

PCWEEK

MARCH 1, 1999 ■ VOLUME 16, NUMBER 9

NEWS SCAN

IBM's Cornhusker, software for linking Netfinity servers into eight-node clusters, could reap a harvest of high data availability. **PAGE 3**

Linux arrives in a big way at LinuxWorld, where HP and IBM lead the pack in promising broad support. **PAGE 8**

MS SQL Server 7.0 shows few gains on V6.5 in OLTP speed but pulls ahead in data warehousing in PC Week Labs' megatests. **PAGE 10**

Repetitive stress injuries are a big problem, but the Labor Department's new guidelines could help companies avoid the pain. **PAGE 39**

IBM Global Services assembles a service suite, Total Systems Management, for swamped CIOs. **PAGE 55**

Toro took the bull by the horns and built an extranet to reach key customers without mowing down its distributors. **PAGE 123**

Cisco's 1720 VPN router is a full-featured product but will baffle all but the surest IOS experts. **PAGE 139**

Digital certificates are making electronic commerce a safer bet for buyers and sellers. **PAGE 143**

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COVER STORY

PIII: 8% Is Not Enough

In tests by PC Week Labs, the performance boost provided by Intel's latest Pentium chip was disappointing when running business applications. Before you run out and replace all your desktop PCs, see **PAGE 14**.

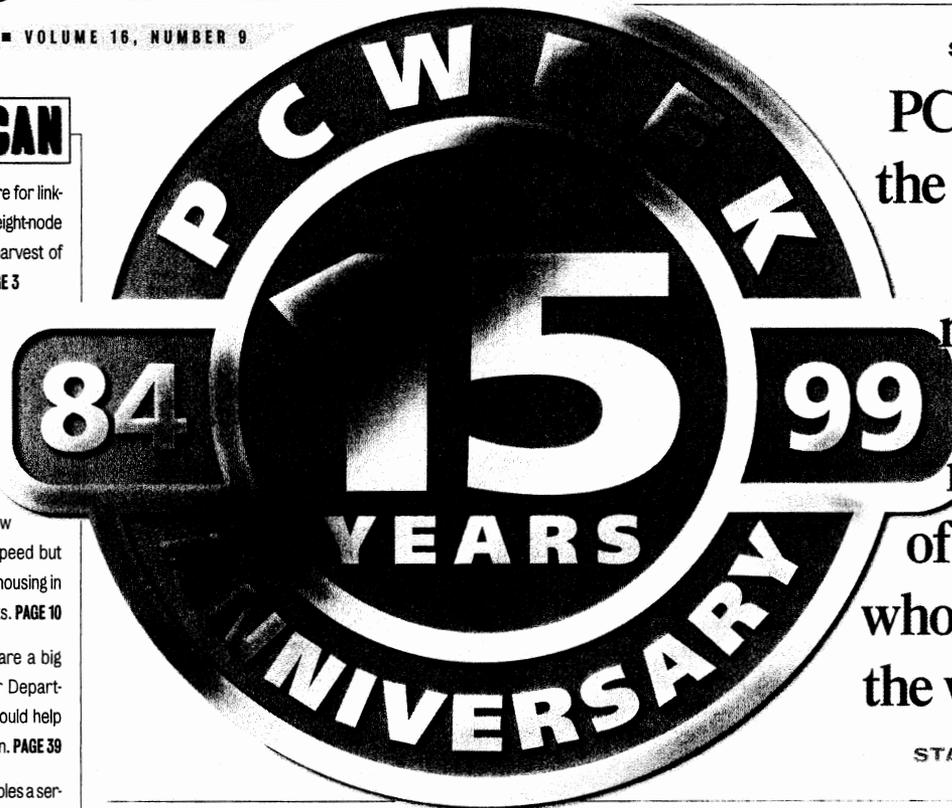


Dell's OptiPlex GX1 tested best.

SPECIAL REPORT

PC Week hails the cutting edge of the IT revolution and the new wave of innovators who will redefine the way we work.

STARTING ON PAGE 63



Sun, Java to cash in on AOL/Netscape deal

BY ANTONE GONSALVES AND SCOT PETERSEN IN CUPERTINO, CALIF.

SUN MICROSYSTEMS INC. IS AMBITIOUSLY pursuing multiple avenues to make the newest Java platform as ubiquitous as possible—even without Microsoft Corp.'s help.

Sun plans to work with America Online Inc. and Netscape Communications Corp. to bundle Java 2 directly in the AOL client and the Navigator/Communicator

browser. It also is working on a "portal-in-a-box" strategy that combines the best of Sun's and Netscape's Internet applications.

"Our plans for distribution are to leverage vehicles other than Microsoft," said Alan Baratz, president of Sun's Java division here, in an interview last week. "The point is to get [Java 2] out through a couple of different distribution channels ... and then deliver it in such a way that, while it may have gotten put on the hard drive because you installed Communicator, any application can use it once it's there."

The bundling arrangements won't happen until several months after the pending merger between AOL, of Vienna, Va., and Netscape, of Mountain View, Calif.,

CONTINUED ON PAGE 18 ▶

DAY OF RECKONING

A Microsoft victory looks doubtful; so what's next?

BY WILL RODGER, CONNIE GUGLIELMO AND LISA BOWMAN

FEW WOULD CHARACTERIZE Microsoft Corp. as defenseless. But antitrust specialists who not long ago downplayed the

chances that the courts would rule against the software giant are now thinking the unthinkable: The government will win its antitrust case—and withstand an appeal.

MICROSOFT 2000
THE ROCKY ROAD AHEAD
ZD TEAM REPORT

There's absolutely no doubt about that," said University of Baltimore Professor Bob Lande, who dismissed the chance of successful

CONTINUED ON PAGE 16 ▶



PC Week Names The Top Companies That Made a Difference Over the Last 15 Years

3Com Corp.	Hewlett-Packard Co.
Adobe Systems Inc.	IBM
Apple Computer Inc.	Intel Corp.
Cisco Systems Inc.	Lotus Development Corp. (an IBM subsidiary)
Compaq Computer Corp.	Microsoft Corp.
CompuServe Interactive Services Inc. (an AOL subsidiary)	Netscape Communications Corp.
Dell Computer Corp.	Novell Inc.
Hayes Corp.	Sun Microsystems Inc.

Congratulations!

SPECIAL ANNIVERSARY REPORT
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THE PEOPLE

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WE WORK.

PCWEEK

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PCWEEK

MARCH 1, 1999 ■ VOLUME 16, NUMBER 9

The past 15 years

69 The 15 most influential people in high tech

PC Week unveils its list of 15 people who were the most instrumental in the development of the products and technologies that are integral computing components today.

76 Companies that made a difference

PC Week names the companies that have had the greatest impact on the high-tech industry over the past 15 years. These are the companies that got us where we are today.

84 Test your knowledge of computing trivia to see how many of the now-obsolete products, companies and terminology you can remember that made the headlines over the years.

90 What do Federal Express, Price Waterhouse, United Airlines and Dell Computer have in common? They, among others, gambled on technology and won huge payoffs.

86 PC Week Labs identifies the 15 most influential technologies/products that were the foundation for revolutionary advances in high tech.

90 CIOs have come a long way from the glass house's back office. Hard work and recognizing the benefits of technology have earned some the CEO seat.

The next 15 years

95 Power brokers of the future

Who are the people to watch this year and beyond? Check out PC Week's list of next-generation "power brokers." Most have one thing in common—the Net.

101 Technologies poised for liftoff

Tune your IT radar screens to the 15 technologies PC Week has identified as those ready for liftoff—they have the power to impact your organization.

105 Want to know which companies will be hot in the next few years? Take a look at PC Week's list of the 15 companies to watch in 1999.

107 The Internet's "Net-energy" has given power to trends that will reshape computing as we know it. Which are the 15 most important?

112 Spencer F. Katt has seen it all. Take a look at his scrapbook of his most memorable moments while on the beat for the past 15 years.



EDITOR'S NOTE



Like a rocket and Eric Lindquist, we've been on a mission to get the user—rather than under control of our whims or the whims of our editor. Today, the PC has become a companion machine and one of the fundamental enabling architectures for bringing the Internet connection to your company, your customers, and yourself.

It has been a wild ride. Companies and markets have blossomed and withered as the industry's vast expanse has displayed the best and the worst aspects of the human condition: hope and despair, greed and benevolence, innovation and extortion have all been played out in our pages as the technology industry has grown from the confines of a few to a global cultural force.

My thanks to Senior Editor Steve Halkow, Linda Budge, and the other top 15th anniversary issue—from concept to completion—thank you to the staff, as this issue has been a true collaborative effort. Our editorial staff has made PC Week the top IT publication for the past 15 years and will keep it that position in the future. My thanks to Spencer Katt for maintaining a sufficient number of good articles. Some of the best of the past has taken place over the past 15 years and the next decade. We thank you for our 400,000 print readers and many more Web readers. Please give your fans as well as your praise.

Finally, I'd like to dedicate this anniversary issue to the late Leire Doty. As PC Week's production director for 13 years, Leire's efforts to get PC Week printed and in readers' hands on time week after week is the stuff of publishing legends. His untimely death two years ago saddened us. He would have enjoyed celebrating PC Week's 15th birthday.

As always, I welcome your comments on our choices for the highlights and low moments of the past 15 years, and stand ready for the raves and raves regarding our look into the future.

Eric Lundquist
Editor in Chief
eric_lundquist@zd.com



Eric Doty

The 15 most influential



MARCH 1, 1999
69

1984

The premier issue of PC Week debuted in late February 1984—about a month after Apple announced the Macintosh. IBM PCs and XT's were hot, but the PC AT was top-of-the-line. About 30 percent of PC Week readers had LANs at their sites, but few had ever heard of the Internet.



THE DYNAMICS OF THE HIGH-TECH INDUSTRY alone—not to mention the hundreds of innovators who have had a hand in shaping it—made the task of selecting the 15 most influential people over the last 15 years a daunting one.

So much has changed since PC Week published its first issue in 1984. Hey, back then the IBM PC AT was awe-inspiring. But we remember the products and technologies that dramatically altered our computing experience—those that transformed the PC from a cool, yet glorified, typewriter into

an indispensable part of our everyday lives.

Here we salute the people behind those products as well as recognize the pioneers whose ingenuity has resulted in technologies that were unimaginable 15 years ago.

Andy Grove oversaw the creation of the microprocessor, and Michael Dell revolutionized the PC purchase process from his college dorm room. Ray Noorda made the corporate LAN a reality with NetWare, while Mitch Kapor introduced PC users to Lotus 1-2-3. Linus Torvalds' Linux ignited the open-source movement.

Tim Berners-Lee forever transformed the global business and computing model with the creation of the Web, and Stephen Case brought Internet access to the masses with AOL.

But, rather than writing about them, we asked each of the 15 on our list to answer five questions (see Page 72). Thirteen responded. Their personal responses give all of us a glimpse of what it was like to be a pioneer during the PC, LAN and Internet phenomena.

—Linda Bridges

Tim Berners-Lee

WORLD WIDE WEB CREATOR

Currently director, World Wide Web Consortium, and principal research scientist at the MIT Laboratory for Computer Science

15 YEARS AGO: "I was working at Image Computer Systems, in Ferndown, Dorset, England. I had applied to CERN, the European Laboratory for Particle Physics, in Geneva, and been accepted for a fellowship the following fall."

MOST SIGNIFICANT EVENT: "The spread of the Internet. If the Internet had not slowly displaced proprietary networks, as well as Europe's attempt to build its own protocols, then the Web would not have been possible. By 1989, when I first proposed the Web, the Internet was well-established in the United States and was making big inroads in Europe."

GREATEST PERSONAL IMPACT: "Was it my boss, Mike Sendall, allowing me to go ahead and program a global hyper-text space? Was it un-

wrapping the NeXT from its box? My working life, looked back on, seems not to have one item, but a morass of memorable things."

GREATEST ACCOMPLISHMENT: "Inventing the World Wide Web and learning to say 'no' to requests to travel places."

HIGH-TECH IN 2014 AND ROLE: "The Web will have a new aspect—Webs of data between all the databases, forming a semantic Web, which programs will be able to surf automatically. There will be a whole new world in which a smart algorithm will be able to take advantage of everything out there and draw new conclusions, put deals together and, possibly, make a lot of money! A combination of the semantic Web with digital signature will produce, I hope, a Web of trust in which human trust is faithfully echoed in the Web of signed documents. We will be able to form groups, dream and trade in confidence, with software agents running around doing the boring work for us. I have no idea what my role will be, but I know the World Wide Web Consortium will have its role as a meeting place for those who are concerned about the Web's future for a good few years yet." ◀



PHOTO: BOB OSAMALDI

Rod Canion

CO-FOUNDER, COMPAQ COMPUTER CORP.

Currently chairman/CEO, Insource Technology Group

15 YEARS AGO: "I was president and CEO of Compaq. We had just completed our first year of sales with an incredible \$111 million. We had also just completed our IPO and raised \$66 million. Our stock opened at \$11 and went up to \$14. Then all hell broke loose. Our sales simply dried up in January. The reason was that IBM had begun showing their portable PC to the dealers, and the predictions of Compaq's demise had already started. If that weren't bad enough, Apple announced the Macintosh in February. Our stock plummeted. What looked like a silver bullet, however, went whizzing past our ear—our sales took off after customers continued to buy the Compaq portable over the IBM portable, and our sales

for 1984 continued at a record pace up to \$329 million."

MOST SIGNIFICANT EVENT: "The most significant event occurred on Sept. 9, 1988. That was the day the 'gang of nine,' led by Compaq, announced that the PC industry would not blindly follow IBM down the Micro Channel path to long-term IBM domination. At this point, the survival of the industry standard based on Windows and the X86 architecture was assured, and the keys to the kingdom were passed from IBM to Microsoft and Intel. Had Compaq followed IBM to Micro Channel, all the other PC makers would have followed as well. IBM would have regained tight control over technology progress, and the world would be in a much different place—especially Microsoft and Intel."

GREATEST PERSONAL IMPACT: "Ben Rosen had the



PHOTO: DAN FORD CONNOLLY

greatest impact on me. When we started Compaq, I had very clear ideas on product strategy and on how to build a team and a culture, but I didn't know the first thing about public speaking or how to communicate with the press and financial analysts. Ben introduced me to all the key press people as well as many important people in the financial community. He coached me on how they thought and what they were interested in. I learned more and changed more in the first four years [at] Compaq than I ever imagined possible."

GREATEST ACCOMPLISHMENT: "Leading the Compaq team to make the decision not to follow

Stephen Case

CO-FOUNDER/CHAIRMAN/CEO, AMERICA ONLINE INC.

15 YEARS AGO: "I was managing marketing for a company called Control Video Corp. that planned to distribute video games through a modem that was connected to an Atari game machine. Un-

fortunately, the bottom fell out of the Atari market, and CVC came crashing down. From the ashes of CVC, we created a new company in 1985 that set up online services for major computer companies. That new company is now America Online."

MOST SIGNIFICANT EVENT:



"The growth and evolution of the Internet. It's staggering how far

we've come in the past 15 years—you can easily forget that just five years ago AOL had less than 1 million members and the World Wide Web was just being invented. Never before in history has a new medium reached so many people so quickly and had such a pro-

CONTINUED ON PAGE 70 ▶



MARCH 1, 1999
70

1985

1985 was a year of significant firsts. IBM announced in October its long-awaited Token-Ring LAN—now a whopping 260 PCs could be linked over twisted-pair cabling. Token-Ring was almost instantaneously adopted as an industry standard. Later that month, Intel announced the 16MHz 386 processor, which significantly enhanced PC power. Microsoft shipped Windows 1.0 in November, bringing the GUI to PC users.



CONTINUED FROM 69

found impact on their daily lives. The telephone took decades to achieve the level of success that the Internet has today. And that process of transformational change has only just begun.”

GREATEST PERSONAL IMPACT: “Before we started AOL, I worked as a marketing executive for

Procter & Gamble and Pizza Hut. The simple lesson I learned then has guided my business philosophy ever since: Focus on the consumer. Too many companies focus on an exciting new technology and ignore the people who are supposed to use it. At AOL, we created a service that is focused entirely on the



Vinton Cerf

TCP/IP CO-INVENTOR

Currently senior vice president of Internet architecture and technology, MCI WorldCom Inc.

15 YEARS AGO: “In 1984 I was leading the design and implementation of the MCI Mail electronic messaging service. Internally, we called it the Digital Post Office. I was VP [of] engineering for the MCI Data and Information Services Co. I lived in Camelot in northern Virginia. I had a couple of Apple IIe’s at home. We used IBM, Digital and HP mainframes and minis for the e-mail service; BBN’s X.25 switches; and dial-up servers.”

MOST SIGNIFICANT EVENT: “The rapid evolution of PC technology and the commercialization of the Internet in 1990.”
GREATEST PERSONAL IMPACT: “The then-president of Rockefeller University, Joshua Lederberg, sat on the board of a company I served as vice president for—the Corporation for National Research Initiatives. Bob Kahn (my partner in the original Internet design) served as president. After I

had given a long presentation about plans for a Digital Library project, Josh looked at me and said, ‘Vint, do something!’ I thought that was pretty succinct advice, and I’ve tried to follow it ever since.”
GREATEST ACCOMPLISHMENT: “Persistent efforts to persuade everyone and anyone to get behind the Internet—whether to use it, provide service, invent products for it or support software for it. In short, doing anything I could to help make it a self-supporting enterprise.”

