

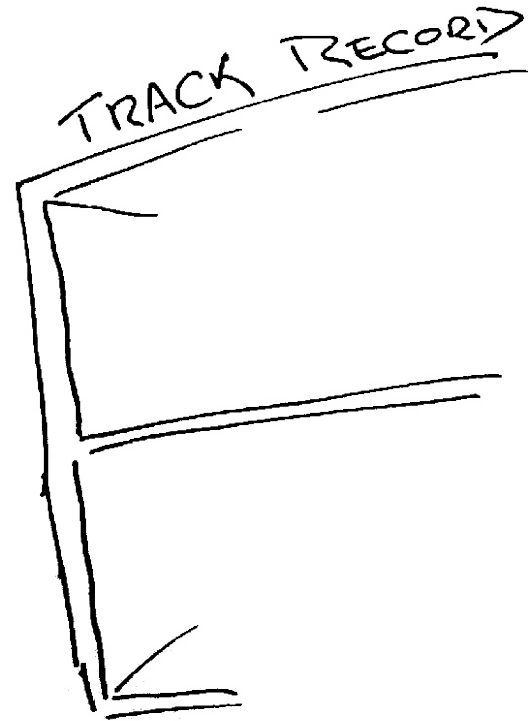
IPv4 Address Exhaustion: A Progress Report

Geoff Huston

Chief Scientist

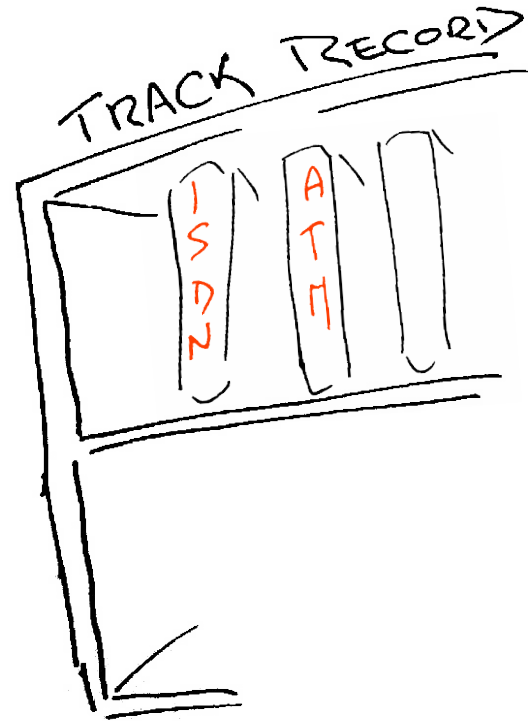
APNIC

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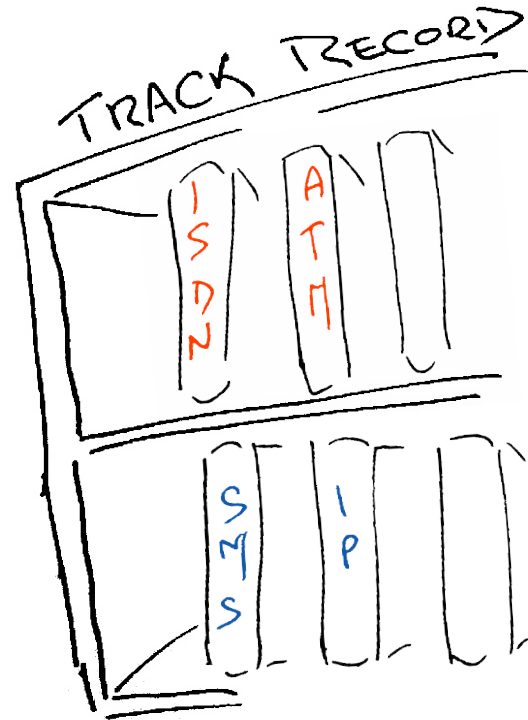
...of making very poor
technology choices



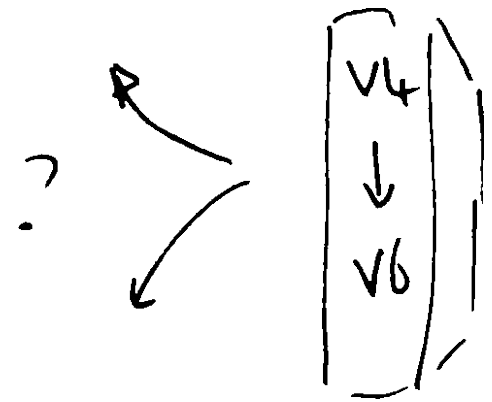
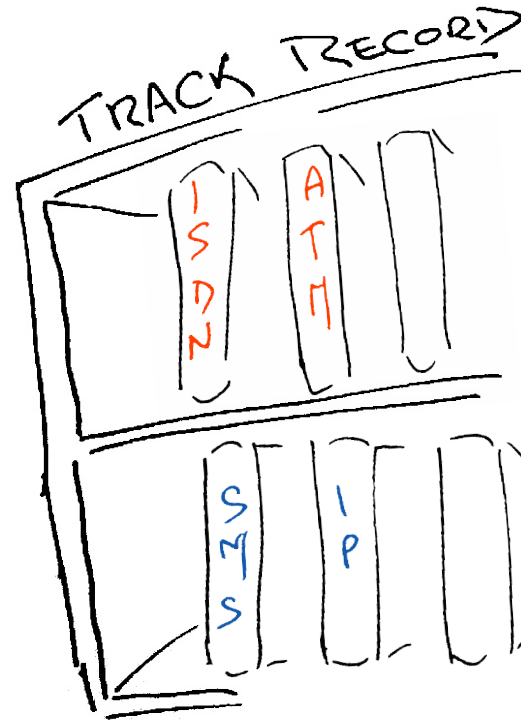
The mainstream
telecommunications
industry has a
rich history

...of making very poor
technology guesses

and regularly being
taken by
surprise!



So, how are we going with the IPv4 to IPv6 transition?



Do we really need to worry about
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Surely IPv6 will just happen — its just a matter of waiting for the pressure of IPv4 address exhaustion to get to sufficient levels of intensity.

