

# Measuring IPv6 Deployment

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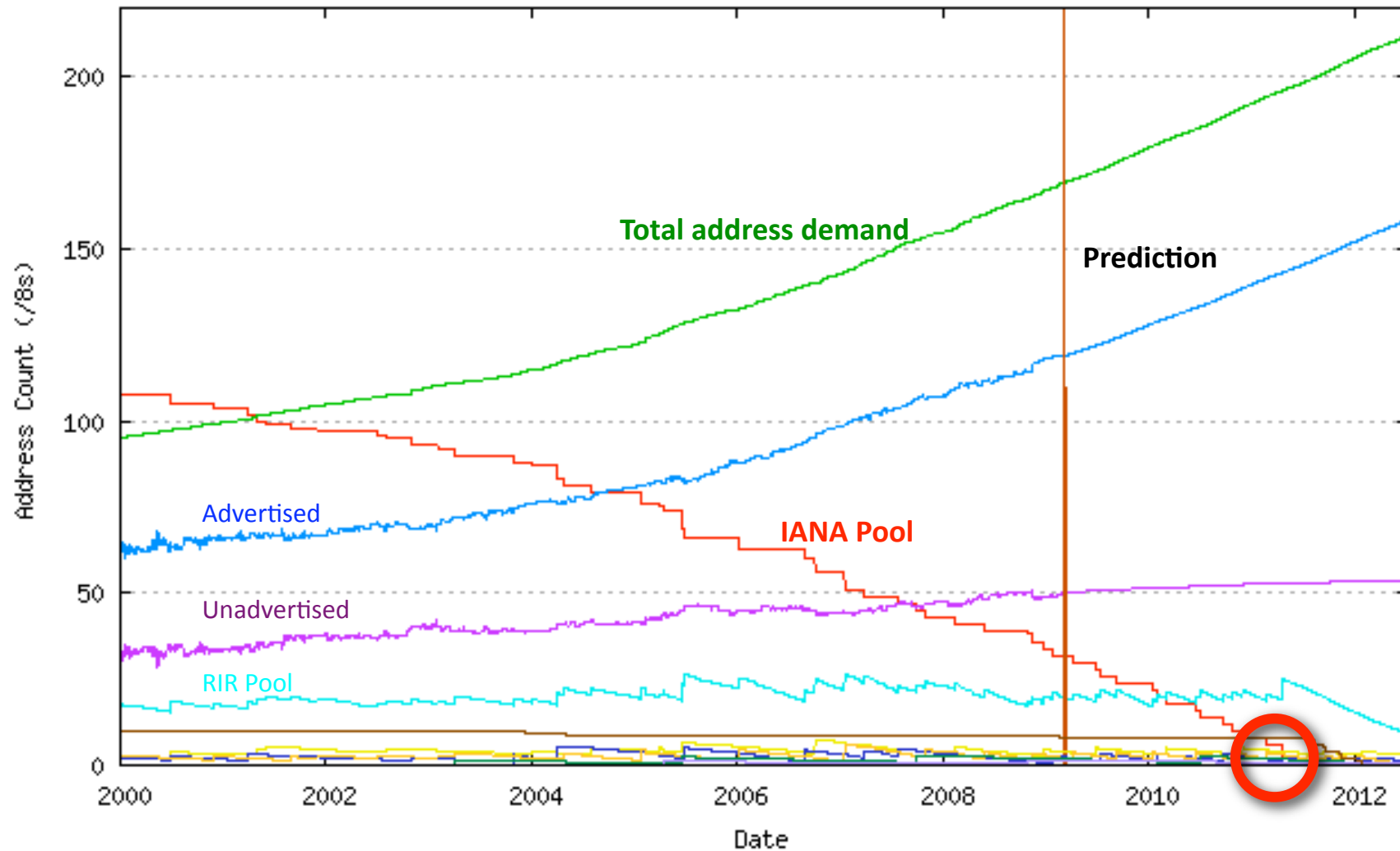
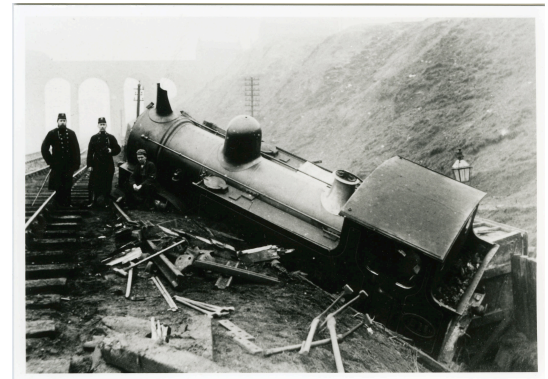


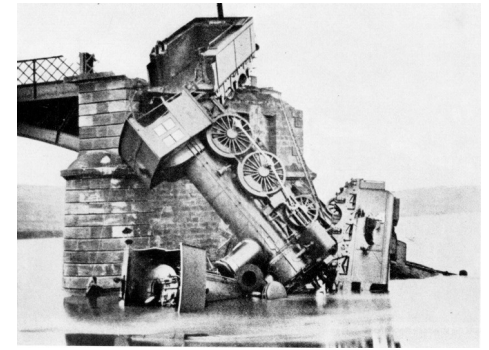
# The story so far...

In case you hadn't heard by now, we appear to be running quite low on IPv4 addresses!



# IANA Pool Exhaustion

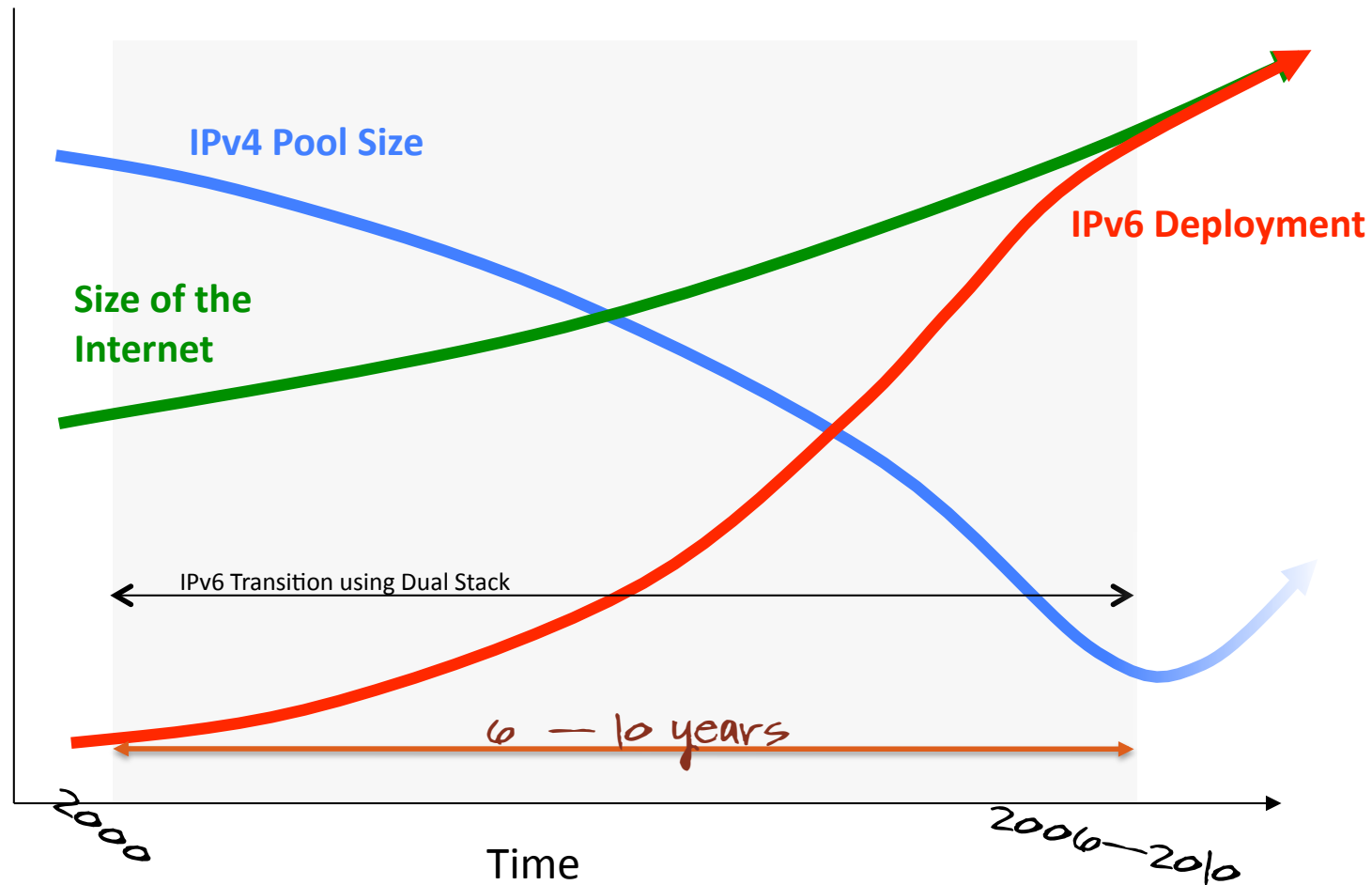




In this model, IANA allocates its  
last IPv4 /8 to an RIR on the 15<sup>th</sup>  
April 2011

This is the model's predicted exhaustion date as of the 10<sup>th</sup>  
March 2009. The predictive model is updated daily at:  
<http://ipv4.potaroo.net>

Ten years ago we  
had a plan ...

