The Next Revolution: What Happens When the Internet Runs Out of Space?

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As early as July this year the Internet will start to run out of space as Internet addresses – the numbers that identify every device and computer linked to the Internet – become all used up. APNIC, the Asia Pacific Network Information Centre, is the registry that issues Internet addresses for the booming Asia-Pacific region, and is expected to be the first to run out, Registries in other regions may last just a few months longer.

Internet standards groups have created the new Internet addressing system, IPv6, to replace the old system, IPv4, which has almost reached the limits of its 4.2 billion addresses. By contrast, IPv6, can handle an amazing 340 billion billion billion addresses. But there is a problem with IPv6. "The two systems (IPv4 and IPv6) are incompatible: they're like oil and water; they don't mix and can't talk," says Kevin Karp, business director at IPv6Now, which provides IPv6-related services and training.

The compatibility issue is creating a major challenge for businesses. They need to position their Internet-related operations to be able to straddle the old and new Internets. Established businesses that fail to add IPv6 to their systems could be isolated from new networks that support IPv6 only, and start-ups that can't get IPv4 addresses risk being cut off from millions of customers still operating on the old system.

There is a growing sense of panic and urgency. "It's well intentioned," according to Paul Wilson, director general of APNIC. "It's a call to action. If we don't pick the sweet spot for transition to v6 it just gets more difficult. Depending on their use of the Internet and specific requirements … organisations need to make a start, and do some planning, some investment and education."

But amid the challenge is opportunity: the massive number of addresses that IPv6 can handle will liberate the Internet. It opens up a new and exciting future where hundreds of billions of Internet-connected devices can be installed in anything from tyres to wine bottles and kettles, and talk to their owners and each other.

All devices connected to the Internet, such as computers and mobiles, have Internet Protocol (IP) addresses, which are generally automatically handed out by an Internet service provider. Each address is a series of numbers that, like a phone number, identifies the device itself within all of the others on the network. An IP address has a "prefix" that identifies the network (rather than the country and city), the subsequent numbers identify the exact computer or device. Users rarely see IP addresses, because they use the more familiar domain names to identify their favourite sites.

Space Invasion

So the numbers – the IP addresses – are vital: it's not possible to be connected to the Internet without having one. When the current Internet system, IPv4, was designed in the late 1980s, it was assumed that its 4.2 billion addresses would be more than enough. "Then it was an awfully big number," Karp says. "Mobile phones didn't exist to the extent they do now, and China and India had not yet come on stream. In the past 20 years, we've had an explosion in the size of the Internet and there are a whole bunch of new things using the Internet."

Like IPv4 itself, the global system for managing IP addresses has been in place for several decades, and

has hardly changed in the last 15 years. The system starts with the Internet Assigned Numbers Authority (IANA), operated by the Internet Corporation for Assigned Names and Numbers (ICANN) in the US. It hands out blocks of addresses to five regional Internet registries (RIRs), including: Europe and the Middle East; the US and Canada; Latin America and the Caribbean; and Africa. The Asia-Pacific is managed by APNIC. The registries then hand addresses on to Internet service providers and hosting companies in their regions.

At a special ceremony held in February 2011 in Miami, US, IANA finally handed out the last five blocks of IPv4 addresses to the five registries. Because of the huge growth in India and China, APNIC is expected to be the first RIR to run out of remaining addresses. Wilson says APNIC has three to six months of addresses left for normal allocations to ISPs. After this, he says, an ISP that comes to ask for a block of IPv4 addresses for their next big network deployment will find that the addresses are not available.

A sign that industry insiders foresee high demand for the old IP addresses in coming months is US-based Microsoft's recent purchase of some 660,000 IPv4 addresses from bankrupted Canadian telco Nortel for US$7.5 million – a hefty price that had many reeling.

The Internet is too vast to have a "flag day" like Y2K, where everyone would switch from IPv4 to IPv6 on the same day, according to Wilson. "That's an impossibility." Though June 8 this year has been declared "World IPv6 Day" and a number of major content providers will turn on IPv6 for a day. The shift will be gradual and could take several years. "We are concerned to make sure the IPv6 transition happens smoothly over the next few years and that it happens successfully," Wilson says.

Changing from IPv4 to IPv6 is "going to be a slow, but progressive change", anticipates Graham Low, a professor in information systems at the Australian School of Business. IPv6 has been out for some time, he points out. "You could argue it's a bit disappointing that people haven't moved more quickly to it." Low surmises that most people who were aware of the eventual need to make the switch have thought "why do it unless you have to?" "But we don't have a choice now," Low cautions. "The Internet wasn't designed for the number of users it currently has, so we have to go (to IPv6)."

