IPv4 Address Exhaustion: A Progress Report

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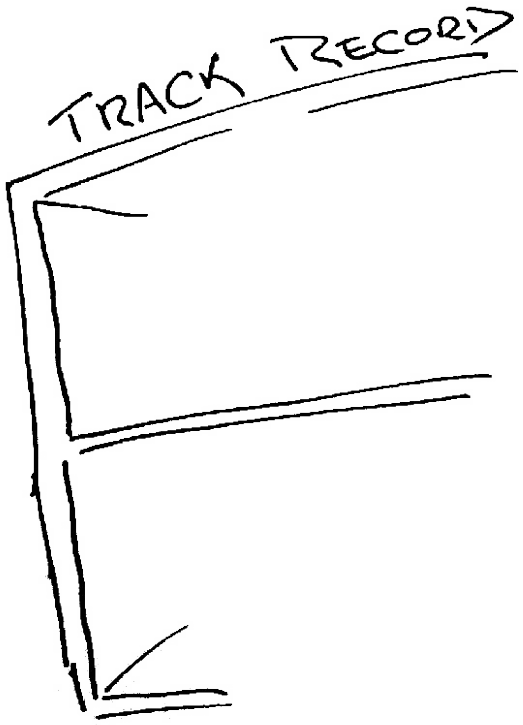
The mainstream telecommunications industry has a rich history



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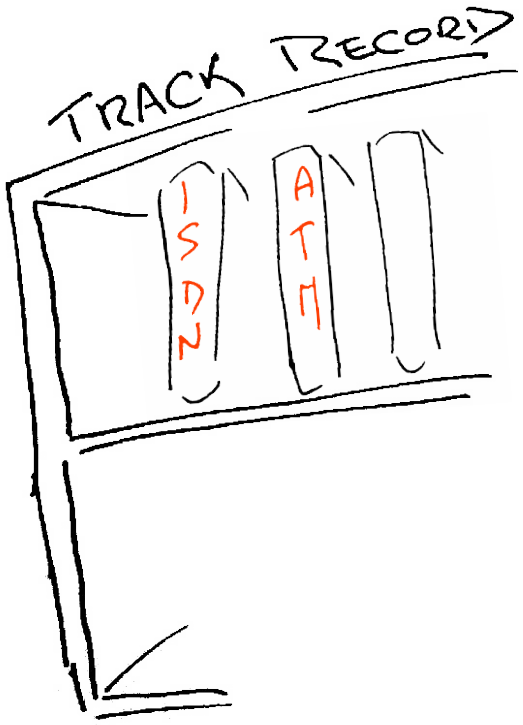
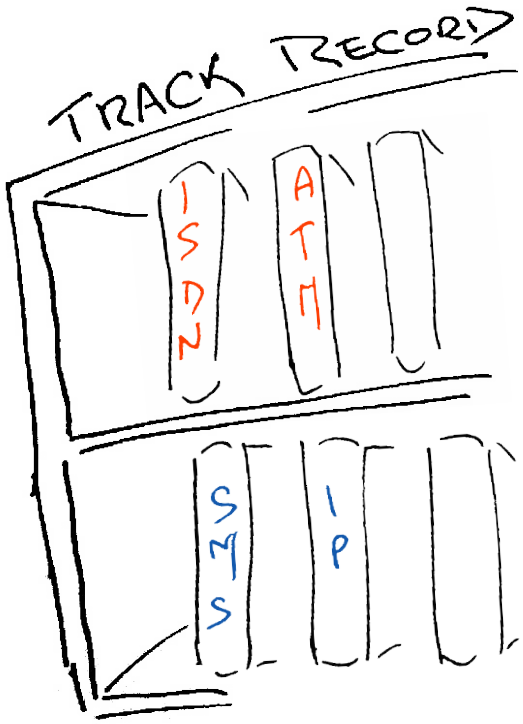
…of making very poor technology choices



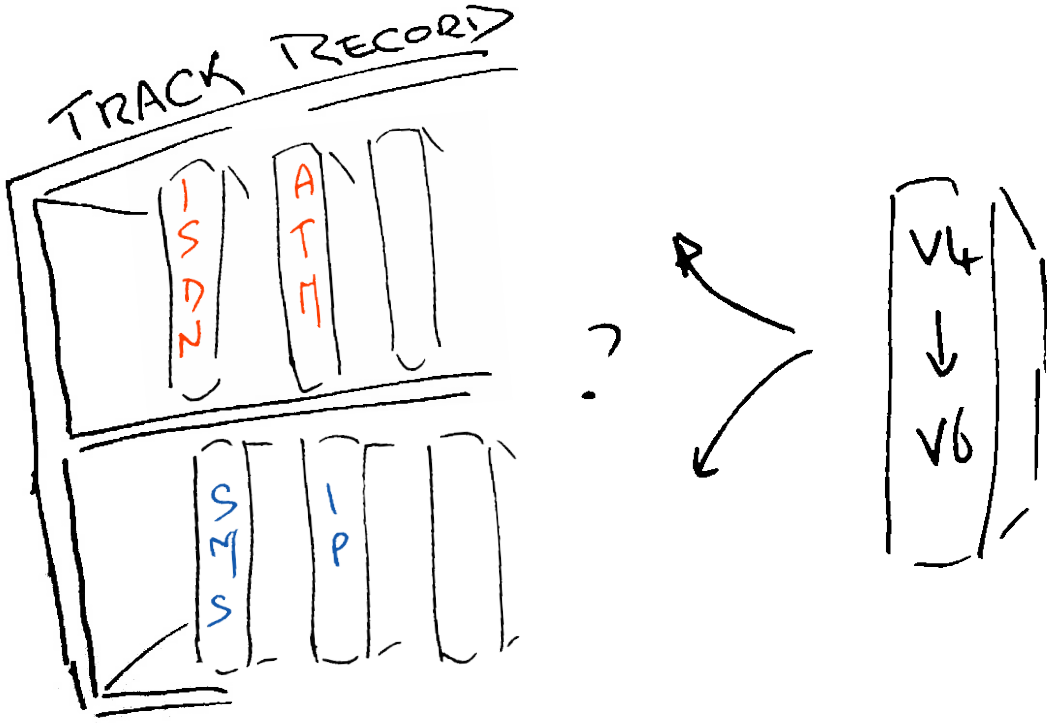
The mainstream telecommunications industry has a rich history

…of making very poor technology guesses

and regularly being taken by surprise!



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



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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
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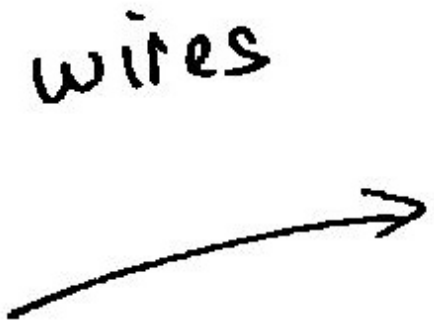
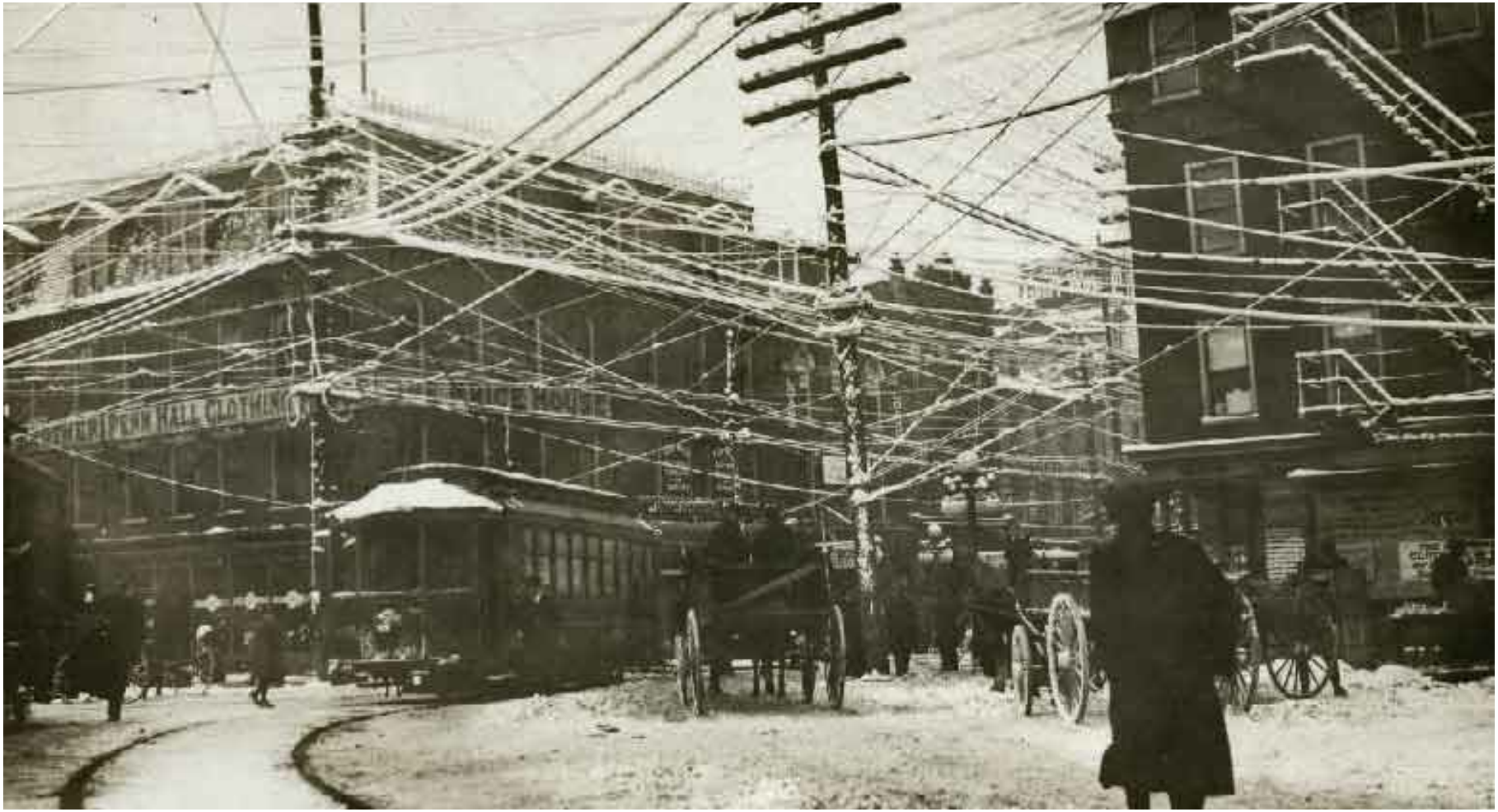
of technological
evolution





