Where are we now?
IPv6 deployment update

13-15 August 2018 | Bandar Seri Begawan, BN

Klée Aiken

klee@apnic.net

APNIC

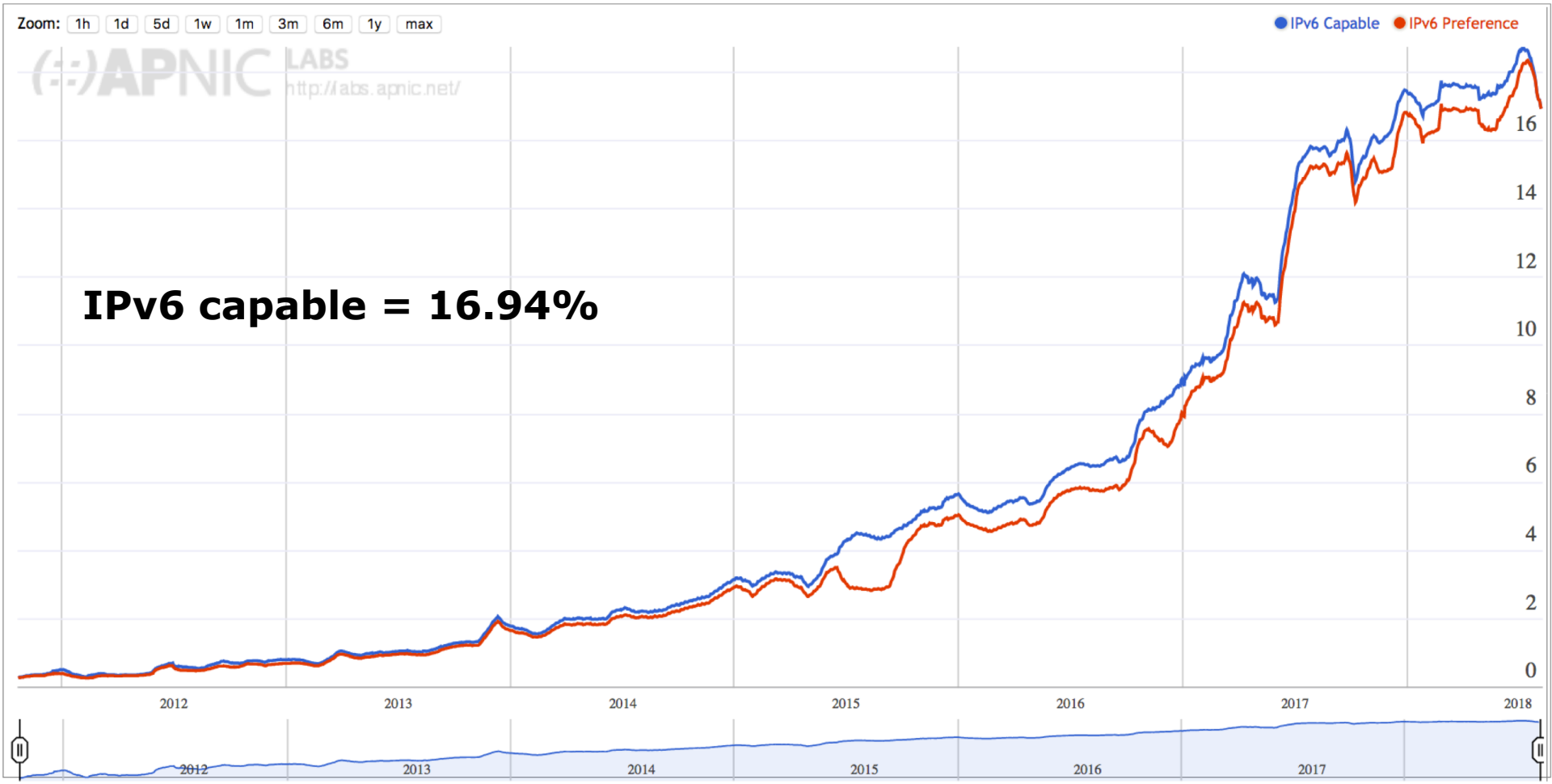
Agenda

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

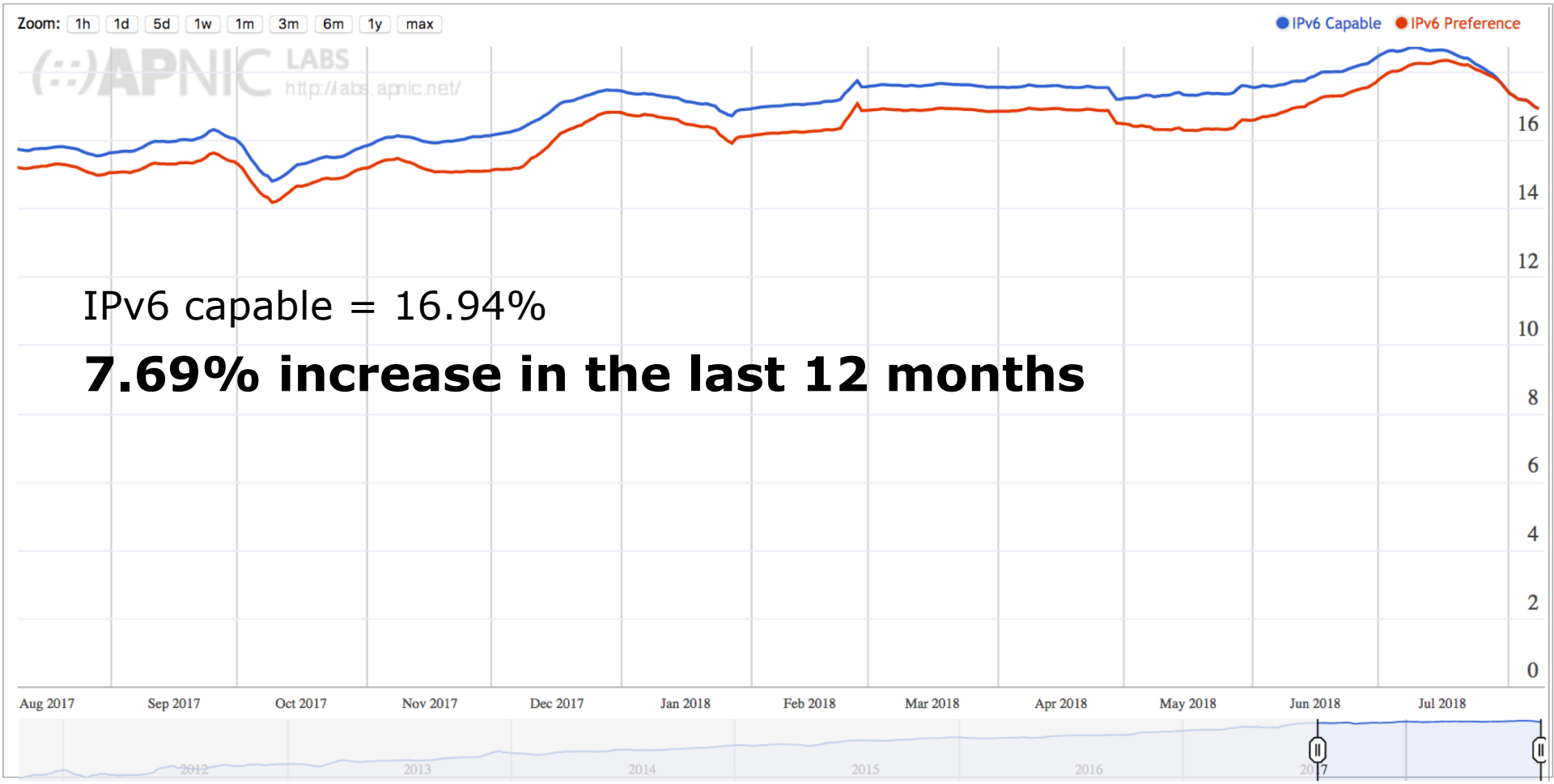
IPv6 stats from: https://stats.labs.apnic.net/ipv6
Retrieved: 10 Aug 2018

