Failure is an Option

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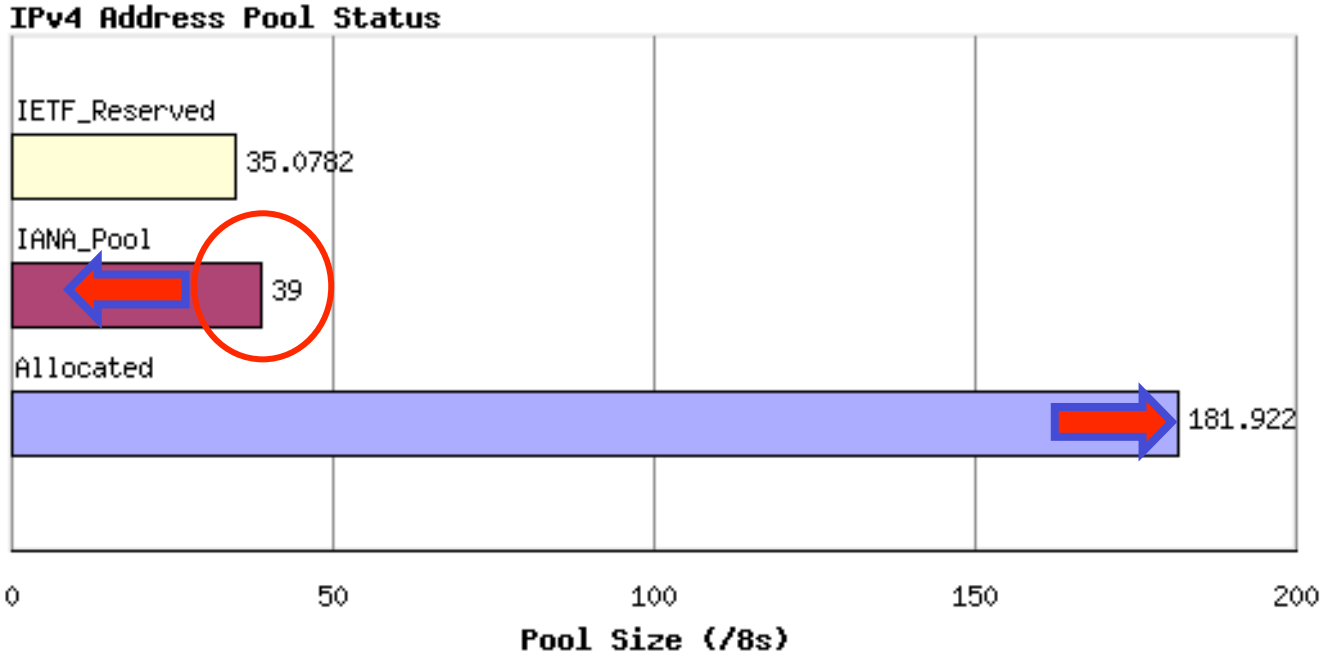
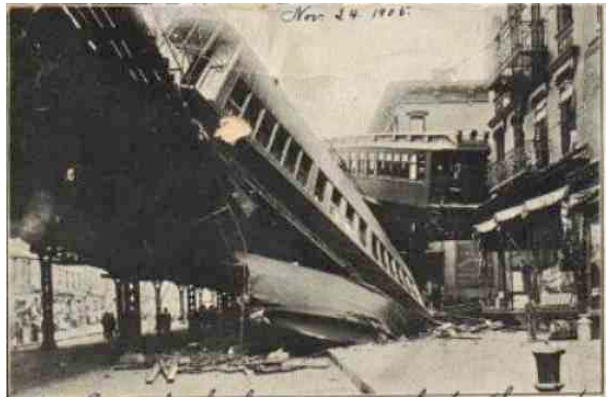
APNIC

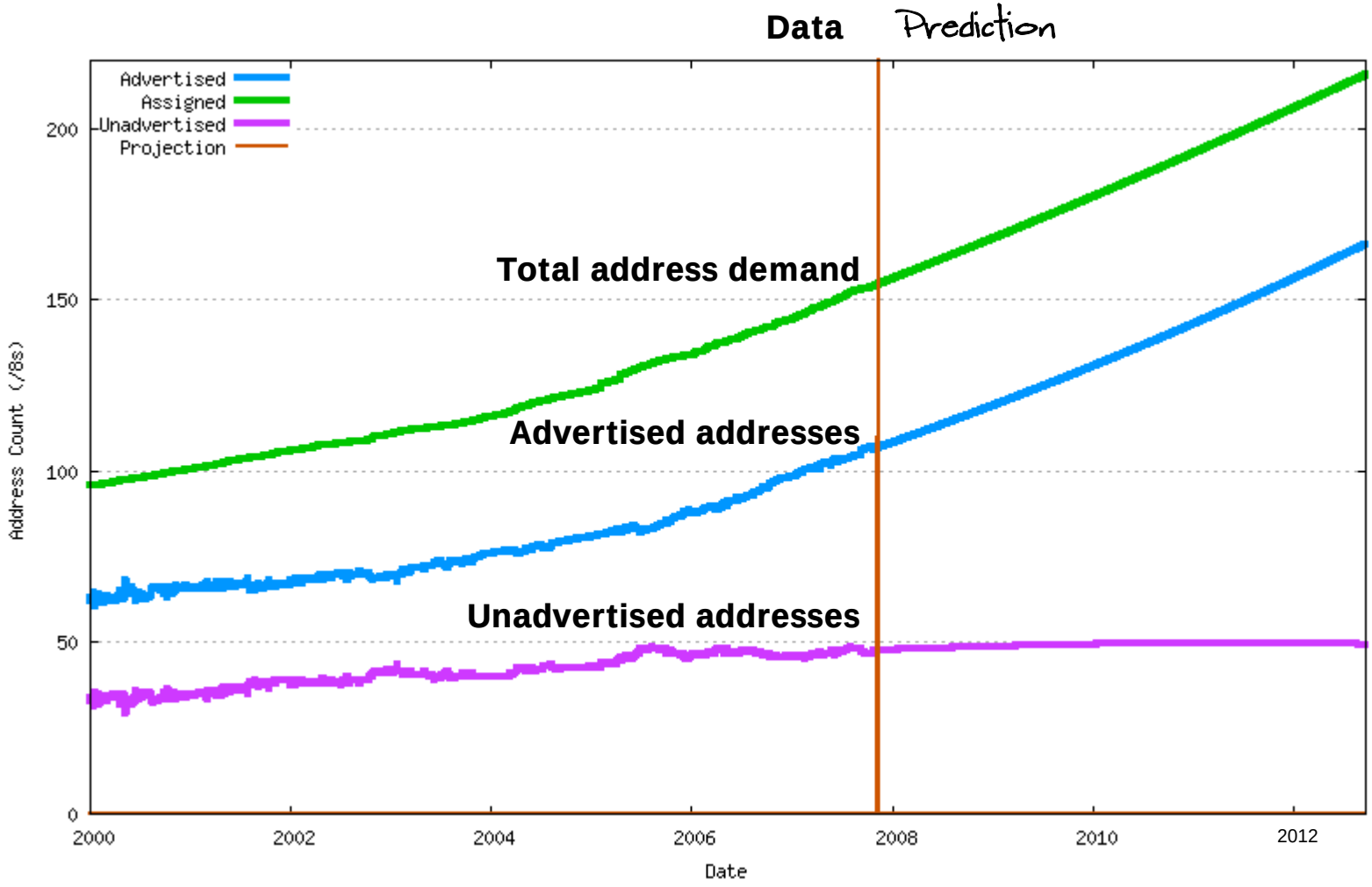
Usual disclaimer stuff:
Noone else wants to own up to having these heretical thoughts, so I guess that they're all mine!


