A review of current worldwide IPv6 deployment (SANOG edition)

APNIC Labs

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APNIC

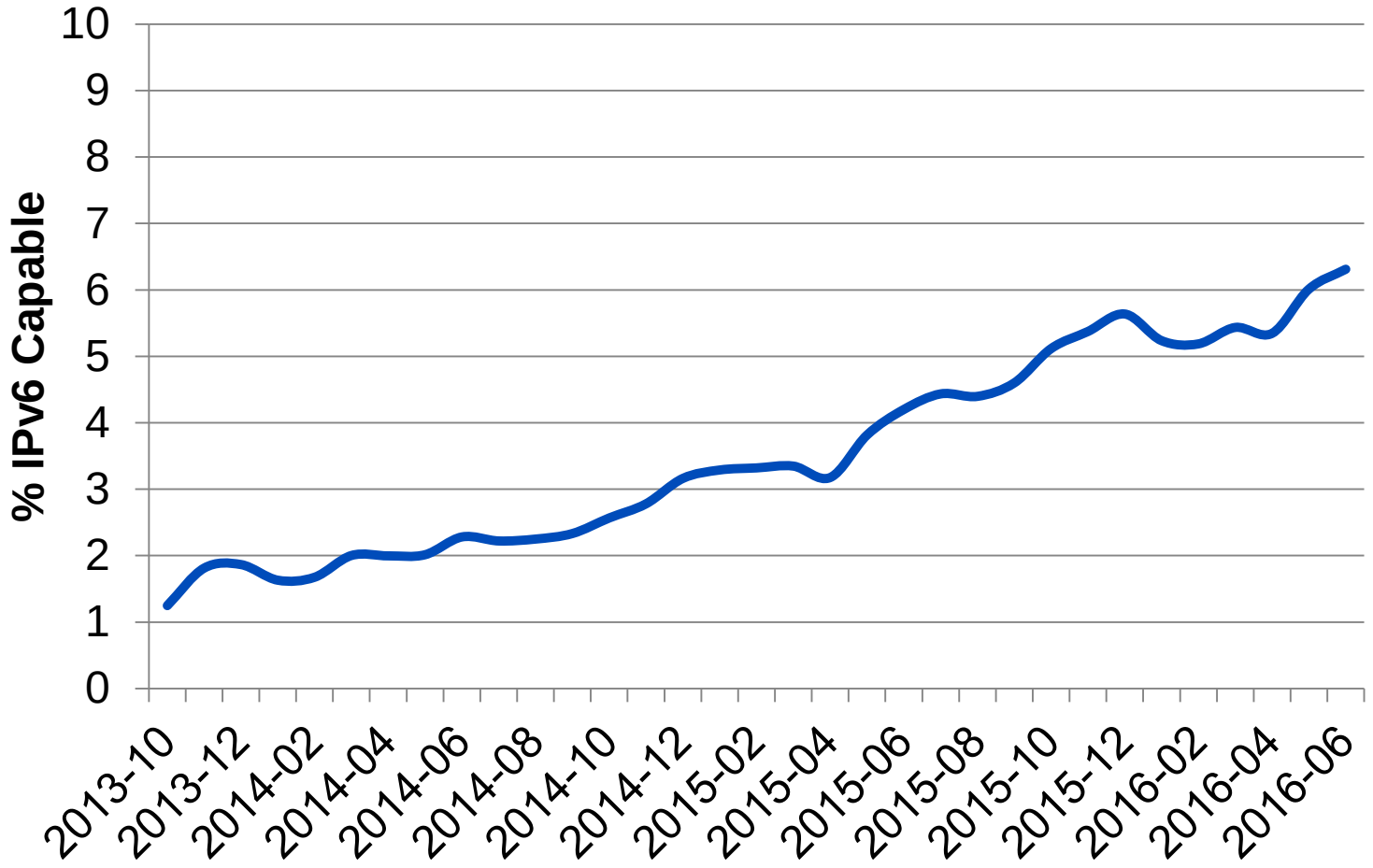
Outline

- IPv6 around the world
- The story for SANOG
- Distribution and allocation
- Observations

IPv6 around the world

APNIC

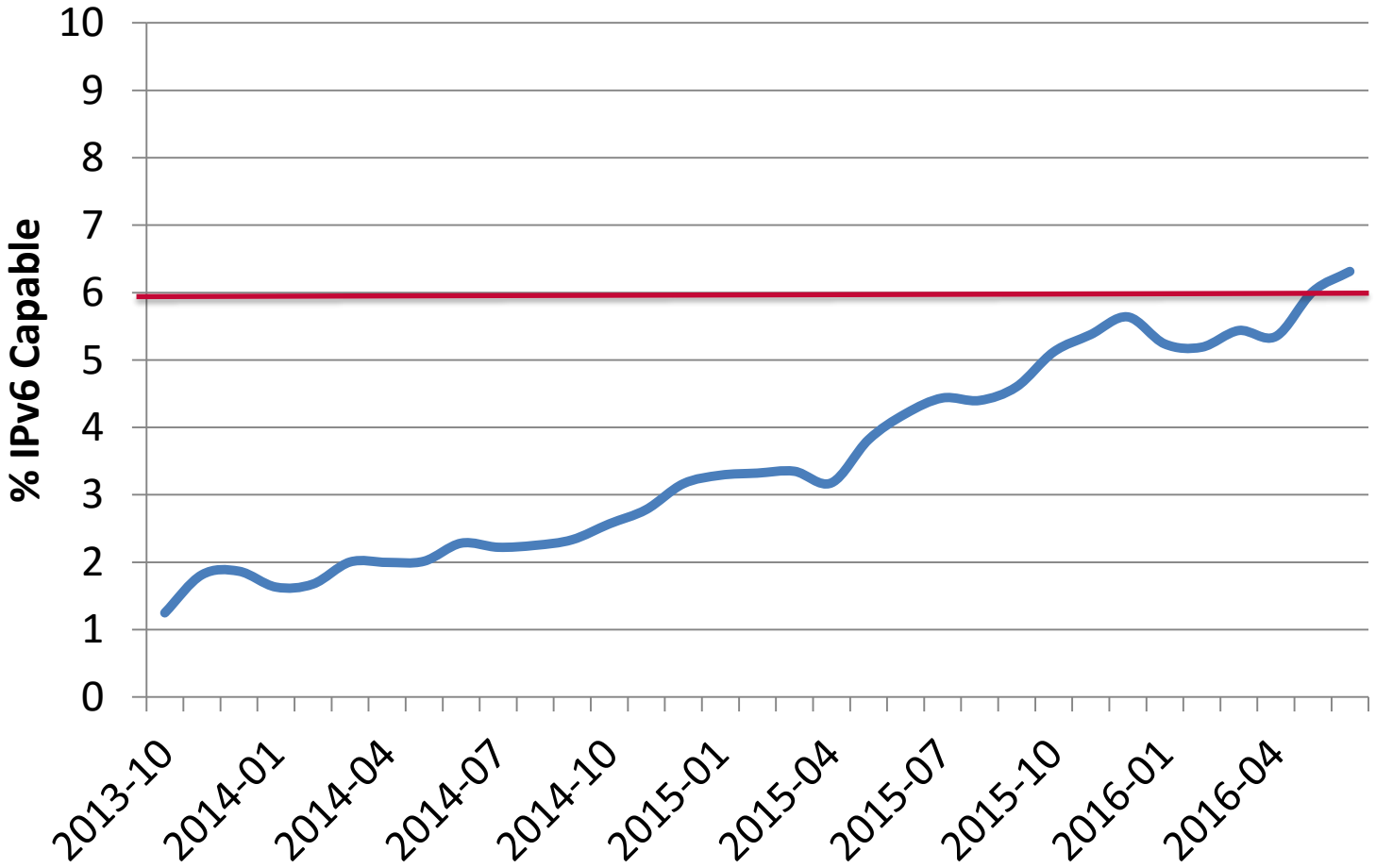
IPv6 capability, worldwide (weighted)



6.5%? Google says 10+?

- APNIC applies a weighting function
  - Based on ITU Internet population figures
- APNIC's measurement is conservative
- The real IPv6 count is probably somewhere in between!

IPv6 capability, worldwide (weighted)



CC	IPv6 %	CC	IPv6 %	CC	IPv6 %	CC	IPv6 %	CC	IPv6 %	CC	IPv6 %
BE	53.35%	CH	29.49%	US	29.02%	DE	28.44%	PT	28.33%	GR	26.77%
EE	19.34%	PE	18.97%	LU	17.63%	JP	16.79%	FI	16.76%	MY	13.81%
EU	12.94%	FR	12.54%	BR	10.86%	GB	10.78%	CA	10.35%	NO	9.65%
HT	9.50%	NL	8.27%	SG	8.23%	RO	8.13%	AT	7.26%	CZ	6.21%

CC	IPv6 %	CC	IPv6 %	CC	IPv6 %	CC	IPv6 %	CC	IPv6 %	CC	IPv6%
IE	5.36%	AU	4.82%	HU	4.56%	BO	4.35%	SE	4.28%	AX	4.05%
SA	3.97%	BA	3.71%	NZ	3.03%	PL	2.86%	TR	2.30%	HK	1.53%
SI	1.51%	LK	1.41%	MT	1.34%	RU	1.33%	IN	1.30%	KR	1.20%
TT	0.96%	BT	0.86%	CW	0.77%	BG	0.68%	CN	0.51%	VN	0.50%
IT	0.49%	UA	0.43%	MD	0.40%	DK	0.39%	IL	0.36%	TH	0.33%
SD	0.27%	BQ	0.23%	SK	0.21%	LV	0.21%	ZA	0.21%	LT	0.21%
BW	0.17%	GF	0.16%	MK	0.12%	TW	0.12%	CL	0.12%	ES	0.11%
IS	0.11%	ID	0.10%	TZ	0.10%	GT	0.10%	PA	0.10%		

Emerging problem in AP region

- Few economies in the AP region are above world-grade IPv6 capability
- Of the economies below the line, many are stagnant, some are moving upward
- Hard to quantify what quality determines ranking:
  - Its not just about economic size, diversity of ISP
  - Is it about capital investment?

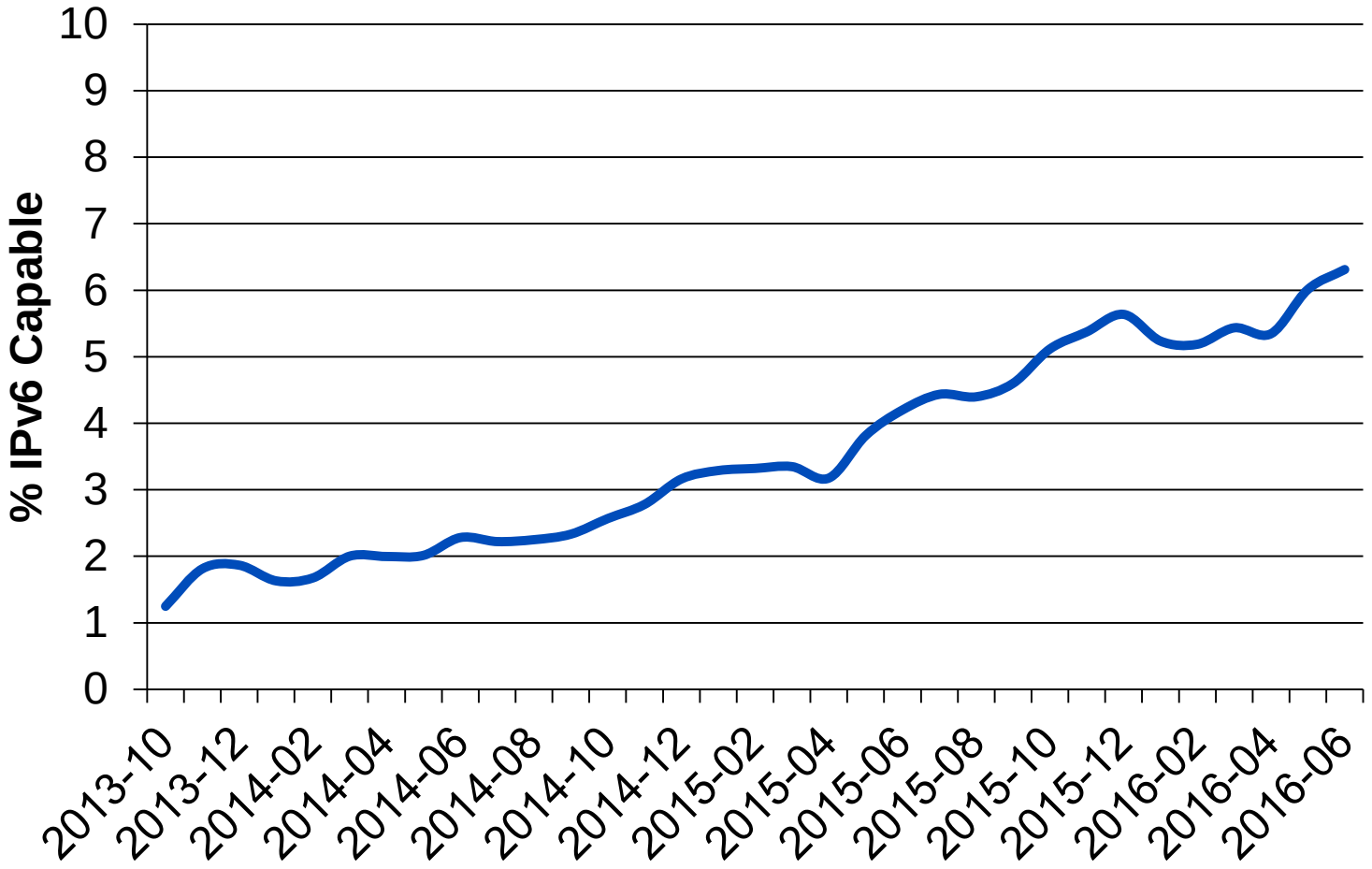
Two kinds of Internet?