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

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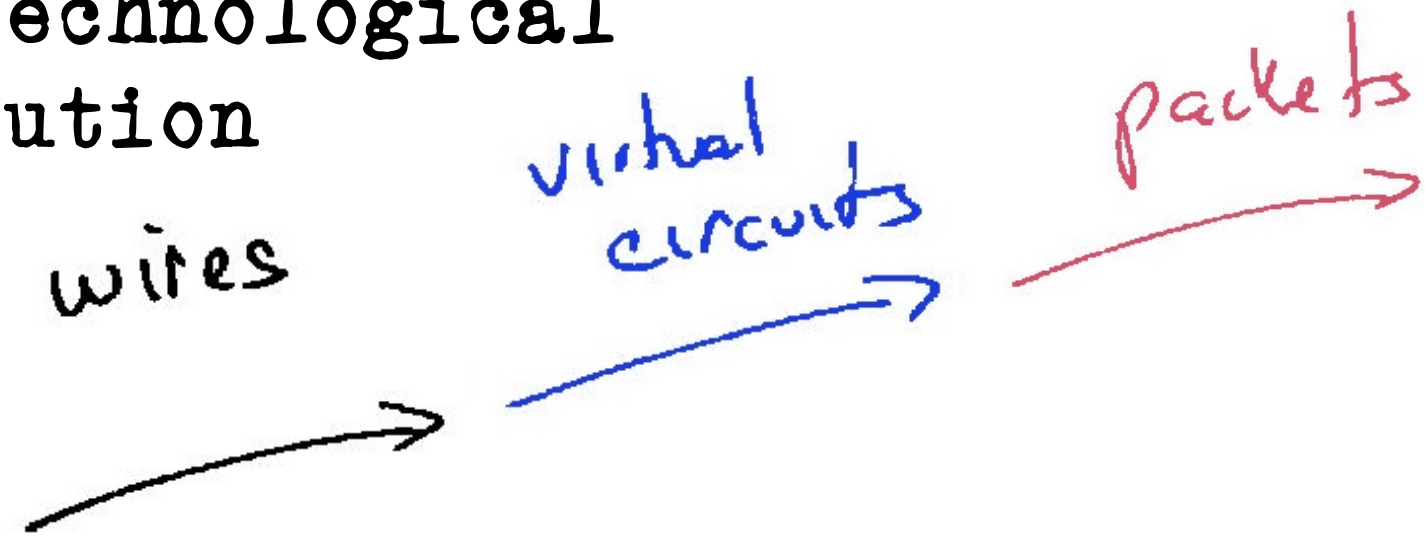

The "inevitability" of technological evolution

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

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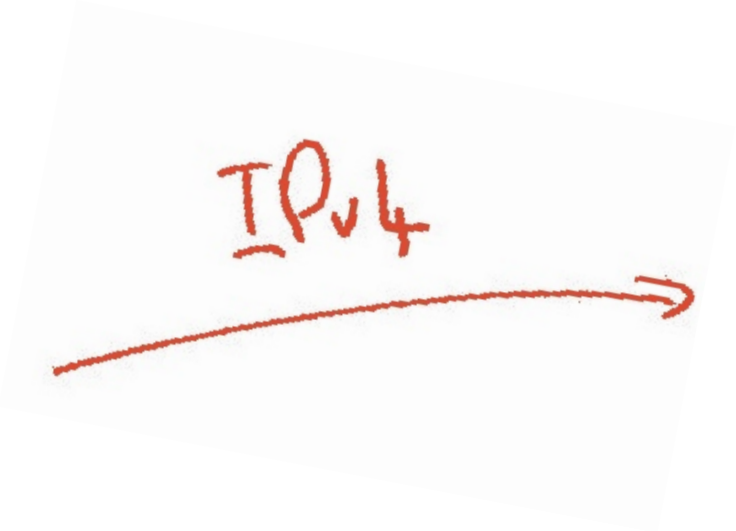
evolution?



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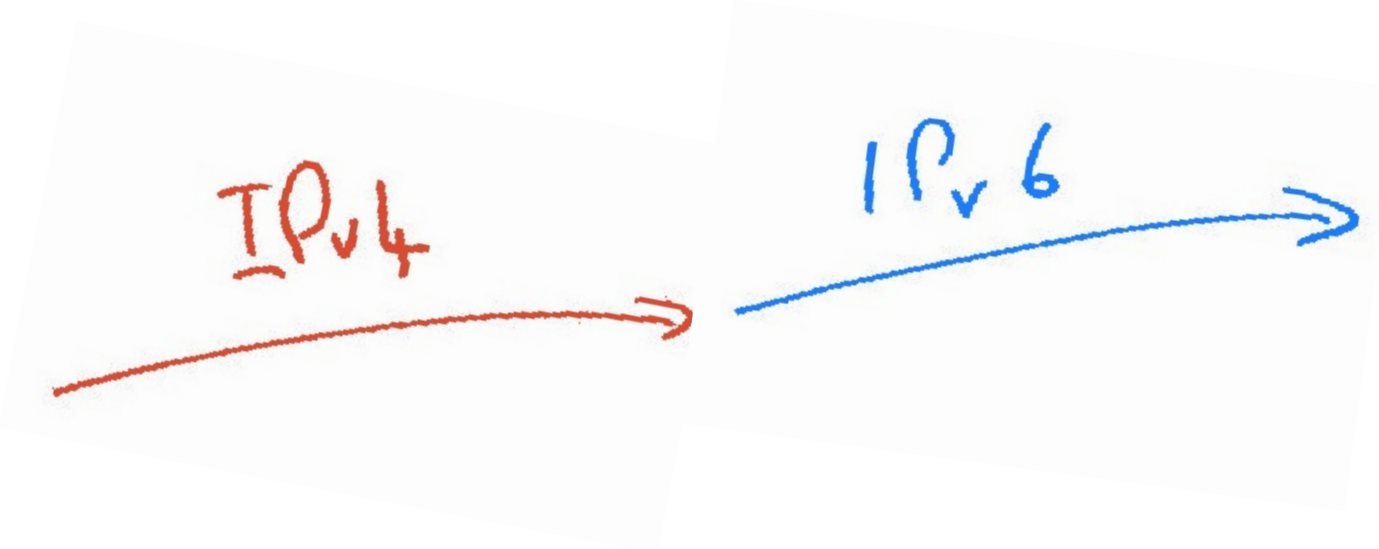
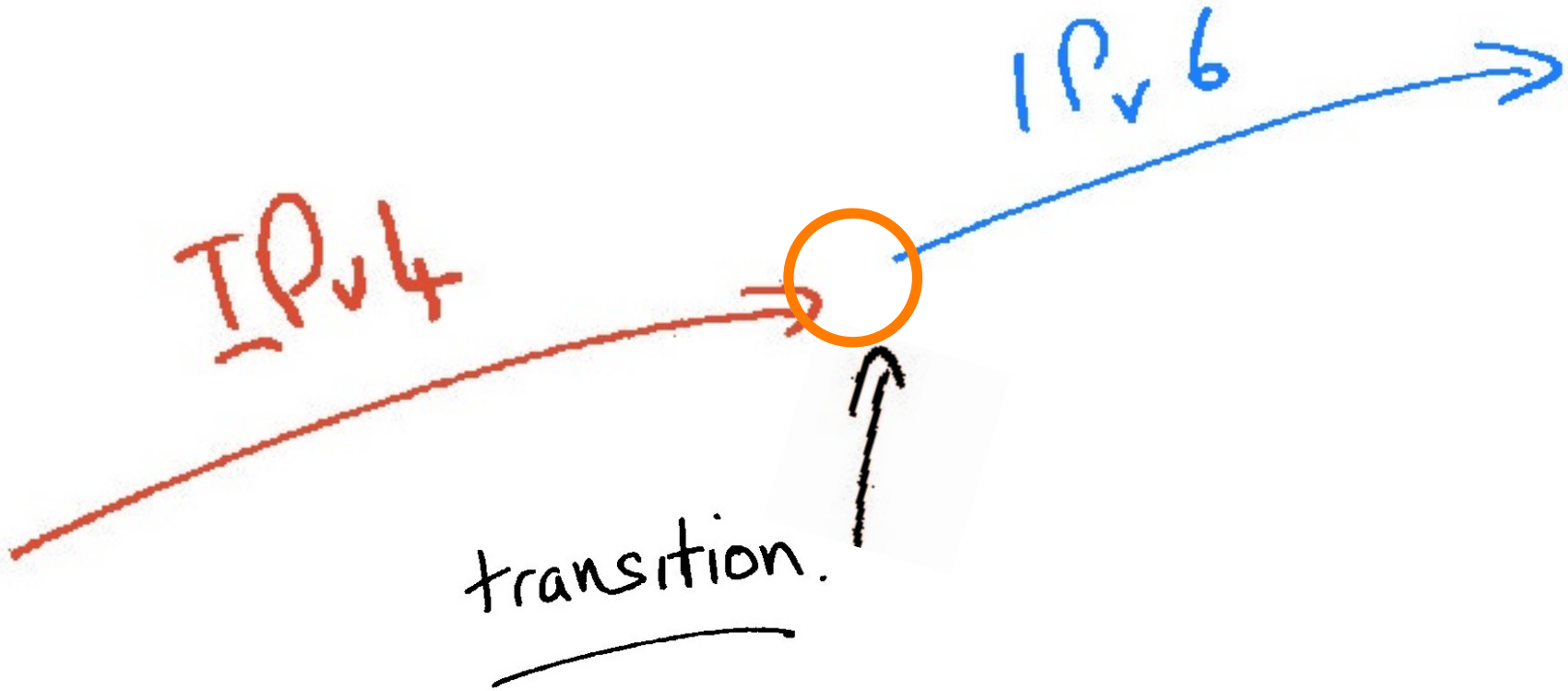


The challenge often lies in managing the transition from one technology to another



