Hello.

How many

IPv6

presentations

have you sat though

in the last 10 years?

20?

200?

2,000?

Had enough yet?

Or

are you ready

for more?

But

do you

really

want to sit though

yet another

mind numbing

presentation

about

how IPv6 is going to be

bigger


better

faster


and shinier

?

Neither do I.

So lets try

something else.

After 10 years

of waiting

for an IPv6

Internet

we’ve achieved

absolutely

nothing.

So

today’s

presentation

#2,328

#2,329

#2,330

#2,331

#2,332

will look

at


IPv6

using

another word:

Failure.

Usual weasel words disclaimer stuff:

Usual weasel words disclaimer stuff:

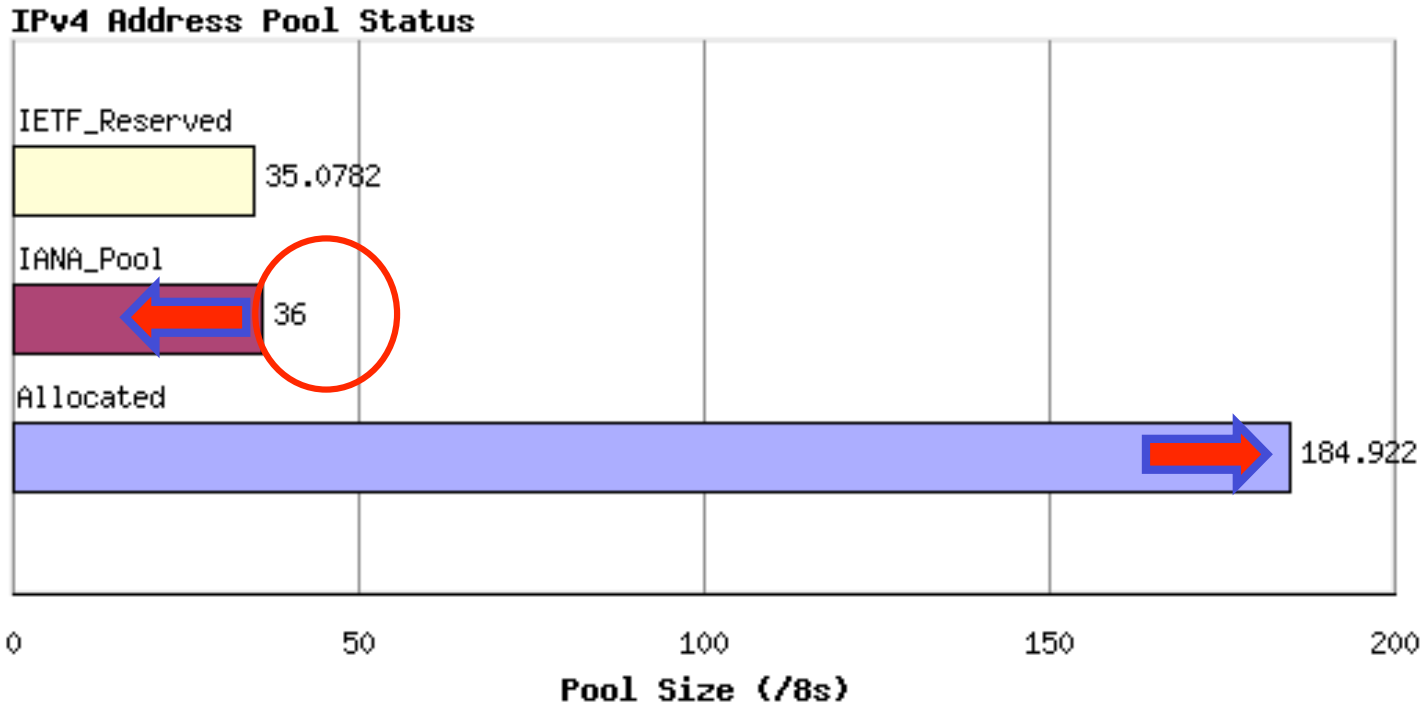
All the bad ideas here are entirely mine.

Usual weasel words disclaimer stuff:

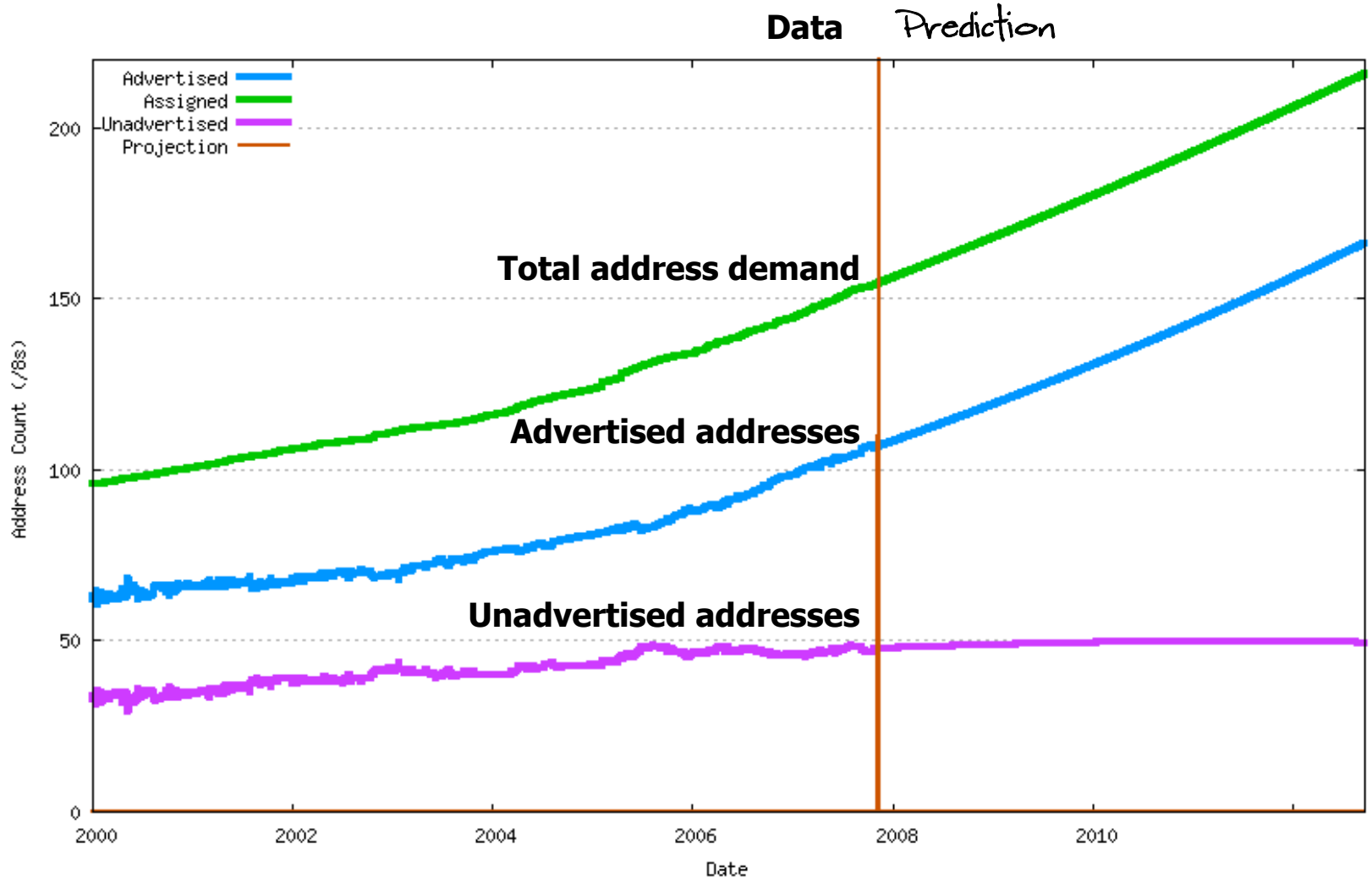
All the bad ideas here are entirely mine.

Any good ideas that snuck in were probably stolen from someone else!

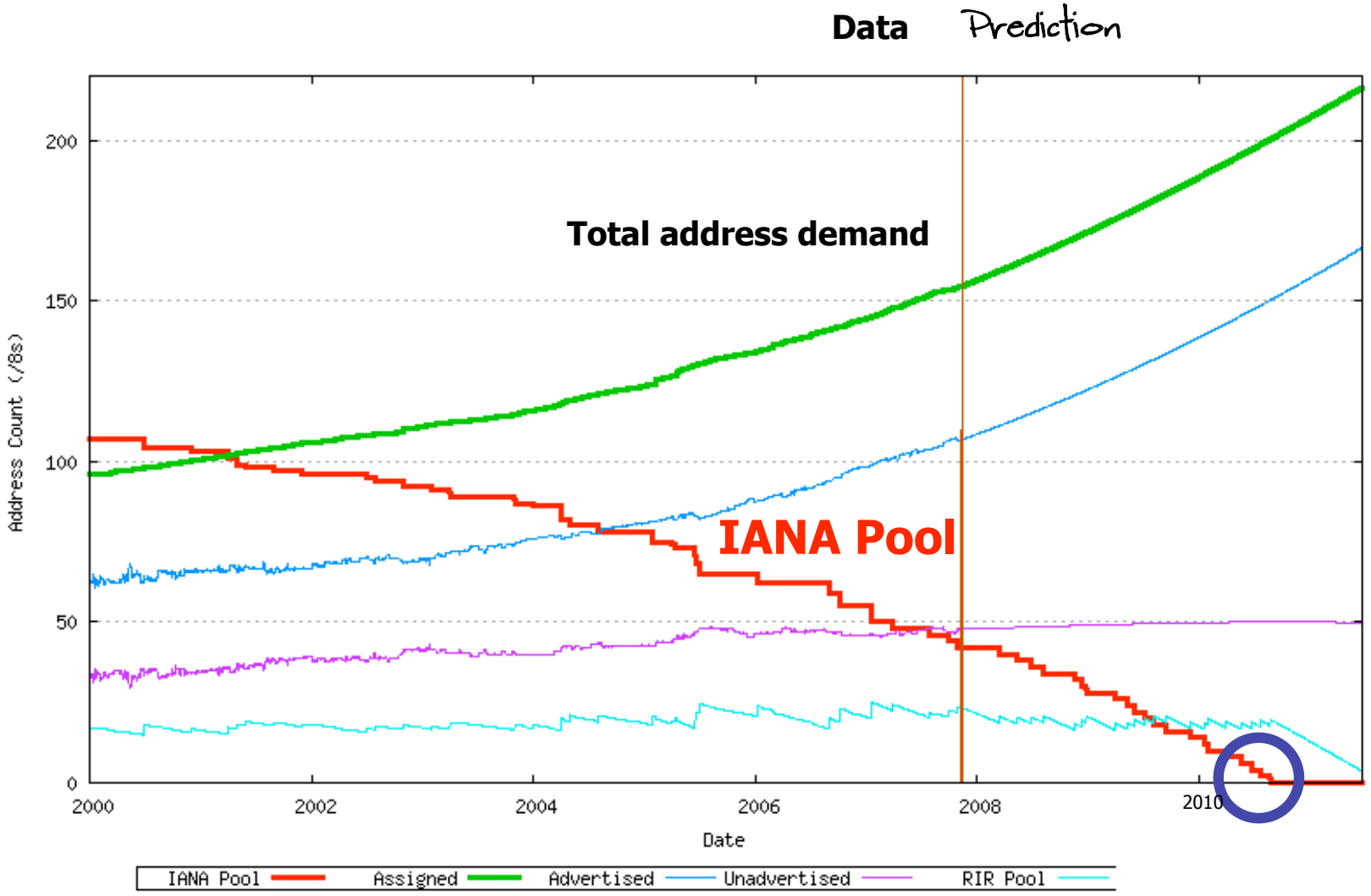
Today


IPv4 Address Pool Status
IETF_Reserved
35.0782
IANA_Pool
36
Allocated
184.922
0
50
100
150
200
Pool Size (/8s)

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
Date

Ooops!


