

# Addressing and Routing in 2014

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APNIC

# The Addressing View

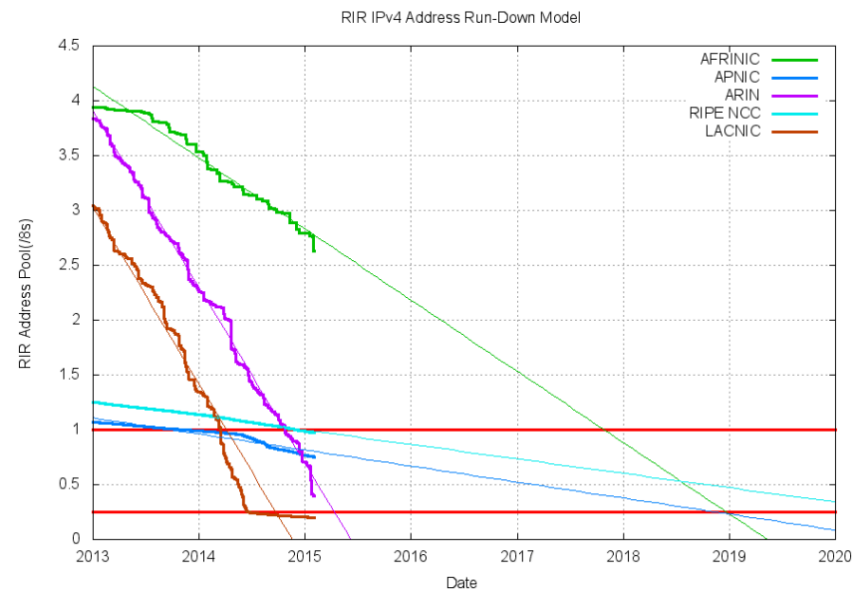


# Addressing V4 Exhaustion

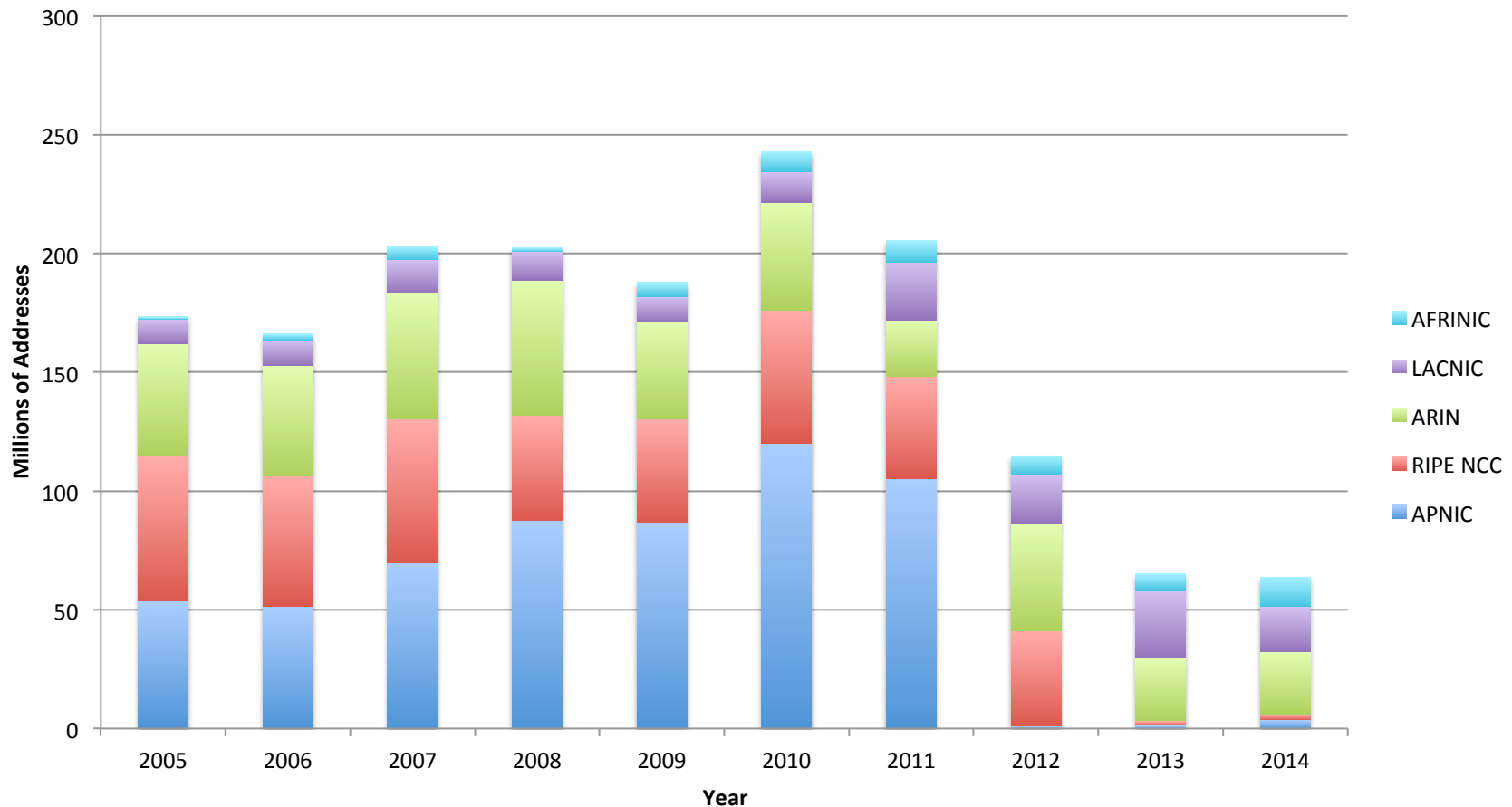
- We have been predicting that the exhaustion of the free pool of IPv4 addresses would eventually happen for the past 25 years
- And, we've now hit bottom!
  - APNIC, RIPE NCC and LACNIC are now empty of general use IPv4 addresses
  - We now have just ARIN and AFRINIC to go – ARIN is expected to run out in the coming weeks

## Projected RIR Address Pool Exhaustion Dates:

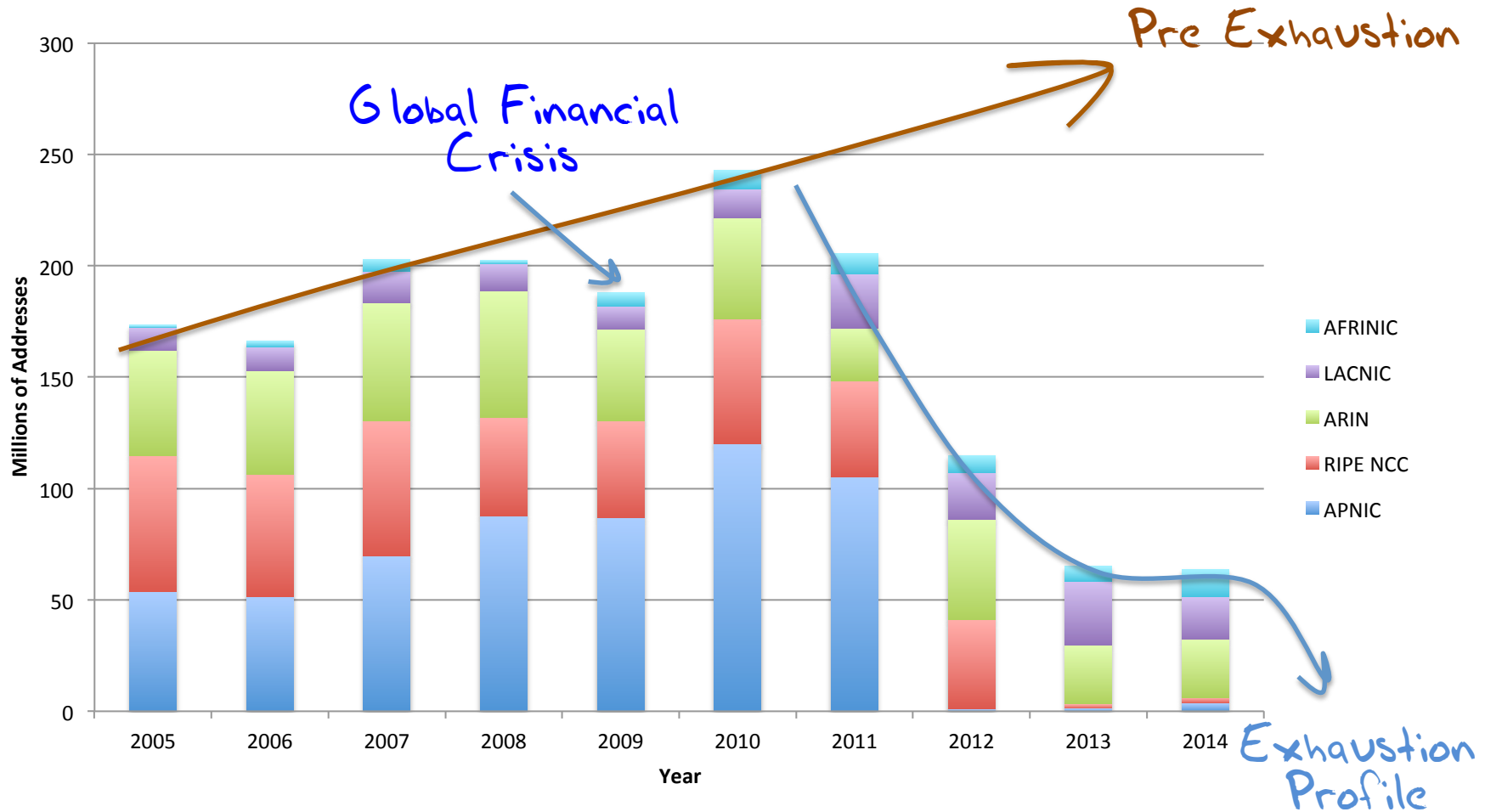
RIR	Projected Exhaustion Date	Remaining Addresses in RIR Pool (/8s)
APNIC:	<b>19-Apr-2011</b> (actual)	0.7520
RIPE NCC:	<b>14-Sep-2012</b> (actual)	0.9700
LACNIC:	<b>10-Jun-2014</b> (actual)	0.1987
ARIN:	<b>16-May-2015</b>	0.3960
AFRINIC:	<b>23-Jan-2019</b>	2.6326



# Allocations in the Last Years of IPv4



# Allocations in the Last Years of IPv4



# Where did the Addresses

# Go?

Volume of Allocated IPv4 Addresses  
(using units of millions of /32s)  
per year

Rank	2010		2011		2012		2013		2014	
1	China	45.2	China	53.1	USA	28.2	USA	25.0	USA	24.5
2	USA	42.3	USA	21.2	Canada	16.7	Brazil	17.4	Brazil	10.9
3	Rep.Korea	25.7	Japan	16.9	Brazil	8.4	Colombia	3.8	Morocco	2.6
4	Japan	10.0	Rep.Korea	7.7	Russia	5.3	Argentina	1.6	Colombia	2.1
5	Australia	9.6	Indonesia	7.1	Iran	4.5	Egypt	1.6	South Africa	1.7
6	India	9.4	Brazil	6.3	Germany	3.4	Canada	1.4	Egypt	1.6
7	UK	8.1	India	6.0	South Africa	3.4	Nigeria	1.2	China	1.5
8	Germany	7.0	France	5.4	Italy	3.3	Chile	1.1	Canada	1.5
9	Russia	6.5	Russia	5.0	Colombia	2.6	Mexico	1.1	Kenya	1.4
10	Brazil	6.3	Germany	4.9	Romania	2.6	Seychelles	1.0	Mexico	1.1

APNIC runs out ↑

RIPE NCC runs out ↑

LACNIC runs out ↑



# The IPv4 After-Market: Address Transfers

- There is a considerable residual demand for IPv4 addresses following exhaustion
  - IPv6 is not a direct substitute for the lack of IPv4
- Some of this demand is pushed into using middleware that imposes address sharing (Carrier Grade NATS, Virtual Hosting, etc)
- Where there is no substitute then we turn to the aftermarket
- Some address transfers are “sale” transactions, and they are entered into the address registries
- Some transfers take the form of “leases” where the lease holder’s details are not necessarily entered into the address registry



