SPECIAL ISSUE

BYTE

EXTRA EDITION

Display until January 15, 1992

TOMORROW

Key technologies forecast by Letwin, Kapor, Canion, Nelson, Kay, Carr, Singh, Dyson, Metcalfe, Shaffer, Slater, Sinclair, and many others

TODAY

Buying and resource guides for 327 products from four key categories, plus introductions and trend analysis by the BYTE staff

CPU Wars 

OSes

Desktop Systems 

Future Software

The Business Perspective

Windowing 

Computers and Society


Networking

On-line Services

Surveys 

European Outlook

Key Technologies and Trend-Setting Products

OUTLOOK '92

0 440237 4 05

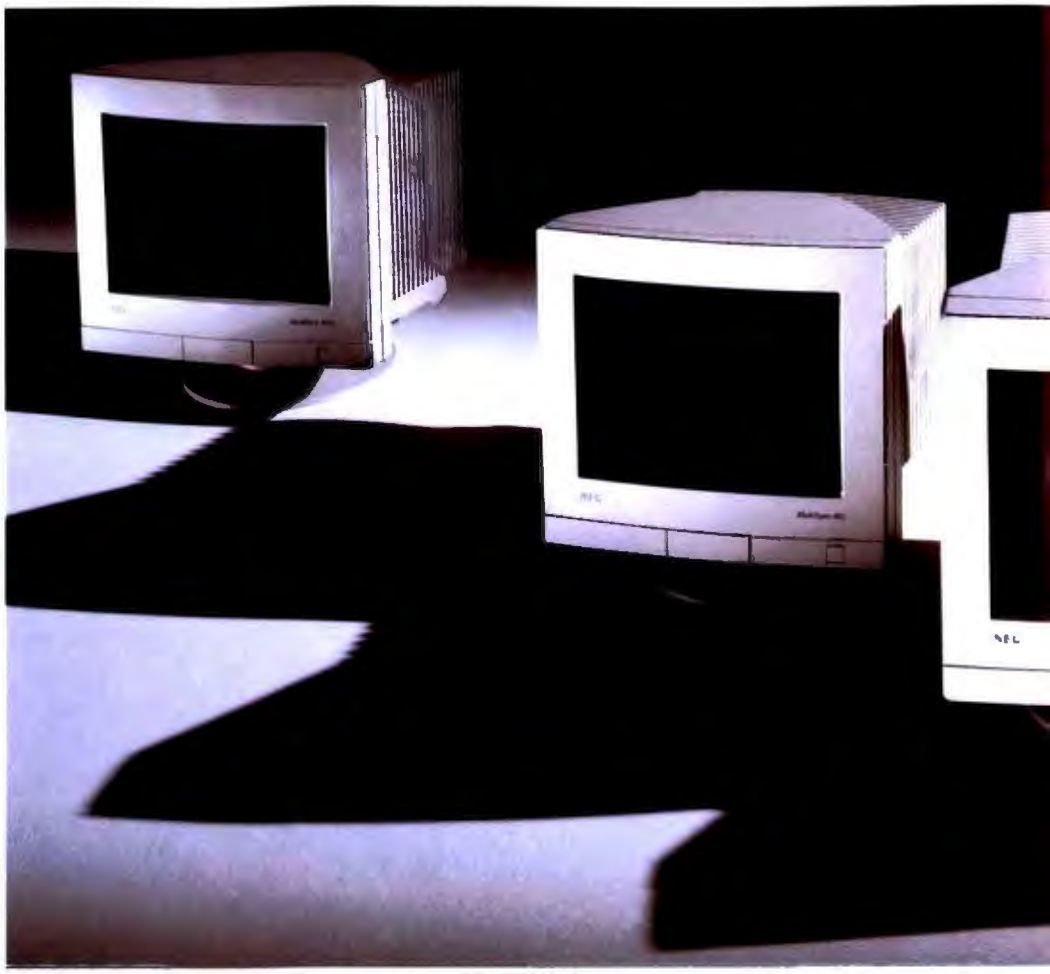
02849

$3.95 U.S.A.
$4.95 IN CANADA
£2.95 U.K.
0360-5280

What do you want in a monitor?

MultiSync 4FG

How about



Last year we invested over $3.6 billion *in research and development. In fact, our investments exceed the annual revenues of most companies. No wonder we were able to design such an innovative line of monitors.*

The new MultiSync® monitors from N

Announcing the new FG™ series of MultiSync monitors. Completely redesigned from the inside out to give you brighter, sharper, more accurate images. Now the monitor you've always wanted has all the features you ever wanted.

Features like our exclusive AccuColor™ Control System*. An amazing advance in computer monitors that provides unprecedented color accuracy. Now you can easily match on-screen colors to printer output, other monitors, process color standards such as Pantone® or even your personal preferences.

Advanced flat square screen technology takes the FG series performance into the future. Larger screens combined with our FullScan™ capability provide an edge-to-edge display with up to 36% greater active screen area** than most conven-

*Not available on the 3FGx. MultiSync is a registered trademark and FG, AccuColor, FullScan and ErgoDesign are trademarks of NEC Technologies, Inc. Pantone is a registered trademark of Pantone, Inc. Apple is a registered trademark of Apple Computer, Inc.
**Dependent on graphics board and signal timing used.

C&C Computers and Communications

Call 1-800-NEC-INFO. (In Canada: 1-800-343-4418.)
For immediate information, call NEC FAST FAX, 1-800-366-0476. Request #1521.

everything?

EC. Not an introduction. A revolution.

tional monitors. Higher refresh rates enable stable, flicker-free images. While the high-contrast screens eliminate blurring, display colors more vibrantly and deliver exceptionally sharp text and crisp graphics.

ErgoDesign™ elements enhance comfort and safety. An antistatic screen coating eliminates dust attraction. And all the controls are in the front where they're easier to use. Plus, our Reduced Magnetic Field™ technology lowers ELF and VLF emissions. In fact, they even meet the strict Swedish MPR II guidelines.

MultiSync monitors support a range of video standards from VGA to 1280 x 1024 non-interlaced, Apple Mac II and many workstation modes.

The all new FG series from NEC. For an image as clear as the one in your mind.

Because is the way you want to go. NEC

Circle 104 on Inquiry Card.

INTRODUCING PHOTOGRAPHY

New FotoMan.™ The portable affordable camera for your computer.

It's positively amazing. Now you don't have to wait around to get your photos developed. Or pay for film. Or prints. New FotoMan takes great shots, displays super sharp digitized pictures on your PC in a flash, and comes with all sorts of creative image editing tools.

Take it anywhere.

Powered by built-in rechargeable batteries, pocket-sized FotoMan can shoot 32 pictures in a session. It also comes with a filter for great shots in the great outdoors. And FotoMan's single button operation, automatic flash, and infinite field of focus make it a snap to use—anywhere.

A darkroom in your PC.

After your photo session, simply plug FotoMan into the serial port of your desktop or portable IBM PC (or compatible) and transfer your images in just seconds. You don't even need a digitizing board. Then preview and select the images you want to save.

FotoMan's Windows™ based image editing software—FotoTouch™—displays images in 256 shades of gray, and makes editing and retouching fast and fun: crop backgrounds, change sizes, adjust contrast and brightness, even create special effects. You can use your perfected pictures in any application. And a file compression feature saves them in a minimum of storage space.

FotoMan comes with everything you'll need, plus something you probably won't: lifetime service and support. And at $799 FotoMan costs hundreds less than any other digital camera. We're positive you'll be impressed. For more information call toll free:

800-231-7717 ext. 345.

LOGITECH

Tools That Power The Desktop.

Circle 84 on Inquiry Card (RESELLERS: 85).


WITHOUT ALL THE NEGATIVES.
FOTOMAN

See the Difference.

"*Using each adapter at VGA, 800-by-600 and 1,024-by-768 pixel resolutions, all test images were displayed crisply.*"

– PC Week

"*The intelligence built into this monitor eliminates all of the arm stretching and wheel turning so often associated with video mode changes.*"

– PC Magazine

"*The image is the brightest we've ever seen, even in the brightly-sunlit new CADalyst office.*"

– CADalyst

"*Nanao thoughtfully places the seven mos used controls on the front of the monitor, unobtrusively tucked below the faceplate.*"

– Macworld

See the difference that the industry experts agree has set the **Nanao Flexscan 9080i** apart from other monitors.

The Difference Will Impress You.

Color yourself impressed by the Nanao Flexscan 9080i's multiscanning abilities and high resolution. The 1280 x 1024 non-interlaced resolution increases productivity and enhances graphics applications beyond compare. Its high refresh rate (74Hz) is easy on the eyes. And with sharper text and brighter colors, the 9080i delivers the high quality professionals need...and want!

The Difference Will Excite You.

Get excited about doing what you've always wanted to do with Windows on the 9080i's larger 16-inch screen area. Highly compatible, in compliance with the Video Electronics Standards Association. Convergence & pin-cushioning controls. Dual inputs for two computers or two boards. The little differences that make for an exciting new monitor.

The Difference Will Comfort You.

Sometimes for high performance you need to give up creature comforts. But not with the 9080i. Sit back a relax in front of your Nanao monitor and its convenien front control panel. Almost every adjustment is within your reach. Nanao Flexscan monitors even align themselves with the Swedish MPR standards of low radiation emissions and give you an anti-static coatin fulfilling your ergonomic needs.

See the family of monitors ready for the nex step in high resolution. To see the differenc for yourself, contact your local Nanao dealer call us at **1-800-800-5202.**

NANAO®

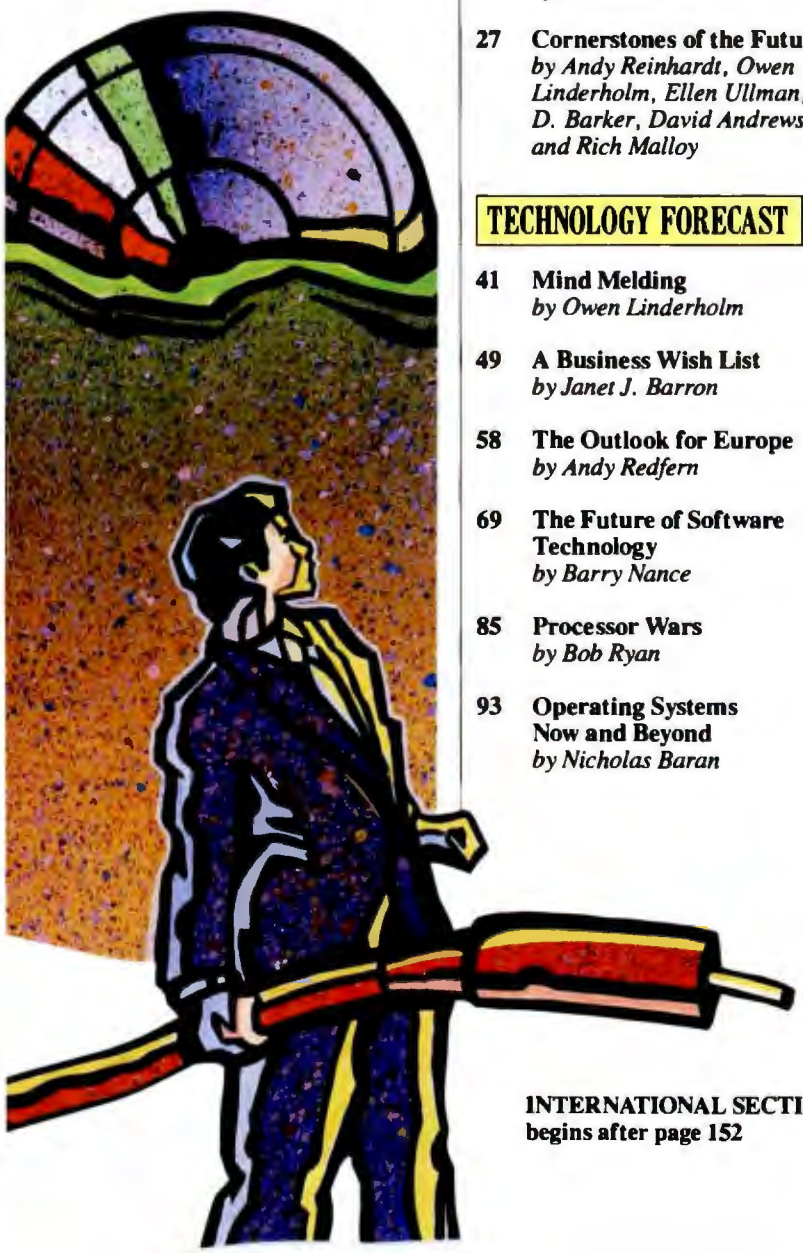
NANAO U.S.A. CORPORATION
23535 Telo Avenue
Torrance, California 90505
(213) 325-5202

Circle 99 on Inquiry Card.

Volume 16, Number 11, 1991

BYTE SPECIAL ISSUE

Outlook '92



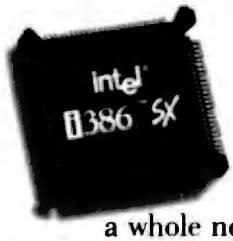
INTERNATIONAL SECTION begins after page 152

BYTE (ISSN 0360-5280/91) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $34.95 per year. Single copies $3.50 in the U.S., $4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. **Postmaster:** Send address changes. USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520

A true
of power
and

*Current DOS users can purchase a 5.0 upgrade package. To order your version of DOS 5.0, see your IBM Authorized Remarketer, or call 1 800 IBM-7699 to order a single copy. IBM, Personal System/2 and PS/2 are registered trademarks and Micro Channel is a trademark of International Business Machines Corporation. 386 is a trademark of Intel Corp.

story fame sX.



Right from the start, the IBM PS/2® Model 55 SX hit the bestseller list, making it the leading i386™ SX machine. And now IBM is opening a whole new chapter with 386 SX 20 MHz models designed to meet your needs.

The Personal System/2® Model 57 SX brings new levels of value to a Micro Channel™ PS/2, providing data integrity and increased performance for multitasking and networking. Standard 4MB RAM is upgradable to 16MB, 80 or 160MB hardfiles are available, and five expansion slots/four DASD bays offer true flexibility and expandability. Our two newest AT-bus PS/2s deliver powerful performance at practical prices. Models 40 SX and 35 SX have 2MB RAM upgradable to 16MB and fast 40 or 80MB hardfiles. The 40 SX has five slots/four bays, while the 35 SX packs its power into a smaller footprint.

IBM also has new ways to improve PS/2 performance, like a new, faster, more user-friendly DOS 5.0 that requires less memory, yet offers more advanced functions.* The new PS/2 3.5″ Rewritable Optical Drive utilizes the latest magneto-optical technology, and the new Model 8504 12″ monochrome display lets you view it all with amazing clarity.

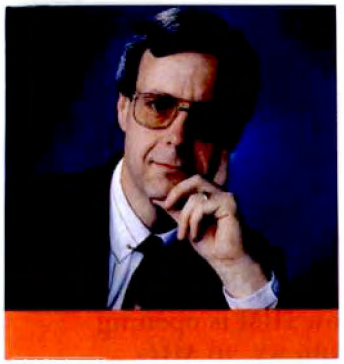
To get the full story, including our "PC Trade-In Offer," contact your IBM Authorized Remarketer or IBM marketing representative. For a remarketer near you, call 1 800 272-3438, ext. 386.

How're you going to do it?

PS/2 it!

IBM®

Circle 72 on Inquiry Card.



EDITORIAL

GENE
SMARTE

R.I.P. IBM

No, it's not what you think. You haven't pulled a Rip van Winkle and slept through the passing of an industry giant. The Rest In Peace refers to BYTE's annual IBM issues, the ones we've labored on for the past seven years. So what happened? Has BYTE abandoned the DOS world, gone platform-specific, maybe? No, but we have fulfilled our mandate to cover the powerful ground swell that the users of the world created.

The first of a new series of annual issues encompassing all of personal computing

While BYTE's mission has always been to look at technologies and products without respect to platform, processor, operating system, or any other specific characteristic, the significance of the DOS-based systems over the past several years has been obvious. And that's a big reason why we produced a special thirteenth issue each year at this time devoted to the DOS environment.

Still, we didn't ignore the rest of the world; each year we also had articles on connectivity, Macintosh, Unix, and other important systems and topics in our annual *IBM Special Editions* (as well as each month in BYTE). Each year, we'd review our reader surveys and trade show polls, talk with users and corporate leaders, and visit researchers and developers to gather data on topics that we felt were the most significant for that year.

During the past couple of years, the industry has reached critical mass. We cannot quite yet include "personal computer" in the same breath with "toaster" or "typewriter," but we are not far away. The diversity of hardware and software, while increasing in complexity and capacity, is becoming more and more transparent to users. Macintoshes, Sun workstations, and plain-vanilla DOS boxes can share data and increase efficiency via networks. Information resources and computing benefits are becoming easier to obtain.

Vociferous supporters of niche systems and products will always be with us, and that's fine, even desirable. But it is clear that computing is becoming more universal; it is becoming a tool rather than an end in itself. It spans platforms, processors, and operating environments as easily as it does oceans and continents.

There are truly worldwide issues that computing power influences, such as international monetary transactions, strategic communications and information gathering, and, most important, the free flow of information among individuals. Recent events in the Soviet republics attest to the power of fast and wide spread information dissemination.

Just where is all this ubiquitous "appliance" compu ing taking us? Where are we now? Where will we be i a few years? What technologies and products should w be buying today that we can use tomorrow? What c users want? What can industry provide? What can con puting technologists develop? These and a hundre other questions are easy to ask. We've tried to get som of the answers in this issue.

So, here we are, with what we hope will be the fir of a series of special annual issues devoted to person computing's future, with emphasis on emerging tecl nologies and their impact on the future *and* a cross se tion of the most significant products you can buy toda

For the future, we searched high and low to identif the important issues. We interviewed scores of corp rate players, industry gurus, and academic researcher We asked leading questions but also gave people an o portunity to speak their minds on what they felt w important. BYTE's News and Technology Departme selected six areas likely to have a major impact on tl future of personal computing. You can find the resul of this forward-looking effort in this issue's Techno ogy Forecast.

What about the buying decisions you need to ma today? We've addressed that point in the Product Pe spectives section. The BYTE Lab chose four critic product categories and provided feature-comparis data for many competing products. We've added som thing special: accompanying text for each category th gives you enough background to make intelligent dec sions, setting the context of the product category, d scribing trends, and hinting at future developments.

I'll not expound further here on this issue's conten Read the overview, "This Way to 1992," to get a fe for where the whole industry is today and for lots pointers to the various topics included in *Outlook '92*

As this is the first in the Outlook series, we expec to grow and evolve with the industry, to try to stay jus little ahead of what's happening. In 1992, we'll aga be identifying the most important technologies a products for *Outlook '93*. We invite your comments a suggestions for topics and spokespersons for our ne issue. Your input can be a vital part of our providi you with the timely information you seek.

—Gene Sma
Senior Editor, Special Proje
(BIX name "gsmarte

Panasonic announces another breakthrough in non-interlaced 1,024x768 graphics.

Value.

If you thought you'd have to compromise on your next High Resolution monitor, think again. With its new 14" PanaSync™ C1395, Panasonic® brings all the compelling clarity and richness of non-interlaced graphics within reach.

Turn it on, and you'll see your most graphics-intensive applications in a whole new light. Compared to interlaced monitors, images will be sharper, edges cleaner, details finer. With noticeably less flicker. Because now you're getting the whole picture, not just every other line. And the C1395 is as easy on your eyes as it is on your wallet.

Like all Panasonic monitors, the C1395 has excellent ergonomics. Controls are front-mounted, and a tilt-swivel stand is included.

So, whether your desktop is MS-DOS, a MAC II* or one of the other leading workstations, before you spend several undred dollars more on a new monitor, spend a few minutes at your uthorized Panasonic dealer. He'll show you that value has never oked so good.

For further information on the PanaSync C1395 Multi-Frequency Monitor, lephone 1-800-742-8086.

Monitors, Computers, Peripherals, Printers, Copiers, Typewriters & Facsimiles

Panasonic
Office Automation OA

Engineered for the office. Designed for people.

IAC II is a registered trademark of Apple Computer, Inc.
n optional cable is required for Macintosh, the C81M2.

Circle 118 on Inquiry Card.

Carbon fiber reinforced case reduces the thickness and weight while increasing its strength.

Large, bright, easy-to-read 9.5" diagonal display.

Nickel Hydride battery works for over 3 hours on a 2 hour charge.

AutoResume lets you start where you left off without rebooting.

Includes MS-DOS* 5.0.

20MHz 386SX 32-bit microprocessor.

12 dedicated function keys.

150-pin expansion bus connector for Desk Station IV docking station.

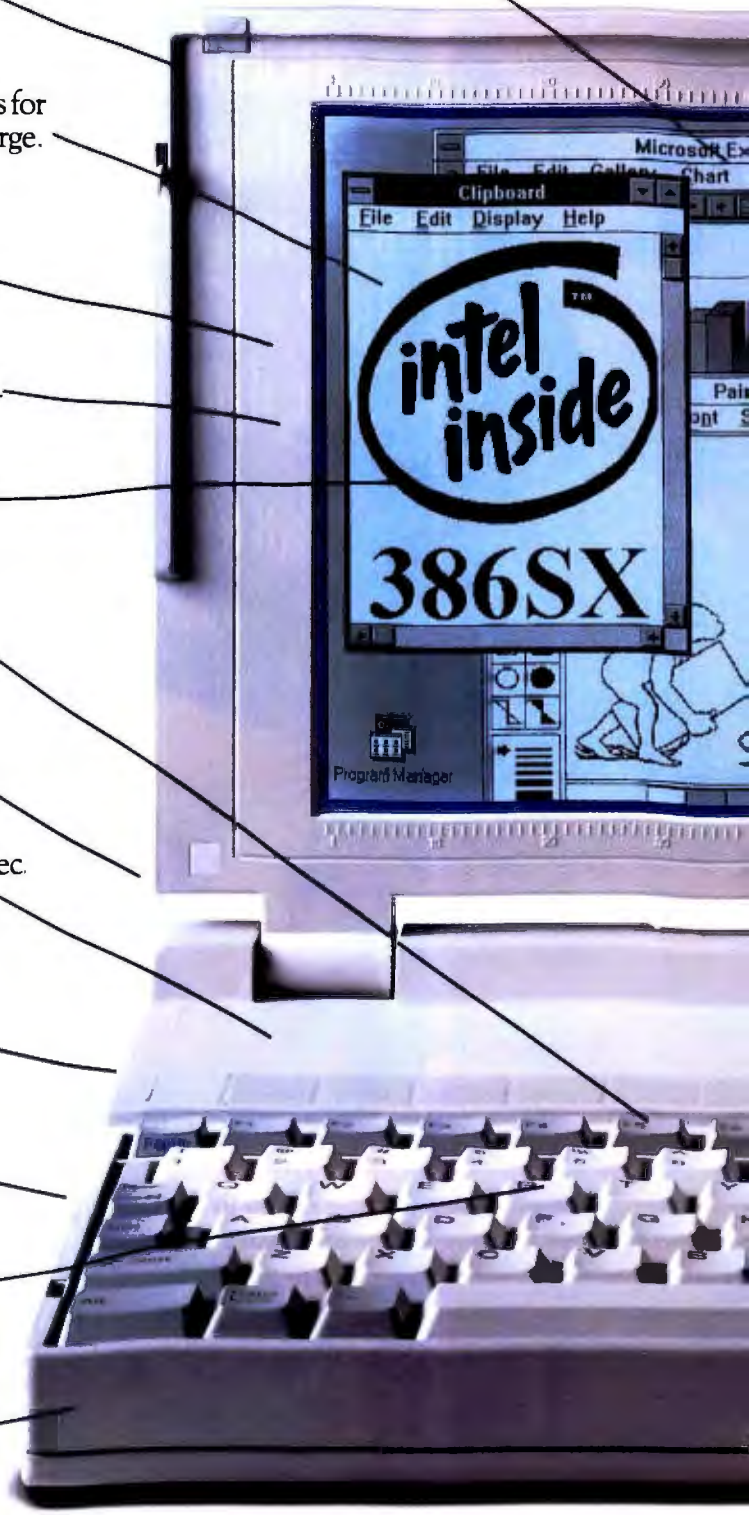
60MB hard disk drive with 19 msec. average access time.

A credit-card sized memory card lets you add up to 8MB of RAM yourself.

Port for numeric keypad or 101-key keyboard adapter.

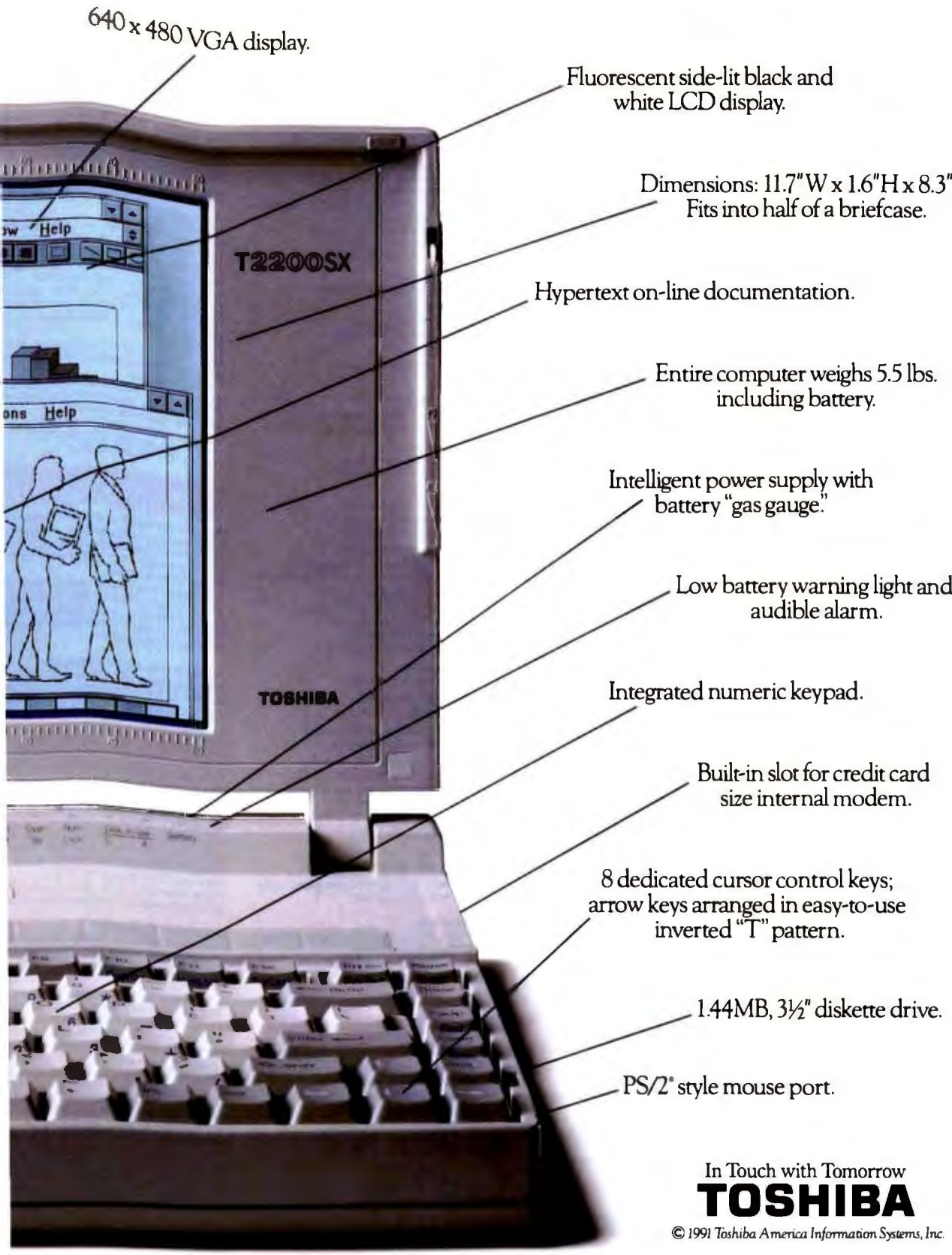
Full function, standard spaced, 82-key keyboard.

2MB RAM standard.



WE JUST REWROTE

Introducing the T2200SX. At just 5.5 pounds, it's everything you've ever want



In Touch with Tomorrow

TOSHIBA

HE NOTEBOOK.

notebook computer, and less. For details, call 1-800-457-7777.

Circle 154 on Inquiry Card.

BYTE

HOW TO CONTACT THE EDITORS

We welcome your questions, comments, complaints, kudos, and submissions.
MAIN OFFICE: One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
WEST COAST: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 15635 Alton Pkwy., Suite 290, Irvine, CA 92718, (714) 753-8140.
NEW YORK: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
UK/EUROPE: Wimbledon Bridge House, One Hartfield Rd., Wimbledon, London SW19 3RU, England, 011-44-81-543-1234.
ELECTRONIC MAIL: On BIX, send to "editors." All BYTE editors and columnists also have individual mailboxes on BIX for easy access.
MCI: 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own name.
OTHERS: Many editors also are reachable through uunet, AppleLink, CompuServe, and numerous other services.
U.S. fax: Editorial: (603) 924-2550
Advertising: (603) 924-7507
U.K. fax: 011-44-81-540-3833

SUBMISSIONS

Authors: We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for lost manuscripts or photos.
Vendors: We welcome news of your new products; please call the News department or the BYTE Lab at the earliest possible date. We cannot be responsible for unsolicited product samples.

SUBSCRIPTION CUSTOMER SERVICE
Inside U.S. (800) 232-BYTE; outside U.S. (603) 426-7678. For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, 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, $34.95 for one year, $64.95 for two years, $87.95 for three years. In Europe, £29 (U.S. $50) for fast surface delivery, £41 (U.S. $70) for air delivery. Non-European countries U.S. $50 for surface mail, or U.S. $75 for air mail. Single copy price is $3.50 in the U.S. and its possessions, $4.50 in Canada. 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.

Member
Audit Bureau of Circulation

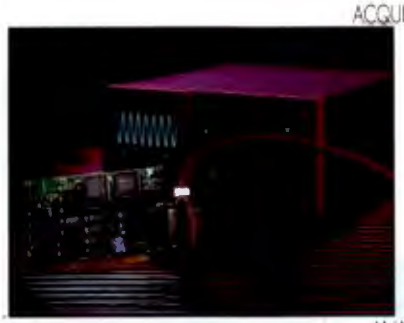
BIX BYTE INFORMATION EXCHANGE

DEMOLINK
BYTE program listings are available at (617) 861-9767 (set modem at 8-1-N, 2400 or 1200 bps). Enter Demolink.

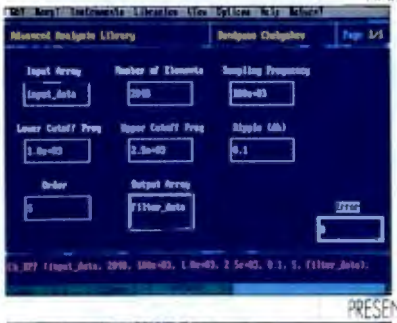
BIX, the "BYTE Information Exchange," is a worldwide, low-cost, on-line information service featuring industry news, downloadable software, powerful electronic mail, previews of upcoming BYTE articles, the full text of published issues of BYTE, and source and/or executable code for BYTE benchmarks and noncommercial software mentioned in feature articles. BIX also offers unmatched "conferences" on virtually every computer-related topic imaginable, where you can share information with thousands of other computer pros. To subscribe via modem, set your communications software to full duplex, 7 bits, even parity, 1 stop bit, and then call 800-225-4129; in MA, call (617) 861-9767. International, call NU1310690157800. Then hit the Enter/Return key and enter "BIX" when asked to log in; then enter "BIX.VILLE" when asked for a name. For current fees and more information, call (800) 227-2983 or (603) 924-7681 on voice phone.

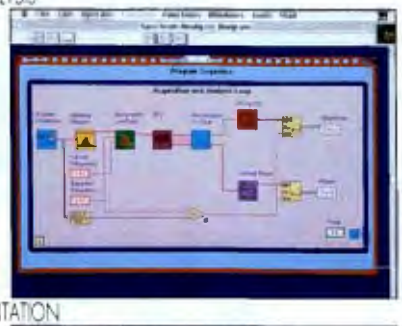
We've given you the best of both worlds...

ACQUISITION

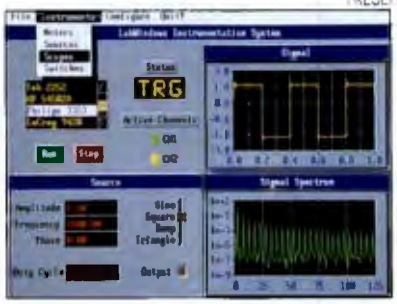


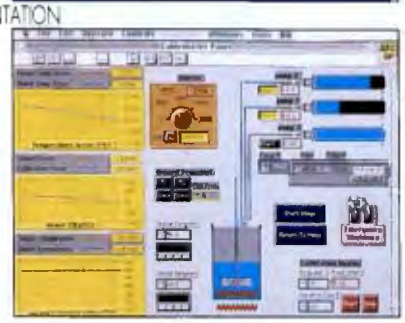
ANALYSIS





PRESENTATION





LabWindows® 2.0
for DOS-based computers

LabVIEW® 2
for Macintosh computers

All You Have To Do Is Choose!

In the 1980s, National Instruments pioneered two paths to the future of instrumentation. LabWindows, an automatic code generation and program development system for the C and BASIC programmer. And LabVIEW, the first graphical programming system to offer ease of use without sacrificing programming flexibility and performance.

LabWindows and LabVIEW address all of your instrumentation needs. You can control GPIB, VXI, and RS-232 instruments, and plug-in data acquisition boards. You can integrate data analysis. And, you can build your own graphical user interfaces.

Today, LabWindows and LabVIEW are leading the revolution in instrumentation software. Through innovative programming methodologies and powerful development tools, LabWindows and LabVIEW are paving two paths to the future–a future in which *The Software is the Instrument.* All you have to do is choose!

Call for your free demo disks (512) 794-0100 or (800) 433-3488 (U.S. and Canada).

NATIONAL INSTRUMENTS®
The Software is the Instrument®

6504 Bridge Point Parkway
Austin, TX 78730-5039

Australia (03) 879 9422 • Denmark (45) 76 73 22 • France (1) 48 65 33 70 • Germany (089) 714 5093
Italy (02) 4830 1892 • Japan (03) 3788 1921 • Netherlands (01720) 45761 • Norway (03) 846 866
Spain (908) 604 304 • Switzerland (056) 45 58 80 • U.K. (0635) 523 545

Circle 103 on Inquiry Card.

No one will solv

That's why the smar

If you have a computer problem, most PC companies react in a predictable way. They point their finger at someone else, and say: "It's not our problem."

You won't hear that from Compaq. If you experience a problem with one of our PCs, running stand-alone or networked in a Banyan, Microsoft, Novell or SCO UNIX operating environment, we promise to take ownership of that problem. We'll help find a solution.

Compaq has made a great commitment to service and support. So you'll find that we're not just a 1-800 number.

We've created alliances with leading hardware and software companies, so support staffs are cross-trained to understand entir systems, not just parts. We've extensively trained a worldwide network of over 3,500 Authorized Dealers who offer a variety of service and support programs which can be tailored to your needs

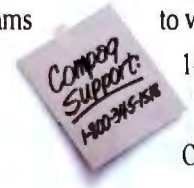
'C problems better.

:hoice is Compaq.

We've amassed a vast library of technical information that u can access instantly from the COMPAQ QuickFind Reference ɔrary, our CD-ROM database. And we've set up programs at help dealers get you the parts you need, when you :ed them.

If you need help with PCs, options or operating stems, we've also made sure that you have access to us through our Customer Support Center—only a phone call away.

For free brochures that show you how to put our resources to work for you, call 1-800-231-0900, Operator 172. In Canada, 1-800-263-5868, Operator 172. We'll also give you the location of your nearest Authorized COMPAQ Computer Dealer.



COMPAQ

It simply works better.

This Way to 1992

In this Outlook '92 issue, BYTE provides some navigational aids to computer technology and buying in the year ahead

NICHOLAS BARAN

In this special Outlook '92 issue, BYTE editors and contributors join with industry experts to assess the state of computing as we approach 1992—no small task. We begin with an article prepared by members of the BYTE news department, called "Cornerstones of the Future," which provides a look at the key events and trends that will shape the computing industry over the next five years. The remainder of the issue is divided into two sections—a Technology Forecast and a Product Perspectives section.

The Technology Forecast section presents a series of articles covering general trends in computing technology and includes the observations and predictions of a variety of industry leaders and experts. The Product Perspectives section contains articles by BYTE editors that look specifically at key product categories and evaluate some of the products within these categories that will be most important in the next few years. The categories include low-cost, high-performance desktop systems, windowing applications and interfaces, notebook PCs, and network management.

Trying to Sort It Out

The first thing that struck me as I read through the manuscripts for this issue is how complex this industry has become. There are few industry sectors that bring together such a complex web of technical disciplines as those required to build today's computer systems and, even more so, the computer systems of the future.

The challenges of high-speed wireless communications, high-resolution graphics and image compression, handwriting and voice recognition, miniaturization, optical mass storage, low power consumption, object-oriented software development, and so on combine to make computers the focus of some of the most advanced research in electrical engineering, mechanical engineering, physics, and, of course, computer science.

Not only are computers technically complex, but the computer industry offers enough political, legal, and marketing issues to keep a huge sector of nontechnical professionals busy for decades to come. We have company alliances, battles over software standards, lawsuits, federal investigations concerning software copyrights, companies dominating particular markets, and the increasingly difficult and important problem of ensuring data security in the age of wireless and cellular communications. We also have new issues to worry about—the rapidly growing European and

Computers continue to expand into uncharted territory, providing functions and capabilities that few people ever imagined just 25 years ago

ILLUSTRATION: DAVE ROTOLONI © 1991

Asian markets, for example.

And, in spite of all the progress and all the cutting-edge technologies that are just around the corner, the computer industry shows a remarkable inertia and resistance to change. The old cliché "the more things change, the more they stay the same" is alive and well in the computer business.

Sometimes it seems that almost all ballyhooed new technologies and products are still on the drawing board months (or even years) after gala product announcements and flurries of articles in the computer press. The recent agreement between Apple and IBM is a case in point. In spite of all the hoopla and cogent analysis from the industry pundits, we probably won't see any products resulting from this alliance for at least three years.

Nevertheless, in spite of the complexity and hype that characterizes the computer industry, it is important for computer users and purchasers to plan for the future—to anticipate both the technical and marketing trends that will affect the way we work with computers in the years ahead. This Outlook '92 issue is an attempt to sort through the complexity and hype.

Let's Not Forget the Customer

Computer manufacturers and vendors are only one side of the equation that determines the future of computer technology. The other, more important side is the customer. It is customers who buy the products and make or break computer companies, and it is the customers' demands that dictate where companies devote their research budgets. If companies don't deliver what customers want at a competitive price, they don't last long. And this industry has a penchant for coming out with "solutions looking for a problem": products that customers simply don't need and don't want. (So-called integrated applications such as Symphony come to mind.)

To keep things in perspective, we've included customers' views in this issue. Janet J. Barron's "A Business Wish List" contains a series of interviews with business executives who were asked to evaluate their requirements for future computer systems. Their responses illuminate the shortcomings of current business systems, and they suggest that the industry faces some major challenges in business computing. Better and more standard access to information, better user interfaces, and better connectivity are just some of the improvements that business users are looking for.

To measure the pulse of a wider group of users, Gene Smarte compiled the results of a series of recent BYTE surveys of subscribers and attendees at computer trade shows such as Comdex and MacWorld Expo in his article entitled "Surveys Say . . ." The surveys provide an interesting perspective on what users think is important and what they actually use in their day-to-day computing. A large number of those surveyed use Microsoft Windows and think that the Intel CPU architecture will continue to dominate the industry. Many believe that optics will be the most important technology in the next five years. And many complained about poor customer support.

Have You Considered Overseas, Dahling?

Although many components and computer systems are manufactured over-

seas, particularly in Japan and Taiwan, the U.S. has remained the headquarters of the computer industry. U.S. companies such as IBM, Apple, Hewlett-Packard, and others continue to dominate the market, and the overwhelming majority of the world's software is still developed in the U.S.

However, things are changing. In particular, the European market is becoming increasingly important. In fact, it is "emerging as the world's largest computer market," says BYTE's U.K./Europe bureau chief Andy Redfern in his article "The Outlook for Europe." It is worth noting that Next Computer recently informed its developers that it expects to sell 30 percent of its systems in the European market this year, and the company exhorted developers to include foreign language capabilities in their products.

The European market can no longer be viewed as secondary to the U.S. market. Manufacturers and developers must deliver products that are tailored to the language and cultural requirements of the European countries if they hope to succeed.

Computers and Society 101

As mentioned earlier, technology is only half the story when it comes to computers. Legal battles over ownership and copyrights are an unfortunate, but inevitable, sideline attraction that often takes center stage. Rich Malloy takes a look at these issues in the "Ownership and Power" section of the Cornerstones article.

But social issues are not merely an unfortunate sideline of the computer business. On-line services, for example, are in fact a social institution with the characteristics and features of libraries, professional societies, and social clubs all rolled into one and accessible through a phone call from your computer. Nevertheless, on-line services have been less successful to date than many industry observers originally anticipated. Michael A. Banks takes a look at the state of on-line services in his article "Are On-Line Services Delivering?"

Sharon Fisher's article on networks ("Networking: Promises and Problems") also touches on the social consequences of computer networking—the problem of protecting privacy and security, as well as the political dangers and opportunities of widespread networks.

Call to Battle

The words *battles* and *wars* have become part of the jargon of the computer business. This industry is having constant spreadsheet wars, database battles, processor wars, and battles of operating systems. These conflicts rarely result in the emergence of clear winners, but rather in constant shifts and retrenchments, unexpected successes and failures, and remarkable durability of the old battlehorses.

A classic example of the shifting-tides phenomenon is Ashton-Tate's dBase. For years, it seemed that dBase would forever remain the undisputed champion of the database arena—until the coming of dBase IV. Mired in endless delays and hampered by bugs and sluggish performance, dBase IV very nearly caused the undoing of Ashton-Tate, and it opened the door for other competitors, such as Borland's Paradox, to gain a strong foothold in the database market. But this is not an isolated case. Virtually every major software and hardware vendor has

had a similar experience.

In this issue, we look at two battlegrounds that are mainly populated with old war-horses—operating systems and microprocessors. "Operating Systems Now and Beyond" explores the future of operating systems and the durability of such old battlehorses as MS-DOS and Unix. While DOS and Unix will certainly hold their own, new alliances such as the Advanced Computing Environment initiative and the recent IBM/Apple deal could produce some new warriors in the next several years.

In "Processor Wars," Bob Ryan takes a look at the microprocessor battlefield, where old war-horses also face new challenges. Intel faces the challenge of Advanced Micro Devices' 80x86 clones, while the 80x86 market in general will be challenged by the increasing popularity of RISC processors. But Intel's 586 may be the most important of the new processors joining the fray.

It's Time to Communicate

Networks and communications remain among the most challenging—and most promising—aspects of computing. The ability of computers to communicate among themselves makes them powerful tools.

But realizing the enormous potential of networks has remained elusive. Networks are still difficult to install and maintain. Compatibility problems and lack of interoperability still plague the network business. As mentioned earlier, there are also social and political issues to worry about. But there are also promising improvements ahead.

Several articles in this issue deal with the future of networks. Sharon Fisher's "Networking: Promises and Problems" explores the potential as well as the problems of networks from the viewpoints of several industry experts. The article looks at the concept of "true interoperability" as well as the problem of standards and security.

The Cornerstones article includes a section written by David Andrews, entitled "Communications," that takes a look at the possibilities of global networks. In addition, Jon Udell looks at the issue of network management and discusses the products that are available for this task in "Trends in Network Management" in the Product Perspectives section.

The Object Is Software Development

Computers today are still hard to use and remain a mystery to a large majority of people. If you want to prove this to yourself, think of all your friends and relatives and consider how many of them know what "graphical user interface" means or, for that matter, how many have ever used a computer. The main reason for this aversion to computing is the state of software.

Software remains difficult to develop, and developers face a never-ending increase in user expectations and demands. Thus, an application that seemed enormously powerful just a few years ago appears crude and primitive today. The software developer's task has been greatly complicated by the advent of GUIs and windowing applications as standard components of virtually all desktop computer systems.

And the problem is exacerbated by the continued dominance of old and complicated operating systems such as Unix and DOS. (See "Operating Systems Now and Beyond" for more on the role of operating systems in software development.) Meanwhile, software developers

Unprecedented 32-Bit Programming Power in a Single Package: WATCOM C8.5/386

Limited-time introductory offer
$795
Regular price: $995

WATCOM C8.5/386 Optimizing Compiler and Tools includes:

- Royalty-free 32-bit DOS Extender
- True 32-bit Windows GUI Application Kit
- Fast, Tight, Reliable 32-bit Code Optimizer
- Licensed Microsoft Windows SDK Components
- Interactive Source-Level Debugger
- Execution Profiler

MICROSOFT WINDOWS

PC MAGAZINE EDITORS' CHOICE

INFO WORLD BEST IN ITS CLASS WATCOM C7.0 1990

COMPUTER LANGUAGE PRODUCTIVITY AWARD 1990

COMPUTER LANGUAGE PRODUCT EXCELLENCE AWARD 1990

Highlights

100% ANSI and SAA compatible: C8.5/386 passes all Plum Hall Validation Suite tests.
Comprehensive tool set includes a debugger, linker, profiler and much more.
Microsoft extensions simplify porting of 16-bit source.
DOS extenders supported include Phar Lap, Rational and Ergo.
Extensive third party support includes products to help with windowing, communications, C++ development and graphics.
AutoCAD ADS development and debugging support.

DOS Extender Features

C8.5/386 includes DOS/4GW, a 32-bit DOS extender developed by Rational Systems and based on the industry-leading technology of DOS/16M, Key features include:

- **Royalty-free runtime license**
- **Virtual memory support up to 32Mb**
- **25K real mode memory footprint**
- **DPMI support** (DOS, Windows DOS Box, etc.)
- **VCPI and XMS** (himem.sys) compatible

32-bit Windows Kit

Develop and debug true 32-bit GUI applications and 32-bit DLL's. Using 32-bit addressing, GUI applications can exploit the flat memory model to overcome inherent Windows memory constraints. Straightforward memory allocation makes Windows application development easier. Key components include:

- **Supervisor** for executing 32-bit applications and DLL's under Windows
- **Debugger** for 32-bit applications and DLL's under Windows
- **Licensed Microsoft SDK components**
- **Access to Windows API** from 32-bit code through special libraries
- **387 math co-processor emulation**
- **32-bit C library** for Windows

WATCOM C8.5/386

• 100% ANSI C Optimizing Compiler
Tools set components:
• Protected-mode version of Compiler • Royalty-free DOS Extender with VMM support • Licensed Components of the Microsoft Windows SDK • Interactive Source-Level Debugger • Linker • Protected-mode version of Linker • Profiler • Object Code Librarian • Object Code Disassembler • MAKE Facility • Patch Facility • Object Module Convert Utility • Windows Supervisor • Bind Facility for Windows Applications • 386 Run-time library object code • Special 32-bit libraries for Windows API • 386 Graphics Library for Extended DOS applications • 386 Run-time libraries for Windows

Also available:

WATCOM FORTRAN 77/386

Includes 100% ANSI FORTRAN optimizing compiler and all tool set components listed above for C8.5/386.

Platforms

Host environments:
DOS, Extended DOS, Windows DOS box, OS/2 1.1 or later
Target environments:
Extended DOS, Windows, Windows DOS box, AutoCAD ADS, embedded systems
Novell's *Network C for NLM's* includes C8.5/386

Price: $995

1-800-265-4555

WATCOM

415 Phillip Street, Waterloo, Ontario, Canada
N2L 3X2 Tel. (519) 886-3700 Fax (519) 747-4971

are looking for new development tools to try to simplify the task of software development.

Clearly, the most promising trend is the shift to object-oriented programming, which is discussed by Ellen Ullman in the "Software Technologies" section of the Cornerstones article. Barry Nance looks at OOP, programming languages, and other software development issues in his article "The Future of Software Technology."

Open the Window; What Do You See?

Software development is one side of the ease-of-use coin. The other side of that coin is the interface that a user actually sees on a computer screen. Of course, software development tools and user interfaces are closely related. In fact, developers spend a good deal of time integrating their applications into the windowing environment and user interface of the computer system on which their applications will run.

User interfaces pose a very thorny problem for developers and software vendors. On the one hand, users don't like change; they don't want to have to learn new tricks. This ensures the continued popularity of interfaces such as Microsoft Windows and the Macintosh Finder. On the other hand, major advances in user interfaces will require users to give up some of their old habits. The key is making the changes so easy to learn that users will willingly abandon their old ways.

In his article "Mind Melding," Owen Linderholm looks at some of the philosophies and theories behind user-interface research and some of the interfaces that we can expect to see in the future, presenting the views and predictions of several experts and visionaries in the user-interface field. And Andy Reinhardt investigates new forms of user interaction, such as pen and voice, in the "User Interaction" section of the Cornerstones article.

Picture Windows

Part of the user-interface story is the capability to display images on the screen. More and more computers have high-resolution displays capable of displaying millions of colors, and users of these computers are looking for true color imagery to use in scientific visualization, motion video applications, and graphic arts work. D. Barker looks at the state of graphics in the "Information Representation" section of the Cornerstones article.

Finally, BYTE editors Stan Miastkowski, Tom Yager, and Tom Thompson look at the latest applications for Microsoft Windows, the X Window System, and the Macintosh, respectively, in the "Windowing: Not by DOS Alone" Product Perspectives section.

A Stop at the Hardware Store

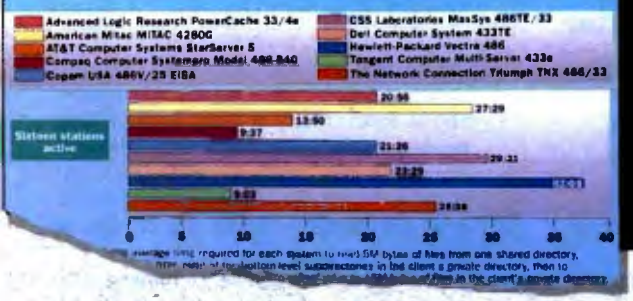
The hardware technology that's generating the most interest right now is the notebook computer. Although in their infancy, notebook computers promise to have a major impact on the computer marketplace. Two articles in this issue take a look at notebook systems. In the "Hardware Technologies" section of the Cornerstones article, Owen Linderholm examines some of the new technologies that make notebook computers possible: low-power CPUs, advanced display technology, and flash EPROM, for example. In the Product Perspectives section, Michael Nadeau takes a look at DOS-based notebooks and discusses some of the new

Once again, editors rave about the Tangent 486.

"...when the full 16 stations included in the test were active. The Tangent Multi-Server 433e was still the fastest..."
PC Week 1/7/91

C WEEK

Tangent Server Maintains Performance Lead As LAN Size Increases



"A consistently strong performer across all tests, the Tangent model 433e stands out in this group." PC Magazine April 16, 1991

PC MAGAZINE EDITORS' CHOICE
April 16, 1991
Tangent 433e

PC Magazine, April 16,1991

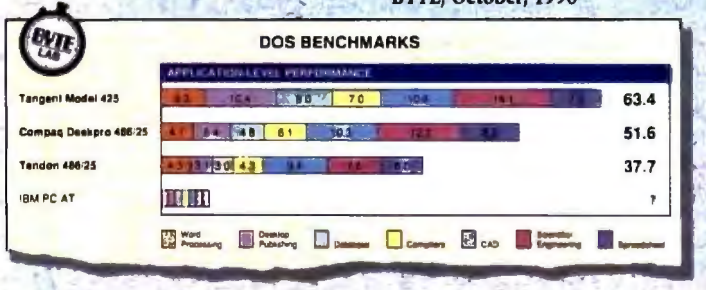
TANGENT COMPUTER INC.

Tangent Model 433e

by Bill O'Brien

Tangent Computer's foray into the realm of the EISA bus is represented by an investment-quality machine.

"The big winner is the Tangent..."
BYTE, October, 1990



When the editors got through writing about Tangent 80486 systems, they didn't leave us a lot to say. Except price. First, compare performance. Then compare price. What you'll see is that Tangent is the price-to-performance leader in 486 systems, with a range of models designed to fit any need.

Tangent Multi-Server 433ms
Capable of replacing 5 to 10 conventional servers.
- Intel 486-33 MHz EISA
- Up to 64 MB RAM
- SCSI Drive Arrays Up to 12 GB
- Continuous 1-3ms Average Access
- Up to 4 Ethernet Ports or 96 Serial Ports
- UNIX or NOVELL Configurations

Priced from $14,900

Tangent 433e / 425e
Our high-end, award winning engineering workstation.
- Intel 486-33 or -25 MHz EISA
- 200 MB to 2.4 GB of Disk Storage
- EISA Caching 32 Bit Disk Controller
- Non-interlaced SuperVGA Monitor

$4,795
Priced from ~~$5,995~~

Tangent 433i/ 425i
A 486 at a 386 price.
- Intel 486-33 or -25 MHz ISA
- 105 MB Up to 2.4 GB of Disk Storage
- Choice of IDE, ESDI or SCSI
- Non-interlaced SuperVGA Monitor

$2,595
Priced from ~~$3,695~~

486 your way. Tell us your applications and operating environment and we'll configure a system to meet your needs 100%. Then we'll build, test and ship your system. Pronto.

We're here when you need us. Our sales and support engineers are as near as your telephone...

Tangent is your first call for affordable high performance.

Call toll free: 1-800-223-6677

TANGENT COMPUTER

197 Airport Blvd., Burlingame, CA 94010
Phone: 415/342-9388 FAX: 415/342-9380

Circle 149 on Inquiry Card.

pen-based systems that are now entering the market.

An important catalyst for the development of lightweight notebook computers is the advancement of techniques for storing data, both on disk and in volatile memory. Storage technology encompasses not only the basic magnetic and optical media, but also techniques for storing data in more efficient ways—techniques such as the use of cache controllers and data compression. Andy Reinhardt brings you up to date on the latest developments in storage technology in his article "Disk, DAT, and the Optical Thing."

In spite of the surge of interest in notebooks and portables, the heart of the computer industry remains the desktop machine. While there may not be any earth-shattering changes in these systems in the next few years, they will remain the primary focus of computer buyers. But there will be some changes. Desktop systems will sport faster processors and hard disk drives in the next few years, as well as multiple processor architectures.

From the product perspective, BYTE technical editors Alan Joch, Tom Yager, and Tom Thompson take a look at DOS-based PCs, Unix machines, and Macintoshes, respectively, in their article entitled "Desktop PCs: The Buyer's Market Continues" in the Product Perspectives section.

Indeed, desktop machines will continue to drop in price, and the workstation market will become more competitive. According to Tom Yager, Next Computer may finally start to make some big sales in 1992. For a more general perspective on desktop machines as well as other types of computers, see the "Hardware Technologies" section of the Cornerstones article.

In spite of the surge of interest in notebooks and portables, the heart of the computer industry remains the desktop machine.

The Next Revolution

In a nutshell, that's what this Outlook '92 issue is about. These pages contain a lot of interesting material and food for thought. When considering computer technology, it's always fun to try to anticipate what the next revolution—the next great technological breakthrough—will be. But it is also very hard to predict. To many observers, technological change has been a slow and arduous process. But then again, this industry is only about 25 years old and has only begun to mature over the last five years.

From a historical perspective, it is quite amazing how much progress has been made in the computer industry in such a short time. Compare the computer industry to the automotive industry, for example. There haven't been any major changes in cars in 30 years. Sure, cars now have better suspensions and engines, more electronic gadgetry, and more aerodynamic bodies, but the basic design and function of the car have remained essentially the same. Meanwhile, computers continue to expand into uncharted territory, providing functions and capabilities that few people ever imagined just 25 years ago.

Soon we'll be seeing a whole new class of workers using computers—namely, mobile workers, such as doctors making the rounds, delivery personnel, maintenance workers, real estate appraisers, and so forth. Many of these workers have never used computers up to now and will provide a new market where the computer industry can innovate and provide new capabilities without the burden of backward compatibility.

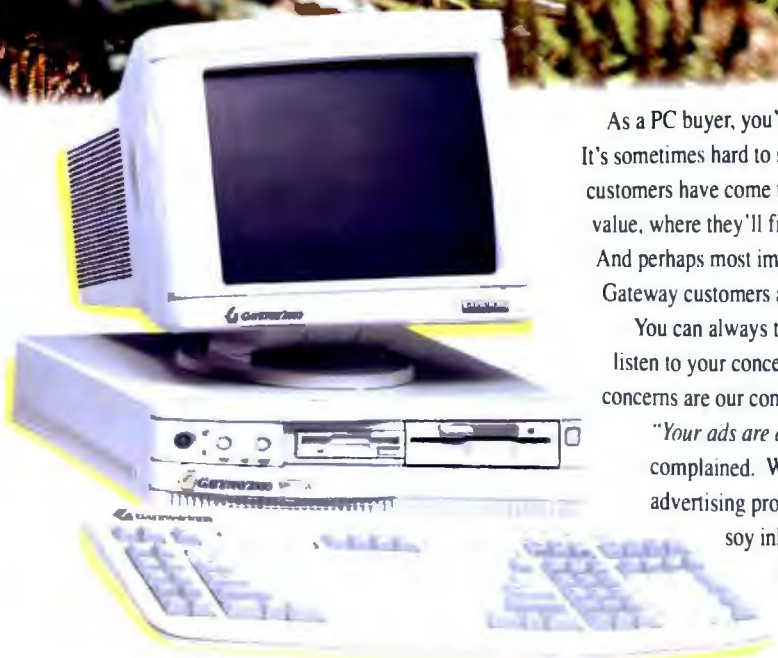
As long as data can be exchanged with existing computer systems, compatibility may not be very important in this new market. And that is an exciting prospect. 1992 should be an important year for the mobile computing, or pen-based, market. And if I may take the liberty, I believe that this is the market where the next revolution in computing will take place. ■

Nicholas Baran (Sandpoint, ID) is a consulting editor for BYTE and coeditor of Pen-Based Computing, The Journal of Stylus Systems. *You can contact him on BIX as "nickbaran."*

Which PC Is Your Only Logical Choice?

GATEW

BECAUSE IT'S A



As a PC buyer, you're constantly confronted with wild claims and overgrown prices. It's sometimes hard to see the forest for the trees in the PC jungle. But Gateway 2000 customers have come to know they can trust us. They know Gateway is a sanctuary of value, where they'll find the best prices on quality systems backed by excellent service. And perhaps most importantly, they know we'll treat them as the special friends all Gateway customers are.

You can always tell if a company truly values its customers by the way its people listen to your concerns and how the company responds. At Gateway, your concerns are our concerns. For example:

"Your ads are a waste of precious natural resources," more than a few customers complained. We listened. And we're responding by using recycled paper in our advertising program. You'll also see us switching from petroleum-based inks to soy inks in our printing soon.

Several customers thought we should down-size our ads to spend less on advertising and to use less paper. From a business standpoint, we didn't want to do that because the ad you're reading is our only store. And we've never exceeded our ad budget, which is a tiny percentage of sales. But we aren't ignoring these customers' concerns. Even though the paper

AY2000

JUNGLE OUT THERE

companies we deal with have excellent reforestation programs, we became a Global Releaf® corporate sponsor. The money we contribute to this American Forestry Association project will plant over 15,000 new trees in the next 12 months.

In the PC jungle, Gateway 2000 is a sanctuary of value, where your concerns are our concerns.

Susan Gerbeth-Jones
Duke University

It's literally a jungle out there at the Organization for Tropical Studies (OTS), a consortium of 52 prestigious universities and research institutions. OTS uses Gateway 2000 systems in Costa Rica to do research in tropical rain forests. Don Stone, OTS's Executive Director, decided to put Gateway computers in the jungle after confirming their great value and reliability with Susan Gerbeth-Jones, Data Processing Specialist at Duke University, one of OTS's member institutions. Don asked Susan if she had ever heard of a company called Gateway 2000, to which she replied, "Why, yes I have – here's one right here." Susan said she's had her Gateway at Duke for over a year. "Everything about it is solid and it runs smoother than any other computer in the department," she commented. "I feel Gateway 2000 has more features for the money."

recycled paper

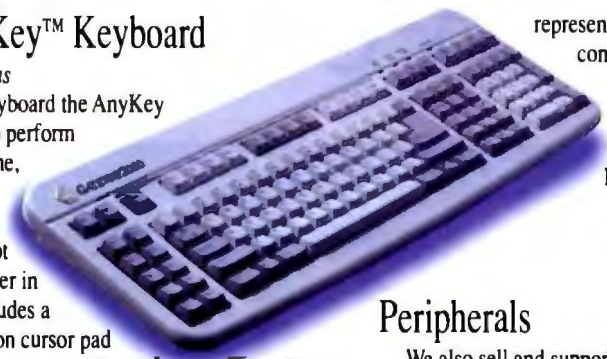
GLOBAL RELEAF

BECAUSE IF YOU BOUGHT ANYTHING ELSE

You'd Read This And Weep

The Programmable AnyKey™ Keyboard

Standard with all Gateway 2000 systems



We call our new 124-key custom keyboard the AnyKey because any key can be programmed to perform any function – anything you can imagine, quickly and easily. Or you can remap the keys to create your own keyboard layout. It's a revolutionary new concept designed to let you talk to your computer in a very personal way. The AnyKey includes a numeric pad and a separate, full-function cursor pad with diagonal keys, plus two sets of function keys located along the top and left side. The AnyKey's versatility is rivaled only by its simplicity. You can learn to program it in just a few minutes. If you goof, you can easily reset the keyboard to a normal configuration. And if you hate the idea of programming anything, you'll still love the feel and extra keys on the AnyKey.

The Crystal Scan 1024NI Color Monitor

Standard with all Gateway 2000 386DX and 486 systems

The new Cystal Scan 1024NI is a non-interlaced VGA color monitor designed for flicker-free video display. The 1024NI has a 14-inch non-glare tube, 0.28mm dot pitch with resolution up to 1024 x 768.

Custom Configurations

Every Gateway 2000 system is custom-built by skilled Midwest technicians to your specifications. If our standard configurations don't suit your needs, we'll add or subtract features for you. Ask your sales representative about our extensive line of optional components including hard drives, monitors, and graphics cards. All optional components and software are installed and tested with your system at our factory, disks and manuals provided.

Peripherals

We also sell and support a full line of competitively priced, quality name-brand peripherals, including dot-matrix and laser printers, tape backups, math coprocessors, and modems.

Just Add Your Favorite Programs

Gateway systems arrive ready to run. The hard drive is formatted and the software that comes with each system is loaded. All you have to do is install your favorite applications. Software diskettes and comprehensive hardware and software manuals are included in your package from Gateway 2000. And by the way, your system comes in our new cow-spotted box. Because our first ads showed a picture of the family cattle farm, many customers know us as "the cow company." We haven't forgotten the cows.

Components and peripherals are sold separately only to Gateway 2000 customers.

GATEWAY2000

"You've got a friend in the business."

800-523-2000

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

GATEWAY 2000

16MHz 286 VGA

- 80286 Processor
- 2 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey™ Keyboard
- MS DOS® 5.0

$1395

16MHz 386SX VGA

- Intel® 80386SX Processor
- 2 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 40 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey Keyboard
- Microsoft® Mouse
- MS DOS 5.0
- MS Windows™ 3.0

$1495

20MHz 386SX Cache

- Intel 80386SX Processor
- 32K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 512K
- 14" Crystal Scan 1024 Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$1795

25MHz 386 VGA

- Intel 80386 Processor
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 80 MB 17ms IDE Drive with 32K Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$1995

BEST BUYS

- Get our 33 MHz 386 Cache system, same configuration as listed, with a 120 MB IDE hard drive instead of the 200 MB drive.

$2395

- Same features as our 33 MHz 486 Cache system except this machine has 4 MB RAM, instead of 8, and a 120 MB IDE hard drive, instead of the 200 MB drive in our standard configuration.

$2845

33MHz 386 Cache

- Intel 80386 Processor
- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$2695

25MHz 486 Cache

- Intel 80486 Processor
- 64K Cache RAM
- 4 MB RAM
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$2995

33MHz 486 Cache

- Intel 80486 Processor
- 64K Cache RAM
- 8 MB RAM, Expands to 64 MB
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 124-Key AnyKey Keyboard
- Microsoft Mouse
- MS DOS 5.0
- MS Windows 3.0

$3395

The Extras – That Don't Cost Extra At Gateway

- One-year warranty on parts and labor
- Replacement parts shipped quickly via overnight shipping at no charge
- 30-day money-back guarantee
- Lifetime toll-free technical support from the service organization that won PC World's Service Excellence Award
- Free on-site service to most locations
- Free bulletin board technical support
- C.O.D. terms and major credit cards honored
- Net 30-day credit terms available to qualified commercial customers
- Leasing options available to qualified commercial customers
- MS DOS 5.0 is standard; versions 4.01 and 3.3 are available at no extra charge
- The programmable AnyKey keyboard is standard; a 101-key keyboard is also available at no extra charge

All prices are subject to change. Prices do not include shipping. *Printed on recycled paper.* *Corporate Sponsor – a program of the American Forestry Association, Box 2000, Washington, DC 20013. Call us for information on how you can support Global Releaf.*

Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (Central Time)
Service Hours: 6am-Midnight Weekdays, 9am-2pm Saturdays (Central Time)

GATEWAY2000
"You've got a friend in the business."

intel inside

8 0 0 - 5 2 3 - 2 0 0 0

610 Gateway Drive • N. Sioux City, SD 57049 • 605-232-2000 • Fax 605-232-2023

Now Toll-Free From Canada!

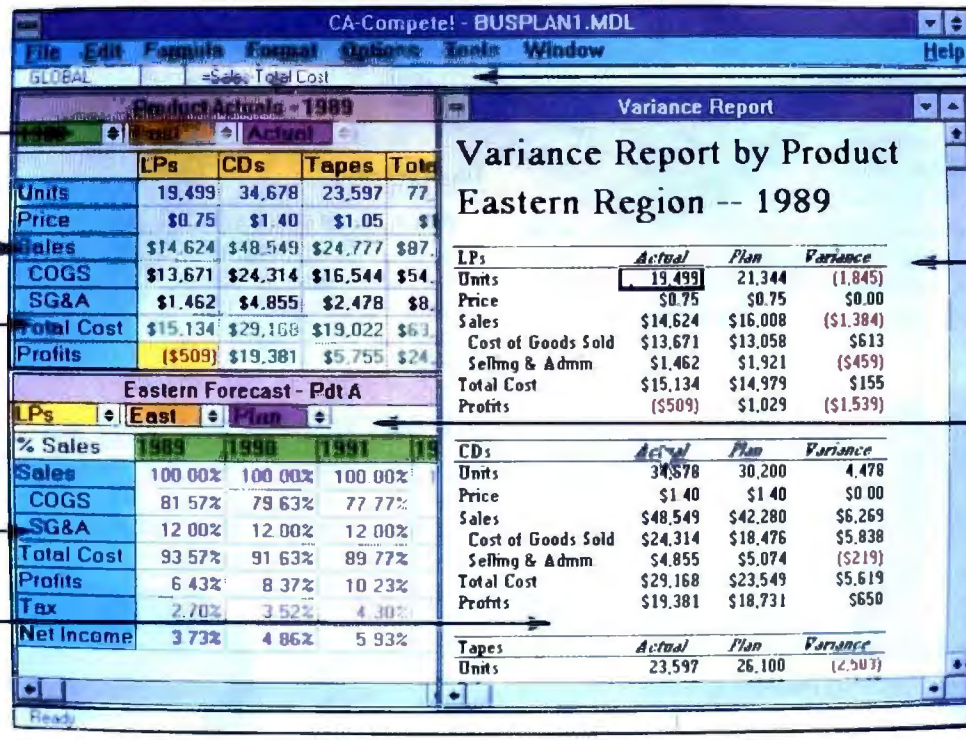
What Comes After Spreadsheets? Introducing New CA-Compete!

Up to 12 different dimensions you can navigate through with the click of a mouse.

Use simple English—no column or row references needed.

Name and save multiple views. Look at up to 12 at a time.

Extra sheets available for custom reports and additional calculations.



Global formulas you can apply to a range of cells.

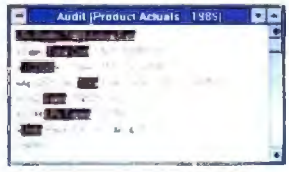
Presentation-quality output with fonts, borders, and shades.

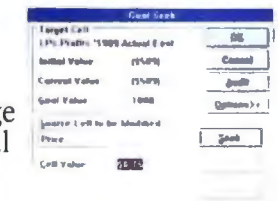
Looks like a spreadsheet with standard commands you know, like cut, paste, copy, and annotate.

*Chosen "Best of 1990" by PC Magazine**

Welcome to the world of multi-dimensional modeling & viewing.

Unlike two-dimensional spreadsheets, CA-Compete! lets you model up to 12 different dimensions and navigate between them instantly with the click of a mouse. And CA-Compete!™ speaks English too, so you can use recognizable names you define, like Sales, Units, Costs and Profit instead of cryptic column and row references. For smarter decision-making there's a broad range of powerful tools like Goal Seek, Allocate, and Forecast, so you can perform extensive "what-is" and "what-if" analyses.





You can also trace the origin of any value with a quick, graphical Audit Trail Tool.

CA-Compete! reads and writes Lotus® 1-2-3,® Excel, dBase,® ASCII and Script Files so you can work with all of your current files.

And with Windows' Dynamic Data Exchange, you can link your data dynamically with any other Windows program.

Call 1-800-645-3003 today to get a CA-Compete! working model.

It's your chance to get a free glimpse of the future.

Free Working Model

COMPUTER ASSOCIATES
Software superior by design.

*PC Magazine, Craig Stinson, 1/15/91.

Circle 26 on Inquiry Card.

CORNERSTONES OF THE FUTURE

From the vantage point of 1991, we can look back to the mid-1980s and see a dazzling array of computer news events. In 1984, Apple introduced the Mac, IBM brought out the AT, and a company called Satellite Software delivered a package called WordPerfect. New arrivals in 1985 included the 386 processor, Windows 1.0, and PageMaker for the Mac. Not all of these products may have seemed important at the time, but with proverbial 20/20 hindsight, we now know they changed the course of computing. Other news events were not as predictive. In 1986—a barren year for lasting breakthroughs—IBM introduced the RT and the PC Convertible, Atari unveiled the 1040ST, and Sperry and Burroughs merged into Unisys. Although some of these announcements were hailed at the time, they didn't turn out to be as successful as their proponents had hoped.

The Crystal Ball

What new products, technologies, and business events of the last 18 months will, from the perspective of five years hence, turn out to be as significant as the Mac and Windows? That was the question we posed to BYTE's staff and contributing editors, who responded with a dizzying assortment of suggestions, ranging from pen-based personal computers to globalization, from wireless LANs to the glut of industry consortiums. Out of dozens of trends, BYTE news editors distilled six major themes that highlight the direction of the industry.

■ **Hardware technologies.** The perennial ideals of computer design—smaller, faster, and cheaper—are still driving innovation. Portables are so powerful that they may obviate the desktop computer, while workstations are encroaching on the high end of the personal computer's turf.

■ **Software technologies.** From the rise of 32-bit operating systems to the emerging "document-centric" paradigm, the software technologies that underlie desktop computing are undergoing dynamic change. Distributed client/server computing requires standards for objects and remote procedure calls. The growth of imaging applications may dictate operating-system enhancements such as Apple's QuickTime.

■ **User interaction.** GUIs have made interacting with computers easier than ever, but humans and machines still don't speak the same language. Handwriting and speech recognition may be the wave of the future, but they're still imperfect. The most interactive experience of all is virtual reality.

■ **Information representation.** Not every problem can be solved with mathematics. Some of the most complex issues are best explored with images, and as some pioneering designers have realized, other than the human brain, there's no better tool for manipulating images than the computer.

■ **Communications.** In the future, computers will be so interconnected that you'll be able to access instantly any piece of data, from anywhere in the world, without even knowing where it originated. New techniques for wireless communications mean you won't even need a cable to be "plugged in" to the data pulse.

■ **Ownership and power.** New technology is exciting, but it's meaningless outside the context of the companies that deliver it to users. Shifts are under way in the power structure of the computer industry that will influence technology directions for decades. At the same time, rapid arrival of new technologies has outpaced our ability to evolve the legal and ethical infrastructure. Will our social institutions adapt to computers, or vice versa?

The next few pages are an effort to identify and analyze current trends and events—the cornerstones of the future—that will shape computing between now and the mid-1990s. For a gaze into our crystal ball, read on.

—Andy Reinhardt

Smaller, Faster, and Cheaper Still Apply

Nonvolatile silicon storage may replace hard disk drives in portable systems.

Dazzling but relentless innovation meets descending hardware prices

The demands on computer hardware are greater every year, as a rising tide of expectations, fueled by relentless innovation, meets the descending price curve. The most dazzling improvements have come at the extremities of the market: workstations so powerful that they can outrun a mainframe, and tiny, full-featured portables that may have obsoleted the term *desktop computer*.

Portables Get Real

Only a year ago, notebook computers were scarce and expensive, while bulky laptops were the norm. Since then, notebooks have appeared so fast that the lowly laptop has all but disappeared. The technologies that brought this about were the 2½-inch hard disk drive and inexpensive, VGA-quality LCDs. With desktop docking stations and peripherals like the Xircom LAN interfaces, notebooks are now good enough to be your primary system. It's no wonder they are the fastest-growing part of the computer market.

New and emerging technologies will make portables even better in the next few years. A major challenge is power consumption and battery life, but the low-power 386SL chip from Intel goes a long way toward solving the problem. Zenith has already shown with its new Mastersport 386/SL that this processor can greatly enhance battery life—up to 8 hours versus a norm of 3 hours. When other power-saving techniques are coupled with more efficient nickel-hydride or lithium batteries, the operating life of notebooks could become almost limitless.

The future for notebook displays is color. A new generation of active-matrix color LCDs is arriving from companies such as Sharp, Hitachi, and IBM/Toshiba, but they now have outrageous prices and consume huge amounts of power. When the costs come down and the panels are combined with special chip sets that make eight-color displays show 256 or more colors, we will see the rapid emergence of good quality, VGA-compatible color notebooks.

Another intriguing possibility for the future lies in flash EPROM. The use of silicon memory—either battery-backed or nonvolatile—in lieu of rotating storage has advantages in speed, size, and power usage. The Fujitsu FMR-Card notebook, available only in Japan, has a full-size keyboard but weighs just 2 pounds and can run for 100 hours because it uses only silicon storage. The JEIDA/PCMCIA standard will help boost acceptance of IC cards and drive down their prices.

The major limit to how small portables can get is the need for a keyboard. But pen-based computers, running operating systems such as PenPoint or Windows for Pens, can be smaller and lighter. Portables also need to have built-in communications; with the rise of wireless networks and packet radio, someday you will be able to hook up your portable to any system in the world, from anywhere and at any time.

The 386SL chip promises dramatically longer operating life.

Unix Workhorses

The success of Sun's Sparcstation line and the appearance of SPARC clones indicate the growing vitality of workstations. IBM, DEC, and Hewlett-Packard are rushing into the open-system business, while the Advanced Computing Environment (ACE) initiative is trying to steer a course between RISC and CISC, and between Unix and OS/2. Although some question the longevity of Intel's 80x86 architecture, the 486 is putting heavy iron onto business desktops. The trend that ties these systems together is networking. As LANs become the norm in corporations, you will see more "downsizing" from minicomputers and mainframes to client/server personal computer networks.

Intel has already demonstrated a 100-MHz version of the 486, and 64-bit processors

CORNERSTONES

HARDWARE TECHNOLOGIES

such as the Mips R4000 are just around the corner. With increased use of techniques such as superscalar architectures, pipelining, and parallelism, and the potential for more esoteric data-flow processors, desktop computer power will continue growing at a breakneck speed.

The More Personal Computer

The counterpoint to the corporate networked workstation is showing signs of life again after years of abandonment: IBM, Tandy, and especially Apple are trying to put the "personal" back into personal computers with inexpensive, easy-to-use systems for the home. The long-awaited "cheap Mac," in the form of the Mac Classic, has put Apple neck and neck with IBM in sales of microcomputers. This success alone proves that the vision of a computer in every home still has great potential.

In the near term, add-in cards for CD-quality sound, high-resolution graphics, and digital video—and agreements on multimedia standards—will make computers far more entertaining. Eventually, computers and TVs will merge into a universal information appliance. Whether computer or consumer electronics companies will lead this charge remains to be seen.

Seeing the Light

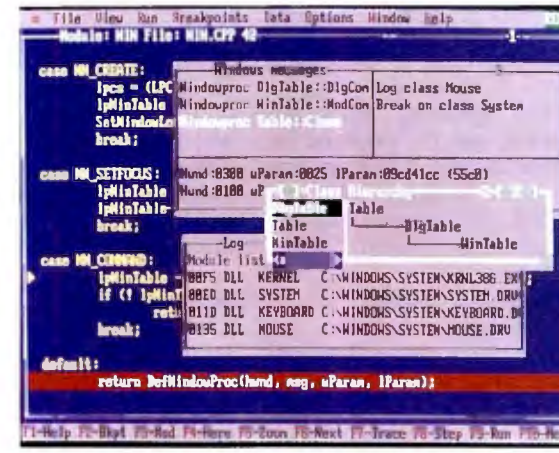
The final frontier in computing may be the use of optics instead of electronics for processing and storing data at the speed of light. IBM has demonstrated a holographic storage method that operates at room temperature and is able to store bits of information at the molecular level. Other advances include holographic, laser-based gate switches, equivalent to the circuits used in current microprocessors. The challenge is to turn these technological demonstrations into real products. When they come, they may revolutionize storage and computer operating speed.

—Owen Linderholm

The new American Dream: a chicken in every pot and a computer in every home.

The Object-Oriented Future

The operating system sees applications as true objects—encapsulated code and data



Borland C++ 2.0: Borland's serious entry into object-oriented languages is fueling the switch from C to C++.

When Microsoft released Windows 3.0 in May 1990, it was hailed as a milestone for bringing the GUI to the PC. But we may look back and see it as a more significant event. Windows 3.0 popularized a new role for desktop operating systems.

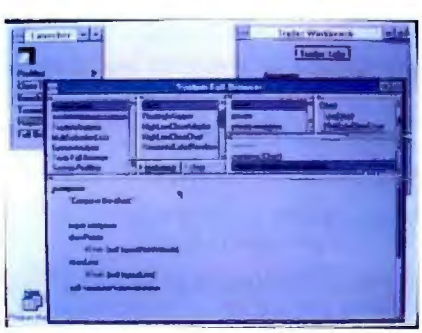
The Object-Oriented Operating System

The operating system, no longer just an interface to the machine, has now taken on more responsibility for applications. It helps programs share data and allows them to be linked to one another. It has become a medium for the creation of new programs out of small application components, or *applets*. From the vantage point of the operating system, applications have become true objects—encapsulated code and data.

Most important, the *user* now controls the linking and data-sharing processes. What were once low-level mechanisms, available only to programmers, are now high-level functions of the user interface. You create the links between applications and decide which procedures will share data.

The role of Windows as an interapplication medium began in version 2.0 with Dynamic Data Exchange. DDE came of age with version 3.0 because extended memory management let multiple programs load simultaneously and exchange live data. Then, in January, Excel 3.0 became the first program to use Microsoft's Object Linking and Embedding technology. OLE allows both data and logic from one program to reside in another; for example, a graph and a pointer to the program that created it can be embedded in a document, or a table can be linked back to a centralized source. The libraries that implement OLE will be a standard feature of Windows 3.1.

Nearly simultaneously with their introduction to Windows 3.0, the idea of component applications and object linking came to the Mac world. With the release of System 7.0 in May, Mac applications began to pass messages to one another using AppleEvents. Object linking became possible with the Publish/Subscribe mechanism.



Objectworks/ Smalltalk from ParcPlace: where object orientation began.

Although Excel 3.0 was the first program to use OLE, Microsoft did not invent object linking. The first major product that offered object linking was NewWave from Hewlett-Packard, but Windows 3.0 and System 7.0 have popularized the idea. Object linking, message passing, data sharing: These are now firmly established as proper and vital functions of future desktop operating systems.

The Component Software Platform

When HP released its NewWave applications development platform in 1989, it also introduced the Agent, a mechanism that became accessible to end users in the May 1990 release 3.0 of NewWave.

The Agent is a type of scripting ability that records both keystrokes and underlying logic, a form of object linking. But, more significant, it lets you name the link, save it, and run it later—in essence creating a new application. With the Agent, the application becomes a suite of high-level components, and you are the application builder.

A new and potentially more powerful component platform is on the way. In July, Apple and IBM stunned the industry by announcing a joint venture to develop a multiprocessor object-oriented operating system. Apple will contribute its nascent system software, code-named Pink. IBM will contribute the IBM/Metaphor Computer Systems software, called the Constellation Project. Constellation applications were originally designed to be small objects combined by developers into copyrighted components; users could assemble the components into customized applications.

When the new Apple/IBM platform appears in 1993, it should consolidate the component software paradigm at every level, from the user interface to the software development process to the heart of the operating system itself.

Fine-Grained Objects

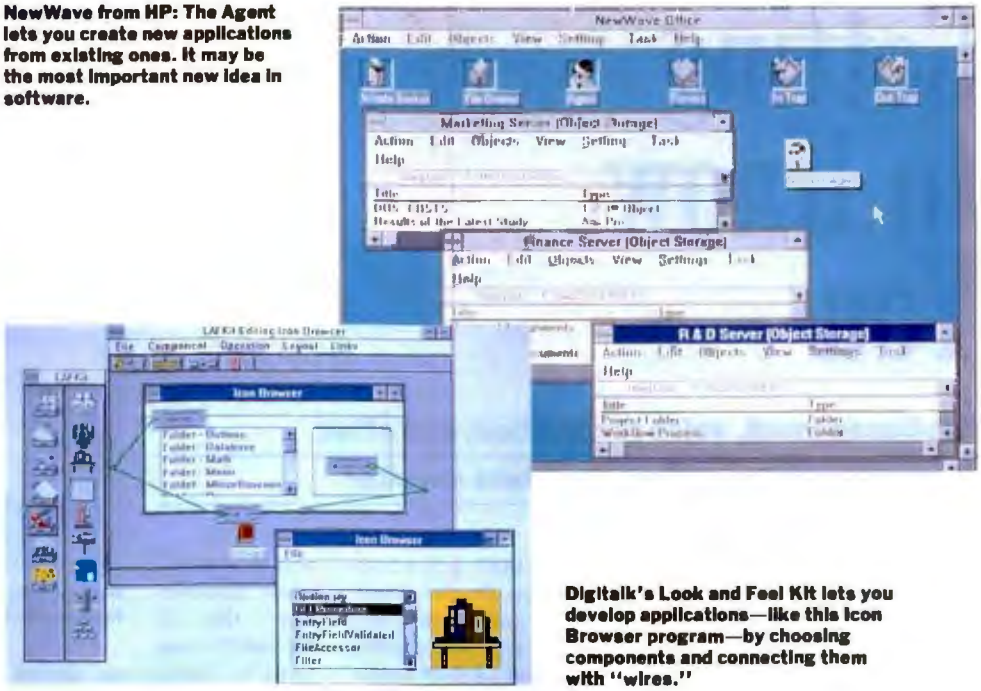
The current programming model is changing. Programmers who used to write in C are moving to C++. Smalltalk, where object-oriented programming began, is still with us. And this year saw a burst of new OOP environments: Borland brought out C++ 2.0 in February, and in March came Objectworks/ Smalltalk for Windows from ParcPlace, and Borland's

Turbo Pascal for Windows, with its ObjectWindows class library. In September, Digitalk unveiled the Look and Feel Kit, a tool that makes the lines of message transmission among Smalltalk objects visible.

The future will be full of talk about granularity. What we once called "programs" will simply be fine-grained objects—class libraries of C++ and Smalltalk objects, the new software atoms. What we once called "applications" will be coarser-grained objects—classes built into components, and components linked and relinked into something like "recombinant applications." And what we call the "operating system" will be kept busy passing messages among all those objects.

—Ellen Ullman

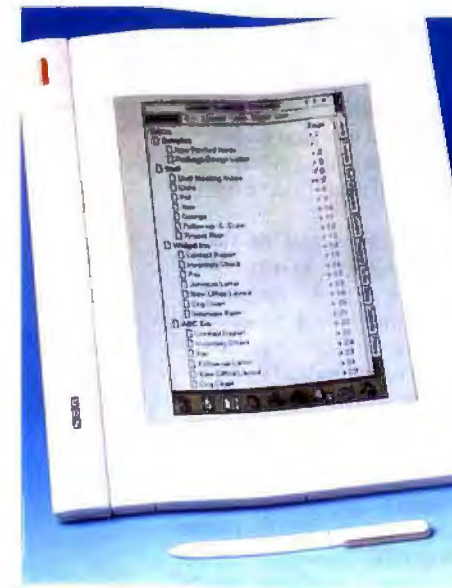
NewWave from HP: The Agent lets you create new applications from existing ones. It may be the most important new idea in software.



Digitalk's Look and Feel Kit lets you develop applications—like this Icon Browser program—by choosing components and connecting them with "wires."

Getting to Know You

Pen-based input, voice recognition, and other new technologies make computers smarter



Pen-input PCs like the NCR System 3125 may fundamentally alter the definition of a computer.

Not long ago, the most interactive way to work with a computer was using a so-called glass teletype, or a keyboard/CRT combo that displayed only characters. Now, we routinely use graphical displays and mouse pointers to manipulate lushly colored and textured interfaces. The Macintosh GUI set a standard in 1984, and Microsoft Windows 3.0 has brought much, but not all, of the Mac's ease of use to PC compatibles. Windows 3.1 and Symantec's Norton Desktop for Windows should improve that situation. And for low-end systems, GeoWorks offers a route into the world of GUIs.

At the same time, elegant GUIs such as Motif, Open Look, and NextStep have entered the Unix market and made using that notoriously arcane operating system something almost anyone can do. Meanwhile, Apple's new System 7.0 enriches the Mac's icon environment with powerful internal improvements such as 32-bit addressing, virtual memory, and interapplication communication.

In the next few years, GUIs will come to dominate computing. New software development will shift to graphical environments because they have numerous benefits: For users, they offer a reduced learning curve and a consistent methodology across applications; for developers, they offer such built-in tools as display and device drivers, interapplication communication, and interface widgets. But the GUI is only the part of the computer that a user sees; in the future, the way in which we interact with computers will undergo a far more profound transformation.

The Isopoint is a space-saving alternative to the mouse or trackball.

Making a Point

The mundane mouse may be an endangered species, because a desktop pointer isn't very practical when there's no desk. New 386SX notebook PCs running Windows highlight this problem: Mobile users still want a GUI but may have nowhere to put a mouse. Microsoft and Logitech have both devised small hand-held trackballs that clip onto the side of a laptop, but these are only stopgap measures.

The solution is to design a pointer that is built into the system, as Apple did with the Macintosh Portable's trackball. A built-in pointer can consume system real estate, but two new devices help to avoid that problem. One is the Isopoint, developed by Culver Research and used in the Grid 1550SX laptop. The Isopoint is a small rolling tube, located below the space bar, that you spin or slide back and forth with your thumb to move the cursor. The other is Home Row's Push-n-Point (also known as J-Mouse), a tiny isometric joystick built into the keyboard under the *J* key.

Capturing Gestures

The future of mobile personal computers may not lie in more-clever pointers but in a wholly new concept: pen-input computing. The latest generation of portables are nothing more than computers wrapped around LCD panels. A prime example is the NCR System 3125, a 386SL-based tablet less than an inch thick that weighs under 4 pounds.

With pen-input systems, instead of using an external pointer to move the cursor, you work directly on the screen with a stylus. More important, the systems understand block printing, so you can enter text by writing on the screen instead of by typing. This makes it possible to use computers while standing up or walking around, which opens up a new range of uses.

What makes these systems

CORNERSTONES

USER INTERACTION

more than just nifty notepads is that they run new, more naturalistic operating systems. Go Corp.'s PenPoint is a break from the past: Designed from scratch for pen computing, the object-oriented system understands gestures and uses a notebook metaphor to lend its interface a familiar appearance and behavior. Microsoft Windows for Pens is an extension to Windows, so it will run existing software, but its backward compatibility may take a toll on intuitiveness.

Talking to a computer is a long-cherished dream, but years of work still lie ahead.

Speak to Me!

In the long run, the most intuitive interface is speech, and remarkable strides have been made in the last few years toward the Holy Grail of speech recognition. Devices from Dragon Systems and Kurzweil AI can now recognize thousands of discrete spoken words without the user's having to extensively pretrain the system. These devices are finding applications in fields such as medicine and as aids to the handicapped.

The problem still to be solved is how to get a computer to recognize conversational speech. A product from Verbex Voice Systems can understand unbroken streams of words, but it has a limited vocabulary and must be trained to know the speaker. In the next five years, as greater processing power becomes available, true continuous speech recognition will become possible, but it may still be too expensive for common use.

While new pointers make using a conventional GUI notebook easier, handwriting and speech recognition profoundly alter the human/computer relationship. Yet even these changes maintain a wall between the user and the machine. In the distant future, however, virtual reality will break even that barrier. We won't anytime soon see simulated environments as sophisticated as the holodeck in *Star Trek: The Next Generation*, but it's something to look forward to.

—Andy Reinhardt

Get a faster buying

PC without a faster PC.

Buying a faster PC is expensive. Making a PC go faster, isn't.

Cyrix™ FasMath™ coprocessors, rated highest ★★★★ overall by PC Week Labs and leading industry magazines, now cost less than ever.

Thanks to an innovative, fully compatible architecture, they run Lotus® 1-2-3®, AutoCAD®, Microsoft® Windows and other leading programs up to three times faster. So you spend less time waiting, and more time working. You can get all this extra speed for $89 to $299, suggested retail price.

Battery-dependent laptop users will especially appreciate the fact that Cyrix coprocessors consume less power.

Plus, they are backed by a five-year limited warranty and a toll-free support hot line.

For a complete rundown of prices and performance specs, call **1-800-FASMATH**. The faster, the better.

Cyrix
Advancing the Standards

Circle 29 on Inquiry Card.

Multimedia Animates Information

The computer is evolving as a visual processing machine

In the future, flat panels could be succeeded by 3-D displays like the TI OmniView.

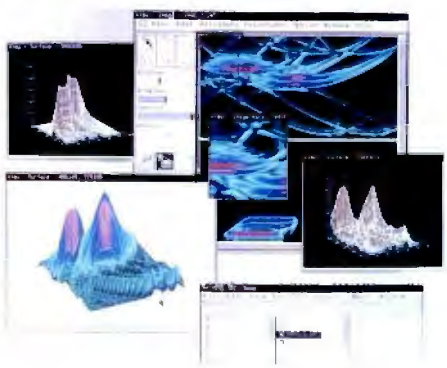
Since Apollo commercialized the concept of integrating two-dimensional graphics in a high-performance workstation, the computer has been evolving as a visual processing machine. Developments of the past year have further refined the idea—and the ideal—of visual computing. In the next five years, heavy R&D will be focused on perfecting the computer as a tool for presenting data graphically.

Even as sophisticated 3-D graphics percolate down to personal computers, multimedia is seizing the low end of the market. No matter how you define it, the basic goal of multimedia is to make computers more stimulating and, ultimately, more informative. The GUI has banished the cold command-line interface; now, by integrating high-quality sound and video, computers will become tools for interacting with information.

Big Deal

Two pacts made this year by Silicon Graphics, a leader in visual computing, could turn out to be very significant because of the influential parties involved. Microsoft licensed SG's Iris Graphics Library, a set of tools for building applications that can generate and manipulate realistic 3-D images. Microsoft plans to incorporate SG's technology in applications and operating systems, which suggests that 3-D may be an integral part of its future software—and, therefore, of yours.

Compaq, with an eye on the workstation business, will rely on SG—in which it has taken an equity stake—to deliver the imaging technology Compaq needs to keep up in the 1990s. The two companies are working together on unspecified products, but SG confirms they involve 3-D graphics. Both companies are members of the Advanced Computing Environment initiative, as is Microsoft, so 3-D imaging may be standard on ACE machines.



Scientific visualization lets you see patterns in data that numbers alone would never reveal.

Visualization = Discovery

The point of visualization is to make data easier to interpret by representing it graphically. In the past year, software that does this has migrated down to the realm of mortals. For example, PV-Wave from Precision Visuals now runs in the graphical SunView and Motif environments on workstations from Sun, DEC, Hewlett-Packard, and SG. This package makes beautiful raster images of floating-point data, so instead of seeing reams of numbers, your answer is a colorful, animated image.

Software this powerful isn't available yet on personal computers, but Precision Visuals may produce a Windows version of PV-Wave. For low-cost machines, Spyglass's Transform converts floating-point results into 2-D graphics, while Spyglass Dicer displays volumetric data as a colored cube that you can "slice" to reveal interior data. This category of software is bound to grow in the nineties.

Render unto Mac

For now, the Mac is the platform of choice for professional illustrators or visual communicators who cannot afford a workstation. A multitude of programs let you construct complex 3-D images on the Mac. For example, Pixar's RenderMan, a scene-description language that defines visual attributes such as surface textures, lighting, reflection, and motion, now runs on the Mac. Supporting applications like MacroMind Three-D and Paracomp's Swivel 3D can model realistic illustrations that look like something on a Personal Iris workstation. Comparable programs will come to the IBM world when the required hardware, such as 24-bit color boards, becomes more common.

Moving Pictures

An important element of the visual computer is motion video. Apple and SuperMac

have demonstrated technology that pumps video from disk through the Mac at speeds fast enough to make it a movie machine. Their research will yield commercial products within a year. Chips & Technologies has introduced a PC Video chip that drastically cuts the cost of hardware for displaying windows of live, full-motion video. The $40 chip, which replaces components that cost about $300, incorporates all the logic needed to put a digitized image in a window and control its size, shape, and location. Video boards using the PC Video chip will sell for $500 to $800, or about $1000 less than they cost now, C&T says.

No matter how high the number of pixels and colors, however, current displays are still flat. But in the future, we may have true 3-D displays that project realistic images. Texas Instruments has already demonstrated such a device, called OmniView, that lets you see solid-looking objects without wearing special glasses. Picture the holograph of Princess Leia in *Star Wars*, and you get an idea of what an OmniView image looks like.

Silicon Graphics' 3-D technology is at the center of two significant licensing deals.

The promise of lower prices suggests that motion video boards will become more commonplace. But personal computers still need lots of storage and a fast bus to move digital video through the system. One solution is to reduce the amount of data by using new hardware and software compression schemes such as Digital Video Interactive and those being developed by the Joint Photographic Experts Group and the Moving Pictures Experts Group. These technologies will likely be built into systems in the future. Indeed, with prices for 3-D graphics falling faster than for personal computers in general, it's safe to say we are at the dawn of the age of visual computing.

—D. Barker

Tapping into the Global Network

Wireless communications, E-mail, and network standards

The Altair wireless modules connect up to 32 Ethernet-addressable data devices within a physical area known as the microcell—about 5000 square feet.

In the 1990s, computers and communications will be inseparable. We're almost at the point now where, by definition, a personal computer is a node on a LAN. The rise of client/server computing and groupware will further alter our way of working: Instead of using your own personal computer and then sharing data with other people, you will use the network for what Steve Jobs calls "interpersonal computing." Both the location of the data and the means by which it is obtained are quickly becoming completely transparent.

Cutting the Cable

One of the most promising technologies for communicating anywhere, anytime is wireless networking. Proponents such as NCR and Motorola say that wireless LANs are easier to install and modify than their cabled cousins. Unfortunately, every product now on the market comes with trade-offs in throughput, range, or flexibility. Yet most experts agree that wireless networking will continue to improve and, barring impediments from the FCC, will become a dynamic area of connectivity.

Wireless communication is especially well suited to the emerging crop of pen-based computers, since they are intended for use by mobile workers. Photonics has demonstrated a prototype diffuse infrared transceiver that lets a mobile unit tap into a network without requiring a physical connection. The PenPoint operating system from Go Corp. instantly recognizes a wireless network when you walk into a room with a pen-based computer in your hand and transmits automatically any messages queued up in the system's Out Basket.

Apple has petitioned the FCC to set aside a chunk of the radio spectrum for data communications. The proposal would let mobile computers that are located up to 150 feet from the base transmitter hook into a wireless LAN. If the proposal is approved, the frequencies would be available to any vendor, not just Apple.

Beyond Mail uses rule sets to let you specify what you want done with your E-mail.

Infrared as well as spread-spectrum radio address connectivity over a short range. For even wider coverage, an emerging option is packet radio, such as the nationwide Ardis network, a partnership between IBM and Motorola. Further out in the future, Motorola's ambitious Iridium project will launch dozens of satellites to create a worldwide communications network.

E-Mail Overload

For many people, E-mail has become an indispensable business tool. But when the messages pile up, E-mail can be too much of a good thing. Two companies to watch, Beyond and Agility Systems, are now readying programs that are based on the work of the MIT Information Lens project and act as smart front ends to E-mail systems. Using message templates, rules, and graphical editors, both programs will prioritize mail messages based on their importance and urgency and will automatically respond to certain types of messages.

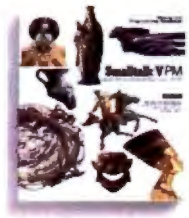
Standards Are the Key

Other networking and communications trends worth noting include the following:

- Sun's Network File System is quickly becoming the lingua franca of networked systems. At the same time, Sun and Hewlett-Packard are working to ease interoperability between Sun's Open Network Computing and Apollo's Network Computing System. But on the OS/2 side, 3Com has dropped LAN Manager, giving it back to Microsoft.
- The X.400 messaging standard, which lets users on different E-mail systems send messages to one another, is becoming widely adopted. GOSIP now requires X.400 functionality, and the Electronic Mail Association says that all major U.S. E-mail services have agreed to link their services via the standard.
- Switch makers AT&T, Northern Telecom, and Siemens, along with other companies, are pushing the new National ISDN 1 standard. This may be the last best chance to bring ISDN to the U.S. by the end of 1992.
- Telecommunications service and hardware suppliers are moving quickly to adopt frame relay, a fast packet-switching protocol that outperforms X.25.
- The ISO and the Unicode Group are sponsoring rival efforts to develop a successor to ASCII that will make it much easier to write multilingual software.
- The National Science Foundation has a research project under way to develop an advanced computer network that will transmit data more than 700 times faster than is currently possible—at 1 billion bits per second using fiber-optic cable.

—David Andrews

WINNER PC WEEK LABS SHOOT-OUT



INTERNATIONAL ALLIANCE IBM AD/Cycle™

WINDOWS AND OS/2: PROTOTYPE TO DELIVERY. NO WAITING.

In Windows and OS/2, you need prototypes. You have to get a sense for what an application is going to look like, and feel like, before you can write it. And you can't afford to throw the prototype away when you're done.

With Smalltalk/V, you don't.

Start with the prototype. There's no development system you can buy that lets you get a working model working faster than Smalltalk/V.

Then, incrementally, grow the prototype into a finished application. Try out new ideas. Get input from your users. Make more changes. Be creative.

Smalltalk/V gives you the freedom to experiment without risk. It's made for trial. And error. You make changes, and test them, one at a time. Safely. You get immediate feedback when you make a change. And you can't make changes that break the system. It's that safe.

And when you're done, whether you're writing applications for Windows or OS/2, you'll have a standalone application that runs on both. Smalltalk/V code is portable between the Windows and the OS/2 versions. And the resulting application carries no runtime charges. All for just $499.95.

So take a look at Smalltalk/V today. It's time to make that prototyping time productive.

Smalltalk/V

Smalltalk/V is a registered trademark of Digitalk, Inc. Other product names are trademarks or registered trademarks of their respective holders.

Digitalk, Inc., 9841 Airport Blvd., Los Angeles, CA 90045
(800) 922-8255; (213) 645-1082; Fax (213) 645-1306

LOOK WHO'S TALKING

HEWLETT-PACKARD

HP has developed a network trouble-shooting tool called the Network Advisor. The Network Advisor offers a comprehensive set of tools including an expert system, statistics, and protocol decodes to speed problem isolation. The NA user interface is built on a windowing system which allows multiple applications to be executed simultaneously.

NCR

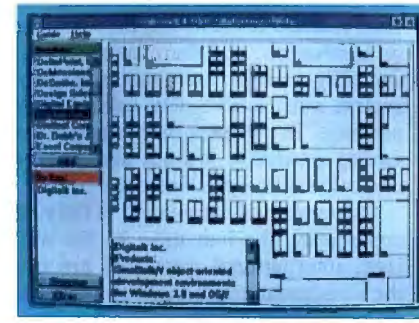
NCR has an integrated test program development environment for digital, analog and mixed mode printed circuit board testing.

MIDLAND BANK

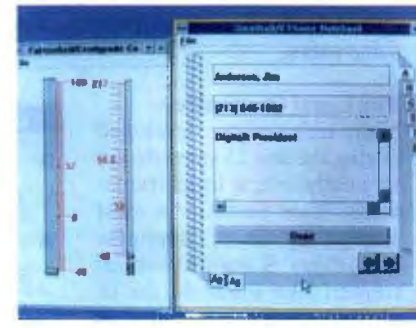
Midland Bank built a Windowed Technical Trading Environment for currency, futures and stock traders using Smalltalk V.

KEY FEATURES

- World's leading, award-winning object-oriented programming system
- Complete prototype-to-delivery system
- Zero-cost runtime
- Simplified application delivery for creating standalone executable (.EXE) applications
- Code portability between Smalltalk/V Windows and Smalltalk/V PM
- Wrappers for all Windows and OS/2 controls
- Support for new CUA '91 controls for OS/2, including drag and drop, booktab, container, value set, slider and more
- Transparent support for Dynamic Data Exchange (DDE) and Dynamic Link Library (DLL) calls
- Fully integrated programming environment, including interactive debugger, source code browsers (all source code included), world's most extensive Windows and OS/2 class libraries, tutorial (printed and on disk), extensive samples
- Extensive developer support, including technical support, training, electronic developer forums, free user newsletter
- Broad base of third-party support, including add-on Smalltalk/V products, consulting services, books, user groups



This Smalltalk/V Windows application captured the PC Week Shootout award—and it was completed in 6 hours.



Smalltalk/V PM applications are used to develop state-of-the-art CUA-compliant applications—and they're portable to Smalltalk/V Windows.

Circle 41 on Inquiry Card.

Technology Is Not the Problem

Legal squabbles focus on competition and threaten innovation

Sometimes the computer business is like a soap opera, replete with backstage intrigue, strange bedfellows, and failed partnerships. In the last year alone, we've seen a public feud between IBM and Microsoft, AT&T's acquisition of NCR, an aborted merger between Lotus and Novell, the establishment of the Advanced Computing Environment initiative, Borland buying Ashton-Tate, IBM and Apple joining forces . . . and the list goes on and on. This dynamism fuels the innovation that has made computers the world's growth industry, but unfortunately, these lawsuits put the focus on competition rather than on innovation, and their outcomes could even chill creativity. But they are also tremendously important, because the legal system must evolve new rules to keep up with technological progress. In a market that values "openness" and compatibility among products, it's not always obvious who should control critical technologies and data.

Ownership of innovation is only one of the social problems confronting the industry. As the world becomes a global village, international standards are increasingly necessary, yet the standards process, which is weighed down by political and economic parochialism, has become ever more glacial. Widespread gathering and dissemination of personal data raises troubling questions about privacy protection. The interconnection of networks has provoked new concerns over data security, especially in the face of the computer-virus menace. And new questions about the health effects of computers have frightened some users.

The Legal Quagmire

Many technologies developed during the last 25 years do not fit neatly into a legal framework. This problem is most acute in the area of copyrights and patents: Software has been treated like other forms of written expression, but it is not. Three lawsuits currently trudging through the courts may help clarify what protections should be afforded to software. All three could have major implications for developers and users.

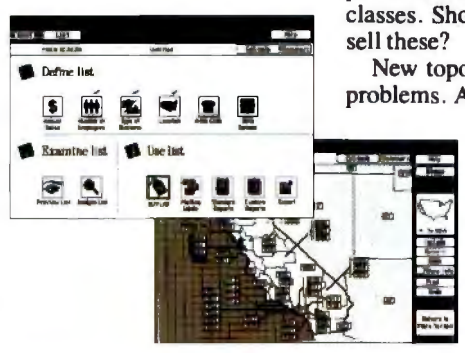
Ashton-Tate v. *Fox Software* is a judicial roller coaster, if you can imagine the ride moving at a snail's pace. The case started two years ago, when Ashton-Tate alleged that FoxBase unlawfully mimicked the look and feel of dBase III. A judge threw out Ashton-Tate's case last December and then reinstated it in April. This suit is significant because it could establish the noncopyrightability of a programming language.

By contrast, both *Apple Computer* v. *Microsoft* and *Lotus* v. *Borland* concern copyrighting a user interface. The Apple case is largely a contract dispute, but it is important because so many users are involved. Lotus's suit follows in the wake of its victory against Mosaic Software for copying the menus of 1-2-3. It could answer the question of how much copying is too much, especially when the objective is to comply with a de facto industry standard.

Who Owns It?

If you create code or data, you usually own it. But what if you improve upon software that you did not originate? New technologies that allow or even encourage modification of electronic assets pose vexing problems of ownership. For example, you can buy a class library for an object-oriented programming language and then create greatly improved descendants of various classes. Should you be able to sell these?

New topologies also create problems. A client/server network allows data to be spread among several locations; as long as all the sites belong to the same company, ownership of the data is clear. But what if your wide-area network includes servers belonging to another company, and a new database table is created that joins data from both sources? Who owns the new table?



A torrent of criticism killed MarketPlace, but privacy concerns won't go away.

Keep It Private

The proliferation of vast databases of personal information is seen by some as a threat to individual privacy. This point was highlighted by the fracas over Lotus MarketPlace, a Mac CD-ROM product that provided detailed demographic data on households and businesses in the U.S. On the eve of its availability last January, Lotus canceled MarketPlace, citing a deluge of protest from people who feared it would violate their privacy.

The source of concern was not necessarily the data itself: The same information is widely available for mainframes and minicomputers, and Lotus had taken considerable steps to prevent misuse of the program. Rather, people were worried that MarketPlace would make accessing and using such data less expensive and easier. The visceral reaction revealed the public's unease about privacy in the electronic age.

One group working to address this problem is the Electronic Frontier Foundation. The EFF has helped defend several hackers snared in government raids, but its long-term objective is to ensure that the First Amendment protections afforded to print and broadcast media are extended to new, electronic forms of expression. The group also aims to educate law-enforcement officials and the public about three interrelated issues that will live with us through the 1990s: computers, privacy, and ownership.

—Rich Malloy

Mind Melding

How far can the human/computer interface go?

OWEN LINDERHOLM

To the novice, the user interface is the most important part of the computer and the computer program. It's how you interact with the computer system and how the system displays results to you. Everything else can be considered black magic. To understand how user interfaces will affect you, you must first establish what is important about them, what sort of decisions must be made when designing them, and which of these decisions are critical to the way the user interface will operate.

Manufacturers and system designers must study new technology and evaluate the situations it will be used in and the tasks it will be used for. They should create a user interface based on how people will want to use the technology rather than what will be expedient or easy for the designers or the manufacturers.

Menuing systems, either character or GUI, are an example of how a simpler selection mechanism evolved after a technology was in place instead of when it was designed. Hardware designers are only now trying to take advantage of the software design and trying to do things like accelerating their graphics systems for drawing straight lines and filling in rectangular areas on the screen. If computer systems had been designed with thought to their uses, this kind of hardware acceleration would already be present. Until computer systems are as standard and as easy to use as everyday appliances like toasters and automobiles, they will continue to hold back people from making full use of them.

PAUL HUDSPETH
Product manager at Apple

BYTE asked five people important in the past, present, and future of user-interface development to discuss some of the major issues of the field.

What do you see as important about the interface between the computer and the user?

Stuart Card: The most important user-interface [UI] problem now is how to increase the number of functions users can do while, at the same time, decreasing the training time. The number of features is increasing nearly exponentially for almost everything from word processors to thermostats, from spreadsheets to jet-fighter cockpits. Workstations come with manuals that would require nearly the whole work year just to read.

Clearly, then, user-interface widgets cannot increase linearly with the number of functions they connect to: The user interface would be impossibly baroque for high-functionality systems, and the manual impossibly ponderous. The user interface sets the ratio of what you've got to know to what you want to be able to do, and this ratio determines what it is possible to use computers for.

Paul Hudspeth: The most straightforward UI is a command-line prompt. You type in what you want, and it does it. The problem is that it requires you to remember what to type and what parameters are needed. Enter the wonderful world of GUIs. They're great—not typing but direct manipulation. The problem is that there are lots of entities to deal with: tools, windows, palettes, and icons.

System 7.0 has human-interface elements that illustrate what Apple is all about. The key points are the trade-off between layers of complexity and functionality. The trade-off is that adding functionality increases complexity. The whole goal is to make the operating system transparent so the user can concentrate on doing things. The other goal is to work the way people do.

It is important to understand that just because a user interface has icons and windows doesn't mean it works the way people do. Apple knows that users don't give something 20 seconds to figure it out. If [users] can't figure it out right away, then they close the feature and don't use it.

Aaron Marcus: Without an effective user interface, the user cannot fully access the power of the computer. User interfaces consist of the following components: a collection of metaphors, a cognitive model, a task-oriented organization of functions and data, a navigation system for moving within the model, appearance characteristics (the look), and interaction techniques (the feel).

The user interface is a *mask* (i.e., appearance) and a *ritual* (i.e., interaction) that clothes task-oriented, user-centered

organizations of functions and data. The user interface enables products to be more appealing, easily learned, easily used, and it enables users to be more productive in their work and play.

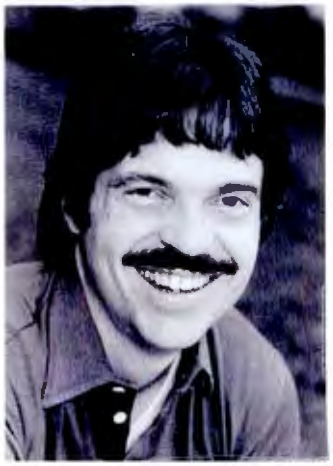
In the past, user interfaces were modest portions of code. In the future, more and more attention—and code—will be given to supporting effective user-interface designs. New kinds of companies will arise that will be user-interface companies, offering products that work with a variety of hardware, applications, networks, operating systems, and user groups. As user interfaces become consumer items, more and more emphasis will be given to marketing differentiations in user-interface design.

Ted Nelson: The real problem is that the design of software virtuality, as I prefer to say, is an extremely complex, aesthetic design issue—and universally confused with a technical issue. In other words, I hold that the design of software is intrinsically a branch of cinema. This is an exact statement about the nature of software and the nature of cinema. Motion pictures are events on a screen that affect the minds and hearts of the viewer. Software is events on the screen that affect the mind and heart of the viewer *with* interaction. So the only difference is that interaction is possible, so you have extended cinema in which the user exerts a certain measure of control.

Now, *virtuality* is my term for the most important defining traits of software. Other people say things like *interface*, and to me the entire issue is one of virtuality. Virtuality is essentially the seeming of something as distinct from its reality, which is the nuts and bolts of the hardware. So, everything has a virtuality, and you either design it explicitly or you do not.

Virtuality consists of conceptual structure and feel. This concept of virtuality extends to everything from video games to automobiles to music to software. So, software is merely a special case of the design of virtuality.

A movie's virtuality is the conceptual structure and feel of that movie. So, the conceptual structure is the script and the characters, and the feel is the mise-en-scène, the atmosphere, the feelings that go with different scenes. And these are highly arbitrary and idiosyncratic and basically controlled by the director with great difficulty in the creation of the motion picture. So, that's where the distinction between conceptual structure and feel is for a movie.



ALAN KAY
One of the developers of the Xerox Star system, and the inventor of the Dynabook concept of a portable computer

The conceptual structure of all automobiles is the same. They go left and right, forward and back, fast and slow, and there is very little beyond that. But the feel of different automobiles is very different, and that is why automobiles have such variety.

So, what I claim is that the conceptual structure and feel is the heart of a lot of things, but it is certainly the heart of software design. The conceptual structure is arbitrary, and the feel is very hard to control. And so, creating, under control, the sort of feel you want to have for the software is a very difficult matter that everyone attempts in a different way.

Alan Kay: I think the big breakthrough when personal computing came about was the idea that some human is going to have to use it, and we're not going to be able to train all of them, and so the person is going to have to do some learning on their own. One way of characterizing what we did at Xerox PARC [Palo Alto Research Center] is to say that the job of the user interface is not mainly access to function, but the job is to be a learning environment.

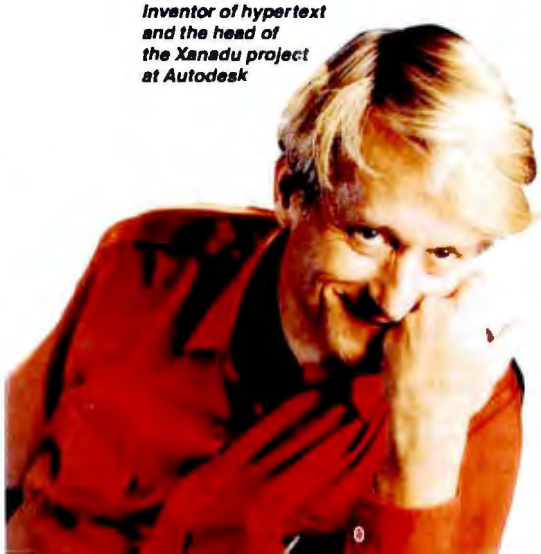
The first law in user-interface design is that the users aren't like us, and *that* is something that most engineers do not even think about or believe. It is like driving in Boston. If you don't already know it, that must mean you're a foreigner, so tough. That's the engineering approach to user interface.

The biggest set of ideas that we put into that thing—that later became the Macintosh-style user interface—came from cognitive psychology, most specifically from Jerome Bruner. Bruner redid many of Piaget's experiments [on child psychology]. You probably know the famous one of the water pouring, where you pour from a squat glass into a tall, thin one. The six-year-old kid says, "There's more water." Well, Bruner got that result with children, but he did something that Piaget never thought to do. He covered up the tall, thin glass with cardboard after the kid gave the typical answer, and the kid changed his mind and said, "Oh, wait a minute! There can't be more water. Where would it come from?" And when Bruner revealed the tall, thin glass again, the kid changed his mind back and said, "No, look, there's more water." He could reliably switch the thing back and forth depending on whether the kid could see or was prevented from seeing.

