

# Addressing 2015

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APNIC



# The Addressing View

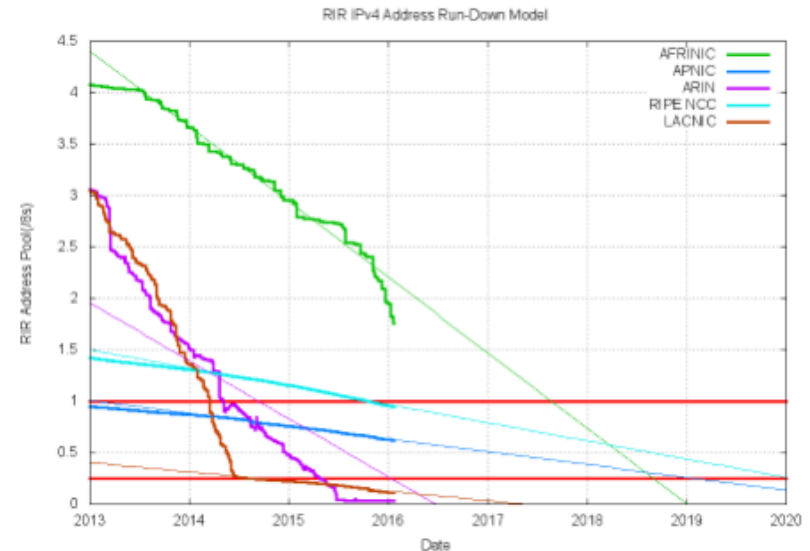


# Addressing V4 Exhaustion

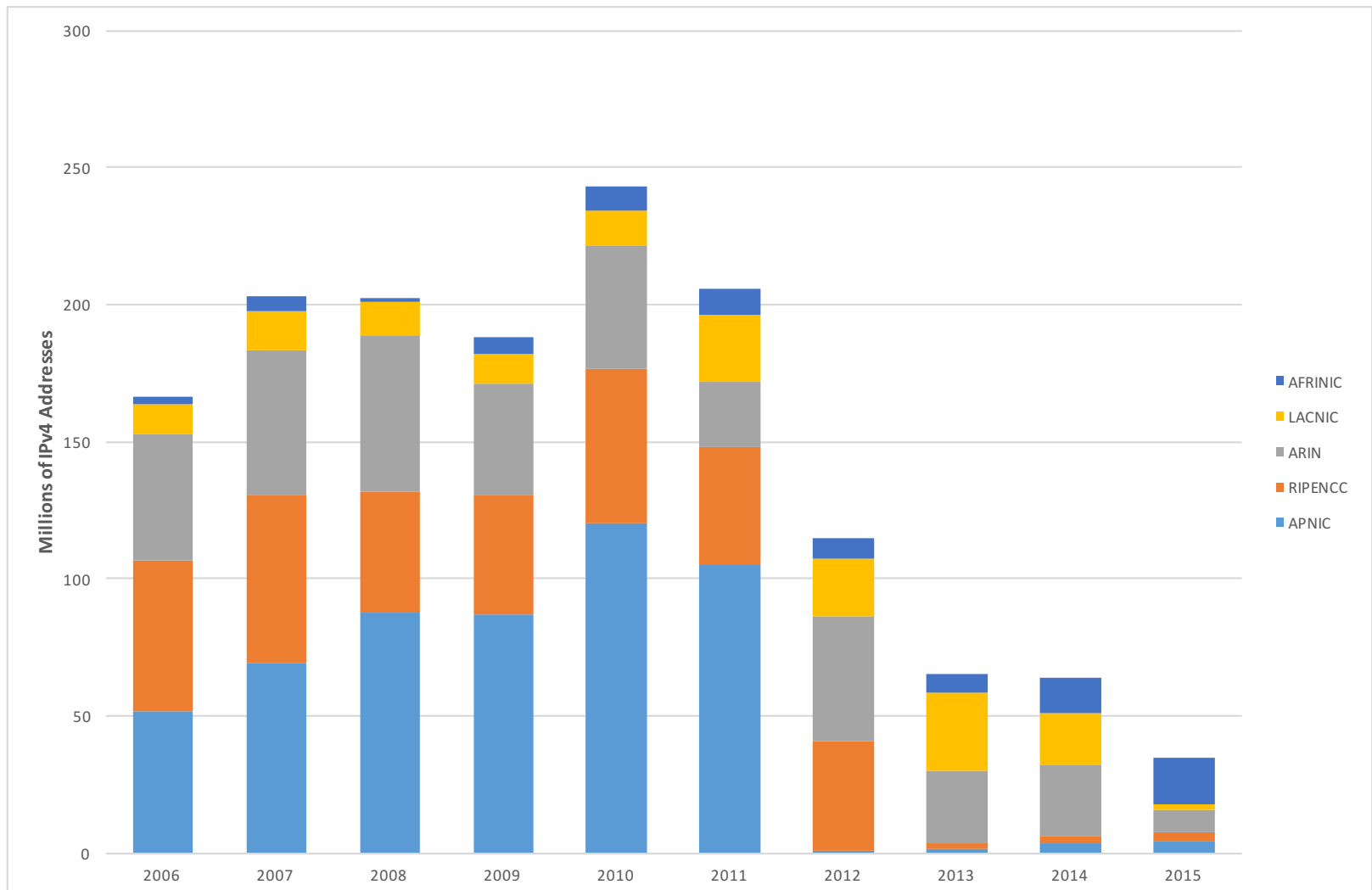
- We have been predicting that the exhaustion of the free pool of IPv4 addresses would eventually happen for the past 25 years!
- And, finally, we've now hit the bottom of the address pool!
  - APNIC, RIPE NCC, LACNIC and ARIN are now empty of general use IPv4 addresses
  - We now have just AFRINIC to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

## Projected RIR Address Pool Exhaustion Dates:

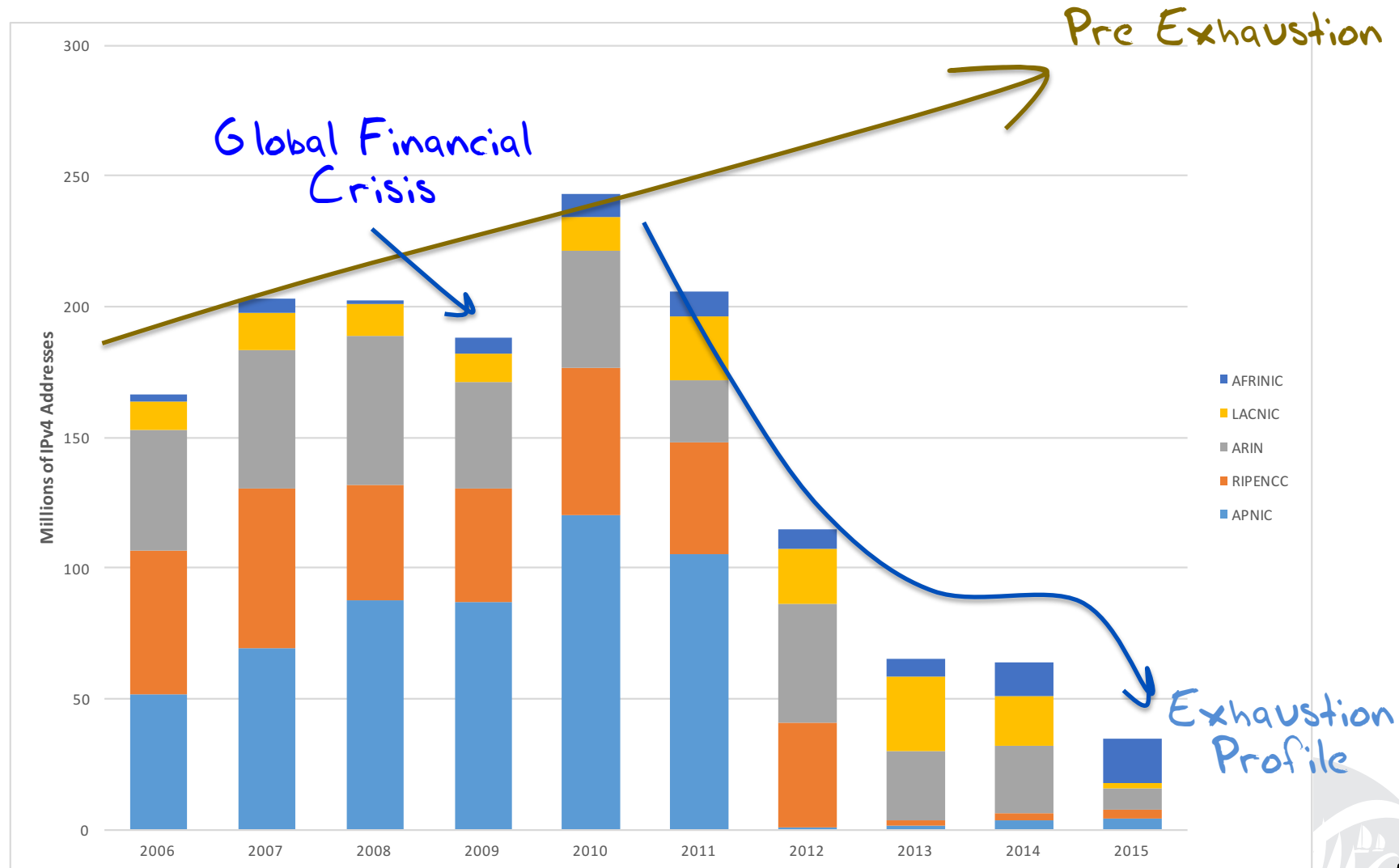
RIR	Projected Exhaustion Date	Remaining Addresses in RIR Pool (/8s)
APNIC:	<b>19-Apr-2011</b> (actual)	0.6220
RIPE NCC:	<b>14-Sep-2012</b> (actual)	0.9484
LACNIC:	<b>10-Jun-2014</b> (actual)	0.1110
ARIN:	<b>24 Sep-2015</b> (actual)	
AFRINIC:	<b>01-Jul-2018</b>	1.7587



