CONTROL	308
21	ANALOG & DIGITAL PERIPH.	309	102	DIVERSIFIED COMPUTER	319	177	MICROPROCESSORS UNLTD.	310
22	ANNABOOKS	299	103	DIVERSIFIED TECH	102	178	MICROFORM	209
*	ANTHRO	48	104	DSP	32	179	MICROFORM	209
23	APPLIED PROGRESSIVE ELECT	312,313	105	DTK	153	182	MICROSOFT CORP.	6,7
24	ATI TECHNOLOGIES	199	108	DYNAMIC ELECTRONICS	319	183	MICROSOFT CORP.	6,7
25	ATRON	31	107	ECOSOFT	88	184	MICROSOFT CORP.	19
26	AVOCET SYSTEMS	79	108	EMERSON COMP. POWER	190	185	MICROSOFT CORP.	19
27	AVOCET & QUELO	310	319	EMPIRICAL RESEARCH	210	*	MICROSOFT CORP.	268
29	B P MICROSYSTEMS	314	*	EPSON	20,21	*	MICROSOFT CORP.	276
30	B & B ELECTRONICS	321	109	EXECUTIVE PHOTO & SUPPLY	208	186	MICROSTAR LAB	322
31	B & C MICRO	319	248	FASTLYNX/RUPP	131	187	MICROTECH CONVERSION SYS.	321
32	B & C MICRO	321	98	FLAGSTAFF ENGINEERING	108	188	MICROWAY	133
33	B & C MICRO	321	97	FLAGSTAFF ENGINEERING	108	*	MICROWAY	180
34	BAY TECH	200	98	FLAGSTAFF ENGINEERING	108	189	MIDI MUSIC	324
35	BAY TECH	200	99	FLAGSTAFF ENGINEERING	108	190	MITSUBISHI	107
36	BE AWARE, INC	78	110	FORTRON CORP.	247	191	MITSUBISHI	107
37	BE AWARE, INC	78	111	FORTRON CORP.	247	192	MITSUBISHI	116,117
38	BEST COMPUTER	305	112	FOX SOFTWARE	23	193	MITSUBISHI	116,117
39	BINARY TECH	310	113	FTG DATA SYSTEMS	317	194	MIX SOFTWARE	283
40	BIOLOGICAL ENGINEERING	320	114	GATEWAY 2000	10,11	195	MKS (AKA MORTICE KERN)	285
41	BIT WISE	306	115	GENERAL ELECTRIC (GEISCO)	103	*	MONTGOMERY GRANT	127
42	BIT WISE	308	118	GENERIC SOFTWARE	227	196	MULTI-MICRO	37
450	BIX	74,75	117	GENERIC SOFTWARE	227	197	MULTI-MICRO	37
*	BIX	130	119	GENESIS DATA SYSTEMS	94	198	NANAO	142
*	BIX	152	116	GENESIS DATA SYSTEMS	94	199	NANAO	142
43	BLAISE COMPUTING	55	120	G-TEK INC.	150	312	NATIONAL INSTRUMENTS	CIII
44	BOLT SYSTEMS	128	121	G-TEK INC.	150	313	NATIONAL INSTRUMENTS	CIII
45	BOLT SYSTEMS	128	122	HAMMERLY COMPUTER SERV.	232	*	NEC HOME ELECTRONICS	32
46	BORLAND	61	123	HAMMERLY COMPUTER SERV.	233	*	NEC HOME ELECTRONICS	33
47	BORLAND	61	200	HANTZ & PARTNER	324	205	NEW GENERATION SYSTEMS	324
48	BUFFALO PRODUCTS	157	*	HEWLETT-PACKARD COMP.	14,15	206	NOHAU	321
*	BUYER'S MART	288-298	124	HEWLETT-PACKARD PERIPHERAL	50,51	207	NU-MEGA TECHNOLOGIES	111
*	BYTE BACK ISSUES	307	125	HEWLETT-PACKARD PERIPHERAL	80,81	208	ON TARGET ASSOCIATES	322
330	BYTE BITS	314	127	HEWLETT-PACKARD PERIPHERAL	195	209	ON-LINE STORE	68,69
*	BYTE SUB MESSAGE	102	126	HEWLETT-PACKARD PERIPHERAL	197	*	ORACLE	71
*	BYTE SUB MESSAGE	282	129	HIGH RES. TECH	322	210	OVERLAND DATA	321
49	BYTEK	310	130	HI-Q INTERNATIONAL, INC	86	211	PACIFIC COMPUTER	304
*	BYTEWEEK/NEWSLETTER	178	131	HI-Q INTERNATIONAL, INC	86	215	PARA SYSTEMS	97
50	C W DATA-LABS	308	132	HITECH EQUIPMENT CORP.	324	216	PATTON & PATTON	120
*	CALIFORNIA DIGITAL	323	133	I C EXPRESS	317	217	PAUL MACE SOFTWARE	132
51	CAMBRIDGE N.A.	172	*	IBM-SAA DIVISION	13	218	PERFORMANCE TECH.	164
52	CAPITAL EQUIPMENT	198	*	IBM-SAA DIVISION	28,29	219	PERISCOPE	121
54	CENTURY SOFTWARE	136	*	IBM CORP.	189	220	PERISCOPE	121
55	CENTURY SOFTWARE	136	137	IDEA WORKS	309	221	PERSONAL TEX	40
*	CERMETEK MICROELECTONIC	48	136	IMCO MANUFACTURING CORP	299	224	PRECISION DATA PRODUCTS	310
*	CIOS 21 WORLD		144	INDUSTRIAL COMPUTER SRC	248	225	PRENTICE HALL	223
*	MANAGEMENT CONGRESS	338	141	INFORMIX	43	228	PROGRAMMER'S PARADISE	62,83
*	CLEO SOFTWARE	187	142	INTEGRAND	184	227	PROGRAMMER'S SHOP	112
56	CLONE COMPUTERS	300,301	143	INTERNATIONAL COMP GROUP	41	228	PROTECH MARKETING	94
57	CMO	84,85	145	IO TECH	101	229	PROTEUS TECHNOLOGY CORP.	27
59	COMPACT DISK PRODUCTS	171	146	IO TECH	322	230	QMS	49
*	COMPAQ	56A-D	147	JADE COMPUTER	315	231	QUA TECH	282
80	COMPUCLASSICS	113	148	JAMECO ELECTRONICS	302,303	232	QUALSTAR CORP.	322
61	COMPUCOM	299	8	J.D.R. MICRODEVICES	328-329	233	QUANTUM SOFTWARE SYS.	73
62	COMPUSAVE	307	7	J.D.R. MICRODEVICES	328-329	234	QUARTERDECK	134,135
63	COMPUTER ASSOCIATES	24,25	*	JENSEN & PARTNERS	115	235	QUARTERDECK	134,135
64	COMPUTER FRIENDS	309	150	JYACC, INC	77	236	QUARTERDECK	134,135
65	COMPUTER SYSTEMS RES.	36,39	151	KADAK	179	237	QUARTERDECK	134,135
66	COMPUTERLANE	145	152	KEA SYSTEMS	163	239	RADIO SHACK	CIV
67	COMPUTRADE	96	153	KNOWLEDGE GARDEN	343	*	RAIMA	35
68	COMP. DISCOUNT WAREHOUSE	119	154	KORE INC	314	240	RAINBOW TECHNOLOGIES	186
69	CONNECTIX	146	155	LAHEY COMPUTER SYSTEMS	112	241	RAINBOW TECHNOLOGIES	186
70	CONTECH	310	156	LANTANA TECHNOLOGY	48	242	RAINBOW TECHNOLOGIES	234
73	CONTROL VISION	317	157	LANTANA TECHNOLOGY	48	243	RAINBOW TECHNOLOGIES	234
74	CORPORATE COMPUTERS OF IOWA	243	158	LAWSON LABS	321	244	REAL TIME DEVICES	324
75	CORPORATE COMPUTERS OF IOWA	243	159	LINK COMPUTER GRAPHICS	317	245	ROSE ELECTRONICS	151
76	COUNT DISK	210	160	LOGICAL DEVICES	324	322	RUPP CORP.	219
77	COVOX	314	161	LOGICAL DEVICES	324	323	RUPP CORP.	219
78	CUBIX CORP.	165	162	LOGITECH	85	324	RUPP CORP.	219
79	CUBIX CORP.	185	163	LOGITECH	85	325	RUPP CORP.	219
326	RUPP CORP.	219	327	RUPP CORP.	219	328	SANTA CRUZ OPERATION	87
327	RUPP CORP.	219	248	SABINA INT'L	310	249	SAFEWARE	324
248	SABINA INT'L	310	317	SAIC	82	250	SANITARY COMPUTER	341
249	SAFEWARE	324	251	SCANDEC TRIBUTOR	319	252	SCHWAB COMPUTERS	258
317	SAIC	82	253	SCIENTIFIC ENDEAVORS	322	254	SCIENTIFIC ENDEAVORS	322
250	SANTA CRUZ OPERATION	87	255	SCIOTO COMPUTERS	321	*	SOFTWARE DEV. SYSTEMS	91
251	SCANDEC TRIBUTOR	341	256	SOFTWARE LINK	205	257	SOFTWARE LINK	205
252	SCHWAB COMPUTERS	319	258	SOFTWARE LINK	267	259	SOFTWARE LINK	267
328	SCIENCE ACCESSORIES	258	260	SOFTWARE SECURITY	95	261	SPECTRUM	83
253	SCIENTIFIC ENDEAVORS	322	262	SPSS	192	263	STATSOFT	123
254	SCIENTIFIC ENDEAVORS	322	284	STERLING CASTLE	122	285	STERLING CASTLE	122
255	SCIOTO COMPUTERS	321	267	STORAGE DIMENSIONS	138,139	268	STORAGE DIMENSIONS	138,139
*	SOFTWARE DEV. SYSTEMS	91	268	STORAGE DIMENSIONS	138,139	320	STORAGE DIMENSIONS	138,139
256	SOFTWARE LINK	205	321	STORAGE DIMENSIONS	138,139	289	SUPERSOFT	257
257	SOFTWARE LINK	205	270	SURAH	319	271	SWIRL SOFT	324
258	SOFTWARE LINK	267	272	SYSGEN	47	274	SN'W ELECTRONICS	52
259	SOFTWARE LINK	267	318	S & S COMPUTER PROD.	299	275	TALKING TECHNOLOGY	319
260	SOFTWARE SECURITY	95	276	TELEBIT	147	277	TELEBYTE TECHNOLOGY, INC.	86
261	SPECTRUM	83	277	TELEBYTE TECHNOLOGY, INC.	86	278	THOMAS CONRAD	159
262	SPSS	192	278	THOMAS CONRAD	159	279	THOMAS CONRAD	181
263	STATSOFT	123	280	TMI INC.	78	281	TOSHIBA	221
284	STERLING CASTLE	122	282	TOSHIBA	221	283	TOUCHBASE SYSTEMS	36
285	STERLING CASTLE	122	283	TOUCHBASE SYSTEMS	36	284	TRAVELING SOFTWARE	239
267	STORAGE DIMENSIONS	138,139	284	TRAVELING SOFTWARE	239	285	TRUE DATA	140
268	STORAGE DIMENSIONS	138,139	286	TRUEVISION	93	287	TURBO POWER	281
320	STORAGE DIMENSIONS	138,139	287	TURBO POWER	281	288	TWIX INTERNATIONAL	319
321	STORAGE DIMENSIONS	138,139	289	T.W.S. MICROTECH	284	290	ULTIMATE TECHNOLOGY	314
289	SUPERSOFT	257	290	ULTIMATE TECHNOLOGY	314	291	UNITEK	318
270	SURAH	319	292	UNIVERSAL CROSS-ASSEMBLERS	317	293	V N S	53
271	SWIRL SOFT	324	293	V N S	53	295	V N S	224
272	SYSGEN	47	*	VERMONT CREATIVE	16	297	VICTORY ENTERPRISES	140
274	SN'W ELECTRONICS	52	298	WAREHOUSE DATA	211	299	WELLS AMERICAN (N. AMERICA)	275
318	S & S COMPUTER PROD.	299	300	WELLS AMERICAN (INT'L)	275	301	WESTERN CONTAINER & CASE	308
275	TALKING TECHNOLOGY	319	302	WINTK CORP.	9	303	WINTK CORP.	308
276	TELEBIT	147	308	XELTEK	308	308	XENTEK	308
277	TELEBYTE TECHNOLOGY, INC.	86	307	ZENITH DATA SYSTEMS	183	309	ZEOS INTERNATIONAL	44,45
278	THOMAS CONRAD	159	310	ZORTECH	249	311	Z-WORLD	310
279	THOMAS CONRAD	181					INTERNATIONAL SECTION 88 IS 1-56	
280	TMI INC.	78					No North American Inquiries please.	
281	TOSHIBA	221	401	ACER	88IS-46,47	402	AMDS	88IS-18
282	TOSHIBA	221	*	BIX	88IS-38	403	BIX	88IS-55
283	TOUCHBASE SYSTEMS	36	404	BLUZE CHIP	88IS-32	*	BYTE BACK ISSUES	88IS-34
284	TRAVELING SOFTWARE	239	405	BYTE BITS	88IS-32	*	BYTE PUBLICATIONS	88IS-35
285	TRUE DATA	140	*	BYTE PUBLICATIONS	88IS-56	*	BYTE SUB SERVICE	88IS-40
286	TRUEVISION	93	*	BYTEWEEK NEWSLETTER	88IS-45	408	CLARION SOFTWARE	88IS-23
287	TURBO POWER	281	407	CLARION SOFTWARE	88IS-23			

