

Dreaming of the Future

Digital technology could help make this a better world. But we've also got to change our way of thinking.

Despite the rapid progression of computing technology, the world faces incredible hazards as we enter a common economic-political vehicle, traveling at an ever-accelerating pace through increasingly complex terrain. Our headlights are much too dim and blurry, and we have totally inadequate steering and braking controls.

Many years ago, I dreamed that digital technology could greatly augment our collective human capabilities for dealing with complex, urgent problems. Computers, high-speed communications, displays, interfaces—it's as if suddenly, in an evolutionary sense, we're getting a super new nervous system to upgrade our collective social organisms. I dreamed that people were talking seriously about the potential of harnessing that technological and social nervous system to improve the collective IQ of our various organizations.

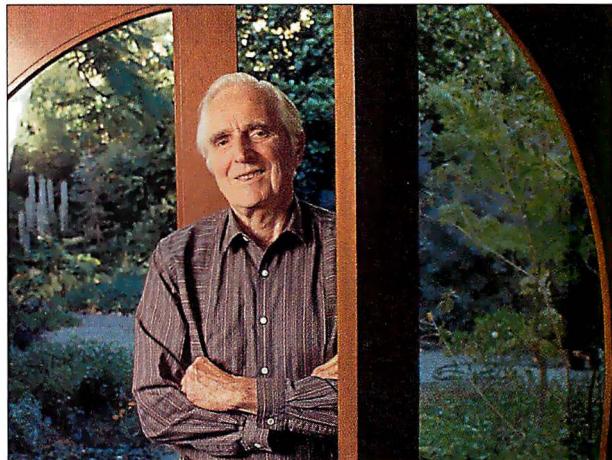
Then I dreamed that we got strategic and began to form cooperative alliances of organizations, employing advanced networked computer tools and methods to develop and apply new collective knowledge. Call these alliances NICs (Networked Improvement Communities). This seemed eminently sensible. The new technologies could enable much more effective distributed collaboration, and the potential for shared risk and multiplied benefits seemed promising.

In the dream, the solution involves giving high priority to the collective capability for a distributed community (or organization) to develop, integrate, and apply new knowledge. We already had this capability, of course; organizations handle new collective problems all the time. But yes, it would be nice if we could be a lot more effective at it. In the dream, this collaborative capability was called CoDIAK, for Concurrent Development, Integration, and Application of Knowledge.

Sounds great. The better we get, the better we get at getting better. Call it bootstrapping. And just think of the important role for technologists.

Although exciting new technology innovations have indeed been introduced within the NICs, the technology efforts have been overshadowed by the concurrent efforts in "human-system" innovation. This includes new skills, methods, collaborative organizational structures, telecommuting, knowledge-worker teams, distributed goal setting, planning and management processes.

One of the ideas computer-oriented folks have contributed is the open hyperdocument system. For this to make a difference, we must shed our outdated concept of a document. We need to think in terms of flexible jump-



DAVID TOERGE © 1995

ing and viewing options. The objects assembled into a document should be dealt with explicitly as representations of kernel concepts in the authors' minds, and explicit structuring options have to be utilized to provide a much enhanced mapping of the source concept structures.

The Web/HTML (Hyper ext Markup Language) publishing-browsing landslide has moved steadily toward a highly structured, object-oriented architecture with integrated editor-browser tool sets. But this needs to become the way the majority of people do all their work. Draft notes, E-mail, plans, source code, to-do lists, what have you—all can be hyperdocument pieces, instantly and intrinsically linkable, and with work processes involving fewer and fewer hard-copy printouts.

It has been exciting to watch the emergence of total-quality management, process reengineering, NII (National Information Infrastructure), the World Wide Web, and so forth. But it pains me that we haven't yet put up an explicit CoDIAK target, nor explored how NICs could fly. Since the first of these dreams got fixed in my head, decades ago, I've struggled with the realization that the sooner the world gets serious about pursuing the possibilities, the greater the chance that we can reduce the hazards facing this careening vessel carrying us along.

If the dream of improving human destiny doesn't move people, how about the thought that the companies that adopt the best CoDIAK-improvement strategy will have a significant competitive advantage. Wouldn't you want your group to have the highest collective IQ?