# 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	2011	2012	2013	2014	2015
1	China 53.07	USA 28.2	USA 25.0	USA 24.5	USA 7.6
2	USA 21.21	Canada 16.7	Brazil 17.4	Brazil 10.9	Egypt 7.4
3	Japan 16.91	Brazil 8.4	Colombia 3.8	Morocco 2.6	Seychelles 2.1
4	Rep.Korea 7.68	Russia 5.3	Argentina 1.6	Colombia 2.1	South Africa 2.0
5	Indonesia 7.09	Iran 4.5	Egypt 1.6	South Africa 1.7	Tunisia 1.8
6	Brazil 6.29	Germany 3.4	Canada 1.4	Egypt 1.6	Brazil 1.4
7	India 6.01	South Africa 3.4	Nigeria 1.2	China 1.5	China 1.3
8	France 5.39	Italy 3.3	Chile 1.1	Canada 1.5	India 1.3
9	Russia 5.02	Colombia 2.6	Mexico 1.1	Kenya 1.4	Canada 1.1
10	Germany 4.92	Romania 2.6	Seychelles 1.0	Mexico 1.1	Ghana 0.6

APNIC runs out ↑

RIPE NCC runs out ↑

LACNIC runs out ↑

ARIN 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	2015
ARIN	79	31	58	277
APNIC	255	206	437	514
RIPE NCC	10	171	1,050	2,852
<b>Total</b>	<b>344</b>	<b>408</b>	<b>1,545</b>	<b>3,643</b>

*Number of registered  
Address transfers per year*



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



Receiving RIR	2012	2013	2014	2015
ARIN	6,728,448	5,136,640	4,737,280	37,637,888
APNIC	3,434,496	2,504,960	4,953,088	9,836,288
RIPE NCC	65,536	1,977,344	9,635,328	10,835,712
<b>Total</b>	<b>10,228,480</b>	<b>9,618,944</b>	<b>19,325,696</b>	<b>58,309,888</b>





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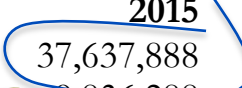
Number of registered Address transfers per year



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



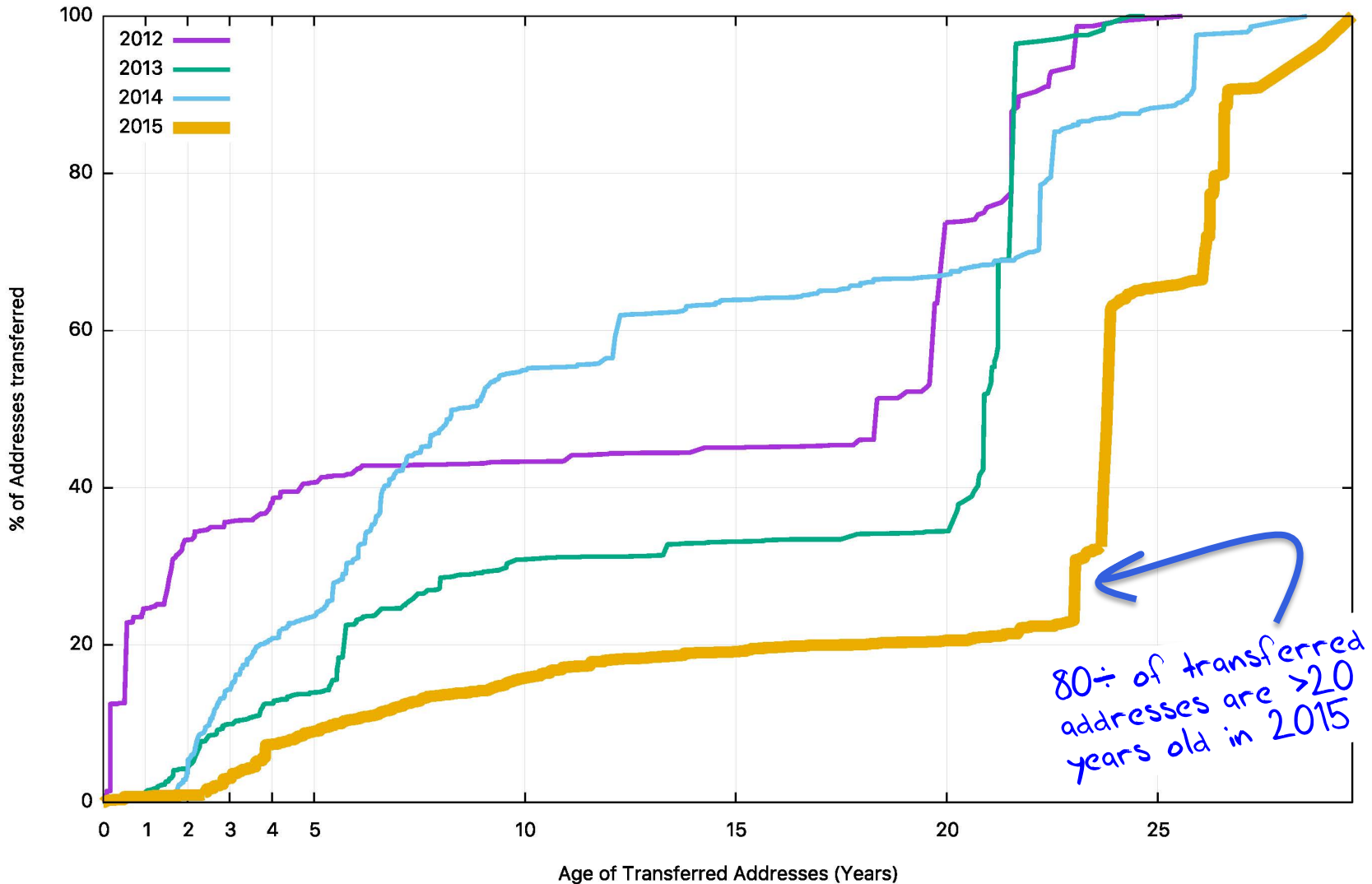
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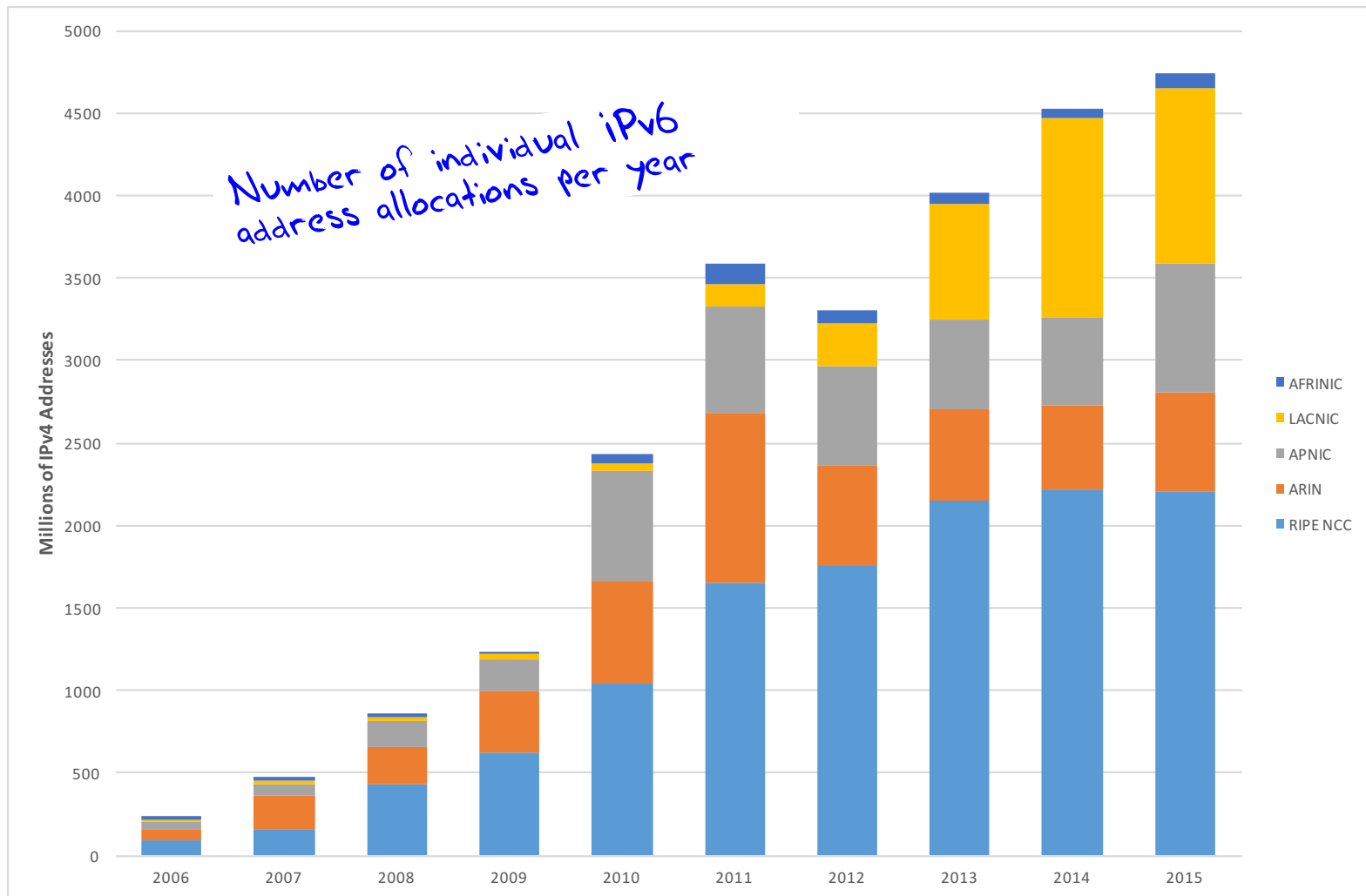
Movement of legacy addresses in 47/8 (to Microsoft) and 52/8 (to Amazon EC2)