READER SERVICE

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
408 COPAM ELECTRONICS CORP.	88IS-25	INT'L DIRECT RESPONSE POSTCARDS		495 EDIMAX COMPUTER CO.	NE-9	551 MELBOURNE HOUSE	PC-13
409 DATEX SYSTEMS, INC.	88IS-15	* EIKON SYSTEMS	88IS	496 ELECTRIFIED DISCOUNTERS	NE-12	552 MEXTEL CORP.	PC-4
410 DISK STAR	88IS-26	* MICROSIM	88IS	507 HALSKAR SYSTEMS	NE-11	553 MIRACLE COMPUTERS	PC-2
* ELONEX	88IS-31	* SOFTWARE BLACKSMITH	88IS	508 HALSKAR SYSTEMS	NE-11	554 OSMOS, INC.	PC-6
411 GAMMA PRODUCTIONS	88IS-24	* SOFTWARE EXCITEMENT	88IS	497 MEXTEL	NE-2	555 OSMOS, INC.	PC-6
412 GREY MATTER	88IS-48	* TOUCHBASE SYSTEMS	88IS	498 OWL COMPUTER	NE-4	556 TELETEK	PC-5
413 GTCO	88IS-19	* T.S.A. CORPORATION	88IS	499 OWL COMPUTER	NE-4	557 TELETEK	PC-5
415 INES	88IS-28			500 PC LINK CORP.	NE-5	558 USM DISTRIBUTORS	PC-11
416 INTERQUADRAM	88IS-5			502 ROCHESTER INSTITUTE/TECH.	NE-6	559 USM DISTRIBUTORS	PC-11
417 INTERQUADRAM	88IS-7			503 TELETEK	NE-7	560 ZERICON	PC-1
418 INTERQUADRAM	88IS-9			504 TELETEK	NE-7		
414 I X I LIMITED	88IS-30			505 WEDGE TECHNOLOGIES	NE-3		
422 JAMECO ELECTRONICS	88IS-43			506 WEDGE TECHNOLOGIES	NE-3		
423 KAP	88IS-16						
424 LOGIC PRGRAMMING ASSOC.	88IS-28						
425 MASHOV	88IS-21						
426 MAYFAIR MICROS	88IS-36						
* MICROCOMP. MKTG. CNSL.	88IS-53						
427 MICROMINT	88IS-20						
428 MICRON TECHNOLOGY INC.	88IS-29						
429 MICROPHAR	88IS-22						
* MOSAIC SOFTWARE	88IS-30						
430 NICHOLS-MORLOS	88IS-38						
431 NOVELL	88IS-17						
432 PERICOM	88IS-27						
433 SCANDEC TRIBUTOR, INC.	88IS-2						
434 SCOTTSDALE SYSTEMS	88IS-11						
435 SCOTTSDALE SYSTEMS	88IS-11						
440 SIEMENS	88IS-39						
* SOFTLINE CORP.	88IS-41						
438 SOFTWARE CONSTRUCTION	88IS-33						
437 TRIANGLE DIGITAL	88IS-30						
438 U S A SOFTWARE	88IS-13						
439 ULTIMATE TECHNOLOGY	88IS-32						

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, 8111 LBJ Freeway, Suite 1350, Dallas, TX 75251, tel. (214) 644-1111
 L. Bradley Browne, Telemarketing Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281

NEW ENGLAND
 ME, NH, VT, MA, RI, ONTARIO
 CANADA & EASTERN CANADA
 John C. Moon (617) 262-1160
 McGraw-Hill Publications
 575 Boylston Street
 Boston, MA 02116

ATLANTIC
 NY, NYC, CT, NJ (NORTH)
 (212) 512-2645
 McGraw-Hill Publications
 1221 Avenue of the Americas—
 36th Floor
 New York, NY 10020

EAST
 PA, NJ (SOUTH),
 MD, W. VA, DE, D.C.
 Thomas J. Brun (215) 496-3833
 McGraw-Hill Publications
 Three Parkway
 Philadelphia, PA 19102

SOUTHEAST
 NC, SC, GA, FL, AL, TN, VA, MS
 Thomas Tolbert (404) 252-0626
 McGraw-Hill Publications
 4170 Ashford-Dunwoody Road
 Suite 420
 Atlanta, GA 30319

MIDWEST
 IL, MO, KS, IA, ND, SD, MN,
 KY, OH, WI, NB, IN, MI
 Kurt Kelley (312) 751-3740
 McGraw-Hill Publications
 Blair Building
 645 North Michigan Ave.
 Chicago, IL 60611

**SOUTHWEST,
 ROCKY MOUNTAIN**
 CO, WY, OK, TX, AR, LA
 Karl Heinrich (713) 462-0757
 McGraw-Hill Publications
 7600 W. Tidwell Rd.—Suite 500
 Houston, TX 77040

SOUTH PACIFIC
 SOUTHERN CA, AZ, NV,
 LAS VEGAS
 Ron Cordek (714) 557-6292
 McGraw-Hill Publications
 3001 Red Hill Ave.
 Building #1—Suite 222
 Costa Mesa, CA 92626

