

Where are we now? IPv6 deployment update

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APNIC



Agenda

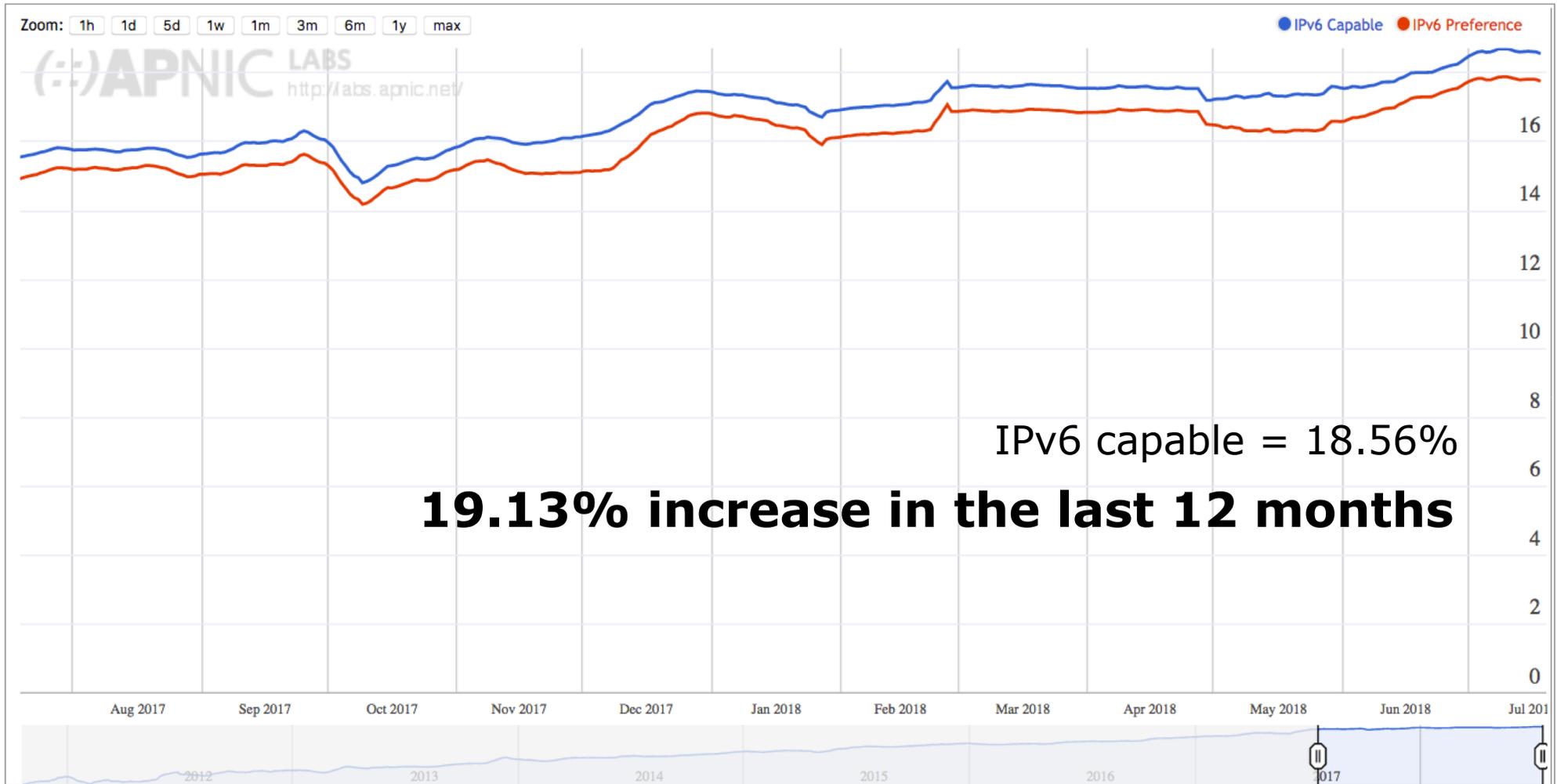
- IPv6 End-User Readiness
- IPv6 Performance
- Industry Trends
- Observations