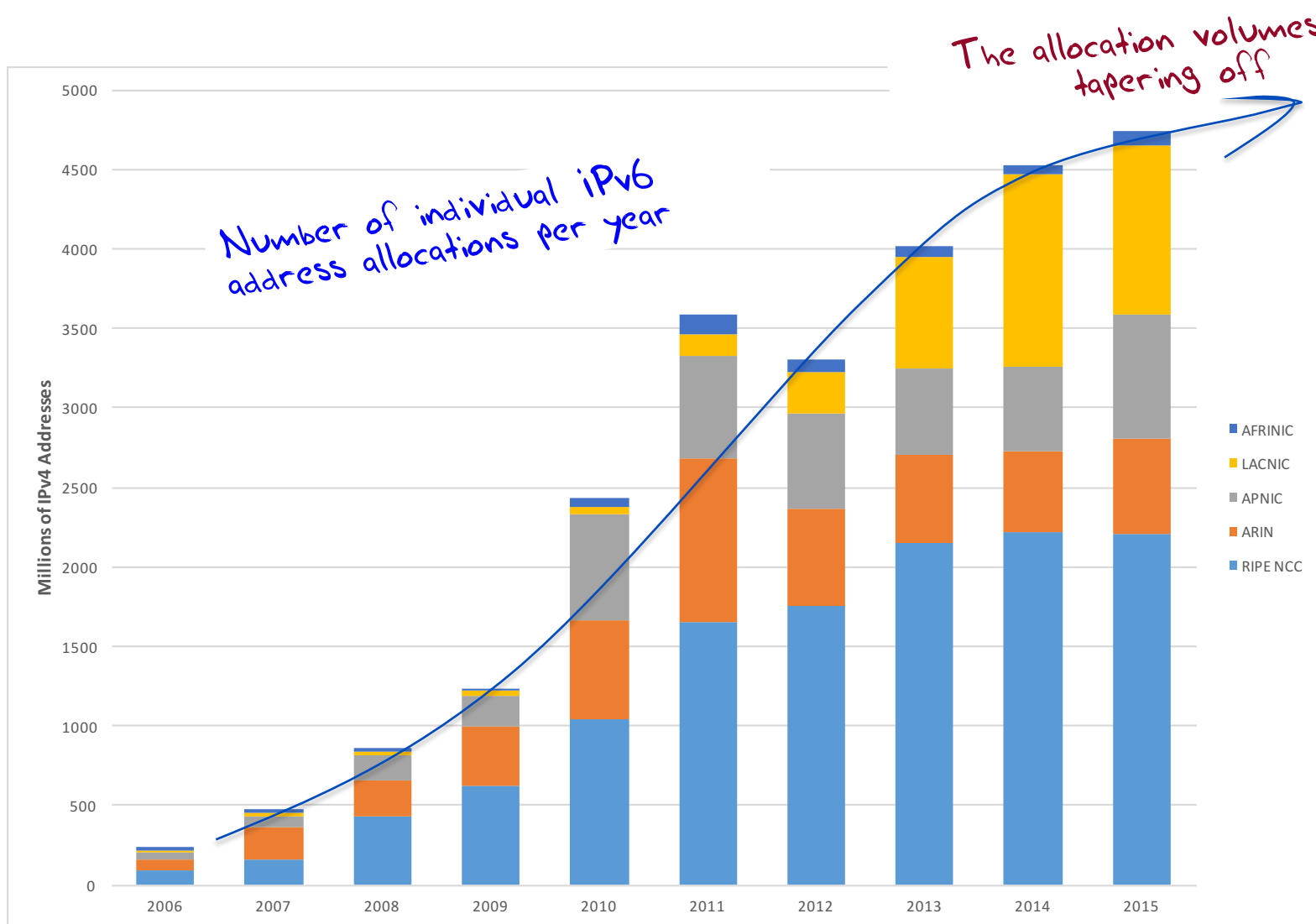
# How old are transferred addresses?



