accenture

High performance. Delivered.

This article originally appeared in the May 2008 issue of

Outlook

The journal of high-performance business

Interview

Catching the next wave of innovation

Vint Cerf, chief Internet evangelist, Google

The Internet's ability to enable collaboration will be the key to breakthrough innovation, says this industry pioneer, from business to education to scientific research.

Internet pioneer Vint Cerf still remembers standing at that "terrible fork in the road."

It was summer, 1958. Cerf was 15 and a passionate student of the cello. While working at System Development Corporation in Santa Monica, he had been introduced to a new instrument—a tube-based computer that was part of the US Distant Early Warning system against Soviet bombers. "I was just completely mesmerized by the fact that you could actually do stuff like that," he recalls.

Realizing he couldn't put in the time required to master both instruments, Cerf reluctantly put the cello aside. Thus began a lifelong love affair with the computer and, ultimately, the Internet.

Classical music's loss would prove to be society's gain. In 1969, while a graduate student at UCLA, Cerf wrote the software to connect a computer to the US Defense Department's Advanced Research Projects Agency network—ARPANET—which was a precursor of the Internet. Then in 1973, while at Stanford, he and DARPA colleague Bob Kahn designed the TCP/IP protocols and architecture that enable computers to talk to each other—on what was then called an "internetwork."

Thirty-five years later, the ongoing development and expansion of the Internet remains the focus of Cerf's work. In 2005, he joined Google, where, as befits the company's official chief Internet evangelist, his mission is to

Vint Cerf

Vice president,
chief Internet evangelist, Google

Born:
New Haven, Connecticut, 1943

Education:
Stanford University, B.S. in Math and Computer Science, 1965

University of California at Los Angeles, Computer Science, M.S., 1970; Ph.D., 1972

Professional highlights:
Assistant professor of electrical engineering and computer science, Stanford University, 1972–76

Program manager, principal scientist, US Defense Advanced Research Projects Agency (DARPA), 1976–82

Vice president, MCI Digital and Information Services Co., 1982–86

Senior vice president, MCI Telecommunications Corp./WorldCom Corp., 1994–2005

Distinguished visiting scientist, NASA's Jet Propulsion Laboratory, 1998–present

Chairman, Internet Corporation for Assigned Names and Numbers, 2000–2007

Vice president, chief Internet evangelist, Google Inc., 2005–present

ensure that the Internet remains a free and open environment that will continue to be a hothouse for innovation. Cerf is also an earnest and eloquent advocate for the more than 5 billion people who do not yet have access to the Internet.

Earlier this year, Cerf sat down with *Outlook* Editor-in-Chief David Cudaback and Managing Editor Tish Burton one morning at the Google offices in Washington, D.C. Although he had a plane to Geneva to catch later that day (he was going there to participate in an Open Standards conference), Cerf was relaxed and charming and gave his visitors the impression that he had all the time in the world for them.

And why not? It was simply one more opportunity for the chief Internet evangelist to preach his favorite gospel.

Outlook: **You have said that 97 percent of the applications for the Internet are still to be invented.**
Cerf: Let me first make a couple of simple observations about innovation on the Internet.

The metaphor for the Internet might be roads: They all connect together; you can start anywhere and end up anyplace. But you didn't say anything about the vehicles that are on the road, you didn't say anything about what buildings are adjacent to the road. You basically said, "Here's the road system, and here are the rules: Please drive on the right, and please signal when you're making turns," and so on. But that's it. The Internet was designed to be application agnostic.

But the roads and vehicles have changed over time.
People misunderstand the evolution of the Internet. In fact, it isn't even half evolved. Its basic design is as it was 35 years ago. But what has happened is that the roads have gotten faster, which means that you can do things on the highway that you couldn't do [before], like deliver something overnight. It's the difference between driving across the country in a car on the interstate highway system or in a Conestoga wagon.

So applications have evolved because the system has evolved to allow them to happen.

What will the new applications look like?
I'm expecting to see literally billions of devices going on the Internet, things that heretofore have not been part of the Internet class—like automobiles, household appliances, office equipment. You'll find heating and ventilation units, refrigerators, all these other things.

Have you had any personal experiences with devices like these?
I have picture frames around the house that are Internet enabled, and they pull data off the websites that they log into, and the information they get is from people who have uploaded digital imagery onto those websites. So I upload my digital pictures onto the website, and the picture frame downloads them.

I also have a wine cellar. I care a lot about the humidity and temperatures in the wine cellar, and I can track that. The compressor failed a couple of weeks ago, and the only reason we detected it is my wife happened to be home and went down and noticed the temperature was 66 degrees. But if I'd instrumented that, I would have gotten an e-mail or a page or something.

What else are you expecting?
I think our ability to work together in a collaborative way will improve over time.

Think about large colliders. They're really powerful machines, and they

produce just huge amounts of information per second. And in order to examine the data and then present it, you need computing power. What you would like is if you could take that data and, even though you're physically apart from a research colleague, together explore a three-dimensional presentation.

And if multiple parties are able to see the same rendering, and talk to each other about it in that 3D presentation, you could take advantage of human beings' ability to recognize patterns that machines are not very good at.

"If multiple parties are able to see and talk about the same 3D presentation, you could take advantage of human beings' ability to recognize patterns that machines are not very good at."