APNIC

Global IPv6 End-User Readiness



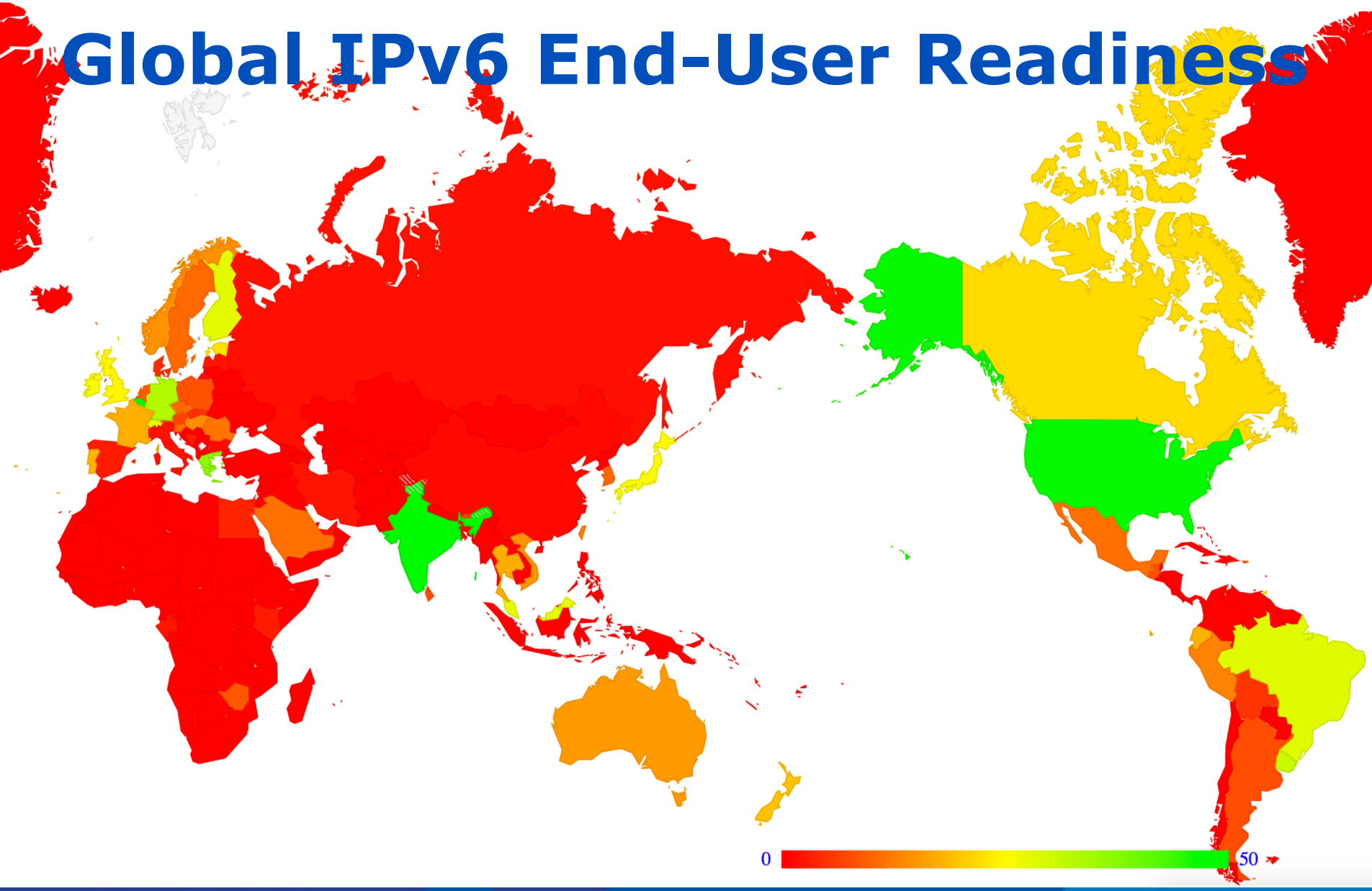
Global IPv6 End-User Readiness



IPv6 capable = 16.94%

7.69% increase in the last 12 months

Global IPv6 End-User Readiness



The IPv6 economy league table

CC	Economy	IPv6 capable (%)	IPv6 Preferred (%)
IN	India	58.28	58.27
BE	Belgium	58.12	58.12
US	United States	45.97	45.96
GR	Greece	36.72	36.70
DE	Germany	33.27	33.27
UY	Uruguay	30.71	30.70
BR	Brazil	28.35	28.35
CH	Switzerland	27.94	27.94
FI	Finland	27.87	27.86
MY	Malaysia	27.49	27.49