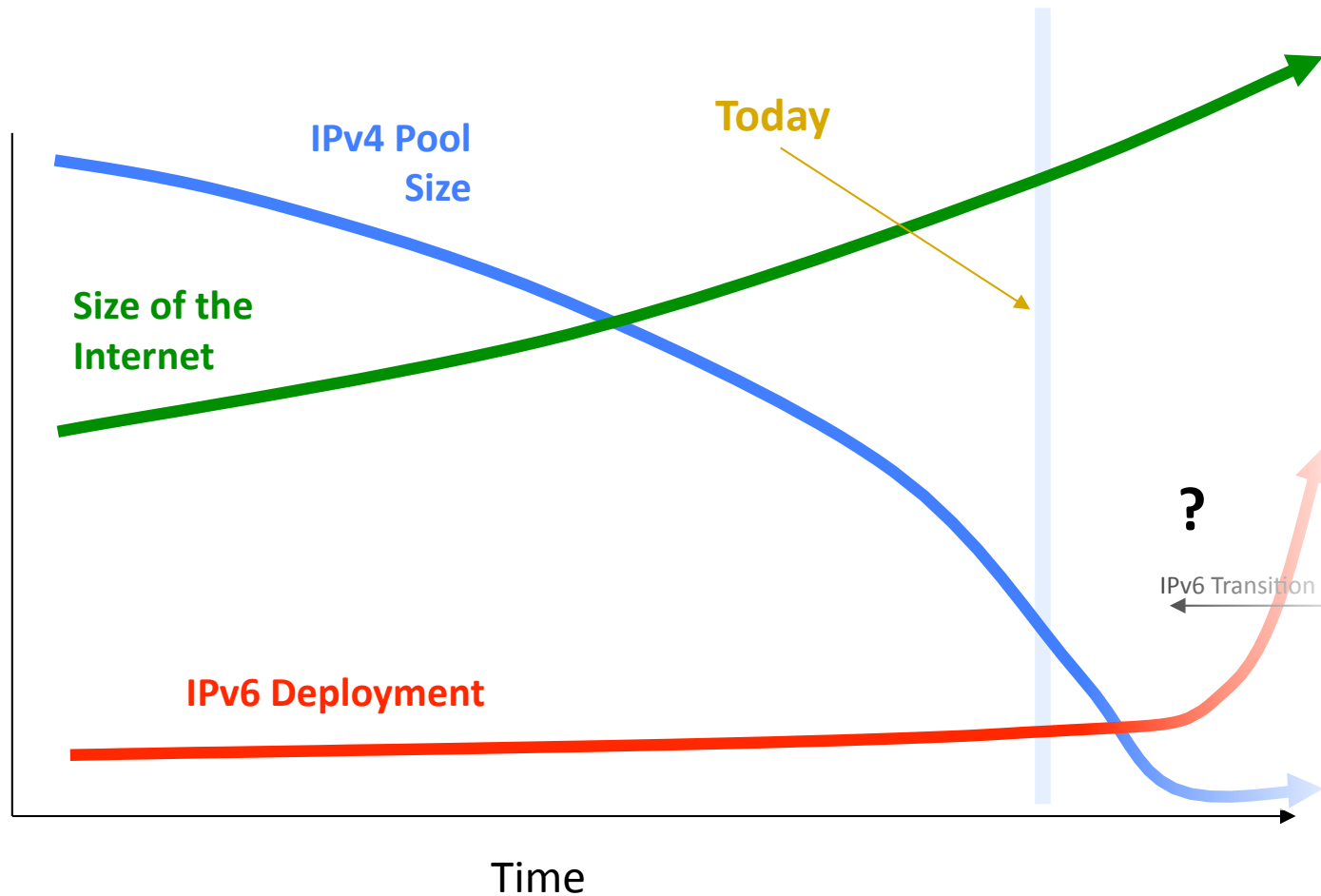
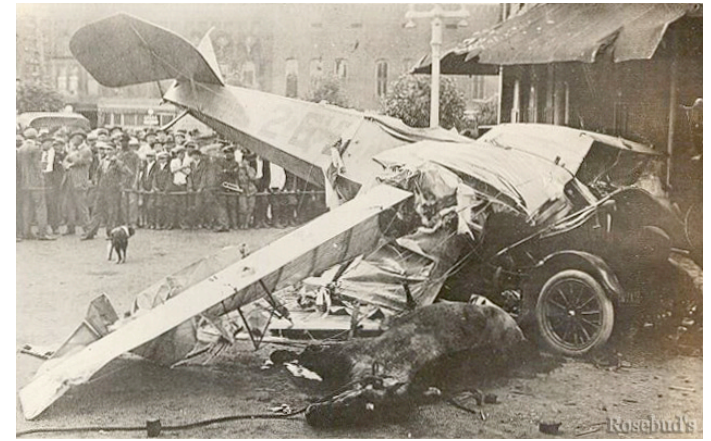


# Oops!



We were meant to have completed the transition to IPv6 **BEFORE** we completely exhausted the supply channels of IPv4 addresses!

# What's the revised plan?

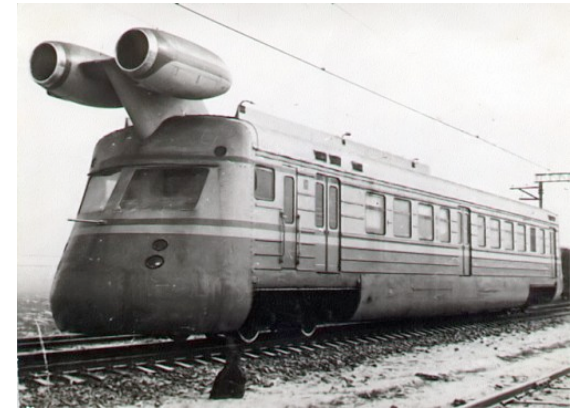




Its just not looking good is it?



# IPv6 Deployment



The new version of the plan is that we need to have much of the Internet also supporting IPv6 in the coming couple of years

How are we going  
today with this  
new plan?



How are we going  
today with this  
new plan?



OR: How much IPv6 is being used today?

Can the data we already collect be interpreted in such a way to provide some answers to this question?

# How much IPv6 is being used today?

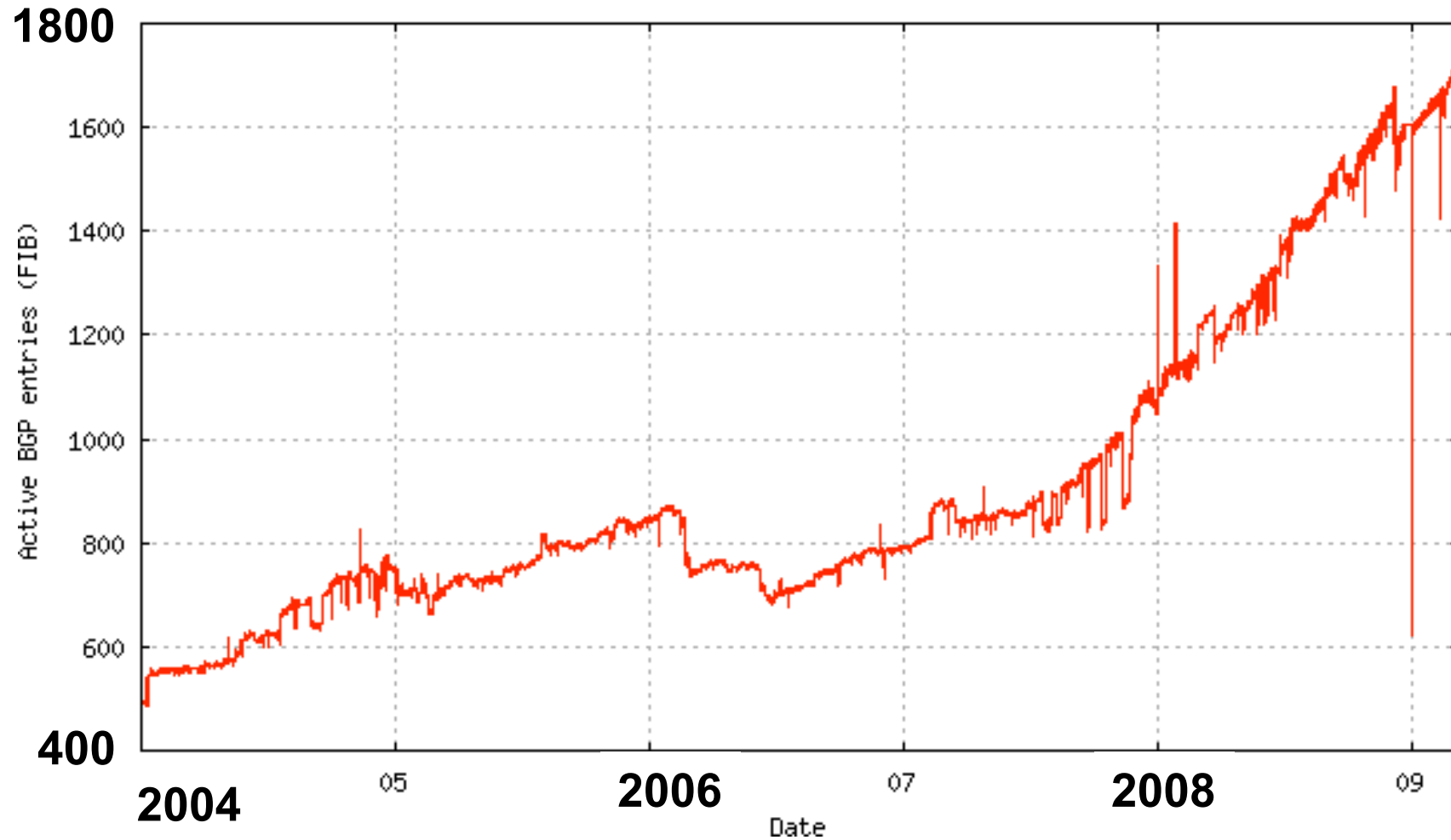
At APNIC we have access to dual-stack data for:

- BGP Route table
- DNS server traffic
- WEB Server access

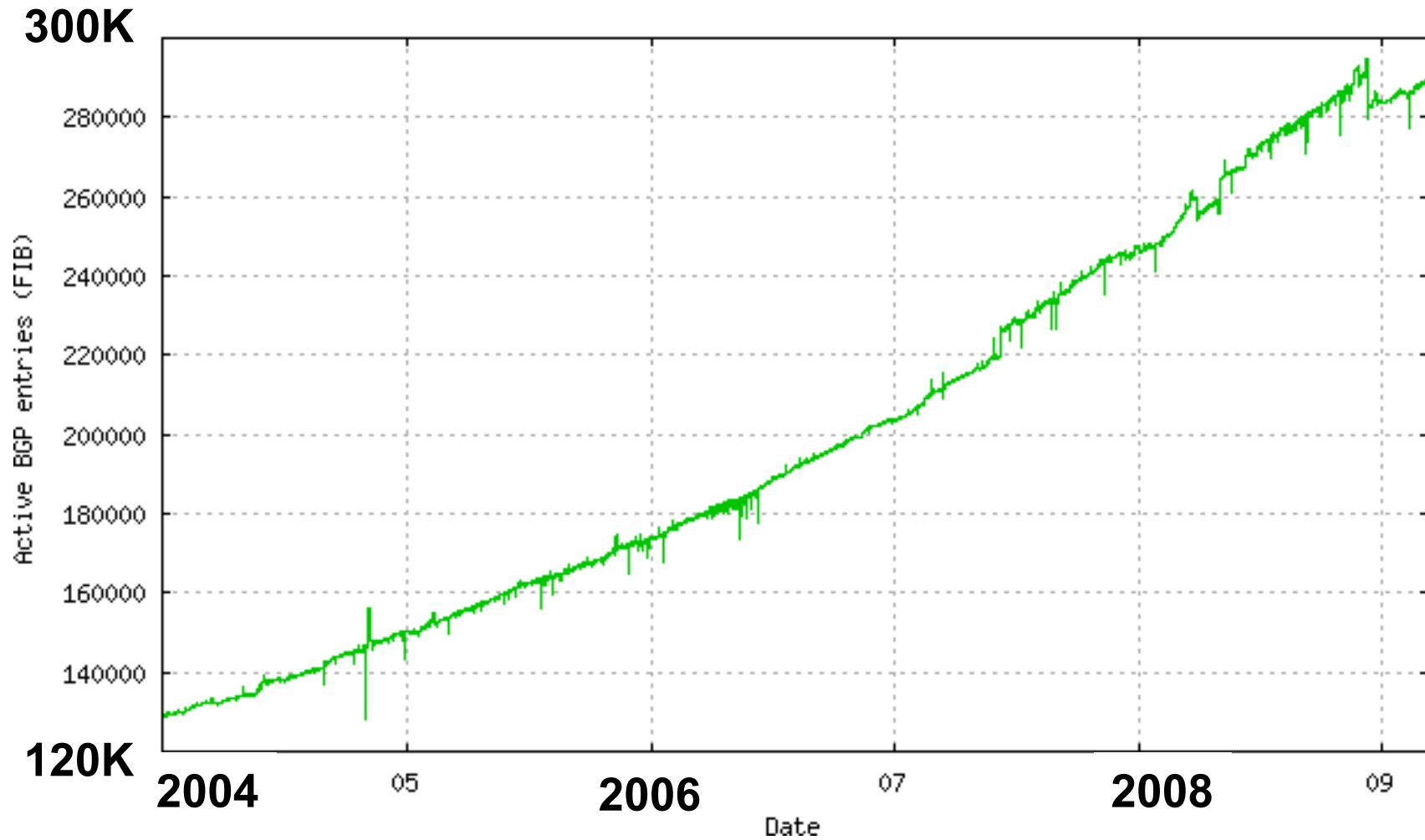
and the data sets go back over the past 4 years

What can these data sets tell us in terms of IPv6 adoption today?

