

31st October 2016

Moving the network with measurements

World IPv6 Launch and beyond



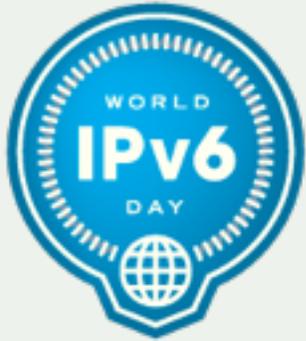
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Moving the network with measurements



Clear objective

- What is the obstacle on the path to deployment that is being overcome?



- IPv6 Day
 - Understand and minimise the number of users negatively impacted by making content dual-stack



- IPv6 Launch
 - Break the 'chicken-and-egg' logjam
 - Make content available (permanently)
 - Obtain (measurable) commitments from networks to permanently enable end-user IPv6



Measurable result

- If the goal of the exercise isn't measurable, it's marketing
- What can you do that is externally measurable, reportable, and visible to everyone?
- For v6 day it was turning up IPv6 on your main website for 24 hours
 - Measurable around the globe via DNS
- For v6 launch, it was turning it up and leaving it on for websites, and turning up 1% of your users for networks
 - Networks measurable by aggregating data from major content providers



A concrete publicly visible date helps

- Part of the purpose of a flag day is to give people a goal
 - feedback on both v6 events was that this greatly helped organizations internally
- This gave engineers something to show to managers as a deliverable date
- This gave companies a reason to do something a little sooner than they had already planned to do it



I want to be like...

- Google, Facebook, and Yahoo!
- Heard this from a lot of people:
 - Having a headlining big brand standing up and saying they are making a commitment to a technology has a TON of pull in the industry (marketing)
 - Having a really big player do this makes it safe for others (engineering)
- What is the pull to drive others to want to do something?



Who are the leaders?

- Small group of industry leaders who are committed to doing this together
- Can you identify them?
- Can they agree to
 - cooperate?
 - share risks?



Clear result

- How is the Internet different after it's over?
- After v6 day it was clear that turning up v6 at scale didn't break the Internet, or v4 users
- Since v6 launch it is increasingly clear that v6 is part of the Internet as regular business



Mutually Agreed Norms for Routing Security (MANRS)

MANRS defines four concrete actions that network operators should implement

- Technology-neutral baseline for global adoption

MANRS builds a visible community of security-minded operators

- Promotes culture of collaborative responsibility

<https://www.manrs.org/>



Measuring IPv6

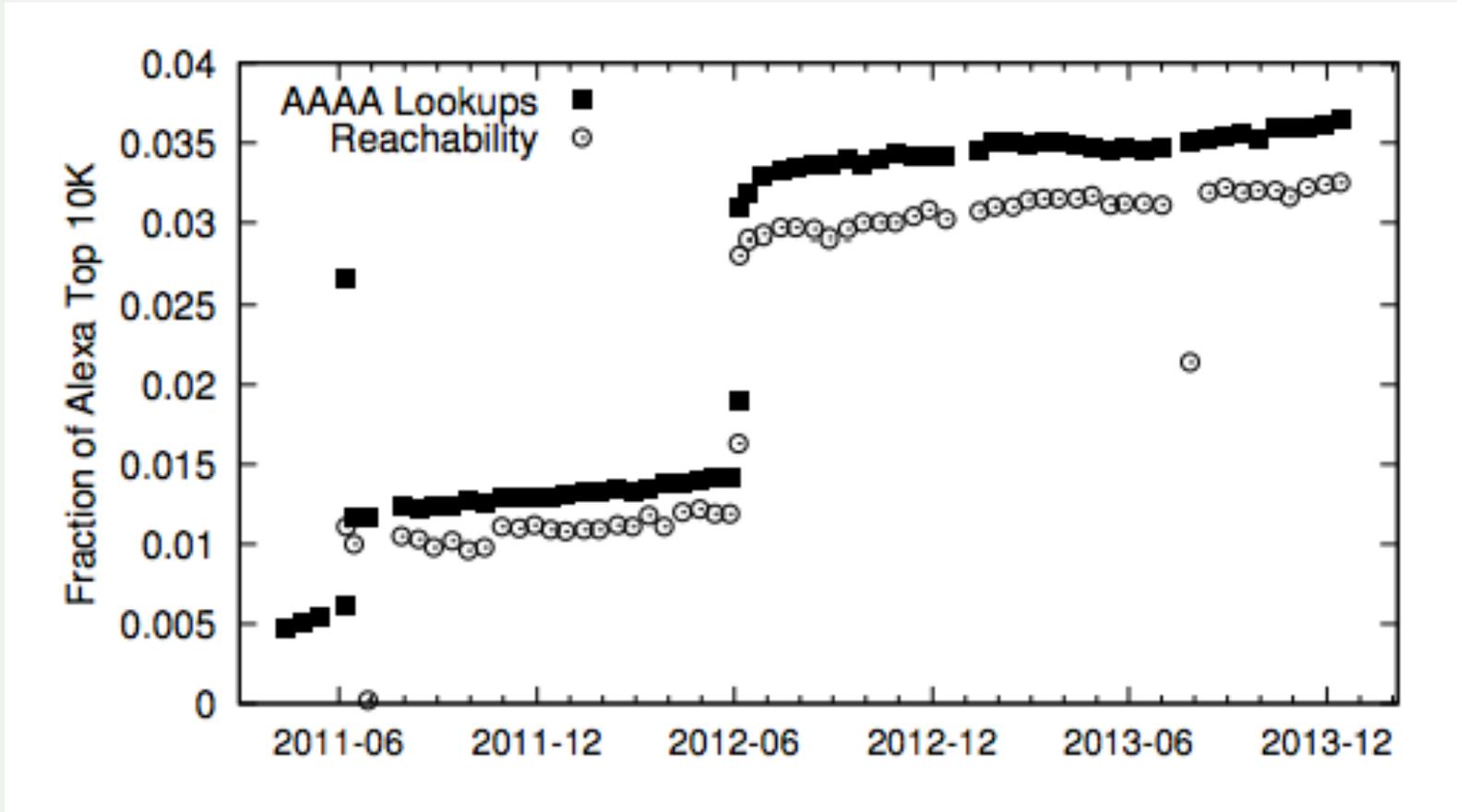


Agenda – Measuring IPv6

- Measuring Web content
- Measuring network operators from the outside
- Measuring network operators from the inside
- Measuring countries
- Measuring the DNS
- Measuring performance
- Predicting the future

Measuring IPv6

Measuring Web content



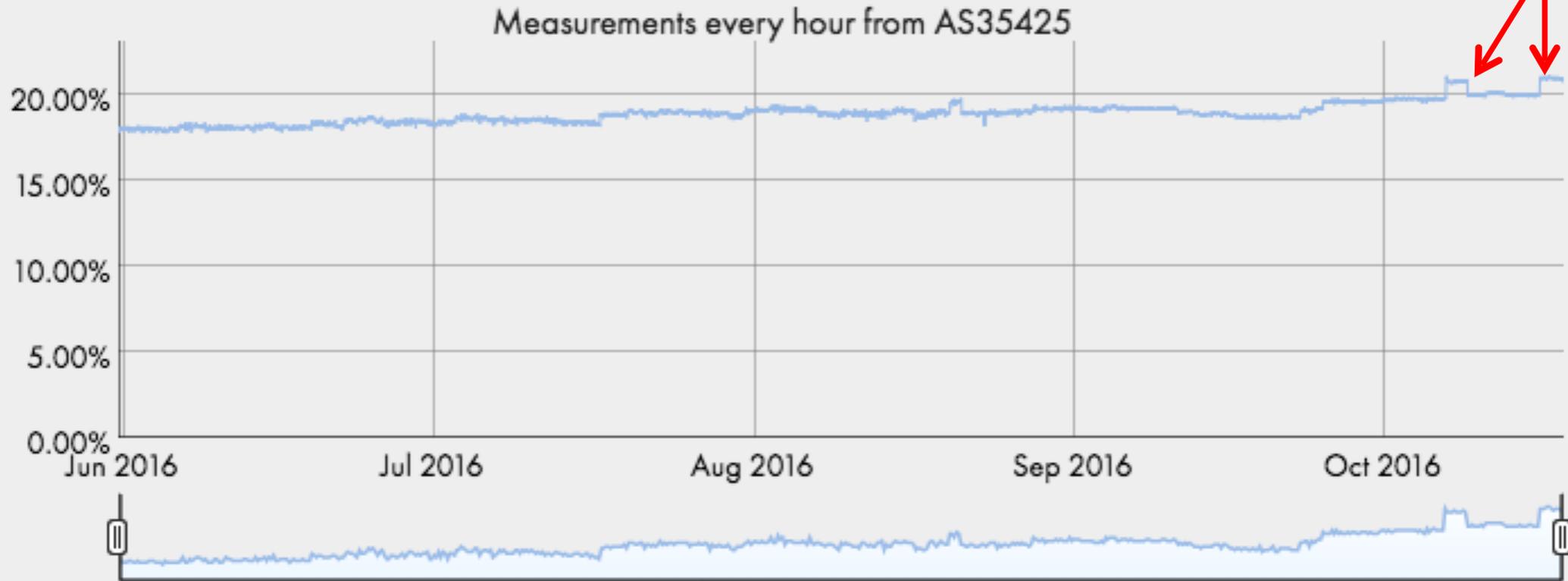
Measuring IPv6 adoption. By: Jakub Czyz, Mark Allman, Jing Zhang, Scott Iekel-Johnson, Eric Osterweil, Michael Bailey. Appears in: CCR August 2014.