# Address Transfers

Receiving RIR	2012	2013	2014
ARIN	28	19	42
APNIC	148	152	340
RIPE NCC	9	154	919
<b>Total</b>	<b>185</b>	<b>325</b>	<b>1,301</b>

*Number of registered  
Address transfers per year*



*Volume of addresses transferred  
per year (millions of /32s p.a.)*



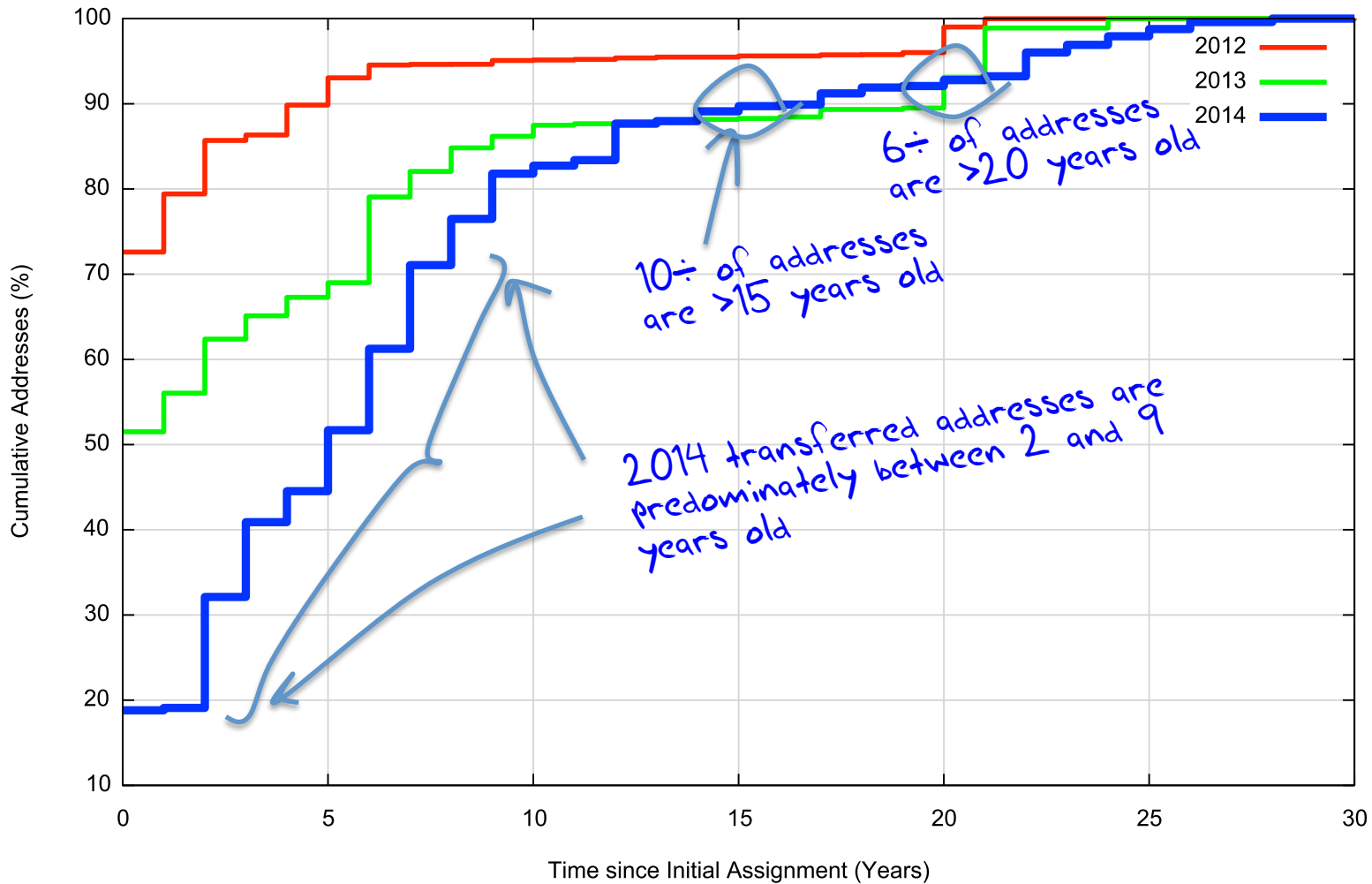
Receiving RIR	2012	2013	2014
ARIN	4.86	3.90	2.91
APNIC	1.78	1.74	3.71
RIPE NCC	0.06	1.81	9.35
<b>Total</b>	<b>6.70</b>	<b>7.46</b>	<b>15.98</b>



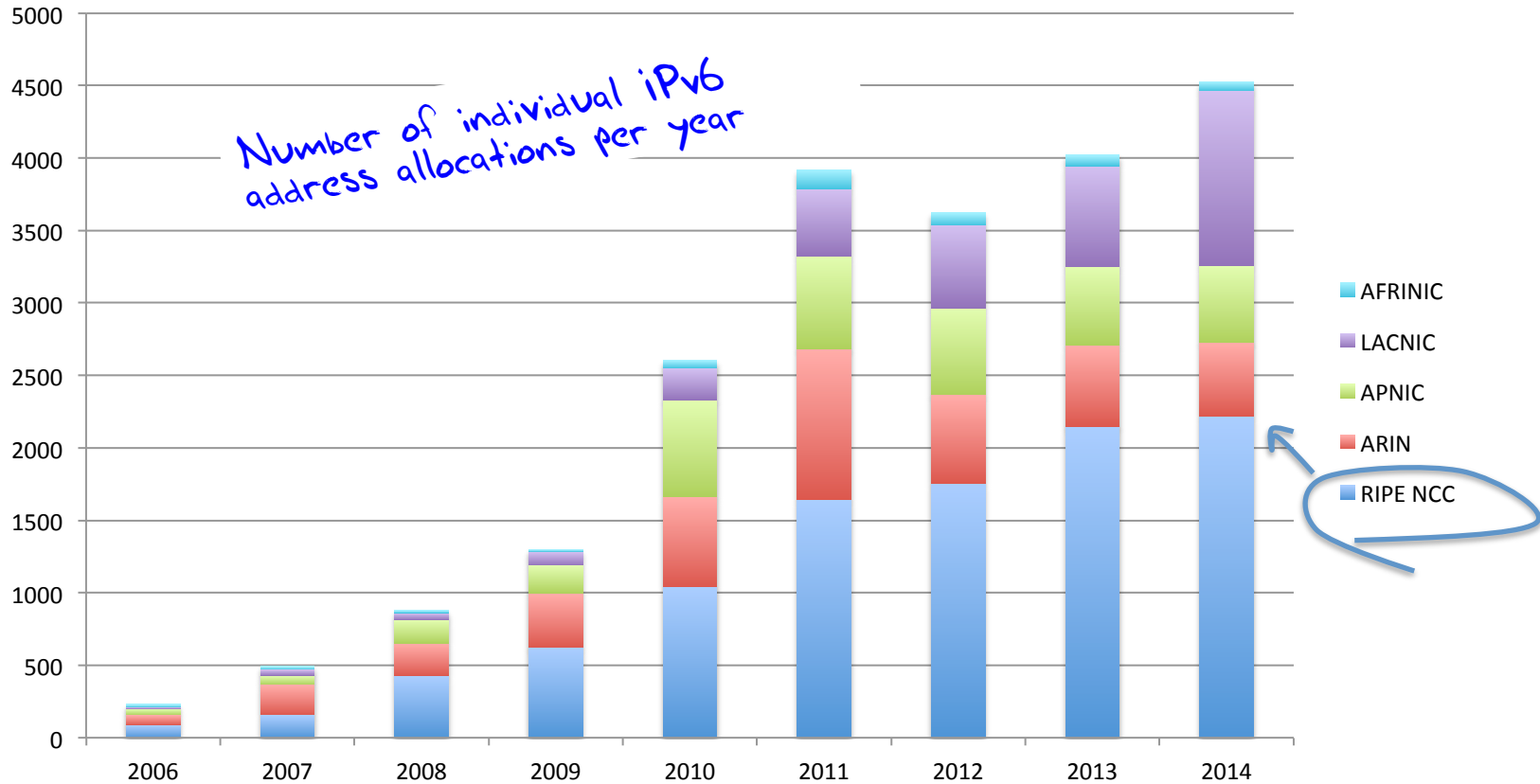


# How old are transferred addresses?

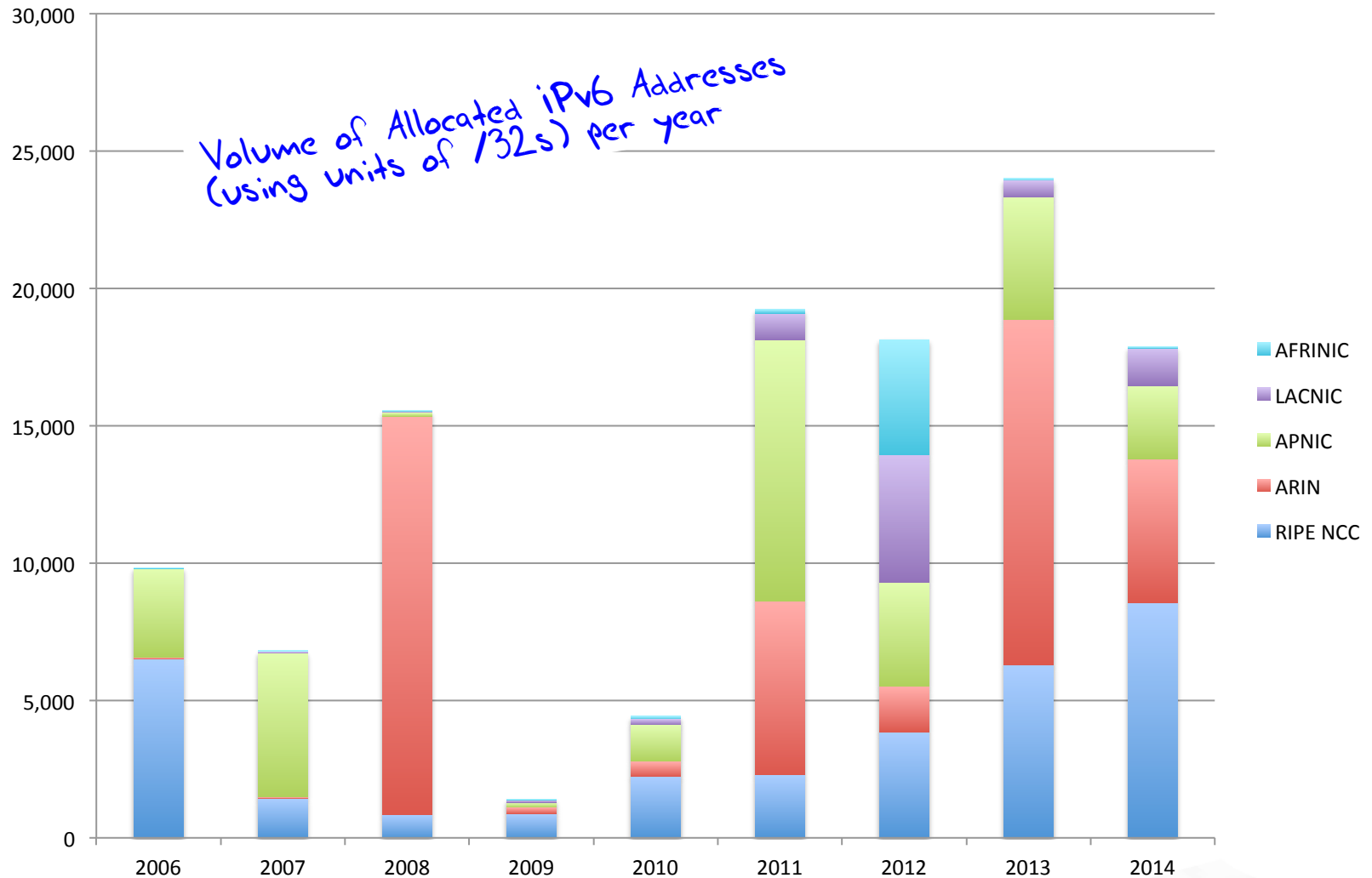
Cumulative Address Age Distribution for Transferred Addresses



