IPv6 – Past, Present and Future

Geoff Huston

research@apnic.net

APNIC


文明观赏
请勿攀爬
Civilized watching No climbing

A question to each of you…

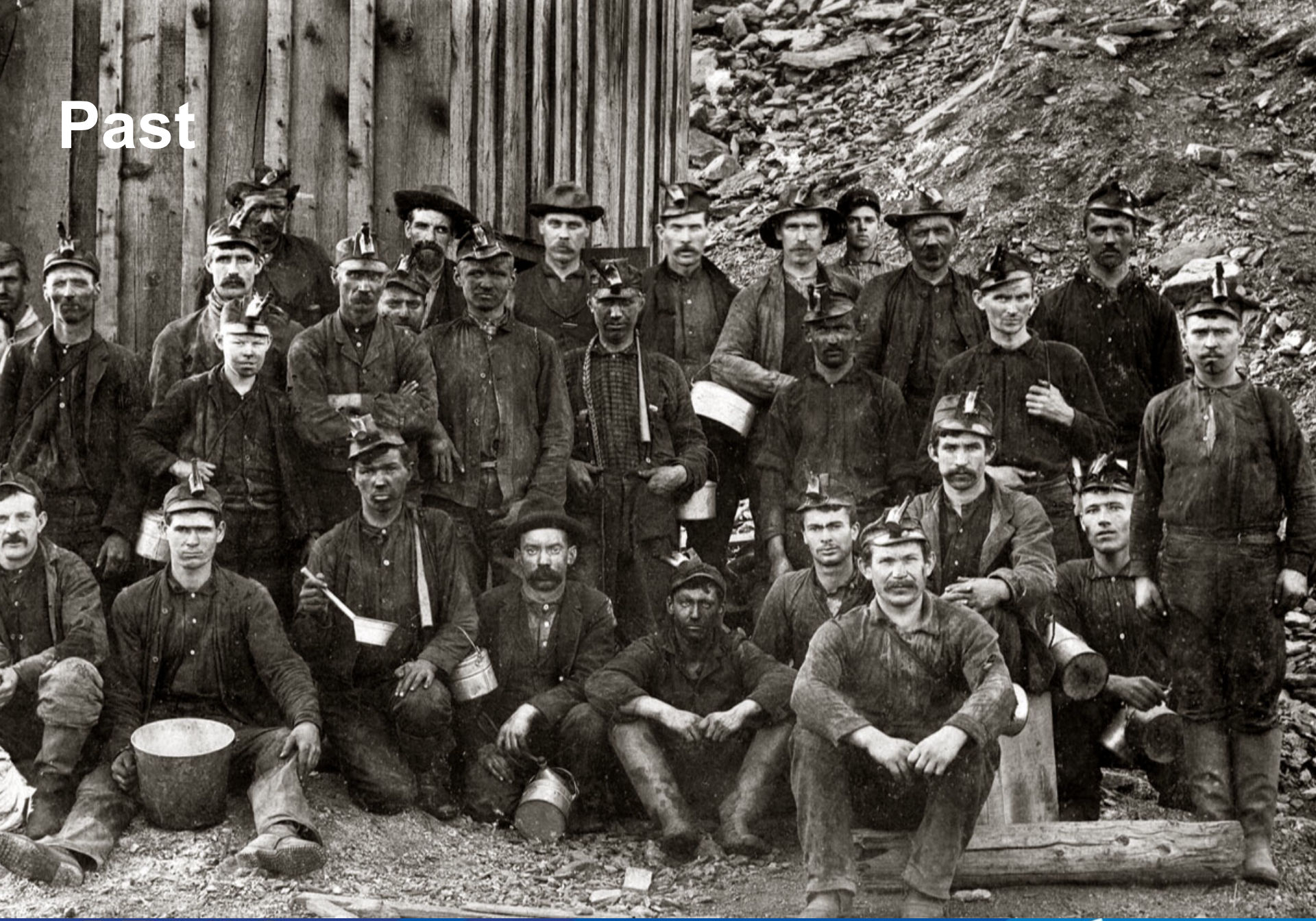
A question to each of you…

How many IPv6 presentations have you sat through?

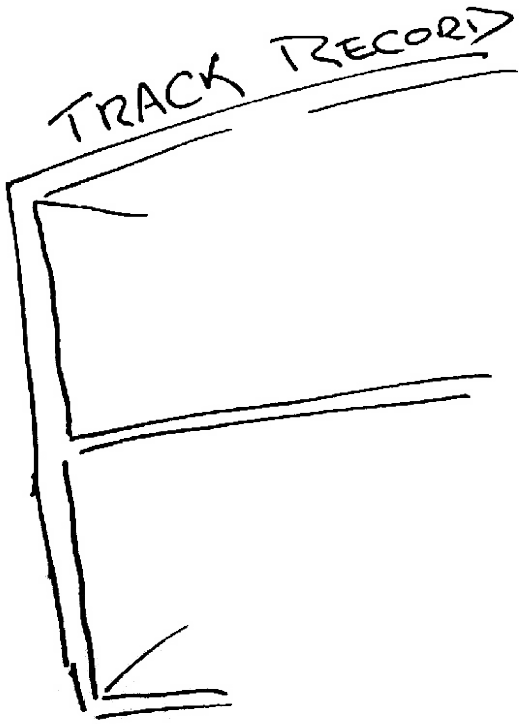
A question to each of you…

How many IPv6 presentations have you sat through?

- ☐ 20?
- ☐ 100?
- ☐ 1,000?
- ☐ I don't know - I was comatose by the end!

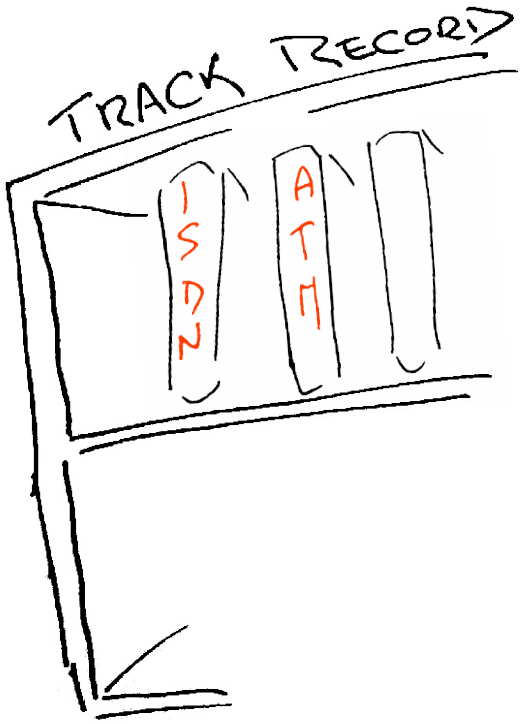

Past

The mainstream telecommunications industry has a rich history



The mainstream telecommunications industry has a rich history

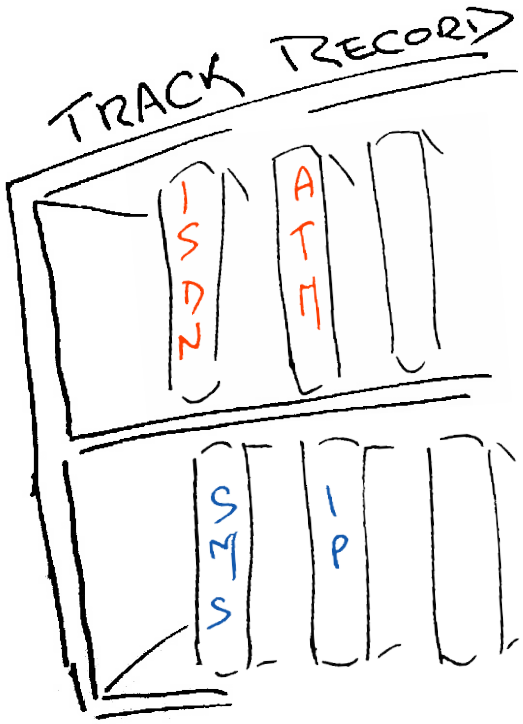
…of making very poor technology choices



The mainstream telecommunications industry has a rich history

…of making very poor technology guesses

and regularly being taken by surprise!



The Internet...

Has been a runaway success that has transformed not just the telecommunications sector, but entire social structures are being altered by the Internet

And now just as we are gearing up, we are about to stuff it up! We've used up most of the Internet's 32bit address pool and that's a huge problem!

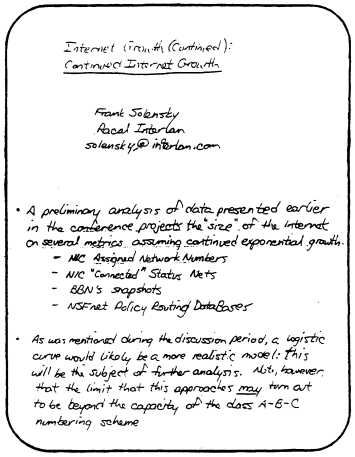
The Internet...

Has been a runaway success that h
transformed not just the tele tions
sector, but entire social s are
being altered by the T

And now just e gearing up, we are
about to up! We've used up most of
the 32bit address pool and that's
a blem!

This is should not be news - we've known about this looming IPocalypse for the past twenty years

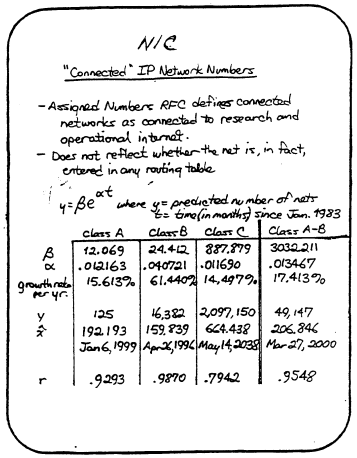
IETF Meeting – August 1990



Internet Growth (Continued):
Continued Internet Growth

Frank Solensky
Racal InterLan
solensky@interlan.com

- A preliminary analysis of data presented earlier in the conference projects the "size" of the Internet on several metrics, assuming continued exponential growth.
  - NIC Assigned Network Numbers
  - NIC "Connected" Status Nets
  - BBN's snapshots
  - NSFnet Policy Routing DataBases
- As was mentioned during the discussion period, a logistic curve would likely be a more realistic model: This will be the subject of further analysis. Note, however, that the limit that this approaches may turn out to be beyond the capacity of the class A-B-C numbering scheme



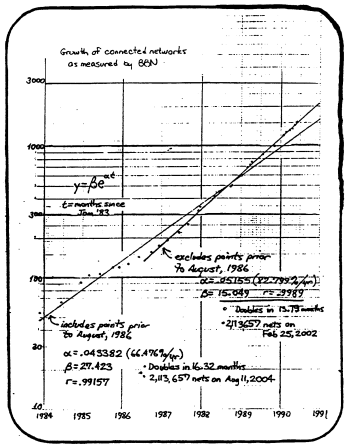
NIC

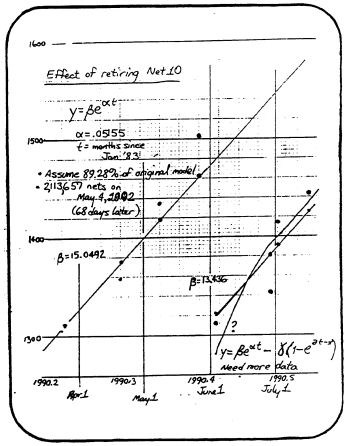
"Connected" IP Network Numbers

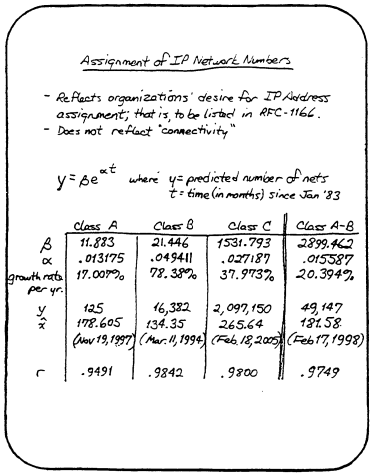
- Assigned Numbers RFC defines connected networks as connected to research and operational internet.
- Does not reflect whether the net is, in fact, entered in any routing table.

$y = \beta e^{\alpha t}$ where y = predicted number of nets, t = time (in months) since Jan. 1983

	Class A	Class B	Class C	Class A-B
β	12.069	24.412	887.879	3032.211
α	.012163	.040721	.011690	.013467
growth rate per yr.	15.613%	61.440%	14.497%	17.413%
y	125	16,382	2,097,150	49,147
$\hat{x}$	192.193	159.839	624.438	206.346
	Jan 6, 1999	Apr 26, 1996	May 14, 2038	Mar 27, 2000
r	.9293	.9870	.7942	.9548





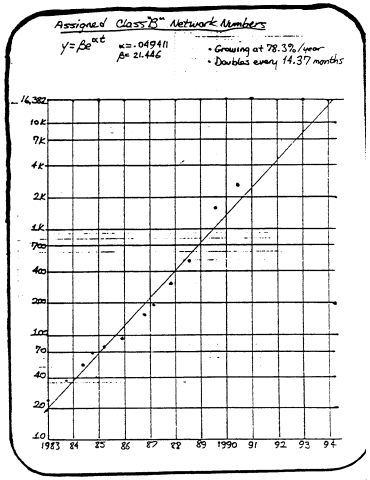


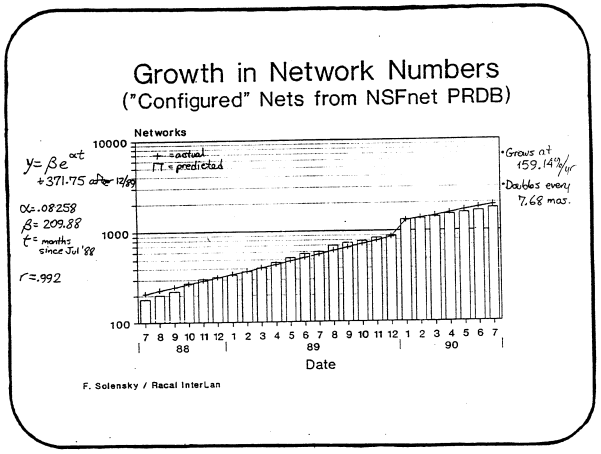
Assignment of IP Network Numbers

- Reflects organizations' desire for IP Address assignment; that is, to be listed in RFC-1166.
- Does not reflect "connectivity"

