

Where are we now?

IPv6 deployment update

IPv6 Infrastructure Workshop | 19-21 June 2017 | Thimphu, BT

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APNIC



Agenda

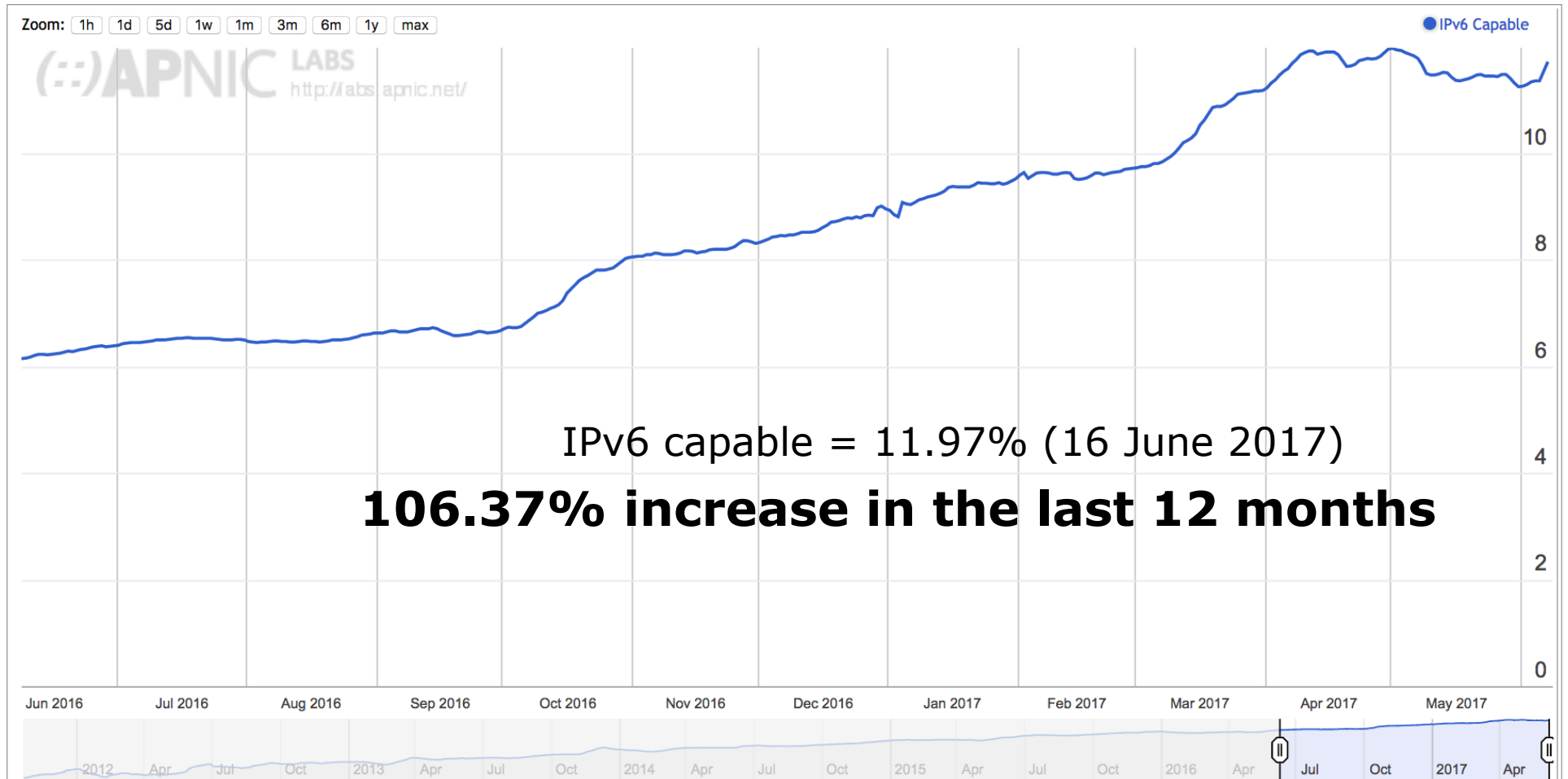
- IPv6 End-User Readiness
- IPv6 Performance
- Industry Trends
- Observations