# IPv6 Allocations



# IPv6 Allocated Addresses



# Where did the IPv6 addresses go?

	2010		2011		2012		2013		2014	
1	Germany	654	China	8,997	Argentina	4,177	United States	12,537	United States	4,930
2	Japan	630	United States	6,253	Egypt	4,098	China	4,135	China	2,127
3	United States	504	Spain	667	China	3,136	UK	782	UK	1,090
4	China	339	UK	476	United States	1,337	Germany	651	Brazil	863
5	Belgium	270	Brazil	311	Italy	635	Russia	523	Germany	749
6	France	195	Germany	300	Russia	403	Netherlands	463	Netherlands	719
7	Brazil	160	Mexico	261	Germany	399	Brazil	450	Russia	716
8	UK	123	Venezuela	261	UK	356	France	435	France	436
9	Russia	117	Netherlands	241	Canada	323	Italy	339	Italy	410
10	Netherlands	103	Russia	160	Brazil	294	Switzerland	265	Switzerland	369

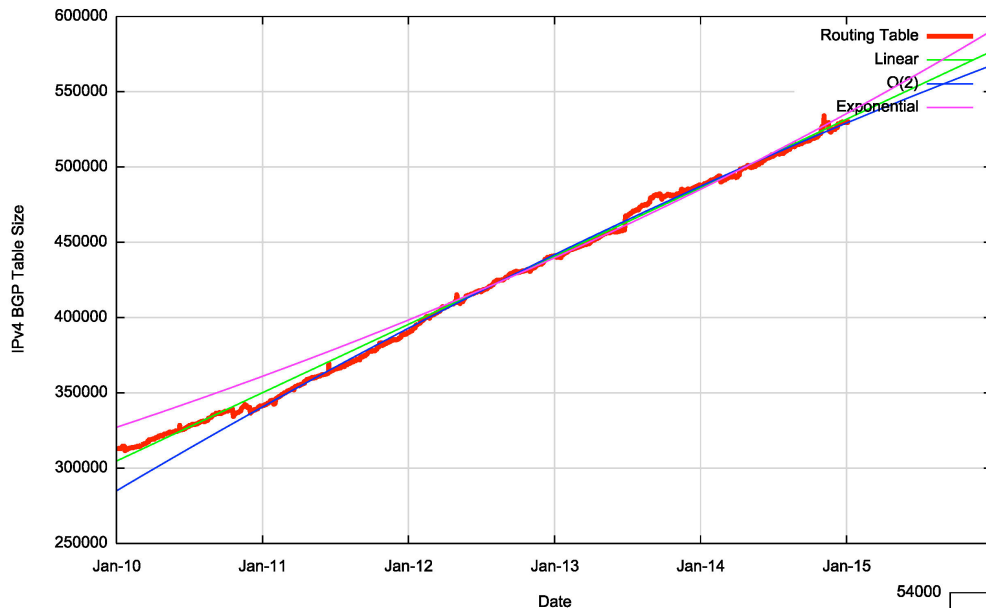
Volume of Allocated IPv6 Addresses  
(using units of /32s) per country,  
per year



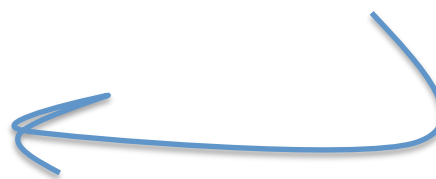
# The Routing View



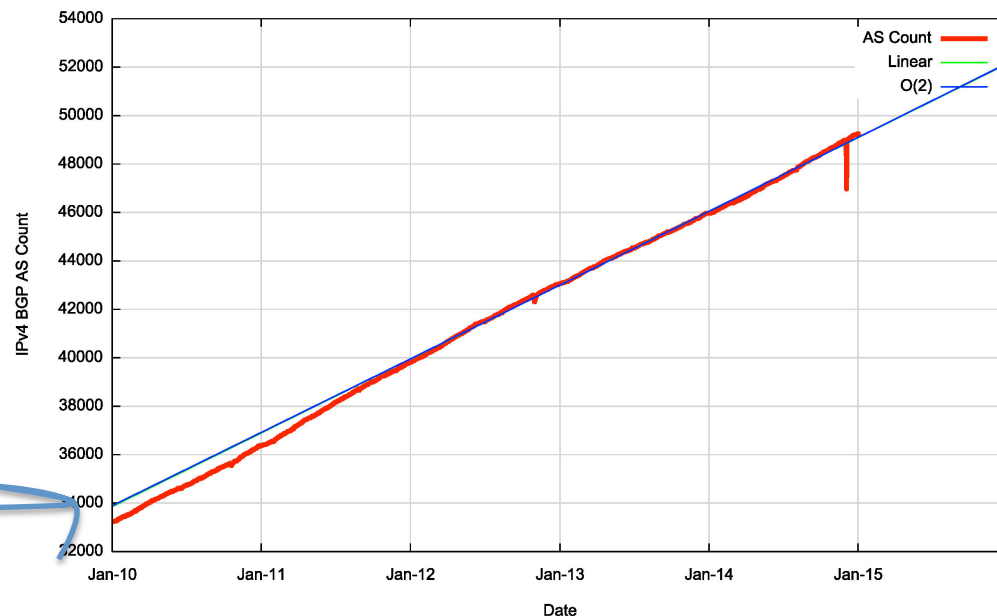
# Routing Indicators for IPv4



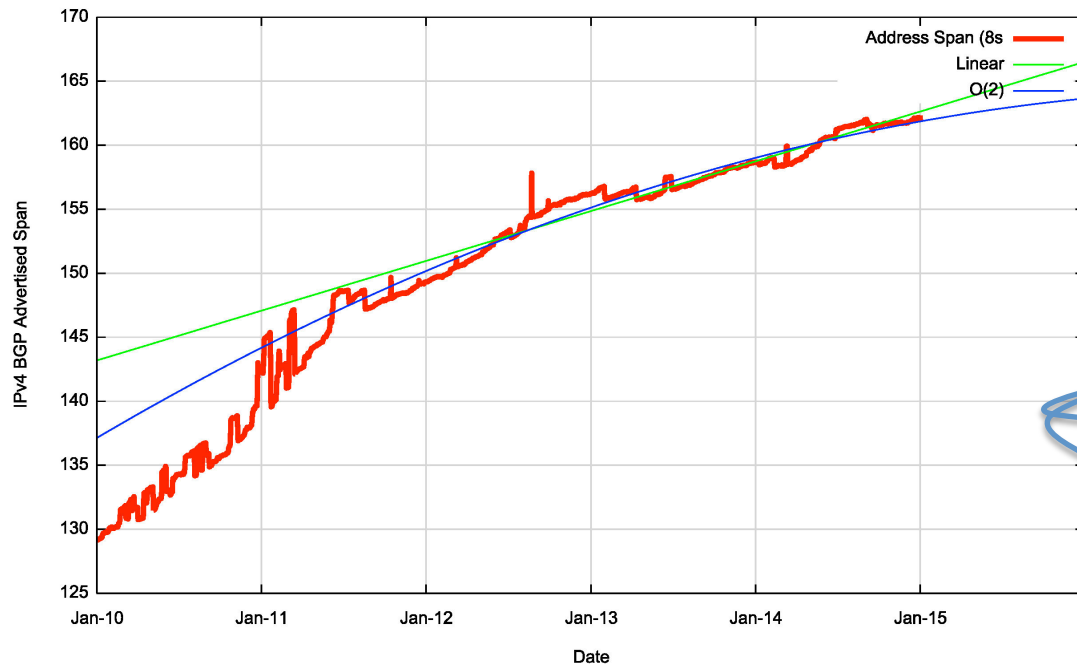
Routing prefixes - growing by some 45,000 prefixes per year



AS Numbers - growing by some 3,000 ASNs per year



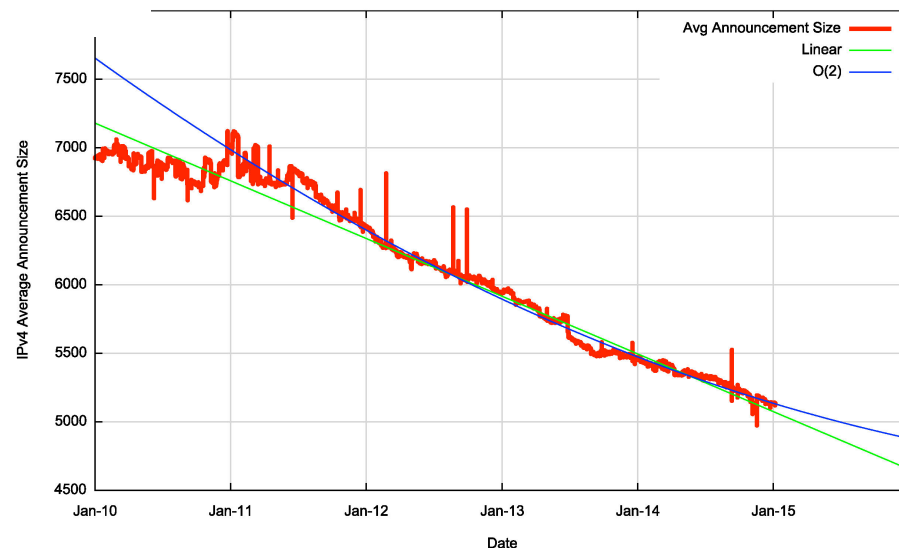
# Routing Indicators for IPv4



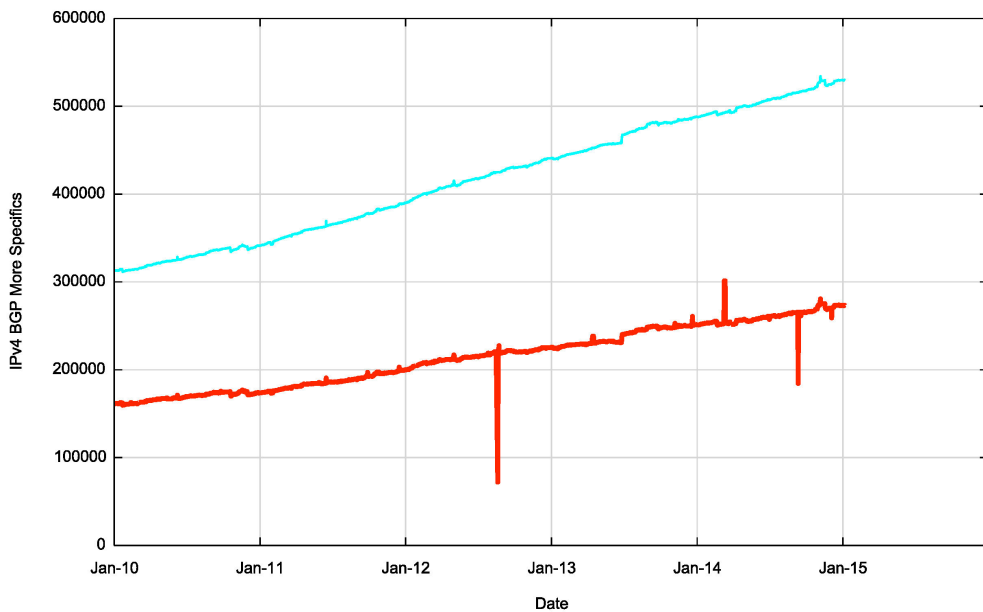
Address Exhaustion is now visible in the extent of advertised address space