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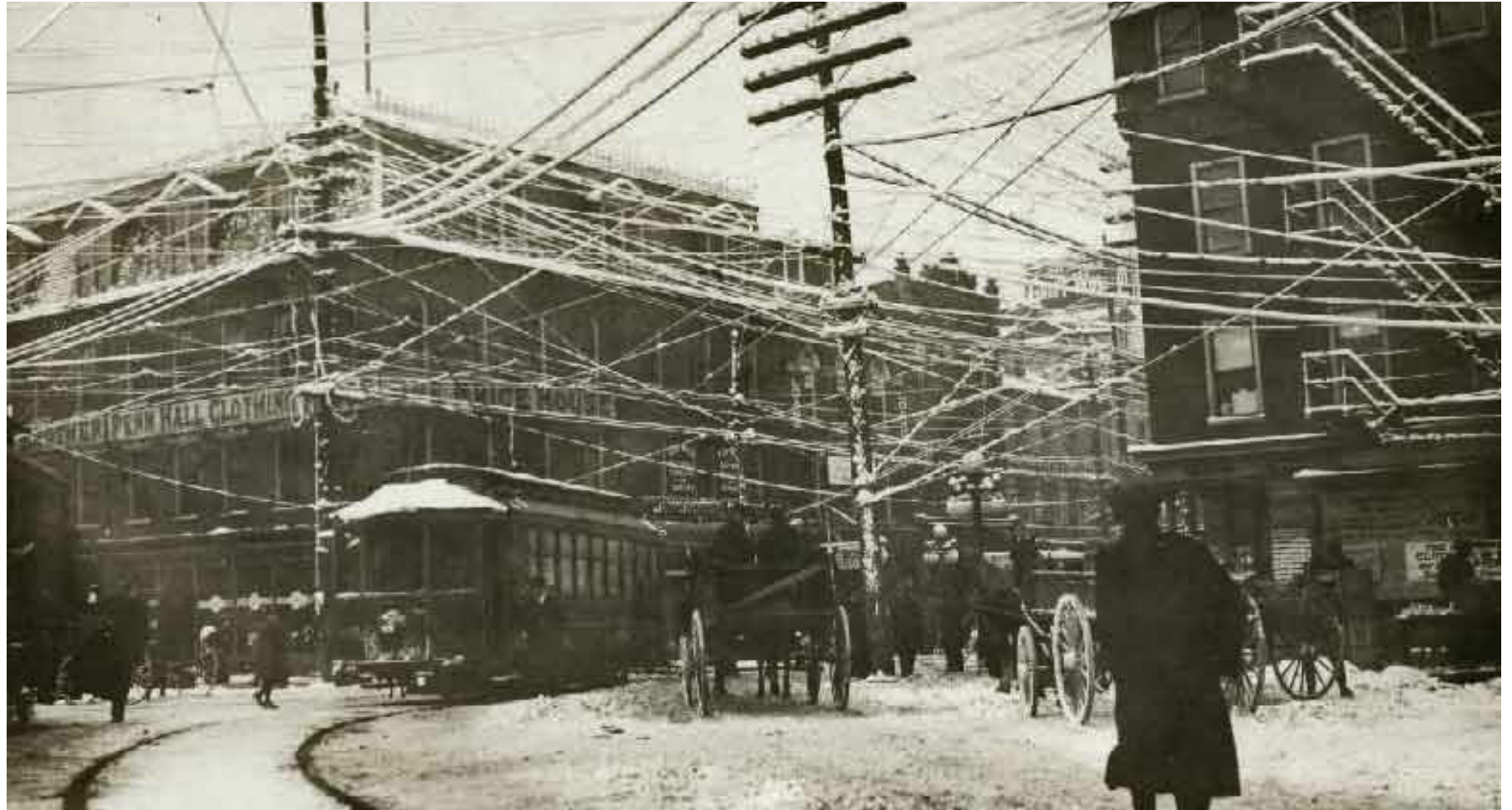
Surely IPv6 will just happen — its just a matter of waiting for the pressure of IPv4 address exhaustion to get to sufficient levels of intensity.

Or maybe not — let's look a bit closer at the situation

The
"inevitability"
of technological
evolution

wires





The
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wires



Well what did you expect? They are VIRTUAL circuits, so a picture was always going to be a challenge!

The
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The "inevitability" of technological evolution

Now lets look at something a little
more topical to today!

The
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IPv4

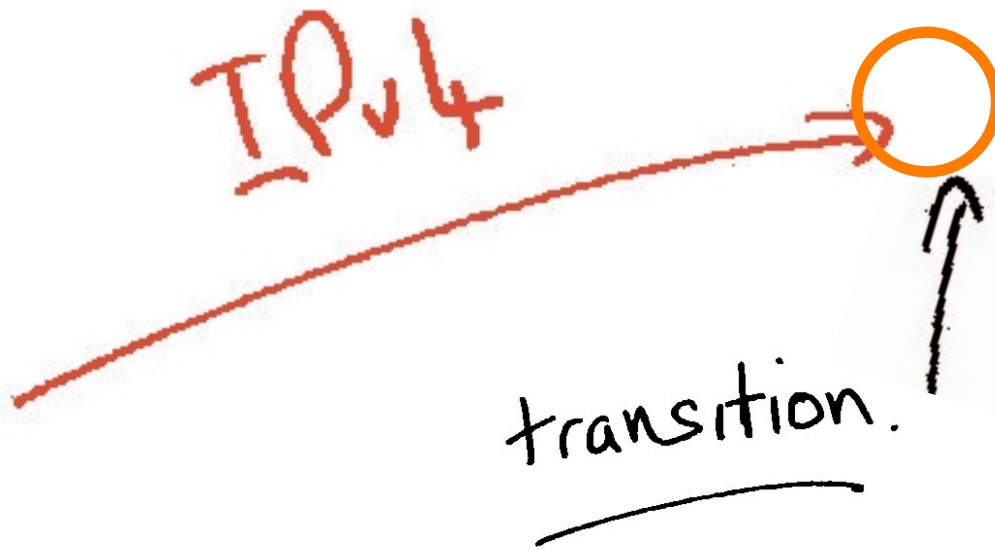


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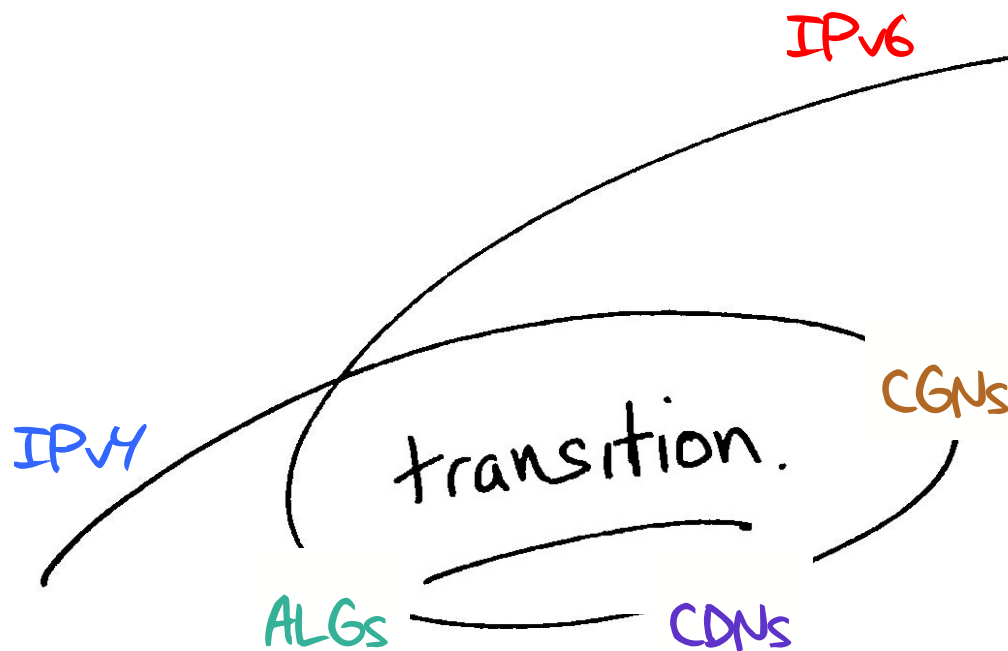


