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IPv6:

Are We There Yet?

IPv6: Are We There Yet?

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Introduction

In 1998, IPv6 was officially introduced with RFC 2460. Now the Internet, businesses, and home users are all implementing IPv6, correct? Well, maybe not totally correct or even close to correct. The fact that the widespread implementation of IPv6 is taking so long leads to some questions:

- Why is IPv6 implementation taking so long?
- Who is Using IPv6 now?
- What are the predicted trends for IPv6?
- What are the business benefits of implementing IPv6?

Why is IPv6 implementation taking so long?

The world has been hearing for years that we are running out of IPv4 address space, yet it seems that most organizations have not been rushing to immediately implement IPv6. The cost associated with new hardware and software that supports IPv6 is certainly one of the reasons for this lack of interest, along with the associated expenses of training for IPv6 implementation. Also, many organizations implemented strategies such as Network Address Translation (NAT) and Port Address Translation (PAT) as a workaround for needing more IP addresses. While this mitigates the problem of running out of IPv4 address space, it introduces new problems. Multiple NAT implementations make troubleshooting more difficult and break the original end-to-end IP model.

One of the original organizations pushing for IPv6 compliance in the United States was the Department of Defense (DoD). By 2008 the DoD had piloted IPv6 on its network backbone. However, in a December 2014, a report by the DoD determined the following:

 "Although DoD satisfied the requirement to demonstrate IPv6 on the network backbone by June 2008, DoD did not complete the necessary Federal and DoD requirements and deliverables to effectively migrate the DoD enterprise network to IPv6. This occurred because:

- The DoD Chief Information Officer (CIO) and U.S. Cyber Command (USCYBERCOM) did not make IPv6 a priority
- The DoD CIO, USCYBERCOM, and Defense Information Systems Agency (DISA) lacked an effectively coordinated effort and did not use available resources to further DoD-wide transition toward IPv6; and
- The DoD CIO did not have a current plan of action and milestones to advance DoD IPv6 migration."

Marco Hogewoning, one of the Reseaux IP Europeenne (RIPE) IPv6 Working Group co-chairs, cites the "lack of a clear business case to recover the cost of such a deployment" as a reason for the slow implementation. He goes on to say, "The fundamental problem here is that the majority of market players still view IPv6 as a product, rather than what it really is: a building block to a new future."

This paper will explore looking at IPv6 as a building block and also we'll take a look at who is implementing IPv6 as well as the current trends in IPv6 implementation.

What are the business benefits of implementing IPv6?

- The most obvious benefit is the abundance if IP address space. There are 340 undecilion, or 3.4×10^{38}, possible IPv6 addresses. This benefit will become more obvious when we discuss the Internet of Things (IoT)
- More secure: a wide range of security features are built into IPv6
- More efficient header, enabling more efficient routing
- IPv6 brings much more flexibility for mobile devices connected to a network than IPv4 does
- Enhanced communications with international Trading Partners, specifically China and India
    - [China and India combined have only 8 percent of the IP addresses](#)—their governments are pushing strongly for IPv6 compliance

Who is using IPv6 now?

Some of the companies presently committed to and implementing IPv6:

- Google
- Yahoo
- Amazon
- Comcast
- T-Mobile
- NTT
- France Telecom
- China Telecom
- Telstra
- China Mobile

If we look at Comcast (included in the list of companies above) as an example of one of the key players in implementing IPv6, their focus is to make the company's content available over IPv6. They are using a dual-homed strategy (sometimes called dual-stack) as they migrate to IPv6. On their site they have information available to users about the migration and even have a link for home users to see if their computer and home network support IPv6.