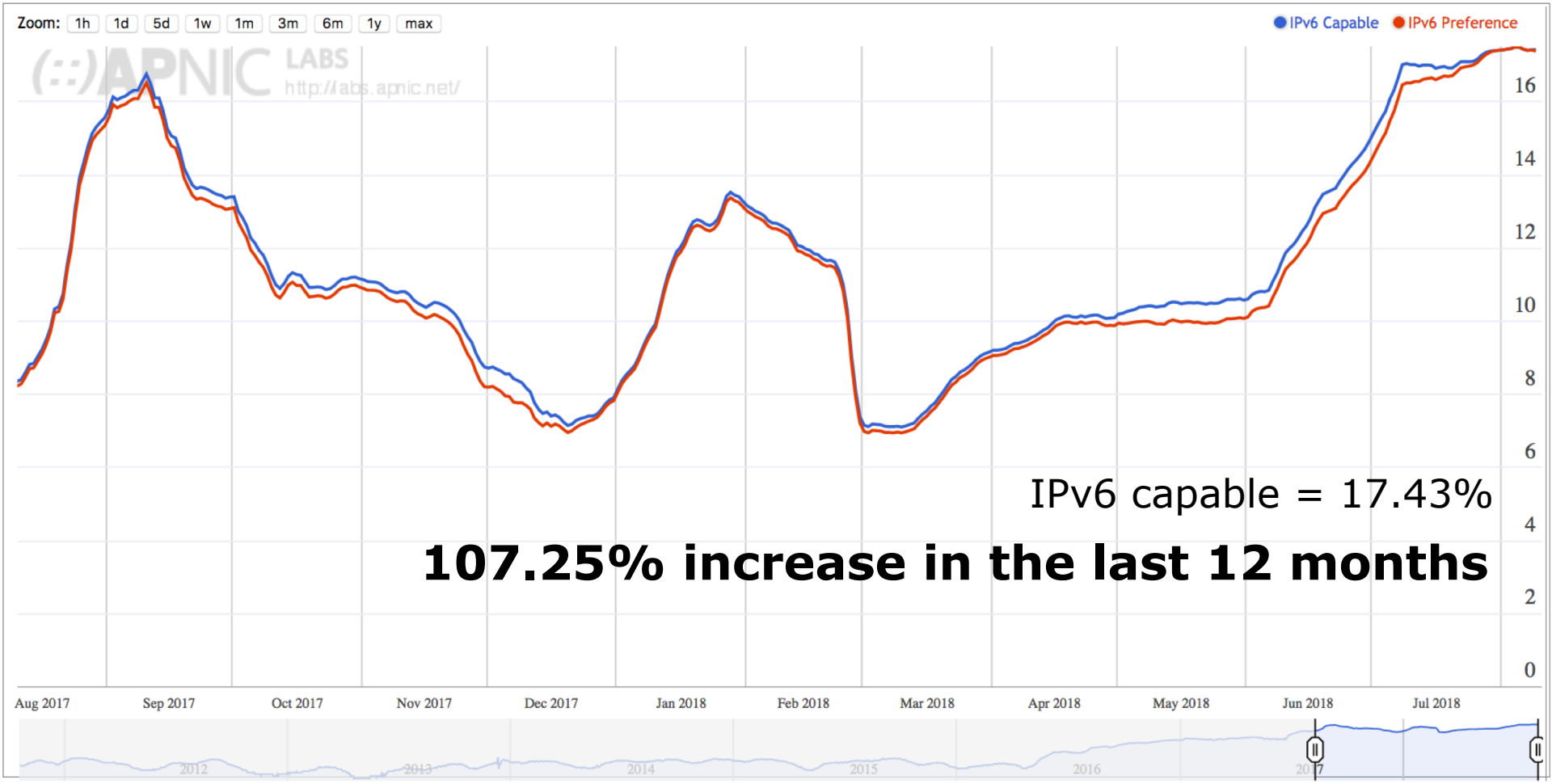
What about Southeast Asia?

CC	Economy	IPv6 capable (%)	IPv6 Preferred (%)
MY	Malaysia	27.49	27.49
TH	Thailand	17.43	17.39
VN	Vietnam	14.87	14.82
SG	Singapore	7.53	7.51
ID	Indonesia	0.11	0.11
PH	Philippines	0.03	0.03
KH	Cambodia	0.03	0.03
TL	Timor-L'este	0.03	0.01
BN	Brunei Darussalam	0.01	0.01
LA	Lao	0.01	0.01
MM	Myanmar	0.01	0.01

What about Southeast Asia?

CC	Economy	IPv6 capable (%)	IPv6 Preferred (%)
MY	**Malaysia**	**27.49**	**27.49**
TH	**Thailand**	**17.43**	**17.39**
VN	**Vietnam**	**14.87**	**14.82**
SG	Singapore	7.53	7.51
ID	Indonesia	0.11	0.11
PH	Philippines	0.03	0.03
KH	Cambodia	0.03	0.03
TL	Timor-L'este	0.03	0.01
BN	**Brunei Darussalam**	**0.01**	**0.01**
LA	Lao	0.01	0.01
MM	Myanmar	0.01	0.01

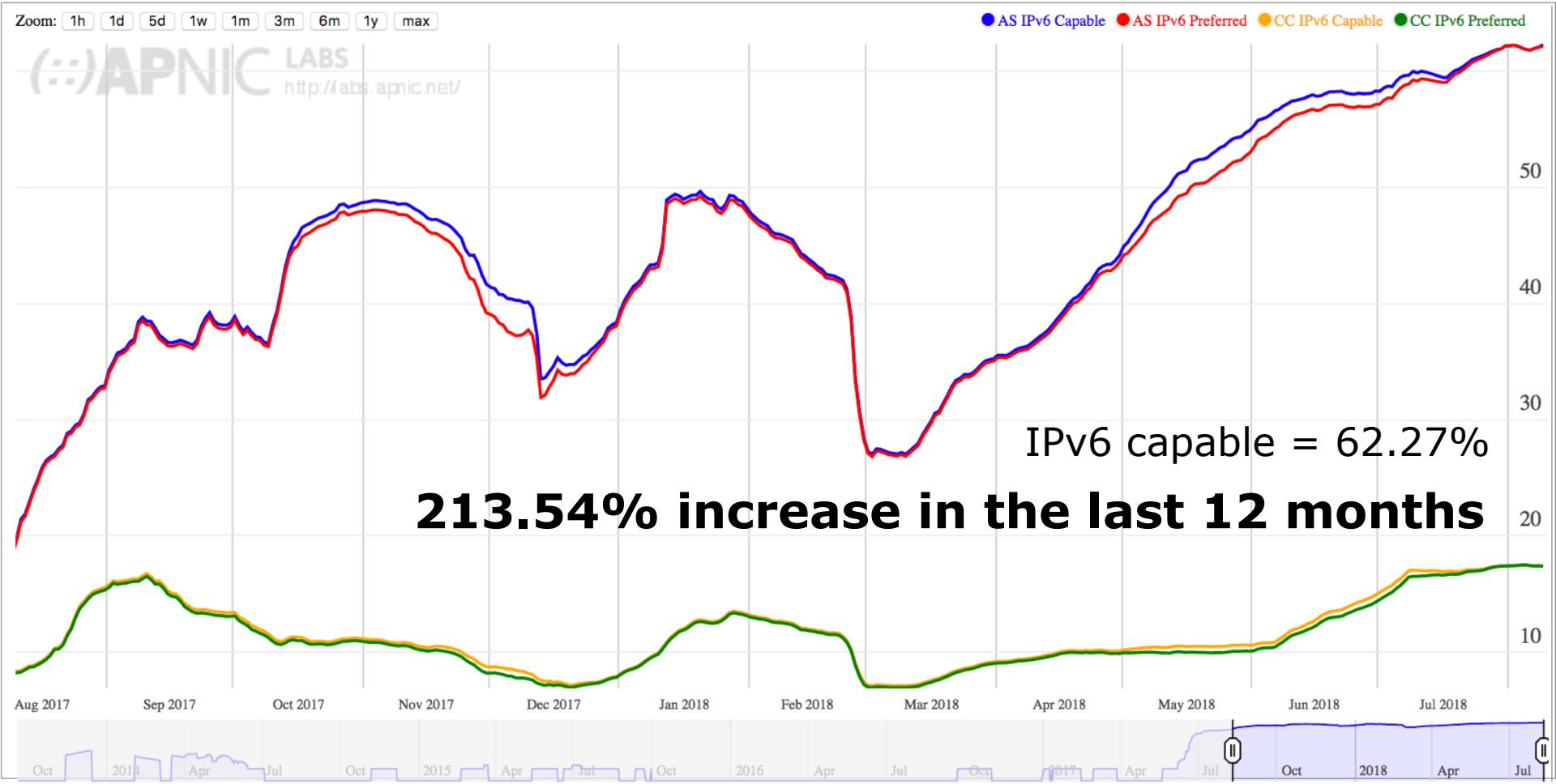
Thailand IPv6 End-User Readiness



Thailand IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
131445	AIS 3G	62.27	62.10
133481	AIS Fibre	53.82	53.69
45649	JasTel	28.80	28.72
7470	True Internet	0.16	0.16
131090	CAT Telecom	0.15	0.15
23969	TOT	0.11	0.11
132061	Realmove Company	0.06	0.06
24378	Total Access Communication	0.05	0.05