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

That's 29th January 2011

http://ipv4.potaroo.net

That's 29th January 2011

YAWN - seen all this before

It's now BORING!

http://ipv4.potaroo.net

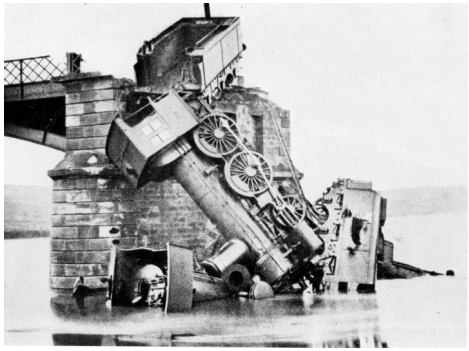
That's a highly uncertain prediction - it could be out by as much as 18 months

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

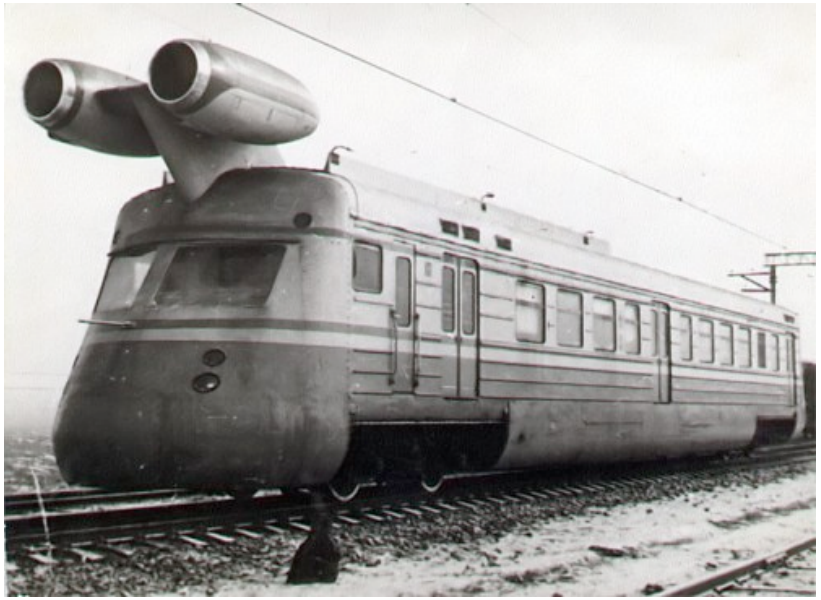
And modeling uncertainty due to:

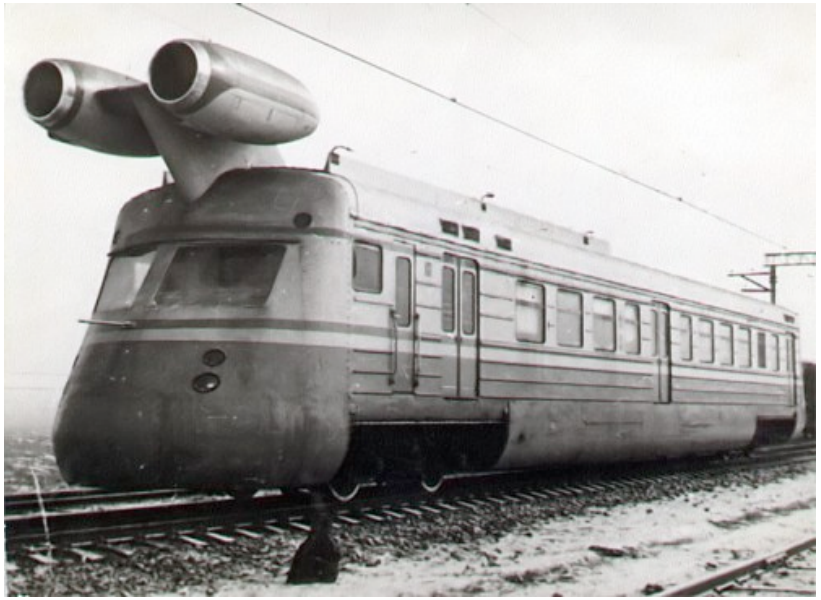
highly skewed data used to make projections



