Where are we now?
IPv6 deployment update

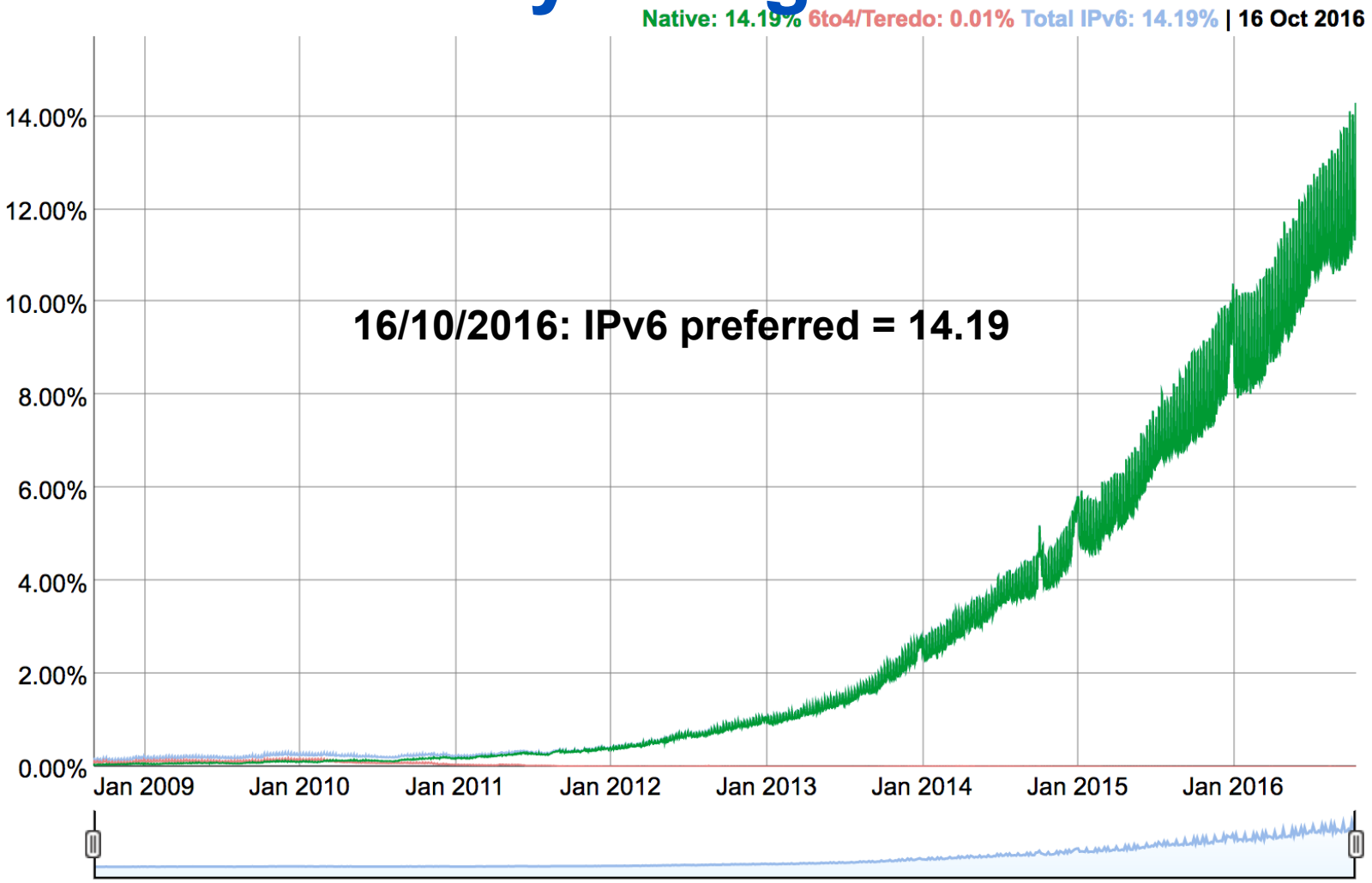
IPv6 Workshop | Chengdu & Beijing | October 2016

APNIC

Agenda

- Update on IPv6 in the world and APNIC region
  - Review of IPv6 deployment statistics
  - IPv6 performance
  - Industry trend: Mobile
  - Conclusion