- IPv4 and IPv6 can't directly inter-operate as protocols
  - You can tunnel, and you can gateway but you can't send IP packets directly from
    - 2000::/3 to 10.0.0.0/8
  - The decision to proceed with IPv6 deployment implies dual-stack operations, short or long term
  - The decision to remain in IPv4 implies increasing use of CGN and other techniques to maximise address re-use
- There is no avoidance of extra technology cost to continue to grow the Internet.

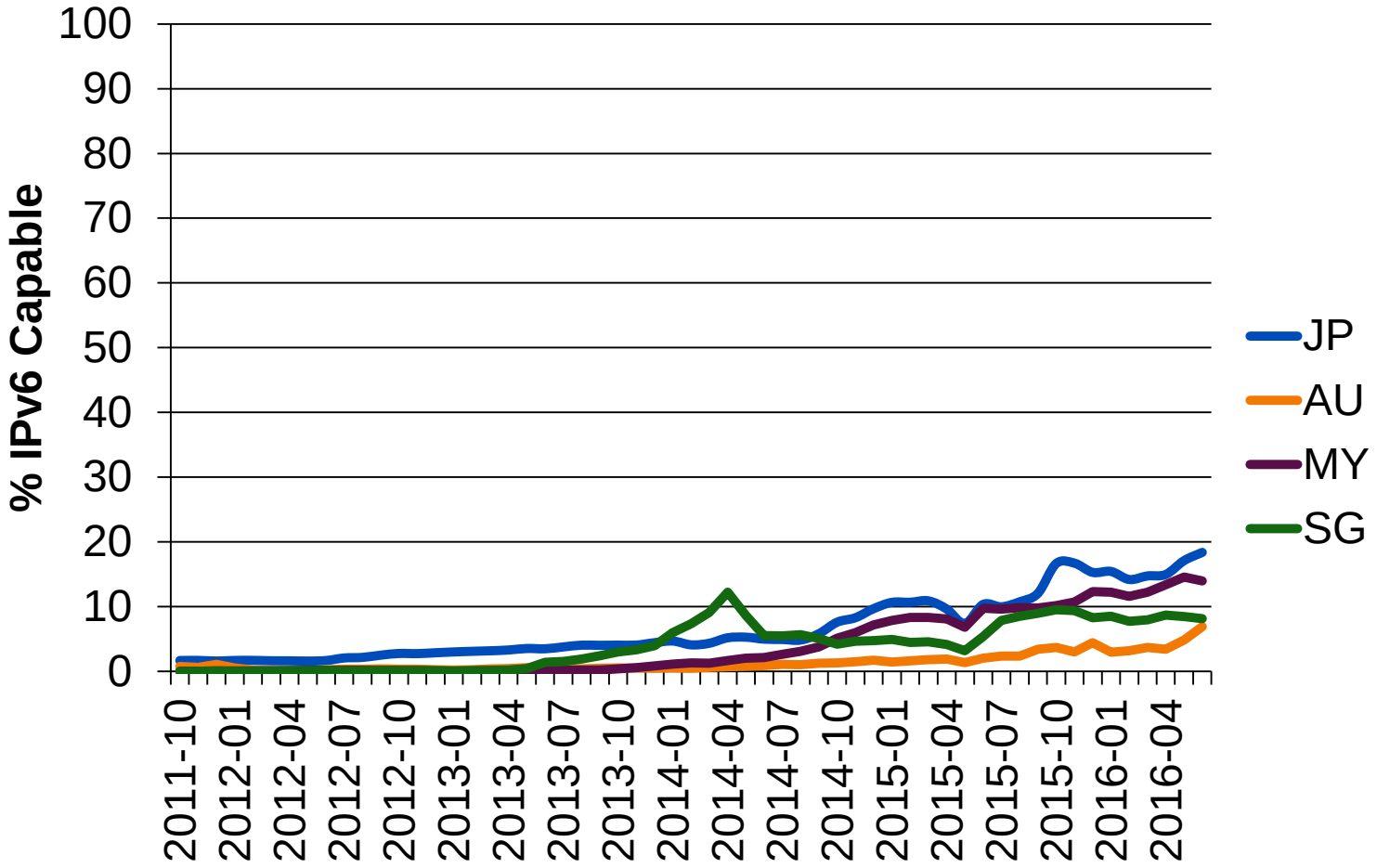
It looks like it on macro scale

- There are signs that at a high-level view, the economies investing in IPv6 are now diverging from the ones who are staying in IPv4
  - Its not just about size, or economic capacity
- Lets review some of the players in each ‘camp’
  - Some economies with signs of significant IPv6 deployment
  - Some economies with little or no sign of significant IPv6 deployment

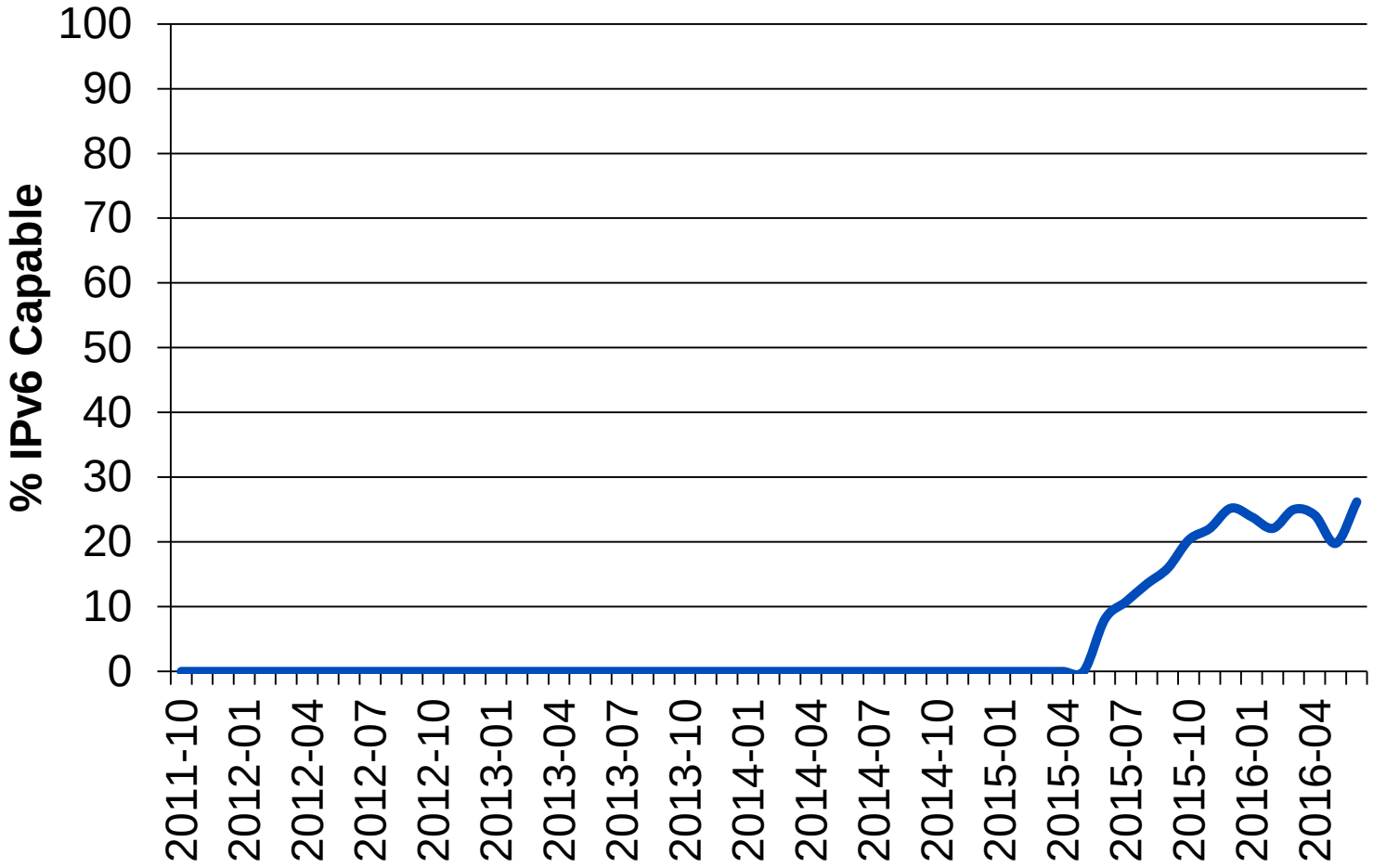
IPv6 capability, worldwide (weighted)