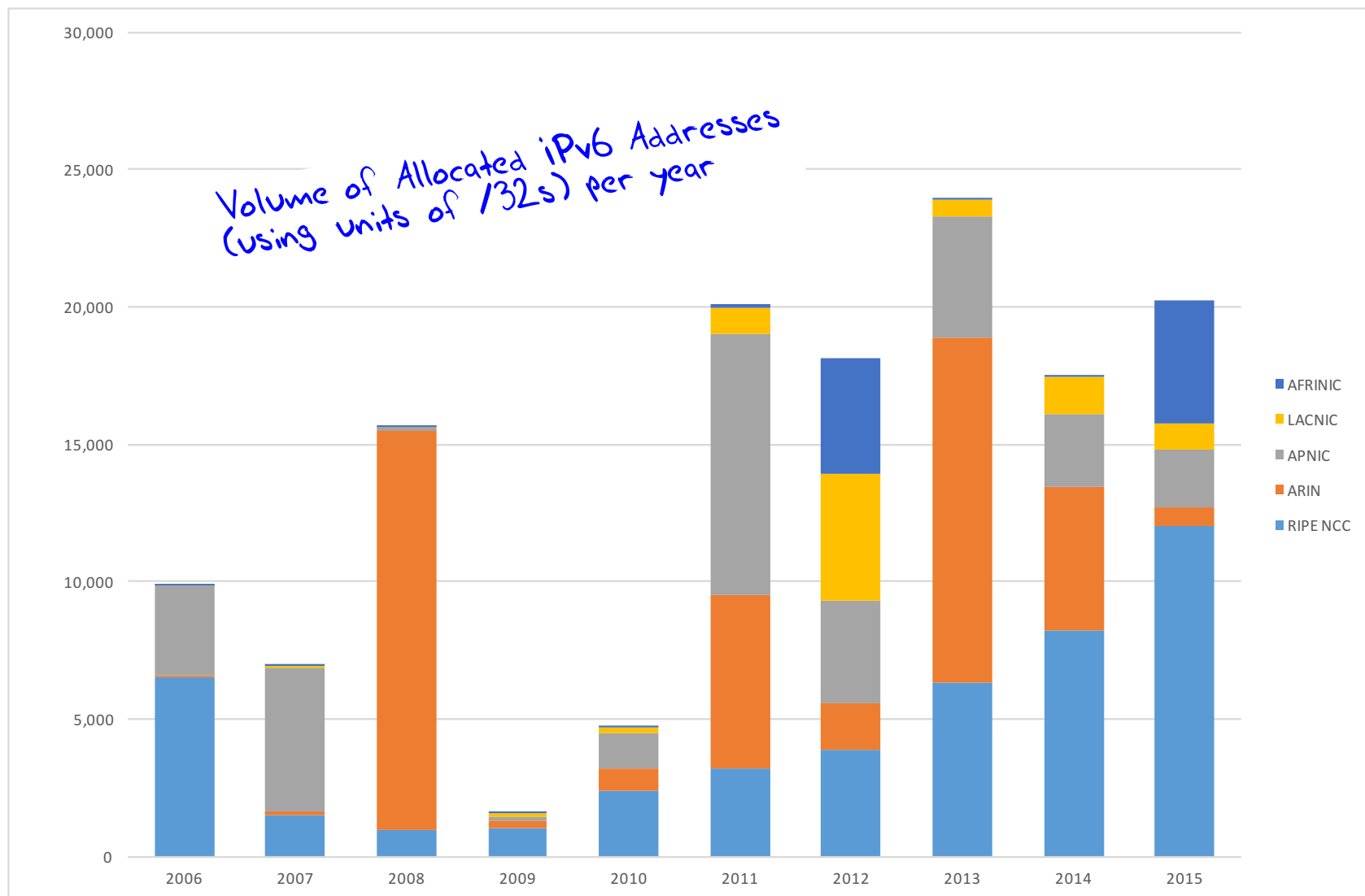
# IPv6 Allocations



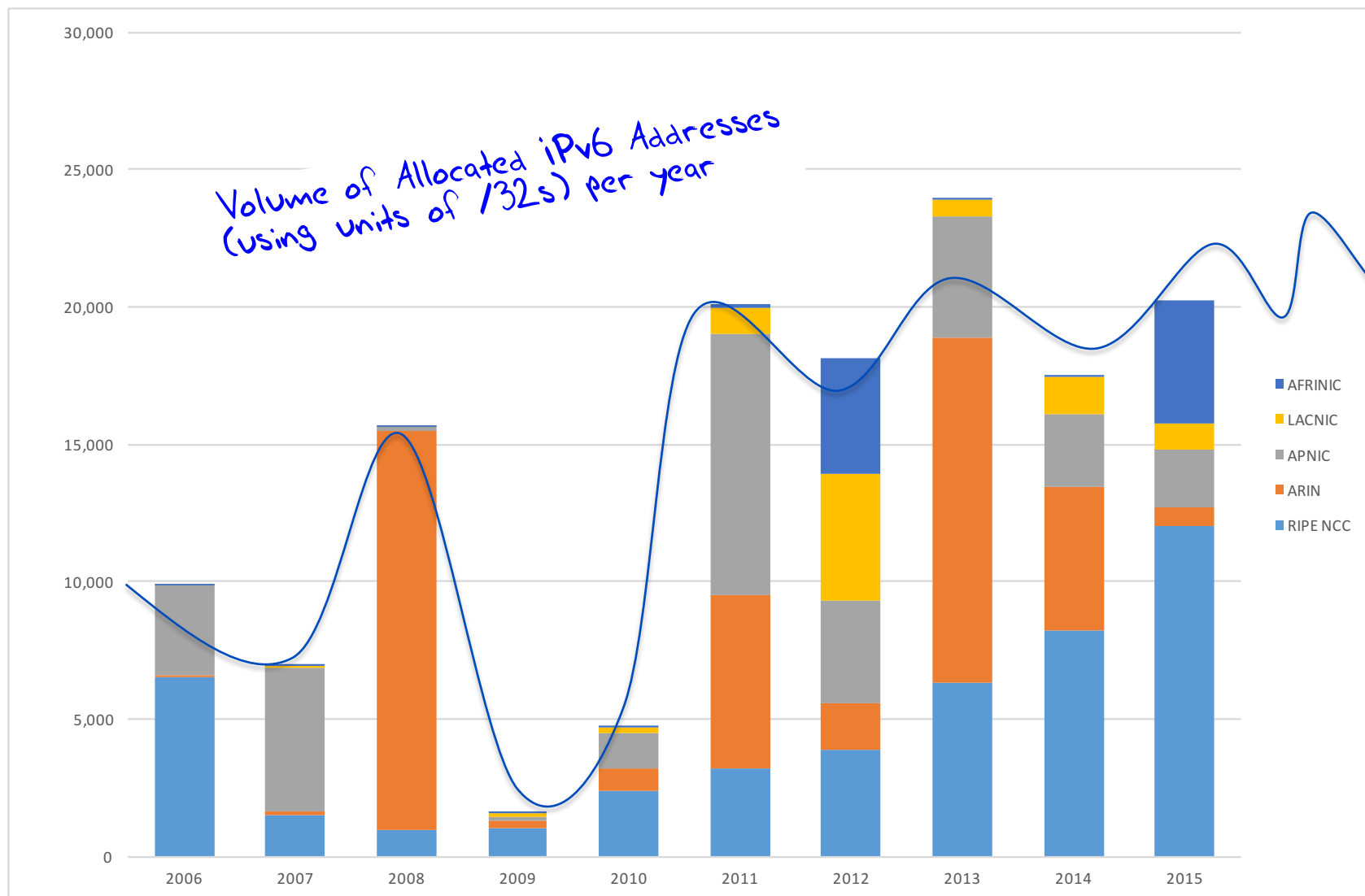
# IPv6 Allocations



# IPv6 Allocated Addresses



# IPv6 Allocated Addresses



# Where did the IPv6 addresses go?

	2011		2012		2013		2014		2015	
1	China	8,997	Argentina	4,177	United States	12,537	United States	4,930	South Africa	4,441
2	United States	6,253	Egypt	4,098	China	4,135	China	2,127	China	1,797
3	Spain	667	China	3,136	UK	782	UK	1,090	UK	1,297
4	UK	476	United States	1,337	Germany	651	Brazil	863	Germany	1,269
5	Brazil	311	Italy	635	Russia	523	Germany	749	Netherlands	1,010
6	Germany	300	Russia	403	Netherlands	463	Netherlands	719	Russia	864
7	Mexico	261	Germany	399	Brazil	450	Russia	716	Brazil	755
8	Venezuela	261	UK	356	France	435	France	436	Spain	708
9	Netherlands	241	Canada	323	Italy	339	Italy	410	Italy	707
10	Russia	160	Brazil	294	Switzerland	265	Switzerland	369	United States	662

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



# The Full Picture

Addresses	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
IPv6 (/32s)	9,854	6,916	15,634	1,555	4,754	20,009	18,136	23,935	17,513	20,225
IPv4 (/32s)(M)	168.1	203.9	203.3	189.4	248.8	201	114.9	65.1	63.9	34.8
IPv4 xfers (reg)							10.2	9.6	19.3	58.3
IPv4 xfers (xreg)	?	?	?	?	?	?	?	?	?	?
IPv4 NAT	?	?	?	?	?	?	?	?	?	?

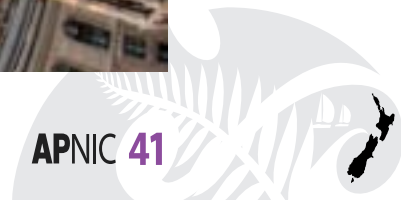
What we don't know is:

- the volume of unregistered address transfers
- the populations of devices using private addresses located behind NATs