IPv6 adoption statistics by Google



http://www.google.com/intl/en/ipv6/statistics.html 1490202016

IPv6 measurement by APNIC
End user readiness: World

http://stats.labs.apnic.net/ipv6/XA as of 19/10/2016

The IPv6 economy league table
IPv6 capable %

CC	Economy	IPv6 capable (%)
BE	Belgium	52.64
US	United States of America	33.69
CH	Switzerland	31.51
DE	Germany	27.63
GR	Greece	27.53
LU	Luxembourg	24.17
PT	Portugal	22.90
GB	United Kingdom	21.62
PE	Peru	18.67
EC	Ecuador	18.60
EE	Estonia	17.22
JP	Japan	15.82
MY	Malaysia	14.66

http://stats.labs.apnic.net/ipv6/ as of 19//10/2016

Malaysia

http://stats.labs.apnic.net/ipv6/MY 12/06/2016

Malaysia IPv6 leaderboard

ASN	Organization	IPv6 capable (%)
17564	GITN (M) Sdn Bhd	23.75
4788	TM Net	21.04
55720	Gigabit Hosting	9.16
38044	GITN Network	3.76
4818	DiGi Telecommunications	2.93
38466	U Mobile Sdn Bhd	2.84

http://stats.labs.apnic.net/ipv6/MY 21/06/2015)

How about East Asia?

CC	Economy	IPv6 capable (%)
JP	Japan	15.82
TW	Taiwan	1.86
HK	Hong Kong SAR	1.54
KR	Korea	1.06
CN	China	0.43
MO	Macao SAR	0.11
MN	Mongolia	0.00
KP	DPR Korea	0.00

China IPv6 leaderboard

ASN	Organization	IPv6 capable (%)
24424	Google China	100.00
23910	China Next Generation Internet (CERNET2)	99.13
7497	CST Net	36.89
4538	China Education and Research Network Centre	16.41
37943	ZhengZhou GIANT Computer Network Tech	14.15
17964	Beijing Dian-Xin-Tong Network Technologies	8.08
58543	China Telecom Guangdong IDC	4.16
38019	Tianjin Mobile Communication Company Limited	4.04
24151	CNNIC	3.90
58461	China Telecom Hangzhou IDC	2.39

http://stats.labs.apnic.net/ipv6/CN 19/10/2016

IPv6 performance

- Enough data accumulated to analyze IPv6 performance
- APNIC R&D, Geoff Huston's recent study
  - Presented @ APRICOT 2016 (Feb, 2016)

Is IPv6 as "robust" as IPv4?

Measurement: do all TCP connection attempt succeed?

Connection failure = Un-matching incoming SYN and ACK

IPv4 connection failure sits at 0.2%

IPv6 connection failure sits at 1.8%

Came down largely since 2012 (around 5%)