HIGH-TECH IN 2014 AND ROLE: “High-tech will have a heavy bioelectronic component. Bioelectronic prostheses will proliferate (e.g., cochlear implants, muscle control devices). The Internet will be ubiquitous, and most devices will be online all the time—wired and wireless. Software will be a major, if not the major, source of new products and services. We will still be struggling to make software development efficient and to manage the increasing complexity of the interaction of millions, if not billions, of software-enabled devices linked by networks. I hope I am still around to marvel at what others have accomplished and to continue to stimulate and encourage creative, out-of-the-box thinking by new contributors.” ◀

consumer—that’s easy to set up, easy to use, convenient, community-oriented, useful, friendly and familiar. We couldn’t have done it without state-of-the-art technology, but we never lost sight of the fact that technology was a means to the end—not the end itself. The magic of great technology is [that] it becomes invisible, enabling consumers to focus on what they are doing, not on how they are doing it. That’s the magic of AOL: It’s so easy [that] anybody can use it and benefit from it.”

GREATEST ACCOMPLISHMENT: “I’ve always thought of this as a marathon—not a sprint—and I think

there is still much to be done to make this medium all it can be. So I tend to focus less on the past and more on the future. But, generally speaking, I’d have to say that what I’m most proud of is the team we’ve assembled at AOL that shares such a passion about the possibilities of this new medium. Together, we’ve created an online community with tens of millions of people learning how to communicate, exchange ideas, travel, trade, shop, explore and live with one another. I’m also proud of the leadership role that AOL has taken recently in proactively addressing some of the

toughest issues we have to face in this new medium—from child safety to privacy, pornography and law enforcement. We recognize that we can’t just focus on building our service and growing our company—we also need to be focused on building a medium we can be proud of.”

HIGH-TECH IN 2014 AND ROLE: “It’s hard to say for sure—that’s what makes this industry so exciting—but my hope and expectation is that what we do will just be part of everyday life. Rather than thinking of it as a high-tech industry, we’ll likely think of it as just industry. Rather than think of it

as new media, it will just be media. Rather than think of it as e-commerce, it will just be commerce. Rather than think of it as the New Economy, it will just be the economy. The key is how we integrate this new medium into society in a responsible fashion. That will require increased cooperation among companies, governments and individuals all around the world. We need to build a framework to ensure kids are safe, privacy is guaranteed, laws are enforced, speech is protected, commerce is secure and opportunities remain as broad and open as a person’s imagination.” ◀

John Chambers

PRESIDENT/CEO, CISCO SYSTEMS INC.

15 YEARS AGO: “I was a vice president at Wang Laboratories, and I oversaw the central part of the nation. My operation had about 1,500 people, and the computer I used was a Wang minicomputer system.”
MOST SIGNIFICANT EVENT: “The evolution of the Internet—from a technology used by few into a business tool driving global competition and market opportunities. Before computer systems were networked, they were good individual or group productivity tools. Once we began to connect computers with a common network fabric, the way we run our businesses changed—and im-

proved—forever.”
GREATEST PERSONAL IMPACT: “The most important lesson was watching Wang Laboratories—which was on top of the office automation industry and a very strong player in the minicomputer market—pay a terrible price for getting too far away from its customers. Seeing other computer companies make this same mistake again and again has had a tremendous influence on my personal development. This is why, at Cisco, we focus on the customer almost fanatically and do things like tying our employee reward systems to customer satisfaction. I myself receive a critical account status update 365 days a year.”
GREATEST ACCOMPLISHMENT: “Playing a role, along with my wife, Elaine, in



the development of our two children. They are both young adults in college now, and I am extremely proud of them. From a business perspective, my greatest achievement has been playing a role in bringing Cisco from \$70 million in annual sales to its current run-rate of over \$10 billion.”
HIGH-TECH IN 2014 AND ROLE: “Economists are beginning to realize that the greatest driver of the United States economy is the utilization of technology in all business segments: the en-

terprise, service providers, small and medium businesses, and, in time, the home. I believe that high-tech will continue to be the key determining factor in the economic strength of companies around the world. I also believe that the Internet will continue to evolve, changing every aspect of our lives in ways we can’t even imagine today. If I am still heading up Cisco in 15 years, I will be working to move Cisco into the role of being the most influential computer telecommunications company in history. If I have turned the company’s reins over to someone else, then I will be teaching. I think it would be a lot of fun to teach young students and to challenge their creativeness.” ◀

Jim Clark

CO-FOUNDER, NETSCAPE COMMUNICATIONS CORP.

Currently chairman, Netscape, and chairman, Healthcon

15 YEARS AGO: “I had founded Silicon Graphics one and a half years before, and we were preparing to ship our first product. I was the chairman



and VP [of] engineering using a VAX 11/780 computer sys-

tem running Unix (just about 1 mips) because we had not yet created our first workstation. This was the year I finally decided to terminate my leave of absence from Stanford, leaving academia forever.”
MOST SIGNIFICANT EVENT: “The emergence of the World Wide Web, and

emergence of the commercial potential of the Internet, is the most significant development in the computer industry—perhaps in its history. The only comparable development is the PC.”
GREATEST PERSONAL IMPACT: “My experience with the venture business in

CONTINUED ON PAGE 72 ▶



MARCH 1, 1999
72

1986

Compaq introduced the first 386-based PC, beating IBM to the punch and begetting the PC clone market. The number of computers in the United States exceeded 30 million, and e-mail use was on the rise. MCI Mail and CompuServe, for example, offered links between their respective e-mail services, marking the first interconnection—albeit limited—between competing U.S. e-mail providers.



CONTINUED FROM 70

starting Silicon Graphics has probably influenced me more than anything else. Because I was desperate for funding and had no experience, I allowed them to undervalue the contribution we had already created. Thus, when I started Netscape, I resolved to be the venture capitalist and to treat the rest of the management team better than I had been treated in my previous company.”

GREATEST ACCOMPLISHMENT: “... has been to recognize the power of the Web as enabled by the Mosaic browser created by Marc Andreessen and his team at the University of Illinois, and then to harness this in enabling the commercial potential of the Internet by founding Netscape with them, building the

management team and providing the funding.” **HIGH-TECH IN 2014 AND ROLE:** “There will be no distinction between the systems of communication—all will be one system that will encompass voice, video and data communications. It will be an expansion of the Internet and backward-compatible, probably called the Internet. Technology will transform many industries, leaving behind those who have ignored it. The financial power being created by technology companies will surpass that created in the Industrial Revolution, and the San Francisco/Silicon Valley area will surpass New York in its financial might. I’d hope my role is to make a lasting impact on the educational system at all levels.” ◀



Larry Ellison

**FOUNDER/
CHAIRMAN/CEO,
ORACLE CORP.**

Larry Ellison’s brazen personality has made him one of the most visible players in the high-tech industry. Ellison founded Oracle Corp. in 1977 and has built the database developer into the world’s second-largest software com-

pany, with more than \$8 billion in revenues.

After watching Oracle flourish in the client/server heyday of the late 1980s, Ellison is now leading his company’s transition into the network computing universe. While doing so, he’s hoping to unseat archrival Bill Gates and Microsoft as the industry’s standard-bearer.

On the flip side, Ellison sits on the board of directors at Apple—and once publicly speculated about buying the company. Maybe that’s why Ellison and Steve Jobs (see story, Page 74) declined to respond to our questions. ◀



Michael Dell

**FOUNDER/CHAIRMAN/CEO,
DELL COMPUTER CORP.**

15 YEARS AGO: “I had just embarked on my first major business venture: I had recently registered our industry’s first direct computer company as PC’s Limited (which later became Dell Computer Corp.). I was selling between \$50,000 and \$80,000 a month in upgraded IBM PCs, upgrade kits and add-on components, and the profits allowed me to move from my freshmen dorm at the University of Texas to a nice condominium nearby. I was using an IBM PC because we hadn’t yet introduced our own Dell-designed PC. That intro came about two months later, and you can be sure I was the first of many IBM customers to switch to Dell!”

MOST SIGNIFICANT EVENT: “Our industry is so dynamic, and the changes that it has brought to global businesses are so profound, that it is hard to cite just one event as the most important. The

emergence of direct as a dominant business system for PCs has been a very significant event. Before direct sales, customers were not able to get built-to-order systems, knowledgeable technical support and on-site service didn’t exist, and the typical prices for reseller-bought computers were prohibitive for many people. The strong adoption of industry standards, especially for processors and operating systems, has also been very important. Standards have taken huge amounts of complexity and cost out of buying and owning computers.”

GREATEST PERSONAL IMPACT: “I’ve had lots of valuable lessons in the last 15 years; if I didn’t, I wouldn’t be learning, and in this industry, you either learn quickly or you’re dead. Probably the most valuable thing I have ever learned is to listen—and listen well. I remember visiting the people at Sony back in 1993. We were talking about all sorts of multimedia technologies, and after the meeting a young man came up to me from the energy power systems group. I thought he might want to sell me a power plant, but I listened to him anyway. He described a new battery technology called



Mitch Kapor

**FOUNDER, LOTUS
DEVELOPMENT CORP.**

Currently partner,
Accel Partners

15 YEARS AGO: “I was president, chairman and CEO of Lotus Development Corp. I was living in Cambridge, Mass., and using a

floppy-based IBM PC.” **MOST SIGNIFICANT EVENT:** “Definitely the emergence of the Internet as a global communications medium. It marked the end of the era of the stand-alone personal computer and the beginning of an era in which connection and collaboration matter more than pure computation.”

GREATEST PERSONAL IMPACT: “The success and expanding dominance of Microsoft has been the defining fact of the past 15 years. I predicted that they would ‘win it

lithium-ion. We became the first company to use this technology in notebooks. The point is, you never know where the next big opportunity might be waiting, and if you listen well to your customers, your suppliers and your people, you’ll have a better chance of finding it.” **GREATEST ACCOMPLISHMENT:** “There are two. One is the founding of the first direct computer company in the world, and the second is being father to four wonderful children.” **HIGH-TECH IN 2014 AND ROLE:** “One of the biggest problems our industry has had is that many people spend a lot of



Bill Gates

**CO-FOUNDER/
CHAIRMAN/CEO,
MICROSOFT CORP.**

15 YEARS AGO: “I was doing much the same kind of thing I’m doing today—working to build great software and to keep our product teams focused on offering consumers the best value for [their] money. I was living near Seattle, working on the fast-growing Microsoft campus and using MS-DOS. I was also staying up much later than I do today and working more weekends. And getting a lot of speeding tickets.”

MOST SIGNIFICANT EVENT: “The incredible success of the PC model, which has given hundreds of millions of consumers an amazing choice of hardware and software produced by thousands of companies and which has revolutionized the economics of the computer industry. Fifteen years ago, the

time theorizing about what will happen in the future without paying enough attention to what customers are saying today. I’ll bet the pages of PC Week past are littered with predictions that haven’t come true. Only one thing I know for sure: If you look at the relatively low penetration rates for computer systems in the global marketplace, it is clear that our industry will experience robust growth for many years. In fact, I believe we are still in the very early stages of the IT industry, which is fast becoming the most important industry in the world.” ◀

idea that you would soon be able to have the power of a mainframe computer on your desktop seemed almost unthinkable.”

GREATEST PERSONAL IMPACT: “That would have to be meeting my wife, Melinda, and helping to raise our first child, Jennifer. This may sound a bit sentimental, but between them they’ve had a profound impact on my life.”

GREATEST ACCOMPLISHMENT: “I’ve been lucky enough to work with many others who shared the dream of making computers available to everyone. It’s been amazing to help make the vision of high-volume, low-cost software—and the dream of a computer on every desk and in every home—a reality.”

HIGH-TECH IN 2014 AND ROLE: “The Internet will be as ubiquitous as the telephone is today and will be connected to all kinds of computerized home appliances. The vision of a smart home will soon be a reality. The first part of the 21st century looks like being the most exciting era of the digital age, and I’m looking forward to leading Microsoft through those years.” ◀

CONTINUED ON PAGE 74 ▶



MARCH 1, 1999
74

1987

IBM introduced its ill-fated PS/2 computer line. The inclusion of VGA, however, marked the first time graphics were included as an integral part of a PC system. IBM also unveiled OS/2. Giving in to user demand, Lotus removed copy protection from its 1-2-3 spreadsheet.



CONTINUED FROM 72

all' in my private journal in 1984. Its combination of strategic smarts and ruthlessness has undeniably been the master formula for success. The final lesson won't be drawn until it becomes clear where we draw the line in society about what constitutes acceptable ways to win."

GREATEST ACCOMPLISHMENT: "Longevity and playing a variety of roles over a long period of time—entrepreneur (Lotus), activist (Electronic Frontier Foundation)

and investor/venture capitalist (UUNet, RealNetworks)—and showing that it's possible to be successful without compromising one's integrity."

HIGH-TECH IN 2014 AND ROLE: "The high-tech industry will be the dominant sector in the economy, but millions of lines of COBOL programs will still be running. I hope to be helping build great companies that are financially successful, innovative, great places to work and great firms to do business with." ◀

Steve Jobs

CO-FOUNDER, APPLE COMPUTER INC.

Currently chairman/CEO, Pixar Animation Studios, and interim CEO, Apple Computer Inc.

Steve Jobs, who declined to answer our questions, co-founded Apple and co-designed the Apple II. Jobs also led the development and marketing of the Macintosh.

After leaving Apple, Jobs co-founded NeXT Computer Inc., which was acquired by Apple in 1997.

In 1986, Jobs co-

founded Pixar Animation Studios. Pixar's first feature film, "Toy Story," was released by Walt Disney Pictures in 1995 with great success.

Jobs returned to Apple and currently holds the title of interim CEO. ◀



PHOTO: GARY WALKER

Andy Grove

FOUNDER/CHAIRMAN, INTEL CORP.

15 YEARS AGO: "I was president and chief operating officer of Intel. I lived in the same place I live now and used no computer at all."

MOST SIGNIFICANT EVENT: "The World Wide Web and browsers. [That's what] made the Internet ubiquitous."

GREATEST PERSONAL IMPACT: "The Berlin Wall being taken down—incredible, given its history."



PHOTO: GARY WALKER

Estridge: Gone, but not forgotten



Any retrospective that looks at the personal computer era would be incomplete without mention of Philip "Don" Estridge.

The first IBM PC was engineered and brought to market in

1981 by a team of engineers led by Estridge, an IBM engineer himself whom many consider to be the father of the PC.

As president of IBM's Entry Systems Division in 1984, Est-

made the Web popular, leading to a fundamental shift in the way we think of computing today. While TCP/IP, NFS and Unix mail got it started, the browser unleashed the Net big time."

GREATEST PERSONAL IMPACT: "Two lessons have stayed fresh in my mind since 1989. That was the year Sun lost money and almost went bankrupt when we turned on our new MIS system on a mainframe. We had record bookings, record back-

Scott McNealy

CEO/CHAIRMAN, SUN MICROSYSTEMS INC.

15 YEARS AGO: "I was the manager of manufacturing at Sun Microsystems; I lived in an apartment while paying off my car; I used a Sun II; and I didn't like DOS then, either."

MOST SIGNIFICANT EVENT: "I consider the HTML browser to be the most important breakthrough in the computer industry in the last 15 years. This has



log, record inventory and lost money in the quarter (the only time we ever lost money), and the banks almost took control. This taught me two things: 1) You need a CIO because mainframe computing is a hard-to-

manage hairball, and 2) try not to borrow money when you need it."

GREATEST ACCOMPLISHMENT: "Finding the most incredible wife on the planet, who puts up with me and has given me the neatest two kids I have ever seen."

HIGH-TECH IN 2014 AND ROLE: "I am not a visionary, and I believe that is what makes Sun successful. I leave the 'visioning' to the really smart people at Sun. In 15 years' time, my role will be small." ◀

Ray Noorda

FOUNDER, NOVELL INC.

Currently chairman, Canopy Group



15 YEARS AGO: "I was approached by Safeguard Scientific to join a little company in Utah called Novell Data Systems, or they were going to shut it down. Those are the kind of risks I like, plus I got back to my home state."

MOST SIGNIFICANT EVENT: "The recognition, adoption and effort IBM put behind the PC. Its leadership changed the industry forever. By the way, it made Microsoft, and

Intel isn't complaining too much."

GREATEST PERSONAL IMPACT: "My wife. She is the one who inspires me to work hard."
GREATEST ACCOMPLISHMENT: "Creating good jobs for people."

HIGH-TECH IN 2014 AND ROLE: "I hope the environment is still competitive. And at my current age of 75, I hope I'm still competing." ◀

"You need a CIO because mainframe computing is a hard-to-manage hairball, and try not to borrow money when you need it."

—Scott McNealy

Linus Torvalds

LINUX CREATOR

Currently software engineer, Transmeta Corp.

15 YEARS AGO: "I was in my early teens, and my computer system was a Commodore VIC-20."

MOST SIGNIFICANT EVENT: "Cheap and ubiquitous anything new to me per se. But what was new was that with Unix I got the strong sense of trying to program with the operating system rather than work around it. That, obviously, was one of the initial pushes for what was to become Linux."

GREATEST ACCOMPLISHMENT: "Being able to work together with others—to take advantage of what other people on the Internet did with a project that started out as a purely personal one. Standing on the shoulders of giants, indeed."
HIGH-TECH IN 2014 AND ROLE: "My crystal ball just rebooted spontaneously." ◀

paved the way for 'normal people' to have computer access."

GREATEST PERSONAL IMPACT: "This probably sounds corny, but I think the biggest impact came with [my] first course in Unix at the University of Helsinki. I'd been programming for half my life before that, so computers weren't anything new to me per se. But what was new was that with Unix I got the strong sense of trying to program with the operating system rather than work around it. That, obviously, was one of the initial pushes for what was to become Linux."

GREATEST ACCOMPLISHMENT: "Being able to work together with others—to take advantage of what other people on the Internet did with a project that started out as a purely personal one. Standing on the shoulders of giants, indeed."