Tom Harvey (213) 480-5243
 McGraw-Hill Publications
 3333 Wilshire Boulevard #407
 Los Angeles, CA 90010

NORTH PACIFIC
 HI, WA, OR, ID, MT,
 NORTHERN CA,
 NV (except LAS VEGAS),
 W. CANADA, UT
 Christine Kopec (415) 362-4600
 McGraw-Hill Publications
 425 Battery Street
 San Francisco, CA 94111

Bill McAfee (408) 879-0371
 McGraw-Hill Publications
 1999 South Bascom Ave.
 Suite #210
 Campbell, CA 95008

BYTE BITS (2x3)
 Mark Stone (603) 924-6830
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

The Buyer's Mart (1x2)
 Brian Higgins (603) 924-3754
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

Regional Advertising
 Scott Gagnon (603) 924-4380
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

Larry Levine (603) 924-4379
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

Barry Echavarría (603) 924-2574
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

National Sales
 Liz Coymann (603) 924-2518
 Dan Harper (603) 924-2598
 Elisa Lister (603) 924-2665
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

BYTE Deck Mailings
 Ed Ware (603) 924-6166
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

A/E/C Computing Deck
 Computing for Engineers
 Mary Ann Goulding
 (603) 924-2664
 BYTE Publications
 One Phoenix Mill Lane
 Peterborough, NH 03458

International Advertising Sales Staff:

Frank Tanis, European Sales Manager, BYTE Publications,
 Batenburg 103, 3437 AB Nieuwegein, The Netherlands, tel: 31 34 02 49496, fax: 31 34 02 37944

Karen Lennie
 McGraw-Hill Publishing Co.
 34 Dover St.
 London W1X 4BR
 England 01 493 1451

Ros Weyman
 Serving Germany, Austria, & Switzerland
 McGraw-Hill Publishing Co.
 34 Dover St.
 London W1X 4BR
 England 01 493 1451

Alessandro Coari
 McGraw-Hill Publishing Co.
 Via Flavio Baracchini 1
 20123 Milan, Italy
 (2) 89010103

Mrs. Maria Sarmiento
 Pedro Teixeira 8, Off. 320
 Iberia Mart I
 Madrid 4, Spain
 1 45 52 891

Masaki Mori
 McGraw-Hill Publishing Co.
 Overseas Corp.
 Room 1528
 Kasumigaseki Bldg.
 3-2-5 Kasumigaseki,
 Chiyoda-Ku
 Tokyo 100, Japan
 3 581 9811

Seavex Ltd.
 503 Wilson House
 19-27 Wyndham St.
 Central, Hong Kong
 Tel: 5-260149
 Telex: 60904 SEVEX HX

Seavex Ltd.
 400 Orchard Road, #10-01
 Singapore 0923
 Republic of Singapore
 Tel: 734-9790
 Telex: RS35539 SEAVEX

Mr. Ernest McCrary
 Empresa Internacional de
 Comunicacoes Ltda.
 Rua da Consolacao, 222
 Conjunto 103
 01302 Sao Paulo, S.P., Brasil
 Tel: (11) 259-3811
 Telex: (100) 32122 EMBN

READER SERVICE

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.

Index to Advertisers by Product Category

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
HARDWARE							
800	ADD INS	29	B P MICROSYSTEMS 314	808	MONITORS	285	TRUE DATA 140
14	ALPHA PRODUCTS 311	31	B & C MICRO 319	192	MITSUBISHI 116,117	814	SOFTWARE SECURITY
402	AMDS 88IS-18	49	BYTEK 310	193	MITSUBISHI 116,117	429	MICROPHAR 88IS-22
24	ATI TECHNOLOGIES 199	120	G-TEK INC. 150	198	NANAO 142	228	PROTECH MARKETING 94
32	B & C MICRO 321	121	G-TEK INC. 150	199	NANAO 142	240	RAINBOW TECHNOLOGIES 186
33	B & C MICRO 321	154	KORE INC 314		* NEC HOME ELECTRONICS 32	241	RAINBOW TECHNOLOGIES 188
404	BLUE CHIP 88IS-32	159	LINK COMPUTER GRAPHICS 317		* NEC HOME ELECTRONICS 33	242	RAINBOW TECHNOLOGIES 234
52	CAPITAL EQUIPMENT 198	160	LOGICAL DEVICES 324	809	NETWORK HARDWARE	243	RAINBOW TECHNOLOGIES 234
73	CONTROL VISION 317	181	LOGICAL DEVICES 324	10	ACS COMMUNICATIONS 310	280	SOFTWARE SECURITY 95
77	COVOX 314	308	XELTEK 308	20	ANAHEIM AUTOMATION 309	815	SYSTEMS
81	CURTIS INC 308	803	INSTRUMENTATION	48	BUFFALO PRODUCTS 157	401	ACER 88IS-48,47
82	DATA TRANSLATION 54	104	DSP 34	78	CUBIX CORP 185	15	ADVANCED LOGIC RESEARCH 2,3
103	DIVERSIFIED TECH 102	804	KEYBOARDS/MICE	79	CUBIX CORP 185	18	ADVANCED LOGIC RESEARCH 2,3
411	GAMMA PRODUCTIONS 88IS-24	413	GTCO 88IS-19	409	DATEX SYSTEMS, INC. 88IS-15		* AMPRO 110
200	HANTZ & PARTNER 324	182	LOGITECH 85	92	DIGIBOARD 230,231	38	BEST COMPUTER 305
129	HIGH RES. TECH 322	183	LOGITECH 85		* IBM-SAA DIVISION 28,29	39	BINARY TECH 310
415	INES 88IS-28	497	MEXTEL 88NE-2	138	IMCO MANUFACTURING CORP. 299	41	BIT WISE 308
416	INTERQUADRAM 88IS-5	552	MEXTEL CORP. 88PC-4	148	IO TECH 322	42	BIT WISE 308
417	INTERQUADRAM 88IS-7	328	SCIENCE ACCESSORIES 258	318	M2 LAB/MICTRO 248	51	CAMBRIDGE N.A. 172
418	INTERQUADRAM 88IS-9	805	MASS STORAGE		* MAXCIMA 309	534	CDS 88PC-12
145	IO TECH 101	12	AK SYSTEMS 308	218	PERFORMANCE TECH 184		* COMPAQ 58A-D
547	JST PRODUCTS 88PC-9	40	BIOLOGICAL ENGINEERING 320	245	ROSE ELECTRONICS 151	87	COMPUTRADE 98
548	JST PRODUCTS 88PC-9	70	CONTECH 310	251	SCANDEC TRIBUTOR, INC 341	511	COMTEQ COMPUTER CORP. 88SO-2
423	KAP 88IS-18	90	DIGI-DATA CORP. 317	433	SCANDEC TRIBUTOR, INC 88IS-2	512	COMTEQ COMPUTER CORP. 88SO-2
158	LAWSON LABS 321	91	DIGI-DATA CORP. 314	277	TELEBYTE TECHNOLOGY, INC. 88	408	COPAM ELECTRONICS CORP. 88IS-25
171	MAXON 98	173	MEGA DRIVE 185	278	THOMAS CONRAD 159		* DAMARK 188
427	MICROMINT 88IS-20	187	MICROTECH CONVERSION SYS 321	279	THOMAS CONRAD 181	83	DCI COMPUTERS 309
428	MICRON TECHNOLOGY, INC 88IS-29	210	OVERLAND DATA 321	810	POWER SUPPLIES		* DELL COMPUTER 178A-B
188	MICROSTAR LAB 322	218	PERFORMANCE TECH 184	108	EMERSON COMP. POWER 190	87	DELL COMPUTER CII,1
169	MIDI MUSIC 324	232	QUALSTAR CORP. 322	215	PARA SYSTEMS 97	105	DTK ELECTRONICS 153
208	NOHAU 321	320	STORAGE DIMENSIONS 138,139	811	PRINTERS/PLOTTERS	110	FORTRON CORP. 247
220	PERISCOPE 121	321	STORAGE DIMENSIONS 138,139		* EPSON 20,21	111	FORTRON CORP. 247
219	PERISCOPE 121	806	MISCELLANEOUS	124	HEWLETT-PACKARD PERIPHERAL 50,51	114	GATEWAY 2000 10,11
231	QUA TECH 282	34	BAY TECH 200	125	HEWLETT-PACKARD PERIPHERAL 80,81	518	GENERAL BUS. MACHINES 88SO-11
244	REAL TIME DEVICES 324	35	BAY TECH 200	127	HEWLETT-PACKARD PERIPHERAL 195	519	GENERAL BUS. MACHINES 88SO-11
322	RUPP CORP 219	144	INDUSTRIAL COMPUTER SRC 246	128	HEWLETT-PACKARD PERIPHERAL 197	507	HALSKAR SYSTEMS 88NE-11
323	RUPP CORP 219	142	INTEGRAND 184	239	RADIO SHACK CIV	508	HALSKAR SYSTEMS 88NE-2
324	RUPP CORP 219	175	MERITT COMPUTERS 198	580	ZERICON 88PC-1		* HEWLETT-PACKARD COMP. 14,15
325	RUPP CORP 219	318	S & S COMPUTER PROD. 299	486	ZERICON, INC. 88MW-7	479	ISD 88MW-9
326	RUPP CORP 219	288	TWIX INTERNATIONAL 319	527	ZERICON, INC. 88SO-5	480	ISD 88MW-9
327	RUPP CORP 219	289	T.S. MICROTECH 284	812	PRINTER RIBBONS	174	MEGATEL COMPUTER 128
503	TELETEK 88NE-7	297	VICTORY ENTERPRISES 140	64	COMPUTER FRIENDS 309	176	MICRO LINEAR CONTROL 308
504	TELETEK 88NE-7	807	MODEMS/MULTIPLEXORS	191	MITSUBISHI 107	190	MITSUBISHI 107
558	TELETEK 88PC-5		* CERMETEK MICROELECTONIC 46	196	MULTI-MICRO 37	191	MITSUBISHI 107
557	TELETEK 88PC-5		* CLEO SOFTWARE 167	197	MULTI-MICRO 37	430	NICHOLS-MORLOS 88IS-38
286	TRUEVISION 93	61	COMPUCOM 299	498	OWL COMPUTER 88NE-4	499	OWL COMPUTER 88NE-4
801	DRIVES	540	E-TECH RESEARCH, INC. 88PC-10	522	OWL COMPUTER 88SO-6	523	OWL COMPUTER 88SO-6
21	ANALOG & DIGITAL PERIPH. 309	554	OSMOS, INC. 88PC-6	229	PROTEUS TECH. CORP. 27	255	SCIOTO COMPUTERS 321
173	MEGA DRIVE 185	555	OSMOS, INC. 88PC-6	440	SIEMENS 88IS-39	280	TMI, INC. 78
267	STORAGE DIMENSIONS 138,139	276	TELEBIT 147	281	TOSHIBA 221	282	TOSHIBA 221
268	STORAGE DIMENSIONS 138,139	283	TOUCHBASE SYSTEMS 36	282	TOSHIBA 221		
272	SYSGEN 47						
802	HARDWARE PROGRAMMERS						
27	AVOCET & QUELO 310						