Still some space to improve

http://www.potaroo.net/presentations/2016-02-10-ad-measurement.pdf

IPv6 performance

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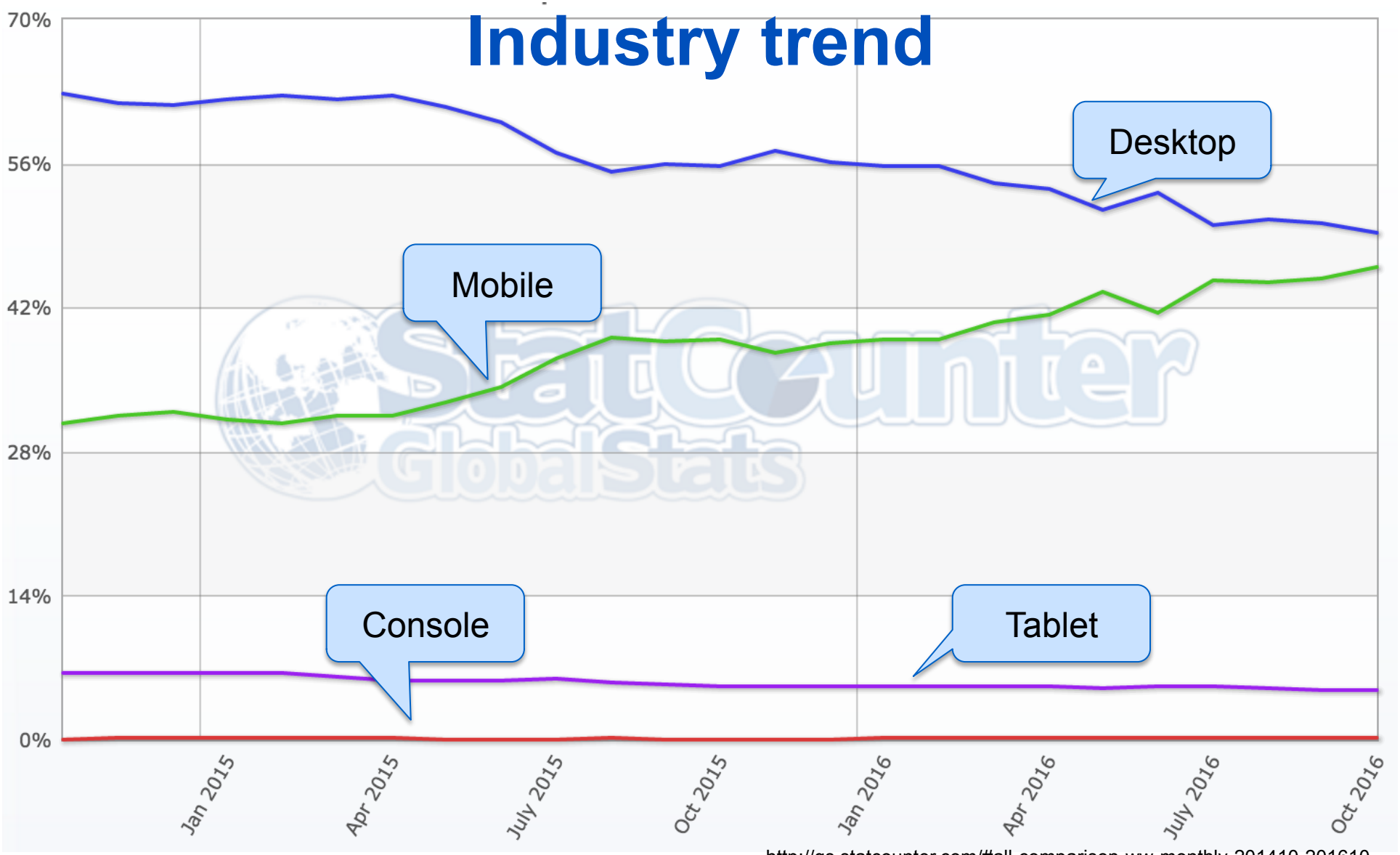
Is IPv6 as "fast" as IPv4? (use of IPv6 unicast)
Chronological comparison of RTT since 2012
RTT measurements from the SYN-ACK exchange