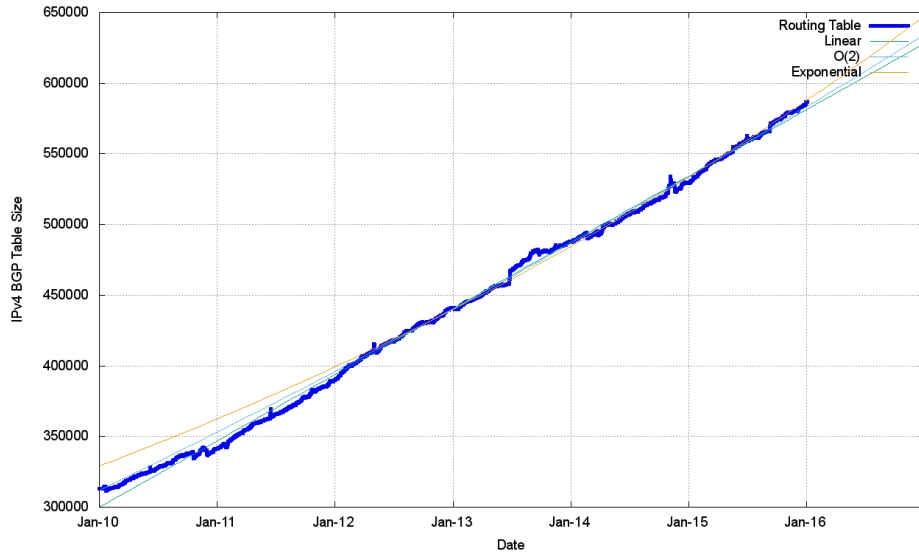




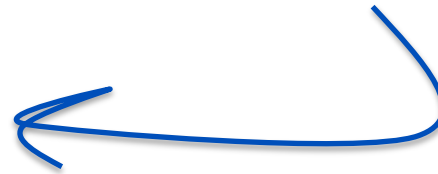
# The Routing View



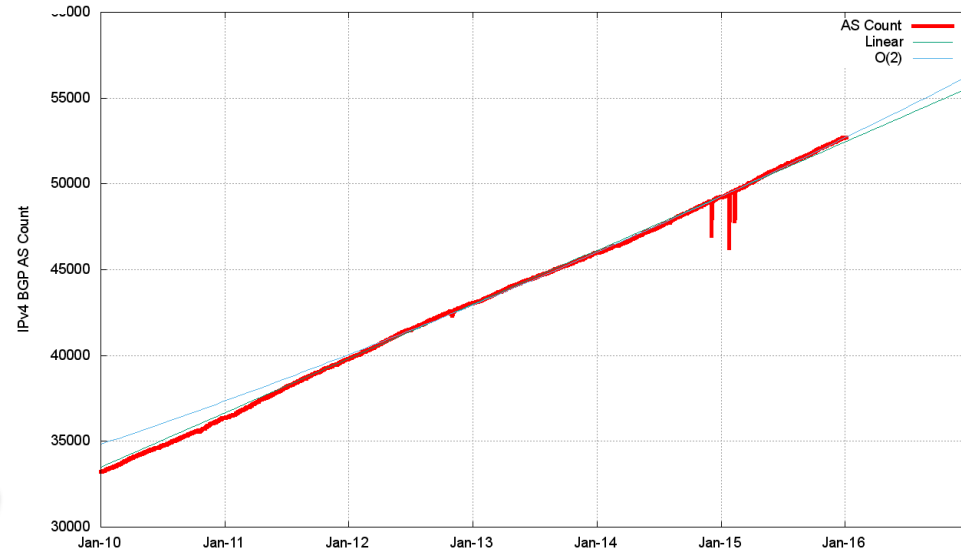
# Routing Indicators for IPv4



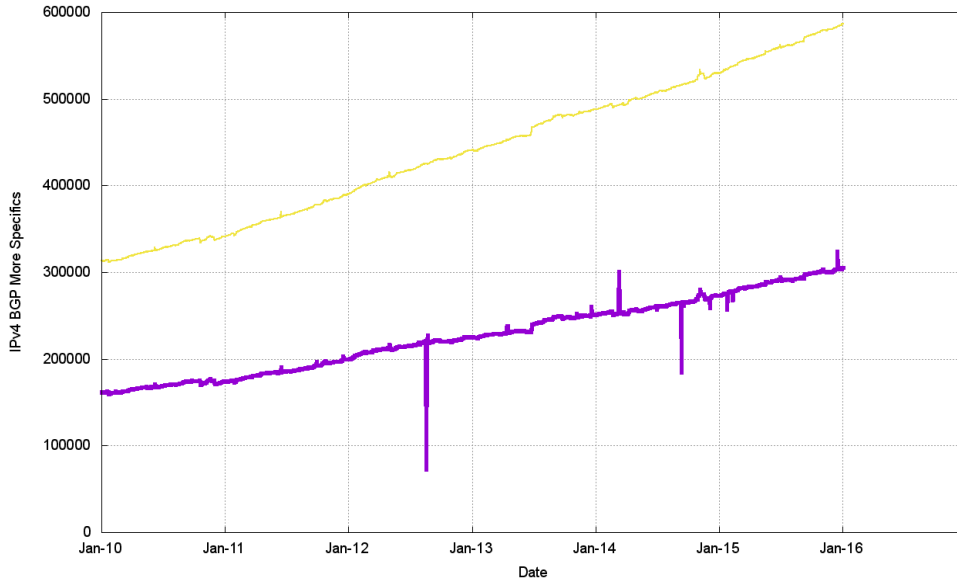
Routing prefixes - growing by some 47,000 prefixes per year



AS Numbers - growing by some 3,100 prefixes per year



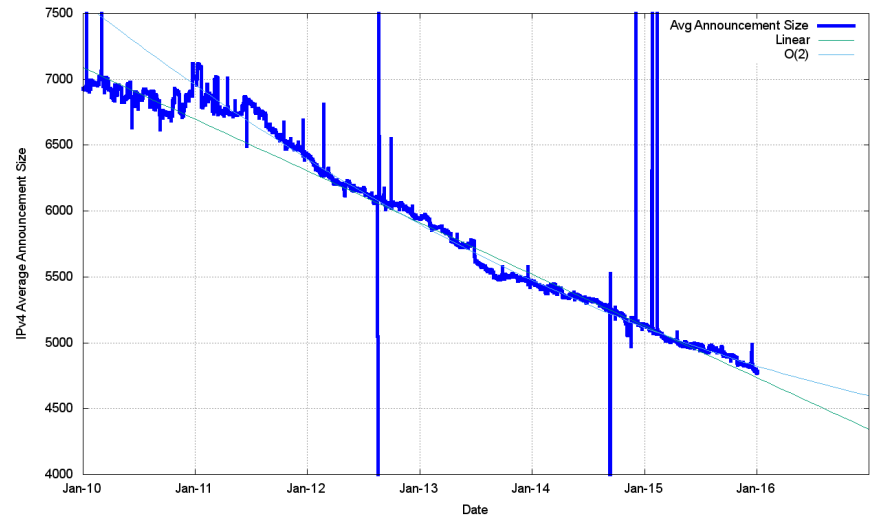
# Routing Indicators for IPv4



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



But the average size of a routing advertisement is getting smaller

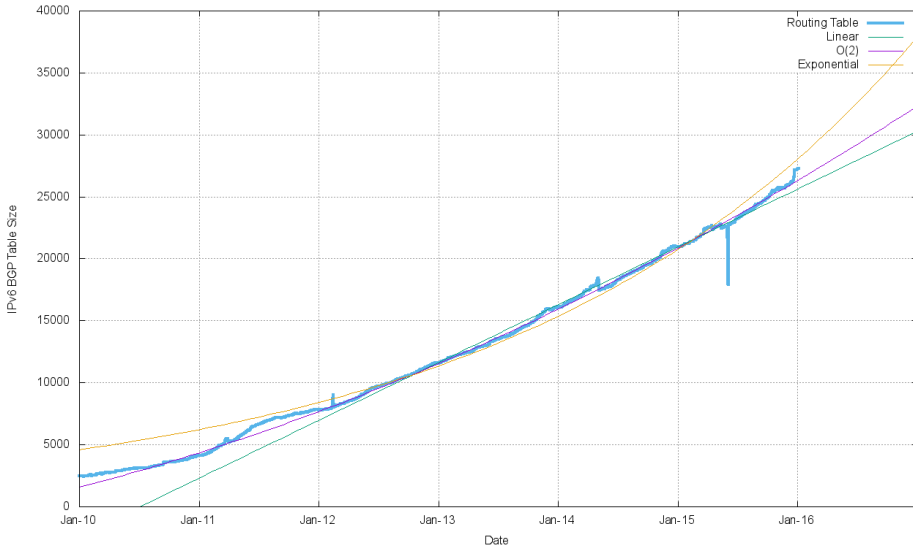


# What happened in 2015 in V4?

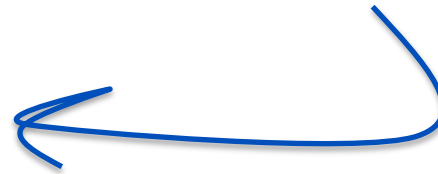
- From the look of the growth plots, its business as usual, despite the increasing pressure on IPv4 address availability
- The number of entries in the default-free zone is now heading to 600,000
- The pace of growth of the routing table is still relatively constant at ~50,000 new entries per year
  - IPv4 address exhaustion is not changing this!



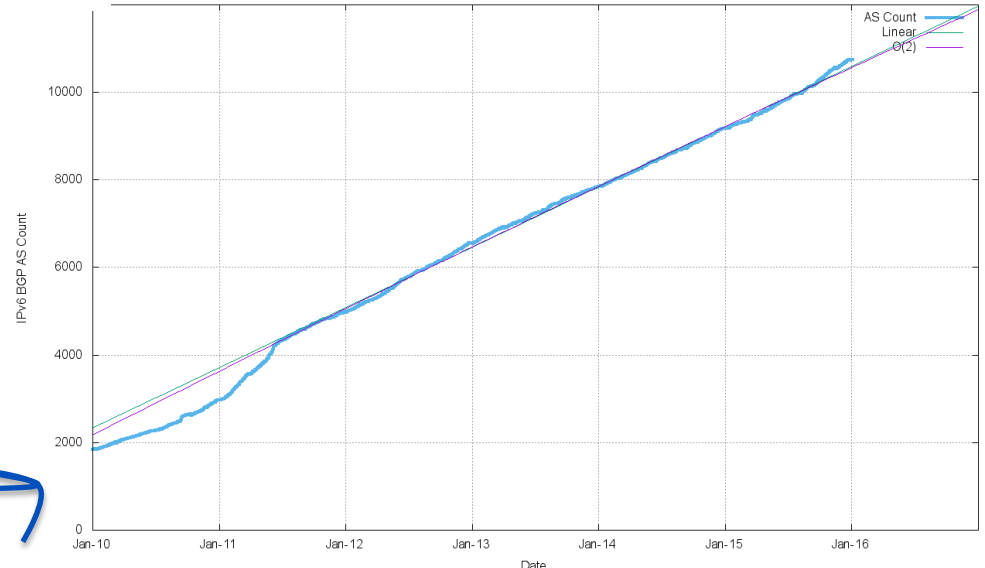
# Routing Indicators for IPv6



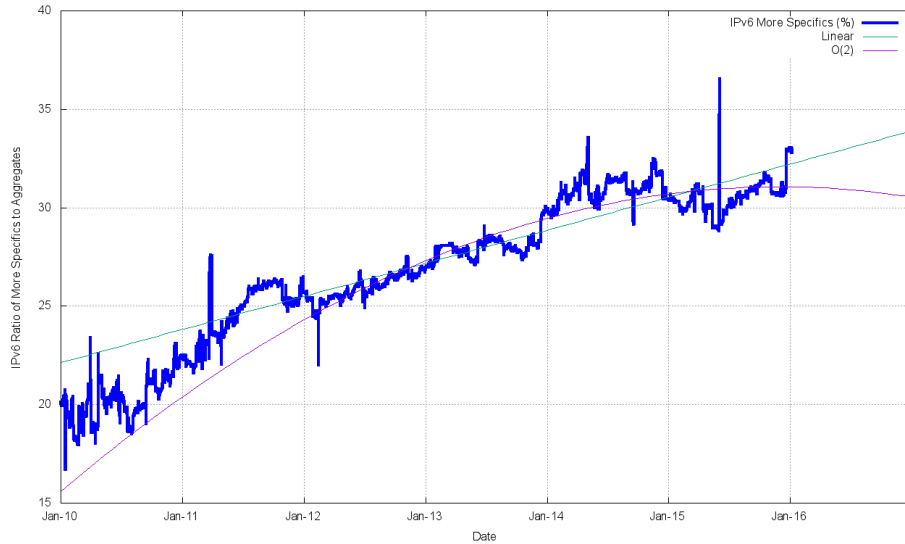
Routing prefixes - growing by some 6,000 prefixes per year