The following chart is a comparison of 10 companies implementing IPv6 published in February of this year:
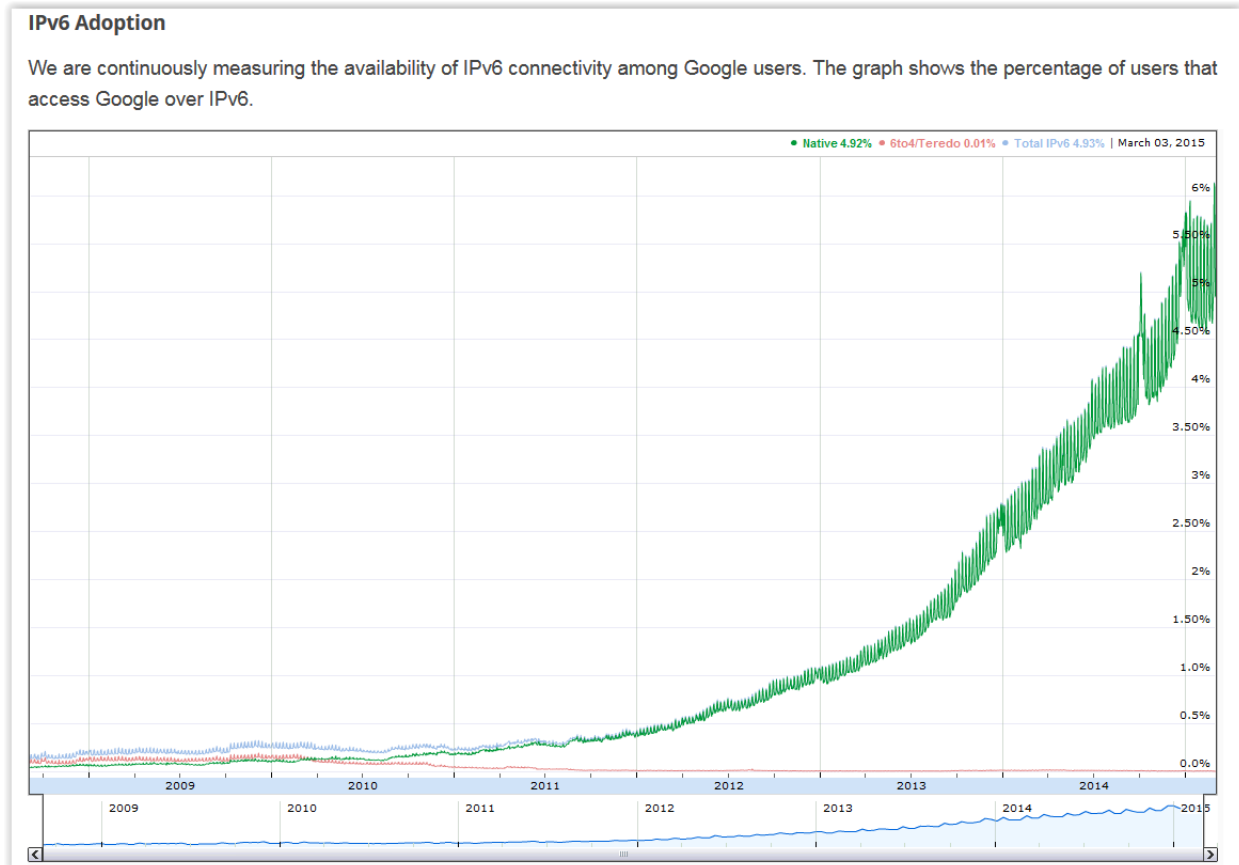
Network Operator Measurements
http://www.worldipv6launch.org/measurements/

Participating Network	ASN(s)	IPv6 deployment
Comcast	7015, 7016, 7725, 7922, 11025, 13367, 13385, 20214, 21508, 22258, 22909, 33287, 33489, 33490, 33491, 33650, 33651, 33652, 33653, 33654, 33655, 33656, 33657, 33659, 33660, 33661, 33662, 33664, 33665, 33666, 33667, 33668, 36732, 36733	35.95%
ATT	6389, 7018, 7132	38.14%
KDDI	2516	18.17%
Verizon Wireless	6167, 22394	64.57%
Time Warner Cable	7843, 10796, 11351, 11426, 11427, 12271, 20001	14.35%
Deutsche Telekom AG	3320	33.15%
Free	12322	35.33%
T-Mobile USA	21928	50.86%
Telenet	6848	56.35%
Liberty Global	5089, 6830, 20825, 29562	8.10%

Showing 1 to 10 of 313 entries

There is a marked increase in the percentage of IPv6 deployment since September of last year. According to the Internet Society, as of September 2014 AT&T wasn't quite hitting 25 percent IPv6 usage, Verizon Wireless was at 56 percent and T-Mobile was a little over 40 percent. As shown in the chart, as of February of this year AT&T was up an additional 13 percent, Verizon up 8 percent and T-Mobile up more than 10 percent.