IPv6 stats from: <https://stats.labs.apnic.net/ipv6>
Retrieved: 16 June 2017

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Global IPv6 End-User Readiness



The IPv6 economy league table

CC	Economy	IPv6 capable (%)
BE	Belgium	54.71
IE	Ireland	50.68
DE	Germany	43.25
CH	Switzerland	37.18
US	United States	37.13
GR	Greece	34.95
LU	Luxembourg	34.07
IN	India	32.06
EE	Estonia	31.55
GB	United Kingdom	24.62
JP	Japan	24.51
PT	Portugal	22.94
FR	France	19.50
TT	Trinidad and Tobago	18.84

The IPv6 economy league table

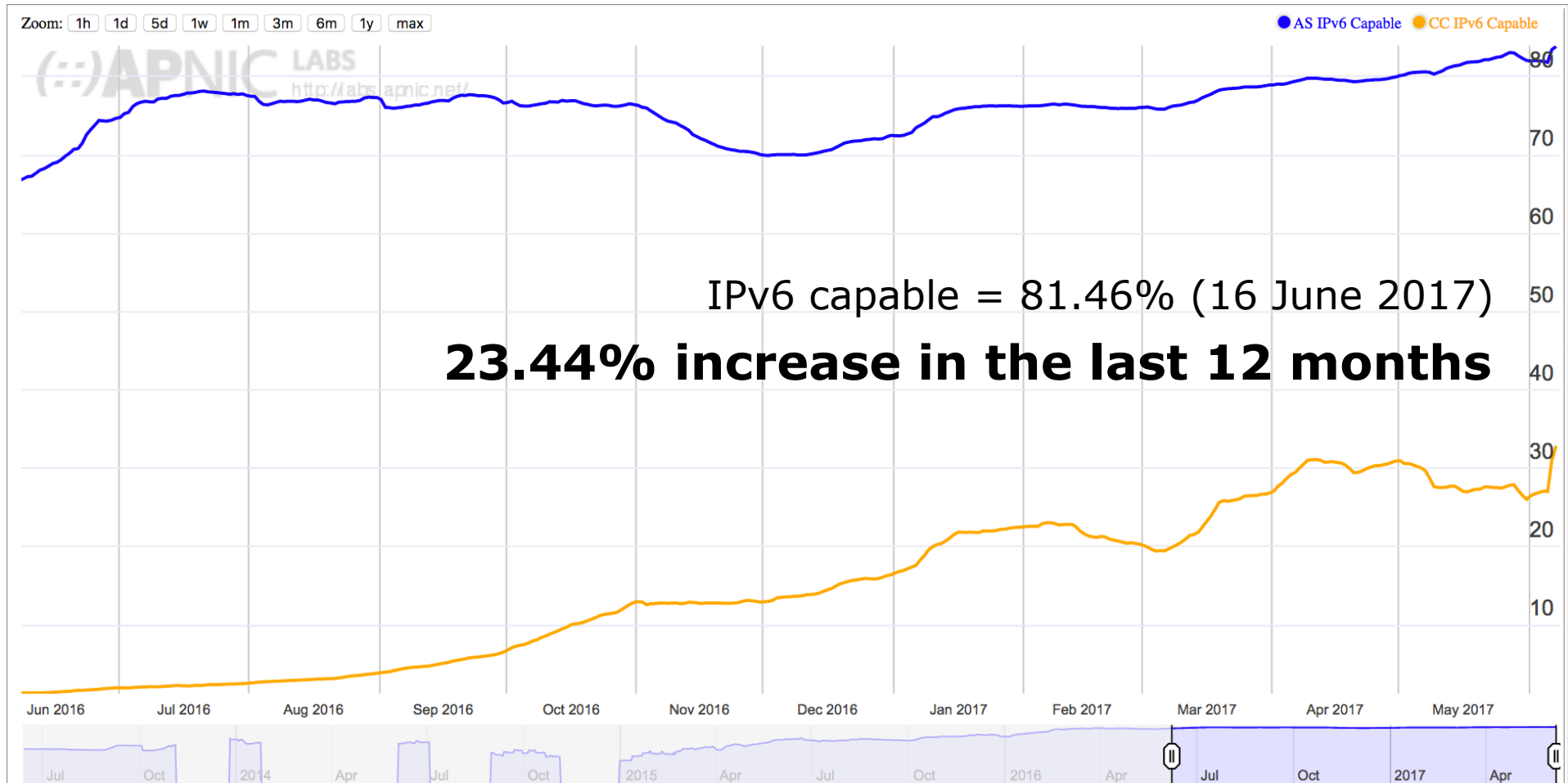
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India IPv6 leaderboard