READER SERVICE

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
437 TRIANGLE DIGITAL	88IS-30	821	IBM/MSDOS — CAD	156 LANTANA TECHNOLOGY	48	* CALIFORNIA DIGITAL	323
482 USER FRIENDLY	88MW-2	18 AMERICAN SMALL BUS. COMP 124		157 LANTANA TECHNOLOGY	48	56 CLONE COMPUTERS	300,301
483 USER FRIENDLY	88MW-2	19 AMS	308	168 LOGITECH	170	57 CMO	84,85
293 VNS	53	290 ULTIMATE TECHNOLOGY	314	187 LOGITECH	170	59 COMPACT DISK PRODUCTS	171
505 WEDGE TECHNOLOGIES . 88NE-3		439 ULTIMATE TECHNOLOGY 88IS-32		425 MASHOV	88IS-21	60 COMPUCLASSICS	113
508 WEDGE TECHNOLOGIES . 88NE-3		302 WINTEK CORP.	9	170 MATRIX SOFTWARE	214	62 COMPUSAVE	307
299 WELLS AMERICAN (N. AMERICA)	275	303 WINTEK CORP.	308	194 MIX SOFTWARE	283	491 COMPUTER DOCTOR	88NE-1
300 WELLS AMERICAN (INT'L)	275			207 NU-MEGA TECHNOLOGIES	111	492 COMPUTER DOCTOR	88NE-1
307 ZENITH DATA SYSTEMS	183			217 PAUL MACE SOFTWARE	132	65 COMPUTER SYSTEMS RES. 38,39	
309 ZEOS INTERNATIONAL	44,45			234 QUARTERDECK	134,135	66 COMPUTERLANE	145
		822	IBM/MSDOS — LAN	235 QUARTERDECK	134,135	88 COMP. DISCOUNT WAREHOUSE	119
		538 EDIMAX COMPUTER CORP.	88PC-15	238 QUARTERDECK	134,135	74 CORPORATE COMPUTERS OF IOWA 243	
		539 EDIMAX COMPUTER CORP.	88PC-15	237 QUARTERDECK	134,135	75 CORPORATE COMPUTERS OF IOWA 243	
		494 EDIMAX COMPUTER CORP. 88NE-9		436 SOFTWARE CONSTRUCTION . 88IS-33		493 DIRECT OF NEW ENGLAND 88NE-9	
		495 EDIMAX COMPUTER CORP. 88NE-9		264 STERLING CASTLE	122	410 DISK STAR	88IS-26
		* ELONEX	88IS-31	265 STERLING CASTLE	122	100 DISKOTECH	309
		143 INTERNATIONAL COMP GROUP 41		269 SUPERSOFT	257	101 DISKETTE CONNECTION	317
		528 ZYTEC	88SO-11	271 SWIRL SOFT	324	108 DYNAMIC ELECTRONICS	319
				287 TURBO POWER	281	496 ELECTRIFIED DISCOUNTERS. 88NE-12	
		823	IBM/MSDOS — GRAPHICS	* VERMONT CREATIVE	18	109 EXECUTIVE PHOTO & SUPPLY 206	
		107 ECOSOFT	88	310 ZORTECH	249	515 EXPERT SYS. INTEGRATORS	88SO-6
				311 Z-WORLD	310	541 FINALSOFT CORP.	88PC-16
		824	IBM/MSDOS — LANGUAGES			542 FINALSOFT CORP.	88PC-16
		38 BE AWARE, INC	78	826	IBM/MSDOS COMMUNICATIONS	516 FINALSOFT CORP.	88SO-3
		37 BE AWARE, INC	78	54 CENTURY SOFTWARE	138	517 FINALSOFT CORP.	88SO-3
		46 BORLAND	81	55 CENTURY SOFTWARE	138	412 GREY MATTER	88IS-48
		47 BORLAND	81	102 DIVERSIFIED COMPUTER	319	478 HARD DRIVES	88MW-1
		118 GENESIS DATA SYSTEMS	94	246 FASTLYNX/RUPP	131	520 HARD DRIVES	88SO-7
		119 GENESIS DATA SYSTEMS	94	131 HI-Q INTERNATIONAL, INC	86	133 IC EXPRESS	317
		* JENSEN & PARTNERS	115	130 HI-Q INTERNATIONAL, INC	88	147 JADE COMPUTER	315
		150 JYACC, INC	77	152 KEA SYSTEMS	183	148 JAMECO ELECTRONICS	302,303
		155 LAHEY COMPUTER SYSTEMS 112		549 KORTEK, INC.	PC-8	422 JAMECO ELECTRONICS	88IS-43
		182 MICROSOFT CORP.	6,7	550 KORTEK, INC.	PC-8	546 JB TECHNOLOGIES, INC.	88PC-7
		183 MICROSOFT CORP.	6,7	432 PERICOM	86IS-27	8 J.D.R. MICRODEVICES	326-329
		184 MICROSOFT CORP.	19	253 SCIENTIFIC ENDEAVORS	322	7 J.D.R. MICRODEVICES	328-329
		185 MICROSOFT CORP.	19	254 SCIENTIFIC ENDEAVORS	322	188 MARYMAC INDUSTRIES	322
		* MICROSOFT CORP.	288	275 TALKING TECHNOLOGY	319	428 MAYFAIR MICROS	88IS-36
		317 SAIC	82			172 MEAD COMPUTER	318
		310 ZORTECH	249	827	OTHER APPLICATIONS	* MICROCOMP. MKTG. CNSL 88IS-53	
					Business/Office	* MICROCOMP. MKTG. CNSL . 88PC-8	
		825	IBM/MSDOS — UTILITIES	250 SANTA CRUZ OPERATION	67	177 MICROPROCESSORS UNLTD. 310	
		531 AKER	88PC-3			188 MICROWAY	133
		532 APPLAUSE SOFTWARE	88PC-10	828	OTHER — UTILITIES	* MICROWAY	180
		533 APPLAUSE SOFTWARE	88PC-10	319 EMPIRICAL RESEARCH	210	553 MIRACLE COMPUTERS	88PC-2
		25 ATRON	31			195 MKS (AKA MORTICE KERN)	285
		26 AVOCET SYSTEMS	79	829	OTHER — CROSS DEVELOPMENT	* MONTGOMERY GRANT	127
		43 BLAISE COMPUTING	55	* SOFTWARE DEV. SYSTEMS	91	209 ON-LINE STORE	66,69
		44 BOLT SYSTEMS	128	292 UNIVERSAL CROSS ASSBRS . 317		211 PACIFIC COMPUTER	304
		45 BOLT SYSTEMS	128			500 PC LINK CORP	88NE-5
		80 CURTIS INC	179	830	MAIL ORDER/RETAIL	224 PRECISION DATA PRODUCTS 310	
		89 DEPARTMENTAL TECH	141	11 ADVANTAGE SOFTWARE	273	226 PROGRAMMER'S PARADISE 62,63	
		118 GENESIS DATA SYSTEMS	94	17 AMERICAL GROUP	314	227 PROGRAMMER'S SHOP	112
		119 GENESIS DATA SYSTEMS	94	23 APPLIED PROGRESSIVE ELECT. 312,313		248 SABINA INT'L	310
		122 HAMMERLY COMPUTER SERV 232		28 A.C.P.	325	252 SCHWAB COMPUTERS	319
		123 HAMMERLY COMPUTER SERV 233		28 A.C.P.	325	434 SCOTTS DALE SYSTEMS	88IS-11
		132 HITECH EQUIPMENT CORP.	324	30 B & B ELECTRONICS	321	435 SCOTTS DALE SYSTEMS	88IS-11
		414 I X I LIMITED	88IS-30			274 SN'W ELECTRONICS	52
		545 ISLAND SYSTEMS	88PC-12			* SOFTLINE CORP	88IS-41
		150 JYACC, INC	77			270 SURAH	319
						438 U S A SOFTWARE	88IS-13
						* U S DIGITAL CORP.	88SO-12