# The BGP view of IPv6

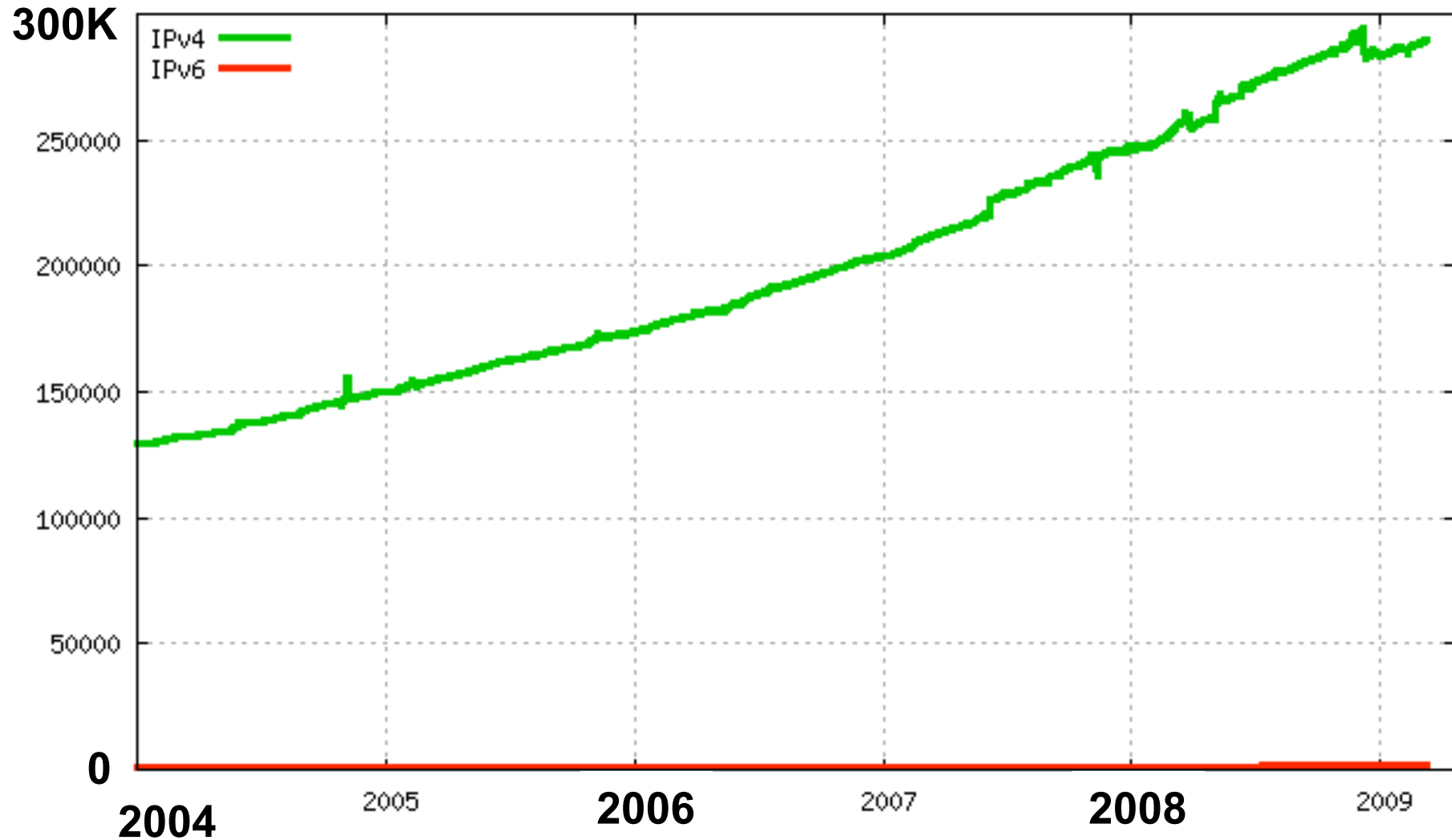


# The BGP view of IPv4





# BGP: IPv6 and IPv4



# BGP IPv6 : IPv4



# What's this saying?

- Since mid-2007 there appears to have been increasing interest in experience with routing IPv6 over the public Internet

# What's this saying?

- V6 is 0.6% of IPv4 in terms of routing table entries
  - Growth is 0.22% p.a., linear
    - IPv6 deployment will reach IPv4 levels in 452 years
    - But the routing domain of IPv4 is heavily fragmented, while IPv6 is not
  - Assuming IPv6 will exhibit 1/3 of the routing fragmentation of IPv4, then IPv6 deployment will fully span the Internet in about 149 years!

# What's this saying?

- IPv6 is 0.6% of IPv4 in terms of routing table entries
  - Growth is 0.22% p.a. near IPv4 levels
    - IPv6 deployment will reach IPv4 levels in 452 years
    - But the rate of IPv4 is heavily skewed towards IPv6 is not
  - Assume IPv6 exhibit 1/3 of the fragmentation of IPv4, the deployment will fully span the Internet in about 149 years!

*This seems highly implausible!*

# What's this saying?

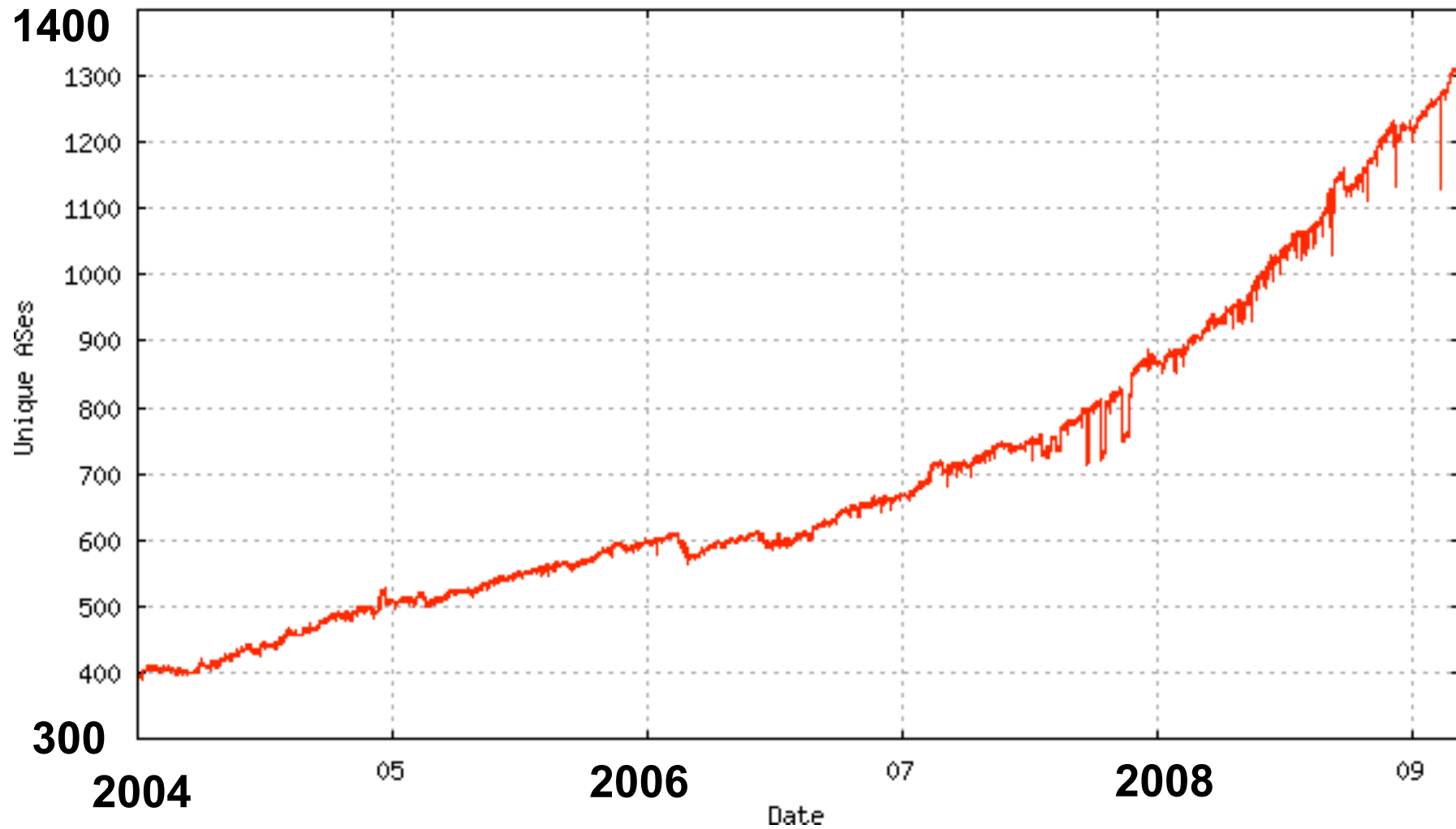
- Routing is not traffic - the relative level of IPv6 use cannot be readily determined from this BGP announcement data

Lets refine the question

How much of the Internet today is  
**capable** of running IPv6?

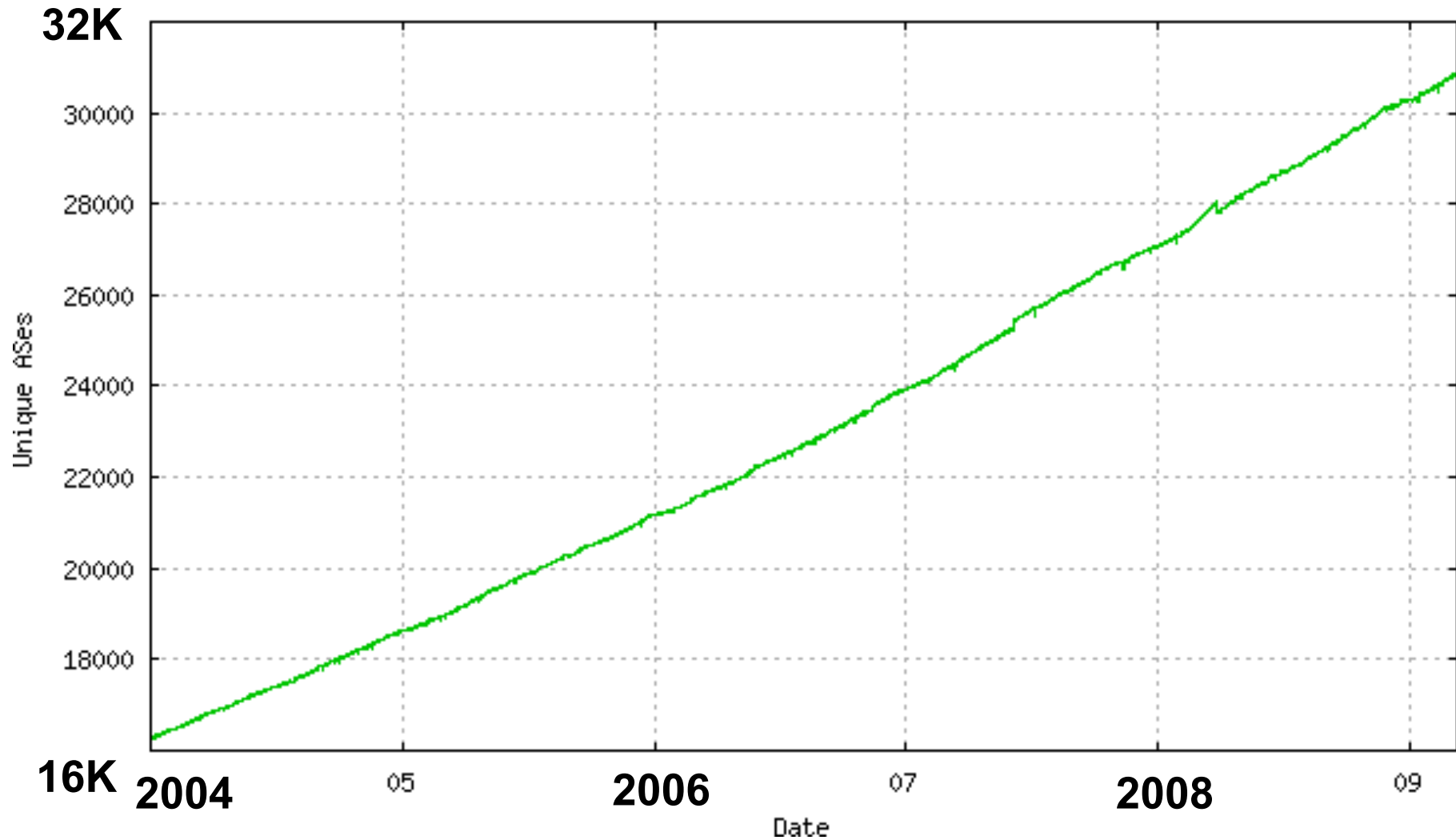
One way to answer this is to look  
at IPv6 routing on a per-AS basis