IPv4 Address Pool Status
IETF_Reserved
35.0782
IANA_Pool
39
Allocated
181.922
0
50
100
150
200
Pool Size (/8s)

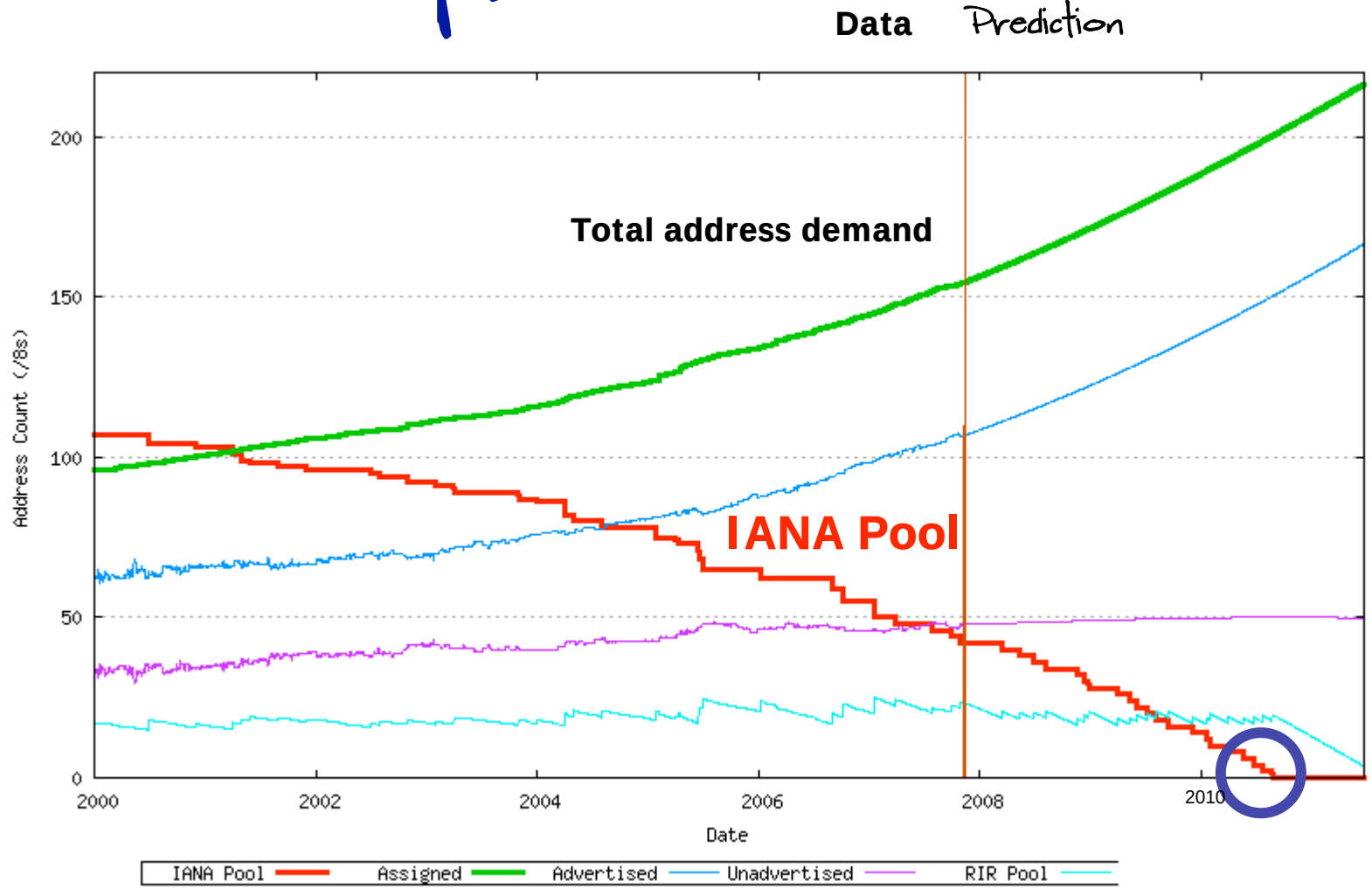
Today

Tomorrow




Data
Prediction
Advertised
Assigned
Unadvertised
Projection
Total address demand
Advertised addresses
Unadvertised addresses
Address Count (/8s)
0
50
100
150
200
2000
2002
2004
2006
2008
2010
2012
Date

Ooops!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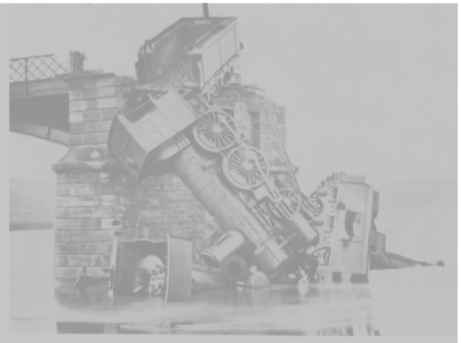
2006
2008
2010
Date
IANA Pool
Assigned
Advertised
Unadvertised
RIR Pool

That's 5th February 2011

http://ipv4.potaroo.net



That's 5th February 2011

YAWN - seen all this before

It's now BORING!

http://ipv4.potaroo.net

That's a highly uncertain prediction - it could be out by as much as 18 months

I can't model changes in demand due to:

- Panic — last minute rush
- New Policies - "reservations" of remaining address space
- Change of relative IPv4 / IPv6 demands

And modeling uncertainty due to:

- highly skewed data used to make projections

That's sometime between
late 2009 and early 2011

That's sometime between late 2008 and early 2011

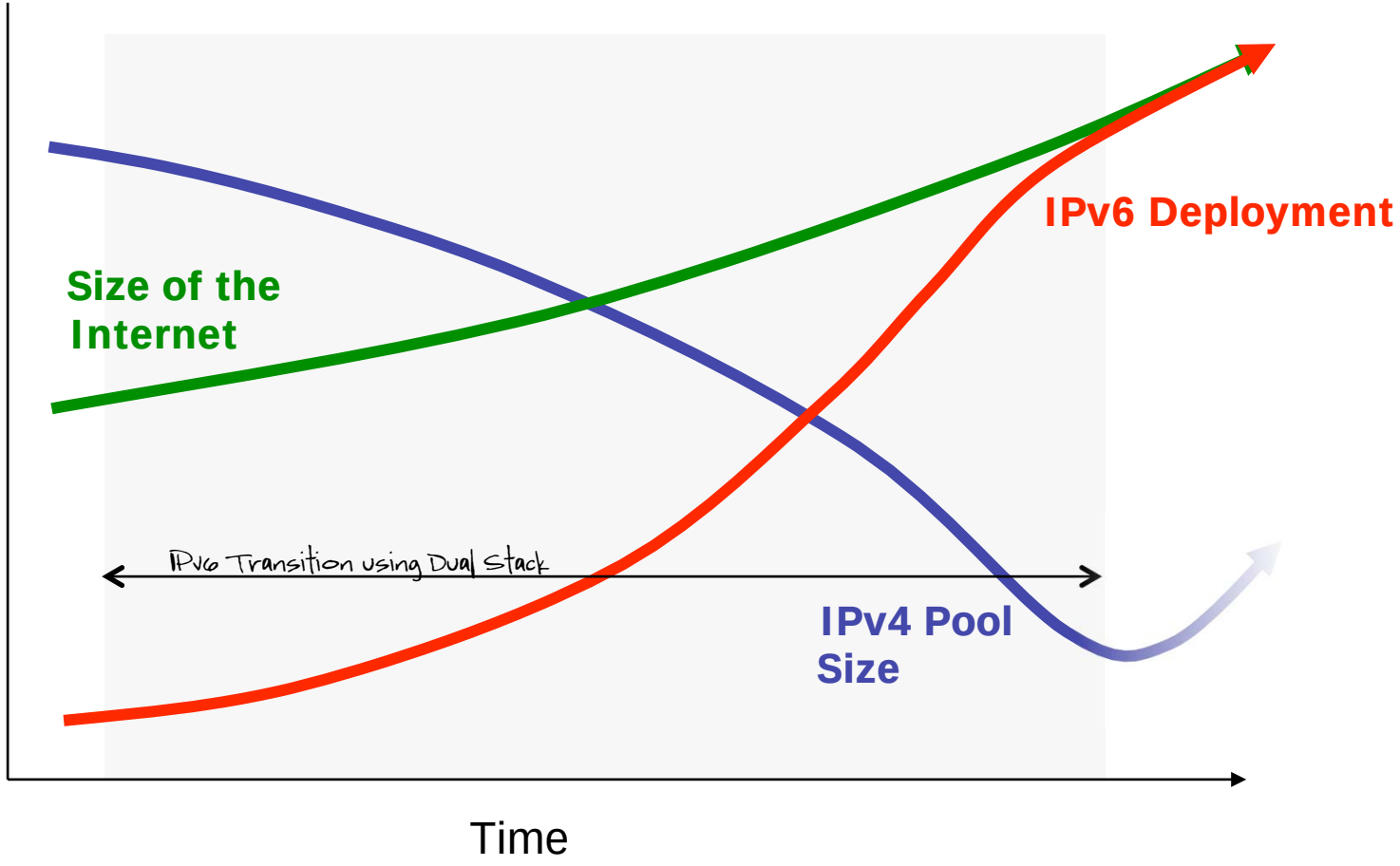
so what?

we've all heard this before nothing new to see here - move along!

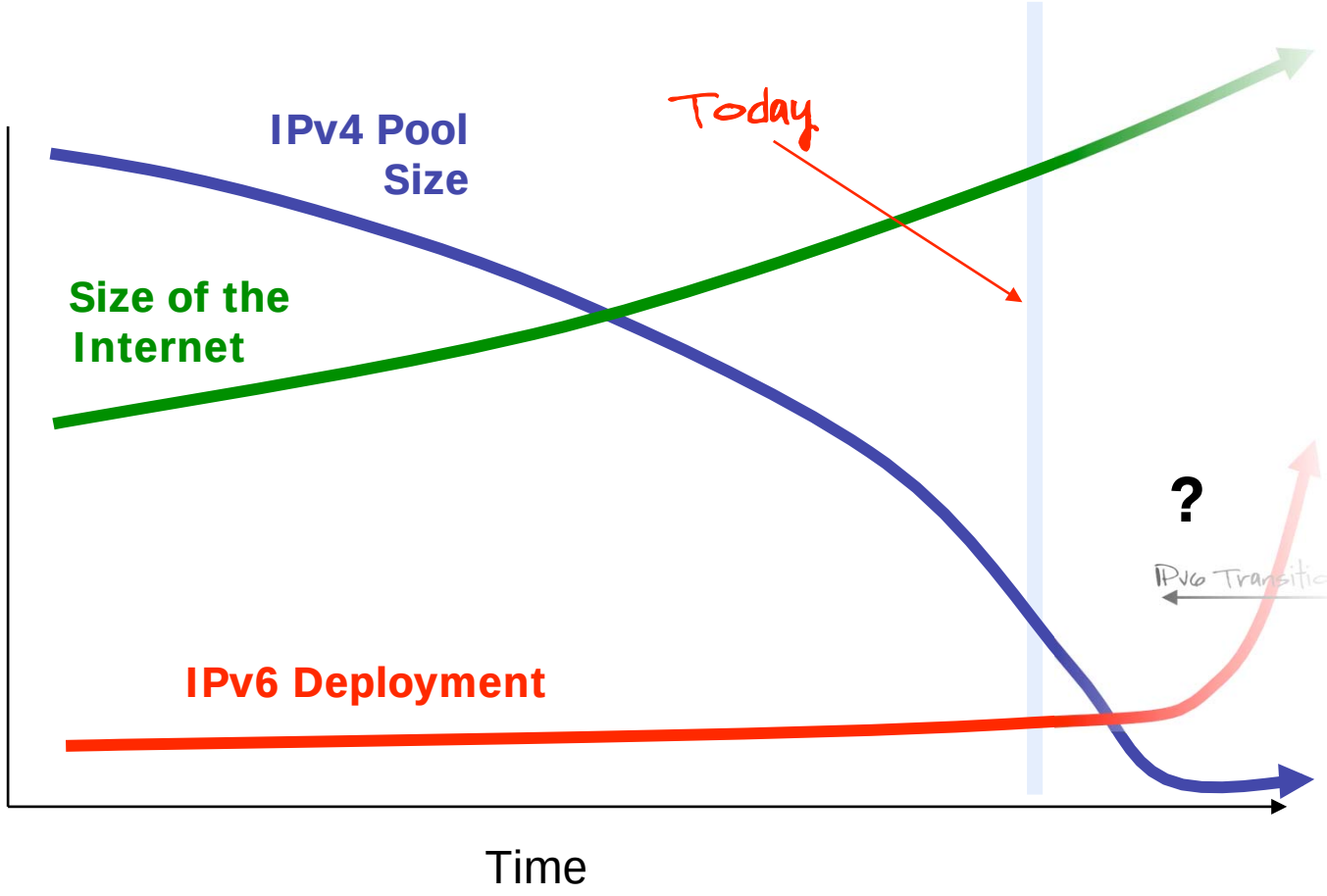
what then?

IPv6!