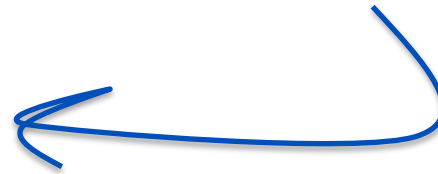
AS Numbers - growing by some 1,600 prefixes per year



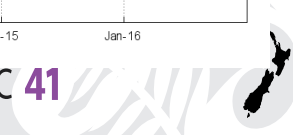
# Routing Indicators for IPv6



More Specifics now take up one third of the routing table



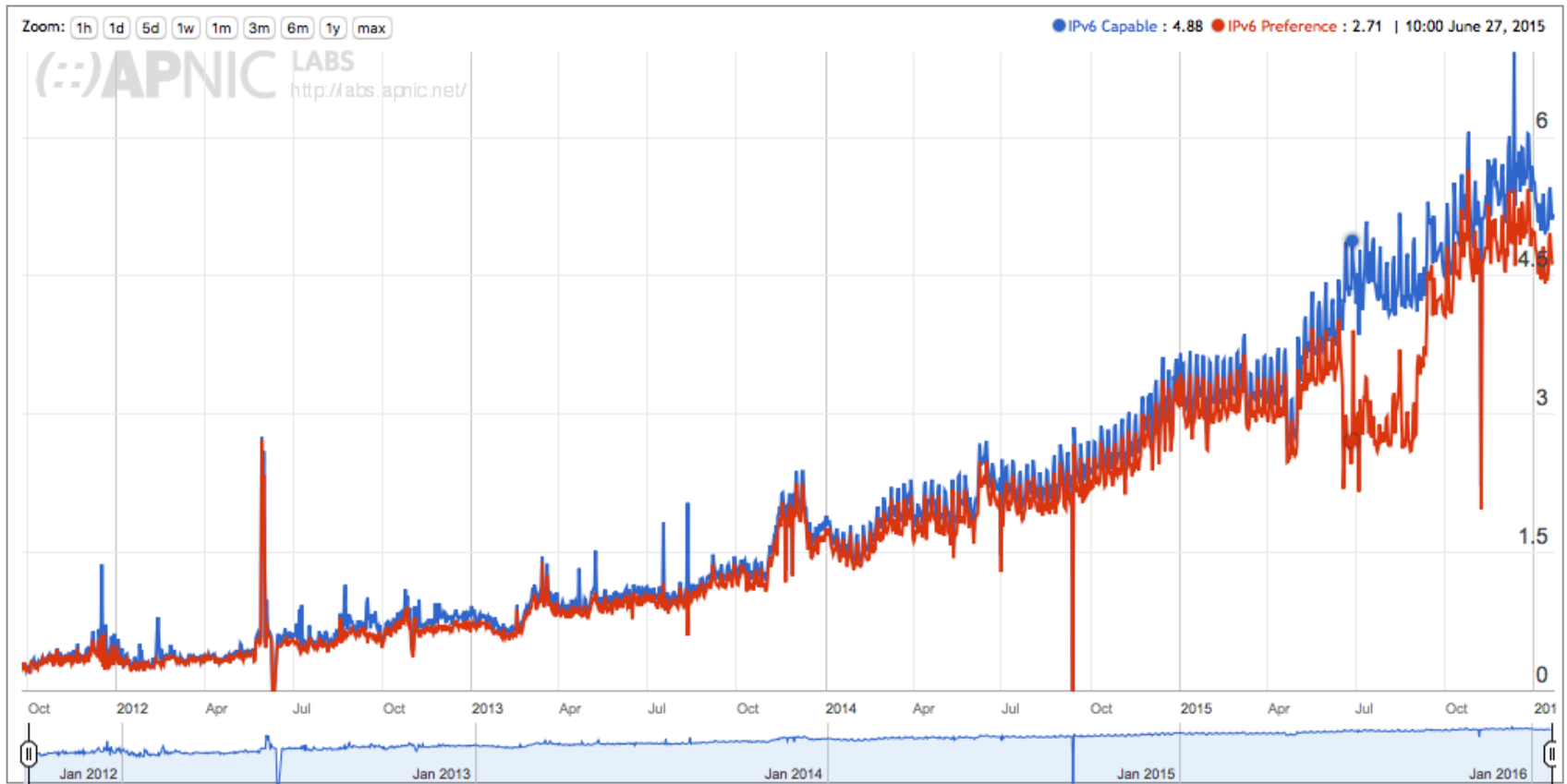
The average size of a routing advertisement is getting smaller



Are we all now using V6?