Measuring IPv6

Measuring Web content

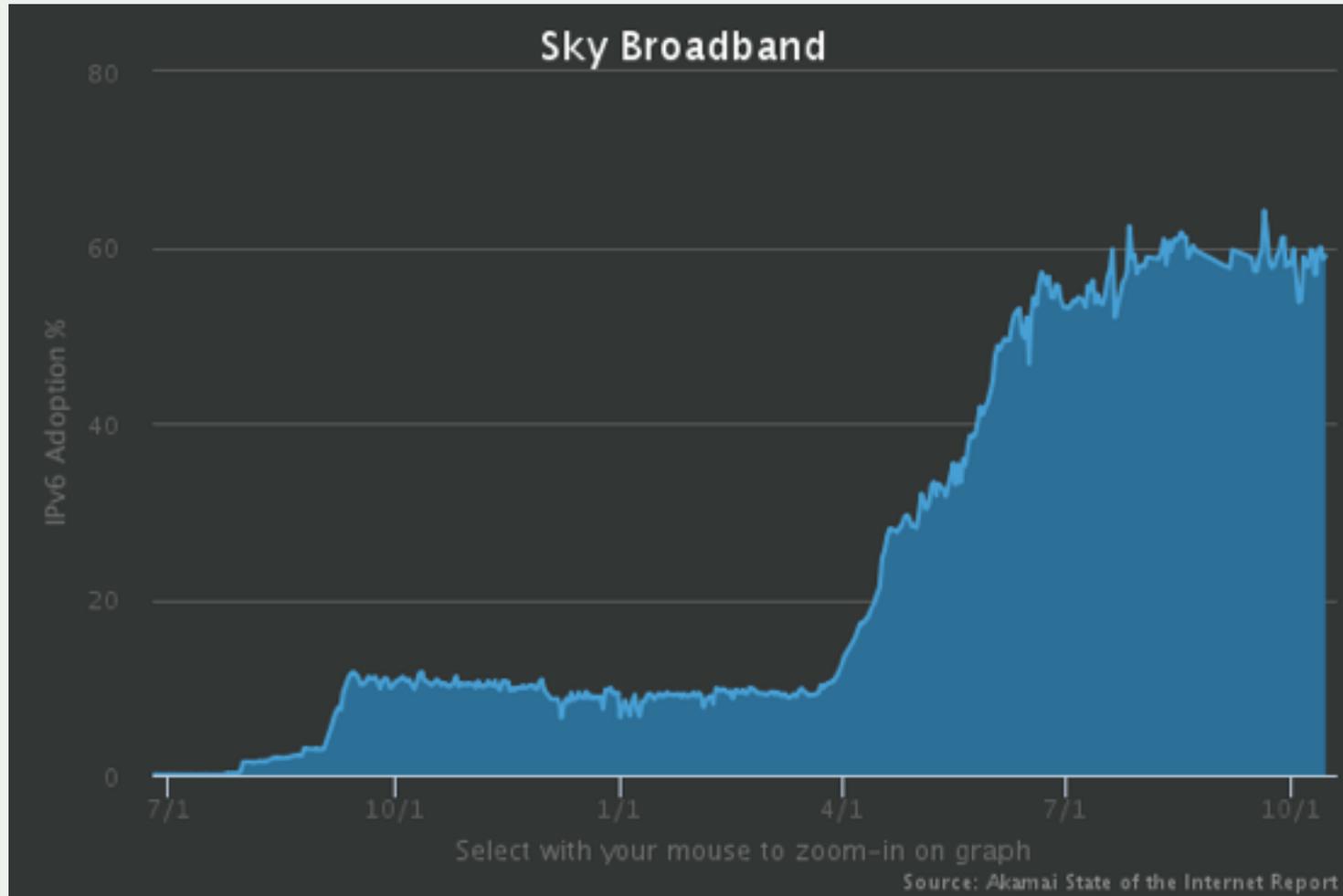
Percentage of Alexa Top 1000 websites currently reachable over IPv6

Cloudflare?



Measuring IPv6

Measuring network operators from the outside – Akamai



Measuring IPv6

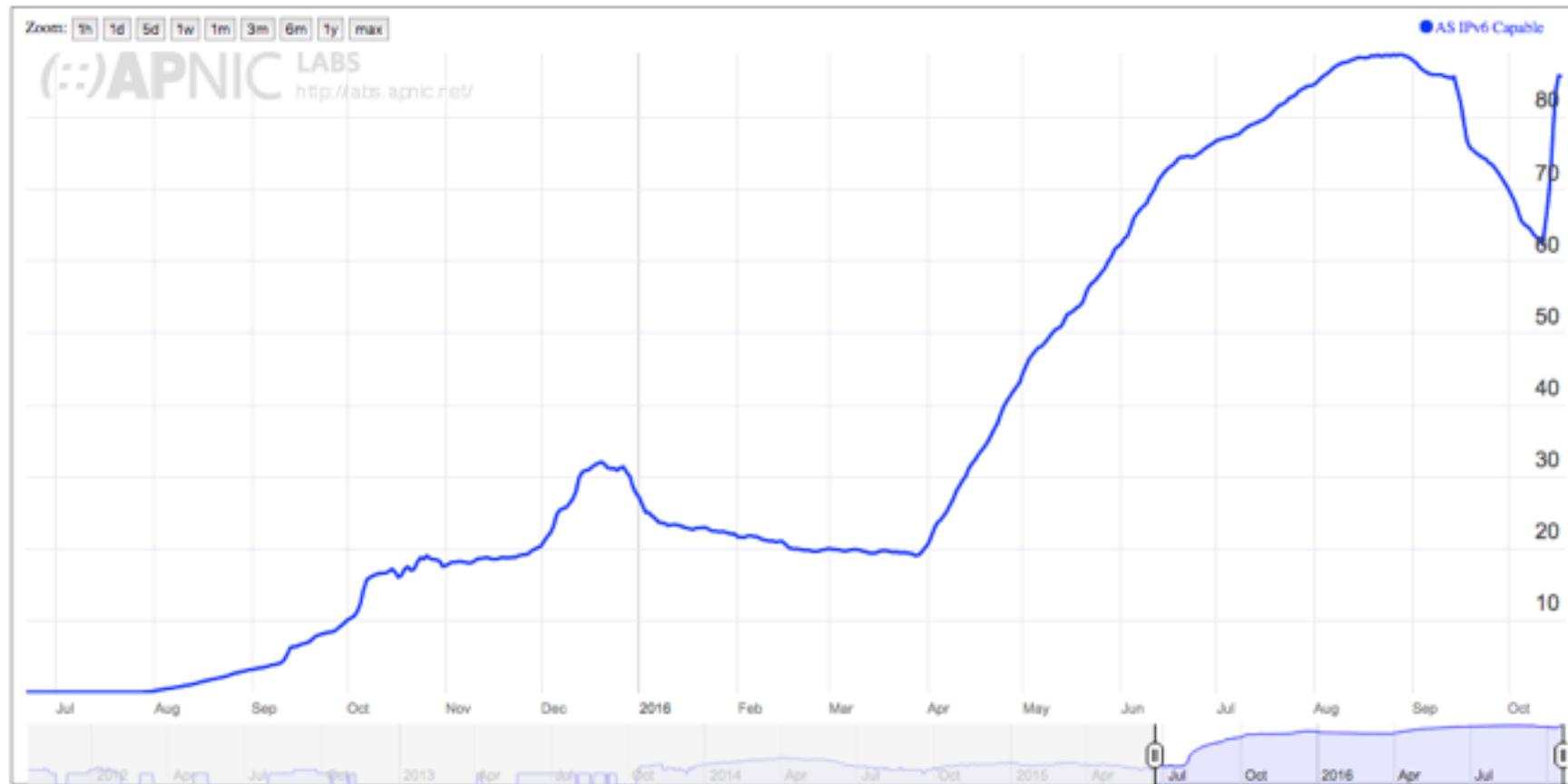
Measuring network operators from the outside – Akamai



Measuring IPv6

Measuring network operators from the outside – APNIC

IPv6 Deployment for AS5607: BSKYB-BROADBAND-AS Sky UK Limited



Measuring IPv6

Measuring network operators from the outside – World IPv6 Launch



Show 10 entries Search:

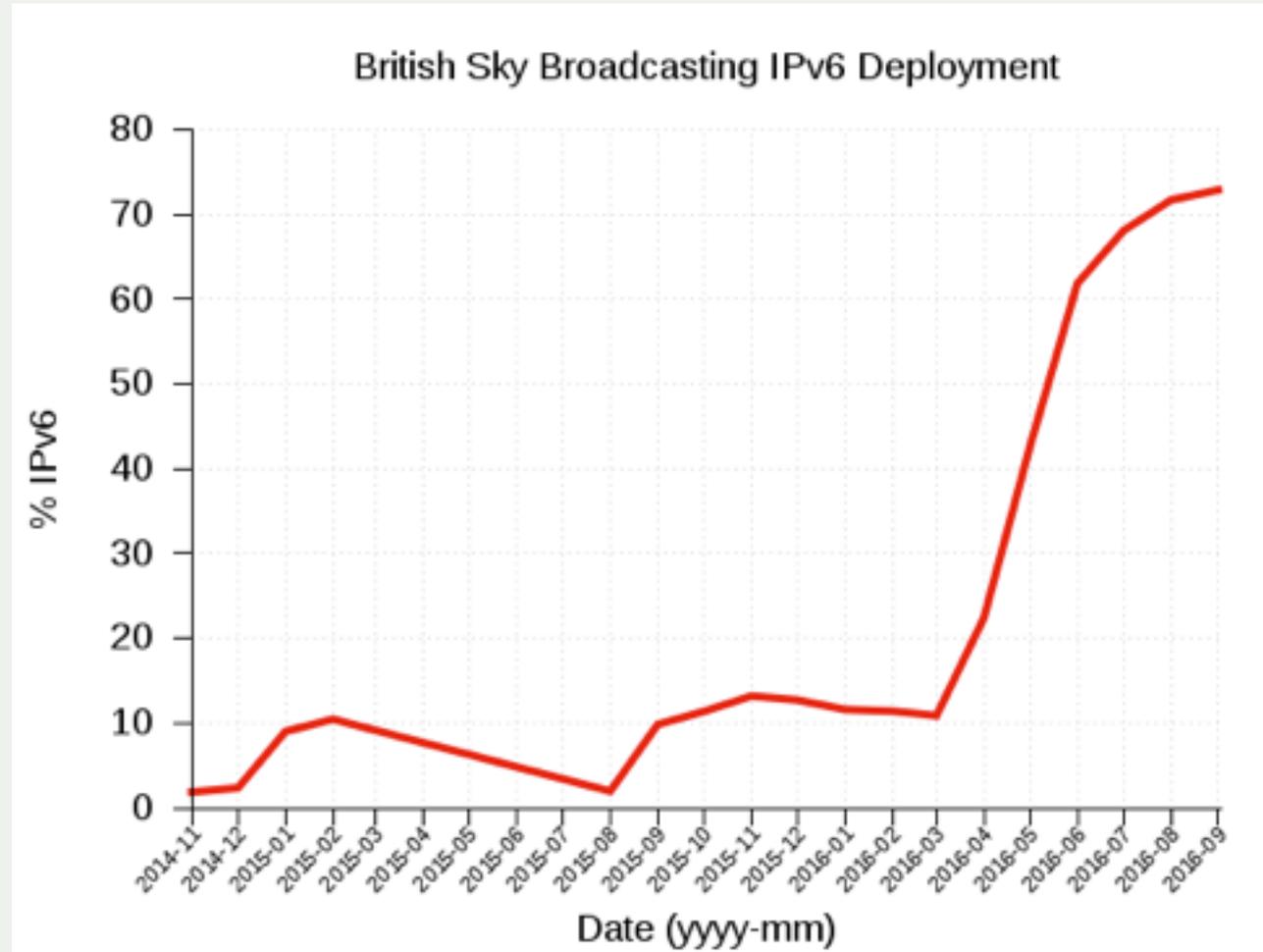
Rank	Participating Network	ASN(s)	IPv6 deployment
1	Comcast	7015, 7016, 7725, 7922, 11025, 13367, 13385, 20214, 21508, 22258, 22909, 33287, 33489, 33490, 33491, 33650, 33651, 33652, 33653, 33654, 33655, 33656, 33657, 33659, 33660, 33661, 33662, 33664, 33665, 33666, 33667, 33668, 36732, 36733	48.90%
2	ATT	6389, 7018, 7132	60.68%
3	KDDI	2516	25.48%
4	Verizon Wireless	6167, 22394	75.59%
5	Time Warner Cable	7843, 10796, 11351, 11426, 11427, 12271, 20001	30.59%
6	SoftBank	17676	15.32%
7	T-Mobile USA	21928	72.08%
8	British Sky Broadcasting	5607	72.87%
9	Deutsche Telekom AG	3320	29.37%
10	Telefonica del Peru	6147	13.87%