Let's say some time between
late 2009 and early 2011

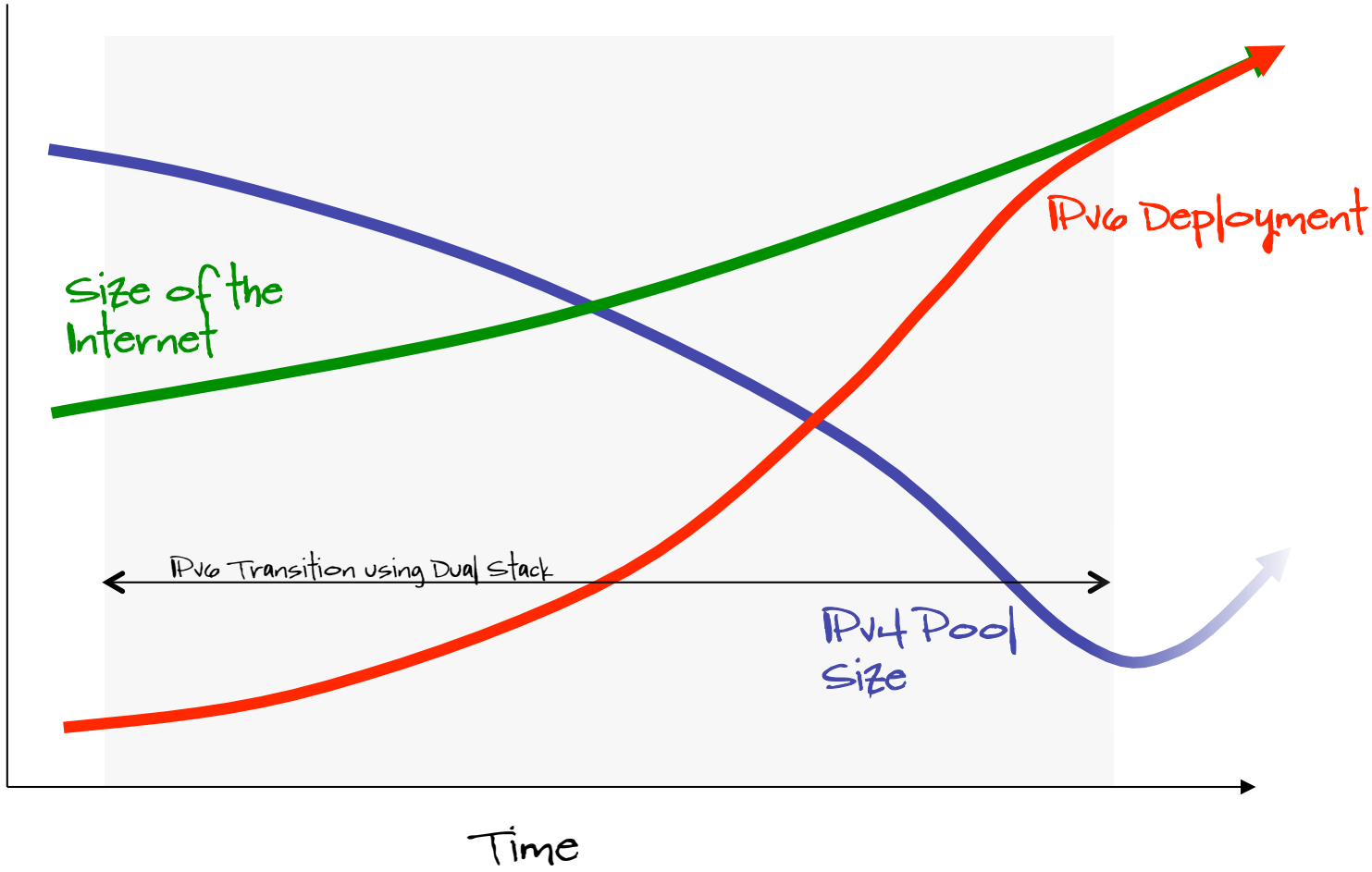
what then?