Google tracks their IPv6 usage and here are their numbers as of March 3, 2015:

IPv6 Adoption

We are continuously measuring the availability of IPv6 connectivity among Google users. The graph shows the percentage of users that access Google over IPv6.
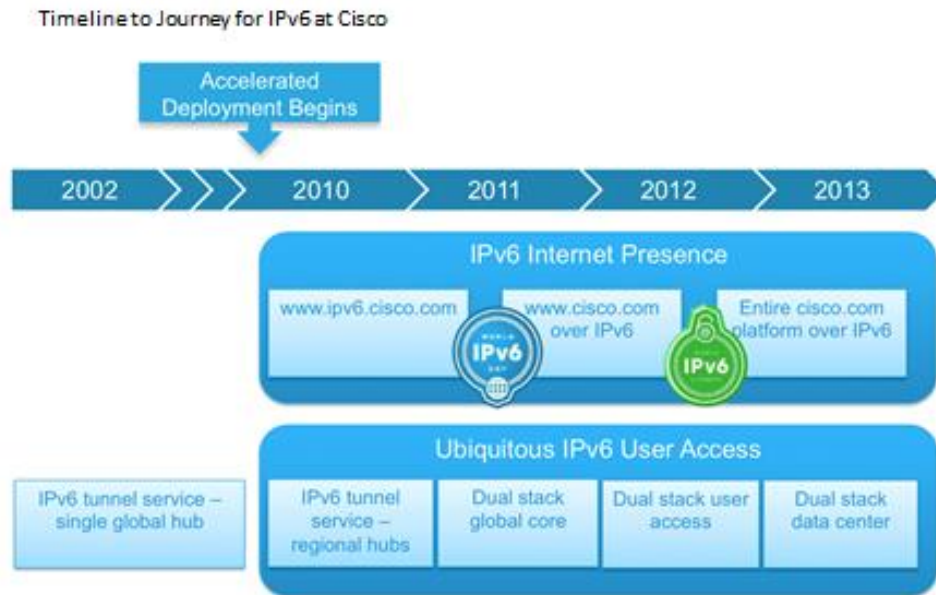

Total IPv6 usage on Google for 2015 is about 5.5 percent. While that may not seem like a high percentage, you need to look at the trend over the past two years to see that IPv6 usage has gone from about 1 percent at the end of 2012 to over 5.5 percent now. If you compare that to the previous two years' growth, the percentage of IPv6 usage on Google only went up by about one-half of one percent.

Further evidence of IPv6 momentum is reflected in the following chart:

Companies like Cisco and Microsoft are also key players in the move toward IPv6. Information from www.ipv6now.com states that Microsoft has switched to full IPv6 on its internal system and uses IPv4 only at edge connections*.

Cisco is another key player:

Timeline to Journey for IPv6 at Cisco

Accelerated Deployment Begins

2002 → 2010 → 2011 → 2012 → 2013

IPv6 Internet Presence

www.ipv6.cisco.com | www.cisco.com over IPv6 | Entire cisco.com platform over IPv6

Ubiquitous IPv6 User Access

IPv6 tunnel service – single global hub | IPv6 tunnel service – regional hubs | Dual stack global core | Dual stack user access | Dual stack data center

** From Cisco IT Case Study March 2013 – IPv6 Implementation

If you look at the IPv6 trend globally, you'll see that the United States is lagging behind countries like India and the entire country of China. This is important in that both India and China have become key players in the global economy. As IPv6 is not backward compatible with IPv4, it is imperative that we can optimally communicate with China and India over the Internet.
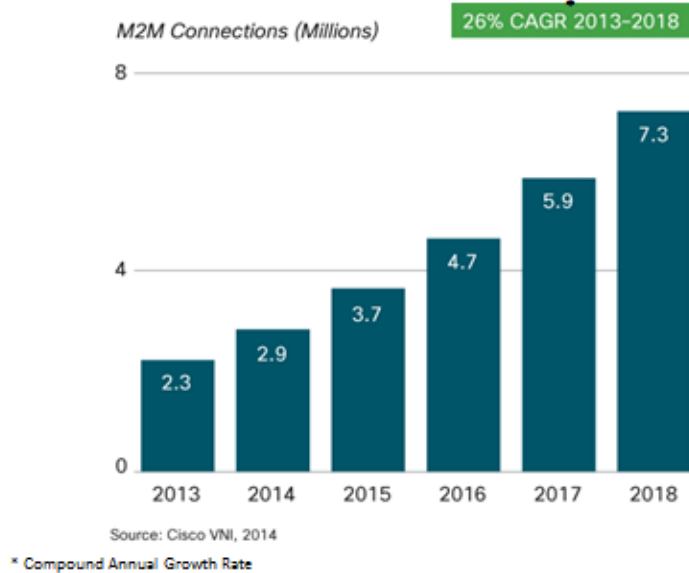
IPv6 GLOBAL REACH