IPv6 as fast as IPv4
IPv6 is faster about half of the time

http://www.potaroo.net/presentations/2016-02-10-ad-measurement.pdf

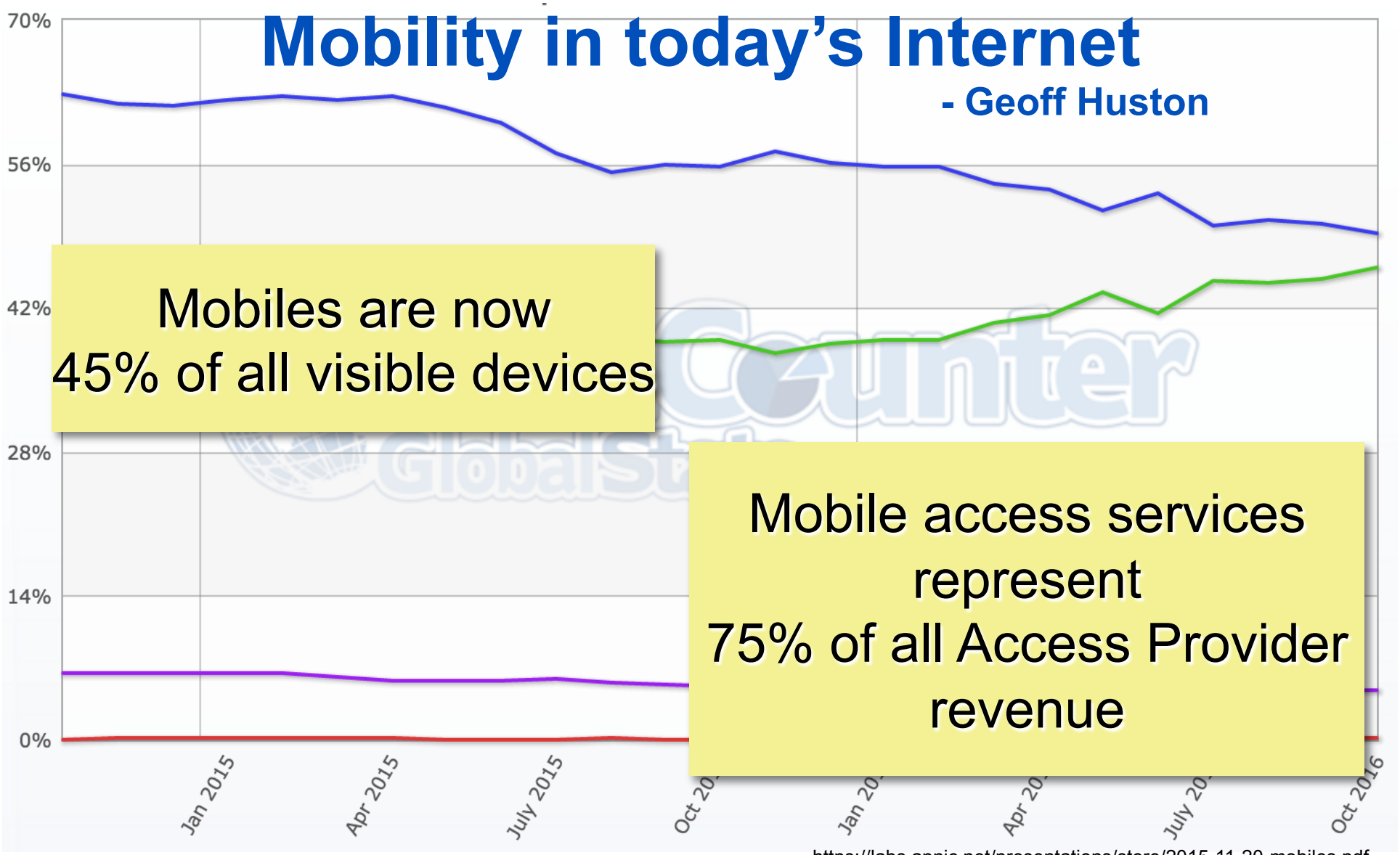
Industry trend



http://gs.statcounter.com/#all-comparison-ww-monthly-201410-201610

Mobility in today's Internet

- Geoff Huston



Mobiles are now
45% of all visible devices

Mobile access services represent
75% of all Access Provider revenue

https://labs.apnic.net/presentations/store/2015-11-20-mobiles.pdf

Industry trend: Who's playing?

Android

- 87% of all smartphone shipments in 2016Q2
- Multi-vendor adoption
- Android also extending into tablets and large screens

Apple iPhone / iPad

- 12% of all smartphone shipments in 2016Q2

Windows

- <1% market share

http://www.idc.com/prodserv/smartphone-market-share.jsp

Industry trend: Who's in control?

- Mobiles!
- The mobile market is the market "driver" for Internet technology:
  - The PC and laptop market is in terminal decline
  - Mobiles represent the highest revenue sector, and show the highest growth numbers
  - The mobile Market was born and raised on NATs
    - The IPv4 model for cellular mobile service is still heavily based on CGNs
  - The true driver for IPv6 adoption in the Internet is in the mobile sector

https://labs.apnic.net/presentations/store/2015-11-20-mobiles.pdf

IPv6 in mobile networks

- Mobile devices and IPv6
  - Android supports 464XLAT transition technology
  - Apple iOS 9 supports IPv6 only network services (Aug 2015)
    - All apps submitted to the App Store must support IPv6 starting in early 2016

https://developer.apple.com/news/?id=08282015a

- Alcatel Lucent

  'Introducing IPv6 into mobile network reduces the CG-NAT bandwidth required by the mobile operator resulting in reduced CAPEX'