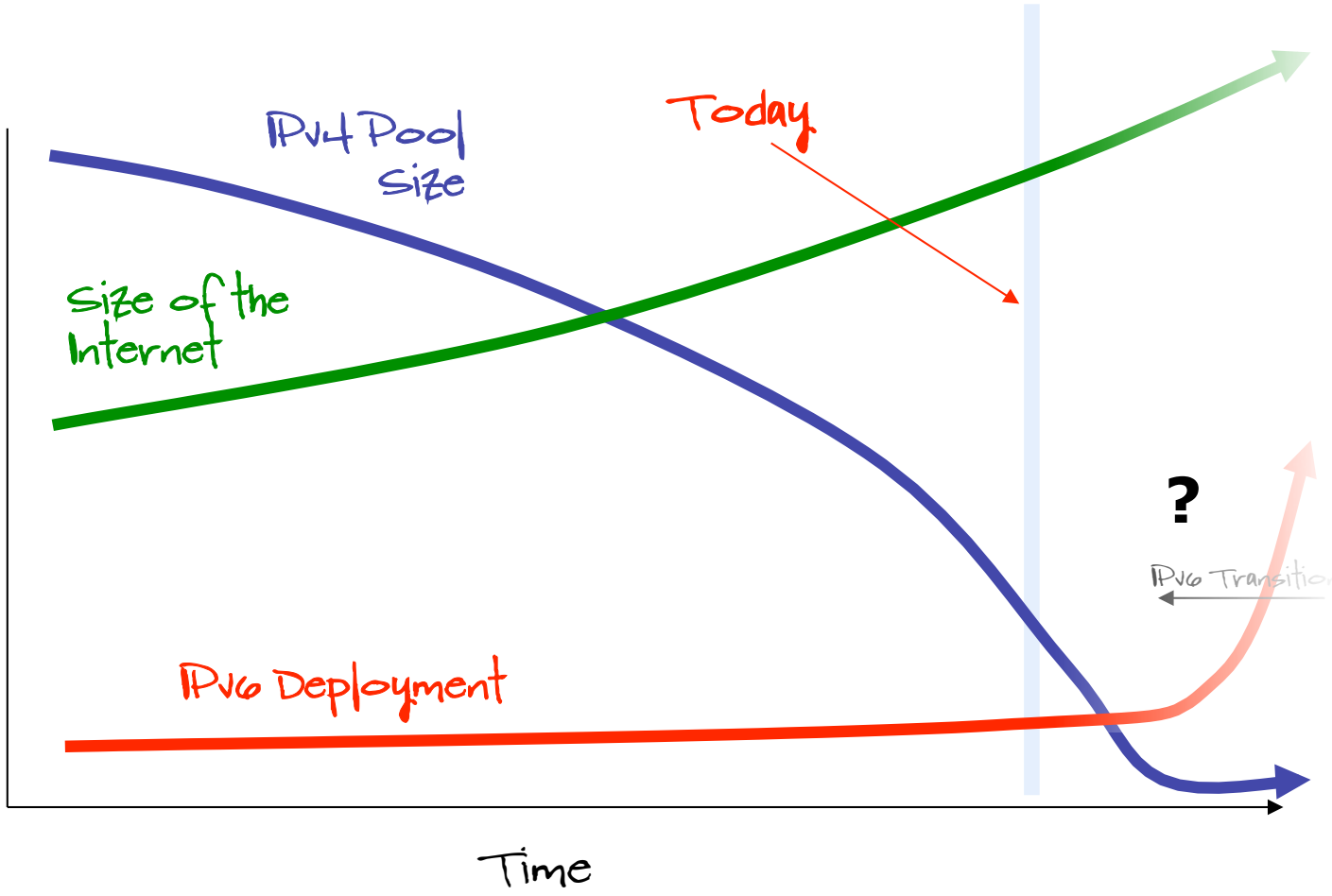




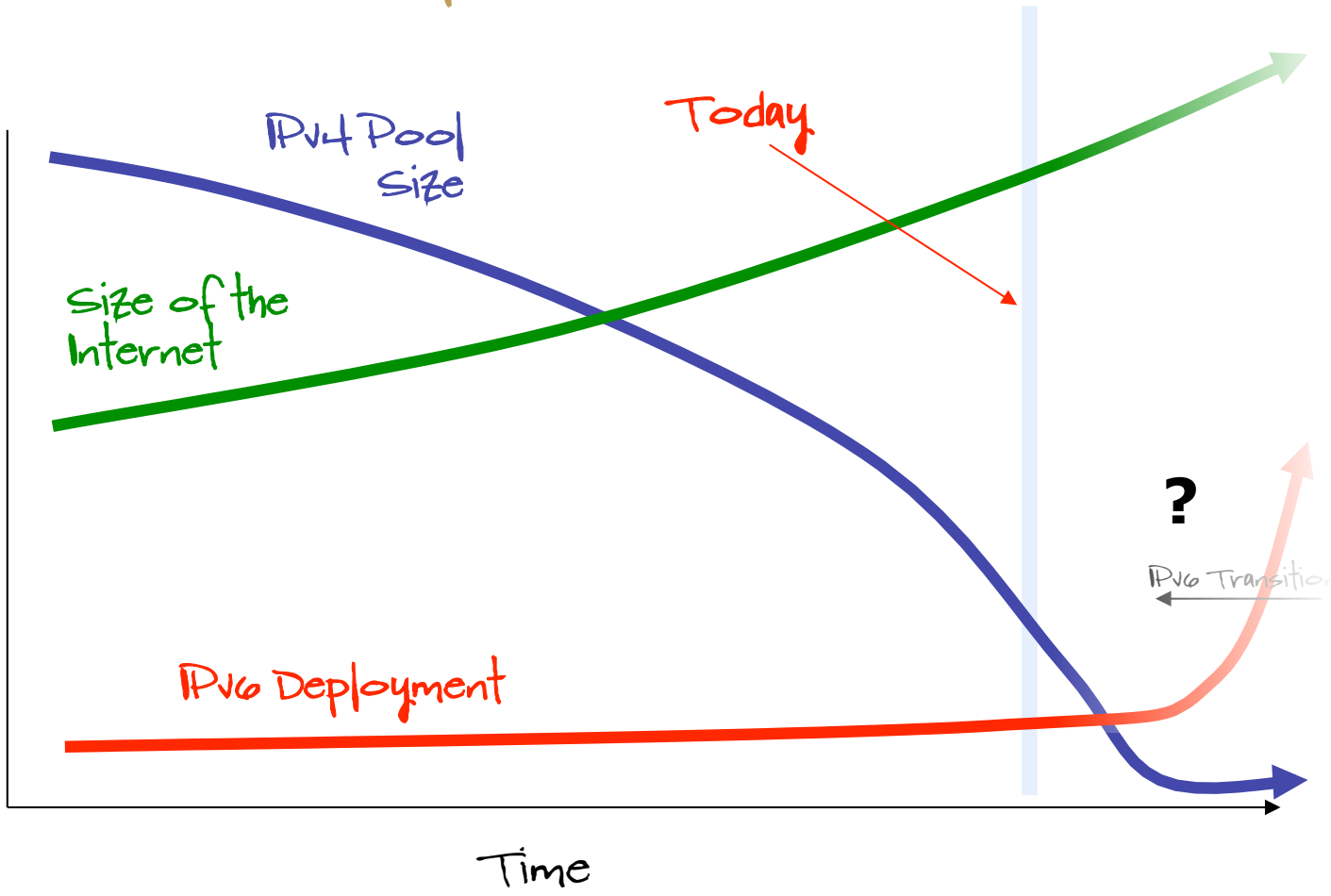
IPv6!

We had this plan …


IPv6 Deployment
Size of the Internet
IPv6 Transition using Dual Stack
IPv4 Pool Size
Time