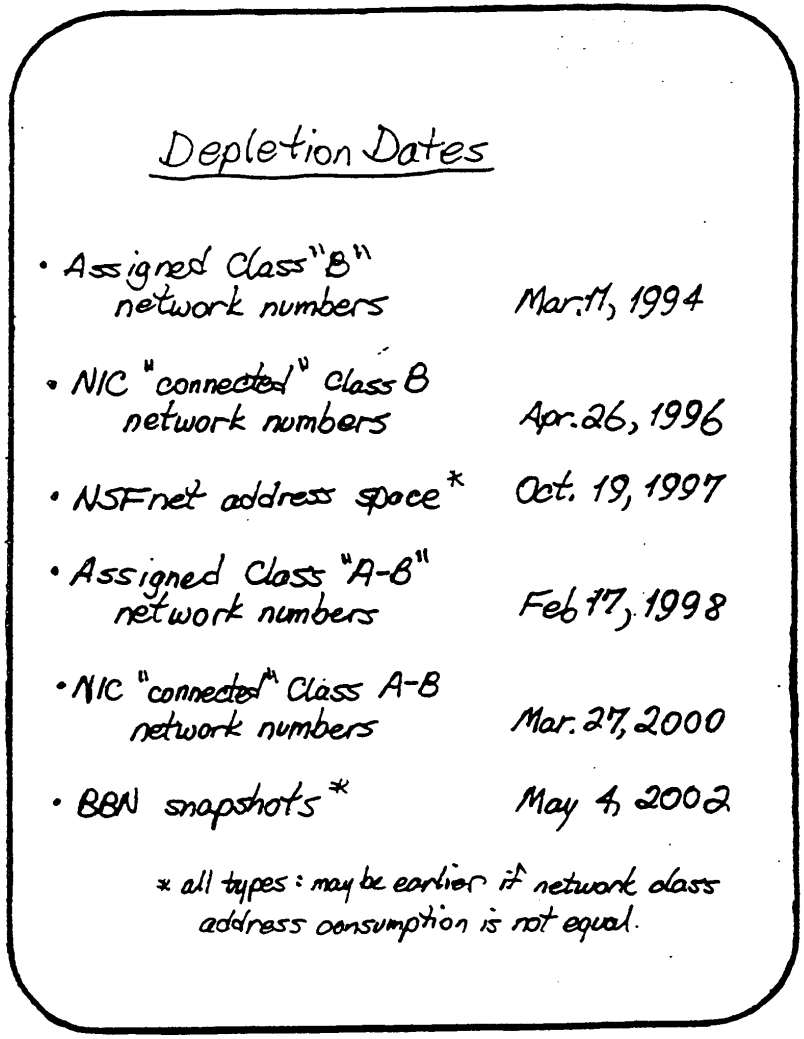
$y = \beta e^{\alpha t}$ where y = predicted number of nets, t = time (in months) since Jan '83

	Class A	Class B	Class C	Class A-B
β	11.883	21.446	1531.793	2899.462
α	.013175	.049411	.027187	.015587
growth rate per yr.	17.009%	78.389%	37.973%	20.394%
y	125	16,382	2,097,150	49,147
$\hat{x}$	178.605	134.35	265.64	181.58
	(Nov 19, 1997)	(Mar. 11, 1994)	(Feb. 18, 2005)	(Feb 17, 1998)
r	.9491	.9842	.9800	.9749





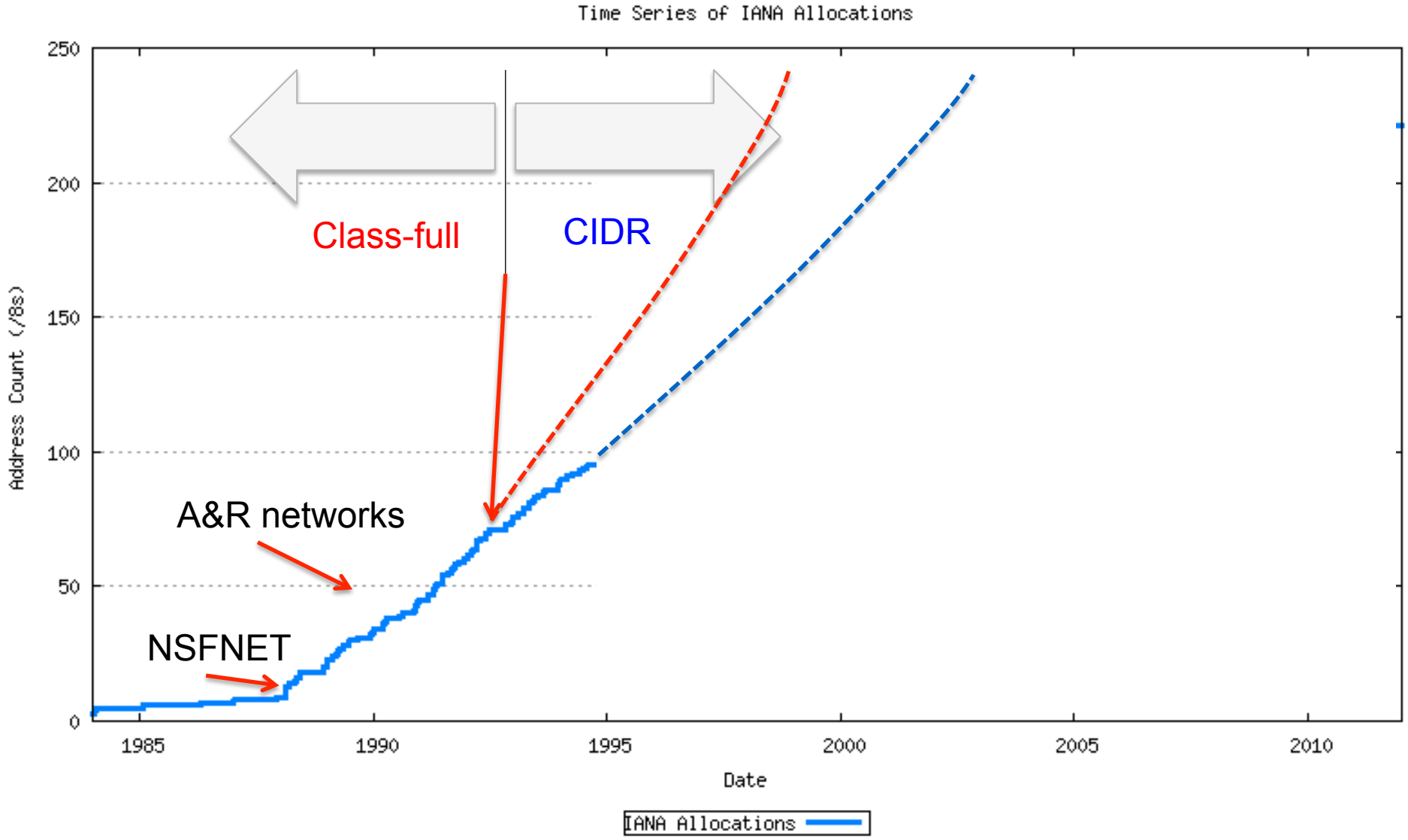
IETF Meeting – August 1990



What did we do back in 1992?

We bought some time by removing the CLASS A, B, C address structure from IP addresses

The CIDR Fix


Time Series of IANA Allocations
Address Count (/8s)
250
200
150
100
50
0
1985
1990
1995
2000
2005
2010
Date
Class-full
CIDR
A&R networks
NSFNET
IANA Allocations

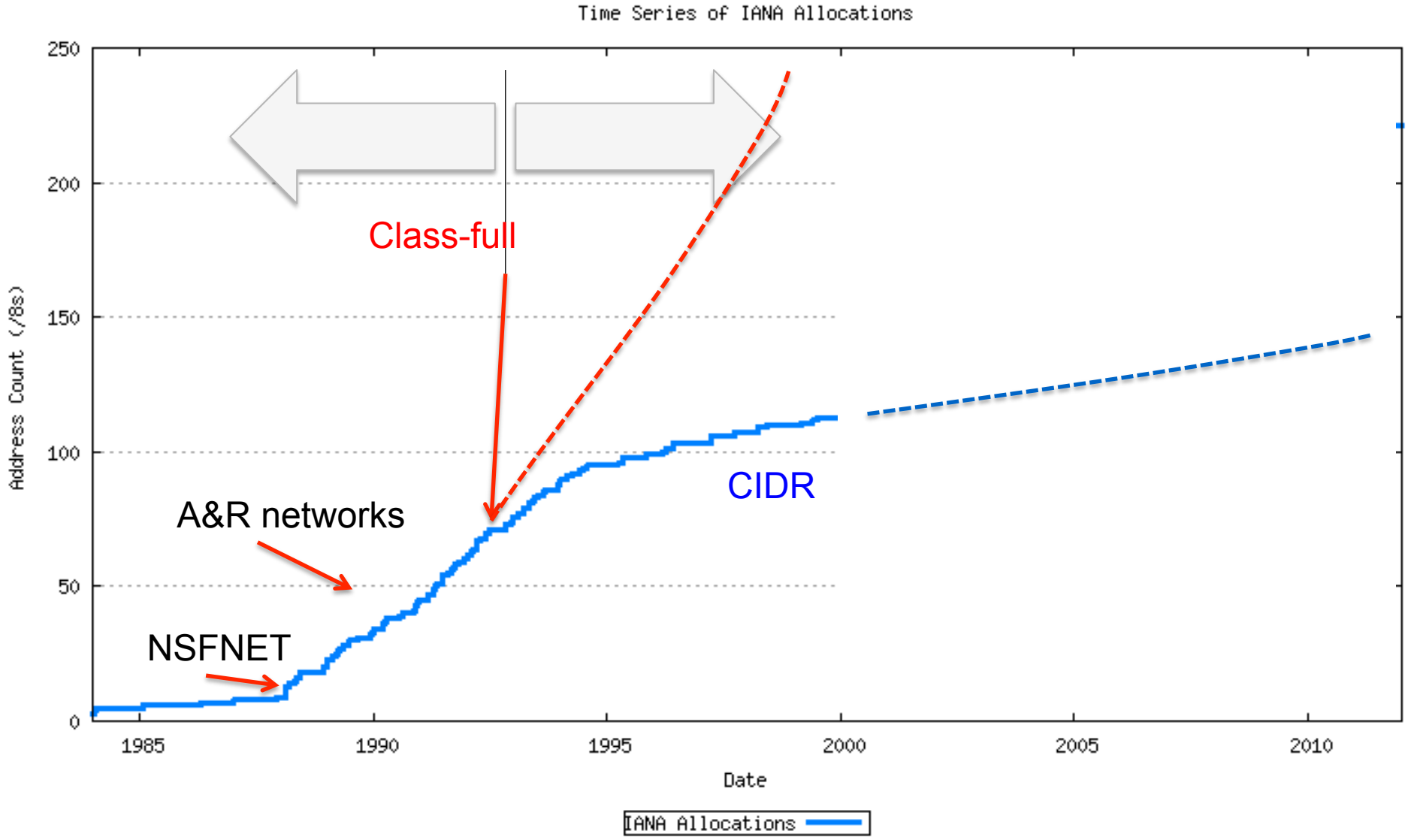
What else did we do back in 1992?

And we started working on a new Internet Protocol - to become IPv6 - to replace IPv4

We left the task of transition until after we had figured out what this new protocol would look like


ZZZZZZ
For a long while this did not look to be an urgent problem...

CIDR just worked!

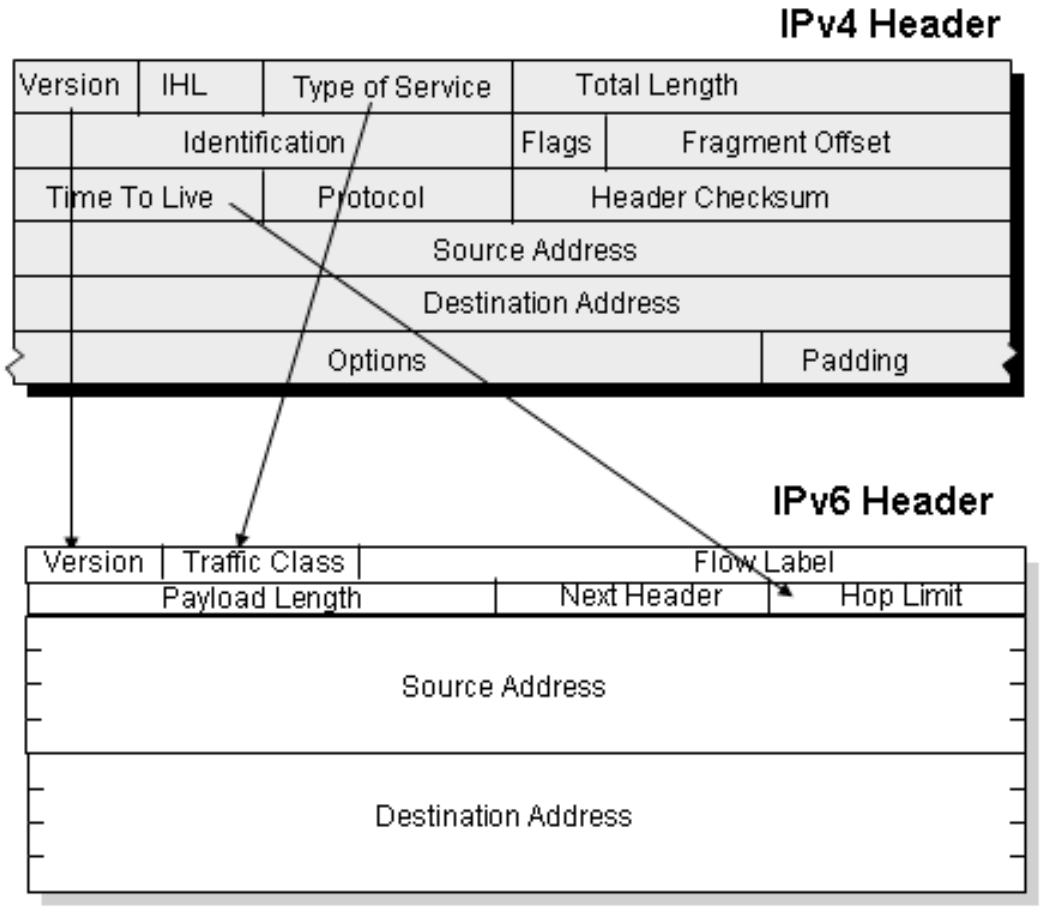


Meanwhile, back at the IETF

1992-1994 - the search for requirements:

- Larger address space (48bits, 64bits, 128bits, variable?)
- Scalable Routing
- No broadcast, just multicast
- Stateless Autoconfiguration
- No fragmentation on the fly
- Raise the Minimum MTU
- No NATs, Just Public Addresses
- Ease of Renumbering
- Backward compatible

Changes to the IP header



From IPng to IPv6

1992-1994 - the search for requirements:

- Larger address space (128bits) ✓
- Scalable Routing — Routing scaling remains a problem
- No broadcast, just multicast — Host-based multicast overhead
- Stateless Autoconfiguration — DHCP6 seems to have won the day!
- No fragmentation — This has caused its share of operational problems!
- Raise the min MTU — To 1280 ✓
- No NATs, Just Public Addresses — Now we have ULAs
- Ease of Renumbering — Not Delivered
- Backward compatible — Not Delivered

What actually changed with IPv6

- Address fields expanded
- Packet Fragmentation control at source, not on the fly
- Addressing changed, from per-network to router realms

What actually changed

- Address fields expanded
- Packet Fragmentation control at source, not on the fly
- Addressing changed, from per-network to router realms

Good!