# IPv6 AS Count





# IPv4 AS Count



# AS Count IPv6 : IPv4



# What's this saying?

The number of AS's announcing IPv6 routes has risen from 2.5% to 4.2% from Jan 2004 to the present day

4.2% of the networks in the Internet are possibly active in some form of IPv6 activity

# What's this saying?

At a relative rate of update of 0.8% per year, a comprehensive update to IPv6 is only 120 years away.

What's this saying?

At a relative rate of 0.8% per year, it takes 120 years to update the model. This is highly sensitive to the value of  $\lambda$ .

*This too seems highly implausible!*

120

That 4.2% is not uniform

In IPv4 4,002 AS's are transit networks  
and 26,874 are origin-only

Of the 4,002 IPv4 transit AS's 687 also have IPv6 routes  
440 of these IPv4 transits are IPv6 stub ASs

17.1% of V4 Transit AS's also route IPv6

Of the 26,874 V4 stub AS's 630 also route IPv6  
49 of these IPv4 stubs are IPv6 transit ASs

2.3% of V4 Origin AS's also route IPv6

# What's this saying?

- The proportion of IPv4 transit ASNs announcing IPv6 prefixes has risen by 3.3% in 12 months
- At this rate comprehensive Ipv6 deployment in the "core" will take only 25 more years.

# What's this saying?

- The proportion of ASNs announcing routes has risen 12 months
- At the time of the comprehensive IPv6 deployment the "core" will take 25 more years.

*Even this seems highly implausible!*



# Capability vs Actual Use

As 17% of the number of transit AS's are announcing IPv6 address prefixes, does this mean that 17% of the Internet's "core" is running IPv6 right now?

# Capability vs Actual Use

As 17% of the number of transit AS's are announcing prefixes, and that 17% of the Internet is running IPv6

*This seems highly implausible!*

# Interpretation of BGP data

- Transit-AS uptake appears to be the most relevant indicator of IPv6 uptake in the ISP sector
- An investigation of topology comparison of IPv4 and IPv6 inter-AS network should be undertaken
- Is the IPv6 BGP network isomorphic to the IPv4 BGP network? Or is this network being constructed as an overlay using a different set of connectivity enablers and constraints?

# DNS Server Stats

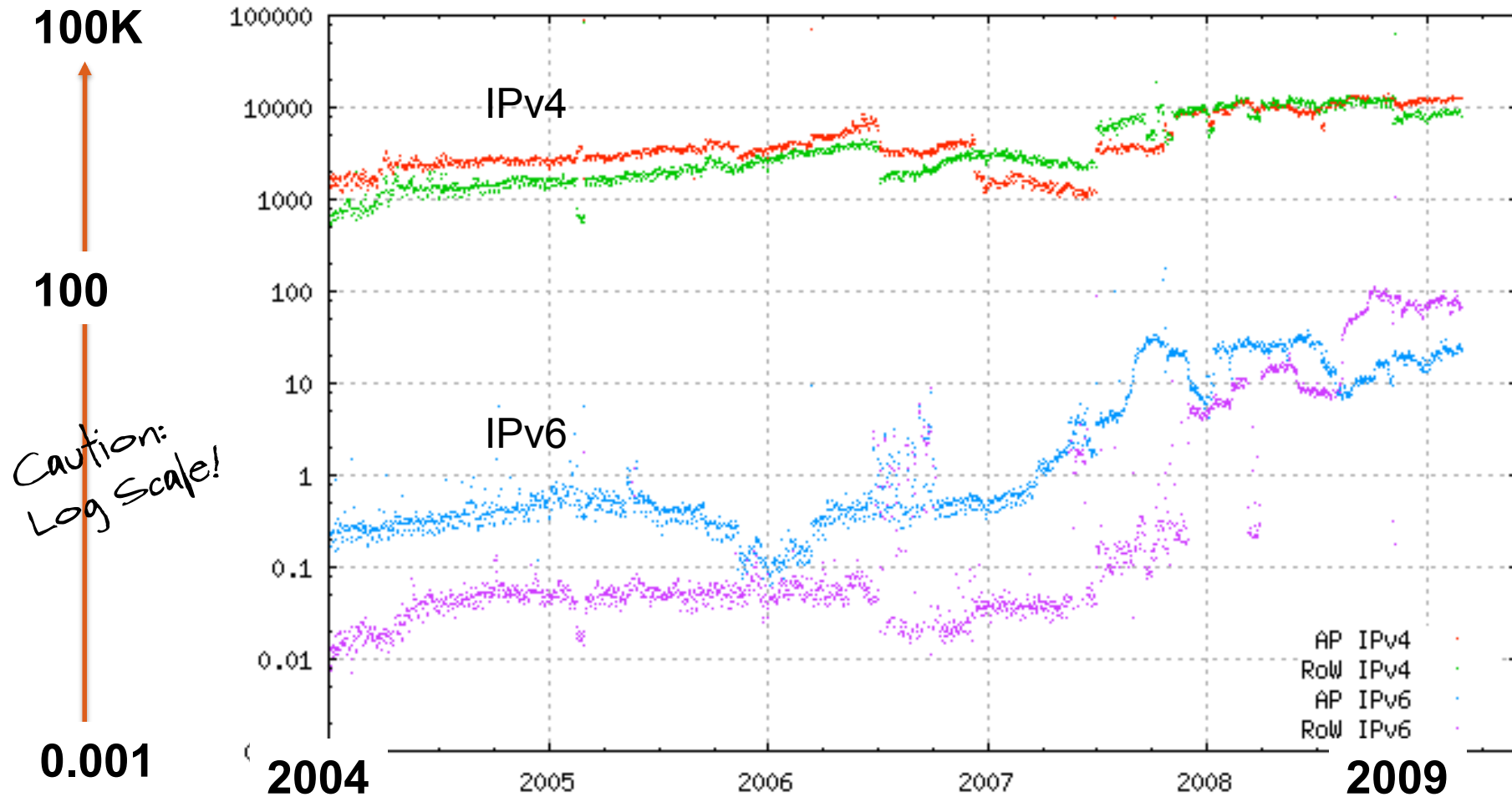
- APNIC runs two sets of DNS servers for the reverse zones for IPv4 and IPv6
  - One set of servers are used to serve reverse zones for address ranges that are deployed in the Asia Pacific Area
  - The second set of servers are used as secondaries for zones served by RIPE NCC, LACNIC and AFRINIC

# DNS Reverse Query Load

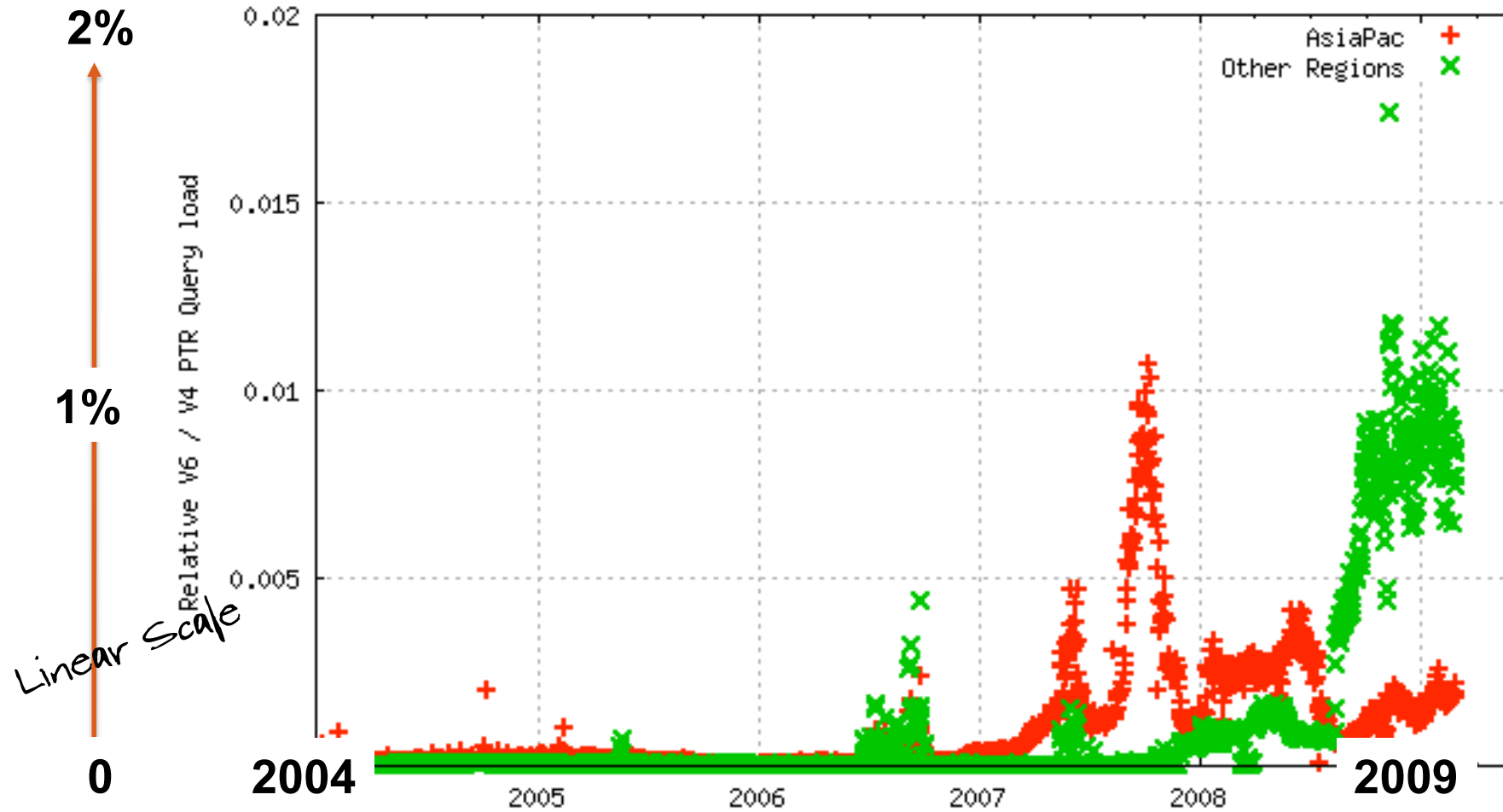
- Examine the average query load for reverse PTR queries for IPv6 and IPv4 zones for each of these server sets