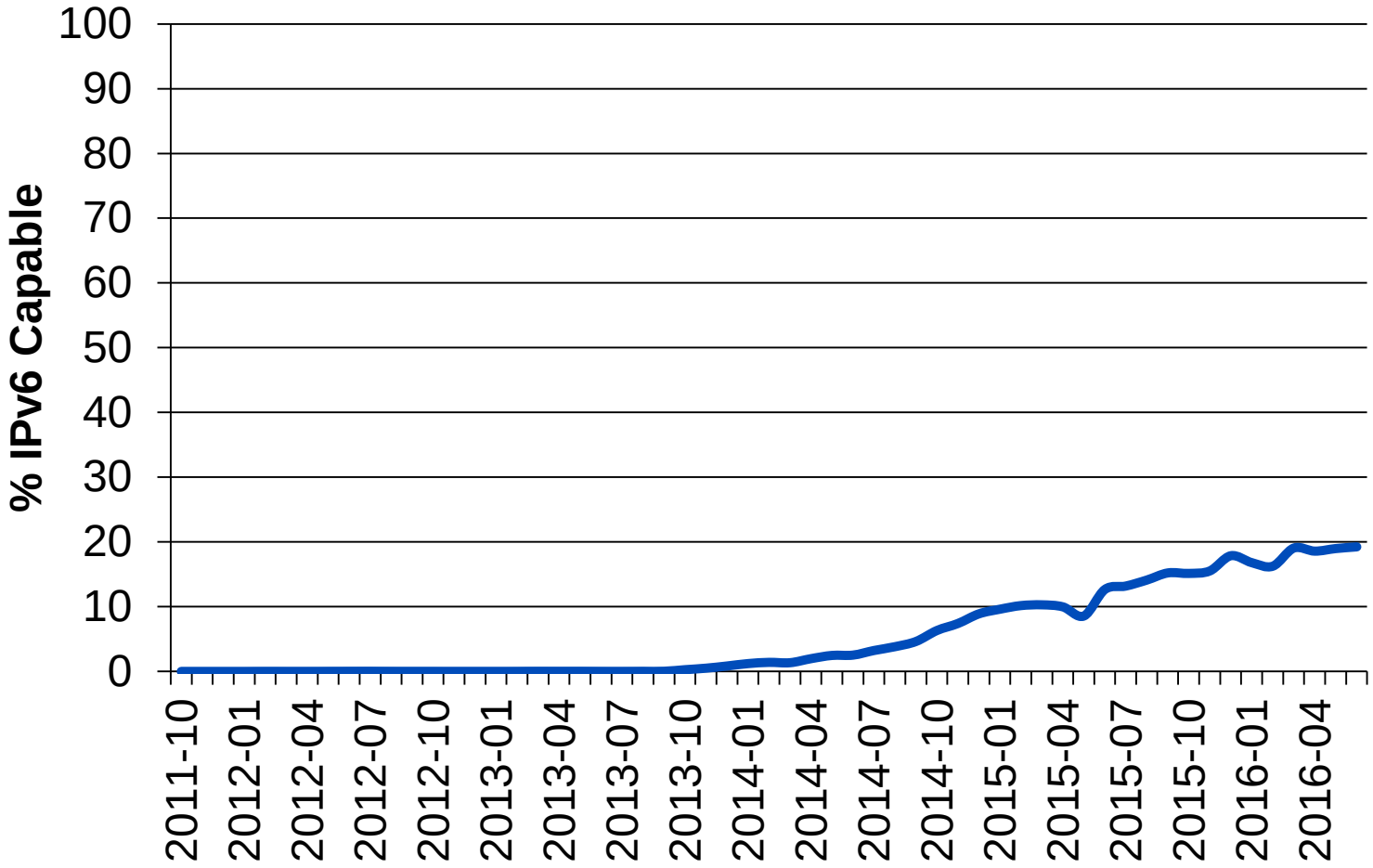
Higher IPv6 capability in Asia-Pacific



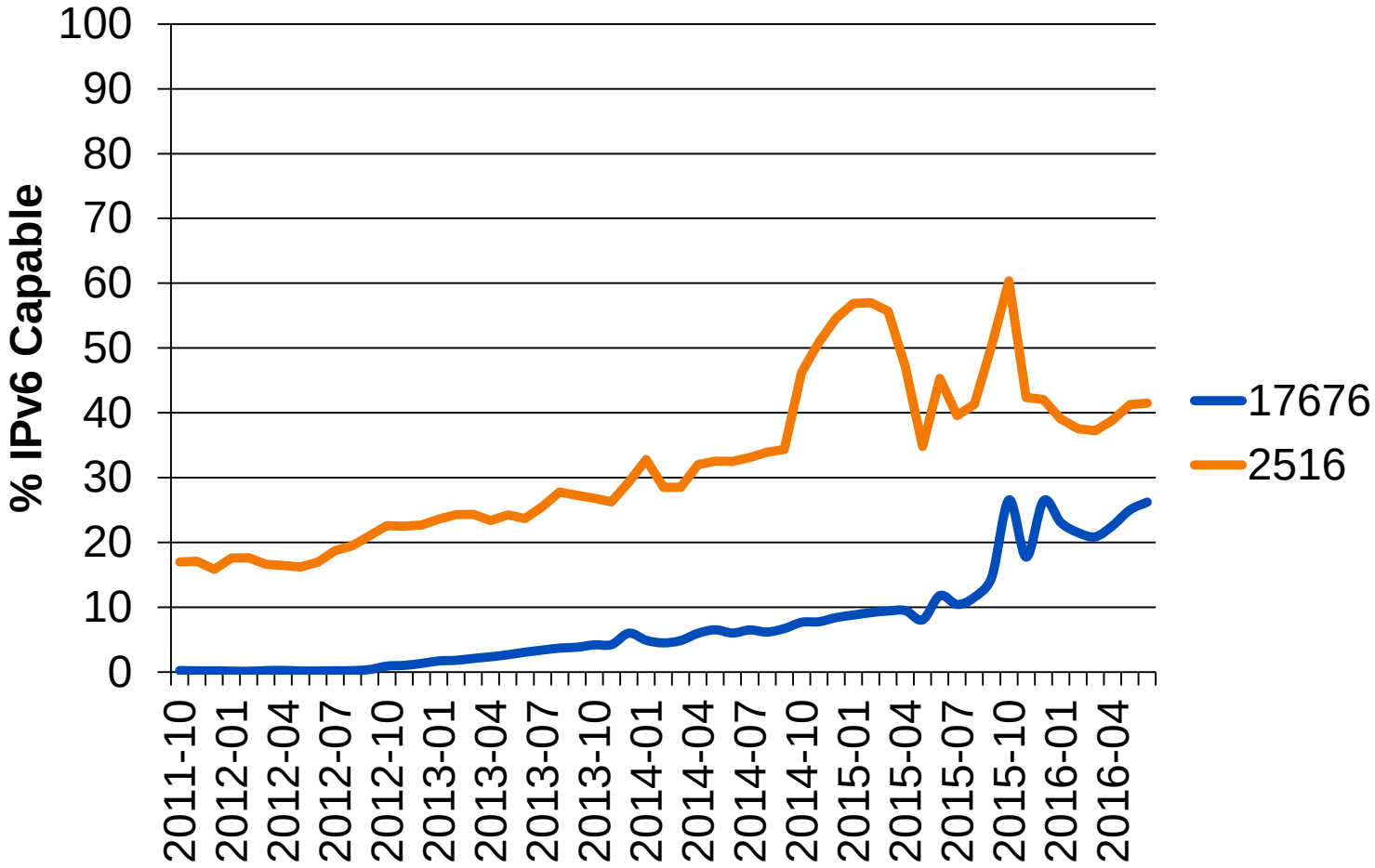
SK Telecom (Korea)



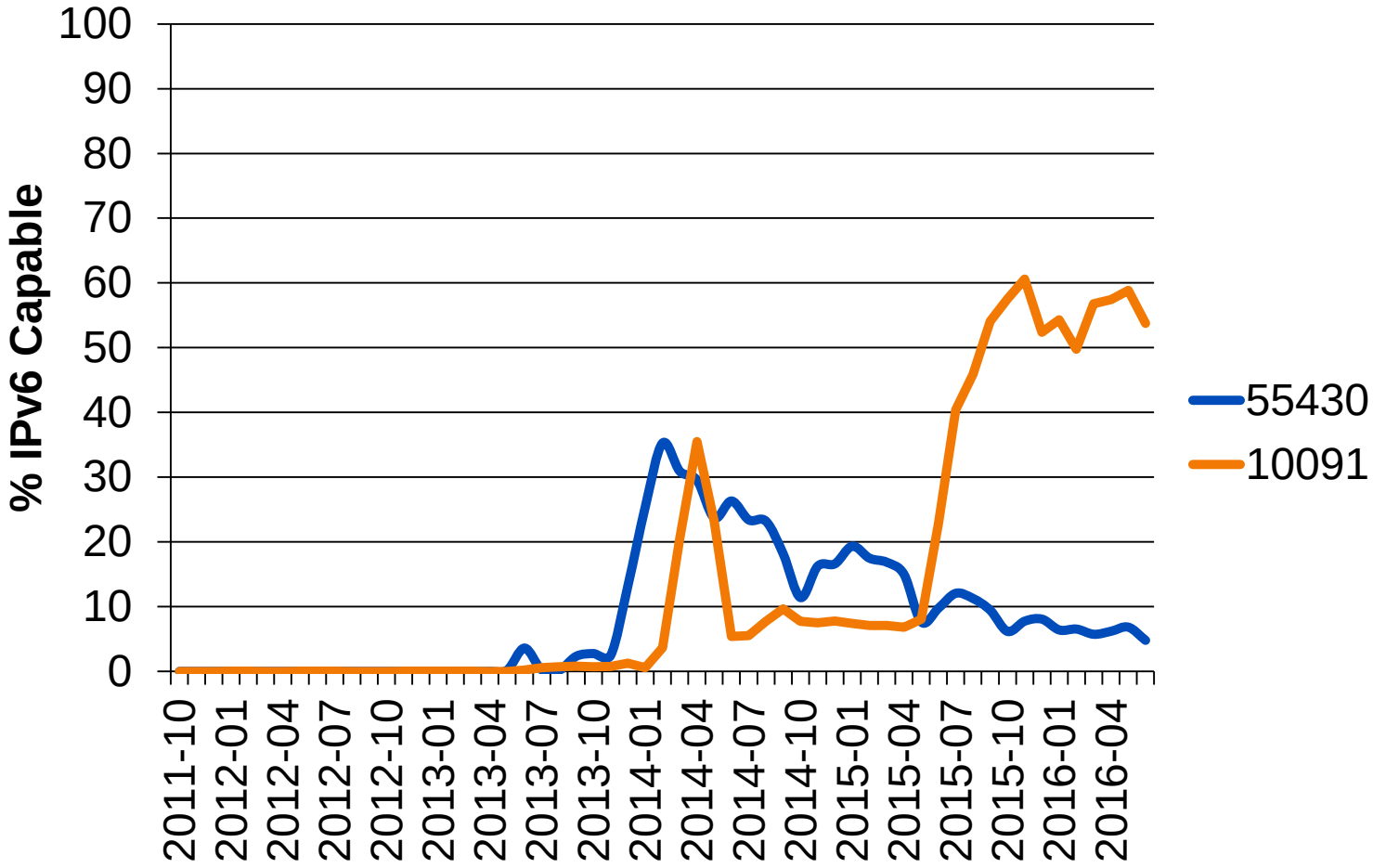
TMNET (Malaysia)



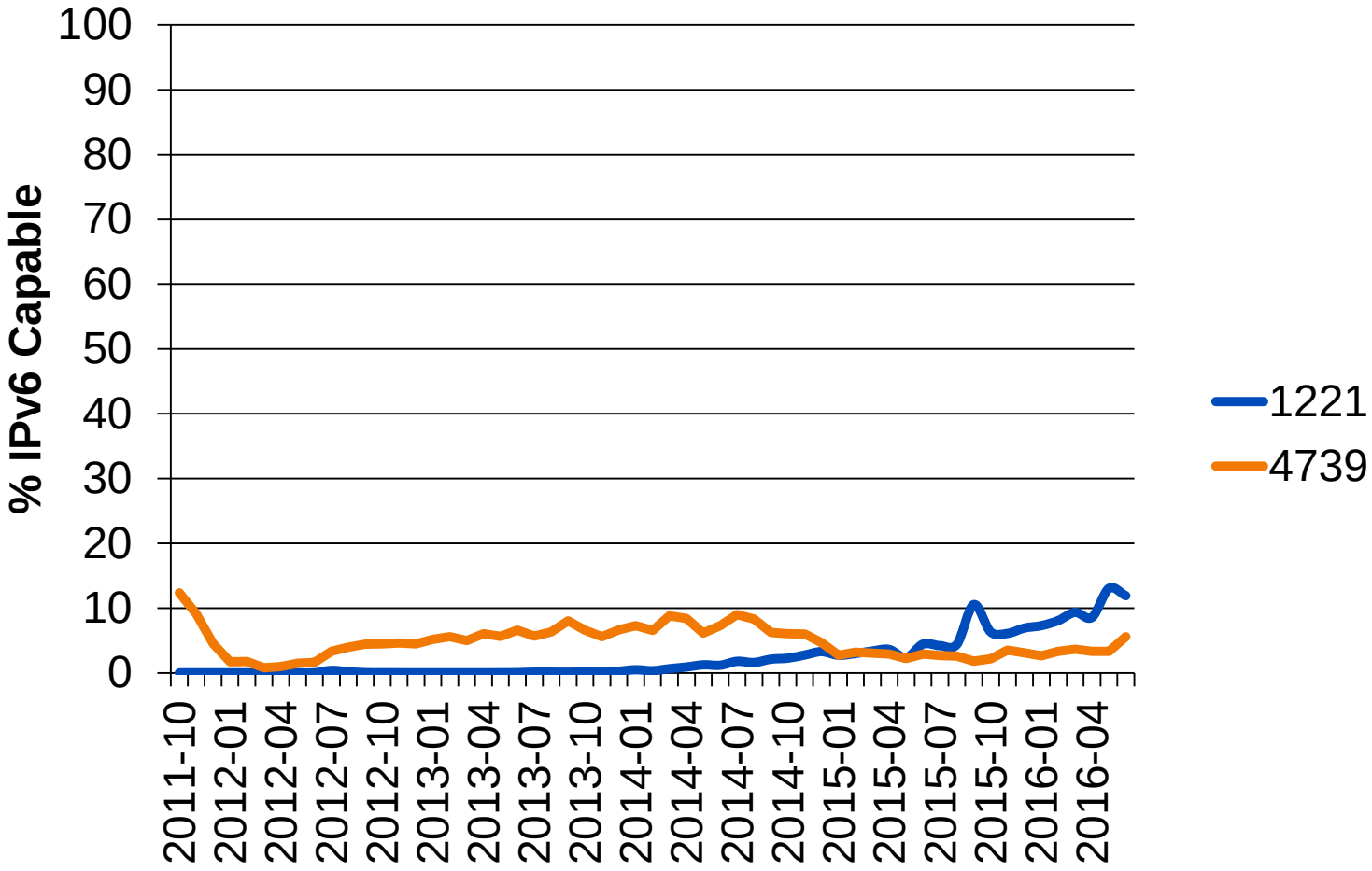
Softbank-BB, KDDI (Japan)