We had this plan …



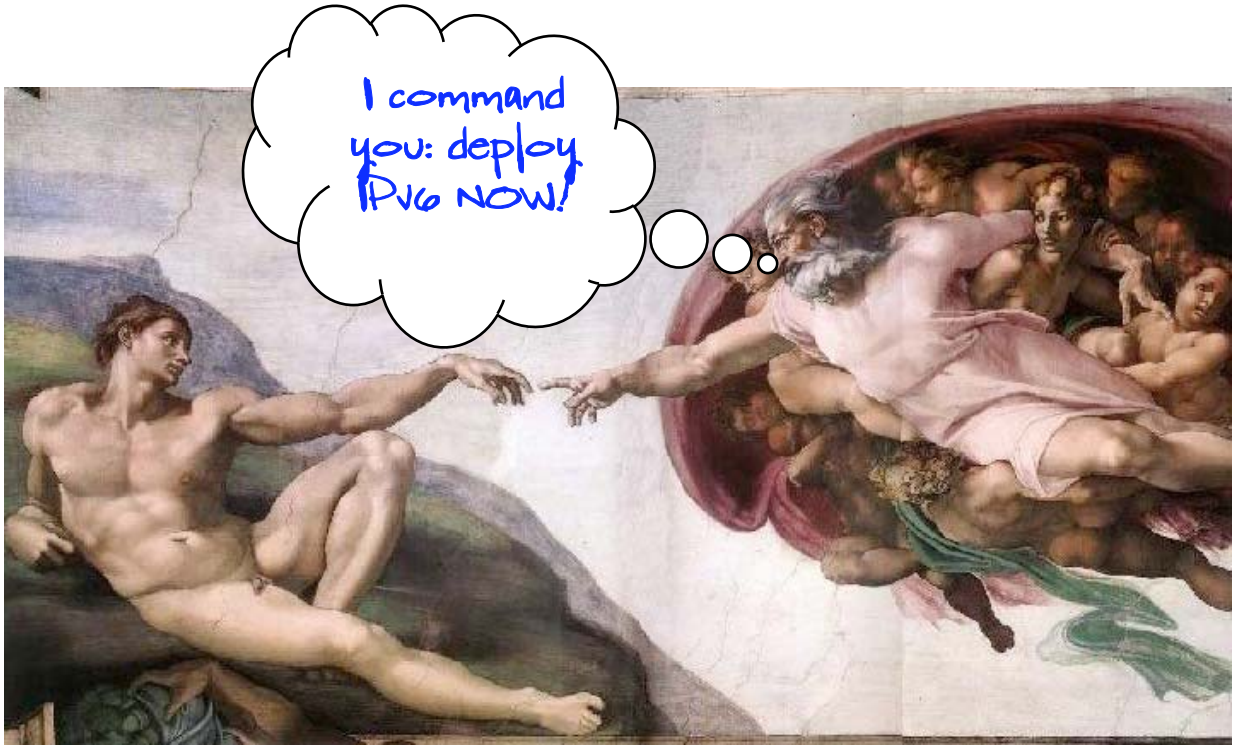
what's the revised plan?



If IPv6 is the answer then...

Plan A: its time to move!

The global internet adopts IPv6 universally before January 2009 and completely quits all use of IPv4 well before address pool exhaustion occurs

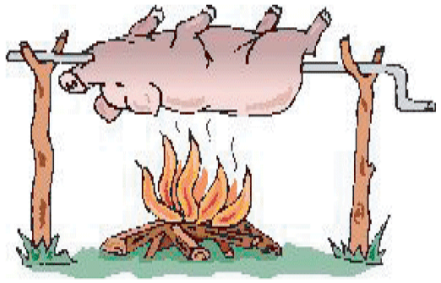

I command you: deploy IPv6 NOW!

If IPv6 is the answer then..

Plan A: its time to move!

The global Internet, with more than 1.7 billion users, a similar population of end hosts, and hundreds of millions of routers, firewalls, and billions of lines of configuration codes, and hundreds of millions of ancillary support systems, where only a very small proportion are IPv6 aware, , are all upgraded and fielded to work with IPv6 in the next 120 days, and then completely quits all use of IPv4 in 10 days later.

Really



BIG and FAST don't go together!

If IPv6 is the answer then...

Plan B: Dual Stack

Leisurely IPv6 deployment

and

Persist with IPv4 networks using more NATs

If IPv6 is the answer then...

Plan B: Dual Stack

Make IPv4 work using more intense levels of NAT deployment in new products and services for as long as the existing deployed networks continue to use IPv4

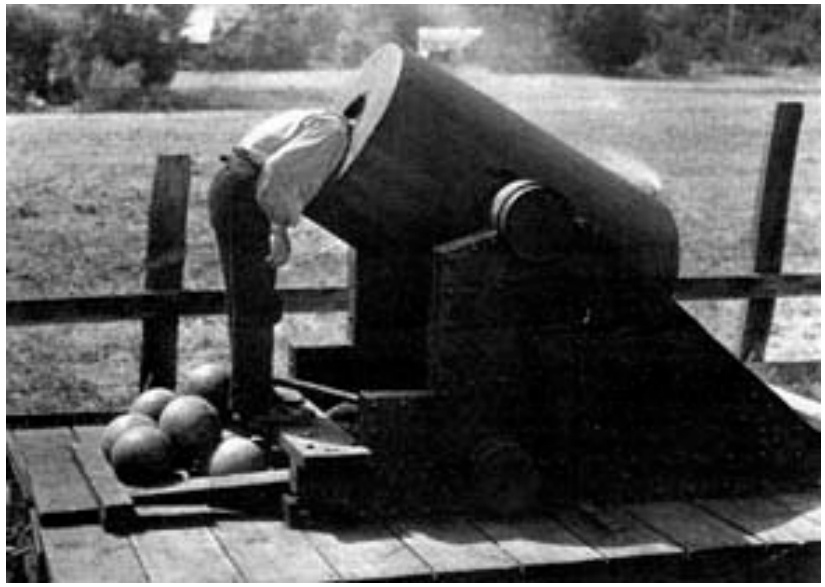
This may take a decade or two

If IPv6 is the answer then...

Plan B: Dual Stack

So if IPv4 is a necessity for the next 10 or 20 years, what exactly is IPv6's role here?

What immediate marginal benefit is obtained from the additional cost of deploying IPv6 in a dual stack?



Its just not looking very good is it?

Why are we here?

Its just Business ...

This entire network is customer funded

Every vendor is intensely focussed on meeting customer needs

Customers have absolutely no clue what this IPv6 stuff is about — so they are not paying extra for IPv6!

And vendors and service providers are not about to build IPv6 for free

We appear to be seriously wedged!

Or Business Failure?

IPv6 adoption offers all the marginal benefit of a pretty minor technology change change with all the costs and disruption of a major forklift upgrade

On the other hand there are more options...

What options for the Internet's future exist that do not necessarily include the universal adoption of IPv6?

The Failure Option

What if IPv6 doesn't happen?

The Failure Option

What if IPv6 doesn't happen?

- Existing network deployments continue to use IPv4 — no change there
- New networks will have to use IPv4 - no change there either
- We are going to have to make IPv4 last past exhaustion, coupled with intense use of NATs - no change there either!

If IPv6 is NOT the answer then...