FREE INFORMATION

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 _____ (_____) _____
 Phone _____
 Company _____
 Address _____
 City _____ State _____ Zip _____

A. What is your level of management responsibility?

- 1 Senior-level Management
- 2 Other Management
- 3 Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

- 1 Administration
- 2 Accounting/Finance
- 3 MIS/DP/Information Center
- 4 Product Design and Development
- 5 Research and Development
- 6 Manufacturing
- 7 Sales/Marketing
- 8 Purchasing
- 9 Personnel
- 10 Education/Training
- 11 Other: _____

C. Please indicate your organization's primary business activity: (Check one.)

- Computer-Related Businesses:
 1 Manufacturer (Hardware, Software)

- 2 Computer Retail Stores
 - 3 Consultants
 - 4 Service Bureau/Planning
 - 5 Distributor/Wholesaler
 - 6 Systems House/Integrator/VAR
 - 7 Other: _____
- Non-Computer-Related Businesses:
- 8 Manufacturing
 - 9 Finance, Insurance, Real Estate
 - 10 Retail/Wholesale
 - 11 Education
 - 12 Government
 - 13 Military
 - 14 Professions (Law, Medicine, Engineering, Architecture)
 - 15 Consulting
 - 16 Other Business Services
 - 17 Transportation, Communications, Utilities
 - 18 Other: _____

JULY
IRSD002

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570
571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630
631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690
691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750
751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870
871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930
931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990
991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050
1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110
1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170
1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200

Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.



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



READER SERVICE
PO Box 5110
Pittsfield, MA 01203-9926
USA



FREE INFORMATION

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.



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



READER SERVICE
PO Box 5110
Pittsfield, MA 01203-9926
USA



Fill out this coupon carefully. PLEASE PRINT.

Name _____

Title _____ (_____) Phone _____

Company _____

Address _____

City _____ State _____ Zip _____

- A. What is your level of management responsibility?** (Check one.)
- 1 Senior-level Management
 - 2 Other Management
 - 3 Non-Management
- B. What is your primary job function/principal area of responsibility?** (Check one.)
- 1 Administration
 - 2 Accounting/Finance
 - 3 MIS/DP/Information Center
 - 4 Product Design and Development
 - 5 Research and Development
 - 6 Manufacturing
 - 7 Sales/Marketing
 - 8 Purchasing
 - 9 Personnel
 - 10 Education/Training
 - 11 Other: _____
- C. Please indicate your organization's primary business activity:** (Check one.)
- 1 Computer Retail Stores
 - 2 Consultants
 - 3 Service Bureau/Planning
 - 4 Distributor/Wholesaler
 - 5 Systems House/Integrator/VAR
 - 6 Other: _____
- Non-Computer-Related Businesses:**
- 8 Manufacturing
 - 9 Finance, Insurance, Real Estate
 - 10 Retail/Wholesale
 - 11 Education
 - 12 Government
 - 13 Military
 - 14 Professions (Law, Medicine, Engineering, Architecture)
 - 15 Consulting
 - 16 Other Business Services
 - 17 Transportation, Communications, Utilities
 - 18 Other: _____

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330
331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390
391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450
451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570
571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630
631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690
691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750
751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810
811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870
871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930
931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990
991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050
1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110
1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170
1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200

Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.

JULY
IRSD002

REQUEST FREE INFORMATION BY FAX

Attention BYTE Readers!! Now you can fax your requests for free product and advertiser information featured in this issue.

Just fax this page to 1-413-637-4343. You'll save time because your request for information will be processed as soon as your fax is received.

1 Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.

2 Check off the answers to questions "A" through "C".

3 Print your name, address, and fax number clearly on the form.

4 Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name _____

Title _____

Company _____

Address _____

City _____

State/Province _____ Zip _____

Country _____

Phone Number _____ Fax Number _____

A. What is your level of management responsibility?

- 1 Senior-level Management
- 2 Other Management
- 3 Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

- 1 Administration
- 2 Accounting/Finance
- 3 MIS/DP/Information Center
- 4 Product Design and Development
- 5 Research and Development
- 6 Manufacturing
- 7 Sales/Marketing
- 8 Purchasing
- 9 Personnel
- 10 Education/Training
- 11 Other: _____

C. Please indicate your organization's primary business activity: (Check one.)

Computer-Related Businesses:

- 1 Manufacturer (Hardware, Software)
- 2 Computer Retail Stores
- 3 Consultants
- 4 Service Bureau/Planning
- 5 Distributor/Wholesaler
- 6 Systems House/Integrator/VAR
- 7 Other: _____

Non-Computer-Related Businesses:

- 1 Manufacturing
- 2 Finance, Insurance, Real Estate
- 3 Retail/Wholesaler
- 4 Education
- 5 Government
- 6 Military
- 7 Professions (Law, Medicine, Engineering, Architecture)
- 8 Consulting
- 9 Other Business Services
- 10 Transportation, Communications, Utilities
- 11 Other: _____

Please send me one year of BYTE Magazine for \$24.95 and bill me. Offer valid in U.S. and possessions only.

IBJF007

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580
581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740
741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860
861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920
921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940
941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980
981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060
1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120
1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160
1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180
1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200

MANAGEMENT FOR THE 1990's

Share a view from the top at the CIOS 21 World Management Congress
September 21 - 23 — New York City



Joseph L. Dionne, Chairman and CEO
McGraw-Hill, Inc.

Chairman Joseph Dionne speaks out on "Managing Innovation — Impact On Global Productivity". He and 8 top international leaders in business, government and academia lead a provocative exchange on the critical issues facing future management.

The Issues and the Players

Issue 1

New Forces With Which Management Must Deal

Chairman: James E. Hennessy
Executive V.P. Marketing and Technology,
NYNEX

How will management handle the changing attitudes toward work, ethics, consumerism and the role of women. Participants include: Tadashi Suzuki, President, NEC America; Dr. J. Brademas, President, NYU; Sir Eric Sharp, CEO, Cable and Wireless.

Issue 2

Putting New Technologies to Work

Chairman: Dean P. Phypers
Retired member, I.B.M. Board and
Management Committee

What new technologies will emerge in the 1990's and how quickly can they be put to competitive use. Plenary Paper by: J.D. Kruehler, Vice Chairman of the Board, I.B.M. Corp. Participants include: Prof. N. Negroponce, M.I.T. Labs; Dr. R. Schmitt, President, R.P.I.

Issue 3

The Board and Top Management

Chairman: Arthur Taylor
Dean of the Faculty of Business,
Fordham University

What will be the role of the board of directors in the next decade. Participants include: Carl Icahn, Financier; Fred H. Joseph, CEO, Drexel Burnham Lambert; Larry Horner, Chairman, K.P.G. Peat Marwick.

Issue 4

The Corporation in the 1990's

Chairman: Dr. Michael Schulhof,
Vice Chairman, SONY Corp. of America

How will globalization, international competition, and restructuring impact on the corporation of the 90's. Participants include: Alfred DeCran, Chairman, Texaco; John C. Whitehead, Department of State.

Issue 5

Maintaining Dynamism in the Delivery of Public Service

Chairman: Frank A. Well
Chairman and CEO, Abacus and Associates

How will public sector activity in the 90's deal with trends such as privatization and special interest groups.

Issue 6

Managing Innovation

Chairman: Joseph L. Dionne, Chairman and
CEO, McGraw-Hill, Inc.

Why some organizations have a reputation for being innovative while others do not. Plenary Paper by: Dr. Michael Porter, Harvard Business School.

Issue 7

The Financing of Business in the 1990's Chairman: Fred H. Joseph, CEO, Drexel Burnham Lambert

Have traditional methods of corporate financing become outdated by leveraged buyouts and new trading strategies. Plenary Paper by: Henry Kravis, Kohlberg, Kravis, Roberts.

Issue 8

Managing Human Resources in the 1990's Chairman: Harry D. Garber, Vice Chairman, Equitable Life Assurance Society of America

What is the outlook for human resources management, particularly in the light of world competition, demographic changes and the need for a more skilled labor force. Participants include: Fredrick Salerno, President and CEO, New York Telephone.

Issue 9

Industrial Development in Third World Countries

Chairman: Maurice Strong
Chairman, Strovest Holding Inc.

What are the key factors in successful industrialization and why do some countries succeed while others fail. Plenary Paper by: David Hopper - Sr. V.P. for Policy, World Bank.

Reserve your place now at Management for the 1990's

CIOS 21 World Management Congress
September 21 - 23, 1989, Waldorf Astoria,
New York City

Hurry . . . attendance is limited.

For Registration Form, write to:
World Management Council
475 Park Avenue South
New York, N.Y. 10016
Att: Registrar
Telex: 427395 Fax: (212) 779-9167

Founded over 60 years ago, CIOS today has as its affiliates 49 of the world's leading management institutes and associations. It also enjoys United Nations Advisory Status.

The Experience

Participate in a global meeting with the most distinguished minds in industry, government and education as they discuss what will shape the Managers' role in the next decade. The challenge of the new forces and technologies, as well as the opportunities. It's a rare, top-echelon window-on-the-future to recharge and enrich your thinking — and your role in management.