IPv4 Pool Size
Today
Size of the Internet
?
IPv6 Transition
IPv6 Deployment
Time

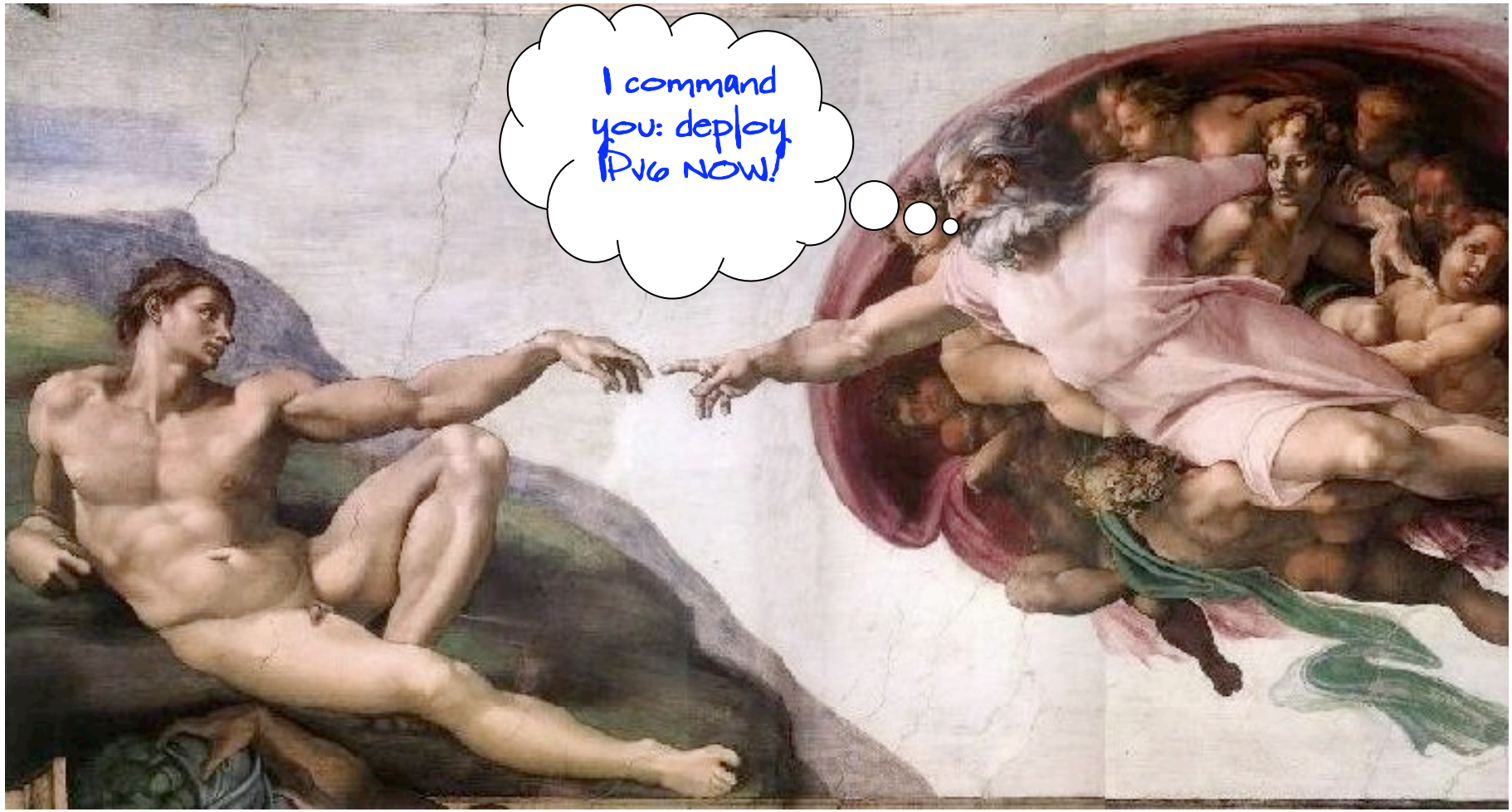
what's the revised plan?



If IPv6 is the answer then...

Plan A: its time to move!

The global internet adopts IPv6 universally, 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

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Plan A: its time to move!

The global Internet, with more than 1.7 billion users

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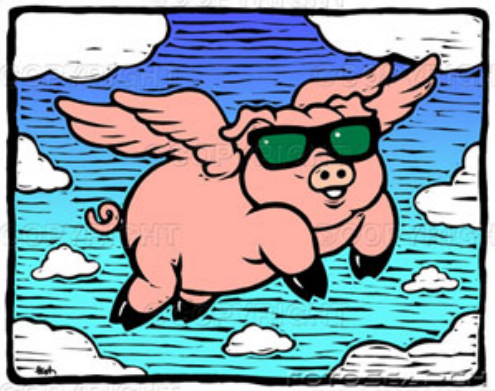
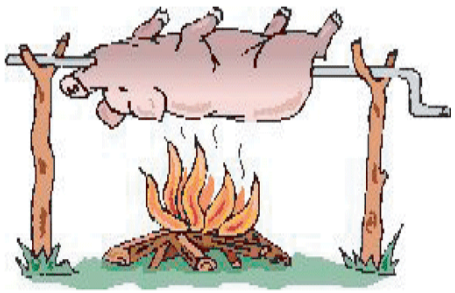
Really



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 to keep it going)

If IPv6 is the answer then...

Plan B: Dual Stack

Make IPv4 keep on working across an ever-larger Internet, using more intense levels of NAT deployment in new products and services, for as long as the existing deployed networks continue to use IPv4 as part of a Dual Stack transition

This may take a decade

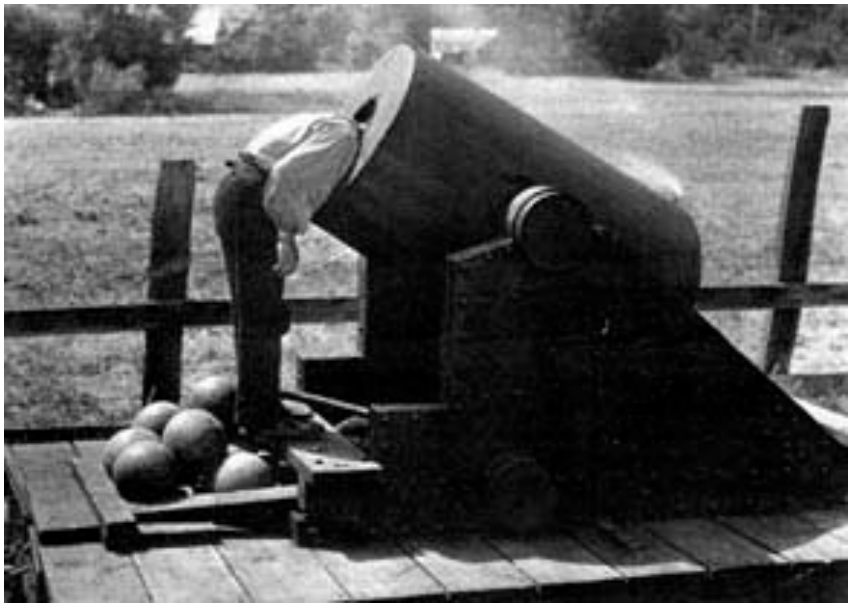
or even two!