IPv6 stats from: <https://stats.labs.apnic.net/ipv6>
Retrieved: 26 Jul 2018

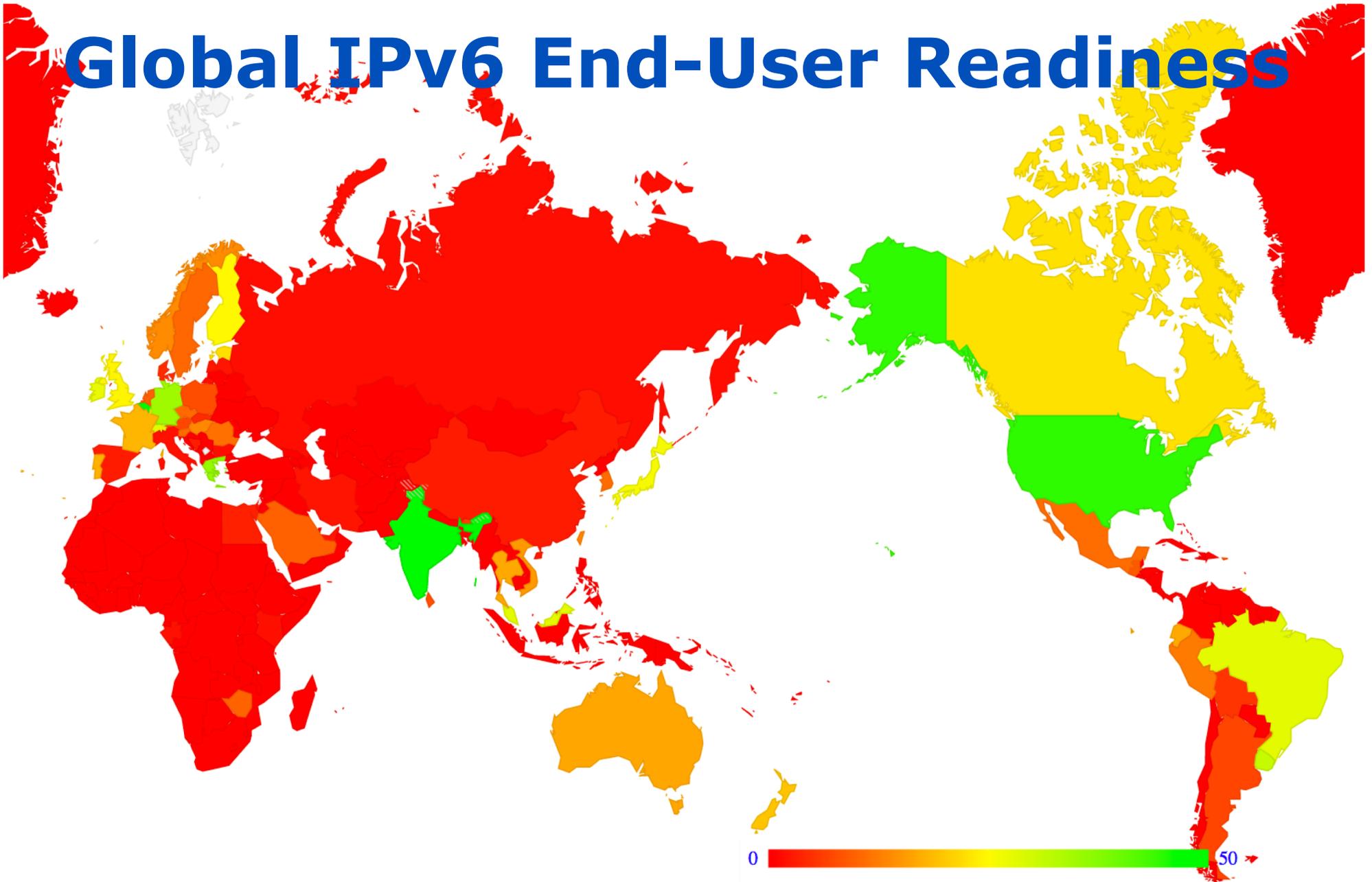
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Global IPv6 End-User Readiness



Global IPv6 End-User Readiness



The IPv6 economy league table

CC	Economy	IPv6 capable (%)	IPv6 Preferred (%)
IN	India	60.25	58.21
BE	Belgium	58.65	56.46
US	United States	44.66	42.58
GR	Greece	36.22	35.59
DE	Germany	35.07	33.50
UY	Uruguay	31.07	30.21
CH	Switzerland	28.10	26.42
MY	Malaysia	27.96	26.85
BR	Brazil	27.94	26.61
IE	Ireland	27.31	26.61

What about South Asia?

CC	Economy	IPv6 capable (%)	IPv6 Preferred (%)
IN	India	60.25	58.21
LK	Sri Lanka	8.03	7.71
BT	Bhutan	6.40	6.08
AF	Afghanistan	0.03	0.02
PK	Pakistan	0.02	0.02
NP	Nepal	0.01	0.01
BD	Bangladesh	0.00	0.00
MV	Maldives	0.00	0.00