Bad! For UDP (DNS) this is a major problem

Ugly! Source address selection and BCP38 is confusing

And the IPv6 Mythology started…

At that time we heard that IPv6 was:

- More secure
- Better for Wireless
- Better for Qos
- Required for Mobility
- Faster
- Solves Routing Scaling
- Renumbers
- Auto-configuration

2002: On IPv6 Myths

IPv6 vs IPv4

- There is no compelling “feature” or aspect of V6 that does not have a functional counterpart in V4.
- Any industry adoption of V6 cannot be based on superior functionality of V6 over V4 as a protocol platform

The “anti-hype” message – IPv6 is not brighter, shiner, or more miraculous. It just has more addresses!

2003: On IPv6 Myths

IPv6 vs IPv4

- **A view from Noel Chiappa:**

> "The IPv6 community got into the corner it's in now because it took the path of least technical resistance: IPv6 looks a lot like IPv4 because we "know "that IPv4 "works". Well, guess what, IPv4 *doesn't* work, and IPng needed to look really different, and those of us who tried to tell the rest of the IETF that didn't get very far - although I think we gave it a pretty good try.
>
> So if the IPv6 community again takes the path of least technical resistance, having not learned the first time around that that's really not the answer, God help you all".

Posting to IETF multi6 WG, 26 Feb 2003

The "anti-hype" message – IPv6 is not brighter, shiner, or more miraculous. It just has more addresses!

2003: On IPv6 Myths

IPv6 Renumbering

- A view from Tony Li:

  "One of the big selling points of v6 was that renumbering was gonna be easy, right? So we didn't have to do funky addressing... Are you telling me that one of the selling points of v6 is bunk?

  Tony"

Posting to routing-discussion@ietf.org, 26th March 2003, within a discussion about the implications of deprecating of site-local addresses and whether there was a residual requirement for NAT-like functionality in IPv6

The "anti-hype" message – IPv6 is not brighter, shiner, or more miraculous. It just has more addresses!

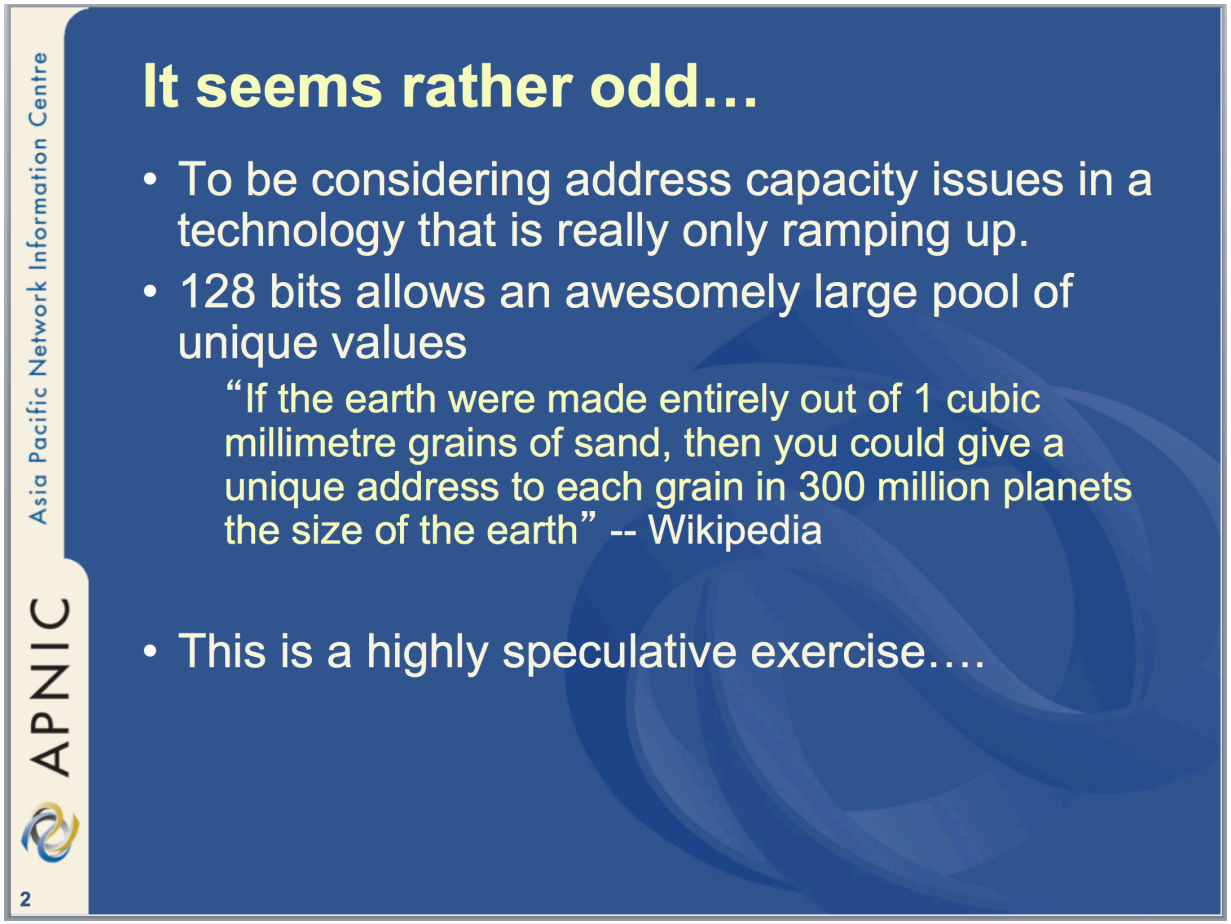
2003: Wavering in the ranks!

The Bottom Line

- Its looking like its a NAT vs V6 choice
  - And its not obvious that the market is going to correctly balance the longer term interest against very short term expediency

Moments of doubt and uncertainty!

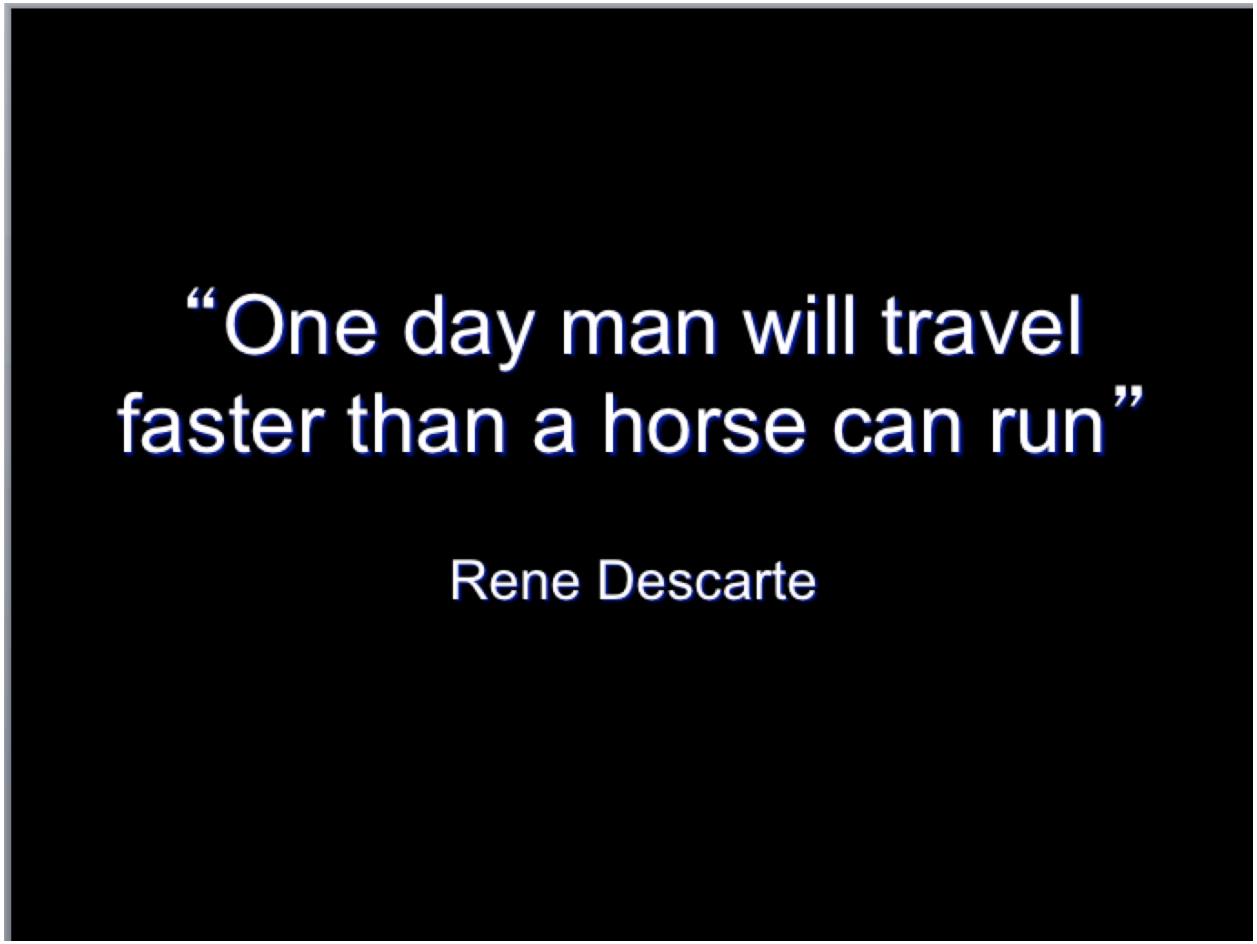
2004: IPv6 Address Policies Revisited



Contemplating changing the HD Ratio and the 48 bit end site prefix.

"*But you can't do that! The installed base of IPv6 is too big to change!*"

2005:


“One day man will travel faster than a horse can run”
Rene Descarte

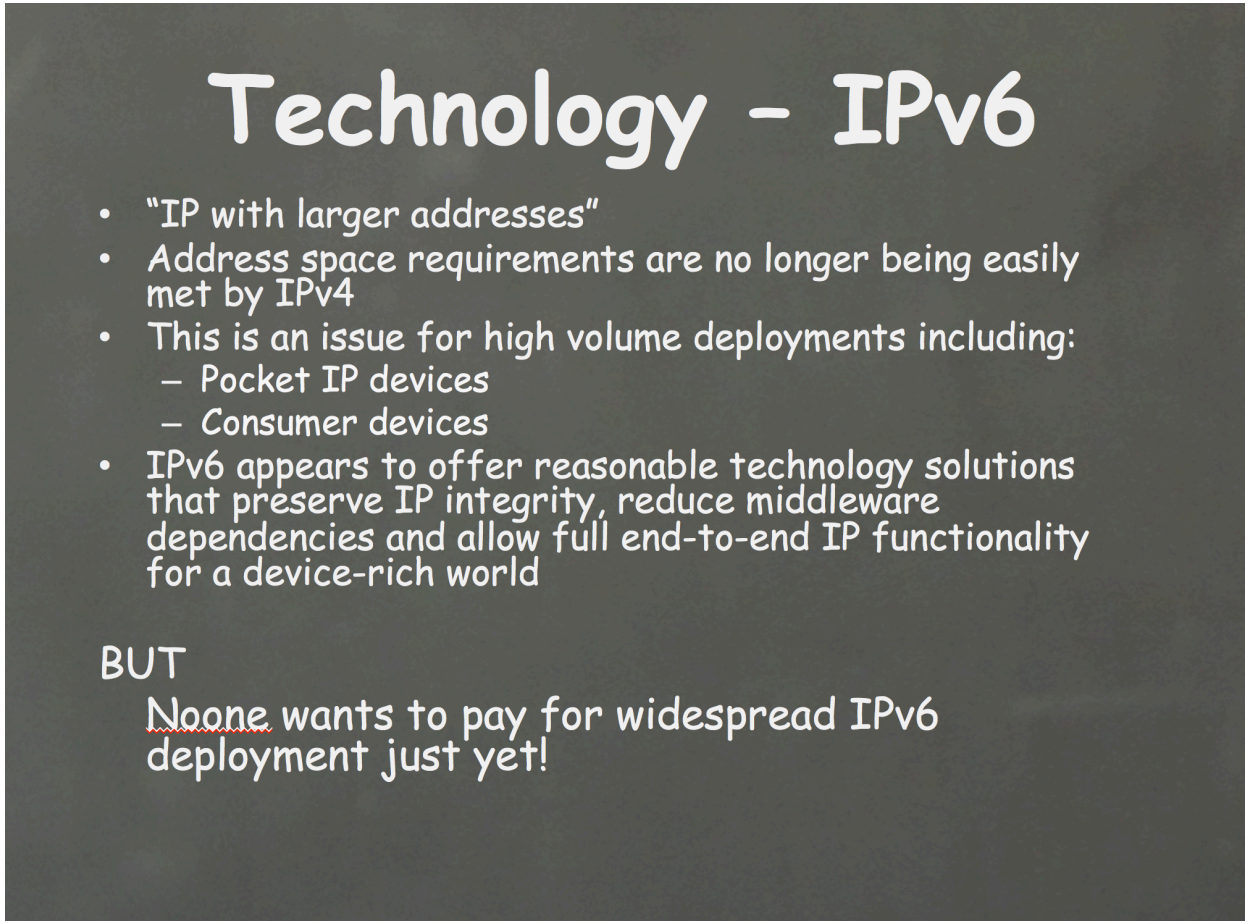
2005: defining terms of engagement

It looks like the IPv6 future may well be "revolution" where IPv6 is forced into direct competition with existing IPv4+NAT networks

