SLOW CHANGE

SWIFT TRANSITION TO IPV6 HAS BEEN ANYTHING BUT

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For more than a decade, numerous international organizations have recommended a swift transition from IPv4 to IPv6. Despite their warnings that depletion of IPv4 addresses was imminent, until very recently little progress was made.

Indeed, it is generally accepted that only 0.002 percent of Internet traffic in 2008 was IPv6. Today, however, IPv6 transition is finally taking hold, as evidenced by recent IPv6 support by a number of popular Web sites, including Google's YouTube, Facebook and Cisco.

Why is 2010 the year that the world is adopting IPv6? Interestingly, many of the reasons relate to international developments.

WHAT IS IPV6?

Technical specifications and software releases have a tendency to use even numbers for publicly available releases. That's why the Internet is transitioning from version four to version six of the Internet's underlying Internet Protocol (or IP).

IPv4 has been in use since the early 1980s when the Internet was simply a research network with a finite number of organizations interconnected. The researchers who produced the specifications for IPv4 decided that 32-bits were sufficient to handle the addressing-needs of what was thought to be a somewhat temporary network.

But the explosive growth of the Internet and the need for greater address space forced the Internet Engineering Task Force IETF to go back to the drawing board and design what we now call IPv6.

WORLDWIDE TRANSITION TO IPV6

Growth in Internet-connected devices is accelerating worldwide. According to one conservative estimate, by 2013 the total number of devices connected to the Internet will balloon to 2.7 billion – more than 1 billion of these will be mobile phones.

By 2013, it is estimated that half of all new TVs sold worldwide will be Internet enabled.

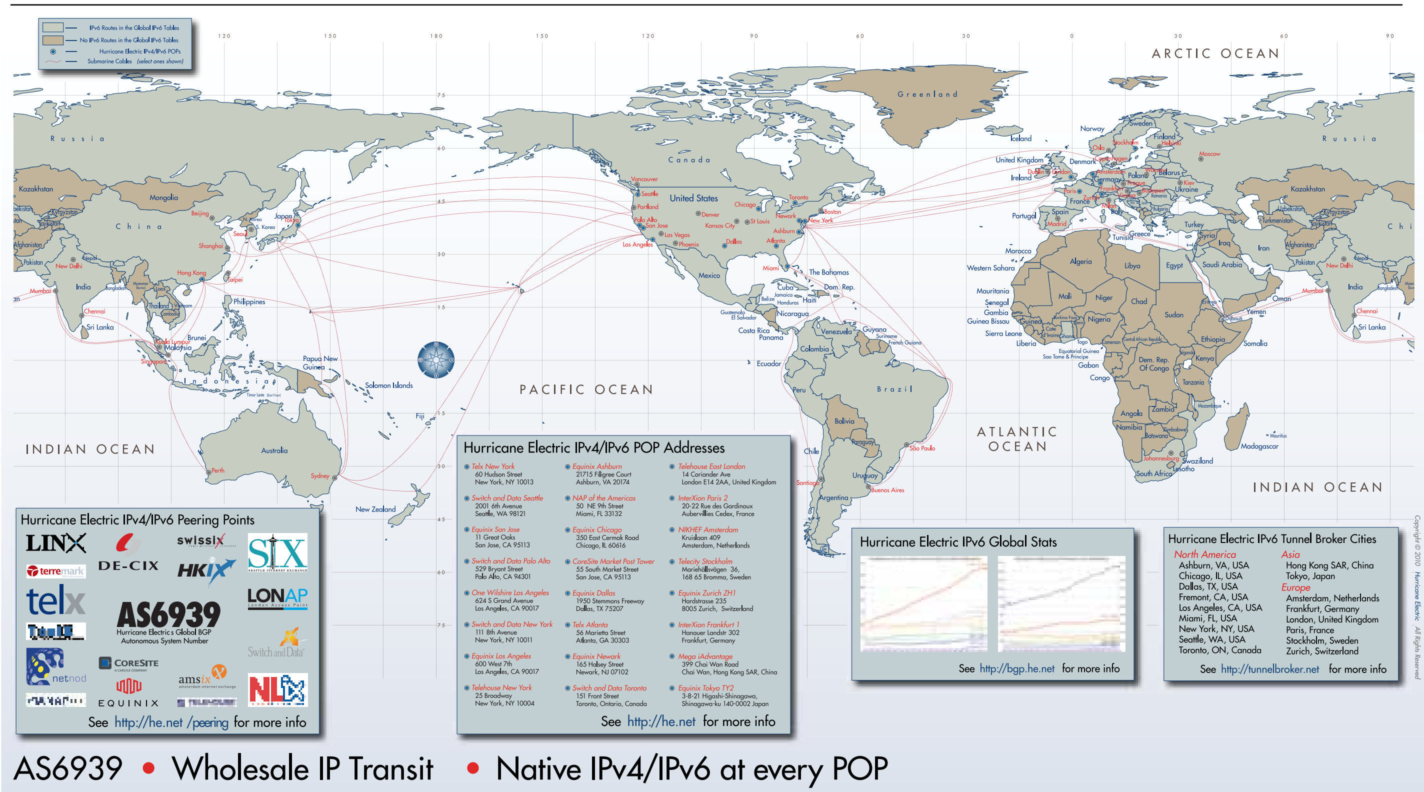
Because of this growth, the time will come when you will not be able to request from your ISP a public-facing IPv4 address. But exactly when depends where you are located.