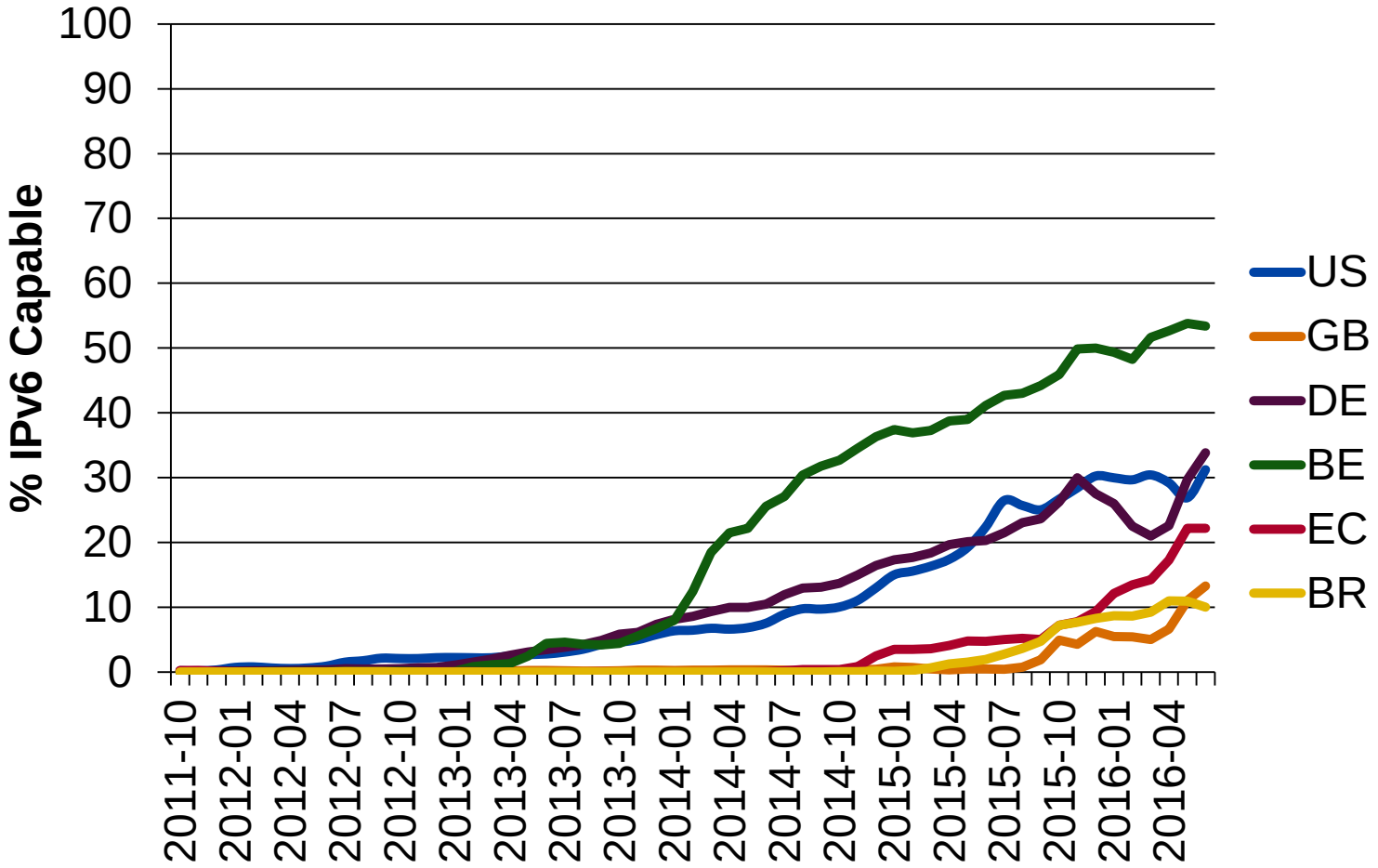
StarHub (Singapore)



Telstra, Internode (Australia)



High IPv6 capability, selected economies Worldwide



Top 10 by sample, US

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS7922	Comcast Cable Communications	61.75%	57.28%	14304843
AS7018	ATT-INTERNET4 - ATT Services	80.57%	73.20%	8526953
AS8075	Microsoft Corporation	0.00%	0.00%	5325116
AS701	Verizon Business	0.14%	0.01%	4728691
AS20115	Charter Communications	0.10%	0.02%	3463344
AS22773	Cox Communications Inc.	17.46%	16.15%	3164061
AS22394	Verizon Wireless	89.70%	80.89%	2621733
AS209	Qwest Communications Company	0.17%	0.10%	2432793
AS20057	ATT Mobility	9.50%	9.32%	2410034
AS10796	Time Warner Cable Internet	23.30%	21.79%	1999827

Top 10 by sample, BE

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS5432	BELGACOM-SKYNET Proximus	44.06%	42.09%	958021
AS6848	TELENET-AS Telenet N.V.	71.09%	67.94%	879004
AS12392	ASBRUTELE Brutele SC	72.96%	70.51%	237980
AS47377	MES Mobistar SA	0.20%	0.05%	56730
AS21502	Numericable S.A.	0.01%	0.01%	48287
AS2611	BELNET BELNET	13.39%	12.44%	25361
AS44944	BASE-AS BASE Company NVSA	0.45%	0.16%	22518
AS29587	SCHEDOM-AS schedom vof	0.00%	0.00%	9654
AS41756	Orascom Telecom Algeria Spa	0.00%	0.00%	8245
AS51964	ORANGE-BUSINESS-SERVICES-IPSN	0.00%	0.00%	7811

Top 10 by sample, GB

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS5607	Sky UK Limited	51.06%	49.36%	798472
AS5089	NTL Virgin Media Limited	0.01%	0.01%	739599
AS43766	MTC-KSA-AS MTC KSA	0.00%	0.00%	676236
AS2856	British Telecommunications PLC	0.26%	0.24%	658706
AS13285	TalkTalk Communications Limited	0.00%	0.00%	173033
AS12576	ORANGE-PCS EE Limited	0.10%	0.05%	154985
AS9105	TISCALI-UK Tiscali UK Limited	0.00%	0.00%	153678
AS9009	M247 M247 Ltd	0.06%	0.02%	142583
AS60339	H3GUK Hutchison 3G UK Limited	0.09%	0.03%	97854
AS34825	ONAVO Onavo Mobile Ltd	0.01%	0.00%	90392

Top 10 by Samples, DE

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS3320	DTAG Deutsche Telekom AG	50.24%	48.39%	256677
AS200185	XANDMAIL-ASN X AND MAIL SA	0.00%	0.00%	115142
AS3209	VODANET Vodafone GmbH	0.15%	0.07%	81574
AS24940	HETZNER-AS Hetzner Online	5.86%	4.78%	65769
AS28753	Leaseweb Deutschland GmbH	39.91%	0.71%	61988
AS31334	Vodafone Kabel Deutschland	69.06%	65.82%	59817
AS6805	Telefonica Germany GmbH	0.41%	0.33%	52396
AS6830	Liberty Global Operations B.V.	58.68%	55.50%	40648
AS8972	PLUSSERVER-AS PlusServer AG	0.81%	0.05%	25969
AS29562	KABELBW-ASN Kabel BW GmbH	56.36%	53.48%	23299

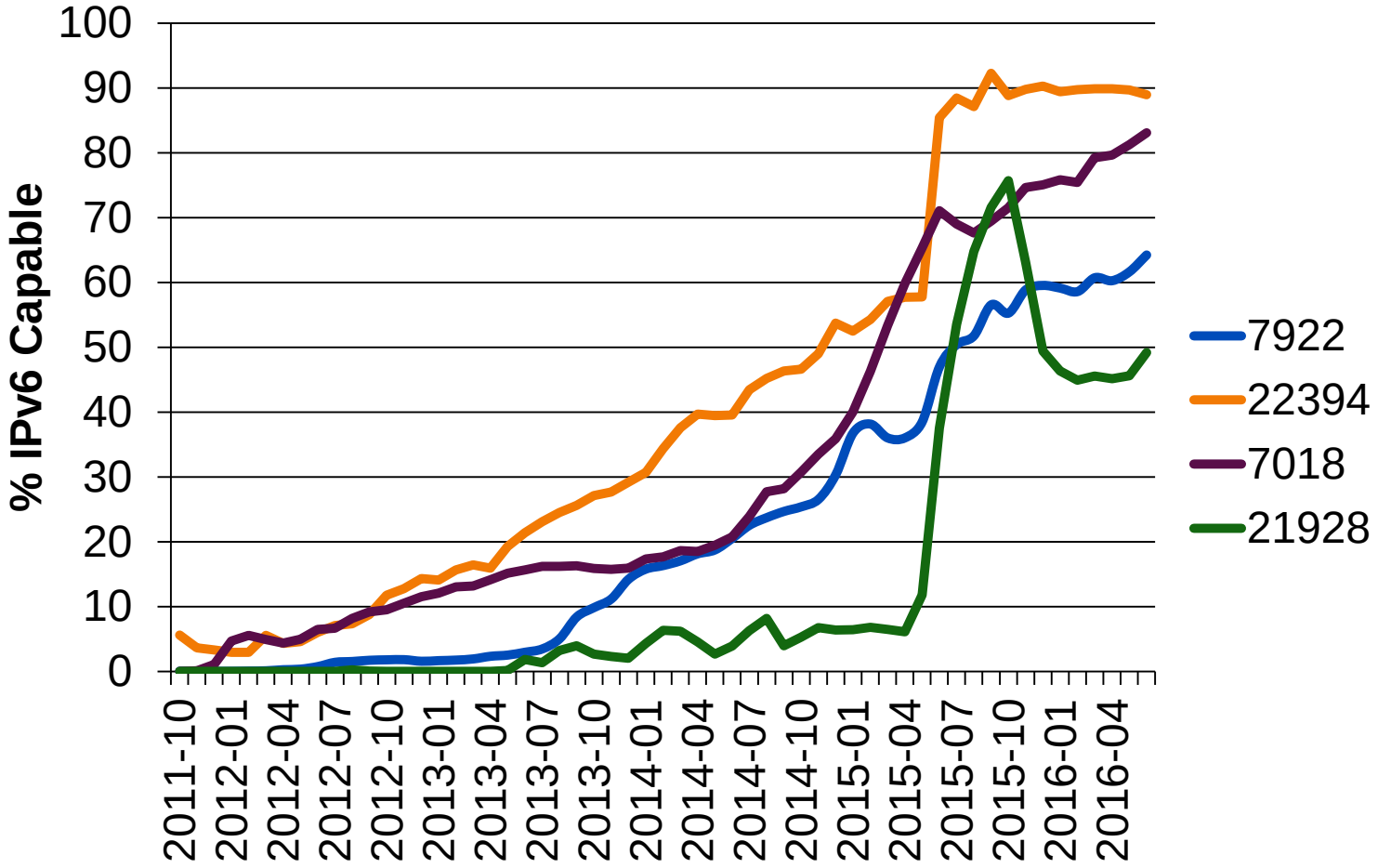
Top 10 by Samples BR

ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS28573	CLARO S.A.	22.60%	20.60%	1354868
AS18881	Global Village Telecom	21.89%	20.73%	892808
AS7738	Telemar Norte Leste S.A.	3.84%	3.68%	575631
AS27699	TELEFNICA BRASIL S.A	2.26%	2.10%	419031
AS8167	Brasil Telecom SA -	2.46%	2.39%	339728
AS26615	Tim Celular S.A.	4.71%	4.60%	104354
AS26599	TELEFNICA BRASIL S.A	13.51%	13.12%	102621
AS53006	ALGAR TELECOM SA	0.05%	0.05%	62938
AS14868	COPEL Telecom S.A.	22.30%	21.73%	44573
AS22085	Claro SA	0.19%	0.04%	40324

Top 10 by Samples, EC

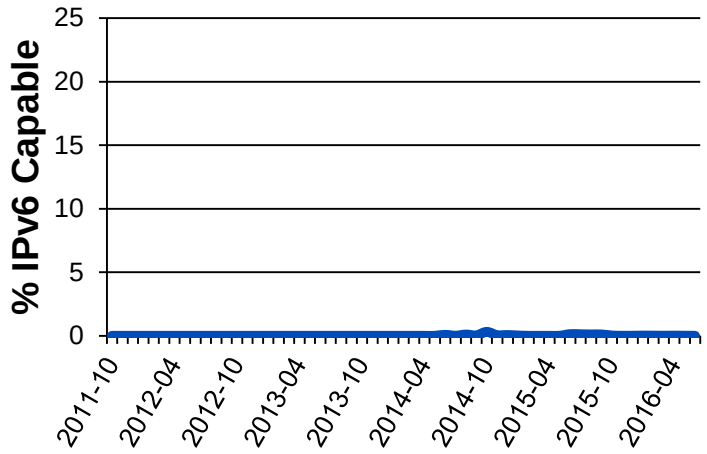
ASN	AS Name	IPv6 Capable	IPv6 Preferred	# Samples
AS14420	CNT EP	45.13%	43.66%	1582536
AS14522	Satnet	0.00%	0.00%	438480
AS27947	Telconet S.A	0.03%	0.03%	424395
AS27738	Ecuadortelecom S.A.	0.00%	0.00%	278140
AS23487	CONECEL	0.02%	0.01%	157551
AS19114	Otecel S.A.	0.03%	0.01%	155074
AS52257	Telconet S.A	0.01%	0.00%	135138
AS27668	ETAPA EP	0.00%	0.00%	126933
AS22724	PUNTONET S.A.	0.01%	0.01%	110372
AS28006	CNT EP	0.02%	0.01%	42226

Comcast, AT&T, Verizon, T-Mobile



What about SANOG?