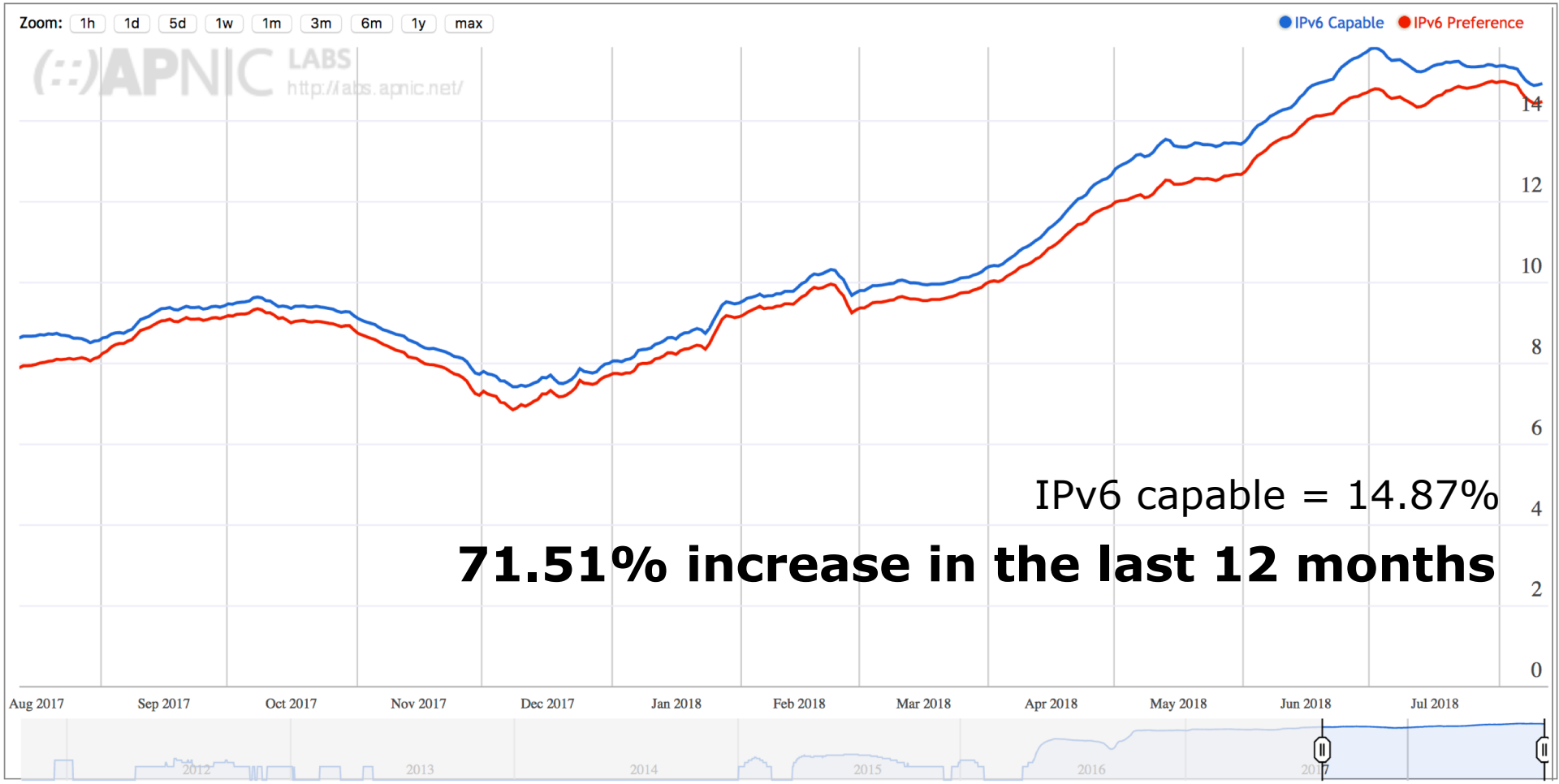
AS 131445: AIS 3G



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

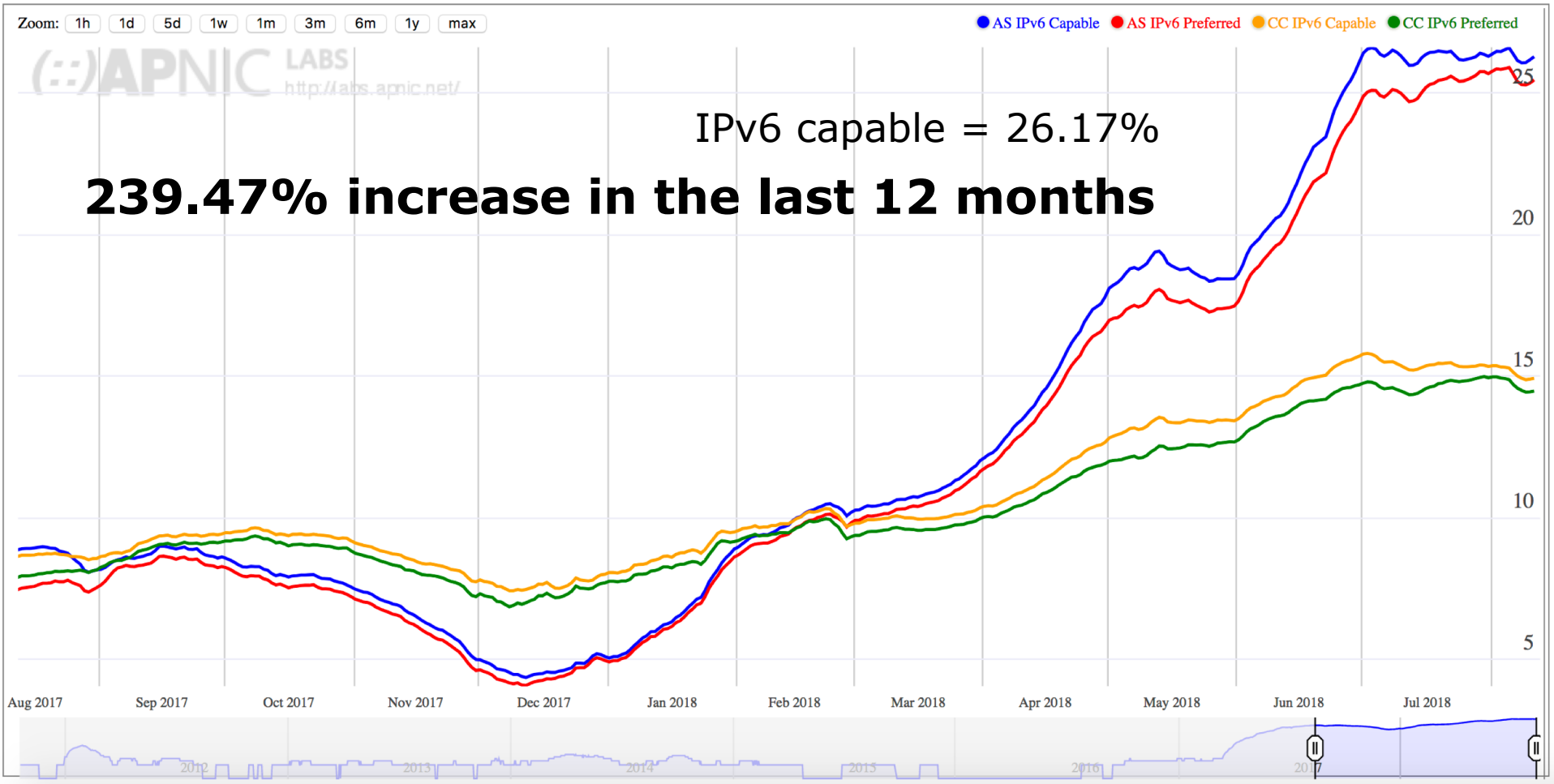
Vietnam IPv6 End-User Readiness



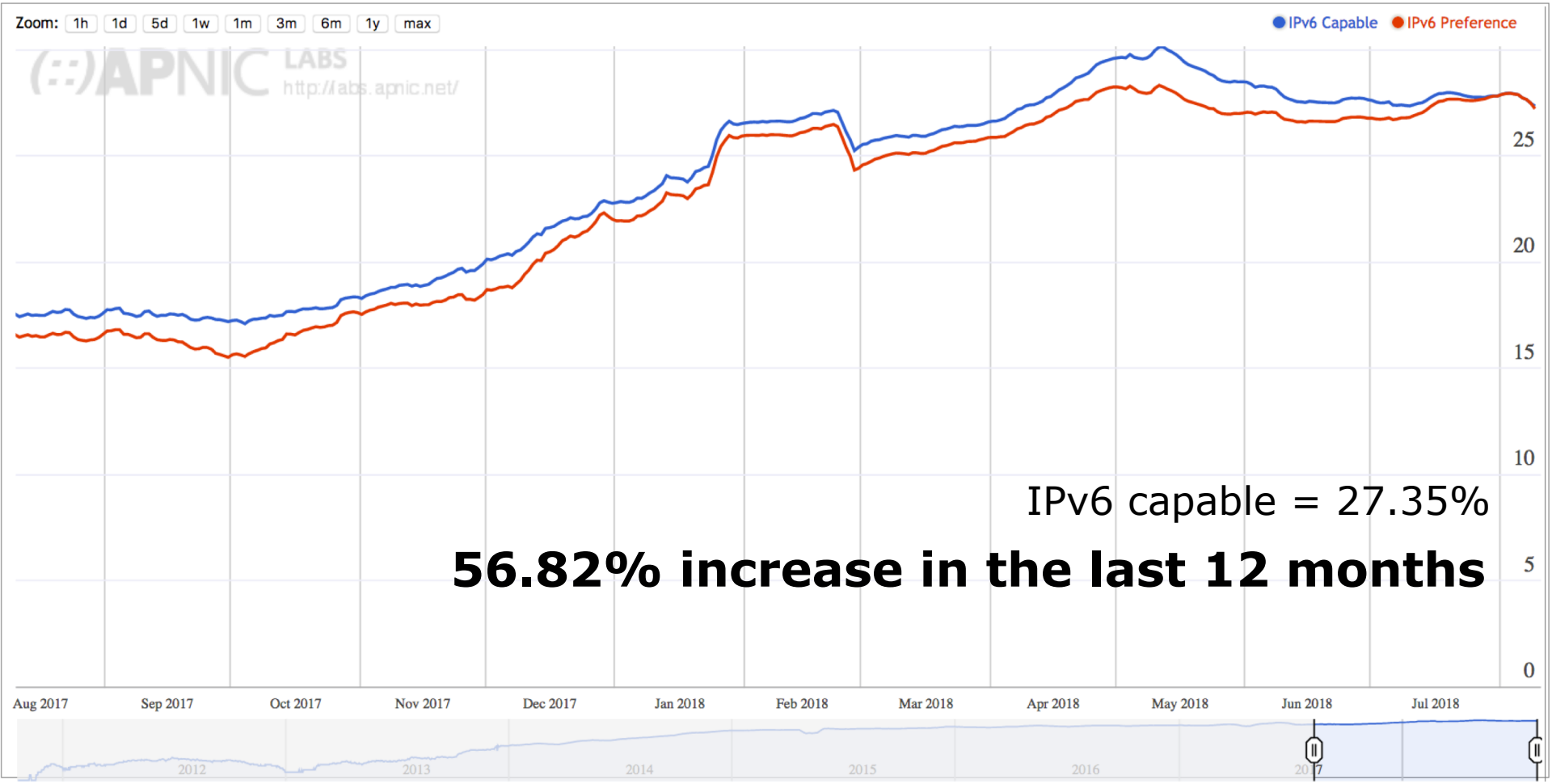
Vietnam IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
45899	VNPT	26.28	25.46
18403	FPT	23.49	22.88
45543	SaiGon Tourist Cable Television Company	1.25	1.22
7552	Viettel	0.36	0.34
131429	MOBIFONE	0.17	0.12
45903	CMC Telecom	0.16	0.15
38247	Vietnamobile	0.13	0.11
24806	Viettel	0.08	0.07