ASN	Organization	IPv6 capable (%)
55836	Reliance Jio Infocomm	81.46
131222	MTS India	26.46
55441	TTSL	14.97
45271	Idea Cellular	11.14
10199	Tata Communication	10.29
55740	Tata Teleservices	9.84
38266	Vodafone Essar	1.83
45609	Bharti Airtel	0.74
18196	Seven Star ISP	0.58
23870	Telenor Communications	0.50

AS55836: Reliance Jio



How about South Asia?

CC	Economy	IPv6 capable (%)
 IN	India	32.06
LK	Sri Lanka	3.30
 BT	Bhutan	0.43
AF	Afghanistan	0.12
PK	Pakistan	0.03
BD	Bangladesh	0.01
MV	Maldives	0.00
NP	Nepal	0.00

Bhutan Stats

- 291,631 Internet users
- 37% Internet penetration
- 8 ASNs
- 0.43% IPv6 readiness



IPv4	
Addresses	29,952
Per Capita	0.04
ASNs in BGP	6
% Visible	91%

IPv6	
Addresses	475 x10 ²⁷
Per Capita	6.34 x10 ²³
ASNs in BGP	5
% Visible	33%

Bhutan: IPv6 End-User Readiness



Bhutan IPv6 leaderboard

ASN	Organization	IPv6 capable (%)
38740	TashiCell	1.29
17660	DrukNet	0.21

Bhutan IPv6 leaderboard

ASN	Organization	IPv6 capable (%)
38740	TashiCell	1.29
17660	DrukNet	0.21

ASN	Organization	Delegated prefix	Routed
38740	TashiCell	2405:ec00::/32	YES
17660	DrukNet	2405:d000::/32	YES
132232	DCS	2403:8700::/32	YES
136039	NANO	2400:50c0::/32	YES
135666	MoIC	2400:1440::/32	YES
134715	DrukREN	2403:580::/32	NO
	ThimphuIX	2001:deb:8000::/48	NO

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?**
 - Do all TCP connection attempt succeed?
 - Connection failure = No ACK for acknowledged SYN
 - IPv4 connection failure sits at 0.2%
 - IPv6 connection failure sits at 1.8%

[source : <http://www.potaroo.net/presentations/2016-02-10-ad-measurement.pdf>]

IPv6 performance

- Enough data accumulated to analyze IPv6 performance
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- **Is IPv6 as fast as IPv4?** (IPv6 unicast)
 - Comparison of RTT (e2e)
 - Time since SYN till ACK (factors out any congestion issues)
 - IPv6 is faster about half of the time
 - 36-90ms faster
 - **IPv6 as fast as IPv4**