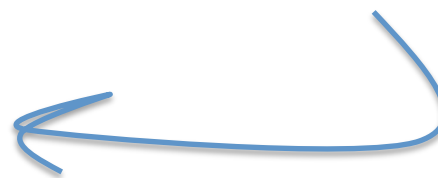
The average size of a routing advertisement is getting smaller



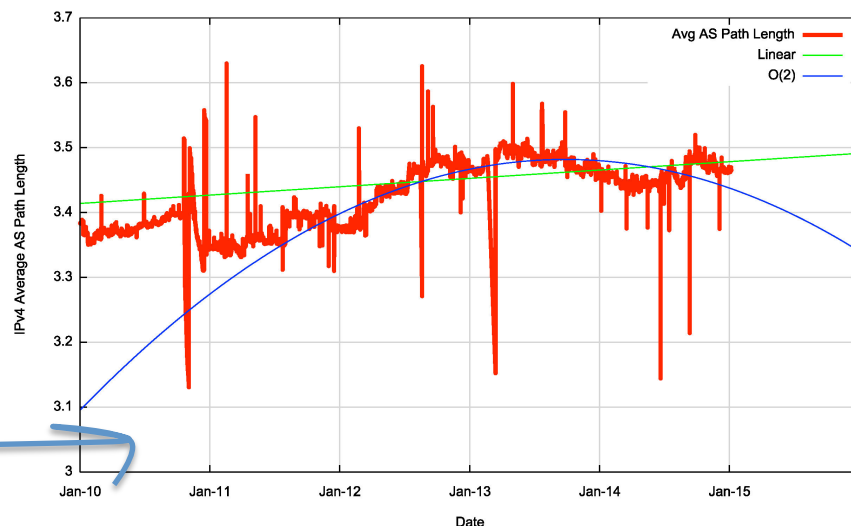
# Routing Indicators for IPv4



More Specifics are still taking up one half of the routing table



The "shape" of inter-AS interconnection appears to be steady, as the Average AS Path length has been held steady through the year





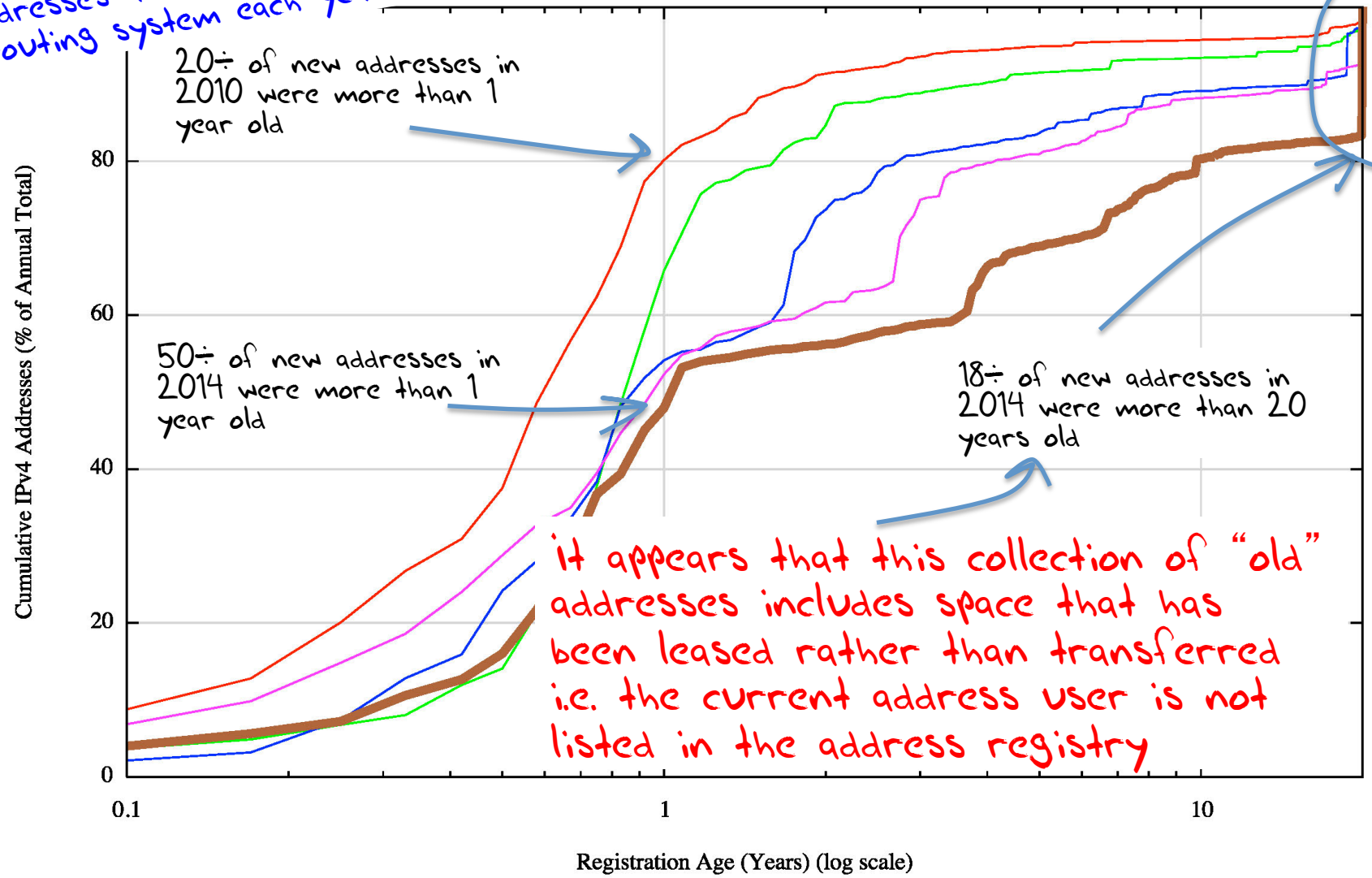
# How can the IPv4 network continue to grow when we are running out of IPv4 addresses?

We are now recycling old addresses back into the routing system

# IPv4 Address Reuse

The age distribution of new addresses announced into the routing system each year

Relative Age of New Reachable IPv4 Addresses per Year

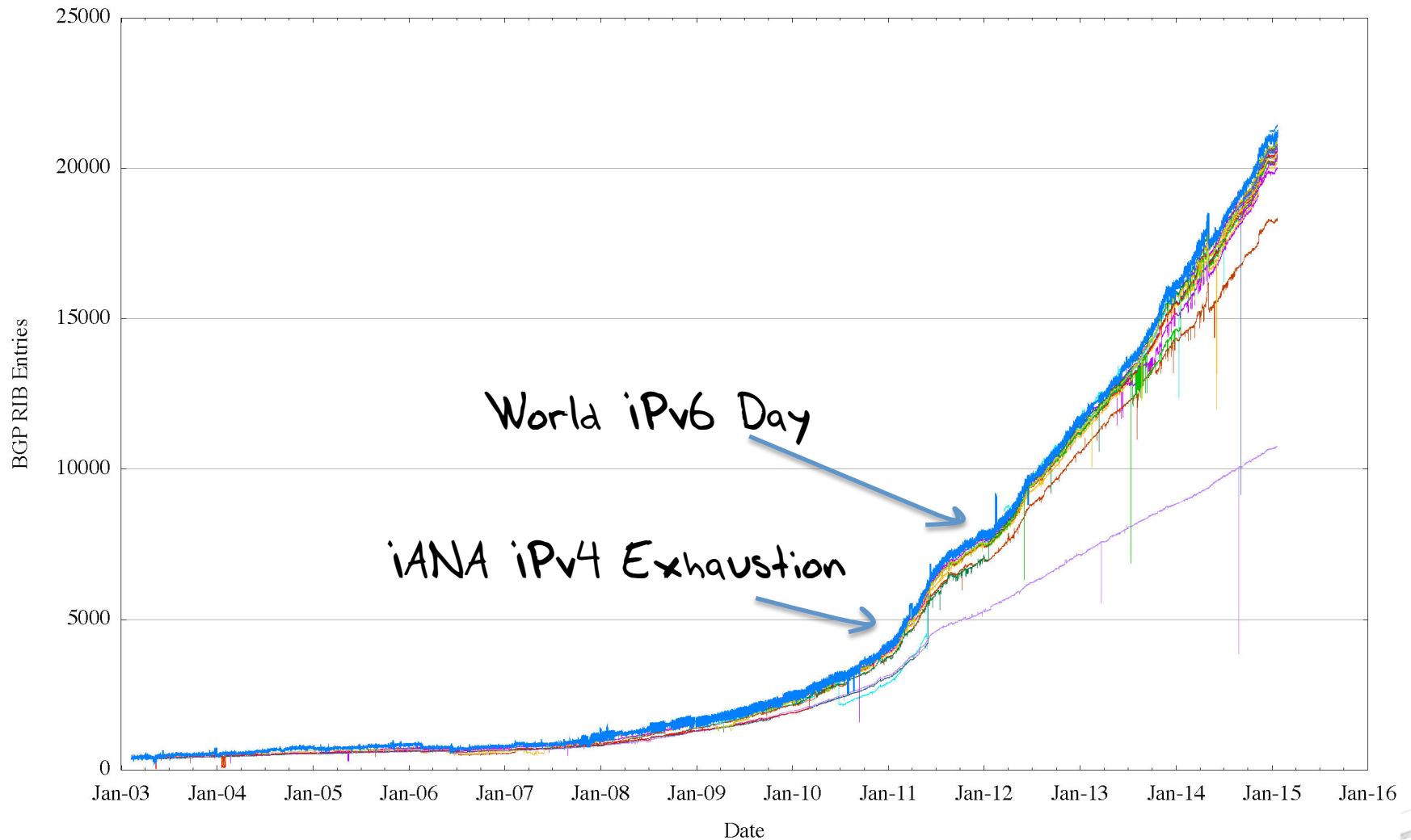


# IPv4 in 2014 - Growth is Slowing

- Overall IPv4 Internet growth in terms of BGP is at a rate of some **~9%-10% p.a.**
- Address span growing far more slowly than the table size
- The rate of growth of the IPv4 Internet is slowing down
  - Address shortages
  - Masking by NAT deployments and transfers
  - Saturation of critical market sectors
  - Transition uncertainty

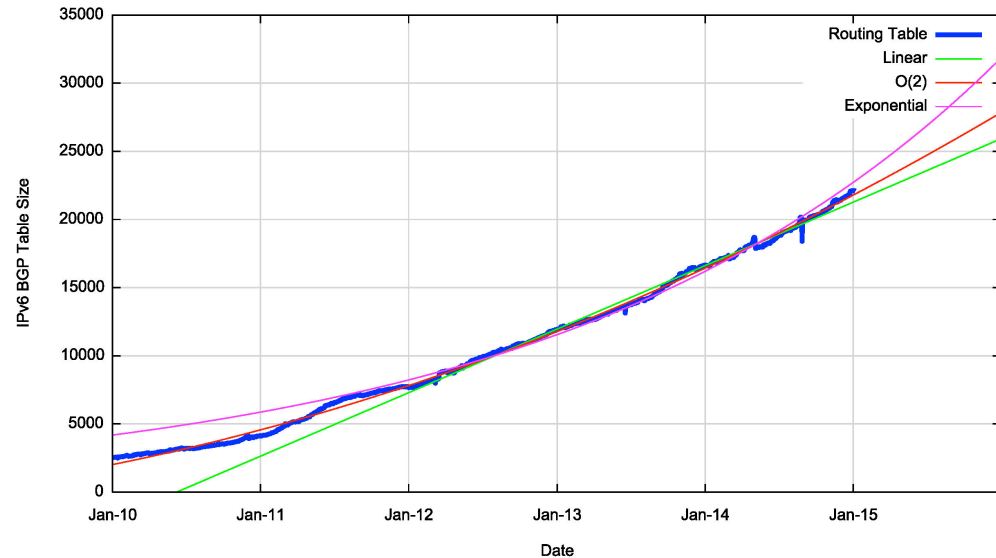


# The Route Views view of IPv6

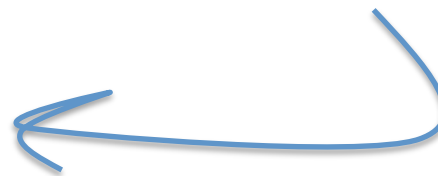


# Routing Indicators for IPv6

V6 BGP FIB Size



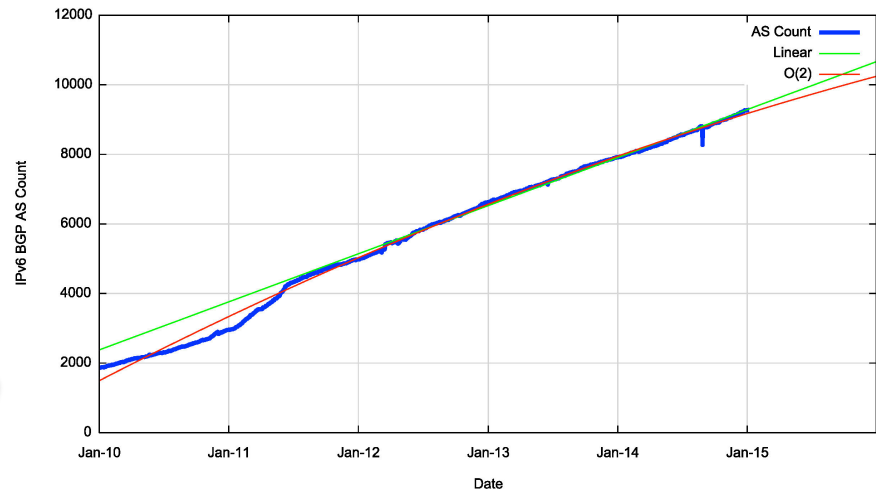
Routing prefixes - growing by some 6,000 prefixes per year