AS 45889: VNPT



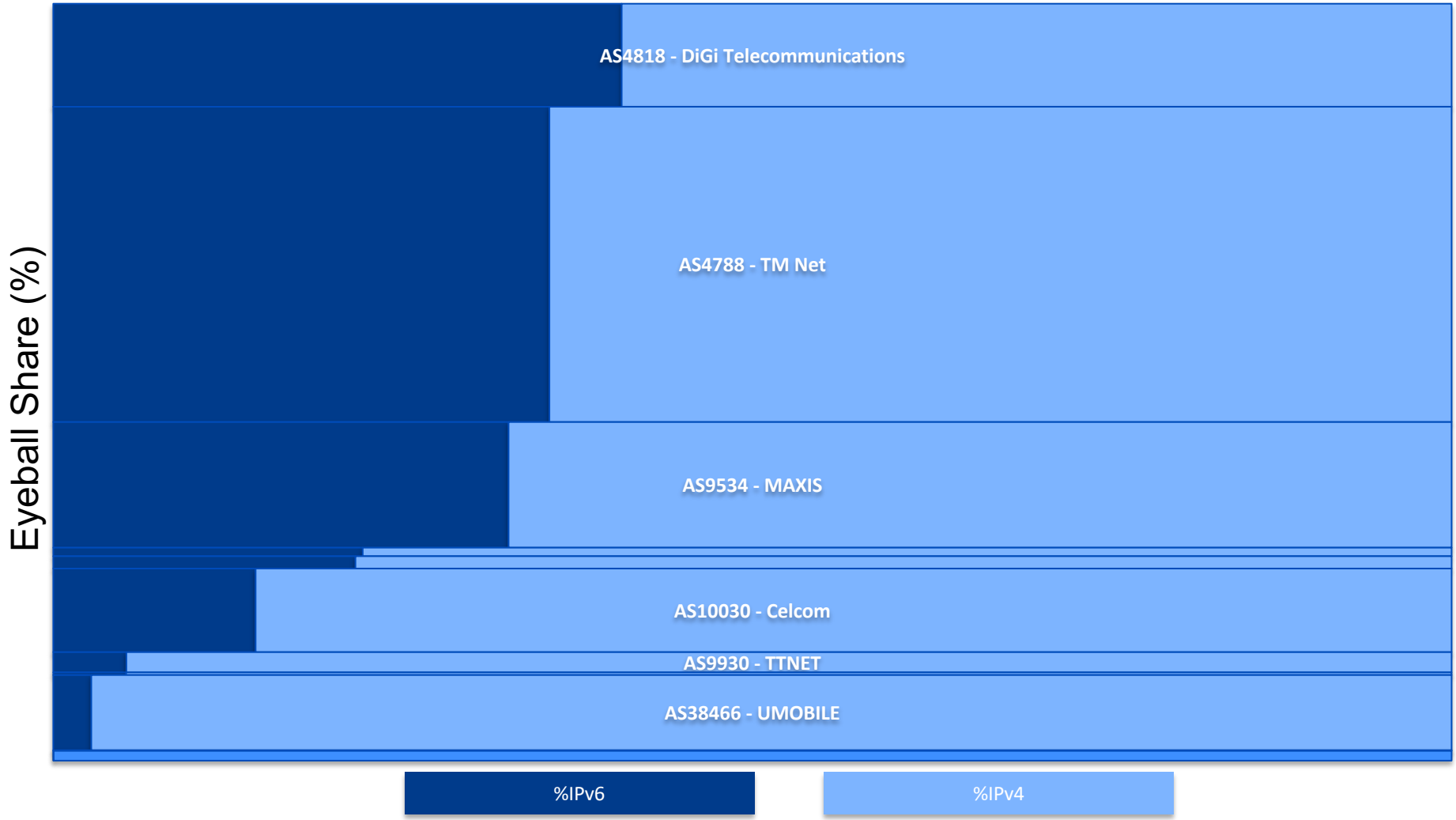
Malaysia IPv6 End-User Readiness



Malaysia IPv6 leaderboard

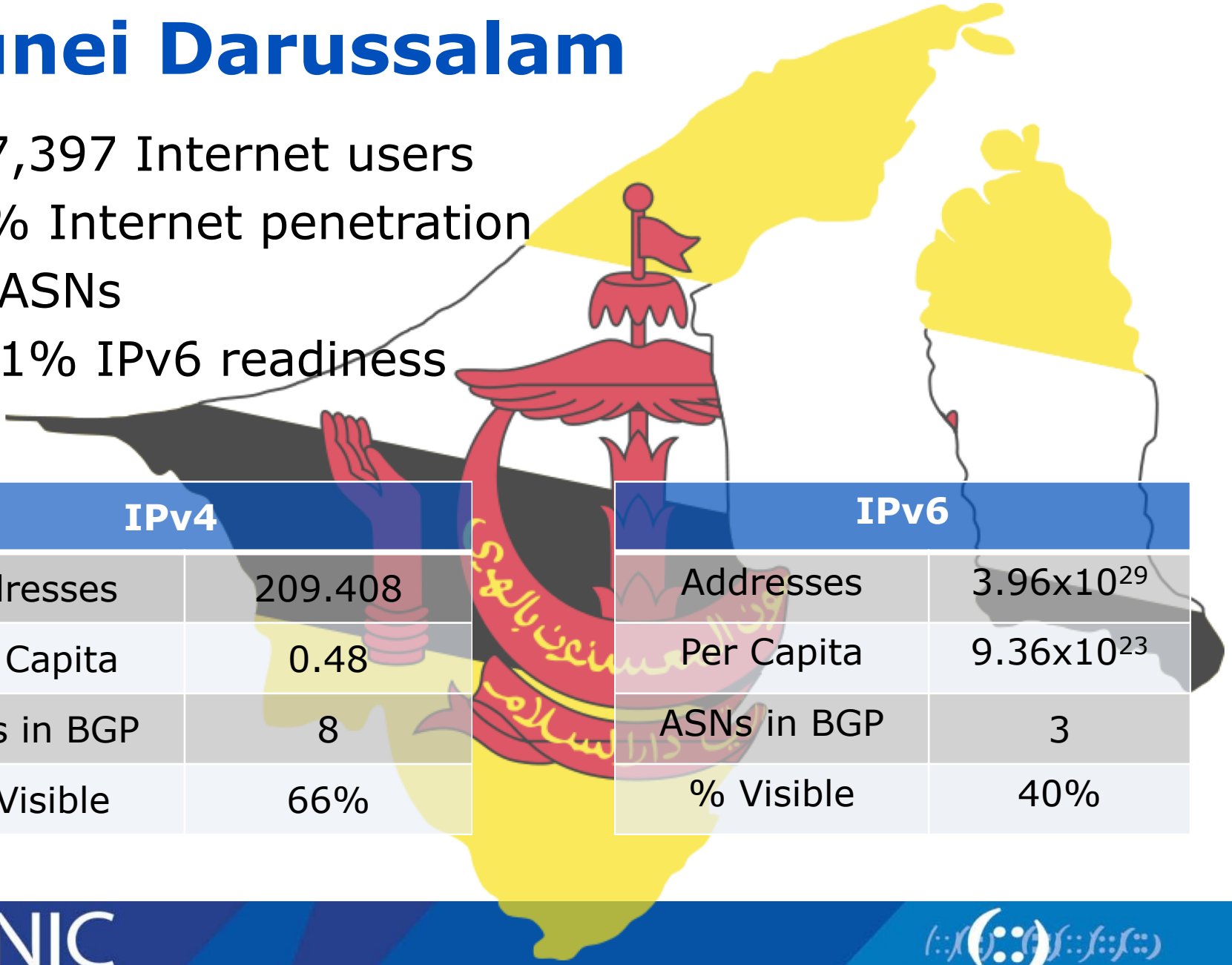
ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
4818	DiGi Telecommunications	38.77	38.60
4788	TM Net	34.11	33.98
9534	MAXIS	28.93	28.80
38322	WEBE Digital	23.81	23.71
45960	YTL Communications	23.05	22.93
38466	U Mobile	8.72	8.66
9930	TTNET	2.18	2.17

Malaysia IPv6 leaderboard



Brunei Darussalam

- 317,397 Internet users
- 75% Internet penetration
- 13 ASNs
- 0.01% IPv6 readiness