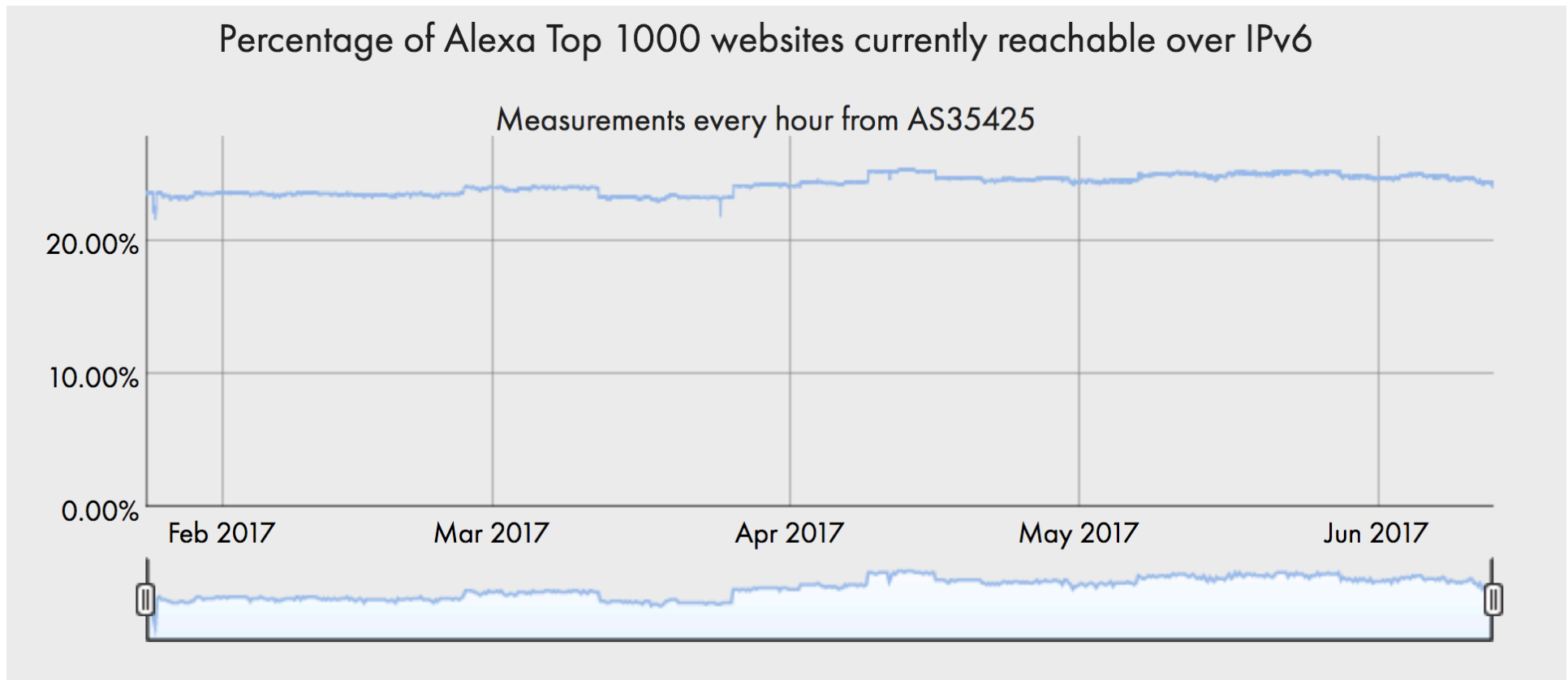
[source : <http://www.potaroo.net/presentations/2016-02-10-ad-measurement.pdf>]

IPv6 performance

- There are good use cases and implementation
- LinkedIn Senior Director of Infrastructure Engineering, Zaid Ali Kahn
 - [Presented @ APNIC42 \(September, 2016\)](#)
- **IPv6 at LinkedIn**
 - For some select networks in Europe, LinkedIn is seeing up to **40% performance improvements over IPv6**, and in the **US, up to 10%**.
 - **TCP timeout on IPv4 over mobile** carrier networks is as high as **4.6%** and **IPv6 timeouts** are on a much lower side at **1.6%**.