Showing 1 to 10 of 272 entries

First Previous 1 2 3 4 5 Next Last

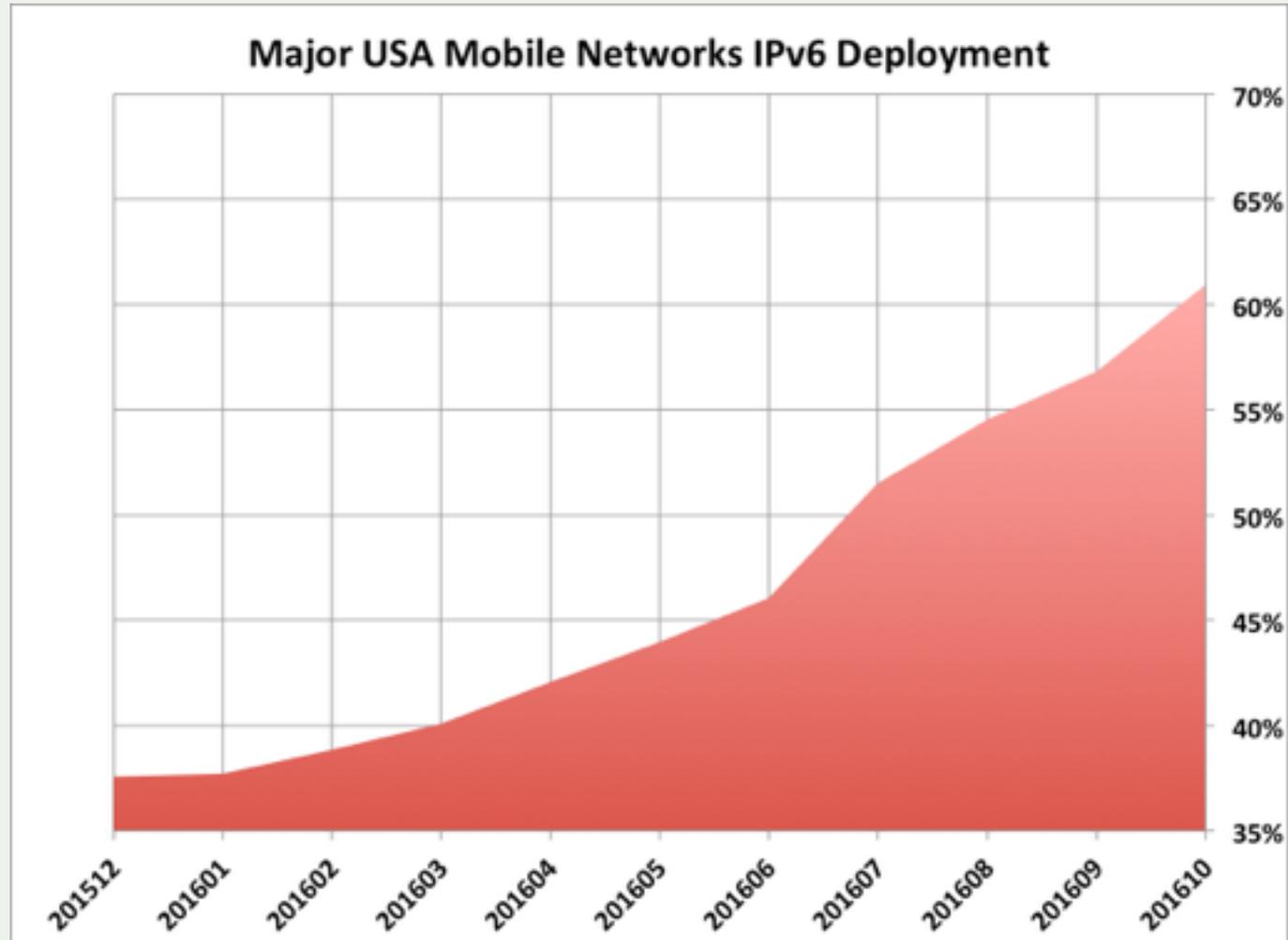
Measuring IPv6

Measuring network operators from the outside – World IPv6 Launch



Measuring IPv6

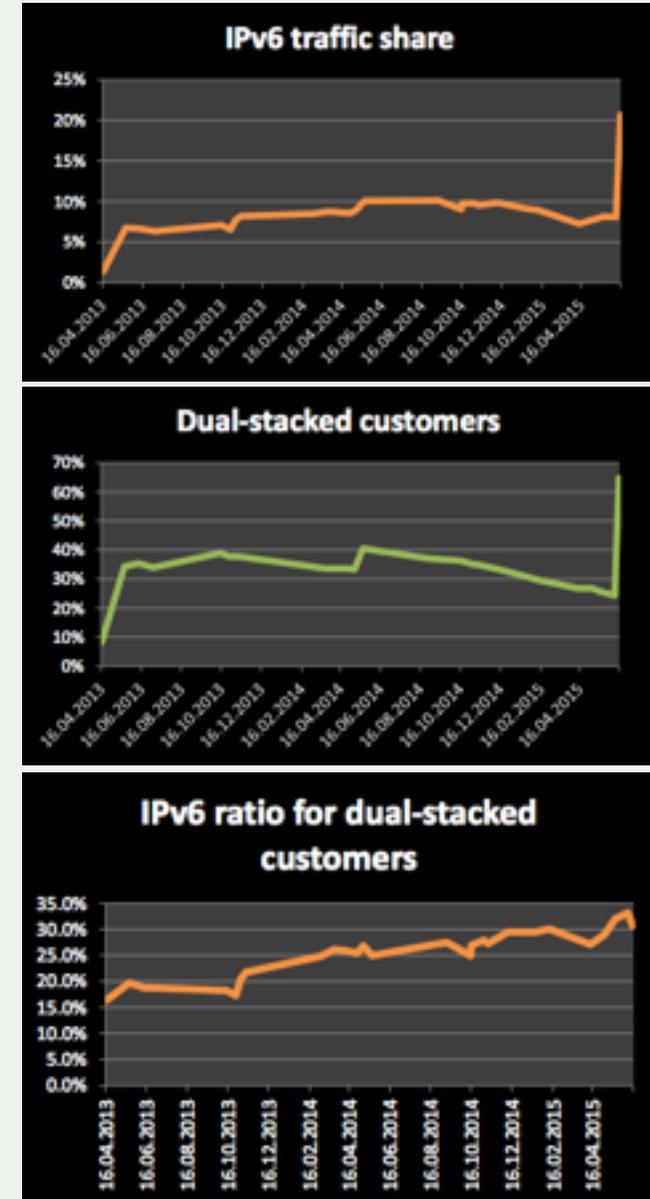
Measuring network operators from the outside – World IPv6 Launch



Measuring IPv6

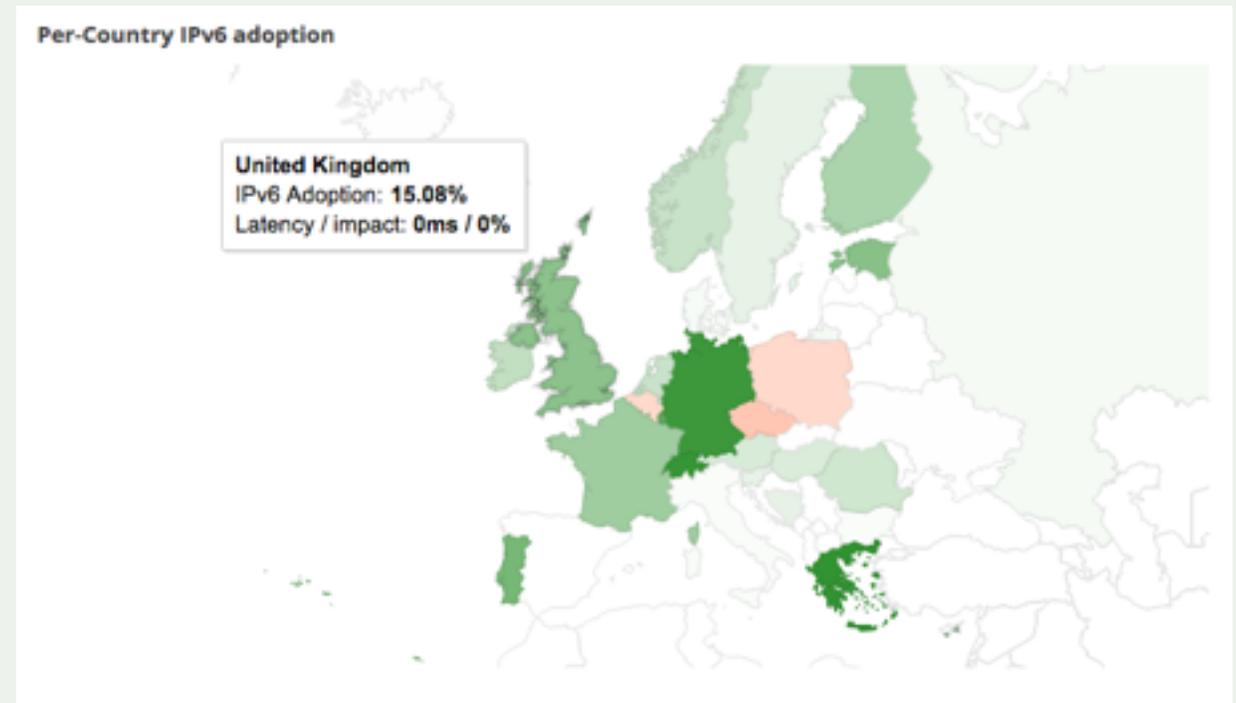
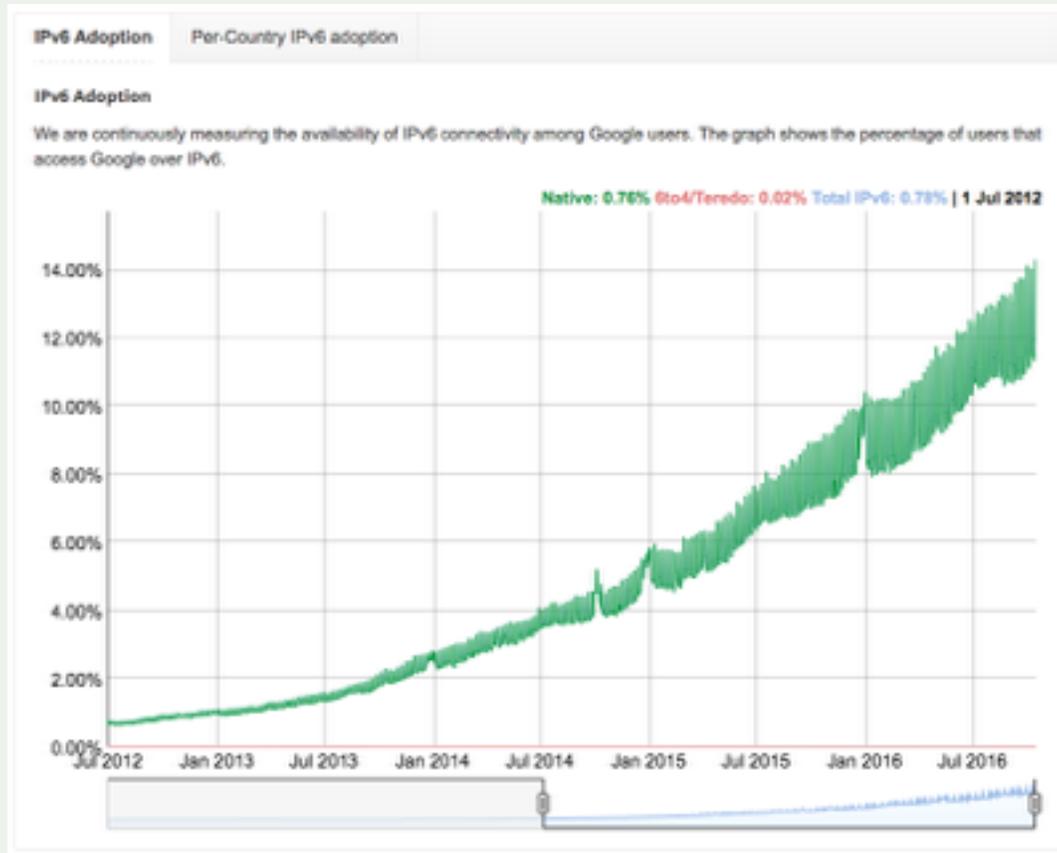
Measuring network operators from the inside

- Martin Gysi of Swisscom wrote for us in 2014
 - At that time, 35% of subscribers were IPv6-capable
 - 8.5% of peak traffic was IPv6
- Presentation on IPv6 deployment at Swisscom in mid-2015
 - 67% of subs dual-stacked
 - >20% of traffic was IPv6
 - 31% of IPv6 user's traffic was IPv6 (mostly Google)