The Format

A stimulating, involving, international forum and multi-media event. Mornings: presentation of major papers on issues. Afternoons: state-of-the-art enactments of the issues in action. Confrontations, interviews, teleconferencing, all the drama of management in play.

World Management Congress

CIOS XXI

John Diebold, President CIOS
David Rockefeller, Chairman, Honorary Council

```

{
  switch (type->defProcID) {
    case documentProc: type->defProcID = zoomDocProc; break;
    case noGrowDocProc: type->defProcID = zoomNoGrow; break;
    case zoomDocProc:
    case zoomNoGrow:
      /* do nothing */ break;
    default: fatal("add_zoom: can't add to this doc type");
  }
}

/***** Methods *****/

w_init(window)
WindowPtr window;
{
}

w_activate(window, event)
WindowPtr window;
EventRecord *event;
{
  SetPort(window);
  if (W_TYPE(window)->growable)
    DrawGrowIcon(window);
}

w_deactivate(window, event)
WindowPtr window;
EventRecord *event;
{
  if (W_TYPE(window)->growable) {
    WITH_PORT(window)
      DrawGrowIcon(window);
    END_PORT;
  }
}

w_update(window, event)
WindowPtr window;
EventRecord *event;
{
  WITH_PORT(window)
    BeginUpdate(window);
    EraseRect(&window->portRect);
    vsend_window(window, Draw, NULL);
    UpdtControl(window, window->visRgn); /* for 128K ROM only */
    if (W_TYPE(window)->growable)
      DrawGrowIcon(window);
    EndUpdate(window);
  END_PORT;
}
}

```

continued from page 286

A Better Perspective

Now it's time to pull back from the depths of seeming tragedy and try to get some perspective. In the real world, a little code-copying and some careful attention to detail are not all that big a deal. Heck, if you program in C, a language that doesn't check array bounds, a language that would happily let you multiply a pointer to the disk driver by your mother's maiden name, you are used to being careful.

Whatever the horrors my window development tool engenders, they're nothing compared to what you have to go

through if you don't use it. I've found that using these object-oriented methods makes programming a wonderful machine a little more wonderful to do—or, to put it another way, a little bit less painful. ■

Editor's note: *The entire source code for this package, with examples of its use and extension, is available in a variety of formats. See page 5 for further details.*

Jonathan Amsterdam is a graduate student in computer science at MIT and lives in Cambridge, Massachusetts. He can be reached on BIX c/o "editors."

One thing every executive should have after retirement:

An adventure.

Gold watches are fine for some retired executives. But after a lifetime of experience, moving from the trenches to the front offices, your knowledge is worth more—to us and to hundreds throughout the world in need of your special skills.

Through the International Executive Service Corps—the not-for-profit organization that sends U.S. managers to help businesses in developing nations—you can volunteer for short-term assignments in foreign countries where you're truly needed. Although you will not be paid, you and your spouse will receive all expenses, plus the personal satisfaction of teaching others while you discover more about yourself.

It's an adventure of the spirit. And the time to explore it is now. So please, don't let this golden opportunity pass by. Send for more information today.



**International
Executive
Service Corps**



Turn your lifetime of experience into the experience of a lifetime.

YES, I'd like to share my lifetime of experience with others. I recently retired from my position as a hands-on manager with a U.S. company. I also understand that volunteers and their spouses receive expenses, but no salary. Please send me more information now.

Name _____

Address _____

City _____ State _____ Zip _____

In what publication did you see this ad?

Write to: IESC, 8 Stamford Forum, P.O. Box 10005
Stamford, CT 06904-2005. Or, for faster
response, call this number: (203) 967-6000. AI

Hugh Kenner

Predicting Chaos

**DOES GOD PLAY DICE?:
The Mathematics of Chaos**
by Ian Stewart

Editor's note: Regular readers of our Book Review section will be familiar with Hugh Kenner. He is one of America's foremost literary critics; check out *Who's Who or Contemporary Authors* for a long list of his credits. He is currently a professor of English at Johns Hopkins University. His recent works include *A Sinking Island and Mazes*.

Hugh also happens to be a computer-literate commentator. Those of you who haven't read his reviews have a treat in store. Beginning with this issue, Hugh will be commenting monthly on a significant book in the field of computers, computer science, or a related technology. We're honored and excited to have him on board as a member of the BYTE team.

Janus, the Johns Hopkins library's on-line catalog, is my best source of clues to what's hot at the moment. Under "Chaotic Behavior in Systems," Janus has just now listed me 16 books plus a surprising 27 volumes of conference proceedings. None dates from before 1982, not many from before 1986. And no point in my going over to sample a few. As of this morning, nearly every single one is checked out. A couple even had to be replaced after getting "lost."

Which confirms, if we hadn't guessed it from the long tenure of James Gleick's *Chaos: Making a New Science* on best-seller lists, that scientists of many stripes are reveling in a Chaos Decade. And although Gleick, first-rate reporter that he is, deserves credit for bringing the subject to lay attention, readers even a little removed from lay status will have sensed that from time to time he's slightly fuzzy about what he reports.

That is a fact I glossed over when I reviewed his book in the May 1988 BYTE, though it was, after all, inherent in his method. Writing from the outside, Gleick interviewed insider after insider. They spoke to him via analogies, which he duly relayed.

But Ian Stewart, a mathematician at the University of Warwick (England), writes from the inside. No dub hand at analogies, Stewart has written popularizing books with titles like *Oh! Catastrophe!* and *The Groups of Wrath*. His new exposition—*Does God Play Dice?: The Mathematics of Chaos*—clearly comes from a man who knows exactly what he's talking about; knows where each analogy starts and where it must stop; and knows when we'll be best served by just an oracular equation, like $vr = gn/4$.

Here's the example at hand: We're tossing a coin, and v is its vertical velocity, r is its rotation in turns per second, and g is gravity's acceleration. Then (I'm skipping steps) $vr = gn/4$ is "the head-tail boundary," and by controlling r and v exactly, I could force heads or tails at pleasure. But I can't control them exactly, so Stewart presents a nice graph to show why, as long as they vary within even narrow limits, the head-tail distribution looks "random." Looks random, though it's determined by r and v .

"With hindsight," Stewart writes, "you can often see things that weren't anything like as clear at the time. The trick is not so much to know something, but to know that you know it. That is, to appreciate that it's important, and to have a context in which to put it." Let's note, with hindsight, something not even Ian Stewart happens to discuss, that the question he shows everyone shunning a mere century ago—"can a simple deterministic system behave like a random one?"—was in fact addressed as long ago as 1948, when D. H. Lehmer outlined a simple pseudo-random-number generator, of the sort our software still uses. That is to say, a key to chaos theory was available 40 years back. It was one of the things countless people didn't know they knew.

Given suitable constants, Lehmer's algorithm can generate, for as long a span as you

continued



SCANDEC GIVES YOU SOLUTIONS

Unique Features
Unique Economy

REQUIREMENT: ELIMINATE MANUAL
PRINTER SETUP



SOLUTION: SCANSHARE[®]

Intelligent printer controller/sharer and string conversion, with setup for each input port (4 parallel input) from a dedicated control serial port connected to a PC.

REQUIREMENT: UNIVERSAL NETWORK
COAX CONNECTION



SOLUTION: SCANANIO[®]

Arcnet interface with controller for connection of 2 printers to a standard Arcnet Coax. Support both Star and bus (Jumper). 100% compatible with SMC (Standard Micro System Corporation), PC 120 and PC 220.

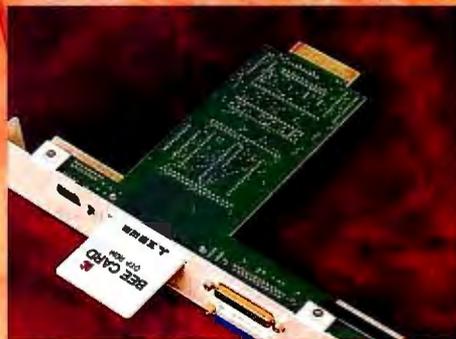
REQUIREMENT: LAP TOP ARCNET



SOLUTION: SCANARCNET

PcArcnet interface board very low power 0.5W (Zero point five). Specially very good for PC Lap Top, running battery. Support both Star and bus (Jumper). 100% compatible with SMC (Standard Micro System Corporation), PC 120 and PC 220.

REQUIREMENT: HIGH CAPACITY
ELECTRONIC FORMS



SOLUTION: SCAN LOGO AND
SCANFORM[®]

Build in printer share for Canon II models, (SX engine) and HP II series (SX engine). Easy access to prewritten overlays and logos if using a Fontcardtridge with burn in logos on a swappable memorycard (same size as credit card).

DEALERS

are invited to share the distribution of these products in their own markets. Please write or fax Scandec Tributor to order these products. Excellent documentation and manufacturers guarantees provided.

REQUIREMENT: TRAINABLE OCR
SOFTWARE

SOLUTION: SPOT[®] 3.0

Fast, accurate, low cost OCR Software, that trains an MS DOS PC to recognise all printed fonts. Reads 35 cps on 16 MGz AT and 65 cps with 25 MHz (780 words per minute). Supports major Scanners.

\$999 U.S.

REQUIREMENT: INTELLIGENT
CHANGING OF I/O



SOLUTION: SCANSIPO[®]

An intelligent serial to parallel or reverse converter, strapable baud, parity, bits, protocol (on serial), and strapable (3 kinds of timing for parallel output). Can be expanded with up to 32k of buffer).