IPv6-ENABLED INTERNET NETWORKS BY REGION

This graph shows the percentage of networks (ASes) that announce an IPv6 prefix for RIR regions, according to RIPE NCC as of 30 April 2014.
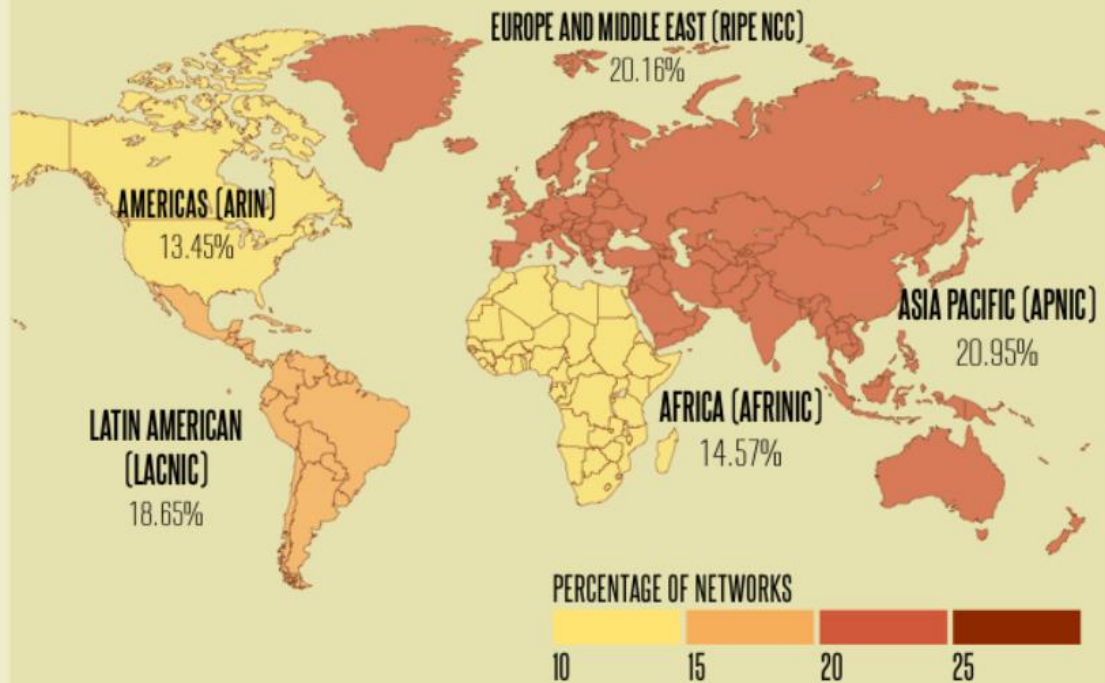
After over 20 years, why are we now seeing this push toward IPv6?

The first big push toward implementation of IPv6 was mobile devices. Now, one of the driving forces is the Internet of Things. As the name implies, this means everything, including machine to machine communication (M2M). M2M means communication that works without human interaction. For example: think of monitoring the thermostat at your house during the winter so that the temperature will automatically be set 5 degrees higher at 5:00 pm every day. By the time you get home the house is nice and toasty! Think of a patient in a hospital whose monitoring equipment will automatically notify a nurse that his or her heart rate has increased above a certain threshold. This is the future of the Internet. Without thinking about it for very long, most people can think of an example of M2M communication that in some way touches their lives.