The challenge often
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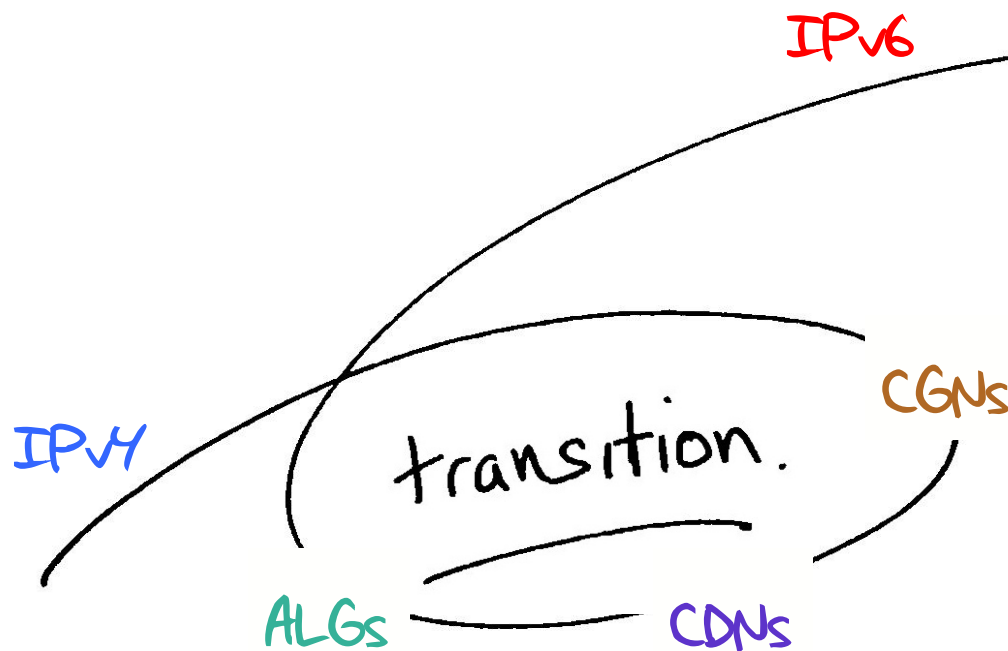
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To get from "here" to "there" requires an excursion through an environment of CGNs, CDNs, ALGs and similar middleware 'solutions' to IPv4 address exhaustion



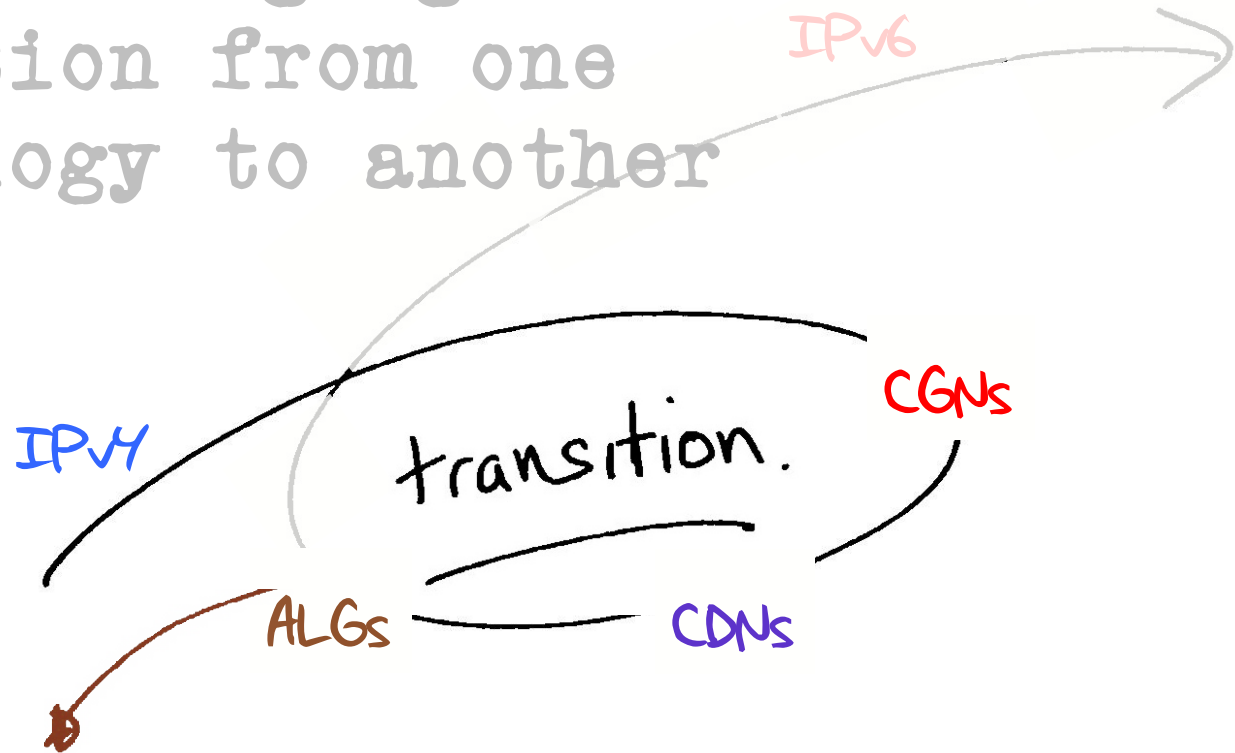
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Transition requires the network owner to undertake capital investment in network service infrastructure. What lengths will the network owner then go to to protect the value of this additional investment by locking itself into this "transitional" service model for an extended/indefinite period?

The challenge often lies in managing the transition from one technology to another



The risk in this transition phase is that the Internet heads off in a completely different direction!

How can we "manage" this
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To ensure that the industry maintains a collective focus on IPv6 as the objective of this exercise!

