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When Really Big Numbers Aren't Nearly Enough

Like ZIP Codes and Phone Numbers, Internet Addressing Suffers Growing Pains; Avoiding the Dreaded '666'

By CARL BIALIK

The nine-digit Social Security Number is holding strong after 73 years. The 10-digit phone number is six decades old and counting. But the Internet will soon outlive its equivalent numbering system for identifying Web surfers and the sites they visit, which could have disruptive and costly consequences for life online.

As originally designed, Internet Protocol addresses contained 32 bits, represented in four sets of numbers from 0 to 255. There are 4.3 billion different possible combinations, which seemed like plenty to Vint Cerf, who helped develop the IP standards in the late 1970s.

"It was an experiment with an uncertain outcome," Mr. Cerf, now chief Internet evangelist for Google, says of the Internet. Some other online pioneers argued for 128 bits, but they lost out. "I couldn't imagine arguing that we needed 340 trillion trillion trillion addresses to carry out an experiment," Mr. Cerf says.

Most likely, the transition to a system that can accommodate that many addresses will be messy but not catastrophic. The worst-case scenario: "Organizations that have money will have addresses, while organizations that don't have money will fall off the 'Net," says Tony Hain, a fellow at the IPv6 Forum, a group backing a new, expanded Internet-addressing system.

Numerical identifiers blossomed in the 20th century as the favored way to distinguish post offices, bank accounts, online auctions, packages and just about anything else. The creators of these systems had to guess about the correct number of digits, which makes it impressive that so many numbering systems have proven robust. When digits have run out, these systems have adapted. Internet service providers who are working to move the Web onto a new addressing platform are seeking to emulate other numbering evolutions that ensured continuity.

In 1983, the U.S. Postal Service appended four digits to ZIP codes, identifying individual blocks or even buildings. And in 1995, the North American Numbering Plan, which governs the region's phone numbers, increased the number of available area codes by 400% by eliminating a ban on second digits other than 0 or 1. Enter 646 and 347 to ease the strain on 212 and 718. Now the plan is projected to hold strong for at least another 30 years, without any need to add another digit, according to John Manning, director of the numbering plan.

More recently, eBay went from a system that allowed for two billion auction items, counting up from the first one to take bids -- founder Pierre Omidyar's broken laser pointer -- to one that can handle 18 billion billion. (Many auction numbers today have 12 digits.) "It will take approximately 82 years to exhaust the current supply of available numbers," says eBay spokesman Usher Lieberman.

Social Security numbers should also last well into the later part of this century, according to Social Security Administration spokeswoman Cynthia W. Edwards. The agency has assigned about 450 million numbers, including 5.8 million last year, but nearly a billion are possible -- not quite a billion because some numbers, including those that start with 666, aren't allowed.

Tom Judd, the routing-number administrator for the American Bankers Association, isn't as accommodating when banks want to avoid that Number of the Beast from the Book of Revelation. "We had a bank call up, mad," because 666 was in its assigned routing number. Others have complained about numbers that included 1313, double bad luck if you're so inclined. But Mr. Judd stood firm. Customers who don't like seeing that number on their check "will have to go to another bank," he says.

It might seem like overkill for bank identifier numbers to be as long as Social Security numbers -- particularly when "we've been retiring five times as many as we've been adding over the last dozen years," because of bank mergers or acquisitions, Mr. Judd says.

But many ID numbers are even longer, because they convey information beyond a unique identity. The first two digits of a bank routing number, for instance, identify the Federal Reserve district. And the ninth digit is a so-called check digit, a security check of a number's validity. The check digit is the result when the preceding digits are fed into an algorithm, and if it doesn't check out, the number's no good.

UPS also uses a check digit in its particularly lengthy 18-character tracking number. Other characters identify the shipper and the service used. The 15-digit American Express number also includes a check digit, and the first six digits indicate the issuer.

Today's AmEx numbers may have seemed enormous to senior executives in 1958. "It's ten digits and it's a long number, but that's very necessary and it is historic," according to a memo to senior executives which pointed out the potential speed of transactions. "We have to sacrifice, I guess, for progress, because we are going to be able to effect very many services by the very use of this account number."

The IP address has been integral in delivering the plethora of Web services available today, which go far beyond the "experiment" Mr. Cerf and his colleagues envisioned. It allows for versatile pathways between two Internet-connected computers, each of which can find each other using just this number. Domain names, such as WSJ.com, are aliases for these underlying addresses. But the unallocated pool of IP addresses is expected by Mr. Hain, of the IPv6 Forum, and other projections to run out by some time in 2012. At that point, people wishing to get new access, or to develop new Web sites, may be shut out.

One solution is to move the Internet onto IPv6, a new addressing protocol that will explode the number of available computers in the network. The problem is that the old addresses and the new ones don't communicate easily with each other -- meaning people on one system may have trouble accessing the other.

"The 'Net won't come to an end, but it will become more fragmented if we don't have widespread implementation of IPv6," says Mr. Cerf.

But not everyone is as worried about running out of these numbers. Todd Underwood, chair of the program committee for the North American Network Operators Group, which runs conferences for Internet service providers, backs an after-market for these addresses, so that once they run out, those people or businesses who need addresses can buy from those who have unused ones. That may increase the price of Internet access, which Mr. Underwood sees as a spur toward IPv6 adoption, much like gasoline taxes are seen as a way to encourage the development of alternative-energy sources. As a solution, "it's not great, but it's fine," Mr. Underwood says.

Mr. Hain disagrees and worries that poorer nations will be forced to pay for numbers that rich institutions got free of charge: "There will be political backlash."

Write to Carl Bialik at numbersguy@wsj.com

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