HIGH-TECH IN 2014 AND ROLE: "My crystal ball just rebooted spontaneously." ◀

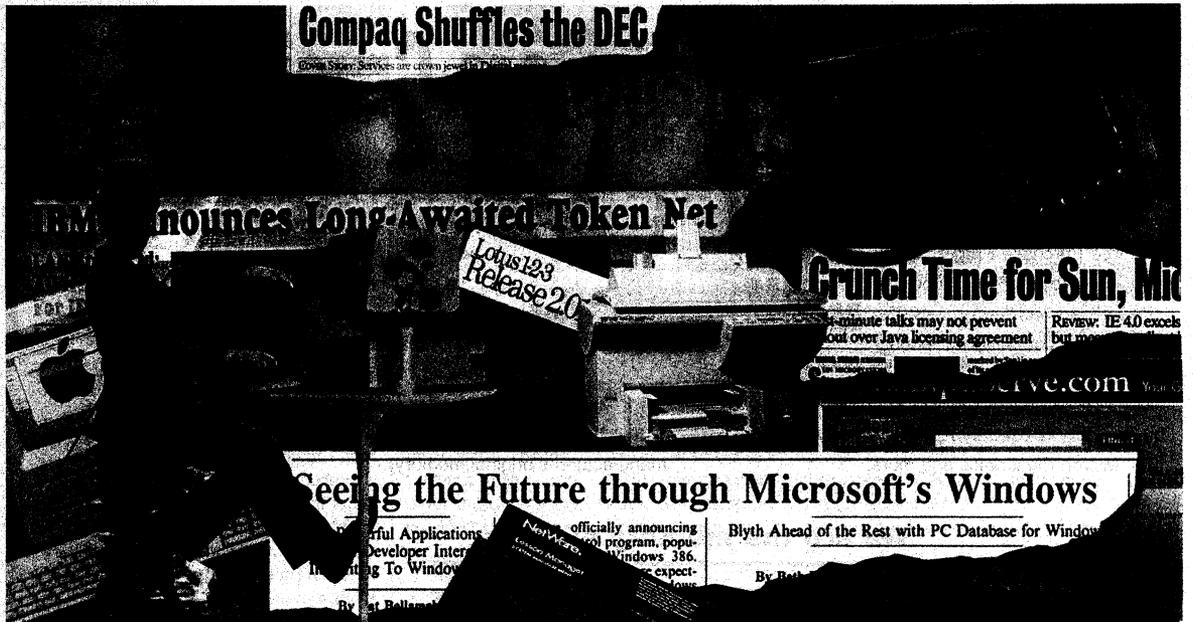
PHOTO: GARY WALKER



MARCH 1, 1999
76

1988

Apple sued Microsoft and HP over the "look and feel" of the PC interface. On the hardware front, Compaq led a consortium of PC hardware makers, known as "the gang of nine," and created the EISA standard to counter IBM's PS/2 Micro Channel bus. Within weeks of the EISA announcement, IBM revived its AT-bus architecture with the PS/2 Model 30-286. It also unveiled its long-awaited AS/400 mid-range system. PC Week's tag line changed from "The National Newspaper of IBM Standard Microcomputing" to "The National Newspaper of Corporate Microcomputing."



Making a difference

IT'S NOT BY COINCIDENCE THAT NINE OF THE 16 COMPANIES (THERE WAS A TIE*) WE'VE IDENTIFIED as having the greatest impact on the high-tech industry were founded by the technology innovators included on our list of the most influential people (see story, Page 69)—the two go hand in hand. But there are others as well. The industry would not be what it is today if not for the vision, ingenuity and courage of the people behind these companies. We used these criteria in making our selections and offer a glimpse of the companies and products that got us where we are today. —Linda Bridges

3COM CORP.
Santa Clara, Calif.
www.3com.com
Founded in 1979
by Robert Metcalfe,
a co-inventor
of Ethernet

3Com is synonymous with Ethernet—the technology it brought to the mainstream. With more than 180 U.S. patents, the networking pioneer's innovation is apparent in important networking features, such as parallel tasking performance for increased throughput in Ethernet, Fast Ethernet NICs and PC Cards; PACE technology for multimedia over Ethernet; the Xjack connector, which attaches a LAN, modem or PC Card to a phone line or network cable; V.90 56K-bps technology, enabling high-speed downloading of data over traditional phone lines; and repeaters for secure Ethernet LAN hub security, among others.

ADOBE SYSTEMS INC.
San Jose, Calif.
www.adobe.com
Founded in 1982
by John Warnock and
Charles Geschke

Adobe created the PostScript printing technology, which, for the first time, allowed Macintosh and PC users to print exactly what was intended—color, graphics, images and text. Adobe acquired Aldus Corp. in 1994, maker of the popular PageMaker desktop publishing program, which had revolutionized desktop publishing in the 1980s. Adobe is now a leading provider of publishing and imaging software technologies and one of the largest software companies, with annual revenues approaching \$1 billion.

Apple Computer ignited the personal computer revolution in the 1970s with the Apple II and reinvented the personal computer in the 1980s with the Macintosh. Apple is still committed to its original mission—"to bring the best personal computing products and support to students, educators, designers, scientists, engineers, business persons and consumers." Apple had a bumpy ride in the mid-1990s, but it is innovating again with its iMac line.

APPLE COMPUTER INC.
Cupertino, Calif.
www.apple.com
Founded in 1977
by Steve Jobs and
Steve Wozniak

Cisco is best known for creating network routers. The company shipped its first AGS router in 1986, when its total employee count was four. From there, Cisco developed switches and remote access servers—the hardware necessary for enterprisewide networking infrastructures, as well as the Internet. Its 100,000th router was produced in 1993, the same year of its first acquisition—Crescendo Communications Inc.—for \$89 million. Before 1996, Cisco acquired eight companies; since then it has added more than 20. Its strategy of acquiring whatever technology it cannot develop in-house has been successful. In 1994 alone, Cisco surpassed \$1 billion in revenues. In 1997, it became the initial "partner" for the Internet2 project.

CISCO SYSTEMS INC.
San Jose, Calif.
www.cisco.com
Founded in 1984
by Sandy Lerner
and Len Bosack

CONTINUED ON PAGE 78 ▶

*Our goal was to limit the list to 15. However, Hayes' and Sun's contributions made for a tie.



MARCH 1, 1999
78

1989

In April, Intel announced the 486 processor. Other significant product announcements included IBM's OfficeVision, its first major suite of Systems Application Architecture applications; Lotus 1-2-3 Version 3.0; Apple's Portable Macintosh; and the first round of EISA-based systems. Compaq also entered the laptop arena with its battery-powered LTE/286. By the end of the year, there were 100,000 hosts on the Internet, and the number of computers in use worldwide surpassed 100 million.



CONTINUED FROM 76

**COMPAQ
COMPUTER CORP.**
Houston
www.compaq.com
Founded in 1982
by Rod Canion,
Bill Murto and
Jim Harris

Compaq, striving for compatibility and quality (hence "Compaq"), introduced the first "portable" computer, based on Intel's 8088 processor, in 1982. The 30-pound unit was often referred to as the "luggable" and resembled a sewing machine case when stored for transport. Four years later, in September 1986, Compaq unveiled the first mainstream Intel 386-based PC—beating IBM out the door with a 386 box and essentially spawning the PC clone industry. In 1989, the battery-powered notebook became a full-function computer, including hard drive and floppy disk, with the arrival of Compaq's LTE and LTE/286. In the '90s, Compaq revamped its pricing structure, began its move into the direct-sales market and diversified its business with the acquisition of Digital Equipment Corp., among others.

**COMPUSERVE
INTERACTIVE
SERVICES INC.**
(an AOL subsidiary)
Columbus, Ohio
www.compuserve.com
Founded in 1969

CompuServe was one of the original online service providers. With the creation of bulletin board services, CompuServe essentially pioneered the concept of online technical product support—a staple of today's Internet. CompuServe has more than 2 million members worldwide and is available in 185 countries—not bad for a company that started out providing computer "time sharing." America Online Inc. acquired CompuServe in early 1998 from H&R Block Inc. Last month, CompuServe and MCI WorldCom Inc. introduced MCI WorldCom Internet, a consumer Internet service using MCI WorldCom's UUNet Internet network.

DELL COMPUTER CORP.
Round Rock, Texas
www.dell.com
Founded in 1984
by Michael Dell

A small company in Texas called PC's Limited was launched the same year PC Week began publishing. Few expected the company to revolutionize the PC purchasing process, but it did. PC's Limited, which later became Dell Computer, pioneered the direct-sales model. It was the first to accept custom PC orders over the phone, as well as provide on-site technical support. The company took off, and so did the idea. Corporations liked the concept of ordering custom, preconfigured PCs. After a few hiccups, including a short stint in retail, Dell returned to its successful direct-marketing roots. In the '90s, Dell felt new pressure as other companies jumped on the direct-sales bandwagon—including its Texan neighbor, Compaq.

Hayes pioneered the dial-up industry with the first modem and accompanying Hayes command set. The modem and cryptic commands chartered by Hayes are one of the earliest examples of interoperability in computer information exchange (see story, Page 86). Other modem makers were quick to adopt the Hayes command set, making it an industry standard. Access Beyond Inc., a \$30 million remote access server company, merged with Hayes Microcomputer Products Inc. in December 1997 to create Hayes Corp. The merger was not successful. Shortly after celebrating its 20th anniversary, Hayes filed for bankruptcy. It officially closed its doors last month—marking the end of an era.

HAYES CORP.
Norcross, Ga.
www.hayes.com
Founded in 1978
by Dennis Hayes,
inventor of the
PC modem

HP introduced its first personal computer, the HP-85, in 1980. In 1984, the company pioneered ink-jet printing technology with the HP ThinkJet printer. That same year, HP introduced its single most successful product ever—the LaserJet printer. Fifteen years later, a variety of LaserJet models are still used in almost every company around the world. HP has now sold more than 20 million printers. In 1986, HP took on its most expensive R&D effort ever—a family of computer systems based on the RISC architecture. The venture cost more than \$250 million over five years. In 1991, the company introduced its first handheld device, the 11-ounce HP 95LX palmtop PC. Today, most of HP's revenue comes from computers—ranging in size from palmtops to supercomputers—plus peripherals and services. HP is also making inroads into the e-commerce market. In 1997, it acquired e-commerce solution provider VeriFone Inc.

HEWLETT-PACKARD CO.
Palo Alto, Calif.
www.hp.com
Founded in 1939
by Bill Hewlett
and Dave Packard

PC Week and the IBM PC AT (Advanced Technology) both debuted in 1984. IBM's Token-Ring network, introduced a year later, was a favorite for linking local PCs and printers within a building. Still, IBM struggled during the late '80s and early '90s. It was caught off-guard by the dramatic changes caused by the PC revolution (the failure of its Micro Channel-based PS/2 line and OS/2) and the shift to a client/server computing model. In 1992, IBM introduced its first popular laptop, the ThinkPad. Nevertheless, by 1993, IBM's annual net losses reached a record \$8 billion. Lou Gerstner took the helm in April of that year. Two years later, IBM had a new network-oriented blueprint and aggressively acquired Lotus Development Corp. and Tivoli Systems Inc.

IBM
Armonk, N.Y.
www.ibm.com
Incorporated in 1911.
In 1981, the IBM PC
debuted, which
coincided with
John Opel's
appointment
as CEO

CONTINUED ON PAGE 81 ▶

COMPANY 50TH ANNIVERSARY

Web Story: Services are crown jewel



MARCH 1, 1999

CONTINUED FROM 78

INTEL CORP.
Santa Clara, Calif.
www.intel.com
Founded in 1968
by Robert Noyce,
Gordon Moore
and Andy Grove

Intel got its start making memory chips, then—thanks to Federico Faggin and his team of engineers—created the first general-purpose programmable chip. Intel introduced the first microprocessor in the early 1970s, which sparked the computer revolution. The creation of the microprocessor is hailed as one of the top inventions in the U.S. technology industry. IBM picked Intel's processor for its first PC, which debuted in 1981. Intel surpassed co-founder Gordon Moore's well-known "Moore's Law," in which he predicted that the number of transistors the industry would be able to place on a computer chip would double every two years. Intel's first chip, the 4004, had 2,300 transistors. The Pentium Pro has 5.5 million transistors. Today, more than 80 percent of the PCs in use are Intel-based.

LOTUS DEVELOPMENT CORP. (an IBM subsidiary)
Cambridge, Mass.
www.lotus.com
Founded in 1982
by Mitch Kapor and Jonathan Sachs

In its founding year, Lotus announced its first product at Comdex/Fall and released it in January 1983. Lotus' 1-2-3 spreadsheet was one of a select few software programs that spurred the PC revolution. In 1986, Jim Manzi was named CEO and Mitch Kapor resigned as chairman of the board. In 1989, Lotus pioneered another industry when it announced Lotus Notes, a "group communications software program"—the concept and benefit of which were difficult to articulate in the early days. In 1995, PC Week stopped the presses to cover a late-breaking story of historical significance: IBM was mounting a hostile bid for Lotus for \$3.5 billion in cash.

MICROSOFT CORP.
Redmond, Wash.
www.microsoft.com
Founded in 1975
by Bill Gates and Paul Allen and incorporated in 1981

In 1981, Microsoft introduced MS-DOS 1.0, which was used on IBM's first PC. In 1985, Microsoft shipped Windows—a graphical interface that changed the way PC users interacted with their systems. From that point on, the DOS prompt took a back seat for a lot of users. The company went public in 1986 at \$21 per share. OS/2 was unveiled in April 1987—this new operating system was the first product resulting from a 1985 joint development agreement with IBM. Later that year, Windows 2.0 and Excel debuted. In 1988, Microsoft and Ashton-Tate Corp. announced SQL Server—relational database server software for LANs. Microsoft in 1990 became the first PC software company to exceed \$1 billion in sales in a single year. Well on its way to becoming the household name it is today, the company in 1992 launched its first TV ad campaign and shipped Windows 3.1. In April 1993, there were 25 million licensed Windows users, the same year Windows NT was launched. Two years later, Windows 95 was released—with more fanfare than any other product release to date.

Netscape is the youngest company on our list—it turns 5 next month. The company cruised in on the Internet wave. Marc Andreessen created the Mosaic browser prototype for the Internet with a team of students and staff at the University of Illinois, in Champaign. The first browser to use images for Internet navigation was free and well-received. Mosaic gained an estimated 2 million users worldwide in a little more than one year—the team was onto something huge. A beta version of Netscape Navigator was released in October 1994, and the first Navigator products shipped two months later. Netscape and Sun Microsystems Inc. announced JavaScript a year later. In June 1996, Netscape reported more than 38 million Navigator users. But its fortunes turned after Microsoft mounted a fierce campaign to compete in the browser market. Late last year, AOL announced its plans to acquire the Internet pioneer.

NETSCAPE COMMUNICATIONS CORP.
Mountain View, Calif.
www.netscape.com
Founded in 1994
by Jim Clark and Marc Andreessen

Novell played a crucial role in making the corporate LAN a reality. Early versions of its NetWare network operating system allowed for storing shared files and providing access to network printers on low-cost server hardware—and for a compelling per-user cost. Novell, however, neglected to advance NetWare's ease-of-use features and was slow to respond to the demand for TCP/IP networking. It lost market share to Windows NT as a result. Despite these and other rocky times, including rumors of it being acquired, Novell has survived. NetWare has an installed base of more than 81 million users and 4 million servers worldwide. NetWare 5.0 shipped in September 1998. Under the leadership of CEO Eric Schmidt, Novell's mission is to become a pure Internet/intranet network software market leader.

NOVELL INC.
Provo, Utah
www.novell.com
Incorporated in 1983
by its founder, Ray Noorda

The first Sun system, the Sun-1 running Unix, debuted in 1982. In 1988, Sun reached \$1 billion in revenues and shipped its 100,000th system. The bulk of Sun's revenues still come from hardware sales. Sun also got into the software business; it launched Solaris 2—the first shrink-wrapped version of SunOS—based on Unix SVR4, and it introduced Solaris for the Intel X86 platform in 1991. But its most significant launch took place in 1995 when Sun introduced Java—the first universal software designed with Internet application development in mind, as well as for in-house corporate intranet developers to write applications that run on any computer, regardless of the processor or OS. Java set the stage for Sun's epic battle with Microsoft and spawned a new type of Internet-centric computing. ◀

SUN MICROSYSTEMS INC.
Palo Alto, Calif.
www.sun.com
Founded in 1982
by Andreas Bechtolsheim,
Bill Joy, Vinod Khosla
and Scott McNealy

Rob O'Regan and Linda Silva contributed to this story.

1990

Early in April, Lotus and Novell rocked the industry with a proposed merger—only to see the deal fall apart a month later. While Lotus regrouped, Microsoft spent \$10 million on the introduction of Windows 3.0. In September, IBM and Microsoft rewrote the terms of their partnership: IBM took responsibility for OS/2 1.x and 2.x, and Microsoft got portable OS/2, DOS and Windows. Motorola debuted its 68040 processor, and Apple introduced its low-end Macs: the Classic, LC and IIsi. Keeping up with the times, PC Week again changed its tag line—"The National Newspaper of Corporate Microcomputing" became "The National Newspaper of Corporate Computing."



Do you remember?

MARCH 1, 1989
84

15 companies that enjoyed 15 minutes of fame

1. DeScribe Inc.
2. Digital Communications Associates Inc.
3. Digital Research Inc.
4. Parallax Computer Inc.
5. Power Computing Inc.
6. Leading Edge Products Inc.
7. Multimate International Corp.
8. Northgate Computers Systems Inc.
9. Microrim Inc.
10. Paperback Software International
11. Samna Corp.
12. Slate Corp.
13. Fox Software Inc.
14. Go Corp./Eo Inc.
15. Ventura Software Inc.