  - Whitepaper published in April 2015
    - 464XLAT in mobile networks: IPv6 migration strategies for mobile networks

https://www.apnic.net/community/ipv6-program/IPv6_Migration_Strategies_for_Mobile_Networks_Whitepaper.pdf

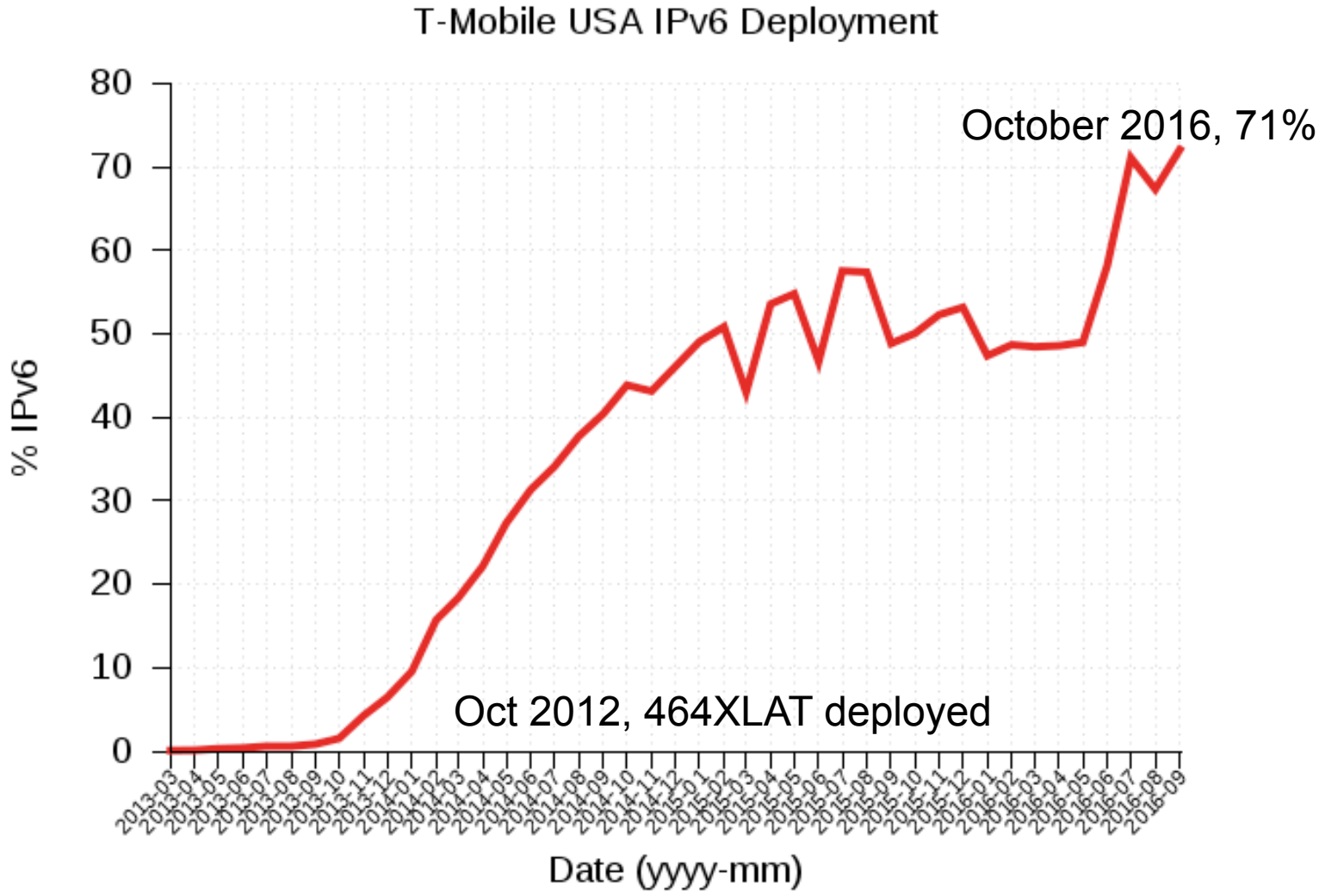
IPv6 enabled devices

- Generic Google devices
  - Nexus 5, Nexus 7
- Samsung
  - Note Family
  - Galaxy S4 onwards
- Sony
  - Xperia Z Family
  - Xperia SP
- HTC
  - One M8
- LG
  - 3G
- And more…