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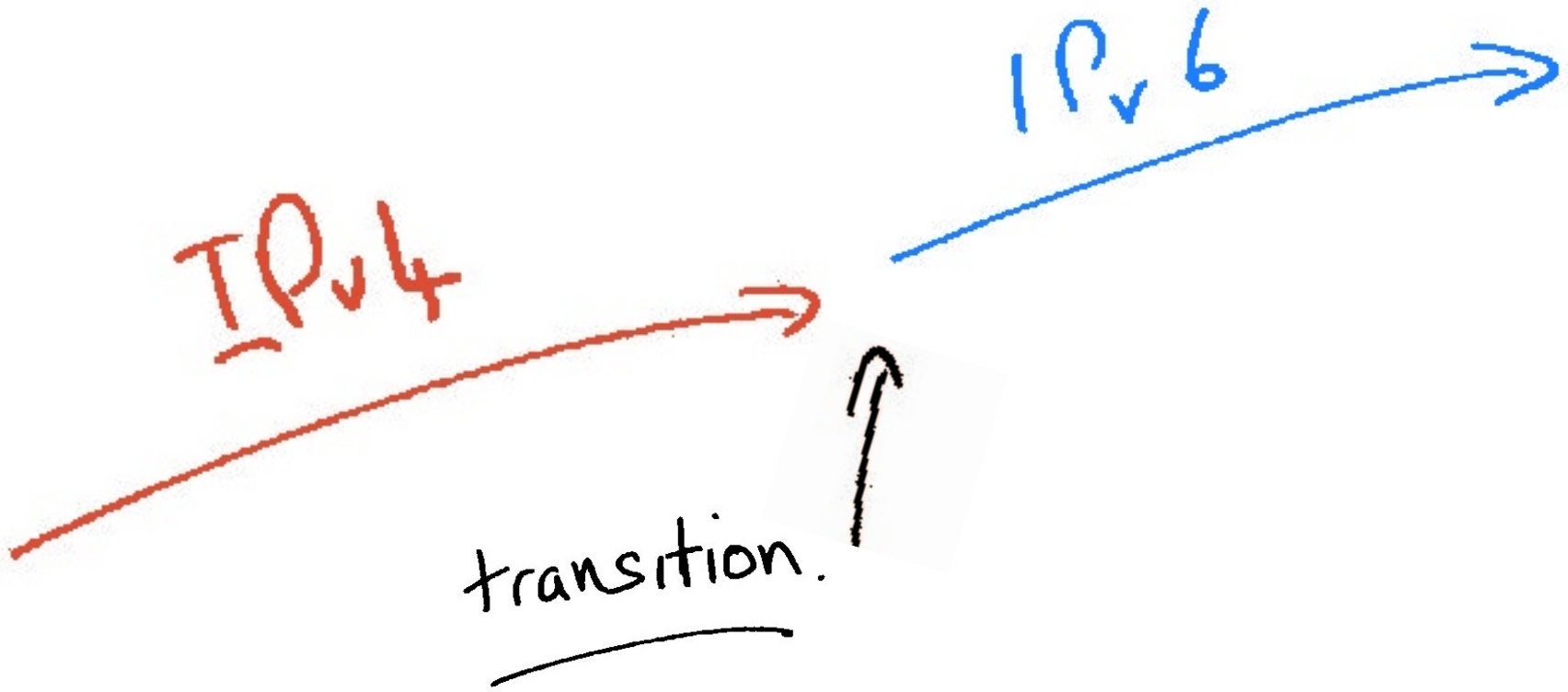
To get from "here" to "there" requires an excursion through an environment of CGNs, CDNs, ALGs and similar middleware 'solutions' to IPv4 address exhaustion



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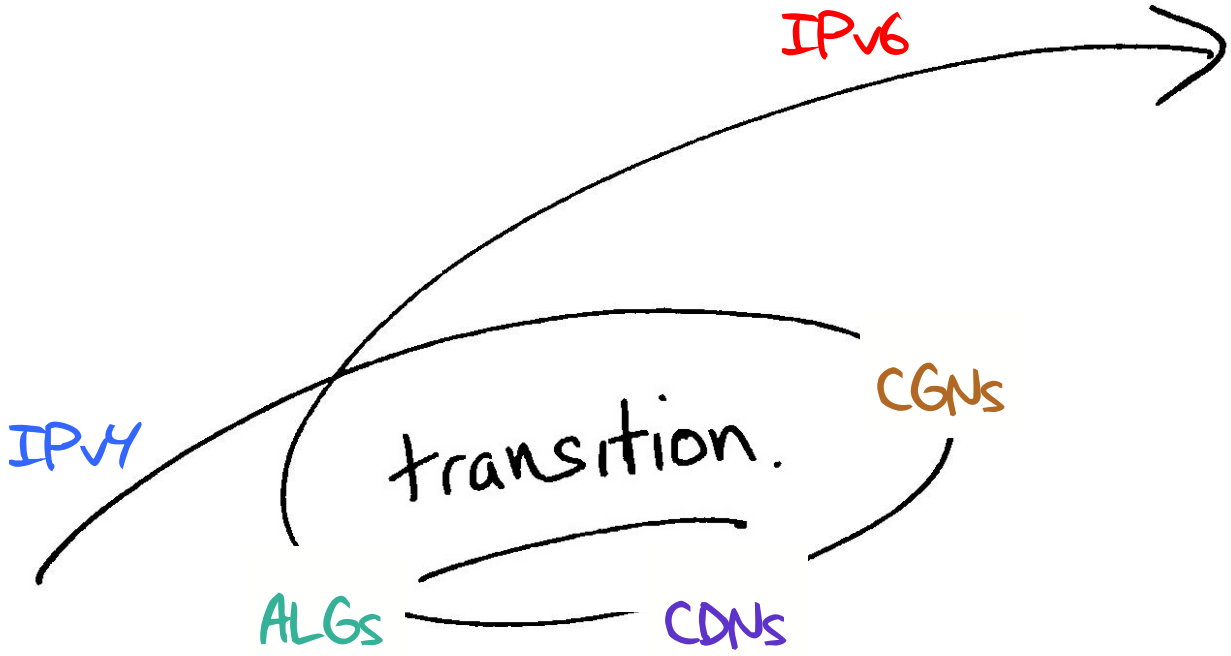
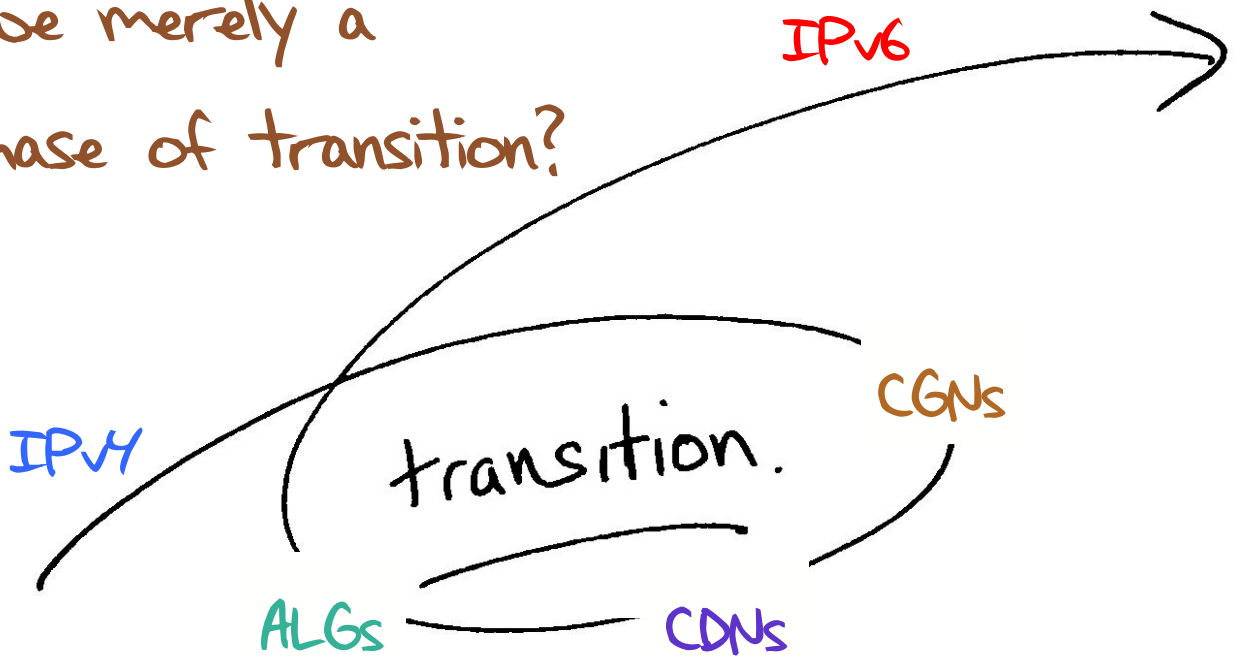


But will this be merely a temporary phase of transition?



Transition requires the network owner to undertake capital investment in network service infrastructure to support IPv4 address sharing/rationing.

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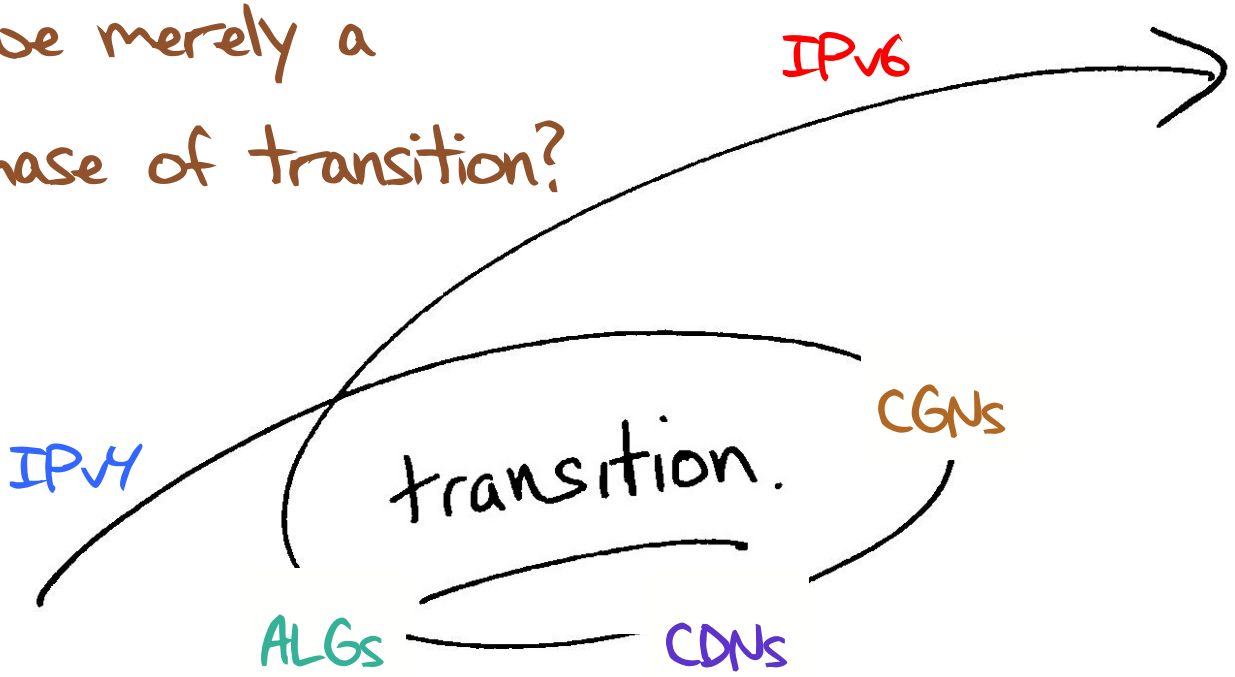
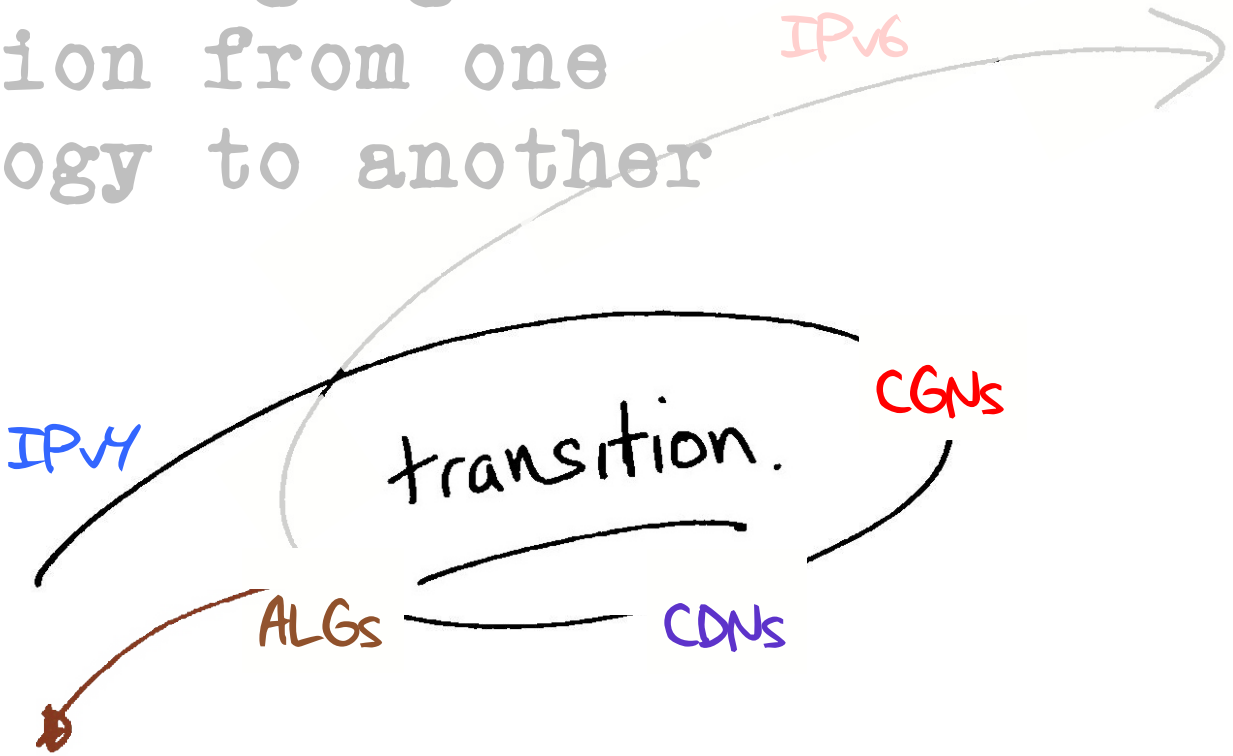