15 products that were better off dead, ahead of their time, behind the curve, or never saw the light of day

1. HP NewWave
2. Micro Channel PS/2
3. Personal VAX
4. Portable NetWare
5. Pen Windows and PenPoint
6. LAN Manager
7. OfficeVision
8. Microsoft Bob
9. Momenta stylus PC
10. "Pink" operating system
11. Poqet PC
12. Newton
13. NeXT workstation
14. IBM PCjr
15. Lotus Javelin

15 pairings, partnerships or purchases that ultimately crashed and burned

1. IBM-Rolm
2. IBM-Microsoft
3. ACE (Advanced Computing Environment) Consortium
4. Lotus-Novell
5. Borland/Ashton-Tate
6. Digital-Apple
7. COSE (Common Open Software Environment)
8. Novell-WordPerfect
9. Microsoft-Intuit
10. Sun-Microsoft
11. Computer Associates-CSC
12. AT&T-NCR
13. Lou Gerstner-Jim Manzi
14. Compaq-Rod Canon
15. Steve Jobs-Gil Amelio

15 outdated terms

bus mastering
floptical disk
office automation software
PROTECTED MODE
MENU-DRIVEN
CASE
IBM-compatible microcomputer
terminate and stay resident
DIP switch
information highway
RAM cram
copy protection
brouter?
PUSH

15 years of memorable PC Week headlines

Memory, speed problems pull shades on Microsoft Windows until June
(Oct. 23, 1984)

Inninent Win 3.0 keeps industry on hold
(Feb. 26, 1990)

Windows 95 delay guns up the works
(Dec. 26, 1994)

NT 5.0 continues to slip
(June 29, 1998)
The more things change...

Lotus, Novell form software giant
(April 8, 1990)
For a couple of weeks at least.

Ashton-Tate raises wholesale prices on entire product line
(April 1, 1986)
No wonder they're not around anymore.

IBM OfficeVision heralds dawn of SAA era
And then dusk set in, quickly.

Users cope with new technology
(March 31, 1987)
Stop the presses!

Natscape's Andressen eyes 'Internet OS'
(June 17, 1989)
Hey, does the Justice Department know about this?

GE to sell software online; scheme faces uphill battle
(Feb. 26, 1985)

IBM, PBS, Merrill-Lynch to broadcast stock quotes to PCs
(Feb. 28, 1985) *So maybe this e-business thing isn't such a new idea.*

Compaq, AT&T prime IBM 'PC' challengers
(July 10, 1984)
Well, we were right about Compaq, at least.

33MHz 386 spawns powerful PCs
(April 10, 1989)
Was that really just 10 years ago?

Novell to buy DRI in bid for OS claim
(July 22, 1991)
Bad idea No. 1...

Novell bets big on Unix
(Dec. 28, 1992)
Bad idea No. 2...

Novell, WP liaison prompts integrated desktop bid
(March 28, 1994)
Bad idea No. 3.

Slate leads pen PC charge into mainstream
(Feb. 17, 1992)
Define "mainstream."



MARCH 1, 1999
86

Revolutionary advances

THE TECHNICAL ADVANCES OVER the last 15 years have been extraordinary. After much debate, PC Week Labs chose the 15 most influential technologies—the foundation for revolutionary products.

386 processor

The PC as we know it today, with its shrinking price and ability to run 32-bit operating systems and applications, started with Intel Corp.'s introduction of the 386 in 1985. Intel designers incorporated three key architectural improvements that made the 386 a watershed release: paged memory management, 32-bit extensions and a virtual 8086. This allowed developers to overcome memory and performance barriers associated with Intel's previous chips and develop 32-bit, multitasking OSes, yet maintain DOS compatibility. The virtual 8086 feature ultimately decided the fate of the desktop OS by allowing the 386 to multitask multiple 16-bit DOS sessions and giving users a significant reason to pick Microsoft Windows 3.x over OS/2 1.x.

CD-ROM

CD-ROMs' voluminous capacity has freed IS managers from literally hours of drudgery, loading floppy

after floppy of corporate applications, and made multimedia mainstream. Although it took several years for the optical laser technology of CD-ROM to gain widespread acceptance, there are now countless software applications, encyclopedias, games and other multimedia programs available on the media. What was originally designed to carry 74 minutes of high-quality digital audio can now hold as much as 650MB of data. Today's mass-produced CD-ROM drives are faster and cheaper than ever before and are in the process of displacing floppy drives. The heyday of CD-ROM may be waning, however, as DVD-ROM and RAM drives with optical disks capable of holding 4.7GB of data take hold.

Encryption

Without the robust and efficient encryption algorithms that have been developed, refined and proven during the past 15 years, electronic commerce would still be merely a future prospect and not the present-day foundation of the Internet's growing prosperity. Encryption is a crucial tool for establishing the identities of parties to a transaction and for making transactions secure. Pretty Good Privacy, created by Philip Zimmermann, raised the collective crypto consciousness with its open architec-

ture and its accessible packaging of robust mathematical techniques. Other leaders in this area include RSA Data Security Inc., which continues to test the limits of proposed encryption techniques with its series of challenge events, and Certicom Corp., with innovations such as the bandwidth-saving elliptic curve protection that's an integral part of 3Com Corp.'s Palm.Net initiative.

Hayes command set

Before Web sites, there were bulletin board systems, accessed only by modems that in turn were controlled almost exclusively by the Hayes command set. In fact, the cryptic commands developed by Hayes Corp. are one of the earliest examples of interoperability in computer information exchange and form the backbone that allows telecommuting and home access to the Web today. Although Hayes shut down last month, the ubiquitous "ATDT" (attention, dial, tone) found in almost every dial-up script is destined to be with IT administrators for several years to come—more than 125 million Hayes-compatible modems are in use in North America alone. Although the V.90 standard has resolved incompatibilities between 56K modems, it will be a while before IT managers achieve the same interoperability with asymmetric digital subscriber line and cable modems.

ISA

ISA marked the beginning of the end of the terms "IBM" and "PC" being synonymous. ISA, the bus chosen to replace IBM's venerable but poky AT bus, was defined not by IBM but by the "gang of nine," led by Compaq Computer Corp. This opened the doors for an era of open computing whose ramifications are still being felt.

LANs and Ethernet

More than any other products, NetWare 2.11 and 10BaseT and 10Base2 Ethernet brought shared data and computing resources into widespread corporate use. NetWare turned an inexpensive computer into a mainframe-like machine, and Ethernet provided the glue to link computers together. Without either of these symbiotic technologies, the Internet explo-

sion could never have happened, and networking would have remained in the glass house of ultra-expensive computers. Both technologies have also proven themselves to be highly resilient: Ethernet just keeps getting faster and spreading to new media, and LANs are being interconnected into a much larger, more inclusive whole.

Macintosh

In 1984, Apple Computer Inc. launched its Macintosh personal computer and changed forever the way people interact with computers with three important technology advances (first used in Apple's pricey Lisa line): a GUI; a mouse for navigation; and high-capacity, sturdy 3.5-inch floppy disks. Although the Mac owes its spiritual beginnings to ideas developed at Xerox Corp.'s Palo Alto Research Center, Apple refined those ideas and made them practical for a mass-production personal computer. By refusing to port Mac OS to CPUs other than the 68000 family of processors or license it to other companies, Apple forced potential clone makers to look elsewhere for an operating system. Microsoft Corp. swooped in, and as Apple lost its corporate focus and took too many divergent paths, Windows eventually became the preferred operating system for corporations and consumers alike. However, Apple's successful migration to IBM's powerful RISC-based PowerPC chip and the company's introduction of its popular iMac line of consumer computers continue to keep the Macintosh afloat in a sea of Windows-based PCs.

Open source

Frustrated by expensive sealed-box software that didn't work as advertised, the IT community in the mid-1990s began experimenting with the open-source model of software development, gaining the rights to tinker with system internals. While Microsoft Corp. tried to figure out its Web strategy and Solaris proved too expensive for shoestring IS budgets and then nonexistent Internet budgets, companies began deploying open-source Apache Web servers, which often sat on top of the freeware Linux. As software systems become even

CONTINUED ON PAGE 111 ▶

Groupware

THE AGE OF E-MAIL THE AGE OF GROUPWARE THE AGE OF REAL-TIME

Groupware's roots are in mainframe- and minicomputer-based store-and-forward e-mail and conferencing systems, particularly in the academic and research communities.

PCs, networking and common protocols spurred communications inside and among organizations; cc:Mail and Novell's Message Handling Service helped spread e-mail on corporate desktops, while Lotus Notes provided customized programming tools and links to external applications.

Groupware has moved to synchronous real-time communications (chat, videoconferencing and application sharing), smashing barriers of time and space and providing the mechanism for major changes in work and lifestyle patterns.



MARCH 1, 1999
90

Gambling on technology



RISK IS ALWAYS A FACTOR when implementing new technology. But when done right, the payoffs are huge. Here are six examples of successful IT projects.

On track

In 1984, Federal Express Corp. launched itself past larger, more established rivals such as United Parcel Service of America Inc. with its deployment of "Supertracker."

The system was built on FedEx's mainframe-based package tracking system, called the Customers, Operations, Services, Master On-line System. Supertracker allows couriers in the field to use handheld devices and a wireless digital radio network to enter the status and position of packages as they passed through FedEx's monolithic distribution system.

With a call, customers were also able to determine the location of their packages and when to expect delivery. The Atlanta-based company touted this feature in major advertising campaigns—and gained market share. FedEx now has 40,000 handheld devices in the field generating 6 million scans daily. (See story, below.)

Accounting groupware

In 1989, IT executives at Price Waterhouse made what, on the surface, might have seemed like a career-ending decision.

The company announced it would rip out the e-mail system it had just finished installing on 10,000 desktops and replace it with a first-of-its-kind product that the vendor had a hard time categorizing or describing. Furthermore, it planned to deploy this untried system on OS/2.

The New York company's decision to become the first large company to deploy Lotus Development Corp.'s Notes enterprise-wide paid off big time. Relying on Notes' strong security, Price Waterhouse built client engagement databases that allowed

the company to manage projects globally.

Use of groupware took off, particularly in service-oriented industries. For example, competitors such as Coopers & Lybrand LLP—which last year merged with Price Waterhouse—standardized on Notes in 1993. When the companies merged, Notes helped bring them together.

Today, the combined company has over 100,000 Notes users. Deployment was not perfect, however. The company migrated from OS/2 to Windows in the mid-1990s.

GUIs take off

In the midst of a deep slump in the airline industry, United Airlines Inc. decided in 1990 that replacing character-based dumb terminals with a PC-based GUI in its reservation system could produce big savings.

Deeming Windows too unstable, United developed its own

GUI. The system, running on 286-based PCs, gave operators a menu interface rather than requiring them to enter cryptic commands.

United cut the average reservation processing time by up to 10 percent, reduced training time by 25 percent and saved \$9 million in the first year.

Data in aisle 3

In the mid-1980s, Bentonville, Ark., retailer Wal-Mart Stores Inc. plotted a major expansion beyond its traditional Midwestern market area.

The challenge: How could the retailer continue to operate its expanding number of stores as if they were family-owned, catering to the needs of local communities?

Wal-Mart managers hit on the idea of tracking point-of-sale data at each store and of using that data to respond quickly to changing product demand and inventory trends.

The result? One of the largest and most successful data warehouses ever.

The system quickly grew to 700GB and allowed the retailer to share product demand information with its suppliers, which, in turn, were expected to manage Wal-Mart's inventory. Wal-Mart improved its in-stock performance significantly and surpassed retail giants

such as Sears, Roebuck and Co. Meanwhile, the data warehouse, running on NCR Corp.'s Teradata hardware and software, has grown to 24 terabytes.

Book IT

In 1995, while bookseller giants such as Barnes & Noble Inc. and Crown Books Corp. raced to build more brick-and-mortar retail outlets, Jeffrey Bezos, an IT guy at Chicago-based Bankers Trust Co., had a better idea. (See related stories, pages 95 and 105.)

Bezos moved to Seattle and launched Amazon.com, which quickly became an Internet icon—the first successful, built-from-the-ground-up virtual business. (Well, successful if you look at the stock price.)

In spite of widespread concern over online security, Amazon demonstrated that you could, in fact, sell merchandise online. Amazon now offers 4.7 million book titles online, plus CDs, audio books, digital versatile disks and computer games.

Today, 4.5 million people in 160 countries have bought products online from Amazon, Crown is out of business, and Barnes & Noble has jumped into the electronic commerce game.

And while Amazon's stock is trading at over \$100 per share on the e-commerce-crazed market, the company reported losses of \$78.1 million through the first nine months of last year.

The path to IT leader

WHO WOULD HAVE THOUGHT, 15 years ago, that IT professionals could work their way out of the glass house's back office and into chief posts?

Today, chief information officers sit at the management table alongside other chiefs—chief financial officers, chief operating officers and chief executive officers—and play critical roles in driving the key technologies, such as e-commerce and ERP systems, that are reshaping the way companies—even whole industries—do business.

Today's CIOs wouldn't be able to claim their seat at the top echelons of corporate management if it weren't for a select few IT chiefs who, early on, paved the way for what was to come. These

top CIOs, such as the seven featured here, were ahead of their time in steering new technologies and positioning IT to play a more strategic role in business.

If not for the work of these and other leaders, the IT profession might have continued without a chief.

Million-dollar man

As CIO for Merrill Lynch & Co. Inc., DuWayne Peterson was the first with his title to earn \$1 million in a public company—which opened the



DuWayne Peterson

door for other CIOs to get top billing.

His accomplishments transcend money, however. Peterson took a risk in the late 1980s by consolidating data centers and installing networked client/server systems as a way to increase efficiency and lower computing costs at Merrill Lynch. It worked.

As a result, many IS executives followed suit—turning the 1990s into a client/server technology frenzy.

The "selective outsourcing" concept—when a portion of an IT department's responsibilities are handed over to a third party—is also high on Peterson's achievements list. Peterson contracted with MCI WorldCom Inc. to manage Merrill Lynch's voice

and data network. The move proved that a company could let go of day-to-day tasks—without losing control.

Peterson left Merrill Lynch in 1991 to head his own consulting firm. Today, he serves as vice chairman at Software Testing Assurance Corp., a year 2000 certification service.

GM's IT success

When Ralph Szygenda accepted the CIO job at General Motors Corp. in June 1996, some said he signed on for the "mother lode" of all CIO posts.

More than two and a half years into the assignment, Szygenda has driven technology change

CONTINUED ON PAGE 92 ▶

Be like Mike (Dell)

With its landmark electronic commerce site, dell.com, Dell Computer Corp. proved not only that it's possible to sell PCs and servers online, but that the real payoff lies in integrating e-commerce with supply chain processes and systems.

Launched in early 1997, Dell's site gives customers accurate delivery date information by checking on parts inventories at the time orders are placed. More importantly, Dell is able to share up-to-the-minute demand and planning information with parts suppliers, trimming inventory costs and improving customer service.

Customers responded by driving Dell's online sales to more than \$10 million a day. (See related stories, pages 69, 76 and 95.) ◀

Written by Jeff Moad



MARCH 1, 1999
92

CONTINUED FROM 90

throughout all areas of the \$178 billion automotive giant.

First and foremost, Szygenda, formerly CIO at Bell Atlantic Corp., worked to wean GM away from its outsourcing arrangement with Electronic Data Systems Corp. and get other outsource



Ralph Szygenda

into the mix. He also brought structure to GM's highly autonomous IS groups by hiring 40 divisional CIOs, who worked with him to establish common software platforms and processes that could be applied companywide.

With these moves, Szygenda has helped GM slash IT expenses by hundreds of millions of dollars, and officials say that's only a start.

From CIO to CEO

Katherine Hudson, former CIO of Eastman Kodak Co., decided to take the outsourcing route nearly a decade ago.

Hudson was the brains behind the 1989 landmark outsourcing deal between Kodak, IBM and Businessland Inc., among others, where the day-to-day chore of running the data center would be off-loaded to the outsourcing team.

As such, Hudson was among the first IT leaders to recognize—and act on—the idea that IT should focus on creating systems to leverage a company's core competencies, which in most cases



Katherine Hudson

do not include running a data center.

After 12 years at Kodak, Hudson is among the elite group of technology chiefs who have traded their CIO posts for CEO seats. She now serves as president and CEO of W.H. Brady Co., a \$455 million international manufacturer of industrial identification and specialty tape products.

Banking on IT success

Long before he became chairman and co-CEO of Citigroup Inc., John Reed spent years in various IT roles at Citicorp, promoting technology as the means to automate many of the bank's functions.

Reed was touting the benefits of technology long before Citicorp and Travelers Inc. merged to create Citigroup. In 1965, for example, one of Reed's first assignments was to help design the bank's management information system. He also assembled the team of technology professionals that paved the way for Citibank's automated corporate and consumer banking services—including proprietary ATMs and bank cards.

By orchestrating all these technological efforts—which essentially changed the way Citibank did business—Reed was among the first CIOs to step into the CEO role. He has been chairman and CEO of Citicorp and its principal subsidiary, Citibank, since September 1984.



John Reed

Business-minded CIO

The concept of using technology to create competitive advantage was in large part cultivated by Max Hopper.

The former American Airlines Inc. CIO adeptly navigated the network waters in the 1970s when he initiated a plan—dubbed InterAAct—that linked all airline employees, from the chairman to the baggage handlers.

Hopper's strategy, to empower employees through information accessibility, was instrumental in helping American react quickly in the event of a pilot strike or competitive pressure.

Hopper moved from American to become chairman of The Sabre Group, a subsidiary of AMR Corp., which is also the parent company of American Airlines. He retired from Sabre in 1995 and is now president of Max D. Hopper Associates Inc., a consultancy in Dallas.