IPv6 in mobile networks

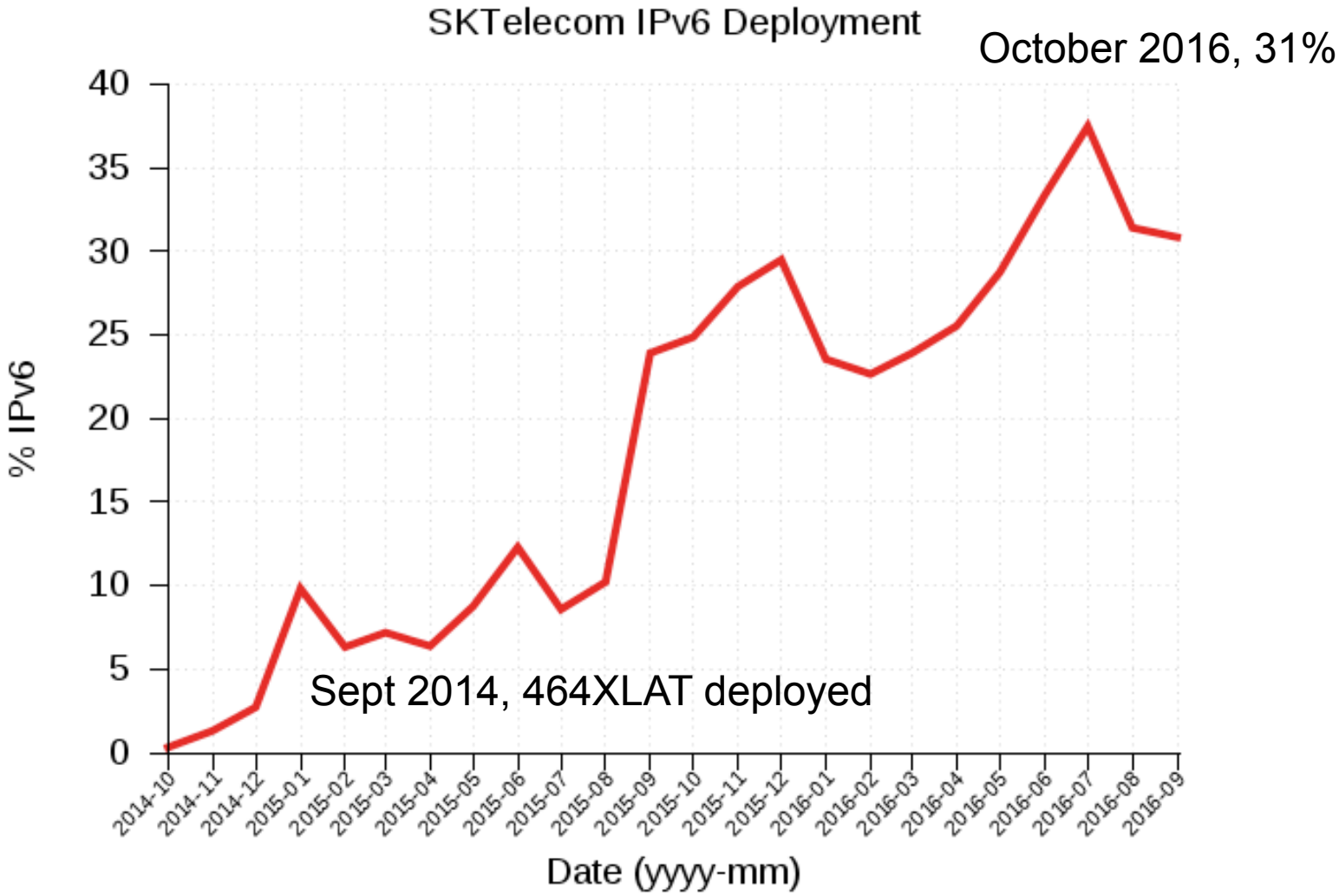
- Verizon Wireless (USA)
  - Deployed dual stack transition technology in 2011
- T-Mobile USA (USA)
  - Deployed IPv6 transition technology (464XLAT) in Oct 2012
- Telstra Australia (Australia)
  - Deployed IPv6 transition technology (464XLAT) in Sept 2016
- SK Telecom (Korea)
  - Deployed IPv6 transition technology (464XLAT) in July 2014
  - Why did SKT adopt IPv6 in their mobile networks?
    - CAPEX for Network Address Translator (NAT) equipment
    - Difficult to operate duplicated networks
    - Korean government's encouragement