For example organizations in the United States have received roughly half of the allocated IPv4 addresses. Many reasons exist for this including the legacy of how companies, govern-ment entities and universities were allocated IP space well before there any rules.

Adding to that early advantage, U.S. companies have established networks leveraging a number of address-saving technologies (CIDR, NAT, etc.) that have allowed providers to delay their transition to IPv6.

But other countries (like China, which has less than one IPv4 address per four of its citizens) perceive greater urgency in making the transition. Developed nations such as Japan and Korea have taken steps to move to IPv6, and India expects all telecoms and ISPs to be IPv6-compliant by December 2011.

The Global IPv6 Map



Source: Hurricane Electric

GLOBAL CHANGE

These international developments will help promote IPv6 adoption globally. For example, let's say you travel to China on business. Because of IPv4 address depletion, it is quite possible that the Internet access provided in your Chinese hotel will assign you an IPv6 address only.

A similar situation could occur either within the United States or abroad when you try to connect your laptop to a 3G network.

Because of the cost and complexity of maintaining Enterprise NAT, the time will come when your mobile provider assigns IPv6 addresses only. So, even if your corporate network has plenty of IPv4 addresses, you may find yourself without connectivity.

There are other reasons why IPv6 adoption globally will drive further adoption. Imagine your company has a Web server on the Internet with an IPv4 address. Someone in another country (with pure IPv6 connectivity) wants to access your Web site. To allow this, you must purchase a v6-to-v4 relay service from your ISP.

In addition to the cost of the relay, it is possible that throughput through the relay could be less than if your Web server were native IPv6.

As such, foreign adoption of IPv6 should drive global e-commerce and customer-support sites to transition to native IPv6 globally.

MORE REASONS TO SWITCH

Of course, there are plenty of other good reasons to switch from IPv4 to IPv6 now. Some software systems, like Microsoft's DirectAccess in Windows 7, require IPv6.

IPv6's globally-reachable address space is more supportive of certain technologies like peer-to-peer systems, which do not behave well in the presence of NAT.

In addition, IPv6's massive 128-bit address-space allows for more efficient route aggregation and simplified network configuration.

Finally, by transitioning to IPv6 now, you give yourself time to learn about the additional considerations required within IPv6 configuration. Like all new technologies, it's important to understand the security aspects of adding IPv6 to your network – before malware writers do.

CHANGING MINDS

One of the greatest challenges in an IPv6 transition is changing the mindset of system administrators, data-center managers and application developers. For all their intelligence, technologists are often reluctant to go from an IP address like "127.0.0.1" to an address like "2001:0DB8:71A3:0801:1319:0211:FEC2:82DC," and syntax like this takes some getting used to:

• 2001:470::5
• ::FFFF:66.220.2.75
• 2001:db8::/32
• fe80::1%lo0
• http://[2001:470:0:64::2]:80

Education is required to embrace a new mental model. It is essential to train network personnel on the nuts and bolts of IPv6.

For example, IPv4 devices usually have one IP address per network interface, while IPv6 features multiple addresses per interface and use Neighbor Discovery for selecting addresses.

Whereas IPv4 usually has one default gateway, IPv6 promotes multiple default gateways that advertise themselves with Router Advertisement messages, and IPv6 endpoints may send Router Solicitation messages explicitly.

For IPv6, there is a new "AAAA" DNS record that is analogous to the IPv4 "A" DNS record. In IPv4, duplicate address detection is optional, whereas in IPv6 it is mandatory.

Although it would appear that updating operating systems and data-center hardware would be the primary task in an IPv6 transition, don't underestimate the importance of updating the applications that run in the data center.

Custom networking applications are likely to be IPv4-centric. User interfaces with IP address fields that support only dotted-quad notation, log parsers and field validators must all be rewritten.

Internal data structures must expand all 32-bit database fields to support both 32-bit IPv4 addresses and 128-bit IPv6 address. Network monitoring tools and intrusion-detection software must be upgraded to support IPv6.

SECRETS OF A SUCCESSFUL TRANSITION

The transition to IPv6 takes time and effort. But with careful planning and execution, adoption can be seamless.

Because IPv4 address-space exhaustion is inevitable. Encourage your team to read a good IPv6 book or two, become familiar with the relevant RFCs, and spend time with packet-sniffer tools like WireShark.

Remember that a careful transition is better than one done in a panic.

Failing that, remind your team that once your transition to IPv6 is complete, you'll never have to worry about address exhaustion again – IPv6 provides more than 4 quadrillion addresses for each star in the observable universe. That will be plenty.

Martin Levy has been involved in the TCP/IP world since the 1980s. Born and educated in England, Levy moved to the United States to work as a software developer at Bell Labs. It was there he ran its first TCP/IP network-enabled UNIX computers. After seven years, Levy moved to California and joined the Silicon Valley entrepreneurial-life. Since then he has been building networks in Asia, Europe, Latin America and the United States. Since joining Hurricane Electric in early 2008, Levy has taken on the role of expanding Hurricane Electric's IPv6 global connectivity services.