Plan C: IPv4 for ever

~~Leisurely IPv6 deployment~~

~~and~~

Persist with IPv4 networks using more NATs

Making IPv4 Last Longer

Redeploy "idle" IPv4 addresses?

Not every address is "in use"

End host utilization levels of addresses are estimated to be around 5% — 20% of the address pool

So could we flush more addresses back into circulation?

Yes, but it will take money and markets to flush them out!

NATs on Steroids?

We need to get really good at NATs …

Fun new products to play with: carrier scale NATs?

Multi-level NAT deployments both at the customer edge and within the ISP network

Standardise NAT behaviours to full cone behaviour allow application determinism and maximum address / port utilization

Load applications with greater levels of context discovery, multi-party rendezvous, and adaptive parallelsim

NAT Futures

Are NATs just more of the same? Is this the "safe" option?

How far can NATs scale?

How complex can we get with this network?

Are we willing to find out?

NAT limits?

Recent studies on application behaviour:

- Applications use parallel sessions to improve performance
- Each host needs an allowance of 100 - 300 ports for the more extravagant applications
- Each NAT IP address can serve 200 hosts, or maybe 100 customers within the framework of existing application behaviours — without creating too much havoc!

Numbers, numbers, numbers

Assume that:

- dual stack transition will take a further 10 years
- the growth pressure for network connectivity will average 200 million new connections per year
- All growth will be using IPv4

A /16 could service around 6 million customers if you achieved 100% packing density with NATs

Numbers, numbers, numbers

Assume that:

- dual stack transition will take a further 10 years
- the growth pressure for network connectivity will average 200 million new connections per year
- All growth will be using IPv4
- CGNats achieve average of 50% address utilization efficiency with allowance of 600 ports per customer

Could that scale to 1 billion customers on a /8 ?

Numbers, numbers, numbers

Assume that:

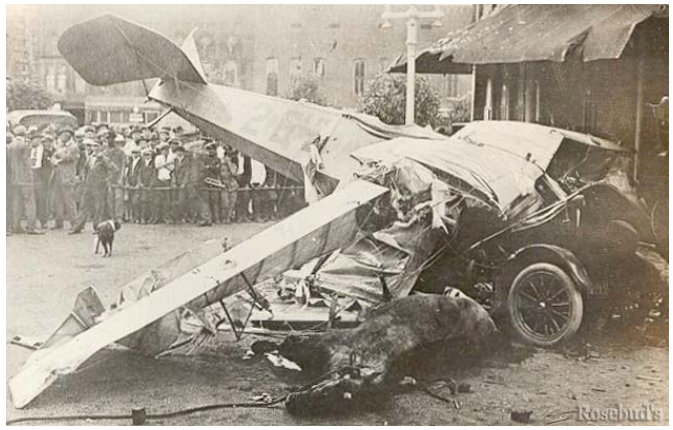
- dual stack transition will take a further 10 years
- the growth pressure for network connectivity will average 200 million new connections per year
- All growth will be using IPv4
- CGNats achieve average of 50% address utilization efficiency with allowance of 600 ports per customer

Then the IPv4 requirements for the next 10 years of Internet growth would be possible within a pool of 4 /8s !

But what about the next 10 years?

And the next 10?

And ...



Maybe that's pushing NATs a bit too far

what other options do we have?

If IPv6 is NOT the answer then...

Plan X: end-to-end IP is NOT the answer either!

huh?

Application Level Gateways!

For example:
Use the 3G approach - IMS

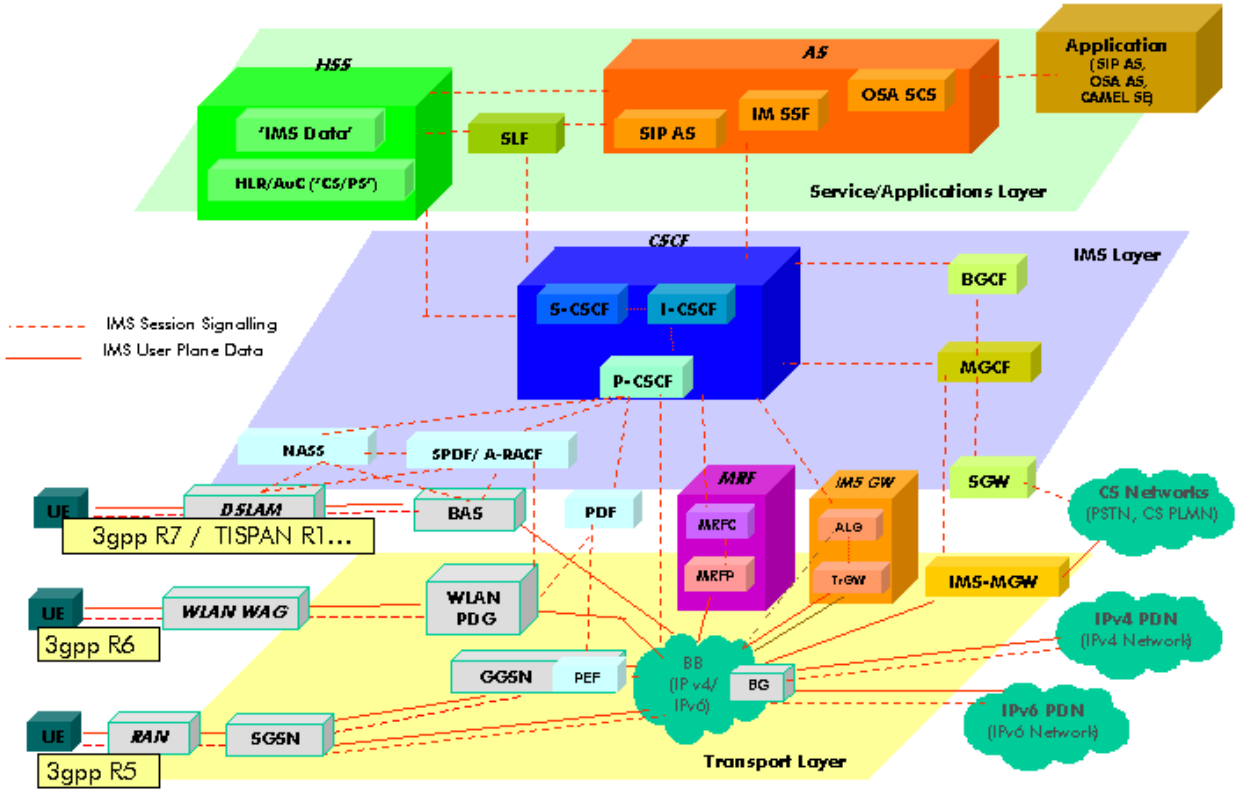
IMS is an architecture of application level gateways

front-end proxies act as agents for local clients

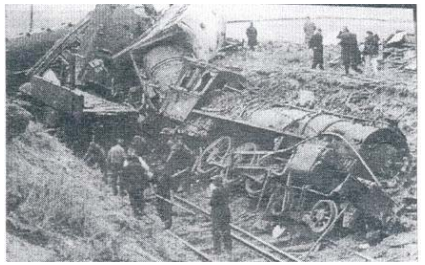
applications are relayed through the proxy

no end-to-end IP at the packet level

Yes, it's VERY ugly!