There's nothing in Piaget's model of stages going from kinesthetic stages to iconic stages to symbolic stages that accounts for that. So, Bruner had this idea that maybe it wasn't like a caterpillar becoming a butterfly, which is the way Piaget thinks of the metamorphosis of the child's mind. Bruner said maybe what's actually going on here is we have multiple mentalities. There is a separate kinesthetic mentality and a separate iconic mentality and a separate symbolic mentality. The Piaget progression is actually a change of dominance between them, but they are all there at the same time. That is what led to a user interface that said, "Well, the mentality that orients us in space, which is the one that makes us feel a part of the world, is actually the kinesthetic one."

People say things like *interface*, and to me the entire issue is one of virtuality.

TED NELSON
Inventor of hypertext and the head of the Xanadu project at Autodesk



The iconic mentality is very good at remembering scenes. You have probably flipped channels on TV and flipped into the middle of a movie you haven't seen for 18 years, and it's probably taken you 2 or 3 seconds to recognize that you've seen that movie before. If you think about what that means, you can appreciate a lot about what the iconic mentality can actually do. Most people—about 60 or 70 percent—after they have recognized the movie, can remember what is going to happen next. So, the visual system is quite remarkable at being able to remember almost every scene that you have ever seen. And the other thing that it is very good at is it can keep track of about 100 things at the same time, almost subliminally. If you put up 100 pictures of animals scattered randomly on a big wall, you can find the elephant about four times faster than you could find the word *elephant* if the words were put up on the wall.

Finally, we have a symbolic mentality whose main interest is to chain together paths of evidence for things. Its greatest strength is finding out things that are in the context that aren't there obviously, and its greatest weakness is that it does not pick the context that it works in.

The obvious thing seemed that what we should do is try to find some synergies between these mentalities that don't often talk to each other. And the way that you practically realize it in a computer system is you give kinesthetic contact with what is going on by using something like a mouse. You could make that a lot stronger by making the mouse react to the things that you are dealing with. We have mice at Apple where you can feel the weight of the things that you are moving around, which gives you an even closer kinesthetic contact with it.

Then you have the icons and the windows, which give a theatrical representation of something underneath that your visual system can recognize almost instantly. And then, finally, you should have a system like HyperCard or SuperCard or something like that, which provides a symbolic underpinning that gives you abstraction in each of these different areas. And that was our rendering of Bruner's educational environment back then.

Now we look at some of the technologies involved in some of the leading user interfaces at the moment. These include advanced GUIs, such as Apple's System 7.0, speech-recognition systems, virtual reality devices, and handwriting recognition.

Nelson: I have a very radical position on software, which can be very easily stated. I believe that there is virtually no acceptable software in the world today. People think I'm joking; people think I'm making some sort of a wisecrack. I mean it passionately. Everybody is imitating the Macintosh now. That's like nowhere. All the looks and feels have not been seen and felt. I think it's hilarious that they want to standardize now. There are going to be many new ideas that will change software so radically that software 10 years from now will be scarcely recognizable.

Marcus: In hardware technologies, palmtops, and pen-oriented computers, an example is Go Corporation's handheld computer. High-performance PCs and workstations with high-quality color and multimedia are another example. A really important feature is the use of sound cues in the interface.

On the software side, we are seeing sophisticated GUI paradigms. One example is OSF/Motif. We are also seeing multimedia display software and hypertext software, which is now sometimes used to support on-line help. Other current design and technology challenges include software agents, color design, control-panel design, expert assistance, internationalization, I/O devices, intellectual property rights, sound, spatial organization, standards, symbolism, virtual realities, and video.

Card: To me, leading-edge technologies are interactive computer graphics, as represented on the latest Silicon Graphics computers; integrated pen/flat-panel display interfaces, as represented by the Go system; recognition-based input technologies, as in the Nestor character-recognition system or the Kurzweil and Dragon-Dictate speech-recognition systems or other perceptual-recognition technology; and the virtual reality technologies, as represented in the work of Tom Furness at Armstrong Aerospace Medical Research Laboratory or the NASA group or VPL [VPL is a company that makes virtual reality devices, namely, goggles you wear that enable you to see 3-D from the computer and a DataGlove that you wear to manipulate things in the 3-D environment].

We now turn to technologies that may improve user interfaces in the future, especially hardware, software, and design technologies. These include new input devices, such as DataGloves, pen-input systems, and better voice recognition.

AARON MARCUS
Head of Aaron Marcus & Associates

New software technologies include agents—software programs that actively perform tasks for you with minimal instruction—and more refined graphical interfaces, perhaps in 3-D.

Probably the most important technologies, however, will be the result of new designs that make use of existing and as yet unenvisioned technology in better ways than current interfaces do.

Kay: When you have pervasive networking, the user interface that works so well on the Macintosh and Windows 3.0 simply won't work anymore. The reason is that it is a browsing interface that assumes you are going to be dealing with somewhere between 100 and 500 resources, and now we are talking about being connected up to over a trillion resources. You can't make the Mac or Windows better in order to deal with this. We have to think of something else, and the thing that is suggested is to have what are called agents.

Agents are semi-intelligent software programs that you can delegate your goals to. Initially, because these agents won't be very smart, the first ones to come along, the equivalent of the simple word processing done 10 and 15 years ago, will be agents that will act like your personal news reporters, whose jobs will be to scour the networks that you are connected to and find things that are relevant to the goals you are pursuing right now. So, you can think of them as a personal news service. But, of course, their job is not just to find anecdotes but also tools and other kinds of things that are related to what you are doing.

Probably the best example of the kind of agent we'll be dealing with 10 years

from now is a system called CYC. It is basically an attempt to model, as an expert system, the general knowledge and common sense of a human being. So, the idea is that common sense is a collection of, usually, rules of thumb that may or may not be logically connected with other rules of thumb. There's something like a fabric of them—there may be 200,000 or a million of them that we use, some organized logically and some organized figuratively. And it will be a very difficult task to work out what goals people are working on until you have some sort of structure like this.

You can think of this as an encyclopedic system in which the modeling is as interested in what is in between the sentences as it is in the sentences themselves. In other words, what is it that the reader has to know in order to go from one sentence in an encyclopedia article to the next? When they model these articles, they do not just model the knowledge in them, but they model the knowledge the human has to have and the inference processes that the human has to have in order to make sense out of each article.

Marcus: Some of the technologies to improve human-computer interfaces in the future include virtual reality systems, like VPL's prototype applications that provide color, animation, and sound in wraparound environments that the user is a part of. Interaction with the environment is facilitated through DataGlove-like devices or speech input.

Multimedia will work with hypertext to create full, rich hypermedia environments that offer video, sound, etc., with complex, linked relationships.

Spoken and manual input, including writing and drawing, will help eliminate keyboard and mouse input.

Agents will simplify the performance of routine tasks. Multiple metaphors and knowledge visualization [schemata] will permit users to understand processes and structures better and more quickly.

One novel development will be the licensing of *personalities*, such as Marilyn Monroe, to promote data and function display and make user interfaces more engaging.

Hudspeth: The problem is that you have to present larger and larger volumes of information at a high level that makes deeper levels available as you look into them. The major breakthrough in software-human interface is automatically associating attributes with information. Somehow the system will know how to associate and gather information. So, the computer is going to have to know how to associate different kinds of information.

Card: The extent to which an understanding of the human—the cognitive structure of the human; the nature of human activity; and the task, organizational, or social settings of humans—is important to fundamental advances in human interfaces is underappreciated. The success of future systems will depend heavily on the extent to which they are compatible with their social and organizational settings. As work on human interfaces matures, knowledge is gradually beginning to accumulate as methodologies, tools, and theories, and I expect these to affect design in the future.

I expect improvements in theoretical foundations for user interfaces and in design methodologies and in toolkits. There is even a prospect for some human progress in computational human factors

← Circle 139 on Inquiry Card.

Power Packed & Built To Last.

XT/SLIM

STANDARD 200XT $69

Economical This UL approved, fully tested unit is one of the best generic 200s available. Costs no more than our Standard 150 it replaces.

SILENCER 200 $129

Ultra-Quiet Stop that irritating noise with the Silencer 200. Its large, low speed, German fan keeps your system 5° to 15° cooler and 84% quieter. Virtually inaudible! Great in the executive suite or home office.

TURBO-COOL 200 $169

High Performance Put AT power and 200% more cooling under the hood of your PC/XT with our UL approved Turbo-Cool 200. Its patented twin fan, sloped-cover design keeps your system 30° to 45° cooler, preventing data errors and other heat-related problems. Perfect for hot rod PCs and Mini ATs!

TURBO-COOL 300S $169

Slim and Powerful Give your Slimline or Mini-Tower computer up to 100% more power and cooling with our low profile, direct replacement Turbo-Cool 300S. With a peak capacity of over 350 watts, it will easily start even the largest hard drives and peripherals!

AT/TOWER

STANDARD 220 $99

Economical This UL approved, fully tested unit is one of the best generic 220s available. Ideal for basic systems.

SILENCER 220 $139

Ultra-Quiet Unrattle your nerves with the Silencer 220. Its custom, thermostatically-controlled fan maintains the correct system temperature while reducing noise by up to 95%. Great in the executive suite or home office.

TURBO-COOL 300 $189

High Performance Upgrade your AT/386 with our powerful Turbo-Cool 300. This popular OEM unit features built-in line conditioning, UL/CSA/TUV approval, 2 year warranty, and a high-capacity, adjustable-speed fan that keeps your system 20° to 35° cooler for up to three times longer life. Great value!

TURBO-COOL 450 $349

Maximum Performance The choice of PC professionals, our Turbo-Cool 450 features built-in line conditioning, autoselect input, independent regulation, external DC voltage adjustment, triple-stage output filter, 50cfm cooling fan, UL/CSA/TUV approval, 100,000 Hr. MTBF and 2 year warranty! Ideal for high-end workstations and network file servers.

COMPAQ

CP160 $169

Original Portable Upgrade Double your power with our direct replacement CP160. Allows 286, 386, and hard disk upgrades.

CD270 $249

Deskpro Upgrade The power user's power supply! Our direct replacement CD270 gives your 8086/286/386 Deskpro up to 70% more power and the reliability it deserves. Prevents nuisance rebooting. Advanced design includes autoselect 110V/220V. 2-year warranty.

INTERNAL UPS!

"An excellent product"
– PC Magazine, Nov 27, 1990

Our UL approved InnerSource is the first AT/386 power supply with a *built-in* UPS. Its auto-recharge battery provides up to 15 minutes of reliable backup power for both your PC and monitor. This integrated protection costs less than a bulky 550VA external UPS, and it saves space, too. A Novell NetWare interface is available. **$395**

Most orders shipped same day. We accept Visa, MC, COD or PO on approved credit.

PC POWER & COOLING, INC.

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

Circle 121 on Inquiry Card (RESELLERS: 122).

as part of CAD tools for human interfaces.

What do you think user interfaces will be like in the year 2000?

Nelson: There will be a lot more of this glove stuff. This is very important. But there will still be some people clunking along on DOS, and there are people who like that stuff. I think that the greatest rule of the computer field is that nothing ever goes away, or things don't go away anywhere near as quickly as people expect them to. So, there are those who will still be using Lotus. I'm all for people doing exactly what they want to do—no matter how stupid. I want everyone to have the software that they want most, and the only problem is how to get it to them.

DR. STUART CARD
Researcher at Xerox PARC

Kay: One of the best predictions we can make is that there will still be lots of COBOL programmers. You just can't get rid of anything that's once worked. The style of interface I was associated with, the overlapping windows and all that stuff, I'm sure will still be there, but I think that many of the windows will be controlled by a bevy of agents. The agents will get smarter and smarter, and if CYC can work, if there's not something fundamentally wrong with CYC, then it should be possible to have a system that has a low-level understanding of a rather large number of human goal structures and can simply act as an amplifier for those goal structures. I don't think we should worry about whether it's going to be intelligent like a human or not. That's not an operative thing. The real question is whether it can be more useful than annoying.

Hudspeth: Have you ever seen Knowledge Navigator [an Apple video showing an animated, intelligent software agent]? Don't laugh! Apple is really serious about this. We are working on all the pieces that have to go into place to make that kind of user interface possible—multimedia, voice recognition, telephones, and so on.

Card: The concept of the workstation is just a temporary technological compromise. Alan Kay and company understood from the beginning that what they wanted was a portable machine based around some thin panel display. Desktop workstations were just a temporary expedient, because the appropriate display technologies weren't ready, and CRTs require large power supplies and big tubes.

As soon as the display technology begins to be adequate, the workstation concept weakens in favor of all sorts of computational media. So, I expect user interfaces in the year 2000 to be not so workstation-centric. Furthermore, computers are merging with televisions, VCRs, fax machines, telephones, and consumer products.

User interfaces in the year 2000 will be different, because there will be a lot of direct pen-based interaction with large, wall-size displays, with notebook-size devices, and with smaller devices. There will be more graphics and animation. Many devices will be seriously portable and heavily linked into communications networks. Input will make heavier use of recognition-based technologies.

Marcus: By the year 2000, user interfaces will consist of large, wall-size displays for group viewing; projections on personal eyeglasses that overlay displays on normal views; and the specialized displays on various appliances, like wristwatches that contain the equivalent of a current workstation, in a piece of clothing with microprocessors built in to change its thermal or color characteristics, or auto displays.

Multimedia, hypertext, three dimensions, color, multiple agents and metaphors, speech input, completely portable access to telecommunications with people and computers will all be standard. User interfaces will be consumer products, appearing in many different designs, including designer labels by the design profession's leaders.

User interfaces are obviously complex parts of any program. Much of the functionality of user interfaces is now being moved from end-user programs to the operating system in order to ensure that the interfaces that users see are consistent. It is also becoming clear that the most popular, consistent, and usable interfaces are being based on research on what people really can use easily rather than on guesswork. This approach of using cognitive psychology is paying off in ease of use, but it has not yet addressed all the issues of presenting the complexity of information.

Ironically, just as user interfaces are becoming aids of our use of computers on current platforms, the underlying hardware technologies are changing to new modes of input and output that will require interfaces to be redesigned. But this time around, the designers have a jump on things, and they know where we are headed. So, we can expect the next range of technologies to be considerably easier to use, not just because pen-input and voice-input are naturally simpler, but because all these things are being carefully integrated into an entire system of information acquisition and retrieval. ■

PARTICIPANTS

- ***Aaron Marcus** is head of Aaron Marcus & Associates, a consulting firm based in Emeryville, California, that specializes in user interfaces and visual communication. He is a frequent speaker on the subject at conferences.*
- ***Dr. Stuart Card** is a researcher at Xerox PARC, doing work, in particular, on using 3-D environments. His recent work was extensively covered in "An Easier Interface," an article in the February BYTE.*
- ***Paul Hudspeth** is the product manager at Apple for the Finder in System 7.0. His responsibilities include the interface of System 7.0 and future operating-system products.*
- ***Ted Nelson** is the inventor of hypertext and the head of the Xanadu project at Autodesk. He is also working on ZigZag, a new project that integrates all the standard applications of a computer into one program.*
- ***Alan Kay** is an Apple Fellow and one of the developers of the Xerox Star system, which was the forerunner of the Apple interface. He is also the inventor of the Dynabook concept of a portable computer that can be used anywhere, with worldwide access to a huge network of computer information, while remaining a friendly, easy-to-use, portable system.*

Owen Linderholm is a BYTE senior news editor in San Francisco. You can contact him on BIX as "owenl."

REMARKABLE!

FLYTECH'S NEW NETWORKABLE CARRY-1 COMPUTERS ARE THE PERFECT DESK-CORNER PCS FOR TODAY'S COMPUTER-COMFORTABLE EXECUTIVE, WHO WANTS HIS DESK BACK.

Carry-1 booksize desktop PCs can be at hand wherever you work, whenever you work. Small, yet powerful, they are completely compatible with all DOS and Windows applications. Now our 5000 series adds more versatility with two 16-bit expansion slots. But the essence of the Carry is **to be handy.** It's still small enough to tote to the corner of the desk where the work is waiting.

Get the whole story. For the name of your nearest dealer, call 408-727-7373.

CARRY-I

THE NEW STANDARD

COMDEX/FALL '91 BOOTH: S4050

Circle 54 on Inquiry Card.

FLYTECH GROUP INTERNATIONAL

U.S.A. OFFICE:
EL (408) 727-7373, 727-7374
AX (408) 727-7375

ustralia: Sigma 61-2-9573777 Fax 61 2 9572013
ustria: Macrotron 0222-408-1543-0 Fax 0222-4081543 50
razil/ Paraguay: Microface 305-477-0222 Fax 305-477 3208
elgium: Celem 32-41-676434 Fax 32-41-676515
hile: Ingram 56-2-2771518 Fax 56-2-334989
ance: M3C 33-1-4827-1976 Fax 33-1-4235-5918

GERMANY OFFICE:
TEL (069) 746-081, 746-453
FAX (069) 749-375

Germany: Macrotron 49-89-420-8233 Fax 49-89-422 863
Greece: Altec 30-1-8832017 Fax 30-1-8816187
Hong Kong: Parkly 852-305-1268 Fax 852-796-8427
Hungary: Minor 361 1224-687 Fax 361-1415-656
Italy: Prima 39-522-518599 Fax 39-522 518599
Israel: MLL 972-3-7515511 Fax 972-3-7516615

H.K. OFFICE:
TEL: 305-1268
FAX 796-8427

India: Unicorp 91 11-6831341 Fax 91 11-6845828
Korea: Mccoy 82-2 7436055 Fax 82-2-7431898
Malaysia: Comtec 60-3 274 8888 Fax 60-3-274-9988
Mexico: Tronica 52-5-2591221 Fax 52-5-2591447
Norway: Secus 47 2-722 510 Fax 47-2-722-515
Netherland: KN 31 20-6584141 Fax 31-20-6597436

TAIWAN OFFICE:
TEL (02) 785-2556 • FAX (02) 785-2371 783 7970
TELEX: 22233 FLTCO

New Zealand: TL System 64-9-665805 Fax 64 9-665803
Singapore: Transniko 65-4758408 Fax 65-4713803
South Africa: P C. Mart 27 11 23-0131 Fax 27 11 23-3248
Spain: Abaco 34-185-11852 Fax 34-185-08093
Saudi Arabia: Fida 9663-8349796 Fax 9663-8335215
Switzerland: Euro Software 41-22-822-020 Fax 41 22-815-850
U.K.: CI 44-256-463754 Fax 44-256-843174

Now your Carry can have a 386 processor, a modem-and-fax card, and still have one extra 16-bit slot for expansion. Ready? Give us a call.

1,000 Words On Quality.

See the picture of quality for yourself. Discover the unsurpassed picture crispness, brilliance, and infinite range of color of the CTX monitors.

Compare the superlative quality with the rest. Then check the affordable prices.

1,000 words won't do it justice.

Available from CTX is a full range of powerful 14" color monitors: from the top-of-the-line Multiscan to a Super VGA and Deluxe and Standard VGAs as well as EGAs and CGAs.

	Multiscan	*Super VGA*	*Deluxe VGA*	*Standard VGA*
Model	3436	5468	5432	5439
Resolution	1024×768	1024×768	640×480	640×480
Horiz. Freq.	15.75-38 KHz	30-38 KHz	31.5 KHz	31.5 KHz
CRT Dot Pitch	.28 mm	.28 mm	.29 mm	.39 mm

Add to all these features complete IBM and Macintosh compatibility, handy up-front controls, non-glare direct etch screens, detachable tilt/swivel bases, and reliable nationwide servicing, and you will agree that the CTX monitors are the best deal available on the market.

—Technological Excellence.
—Unbeatable Performance.
—Exceptional Pricing.

For a real picture of quality, see your local CTX dealer or contact:

CTX INTERNATIONAL, INC.
161 Commerce Way, Walnut, CA 91789
714/595-6146, FAX 714/595-6293

CTX SOUTH, INC.
6090-F Northbelt Parkway, Norcross, GA 30071
404/729-8909, Fax 404/729-8805

Factory:
CHUNTEX ELECTRONIC CO., LTD.
6F, No. 2, Alley 6, Lane 235, Pao Chiao Rd.
Hsin Tien, 23115 Taipei Hsien, Taiwan, R.O.C.
886-2-9175055, Fax 886-2-9172736

Watch for CTX's new 17" and 21" Large Screen Displays coming soon.

CTX

WHERE MONITORS ARE CTXELLENT

IBM is a registered trade mark of International Business Machines. Macintosh is a registered trade mark of Apple Computer, Inc.

Circle 28 on Inquiry Card.

A Business Wish List

Some still-missing ingredients include universal data accessibility, affordable technology, and ease of use

JANET J. BARRON

Everyone has "wish lists." Airline companies want more passengers to fill their more-often-than-not high-priced seats. Automobile dealers want more customers to take away some of the many gas-guzzlers gathering rust on their lots. Home sellers want more home buyers. And the PC industry wants more people to become PC users.

We decided to find out what the highest priority items are on your high-technology wish list—what's still missing that would make your working life easier and more efficient. And we also inquired about what you need in the way of capabilities, systems, and technology to make your company more productive and profitable.

Who Participated

To get informative feedback, we solicited opinions from people in widely diverse areas of business: a consultant in the computer field; an executive of a medium-size business; the president of one of the nation's largest computer retailers; BYTE's own editor in chief; an academic; and a representative of a vendor that produces a potpourri of computer hardware and software.

WILLIAM A. BOLLER
General Manager of Strategic Consulting, Hewlett-Packard

And to give you an idea of what a wish list might look like from a more "galactic" perspective, we asked for, and received, input from Craig I. Fields (see the text box "A Global Business Wish List" on page 50). During the Reagan administration, Fields directed the Defense Advanced Research Projects Agency (DARPA). Currently, he is president and CEO of one of the oldest and best-known computer consortiums: the Microelectronics and Computer Technology Corp. (MCC) in Austin, Texas.

High on Their Lists

Generally, when we survey a number of people on a particular topic, we find a good bit of similarity in their responses. In reading through these thoughtful wish lists, you'll see some common threads. However, several participants presented some significantly different opinions on why the industry hasn't yet put a computer on every desk. They also set out some interesting reasons why business computer users are still seriously frustrated about some important "wish we had, but still don'ts."

Almost all the respondents mentioned the inability to get at information they need to have and use it when and where they want. Patricia Seybold, president of the Seybold Office Computing Group in Boston, put it this way: "The basic problem is having the right information in the right form for the right people at the right time."

She provides a perfect example of this phenomenon: "One very large retailer has this wonderful centralized information system. But none of the people there—in the catalog store, the retail store, the warehouse, etc.—can tell you anything. They used to be able to, and they're very frustrated. I ended up having to order two dishwashers and cancel one."

Seybold also told us war stories about situations in the manufacturing environment where, because of an inability to access information when and where it is needed, some decisions about which batch of goods to produce are being made by the wrong people. One suggestion she offers as a possible solution to this situation is the use of *data dictionaries*.

Modularity is an issue that more than one of our respondents mentioned. Several participants discussed the need to upgrade their capabilities without having to throw out the computer with the obsolete software (or CPU, as it were). Fred Langa, BYTE's editor in chief, comments on CPU-upgradable systems and their entry into the arena to address this problem.

System administration is another area in which modularity of a different kind would be welcomed, says Paul N. Wyatt, vice president of engineering at Covalent

A GLOBAL BUSINESS WISH LIST

Most businesses in developed countries use information technology to improve the quality of products or services or to lower the cost—and thus the price—of those products or services. These firms also use information technology to get new products and services into the marketplace faster than the competition and to better service customers through better marketing.

There are plenty of tactical problems in employing information technology: interoperability, standards and the installed base, privacy and security, reliability and availability, intellectual property protection, and much more. But despite the continuing stream of difficulties—which probably will never end—businesses continue to employ, and in fact are increasingly dependent on, information technology. We have even created the position of CIO (chief information officer) in the executive suite.

How do we make industry more productive? One opportunity, and in fact a crucial need, is to develop an information infrastructure that provides a foundation for improved business success and economic performance. The telecommunications system is the underpinning of this emerging business information infrastructure. The 1990s will see an explosion of global (increasingly digital) networking underlying a distributed information infrastructure driven by changes in telecommunications regulation and technology. That networking will be transparent, seamless, and high-capacity—up to gigabits per second between fixed sites. And that networking will be ubiquitous—sustaining large numbers of portable and mobile subscribers with increased availability of spectrum and digital signal processing.

CRAIG I. FIELDS
President and CEO
Microelectronics and Computer Technology Corp.

Global Network

The global network will reach not only businesses, government, and schools, but homes as well. It will carry not only numbers, text, and speech, but high-definition pictures and video. And the global network will connect not only automated data-processing systems—ranging from laptop/pocket PCs to supercomputers—but also media systems, such as television, and embedded systems, including "smart" buildings, homes and appliances, motor vehicles, and industrial equipment.

But a global telecommunications network is not enough; more is required to have a real business information infrastructure. To stay competitive in the global marketplace, businesses must adopt information technology for better integration among business enterprises and for computerized commerce.

Businesses have been investing heavily to automate and augment operations within the firm. The next frontier is automation *among* firms, for marketing, designing, developing, producing, testing, and servicing products with the shortest time to market, the highest quality, and the lowest capital investment. Increasingly, the productivity of complex, global enterprises is limited not by labor or capital, but by the problems associated with both human and machine information processing.

For example, getting a product to market rapidly depends on countless highly interdependent, informed decisions made by hundreds or thousands of individuals working for a number of vertically integrated companies. Success in the 1990s requires new, highly developed technologies that promote the sharing of information not only within but also among enterprises.

Looking into the distant future, we

Systems in Fremont, California. High on Wyatt's wish list is "standard architectural frameworks to allow us to independently select and procure personal software and groupware and then 'snap them together' into an enterprise-wide information system."

One subject that popped up as regularly as your monthly electric bill is a promise that's been made and broken so often, some users have lost faith in the whole industry. This high-on-the-wish-list issue is the serious and continuing need for something called *ease of use*.

Recently, the results of a number of studies have been made public concerning people's ability (or, rather, their *in*ability) to program their home VCRs. It seems that even the most intelligent folks have been unable to perform this seemingly simple task. Is it any wonder then that the complexity of today's high technology prevents the average person from being able to get a new PC or piece of software up and running, much less from being able to install a network or integrate several dissimilar computing environments?

You Gotta Have Deep Pockets

Now, just for the sake of argument, let's suppose that every item on your business wish list somehow could be satisfied. Could your company afford to be a dues-paying member of this utopian world? Probably not. It's hard for businesses to find the funds to keep up with the state of the art in what's already available, much less what's coming in the future. As the price curve for older devices and components curlicues downward, the curve of our ever-increasing performance needs skyrockets upward.

Read what William A. Boller, general manager of strategic consulting at Hewlett-Packard, has to say on this subject. He and others agree that funding and justifying high technology's ever-increasing costs is a *major* predicament for both end users and MIS departments alike.

We solicit your feedback on the subject

must achieve a rich information infrastructure on top of the growing global network. And we also must achieve real enterprise integration among firms via the right standards, electronic catalogs, scheduling tools, automated and secure invoicing and payment, and much more. When we get to this point, then savvy businesses will enjoy

- more rapid product cycles achieved through reuse and continual incremental refinement;
- elimination of almost all unplanned engineering changes and reworking;
- the possibility of point-of-sale customization enabled by intelligent factories oriented toward short runs and flexible product mixes;
- tighter coordination with subcontractors and suppliers, making possible production economies without [having to rely on] scale;
- elimination of some supervisory jobs and the attendant streamlining of organizations; and
- creation of new markets facilitated by the information infrastructure itself.

Much of the necessary technology is already here or is coming close to reality. The challenge we face is to integrate the technologies efficiently and adopt them into our corporate processes and cultures.

of a business wish list. Write and tell us how the items mentioned here agree with those on your list and where they differ. What do *you* think we still need that we don't yet have? Then take a stab at providing some possible solutions for the missing links. We look forward to hearing from you. In the meantime, enjoy reading what our correspondents have to say on the issue of a business wish list.

William A. Boller
General Manager of Strategic Consulting
Hewlett-Packard

Quite candidly, businesses view technology as a means to achieve an end. They are not interested if you talk to them about technology unless you start discussing their particular business issues. There are two that are most significant to them. One is to improve their competitiveness. The other is to improve their financial viability.

When you talk about white-collar productivity, a priority is *ease of use*. That term breaks down into ease of use for the end user and ease of use for in-house systems people. There are two categories of ease of use. One is for the plug-and-play systems like the PC, and one is for the MIS community. When you talk about ease of use for the end user, you talk about technologies such as a common GUI. And you talk about the transducer-to-the-human. Do you use a keyboard or voice recognition to get the data into the machine? Do you use a CRT or a voice synthesizer to get the data out of the machine? Now, when you get into portability, you can't carry around a CRT, so manufacturers use LCDs. Then there's the question of voice synthesis and being able to use your modem to talk back to your office and get in and out of the system, and what have you.

When you consider the possibility of using technologies such as agents, then you get into object orientation and distributed computing, client/server, etc. End users don't say, "I want object orientation." They say, "I need to show my boss I'm being productive. In order to do that, I need to have systems and technologies that are easier to use. Where are those?"

Besides ease of use, there's another consideration, and that's *value for use*—i.e., it does something good. A sports car is easy to drive, but if your objective is to deliver furniture, it's not functional. So when you start talking about value for use, you're talking about *access to data*—the functionality and the quality of the data that are provided.

On that level, you get into technologies like artificial intelligence, and you also definitely get into the data-access issue. You're talking about networking, connectivity, distributed computing, and client/server. You're talking about being able to sit at a local terminal—PC or workstation—and empower the user to effect decisions. Empowering users means enabling them to get from their local desks out through networks to other data sources.

Then there's interoperability. Now you're talking about a requirement for being able to interface with multiple remote systems. In addition, you have the legacy (older) systems that you have to work into that scenario, and you have to have some consideration for the future systems. Now you have uncovered the requirement for open systems.

Competitive and Financially Sound

The reason for open systems is to allow workers to be more successful in interfacing more broadly, horizontally. The bottom line is that companies will need such things as open systems, client/server, objects, AI, distributed databases, and sophisticated technology. These things will allow the user to add value so that the systems can contribute to the company's overall productivity, making the company more competitive and more financially sound.

CEOs say, "Come show us how to improve our competitiveness, cost/performance, return on investment, and so forth, so we can stay in business and continue to make a profit." The MIS community has clearly been asked by its management to show productivity improvements. They have to prove that cost/performance is there—they have to do more for less. A lot of executives are now going to the MIS department and saying, "Before I give you next year's budget, I want you to show me what I got from the last five years' worth of funding. Show me how my business is better." □

Fred Langa
Editor in Chief
BYTE

For business, the biggest problem—and it's been there since day one and probably will be there until infinity—is pricing. Yes, prices have dropped signifi-

cantly. The trouble is that computer users' needs continue to grow. In theory, things like GUIs, where the machines become easier to use, open up computing to more people. But the price tag is so high the industry doesn't achieve the critical mass that it might if the price were lower. So users are still on the outer edge of the price curve.

Portable computing is a big deal these days. Being able to be productive whenever and wherever you need to is a very attractive benefit. Yet these portable machines can be even more expensive than the desktops they are designed to replace. The things that free you from your desk become so expensive or valuable that you don't want to take them anywhere.

If you want to spend money in a corporate setting, even if the technology is there, it's a question of "If it ain't broke, don't fix it." It keeps coming down to dollars. Of course, if you have an infinite checkbook, you can solve all your problems. Vendors have to achieve as much profits as possible. But some of them are very shortsighted, because they are focused on maximizing short-term profits—value *subtracted* rather than value *added*.

Many systems manufacturers are responding to these types of budgetary concerns, and that's why we're now seeing this slew of CPU-upgradable systems. Suppose you buy something today, and six months down the road you change your mind. These types of systems keep you from having to turn in the whole box. Instead, you just upgrade the CPU.

The advantages of this solution are indirect and aren't that important to individual end users. When those users go to upgrade, they want a larger hard disk, a better monitor, a better video card, and so forth. When they need a new box, they want to start over. The benefits to the CPU-upgrade strategy are more for the MIS directors who have to support a large number of systems and for people in the channel (e.g., dealers and resellers). MIS people can buy a finite number of boxes and a pile of CPU cards and just plug and play as needed.

Getting in Sync

Businesses often have problems getting many different generations of systems in sync with each other. Wireless technology holds real promise. Being able to jump across physical locations and device generations via transparent connectivity is the way it should be. People sitting and talking to each other don't have to think about manipulating their vocal cords. It just happens.

Time consumption is another problem (see "Why Doesn't Software Work?" in the March BYTE). The hours required to learn each new program is one reason some people don't switch software; they just don't have the time to start all over again.

What do businesses want to achieve the most with the technology that already exists? In the short term, it's to keep from wasting money and to expect that buying technology will deliver great benefits, speed things up, and make things better. But they've found out that it doesn't. In the long term, it would be to find a way to realize the benefits that people have been talking about for 15 years now—to achieve *the promise*.

Most of the basic capabilities are available; the trick is to get access to those capabilities. There are still some minor things we need, such as networking for dissimilar machines. But you can solve most of those problems if you write a big-enough check. It's doing things easily and simply that's a problem, not the absence of the technology. The tools really are there. □

Paul N. Wyatt
Vice President, Engineering
Covalent Systems

PAUL N. WYATT
Vice President, Engineering
Covalent Systems

Especially in small and medium-size firms, the use of technology to *manage* business is very limited. Islands of information exist, but integration of these islands into an enterprise-wide information-system is extremely rare.

The software development backlog of the 1970s was partially solved by firms purchasing personal or departmental software packages that solved specific problems. It's easy to see the benefits to be obtained by sharing data among these packages, but this process is a difficult

EDWARD R. ANDERSON
President
ComputerLand U.S.A.

task. The problem is not just hardware and operating-system incompatibility, but data format incompatibility.

Because of the complexity involved, trained personnel are needed to administer systems beyond the desktop level, such as multiuser systems and networked PCs. But small and medium-size businesses are unable, or unwilling, to add systems administrators to their staffs.

To solve this predicament, information-system standards must go beyond the operating-system, user-interface, and database levels. We must develop standard architectural frameworks that will allow us to independently select and procure personal software and groupware and then "snap them together" into an enterprise-wide information system.

Other technology needs include the enhancement of DBMSes to store the rules for using data along with the data, and the ability to transfer these rules with the data. In addition, systems administration and recovery must be made foolproof and nearly automatic.

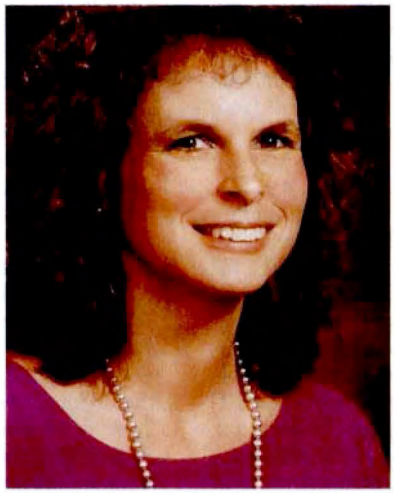
Most business-oriented computer technology is used to automate tasks and processes that were previously performed manually. For businesses to grow and prosper, we must use technology to restructure business processes. Data must be turned into information that is available when and where it is needed. We must use computers to impose strategy and control instead of simply to collect operational data.

Better GUIs

For computer systems to be widely used, they must be nonintrusive. The user-interface technologies must go far beyond Mac-like GUIs. Pen-point interfaces such as that developed by Go Corp. will

be useful for some applications, but additional innovative interface technologies are required. Business will continue to adopt technology slowly and in isolated pockets. Enterprise-wide adoption of technology requires that procedures be rethought and reworked and that organizations be changed. This is a very painful process.

Companies still want computers to be a wonder drug that will solve problems management hasn't been able to solve. When computers are unable to live up to this promise, users become disillusioned. The computers that businesses adopt the quickest and easiest are those that are embedded within machinery to improve their capabilities and the quality of their output. □



PATRICIA SEYBOLD
President
The Seybold Office
Computing Group

Edward R. Anderson
President
ComputerLand U.S.A.

We have three classes of customers—small, medium, and large. The medium-to-large accounts have similar needs. Recently, the large accounts have communicated to us that they are very nervous about the lack of profitability in the retail channel. In other words, by virtue of all the recent consolidations, there are only about 10 top resellers in the U.S. and only five chairs for those 10 to fit into.

To address the issue of consolidation of the retailer channel, we agreed to buy the NYNEX Business Centers by June 1 [1991]. The philosophy is to merge the back offices, keep the front offices, and eliminate the duplicate real estate. Retailers will either go broke, go away, or consolidate and get larger. Those without enough margin will go broke.

One Size Doesn't Fit All

Some people outside the [computer] retail business think that large companies want to deal with vendors so they can get good deals. Our experience is that they want to deal with an intermediary instead so they can write one purchase order and get a mix of products. For instance, they might want to buy one brand of hard disk drives, another brand of monitors, and so forth.

Since these companies are migrating to new products or generations of products, the support issue also is becoming more and more important. We hear things like "I'm in the airline business and modular outsourcing is a very important issue to me. What can you do that I do internally because I don't want to be in that kind of business (i.e., help, service, maintenance, training, and so forth)?"

Everyone used to talk about "selling the whole solution." We believe the business is radically and rapidly changing to à la carte service: "Can you give me around-the-clock server maintenance, unbundled service pricing, and so on?" They don't want to feel like they will be gouged by a dealer selling total solutions, some of which they don't need. They want to pay for select services that they do need—both on a contract basis and ad hoc—with a guarantee of real results. □

Patricia Seybold
President
The Seybold Office
Computing Group

It sounds pretty simple. The basic problem is having the right information in the right form for the right people at the right time. First, businesses need information in the field to serve the customer, and they don't have it. Second, they're trying to consolidate all the information related to the customer and have that available to everybody involved, but they can't.

A single individual needs to be able to have consolidated information about inventory, ordering, pricing, everything. And whomever the customers contact, those people need to have the whole picture, but they don't. In the manufacturing arena, decisions about which batch of products to make are sometimes being made by the wrong person.

So what are some of the technologies necessary for solving this problem? Besides the obvious ones people are already using, there could be data dictionaries and data repositories. A data dictionary is basically an English dictionary referring to what kind of information you have and how to find it. By looking at a data dictionary, you could see what kinds of information the corporation has—what they call the *fields*—and how to go about finding them.

Then you have to deal with how to take data (in a formal database or flat files) and organize, manipulate, and manage it. Object management is one way to turn data into information and add meaning and context. You may be hearing the term *intelligent database*, but an intelligent database implies a single database, whereas object management implies a layer of software, or whatever, that will span across databases, networks, and systems and pull in information from many different sources.

E-Mail: Backbone of Connectivity

One technology that has already made a reasonable amount of progress is E-mail. It is a backbone of connectivity in general. It's now accepted in large corporations that E-mail is for much more than just sending memos. It is in fact the communications infrastructure used to send information across the whole organization. You can think of it as EDI [electronic data information]: Every time that anyone does anything, everyone gets a notification. They know exactly what's going on at all times.

We need capabilities not only in the area of technology but also in tools—integration tools, system-integration tools, and application development tools. People need real-time evolutionary application development tools for ad hoc application development; it takes too long today. If it takes two years to develop an application, by the time it's developed, it's obsolete. We need to be able to develop applications from start to finish within six months. Rapid prototyping is becoming much more popular. The distinction between prototyping and production is going away.

Other technologies that seem particularly necessary include laptop pen-based systems, voice and image integration, and workflow design (visualization and improvisation). As you begin to do workflow design like application development (much of the implementation will use an E-mail backbone), you find that you can't do it once and get it right. You have to design your workflow to improve the process and improvise with flexibility, modularity, and interconnectedness.

Usability Essential

The next hurdle is usability. Just about everybody in any business will tell you

that computers and systems of all kinds, including your home VCR, are much too hard to use. Clearly, we need some breakthroughs in this area. An encouraging direction is the Go Corp. tablet and its software and an increased awareness of the role of multimedia—bringing it all together finally. We need to put a big push on usability and portability.

Another technology hurdle is operating systems and networks. You cannot build a real-time organization with today's technology. Networks aren't robust enough; operating systems have to be brought down and brought up again. You can't make modifications on the fly. Basic infrastructures and basic operating systems and networks need to be reworked.

DR. WALTER BENDER
Principal Research Scientist
MIT Media Lab

There needs to be a shift in the corporate culture that says "learning is a responsibility of every individual and every group and every division." And that we, as a company, will value that and reward you and set up infrastructures to foster that. Part of this scenario is that *everyone* must have systemic interrelationships. Everyone needs to be able to know everything that affects his or her job; the old-timey "check your brain at the door" thinking just won't make it. Everyone has to be empowered. I think we're heading in that direction now. □

Dr. Walter Bender
Principal Research Scientist
MIT Media Lab

We're still not able to communicate information to the place we want to communicate it. Also, we can't manipulate data in a timely or convenient fashion. For example, when I'm at my desk, I have this wonderful workstation and a network that can transmit, manipulate, and retrieve the information I want. But when I'm out of my office, at a remote site, on the road, or elsewhere, I don't. I only have devices such as a laptop, radio, or a cellular phone. These are much less powerful tools, and, in this kind of a different situation, I'm greatly limited in my capabilities.

The notion that information and communication channels can be scalable is not accurate. Information architecture is not scalable, either in terms of bandwidth or content. I can do multimedia when I am at my desktop, but not when I'm at a remote site. How do I translate the data that was going to come as video, and light, as text? Dimensional multimedia as seen by your face looks different from flat text.

E-Mail vs. Fax

On a related theme, the form in which we are pushing this information around doesn't make it amenable to very sophisticated manipulation—for example, the difference between fax and E-mail. Both are very efficient ways of getting information from here to there. But when a fax arrives, it is static. When E-mail arrives, I can manipulate it. That's one reason we're beginning to see optical character recognition really take off.

Building a structure around these particular transactions would make this information easier to work with across environments. How do you find the message this information refers to or the person who sent it? References are beginnings, and they are an indicator of more structure and better things to come.

With this kind of capability, you could take E-mail data and make it into a report that would help you do a better job of tracking competition, for instance. The more structure the computer builds in, the more it can do and the less you have to do—the less you have to manipulate. After all, you should be analyzing and thinking about the implications of the data—not having to worry about the logistics of retrieving it.

We need a lot more capabilities like these audit trails in E-mail (embedded in the information) so the computer can leverage off that data to make it more pertinent to the user. Technology should eliminate some of the burden of manipulation—do the logistics for us—so we can concentrate on the higher aspects of the evaluation and analysis of the information. ■

PARTICIPANTS

- ***William A. Boller*** *is responsible for Hewlett-Packard's Strategic Consulting Program and System Integrator Partner's Program. Before assuming this position, he was general manager of HP's Industrial Center. He holds three patents for devices he invented.*
- ***Fred Langa*** *is BYTE's editor in chief.*
- ***Paul N. Wyatt*** *is vice president and chief technical officer of Covalent Systems in Fremont, California. He is responsible for engineering and product marketing.*
- ***Edward R. Anderson*** *was appointed CEO of ComputerLand U.S.A. in May 1988. He became president of the firm in July 1990. Before joining ComputerLand, he held positions with the Computer Factory in Elmsford, New York, W. R. Grace & Co., and American Express Co. He holds degrees from the University of Michigan and Harvard University.*
- ***Patricia Seybold*** *is president and founder of the Seybold Office Computing Group in Boston, Massachusetts. Her firm carries out computer industry research and consulting, sponsors seminars, and also publishes four technology newsletters and special in-depth research reports. Her current areas of research are organizational learning and democratic access to information.*
- ***Dr. Walter Bender*** *is director of the Electronic Publishing Group at MIT's Media Lab. In 1980, he received his M.S. from MIT. In the late 1970s, he worked with Nicholas Negroponte and the Architecture Machine Group (forerunner of the Media Lab), where he has been ever since. His current work is on computational access to information.*
- ***Craig I. Fields*** *is president and CEO of Microelectronics and Computer Technology Corp., a computer research consortium based in Austin, Texas. MCC's specific technical emphasis is in the areas of distributed information systems, enterprise integration, and high-value electronic components. Before joining MCC, he was with the Department of Defense and was director of the Defense Advanced Research Projects Agency.*

Janet J. Barron is a technical editor for BYTE. She can be reached on BIX as "neural."

RAINBOW TECHNOLOGIES

The Keys To Your Success

No matter where in the world you sell your software, Rainbow Technologies' Software Sentinel™ family of hardware keys will protect your investment and revenues.

Rainbow keys offer virtually unbreakable security against unauthorized software use. Custom-designed with ASIC technology, they are easy to install and totally transparent in operation. More than 100 high-level language interfaces are available for most operating environments, including DOS, OS/2, Windows, Unix, Xenix, Novell and the Apple Macintosh.

With 1.5 million keys protecting more than $2 billion worth of software, Rainbow Technologies leads the world in Execution Control, Revenue Protection and Information Security. You're assured of first-class support, service and supply from world-class distributors around the globe.

For additional information or an evaluation package, contact your nearest Rainbow representative today.

SOFTWARE DEVELOPERS

Protect your sales and profits with Rainbow's Software Sentinel keys...

- **SentinelPro™** Rainbow's flagship key uses an algorithm technique for maximum security.
- **Sentinel-C™** Protects multiple packages, contains 126 bytes of developer-programmable memory.
- **SentinelScribe™** Version of Sentinel-C which can be dynamically alterable in the field.
- **SentinelShell™** Protects without requiring access to the source code.
- **NetSentinel™** Site license revenue protection of LAN applications (NetPro & Net-C versions).
- **EvE™** For Apple Macintosh SE models and above, protects multiple packages.

RAINBOW TECHNOLOGIES

GLOBAL SALES AND SERVICE:

Rainbow Technologies Ltd
Shirley Lodge, 470 London Road
Slough, Berkshire SL3 8QY
United Kingdom
Tel: (44) 0753 541512
Fax: (44) 0753 543610

Rainbow Technologies GmbH
Oskar-Messter-Strasse 16
Postfach 1243, D-8045 Ismaning
Germany
Tel: (49) 89 961 3051
Fax (49) 89 961 2617

Rainbow Technologies SARL
2 Rue du Gué
78120 ORCEMONT
France
Tel: (33) 1 3955 0202
Fax: (33) 1 3963 2875

Rainbow Technologies, Inc.
9292 Jeronimo Road
Irvine, California 92718
USA
Tel: (1) 714 454 2100
Fax (1) 714 454 8557

■ **NORTHERN EUROPE: United Kingdom: Rainbow Technologies Ltd.**, Tel: (44) 0753 541512 **Benelux**: IntroCom Electronica, Netherlands, Tel: (31) 74 430 105 **Belgium**, Tel: (32) 2 645 0944 **Scandinavia: PERICO A/S**, Tel: (47) 2 49 1500 ■ **CENTRAL EUROPE: Germany: Rainbow Technologies GmbH**, Tel: (49) 89 961 3051 **Switzerland: TCD Technology AG**, Tel: (41) 56 91 3434 **IBV AG**, Tel: (41) 1 737 0176 ■ **SOUTHERN EUROPE: France: Rainbow Technologies SARL**, Tel: (33) 1 3955 0202 **Aetis**, Tel: (33) 93 53 09 87 **Spain: MECCO**, Tel: (34) 3 422 7700 **Italy: BFI IBEXSA SPA**, Tel: (39) 2 331 00535 **Greece: Byte Computer Applications**, Tel: (30) 1 923 2335 **Turkey: Bimek Limited**, Tel: (90) 1 346 9000 **Middle East & North Africa: CDG Engineering**, Tel (962) 6 818 360 **Israel: PC Soft**, Tel: (972) 3 664 535 ■ **PACIFIC RIM: USA: Rainbow Technologies, Inc.**, Tel: (1) 714 454 2100 **Japan: Giken Shoji Co., Ltd.**, Tel: (81) 52 972 6544 **Australia: FMS Pty. Ltd.**, Tel (61) 3 699 9899 **Korea: Genesis Technologies Corp.**, Tel: (82) 2 588 6318 **India: Threshold Technologies**, Tel: (91) 11 727 3820 **Thailand: BCS International**, Tel: (66) 2 319 4451, **Taiwan: Lehightek**, Tel: (886) 2 312 2145, **Hong Kong: Beta Trading**, Tel: (85) 2 544 8963 ■ **LATIN AMERICA: USA: Rainbow Technologies, Inc.**, Tel: (1) 714 454 2100 **Mexico & Central America: Impex Computación, S.A. De C.V.**, Tel: (52) 66 21 0291 **Venezuela: MicroMega/H&R&TOSERS**, Tel: (58) 2 332 249 **Argentina: Agri-Aid**, Tel: (54) 1 46 8364 **Chile: Halcon, S A** , Tel: (56) 2 333 536

Circle 134 on Inquiry Card.

Pretty.

Mission Critical Workstation 1448: 9 option slots and 2 drive bays

A PC that looks good in your office won't look good for long out in the plant.

Heat murders microprocessors. Dust decimates disk drives. Vibration victimizes video cards.

Any or all can wreck your entire operation.

Texas Microsystems line of rugged, reliable ISA Bus products and systems are specifically engineered for those brutal industrial environments that eat pretty PCs for breakfast.

To ensure maximum reliability we design and manufacture from scratch practically everything that goes into our systems, like passive backplanes which we pioneered for microcomputers in 1983. These backplanes accommodate a full compliment of convenient, plug-in components, all compatible with IBM®. They're why our Mean Time To Repair (MTTR) is a phenomenal 10 minutes.

You won't find passive backplanes — or lower MTTR — in any of the leading office PCs.

We also build industrial-strength option cards to handle myriad functions, in addition to our 286, 386™ and 486™ CPU cards in a full range of processor speeds. Our CPU card designs use Very Large Scale Integrated circuits and programmable array logic devices to reduce component counts by 50-60% which enhances reliability and resistance to physical stress. Ultimately, the design contributes to our remarkably long Mean Time Between Failures (MTBF): 70,000-100,000 hours, calculated against the MIL Standard Handbook 217E.

Ultra-fast 32-bit (80386) AT™ equivalent CPU board B386S Available at 16, 20, 25, 33 MHz

Mission Critical Benchtop 2003 10 option slots and 2 drive bays

You won't find that kind of card selection — or MTBF — among the leading PC makers.

You won't find them torturing their systems like we torture ours, either. Not only do we perform extensive "shake, rattle and roll" tests on each new design, we pretest all our systems before they leave our dock. We burn them in at 55°C/131°F for 48 hours straight just to make sure they can take the heat at your plant.

Pretty reliable.

What's more, we shock-mount our disk drives to stand up to vibrations surpassing Richter scale proportions and we use only high-reliability power supplies that can go 100,000 hours ing PC makers, Texas Microsystems has the longest history of design using Intel microprocessors: 15 years in all. You' ll find our systems hard at work in harsh operating environ-

I want FREE information about the Tough Choices in PC systems available from Texas Micro.

ount 2001
ive bays

I am very interested! ☐ Call me to discuss specifications ☐ Send me free information

Name _____ Title _____

Company _____ Phone _____

Address _____ City _____ State _____ Zip _____

Are you a/an ☐ End user ☐ Corp. purchaser ☐ VAR ☐ Consultant ☐ Government Agency ☐ DP/MIS ☐ Govt. contractor

What product(s), service(s) do you provide _____

Applications you are running _____

1 How many PCs does your company plan to purchase?

Timeframe: ☐ Within next month ☐ Within three months ☐ Within six months

Quantity _____ _____ _____

2 What type of configuration are you interested in?

☐ Rack-mount workstation ☐ Benchtop workstation ☐ Tower system ☐ Industrial workstation ☐ CPU Cards

3 Which processor do you require in your system?

☐ 286-based systems ☐ 386-based systems ☐ 486-based systems ☐ Other

4 How many expansion slots do you need? _____

5 What specifications are most important to your application?

☐ Heat ☐ Dust ☐ Shock ☐ Vibration ☐ High availability ☐ Fault tolerant ☐ Other

5

demark
stered.

B-10-91

The Outlook for Europe

Europe's research and innovation may have led the computer industry once, but what's the future for its researchers, innovators, and manufacturers?

ANDY REDFERN

Since Charles Babbage first began designing his mechanical Difference Engine, Europeans have played a significant—often leading—role in the advancement of computer theory, design, and manufacture. Manchester University may well have created the world's first computer, but the tide has been turning ever since, and Europe's research and innovation lead has significantly diminished. Japanese and U.S. companies now dominate virtually every area of computing, from the initial research to the fully implemented design. Can European companies regain a strong position, or will they become just the minor research departments of the American and Japanese multinationals? And if European innovation can survive, just what will European researchers be excelling in over the next five years?

The recent wave of purchases of European companies by American and Japanese manufacturers has generated resentment, and some countries are renewing calls for protectionist measures to shield their industries. Coupled with the fact that the European Commission (EC) seems to be perpetually investigating charges of "dumping" everything from floppy disks to dot-matrix printers, the argument for protectionism seems to be strong. The new French prime minister Edith Cresson is already being dubbed Europe's new Iron Lady as she attempts strong stands against the Japanese. "The Japanese have a strategy to conquer. And they're about to devour Europe," she asserted in a recent interview. Her feelings toward the U.S. are slightly more conciliatory; she maintains that the Americans and the Europeans "need to collaborate."

SIR CLIVE SINCLAIR
British inventor and innovator

But some figures in the high-technology industry see things in a more positive light. Sir Clive Sinclair, the creator of a number of successful microcomputers in the early 1980s, has reason to fear foreign countries dominating Europe. His company, Sinclair Computers, was swallowed up by Amstrad after his company crashed. His products were squeezed out of the market by American and Japanese consoles and game machines on one side and the emerging IBM PC standard on the other. Yet he strongly disagrees with Cresson's stance: "There is no room for protectionism in Europe. Through technologies like parallel processing we have the base technology in place to take a lead, but whether we have the commercial sense to capitalize on it is another question."

Sinclair also does not support the way many European governments prop up their ailing high-technology companies. "The government should only help by getting the general structure right. It should simply be responsible for providing educated staff and maintaining freedom for enterprise and innovation." He does not see the long-term value of European governments pumping money into companies that are failing to compete in the world market. Although there is European legislation to prevent member states from creating unfair advantage through government subsidy, it hasn't stopped the French government from recently announcing a $1 billion investment in Bull.

Fortress Europe

Even more vociferous than Sir Clive Sinclair is Peter Horne, the managing director of the U.K. personal computer manufacturer Apricot. It is his belief that "Fortress Europe is being built, brick by insane brick" as the European community contemplates new ways of staving off the external competition. He fears that the information technology industry will go the same way as the automobile industry.

The EC already exercises a quota system limiting the number of Japanese cars that can be imported into Europe. Its definition of *import* includes Japanese designs manufactured in Europe, as well as the cars shipped directly from Japan. Horne maintains that "this policy systematically discourages the flow of Japanese capital and skills into the EC and artificially bolsters European manufac-

ILLUSTRATION MARK FISHER © 1991

turers in the short term."

Cynical commentators might observe that Horne has an ax to grind because Apricot was bought by the Japanese industrial giant Mitsubishi Electric in May 1990. He maintains that without the investment from Mitsubishi, Apricot might not have remained in the personal computer hardware market, and jobs, R&D, and manufacturing expertise would all have been lost.

RAY ANDERSEN
Managing director of IXI

Apricot is not the only European company to have looked outside Europe for the investment that it needs. European banks have been notoriously bad at providing the necessary levels of investment that high-technology firms need to maintain R&D of new technologies.

International Computers Ltd., which is undoubtedly Europe's most consistently profitable computer manufacturer, sold an 80 percent stake to Fujitsu in November 1990. Since then, its investment in R&D has increased from £16 million to £215 million. Fujitsu has left the company to plan its own strategy for growth, simply offering a £250 million three-year revolving-credit agreement. This provides a level of investment and support for technological innovation that previously had been difficult for ICL to find in Europe.

Even though Japanese investment has protected 400 jobs in the U.K. at Apricot and 21,000 jobs around the world at ICL, the EC has not welcomed this investment that some claim protects European innovation. The Joint European Submicron Silicon Initiative is a European research collaboration designed to spearhead a new generation of microprocessors and other assorted silicon chips. In the beginning, ICL was heavily involved in this project, but its acquisition by Fujitsu caused it to be expelled from three of the projects and from the European Information Technology Round Table lobby group.

The other advantage that this inward investment has had for companies like Apricot is in providing new resources to tackle previously impossible markets. Apricot has just launched its range of products in Japan—a move that would have been impossible without Mitsubishi's help. Ray Andersen, managing director of IXI, the X Window System GUI manufacturer, believes that a European company will only be secure in the long term if it ventures into the U.S. and Japanese markets. He insists that European innovation will survive only if companies are willing to tackle the overseas companies in their own markets. Relying on people to buy your product because they live in the same country as you do will never bring major success.

Andersen also believes that fear of Japanese investment is short-sighted. "Ownership of the companies may be changing, but the people aren't. If I could see an area of the world where there were original ideas being generated, then I'd want to invest in research initiatives in that place, and that is exactly what the Japanese are doing. It is far more than tokenism."

European Innovation

The fact that Japanese and U.S. companies invest in European innovation and research would seem to indicate that European researchers have something new and original to say. Niels Jensen, managing director of Jensen & Partners International (JPI), one of the world's leading compiler manufacturers, believes that European developers "provide a higher quality of research" than anyone else. Being a language developer, he looks to the compiler market to illustrate his point.

"The C language has spread all over the world, but from a technical standpoint it is probably the poorest choice. All kinds of unsuitable applications use C, simply because the U.S. market has become dominated by it. In Europe, some application developers have been more sensible in selecting the language that best suits the application. For example, the European Space Agency has chosen the European-designed Modula-2 language for the bulk of its development."

Jensen believes that C++ is another bad step for the industry as a whole. It is not a well-thought-out and -researched language that places power in the hands of the users, he believes, but a clumsy add-on to C that is more likely to cripple the industry than to help it.

"European research in programming languages is way ahead of everyone else. Oberon is an excellent example of what happens when a language is researched rather than thrown together." Jensen admits that JPI is currently producing a C++ compiler, but he explains that the company is simply committed to providing the best compiler for each language and actually hopes people will use the multilanguage environment as a way of gradually migrating to Modula-2.

The Next Five Years

Sinclair, Horne, Andersen, and Jensen all have one thing in common: They believe that Europe's researchers have original ideas to offer the world. But what do they see as the major areas of growth and expansion over the course of the next five years?

Andersen believes that information organization, open systems, and communications are fields in which European companies have the base platform of research. Communications is one area in

European developers provide a higher quality of research.

NIELS JENSEN
Managing director of Jensen & Partners International

which European companies have invested in the infrastructure to such a level that they could be dominant.

As an example, he points to the system of *back billing* used by phone companies. When a phone call is carried by more than one carrier, there has to be a simple way of billing the call originator. The European system was designed to allow for virtually all possible billing eventualities, so even if a call is made to a mobile phone number in a different country, all the costs are charged to the call's originator. The U.S. system cannot cope with these complex calls that way, and the part of the call charges that cannot be backwardly billed is added to the call recipient's bill. These technical advantages, Andersen insists, will give Europe a chance to dominate and lead the communications market.

Sinclair sees highly parallel processing as the one area where Europe is poised to dominate a market, although he believes that mass-market sales are still some way off. Similarly, AI is an area of development that has been predicted as a major growth area for at least 10 years, and Jensen now believes that the next five years will see AI finally taking center stage. "Speech recognition is the key to mass-market success—talking is the easiest way to communicate. Many people are frightened of mice and keyboards. In fact, the mouse is probably one of the most ridiculous user-interface tools yet to be invented. Pen computing is a step on the way, but speech recognition will be the next revolution."

Eastern Europe—A European Advantage?

The major area of opportunity for European companies must surely lie in the democratization of the Eastern Bloc. Although U.S. and Japanese companies have been quick to dip their toes into the Eastern European waters, few of them have yet invested heavily. Surely through the European expertise in translating and adapting software for new cultures and through proximity to the new market, the European companies must have a significant advantage.

PETER KRUGER
Managing director of Digithurst

Everyone is talking about getting a slice of the Eastern European action—everything from joint ventures to the relaxing of the Coordinating Committee for Multilateral Export Controls agreement has caused a mood of optimism to sweep most of the Western world (see the text box "What Is the CoCom Agreement?" on page 62). In fact, this has led to the creation of the false perception that Eastern Europe is already a thriving market. But many companies have found that making serious investments in the Soviet Union and other Eastern nations is considerably harder than they had anticipated.

Opus, the U.K. PC manufacturer, has started a joint-venture company, called Balutech, with four other organizations (including the Soviet Union's state-run airline Aeroflot) to allow its products to be manufactured and marketed in the Soviet Union. Martin Breffit, Opus's marketing director, is quick to acknowledge not just the advantages of the joint venture but also the huge amount of time involved in negotiating it. "It took 2½ years to set the joint venture up. We now have an 11,000-square-foot production plant in Riga that basically completes partly assembled computers sent from our U.K. production plant."

Although business has so far been slow, Breffit believes it has been very successful. Balutech has sold around 500 machines and suffers mainly from the lack of hard currency to pay for the kits from Opus in the first place. "Lots of people require PCs," says Breffit. "They just haven't got the money to pay for them." Five hundred machines may sound like peanuts compared to the widely reported order of almost a million PCs that the Soviet Union placed just over a year ago. The country wanted the machines, but in the end the suppliers—Siemens-Nixdorf, Apricot, Bull, and many other European manufacturers—could not deliver because there simply wasn't the hard cash available to buy the machines.

As to whether the recent tightening of central government will make any difference, Breffit believes that in the long term it won't significantly affect Balutech's ability to bring technology to the marketplace.

Hard Currency? Hard Luck

By far the biggest problem to be faced by most companies entering the Eastern European markets is the lack of hard currency (e.g., dollars, sterling, or deutsche marks) to pay for the equipment or services being supplied. Companies demanding hard currency often find themselves undercut by those willing to take a more creative approach.

MARTIN BREFFIT
Marketing manager of the U.K.-based PC manufacturer Opus

Uniexport is a high-technology company specializing in the export of electron microscopes and spectrum analyzers to universities and medical centers across Eastern Europe. To be successful, it has had to learn about the ancient art of bartering. Basically, the company found that while its equipment was in great demand, its sales volume was severely restricted by the lack of currency. So, on a number of occasions, it has exchanged its products for commodities, simply to help complete the sale.

Uniexport has accepted things as diverse as software and timber as payment for its hardware. But, explains John Ingleby, a member of Uniexport's sales staff, often the problem is that even the raw materials being supplied are not up to Western standards and therefore fail to command a good price in the market. "In one case, we were offered some gallium-arsenide wafers, and everyone was looking forward to seeing them, as they had great potential for generating cash in Europe and the U.S.A. But when they arrived and we looked at them under the microscope, the surface looked like sandpaper. They could create the basic raw material, but their polishers just weren't good enough. And, of course, they need foreign currency to buy better ones."

But if the Soviets can't compete on technology, then perhaps they have the

DBMS Case Study:

Testing The F-15 Fighter

The Challenge

Every time he straps in, a military pilot puts his life on the line. He trusts his aircraft to respond instantly in split-second supersonic maneuvers. Constant testing and re-testing of his jet's hydraulic control systems are essential to assuring success—and survival.

The Application

HR Textron's F-15 STS Test Stand takes the computer-controlled hydraulic system that controls a jetfighter's flaps and ailerons through tests that simulate flight situations. A graphical user interface includes test fail dialogue boxes and menu trees that lead the operator through a complex series of diagnostic procedures. Limit-testing, self-calibration and archiving of results are handled by the test stand's integrated database.

The Solution

The system software for the test stand was developed using the db_VISTA III DBMS from Raima. Rich Rutkowski, Director of Engineering for the project, looked at the relational database products available and determined that they fell short of the design specifications. "Only db_VISTA III handled the complex data relationships, and also provided the speed and portability necessary for this application. We're not close to using all the power and flexibility db_VISTA III has to offer."

Whether in aerospace or in accounting, finance or manufacturing, critical applications demand the unique advantages of db_VISTA III:

Over 90,000 missions were flown in the recent Persian Gulf conflict. Allied forces lost only five aircraft to mechanical failure — an incredible record made possible in part by exhaustive, thorough performance testing.

- **Speed** — faster access to data
- **Portability** — supports most environments
- **Royalty-free** — increase your profits
- **Source Code Available** — total programming flexibility

Call Raima and find out how db_VISTA III can pass your next application development test.

$195 **Special db_VISTA Developer's Edition** — Windows, DOS, OS/2

Developer license only; not for distribution.

Call: 1-800-db-RAIMA

(1-800-327-2462)

In Washington State call:
(206) 747-5570

Circle 133 on Inquiry Card.

db_VISTA™ III
Database Management System

RAIMA™ CORPORATION

Specifications Relational B-tree indexing. Network data model. Relational SQL query and report writer. Single & multi-user. Automatic recovery. Built-in referential integrity. **Supports:** MS-DOS, MS Windows, UNIX, SCO UNIX, SunOS, QNX, VMS, Macintosh, OS/2 compatible. **Most C Compilers and LANs supported.**

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA **(206)747-5570** Telex: 6503018237 MCI UW Fax: (206)747-1991

International Distributors **Australia:** 61 2 419 7177 **Belgium:** 32 2 734 9818 **Brazil:** 55 11 531 5297 **Central America:** 506 28 07 64 **Finland:** 358 080405350 **France:** 33 1 46 09 27 84 **Germany:** 49 7022 34077 **Italy:** 39 49 829 1285 **Japan:** 81 33 865 2140 **Mexico:** 52 83 49 53 00 **The Netherlands** 31 2503 26312 **Norway:** 472 448855; 472 38 48 88 **Singapore:** 65 294 6714 **Sweden:** 46 13 111 588 **Switzerland:** 41 64 517475 **Taiwan:** 886 2 552 3277 **Turkey:** 90 1 152 05 16 **United Kingdom:** 44 992 500919 **Uruguay:** 598 292 0959 **USSR:** 01 22 35 99 07; 812 292 7210

BYS111

WHAT IS THE COCOM AGREEMENT?

The Coordinating Committee for Multilateral Export Controls is an alliance of 17 nations devoted to preventing the export of militarily useful high technology to the nations that formerly made up the Eastern Bloc. Its current list includes some 120 products that, to be exported, require a license granted by the member state or CoCom itself. The list includes a range of vastly different products, but the two most sensitive areas are high-speed computers and high-speed communications.

In June 1990, several of the organization's members campaigned to reduce the list to just eight product categories. Through negotiation, that number has been expanded to 10, but this may still not be enough to bring the new proposals in.

Some members have fears stemming from the use of technology during the Gulf War. The war taught CoCom that the dividing line between military and commercial use is more blurred than people had imagined. For instance, fiber-optic cable proved to be significant in allowing communications between the Iraqi control centers. Surface cables and radio signals can be destroyed, but deeply buried fiber optics are almost impossible to locate and eliminate. And a single fiber can multiplex many data and voice calls.

In June, the CoCom restrictions on many goods were relaxed. There is no longer a restriction on selling 32-bit processors or machines based on them. In fact, the agreement now allows any chip that has chip features greater than 1.5 microns to be sold throughout Eastern Europe. Needless to say, the restrictions still apply to any products intended for military use, and night-vision equipment and high-speed fiber-optic cables are still banned.

Even though these changes have been implemented, it seems doubtful that there will be a flood of technology into Eastern Europe. There just isn't the foreign currency to pay for it.

opportunity to market their expertise. For example, Uniexport is investigating the possibility of importing image-processing software from the Moscow State University.

Ingleby explains that the faster a computer is, the better it runs image-processing software, but fast hardware can make programmers lazy. He maintains that because of the slow speed of the technology available to Russian programmers, they have been forced to write much slicker code, and the combination of slick code and a fast PC may well be an attractive proposition for a number of Western researchers.

But even here there are problems. The cultural difference results in the creation of a style of software that is different from what the Western Europeans were expecting. American software, except in the games industry, has traditionally been conservative and tries to look serious. But many of the Soviet programmers like to add fancy sounds and graphics to their packages. Uniexport has had to try to explain the difference and then temper the software produced to make it more suitable for sale outside Eastern Europe.

Even though bartering has been important to his company's success in dealing with the Soviet Union, Ingleby is realistic about the value of the products and technologies he's found in the U.S.S.R. "I can't understand how they became a world force. In all our searching, we have yet to come up with anything really useful," he says.

Licensed to Sell

After hard currency, the other area of risk for companies is the apparent confusion over what technologies can and cannot be exported to Eastern Europe. Although the CoCom agreement appears fairly specific, there are some cloudy areas, and in the past, some companies have faced lengthy investigations to ascertain exactly what their products were being used for.

Digithurst is a Northern European supplier of video-output and image-processing cards whose production facilities were located in the U.K. It has sold a number of systems to various universities across the Soviet Union. But in early 1988, something happened that caused the company to be investigated for three months, during which time it was not allowed to export anything from its U.K. production facilities.

One night on the evening news, Soviet General Secretary Gorbachev was at a university in Moscow. The university's academics were showing him the high standard of Russian technology, and Gorbachev was in turn showing this technology to the world press. He lifted up a circuit board and told everyone that Russian technology was finally catching up with Western technology. Peter Kruger, Digithurst's managing director, was more than a little amused, as what Gorbachev was holding looked like one of the video boards he had sold to the university.

The amusement turned sour the next morning when the U.K.'s Customs and Excise officers moved in and slapped a ban on all his company's exports while they investigated whether or not the technology was on the proscribed list. Kruger still appears nervous when he tells the story; no business can afford to risk that kind of an export ban. The company has since opened production in other European countries so that if anything similar were to happen again, the results would not be so devastating to the company's overseas sales. Kruger acknowledges that there have been subsequent relaxations since early 1988, but his experience stands as a stark reminder to all those who would follow him into Eastern European markets.

Observers may not agree on how fast the market in Eastern Europe will grow, but what they all agree on is that it will grow, and in some places very rapidly. As this growth is coupled with the removal of trade restrictions between most European countries, many people are now talking about the New Europe.

One Europe—One Market?

Once the European community decided that 1992 was the year for the cross-border trade restrictions to end, each member state's government set about an aggressive campaign to alert the country's companies to the benefits they would get if they were prepared to enter Europe in 1992.

In the U.K., the Department of Trade and Industry used Alan Sugar, managing director of Amstrad, as an industrial figure who could communicate to small and medium-size businesses. During the TV campaign, he explained that he currently had to make a different machine for each European country because of the different regulations regarding health and safety and electrical emissions. He said that in 1992 he would only have to make

PERFECTLY EXECUTED

Electronic and Computer Products That Score Every Time

It's the fourth quarter, and you need reliable electronic and computer components now! Make your next call to Jameco for a strong, balanced product line, thorough customer support, stringent quality controls, and competitive pricing.

Jameco's team has spent 16 years distributing quality electronic components, test and measurement equipment, accessories, and computer systems—from advanced, to mid-range, to starter. There are over 4,000 products in the Jameco game plan; order them 24 hours a day!

Our customer-support team backs you at each step, starting with your purchase plan. Our expert technical staff fields your questions by phone to discuss your needs. We scout the world's latest technology for the best values, thoroughly prequalifying each vendor and testing products received into stock.

So join Jameco's large family of loyal fans from big and small businesses, schools and universities, government, and individuals. When your next electronics or system product has to score, check our catalog or stop by our catalog-store. Or, make the call to Jameco, for a purchase that is perfectly executed.

Panasonic Laser Printer

Jameco 16MHz 80386SX Computer Kit
- 2MB RAM (expandable to 8MB)
- 200 Watt power supply
- 101-key Keyboard • Multi I/O Card
- Toshiba 1 44MB, 3.5" Floppy Drive
- DR DOS 5.0 and AMI diagnostic software

$749.95/JE3816A
Video monitor/adapter not included

Jameco 33MHz 64KB Cache 80386 Computer Kit
- 4MB RAM (expandable to 32MB)
- 300 Watt power supply
- 6 half-height drive bays
- 101-key Keyboard • Multi I/O Card
- Toshiba 1 44MB, 3.5" Floppy Drive
- DR DOS 5.0 and AMI diagnostic software

$1399.95/JE3833B
Video monitor/adapter not included

Jameco 12MHz 80286 Computer Kit
- 512KB RAM (expandable to 4MB)
- 200 Watt power supply
- 101-key Keyboard • Multi I/O Card
- Toshiba 1 44MB, 3.5" Floppy Drive
- DR DOS 5.0 and AMI diagnostic software

$499.95/JE2812A
Video monitor/adapter not included

Printer Cable & Adapter

UVP EPROM Eraser

Jameco 16MHz 80386SX Motherboard

Integrated Circuits

Colorado Memory Systems Tape Back-up

Weller Soldering Station

Connectors

JAMECO®
ELECTRONIC COMPONENTS
COMPUTER PRODUCTS

Please refer to Mail Key 21 when ordering

1355 Shoreway Rd., Belmont, CA 94002 1-800-831-4242 (415) 592-8097 FAX: 1-800-237-6948

Terms: Prices are subject to change without notice. Items subject to availability and prior sale. Complete list of terms/warranties is available upon request.

Circle 78 on Inquiry Card.

one machine, because those regulations would have been standardized throughout the European community.

Although there is some truth in this, it overlooks the biggest barrier for any company trying to sell across the whole continent—the language differences. Although the basic hardware will be the same in every country, the keyboard, the version of DOS, and the documentation will probably need to be different. So selling into this single market requires a number of different products to meet the different cultural requirements.

PETER HORNE
Managing director of Apricot

Some European manufacturers have tried creative solutions to this problem. One Dutch-based PC manufacturer is investigating the possibility of creating a keyboard that uses a tiny LCD instead of a key cap on each key. The screen can then be programmed to display whatever key layout the user requires: The standard QWERTY, the French AZERTY, or the more unusual Dvorak keyboards would be available at the flip of a switch. Researchers within the company believe that they can create a design cheap enough that the slightly more expensive keyboard will still be much cheaper than it would be to create lots of different versions.

Siemens-Nixdorf has already developed an alternative technique. Using a laser printer, the company has perfected a technique that prints the characters onto the finished keyboard as the final stage of the production process.

Although making slight variations for different products may seem a problem to some, many European companies perceive it as an advantage they can capitalize on. Richard Muller, general sales manager of MT Datacom, one of the few indigenous modem manufacturers in the Netherlands, believes that his company can use the remaining differences to its advantage. Getting a modem approved by the relevant communications company in each country is a difficult task. Couple with that the need to support different languages and different communications protocols, like the exclusively European V.23 split-baud-rate system, and you can see why European companies believe they have the edge.

Muller maintains that the experience that his company has gained in getting through the various approval bodies and in supplying its systems across Europe is a tangible advantage that will allow it to react to new markets and new standards much more quickly than U.S. manufacturers will be able to. USRobotics' acquisition of the sinking U.K. modem manufacturer Miracom takes on a whole new meaning when viewed in these terms.

The changes brought about in 1992 don't stop there. As Europe will effectively be a single market, companies will be unable to prevent products from being sold across national barriers. Previously, a manufacturer could appoint a distributor to a geographical area and could prevent the distribution company from supplying customers outside its territory. Now, any distributor can sell anywhere that people want to buy the product it sells, even if that particular market was traditionally covered by a different dealer. Companies that try to coerce their dealers into respecting national boundaries are in danger of prosecution for restriction of trade.

In fact, the companies that will suffer most from this are American and U.K. manufacturers. English is fast becoming the accepted language of computing, so in Sweden, for example, 50 percent of the copies of Ventura Publisher sold are English, even though a Swedish version is available. But the converse is not true; a Swedish company can be sure that the Swedish version will sell only in Sweden, as few other countries have large numbers of Swedish speakers.

The changes across Europe will continue for many years to come. With economic union attempting to create a single European currency by 1995 and the Channel Tunnel linking the U.K. to mainland Europe in 1993 (for the first time since the ice age), new opportunities will abound.

The consensus appears to be that European innovation will still play an important—some believe key—role in the shaping of the new technologies developed by the computer industry in the next five years. What is uncertain is whether those Europeans will be working for American-, Japanese-, or European-owned companies. ■

PARTICIPANTS

- ***Sir Clive Sinclair**, British inventor and innovator, has launched a string of ground-breaking electronic products, including a number of Z80-based home computers, the Z88 notebook machine, a miniature TV, and the world's first truly pocket-size calculator. Through Sinclair Research, he is working on wafer-scale integration, mobile communications, and a collapsible briefcase-size bicycle.*

- ***Peter Horne** is managing director of Apricot, the U.K. personal computer manufacturer bought by Mitsubishi in 1990. He worked for the European Organisation for Nuclear Research at CERN before joining Apricot in 1983.*

- ***Ray Andersen** is managing director of IXI, a world leader in developing an intuitive GUI to Unix through the X Window System. Although his company has scored major successes in both the U.S. and Japan, he believes that the time difference between the U.S. and the U.K. is one thing that holds most European companies back.*

- ***Niels Jensen** is managing director of Jensen & Partners International, maker of the TopSpeed language compilers. A firm believer in European innovation, he left Borland's European operation with Modula-2 when Borland began taking all its R&D to its Scotts Valley, California, headquarters. Danish by birth, he currently lives in the U.K.*

- ***Martin Breffit** is marketing manager of the U.K.-based PC manufacturer Opus. After nearly three years of negotiations, the company has opened a joint-venture company in the Soviet Union called Balutech. The Balutech venture includes a Soviet state ministry and Aeroflot, the Soviet state airline. Balutech is building personal computers for the Soviet market from kits supplied by Opus.*

- ***Peter Kruger** is managing director of Digithurst, a company specializing in the development of graphics cards, data compression tools, and image-processing software. He believes that his biggest achievement so far has been to make German women more beautiful through a specialist image-manipulation application for hairdressers.*

Andy Redfern is the bureau chief in BYTE's London office. He is responsible for BYTE's International Section. You can reach him on BIX as "aredfern."

PC-MOS

The Multiuser DOS Platform For The '90s

The 386 and now the 486 microprocessors have focused a lot of attention on the multiuser, multitasking possibilities of advanced PCs. A myriad of software and hardware manufacturers are promising a new age of multiuser options in the '90s.

But when you take a closer look, only one solution focuses on the features you want and anticipates the capabilities you need to use your PCs to their greatest potential. That solution is PC-MOS™ from The Software Link, the first DOS-compatible, multiuser, multitasking operating system.

A Network Alternative

The advantage to the PC-MOS shared processing solution is its ability to maximize the available memory on your PC, taking full advantage of extended memory and sharing it with up to 25 users on inexpensive terminals or monitors. You can share data with the same speed and integrity of a network solution without the expense of network cards and the waste of under-utilized PCs. And no additional investment is required to get the multitasking capabilities inherent in PC-MOS.

A Network Enhancer

For affordable network expansion, PC-MOS servers can be connected to other servers with The Software Link's LANLink or with the PC-MOS GATEWAY™ to Novell's NetWare®. This connectivity lets a business configure its automation systems for departmental efficiency and expand affordably as needs grow with LANs or even WANs.

DOS Compatible

The PC-MOS alternative is clear: DOS compatibility means your users can continue to use all the popular software packages. And that means no investment loss, no retraining and no limitations in available applications.

An Unbeatable Solution

The next decade of shared processing will be clouded with choices. Only one operating system was first to offer you DOS-compatible, multiuser, multitasking solutions. Only one operating system continues to provide unbeatable multiuser solutions for over 150,000 users. PC-MOS from The Software Link. Call today and set your computing sights on a more productive horizon.

THE SOFTWARE LINK
1-800-766-LINK
3577 Parkway Lane, Norcross, GA 30092
(404) 448-5465 FAX: (404) 263-6474 TELEX: 4996147 SWLINK

VARS and RESELLERS:
Ask about our Sales Support Program
GSA Schedule/GSOOK 90 AGS6448

Circle 152 on Inquiry Card (RESELLERS: 153).

Our New DMP™-160 Seri of Four Plotters, a Sca

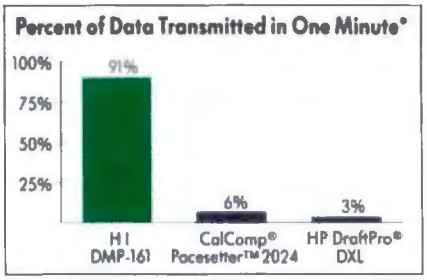
Never before has one family of plotters done so much, so fast, and so well.

The new Houston Instrument DMP-160 Series Plotters are here. Now you can send four plots or more

to a DMP-160 Series Plotter in the time it takes to send just one to other plotters. The DMP-162R is the only plotter at its price that delivers unattended plotting during the busy workday—or late into the night. And all DMP-160 Series Plotters can be converted into sophisticated wide-format scanners. In less than sixty seconds.

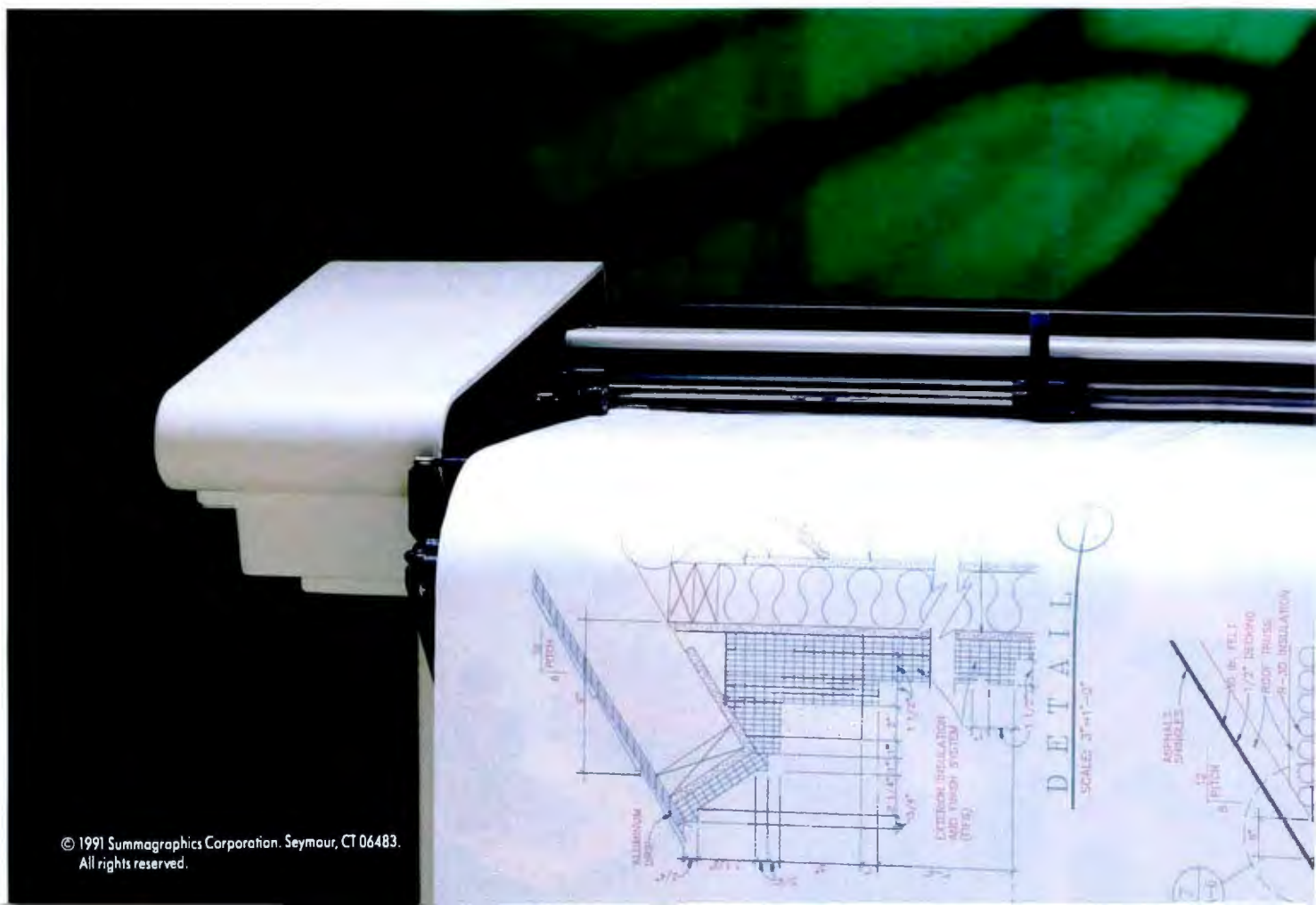
Now One Plotter Does the Work of Four.

Compare our new series to anything else in their category. You'll find our D- and E-size plotters are the only ones that include the new, highly compact HP-GL/2 plot language and 512K standard memory. That's the equivalent of 2 MB on other plotters—or four times the memory at one-fourth the cost. And they're



* Using CADalyst's test drawing (4775.DWG) on a Compaq® 386/16MHz. Platters were set to manufacturer's recommended settings

the only ones that can be expanded to 4 MB, or the equivalent of 16 MB! So instead of tying up you and your computer during long or multiple plots, our new plotters release your equipment fifteen to thirty times faster than the competition.



es Plotters Do the Work nner and a Night Shift.

Increased AutoCAD® Productivity. These new plotters arrive AutoCAD ready with ADI® drivers which allow you to harness and use the full productivity features of the DMP-160 Series.

Set-It-and-Forget-It Unattended Plotting.

Our DMP-162R E-size plotter comes with 1 MB of memory and an automatic rollfeed and cutter system for hours of unattended plotting—ideal for network, multi-user or heavy plotting requirements. This workhorse does it all: Configures your plotter directly from your PC or Macintosh® with our Hot-To-Plot™ programs. Stores up to four different user configurations. Uses a pen grouping feature for up to eight times the pen life. And cuts and gathers plots in a catch-basket for immediate access—no waiting for a batch of plots to be finished. Just load a 150' roll of D- or E-size paper, push a few buttons and go back to work. Or go home.

Turn Your Plotter Into a Scanner.

Only Houston Instrument offers the optional SCAN-CAD™ accessory and software that allows a DMP-160 Plotter to double as an affordable, large format scanner. That in itself

saves 80% of the cost, and all of the floor space, of a stand-alone scanner.

Every Decision Should Be This Easy™.

See the new DMP-160 Series today. And find out what it's like to go home early at night. For information, or the dealer in your area, contact Houston Instrument at 1-800-444-3425.

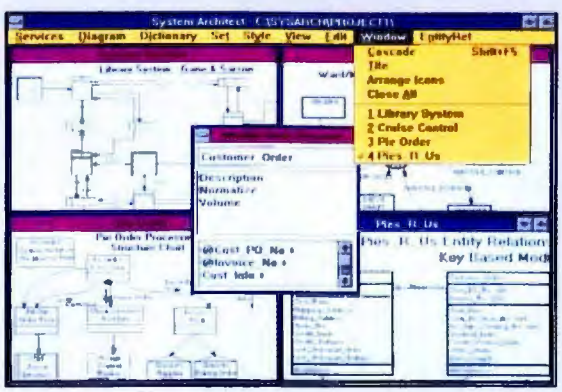
HOUSTON INSTRUMENT®
A Summagraphics Company

For IBM/Compatible information, circle 69; For MAC information, circle 70; For Reseller information, circle 71 on Inquiry Card.

System Architect has the power to handle your most complex applications. And it's so easy to use, even beginners will be productive in no time.

Use such methodologies as DeMarco/Yourdon, Gane & Sarson, Ward & Mellor (real-time), Entity Relation diagrams, Decomposition diagrams, Object Oriented Design (optional), State Transition diagrams, & Flow Charts.

Create an integrated data dictionary/encyclopedia, and get multi-user support both with and without a network.



Take advantage of such advanced features as:

- Normalization
- Requirements Traceability
- Import/Export Capability
- Extendable Data Dictionary
- Rules & Balancing
- Network Version
- Custom Reporting
- Auto Leveling

Rely on a proven CASE product. System Architect has received rave reviews from the press and users. IEEE Software Magazine called System Architect "a useful, well-planned, affordable CASE tool." CASE Trends found System Architect "to be extremely easy to use. . . . with many features that are completely lacking in higher priced competitors." Toshiba found that "System Architect stood out from many other prospects because it had the best core technology." System Builder called System Architect "truly a price/performance leader."

Work in the Windows 3.0 environment, or OS/2 Presentation Manager (call for availability), and count on context-sensitive help.

For today's price/performance leader, call:
Italy: 39-49-8700366
Germany: 49-(0)6151-82077
Sweden: 46-8-(0)626-8100
Netherlands: 31-(0)3406-65530
England: 44-(0)926-881186
Elsewhere: 1(212)571-3434

POPKIN
Software & Systems Inc.
11 Park Place, NY, NY 10007
Tel: (212) 571-3434
Fax: (212) 571-3436

MICROSOFT WINDOWS

SystemArchitect™

Supporting IBM's AD/Cycle

Circle 127 on Inquiry Card.

The Future of Software Technology

A cross section of viewpoints on program development reveals some common and some diverse themes

BARRY NANCE

Software technology is getting more complicated. Developers have to hack through a jungle of computer languages, operating environments, user interfaces, and shifting standards to choose how they'll create their software. It's not an easy job. Software purchasers will have to live with the result for years to come. Which advances in software technology will prevail? Which ones will be just a flash in the pan?

I chose a cross section of well-known developers and asked each to talk about current and future trends in software technology. The following dialogue reveals some common and some diverse themes.

In general, do you think software purchasers are getting what they need? What should developers be doing differently to give purchasers a better product?

David Nanian: I don't think that software purchasers are getting the technical support they need. While the products are getting more and more complex, and in many ways more and more expensive, it seems that support is starting to be thought of as an additional business opportunity.

Products are, in many major categories, largely feature-complete. There's just not a whole lot of additional stuff to do. Because of this, we may be entering a new, more exciting arena—one where the approach is rethought, rather than just adding a new function or feature. Lotus Improv on the Next [computer] is a good example of this type of product.

Michael Geary: Applications are getting too big, and they try to do too much. Versatile and powerful, yes; but overwhelming. I think what we need are simple little programs that are easy to understand and use, and that work together to accomplish more complex tasks.

Patrick Wood: Software vendors think the purchasers are [getting what they want]; purchasers often aren't. In general, I think people are getting what they want—there's a lot of creative stuff being done with paint software, word processors, DTP [desktop publishing] systems, and the like. Do the users want more? Of course! The computer is an incredible tool, and any software that makes it easier/faster/more creative/cost-effective will be in demand.

Terje Mathisen: I would like to see more building-block-type software, with easy integration between different apps and user-specified links between them—something like all the best features of HP's NewWave, Microsoft's Object Linking and Embedding, and Remote Procedure Calls joined together seamlessly. This would probably depend on a very object-oriented API from the OS.

Tom Thompson: If the user's needs fit the off-the-shelf application, they are [getting what they want]. (Specialized software should be written in-house for businesses.) Developers should add features that the customer needs, not what they think [customers] want. Some effort should be done to get feedback from the

GORDON LETWIN
Chief architect of MS/DOS and OS/2

users before making an upgrade so that the proper features are added.

Walter Bright: Purchasers' needs seem to always outstrip the capability of the available software by a constant time frame of six to 12 months.

Would you characterize most PC software users as sophisticated, repeat buyers or first-time buyers? What effect does this have on software developers?

Nanlan: No, I don't think that most PC users are sophisticated—far from it. Although compared to users on other systems, they are more tolerant of faulty design.

Geary: I think that the vast majority of software users are barely able to cope with the programs they are using. They probably use only 10 percent of the features in any given application. Having found it so hard to use the software they are now using, they are afraid to try anything new.

New software will be bigger, more complicated, overwhelming. It'll be oriented to corporate workgroups and MIS control instead of liberating individual computer users, as was the promise of the personal computer.

Wood: Both. There are new users coming on board every day. I think most *major* purchases are done by repeat buyers. For example, most first-timers won't pay $500 for PageMaker (or whatever it costs these days), but with Windows bundled with most PCs, every new user is "buying" something.

Mathisen: I don't know about the single-user community, but in a large company like Norsk Hydro, the buyers are definitely in the sophisticated category.

Thompson: Most are repeat buyers, unless the purchase is a unique program like a CAD/CAM application. Even for repeat, volume buyers, GUIs are a win, because the consistency between each program interface makes it easier to learn and remember. Developers should write to a GUI and stick to the guidelines.

Bright: About half and half. This makes it very tricky for a developer, as the needs of the two groups are quite different.

Is there a shift from off-the-shelf software to in-house-developed (corporate) software? Does this affect how software is written?

Nanlan: In some arenas, yes. I think that's mostly due to the fact that many of the major packages aren't sufficiently customizable. Clearly, you need to write a flexible package as well as one that has a lot of functionality.

Gordon Letwin: I can't speak authoritatively on this marketing question, but I'd guess that it's going away from internal development. Software development is always a difficult and disappointing task; as commercial packages become more sophisticated, in-house development seems less and less practical. How many equipment companies build their own electric motors? As the commercial products become better, it's harder and harder to justify a "make" decision over a "buy" one.

Bright: There will always be a large market for both standardized off-the-shelf software and for custom work. I don't see the ratio changing.

Purchasers' needs seem to always outstrip the capability of the available software by a constant time frame of six to 12 months.

WALTER BRIGHT
Principal of Zortech, maker of Zortech C++

Wood: For office software, yes, I believe this is true. I think that it affects how software is marketed more than how it is written: Larger corporations are interested in buying source [code], customizing it, and self-supporting the resulting product.

Mathisen: Both: More off-the-shelf software is bought each year, while at the same time, more "glue" software is written in-house to integrate everything.

Thompson: Where an off-the-shelf application doesn't fit a particular need, an in-house program will be written. What this really means is that there will be a growing market for development tools and GUI libraries.

Will the Common User Access (CUA) part of Systems Application Architecture (SAA) catch on as a user-interface standard?

Nanlan: I hope not. It's just not a very good standard,

although any standard is better than *no* standard.

Geary: Yes, it already has. But "standard?" Everyone messes it up. Consider Borland's C++. It tries to be CUA, but they got the Minimize and Maximize icons reversed! (They did Max/Min instead of Min/Max, like it's supposed to be.) And instead of Control-Home going to the top of a document and Control-PageUp to the top of a window, those are reversed to the antique DOS standard of Control-Home being top of window and Control-PageUp [being] top of document.

PATRICK WOOD
Coauthor of several books

Bright: Yes. Just like the controls on a car are roughly standardized.

Wood: Bah, humbug. MAP has more of a chance than SAA. Once again, this only affects the big, corporate user.

Mathisen: It probably will, because of IBM's backing.

Thompson: For an IBM house, yes. But for Unix and a mixed environment, other GUIs will pervade. It depends on how effectively digital video is integrated into computers and whether video-style applications will truly address a need. (Do I really need to *see* the person I'm talking to?)

Will text-mode applications still be developed, or will everything eventually run under a GUI?

Nanian: A "graphical" command-line tool is not very useful. Even on the Macintosh, certain segments of the community run command-line applications (e.g., their programming environment). But that command line may run within a graphical environment.

Geary: Text-mode apps will still be developed, but they will look a lot like the GUI apps. At least this gives some user-interface consistency.

Bright: Text-mode apps will continue, but they will probably reside in a text window inside a GUI. Text apps are so simple compared to GUI apps. They are well suited to one-time programs.

Letwin: Yes and no. The cost of a GUI gets proportionately lower. Eventually, standardization pressures will eliminate the non-GUI low end.

No GUI app is forced to take advantage of the GUI environment. There are still TTY-style interfaces around, here and there. These applications run on CRTs, even though they don't use full-screen capabilities.

Writing a character-mode full-screen application is a hassle. You've got to play games with the character set to get nice boxes; you've got to compute and keep track of your screen size; the work is tremendous. A good GUI does all of this for you.

Wood: Text mode will be developed—there's still a huge installed base of non-windows systems—but the market will be the lower-end home users and small offices. Over the next five to 10 years, text mode will go the way of the dinosaur. It will not happen overnight.

Mathisen: Text mode will stay, maybe in separate windows. Most business applications are basically "fill-in-the-forms" types of programs, which don't need GUIs.

Thompson: GUIs will grow, because today's growth in computer sales practically demands this. There will still be text-mode applications, especially for development or batch-style environments.

Will multimedia have any serious effect on the software marketplace? Do you think you'll do some multimedia programming in the near future?

Nanian: I don't know—but I don't expect to be doing any multimedia programming. It's nice, though, to be able to combine text, graphics, and sound in a mail message on the Next. If that's what you mean by "multimedia," it's great. But the "multimedia solution" touted by many isn't, in my opinion, very useful. Personally, I prefer books.

Bright: Not till the hardware price drops drastically.

Geary: I don't know what effect it will have, but I'd like to do some. Sounds like fun! But is it part of the trend to bigger, more complex software that individual programmers can't write and individual users can't use?

Wood: Maybe. I think the jury is still out on multimedia, regardless of what Jobs [and] Gates (et al.) say. It's a technology looking for a market right now. Most users don't have access to the technology to make multimedia work for them. It takes more than a Mac and a LaserWriter to do multimedia, much unlike the desktop publishing revolution that all the vendors point at as the model for making MM happen. Will I program for multimedia? No.

Mathisen: Not for day-to-day running of big companies, but maybe for presentations, visual effects, and PR. It will take many years, if ever, before this is a mainstream application.

Thompson: Multimedia is having a serious effect on the market now, but probably for all the wrong reasons. There will be a marketplace for multimedia, but it won't be as large as DTP, since a lot more expertise is required to storyboard an idea and fit information into a tightly timed sequence. That takes more skill that any DTP layout requires. No multimedia programming for me in the near future, because I don't think the hardware's there yet.

continued

TOM THOMPSON
BYTE senior technical editor at large

Do you think developers are paying more attention to making software LAN-aware?

Nanian: I think they're doing so now.

Geary: Probably. I don't have a lot of personal interest in this area; I'm more interested in developing software for individuals rather than groups.

Bright: No serious app on the market today can exist without being network compatible.

Mathisen: Most already do, I hope!

Thompson: This issue is already being forced by Apple's System 7.0. A System 7.0–savvy application can request processing resources from another application. New products that ignore the ability to "augment themselves over a network" won't survive.

Do you see a shift toward mission-critical, distributed-processing systems on PCs replacing mainframe software (i.e., "downsizing")?

Wood: Yes, but not on distributed PCs. PCs will become powerful enough to handle transaction processing–type jobs by themselves. I see multiprocessor PCs running in shadow mode with shadow disk drives for mission-critical jobs. It's starting to happen. Take a look in any digital-switching office. A #5 Electronic Switching System is just an AT&T 3B20 computer in a big frame. Not much more smarts than a 32-bit PC or Unix system.

TERJE MATHISEN
Develops PC software for Norsk Hydro

Mathisen: Absolutely! *Client-server* and *RPC* are *the* buzzwords here this year. When the price/performance ratio between 3090s and RS/6000s is so incredibly high, even the accountants get interested.

Bright: Yes. I definitely think that the future is networked workstations.

DAVID NANIAN
One of Brief's authors

Letwin: The only thing keeping midsize mainframes alive is the software compatibility issue, plus tradition and inertia on the part of corporate MIS. Micros will continue to eat at the mainframe market from the bottom up. The process is retarded by some human and technical factors, but it's an inevitable trend. And it's one that will be accelerated as networking improves.

Note that, in the past, many micro software products were just mainframe products redone for small environments. As such, people knew what a compiler or an operating system was supposed to look like. The first versions of these products, on micros, were already mature. Distributed data and software processing are brand new, and it takes time and generations of products for even the smartest people to feel their way. Look at version 1.0 of any product you admire today—software, cars, telephones, anything—and you'll laugh.

Thompson: PCs aren't as reliable as mainframes. You'll need mainframes that hold sensitive material, with controlled access, for some time to come.

Will programmers need OOP [object-oriented programming] skills in the future?

Nanian: OOP techniques are crucial to the development of more complex, structured programs and also important to new, more complex environments. They are not yet exploited well on the PC, but they are very well handled on the Next.

Geary: Yes, but I think a lot of the OOP people are living in fantasyland. They are making up terminology no one can understand. The book *Doublespeak* could use a new chapter on OOP. A friend of mine who has done a lot of C++ programming but hasn't forgotten how to program said, "I finally realized that when I can't figure out what the OOP gurus are talking about, it's probably because what they're saying really doesn't make any sense."

Mathisen: Yes, at Norsk Hydro, we started to use OOP for production software development two years ago.

Thompson: The complexity of GUIs will require OOP to handle the application's front-end, while the programmer writes the relevant function code.

Should developers be familiar with multiple programming languages?

Nanian: It's not that important at the moment. C [and] C++ are pretty dominant.

Geary: Definitely. Programmers should be comfortable in assembly, no matter what high-level tools they are using. Programmers should start using "tool" languages like AWK and PERL. People seem to love making fun of AWK. I think it's because they're set in their ways and afraid of trying something new. Also, programmers shouldn't hesitate to make up a minilanguage customized for the application when it's appropriate.

Mathisen: Maybe? Some will need it; others will write everything in C++. Personally, I like to understand my CPU to the bare metal, and that includes ASM programming and knowledge of cycle counts, op-code lengths, and what code will be generated by the different compilers I use.

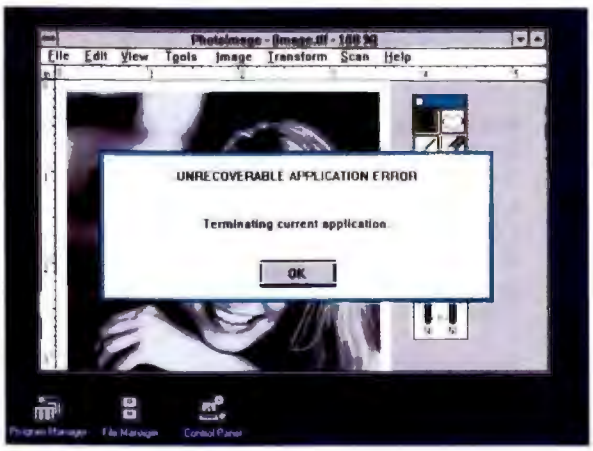
Thompson: For [a person's] resumé, this sounds good. Whether or not programmers of the future will actually use a smattering of languages is another matter. It's probably safer to standardize on one language.

Should developers be familiar with multiple operating systems?

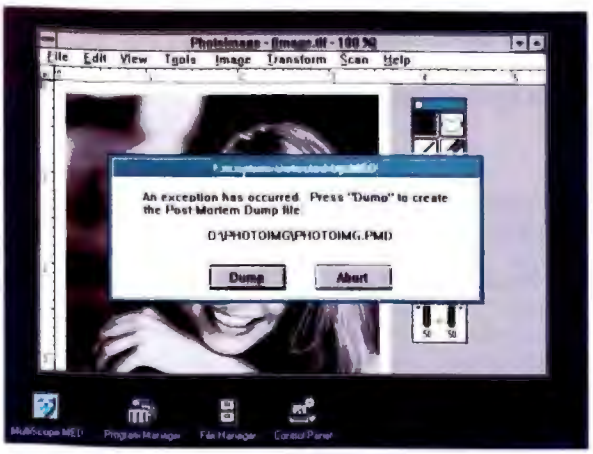
Nanian: As the market begins to fragment more and more, the answer

xperiencing "Unrecoverable Application Errors"?
Don't Fear...
MultiScope Crash Analyzer is Here!

Without the MultiScope Debuggers for Windows:



With the MultiScope MED (Monitor Execution and Dump) and Crash Analyzer tools:



MULTISCOPE DEBUGGERS FOR WINDOWS

MultiScope Debuggers for Windows provide the MultiScope Windows Run-Time Debugger, and the Crash Analyzer System (MED and the Crash Analyzer) for an introductory price of $379

For more information, call MultiScope Sales at (800) 999-8846

Available from EGGHEAD discount SOFTWARE

MULTISCOPE

415 968 4892 PHONE
415 968 4622 FAX

Circle 98 on Inquiry Card.

becomes pretty clear. While a presence in DOS is important, it's difficult to get significant market share, because it's very crowded. Having your application run on many OSes makes this less of a problem.

Mathisen: Yes, distributed programming and RPC need people who can understand both ends of a connection. This *might* change as the tools get better and more standardized.

Thompson: It helps; but in most cases, a big organization will hire consultants and programmers with expertise in a particular OS to do a port.

Will skills in Windows/Presentation Manager programming techniques (message queues) be useful?

Geary: Definitely. Learn to write programs where the user is in control, instead of the program. Learn the philosophy behind this kind of programming—not just the nuts and bolts. Every programmer should read the Apple *Human Interface Guidelines* and Donald Norman's *The Design of Everyday Things*.

Mathisen: Yes, and I believe this type of programming should preferably be done with an OOP language, as all the basic mechanisms are OOP oriented.

Thompson: Apple Macintosh System 7.0 "Publish/Subscribe" and "Apple events" programming paradigms will be important (and useful).

Will developers use CASE more in the future?

Nanian: I hope not, at least not in its current form.

Bright: I'm not sold on CASE. I don't use it.

Geary: Probably, but everyone I know who has tried these tools has gone back to traditional programming methods.

Wood: Depends on the project. For big team projects and mission-critical software, it's quite likely. For smaller (less than 20K lines of code), no.

Thompson: CASE's reputation is entirely overblown. It's a product looking for a solution. A better answer is OOP.

Which programming languages will be most popular?

Nanian: For now, C++, C, and (hard to believe) COBOL—which is very popular in many companies—will prevail.

Geary: Same as always: COBOL! And of course C, and gradually C++.

Bright: C++, FORTRAN, and COBOL will be prevalent.

Wood: C, C++, Ada, Pascal, and FORTRAN are the languages that programmers are writing code in.

Mathisen: Turbo Pascal, Turbo Pascal for Windows, C++, and maybe a pure OOP language like Actor or Smalltalk for prototyping will be popular.

Thompson: I think the answer is C or C++.

Should developers design and code for Unix, DOS, OS/2, or all three—or for something else entirely?

Nanian: Depends on the product, really.

MICHAEL GEARY
Known for his work on SQL Windows

Geary: Maybe people should code for XVT so they can run on all three and Macintosh, too. (The XVT toolkit, from Marc Rochkind's Advanced Programming Institute in Boulder, Colorado, is a C library that lets you write applications that are portable between the Macintosh, Microsoft Windows, OS/2 Presentation Manager, and the X Window System.)

Bright: All three. You should never bet on any single platform.

Wood: Unix—yes. DOS—yes. Windows/DOS—absolutely. OS/2—who cares?

Mathisen: Depends. Commercial programs for the mass market should probably be written directly for the target OS, using all possible tricks to get maximum performance, while in-house programming could probably use a higher level of abstraction to facilitate porting between different OSes.

Thompson: Macintosh!

Will programmers begin to rely on source code generator tools, or will "doing it by hand" still be the custom?

Nanian: Source code generation, no. Interface generation (e.g., Interface Builder on the Next), probably. Object library built into the operating system, yes.

Interface Builder is a terrific program on the Next [and] handles the vast majority of the "stuff" you have to deal with to program the interface on a graphical system. Since the interface objects themselves are built into the Next system, you need only use Interface Builder to drop a few of them into your program, "connect" them to controls (most of which are handled completely by the system), and link.

Bright: Hand coding will always be where the professionals work.

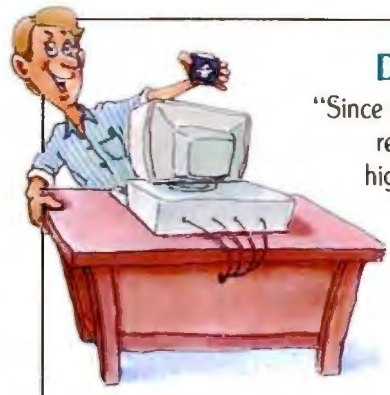
Geary: Corporate programmers will probably use source generator tools; the shrink-wrapped apps will be written by hand.

Letwin: Source code generators will be one of the tools used more and more in the future. As machines become more powerful and RAM cheaper, you can waste more time and space for a given program. So the goal is to always write the program as fast as you can, as long as you stay within the requirements for speed and memory usage.

The methodology you use depends strictly on the limits called out in the requirements. I use Excel as a "programming language" to do certain operations that I'll only do a handful of times. I don't care how much RAM Excel needs; and I don't care if the program takes ½ second or 1/100 second. I got my answer in short order without even having to write a C program.

There are always tasks that push the speed/memory envelope and need to be written efficiently. Some things—like floating-point emulators and OS kernels—need to be written in ASM. Today, C is fast enough for most software

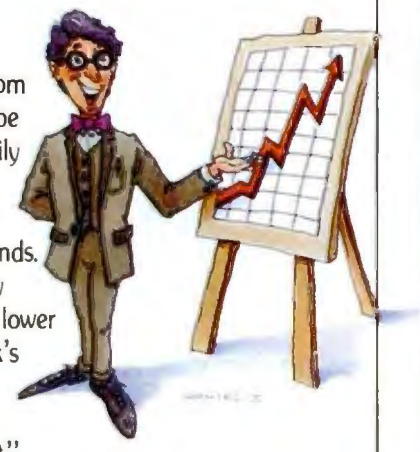
WHY SOFTWARE COMPANIES ARE CHOOSING HARDLOCK™



Developers Say. . .

"Since the Hardlock uses an algorithmic response chip, I am assured of the highest level of protection. Also, the optional programmable memory means I can keep custom configurations in Hardlock rather than in a file. I can protect my .EXE or .COM files directly and/or incorporate Glenco's high level language interface routines into my software. And, I feel confident I'll have Glenco's support if I use other programming languages."

Accountants Say. . .



"Hardlock provides our company with a healthier bottom line. Since our software can't be copied, our revenue has steadily increased. The unique programming board allows us to program the Hardlock in seconds. This ensures optimum delivery schedules from Glenco and a lower inventory cost for us. Hardlock's field programmable feature means a single Hardlock can protect more than one product."

Actual size shown

Hardlock — programmable, algorithmic response and memory option — all in one

End Users Say. . .

"Hardlock allows me to backup my software investment. I just plugged Hardlock into the printer card, connected the printer cable, and forgot about it. Since Hardlock doesn't require a battery, I am assured of reliability and no down time.

HARDLOCK™ The Preferred Protection System!

1-800-562-2543

GLENCO ENGINEERING INC.

SERVING THE SOFTWARE INDUSTRY SINCE 1979

270 Lexington Drive
Buffalo Grove, Illinois 60089-6930
(708) 808-0300 FAX 808-0313
1-800-562-2543

H A R D L O C K

For a distributor in Europe contact, FAST Electronic GmbH 49-89-539800-20 FAX 49-89-539800-40

For International information circle 60, For End-User information circle 61 on Inquiry Card.

products.

A program like FORMAT.COM, or even CHDIR, could be written in practically any methodology that you care to name, and it would still be fast and small enough.

Mathisen: I *might* use code generators for repetitive type of coding, but this is an area handled better by the reuse of objects.

Thompson: A small shop might use a source code generator, but most developers will use a set of customized, optimized routines and libraries that are made by hand.

What programming tools do you expect to use over the next few years?

Nanian: Compilers, editors, debuggers, profilers, source code control systems, interface builders, object libraries. Specifically? Hard to say, really. Depends on what's available.

Geary: Same old stuff I've been using, probably. C++ instead of C, if I can get past the jargon and remember how to write programs. More of my own little tools written in AWK or PERL. More customizing in the editor. I never did get the hang of writing macros in Brief, though. (Sorry, David!)

Maybe someday I'll get to write applications in a truly interactive language—like I used to do 18 years ago at Tymshare.

Wood: C, C++, Unix, source debuggers under Unix, Borland C++ (and related source debuggers), whatever Windows app generators happen to be in vogue when I get stuck with a Windows project. Lint, GNU tools. Profilers. We're not likely to use CASE in the foreseeable future, even though we support more than 50K lines of code. I just don't see us starting from a clean code base in the near term.

Mathisen: Some prototyping tools, alternate compilers with better optimization, prototyping languages like Actor.

Thompson: Debuggers, editors, resource editors, code profilers, memory watchers (monitors), C compilers.

What's It All Mean?

I've saved my own comments for last. I feel fortunate to be able to look at what these developers have had to say and see some patterns that will fundamentally influence software over the next several years.

Some things are crystal clear. Whether you are a developer of software or a purchaser of software, a GUI is in your future, and it will likely be SAA/CUA compliant. Your computer will be networked with others in the office if it is not already. The concept of *downsizing* is putting the brakes on mainframe growth. You may not understand all the buzzwords that go along with OOP, but OOP is here to stay.