Afghanistan (.AF)

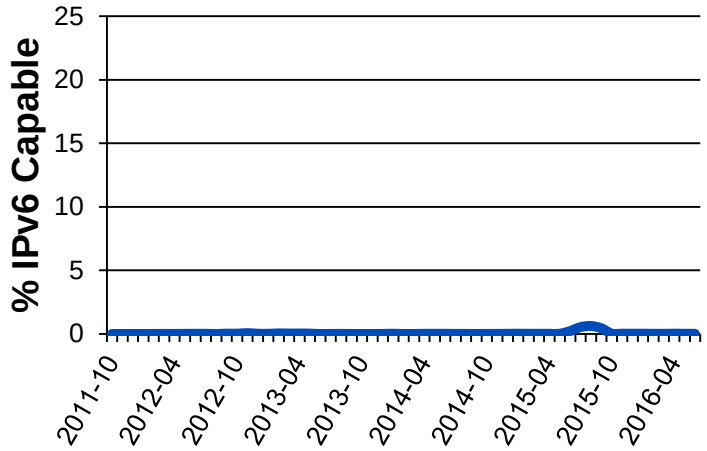


33,358,997	people
4,103,156	users
12%	penetration
44	ASes
20.02B	GDP

IPv4	32 in BGP
165,120	addresses
0.00	per head
62%	visible

IPv6	3 in BGP
51,539	M addresses
1,544	per head
17%	visible
0%	capability

Bangladesh (.BD)

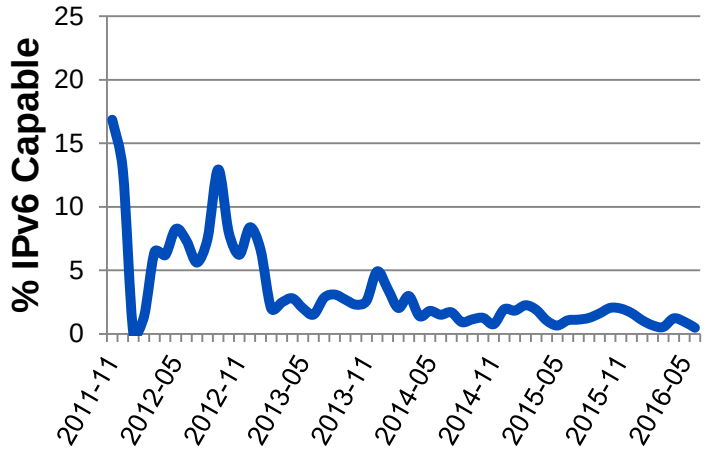


162,884,606	people
51,960,189	users
32%	penetration
382	ASes
172.82B	GDP

IPv4	308 in BGP
1,255,680	addresses
0.01	per head
86%	visible

IPv6	29 in BGP
536,872	M addresses
3,296	per head
8%	visible
0%	capability

Bhutan (.BT)

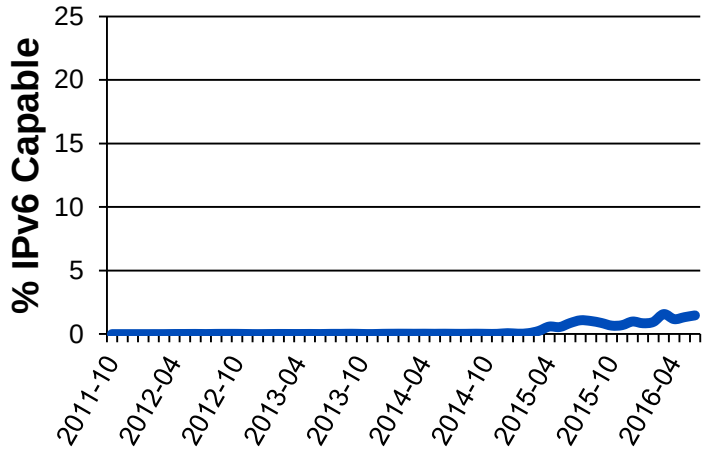


783,983	people
269,690	users
34%	penetration
6	ASes
1.96B	GDP

IPv4	4 in BGP
27,904	addresses
0.04	per head
92%	visible

IPv6	2 in BGP
17,179	M addresses
21,913	per head
0%	visible
0%	capability

India (.IN)

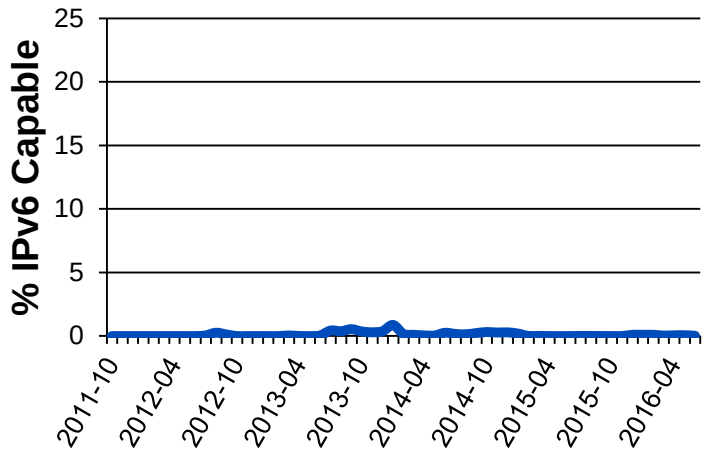


1,326,586,355	people
375,423,938	users
28%	penetration
1,628	ASes
2.05T	GDP

IPv4	1055 in BGP
39,426,816	addresses
0.03	per head
80%	visible

IPv6	153 in BGP
1,606,331	M addresses
1,210	per head
8%	visible
2%	capability

Maldives (.MV)

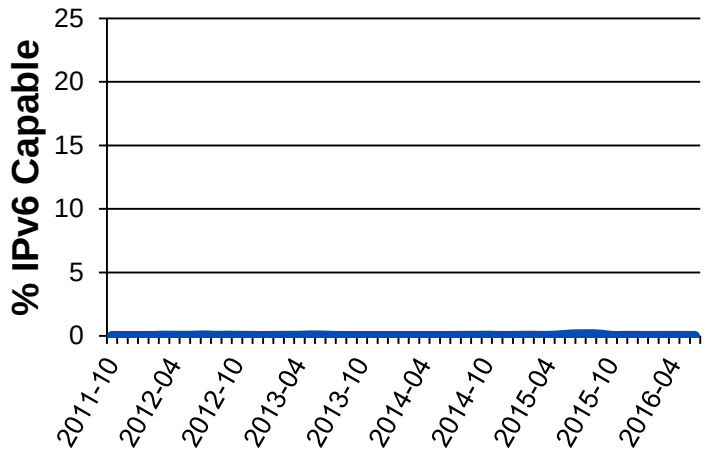


369,729	people
182,276	users
49%	penetration
6	ASes
3.06B	GDP

IPv4	4 in BGP
60,160	addresses
0.16	per head
97%	visible

IPv6	2 in BGP
17,179	M addresses
46,466	per head
0%	visible
0%	capability

Nepal (.NP)

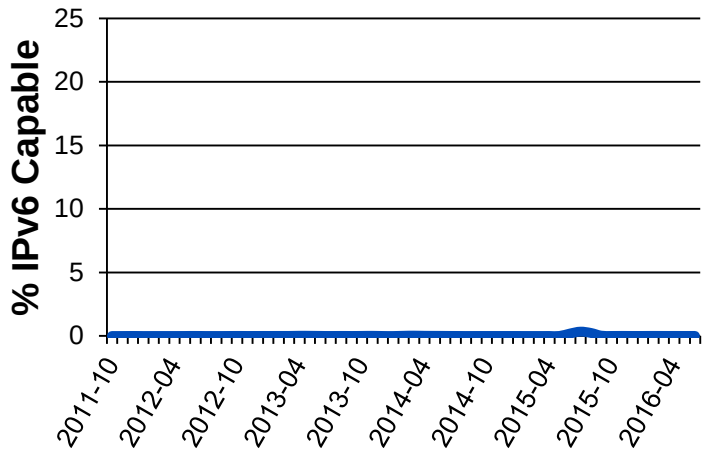


28,846,110	people
4,442,300	users
15%	penetration
56	ASes
19.76B	GDP

IPv4	42 in BGP
509,440	addresses
0.02	per head
99%	visible

IPv6	11 in BGP
111,670	M addresses
3,871	per head
19%	visible
0%	capability

Pakistan (.PK)

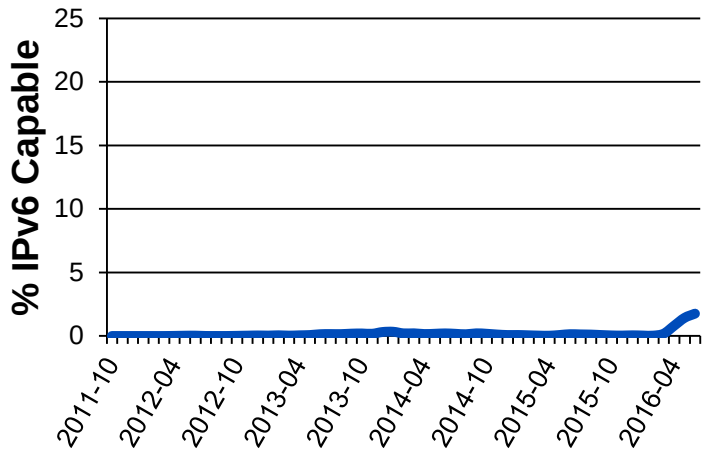


192,772,832	people
28,530,379	users
15%	penetration
116	ASes
243.47B	GDP

IPv4	84 in BGP
5,299,712	addresses
0.03	per head
98%	visible

IPv6	15 in BGP
223,338	M addresses
1,158	per head
10%	visible
0%	capability

Sri Lanka (.LK)



20,809,521	people
5,368,856	users
26%	penetration
22	ASes
78.81B	GDP

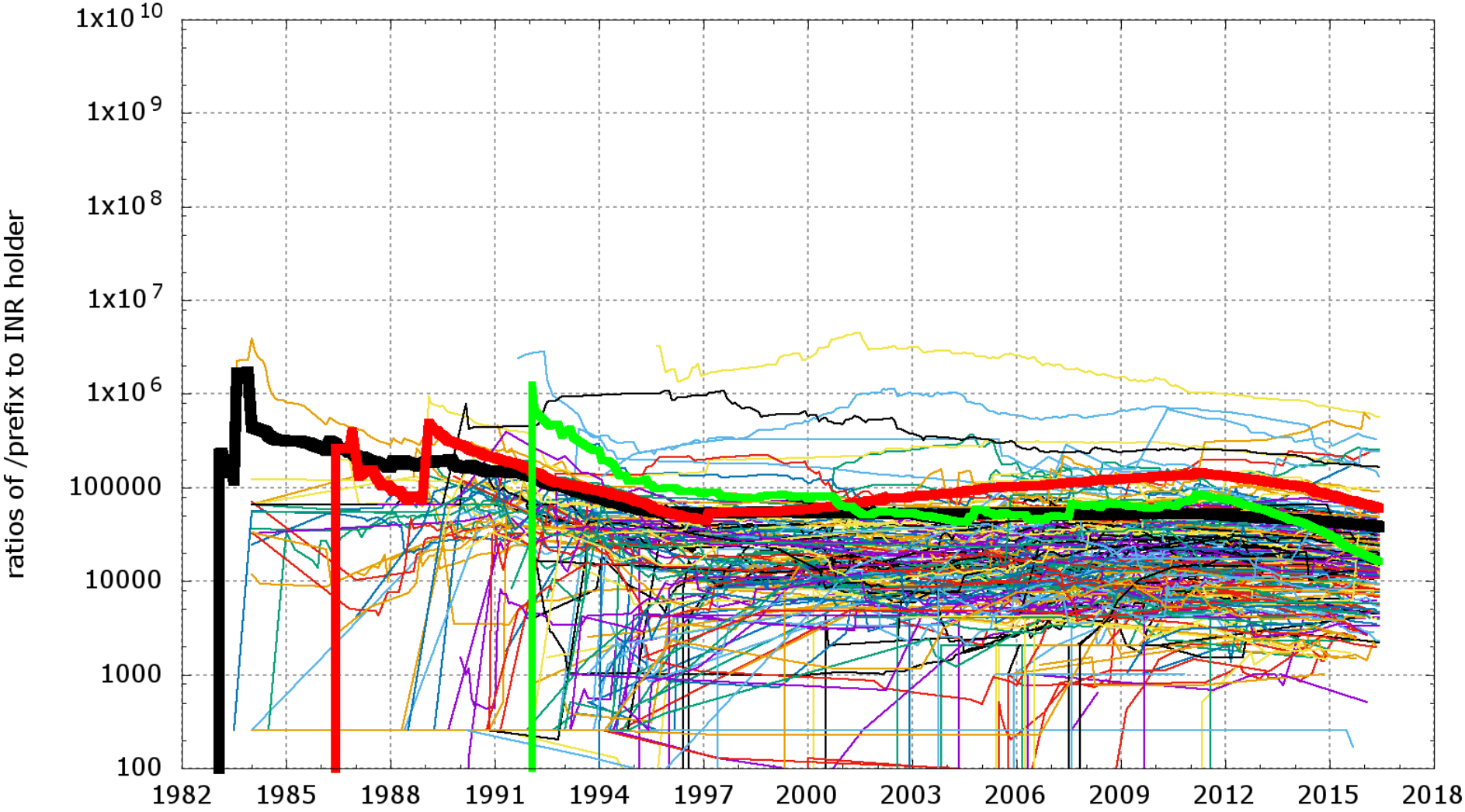
IPv4	17 in BGP
540,672	addresses
0.03	per head
100%	visible