I confess that I am a dreamer. Someone once called me "just a dreamer." That offended me, the "just" part; being a real dreamer is hard work. It really gets hard when you start believing in your dreams. ■

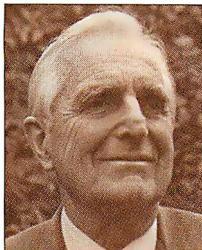
As a researcher and inventor in the late 1950s and early 1960s, Douglas Engelbart envisioned most of the computing concepts we now take for granted (see the brief biography on page 137). He heads the Bootstrap Institute. You can reach him by sending E-mail to engelbart@bootstrap.org.

THE 20 MOST IMPORTANT PEOPLE

of our top 20, is the latest wunderkind to compile. What Steve Jobs was to the desktop, Andreessen is to the Internet. His Netscape Navigator (née Mosaic) for PCs, Macs, and Unix machines already accounts for more than half of all Web browsing. He led the development of the prototype while he was an undergraduate at the University of Illinois. Unlike some of the other wunderkind (whose names we won't mention), Andreessen graduated from college.

■ Bill Atkinson

If you knew the Lisa like Bill Atkinson knew the Lisa, then you knew a lot more about the Lisa than most of us wanted to know. But from this scarlet woman, named for Steve Wozniak's daughter, came a GUI. Atkinson was the chief wizard behind its graphics engine. The Lisa begat the Mac, and the rest is history. Today, as cofounder of Apple spin-off General Magic, Atkinson wants to create technology that he hopes will be welcomed into people's lives, rather than be a source of stress—technology like MagicCap. We also fondly recall that he



DOUG ENGELBART



GRACE MURRAY HOPPER

standards, from which he wove the Web. Since launching the Web in 1991, he has often endorsed the idea of people using it for profitable transactions. He's now at MIT, where he directs the World Wide Web Consortium, which deals with Web security and other issues. He deserves a Nobel prize of some sort.

■ Doug Engelbart

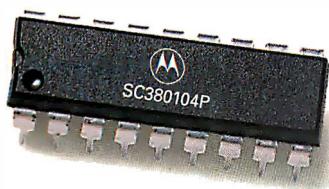
Got patent envy? You'll have a hard time matching this pioneer, who holds 20, most of which are on basic features in microcomputing. Imagine microcomputing without windows; or word processing; or hypermedia, E-mail, and groupware; or the Internet. Imagine microcomputing without Doug Engelbart, now 70, who for years was a fixture at Stanford Research Institute. Engelbart had a vision that computers could be more than giant adding machines; they could be tools for human beings. A few years ago, he founded the Bootstrap Institute, dedicated to getting companies to collaborate on innovation. Comparisons with Thomas Edison do not seem

was the chief designer of HyperCard, the software construction kit that put Mac programming tools into the hands of millions of Mac users.

■ Tim Berners-Lee

If the snobs who whine about the Internet's exploding popularity ever form a vigilante posse, the first man they'll hang is Tim Berners-Lee. He's the guy behind the World Wide Web, which he developed for the CERN (European Council for Nuclear Research) in Geneva, Switzerland, so that physicists could swap data easily. Berners-Lee developed the URL, HTML, and HTTP

POWERED BY MOTOROLA.



NEITHER RAIN NOR SLEET NOR HAIL NOR DEAD OF NIGHT WILL STOP THE STANLEY

"PREMIER" GARAGE DOOR OPENER FROM THE SWIFT COMPLETION OF ITS APPOINTED

ROUNDS. IT'S SUPER-RELIABLE BECAUSE IT COUNTS ON A MOTOROLA CUSTOM CHIP TO HANDLE LIFE'S UPS AND DOWNS.

FROM HARDWARE TO PERSONAL COMPUTERS, PRODUCTS POWERED BY MOTOROLA ARE FAST BECOMING A WAY OF LIFE.

FOR INFORMATION CALL 1-800-521-6274.



MOTOROLA

Semiconductor Products Sector

THE 20 MOST IMPORTANT PEOPLE

farfetched, which reminds us: He's best known for the first mouse—a wooden rodent invented in 1963.