And to ensure that we do not get distracted by attempting to optimize what were intended to be temporary measures

Challenges:

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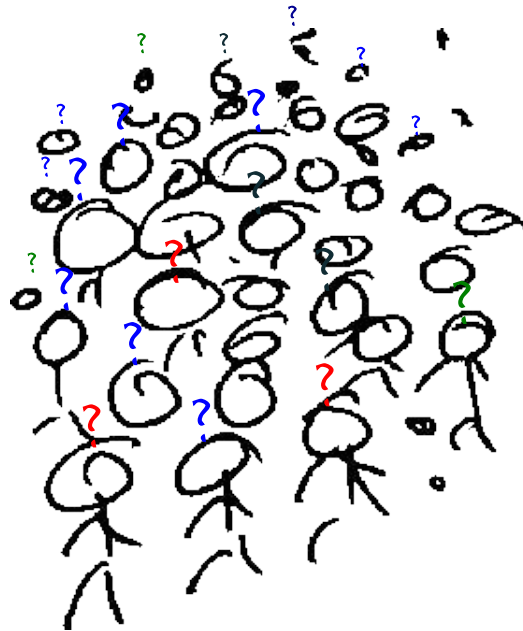
It is NOT a case of a single
"either/or" decision



Challenges:

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There are many different players
Each with their own perspective