SCANDEC TRIBUTOR A/S and its sister company Scandec Tributor (USA) INC are successful developers of Laser Printer Interface Systems. Widely known in Scandinavia as an innovator of Laser Printer Enhancement products, Scandec Tributor is encouraged to bring these products to users worldwide. Scandec Tributor is a primary Hewlett-Packard and Canon Laser Printer dealer in Norway.

**SCANDEC
TRIBUTOR**

Sam Eydes vei 1B,
P.Box 71, 1412 Sofiemyr, Norway
Office-tel.: + 47 2 80 59 60,
Telefax: + 47 2 80 59 59,
Telex: 74 840 scand. n

SCANDEC TRIBUTOR (USA), INC.
3001 Redhill Ave., Suite 222, Bldg. 1,
Costa Mesa, CA 92626.

[®] Designed and produced by SCANDEC UDVIKLING in Denmark.
Prices good in North America only

Circle 251 on Reader Service Card

like, numbers that pass whatever test for "randomness" you think to apply. Starting from a "seed," each iteration feeds the next. Yet start again with the same seed, and lo, the same series of outputs! So, being repeatable, those numbers cannot be random.

Likewise, as Stewart reminds us, many a kitchen gadget—cake-mixer, egg-whisk, Cuisinart—does something perfectly

Stewart
reminds us that
many a kitchen gadget
does something
perfectly regular, round
and round, yet
somehow randomizes
the stuff it stirs.



regular, round and round, yet somehow randomizes the stuff it stirs. Traditional dynamics had no explanation for this, offering as it did two main possibilities:

1. Sit still.
2. Go round and round.

Chaos theory has a third to offer:

3. Stretch and fold. (Here, it's helpful to visualize someone pulling toffee.) Then, "Regular cause, irregular effect."

What's being stretched and folded gets a little esoteric, since we're moving back and forth between kitchen instances and phase-space graphs. Thus, a French astronomer named H_unon starts worrying in 1962 about how stars move within a galaxy, gets anomalous numbers from his computer ("Meatballs of regularity in a stochastic spaghetti"), and by 1976 is pondering stretch-and-fold concepts that come "in layers, folded over each other like a puff pastry."

Or, "fold" a line back over itself with the help of a simple equation like

$$x \rightarrow kx(1-x),$$

where, with k a constant between 0 and 4, we keep getting our line stretched or compressed nonuniformly, and then folded back on itself. And for values of k above 3, what we see is chaos, and we're immersed in the vagaries of a not-very-well-behaved Lehmer generator. Yet doesn't that equation look harmless?

But look, I'm tunneling deeper than I meant to. Let's go back to where our author takes off.

Stewart's fetching exposition starts with *Voyager 1*'s flyby of Saturn, where the moon Hyperion, "irregular in shape, a cele-

tial potato," tumbles complexly around its regular orbit. The equations that brought *Voyager 1* into such precise proximity with that system, surely they could also compute Hyperion's attitude a few months hence? But no, they couldn't, not even if *Voyager 1* measured the observable tumbling clear to 10 decimal places (as it didn't, but never mind).

And why couldn't they? Because—my analogy, not Stewart's—calculations with Newton's austere simple laws can sometimes act like a Lehmer generator. Feed in this instant's data to obtain the next instant's, repeat with the result, repeat, repeat. . . . Soon the output is so pseudorandom it's meaningless. A change in the tenth place, or the twentieth, of the initial seed (assuming enough precision to recognize it) would generate a different series entirely.

Stewart next offers a simple BASIC program:

```
10 INPUT K
20 X = 0.54321
30 FOR N = 1 TO 50
40 X = K*X*X - 1
50 NEXT N
60 FOR N = 1 TO 100
70 X = K*X*X - 1
80 PRINT X
90 NEXT N
100 STOP
```

Try that with $K = 1.1$, and then with $K = 1.74$. The first input (if your machine resembles mine) gives simple alternation. The second offers "well-developed chaos." Stewart's comment: "We started out not understanding Hyperion. Now we don't even understand $2x^2 - 1$. In mathematical terms that constitutes stunning progress." Precisely: We've moved the Hyperion problem into math, where we can examine it without space probes.

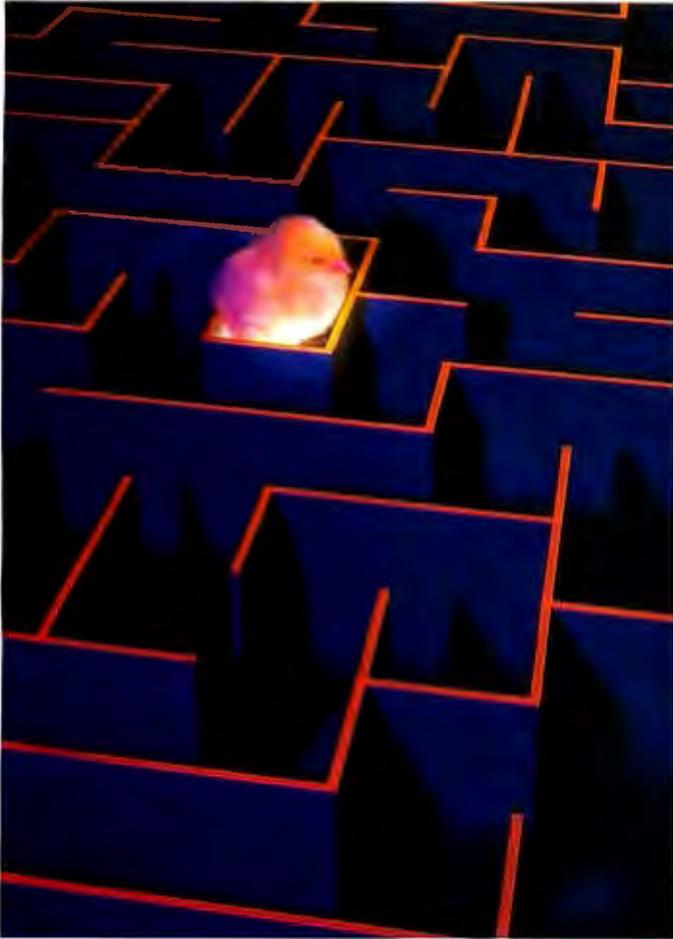
The sentence I last quoted is typical of Stewart: It sounds like offhand wit and turns out to have technical import. If the problem is mathematical, not dynamical, it's mathematicians who are going to have to address it. The real hero of his book is "the last universalist," Henri Poincaré (1854–1912), who on the way to chaos theory invented topology, and who stated almost a century ago what James Gleick found that various workers (e.g., meteorologists and population specialists) were chancing to rediscover in our generation.

"A very slight cause, which escapes us,"—Poincaré speaking—"determines a considerable effect which we cannot help seeing, and then we say this effect is due to chance." (Thus, the famous "butterfly effect"—a butterfly in Beijing affecting the weather months later in Dubuque.) "If we could know exactly. . . we should be able to predict exactly. . . ." If we could know only approximately, we'd be happy to predict to the same degree of approximation. "But this is not always the case; it may happen that slight variances in the initial conditions produce very great differences in the final phenomena; a slight error in the former would make an enormous error in the latter. Prediction becomes impossible and we have the phenomenon of chance."

That's something mathematicians long knew but didn't know they knew. Its consequences now burst upon us. Witness Benoit Mandelbrot's fractals, Mr. Gleick a best-seller, and the Johns Hopkins library hard put to keep track of just which users at this moment are responsible for 43 volumes on chaotic behavior. ■

Basil Blackwell, New York: 1989, 317 pages, \$19.95

Knowledge Processing



Don't leave your users lost in a maze of information!

A knowledge processor communicates knowledge - the natural extension of everything we do on a computer.

It's the intelligent integration of everyday resources like data, text, logic, graphics, and video that turns information into knowledge.

KnowledgePro is the first knowledge processor. It combines a high-level, object-oriented programming language with hypertext and expert systems technology.

KnowledgePro gives you a total development environment with the tools you need to create intelligent multi-media applications.

PC Magazine, Holland... *"KnowledgePro is the first of a new generation of software, the knowledge processor...it has the power of, for example, Pascal or PROLOG, but the programmer isn't troubled with the technical details."*

PC Week, USA... *"It's rare, but every so often a PC application comes along that breaks new ground and creates a fundamentally different way to use computers. According to its corporate users...KnowledgePro does just that."*

Infoworld... *"We don't live in a computational world. If we're going to move knowledge around we need tools...The same person who will learn macros in Lotus can learn this."*

KnowledgePro costs \$495 with no runtime fees. It runs on IBM PC, XT, AT and PS/2 compatible machines with 640k of memory and a hard disk. A working demo with a 100 page manual is available for \$33 including shipping (\$38 foreign) with credit towards purchase of the full system.

Find out what knowledge processing is all about. Call 518-766-3000 (FAX 518-766-3003) or write to Knowledge Garden Inc., 473A Malden Bridge Rd., Nassau, NY 12123, USA. Amex, Visa or M/C accepted.

KnowledgePro® The intelligent way out

Circle 153 on Reader Service Card

Another
intelligent
tool from



Editor's note: *The newest addition to BYTE, Stop Bit will be a forum for our staff, readers, and industry leaders to take on the myths, shibboleths, and conventional wisdom of the computer industry. More than just a soapbox, this column will address serious, sometimes controversial issues, with hard-nosed facts, true experiences, and an occasional touch of humor. In the months to come, you'll see some highly recognizable names here and some names you've never seen before. The opinions offered here will be those of the author and not those of BYTE, McGraw-Hill, or its employees. We welcome your feedback.*

What if literature were published the way software is?