# IPv6: How Many Can?

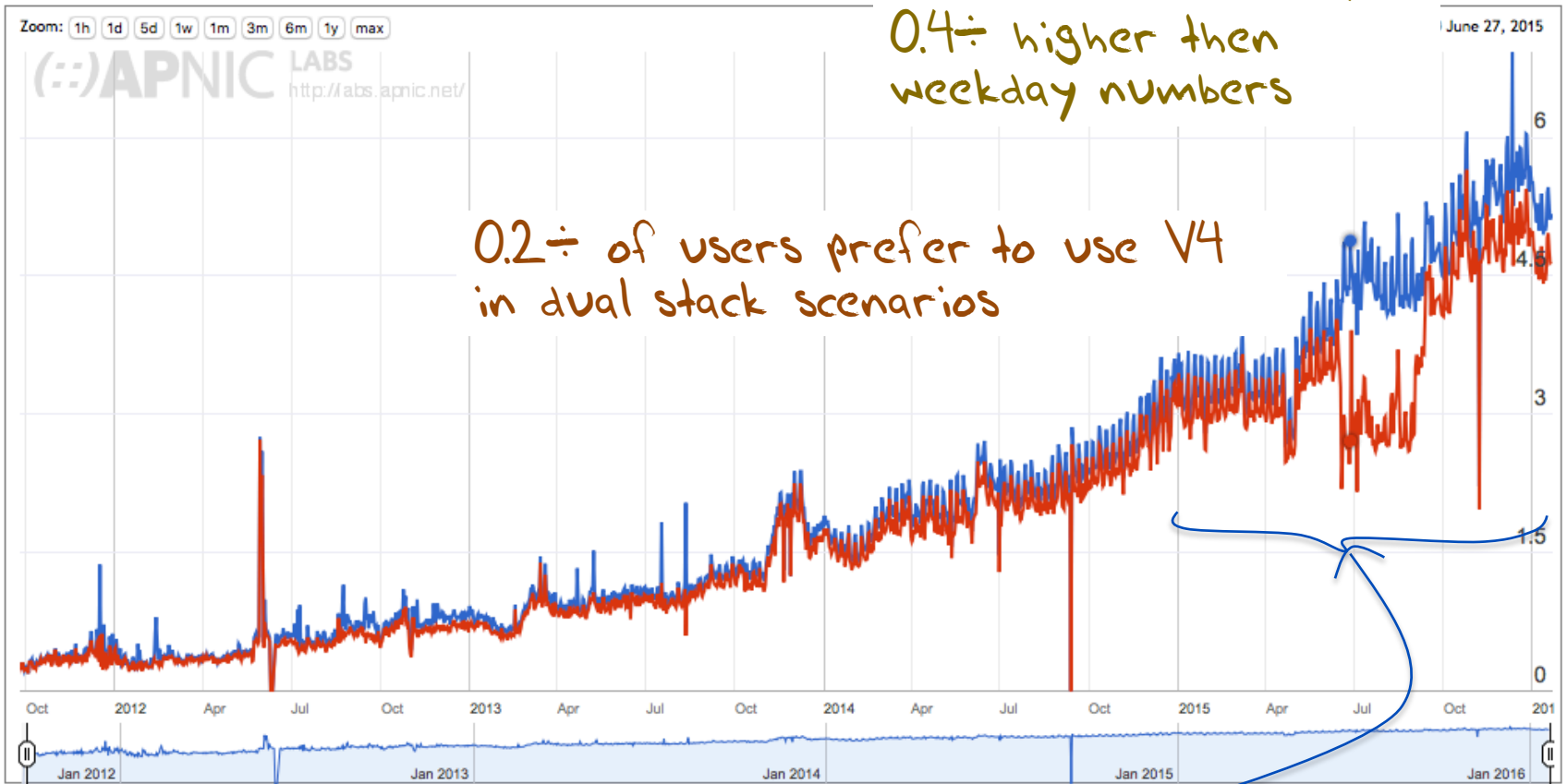




# IPv6: How Many Can?

Weekend numbers are 0.4x higher than weekday numbers

0.2x of users prefer to use V4 in dual stack scenarios

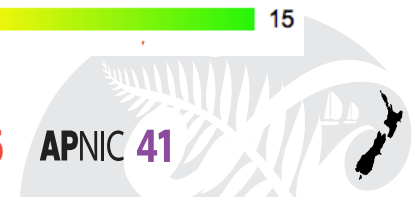
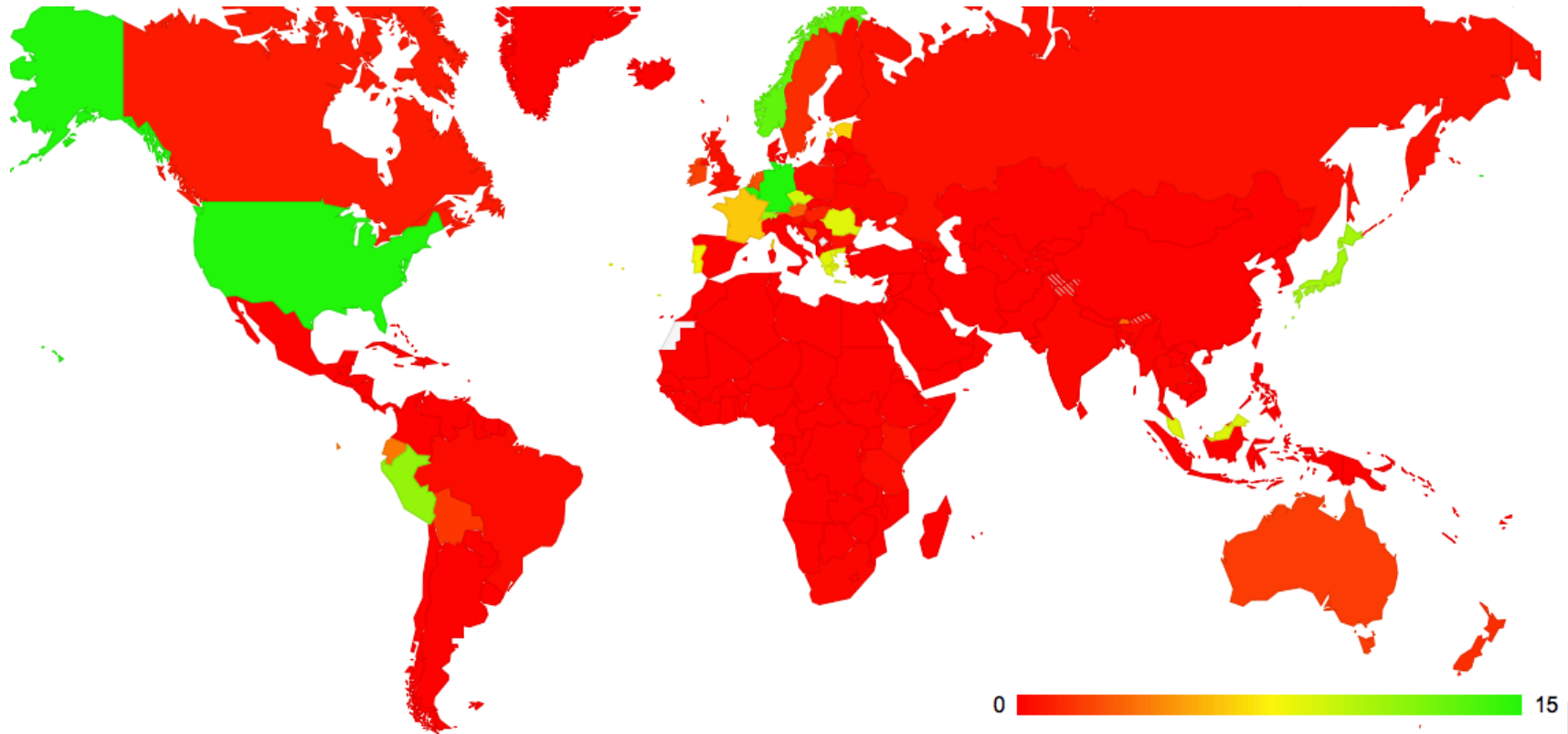


IPv6 use has doubled across 2015



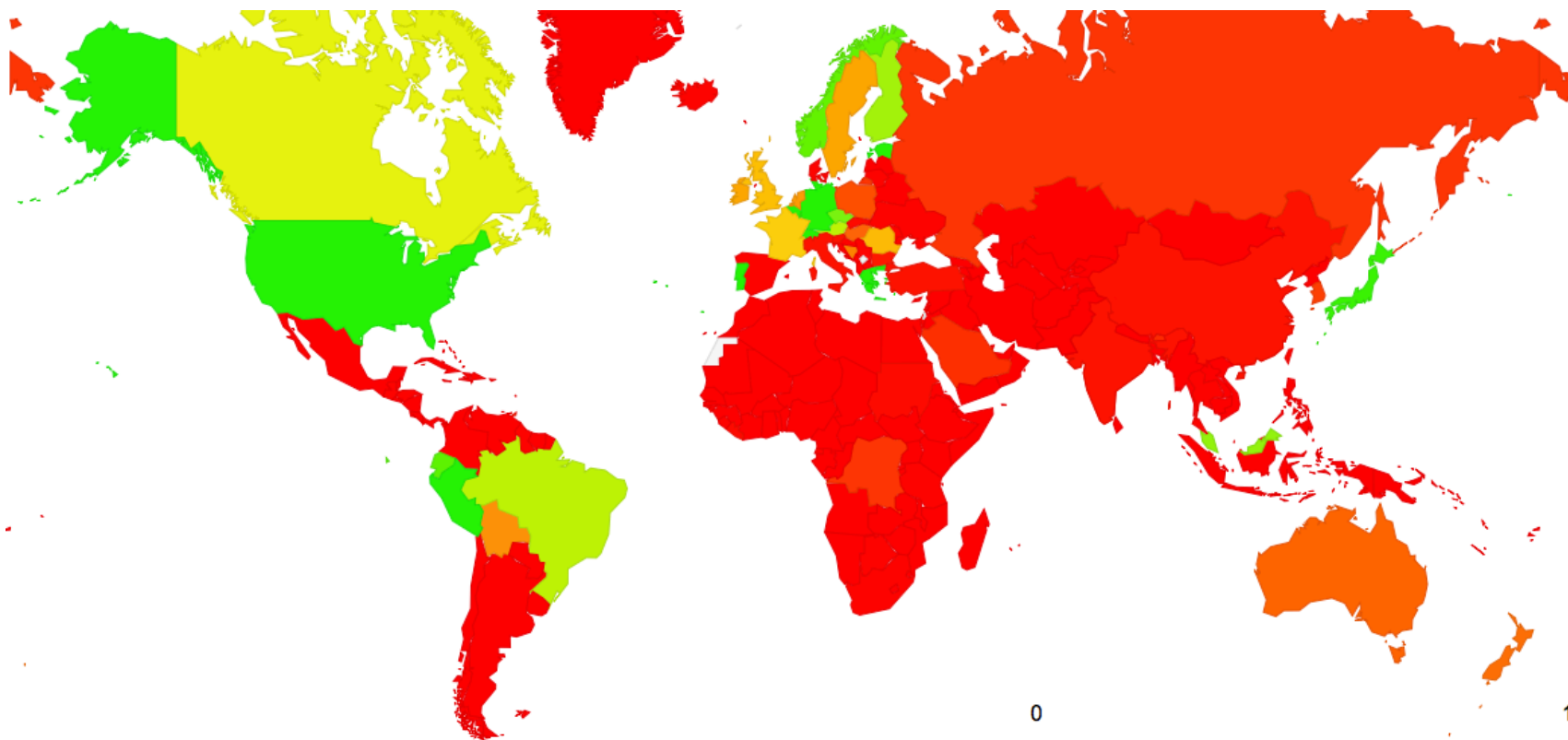
# IPv6: Who Could?

