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# Drumming Up More Addresses on the Internet

By LAURIE J. FLYNN

Who could have guessed that 4.3 billion Internet connections wouldn't be enough?

Certainly not Vint Cerf.

In 1976, Mr. Cerf and his colleagues in the R. & D. office of the Defense Department had to make a judgment call: how much network address space should they allocate to an experiment connecting computers in an advanced data network?

They debated the question for more than a year. Finally, with a deadline looming, Mr. Cerf decided on a number — 4.3 billion separate network addresses, each one representing a connected device — that seemed to provide more room to grow than his experiment would ever require, far more, in fact, than he could ever imagine needing. And so he was comfortable rejecting the even larger number of addresses that some on his team had argued for.

"It was 1977," Mr. Cerf said, in an interview last week. "We thought we were doing an experiment."

"**The problem was, the experiment never ended,**" added Mr. Cerf, who is a former chairman of the [Internet Corporation for Assigned Names and Numbers](#), or [Icann](#), a nonprofit corporation that coordinates the Internet naming system. "We had no idea it would turn into the world's global communications network."

Today, the Internet that Mr. Cerf helped create more than 30 years ago is about to max out. Within the next 12 to 18 months, or perhaps sooner, every one of the 4.3 billion Internet Protocol addresses will have been allocated, and the Internet, at least as it exists today, will have reached full capacity.

I.P. addresses are the unique sequence of numbers assigned to each Web site, computer, game console or smartphone connected to the Internet. They are distinct from domain names, which identify Web sites, like [nytimes.com](http://nytimes.com).

“There are 4.3 billion addresses, and a lot of people have more than one,” said Leo Vegoda, manager of number resources at Iann. “And there are seven billion people on the planet. That’s a big mismatch.”

The rapid expansion of Internet adoption in Asia has sped things up even more.

Experts saw this problem coming years ago, and the transition to a new system, referred to as Internet Protocol version 6, is well under way. This new standard will support a virtually inexhaustible number of devices, experts say. But there is some cause for concern because the two systems are largely incompatible, and as the transition takes place, the potential for breakdowns is enormous.

“This is a major turning point in the ongoing development of the Internet,” Rod Beckstrom, Iann’s president and chief executive, said. “No one was caught off guard by this.”

Still, the question looms, is the Internet industry prepared?

The answer depends on whom you ask. While it is true that no one has been caught off guard, some parts of the industry responded faster than others, leaving some technology companies scrambling to catch up. Software companies like [Google](#), [Microsoft](#) and [Facebook](#), along with PC makers, say they have been taking the problem seriously for years in hopes of thwarting any major calamities. The major operating systems — like Microsoft’s Windows 7 and [Apple’s Mac OS X](#) — have already incorporated the new system. And providers, including [Comcast](#), say they are ready to make the switch.

But Mr. Cerf is critical of Internet service providers, along with the manufacturers of Internet devices, for not addressing the problem sooner, saying that **many chose to wait until customers started asking for the new system.**

**“How can customers be expected to know what they need?”** Mr. Cerf said. He compared Internet protocols to the internal workings of a car engine. “It’s like changing a gear in a car’s transmission,” he said. “People shouldn’t have to worry about that.”

I.P. addresses are allocated by the Internet Assigned Numbers Authority, which is operated by Iann, to five registries representing regions of the globe. Those registries distribute the addresses to Internet service providers like cable and phone companies, universities, governments and large corporations. Millions of new devices will be attached.

At a ceremony early this month in Florida, the last block of addresses based on the original standard, known as IPv4, were allocated to the five registries.

Comcast began working on the problem nearly six years ago, and last year began customer trials nationwide. Jorge Alberni, a Comcast spokesman, said the trials so far had gone smoothly.

Comcast is now beginning to distribute **dual-mode cable modems**, for example, that support both the original and the new Internet Protocol versions. By the time the transition is fully under way, Mr. Alberni said, most Comcast customers will already be using cable boxes and modems that support IPv6, as the new version is commonly called. In some case, customers with older equipment will have to make a swap.

“We don’t foresee any problems for our customers,” he said.

To help make the transition to IPv6 easier, **Yahoo**, Google and Facebook, whose Web sites generate a combined traffic of more than a billion visits a day, have agreed to participate in a sort of trial run on June 8, named **World IPv6 Day**, to make sure their systems are ready. Participants are hoping that such an experiment will shed light on potential glitches.

Still, Leslie Daigle, chief Internet technology officer at the Internet Society, a nonprofit Internet policy organization overseeing the test run, warned that the transition to IPv6 was complex, and would most likely cause headaches for customers as they grappled with compatibility problems. The hope is that the test run will reveal the exact scope of the challenge.

The change will require companies to retrain technicians and instruct **help desk personnel** how to field compatibility questions.

“I almost wish we could train the **Boy Scouts** and **Girl Scouts** to come to people’s houses to help out with this,” said Mr. Cerf, now chief Internet evangelist at Google. “**This is not just about adding extra numbers**,” he said. “**It’s a different system.**”

If the transition is not done right and done quickly, he said, Internet users with new equipment could face problems viewing Web sites based on the original standard.

Mr. Cerf compares the size of the challenge to the problem facing computer users at the turn of the 21st century, when every software program out there had to be modified to recognize the year 2000 and beyond.

“We had to find every place on the network,” he said.

In the end, the year 2000 issue, often referred to as Y2K, caused very few interruptions. But in this case, the problem won’t go away after a certain date.

Mr. Vegoda is optimistic that most people will not notice the difference between the two standards, and expects the transition to go relatively smoothly. “**Most Internet users have no idea they’re using IPv4 today** and if things go well they will have no idea they’re using IPv6 in the future,” he said.

*This article has been revised to reflect the following correction:*

***Correction: February 14, 2011***

*Because of an editing error, a previous version of this story misstated Vint Cerf's relationship with the Internet Corporation for Assigned Names and Numbers, or Icann. He is a former chairman, not the current chairman.*