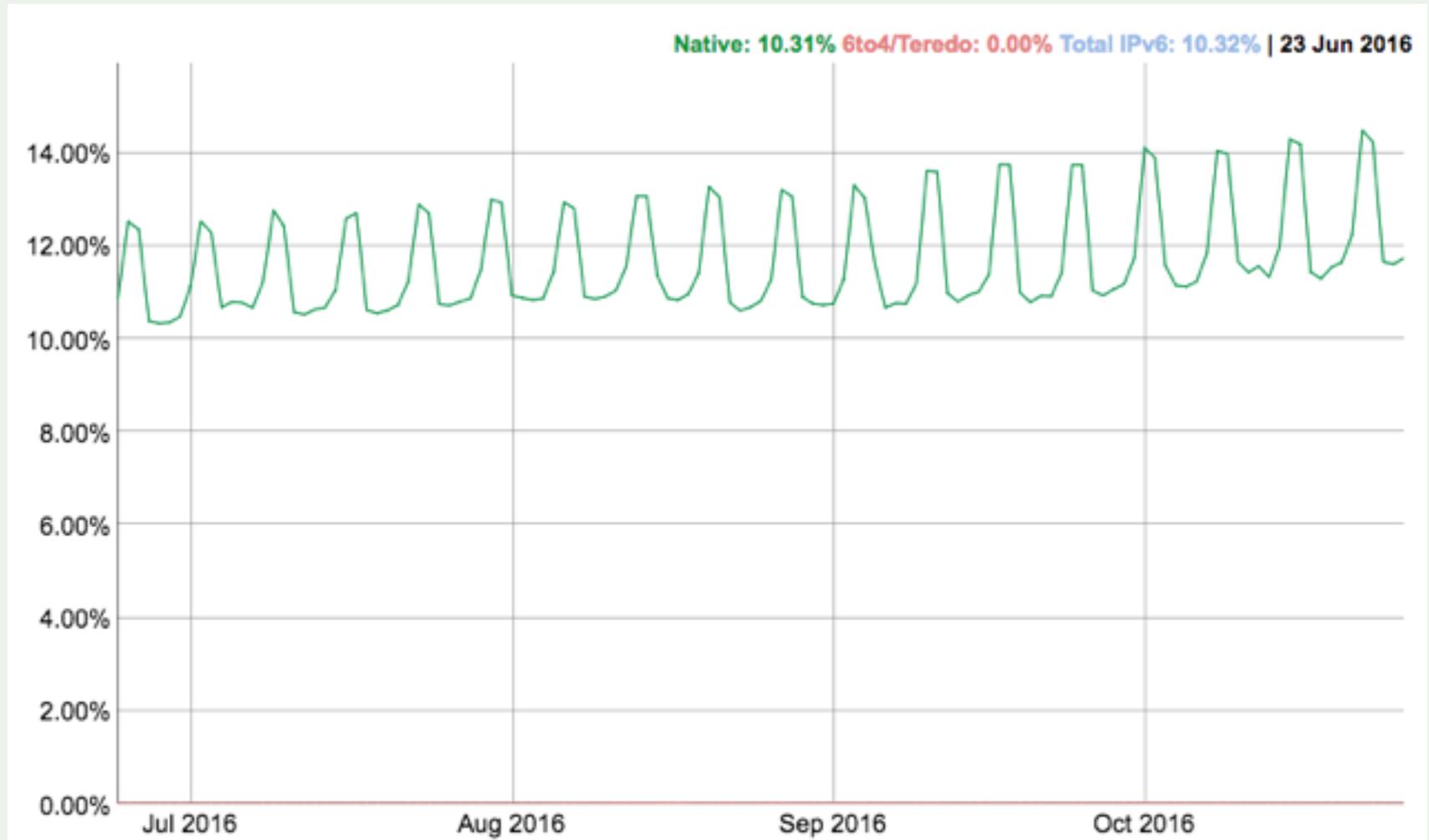
Measuring IPv6

Measuring countries – Google



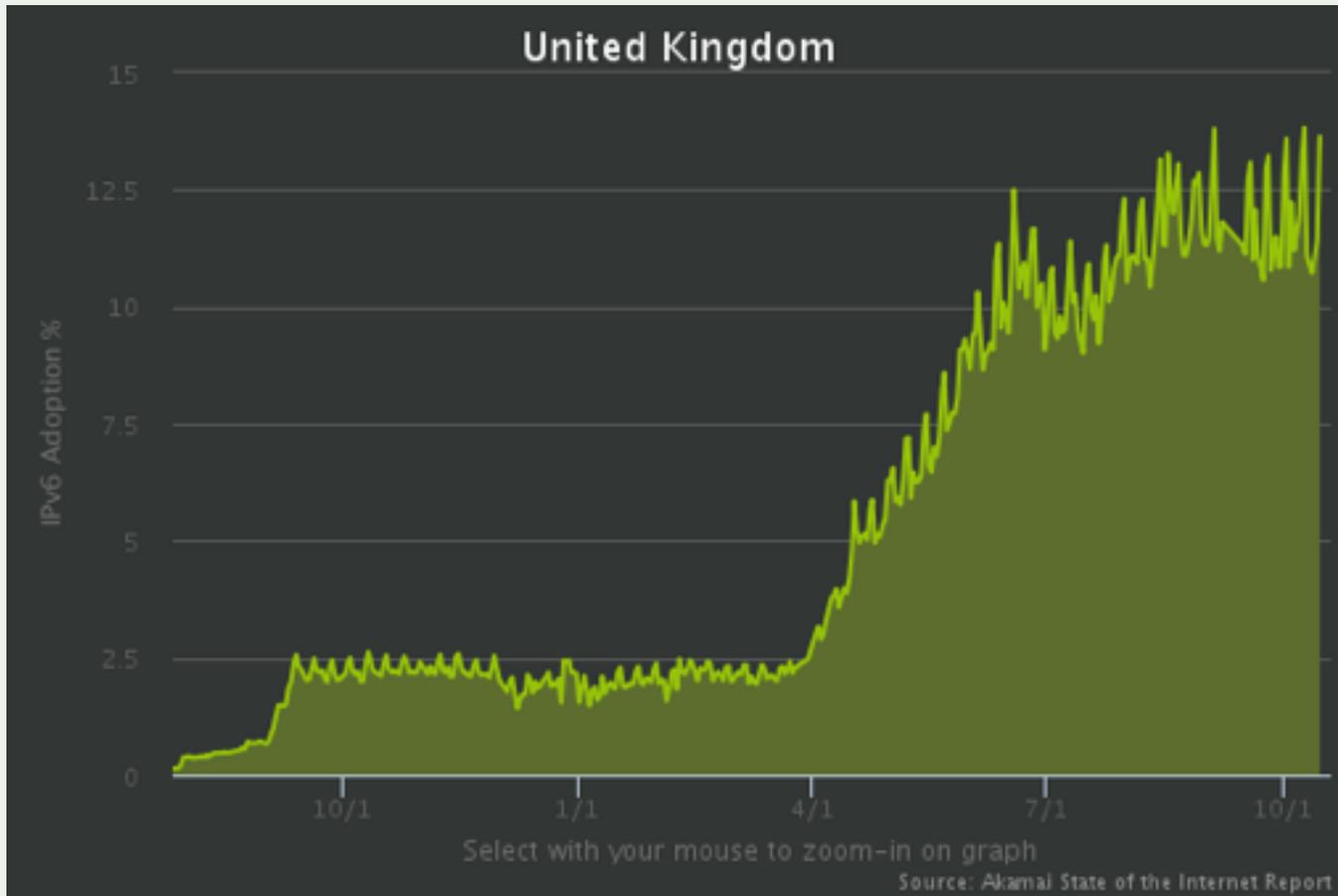
Measuring IPv6

Measuring countries – Google



Measuring IPv6

Measuring countries – Akamai

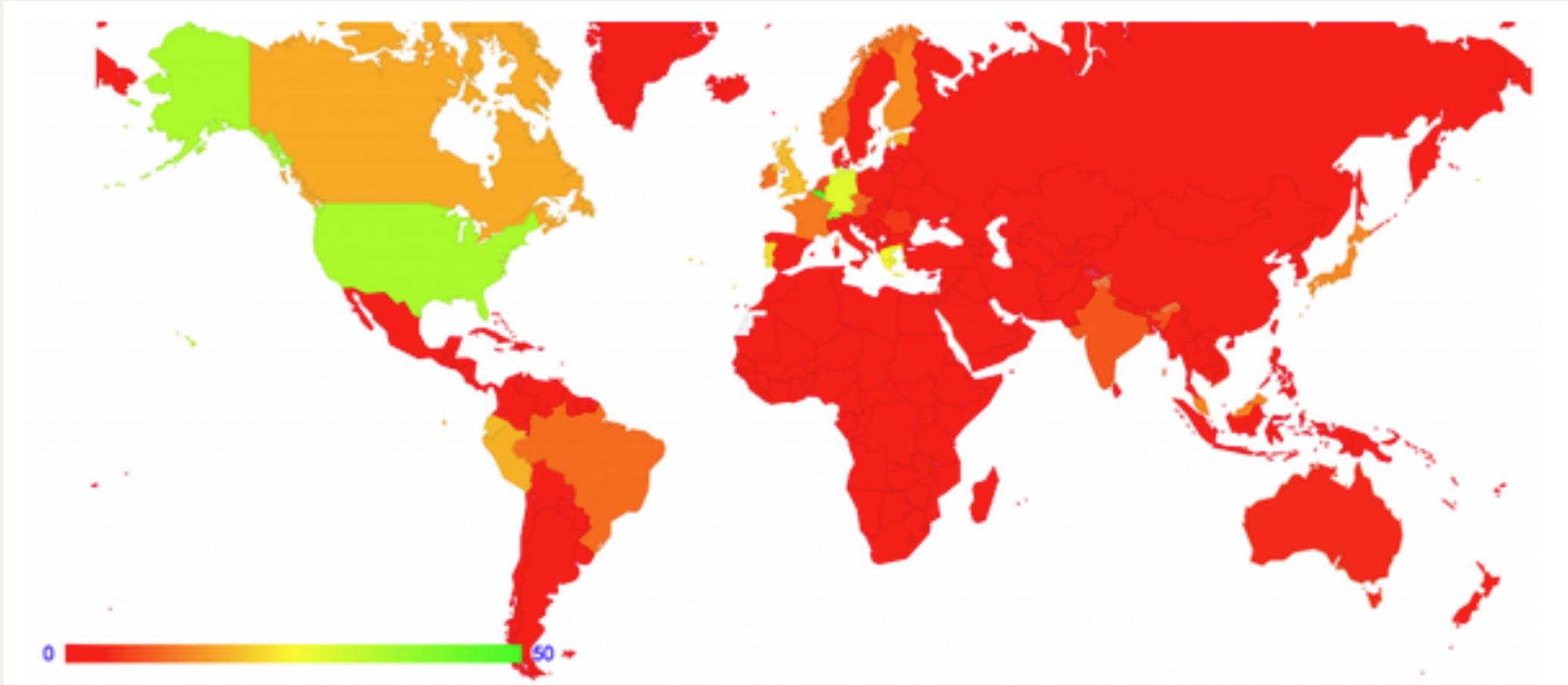


RANK	IPv6 %	COUNTRY
1	46.8%	Belgium
2	27.6%	Greece
3	26.1%	Germany
4	25.6%	Switzerland
5	25.4%	India
6	23.6%	United States of America
7	23.4%	Luxembourg
8	18.3%	Portugal
9	16.4%	Estonia
10	13.6%	United Kingdom
11	13.2%	Ecuador