Transition requires the network owner to undertake capital investment in network service infrastructure to support IPv4 address sharing/rationing.

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 transition?

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To ensure that the industry maintains a collective focus on IPv6 as the objective of this exercise!

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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

How can we "manage" this transition?

This was always going to be a very hard question to try and answer!

And the data on IPv6 update so far suggests that we are still not managing this at all well. Progress at the customer edge of the network with IPv6 access is glacial.

How can we "manage" this transition?

This was always going to be a very hard question to try and answer!

And at the moment we seem to be making the task even harder, not easier, by adding even more challenges into the path we need to follow!

Challenges:

1. This is a deregulated and highly competitive environment

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

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There are many different players

Each with their own perspective

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There are many different players

Each with their own perspective

And all potential approaches will be explored!

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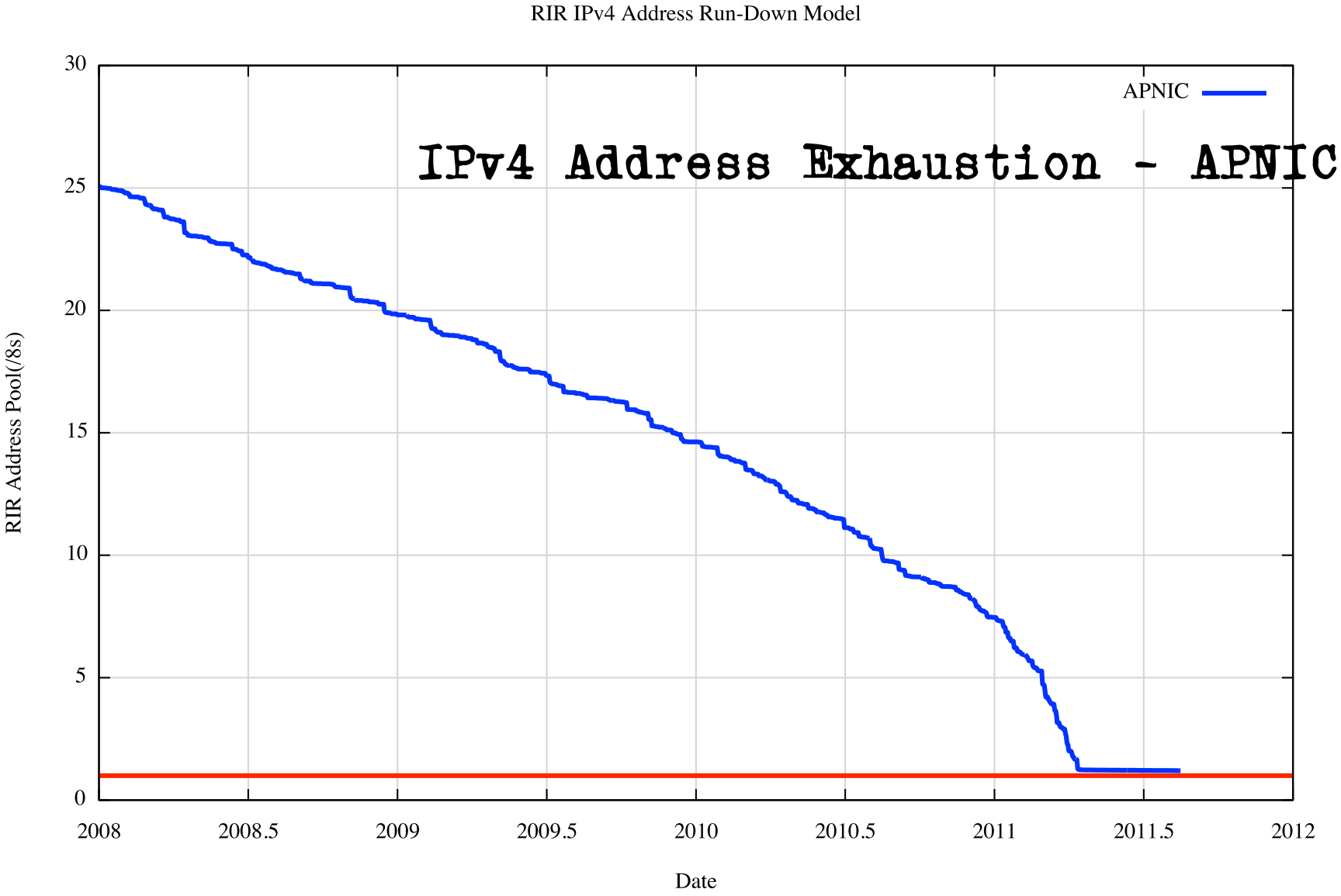
2. Varying IPv4 Address Exhaustion Timelines


RIR IPv4 Address Run-Down Model
IPv4 Address Exhaustion - APNIC
APNIC
RIR Address Pool(/8s)
Date
30
25
20
15
10
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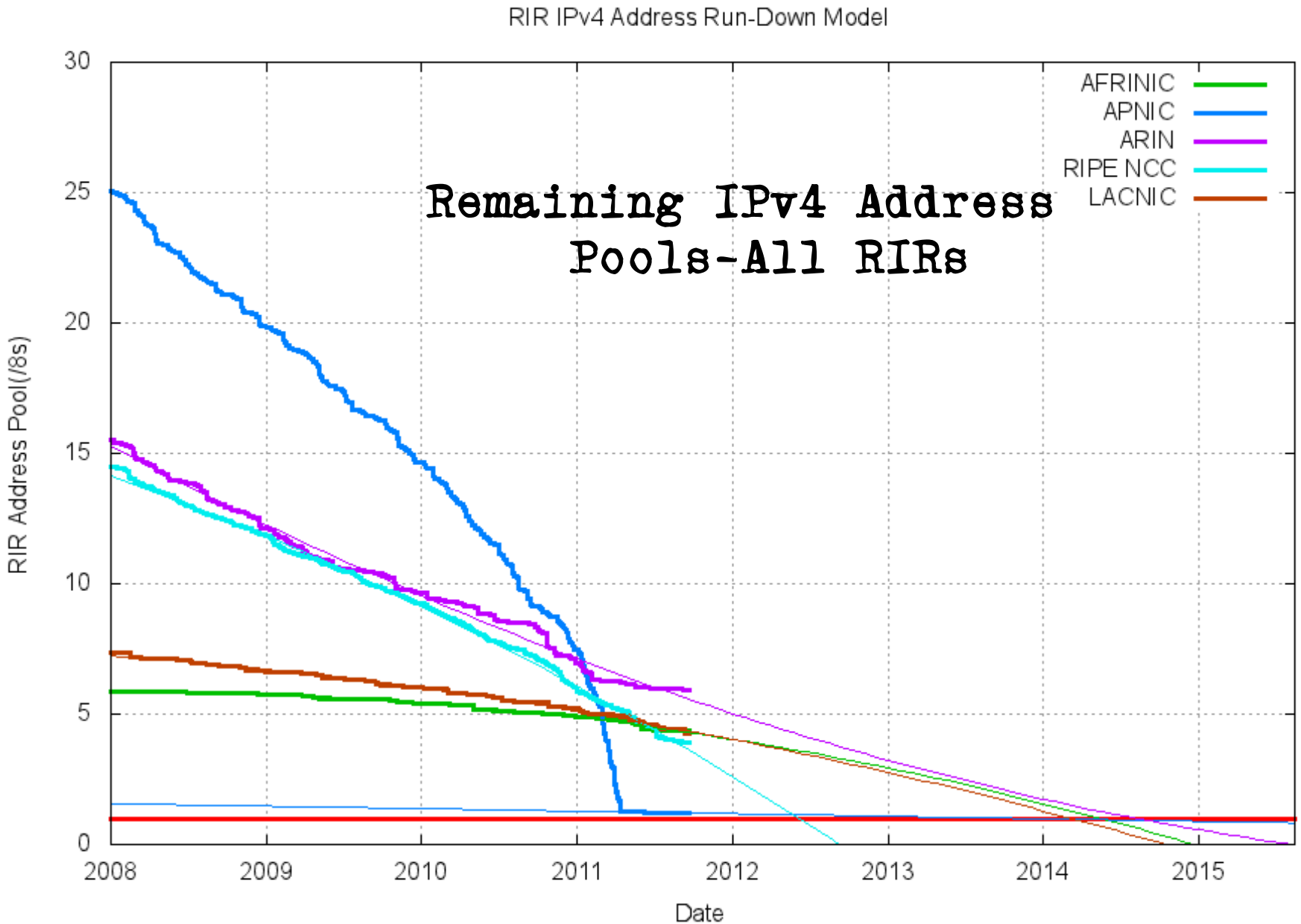
2008
2008.5
2009
2009.5
2010
2010.5
2011
2011.5
2012