M2M Connections (Millions)

26% CAGR 2013-2018

Source: Cisco VNI, 2014

* Compound Annual Growth Rate

This evolution of the Internet of Things would be impossible without a limitless supply of IP addresses. IPv6 is the only logical answer.

Here are some numbers published by Cisco in June of 2014 (*The Zettabyte Era: Trends and Analysis)* that address the Internet of Things and the increase in the number of wireless and mobile devices and how they will impact traffic on the Internet:

- **Over half of all IP traffic will originate with non-PC devices by 2018**. In 2013, only 33 percent of total IP traffic originated with non-PC devices, but by 2018 the non-PC share of total IP traffic will grow to 57 percent. PC-originated traffic will grow at a compound annual growth rate (CAGR) of 10 percent, while TVs, tablets, smartphones, and M2M modules will have traffic growth rates of 35 percent, 74 percent, 64 percent, and 84 percent, respectively.
- **Traffic from wireless and mobile devices will exceed traffic from wired devices by 2016**. By 2016, wired devices will account for 46 percent of IP traffic, while Wi-Fi and mobile devices will account for 54 percent of IP traffic. In 2013, wired devices accounted for the majority of IP traffic at 56 percent.
- **Global Internet traffic in 2018 will be equivalent to sixty-four times the volume of the entire global Internet in 2005**. Globally, Internet traffic will reach 14 gigabytes (GB) per capita by 2018, up from 5 GB per capita in 2013.
- **The number of devices connected to IP networks will be nearly twice as high as the global population by 2018**. There will be nearly three networked devices per capita by 2018, up from nearly two networked devices per capita in 2013. Accelerated in part by the increase in devices and the capabilities of those devices, IP traffic per capita will reach 17 GB per capita by 2018, up from 7 GB per capita in 2013.

As you look at Cisco's numbers remember that your mobile providers, T-Mobile, AT&T, and Verizon are all moving rapidly toward IPv6-only deployment.

In January of this year, John Curran, president and CEO of the American Registry for Internet Numbers (ARIN), made a strong argument for the adoption of IPv6. He stated that the Internet "was never designed to carry the volume of devices and websites now in use throughout the world."

He went on to say that "customers attempting to reach an IPv4-only website via a smartphone or tablet are increasingly likely to be forced through transition gateways as more mobile providers turn to IPv6 to grow their networks. "

He cites research by the Aberdeen Group, stating that just a one-second delay in page-load time results in 11 percent fewer page views, and a 16 percent decrease in customer satisfaction. To remain competitive in today's marketplace, businesses must update their public-facing websites to support IPv6—or else they risk loss of revenue and customer loyalty.

Conclusion

In short, it appears that the time is now. Organizations can no longer look the other way and pretend that IPv6 is not an important transition to their network. Yes, this comes at a cost but here are some of the arguments that the time is now:

- Adopting IPv6 now will ensure that your corporate websites have the best performance possible. Without adopting IPv6, businesses risk accessibility issues of their websites as more and more consumers attempt to reach the Internet through mobile sources.

- IPv6 is critical for analytics. Business unit leaders, executives, and boards of directors want to make informed decisions about where to place emphasis in the business and how to grow the organization. The analytics that businesses use to make decisions is incomplete for websites that are not IPv6-enabled, instead returning location information on the compatibility gateways.

- IPv6 maximizes your return on your existing website investment. By enabling IPv6, businesses will ensure that their web applications are future-proof and will avoid a major upgrade in the future to catch up with their competitors.   **

* www.ipv6now.com
** http://www.baselinemag.com/networking/making-a-strong-case-for-ipv6.html

Learn More

Learn more about how you can improve productivity, enhance efficiency, and sharpen your competitive edge through training.

IP6FD - IPv6 Fundamentals, Design, and Deployment v3.0

ICND2 v2.0 - Interconnecting Cisco Networking Devices, Part 2

ROUTE - Implementing Cisco IP Routing v2.0

SPROUTE - Deploying Cisco Service Provider Network Routing

SPADVROUTE - Deploying Cisco Service Provider Advanced Network Routing v1.2

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About the Author

Carol Kavalla has been teaching about Cisco technology and its products for more than 14 years. She owns a consulting company and specializes in routing, switching, and data center implementations.