His legacy of integrating business and technology lives on in many of today's CIOs.



Max Hopper

Trading for success

Dealing in securities is always risky business, but Charles Schwab & Co. Inc. CIO Dawn Lepore is never one to back away from a challenge.

Lepore was among a handful of executives who pushed the largest discount broker onto the Web in 1996 with E-schwab, an online stock trading service.



Dawn Lepore

involved in business strategy discussions.

Armed with critical knowledge of the business, Lepore is championing continued investment in IT. Her goal is to extend the Schwab brand by developing other online services that appeal to both consumers and institutional investment firms.

Turning a Web profit

Federal Express Corp.'s "Point, Click and Ship" is no longer just an advertising slogan—it's a convenience that millions take for granted every day as they track and route packages from their desktops using Web browsers.

This is one of many advances Dennis Jones, FedEx's CIO, has brought to the delivery service business. Other examples include Web-based drop-off locators and online cost calculators.

Jones' leadership in tapping the Web to automate key customer processes has put FedEx in front of the pack of companies profiting from the Internet.

Jones is in the process of leading FedEx away from a 3270 terminal infrastructure to Windows-based PCs. The goal is to create a desktop environment best



Dennis Jones

suited to run a full arsenal of Internet-based applications.

Although Jones' initial plan called for network computers, FedEx has backed off NC deployment and is considering other hardware options to achieve its goal. ◀

Written by Beth Stackpole and Stephanie Neil

15 YEARS OF IT DEPLOYMENT TRENDS

(Year products were deployed, not announced)

1984 PC spreadsheet (Lotus 1-2-3) is the killer app that drives business to purchase PCs in huge quantities. • Macintosh emerges as an alternative to MS-DOS PCs

1985 PC AT takes desktop by storm

1986 The year of the desktop database, dBASE rules, Excel emerges. • Digital Equipment has its strongest year, becoming a threat to IBM, but the minicomputer's last stand.

1987 386 gains desktop

1988 Unix gains mind share, growing faith in minicomputers and mainframes

1989 CD-ROM E-Home takes hold. It's finally the year of the LAN (network) wars cease, as hubs and adapters from SynOptics and 3Com are everywhere. • Fax is the way for client/server apps of the 80s

1990 Router deployment goes through the roof. It's the year of the WAN as companies tie their newly built LANs together across the enterprise.

1991 Windows, Windows everywhere. The monopoly takes its big time. Curtains for OS/2

1992 Year of LAN-based applications. NetWare is everywhere, and one comes to grips with groupware as Notes use becomes prevalent. • Outsourcing grabs headlines as Kodak does big deal.

1993 Widespread Pentium deployment begins

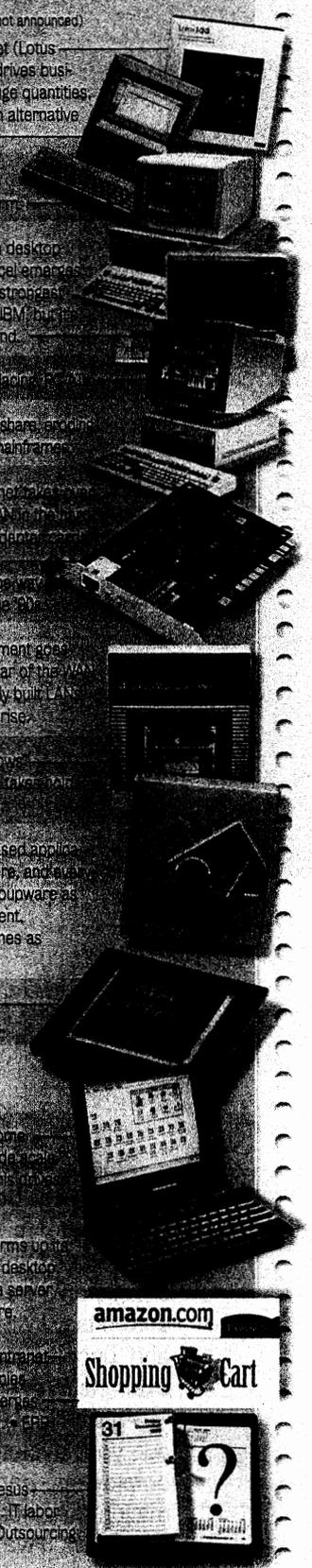
1994 Client/server computing takes hold.

1995 Notebooks become desktop alternative on a wide scale as mobile Pentiums ship. This leads to a surge in telecommuting.

1996 The Monopoly firms up its grip. Win 95 takes over the desktop. NT gains major ground as a server platform, displacing NetWare.

1997 The year of the Internet: the vast majority of companies use them. E-commerce emerges and enters the mainstream. • ERP suites are everywhere.

1998 Y2K scares bejesus out of IT and everyone else. IT labor shortage becomes acute. Outsourcing and services flourish.



The ones to watch



MARCH 1, 1999

95

THE PEOPLE WE CHOSE AS THE MOST influential during the last 15 years (see story, Page 69) represent all walks of technology—a time line of the industry personified.

When choosing the “power brokers” of the future, we filtered our choices through the Internet: The majority of the 15 people profiled below broke significant new ground, either cre-

ating new business cases or reshaping old ones using the Web as a mold.

Indeed, Michael Dell’s and Stephen Case’s desire and ability to adapt with the times have made their companies, Dell and America Online, respectively, forces to be reckoned with and harbingers of new business methodologies.

The challenge for these folks is to remain at

the top of their game because for every Amazon.com there is a barnesandnoble.com. Others are expanding the Internet highway to handle increased traffic.

Internet time has increased competition to dizzying levels, and it won’t be long before we see the Jeff Bezoses of the industry blaze new Internet trails.

—Debra Donston



Steve Ballmer

PRESIDENT
MICROSOFT CORP.

Bill Gates has said he will not manage Microsoft beyond his 50th birthday, which falls on Oct. 28, 2005. The golden anniversary of Gates’ birth will pave the way for his longtime No. 2 and college buddy, Steve Ballmer, to take over.

But if the govern-

ment wins its case and successfully breaks up Microsoft, as some predict, which company will Ballmer inherit? The one that he picks at the time of divestiture, which could take place, say, two years from now, will be critical.

Some pundits expect Microsoft to spin off four “Baby Bills” and that Ballmer will pick the interactive media venture, which will include The Microsoft Network and MSNBC. Ballmer is tired of the last-generation operating system and applications areas because, well, they’re just too boring.

The danger: By the

time the fiery Ballmer gets to be No. 1, he may not be so fiery.

Still, he’s one hell of an executive. He’s not a techie, but his dedication to customers has been indispensable at Microsoft. Expect that to carry over to the new company. His relentless drive and marketing savvy would give any business a boost but will be particularly advantageous in an interactive media endeavor. Above all, he’ll want to prove to the world that Gates was not necessary for him to have become a success. We’re betting he’ll continue to make his mark long after Gates retires. ◀

Steve Case

CEO
AMERICA ONLINE INC.

Just when they said the Internet would be the death of America Online, CEO Steve Case launched one of the boldest customer grabs in the history of marketing. Rather



PHOTO: STEVE FREEMAN/PH

Jeff Bezos

CEO
AMAZON.COM

If there were to be an election to determine who invented electronic commerce, Jeff Bezos would probably win by a landslide.

He got in on the ground floor of the Web, founding Amazon.com in 1994, when most were still wearing Internet diapers—trying to figure how to use Mosaic and get a stable IP connection.

The most remarkable aspect of Amazon is its impact on customer service. Through a combination of computers and people, Amazon’s responsiveness to customer needs is unmatched, and Amazon has become the example of all that e-commerce can be. The onus is on Bezos and Amazon to continue to lead the e-commerce charge. ◀

than adopt a defensive posture, AOL took the offensive, putting an installation disk or CD within 20 feet of every man, woman and child in the United States.

The rest is history. AOL is poised to add 17ers to its stable of 14 million online customers, and, in another bold stroke, AOL plans to purchase Netscape Communications Corp., the company credited with bringing the Internet to the public.

But Case, a native Hawaiian, has a long row to hoe before IT views the \$2.2 billion online behemoth as a key supplier. Netscape,



whose primary target was IT, lost ground to Microsoft in 1998 on the server and client sides of the Internet equation. Some argue that all AOL is buying is the popularity of Netscape’s Web site.

Still, AOL is poised to reap the medium’s rapid growth, which shows no sign of abating. Pretty good for a poli-sci major raised in the South Seas. ◀

Christos Costakos

CEO
E*TRADE GROUP INC.

Christos Costakos won a Purple Heart and a Bronze Star for valor in the Vietnam War. Today, as CEO of E*Trade, he duked it out with companies such as Merrill Lynch & Co. Inc. and Charles Schwab & Co. Inc.

The online brokerage at the head of the pack in the massive growth of individual investing, E*Trade handles average daily deposits from investors of about \$60 million. (Softbank Corp., parent company of PC Week publisher Ziff-Davis Inc., has holdings in E*Trade and Yahoo, whose co-founder, Jerry Yang, is



profiled on Page 98.) Costakos joined E*Trade in March 1996, leaving his post of president and co-CEO of A.C. Nielsen Inc. The online brokerage company began as a service bureau providing quote and trading services, then offered electronic brokerage services to the public through America Online and CompuServe. Costakos oversaw the launch of the company’s Web site and its initial pub-

lic offering.

Both E*Trade and Costakos have been branching out—the company to the mutual fund business and Costakos to the boards of half a dozen companies. One of these companies, E*Offering, is an e-commerce investment bank that will allow individual investors to invest online in initial public offerings and is backed by Robertson, Stephens & Co. founder Sandy Robertson and Cruttenberg Roth Inc. President Walter Cruttenberg.

Watch for Costakos to continue to democratize the financial services market, bringing more opportunities to the individual investor and moving business further into the electronic world. ◀



Eric Schmidt

CEO
NOVELL INC.

Not two years into his tenure at Novell, Eric Schmidt has turned the company from a has-been giant in LAN networking to one poised to seize a big piece of a surging technology area—directories. Yet some things never change: Novell faces competition in the directory market from its eternal rival, Microsoft, which is ready-

ing its own directory technology.

But Schmidt, perhaps learning a few things about rivalry with Microsoft in his stint as chief technology officer at Sun, has wisely refocused Novell to work alongside Microsoft rather than in head-to-head competition. In addition, he has forged relationships with management, networking, security and enterprise resource planning vendors and has brought in new blood from Silicon Valley to revitalize Novell.

Will Schmidt’s efforts be enough? IT administrators generally prefer NetWare for its reliability and network ser-

CONTINUED ON PAGE 96 ▶

1991

PC Week’s banner headline in the July 8, 1991, issue read: “IBM, Apple Seek a Brave New World.” This unusual pairing was an attempt to broadside the rest of the computing industry. It didn’t happen. What did happen in 1991, however, was the birth of the World Wide Web: Tim Berners-Lee, while at CERN, released the first Web server. Business spending on computing exceeded spending for industrial, mining, farming and construction equipment. PC Week unveiled a redesigned logo.





MARCH 1, 1999
96

CONTINUED FROM 95

1992

IBM and Microsoft officially ended their cooperative work agreement. For the first time, IBM reported a year-end loss, of \$564 million. Ken Olsen's departure marked the start of a new era for Digital. Intel announced its "clock doubler" and debuted the 486DX2 processor. IBM announced the first in its popular notebook line—the ThinkPad. The number of hosts on the Internet swelled to 1 million.



vices, but increasingly corporations are adopting Windows NT (soon to be Windows 2000) as a corporate standard.

NetWare 5.0 has done well, and NDS is gaining ground both on multiple platforms and

across multiple technologies. Whether Schmidt can exhort his team to bring NDS into the next realm—a highly versatile, pervasive object store of personal information for the "digital persona"—is the question. ◀



Michael Dell
FOUNDER/CEO
DELL COMPUTER CORP.

Michael Dell has already rewritten the rules of the PC business and forced larger and older companies to adapt to the direct-sales model or die. Did he just get lucky with the Inter-

net, or has he had all the right instincts since he started building PCs for fellow students in his college dorm room?

All we really have to know is that, at 34, Dell is young enough to keep making an impact for many years to come—even if he should stumble along the way.

With Compaq stepping up its direct-sales efforts, though, Dell will have to switch from the role of upstart battling the big guys to incumbent defending his direct-sales turf. ◀



Joel Kocher
CEO
MICRON ELECTRONICS INC.

He's a brash, marketing-savvy CEO hoping that lightning can strike twice in the direct-PC market. Joel Kocher has led a turnaround at Micron in an effort to propel the company into the top tier of PC makers.

His team has combined high-caliber products and more aggressive pricing while cutting operating expenses. To make a significant dent in the PC market—and, in particular, to gain ground on rivals Dell and

Gateway Inc., which turned direct PC marketing into an art form—Kocher must turn his new business model into product sales, both in the United States and around the world.

With the Internet changing the way PC companies do business, Kocher seems in the right position at the right time to make his, and Micron's, mark. ◀



Judy Estrin
CHIEF TECHNOLOGY OFFICER
CISCO SYSTEMS INC.

Keep an eye on Judy Estrin. The chief technology officer at Cis-

costands to play a major role in the next generation of networking.

Estrin, who has co-founded three companies that addressed different sectors of the networking market, is considered an industry visionary. Her last company, Precept Software Inc., was purchased by Cisco last spring.

Now Estrin is chartered with helping to

lead Cisco into the world of data, voice and video convergence. In that role, she oversees Cisco's aggressive acquisition and investment strategy. Estrin also sits on the boards of directors at Federal Express Corp., Rockwell International Corp. and Sun Microsystems Inc.

It's a lofty perch, but one from which Estrin no doubt relishes the view. ◀

Richard McGinn
CEO/CHAIRMAN
LUCENT TECHNOLOGIES INC.

Communications equipment is not the sexiest of product areas, but it's certainly the most pivotal for building next-generation networks. Richard McGinn, chairman and CEO of Lucent, is poised to play a major role in determining the direction this market takes.

McGinn, who



helped launch Lucent three years ago when it spun off from AT&T Corp. as part of the telecommunications giant's divestiture, capped off a buying spree last month with

his \$20 billion bid for Ascend Communications Inc. If the deal goes through, the combined entity will take on Cisco in a bid to become the equipment supplier of choice to Internet service providers.

To the victor go the spoils of convergence: networking gear that combines data, voice, video and Internet traffic. Call it the new frontier of communications. ◀



Eckhard Pfeiffer
CEO
COMPAQ COMPUTER CORP.

Eckhard Pfeiffer brought Teutonic efficiency to Compaq,

the Texas clone maker that was verging on suffocation in the shrinking high end of the PC market.

Compaq was able to live off its reputation for quality for years, even as it moved down-market and toward high volume and so-so quality. Pfeiffer's strategy was so successful that he was able to set out in an entirely new direction by buying Digital

Equipment Corp.

Now all Pfeiffer has to do is meld Digital's integration and services business with Compaq's core PC business to create a player the caliber of, say, Hewlett-Packard Co. (and maybe, tomorrow, IBM). We're betting he'll succeed, but if he is not well on his way to becoming king of the hill in a few years, he'll likely pass the baton to a swifter runner. ◀

Toby Lenk
CEO
ETOYS.COM

Toby Lenk's eToys was the e-commerce wunderkind of the 1998 Christmas shopping season. Customers could not say enough about the toy shopping site's service.

The eToys formula is a page right out of Amazon.com's playbook. Just as



Amazon chases down hard-to-find books, eToys specializes in information-rich toys that traditional retailers won't touch.

eToys also offers personalization under the aegis of "My eToys," providing shoppers with order status, birthday reminders and a wish list for toys to purchase later.

Christmas was Lenk's free ride. But the behemoth of toys—Toys 'R' Us Inc.—is in the online game now and will pose a challenge to eToys' leadership. ◀

William Schrader
CEO/CHAIRMAN/FOUNDER
PSINET INC.

As CEO, chairman and founder of upstart ISP PSINet, William Schrader has made a name for himself as an outspoken voice in the booming service market and an occasional cowboy-hat wearer.

Unlike a host of other Internet service



Spencer F. Katt
COLUMNIST
PC WEEK

He's here, he's there, he's everywhere, sniffing out news tips and delivering them to readers in unmatched alliterative elegance.

Spencer F. Katt, PC Week contributing editor and resident rumormonger, has been taking the pulse of the computer industry—and pointing out the foibles of its major players—since PC Week's inception.

The Power Meower's track record is (nearly) impeccable, from his early days as a cub reporter covering companies such as Commodore and VisiCorp to his current status as pundit nonpareil.

Heading into the next century, the cantankerous Katt—he declines to give his age, in either human or feline years—shows no signs of letting up.

Want proof? Keep reading. He's very likely to tell you what the other executives on this list are planning to do before they know it. ◀



providers focused on the consumer market, PSINet has from its inception in 1989 specialized in corporate

CONTINUED ON PAGE 98 ▶



MARCH 1, 1999
98

1993

IBM reported its worst year in history with a loss of \$4.97 billion on revenues of \$64.5 billion. Louis Gerstner took IBM's reins—the first “outsider” to hold the CEO post—replacing John Akers. Apple's “look and feel” lawsuit against Microsoft and HP was dismissed. 1993 was also a year of significant product and technology announcements: Intel unveiled the 60MHz Pentium processor, Apple rolled out the Newton MessagePad, Novell announced NetWare 4.0, Lotus Notes 3.0 debuted, and Microsoft unveiled Windows NT. Keeping pace with the evolving industry, a new PC Week logo debuted.



CONTINUED FROM 96

Internet services. PSINet today has almost 50,000 corporate customers in 12 countries.