RIR IPv4 Address Run-Down Model
Remaining IPv4 Address Pools-All RIRs
AFRINIC
APNIC
ARIN
RIPE NCC
LACNIC
RIR Address Pool(/8s)
Date
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2008
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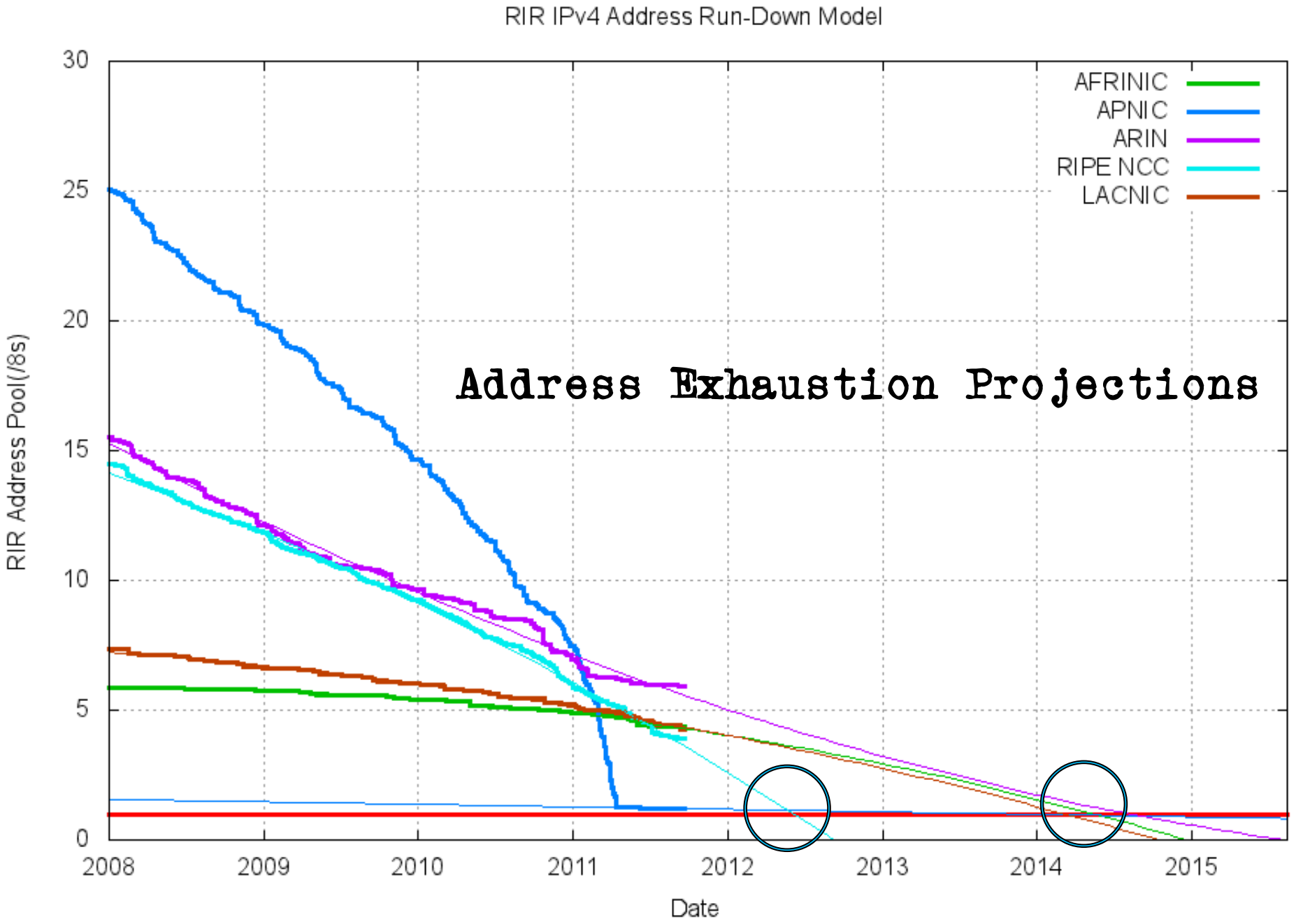
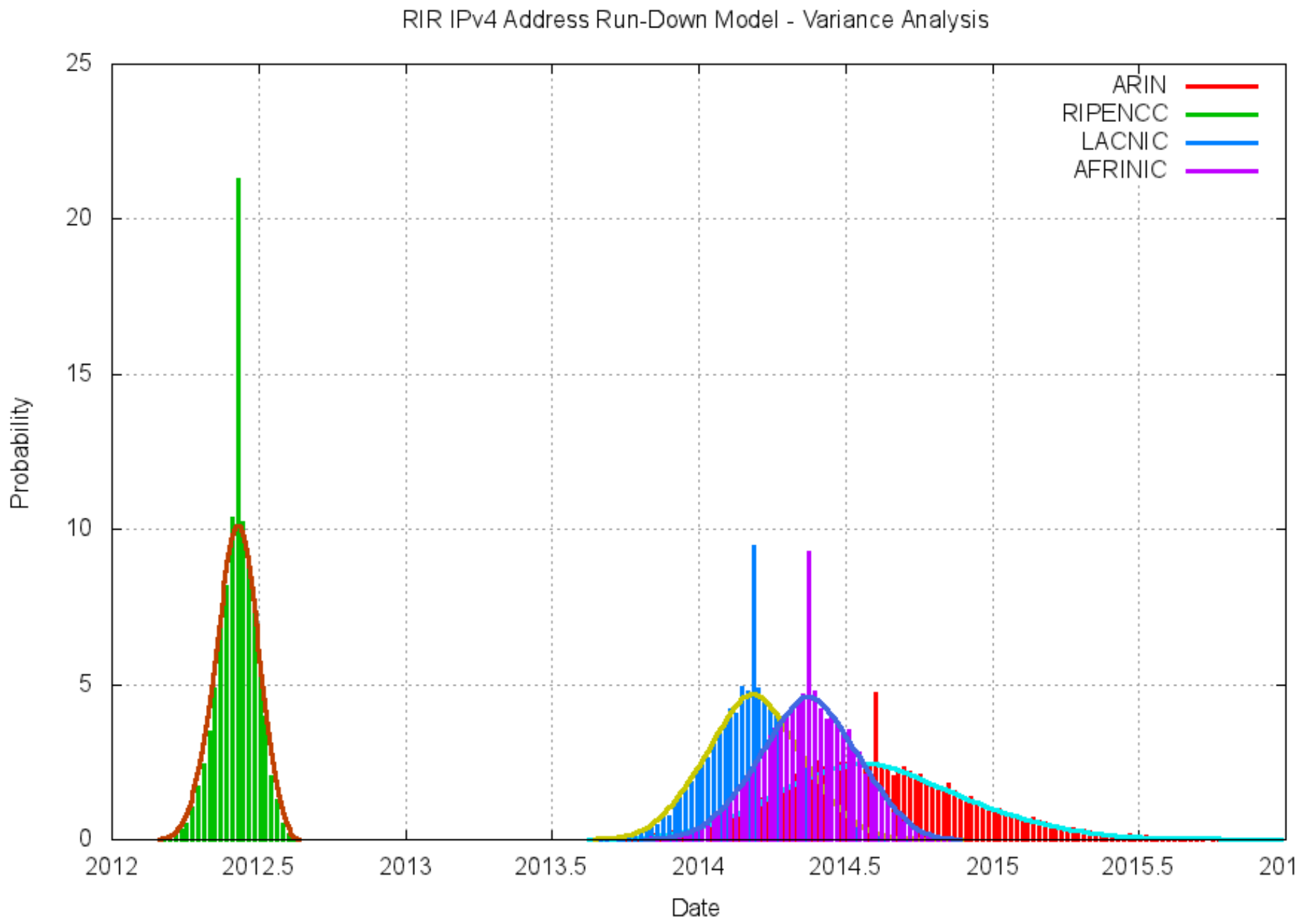
2012
2013
2014
2015


RIR IPv4 Address Run-Down Model
AFRINIC
APNIC
ARIN
RIPE NCC
LACNIC
Address Exhaustion Projections
RIR Address Pool(/8s)
Date
0
5
10
15
20
25
30
2008
2009
2010
2011
2012
2013
2014
2015

Exhaustion Predictions

RIR	Predicted Exhaustion Date *	Remaining Address Pool (2 Oct 2011)
APNIC	19 April 2011 (actual)	1.20 /8s (0.3 /8s rsvd)
RIPE NCC	9 June 2012	3.91 /8s
LACNIC	1 March 2014	4.27 /8s
AFRINIC	28 May 2014	4.38 /8s
ARIN	9 Oct 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
ARIN
RIPENCC
LACNIC
AFRINIC
Probability
Date
0
5
10
15
20
25
2012
2012.5
2013
2013.5
2014
2014.5
2015
2015.5
2016

So what?

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?

Well, that depends on where you happen to be! If it hasn't happened to you yet, then denial is still an option!

Reality Acceptance

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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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   There is a credibility problem!