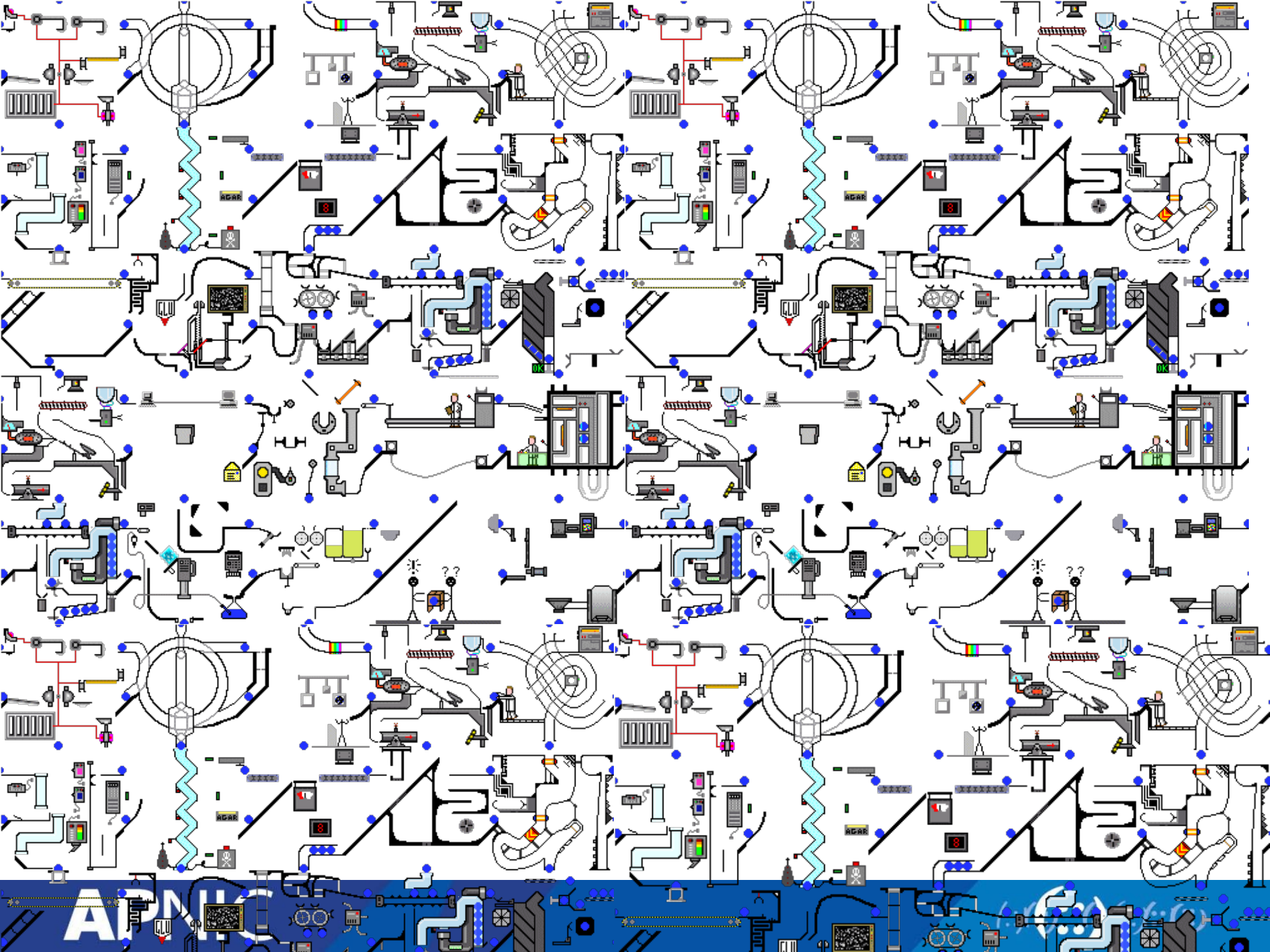
And the primary leverage here is one of "cheaper" and "bigger", and not necessarily "better"

The realization that IPv6 won't just happen – there are other factors at play here.

2006:



Searching for drivers for IPv6 adoption



i could watch that for hours!

2007:

Maybe it's just deregulation

- Near term business pressures simply support the case for further deferral of IPv6 infrastructure investment
- There is insufficient linkage between the added cost, complexity and fragility of NAT-based applications at the edge and the costs of infrastructure deployment of IPv6 in the middle
  - Deregulated markets are not perfect information markets – pain becomes isolated from potential remedy

It's not just a technology issue – there are business drivers here as well

2008:

New Markets for IPv6?

The Universe of Tiny Things?

The world of billions of chattering devices unleashing new rivers of gold into the IP industry?

Or is this just the economy? There is no new money and these billions of chattering devices will generate much the same revenue as we have today

So we have to cram all these billions of new devices trillions of new packets into the same money that we have today.

technology leverage will make tomorrow's networks 1,000 times CHEAPER to deliver an IP packet than today's network?

Or have we reached some limit to the economic viability of communications that imply that ever smaller valued transactions can't be sustained over ever larger networks?

Do RFID and Bluetooth provide a different model of communication that is viable in the universe of things, where the identity is global but the communication is strictly limited in scope and

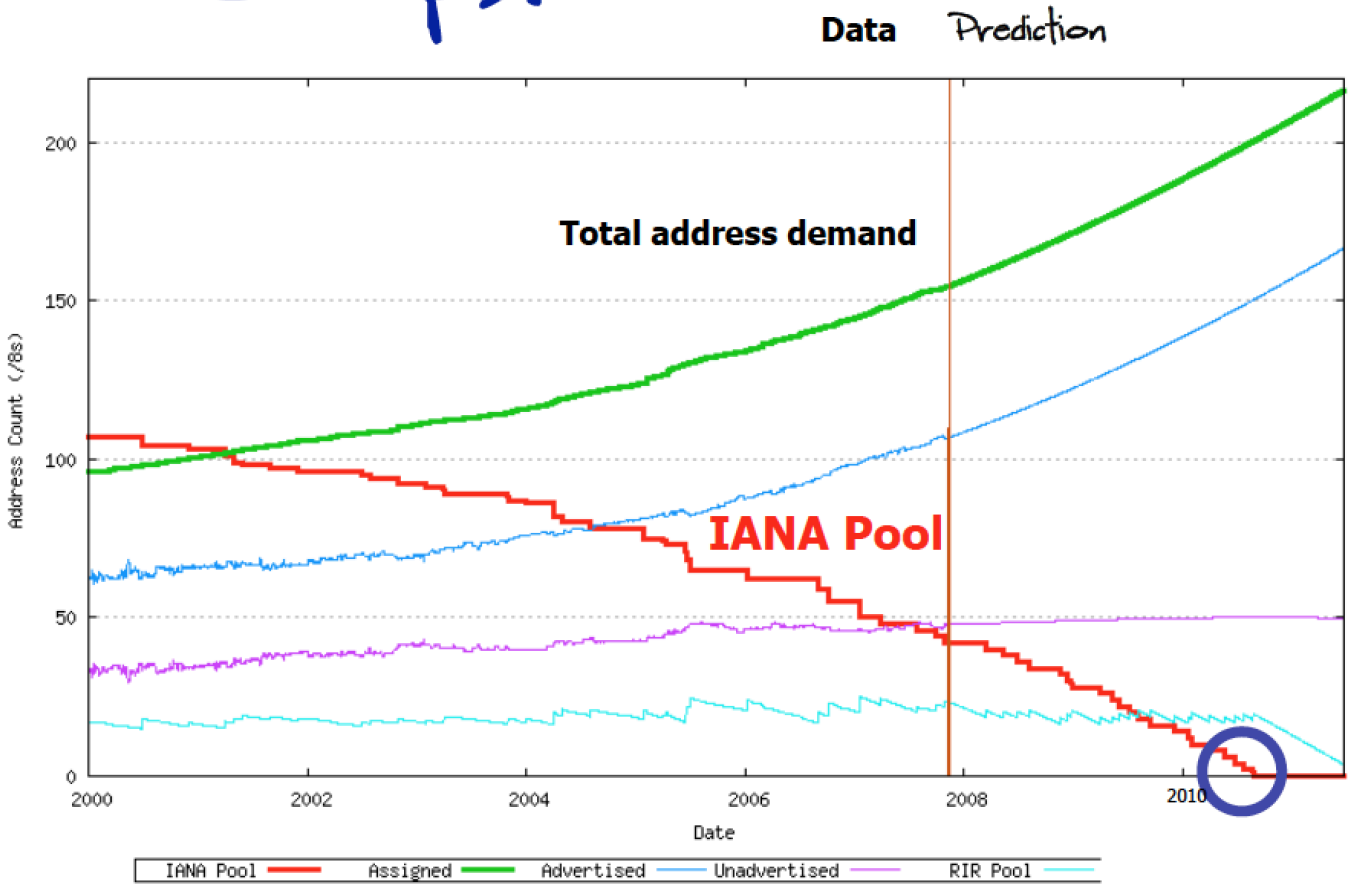
And if you ever are curious enough to enlarge this slide to see if there is text all the way down the page you will have got yourself to this point, where it becomes obvious that I've got nothing more to say and I want to fill up the bottom of the slide with tiny text.

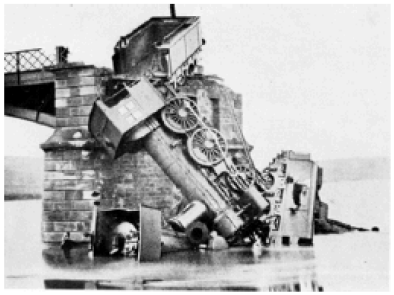
2008

This is the time of the “**IPv4 exhaustion is coming. What are we going to do?**” presentations.

Lets dive into one of them for a few slides from 2008…

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 5th February 2011

http://ipv4.potaroo.net

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

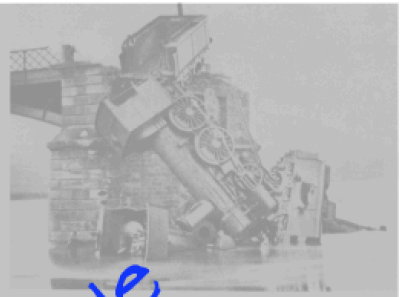
I can't model changes in demand due to:

- 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

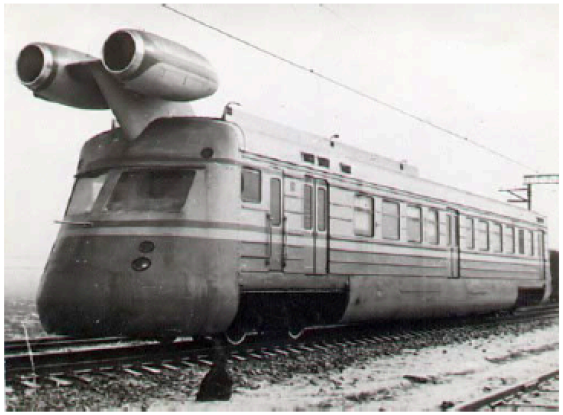


That's sometime between late 2009 and early 2011

so WHAT?

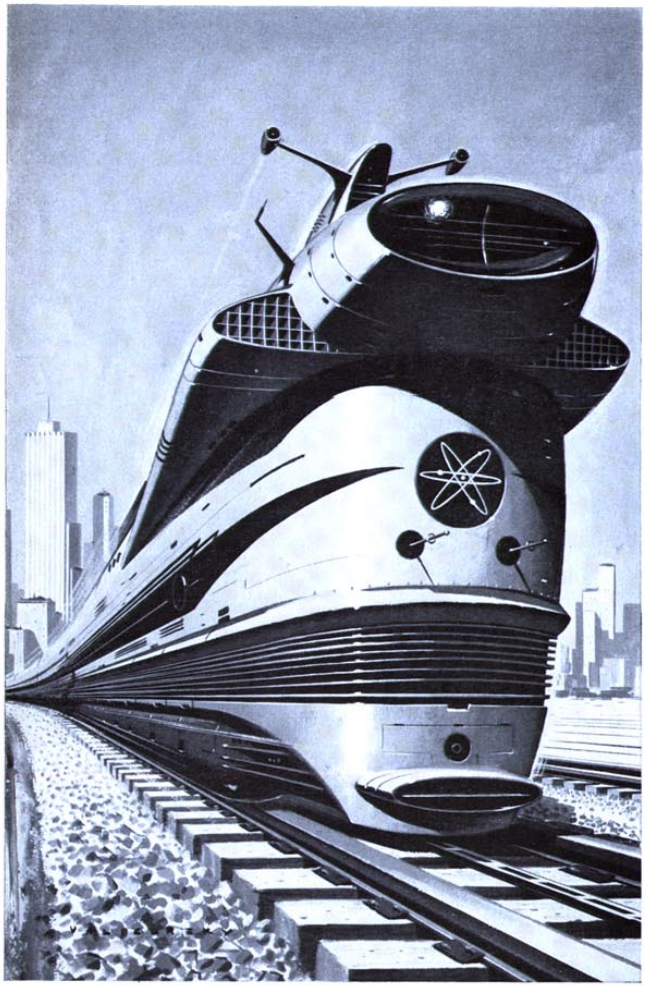
we've all heard this before nothing new to see here - move along!

what then?



IPv6!

Will atomic energy power tomorrow's railroads?



Some day you may see a train like this—powered by the energy locked up in the atom.

Possibly the locomotive will have its own nuclear reactor. Or perhaps it will use electricity generated at atomic power stations. But this much is certain. Of all forms of land transportation, railroads offer the greatest opportunities for the efficient use of nuclear energy.

Railroads are constantly exploring exciting possibilities like this. Such progressive thinking is important to all of us—for we're going to need railroads more than ever in the boom years ahead.