AS Numbers - growing by some 1,600 prefixes per year (which is half the V4 growth)

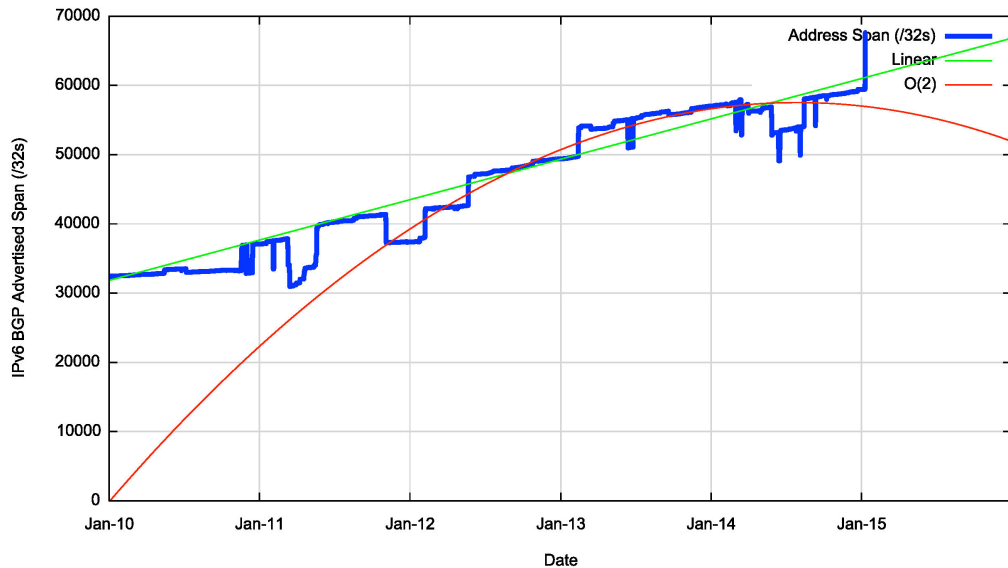


AS Count

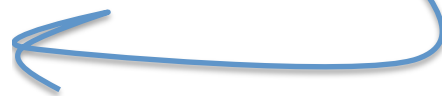


# Routing Indicators for IPv6

Advertised V6 Address Span (/32s)



Address consumption is happening at a constant rate, and not growing year by year



The average size of a routing advertisement is getting smaller

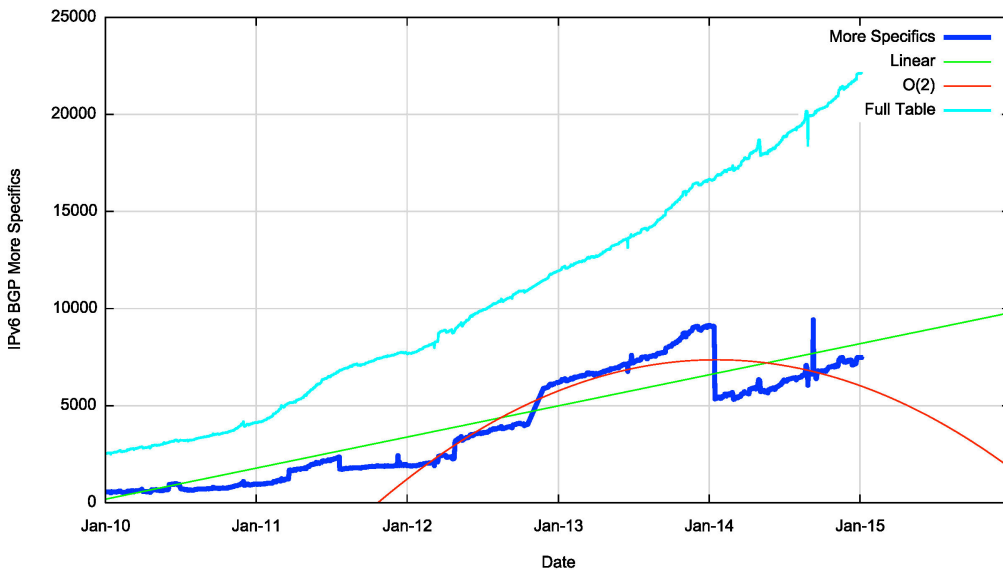


IPv6 Average Announcement Size

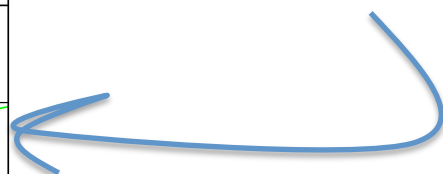


# Routing Indicators for IPv6

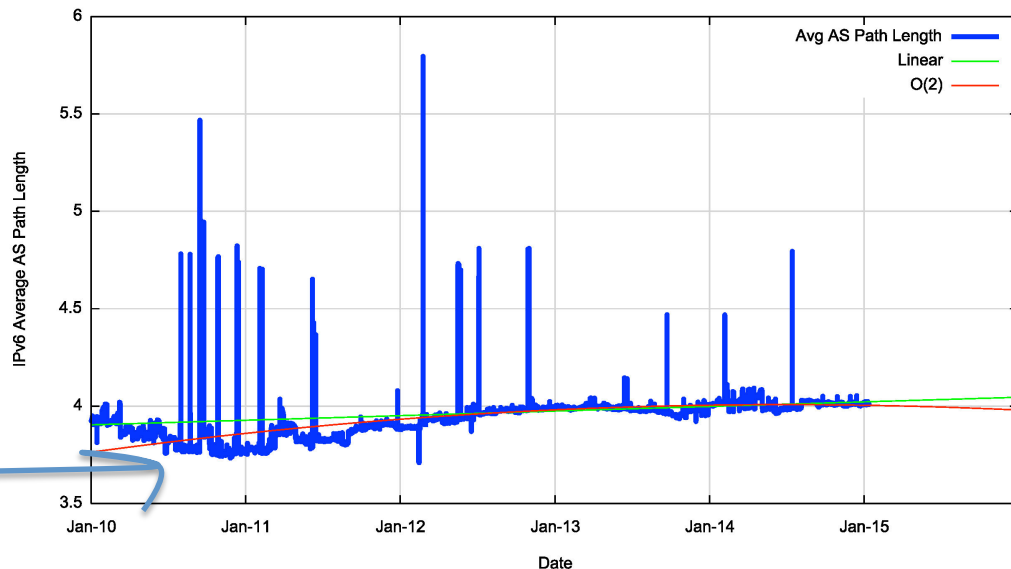
BGP More Specifics



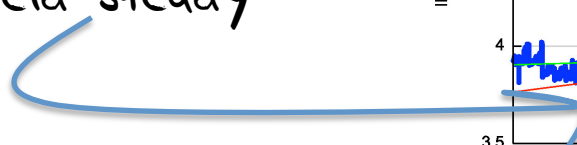
More Specifics now take up one third of the routing table



Average AS Path Length



The "shape" of inter-AS interconnection appears to be steady, as the Average AS Path length has been held steady through the year



# IPv6 in 2013

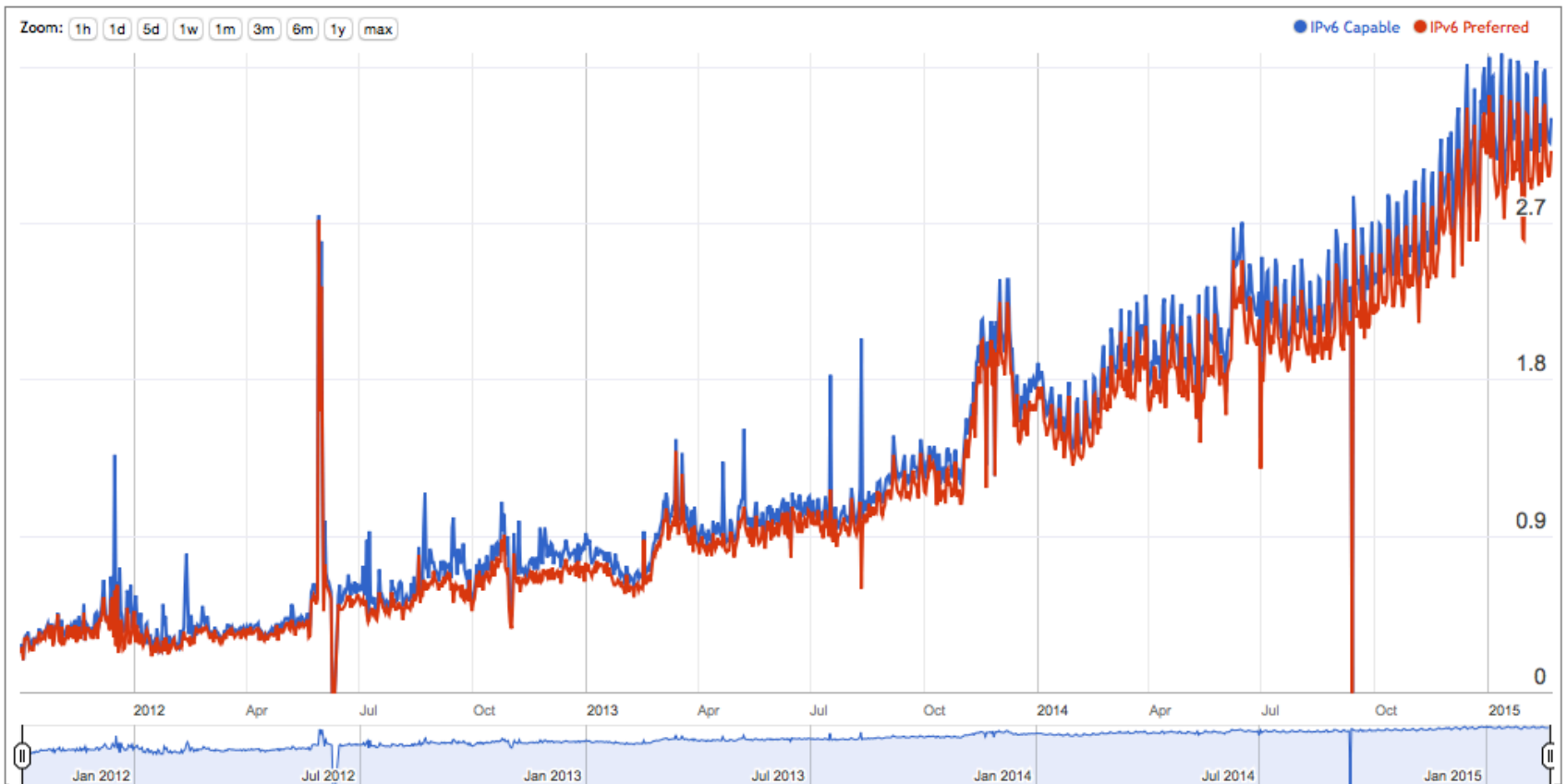
- Overall IPv6 Internet growth in terms of BGP is **20% - 40 % p.a.**
  - 2012 growth rate was ~ 90%.