IPv6	8 in BGP
60,129	M addresses
2,889	per head
21%	visible
2%	capability

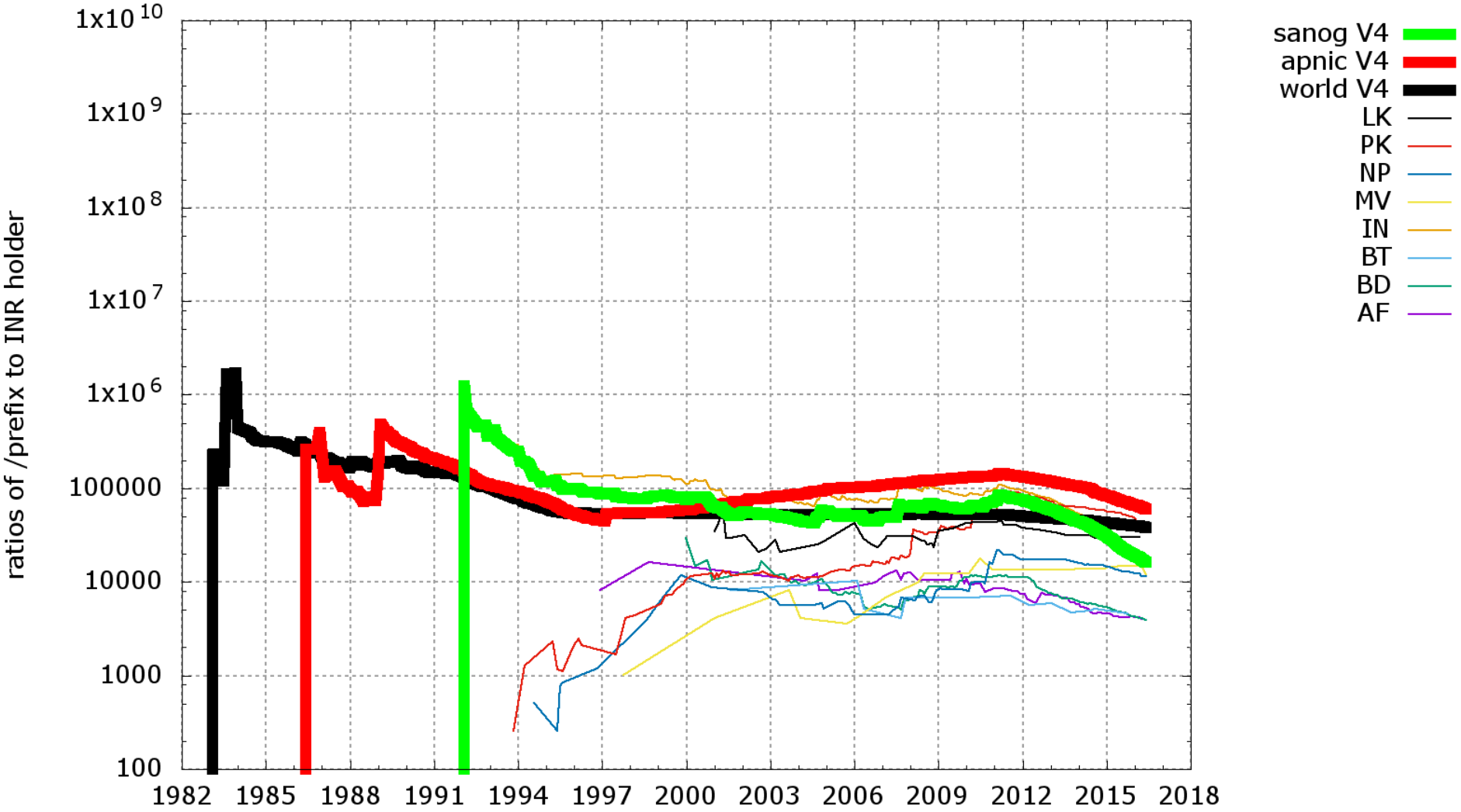
Distribution and Allocation

APNIC

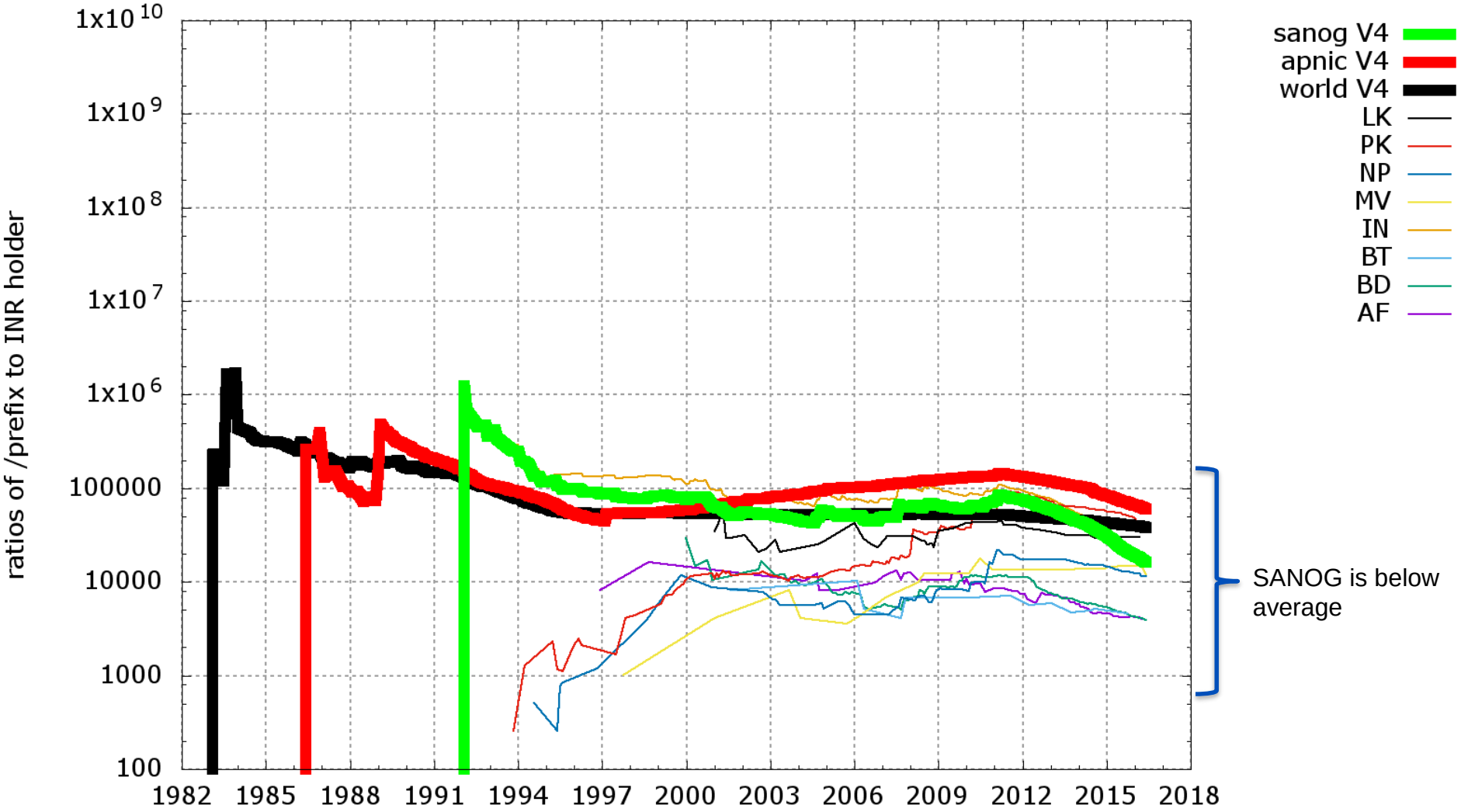
IPv4 by economy by holder - world



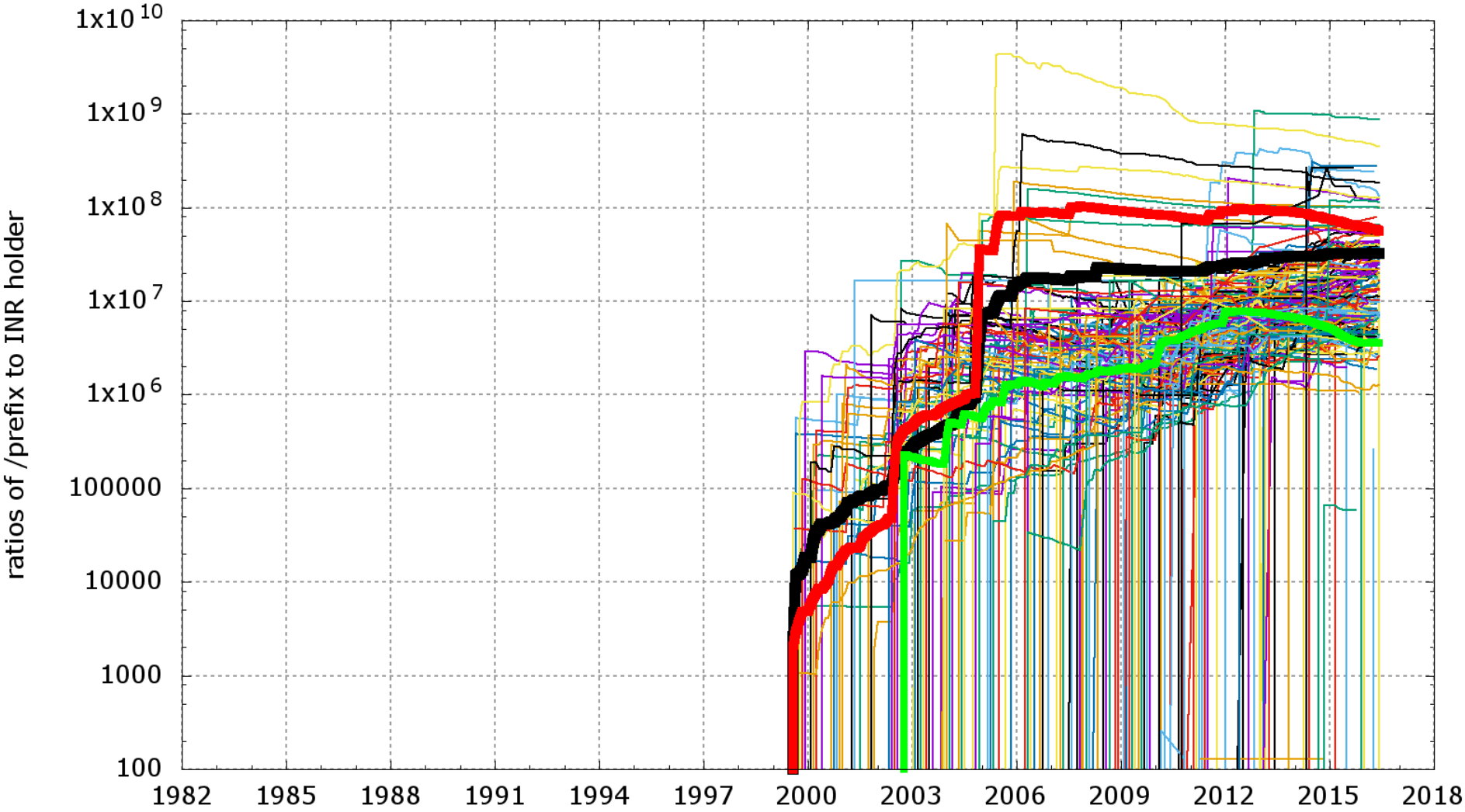
IPv4 by economy by holder - SANOG



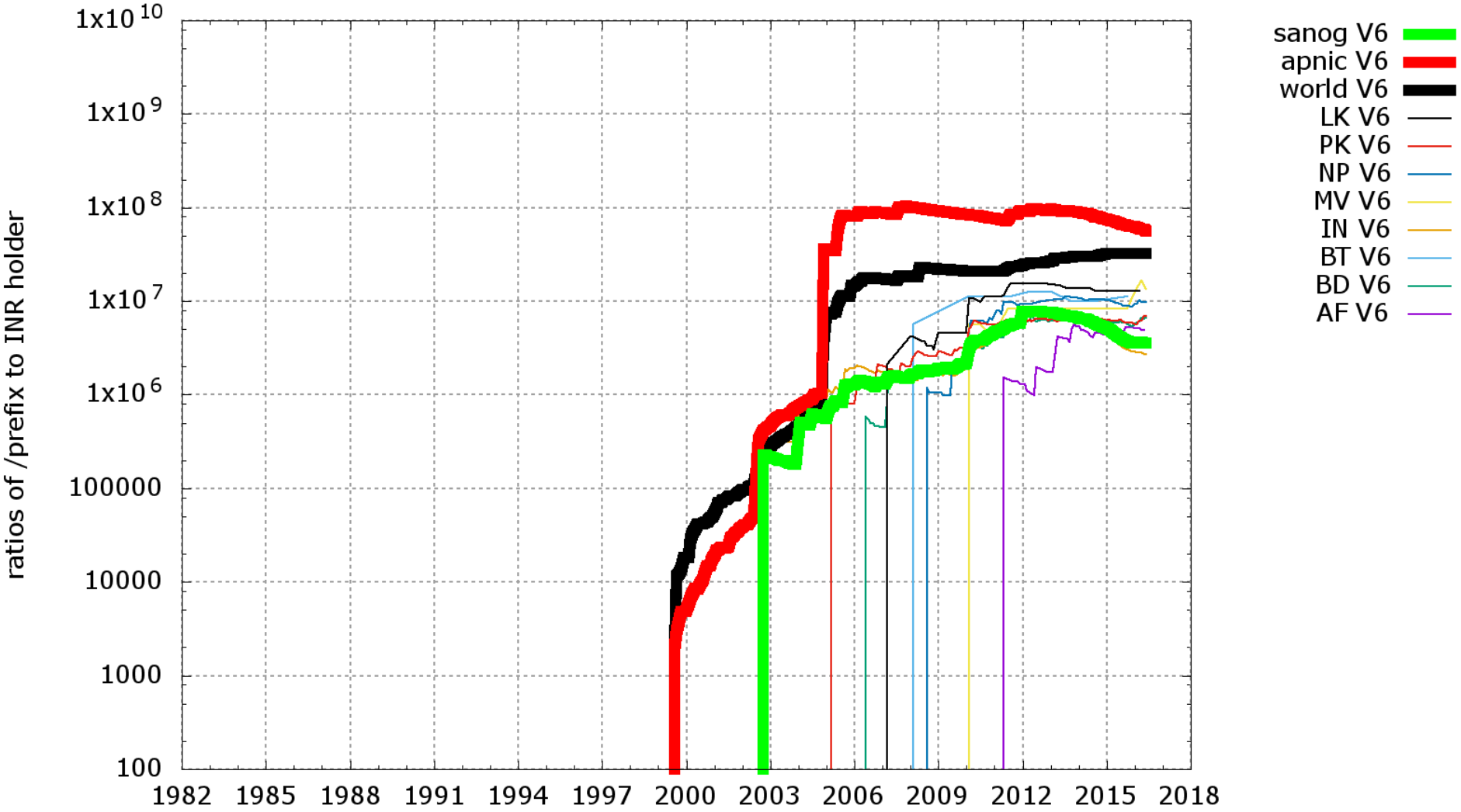
IPv4 by economy by holder - SANOG