■ Grace Murray Hopper

As a child, Grace Murray Hopper liked to take apart alarm clocks. She was the first woman to earn a doctorate in math at Yale. In World War II, she joined the Navy and was assigned to its computational center at Harvard. Amazing Grace later developed the first compiler for Remington Rand's UNIVAC in the early 1950s and led the charge to create COBOL. The Navy recalled her in 1967, and she was on active duty until 1986. She died in 1992 at the age of 85 with the rank of rear admiral. Anyone who met her could not help but be awestruck by this diminutive fire storm of a human being. One pictures her stuck in purgatory, refusing to enter Heaven until St. Peter agrees to computerize. With a Lucky Strike hanging from her lip, she fires at the grand saint: "Beg your pardon, Sir, but your excuse, 'We've always done it this way,' is the most damaging phrase in the language."



PHILIPPE KAHN

DREW MAJOR

■ Philippe Kahn

French swagger, German determination, jazz artistry—must be Philippe Kahn. This software swashbuckler writes great compilers, plays David against Microsoft's Goliath, and never bores us. The son of a German father and a French mother, Kahn grew up in Paris. He studied Pascal with Niklaus Wirth, took a degree in math, earned money playing jazz, and developed applications on an Apple II. But Pascal compilers were too slow, so he wrote Turbo Pascal. Then he marketed it. With only \$2000 in his pocket, he landed in the U.S. with no green card and no job. He founded

Borland International in an office over an automobile repair shop in 1983. Despite the humble abode, Kahn convinced a BYTE ad salesperson to accept on credit a full-page color ad for Turbo Pascal. At a ridiculous \$49.95, Kahn was swamped with orders.

■ Mitch Kapor

"Software has been very, very good to me," Mitch Kapor once said. And, we add, Mitch Kapor has been very, very good to software. In 1982, he founded Lotus Development and, with Jonathan Sachs, created Lotus 1-2-3. Dan Bricklin invented the electronic spreadsheet (VisiCalc), but Kapor turned it into a more powerful, yet friendly, business tool. Lotus 1-2-3 remains the world's most widely used application. Given IBM's takeover of Lotus, it's interesting to note that Kapor once tried and failed to interest Big Blue in an exclusive marketing deal for 1-2-3. He left Lotus in 1986. In 1990, he cofounded the Electronic Frontier Foundation, a nonprofit group dedicated to understanding the social impact of the digital revolution.



Ladies & Gentlemen, Start Your Workstations!

Rave Computer Association is the leading reseller of remanufactured Sun Microsystems computer hardware.

HUGE SAVINGS

Off List Price

SPARC 1, 2, 5, 10 & 20's
Immediate Delivery
Call today for free brochure!

Rave Computer Association, Inc.

36960 Metro Court
Sterling Heights,
MI 48312

Fax: (810) 939-8230

1-800-966-7283

E-Mail: sales@rave.com



Tadpole Technology is the leading developer and manufacturer of portable workstation-class computers. Their modular design allows user-upgrade of memory and disks for optimal performance.

Tadpole P1000

- First 100MHz Pentium notebook.
- Workstation-class performance for Windows, Windows 95, Windows NT and Solaris/PC UNIX users.
- Up to 128MB DRAM, 256KB write-back cache, 810MB SCSI-2 removable hard disk.
- Active 10.4" full color TFT display with 16-bit CD quality audio.
- Rugged magnesium case and more...



TADPOLE
TECHNOLOGY

Authorized
Distributor

Rave offers in-stock availability, custom configurations, software installation and a full warranty.

Top 20 Technologies

Evolving standards will make DSP application development easier, while general-purpose OSes, including Windows 95, are expected to include DSP programming interfaces, which could push DSPs further into traditional markets. In the future, digital hard drives will likely rely on DSP-powered drive controllers to process signals from the disk.

Floppy Disks

Like the proverbial 2-cent bolt that can ground a 767, how could we have worked without the lowly floppy disk? It has given us an inexpensive way to distribute applications and data. Floppies also gave uncon-

nected workgroups "sneakernets," inelegant but essential hacks in the pre-networked world. The Internet, WANs, and CD-ROMs may be cutting into the floppy's territory. And the world probably already has enough floppies in circulation—we just need to reformat all the disks stashed in desk drawers and file cabinets. But before you think floppies are obsolete, break the shrinkwrap on Microsoft's Office Professional 4.3: The collection of programs is still available on 31 disks.