If these relative growth rates persist then the IPv6 network would span the same network domain as IPv4 in ~16 years time

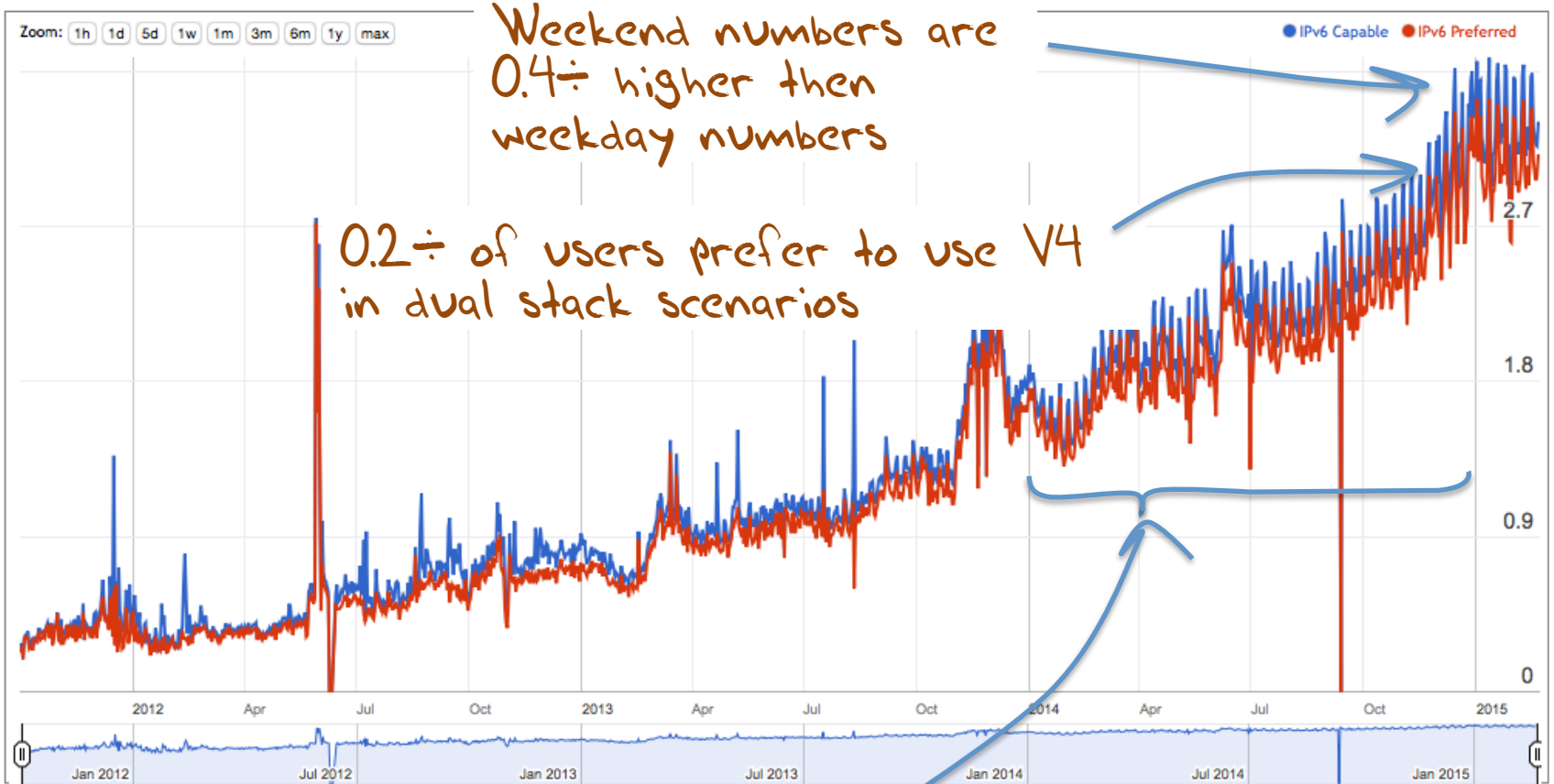


Are we all now using V6?

# IPv6: How Many Can?



# IPv6: How Many Can?



IPv6 use has doubled across 2014



# Forward Guesstimates

Best Case: IPv6 uptake doubles every year:

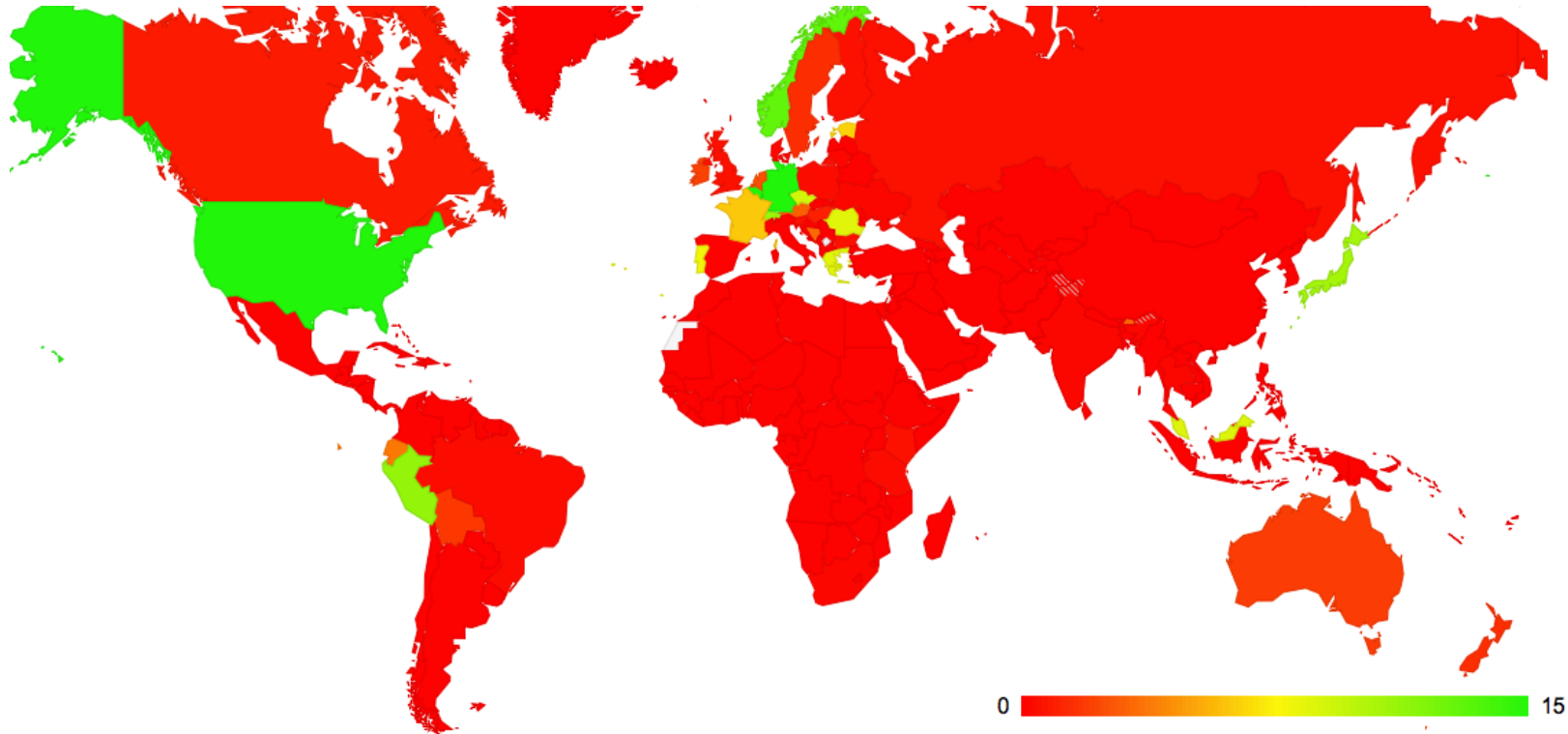
2019

Worst Case: IPv6 uptake constant 2% every year:

2067

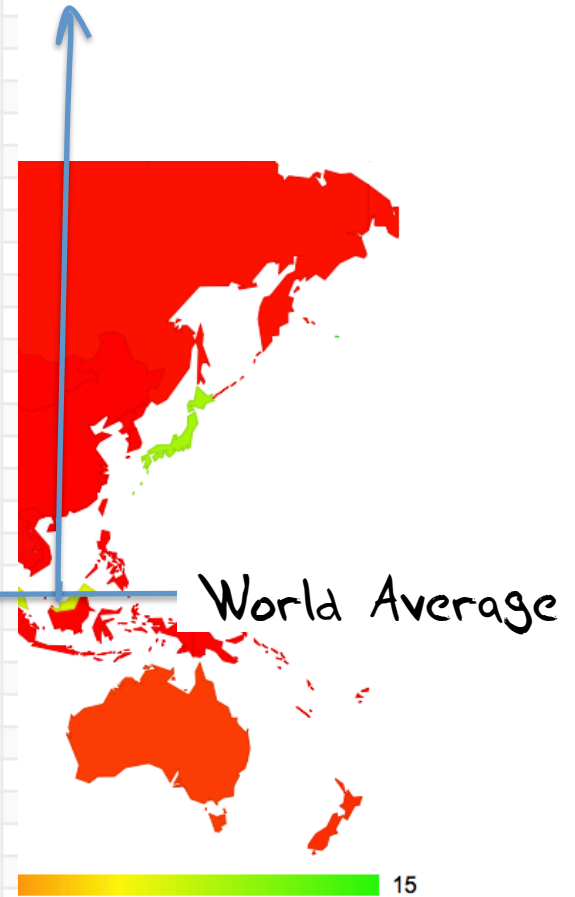
# IPv6: Who Can?