By this time next year, multimedia and Coleco's ADAM computer may share a common trait: obscurity. CASE may be shunned in favor of the do-it-by-hand methodology. But you'll see software products ported to many environments—DOS, Unix, OS/2, and the Mac. As I said, life is getting complicated. ■

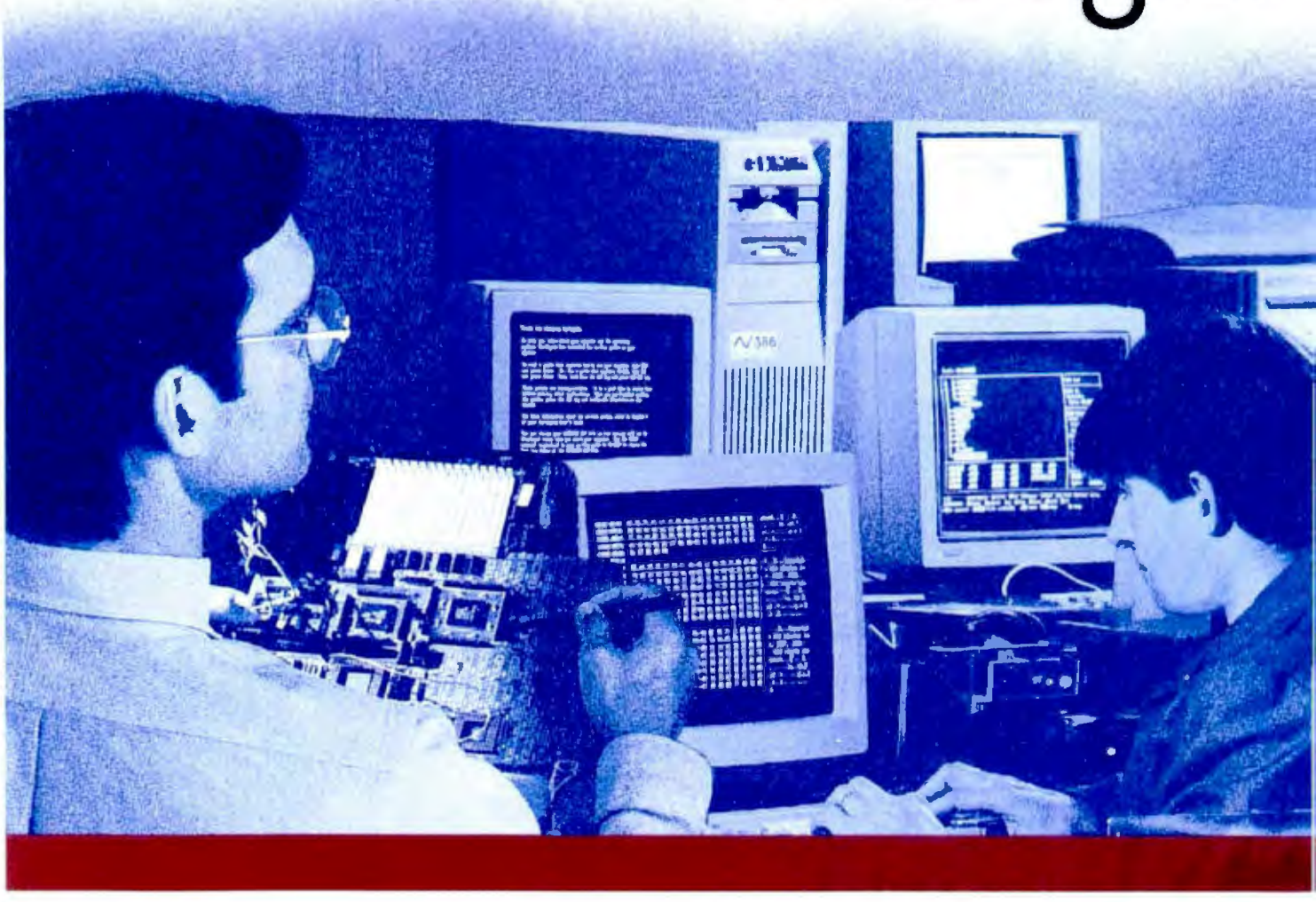
PARTICIPANTS

- ***David Nanian** is one of the authors of Brief, a popular programmer's text editor from Solution Systems.*
- ***Michael Geary** is best known for his work on SQL Windows, a product from Gupta Technologies, and Adobe Type Manager (ATM) from Adobe.*
- ***Patrick Wood** is coauthor of several books, including* UNIX System Security *(Howard W. Sams & Co., 1985) and* UNIX System Networking *(Howard W. Sams & Co., 1989), and is familiar with Unix, PostScript, and desktop publishing.*
- ***Terje Mathisen** develops PC software for Norsk Hydro, the largest company in Norway.*
- ***Tom Thompson** is a BYTE senior technical editor at large and an expert in Apple Macintosh technology.*
- ***Walter Bright** is an expert in object-oriented compiler technology and a principal of Zortech, maker of Zortech C++.*
- ***Gordon Letwin** of Microsoft is a chief architect of MS/DOS and OS/2.*

Barry Nance does R&D and technical support work for Insurance Software Systems, a software development company in Hartford, Connecticut. He also is the author of Network Programming in C *(Que Publishing, 1990) and is the IBM Exchange editor on BIX, where you can reach him as "barryn."*

Why Is Northgate® Going Public With Confidential Information?

To Illustrate The Northgate



Take a behind-the-scenes look at Northgate quality.

It's no secret that Northgate makes some of today's finest computer systems. A room full of awards from major industry publications is proof of that. But the tour you're about to take will show you *how* Northgate achieved its worldwide reputation for quality.

The reason we're "going public" with this information is simple. People who already own a Northgate system know from experience that we make no compromises on quality. Now we want the rest of the world to know about the qualities that made Northgate a leading direct marketer of high-quality systems.

Complete line of systems.

- Latest technology. The Northgate systems you buy today won't become obsolete tomorrow.
- Complete product line. From lightweight notebooks to giant network file servers, Northgate makes a complete range of computers to handle every business application. Our newest products include low-priced 386SX,™ 386 and 486™ systems.
- Award-winning performance. Our most recent triumphs include *InfoWorld* and *BYTE* magazines' "Desktop Computer of the Year" awards. Seven *PC Magazine* Editors' Choice awards, eight *Computer Shopper* Best Buy and three other *InfoWorld* recognitions are added proof of Northgate quality.
- Customized, ready-to-run systems. Northgate custom configures every system to meet your specific requirements. We'll even rack mount or hard case your systems.
- Finest components. We test and use components from only the best manufacturers to ensure peak performance and reliability.
- Flawless software compatibility. Our systems are fully compatible with MS-DOS,® OS/2,® Novell® and other operating systems.
- Product testing and burn-in ensures your system will work perfectly from day one.
- All systems are FCC Class B Certified for home and office use.

Network solutions.

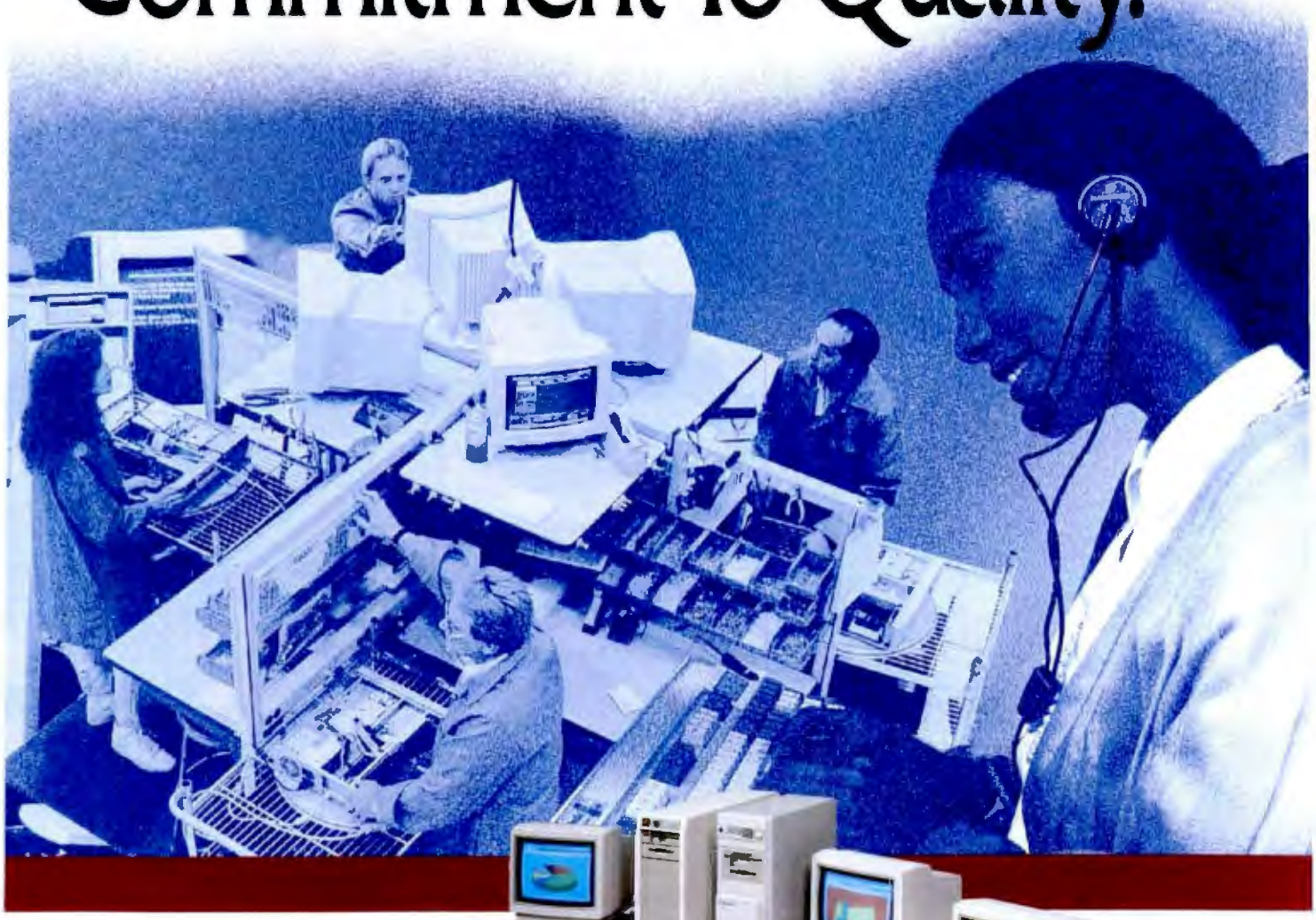
- Northgate LAN specialists are uniquely qualified to configure and install high quality products that provide a solid foundation for networking.

Novell Gold Authorized Reseller

- Novell Certified Gold Dealer. We certify and test all products to work perfectly with Novell as well as OS/2, SCO/UNIX® and Banyan® Vines. And our staff of Certified NetWare® Engineers will help keep your LAN operating at peak efficiency.

Circle 107 on Inquiry Card.

Commitment To Quality.



Customer service and support ensures your complete satisfaction.

- 24-hour toll-free technical support 365 days a year, for as long as you own your system.
- Free year of on-site service provided by NCR® Your complete satisfaction is our commitment. If necessary, we'll even send a skilled technician to your home or office.
- Free overnight shipment of replacement parts to minimize computer downtime.
- 30-day money-back guarantee safeguards your purchase decision.
- Full parts and labor warranties — 1 year on systems, 5 years on keyboards.
- Customized service and support plans for corporate customers. Whatever you need in the way of service, Northgate delivers. We offer a variety of customized service options including disaster recovery planning.

Affordable quality is yours with Northgate.

- Low Factory-Direct Prices.
- GSA/Government and VAR discounts.
- Leasing plans with low monthly installments and flexible terms up to five years.
- 100% financing with Northgate's Big 'N' Card. We can usually set up your account the same day you call.
- Other convenient payment options include MasterCard, VISA, American Express and Discover cards, wire transfers, personal and corporate checks, Corporate Purchase Orders and C.O.D.

Our promise: no compromises.

As you're about to see, our reputation for quality is built on a solid foundation of superior design, engineering, manufacturing, and service.

Turn the page to begin your tour of Northgate.

CALL TOLL-FREE 800-345-8709

NORTHGATE COMPUTER SYSTEMS, INC.

"Smart Tools For Business"™

7075 Flying Cloud Drive, Eden Prairie, MN 55344

See Us At Fall Comdex
Booth #S2286
At The Sands

Circle 107 on Inquiry Card.

Quality Through Engineering

Manufacturing high-performance, quality systems takes more than just a top-notch Research and Development team. It requires a strategic alliance with the industry's premier component vendors. To meet our rigid standards, Northgate engineers work in tandem with our suppliers to design a full range of components. Then, they test hundreds of configurations to find the optimum combination of performance and reliability.

Throughout the entire vendor relationship, Northgate uses sophisticated failure analysis techniques (including microphotography) and statistical process control methods to ensure our suppliers consistently produce high quality componentry.

New Northgate 386 and 486™ Systems

Northgate 386SX™/16 or 20

- Intel® 80386SX/16 or 20 MHz Processor
- 1MB RAM (Expands to 16MB)
- 52MB IDE Hard Drive with 17 ms Seek Time
- Five-Bay Case; Three 5.25" and Two 3.5" Bays
- Six 16-Bit Expansion Card Slots
- Choice of 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive
- Exclusive *OmniKey*® Keyboard
- SVGA 800 x 600 Color Monitor
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$1599.00/$1699.00

Northgate 386DX/25 or 33

- Intel 80386/25 or 33 MHz Processor
- 2MB RAM (Expands to 32MB)
- 52MB IDE Hard Drive with 17 ms Seek Time
- 64K Cache
- Choice of 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive
- Six 16-Bit and Two 8-Bit Expansion Card Slots
- Five-Bay Case; Three 5.25" and Two 3.5" Bays
- Exclusive *OmniKey* Keyboard
- SVGA 800 x 600 Color Monitor
- Microsoft® Windows™ 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

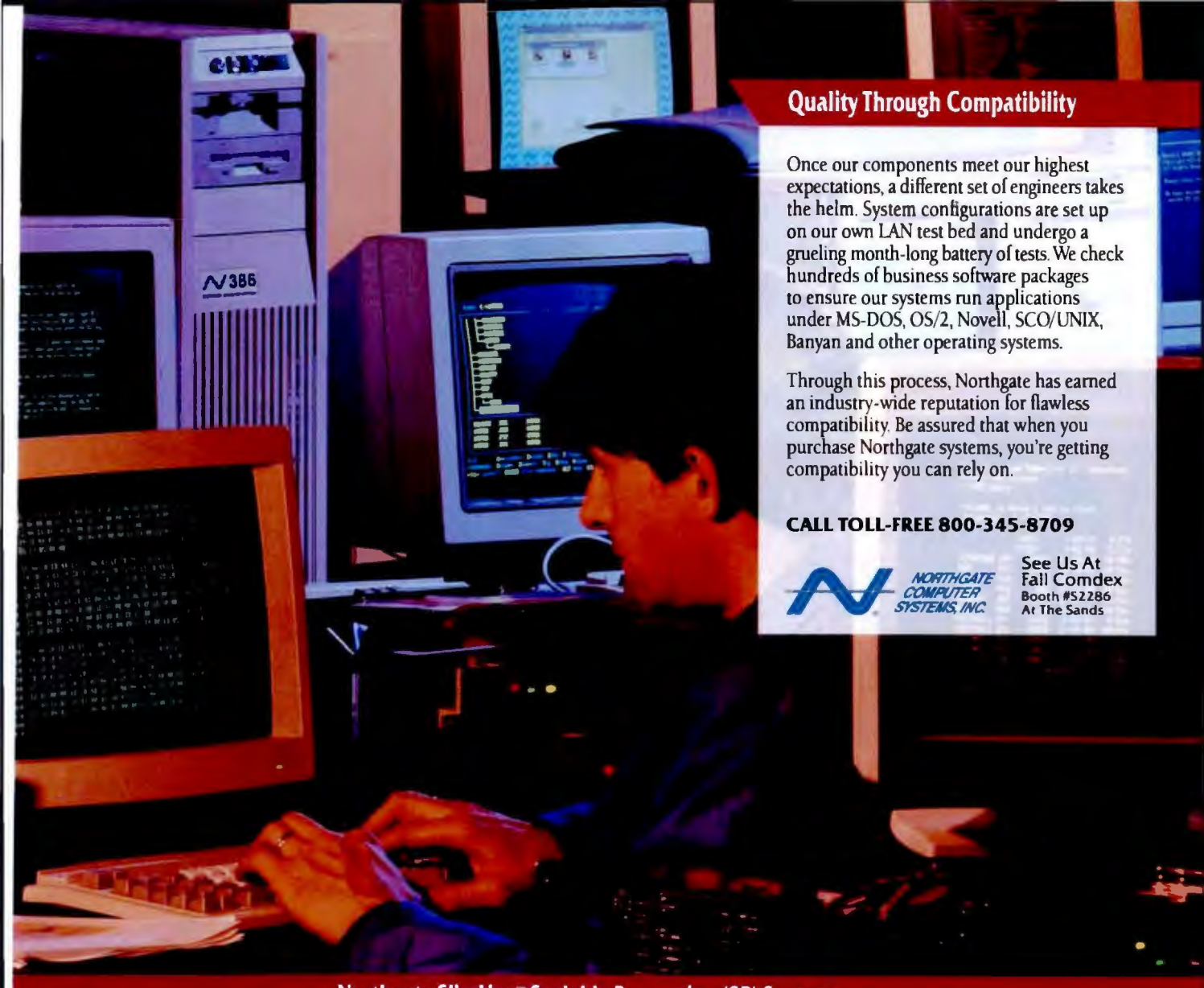
$2099.00/$2199.00

Northgate 486SX/20 or 486DX/33

- Intel 80486SX/20 or 486DX/33 MHz Processor
- 4MB RAM (Expands to 32MB)
- 52MB IDE Hard Drive with 17 ms Seek Time
- 64K Cache
- Choice of 1.2MB 5.25" or 1.44MB 3.5" Floppy Drive
- Six 16-Bit and Two 8-Bit Expansion Card Slots
- Five-Bay Case; Three 5.25" and Two 3.5" Bays
- Exclusive *OmniKey* Keyboard
- SVGA 800 x 600 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$2699.00/$2899.00

Circle 107 on Inquiry Card.



Quality Through Compatibility

Once our components meet our highest expectations, a different set of engineers takes the helm. System configurations are set up on our own LAN test bed and undergo a grueling month-long battery of tests. We check hundreds of business software packages to ensure our systems run applications under MS-DOS, OS/2, Novell, SCO/UNIX, Banyan and other operating systems.

Through this process, Northgate has earned an industry-wide reputation for flawless compatibility. Be assured that when you purchase Northgate systems, you're getting compatibility you can rely on.

CALL TOLL-FREE 800-345-8709

NORTHGATE COMPUTER SYSTEMS, INC.

See Us At Fall Comdex
Booth #S2286
At The Sands

Northgate SlimLine™ Scalable Processing (SP) Systems

Northgate SlimLine SP™ 386/25 or 33

- Intel 80386/25 or 33 MHz Processor on Power Module
- Fast, Affordable Upgrades – Simply Replace Power Module
- 4MB RAM (Expands to 32MB)
- 52MB IDE Hard Drive with 17 ms Seek Time
- 64K Cache Memory
- Continuous Edge Graphics Chip
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$2999.00/$3099.00

Northgate SlimLine SP 486SX/20

- Intel 80486SX/20 MHz Processor on Power Module
- Fast, Affordable Upgrades – Simply Replace Power Module
- 4MB RAM (Expands to 32MB)
- 52MB IDE Hard Drive with 17 ms Seek Time
- 64K Cache Memory
- Continuous Edge Graphics Chip
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$3399.00

Northgate SlimLine SP 486DX/33

- Intel 80486DX/33 MHz Processor on Power Module
- Fast, Affordable Upgrades – Simply Replace Power Module
- 4MB RAM (Expands to 32MB)
- 52MB IDE Hard Drive with 17 ms Seek Time
- 64K Cache Memory
- Continuous Edge Graphics Chip
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$3599.00

Circle 107 on Inquiry Card.

Quality Through Manufacturing

Northgate has studied manufacturing methods and has selected a process that gives the greatest quality and productivity.

Our technicians are skilled in all phases of manufacturing. Working in teams of four, they bring the elements of quality together with craftsmanship that knows no equal. A detailed system of checks and balances ensures strict adherence to our rigid quality control standards. When all is complete, comprehensive burn-in and final testing begin.

Northgate Elegance™ Scalable Processing (SP) Systems

Northgate Elegance SP™ 386/25 or 33

- Intel 80386/25 or 33 MHz Processor on Power Module
- Fast, Affordable Upgrades – Simply Replace Power Module
- 4MB RAM (Expands to 32MB)
- 106MB IDE Hard Drive with 19 ms Seek Time
- 64K Cache Memory
- Desktop Case
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$3299.00/$3399.00

Northgate Elegance SP 486SX/20

- Intel 80486SX/20 MHz Processor on Power Module
- Fast, Affordable Upgrades – Simply Replace Power Module
- 4MB RAM (Expands to 32MB)
- 106MB IDE Hard Drive with 19 ms Seek Time
- 64K Cache Memory
- Desktop Case
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

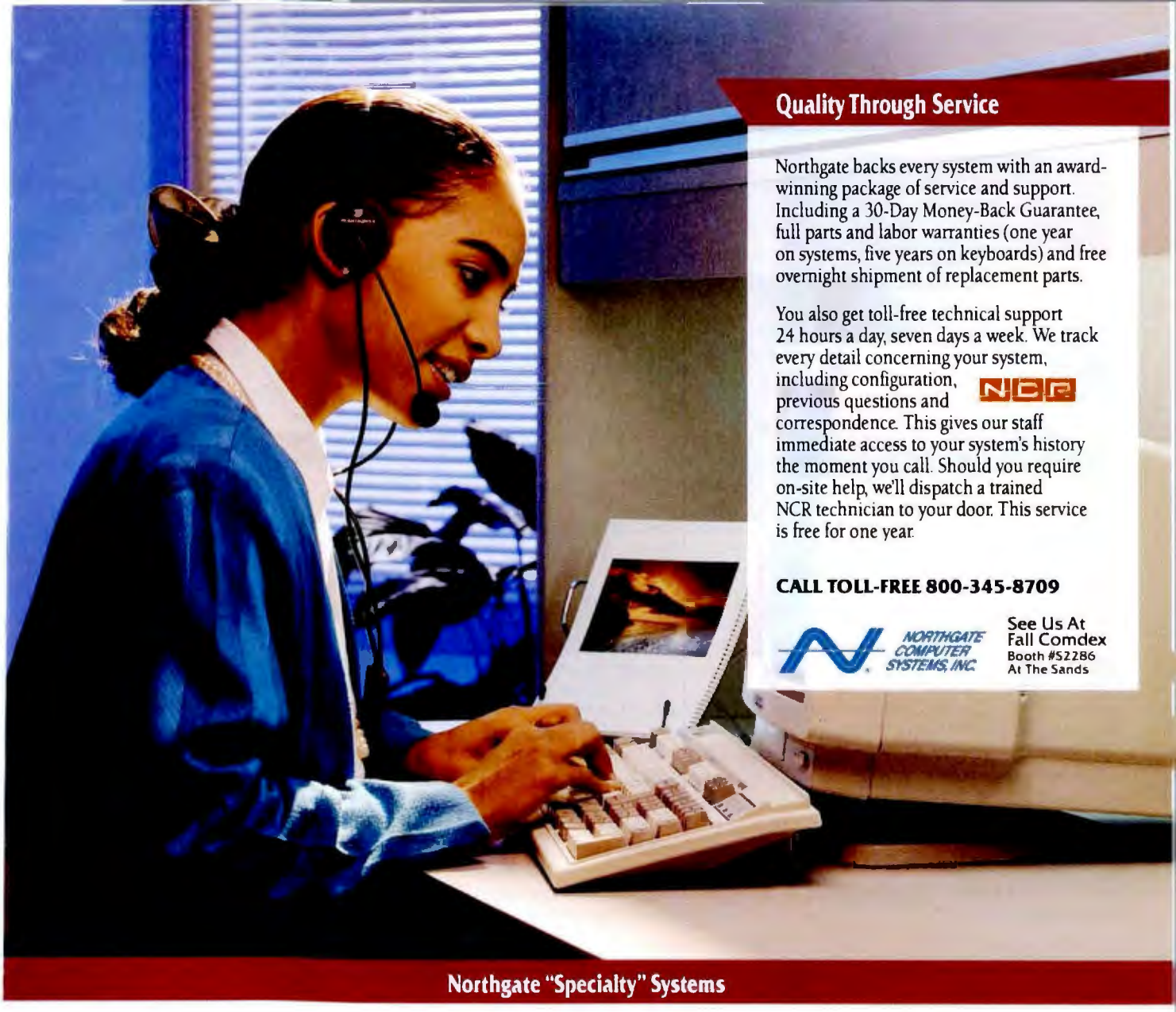
$3699.00

Northgate Elegance SP 486DX/33

- Intel 80486DX/33 MHz Processor on Power Module
- Fast, Affordable Upgrades – Simply Replace Power Module
- 4MB RAM (Expands to 64MB)
- 106MB IDE Hard Drive with 19 ms Seek Time
- 64K Cache Memory
- Vertical Power Case
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$3999.00

Circle 107 on Inquiry Card.



Quality Through Service

Northgate backs every system with an award-winning package of service and support. Including a 30-Day Money-Back Guarantee, full parts and labor warranties (one year on systems, five years on keyboards) and free overnight shipment of replacement parts.

You also get toll-free technical support 24 hours a day, seven days a week. We track every detail concerning your system, including configuration, previous questions and correspondence. This gives our staff immediate access to your system's history the moment you call. Should you require on-site help, we'll dispatch a trained NCR technician to your door. This service is free for one year.

CALL TOLL-FREE 800-345-8709

NORTHGATE COMPUTER SYSTEMS, INC.

See Us At Fall Comdex
Booth #S2286
At The Sands

Northgate "Specialty" Systems

Northgate Elegance 486/25 or 33 EISA

- Intel 80486/25 or 33 MHz Processor
- 4MB RAM (Expands to 32MB)
- 200MB IDE Hard Drive with 15 ms Seek Time
- 128K Cache Memory
- EISA Bus
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Vertical Power Case
- Exclusive *OmniKey* Keyboard
- SVGA 1024 x 768 Color Monitor
- Microsoft Windows 3.0 and Mouse
- MS-DOS 3.3, 4.01 or 5
- FCC Class B Certified

$4599.00/$5599.00

Northgate SlimLite™ 386SX/20

- Intel 80386SX/20 MHz Processor
- 1MB RAM (Expands to 5MB)
- 40MB Hard Drive
- 1.44MB 3.5" Floppy Drive
- 84-Key Keyboard Emulating 101
- 8.5" LCD Screen Supports 32 Shades of Gray; VGA 640 x 480
- 11.7" x 8.25" x 1.9"; 6.1 Lbs.
- AC Adapter
- Stacker™ Software (Provides up to 80MB of Storage)
- Magic Cursor™ for Windows or No-Squint II™ for DOS
- MS-DOS 4.01 or 5
- FCC Class B Certified

$2799.00

Northgate OmniSystem™

- Dedicated File Server With Intel 80486/25 Processor
- 8MB RAM (Expands to 128MB)
- Dual-Channel Intelligent Disk Subsystem With On-Board 80386 Processor (Expands to 6GB with Five 1.2GB Drives)
- EISA I/O Bus
- High-Speed 100MB/Sec. Memory Bus
- 1.2MB 5.25" and 1.44MB 3.5" Floppy Drives
- Vertical 10-Bay Power Case
- Exclusive *OmniKey* Keyboard
- VGA Monochrome Monitor
- FCC Class B Certified

Call For Pricing

Circle 107 on Inquiry Card.

Quality Custom Configurations

Northgate custom configures every system to meet your most demanding needs. We offer a comprehensive range of top quality components, giving us the capability of tailoring a system over 3,000,000 ways. To find out which is best for you, call one of our Systems Consultants toll free.

Hard Drives
Options include IDE hard drives with capacities of 52MB, 100MB, 200MB or 340MB. Also available are ESDI and SCSI hard drives with capacities as high as 1.2GB. Call for other drive size options.

Memory Expansion
Northgate systems have a variety of memory expansion capabilities. Our Systems Consultants can help you decide how much memory you need for both current and future applications.

Monitors
Northgate offers 12″ VGA monochrome, 14″ monochrome (amber), 14″ VGA monochrome, 14″ VGA color, 16″ VGA color and 19″ VGA color monitors. Resolutions include 640 x 480, 800 x 600, 1024 x 768, and 1280 x 1024. NEC 15″, 17″ and 19″ flat-screen, low-radiation monitors also available.

Math Coprocessors
Speed up processor-intensive business applications with an Intel or Weitek® math coprocessor. A Northgate Systems Consultant can help you select the right one for your system.

Tape Backups
To protect your valuable data, Northgate offers an array of high-speed tape backup devices. Choose internal or external designs in the following capacities: 40/120MB, 80/304MB, 80MB, 150MB, 300MB and 1.3GB.

Communications
Northgate has the right equipment to link your system to other computers or fax machines. Products include internal and external MNP-5 modems in 2400 and 9600 baud speeds. Also available is Northgate FaxIt for Windows, a revolutionary fax card designed to work from within your Microsoft Windows applications.

Printers
The best thing to have beside your computer is a printer from Northgate. Printer options include low-cost 9-pin and 24-pin dot matrix printers as well as PostScript-compatible laser printers for the very best print quality.

Floppy Drives
Floppy drive options include 5.25″ models in 360K and 1.2MB designs and 3.5″ models with capacities of 720K and 1.44MB.

CD-ROM & Other Hardware
We can also configure your Northgate system with many other hardware options, including CD-ROM drives, upgraded video cards, and I/O cards. Call and ask a Northgate Systems Consultant for the latest options and prices.

intel inside

PC MAGAZINE EDITORS' CHOICE

WEBCO PRODUCT OF THE YEAR 1990

BYTE

CALL TOLL-FREE
24 HOURS EVERY DAY 800-345-8709

Major corporations, volume purchasers and government agencies call National Business Accounts: **800-545-6059**

Fax your order! 800-323-7182

Notice to the Hearing Impaired: Northgate has TDD capability. Dial 800-535-0602.

See Us At Fall Comdex, Booth #S2286 At The Sands

NORTHGATE COMPUTER SYSTEMS, INC.

"Smart Tools For Business"™

7075 Flying Cloud Drive, Eden Prairie, Minnesota 55344

Northgate *OmniKey* Keyboards – Quality Designs No System Should Be Without!

OmniKey/101NI
- 12 F-Keys On Top
- Alps Click/Tactile Key Switches
- Independent Inverted T Cursor Control And Numeric Keypads
- Rate Select From 3-120 CPS
- Period/Comma Lock Key Locks out < > Even When Shifted
- Interchangeable CTRL, ALT, CAPS LOCK Keys
- Unmatched IBM® Compatibility
- FCC Class B Certified

$89.00

OmniKey/102
- 12 F-Keys On Left
- Alps Click/Tactile Key Switches
- Independent Inverted T Cursor Control And Numeric Keypads
- Rate Select From 3-120 CPS
- Period/Comma Lock Key Locks out < > Even When Shifted
- Interchangeable CTRL, ALT, CAPS LOCK Keys
- Unmatched IBM Compatibility
- FCC Class B Certified

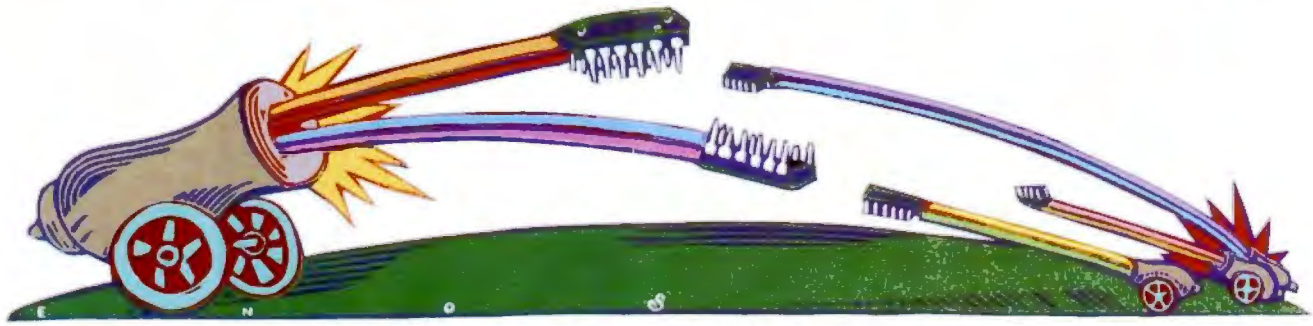
$89.00

OmniKey/ULTRA
- 12 F-Keys On Left And Top
- Alps Click/Tactile Key Switches
- Independent Inverted T Cursor Control And Numeric Keypads
- Rate Select From 3-120 CPS
- Period/Comma Lock Key Locks out < > Even When Shifted
- Interchangeable CTRL, ALT, CAPS LOCK Keys
- Unmatched IBM Compatibility
- FCC Class B Certified

$129.00

Circle 107 on Inquiry Card.

CODE B1418A



Processor Wars

Intel's dominant position on the desktop is being challenged—and, for a change, the winner will be you

BOB RYAN

This past year has been one of transition in the hardware industry. Predictably, processors have gotten faster, memories have gotten denser, graphics have gotten hotter. These trends are not new; they were set in motion with the invention of the IC over 30 years ago, and they will continue for at least the next decade. The big event in 1991 was the end of Intel's monopoly on the 386 architecture. The effect of this event promises to be an even bigger story in 1992.

The most important piece of hardware in any computer system is, of course, the CPU. Intel's designs and products dominate the desktop computing market, with Motorola a distant second and various RISC vendors—including Sun Microsystems—showing up as mere blips on the horizon (albeit as stronger blips with every passing day). Having one company as the sole source of the architecture on which so much of the industry depends makes many in the industry nervous. As long as it alone supplied 386-family products, for example, Intel wasn't forced to compete on the basis of price. In 1991, however, several companies introduced 386-compatible CPUs. The repercussions from these introductions will reverberate throughout the industry in 1992.

King of the Hill

Ever since IBM chose the 8088 for the original IBM PC, Intel has enjoyed success unparalleled in the semiconductor industry. By maintaining compatibility with previous models while upgrading the capabilities of the 80x86 line, Intel has done a masterful job of moving forward both the technology and the industry.

RICHARD SHAFFER
***Editor and publisher of* ComputerLetter**

Through the first half of the 1980s, Intel, though dominant, was not the only company supplying chips (8088s and later 286s) for MS-DOS computers. Through various second-source and cross-licensing agreements, companies such as NEC, Advanced Micro Devices (AMD), and Harris also produced industry-standard chips and provided important competition for Intel. With the advent of the 386 in 1986, however, Intel became the sole supplier of the architecture that will undoubtedly carry the industry into the twenty-first century. That monopoly ended this year, and 1992 will see various companies and groups attempt to loosen Intel's stranglehold on the industry-standard architecture. In addition, the year will also see important advances in microprocessors in general (see the text box "A Banner Year for Processors" on page 87).

Clones and Beyond

There are basically two ways you can go about challenging the dominance of Intel on the desktop. The first involves making alternatives to the 386, either by cloning it directly or by making a functional equivalent. The second is to redefine the industry-standard architecture so that it can include hardware architectures outside the 386 family.

After a tortuous legal battle that, as of this writing, is not yet completely resolved (questions about AMD's use of Intel's microcode remain), AMD this year released its clones of the 386 chip, thus becoming a second source for the 386 architecture. Cloning the 386 is the most obvious way to introduce more competition into the desktop CPU marketplace, and AMD has already scored some design wins with its chips. Whether it can garner enough of the market to remain a viable alternative to Intel will be one of the prime questions answered in 1992.

While cloning the 386 or the 486 is the most straightforward way to produce a 386 chip, it is highly unlikely that any other company can go this route. No other company has the legal access to Intel's patented technology that AMD has.

The alternative to cloning—creating a functional equivalent of the 386 architecture—is a much tougher proposition. As Richard Shaffer of Technologic Partners/*ComputerLetter* says, "Reverse engineering is legally cleaner and more broadly available [to other companies], but it is an order of magnitude more difficult. Not even Intel knows what all of its instructions do. Some instructions of the 386/486 are undefined; others combine in unpredictable ways. So it's hard to reverse-engineer or emulate an instruction

ILLUSTRATION: RANDALL ENOS © 1991

set if you can't fully and completely specify it."

Although more difficult than cloning, creating a functional equivalent of the 386 architecture is the method used by NexGen Microsystems. NexGen has produced an eight-chip superscalar RISC implementation of the 386 architecture that it claims is binary-compatible with Intel's top-of-the-line 486DX and runs twice as fast.

Other companies are also expected to announce functional equivalents to the 386 architecture by early 1993. Like NexGen's implementation, these are expected to be "clean room" efforts. Some of these chips are expected to plug directly into sockets meant for Intel (and AMD) chips and perhaps to add features and functionality not found in straight clones of the 386.

Over the Hump

Though formidable, the technical obstacles facing AMD, NexGen, and others could pale in comparison to the task of convincing OEMs and end users that they offer a viable alternative to Intel's chips. Any firm that wants a piece of Intel's business must ensure that its products can do whatever an Intel chip can do.

Gary Baum, director of product marketing in Chips & Technologies' New Product Development Group, is familiar with the problems inherent in producing compatible products. Chips & Technologies created the first chip sets that let OEMs create IBM AT–compatible products with just a few pieces of silicon. "When Compaq and others came out with systems in the early eighties, everyone's concern was whether the systems were really compatible [with the IBM PC]," says Baum. "Today, Fortune 1000 companies buy clone PCs and don't think twice about the compatibility—it's a given."

TOM MACDONALD
Product manager for Intel's 386/486 microprocessor family

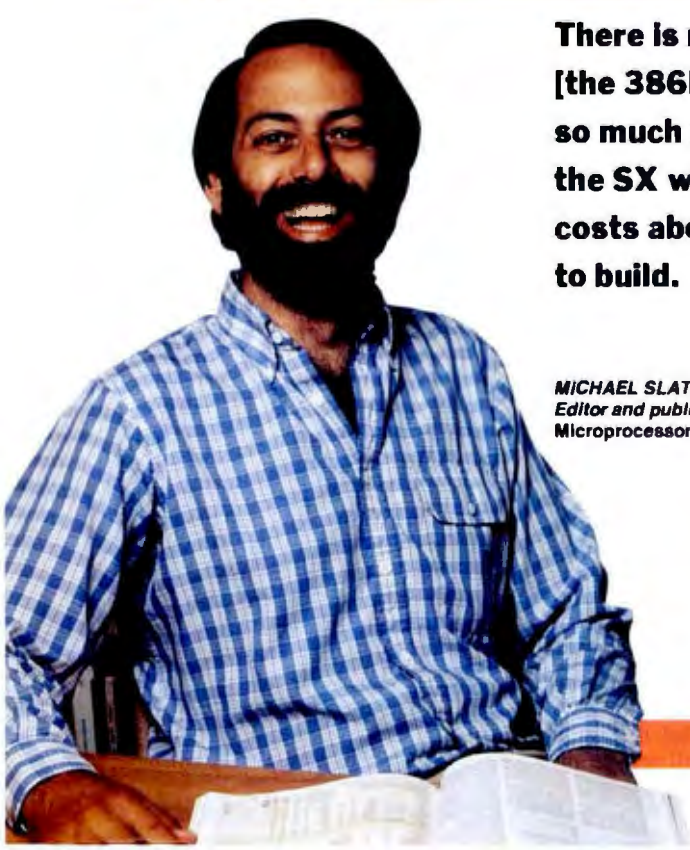
Baum thinks the pattern will repeat itself with alternative processors: "Initially, compatibility will be an issue, but those concerns tend to be short-lived. The industry will know very rapidly whether or not the products are compatible—it won't take very long. There may be start-up bugs—everybody has some errata, as Intel did with the 486—but if the alternatives prove to be fundamentally compatible, then everything is cost/performance and functionality. And, in that regard, there may be reasons not to use Intel processors, just as there are reasons not to buy all your computers from IBM."

Baum doesn't see IBM or Compaq using a second source for processors: "They don't have to use alternative processors to get the benefits of them being there," he says. "They've always been treated very well by Intel." J. Rod Canion, cofounder of Compaq, concurs, saying, "Intel has been dropping prices and reinvesting in their technology. In fact, I think they've done a great job providing new technology. We don't have any reason to look elsewhere." (Canion wouldn't comment on Compaq's plans vis-à-vis NexGen, in which it has a minority investment.) According to Baum, the winning designs for the alternative processors will most likely come initially from other first- and second-tier clone makers.

Whatever the fallout inside the industry, consumers are sure to be big winners in 1992. According to Baum, by next year OEMs may have a choice of up to 40 different 386/486 processors, including differently clocked versions of the same chips, each with a different mix of price/performance and functionality.

Tom MacDonald, marketing manager for Intel's 386/486 product line, doesn't sound like a man who expects to lose a lot of sleep—or a lot of business—from renewed competition in the 80x86 product arena. "There have always been different competitors, and they change names over time and try different things," says MacDonald. "We don't view any one company or architecture as competition. Intel's plan is to continue to offer products that meet the requirements of different market segments. The 386SL is a terrific example. We will continue to proliferate the 386/486 family so that it meets the [needs of the] individual market segments that have formed over the last few years in the computer industry."

Michael Slater, editor and publisher of the *Microprocessor Report*, thinks the big fallout from the clone chips will be



There is no reason [the 386DX] should cost so much more than the SX when it only costs about $10 more to build.

MICHAEL SLATER
Editor and publisher of
Microprocessor Report

PHOTOGRAPHY: MITCHELL RICE © 1991

major price reductions in 386DX chips to even out the anomalies in DX pricing. "There is no reason [the 386DX] should cost so much more than the SX when it only costs about $10 more to build," asserts Slater. "Likewise, the [386]DX shouldn't cost just $50 less than the 486SX, which costs a lot more to fabricate."

ACE up a Sleeve

While fending off alternative sources of its 80x86 products, Intel faces another challenge for supremacy on the desktop in the form of RISC-based systems. In fact, Richard Shaffer sees RISC as the most important long-term threat to Intel's hegemony in business personal computing.

"Companies need to forget about chip-level compatibility," says Shaffer. "All the user really cares about is industry standard in terms of the graphics interface and the [underlying] applications programming interface." According to Shaffer, the best chance the industry has of injecting more competition into CPUs for the desktop is the ACE initiative.

Announced last April, ACE (Advanced Computing Environment) is the result of the efforts of a group of industry companies—including Compaq, Microsoft, and DEC—to create a new standard for desktop computers. The ACE plan is not to standardize the hardware, but to standardize the user environment. The ACE specification supports two hardware architectures—the Intel 386/486 and the MIPS R3000/ R4000—and two operating systems—Microsoft's OS/2 3.0 (a.k.a. OS/2 NT) and The Santa Cruz Operation's Open Desktop. Many observers see ACE as an attempt by Compaq and others to break into the workstation market; Shaffer sees it as an attempt to break Intel's monopoly by bringing RISC to the commercial desktop.

"If you can raise the level of user awareness to the graphical interface, then the engine under the hood becomes irrelevant to most consumers, who focus basically on the dashboard," says Shaffer. "ACE creates an alternative MPU system and an alternative OS that will run what the user thinks are the same programs, so that he doesn't care whether his 1-2-3 is running on a Sparcstation or on a PS/2. Once you accomplish that, Intel's clout in the market diminishes substantially. Long term, I think that's the real significant contest."

Although one of the effects of ACE will be to diminish the impact of Intel on the marketplace, Shaffer doesn't see it as simply an anti-Intel strategy. "ACE is not about throwing out Intel and taking up RISC. It's about having your choice: Either of the operating systems will run on either of the two processors. You can't have both your hardware investment and all of your software investment, but you can come pretty close on both of them."

Shaffer is not sanguine about the probability that ACE can make significant inroads in the business marketplace: "The odds are very high against it, but I don't see any other logical approach. I don't know whether ACE will succeed in creating a RISC alternative that is truly portable in terms of software, but if they come close, then they will have kept Intel honest, and they will have kept the 586 at a reasonable price. That's a pretty remarkable achievement in its own right."

Compaq's Rod Canion takes a different view of ACE. "ACE isn't simply an attempt to move RISC onto the desktop or to move Compaq into workstations. It is actually a far-reaching idea that will play out over the next decade. ACE is designed to provide a standard computing platform that bridges PCs and workstations, and even minicomputers and

A BANNER YEAR FOR PROCESSORS

Major introductions and processor shipments in 1992 will intensify both the battle for supremacy in the workstation market and the dogfight between RISC and CISC (complex instruction-set computer). According to Michael Slater of the *Microprocessor Report*, new RISC processors scheduled to sample or ship in 1992 include at least three SPARC processors, the next-generation processors from Mips and Motorola, and the latest 860 from Intel. The year will also see the introduction of the Intel 586 and the Motorola 68050. The 586 may, in fact, be available in limited quantities by the end of the year, whereas the state of the 68050 is less well known. Undoubtedly, IBM and Hewlett-Packard are also upgrading their proprietary RISC architectures.

The SPARC processors that will ship—perhaps in quantity—next year are the Pinnacle processor from Cypress Semiconductor, the Lightning from LSI Logic, and, most important, Viking from Texas Instruments. Viking is a single-chip implementation of SPARC. Using a BiCMOS process (a CMOS core with selected bipolar elements in speed-critical areas), Viking promises to restore SPARC to the forefront of processor performance, where it has been absent since the introduction of the IBM RISC System/6000 and HP's Precision Architecture. At 3 to 4 million transistors, Viking also promises to set the record for the most highly integrated commercial processor, at least until the introduction of the 586.

The Motorola 88110, the next-generation 88000 processor, is expected to restore some of the luster to Motorola's RISC prospects, especially if, as expected, Apple selects it as the CPU of its RISC-based workstations. Whether the Apple win will be enough to ensure the long-term success of the 88000 family remains to be seen. The Mips R4000 is the 64-bit superpipelined successor to the R3000. The next-generation 860 will further entrench that chip in both high-performance multiprocessing and graphics processing. Although the 860 isn't a major contender in the desktop workstations market, its success in multiprocessing and graphics will ensure its long-term viability.

According to Slater, the most significant trend in both RISC and CISC processors is the use of multiple functional units. Current superscalar processors usually have one load-store unit, one integer unit, and one FPU. A number of the new processors will have multiple copies of one or more of these functional units (except perhaps the FPU, which takes up a lot of silicon), providing new levels of performance via microparallelism. As a result, Slater thinks that by the end of 1992, while IBM and HP will still dominate floating-point performance, Viking and the R4000 will be the integer-performance champions.

Despite all the hoopla about RISC, the fact remains that the most important introduction of the year will be Intel's 586 microprocessor. Packing up to 4 million transistors, the 586 will ensure that PC users have access to the same class of performance as workstation users have. And that promise should keep the 80x86 architecture dominant for a long time to come.

mainframes. As desktop computers and networks take on many of the tasks of larger machines, we think it is necessary to bridge the Unix-PC gap and provide a platform that incorporates both."

Canion also disputes the risky nature of ACE. "I think there is little risk in ACE. Certainly for the companies currently using Mips, the risk is minimal." Canion states that Compaq looked at other solutions to the standards problem but didn't find any in the workstation arena that met its requirements for openness. "We looked at Sun [Sparc International] and decided that Sun wasn't as open as we would have liked."

Tom MacDonald of Intel doesn't see much use for ACE: "We don't think another consortium is necessary—there are already many consortia—but more importantly, there is *already* one industry standard, and that's the PC, based upon the Intel 386/486 architecture. Given the performance of the architecture, given the huge installed base of software—40,000 to 50,000 applications—and an installed base of 70 to 80 million systems, there clearly is one established standard, and why would anyone want to do anything else?"

With ACE nothing more than a design goal until systems and software arrive, it is unclear how easy it will be to move software between the various ACE platforms. While Canion expects that the first ACE hardware and systems software will hit the market in 1992, getting a critical mass of applications software in place will obviously take longer.

The Cup and the Lip

While there is great appeal in a platform that spans the enormous installed base of 80x86 computers and allows for migration to high-performance RISC machines, much can go wrong between now and the introduction of the first ACE systems. Already, there are cracks in the ACE initiative, as a number of companies make the case for running AT&T Unix System V release 4 using AT&T's application binary interface for Mips processors. While this would provide a software standard for Unix applications, it would also jettison the initiative's stated goal of bridging Unix and the current 80x86 installed base, resulting in something akin to the 88/Open group that supports the Motorola 88000 family of processors.

In addition, the head start enjoyed by non-ACE members Hewlett-Packard, IBM, and especially Sun Microsystems narrows the chances that ACE can gain a significant foothold in the RISC workstation end of the market.

A more basic question is whether you need a bridge between the 386/486 architecture that dominates business computing and the RISC technology that underlies almost all Unix workstations. As Gary Baum says, "From a processor perspective, RISC and CISC [complex instruction-set computer] will continue to blur."

Tom MacDonald of Intel states that the "RISC is better than CISC" argument is simply false. "We've proven time and time again that the 486 is as fast as any microprocessor on the market," says MacDonald, "and we'll continue to grow the performance of the 486 family to be competitive with any microprocessor on the market." Another problem, as Richard Shaffer points out, is that "RISC is just very small. It can grow phenomenally and still be only a tiny percent of Intel's market."

Michael Slater thinks it is simply too early to tell about ACE: "I can come up with a dozen different scenarios in which it establishes itself as the second desktop standard and a dozen more where it fizzles out. We just don't have enough information to go on."

Another obstacle facing RISC vendors, whether of the ACE persuasion or not, is the specter of Intel moving its designs into workstations, rather than sitting on its hands waiting for RISC to garner a greater share of the desktop. As Tom MacDonald puts it, "The 486, when married to high-performance graphics, an integrated design, small form factor, networking, and so forth (as in the DEC-pc), can provide everything and more than can any technical workstation on the market. We view the 486 as the basis of a new class of computers called 'business workstations' that will bring the PC architecture into what you'd call the workstation market, but it's really a business workstation for the business user."

Meet the New Boss

1992 will be a pivotal year for many companies in the microprocessor arena. For AMD, NexGen, and any others who enter the 386 market, the year will make or break their attempts to garner a significant share of 386 architecture sales. 1992 will also bring intensified competition in the workstation market as the prime players keep upping the performance ante. In addition, the year will see the strongest challenges to date by RISC vendors—especially Sun and the ACE companies—to establish some form of RISC as the second standard on business desktops. In fact, Richard Shaffer sees this as the biggest development of the year.

Of course, for any other company or architecture to make major inroads in desktop computing, it has to contend with Intel, simply because Intel owns the market. And as the 586 shows, Intel isn't about to roll over without a fight. As Shaffer says: "Intel has a lot of competition left in it. It owns the market, so it can cut prices on the 386, the 486. Most RISC folks have point products, not complete product lines; they don't have processors at every price point you could possibly want. Intel does. There are some pieces of rust on the armor, but it is still an incredibly strong company."

As Tom MacDonald puts it: "The Intel standard is clearly the one that meets the needs of the end user for performance and choice." Unless some other company, technology, consortium, or whatever can disprove that, the 386/486 architecture, both from Intel and from second sources, will still be king of the hill when we ring in 1993. ■

PARTICIPANTS

- ***Richard Shaffer** is editor and publisher of* ComputerLetter, *a newsletter focused on the business side of the computer industry. Shaffer is founder and principal of Technologic Partners, which produces both* ComputerLetter *and conferences on the high-tech industry.*

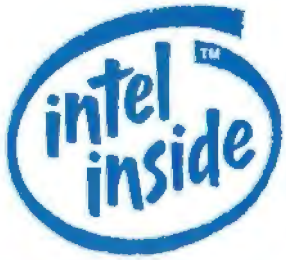
- ***Michael Slater** is editor and publisher of the* Microprocessor Report, *a newsletter covering microprocessor hardware. It is published by MicroDesign Resources, which also produces the annual Microprocessor Forum.*

- ***J. Rod Canion** is cofounder, president, and CEO of Compaq Computer. He has directed the company's operations since 1982 and previously spent 16 years in engineering and management at Texas Instruments.*

- ***Gary Baum** is director of product marketing in Chips & Technologies' New Product Development Group.*

- ***Tom MacDonald** is product manager for Intel's 386/486 microprocessor family. Prior to joining Intel, he worked at Bain, the largest strategic consulting firm in the U.S. MacDonald holds an M.B.A. from Northwestern's Kellog School.*

Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan."



very best PCs.

It's really quite easy. Just look for PCs that have a genuine Intel microprocessor inside. Either the Intel386,™ Intel386 SX, Intel386 SL, Intel486™ or Intel486 SX microprocessor.

Intel is the world's leader in microprocessor design and development. In fact, Intel introduced the very first microprocessor. So with Intel inside, you know you've got unquestioned compatibility and unparalleled quality. And you'll know you're getting the very best PC technology.

So look for the Intel Inside symbol on ads for leading PCs. Or call 800-548-4725 for more information. It'll show you've got an eye for spotting the best.

intel®

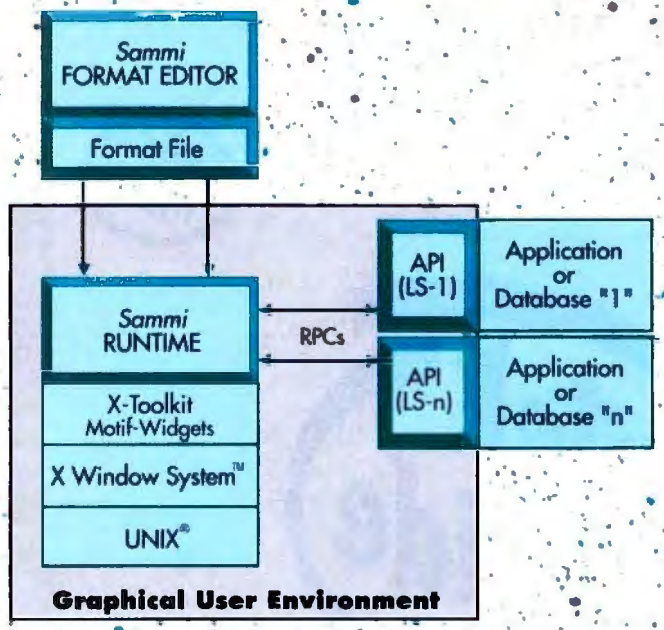
The Computer Inside.™

Graphical User Environment /graf'ik al yo͞oz'er envīr' enment/ n 1. user interface builder for managing **networked** information graphically; 2. combines the functions of a GUI with **full network communication support.**

Sammi™

The ADVANCED Graphical User Environment

Sammi Architectural Overview



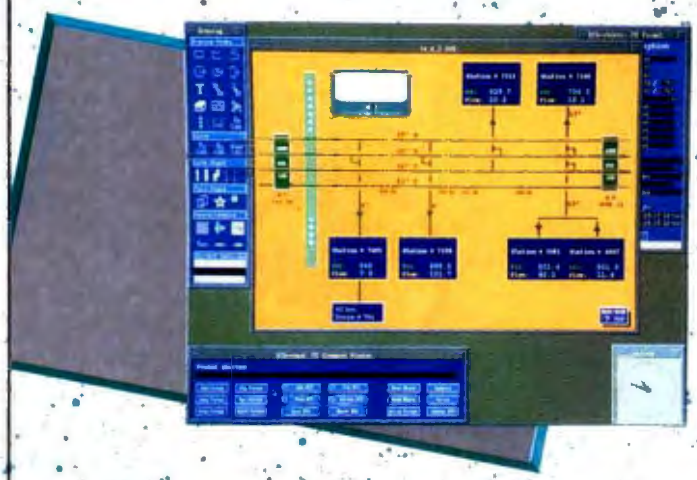
More than a GUI, *Sammi* operates as an integral part of a client/server network environment. Now, in a single display, users can graphically present, organize and manage information from multiple databases and applications across heterogeneous networks.

Sammi's distributed software architecture is optimized to allow users to create and modify customized graphical displays to meet specific application requirements with no programming!

Use *Sammi* to build real-time or static graphical user interfaces for process control/manufacturing, aerospace and network monitoring applications. *Sammi's* ability to create a specific "look-and-feel" for graphical displays makes it an ideal product for system integrators, VARs/OEMs and ISVs. The *Sammi* environment is the perfect choice when monitoring and processing real-time data is critical to the success of your business.

ADDITIONAL FEATURES:

- Standards compliant
- Hardware independent (UNIX-based)
- No embedded code
- Rapid prototyping
- Distributed computing support
- Real-time asynchronous communication
- Multi-level security system



To learn more about how *Sammi* can benefit your company, please contact one of our offices listed below:

CORPORATE:
Houston, TX
(713) 953-8300

Southwest:
Santa Clara, CA
(408) 562-6233

KINESIX

Southeast:
Denton, TX
(817) 387-6665

Northeast:
North Andover, MA
(508) 689-0063

Circle 80 on Inquiry Card (RESELLERS: 81).

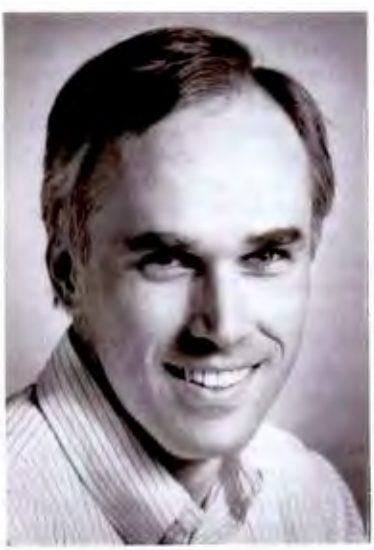
Operating Systems Now and Beyond

Will the pen be the catalyst that radically alters our slowly evolving operating systems?

NICHOLAS BARAN

As we approach 1992, it is remarkable how little operating systems have changed since the introduction of the IBM PC and, a couple of years later, the Macintosh. Unix was already in existence and in widespread use in 1981 and is now an even more powerful force as workstations compete with PCs and Macs in the commercial and business markets.

MS-DOS has seen substantial improvements in its decade of existence but nevertheless is still a single-tasking, single-user operating system with a command-line interface. Similarly, Apple has bestowed the Mac OS with a host of new features in its new System 7.0, but the underlying core of the operating system is still the same as in earlier versions (see "Seven's a Success," June BYTE, for an overview of System 7.0).



JOHN OUSTERHOUT
Cal-Berkeley Professor of Electrical Engineering and Computer Sciences

The Move Toward GUIs

With the exception of the Mac OS, which has had an integrated GUI since its introduction in 1984, the big change in the operating-system arena in recent years has been the addition of windowing systems and GUIs to DOS and Unix, both of which traditionally have had command-line interfaces. Microsoft Windows 3.0 is gradually becoming the standard interface for MS-DOS machines, although millions of users still make do with the C> command-line prompt to run their computers.

The X Window System has become the standard windowing system on many Unix platforms and is supported by virtually every Unix system vendor. Next offers a Unix operating system with a proprietary GUI called NextStep, which is an integral component of the operating system. But, in both DOS and Unix environments (with the exception of the Next system), GUIs are an optional layer on top of the operating system rather than an integrated component of the system, as in the case of the Macintosh.

Of course, there is one obvious reason for the slow change in operating-system technology, and that is, in a word, compatibility—compatibility with the huge data and application base that already exists on millions of computers around the world.

The Portable OS

So far, I've been discussing traditional operating systems for desktop machines. However, a new type of operating system is beginning to emerge for operating pen-based, mobile computing systems. The forerunner in this category is the PenPoint operating system from Go Corp. (For an overview of PenPoint, see "The Point of the Pen," February BYTE, written by Go's Robert Carr, one of the principal architects of PenPoint.)

Because pen-based, mobile computing is a new category of computing, application compatibility is not a major issue (as long as data can be exchanged between the mobile system and the desktop system at the home office). In fact, pen-based systems pose different design challenges and requirements and will therefore generate a new class of software applications. It is therefore reasonable to expect more dramatic changes and developments to occur in the pen-based operating-system arena than in the traditional desktop operating-system category.

With this background, operating-system developers and software engineers who work at the operating-system level nevertheless confront a variety of challenges and issues. While there may be few revolutionary developments in the near term, there are many ways in which operating systems will improve. I talked with several experts in academia and at some major software development organizations to find out what is going on.

Performance Is Not an Issue

First of all, it is becoming clear that performance is no longer an issue at the

operating-system level. Professor John Ousterhout of the University of California Department of Electrical Engineering and Computer Sciences in Berkeley has developed several experimental operating systems (e.g., the Sprite network-oriented file system) and is currently working on a development toolkit for X. He says that "X is getting to the point of good performance on 10-MIPS machines, and on the 20- to 50-MIPS machines that we're seeing today, performance just isn't a problem."

PC veteran Vern Raburn of Slate puts it a little differently: "We finally have enough MIPS to isolate the developer from the hardware. ROM BIOS tricks are no longer necessary." Because many MIPS eases the burden for software developers, Raburn thinks that RISC architectures will become increasingly important. "The virtual monopoly of Intel is not going to last."

Portability—Microsoft's ACE in the Hole?

If, in fact, Intel loses its grip on the PC environment, then PC-based operating systems will have to become portable. In other words, operating systems will have to be able to run on multiple types of microprocessors and also offer binary compatibility at the application level. It should be possible to purchase a spreadsheet or word processing program off the shelf and run it on either an Intel-based or RISC-based system. Unix is the only operating system that approaches binary portability across hardware platforms. However, virtually all Unix systems still require recompilation when moving an application from one platform to another, and in many cases, at least minor code modifications are necessary.

That could all change with the Advanced Computing Environment, an initiative recently announced by some 21 hardware and software manufacturers. The key element of ACE is operating-system portability on both Intel 80x86 processors and Mips Computer Systems' RISC processors. A key player in ACE is Microsoft, which plans to introduce a portable version of OS/2 that will run on both Intel and Mips platforms. The Santa Cruz Operation is in charge of delivering a portable version of SCO Unix for the two platforms.

ROBERT CARR
President of Software at Go Corp.

The most interesting aspect of the ACE initiative is Microsoft's ambitious plan to produce a portable OS/2, which it calls the New Technology foundation or the NT Kernel. Not only will NT run on multiple hardware platforms, but it will also support Windows, DOS, and Posix-compatible programs. It also is reportedly able to brew coffee automatically.

Microsoft has talked about this idea for some time, but actually delivering such a system is an enormous challenge. I talked to Mark Linton about both Microsoft's and SCO's role in ACE. Linton, a former professor of computer science at Stanford University, is now working at Silicon Graphics on Unix and software development tools. (Silicon Graphics is a member of the ACE group.)

Says Linton, "It's an implementation thing. Can we have a coherent application binary interface so that vendors can build one application that runs on all platforms? Can Microsoft really build a full-featured OS for multiple processors?" Linton points out that the task is enormously complex and perhaps more than Microsoft bargained for. "You have to consider multiprocessing, cache systems, multithreaded file systems, networking. It's a big challenge for Microsoft." As for competition between SCO and Microsoft, Linton says, "Whoever has the best product will win."

The fundamental concept behind Microsoft's portable OS/2 is the layered or microkernel approach to building operating systems, first introduced in Mach.

PITO SALAS
General manager of Lotus Development's Advanced Technology Group

Microkernels Are the Key

The fundamental concept behind Microsoft's portable OS/2 is the layered or microkernel approach to building operating systems. First introduced in Carnegie Mellon University's Mach operating system (a Unix-compatible operating system developed at Carnegie Mellon and used in several commercial implementations, including the Next computer environment), the microkernel concept allows various functions of the operating system to be coded in separate layers or "protected subsystems." The basic operating-system functions are contained within the kernel or, in Microsoft's terminology, the Executive. The figure shows the basic layout of Microsoft's NT operating system.

The basic advantage of the microkernel approach is that many of the specialized functions required on various hardware platforms and different operating environments can be isolated from the main kernel of the operating system, thus allowing various layers to be added, de-

pending on the implementation. Microsoft says that its Executive kernel will consist of about 50 kilobytes of code.

Berkeley's Ousterhout agrees that microkernels are, indeed, the wave of the future: "We may not see any dramatic breakthroughs, but [we will see] a lot more work in microkernels like Mach—the way operating systems are implemented."

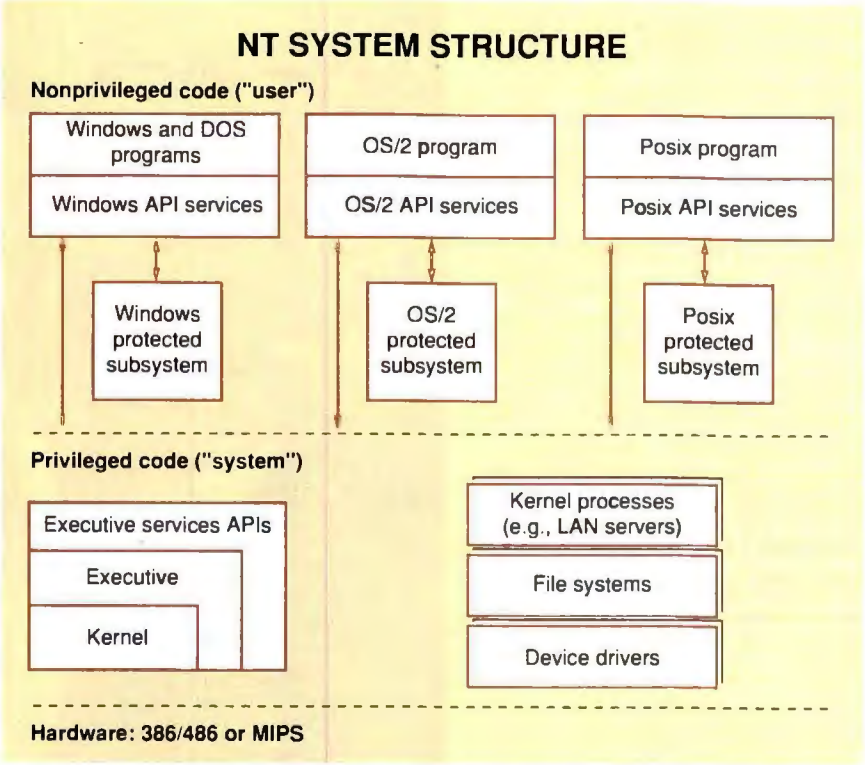
In any event, portability appears to be a key issue in future operating-system development. Linton says that real binary portability is more likely to occur because there will be fewer hardware platforms. In addition, software licensing (e.g., Sun Microsystems' licensing of SunOS) and consortia such as the X Consortium, ACE, and the Open Software Foundation will help promote the move toward true application portability across platforms.

The Need for Development Tools

Everyone that I talked to agreed that the biggest weakness of current operating systems is the lack of good software development tools—tools for debugging programs, for setting up interfaces, and for making programs run in window environments. For example, Ousterhout says that developing X-based applications is "extremely difficult. It requires an awful lot of code." Ousterhout is working on an X development toolkit that uses a high-level interpretive language called tool command language (TCL) to allow programmers to create simple scripts for specifying X functions in their applications.

I also talked with Pito Salas, the architect of Lotus Improv for Next computers and general manager of Lotus Development's Advanced Technology Group. Salas says, "The quality of tools that come with [the] Mac and Windows are not what they could be." Salas, who admits he's biased, thinks that NextStep is far ahead of the competition in the quality of its development tools.

The problem with Windows and System 7.0 on the Macintosh, says Salas, is that there is "always a certain wall that you hit because the underlying environment is what it was before. There's a threshold because of the compatibility requirements." NextStep, on the other hand, is "truly object-oriented," says Salas. (NextStep supports Objective C and uses object-oriented toolkits for software development.) He adds, "You just can't bolt on object-oriented languages." Nevertheless, Salas thinks that new and improved tools will appear on Windows and Mac systems.



The ambitious layout of Microsoft's New Technology (NT) portable system software, designed to run on both Intel 80x86 and Mips Computer Systems RISC processors. The microkernel approach allows the basic functions of the operating system to be isolated in the Executive kernel, which Microsoft says will take up only 50 kilobytes of memory.

Silicon Graphics' Mark Linton agrees that new, high-level tools are needed for developing more sophisticated applications. "The good news is that software that we developed 10 years ago is easier to develop now. The bad news is that the software we want to develop now is much more complex." Linton concedes that "NextStep is definitely ahead" but says that other vendors will eventually catch up. Linton foresees tools based on C++ that are similar to NextStep's Interface Builder appearing on other Unix platforms. The problem with Next, says Linton, "is that they have kind of an Apple mentality—they don't care about portability or standards."

Go's Robert Carr told me that now that Go has released PenPoint, "we're turning our attention to development tools and will invest heavily in this area in the next couple of years." Go will eventually introduce a "suite of tightly integrated tools" for PenPoint software development, says Carr.

Carr offered a more pessimistic view of software development in the traditional desktop market. "There are so many obstacles," says Carr. "There's the burden of developing for today's GUIs—the complexity of coding, poor development tools, and the saturation of the marketplace with standard applications. It's difficult to contribute to existing platforms. There's tremendous pressure in developing new spreadsheets, word processors, communications, E-mail, and so forth. The cost of replicating the basic functionality is enormous before you can add

MARK LINTON
Former computer science professor at Stanford University

Renowned computer columnist. Industry luminary. Best-selling science fiction writer. Ph.D. in Psychology. Chairman of the Citizens' Advisory Council on Space. Dr. Jerry Pournelle has been a successful evaluator of computing trends for so many years that his first computer is on display at the Smithsonian.

So when Dr. Pournelle writes about a *"CD-ROM explosion,"* and about the Pioneer CD-ROM Minichanger as a surprisingly effective way to help manage that explosion, he writes from experience.

One CD-ROM can hold up to 128,000 pages of information. The Pioneer CD-ROM Minichanger holds up to 6 discs at once – more than 3

We did it with the world's first and only CD-ROM Minichanger.

gigabytes of data – in a compact, reliable, easy-loading magazine. And as Dr. Pournelle reports, *"it's surprising how fast you can switch back and forth among them"* ***(Byte, Jan., '91)***.

Why lose time searching for the right disc when it only takes seconds to search across discs to the right piece of data? You can even daisy-chain up to 7 Minichangers from the same controller for access to more than 5 million pages of data.

The Minichanger supports standard ISO 9660 file format

through a SCSI interface for IBM, Macintosh, and other platforms. You can also use it as a CD-Audio jukebox.

PIONEER BUNDLES AN UNBEATABLE SIX PACK

Pioneer is currently selling a six pack of CD-ROMs (valued at $1,256) for only $395, less than 1/3 suggested retail price: ***Countries of the World*** (a valuable tool for businesses, libraries, universities and schools, with up-to-date geographic, economic, and demographic information as topical as the war in Iraq, plus detailed color maps); ***US History*** (more than 100 books); the complete works of ***Shakespeare;*** the complete ***Sherlock Holmes***; Audubon's ***Birds of America*** (with color illustrations and actual bird calls); and ***Software Potpourri*** (including major software programs, a Movie Database, and the complete Bible.)

See the list below for the distributor or dealer nearest you, or call Pioneer at 1-800-LASER-ON. To find out whether you qualify to become an authorized reseller, call Kent Ekberg, Director of Marketing, Pioneer Communications of America, at (201) 327-6400.

Let the final word on the Pioneer CD-ROM Minichanger come from Jerry Pournelle himself: *"Recommended."*

YOU HAVE TO BE PRETTY QUICK TO SURPRISE JERRY POURNELLE.

PIONEER®

IDEAS THAT BECOME STANDARDS.

INTRODUCING THE FIRST AND ONLY CD-ROM MINICHANGER.

All product names are trademarks of their manufacturers.

Distributors: ***Bureau of Electronic Publishing*** Parsippany, NJ contact: Barry Cinnamon 800-828-4766 / ***Bytewide*** Lachine, Quebec contact: Robert Elman 514-636-5938 ***Compact Disk Products*** New York, NY contact: Frank Graziano 800-634-2298 / ***Computer Upgrade Corporation*** Anaheim, CA contact: Scott Lamb 714-630-3457 ***FlexSys Corporation*** Newburyport, MA contact: Steve Mycko 800-533-7756 / ***Gentry Associates, Inc.*** Orlando, FL contact: Richard Baker 800-688-2223 Ext. 395 ***Graphics Techologies, Inc.*** Edina, MN contact: Stephen Harold 800-999-9382 / ***Kintronics, Inc.*** Elmsford, NY contact: Bob Mesnik 800-431-1658 ***Optical Access International***, Woburn, MA contact: Neil Salamack 800-433-5133 / ***Relax Technology, Inc.*** Union City, CA contact: John Milich 415-471-6112

Circle 125 on Inquiry Card.

any new functionality." The attraction of the pen-based computing environment, says Carr, is the possibility of developing new applications and new product categories. "We have a lot of very capable and very excited small developers working on PenPoint applications."

ROBERT VALLONE
Director of User Research at Go Corp.

Will Pens Up the Ante?

As I mentioned earlier, pen-based systems pose new challenges to operating systems. It is not my purpose here to discuss the details of pen-based computing, or to evaluate its chances for success, which are still open to question. But whether pen-based systems become a major factor or not, the technology will have an impact on operating systems, particularly in the areas of communications and multitasking.

For example, Go's PenPoint operating system has a feature called "detachable networking." This capability allows a mobile notepad computer running PenPoint to instantly connect to or disconnect from a LAN, simply by connecting or disconnecting the network cable. The operating system automatically detects the connection or lack thereof and takes the appropriate actions to open or close the network link.

Mobile systems will require "superb data compatibility and connectivity," says Robert Carr. Indeed, a pen-based system must be able to exchange data with Unix, Macintosh, OS/2, and DOS-based networks with little or no effort required from the user. "Other operating systems," says Carr, "are islands that are good at talking to themselves but have a hard time talking to each other."

The other key feature in pen-based operating systems is preemptive multitasking While preemptive multitasking is not new, it is of critical importance in a pen-based system for two reasons. First, communications must take place in the background. Second, the user must always have access to the pen. For example, PenPoint performs its handwriting recognition functions in the background as the user enters each letter with the pen. Says Robert Vallone, director of user research at Go, "Because translation takes place in the background, the time to translate is perceived as the same whether it's one line or 20 lines. Preemptive multitasking is crucial for pen-based systems. The primary input device is the pen. It must be able to interrupt any task at any time; it can never be locked out."

PenPoint also supports the *embedded document architecture*, a concept in which documents from multiple applications can appear within each other and are instantaneously and smoothly accessible with the pen. There is no time for task switching as in a yield-based or cooperative multitasking environment such as Windows or System 7.0.

One problem that you have with yield-based multitasking systems such as Windows or System 7.0 is that applications written for these systems must follow a specific set of rules that require the application to yield processing time to other applications running on the system. If an application is not written properly (it "misbehaves") and does not have provisions for yielding CPU time, it can crash the entire system. There is no memory protection in a yield-based multitasking system.

Preemptive multitasking, on the other hand, requires no special programming rules for yielding CPU time. The system can regain control of the processor even if an application crashes. This is because each application runs in a protected area of memory. Preemptive multitasking makes for a much more reliable operating system and also makes software development less complicated. In addition, preemptive systems offer smoother responsiveness than yield-based systems, which can be very "jumpy" if applications do not yield processing time fast enough to another application on the system.

Pens May Force Switch to Preemptive Multitasking

Whether pen-based systems succeed or not, they have definitely sparked a great deal of interest from major developers such as Microsoft and Apple. Microsoft has released a version of Windows called Windows for Pens, which supports pen input, and Apple is reportedly hard at work on a pen-based computing system.

For Microsoft and Apple to be competitive with Go's PenPoint, however, they will have to offer preemptive multitasking versions of Windows and System 7.0, respectively. (There is the possibility, however, that Apple may license Go's technology for its pen-based systems.) Microsoft will, in fact, come out with a 32-bit, preemptive-multitasking version of Windows next year, called Windows 4, which will support the NT Kernel. The logical step for Apple is to add preemptive multitasking in a future version of the Mac OS, regardless of its involvement in the pen-based arena.

Are There Winners and Losers?

In spite of the changes and advancements in operating-system technology, it is clear that the old standards are here to stay. MS-DOS is still the hands-down leader in numbers of users. Says Marshall McKusick of the Computer Systems Research Group at Berkeley, "MS-DOS won't go away any more than FORTRAN or COBOL are going to go away."

But Ousterhout sees Unix getting a stronger foothold in the PC arena. "I actually think that Unix and X will take a significant fraction of the market from PCs and MS-DOS." Ousterhout thinks that Unix systems offer more power and much better networking capability for about the same price as DOS-based PCs and cites the difficulty of software development under Windows as an increasing

PRADEEP SINGH
Product manager for Windows for Pens at Microsoft

factor in causing developers to switch to Unix.

But Pito Salas of Lotus is less convinced that Unix is making inroads into the PC market. "From what I'm aware of, the interest is heavily weighted to DOS and Windows." The conservative conclusion is that both DOS and Unix will have healthy futures.

Eventually, we will see greater portability, better multitasking, and better software development tools.

Says Mark Linton of Silicon Graphics, "There's a lot of investment in Unix technology that people want to carry forward." Linton says he expects to see significant architectural improvements in Unix over the next few years—improvements such as *multithreading* (concurrency within a single task) and improved standards for graphics and video.

Go's Robert Vallone says, "There will be very little, if any, movement in OS and GUI standards." If anything, various operating-system interfaces are becoming more and more alike. "A Mac user," says Vallone, "can navigate a Windows screen or an OS/2 or Motif screen. The control and operation aren't radically different." However, Vallone sees the addition of new data types to support multimedia features such as audio files and video images.

Technical Merit Is Not Enough

The endurance of DOS points out that technical merit is not necessarily the decisive factor governing the success or failure of a new operating system or environment. Next is a prime example. Although many industry experts acknowledge that Next's software is technically superior to that of its competitors, Next is nevertheless struggling in the marketplace. Says Robert Carr, "Next is doomed to be a niche market. They're fighting an entrenched desktop market."

But Go's PenPoint could suffer a similar fate. Says Microsoft's product manager for Windows for Pens, Pradeep Singh, "From a design perspective, PenPoint is very cool. They abandoned everything and started from a clean slate. It was an easy decision from a technology perspective, but not from a marketing perspective. It will take a long time for PenPoint code to settle down and become stable. We're only adding 35 APIs [application programming interfaces] to Windows, not building a complete operating system with multitasking and memory management." It must be pointed out, however, that it may also take quite some time for the code in the NT Kernel and in Windows 4 to settle down and become stable.

The bottom line is that operating systems will continue to evolve gradually. Eventually, we will see greater portability, better multitasking, and better software development tools. The most interesting battle may occur in the emerging pen-based computing market. ■

PARTICIPANTS

- ***John Ousterhout,*** *a professor of electrical engineering and computer sciences, has developed several experimental operating systems (including Sprite) and currently is working on a toolbox for the X Window System.*
- ***Mark Linton*** *is a former computer science professor at Stanford University and is the author of the widely used DBX debugger for Unix.*
- ***Pito Salas*** *is the architect of Lotus Improv for Next computers and general manager of Lotus Development's Advanced Technology Group.*
- ***Robert Carr*** *is vice president of software at Go Corp. and a principal architect of the PenPoint operating system.*
- ***Robert Vallone*** *is director of user research at Go Corp.*
- ***Pradeep Singh*** *is product manager for Windows for Pens at Microsoft.*

Nicholas Baran is a consulting editor for BYTE and coeditor of Pen-Based Computing, The Journal of Stylus Systems *(Sandpoint, ID). He can be reached on BIX as "nickbaran."*

Rely On The MINUTEMAN UPS For LAN Protection

Spikes. Surges. Overvoltage. Undervoltage. Brownouts. These things happen. And they can do irreparable damage to your equipment and data — unless you're protected with MINUTEMAN Uninterruptible Power Supplies.

MINUTEMAN protects all your equipment and data. All the time. In fact, in the event of power failure, it will safely and automatically shut down an unattended network.

No matter what your needs are, MINUTEMAN can protect and interface with everything from a stand alone workstation to the largest of the IBM AS/400s. We also provide 220-volt international models and Automatic Voltage Regulators.

So call the experts for LAN protection and receive a free power protection package.

MINUTEMAN detects power failure, alerts network and continues to provide computer grade power until shut down command is issued.

1-800-238-7272

STANDBY UPS MODELS
300 VA to 2300 VA
Sinewave output
Small, lightweight design

ON-LINE UPS MODELS
500 VA to 10,000 VA
True double conversion
Static by-pass standard
Sinewave output
Lower pricing than ever

UNATTENDED SHUT DOWN
MINUTEMAN UPSs are network ready for unattended, orderly shut down of **every available operating system.**

See us at
COMDEX
Booth #129
and
NETWORLD
Booth #1819

FOR L.A.N.
NOVELL LABS
TESTED AND APPROVED
NetWare Compatible

MINUTEMAN®
UNINTERRUPTIBLE POWER SUPPLIES

Novell approved UPS monitor boards

© Para Systems, Inc. 1455 LeMay Drive, Carrollton, Texas 75007 Phone: 214-446-7363 FAX: 214-446-9011

Circle 119 on Inquiry Card.

An Out-of-Towner's Introduction to the BIX Community

BIX is for people who use microcomputers for business, finance, research, and career and personal development. There's always something interesting happening here. No matter what you're into. The latest industry news. Top-notch software libraries. Private electronic mail. Real-time chatting. And every month, the complete text of *BYTE* magazine. (Read more about BIX, and how to join, on adjacent page.)

From Artificial Intelligence to Zenith Laptops...

Whatever your interest, BIX has a conference for you. Here's a sampling from our latest list. (In each Exchange, Conference name appears on left, description on right.)

■ Amiga Exchange

Joanne Dow, Exchange Editor

amiga.user	Exchange ideas, solve problems, compare notes
amiga.sw	Amiga programming and developer issues
amiga.hw	Amiga hardware design, use, and hookup
amiga.arts	Artistry using the Amiga
amiga.int	Developing for the international Amiga
amiga.special	Special guests and events
amiga.dev	Commodore's conference for developers

■ IBM Exchange

Barry Nance, Exchange Editor

ibm.pc	The venerable PC
ibm.at	The AT series and workalikes
ibm.ps	The PS/2 series
ibm.os2	OS/2 operating system
ibm.dos	PC/DOS & MS/DOS operating systems
ibm.os.386	Alternative 386 operating systems
ibm.utils	Utility software for IBM computers
ibm. repairshop	Garage and Tune-up Shop

BIX
COMMUNITY CALENDAR
OCTOBER 1991

ibm.new. prods	New products for IBM computers
ibm.exchange	IBM Exchange clearinghouse
ibm.listings	Index to program files in the Exchange
ibm.other	Apps, printers, modems, etc.
microsoft	Products from Microsoft

■ Programmers' Exchange

Bill Nicholls, Exchange Editor

ada	The Ada language conference
ai.theory	Artificial intelligence and expert system theory
assembler	Assembly language
basic	Your BASIC conference
c.language	C programming language
c.plus.plus	Discuss the C++ programming language
cad	Computer-aided design
cpm	CP/M conference
editors	The Programming Editors Conference
forth	FORTH programming
fortran	FORTRAN language conference
games	Game programming and design
graphic.pgms	Programming and graphics
hypertext	Hypertext publishing
lisp	LISP language conference
modula.2	Modula-2 language conference
neural.nets	Neural Networks
ood	Object-oriented development conference
os.9	OS-9 conference
pascal	Pascal language conference
pick	The PICK operating system
postscript	Postscript
smalltalk	Smalltalk language conference
soft.eng	Efficient and reliable software design
telecomm. pgms	Telecommunications programs
unix	The UNIX conference

■ Macintosh Exchange

Dr. Larry Loeb, Exchange Editor

mac.apple	The word from Cupertino
mac.business	Macs in the office
mac.desktop	Publishing with a Mac
mac.external	Information from all over
mac.hack	Technical information about the Mac
mac.hypercard	Using the HyperCard programming environment
mac.news	Up-to-the-minute information
mac.novice	For beginners
mac.products	Listings of new hardware and software
mac.sandbox	For off-hours fun

■ Tojerry Exchange

Jerry Pournelle, Exchange Editor

tojerry	Messages for and from Jerry Pournelle
chaos.manor	Computing at Chaos Manor
astronomy	A star party for amateur astronomers
contact	Science fiction meets science
disasters	Natural and man-made disasters
education	Computers in American classrooms
mathematics	Talk about high-level mathematics
sciences	Scientific programs
space	Space exploration and development
technology	New technologies and their impact

BEAM YOURSELF TO A PLACE WHERE COMPUTER SAVVY ABOUNDS.

■ Imagine a setting in which communal wisdom is on tap. A place that has the fit and feel of a small, friendly town, yet the sophistication and resources of a global community. One which you can visit electronically—to increase your knowledge of computers and their applications, hone your skills, share insights with thousands of other computer pros, and have fun. Such a community would be called BIX.

Subscribe to BIX, the flat-fee, on-line information service.

BIX is your access to industry news. And to many special interest Exchanges—such as our *Amiga, IBM, Mac, Writers'*, and *Interactive Games* Exchanges—which include thousands of free, downloadable programs. All for just $39 per quarter.*

Subscribe via your computer...

Set your program for full duplex, 7 bits, even parity, 1 stop bit. Call BIX on our registration-only number: 800 225-4129. In MA: call 617-861-9767. International: call NUI310690157800. Then hit the return key, and respond:

Prompt:	**You Enter:**
login	bix
Name?	bix.ville

You may buy off-peak access via *Tymnet* at $20 per month or $3 per hour, or you may buy peak access at $6 per hour.**

*Based on a $156 annual fee, billed quarterly. Telecommunications charges are extra. You may cancel at any time without future charges.

**Available only in contiguous 48 states. Tymnet rates subject to change.

800-227-2983 • In NH 603-924-7681

BIX

Disk, DAT, and the Optical Thing

Current and future technologies seek to store more with less

ANDY REINHARDT

If ever a group subscribed to the dictum "smaller, faster, cheaper," it would be the mass-storage industry. While it may lack some of the glamour of the semiconductor or applications software field, its accomplishments over the last two decades have been no less spectacular nor any less crucial to the evolution of small computers. Jim Porter, president of Disk/Trend and a dean among mass-storage analysts, summed it up best when he observed, "They call it Silicon Valley, but they really ought to call it Disk Drive Valley."

The business and technology of mass storage continue to evolve at a dizzying pace. Magnetic disks get both smaller and higher in capacity, while new floppy disk drive options are emerging. New medium types and drive interfaces may lie on the horizon, while optical disks seem finally to have arrived—assuming that people will want to buy them. Silicon storage is trying to steal the thunder from tiny drives in palmtop PCs, and even stodgy tape backup is crackling with a capacity race and standards wars.

BO LARSSON
Vice president of Sony's Magnetic Storage Products Division

In this roundtable discussion woven from eight interviews, leading analysts and players in the mass-storage industry address these and other issues.

MAGNETIC STORAGE

Let's start with a general question: What will be the typical mass-storage configuration of a desktop PC in 1992?

Ross Johnston: It will definitely be a magnetic system, for the simple fact that magnetic storage is still the cheapest in cost per bit, no matter what. It's still cheaper than any silicon memory or optical storage by a significant amount.

Jim Porter: I don't look for any revolutionary changes. Basically, we're going to see an extension of the trends that have been obvious for the last several years: higher capacities each year, on average, and higher performance. We're really talking here about 3½-inch hard drives primarily; there are still some 5¼-inch drives used on PCs, but the new systems are typically coming out with 3½-inch drives.

Bill North: If history is any indicator, as I look at the image-processing and GUI applications cropping up on desktop systems today, we're going to see dramatic increases in the amount of storage kept locally. That could vary a bit, depending on whether you believe most PCs will be networked or not.

Ed Rothchild: In the next few years, optical will be complementary to magnetic, not competing. Several major technological things have to happen before optical really competes with magnetic for storage domination on the desktop. The latter part of the decade is when we're going to see optical make major inroads against magnetic.

What will be a typical entry-level configuration?

Bo Larsson: On a low-end PC, you will see a floppy disk drive and an 80-MB hard drive. That'll be a 2-MB floppy drive on a low-cost system; as you go higher in cost, of course, the hard drive increases, and you might start to see 4-MB floppy drives. And in workstations, you would probably see a DAT [digital audiotape] tape backup device, erasable optical, and very high capacity hard drives.

North: In 1992, a typical desktop system is likely to have an 80- to 100-MB 3½-inch drive as its basic platform. Maybe 18 months from now, the average will be more like 150 or 160 MB. The seek times of those products are likely to

be in the 16- to 20-millisecond range. And we'll probably have some form of high-capacity removable medium, like read/write optical.

Porter: The range of capacities that one would think about putting on a new PC today is anywhere from 40 MB as a starting point up to about 500 MB. The fastest-growing area has been in the range of 100 to 120 MB. It is quite normal today for drives in that range to be offered with seek times of less than 20 ms.

ED ROTHCHILD
Chairman of Rothchild Consultants

What about in laptops and notebooks?

Porter: They are a different ballgame because of the constraints on package size and power. Just about 100 percent of the notebook PCs are using 2½-inch drives instead of 3½-inch drives. The industry is going to move rapidly to 30- and 40-MB drives as the minimum level for notebooks because that's what the market is demanding.

At the other end of the scale, how high will capacity get?

Porter: For 3½-inch drives, the highest capacity offered to date is 550 MB. In 5¼-inch drives, the highest announced capacity is 2.4 gigabytes, and there are several manufacturers shipping 1.7-gigabyte drives.

North: It's safe to say that during 1992, you'll see 3½-inch drives that break the 800-MB to 1.2-gigabyte capacity range. And I would expect to see 200 to 300 MB in a 2½-inch form factor coming from some of the manufacturers. In the 5¼-inch arena, almost the sky's the limit: By the end of the year, we'll see 2.6 gigabytes on a spindle, and within the next 18 months, we'll certainly see 3- or possibly 4-gigabyte spindles.

Porter: The 5¼-inch drives are declining in shipments in every range except 700 MB or above. Everything below that has been declining as they're replaced by 3½-inch drives. The 5¼-inch drives will go up to about 3 gigabytes, but they may not go much further. Technically, they could do it, but they may not because the really high capacity ranges will probably be served by arrays of 3½-inch drives.

What's coming in smaller disk drives?

Porter: There have been laboratory demonstrations of 1-inch drives, but the next step is pretty clearly going to be 1.8 inches. I feel comfortable projecting that, by the end of 1992, there will be three to four companies producing 1.8-inch drives, including several that are leaders in the 2½-inch drive area. You'll be looking at 2-pound computers coming out toward the end of 1992 that will have 20- and maybe 30- or 40-MB 1.8-inch drives.

Larsson: Those disk drives will come in 1992. Their form factor will fit into a memory card slot, so you could, for example, have a 1.8-inch 30-MB drive that is removable and that you could use in your hand-held computer or desktop. You could take your whole database with you, basically.

North: We've seen technology demonstrations of 1-inch, very-low-power-consumption drives. They're not even intended specifically for use in computers. They're meant for desktop telephones, and they draw their power from the phone lines.

Will caching become ubiquitous in disk drives or controllers?

Porter: Caching has been used for many years in the mainframe and minicomputer worlds, but PC-type caching has to be more general-purpose. In the mainframe business, system analysts tune the cache so that it's optimized for the application it's running. But you can't do that with a drive that's sold for mass use as a disk drive in the PC business.

North: We don't offer caching controllers in any of our product lines today. The only place they're beneficial is in operating systems like DOS that do a great deal of contiguous disk I/O. But with NetWare, which has caching built in, in every case we've ever tested, a caching controller slowed it down.

Richard Green: A lot of companies now are using caching on all of their controllers. In the not-too-distant future, seek times are going to be almost irrelevant because everybody is going to have caching controllers. It's happening in the optical area as well. The new drives coming out now have larger buffer sizes to take advantage of caching. When you combine that with caching bus-mastering host bus adapters, it's very hard to tell what's on the other side of the interface as far as performance is concerned.

What about data compression? Will it become standard?

Porter: There have been some aftermarket products offered to PC users that use lossless data compression. They're either add-in boards, where it's done in firmware, or it's done in software. The problem is that there's no industry standard on this.

Mike Peterson: The system OEMs asked the drive vendors to put hardware compression in the peripherals. I don't believe it belongs there; it belongs back at the I/O area. There's a real opportunity for data compression in the network interface card. What you want to be doing is sending compressed data over the wire. Then, you don't decompress it until you're going to use it.

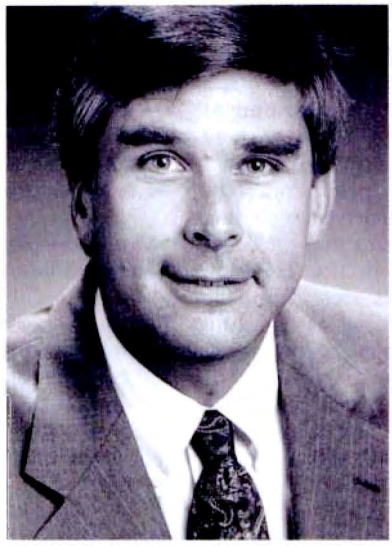
continued

BILL NORTH
Director of LANStor product marketing for Storage Dimensions

What role will RAID (redundant array of inexpensive disks) play in the future?

Porter: RAID 5 will probably be more important in the PC arena. It's definitely going to be fairly widely used in servers for good reason: Compared with one system going down for a single user, if a PC network goes down, it can inconvenience as many as 100 users.

North: I think that it's mostly smoke and mirrors. The real benefit of RAID 3 and RAID 5 architectures to desktop computing is going to be felt only when the array processor—that is, the thing that controls what gets written to the disk and does the data massaging—can be made fast enough and cheap enough that it's not a significant fraction of the total storage expense.



CHUCK MORAN
Vice president of marketing and sales for Insite Peripherals

DRIVE INTERFACES

What's going to happen with drive interfaces?

North: In the next year or two, IDE [Intelligent Drive Electronics] and SCSI will be the interfaces of choice. Most of the drive manufacturers either have eliminated or are rapidly phasing out any kind of development efforts on ESDI, the only other player.

Porter: ESDI is certainly becoming a very small part of it. IBM has gone to SCSI-2 basically across the board on almost all its new announcements from the last year and a half: on PS/2s, RISC System/6000s, and AS/400s. Apple is SCSI, of course, in the Mac. And in the meantime, most of the AT-type systems are using IDE-AT.

North: The IDE interface will probably continue to be the dominant interface at the 100-MB and below level, maybe even at 200 MB and below. It is easy to integrate, offers reasonable performance, and is very well documented. For multiuser systems or servers, where it's reasonable to expect the need for storage continually to grow, SCSI is clearly the winner. From an expansion and overall performance point of view, SCSI wins hands down.

How will SCSI be improved?

North: SCSI-2 has a bunch of new commands in it, but that's not really the bulk of it. What will happen with wide SCSI and fast SCSI isn't ironed out yet. Wide SCSI takes the 8-bit bus and doubles it or quadruples it to 16 or 32 bits. With fast and wide SCSI, we can get up to 20-MBps or even faster data transfer rates from a single drive. The bad news is you've got to find someplace to put all those wires.

Are there any other interfaces that may emerge?

Rothchild: Not in the near future. IBM may come out with an optical drive that plugs directly into a Micro Channel slot, as they do now with a few of their hard drives. I wouldn't be at all surprised to see an interface like that.

North: If you look not much more than two years ahead, you'll see fiber-optic links at the drive level. It's still pretty much blue sky technology; there's a lot of technological hurdles. But in all areas of data communication, optical gives wide bandwidth in a small package.

HIGH-CAPACITY FLOPPY TECHNOLOGY

Are the new 4-MB floppy drives and media going to take root? Or will a higher-capacity alternative like 20 MB be the next big success?

Larsson: I wish I knew. As for Sony's standpoint, we are now in full production of 4-MB drives and media, and unless we believed in 4 MB, we wouldn't go into production. We also have around 20-MB technology available.

Porter: IBM has decided. Most of the other makers of IBM-compatible PCs plan to follow suit. It's a given that 4 MB will be very widely used within a couple of years and will eventually substantially replace the lower-capacity systems. It's no sweat for anybody because it is downward compatible. Since a 4-MB drive can read 1- and 2-MB disks—you know, 720 KB or 1.44 MB to speak in formatted terms—it's one of the most painless migrations in a medium type that the industry will ever be presented with.

Chuck Moran: The 4-MB floppy disk, which formats down to 2.88 MB, is not the capacity increase that users need today to satisfy their applications. Had this been introduced like it was supposed to be more than two years ago, the 4-MB system would have received a warmer reception.

That's not to say that it won't find a niche and won't succeed—and I think it will—but it's not going to be what it could have been a few years ago.

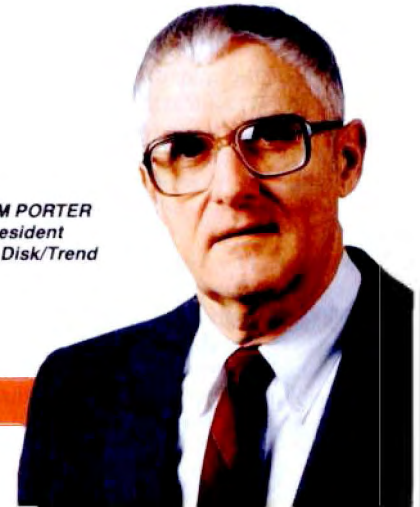
What's beyond 4 MB?

Peterson: It is physically possible to step up to 20- and 40-MB capacities and still maintain read/write compatibility. That drive can definitely be built, and of course we've seen it achieved in the Brier and Insite products.

Porter: The 20-MB and later the 40-MB drives are likely to be widely used. The problem there is that IBM has not settled the standards argument. It's probable that the leading type at the moment is the Insite drive, with an optical recording track and magnetic recording. Brier is taking a more specialized approach, a niche approach.

continued

We're going to see dramatic increases in the amount of storage kept locally.



JIM PORTER
President
of Disk/Trend

The Legacy M.A.S.S. HFD "hot fix" storage subsystem.

It puts "zero downtime" within easy reach for networks.

In the short time since it was introduced, the Legacy M.A.S.S. HFD has been widely acclaimed by leading computer publications and network users alike.

The Legacy M.A.S.S. HFD gives you unprecedented cost effectiveness.

For the first time, you can have the benefits of zero downtime with a SCSI storage subsystem that offers:

- true "hot fix" capabilities
- total fault tolerance
- automatic background rebuilding during normal read/write operations
- RAID Level 5 architecture
- enhanced access time and speed of retrieval
- controlled user access

These high-performance HFD systems are available in capacities ranging from 420Mb to 28Gb and are compatible with virtually all operating environments, including OS/2 and Unix/Xenix. For NetWare 386, achieve new performance levels and serviceable fault tolerance with Legacy NetWare 386 device drivers.

The Legacy M.A.S.S. HFD. Find out why, almost overnight, it has become the preferred solution for mission-critical applications requiring zero downtime.

Call **1-800-267-6442** for your free "Report on Fault Tolerance" covering everything from disk mirroring/duplexing to RAID Level 5 architecture.

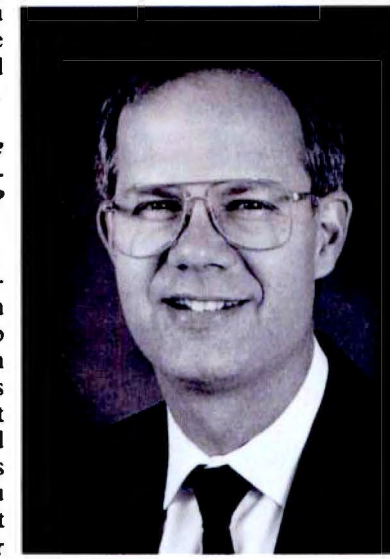
Legacy

Legacy Storage Systems Inc.

For U.S. inquiries: 200 Butterfield Drive, Unit B, Ashland, MA 01721; Tel.: (508) 881-6442 Fax: (508) 881-4116
Canadian and International inquiries: Tel.: (416) 475-1077 Fax: (416) 475-1088

Circle 83 on Inquiry Card.

Peterson: All drives of this class will have an embedded servo of some form. With the exception of Insite, everyone else is magnetic. There are six different ways that it has been achieved at this point, seven if you count NEC. And it isn't going to settle out for a couple more years. Here in the U.S., Brier is shipping a product currently, but Insite is making a lot more noise. There is definitely a demand for a product like this.



MIKE PETERSON
President of Peripheral Strategies

What about the drive that's been announced by Citizen? Is it a contender?

Peterson: The approach that Citizen was taking was to maintain medium compatibility, but it's not a technology that is being championed by anyone at this time. I could tell you that Japan Inc. isn't going to roll over here. Matsushita is running around the standards committee with their own product, and everybody else in Japan seems to be thinking about going along with that.

When might very high capacity floppy drives become common in PCs?

Porter: Two different scenarios are possible. The first is that IBM decides within the next year what it needs to do, selects one of these things, and starts to use it, probably as a backup device instead of a tape drive. The other scenario is that IBM doesn't act, and we have three to four years of tilting at windmills while consensus gets established around one of the standards, either Insite's or something coming out of Japan. If there is no referee to settle the argument, it'll take the industry quite a while, just as it did on the original 3½-inch floppy disk.

Moran: The market is ready to accept it, so it's not going to take an IBM to endorse 20 MB to make it successful. That is not to say it wouldn't help. You'll be able to see 20-MB floppy drives in some systems by the end of this year. But without an Apple or an IBM endorsing something, it takes a ground swell of support. It'll probably take a couple of years before you can go into a store and see a hundred manufacturers offering the product either as a standard in some products or as an option in others.

How does the price of a floptical compare with a typical 2-MB floppy drive?

Moran: It's expensive because you're comparing two different technologies. You can get a 2-MB floppy drive at an OEM price of $40 or $50 in production volumes. But that's with a floppy-type interface—with no intelligence, no error correction—and its performance is slower. Our drive has a SCSI, it supports ECC [error-correction code] and CRC [cyclic redundancy check], and it has a much higher data transfer rate. It's about six times the price.

Will 20-MB floppy systems be used mostly for backing up?

North: If I could get 20 MB on a floppy disk, all of a sudden, disk backup becomes a viable alternative. There's a real advantage to that as well: It's random access, and you don't need to do a restore in order to get at the file.

Johnston: Traditionally, the desktop computer has been the province of either floppy disks or DC2000-type QIC [quarter-inch cartridge] tape for backup. The advantage of tape is that you get one backup per volume, so you push the button and go home. These high-capacity floppy disks are still limited to only 20 MB; until they get to an 80-MB capacity, where you can back up one hard disk onto one floppy disk, it's not really going to have a serious impact on tape.

Moran: The penetration of DC2000 tape drives—the predominant type on PCs—is less than 10 percent. That says something. It says that users aren't accepting it, and it's not because they don't believe they should back up. They're not willing to pay the additional cost to put in a third device. But when you put a floptical into a system, you relieve the burden of adding a third device because it substitutes for the standard floppy drive.

CHANGES IN MEDIA

Are there changes pending in recording media that will affect data storage?

Peterson: The big issue is whether metal particle or barium ferrite will be the next step. All of Japan is going with metal particle with the exception of Toshiba. And only the U.S. guys are doing barium ferrite. The difference has to do with signal-to-noise [ratio] and with recording technology. Barium ferrite records differently, the read/write channels are different, and the equalizations are different. Metal particle is a lot closer to the older ferric oxides.

Moran: Metal-particle media are corrosive, as maybe everybody knows and doesn't like to discuss sometimes. What happens is that iron oxide, which is rust, appears over time.

Peterson: One of the reasons Insite went to a low recording density [and narrow track pitch] is that it's hard to do a high recording density on barium ferrite. I believe that metal particle is the path that is going to result in a lower-cost drive.

Porter: Several of the Japanese companies have made it obvious that they prefer metal-powder media for 20-, 40-, and 80-MB floppy disks. It's probable that metal powder could eventually go to higher densities than barium ferrite, and that's the reason there's an argument.

Peterson: On tape, we're going through metal particle, but barium ferrite is the next path for QIC. The real evolution for tape is the metal-evaporated medium, currently in use in two product classes. The 19-mm half-inch D1D2-class helical-scan products use metal-evaporated tape, and the high-band 8-mm consumer product uses metal-evaporated tape. It's a medium that will move into 4 mm once it's commercially available. Then behind that is optical tape.

OPTICAL STORAGE

There was a lot of excitement over optical storage. Why hasn't it been more of a success?

North: The magneto-optical [M-O] technology available today is proving itself viable in desktop applications. But it suffers from a kind of identity crisis. If you need removable media or secure data, it's an excellent choice. But that's something of a niche. It's an excellent backup medium, but the cost per megabyte on the cartridges tends to exceed that of tape by quite a bit.

Porter: Erasable optical drives are at a terrible disadvantage by every performance parameter—that is, by head positioning, by latency, and by transfer rate. And, of course, the optical drive is much more expensive, typically about three times the price of magnetic drives of the same capacity.

Peterson: The medium is too expensive. And what do I use it for? There are no applications. Optical has come into an environment that has made the transition from a hardware focus to an applications focus. CD-ROM has made a dynamite market for itself because it has applications. WORM technology has made an acceptable market because it has a purpose. But M-O is still looking for a home. Without specific applications, it's always going to struggle.

What is going to turn this situation around?

Porter: Time. The power of the diode lasers is being improved. The head array, the optical element, is going to become much smaller. Probably by the end of this decade, optical will be close to parity in performance with magnetic drives. And as quantities go up, the price will come down.

Green: In the next few months, you're going to see announcements from major OEM suppliers placing optical not as an option, but as a mainstream peripheral device in system configurations.

RICHARD GREEN
Senior marketing manager for Sony

Rothchild: Cost is dropping rapidly. The retail price of 5¼-inch M-O media has been running between $200 and $250, but a price war has started to develop, and OEM prices have dropped by 30 percent to 40 percent in the last few months.

Green: Last year it was $230; now it's down to $199. In two years, it'll be less than $100. Once that price gets down below $100, I think that's going to be a turning point.

Peterson: With multimedia PCs and large imaging and graphics files, optical can find a home. A brilliant maneuver that IBM made when they announced the 3½-inch M-O drive at fall Comdex was to package it with applications; they did not just launch a piece of hardware, they gave it a purpose in life. So now, 3½-inch has found a home as a multifunction product: as a rewritable drive for image and data storage, and as an optical-ROM drive [for code and data distribution].

Rothchild: IBM's pushing it that the first M-O drives are really for floppy disk replacement and software distribution. On a floppy disk, the cost per megabyte is about $1.25; on this IBM M-O disk, it's 55 cents. In fairness, you could buy OEM floppy drives for $75, whereas the initial OEM price of a 3½-inch M-O drive is going to run between $800 and $1000. You need to look for media-intensive applications to cost-justify optical on that basis alone.

What's the next step for optical, in speed and capacity?

Rothchild: For 1992 and beyond I'll give you two scenarios, one with 5¼-inch optical and one with 3½-inch optical. Beyond that will probably be 2- or 2½-inch optical. For 5¼-inch next year, we're looking at 650 MB to 1 gigabyte per double-sided cartridge; in access speeds, anywhere from 45 ms for the fastest up to 75 to 80 ms for the slowest viable ones. Today, the numbers range from 48 to about 110 ms.

Green: Sony, IBM, and Nakamichi have now announced 3½-inch drives with 128-MB capacity. That's where we're going to start seeing tremendous growth in the general marketplace, the development of the 3½-inch optical drives.

continued

Rothchild: On 3½-inch next year, we'll be looking at two different capacities. The first generation is 128-MB single-sided, and we should be seeing the first of the second generation, which will be double that. They'll be single-sided also, but twice the density because they use what's called M-CAV [modified constant angular velocity] format, which adds extra sectors to the outer radii. Access times in 1992 will be running between 20 and 35 ms.

Green: The generation after that will be somewhere in the 400-MB range, also single-sided.

Rothchild: The next jump for 5¼-inch is to a gigabyte per side; we're about a year or two from that. That may require shorter-wavelength lasers. The shorter the wavelength, the smaller the spots you can make on the disk, and the tighter the track pitch.

How big will optical disks get?

Rothchild: The capacities possible this decade could be anywhere from a 40-times improvement up to a few-hundred-times improvement. Conservatively, this decade you could be looking at 20 gigabytes per side on a 5¼-inch disk and several gigabytes per side on a 3½-inch disk.

I mention per side because eventually you will see double-sided 3½-inch disks, even if you do not see double-headed drives. People are talking now about introducing double-sided 3½-inch media by next year. And two-headed 5¼-inch drives have been shown privately in Japan.

The size of choice will be 3½-inch, but 5¼-inch won't die. It'll be in an upscale niche market. Because all 5¼-inch disks today are double-sided, and double-headed drives will be feasible in the 5¼-inch a lot sooner than they will be in a 3½-inch, eventually 5¼-inch is going to replace some of the applications that currently are being addressed by 12-inch WORM.

DAN STERNGLASS
President of Databook

Is WORM doomed by rewritable optical?

Green: I don't think WORM is doomed, but its growth is certainly going to be stopped by multifunction drives. In the technique that Sony and HP have developed, you use a rewritable optical medium with special encoding and protection to make it write-once. But in a lot of peoples' eyes, write-once means an ablative medium, so there will be a need for what people perceive as true WORM until they feel comfortable with the new multifunction technology.

Tell me more about these multifunction drives.

Rothchild: There's the sampled servo drive made by Pioneer, and the Sony/HP, which is continuous composite, and the Panasonic, which is not M-O at all but phase change. Even though the initial sales have been disappointing, there'll be a lot more of these introduced because for most drive makers it now seems obvious that it's the way to go. Long-term, say by 1995, we would expect that the multifunction drives will equal and pass sales of dedicated rewritable only. And once you've got a multifunction drive, there's no reason whatsoever to continue to make a write-once drive. Write-once drives may be doomed, but not the write-once medium. It will go on in multifunction drives.

What changes will occur to optical media in the future?

Rothchild: Direct overwrite. That'll be the next big deal. Currently on M-O, it can take up to five disk revolutions for a write operation. You can do it in one revolution with direct overwrite, which exists today in the phase-change technology and has been demonstrated publicly on M-O but won't be available commercially for one to two years. The next big change in the medium will be when we go from the current infrared or red lasers to blue, or a wavelength of roughly 400 nanometers. That's coming later in this decade. It will require a very different medium.

Peterson: I really think phase change is the medium we'll end up with, principally because it's lower cost. Also because it allows direct overwrite. But we have to get through the mythology over how many times you can overwrite: The reality is you don't do it very many times. Even 100,000 is a huge number in a specific area.

What else is on the horizon?

Peterson: The real product in my opinion is CD-ROM rewritable with a phase-change medium. You're looking at a $300 to $400 drive and a medium under $10. That's going to be the real product, in terms of something really opening up the volume.

Rothchild: A number of companies are developing rewritable CDs. Sony demonstrated them over a year ago, in fact even showed one in a battery-powered portable to really rub it in that they've got the technology developed. Long-term you can expect this to be a consumer product.

How soon is this going to happen?

Peterson: Very soon. Two years. It's being actively worked on right now. I'm going to make a prediction here: Some people would say that 3½-inch optical might be the next software distribution step, but I'm going to say it'll be a small-form-factor rewritable CD. It could be the next floppy disk.

Rothchild: It's not a question of development of technology, it's a question of the copyright issues and when to bring this on the market. When the copyright issues are solved, you can expect everybody and his grandmother in Japan to jump in with recordable CDs.

Is there a future for dye polymer media, like Tandy's THOR?

Rothchild: I think THOR is dead as an optical technology. Tandy has got some severe technical problems to overcome. No one has ever successfully introduced an erasable dye polymer technology. The Tandy technology is supposedly good for a few hundred erasure cycles, which on an audio disk is perfectly fine. You

BIG NEWS

Announcing The World's First DBMS With An Object-Oriented 4GL

Professional developers agree, DataFlex 3.0 is the ideal application development environment for simple and complex commercial applications. By combining a flexible, full-featured object-oriented 4GL, WYSIWYG application generator, and a powerful database management system, in a single, integrated package, DataFlex represents a radical improvement in the process of application development. ***"Its comprehensive set of built-in productivity tools and utilities make creating large, complex applications much easier, much faster, and much more economical than with any other development system available today."*** *Jerry Busick, President, DataModes, U.S. Software Development Company.* ***"I design the forms in the WYSIWYG screen painter and DataFlex automatically generates and compiles the code. I can run the finished application in minutes!"*** *Tony Figueiredo, Systems Analyst, Laurentian General Insurance Company of Canada.* ***"Reusable procedural and object-oriented command modules including forms, tables, editors, prompts, pull-down menus, action bars, and scrollable selection lists from the built-in library save substantial development time."*** *Paul Wu, M.I.S. Director, Associated Press* ***"DataFlex 2.3b was already a powerful and stable product. DataFlex 3.0 has reduced our development time by more than 25%!"*** *Craig Bilodeau, Systems Programmer, Raytheon Company.* See how you can eliminate time-consuming drudgery and port to all the most popular supported environments,* by calling us now for more information on DataFlex 3.0.

DATAFLEX 3.0

For more information in the U.S., call us at 800/451-FLEX or contact one of the following International distributors:

Switzerland ABACUS RESEARCH AG 41-71-259-325	***Singapore*** BIZPOINT SYSTEM PTE LTD 65-775-5588	***Canada*** CANVEON SYSTEMS 416-226-2181	***Germany & BeNeLux*** DATA ACCESS EUROPE GmBH 49-6172-75014	***United Kingdom*** DATAFLEX SERVICES LTD 44-71-729-4460
Scandinavia EUROSOFT AB 46-300-195-30	***Mexico*** INFO-RED 525-545-6327	***Brazil*** INTERCOMP LTDA. 55-11-872-9266	***Italy*** LAN SYSTEMS SRL 39-51-437-025	***Spain*** S E I 341-402-2298

* Currently multi user DOS, and soon to be ported to a variety of other environments including OS/2 and UNIX

® DataFlex is a registered trademark of Data Access Corporation.

DATA ACCESS
CORPORATION
14000 SW 119 Avenue
Miami, Florida 33186
305/238-0012

For information via CompuServe: GO DAC

Circle 30 on Inquiry Card (RESELLERS: 31).

don't need the millions of cycles you get on M-O.

What's happening with optical cards?

Rothchild: It is almost impossible to predict whether optical cards are going to be a major industry or not. The whole concept behind the Drexler Technology card system is cheap and dirty: low capacity, low performance, and low price on the reader/writers and cards. At the moment, they range from 2 to 3 MB. Other companies have proposed cards with up to 500 MB. Canon has taken a license from Drexler and has a 2-MB card using its own medium. There's a consortium of five companies in Japan that also took a license to second-source. The optical card is taking off initially in Japan, primarily for medical records, and there's a major test going on in hospitals in Italy and England. Mass production is likely to come in the next one to two years from the Japanese.

Will optical cards be a computer storage medium?

Rothchild: Possibly for software distribution. But I think 3½-inch optical and CD-ROM are more viable because they have much faster access times and data rates. Almost all of the optical cards work on an *x-y* axis read and write.

Dan Sternglass: I don't think it's mass storage for a portable. It's data distribution. The ability to carry multimegabytes on a thin, flexible card that goes in your wallet—there are definitely niches for that, but it's not portable PCs.

Rothchild: We'll see some further development of optical cards, but I would have to say at this point it's not mainstream. It's certainly not in the small computer market.

How do optical cards compare with IC memory cards?

Sternglass: There's a tendency among people who are familiar with the Drexler card to ask how we can compete with that. For certain types of applications, we don't compete. The difference is that the memory card is entirely electronic and can be interfaced using a single ASIC [application-specific integrated circuit]. It's ideal for high-speed random access at low power.

But if you want to carry your medical life history around with you and read it on a desktop computer at the hospital, you don't care how much power it takes or how big the reader is. I'm sure that flash memory will never get that cheap in cost per megabyte. But the laser cards are serial, they're slow, and they require a bulky and relatively high power read/write device.

TAPE BACKUP

Tape backup is a hot area right now. Do you think there will be a clear market winner between QIC, 8-mm, and DAT?

Peterson: I don't know that there will be a shakeout. I think that there is a very clear market segment for all of them. There's a lot of overlap and lots of reasons why each technology has found a home. I would give helical scan the winner's cap for the capacity race at this point, but longitudinal tape still has the performance characteristics.

ROSS JOHNSTON
Founder and vice president for planning and development of R-Byte Corp.