Software Components

How do you implement custom applications quickly and not bust your operations budget? Plug in a component—those reusable, binary software objects that extend OSes by addressing specific needs. For Windows and the Mac, there are already OCXes (OLE controls); and components are also reshaping the various implementations of Unix and OS/2.

The Mouse

Like God and Man touching fingertips in Michelangelo's *Creation*, no other peripheral has done more to symbolically link computers with our humanness. Forget touch-typing or even hunt and peck; the mouse provided a way for computers to become accessible for millions of people. The original design dates back to the Stanford Research Institute and Douglas Engelbart's 1963 wooden prototype. In 1982, Mouse Systems introduced the first commercial mouse (a three-button design) for the IBM PC. The Apple mouse, originally for the Lisa, and Microsoft's mouse, with two buttons, came a year later. Today, the basic structure of interacting with our computers, whether Macintosh, Windows, or Unix, hinges on the mechanical or optical strains of this peripheral.

GUIs

The second component in humanizing how we interact with computers, modern GUIs

11
YEARS
AGO IN
BYTE



A new Seiko wristwatch computer lets you enter data with a separate Hershey bar-size keyboard.

An unemployed security guard kills 20 people at a McDonald's in San Ysidro, California.

trace their roots to PARC (Palo Alto Research Center) research and the Xerox Star. GUI features introduced successfully in 1984 with Apple's Macintosh (e.g., windows, point-and-shoot menus, program and file icons, dialog boxes, and other now-familiar elements) let us manage our electronic desktops to suit our individual desires.

Hard Drives

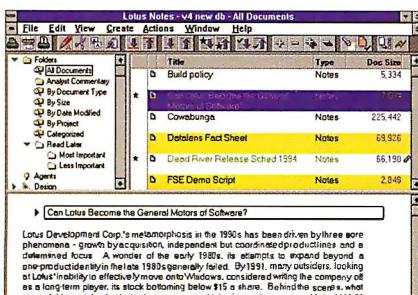
The peripheral that taught us that too much is never enough. The fixed disk drive became a staple of microcomputers, thanks to its fast data access and transfer speeds. The technology never stood still. We're now getting gigabytes of storage space in petite form factors. In recent years, hard drives have increased data densities at an annual rate of about 60 percent. Magneto-resistive heads are leading the next charge by providing greater areal density than thin film or ferrite-inductive heads. Lower seek times, caching optimizations, and higher spin rates push performance even more. In the future, the digital read channel may double the amount of information we can jam onto drive platters.

Laser Printers

These fast, trusty machines have done more to impede the paperless office than any other peripheral. Once laser beams began to transfer images into toner on a

Faster Faster

ETHERNET,
DISK DRIVES,
MICROPROCESSORS,
RAPID APPLICATION
DEVELOPMENT



The mind of the corporation, the soul of reengineering: Groupware.

S P E C I A L I S S U E

SEPTEMBER 1995

BYTE

THE MAGAZINE OF TECHNOLOGY INTEGRATION

Revealed! When the P6 Is
Slower than the Pentium P. 24

Telephony's Killer App P. 215

CompuServe, AOL, Prodigy:
Which Wins Web War? P. 229

best
COMPUTERS

top
PROGRAMS

bigest
TECHNOLOGIES

most
influential
PEOPLE

YEARS

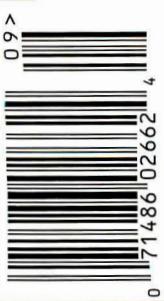
plus!

Weirdest Error Messages

Worst Bugs

Amazing Hacker Feats

AND MORE...



BYTE

SEPTEMBER 1995

VOL. 20, NO. 9

20 YEARS

SPECIAL ISSUE

Message from the Editor.....	53
Top 20 Small Systems	54
Top 20 Software Products	64
Most Important Chips.....	74
Most Important Networking Products.....	79
The Best Things On-line.....	85
Most Important Companies.....	99
Top 20 Technologies.....	109
Notorious Bugs	125
The 20 Most Important People.....	133
20 Spectacular Failures	145
Noted and Notorious Hacker Feats.....	151

Features

MANAGEMENT

- Assets on the Line.....** 37

BY SALVATORE SALAMONE

You can cut support costs if you've got an inventory of hardware and software.