T-Mobile USA



http://www.worldipv6launch.org/apps/ipv6week/measurement/images/graphs/T-MobileUSA.png 21/10/2016

SK Telecom (KR)



http://www.worldipv6launch.org/apps/ipv6week/measurement/images/graphs/SKTelecom.png 17/05/2016

Mobile networks

- The business competency of mobile network operators:
  - Shifting from being a traditional voice and messaging provider to a mobile broadband service provider
  - Services on voice, messaging and data are converging on IP based services
  - Rapidly increasing LTE deployment in the region
- Decision makers' (mobile network operators) view
  - Ready to move to Voice over LTE?
  - Mobile cloud computing on top of the LTE network?
  - What are key building blocks for all-IP strategy?

http://lteconference.wordpress.com/

Conclusion

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Observations

- IPv6 deployment is increasing steadily
  - New organizations are rapidly getting ready with IPv6
  - But varies among regions, economies, and individual ASNs
  - Not happening simultaneously
  - Some economies and ASNs have been very active in terms of IPv6 deployment
    - Close to 80% of end users are via IPv6 in some ASNs
    - Particularly some mobile network operators and cable TV operators
    - Regional smaller size operators show higher level of IPv6 readiness
    - Once they enable IPv6 in their network and handsets, their end-user readiness grows VERY rapidly
    - It strongly impacts respective economy's IPv6 readiness level

www.apnic.net/ipv6

- ▸ Policy development
- ▸ Participation
- ▸ Community activities
- ▸ IANA transition
- ▸ Internet ecosystem
- ▸ Security@APNIC
- ▾ IPv6@APNIC
  - ▸ Key IPv6 messages
  - ▸ IPv6 data and statistics
  - ▸ IPv6 transition stories
  - ▸ IPv6 for governments
  - ▸ IPv6 for mobile networks
  - ▸ IPv6 Best Current Practices
  - ▸ IPv6 for Decision Makers
  - ▸ IPv6 for CTOs
  - ▸ About CGN
- ▸ IPv4 post-exhaustion
- ▸ IPv4 exhaustion

IPv6@APNIC

IPv6 is a top issue for the Asia Pacific Internet community. APNIC engages in activities throughout the region to help facilitate a smooth transition. The greater goal is to support the Asia Pacific in deploying IPv6 to maintain a scalable Internet for everyone.

APNIC reached the last /8 of IPv4 addresses in April 2011, and now delegates IPv4 resources according to the "last /8 policy". The scarcity of IPv4 makes IPv6 deployment critical for all networks and organizations in the Asia Pacific. Here's what APNIC is doing to support the community in achieving real and tangible IPv6 deployment:

Distributing IPv6 addresses

Getting an IPv6 block is the first step in your transition, and the process is very simple.
Kickstart IPv6 - one click to IPv6

IPv6 training and education

Is your technical staff ready to deploy IPv6? Gaining technical knowledge does not happen overnight. Plan and implement training for your personnel. APNIC Training is constantly updating our IPv6 content, to reflect the industry's best current practices.
Upcoming training events