# DNS Reverse Query Load

PTR queries per second



# Relative DNS Query Load

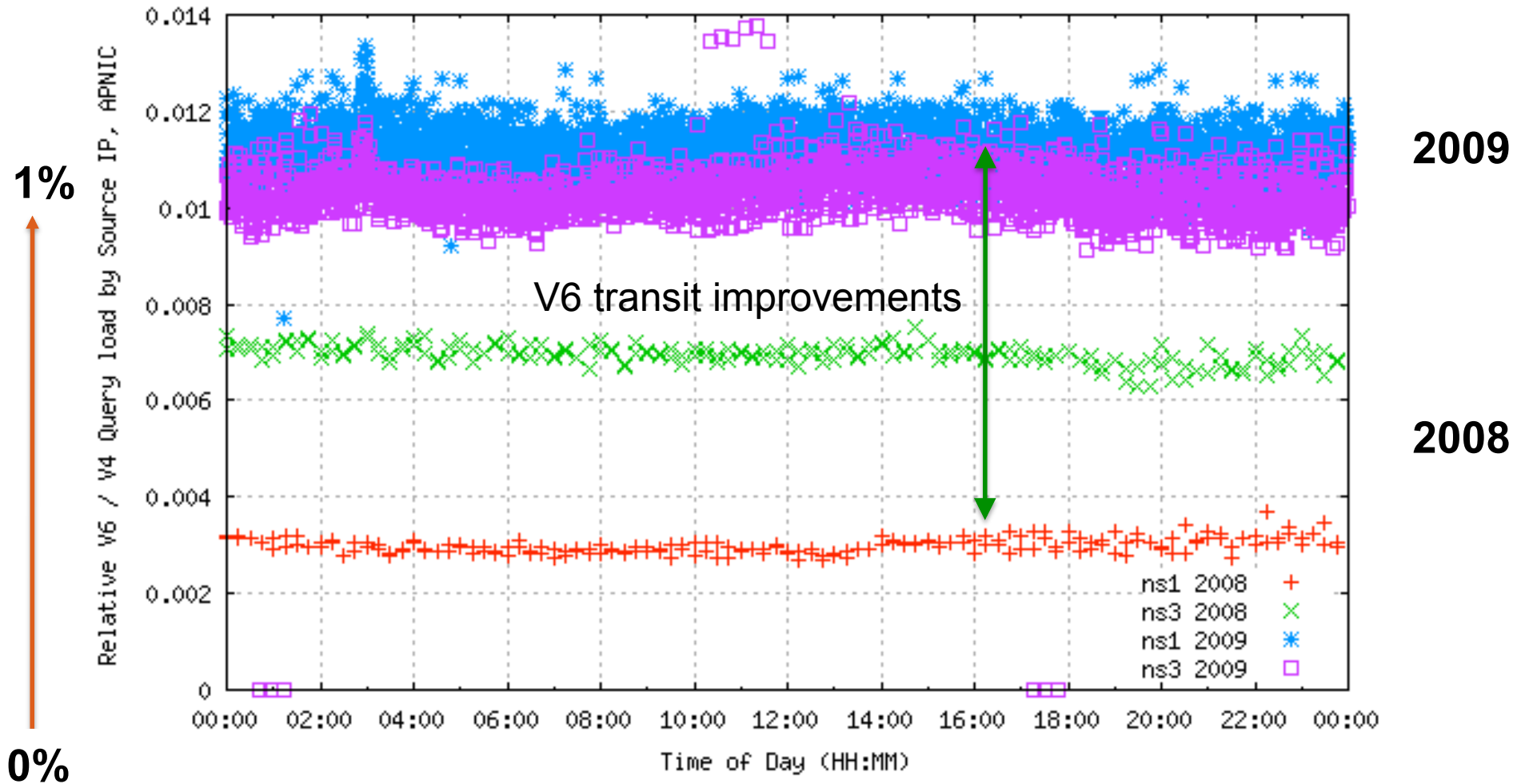


# What's this saying?

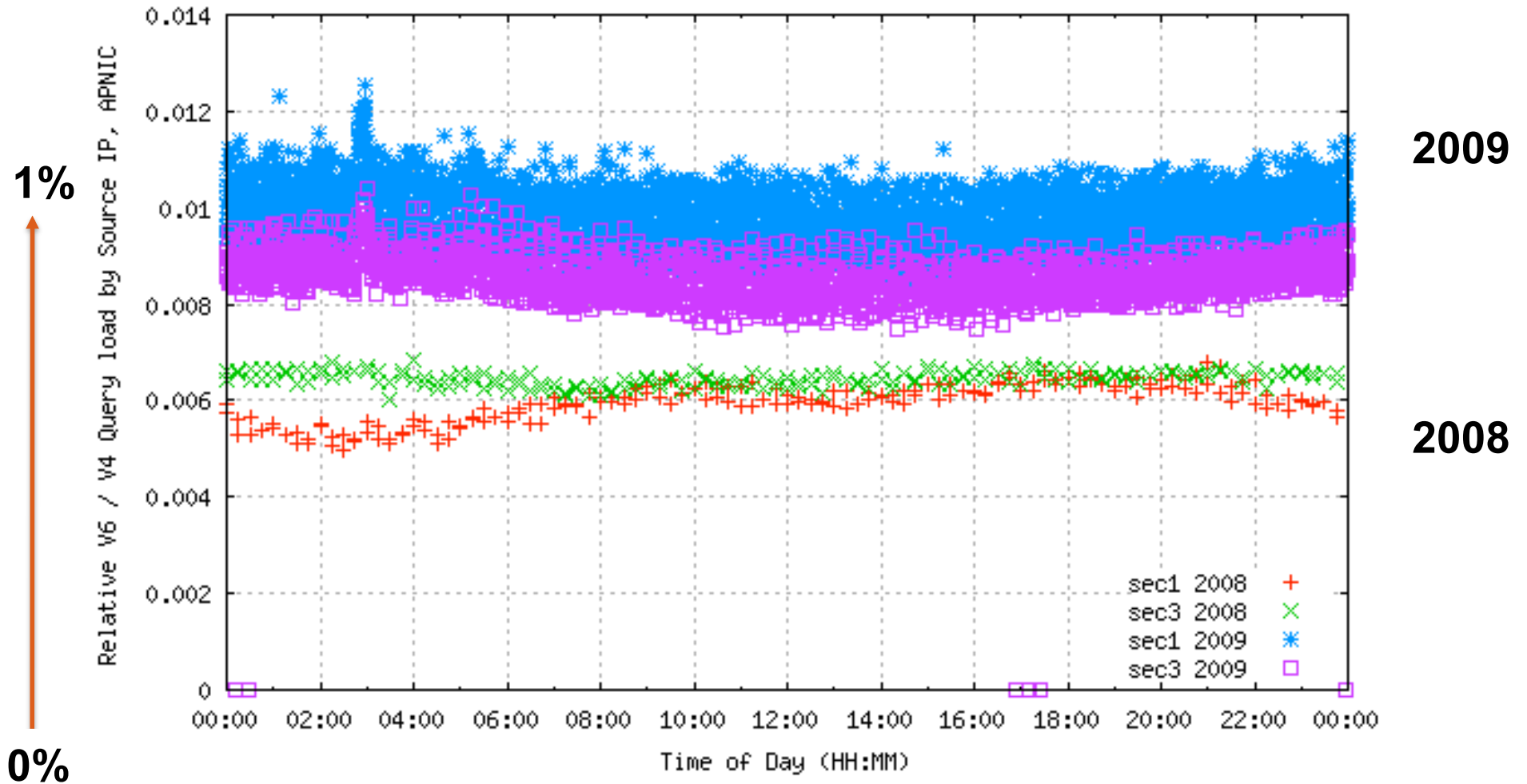
- Reverse DNS queries for IPv6 addresses are around 0.2% of the IPv4 query load
- AsiaPac IPv6 query load was higher than for other regions to 2008, now lags
- Query load has increased since 2007
- The interactions of forwarders and caches with applications that perform reverse lookups imply a very indirect relationship between actual use of IPv6 and DNS reverse query data



# DITL 2008 to Present AP



# DITL 2008 to Present Row



# What's this saying?

- Best-case improvement in V6/V4 ratios from 2008 is 2x increase in V6 in a year
  - Arguably more improvement if V6 transit improved than from 'growth' in V6
- AP saw bigger increases than RoW
  - Local RTT preference?

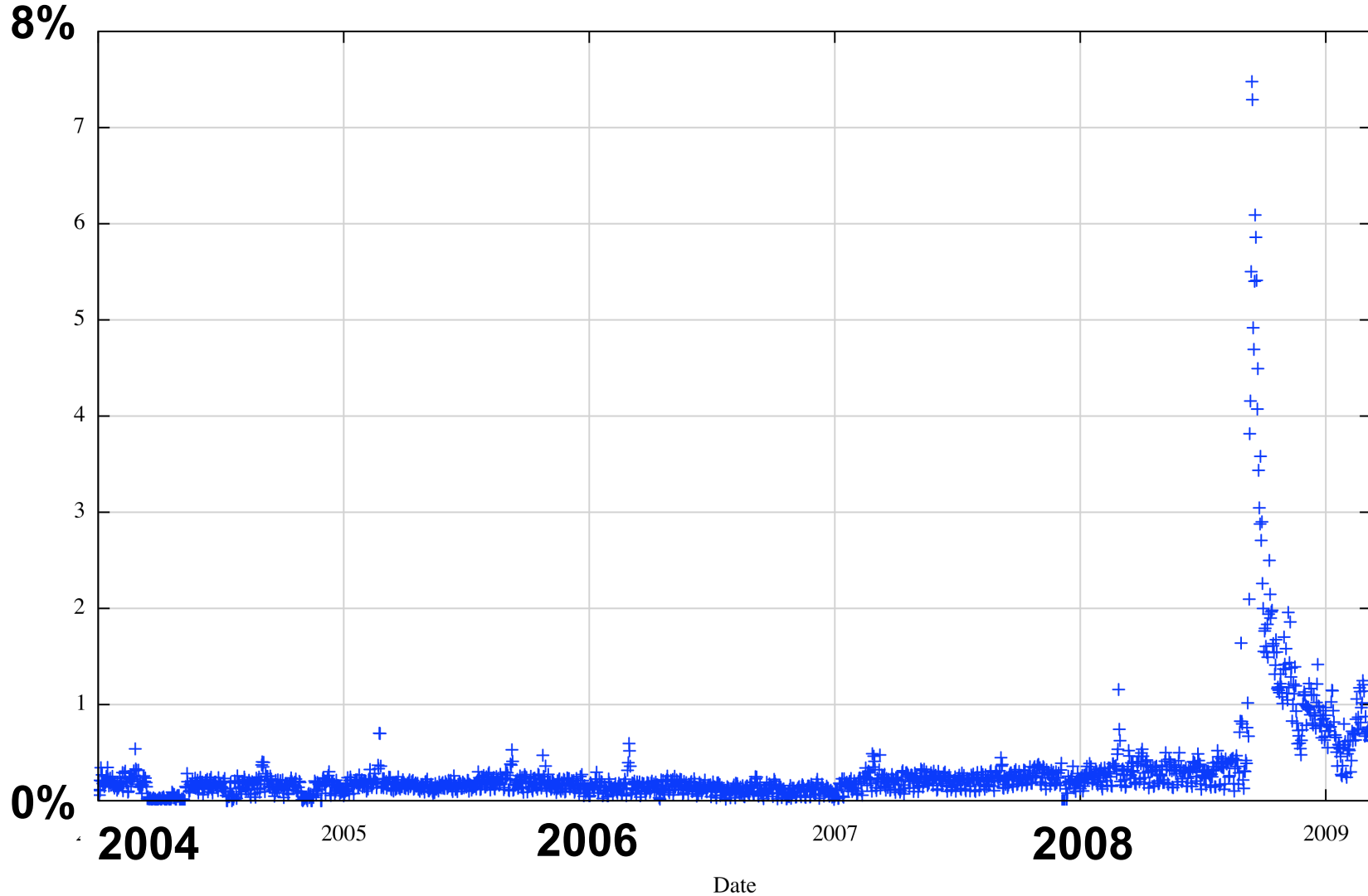
# Web Server Stats

- Take a couple of dual-homed web servers:  
<http://www.apnic.net>  
<http://www.ripe.net>
- Count the number of distinct IPv4 and IPv6 query addresses per day
  - Not the number of 'hits', just distinct source addresses that access these sites, to reduce the relative impact of robots and crawlers on the data and normalize the data against different profiles of use
- Look at the V6 / V4 access ratio