Schrader has been involved in the Internet services business for many years. Prior to PSINet, he founded and ran NYSerNet, a regional Internet network provider for universities, corporations and government bodies in New York. Prior to that, Schrader helped found and ran the Cornell Theory Center, where he guided the construction of a \$100 million super-computer center.

The ever-outspoken Schrader, who frequently advocates the customer's point of view, has predicted that during the next five years the number of ISPs will expand to about 50,000 and that the

definition of what an ISP is and can offer will change.

Schrader somewhat controversially asserts that as competition increases and prices fall, distance-based services will decline and flat-rate pricing, most likely with different tiers of services, will rise. And PSINet will probably be there, leading the way. ◀

Meg Whitman

CEO
EBAY INC.

eBay enjoys the distinction of being one of the few Internet companies whose rocketing stock was propelled by actual earnings. That must warm the heart of President and CEO Meg Whitman, who has been with eBay not quite a year.

Whitman symbolizes the new breed of high-tech executives,

who, unlike their predecessors, don't have a sea-changing technical vision to share but do have management credentials—in Whitman's case, a Harvard MBA. Her position prior to eBay was shepherding the Mr. Potato Head and Playskool lines at Hasbro Inc. She also held positions at FTD Corp., Stride Rite Corp. and The Walt Disney Co., where eToys.com's Toby Lenk cut some of his



teeth, and did a stint at Procter & Gamble Co., where stars such as Steve Ballmer started out.

Whitman's company bio describes the strength an online CEO must have:

“Meg's expertise [is] in brand building combined with her consumer technology experience.” Hear that, ITers with e-commerce aspirations?

As an online trading site, eBay is truly unique. It lists 70,000 new products every day, ranging from gemstones to pottery and from computers to antiques. eBay truly has put the old saying, “One man's junk is another man's treasure,” to work. ◀

Jerry Yang

CO-FOUNDER
YAHOO INC.

Jerry Yang is the king of the portals. By most measures, his site is the busiest on the Web.

He's also the king of stock prices. When Yahoo stock was trading at one-third of what it was in mid-January, he said he did not take the valuation seriously. But Wall Street does (the stock

closed at \$128.88 on the day this article went to press).

Yang, along with David Filo, started Yahoo—which stands for “Yet Another Hierarchical Official Oracle”—while he was studying electronic engineering at Stanford. In spite of their cool, lively and sometimes flip persona, these yahoos, which is what Yang



and Filo consider themselves, are to be taken seriously, even if their computers were named after Hawaiian sumo wrestlers.

Of course, their huge search engine and databases have long since been moved to larger computers.

When portal history is written, Yang will be credited with the invention of the site genre, where you can find most anything—products, services, news and sports scores. And if Yahoo doesn't have it, the site will point to where it is.

Portalsites are barely reaching maturity. There's plenty more refinement and new customers to go before any movement toward consolidation. The trick for Yang will be to invent the next big hit. ◀

John Dodge, Stan Gibson, Margaret Kane, Rob O'Regan and Erica Schroeder contributed to these profiles.

Eyes on the industry and its players

Thomas Penfield Jackson, the federal judge presiding at the DOJ vs. Microsoft antitrust trial: Hizzoner may occasionally doze in his stuffy courtroom, but he hasn't missed a beat in the trial.

Ronald Whyte, the federal judge presiding in Sun vs. Microsoft case: Is this case, like the DOJ's, that strong against Microsoft? Whyte and Jackson must exchange notes because they so consistently rule against the software giant.

Joel Klein, assistant attorney general for antitrust cases, leading the government's effort against Microsoft: A smooth, ambitious politi-

cian who, having been a New York crime fighter, is every bit Microsoft's match.

U.S. District Judge Harold Greene: The courtly jurist's 1982 consent decree established the model for telecommunications competition.

Rep. Edward Markey (D-Mass.): The staunchly liberal lawmaker capped six years of tireless effort with the passage of the Telecommunications Act of 1996.

▼ **The Supreme Court**: As the likely final destination of DOJ vs. Microsoft, the court's nine justices seem destined to weigh Gates' fate.

▶ **Attorney General Janet Reno**: As the nation's DOJ heavyweight, she can counter any punches thrown her way by high-tech pugs who step into the ring.

Vice President Al Gore: The veep's presidential bid leaves his nearly forgotten Information Superhighway project eating Al's dust.

FBI Director Louis Freeh: The hard-nosed former agent and encryption foe wants just the facts, ma'am, and the data on your hard drive.

FCC Chairman William Kennard: A Clinton/Gore insider, he's making sure communications megamergers don't turn the Telecom Act on its head.

—John Rendleman, John Dodge



Poised for liftoff



MARCH 1, 1999

101

YOU'VE PROBABLY HEARD OF THEM, SINCE THE CONCEPTS AREN'T NECESSARILY NEW—but now's the time to pay attention. It's imperative that each of these technologies be on your IT radar screen because they are poised for liftoff and will impact your organization soon.

1 Internet2: Back to the future

Universities band together to create a high-speed, noncommercial backbone network. Sound familiar?

It happened with the Internet, and it's happening again with Internet2, an initiative started by 34 universities in 1996. With a membership that has swelled to include more than 140 universities and 45 corporations, the new Internet will serve as a testbed for advanced technologies such as QOS (quality of service), digital video, multicasting and distributed storage.

Many of these technologies will migrate to the original Internet, offering users a much-needed bandwidth and performance boost, along with advanced collaboration and multimedia applications.

The goal is to keep the two networks separate, ensuring that the spirit of research and noncommercial use remains alive well into the future.

2 Wires give way to thin air

Wireless networking will reshape the computer industry more than any other development. No longer will we be bound by wires to our offices, buildings or even homes.

Broadband radio technology is finally becoming standardized

enough to start making inroads for widespread data transmission. And data compression techniques can be used to squeeze larger amounts of data over limited bandwidth.

On the local LAN side, the 802.11 standard will finally lead to the commoditization of wireless adapters. For nationwide communications, PCS (Personal Communications Service) technology will slowly include more and more data services.

While the networking revolution of the '90s has been largely a wired one, the first years of the new millennium will see wire give way to thin air. Now, if only we could find a way for ethereal power transmission.

3 Blazing-fast backbones

Continuing improvements in network backbone technology will ensure that dire predictions of systemwide Internet crashes from traffic overload will never come to pass.

Where Fast Ethernet, Layer 3 switches and now Gigabit Ethernet have made the need for more-intelligent network applications and QOS irrelevant, expect to see even greater breakthroughs in packet transmission and routing over the next 15 years. Just as Fast Ethernet eventually migrated to copper from fiber-optic cabling, so too will Gigabit Ethernet.

Terabit Ethernet is just around the corner. Remember, you heard it here first!

Layer 3 switches are still in their infancy but will ultimately become the de facto technology behind every router on the Internet, ensuring that even greater amounts of data can be carried without a hiccup.

4 The melding of voice and data

Voice is data. No longer will the two coexist—one will be completely subsumed by the other, with voice becoming just another data type flowing on the network.

By treating voice as another form of data, IT departments will be able to merge their two networks—not to mention telecom and IT departments. While voice/data convergence won't change the way we speak, it will have an impact on everything else. Intelligent network services won't be simply caller ID—they'll evolve into sophisticated applications, intermingled with computer systems that use voice as just another medium for accessing the system. Web pages will have "click-to-call" buttons, and the term "voice mail" will gain a whole new meaning. Combine these intelligent services with dramatic cost savings, and you have a technology worthy of your full attention.

5 Artificial constellations

Near-Earth space has been decorated with humanity's first ar-

tificial constellations—space-based satellite networks.

Unlike other infrastructures, satellites can serve remote locations without exposing valuable hardware to the whims of politicians or vandals. Copper wire can be stolen, and capricious governments can seize the older generation of satellite Earth stations. However, an Iridium World Communications Ltd. satellite telephone is portable and secure, while the satellites are safely out of reach.

GPS (Global Positioning System) offers new intelligence in transportation, manufacturing and other operations in which decisions must be made on the location of assets. When linked with weather satellites, GPS-equipped vehicles can improve the efficiency of many enterprise activities. Plus, when data access and communications are "local" between all points, the efficient dynamics encompass a worldwide population.

6 DSP power

No single device stands more of a chance of changing the way we use computers than the DSP (digital-signal processor).

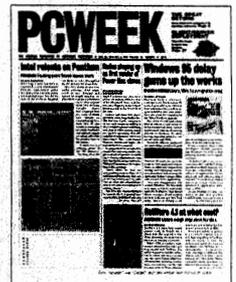
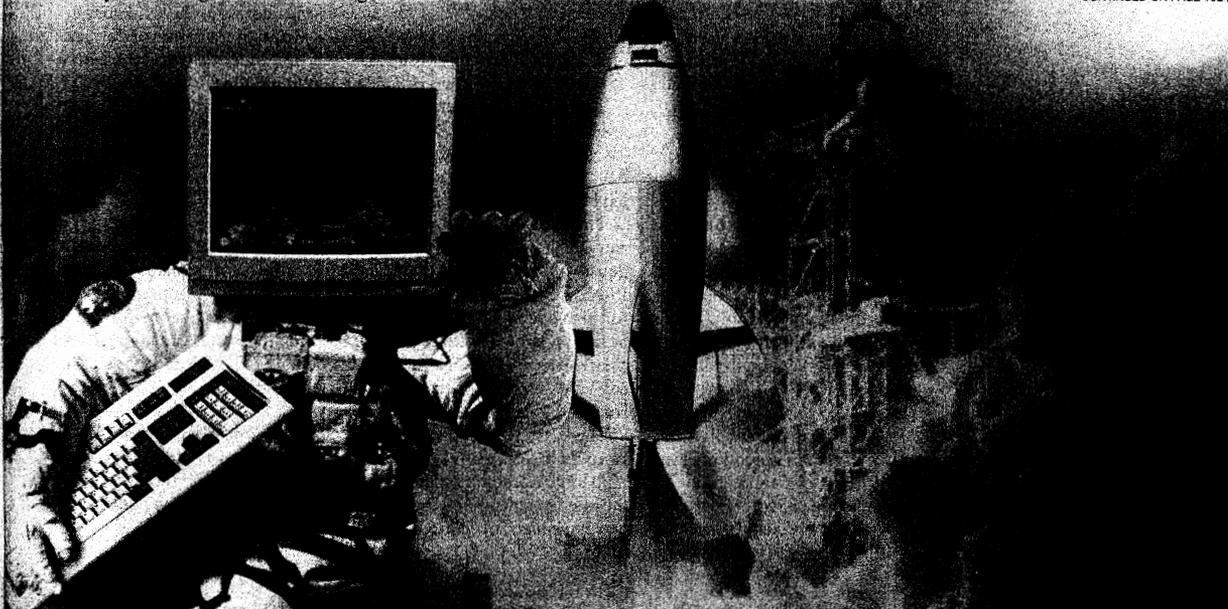
Some seemingly simple applications, such as voice recognition and visual processing, require enormous amounts of mathematical processing.

But it is not only in single computers that DSPs will play a pivotal role. Emerging broadband network access methods—from DSL

CONTINUED ON PAGE 102 ▶

1994

Intel put an end to its public relations nightmare by implementing a no-questions-asked Pentium chip replacement policy. Users weren't happy when Microsoft announced that Windows 95 wouldn't ship until August 1995, forcing many to revise their plans for migrating to the 32-bit Windows upgrade. The M&A frenzy continued, with Novell acquiring WordPerfect for \$1.14 billion and Aldus and Adobe merging in a transaction worth \$525 million. Apple entered the online service market with eWorld, and Wall Street's darling, Netscape, was founded. PC Week launched its Web site, www.pcweek.com.





MARCH 1, 1999
102

CONTINUED FROM 101

1995

"IT bullish on IBM-Lotus pairing," read PC Week's banner headline in the June 12 issue, as IBM made a \$3.5 billion bid for a struggling Lotus. In August, Microsoft shipped Windows 95. And Intel debuted the 150-200MHz Pentium Pro. CompuServe, AOL and Prodigy began offering Web access, and Netscape launched the third-largest NASDAQ IPO ever. By year's end, 9 million hosts were connected to the Web.



(digital subscriber line) and cable modems to wireless networks—require DSPs. As signal processing power increases, we'll be able to squeeze more data on smaller lines—and our computers will really understand us.

7 Getting crackers for security

Willie Sutton said that he robbed banks "because that's where the money is." As most of the world's negotiable assets metamorphose into bitstreams, the vaults that hold commercial data will become the targets of the prankster and the terrorist as well as the thief.

Computer security is the growth industry of the next decade—at least.

Next-generation IT managers will have to contain risks by limiting their companies' exposure to ingenious attacks.

IT professionals are well-trained in the art of making things work, but rarely do they have the orientation or knowledge to anticipate the ways systems can be made to misbehave. Security specialists think like crackers, not like operators, and good ones will be able to name their price.

8 Knowledge management

The rise of the Internet, intranets and ERP (enterprise resource planning) has inundated business users with more information than they can possibly digest.

To avoid information overload, IT

managers will be spending more time over the next few years seeking out knowledge management solutions to help users put key data to competitive use.

Cultural barriers will be knocked down, and IT managers will begin to understand, and thus embrace, the most effective knowledge management tools. These

tools will become a key part of the way business is conducted.

Many companies are even creating a new position—chief knowledge officer—to oversee the effort.

9 XML picks up where HTML left off

The Web may offer paths to a world of data, but many Web users have found those paths poorly marked. With XML (Extensible Markup Language), the Web gains a standard notation that describes the meaning of data, complementing HTML's role in describing how data is presented.

HTML can lay out a table, but it can't denote relationships among the table's elements. XML allows Web page authors to create and use their own tag vocabularies to give more depth to data. Pages will be able to filter and present data using more than the raw text-pattern matching that can make current Web search tools frustrating to use.

Higher-level notations are already rising on XML foundations. Resource Definition Format, for Web site self-description; Precision Graphics Markup Language; and Synchronized Multimedia Integration Language are among the XML-based tools that will enable

next-generation authoring and the use of richer Internet content.

10 Linux to crash OS party

As Microsoft Corp. feasts on its extraordinary earnings performance over the last several quarters, a ghost looms at the end of the table.

Linux may not be eating much of Microsoft's market share, but its presence definitely casts a pall over the festivities.

Every major database vendor recognizes Linux as a potential platform. Many applications vendors are eyeing the Linux desktop market. IT managers are gaining confidence in the ability of the Linux community,

including distributors such as Red Hat Software Inc., to offer an immediacy of response that Microsoft can't—or chooses not to—provide.

Corporate IT departments will be tempted by the idea of building systems on a platform that's widely shared but that they can tailor to their own needs with the aid of experts who make house calls.

11 Get in sync with metadirectories

Metadirectories enable corporations with disparate directories, such as Lightweight Directory Access Protocol, X.500, Novell Directory Services and Microsoft's soon-to-be-released Active Directory, to tie the directories together centrally, as well as synchronize them.

Only a few small vendors have introduced metadirectory products as of yet, and as in many other markets, customers are not willing to shelve investments in existing platforms for the hope of a bigger payoff brought through standardization on one platform.

Netscape Communications Corp. will buck that trend later this year when it releases its Meta Directory 1.0, which uses technology from Isocor Inc. to link Microsoft Exchange and Lotus Development Corp.'s Notes; SAP AG and PeopleSoft Inc. ERP platforms; and Oracle Corp., Sybase Inc. and Informix Software Corp. databases.

12 DSL ready to use

DSL will soon become an avenue of choice for connecting businesses to the Internet.

There has been a spate of announcements recently from major vendors showing that DSL is real and will be a key network building block for years to come.

The DSL family of technologies—high-bit-rate DSL, very-high-density DSL, symmetric DSL and ISDN DSL—can meet the need for high-speed Internet access in homes and branch offices because they use existing phone lines, unlike cable modems, which rely on coaxial TV cabling.

There are scores of equipment vendors already offering wares. And large telecom carriers are on the bandwagon, joined by smaller players, which specialize in DSL.

13 Micropayments mean big bucks

No one would even think of paying for something that costs 25 cents or less over the Internet today.

Micropayments, the ability to easily charge for items costing tens of cents, will change all that.

With a solid micropayment infrastructure, entirely new business models will exist online, enabling companies such as publishers to charge a nickel to view an article, for example.

With these new business models, the sale of many more products will become viable over the Internet, and using micropayments, the companies hawking them may even be profitable.

14 New levels of collaboration

Moving beyond threaded e-mail and videoconferencing, future collaborative tools will combine historical data, predictive analysis and real-time discussion to create a decision-making process that is more rapid and better informed.

Network bandwidth growth will be multiplied, in effect, by sophisticated compression algorithms and hardware that will make rich media streams fit into available channels. Content analysis tools will make it easier to identify relevant experience and expertise.

15 Getting serious about clustering

Clustering, long the Holy Grail of server technology, is a common notion in the mainframe and mini-computer world. Yet it has had scant success in the PC market.

Operating system vendors such as Sun Microsystems Inc., Microsoft and Novell Inc. have been at work on clustering wares but have not gone much beyond two-node clusters, which provide simple failover services to the second node if the first node fails.

Starting in 1998, operating system makers turned their sights to providing more scalable wares, and application developers began to embrace clustering platforms.

In the years ahead, users should be able to get more from clustering vendors. ◀

Pankaj Chowdry, Peter Coffey, Stan Gibson, Rob O'Regan, Erica Schroeder, Beth Stackpole and Michael Surkan contributed to this story.



Fifteen companies to watch



MARCH 1, 1999

105

Every year new companies, products and technologies are introduced by small, often obscure startups. This stream of creativity will flourish this year and beyond. Topping our list of companies to watch are those

concentrating on online processing, electronic commerce, bandwidth enhancement, Linux development, network consulting and outsourcing services, security, and chip development. Keep an eye on them.