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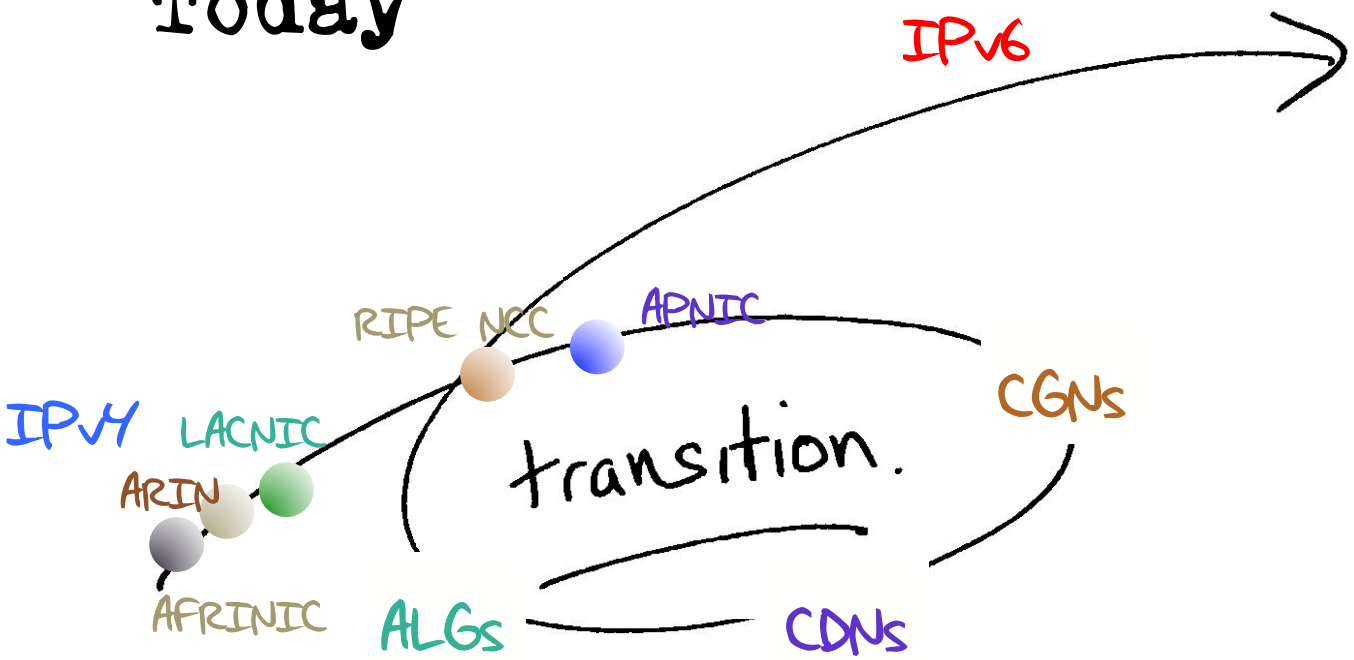
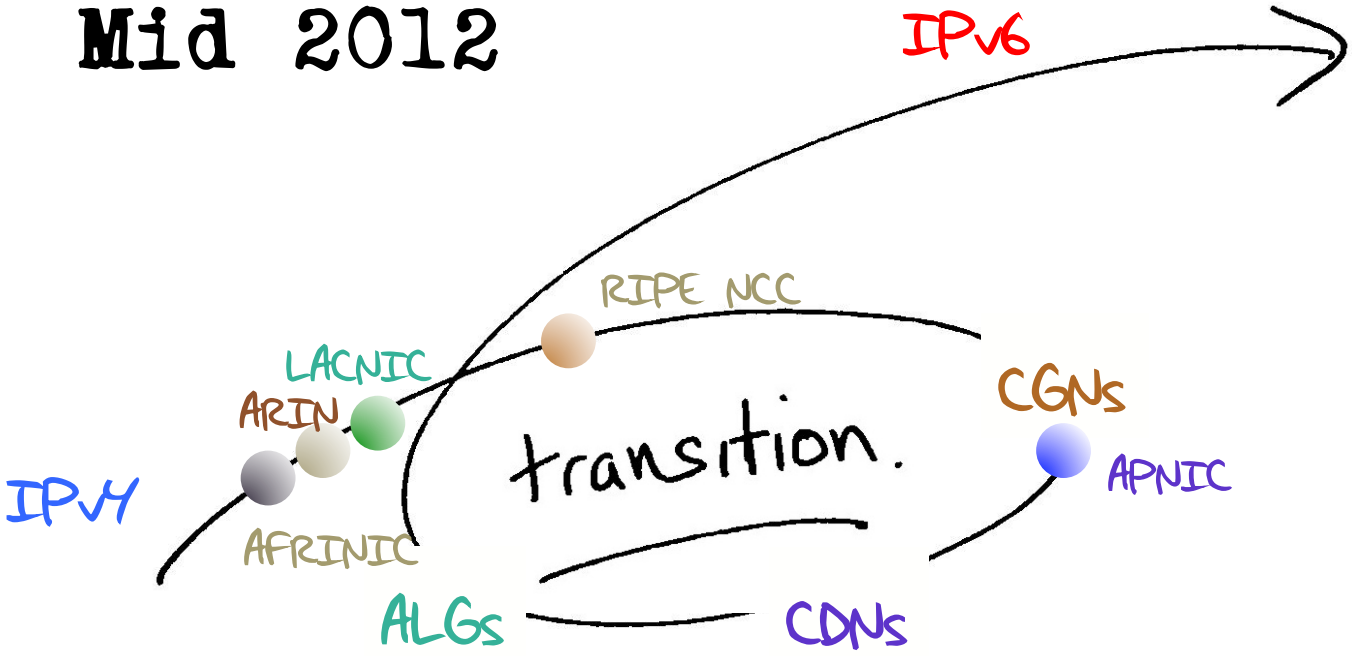
Today


IPv6
RIPE NCC
APNIC
IPv4
LACNIC
ARIN
AFRINIC
transition.
CGNs
ALGs
CDNs

Mid 2012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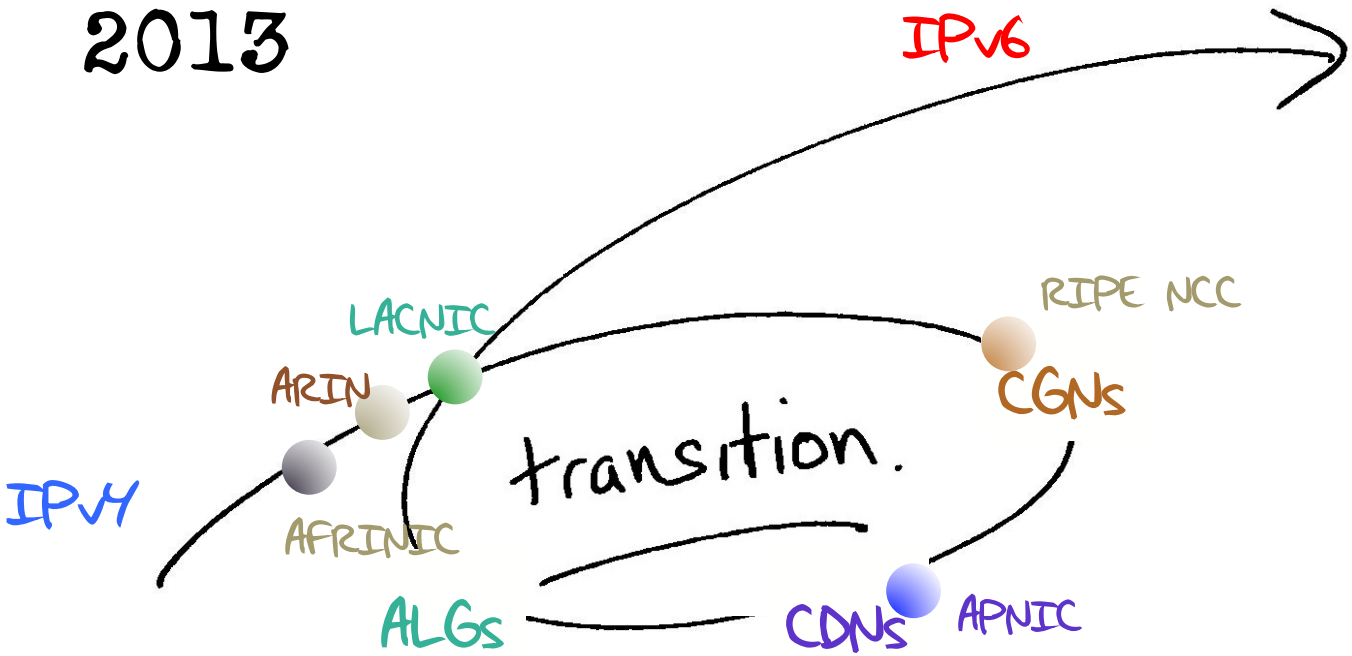
2013
IPv6
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By 2013 it is possible that different regions of the world will be experiencing very different market pressures for the provision of Internet services, due to differing transitional pressures from IPv4 exhaustion

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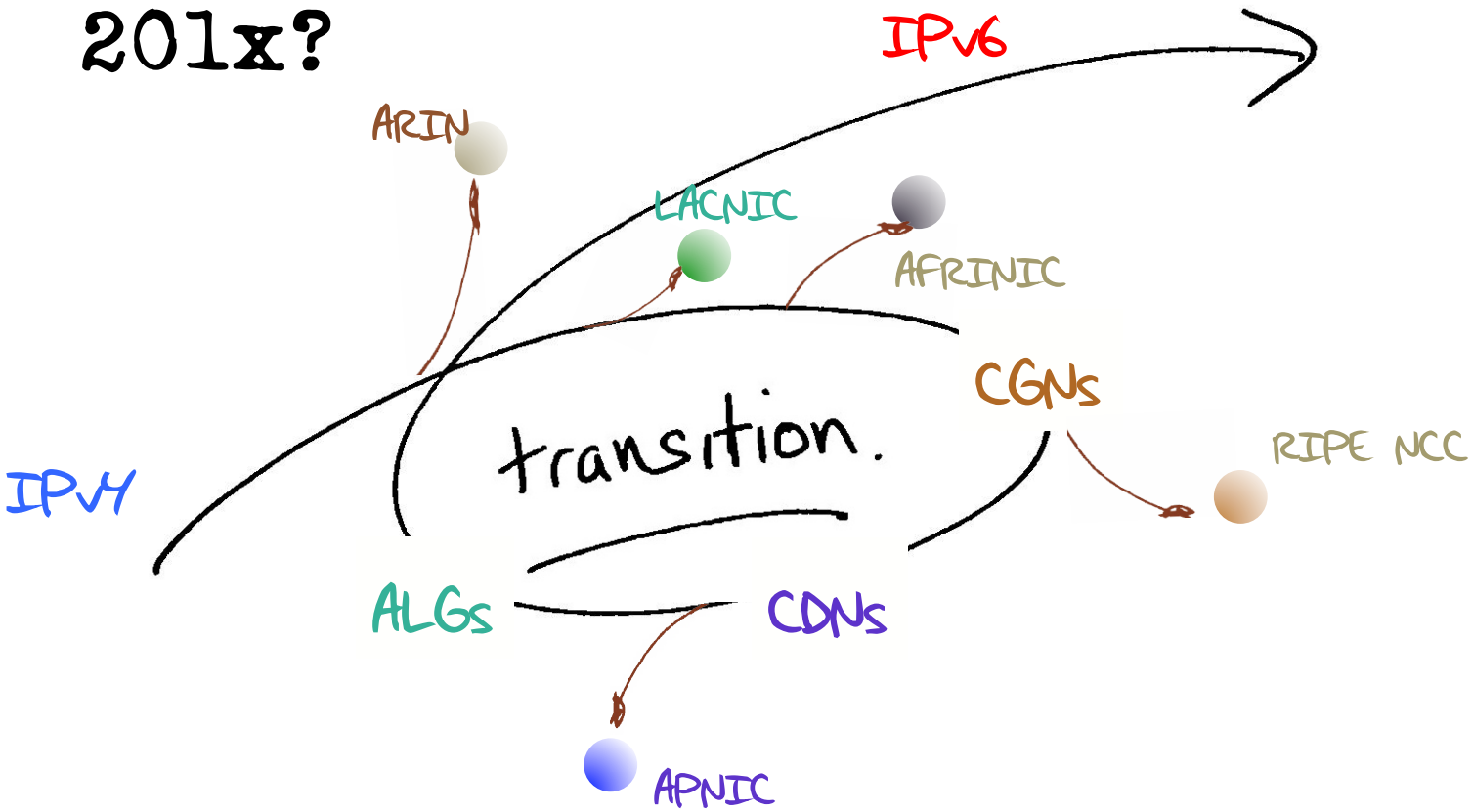
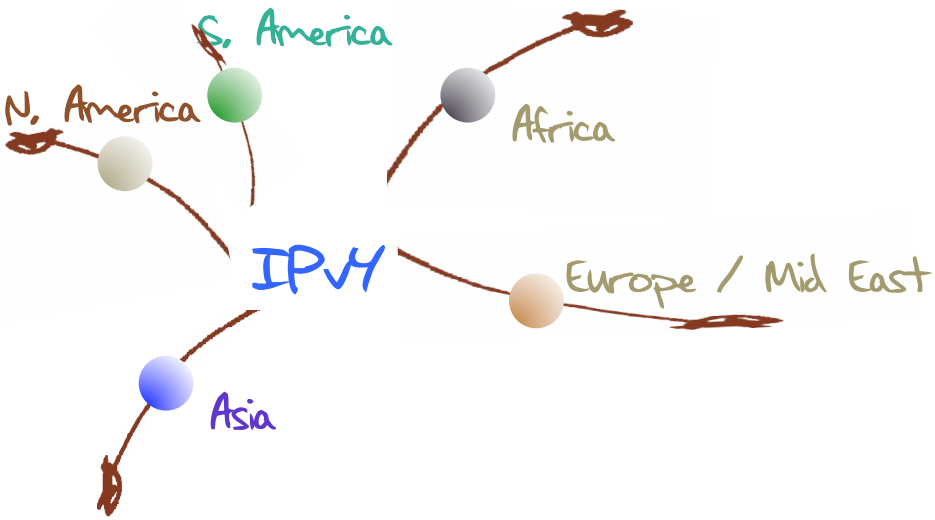
Are we still committed to the plans we had 5 years ago? How about our 10 year old plans?