But the real volume tape product now is QIC, and that isn't going to change. I see 4-mm [DAT] coming in second. Teac's digital data cassette is still ahead of 8-mm, but it's a pretty close race. The 8-mm will continue to grow and will displace digital cassette in the hierarchy. But there isn't a case where one's going to win out over the other.

How will these tape formats be improved in the future?

Johnston: DAT will go higher in density, and it will also go higher in capacity. The transfer rate is not at all limited by the current state of the art; for instance, we are going faster today, and we can continue to go even faster without impacting the mechanical technology.

Peterson: There are two basic factors that will enable DAT to move up in capacity: making the track pitch smaller, and putting in longer tapes. Ninety-meter tape is now being announced, and there will be 120-meter tape within this two-year period. I have no problem seeing 4-mm make a few more substantial capacity steps. There's an awful lot of R&D going into 4-mm, so I have to give it some credibility. In 8-mm, you've got 5 gigabytes now, and they're talking about an 8-gigabyte step and a 15-gigabyte step.

Johnston: Exabyte has a distinct advantage over DAT in real estate, or area of the tape. If the bits per square inch were the same, you'd just physically store more data on 8-mm tape. In QIC, on the other hand, they have a much greater problem in their technology because it isn't helical scan, it's longitudinal. So the physical area of the tape is greater than the other two, but utilization of the surface area of the tape is not as efficient.

Peterson: QIC has got a plan that says it's going to 6 gigabytes in the 1993 time frame on full-size data cartridges, and 2 gigabytes in the same time frame on mini cartridges. Will they achieve that? I've got reason to believe that they are finally getting there, a year or two late from what they have previously said.

Are any new tape technologies coming along?

Johnston: That's quite unlikely. DAT is not tapped out, nor is helical-scan recording in general. It can continue to grow in capacity as well as performance. Maybe optical tape, but it's a technological push to get it to work. In maybe 15 or 20 years, if they get it straightened out, that may be viable as well.

Peterson: I don't see any new tape technology around the corner, except the Philips digital cassette and optical tape. And I don't think the digital cassette will be used for data applications.

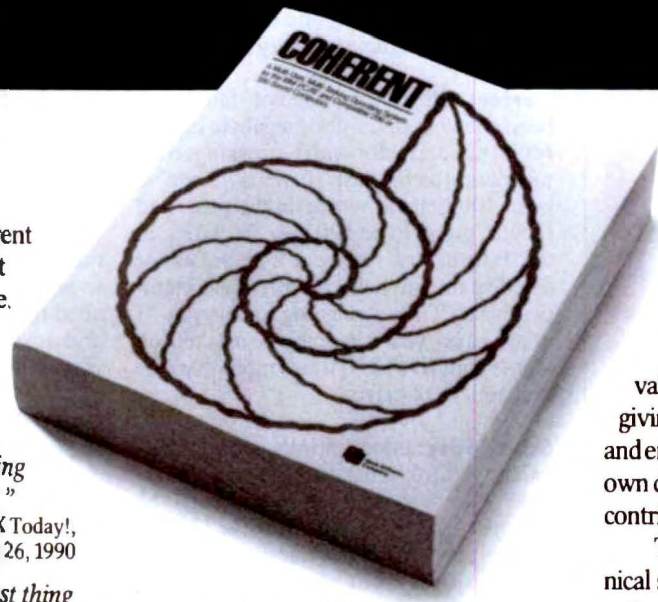
SILICON STORAGE

Flash memory and IC cards have gotten a lot of attention recently. What kind of role are they going to play in the future?

Johnston: Silicon memory is going to become more prominent. It will still be much more expensive than magnetic systems, of course, but it will have the advantage of increasing performance in the

"I can't believe it's not UNIX."

– Sean Fulton, UNIX Today!



Take it from the critics, Coherent is so close to UNIX, you won't believe your eyes. Or the price.

"Mark Williams Co. seems to have mastered the art of illusion; Coherent comes so fully qualified as a UNIX clone, you find yourself thinking 'I can't believe it's not UNIX.' "
– Sean Fulton, UNIX Today!, November 26, 1990

"...(Coherent) may be the best thing that has happened to UNIX yet."
– William Zachmann, PC Week, November 5, 1990

"If you want to come as close as you can to real UNIX for a low price, COHERENT can't be beat."
– Warren Keuffel, Computer Language Magazine, November 1990

"If you want a UNIX-like development and learning system for less than $100...I don't see how you can go wrong with Coherent."
– David Fiedler, BYTE Magazine, November 1990

OVER 25,000 USERS, AND MORE EVERY DAY!

Why is Coherent now the world's best-selling UNIX clone?

	MWC COHERENT Version 3.2	SCO XENIX 286 Version 2.3.2.
No. of Manuals	1	8
No. of Disks	5	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	$99.95	$1495.00

*Byte Execl benchmark, 1000 iterations on 20 MHZ 386. Hardware requirements 1.2 meg 5¼" or 1.4 meg 3½" floppy, and hard disk. Does not run on Microchannel machines.

NEW RELEASE 3.2

$99.95*

Because like the original UNIX, Coherent is a powerful, multi-user, multi-tasking development system with a complete UNIX-compatible kernel and C compiler.

Features include Lex and Yacc, a vi editor, SCSI support and UUCP capabilities.

And Coherent comes with a full set of over 200 UNIX commands including text processing, program development, administrative and maintenance functions. All of it fully documented in our highly acclaimed 1200 page manual.

WHAT UNIX WAS MEANT TO BE.

Unlike current versions of UNIX, Coherent is lean and efficient. Small and beautifully powerful, the way UNIX was originally designed.

Coherent runs on affordable 286 as well as 386 and 486 based IBM-PCs and compatibles with space to spare. Enough space to keep DOS co-residing on your hard disk.

And it's so fast to install, so fast to learn and just so fast, Coherent leaves UNIX in the dust.

HARD TO BELIEVE? IT KEEPS GETTING BETTER.

Coherent gives you more value from the start and keeps on giving. Like regular updates with new and enhanced features. Our write-your-own device driver kit and COHware, contributed software on diskette.

There's also on-going free technical support via telephone. An active user network and a UUCP Bulletin Board System. *Plus, with our new 3.2 release:*

- A new Korn shell with sophisticated command-line editing.
- Postscript and PCL support for troff adding access to hundreds of new fonts.
- Improved UUCP support.
- International keyboard and character set support.

TAKE 60 DAYS TO CONVINCE YOURSELF.

Will you agree with the critics and Coherent's 25,000-plus users?

Try it. And if you don't think Coherent is everything you ever wanted in UNIX, we'll refund your money. No problem. No hassle.

You can't go wrong. So get to a phone, FAX or mailbox now and order Coherent today. At $99.95, it's unbelievable.

1-800-MARK WMS

(1-800-627-5967 or 1-708-291-6700)
FAX: 1-708-291-6750
60-DAY MONEY BACK GUARANTEE!

Mark Williams Company
60 Revere Drive
Northbrook, IL 60062

*Plus shipping and handling. Coherent is a trademark of Mark Williams Company. UNIX is a trademark of AT&T. XENIX is a trademark of Microsoft.

system. But the likelihood of having silicon replace magnetics is very, very low.

Porter: The semiconductor fans have been showing price-per-megabyte curves for semiconductor stuff crossing over magnetic for the last 10 years. They've been 100 percent wrong in the past, and they're going to be 100 percent wrong in the future. Let's project that in two or three years you have 10-MB flash memory cards. Those are going to cost you—I don't care what these guys are telling you—from five to 10 times more than the magnetic disk drive.

Sternglass: I don't think anybody realistically thinks that the cost per megabyte of memory is going to approach the cost per megabyte of hard disk. That's not the issue at all. The question has to do with what the word *performance* means to the end user. Performance has a lot of components to it: the weight of the machine, the size of the machine, the battery life. Speed per se is not the selling point with memory card systems: It's usually the light weight, which derives from the low power consumption and smaller batteries.

How cheap will silicon memory get?

Sternglass: There will be major price competition. Intel is not the only flash memory maker. I believe that $100 a megabyte to the end user will be attainable in 1992, which is somewhere between 30 percent and 40 percent of what it is today.

Porter: The big hazard for the flash memory guys will be the next generation of 1.8-inch disk drives, which will be available in a year. The 2-pound computer will be mostly equipped with 1.8-inch 20-, 30-, and 40-MB hard drives.

Sternglass: Jim Porter made a pretty good point that the 1.8-inch drives are coming, and they're small and light. But they have essentially no lower power consumption than the 2½-inch drives. Maybe 20 percent or 30 percent, but not an order of magnitude, like the memory cards. The reason you would go to a memory card in the first place is because you want to reduce the power consumption of the system so you can throw out several pounds of nickel-cadmium batteries and replace them with a couple of AA batteries.

What other opportunities lie in the future?

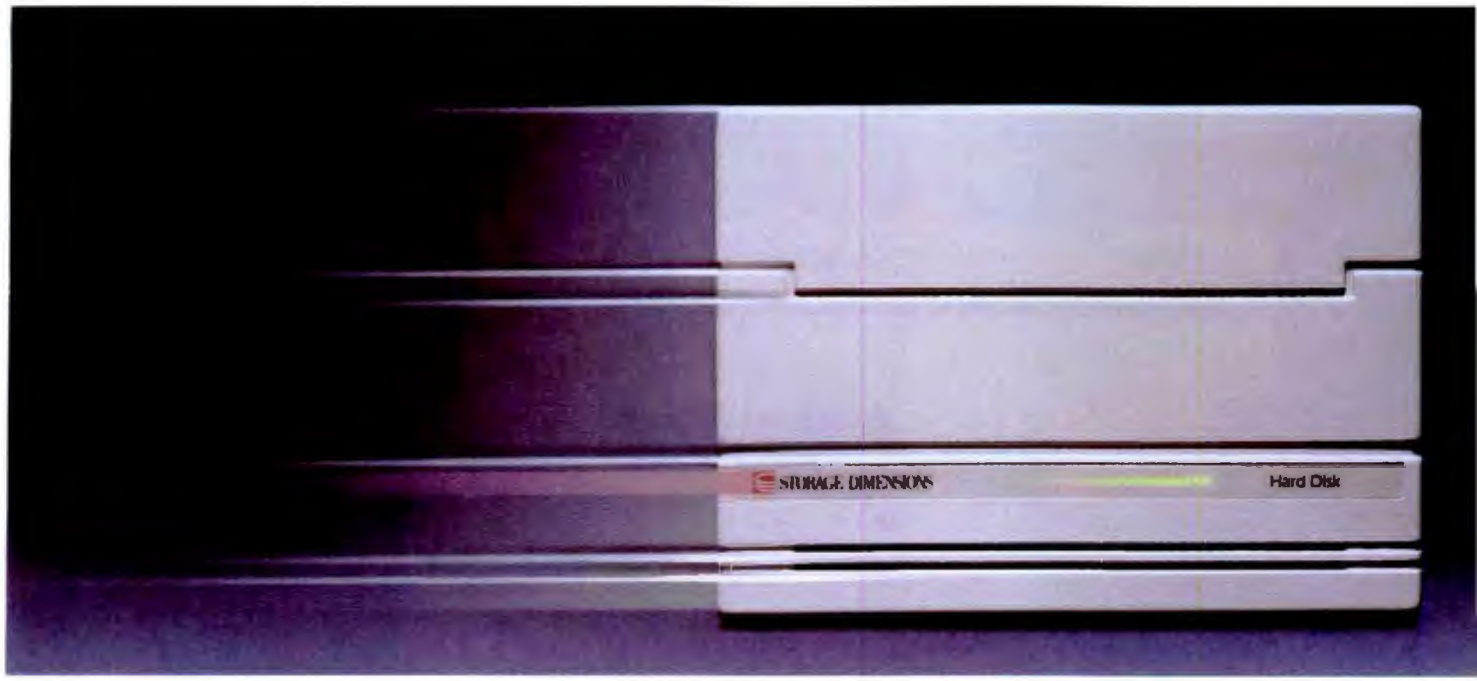
Peterson: One of the messages I have for the industry is to look at the opportunities downsizing brings for noncomputer applications. Take one simple example: We are starting to see disk drives in the integrated printer/fax, document-imaging-type machines. We are seeing tape drives in copiers now for image capture. There are all sorts of interesting noncomputer applications that are going to grow out of all of this, so that people need to go into this with their eyes open and to look for opportunities everywhere. ■

PARTICIPANTS

- ***Richard Green** is the senior marketing manager for Sony's rewritable optical program in San Jose, California.*
- ***Ross Johnston** is the founder and vice president for planning and development of R-Byte Corp., a maker of DAT tape drives in San Jose, California.*
- ***Bo Larsson** is the vice president of Sony's Magnetic Storage Products Division in San Jose, California.*
- ***Chuck Moran** is the vice president of marketing and sales for Insite Peripherals, a developer of very high capacity floppy disk drives in San Jose, California.*
- ***Bill North** is the director of LANStor product marketing for Storage Dimensions in San Jose, California.*
- ***Mike Peterson** is the president of Peripheral Strategies, a market research consulting firm in Santa Barbara, California, specializing in removable-media data storage and applications.*
- ***Jim Porter** is the president of Disk/Trend in Mountain View, California, a market research firm specializing in magnetic and other mass storage.*
- ***Ed Rothchild** is the chairman of Rothchild Consultants, a San Francisco–based consulting and publishing firm specializing in optical storage and imaging systems.*
- ***Dan Sternglass** is the president of Databook, a developer of IC memory card products and interface software in Ithaca, New York.*

Andy Reinhardt is a BYTE news editor in New York. You can reach him on BIX as "areinhardt."

Just When The Competition Thought It Was Catching Up.



The New Series 1300.™

Defining the Next Standard for Storage.

Storage Dimensions' Series 1300. More speed, more capacity and more reliability than any storage systems you've ever used.

At the heart of every Series 1300 model is a drive mechanism with remarkable specifications. 11.5 ms average seek time and 5400 RPM spindle motor to dramatically improve access to your data. 1.3 gigabytes formatted capacity. And MTBF ratings that can be measured in decades. But it takes more than just numbers to set a new standard.

PERFORMANCE MATCHED · FOR
NetWare
OS/2 UNIX
Macintosh

Mainframe Capacity and Performance.

It's what you do with the numbers that counts. Our Series 1300 has transformed them into storage solutions with unparalleled performance and reliability. We applied our fully integrated, systems engineering approach to the design. We added our advanced 16- and 32-bit bus master adapters. And we incorporated the latest performance innovations in our device drivers to nearly double the work your system can do.

Our Series 1300 is available today for NetWare,® OS/2,™ UNIX® and Macintosh,® in subsystem capacities from 1.3 to 5.2 gigabytes. To build systems to over 36 gigabytes. Now those are numbers — mainframe level numbers — your systems can *really* put to work.

Stay Ahead of the Pack.

Cutting edge technology. Innovative design. Comprehensive systems focus. Three reasons our Series 1300 is the latest example of how the Number One company in network and desktop storage stays in front. Call toll free **(800) 765-7895**. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.

STORAGE DIMENSIONS

Circle 147 on Inquiry Card.

Tanks for th

e memories.

Vaults for your information. Fortresses for your data. Whatever you call them, Sony rewritable and multifunction optical drives are extraordinarily reliable storehouses for data-intensive applications like image storage, CAD/CAM and network back up.

Our optical drives are tested to exacting specifications. And when you use Sony removable optical media, you're doubly safe, since it's tested to the same high standards as our drives.

So if having reliable access to your data is important to you, trust it to Sony optical products. Because nobody knows the technology better than we do.

For a complete catalog of Sony storage products, call 1-800-433-3422.

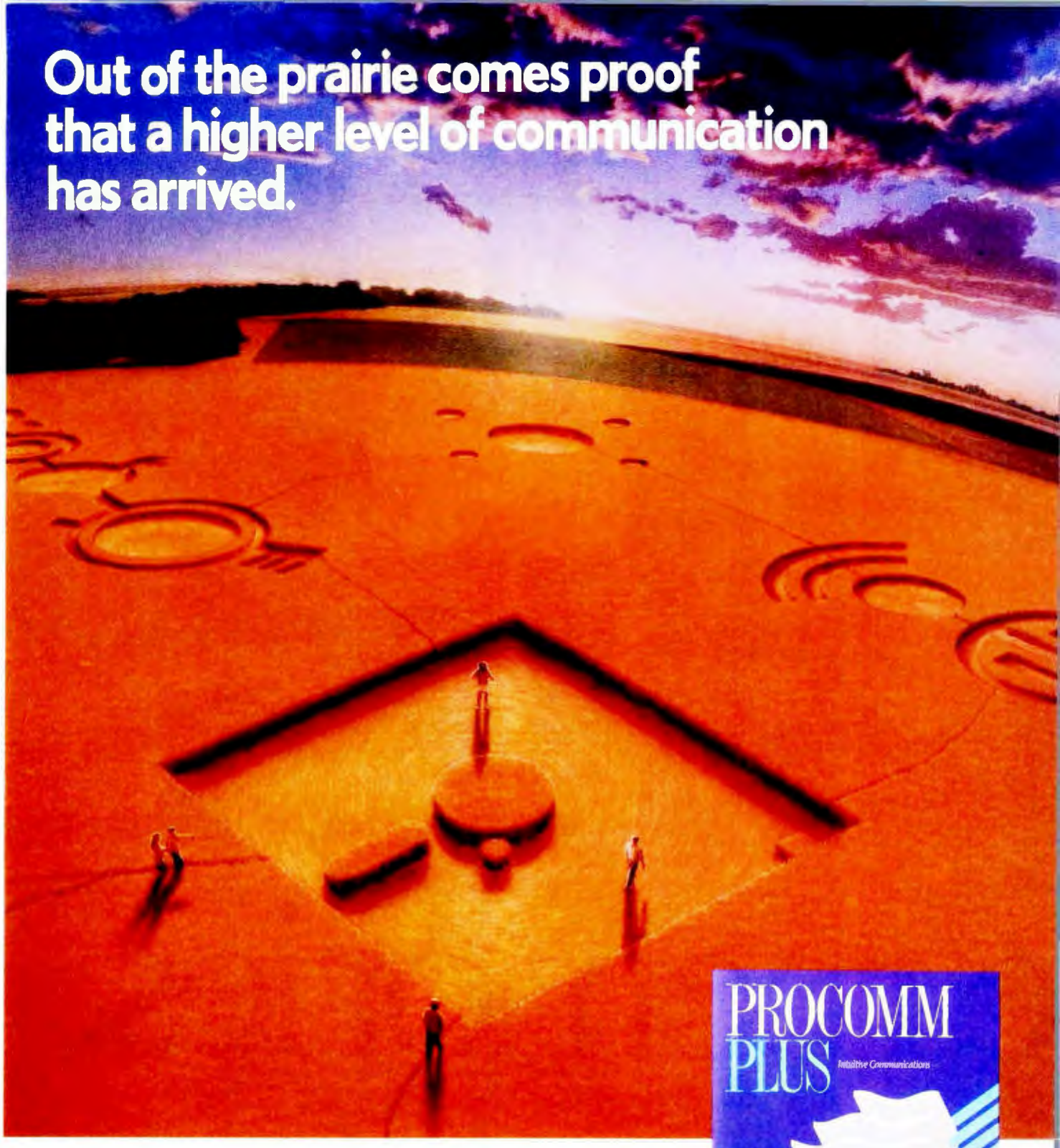
SONY

SONY COMPUTER PERIPHERAL
PRODUCTS COMPANY

Sony Computer Peripheral Products Company, 655 River Oaks Parkway, San Jose, CA 95134

Circle 145 on Inquiry Card.

Out of the prairie comes proof that a higher level of communication has arrived.



Presenting the New Version of PROCOMM PLUS.

Leaving a very big impression on the field of communications is what PROCOMM PLUS has always done best. But today, it's done one better.

PROCOMM PLUS 2.0. The new version of the best-selling communications software in the world. With internal Zmodem, an enhanced ASPECT script language with hundreds of new commands, and script compiling for much faster execution speed; an enhanced dialing directory with many new features; a time-saving Filename Clipboard (Patent Applied For); 33 terminal emulations with 132 column and full EGA/VGA support; and much more.

If you own PROCOMM PLUS, you can upgrade to PROCOMM PLUS 2.0 for just $39.00 by calling toll-free 1-800-333-4559. So call today. You'll get computer communication in its highest form. For a very down-to-earth price.

See your dealer today for PROCOMM PLUS 2.0. Current PROCOMM PLUS users: call 1-800-333-4559 now to upgrade.

DATASTORM

DATASTORM TECHNOLOGIES INC

P.O. Box 1471 • Columbia, MO 65205 • 314 443.3282

Circle 34 on Inquiry Card.

Networking: Promises and Problems

Are we a stone's throw from global interoperability, and if we are, what might be the consequences?

SHARON FISHER

The whole is greater than the sum of its parts." Indeed. Other articles in this special issue focus on the tools that individuals can use; this one, instead, focuses on bringing individuals and their ideas together. Or, as marketing people would say, on *synergy*.

Networking people tend to be both visionary and pragmatic: visionary because they have the charter to bring to fruition the sort of future that we've seen in science fiction, and pragmatic because they still have to work with what we have today. Linking two systems requires knowing about and dealing with the faults of each.

At the same time, networking people have to be aware of the way in which their inventions can be used to repress: Remember, Orwell could not have had a *1984* without networks. Nearly every participant in this article brought up the issue of privacy, as well as how networking could be used to increase citizens' participation in government. Another, more mundane, issue is that of junk mail and filtering the increasing amount of data that universal networks could bring.

For this article, I asked a cross section of industry experts questions about networking activities today and for the future. Their responses reflect some of the promises and problems of linking people and information together worldwide. Note that not all of the participants tried to answer all of the questions.

ROBERT M. METCALFE
Principal Inventor of Ethernet and founder of 3Com

What problems are keeping us from true interoperability, and how can these problems be solved?

Esther Dyson: Progress. If we stopped improving things, we could make everything interoperate fairly quickly, but people keep on innovating and improving instead of working on interoperability. It's the fight between continuous local improvements and global, static interoperability. We get continually better systems with the local improvements, but incompatibility and inconvenience are the price.

James P. Gray: True interoperability requires semantic convergence—that is, the meanings of messages transmitted across the network must match. The formats can be translated at application programming interfaces or at gateways, but no matter what, the meanings have to match. The good news is that this is happening across a wide spectrum of services in computing today; the bad news is that it is happening incrementally and, hence, not as quickly as we would like.

For example, IBM's Common Program Interface for Communications (CPI-C) allows programs to use OSI [Open Systems Interconnection] or SNA [Systems Network Architecture] without change, mail systems are increasingly able to interoperate, and many components of networks can be shared already, such as LANs. I think we are getting good results out of what is, after all, a very large, distributed computation involving all of the computer systems designers in the world. But patience is required. Complete interoperability won't happen overnight.

Robert M. Metcalfe: Interoperability is best achieved through *real* standards. Novell's IPX network protocols, for example, have been useful standards, but they are de facto standards, the evolution of which is not subject to due process.

DoD's [Department of Defense] TCP/IP network protocols have been useful standards for twice as long, but they are reaching their technological limits and lack international acceptance. IPX and TCP/IP must now give way to OSI.

The needed movement toward real standards is inexorable, but slow. Users can accelerate interoperability by demanding real standards; vendors can accelerate interoperability by shipping real standards. Each will move forward a little at a time. A key factor will be the general availability of OSI in our various operating systems—DOS, Macintosh,

Unix, OS/2, VMS, MVS, and VM, to name a few. If only we could have OSI in a really standard operating system.

Olof Soderblom: What do you really mean by true interoperability? What do we need to achieve? You're making an assumption that we are not achieving true interoperability. If you pick the components that you know fit, using TCP/IP or some logical network, there is, in fact, interoperability. If you're aiming toward "everything talks to everything on every protocol," you'll never get there. Interoperability is not an end in itself.

What's left to be discovered in networking? Or are we just going to spend time in the future linking what we already have?

Dyson: Aside from making brilliant, clever discoveries, someone has to do the dirty, uninnovative work. Two things require a lot of cleverness but no genius: automating network support and installation, and interoperability.

If you can specify how to install and run something, you should be able to do so automatically and provide a usable interface so that network administrators don't need to be professionals. I call this hypothetical tool "Janetor"; it is an expert system and scripting tool that contains modules for every known network system (both wide area and local). The right modules load automatically, and it converses with users in intelligible menus. It takes only a few questions to hook up anything and to find out what any given user wants to do, and then Janetor makes it happen (within limits of installed equipment, security, privacy, and budgets). Of course, each vendor has to supply Janetor with the appropriate information on interfaces, protocols, and installation routines.

As for interoperability: If you're willing to tolerate slow performance, there's always a way for two systems to work together, although not necessarily well. Since we won't ever get everyone to agree on standards (thank goodness), we should probably work harder on facilities for interoperability (Janetor, for example).

JAMES P. GRAY
Manager of SNA studies at IBM

Gray: There is a whole class of network technologies that is on the verge of becoming important and that will enable us to build a universal service network. Chief among them is packet technology to serve "circuit-switched" applications. The looming change requires us to recognize that every use of a network has service needs that can be quantified along these axes: speed, delay, jitter, bit-error rate, data-loss rate, cost, and connection setup time.

If we recognize this, the next item to consider is what kind of network is able to provide a universal service. Clearly, the answer is networks that have the greatest transmission efficiency. Two techniques for attaining this that the industry is keying on are fixed-length cells and variable-length packets.

My guess is that the latter will be the right answer when a suitable bound is placed on the maximum length of the packets.

Metcalfe: This may not be what you were looking for, but against a backdrop of increasing speeds we must, again, converge on standards and then invest in a worldwide information infrastructure.

Here is my view of past and future computer networking history:

- 1970s—Wide-area (as in ARPANET among minicomputers)
- 1980s—Local-area (as in Ethernet among personal computers)
- 1990s—Internetwork (hubs, bridges, routers, gateways)
- 2000s—Interenterprise (especially standards-based EDI)
- 2010s—Infrastructure (huge government investments toward "superhighways")
- 2020s—Ubiquitous (into homes, as computers disappear into the woodwork)

Soderblom: There's a big void that has to do with high-bandwidth wide-area networks. The problem we're running up against is very high bandwidth LANs that want to talk to very high performance mainframes, but the bandwidth required isn't available. We're talking about hundreds of megabits. I am convinced the mainframe is here to stay and will be the major source of computing power for the foreseeable future.

OLOF SODERBLOM
Vice chairman of Willemijn Holding BV

What's the biggest technological hurdle today that needs to be solved?

Dyson: Complexity and scale. I don't think there's one missing algorithm that could solve everything. We just need to keep improving. Standards help, but they also impede progress.

Gray: Without a doubt, the biggest unsolved technical problem today is seamless interoperability at the transport level. But progress is being made, as evidenced by the work the XOPEN Consortium is doing to help define an interface (XOPEN Transport Interface) to be used for software communications.

Metcalfe: Getting "multimedia" into our computer networks, the problem being the very large, time-sensitive bandwidths required.

Soderblom: Solving [problems] in a cost-efficient way. I think we know what the problem is, but we don't know what the solution is.

What social issues are going to crop up with increased networking, and how can they be solved?

Dyson: Social issues will overwhelm us as networks infiltrate everything we do. They'll probably be blamed for homelessness, illiteracy, drug abuse, as well as abuses of privacy, poor manners, whatever. But specifically, issues of pri-

vacy, both at work and for consumers, become significant. With more information, more access to it, and better tools for sifting through all of it, privacy will have to be protected by law and by convention, rather than by physical reality. For example, you can't look through walls, and sorting through card files and paper forms is painful work, but you can easily do a computer search. The solution, in part, is careful laws to control access and effective ways of enforcing them.

Other issues will include the access of the poor to information networks and all the benefits they bring. These are in fact social and economic issues, but now they concern information and communication instead of bread or housing.

Another issue that concerns me is the effectiveness of filtering. As an example, if right-wingers read only right-wing news, how are they ever going to change their minds about anything? (But I don't want them to be forced to read John Kenneth Galbraith, either.)

Also, advertising has been a great force behind mass media, education, and access to information. As advertisers get better and better at targeting customers, who will subsidize the public's access to information? What effect will all this have on democracy, on voting patterns, on people's knowledge of and interest in the government's activities? In general, the happier people are, the less interest they take in their government (unless they're paralyzed with fear). Will everything be controlled by special-interest groups? How can communications contribute to voting patterns, to expressing opinions, to public education—and not to indoctrination?

I think markets will work fine for dissemination of information in the commercial sphere, but I'm worried about increased segmentation of our society—without wanting the government to control the proliferation of networks, which I think can best be accomplished through market forces.

Gray: Privacy and limited government are two of the [important social issues]. We have created a vast cyberspace with our technology. It can be used beneficially (in the way that, say, the interstate highways and roads in general have increased the effective freedom of individuals) or detrimentally, to repress individuals. One hopeful technology trend is the lower cost of cryptographic technology and the potential for public key crypto systems to decentralize the security of the planetwide network.

Mitch Kapor: Privacy. Freedom of speech. What constitutes good citizenship in cyberspace? The EFF [Electronic Frontier Foundation] is working on these issues.

Metcalfe: What new form of democracy is required? Ours is 200 years old and was designed when it took weeks and even months for information to move across the country. How should we govern ourselves in a world where our president can ask the American people, say, their take on an issue, and then get their accumulated answers live, for all to see, as he talks to them on TV?

Soderblom: That's not really a network problem, but an application problem: What do you use networking for, and how do you use it? It's not really a problem of networks. The important social issue is the consequences of people not having to go to their offices. Certainly society right now is built upon people having to get from one place to another, and that will change.

Of the various hot new technologies that are getting a lot of attention these days, which one will be the most useful to users?

Dyson: Overall, tools for understanding, classifying, and automatically dealing with text and images will be of most use to people. They will help us deal with the floods of information we will create (using those same text tools, in many cases). They'll help people to overcome the increasing complexity of the world around them, for starters. (For example, feed the scanner all your receipts and financial records, and it will automatically do your taxes for you.)

All this really has to do with creating explicit models of the complexity around us, so that ordinary people can interpret and handle it intelligently. There will be more use of shared knowledge.

Gray: I think that electronic desktop conferencing has the potential to be the next "must-have" application. The displaceable costs are large, and the incremental costs of the required desktop upgrades are coming down each year. The takeoff could happen as early as 1992, but before 1995 for sure.

Metcalfe: Sorry, but my answer after 20 years is still. . . E-mail. The X.400 mail and X.500 directory standards will bring long-awaited ubiquity. EDI, graphics, images, voice, and video are creeping into E-mail, and as they do, E-mail will remain the number-one application of computer networks.

With more and more access to more and more information, how will we learn to deal with it?

Dyson: First, filtering services won't look just at words, but at all kinds of criteria like the ones you use in real life. Who wrote it? Who else read it and liked it? How many other people have cited it? Who published it? Does it have good illustrations? How many other people was it sent to? Who else is in the reader group? Does it cite other people whose work I know? How much does it cost? How much do I care about the topic? I want to read more articles with the same profile as this one, but with a little more/less on a particular aspect.

And of course, you'll be able to follow hypertext links embedded automatically, or select links placed by the editors you trust. You may also be able to broadcast requests for information and solicit custom studies and negotiate the pricing, all over a network. (American Information Exchange, owned by Autodesk, is about to launch such a system.)

You may have an agent that follows particular kinds of news for you and automatically generates you a personal newspaper that consists of a laid-out set of responses to a set of queries that are run daily. Thus, each day you could get, for example, software news in the upper right-hand corner, Bill Gates' daily activities in a box at the lower left, lacrosse on the upper left, and any mention of your own name featured in boldface type

What effect will all this [networking] have on democracy?

ESTHER DYSON
President of EDventure Holdings

on top in the center. (Apple has such a project.)

Gray: Thomas Sowell wrote a great book on this subject, *Knowledge and Decisions*, published by Basic Books in 1982. His basic point is that societies are defined by their information flows. Further, information has costs and benefits exactly like tangible items do. We can then see that the concept that we can be awash in information is false. We are not, and will not be, awash in information—we may be awash in data, in junk mail, if you will, but we won't be awash in information.

MITCH KAPOR
Founder of Lotus Development

In fact, as the costs of collecting data and turning it into information are gradually worked into the global network, various mechanisms that are latent today will come into use to protect each of us from being flooded by junk mail. Crypto may help here: If you don't send a secret code with your mail, one that I have previously given you, perhaps my personal mail daemon will file your letter in the electronic trash can. Another aid, coming to a market near you soon, is a mail reader/sorter that watches what you do with mail and gradually copies your behavior—sorting the junk mail to the bottom of the pile, and maybe eventually automatically discarding mail from a list of addresses.

Kapor: Information-filtering tools will be developed to help screen out any unwanted information. Intelligent agents will be deployed across the network to search for and retrieve any interesting information.

Also, entrepreneurs will discover that there is a market for information [brokers,] whose primary function will be to assemble bundles of useful information for people who are too busy to assemble [the information] for themselves.

Metcalfe: The ability of computers to filter information will always lag by a bit, but only by a bit, their ability to generate information. Yes, we will always dread junk mail. I urge that you not lose sleep over this problem.

Soderblom: Expert systems. There will be an interface between information and the human being—intelligent selection mechanisms and a preselection process.

How can we get the "have-nots"—countries without reliable telecommunications equipment, plus the poor and the uneducated all over the world—access to networks and networked information?

Dyson: We have to invest in them, not give them things. By investing, we will have a vested interest in our success. And the biggest investment we can make in people is education.

To businesses, educated people represent markets, customers, and workers. Businesses just have to be encouraged to see it that way. After all, the rich communities we live in are getting more and more saturated with stuff; it takes huge efforts (advertising) to get us to buy things. Poor people, if you can provide them education and jobs to earn money, will gladly spend that money to buy goods and information; they don't yet have too much.

Gray: First, let's make some distinctions that are blurred by the question. For example, individuals can have low incomes, countries can have low aggregate incomes, and businesses or individuals who have good incomes can be located in countries with low aggregate incomes. The poor individuals, for example, are concerned with how they may increase their personal incomes, while the poor countries may be concerned with how they can attain rapid economic growth. Each concern leads to different detailed questions and answers.

Technology is providing an increased range of choices, however. For example, satellite systems provide point-target communications, which can help to bootstrap overall economic development. Indonesia is an example of a country that has deployed a data communications infrastructure by using satellites.

Once some linkage to the global network is available, opportunities for trade in knowledge are created. For example, businesses in India now offer programming services that are delivered by network to customers in the U.S. Of course, wise economic policies and political stability are necessary prerequisites for technology to take hold and bring real benefits. Countries such as Japan, Korea, Taiwan, and Singapore have succeeded by applying the same methods that Europe, the U.S., Canada, and others applied earlier: free markets within the context of stable law, private-property rights, and stable money.

Metcalfe: Let's get them fed and educated first. Getting networks to the third world has to be far down on our list of problems. No, I do not think that telecommunications holds any real early potential for solving problems that have, for example, endured Christian charity for two thousand years. I find more hope in the demise of communism than in the rise of networking.

Soderblom: Satellites. Not that they're a particularly good way of networking, but it's a cheap way of installing a wide-area network.

If you could work on any sort of networking problem right now, what would you want to work on?

Dyson: In my own way, I already am. The problem is getting effective telecommunications capability into Central and Eastern Europe, so that other kinds of businesses will be willing to go [into these regions] and invest and prosper. (This is my own particular area of interest, but the world needs individuals working on specific problems they care about, not spurious global solutions.) The way I'm doing so is by providing information about what's happening, helping people to find each other, and in general oiling the joints of the invisible hand. As usual, technology is the smallest part of the problem. Inertia and uncertainty are the real issues.

Gray: Right now, the teams I spend the most time with are working on two closely related problems. First is interoperability, especially of transport networks. This could be called the multiprotocols transport network problem. Second is the creation of networks able to carry any class of traffic whatsoever, including digitized HDTV at 20 Mbps to and from the desktops of everyone in the network. We might call this the universal desktop problem.

BY AIR MAIL
PAR AVION

Place Stamp Here

BYTE

McGraw-Hill Information Services
McGraw-Hill House
Shoppenhangers Road
Maidenhead, Berkshire SL6 2QL
England

Attn: International Circulation Department

BY AIR MAIL
PAR AVION

Place Stamp Here

BYTE

McGraw-Hill Information Services
McGraw-Hill House
Shoppenhangers Road
Maidenhead, Berkshire SL6 2QL
England

Attn: International Circulation Department

Kapor: I'm working on increasing access to the Internet by ordinary computer users. This includes policies that promote increased access, easier-to-use tools, and public education about the subject.

Metcalfe: I really can work on any sort of networking problem right now, and I am choosing to work on understanding and communicating the early history of computer networking as a guide to the momentous events ahead. ■

PARTICIPANTS

- *Esther Dyson is president of EDventure Holdings. She also writes* Release 1.0, *a newsletter that covers the computer business (especially PCs) with primary focus on software and software design, text manipulation, legal issues, and the transformation of AI into a commercial technology.*
- *James P. Gray has contributed to microprocessor architecture and to several portions of SNA. He holds a B.E. in electrical engineering and a Ph.D. in communications theory from Yale. He was named an IBM Fellow and manager of SNA studies at IBM.*
- *Mitch Kapor is founder of Lotus Development. With John Perry Barlow, he also founded the Electronic Frontier Foundation, an organization committed to making sure that the Bill of Rights applies to the field of electronic communications.*
- *Robert M. Metcalfe is the principal inventor of Ethernet, the local-area networking technology on which he shares four patents. He worked for Xerox Palo Alto Research Center, founded 3Com, and received the Association for Computing Machinery's Grace Murray Hopper Award and the IEEE Alexander Graham Bell Medal.*
- *Olof Soderblom, a native of Sweden, holds several patents, most notably for the token ring. He is vice chairman of Willemijn Holding BV, with primary responsibility for the token-ring licensing program, and chairman of Compass Holding BV, with responsibility for corporate and product development.*

Sharon Fisher is a San Francisco–based freelance writer specializing in data communications. You can contact her on BIX as "sharonfisher."

This is your dot matrix, printing.

This is our new quiet 2624, printing.

This is the one you've been waiting for. Panasonic® presents the first of a new generation of quiet dot matrix printers.

The KX-P2624 wide-carriage.

It doesn't scream, it whispers. Through multi-part forms, those 'industrial strength' spreadsheets, and your customer correspondence. And does them all with ease, speed and the superb reliability we've built a reputation on. It has all the features you've come to expect from the leader in dot matrix printing. And then some. One super letter-quality and seven letter-quality fonts. Multiple paper paths. An LCD display. A top speed of 300 cps in draft mode, 100 cps in letter quality. A two-year limited warranty on parts and labor.* And serene quiet.

For more information call us toll-free: 1-800-742-8086. Or, better yet, see your Panasonic dealer.

You'll like what you don't hear.

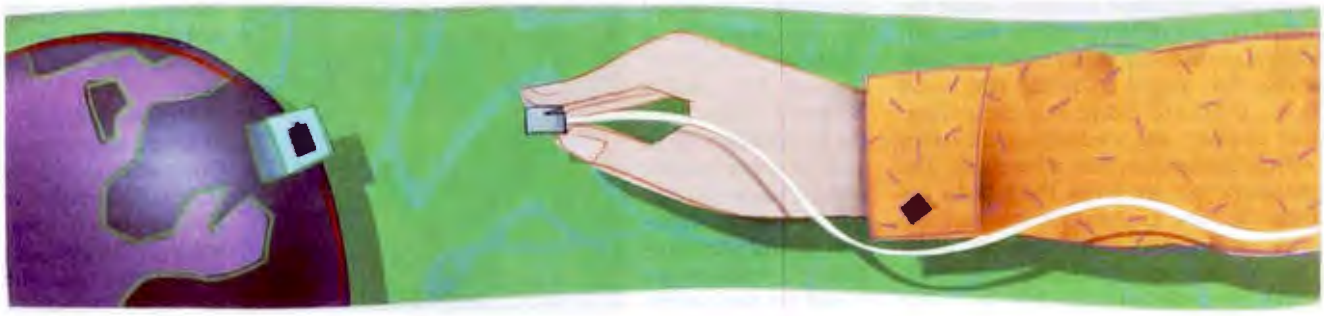
Printers, Computers, Peripherals, Copiers, Typewriters & Facsimiles

Panasonic
Office Automation OA

PQ8-BY

*See your dealer for details.

Circle 117 on Inquiry Card.



Are On-Line Services Delivering?

For the most part, yes, but it usually depends on your interpretation of what's being offered

MICHAEL A. BANKS

On-line service usage is at an all-time high in both the number of users and the amount of time spent on-line. Just as personal computers have become an integral element in the daily lives of almost everyone in the U.S. and most other industrialized nations, on-line services promise to touch almost everyone.

When will this happen? Probably not by the end of the century, and perhaps not for a couple of decades. But on-line services are no longer the province of techies and the "plug-and-go" users who dial up database services as a part of their workaday chores. The word is out on on-line services, and they are rapidly becoming identified with personal computers.

RUSTY WILLIAMS
Vice president of sales and marketing for Delphi

Thanks to the computer virus scares of the late 1980s and more recent adverse and somewhat misleading publicity in business and consumer publications involving BBSes and other commercial services, even the non-computer-using public is at least aware of on-line services—and they're curious. The high profile of on-line services, coupled with the decreasing cost of hardware, software, and the services themselves, form the foundation of a trend that will culminate in on-line services' being as popular as personal computers.

The Way of the Future

In the late 1970s and early 1980s, the only people who used on-line services were those who used the big database and information-retrieval services for research—and the more technically oriented, who were after free software and being on-line for its own sake. This is less true today. A minority of dial-up modem users are logging on to research obscure technical databases; to get specialized information, like commodities prices; to download the latest from on-line newswires; and to do their banking and shopping.

On-line services and industry experts still attempt to project a serious image—though not as heavily as they used to. The flashy ads and press releases nowadays are more likely to tout the latest on-line game or full-text newspaper or magazine database than time-delayed commodities quotes. The myth of seriousness is gently perpetuated, but the grass-roots constituency of the on-line world—those who sit at home in front of their computers with their modems keeping the telephone lines singing every night—seem to be more interested in games, communicating with other users, and researching information for personal or vocational reasons than they are in checking grain prices.

Steve Case, CEO of Quantum Computer Services, agrees that the on-line world is not what it was first projected to be. In talking about America Online, one of Quantum's services, he says, "It is not the kind of on-line information service that was envisioned five years ago." Case sees the real value, at least for consumer services, as in how interactive a service is (i.e., how much of a service involves two-way communication and user interactivity). The interactive elements can range from game-playing to real-time conferencing to messaging—anything that gives a user feedback. "With an interactive service," Case says, "the value increases in proportion to the number of people using a product."

It comes down to this: On the commercial services, people devote far more on-line time to what the 1980 image of telecomputing would have considered less-than-serious activities. And they devote that time in large part to analogs of more

ILLUSTRATION: JOHN NELSON © 1991

informal real-world activities. Once the initial novelty of being on-line wears off, people go on doing pretty much the same things that they'd do in the real world (e.g., checking the news, researching, and chatting and exchanging messages with acquaintances and colleagues). The reason people are doing these tasks on-line is because it offers more convenience and ease and a lot more bells and whistles. Another reason is because there are many products and services available that have no off-line counterpart.

Delivering on Their Promises?

Amid growing awareness of on-line services and their increasing utility and accessibility, it is prudent to question whether on-line services are delivering on their promises. What are these promises? What do on-line service users want? What about the future of on-line services?

To answer these and other questions, I spoke with several people in the business—including on-line service managers, information providers, and consumers. A clear consensus emerged from the discussions, along with some interesting

MARTHA GRIFFIN
Program manager for Prodigy

concepts on the current and future state of on-line services.

Promises are implicit in advertisements for on-line services, but services advertise no more than they can deliver—most deliver quite a bit more. What's promised is, of course, open to interpretation, as evidenced by the daily spats between customers and on-line service management. Documentation and on-line service content imply certain promises, and this is the source of some misinterpretation. In view of the problems that are sometimes caused by, for example, a customer's interpreting a public-access BBS as an open vehicle for anything up to and including slander and personal attacks, not to mention tasteless drivel and profanity, customers would do well to examine exactly what a service promises in its user agreement and how others use the service.

Inferences, Perceptions, and Reality On-Line

Popular perceptions often get in the way of a clear interpretation of what a service is promising. This is why GEnie's director of marketing Neil Harris says, "It depends on who made the promises," referring to his statement about the predictions made by analysts and others in the early 1980s: "On-line service customers often have preconceived notions of what an on-line service should be and infer 'promises' therefrom."

This points to a larger truth: Customers should pay attention to the stated promises of on-line services rather than to inferences or popular perceptions.

Customer Feedback

Customer surveys support this idea. According to Rusty Williams, vice president of sales and marketing at General Videotex, "On-line services have lived up to their promises, and in many ways exceeded them. We recently conducted a survey on Delphi, which was developed by the Videotex Industry Association, to collect information about user satisfaction industrywide. Of course, many people had suggestions for additional features, but on the whole, they were very happy with the [service's] value."

Martha Griffin, communications program manager at Prodigy, also agrees that service finds a high level of customer satisfaction in surveys: "We've done surveys of customer satisfaction, and the satisfaction level of our members is around 95 percent."

Richard Ream, Dialog's vice president of worldwide sales and service, reports that his service makes extensive use of customer surveys. "We run surveys and focus groups, both through professional third parties and things that we do on our own," Ream notes.

RICHARD REAM
Vice president of worldwide sales and service for Dialog

Sharon Magee, a longtime employee of CompuServe whose title is CompuServe Evangelist, emphasizes the importance of surveys. "As with any other industry," Magee says, "the only way to determine whether you are delivering what customers need and expect is to stay close with them. CompuServe has, for years, held focus groups around the country, and there's our feedback section."

The people who make up an on-line service's audience is a determining factor in what they expect and what they infer to be promises. Ream says, "I think so much depends on the audience. For the information specialist, Dialog is definitely delivering on its promise and expectations. We have come out with some really important key features, and we pay attention to the marketplace and stay close to it."

Patricia McParland, a marketing communications specialist at NewsNet, concurs. "We're appealing to a market that is kind of segmented," McParland explains. "People are coming from all angles. The need that NewsNet has responded to [has made us] a timely information service, as opposed to an archival database. This has been a gradual evolution since 1982. We started strictly as a newsletter database with 15 newsletters. Now we have more than 500."

Jay Scheth, director of marketing for SprintMail's international value-added networks, states, "I think that services like SprintMail are delivering on their promises, without question." Like others, Scheth cites his service's growth and customer-survey responses as indicative of success in delivering on its promises.

Growth and Changes

Every on-line service has several direct competitors. For instance, NewsNet competes with services such as Dialog, IQuest, and Dow Jones News/Retrieval Service. SprintMail's head-on competition includes BT Tymnet's Dialcom, MCI Mail, AT&T Mail, and a host of other E-mail services. However, the

competition for these larger services isn't suffering; all of them seem to be enjoying growth in a market where there's plenty of room for everyone. But there is a definite feeling in the industry that some services are experiencing proportionally larger growth rates than others.

The situation is similar among the consumer-oriented on-line services. Sharon Magee cites CompuServe's growth as evidence of the service's delivering on its promises. The promises change as the market evolves to what users want and services strive to adapt to the changing market.

STEVE CASE
CEO for Quantum Computer Services

Martha Griffin emphasizes Prodigy's commitment to delivering on its promises. "The promise that we make at Prodigy is [to provide] a service with something for everyone in the family—a service that can be personalized," she says. "Although we now have nearly 1 million members and are still growing fast, each one of those members can create his or her own personal service." She refers here to Prodigy's Findword feature, which looks up products related to a topic and presents a categorized menu from which the customer can select the desired product.

Patricia McParland says that NewsNet has a strong commitment to keeping up with changes in the marketplace as a means of delivering on its promises. "Now the emphasis is on having a 'current awareness' database," she explains. "We've added a lot more newswires; we [now] have 20, almost all of which are real time." *Real time* means that news is available to subscribers only minutes after the newswire posts it. "We're marketing to a combination of information specialists, corporate librarians, and researchers," McParland continues, elaborating on the need to deliver timely information.

At Quantum, Steve Case notes that "the market is evolving in a pretty predictable manner. People expect these services to take off, but it takes a while, like any kind of media." Quantum seems to proceed carefully, bringing in innovations only after considering whether they are what the company should be doing to fulfill its promises.

What the Users Say

It's easy to let on-line service industry spokespersons explain that their companies are doing everything correctly and that their services are delivering. But what do the users say? After all, the users are the ones who pay the bills and must justify their time and monetary costs.

From a user's perspective, the comments of industry expert Jerry Pournelle echo those of an overwhelming majority of users polled: "On-line services are delivering what they promise. We're still learning management methods, so that on-line communications don't dissolve in 'flame wars,' but that's shaking down, too. Most of the on-line outfits do deliver more than the customers know—there are often unused features hidden behind poor documentation or balky user interfaces."

Some of the on-line service growth is probably due to the effects of the recent price competition among consumer on-line services. GEnie's new flat-rate pricing produced "an explosion in usage," says Neil Harris. Delphi and BIX also report that new flat-rate or alternative pricing structures have been successful, and CompuServe is putting together its own version of flat-rate pricing for a tier of services. Steve Case, who helped pioneer flat-rate pricing for consumer services, opines that prices are almost bottoming out.

"The pricing thing has gone as far as it's going to go," he notes. "Things will slow down. The market is not going to grow because of pricing; now the market growth is going to be driven by value."

Are Customers Getting What They Want?

Value—services received for money paid—is certainly an important issue for customers. And it's quite separate and distinct from on-line services' delivering what they promise. At first glance, the distinction between the two may seem nonexistent. However, on-line services are very sensitive to what their customers want. In fact, to a great extent, customer demand shapes what on-line services offer in terms of products, services, and how they are accessed. It's almost a natural phenomenon—if customers don't use a service or product, it doesn't generate revenue and usually disappears; if a product is popular, it generates revenue and stays.

Customer feedback and demand often help create some new products. Magee says this happens frequently on CompuServe. "Ideas for many products have come directly from customers. We receive 200 to 300 suggestions from customers per week," she notes. She relates one instance in which demand forced a new product into being. "We used to have a genealogy section within another forum. It was really popular, so we decided to spin that out into a forum on its own." The genealogy forum has been an unqualified success.

GEnie takes the approach of adding as many new services as possible in response to customer demand. "There are lots of new services coming up every month," Harris enthuses. "We're looking for more information services, more topics for special-interest roundtables, and, of course, support for new computers and software companies."

Dialog's Ream reports, "We certainly have strong content and support for the information professional, and [we] have a well-deserved reputation in the areas of documentation, search aids, training, and so forth. I'm comfortable that we are

The promises change as the market evolves.

SHARON MAGEE
Works for CompuServe

meeting the [users'] needs. Everyone would like more predictable pricing, or whatever it may be, but I feel really good about how we are doing in our core market."

Dealing with the information end-user market is another matter. "When you move toward the professional end user, you have someone who wants to come into contact with the information and not the service," Ream says. "I think people feel guilty that they know information is out there and know it's important but can't quite figure out how to get their hands on it. Getting unnecessary information, or more than you expected or wanted, is really no more acceptable than getting no information."

Here Ream brings up a problem that all on-line services have to deal with—the accessibility of information and a service's need to present itself as a service rather than as a "computer network." This is partly because the on-line service market—computer users, in general—is far less technically oriented than it was five or even two years ago. That, in turn, is due to the technology's becoming easier to use as it becomes more ubiquitous.

At NewsNet, McParland gets lots of customer feedback regarding making the service easier to use. "One thing that would make customers satisfied," she says, "is a common command language. That's the area in which I see on-line databases headed eventually, because that's the number-one question or complaint I hear: 'Why can't I use the same kind of commands as on Dialog or Mead Data?' " Customers on other services echo this complaint, and it is certainly one reason front-end software such as GEnie's Aladdin and Dialog's DialogLink exist—to make accessing a service as easy as possible. Or, to echo Ream's idea, to contact the information rather than the service.

General Videotex's Rusty Williams maintains that on-line services are, in general, delivering what the customers want. "The variety of services available is amazing," he remarks. "Whatever you may need, it is likely you'll find it somewhere on-line."

However, like others, Williams sees some problems for modem users in finding what they're after. "The challenge for potential customers is understanding the steps involved in locating and using the service they want. Issues like pricing structures, accessibility, and navigation methods all need to be understood first. These are considerable hurdles for people who are looking to conserve time and effort in the first place. The recent changes in pricing and service design by many on-line services have helped simplify this process somewhat, but there's still lots of room for improvement."

Williams echoes the thoughts of on-line service managers with regard to making things easier. "The more we can simplify and standardize, the more likely it is we'll finally reach the mass-market potential," he says.

Jerry Pournelle is less enthusiastic in this area. When asked if on-line services are delivering what customers want as opposed to what the services promise, he replies, "Nothing does. Everyone wants more from almost every service." But, he adds, on-line services are delivering "some of it." He notes that there are roadblocks to on-line services' getting everything that they'd like on-line. In particular, he says that "information utilities haven't yet solved the problems of intellectual property, but they are working on it."

50 million kids are coming up behind my generation; all of them are learning about computers.

TONY LOCKWOOD
Managing editor for BIX

On-Line Ideals

Given that on-line services are delivering on their promises and providing most of what customers want (although with a few problems), I asked on-line service managers what they thought the ideal business situation would be. Steve Laliberte, BIX's director, is interested in having more consistent business practices among on-line services. "I would hope that we would see an Audit Bureau of Circulation report for on-line services," he says.

JERRY POURNELLE
Science fiction writer and senior contributing editor for BYTE

Commenting on an element that almost everyone sees as a major issue, Williams states, "I'd like to move away from the technology side of on-line services and concentrate on the programming side. I purposely choose the term *programming* to draw an analogy to television. Ideally, we would sell our services much like cable television options: There would be universal access to services, and the interface would be standardized. People would look solely at the substance and price of a service to make their purchase decision. To continue the analogy, we'd have people choosing between SportsChannel and HBO rather than thinking about stop bits and file compression."

Williams is not alone in preferring that customers move away from the "computer network" orientation and concentrate more on the content than the on-line media. Prodigy's Griffin sees a similar need. "We would like to see people think of Prodigy as an information appliance, as something routine in their daily lives," she says. "[We'd like to see it become] common not only in homes and offices, but also in public institutions such as libraries, hotels, and hospitals."

There is, however, a major problem in getting people who are new to modems or computing to look at on-line services. "It's an unknown, and when something is an unknown, people are less willing to try it," Griffin explains. "But once they try it, members tell us, it becomes a part of their lifestyles, and we would like to see that phenomenon broaden."

Magee elaborates on the concept: "I think the challenge of an on-line service is being able to use your computer to log onto this big entity—the entity being

The nerve! They just took away our cable!

INFRALINK

The first and only connection between computers and printers that won't leave you dangling from a wire.

As of now computers and peripherals can communicate with each other via infra-red – virtually through thin air. Just like you are used to with the familiar printer cable – only at a much greater distance. With INFRALINK you can finally set up your office space the way you want – instead of having to reduce everything to the lowest common length of your printer cables. The printer is now on its own. Wherever the printer should be located is only up to you. And INFRALINK's active error control feature guarantees distortion-free operation. INFRALINK breaks new ground in office communications: see us at Comdex Fall, booth 3642.

INFRALINK
of America, Inc
1925 N Lynn St
Suite 703
Arlington, VA 22209
Tel (703) 522-4412
Fax (703) 522 4737

Finally freedom from cables.

...But not the connection!

Circle 73 on Inquiry Card.

product, services, and people—and use that in other aspects of your life, beyond computing."

As for what Case would like to see in the personal computer communications arena, he says that he'd like to see "some expansion of recent trends: the growing awareness of on-line services, modems bundled with every computer, and lots of portable computing devices for communication." It is a safe bet that everything Case lists will happen eventually.

JAY SCHETH
Director of marketing for SprintMail

Magee thinks that putting modems and communications software in the hands of computer buyers will help legitimize on-line services. "Every PC should come with a modem and an on-line service, which would be thought of on the same level as a word processor," he explains. "Basic PC software would be databases, word processors, spreadsheets, and information services." Ream sums it up: "I think in some ways the number-one need is to increase the value and awareness of information, building the awareness that the personal computer is an important device for compiling, storing, and accessing information."

The Future

The preceding comments imply some obvious directions for the future of on-line services: easier access, more consumer-oriented products, and a continuing effort to educate the masses to the benefits of modem use. Our experts see these and many other changes in the next 10 to 20 years. Harris claims that on-line services will continue to be "bigger, easier to use, faster, and with more to do for a lower price. We have more members joining now than ever before, and a lot fewer leaving."

CompuServe, which already holds a record for offering more front-end programs for more kinds of computers than any other service, is going to continue to work on making access easier, according to Magee. "CompuServe's effort in the next couple of years will be to improve the GUI and automate the access," she says. Laliberte sees on-line graphics presentation in the future, but he doesn't believe that it is an end in itself. "I think that services will get more specialized and more visual," he notes. But at the same time, he says, "There will be a greater concern for the quality of the information and the interaction."

Delphi, a strong text-based service, is moving into the front-end business, but it is not worried about having a GUI. "With the success of the Macintosh and Microsoft's Windows, some people talk about 'text-based' as if it's inherently inferior," Williams notes. "The contrary is actually true. In many cases, a simple text-based interface may be the fastest and easiest method of accessing information. When the information is what matters, the presentation becomes less important. Most Delphi members use the text-based menus and appreciate the speed and ease of use."

Case, however, makes it clear that "the future is our kind of service," referring to Quantum's front-end-based approach. "You have to have a slick, easy-to-use, broader interface that is reasonably easy to use, but not at the expense of being functional," he says.

At Prodigy, where using a front end is standard operating procedure, the future lies in part in being flexible. "We are not wedded to a specific technology," Griffin says. "We are an information and transaction service. Our commitment is to serve our members and to use the best technology available to do that. Presently, the best way is [with] a computer and modem, and we do offer some excellent graphics presentations. However, if we find that multimedia equipment is available in large numbers of households, and if that's the way the market is going, then that's the way Prodigy will be transmitted."

Eventually, we may see one front end that connects with all on-line services. McParland sees the possibility for this, something along the lines of a "complete information center" that would send and receive E-mail and find information on-line without the user's knowing which services were being accessed—or even if the computer was on-line.

Ream agrees that "the user interface is clearly very important, but there is

FOR MORE INFO

BIX
One Phoenix Mill Lane
Peterborough, NH 03458
(800) 227-2983
(603) 924-7681
Circle 976 on Inquiry Card.

CompuServe, Inc.
P.O. Box 20212
Columbus, OH 43220
(800) 848-8199
(614) 457-0802
(CompuServe: 70006,313)
Circle 977 on Inquiry Card.

Dialog Information Services, Inc.
3460 Hillview Ave.
Palo Alto, CA 94304
(800) 334-2564
(415) 858-3810
Circle 978 on Inquiry Card.

General Videotex Corp.
Three Blackstone St.
Cambridge, MA 02139
(800) 544-4005
(617) 491-3393
Circle 979 on Inquiry Card.

GEnie
401 North Washington St.
Rockville, MD 20850
(800) 638-9636
(301) 340-4000
Circle 980 on Inquiry Card.

NewsNet
945 Haverford Rd.
Bryn Mawr, PA 19010
(800) 345-1301
(215) 527-8030
Circle 981 on Inquiry Card.

Prodigy Services Co.
445 Hamilton Ave.
White Plains, NY 10601
(800) 776-3449
(Prodigy ID: KVPP12A)
Circle 982 on Inquiry Card.

Quantum Computer Services
8619 Westwood Center Dr., Suite 200
Vienna, VA 22182
(800) 227-6364
(703) 448-8700
Circle 983 on Inquiry Card.

SprintMail
12490 Sunrise Valley Dr.
Reston, VA 22096
(800) 736-1130
(800) 336-0437
Circle 984 on Inquiry Card.

another dimension called *accessibility*. With the globalization of data networks and the power of on-line services, there is going to be a big change in how services are being used. I think the future is somewhat dependent on our success in being able to deal with 'controlled usage' by businesses and institutions and elec-

You will see many more on-line services being offered on an international scale.

tive usage by individuals. If we continue to service the professional, we'll have a nice usage and continue to grow. If we want to explore the full available potential of the market, we have to be effective in distributed environments."

At NewsNet, McParland envisions market-customized services. "That's a direction in which we're heading now," she says. "We're trying to appeal to searchers by profession, to information professionals, and end users who are computer literate, but not on-line-service literate. To reach all these markets, we have to make it easier for the end user. What I see us doing is having a whole range of different interfaces for a whole range of users."

Ream sees "tremendous opportunity with the change in the Eastern Bloc countries; there's viable opportunity in Russia, too." These are interesting comments from a vice president of a service that has customers in 103 countries and that was able to support a presence in Mexico, where business has been lean and other services have pulled out, during the past 10 years.

Jay Scheth sees an expanding global marketplace, too. He observes, "You'll see many more on-line services being offered on an international scale. There is a deregulation trend that is taking place, in different flavors. Some countries, such as the U.K., are even more deregulated than the U.S. Countries are relaxing their control and allowing the presence of American carriers. We will have 'global one-stop shop' capability with billing from one source."

There is already a solid international

AW... WHAT THE HECK!

Let's see the other guys beat this Price!

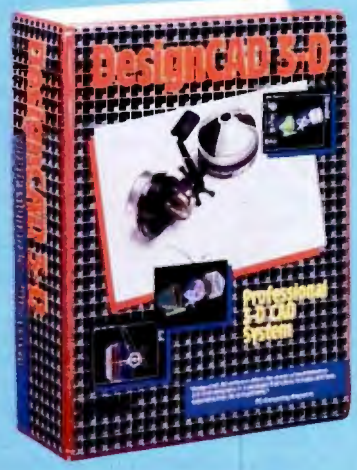
PC MAGAZINE EDITORS' CHOICE December 11, 1990

BUYERS ASSURANCE SEAL

If there ever was a CAD program out to prove that AutoCAD, CADKEY, VersaCAD, and other $3000 programs are overpriced, it's DesignCAD!

(MicroCAD News review)

DesignCAD 3D



$399

We Added...

to DesignCAD 3D version 3.1: A Basic-like programming language entitled BasicCAD. We added new commands. We added hardware support for dozens and dozens of new devices We made hundreds of overall internal enhancements! We improved the manuals, the packaging and the speed!

How much extra did we charge?

Nada. Nothing. Zip. No extra charge at all. Oh, sure...our accountant said we could increase the price. Our lawyer said there was no legal reason not to charge more. A minister said we had no moral obligation to keep the same price! So, why didn't we raise the price for DesignCAD 3D version 3.1? Because...in the Great American Tradition we said "Aw...What the Heck. Let's see the other guys beat this price!" DesignCAD 3D version 3.1 sells for $399.

Does this include everything?

Yes. We include everything! The programming language, the hardware device drivers (more than 450), built-in shading capability, hidden line removal capability, solid-object modeling capability, translators to-and-from other file formats, are all included!

How can you afford to sell a program like this at such a low price?

This is our most often asked question. We have a simple answer. Volume. We sell thousands of these programs each month! If we were to charge thousands of dollars per copy (like our competitors) we would restrict our sales to the professional trades only. By lowering our price we sell to professional architects and engineers as well as the ordinary individual!

Many ordinary individuals purchase DesignCAD 3D for personal projects. Many people purchase DesignCAD 3D and perform CAD Drafting at nights and on weekends as a second job! People design "dream homes" and "widgets". The uses are limited only by YOUR imagination!

Remember - American Small Business Computers also sells a 2D version of DesignCAD. It costs only $299! Write or call for FREE brochures that will help you determine which program best suits your need.

American
Small Business Computers, Inc.
327 South Mill Street • Pryor, Oklahoma 74361
(918) 825-4844 • FAX (918) 825-6359

Circle 12 on Inquiry Card.

movement among consumer services. BIX promotes overseas access heavily, and CompuServe, Delphi, and GEnie each have gateway arrangements with services in Japan. CompuServe and GEnie have set up direct-dial access from a variety of European countries, and they are gearing up for further expansion of these services.

STEVE LALIBERTE
Director for BIX

Some of the consumer services' incoming gateways include customized services designed for use in other countries; for example, Delphi's Argentina service and GEnie's German service both feature versions in the countries' native languages. An outgoing gateway to Japan's PC-Van from GEnie does the reverse, providing American callers with 7-bit English and 2-byte kanji and hiragana characters.

In addition to customizing for international use, there's a trend toward customizing for specific markets. Ream notes that Dialog has to "present that end user with really a sort of 'wizard behind the curtain' technology." BIX's managing editor Tony Lockwood sees quite a bit of custom services in the future of on-line services. "Most electronic services are taking the 'be everything for everybody' track," Lockwood says. "In the coming years, niche markets will develop."

Interconnectivity on the home front is in the future, too. On this issue, Magee says, "I think interconnectivity is an important issue. We [CompuServe] recently completed an X.400 agreement with AT&T Mail, which was the first of what will probably be multiple interconnections. Our Internet gateway was kind of a first, taking a public, commercial mail system like CompuServe's and hooking it up with a university/government mail system. I definitely think that's the way everyone's going."

McParland indicates that NewsNet is looking at interconnectivity as a means of distributing information products. "I see us reaching out toward delivering information from NewsNet through our NewsFlash clipping service to someone who doesn't have a computer," she says, "through fax and FM sideband, as well as through any E-mail system set up with X.400 interconnections."

New technology should bring increased line and transmission speeds not only to modem users but also to new products. Magee thinks that faster transmission will "have some impact on the kinds of information we can deliver. It's been almost impossible to do complete software package delivery, for instance, but with faster speeds, size becomes less of a factor." She believes the transition to 9600-bps transmission will take a relatively short time. "The migration from 300 to 1200 bps took about two years—2400 was more like a year. The transition to 9600 should take less time. A lot of it has to do with the price of the hardware, though."

Harris concurs. "We've just launched 9600-baud service using the V.32 standard. Next year, we'll add V.42 also, which makes the service even faster. As more and more people move up in speed, all sorts of things become possible—you might see multimedia come to on-line services before long. A few years back, 80 percent of our usage was at 1200 baud or slower. Today, 80 percent is at 2400, and it won't be long before it moves up another notch or two."

Almost everything depends on on-line services' being "legitimized" in the marketplace, a trend that Lockwood believes is well on its way. "This industry is going everywhere," he claims. "There are 50 million kids coming up behind my generation; all of them are learning about computers and telecommunications. They'll get on-line like my generation uses the TV.

"Perhaps an AT&T spokesperson said it best when she was asked who she thought would use AT&T's new modem/terminal/telephone: 'It took 20 years for the Touch-Tone phone to catch on,' " Lockwood continues. "It may take 20 years, but on-line systems are here for good, and we're taking over."

Jerry Pournelle is equally enthusiastic. "On-line services are rapidly becoming indispensable," he affirms. "John McCarthy talked about the upcoming Information Utilities back in the early 1970s; it looks as if the 1990s will see them happen. All told, they have a great future." ■

PARTICIPANTS

- *Steve Case joined Quantum Computer Services in 1985. He served as executive vice president until early this year, when he was named CEO.*
- *GEnie director of marketing **Neil Harris** has been with the company for five years.*
- ***Rusty Williams**, vice president of sales and marketing, joined Delphi in 1986 and has been involved in the management of regional services, joint marketing programs, and national promotions.*
- ***Martha Griffin** is Prodigy's communications program manager.*
- *On-line veteran **Richard Ream** is Dialog's vice president of worldwide sales and service. He is active in promoting international telecommunications and innovative information products.*
- ***Sharon Magee** has been a CompuServe employee for eight years and works out of the company's Atlanta regional office as a CompuServe Evangelist.*
- ***Patricia McParland** is a marketing communications specialist for NewsNet. She is currently working on several projects related to alternative delivery of on-line news and information.*
- ***Jay Scheth** is director of marketing for SprintMail's international value-added networks. He is particularly interested in the potential for customized on-line news and information services.*
- ***Jerry Pournelle** is a science fiction writer and a regular columnist and senior contributing editor for BYTE.*
- ***Steve Laliberte** is director for BIX.*
- ***Tony Lockwood** is managing editor for BIX.*

Michael A. Banks is the author of The Modem Reference *(Brady Books/Simon & Schuster, 1991) and more than two dozen other nonfiction books and novels. He can be reached on BIX as "mike_banks."*

THE PROGRAMMER'S SHOP™

FREE Book Offer from Microsoft® and

THE PROGRAMMER'S SHOP™!

Choose any of these industry-standard, professional software development tools from Microsoft and receive a valuable reference text from Microsoft Press absolutely free.

Limited time offer!

This special Microsoft promotion won't last! You must purchase by November 30, 1991 to receive your free book, so call 800-421-8006 today to order!

BUY:

Microsoft C Professional Development System Version 6.0 (retails for $495, PS price $349) -State-of-the-art environment with new language enhancements. The pro's tool for DOS, Windows, and OS/2 development.

FREE:

Microsoft C: Secrets, Shortcuts, and Solutions by Kris Jamsa. A $27.95 value.

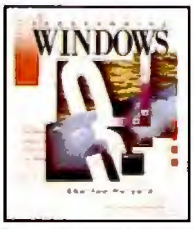
BUY:

Microsoft Windows Software Development Kit (retails for $500, PS price $365) -The most powerful set of tools for Windows applications development, from the creators of Windows.

or

Microsoft Windows Device Development Kit (retails for $500, PS price $365) -Give your customers the device support they want. Extensive documentation and sample code (requires SDK).

FREE:



Programming Windows 2nd Edition by Charles Petzold. A $29.95 value.

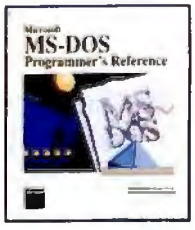
BUY:

Microsoft COBOL Optimizing Compiler Version 3.0 (retails for $900, PS price $639) -Complete environment, native compilation, certified High-level ANSI 85, for DOS and OS/2 development.

or

Microsoft FORTRAN Professional Development System Version 5.1 (retails for $450, PS price $309) - Run your 16-bit apps in Windows without writing any new code. Break the 640K barrier!

FREE:



Microsoft MS-DOS Programmer's Reference by Microsoft Corporation. A $24.95 value.

"BYA91O"

To Order, Call 800-421-8006

Nat'l Accounts 800-446-1185 • Canada 800-446-3846 • Int'l Dealer 617-740-2017 • FastFaxts 617-740-0025

THE PROGRAMMER'S SHOP™

FutureSoft™

DynaComm Asynchronous 3.0Z

DynaComm Asynchronous 3.0Z is the best communications software package available on the market. It's easy to use, installs quickly, and includes excellent documentation. In 1991, PCWeek and PCMagazine rated DynaComm Analyst's Choice and Editor's Choice respectively. DynaComm boasts 13 popular terminal emulations, 7 file transfer protocols, and LAN support for Pathworks, plus many more. DynaComm provides easy automated log-ons to 7 popular on-line services through its Director script. For power users, DynaComm's rich scripting language includes over 300 commands and functions to automate tasks and construct new Windows front-ends for old applications. Windows and NewWave are provided; OS/2 is available.

List Price: $295 **PS Price: $249**

FastFaxts 2139-004

"BYA91O"

To Order, Call 800-421-8006

Nat'l Accounts 800-446-1185 • Canada 800-446-3846 • Int'l Dealer 617-740-2017 • FastFaxts 617-740-0025

THE PROGRAMMER'S SHOP™

BORLAND

Rogue Wave

Special bundle offer. SAVE $200!

Borland C++ 2.0 with Rogue Wave's Tools.h++ and Math.h++

Exclusively from The Programmer's Shop

Get Borland C++ 2.0 plus binary versions of Tools.h++ and Math.h++ for only $495 — a savings of $200 off the combined retail price of $695!

Rogue Wave Tools.h++ class library

The Tools.h++ foundation class library gives you a wide variety of functions to help you get the most out of Borland C++ 2.0. Tools.h++ is Windows 3.0 compatible and can be run as a Dynamic Link Library (DLL) for smaller executables, code sharing, and easier maintenance.

Tools.h++ is a complete toolbox of over 60 C++ classes, including support for:

- complete time and date classes
- regular expressions
- strings and substrings
- tokenizers for parsing
- Smalltalk™ like collection classes
- link lists, stacks, queues
- Btree disk access
- file handling classes
- Windows (DDE) and clipboard support
- and much more

All classes are not derived from a single root object, so they can be easily integrated with other class libraries.

All classes have an isomorphic Persistent Store facility which allows complex objects to be stored and retrieved on heterogeneous networks or through the Windows 3.0 Dynamic Data Exchange facility. The classes are bulletproof, optimized for speed, and well tested.

Rogue Wave Math.h++

Rogue Wave Math.h++, a collection of mathematical C++ classes, includes:

- complete vector and matrix classes
- regression analysis
- random numbers
- complex numbers
- statistics
- linear algebra
- Fast Fourier Transform classes
- and much more

Rogue Wave Math.h++ lets you invoke each function the same way regardless of the data type you are using. It gives responsibility of picking the appropriate algorithm to the object, rather than you, the programmer. This frees you up to concentrate on the problem you are trying to solve, rather than the programming details.

Limited Time Offer!

Special Bundle Pricing!

ACT NOW!

Available only until Nov. 30, 1991.

Borland C++ 2.0 with Rogue Wave Tools.h++ and Math.h++, **only $495.**

Save $200 off the combined retail price of $695!

Borland C++	*FastFaxts*	*777-120*
Rogue Wave Tools.h++	*FastFaxts*	*2807-001*
Rogue Wave Math.h++	*FastFaxts*	*2807-004*

"BYA91O"

To Order, Call 800-421-8006

Nat'l Accounts 800-446-1185 • Canada 800-446-3846 • Int'l Dealer 617-740-2017 • FastFaxts 617-740-0025

THE PROGRAMMER'S SHOP™

GOTOLESS CONVERSION

BAS_C

BAS_C not only translates BASICA/Quick BASIC source program into C source program automatically. It goes far beyond the mere translator. It restructures any spaghetti code into gotoless, indented, structured code. Every execution path is checked to transform the spaghetti code into the nested while, do-while if-then-else statement. This process also reports the dead code.

Variables are scoped into local to each C functions or global to the whole program depending on how they are used. BASIC program is split into many C functions at the top–down fashion. Variable names and comments are copied into C program to keep the original flavor.

At the first attempt BASIC statement/function is mapped into C function. (BASIC INPUT becomes C Scan).

If C does not have any equivalent function, it becomes BASIC runtime library call which is written in C. (BASIC MID$(A$,2,3) becomes C b_mid_str (a_str,2,3). Commercial model includes all C source code for BASIC runtime library. So there is no hidden trick. You get the whole C source code.

Customizer can add new BASIC statements/functions and their translator rule. It helps to translate non-Microsoft BASIC. The translated C source program is syntax-error free. It can be directly compiled by C compiler.

All that means to you is the better readability, lower maintenance cost and portability.

Economy List Price: $375 **PS Price: $349** *FastFaxts 675-005*

Commercial List Price: $895 **PS Price: $819** *FastFaxts 675-005*

INTERSOLV

PVCS

PVCS provides complete control over the configuration of your software. Previous configurations are easily recovered at any time. The most up-to-date version is instantly available and its genesis is completely auditable. Conflicting module changes from two or more programmers are eliminated. You always know who made a change, what the change was, when it was made, why it was made and what revisions contain the change. You can even prevent unauthorized changes and coordinate revisions, special versions and upgrades - automatically.

Whether you program alone or in a team, you know that housekeeping requirements grown exponentially with project complexity. Without capable version control you soon spend more time managing a project than you do coding. PVCS excels in the LAN environment, not only making development safer, but actually making it easier by enabling parallel development and experimental or alternative lines of development.

PVCS is the market leader in Configuration Management software. Thousands of companies are using PVCS to gain control over the development process, reduce bugs, meet budgets and deadlines, boost productivity of managers and programmers and improve documentation.

List Price: $600 **PS Price: $530**

FastFaxts 111-089

"BYA91O"

To Order, Call 800-421-8006

Nat'l Accounts 800-446-1185 • Canada 800-446-3846 • Int'l Dealer 617-740-2017 • FastFaxts 617-740-0025

THE PROGRAMMER'S SHOP™

QUALITAS®

386MAX® and BlueMAX™

Enhance Windows and supercharge DOS 5! 386MAX and BlueMAX are the right choice for getting the maximum amount of usable memory on your 386- or 486-based system. With MAX intelligence, you'll automatically get back the RAM you need to run those memory-hungry programs.

For PS/2 users BlueMAX is the only memory manager designed especially for 386- and 486-based IBM PS/2s. You get all the memory management capabilities of 386MAX, plus an extra 80-84K of high DOS memory, thanks to its unique BIOS compression technology.

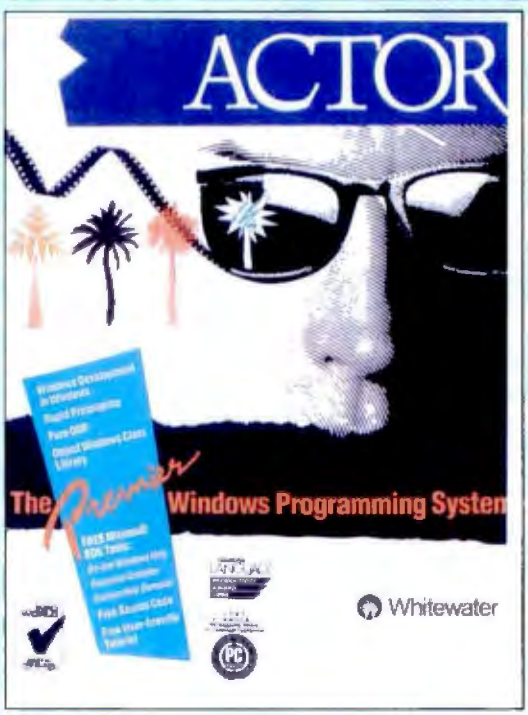
The MAXIMIZE optimization utility built into 386MAX and BlueMAX automatically finds the single most efficient configuration, often choosing from millions of possibilities. And with TSR instancing, Windows users can now run multiple Windows sessions of nearly every pop-up utility without the usual conflicts.

DOS 5 users will see how perfectly Qualitas memory managers and DOS 5 compliment each other by freeing up more memory than ever before possible. Because while DOS 5 is good, DOS 5 with MAX is outstanding.

Each copy of 386MAX and BlueMAX includes free copies of 386Cache, our disk cache, and ASQ™, our precision memory evaluator and extraordinary memory coach.

386MAX List Price: $130
PS Price: $ 95
FastFaxts 123-004

BlueMAX List Price:$155
PS Price:$149
FastFaxts 123-010



Whitewater

Actor 4.0

Actor is the original object-oriented programming system with a language and environment designed to free you from the time-consuming implementation details which slow your Windows work. Actor is the development system for fastest techniques for producing today's graphical applications.

Actor has two versions: **Actor**, the perfect way to learn object-oriented techniques and get started with Windows development , and **Actor Professional**, the most powerful system available for designing effective Windows applications with graphics, visual editing and database capabilities.

Actor pure object-oriented language and Windows-hosted integrated development environment makes Windows development easy. Actor includes an enhanced ObjectWindows library, a Windows Description macro Language that makes window creation easy, safe multiple inheritance through a new protocol process, and a powerful set of programming tools.

Actor Professional also provides SQL libraries for simplified access to most popular databases, the ObjectGraphics libraries for easy and consistent graphics development, and the Whitewater Resource Toolkit, the leading visual tool for editing Windows resources. You don't need the Microsoft Windows Software Development Kit or any other tool to develop complete standalone Windows applications. Order you copy today!

Actor 4.0 List Price: $249
PS Price: $225
FastFaxts 800-016

Actor Prof. List Price:$495
PS Price:$449
FastFaxts 800-017

"BYA91O"

To Order, Call 800-421-8006

Nat'l Accounts 800-446-1185 • Canada 800-446-3846 • Int'l Dealer 617-740-2017 • FastFaxts 617-740-0025

THE PROGRAMMER'S SHOP™

Incredible Pricing!
Complete Package!

	Value	PS Price
C³ FORTRAN -77	$ 1,495	$ 395!
C³ ANSI C	$ 1,195	$ 325!
C³ Pascal	$ 1,195	$ 325!

Price includes compiler, debugger, libraries, DOS extender & tools! No royalties!

SILICON VALLEY SOFTWARE

A Software Systems Company

NEW! SVS C³ Code Construction Series:

32-Bit Compilers and Tools at 16-Bit Prices!

SVS 386/486 Compilers and Development Tools ... 32-Bit DOS and Windows Compatible!

Save money, time, and effort.
SVS offers a single source solution to your 32-bit development needs in a single package. You get a comprehensive development package at a fraction (less than half) of the initial price of other similar products. And you will never have to pay royalties for the sale and distribution of programs you develop.

DOS extender and 32-bit tools included at no additional cost.
SVS 386/486 compilers for DOS and Windows include all of the features necessary for full 32-bit development and code generation. The DOS extender and associated tools included with each compiler provide a total system.

No hassle–single source for SVS compilers and 32-bit tools.
- SVS C³ compiler systems for FORTRAN-77, ANSI C and Pascal
- Source level debugger
- Linker, librarian and make utility
- Intel 387 coprocessor emulator
- Complete systems documentation
- DOS-extender w/virtual memory–DPMI compliant
- Microsoft C compatible libraries (C compiler)
- Graphics and scientific libraries (FTN compiler)

Superior technologies.
C³ FORTRAN-77, C³ Pascal, and C³ ANSI C are legendary performers in 32-bit code development and execution from a leader in 32-bit microprocessor compiler technologies for over 10 years.

SVS has developed and employs the most current 386/486, DOS, and Windows technologies to deliver the most effective solutions available today.

If you've got a 32-bit processor, use it!
The i386 and i486 chips were designed to operate best in the 32-bit, or "protected" mode.

Using SVS development tools, you'll get better performance, development will be easier, and you'll get results faster.

SVS direct support services.
SVS hot-line support is offered at no cost to the SVS development systems user.

If you're writing code for 386's or 486's, SVS is what you need now!
- 32-bit development environment
- Integrated compiler/extender
- DPMI 1.0 full support
- 4 gigabyte, flat address base
- DOS and Windows compatible
- Easy migration for 16-bit code

Exclusive Offer

only from
THE PROGRAMMER'S SHOP™.
Not guaranteed past 12/31/91.

C³ FORTRAN -77	FastFaxts	1958-049
C³ ANSI C	FastFaxts	1958-048
C³ Pascal	FastFaxts	1958-050

"BYA91O"

To Order, Call 800-421-8006

Nat'l Accounts 800-446-1185 • Canada 800-446-3846 • Int'l Dealer 617-740-2017 • FastFaxts 617-740-0025

Surveys Say. . .

Do we see common threads in personal computing's future?

GENE SMARTE

During the course of each year, BYTE takes the pulse of both readers and nonreaders to gauge opinion and day-to-day realities in this dynamic industry. Most of the information we accumulate makes pretty interesting reading, because it lets us know what other folks are thinking and doing. It also provides another factor in BYTE's editorial equation, so we anxiously await the results of each poll and survey to see how you and we are doing. As part of our Outlook '92 issue, we thought we'd share some key results of several surveys the magazine has conducted this past year.

As usual, we can't claim that these surveys speak authoritatively for *all* the millions of personal computer users out there. Those who pitched in their two cents, however, paint an enlightening and often entertaining picture of computer-related activities at this exciting time. We've provided little annotation, so you can draw your own conclusions.

Comdex Operating-System Polls

Beginning in the spring of 1988 and continuing through the spring of 1991 (so far), BYTE has put this question to Comdex attendees who stop by the BYTE booth: *"Which operating system/user interface will become the dominant force in the personal computer industry by the end of the next five years?"* Some trends have begun to emerge; others remain murky. Windows 3.0 was added to the Extended DOS category in the fall of 1990; its impact is evident in the spring 1991 poll. The table summarizes the results of these polls. Note that the totals often do not add up to 100 percent, owing to multiple responses given to some questions.

Comdex Technologies Poll

At the 1991 Spring Comdex, BYTE combined forces with other members of McGraw-Hill's TechNet publications group, *Data Communications*, *LAN Times*, *UnixWorld*, and *BusinessWeek*. We took this opportunity to include new questions about key technologies along with our traditional operating-system/user-interface question. Here, then, are the results when 4400 Comdex attendees were asked to "check only one."

Which of the following technologies will have the greatest practical impact on computing at your company in the next five years?

Multimedia (video, graphics, and sound): 34%
Portability (laptops and notebooks): 27%
Wireless communications (LANs, wide-area networks, and cellular modems): 18%
Object-oriented programming: 15%
Voice technologies (input, synthesis, and annotation): 10%
Pen input: 6%

Which LAN operating system will be dominant by the end of the next five years?

NetWare 386: 55%
LAN Manager: 28%
IBM LAN Server: 12%
Banyan Vines: 4%
TOPS: 2%

Which workstation CPU architecture will be the most prevalent by the end of the next five years?

Intel: 68%
SPARC: 12%
Mips: 12%
Motorola: 8%

A Fenestrated Survey

While *fenestra* may refer to windows in Latin, Windows 3.0 is not Greek to the industry, as this survey found out. The Windows 3.0 User Survey asked a cross section of BYTE readers about their involvement with Windows. The one qualification for participation was that they had to have access to Windows 3.0 at their workplaces; they did not have to be using it. Of the readers we contacted, 49 percent met this qualification. Here are the highlights:

- 69 percent currently use Windows at work and have been using it for an average of seven months (as of April); 15 percent plan on using it within the next year; 15 percent are not using it; 49 percent use Windows' multitasking capabilities.
- 68 percent run Windows-based word processing, spreadsheet, and/or database programs, and 44 percent plan to replace their character-based programs.
- 54 percent of the WordPerfect users would reconsider Windows as soon as WordPerfect for Windows is ready. The Lotus 1-2-3 and dBase IV users were not so inclined to move, with only 30 percent and 27 percent, respectively, willing to reconsider.
- Hardware upgrades are delaying the use of Windows for 30 percent of those

COMDEX OPINION POLL RESULTS

Which operating system/user interface will become the dominant force in the personal computer industry by the end of the next five years? Results are in percentage. (N/A=Not applicable.)

	Spring 1988	Fall 1988	Spring 1989	Fall 1989	Spring 1990	Fall 1990	Spring 1991
DOS alone	30	18	14	18	23	18	6
Windows/Extended DOS	N/A	31	30	31	32	39	56
Unix/Xenix	24	23	22	18	21	16	18
OS/2	32	16	20	16	13	12	12
Macintosh	4	3	3	3	2	2	2
None	9	8	10	13	<9	12	9

surveyed. A minimum recommended configuration is a 386SX and 2 megabytes of RAM, but most users have a 386DX and 4 MB of RAM.

• Most users rated Windows' features between excellent and average, with the exceptions of speed and network-specific functionality, which they rated average.

BYTE Outlook Issue Survey

In the spring of 1991, BYTE mailed a survey form loaded with questions about technologies and products, current and future, to a cross section of its readers. The results are quite diverse, yet some points show up regularly. Because of the diversity of answers (respondents could write in any answer they wanted), we don't have the space to publish each response. I'll try to summarize the most popular replies. Some pet peeves also emerged, as you'll see.

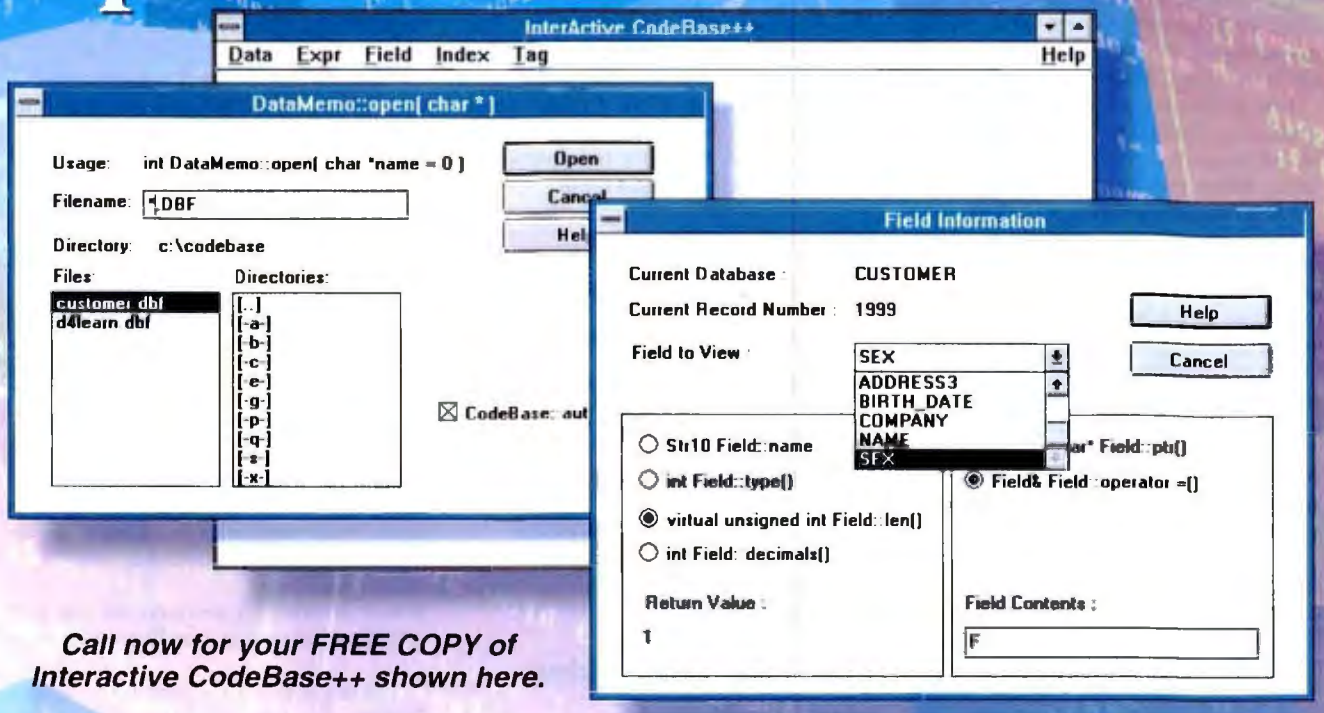
BYTE thanks all of you who completed the four-page survey. That alone says something about how involved you are with your computing environments. In addition to responding to the questions asked, however, some of you added pages of details that outlined why you felt this or that way and why things were or were not important to computing environments large and small.

Interestingly, we have received several very detailed pleas for improved keyboard design. Whether carpal tunnel syndrome, inconvenience, annoyance, or combinations of these and other perceived deficiencies are behind these requests, we don't know. It is important to note, however, that the keyboard is today's primary tactile interface, and if lengthy unsolicited comments on what's right and wrong with keyboards arrive in disproportionate share, improvements might be worthwhile. We thank you all for sharing what concerns you most.

Which technologies do you feel will be most important for the next five years, and why?

In the hardware category, the clear winner was optical storage—CD-ROM and WORM (write once, read many

Why do dBASE professionals use C++?



Call now for your FREE COPY of Interactive CodeBase++ shown here.

• dBASE Functionality

Use CodeBase++, a C++ class library, for database management.

• Object Oriented Syntax

dBASE Code

```
* Assign to field LAST_NAME
LAST_NAME = "Jones"
```

CodeBase++ Code

```
// Assign to field LAST_NAME
LAST_NAME = "Jones" ;
```

• Low Memory Requirements

A CodeBase++ .EXE file is as small as 20k.

• Speed

"CodeBase++ is fast: I indexed a .dbf of 10,000 records in 32 seconds; dBASE IV took 40 seconds." Kathy Cea, DBMS

• Portability

CodeBase++ ships with a Microsoft Windows 3.0 DLL.

• Compatibility

Codebase++ is completely compatible with dBASE and Clipper data and index files.

CodeBase++

The Power of dBASE, the Versatility of C++

SEQUITER SOFTWARE INC.

TEL. 403•437•2410
FAX 403•436•2999

#209,9644-54 AVE., EDMONTON, AB, CANADA T6E-5V1

Circle 142 on Inquiry Card.

times)—with fiber-optic networking also mentioned. Multimedia (the hardware parts) also garnered a large share of the voting, as did image processing, color flat-panel displays, handwriting and voice processing, and lower-cost and color laser printers. These were all tied to increased processing speed brought about by faster, denser chips.

For software, object-oriented programming showed up in a clear majority of the responses, followed by user interfaces. Many respondents felt that AI, including neural networks, will begin to be a factor in software capabilities. More mundane trends will include desktop publishing perhaps becoming more common than word processing, and optical character recognition uses accelerating. Other respondents noted that diverse software and interfaces might begin to work together more seamlessly.

Which specific types of products and services do you feel are needed most in the next five years, and why?

A couple of clear winners emerged here. First, standardization, in which programs run transparently across platforms and operating environments, is a prize that many see as crucial. Second, support has been found wanting; people can't seem to get their questions answered. Coupled with the perceived lack of support is a cry for better computer education in the classroom. The third theme was better large-scale database structures and communications accessibility.

Regarding existing products, which in the following categories do you now use and plan to retain?

We divided this question into several categories. Under computer systems, the dominant platform cited was the 386 with lots of RAM and big hard disk drives, but that system was followed closely by similarly equipped 286s and Macs. While the 486 and 68040 technologies were acknowledged, many respondents noted that costs had not quite come down enough. In the peripherals category, 24-pin and laser printers dominated, along with 2400-bps modems.

For applications software, a diverse group of word processors, databases, and integrated packages was listed. As noted in the Windows survey and in comments with this survey, people need good reasons for leaving their old software. The development software category found C, C++, and assembly language prevalent. Pascal and BASIC showed up occasionally, too. Finally, DOS with Windows dominated the operating-system category, although Unix and the Mac OS also were sprinkled in there.

Describe products that could use existing technology and are not being manufactured that you'd like to see and why.

This question was the first of three that gave the survey respondents a chance to express their ideas of the future. Others reviewing this data might uncover a trend here and there, but to me the diversity of the answers is the biggest trend.

Which technologies do you feel will be most important for the next five years? In the hardware category, the clear winner was optical storage—CD-ROM and WORM, with fiber-optic networking also mentioned.

Many asked for products to be less expensive, considering that if a product is not affordable, it's the same thing as not being manufactured. Others had very esoteric requests, especially for more universal and disability-specific solutions to working with computers. Still others mentioned wanting products that we knew existed, highlighting the bigger problem of finding what you need even when it's already available. And, finally, we found that what one person wanted as a solution could cause problems for others; a lot of subjectivity is ricocheting around in these responses.

Here are some of the responses, quoted verbatim and without comment:

"A floppy drive with a 1.44-MB cache that is filled [copied from disk to cache] when the [drive] latch is closed."

"Diagnostic programs [for] car, TV, dishwasher. Enter the symptoms and get an analysis and repair instructions."

"As heat is a major enemy of integrated circuits, it seems obvious that a PC should have one or more thermometers built into its design, with the data reported to an I/O port and a TSR (or even part of the operating system) that would issue warnings if the temperature was too high or too low."

"Operating systems which track a user's habits and anticipate commands or uses and execute the command unless instructed not to. The same would hold true [for] applications."

"Combination laser printer/copier/fax machine."

"Self-configuring hardware and software that is brand (architecture) independent."

Before finishing up with a look at what the survey respondents think personal computing will be like in five years, I have one more task. Progress usually leaves some casualties in its path, so we asked the following question:

Which present-day products do you feel will disappear in the next five years?

The answers to this question *were* predictable: The 8-bit machines are gasping, and the 286 is not far behind. Also fading are low-capacity and slow hard disk drives, as well as slow (below 2400-bps) modems. Dot-matrix printers also are on the endangered list, along with floppy disk drives and monochrome displays. Text-only-based software products have a fair chance of disappearing, too. Some verbatim replies follow:

"Next [computer] (sorry, Ross Perot)."

"Macintosh and mainframes."

"IBM PCs should disappear but won't."

"Vanilla DOS machines—good riddance! (wishful, I know)"

"Software that does not let the user share data across many software packages and operating platforms."

"Turntables for LPs."

Please comment on how you envision personal computing evolving in five years. For example, typical system capabilities (e.g., sizes, speeds, portability, mass storage, and display type), networking, communications, costs, software capa-

Enjoy a more colorful view from your Windows™.

Ultra Image with HiColor™

$199.00 SUGGESTED RETAIL PRICE

Windows. AT 32,768 COLORS

Ultra Image HiColor™

- Non-Interlaced
- 1280 x 1024 with 16 colors
- 1024 x 768 with 256 colors
- 800 x 600 with 32,768 colors
- 72 Hz Flicker Free Refresh

DRIVERS

- Wordperfect 5.1
- GEM 2.2/3.0/3.1
- Ventura Publisher 1.2/2.0
- Lotus 2.xx
- Symphony 1.1
- Wordstar 4.0/5.0
- AutoCAD 11/386
- AutoCAD 10/386
- Auto Shade 2.0 w/RenderMan
- 3D Studio
- Windows 3.0

Circle 158 on Inquiry Card.

Windows. AT 32,768 COLORS

UNITED SOLUTIONS, INC.
6382 Arizona Circle, Los Angeles, CA 90045 • 213-645-3232

Fig. 1

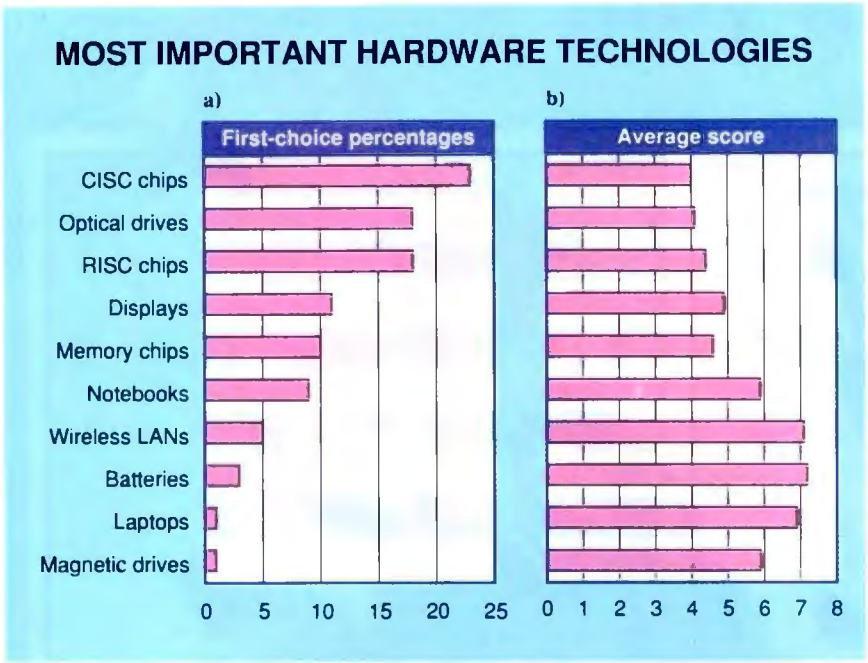


Figure 1: (a) **BIX's survey of the most important hardware technologies for the next five years. Each column represents the percentage of number-one picks for that topic.** ***(b):*** **Alternative hardware technologies' ranking, in which the total points for each category were counted, with the lowest overall score the most important, and the highest score the least important.**

bilities, dominant languages, operating systems, and so forth.

Now we turn to the crux of this survey, the final question. Here is where we hoped to get the goods on the future and share it with everyone. Some responses looked too far into the future, expressing hope for a 100-million-instruction-per-second machine the size of a pack of cigarettes, with voice actuation, real soon (i.e., now). Most, however, were quite practical in their expectations.

As you might expect, the trends under way today will continue. Everyday desktop systems will be more powerful; the 386/486 will be commonplace, with future 80x86 processors leading the pack. RAM will range from 8 to 16 MB, with optical drives securing a stranglehold on mass storage. Street prices will average around $2500. Networking and file sharing will be much easier as a result of improved and standardized communications. The user-interface picture is not as clear, although everyone seems to agree that it ought to be better. Portables will almost equal desktop systems in power and convenience.

The survey respondents speak:

"Everyone will be using Windows 3.0 and hating it. DOS will never die. OS/2 will become the CP/M of multitasking systems. Unix will never die—it will mutate away!"

"GUIs will have to become much more efficient for experienced users. Most users will remain computer illiterate, proficient only in word processing or some specific canned application. All activities will be centrally controlled."

"Students must own a computer at junior high school level—like a pencil."

"In order to get computers to the mass public, they must be small, powerful, cheap, running software to do everyday things like purchasing, payments, financial transactions, entertainment, recording, and so forth, easily without [a] keyboard."

"The limits will always be pushed until we have a Cray on a wristwatch."

"More standards will be developed to let various vendors' stuff interact. More good cheap software. More BBS usage. More viruses."

"Neural computing may be important in voice and handwriting recognition. Languages that support/enhance these functions would evolve."

"Desktop systems will be relegated to secretarial, clerical, and specialized workstation applications. Personal computers will be pocket-size organizers [having] icon-oriented user interfaces with no manuals. A user will not have to use a keyboard to be a power user."

"I see operating systems evolving into a single standard (over the next 20 years)."

"Telephone, TV, video, and sound will be successfully integrated at a consumer-level cost."

"As far as software goes, it is almost too difficult to imagine, but I certainly look forward to the advancements."

Reader Survey on BIX

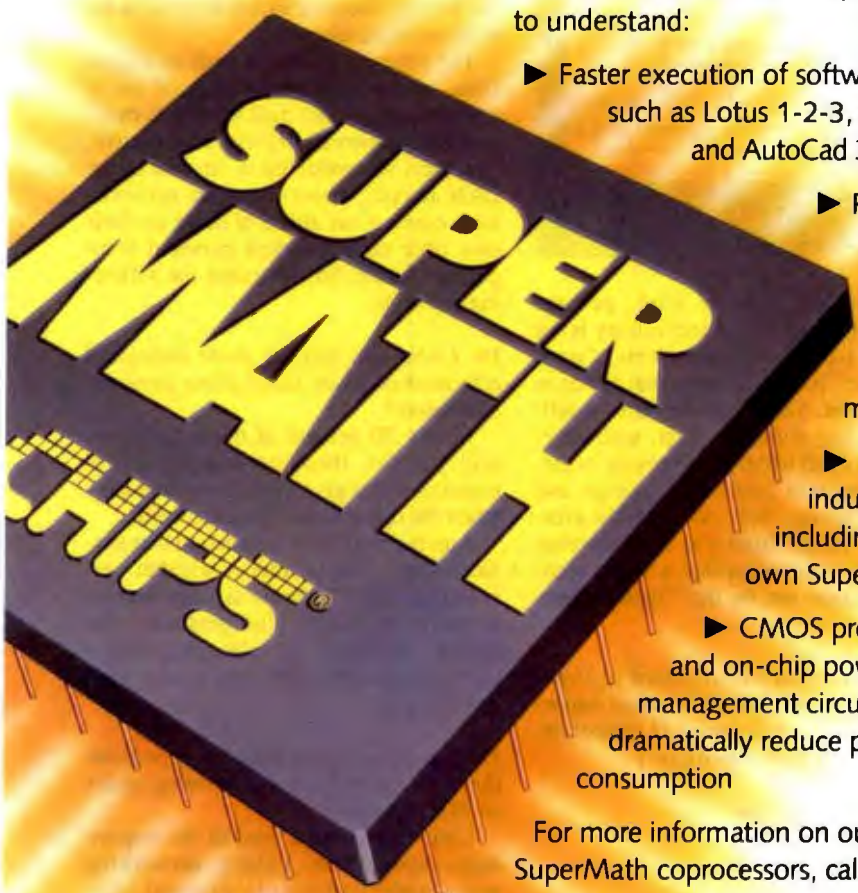
Along with mailing out written surveys to BYTE readers, we also conducted a survey on BIX. The cost of telecommunications coupled with the possible quagmire of data reduction from too many comments forced us to shorten and modify the written survey before we presented it on BIX. We did try to pose the same general questions within the format available, and, for the most part, the answers from the two surveys track well.

Please rank from 1 to 10 which hardware technologies you feel will be most important for the next five years (1 is most important; 10 is least important).

Microprocessor (CISC) chips
RISC chips
Memory chips
Magnetic drives
Optical drives
Displays
Batteries
Laptop computers
Notebook computers
Wireless LANs

There are at least a couple of different approaches to interpreting the results of the voting. First, if you count only the votes for the technology ranked number one, you can produce the chart shown in figure 1a. In it, 23 percent of the respondents name complex-instruction-set computer (CISC) chips as the most important hardware technology in the next five years. Optical drives and RISC technologies tied for second place, receiving the next largest number of "most important" votes. Certainly, optical drives were a heavy winner in the earlier poll results. The "most important" voting tabulations continue, with those responses receiving the fewest "most important technology" votes trailing to the right. Although most respondents use

When You Think 387, Think Faster.



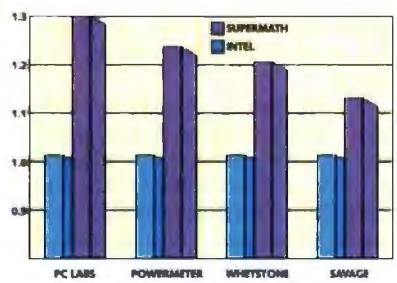
Introducing The Price Performance Leader In Math Coprocessors.

The benefits of our new SuperMath™ coprocessors are very easy to understand:

- ▶ Faster execution of software packages such as Lotus 1-2-3, Microsoft Excel, and AutoCad 386
- ▶ Plug-in compatible and software compatible with industry standard 387DX and 387SX coprocessors
- ▶ Up to 600% better performance at the instruction level
- ▶ Perfect system companion to industry compatible 80386 CPUs – including CHIPS' own Super386
- ▶ CMOS processing and on-chip power management circuitry dramatically reduce power consumption

SuperMath Coprocessor

PART NO.	PKG.	PIN-OUT
38700SX	68-pin PLCC	Pin-Compatible
38700DX	68-pin CPGA	Pin-Compatible



For more information on our SuperMath coprocessors, call (800) 944-MATH.

SuperMath Coprocessors. The fastest way to improve your system.

CHIPS®

Opening The Future Of Microprocessing.

Circle 24 on Inquiry Card.

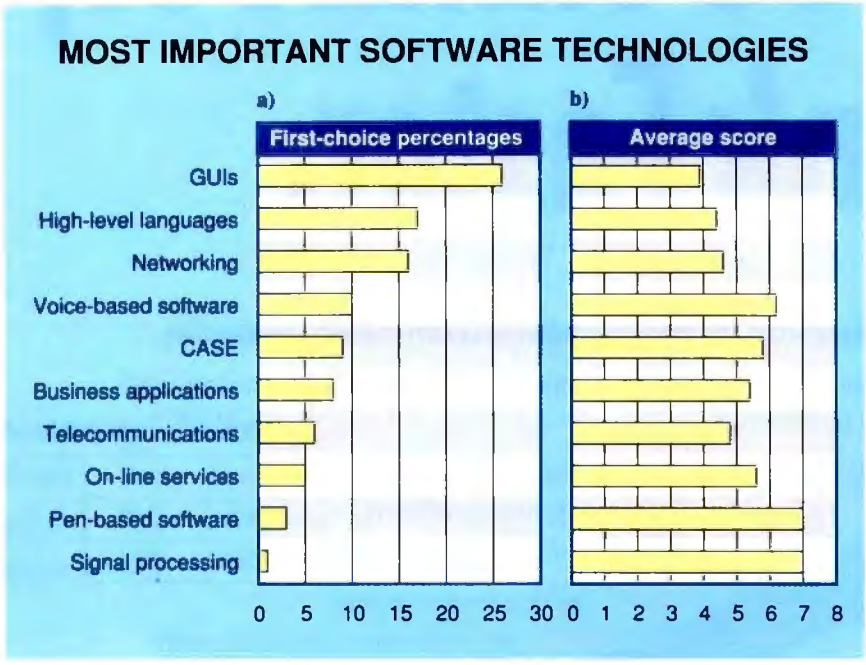


***Figure 2: (a)* BIX's survey of the most important software technologies for the next five years. Each column represents the percentage of number-one picks for that topic. *(b):* Alternative software technologies' ranking, in which the total points for each category were counted, with the lowest overall score the most important, and the highest score the least important.**

magnetic drives today, it would seem that most thought they would not in the future.

It's interesting, also, to see that while CISC was the winner, it received only 23 percent of the vote—not a majority and not even an overwhelming fraction of the total. Optical drives and RISC each received 18 percent. Thus, between the top three, the responses equal just 59 percent. One conclusion is that few of the respondents felt that only one technology was key.

As a second way of looking at the voting results, you could count the total points for each category, with the *lowest* overall score the *most* important, and the *highest* score the *least* important. You then get a slightly different picture of the survey respondents' responses, as shown in figure 1b. This interpretation minimizes the results of one category's getting most of the votes for the number-one ranking, along with a majority of, say, votes for the number-nine ranking.

As figure 1b illustrates, displays and memory chips swap positions. But they were close neighbors (11 and 10 percent, respectively). Magnetic drives, however, leap from last place to sixth, perhaps meaning that while that technology is not near the top of the respondents' "most important" list, it is a very real factor in the equation. There is some other small-scale jostling at the far right, with wireless LANs and battery technology bringing up the rear instead of laptops and magnetic drives. Note, too, that the average score ranges from 4 to 7, reinforcing the earlier conclusion that a single technology might not be the "most important."

Please rank from 1 to 10 which software technologies you feel will be most important for the next five years? (1 is most important; 10 is least important.)

High-level languages
Pen-based software
Voice-based software
GUIs
Signal processing
Business applications
Telecommunications
On-line services
CASE
Networking

Figure 2a plots the "most important" software voting using the highest number of votes for the number-one ranking. GUIs have a commanding lead, with 26 percent of those surveyed ranking it as the most important software technology. High-level languages and networking tie for second in the software category, indicating, along with the GUIs' importance, that humans need to talk to computers and computers need to talk to each other. While we hear interesting things about pen-based computing, the survey takers were unimpressed, picking voice-based software by a margin of 3-to-1 over pens.

Figure 2b uses the "average vote" criteria. The first three categories remain the same, but voice technology takes a big dive from fourth place to eighth, CASE goes from fifth to seventh and telecommunications from seventh to fourth, and business applications and online services move a notch or two. Following the hardware category's trend, the average scores also are very close for software technology.

The promise of things such as shared files, workgroups, near-universal (or at least companywide) data access, E-mail, and other network attributes is attractive. However, we wondered if, in spite of the LAN hoopla, those users on networks were coming out ahead of those on their own little nonnetworked personal computing islands. So, we asked the following question:

Do LANs now provide more individual effectiveness than stand-alone personal computers?

Nearly 70 percent of the respondents said yes. So, those networkphobes remaining might give interconnection a try when the opportunity presents itself.

Another networking question that surfaces from time to time is whether networking might be some sinister plan to recentralize control of all personal computing. We asked the following, admittedly provocative, question to see what you thought:

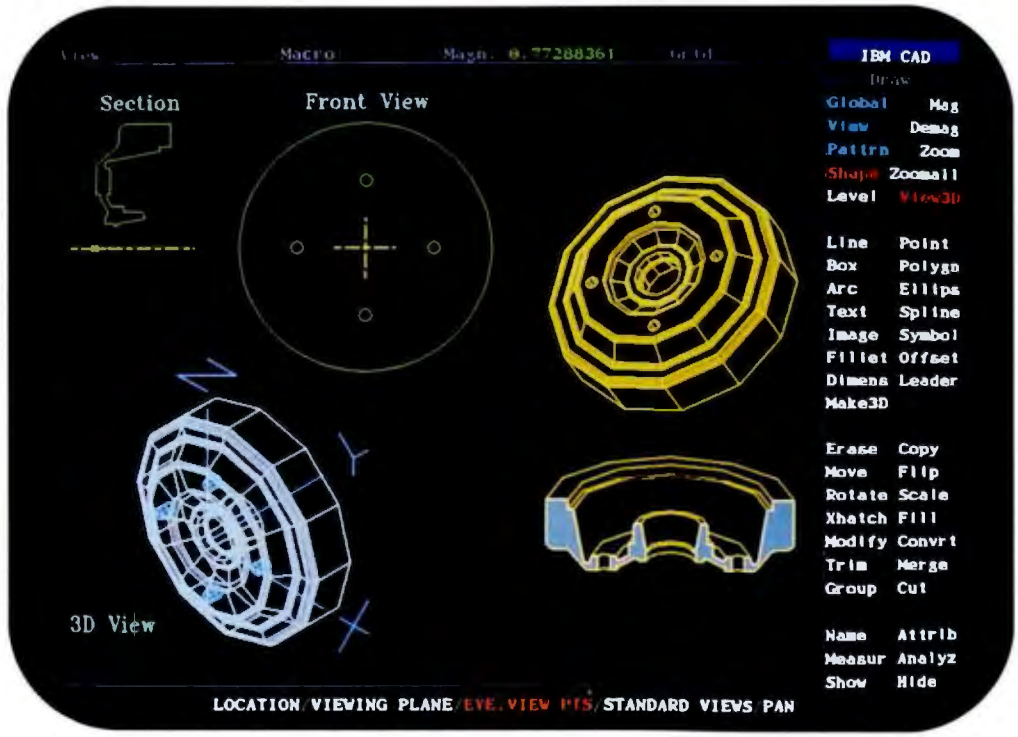
Do you view networking as a possible threat to reconsolidate computing under an MIS department?

Little more than a third of the respondents thought that, indeed, networking was a potential threat to personal computing independence. The fact that almost two-thirds did not, coupled with nearly 70 percent rating an increase in self-effectiveness as indicated in the previous question, doesn't mean it isn't so. But the vast majority is unconvinced.

Finally, we wondered which, if any, microprocessor would dominate the personal computer industry in the next two years. So we asked you to answer this question:

Which microprocessor do you feel will power your principal personal computer system in two years? Select one only from the following list as they appear.

IBM CAD for PC's. At half the cost of comparable systems, seeing is believing.



IBM® CAD is the ideal full function PC CAD tool for every engineer. That's because it's not only easy to use, but also very easy to afford.

Whether you're in design, product engineering or manufacturing IBM CAD can make you more productive. It gives you advanced functions including construction of 3D objects, support for scanned images, 2D Boolean operations, engineering analysis, dimensioning, and parametric design.

With IBM CAD's on-line documentation, even occasional users can go right to work without wading through bulky manuals. If you have a question, just press the HELP key and you'll see a graphical explanation of the task at hand. Press the key again and you're back to work. IBM CAD's context-sensitive hypertext help menus give you the answers you need fast.

All by itself, or as a complement to your company's existing CAD installation, IBM CAD is the perfect solution for people who don't have time to re-learn the system every time they use it.