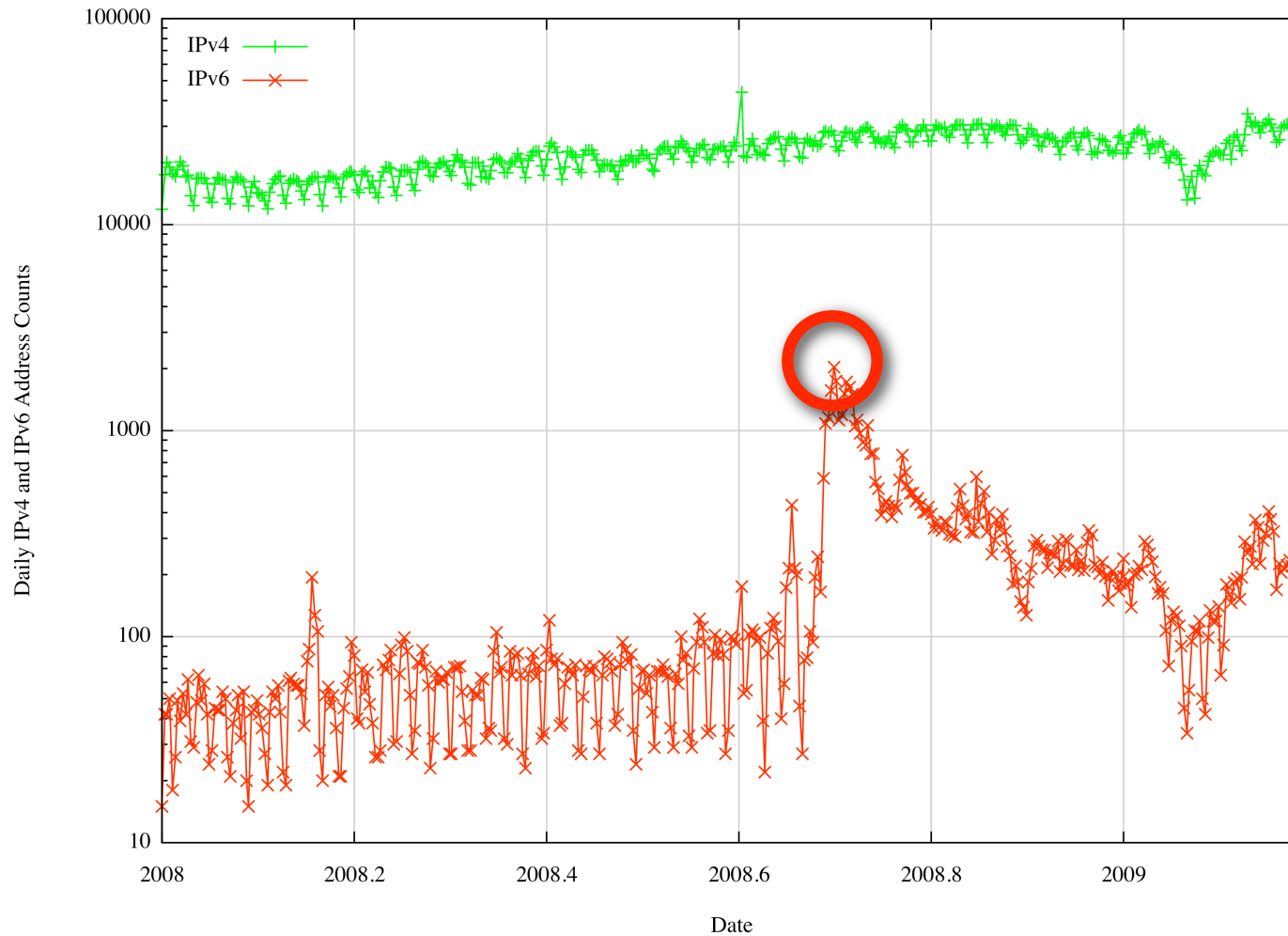
what proportion of end host systems will prefer end-to-end IPv6, when there is a choice?

# APNIC Web Server Stats

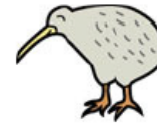
www.apnic.net server logs: V6 / V4 daily ratio



# What happened on the 12<sup>th</sup> September 2008?



## Are you an IPv4 sheep or an IPv6 kiwi?



- Hope we can see as many as kiwis hopping around:
  - <http://www.apnic.net/meetings/26/ipv6/v6kiwi/>
- The value of this experiment:
  - Everyone attempts IPv6 connectivity
  - Enjoy the experiment
  - And share knowledge and information



## ✿ CNGI高校驻地网IPv6用户数量测试

✿ [查看](#)

✿ [合作](#)

欢迎访问CNGI高校驻地网IPv6用户数量测试网站！

您的IP: 2001:dc0:2001:10:217:f2ff:fec9:1b10

来自：

来自这个学校共有 0 个人

验证码： 3545 (必填)

邮件地址： (选填)

开始测试

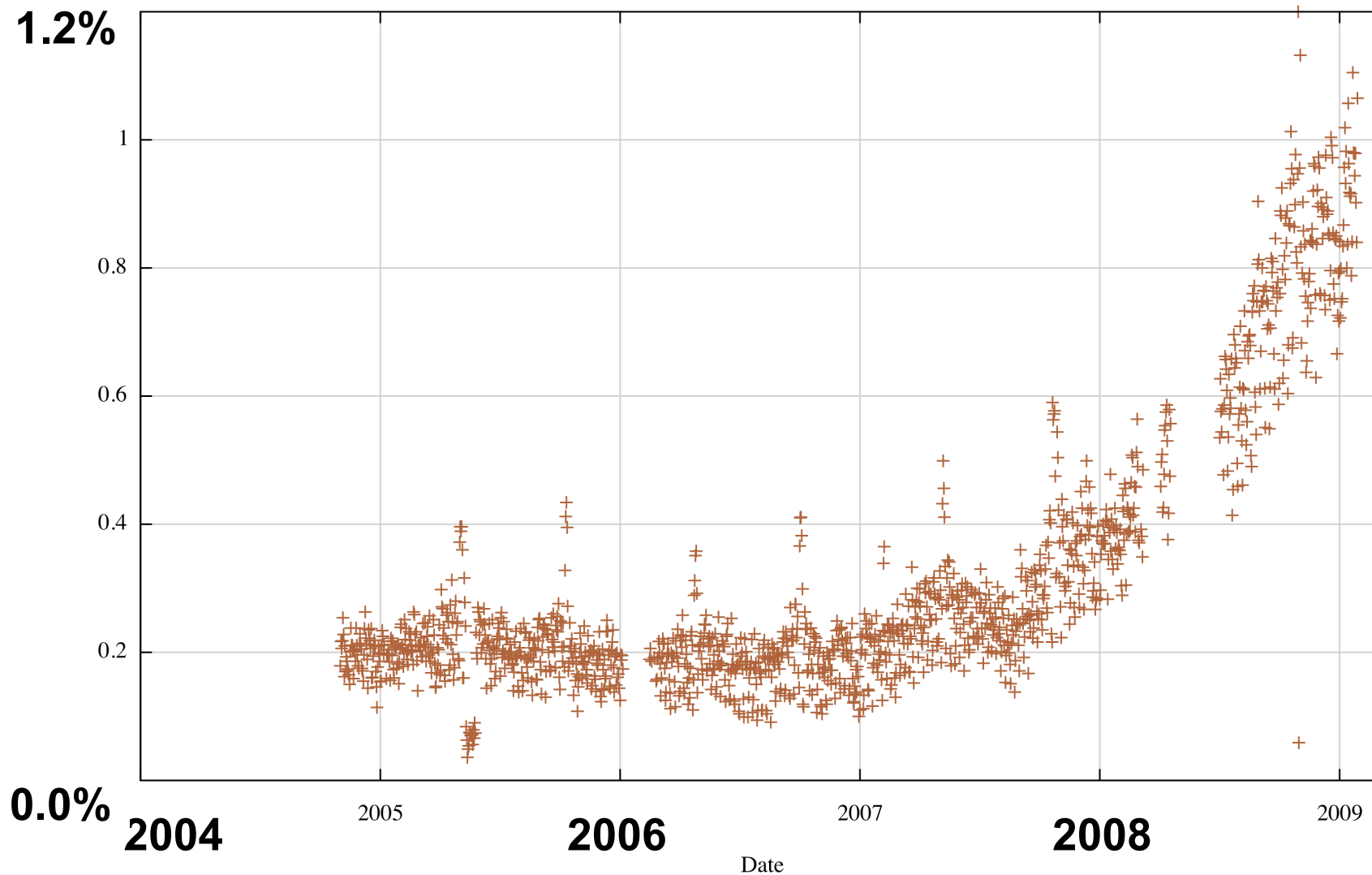
## ✿ IPv6常用资源链接

[Beijing 2008 Olympics](#) [IPTV via IPv6](#) [IPv6 Enabled Webcams](#) [Dancing KAME](#)  
[IPv6 Google site](#) [v6kivi](#) [Network Time Protocol](#) [IPv6 BitTorrent Clients](#)  
[上海交大视频直播网](#) [中科大影视无限](#)