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And all potential approaches will be explored!

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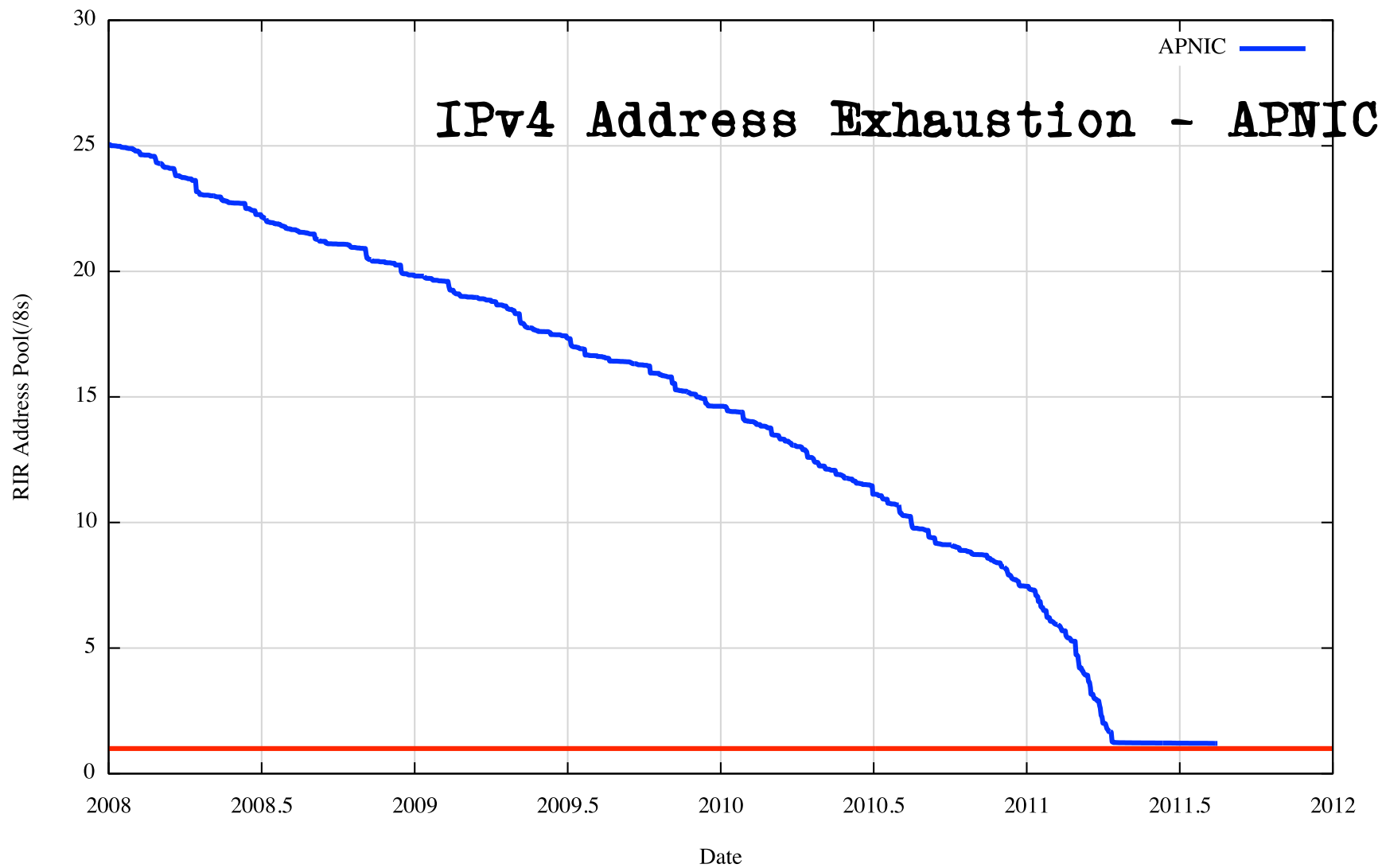
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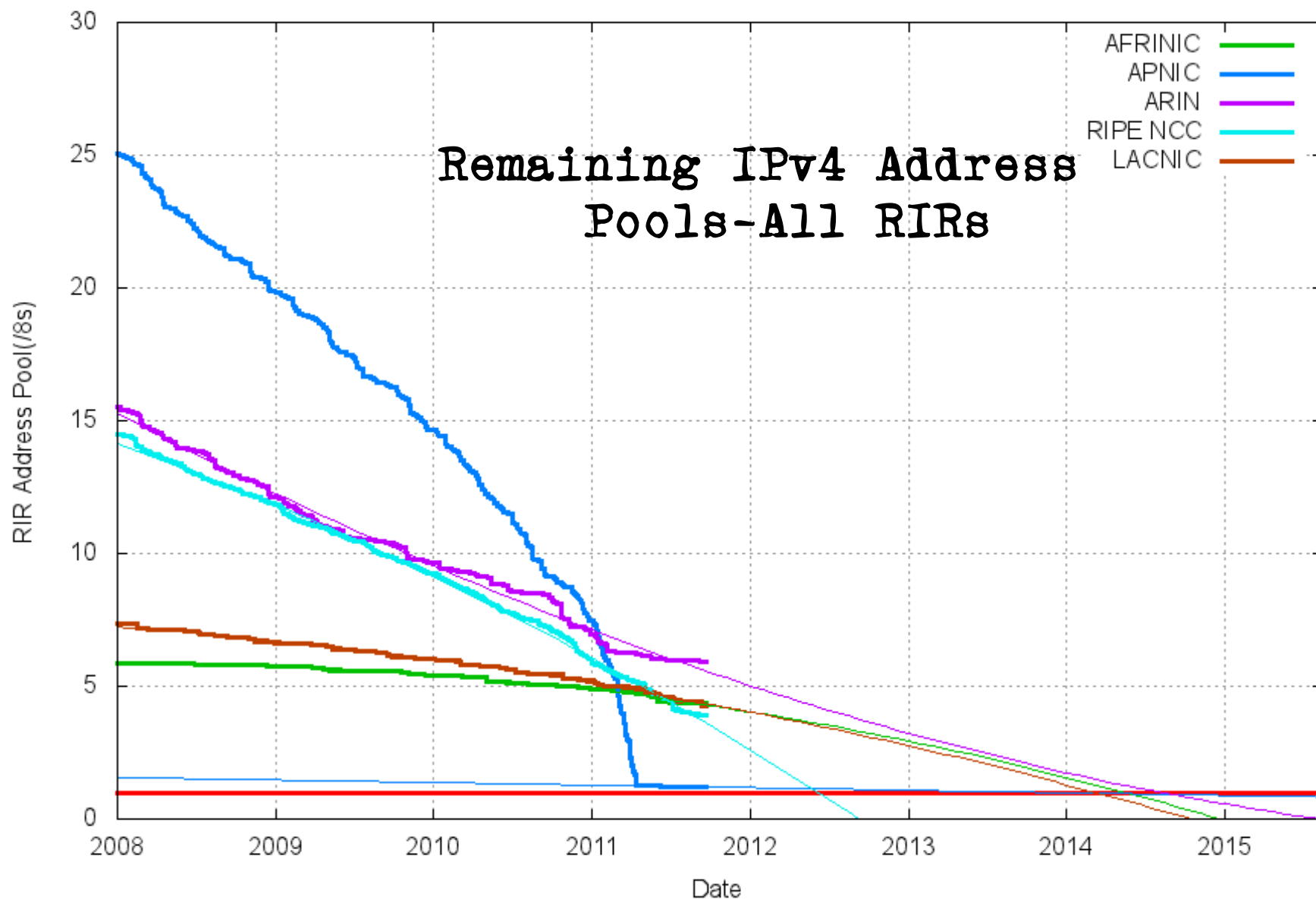
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2. Varying IPv4 Address Exhaustion Timelines