IPv6 use by Country – February 2015



# IPv6: Who Can?

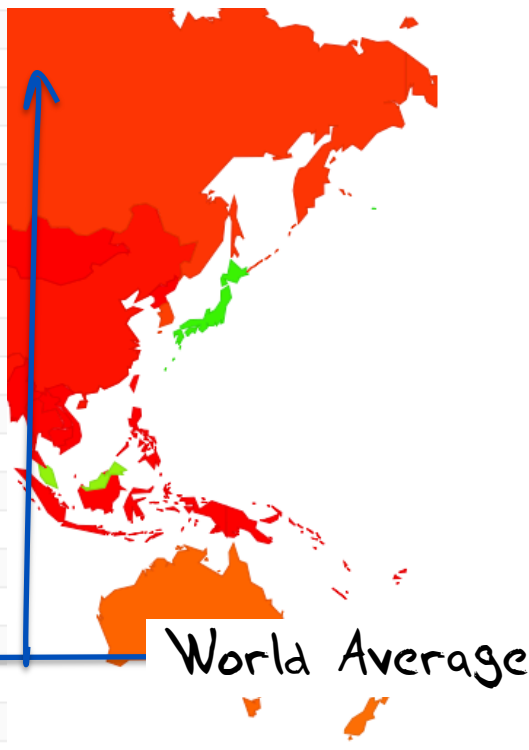
IPv6 use by Country – January 2016



# IPv6: Who Can?

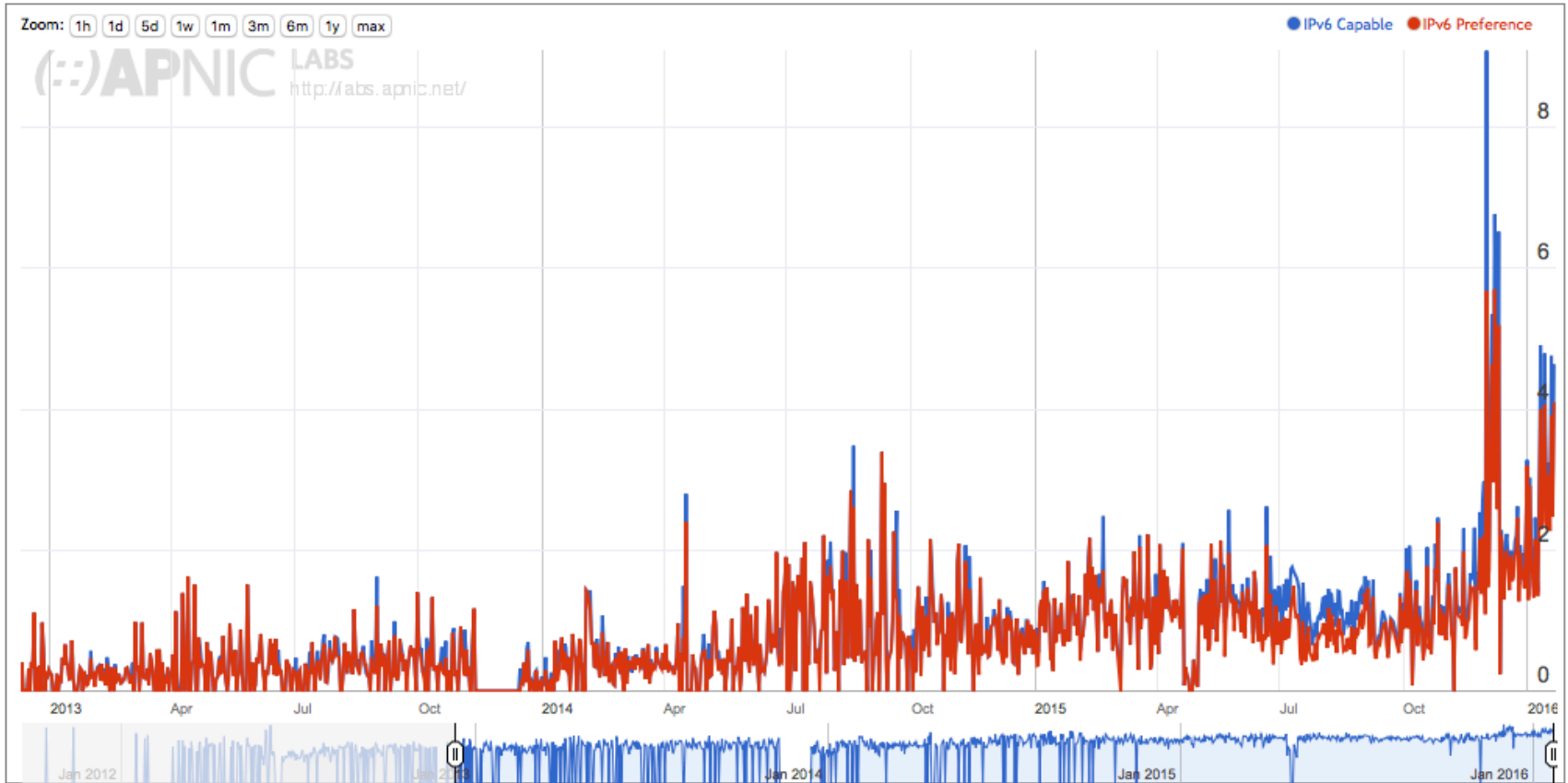
IPv6

CC	Country	IPv6 Capable
BE	Belgium, Western Europe, Europe	49.82%
CH	Switzerland, Western Europe, Europe	30.16%
US	United States of America, Northern America, Americas	29.80%
DE	Germany, Western Europe, Europe	28.74%
PT	Portugal, Southern Europe, Europe	26.01%
GR	Greece, Southern Europe, Europe	21.73%
LU	Luxembourg, Western Europe, Europe	19.51%
PE	Peru, South America, Americas	17.92%
EE	Estonia, Northern Europe, Europe	17.00%
JP	Japan, Eastern Asia, Asia	15.70%
CZ	Czech Republic, Eastern Europe, Europe	11.59%
MY	Malaysia, South-Eastern Asia, Asia	11.53%
NO	Norway, Northern Europe, Europe	10.73%
EC	Ecuador, South America, Americas	10.23%
LR	Liberia, Western Africa, Africa	9.86%
FI	Finland, Northern Europe, Europe	9.11%
SG	Singapore, South-Eastern Asia, Asia	8.75%
CA	Canada, Northern America, Americas	8.29%
BR	Brazil, South America, Americas	8.14%
AT	Austria, Western Europe, Europe	7.89%
FR	France, Western Europe, Europe	7.25%
RO	Romania, Eastern Europe, Europe	6.39%
NL	Netherlands, Western Europe, Europe	5.25%
GB	United Kingdom of Great Britain and Northern Ireland, Northern Europe, Europe	5.10%
BO	Bolivia, South America, Americas	4.47%
SE	Sweden, Northern Europe, Europe	4.32%
IE	Ireland, Northern Europe, Europe	3.97%
AU	Australia, Australia and New Zealand, Oceania	3.22%
HU	Hungary, Eastern Europe, Europe	3.07%



World Average

# The Local View: New Zealand



# The Local View: New Zealand

ASN	AS Name	IPv6 Capable	IPv6 Preferred	Samples ▼
AS4771	SPARKNZ Spark New Zealand Trading Ltd.	0.01%	0.00%	362861
AS7657	VODAFONE-NZ-NGN-AS Vodafone NZ Ltd.	0.01%	0.01%	214168
AS9790	CALLPLUS-NZ-AP CallPlus Services Limited	0.01%	0.01%	72670
AS4768	CLIX-NZ TelstraClear Ltd	0.01%	0.00%	55217
AS17746	ORCONINTERNET-NZ-AP Orcon Internet	13.33%	12.40%	50517
AS9500	VODAFONE-TRANSIT-AS Vodafone NZ Ltd.	0.01%	0.00%	33587
AS55850	TRUSTPOWERLTD-AS-AP TrustPower Ltd	1.04%	1.00%	23913
AS23655	SNAP-NZ-AS Snap Internet Limited	53.07%	46.22%	23309
AS38793	NZCOMMS-AS-AP Two Degrees Mobile Limited	0.05%	0.02%	18760
AS58600	FLIP-AS-AP Flip Services Limited	0.01%	0.00%	12634
AS4648	NZIX-2 Global-Gateway Internet	0.13%	0.10%	10697
AS9876	AIRNET-HB-AS-AP NOW	0.03%	0.01%	7103
AS25605	SCANSAFE - Cisco Systems Ironport Division	0.00%	0.00%	4259
AS55853	MEGATEL-AS-AP Megatel	0.00%	0.00%	4146
AS133124	SPARKVENT-AS-AP Spark Ventures	0.03%	0.03%	3971
AS38305	OTAGO-UNIVERSITY-AS-NZ-AP The University of Otago	0.05%	0.05%	3742
AS133878	UNICOM1-AS-AP UNICOM NEW ZEALAND LIMITED	0.00%	0.00%	3710
AS45230	UBERGROUP-AS-NZ UberGroup Limited	0.03%	0.00%	3276
AS58610	TELNET-AS-AP Telnet Telecommunication Limited	0.00%	0.00%	3265
AS9872	ITNET-NZ-AS-AP Actrix Networks Ltd	0.00%	0.00%	3182
AS55872	BAYCITY-AS-AP BayCity Communications Limited	0.03%	0.00%	3015
AS9503	FX-PRIMARY-AS FX Networks Limited	0.72%	0.72%	2931



Thank You