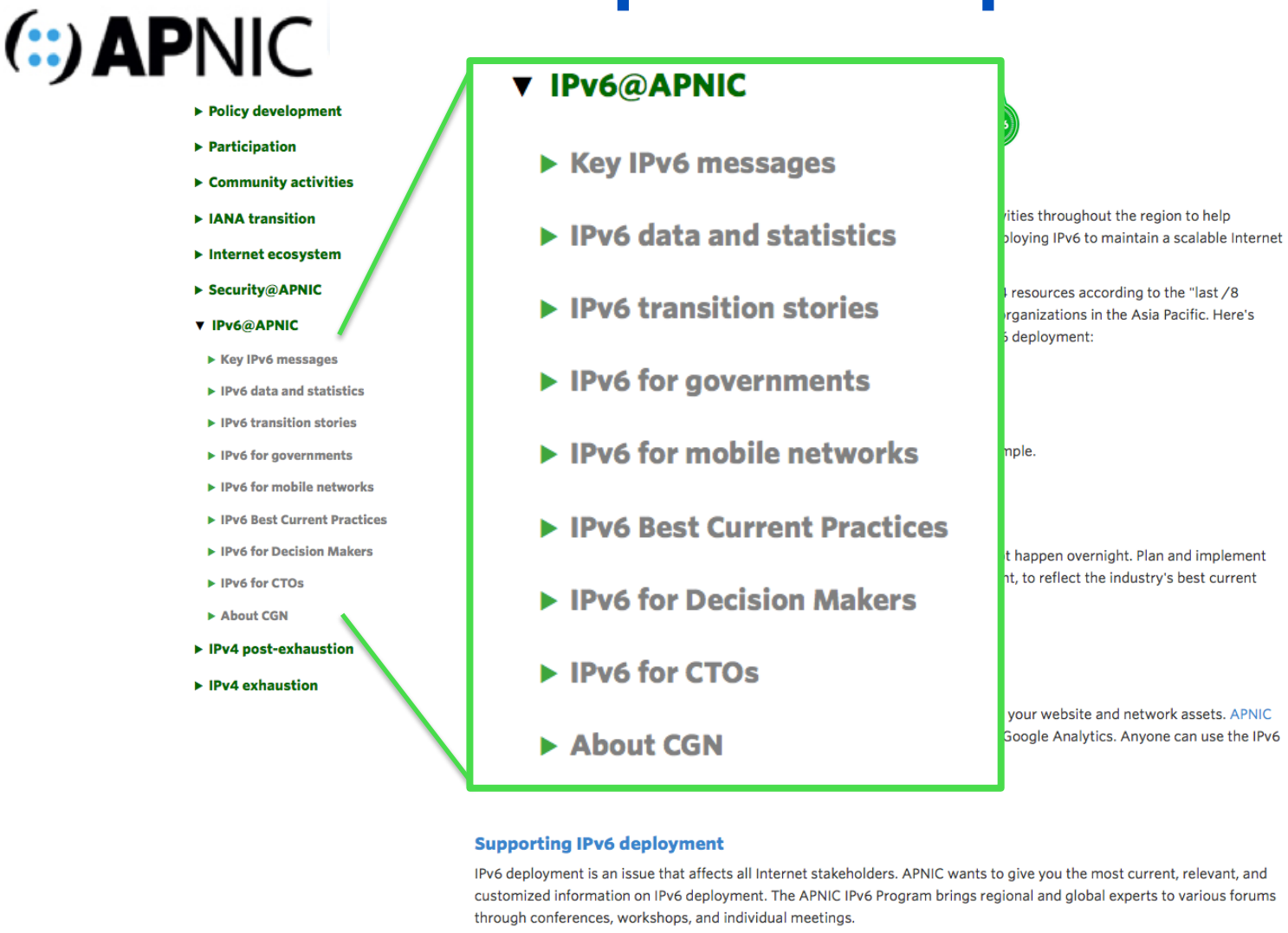
Monitoring IPv6 deployment

Do you offer your services over IPv6? Understand your clients' capabilities, facing your website and network assets. APNIC Labs has designed a javascript test system that reports on end-user capability in Google Analytics. Anyone can use the IPv6 Tracker, even without native IPv6 capability.
Learn more about APNIC Labs IPv6 measurements.

Supporting IPv6 deployment

IPv6 deployment is an issue that affects all Internet stakeholders. APNIC wants to give you the most current, relevant, and customized information on IPv6 deployment. The APNIC IPv6 Program brings regional and global experts to various forums through conferences, workshops, and individual meetings.

www.apnic.net/ipv6



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