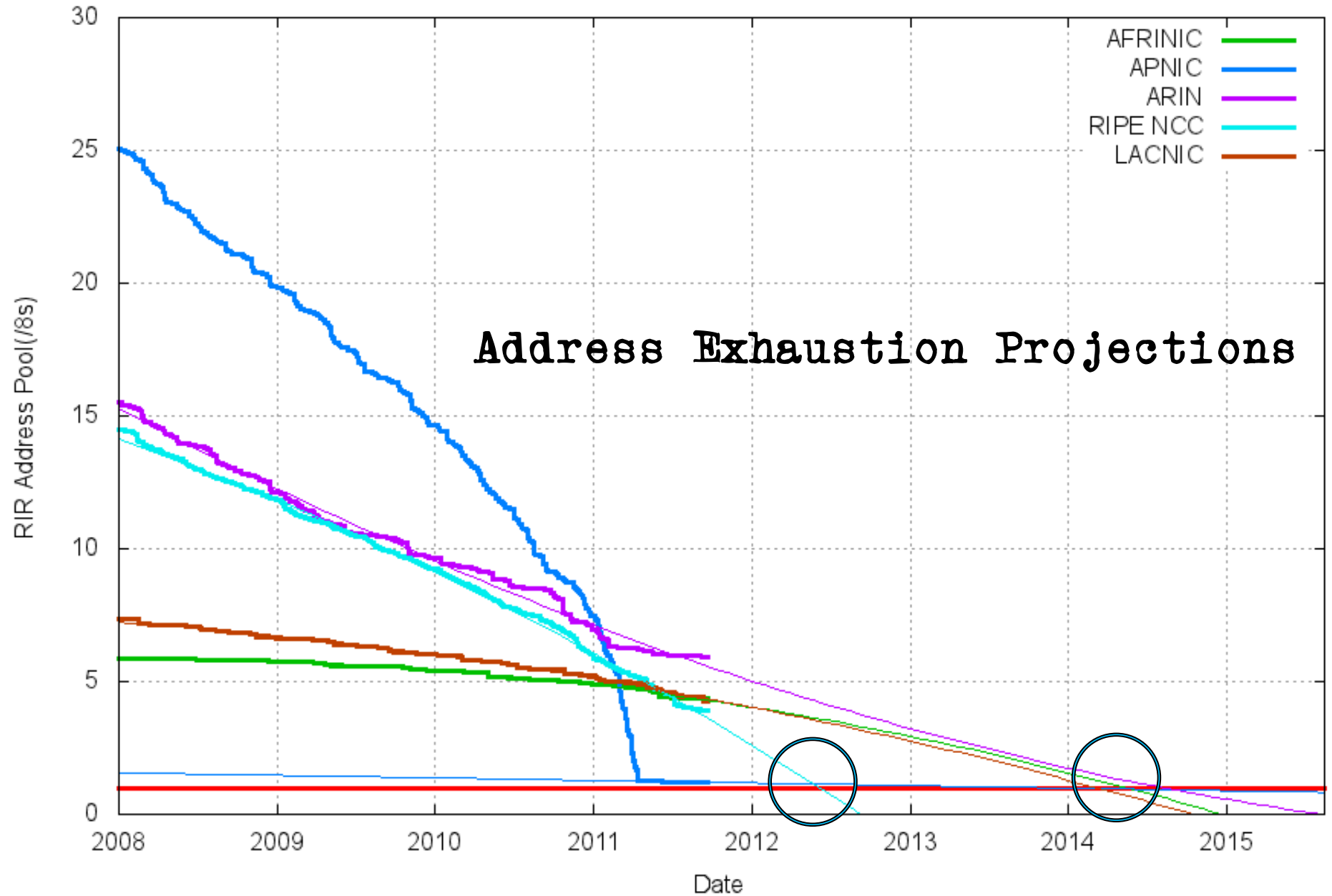
RIR IPv4 Address Run-Down Model



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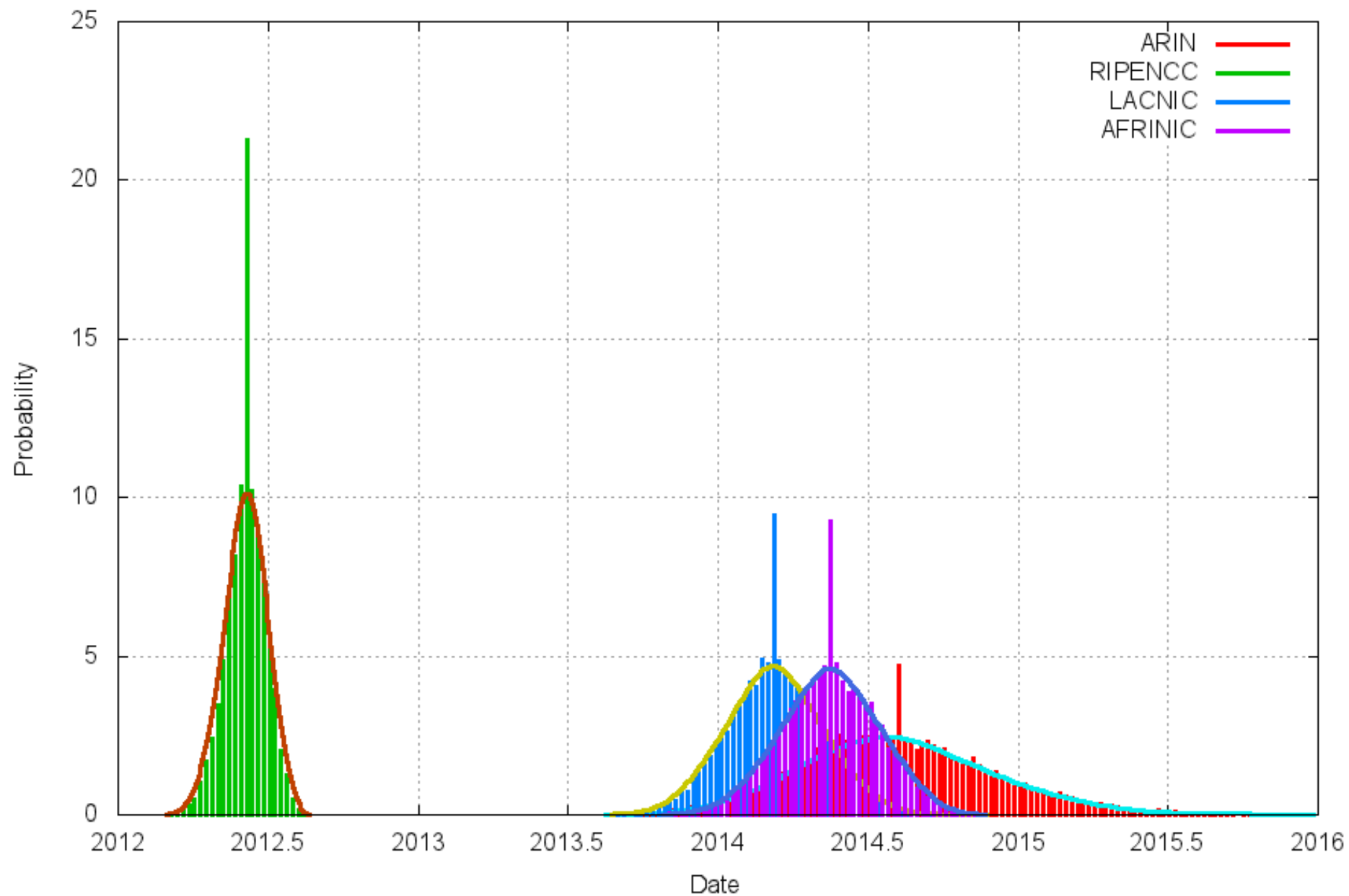


Exhaustion Predictions

RIR	Predicted Exhaustion Date *	Remaining Address Pool (20 Sep 2011)
APNIC	19 April 2011 (actual)	1.20 /8s (0.3 /8s rsvd)
RIPE NCC	4 June 2012	3.91 /8s
LACNIC	8 March 2014	4.27 /8s
AFRINIC	16 May 2014	4.38 /8s
ARIN	8 Aug 2014	5.91 /8s

** Here “exhaustion” is defined as the point when the RIR’s remaining pool falls to 1 /8*

RIR IPv4 Address Run-Down Model - Variance Analysis



Reality Acceptance

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Or not

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Is IPv4 address exhaustion a "here and now" problem or a "some time in the future" problem?

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Is IPv4 address exhaustion a "here and now" problem or a "some time in the future" problem?

It's not happening until its happening to me!