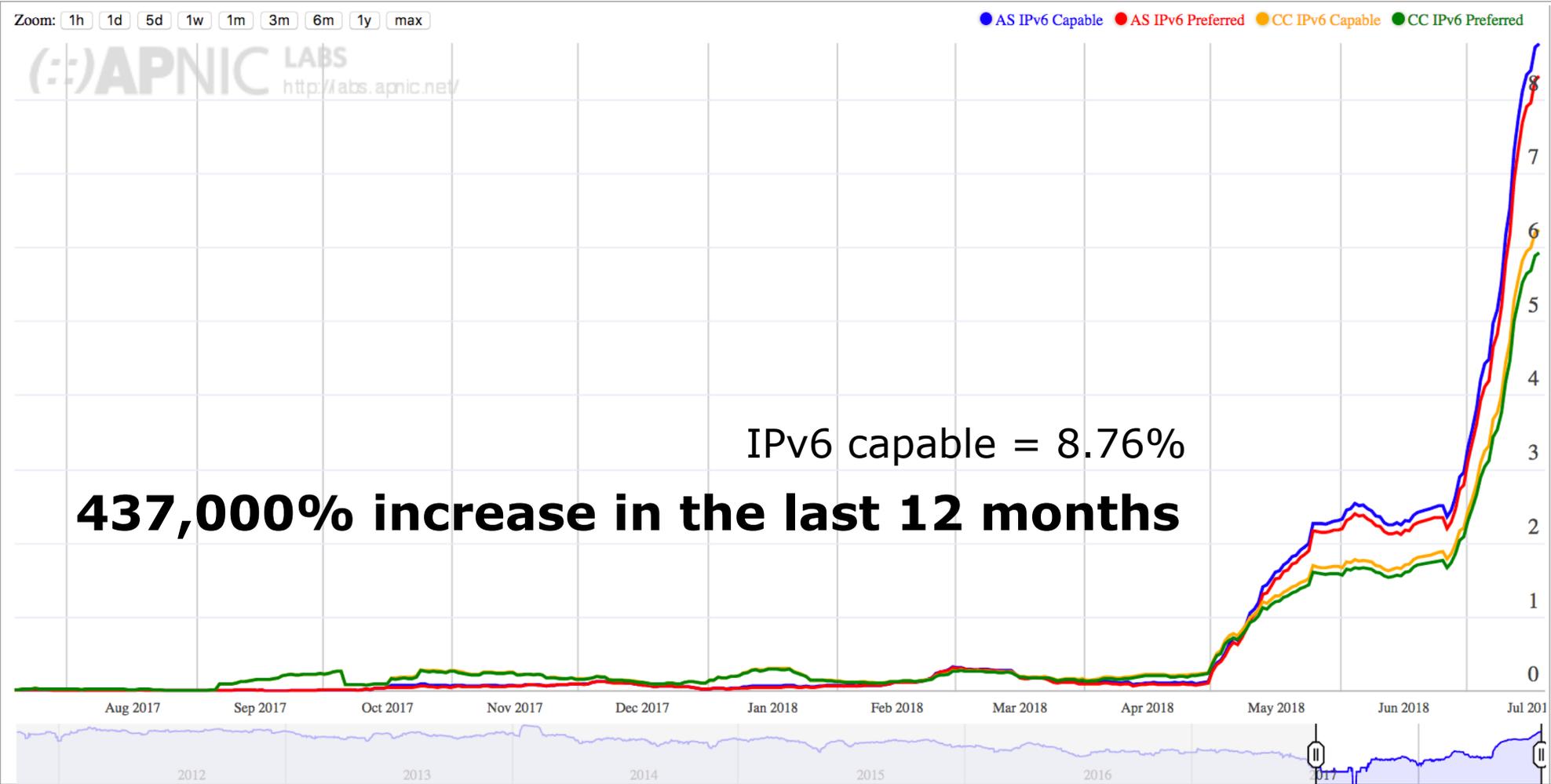
Bhutan IPv6 End-User Readiness



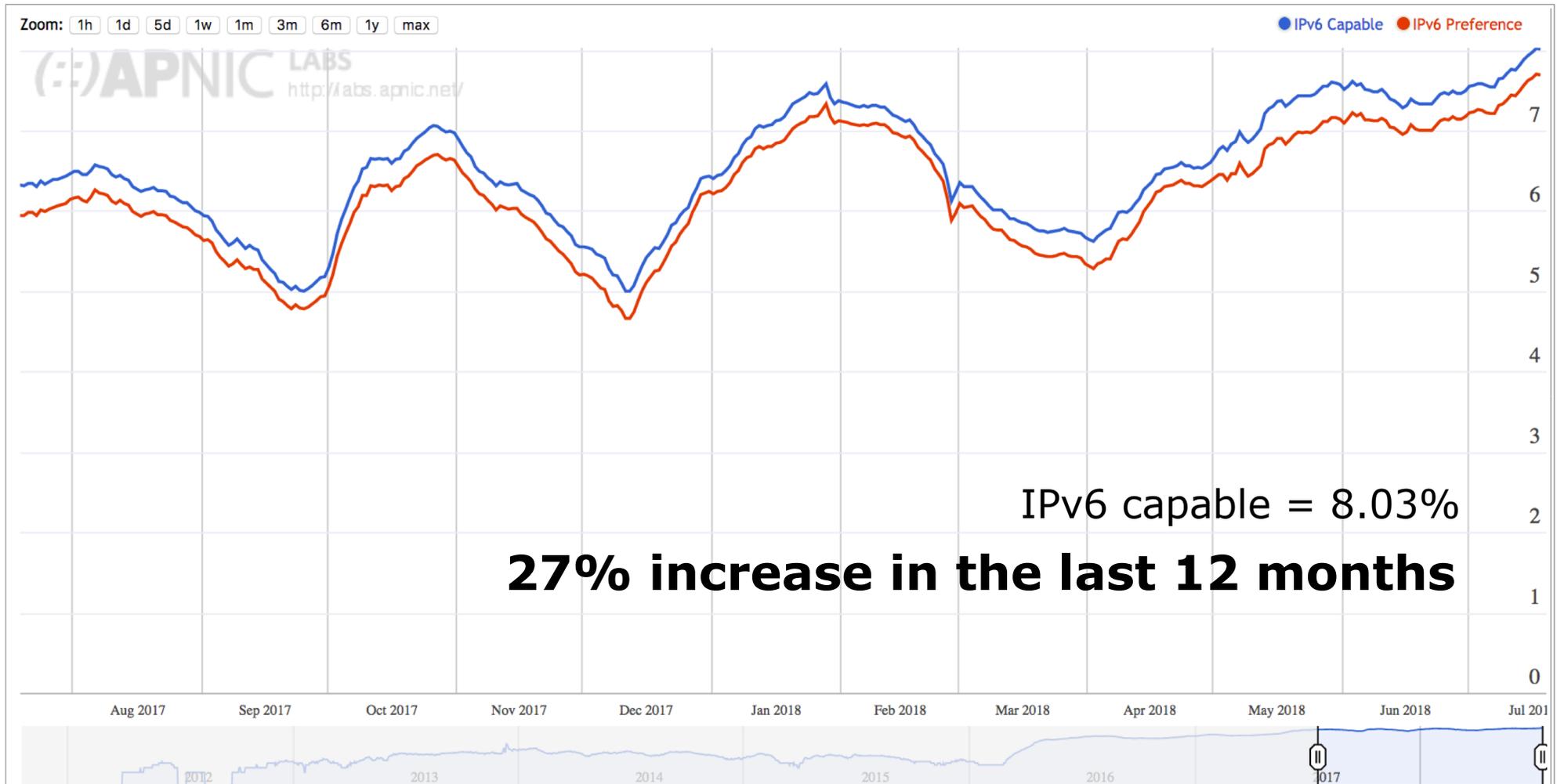
Bhutan IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
17660	DrukNet	8.76	8.32
134715	DrukREN	3.74	3.50
38740	TashiCell Transit	0.59	0.57
136039	NANO	0.56	0.56