Company	Year est.	Public/private	CEO	Primary line of business	Why the company is worth watching
Amazon.com Inc. Seattle www.amazon.com	1995	Public	Jeffrey P. Bezos	Online shopping for books, music, videos and gifts	Amazon.com, although it has yet to turn to a profit, not only serves as the exemplar for Web commerce, but also has defined new levels of service for consumers. In doing so, this David has posed a credible and serious challenge to the Goliaths of the bookselling industry.
Caldera Inc. Orem, Utah www.caldera.com	1994	Private	Ransom H. Love	Linux-based business solutions	Along with companies such as Red Hat, Caldera is helping to bring Linux beyond the world of computer science departments to the realm of commercial enterprise platforms. Backed by software developers and PC makers, Linux is leading the open-source movement into the mainstream.
Foundry Networks Inc. Sunnyvale, Calif. www.foundrynet.com	1996	Private	Bobby Johnson	Gigabit Ethernet products for enterprises and ISPs	Foundry Networks' Layer 3 Gigabit Ethernet switch could usurp Cisco's lock on the router market—moving the market toward Layer 3 switches—and lead the way in opening competition and bringing down costs.
Ganymede Software Inc. Morrisville, N.C. www.ganymedesoftware.com	1995	Private	Dennis Phillips	Tools for in-house application development and enterprise performance management	Ganymede is in the right place at the right time. Performance management is going to take center stage for IT over the next 24 months. Ganymede's tools monitor end-to-end performance of critical and distributed applications and will make the company a leader in that space.
HotJobs.com Ltd. New York www.hotjobs.com	1996	Private	Richard Johnson	Online recruiting and job search	HotJobs.com is not the biggest online employment site, but it may try harder. Competing with Monster Board and Career Mosaic, HotJobs has looked to technology for an edge.
Indus River Networks Inc. Acton, Mass. www.indusriver.com	1996	Private	Per Suneby	Remote networking solutions for large corporate environments	Indus River's RiverWorks Enterprise VPN is optimized for the remote connectivity needs of laptop users via the Internet. It provides policy management and administration for VPNs. Indus River has seized on a key IT need: manageable remote access from anywhere in the world over the Internet.
International Network Services Sunnyvale, Calif. www.ins.com	1992	Public	John L. Drew	Network consulting and software solutions for enterprise networks	INS' growth trajectory is impressive, and its timing is perfect. INS offers IT managers the option of outsourcing the thorniest part of their job—managing increasingly complex enterprise networks, while still keeping control over high-profile, critical jobs such as supporting ERP systems.
Irvine Sensors Corp. Costa Mesa, Calif. www.irvine-sensors.com	1980	Public	James D. Evert	3-D semiconductors and SIRComm technology used for wireless infrared communications	What other company is working on 3-D interconnects for chips, photonic communications and optical computing? Irvine Sensors, complete with its DARPA funding, is providing a slew of new technologies for the coming computer architecture revolution.
NetReference Inc. Sterling, Va. www.netreference.com	1994	Private	Lee Maybaum	Network consulting and services	NetReference capitalizes on the ready access and interactivity of the Web to bring consulting expertise to a wider audience than ever before. Its Web site lets clients walk through the daunting process of enterprise network design, for a price that all companies can afford.
Optimal Network Solutions Mountain View, Calif. www.optimalnetworks.com	1993	Private	Maurice Bailey	Network consulting and outsourcing services	Optimal has the tools necessary to precisely pinpoint the source of enterprise-wide network problems. Its software has the potential to bridge the gaps between IT divisions and give the groups a common language for managing the different elements that make up a distributed system.
RedCreek Communications Newark, Calif. www.redcreek.com	1996	Private	Thomas Steding	Network security for online transactions and e-commerce	RedCreek is in position to ride the security wave with low-cost VPN hardware and software. RedCreek's patented CryptoCore technology provides high levels of encryption without degrading network performance.
Red Hat Software Inc. Research Triangle Park, N.C. www.redhat.com	1994	Private	Robert Young	Linux operating system	Linux innovator Red Hat, like its sibling and competitor Caldera, has racked up a great deal of notice and support in the past year. With agreements and investments from major software and hardware vendors, Red Hat is a growing Linux company to watch.
Sapient Corp. Cambridge, Mass. www.sapient.com	1991	Public	Jerry Greenberg, J. Stuart Moore	Business consulting, software integration, ERP, custom software development and support	Sapient has quietly grown from a small outsourcer to a large provider of Web services and client/server development. Sapient has merged its back-end development services with Web strategy and front-end services. Growth in the service area is due to the shortage of skilled IT labor and the move by many corporations to outsource development projects.
The Silk Road Group Inc. Washington www.silkroad.com	1991	Private	Tim Bass	Network consulting, design and services	Last fall, this startup demonstrated an innovation that, if proven feasible, could transform the nature of commercial networks. Its Silk Road Solution technology can transmit 6 terabits of data per second onto a single fiber-optic strand. This feat gets to the heart of the problem—the need for equipment that can deliver huge amounts of data over network pipes.
Xilinx Inc. San Jose, Calif. www.xilinx.com	1984	Public	Willem P. Roelandts	FPGAs (field-programmable gate arrays)	ASICs, which are hard-coded and expensive, can't always keep up with the pace of innovation. Enter Xilinx with its FPGAs, which can be reprogrammed on the fly. These FPGAs are showing up in everything from microwaves to supercomputers, and with Xilinx now pushing 1 million gates into a single FPGA, we can expect to see the technology first in FPGAs, then in ASICs.

1996

In 1996, the Web enlivened the industry. Network computers moved past the concept stage and solidified with real product announcements. The corporate intranet became a reality, and Java made front-page news. Mainstream businesses began developing Web sites, and "www.com" was no longer a foreign term. Microsoft finally embraced the Web. In July, 12,880,000 hosts were connected to the Internet.



Chart compiled by Christine Macaуда



PC Week Congratulates The 15 Most Influential People in High-Tech Over the Last 15 Years

- | | |
|-----------------|---|
| Tim Berners-Lee | ▪ World Wide Web creator |
| Rod Canion | ▪ Co-founder, Compaq Computer Corp. |
| Stephen Case | ▪ Co-founder/CEO, America Online Inc. |
| Vinton Cerf | ▪ TCP/IP co-inventor/senior vice president of Internet architecture and technology, MCI WorldCom Inc. |
| John Chambers | ▪ CEO/president, Cisco Systems Inc. |
| Jim Clark | ▪ Co-founder/chairman, Netscape Communications Corp. |
| Michael Dell | ▪ Founder/CEO, Dell Computer Corp. |
| Larry Ellison | ▪ Founder/CEO, Oracle Corp. |
| Bill Gates | ▪ Co-founder/CEO, Microsoft Corp. |
| Andy Grove | ▪ Co-founder/chairman, Intel Corp. |
| Steve Jobs | ▪ Co-founder/interim CEO, Apple Computer Inc. |
| Mitch Kapor | ▪ Founder, Lotus Development Corp. |
| Scott McNealy | ▪ CEO/chairman, Sun Microsystems Inc. |
| Ray Noorda | ▪ Founder, Novell Inc. |
| Linus Torvalds | ▪ Linux creator |

High-tech rejuvenation



MARCH 1, 1999
107

IF WOODSTOCK HAD TAKEN PLACE IN THE '90S, IT MIGHT WELL HAVE BEEN called Webstock. The Internet's momentum has given consumers and IT professionals alike the freedom of voice and choice. This "Net-energy" has also given life to trends that are not directly related to the Internet.

Here we present 15 trends that have the power to reshape computing as we know it today.

Truly mobile devices

Shrinking mass storage devices, efficient microprocessors and pervasive wireless networks will make mobile computing a primary component of future personal information systems.

Portability will go beyond the limited interaction of keyboard, mouse and pen to incorporate the microphone and the camera for hands-free input and voice synthesis for eyes-free output. The personal digital assistant will not be merely a note taker and scheduler but will also be a useful presence in our lives that has the effect of enhancing our memories and dramatically expanding our store of on-call knowledge.

Fifteen years have produced a tenfold reduction in the weight of portable machines, even as their memory and storage capacities have multiplied by hundreds or thousands. With the continued decline of hardware costs, we look forward to having information appliances that provide both reliable and transparent operation—without the maddening complexity of Windows or the narrow limitations of current PalmOS applications. This implies an opportunity for new players to create new portable technology.

Here comes the euro

American companies will be relying on IT to coordinate their pan-European operations and thus expand opportunities created by the newly unified European market.

Oracle Corp. and Microsoft Corp., for example, have already chosen the favorable tax climate and skilled labor force of Ireland as their base for European manufacturing. Once the euro is fully established, many U.S. companies may find it more feasible to play in the international arena.

U.S. companies also face new threats in the new euro world. The world's most vital bit streams may currently be made up of U.S. dollars, but tomorrow they may well be made up of euros. This likely shift may affect the balance of international leadership in defining standards and propelling the advance



of networks and technologies.

Prices in Europe may fall in the next several years, as a unified currency exposes past price discrepancies. With electronic commerce creating international markets for consumers, as well as for corporations, falling prices in Europe would put the squeeze on companies here in the United States as well.

IT labor crunch

The labor crunch has been a real Catch-22 for IT professionals. On one hand, the dearth of skilled talent in critical areas such as enterprise resource planning software, e-commerce and year 2000 remediation has been a career booster for IT professionals with the business smarts and the technical credentials to market themselves into a top-paying dream job. At the same time, however, the shortage—which some human resources experts say reached crisis proportions last year, with no signs of abating this year and beyond—has caused some real angst for CIOs and IT executives doing the hiring.

IT leaders must be proactive about their hiring practices—and rather quickly. IT executives also have to explore new tools such as Web-based job sites, skills asset management software and résumé tracking applications to take some of the sting out of the hiring process.

But even these practices aren't

enough to guarantee a stable IT shop. Today's CIOs face stiffer competition from other IT staffs, consultants and even software companies, which are constantly trying to hire away their best IT talent. That means IT managers are also going to be forced to master team-building management techniques to ensure that the staffers they have are content and stick around.

Security blowout

An explosion of security technologies will change the way we perceive how our data is treated and accessed.

With VPNs (virtual private networks), firewalls, centrally administered security policies, extranets, intranets and, above all, the Internet, the way employees and customers access corporate information is fundamentally changing.

So why bother? Obviously, IT faces challenges in making corporate data available to external customers and partners-at-large—but the opportunities are great. The ability to establish and maintain user and application-based security policies enables IT to more flexibly roll out applications and services to end users and helps them more resiliently deal with staffing changes, moves and so forth.

For secure remote access to intranet data, corporations can ditch expensive dedicated lines and move

to commercial VPN services. Such VPN services also free employees (and partners) in how they connect back to corporate headquarters. However, the potential risks in exposing proprietary resources to external networks are indeed high, and security experts are scarce. Some have posited that the key will be to develop "digital personas" that help customers and users access information securely, while protecting corporate assets. Not surprisingly, notions such as those, while designed to protect privacy, actually rile privacy advocates.

M&A madness

While Web portal sites trip over themselves to buy companies or to be bought, M&A (merger and acquisition) activity in the red-hot e-commerce arena is only trickling compared with the torrent it eventually will be.

Driven by expansion and non-players' desire to thrust a stake into the ground, as opposed to the dreariness of consolidation, M&As and IPOs (initial public offerings) haven't begun to reach their potential. Stratospheric stock valuations have seen to that. But once the bubble bursts, the Amazons and Yahoos could be fair game for corporations desperate to get in.

Compaq Computer Corp.'s acquisitions of AltaVista, by way of the

CONTINUED ON PAGE 108 ▶

1997

The Web frenzy continued full force. The fact that the Internet was open for business was no secret, and the Web became a household word. Navigation got easier with improved search engines and browsers. Processing power increased when Intel announced the 200MHz Pentium Processor with MMX Technology. PC Week got a makeover.





MARCH 1, 1998
108

CONTINUED FROM 107

late Digital Equipment Corp., and Shopping.com could be the tip of the iceberg. It shouldn't be long before IBM (running counter to the tide by selling off assets) and Sun Microsystems Inc. get into a buying mood.

Large media companies want in badly, too. Witness The Walt Disney Co.'s joint venture with Infoseek Corp., America Online Inc.'s acquisition of Netscape Communications Corp. and NBC's deal with CNET Inc. Lycos Inc., which claims it will remain independent, and The Microsoft Network are rumored to be on the block. (Who knows? They might be under agreement by the time you read this.)

The action with IPOs won't relent unless the market turns south—which it's showing no signs of doing. Others will replicate Compaq's act in spinning out AltaVista along with Shopping.com. These upstarts need freedom and independence from "mother ship" stuffiness and inertia.

The message for IT: Be ready to pick up the ball when your company buys a hot e-commerce site or decides to do one on its own.

The people's choice

Once a paradigm is established, it is secure until a lower-cost, broader-reach, not necessarily better-quality alternative emerges. When the time is ripe for such a new paradigm, it's called a "strategic inflection point."

That was the expression popularized in former Intel CEO Andrew Grove's book, "Only the Paranoid Survive." The PC, its operating systems and applications took over from minicomputers and mainframes in much this way.

During the PC era, the paradigm of low-cost, broadly available operating system software—the Microsoft paradigm—has been in effect. Now, that paradigm could be on the verge of being upset by open-source software, such as Linux.

Under this paradigm, software becomes a nearly free commodity, and everyone participates in building it. In a sense, everyone is already participating in building Microsoft products—but they're not nearly free.

Open-source software, not Department of Justice lawyers, could be the greatest threat to Microsoft hegemony.

Just say no to bugs

No longer will large corporations adopt knee-jerk upgrades—a corollary to the open-source software revolution.

Users understand they are already playing the role of software testers—for free. So why should they pay someone for the privilege? And even with hundreds of thousands of beta testers, the products from Microsoft and others still come out buggy.

The worst part is that users have no choice. Microsoft upgrades, for example, are dictated according to Microsoft's quarterly-results timetable. IT managers will finally get the idea that they don't have to follow like lemmings. Office 97 will stay in production at major companies for a long time.

Rent the apps

Classical groupware and desktop suites will fade into the past, as more and more companies rent applications over the Internet rather than buy them.

There's no need to be stuck on the upgrade treadmill any longer, writing check after check to keep Microsoft programmers employed—not when you can rent applications over the Internet as you need them.

And why rent more than you need? Bloatware will become a thing of the past as users rent only the applications needed for specific workers and specific tasks. As needs change, so will the patterns of software use by a new generation of renters.



E-commerce rules

The Web is the great enabler. Even though EDI (electronic data interchange) has been around for years—with many of the same goals—the ubiquity, ease of use and low cost of the Web make it the thoroughfare of choice for conducting business.

Snail-mail and paper-pushing clerks will recede into almost-complete oblivion as their functions are automated and customers don't mind not talking to a person.

Extranets will become the means through which companies talk to their suppliers and customers. Inspired by the Automotive Network Exchange, which is designed to streamline the automobile industry's parts chain, and RosettaNet, which does the same for electronics manufacturers, other industries will set up extranets of their own to

increase efficiency and lower costs.

As usual, there are unintended consequences, not all of which are good. Cybercrime will increase. This will be followed by a spate of cybercrime prevention, as law enforcement agencies do their best to prevent fraud—but archaic laws impede them. The government will respond with e-commerce statutes, the merits of which we'll still be debating 15 years from now.

Post-Y2K

No one knows what will happen at midnight, Dec. 31. The consensus is that life as we know it will not come to a halt, but there will be some malfunctions.

How serious these problems will be is still a mystery. Since most people on the street believe the Y2K problem to be 1) silly and 2) avoidable, computer-phobes the world over will have an "I told you so" field day.

The rest of us who think we know better will secretly wish never to be as fully dependent on computer systems as we were before the turn of the millennium.

The public, businesses and even software developers will become more cautious about re-engineering business practices and rapid adoption of new code.

It's an unintended benefit, but the Y2K bug will spawn a more cautious attitude toward computer systems generally, creating an opposing effect: higher-quality software.

7-by-24 data centers

The 7-by-24 data center will soon become the rule rather than the exception. Why else would you have something called a data center, if not to guarantee the uptime of the systems contained therein?

The trend is driven by e-commerce, which must cater to customers around the world who want to do business at their own local time. The trend is possible because of the decreasing cost of storage, the availability of network bandwidth and the widespread use of clustered failover systems.

No amount of computerization fully eliminates the graveyard shift, however, as computer operations people are either on duty or on call around the clock to keep things hum-

ming or answer customer support questions. "The computer is down" is something heard less and less. Companies where the phrase is uttered will not be in business for long.

Mini-Microsofts

We predict that Microsoft will eventually break up, which will spur competition as well as Microsoft shareholder value.

It's the remedy Microsoft seemingly wants to avoid the most. But it's the one it secretly desires more than any other.

Far from wreaking the destruction of Microsoft, the breakup of the erstwhile software monopoly into four "mini-Microsofts" will spur yet another huge increase in Microsoft shareholder value, as holders will have stock in four companies that dominate their markets—instead of only one.

Increased competition in the "Baby Bills" markets (operating systems, applications, content and new media) will help users, who have more choices than ever. And the spinoff companies will do quite nicely, thank you, as they dream up new products freed from an overarching strategy that links them to Windows.

The PC as appliance

We're already there, or close to it, but the age of the PC as an expensive and complicated item will come to a close, as the desktop PC becomes known as a desktop appliance.

Inspired by the iMac, styling and color will take hold as important marketing factors as the machines themselves become more generic. Price tags for a complete business system will seldom exceed \$1,000 and will often be much less. Homes will have networks of these appliances and other smaller devices.