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


201x?
IPv6
ARIN
LACNIC
AFRINIC
CGNs
transition.
IPv4
RIPE NCC
ALGs
CDNs
APNIC

20xx?



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

If IPv6 is what we are after as an open and accessible platform for further network growth and innovation then the public interest in a continuing open and accessible network needs to be expressed within the dynamics of market pressures.

Today's question is:

How can we do this?

How can we help the Internet through this transition?

How can we help the Internet through this transition?

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

Yes, that was intentionally left blank!

I really don't know what will works.

And as far as I can see, nor does anyone else!

But even though I don't have an answer here, I have some thoughts to offer about this issue of pulling the Internet though this transition

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 our common interest in a single cohesive network

that remains open, neutral, and accessible

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

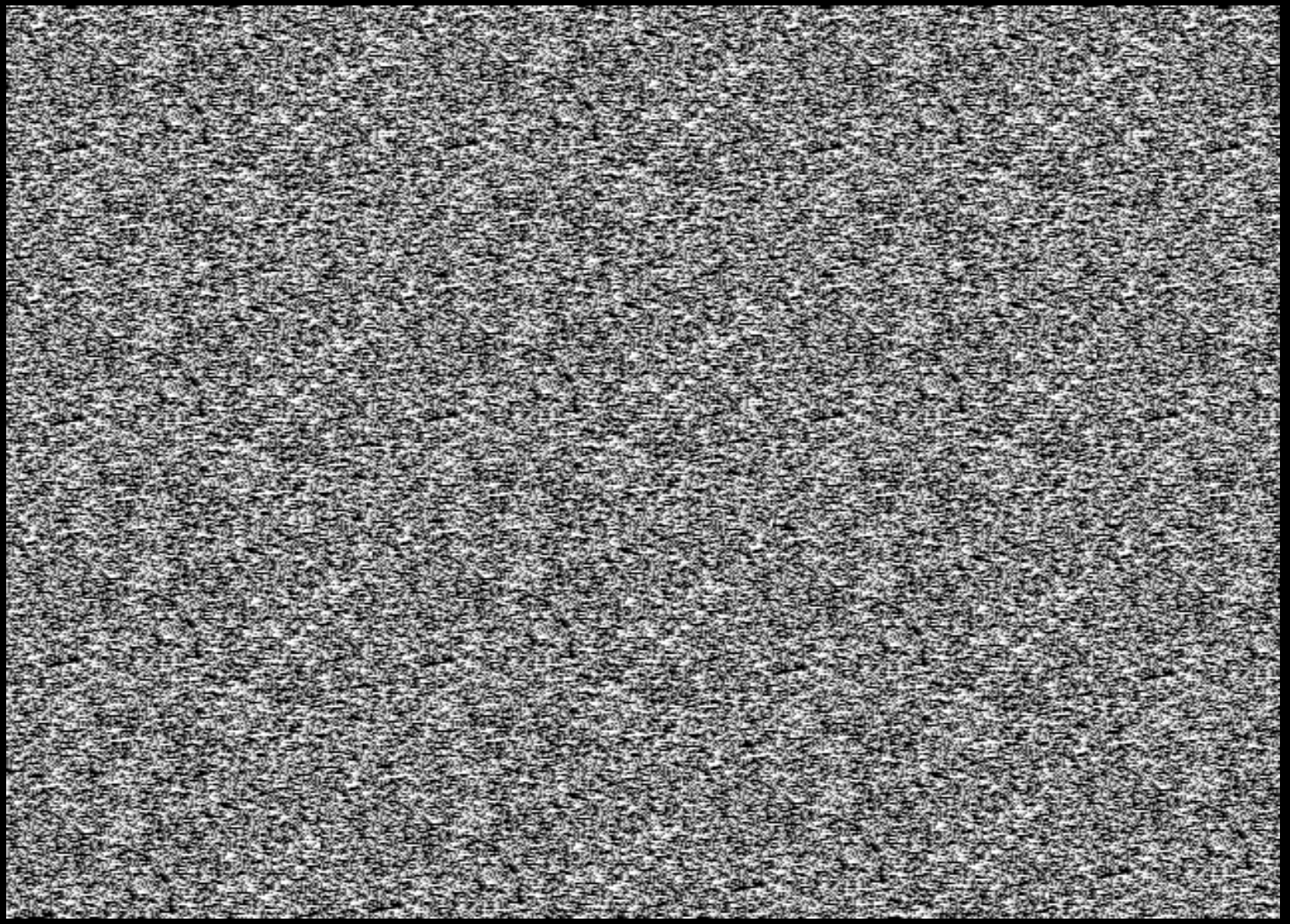
Finally...

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 greater the pain to our customers, and the higher the risk that we will lose track of the intended temporary nature of transition and the greater the chances that we will forget about IPv6 as the objective!

Thank You!

Of course, there is another perspective on this transition to Ipv6...



IPv4 as a Strategy

or how address shortage will provide control over services again

Consultants

Because Meat and Malbec is simply not enough

Services generate value

- Users do not care about the network, they care about services
  - voice, games, music, movies, and other entertainment
  - self-ordering fridges, automotive intelligence, and other device2device or device2human interaction

Prior to the Internet

- Telecom operators provided the services and controlled the value chain and its revenue
  - high stability, high margins, stockholder value
  - successful innovations: telephony, fax, minitel, 800 and 900 number based services

Internet is a virus?!

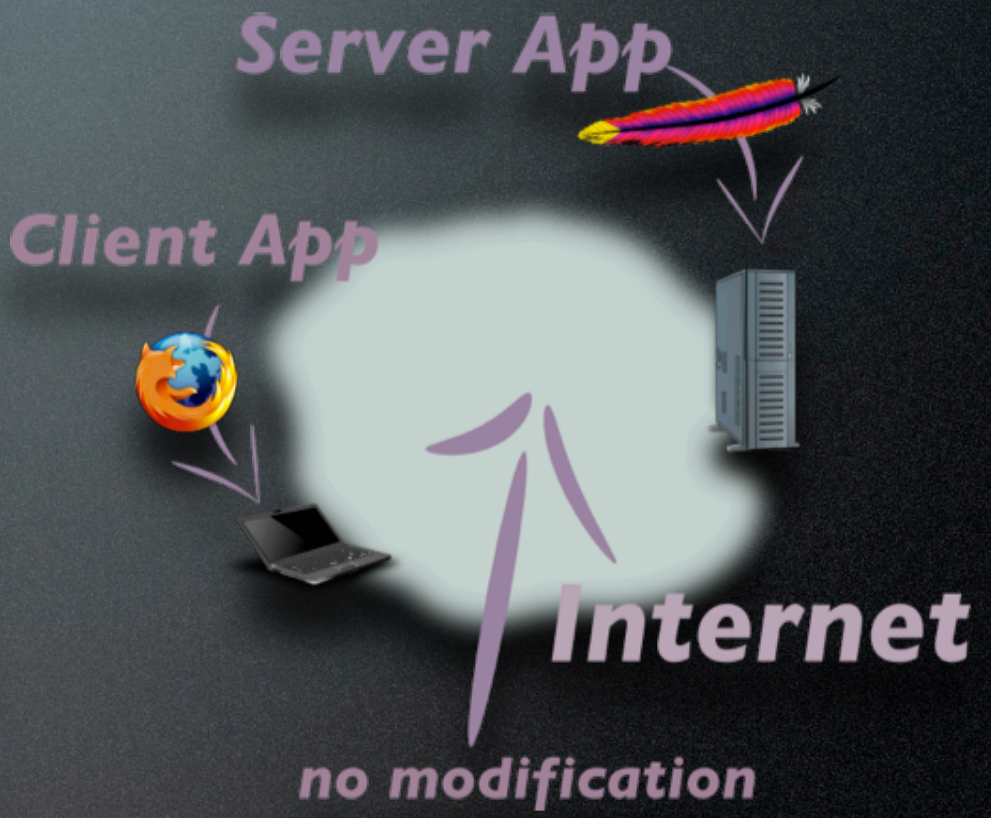
- Internet caught us by surprise:
  - Customers connected to Internet Service Providers via modems over telephony infrastructure
  - Applications where offered without our permission
- Turned the intelligent telephony network into a dumb transport service