IPv6 by economy by holder - world



IPv6 by economy by holder - SANOG



It’s partly an allocation problem

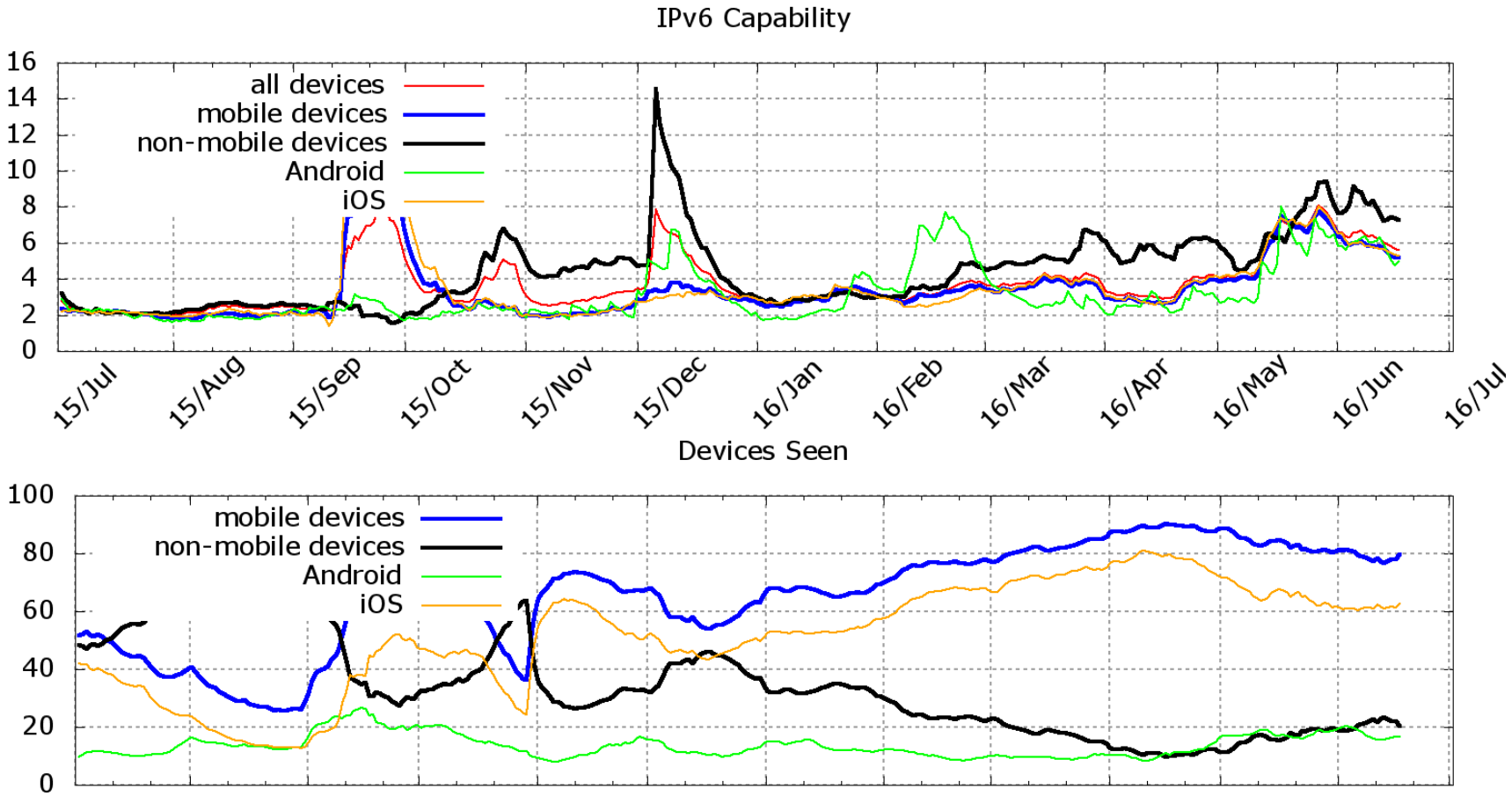
- APNIC IPv4/v6 distribution is close to world average
- SANOG economies are below APNIC average

- Is there a *deployment* problem?

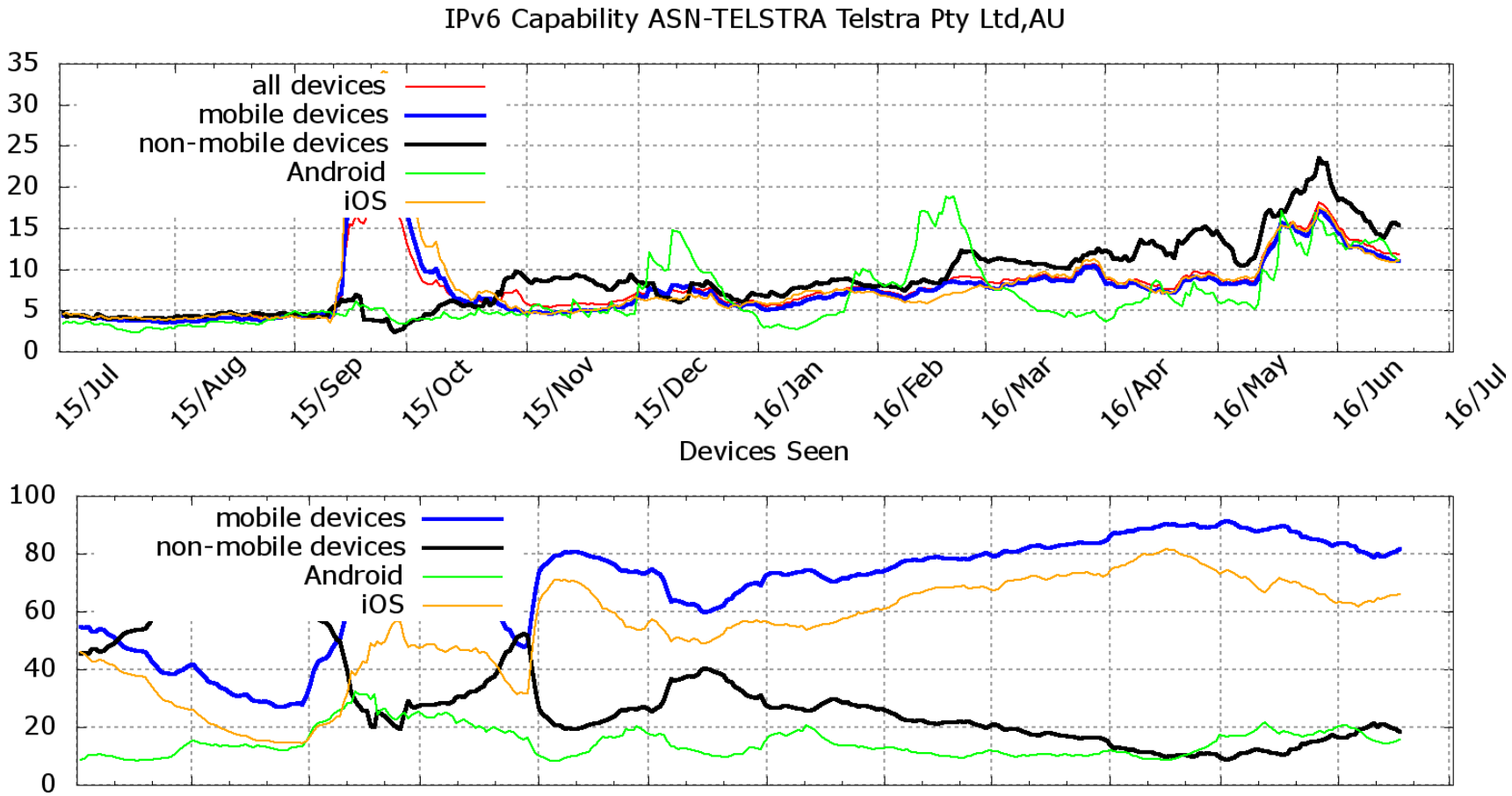
What kinds of deployment are working worldwide?