While registries will run out of IPv4 addresses this year, that doesn't mean that all service providers will be stranded with none left. "Some ISPs have been hoarding IPv4 addresses, and they're going to be fine for a few years," said Holly Raiche, executive director of the Internet Society of Australia. "Depending on the ISP country telecoms provider and places, we don't know exactly at what time a particular ISP will run out of addresses."

A spokeswoman for Optus, the Australian operation of Singapore-based SingTel, says Optus identified the importance of IPv6 10 years ago, and the company has a pool of IPv4 addresses available to ensure business continuity. Optus will continue to use addresses in the pool for fixed and mobile broadband and smartphone customers.

Despite the challenges, there are significant opportunities. "IPv6, for those who adopt it early at the right time, will provide a major competitive advantage in sales, perception and potential technical performance and efficiencies," Wilson suggests. "We will move from having an Internet of 5 to 6 billion people talking to each other; to many billions, potentially hundreds of billions, of objects directly connected to the Internet," he says.

Next Gen Connections

The capacity of IPv6 to handle so many addresses will radically alter the nature of the Internet. The limitation of IPv4 addresses meant much of the Internet was largely restricted to connecting people to the Internet. With IPv6 there will be enough addresses so billions of devices can connect and communicate. "That's the vision of what's sometimes called the 'Internet of things'," Wilson says.

Raiche says businesses need to think about the potential and opportunities of the new era when it's possible to communicate at a distance with "things", even windscreen wipers. In Japan, for instance, some of the taxis have IPv6 addresses in their windscreen wipers. When taxies turn on their wipers, the cab company knows and can send lots of cabs to the area because it's raining. "There are so many opportunities for other sorts of business and what you can do in terms of communication," Raiche says.

Carmakers are also installing IPv6 addresses in key components. Current car tyres can communicate with the dash and tell it there is a flat. But no further communication can occur. "The next generation tyre can talk to the car mechanic, and the car mechanic can talk back to the tyre and the owner and say 'there's a flat, you need to do this and drive into the repair shop'," Karp reports.

Karp says the huge number of IPv6 addresses means that as well as being a means of establishing communication, the Internet can also be a means of tracking and measuring. "For instance, if each milk carton has its own IP address then a supermarket can know how much milk is on the shelves of a particular store and automatically re-order when needs be," he says.

IPv6 has other applications, as Karp outlines. An adult may have an ageing parent and would like them to have a smart phone, not only for emergency calls, but also as a health-monitoring device that can monitor heart rate, temperature, and whether they're standing up. "That new application can't be done with the old Internet," Karp points out. "There's a whole range of new things that we can do that we previously haven't thought of. That's going to be the challenge: to have sufficient vision and determination to develop those things."

The Great Migration

But before taking advantage of opportunities, business must manage their migration from IPv4 to IPv6. Wilson says that while ISPs are generally well-informed and well-prepared for IPv6, the same may not be said for businesses, even those that rely heavily on the Internet. But sooner or later businesses will face a complex situation. There will be no new IPv4 addresses. And there will be an increasing number of customers migrating to newer IPv6 addresses. For existing businesses running services and infrastructure on the Internet, the solution is relatively simple – ensure there is support for both IPv4 and IPv6 on all systems and infrastructure.

Karp says start-up businesses could face more challenges with IPv6 than existing businesses when addresses run out. "If you're a start-up and want a bunch of new addresses – 10 to 20 new addresses – where are you going to get them from?" he asks. "Some ISPs simply won't be able to give you the addresses." ISPs that can provide IPv4 addresses are likely to charge more for them, forcing new businesses to use IPv6 addresses. "That could mean you're invisible to the IPv4 world." Wilson believes that any ISP that cares about customers should at least provide private IPv4 addresses, which will allow connectivity to the IPv4 Internet, but with sometimes degraded performance.

There are a series of questions managers need to be asking now. Smaller businesses need to ring their full-service hosting provider and ask if they are supporting IPv6. Managers also need to ask anyone providing them with Internet-related services whether it is ready to carry and serve IPv6. For bigger businesses with their own internal IT departments, and that run their own servers, the questions are similar but cover more components, such as routers, and whether tech staff are trained to know how to run IPv6.

"If the answer is 'no' then your next question is 'when', and you don't stop asking until you understand and trust the answers," advises Wilson. "The push we're making is towards content providers who actually want to maximise audience and market. We're saying: 'please, get yourselves ready for IPv6'. In order to have the maximum audience, and to give every member of that audience the best performance, you must have both IPv4 and IPv6."

To manage the Internet running out of addresses, managers need to focus on the defence – managing the transition from IPv4 to IPv6. But at the same time they can't ignore the offence – the opportunities raised by almost infinite IPv6 addresses. "The focus of business should be on opportunity," Karp says. "IPv6 opens up a whole world of things you can do with the Internet."