Flat-panel displays, once a luxury, will become commonplace. Microsoft will jockey for position with its Windows CE technology, which it will adapt to appliances such as DVD players.

In parallel, the Palm Computing Platform will continue to add power and features. Sun's Jini will fulfill its role as the networking technology for any and all devices—as they announce themselves to one another, first across LANs and then across WANs.

Movement to VPNs

IT organizations looking to implement VPNs are counting on their promise to simplify remote connectivity and at the same time reduce costs.

CONTINUED ON PAGE 111 ▶

1998

"Webward Ho!" This Jan. 26 PC Week headline effectively characterized the year. Other significant non-Web-related events took place, such as Compaq's acquisition of Digital, but doing business on the Web was the strongest theme. While Microsoft's battle with the DOJ began in earnest, real business was conducted on the Web. PC Week's circulation grew to 400,000, and 100 percent of our readers had an Internet infrastructure in place—a far cry from 15 years ago.



Initially, corporate IT is looking to VPNs to get rid of a big "headache" as well as lower costs for remote access.

With remote access VPNs, users can dial a local ISP (Internet service provider) and gain access to the Internet and then the corporate network. When problems occur, users can call the ISP.

Beyond that application, VPNs also promise to increase efficiency in dealing with customers, suppliers and business partners. Today only large and fully staffed IT organizations can support private network connections between businesses for sharing sensitive product information and invoices using EDI. EDI, a less-flexible and cumbersome technology, will give way to VPN-based extranets that can limit access to sensitive product data or pricing only to customers—keeping competitors out—while using the open Internet infrastructure to deliver connectivity.

Both private dial-up remote access networks and more static EDI-based networks will take some time to phase out, however, while users determine whether VPNs live up to their promise.

Potent Java

This winter's debut of Java 2.0 will change many perceptions of Java as language and as platform.

Enterprise computing is where Java 2.0 makes its strongest comeback play. The original potential of Java's security features will be fully realized by Java 2.0's policy-based approach, while Java's access to Common Object Request Broker Architecture distributed objects and SQL databases makes it relevant to every modern IT installation.

As a platform-neutral language, Java 1.x made a lukewarm first impression with its limited facilities for building a modern user interface. Java 2.0 addresses these needs with the Java Foundation Classes, the Swing component library and other improvements, including much-needed printing facilities.

Java's early versions didn't meet some developers' performance expectations. Java 2.0 creates new opportunities for just-in-time compilation and other speed enhancements and offers more efficient use of memory than Java 1.x. ◀

Linda Bridges, Michael Caton, Peter Coffee, John Dodge, Stan Gibson, Paula Musich, Erica Schroeder and Beth Stackpole contributed to this story.

more complicated, the open-source model will be the most efficient development model, allowing technologists to act as a community of developers who have some control over the machines that they use, not the other way around.

RAD

The past 15 years produced new programming tools with graphical environments for crafting a user interface and integrated facilities for testing and modifying software. Initially, RAD (rapid application development) merely tightened the cycle of edit/compile/debug that had long been the essence of the programming process. In the mid-1980s, products such as Borland International Inc.'s Turbo Pascal dramatically accelerated the development of text-based applications for DOS-based PCs. However, it was Microsoft Corp.'s Visual Basic, which debuted in 1991, that set a new standard for every subsequent tool to match—at least in programmer convenience, though not in application speed or in robustness of software engineering. With its popularization of commercial software components, Visual Basic propelled a transition that more elegant languages had merely promised, paving the way for the reusable classes of Java and other tools that have since emerged.

RISC

RISC technology, introduced to desktop systems in IBM's 1986 PC RT, has made it practical for chips to keep scaling the heights of computational performance. A Reduced Instruction Set Computer was expected to perform common operations with much greater speed and ease multiprocessor computing with more predictable memory interactions. But early proponents of new RISC designs underestimated the momentum of the Intel Corp. X86 architecture and its installed base of software, tools and skills. Digital Equipment Corp.'s Alpha, Sun Microsystems Inc.'s SPARC and Motorola Inc.'s PowerPC have all pressured Intel on brute processing speed, but Intel assimilated RISC techniques into the core of its X86 line. Pentium-family chips, and competitors from Advanced Micro Devices Inc. and others, apply RISC principles to make efficient internal optimizations while remaining back-

ward-compatible. Users have been the winners.

SCSI

In the early 1980s, most people weren't concerned with the interoperability of their hard drives. But industry pioneer Al Shugart saw that, for wide industry acceptance of PCs, a standard method of accessing peripherals would be necessary. Enter SCSI, which in 1986 added byte-wise access to data and a logical addressing scheme, obviating the need for inefficient and cumbersome serial access of physically addressed data. However, it wasn't until the Common Command Set was added to SCSI a year after its debut that it became the basis of a lingua franca for peripherals, jump-starting the drive industry and paving the way for such important innovations as RAID.

VGA

It wasn't the first time for color on a PC, but IBM's 1987 release of VGA, included in its PS/2 line, was the most significant. The jump from 16 to 256 colors (at 320-by-200-pixel resolution) could only be described as breathtaking, giving users more than ever before the ability to reproduce information as they saw it in life. VGA also let users display information at 640-by-480 resolution (16 colors). This helped usher in the dawn of the GUI, desktop publishing and arcade-style com-

puter games on the PC. Even today, VGA is the basis of virtually every video adapter on the market. VGA also marked one of the last major contributions to the PC hardware design from IBM, as competitors and a growing third-party hardware market significantly sped up innovation.

Windows

Nearly 15 years old itself, Microsoft Corp.'s Windows epitomizes the savvy-over-smart culture that has led to Microsoft's success. Initially a pale imitation of the GUI introduced in the Mac OS, Windows has been prone to bugs and is hobbled by its DOS underpinnings. However, Microsoft has shown time and again that attention to backward compatibility, mundane but productivity-driving needs, developer support and OEM deals are more important to the success of an operating system than technical merit alone, resulting in the mass adoption of Windows on the desktop. Microsoft in 1993 applied this formula for success to drive adoption of Windows NT in the server room and on the engineer's desktop, catching Novell Inc. and Unix vendors off guard. ◀

Herb Bethoney, Michael Caton, Pankaj Chowdry, Peter Coffee, Matt Kramer, Jim Rapoza, Cameron Sturdevant, Michael Surkan, John Taschek and Chris Yates contributed to this story.



MARCH 1, 1999

111

The Web

THE AGE OF CREATION

When Tim Berners-Lee applied hypertext to the Internet and coined the term "World Wide Web," he envisioned a way for easy collaboration on projects. What he got was one of the signature innovations of our time, transferring the academic Internet into a medium that has changed how information is distributed.

THE AGE OF THE WEB

In the nine years since Berners-Lee developed the first Web browser and server while at CERN, the World Wide Web has evolved to the point of ubiquity. Information and publishing were the first driving forces on the Web, spurred in late 1993 by the release of Mosaic and its use of graphics.

THE AGE OF COMMERCE

The general business community is now realizing the potential of the Web and searching for tools to rein in its power. Improved security has helped ease consumer fears about buying on the Web, while new technologies such as XML have smoothed the path for companies to do business over the Internet.



MARCH 1, 1999
112

SPENCER'S FIFTEEN MEMORABLE MOMENTS



15 Microsoft's Steve Ballmer dismisses a battle between Bill Gates and Ashton-Tate Chairman John Esber during Agenda '89 as "... a case of people not knowing what to make of Bill when he is being his extreme self."

14 "I'm going to Disney World," Lotus' Jim Manzi might have said as he flew the family to Orlando, assuming a big merger with Novell had been completed. After day one with Mickey & Co., a blinking phone light took the magic out of the kingdom: Ray Noorda had called to cancel the deal.

13 Bonard honcho Philippe Kahn's infamously decadent toga party at Caesars Palace, during Comdex/Fall '85, saw all the major industry players of the day wearing sheets (and, in most cases, three sheets to the wind).

12 In a 1987 promo video for Microsoft's Excel, workers so impressed the boss with a 386 PC running Excel that the big man decided to fill the office with the products. In came Bill Gates, dressed as an office clerk, wheeling in a PC and announcing, "Sure, I'll be glad to put one on every desk!"



11 My favorite Memo: In a 1994 memo, Chairman Bill said he felt it was time to tighten budgetary belts. The internal memo, titled "Shrimp and Weenie Guidelines," stated, "Novell recently announced (yet another) record quarter of revenue growth and profitability. The frosting on this cake was to lay off 4 percent of their 3,600 employees. Novell is serving weenies, not shrimp."



10 Tangled ropes and a backwards costume spoiled Lotus senior exec John Landry's attempt at a cool Spider-Man entrance to Lotusphere 1995.



9 At World '92: Digital CEO Ken Olson excitedly talked about new VAX enclosures with "cherry-pubbed finishes" so they would blend easily into office settings.

8 A 1987 Newsweek article asked notable businessmen where they were during the Vietnam War. Mitch Kapor, founder of Lotus, said he was marching in protests at Yale and "experimenting heavily with recreational chemicals. It was a central part of my existence. I'm just horrified at what I did. The thing that made the most difference to me then was psychedelic rock."

7 At the 1993 PC Forum, Congressman Ed Markey maligned the PC industry for lacking a federal lobbying effort. To that, Lotus' Jim Manzi snorted, "I'm not relying on the government to make my applications more competitive with Microsoft."



6 Warren Buffett and Willie Nelson got in, but Katt spy Rich Duce was pined off the side of a cliff and ejected by security as he tried to snap photos of Bill Gates' 1994 New Year's Day wedding on the Hawaiian island of Lanai.

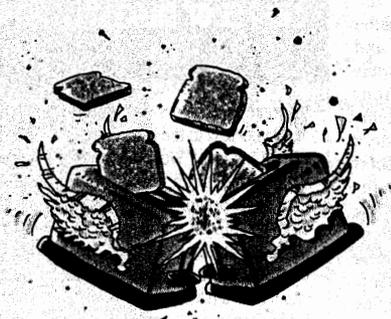
5 At the PC Expo Katt Party in '94, Spencer Katt was set ablaze as a Michael Jackson while helping editors wheel out a birthday cake to mark the first-year anniversary of PC Week's Inside section.



4 SunWorld '95 attendees witnessed some unidentifiable tricks as Sun CEO Scott McNealy unsuccessfully tried to coax a 135-pound Greater Swiss Mountain dog called Network to urinate on four cardboard fire hydrants labeled DEC, IBM, HP and Microsoft.

3 Jack Hanson, a former IBM employee, introduced a line of wines in 1987 called Big Blue. The winery's label used bar lettering similar to IBM's logo and gained national exposure via an AP story speculating on whether or not the Armonk legal department would take action.

2 While the greater minds of the industry pondered the digital highway at NetworkWorld '93, Berkeley Systems and Delrina duked it out over just who owns what rights to the flying-toaster screen saver.



1 Perhaps the most "exotic" soiree held during Fall '97 was at the home of Hayes Microcomputer Chairman Dennis Hayes. The "down-home barbecue" at Chez Hayes featured "hostesses" who would have made Howard Stern blush.



15 YEARS OF THE UNEXPECTED

YOU JUST NEVER KNOW. THAT'S THE BIGGEST LESSON WE'VE learned in 15 years of covering this business. This week's 15th anniversary commemorative edition of PC Week chronicles the unpredictable—often astounding—changes that have taken place over the past decade and a half.

Few people predicted the PC revolution. Great minds, such as Digital's Ken Olsen, were in denial even after the revolution was well under way. The acquisition of Digital by Compaq, the first major IBM PC clone maker, was that revolution's apotheosis.

The PC revolution itself spawned many unforeseen events and trends: notably, the rise of Microsoft. In the early 1980s, the company seemed to be IBM's pet poodle—then it turned on its erstwhile master and savaged it. In the process, Microsoft came to resemble IBM, relentlessly pursuing market share and being pursued, in turn, by the Justice Department.

THE OPEN-SOURCE MOVEMENT WILL LEAD TO A MICROSOFT THAT LOOKS FAR DIFFERENT FROM THE ONE WE KNOW NOW. Lotus, which was the largest PC software maker in 1984, sputtered in competition with Microsoft, only to be acquired by IBM, which had failed to develop groupware that was on a par with Lotus Notes.

Although the Internet was not new in 1984, few people were dreaming of the World Wide Web—not to mention the e-commerce revolution. And did anyone in 1984 imagine Internet pornography and the problems of safe Internet access for children? We don't think so.

Although Unix was making rumblings in commercial computing 15 years ago, who would have predicted that an obscure Finnish engineer named Linus Torvalds would launch what appears to be a paradigm shift in the software industry, the open-source movement, and at the same time give Microsoft's operating system monopoly its first real challenge?

In hindsight, the Y2K crisis was predictable. But 15 years ago, ironically, no one was predicting it. And who would have predicted the rise of ERP suites and a "wundervendor" from Germany with the unlikely initials SAP?

Looking ahead, where will we be 15 years from now?

We predict that the trend toward cheaper PCs will continue—to the point where PCs will be given away. Money will be made from Internet access charges and charges for Web content. The data gleaned in tracking customers across the Net will become a common currency that will grease the wheels of the Internet commerce machine.

Software will also be given away, or nearly so. The open-source software movement is not a flash in the pan. This will lead to a Microsoft that looks far different from the one we know now. Its operating system monopoly will wither away, but the company could be hugely successful in new areas such as interactive media. In addition, security for all users at all times will become absolutely essential. Cyberrobbery and cyberterrorism will become problematic.

We'll stop there. Those trends seem plausible enough. But it's the implausible trends that we're particularly looking forward to. We know they'll surprise us—and continue to make this industry the greatest in the world to cover. ◀



Readers agree that the Pentium III's serial number would be only one of many IDs but disagree on its effects. Another examines SANs.

Halt! Who goes there?

Finally, a member of the technical press who puts some real thought behind his comments (Bill Machrone, "Serial numbers for CPUs: Benefits outweigh drawbacks," Feb. 8, Page 67).

It was amazing how fast the world turned on Intel and its inclusion of serial numbers on the Pentium III processor. Somehow, [the inclusion] became the embodiment of evil and Big Brother. But the serial numbers are just some of perhaps 25 such numbers that can be associated with a person. In fact, [the PIII ID] is a feature that is meaningless unless some form of software reads and authentically reports it. As Machrone said, the benefits of validation outweigh the potential abuse or criminal issues.

Machrone is the only journalist who rightly points out the wealth of serial numbers already associated with an individual. Why the average person would have privacy concerns now is a mystery. Do folks remember that they have one or more telephone numbers, Social Security numbers, checking account numbers, vehicle ID numbers, credit card numbers, ZIP codes, MAC addresses, IP addresses, e-mail addresses and driver's license numbers?

If this were 1975, then the threat of technologies that empower Big Brother might have been interesting reading. But, like it or not, Big Brother capability is here now. How and when this information is used is of concern—not the fact that the information exists.

MARK HARRIS
DIRECTOR OF CHANNELS MARKETING
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Bill Machrone's column on serial numbers was wrong on both technical and emotional grounds.

He states that every PC already has a unique ID on its NIC. Yes, but the MAC address does not get sent to the destination address unless the destination is on the same subnet. Almost no one sees your MAC. He says that every cell phone

has a unique ID. Yes, but it does not get sent to the person you're calling, only to the service provider. Caller ID would have been a better example, and even this is blockable. The code in your radio to prevent theft is a completely separate issue. This is more like a key that turns the radio off. It is not anything that can identify you.

On the emotional front, I believe he missed the point. I am not a privacy fanatic who thinks there are people tracking me on the Internet. I don't use anonymous remailers, and I let most cookies through. Even so, I am bothered by a method to permanently track me. It would be like requiring people to leave their Social Security numbers at every store that they browse in.

If I decide to transact business with a company, sure, it needs some information. But if I'm just looking or just get thrown into its Web site by accident, I do have some expectations of privacy.

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SENIOR SOFTWARE ENGINEER
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Fibre Channel, yes

While Michael Surkan's musings on Gigabit Ethernet LAN alternatives to Fibre Channel SANs were thought-provoking, there are clear technological and market advantages to the current storage-area network model, especially scalable and fault-tolerant switched SANs ("Just say no to Fibre Channel SANs," Feb. 15, Page 102).

For example, Gigabit Ethernet, despite its appropriateness as an IP networking technology, is a poor channel technology. Gigabit Ethernet's small 1.5KB packet size

induces a large processor load because the processor has to service so many more interrupts. Each time a packet is received from the network, an interrupt is sent to the processor. Obviously, a 1.5KB packet stream interrupts the processor roughly 85,000 times more often than a 125MB Fibre Channel packet stream. That leaves less processor bandwidth available for other applications. One workaround would be to use 2KB frames and implement sequencing, but this is incompatible with most Gigabit Ethernet LANs, voiding the benefits of Gigabit Ethernet standardization.

Flow control is another case in point; using packet loss as a trigger for flow control is a waste of resources. Fibre Channel does not lose frames, due to its built-in, standard, flow-control mechanism.

In addition, there is the issue of SCSI support. Fibre Channel has it; Gigabit Ethernet doesn't. In fact, ask any RAID, disk drive or tape vendor about its plans for Gigabit Ethernet—they don't exist. Without SCSI support, Gigabit Ethernet cannot circumvent SCSI's scalability and performance limits. Meanwhile, vendors and server companies have announced SCSI-over-Fibre Channel support.

Finally, mention of Gigabit Ethernet interoperability's growing pains was absent from Surkan's column. Fibre Channel interoperability is near completion. Gigabit Ethernet for everything doesn't make sense. Wasn't that also the promise of ATM? Meanwhile, Fibre Channel products and complete SAN solutions are shipping today.

THOMAS RAEUCLHE
VICE PRESIDENT OF ENGINEERING
ANCOR COMMUNICATIONS INC.

DROP US A LINE

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