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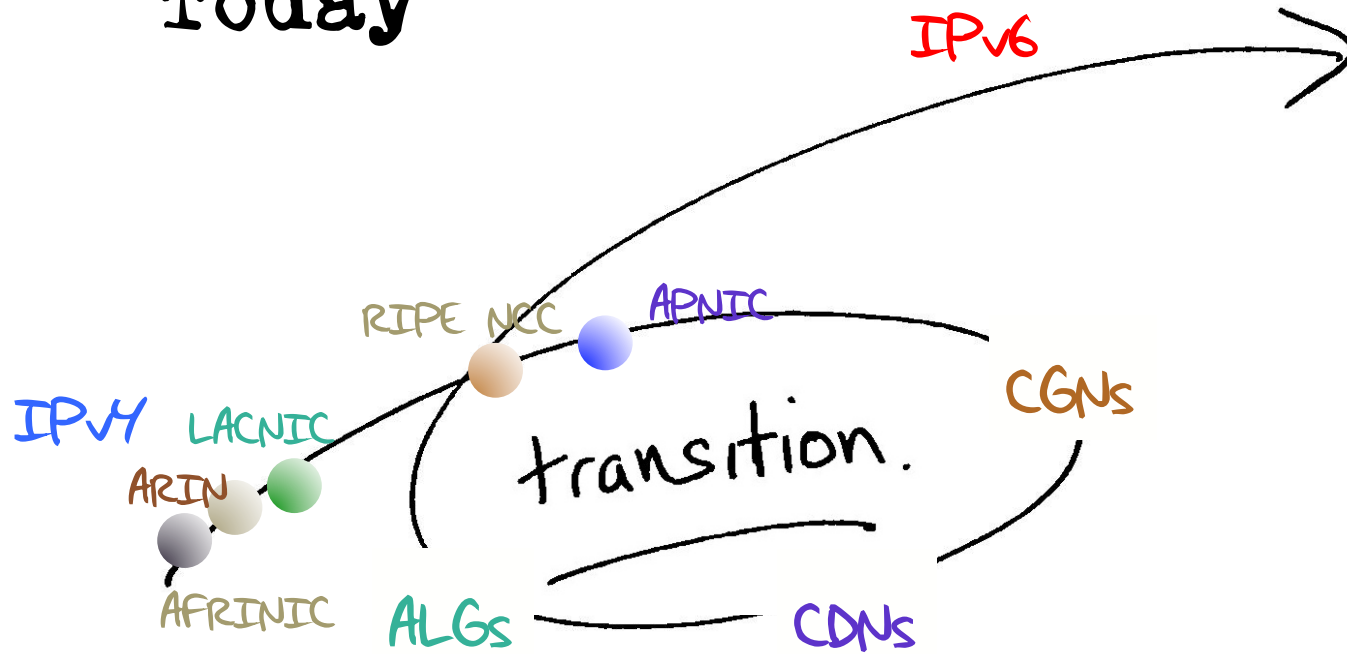
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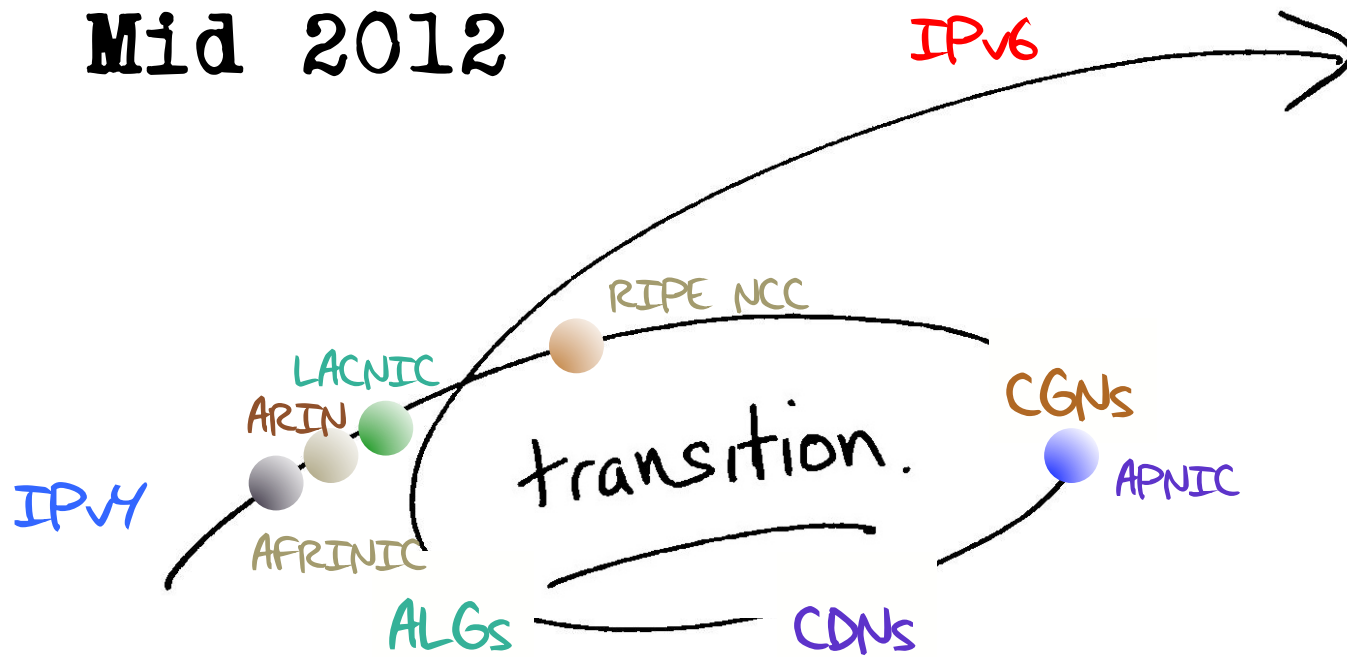
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3. Regional Diversity

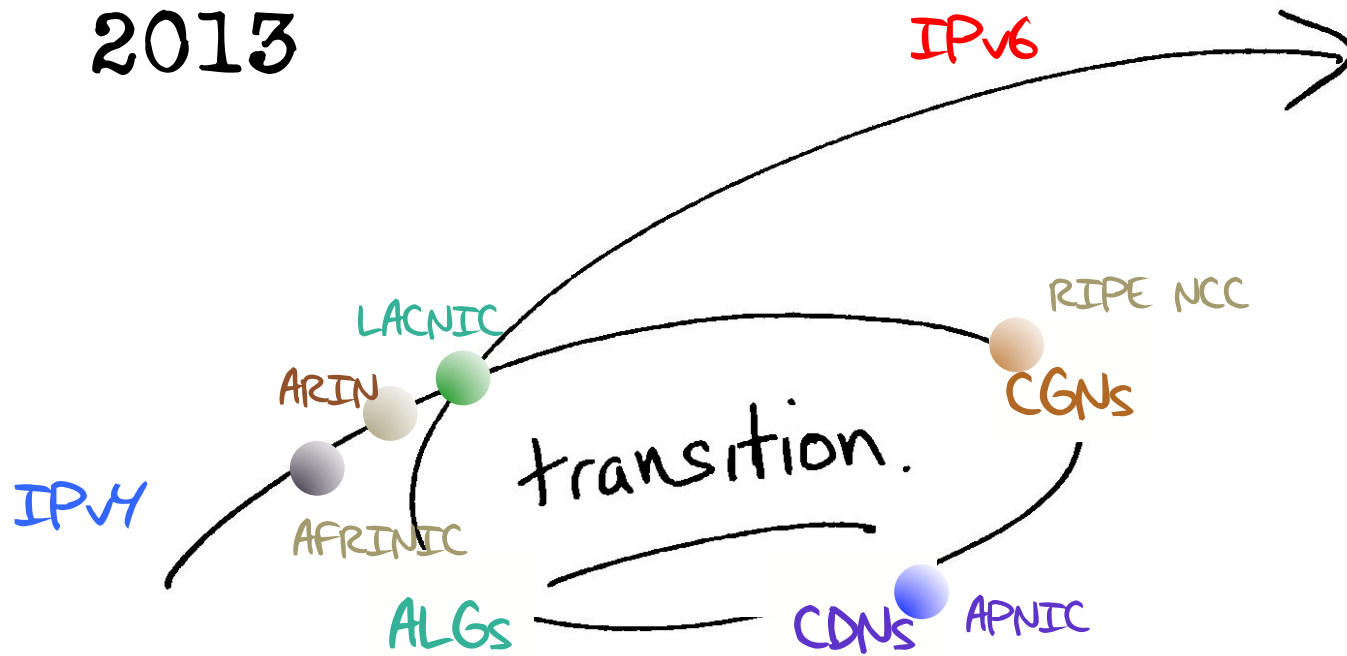
Today



Mid 2012



2013



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What's the level of risk that the differing environments of transition lead to significantly different outcomes in each region?

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Will we continue to maintain coherency of a single Internet through this transition?