AS 17660: DrukNet



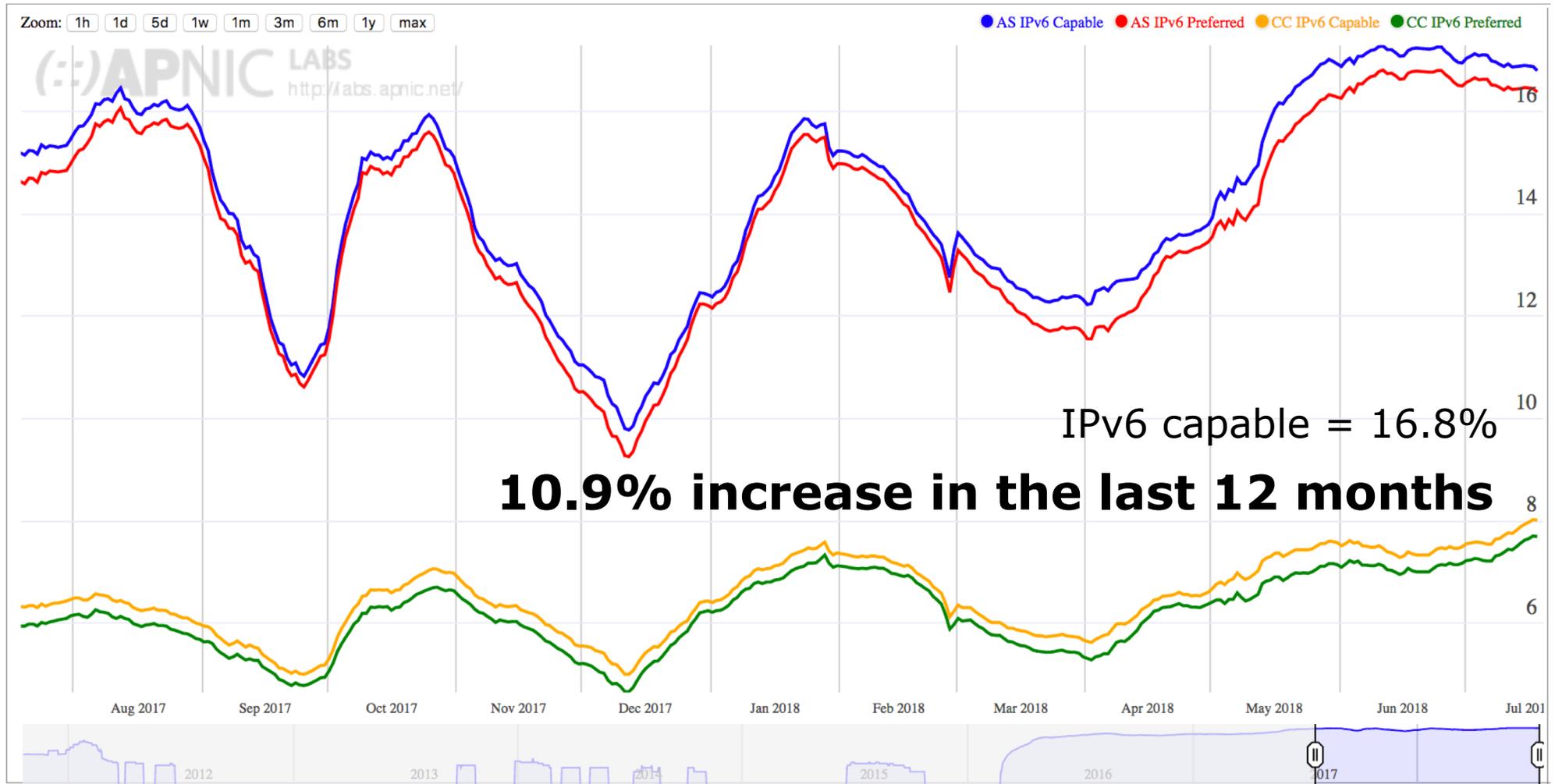
Sri Lanka IPv6 End-User Readiness



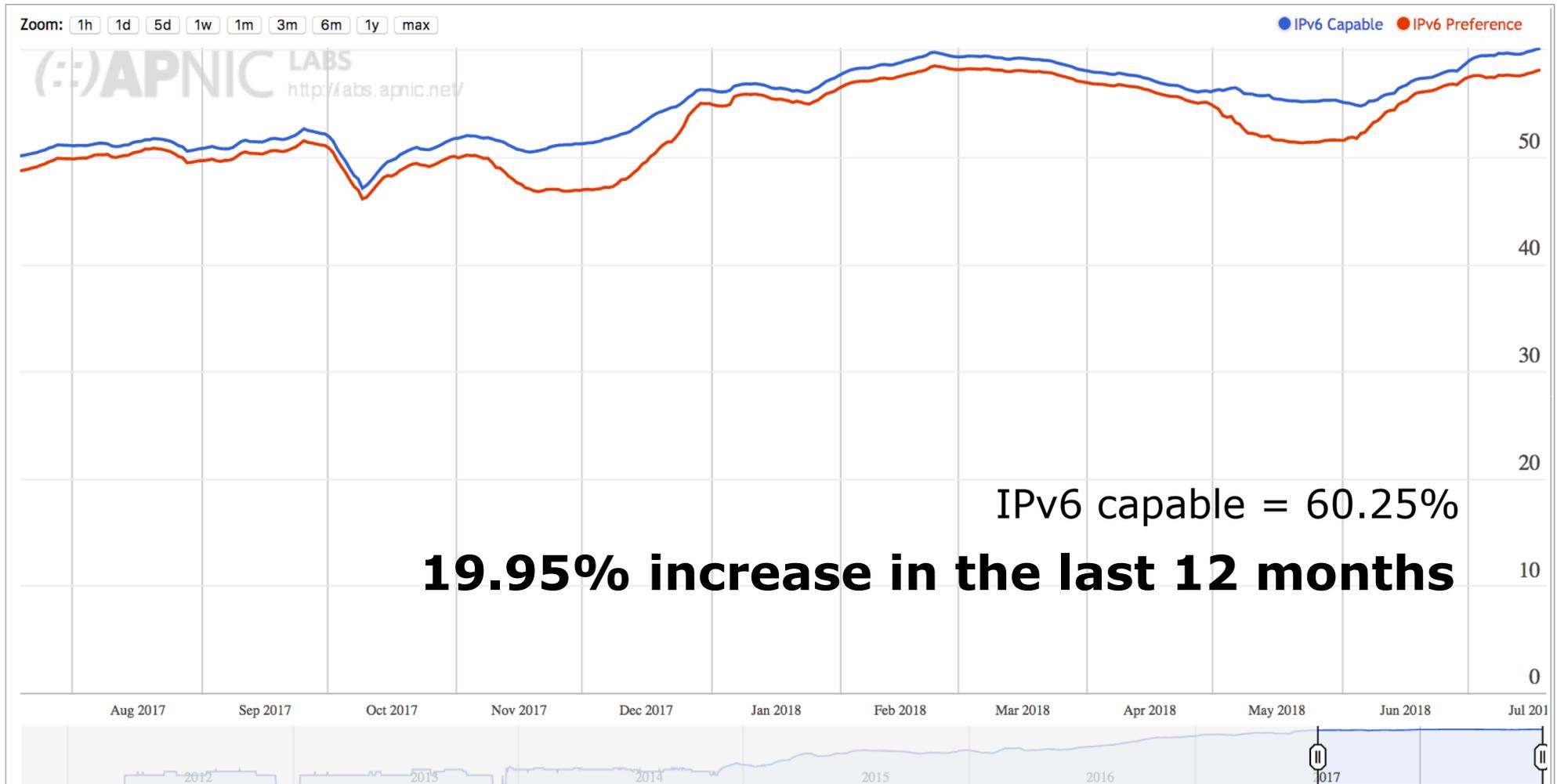
Sri Lanka IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
38229	LEARN	24.61	15.82
18001	Dialog	16.80	16.38
9329	Sri Lanka Telecom	1.85	1.80
45356	Mobitel	0.03	0.00
45224	Lanka Bell	0.03	0.00
132045	Bharti Airtel	0.01	0.00
132447	Hutchison	0.01	0.00