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?



Its just not looking very good is it?

Why are we here?

Its just Business …

This entire network is customer funded

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we appear to be seriously wedged!

Or just another Business Failure?

IPv6 adoption offers all the marginal benefit of a pretty minor technology change change

Or just another 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?

Failure Options

What if IPv6 doesn't happen?

Existing network deployments continue to use IPv4

Existing network deployments continue to use IPv4 — no change there from the Dual Stack plan

New networks will have to use IPv4

New networks will have to use IPv4 -
but they would have to do that under the Dual
Stack plan anyway, so no change there either

We are going to have to make IPv4 last past exhaustion, coupled with intense use of NATs

We are going to have to make IPv4 last past exhaustion, coupled with intense use of NATs - no change there either from what is needed with the Dual Stack transition!

Failure Options

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 X: 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

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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 maybe 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 deep in the network coupled with port-rationing of end customers?

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

Smarter applications with greater levels of context discovery, multi-party rendezvous, and adaptive parallelism

NAT Futures

Are NATs just more of the same?

Is this the "safe" option of changing almost nothing?

How far can NATs scale?

How complex can we get with this network?

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Are NATs just more of the same?

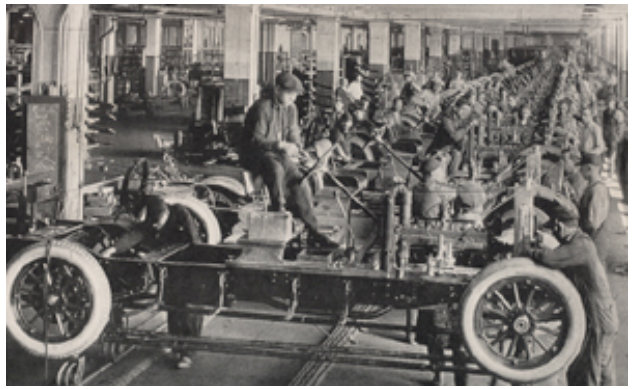
Is this the "safe" option of changing almost nothing?

How far can NATs scale?

How complex can we get with this network?

Are we willing to find out?

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
- Carrier Grade Nats 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 Z: end-to-end IP is NOT the answer either!

huh?

Application Level Gateways!

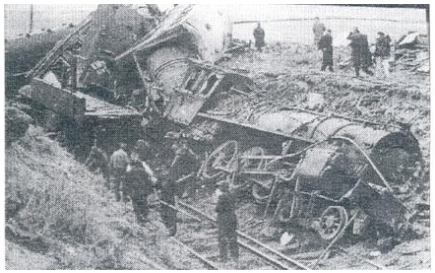
Remember them?



They're what we used to do in the 80's!



Is there something about networking architecture evolution lurking here?



circuit networking

shared capable network with embedded applications

simple 'dumb' peripherals

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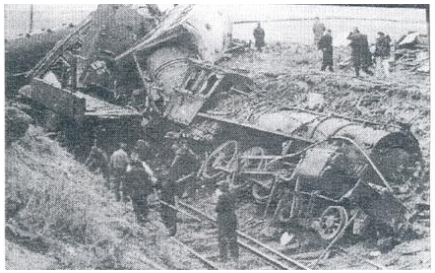

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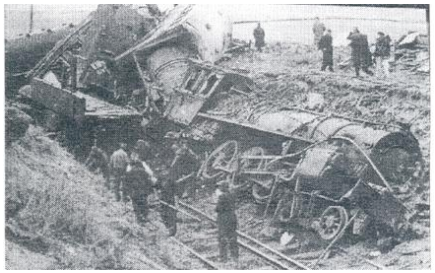


- circuit networking
  - shared capable network with embedded applications
  - simple 'dumb' peripherals
- packet networking
  - simple datagram network
  - complex host network stacks
  - simple application model
- identity networking?
  - sets of simple datagram networks
  - locator–based host network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

huh?

Do we understand enough to bet the entire future of the Internet on scaling the network based on this theory of the evolution of network architectures?