Is anyone working in this area?
I watched some researchers at the National Institute of Standards and Technology last summer doing something very much like that.

There were two people working together, one where NIST headquarters is located, and the other one was in Boulder, Colorado. And I watched them discussing this 3D object, and making measurements, and the system would capture and measure data, and simulate it, and then analyze it for you.

So all this interaction was taking place, mediated by computing power. The technology allows you to literally walk around in this three-dimensional space.

I expect to see a lot more of this collaborative stuff, and also expect to see the harnessing of large quantities of computer power.

Harnessing computer power to what end?
For doing what we call "computing in the cloud." You'd use computer power that's shared in a network. And when you need it, if you have it assigned properly, you'll be able to expand the amount of computer power that you need in order to do a particular computation. And then when you're not using it, somebody else can. [For more information on "cloud computing," see "Computing in the clouds," *Outlook*, May 2008.]

This is the theory behind the law of large numbers, which says that if you have lots of variation in demand, you can service that by lumping together all the capacity, and service the average demand over all the people that use the system, rather than having to service the sum of the peak demands of all users.

Exactly what the applications are, I have no idea. That's what gets invented by people who have the freedom to try things out.

You've expressed your disappointment at the way in which the Internet has been used in education. How should the Internet be used in this sphere?
I'm a big fan of trying to use computers as tools for exploring knowledge. I honestly believe that we have barely scratched the surface of what we can do with network-based services in the educational environment.

But today I see the Internet being used as kind of a television replacement, a captive presentation of content, as opposed to something we can interact with and experiment with.

The guy who is most expressive about this is Alan Kay, who actually visualized the first notebook computer in 1968, when he was at the University of Utah. Alan has worked on interactive, object-oriented programming languages for years, and his view of education is that it should be something you explore. He loves the idea of people using computers to try things out.

For example?
When Alan was at Disney as an imagineer, he wrote a program they call Squeak.

This program knows about the Internet, or networking in general,

"In education, we need to facilitate more content production that takes advantage of the interactive nature of the network."

and it has such a simple interface that kids can use it to write programs. And because the programming language of Squeak has built into it contents that relate to networking, one kid can build an interactive game, and then put it up on the Net, and then everybody else can use it, and they can play with each other. So they explore what you can do, and they invent different kinds of games.

Is this just about games?
No. For science, Squeak also has this amazing capability. At one point, a class went outside of the building, and one of the teachers went up to the top of the building and dropped a ball. The kids videotaped this and digitized it. The computer now has this digital videotape, and you can show the image and stop it whenever you want to.

So they measured how far the ball went in the first second, and they measured how far the ball went in the second. And then they derived the formula for gravitational pull by calculating these differences.

What else could be done to use the Internet to improve education?
I'm of the opinion that we need to facilitate more content production that takes advantage of this interactive nature of the network.

A good friend of mine has developed something he calls The Supercourse. He started accumulating PowerPoint presentations from people who were really smart and experts in their field. He began focusing on epidemiology, because that's his specialty. He accumulated a lot of these PowerPoint presentations, he put them up on the Net, and made them available to anybody who wanted to use them to teach.

So it wasn't so much that the student went and looked at the PowerPoint and then somehow tried to figure it out; it was more the teacher got access to content and then used it to teach. And now he has thousands of these PowerPoint presentations that are available to anyone who wants to make use of them to teach classes in various subjects.

You mentioned the Internet and collaboration. Do you see educational potential there?
There are going to be a lot of instruments that are on the Net: telescopes, spectroscopes and things like that. And people will be able to share access to them. And so you can imagine creating independent virtual environments, like Second Life, for doing science. Kids go into this virtual laboratory and they do experiments, but the actions they're taking in this virtual world are actually having an effect on a real instrument somewhere. And so they're getting real data from an electron microscope, for example. It kind of looks like it's in this little virtual lab.

You can imagine kids meeting each other in this virtual laboratory from different schools and comparing their results, or getting a measurement and working together.

What attracted you to Google?
Part of my attraction to Google is that I use it a lot. I thought it was a great tool, and I was excited about working with the company. Also, almost all of the employees were too young to know that "You can't do that."

What has most surprised you about the Internet?
If you look at the economics of digital information, it is mind-blowing, stunning. Small example: I bought two terabytes of disk storage a few months ago for about $600. And then I remembered in 1979, I had paid $1,000 for ten megabytes—and it was the size of a shoebox. So then I thought, "Oh, what if I tried to buy a terabyte of this memory in 1979?

What would it have cost?" It would have been $100 million. And I didn't have $100 million back then. And if I had, I'm sure my wife would rather I spent it on something other than disc storage!

But the fact is today, you can afford it. And that's true of digital processing, and it's also true of transmission. All of the costs have come down. So the business models that were based on earlier economics have to be rethought.

And therein lies the real danger, because some companies don't recognize that the economics are so dramatically different.

Do you regret giving up the cello?
When I was 15, I loved the instrument—beautiful, beautiful. The sound is . . .

I sort of regret that now, but I don't think I have the flexibility or muscle memory to take it up again. But I love classical music. Big Brahms fan, Wagner and Beethoven.

Outlook is published by Accenture.

For more information about Accenture, please visit www.accenture.com