As a fan of great literature, I found myself wondering the other day, "What if novels were published the way software is?" If they were, the process might go something like this:

Herman Melville would announce the publication of *Moby Dick* a year before you could actually buy it. Reviewers would praise it, and several literary magazines would select it as "Editor's Choice" for best novel of the year—all before it ever appeared on bookstore shelves.

Eventually, the publisher would send out a press release to announce that copies of *Moby Dick* were actually shipping. The public, tantalized by the pre-publication hype, would rush out to buy the book like sharks at a feeding frenzy. The novel would become an overnight bestseller, thereby confirming the media's amazing prophetic abilities.

The book would come wrapped in oilcloth, with a long parchment notice explaining when and where you could read it, that you couldn't loan the book to anyone, and that the publisher wasn't responsible if anything in the book were to cause damage to your life, liberty, or kidneys. If you violated the rules of the reader agreement, you would forfeit your firstborn child.

After struggling through the first few chapters of the book, two-thirds of *Moby Dick*'s readers would realize that they had no idea what it was about. Most of them would put the book away, haul it out now and then, and one day find a registration card that they had never bothered to send in. On sending in the card, they would receive the following letter:

MOBY DICK 2.1

Dear Registered *Moby Dick* Reader,

Enclosed you will find *Moby Dick* version 2.1, which replaces earlier versions.

1. Version 2.1 restores several key characters that readers reported were missing in version 2.0, which was subsequently recalled. We have also added several new characters to version 2.1. In particular, several readers reported that the character of Harold the bookkeeper, who was intended to act as a foil for Ishmael, simply did not work. This character has been replaced by Queequeg, a South Seas savage. Further modifications should not be necessary.
2. Version 2.1 contains corrections to errors reported by readers of earlier versions, most of whom were being too picky. However, one misprint on page 127 could make it difficult for you to follow the remainder of the story. Note that it is a "gold piece" that Ahab nails to the main mast, not a "cod piece." (Also note: If, beginning in this section, your version of *Moby Dick* refers consistently to "the Great White Tuna," you have the original version, 1.0.)
3. Early readers of *Moby Dick* commented that the hardcover modification (intended to discourage unauthorized copying of the book) made it impossible to install the book into their libraries. Version 2.1 contains a modified "key-type" protection. In the enclosed envelope, you will find a key that will open your copy (and only your copy) of the book. Attempting to open the book without using your key will invalidate your readership license.
4. With this version of *Moby Dick*, we are inaugurating our telephone support service, available free of charge to all registered readers. If you have a problem while reading the novel, please refer to the *Moby Dick Technical Reference Manual* (#MD-1024), which contains answers to the most commonly asked questions and includes a complete table of literary symbols used in the book. If you still cannot resolve the difficulty, call (800) BIG-FISH. The customer service representative will ask for the serial number of your book before assisting you.
5. Finally, it has come to our attention that certain unscrupulous publishers have pirated portions of the *Moby Dick* reader interface or are producing complete *Moby Dick* "clones." The most flagrant example involves a pirate captain whose hand has been swallowed (along with an alarm clock) by a large crocodile. We are suing the publisher of this work. If you buy it, you could become a codefendant in the lawsuit. You'll also receive a visit from large men with blunt instruments.

Please complete the enclosed registration card so that we can send you information on new versions of *Moby Dick*. We will also inform you of forthcoming products, such as our state-of-the-art novel, *Ambergris*, an integrated tale of daring and intrigue in the perfume and whaling industries, to be released in the fourth quarter of 1889.

Melville Press
Seattle, Washington

We've Invented the Future of Instrumentation Software . . . Twice.

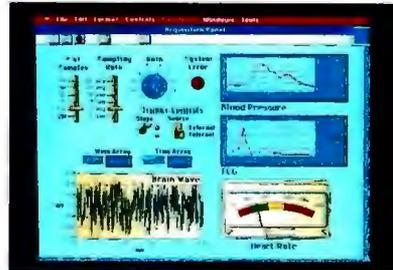
With Words With Pictures

Acquisition

Integrated libraries for GPIB, RS-232, A/D-D/A-DIO plug-in cards, and modular instruments.



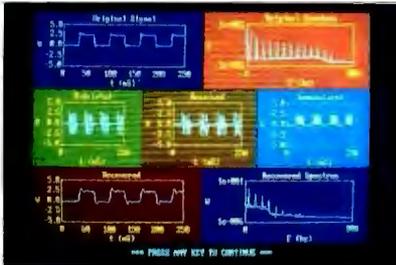
Intuitive character-based function panels that automatically generate source code.



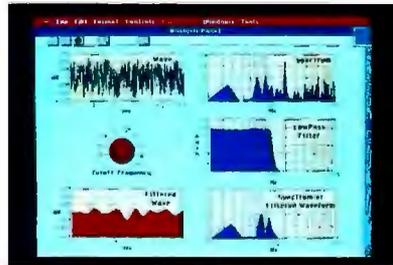
Front panel user interface with virtual instrument block diagram programming.

Analysis

Extensive libraries for data reduction, digital signal processing, and statistical analysis.



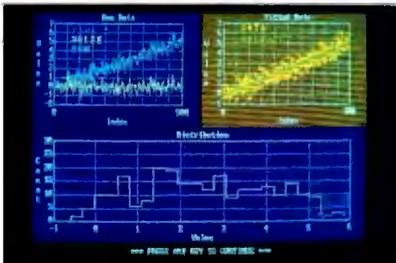
Over 100 analysis functions plus all the built-in functions of your language.



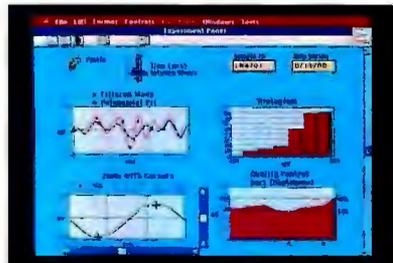
Over 250 icons for computation and analysis.

Presentation

Flexible high-performance graphics and report generation.



Extensive graphics support for CGA, EGA, MCGA, VGA, and Hercules.



Macintosh Desktop Publishing compatibility.



NATIONAL INSTRUMENTS®
The Software is the Instrument™

12109 Technology Boulevard
Austin, Texas 78727-6204
800/531-4742 512/250-9119

LabVIEW®
for the Apple Macintosh.

LabWindows®
for the DOS-based PC and PS/2,
with Microsoft QuickBASIC or C.

National Instruments of Japan 81 (03) 788-1921 • National Instruments of France (1) 48 65 33 70 • National Instruments United Kingdom 44-01-549-3444 • ARGENTINA 541/46-5776 /0628
• AUSTRALIA 61 (3) 879-2322 • BELGIUM 02/735.21.35 • CANADA 416/890-2010-613/596-9300-(514) 747-7878-403/295-0822-(604) 988-2195 • CHILE 56 2253689 • DENMARK 45 02-251122
• FINLAND 358 90-372 144 • FRANCE 33 (1) 69077802 • HONG KONG 852 0-262707-852 0-262945 • IRELAND 353 042 72282 • ISRAEL 972 324298 • ITALY 39-2-98491071-2-3 • KOREA (02) 776-38
• MEXICO 52 660 4323 • THE NETHERLANDS 31 070-996360 • NEW ZEALAND 64 09 444-2645 • NORWAY 02-531250 • PORTUGAL 19545313 • SINGAPORE 65 29 11336
• SOUTH AFRICA 27 (011) 787-0473 • SPAIN 34 (1) 455 81 12 • SWEDEN 46 08 792 11 00 • SWITZERLAND 41 65 52 8949 • TAIWAN/THE REPUBLIC OF CHINA 886 (02) 7036280 • THAILAND 66 2349330
• UNITED KINGDOM 44 273 608 331 • WEST GERMANY 49 89 807081

Circle 312 on Reader Service Card for LabWindows. 313 for LabVIEW.

Next to
your computer,
nothing beats
a Tandy®
printer.



The Tandy LP 1000...now available with PostScript™ compatibility.

Along with your PC and easy-to-use software, the Tandy LP 1000 Laser Printer brings you publishing capabilities previously handled either manually or by expensive dedicated systems. You can design, edit and print high-quality reports, newsletters, brochures, manuals and signs.

The LP 1000 delivers clarity that rivals professional typeset quality. It features built-in HP

LaserJet Plus® emulation, and its 1.5MB memory gives you 300 x 300 dots-per-inch quality on a full 8½ x 11" page.

And you can put the Tandy LP 1000 Laser Printer to work with the PostScript language, today's new standard for quality word processing, desktop publishing/presentation, as well as device-independent engineering and scientific applications.

The optional Destiny Page-styler kit gives your LP 1000 PostScript compatibility with every popular software package with a PostScript language driver. Now you can create Macintosh™-like publishing presentations with your PC.

Get the best in publishing-quality production with the affordable, high-performance Tandy LP 1000 Laser Printer.

Tandy Printers: Because there is no better value.™

PostScript/TM Adobe Systems, Inc. HP LaserJet Plus/Reg. TM
Hewlett-Packard. Macintosh/TM Apple Computers, Inc.

Radio Shack®
The Technology Store™

A DIVISION OF TANDY CORPORATION

Circle 239 on Reader Service Card