[source : <https://blog.apnic.net/2016/05/13/linkedin-ipv6-measurements/>]

Industry Trend: Content



[source : <http://www.worldipv6launch.org/measurements/>]

Internet usage in Bhutan

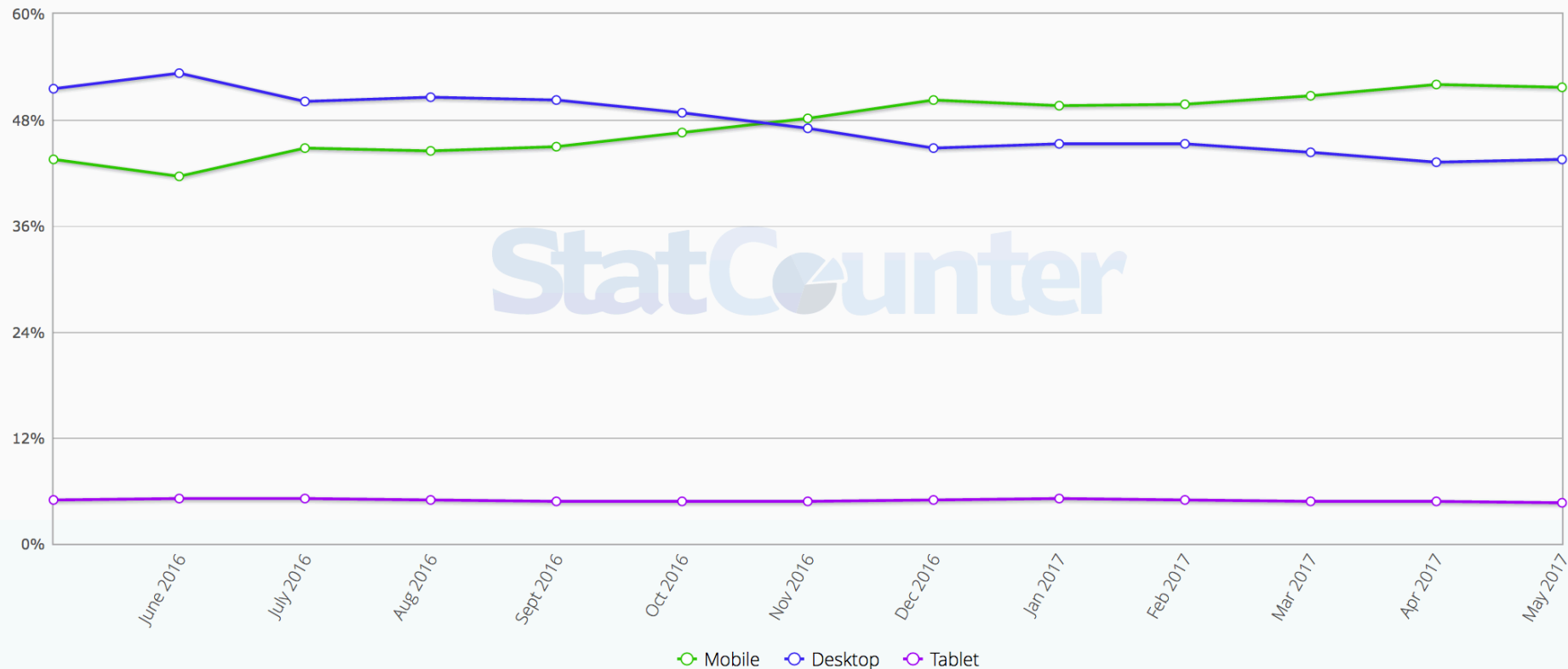
Network Operator	ASN	Traffic %
Google	15169	43.7
Facebook	32934	28.6
Akamai	20940	5.7
Apple	6185	3.3
Microsoft	8068	2.7
Level3	3356	1.9
Amazon	38895	1.5
Akamai	16625	1.4
Limelight	22822	0.7

[source : <https://www.nog.bt/btnog4/presentations/Futures.pdf/>]

