IPv4 Address Exhaustion: A Progress Report

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The mainstream telecommunications industry has a rich history
The mainstream telecommunications industry has a rich history 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 this?
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Surely IPv6 will just happen — it's just a matter of waiting for the pressure of IPv4 address exhaustion to get to sufficient levels of intensity.
Do we really need to worry about this?

Surely IPv6 will just happen – it's 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
The "inevitability" of technological evolution

wires → virtual circuits
Well what did you expect? They are VIRTUAL circuits, so a picture was always going to be a challenge!
The "inevitability" of technological evolution

wires \rightarrow \textit{virtual circuits} \rightarrow \textit{packets}
The "inevitability" of technological evolution

Now let's look at something a little more topical to today!
The "inevitability" of technological 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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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 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.
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
Challenges:

1. This is a deregulated and highly competitive environment

   There are many different players

   Each with their own perspective
Challenges:

1. This is a deregulated and highly competitive environment

   There are many different players
   Each with their own perspective

   And all potential approaches will be explored!
Challenges:

1. This is a deregulated and highly competitive environment
   There is no plan!
Challenges:

1. This is a deregulated and highly competitive environment
   There is no plan, just the interplay of various market pressures
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2. Varying IPv4 Address Exhaustion Timelines
IPv4 Address Exhaustion - APNIC
Address Exhaustion Projections
## Exhaustion Predictions

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

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

Or not
Reality Acceptance

Or not

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

Or not

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

It's not happening until it's happening to me!
Challenges:

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2. Varying IPv4 Address Exhaustion Timelines
   There is a credibility problem!
Challenges:

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2. Varying IPv4 Address Exhaustion Timelines
   There is a credibility problem: This industry has a hard time believing reality over its own mythology
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3. Regional Diversity
Today

IPv4
IPv6

transition.

CGNs
ALGs
CDNs
APNIC
RIPE NCC
LACNIC
ARIN
AFRINIC

IPv4
IPv6
Mid 2012
2013

IPv4

IPv6

transition.

IPv4

ALGs

CDNs

APNIC

RIPE NCC

CGNs

ARIN

AFRINIC

LACNIC
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?
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.

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

What's the level of risk that the differing environments of transition lead to significantly different outcomes in each region?
The Myth of the Long Term Plan
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"Transition will take many years...

5 years, maybe 10 years, maybe longer"
The Myth of the Long Term Plan

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Are we still firmly committed to the plans we had 5 years ago?
The Myth of the Long Term Plan

“Transition will take many years... 5 years, maybe 10 years, maybe longer”

Are we still firmly committed to the plans we had 5 years ago? How about our 10 year old plans?
The Myth of the Long Term Plan

“Transition will take many years...”

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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?

IPv4

IPv6

transition.

ARIN

LACNIC

AFRINIC

CGNs

RIPE NCC

ALGs

CDNs

APNIC

201x?
20xx?

IPv4

N. America

S. America

Asia

Europe / Mid East

Africa

IPv6
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3. Regional Diversity
   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?
Can we help the Internet 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!