IPv4	
Addresses	209.408
Per Capita	0.48
ASNs in BGP	8
% Visible	66%

IPv6	
Addresses	3.96×10^{29}
Per Capita	9.36×10^{23}
ASNs in BGP	3
% Visible	40%

Brunei IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
131467	E-Government National Centre	0.22	0.22
10094	BruNet	0.01	0.01
10101	Simpur	0.01	0.01

Brunei IPv6 leaderboard

ASN	Organization	IPv6 capable (%)	IPv6 Preferred (%)
131467	E-Government National Centre	0.22	0.22
10094	BruNet	0.01	0.01
10101	Simpur	0.01	0.01

ASN	Organization	Delegated prefix	Routed
45259	**Bruhaas**	**2001:df1:ba00::/48**	**YES**
	Beemee Co LTD	2001:df1:f800::/48	NO
	ZFlow	2001:df2:8000::/48	NO
	Beebee Co LTD	2001:df5:4800::/48	NO
	BruNet	2400:9400::/32	NO
	Progresif Cellular	2404:8980::/32	NO
132395	**DST Headquarters**	**2405:1700::/32**	**YES**
10101	**Simpur ISP**	**2406:7800::/32**	**YES**
	DST Multimedia	2406:7801::/32	NO

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**

[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**
- **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

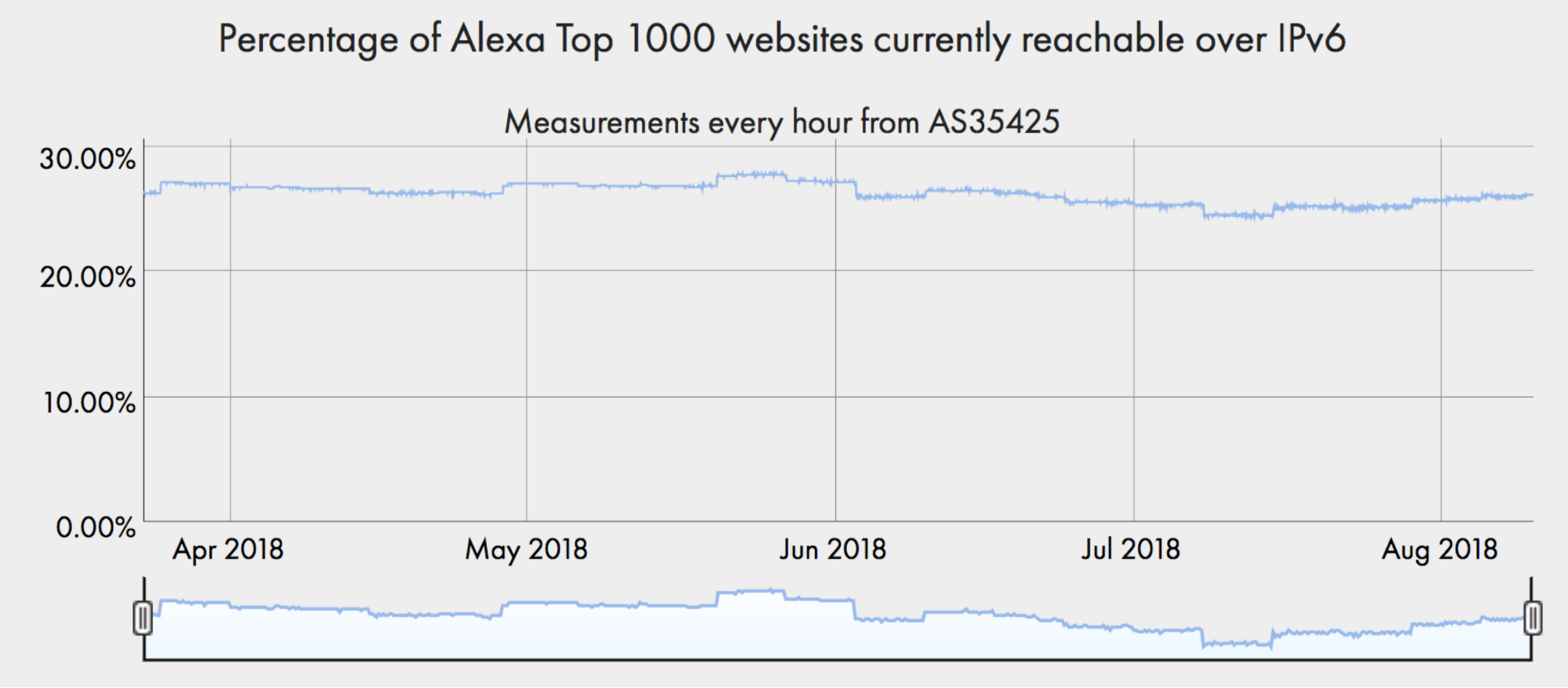
[source: https://blog.apnic.net/2017/09/29/network-operator-perspective-ipv6-performance/]

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**
- **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%.**

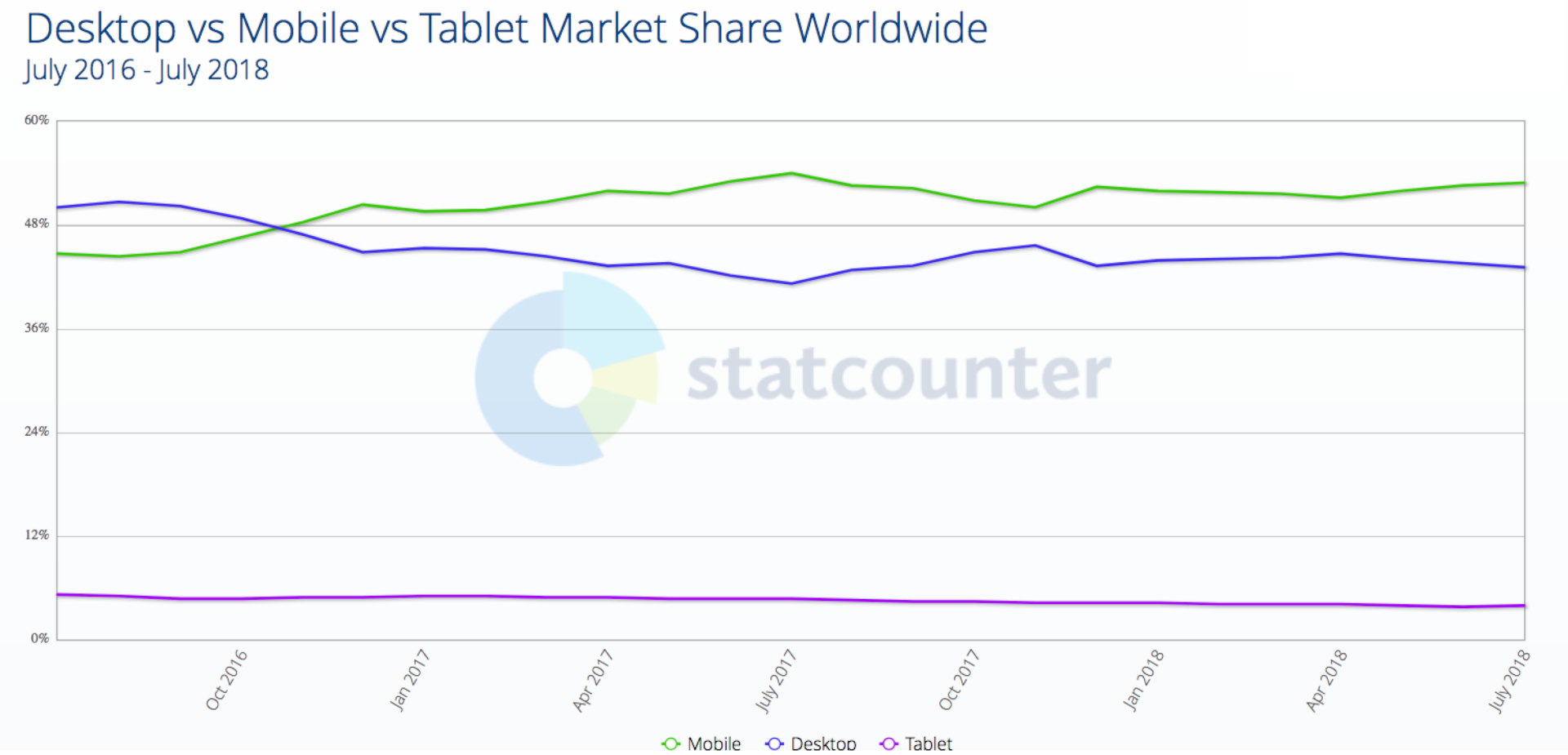
[source : https://blog.apnic.net/2016/05/13/linkedin-ipv6-measurements/]