AS 18001: Dialog



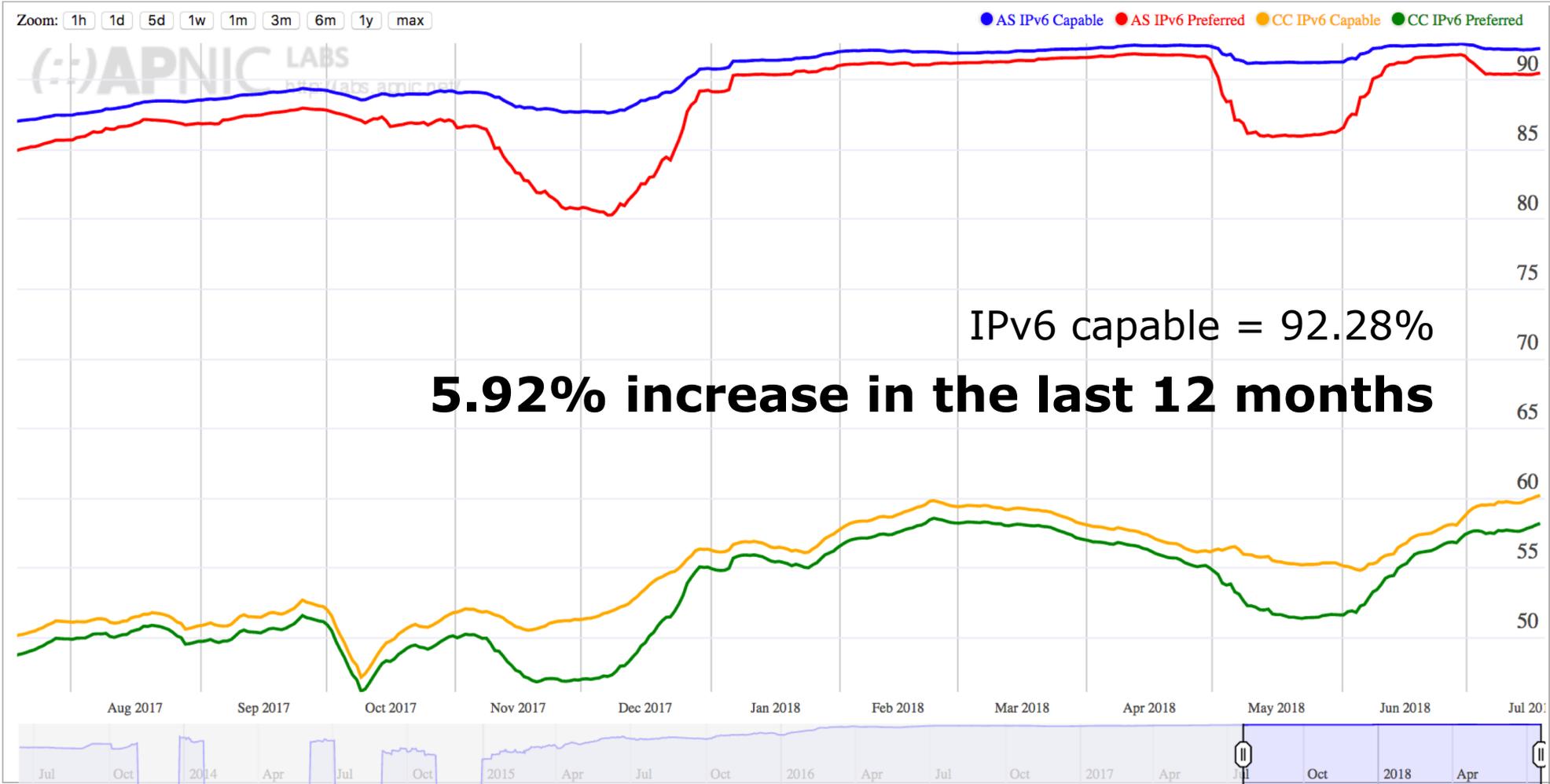
India IPv6 End-User Readiness



India IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
55836	Reliance Jio	92.28	90.52
38266	Vodafone	47.12	45.91
45271	Idea Cellular	45.04	33.94
55441	TTSL	21.39	20.07
45609	Bharti Airtel	10.37	10.07
24309	Atria Convergence Technologies	2.18	2.10
18209	Atria Convergence Technologies	2.11	1.98