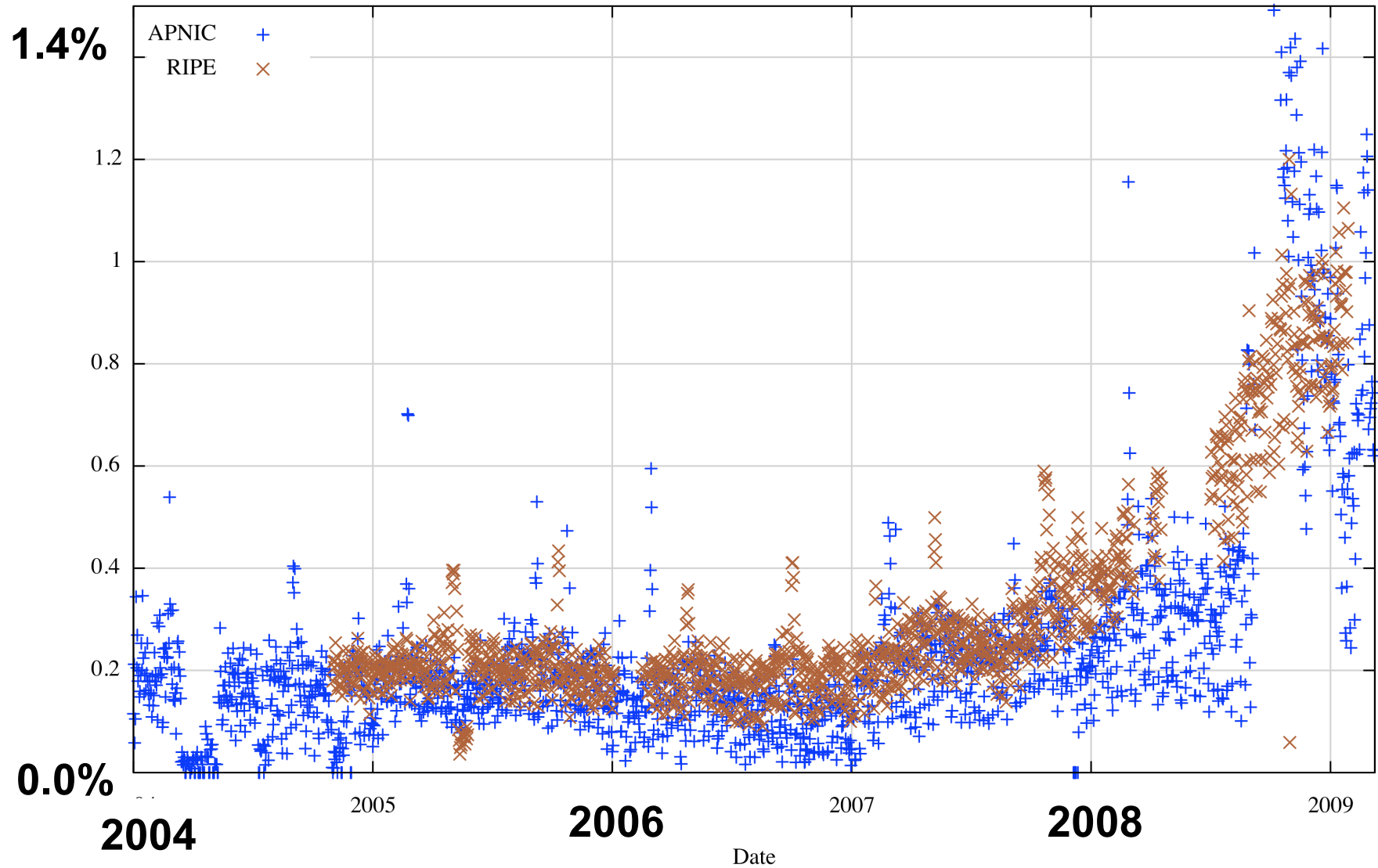
# RIPE NCC Web Server Stats

www.ripe.net server logs: V6 / V4 daily ratio



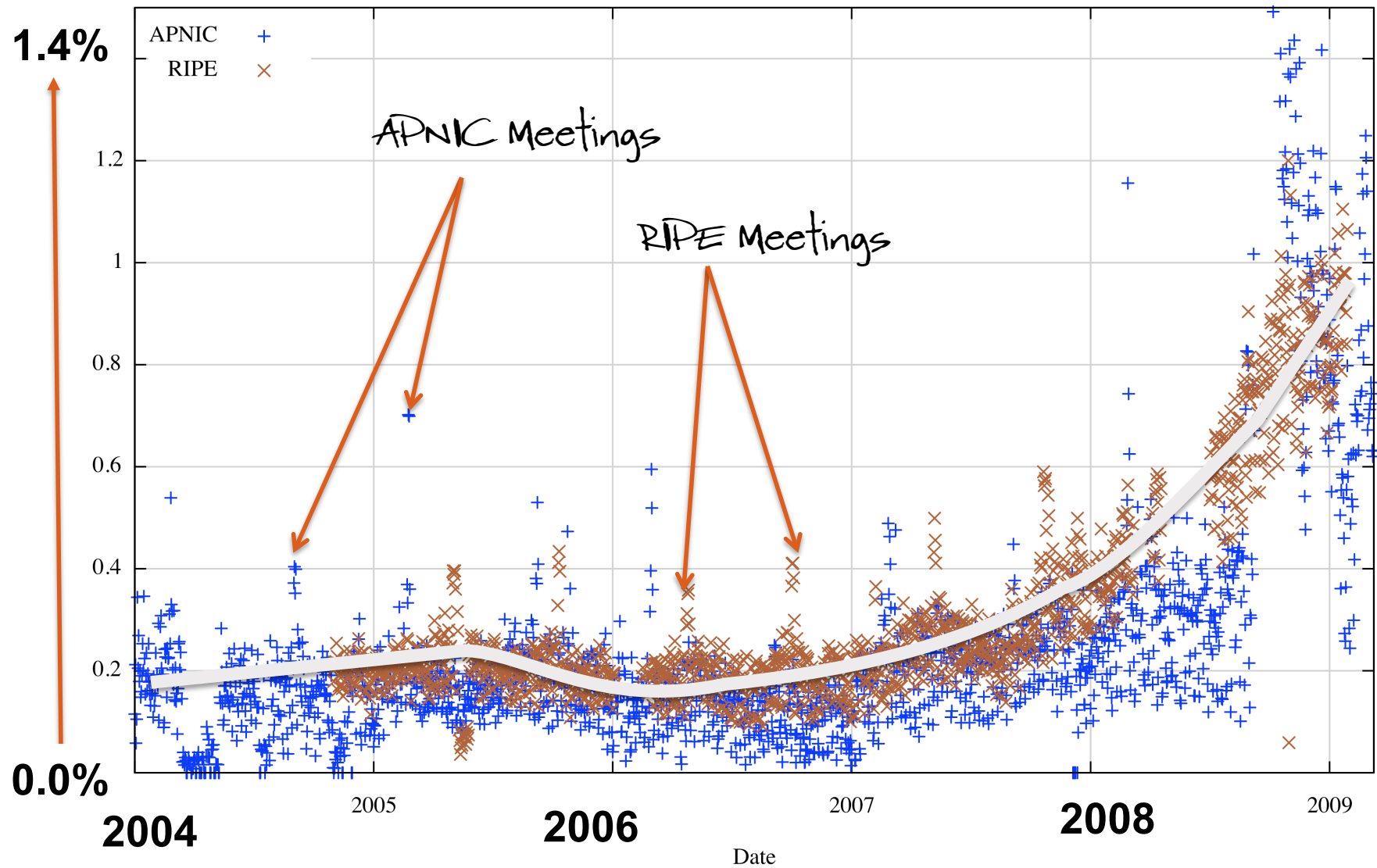
# Combined Stats

RIPE and APNIC server logs: V6 / V4 daily ratio



# Combined Stats

RIPE and APNIC server logs: V6 / V4 daily ratio

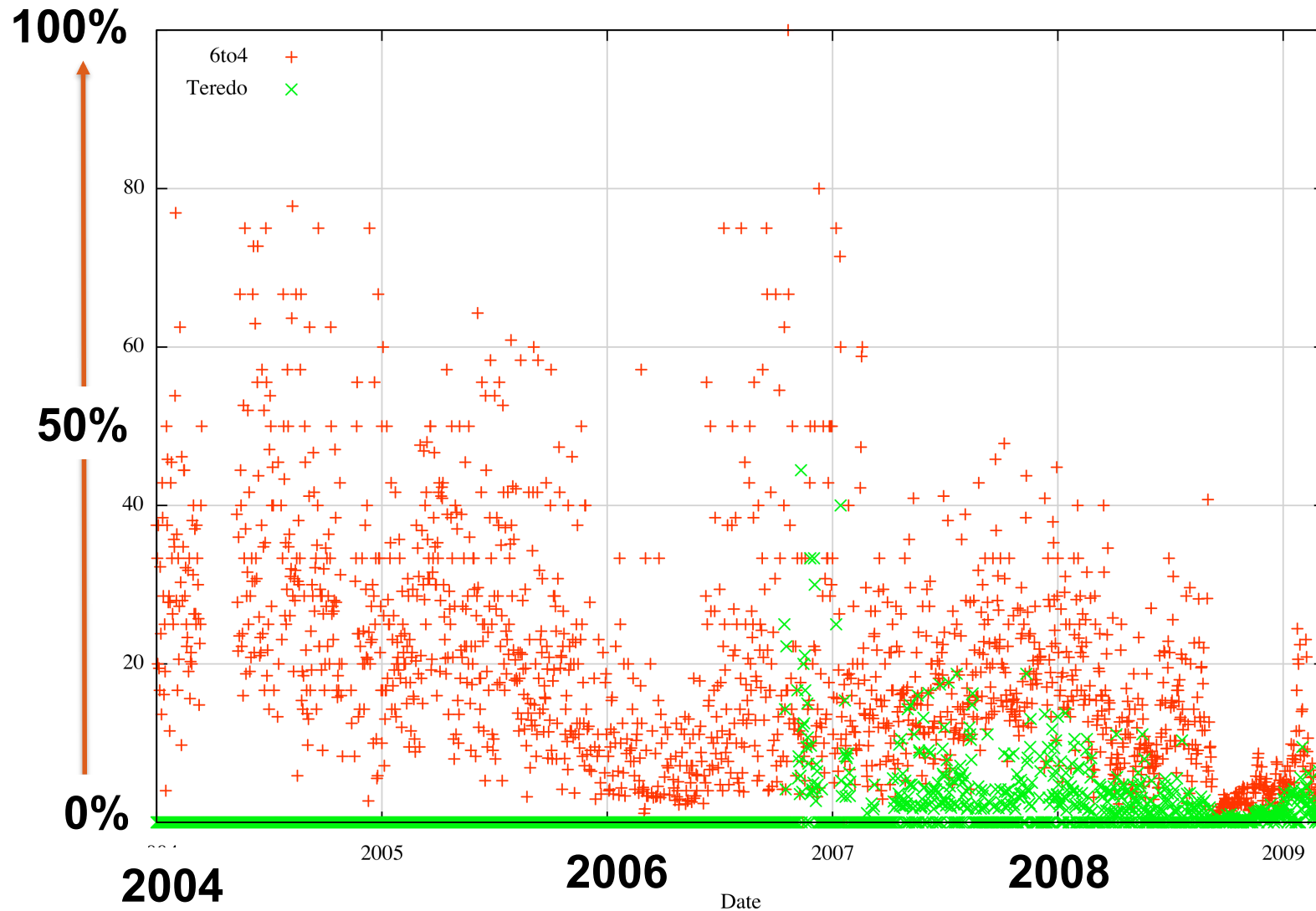


# What's this saying?

- Relative use of IPv6 when the choice is available is 0.2% in the period 2004 - 2006
- Relative use of IPv6 increased from 2007 to around 1% today
  - Is interest in IPv6 slowing picking up again?
  - Increased use of auto-tunneling of IPv6 on end host stacks?