You can quickly rough out conceptual ideas, create final designs, and edit CAD drawings created on other systems, and do "red-lining" and management reviews. You'll find it amazingly easy to exchange drawings with the most widely used mainframe, workstation and PC-based CAD systems.

Its low start up cost makes IBM CAD the affordable solution.

But seeing is believing. So CADAM is offering you a free demo disk that allows you to preview all of IBM CAD's advanced functions. Once you've seen the demo, you can start using the real thing for half the cost of a comparable CAD system. Just return the attached postage-paid reply card or call CADAM toll-free today.

1-800-4 IBM CAD

CADAM
AN IBM COMPANY

World Class CAD Productivity

Circle 21 on Inquiry Card.

68000
68020
68030
286
386SX
386
486
860
RISC

Figure 3 shows the responses to this question. Unfortunately, the 68040 was inadvertently omitted from the list. (Thanks to those who contacted us about the error; unfortunately, it was too late to redo the survey.) The 68030 made such a strong showing that we are itching to find out which (030 or 040) will lead and whether the 030's score was so high because the respondents couldn't vote for the 040. We'll have the 040 in the next survey. In any event, it looks like the processor wars will continue, to the benefit of all of us.

A Grain of Salt

While the foregoing may make for interesting reading, please don't cash in your insurance policy to start a new business based on these results. For that matter, don't do anything hasty based on *any* poll or survey, unless you're sure of your statistical and methodological prowess or can count on someone else's.

We hope that we have accurately documented some important trends; we know we have tried to maintain our nonplatform-specific objectivity to provide a possible look at the future. Polls and surveys from various sources can either corroborate or conflict ("lies, damned lies, and statistics"), and we will probably only know what the truth was via hindsight. Nonetheless, you have spoken, and we take note of it. ■

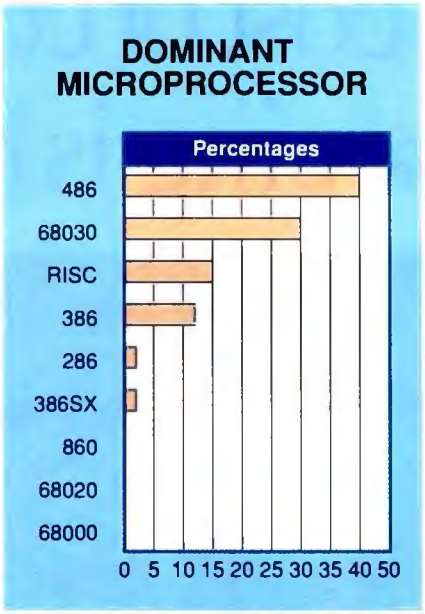


Figure 3: **The answers to the BIX survey question, "What microprocessor do you feel will power your principal PC system in two years? Select one only from the following list."**

ACKNOWLEDGMENTS

Thanks to BYTE employees Julie Perron, Carol Sanchioni, and Cindy Sands for their help with the poll and survey data. Also, thanks to the BIX staff for their help with the reader survey that was available on BIX.

Gene Smarte is BYTE's senior editor for special projects. Located in Irvine, California, he can be contacted on BIX as "gsmarte."

NEWS

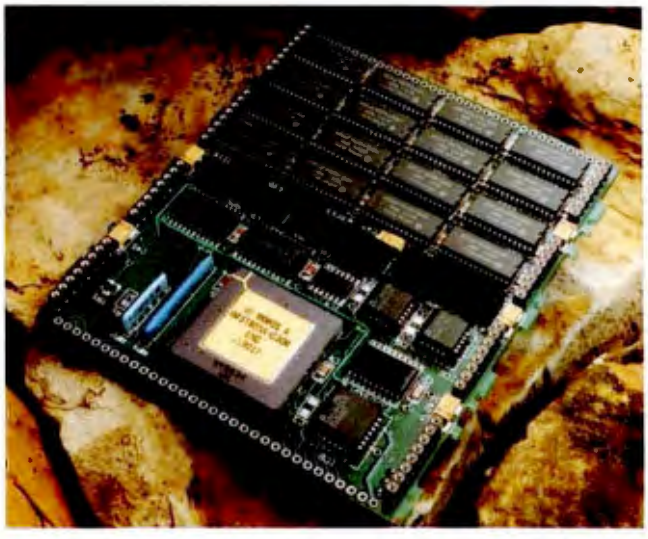
Three New X Terminals

Westward Technology has added three new products to its 4500 series of X Window System terminals. The 4520T is a 20-inch color X terminal incorporating a Trinitron tube and providing high-quality screen reproduction; the 4517 is a 17-inch flat-square-tube color X terminal; and the 4515 is a low-cost 14-inch monochrome X terminal. The terminals offer the functionality of Unix workstations, making it possible for you to run multiple X applications from more than one host in a distributed X environment at a cost that is lower than buying individual workstations for each user.

The 4500 series optionally lets you pan and scroll across a virtual screen size of up to 2048 by 1024 pixels regardless of the physical screen resolution. This feature allows applications that were developed for use on high-resolution screens to run on terminals that have a lower physical screen resolution.

The 4500 series of X Window System terminals run at 50 MHz and include 1 MB of RAM, 16 colors, and over 480 fonts.

All models in the 4500 range run at 50 MHz and include 1 MB of RAM (expandable to 8 MB), 16 colors selected from a palette of 256,000, and over 480 fonts, including the new X Window System 11 release 4 fonts.
Price: £3995 for the 4520T; £2995 for the 4517; £1995 for the 4515.
Contact: Westward Technology Ltd., Technology Park, Shannon Way, Tewkesbury, Gloucestershire GL20 8NB, U.K., 44-684-298600; fax 44-684-297124.
Circle 1279 on Inquiry Card.



The PST203 Super-Fast TRAM combines a 30-MHz T805 transputer and up to 8 MB of memory for applications such as image and signal processing, AI, and modeling.

Superfast Transputer Processing

A self-contained subsystem, the PST203 Super-Fast transputer module (TRAM) combines the processing power of the 30-MHz transputer and up to 8 MB of memory with an access time of 35 ns. The PST203 is ideal for transputer applications such as image and signal processing, AI, and modeling.

The Size 4 TRAM features the Inmos T805 floating-point transputer, which is capable of performance speeds of 30 MIPS and 4.3 MFLOPS and can have 1, 2, 4, or 8 MB of DRAM. Thanks to Paratech Solutions' use of low-profile surface-mount technology, you can stack more TRAMs on top of the PST203.
Price: £1135 and up.
Contact: Paratech Solutions Ltd., Sentinel House, 163 Brighton Rd., Coulsdon, Surrey CR5 2NH, U.K., phone and fax, 44-81-763-1540.
Circle 1280 on Inquiry Card.

3-D Design for the Mac

Perspective Design says that its Realise solid modeler for the Mac is packed with functionality for engineers, designers, and desktop publishers. The modeling engine is the same as the one in PDL's MicroSolid, Radan's Radesign, Tangram's Swift-3D, and Robocom's RoboSolid.

The package includes modeling functions such as extrusions, patterns, and Boolean combinations. Features include realism with full-color shaded imagery or hidden-line removal, smooth realistic shading of realistic materials (e.g., plastics, metals, and glass) in real time, and cast shadows. Realise supports 24- and 8-bit color as well as black-and-white stipple shading. The package calculates volumes, areas, weights, center of gravity, moments, and products of inertia of any mix of materials and all in a form that you can inject straight into spreadsheet software.

PostScript output capability lets you print all visualizations or embed them in desktop publishing programs. You also get DXF input and output, importing of preliminary 2-D design work, and export of full hidden-line drawings for dimensioning, framing, and plotting.

Realise takes up less than half a megabyte in your Mac and will run in 1 MB; the more memory you have, the more you can build with it.
Price: £495.
Contact: Perspective Design Ltd., Innovation Centre, Cambridge Science Park, Milton Rd., Cambridge CB4 4GF, U.K., 44-223-420514; fax 44-223-420661.
Circle 1281 on Inquiry Card.

Two-Color 400-dpi Plotting

CalComp has added the 52436 (A0) and 52424 (A1) plotters to its DrawingMaster Plus range. The plotters feature a RISC-based processor for high-speed vector-to-raster conversion and freeing up the host computer. The storage capacity of 25 MB is sufficient to plot all data required for most complex plots containing up to 3 million vectors. The plotters feature their own built-in networks for up to four users and incorporate standard network interfaces.

CalComp's Quikplot mode lets you double the normal plotting speed to 2.3 inches per second while outputting at a resolution of 200 by 100 dpi. An optional media take-up reel allows full unattended operation and the ability to plot a continuous drawing up to 60 meters long on a single roll. The 52436 and 52424 plotters can produce draft or final-quality plots in one or two colors on roll-feed media 24 or 36 inches wide. A variety of thermosensitive paper and film is available.

The 52436 and 52424 plotters from CalComp's DrawingMaster Plus range can plot simultaneously in red and black and produce a fully configured plot at a resolution of 406 dpi in both axes.

All the DrawingMaster Plus plotters support CalComp's Compressed Raster Format, which minimizes the size of the raster plot files, with compression ratios of 100-to-1 or more, reducing data transmission time from the host computer to the plotter.

The 52436 and 52424 plotters can be wall or floor mounted. They are preset for use with an IBM PC using AutoCAD, although you can easily amend all parameters for most CAD/CAE software packages.

Price: £12,950 and up.
Contact: CalComp Ltd., Vector House, Ruscombe Business Park, Twyford, Berkshire RG10 8BR, U.K., 44-734-320032; fax 44-734-341215.

Circle 1274 on Inquiry Card.

Client, Server Confusion ?

A proposal from the World's most open Vendor

SequeLink: the efficient client/server solution

SequeLink is transparant client/server software which optimises the interaction between your client-workstations, servers, RDBMSes, networks and applications. It bridges every standard you have already chosen, while giving you a free choice of the range of hardware and software you may want to use in the future.
Thus, you increase the return on your computing investment.

Since its introduction three years ago, the developers of SequeLink have gathered more experience than anyone else in the design and implementation of client/server software in a truly multi-vendor environment.

Being a product of GnOsIs, an independent software developer, SequeLink does not discriminate against any particular application, platform, RDBMS or network. It supports all of these components equally efficiently and regardless of brand. This is why SequeLink is so powerful.

Hundreds of large and medium-sized corporations in the U.S., Europe and Japan are already satisfied users. Choosing SequeLink is opting for a proven and efficient client/server solution.

SequeLink™
Client/Server Middle Ware ™

Just tell us about your environment. We will send you a customized solution.

DATABASE	SERVER	NETWORK	CLIENT	APPLICATIONS
❑ AS/400	❑ ORACLE	❑ NETBIOS	❑ WINDOWS 3	❑ EXCEL
❑ VAX/VMS	❑ RDB	❑ TCP/IP	❑ MACINTOSH	❑ WINGZ
❑ UNIX	❑ INGRES	❑ DECNET	❑ UNIX	❑ EASEL
❑ MVS	❑ SYBASE	❑ APPC	❑ OS/2	❑ HYPERCARD
❑ OS/2	❑ DB2	❑ APPLETALK	❑ _____	❑ TOOLBOOK
❑ VM	❑ SQL/400	❑ NETWARE		❑ 4TH DIMENSION
❑ _____	❑ SQL SERVER	❑ _____		❑ SMALLTALK
	❑ OS/2 DBM			❑ OMNIS 5
	❑ INFORMIX			❑ C, PASCAL
	❑ _____			❑ _____

Name: .....
Company: .....
Job Title: .....
Address: .....
City: .....
Post Code: .....
Country: .....
Telephone: .....
Fax: .....

GnOsIs NV
Kardinaal Mercierlei 30
2600 Antwerp
BELGIUM
Tel: +32/3/230 02 22
Fax: +32/3/218 87 82

GnOsIs France
2, Chemin du Pigeonnier
de la Cépière
31100 Toulouse
FRANCE
Tel: +33/61.76.17.18
Fax: +33/61.76.18.44

GnOsIs (U.K.) Ltd.
GnOsIs House
3 Acorn Business Centre
Heaton Lane, Stockport
Cheshire SK4 1AS
UNITED KINGDOM
Tel: +44/61 474 19 63
Fax: +44/61 474 19 58

TechGnOsIs, Inc.
Northern Trust Plaza
301 Yamato Road, Suite 2200
Boca Raton FL 33431
Tel: +1/407.997.6687
Fax: +1/407.241.6143

GnOsIs
Focus on mission critical systems

BYTE /09 / 91

Present Perfect Molecules on Macs

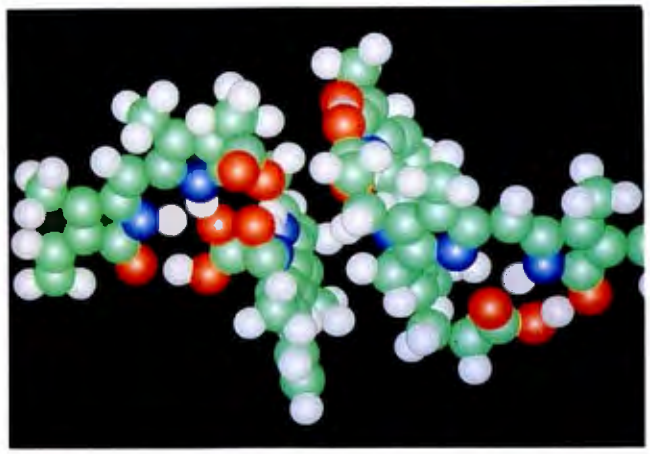
Ball & Stick 3.0 has a variety of features for importing, viewing, editing, and outputting publication-quality molecular models on your Mac. You get one-step commands for importing coordinates from other structural modeling packages; an array of display options to customize virtually all aspects of the module—five display styles, stereo images, customizable atom labels, tonal shading, zooming, and clipping; animation of rotations; two concurrent display windows; and export facilities to other word processing and drawing packages.

Version 3.0 provides real-time interactive viewing. With the mouse, you can place molecules anywhere in 3-D space and view them from any direction. Real-time operations include rotation, x,y translation, x,z translation, distance change, angle change, and torsion change. Ball & Stick also lets you easily produce real-time animation of rotations.

Price: £249 for commercial users; £149 for educational users.

Contact: Cherwell Scientific Publishing Ltd., 27 Park End St., Oxford OX1 1HU, U.K., 44-865-794884; fax 44-865-794664.

Circle 1275 on Inquiry Card.



With Ball & Stick 3.0, you can import, view, edit, and output high-quality molecular models on your Mac.

The Ideal Dimension for Monitors

Sygnos Technology has brought LCD technology into direct competition with the CRT with its Sygnos-S28 stand-alone LCD monitor. The black-and-white monitor has a PC interface that removes the need for a proprietary card and allows the Sygnos-S28 to use a standard VGA card.

The monitor provides an LCD resolution of 640 by 480 pixels with high contrast and 28 gray scales. It weighs just under 2 kg and has a footprint of 9 by 8.5 cm. Other benefits include a diagonal display size of 25.8 cm; a text format of 25 lines by 80 characters; low, 12-W power consumption; and negligible heat generation. According to the company, the Sygnos-S28 emits less than 8 percent of the low-frequency electromagnetic radiation produced by conventional low-radiation CRTs.

The screen is nonreflective and backlit. The Sygnos-S28 is compatible with CGA, EGA, VGA, and MGA standards.

Price: US$1660.

Contact: Sygnos Technologies Ltd., 17th Floor, Somerset House, 28 Tong Chong St., Quarry Bay, Hong Kong, 852-880-0779; fax 852-565-8337.

Circle 1276 on Inquiry Card.

The Sygnos-S28 stand-alone LCD monitor is compatible with CGA, EGA, VGA, and MGA standards.

Oddules for I/O

A new concept in low-cost computer I/O devices, called the Oddule, communicates with the host computer using the Philips I²C bus. The bus is already implemented in some computers (e.g., the Acorn Archimedes), board-level systems, and hand-held computers, and you can easily implement it in other computer systems with software (and sometimes a little hardware). You can easily connect Oddules into external systems, and you can daisy chain Oddules together to create a peripheral configuration to suit your needs.

The AnDi Oddule is the first product in the range. It is a combined A/D I/O Oddule that combines four 8-bit analog input channels, one 8-bit analog output channel, and 8 bits of digital I/O. The digital interface combines eight TTL-compatible I/Os and eight open-collector outputs, each of which is capable of sinking up to 500 mA. You can connect up to eight AnDi Oddules together on the same bus.

According to the company, Oddules currently under development include a multimeter, a CRT, a teletext data acquisition system, a video subtitling system, a speech synthesizer, and a bus-expansion system. Interfaces for computers without a built-in I²C bus will also be available.

Price: £39.

Contact: Ian Copestake Software, 10 Frost Dr., Wirral, Merseyside L61 4XL, U.K., 44-51-632-1234; fax 44-51-632-3434.

Circle 1277 on Inquiry Card.

Short-Range Modems for Macs

Two new short-range modems for the Mac connect directly via an eight-pin mini-circular plug and operate without AC power, using ultralow power from the Mac's data and control signals. The SRM-3D/Mac is a line driver for indoor use that you couple directly to the four-wire line, while the SRM-3A/Mac is transformer-coupled, providing isolation, protection, and the ability to transmit through switching equipment. You can use the miniature asynchronous modems for applications such as remote connection of the Mac to a multiplexer or to an X.25 PAD, connection to an IBM PC, and remote operation of the ImageWriter.

The SRM-3D/Mac and SRM-3A/Mac short-range miniature modems for the Mac allow full-duplex, asynchronous transmission over four-wire telephone lines at data transfer rates of up to 19,200 bps.

The modems allow full-duplex, asynchronous transmission using unconditioned four-wire telephone lines at data transfer rates of up to 19,200 bps. They operate over distances of up to 18 km, depending on wire gauge and data rate.

Using appropriate protocol conversion software and a communications package, the modems let you connect Macs to non-Macintosh equipment. The low transmit level minimizes cross talk onto adjacent circuits within the same cable. The SRM-3D/Mac and SRM-3A/Mac transmit and receive data at a balanced impedance, ensuring immunity to circuit noise.

The SRM-3D/Mac and SRM-3A/Mac measure 60 by 30 by 20 mm, and they weight 30 g.

Price: £97 for the SRM-3D/Mac; £117 for the SRM-3A/Mac.

Contact: GADC Ltd., P.O. Box 353, Akeman St., Tring, Hertfordshire HP23 6OB, U.K., 44-44282-8681; fax 44-44282-7962.

Circle 1278 on Inquiry Card.

Laps Ahead

LT-320X Laptop

- 20Mhz 80386SX processor
- 32k cache RAM
- VGA-compatible backlit LCD display, 16 shades of grey. Port for external VGA monitor
- REMOVABLE hard disk
- 3½" 1.44MB floppy drive Port for external drive
- 1 parallel 1 serial port
- 80387SX-20 maths socket
- 85 keys with 12 functions Connector for external keyboard
- Rechargeable, removable NiCad Battery pack (up to 2½ hours) with AC adaptor
- One 16-bit AT card slot
- Carrying case
- Mouse
- Microsoft MS-DOS 5
- Microsoft Windows 3
- Optional modem
- Optional local area network connection
- Unlimited Technical Hotline support
- 12-month Warranty, optional on-site service at £25 from Response Computer Maintenance (081-965-3225)

£1495

2MB RAM	Hard Disk	5MB RAM
£1495	40MB	£1645
£1665	120MB	£1815

All prices are exclusive of carriage and VAT

Elonex reserves the right to change specifications and prices without notice.

Elonex acknowledges all trademarks.

LONDON OFFICE
Elonex plc, 2 Apsley Way, London NW2 7HF
Fax 081-452 6422
Tel 081-452 4444

NORTHERN OFFICE
Elonex plc, 7-9 Campus Road, Listerhills Science Park, Bradford, West Yorkshire BD7 1HR
Fax (0274) 307294
Tel (0274) 307226

EIRE
ERS Computers, Merchants Court, 24 Merchants Quay, Dublin 8
Fax 1-6791728 Tel 1-6797774/5

BELGIAN OFFICE
Marktech (Benelux) SA Route Provinciale 224, Bte 7, B-1301 Wavre (Bierges), Belgium
Fax 10-41 45 96 Tel 10-41 42 26

ELONEX

PERSONAL COMPUTERS

Take a fast 32-bit processor, enhance it with 32k of cache memory, and combine it with a crystal-clear VGA display.

For Portability, include a robust battery. For Security, a removable hard disk. For Flexibility, a spare 16-bit card slot. For User Friendliness, a mouse and the award-winning Windows.

Add the Elonex reputation for professional Technical Support and expertise in connecting personal Computers together.

You then realise why the LT-320X offers more than just Value.

LX17

Please send me details of Elonex's products and services

COMPANY NAME _____

NAME _____ POSITION _____

ADDRESS _____

TELEPHONE _____

NEC's Notebook PC

Standard features of NEC's new UltraLite 286F notebook PC include a 12-MHz 286 microprocessor, 1 MB of RAM (expandable to 5 MB), a 3½-inch 1.44-MB floppy disk drive, and a 20-MB hard disk drive. The black-and-white backlit LCD screen has a double-scan CGA resolution of 640 by 400 pixels and provides easy-to-read high-contrast characters.

The full-size 78-key keyboard has 12 function keys and separate cursor-control keys. Other features include a modem I/O slot, an I/O slot for dedicated high-speed memory, serial and parallel ports, and a connector for an external floppy disk drive.

Under battery power, the UltraLite 286F provides up to 3 hours of continuous use. You can recharge the battery in 3½ hours with an AC adapter.

The UltraLite 286F package includes a carrying case, DOS, an AC adapter, and a battery. External dimensions are 8½ by 11½ by 2 inches, and the laptop weighs about 6 pounds.

Price: £1795.

Contact: NEC (U.K.) Ltd., NEC House, 1 Victoria Rd., London W3 6UL, U.K., 44-81-993-8111; fax 44-81-992-7161.

Circle 1271 on Inquiry Card.

Under battery power, the UltraLite 286F notebook PC provides up to 3 hours of continuous operation.

Siatel's Video Controller for A4 Monitors

Based on the L5251 graphics processor, the CAX550 and CAX750 video controllers from Siatel can control full-page A4 and A3 monitors. The boards provide programmable vertical and horizontal frequencies so that different kinds of monitors can accept those frequencies.

The controllers have a standard full-page graphics resolution of 1008 by 736 pixels; a text-plus-graphics resolution of 80 columns by 25, 66, or 72 rows with overscan; a horizontal frequency of 82 kHz; and a vertical frequency of 85 Hz. The boards support the standard IBM character set of 256 characters, as well as several alternative character sets and languages.

A menu-driven program puts the video subsystem into the desired mode and configures the screen and controller options. Data transfer rates are 780,000 cps and 12 million pixels per second.

The half-length CAX550 board is for ISA machines with a 16-bit slot configuration, while the CAX750 is for Micro Channel architecture machines.

Price: About 2000 FF each.

Contact: Siatel, 30 bd Galliéni, BP 111, 92394 Villeneuve-la-Garenne, France, 33-1-47-98-94-11; fax 33-1-47-92-15-83.

Circle 1272 on Inquiry Card.

Siatel's CAX-550 and CAX-750 video controllers provide programmable vertical and horizontal frequencies so that different kinds of monitors can accept those frequencies.

Accent Computers Offers Imagraph Card

You can buy Imagraph's TI-1210 graphics controller and software driver, Imazoom, from Accent Computers. Offering a resolution of 1280 by 1024 pixels in either a 16- or 256-color version, the TI-1210 provides CAD users with faster redraw capabilities.

Available as an option with the Imagraph TI-1210, the Imazoom display-list driver for AutoCAD provides real-time on-screen touring in zoom/pan mode, toggling between zoomed view and full view in the main menu, and compression routines for display-list storage. Imazoom also features multiple viewports up to 50 times faster than the AutoCAD Set Viewport command and offers redraw speeds of between 28,000 and 40,000 vectors per second.

The TI-1210 gives you a color palette of 4096 shades on the 16-color version and 16.7 million colors on the 256-color version. The card comes with up to 4 MB of high-speed RAM, which is accessible via the drawing processor. The card requires a full-length slot in an IBM XT, AT, or RT and provides CGA, MDA, Hercules emulation, and, optionally, VGA pass-through.

Price: £1275 or £1395 for the 16-color TI-1210; £1920 and £2040 for the 256-color TI-1210; £205 for Imazoom.

Contact: Accent Computer Ltd., Kendal House, Victoria Way, Burgess Hill, West Sussex RH15 9NF, U.K., 44-444-870444; fax 44-444-870222.

Circle 1273 on Inquiry Card.

NEWS

INTERNATIONAL

The 4-ppm MT904 laser printer combines a small footprint and a small price tag.

A Low-Cost 4-ppm Laser Printer

If you're looking for a laser printer that combines a small footprint and a small price tag, then Mannesmann Tally's MT904 may be for you. The 4-ppm printer, which measures just 36.5 by 40.5 cm, includes 14 Hewlett-Packard-compatible resident fonts and HP LaserJet IIP emulation.

The MT904 comes with 512 KB of memory, which is expandable with 1-MB memory upgrades up to a total of 2.5 MB. A single slot lets you add HP-compatible plug-in fonts, and the printer comes with Centronics and RS-232 interfaces.

Paper handling on the MT904 includes a 100-sheet feeder, manual feed, and a face-down output tray.

Price: £949.

Contact: Mannesmann Tally Ltd., Molly Millar's Lane, Wokingham, Berkshire RG11 2QT, U.K., 44-734-788711; fax 44-734-791491.

Circle 1282 on Inquiry Card.

A Relational Database for the Atari ST

Kuma Computers offers Adimens 3.0, a relational database for the Atari ST that provides features such as export and import of data, calculating fields, multilevel sorting, time fields, character replacement, menu prompts, and graphical controls. The package also features a merge form option; interfacing to other programs, such as K-Word 2, for mail-merge applications; system time and date handling; error checking and error messages; and an editable printer driver. Adimens 3.0 is compatible with all versions of the Atari ST operating system.

Price: £129.95.

Contact: Kuma Computers Ltd., 12 Horseshoe Park, Pangbourne, Berkshire RG8 7JW, U.K., 44-734-844335; fax 44-734-844339.

Circle 1283 on Inquiry Card.

Flexible Storage for Workstations

Costgold Research says that its XSA-1 Storage Expansion System provides a flexible and compact method for workstation users who want to upgrade their data-storage requirements and offers options that let you configure your system to meet your needs. One single enclosure can accommodate up to 4 gigabytes of disk storage or a mixture of hard disk drives, Exabyte tape drives, magneto-optical devices, ¼-inch cartridge tapes, and CD-ROM drives to suit most small systems needs.

The XSA-1 is a compact unit that you can have on your desktop or by the desk. It is normally supplied with two SCSI or SCSI-2 interfaces, allowing loop-through with other SCSI devices. It has space for a full-height 5¼-inch hard disk drive with a capacity of from 200 MB to 2 gigabytes, and three half-height 5¼-inch front-panel cutouts, into which you can install either more hard disk drives or a full range of SCSI peripheral devices.

Costgold Research can supply systems suitable for connection to Sun, DEC, IBM, and PC-based workstations.

Price: £1996 to £6652.
Contact: Costgold Research Ltd., 61 Green End Rd., Cambridge, Cambridgeshire CB4 1RU, U.K.; phone and fax, 44-223-425734.
Circle 1284 on Inquiry Card.

One XSA-1 Storage Expansion System can accommodate up to 4 gigabytes of disk storage or a mixture of hard disk drives, tape drives, magneto-optical devices, cartridge tapes, and CD-ROM drives.

Stabilize Your Hand-Held Scanner

ScanTrac is a stabilizing and guidance system for all makes of hand-held scanners that is designed to eliminate the problems of distortion, skewing, and jolting caused by erratic hand movements while scanning. The lightweight acrylic unit consists of three parts: a clear base plate with hinged cover, a tracking bar, and a scanner support.

To use ScanTrac, you sandwich the original image securely between the base plate and the hinged cover, which provides a smooth surface for scanning while the tracking bar allows smooth, continuous movement in both vertical and horizontal planes. You can use ScanTrac with virtually all makes of hand-held scanners, whether they are monochrome or color.

Price: £39.95.
Contact: Electrone Ltd., Stonefield Way, Ruislip, Middlesex HA4 0QJ, U.K., 44-81-864-5559; fax 44-81-864-2228.
Circle 1285 on Inquiry Card.

With the ScanTrac stabilizing and guidance system for hand-held scanners, you get a smooth surface for scanning, a tracking bar, and a scanner support for smooth continuous movement in both vertical and horizontal planes.

Tools for Turbo Pascal Programmers

P.C. Code Library is a collection of programmer's tools for use with Borland's Turbo Pascal compiler. The package includes eight units, each of which offers tools for the different aspects of programming applications in Turbo Pascal.

Enhanced string-handling facilities include parsing, justification, replacement, and extended formatting of numeric output. Two units provide facilities for inputting, outputting, and manipulating date and time values. Three of the units offer console-oriented input and output.

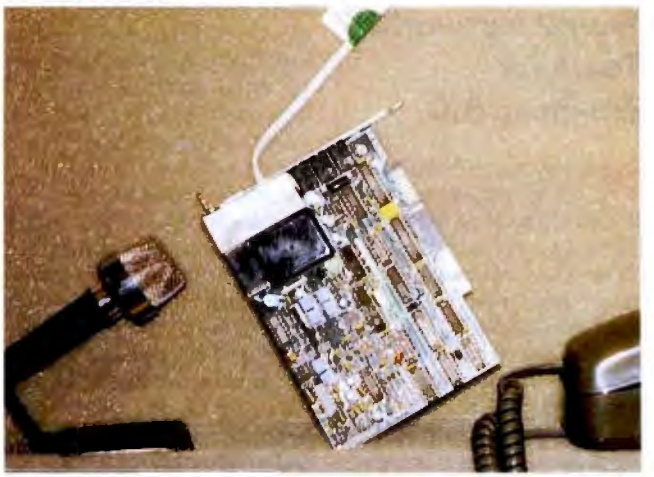
Routines include on-screen editing of strings, numeric values, dates, and times, with full control over the cursor and insert/overwrite modes. You can define up to 255 windows, allowing a program to set up status lines, pop-up menus, and so on. Each window can have its own border with title text, and you can open, close, move, and hide them as required. An on-line help unit makes use of windows to provide a simple way of implementing pop-up help for any program.

P.C. Code Library includes complete Pascal and assembly language source code, so you can easily modify it for special projects and recompile it for the various versions of Turbo Pascal.

Price: £40.
Contact: Paul Coxwell, 30 Alford Rd., Sutton on Sea, Lincolnshire, U.K., 44-507-442160.
Circle 1286 on Inquiry Card.

NEWS

INTERNATIONAL



The StarTalker interactive voice-response card can record and play back speech and other sounds to and from your computer's hard disk, via a microphone or a telephone.

IVR for the PC

StarTalker is an interactive voice response card for 286-based IBM ISA and EISA PCs that offers features such as single- to four-line operation, dial in and out, dual-tone multifrequency recognition, and full call progress. The package includes a half-length card, a microphone, a speaker, and a software toolkit.

The card can automatically answer and dial. It uses A/D and D/A circuits to record and play back speech and other sounds to and from your computer's hard disk, via either a microphone or the telephone line.

The memory-resident software occupies less than 7 KB of RAM and provides a library of C routines. The package supports assembly language, C, and QuickBASIC, as well as other languages that can address a software interrupt.

Price: £400.

Contact: Staria Ltd., 50 Dewlands Way, Verwood, Dorset BH21 6JN, U.K., 44-202-813141; fax 44-202-813030.

Circle 1287 on Inquiry Card.

Development Tools for OS/2

The OS/2 User Group offers a range of development tools, including Memmon, a utility that graphically displays memory utilization, and Disk Daemon/2, a full-screen file and sector editor for IBM PCs and PS/2s. If you are an OS/2 developer creating large applications, Memmon will help you keep track of how much memory you have used and how much memory you have left.

Disk Daemon/2 lets you view or edit the contents of both PC files and hard disk sectors. You can simultaneously open up to three files and copy data between files or sectors using single-keystroke commands or a mouse.

Price: £95 for Memmon; £50 for Disk Daemon/2.

Contact: OS/2 User Group, Cecily Hill Castle, Cirencester, Gloucestershire GL7 2EF, U.K., 44-285-655888; fax 44-285-640181.

Circle 1288 on Inquiry Card.

NEWS

INTERNATIONAL

Neural Network Tools for Windows 3.0

Namename, a Windows 3.0–based package from Neural Computing Sciences, lets you use neural networks to assist with daily tasks, providing fast, intelligent help for many complex and problematic situations. The package learns from human experience and simulates the decision-making process, so applications span the spectrum of commercial and scientific activity.

The system lets you build networks using high-level mouse- and menu-driven commands and easily link them with existing working practices. Namename will interface with PC-based application programs compatible with the Dynamic Data Exchange facility, including popular databases and spreadsheets. Using DDE, you can transfer data transparently and in real time, making it simple to teach and run neural networks; for example, you could convert an existing database to smart status without making changes to the operator interface.

Namename consists of two major elements—NeuModel and NeuRun—for constructing networks and training or running them, plus a package called NeuDesk, which offers a high-level interface to automate the process. The package utilizes the basic feed-forward neural network technique, with a choice of three methods—all variations on the back-propagation algorithm—for modifying its behavior when learning.

To build a network, Namename adopts a spreadsheet approach for ease of design and data entry, allowing you to initially consider and construct systems as simple tables. First, you decide how many inputs and outputs you need, and then you assign number ranges for those nodes to represent the real-life data. Next, you assign the number of hidden layers—the interconnecting network of neuron elements that forms the basis for learning the response behavior. You can do this manually from an experienced user's decision or automatically by the system. The next step is to decide the various gains and offsets applied at each intermediate level, which, again, can be automatically provided by the system using a randomization facility.

The network is then ready for training. Using the spreadsheet approach, you can quickly enter the results of previous sample cases. The network can then start to learn and modify its behavior by running and rerunning this set of data. You set up acceptable threshold levels for the answer and begin to run the data. Namename presents a dynamic performance graph to show how the network is modifying its internal gains and offset values to attain the ideal response. Once the network consistently achieves the correct responses to real-life inputs, it is ready for operational use. You can also modify or retrain networks in situ.

Namename requires an IBM AT with Windows 3.0; the company recommends a math coprocessor.

Price: £985.

Contact: Neural Computing Sciences, Unit 2, Freemantle Business Centre, 152–156 Millbrook Rd., Southampton SO1 0JR, U.K., 44-703-211623; fax 44-703-634502.

Circle 1289 on Inquiry Card.

FREE PRODUCT INFORMATION

Mail Your Completed Card Today. For Quicker Response, Fax to 1-413-637-4343!

Circle the numbers on Inquiry Card which correspond to inquiry numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "E".

Print Your name and address and mail, or fax to 1-413-637-4343

Fill out this coupon carefully. PLEASE PRINT.

NAME

TITLE

COMPANY

ADDRESS

CITY COUNTY CODE

( ) ( )

PHONE FAX

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)

12 ☐ PC/MS DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?

18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

OUTLOOK
410EINT

Inquiry Numbers 1-493

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

Inquiry Numbers 494-986

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	862	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

Inquiry Numbers 987-1479

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	1201	1202	1203	1204	1205	1206	1207
1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224
1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241
1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258
1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275
1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292
1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309
1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326
1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343
1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360
1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377
1378	1379	1380	1381	1382	1383	1384	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394
1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410	1411
1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424	1425	1426	1427	1428
1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441	1442	1443	1444	1445
1446	1447	1448	1449	1450	1451	1452	1453	1454	1455	1456	1457	1458	1459	1460	1461	1462
1463	1464	1465	1466	1467	1468	1469	1470	1471	1472	1473	1474	1475	1476	1477	1478	1479

PLACE POSTAGE HERE

BYTE

TNT MAILFAST
FRG/BOS/700252/M01
P.O. Box 66
Hounslow
TW5 9RT
England

FREE PRODUCT INFORMATION

Mail Your Completed Card Today. For Quicker Response, Fax to 1-413-637-4343!

Circle the numbers on Inquiry Card which correspond to inquiry numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "E"

Print Your name and address and mail, or fax to 1-413-637-4343

PLACE POSTAGE HERE

BYTE

TNT MAILFAST
FRG/BOS/700252/M01
P.O. Box 66
Hounslow
TW5 9RT
England

Fill out this coupon carefully. PLEASE PRINT.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ COUNTY _____ CODE _____

( ) ( )

PHONE _____ FAX _____

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior level
8 ☐ Middle level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply)

12 ☐ PC/MS DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?

18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

OUTLOOK
410EINT

Inquiry Numbers 1-493

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

Inquiry Numbers 494-986

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

Inquiry Numbers 987-1479

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 1201 1202 1203 1204 1205 1206 1207
1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224

1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241
1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258
1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275
1276 1277 1278 1279 1280 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292
1293 1294 1295 1296 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309
1310 1311 1312 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326
1327 1328 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343

1344 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360
1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377
1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392 1393 1394
1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408 1409 1410 1411
1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 1426 1427 1428
1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445
1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462
1463 1464 1465 1466 1467 1468 1469 1470 1471 1472 1473 1474 1475 1476 1477 1478 1479

The greatest advantage in PC quality since the dawn of the machine age

QAPLUS™...
The industry standard for PC diagnostics, tuning and compatibility testing–at every level.

- More than 1,000,000 people around the globe use **QAPlus** products.
- The world's only troubleshooting and tuning software for Windows 3.0... **QAPlus/WIN**
- Service, customer support and repair departments use **QAPlus/fe**... on-site or **QAPlus** remotely.
- Virtually every major computer manufacturer relies on **QAPlus, QAPlus/Factory** or **QAPlus/fe.**

THE DISCOVER Awards FOR TECHNOLOGICAL INNOVATION

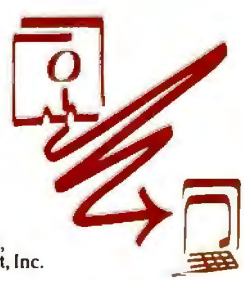
Concerned about ISO 9000 compliance? Call us.

- Many government agencies require acceptance testing using **QAPlus.**

Whether you're a manufacturer, reseller or a PC user, don't trust your systems to anything less.

QAPlus PC performance products are available worldwide from leading VARs and software dealers. Or, contact us today! DIAGSOFT, 5615 Scotts Valley Drive, #140, Scotts Valley, CA 95066

Phone (408) 438-8247
Fax (408) 438-7113



Currently Shipping: QAPlus 4.52, QAPlus/fe 5.03, QAPlus/fe Tech 5.03, QAPlus/Factory 1.1, Power Meter 1.8

DIAGSOFT™

Circle 38 on Inquiry Card (RESELLERS: 39).

The ONES to WATCH

BYTE editors look at trends for 1992 in four key product categories

DESKTOP PCS/Gateway 25 MHz 486 Cache

The first half of *Outlook '92* examined 10 major industry categories from lofty viewpoints. In this half, we delve into the four *product* areas that BYTE believes will have the greatest impact on users and computer buyers in the coming year: desktop systems, windowing applications, notebook computers, and network management tools.

We chose these four categories after looking at technological developments and trends that exist within real and potential markets. Prices for desktop systems, be they DOS-, Unix-, or Mac-based, are falling across the board. In terms of bang for the buck, users are in for great deals. GUIs on all platforms continue to be popular, and applications continue to take greater advantage of what graphical interfaces offer.

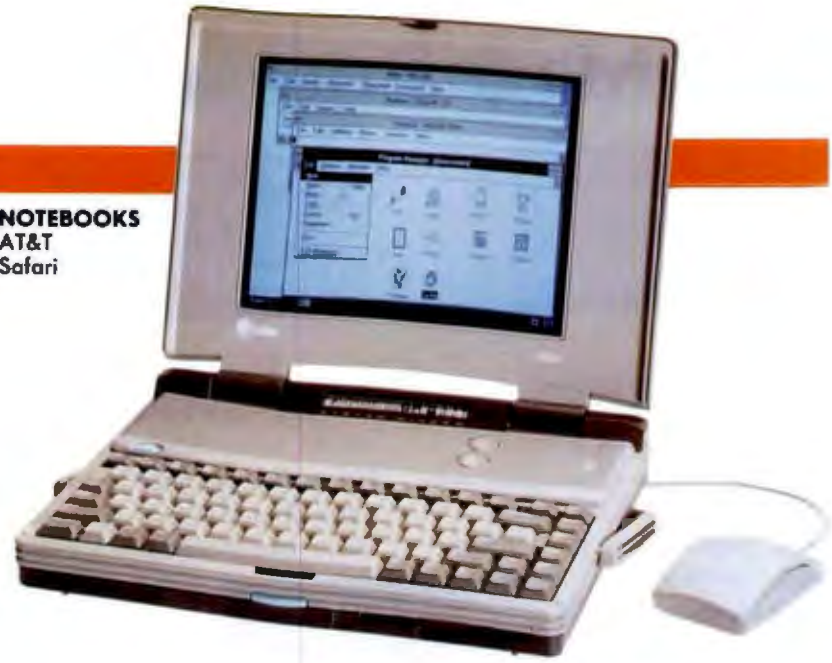
Growth projections for notebook computers are phenomenal. If you travel, you will likely be using one in the coming year. Finally, with the proliferation of LANs, it's becoming ever more important for network managers to have better tools to do their jobs.

The Road Map, Please

With a few exceptions, this Product Perspectives section is arranged as follows: Each topic is treated separately, with a written analysis that explains the trends. Each analysis is accompanied by one or more Product Guides, Company Information boxes, or both.

Although the articles look at the topics from mostly practical angles, they include information on the technologies behind the products as well. Where appropriate, discussions of marketing issues, installed base, and user needs are included.

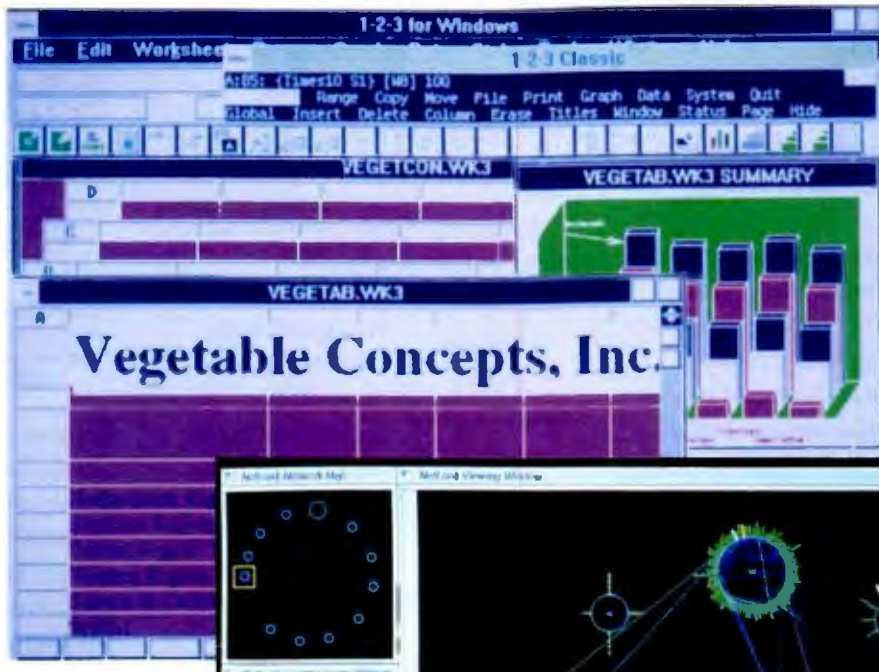
The Product Guides provide tabular compilations of product attributes, and you can use them to make fast comparisons among many competing products. Once you've read the corresponding article, you'll better understand the significance of the features included in the tables and how they might affect



NOTEBOOKS
AT&T
Safari

you. Please note that the data in these tables came from the manufacturers in most instances, and not from personal evaluation by BYTE editors. Where applicable, we've provided multiple tables to make it easier to find, for example, Macintosh-related products. The Company Information listings provide addresses and phone numbers for vendors in each product category.

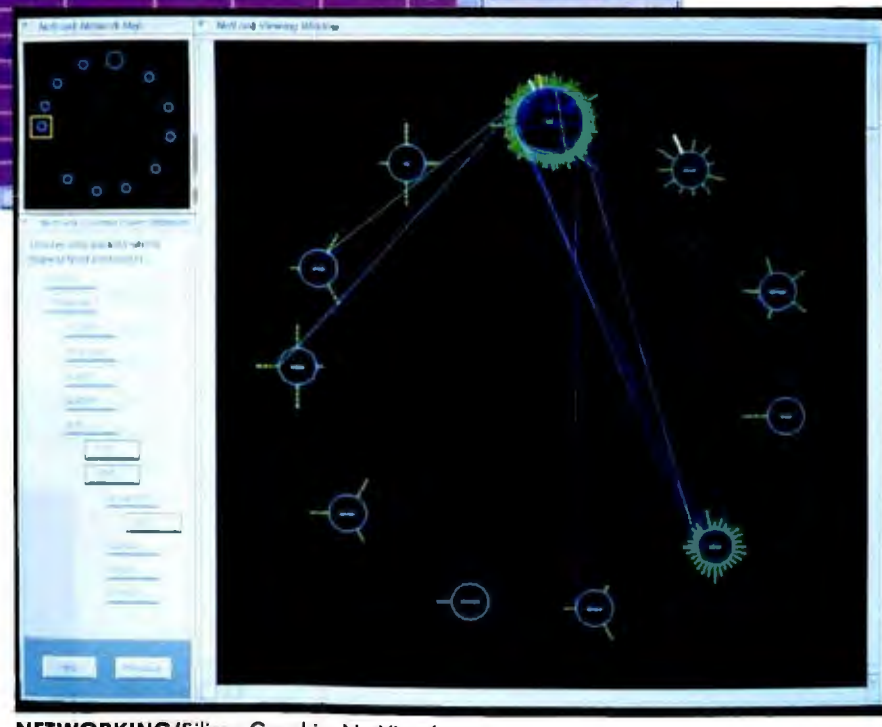
Because of the diverse nature of available products, neither the network management article ("Trends in Network Management") nor the X Window System section of the windowing applications article ("Windowing: Not by DOS Alone") includes Product Guides with detailed feature comparisons. Instead, the Company Information listings for these sections include product names and prices to help you better survey the market. These are intended to show a representative cross section of available vendors and products.



WINDOWS/Lotus 1-2-3 for Windows

Each article includes products that the BYTE editors believe embody the trends and technological advances you're likely to see over the coming year and whose existence will affect new generations of products for years beyond. We've labeled them as the "Ones to Watch." To identify them in the tables and listings, look for the Ones to Watch icon:

Special recognition goes to BYTE Lab Assistant Selinda Chiquoine, who coordinated our product information gathering; to editorial staffers Peggy Dunham, Linda Ryan, and June Sheldon, who fact-checked the product listings; and to Anne Joch, who copyedited the Product Perspectives section. ■



NETWORKING/Silicon Graphics NetVisualyzer

PC Magazine caught us speeding.

"PacificPage XL beats HP on LaserJet PostScript printing"

PC Magazine, June 25, 1991

FASTEST PRINTING SPEED. LOWEST PRICE.

PacificPage XL is fast. So fast, that PC Magazine has cited it for exceeding the speed limit of Hewlett-Packard's PostScript® Cartridge by more than six times.

If by chance the speed doesn't sell you, the low price will. Because it's the one feature of PacificPage XL that doesn't exceed HP's cartridge.*

"PacificPage XL provides the fastest PostScript printing available on a desktop."

How do we get it to work so fast? It's really quite simple. We've taken our award-winning PostScript language emulation cartridge called PacificPage P•E, and combined it with a high speed accelerator board that installs easily into your LaserJet IIP, III, IIID or IIIP printer memory slot. LaserJet printing speeds are boosted by the fast Intel i960™ RISC processor that's mounted on the board alongside 2 MB of printer memory.

"An Intel i960 RISC processor on the accelerator board helps the PacificPage XL print graphics more than six times as fast as the HP PostScript Cartridge."

Do you use a shared printer? If you do, you'll definitely want the speed of PacificPage XL. Because output is printed so fast, other users won't have to wait for their jobs to print.

Make a quick price/performance comparison and you'll see — PacificPage XL is the smart choice!

35 POSTSCRIPT COMPATIBLE FONTS

Acquiring stylish, professional looking output is easy with PacificPage XL. Because we've included 35 fully scalable Apple LaserWriter equivalent fonts. These high quality Bitstream designs provide you with the tools you need to create output that shines. For even greater versatility, PacificPage XL supports Bitstream's Speedo fonts and Adobe Type 1 and 3 fonts.

COURIER
SWISS
SWISS NARROW
DUTCH
ZAPF CALLIGRAPHIC
GEOMETRIC
REVIVAL
CENTURY
CHANCERY
Zapf Dingbats
✱✲❶✂✔★✤❷✧
Symbol
↔Δ•ΦΓ∝ϒNX≠

Each typestyle comes in normal, bold, italic and bold italic treatments except for Chancery, Zapf Dingbats, and Symbol.

"The native 35 PostScript compatible fonts in PacificPage XL are Bitstream designs, some of them superior to Adobe's version."

100% POSTSCRIPT LANGUAGE COMPATIBILITY — GUARANTEED

Today, many HP LaserJet users are lead to believe that only true Adobe PostScript gives true PostScript capabilities. The truth is, PacificPage XL provides exactly the same graphics capabilities for your LaserJet as Adobe PostScript. Exactly. So you can pay more for a name and get less for your money. Or you can pay less and, in addition to speed, get all of PostScript's powerful graphics functions. If you can create it, PacificPage XL can print it. We're so sure of it that we give you our money back guarantee of satisfaction.

"PacificPage XL swiftly and accurately renders some test EPS files that other interpreters distort and had no trouble with any of the large and complex images used for testing."

SATISFACTION GUARANTEED OR YOUR MONEY BACK

For more information or a dealer near you, contact Pacific Data Products, 9125 Rehco Road, San Diego, CA 92121, (619) 597-4610, Fax (619) 552-0889.

* Suggested list price effective 8/15/91 and includes the cost of 2 MB of memory. Quotes reprinted from PC Magazine, June 25, 1991. © 1991 Ziff Communications Company. PacificPage XL and PacificPage P•E are trademarks of Pacific Data Products, Inc. Adobe and PostScript are registered trademarks of Adobe Systems Inc. HP and LaserJet are registered trademarks of Hewlett-Packard Company. i960 is a trademark of Intel Corporation. All other product, company, and typeface names are trademarks of the company or manufacturer respectively. ©1991 Pacific Data Products, Inc.

PACIFIC DATA PRODUCTS

DESKTOP PCS

Micro Express's ME 486-ISA/LC: *This $2999 system distinguishes itself among the price leaders with its standard 8 MB of RAM and two-year warranty.*

The Buyer's Market Continues

Falling prices and rising horsepower will make 1992 a good year for consumers

Whether it's for yourself or for your company, nothing beats getting more performance for the money. It is great news, then, that the trend in the desktop system market has been falling prices and rising horsepower. This news holds true across the three major computing platforms: DOS, Macintosh, and Unix.

Intense competition, rapid advances in technology, and increasing demand for more performance drive this trend. On the DOS side, the recent recession forced many system buyers to look more closely at lower-cost PCs from second- and third-tier vendors. The result has been dramatically lower prices from major vendors such as IBM and Compaq.

Workstations have traditionally been considered high-ticket items. To expand their base, workstation vendors have decided to target the high-end DOS and Mac markets with fast, competitively priced Unix boxes. Usually based on a RISC CPU, these systems often provide superior performance to even the best DOS and Mac units.

Although the Mac faces little competition on its own turf, systems on other platforms have begun providing similar performance for running applications in a graphics environment at a lower price. Consequently, Apple has introduced new lower-cost models and slashed prices on its existing high-end line.

The forces that are driving the price/performance ratio in the consumer's favor should continue into the coming year. What follows are views from BYTE editors Alan Joch, Tom Yager, and Tom Thompson on exactly what system buyers can expect in 1992.

DOS SYSTEMS / Alan Joch

The PC Juggernaut

Like late-night TV ads that chant "But wait, there's more," desktop system choices in the coming year could leave your head spinning. If you're buying a system for yourself or plan a block purchase to power an office suite, your choices range from venerable and economical units to ones with full-blown multiprocessing power. But wait....

Last year, 386 system prices dropped by as much as 30 percent. Next year, when vendors are expected to ramp up systems based on Intel's 50-MHz 486 chips, 386 systems will fall even farther into the low end of the price spectrum. In between, you'll see more choices of CPU vendors, CPUs with integrated or disabled coprocessors, and better components to rev up graphics output and overall system performance.

Fortunately, plowing through all the choices and CPU confusion can help you find sophisticated desktop systems at impressive price points. As table 1 shows, today's midrange systems—25-MHz 486 systems with some respectable components like Super VGA hardware and Intelligent Drive Electronics (IDE) hard

PRODUCT GUIDE: DOS-BASED SYSTEMS

Table 1: *Today's midrange PCs must efficiently run GUIs, graphical spreadsheets, and other power-draining applications as a matter of course. Fortunately, this class of hardware is becoming more economical than ever. These 45 systems all sell for less than our $7000 price limit (many cost less than $5000). Our sample configuration, which represents a standard platform for today's sophisticated business user, consists of a 25-MHz 486 CPU; 4 MB of RAM; a 100-MB (or next higher size) IDE hard disk drive; a Super VGA card with 1 MB of memory; a noninterlaced Super VGA monitor with 1024- by 768-pixel resolution; a floppy disk drive; and one parallel and two serial ports.*

System	List price	Case size (inches; W×H×D)	Bus type	On-board memory (std./max.)	Motherboard	ROM BIOS	Number of slots (8-/16-/32-bit)	Hard disk drive supplier
Abtech 486/25	$2595	20×27×8	ISA	4 MB/64 MB	VEGA	AMI	0/8/0	Conner
Acma 486/25 ISA	$2495	21×6.5×16.5	ISA	4 MB/16 MB	FTC	AMI	0/8/0	Quantum
Acma 486/25 EISA	$4295	21×6.5×16.5	EISA	4 MB/64 MB	FTC	AMI	0/2/6	NEC
ACT 486/25 ISA	$3615	8×15×19 (tower)	ISA	4 MB/16 MB	AIR	AMI	0/7/1	Seagate
ACT 486/25 EISA	$4515	8×15×19 (tower)	EISA	4 MB/64 MB	AIR	Phoenix	0/0/8	Seagate
ALR BusinessVEISA Model 120-5	$6093	15×6×17	EISA	1 MB/17 MB	ALR	Phoenix	0/2/4	Multiple suppliers
ALR MPS Model 120-5	$6592	15×6×17	MCA[1]	5 MB/17 MB	ALR	Phoenix	0/4/2 (2 32-bit proprietary)	Multiple suppliers
Amax 486/25	$3535	16.75×25.25×7.5	ISA	4 MB/16 MB	Amax	AMI	0/8/0	Quantum
AMI 486/25	$2690	7.5×21×16	ISA	4 MB/32 MB	Novacor	AMI	2/5/0	Conner
AMKLY 486/25E Model 125	$6900	17×6×16.5	EISA	4 MB/16 MB	AMKLY	Phoenix	0/0/6 (EISA)	Conner
APS 486-25 MHz	$3295	16×7×16	ISA	4 MB/64 MB	AMI	AMI	2/6	Maxtor
Arche Legacy 486-25	$5671	17×16.25×17	ISA	4 MB/16 MB	Arche	Arche	1/7[2]/0	Conner
Ares 486-25 Sonic	$2995	8.5×18.5×18	ISA	4 MB/32 MB	Ares/Technology Power	AMI	0/7/1	Quantum
Atico 486-25	$3395	8×25×17	EISA	4 MB/64 MB	Mylex	AMI	0/0/8	Conner
Austin 486/25 WinStation	$3590	21×6×16	ISA	4 MB/32 MB	Austin	AMI	1/6/0	Seagate
Blackship 486/25	$3195	21×16.5×6.5	ISA	4 MB/16 MB	ECS	AMI	0/8/0	Conner
CompuAdd 425	$4095	16.25×4×15.5	ISA	4 MB/32 MB	CompuAdd/TI	Phoenix	2/3/0	Maxtor or Seagate
Cube 486/25	$3990	13-in. desktower/ 24-in. tower	ISA	4 MB/32 MB	ICC	AMI	2/6/0	Conner
Datacomp DCC 486/25	$2595	17.25×6.5×15.75	ISA	4 MB/32 MB	DEICO	QUADTEL	2/6/0	Quantum
Datacomp DCC 486/25E	$3295	17.25×6.5×15.75	EISA	4 MB/32 MB	AMI	AMI	0/0/8	Quantum
Dataworld Data 486-25ec Desktop	$3119	21.5×6.5×16.5	ISA	4 MB/16 MB	Dataworld	AMI	1/6/1	Conner
Dell System 425E	$6199	21.1×6.4×17.6	EISA	4 MB/16 MB	Dell	Phoenix/Dell	0/2/6 (EISA)	Quantum
Dyna Micro Work Master 486	$4195	Six choices	ISA	4 MB/16 MB	AIR	AMI	2/5/1	Conner
Eltech Model 4250	$3675	16×6.5×16.5	ISA	4 MB/16 MB	Eltech	AMI	1/6/1	Toshiba
Gateway 25 MHz 486 Cache	$2995	21×6×16.5	ISA	4 MB/16 MB	Micronics	Phoenix	0/8/0	Western Digital
IBC Emcat 486/25	$5780	21×6×16.5	EISA	4 MB/64 MB	IBC	IBC EMC	0/7/3 (proprietary)	
Iverson 486/25	$2825	9.5×19.5×26 (tower)	ISA	4 MB/64 MB	Alptech	Award	1/6/1 32-bit	Seagate
Jaco JCP486-25	$3295	Full-size tower	ISA	4 MB/16 MB	AIR	AMI	0/8/0	Maxtor
Leading Technology PC Partner QX	$3999	17.5×6.5×17	ISA	2 MB/16 MB	VTI	AMI	2/6/0	Western Digital
Link/Sceptre File Server 486/25	$6499	8.2×26.3×18.3	ISA	4 MB/64 MB	Sceptre	AMI	1/6/1	Seagate
Micro Express ME 486-ISA/LC	$2999	15×7×16.25	ISA	8 MB/32 MB	Micronics	Phoenix	2/6/0	Conner
New MMI 425	$3350	16.5×6×21	ISA	1 MB/8 MB	DTK	DTK	1/6/1	Maxtor
Northgate 486/25	$4499	21.25×6.5×16.75	ISA	4 MB/16 MB	Northgate	AMI	1/6/1	Seagate
PC Brand 486/25	$2626	19.5×16.5×6.5	ISA	1 MB/16 MB	PC Brand	AMI	1/6/1	Toshiba
PC House 486/25	$2995	Medium tower	ISA	4 MB/32 MB	Micro Q	AMI	0/6/2	Seagate
Polywell Poly 425i	$3425	21×6.75×16.5	ISA	4 MB/32 MB	Polywell	AMI	0/8/0	Maxtor
Reply Model 32 i486-25	$6994	14.2×5.5×16.5	MCA	4 MB/16 MB	Reply	Reply	0/0/5	Conner
SAI 486E-25	$3150	Standard AT size	EISA	4 MB/64 MB	AIR	Phoenix/AMI	0/0/8	Conner
Swan 486/25	$3735	21×6×15	ISA	4 MB/16 MB	Micronics	Phoenix/MCI	0/8/0	Conner
Tangent Model 425i	$3290	21×6.3×16.5	ISA	4 MB/32 MB	Tangent	AMI	0/7/1[3] bit	Quantum
Tatung TCS-9000T	$4195	21.3×6.5×17	ISA	2 MB/16 MB	Tatung	Phoenix	2/5/1	Quantum
Touche Enterprise 486/25 Model 5550T	$4399	7.5×24×17.5	EISA	4 MB/32 MB	AMI	AMI	1/6/1	Multiple suppliers
Ultra-Comp Ultra-Max 486-25	$3595	21×5.75×16.5	ISA	4 MB/16 MB	Micronics	Phoenix	0/0/8	Maxtor
Zeny Zen 486402	$3495	16×7×16	ISA	4 MB/32 MB	Zeny	AMI	2/5/1	Maxtor
Zeos 486-25E	$6495	19×6.5×18.4	EISA	1 MB/32 MB	Mylex	Mylex	0/0/8	Seagate

N/A = Not applicable

Pricing does not necessarily reflect the standard system. For example, many systems come standard with 1 MB of RAM, whereas they are all priced for 4 MB of RAM and Super VGA with 1MB of RAM.

[1] Micro Channel architecture.

[2] 8- or 16-bit.

[3] 8- or 32-bit.

[4] 5-year warranty on American-made Polysystems, 2-year warranty on American-made motherboards, 4-year warranty on the Orchid cards, and 1-year warranty on all other makes.

[5] 3-year warranty: 1 year parts, 3 years labor.

[6] System configured with CM-1495H monitor and OMNI VGA Plus card.

Controller cache (std./max.)	Floppy disk drives	Video controller	Video RAM (std.)	Maximum resolution (pixels)	Power supply (watts)	Distribution channel	Warranty (years)	On-site service
64 KB/256 KB	1.44 MB & 1.2 MB	Trident	1 MB	1024×768	230	Direct	1	Option
N/A	1.44 MB & 1.2 MB	Tseng Labs	1 MB	1024×768	250	Direct, mail order	1	Option, TRW
512 KB/4 MB	1.44 MB & 1.2 MB	Tseng Labs	1 MB	1024×768	250	Direct, mail order	1	Option, TRW
N/A	1.44 MB & 1.2 MB	Diamond SpeedStar	512 KB	1024×768	200	Mail order, dealers, VARs, reps	1	1-year, Texas Instruments
N/A	1.44 MB & 1.2 MB	Diamond SpeedStar	512 KB	1024×768	200	Mail order, dealer, VARs, reps	1	1-year, Texas Instruments
N/A	1.44 MB & 1.2 MB	Paradise (WD)	256 KB	800×600	145	Resellers, retail, CompUSA	1	Option
N/A	1.44 MB	Paradise (WD)	512 KB	1024×768	145	Distributors, retail, dealers	1	Option, Intel
N/A	1.44 MB or 1.2 MB	Impression	1 MB	1024×768	250	Resellers, dealers	1	Option, Memorex, Telex
128 KB/256 KB	1.2 MB or 1.44 MB	Trident	256 KB	1024×768	230	Direct	1	N/A
N/A	1.2 MB or 1.44 MB	Trident	1 MB	1024×768	200	VARs, system integrators	1	Option
N/A	1.44 MB & 1.2 MB	Focus	1 MB	1024×768	230	Direct	1	1-year
N/A	1.2 MB	Arche/Tseng Labs	256 KB	1024×768	200	Distributors, resellers, VARs	2	90-day
64 KB	1.2 MB or 1.44 MB	Diamond SpeedStar	1 MB	1024×768	250	Direct	2	TRW, included
128 KB	1.2 MB	ATI	128 KB	1024×768	250	Mail order	1	N/A
32 KB	1.44 MB or 1.2 MB	Tseng Labs	1 MB	1024×768	200	OEMs, distributors	1	1-year with option
64 KB	1.2 MB & 1.44 MB	Diamond SpeedStar	1 MB	1024×768	200	Direct	1	1-year, GE
N/A	1.44 MB or 1.2 MB	CompuAdd	1 MB	1024×768	145	Direct, retail	1	1-year
32 KB/64 KB	1.44 MB & 1.2 MB	Tseng Labs	1 MB	1024×768	230	Direct, dealers	1	1-year with option
64 KB	1.44 MB & 1.2 MB	Cardinal	256 KB	1024×768	200	Direct, VARs	2	Option, Bell Atlantic/Sorbus
64 KB	1.44 MB & 1.2 MB	Cardinal	256 KB	1024×768	200	Direct, VARs	2	Option, Bell Atlantic/Sorbus
8 KB/128 KB	1.2 MB	Orchid ProDesigner	1 MB	1024×768	200	Direct, mail order	1	1-year
N/A	1.44 MB or 1.2 MB	Paradise	256 KB	1024×768	230	Direct, CompUSA, VARs	1	1-year, Xerox
512 KB/12 MB	1.44 MB & 1.2 MB	Orchid Pro IIS	1 MB	1024×768	275	Dealers to OEMs	1	1-year, Int. Auto.
32 KB	1.44 MB & 1.2 MB	Diamond Computer	1 MB	1024×768	200	Direct, dealers, VARs	1	N/A
64 KB	1.44 MB & 1.2 MB	Diamond SpeedStar	1 MB	1024×768	200	Mail order	1	1-year
N/A	1.2 MB	Paradise	1 MB	1024×768	230	VARs, OEMs	1	Option
N/A	1.44 MB or 1.2 MB	Trident	1 MB	1024×768	250	Direct, distributors	1	1-year
32 KB	1.2 MB	Diamond SpeedStar	1 MB	1024×768	220	Direct, OEMs	1	N/A
N/A	1.44 MB & 1.2 MB	Focus	1 MB	1024×768	200	Distributors, retail, resellers	1	1-year, GE
N/A	1.44 MB & 1.2 MB	Trident	1 MB	1024×768	250	Dealers, distributors	1	N/A
N/A	1.44 MB & 1.2 MB	Micro Express	1 MB	1024×768	220	Direct, mail order	2	Option
64 KB/256 KB	1.44 MB or 1.2 MB	Boca	256 KB	1024×768	220	Direct	1	TRW option
64 KB	2 1.2 MB or 1.44 MB	Orchid	1 MB	1024×768	230	Direct	1	1-year
32 KB/128 KB	1.44 MB or 1.2 MB	Trident	1 MB	1024×768	200	Mail order	5 years prorated	90-day with option
64 KB/256 KB	1.44 MB or 1.2 MB	Trident	1 MB	1024×768	200	Direct	1	1-year, PC House
64 KB	1.44 MB & 1.2 MB	Orchid Pro IIS	1 MB	1024×768	220	Resellers, direct	1[4]	Option
N/A	1.44 MB	Chips & Technologies	512 KB	1024×768	200	Direct	1	Option
64 KB	1.44 MB or 1.2 MB	Diamond SpeedStar	1 MB	1024×768	200	Direct, dealers	1[5]	3-year
64 KB	1.44 MB & 1.2 MB	Tseng Labs	512 KB	1024×768	200	Direct	2	2-year
64 KB	1.44 MB or 1.2 MB	Orchid ProDesigner	1 MB	1024×768	270	Direct	1	Option, TRW
N/A	1.44 MB & 1.2 MB	STB	1 MB[6]	1024×768	220	Direct	1	120-day with option
64 KB/256 KB	1.44 MB & 1.2 MB	Orchid ProDesigner IIS	1 MB	1024×768	300	Mail order	2	Through TRW
N/A	1.44 MB & 1.2 MB	Orchid ProDesigner	1 MB	1024×768	220	Mail order	1	1-year (within 100 miles)
N/A	1.44 MB or 1.2 MB	Tseng Labs	1 MB	1024×768	230	Direct	1	1-year
2 MB/8 MB	1.2 MB & 1.44 MB	Diamond SpeedStar+	1 MB	1024×768	300	Direct	1	TRW option

disk drives—will sell for between $3000 and $4000, roughly what you would have paid for a 33-MHz 386 with VGA just a year ago.

Certainly, PC system vendors are establishing prices that garner market share in tough economic times. Recently, even IBM and Compaq have instituted price cuts that are meant to chip away at their reputations for setting the upper limits on price. But PC vendors face competition from more than just one another. More economical Unix workstations are giving system buyers pause when charting price/performance, while Macintosh prices are bending under similar competitive pressures. More on Unix and the Macintosh later. First, a look at the DOS world.

Atlco's 486-25: *This EISA system's Mylex motherboard, 128 KB of disk cache, and 250-W power supply make a nice bundle for only $3395.*

Dueling CPUs

For traditional DOS applications, the 386 will remain a workhorse for many applications. Consumers satisfied with Windows 3.0 can use a 386 system to run an ever-increasing array of Windows applications and continue to feel free from the shackles of 286 memory constraints. Many people in this group still won't need the 486's integrated FPU or boosted processing power. In fact, those who can live with 16-bit I/O performance can continue to take advantage of 386SX economy. For example, when IBM announced a new line of SX PS/2s, it maintained the viability of existing SX models by doubling RAM and the capacity of the standard hard disk drive without increasing the system price.

Life would be grand for Intel if it weren't for complications wrought by Advanced Micro Devices. As the BYTE Lab has shown (see "The 486SX Falls Short," June BYTE), the battle for economy-minded midrange buyers is somewhat murky. The 40-MHz Am386 entered the market as the first alternative 386 chip (look for more during 1992), prompting Intel to push the 486SX as the midrange price champion. At press time, systems based on the 486SX, with its disabled FPU, performed in the same range as the Am386 systems but outpriced them by a third to a half more.

For its part, Intel will continue with its strategy to move beyond the 386 by selling the 486 family as the chips of the future. Intel will try to do this partly by luring system vendors with low 486 chip prices, which have fallen regularly over the last year. Also, Intel will expand the power of its high-end chips. Systems with the 50-MHz 486 should begin showing up in quantity early in 1992. Vendors should be ready to ship upgrade boards and full systems once Intel provides commercial quantities of stable chips. As this issue went to press, a dozen companies had announced intentions to support the faster 486, including IBM, Compaq, AST Research, and NCR.

The 50-MHz processor also includes support chips: an external cache controller (82495DX) and static RAM devices designed to work with the 486/50 and the 82495DX.

Intel is also reportedly working on a version of the 486/50 that will run twice as fast internally as externally. Current CPUs require a clock that runs twice the speed of the CPU. The newer 486 will require only a 50-MHz clock and will be a drop-in replacement in current 486/25 system designs.

Component Considerations

Of course, processors aren't the whole story. System vendors will continue to add more sophisticated components to boost performance and turn the heads of buyers who are seeking the most for their money.

As many people have already learned, even the fastest processors can't overcome data bottlenecks from hard disk drives. More companies will, as a matter of course, include software or hardware caching on their systems.

In addition, IDE hard disk drives and controllers are becoming standards in midrange and high-end systems. The reason for this is clear: IDE drives combine ESDI speed with SCSI intelligence. Also, the IDE controller is integrated in the hard disk drive's circuitry, freeing a system expansion slot that would otherwise house a conventional hard disk drive controller.

Also look for Super VGA cards and monitors to brighten an increasing share of desktop systems. Prices for Super VGA boards with a megabyte of memory are dropping below $400 and going lower. For Windows and other graphics-based programs, this means not only thousands of more colors, but sharp, flicker-free screens when the boards are teamed with noninterlaced monitors running at 70 Hz or better.

Big Blue aficionados should also be on the watch for more Micro Channel motherboards with integrated XGA, IBM's latest graphics standard, which offers 1024- by 768-pixel resolution and downward compatibility with VGA.

A new wrinkle has been introduced by desktop systems designed for multimedia; the systems may help prove or disprove the viability of multimedia as a

Acma's 486/25 ISA: *At $2495, not only is it the lowest-priced system on our list, it also offers features you might not expect to find in a price leader, including 4 MB of RAM standard, 1 MB of video RAM on its Tseng Labs Super VGA card, and a 250-W power supply.*

Datacomp's DCC 486/25E: *Although not the lowest-priced EISA system, this computer comes with a two-year warranty, 4 MB of RAM, and a 64-KB disk cache for $3295.*

commercial market in the coming year. Tandy became the first system vendor to ship multimedia systems—desktop models that carry a CD-ROM drive, video cards, and multimedia-extended Windows, among other features. IBM and others will be offering "one-stop shopping" for multimedia systems in the months ahead, aiming their products at the training and desktop-presentation markets.

32-bit Programs

If IBM has its way, OS/2 will come into its own in the next year with version 2.0, which will run 16- and 32-bit OS/2 applications simultaneously with DOS and Windows programs; the latter two should run faster than in native mode. But look for the chill between Microsoft and IBM to continue in the months ahead when Microsoft releases an application programming interface that lets Windows run 32-bit operations, perhaps at the expense of the OS/2 market.

Each of these developments could be the final impetus to spur those who have delayed upgrades from 286 machines to the 32-bit 386 and 486 architectures.

Picking and Choosing

In most years, attention focuses on a handful of small companies aiming to produce a spark of innovation that can make their systems stand out from the pack. Next year, however, it may be most fun to watch some of the biggest names in the business. AT&T will be looking to finally make its mark in desktop systems with its expected acquisition of NCR. Initial reports point to AT&T's letting NCR set the technology pace by guiding new introductions. Similarly, Compaq may continue to wrestle with its reputation as an upper-limit price setter by further discounting system prices, a trend that began in 1991.

Finally, in what may be computing's answer to the unification of East and West Germany, the continued, albeit furtive, advances of IBM and Apple could provide a year's worth of rich speculation and, perhaps, technological breakthroughs.

In the end, if current trends persist, 1992 should be a buyer's market where performance is the hottest commodity.

Gateway 2000's 25 MHz 486 Cache: *A low-priced ($2995) system with 64 KB of disk cache standard, along with a competitive amount of system and video memory.*

Alan Joch is a technical editor for the BYTE Lab. You can contact him on BIX as "ajoch."

UNIX SYSTEMS / Tom Yager

Unix: Status and Speculation

Unix has long endured an unjustified stigma. Until recently, when people heard the word *Unix*, they thought of huge, noisy minicomputers on raised floors in bone-chilling rooms. Advances in hardware and software technology have allowed Unix to grow from a highly specialized scientific and engineering platform to a general-purpose multitasking operating system.

For all the progress Unix has already made, it, and the companies that support it, now stand on the brink of more sweeping change, as seen in the moves toward standards, heterogeneous networking, and high-performance low-cost workstations. In this discussion, I'll indulge in a bit of speculation about where all these changes might leave the Unix market, including potential consumers of Unix, in the coming year and beyond.

The Year Ahead

Sun Microsystems, the undisputed workstation champ, is (perhaps ironically) largely responsible for kicking off a round of clone wars with its decision to

PRODUCT GUIDE: UNIX-BASED SYSTEMS

Table 2: *The Unix workstations in this table are representative samples of current technology. All systems listed here cost less than $15,000 fully configured and have in common two factors: Unix as the primary operating system and a standard graphical interface.*

		Least costly configuration					Least costly color configuration with hard disk drive		
System	CPU/speed (MHz)	Disk/diskless	Std. disk size	Mono/color	Std. memory (RAM)	Price	Configuration	Memory	Price
Altos System 400	386SX/20	Disk[1]	88 MB	Color	4 MB	$4821[2]	Same	Same	Same
Altos System 700	386/33	Disk[1]	88 MB	Color	4 MB	$7589[2]	Same	Same	Same
Altos Series 1000 Model 1820-486SX	Intel 486SX/20	Disk[3]	210 MB	Mono	8 MB	$10,000[2]	Altos Color	8 MB	$10,200
CompuAdd SS•1+	SPARC/25	Diskless	N/A	Mono	8 MB	$5495	SS•1+ Color, 210-MB hard disk drive	8 MB	$7695
Data General Aviion AV100	Motorola 88100 RISC/ 16.7	Diskless	N/A	Mono	8 MB	$3995	None	N/A	N/A
Data General Aviion AV210	Motorola 88100 RISC/ 20	Diskless	N/A	Mono	8 MB	$5950	Model AV310 CD, 332-MB hard disk drive	8 MB	$11,995
Data General Aviion AV410	Motorola 88100 RISC/ 20	Diskless	N/A	Color	16 MB	$13,995	AV410 Color with 332-MB hard disk drive	16 MB	$15,090
DECstation 3100	MIPS RS2000/ 16.67	Diskless	N/A	Mono	8 MB	$4995	104- & 209-MB hard disk drives, 1.4-MB floppy disk drive	16 MB	$12,995
Futura Mercury 1000i	486/33	Disk	200 MB	Mono	8 MB	$7015	Mercury 1000 with VGA, 200-MB hard disk drive	8 MB	$7250
HP Apollo 9000 Model 425e	68040/25	Diskless	N/A	Gray-scale	8 MB	$5490	200-MB hard disk drive	8 MB	$9490
HP Apollo 9000 Model 425t	68040/25	Diskless	N/A	Gray-scale	8 MB	$8990	Model 425t CRX, 200-MB hard disk drive	8 MB	$14,990
HP Apollo 9000 Model 720	HP PA RISC/50	Diskless	N/A	Mono	16 MB	$11,990	Model 720 CRX, 210-MB hard disk drive	16 MB	$20,990
IBC Personal Workstation System 100	386/33	Diskless	N/A	Mono	8 MB	$7800	System 100 color, 239-MB hard disk drive	8 MB	$9295
IBC Personal Workstation System 200	486/33	Diskless	N/A	Mono	8 MB	$8500	System 200 color, 239-MB hard disk drive	8 MB	$9995
IBM RISC System/6000 Powerstation 320	RS6000/20	Disk	160 MB	Mono	8 MB	$13,507	16-MB hard disk drive	8 MB	$15,697
Mobius Protege PWS/425cf	486/25	Disk	110 MB	Color	8 MB	$5990	Same	Same	Same
Mobius Protege PWS/433cx EISA	486/33	Disk	210 MB	Color	8 MB	$11,490	Same	Same	Same
Nextstation	68040/25	Disk	105 MB	Mono	8 MB	$4995	Nextstation Color, 400-MB hard disk drive	16 MB	$12,495
Opus Personal Mainframe 5120	SPARC/25	Diskless	N/A	Mono	8 MB	$7995	Model 5120 Color, 207-MB hard disk drive	8 MB	$9995
Solbourne 4000-8-M	SPARC/33	Diskless	N/A	Mono	8 MB	$8995	Model 4000-8-F-P1, 200-MB hard disk drive	8 MB	$12,995
Sun Sparcstation ELC	SPARC/33	Diskless	N/A	Mono	8 MB	$4995	207-MB hard disk drive, no color	8 MB	$6295
Sun Sparcstation IPC	SPARC/25	Disk	207 MB	Mono	8 MB	$7995	207-MB hard disk drive, GX accelerator	8 MB	$9995
Sun Sparcstation IPX	SPARC/40	Disk	207 MB	Gray-scale	16 MB	$11,995	207-MB hard disk drive, GX accelerator	16 MB	$13,495

[1] Comes standard with 150-MB tape drive
[2] Prices are estimated by Altos; actual pricing depends on VAR configuration.
[3] Comes standard with 525-MB tape drive
N/A = Not applicable

license its SPARC RISC technology to any company that can pay. Now Intel, Motorola, and Mips have formed (or are otherwise involved in) consortia that devise and publish hardware and software standards. Among other things, these standards ensure that software written for one vendor's system will run on any other vendor's system based on the same technology. That's no pipe dream: Software written for Sun's Sparcstation will run, *today*, without modification on an Opus System 5000, CompuAdd SS1, or any one of a number of other SPARC systems. And soon workstations will appear that adhere to the latest revision of SPARC International's specification, which will accommodate multiprocessor systems.

Things are hopping in the operating-system field as well, as a planned convergence of different flavors of Unix takes place in the form of System V release 4.0 (sometimes referred to as V.4). This Unix will bring together what is best about the operating systems now known as System V release 3.2, Berkeley Standard Distribution, Xenix, and SunOS. It will also include the X Window System and TCP/IP networking (including Remote File System and Network File System file sharing and Sun's Remote Procedure Call client/server interface). For developers, this confluence of technologies means that the lowest common denominator to which applications must be written, compared with what previously existed, has just advanced into the stratosphere. This paves the way for a whole new era in graphics, client/server, and other distributed applications.

If nothing else, V.4 will bring unity to

Operating system type, version	Networking
Altos Unix Sys. V/386 3.2 release 2.0	TCP/IP, NFS, RFS
Altos Unix Sys. V/386 3.2 release 2.0	TCP/IP, NFS, RFS
Altos Unix Sys V/386 v5.3 et3	TCP/IP, NFS, RFS, DOS server
SunOS 4.1	TCP/IP, NFS
DG/UX 5.4	Asynch., TCP/IP, NFS
DG/UX 5.4	Asynch., TCP/IP, NFS
DG/UX 5.4	Token Ring, Asynch., TCP/IP, NFS
DEC ULTRIX	TCP/IP, NFS
OS/2, SCO Xenix	TCP/IP, NFS option
HP-UX 8.0 or Domain/OS 10.3	TCP/IP, NFS
HP-UX 8.0 or Domain/OS 10.3	TCP/IP, NFS
HP-UX 8.01	TCP/IP, NFS
AIX 3.0	NFS, NCS, TCP/IP, X.25
SCO Unix 3.2 within Open Desktop 1.1	TCP/IP, NFS, LAN Mgr
SCO Unix 3.2 within Open Desktop 1.1	TCP/IP, NFS, LAN Mgr
ISC Unix 3.2 or SCO Open Desktop or AT&T V.4	NFS, TCP/IP
ISC Unix 3.2 or SCO Open Desktop or AT&T V.4	TCP/IP, NFS
Mach/Next OS	TCP/IP, NFS, Next proprietary
SunOS 4.1	NFS, TCP/IP
OS/MP 4.00a (deriv. of SunOS 4.0.3)	TCP/IP, NFS
SunOS 4.1	NFS, TCP/IP, PC-NFS, TOPS
SunOS 4.1	NFS, TCP/IP, PC-NFS, TOPS
SunOS 4.1	NFS, TCP/IP, PC-NFS, TOPS

a disheveled, struggling PC Unix market. Even though the 486 is very well suited to running Unix, buyers are showing a preference for non-Intel workstations because of a lack of standardization and also because most traditional workstation vendors bundle complete operating systems with their machines at no extra charge. PC Unix will still have to fight that battle after V.4's introduction: Sun (one of the companies that worked on V.4) plans to make V.4 standard on its SPARC machines and will license it to makers of SPARC-compatible systems.

The Solbourne 4000-8-M *is a high-performance SPARC system suitable for both compute- and file-I/O-intensive operations. The standard color configuration includes a 2-D graphics accelerator. This system was selected for its unique price/performance value.*

The Future of Workstations

When all these changes, along with some others, are added together, it bodes well for those who are still limping along on technology too weak to support them. Today, it's possible to purchase a fully configured Sun workstation for less than a comparably equipped Compaq or IBM 486 PC. And when I say "fully configured," I mean 8 MB of memory, a 200-MB SCSI hard disk drive (minimum), Ethernet, a high-resolution monochrome display, a Unix operating system with X, and networking and development tools (see table 2). Want E-mail? It's in there. A high-resolution GUI? Standard. Multitasking? That, too. File sharing, advanced file systems, backup utilities, you name it: Those things that DOS users have grown accustomed to paying for with PCs are part of nearly all the workstations sold today, and the list of standard features grows constantly. What can those who are now thinking about Unix expect over the next year or two? There are no clear-cut answers, but I'll close this discussion by sticking my neck out to make a few predictions.

CD-ROM will become standard fare. Compared with quarter-inch tape, CD-ROM is less expensive, more reliable, and easier to ship and store; it holds more data and can be directly mounted as a random-access Unix file system. Expect, too, to see the 8-MB base memory standard go away. Graphical interfaces and networking are demanding, and I think 16 MB will become the new base. Similarly, as more features are packed into standard software offerings, standard disk sizes will rise; I expect to see standard hard disk drives settle into the 330- to 400-MB range during 1992.

Monochrome monitors will begin to disappear, replaced by smaller color monitors. Someone will release a 16- or 24-bit graphics system (that runs X) in a low-cost configuration, and the competition will rush to get their answers on the market. The $5000 color workstation will become a common sight, and Unix software prices will start falling to PC pricing levels.

It won't all happen in 1992, but more major PC and Mac software vendors will jump on the Unix bandwagon. Lotus, Ashton-Tate, Microsoft, Adobe, and others are already there. Developers will be drawn by Unix's stability (compared with Windows) and the ease with which software can be made available on a wide variety of hardware types.

Hardware and software vendors alike will have two key objectives in 1992: heterogeneous networking and ease of use. By the end of the year, it will be much easier to connect PCs, Unix workstations, and Macs to the same network and share files and data. Distributed applications will begin to appear, and more capable Unix systems will take their

The Nextstation *delivers solid performance at a low cost and comes bundled with software including word processing, a GUI layout tool, and a graphical environment capable of displaying PostScript files. It was selected for its unique "out-of-the-box" usability.*

places as "process servers," lifting the burden of demanding applications off the shoulders of the PCs and Macs in the office. System and network administration will become much simpler (it will approach automatic), and front ends will be devised that swaddle Unix-fearful users.

Who will the leaders be in 1992, and how will they get there? I expect to see Sun maintaining a lead and increasing it by, among other things, making its systems fit in seamlessly with networks of PCs. The faltering economy gave Sun a breather during which it could shuffle its priorities, spin off a couple of new divisions, and get its whole "open computing" story straight. In 1992, a fresh-faced, more aggressive Sun will emerge, reaping the benefits of licensing (such as a huge installed base) while still keeping the best new technology to itself. Expect Sun to make waves in both the high and low ends of the workstation market in 1992 by introducing several new products. Expect, too, that Sun will take a stab at the applications software market, much the way Apple's Claris has done so successfully.

In addition to stocking shelves with SPARC software, Sun's Solaris (V.4 Unix with Sun extensions) will be made available for Intel-based PCs, among others. Sun has always been revered for the quality of its operating system and add-on software. With its marketing savvy, Sun might just carve itself a niche in the fast-growing PC Unix market.

The other workstation vendor to watch is Next. It's left the sluggish, disappointing cube in the dust in favor of a fast, sleek design. The new unit (the Nextstation) has speed, a much improved operating system, and, at long last, color. While everyone else is figuring out how to build ease of use into their systems, Next will be filling orders. I see the Nextstation as the only workstation that can, starting now, draw users away from Windows-based PCs and the Mac.

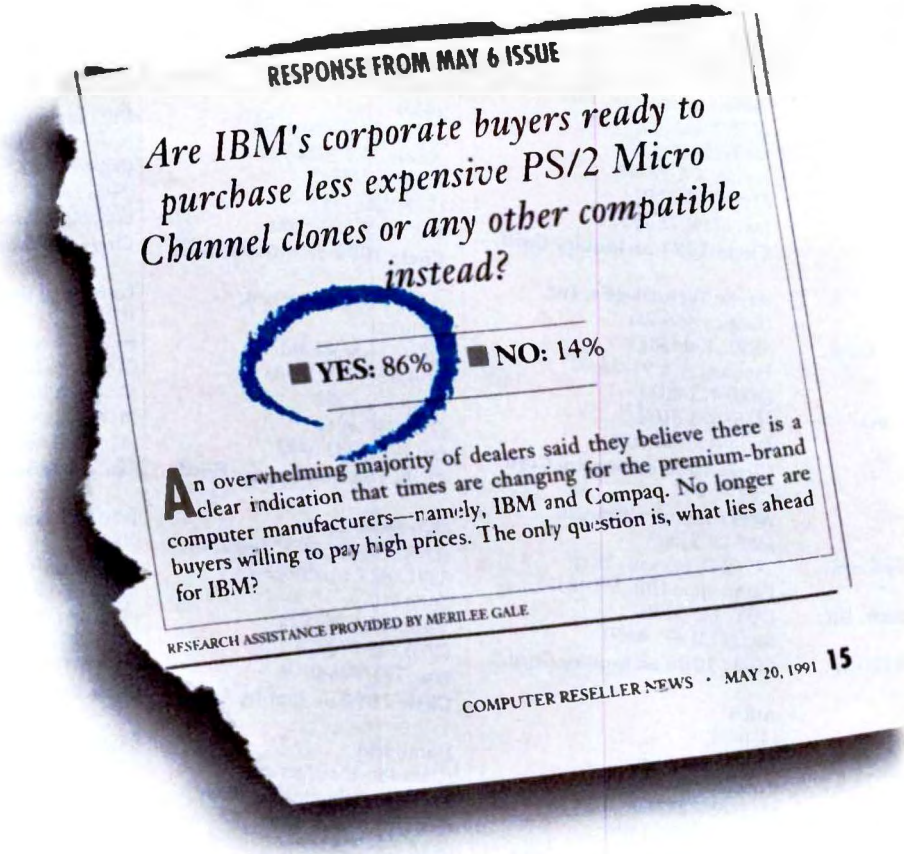
The other thing that the Nextstation has going for it is not so obvious: Developers positively love it. Every Nextstation comes with a complete set of development tools, and there is simply no better environment for building graphical applications. Even if a company cannot define a clear Nextstation market for its new product, chances are that the development staff will browbeat management into letting it build something on the Next.

People who are now using the Next are nothing short of gaga over it, and their lust is justified. I think 1992 will be the year that Next lands solidly on the map, and it'll be leading a pack of workstation vendors that will make trouble for PCs and Macs.

continued

The new Sun Sparcstation ELC and IPX *offer increased performance over their predecessors (the SLC and IPC) while holding the line on cost. The IPX is Sun's least expensive color system that includes accelerated 2-D graphics. The ELC is a very low-cost, diskless, monochrome workstation. These systems were selected for their solid performance, excellent operating system and GUI, and good value for the money.*

86% OF CORPORATE AMERICA IS READY TO BUY A PS/2 ALTERNATIVE.



RESPONSE FROM MAY 6 ISSUE

Are IBM's corporate buyers ready to purchase less expensive PS/2 Micro Channel clones or any other compatible instead?

■ YES: 86% ■ NO: 14%

An overwhelming majority of dealers said they believe there is a clear indication that times are changing for the premium-brand computer manufacturers—namely, IBM and Compaq. No longer are buyers willing to pay high prices. The only question is, what lies ahead for IBM?

RESEARCH ASSISTANCE PROVIDED BY MERILEE GALE

COMPUTER RESELLER NEWS · MAY 20, 1991 15

HERE'S OUR REPLY.

You've been looking for a better source of PS/2® price/performance. It's here — in fully PS/2 compatible systems from Reply.™ Any way you want them.

Built-to-order at the factory, you can pick your processor option — all the way up to the hottest i486™ — and choose your hard drive capacity from 40MB up to 1.2GB. Or go diskless. It's up to you.

And, while you're at it, ask for actual IBM® hardware and software options. Like Token Ring adapters, SCSI solutions and OS/2®.

We put it all together in a 5BY5™ desktop design (5 slots, 5 bays), with user-upgradeable processor options and 1024 x 768 integrated video. All in the same small footprint as the IBM Model 70.

In 1987, the standard was set. In 1991, we raised it. So, when you demand brighter PS/2 solutions — ask for our Reply.

reply™

A Brighter Shade of Blue

See our Reply at COMDEX/Fall '91, Sands Convention Center, Booth S1229

Reply Corporation. 4435 Fortran Drive, San Jose, CA 95134 800.955.5BY5(5295) 408.942.4804 FAX 408.942.4897

Sales office locations in Atlanta, Chicago, San Jose, Seattle & Washington DC Reply, 5BY5, and the Reply logo are trademarks of Reply Corporation.

IBM, PS/2 and OS/2 are registered trademarks of International Business Machines Corporation. i486 and the Intel Inside logo are trademarks of Intel Corporation.

COMPANY INFORMATION:

DESKTOP SYSTEMS

DOS

Abtech, Inc.
(486/25)
1431 North Potrero Ave.,
Unit B
South El Monte, CA 91733
(800) 992-1978
(818) 575-0007
fax: (818) 575-1500
Circle 1075 on Inquiry Card.

Acma Computers, Inc.
(486/25 ISA, 486/25 EISA)
117 Fourier Ave.
Fremont, CA 94539
(800) 456-1818
(415) 623-1212
fax: (415) 623-0818
Circle 1076 on Inquiry Card.

Advanced Logic Research, Inc. (ALR)
(BusinessVEISA Model 120-5, MPS Model 120-5)
9401 Jeronimo
Irvine, CA 92718
(800) 444-4257
(714) 581-6770
fax: (714) 581-9240
Circle 1077 on Inquiry Card.

Advanced Personal Systems (APS)
(486-25 MHz)
448 26th Ave.
San Francisco, CA 94121
(415) 769-3795
fax: (415) 522-0913
Circle 1078 on Inquiry Card.

Amax Engineering Corp.
(486/25)
47315 Mission Falls Court
Fremont, CA 94539
(800) 888-2629
(415) 651-8886
fax: (415) 651-3720
Circle 1079 on Inquiry Card.

AMI International
(AMI 486/25)
2393 Qume Dr.
San Jose, CA 95131
(408) 432-1790
fax: (408) 432-0677
Circle 1080 on Inquiry Card.

AMKLY Systems, Inc.
(486/25E Model 125)
60 Technology Dr.
Irvine, CA 92718
(714) 727-0788
fax: (714) 727-9521
Circle 1081 on Inquiry Card.

Arche Technologies, Inc.
(Legacy 486-25)
48502 Kato Rd.
Fremont, CA 94538
(800) 422-4674
(415) 623-8100
fax: (415) 683-6754
Circle 1082 on Inquiry Card.

Ares Microdevelopment
(486-25 Sonic)
24762 Crestview Court
Farmington Hill, MI 48335
(800) 322-3200
fax: (313) 473-4450
Circle 1083 on Inquiry Card.

Atico
(486-25)
1300 Galaxy Way
Concord, CA 94520
(415) 680-8271
fax: (415) 680-1408
Circle 1084 on Inquiry Card.

Austin Computer Systems
(486/25 WinStation)
10300 Metric Blvd.
Austin, TX 78758
(800) 752-1577
(512) 339-3500
fax: (512) 454-1357
Circle 1085 on Inquiry Card.

Automated Computer Technology Corp. (ACT)
(ACT 486/25 ISA, ACT 486/25 EISA)
10849 Kinghurst
Houston, TX 77099
(800) 521-9237
(713) 946-0731
fax: (713) 946-3117
Circle 1086 on Inquiry Card.

Blackship Computer Systems, Inc.
(486/25)
4031 Clipper Court
Fremont, CA 94538
(800) 877-6249
(415) 770-9300
fax: (415) 770-8674
Circle 1087 on Inquiry Card.

CompuAdd Corp.
(425)
12303 Technology Blvd.
Austin, TX 78727
(800) 531-5475
(512) 250-1489
fax: (512) 250-5760
Circle 1088 on Inquiry Card.

Cube Computer Corp.
(486/25)
150 Clearbrook Rd.
Elmsford, NY 10523
(800) 522-2823
(914) 592-8282
fax: (914) 592-3482
Circle 1089 on Inquiry Card.

Datacomp Corp.
(DCC 486/25, DCC 486/25E)
8391 Old Courthouse Rd.,
Suite 210
Vienna, VA 22182
(703) 848-0788
fax: (703) 848-0704
Circle 1090 on Inquiry Card.

Dataworld
(Data 486-25ec Desktop)
3733 San Gabriel River Pkwy.
Pico Rivera, CA 90660
(800) 736-3282
(213) 695-3777
fax: (213) 695-7016
Circle 1091 on Inquiry Card.

Dell Computer Corp.
(System 425E)
9505 Arboretum Blvd.
Austin, TX 78759
(800) 426-5150
(512) 338-4400
fax: (512) 338-8421
Circle 1092 on Inquiry Card.

Dyna Micro, Inc.
(Work Master 486)
30 West Montague Expy.
San Jose, CA 95134
(800) 336-3962
(408) 943-0100
fax: (408) 943-0714
Circle 1093 on Inquiry Card.

Eltech Research, Inc.
(Model 4250)
47266 Benicia St.
Fremont, CA 94538
(800) 234-4331
(415) 438-0990
fax: (415) 438-0663
Circle 1094 on Inquiry Card.

Gateway 2000
(25 MHz 486 Cache)
610 Gateway Dr.
North Sioux City, SD 57049
(800) 523-2000
(605) 232-2000
fax: (605) 232-2023
Circle 1095 on Inquiry Card.

Integrated Business Computers (IBC)
(Emcat 486/25)
21621 Nordhoff St.
Chatsworth, CA 91311
(818) 882-9007
fax: (818) 882-8353
Circle 1096 on Inquiry Card.

Iverson Computer Corp.
(486/25)
1356 Beverly Rd.
McLean, VA 22106
(800) 444-7290
(703) 749-1200
fax: (703) 883-0722
Circle 1097 on Inquiry Card.

Jaco Computer Products
(JCP486-25)
687 North Pastoria Ave.
Sunnyvale, CA 94086
(408) 732-8800
fax: (408) 732-9455
Circle 1098 on Inquiry Card.

Leading Technology, Inc.
(PC Partner QX)
10430 Southwest Fifth St.
Beaverton, OR 97005
(800) 999-5323
(503) 646-3424
fax: (503) 626-7845
Circle 1099 on Inquiry Card.

Link Computer (Sceptre Technology, Inc.)
(Sceptre File Server 486/25)
560 South Melrose St.
Placentia, CA 92670
(714) 993-0800
fax: (714) 993-0705
Circle 1100 on Inquiry Card.

Micro Express
(ME 486-ISA/LC)
1801 East Carnegie Ave.
Santa Ana, CA 92705
(800) 642-7621
(714) 852-1400
fax: (714) 852-1225
Circle 1101 on Inquiry Card.

New MMI Corp.
(425)
2400 Reach Rd.
Williamsport, PA 17701
(800) 221-4283
(717) 327-9575
fax: (717) 327-1217
Circle 1102 on Inquiry Card.

Northgate Computer Systems, Inc.
(486/25)
7075 Flying Cloud Dr.
Eden Prairie, MN 55344
(800) 548-1993
(612) 943-8181
fax: (612) 943-8331
Circle 1103 on Inquiry Card.

PC Brand, Inc.
(486/25)
877 Supreme Dr.
Bensenville, IL 60106
(800) 722-7263
(312) 226-5200
fax: (312) 226-6841
Circle 1104 on Inquiry Card.

PC House
(486/25)
841 East Artesia Blvd.
Carson, CA 90746
(213) 324-8621
fax: (213) 324-8654
Circle 1060 on Inquiry Card.

Polywell Computers, Inc.
(Poly 425i)
61-C Airport Blvd.
South San Francisco, CA 94080
(800) 999-1278
(415) 583-7222
fax: (415) 583-1974
Circle 1061 on Inquiry Card.

Reply Corp.
(Model 32 i486-25)
4435 Fortran Dr.
San Jose, CA 95134
(800) 955-5295
(408) 942-4804
fax: (408) 942-4897
Circle 1062 on Inquiry Card.

SAI Systems Laboratories, Inc.
(486E-25)
911 Bridgeport Ave.
Shelton, CT 06484
(800) 331-0488
(203) 929-0790
fax: (203) 929-6948
Circle 1063 on Inquiry Card.

Swan Technologies
(486/25)
3075 Research Dr.
State College, PA 16801
(800) 468-9044
(814) 238-1820
fax: (814) 237-4450
Circle 1064 on Inquiry Card.

Tangent Computer
(Model 425i)
197 Airport Blvd.
Burlingame, CA 94010
(800) 223-6677
(415) 342-9388
fax: (415) 342-9380
Circle 1065 on Inquiry Card.

Tatung Company of America, Inc.
(TCS-9000T)
2850 El Presidio St.
Long Beach, CA 90810
(800) 827-2850
(213) 979-7055
fax: (213) 637-8484
Circle 1066 on Inquiry Card.

Touche Micro Technologies/ PC Pros
(Enterprise 486/25 Model 5550T)
8205 South Cass Ave.
Darien, IL 60559
(708) 810-1010
fax: (708) 810-9490
Circle 1067 on Inquiry Card.

Ultra-Comp Computer
(Ultra-Max 486-25)
3801 Ultra-Comp Dr.
Earth City, MO 63045
(800) 435-2266
(314) 298-1988
fax: (314) 298-1288
Circle 1068 on Inquiry Card.

Zeny Computer Systems, Inc.
(Zen 486402)
4033 Clipper Court
Fremont, CA 94538
(415) 659-0386
fax: (415) 659-0468
Circle 1069 on Inquiry Card.

Zeos International, Ltd.
(486-25E)
530 Fifth Ave. NW
St. Paul, MN 55112
(800) 423-5891
(612) 633-4591
fax: (612) 633-1325
Circle 1070 on Inquiry Card.

MAC

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Circle 1071 on Inquiry Card.

UNIX

Altos Computer Systems
(System 400, System 700, Series 1000 Model 1820-486SX)
2641 Orchard Pkwy.
San Jose, CA 95134
(800) 258-6787
(408) 432-6200
fax: (408) 433-9335
Circle 1072 on Inquiry Card.

CompuAdd Corp.
(SS•1+)
12303 Technology Blvd.
Austin, TX 78727
(800) 531-5475
(512) 250-1489
fax: (512) 250-5760
Circle 1073 on Inquiry Card.

Data General Corp.
(Aviion AV100, Aviion AV210, Aviion AV410)
4400 Computer Dr.
Westborough, MA 01580
(800) 328-2436
(508) 366-8911
fax: (508) 366-1299
Circle 1074 on Inquiry Card.

Digital Equipment Corp.
(DECstation 3100)
146 Main St.
Maynard, MA 01754
(508) 493-5111
fax: (508) 493-8780
Circle 1221 on Inquiry Card.

Futura Systems, Inc.
(Mercury 1000i)
40 Bayfield Dr.
North Andover, MA 01845
(800) 448-1461
(508) 685-1925
fax: (508) 685-5017
Circle 1222 on Inquiry Card.

Hewlett-Packard Co.
(HP Apollo 9000 Model 425e, Model 425t, Model 720)
974 East Arques Ave.
Sunnyvale, CA 94086
(408) 720-3000
Circle 1223 on Inquiry Card.

IBM Corp.
(RISC System/6000 Powerstation 320)
Old Orchard Rd.
Armonk, NY 10504
(800) 426-2468
(914) 765-1900
fax: (914) 642-5795
Circle 1224 on Inquiry Card.

Integrated Business Computers (IBC)
(Personal Workstation System 100, Personal Workstation System 200)
21621 Nordhoff St.
Chatsworth, CA 91311
(818) 882-9007
fax: (818) 882-8353
Circle 1225 on Inquiry Card.

Mobius Computer Corp.
(Protege PWS/425cf, Protege PWS/433cx EISA)
1717 Embarcadero Rd.
Palo Alto, CA 94303
(800) 662-4871
(415) 493-7777
fax: (415) 856-9820
Circle 1226 on Inquiry Card.

Next Computer, Inc.
(Nextstation)
900 Chesapeake Dr.
Redwood City, CA 94063
(800) 848-6398
(415) 366-0900
fax: (415) 780-3714
Circle 1227 on Inquiry Card.

Opus Systems
(Personal Mainframe 5120)
329 North Bernardo Ave.
Mountain View, CA 94043
(415) 960-4040
fax: (415) 960-4001
Circle 1228 on Inquiry Card.

Solbourne Computer, Inc.
(4000-8-M)
1900 Pike Rd.
Longmont, CO 80501
(800) 356-8765
(303) 772-3400
fax: (303) 772-3646
Circle 1229 on Inquiry Card.

Sun Microsystems, Inc.
(Sparcstation ELC, IPC, IPX)
2550 Garcia Ave.
Mountain View, CA 94043
(800) 821-4643
(800) 821-4642 in California
(415) 960-1300
fax: (415) 969-9131
Circle 1230 on Inquiry Card.

Sportscasters are happy if they're correct on more than half of their predictions. The way things stand now, I feel pretty confident about everything I've said, but there's one thing about this business that you can *always* count on: Things change quickly. Thankfully for long-term Unix fans, our days of languishing in a minority seem to be coming to an end. The private club was nice for a while, but I am looking forward to a more crowded dance floor in 1992.

Tom Yager is a BYTE technical editor, manager of the BYTE Unix Lab, and author of the book Unix Program Development *(Addison-Wesley, 1991). You can contact him on BIX as "tyager."*

MAC SYSTEMS / Tom Thompson

More Bang, Less Buck

It used to be that the Macintosh was an expensive computer—a *very* expensive computer. The situation was such that in a number of cases it was less expensive to buy a PC with a hard disk drive and use Sitka's TOPS software for file sharing than to purchase a Mac Plus and a hard disk drive to act as a file server. That situation has changed, to the benefit of everyone.

Three Macs—the Classic, the LC, and the IIsi—now represent the low-range Mac product line. For slightly less than the price of a bare-bones Mac Plus with only an 800-kilobyte floppy disk drive and 1 MB of RAM, you can now buy a fully loaded Mac Classic with a 1.44-MB Superdrive, a 40-MB hard disk drive, and 2 MB of RAM. A Mac LC with a color monitor, 2 MB of RAM, and a 40-MB hard disk drive goes for less than what it costs to buy a stripped Mac SE with only an 800-KB floppy disk drive and 1 MB of RAM. Even the file-server example no longer applies: You can get a stripped Mac Classic and a third-party 100-MB hard disk drive for about $1500.

If you're on a tight budget and need a big display or better performance than the LC can provide, the Mac IIsi is the way to go. A list price of $4897 nets you a 20-MHz 68030-based Mac with 3 MB of RAM and a 40-MB hard disk drive. You have your choice of an optional NuBus or Direct Slot connector for expansion boards. Choose a connector and spend the $249. Even if you don't need an expansion board right away, you will want the bundled 68882 math coprocessor for number crunching.

A gallery of low-cost Macs *(left to right): The 20-MHz 68030-based Mac IIsi, sporting a 13-inch AppleColor monitor; the 16-MHz 68020-based Mac LC, using a 12-inch RGB monitor; and the 8-MHz 68000-based Mac Classic, with a black-and-white monitor built in. The Mac IIsi can use either a NuBus or a 68030 Direct Slot expansion board. The Mac LC has a single 68020 Direct Slot for expansion boards.*

But prices have come down even for the mid- and high-range Macs. Early in the year, the prices of the Mac IIfx, IIci, and Mac SE/30 tumbled by as much as 30 percent.

For example, the price of a Mac SE/30 with 4 MB of RAM and an 80-MB hard disk drive fell from $5569 to $3869. A fully loaded (4 MB of RAM, 160-MB hard disk drive) IIfx's price dropped by 20 percent, hacking about $2300 from the original price and bringing the current list price to $8669.

Mac IIci: *A list price of $7097 buys you a powerful 25-MHz 68030-based Mac with 5 MB of RAM and an 80-MB hard disk drive. On top of that, the IIci has a svelte desktop footprint, three NuBus slots, a 68882 math coprocessor, and built-in 8-bit color video.*

For those of you still using Mac SEs and IIcxs, the upgrade prices have fallen as well, allowing you to protect your hardware investment without going broke. For instance, $999 currently converts an 8-MHz 68000 Mac SE high-density floppy disk clunker into a feisty 16-MHz 68030 Mac SE/30. Likewise, transforming your 16-MHz Mac IIcx into a 25-MHz IIci with built-in video will set you back only $1499.

Apple introduced the low-end Macs to grab market share. Given the phenomenal sales volume of these machines, it just may succeed. But let's hope the company keeps this long-term market growth plan in mind when it introduces the new 68040-based Macs and notebook computers. Aggressive prices are a sure ticket to success for Apple. ■

Tom Thompson is a senior technical editor at large. You can contact him on BIX as "tom_thompson."

GATEBUSTERS!

$3,599 486-33 ISA* | **$4,599** 486-33 EISA**

- 32-Bit Intel 80486/33 MHz CPU
- Burst Mode Support
- **Zero-Wait 64KB (Exp. to 256KB) High Speed Cache***
- **Zero-Wait 128KB High Speed Cache****
- 4MB Zero-Wait State 32-bit Memory on the World's Best Motherboard made by AMI (Expands to 32MB*/96MB**)
- 8 Expansion Slots: 16-bit* / 7-EISA and 1-32/8 bit* *
- **Sony 1304 HG 14" SVGA Monitor (1024 x 768 Resolution, Non-interlaced)**
- Orchid ProDesigner II VGA Card with 1MB RAM
- 207MB 15ms Maxtor IDE Hard Drive
- Teac 1.2 and 1.44 Floppy Drives
- 2 Serial/1 Parallel Ports I/O*
- 2 Serial/2 Parallel Ports I/O**
- PC Power & Cooling 300 Watt Power Supply
- Vertical Case: 6 Bays/Security Lock/LED **(Also shown is our optional deluxe case 12 1/2ht bays with 450 watt power supply)**
- **Keytronics 101-key Enhanced Keyboard**
- **AMI BIOS/CMOS Set-up/Diagnostics/ Clock/Calendar**
- 3-Ring Cloth Binder for Manual and Software
- 10-year Lithium Battery/ TOUCHE Tool
- 800 number for Lifetime Technical Support
- TRW On-Site Service Available to Most Locations
- Federal Express Replacement of Defective Components
- FCC B Certification

$2,999
386-33 MHz
COMPLETE SYSTEM
Upgradable to 486 with Plug In Board!

LEADING THE WAY!

State of the art technology is what you receive when you order a TOUCHE computer. The heart and soul of any computer is the motherboard. An AMI in a TOUCHE computer is quite simply the very best. We mean what we say and here are the facts!

FACT: Computer Shopper compared 3 systems in its July cover feature. TOUCHE beat NORTHGATE and DELL in the overall total speed test for performance! Shopper also said, "TOUCHE's system operated quietest. TOUCHE obviously offers the fullest expansion of the three systems. TOUCHE's ESDI edged out NORTHGATE'S IDE drive and DELL'S slower IDE" Of all three systems TOUCHE was the least expensive. Shopper also said, "In fit and finish TOUCHE offers among the best we've seen."

FACT: Our AMI partnership enabled us to begin shipping 386 to 486 upgradable systems in 1989... 2 years before NORTHGATE even announced theirs! Northgate President Art Lazere is quoted in PC WEEK 06/03/91, "Upgradable is the wave of the future." Unfortunately anyone riding the NORTHGATE wave is sunk when it comes to upgrading their 386 systems. Now that everyone wants a 486 anyway, what good is that to customers that bought Northgate systems for the past 2 years? Only GATEWAY knows when their upgradable system will ever become available.

FACT: TOUCHE was first to offer a 386 caching motherboard because AMI was the first to design a caching 386 motherboard.

QUALITY

We take great pride in the fact that we include a 2-year replacement part warranty on every component. Gateway, Northgate, and Dell include only a 1-year warranty. After you buy a TOUCHE you'll never need to worry which component might fail after only 1-year of use! Even more importantly replacing failing parts can be extremely expensive. Investigate the cost of repairing your IDE or ESDI hard drive. There goes a whopping $300-$400! Maybe you'll get it back in working condition after 3 or 4 weeks. We won't even try to guess what happens when their motherboard fails! You simply can't afford to buy any system which offers you only a 1-year warranty!

The quality and craftsmanship that go into every TOUCHE computer is unmatched in this industry. All systems are diligently assembled in Darien, Illinois by our team of dedicated technicians. We guarantee that you will receive a custom-built configuration exactly as ordered using our uncompromising WYSIWYG standards. Be certain when you're shopping, that other companies provide you with a list of the manufacturer and model number of every component they plan (promise) to use in their system.

From the world-renowned AMI motherboard to the #1 rated PC Power Cooling switching power supply EVERY component we use is simply unbeatable.

MORE FACTS

GATEWAY? Ask them about their EISA systems. They don't even offer this very latest standard in computer technology. Did you know every customer who ordered a 386 computer from TOUCHE since early 1990, over 1 year ago, can easily upgrade to a 486 with our simple plug-in card for only $999? Not a single GATEWAY, NORTHGATE, or DELL computer purchased in 1989, 1990 and most of 1991 can be upgraded from 386 to 486 like the tremendous number of customers who have already taken advantage of this state of the art option TOUCHE offers. We're sure they'll gladly take your order for a new 486 though. Give yourself a break and buy a TOUCHE!

Call TOUCHE and speak to one of our sales associates today!

Made in the USA

TOUCHE

A PC PRICES Company
8205 South Cass Avenue Darien, Illinois 60559
708/810-1010 Fax 708/810-9490

VISA MasterCard DISCOVER FEDERAL EXPRESS

WHO YA GONNA CALL?
708/810-1010

Circle 123 on Inquiry Card.

If you expect n "out of memory" messa you need ou

This Manifest memory analysis shows 618K of memory available for DOS programs after running QEMM 6.0. That's enough to avoid the dreaded "out of memory" message.

Here's how you can get more memory. Network drivers, TSRs and other utilities that usually take memory away from your programs have been moved up into high memory, automatically—using QEMM's 'optimize' command.

Manifest, our memory management utility bundled free with QEMM, clearly shows you how your memory is being used.

This example system is a Toshiba, but most 386SX, 386 and 486 IBM® PCs and PS/2s™, and most 100%-compatible 'clones' allow the high memory breakthrough.

QEMM 6.0 Stealth technology 'remaps' ROMs, freeing-up as much as an additional 115Kto be used by your favourite programs.

Quarterdeck expanded memory manager—QEMM-386—became the best selling utility in the industry because it does a better job of managing memory.

QEMM solves memory problems smoothly and invisibly. It 'pools' memory so that it's available in whatever form your programs need—expanded or extended. You don't even need to know the difference. QEMM does it all for you. Instantly. All other managers require you to manually allocate memory and re-boot every time you need to change.

Our new version 6 is better still. First, we improved our unique 'optimize' feature. It's still as easy as ever to use: all you have to do is type 'optimize' and QEMM automatically seeks out TSRs and device drivers and moves them out of your PC's conventional memory and into high memory. Now it lets you set up "what-if" scenarios and 'play' with combinations of your own.

Either way, QEMM-386 v6 finds more memory for your programs than any other memory manager. Period.

And QEMM monitors your memory—checking to be sure TSRs and utilities can be moved safely before it does so.

Who'd have thought there'd be another 115K of memory in your PC?

Breakthrough 'Stealth' technology results in a gain of up to 115K of high memory on many PCs by taking advantage of the memory map of most IBM, Compaq and 100% compatible PCs to 'map' ROM into other areas of memory. Only our memory wizards fully understand the technology behind it, but every user can appreciate the huge increase in available memory.

Of course, not every PC has 115K of extra high memory, but every PC can benefit from 'Squeeze'—ou new feature to manage all those TSRs tha need more memory at start up and less when they're resident. Their memory allocation is temporarily increased at sta up, then squeezed down when it's no longer needed.

QEMM automatically uses idle VidRAM to produce a further 96K gain o EGA and VGA-equipped systems when running character-based programs.

QEMM reorganises the way your memory is used, fill memory gaps and squeezing every last ounce of performance out of the software you now own.

ore than faster
es from your 386 or 486,
new QEMM.

QEMM gives you more memory with less pain.

New breakthroughs aside, QEMM does its basic job better than any other memory manager. For example, the DOS 5.0 EMM uses a manual, trial-and-error process to optimise memory while QEMM does it automatically.

And QEMM 50/60 v6 offers these features (except Stealth) and 'loads high' on IBM® PS/2 Models 50 and 60. DOS 5.0 doesn't.

QEMM isn't just for power users. It's for anyone who wants to get the most out of the PC. Whether you're using a PS/2 model 50 and DOS 3.3, a 486 with 5.0, or something in between, we can improve the way it works.