Industry trend: Devices

Desktop vs Mobile vs Tablet Market Share Worldwide

May 2016 to May 2017

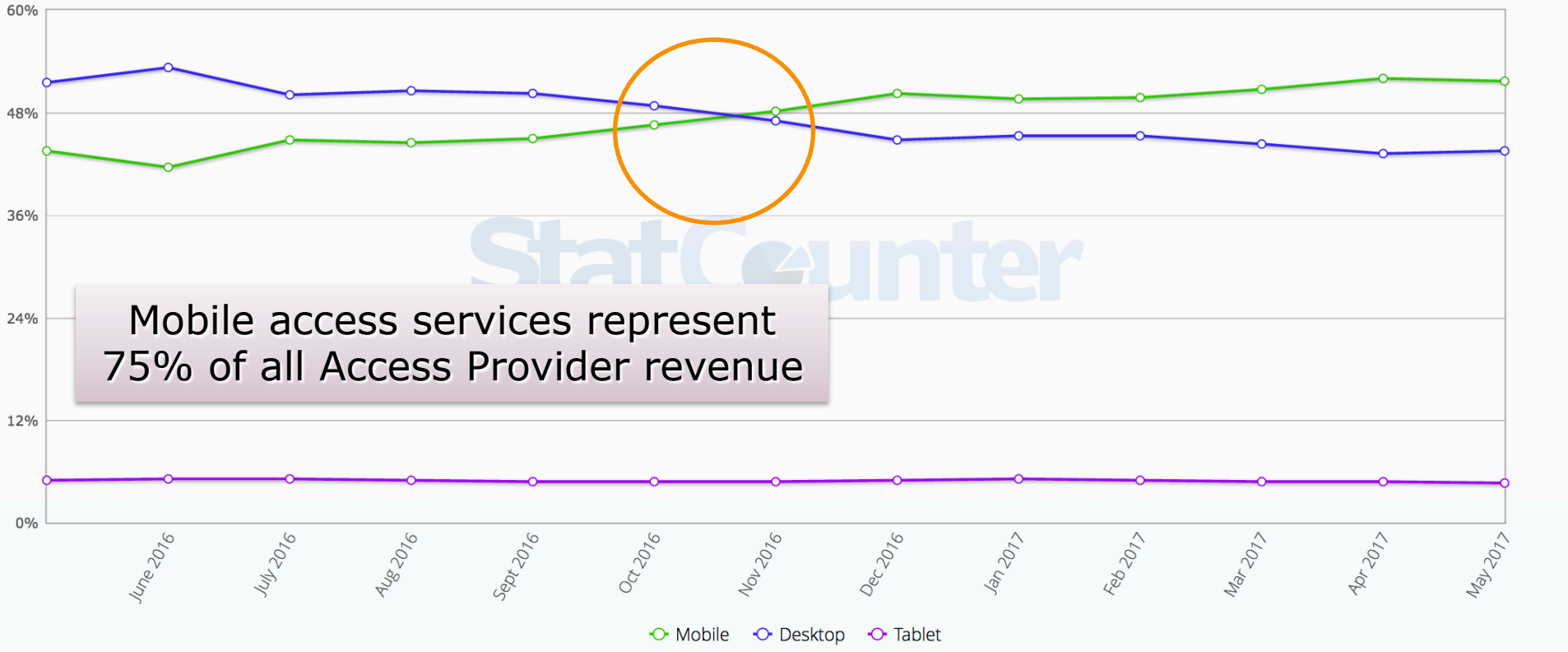


[source : <http://gs.statcounter.com/platform-market-share/desktop-mobile-tablet>]

Industry trend: Devices

Desktop vs Mobile vs Tablet Market Share Worldwide
 May 2016 to May 2017

Mobiles are now 50% of all visible devices



Mobile access services represent 75% of all Access Provider revenue

[source : <http://gs.statcounter.com/platform-market-share/desktop-mobile-tablet>]

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

IPv6 enabled devices

OS	Version	Installed by default	DHCPv6
Android	4.4	Yes	No
iOS	4.1	Yes	Yes
Windows Phone	8.1	Yes	Yes