AS 55836: Reliance Jio



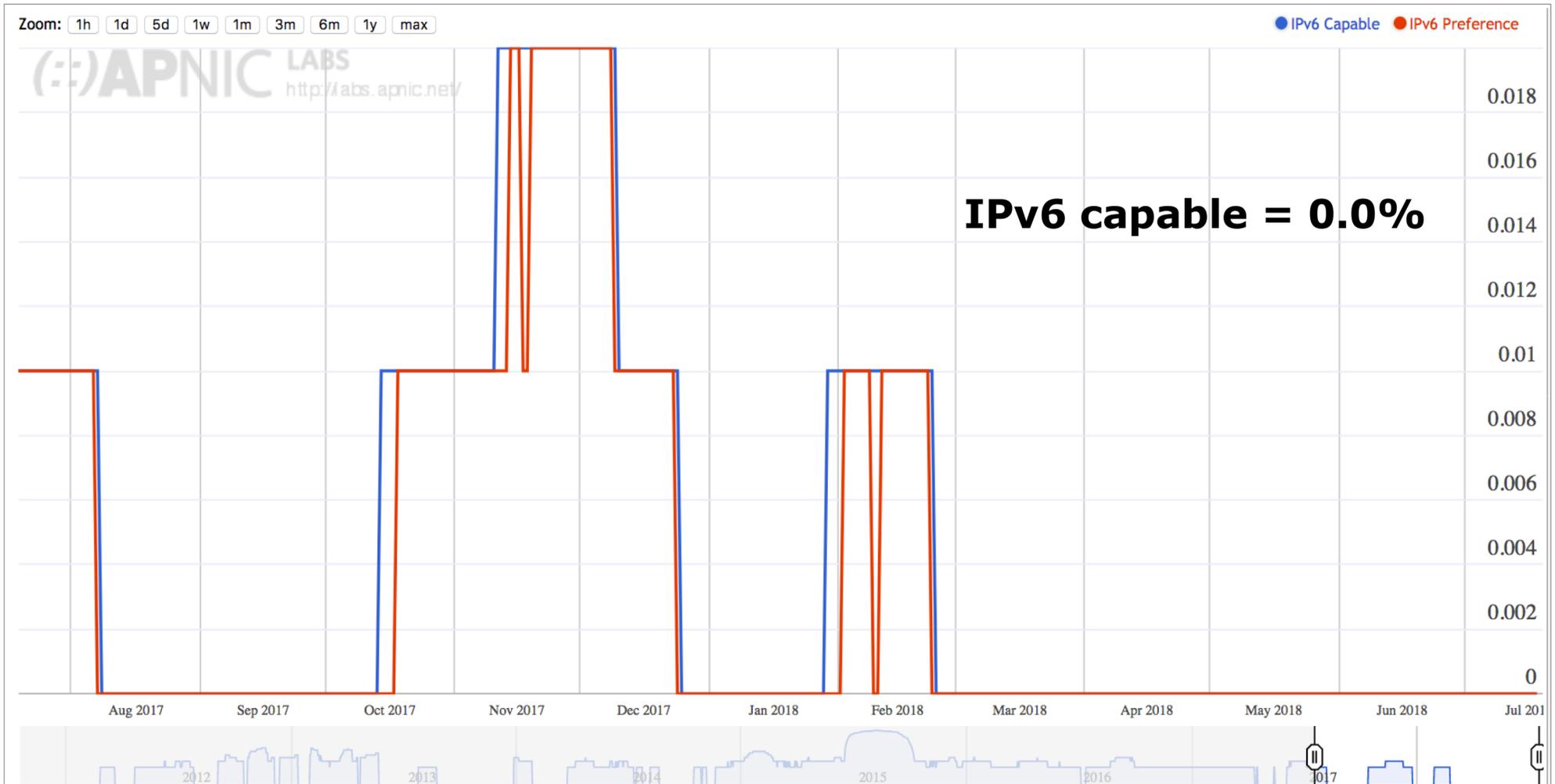
Bangladesh

- 29,666,000 Internet users
- 18.2% Internet penetration
- 644 ASNs
- 0.00% IPv6 readiness

IPv4	
Addresses	1,561,344
Per Capita	0.01
ASNs in BGP	514
% Visible	89%

IPv6	
Addresses	2.84×10^{25}
Per Capita	1.74×10^{17}
ASNs in BGP	57
% Visible	4%

Bangladesh IPv6 End-User Readiness



IPv6 in Action: Performance

- 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 in Action: Performance

- **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**

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- **Testing HTTP Traffic**
 - TechArk Network Operator Measurement Activity (NOMA) conducted preliminary tests of IPv6 performance for HTTP traffic using RIPE Atlases.
 - Found performance of IPv6 is better when measuring to a “near” target