IPv6 use by Country – February 2015



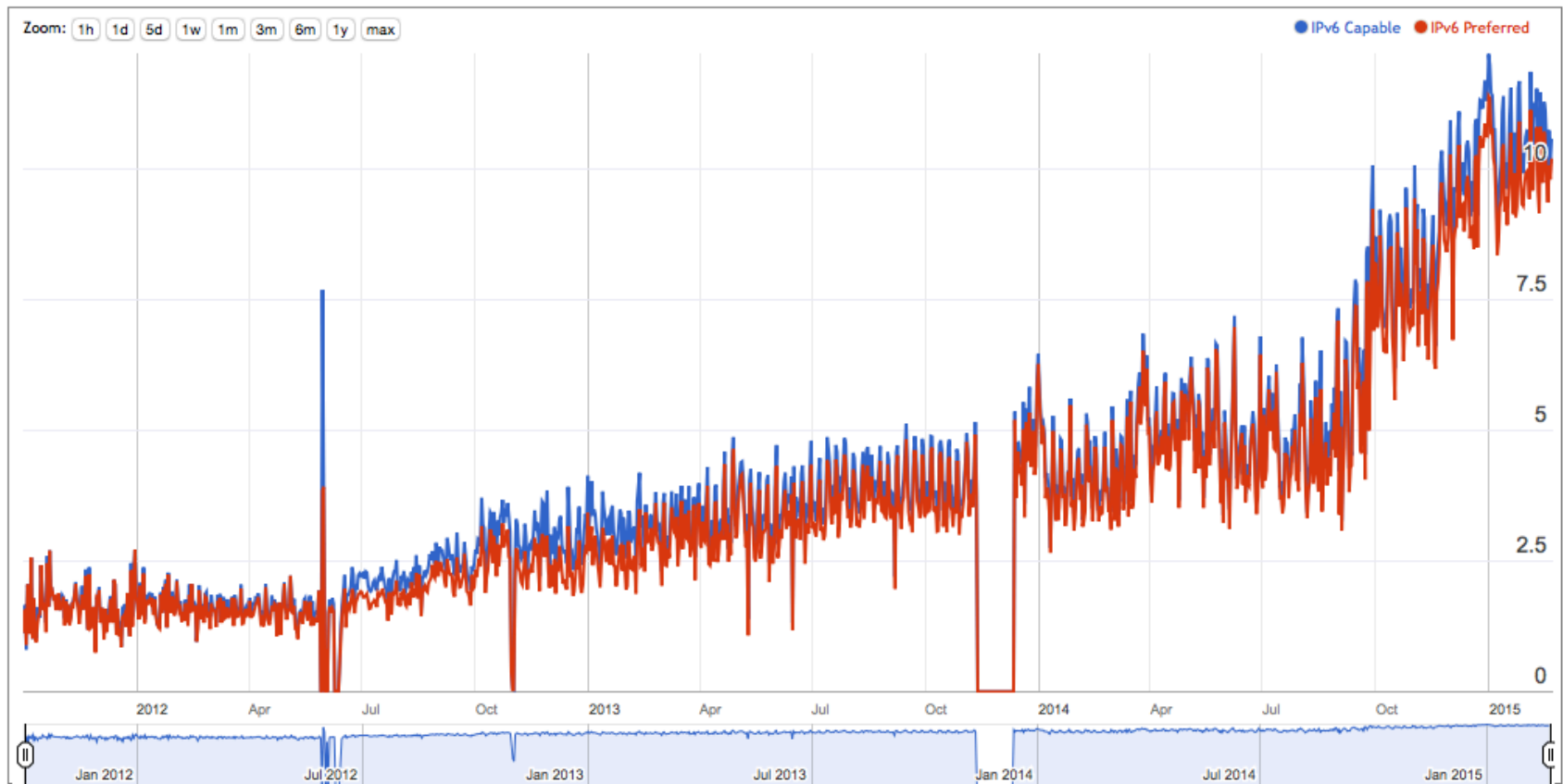
# IPv6: Who Can?

CC	Country	IPv6 Capable
BE	Belgium, Western Europe, Europe	37.04%
DE	Germany, Western Europe, Europe	17.32%
LU	Luxembourg, Western Europe, Europe	15.04%
US	United States of America, Northern America, Americas	14.96%
NO	Norway, Northern Europe, Europe	13.84%
CH	Switzerland, Western Europe, Europe	11.10%
EU	European Union, Western Europe, Europe	11.07%
JP	Japan, Eastern Asia, Asia	10.49%
PE	Peru, South America, Americas	10.14%
CZ	Czech Republic, Eastern Europe, Europe	9.14%
RO	Romania, Eastern Europe, Europe	8.43%
MY	Malaysia, South-Eastern Asia, Asia	7.93%
GR	Greece, Southern Europe, Europe	7.77%
PT	Portugal, Southern Europe, Europe	6.38%
FR	France, Western Europe, Europe	5.91%
EE	Estonia, Northern Europe, Europe	5.75%
SG	Singapore, South-Eastern Asia, Asia	4.71%
BA	Bosnia and Herzegovina, Southern Europe, Europe	3.37%
EC	Ecuador, South America, Americas	3.31%
AT	Austria, Western Europe, Europe	2.73%
NL	Netherlands, Western Europe, Europe	2.37%
BT	Bhutan, Southern Asia, Asia	2.14%
AU	Australia, Australia and New Zealand, Oceania	1.58%
IE	Ireland, Northern Europe, Europe	1.43%
SE	Sweden, Northern Europe, Europe	1.36%
NZ	New Zealand, Australia and New Zealand, Oceania	0.95%
BO	Bolivia, South America, Americas	0.92%
CA	Canada, Northern America, Americas	0.86%
TW	Taiwan, Eastern Asia, Asia	0.71%
GB	United Kingdom of Great Britain and Northern Ireland, Northern Europe, Europe	0.69%
CN	China, Eastern Asia, Asia	0.59%
SI	Slovenia, Southern Europe, Europe	0.55%
FI	Finland, Northern Europe, Europe	0.52%
RU	Russian Federation, Eastern Europe, Europe	0.50%



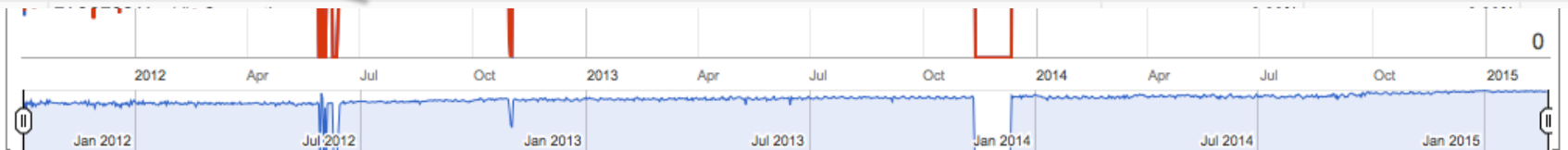
# The Local View: Japan

## IPv6 Country Deployment for Japan (JP)



# The Local View: Japan

ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples
AS4713	OCN NTT Communications Corporation	0.63%	0.54%	195716
AS2516	KDDI KDDI CORPORATION	56.53%	53.60%	92293
AS17676	GIGAINFRA Softbank BB Corp.	8.92%	8.43%	76877
AS2518	BIGLOBE BIGLOBE Inc.	0.53%	0.50%	35332
AS2527	SO-NET So-net Entertainment Corporation	21.17%	19.33%	30164
AS9824	JTCL-JP-AS Jupiter Telecommunication Co. Ltd	0.01%	0.01%	27779
AS17511	K-OPTICOM K-Opticom Corporation	0.21%	0.18%	25273
AS10013	FBDC FreeBit Co.,Ltd.	0.76%	0.74%	21830
AS2510	INFOWEB FUJITSU LIMITED	0.54%	0.48%	19657
AS17506	UCOM UCOM Corp.	0.66%	0.63%	15194
AS10010	TOKAI TOKAI Communications Corporation	21.63%	19.85%	15018
AS2497	IiJ Internet Initiative Japan Inc.	0.31%	0.28%	14519
AS2519	VECTANT VECTANT Ltd.	0.32%	0.30%	11864
AS9617	ZAQ KANSAI MULTIMEDIA SERVICE COMPANY	0.00%	0.01%	11507
AS2514	INFOSPHERE NTT PC Communications, Inc.	0.13%	0.10%	11122
AS18126	CTCX Chubu Telecommunications Company, Inc.	48.48%	40.19%	8816
AS4685	ASAHI-NET Asahi Net	0.07%	0.07%	8056
AS7679	QTNET Kyushu Telecommunication Network Co.,Inc.	0.00%	0.00%	6488
AS4725	ODN SOFTBANK TELECOM Corp.	0.45%	0.00%	6379
AS37903	EMOBILE Ymobile Corporation	0.00%	0.00%	6326
AS4721	JCN Jupiter Telecommunications Co., Ltd.	0.02%	0.00%	6218
AS2907	SINET-AS Research Organization of Information and Systems, National Institute of Informatics	2.72%	2.59%	5222
AS9354	TDNC Community Network Center Inc.	5.28%	4.94%	4714
AS9365	ITSCOM its communications Inc.	8.65%	8.54%	4450
AS7522	STCN STNet, Incorporated	29.42%	24.94%	4034





# The Internet's IPv6 Top 30

		Est. V6 Users	V6 Takeup
1	AS7922 COMCAST-7922 - Comcast Cable Communications, Inc.	US 17,355,202	37.9%
2	AS7018 ATT-INTERNET4 - ATT Services, Inc.	US 9,723,491	44.3%
3	AS2516 KDDI KDDI CORPORATION	JP 7,202,025	57.0%
4	AS3320 DTAG Deutsche Telekom AG	DE 5,522,595	23.6%
5	AS12322 PROXAD Free SAS	FR 2,669,010	22.6%
6	AS31334 KABELDEUTSCHLAND-AS Kabel Deutschland Vertrieb und Service GmbH	DE 2,206,030	42.5%
7	AS6848 TELENET-AS Telenet N.V.	BE 1,883,091	60.4%
8	AS4788 TMNET-AS-AP TM Net, Internet Service Provider	MY 1,496,962	10.0%
9	AS20825 UNITYMEDIA Unitymedia NRW GmbH	DE 1,433,337	34.3%
10	AS20001 ROADRUNNER-WEST - Time Warner Cable Internet LLC	US 1,277,087	24.2%
11	AS6147 Telefonica del Peru S.A.A.	PE 1,166,632	12.5%
12	AS29562 KABELBW-ASN Kabel BW GmbH	DE 970,595	36.6%
13	AS17676 GIGAINFRA Softbank BB Corp.	JP 952,051	9.1%
14	AS2527 SO-NET So-net Entertainment Corporation	JP 870,065	21.1%
15	AS5432 BELGACOM-SKYNET-AS BELGACOM S.A.	BE 828,286	19.9%
16	AS12271 SCRR-12271 - Time Warner Cable Internet LLC	US 825,253	28.2%
17	AS8708 RCS-RDS RCS RDS SA	RO 823,591	19.5%
18	AS3303 SWISSCOM Swisscom (Switzerland) Ltd	CH 801,227	25.2%
19	AS12392 ASBRUTELE Brutele SC	BE 762,615	66.2%
20	AS5610 O2-CZECH-REPUBLIC Telefonica Czech Republic, a.s.	CZ 724,773	33.2%
21	AS4134 CHINANET-BACKBONE No.31,Jin-rong Street	CN 698,620	0.3%
22	AS10796 SCRR-10796 - Time Warner Cable Internet LLC	US 695,620	12.1%
23	AS11426 SCRR-11426 - Time Warner Cable Internet LLC	US 580,599	16.8%
24	AS4837 CHINA169-BACKBONE CNCGROUP China169 Backbone	CN 570,117	0.3%
25	AS6389 BELLSOUTH-NET-BLK - BellSouth.net Inc.	US 569,459	34.6%
26	AS18126 CTCX Chubu Telecommunications Company, Inc.	JP 566,614	48.4%
27	AS11427 SCRR-11427 - Time Warner Cable Internet LLC	US 550,651	15.5%
28	AS4538 ERX-CERNET-BKB China Education and Research Network Center	CN 539,349	27.1%
29	AS39832 NO-OPERA Opera Software ASA	NO 533,040	99.8%
30	AS22394 CELLCO - Cellco Partnership DBA Verizon Wireless	US 476,140	53.6%