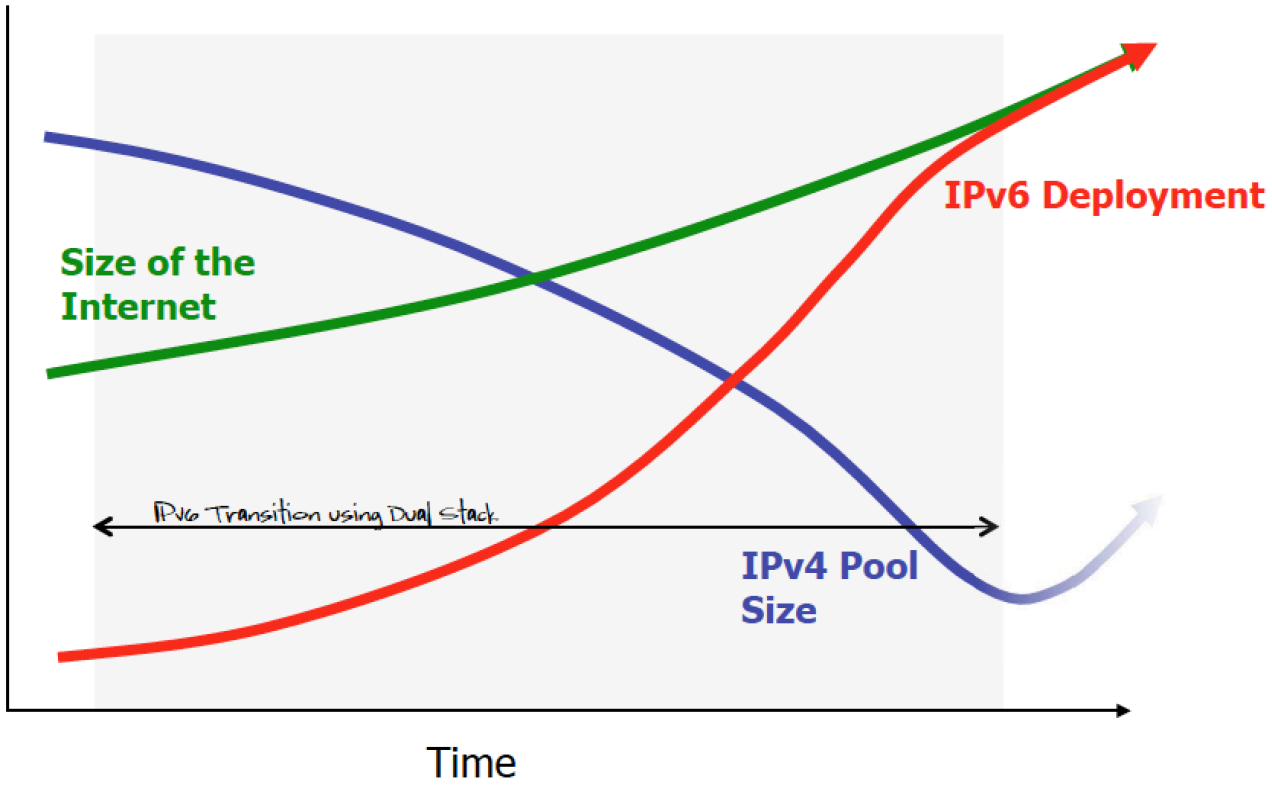
Clearly, it's in the national interest to give railroads equal opportunity and treatment with other forms of transportation. America's railroads—the lifeline of the nation—are the main line to *your* future.

ASSOCIATION OF

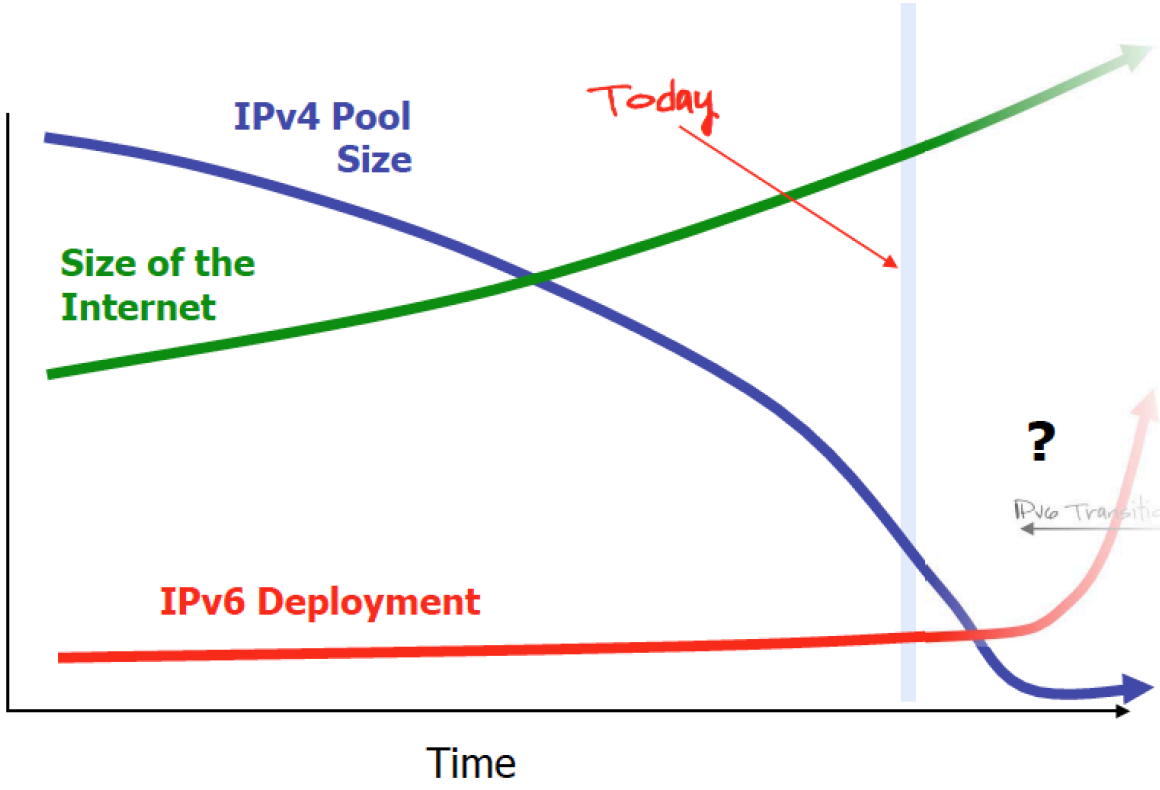
AMERICAN RAILROADS

WASHINGTON 6, D. C.

We had this plan …



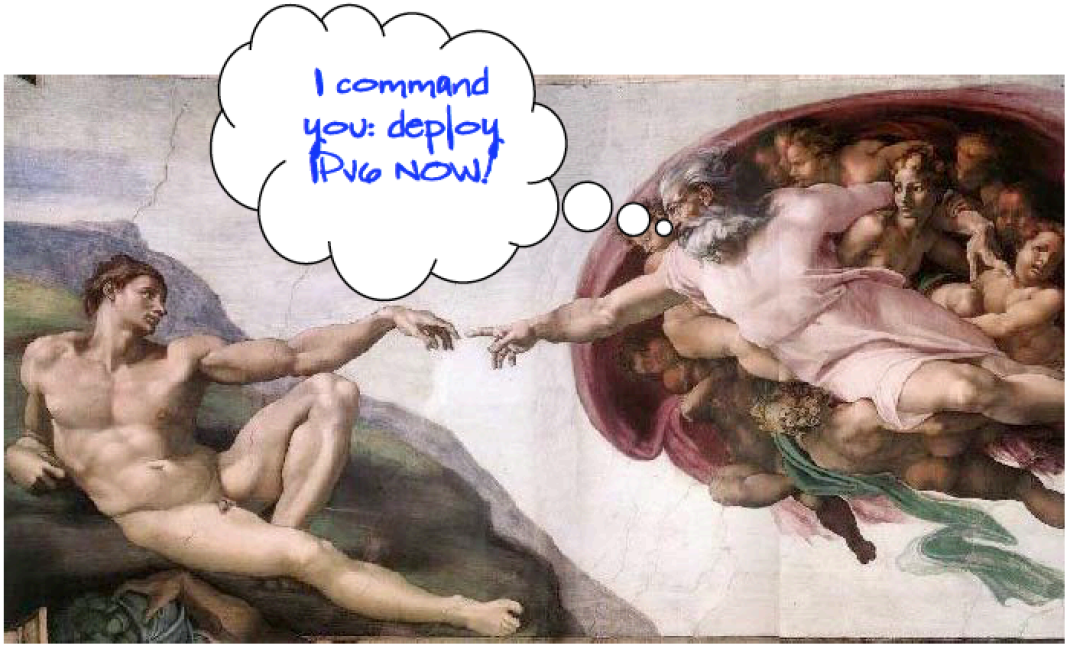
what's the revised plan?



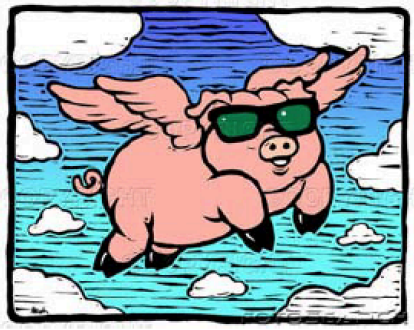
If IPv6 is the answer then...

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

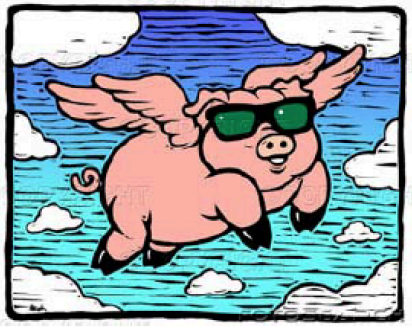

I command you: deploy IPv6 NOW!

If IPv6 is the answer then..

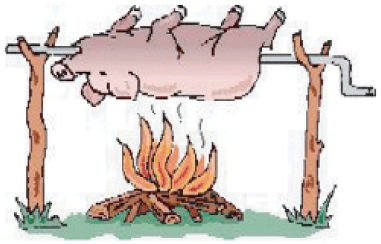


Plan A: its time to move!

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

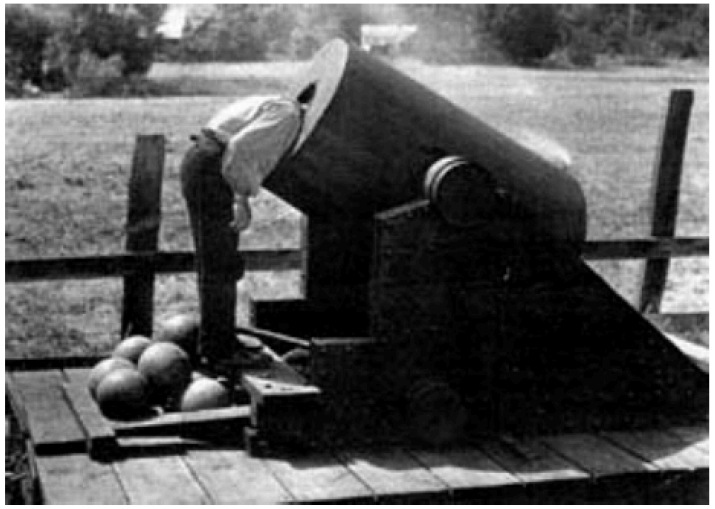
Persist with IPv4 networks using more NATs

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

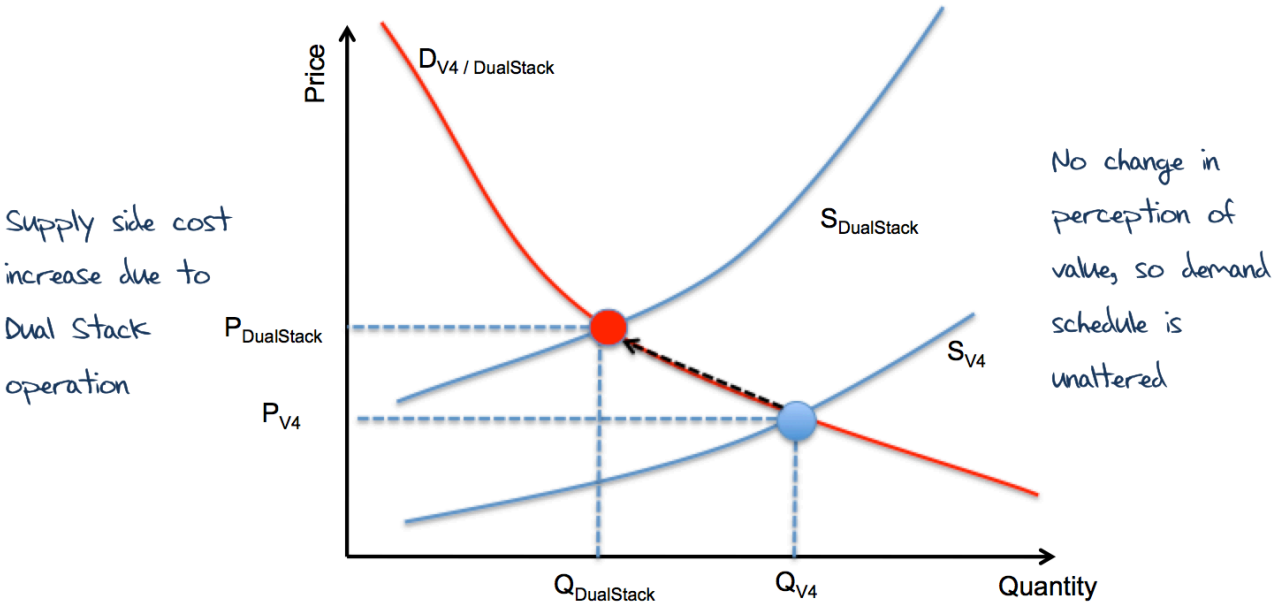


Its just not looking very good is it?

Why are we here?

2010 – invoking economics!

IPv4 to Dual Stack: The Demand Schedule Shift



2010 – invoking economics!

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!

2012: measurement

Counting IPv6...

Some 50% of the Internet's transit ISPs support IPv6 transit

Some 50% of the Internet's host devices have an active IPv6 stack

and the rest run Windows XP!

But only 0.5% of the Internet actually uses IPv6!

and the problem appears to lie in the last mile access infrastructure!

Which brings us to…


The Present
190
~
280
环景臻境
天鹅堡
2期
学校

6 June 2012

Was it only a year ago?

World IPv6 Launch

“This time it’s forever”

Urging service providers to turn on IPv6, and leave it on.

Reach out to network, access and content providers to start moving in public on IPv6 services

Some Questions one year later…

- Did it work?
- What has changed in the past 12 months?
- Who is deploying IPv6?
- Where are they?

APNIC's IPv6 Measurements

- The Internet is all about end-to-end services
- We want to also perform end-to-end measurements
- But how can we measure the IPv6 capability of millions of end users?
- And do so day by day?

Measuring Millions?

Option A - Be Google!

Measuring Millions

Option B - Use Google!