REMOTE ACCESS

- You Can Take It with You.....** 41

BY JEFFREY FRITZ

So you're working in Hooterville and that file you need is on a server at the home office in Chicago. No problem. With digital services like ISDN, and even analog technology, you can connect to the corporate network.



- Web Search.....** 223

BY JON UDELL

Why wait for the Web equivalent of the Dewey decimal system? You can index your Web collection now. Here are a couple of ways to do it. Plus tips on naming, hot links, and the answer to the question, "What About WAIS?"



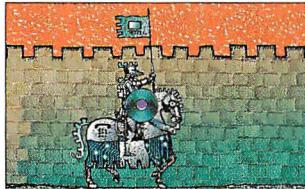
State of the Art

COMPUTER TELEPHONY

- Collision!** 199

BY RUSSELL KAY

Tying together telephones and computers is a great concept. New technologies, products, and standards are finally taking computer telephony beyond the concept stage and into your office.



- Standard Issue.....** 201

BY JAMES BURTON

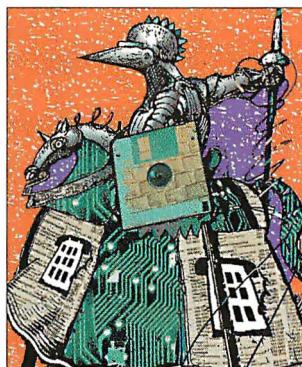
When there was just one phone company, standards and interoperability weren't even questions. Now we've got multiple answers.

Strategic Industry Alliances—203
A Checklist for Making CTI Decisions—206

- Building Telephony Applications.....** 211

BY JAMES BURTON

As more organizations use computer telephony, those that don't may be at a competitive disadvantage. Here's a guide to development tools you'll need to construct computer telephony systems.



- Telephony's Killer App** 215

BY JOHN P. MELLO JR.

It's going to take unique software to make telephony a gotta-have-it resource. Here are some of the contenders that might be natural-born killers, including PhoneNotes, FastCall, and VoiceView.

Wildfire: One Wild and Not-So-Crazy Helper—216

News & Views

PROCESSORS

- P6 Weakness Revealed.....** 24

People who buy the first computers based on Intel's P6 processor will be in for a surprise when they run 16-bit DOS and Windows applications. According to benchmarks, a Pentium runs 16-bit DOS/Windows programs *faster* than a P6 at the same clock speed, even though the next-generation P6 is supposed to be a "faster" CPU.

LITTLE THINKING MACHINES

- PC Power Comes to the Calculator.....** 25

Texas Instruments plans to release a new calculator that's a whole lot smarter than its predecessors.

WINDOWS DEVELOPMENT

- Delphi and VB Turn 32.....** 26

New versions of Borland's Delphi and Microsoft's Visual Basic have stronger client/server and OLE development capabilities for 32-bit programs.

ON-LINE SERVICES

Gateways to the Internet 229

BY GEORGE BOND

A veteran Internet roamer finds that the Big Three on-line services offer adequate but pricey gateways to the Net.

Convenience, but at What Price?—229

MSN: Desktop Internet—231

NOTEBOOK COMPUTERS

Presentation Quality 233

BY EDMUND X. DEJESUS

IBM's slick new screen technology turns the ThinkPad 755CV into a remote-control color presentation panel.

OPERATING SYSTEMS

Networking at Warp Speed 235

BY BARRY NANCE

If OS/2's technical advantages don't wow you, maybe Warp Connect's networking goodies

will. This 32-bit OS bundle includes peer services, LAN requesters, a slick approach to over-the-wire installation, and a passel of handy programs.

COLOR PRINTERS

To Print a Rainbow 239

BY TOM THOMPSON

Second-generation color lasers from Apple and Tektronix set new standards for print quality, network connectivity, and ease of maintenance.

GRAPHICS ACCELERATORS

3-D Graphics Go Zoom 243

BY GREG LOVERIA

Intergraph and Omnicomp offer two different routes to the land of glorious photo-realistic images—a workstation and a plug-in PC card.