- Drill down into the APNIC data, by ASN and Economy
- Within the ASN or Economy, what kinds of devices are using IPv6?
- Plot the IPv6 capability by device category
  - Mobile vs ‘Desktop’
  - Android vs iOS
- Note: we don’t control the presentation ratio by device type: this is outside our control
  - So the absolute numbers don’t mean very much
  - There is undoubtedly a lot of internet on mobile devices
- Note: mobile device doesn’t necessarily mean on cellular carrier
  - But we know many ISPs are cellular ISPs

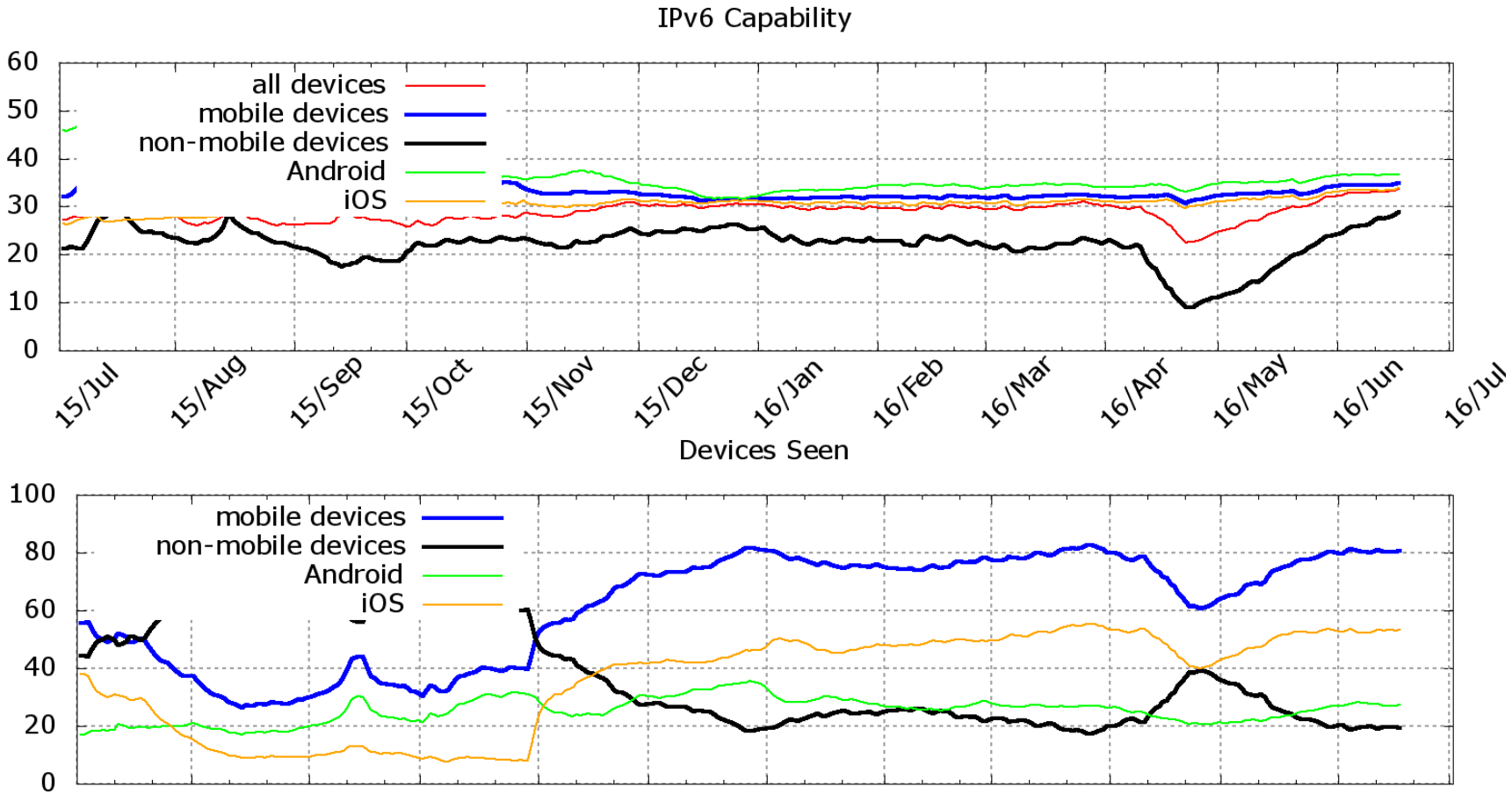
IPv6 by Device: AU



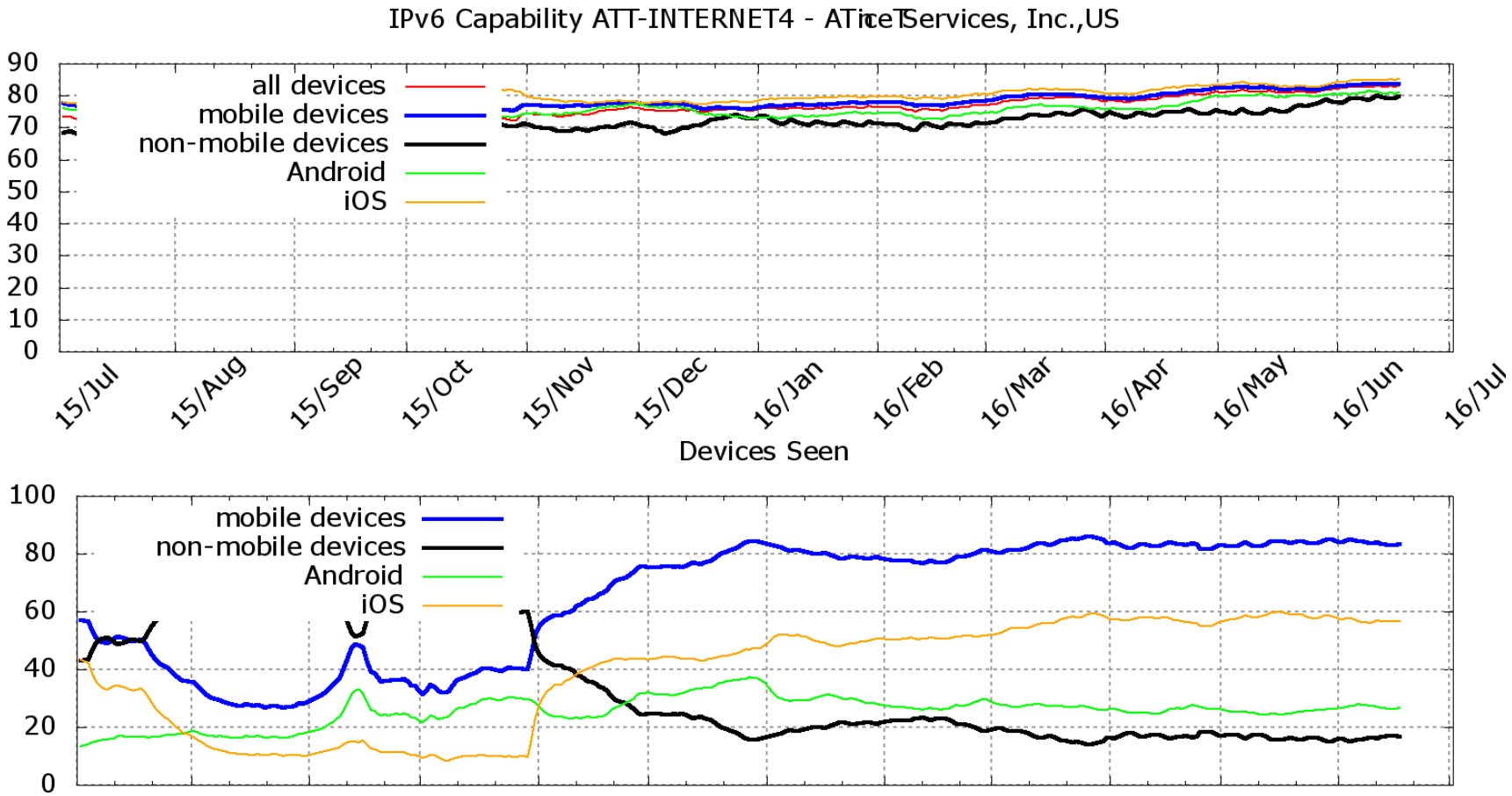
AS1221


IPv6 Capability ASN-TELSTRA Telstra Pty Ltd,AU
35
30
25
20
15
10
5
0
all devices
mobile devices
non-mobile devices
Android
iOS
15/Jul
15/Aug
15/Sep
15/Oct
15/Nov
15/Dec
16/Jan
16/Feb
16/Mar
16/Apr
16/May
16/Jun
16/Jul
Devices Seen
100
80
60
40
20
0
mobile devices
non-mobile devices
Android
iOS

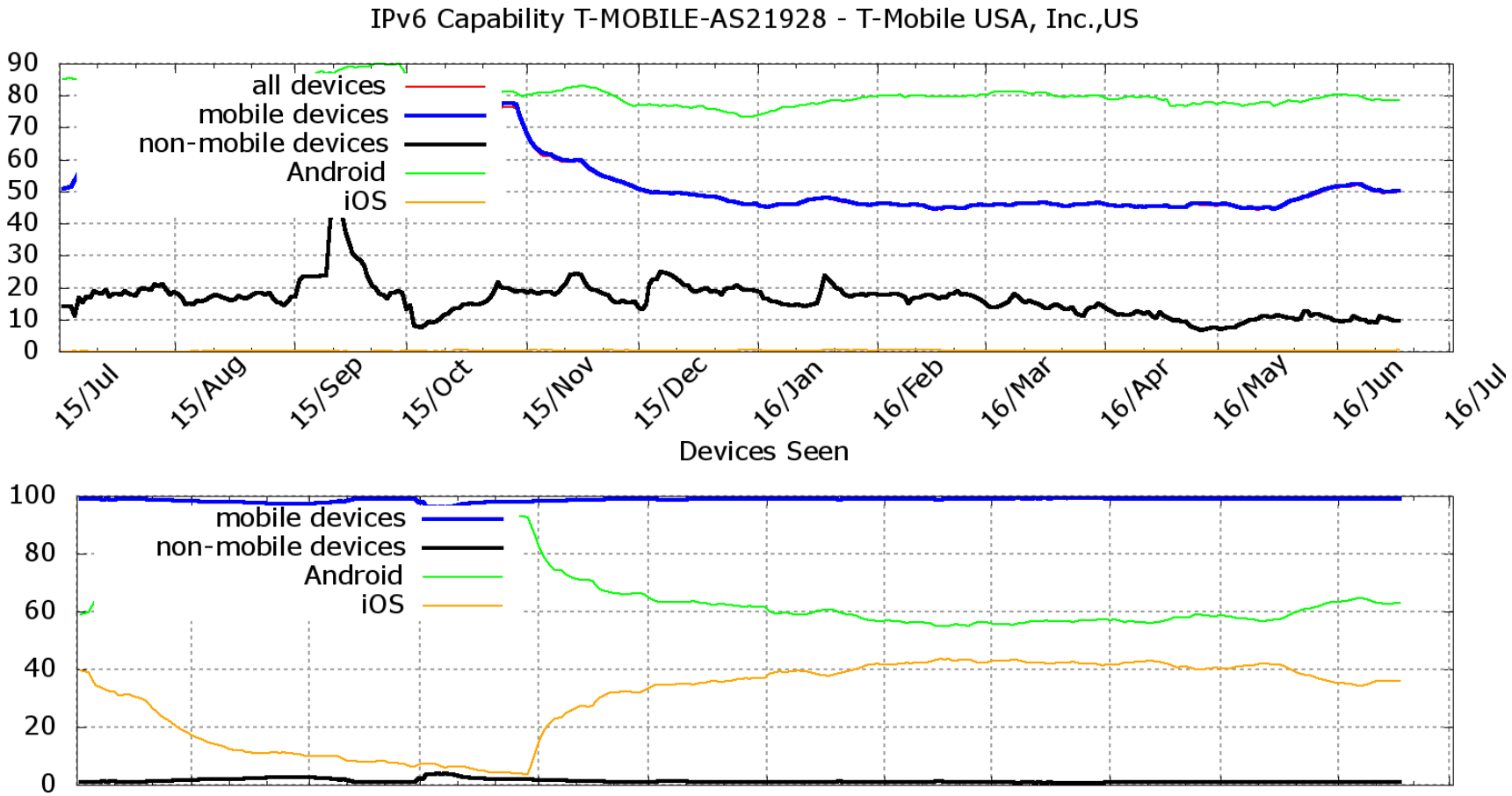
IPv6 by Device, US



AS7018


IPv6 Capability ATT-INTERNET4 - AT&T Services, Inc.,US
all devices
mobile devices
non-mobile devices
Android
iOS
90
80
70
60
50
40
30
20
10
0
15/Jul
15/Aug
15/Sep
15/Oct
15/Nov
15/Dec
16/Jan
16/Feb
16/Mar
16/Apr
16/May
16/Jun
16/Jul
Devices Seen
mobile devices
non-mobile devices
Android
iOS
100
80
60
40
20
0

AS21928


IPv6 Capability T-MOBILE-AS21928 - T-Mobile USA, Inc.,US
all devices
mobile devices
non-mobile devices
Android
iOS
90
80
70
60
50
40
30
20
10
0
15/Jul
15/Aug
15/Sep
15/Oct
15/Nov
15/Dec
16/Jan
16/Feb
16/Mar
16/Apr
16/May
16/Jun
16/Jul
Devices Seen
mobile devices
non-mobile devices
Android
iOS
100
80
60
40
20
0

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- There is probably a capital investment and logistical problem
- Not deploying IPv6 carries the risk of falling behind in international competitiveness

Questions!


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