Use their online ad network as a vehicle for embedded measurement tests

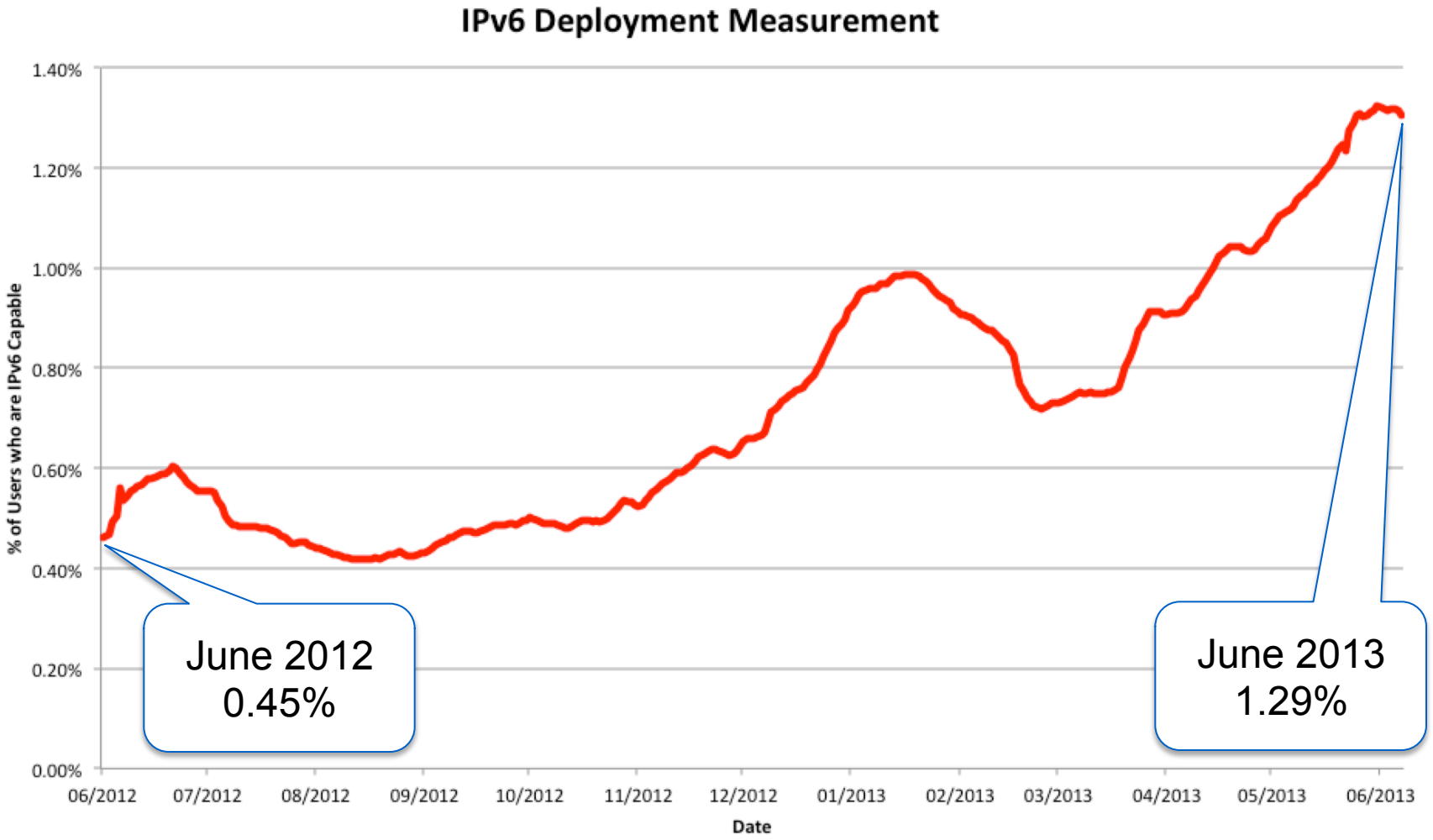
Embedded on the ad are 3 tests

- V4 only URL
  - Control comparison (Reliability, RTT)
- Dual Stack URL
  - Which protocol will the client PREFER to use?
- V6 only URL
  - Is the client CAPABLE of using IPv6?

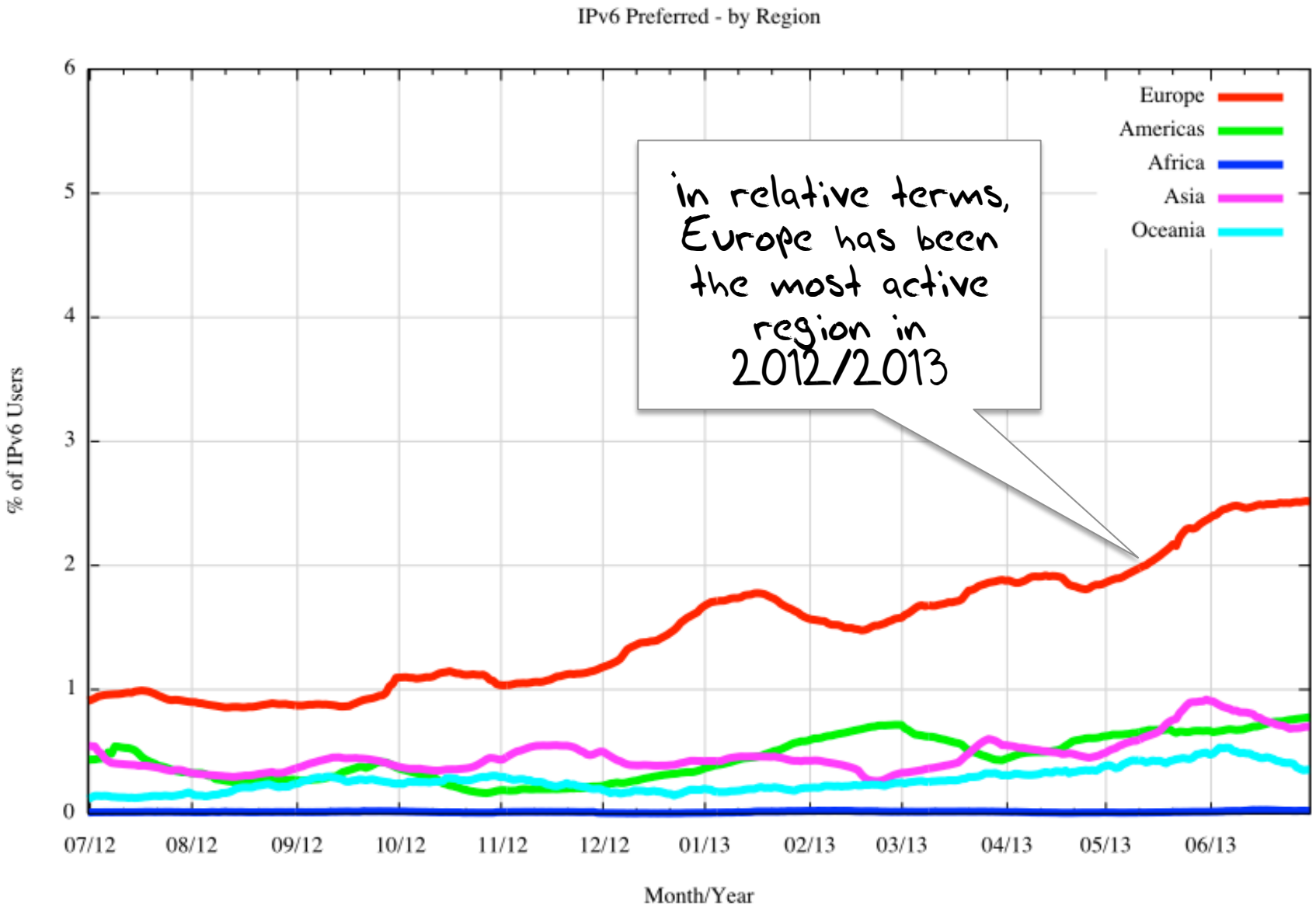
And this is what we saw

When we asked 300,000 new end users every day about their IPv6 capability we saw this…

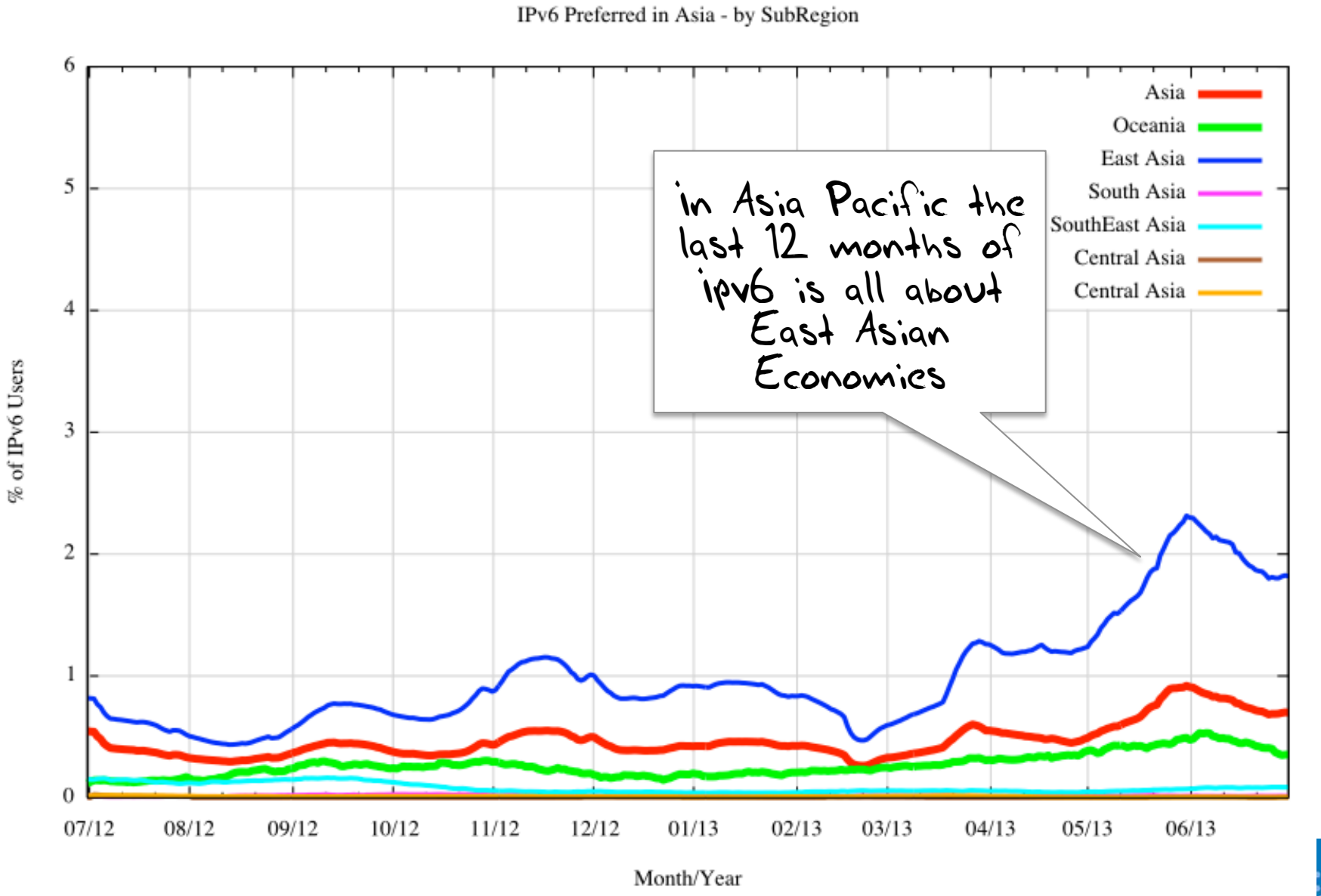
IPv6, Globally



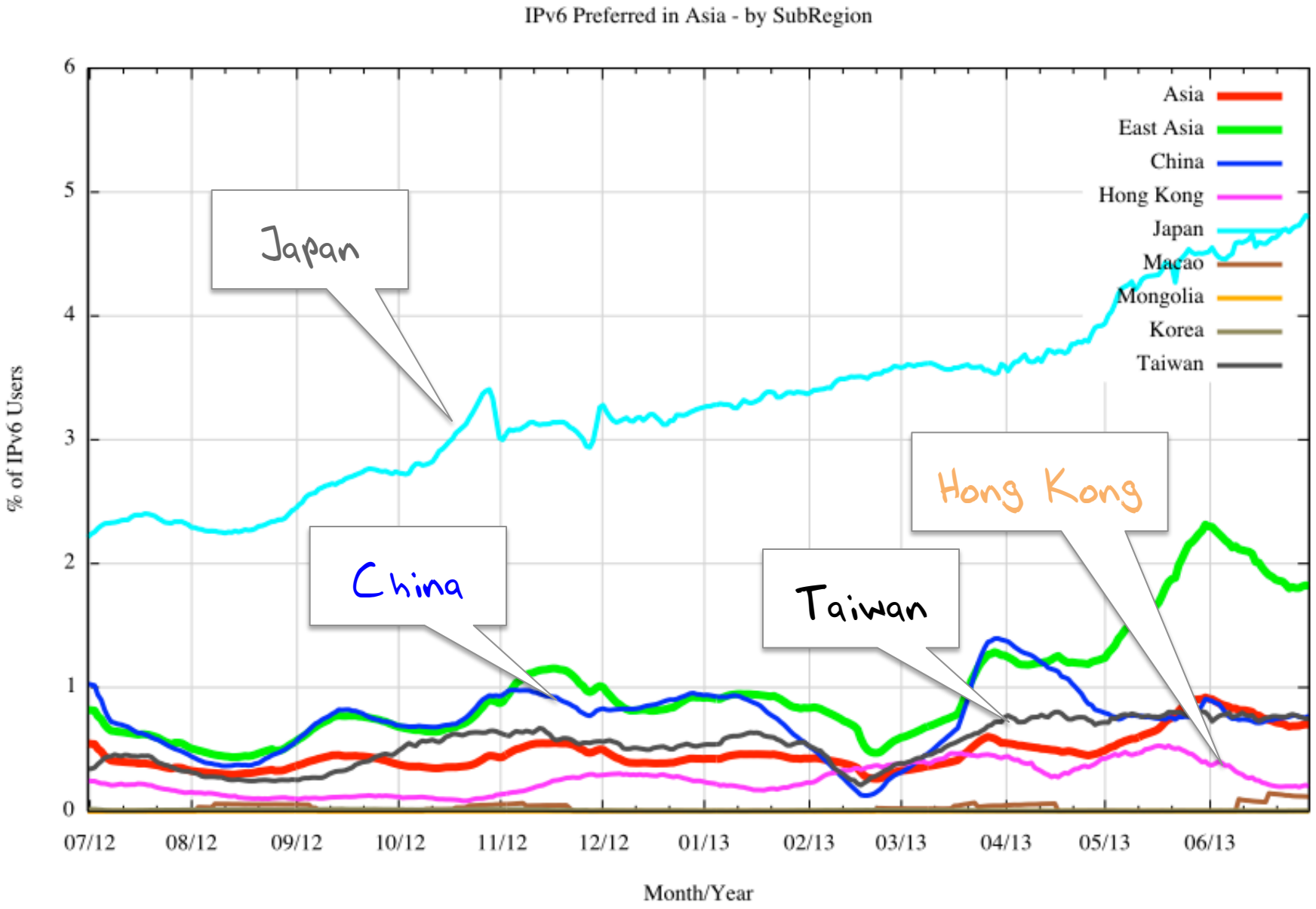
IPv6, Regionally



IPv6 in the AP Region



IPv6 in East Asia



Globally Speaking

- IPv6 did not happen everywhere and all at once in 2012 / 2013
- Some economies have been very active in terms of IPv6 deployment
- So lets look at this on a country-by-country basis…