Measuring IPv6

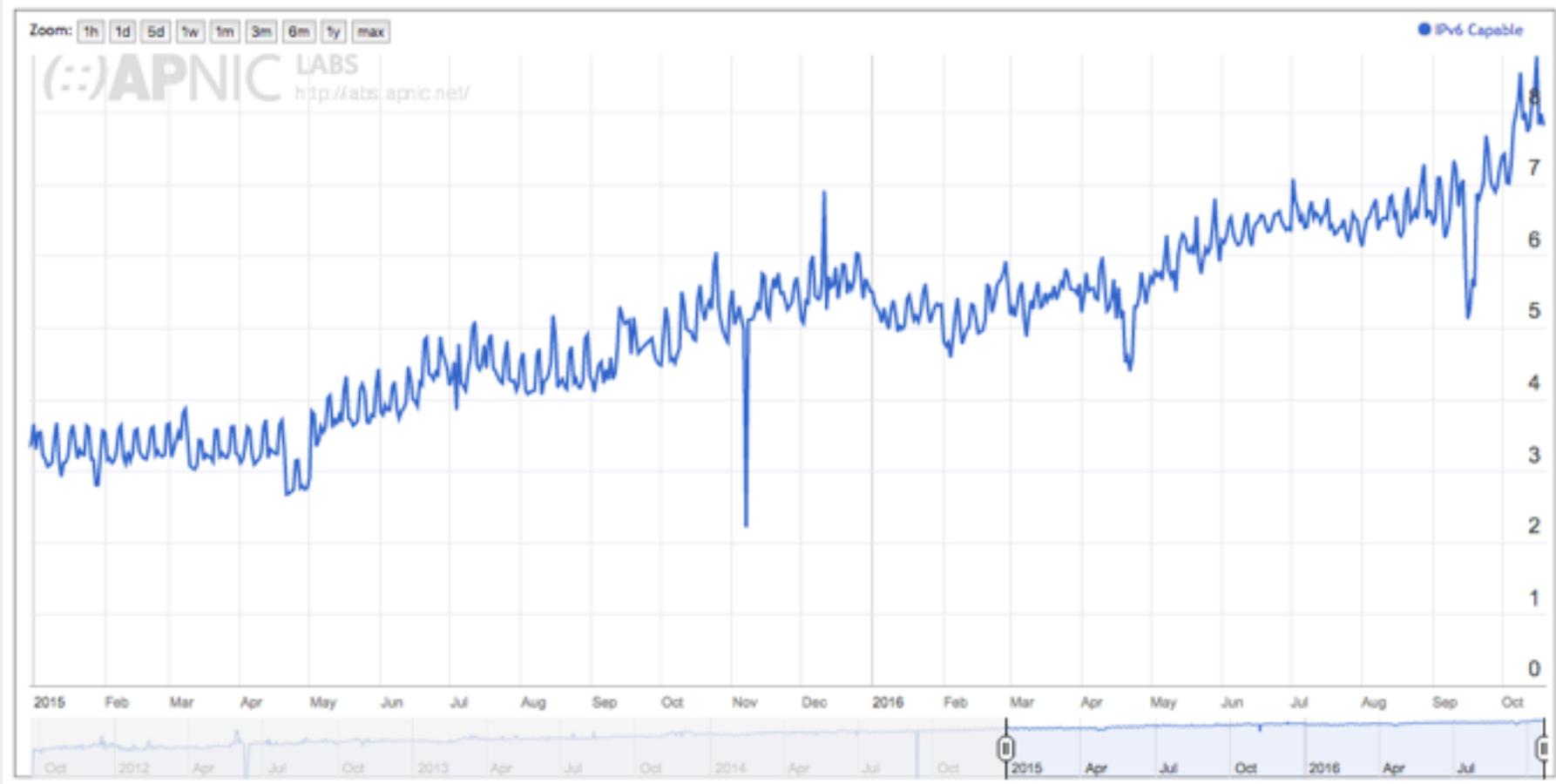
Measuring countries – APNIC



Global IPv6 deployment, as measured by the relative capability to use IPv6

Measuring IPv6

Measuring countries – APNIC



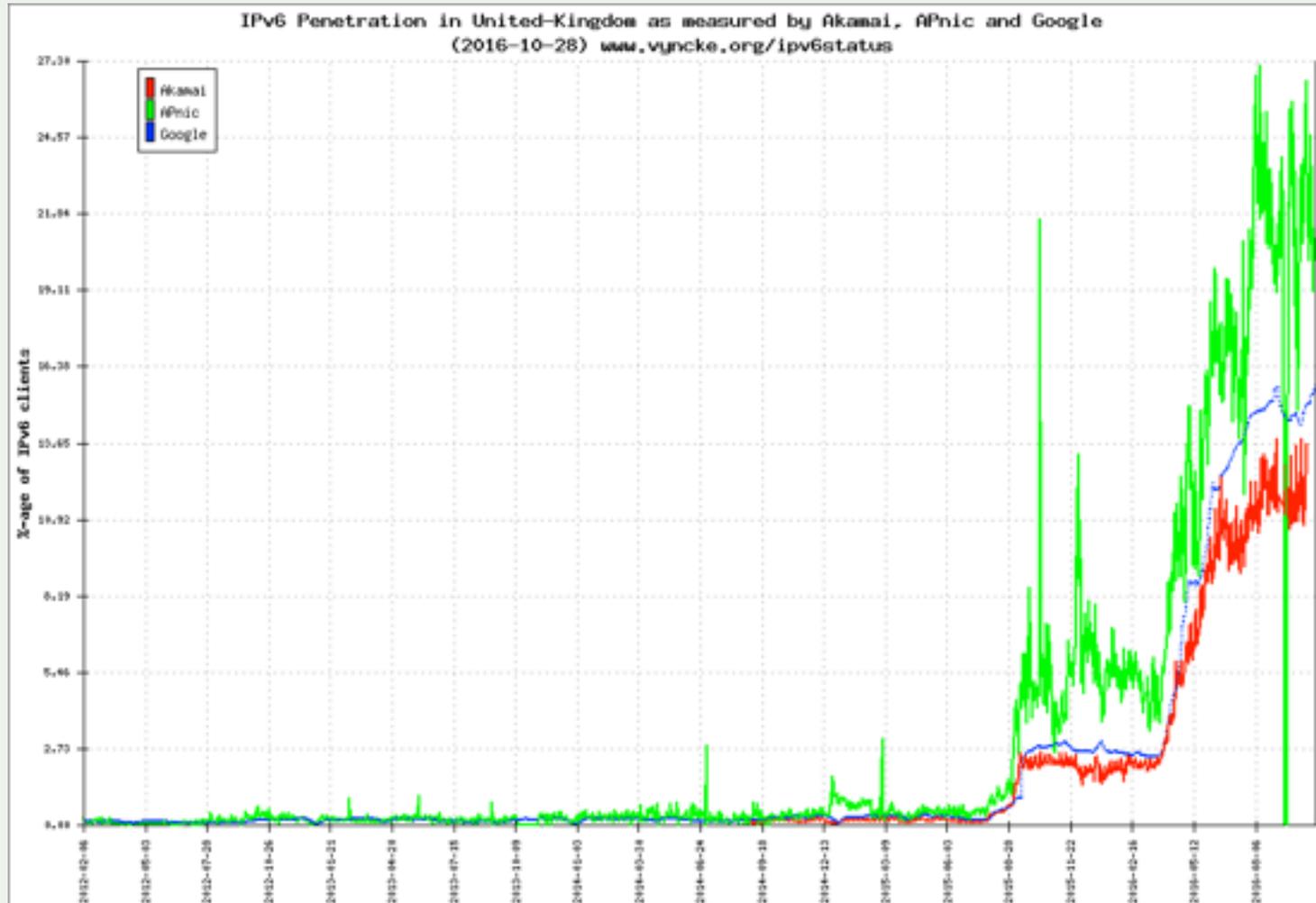
Use of IPv6 worldwide

<http://stats.labs.apnic.net/ipv6/XA>



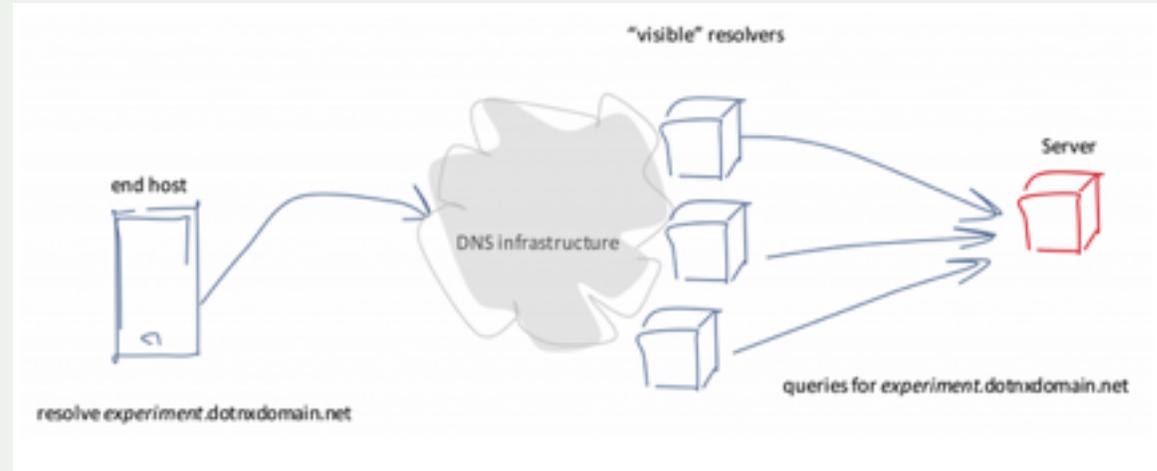
Measuring IPv6

Measuring countries – methodologies compared



Measuring IPv6

Measuring the DNS



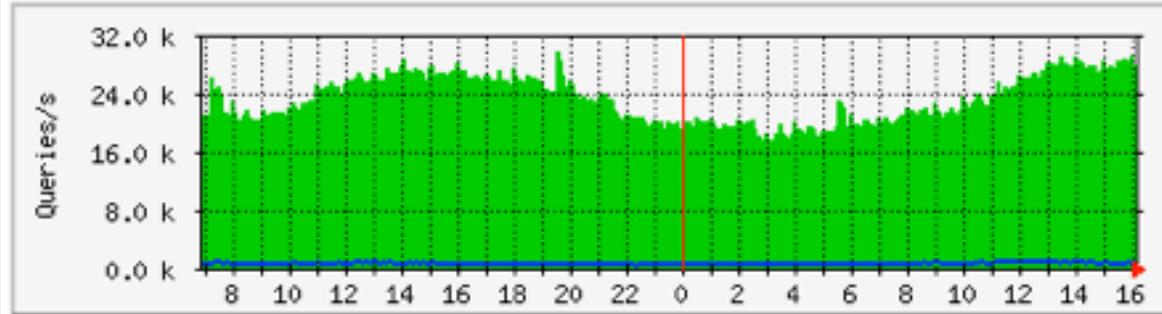
Geoff Huston, APNIC

- Around one third of the Internet's user population invoke DNS resolvers that are capable of using IPv6 to resolve a DNS name
- Half of those users are invoking Google, AT&T and Comcast