- Android and Windows Phone support 464XLAT transition technology
- Apple iOS IPv6-only network support since version 9
- Since 2016 all Apple AppStore apps must include IPv6 support

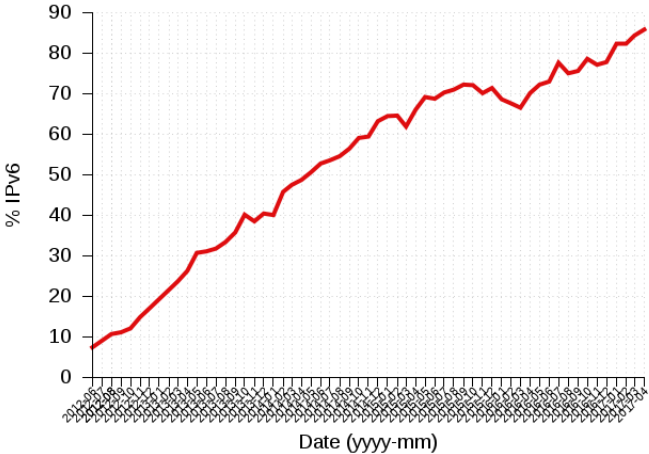
[source : <https://getipv6.info/display/IPv6/3GPP+Mobile+Networks>]

IPv6 Mobile Networks: Technology

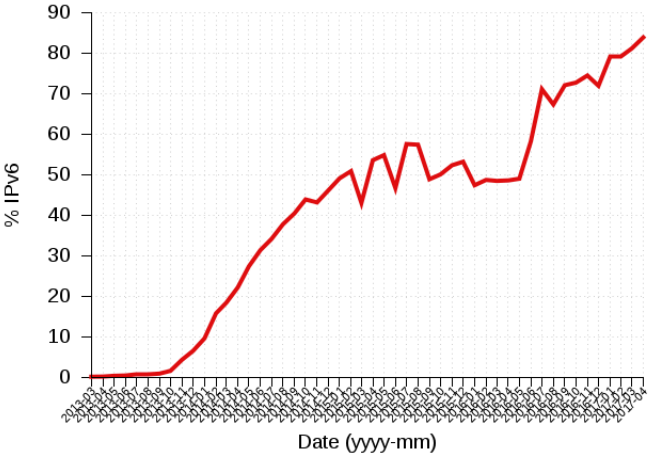
Carrier	Economy	Note
Verizon Wireless	USA	Deployed dual stack transition technology in 2011
T-Mobile	USA	Deployed IPv6 transition technology (464XLAT) in 2012
SK Telecom	Korea	Deployed IPv6 transition technology (464XLAT) in 2014
Telstra	Australia	Deployed IPv6 transition technology (464XLAT) in 2016
Reliance Jio	India	Deployed dual stack transition technology in 2016