Where is IPv6?
The National Top 20 – Then and Now

2012

Rank	Economy	% of Internet Users	# of IPv6 Users (est)
1	Romania	7.40%	641,389
2	France	4.03%	2,013,920
3	Luxembourg	2.59%	12,049
4	Japan	1.75%	1,766,799
5	Slovenia	1.07%	15,175
6	United States	1.01%	2,500,684
7	China	1.01%	5,209,030
8	Croatia	0.85%	22,551
9	Switzerland	0.80%	51,575
10	Lithuania	0.66%	13,845
11	Czech Republic	0.55%	39,694
12	Norway	0.51%	23,333
13	Slovakia	0.44%	19,112
14	Russian Fed.	0.39%	238,576
15	Germany	0.32%	217,494
16	Hungary	0.31%	19,896
17	Portugal	0.30%	16,406
18	Netherlands	0.27%	40,870
19	Australia	0.25%	49,425
20	Taiwan	0.24%	38,843

2013

Rank	Economy	% of Internet Users	# of IPv6 Users (est)
1	Romania	10.84%	1,053,237
2	Switzerland	10.72%	700,777
3	Luxembourg	6.96%	32,535
4	France	5.46%	2,824,465
5	Belgium	4.17%	339,651
6	Japan	4.13%	4,137,476
7	Germany	3.24%	2,212,062
8	United States	2.72%	6,768,264
9	Peru	2.42%	273,370
10	Czech Republic	2.12%	157,203
11	Singapore	1.58%	54,060
12	Norway	1.21%	53,677
13	Slovenia	0.92%	13,230
14	China	0.90%	4,651,953
15	Greece	0.78%	44,572
16	Portugal	0.76%	45,408
17	Taiwan	0.72%	120,180
18	Netherlands	0.70%	109,425
19	Australia	0.69%	121,256
20	Slovakia	0.52%	21,169

Where is IPv6?
The National Top 20 – Then and Now

2012

Rank	Economy	% of Internet Users	# of IPv6 Users (est)
1	Romania	7.40%	641,389
2	France	4.03%	2,013,920
3	Luxembourg	2.59%	12,049
4	Japan	1.75%	1,766,799
5	Slovenia	1.07%	15,175
6	United States	1.01%	2,500,684
7	China	1.01%	5,209,030
8	Croatia	0.85%	22,551
9	Switzerland	0.80%	51,575
10	Lithuania	0.66%	13,845
11	Czech Republic	0.55%	39,694
12	Norway	0.51%	23,333
13	Slovakia	0.44%	19,112
14	Russian Fed.	0.39%	238,576
15	Germany	0.32%	217,494
16	Hungary	0.31%	19,896
17	Portugal	0.30%	16,406
18	Netherlands	0.27%	40,870
19	Australia	0.25%	49,425
20	Taiwan	0.24%	38,843

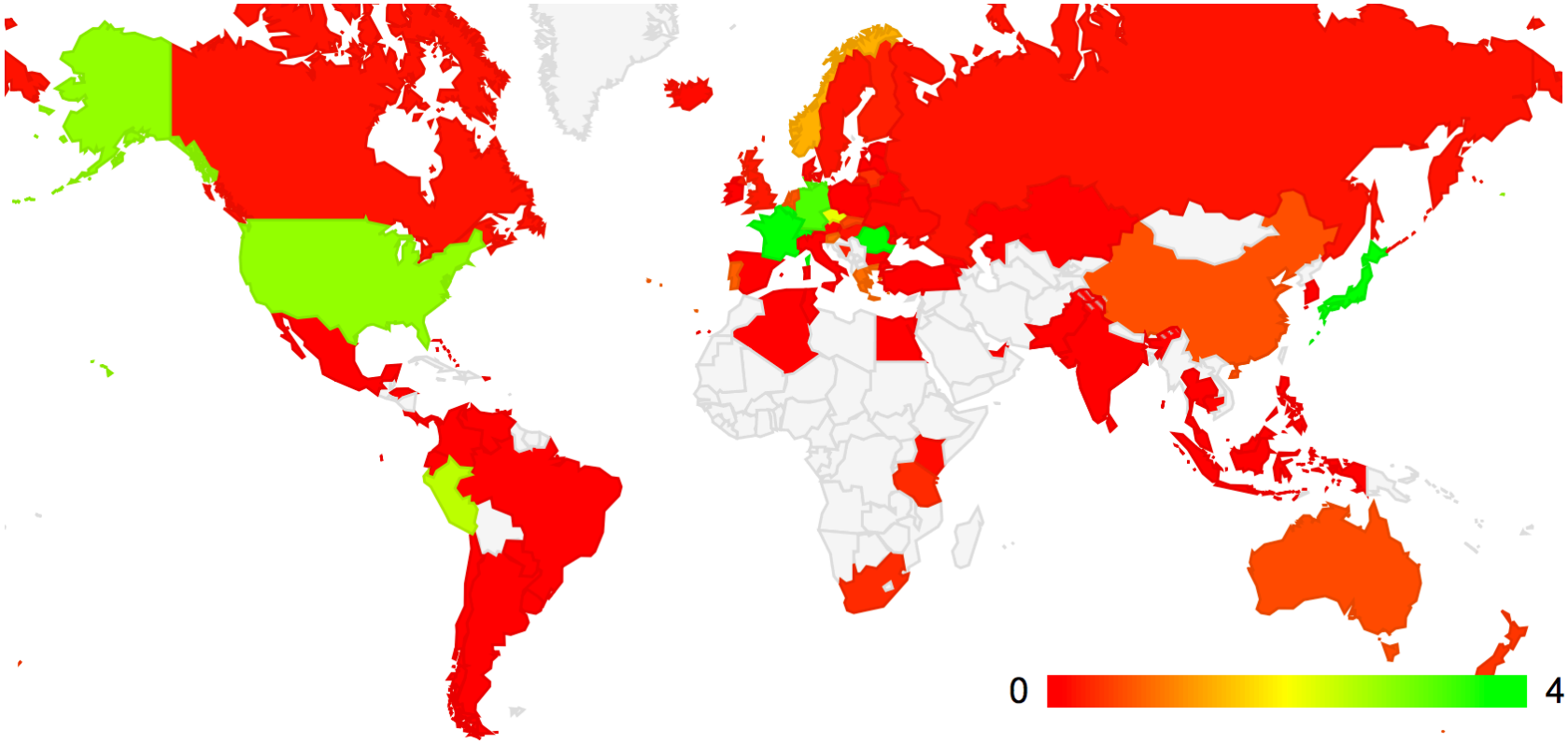
2013

Rank	Economy	% of Internet Users	# of IPv6 Users (est)
1	Romania	10.84%	1,053,237
2	Switzerland	10.72%	700,777
3	Luxembourg	6.96%	32,535
4	France	5.46%	2,824,465
5	Belgium	4.17%	339,651
6	Japan	4.13%	4,137,476
7	Germany	3.24%	2,212,062
8	United States	2.72%	6,768,264
9	Peru	2.42%	273,370
10	Czech Republic	2.12%	157,203
11	Singapore	1.58%	54,060
12	Norway	1.21%	53,677
13	Slovenia	0.92%	13,230
14	China	0.90%	4,651,953
15	Greece	0.78%	44,572
16	Portugal	0.76%	45,408
17	Taiwan	0.72%	120,180
18	Netherlands	0.70%	109,425
19	Australia	0.69%	121,256
20	Slovakia	0.52%	21,169

Where is IPv6?
Asian Economies in The National Top 20

2013 Rank	Economy	% of Internet Users	# of IPv6 Users (est)
1	Romania	10.84%	1,053,237
2	Switzerland	10.72%	700,777
3	Luxembourg	6.96%	32,535
4	France	5.46%	2,824,465
5	Belgium	4.17%	339,651
6	Japan	4.13%	4,137,476
7	Germany	3.24%	2,212,062
8	United States	2.72%	6,768,264
9	Peru	2.42%	273,370
10	Czech Republic	2.12%	157,203
11	Singapore	1.58%	54,060
12	Norway	1.21%	53,677
13	Slovenia	0.92%	13,230
14	China	0.90%	4,651,953
15	Greece	0.78%	44,572
16	Portugal	0.76%	45,408
17	Taiwan	0.72%	120,180
18	Netherlands	0.70%	109,425
19	Australia	0.69%	121,256
20	Slovakia	0.52%	21,169

The IPv6 world, Geographically Speaking…



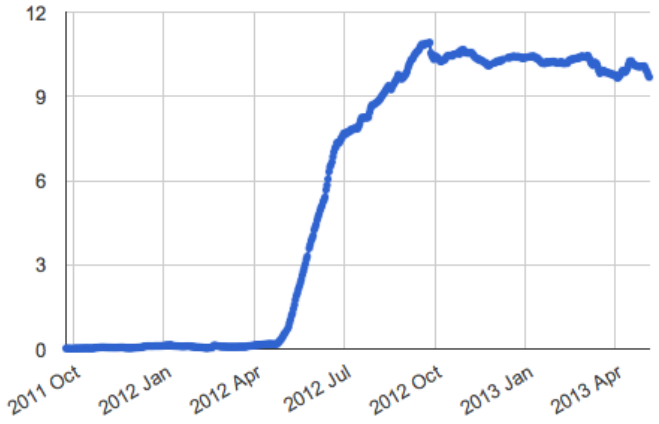
Nationally, who's deploying IPv6 over the past year?

2013 Rank	Economy	Diff (%)	Diff IPv6 User Count
1	Switzerland	+9.92%	+ 649,202
2	Luxembourg	+4.37%	+ 20,486
3	Belgium	+4.07%	+ 331,153
4	Romania	+3.44%	+ 411,848
5	Germany	+2.92%	+1,994,568
6	Peru	+2.41%	+ 272,327
7	Japan	+2.38%	+2,370,677
8	United States	+1.71%	+4,267,580
9	Czech Republic	+1.57%	+ 117,509
10	Singapore	+1.43%	+ 48,524
11	France	+1.43%	+ 810,545
12	Greece	+0.70%	+ 40,530
13	Norway	+0.70%	+ 30,344
14	Taiwan	+0.48%	+ 81,337
15	Portugal	+0.46%	+ 29,002
16	Australia	+0.44%	+ 71,831
17	Netherlands	+0.43%	+ 68,555
18	New Zealand	+0.35%	+ 13,174
19	South Africa	+0.33%	+ 34,022
20	Bosnia and Herz.	+0.32%	+ 8,914

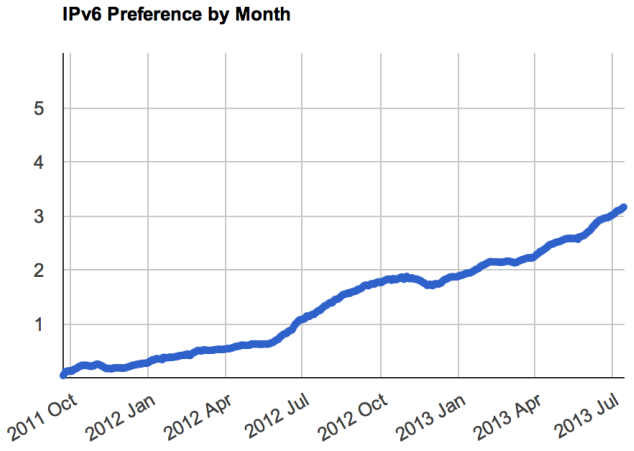
Nationally, who's deploying IPv6 over the past year?