Prior versions of QEMM have won lots of awards—and become the #1 selling utility in the U.S. PC industry.

Don't leave DOS without us.

QEMM provides an additional 8-24K of conventional memory to Windows 3

Our new DESQview-386 version 2.4 incorporates the latest memory-maximising QEMM technology. That means it provides an even better solution for users who want low-overhead, high performance windowing and multitasking.

enhanced mode—maximising memory to help make everything run better. While DOS 5.0's EMM isn't even compatible with Windows' Standard Mode!

Experts agree: QEMM is the best memory manager to use with any multi-tasking software on the PC.

Quarterdeck Manifest maps your way to the gold.

Our award-winning memory utility gives you complete and clear understanding of how your memory works.

You can actually see where programs, TSRs, network drivers and utilities run. Check memory speed. And find the best way to use all of what you've got.

Manifest is included right on the disk when you buy QEMM or DESQview-386.

New DESQview-386 A performance bonanza for demanding users.

DESQview-386 is our combination of QEMM-386 and DESQview. The result is a simple multitasking environment that works similarly to Windows 3.0, without all the memory and cpu 'overhead' associated with an added-on 'graphical interface'.

Our memory breakthroughs result in real benefits to users with lots of memory demands—especially network users. DESQview-386 allows programs to run in several windows side-by-side while using only about 9K of conventional memory on a typical PC.

As you might expect, its low memory demands mean DESQview-386 runs fast. So fast, you might not need to upgrade your computer to achieve a jump in productivity And you won't need to upgrade your software, since DESQview works with virtually every program you're likely to own.

Quarterdeck productivity programs help you get more performance out of your PC investment today. And tomorrow.

Quarterdeck

United Kingdom
Quarterdeck Office Systems, UK Ltd.
(0245) 496699

France
Quarterdeck Office Systems S.A.R.L.
(1) 47 4219 98

Germany
Quarterdeck Office Systems GmbH
Reception 02 11 - 59 79 0-0

Middle East
Quarterdeck Cyprus
(357) 2 311 630

Ireland–European Headquarters
Quarterdeck International Limited
(353) (1) 2844-144

Circle 131 on Inquiry Card.

WINDOWING

Not by DOS Alone

Whether you like it or not, a windowing application is probably in your future

These days, when someone mentions the word *windows*, most people think of Microsoft. But windows neither begin nor end with the popular DOS version. In fact, the Macintosh made windows popular in 1984 with the first widespread use of the GUI concept. Today, most Unix workstations are based on the X Window System, a widely accepted graphical interface that was developed at MIT. Capabilities and tastes notwithstanding, some sort of windowing environment seems to be in most of our futures.

The main attraction of windowing applications is their ease of use. It is much simpler to learn one consistent command structure that, in general, applies to a range of applications than it is to learn separate command structures for each application you use. The GUIs themselves, with their graphical orientation, are intuitive, which cuts down on training time. Businesses that pay significant sums for software training see GUI-based applications as a means of saving time and money.

In this article, three BYTE editors take a closer look at software for windowing environments. For DOS-based Windows 3.0 and Macintosh environments, we look at three general-purpose areas: word processers, databases, and spreadsheets. Each is represented in the accompanying Windows 3.0 and Macintosh Product Guides (see tables 1–6). The disparity of products and product capabilities available for the X environment ("shrink-wrapped" X applications just began appearing within the last year) prevented us from making a useful Product Guide, but we do provide a listing of vendors in the word processing, database, and office productivity categories.

WINDOWS 3.0 / Stan Miastkowski

The Promise Fulfilled

Whether you think Windows 3.0 is a great leap forward or part of a conspiracy to extend the life of a tired old operating system, there's no denying its dominance in the computer industry for the past year and a half. In May 1990, Windows 3.0 hit the streets with a whole raft of ready-to-run applications. As of this July, about 1500 retail Windows 3.0 applications had become available, according to a Microsoft spokesperson I talked to. That number, of course, doesn't take into account the thousands of Windows 3.0 applications developed for specialized markets.

1-2-3 for Windows: *1-2-3 for Windows uses Lotus's SmartIcons software, which lets you automate and fine-tune the user interface. But die-hard fans of the original interface, fear not: It appears as a 1-2-3 Classic menu choice.*

Microsoft claims to have sold millions of copies of Windows 3.0 since its release. Although there's been a lively debate over how many of these copies are actually being used, the point is that applications developers have, with few exceptions, climbed aboard the Windows 3.0 bandwagon.

Is this activity mere hype or a sign of genuine innovation? In a way, it really doesn't matter. Windows 3.0 has given us a *consistent* way to interact with our computers. Of course, the details of that interface are the subject of incessant grousing among users and developers. Like it or not, we've become active users of mice (or other pointing devices). Windows 3.0 is the shining example of the IBM-developed-and-pushed Common User Access. (For more information on how users are reacting to Windows, see "Surveys Say . . ." on page 143.)

In the main, developers of Windows 3.0 applications have stayed close to the defined interface. Those occasional applications from developers determined to do their own thing have usually died a quick death in the marketplace.

The discipline of the Windows 3.0 interface is slowly but surely spawning

a generation of more computer-literate users. Make no mistake, understanding the nuances of the Windows 3.0 interface isn't as easy as Microsoft's big-bucks marketing juggernaut would have us believe. The learning curve is relatively steep, but it's a single learning curve. The elegance of the Windows 3.0 interface is that once you've learned it, you can pick up nearly any off-the-shelf retail Windows application and begin to use the package immediately. For large corporations, the savings in software training and support are considerable—over both the short and long term.

What the Pros Use

In an informal poll of serious Windows 3.0 users who belong to the ibm.windows conference on BIX, Word for Windows, Excel, and PageMaker were repeatedly mentioned as the most used Windows 3.0 applications. It's no mere coincidence that the first two are Microsoft applications: The folks who actually developed Windows 3.0 are also the ones who have so far "gotten it right" when it comes to developing Windows 3.0 applications.

Are these and other popular Windows 3.0 applications revolutionary? Manufacturer marketing hype to the contrary, the answer is no.

The term *evolutionary*, although overused, is a better word for today's most popular Windows 3.0 applications. Even rabid Windows 3.0 users still run plain-vanilla DOS applications from within the Windows 3.0 environment. This may simply be a function of user inertia; once used to an application, most of us are reluctant to discard it. It will be interesting to see what happens as the most tried-and-true DOS applications appear in their Windows incarnations. Lotus 1-2-3, WordPerfect, and Paradox are prime examples.

The Task at Hand

One feature that's sure to become more important in the near future is Windows' multitasking capability. As the 386 and 486 push out the aging crop of 286-based systems, more and more users will discover the advantages of running concurrent applications. Corporate users are already using Windows 3.0 multitasking, often for client/server applications on company LANs.

As multitasking becomes more common, Windows' *cooperative* multitasking could become problematic, because Windows is really just a fancy shell wrapped around DOS—and DOS was never designed for multitasking. In order for Windows 3.0 applications to do multitasking, they must be "well behaved"—that is, written in strict compliance with Microsoft's programming guidelines. That, unfortunately, is not always the case.

The issue of compliance raises the subject of OS/2, which was designed from the ground up as a true *preemptive* multitasking operating system. The debate over whether OS/2 will ever replace DOS is beyond the scope of this article, but IBM's promise that the soon-to-be-released OS/2 2.0 will "run Windows applications better than Windows" points to some interesting times ahead.

Do It Yourself

One of the most interesting trends to develop since Windows 3.0's introduction

PRODUCT GUIDE: WINDOWS 3.0 DATABASE APPLICATIONS

Table 1: *A number of new vendors are using the Windows platform to make their entry into the PC market. This listing includes both relational and flat-file Windows database managers.* (● = *yes*; ○ = *no.*)

Product	Price	Minimum RAM	Hard disk space required	Minimum CPU	Mouse required?	Other versions	Popular file formats supported	SQL support?
Ace AceFile	$295	2 MB	3 MB	286	●	DOS	Lotus 1-2-3, Symphony, ASCII, dBase, hot-links Excel, Word for Windows, Ami Pro, Windows DDE protocol	○
Blyth Omnis 5	$1000	1 MB	1 MB	286	●	Mac	DIF, SYLK, DBF, WKS	●
Coromandel ObjectTrieve	$495[1]	200 KB	1 MB	286	○	DOS, Unix	ASCII	●
GenSoft dBFast for Windows	$495	1 MB	1 MB	286	○	DOS, Mac	DBF	○[2]
MDBS M/4 Windows	$995	50 KB	300 KB	286	○	DOS, Unix,	None	●
Raima DB Vista III	$695	640 KB	80 KB[3]	286	○	DOS, Unix, VMS, OS/2, Mac	ASCII	●
Software Products WindowsBase	$495	2 MB	640 KB; 2 MB recommended	286	●	None	DBF, VMS, OS/2	●
Software Publishing SuperBase 2	$345 with sample files	640 KB	2.4 MB	386SX	○	None	ASCII, WKS, WK1, Excel, DIF, PCX, EPS, TIFF	○[4]
Software Publishing SuperBase 4	$695	640 KB	1.2 MB	386SX	○	None	ASCII, WKS, WK1, Excel, DIF, PCX, EPS, TIFF	○[4]

[1] Price is for version that supports binary objects.
[2] SQL support available only through DDE.
[3] Requirement given is for application; developer environment requires 2 MB.
[4] Product lets you embed SQL commands, but to use them you must purchase SuperBase SQL Library ($495).

PRODUCT GUIDE: WINDOWS 3.0 WORD PROCESSING APPLICATIONS

Table 2: *Word processing represents a large part of the potential Windows applications market. By the time you read this, all the major word processing vendors will have Windows versions available. The size of the Windows market opens up opportunities for new players, such as DeScribe. The possible result: The current DOS-based favorites might not be ranked the same in the Windows environment. (● = yes; ○ = no.)*

Product	Price	Minimum RAM	Hard disk space required	Minimum CPU	Mouse required?	Other versions	Popular file formats supported
DeScribe Word Processor	$495	2 MB	2 MB, 8 MB recommended	386SX	○	PM	ASCII, DCA, DisplayWrite, Excel, Framework 3.0, WK1, Word, MultiMate, WordPerfect, XyWrite, PFS: First Choice, PFS: First Write, WordStar, Professional Write, GEM, PCL, PIX, PIC, CGM, PCX, WMF, TIFF
Lotus Ami Pro	$495	1 MB	5.5 MB	286	○	NewWave	ASCII, DCA, WordPerfect, DisplayWrite, WordStar, MultiMate, Word, Word for Windows, RTF, WKS, WK1, WK3, Excel, DBF, SuperCalc, DIF, EPS, PIC, PCX, CGM, HPGL, WMF, TIFF
Microsoft Word for Windows	$495	640 KB	3.2 MB	286	○	Mac	WordPerfect, MultiMate, DisplayWrite, WordStar, Works, ASCII, WKS, WK1, WK3, HPGL, PCX, TIFF, PIC
NBI Legacy	$495	640 KB	3.8 MB	286	●	None	ASCII, WordPerfect, Word, DisplayWrite, MultiMate, RTF, DIF, PIC, DRW, HPGL, CGM, EPS, TIFF, PCX, WMF, WKS, WK1
Software Publishing Professional Write Plus	$249	1 MB; 2 MB with grammar checker	4 MB	286	○	DOS	CGM, PCX, PIC, Word, DCA, Professional Write Plus, MultiMate, WordPerfect, Professional Write, OfficeWriter, WordStar, WordStar 2000, ASCII, RFT, EPS, TIFF, WMF, Excel, SuperCalc
Symantec JustWrite 1.0	$199	2 MB	4 MB	286	●	None	Ami, Ami Pro, ASCII, Word, MultiMate, Professional Write, Professional Write Plus, RTF, Q&A Write, Word for Windows, WordPerfect, WordStar, XyWrite
WordStar Legacy	$495	1 MB; 2 MB recommended	4.3 MB	286	○	None	WordStar, WordStar 2000, WordPerfect, ASCII, DIF, RFT, MultiMate, Professional Write, PFS: First Choice, PIC, DRW, HPGL, CGM, EPS, WMF, TIFF PCX, BMP, DCA, RFT

Note: IBM Signature and WordPerfect for Windows are still under development; no pricing or system requirements are available for these products.

has been the appearance of application development tools. This trend is sure to continue. Until very recently, developing Windows 3.0 applications was a job for the truly dedicated. First of all, you needed to lay out several thousand dollars for a Windows Software Development Kit and the tools to use it. Then you needed to be an advanced C programmer with lots of time to learn the intricacies of programming for Windows. Even if you fulfilled these prerequisites, the job wasn't easy: Witness the many major applications developers whose products were delayed while teams of programmers wrestled with the black art of Windows programming.

Things are improving—slowly. You no longer have to dedicate your life to C to develop Windows applications. Although the market is flooded with high-ticket development tools designed mainly for serious corporate developers, Borland's introduction of a Turbo Pascal version complete with Windows programming tools has brought Windows 3.0 programming closer to the user. More recently, we've seen the introduction of Microsoft's Visual Basic and Within Technologies' Realizer. Both let you develop Windows 3.0 applications using an extended version of the old familiar BASIC.

The trend toward accessible Windows 3.0 programming tools will continue. But be warned: It still isn't easy. Despite the advertising claims of quick and easy Windows applications development, the reality is that you simply can't sit down and pop out an application as you can for DOS. That begs a more important question: Should you? There's a wide range of Windows 3.0 applications available now. Many more will be available in the future. And increasing competition continues to drive down prices. For the foreseeable future, Windows 3.0 applications development is likely to be confined to those who need applications that aren't otherwise available.

On the Horizon

Windows 3.1, which should become available by the end of the year, will include Microsoft's Object Linking and

WINDOWS COMPATIBLE

Fax Flexibility

Suggested Retail Price $149

Suggested Retail Price $249

Suggested Retail Price $199

There are a few things in today's life we can't do without. Faxes are one of them! That's why Best Data has developed the only complete family of internal, external and battery-operated pocket-sized fax modems. Now you can fax whenever and however you want with reliable, affordable Smart Ones™ or Smart One Travelers™ from Best Data, a feature-packed family of fax/data modems that lets you fully capitalize on the power of the fax.

Whether you choose our slick internal half-card, handsome desk top unit, or convenient pocket-size fax/modem, you'll enjoy 9600 bps send-and-receive fax and 2400 bps modem efficiency. Along with an unlimited phone book, selectable font options, and the ability to view, edit and rotate received faxes, Smart One lets you read d-Base III format files for fax broadcasting. And, since Smart One fax/modems are built according to the latest industry standards, you have the freedom to use any commercial fax software.

For anyone with a PC, laptop or MAC, Smart One's three unbeatable packages provide total faxing freedom. Call us at **(818)773-9600** and we'll hook you up with a Smart One dealer near you.

BEST DATA PRODUCTS, INC

9304 Deering Avenue, Chatsworth, CA 91311
Tel 818/773-9600 • Outside CA 800/632-2378 • Fax 818/773-9619
Best Data Europe • DeLescluzestraat 63 • 2600 Antwerp, Belgium
Tel 32 03 281 0645 • Fax 32 03 281 0612

See us at COMDEX Hilton #7842

Circle 16 on Inquiry Card

PRODUCT GUIDE: WINDOWS 3.0 SPREADSHEET APPLICATIONS

Table 3: *The list of Windows spreadsheet products mirrors that of the DOS world. The spreadsheet market is an expensive one in which to carve out a profitable niche, so the current favorites are likely to remain so among Windows users.* (● = *yes*; ○ = *no.*)

Product*	Price	Minimum RAM	Hard disk space required	Minimum CPU	Mouse required?	Other versions	Popular file formats supported
Bell Atlantic Thinx	$495	1 MB	2 MB	286	●	None	WK1, DBF, XLS, DRW
Informix Wingz	$499	2 MB	1.5 MB	286	●	Ultrix, OS/2, SunOS, Excel, Mac	WKS, WK1, WK3
Lotus 1-2-3 for Windows	$595	2 MB	5 MB	286	○	DOS, Mac, ALL, Unix, PM	WK1, WK3, WKS, WKR, FMT, VMS, SunOS, FM3, VM, MVS
Microsoft Excel	$495	1 MB	3 MB	286	○	OS/2, Mac	ASCII, WKS, WK1, DBF, SYLK, DIF, DBF2, DBF3, DBF4

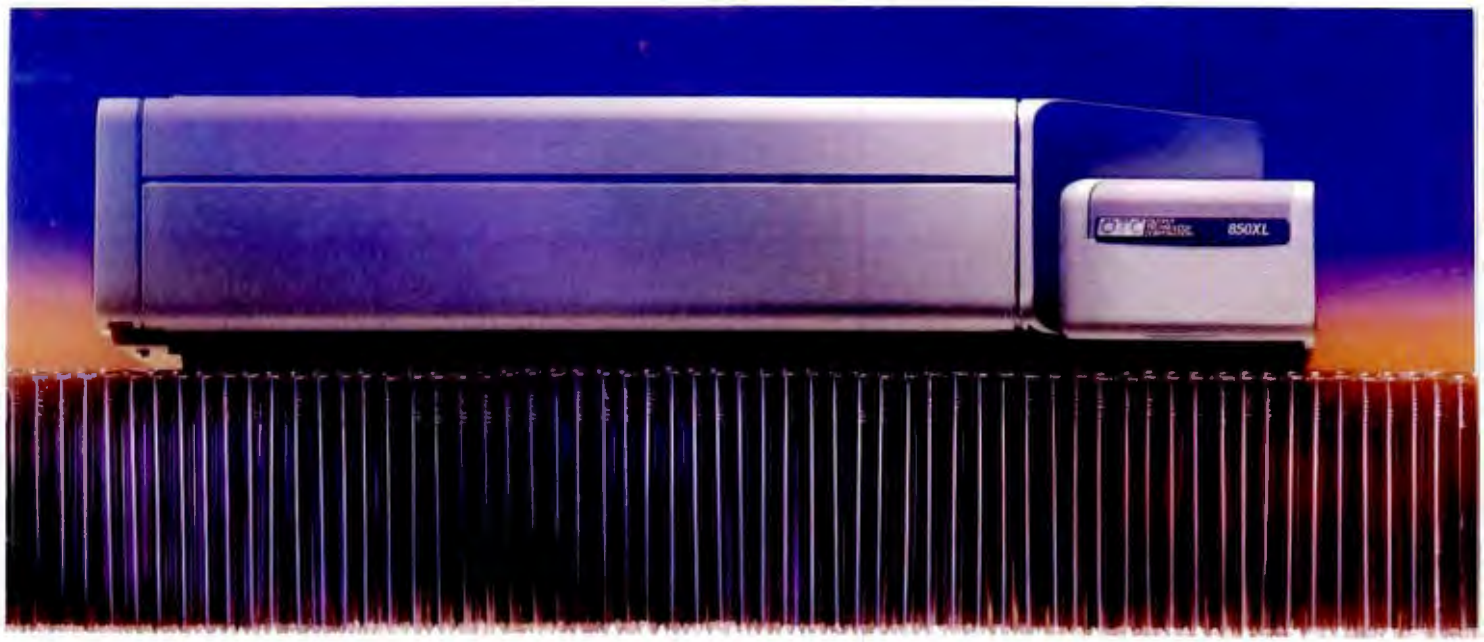
* Quattro Pro for Windows is still under development; Borland has not released pricing or system requirements for this product.

Embedding technology. This will have a profound effect on Windows applications. OLE has the potential to deliver on the long-delayed promise of fully integrated applications. Going way beyond Dynamic Data Exchange, OLE will enable applications to communicate fully with one another.

For example, take the process of integrating graphics, a spreadsheet, or a database with a document prepared by your favorite word processor. If you're using the Windows Clipboard, this is a cut-and-paste chore. Once you have integrated your data, changing it is a hair-tearing exercise. With OLE, you'll be able to click on whatever data you want to update or change and be taken directly into the corresponding application.

The caveat is that Windows applications will have to include OLE capabilities. This requirement opens the door for a new generation of applications that could very well encourage even the most recalcitrant Windows naysayers to join the fold.

Windows 3.1 will also include the



850 CPS & TOUGH AS NAILS!

850 CPS. That's right – 850 characters-per-second!

TOUGH AS NAILS. Why take a chance? Thousands of owners use the 850XL printer from 2 to 18 hours per day. It just keeps on printing, day-in, day-out! And, over 50% of all 850XL printers sold are purchased by existing owners. That alone tells the story for this American-made printer.

FREE 30-DAY TRIAL. We offer a free, 30-day trial to any qualified buyer. No strings attached. What other manufacturer believes this strongly in their product?

Call Us Today! **(800) 468-8788** GSA pricing: 800-633-9433

OTC OUTPUT TECHNOLOGY CORPORATION

Printing Solutions For Business Critical Applications

Should you need service, there are over 400 service locations nationwide to serve you. EPSON, IBM and DEC are trademarks of others and do not belong to Output Technology Corporation

Circle 116 on Inquiry Card.

COMPANY INFORMATION:

WINDOWS 3.0 APPLICATIONS

WORD PROCESSING

DeScribe, Inc.
(DeScribe Word Processor)
4047 North Freeway Blvd.
Sacramento, CA 95834
(916) 646-1111
Circle 985 on Inquiry Card.

IBM Corp.
(Signature)
Old Orchard Rd.
Armonk, NY 10504
(800) 426-2468
Circle 986 on Inquiry Card.

Lotus Development Corp.
(Ami Pro)
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Circle 987 on Inquiry Card.

Microsoft Corp.
(Word for Windows)
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 988 on Inquiry Card.

NBI, Inc.
(Legacy)
P.O. Box 9001
Boulder, CO 80301
(800) 624-1111
Circle 989 on Inquiry Card.

Software Publishing Corp.
(Professional Write Plus)
P.O. Box 7210
Mountain View, CA 94039
(415) 962-8910
Circle 990 on Inquiry Card.

Symantec Corp.
(JustWrite 1.0)
10201 Torre Ave.
Cupertino, CA 95014
(800) 441-7234
(408) 253-9600
fax: (408) 253-4092
Circle 991 on Inquiry Card.

WordPerfect Corp.
(WordPerfect for Windows)
1555 North Technology Way
Orem, UT 84057
(800) 321-4566
(801) 225-5000
fax: (801) 222-4477
Circle 992 on Inquiry Card.

WordStar International, Inc.
(WordStar Legacy)
201 Alameda del Prado
Novato, CA 94949
(800) 227-5609
Circle 993 on Inquiry Card.

SPREADSHEET

Bell Atlantic Software Systems, Inc.
(Thinx)
P.O. Box 3528
Princeton, NJ 08543
(800) 688-4469
Circle 994 on Inquiry Card.

Borland International, Inc.
(Quattro Pro for Windows)
P.O. Box 660001
Scotts Valley, CA 95066
(408) 438-8400
Circle 995 on Inquiry Card.

Informix Software, Inc.
(Wingz)
4100 Bohannon Dr.
Menlo Park, CA 94025
(800) 438-7627
(415) 926-6300
fax: (415) 926-6593
Circle 996 on Inquiry Card.

Lotus Development Corp.
(Lotus 1-2-3 for Windows)
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Circle 997 on Inquiry Card.

Microsoft Corp.
(Microsoft Excel)
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 998 on Inquiry Card.

DATABASE

Ace Software Corp.
(AceFile)
1740 Technology Dr.,
Suite 680
San Jose, CA 95110
(800) 345-3223
(408) 437-3456
fax: (408) 437-1018
Circle 999 on Inquiry Card.

Blyth Software, Inc.
(Omnis 5)
1065 East Hillsdale Blvd.,
Suite 300
Foster City, CA 94404
(800) 843-8615
(415) 571-0222
fax: (415) 571-1132
Circle 1000 on Inquiry Card.

Coromandel Industries, Inc.
(ObjectTrieve)
70-15 Austin St., Third Floor
Forest Hills, NY 11375
(800) 535-3267
(718) 793-7963
fax: (718) 793-9710
Circle 1001 on Inquiry Card.

GenSoft Development Corp.
(dBFast for Windows)
4122 128th Ave. SE,
Suite 200
Bellevue, WA 98006
(206) 562-0690
Circle 1002 on Inquiry Card.

MDBS, Inc.
(M/4 Windows)
P.O. Box 5268
Lafayette, IN 47903
(800) 344-5832
(317) 449-4878
fax: (317) 447-2120
Circle 1003 on Inquiry Card.

Raima Corp.
(DB Vista III)
3245 146th Place SE,
Suite 230
Bellevue, WA 98007
(800) 327-2462
(206) 747-5570
fax: (206) 747-1991
Circle 1004 on Inquiry Card.

Software Products International
(WindowsBase)
10240 Sorrento Valley Rd.
San Diego, CA 92121
(800) 937-4774
(619) 450-1526
fax: (619) 450-1921
Circle 1005 on Inquiry Card.

Software Publishing Corp.
(SuperBase 2, SuperBase 4)
1901 Landings Dr.
Mountain View, CA 94043
(415) 962-8910
Circle 1006 on Inquiry Card.

Apple-developed TrueType outline font technology. In many current Windows 3.0 applications, what you see on the screen isn't necessarily what you get from the printer. TrueType will change that. More important, documents will be portable between the Macintosh and Windows environments.

Sound and Pictures

And there are even more advanced applications coming over the horizon. Microsoft's recently introduced Multimedia Development Kit for Windows promises the integration of hi-fi sound and high-resolution full-motion video with the Windows environment (see "Multimedia Window Dressing," page 48, August BYTE). But so far, the word *promise* sums up the situation. The lack of any real progress is largely a function of industry confusion over what, exactly, multimedia is and, more important, who will buy it.

Finally, there is the PenWindows

WORD PROCESSING FOR WINDOWS AND OS/2

SIMPLICITY SPEED SUCCESS

You're on your way with WINDOWS and OS/2 Word Processing from DeScribe 3.0

Simple to use, DeScribe® Word Processor 3.0 places power at your fingertips. Let your thoughts fly because DeScribe smoothly matches your pace to help you streak across the finish line in record time.

Best of all, simplicity does not mean sacrifice. DeScribe includes all the advanced features you expect in a modern word processor and more! Like multilingual spell checking and thesaurus. Built-in definitions dictionary. Dynamic Data Exchange. Tables, drawing tools and more import filters for text and graphic formats than any other word processor on the market.

Plus, formatting is just a mouse click away with the unique Text Toolbox. Merge text and graphics. Draw lines. Be creative. Have fun. DeScribe is there to help you.

All done? Restore past work with DeScribe's unlimited UNDO. Snapshot automatically protects you from WINDOWS UAE's and those times when power goes out.

Still uncertain? Ask for a Trial Disk and take DeScribe for a test drive.

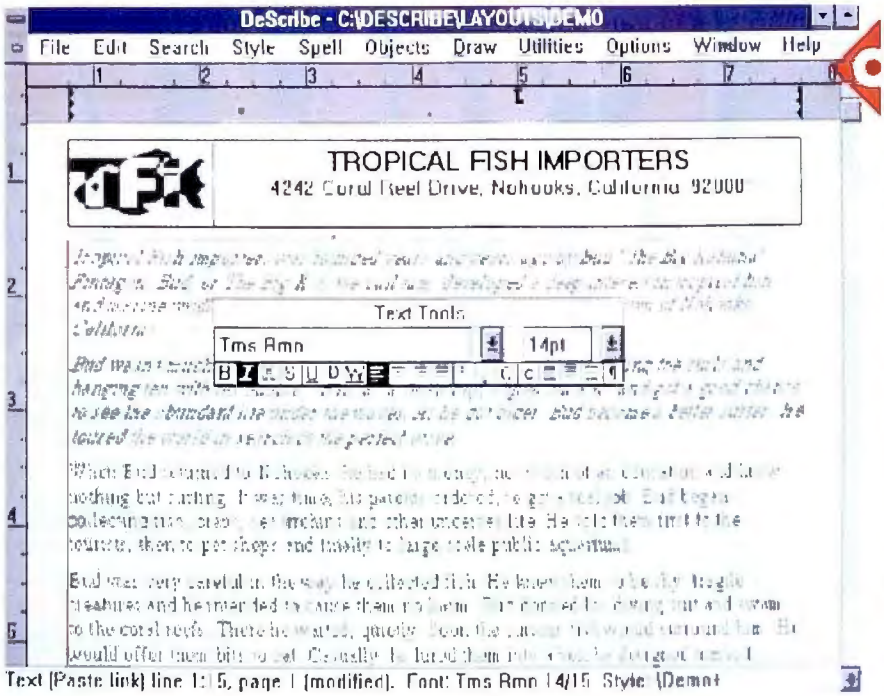
DESCRIBE®
WORD
PROCESSOR

Call Department 222 at:
1-800-448-1586
FAX 916-923-3447
MCI MAIL DESCRIBE

MICROSOFT WINDOWS

OS/2
PRESENTATION MANAGER
COMPATIBLE PRODUCT

Circle 37 on Inquiry Card.



DeScribe: *DeScribe first coined the term word publisher with an OS/2 package that combined the best features of a word processor and a desktop publisher. DeScribe Word Processor 3.0 is the company's first product for Windows. Besides speed and performance improvements, it includes a raft of new features (e.g., extensive drawing capabilities) that ease the preparation of all sorts of documents.*

operating environment from Microsoft. Pen-based computing is in its infancy, but it's sure to spawn a huge new market, mainly in vertical segments that have been left in the dust by the PC revolution.

Its advantages and disadvantages aside, Windows has opened up the applications market, generating excitement and innovation in the PC software market. The next year will see a continued avalanche of Windows applications. Many will be simple ports of existing applications shoehorned into the Windows interface. Some, however, will be standout applications that begin to take full advantage of the promise of Windows.

Stan Miastkowski is BYTE's senior editor for new products. He can be reached on BIX as "stanm."

X WINDOW SYSTEM / Tom Yager

Setting a Standard

Considering its handicap upon entering the market, the X Window System, the graphical environment that Next's Steve Jobs once dubbed "brain damaged," has come a long way. It remains the only universally implemented graphical interface system, available on everything from Unix workstations to PCs, Macs, and Amigas. It's even available for the Next (but not *from* Next).

X empowers developers to create applications that run on one machine and converse with the user through any other machine, all transparently. It defines a clear, publicly available standard (even the source code is publicly available without a license fee) that allows anyone to create new hardware or software that's guaranteed to work with all other properly implemented X products. Unlike the Windows, OS/2, and Mac interfaces, X came out of the gate ready to be networked and gave a lot of us our first taste of distributed computing.

Despite X's impressive history, new applications are still appearing rather slowly as software vendors wait to see how X will catch on in the broad marketplace. There's hope that some recent and coming developments will change that.

The Great Debate

Since their introductions, Open Look and Motif have been at odds with one another. Both are X layers that provide user-interface elements (e.g., buttons and scroll bars) for programmers and window management facilities for users. Motif got the market's attention first and introduced many workstation users to three-dimensional shading and effective use of color.

Open Look's appearance, at the time of its introduction, was sick in comparison, and potential users and developers couldn't get over how much better Motif looked. Today, Open Look, too, has 3-D shading, and it also has a number of things that Motif doesn't have, such as pushpins and drag-and-drop capability. In fairness, Motif has some unique advantages, too, such as keyboard shortcuts for menus and a self-managing file-selection dialog box. In the end, though, I think it comes out about even; neither is any harder or easier to work with than the other, because both of them rely on the X Toolkit. That gives them nearly identical programming interfaces.

The battle, according to some experts, is over: Motif is everywhere, and Open Look is not. Even Sun, the strongest proponent of Open Look, must compete against a number of third-party Motif implementations on Sun's own machines. The move to put Motif on Sun workstations was spurred by Sun's weak, nonstandard X/Open Look implementation, Open Windows 1.0. Even with the more stable Open Windows 2.0, some vendors, claiming that Open Windows 2.0 has some serious flaws, still insist that their software be run under Motif.

Sun may have been a little slow to come around, but it now seems to realize that X is no small issue and that Open Look won't sell itself. Open Windows 2.0 sweetens the pot with X11/News, a combined X- and PostScript-compatible graphical interface server. Applications can be written to use a combination of X and PostScript functions. What PostScript compatibility brings to the party is what X has desperately needed from the beginning: scalable fonts and graphics. All fonts in X's current release (X11.4) are bit maps. The software has a lot of them (over 150 on the machine I'm using to write this), but they are bit maps of fixed size. If you want a size that's not included, tough; X doesn't even include a facility to scale a bit map.

Enter Sun's News, with its PostScript-compatible graphics server. With it, you can display text in a number of fonts, at any size and at any rotation. The graphics are scalable, and everything is directly printable. What you see on-screen in the

Command Your Environment

with E'vent™ Manager for Windows™

EASY TO USE

E'vent Manager uses an innovative 'point and click' interface that allows you to quickly click through lists of applicable words to build error-free, English-like statements that tell E'vent Manager which events to monitor and what commands to execute.

For example:

IF the time is after 8:00:00 PM and it has been 30 minutes since the last user input

THEN output '[f]p' to Spreadsheet post a message box that says 'Printing Document'

No programming experience is required. E'vent Manager is simple enough for a novice to use while still satisfying the demands of the most power-hungry users.

PRACTICAL APPLICATIONS

Anyone interested in increasing computer efficiency by taking advantage of unused computer time and by making time at the computer more productive will find significant uses for E'vent Manager. Its work automation capabilities will appeal to any user, regardless of technical expertise or business size.

E'vent Manager helps you create custom solutions to meet your specific needs in the Windows environment and works with the software you currently own

FOR MORE INFORMATION

Call Merasoft Corporation
800-368-1596 for information
800-368-0362 to order
FAX: 801-225-9984

For machines running Windows 3.0 or higher
Suggested Retail Price: $179.99 USD

Introducing the "Missing Utility" for Windows: an "agent" that will change the way you compute!

- Gain power and control over your Windows environment
- Replace many of the utilities required for enhanced system operation and automate the use of all other utilities and applications.
- Customize your computer and applications to meet specific needs.
- Never again worry about whether you remembered to save or back-up your work.
- Assign the commands you use most to the extra mouse buttons you use least
- Keep your computer working through the night

With E'vent Manager, the possibilities are endless!

You decide what E'vent Manager should do for you. No other application gives you the power and control over all your software that E'vent Manager provides.

DYNAMIC EVENT MANAGEMENT™

'Events' constantly occur in a computer --keys are pressed, applications open and close, periods of time elapse when nothing occurs, etc. Through the power of Dynamic Event Management (DEM), E'vent Manager monitors 180 time and system events inside the computer and can make intelligent decisions about when to execute the commands you specify.

BEST of SPRING 1991 DATA PCWORLD FINALIST

COMPUTER TECHNOLOGY REVIEW Editor's Choice

"E'vent Manager is a must-have tool for any desktop integrator involved with the Windows environment." --Computer Technology Review

MERASOFT™

Merasoft Corporation 384 East 720 South, Suite 204, PO Box 1918, Orem, UT, 84059-1918

Circle 89 on Inquiry Card (RESELLERS: 90).

COMPANY INFORMATION:

X WINDOW APPLICATIONS

WORD PROCESSING

ArborText, Inc.
535 West William St.,
Suite 300
Ann Arbor, MI 48103
(313) 996-3566
The Publisher 3.0.4b.....*$3495*
Circle 1007 on Inquiry Card.

Elan Computer Group, Inc.
888 Villa St., Third Floor
Mountain View, CA 94041
(415) 964-2200
Avalon Publisher (SPARC) . *$995*
Elan/Express
(SPARC)..... *$495*
(PC Unix)..... *$295*
Circle 1008 on Inquiry Card.

Electronic Book Technologies, Inc.
1 Richmond Sq.
Providence, RI 02906
(401) 421-9550
DynaText (floating license, five simultaneous users)... *$2500*
Circle 1009 on Inquiry Card.

Frame Technology Corp.
1010 Rincon Cir.
San Jose, CA 95131
(408) 433-3311
FrameMaker 3.0
(single user)..... *$995*
(floating license)..... *$2500*
Circle 1010 on Inquiry Card.

Image Network
140 South Whisman Rd.
Mountain View, CA 94041
(415) 967-0542
Xroff
(base price, single user).. *$795*
(full single-user package with all fonts)..... *$1300*
Xpage..... *$260 and up*
Circle 1011 on Inquiry Card.

Interleaf, Inc.
9 Hillside Ave.
Waltham, MA 02154
(617) 290-0710
Interleaf 5 (single user, Unix).....*$1795*
Circle 1012 on Inquiry Card.

Island Graphics Corp.
4000 Civic Center Dr.
San Rafael, CA 94903
(415) 491-1000
Island Write, Draw, and Paint (single user)..... *$995*
Island Draw and Paint (single user, color)..... *$695*
Circle 1013 on Inquiry Card.

Odesta Corp.
4084 Commercial Ave.
Northbrook, IL 60062
(708) 498-5615
ODMS (15 users)..... *$27,000*
Circle 1014 on Inquiry Card.

SoftQuad, Inc.
720 Spadina Ave.,
Suite 200
Toronto, Ontario,
Canada M5S 2T1
(416) 963-8337
SoftQuad Publishing Software 2.9 (SPARC, single user).... *$995*
Circle 1015 on Inquiry Card.

DATABASE MANAGEMENT

Empress Software, Inc.
6401 Golden Triangle Dr.
Greenbelt, MD 20770
(301) 220-1919
Empress RDBMS 4.0
(single user, SPARC) ... *$2800*
(with Empress 4GL).....*$4200*
Circle 1016 on Inquiry Card.

RSW, Inc.
131 Rathburn Way
Santa Cruz, CA 95062
(408) 429-6229
/rdb (single user).....*$1295*
/rdbX (with Xve visual table editor).....*$1295*
Circle 1017 on Inquiry Card.

OFFICE PRODUCTIVITY

Access Technology, Inc.
2 Natick Executive Park
Natick, MA 01760
(508) 655-9191
20/20 (spreadsheet)..... *$595*
Circle 1018 on Inquiry Card.

Aldrich Computer Services, Inc.
212 Bridge St.
Yuba City, CA 95991
(916) 673-6571
As-Admin (college administrative information)..... *$70,000*
Circle 1019 on Inquiry Card.

Applied Information Systems, Inc.
500 Eastowne Dr.
Chapel Hill, NC 27514
(919) 942-7801
Xess (engineering/scientific spreadsheet, single license). *$595*
Circle 1020 on Inquiry Card.

Applix, Inc.
112 Turnpike Rd.
Westborough, MA 01581
(508) 870-0300
Alis (office automation).....*$1295 and up*
Asterix (desktop productivity)..... *$695*
Circle 1021 on Inquiry Card.

BBN Software Products
150 Cambridge Park Dr.
Cambridge, MA 02140
(617) 873-5000
BBN/Slate (multimedia document communication, SPARC)..... *$995*
Circle 1022 on Inquiry Card.

The Bristol Group, Ltd.
P.O. Box 910
Londonderry, NH 03053
(603) 437-3700
IsoFax (fax management, single user, SPARC)..... *$995*
Circle 1023 on Inquiry Card.

CrossWind Technologies, Inc.
6630 Highway 9, Suite 201
Felton, CA 95018
(408) 335-4988
Synchronize (time management)..... *$100 per user*
Circle 1024 on Inquiry Card.

Gecko Software
261 Hamilton Ave.,
Suite 303
Palo Alto, CA 94301
(415) 327-8982
Gecko Meeting (group scheduler, six-user license) *$1000*
Circle 1025 on Inquiry Card.

Hunter Systems
2225 East Bayshore Rd.
Palo Alto, CA 94303
(415) 965-2400
XDOS Applications (Unix implementations of DOS applications):
DataEase Database Management System *$1495*
MultiMate Advantage II ... *$595*
Quattro *$299*
Word 5.0..... *$595*
XyWrite III Plus *$1295*
Lotus 1-2-3..... *$695*
Circle 1026 on Inquiry Card.

Informix Software, Inc.
16011 College Blvd.
Lenexa, KS 66219
(913) 599-7100
Wingz (spreadsheet, SPARC)..... *$699*
Circle 1027 on Inquiry Card.

Quality Software Products
5711 West Slauson Ave.,
Suite 240
Culver City, CA 90230
(213) 410-0303
Exclaim (OSF/Motif-based spreadsheet) *$695*
Circle 1028 on Inquiry Card.

Quest Systems Corp.
2700 Augustine Dr.,
M/S 242
Santa Clara, CA 95054
(408) 496-1900
XDeskManager (stand-alone) *$495*
XOfficeManager (stand-alone) *$495*
XCorporate (stand-alone)... *$895*
Circle 1029 on Inquiry Card.

Soft-tek International, Inc.
1999 North Amidon,
Suite 340
Wichita, KS 67203
(316) 838-7200
Tactician (spreadsheet interface to major DBMSes, SPARC, single user)..... *$245*
Circle 1030 on Inquiry Card.

Uniplex Integration Systems, Inc.
150 West Carpenter Frwy.
Dallas, TX 75039
(214) 717-0068
Uniplex II Plus (business software, single user).....*$1225*
Advanced Office System (Uniplex add-on)..... *$475*
Advanced Graphics System (Uniplex add-on)..... *$310*
Uniplex Data Link *$310*
Circle 1031 on Inquiry Card.

V-Systems, Inc.
39 Brookhollow Dr.
Santa Ana, CA 92705
(714) 545-6442
*VSI*Fax* *$1595*
Circle 1032 on Inquiry Card.

WordMarc International Corp.
940 East Meadow
Palo Alto, CA 94203
(415) 813-8989
WordMarc Composer Plus (word processor and desktop publisher, SPARC, single user)..... *$595*
Circle 1033 on Inquiry Card.

At 9ms, This Should Be On The Cover.

Stop the presses, call the editor. Now you can get more speed, more room, more power, more of everything. Except price.

Presenting Hardcard II *XL*™. A hard drive with 9ms effective access time[1] designed for 286/386 systems.

Now here's the news. *The New York Times* says Hardcard II *XL* offers "more speed than regular drives for a comparable price."

And the numbers confirm this. Hardcard II *XL* runs up to 9 times faster than a typical 28ms drive, thanks to a staggering 1.4 MB per second sustained transfer rate.[2] With 50 or 105 MB capacity, you have enough room to run Windows™ 3.0.

There's also a two year warranty and a level of service and reliability our customers (and *PC Magazine**) tend to brag about.

All this for about the same price as the typical 28ms drive.

Nice cover.

For your nearest dealer, call 1 800 624-5545.

Plus Hardcard

THE 9ms ERA

XL

HARDCARD II XL

**PC Magazine* service and reliability survey ranked Plus Development #1. September 25, 1990.

Circle 126 on Inquiry Card.

PostScript previewer is close to what appears on paper. Sadly, News has been slow to appear in applications. FrameMaker, a very popular technical desktop publishing package, will reportedly be among the first to take advantage of the News server's PostScript capabilities.

News may not single-handedly save Open Look from obscurity, but perhaps it will drive those developing X to get the standard server to do at least as much as GeoWorks (an inexpensive PC graphical environment that includes scalable text and graphics). MIT may never have imagined that X would be considered a potential market force, but that possibility exists now. I think MIT's corporate sponsors, companies like Digital and IBM that are married to X, will force the system into shape as a more commercially viable product.

The X Factor

Political and technical wrangling aside, I must rush to point out that I very much like X. It provides the earliest evidence I know of that fierce adversaries can get together and create something truly good. I won't wax eloquent about X's roots; it's gone way beyond its original charter. But now that X has established itself, it's interesting to see how it has affected the market.

Its earliest effect was the unification of Unix workstations behind a single graphical interface standard. This helped to plant the idea that networks of mixed-vendor workstations might be a good thing, and the concept blossomed (along with the workstation market). Now X is taken for granted as standard software on most Unix workstations, and the low cost of implementation has helped bring down the price of high-performance graphics systems.

X is taking hold in other areas, too. Sales of PC and Windows X-server software, for instance, are brisk, and Quarterdeck is banking on X to help keep Desqview on the map. X has become an important tool in the recent push for cross-platform connectivity.

Without X's networking capabilities, there would be no X terminals. By bringing together only the most essential graphics, CPU, networking, and software resources, these terminals epitomize what's best about X. They are, by any reasonable definition, computer systems, but X terminals provide user I/O services only to applications that are running on other machines. Because hard disk drives, operating systems, and the like can be left out, X terminals can be inexpensive and compact. There's still some question about whether color X terminals, which can cost $5000 or more, can reasonably compete against low-end diskless workstations as prices continue to fall.

Accompanying this article is a list of X applications vendors. The ones listed are only a representative sample from three product categories: word processors, database managers, and office productivity tools. The list was taken from the *Export Catalog*, a document published by Network Computing Devices (an X terminal manufacturer) and updated regularly. The complete catalog can be obtained by contacting NCD at (415) 694-0650.

Tom Yager is a BYTE technical editor. You can contact him on BIX as "tyager."

MACINTOSH / Tom Thompson

Behind-the-Scenes Innovation

For Apple, the major event of this year was, of course, the release of System 7.0. It revamped the Mac's GUI to bring a point-and-click consistency to desk accessories and the Control Panel. It also provided a mechanism that lets you add fonts or sounds without restarting the Mac. However, the most crucial improvements System 7.0 brought to the Mac weren't dancing about in windows on the screen, but quietly and effectively operating behind them.

AppleTalk Phase 2, 32-Bit QuickDraw, and the Communications Toolbox—formerly separate add-on modules that expanded the Mac's network capabilities, provided high-quality imaging, and enhanced external I/O—were integrated into System 7.0. Next, built-in peer-to-peer file sharing allows the easy exchange of information without requiring a file server. Finally, as an integral part of System 7.0's design, there's Interapplication Communication (IAC)—the ability of Mac applications to share information, or request services from other applications, even if those applications reside on computers across an AppleTalk network.

IAC supports two tiers of use: workgroup functions and "hybrid applications." A workgroup typically consists of a small group of people whose jobs require them to work with one another and to share documents that are constantly being revised. System 7.0's Publish/Subscribe mechanism provides an easy way to distribute and track changes in such documents.

Setting up the arrangement is simple and intuitive: It requires only a menu selection, clicking and dragging on the portion of the document you want to publish, and then typing the name of an edition file. Other users "subscribe" to the document through a menu selection that lets them pick the edition file. We will see many Mac applications rapidly adopt this Publish/Subscribe capability so that they can fit into workgroup situations. In fact, some are already appearing: Microsoft Excel 3.0 has it, as does Claris's Resolve, Adobe Photoshop 2.0, and a beta version of Claris's MacWrite Pro.

However, IAC is not limited to Publish/Subscribe. A special set of high-level events called Apple events lets applications launch other applications, query them for information or process

Ray Dream's Designer *is a solid modeling–cum–ray-tracing application. It has the ability to hand off the computationally expensive ray-tracing portions of a job to other networked Macs. It does this by using System 7.0's built-in file sharing and Apple event mechanisms.*

Designers using low-end color Macs can construct framework models that they submit to a single Mac IIfx or a 68040-based Mac. As shown in the screen, a user can select any networked Mac running a copy of Designer.

Why ONE OF AMERICA'S MOST THOUGHT-PROVOKING ENGINEERS NOW USES THE DESIGN TOOL THAT THINKS.

Two years after the Voyager completed its record-shattering around-the-world flight, you could still find its designer, Burt Rutan, working at a drafting table with pencil and paper.

Hardware wasn't the problem. He had computers. His company could buy any design system worth owning. What kept Burt grounded was software. CAD so clumsy, it squashed creativity. Or so weak, it simply couldn't do his job.

Maybe that's why the first time he sat down to design with Ashlar Vellum, Burt compared the exhilaration to flight. Vellum is the first CAD program with a built-in autopilot.

Burt Rutan. Inventor. Engineer. Another Vellum user with no intention of going back to the drawing board.

INDUSTRIAL-STRENGTH CAD THAT THINKS.

From GD&T symbols to NURB splines to DXF and IGES file format translators, Vellum has every professional design and drafting tool your job demands. But its real breakthrough is an expert system called The Drafting Assistant™ (Pat. Pending)—built-in intelligence that instantly makes every designer more productive. Even on enormously complex jobs.

Instead of fighting the keyboard, or guessing about alignment, Vellum pinpoints and spells out every logical design point for you, right on the screen.

Draw a simple line and the midpoints, endpoints, and construction lines appear automatically. Click the mouse and you get precise alignment to 16 decimal places, in a fraction of a second.

THE POWER OF PARAMETRICS.

Before Vellum, using CAD for conceptual design was like trying to draw in the dirt with a backhoe.

Now, Vellum makes precise design as natural as free hand sketching, with the combined power of Parametrics and Associative Dimensioning.

Simply draw a rough approximation of your design, dimension it, plug in values and *click*: geometry is automatically redrawn to scale. A part needs to change? Simple. Just change the dimensions and the geometry updates as you watch. Or change the geometry and all the dimensions update perfectly.

FROM CONCEPT TO FINISH IN HALF THE TIME.

According to Burt, "the only way to fully appreciate Vellum is to sit down and use it; tackle a tough job, right off."

Run through the full range of professional CAD tools. Try Vellum's Smart Wall tool that trims walls automatically.

See if the Drafting Assistant doesn't make you two, or even three times more productive than any other CAD package.

If you're like Burt Rutan, you'll find yourself using Vellum from conceptual design right through finished drawings. Best of all, you'll never give the drafting board, or another CAD program, a second thought.

For more information, a free video, a trial version, or the name of an authorized Ashlar reseller near you call 408-746-1800.

Engineering drawings courtesy of Burt Rutan/Scaled Composites, Inc.

ASHLAR®
Software That Thinks.®

Available for Macintosh, Windows 3.0 and Silicon Graphics. © 1991 Ashlar, Incorporated.

Circle 167 on Inquiry Card.

PRODUCT GUIDE: MACINTOSH DATABASE APPLICATIONS

Table 4: *Listed here are some of the popular Mac database applications.* (● = *yes;* ○ = *no.*)

Product	Price	Minimum RAM	Hard disk space required	System 7.0–compatible?	Popular file formats supported
Acius File Force 1.1	$395	1 MB	1.5 MB	●	SYLK, DIF, text
Acius 4th Dimension 2.2	$795*	1 MB	1.3 MB	● savvy	SYLK, DIF, text
Baseline Publishing Database 1.51	$130	1 MB	1.5 MB	●	Tab- and/or comma-delimited, returns, custom export, Excel, FileMaker, Full Impact, FullWrite, Double Helix, More, Word, Works, WordPerfect, WriteNow, 4th Dimension
Blyth Omnis 5 1.2	$1000	640 KB	1 MB	●	DIS, SYLK, dBase, DBS, Lotus, WKS, tab- and/or comma-delimited, character-kerned
FoxBase Plus/Mac 2.01	$495	1 MB	3 MB	●	ASCII, DBS, X commands
Odesta Double Helix 3.5	$695	1 MB	1 MB	●	ASCII, DIS, SYLK
Oracle for Macintosh 1.2	$199	2 MB	6 MB	●	Any ASCII, DB2, SQL/DS, RMF
ProVue Panorama 2.0	$395	1 MB	1 MB	●	ASCII
Software Discoveries RecordHolderPlus	$150	512 KB	500 KB	●	Text, ASCII
TSP Filevision IV 1.1	$295	1 MB	430 KB	●	Any text; allows you to create custom export files

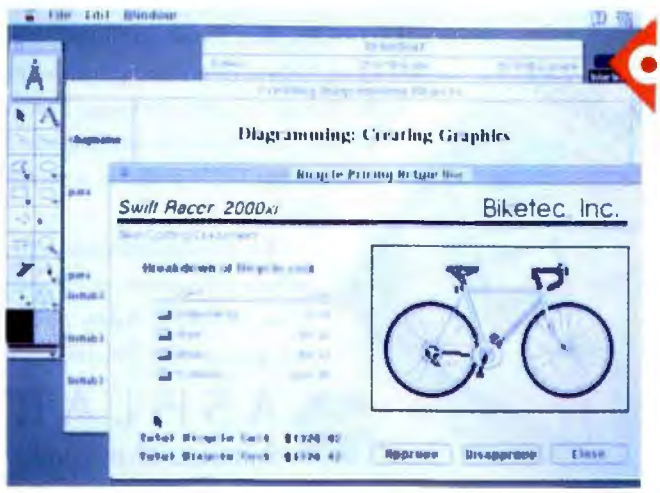
* Run-time price: four-pack, $395; single-pack, $125.

data, and terminate them when the work is done. In this way, Mac applications can augment their capabilities by simply passing certain tasks off to other applications that are better suited for the work.

For example, a word processor might pass a request for a charting operation to a graphics application, have a spreadsheet compute a balance, or use a database to retrieve a mailing list. As with Publish/Subscribe, these second-tier IAC applications function across an AppleTalk network. Such applications become more capable by melding the strengths of other ones, producing the hybrid applications mentioned earlier.

Also new behind the scenes is System 7.0's Data Access Manager, which will

***Resolve** uses System 7.0's Interapplication Communication to trigger scripts that compute the quarterly budget, plot the weekly sales figures, and print the shareholders' statement figures. Like Designer, Resolve can thus off-load heavy-duty number-crunching jobs onto a more powerful Mac.*



***Interleaf 5,** an electronic publishing package, uses Interleaf's own Active Document technology and Apple's System 7.0 features to create and manage documents that use dynamic data. Active Document technology is Interleaf's Lisp-based programming environment that lets you access, evaluate, and act on a document's information. The Active Document shown here describes a bicycle down to its individual parts, displaying and tracking the current prices for each part. You can check on the bicycle's cost before approving the design for manufacturing. Interleaf 5 uses System 7.0's Data Access Language, a high-level Structured Query Language–based language used by Mac database applications to query remote databases for information. In the case of the bicycle project, the Active Document uses DAL to access an Oracle database on a remote VAX for the part information. The combination of Interleaf's Active Document technology and System 7.0's DAL mechanism allows managers to accomplish the nearly impossible: document and track designs whose information is in a state of flux.*

GENERIC CADD. FULL-TIME CADD AVAILABLE FOR PART-TIME WORK.

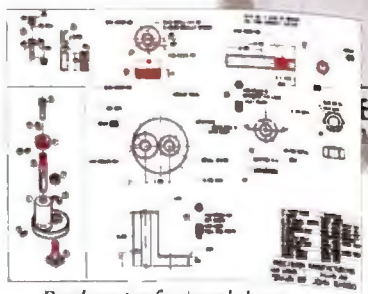
Finally, there's a full-powered CADD package for those who need to create professional designs, but don't want to spend a lot of time and money producing drawings. Generic CADD 5.0 is an affordable tool for the busy professional who only wants CADD part of the time.

GENERIC CADD HAS EXCELLENT COMMUNICATION SKILLS.

Whether you're selling a concept to your client, reporting to your management, passing roughs to the drafting department or just fine-tuning your own ideas, Generic CADD allows you to communicate faster. Clearer. Cleaner. And you can try out design alternatives you'd probably skip if you had to draw them by hand.

Revisions? Make them in minutes, not hours.

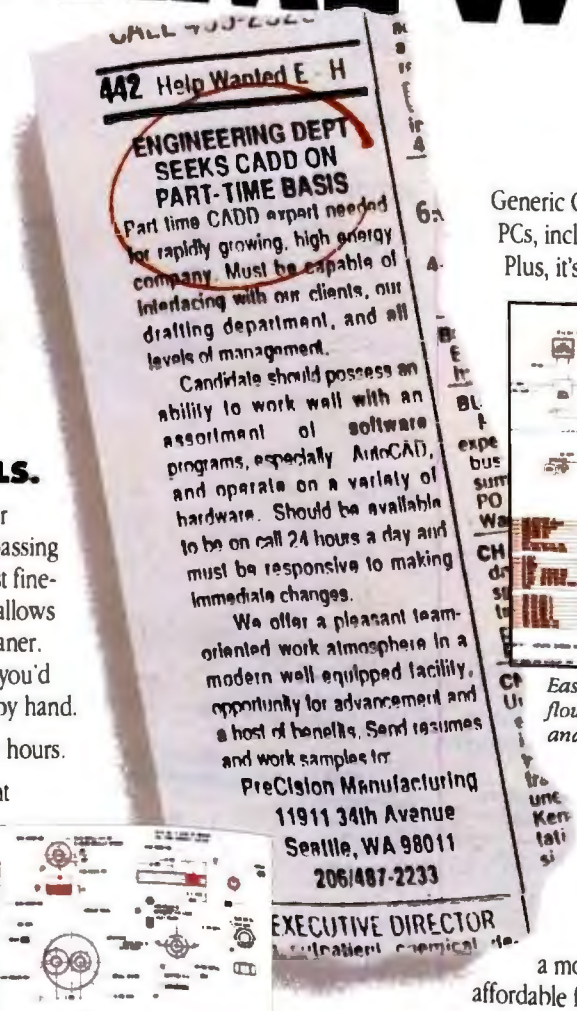
As your concept passes from department to department, Generic CADD's superior 2D detail and functionality leave little room for errors in interpretation by anyone along the way.



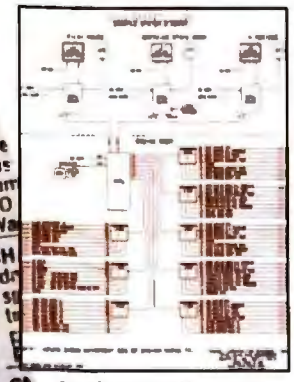
Produce professional drawings from initial concepts to finished production blueprints.

GENERIC CADD WORKS WELL WITH OTHERS.

Even the most complex drawings can be created by selecting from the menu or by using simple two-key commands. Plus Generic CADD comes with a comprehensive hands-on tutorial. So even if you're only an occasional CADD user, you'll take less than a day or two to get up and running.



Generic CADD runs on all of the most common PCs, including XTs, ATs, 386s and even portables. Plus, it's compatible with word processors, desktop publishers and many other frequently used software programs. Such as WordPerfect, PageMaker and a wide variety of draw and paint packages. Increase the productivity of your investments without sacrificing CADD power.



Easily generate process flow, system diagrams and schematics.

AT $495, IT'S PRICED FOR PART-TIME WORK.

Most CADD systems cost thousands of dollars. Generic CADD 5.0 is priced so even if you only use it once or twice a month, you'll easily justify the cost. Now it's affordable for every engineer to have a copy.

Get a CADD package with full-time capabilities at a part-time price. For more information or the name of the Generic CADD retailer near you, call us at **1-800-228-3601**.

FREE!
AutoCAD Compatibility.
Buy Generic CADD 5.0 between October 1 and December 31, 1991 and receive your free copy of AutoConvert,* our DXF translator. A $100 value.
*Just send in dated proof of purchase and registration

Generic
SOFTWARE
An Autodesk Company

Circle 59 on Inquiry Card.

PRODUCT GUIDE: MACINTOSH WORD PROCESSING APPLICATIONS

Table 5: *Some representative Mac word processors. MacWrite Pro is System 7.0–savvy: It will be able to use Publish/Subscribe and Interapplication Communication. (● = yes; ○ = no.)*

Product	Price	Minimum RAM	Hard disk space required	System 7.0–compatible?	Popular file formats supported
Claris MacWrite Pro	$249	1 MB	1.6 MB	● savvy	MacPaint, PICT, Color PICT2, TIFF, EPSF, Acta, AppleWorks, DCA, Word, Works, Write, WordPerfect, WriteNow
Claris MacWrite II	$249	1 MB	735 KB	●	Word (Mac and IBM), WordPerfect, (Mac and IBM), DCA, RTF
DeltaPoint Taste 1.02	$149	2 MB	2 MB	●	AppleLinks, Works 2.0, MacWrite, Word, WordPerfect, WriteNow
Microsoft Word for Macintosh 4.0	$395	512 KB	1.6 MB	●	Excel, Word, Works, WordPerfect for PC, RTF, DCA, MacWrite, ASCII, PageMaker
New Horizons WordMaker 1.0.2	$125	512 KB	425 KB	●	MacWrite
Paragon Nisus 3.06	$395	1 MB	1 MB[1]	●	MacWrite, Word; with XS module, Claris XTND capability
Power Up Letter Writer Plus	$89.95	1 MB	None	●	MacWrite 5.0 Plus, text files
T/Maker WriteNow 2.2	$199[2]	512 KB	800 KB	● 24-bit mode	Word, Write, MacWrite, RTF, AppleShare, TOPS, PageMaker, Letraset Ready-Set-Go, QuarkXPress, Springboard Publisher
WordPerfect for Macintosh 2.0.1	$495	1 MB	20 MB	●	TIFF, EPS, PICT, GIF, WPG, Word
Working Software QuickLetter 1.1.5	$49	512 KB	165 KB	●	Imports MacWrite, Word, text; exports MacWrite, text, stationery

[1] 2 MB with MultiFinder, 4 MB with System 7.0
[2] Includes Grammatik Mac 2.0

PRODUCT GUIDE: MACINTOSH SPREADSHEET APPLICATIONS

Table 6: *Some of the popular Mac spreadsheets. Resolve 1.0 and Excel 3.0 can utilize System 7.0's Publish/Subscribe mechanism to transmit changes in the spreadsheet to other documents. (● = yes; ○ = no.)*

Product	Price	Minimum RAM	Hard disk space required	System 7.0–compatible?	Popular file formats supported
Bravo MacCalc 1.2D	$139	512 KB	200 KB	●	Lotus 1-2-3, SYLK data
Claris Resolve 1.0	$399	1 MB*	1.25 MB	● savvy	Excel, Wingz, Lotus 1-2-3, DIF, SYLK, text
Informix Wingz 1.1A	$399	1 MB	2.5 MB	No	DIF, SYLK, Lotus 1-2-3, text
Microsoft Excel 3.0	$495	1 MB	3 MB	● savvy	BIFF, SYLK, text, CSV, WKS, WK1, WK3, DIF, dBase, DBF2, text and CSV for Windows, DOS, OS/2, template
Occam Muse	$695	2 MB	2 MB	●	WKS, SYLK, text, DBS, WK1, fixed field

* 2.5 MB if using System 7.0

allow any application to inquire and receive information from remote databases. The DAM uses the Data Access Language, which is a Structured Query Language–based mechanism used to communicate with these databases. An application that knows nothing about conversing with a database will use a *query document* to accomplish this. The query document frames a variety of application requests into the appropriate DAL questions. The query document also describes to the application how to understand the results passed back from the database. An initial user creates these query documents, but once they are made, anyone using the application can use them to access the database. A demonstration of the Interleaf 5 application from Interleaf showed how DAL communicated to a VAX and then updated the document's information on the fly.

Distribute the Work

It's possible that a tightly integrated suite of Mac applications on several computers, communicating via AppleTalk, become a gestalt, where the whole is greater than the sum of its parts. Some early examples of Apple event use seem to bear this out. For example, a beta version of Ray Dream's Designer, a solid-modeling and ray-tracing application, can hand off a heavy-duty processing job

A MAP FOR ALL REASONS...

Most business people still view maps as a tool used only for planning things like an RV vacation, or teaching geography to the kids. At Strategic Mapping™ we're helping businesses use maps to enhance their information systems. By linking maps to a database or spreadsheet on a personal computer, we've taken the classic model of an atlas into the 21st century. Now, over 20,000 companies – including many of the Fortune 500 – are using our Atlas Software to help make critical business decisions for a multitude of reasons.

Target Marketing – Companies such as General Foods, Prudential Insurance and American Express are leveraging their sales and marketing program dollars with Atlas Software by focusing on the right customers – in all the right locations.

Sales Territory Management – Sony, 3M and Eastman Kodak use Atlas Software to manage their sales territories more effectively – maximizing profits.

Site Selection – Citibank, Kaiser-Permanente and Pizza Hut are taking the guesswork out of selecting new business locations by using Atlas Software.

Distribution Planning – Federal Express, Miller Brewing and Coca-Cola are radically improving productivity and efficiency with Atlas Software making certain that deliveries are on time, and on budget.

Research shows that 85% of business databases contain critical location based information, yet most businesses fail to view their information geographically. With Atlas Software, you can visualize your database, and even print high quality map graphics and database reports – adding sizzle to your presentations.

Other PC software programs use maps to display data, but only Strategic Mapping, Inc. provides the combination of power, ease of use and affordability that has made us the leader in desk-top mapping since 1984.

Call us today for a free *Desktop Mapping Guidebook* and demo disk. You'll see why we were rated #1 by *PC Week* – and why *MacUser* gave us their *5 mice* rating.

CALL: 408/985-7400
FAX: 408/985-0859

NEW! PRODUCTS FOR DOS, MAC AND WINDOWS!

Strategic Mapping, Inc.
4030 Moorpark Ave., Suite 250
San Jose, CA 95117

Circle 148 on Inquiry Card.

COMPANY INFORMATION:

MACINTOSH DATABASE APPLICATIONS

DATABASE

Acius, Inc.
(File Force 1.1, 4th Dimension 2.2)
10351 Bubb Rd.
Cupertino, CA 95014
(408) 252-4444
fax: (408) 252-0831
Circle 1039 on Inquiry Card.

Baseline Publishing, Inc.
(Database 1.51)
1770 Moriah Woods Blvd., Suite 14
Memphis, TN 38117
(800) 926-9676
(901) 682-9676
fax: (901) 682-9691
Circle 1040 on Inquiry Card.

Blyth Software, Inc.
(Omnis 5 1.2)
1065 East Hillsdale Blvd., Suite 300
Foster City, CA 94404
(800) 346-6647
(415) 571-0222
fax: (415) 571-1132
Circle 1041 on Inquiry Card.

Fox Software, Inc.
(FoxBase Plus/Mac 2.01)
134 West South Boundary St.
Perrysburg, OH 43551
(800) 837-3692
(419) 874-0162
fax: (419) 874-8678
Circle 1042 on Inquiry Card.

Odesta Corp.
(Double Helix 3.5)
4084 Commercial Ave.
Northbrook, IL 60062
(800) 323-5423
(708) 498-5615
fax: (708) 498-9917
Circle 1043 on Inquiry Card.

Oracle Corp.
(Oracle for Macintosh 1.2)
500 Oracle Pkwy.
Redwood Shores, CA 94065
(800) 345-3267
(415) 506-7000
fax: (415) 595-0630
Circle 1044 on Inquiry Card.

ProVue Development Corp.
(Panorama 2.0)
15180 Transistor Lane
Huntington Beach, CA 92649
(714) 892-8199
fax: (714) 893-4899
Circle 1045 on Inquiry Card.

Software Discoveries, Inc.
(RecordHolderPlus)
137 Krawski Dr.
South Windsor, CT 06074
(203) 644-9225
fax: (203) 644-2081
Circle 1046 on Inquiry Card.

TSP Software
(Filevision IV 1.1)
4790 Irvine Blvd., Suite 105-294
Irvine, CA 92720
(714) 731-1368
fax: (714) 832-8568
Circle 1047 on Inquiry Card.

WORD PROCESSING

Claris Corp.
(MacWrite Pro, MacWrite II)
5201 Patrick Henry Dr.
Santa Clara, CA 95052
(800) 325-2747
(408) 987-7000
fax: (408) 987-7440
Circle 1048 on Inquiry Card.

DeltaPoint, Inc.
(Taste 1.02)
2 Harris Court, Suite B-1
Monterey, CA 93940
(800) 367-4334
(408) 648-4000
fax: (408) 648-4020
Circle 1049 on Inquiry Card.

Microsoft Corp.
(Microsoft Word for Macintosh 4.0)
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 1050 on Inquiry Card.

New Horizons Software, Inc.
(WordMaker 1.0.2)
206 Wild Basin Rd., Suite 109
Austin, TX 78746
(512) 328-6650
fax: (512) 328-1925
Circle 1051 on Inquiry Card.

Paragon Concepts, Inc.
(Nisus 3.06)
990 Highland Dr., Suite 312
Solana Beach, CA 92075
(800) 922-2993
(619) 481-1477
fax: (619) 481-6154
Circle 1052 on Inquiry Card.

Power Up Software Corp.
(Letter Writer Plus)
2929 Campus Dr.
San Mateo, CA 94403
(800) 851-2917
(415) 345-5900
fax: (415) 349-1356
Circle 1053 on Inquiry Card.

T/Maker Co.
(WriteNow 2.2)
1390 Villa St.
Mountain View, CA 94041
(415) 962-0195
fax: (415) 962-0201
Circle 1054 on Inquiry Card.

WordPerfect Corp.
(WordPerfect for Macintosh 2.0.1)
1555 North Technology Way
Orem, UT 84057
(800) 321-4566
(801) 225-5000
fax: (801) 222-4477
Circle 1055 on Inquiry Card.

Working Software, Inc.
(QuickLetter 1.1.5)
P.O. Box 1844
Santa Cruz, CA 95061
(800) 229-9675
(408) 423-5696
fax: (408) 423-5699
Circle 1056 on Inquiry Card.

SPREADSHEET

Bravo Technologies, Inc.
(MacCalc 1.2D)
P.O. Box 10078
Berkeley, CA 94709
(415) 841-8552
Circle 1034 on Inquiry Card.

Claris Corp.
(Resolve 1.0)
5201 Patrick Henry Dr.
Santa Clara, CA 95052
(800) 325-2747
(408) 987-7000
fax: (408) 987-7440
Circle 1035 on Inquiry Card.

Informix Software, Inc.
(Wingz 1.1A)
4100 Bohannon Dr.
Menlo Park, CA 94025
(800) 438-7627
(415) 926-6300
fax: (415) 926-6593
Circle 1036 on Inquiry Card.

Microsoft Corp.
(Excel 3.0)
1 Microsoft Way
Redmond, WA 98052
(800) 426-9400
(206) 882-8080
fax: (206) 883-8101
Circle 1037 on Inquiry Card.

Occam Research Corp.
(Muse)
42 Pleasant St.
Watertown, MA 02172
(617) 923-3545
fax: (617) 926-3262
Circle 1038 on Inquiry Card.

to a more powerful Mac on a network.

Using a Mac II, you might build an object in Designer and then request a remote Mac IIfx to perform the ray-tracing computations. Designer saves this wireframe file in a shared folder and then sends an Apple event to a copy of Designer running on the chosen IIfx. This Apple event tells the remote IIfx where the request came from and what to do. The IIfx then processes the wireframe file, drops a PICT image into the shared folder, and sends an Apple event to the local Mac II, informing you that the job is done. The same event also instructs the local copy of Designer to open and display the image file. All you do is make the request from a menu selection;

Pick A Card

Volante

Draw your winning card from National Design's Volante Series of high speed graphics boards.

PC MAGAZINE EDITORS' CHOICE
June 25, 1991
National Volante AT1000

All Volante high speed graphics boards offer:

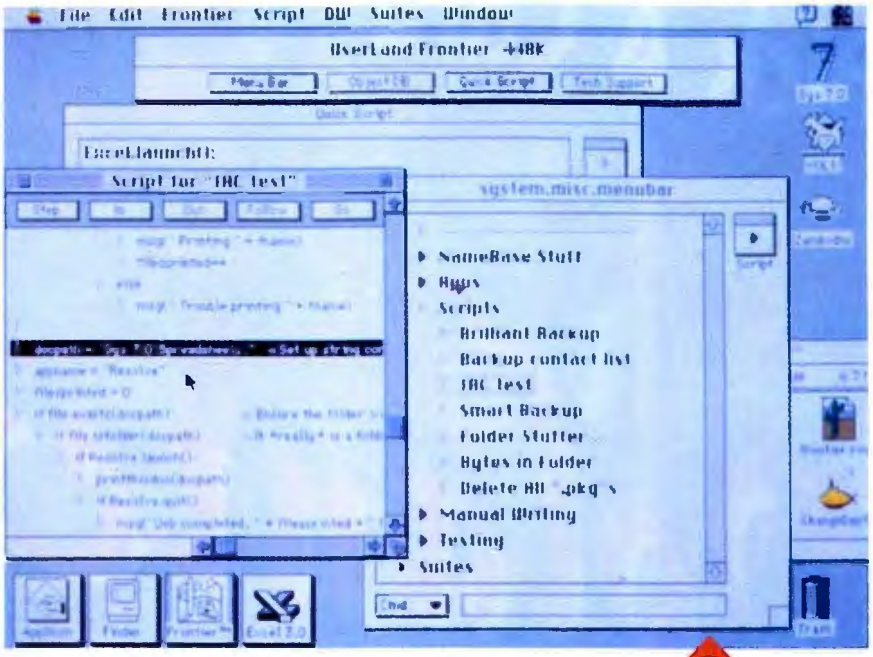
- Built on ISA, MicroChannel or VME bus
- Video memory upgrades to 4 MB
- Program memory upgrades to 4 MB
- Razor sharp resolutions from 1024x768 up to 1600x1280
- Blazing color selection from 8-bit to 24-bit true color
- Optional TI TMS34082 floating point processor for enhanced 3D acceleration
- Superior speed of the TI TMS34020 graphics engine paired with National Design's advanced ASIC technology
- LIFETIME WARRANTY - no gamble here!

Whether your game is CAD, Microsoft Windows, graphic arts, multi-media or medical imaging, Volante has a card for you at a fraction of the cost charged by the competition.

Call **800-253-8831** now for information on the breathtaking Volante series.

NDI
NATIONAL DESIGN, INC.
9171 CAPITAL OF TEXAS HWY, H-230
AUSTIN, TEXAS, 78759

Circle 100 on Inquiry Card (RESELLERS: 101).



*In a way, **Frontier** is a last frontier: a command-line interface for writing scripts on the Mac. UserLand's Frontier provides a C-style scripting language rich with variables, looping constructs, and control statements. Under System 7.0, it also can generate Apple events to launch and control Mac applications.*

several minutes later, a window opens with the end result.

In another example, an expert user might write several scripts in Resolve, a program that uses Informix Software's scripting technology. These scripts might draw graphs, compute the quarterly budget, or process tax-related accounting information. A copy of Resolve, running on a IIfx or a 68040-based Mac, would handle incoming requests. The contents of the Apple event would trigger the appropriate Resolve script and then return the result.

In the future, you can expect to see networked high-powered Macs acting as process servers, fielding computationally expensive jobs from all over the network. Each server will have an "object brew" of software capable of dealing with any possible demand. While IAC isn't smart enough yet to scout out idle Macs to handle distributed network computations as some Unix networks can, it's off to a good start, and you can expect it to improve.

The Script's the Thing

One of the major complaints with the Mac OS has been that there's no easy way of making it perform custom tasks (deleting all files with the Temp extension, for example) or automate routine tasks (such as backing up your files every evening). Not any longer. After consultation with UserLand Software and Simple Software, two scripting-language developers, Apple released its Open Scripting Architecture. OSA provides a standard by which scripting applications can communicate and drive Mac applications. The architecture is based on System 7.0's Apple events, which means that scripting applications will work only with System 7.0–savvy applications.

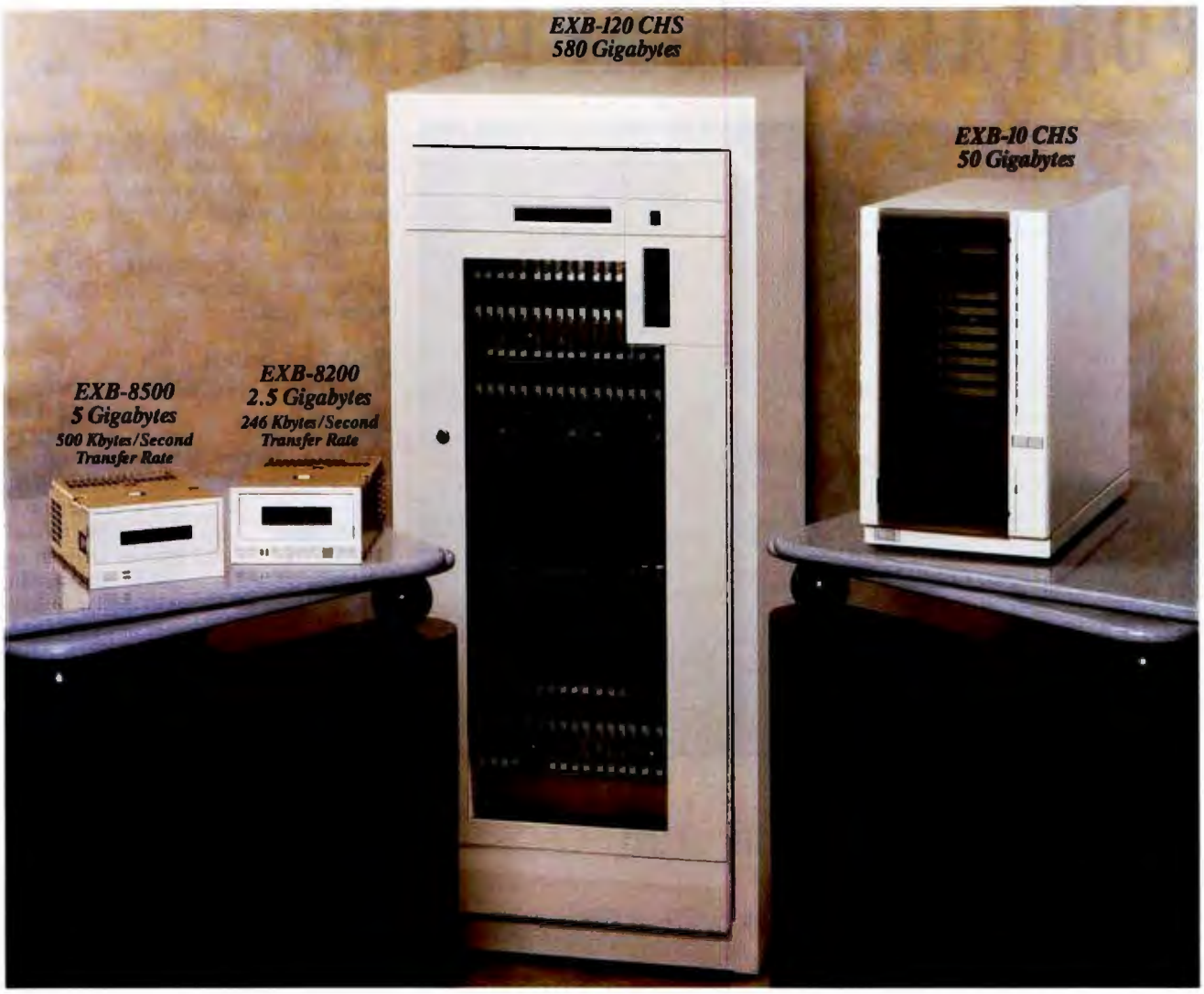
Now, using a scripting application such as UserLand's Frontier, you can write scripts that might, say, take all the word processing files you modified today and copy them to a file server. Or another script might have a word processor search your E-mail inbox and print out new messages. This lets Mac users write batch scripts to handle an army of chores. While critics might argue that this proves that a GUI is a failure in some sense, for those of us who are looking for a way to get our jobs done, scripting is an answer to a big problem. ■

ACKNOWLEDGMENTS

I would like to thank Robert Roblin of Claris, Dave Winer of UserLand Software, and Yann Corno of Ray Dream for their insights.

Tom Thompson is a BYTE senior technical editor at large. You can contact him on BIX as "tom_thompson."

8mm=Capacity



With its ability to store up to *2.5 gigabytes* of information on a single 8mm cartridge, the **EXB-8200 8mm Cartridge Tape Subsystem** is the answer for today's data-intensive storage requirements. And with over 200,000 installed worldwide, the EXB-8200 has become the *de facto* storage standard in workstation, midrange system, and file server environments.

The **EXB-8500 8mm Cartridge Tape Subsystem** advances beyond the performance of the EXB-8200 by achieving an extraordinary data transfer rate of *500 Kbytes/second*, while providing over *5 gigabytes* of storage capacity. In addition, high-speed search at *37.5 Mbytes/second* allows for rapid file retrieval. Keeping pace with today's phenomenal disk capacities, the EXB-8500 can back up a 760 megabyte disk drive in approximately 25 minutes!

Featuring an unparalleled compact design, the **EXB-10 Cartridge Handling Subsystem** provides access to as much as *50 gigabytes* of information. An integral robotic handler performs automatic loading and unloading of up to ten 8mm data cartridges. Eliminating the need for manual intervention, the EXB-10 is well-suited for LAN and super minicomputer backup applications.

And if you have an application that demands extraordinary storage capacity, the **EXB-120 Cartridge Handling Subsystem** delivers up to *580 gigabytes* of storage in only 4 square feet of floor space. It's ideal for the backup of large computer systems or near online access to network data bases. With a potential for 12 days of nonstop, hands-off data recording, the robotically-driven EXB-120 makes long-term unattended storage a reality.

So whether it is simply backing up your workstation hard disk or online access to sequential data sets, we have the right 8mm data storage solution. Call the regional office nearest you or write EXABYTE Corporation at 1685 38th Street, Boulder, CO 80301.

Eastern U.S. (407) 352-5622, Ext. 82
Central U.S. and Canada (708) 953-8665
Western U.S. (714) 582-5211, Ext. 4
Europe (Amsterdam) 31-3403-51347

SEE US AT COMDEX! BOOTH #8406.

EXABYTE®
The Capacity to Succeed

Circle 49 on Inquiry Card (RESELLERS: 50).

PORTABLE COMPUTING

Zenith introduced the first Intel 386SL-based notebook, the Mastersport 386SL. The Mastersport takes full advantage of the SL's capabilities, allowing most users to work through the day without a recharge.

Notebooks Coming of Age

Improved capabilities and longer battery life make notebooks more and more attractive

MICHAEL NADEAU

Notebooks are hot. Dataquest predicts that notebook sales will mushroom from nearly $700 million in 1990 to more than $13 billion in 1994. That's more than twice the projected figure for laptop sales. With numbers like these, it's safe to say that if you aren't already using a notebook PC, you most likely will be shortly.

What makes these little systems so attractive? When you're traveling, they give you access to processing power that is equivalent to that of most desktop PCs. You can have your contact list, agenda, word processor, spreadsheet, database, and communications/fax capability in one 6- or 7-pound package. You can access, process, and output the same business information you do at the office and sacrifice little or no functionality. That spells productivity.

What Is a Notebook PC?

Unlike more traditional laptop PCs, notebooks are intended for use in a mobile environment. Designed to fit easily inside a briefcase, notebooks generally weigh less than 8 pounds and typically measure 12 inches wide by 10 inches deep by 2 inches thick.

To maximize luggability, notebooks must make certain trade-offs. Expansion is limited. RAM capacity rarely exceeds 5 megabytes. Typical hard disk capacity is only 20 MB, but drive vendors are rapidly improving the 2½- and 3½-inch disk drives used in notebooks. By next year, 60-, 80-, and even 100-MB capacities should be readily available. Expansion slots are usually limited to proprietary modem or memory cards, although external expansion buses are relatively common.

Sacrifices in the keyboard and video are also made, but vendors are beginning to address these.

Built for Comfort

Don't expect to see dramatic reductions in the size and weight of notebook PCs during the coming year. On average, they may shrink a fraction of an inch in height and depth, and they may lose a few ounces. A popular "small" notebook size is $11\frac{7}{10}$ by $8\frac{1}{2}$ by about $1\frac{3}{4}$ inches. Further reductions are limited by the "human interface," that is, the keyboard and the display.

Vendors are finding that in the notebook class, customers are more interested in ease of use and features than in getting the smallest possible size. A keyboard that is less than standard width—about $11\frac{1}{4}$ inches—requires reducing the size of the key caps, putting them closer together, changing the layout, or doing a combination of these. One keyboard change you will see less of is the elimination of separate PageUp, PageDown, Home, and End keys. Some notebooks require that you press a function-key combination to access these keys. But on some applications, this arrangement is awkward, at best. Users are complaining, and vendors seem to be listening.

The popularity of Windows 3.0 is driving the demand for bigger and better notebook displays. The best LCD screens now feature a 10-inch VGA display with 64 levels of gray, courtesy of new video chip sets from Chips & Technologies (C&T), Cirrus Logic, and others. Only a handful of vendors offer this display now, but most of the premium models coming out in the next few months will have it. No notebook PC currently has a color display. Expect to see a few com-

mercially available next year, but prices will be high (probably in the $7000–$9000 range) and sales slow. The color notebook's time will come, but not until manufacturing yields on the screens are high enough to keep costs down. That is not likely to happen in 1992.

The battery will remain a large factor in determining the size and weight of notebook PCs. For the coming year, the battery will account for 1½ to 2 pounds of weight and at least an inch, probably in depth, of size. On the brighter side, power management is improving rapidly enough to offset the penalties of battery bulk.

The 8-Hour Workday

Wouldn't it be great if you could use your notebook all day on battery power and just recharge it at night? For a few models, that might be possible in 1992. One reason: Intel's new 386SL CPU.

The 386SL was designed to address the power conservation needs of battery-powered systems. The 386SL integrates all cache, bus controller, and memory controller circuitry in one chip. A companion chip, the 82360SL, contains circuitry for all I/O, power management, real-time-clock operation, timers, interrupt and DMA control, and nonmaskable interrupts. With this two-chip set, you need only add main memory and graphics, keyboard, and floppy disk drive controllers to have a complete system—a total of seven chips.

Reducing the system chip count is just a tiny part of the SL's power-saving capabilities. In a nutshell, the SL chip set frees system resources from having to handle power management chores. With a BIOS written for the SL, control of power to various system components works independently of your operating system, applications, and main memory. This arrangement not only is more efficient, it also ensures that the power management functions will not cause compatibility problems by, for instance, grabbing a piece of memory that is being used by an application.

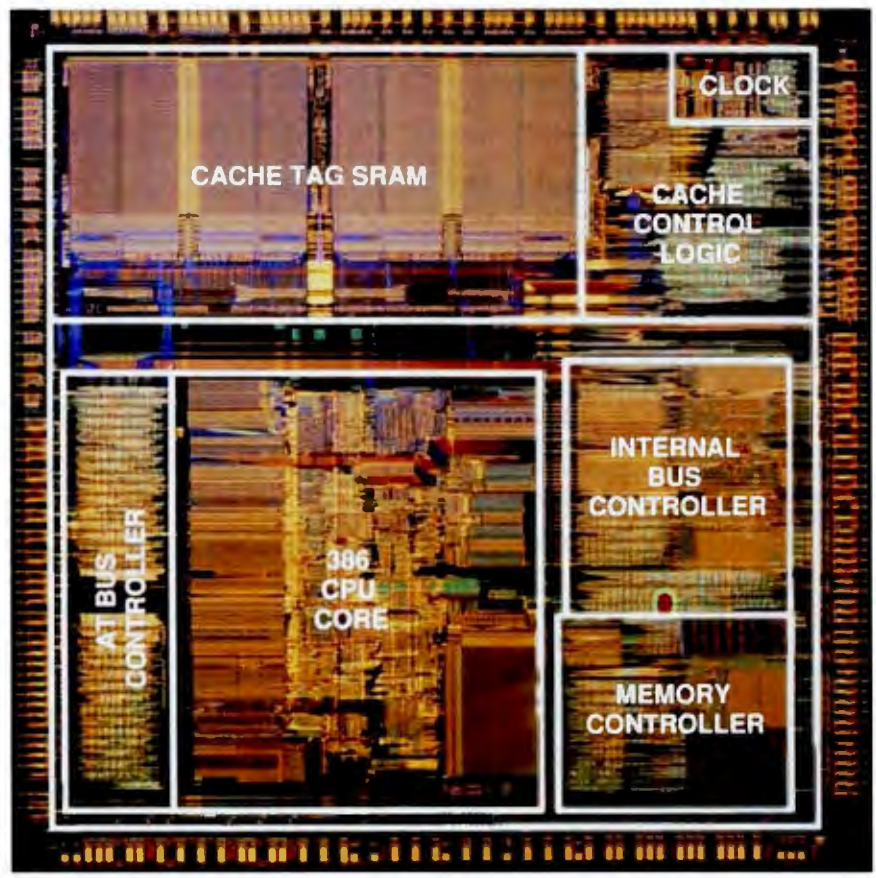
In constant use, where the power management does not get a chance to power down components, an SL system runs no longer on a battery than an SX-based system does. But in normal use, the efficiencies of the SL's power management provide as much as 33 percent more battery operation. And Intel estimates that a typical SL system will survive for more than 1000 hours in suspend mode, in which everything but the memory holding your application is shut down.

By the time you read this, several SL-based notebooks will be shipping, even though using the SL requires vendors to build a system from scratch. By the end of 1992, most notebook vendors will have an SL system offering. Without the resources of the major players, however, smaller vendors will be hard-pressed to bring SL systems to market in a timely manner. They will have help, however. Traditional OEM sources will produce a wide variety of SL models for sale under other brand names, for instance.

Small vendors will also get help from companies such as Phoenix Technologies, best known for its system BIOS business. Designing a BIOS capable of managing the 386SL is a difficult task, one that is already delaying some SL-based systems from entering the market. Phoenix is well positioned with its BIOS expertise, working relationship with Intel (it should be noted that Intel is working closely with all the most popular BIOS vendors), and established customer base to help system vendors quickly design a viable 386SL notebook. And it has.

The PhoenixBIOS Lap386SL (you'll never see it sold under this name) is built around the Phoenix SL Superset: two VLSI devices that include a cache controller, memory controller, peripheral subsystem, and CPU. Embedded in the SL Superset is the power management support software, which allows full suspend and resume capabilities, as well as standby operation. Also built in is a great deal of flexibility for configuring the system at both the vendor and user level. The vendor, for example, has the option of modifying the BIOS source code, while the user can reset parameters for, say, component time-outs.

But the 386SL is not the only low-power CPU in town. Advanced Micro Devices' (AMD) 386SX clone also has power conservation features, although not



***Intel's 386SL CPU** integrates functions of several chips onto one piece of silicon. Its advanced power management capabilities will be a boon to notebook users, but vendors will be slow in introducing SL-based units, which must be designed from scratch.*

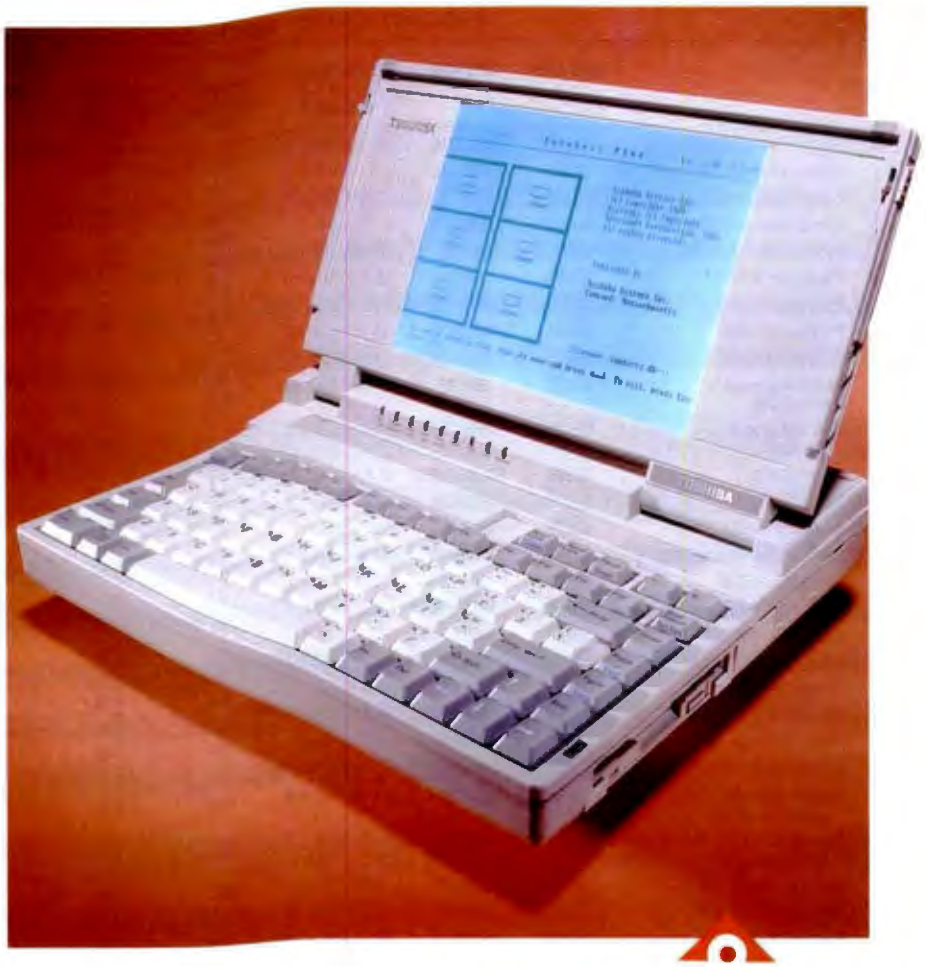
PRODUCT GUIDE: NOTEBOOK COMPUTERS

This Product Guide lists 89 286, 386SX, 386DX, and 486 notebook PCs. BYTE defines a notebook PC as weighing less than 8 pounds and measuring no more than 12 inches wide by 10 inches deep by 2 inches high. Some systems listed here might exceed one or more of these dimensions but are close enough to the desired form factor to warrant inclusion. (● = yes; ○ = no.)

	Base price	CPU/MHz	Dimensions (W × D × H, in inches)	Weight w/battery (lbs.)	RAM (std./max., in MB)	Hard disk drive (std./max., in MB)	Floppy drive standard?	Math socket?	Video (pixels; gray scales)
Acer AnyWare 1120NX	$3195	386SX/20	11 × 8.5 × 2	7.4	1/5	20/60	●	○	640 × 480 VGA; 32
ALR Venture/16	$2795	386SX/16	12.2 × 8.6 × 2.1	7.5	1/5	20	●	●	640 × 480 VGA; 32
Altima LSX	$2999	386SX/20	11 × 8.6 × 2	6.3	1/5	40	●	●	640 × 480 VGA; 32
Amax EZ-Lite SX-16	$3495	386SX/16	11 × 8.5 × 2	6.4	1/5	20/40	●	●	640 × 480 VGA; 16
American Mitac 3025D	$2195	386SX/16	11.6 × 8.7 × 2.3	7.5	1/2	20/40	●	●	640 × 480 VGA; 16
Andrex Voyager SX	$2495	386SX/20	11.7 × 8.25 × 1.9	6.2	1/5	20/60	●	●	640 × 480 VGA; 32
AST Premium Exec 386SX/20	$2995	386SX/20	11.4 × 9 × 2.25	7	2/8	20/60	●	●	640 × 480 VGA; 32
AT&T Safari NSX/20[3]	$5399	386SX/20	12 × 9.5 × 1.8	7.3	2/8	40/80	●	●	640 × 480 VGA; 32
Austin 386/SX Notebook	$2295	386SX/20	11.7 × 8.5 × 2	6	2/4	20	●	●	640 × 480 VGA; 32
Bondwell B330SX	$2700	386SX/25	11.1 × 8.5 × 2.2	6.3	1/5	60	●	●	640 × 480 VGA; 16
Chaplet Halikan NBA386SX	$2995	386SX/20	11.7 × 8.7 × 2	6.5	1/5	20/60	●	●	640 × 480 VGA; 16
Commax Ultrathin 386SX/20	$3295	386SX/20	10.25 × 8.25 × 1.25	4	1/4	30/60	● (ext.)	○	640 × 480 VGA; 32
Compaq LTE/286	$3499	286/12	11 × 8.5 × 1.9	6.7	640KB/4.6	20/40	●	●	640 × 200 CGA; 4
Compaq LTE 386s/20	$4399	386SX/20	11 × 8.5 × 2.2	7.5	2/10	30/60	●	●	640 × 480 VGA; 16
CompuAdd Companion SX	$2995	386SX/20	11 × 8 × 1.8	5.7	2/6	20/40	●	●	640 × 480 VGA; 32
CompuAdd 316NX	$1995	386SX/16	11 × 8.5 × 2.1	7	1/5	30/60	●	●	640 × 480 VGA; 64
Cordata CPC-9100	$3599	386SX/20	12 × 10 × 1.8	6.5	1/5	30/60	●	●	640 × 480 VGA; 32
Darius 386 Notebook-20	$3999	386SX/20	12 × 10 × 1.8	6.5	1/5	30/60	●	●	640 × 480 VGA; 16
Darius 386 Notebook-20B	$2895	386SX/20	11.8 × 8.3 × 2	6.7	1/5	20/40	●	●	640 × 480 VGA; 16
Dataworld NB-320SX	$2650	386SX/20	11 × 9 × 2.5	7	2/16	20	●	●	640 × 480 VGA; 32
Dauphin 500-SX	$2595	386SX/20	11.7 × 8.3 × 1.9	7	1/8	40	●	●	640 × 480 VGA; 32
Dell System 212N	$2399	286/12	11 × 8.5 × 2	6.4	1/5	40/60	●	●	640 × 480 VGA; 16
Dell System 320N	$3399	386SX/20	11 × 8.5 × 2	6.4	1/5	40/60	●	●	640 × 480 VGA; 16
Epson NB3s	$3995	386SX/16	11.7 × 8.5 × 1.7	5.8	1/5	20/60	●	●	640 × 480 VGA; 16
Everex Tempo LX/20	$2999	386SX/20	12 × 10 × 2	6.9	1/5	20/60	●	●	640 × 480 VGA; 16
First Computer 386SX-20	$2199	386SX/20	11.7 × 8.5 × 2	6.5	1/3	20/40	●	●	640 × 480 VGA; 16
Fora NBS-386S	$2995	386SX/16	11 × 8.6 × 2	6.4	1/5	20/40	●	●	640 × 480 VGA; 16
Fora NBL-386S/20	$3495	386SX/20	11 × 8.6 × 1.4	4.5	1/4	30	● (ext.)	●	640 × 480 VGA; 32
Grid 1720[3]	$3495	286/16	12.2 × 10 × 1.7	6.9	1/5	20	●	●	640 × 400 CGA; 16
Grid 1750	$3795	386SX/20	12.2 × 10 × 1.7	6.7	1	60	●	●	640 × 480 VGA; 16
Hertz 386/SX Notebook	$2195	386SX/16	12 × 10.4 × 1.9	7	1/5	20	●	●	640 × 480 VGA; 32
Hyosung NPC II	$2495	286/12	11.4 × 9.8 × 2.25	6.9	1/2	20/40	●	●	640 × 480 VGA; 16
Hyundai Super-NB386Sc	$2995	386SX/20	11.7 × 8.2 × 1.8	7	1/5	20/40	●	●	640 × 480 VGA; 16
ITC 386 PEP[3]	$4519	386SX/16	12 × 11.25 × 2.5	7.9	2	40	●	○	640 × 480 VGA; 16
Leading Edge N3/SX	$2599	386SX/16	11 × 9 × 2	6.9	1/5	20	●	●	640 × 480 VGA; 32
Leading Edge N3/SX20	$2999	386SX/20	11 × 9 × 2	6.9	1/5	30/60	●	●	640 × 480 VGA; 32
Leading Technology PC Partner XL	$2495	386SX/20	11.7 × 8.7 × 2	6.5	1/8	40	●	●	640 × 480 VGA; 16
Librex 286 Notebook	$2999	286/12	11.7 × 8.4 × 2	6	1/3	20/40	●	●	640 × 480 VGA; 16
Librex 386SX Notebook	$4299	386SX/20	11.7 × 8.4 × 2	6	4	20/60	●	●	640 × 480 VGA; 16
Link 386SX20	$2999	386SX/20	11 × 8.7 × 2.4	7	1/5	20/40	●	●	640 × 480 VGA; 16
Micro Express NB5620	$1999	386SX/20	11.8 × 8.3 × 2	6.8	1/5	20/60	●	●	640 × 480 VGA; 16
Modern Computer NoteStar NP-902	$1600	286/12	12.2 × 9.5 × 2.1	7.7	1/8	20/60	●	●	640 × 480 VGA; 32
Modern Computer NoteStar NP-903	$2800	386SX/16	12.2 × 9.5 × 2.1	7.7	2/8	40/60	●	●	640 × 480 VGA; 64
Myoda Notebook 386SX	$2899	386SX/16	11 × 9 × 2	6.9	1/8	20	●	●	640 × 480 VGA; 32
NEC UltraLite 286F	$2799	286/12	12 × 8 × 2	7	1/5	20	●	●	640 × 400 CGA; 8
NEC UltraLite 286V	$3199	286/12	12.2 × 9.5 × 1.7	6.5	1/5	20	● (ext.)	○	640 × 480 VGA; 16
NEC UltraLite SX/20	$4899	386SX/20	11.5 × 8.6 × 2.4	7.5	2/10	40/60	●	●	640 × 480 VGA; 16
Northgate SlimLite	$2999	386SX/20	11.75 × 8.25 × 2	6.2	3/5	20/40	●	●	640 × 480 VGA; 32
Notebook Computer 486Notebook Workstation 486-T20	$4495	486SX/20	11 × 8.5 × 1.4	4.5	1/8	20/100	○	○	640 × 480 VGA; 16
Notebook Computer 486Notebook Workstation 486-T33	$6795	486/33	11 × 8.5 × 1.4	4.5	1/10	40/100	○	○	640 × 480 VGA; 16
Ogivar Internote 286	$2999	286/12	12.3 × 10 × 2	7	1/5	20	●	●	320 × 200 VGA; 32

Battery type and life (in hours)[1]	External ports[2]	Number of keys	DOS included?
NC, 3	P, S (2)	87	●
NC, 3	P, S (2)	82	●
NC, 2.5	P, S, V, K	80	●
NC, 2.5	P, S, V	80	●
NC, 3	P, S	84	●
NC, 2	P, S, K, V	84	○
NC, 3.5	P, S, V, K	82	●
NC, 6	P, S, V, K, E	82	●
NC, 7	P, S (2)	83	●
NC, 4	P, S, V, K	81	●
NC, 2.5	P, S, K, V, E	81	●
NC, 1	P, S, V, MS	79	●
NC, 3.5	P, S, V, K, D	80	○
NC, 3.5	P, S, V, KP	81	●
NC, 3	P, S	79	●
NC, 2	P, S, V, KP	80	●
NC, 3	P, S, V, K	84	●
NC, 2	P, S, V, K	84	●
NC, 2	P, S (2), V, K, D	83	○
NC, 2.5	P, S (2), V, K	80	●
NC/alk., 3.5	P, S, V, K, D	84	●
NC, 4	P, S, V, D, KP, K	85	○
NC, 3	P, S, V, D, KP, K	85	○
NC, 3	P, S, V, KP, D	82	●
NC, 3	P, S	82	●
NC, 2	P, S, MS	81	●
NC, 2.5	P, S, V, K	80	●
NC, 2	P, S, V, D, E	80	●
NC, 2.5	P, S	84	●
NC, 2.5	V, K, P, S	84	●
NC, 2.5	S (2), P, K	82	○
NC, 3	P, S	75	●
NC, 2	P, S (2), V	83	●
NH, 2.5	P, S, V	79	●
NC, 3	P, S, K, V	84	●
NC, 3	P, S, K, V	84	●
NC, 2.5	P, S, K, V, D	80	●
NC, 3	P, S (2), V	82	●
NC, 2.5	P, S (2), V	82	●
NC, 3	P, S, D, V, K, E	80	●
NC, 3	P, S (2), V, K, D	83	●
NC, 4	P, S, K, V, E, D	83	●
NC, 4	P, S, K, V, E, D	83	●
NC, 3	P, S	80	●
NC, 3	P, S	78	●
NC, 2.5	P, S, V	78	●
NC, 2	P, S, V, D	78	●
NC, 3	S, P, V	84	●
NC, 1	P, S, V, E	79	●
NC, 1	P, S, V, E	79	●
NC, 2	P, S	82	●

continued



***Toshiba** pioneered many of the popular power management features, and its systems, such as the **T2000SXe** shown here, provide impressive battery life without the services of Intel's 386SL.*

as extensive as the SL's. For example, it is capable of suspended operation, meaning that its clock can be slowed to 0 MHz.

New CPUs from C&T show much promise. Ranging from 286 to 386DX classes, they all feature power conservation features similar to the 386SL's. At the high end, the 38605DX can operate at speeds of up to 40 MHz and provides additional functions not found in Intel's processor while maintaining compatibility. The 8680-series 286-compatible CPU is actually a complete PC on a chip, sans memory. These processors claim superior performance to the 286 while featuring advanced power management capability. C&T expects the 8680 series to be popular in very small systems—from hand-helds to notebooks.

The main question now for both AMD and C&T is market acceptance. System vendors will want to be assured of availability and compatibility, and the CPUs will have to be priced competitively. AMD's chip has been out longer, to date no serious flaw has emerged, and vendors say availability is not a problem. C&T has gone to great lengths to simulate the operation of its new CPUs in the lab. And all these parts are priced well in comparison to Intel's products. You will see notebook systems using CPUs from both these companies next year, but many vendors will wait and see how the pioneers fare before using them.

Several manufacturers have shown an almost maniacal devotion to squeezing out every possible minute of battery operation. The tricks used are many: shutting off ports when not in use, stopping the processor between keystrokes, using more low-power components, and embedding power management software in the system to monitor it all.

Two vendors are particularly noteworthy on this front: Toshiba and Zenith. Toshiba pioneered power management and is the first major vendor to use nickel-hydride batteries. Nickel hydrides tend to hold power longer, and they don't exhibit the "memory effect" of nickel-

PRODUCT GUIDE: NOTEBOOK COMPUTERS (CONT.)

	Base price	CPU/MHz	Dimensions (W x D x H, in inches)	Weight w/battery (lbs.)	RAM (std./max., in MB)	Hard disk drive (std./max., in MB)	Floppy drive standard?	Math socket?	Video (pixels; gray scales)
Ogivar Internote SX386	$3249	386SX/20	12.3 x 10 x 2	7	1/5	20	●	●	320 x 200 VGA; 32
Olivetti Notebook V16	$2800	386SX/16	11 x 9 x 2	7.26	2/6	40	●	●	640 x 480 VGA; 32
Olivetti Notebook A12	$2300	286/16	11 x 9 x 2	7.26	1/5	20	●	○	640 x 400 CGA; 32
Olivetti Notebook S20	$3500	386SX/20	11 x 9 x 2	7.25	2/6	60	●	●	640 x 480 VGA; 32
Packard Bell PB286NB	$3995	286/12	11 x 8.7 x 1.9	6.6	1/8	20	●	●	640 x 480 VGA; 32
Panasonic CF-270	$3199	286/16	12.2 x 10 x 1.7	6.6	1/5	20	●	●	640 x 480 VGA; 16
Panasonic CF-370	$4799	386SX/20	12.25 x 10 x 1.75	6.8	1/5	60	●	●	640 x 480 VGA; 16
PC-Ease NB-8800	$3355	386SX/20	11 x 8.6 x 1.4	4.5	1/4	20/40	● (ext.)	●	640 x 480 VGA; 32
PC-Ease NB-9300	$5775	386DX/33	11 x 8.6 x 2	9	2/16	40/120	●	●	640 x 480 VGA; 32
Philips Magnavox Metalis/286	$2699	286/12	11 x 8.5 x 2.1	6.9	1/8	20	●	●	640 x 480 VGA; 32
Philips Magnavox Metalis/SX	$3199	386SX/16	11 x 8.5 x 2.1	6.8	1/5	40	●	●	640 x 480 VGA; 32
Psion MC600	$2995	80C86/7.68	12.4 x 8.9 x 1.9	4.3	640 KB	N/A	○	○	640 x 200 CGA; 16
SAI SAIBook	$2395	386SX/16	11.4 x 8.9 x 2.1	5	2	20/40	●	●	640 x 480 VGA; 16
Saint Croix 386SX	$2298	386SX/16	12.2 x 9.5 x 2.1	7.7	2/8	20/40	●	●	640 x 480 VGA; 64
Samsung NoteMaster 386S/16	$2799	386SX/16	11 x 8.5 x 2.1	7	1/5	20/40	●	●	640 x 480 VGA; 64
Sanyo MBC-17NB	$2999	286/12	12.3 x 10 x 2	7	1/5	20	●	○	640 x 480 VGA; 16
Sanyo MBC-18NB	$3499	386SX/16	12.3 x 10 x 2	7	1/5	20	●	●	640 x 480 VGA; 16
Sanyo MBC 18NB6h	$3749	386SX/20	12.3 x 10 x 2	7	1/5	20	●	●	640 x 480 VGA; 16
Sharp PC-6220	$3995	286/12	11 x 8.5 x 1.4	4	1/5	20	○	●	640 x 480 VGA; 16
Tandon NB/386SX	$3495	386SX/20	11 x 8.5 x 2.25	6.5	2/16	30/60	●	●	640 x 480 VGA; 16
Tandy 2810 HD	$2199	286/16	12.2 x 20 x 1.7	6.7	1/5	20/60	●	●	640 x 480 VGA; 32
Tandy 3810 HD	$3299	386SX/20	12 x 10 x 2	7	1/5	60	●	●	640 x 480 VGA; 32
Tangent 320N	$1995	386SX/20	11.75 x 8.25 x 2.25	7.1	1/5	20/60	●	●	640 x 480 VGA; 16
Texas Instruments TravelMate 2000	$2199	286/12	11 x 8.5 x 1.4	4.4	1/3	20	○	●	640 x 480 VGA; 16
Texas Instruments TravelMate 3000	$3199	386SX/20	11 x 8.5 x 1.8	5.7	2/6	20/40	●	○	640 x 480 VGA; 32
Toshiba T1200XE/20	$2299	286/12	12.2 x 11 x 2	8.1	1/5	20/40	●	○	640 x 400 CGA; B/W
Toshiba T2000	$3149	286/40	12.2 x 10 x 1.9	6.9	1/9	40	●	●	640 x 480 VGA; 16
Toshiba T2000SX/20	$3399	386SX/16	12.2 x 10 x 1.9	6.9	1/9	20/40	●	●	640 x 480 VGA; 16
Toshiba T2000SXe	$4199	386SX/20	12.2 x 10 x 1.9	6.9	1/10	40/60	●	●	640 x 480 VGA; 16
TransPacific TL 1020SX	$2375	386SX/20	11.8 x 9.8 x 1.8	6.5	2/5	20/40	●	●	640 x 480 VGA; 32
Twinhead Supernote 386SX	$2799	386SX/16	11 x 8.5 x 1.9	6.5	2/4	40/120	●	●	640 x 480 VGA; 32
Twinhead Supernote 20C	$3999	386SL/20	11 x 8.5 x 2	6.2	2/8	40/160	●	●	640 x 480 VGA; 64
Veridata ExecuLite 386s	$3799	386SX/20	11 x 8.6 x 1.4	4.5	1/4	20/40	● (ext.)	○	640 x 480 VGA; 32
Zenith Mastersport 286	$2699	286/12	11 x 8.5 x 2	6.6	1/2	30	●	●	640 x 480 VGA; 16
Zenith Mastersport 386SX	$3999	386SX/20	11 x 8.5 x 2	6.6	2/4	60	●	●	640 x 480 VGA; 16
Zenith Mastersport 386SL	$4999	386SL/20	12.4 x 8.3 x 1.8	6.8	2/8	60	●	●	640 x 480 VGA; 64
Zeos Notebook 386	$1995	386/16	12.3 x 10 x 2	7	1/5	20	●	●	640 x 480 CGA; 32
Zeos Notebook 386/SX	$2295	386SX/20	12.3 x 10 x 2	7	1/5	20	●	●	640 x 480 CGA; 32

[1] NC = nickel-cadmium, NH = nickel-hydride, alk = alkaline
[2] P = parallel, S = serial, V = external video; K = keyboard; E = expansion bus, MS = mouse, D = disk drive; KP = keypad, SC = scanner
[3] Modem is standard.

cadmium batteries. Zenith is the first to announce a 386SL system, and it worked closely with Intel to take advantage of the CPU's capabilities.

These vendors claim that, for an average workday, you shouldn't need to plug in their most power-efficient models. That's assuming, of course, that you are not typing continuously for 8 hours. Most people work in a series of short periods on a notebook. Systems with good power management shut down when not in use, even if for a fraction of a second.

So, you are still stuck with a bulky battery that needs regular recharging, but power management is becoming more attuned to the way most people work. Improved power management has a positive side effect, too: It allows notebook-class PCs to be built with CPUs more powerful than the 386SX or SL.

Lean, Mean Computing Machines

The vast majority of notebook PCs will continue to be powered by 286 or 386SX/SL CPUs in the coming year. And their performance will be roughly equivalent to their like-powered desktop siblings. For some people, however, these processors won't cut it for the applications they run. Engineers, architects, and anyone else running programs that require a lot of processing power have the same system portability needs as everyone else. By next year, they will be able to choose among notebook PCs powered by 386DX (from Intel and AMD), 486SX, and (maybe) 486 CPUs.

Some systems have already been announced (see the table), but none is from a name player. I will go out on a limb and predict that at least one major vendor will offer a high-performance notebook by the end of next year. It will be expensive in terms of price and trade-offs, though.

Battery type and life (in hours)[1]	External ports[2]	Number of keys	DOS included?
NC, 2	P, S	82	●
NC, 3.5	P, S, V, K, MS	82	●
NC, 3.5	P, S, V, K, MS	82	●
NC, 3.5	P, S, V, K, MS	82	●
NC, 3	P, S	80	●
NC, 2.25	P, S	84	●
NC, 3	S, P, V, K	84	●
NC, 2	P, S, D, MS	80	●
NC, 2	P, S, D, MS, E	82	●
NC, 4	P, S, V, K, E, KP	80	●
NC, 3	P, S, V, K, E, KP	80	●
Alk., 20	P, S, E	86	●
NC, 2	P, S, V, K, SC	80	●
NC, 3.5	P, S, K, V	83	●
NC, 3	P, S(2)	80	●
NC, 3	P, S, V	82	●
NC, 3	P, S, V	82	●
NC, 3	P, S, V	82	●
NC, 5	P, S, D, KP	79	●
NC, 3	P, S(2)	84	●
NC, 3.5	P, S, D, V, K	84	●
NC, 3	P, S, D, V, K	84	●
NC, 3	P, S(2), K, V	83	●
NC, 2	P, S, D, KP	79	●
NC, 2.5	P, S, V, KP, E	79	●
NC, 2	P, S, V, KP, E	82	●
NH, 3	P, S, V, K, E	86	●
NH, 3	P, S, V, K, E	86	●
NH, 3	P, S, V, K, E	86	●
NC, 3	P, S(2)	83	○
NC, 3	P, S(2), V, KP	80	●
NC, 4	P, S(2), E, V, K	84	●
NC, 4	P, S, K, V	79	●
NC, 2.8	P, S, V	80	●
NC, 2.8	P, S, V	80	●
NC, 8	P, S, MS, V, D	82	●
NC, 3	P, S, V	82	○
NC, 3	P, S, V	82	○

Battery life, for instance, will likely be no more than 2 hours, and that's using every practical power conservation trick. But notebook PCs will have entered another market niche.

And these small systems are extending their reach. I've already mentioned the sales projections, but what's probably more indicative of their market impact is the third-party hardware and software industry that has begun to emerge.