- “The DNS is well on the path of transition and perhaps further along this path than all the other elements of the Internet's infrastructure.” (<https://labs.ripe.net/Members/gih/ipv6-and-the-dns>)
- And as of earlier this month, all DNS root servers are IPv6-enabled

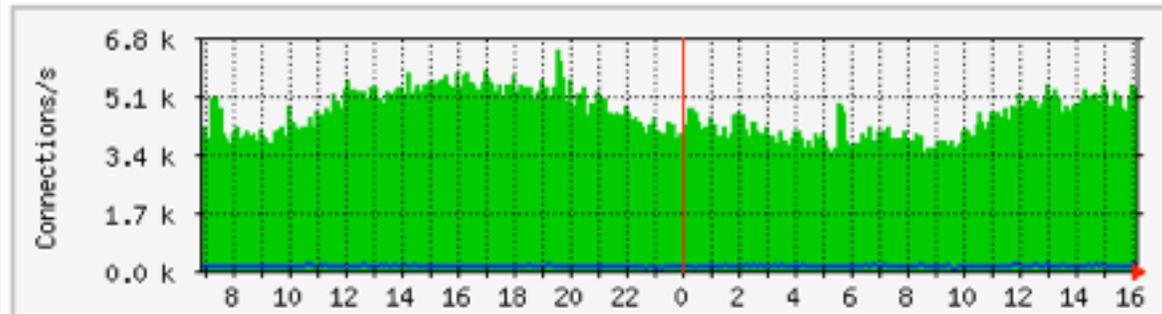
Measuring IPv6

Measuring the DNS – h.root-servers.net

IPv4 query rate



IPv6 query rate



Measuring IPv6

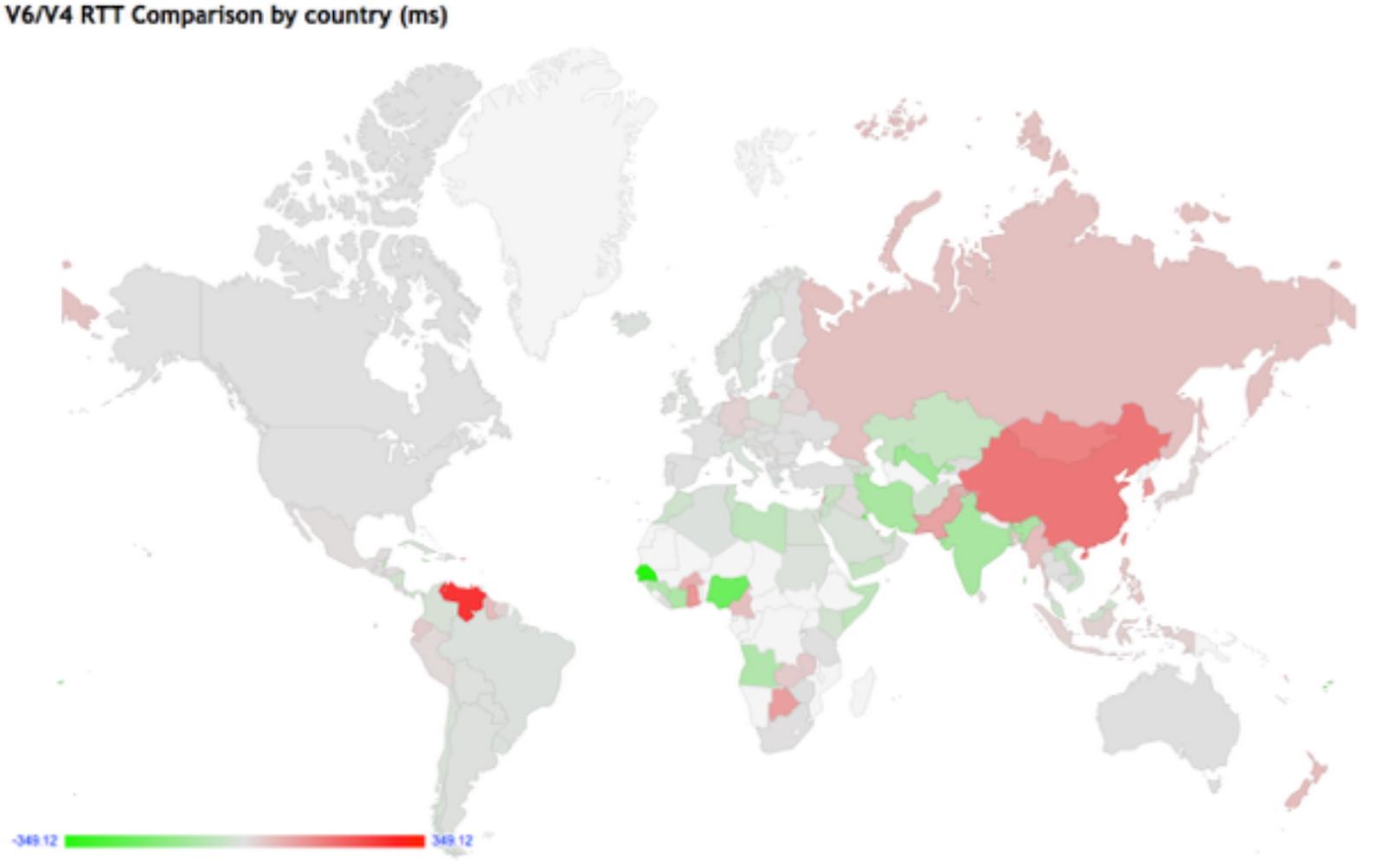
Measuring performance

- Facebook have described controlled A/B tests that show IPv6 to be 15% faster on average for devices on mobile networks in the US, with some devices showing even better results.
- Measurements using Akamai's RUM system have also shown measurable performance improvements for IPv6 connections from US mobile networks.