But is something deeper about networking architecture evolution lurking here?



- circuit networking
  - shared capable network with embedded applications
  - simple 'dumb' peripherals
- packet networking
  - simple datagram network
  - complex host network stacks
  - simple application model
- identity networking?
  - sets of simple datagram networks
  - locator–based host network stacks
  - identity–based application overlays

But do we understand enough to bet the entire future of the Internet on this theory of the evolution of network architectures?

Probably not!

There are options that do not include the universal deployment of IPv6

But these options represent a pretty dismal future of:

- escalating network cost,
- escalating application complexity and fragility
- massively reduced flexibility,
- massively increased risks of failure

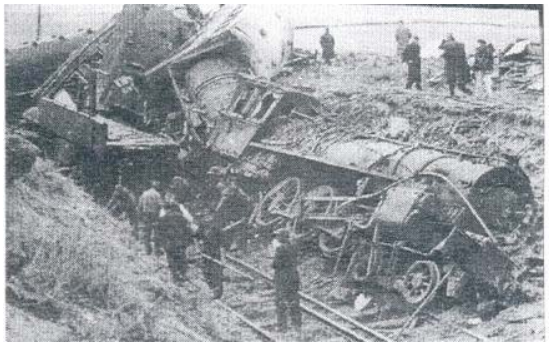
Is this a bit like the economics of climate change?

Right now individual short term interests are leading the Internet towards collective long term sub—optimal outcomes

At some point very soon the Internet will need some external impetus to restate short term interests to align with common longer term objectives

If we want IPv6 to happen we might need a large kick in the rear to get us there!