2013 Rank	Economy	Diff (%)	Diff IPv6 User Count
1	Switzerland	+9.92%	+ 649,202
2	Luxembourg	+4.37%	+ 20,486
3	Belgium	+4.07%	+ 331,153
4	Romania	+3.44%	+ 411,848
5	Germany	+2.92%	+1,994,568
6	Peru	+2.41%	+ 272,327
7	Japan	+2.38%	+2,370,677
8	United States	+1.71%	+4,267,580
9	Czech Republic	+1.57%	+ 117,509
10	Singapore	+1.43%	+ 48,524
11	France	+1.43%	+ 810,545
12	Greece	+0.70%	+ 40,530
13	Norway	+0.70%	+ 30,344
14	Taiwan	+0.48%	+ 81,337
15	Portugal	+0.46%	+ 29,002
16	Australia	+0.44%	+ 71,831
17	Netherlands	+0.43%	+ 68,555
18	New Zealand	+0.35%	+ 13,174
19	South Africa	+0.33%	+ 34,022
20	Bosnia and Herz.	+0.32%	+ 8,914

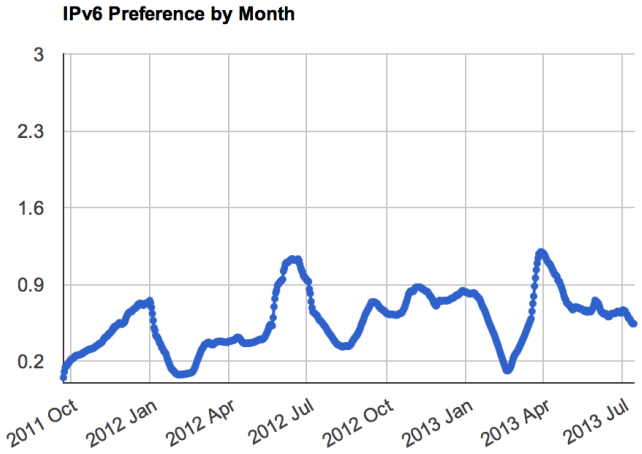
And Some Countries…



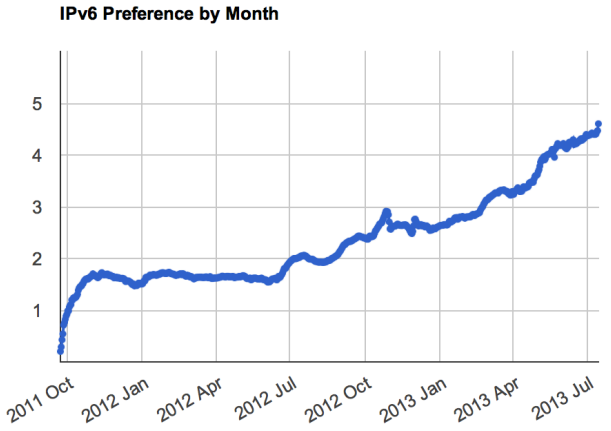
Romania



United States



China



Japan

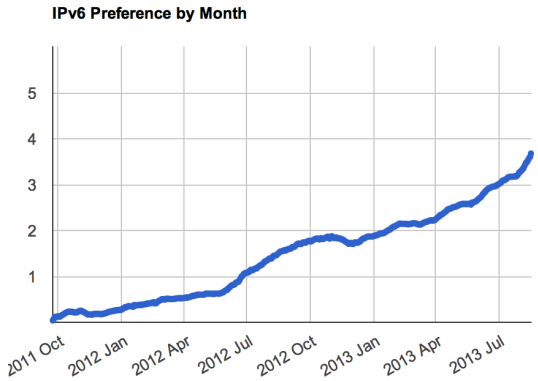
Drilling down to the AS level…

Economy	AS Number	AS Name	2012 IPv6 (%)	2013 IPv6 (%)
United States of America				
	AS6939	Hurricane Electric	29%	37%
	AS22394	Cellco Partnership DBA Verizon Wireless	6%	20%
	AS7018	AT&T Services	6%	15%
	AS3561	Savvis	1%	5%
	AS7922	Comcast	1%	3%
Japan				
	AS2516	KDDI	16%	27%
	AS18126	Chubu Telecomm	0%	23%
	AS17676	Softbank	1%	4%
Germany				
	AS3320	Deutsche Telekom AG	0%	5%
	AS31334	Kabel Deutschland	1%	7%
	AS29562	Kabel BW GmbH	0%	10%
France				
	AS12322	Free SAS	19%	22%
Switzerland				
	AS67722	Swisscomm	0%	23%
	AS559	Switch	11%	18%
Romania				
	AS8708	RCS & RDS SA	11%	24%
Belgium				
	AS12392	Brutele SC	0%	33%
	AS2611	BELNET	2%	22%
Peru				
	AS6147	Telefonica del Peru SA	0%	3%
Czech Republic				
	AS2852	CESNET z.s.p.o.	20%	27%
	AS5610	Telefonica Czech	0%	3%
	AS51154	Internethome; s.r.o.	0%	2%

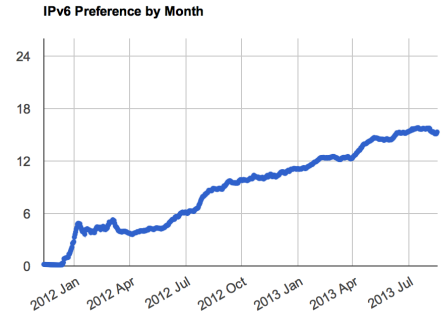
Economy	AS Number	AS Name	2012 IPv6 (%)	2013 IPv6 (%)
United Kingdom				
	AS786	JANET	51%	68%
	AS13213	UK2 Ltd	0%	23%
Taiwan				
	AS9264	Academic Sinica	0%	21%
	AS1659	Taiwan Academic	2%	8%
Australia				
	AS7575	AARNet	13%	21%
	AS4739	Internode	5%	11%
Netherlands				
	AS3265	XS4ALL Internet	6%	27%
Singapore				
	AS7472	Starhub Internet	0%	13%
	AS4773	MobileOne Ltd.	0%	10%
Greece				
	AS5408	Greek R&D	17%	19%
South Africa				
	AS2018	TENET	0%	3%
Canada				
	AS6453	TATA Comms.	10%	13%
	AS22995	Xplornet Comms	0%	9%
Norway				
	AS224	Uninett	16%	24%
	AS39832	Opera Software	1%	100%
	AS57963	Lynet Internett	0%	56%
Portugal				
	AS3243	PT Comunicacoes	0%	1%
Luxembourg				
	AS6661	Postes et Telecom	4%	14%

Moving on…

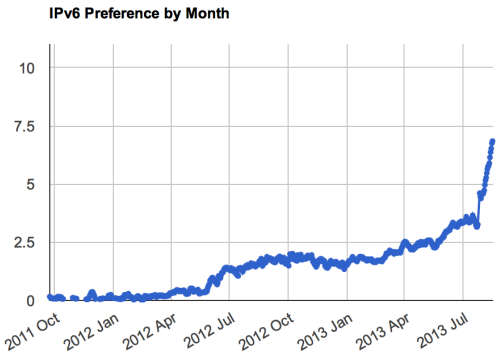
The pace of deployment continues in some countries



United States

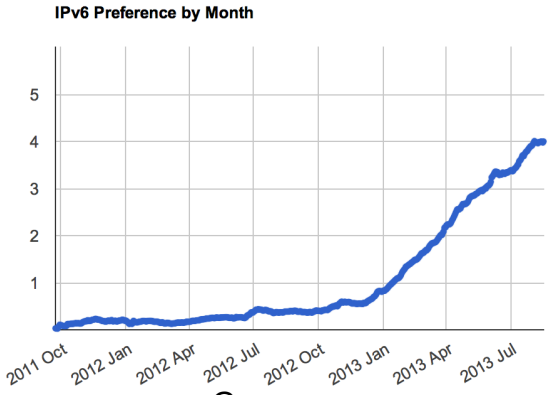


AT&T Internet Services (AS7018)

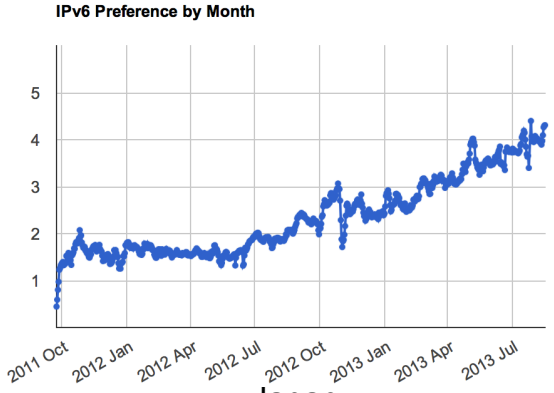


Comcast (AS7922)

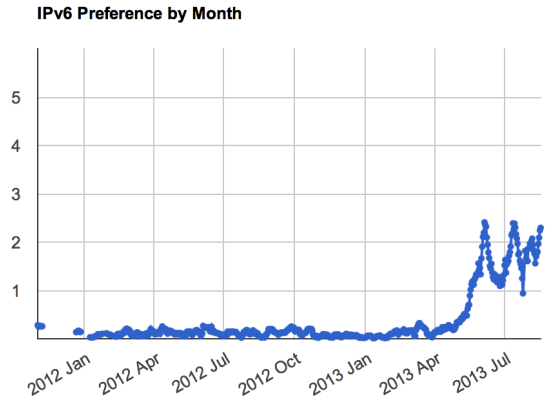
Moving on…



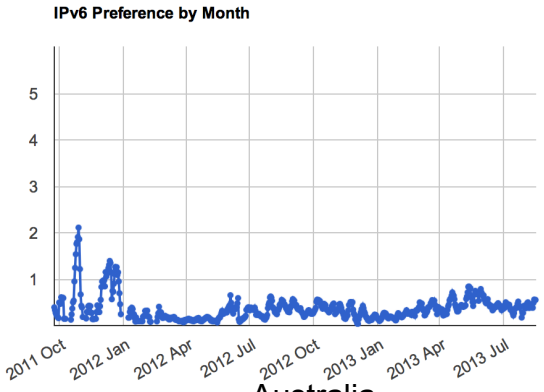
Germany



Japan

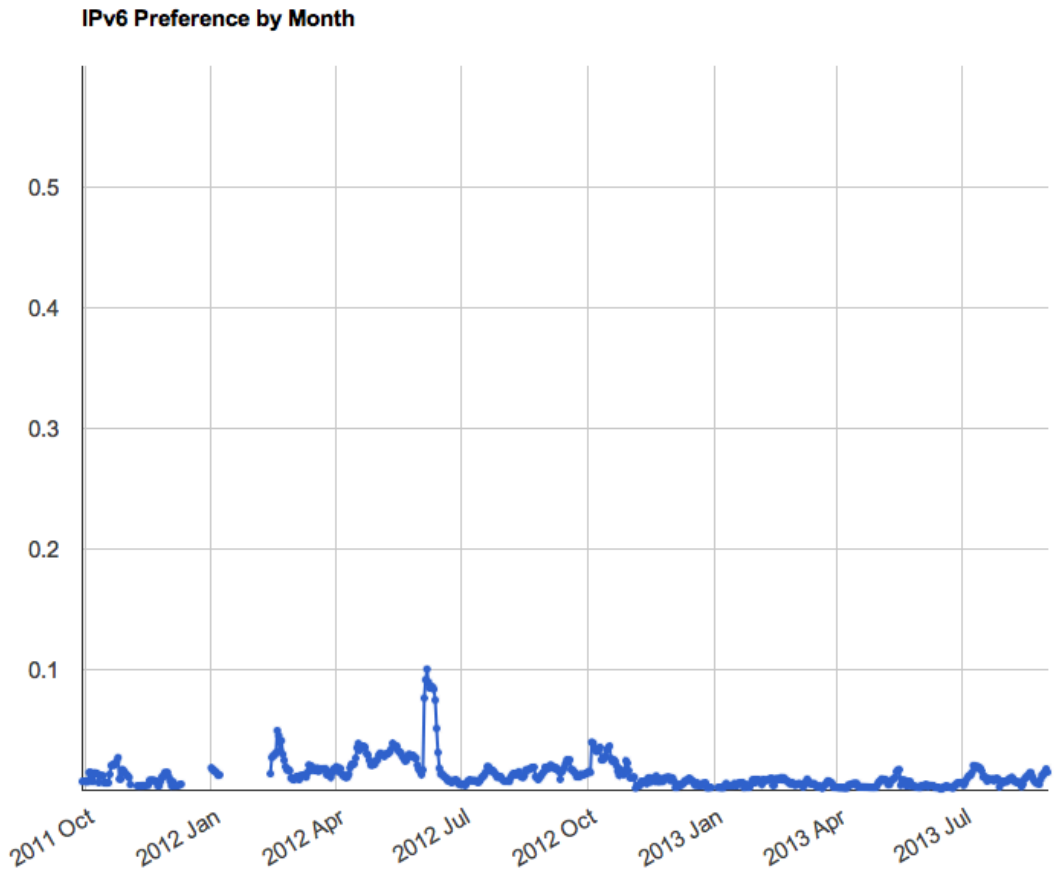


Singapore

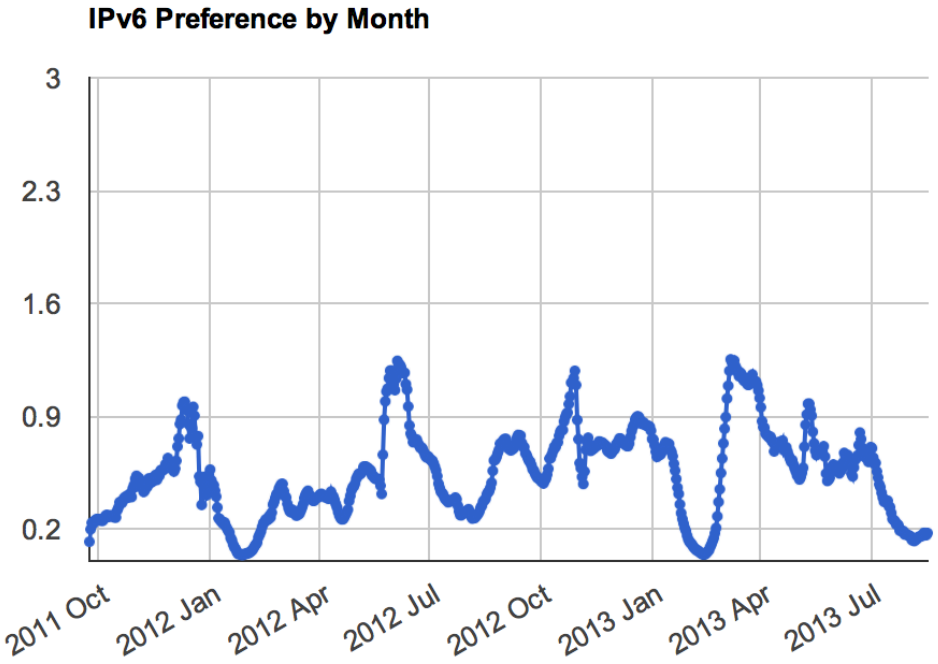


Australia

South Korea


IPv6 Preference by Month
0.5
0.4
0.3
0.2
0.1
2011 Oct
2012 Jan
2012 Apr
2012 Jul
2012 Oct
2013 Jan
2013 Apr
2013 Jul

And then there's China…



This high variance is difficult to explain. This is a view of clients' IPv6 capabilities when the client is located within China and the server is external to China. The picture may be different if the experiment's server was located within China as well.

Future

What are we seeing?

IPv6 deployment is not happening everywhere.

IPv6 is not happening all at once.

But it IS happening.

What are we seeing?

What we appear to be seeing are concentrated areas of quite intense IPv6 activity.

Is IPv6 still “A Waiting Game”?

So far what we have heard from many industry actors about IPv6 is:

> “I’m waiting for others. I’ll jump when they jump.”

Is IPv6 still “A Waiting Game”?

In the past year we have seen a number of major commercial network service operators, primarily in the United States, Japan, Germany, France, Switzerland and Romania, launch programs that integrate IPv6 services into their mass market retail offerings.

Is IPv6 still “A Waiting Game”?

Is this effort “enough” to break out of the waiting game?

I’d like to think so!

Because there really is NO Plan B!

A question to each of you…

How many IPv6 presentations have you sat through?

- [ ] 21?
- [ ] 101?
- [ ] 1,001?
- [x] I don't know - I was comatose by the end!

Thank You!

APNIC