The Right Tool for the Job

You don't work the same on the road as you do in your office, and neither should your notebook. You need peripherals that don't weigh you down and software that works well on the go without usurping too much of your system's resources. Solutions for these needs, designed with portable computing in mind, are available now. Next year, the selection will only get better.

Portable printers, for instance, represent a remarkably innovative part of the industry. In your briefcase, you can carry not only your PC, but a printer capable of high-quality output that will embarrass no one. The technologies used include dot matrix, ink jet, and a variation of the laser engine. Some are color capable.

The market for portable printers is intensely competitive right now, and that is good for the consumer. Six months ago, the Canon BubbleJet was the cat's meow of portable printers. Now, Citizen's new PN48 Notebook Printer with its laser-quality output is threatening to set a new standard. This leapfrogging will continue as the big players in small printers battle for market share.

Windows 3.0 is also driving the demand for portable pointing devices, and you will have choices there—too many. Touchpads, roller pens, trackballs, keymice, and the Isopoint all are claimed to be the best solution to portable pointing. My personal bias: None is as good as a mouse, but a mouse is not often practical for on-the-go use. I have found the touchpads difficult to use, the keymice hard to control, and the Isopoint less than intuitive. The trackballs and roller pens are more mouselike in terms of feel and accuracy. Which ones will prevail is an open question. A lot of R&D effort is going into each design, and you can expect each to improve in the coming year.

AT&T *designed the Safari* ***NSX/20*** *to be a communications device as much as a notebook PC. It looks sharp, too.*

One observation: Although some notebook vendors do it, building a pointing device into the system tends to turn off anyone who prefers another type. Choosing a pointing device is largely a matter of personal preference, and people don't like paying for something they won't use. I predict that while more and more vendors will offer pointing-device options, fewer systems will be designed with one built in.

With only a 20- or 40-MB hard disk drive, you want to be selective about what software and data you keep on your notebook. For this reason, integrated software packages such as Microsoft Works and LotusWorks have become increasingly popular among the portable computing set. Providing word processing, spreadsheet, database management, and other common applications in one package saves system resources, not to mention the cost of buying each function separately.

Software designed exclusively for portable use is beginning to appear. These packages tend to be specialized products that are optimized for one specific task: Expense reporting, scheduling, contact

What's All the Fuss About Pen Input?

One of the most talked-about new product technologies of the past year is pen-based computing. Without a doubt, this technology represents a very important trend, but it is generating some misconceptions about its impact on the market. The hype would have pen input replacing keyboards. It isn't going to happen, at least not in the foreseeable future.

The pen-based computing market is really twofold: It has a vertical segment aimed at forms-based applications such as product delivery, warehouse inventory, insurance claims, and so on; and it has another segment aimed at enhancing existing systems. This latter segment will have the greatest impact on notebook computing as we know it, and the impact will be felt soon.

Pen technology is good, and some big companies are spending huge sums on R&D to make it even better. Still, the best software is only about 90 percent to 95 percent accurate when it comes to character recognition. Even if it were 100 percent accurate, the fastest writing is still no match for keyboard input when it comes to speed. At best, you can write only about 20 words per minute (in block characters; cursive handwriting recognition is years away). A mediocre typist can do at least twice that.

Having both pen and keyboard input on a notebook PC significantly increases its versatility and is a boon to productivity. For instance, note taking on a portable computer tends to annoy people. The sound of the keys and the bulk of the system distract those with whom you are meeting. Most people still make all their notes on paper and, with luck, later type them in on their systems. But if you could leave your keyboard behind and grab a stylus instead, holding and writing on the screen tablet would be no more distracting than writing in, well, a notebook.

This scenario requires a new type of software that must be able to store your notes, as translated text or the actual screen image, and allow you to order and store them appropriately. If you make note of an upcoming meeting, for example, you should be able to send the information to a scheduling program. Say good-bye to notes on paper.

By the time you read this, you will be able to purchase such a system for not much more than a standard notebook PC. Several companies have working prototypes of the hardware as I write, and companies such as Slate and Pensoft are developing pen-based software.

management, and communications are prime examples. Pen-assisted applications are also beginning to emerge (see the text box "What's All the Fuss About Pen Input?" above). Communications is an area in which you are likely to see interesting innovation during the coming year, particularly in the areas of fax, E-mail, and paging.

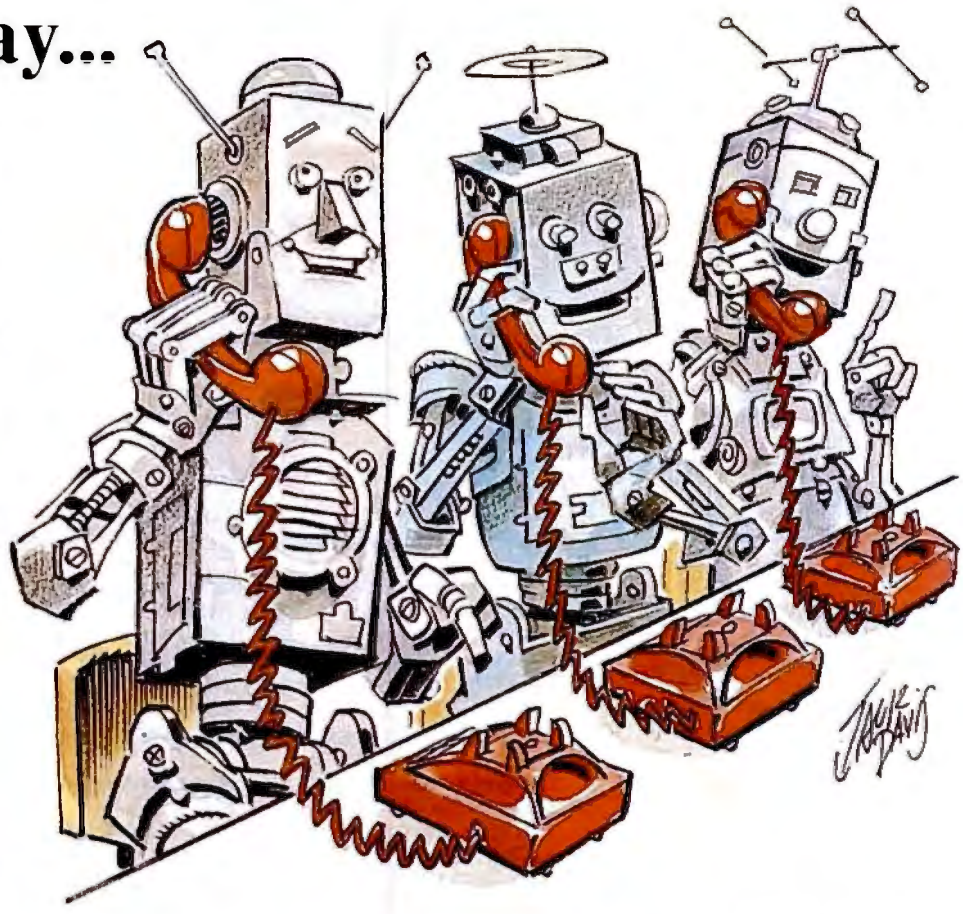
A Port in Any Storm

AT&T's Safari NSX/20 notebook has generated a lot of notice for its sleek design and attention to detail. What's not so obvious, however, is that the Safari was designed as a communications device as much as a portable computer. It comes standard with a 2400-bps fax modem, but more significantly, AT&T has designed the Safari to perform as a portable mailbox. The Safari can send and receive E-mail messages via the AT&T Mail service using preloaded Windows-based software. Through AT&T Mail, you can access other services such as fax, telex, courier, or just plain U.S. mail, not to mention access to on-line, business-oriented databases.

The Safari points to the future of portable computing. Notebook systems are, in effect, your office while traveling. And from a technology standpoint, there is little to keep you from enjoying all the benefits of your office while away. This includes two-way access to corporate LAN resources, staff, and your business contacts using both standard phone lines and cellular communications. From a marketing point of view, it's a different story. Few notebooks offer a modem standard, let alone cellular or fax capability. As notebook users become more sophisticated, however, they will demand more of their systems.

Connectivity to LANs, something early portable users rarely considered, is a requirement for notebooks in many offices today. LAN connectivity solutions

You could hire robots to work for you 24 hours a day...



Improve your overall business responsiveness by doing business faster with an electronic bulletin board system (BBS). Why wait for that spreadsheet file by overnight courier, when you can receive it instantly, by modem? Send and receive software, purchase orders, databases, and word processor files right away, rather than waiting a day.

Open for Business All the Time

Gain a competitive edge by offering your customers round-the-clock service—but without increasing your staff hours! Any hour of the day, your BBS can provide prices, refer people to your dealers, and act as a Q & A clearing-house, all unattended. Your own staff can log on for a few minutes a day, any time it's convenient for them.

NetWare® Compatible

Employees in the office, on the road, or in other offices can keep in touch with each other via E-mail, shared databases, and public message and file areas. People can access your BBS using modems, serial connections, or your Novell® network. The standard edition of The Major BBS includes support for LAN connections using IPX Direct circuits, and there's also an Advanced LAN option which adds support for IPX Virtual and SPX circuits. There's even an option available for direct connections through X.25 networks such as Tymnet® and CompuServe®.

...or you could use The Major BBS®.

Cut Costs, Increase Profit

You'll save money by transferring computer files over telephone lines, instead of paying courier charges. You can also offer files (updates, newsletters, CAD files, whatever your business may provide) to your customers for download, rather than mailing them diskettes or printed matter all the time.

Serve More People At Once

And because The Major BBS can support up to 256 simultaneous users, no one will have to wait to use your BBS. While some people are viewing database records, others can be reading their mail or teleconferencing. As activity increases, you can simply add more lines.

You can get started for as little as $59 with our 2-line software package. It will work with COM1/2/3/4 and IPX Direct LAN circuits under MS-DOS and includes E-mail, file upload/download, teleconferencing, questionnaires, and much more. Initial set-up is quick and easy—15 minutes on the average—and unlimited technical support (within reason) is just a phone call away.

To order, or for more information, call us at 305-583-5990.

GALACTICOMM

Galacticomm, Inc. 4101 S.W. 47 Ave.
Suite 101, Fort Lauderdale, FL 33314

Modem: (305) 583-7808
Fax: (305) 583-7846
Voice: (305) 583-5990

Circle 55 on Inquiry Card (RESELLERS: 56).

COMPANY INFORMATION:

NOTEBOOK COMPUTERS

Acer America Corp.
(AnyWare 1120NX)
401 Charcot Ave.
San Jose, CA 95131
(408) 922-0333
fax: (408) 922-0176
Circle 1166 on Inquiry Card.

Advanced Logic Research, Inc. (ALR)
(Venture/16)
9401 Jeronimo
Irvine, CA 92718
(714) 581-6770
fax: (714) 581-9240
Circle 1167 on Inquiry Card.

Altima Systems, Inc.
(LSX)
1390 Willow Pass Rd.,
Suite 1050
Concord, CA 94520
(415) 356-5600
fax: (415) 356-2408
Circle 1168 on Inquiry Card.

Amax Engineering Corp.
(EZ-Lite SX-16)
47315 Mission Falls Court
Fremont, CA 94539
(415) 651-8886
fax: (415) 651-3720
Circle 1169 on Inquiry Card.

American Mitac Corp.
(3025D)
410 East Plumeria Dr.
San Jose, CA 95134
(408) 432-1160
fax: (408) 432-0866
Circle 1170 on Inquiry Card.

Andrex Corp.
(Voyager SX)
356 South Milpitas Blvd.
Milpitas, CA 95035
(408) 263-3993
fax: (408) 263-3899
Circle 1171 on Inquiry Card.

AST Research, Inc.
(Premium Exec 386SX/20)
P.O. Box 19658
Irvine, CA 92713
(714) 727-4141
fax: (714) 727-9355
Circle 1172 on Inquiry Card.

AT&T Computer Systems
(Safari NSX/20)
1776 On-the-Green
Morristown, NJ 07962
(800) 247-1212
Circle 1173 on Inquiry Card.

Austin Computer Systems
(386/SX Notebook)
10300 Metric Blvd.
Austin, TX 78758
(512) 339-3500
fax: (512) 454-1357
Circle 1174 on Inquiry Card.

Bondwell Industrial Co., Inc.
(B330SX)
47485 Seabridge Dr.
Fremont, CA 94538
(415) 490-4300
fax: (415) 490-5897
Circle 1175 on Inquiry Card.

Chaplet Systems, Inc.
(Halikan NBA386SX)
252 North Wolfe Rd.
Sunnyvale, CA 94086
(408) 732-7950
fax: (408) 732-6050
Circle 1176 on Inquiry Card.

Commax Technologies, Inc.
(Ultrathin 386SX/20)
2031 Concourse Dr.
San Jose, CA 95131
(408) 435-5000
fax: (408) 435-5005
Circle 1177 on Inquiry Card.

Compaq Computer Corp.
(LTE/286, LTE/386s/20)
P.O. Box 692000
20555 SH 249
Houston, TX 77269
(713) 370-0670
fax: (713) 374-1402
Circle 1178 on Inquiry Card.

CompuAdd Corp.
(Companion SX, 316NX)
12303 Technology Blvd.
Austin, TX 78727
(512) 250-1489
fax: (512) 250-5760
Circle 1179 on Inquiry Card.

Cordata Technologies, Inc.
(CPC-9100)
1055 West Victoria St.
Compton, CA 90220
(213) 603-2901
fax: (213) 763-0447
Circle 1180 on Inquiry Card.

Darius Technology, Inc.
(386 Notebook-20,
386 Notebook-20B)
22028 26th Ave. SE
Bothell, WA 98021
(206) 483-8889
fax: (206) 486-2577
Circle 1181 on Inquiry Card.

Dataworld
(NB-320SX)
3733 San Gabriel River Pkwy.
Pico Rivera, CA 90660
(213) 695-3777
fax: (213) 695-7016
Circle 1182 on Inquiry Card.

Dauphin Technology, Inc.
(500-SX)
1125 East St. Charles Rd.
Lombard, IL 60148
(708) 627-4004
fax: (708) 627-7618
Circle 1183 on Inquiry Card.

Dell Computer Corp.
(System 212N, System 320N)
9505 Arboretum Blvd.
Austin, TX 78759
(512) 338-4400
fax: (512) 338-8421
Circle 1184 on Inquiry Card.

Epson America, Inc.
(NB3s)
20770 Madrona Ave.
Torrance, CA 90509
(213) 782-0770
fax: (213) 539-5561
Circle 1185 on Inquiry Card.

Everex Systems, Inc.
(Tempo LX/20)
48431 Milmont Dr.
Fremont, CA 94538
(415) 498-1111
fax: (415) 651-0728
Circle 1186 on Inquiry Card.

First Computer Systems, Inc.
(386SX-20)
3951 Pleasantdale Rd.,
Suite 224
Atlanta, GA 30340
(404) 441-1911
fax: (404) 441-1856
Circle 1187 on Inquiry Card.

Fora, Inc.
(NBS-386S, NBL-386S/20)
3081 North First St.
San Jose, CA 95134
(408) 944-0393
fax: (408) 944-0392
Circle 1188 on Inquiry Card.

Grid Systems Corp.
(Grid 1720, Grid 1750)
47211 Lakeview Blvd.
Fremont, CA 94537
(415) 656-4700
fax: (415) 683-0902
Circle 1189 on Inquiry Card.

Hertz Computer Corp.
(386/SX Notebook)
325 Fifth Ave.
New York, NY 10016
(212) 684-4141
fax: (212) 684-3658
Circle 1190 on Inquiry Card.

Hyosung Computer & Information Systems
(NPC II)
671 East Arques Ave.
Sunnyvale, CA 94086
(408) 733-0810
fax: (408) 733-2638
Circle 1191 on Inquiry Card.

Hyundai Electronics America
(Super-NB386Sc)
166 Baypointe Pkwy.
San Jose, CA 95134
(408) 473-9200
fax: (408) 943-9567
Circle 1192 on Inquiry Card.

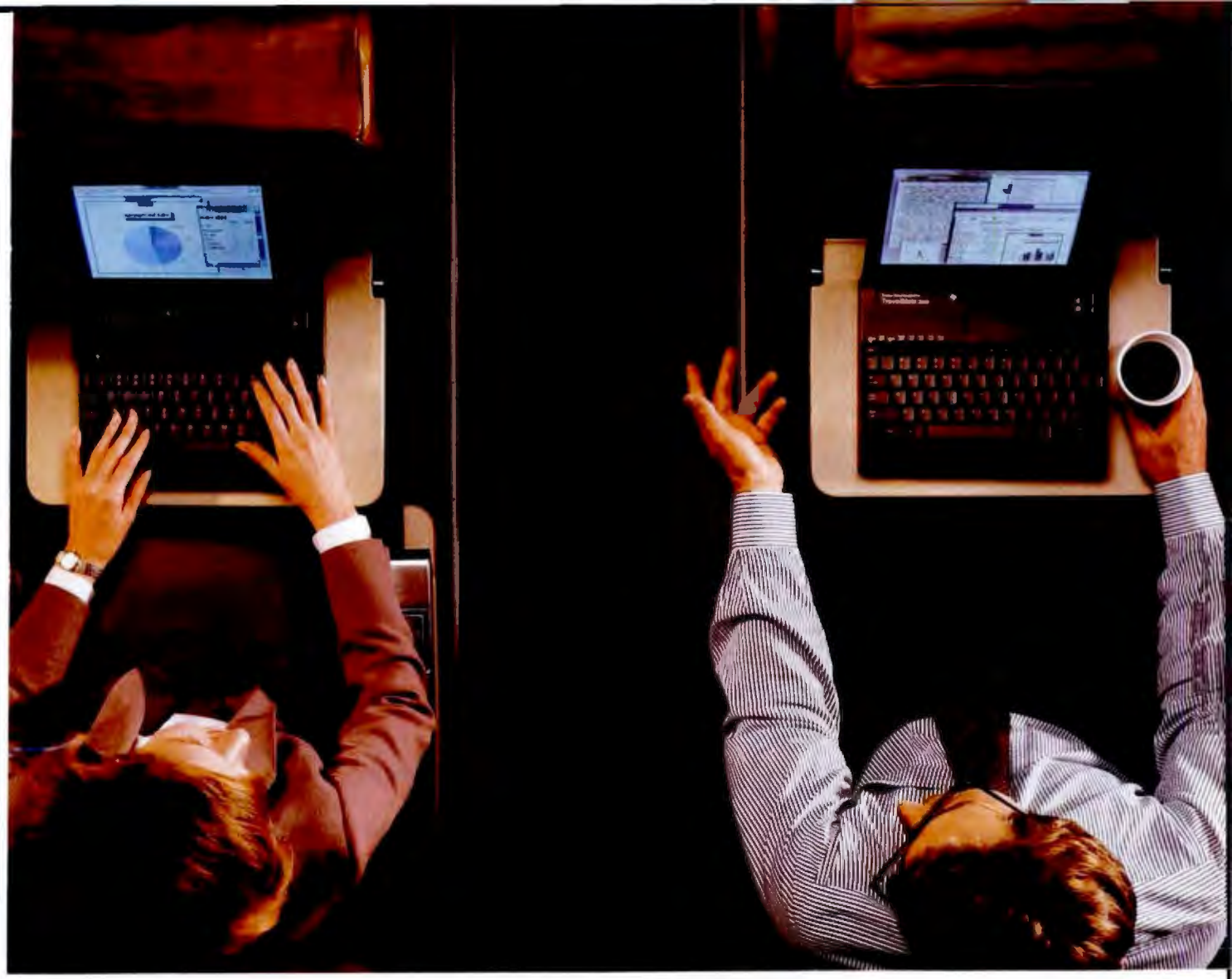
Intelligence Technology Corp.
(386 PEP)
P.O. Box 671125
Dallas, TX 75367
(214) 250-4277
fax: (214) 380-0508
Circle 1193 on Inquiry Card.

Leading Edge Products, Inc.
(N3/SX, N3/SX20)
117 Flanders Rd.
Westborough, MA 01581
(508) 836-4800
fax: (508) 836-4501
Circle 1194 on Inquiry Card.

Leading Technology, Inc.
(PC Partner XL)
10430 Southwest Fifth St.
Beaverton, OR 97005
(503) 646-3424
fax: (503) 626-7845
Circle 1195 on Inquiry Card.

Librex Computer Systems, Inc.
(286 Notebook,
386SX Notebook)
1731 Technology Dr., Suite 700
San Jose, CA 95110
(408) 441-8500
fax: (408) 441-7842
Circle 1196 on Inquiry Card.

Link Computer, Inc.
(386SX20)
560 South Melrose St.
Placentia, CA 92670
(714) 993-0800
fax: (714) 993-0705
Circle 1197 on Inquiry Card.



The TI TravelMates. They're making a hit coast to coast.

The new look of power.

Editors across the country are praising the performance, size and weight of the Texas Instruments TravelMate™ 2000 and 3000 notebook computers.

"The TravelMate is as close as you can get to the ultimate portable." – *BYTE*, November 1990.

"Now TI assumes the lead in performance/pound/price measure of a notebook."– *PC Magazine*, December 11, 1990.*

"Not until you hold this computer in your hands do you begin to understand what sets it apart from the pack."– *PC Computing*, December 1990.**

Both TravelMate models are only 8½" x 11" in size, including a hard disk drive, and feature a 10" diagonal VGA display and comfortable full-function keyboard.

With the TM 2000 you get 286™ processing in a computer that's 1.4" thin and 4.4 lbs. light. The TM 3000, meanwhile, packs 20MHz 386™SX power into a mere 1.8" and 5.7 lbs.

Find out how to take the new look of power with you coast to coast. Or wherever your work takes you.

For the name of the dealer nearest you, call 1-800-527-3500.

TEXAS INSTRUMENTS

TravelMate is a trademark of Texas Instruments Incorporated. 286 and 386 are trademarks of Intel Corporation. *Reprinted from *PC Magazine*, December 11, 1990. Copyright ©1990 Ziff Communications Company. **Reprinted from *PC Computing*, December 1990. Copyright ©1990 Ziff Communications Company. TravelMate 2000 has earned the following awards: 1990 *PC Magazine* Editor's Choice Award (October 16, 1990); 1990 *PC Magazine* Award for Technical Excellence; *BYTE* Award of Excellence; 1990 *PC World* Best Buy. TravelMate 3000 has earned the following awards: 1990 *PC Computing* Most Valuable Product; 1990 *BYTE* Award of Ment

COMPANY INFORMATION: NOTEBOOK COMPUTERS *(continued)*

Micro Express
(NB5620)
1801 East Carnegie Ave.
Santa Ana, CA 92705
(714) 852-1400
fax: (714) 852-1225
Circle 1198 on Inquiry Card.

Modern Computer Corp.
(NoteStar NP-902,
NoteStar NP-903)
1 World Trade Center,
Suite 7976, 79th Foor
New York, NY 10048
(212) 488-5916
fax: (212) 488-5918
Circle 1199 on Inquiry Card.

Myoda, Inc.
(Notebook 386SX)
1053 Shore Rd.
Naperville, IL 60563
(708) 369-5199
fax: (708) 369-6068
Circle 1200 on Inquiry Card.

NEC Technologies, Inc.
(UltraLite 286F, UltraLite 286V,
UltraLite SX/20)
1414 Massachusetts Ave.
Boxborough, MA 01719
(508) 265-8000
fax: (508) 264-8673
Circle 1201 on Inquiry Card.

Northgate Computer Systems, Inc.
(SlimLite)
7075 Flying Cloud Dr.
Eden Prairie, MN 55344
(612) 943-8181
fax: (612) 943-8331
Circle 1202 on Inquiry Card.

Notebook Computer Co.
(486Notebook Workstation
486-T20, 486Notebook
Workstation 486-T33)
1080 First Interstate Plaza
1000 Louisiana St.
Houston, TX 77002
(800) 473-4486
(713) 651-0800
fax: (713) 651-0513
Circle 1203 on Inquiry Card.

Ogivar Technologies, Inc.
(Internote 286, Internote SX386)
7200, Route Transcanadienne
Ville Saint-Laurent, Quebec,
Canada H4T 1A3
(800) 361-3694
(514) 737-3340
fax: (514) 737-4729
Circle 1204 on Inquiry Card.

Olivetti Office USA
(Notebook V16, Notebook A12,
Notebook S20)
765 U.S. Hwy. 202
Bridgewater, NJ 08807
(800) 447-4700
(908) 526-8200
fax: (908) 526-8405
Circle 1205 on Inquiry Card.

Packard Bell
(PB286NB)
9425 Canoga Ave.
Chatsworth, CA 91311
(818) 773-4400
fax: (818) 773-9521
Circle 1206 on Inquiry Card.

Panasonic Communications & Systems Co.
(CF-270, CF-370)
2 Panasonic Way
Secaucus, NJ 07094
(201) 348-7000
Circle 1207 on Inquiry Card.

PC-Ease, Inc.
(NB-8800, NB-9300)
67 Melrose Rd.
Williamsville, NY 14221
(716) 626-0315
Circle 1208 on Inquiry Card.

Philips Consumer Electronics Co.
(Metalis/286, Metalis/SX)
P.O. Box 14810
Knoxville, TN 37914
(615) 521-4316
fax: (615) 521-4406
Circle 1209 on Inquiry Card.

Psion, Inc.
(MC600)
118 Echo Lake Rd.
Watertown, CT 06795
(800) 548-4535
(203) 274-7521
fax: (203) 274-7976
Circle 1210 on Inquiry Card.

SAI Systems Laboratories, Inc.
(SAIBook)
911 Bridgeport Ave.
Shelton, CT 06484
(800) 331-0488
(203) 929-0790
fax: (203) 929-6948
Circle 1211 on Inquiry Card.

Saint Croix Computer Corp.
(386SX)
6640 Shady Oak Rd., Third Floor
Eden Prairie, MN 55344
(800) 950-0174
(612) 943-8618
fax: (612) 643-3854
Circle 1212 on Inquiry Card.

Samsung Information Systems America, Inc.
(NoteMaster 386S/16)
3655 North First St.
San Jose, CA 95134
(800) 446-0262
(408) 434-5400
fax: (408) 434-5653
Circle 1213 on Inquiry Card.

Sanyo Business Systems Corp.
(MBC-17NB, MBC-18NB,
MBC-18NB6h)
51 Joseph St.
Moonachie, NJ 07074
(800) 524-0047
(201) 440-9300
fax: (201) 440-1775
Circle 1214 on Inquiry Card.

Sharp Electronics Corp.
(PC-6220)
Sharp Plaza
Mahwah, NJ 07430
(201) 529-8200
fax: (201) 529-9636
Circle 1215 on Inquiry Card.

Tandon Corp.
(NB/386SX)
301 Science Dr.
Moorpark, CA 93021
(800) 800-8850
(805) 523-0340
fax: (805) 529-2878
Circle 1216 on Inquiry Card.

Tandy Corp.
(2810 HD, 3810 HD)
1800 One Tandy Center
Fort Worth, TX 76102
(817) 390-3011
fax: (817) 390-2774
Circle 1217 on Inquiry Card.

Tangent Computer, Inc.
(320N)
197 Airport Blvd.
Burlingame, CA 94010
(800) 223-6677
(415) 342-9388
fax: (415) 342-9380
Circle 1218 on Inquiry Card.

Texas Instruments, Inc.
(TravelMate 2000,
TravelMate 3000)
P.O. Box 655012, M/S 57
Dallas, TX 75265
(800) 527-3500
(214) 995-2011
fax: (214) 995-4360
Circle 1219 on Inquiry Card.

Toshiba America Information Systems, Inc.
(T1200XE/20, T2000,
T2000SX/20, T2000SXe)
9740 Irvine Blvd.
Irvine, CA 92718
(800) 334-3445
(714) 583-3000
fax: (714) 587-6034
Circle 1220 on Inquiry Card.

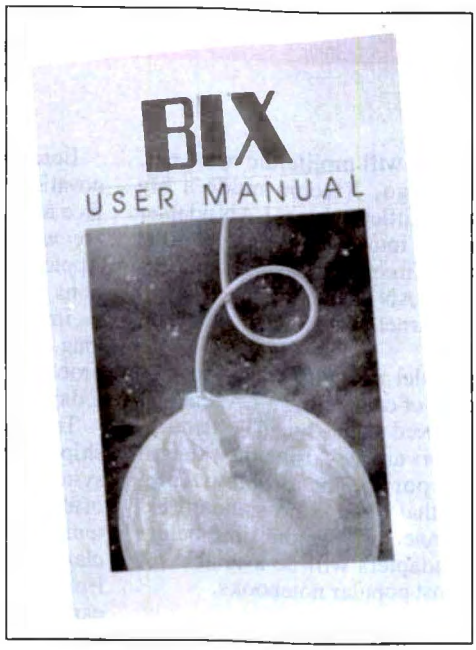
TransPacific Distribution, Ltd.
(TL 1020SX)
2037 Irving St., Suite 216
San Francisco, CA 94122
(415) 221-6044
Circle 1231 on Inquiry Card.

Twinhead Corp.
(Supernote 386SX,
Supernote 20C)
1537 Centre Point Dr.
Milpitas, CA 95035
(408) 945-0808
fax: (408) 945-1080
Circle 1232 on Inquiry Card.

Veridata Research, Inc.
(ExecuLite 386s)
11901 Goldring Rd., Unit A
Arcadia, CA 91006
(818) 303-0613
fax: (818) 303-0626
Circle 1233 on Inquiry Card.

Zenith Data Systems
(Mastersport 286, Mastersport
386SX, Mastersport 386SL)
2150 East Lake Cook Rd.
Buffalo Grove, IL 60089
(800) 553-0331
Circle 1234 on Inquiry Card.

Zeos International, Ltd.
(Notebook 386,
Notebook 386/SX)
530 Fifth Ave. NW
St. Paul, MN 55112
(800) 423-5891
(612) 633-4591
fax: (612) 633-1325
Circle 1235 on Inquiry Card.



Where do you go for help when you're more than just an Amiga user?

BIX—the online service for people who know Amiga.

- ***Get quick answers to tough coding questions***
- ***Interact with other Amiga Developers***
- ***Download source code, utilities and other programs for the Amiga***
- ***Keep up with the latest Amiga developments***
- ***Send and receive private e-mail with binary attachments***
- ***Chat with other Amiga users in real time***

All for just $39 for three months plus $3 per connect hour weeknights and weekends or $6 per connect hour weekdays.*

Subscribe to BIX—just set your telecommunications program for full duplex, 2400 or 1200 baud, 7 bits, even parity, 1 stop bit or 8 bits no parity, one stop bit. Have your Visa, MasterCard or American Express card ready. With your modem, dial your local BT Tymnet number, at "xxx[x[" enter "A." Then at "Please log in" enter "bix"—at "Name?" enter "**bix.amiga**" and complete on-line registration, you'll be on BIX immediately.

*Connect fees are for access via BT Tymnet and are subject to change. Call 800-336-0149 for your local access number. BIX handles billing for BT Tymnet connect fees.

Subscribe Today!

BIX

One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983 or 603-924-7681

for notebooks will proliferate next year. Two years ago, Xircom made a big splash with a little Ethernet LAN adapter that plugged into a portable's parallel port. Now, Xircom has several competitors selling LAN adapters in a variety of flavors: Ethernet, Token Ring, ARCnet, and so on.

The parallel port provided a convenient means of connecting a LAN adapter, but it proved to be a speed bottleneck. Some vendors are now using the external expansion ports. The problem here, though, is that there is no standard expansion connector. For the time being, the faster adapters will be available for only the most popular notebooks.

On Beyond DOS

As I write this, notebook computing is virtually a DOS-only world. That will change in 1992. Apple is expected to announce at least one notebook-class Macintosh system by this fall. Anyone who has ever seen dedicated Mac users lugging around the 17-pound Mac portable as if it *were* a notebook knows there is a tremendous pent-up demand for the real thing.

Because of Apple's reputation for innovation, particularly in the user-interface area, many DOS notebook vendors are watching that company closely. If Apple lives up to its reputation, innovations on its notebook systems are likely to be implemented on the DOS side before long. After all, without the Mac, we probably would not have Windows 3.0 today.

Tadpole Technology is expected to ship a 6-pound SPARC-based notebook system by this fall. The SparcBook 1 will offer a choice of the SunOS or Unix System V release 4.0 operating system and a claimed performance rating of 18 million instructions per second. Don't expect a lot of company for this Unix notebook. The Tadpole sports only 640- by 480-pixel VGA graphics. LCD screens with the resolutions that most Unix folk are used to are rare and expensive in the dimensions required by the notebook form factor. The Tadpole's display, along with its limited expansion capabilities, will severely limit its appeal. Nonetheless, the demand exists in the Unix world for small, portable systems.

Personal Computing's Last Bastion

With more and more desktop systems becoming networked, portable systems may soon be the only truly personal computers available. Their untethered nature allows users to configure them to match the way they work. With the software and peripheral choices available, a smart professional can build a notebook system that will give him or her an edge over competitors and colleagues. The freedom to do that on a desktop system does not exist for everyone.

Tremendous growth is projected for notebook PC sales through the next few years. A great deal of that growth will be fueled by businesses looking to increase productivity of their mobile employees. Just as significant, but less noticed, is the demand at the grass-roots level: small businesses and savvy professionals seeking that competitive edge. Ironically, these are the same people who were the early adopters of the first personal computers. ■

Michael Nadeau is a BYTE executive editor. You can contact him on BIX as "miken."

You must have heard how SOUND BLASTER took the PC market by storm...

Now the ***HURRICANE****...*

SOUND BLASTER PRO

The Multimedia Sound Standard

"It's the next-generation sound card and it is loaded! The operative word is "twice." It has twice the sound channels (22) of the original Sound Blaster with twice the quality of sound in stereo, as well as stereo DACs for digitized speech and sound effects."
Computer Gaming World
August 1991

"With its associated software, it has quietly (no pun intended, but what the heck) become the standard sound system for advanced PCs."
Jerry Pournelle, BYTE June 1991

SEE US AT OUR
3,000 SQ. FT. BOOTH
#S2456
COMDEX FALL
SANDS EXPO, OCT 21-25, LAS VEGAS

COMPUTE August 1991

" ...Creative Labs is now turning up the volume with the Sound Blaster Pro. It's basically two Sound Blasters on a single card with additional multimedia features thrown in. It has twin FM chips capable of creating 22 individual voices, two DACs for stereo voice and sound-effects playback, a stereo microphone jack, and a built-in stereo mixer that can adjust the volume of all your Sound Blaster audio sources (stereo DAC, stereo FM, microphone, stereo line-in, CD-Audio and PC internal speaker).

The built-in mixer makes the Sound Blaster Pro fully compliant with Microsoft's Multimedia Level 1 Extensions to *Windows*. Multimedia software will be able to fade-in, fade-out and pan the various audio sources to create elaborate sound montages.

The Sound Blaster Pro includes a CD-ROM interface for either an internal or external CD-ROM player. There's also an internal connector for CD-Audio. The MIDI interface is compatible with the original Sound Blaster's MIDI interface but adds the MIDI time-stamp that's part of Microsoft's new multimedia standard.

All in all, the Sound Blaster Pro is chock-full of new features, yet it's fully compatible with its younger brother."

Reprinted by permission of COMPUTE ©1991, COMPUTE Publications International Ltd

At a *devastating* price of $299.95 and you get a "chock-full of features":

- Stereo DAC for digitized sound output
- Stereo voice recording from mic, CD or Line-in
- Sampling rate 4KHz to 44KHz
- Stereo 22-voice FM music synthesizer
- Stereo mixer with digital volume controls
- MIDI interface with adaptor and cables
- Built-in CD-ROM interface
- Joystick Port
- Microphone AGC amplifier
- Power amplifier (4W per channel)

and loads of **FREE** bundled software

- MIDI Sequencer
- Pro-Intelligent Organ
- VEDIT2 - Voice Editor & Utilities
- SBTALKER - text-to-speech synthesizer with DR SBAITSO2
- Talking Parrot - voice in/out application.
- MMPLAY Multimedia Presentation
- CD music player
- Windows 3.0 DLL and sound applications

"The big question is, at a list price of $249.95, is the Sound Blaster worth the investment? Yes, yes, a thousand times yes!!!" **PC HOME JOURNAL**

How many "yes!!!" would you give now that the Sound Blaster list price is reduced to **$169.95**! And you get:

- DAC for digitized voice output
- ADC for voice recording
- 11-voice Ad Lib FM synthesizer
- Full duplex MIDI interface
- Joystick Port
- Microphone amplifier
- Power amplifier (4W per channel)
- Bundled software: • Intelligent Organ • Talking Parrot • Voice Toolkit • SBTALKER • DR SBAITSO • Jukebox for Windows 3.0

Sound Blaster Micro Channel Version is also available.

North America master distributor:
Brown-Wagh Publishing
130D Knowles Drive Los Gatos CA 95030
For your nearest dealer, call **1-800-451 0900**
Tel (408) 378 3838 Fax (408) 378 3577

CREATIVE LABS, INC.

2050 Duane Avenue Santa Clara CA 95054
Tel (408) 986 1461 Fax (408) 986 1777

Outside North America, contact:

CREATIVE TECHNOLOGY PTE. LTD.

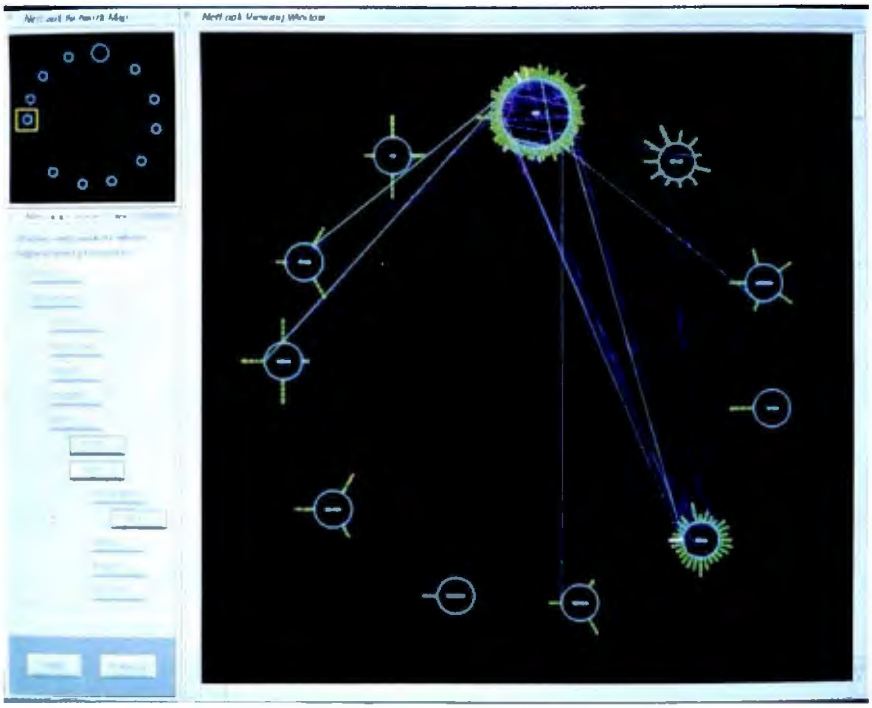
75 Ayer Rajah Crescent #02-04 Singapore 0513
Tel (65) 773 0233 Fax (65) 773 0353

THE PC SOUND STANDARD

Largest support of Multimedia Music, Education, Entertainment & Productivity software under DOS and Windows 3.0

Circle 27 on Inquiry Card.

NETWORKING



Silicon Graphics' NetVisualyzer exploits the graphics prowess of the Iris 4D workstation to create stunning network maps.

Trends in Network Management

Smarter, better-integrated tools are on the way

JON UDELL

What's network management? For me, it's any of the myriad routine or unscheduled activities I'm asked to perform in order to keep BYTE's network running and to keep its users productive. Routine duties include backups, disk management, software upgrades, application development, and—less frequently—planning, implementing, and documenting the network's rearrangement or growth. Unscheduled tasks are even more diverse.

One of the services that I maintain is BYTE's LAN-based X.25 link. From a user's perspective, this service either works or it doesn't. But for me, the "BIX is broken" complaint triggers a complex troubleshooting algorithm. The user might simply have lost the PATH variable that points to the server-resident telecommunications program. Someone may have accidentally misconfigured that program. The TSR program that links LAN workstations to the X.25 gateway machine may not be running. The gateway PC, or the entire LAN, may have had a hardware or software crash. The packet assembler/disassembler or leased-line modem through which we connect to the host may have failed. The X.25 network, or even the BIX machine itself, could be down.

The tension between the user's binary view of network services, and the network manager's kaleidoscopic view of the layered hardware and software components that sustain those services, defines the challenge of network management in the years ahead. Everyone in the networking business—equipment makers, network operating-system companies, third-party toolsmiths—agrees that we'll use fewer, more comprehensive tools to manage tomorrow's networks. But those of us who manage networks today face a bewildering array of product offerings.

Researching this article, I uncovered whole categories I'd never considered but that properly belong under the network management umbrella. Because the discipline is still being invented, categories blur and overlap. In the end, I decided to survey the field broadly. In this article, I'll assess the variety and scope of existing network management products, discuss enabling technologies, and focus on how today's disparate management products foreshadow the integrated solutions of tomorrow.

For more information about the companies and products mentioned, see the Network Management Company Information listing.

Purchase Planning, Simulation, and Modeling

Although networks grow like weeds once they are established, they don't just spring up out of the corporate soil. There's always a set of requirements and some plan for meeting them. Emerging now are tools that can help elicit requirements, specify network products and configurations, and evaluate a specification in terms of compatibility and performance.

How about a tool that helps you translate your networking needs into a purchase order? Trilogy's Netbuild, a sales configuration tool, links a "configuration engine" built around the Open Systems Interconnection (OSI) network model to a database containing information about LAN products. Intended for LAN resellers, Netbuild prompts for the number and types of workstations and printers that need to be connected, as well as for the kinds of applications that will be run.

According to Trilogy, the configuration engine resolves constraints and dependencies. It knows, for example, that PCs on an Ethernet segment can't reach a LaserWriter on a LocalTalk segment without the help of a gateway, and so it might recommend NetWare for Macintosh. The end result is a purchase proposal with a complete bill of materials listing adapters, cables, bridges, gateways, and

system software. Netbuild will ship (about the time you read this) with a complete database of Novell products, supplemented with products from "a few other major vendors." Trilogy plans to follow with database additions, and resellers (or companies that buy LAN equipment in volume) can augment the database on their own.

Network management, according to the new religion, should be proactive rather than reactive. When growing a network or planning a new one, why not anticipate performance bottlenecks before they happen? There are several approaches to proactive performance analysis. Most monitors/analyzers can inject packets onto an existing network, so you can get a feel for the effect of extra traffic generated by new nodes.

ProTools' Protolyzer, for example, makes this sort of experiment easy to do. Using its Presentation Manager–based iconic programming toolkit, you can capture traffic between a server and a station you deem typical of some activity (say, writing legal documents with WordPerfect), clone multiple copies of the sample node, and then play the captured data back through all the copies to emulate a combined network load.

You can use this approach with your existing network, but it won't help you evaluate a new one. Moreover, there are methodological flaws. For example, an individual analyzer trying to emulate multiple network devices must serialize the traffic it creates. In reality, workstations contend for access to their medium. Why not model, or simulate, the network's protocols, devices, and interconnections in software? Several products do just that.

Internetix describes its Softbench package ($995) as "a top-down analytical model calibrated with benchmark data." You might ask Softbench to model a group of 286 and 386 workstations running Paradox under NetWare 2.15 on two Ethernet segments bridged by a 386 server and then examine the effect of upgrading to NetWare 386, or using Token Ring instead of Ethernet, or upgrading 8-bit network interface cards to 16-bit NICs, or bridging with TCP/IP across a backbone.

Internetix targets Softbench for departmental, not enterprise-wide, analysis, and it emphasizes that the results, while useful, are average and approximate. For more complex and more accurate analysis, you might use Internetix's LANsim, a true event-stepped simulator. This DOS-based tool can drive simulations of complex networks using traces collected by Network General's Sniffer.

LANsim abstractly accounts for the lower layers of the OSI model. For application-level traffic that's less amenable to abstract simulation, there's a companion tool called LANAI (for LANsim Analyzer Interface), which can reduce Sniffer data to patterns called *activity blocks*. Given a large sample of packets from a bank teller's workstation, for example, you might use LANAI to extract activity blocks that you'd label "deposit" and "withdrawal" and then include these blocks in a simulation.

An order of magnitude more sophisticated (and expensive) than Softbench is Comdisco's BONES (for Block-Oriented Network Simulator). It's a meta-simulator—an advanced graphical toolkit for building network simulators. Running on a DECstation or a Sun workstation, BONES captures network topology, protocols, and data structures by means of a hierarchical diagram editor. You can take building blocks from a library of primitive models (e.g., queues and timers) or systemic models (e.g., Ethernet, Token Ring, and X.25). You can also add custom-built primitives to the model library—a feature of more interest to designers of protocols and devices than to network managers.

Once you've specified a simulator in this way, BONES writes the C program that implements it. The simulator then runs under the control of a BONES utility that can adjust parameters and attach data-gathering "virtual probes" to various components. As with LANsim, you can elect to drive the simulation with traces collected by a Sniffer or a Hewlett-Packard LANprobe. Finally, a post-processor performs graphical and statistical analyses of the simulator's output.

BONES's extreme flexibility makes it a tool for an elite class of very knowledgeable users. However, Comdisco sees the growing need for general-purpose network simulation tools and will offer a version of the product with a wider selection of canned, pluggable models.

Mapping and Documenting the Network

You can't manage what you can't see, so comprehensive network maps are an essential management tool. It's easy to imagine an ideal scenario: information about wide-area and local network geography, physical and logical topologies, network equipment, and connected stations living in a central (or distributed) repository. Viewed graphically, the repository is a map of nodes, interconnections, and hierarchies. It's also a database that stores operational statistics, equipment records, and user-support histories. You might navigate the map to locate a failing repeater, or query the database for the set of workstations lacking enough memory for a proposed software upgrade. Either way, you'd be accessing a common repository.

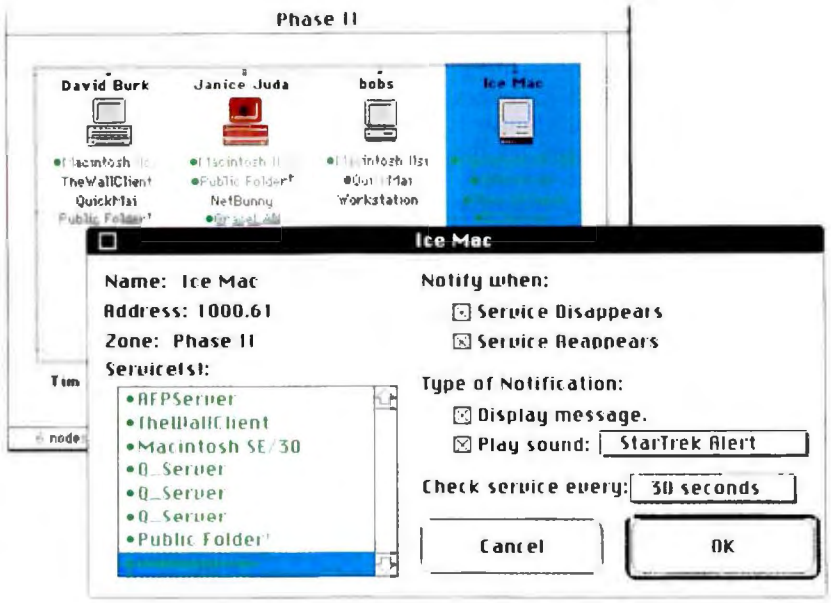
Don't hold your breath waiting for this Holy Grail to materialize. As networks and computing become synonymous, network operating systems will develop, or provide hooks to, unified management repositories into which internal and third-party utilities can feed. Novell, for example, reportedly has such plans under way. In the meantime, managers of small- to medium-size networks who want to cover all the bases must contend with many different mapping, documentation, and reporting tools.

One variety of tool marries CAD and database software to support the management of cabling and communications equipment. IsiCAD's Command 2000 and Network & Communication Technology's Planet are two of these. Both are DOS-based programs that use CAD techniques to depict the cables and network devices in your building; both relate the CAD drawings to databases (dBase and Btrieve, respectively). Once you've fed in the necessary information, you can trace circuits on-screen, calculate cable lengths, track the availability of hub ports, and produce bills of materials, maintenance reports, and leasing schedules.

IsiCAD's Unix-based offering, Command 5000, also features rule-based analysis of network designs—it can ensure, for example, that no thin Ethernet segment runs longer than 600 feet. There's just one problem with this class of software: The map is not the territory. If you rearrange your 10Base-T hubs and the stations connected to them, you'll have to redo the maps accordingly.

Self-Documenting Networks

Since a network is, after all, just a bunch of communicating devices, it's reasonable to suppose that you can make a network document itself. Many network monitoring products do just that. One flavor includes utilities such as Cheyenne's Monitrix, Dolphin's LAN Command, Fresh Technology Group's NetVision, Frye's NetWare Management,



LANSystem's LANSight, NetWave's LAN Track, and Thomas-Conrad's TXD (to name just a few).

These programs query workstations and/or servers in order to answer questions like these: Which version of the network software is running? Has any workstation failed to respond recently? How many packets has a workstation sent and received? How many sockets are open? What kind of load is a bridge carrying? How many errors and retransmissions have occurred? Is disk space low on the server?

I'll call these programs "soft" monitors, since they glean information from network operating software, in contrast to what I'll call "hard" monitors, such as Sniffer, LANprobe, Novell's Lantern, and Spider Systems' SpiderProbe, which watch raw cable traffic.

Some soft monitors can draw a map of the logical network, which you can then explore to see what's happening with particular nodes. Monitrix is one such program in the PC realm; AG Group's Net Watchman and Farallon's NetAtlas (included with the PhoneNET Manager's Pack) are two AppleTalk-monitoring programs that draw iconic maps of a Macintosh LAN's zones and nodes. Other soft monitors present text interfaces that you navigate to locate nodes of interest.

No matter how you access the information, however, the picture of the network that a soft monitor paints, though live, is often fleeting. Dolphin's LAN Command is one exception to this rule. With LAN Command (one of the few utilities in this class that works with NetBIOS LANs as well as with NetWare), you can build a permanent database that describes users, workstations, and network equipment; the monitoring software will store the statistics it gathers in that database.

Many hard monitors also do network mapping, and they, too, typically focus on real-time snapshots of networks. The Lantern Services Manager is a Windows 3.0 program that illustrates the network devices that Novell's Lantern, an Ethernet monitor, can find. Silicon Graphics' NetVisualyzer exploits the graphics abilities of the Iris 4D workstation to create gloriously rich pictures of TCP/IP networks.

Wiring hubs are still another source of network maps. Many hub vendors, particularly those in the 10Base-T business, now routinely offer optional management modules. These are plug-in boards that watch and govern hub ports. The boards are typically driven by Windows or Presentation Manager programs that relate the statistics and controls exported by the management hardware to network maps. In some cases (e.g., BICC Communications' Isoview and NetWorth's EtherManager), these programs also come with databases and can perform asset management.

Only when you enter the rarified sphere of enterprise network management, though, do you begin to see signs of the Holy Grail. Cabletron's Spectrum and HP's OpenView, two of the most advanced platforms for building applications that control multivendor, multiprotocol networks, use object-oriented databases to coordinate open-ended suites of management applications. Ungermann-Bass's NetDirector, which primarily targets LAN Manager networks, uses SQL Server as its management repository.

The applications that run on these platforms today focus on classic physical-layer network management: visualizing topologies, monitoring throughput, and detecting faults. But the platforms themselves incorporate data repositories and aim to enfold a much wider range of management tools. Monitors operating in such environments will not just pump information into a repository. They will also help to automate the creation and maintenance of the repository itself.

***Net Watchman** monitors zones, nodes, and services available on AppleTalk networks. It can notify you when a service stops working, so you needn't wait for users to report problems.*

Managing Hardware, Software, and Human Assets

An increasingly prevalent breed of management tools automatically discovers and records the hardware (and possibly software) assets located at network-connected workstations. PC-oriented examples include Brightwork's LAN Automatic Inventory, Connect Computer's Lanscope Resource Manager, Horizons Technology's LANAuditor, LANSystems' LANSight, and Magee's Network H.Q. Macintosh asset managers include CSG Technologies' Network Supervisor and Pharos's StatusMac.

If you've ever had to perform an inventory of computer equipment, you'll know why these products make sense. Manual inventories of hard disk drives, RAM cards, video adapters, and coprocessors can't keep up with the restless, nomadic existence these gadgets lead in many organizations. But the wire through which workstations communicate can also tether them to administrative control.

In the PC realm, these programs gather the same sorts of information as do programs like Dariana's System Sleuth: DOS version and BIOS signature; processor and coprocessor flavors; conventional, EMS, and extended memory; floppy and hard disk drive types and capacities; and video adapter type. Many of these programs, like soft network monitors, will also report the target machine's network shell version and adapter type. Other kinds of expansion boards remain hidden from view on ISA machines, although fuller disclosure may

Upgrade to NOS 4.0 today! Call 602-293-6363

"My biggest client was using Novell. When I installed LANtastic, they thanked me for giving back their computers."

—Dennis Reese,
Reese Equipment Co.
Plymouth, Indiana

ARTISOFT SHATTERS THE MYTH

LANtastic shatters the myth that networks have to be an employment program for on-site computer technicians.

Out in Indiana farm country in 1988, Dennis Reese indulged his passion for computers by adding a room to his dad's farm equipment company. Last July, he started connecting his customers on LANtastic networks. Today that sideline is turning a million dollars a year.

His biggest client was running a 25-node network on one Novell system and preparing to upgrade to another. That's when Dennis installed Artisoft's LANtastic. "I told them if they didn't like it, I'd pull it out. No charge. Now they're the happiest customer I have. They really like having multiple servers with drives formatted for DOS. They thanked me for giving them back their computers."

LANtastic is so easy to use that Dennis's customers *enjoy* networking. The flexible peer-to-peer structure was another plus. "We have had many applications that bogged down on a client-server network. Now with LANtastic we can redistribute the processing to multiple servers."

Dennis' clientele are people more interested in being experts in their own fields rather than having to become—or hire—experts in an overcomplicated network. They are doctors, lawyers and industrial specialists like a large communications tower producer, a bearing manufacturer and a plastics firm that makes showers and tubs.

There's a myth that networks have to be an employment program for on-site computer technicians. Artisoft's LANtastic shatters the myth with a network that everyday people can install and understand and use with confidence.

"We will now turn down a network job if we are forced to install Novell. We tell people that our network is really called *FANtastic* and that Artisoft just can't spell."

For more information call Artisoft or visit your Artisoft Authorized Five Star Dealer.

AUTHORIZED DEALER

ARTISOFT
Revolutionizing Connectivity

Phone (602) 293-6363 Fax (602) 293-8065

Circle 14 on Inquiry Card.

be possible if the workstation has an EISA or Micro Channel bus. Software assets recorded are typically just the AUTOEXEC.BAT and CONFIG.SYS files—critical components that need to be exposed to network administrators.

Some of these programs were developed hand in hand with remote-control software, such as LANSight and LAN Automatic Inventory. As such, they require TSRs but enable managers to commandeer workstations for remote diagnosis or training. Other programs, like LANAuditor and Network H.Q., specialize in asset management. They run at log-in time, update a database, and then disappear.

Mac asset managers such as Network Supervisor and StatusMac report on Finder, MultiFinder, QuickDraw, and AppleShare versions, Apple Desktop Bus and SCSI devices, and NuBus boards. They're also more aggressive than their PC cousins about cataloging software assets—a task made easier, of course, by well-defined resources embedded within INITs, desk accessories, and regular Mac applications. Because these utilities supply so much information, CSG and Pharos like to point out that they're useful not only for tracking inventory, but also for spotting obstacles to a smooth transition to System 7.0.

Possible obstacles include incompatible INITs, printer drivers, or applications, and Macs in need of memory upgrades or paged memory management units. Pharos tackles the System 7.0 transition in an interesting way. Included with StatusMac is a utility that runs Apple's System 7.0 compatibility checker (a HyperCard stack) against an entire StatusMac database. Those of us responsible for the transition to DOS 5.0 and Windows 3.0 on PC networks can only hope that tools like these will show up in our world soon.

You don't need to be a bean counter to get excited about where this kind of approach might lead. In the realm of physical-layer network management, the most advanced protocol analyzers use rule-based reasoning to ferret out problems and suggest solutions. The same techniques need to be applied to the diagnosis and cure of the myriad software conflicts and configuration errors that can eat up so much of a network manager's day.

Is the misuse of a DOS memory manager a network management issue? Yes, if it prevents someone from accessing the corporate database. Reliable networks can't have weak links. Network management can no longer focus solely on the health of wiring, hubs, bridges, and routers. The discipline must equally encompass workstations, applications, and users.

Products that enfold users in a network management scheme include Brightwork's LAN Support Center and Blue Lance's LT Helpdesk. Both of these products help network managers organize users' anecdotal problem reports, spot patterns that indicate hardware or software troubles, and document the fixes. Users are, after all, a valuable source of information about the network's health. Their input, just like the data that software and hardware probes crank out, should be fed into the management repository.

Everyone in the networking business agrees that we'll use fewer, more comprehensive tools to manage tomorrow's networks.

Tool Synergy

Today's soft and hard monitors, asset managers, and user-support systems—even when offered by the same vendor—typically maintain independent, single-purpose databases and don't talk to each other. But the boundaries that separate these classes of products are rapidly eroding. Toolmakers see that network management really is a holistic endeavor. Frye's NetWare Early Warning System (NEWS) represents one of the first concrete examples of what's sure to become a major trend: monitors that can not only spot trouble, but also take action to avert it.

Like many of the soft monitors that watch NetWare servers, NEWS deploys a value-added process (VAP) or NetWare loadable module (NLM) at the server that ships status information to a DOS monitoring console. When a monitored parameter crosses a specified threshold (say, for example, the number of directory entries drops below 500), NEWS can E-mail, fax, or phone an alert to the responsible administrator. That sounds great, until you imagine your NetWare server calling you at home in the middle of the night.

What administrators really want—and what NEWS provides—is the ability to empower the network to *do something* about the problem it's detected. What power does the NEWS console wield? For each alarm, it can dispatch a responding DOS batch file or program. If directory entries are scarce, for example, you might arrange to launch a scavenger that deletes expendable files.

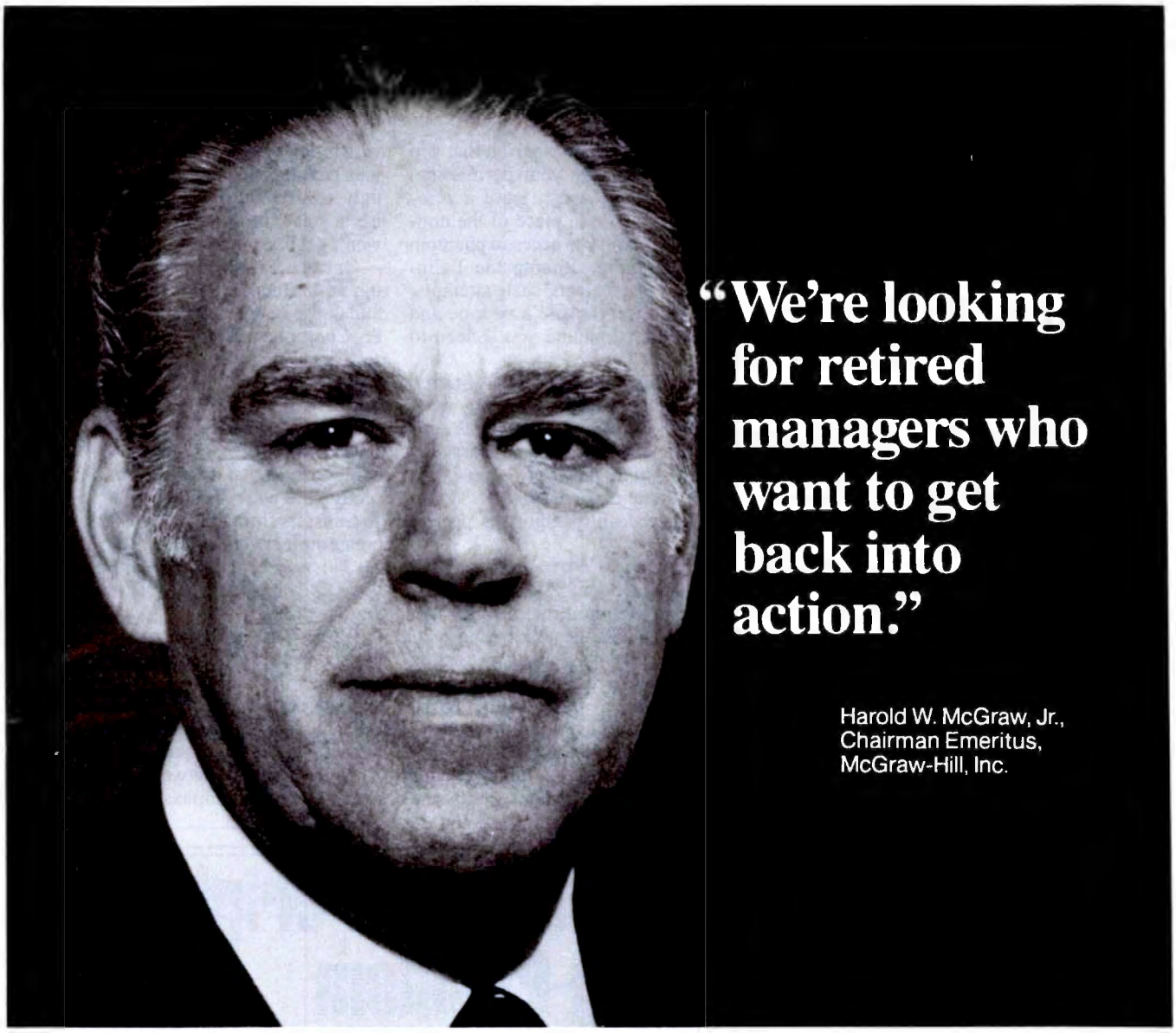
Many tool vendors say they're moving in this direction. AG Group's Net Watchman, for example, currently monitors AppleTalk networks and sends out alerts when zones, nodes, bridges, or services (e.g., E-mail and printing) head south. Responding to such an alert, a network manager might want to launch one of AG Group's protocol analyzers—LocalPeek or EtherPeek—in order to, for example, test the hypothesis that a mixture of Phase 1 and Phase 2 AppleTalk protocols caused the problem.

Why not have Net Watchman automatically wake up the analyzer and have it start capturing data immediately, so the trail won't be cold when the network manager arrives? That's just what AG Group plans to do, by integrating its tool set with System 7.0's Apple events.

In principle, any networked service—database server, uninterruptible power supply, tape backup system, mail server—should export status information and present a standard control interface. It would be convenient to be able to manage all network services from a single console. More important, such an arrangement would pave the way for automating the management of services and for intelligently allocating the resources that they require.

The ultimate flowering of this strategy—manageable services controlled by a network manager (or a managing application)—will require a common framework. Some vendors of network utilities are rolling their own. Others prefer to wait for emerging network management standards such as SNMP and the OSI Common Management Information Protocol (CMIP) to crystallize.

SNMP, in particular, has gained widespread support among vendors of network adapters, hubs, bridges, and routers. There is no reason why other kinds of network entities—including software services—can't define Management Information Base extensions that provide a reporting and control interface to SNMP managers able to digest the extensions. High-end management platforms like Cabletron's Spectrum, HP's



"We're looking for retired managers who want to get back into action."

Harold W. McGraw, Jr.,
Chairman Emeritus,
McGraw-Hill, Inc.

I'm a volunteer supporter of the International Executive Service Corps, a not-for-profit organization with a vital mission:

We send retired U.S. managers overseas to help businesses in developing countries, which often respond by increasing their imports of U.S. goods. In fact, developing countries consume about 40 percent of U.S. exports.

As an IESC volunteer, you would not get a salary. But you would get expenses for you and your spouse, plus a world of personal satisfaction.

IESC leads the field in this kind of work. We've done over 9,000 projects in 81 countries. We could have a project that's just right for you.

For more information, send this coupon to: Harold W. McGraw, Jr., Chairman, McGraw-Hill, Inc., P.O. Box 10005, Stamford, CT 06904-2005.

Dear Mr. McGraw: Tell me more about becoming an IESC volunteer. I am a recently retired manager or technician—or am about to retire—from a U.S. company. I'm free to accept an overseas assignment. I understand that volunteers receive expenses for themselves and their spouses, but no salary.

Name _____

Address _____

City _____ State _____ Zip _____

In what publication did you see this ad? _____ M3

Ad Council

International Executive Service Corps

It's not just doing good. It's doing good business.

OpenView, and Sun's SunNet Manager are all capable of incorporating MIB extensions and thereby monitoring and controlling all kinds of SNMP objects.

Storage Management

Backing up shared disks is one of the classic chores of network management. Traditionally, it's been a boring subject, but recent advances in tape backup devices and software have livened things up quite a bit. As the digital audiotape, Exabyte, and quarter-inch cartridge camps vie for supremacy, tape drive capacities soar and prices plummet. Meanwhile, innovative software products are changing the role that these backup devices play in networked environments. Palindrome's justly acclaimed The Network Archivist (TNA) makes the relationship between primary hard disk storage and secondary tape or optical storage into something akin to the relationship between cache memory and main memory.

With TNA, a dormant file can migrate automatically to tape. In other words, if TNA knows that the file is safely preserved on three separate tapes, and if it sees that no one has accessed the file for 12 weeks (or some other period that you specify), it will (with your permission) delete the file. TNA can leave a zero-length phantom file in place of the emigrated file. If you try to access a phantom file, and if you're running the Palindrome TSR that detects such attempts, the TSR tells you the file's on tape and shows you the command you'll need to recall it.

Clearly, this implementation of tiered storage could improve; it would be nice if immigration were as transparent as emigration. The concept of tiered storage is absolutely sound, however, even if today's file systems and typical off-line storage devices can't support its perfect realization.

From a manager's perspective, TNA is a tremendous boon. File server space is always at a premium, but no one's got the time to weed out the junk. In most situations, the value of automatic migration far outweighs the occasional hassle of manual restoration. TNA's other great strength is that it frees you from having to plan and execute a tape-rotation scheme. Every time you run TNA, it prompts for the appropriate tape and also tells you which tapes belong off-site. This simple idea has taken the industry by storm. The ugly truth about backup is that, unless it's a one-button no-brainer, it usually won't get done properly.

One of the reasons TNA isn't a no-button no-brainer is that it runs under DOS and doesn't come with a built-in scheduler. Cheyenne's ARCserve, which is sold separately and also bundled with drives from Gigatrend, Irwin, Tecmar, and others, exploits NetWare's queuing capabilities to schedule backup jobs. (Another benefit of ARCserve's VAP/NLM component is that it can communicate directly with a server-attached tape drive, so transfers from the server's disk to tape create no network traffic.) Sytron's Sytos Plus and Legato Systems' NetWorker use OS/2 and Unix, respectively, in a similar fashion.

While none of these products can yet match the disk-grooming and media-handling features of TNA, the more advanced operating systems supporting them make it easier to automate their use on nondedicated workstations.

As the scope of network management enlarges to encompass workstations,

Graphical User Interface CLEARING HOUSE

Specializing in products for Microsoft Windows and OS/2 graphical environments

G.U.I. CLEARING HOUSE - PM / Windows Catalog

File Edit Search Order!

1-800-522-4624

International, call (203) 268-4400 Fax (203)261-4636
Monday - Friday 9:00am to 8:00pm EST

*GUI Clearing House is the only national reseller specializing **exclusively** in Windows and OS/2 Presentation Manager environments. This specialization is necessary in order to properly serve you, our customer, in this rapidly evolving market.* ***Our goal is to provide you with the finest customer service in the industry and to ensure that the products you select are the correct ones for your application.***

When you call GUI Clearing House, you will be greeted by one of our friendly, knowledgeable sales staff who will take the time to talk with you to understand your specific requirements. To further assist you, we maintain a staff of technical consultants available to answer in-depth technical questions on products; and to help customers in identifying applications to meet their needs.

Please Note: The applications listed in this ad represent only a small sample of the Windows and OS/2 Presentation Manager products available through GUI Clearing House. Call us for pricing on any Windows or OS/2 applications. We'll promptly get pricing and availability for you. ***CALL TODAY!***

>> HOT NEW PRODUCTS <<

Aldus Type Align	79	Realizer	299
Braincel	229	Remotely Possible	call
Clip & Save for Windows	129	Sitback	119
File Shuttle XPRESS	129	VentanaDRAW	149
ICEWorks Professional	129	Virus Secure	85
PFS: Window Works	149	Visual BASIC	159
Photo Styler	699	Whiskers	25

WINDOWS APPLICATIONS

Development Tools

ACTOR 3.1 Professional	429
ADEPT Expert Application Builder	595
ICEWorks Pro (Icon Editor)	129
Borland C++	339
Borland ObjectVision	99
Borland Turbo Pascal/Windows	199
Bridge 2.0 Tool Kit	629
C-TRIEVE/Windows (Coromandel)	349
C++/Views	469
CASE:W 3.0	459
CASE:W Corporate Edition	895
Graphics Server SDK	399
Knowledge Pro Windows	629
Lasertalk PC	309
Microsoft SDK for Windows 3.0	349
Multiscope for Windows 3	299
ObjectGraphics (WhiteWater)	call
Personal Case	179
PowerLibW	265
ProtoView	585
ProtoGen	409
Pubtech BatchWorks	89
SmallTalk V/Windows	369
SpeedEdit for Windows	255
ToolBox (Drover)	249
The Whitewater Resource Toolkit	179
WindowsMAKER Professional	795
WinTrieve	369
VZ Programmer/Windows	535
Zortech C++ Developers Edition	399

Database/Forms

Access SQL (SPI)	1279
dBFast/Windows	319
ERwin ver 1.5	849
FormWorx Forms Publisher	169
INTEGRA SQL	609
JetForm	399
MARVIN Image Database	2395
Omnis 5/Windows	759
PerForm Pro	299
Q+E ver 2.6, (standard or server)	call
Superbase 2 ver 1.2	249
Superbase 4 ver 1.2	469
Chart Builder for Superbase	169
Thinx	399

Engineering/Planning

ABC Flowcharter	249
Braincel (Neural Net)	229
Design/IDEF	2795
DesignView	749
DRAFIX Windows CAD	459
MathType	199
MetaDesign, diagramming tool	329
Milestones, Etc	129
Project for Windows	469
PUMP-FLO, pump analysis	179
RFFlow, flowcharting	119
SPACETEK:Facility Planner	call
Topdown Project Planner	249

WPMA Member
The Windows & Presentation Manager Association

Connectivity

Business Session for Windows	269
cc:MAIL for Windows	449
DaVinci eMAIL for Windows	call
DynaComm (Sync or Async)	259
DynaComm Elite	399
EXTRA! for Windows	379
Faxit! for Windows ver 2.0	139
MicroPhone II	259
Net Magic (US version)	609
Network Courier	509
Remotely Possible	249
TERM for Windows	179
Windows Workstation	559
WinTerm	409

General/Productivity/Utilities

Adobe Type Manager	69
Asymetrix Toolbook	309
BeckerTools 2.0	99
Distinct Back-up	119
File Shuttle XPRESS	129
File F/X	119
HP New Wave	call
ICEWorks Personal	79
Icon Pak II	89
Intermission	42
More Windows	89
PackRat 3.0 for Windows	call
Personal Librarian	859
PLUS for Windows	179
Publisher's Powerpak	69
PubTech File Organizer	159
PubTech Text Editor	69
SmarText (Samna)	409
Straight Line	89
WideAngle/Windows	119
Windows/On The World	409
Windows Shopper's Guide	16

Publishing/Graphics

Adonis Clip-Art Window Shopper	42
Aldus PageMaker	499
Ami' Professional ver 1.2	319
Archetype DESIGNER	795
Arts & Letters Graphics Editor	509
Corel DRAW! 2.0	399
DoDOT! (capture/convert)	139
Gram-mat-ik for Windows	79
Image-In Full Pak	679
Image-In Scan & Paint	139
Image Prep	269
Instant ORGcharting	NEW
Micrografx Charisma	349
Micrografx Designer 3.01	469
Microsoft Office for Windows	699
Picture Publisher	489
PowerPoint for Windows	329
Publisher's PaintBrush	359
PubTech Multi-Tack	139
Scrapbook+ 2.1 (Elkon)	99
Ventura Gold Series	559
WordScan Plus	795
Word for Windows	329

Financial/Accounting

Accounting Software for Windows	call

PM APPLICATIONS

Active Life for OS/2	135
Aldus PageMaker for OS/2	579
Asymetrix ToolBook for OS/2	329
CASE:PM for C or C++	1875
CASE:PM for MicroFocus Cobol	2375
ChipChat (Cawthon)	279
Clip & Save for OS/2	129
Collage PM	179
Corel Draw! for OS/2	call
DeScribe	529
Excel for OS/2	349
FreeLance for OS/2	499
HyperACCESS/5 for OS/2	169
Lotus 1-2-3/G	579
Micrografx Designer	509
Multiscope for OS/2	349
Nexpert Object, PM Runtime	929
Object-1/PM (MDBS)	895
OS/2 PM Softset (Microsoft)	129
OS/2 PM Toolkit (Microsoft)	409
PackRat for PM	339
PackRat PM Network (3 User)	579
Print Screen for OS/2 PM	72
Perspective for OS/2	259
Q+E/PM ver 2.6 Standard Edition	call
Q+E/PM ver 2.6 Server Edition	call
Relish	139
RT-Graphics (FSI)	959
Sidekick for PM	169
SmallTalk/V PM	339
SpeedEdit for OS/2	255
SpeedEdit for PM	255
Sytos Plus/PM (Sytron)	259
Ventura Gold for OS/2	559
VZ Programmer/PM	1225
WideAngle for PM	119
Wingz	359
Word for OS/2	call
WordPerfect 5.0 for OS/2	339
WinPRO/PM (Xian)	379
Zortech C++ OS/2 Compiler Option	139
Zortech C++ OS/2 Dev Edition	489

HARDWARE, etc.

Image Scanners

Logitech ScanMan 256/PC-AT	399
Microtek scanners	call

Boards

ATI 8514/Ultra	call
Intel SatisFAXtion board	call

MultiMedia Products

Guide 3 (Owl Int'l)	439
IconAuthor (AimTech)	call
Super VideoWindows	599
VideoLinX:FRAMEBUFFER	1119
Erasable Optical Drives	call

GUI Clearing House offers a full line of hardware items selected to augment the Windows, Presentation Manager, and MultiMedia based platforms. If you don't see a particular item, just ask.....we will promptly obtain pricing and availablity for you. ***Call us TODAY!***

PAYMENT Visa, MasterCard, Diners Club and Carte Blanche accepted. Personal and company checks accepted. Please allow 2 weeks for processing. Corporate and institutional purchase orders subject to credit approval and a minimum initial purchase $500, paid via C.O.D. or in advance. C.O.D. minimum purchase is $100, maximum $1,000 payable by cash, cashier's check, or money order. CT residents add 8% sales tax.
SHIPPING Shipping/handling charge is 3% or $6 minimum; $5 extra for C.O.D. Larger shipments may require additional charges. Call for information for shipments to Alaska, Hawaii, and points outside the United States.
TERMS All products carry manufacturer's warranties only. Product warranties, guarantees, rebates, trial period privileges, or other promotional programs are handled by the manufacturer. Defective items replaced or repaired at our discretion. All returned items must be accompanied by a return material authorization (RMA) number. There is a 15% restocking fee on non defective merchandise. Shipping is non-refundable. Opened software and other consumables are non refundable. We can not guarantee compatibility. Item availability, price, terms and policies subject to change without notice. **Graphical User Interface CLEARING HOUSE** is not liable for damage due to omissions or typographical errors. Mailing address is **Graphical User Interface CLEARING HOUSE**: P.O. Box 10, Sandy Hook, CT 06482 (203) 268-4400

190-250

Circle 170 on Inquiry Card.

managing their local disks is rapidly becoming yet another centralized responsibility. And why not? An organization's pool of disks constitutes a single critical resource—its long-term memory. It's in everyone's interest to manage that resource as thoroughly, and as automatically, as possible.

With ARCserve, you can schedule workstation backups just as you schedule server backups. At the appointed hour, the server wakes up an agent TSR at the workstation, which then ships the data to the server and thence to tape. A variety of similar solutions exist for DOS-based LANs. Ultinet's Backman includes a workstation agent called Disk+ that communicates with Sytos Plus running on a LAN Manager server.

Several products (including, with release 2.0, TNA) use Fresh Technology's Map Assist to support peer-to-peer backups between any pair of workstations. Legato's NetWorker can reach out to Unix workstations or to DOS machines running PC-NFS. Mountain Network Solutions says that its Data Management Software, built on a portable communications kernel evolved from an alliance with PeerLogic, will by next year support peer-to-peer backups among DOS, Macintosh, and Unix systems.

For DOS-based LANs, the required TSR agent at each station complicates the task of networkwide storage management. Perhaps because Macintosh INITs are less troublesome, peer-to-peer backup solutions seem to be evolving more quickly in that environment. With Dantz Development's Retrospect Remote, the controlling station can not only back up networked Macintoshes but also restore files to them. Because the controlling station keeps a record of all users' archive sets, Retrospect Remote can save time and space by storing duplicate files just once on behalf of a group of users. Innovations such as these suggest that networked storage management will remain a hot topic in 1992.

Taking the Network's Pulse

Sometime in 1992, according to Forrester Research, network nodes connected through hubs will outnumber the nodes connected by way of unstructured wiring. Yet, while hubs virtually dominate new wiring installations, the large base of older wiring won't disappear anytime soon. These two topological classes, each including Ethernet, Token Ring, and ARCnet equipment, require different approaches to physical-layer management.

A hub is an ideal place to put an SNMP agent that can monitor and (to varying degrees) control the ports to which workstations are attached. Leading hub vendors such as Cabletron and Synoptics have taken this tack for several years. Recently, though, it has been getting hard to find a 10Base-T concentrator that *doesn't* offer an optional SNMP-compliant management module.

The use of National Semiconductor's new DP83950 Repeater Interface Controller chip along with that company's Systems Oriented Network Interface Controller chip accounts in part for this trend. The RIC is a 12-port 10Base-T concentrator on a chip. Paired with a SONIC chip and integrated with a wiring concentrator, the RIC enables the concentrator to deliver per-port Ethernet statistics and thereby monitor traffic to and from all connected stations.

Traditional network monitors that attach to cable segments are also evolving into modules that plug into wiring hubs. For example, Cabletron's Multi Media Access Center, a "smart" hub that supports Ethernet, Token Ring, and Fiber Distributed Data Interface connections and can activate redundant paths to maintain fault-tolerant operation, accepts a modular version of Novell's Lantern monitor. The next logical step is to put analysis, as well as monitoring, in the hub. LattisNet's Network Control Engine, built around a SPARC processor that plugs into the LattisNet System 3000 multimedia hub, can run both monitoring and protocol analysis applications.

What if you're stuck with unstructured wiring? You won't be able to isolate or reroute devices, but there's still a need to monitor them. One approach is to use monitors/analyzers such as SpiderProbe/SpiderAnalyzer, Sniffer, LANprobe, or Digilog's LANVista 100. These products observe and characterize network traffic, sound alarms when systemic or node-specific errors occur, and decode protocols. Traditionally dispatched to troublesome segments only in response to network failures, they're now increasingly used as permanent distributed listening posts that continuously report to central consoles. That's an expensive ounce of prevention—typically on the order of $5000 per segment—but more and more organizations critically dependent on their networks find that they can justify the cost.

Of course, not everyone can dedicate pricey hardware to network monitoring. An alternative is a software-only product such as FTP Software's LANWatch, which converts a DOS PC with a standard Ethernet or Token Ring adapter into

GREAT PERFORMANCE GETS YOUR ATTENTION GREAT TECHNOLOGY KEEPS IT

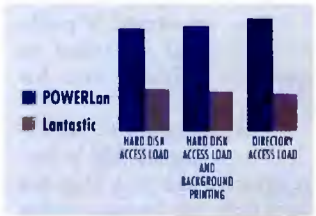
POWERLan

DOS Networking

"POWERLan swept all of the performance categories on our benchmark tests."

"If you need to link DOS, OS/2, Unix, and other platforms in an interoperable network ... POWERLan is the product to choose"

"you can't ignore this powerhouse, POWERLan's features speak for themselves; its speed convinces"



PC MAGAZINE EDITORS' CHOICE
June 25, 1991
POWERLan, Version 2.10

Circle 124 on Inquiry Card.

POWERsave

Network Backup

"This is the fastest single-file restore we found in any of the systems, including server-based units. We didn't believe it either until we ran the test three times."

"simple to use"

"Performance Technology may have the fastest workstation-based drive in Netwaredom."

"offers excellent progress tracking"

"operates ... at warp speed"

LAN Times, June 17, 1991

LAN TIMES RECOMMENDED FOR NETWORKING

POWERfusion

DOS - UNIX Connection

"In our benchmark tests, Performance Technology lived up to its name."

"... the POWERfusion family can support large networks of busy users and still deliver"

"If you're looking for a way to connect your Unix box to a network of DOS-based PCs, look no further."

PC MAGAZINE EDITORS' CHOICE
May 28, 1991
POWERfusion, Version 1.3

"Performance Technology is selling glue technology that can help solve a variety of local- and wide-area networking problems. Lord knows, that's something we all need."

BYTE, March 1991

POWERbridge

LAN to LAN Connection

"Usually I wonder about a product that has "power" associated with it, but POWERbridge ... deserves the honor."

"POWERbridge supports nine operating systems ... links all the networks you'll ever have."

LAN Times, February 4, 1991

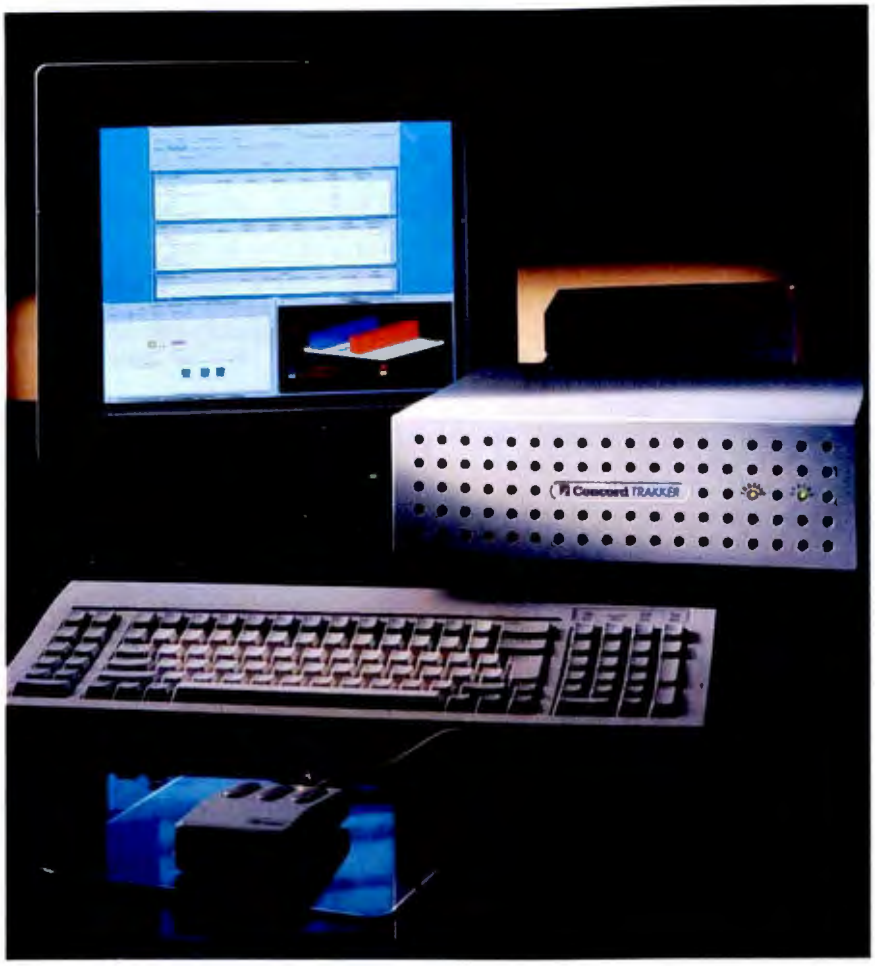
"... well, you haven't lived until ... (you) ... hop through a NetWare LAN to an SMB server running under Unix" (with POWERbridge)

BYTE, March 1991

Sure, we like to make products that go fast. But, performance is just one quality we take seriously. Operating in multi-vendor environments is high on our list too. And there's lots more. Call us to get the rest of the story.

PERFORMANCE TECHNOLOGY

800-FAST-LAN
800-PC-2-UNIX
512-349-2000



***Trakker's** dedicated segment monitors analyze network traffic in real time and report to a central management application based on Sun's SunNet Manager.*

an inexpensive traffic monitor and protocol analyzer.

Another approach to monitoring unstructured Ethernet networks locates intelligence at the nodes themselves. Cabletron offers an SNMP agent (in the form of a TSR) for its own network cards and also for Western Digital and 3Com adapters. The agent can transmit status and throughput data to Cabletron's (or other SNMP-aware) management applications. Racal-InterLan's Roll Call takes a similar tack. SNMP agents running as TSRs ship data to a Racal-InterLan NP600 board located in a NetWare server, which in turn processes the statistics and communicates with a Windows-based management station.

IBM and 3Com also have a proposal for running CMIP on a pared-down protocol stack that DOS PCs could accommodate. Called the Heterogeneous LAN Management specification, it has attracted attention, but no adherents to date.

Diagnosis and Treatment

Networks are proliferating much faster than are folks who can make effective use of protocol analyzers. Like a software debugger, an analyzer requires you to build up a mental model of the operation of a complex system and then generate and test hypotheses about its behavior. Emerging now are smarter analyzers that incorporate such models and test hypotheses on their own.

HP touts its Network Advisor as one of this new breed. A typical session with Network Advisor, according to HP, may go something like this: Network Advisor's Fault Finder software detects an Address Resolution Protocol broadcast storm, conducts an experiment to locate the station whose misconfigured IP broadcast address caused the storm, and then recommends how to reconfigure the offending station.

Cabletron's enterprise management system, Spectrum, hinges on what the company calls *inductive modeling*. The system incorporates models of all Spectrum-supported network components (hardware and software) and troubleshoots by comparing observed network behaviors with those predicted by the models.

Expert systems notwithstanding, the complex idiosyncrasies of networks will keep human experts in business for a long time to come. Analytical tools that can assist these experts are advancing on two fronts: toward continuous real-time monitoring and toward protocol analysis that fully comprehends the application-level semantics, as well as the transport-level syntax, of network communication. Concord's Trakker, introduced recently, represents both of these trends.

Trakker's segment monitors incorporate 20-million-instruction-per-second RISC processors with up to 16 megabytes of RAM. Why so much horsepower? Concord says that the units decode "all protocol layers, all the time, in real time." (That's true, in the initial release, for TCP/IP, DECnet, and AppleTalk; decoding of NetWare and LAN Manager protocols stops at the link layer.) Because up-to-the-minute results of application-level protocol analysis are always present in the distributed monitors' buffers, available for inspection from the SunNet Manager-based console, there's typically no need to re-create a problem in order to produce data for analysis.

Suppose, for example, that a certain mount request issued to a Network File System host fails, not because either the client or the server is at fault but because an intervening router is misconfigured. Trakker can instantly confirm that the client did issue a valid NFS mount request, that the server never saw that request, and that during the same period the server did receive and respond to NFS requests from other clients. Ruling out likely NFS problems in this way, an analyst could quickly proceed to isolate the faulty router.

Concord argues that abundant real-time data, coupled with application-layer analysis, helps the network manager see services, and interruptions of service, at a level of abstraction that's appropriate for solving problems such as "BIX is broken." Which reminds me: BIX really is "broken" this morning, and I've got to go find out why. Let's hope things get simpler next year. ■

Jon Udell, a BYTE senior technical editor at large, manages the BYTE editorial LAN. You can contact him on BIX as "judell."

COMPANY INFORMATION:

NETWORK MANAGEMENT

AG Group
2540 Camino Diablo,
Suite 202
Walnut Creek, CA 94596
(415) 937-7900
fax: (415) 937-2479
EtherPeek *$695*
LocalPeek *$495*
NetPatrol Pack *$1195*
Net Watchman *$195*
Circle 1236 on Inquiry Card.

BICC Communications
103 Millbury St.
Auburn, MA 01501
(800) 447-6526
(508) 832-8650
fax: (508) 832-8689
IsoLAN EtherConnect System/10 ..... *$2390*
Isoview Network Manager 3.0 ..... *$5000*
Management Card *$1995*
Circle 1237 on Inquiry Card.

Blue Lance
P.O. Box 430546
Houston, TX 77243
(713) 680-1187
fax: (713) 622-1370
LT Helpdesk ..... *$495–$995*
LT Stat *$295*
Circle 1238 on Inquiry Card.

Brightwork Development, Inc.
766 Shrewsbury Ave.,
Jerral Center W
Tinton Falls, NJ 07724
(800) 552-9876
(908) 530-0440
fax: (908) 530-0622
LAN Automatic Inventory ... *$695*
LAN Support Center *$595*
Circle 1239 on Inquiry Card.

Cabletron Systems, Inc.
P.O. Box 6257
Rochester, NH 03867
(603) 332-9400
fax: (603) 332-4616
IRM *$2275*
Multi Media Access Center *$1850*
Spectrum *$50,000*
Circle 1240 on Inquiry Card.

Cheyenne Software, Inc.
55 Bryant Ave.
Roslyn, NY 11576
(800) 243-9462
(516) 484-5110
fax: (516) 484-3446
ARCserve
for NetWare 286 ..... *$1195*
for NetWare 386 ..... *$1895*
Monitrix (soft monitor) *$895*
Circle 1241 on Inquiry Card.

Comdisco Systems, Inc.
919 East Hillsdale Blvd.
Foster City, CA 94404
(415) 574-5800
fax: (415) 358-3601
BONES *$20,000*
Circle 1242 on Inquiry Card.

Concord Communications, Inc.
753 Forest St.
Marlborough, MA 01752
(508) 460-4646
fax: (508) 481-9772
Trakker
hard monitor, analyzer (per segment) *$5200*
management console .. *$18,000*
Circle 1243 on Inquiry Card.

Connect Computer Co., Inc.
9855 West 78th St., Suite 270
Eden Prairie, MN 55344
(612) 944-0181
fax: (612) 944-9298
Lanscope Monitor *$295*
Lanscope Resource Manager *$495*
Circle 1244 on Inquiry Card.

CSG Technologies, Inc.
530 William Penn Place,
Suite 329
Pittsburgh, PA 15219
(800) 366-4622
(412) 471-7170
fax: (412) 471-7173
Network Supervisor ..... *$495–$1295*
Circle 1245 on Inquiry Card.

Dantz Development Corp.
1400 Shattuck Ave., Suite 1
Berkeley, CA 94709
(415) 849-0293
(415) 849-1708
Retrospect Remote .. *$495 and up*
Circle 1246 on Inquiry Card.

Digilog, Inc.
1370 Welsh Rd.
Montgomeryville, PA 18936
(800) 344-4564
(215) 628-4530
fax: (215) 628-3935
LANVista 100 ... *$3500–$10,495*
Circle 1247 on Inquiry Card.

Dolphin Software, Inc.
4405 International Blvd.,
Suite B-108
Norcross, GA 30092
(404) 279-7050
LAN Command *$395*
Circle 1248 on Inquiry Card.

Farallon Computing, Inc.
2000 Powell St.
Emeryville, CA 94608
(415) 596-9000
fax: (415) 596-9020
PhoneNET Manager's Pack *$995*
Circle 1249 on Inquiry Card.

Fresh Technology Group
1478 North Tech Blvd.,
Suite 101
Gilbert, AZ 85234
(800) 545-8324
(602) 497-4200
fax: (602) 497-4242
Map Assist *$349*
NetVision *$495*
Circle 1250 on Inquiry Card.

Frye Computer Systems, Inc.
19 Temple Place, Fourth Floor
Boston, MA 02111
(800) 234-3793
(617) 247-2300
fax: (617) 451-6711
NetWare Early Warning System *$495*
NetWare Management *$495*
Circle 1251 on Inquiry Card.

FTP Software, Inc.
26 Princess St.
Wakefield, MA 01880
(617) 246-0900
fax: (617) 246-0901
LANWatch *$1200*
Circle 1252 on Inquiry Card.

Hewlett-Packard Co.
Colorado Telecommunications Division
5070 Centennial Blvd.
Colorado Springs, CO 80919
(719) 531-4000
fax: (719) 531-4505
LANprobe ..... *$4470–$4495*
Network Advisor *$19,500*
OpenView ..... *$7000–$30,000*
ProbeView *$5000*
Circle 1253 on Inquiry Card.

Horizons Technology, Inc.
3990 Ruffin Rd.
San Diego, CA 92123
(619) 292-8320
fax: (619) 292-7321
LANAuditor *$495*
Circle 1254 on Inquiry Card.

Internetix, Inc.
8903 Presidential Pkwy.,
Suite 210
Upper Marlboro, MD 20772
(800) 562-7292
(301) 420-7900
fax: (301) 420-4395
LANsim *$9995*
Softbench *$995*
Circle 1255 on Inquiry Card.

IsiCAD, Inc.
P.O. Box 61022
Anaheim, CA 92803
(714) 533-8910
fax: (714) 533-8642
Command 2000 ..... *$12,950*
Command 5000 ..... *$15,000*
Circle 1256 on Inquiry Card.

COMPANY INFORMATION:

NETWORK MANAGEMENT *(continued)*

LANSystems, Inc.
300 Park Ave. S
New York, NY 10010
(800) 458-5267
(212) 995-7700
fax: (212) 995-8604
LANSight 2.0 ..... *$395*
Circle 1257 on Inquiry Card.

Legato Systems, Inc.
260 Sheridan Ave.
Palo Alto, CA 94306
(415) 329-7880
fax: (415) 329-8898
NetWorker ..... *$2500–$4995*
Circle 1258 on Inquiry Card.

Magee Enterprises, Inc.
P.O. Box 1587
Norcross, GA 30091
(800) 662-4330
(404) 446-6611
fax: (404) 368-0719
Network H.Q. *$395*
Circle 1259 on Inquiry Card.

Mountain Network Solutions, Inc.
240 East Hacienda Ave.
Campbell, CA 95008
(800) 458-0300
(408) 379-4300
fax: (408) 379-4302
Data Management Software
Mountain FileMan (per node) *$199*
Mountain Connect (per network) *$595*
Circle 1260 on Inquiry Card.

NetWave, Inc.
19 Rector St., Suite 1114
New York, NY 10006
(212) 480-1408
fax: (212) 635-2529
LANconfig *$395*
LAN Track (per server) *$595*
Circle 1261 on Inquiry Card.

Network & Communication Technology, Inc.
24 Wampum Rd.
Park Ridge, NJ 07656
(201) 307-9000
fax: (201) 307-9404
Planet *$4995*
Circle 1262 on Inquiry Card.

NetWorth, Inc.
80101 Ridgepoint Dr.
Irving, TX 75063
(800) 544-5255
(214) 869-1331
fax: (214) 556-0841
EtherManager *$2395*
EtherNext Series 4000 ..... *$1295*
Network Management Module *$2395*
Smart 10Base-T Host Module *$2995*
Circle 1263 on Inquiry Card.

Novell, Inc.
122 East 1700 South
Provo, UT 84606
(800) 453-1267
(801) 429-7000
fax: (801) 429-5775
LANalyzer ..... *$10,000–$20,000*
Lantern *$4995*
Lantern Service Monitor ... *$4995*
Circle 1264 on Inquiry Card.

Palindrome Corp.
850 East Diel Rd.
Naperville, IL 60563
(708) 505-3300
fax: (708) 505-7917
The Network Archivist ..... *$995–$2985*
Circle 1265 on Inquiry Card.

Pharos Technologies, Inc.
4243 Hunt Rd.
Cincinnati, OH 45242
(800) 548-8871
(513) 984-9273
fax: (513) 984-1653
StatusMac ..... *$449–$1199*
Circle 1266 on Inquiry Card.

ProTools, Inc.
14976 Northwest Greenbrier Pkwy.
Beaverton, OR 97006
(503) 645-5400
fax: (503) 645-3577
Protolyzer ..... *$6995 and up*
Circle 1267 on Inquiry Card.

Racal-InterLan
155 Swanson Rd.
Boxborough, MA 01719
(800) 526-8255
(508) 263-9929
fax: (508) 263-8655
Roll Call *$995*
Circle 1268 on Inquiry Card.

Silicon Graphics, Inc.
2011 North Shoreline Blvd.
Mountain View, CA 94039
(415) 960-1980
NetVisualyzer Data Station (per segment) *$7100*
NetVisualyzer Display Station *$19,500*
Circle 1269 on Inquiry Card.

Spider Systems, Inc.
12 New England Executive Park
Burlington, MA 01803
(800) 447-7807
(617) 270-3510
fax: (617) 270-9818
SpiderAnalyzer *$15,600*
SpiderProbe ..... *$3450–$4950*
Circle 1270 on Inquiry Card.

Sun Microsystems, Inc.
2550 Garcia Ave.
Mountain View, CA 94043
(800) 821-4643
(800) 821-4642 in California
(415) 960-1300
fax: (415) 969-9131
SunNet Manager *$3000*
Circle 1057 on Inquiry Card.

Synoptics Communications, Inc.
P.O. Box 58185
Santa Clara, CA 95052
(408) 988-2400
fax: (408) 988-5525
LattisNet Advanced Network Management *$5550*
LattisNet Basic Network Management *$2295*
LattisNet Network Management for Unix *$7000*
LattisNet System 3000 ..... *$1395–$3995*
Network Control Engine ... *$9995*
Circle 1058 on Inquiry Card.

Sytron Corp.
117 Flanders Rd.
Westborough, MA 01581
(508) 898-0100
fax: (508) 898-2677
Sytos Plus
DOS *$225*
OS/2 ..... *$295*
Circle 1059 on Inquiry Card.

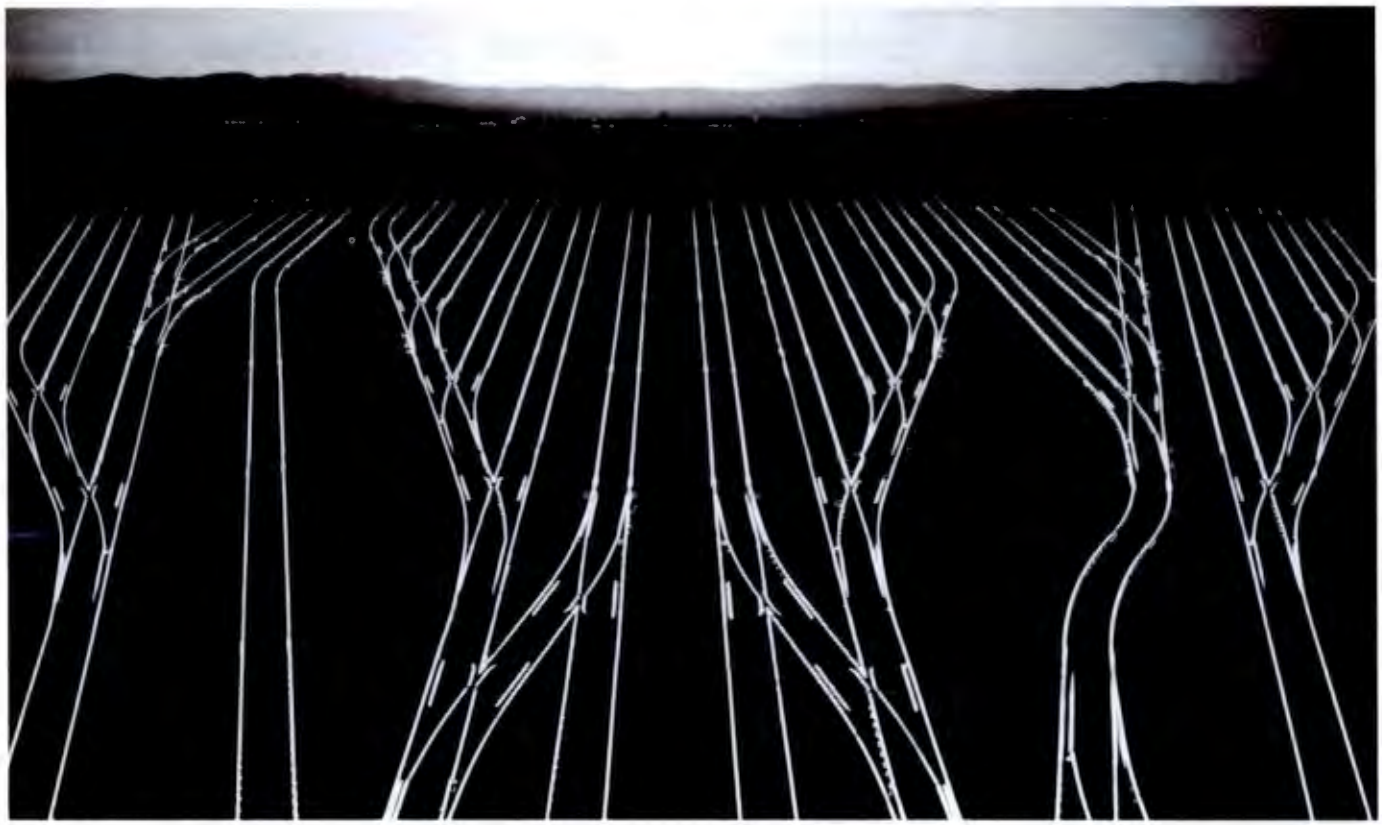
Thomas-Conrad Corp.
1908-R Kramer Lane
Austin, TX 78758
(800) 332-8683
(512) 836-1935
fax: (512) 836-2840
HubTalk *$279*
Smart-Hub ..... *$895 and up*
TXD *$195*
Circle 1119 on Inquiry Card.

Trilogy Development Group
350 Cambridge Ave., Suite 200
Palo Alto, CA 94306
(415) 321-5481
fax: (415) 321-8100
Netbuild ..... *$1000–$2000*
Circle 1120 on Inquiry Card.

Ultinet Development, Inc.
P.O. Box 34016
Los Angeles, CA 90034
(213) 204-0111
fax: (213) 204-0110
Backman ..... *$3257–$6727*
Circle 1121 on Inquiry Card.

Ungermann-Bass, Inc.
3900 Freedom Cir.
Santa Clara, CA 95052
(800) 873-6381
(408) 496-0111
fax: (408) 970-9300
Access/One (11-slot hub) *$2495*
NetDirector (per server) ..... *$7500–$16,000*
Circle 1122 on Inquiry Card.

Need to make technology decisions? Let Datapro put you on the right track.



Technology decisions. The choices are many. And each one determines where you and your company can go in the future.

Whether you're planning, marketing or purchasing technology, you need a source of technology product information that can get you on the right track... and keep you there. That source is Datapro.

Datapro provides information solutions that are:

- **Comprehensive**—We offer a complete range of information services.
- **Accurate**—Our data is dynamically updated from more than 100,000 sources as changes occur.
- **Timely**—Our tiered delivery system gives you essential information when it happens, more in-depth information when it becomes available.
- **Convenient**—You can obtain our information in a range of easy-to-follow, immediately usable formats on a variety of media.

So call 1-800-DATAPRO to find out more about how we can help you get on—and stay on—the right track.

DATAPRO

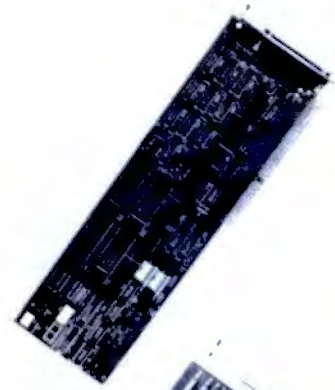
Information Services
Group
600 Delran Parkway
Delran, New Jersey 08075

Your information source for better business decisions.

Circle 166 on Inquiry Card.

QUATECH

"not just another board game"



COMMUNICATION

Quatech produces a full line of communication boards for the PC-XT, AT and MicroChannel systems including:

Asynchronous:

2 port for PC/AT
- DS-100:RS-232
- DS-200:RS-422
- DS-300:RS-485

2 port for PC/XT/AT
- DS-102:RS-232
- DS-202:RS-422
- DS-302:RS-485

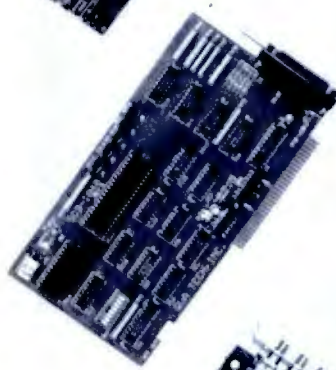
Synchronous

Bisync, SDLC, HDLC
- SCB-1020
  - 1 channel RS-232
- SCB-1040
  - 1 channel RS-422
- SCB-1050
  - 1 channel RS-485

Multiport

8 port RS-232
- ES-100
  - Block addressing
- MS-100
  - Selectable addressing by port

4 port RS-232
- QS-100
  - Flexible addressing

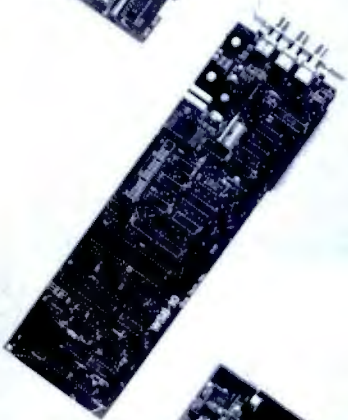


WAVEFORM SYNTHESIZER

The WSB-100 Waveform Synthesizer Board has the best set of numbers in the market. With speeds to 20MHz and 32K memory at $1290, it's making waves in more ways than one.

WSB-10
- •PC/XT/AT, 12 bit arbitrary signal generator
- •Onboard oscillator for independent operation
- •Internal data rates programmable from 200 nS/point to 429 sec/point
- •Output signal defined up to 2048 pts.
- •10 Megahertz maximum output

WSB-100
- •PC/AT, modular arbitrary signal generator
- •DMA support for high speed waveform definition
- •Output signal defined up to 32,000 points
- •20 Megahertz maximum output
- •An analog or digital module is required for operation
  - WSB-A12: 12 bit analog waveform module
  - WSB-D16: 16 channel digital pulse generator module



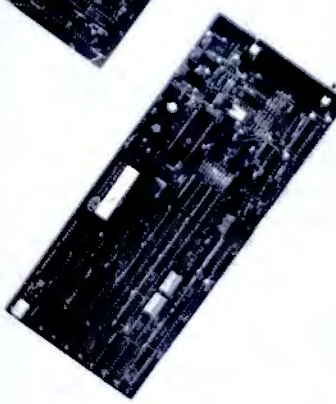
DATA ACQUISITION

Quatech has developed a full line of data acquisition products for the IBM PC-XT, AT, MicroChannel and compatibles. These high performance, low cost boards provide analog-to-digital, digital-to-analog, and digital input/output functions.

PXB-160
- •True 16 bit digital I/O
- •Configurable as two eight-bit ports
- •Handshake signals available for 16 bit I/O transfer
- •List price below $400

SAC-12
- •16 single ended A/D input channels
- •12 bit resolution
- •3 16 bit interval counters/timers
- •3 digital I/O lines
- •Switch selectable address

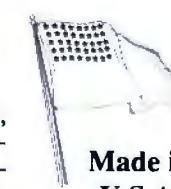
DAQ-16
- •8 A/D inputs & 2 D/A outputs
- •16 bit/100KHz
- •4 digital I/O lines
- •2 DMA channels for continuous acquisition



1-800-553-1170

Call for a free catalog or fax (216) 434-1409

International distributors call: Australia/Interworld Electronics 03-521-2952, Canada (Western)/Interworld VCR 604-984-4171, England/Diamond Point International 634-722-390, Finland/Lab Hitech OY 0672497, France/Elexo 33-1-69302880, Germany/Jupiter Electronic Systems 06181/75041, Israel/RCM Ltd. 972-03-5447885, Italy/N.C.S. Computer Italia 03311 770-016, Netherlands/ACAL Auriema 040-816565. IBM PC-XT, AT and MicroChannel are registered trademarks of IBM Corporation.

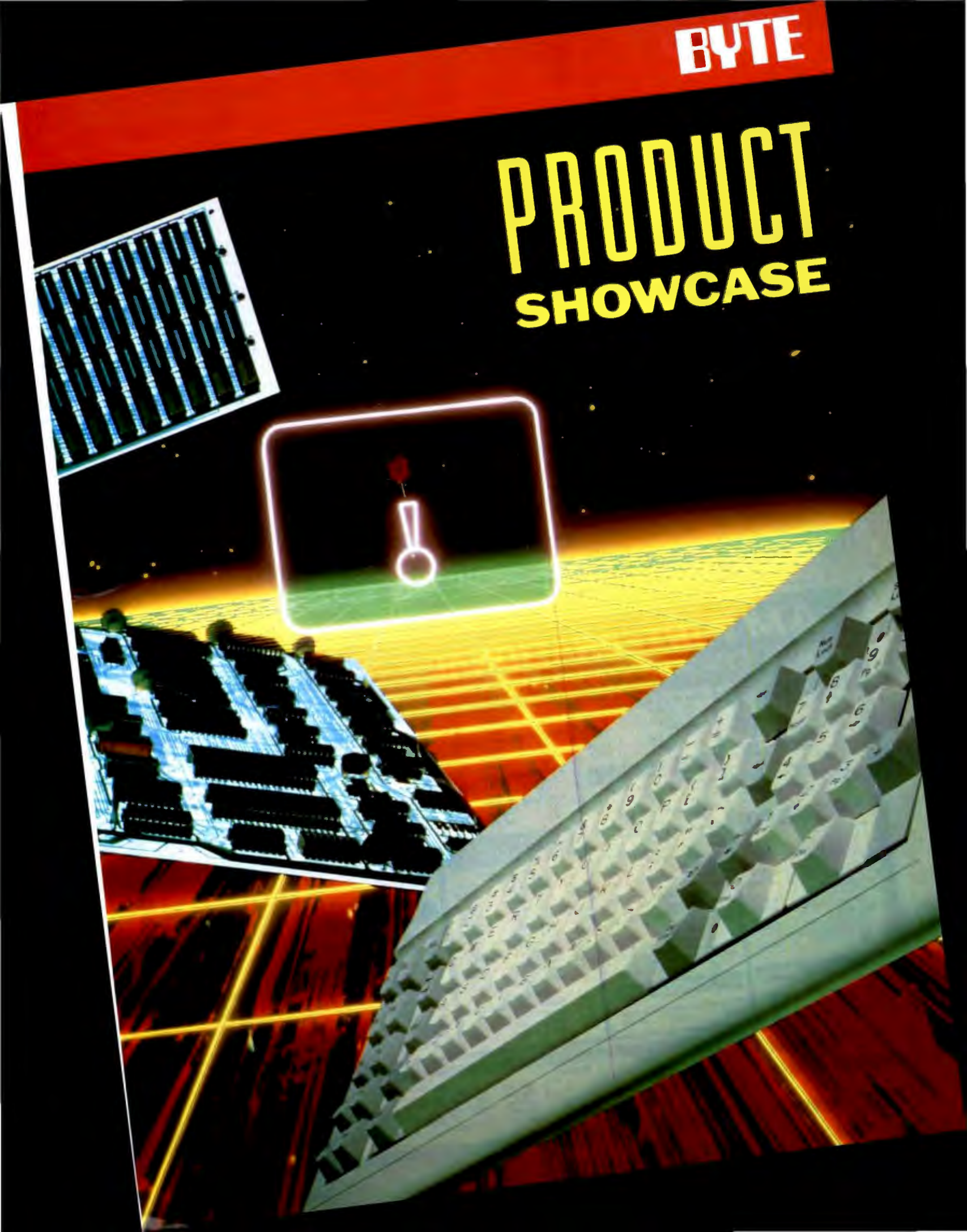


Made in U.S.A.

Circle 132 on Inquiry Card.

BYTE

PRODUCT SHOWCASE



CATALOG SHOWCASE

Advertisers: For more information contact Ellen Perham at (603) 924-2598.

MicroProse Software, Inc.

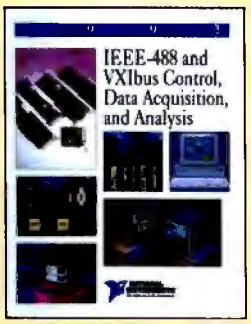
The hottest entertainment software for any PC is at your fingertips! Featuring state-of-the-art graphics and sound, MicroProse games test your decision-making and leadership skills in the most challenging and exciting situations imaginable. From action-packed simulations of America's hottest military weaponry, to fascinating role-playing adventures in fantastic universes, to addictive strategic challenges of amazing depth and detail, MicroProse entertainment software makes computing fun again.

MicroProse Software, Inc., 180 Lakefront Drive, Hunt Valley, MD 21030

301-771-1151 FAX: 301-771-1174

Circle 94 on Inquiry Card

National Instruments



Instrument Control and Data Acquisition

Free 1992 catalog instrumentation products for PCs, workstations, and more. Features IEEE-488.2 interfaces and software, plug-in data acquisition boards, VXIbus controllers, DSP hardware and software, and signal conditioning accessories. Application software for complete acquisition, analysis, and presentation of data, including graphical interfaces. Application tutorials and training classes also detailed.

National Instruments, 6504 Bridge Point Parkway, Austin TX 78730

512-794-0100 FAX: 512-794-8411

1-800-433-3488 (U.S. & Canada)

Circle 102 on Inquiry Card

Avocado Computer Video

Everything you ever wanted to know about video but didn't know where to ask in a free catalog of computer-related video products. Videotapable VGA cards, video digitizers, splitter amplifiers and extension cables, specialty software for titling and imaging, special effects. Applications range from hobby to Hollywood, and training to research. Our special projects department is unfazed by unusual requests.

Contact Avocado Computer Video, P.O. Box 1655, Wheaton MD 20915.

We Speak Video

1-800-627-3432 FAX: 301-593-2757

Circle 15 on Inquiry Card

BYTE Catalog Showcase

Advertisers:

The Catalog Showcase is the most effective low-cost way to promote your product line to 500,000 technically sophisticated, knowledgeable buyers of computer products!

Call Ellen Perham for more details.