Connectivity vs. Service

- Providing television, internet and voice over the same infrastructure provides some value added revenue
- But content is provided more and more by Internet Services
  - Telephony moves to voip (Skype)
  - Television moves to YouTube

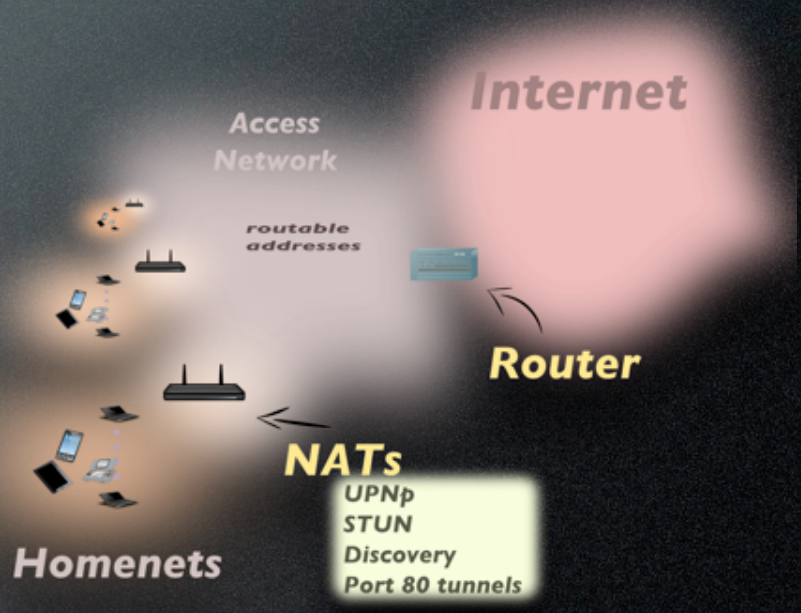
Why did this work?

- The open end-to-end model:
  - Network Layer and Application Layer evolved independently
  - Connected devices could interact without changes to the network



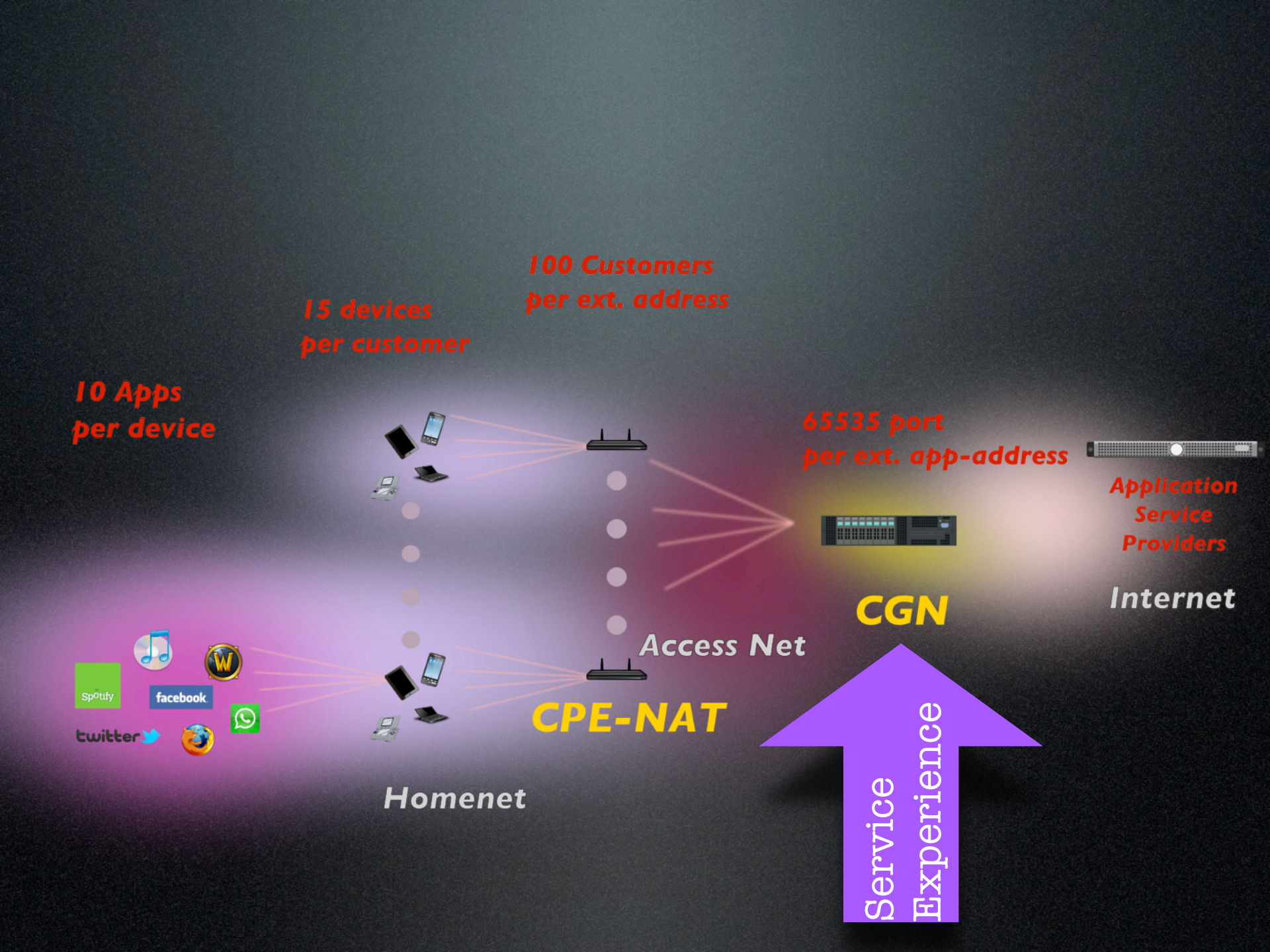
Breaking Openness

- Internet depended on the endless supply of free IP addresses
- Resources are not free:
  - People did not pay for additional addresses
  - rational economic behavior forces intelligence towards the core
- Imagine what we could have didone when we had monetized on NATs from the start



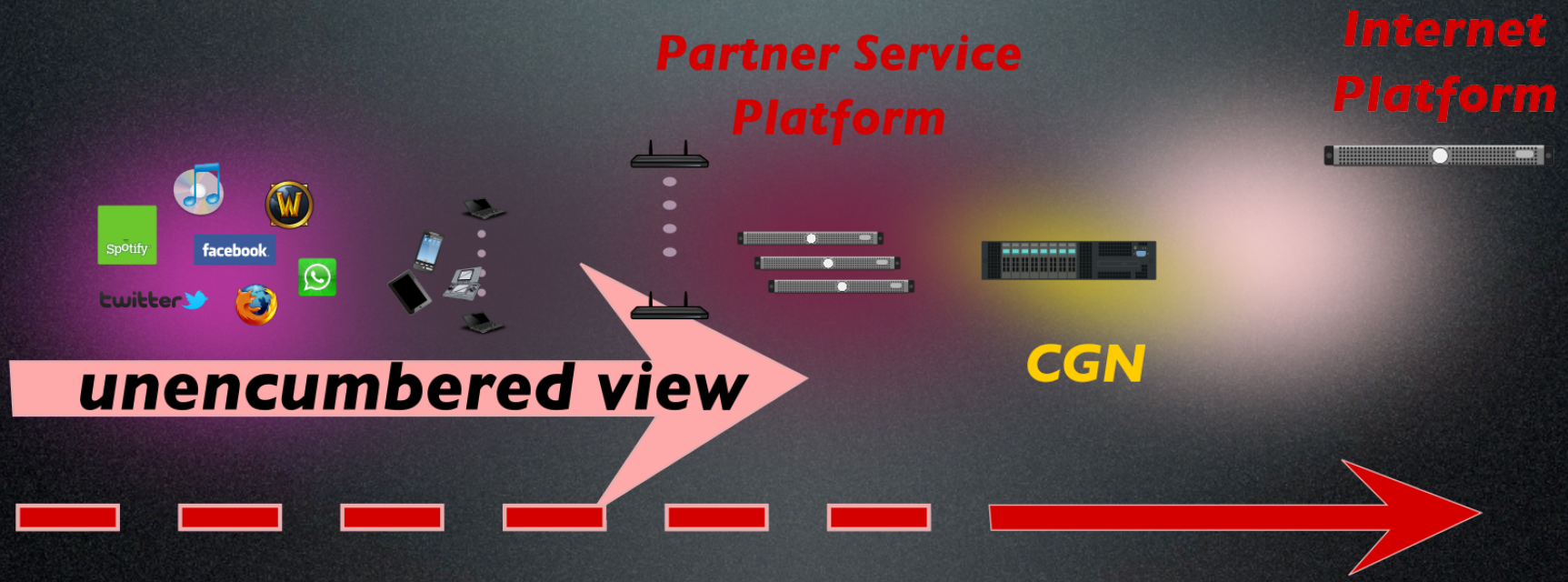
Why is IPv4 Shortage Good For Us?

- Allows us to introduce an additional control point through which we can gain control over the services
  - End user hosts will not be able to connect to the Internet directly
- Technology called Carrier Grade NAT (CGN)


100 Customers
per ext. address
15 devices
per customer
10 Apps
per device
65535 port
per ext. app-address
Application
Service
Providers
Internet
CGN
Access Net
CPE-NAT
Homenet
Service Experience
Spotify
facebook
twitter

Properties of Carrier NAT Architecture

- Turns one limited resource (addresses) into another (ports)
- We can relate the number of ports a customer has available to services
- Results in the possibility of tiered services and variable billing



Experience limited because of global resource limits

In addition

- Some services are extremely difficult to operate over NAT. e.g.:
  - Voice over IP (SKYPE)
  - Bit Torrent
  - Running services

The result

- Incentive for Application Service Providers to partner with us
  - Guaranteed Quality of Service
  - Revenue sharing to keep CGN and network up to par with their needs

Risks

- Potential Regulatory Pressure
  - IPv4 for new entrants
  - Net Neutrality
  - IPv6 ‘as public good’

IPv4 and new entrants

- IPv4 is a scarce resource: 2012 no IPv4 available from the RIRs
  - Market Entrance is a regulatory concern
- We will return IPv4 addresses
  - Goodwill with regulators
  - We'll be moving to CGNs anyway

Net Neutrality

- The CGN based architecture cannot be neutral any longer because the address-scarcity cannot be fixed by investments or market competition
  - External services move inside our network
  - or only have limited ports: bad user experience

IPv6 trials

- Offering IPv6 leads to failure:
  - No application and CPE support
  - Worse user experience: customers will allow us to stay conservative and slowly move to CNGs
- Expensive to participate in
  - But a demonstration of good will

Conclusion

- IPv4 based CGNs to cope with address exhaustion as a positive long term incentive
- CGNs will allow us to generate revenue from services again

Thank You!

Consultants

Because Meat and Malbec is simply not enough