<https://blogs.akamai.com/2016/10/ipv6-at-edge-2016.html>

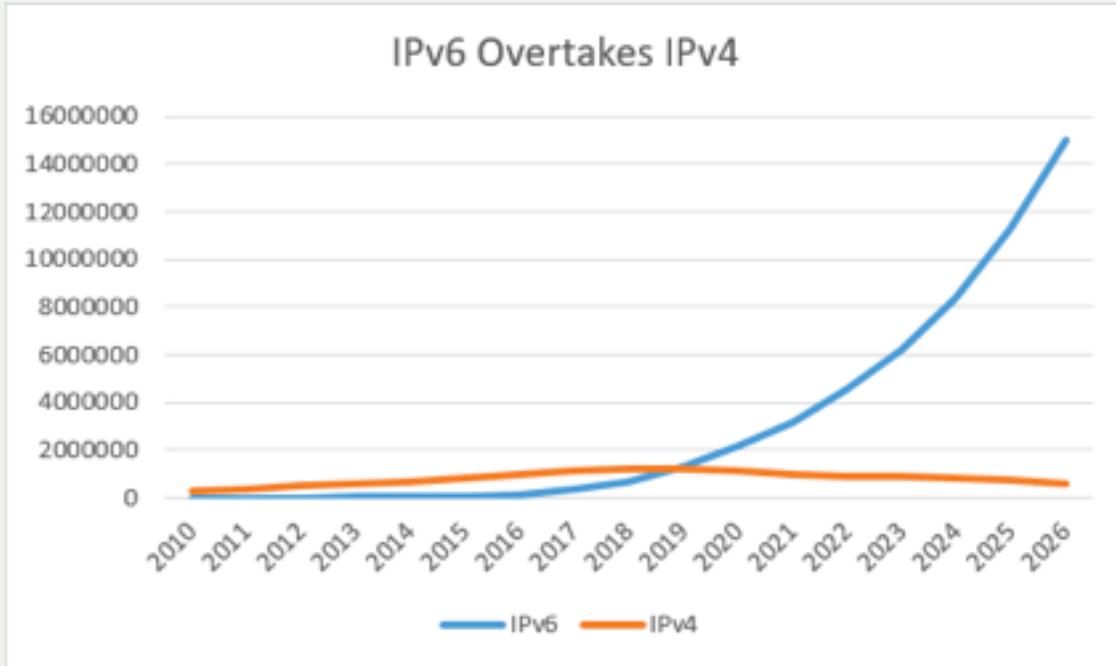
Measuring IPv6

Measuring performance – APNIC



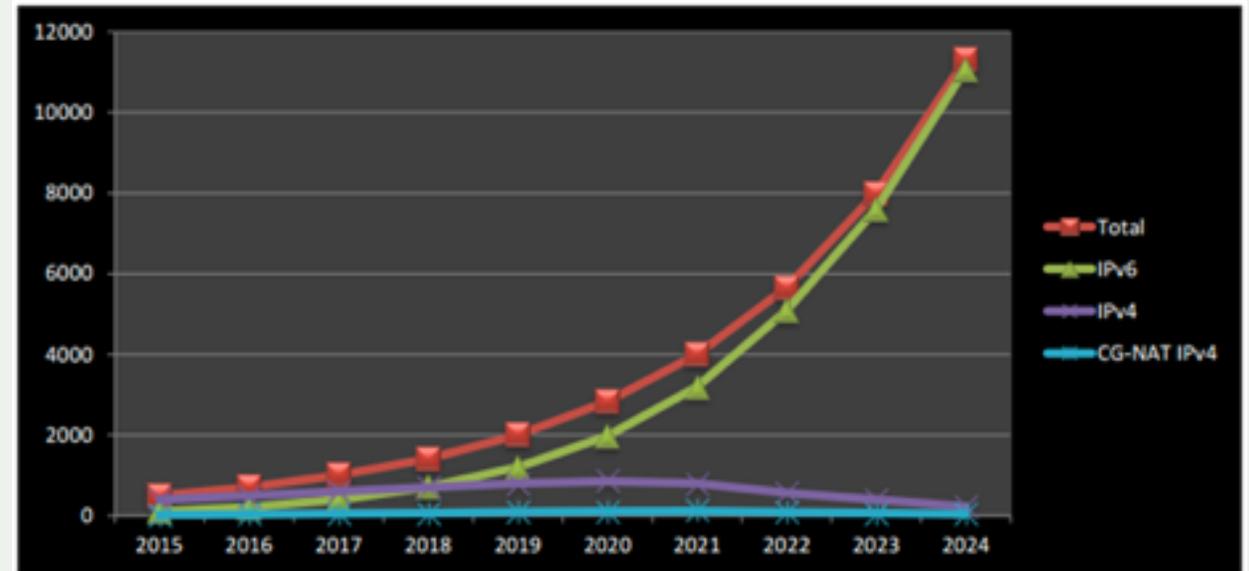
Measuring IPv6

Projecting the future – when will IPv6 overtake IPv4?



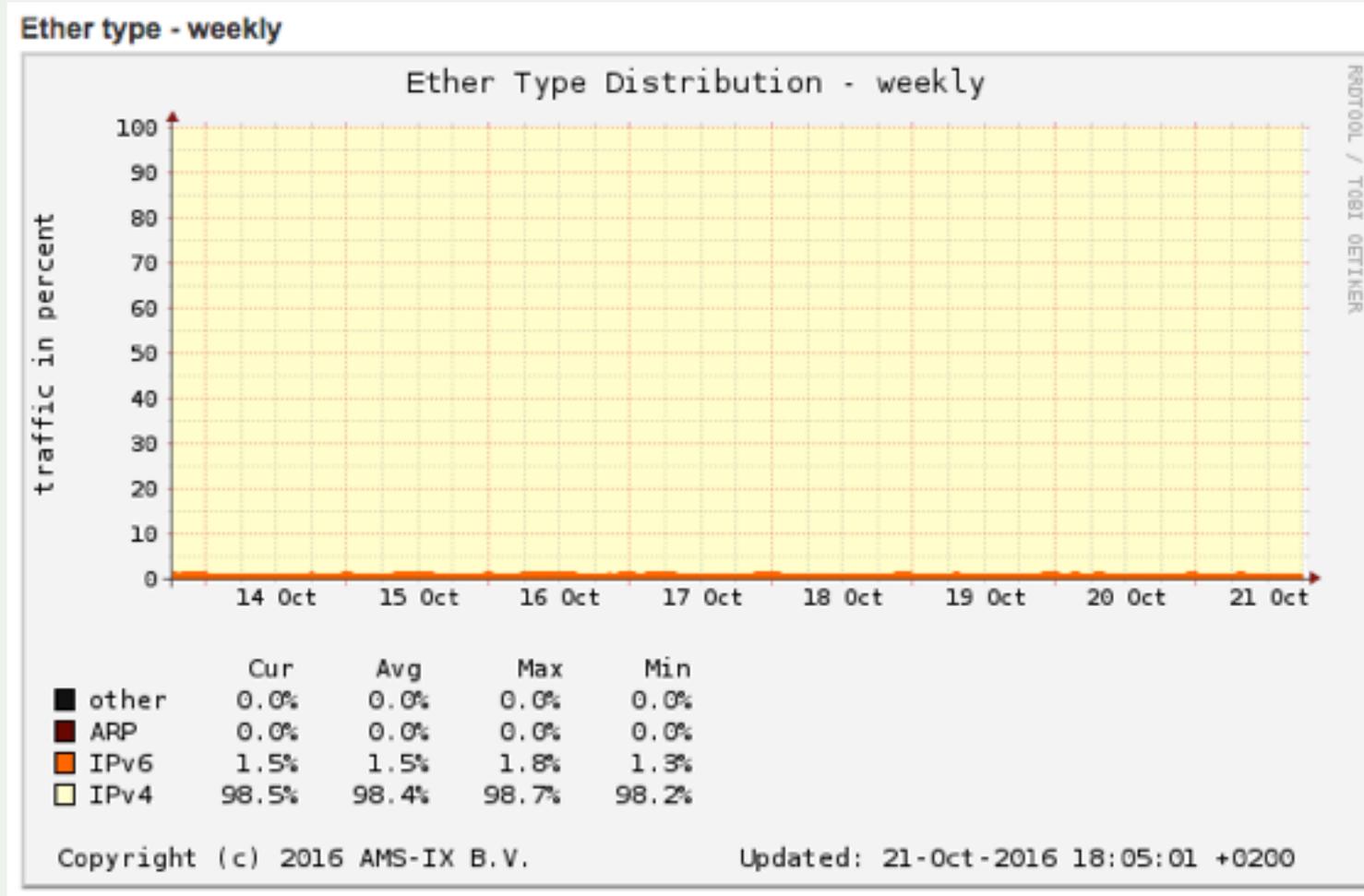
Scott Hogg, Infoblox

Martin Gysi, Swisscom



Measuring IPv6

Another vantage point – AMS-IX



Measuring IPv6

Conclusions

- IPv6 is real
- IPv6 DNS is very real
- Centralisation of hosting/DNS is helping speed up deployment in some cases
- Web content is growing slowly -> needs to be much more pervasive
- When deployments happen, they can happen fast
- IPv6 is dominant protocol in some cases
- IPv6 is faster in some cases
- Interconnection and/or deployment quality is problematic in some cases
- Different vantage points and methodologies yield different results
- IPv6 will be dominant protocol for many operators in 2 – 3 years

Sources

World IPv6 Launch: <http://www.worldipv6launch.org/measurements/>

Akamai: <https://www.akamai.com/uk/en/our-thinking/state-of-the-internet-report/state-of-the-internet-ipv6-adoption-visualization.jsp>

APNIC: <http://stats.labs.apnic.net/ipv6/> + <http://stats.labs.apnic.net/v6perf>

Google: <https://www.google.com/intl/en/ipv6/statistics.html>

Eric Vyncke: <http://www.vyncke.org/ipv6status/>

Thank you.

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