DISK ARRAYS

Lab Report:

16 Fast, Reliable

RAID Subsystems 248

We test a wide array of disk subsystems that minimize network downtime and maximize storage space, then pick the best RAID for database servers and audio/video applications.

How Error Correction Works—250

File Servers with RAID—252

How We Tested—254

Software RAID Solutions—256

Honorable Mentions—259

Helpful Hints—259



Core Technologies

CPU'S

Endian Issues 263

BY WILLIAM STALLINGS

Different processors have incompatible memory-storage arrangements, but the PowerPC can handle them all.

PROGRAMMING

The Joy of J 267

BY DICK POUNTAIN

Successor to APL, the J language extends its ancestor's expressiveness and power. And you don't need a special keyboard.

OPERATING SYSTEMS

Springtime at Sun 271

BY DOUG TAMASANIS

Many of the concepts in Sun's experimental Spring system will bloom in Solaris.

NETWORKS

Tuning In to ISDN 273

BY JEFFREY FRITZ

Satellite and radio technology are breaking the earthly limits of terrestrial ISDN.

PROCESSOR TRENDS

New 486 Chips Deliver Inexpensive Power 30

The 486 might be reaching the end of its life, but it isn't dead yet. AMD has developed two new chips that shatter 486 speed barriers and offer Pentium-level performance at low-end prices. Meanwhile, Cyrix has developed an unusual new CPU that's a cross between a 486 and a 586-class chip.

MULTIMEDIA

Interactive Music Videos Arrive for Macs and PCs 32

New interactive CDs, such as Todd Rundgren's "multimedia album" *The Individualist*, will bring the humble audio CD into the era of interactive content delivery using desktop multimedia systems.

NEW PRODUCTS

What's New 286

Dell's new Latitude XPi P90T notebook combines low-voltage Pentium power with impressive battery life. Plus, Micro Energetics' Nightmare provides power management for printers; Horizons Technology's LANrecord meters software for NetWare LANs; and more.

Opinions

Pournelle: Of COM Ports & Digital Frogs 275

BY JERRY POURNELLE

Jerry explores painless dissection with Digital Frog, then settles down for more bloodless surgery as he tries to make communications software work under Windows 95.

Books & CD-ROMs:

How to Optimize Your PowerPC Code 33

BY TOM THOMPSON, ALAN JOCH, AND

RICH FRIEDMAN

Writing faster native code; plus, commerce on the Internet, and pool and nostalgia CD-ROMs.

Commentary: Dreaming of the Future 330

BY DOUGLAS ENGELBART

Can digital technology make a better world? Improve our collective IQ? In the dreams of this visionary inventor it can.

Editorial BY RAPHAEL NEEDLEMAN 10

Letters 18

Readers' comments on the BYTE Network Project, Internet censorship, and the trouble with Microsoft.

Reader Survey 282

READER SERVICE

Editorial Index by Company 328

Alphabetical Index to Advertisers 324

Index to Advertisers by

Product Category 326

Inquiry Reply Cards 132A, 326A

BUYER'S GUIDE 291

Mail Order

Hardware/Software Showcase

Buyer's Mart

PROGRAM LISTINGS

FTP: ftp to ftp.byte.com

From BIX: Join

"listings/frombyte95" and select the appropriate subarea (i.e., "sep95.")

From the BYTE BBS at 1200-9600 bps: Dial (603) 924-9820 and follow the instructions at the prompt.

Bulk Rate
US Postage
PAID
McGraw-Hill

Third class mail enclosed, edition codes: W1C, W1D, W1E, W1F, W1G

BYTE (ISSN 0360-5280) is published monthly by McGraw-Hill, Inc. U.S. subscriber rate \$29.95 per year. In Canada and Mexico, \$34.95 per year. European surface mail subscriptions \$6.00, airmail \$85. Non-European subscriptions, \$6.00 surface mail or \$85 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. 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, Canada Post International Publications Mail Product Sales Agreement No. 246492. Registered for GST as McGraw-Hill, Inc., GST #123.075673. Printed in the United States of America. Postmaster: Send address changes and fulfillment questions to BYTE Subscriptions, P.O. Box 552, Hightstown, NJ 08520.