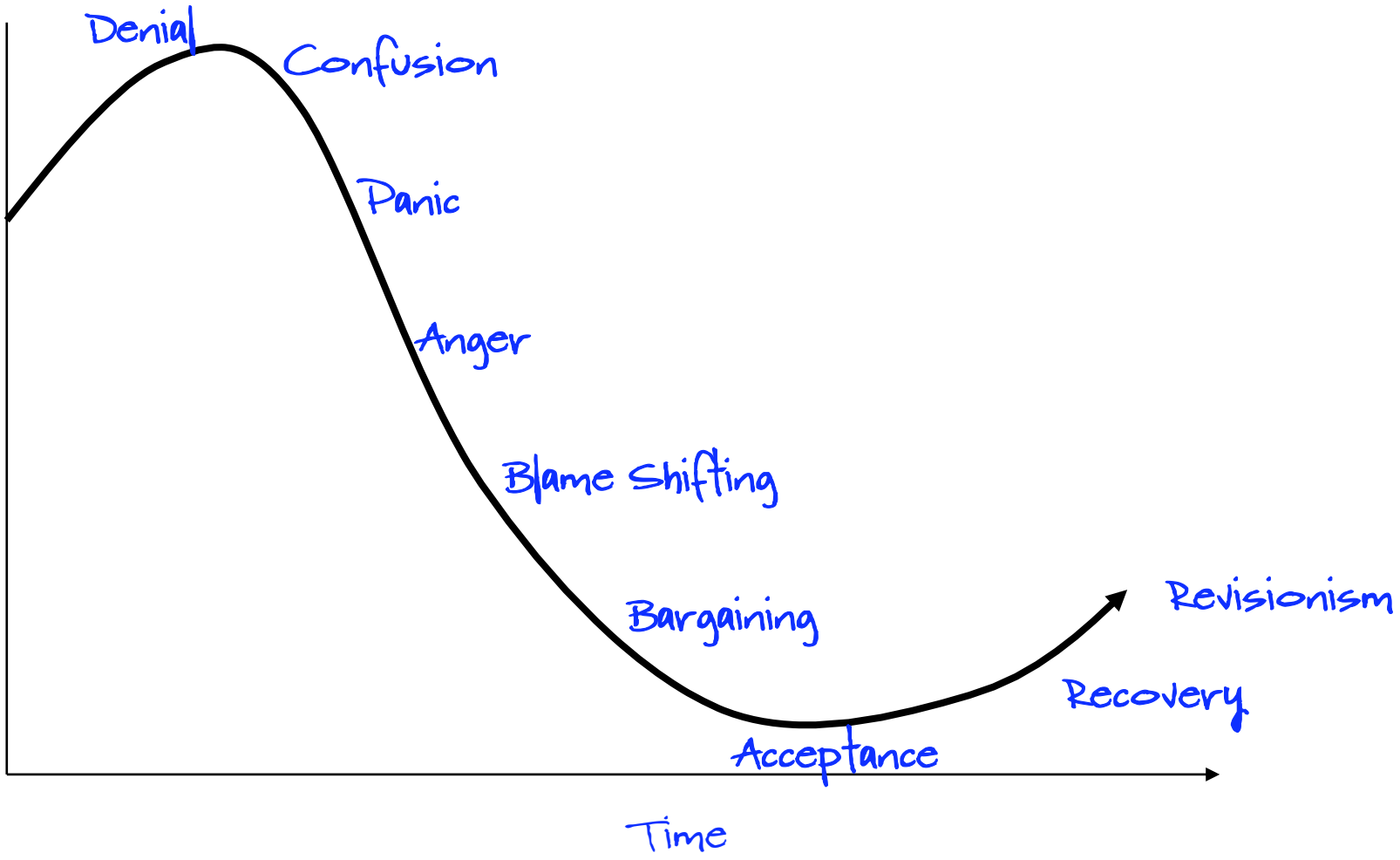
But what could be useful right now is …



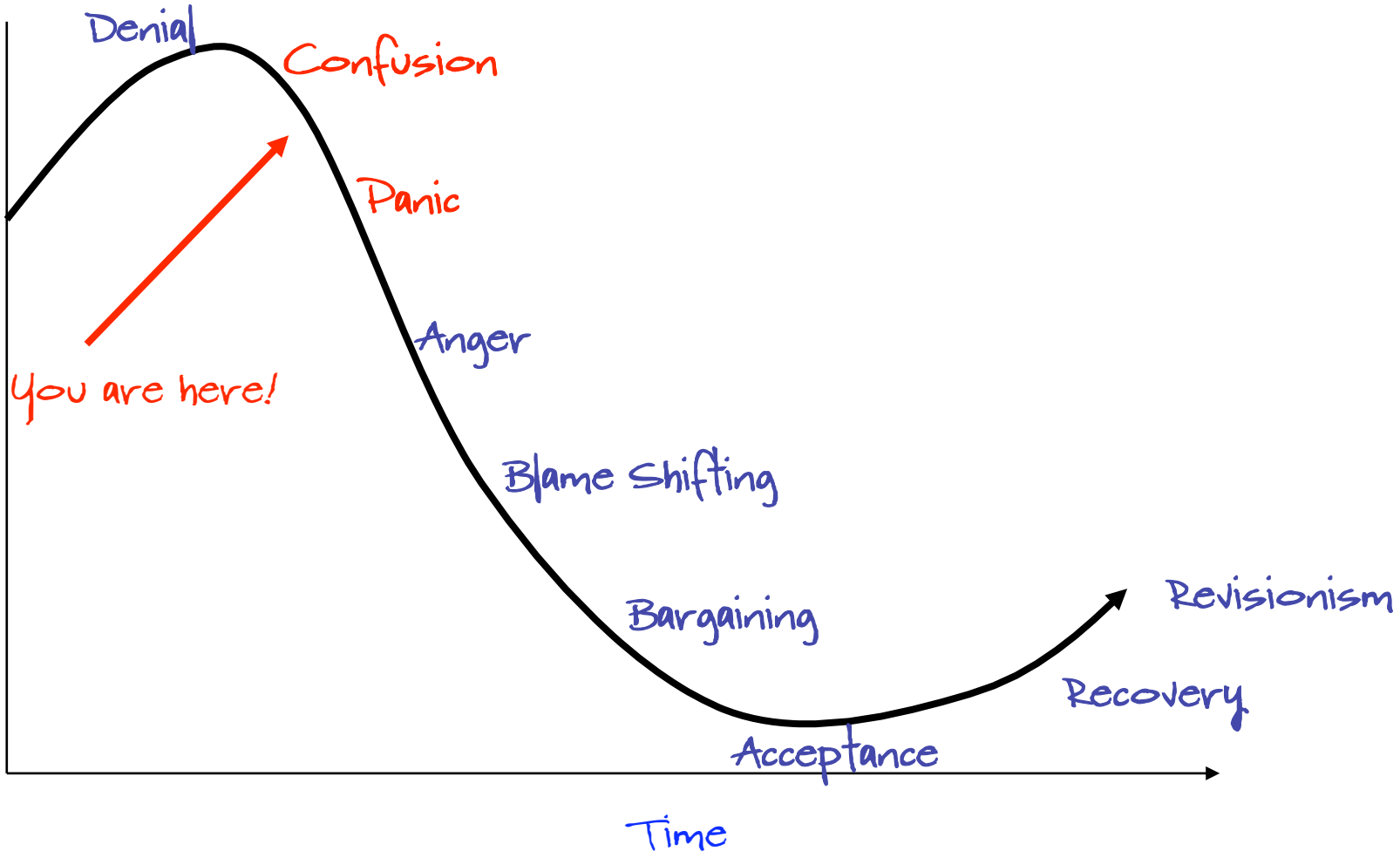
- An appreciation of the broader context of business imperatives and technology possibilities
- An understanding that leaving things to the last millisecond may not be the wisest choice for anyone
- An appreciation IPv6 still represents the lowest risk option of all the potential futures

Fully deregulated environments do not necessarily make the wisest choices – this industry may need some additional applied impetus to get there.

Coping with Crises



Coping with Crises



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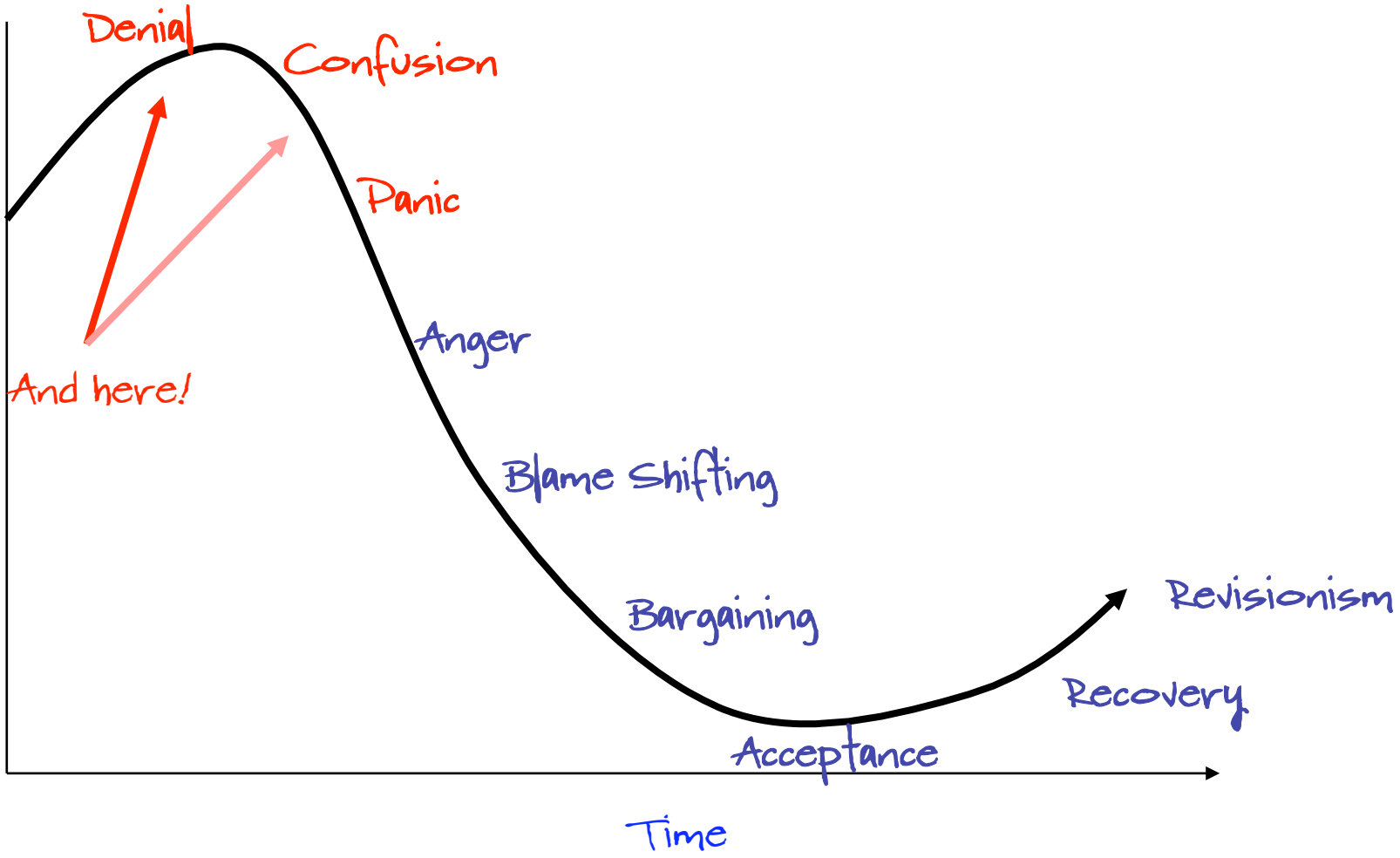