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The Myth of the Long Term Plan

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5 years, maybe 10 years, maybe longer"

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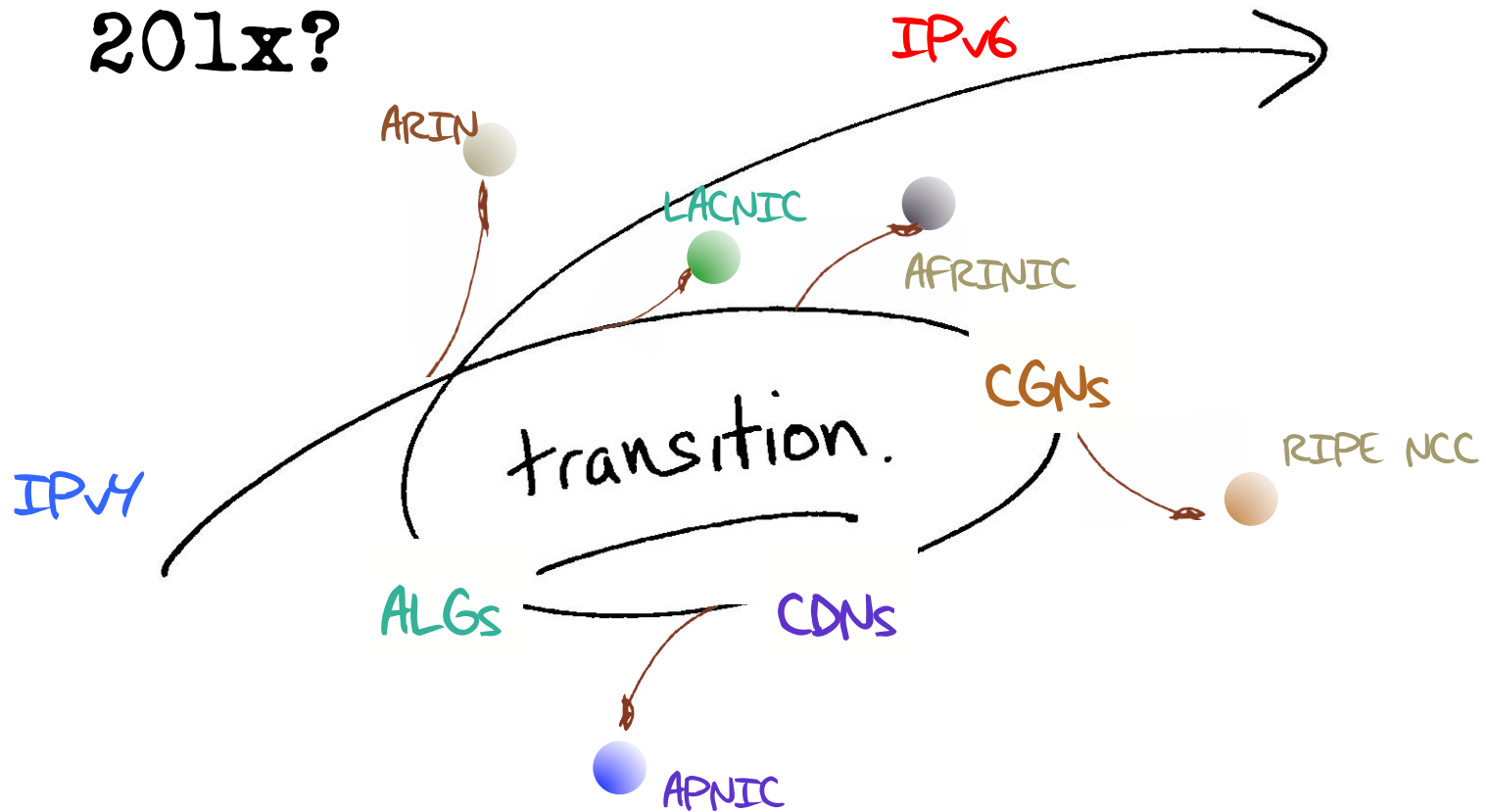
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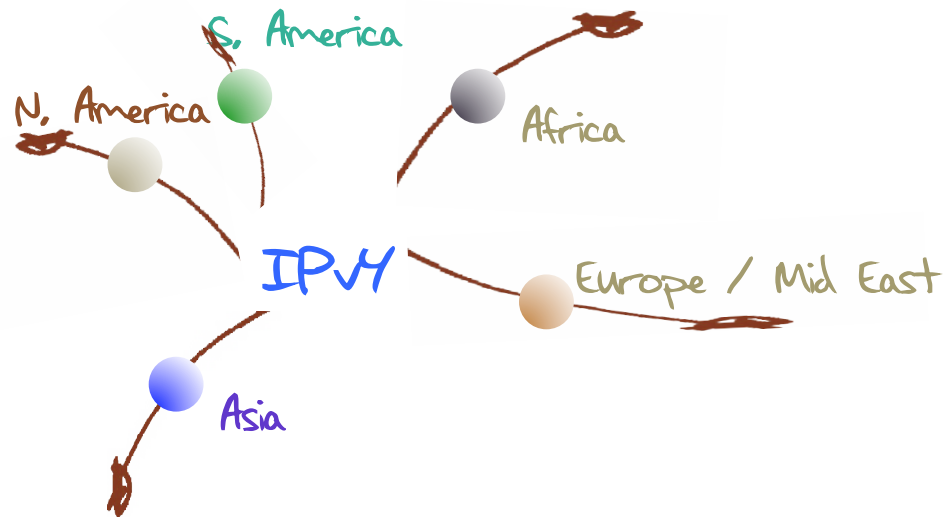
Are we still committed to the plans we had 5 years ago? How about our 10 year old plans?

The longer the period of transition, the higher the risk of completely losing the plot and heading into other directions!

201x?



20xx?



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One network is not an assured outcome!

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3. Regional Diversity

One network is not an assured outcome: Market pressures during an extended transition may push the Internet along different paths in each region

Can we help the Internet
through this transition?

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through this transition?

Or at least, how can we avoid making it any
worse than it is now?

Three thoughts...



Firstly

If we want one working Internet at the end of all this, then keep an eye on the larger picture

Think about what is our common interest here

and try to find ways for local interests to converge with common interests

Secondly

Addresses should be used in working networks, not hoarded

Scarcity generates pain and uncertainty

Hoarding exacerbates scarcity in both its intensity and duration

Extended scarcity prolongs the pain and increases the unpredictability of the entire transition process

Finally...

Bring it on! A rapid onset of exhaustion and a rapid transition represents the best chance of achieving an IPv6 network as an outcome

The more time we spend investing time, money and effort in deploying IPv4 address extension mechanisms, the higher the risk that we will lose track of the intended temporary nature of transition and forget about IPv6!

If we are truly committed to achieving a single and coherent IPv6 Internet as an outcome of this transition then traditional industry reactions of conservatism and caution are probably not going to help us get there!

If IPv6 is what we are after as an open and accessible platform for further network growth and innovation then it may be better to deliberately compress the timelines for transition, not extend them!

Thank You!