603-924-2598 FAX: 603-924-2683

AMT INTERNATIONAL

(408) 432-0552 • (408) 432-1790

Booth No. 14743
COMDEX, Las Vegas
Fax: (408) 944-9801

COMPAQ MEMORY

DeskPro 286-E, 386-20/20E/25
1MB 113131-001 ..... $125.00
4MB 113132-001 ..... $330.00
DeskPro 286N, 386N and 386SX
2MB 118689-001 ..... $200.00
4MB 118690-001 ..... $545.00
DeskPro 386S
1MB 113646-001 ..... $125.00
4MB 112534-001 ..... $315.00
DeskPro 386-33, 486-33 & SystemPro
2MB 115144-001 ..... $200.00

AST MEMORY

Bravo-286, Workstation
512K Kit500510-010 ..... $59.00
2MB Kit 500510-002 ..... $150.00
Premium 386-16/20C
1MB Kit 500510-007 ..... $95.00
4MB Kit 500510-008 ..... $275.00
Premium 386-20
1MB Kit 500510-003 ..... $150.00
4MB Kit 500510-004 ..... $350.00
Bravo-386SX
4MB Kit 500510-008 ..... $369.00
Premium 386-SX/25/33 & 486-25
1MB 500718-002 ..... $80.00

HEWLETT-PACKARD MEMORY

Vectra QS/TS3
1MB D1540A $112.00
4MB D1542A $325.00

Vectra QS/20PC, RS/25PC and 20C
1MB D1640A $126.00
4MB D1642A $365.00
Vectra 486PC
1MB D2150A $115.00
4MB D2151A $390.00

IBM PS/2 MEMORY

Models 30-286, Exp. Board 1497259
512 K Kit 30F5348 ..... $54.00
2MB Kit 30F5360 ..... $175.00
Models 70-E61/121, 55SX, 65SX
1MB 6450603 ..... $95.00
Models 70-E81/121, 50Z, 55SX,65SX
2MB 6450604 ..... $179.00
Models 55SX, 65SX, 34F3077 & 34F3011
4MB 34F2933 ..... $370.00
Models 70-A21
2MB 6450608 ..... $150.00
Models 80-141
1MB 6450375 ..... $145.00
Models 80-111/311
2MB 6450379 ..... $220.00
All Models 70 and 80
2-8MB w/2M 6450605 ..... $489.00
2-14MB w/2M 34F3077 ..... $500.00
2-16MB w/4M 34F3077 ..... $925.00
Models 90, 95Z, 95 SX &80
2-8MB 1497259 ..... $599.00

LASER PRINTER MEMORY

Hewlett-Packard Laser Jet IIP, III & IIID
1MB 33474B $110.00
2MB 33475B $150.00
4MB 33477B $215.00
Hewlett-Packard Laser Jet IIP & IID
1MB 33443B $110.00
2MB 33444B $150.00
4MB 33445B $215.00
IBM Laser 4019 and 4019e
2MB 1039137 ..... $369.00
3.5MB 1038675 ..... $469.00
Canon LBP-8II, 8III, 8IIT
2MB S63-1880 ..... $225.00
4MB Part #N/A $439.00

LAPTOP AND PORTABLE MEMORY

TOSHIBA MEMORY
1MB Model 1000SE/XE $265.00
2MB Model 1000SE/XE $325.00
2MB Model T1200XE $230.00
2MB Model T1600 ..... $230.00
2MB Model T3100E $175.00
2MB Model T3100SX $175.00
4MB Model T3100SX $395.00
2MB Model T3200SX $175.00
4MB Model T3200SX $395.00
2MB Model 5100 ..... $215.00
2MB Model T5200,T8500 ..... $185.00
8MB Model T5200,T8500 ..... $950.00

ZENITH MEMORY
1MB SuperSport 286 & 286E $199.00
2MB SuperSport 286 & 286E $350.00
2MB SuperSport SX/Alpha ... $350.00
4MB SuperSport SX/Beta $350.00

COMPAQ MEMORY
1MB Portable LTE 286 ..... $175.00
2MB Portable LTE 286 ..... $225.00
1MB SLT-286 ..... $225.00
4MB SLT-286 ..... $775.00

NEC MEMORY
1MB Prospeed 286 ..... $270.00
2MB Prospeed 386 ..... $450.00

ZENITH MEMORY

Zenith Z-386/20/25/33 & 33E
1MB ZA36/3800ME $100.00
4MB ZA3800MK $525.00
Zenith Z-386/20/20/25 & 33
2MB ZA3600MG $199.00
Zenith Z-386 SX
2MB Z-605-1 ..... $225.00

MATH COPROCESSORS

INTEL
8087-5MHz $80.00
8087-2 8MHz $116.00
8087-1 10MHz $155.00
80287-6 6MHz $89.00
80287-8 8MHz $89.00
80287XL 8/10MHz $99.00
80287XTL 12 MHz (Laptop) $105.00
80287-10 10MHz $89.00
80C287-12 12MHz $109.00
80387SX-16 ..... $135.00
80387SX-20 ..... $145.00
80387DX-20 ..... $215.00
80387DX-25 ..... $225.00
80387DX-33 ..... $235.00

WEITEK
3167-20 20MHz $300.00
3167-25 25MHz $450.00
3167-33 33MHz $500.00
4167-25MHz $600.00
4167-33MHz $750.00

CYRIX
83D87-16 16MHz $175.00
83D87-20 20MHz $175.00
83D87-25 25MHz $175.00
83D87-33 33MHz $185.00
83SX87-16 16MHz $120.00
83SX87-20 20MHz $125.00

IIT
8C87-8 ..... $69.00
8C287-10 ..... $79.00
8C287-12 ..... $89.00
8C287-20 ..... $99.00
8C387-20 ..... $175.00
8C387-25 ..... $175.00
8C387-33 ..... $200.00

AMD
80C287-10 ..... $89.00
80C287-12 ..... $110.00

SIMM MODULES

IBM TYPE
Add $2.00 for SIPPS
4Mx9-80 ..... $190.00
1Mx9-60 ..... 60.00
1Mx9-10 ..... 45.00
1Mx9-80 ..... 49.00
1Mx9-70 ..... 51.00
256x9-70 ..... 18.00
256x9-10 ..... 14.00
256x9-80 ..... 16.00
256x9-60 ..... 18.00

APPLE-MAC
1Mx8-70 ..... $50.00
1Mx8-10 ..... $40.00
1Mx8-80 ..... $45.00
4x8-80 ..... $190.00

2393 QUME DRIVE,
SAN JOSE, CA 95131

DRAM · DRAM · DRAM

DRAM 1MBX1
1 MGXI-120NS $5.00
1 MGXI-100NX 5.25
1 MGXI-80NX 5.50
1 MGXI-70NX 5.75
1 MGXI-60NX 7.50

DRAM 4MBX1
4164-150 ..... $2.00
4164-120 ..... 2.50
4164-100 ..... 2.75
4164-80 ..... 3.00

DRAM 64X4
4464-15 ..... $1.50
4464-12 ..... 1.99
4464-10 ..... 2.50

DRAM 256X1
256X1-150NS $1.79
256X1-120NS 1.99
256X1-100NS 2.00
256XI-80NS 2.25
256XI-70NS 2.35
256XI-60NS 3.99

DRAM 256X4
256X4-120NS $5.00
256X4-100NS 5.50
256X4-80NS 5.75
256XI-STATIC COL
512S8P-10 ..... $2.99

AAA 2800-08 ..... 3.00
AAA 2800-07 ..... 3.25
AAA 2800-60 ..... 4.50
1X4-80 ZIPP 35.00
1X4-80STT ZIPP 39.00
1X4-70STT ZIPP 39.00

Circle 13 on Inquiry Card.

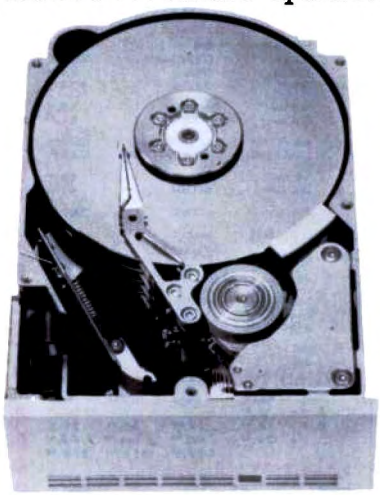
FACTORY DIRECT Hard Drives

(and trade-ins too!)

You can't beat our hard disk prices. They're the best because we sell factory-direct-to-you. Even priced lower than the Superstores!

And not only do we have the best prices, we even have real people to answer your tech questions. Our people are here to help you.

You want reliability and quality? We give you a one-year guarantee, sometimes more . . . that's quality and reliability!



Here's more good news. There's never any "fine print" in our ads . . . just unbelievable factory direct prices and great service.

Call our toll-free 800 number for more details. Ask about our trade-in policy.

ROSE HILL

4865 Scotts Valley Drive
Scotts Valley, CA 95066
(408)438-3871
1-800-248-ROSE

40MB $184

- Western Digital
- MOD # 93044A
- IDE 28MS
- ***Includes:*** Rails, Cables and 5¼" Bracket

80MB $299

- Western Digital
- MOD # AC280
- IDE 17MS
- ***Includes:*** Rails, Cables and 5¼" Bracket

120MB $399

- Microscience
- MOD # 7100-20
- IDE 18MS
- ***Includes:*** Rails, Cables and 5¼" Bracket

200MB $599

- Microscience
- MOD # AT4200
- IDE 17MS
- ***Includes:*** Rails, Cables and 5¼" Bracket

330MB $1095

- Microscience
- MOD # 2414-3414
- ESDI or SCSI-14MS
- ***Includes:*** Mounting, Hardwares and Software

660MB $1495

- Microscience
- MOD # 2777-3777
- ESDI or SCSI-14MS
- ***Includes:*** Mounting, Hardwares and Software

All Drives

- 30-day money back guarantee
- Ask for details on our trade-in policy
- VISA and MasterCard

NEVADA COMPUTER

WE GUARANTEE LOWEST PRICES

ON SYSTEMS, MONITORS & PRINTERS TOO! CALL 800-654-7762

WORDSTAR 6.0

OR WORDSTAR 2000 REL. 3.5

This is not a misprint! These are the exact same ones selling for over $300.00 from our competitors We have thousands in stock

FOR SALE BELOW DISTRIBUTOR COST! LIST $495.00 ea

CALL FOR QUANTITY PRICING!

YOUR CHOICE **99.00** ea.

150 MEG TAPE BACKUP

Mfg by Wangtec Part #5150PK, compatible with MS Dos, Novell, SCO Xenix, Pick systems Complete kit W/ controller, cable and manual FREE SY-TOS Software

LIST $1495.00 YOUR COST **499.00** (60 MEG KIT 399.00)

PS/2 50/60 BOARD

AST ADVANTAGE/2

Comes with 2Meg expandable to 8Meg using SIMMS. SuperPak utility software.

OK - **49.00**

2MEG - **149.00** 4MEG - **249.00** 8MEG - **449.00**

10 MEG HARD DRIVE

Half height - 80 MSEC 6 Month Warranty List 149 00

Your Cost **69.00**

20 MEG HARD DRIVE

3½ " - 40MSEC 6 MONTH WARRANTY

W/ 5¼ "MOUNTS - LIST $249.99 YOUR COST **99.00**

FAX CARD W/ 2400 BAUD MODEM

Automatic group III digital FAX, background operation, send and receive text, screen images, scan pages, Hayes compatible, modem built on

FAX 9600/7200/4800/2400 Software, telephone cord

LIST 695.00 YOUR COST **119.00**

MODEMS

Fully Hayes compatible, monitor speaker w/ volume control 2400/300 Baud transmission rate, addressable COM 1,2,3,4, Compatible w/ IBM PC, XT, AT & Compatibles 2year Manuf. Warranty Full Duplex operation, complete with software Auto dial, Auto answer

INTERNAL **59.00** EXTERNAL **79.00**

SEAGATE HARD DRIVES

MODEL	SIZE	ACCESS TIME	INTERFACE	DRIVE	W/CONTROLLER
ST225	21MB	65MSEC	MFM	149.00	199.00
ST157A	44MB	28MSEC	IDE	199.00	239.00
ST251-1	42MB	28MSEC	MFM	229.00	269.00
ST296N	85MB	28MSEC	SCSI	299.00	439.00
ST1096N	84MB	24MSEC	SCSI	349.00	489.00
ST1102A	86MB	20MSEC	IDE	339.00	379.00
ST4096	80MB	28MSEC	MFM	449.00	538.00
ST1126A	111MB	15MSEC	IDE	359.00	398.00
ST4144R	122MB	28MSEC	RLL	499.00	598.00
ST1144A	125MB	20MSEC	IDE	399.00	438.00
ST1239A	211MB	15MSEC	IDE	449.00	488.00
ST2383A	338MB	16MSEC	IDE	1279.00	1338.00

CONTROLLERS

IDE HD/Floppy **39.00**, 16 Bit WD 2 1 **49.00**, 8 Bit HD only **49.00**

FOR FLOPPYS Super Floppy Controls 1 2, 360K, 720K & 1 44 Drives **49.00**

FLOPPY DRIVES

360K 5¼ " **54.00**, 720 3½ " **54.00**, 1 2 MEG **79.00**, 1.44MEG 3½ " **79.00**

Tandon TM100-2, the original IBM Drive **99.00**

101 or 84 KEY KEYBOARD

New 1 year Warranty, works on XT, AT & 386's Low cost, high quality by Mitsumi

LIST $79.00 YOUR COST **19.00** 101 KEY **39.00**

COMPLETE SYSTEM

299.00

NEW! *6 MONTH WARRANTY*

IBM COMPATIBLE

8088 4.77 OR 8MHZ
2 PARRALLEL, 1 SERIAL
CLOCK/CALENDER
GAME PORT
TEAC 360K ½ HT. FLOPPY
88 KEY KEYBOARD
640K MEMORY, DOS 3.2
12" MONO CARD & MONITOR, COMPLETE DOCUMENTATION.

REAL IBM PS2 MODEM

300/1200 BAUD INTERNAL FOR MICROCHANEL **29.00**

INTEL

COPROCESSOR / 5 YEAR WARRANTY!

8088 BASED MACHINES:	80286 BASED MACHINES:	80386 BASED MACHINES:
8087-5 4MHz, **49.00**	80287-6 6MHz **49.00**	80387-16 16MHz **185.00**
8087-2 8MHz **79.00**	80287-8 8MHz **59.00**	80387-20 20MHz **199.00**
8087-1 10MHz **119.00**	80287-10 10MHz **89.00**	80387-25 25MHz **269.00**
	80287-XL **99.00**	80387-SX16 **129.00**
		80387-SX20 **149.00**

200 WATT POWER SUPPLY

Direct AT replacement, UL Appr , 110/220V, 4 Drive Connectors

LIST $99.00 YOUR COST **39.00** (150 WATT for XT **49.00**)

MINISCRIBE HARD DRIVE

* 3180E 5¼ " * 154MEG * ESDI - 18MSEC Access Time *New Factory Packed! LIST $1295.00 **YOUR COST 499.00**

(71MEG MFM, 20MSEC, ½ HT 5¼ "YOUR COST **349.00**)

*WE WILL BEAT ALL COMPETITION ON MEMORY!!!

COMPAQ MEMORY

MODEL	MEMORY ADDED	COMPAQ EQUIV PART#	YOUR COST
DESKPRO 286	512K KIT	113012-001	59.00
DESKPRO	1MB MODULE	118688 001	79.00
286N, 386N	2MB MODULE	118689 001	148.00
386SX/20	4MB MODULE	118690-001	338.00
DESKPRO	1MB BOARD	108069 001	278.00
386/16	2MB BOARD	108069W71	348.00
	1MB KIT	108071-001	128.00
	4MB BOARD	108070-001	508.00
	4MB KIT	108072 001	318.00
DESKPRO	1MB BOARD	113633 001	138.00
386S	4MB BOARD	113634 001	358.00
	1MB MODULE	113646-001	104.00
	4MB MODULE	112534-001	279.00
DESKPRO	1MB MODULE	113131-001	98.00
386/20, 25, 286E	4MB MODULE	113132-001	338.00
DESKPRO	1MB BOARD	113644-001	138.00
386/20E/25E	4MB BOARD	113645 001	348.00
DESKPRO	2MB MODULE	115144-001	148.00
386/33, 486/25	8MB MODULE	116561-001	799.00
SYSTEMPRO	32MB MODULE	116568 001	4750.00
PORTABLES			
PORTABLE	512K KIT	107331-001	38.00
III	INTFC BD	107808 001	149.00
	EXP BD	107811-001	199.00
	2MB KIT	107332-001	128.00
SLT/286	1MB MODULE	110235-001	158.00
	4MB MODULE	110237-001	498.00
LTE/286	1MB BOARD	117081-001	128.00
	2MB BOARD	117081-002	178.00
PORTABLE	1MB KIT	107651-001	179.00
386/20	INTFC BD	107707-001	88.00
	4MB BOARD	107653-001	498.00
	4MB EXT BRD	107654-001	798.00
SLT/386S	1MB MODULE	108303-001	179.00
	2MB MODULE	108304-001	279.00

RAM CHIPS (DIPS)

DESCRIPTION	150NS	120NS	100NS	80NS	70NS
64X1	1.20	1.80	1.95		
64X4	1.95	2.25	2.45	2.95	
256X1	1.35	1.45	1.65	1.85	2.05
256X4		3.95	4.45	4.95	5.45
1MEG X 1		3.95	4.25	4.45	4.95

TOSHIBA MEMORY

TOSHIBA MODEL	MEMORY ADDED	TOSHIBA EQUIV PART #	YOUR COST
PORTABLE 2000SX	1MB BD	PC14-PA8311U	138.00
T1000SE & XE/LE	2MB BD	PC14-PA8312U	248.00
PORTABLE T1200XE	2MB BD	PC13-PA8306U	168.00
PORTABLE T1600	2MB BD	PC8-PA8302U	158.00
PORTABLE T3100E	2MB KIT	1PC9-PA8341U	138.00
PORTABLE T3100SX	2MB BD	PC15 PA8308U	138.00
	4MB BD	PC15 PA8310U	209.00
PORTABLE T3200	3MB BD	PC6-PA7137U	248.00
PORTABLE T3200SX	2MB KIT	PC12-PA8307U	138.00
	4MB KIT	PC12-PA8309U	209.00
PORTABLE T5100	2MB BD	PC7 PA8301U	168.00
DESKTOP T8500 OR PORTABLE T5200	2MB KIT	PC10-PA8304U	168.00
	8MB KIT	PC10-PA8313U	805.00

ZENITH MEMORY

ZENITH MODEL	MEMORY ADDED	ZENITH EQUIV PART #	YOUR COST
Z386/20/25/33/33E	1MB MOD	ZA3800ME	78.00
	4MB MOD	ZA3800MK	328.00
Z386/25/33	1MB MOD	ZA3600ME	78.00
	2MB MOD	ZA3800MG	148.00
Z248,Z286LP,Z386SX	2MB MOD	Z 605 1	128.00
TURBO SPRT 386 386E	1MB KIT	ZA3034ME	108.00
	4MB KIT	ZA3034MK	368.00
SUPER SPORT	2MB KIT	ZA180 64	188.00
SX	2MB KIT	ZA180 86	188.00
	2MB KIT	ZA180 87	278.00
SUPER SPORT 286	1MB KIT	ZA180 66	138.00
SUPER SPORT 286E SX	2MB KIT	ZA180 64	198.00

BOCA MEMORY BOARDS

8088 XT MACHINES

BOCARAM XT 0-2 MEG BOARD USES 256K D-RAM OK **99.00** 2MEG **219.00**

80286 & 386 AT MACHINES

BOCA AT PLUS (BRAT 80) OK-8MEG BD. 4.0 LIM COMPATIBLE CONVENTIONAL, EXPANDED & EXTENDED MEMORY. SUPPORTS DOS, OS/2, LIM/EMS & FEMS OK-**112.00** 2MEG-**189.00** 4MEG-**289.00** 8MEG-**399.00**

BOCARAM/2 PLUS

FOR PS2 50, 60, 50Z, 65, 70, 80, 90, 95 0-8MB LIM/EMS 4.0, USES 1MB SIMMS 2MB **249.00** 4MB **339.00** 8MB **489.00**

IBM PS/2 MEMORY

IBM PS/2 MODEL	MEMORY ADDED	IBM EQUIV. PART#	YOUR COST
PS/225/286	512K KIT	30F5348	38.00
30-286, 50Z & 55-SX, 65SX	2MB KIT	30F5360	124.00
PS/2 50Z & 55SX, 65SX	1MB SIMM	6450603	59.00
	2MB SIMM	6450604	99.00
55SX & 65SX	4MB MODULE	34F2933/87F9977	279.00
50, 50Z, 55SX 860, 65SX	2 8MB BOARD	1497259/6450609	349.00
PS/2	1MB SIMM	6450603	59.00
70-B61, 061, 121	2MB SIMM	6450604	99.00
PS/270 A21 AX1, BX1	2MB SIMM	6450608	199.00
PS/280-041	1MB MODULE	6450375	88.00
PS/280 1 1,121,311,321	2MB MODULE	6450379	148.00
80-A21, A31	4MB MODULE	6451060	278.00
PS/2	2 8MB BOARD	6450605 OR	378.00
ALL 70s & 80s	2 14MB BOARD	34F3077 OR	388.00
	4 16MB BOARD	34F3011	518.00
90, 95 & 97S	1MB	6450902	188.00
	4MB	6450128	419.00

SIMM MODULES

DESCRIPTION	120NS	100NS	80NS	70NS	60NS
256X8	5.00	8.00			
256X9	9.00	14.00	17.00	26.00	29.00
1MEG X 9		39.00	46.00	56.00	64.00
4MEG X 9			199.00	219.00	279.00

LASER JET MEMORY

MODEL	MEMORY ADDED	H.P. EQUIV.PART#	YOUR COST
HPIII & IIID	2MB MODULE	33444B	138.00
	4MB MODULE	33445B	228.00
HPII & IID	1MB MODULE	33474A/B	88.00
HPIIP	2MB MODULE	33475A/B	138.00
	4MB MODULE	N/A	238.00
CANON LBP4	1MB MODULE	N/A	199.00
CANON LBP	2MB MODULE	S63-1880	138.00
III, IIIP, IIIT	4MB MODULE	N/A	238.00

ORDERS ONLY

800-654-7762

TECHNICAL/CUSTOMER SERVICE/ORDER STATUS:
(702) 294-0204 FAX (702) 294-1168
HOURS: M-F 8:00-6:00 PST, SAT 9:00-3:00 PST

Mfg part #'s for convenience only Some memory products 3rd party

WE ACCEPT INTERNATIONAL ORDERS
WE ALSO PURCHASE EXCESS INVENTORY! FAX OR CALL.
NO SOFTWARE RETURNS
ALL PRICES FINAL.

Trademarks are registered with their respective Co 's 386, 387 287, SX, are trademarks of Intel Corp

NEVADA COMPUTER

NO SURCHARGE FOR MC/VISA

TERMS:

MC, VISA, AE, COD CASH, NET
Purchase orders from Universities Fortune 1000 & Government Agencies
Personal Checks, COD add $5.00
20% Restocking Fee on returns within 30 days
No refunds or exchanges after 30 days WARRANTY ONLY

SE HABLA ESPANOL

*ADVERTISING IN THIS MAGAZINE UNDER SAME TERMS

AD # BSPEC

PRICES SUBJECT TO CHANGE SHIPPING UPS (Min $8 25)

684 Wells Road, Boulder City, Nevada 89005

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.

Effective January 1, 1991.

RATES: 1 issue—$675 3 issues—$625 6 issues—$600 12 issues—$525
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 Joseph Mabe at 603-924-2656. FAX: 603-924-2683.

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 — **$94.50**
Ink Master (Electric) — **$189.00**
1000s of satisfied users. Money-back guarantee.
BORG INDUSTRIES
525 MAIN ST., JANESVILLE, IA 50647
1-800-553-2404 In IA: **319-987-2976**

Inquiry 701.

KEYBOARD, VIDEO, MOUSE
Extension with **EXTENDER**
Splitting with **COMPANION**
Switching with **COMMANDER**
Boosts signals up to 600 feet. Control up to 96 PCs with one keyboard and monitor.
CYBEX CORPORATION
2800H Bob Wallace Ave., Huntsville, AL 35805
Phone 205-534-0011 **Fax 205-534-0010**

Inquiry 702.

HEWLETT PACKARD
Buy — Sell — Trade

Laser Jet II/IID	Color Pro (7440)
Laser 2000 2 Meg/4 Meg upgrades	HP-7550A
Desk Jet	Draft Pro DXL/EXL
Rugged Writer	Draftmaster I/II
Electrostatic Plotters	C1600 (D Size) /C 1601 (E Size)

Science Accessories Corporation Sonic Digitizers
36" x 48" (2750) 60" x 72" (3175)
T. E. Dasher & Associates
4117 Second Ave. S., Birmingham, AL 35222
Phone: (205) 591-4747 Fax: (205) 591-1108
(800) 638-4833

Inquiry 703.

ARRAY PROCESSORS

SCIENTIFIC ACCELERATOR
25 MegaFLOP Floating Point Array Processor with 256K+ static memory. Easily programmed by calling 598 routines from your C, FORTRAN, or Pascal PC programs. 512×512 FFT 1.18 secs. Single slot board with software: $2,495.00.
EIGHTEEN EIGHT LABORATORIES
1247 Tamarisk, Boulder City, NV 89005
Tel: 800-888-1119, Fax: 702-294-2611

Inquiry 704.

ARTIFICIAL INTELLIGENCE

LISP like never before. . .
Affordable!
Software Engineer v 2.0 is the most powerful LISP for Windows. It was designed to put the power of LISP into the hands of individuals. It includes a text editor, a dialog box designer and an icon editor. Functionality includes: OOP, stand-alone EXE's, a debugger, DDE, Menus, Windows API calls and on-line help. Sug. Retail $249.95
Raindrop Software Corporation
845 Arapaho Road, Suite 105, Richardson, Texas 75081
(214) 234-2611 **Fax: (214) 234-2674**

Inquiry 705.

BAR CODE

LABELING SOFTWARE
On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 18 text sizes to 3"-readable at 100'. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39. File Input & Scanned logos/symbols (PCX)—$279. Other programs from $49. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 **(800) 345-4220**

BAR CODE READERS
For PC, XT, AT, & PS/2, Macintosh, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—$399. Top rated in independent reviews. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 **(800) 345-4220**

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 through its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Doubles as On-Line Reader. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 **(800) 345-4220**

PRINT BAR CODES/BIG TEXT FROM YOUR PROGRAM
Add bar codes and big graphics characters to your program. Print from ANY MS-DOS language. Bar codes: UPC, EAN, 2 of 5, MSI, Code 39. Epson, Oki, IBM dot matrix text up to ½". LaserJet up to 2". Font cartridges not required. $179–$239. 30-day $$ back.
Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(408) 458-9938 **(800) 345-4220**

BAR CODE READERS
Keyboard emulation for PC/XT/AT & PS/2's, all clones and any RS-232 Terminal. Transparent to your operating system. Available with Steel wands, Lasers, Slot & Magstripe Readers. Same day shipping, 30-day money-back guarantee. One-year warranty. Reseller discounts available.
AMERICAN MICROSYSTEMS
2190 A Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

BAR CODE

BAR CODE PRINTING SOFTWARE
- MS/PC DOS SYSTEMS
- 9 & 24 PIN DOT MATRIX
- H-P LASER JET/PLUS/SERIES II
- MENU-DRIVEN or MEMORY RESIDENT
- CODE 39, I 2/5, UPC A/E, EAN 8/13
- BIG TEXT & BAR CODE SOFTFONTS

AMERICAN MICROSYSTEMS
2190 A Regal Parkway, Euless, TX 76040
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

BASIC CLIP MUSIC

300 Songs & Sounds + 180 Pg. Book
The Entertainer makes your PC a fun jukebox and teaches you many ways to be creative with computers. Its fun musical projects are great for beginners, yet it teaches even pros how to put music in their QB or C apps. Source code is included. Pay no royalties. Needs BASIC 2.1 or later. Specify 3.5" or 5.25" disks. **$45** + $4 s&h (Europe, Canada & Mexico s&h=$8, others=$11, 1st class air). For fast VISA/MC orders, call:
(800) 727-4140 Money-back guarantee You'll love it!!
PDI Music Software, E. 906 Sanson, Spokane, WA 99207 (509) 483-2114

Inquiry 706.

CAD/CAM

STEPPER MOTOR CONTROL
FROM A PRINTER PORT!
NEW Indexer LPT™ software VERSION 2.1 **$249** VISA/MC
- Controls up to six motors simultaneously
- Linear and Circular Interpolation
- New features to accommodate machine control.
- Easy-to-use DOS device driver. Super Manual.
- CAD-CAM interface available.

Ability Systems Corporation, 1422 Arnold Ave. Roslyn, PA 19001 (215) 657 4338 FAX (215) 657 7815

Inquiry 707.

COMMUNICATIONS

SDLC, HDLC AND X.25 SUPPORT
Use Sangoma hardware and software to provide cost effective, robust and easy-to-use SDLC, HDLC and X.25 links from MS-DOS, UNIX, PC-MOS, etc.
All real time communication functions performed by intelligent co-processor card.
Full function SNA emulation packages also available.
Sangoma Technologies Inc.
(416) 474-1990

Inquiry 708.

COMPUTER SYSTEMS

$29 MATHCHIP EMULATOR
$19 SUPER PASSWORD SYSTEM
FREE with complete system purchased • 286-12 system $645 • 386SX-16 system $790 • 386-25 system $995 • 386-33 system $1065. System incl: CASE, PS, 40MHD, 1.2MFD, 1M RAM, 2S/1P, MONO MONITOR, MGP, 101KB • System Upgrades add: VGA KIT $260, 80MHD $125, 120MHD $200. CALL FOR OTHER PRICES.
MULTIX, INC.
4203 Beltway Dr., Suite 7, Dallas TX 75244
Tel: (214) 239-4989 Fax: (214) 239-6826
We accept MasterCard and VISA

Inquiry 709.

THE BUYER'S MART

CROSS ASSEMBLERS

CROSS ASSEMBLERS/SIMULATORS
New unique full-function simulators for the 8096 and 80C196 controllers, featuring ALL MODES of interrupts, plus the HSI, HSO, and A/D functions
We also support the 8048/49, 8080/85, 8051/52, and Z80 controllers with excellent, reasonably priced Cross Assemblers and Simulators.

Lear Com Company
2440 Kipling St., Ste 206, Lakewood, CO 80215
(303) 232-2226 **FAX: (303) 232-8721**

Inquiry 710.

DATA/DISK CONVERSION

CONVERSION SERVICES
Convert any 9-track magnetic tape to or from over 3000 formats including 3½", 5¼", 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 **(800) Convert**

DATABASE MGMT SYSTEMS

dBASE file Access from C
C programmers use CodeBase to build multi-user, dBASE/Clipper compatible applications. Create popup windows, pulldown menus, and data entry screens. Port between Unix, Microsoft Windows and OS/2.
FREE Demo Disk Call (403) 448-0313
Fax (403) 448-0315
Sequiter Software Inc.
#209, 9644-54 Ave, Edmonton, AB, Canada, T6E 5V1
See our ad on page 145.

Inquiry 711.

DISASSEMBLERS

80x86 .COM/.EXE files: 'Reusable Software'!!!
Automatic!—Only input/output filenames are *required!* Exhaustive flow-analysis distinguishes data from code
Accurate!—Uses scientific methods, not 'guesswork'! Locates even one-byte data items in *instruction* areas!
Complete!—Fully-labeled 80(2)86 code, data, directives! Commented BIOS/DOS INTs give function & operands.
Compatible!— .ASM output file is MASM 5.x-compatible.
NEW! PC-DISnDATe 4.0 (5¼" 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 712.

DUPLICATION

SOFTWARE DUPLICATION
- DISKETTE & TAPE
- DOCUMENTATION PRINTING
- CUSTOM PACKAGING
- FULFILLMENT

MEGASOFT, INC.
P.O. Box 8609, Freehold, NJ 07728
(800) 222-0490 **(908) 462-7628**

Inquiry 713.

ENTERTAINMENT

Go, NEMESIS, Go
Go - a Zen game. So appealing, it has endured 4,000 years. So useful, governments study it.
NEMESIS Go Junior entices novices of any age.
NEMESIS Go Master Deluxe satiates the addicted
Windows Version
Chaos Manor User's Choice Award (BYTE/1990)
Toyogo, Inc. (800) 869-6469
PO Box 25460-Y, Honolulu, HI 96825-0460
(808) 396-5526 **fax: (808) 396-4126**

Inquiry 714.

FINANCIAL SOFTWARE

BrainMaker:
"The most fascinating computer software I've ever seen learn about this stuff."*John Dvorak, PC Mag.* Predicts stocks, bonds, sales, inventories. Comprehensive manual. Menus. Only $195!
Mac version now available
Free Brochure: 916/477-7481
California Scientific Software

Inquiry 715.

FLOW CHARTS

FLOW CHARTING 3
FRIENDLY
FAST
FLEXIBLE
- High resolution print outs, dot matrix or laser
- Multi-page charts portrait or landscape
- Import/export capabilities
- 35 shapes, 10 fonts, 4 line styles

ONLY $250
PATTON & PATTON *Call for free demo disk!*
800-525-0082 ext.1310
Software Corporation 485 Cochrane Cr., Morgan Hill, CA 95037
See our ad on page 20

Inquiry 716.

HARD DRIVE REPAIR

HARD DRIVE REPAIR
ALSO
DATA RECOVERY
FAST TURN!! CALL FOR DETAILS
H&W micro labs, inc.
528-C Forest Parkway, Forest Park, GA 30050
404-366-1600

Inquiry 717.

CAPACITY	MFM/RLL	ESDI/SCSI
10-19Mb	$59	N.A.
20-29	75	75
30-39	89	89
40-49	125	125
50-85	155	175
86-120	195	225
121-160	225	275
161-350	259	345
351-700	N/A	395

LOWEST DISK DRIVE REPAIR PRICES
jb TECHNOLOGIES, INC.
5105 Maureen Lane
Moorpark, CA 93021
Phone: (800) 888-0908
FAX: (805) 529-7712

Inquiry 718.

HARDWARE

AWARD BIOS UPGRADES
Recycle your IBM XT, AT or clone at low cost with an Award BIOS ROM Upgrade. Add IDE drive support, 3½" 1.44Mb floppies, Windows 3.0 support, more. Call for our FREE Catalog.
KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215
ORDERS 800 423-3400 Tech (412) 782-0320

Inquiry 719.

INTERNATIONALIZATION

***TO GLOBALIZE THINK* WORLD-WISE**
We provide Internationalization Expertise in Designing Software, User Interfaces and Documentation for International Markets. Solutions that World-Wise Delivers:
- Internationalization seminars
- Consultancy
- Project Management
- Localization
- Distributor services

For total International Solutions, contact our experts at 1-800-445-WISE
World-Wise International Solutions Inc.
1 Tara Blvd., Suite 406, Nashua, New Hampshire 03062

Inquiry 720.

LAPTOP COMPUTERS

SAVE! **LAPTOPS/NOTEBOOKS** *SAVE!*
TOSHIBA • EVEREX • ZENITH • AT & T • TANDON
AST • SANYO • SHARP • BONDWELL • ALR • LIBREX
PANASONIC • ALTIMA • LEADING EDGE • FORA
PACKARD BELL • SAMSUNG • NEC • TI • COMPAQ
• We *ALSO* carry a full line of accessories •
Computer Options Unlimited
12 Maiden Lane, Bound Brook, NJ 08805
CALL: (800) 424-7678 Need Help?: 908-469-7678
9-9 M-F 9-5 Sat. 6 days Worldwide Sales

Inquiry 721.

WINDOWS FLOWCHARTER $129
RFFlow 2.0 is a professional drawing tool for flowcharts & org charts. Requires Microsoft Windows 3.0. 100 shapes auto adjust in size. Diagonal lines and curves. Auto line routing and re-routing. Click on a shape to bring up a sub-chart. Move charts to other apps. via the Clipboard. Call for free trial disk.
RFF ELECTRONICS
1053 Banyan Court, Loveland, CO 80538
Phone: (303) 663-5767 **FAX: (303) 669-4889**

IBM CONVERTIBLE
MEMORY-128K $79 256K $225 384K $295
MODEMS-Standard $75 Enhanced $175
CRT ADAPTER-for monitors $99
SERIAL/PARALLEL ADAPTER-$120
MONITORS-Monochrome $115 Color $349
COMPACT Carrying Case $39
ENHANCED LCD $79 **BATTERY** -$89
HARD DRIVES 20 Meg-$495 40 Meg-$695
MORE ACCESSORIES AVAILABLE
COMPUTER RESET
P.O. Box 461782, Garland, TX 75046
Phone (214) 276-8072 BBS & FAX (214) 272-7920

Inquiry 722.

OPTICAL DISK

ODIN & VOICE IMAGING SYSTEMS
ARCHIVING & RETRIEVAL SYSTEMS
Utilizing WORM optical disk storage. ODIN runs on Unix workstations. VOICE runs on MS-DOS personal computers. Will scan documents up to "E" size. Proven system. Available now!
Telephone: 1-800-843-9377
Indus MIS, Inc.
340 S. Oak St., West Salem, WI 54669

Inquiry 723.

PROGRAMMERS TOOLS

HYPERINTERFACE™ II
Menu Creator™ — An interactive WYSIWYG editor to generate a menu-driven user interface for your software. **Screen Creator™** — An interactive WYSIWYG editor for quick and easy screen design and a screen database manager for your software. **Advanced Library** — Extended capability for data entry for your programs. FORTRAN, Pascal, C, BASIC supported.
Avanpro Corp.
PO Box 969, Pacific Palisades, CA 90272
(213) 454-3866

Inquiry 724.

FORTRAN TOOLS
FORWARN—Lint for Fortran—finds common programming errors. Also prints detailed cross-references and call-tree diagrams. NEW! Routine and common cross-reference. **$399** (DOS).
FORTRAN DEVELOPMENT TOOLS—includes Pretty (indents, renumbers, restructures, etc.) and 6 more tools **$149** (DOS)
Available for DOS, DOS protected mode, OS/2, and Unix
Quibus Enterprises, Inc.
3340 Marble Terrace, Colorado Springs, CO 80906
(719) 527-1384

Inquiry 725.

PUBLIC DOMAIN

FREE IBM 5¼" Disk with FREE GAMES, UTILITIES and CATALOG
Just to get acquainted with our shareware.
1-800-845-8902
L.A. Software

Inquiry 726.

FREE CATALOG
FOR IBM PD AND SHAREWARE
SELECTED PROGRAMS
LATEST VERSIONS
Low as $1.50
SOFTSHOPPE, INC.
TEL: 800-829-2378 • 313-761-7638
FAX: 313-761-7639
P.O. Box 3678, ANN ARBOR, MI 48106

Inquiry 727.

SOFTWARE/ACCOUNTING

dBASE BUSINESS TOOLS

- GENERAL LEDGER
- ORDER ENTRY
- JOB COSTING
- BILL OF MATLS
- PAYROLL
- PURCH ORD/INVNTORY
- ACCOUNTS RECVABLE
- JOB ESTIMATING
- SALES ANALYSIS
- ACCOUNTS PAYABLE

$99 ea + S&H

dATAMAR SYSTEMS Cred Card-Check-COD
8586 Miramar Place
San Diego, CA 92121 **(619) 452-0044**

Inquiry 728.

SOFTWARE/ENGINEERING

Analog Circuit Simulation

- PC and Macintosh CAE
- Schematic Entry
- SPICE Simulator
- Model Libraries
- Monte Carlo Analysis
- Plotting/Graphics Output

Intusoft has complete simulation systems including everything from schematic entry through SPICE simulation using extended memory to interactive waveform processing. Starting at $95 for IsSPICE, the complete system sells for just $815.

Intusoft
The leader in low cost, full featured CAE tools
P.O. Box 710, San Pedro, CA 90733-0710
(213) 833-0710 FAX (213) 833-9658

Inquiry 729.

SOFTWARE/GRAPHICS

PEN PLOTTER EMULATOR
FPLOT turns your printer into an HP pen plotter. Fast hi-res output, no jagged lines. Vary line width, color. Screen preview with zoom and pan. Stand-alone, background, and device driver modes. Works with most CAD and graphics programs. Supports most printers. New version 3. $119+$3 S&H. 30 day money back. VISA/MC/Check/MO.
FPLOT Corporation
24-16 Steinway St., Suite 605, Astoria, NY 11103
718-545-3505

Inquiry 730.

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, laser, or inkjet printer (incl. Postscript) in up to 64 shades of gray or 256 colors. GRAFPLUS also creates PCX & TIFF files. Supports Windows 3.0 or DOS application graphics - EGA, VGA, Super VGA, Hercules screens. Linkable/OEM versions available.
Jewell Technologies, Inc.
130 Nickerson St., Suite 105, Seattle, WA 98109
1 (800) 284-2574 (206) 285-6860

Inquiry 731.

FORTRAN GRAPHICS
GRAFMATIC - FORTRAN callable graphics Library for creating 2-D and 3-D graphics, contour plots and solid models. PRINTMATIC and PLOTMATIC provide high resolution FORTRAN callable printer and plotter drivers for your graphics. NO ROYALTIES. $249.95 ea.
Supports Microsoft/Lahey/RM FORTRAN compilers.
Jewell Technologies, Inc.
130 Nickerson St., Suite 105, Seattle, WA 98109
1 (800) 284-2574

Inquiry 732.

SOFTWARE/LANGUAGES

IntegrAda
Standard Air Force PC Ada Compilers & environments for MS-DOS and UNIX. Integrated programming systems include validated Ada compilers, language sensitive editors, complete libraries and other Ada programming tools. FREE demo.
AETECH, Inc. *From $495*
380 Stevens Ave., Ste. 212 Solana Beach, CA 92075
(619) 755-1277 Fax: (619) 755-7540

Inquiry 733.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^2 = \sum_{k=0}^{\infty} \left[x_k^{2+s}(\zeta)\right] + \left(\frac{|f^{(n)}|}{\sqrt{a \pm bx}}\right)$$

- *MathEdit constructs math equations to be inserted into WordPerfect, Word, WordStar, and others.*
- *WYSIWYG interface—no codes need to be learned.*
- *MathEdit—$199*

K-TALK COMMUNICATIONS
30 West First Avenue, Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 734.

SOFTWARE/PACKAGING

ONE STOP FOR ALL OF YOUR SOFTWARE PACKAGING NEEDS
The only place in the world that you can find everything you need to label — mail — package your software. From diskettes to manuals — mailers to binders — boxes to index tabs.
EVERYTHING including complete design and turnkey assembly
WE DO LABELS
FREE CATALOG of services — products — prices
SPS SUPPLIES, INC.
YOUR SOFTWARE PACKAGING SOLUTION
9464 Hunters Creek Drive, Cincinnati, OH 45242
(513) 984-9938

Inquiry 735.

SOFTWARE/SCIENTIFIC

FREE CATALOG
A great selection of scientific software products for plotting, non-linear curve fitting, chemical equilibrium, simulation, statistics, symbolic algebra, and more. Prices from $150. Call:
1-800-942-MATH
MicroMath, Salt Lake City, UT 84121-0550

Inquiry 736.

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 Btrieve and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS **$149.** OS/2, XENIX, UNIX **$249.**
(702) 588-3737
Opt-Tech Data Processing
P.O. Box 678 — Zephyr Cove, NV 89448

Inquiry 737.

SOFTWARE/VOICE/FAX

MULTI-VOICE® TOOLS
Multi-Voice Tools is a complete development Toolkit for Pascal or "C" to access all the features for most speech processing boards available today. It helps you write MULTI-LINE VOICE APPLICATION systems in minutes. A number of programming examples are provided. All programs and libraries are delivered with source code.
Dialogic, Rhetorex, Pika, VBX: $599. Watson (Single Line): $99.
ALSO AVAILABLE: FAX Programmer's Toolkit ($199). Based on CAS specifications. Visa/MC accepted.
ITI Logiciel
4263 Cristophe-Colomb, Montreal, Quebec, Can. H2J 3G2
TEL (514) 597-1692 FAX (514) 526-2362

Inquiry 733.

TRANSLATION

Tradoc translates and localizes your software and hardware documentation into the following languages:

+ *French*	+ *Russian*
+ *Spanish*	+ *Arabic*
+ *German*	+ *Italian . . .*

Turnkey service: Desktop Publishing, typesetting and printing of your brochures and manuals
205 Gibson Rd., Annapolis, MD 21401
(301) 267-8655 FAX (301) 267-8180

Inquiry 738.

UTILITIES

UNIX under DOS
Get the Feel & Power of UNIX
include awk, cb, cp, diff, find, grep, ls, make, more, mv, rm, sed, sort, & 25 others. All System V and BSD 4.3 options included. Thorough documentation.
THE BERKELEY UTILITIES $200
for sales 800-542-0938 *inquiries* 718-398-3838
OPENetwork
Power Tools for Power Users
215 Berkeley Place, (B2), Brooklyn, NY 11217

Inquiry 739.

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 Joseph Mabe for more information
603-924-2656 or Fax: 603-924-2683

Inquiry 740.

Circle 47 on Inquiry Card (RESELLERS: 48).

Circle 87 on Inquiry Card (RESELLERS: 88).

Circle 25 on Inquiry Card.

MEMORY!

100% COMPATIBLE OR YOUR MONEY BACK

FIRST SOURCE INTERNATIONAL, INC.

"The Only Source for Computer Memory!"

WE ACCEPT INTERNATIONAL ORDERS AND PURCHASE ORDERS!
3 DAY INTERNATIONAL DELIVERY VIA FEDERAL EXPRESS, UPS, OR DHL!

MADE IN THE U.S.A.

YOUR CHOICE OF QUALITY MEMORY PRODUCTS MANUFACTURED BY: *KINGSTON, PARAGON, AND APRICORN*

- ALL USER INSTALLABLE
- SUPERIOR SERVICE
- FREE TECHNICAL SUPPORT
- QUALITY PRODUCTS
- UNLIMITED SELECTION
- FLEXIBLE PAYMENT OPTIONS
- GREAT PRICES
- EXCEPTIONAL WARRANTY

FAX: 714-588-9872 or CALL: 714-588-9866

IBM MEMORY

PS/1		
2MB	IBM PN N/A	$189.00
PS/2 30-286 and 1497259		
512K Kit	30F5348	$39.00
2MB Kit	30F5360	$119.00
PS/2 70-E61/121,502,555X and 65SX		
1MB	6450603	$69.00
2MB	6450604	$129.00
PS/2 70-A21		
2MB	6450608	$139.00
PS/2 55SX, 65SX, 34F3077 and 34F3011		
4MB	34F2933	$269.00
PS/2 35SX; LS and 40SX		
8MB	6450129	$599.00
PS/2 80-111/311		
2MB	6450379	$139.00
PS/2 80-A21/A31		
4MB	6451060	$269.00
PS/2 90, 95 and P75 (Install in pairs)		
2MB	6450902	$139.00
4MB	6450128	$309.00
Expansion boards for all models 50 and 60		
2-8MB w/2MB	1497259	$389.00
2-16MB w/2M	6450609	$399.00
Expansion boards for all models 70 and 80		
2-14MB w/2M	34F3077	$369.00
4-16MB w/4M	34F3011	$499.00

COMPAQ MEMORY

DeskPro 386-20, 20E and 25		
1MB	113131-001	$99.00
4MB	113132-001	$269.00
DeskPro 386S/16		
1MB	113646-001	$99.00
4MB	112534-001	$269.00
DeskPro 286N and 386N		
0K Board	118700-001	$99.00
DeskPro 286N, 386N and 386SX/20		
1MB	118688-001	$79.00
4MB	118690-001	$299.00
DeskPro 386N and 386SX/20		
2MB	118689-001	$139.00
DeskPro 386-33, 486-33 and SystemPro		
0K Board	116569-001	$229.00
2MB	115144-001	$129.00
8MB	116561-001	$699.00
DeskPro 386-20e and 25e		
1MB Board	113644-001	$149.00
4MB Board	113645-001	$329.00
DeskPro 386S		
1MB Board	113633-001	$149.00
4MB Board	113634-001	$329.00
DeskPro 386/16		
1MB Board	108069-001	$249.00
4MB Board	108070-001	$499.00

LAPTOP MEMORY

AST		
Executive Notebook	1MB	$79.00
	4MB	$299.00
AT & T		
Safari NSX/20	2MB	$429.00
COMPAQ		
Portable LTE386S/20	1MB	$249.00
	4MB	$649.00
Portable LTE 286	1MB	$119.00
	4MB	$459.00
SLT-286	1MB	$149.00
	4MB	$469.00
SLT-386	1MB	$139.00
	4MB	$499.00
EPSON		
NB53 Notebook	1MB	$169.00
	4MB	$469.00
EVEREX		
Tempo LX Notebook	2MB	$189.00
IBM		
L40SX laptop	2MB	$249.00
	4MB	$449.00
	8MB	$999.00

BRAND NEW!

You can upgrade your IBM PS/2 Models 30/286, 50, 50Z and 60 with Kingston's SX/Now!

Kingston TECHNOLOGY CORPORATION

SX/Now! 80386SX 20MHz Processor features:
- ✔ 16 Kbytes of Cache Memory
- ✔ Onboard 20MHz Clock
- ✔ Requires No Expansion Slot
- ✔ 80387SX Co-Processor Socket
- ✔ 5-Year Warranty

SX/Now! provides true multitasking and background operation for Windows 3.0, OS/2, and 386 specific software. SX/Now! allows the new 20 MHz processor to run at full potential speed and improves system performance by up to 250%

SX/Now! 20MHz $469.00

WE WILL BEAT ANY ADVERTISED PRICE! - WHY CALL ANYONE ELSE?

PRINTER MEMORY

Hewlett-Packard LaserJet IIP, III, IIIP and IIID		
2MB	33475B	$139.00
4MB	33477B	$239.00
Hewlett-Packard LaserJet II and IID		
2MB	33444B	$119.00
4MB	33445B	$229.00
Hewlett Packard LaserJet IIISi		
1MB	C2063A	$59.00
4MB	C2065A	$229.00
Hewlett-Packard DeskJet 500 and Plus		
256K	22707B	$109.00
IBM Laser 4019 and 4019e		
2MB	1039137	$159.00
3.5MB	1038675	$229.00
Canon LBP-8II, 8IIR and 8III		
2MB	S63-1880	$129.00
4MB	PN N/A	$229.00
Brother HL-8, 8E, 8V and 8PS		
2MB	MB-820	$199.00
Panasonic 4450I and 4420		
2MB	KX-P441	$159.00
4MB	PN N/A	$249.00
OkiLaser 400		
2MB	OKI PN N/A	$179.00

SIMMS

IBM

4Mx9-80	$239.00
1Mx9-10	$45.00
1Mx9-80	$48.00
1Mx9-70	$50.00
256x9-10	$13.00
256x9-80	$15.00

DRAM

1MBX1

1MX1-10	$4.99
1MX1-80	$5.49

256KX1

256KX1-10	$1.80
256KX1-80	$1.90

AST MEMORY

Premium 386C and 386-16		
1MB Kit	500510-007	$69.00
4MB Kit	500510-008	$219.00
Premium 386 and 386-20		
1MB Kit	500510-003	$89.00
4MB Kit	500510-004	$269.00
Bravo 386-SX, WS/286 and 386		
2MB Kit	500510-002	$109.00
4MB Kit	500510-008	$219.00
Premium 386-SX/16/25/33 and all 486 models		
1MB	500718-002	$69.00
Premium 486 and 486/33		
2MB	500718-004	$179.00
8MB	500780-001	$779.00
Premium II 386SX/20 and 386SX/16		
1MB	500780-003	$79.00
4MB	500780-004	$399.00
Cupid-32 Memory Expansion Board		
0-32MB	500818-001	$379.00

HEWLETT-PACKARD MEMORY

Vectra QS/16S and ES/12PC		
2MB Kit	D1354A	$109.00
Vectra QS/16S and RS/20PC		
1MB Kit	D1540A	$69.00
4MB Kit	D1542A	$219.00
Vectra QS/20PC, RS/25PC, 20C and 25C		
1MB Kit	D1640A	$69.00
4MB Kit	D1642A	$219.00
Vectra 486 PC (Install in Pairs)		
1MB	D2150A	$69.00
4MB	D2151A	$299.00
Vectra 386/25, 486/25T and 33T (Install in Pairs)		
2MB	D2381A	$129.00
Vectra 486PC and 386/25 PC		
8MB	D2152A	$589.00

TOSHIBA

T1000SE/LE/XE, T2000SX	1MB	$149.00
	2MB	$259.00
T1000LE, T2000SX	4MB	$469.00
	8MB	$999.00
T2000SXE	2MB	$289.00
	4MB	$539.00
	8MB	$999.00
T1200XE, T1600, T3100E, T3100SX, T3200SX and T3200SXC	2MB	$149.00
	4MB	$279.00
T3200	3MB	$249.00
T5100	2MB	$149.00
T5200, T5200C, T8500	2MB	$149.00
	8MB	$649.00

NEC

UltraLite 286F, 286V	1MB	$145.00
	4MB	$450.00
Powermate Port SX	2MB	$429.00
	8MB	$1469.00
ProSpeed 286, 386SX16	1MB	$219.00
	4MB	$569.00
ProSpeed SX20	1MB	$219.00
	4MB	$529.00
ProSpeed 386	2MB	$279.00
	8MB	$1079.00

Memory also available for the Grid and Tandon Laptops!

ZENITH MEMORY

Zenith Z-386/20/25/33 and 33E		
1MB	ZA36/3800ME	$69.00
4MB	ZA3800MK	$299.00
Zenith Z-386/25 and 33		
2MB	ZA3600MG	$139.00
Zenith Z-386 SX		
2MB Kit	Z-605-1	$119.00
Zenith TurboSport 386		
1MB	ZA-3034ME	$169.00

EXPANSION BOARDS

BocaRam 30
Up to 2MB for any PS/2 25 or 30 with and 8086 CPU. Provides LIM/ EMS 4.0 only
with 512K *$139.00*

BocaRam XT
Up to 2MB for any XT or 8-bit machines running up to 12MHz. Provides LIM /EMS 4.0 only.
with 512K *$139.00*

BocaRam/AT Plus
Up to 8MB for any AT or 16 bit compatible machines running up to 33MHz. Provides a maximum of 8MB extended or LIM/EMS 4.0
2MB with DRAM's: *$219.00*
2MB with SIMM's: *$239.00*

NEC MEMORY

Powermate 286/12, SX/16 and SX/20		
2MB Kit	OP-410-8103	$129.00
Powermate 286 Plus		
1.3MB Brd	APC-H250K	$329.00
2.3MB Brd	APC-H250K+H251K	$429.00
Powermate SX		
2MB Brd	APC-H855	$529.00
4MB Brd	APC-H853	$799.00
Powermate SX Plus		
1-2MB Brd	APC-H850E	$219.00
Powermate SX/20		
2MB CPU	OP-410-8101	$219.00
2MB Brd	OP-410-8102	$239.00
Powermate 386/20		
2MB	APC-H656E	$399.00
8MB	APC-H656E	$1249.00
Powermate 386/25		
2MB	APC-H655X	$399.00
8MB	APC-H656X	$1249.00
Powermate 386/25S		
2MB Kit	OP-410-5201	$199.00
8MB Kit	OP-410-5202	$659.00
Powermate 386/33E and 486/25E		
2MB	OP-41-5101	$299.00

TOLL FREE FROM ANYWHERE IN THE U.S. OR CANADA

ORDER NOW! 1-800-535-5892

WE ACCEPT VISA, MASTERCARD AND AMERICAN EXPRESS!
- No surcharge on Visa or Mastercard. AmEx add 4%.
- Terms: AMEX, Visa, Mastercard, C.O.D., P.O.'s
- Return Policy: 20% Restocking fee on all nondefective returns and refused orders. All items must be returned within 15 days with original documentation and package. Return Merchandise Authorization # required.
- Manufacturers' part numbers are for your convenience, all products are third party. 100% compatible or full refund!
- Prices and availability subject to change

INT'L 011-714-588-9866
U.S. 800-535-5892
FAX 714-588-9872

MAIL ORDERS TO:
FIRST SOURCE INT'L INC.
36 ARGONAUT, STE 140
ALISO VIEJO, CA 92656

FOLLOW YOUR PACKAGE EVERY STEP OF THE WAY!

FEDERAL EXPRESS · DHL WORLDWIDE EXPRESS · UPS

FAST, INEXPENSIVE AND DEPENDABLE DELIVERY ANYWHERE IN THE WORLD! CHOOSE THE CARRIER TO FIT YOUR DELIVERY NEEDS AT LOW RATES. INFORMATION FOR TRACKING SHIPMENTS IS READILY AVAILABLE AT YOUR REQUEST!

Low Cost and High Quality

The Rose Hill Computers

286 ROSE 12MHz VGA

- 80286™-12MHz processor
- 1MB RAM
- 1.2MB floppy drive or
- 1.44MB floppy drive
- 40MB IDE hard drive
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA monitor
- 16 bit VGA adaptor
- MS DOS 5.0
- Free shipping in USA

$1099

386 ROSE 25MHz VGA

- 80386™-25 processor
- 4MB RAM
- 1.2MB floppy drive
- 1.44MB floppy drive
- 80MB hard drive
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA monitor 1024
- 16 bit VGA adapter 512K
- MS DOS 5.0
- Windows 3.0 with mouse
- Free shipping in USA

$2099

ROSE NOTEBOOK 386sx 20MHz

- 80386sx™-20MHz processor
- 2MB RAM (exp. to 8MB)
- 1.44MB floppy drive
- 60MB IDE hard drive
- Serial, parallel, KB, VGA, ext. floppy & bus ports
- Paper white VGA LCD with CCFT backlit & 64 gray scale
- 7.7 lbs. with 2 battery packs
- MS DOS 4.01
- MS Windows 3.0
- Free software including appointment book, notepad, phone book, card filer, calculator, video & power management utilities
- Carrying case
- Free shipping in USA
- Price does not include on-site service

$2799

386sx ROSE 20MHz VGA

- 80386sx™-20MHz processor
- 2MB RAM
- 1.2MB floppy drive
- 1.44MB floppy drive
- 40MB IDE hard drive
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA monitor 1024
- 16 big VGA adapter 512K
- MS DOS 5.0
- Windows 3.0 with mouse
- Free shipping in USA

$1699

- **286 20MB 1MB RAM $1895**

- **Free shipping in continental U.S.A.**
- **30 day money back guarantee**
- **Two year warranty on labor**
- **One year warranty on parts**
- **Toll free technical support**
- **Express air parts replacement**
- **Free on-site service at most locations**
- **Leasing available for commercial customers**
- **Custom configurations available**
- **The Rose is expert in custom networking and we are Novell authorized.**

Call today toll free

1-(800) 248-ROSE

no charge for shipping

486 ROSE 25MHz CACHE

- 80486™-25MHz processor
- 128K high speed RAM cache
- 4MB RAM
- 1.2MB floppy drive
- 1.44MB floppy drive
- 200MB IDE hard drive
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA monitor 1024NI
- 16 bit VGA adapter with 1MB
- MS DOS 5.0
- MS Windows 3.0 with mouse
- Free shipping in USA

$3249

486 ROSE 33MHz EISA

- 80486™-33MHz processor
- 256K high speed RAM cache
- 8MB RAM
- 1.2MB floppy drive
- 1.44MB floppy drive
- 330MB SCSI hard drive
- EISA 32 bit bus master controller
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA mono monitor
- 16 bit VGA adapter
- MS DOS 5.0
- MS Windows 3.0 with mouse
- Free shipping in USA

$5899

386 ROSE 33MHz CACHE

- 80386™-33MHz processor
- 128K high speed RAM cache
- 4MB RAM
- 1.2MB floppy drive
- 1.44MB floppy drive
- 200MB IDE hard drive
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA monitor 1024NI
- 16 bit VGA adapter with 1MB
- MS DOS 5.0
- MS Windows 3.0 with mouse
- Free shipping in USA

$2799

486 ROSE 33MHz CACHE

- 80486™-33MHz processor
- 128K high speed RAM cache
- 4MB RAM
- 1.2MB floppy drive
- 1.44MB floppy drive
- 200MB IDE hard drive
- 2 serial, 1 parallel & 1 game ports
- 101 key keyboard
- 14" VGA monitor 1024NI
- 16 bit VGA adapter w 1MB
- MS DOS 5.0
- MS Windows 3.0 with mouse
- Free shipping in USA

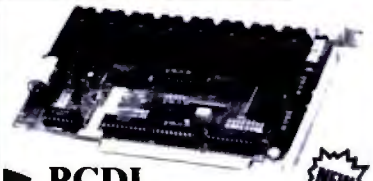
$3599

ROSE HILL SYSTEMS

4865 Scotts Valley Drive • Scotts Valley, CA 95066
(408) 438-3871 • 800-248-ROSE • FAX 438-6342

Terms: C.O.D. cash, Visa, or MasterCard (no surcharge). Company and University P.O.'s accepted upon credit approval. All returns must have an R.M.A. number. Prices are subject to change without notice. MS DOS & WINDOWS 3.0, 286™, 386™SX™, and 386™ are trademarks of Microsoft Corp. and Intel Corp. respectively.

Circle 137 on Inquiry Card.



► PCDI
Solid State Disk

- Rugged, Superfast, All Silicon Hard Disk Replacement That Works Where Hard Disks Fail.
- On Board BIOS. No Drivers Needed.
- Up To 30 Megabytes Of Non-Volatile Memory.

Order Toll Free 1-800-282-GTEK (4835)

GTEK INC *OEM & Dealer Inquiries Welcomed!*

DEVELOPMENT HARDWARE & SOFTWARE
P.O. Box 2310 • Bay St. Louis, MS 39521-2310 U.S.A.
Fax 601-467-0935
Mississippi & Technical Support 601-467-8048

Circle 62 on Inquiry Card.

MODEL 9000
(E)(E)PROM/MPU PROGRAMMER

$499

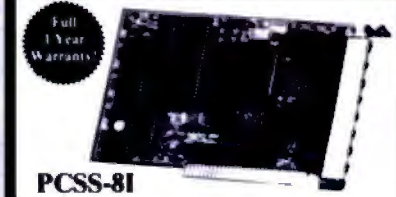
- *Ultra Fast!*
- Programs Eproms (up to 4Mb), EEproms And MPU's
- Up To 57K Baud
- QuickPulse & Intelligent Algorithms

Order Toll Free 800-282-GTEK (4835)

GTEK INC *OEM & Dealer Inquiries Welcomed!*

DEVELOPMENT HARDWARE & SOFTWARE
P.O. Box 2310 • Bay St. Louis, MS 39521-2310 U.S.A.
Fax 601-467-0935
Mississippi & Technical Support 601-467-8048

Circle 63 on Inquiry Card.



PCSS-8I
Intelligent Serial Coprocessor

- On Board Processor Handles Serial Communication Tasks
- 32K - 128K *Dynamemory™*
- Eight Ports Per Board
- High Performance - Low Cost!
- DOS, SCO™XENIX® SCO™UNIX® Drivers Included

Order Toll Free 800-282-GTEK (4835)

GTEK INC *OEM & Dealer Inquiries Welcomed!*

DEVELOPMENT HARDWARE & SOFTWARE
P.O. Box 2310 • Bay St. Louis, MS 39521-2310 U.S.A.
Fax 601-467-0935
Mississippi & Technical Support 601-467-8048

Circle 64 on Inquiry Card.

Data Acquisition Processor™

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) 453-2345
2265 116th Ave. N.E.
Bellevue, WA 98004
FAX (206) 453-3199

Circle 95 on Inquiry Card.

!!!!! NEW !!!!!
32 I/O <– > RS-232

- FINALLY ANY COMPUTER CAN HAVE I/O
- PLUGS INTO ANY STANDARD RS-232 PORT
- 16 DIGITAL INPUTS, 16 DIGITAL OUTPUTS
- ALL I/O OPTO-ISOLATED PROTECTED
- NO ADDITIONAL HARDWARE REQUIRED
- NO MORE SPECIAL PLUG-IN CARDS
- EASY TO PROGRAM IN ANY LANGUAGE
- UP TO 4 BOARDS CONNECT TO ONE RS-232
- IDEAL FOR REMOTE MONITOR & CONTROL
- USED IN INDUSTRY, SCHOOLS, LABS & HOBBY
- INDUSTRIAL VERSION AVAILABLE
- RS-422/485 VERSION AVAILABLE
- GRAFCET CONTROL SOFTWARE AVAILABLE
- COMES WITH PC BASIC PROGRAM DEMO DISK
- STANDARD UNIT PRICED AT ONLY $ 349 QTY 1
- DEALER INQUIRIES ARE WELCOME

P. SHERMAN ENTERPRISES (514) 331-3712

Circle 130 on Inquiry Card.

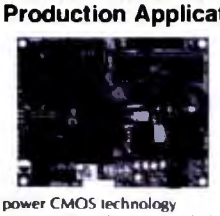
- Intel 80486 50/33 MHz Processor
- 64K(optional 256K) External Cache
- Optional 50/33 MHz Weitek 4167 Co-Processor
- Up to 32 MBYTE Memory
- 8 MHz I / O speed
- Phoenix / AMI / Award / MR. BIOS
- 512K EPROM
- Shadow RAM BIOS by software
- Passive back plane with seven expansion slots

PROFESSIONAL COMPUTER SYSTEMS, INC
550 Valley Way Milpitas CA 95035
(408)263-0222

intel inside

Circle 129 on Inquiry Card.

Compact & Versatile
8051/8052
Microcontroller Board
For Production Applications



- Low power CMOS technology
- Only 3.5"×4.5" with mounting holes
- Supports RS232 or RS485
- Battery-backed RAM socket
- Watchdog timer and power-fail interrupt circuitry
- Parallel I/O: 4½ 8-bit I/O ports
- Configurable for all known byte-wide devices
- 4 Jumper-Selectable Memory Maps

603-469-3232 • FAX: 603-469-3530

Call for detailed brochure and quantity pricing

Binary Technology, Inc.
Main St. • P.O. Box 67 • Meriden, NH 03770

Circle 91 on Inquiry Card.

DOS IN ROM!

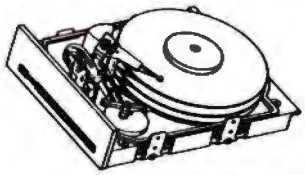
ALWAYS WAITING FOR A PROMPT? SPEED UP WITH NVS ROM DRIVE!
-BOOT 0.1 SEC
-1/2 SIZE CARD
-ANY PGMS, DOS
-LANS, CONTROL
64K..... $95
360K.....200
1.44M... 300
N V S
(508) 792 9507

8088 SINGLE BOARD COMPUTER

PC ON A CARD!
1.DEBUG ON PC
2.TEST SBC RAM
3.BURN EPROM
-BATTERY,SOLAR
-5YR WARRANTY
-62 PIN PC BUS
-2PAR,3SER,RTC
-LCD/KBD PORTS
NVSBC1.. $95
NVBIOS....60
PC CABLE..50
PC CARD...65

Circle 156 on Inquiry Card

HARD DRIVE MANIA



EVERYONES TALKING ABOUT IT LOW LOW PRICING ON SEAGATE/CONNER

SEAGATE			
ST125-1	20MB	MFM	$170
ST125-A	20MB	IDE	$160
ST225	20MB	MFM	$150
ST225R	20MB	RLL	$130
ST138A	32MB	IDE	$175
ST250R	42MB	RLL	$175
ST251-1	42MB	MFM	$175
ST157A	44MB	IDE	$190
ST227R-1	65MB	RLL	$255
ST296N	85 MB	SLSI	$315
ST1102A	84MB	IDE	$380
ST4096	80MB	MFM	$380
ST1144A	125MB	IDE	$490
ST4182E	160MB	ESDI	$505
ST4182N	160MB	SCSI	$505
ST4766	676MB	ESDE	$1130

WE ALSO CARRY

- LAPTOPS
- MONITORS
- MOTHER BOARDS
- VIDEO CARD
- FLOPPY DRIVES
- UPGRADES
- MEMORY
- SOFTWARE
- ALL ACCESSORIES
- PRINTERS

WE HAVE NAME BRANDS LIKE.
TOSHIBA • NEC
SEAGATE • HP
TEAC • EPSON
YOU NAME IT WE GOT IT!

CONNER				
CP3024	21MB	IDE	27MS	$165
CP3044	42MB	IDE	25MS	$245
CP3000	42MB	IDE	25MS	$210
CP3184	80MB	IDE	25MS	$285
CP3164	104MB	IDE	25MS	$410
CP3204	200MB	IDE	19MS	$610

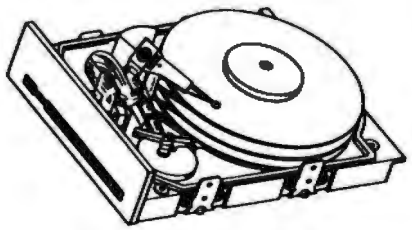
Best Price in the Industry

ORDER NOW THIS IS A LIMITED TIME OFFER!!!

HP LASER JETS

HPIII P	$985.00
HPII P	$ CALL
HPIII	$ CALL

LOW LOW PRICING



2-YEAR WARRANTY
FAST SERVICE
TECH SUPPORT
WE JUST WANT TO HELP OUR CUSTOMERS

CALL US FOR INFORMATION AND PRICING ON ALL PRODUCTS

MCS

TERMS:
1. We accept P.O.s from universities, government agencies, and qualified firms
2. MC, VISA, COD, prepay and approved P.O.s only.
3. We accept international orders.
4. We accept orders through the Fax.
5. 15% restocking fee on returns within 30 days. No refunds after 30 days.
6. No software return.
7. All prices are final after sale.

Trademarks are registered with their respective companies. Prices are subject to change.

FEDERAL EXPRESS · UPS · VISA · MasterCard

453-455 NORTH STREET • ROCHESTER, NY 14605

HOURS: 24 Hour Ordering **CALL 1-800-724-8865**

FAX: 716-423-9978
INT: 716-423-9978

Free Software From Top Publishers Online!

Preview the latest software instantly through BYTE DEMOLINK—It's easy, all you need to access BYTE DEMOLINK is a PC, a modem and a telecommunications program and the latest demo software is at your fingertips!

Software Available on DEMOLINK:

Mathematica 2.0
Mathematica 2.0 is the leading software system for numeric, symbolic, and graphical computation used internationally by professionals in almost every area of scientific and technical computing, on nearly 20 computer platforms. Mathematica, by Wolfram Research
Select the file mathmat.exe

JMP 2.0
JMP 2.0 by SAS Institute is a statistical visualization program for the Macintosh designed to bring innovative statistical techniques to the researcher. JMP is small yet capable, focused, yet widely understandable, unified and up-to-date in its methodology as well as in its technology. JMP 2.0 is designed to do many more things without any change in the personality of the original JMP
Select the file jmp.exe

ZyINDEX
ZyINDEX, by ZyLAB Corp, is the premiere text retrieval system for DOS and Windows. Search thousands of documents in seconds, regardless of where documents are located or with what word processor they were created.
Select the file zyindex.exe

GLOBALHERB
The world's most comprehensive library of Herbal Information for your personal computer. Find safe solutions for health problems. User friendly with advanced research capabilities
Select the file globalherb.exe

ASQ
ASQ 1.3 from Qualitas is a memory management tutorial and system analyzer which teaches you about your system's hardware, configuration, and memory. ASQ 1.3 analyzes your system and suggests ways to improve it
Select the file asq.exe

Multi-Platform Zortech C++
Zortech's multi-platform C++ compilers provide all the benefits of industrial strength C++ with the speed and code size you would expect from the best C compilers. Only Zortech can give you total portability to MS DOS, Windows 3.0, OS/2 DOS 386 and Macintosh. No matter what platform you choose a significant performance increase will be realized
Select the file zortech.exe

C-scape
The Oakland Group's C-scape is a programming tool for programmers. It is a powerful, object-oriented interface management system that includes a function library and a screen designer. The C-scape library is an extensive collection of functions for working with windows, data entry screens, input validation, menus, text editing and hypertext context-sensitive help
Select the file cscape.exe

Nemesis Go Master
Go is an easy-to-learn strategy game which is the national game of Japan. Go is considered a philosophical and analytical tool, in addition to being an addicting game

Nemesis Go Junior
Ideal for novices and Go Master is intended for the serious Go student. Both are from Toyogo Inc.
Select the file gojr.exe for MS DOS Go Junior
Select the file gomast.exe for MS DOS Go Master
Select the file gojr.bin for Macintosh Go Junior
Select the file gomast.bin for Macintosh Go Master

C++/Views
An object-oriented development environment for MS DOS Windows 3.0 based on C++, from CNS Inc. Includes over 75 C++ classes (with complete source) and development tools such as class browser, dialog code generator and class documentor
Select the file cviews.exe

CommonView 2 Illustrator Diskette
Glockenspiel CommonView 2 is a C++ application framework for quick development of applications portable between Microsoft Windows, Presentation Manager, OSF/Motif and HP New Wave.
Select the file comview2.exe

Look&Feel Screen Designer
An interactive screen editor that generates C source code for the screens or saves them in a file callable at runtime—by The Oakland Group
Select the file lnfdemoz.exe

Lotus Magellan 2.0
Lets you find, view, and use all the information on your PC. You can view files as they appear in your favorite program
Select the file magellan.exe

Quattro Pro 3.0
Borland's powerful spreadsheet with features including flexible 3D consolidation, macro building and debugging. Full mouse support, pull-down menus, 132 character-wide display, and 32 resizable windows provide modern user interface
Select the file quattro.exe

Be the first to evaluate the latest software for just the cost of a phone call! To connect with BYTE DEMOLINK, call the office nearest you today!

BYTE DEMOLINK Free Demo Download 617•861•9767*

*Call the nearest DEMOLINK office anytime. Telecom settings: 2400 or 1200 baud, 8 data bits, 1 stop bit, and no parity. Enter DEMOLINK at the prompt.

Chicago	Denver	Los Angeles	New York	San Francisco	Toronto	Washington, DC
312-616-1071	303-220-0328	213-383-9856	212-797-5620	415-434-4510	416-960-3187	202-463-4920

9 Track Tape Subsystem for PC/XT/AT/386/PS2

Best Quality • Lowest Prices

800/1600/3200/6250 BPI

CALL 1-800-266-4827

Laguna Data Systems

26941 Cabot Road
Laguna Hills, CA 92653
Tel: 714-367-0497
Fax: 714-367-0508

Circle 82 on Inquiry Card.

Voice Mail Turnkey Systems

- State-of-the-Art Voice Mail/Call Processing Systems – Ready to GO!
- Effortlessly process your sales, inquiries, and messages.

Complete Systems
(expandable to 16 lines)
from **$1495.**

Visa/Mastercard, C.O.D.

Voice World Technology

43 Monte Vista, Suite 2,
Oakland, CA 94611
Tel: **(510) 655-6020** Fax: **(510) 655-6038**

Circle 162 on Inquiry Card.

ROM Based AT Systems

Single Board Computer

- Run DOS and AT object code from ROM. Use standard PC/AT cards on passive backplane.
- KS6: NEC V53 uP, runs AT Code, 12mHz, AT Bus 4M RAM, 2M ROM, 512K SRAM (battery backed). 5 Serial, 2 Parallel Ports, Clock, Watchdog. $ 399 q1.
- KS7: V40 uP, PC compatible, 8 mHz, PC bus 512K RAM, 512K ROM, 384K SRAM, flop, 3 serial, parallel, keyboard, Clock, Watchdog. $ 245 q1.

303-444-7737 ***KILA***

Fax 303-786-9983 655 Hawthorn Ave Boulder CO 80304

Circle 79 on Inquiry Card.

EISA

15.3 MIPS

Need We Say More??

From the company that has brought the All-In-One Series to the industry...

EISA 486/33 SYSMAX Systems
From $3699

EISA 486/33 & 50MHz Boards
From $1799

HOMESMART COMPUTING
Orders (800) 627-6998
Sales (713) 589-7100
MC/VISA/COD/Prepay Accepted

Circle 66 on Inquiry Card.

FRACTAL IMAGE COMPRESSION

P.OEM™ fractal image compression is a revolutionary technology that can turn millions of existing PCs into powerful image processors by providing:

- ***Ultra-high compression***
- ***Software decompression***
- ***Resolution independence***

Developer's Kits and custom R&D available. Join the future of image compression! Contact Iterated Systems today at (404) 840-0310.

Iterated Systems, Inc.
5550A Peachtree Pkwy Suite 650
Norcross, GA 30092
(404) 840-0310 FAX: (404) 840-0029

Circle 77 on Inquiry Card.

Advertise your computer products through
BYTE BITS
(2" x 3" ads)

For more information call Mark Stone at 603-924-2695

BYTE
One Pheonix Mill Lane
Peterborough, NH 03458

Circle 168 on Inquiry Card.

Lifetime **FREE** software updates via BBS/US Mail
Unlimited toll-free technical support in USA

EP-1140 E/EPROM Programmer

$895.00

- Supports over 1,000 devices
- Recommended by Intel, Signetics, Dallas Semi, Xicor
- Qualified by Intel, Signetics, Dallas Semiconductor
- 1, 2, & 4 megabyte including the 16-bit wide versions
- FLASH EPROMs • E/EPROMs • PSD301
- High-speed CMOS PROMs
- 8-pin serial E/EPROMs • I²C Microwire
- All variations of 87C51 from AMD, Intel, Signetics
- 87C58 and 87C54 • DSP microcontrollers
- Works under Windows • Parallel Interface • Single Executable file

Call 1-800-225-2102 for information.

BP MICROSYSTEMS

BP Microsystems, Houston, TX 77043-3239
Phone: (713) 461-9430 Fax: (713) 461-7413

Circle 20 on Inquiry Card.

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for SEPT. 1, 1991

Memory for almost ALL computers

DYNAMIC RAM			
4M Board for hp LJ's w/2MB			$125.00
SIMM	4Mx9	80 ns	175.00
SIMM	1Mx9	60 ns	55.00
SIMM	1Mx9	80 ns	44.00
4 Mbit	4Mx1	80 ns	25.00
4 Mbit	1Mx4	80 ns	34.00
1 Mbit	1Mx1	80 ns	4.85
41256	256Kx1	100 ns	1.85
41256	256Kx1	120 ns	1.50
44256	256Kx4	80 ns	5.50
4464	64Kx4	100 ns	1.75
EPROM			
27C4001	512Kx8	150 ns	$35.00
D28F010	128Kx8	150 ns	24.00
27C1000	128Kx8	150 ns	12.00
27C512	64Kx8	120 ns	6.95
27128	16Kx8	250 ns	3.40
STATIC RAM			
1 Mbit	128Kx8	100 ns	$13.00
62256LP	32Kx8	100 ns	6.50

OPEN 6½ DAYS, 7 [illegible] SHIP VIA FED-EX ON SAT.

SAT DEL ON FED-EX ORDERS RECEIVED BY: [illegible]

MasterCard/VISA or DHS CASH COD

MICROPROCESSORS UNLIMITED, INC
24,000 S. Peoria Ave.
BEGGS, OK 74421 (918) 267-4961

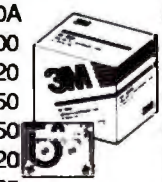
No minimum order $1 for packing materials
Shipping and insurance extra

Circle 93 on Inquiry Card.

pdi Precision Data Products

Save On 3M Data Cartridges

DESCRIPTION	PRICE
DC600A	$ 20.40
DC2000	$ 14.50
DC2120	$ 18.60
DC6150	$ 21.10
DC6250	$ 24.35
DC6320	$ 25.40
DC6525	$ 29.20
DC300XL/P	$ 18.40



Terms to well-rated Min. order $25.00 S&H: FOB Grand Rapids, MI. COD: add'l $5.50 MI residents + 4% tax. Prices subject to change. Visa, Mastercard accepted

616-698-2242 • FAX 616-698-9047
P.O.Box 8367 Grand Rapids, MI 49518

U.S.A. 800-968-0888
In MI, IN, & OH 800-968-2468

Circle 128 on Inquiry Card.

An Out-of-Towner's Introduction to the BIX Community

BIX is for people who use microcomputers for business, finance, research, and career and personal development. There's always something interesting happening here. No matter what you're into. The latest industry news. Top-notch software libraries. Private electronic mail. Real-time chatting. And every month, the complete text of *BYTE* magazine. (Read more about BIX, and how to join, on adjacent page.)

From Artificial Intelligence to Zenith Laptops...

Whatever your interest, BIX has a conference for you. Here's a sampling from our latest list. (In each Exchange, Conference name appears on left, description on right.)

■ Amiga Exchange

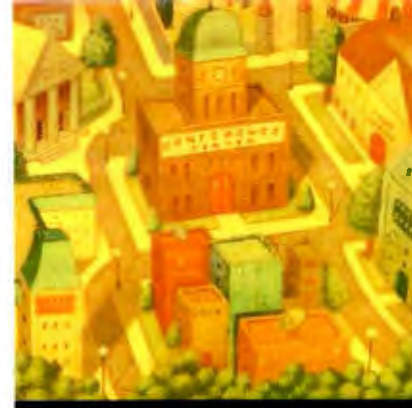
Joanne Dow, Exchange Editor

amiga.user	Exchange ideas, solve problems, compare notes
amiga.sw	Amiga programming and developer issues
amiga.hw	Amiga hardware design, use, and hookup
amiga.arts	Artistry using the Amiga
amiga.int	Developing for the international Amiga
amiga.special	Special guests and events
amiga.dev	Commodore's conference for developers

■ IBM Exchange

Barry Nance, Exchange Editor

ibm.pc	The venerable PC
ibm.at	The AT series and workalikes
ibm.ps	The PS/2 series
ibm.os2	OS/2 operating system
ibm.dos	PC/DOS & MS/DOS operating systems
ibm.os.386	Alternative 386 operating systems
ibm.utils	Utility software for IBM computers
ibm. repairshop	Garage and Tune-up Shop



BIX
COMMUNITY CALENDAR
OCTOBER 1991

ibm.new. prods	New products for IBM computers
ibm.exchange	IBM Exchange clearinghouse
ibm.listings	Index to program files in the Exchange
ibm.other	Apps, printers, modems, etc.
microsoft	Products from Microsoft

■ Programmers' Exchange

Bill Nicholls, Exchange Editor

ada	The Ada language conference
ai.theory	Artificial intelligence and expert system theory
assembler	Assembly language
basic	Your BASIC conference
c.language	C programming language
c.plus.plus	Discuss the C++ programming language
cad	Computer-aided design
cpm	CP/M conference
editors	The Programming Editors Conference
forth	FORTH programming
fortran	FORTRAN language conference
games	Game programming and design
graphic.pgms	Programming and graphics
hypertext	Hypertext publishing
lisp	LISP language conference
modula.2	Modula-2 language conference
neural.nets	Neural Networks
ood	Object-oriented development conference
os.9	OS-9 conference
pascal	Pascal language conference
pick	The PICK operating system
postscript	Postscript
smalltalk	Smalltalk language conference
soft.eng	Efficient and reliable software design
telecomm. pgms	Telecommunications programs
unix	The UNIX conference

■ Macintosh Exchange

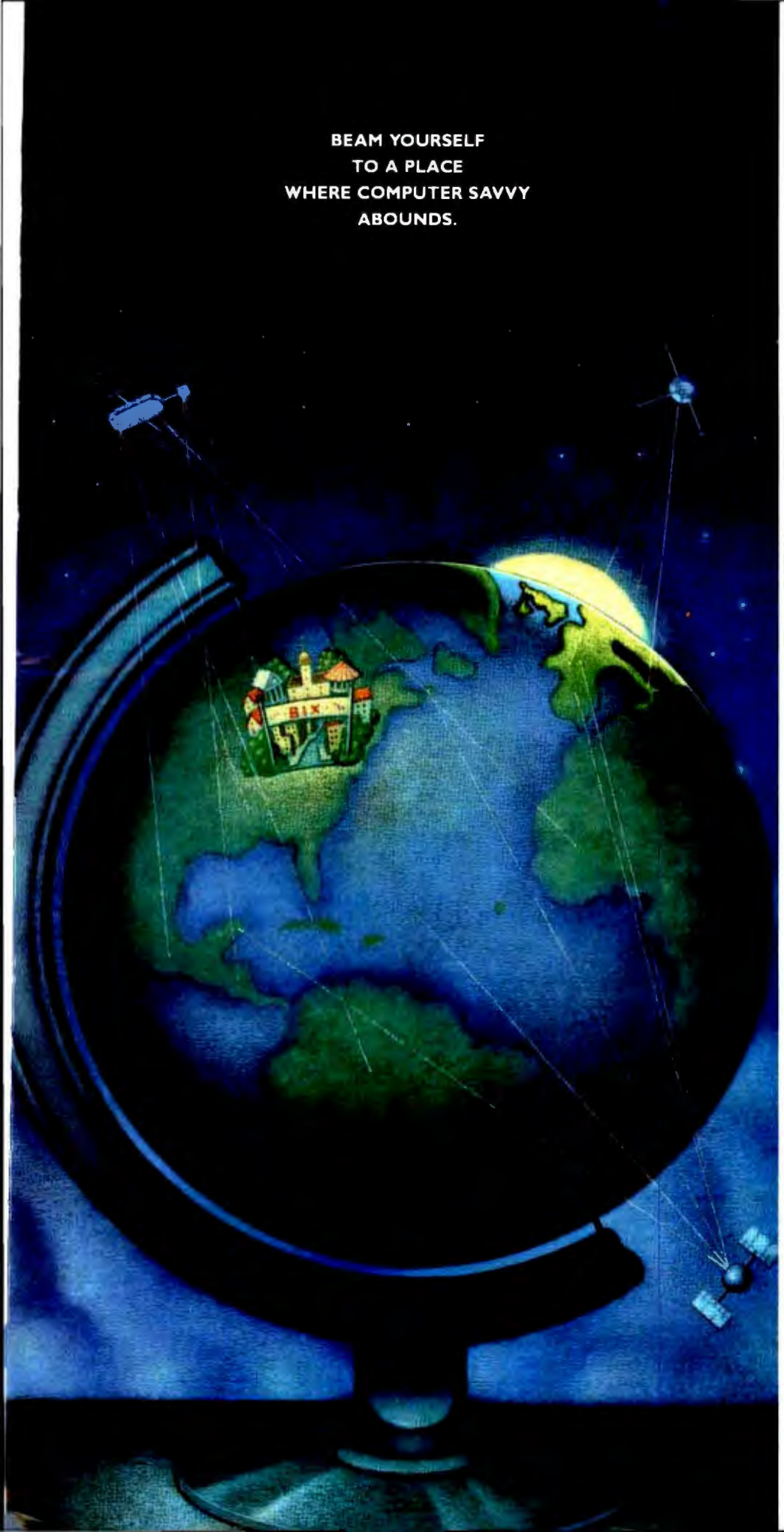
Dr. Larry Loeb, Exchange Editor

mac.apple	The word from Cupertino
mac.business	Macs in the office
mac.desktop	Publishing with a Mac
mac.external	Information from all over
mac.hack	Technical information about the Mac
mac.hypercard	Using the HyperCard programming environment
mac.news	Up-to-the-minute information
mac.novice	For beginners
mac.products	Listings of new hardware and software
mac.sandbox	For off-hours fun

■ Tojerry Exchange

Jerry Pournelle, Exchange Editor

tojerry	Messages for and from Jerry Pournelle
chaos.manor	Computing at Chaos Manor
astronomy	A star party for amateur astronomers
contact	Science fiction meets science
disasters	Natural and man-made disasters
education	Computers in American classrooms
mathematics	Talk about high-level mathematics
sciences	Scientific programs
space	Space exploration and development
technology	New technologies and their impact



■ Imagine a setting in which communal wisdom is on tap. A place that has the fit and feel of a small, friendly town, yet the sophistication and resources of a global community. One which you can visit electronically—to increase your knowledge of computers and their applications, hone your skills, share insights with thousands of other computer pros, and have fun. Such a community would be called BIX.

Subscribe to BIX, the flat-fee, on-line information service.

BIX is your access to industry news. And to many special interest Exchanges—such as our *Amiga*, *IBM*, *Mac*, *Writers'*, and *Interactive Games* Exchanges—which include thousands of free, downloadable programs. All for just $39 per quarter.*

Subscribe via your computer...

Set your program for full duplex, 7 bits, even parity, 1 stop bit. Call BIX on our registration-only number: 800-225-4129. In MA: call 617-861-9767. International: call NU1310690157800. Then hit the return key, and respond:

Prompt:	**You Enter:**
login	bix
Name?	bix.ville

You may buy off-peak access via *Tymnet* at $20 per month or $3 per hour, or you may buy peak access at $6 per hour.**

*Based on a $156 annual fee, billed quarterly. Telecommunications charges are extra. You may cancel at any time without future charges.

**Available only in contiguous 48 states. Tymnet rates subject to change.

800-227-2983 • In NH 603-924-7681

BIX

READER SERVICE

ALPHABETICAL INDEX TO ADVERTISERS

Inquiry No.		Page No.
401	3EST-USA	152IS-9
8	ALACRON	98
169	ALADDIN	176
9	ALDUS	18,19
572-573	AMERICAN BUSINESS INFO	152PC-10
10-11	AMERICAN MEGATRENDS	89
12	AMERICAN SMALL BUSINESS	131
13	AMT INT'L	224
14	ARTISOFT	211
167	ASHLAR,INC	185
15	AVOCADO COMP VIDEO	224
402-403	BAY TECHNICAL ASSOC	152IS-9
16	BEST DATA PROD,INC	175
*	BINARY TECHNOLOGY	234
450	BIX (INTL)	100,101
*	BIX (INTL)	205
450	BIX	238,239
17	BLACK & WHITE INT'L	121
20	BP MICROSYSTEMS	237
404	BRISTOL S/W FACTORY	152IS-6
399	BUFFALO PROD (N.A.)	213
*	BUYERS MART	227–229
*	BYTE BACK ISSUES	144,206
168	BYTE BITS	237
*	BYTE CARD DECK	152
*	BYTE SUB MESSAGE	216
*	BYTEWEEK/NEWSLETTER	207
165	BYTE/DEMOLINK	236
21	CADAM	151
574-575	CEDAR SOFTWARE	152PC-8
24	CHIPS & TECH,INC	149
*	COMPAQ	14,15
25	COMPUCOM	230
26	COMPUTER ASSOCIATES	26
*	COPIA INTERNATIONAL	33
27	CREATIVE LABS,INC	207
28	CTX INTERNATIONAL	48
551	CYBEX CORP	152MW-5
557	CYBEX CORP	152NE-5
576	CYBEX CORP	152PC-11
586	CYBEX CORP	152SO-7
29	CYRIX CORP	34,35
30-31	DATA ACCESS	109
32-33	DATALUX CORPORATION	29
166	DATAPRO INFO SERV	221
34	DATASTORM TECH	116
35	DELL COMPUTER CORP (N.A.)	CIII
36	DELL COMPUTER CORP (N.A.)	CIV
37	DESCRIBE,INC	179
38-39	DIAGSOFT,INC	153
40	DIGITAL RESEARCH (N.A.)	100,101
41	DIGITALK	39
45-46	DYNALINK TECH	176
47-48	ELCEE COMPUTEK	230
*	ELONEX	152IS-7
558-559	EMPOWER MICROSYSTEMS	152NE-3
49-50	EXABYTE CORP	193
52-53	FIRST SOURCE INT'L	231
54	FLYTECH TECHNOLOGY	47
55-56	GALACTICOMM	201
*	GATEWAY 2000	24A–D,25
*	GATEWAY 2000 (INTL)	CIII,CIV
57-58	GEC MARCONI	76
59	GENERIC SOFTWARE	187
552	GFA SOFTWARE TECH,INC	152MW-3
560	GFA SOFTWARE TECH,INC	152NE-7
577	GFA SOFTWARE TECH,INC	152PC-7
587	GFA SOFTWARE TECH,INC	152SO-1
60-61	GLENCO ENGINEERING	75
405	GNOSIS	152IS-3
62-64	GTEK,INC	234
170	GUI CLEARING HOUSE	215
588-589	HI-COMPUTER CO	152SO-6
66	HOME SMART COMPUTING	237
67	HOOLEON CORP	24
68	HORSTMANN S/W DESIGN	130
69-71	HOUSTON INSTRUMENTS	66,67
406	H R BOYNTON CO,INC	152IS-12
72	IBM PS/2 SYSTEM	6,7
407	IDIOMA/I-COM	152IS-12
73	INFRALINK GMBH	127
74-75	INTEL	90,91
76	ISLAND SYSTEMS	121
77	ITERATED SYSTEMS	237
78	JAMECO ELECTRONICS	63
6-7	JDR MICRODEVICES	244
408-409	JDR MICRODEVICES	152IS-5
79	KILA SYSTEMS	237
80-81	KINESIX	92
82	LAGUNA DATA SYSTEMS	237
83	LEGACY STORAGE SYS	105
84-85	LOGITECH,INC	2,3
*	MARK WILLIAMS CO	111
86	MASTER COMPUTER SYS	235
*	MCGRAW-HILL PUBL ONLINE	215
87-88	MEGA COMPUTER SYS	230
89-90	MERASOFT	181
91	MERRIMACK VALLEY SYSTEMS	234
578	METAWARE,INC	152PC-5
92	MICRO SOLUTIONS COMP PROD	33
93	MICROPROCESSORS UNLTD	237
94	MICROPROSE SOFTWARE	224
96	MICROSTAR LABORATORIES	130
95	MICROSTAR LABORATORIES	234
97	MIX SOFTWARE	129
98	MULTISCOPE,INC	73
99	NANAO	4
100-101	NATIONAL DESIGN,INC	191
103	NATIONAL INSTRUMENTS	13
102	NATIONAL INSTRUMENTS	224
104	NEC MONITOR	CII,1
105	NEVADA COMPUTER	226
106	NEW MEDIA GRAPHICS	22
563	NORTHEAST COMP SHOW	152NE-11
107	NORTHGATE COMPUTER	77-84
114-115	ONLINE PRODUCTS	106
22-23	ONTIME SOFTWARE	37
553-554	ONTRACK COMPUTER SYS	152MW-7
561-562	ONTRACK COMPUTER SYS	152NE-10
579-580	ONTRACK COMPUTER SYS	152PC-6
590-591	ONTRACK COMPUTER SYS	152SO-4
116	OUTPUT TECHNOLOGY CORP	177
*	PACIFIC DATA PROD	156
117	PANASONIC DOT MATRIX	122
118	PANASONIC MONITORS	9
119	PARA SYSTEMS	99
120	PATTON & PATTON S/W CORP	20
121-122	PC POWER & COOLING	45
123	PC PROS	169
124	PERFORMANCE TECH	217
125	PIONEER	96
126	PLUS DEVELOPMENT CORP	183
127	POPKIN SOFTWARE	68
128	PRECISION DATA PRODUCTS	237
129	PROFESSIONAL COMP SYSTEMS	234
*	PROGRAMMER'S SHOP	133–142
130	P SHERMAN ENTERPRISES	234
131	QUARTERDECK	170,171
132	QUATECH	222
133	RAIMA CORP	61
134	RAINBOW TECH	55
581	RCS MANAGEMENT	152PC-3
135	REPLY CORP	165
136	ROSE ELECTRONICS	214
138	ROSE HILL SYS,INC	225
137	ROSE HILL SYS,INC	232,233
139	ROYKORE	44
140-141	SAS INSTITUTE,INC	205
142	SEQUITER SOFTWARE	145
145	SONY MICROSYS	114,115
146	STORAGE DIMENSIONS	112
147	STORAGE DIMENSIONS	113
148	STRATEGIC MAPPING	189
410	SURAH	152IS-11
592	SYNERCO,INC	152SO-3
149	TANGENT COMPUTERS	23
150	TEXAS INSTRUMENTS (PPD)	203
*	TEXAS MICROSYSTEMS	56A–B
151	TEXAS MICROSYSTEMS	56,57
152-153	THE SOFTWARE LINK	65
154	TOSHIBA AMERICA	10,11
155	TRANTOR SYSTEMS LTD	37
156-157	TRIBAL MICROSYSTEMS INC	234
411	UNICOTT	152IS-2
158	UNITED SOLUTIONS	147
564-565	UNIX EXPO INT'L	152NE-9
566-567	UNLIMITED SYS	152NE-1
582-583	UNLIMITED SYS	152PC-9
593-594	UNLIMITED SYS	152SO-5
161	UPSONIC	31
162	VOICE WORLD TECHNOLOGY	237
*	WATCOM PRODUCTS	21
412	ZENDEX	152IS-12

** Correspond directly with company*

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

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

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.

Serving you since 1979

JDR Microdevices®

2233 Samaritan Drive, San Jose, CA 95124

BUY WITH CONFIDENCE FROM JDR!
- 30-DAY MONEY BACK GUARANTEE
- 1 YEAR WARRANTY
- TOLL-FREE TECH SUPPORT

MMC

MOTHERBOARDS

NEW LOWER PRICES

16MHz MINI 386-SX $299.95

• NORTON SI 15.3 • LANDMARK AT SPEED 20.8

• EXPANDABLE TO 8MB ON-BOARD • AMI BIOS • CHOOSE 0 OR 1 WAIT STATE FOR USE WITH SLOWER RAM • FIVE 16-BIT AND THREE 8-BIT SLOTS • CHIPS & TECHNOLOGY 'NEAT' CHIPSET • SOCKET FOR 80387-SX CO-PROCESSOR • 8.5" X 13" SIZE FITS MINI-286 & FULL-SIZE 286 CASES

MCT-386SX		$299.95
MCT-386SX-20	20MHZ MINI 386-SX	$349.95
MCT-M386-25	25MHZ MINI 386	$499.95
MCT-C386-33	MINI-SIZE 33MHZ CACHE 386	$699.00
MCT-C386-40	MINI-SIZE 40MHZ CACHE 386	$899.00
MCT-M486-33	MINI 33MHZ CACHE 486	$1295.00
MCT-M286-16	MINI 16MHZ 286	$199.95
MCT-M286-12	MINI 12MHZ 286	$179.95
MCT-TURBO-10	MINI 10MHZ 8088	$69.95

101-KEY $49.95

101-KEY WITH 12 FUNCTION KEYS • 286/386/486 COMPATIBLE

BTC-5339		$49.95
FC-3001	101-KEY,12 F-KEYS & CALCULATOR	$69.95
BTC-5060	84-KEY WITH 10 FUNCTION KEYS	$59.95

DYNAMIC RAM

PART #	SIZE	SPEED	PINS	PRICE
TMS4464-12	65536x4	120ns	18	3.49
41256-100	262144x1	100ns	16	1.99
41256-80	262144x1	80ns	16	2.19
414256-100	262144x4	100ns	20	6.95
414256-80	262144x4	80ns	20	7.95
1MB-100	1048576x1	100ns	18	6.95
1MB-80	1048576x1	80ns	18	7.95
1MB-60	1048576x1	60ns	18	9.95

SIMMS

PART #	SIZE	SPEED	FOR	PRICE
41256A9B-80	256K x 9	80ns	SIMM/PC	21.95
421000A8B-10	1MB x 8	100ns	SIMM/MAC	64.95
421000A9B-10	1MB x 9	100ns	SIMM/PC	64.95
421000A9B-80	1MB x 9	80ns	SIMM/PC	69.95
421000A9B-60	1MB x 9	60ns	SIMM/PC	89.95

MATH CO-PROCESSORS

NEW LOWER PRICES

MANUAL, SOFTWARE GUIDE & 5 YEAR WARRANTY

	PART #	SPEED	PRICE	PART #	SPEED	PRICE
INTEL	8087	5 MHz	89.95	80387-20	20 MHz	209.95
	8087-2	8 MHz	129.95	80387-25	25 MHz	219.95
	8087-1	10 MHz	169.95	80387-33	33 MHz	229.95
	80287-XL	12 MHz	94.95	80387-SX	16 MHz	129.95
	80387-16	16 MHz	199.95	80387-SX20	20 MHz	149.95
CYRIX	83D87-16	16 MHz	199.95	83D87-40	40 MHz	239.95
	83D87-20	20 MHz	209.95	83S87-16(SX)	16 MHz	129.95
	83D87-25	25 MHz	219.95	83S87-20(SX)	20 MHz	149.95
	83D87-33	33 MHz	229.95	83S87-25(SX)	25 MHz	159.95
IIT	2C87-8	8 MHz	79.95	2C87-12	12 MHz	99.95
	2C87-10	10 MHz	89.95	2C87-20	20 MHz	139.95

MAXIMIZE CO-PROCESSOR SPEED

OUR "2ND STAGE" ALLOWS 20MHZ CO-PROCESSORS TO RUN AT FULL SPEED IN THE SLOWEST 286 SYSTEMS

2ND-STAGE FOR 10/20 MHZ 80287'S $49.95

OTHER VERSIONS FOR 8, 12 OR 16 MHZ 80287'S

INTERFACE CARDS

16-BIT IDE MULTI I/O $69.95

- 286/386/486 COMPATIBLE
- SUPPORTS 2 IDE HARD DRIVES & 2 FLOPPIES (360K,720K,1.2MB & 1.44MB)
- TWO SERIAL, ONE PARALLEL & ONE GAME PORT
- SUPPORTS COM1 THRU 4, LPT1, 2, & 3
- ALL FUNCTIONS CAN BE INDIVIDUALLY DISABLED

MCT-IDEIO		$69.95
MCT-FDC-HD	1.44MB FLOPPY(2X) CARD	$49.95
MCT-FDC-HD4	4 FLOPPY VERSION	$59.95
MCT-HDC	HARD DISK CARD	$79.95
MCT-RLL	RLL HARD DISK CARD	$89.95
MCT-FAFH	16-BIT 1:1 MFM F/H CARD	$149.95
MCT-AFH-RLL	16-BIT 1:1 RLL F/H CARD	$199.95
MCT-ESDI	16-BIT 1:1 ESDI CARD	$149.95
MCT-IDEFH	IDE FLOPPY/HARD CARD	$29.95
MCT-IO	MULTI I/O CARD FOR 8088 SYSTEMS	$59.95
MCT-AIO	286/386/486 MULTI I/O CARD	$49.95
MCT-AEMS	16-BIT EMS CARD	$129.95
MCT-EEMS	16-BIT EEMS CARD	$149.95
MCT-VGA	8/16-BIT VGA CARD	$149.95
MCT-VGA-1024	1024 X 768 VGA	$169.95
MCT-VGA-1024+	1024 X 768/256 COLORS	$199.95

UPRIGHT CASE $249.95

- FOR STANDARD, FULL SIZE AND MINI-MOTHERBOARDS
- 250 WATT POWER SUPPLY (110/220V)
- MOUNTS FOR 3 FLOPPY AND 4 HARD DRIVES
- TURBO AND RESET SWITCHES
- SPEED DISPLAY, POWER, DISK LEDS
- MOUNTING HARDWARE, FACEPLATES AND SPEAKER INCL

CASE-100		$249.95

MORE CASES...

CASE-200	UPRIGHT HOLDS 11 DRIVES	$499.95
CASE-120	MINI-UPRIGHT W/200 WATT PS	$199.95
CASE-70	FULL-SIZE 286 STYLE CASE	$89.95
CASE-50	MINI-SIZE 286 STYLE CASE	$59.95

POWER SUPPLIES

PS-135	8088 135 WATT	$59.95
PS-150	8088 150 WATT	$69.95
PS-200X	8088 200 WATT	$89.95
PS-200	286/386/486 200 WATT	$89.95
PS-250	286/386/486 250 WATT	$129.95

1024 x 768 VGA PACKAGE $499.95

- 8088 & 286/386/486 COMPATIBLE CARD & 1024 X 768 INTERLACED MONITOR
- 1:1 ASPECT RATIO; 0.28 DOT PITCH
- 256 COLORS FROM 262,000
- 8/16-BIT CARD HAS 512K VIDEO RAM EXPANDABLE TO 1MB

VGA-PKG-1024+		$499.95
VGA-PKG	640 X 480 VGA PACKAGE	$399.95

MORE MONITORS...

NEC-MULTI-3DS	LOW EMISSION MONITOR	$649.00
VGA-MON-1024	.28mm 1024 X 768 MONITOR	$349.95
VGA-MON-1024N	AS ABOVE, NON-INTERLACED	$479.95

2400 BAUD MODEM $79.95

- 2400/1200/300 BPS INTERNAL DATA MODEM • FULL HAYES AT COMPATIBILITY • INCLUDES PROCOMM SOFTWARE

MCT-24I		$79.95
MCT-FAXM	AS ABOVE W/4800 BPS FAX SEND	$89.95
PCEM7296	INTEL 9600 BPS EXTERNAL	$549.00
PCCB6201	INTEL SATISFAXTION FAX/MODEM	$449.95
VIVA-24MNP	2400 BPS EXT MODEM W/MNP	$149.95

CALL FOR OUR FREE CATALOG TODAY!

FOR PC'S, MONITORS, DISK DRIVES, KEYBOARDS, MODEMS, LAPTOPS, CABLES, CONNECTORS, SOFTWARE, PROGRAMMING PRODUCTS, TEST EQUIPMENT, ICS & MORE!

DISPLAY CARD $49.95 DIAGNOSES SYSTEM ERRORS

PLUG INTO SLOT, READ DISPLAY AND CHECK MANUAL FOR POWER-ON SELF-TEST CODE

- 286/386/486 COMPATIBLE
- WORKS WHEN SOFTWARE WON'T EVEN BOOT PC
- PLACE DISPLAYS ON-BOARD OR ON BACK PANEL

PCODE		$49.95
PCODE+	WITH QA PLUS VERSION 3.12	$69.95

UNIVERSAL PROGRAMMER/TESTER

- PROGRAMS EPROMS, EEPROMS, PALS, BI-POLAR PROMS, 8748 & 8751 SERIES, 16V8 & 20V8 GALS • TESTS TTL, CMOS, DYNAMIC & STATIC RAMS
- LOAD DISK, SAVE DISK, EDIT, BLANKCHECK, PROGRAM, AUTO, READ MASTER, VERIFY & COMPARE • ACCEPTS .3" TO .6" WIDE IC'S (8-40 PINS)

MOD-MUP	REQUIRES HOST ADAPTOR CARD	$499.95

EPROM PROGRAMMING MODULES

- PROGRAMS 24-32 PIN EPROMS, CMOS EPROMS & EEPROMS, 16K TO 1024K • HEX TO OBJ CONVERTER • AUTO, BLANK CHECK/PROGRAM/VERIFY

MOD-MEP		$119.95
MOD-MEP-4	4-EPROM UNIT	$169.95
MOD-MAC	COMMON HOST ADAPTOR CARD	$29.95

BREADBOARD ON-A-CARD

- INCLUDES ADDRESS DECODING LOGIC, DATA BUFFERING, 2 LSI CIRCUITS FOR PROGRAMMABLE DIGITAL I/O & COUNTER TIMING FUNCTIONS • ACCEPTS UP TO 24 14-PIN IC'S • ACCEPTS 9,15, 25, OR 37 PIN D SUBS

PDS-601	8-BIT CARD	$79.95
PDS-611	16-BIT CARD WITH I/O DECODE	$89.95

PROTOTYPE CARDS

JDR'S CARDS INCLUDE FR-4 EPOXY LAMINATE WITH GOLD-PLATED EDGECARD FINGERS & SILK-SCREENED LEGENDS

JDR-PR2	8-BIT WITH I/O DECODE LAYOUT	$29.95
JDR-PR10	16-BIT WITH I/O DECODE LAYOUT	$34.95

3-BUTTON MOUSE $14.95

- SELECTABLE ACCURACY 290 -1450 DPI
- SWITCH SELECTABLE MICROSOFT OR MOUSE SYSTEMS COMPATABILITY MODE
- OPTO-MECHANICAL DESIGN
- WINDOWS 3.0 COMPATIBLE

JDR-MOUSE-3		$14.95

HARD DRIVES 45MB $219

5-1/4"	ST-251-1	42.8 MB	MFM	28MS	$249
3-1/2"	ST-157A	44.7 MB	IDE	28MS	$219
5-1/4"	ST-277-1	65.5 MB	RLL	28MS	$289
3-1/2"	ST-1102A	89.1 MB	IDE	19MS	$399
3-1/2"	ST-1144A	131 MB	IDE	19MS	$499
3-1/2"	ST-1201A	177 MB	IDE	15MS	$749
5-1/4"	ST-2383A	338 MB	IDE	16MS	$1295
5-1/4"	1654	161 MB	ESDI	16MS	$899
5-1/4"	1664	345 MB	ESDI	14MS	$1449
5-1/4"FH	1568	676 MB	ESDI	16MS	$2195

FLOPPY DRIVES

FDD-1.44X	1.44MB 3.5" FLOPPY - BLACK	$79.95
FDD-1.44A	1.44MB 3.5" FLOPPY - BEIGE	$79.95
FD-55GFV	5.25" TEAC DOUBLE-SIDED HD 1.2MB	$99.95
FDD-1.2	5.25" DOUBLE-SIDED HD 1.2MB	$89.95
FD-55B	5.25" TEAC DOUBLE-SIDED DD 360K	$89.95
FDD-360	5.25" DOUBLE-SIDED DD 360K	$69.95

VISA MasterCard

SALES 800-538-5000 Customer Service 800-538-5001 Local/Int'l 408-559-1200
Technical Support 800-538-5002 Fax 408-559-0250

TERMS: For shipping & handling include $5.00 for ground and $7.50 for air. Orders over 1 lb. and foreign orders may require additional shipping charges—contact our Sales Dept. 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, the JDR logo, JDR Microdevices, and the MCT logo are registered trademarks of JDR MICRODEVICES, INC. Modular Circuit Technology, are trademarks of JDR MICRODEVICES, INC.

KEY CODE 1023

Circle 6 on Inquiry Card (RESELLERS: 7).

FREE PRODUCT INFORMATION

Mail Your Completed Card Today. For Quicker Response, Fax to 1-413-637-4343!

Circle the numbers on Inquiry Card which correspond to inquiry numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "E".

Print Your name and address and mail, or fax to 1-413-637-4343

Fill out this coupon carefully. PLEASE PRINT.

NAME

TITLE

COMPANY

ADDRESS

CITY COUNTY CODE

( ) ( )

PHONE FAX

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior level
8 ☐ Middle level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)

12 ☐ PC/MS DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?

18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

OUTLOOK
IRSE009

Inquiry Numbers 1-493

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

Inquiry Numbers 494-986

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

Inquiry Numbers 987-1479

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	1201	1202	1203	1204	1205	1206	1207
1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224
1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241
1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258
1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275
1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292
1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309
1310	1311	1312	1313	1314	1315	1316	1317	1318	1319	1320	1321	1322	1323	1324	1325	1326
1327	1328	1329	1330	1331	1332	1333	1334	1335	1336	1337	1338	1339	1340	1341	1342	1343
1344	1345	1346	1347	1348	1349	1350	1351	1352	1353	1354	1355	1356	1357	1358	1359	1360
1361	1362	1363	1364	1365	1366	1367	1368	1369	1370	1371	1372	1373	1374	1375	1376	1377
1378	1379	1380	1381	1382	1383	1394	1385	1386	1387	1388	1389	1390	1391	1392	1393	1394
1395	1396	1397	1398	1399	1400	1401	1402	1403	1404	1405	1406	1407	1408	1409	1410	1411
1412	1413	1414	1415	1416	1417	1418	1419	1420	1421	1422	1423	1424	1425	1426	1427	1428
1429	1430	1431	1432	1433	1434	1435	1436	1437	1438	1439	1440	1441	1442	1443	1444	1445
1446	1447	1448	1449	1450	1451	1452	1453	1454	1455	1456	1457	1458	1459	1460	1461	1462
1463	1464	1465	1466	1467	1468	1469	1470	1471	1472	1473	1474	1475	1476	1477	1478	1479

PLACE POSTAGE HERE

BYTE

TNT MAILFAST
FRG/BOS/700252/M01
P.O. Box 66
Hounslow
TW5 9RT
England

FREE PRODUCT INFORMATION

Mail Your Completed Card Today. For Quicker Response, Fax to 1-413-637-4343!

Circle the numbers on Inquiry Card which correspond to inquiry numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "E"

Print Your name and address and mail, or fax to 1-413-637-4343

PLACE POSTAGE HERE

BYTE

TNT MAILFAST
FRG/BOS/700252/M01
P.O. Box 66
Hounslow
TW5 9RT
England

Fill out this coupon carefully. PLEASE PRINT.

NAME

TITLE

COMPANY

ADDRESS

CITY COUNTY CODE

( ) ( )

PHONE FAX

A. What is your primary job function/principal area of responsibility? (Check one.)

1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?

7 ☐ Senior level
8 ☐ Middle level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?

10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)

12 ☐ PC/MS DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?

18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

OUTLOOK
IRSE09

Inquiry Numbers 1-493

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

Inquiry Numbers 494-986

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

Inquiry Numbers 987-1479

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 1201 1202 1203 1204 1205 1206 1207
1208 1209 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224

1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239 1240 1241
1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254 1255 1256 1257 1258
1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269 1270 1271 1272 1273 1274 1275
1276 1277 1278 1279 1280 1281 1282 1283 1284 1285 1286 1287 1288 1289 1290 1291 1292
1293 1294 1295 1296 1297 1298 1299 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309
1310 1311 1312 1313 1314 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326
1327 1328 1329 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343

1344 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359 1360
1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374 1375 1376 1377
1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389 1390 1391 1392 1393 1394
1395 1396 1397 1398 1399 1400 1401 1402 1403 1404 1405 1406 1407 1408 1409 1410 1411
1412 1413 1414 1415 1416 1417 1418 1419 1420 1421 1422 1423 1424 1425 1426 1427 1428
1429 1430 1431 1432 1433 1434 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445
1446 1447 1448 1449 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462
1463 1464 1465 1466 1467 1468 1469 1470 1471 1472 1473 1474 1475 1476 1477 1478 1479

THE ONLY LOGICAL CHOICE!


GATE

When you buy a Gateway 2000 personal computer, you get the best price in the industry. You get quality that is unsurpassed anywhere. You get technical support from our award-winning service organization for the life of your machine. And you get it all from the company that sells more PC systems through the direct market channel than any other manufacturer in the United States. Gateway 2000 is the second fastest-growing private company in this country, and has been doing business internationally for years.

Gateway 2000 computer systems are in use today by thousands of customers in over 100 different countries. We know the special needs of international customers and we'll take care of you.

Please refer to our advertisement in the front of BYTE for system configurations and prices. Once you compare what we have to offer, you'll agree. The only logical choice is Gateway 2000!

GATEWAY2000

"You've got a friend in the business."

605-232-2000

610 Gateway Drive • North Sioux City, SD 57049 U.S.A. • Fax 605-232-2023

People The World Over Are Making The Logical Choice!

GATEWAY2000

"You've got a friend in the business."

6 0 5 - 2 3 2 - 2 0 0 0

610 Gateway Drive • North Sioux City, SD 57049 U.S.A. • Fax 605-232-2023