IPv6 Mobile Networks: Deployment

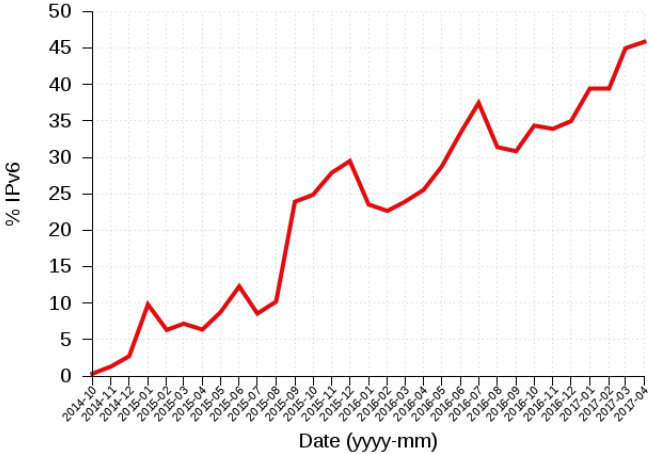
Verizon Wireless IPv6 Deployment



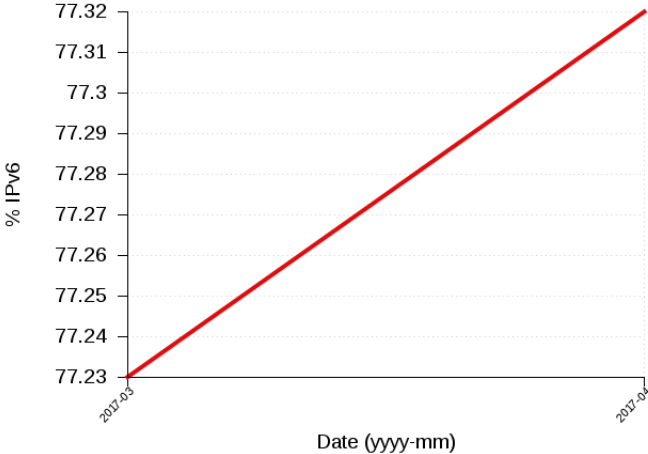
T-Mobile USA IPv6 Deployment



SKTelecom IPv6 Deployment



RELIANCE JIO INFOCOMM LTD IPv6 Deployment

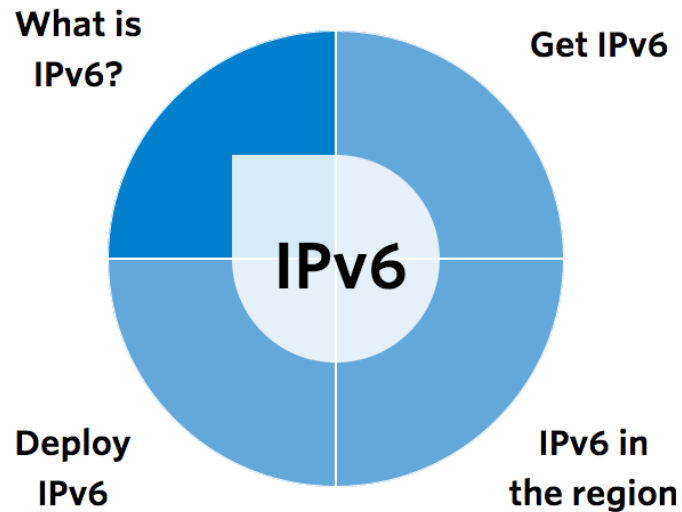


Observations

- IPv6 end-user readiness is increasing across region
 - Varies among region, economies, networks.
- Key market players taking lead on IPv6 continues have sizable impact on economy wide IPv6 readiness.
- Once IPv6 is enabled a network, end user readiness tends to grow rapidly.
- Initial roll-out followed by expansion to smaller market and regional ISPs as well as content, cloud, cable TV, and other service providers.



IPv6@APNIC



What is IPv6?

Why is it important?

What does IPv6 mean to me?

Benefits

apnic.net/ipv6





June 6 – IPv6 Launchiversary

CC	Case Study	Link
MY	Telekom Malaysia	https://blog.apnic.net/2017/06/09/steadily-surely-ipv6-becoming-norm-malaysia/
KH	SINET	https://blog.apnic.net/2017/06/07/sinet-cambodia-deploys-ipv6-future-growth/
IN	Reliance Jio	https://blog.apnic.net/2017/02/07/reliance-jio-boosts-india-past-20-ipv6-capability/
AU	Telstra	https://blog.apnic.net/2017/01/13/telstras-five-year-mobile-ipv6-plan-becomes-reality/
VN	Encouraging IPv6 investment in Vietnam	https://blog.apnic.net/2017/05/26/encouraging-ipv6-iot-investment-viet-nam/
JP	Japan's IPv6 capability set for sharp increase	https://blog.apnic.net/2017/03/07/japans-ipv6-capability-set-sharp-increase-2017/

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Kadrin Chhe

Thank You!

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