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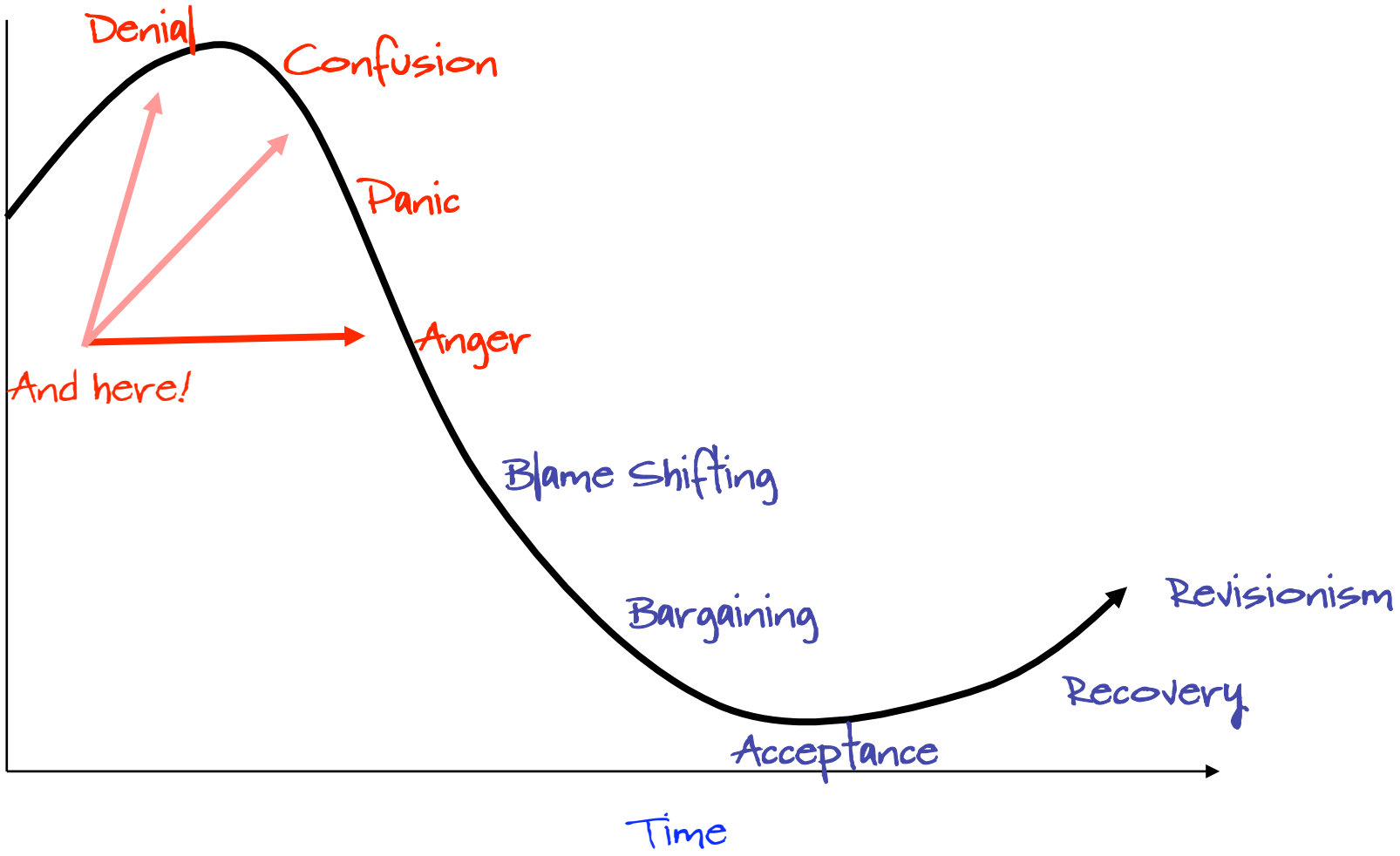
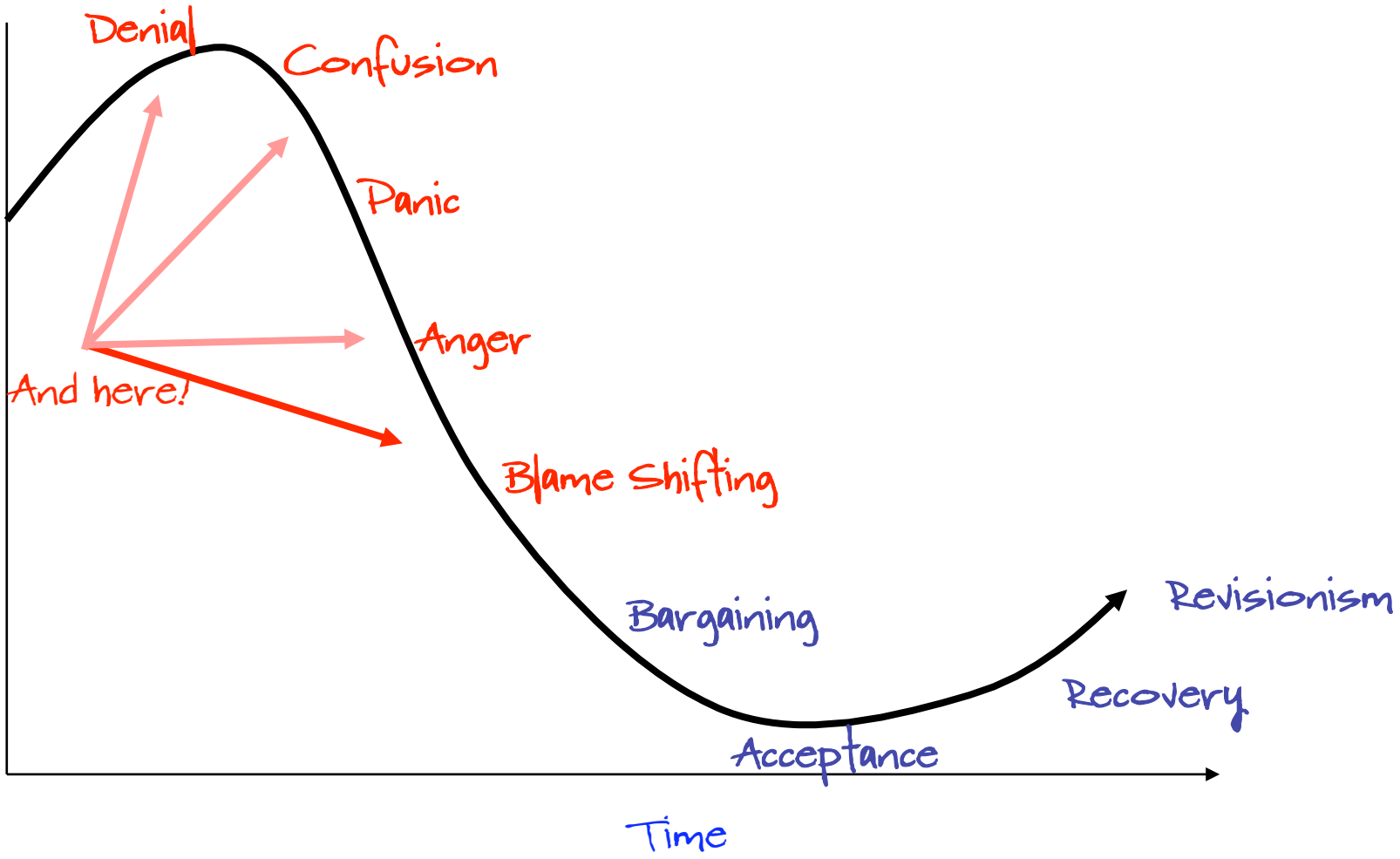


Coping with Crises



Thank You