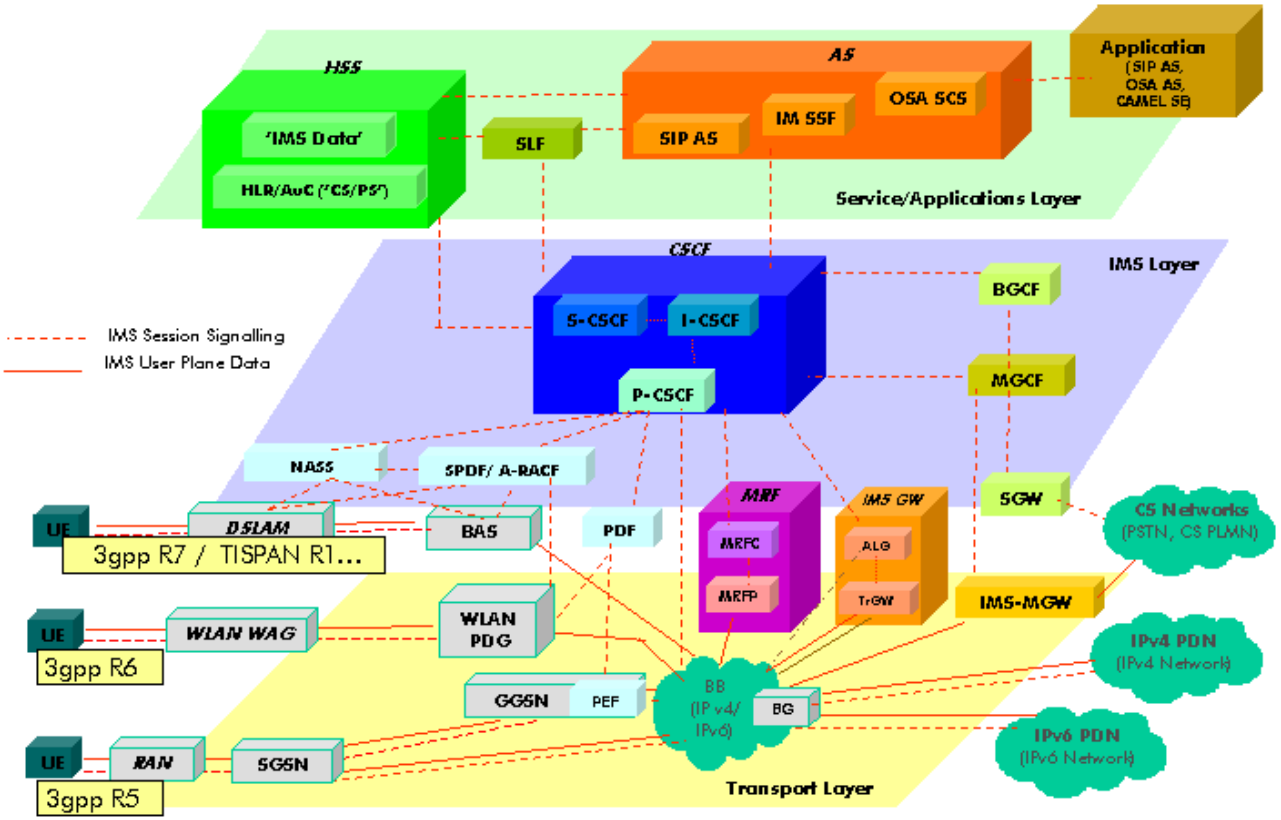
Possibly

And we may be heading down this path already.

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 ugly!


HSS
'IMS Data'
HLR/AuC ('CS/PS')
SLF
AS
SIP AS
IM SSF
OSA SCS
Application
(SIP AS,
OSA AS,
CAMEL SE)
Service/Applications Layer
IMS Layer
CSCF
S-CSCF
I-CSCF
P-CSCF
BGCF
MGCF
SGW
CS Networks
(PSTN, CS PLMN)
IMS Session Signalling
IMS User Plane Data
NASS
SPDF/ A-RACF
MRF
MRFC
MRFP
IMS GW
ALG
TrGW
IMS-MGW
PDF
UE
DSLAM
BAS
3gpp R7 / TISPAN R1...
UE
WLAN WAG
WLAN PDG
3gpp R6
GGSN
PEF
BB
(IP v4/ IPv6)
BG
IPv4 PDN
(IPv4 Network)
IPv6 PDN
(IPv6 Network)
UE
RAN
SGSN
3gpp R5
Transport Layer

But it has its fans!

The true technical solution to the challenge of convergence comes as we make the move to IMS, or IP Multimedia Subsystems, which will provide the common control and protocols for applications to work across our networks. We've been involved in the push for IMS since its inception. In 2006, we drove an initiative called "Advances in IMS", which was executed by a task force of companies, whose purpose was to catalyze closure on worldwide standards for IMS which would make its deployment pragmatic in the near-term for operators. I'm happy to say that we succeeded. With IMS, the customer will no longer be stranded on separate islands of technology for things like messaging, voice, or video. Instead, we'll be able to build an application once and have the network deliver it to customers wherever they need it.

Dick Lynch CTO Verizon, 20 August 2008

The motivation for the IMS and NGN efforts include building a bright shiny future where:

- the focus is on application coherence,
- convergence is realized through integration of delivery systems with services
- services are provided via managed delivery channels
- integration of security and service quality
- control of the user experience by the network operator
- a return to the bountiful economics of vertically integrated carrier monopolies

Put Another Way...

- "We just build the highway. We don't fix your car."
  - Randy Bush, INET '96
- Well, IMS attempts to build parts of your car's engine, brakes, and navigational system(s) into the highway
  - And has a billing model based on where you are going and who/what is in your car
    - Which BTW means that the system needs this information too
- In short: IMS has as a primary design goal to couple higher-layer services to packet transport
  - Note that coupling is one of the primary sources of complexity in dynamical systems (such as the Internet)
    - See http://www.1-4-5.net/~dmm/talks/SANOGV for a little more on this topic

So if its NOT going to be IPv6, then we have these alternate options…

But they all appear to represent a pretty lousy future of:

escalating network cost,

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a return to the dismal economics of vertically integrated carrier monopolies

Is this what we want to see for the Internet?

Not me!

I hope that I've shown you that there **are** options for this industry that do not include the universal deployment of IPv6

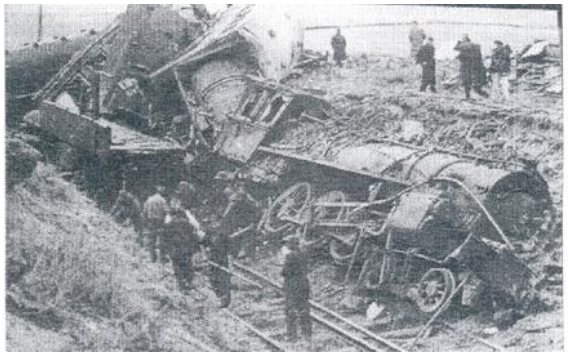
And some sectors of this industry may well prefer to see alternative outcomes here that rebuild their past ~~greed~~ glory

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

Failure to adopt IPv6 really is an option here

But failure is not an option that will serve our longer term interests of operating a capable, effective and innovative communications sector

Failure to adopt IPv6 really is an option here

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

Thank you

for listening to me.

Do you think

that after this talk

you will ever

have me

back

again?

ooops!

Thank You

gih@apnic.net