# The Internet's IPv6 Top 30

		Est. V6 Users	V6 Takeup	Cumulative Sum	
1	AS7922 COMCAST-7922 - Comcast Cable Communications, Inc.	US 17,355,202	37.9%	17,355,202	23.0%
2	AS7018 ATT-INTERNET4 - ATT Services, Inc.	US 9,723,491	44.3%	27,078,694	35.9%
3	AS2516 KDDI KDDI CORPORATION	JP 7,202,025	57.0%	34,280,719	45.5%
4	AS3320 DTAG Deutsche Telekom AG	DE 5,522,595	23.6%	39,803,315	52.8%
5	AS12322 PROXAD Free SAS	FR 2,669,010	22.6%	42,472,326	56.3%
6	AS31334 KABELDEUTSCHLAND-AS Kabel Deutschland Vertrieb und Service GmbH	DE 2,206,030	42.5%	44,678,356	59.2%
7	AS6848 TELENET-AS Telenet N.V.	BE 1,883,091	60.4%	46,561,448	61.7%
8	AS4788 TMNET-AS-AP TM Net, Internet Service Provider	MY 1,496,962	10.0%	48,058,410	63.7%
9	AS20825 UNITYMEDIA Unitymedia NRW GmbH	DE 1,433,337	34.3%	49,491,748	65.6%
10	AS20001 ROADRUNNER-WEST - Time Warner Cable Internet LLC	US 1,277,087	24.2%	50,768,836	67.3%
11	AS6147 Telefonica del Peru S.A.A.	PE 1,166,632	12.5%	51,935,469	68.9%
12	AS29562 KABELBW-ASN Kabel BW GmbH	DE 970,595	36.6%	52,906,064	70.2%
13	AS17676 GIGAINFRA Softbank BB Corp.	JP 952,051	9.1%	53,858,115	71.4%
14	AS2527 SO-NET So-net Entertainment Corporation	JP 870,065	21.1%	54,728,180	72.6%
15	AS5432 BELGACOM-SKYNET-AS BELGACOM S.A.	BE 828,286	19.9%	55,556,467	73.7%
16	AS12271 SCRR-12271 - Time Warner Cable Internet LLC	US 825,253	28.2%	56,381,720	74.8%
17	AS8708 RCS-RDS RCS RDS SA	RO 823,591	19.5%	57,205,311	75.9%
18	AS3303 SWISSCOM Swisscom (Switzerland) Ltd	CH 801,227	25.2%	58,006,539	76.9%
19	AS12392 ASBRUTELE Brutele SC	BE 762,615	66.2%	58,769,155	77.9%
20	AS5610 O2-CZECH-REPUBLIC Telefonica Czech Republic, a.s.	CZ 724,773	33.2%	59,493,928	78.9%
21	AS4134 CHINANET-BACKBONE No.31,Jin-rong Street	CN 698,620	0.3%	60,192,548	79.8%
22	AS10796 SCRR-10796 - Time Warner Cable Internet LLC	US 695,620	12.1%	60,888,169	80.7%
23	AS11426 SCRR-11426 - Time Warner Cable Internet LLC	US 580,599	16.8%	61,468,768	81.5%
24	AS4837 CHINA169-BACKBONE CNCGROUP China169 Backbone	CN 570,117	0.3%	62,038,886	82.3%
25	AS6389 BELLSOUTH-NET-BLK - BellSouth.net Inc.	US 569,459	34.6%	62,608,345	83.0%
26	AS18126 CTCX Chubu Telecommunications Company, Inc.	JP 566,614	48.4%	63,174,960	83.8%
27	AS11427 SCRR-11427 - Time Warner Cable Internet LLC	US 550,651	15.5%	63,725,611	84.5%
28	AS4538 ERX-CERNET-BKB China Education and Research Network Center	CN 539,349	27.1%	64,264,960	85.2%
29	AS39832 NO-OPERA Opera Software ASA	NO 533,040	99.8%	64,798,001	85.9%
30	AS22394 CELLCO - Cellco Partnership DBA Verizon Wireless	US 476,140	53.6%	65,274,142	86.6%



# The Internet's IPv6 Top 30

		Est. V6 Users	V6 Takeup	Cumulative Sum	
1	AS7922 COMCAST-7922 - Comcast Cable Communications, Inc.	US 17,355,202	37.9%	17,355,202	23.0%
2	AS7018 ATT-INTERNET4 - ATT Services, Inc.	US 9,723,491	44.3%	27,078,694	35.9%
3	AS2516 KDDI KDDI CORPORATION	JP 7,202,025	57.0%	34,280,719	45.5%
4	AS3320 DTAG Deutsche Telekom AG	DE 5,522,595	23.6%	39,803,315	52.8%
5	AS12322 PROXAD Free SAS	FR 2,669,010	22.6%	42,472,326	56.3%
6	AS31334 KABELDEUTSCHLAND-AS Kabel Deutschland Vertrieb und Service GmbH	DE 2,206,030	42.5%	44,678,356	59.2%
7	AS6848 TELENET-AS Telenet N.V.	BE 1,883,091	60.4%	46,561,448	61.7%
8	AS4788 TMNET-AS-AP TM Net, Internet Service Provider	MY 1,496,962	10.0%	48,058,410	63.7%
9	AS20825 UNITYMEDIA Unitymedia NRW GmbH	DE 1,433,327		49,491,748	65.6%
10	AS20001 ROADRUNNER-WEST - Time Warner Cable Internet LLC	US		50,768,836	67.3%
11	AS6147 Telefonica del Peru S.A.A.			51,935,469	68.9%
12	AS29562 KABELBW-ASN Kabel BW GmbH		50.6%	52,906,064	70.2%
13	AS17676 GIGAINFRA Softbank BB Corp.	JP 52,051	9.1%	53,858,115	71.4%
14	AS2527 SO-NET So-net Entertainment Co.	JP 870,065	21.1%	54,728,180	72.6%
15	AS5432 BELGACOM-SKYNET	BE 828,286	19.9%	55,556,467	73.7%
16	AS12271 SCRR-12271	US 825,253	28.2%	56,381,720	74.8%
17	AS8700 (Switzerland) Ltd	RO 823,591	19.5%	57,205,311	75.9%
	Switzerland) Ltd	CH 801,227	25.2%	58,006,539	76.9%
	Switzerland) Ltd	BE 762,615	66.2%	58,769,155	77.9%
	CZECH-REPUBLIC Telefonica Czech Republic, a.s.	CZ 724,773	33.2%	59,493,928	78.9%
18	AS4134 CHINANET-BACKBONE No.31,Jin-rong Street	CN 698,620	0.3%	60,192,548	79.8%
22	AS10796 SCRR-10796 - Time Warner Cable Internet LLC	US 695,620	12.1%	60,888,169	80.7%
23	AS11426 SCRR-11426 - Time Warner Cable Internet LLC	US 580,599	16.8%	61,468,768	81.5%
24	AS4837 CHINA169-BACKBONE CNCGROUP China169 Backbone	CN 570,117	0.3%	62,038,886	82.3%
25	AS6389 BELLSOUTH-NET-BLK - BellSouth.net Inc.	US 569,459	34.6%	62,608,345	83.0%
26	AS18126 CTCX Chubu Telecommunications Company, Inc.	JP 566,614	48.4%	63,174,960	83.8%
27	AS11427 SCRR-11427 - Time Warner Cable Internet LLC	US 550,651	15.5%	63,725,611	84.5%
28	AS4538 ERX-CERNET-BKB China Education and Research Network Center	CN 539,349	27.1%	64,264,960	85.2%
29	AS39832 NO-OPERA Opera Software ASA	NO 533,040	99.8%	64,798,001	85.9%
30	AS22394 CELLCO - Cellco Partnership DBA Verizon Wireless	US 476,140	53.6%	65,274,142	86.6%

*It's a very uneven takeup of IPv6 - 86% of the world's IPv6 users sit behind just 30 ISPs*

# Some Observations

- If you allow the customer to own and maintain their own CPE then the CPE upgrade path is a critical issue – old CPE drags the IPv6 numbers down
- Mobile providers should see higher penetration numbers ... but legacy handsets seem to pull the numbers down
- There are some high penetration numbers on “greenfield” deployments, but its rare to see:

49,AS16591,"GOOGLE-FIBER - Google Fiber Inc.",US,155096,87.3%



# The Internet's 30 Largest ISPs

AS	V6 Users	Cum V6 Users	Cum Users	% User:
1 AS4134 CHINANET-BACKBONE No.31,Jin-rong Street	CN 686,462 0.3%	686,462 0.9%	262,501,487	11.4%
2 AS4837 CHINA169-BACKBONE CNCGROUP China169 Backbone	CN 569,568 0.3%	1,256,030 1.7%	436,619,656	18.9%
3 AS7922 COMCAST-7922 - Comcast Cable Communications, Inc.	US 17,369,224 37.9%	18,625,254 24.7%	482,497,561	20.9%
4 AS9829 BSNL-NIB National Internet Backbone	IN 3,536 0.0%	18,628,791 24.7%	515,899,466	22.4%
5 AS8151 Uninet S.A. de C.V.	MX 1,035 0.0%	18,629,827 24.7%	545,386,899	23.7%
6 AS4713 OCN NTT Communications Corporation	JP 201,493 0.8%	18,831,320 24.9%	571,905,467	24.8%
7 AS9121 TTNET Turk Telekomunikasyon Anonim Sirketi	TR 46 0.0%	18,831,367 24.9%	596,613,101	25.9%
8 AS3320 DTAG Deutsche Telekom AG	DE 5,530,042 23.6%	24,361,409 32.3%	620,021,944	26.9%
9 AS8452 TE-AS TE-AS	EG 0 0.0%	24,361,409 32.3%	642,839,031	27.9%
10 AS7018 ATT-INTERNET4 - ATT Services, Inc.	US 9,771,116 44.5%	34,132,526 45.2%	664,814,121	28.8%
11 AS28573 NET Servios de Comunicacao S.A.	BR 130,867 0.6%	34,263,393 45.4%	685,230,533	29.7%
12 AS4766 KIXS-AS-KR Korea Telecom	KR 497 0.0%	34,263,891 45.4%	703,127,048	30.5%
13 AS24560 AIRTELBROADBAND-AS-AP Bharti Airtel Ltd., Telemedia Services	IN 101 0.0%	34,263,992 45.4%	720,384,304	31.2%
14 AS701 UUNET - MCI Communications Services, Inc. dba Verizon Business	US 2,141 0.0%	34,266,133 45.4%	737,608,471	32.0%
15 AS3215 AS3215 Orange S.A.	FR 1,006 0.0%	34,267,140 45.4%	754,795,978	32.7%
16 AS17974 TELKOMNET-AS2-AP PT Telekomunikasi Indonesia	ID 209 0.0%	34,267,350 45.4%	771,821,727	33.5%
17 AS9299 IPG-AS-AP Philippine Long Distance Telephone Company	PH 0 0.0%	34,267,350 45.4%	787,775,284	34.2%
18 AS18881 Global Village Telecom	BR 30,008 0.2%	34,297,358 45.4%	803,599,971	34.9%
19 AS4788 TMNET-AS-AP TM Net, Internet Service Provider	MY 1,498,704 10.0%	35,796,063 47.4%	818,520,387	35.5%
20 AS9808 CMNET-GD Guangdong Mobile Communication Co.Ltd.	CN 76,096 0.5%	35,872,159 47.5%	833,204,643	36.1%
21 AS45595 PKTELECOM-AS-PK Pakistan Telecom Company Limited	PK 29 0.0%	35,872,189 47.5%	846,837,815	36.7%
22 AS45899 VNPT-AS-VN VNPT Corp	VN 25 0.0%	35,872,214 47.5%	860,371,065	37.3%
23 AS3269 ASN-IBSNAZ Telecom Italia S.p.a.	IT 328 0.0%	35,872,543 47.5%	873,716,520	37.9%
24 AS4812 CHINANET-SH-AP China Telecom (Group)	CN 21,640 0.2%	35,894,183 47.6%	886,844,441	38.5%
25 AS2516 KDDI KDDI CORPORATION	JP 7,208,287 57.0%	43,102,471 57.1%	899,497,448	39.0%
26 AS5089 NTL Virgin Media Limited	GB 1,443 0.0%	43,103,915 57.1%	911,955,842	39.6%
27 AS3352 TELEFONICADEESPANA TELEFONICA DE ESPANA	ES 51 0.0%	43,103,966 57.1%	924,334,784	40.1%
28 AS36903 MT-MPLS	MA 35 0.0%	43,104,001 57.1%	936,174,875	40.6%
29 AS12322 PROXAD Free SAS	FR 2,665,721 22.5%	45,769,722 60.6%	948,014,521	41.1%
30 AS7738 Telemar Norte Leste S.A.	BR 975 0.0%	45,770,697 60.6%	959,551,901	41.6%



# Some Further Observations

IPv6 support is still very patchy:

While most of the V6 activity in terms of user counts is confined to 30 ISPs, just 6 of the top 30 largest ISPs have any significant IPv6 deployments

The Internet is heavily skewed

The 30 largest ISPs service 40% of the entire Internet user population

If these 30 providers were to achieve an average 50% IPv6 uptake in their customer base, then the total IPv6 capability level would be 20% rather than 3.6%

Thank You