IPv6 in Action: Content



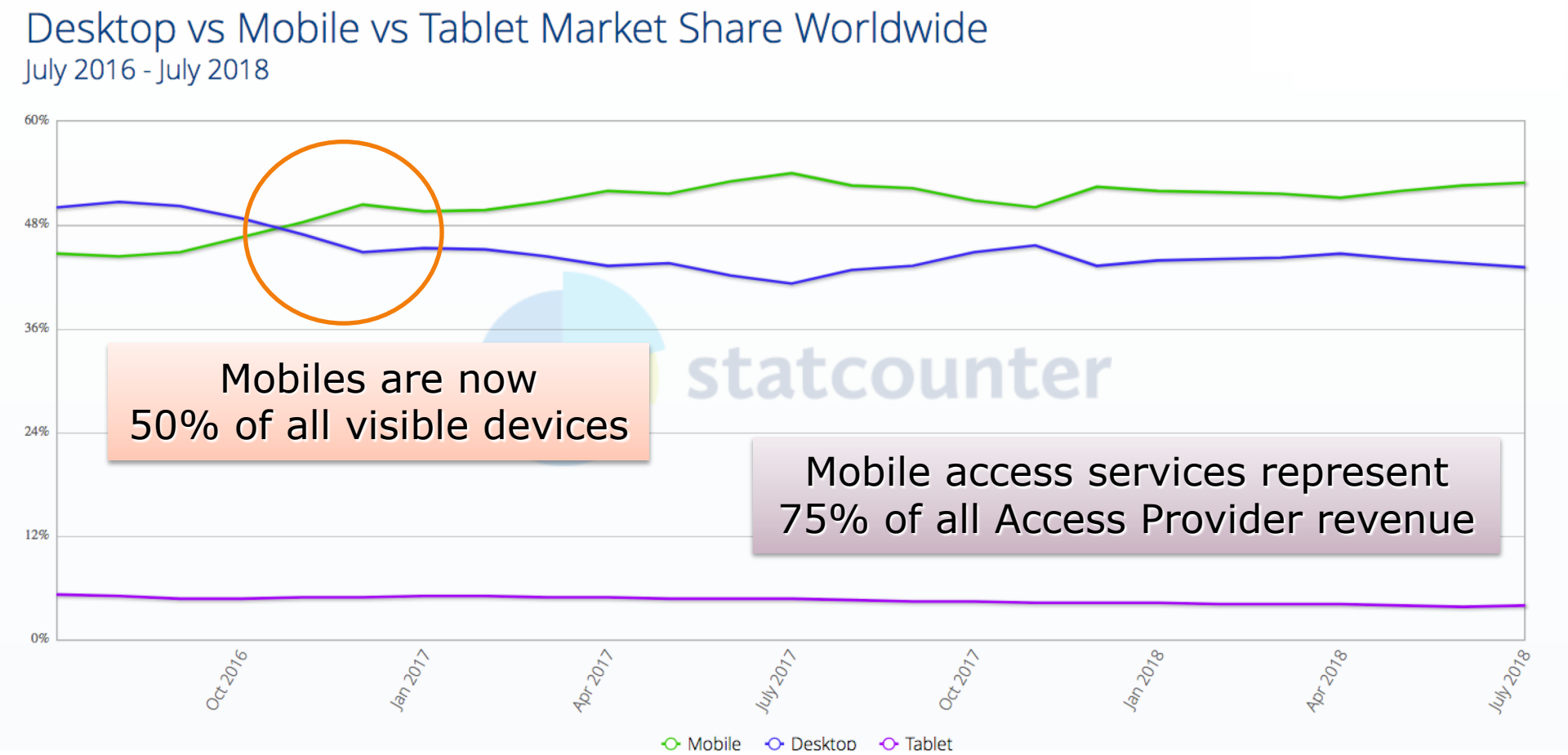
[source : http://www.worldipv6launch.org/measurements/]

Industry Trend: Devices



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

Industry Trend: Devices



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

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 atleast 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)

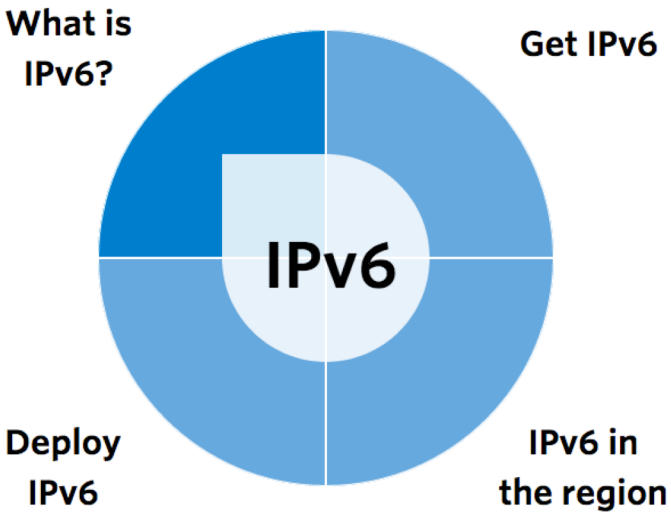
Observations

- 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.

APNIC

Get IP | Manage IP | Training | Events | Research | Community | Blog | About | Contact

IPv6@APNIC



What is IPv6? | Why is it important? | What does IPv6 mean to me? | Benefits

apnic.net/ipv6

Terima Kasih!

Thank You!

APNIC