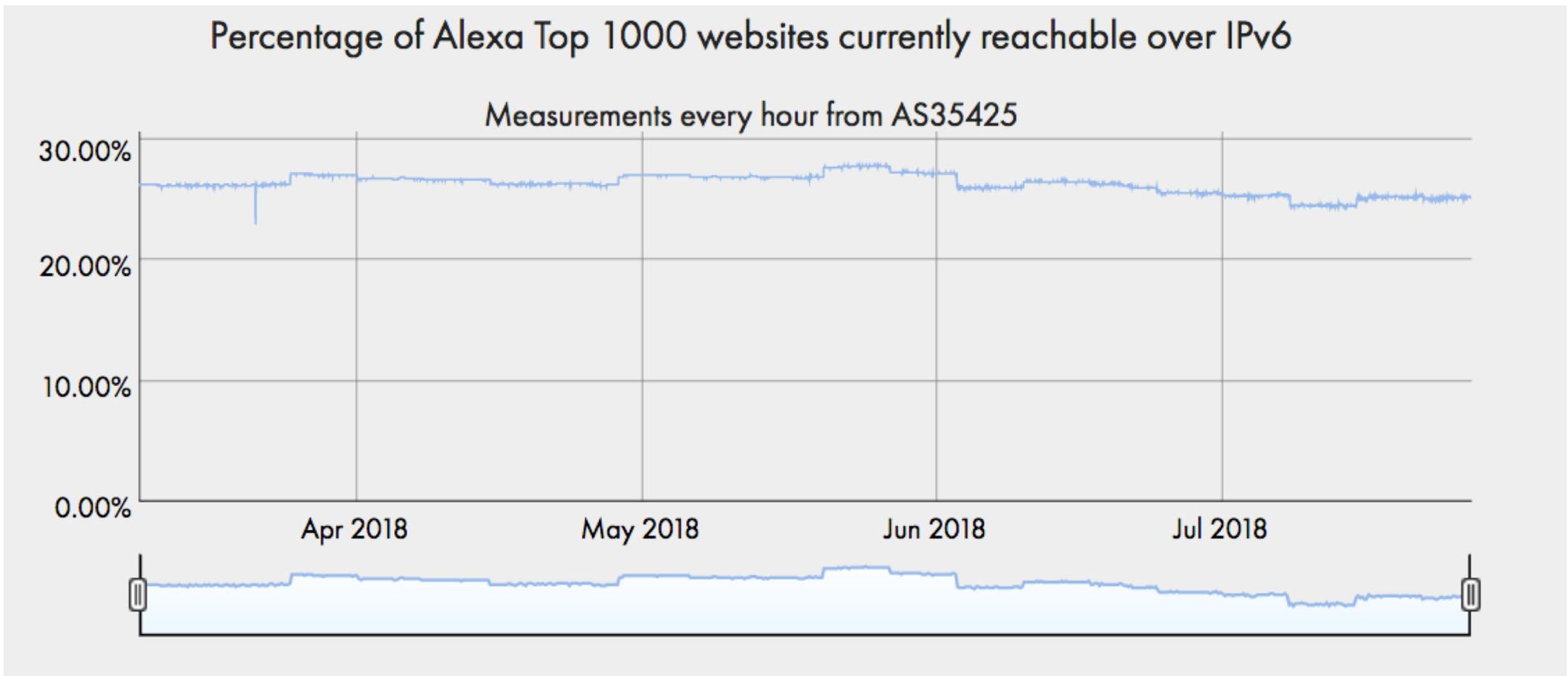
[source: <https://blog.apnic.net/2017/09/29/network-operator-perspective-ipv6-performance/>]

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- **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/>]

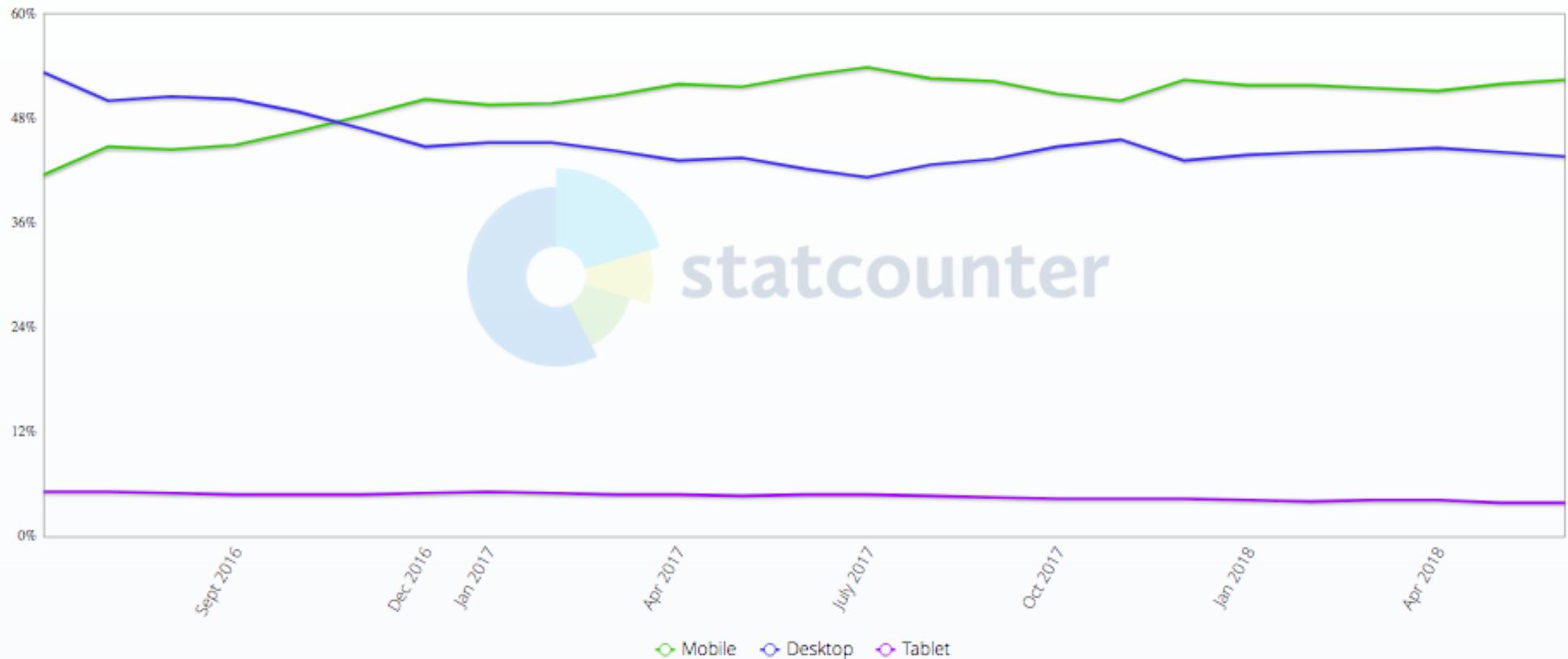
IPv6 in Action: Content



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

Industry Trend: Devices

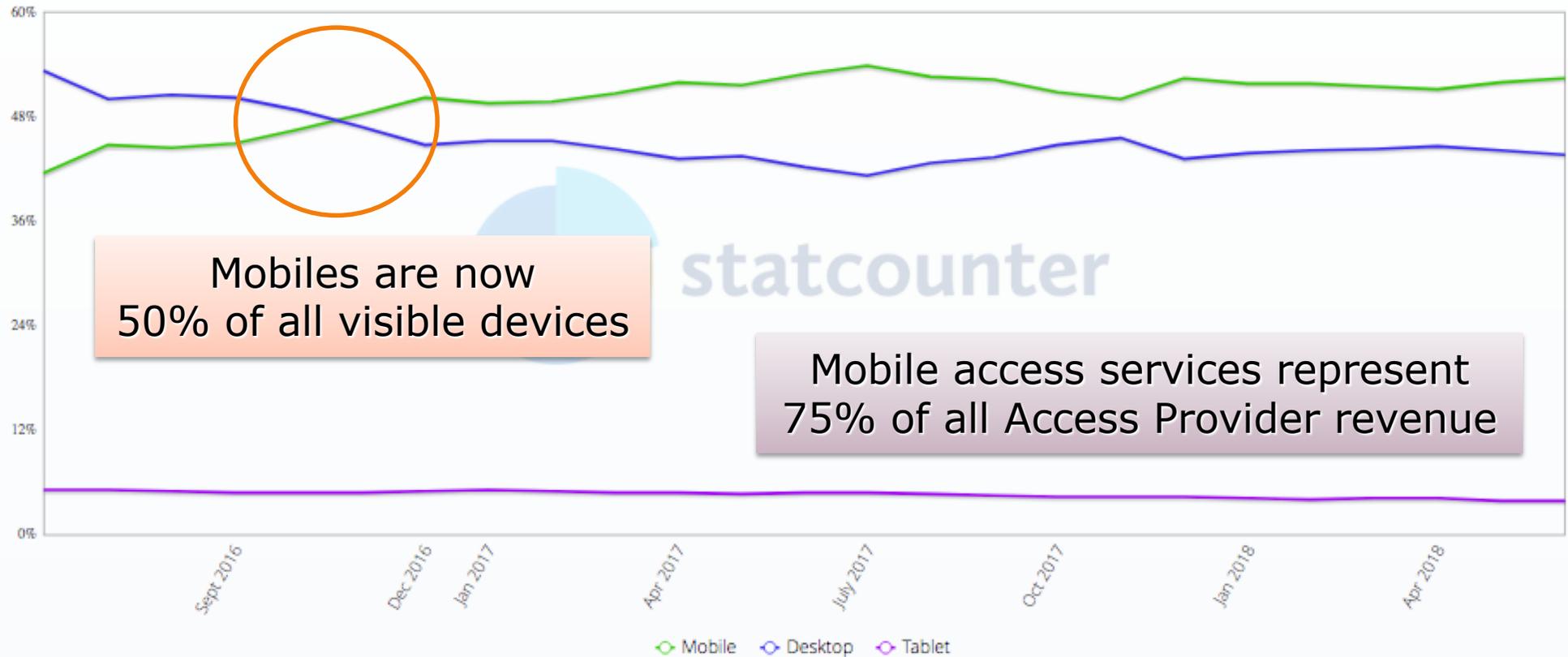
Desktop vs Mobile vs Tablet Market Share Worldwide
June 2016 - June 2018



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

Industry Trend: Devices

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Industry trend: Mobile

- 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 in Action: Mobile Devices

OS	Version	Available 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
- KaiOS, as installed on JioPhone, supports dual-stack IPv6
- Apple iOS IPv6-only network support since version 9. Reports of Carrier Update for dual-stack since at least iOS 11.3.
- Since 2016 all Apple AppStore apps must include IPv6 support

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

IPv6 in Action: Mobile Networks

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
AIS	Thailand	Deployed dual stack transition technology in 2016 (Fibre) and 2017 (3G/4G)
Bhutan Telecom	Bhutan	Deployed dual stack transition technology in 2018 (3G/4G)

Motivation for Early Market Drivers

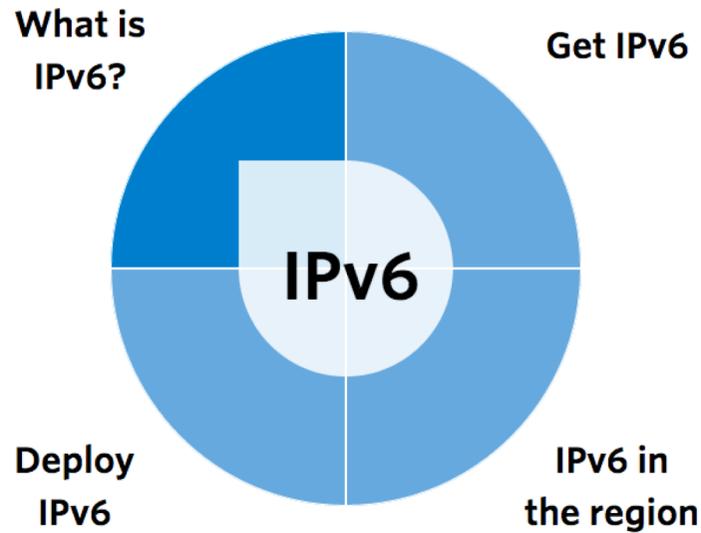
- Capability to support growth, IoT, Smart Cities, future services
- Simplify network design
- Reduce load on CGN
- Lower CAPEX
- Commitment to Internet Tech Evolution
- Government Encouragement

Observations

- IPv6 end-user readiness is increasing across diverse economy profiles.
- Once fully enabled, IPv6 usage increases quickly within networks.
- Common trend sees three stages of economy readiness.
- Mobile operators largely responsible for driving large scale uptake.
- Positive signs for future readiness growth, especially as vendor support grows.



IPv6@APNIC



What is IPv6?

Why is it important?

What does IPv6 mean to me?

Benefits

apnic.net/ipv6



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Thank You!

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