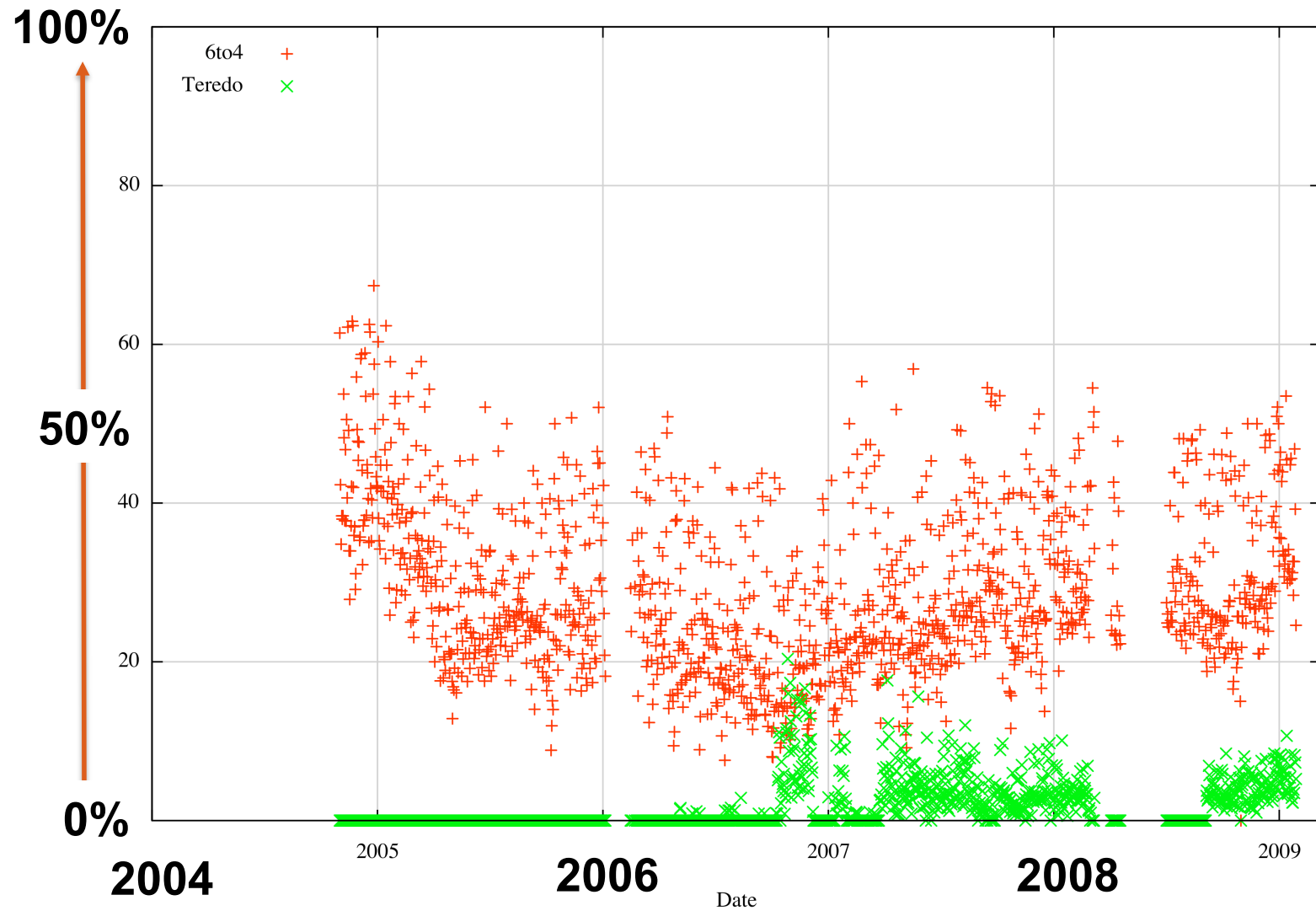
# Use of V6 Transition Tools

- APNIC Web Server Stats



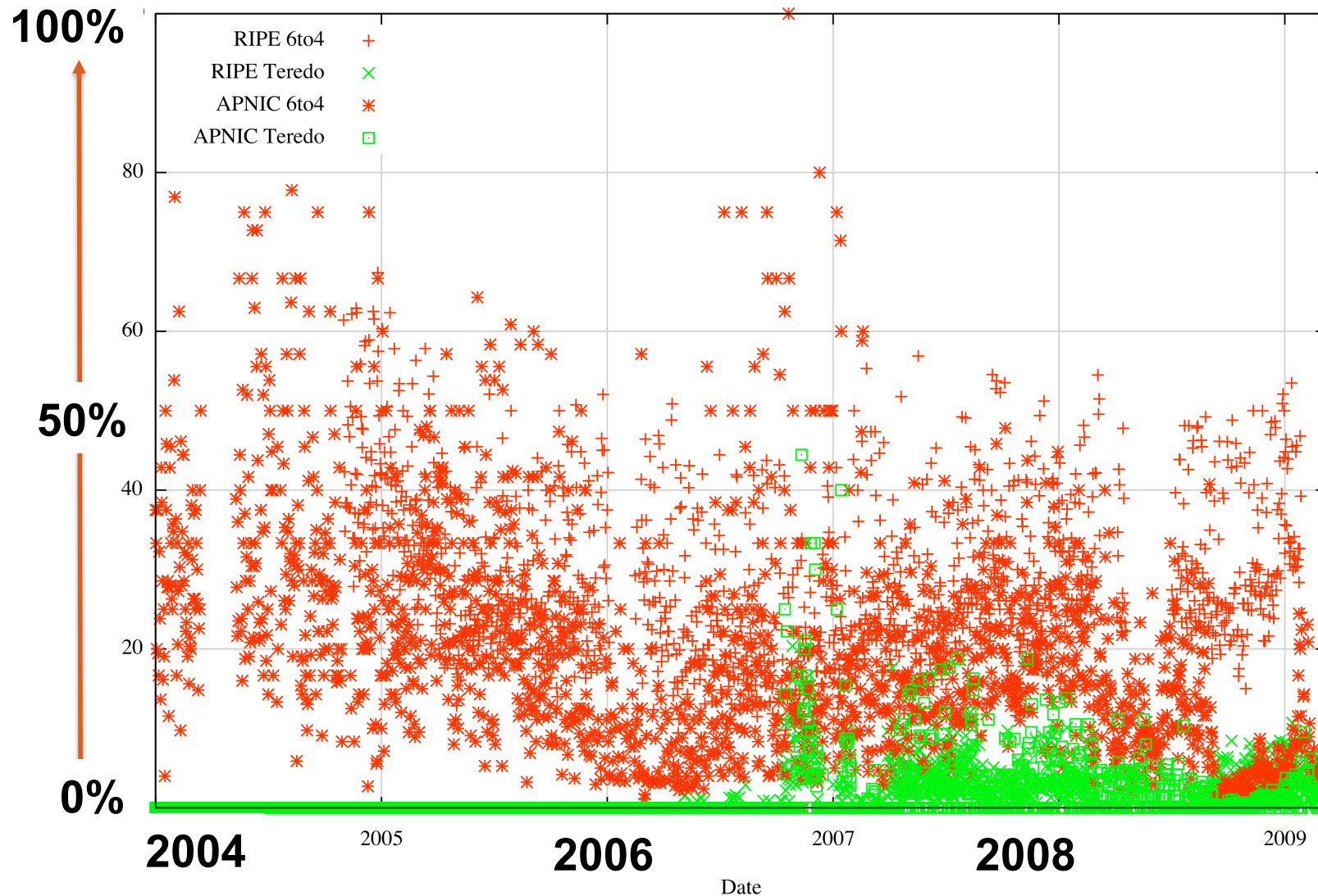
# Use of V6 Transition Tools

- RIPE NCC Web Server Stats



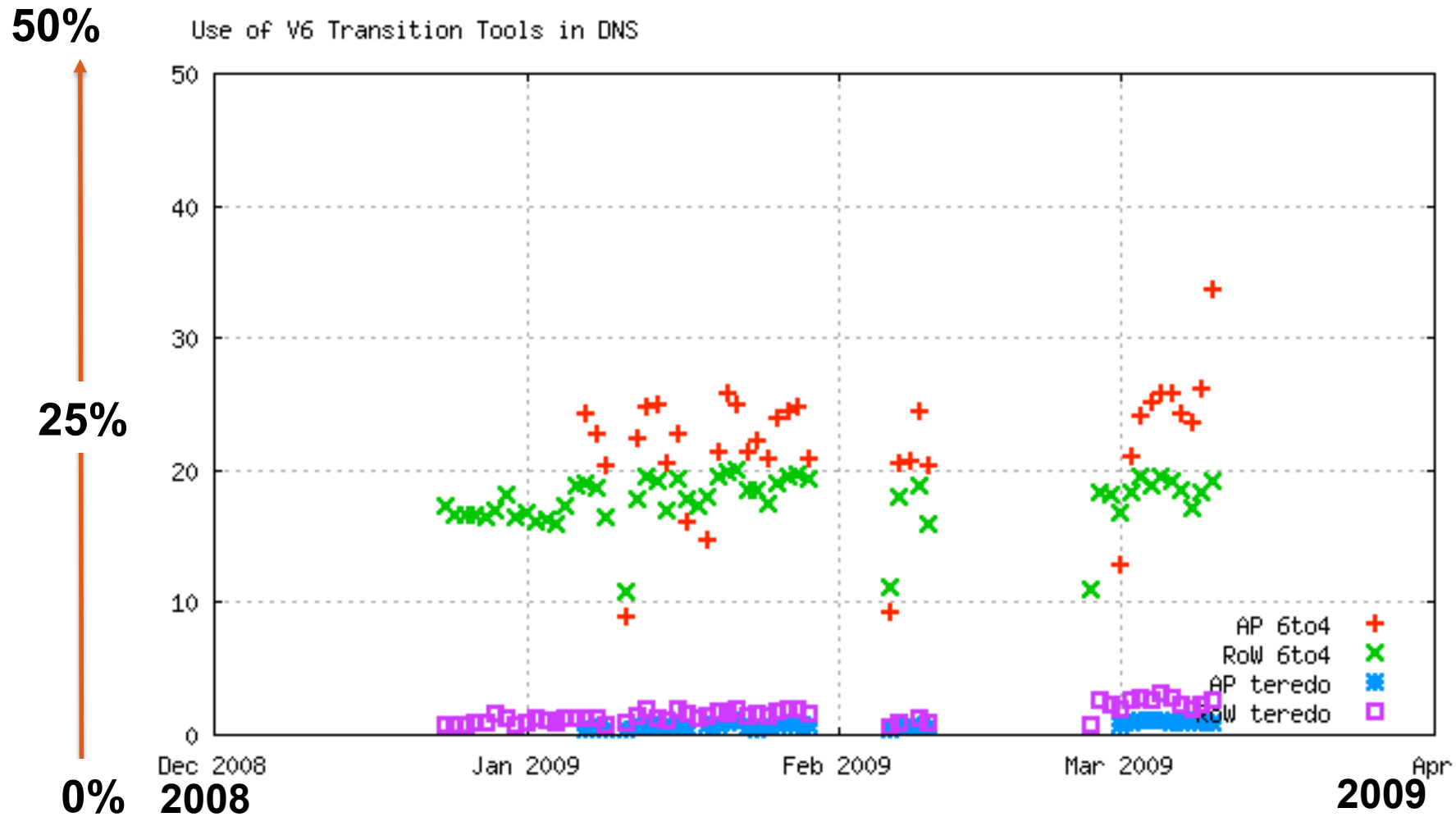
# Use of V6 Transition Tools

- Combined WebStats



# Transition Tools in DNS

- Combined Stats





# What's this saying?

- Up to 25% of IPv6 clients in the Euro/ Mid East Region appear to use access tunneling techniques across an edge IPv4 infrastructure
- The use of IPv6 clients using access tunneling is lower in the Asia Pac region
- Infrastructure DNS is using tunnels
  - Even Teredo
    - (lower pref than v4 in Vista)

# Where are we with IPv6?

- The "size" of the IPv6 deployment in terms of end host IPv6 capability is around **10 per thousand** Internet end hosts at present

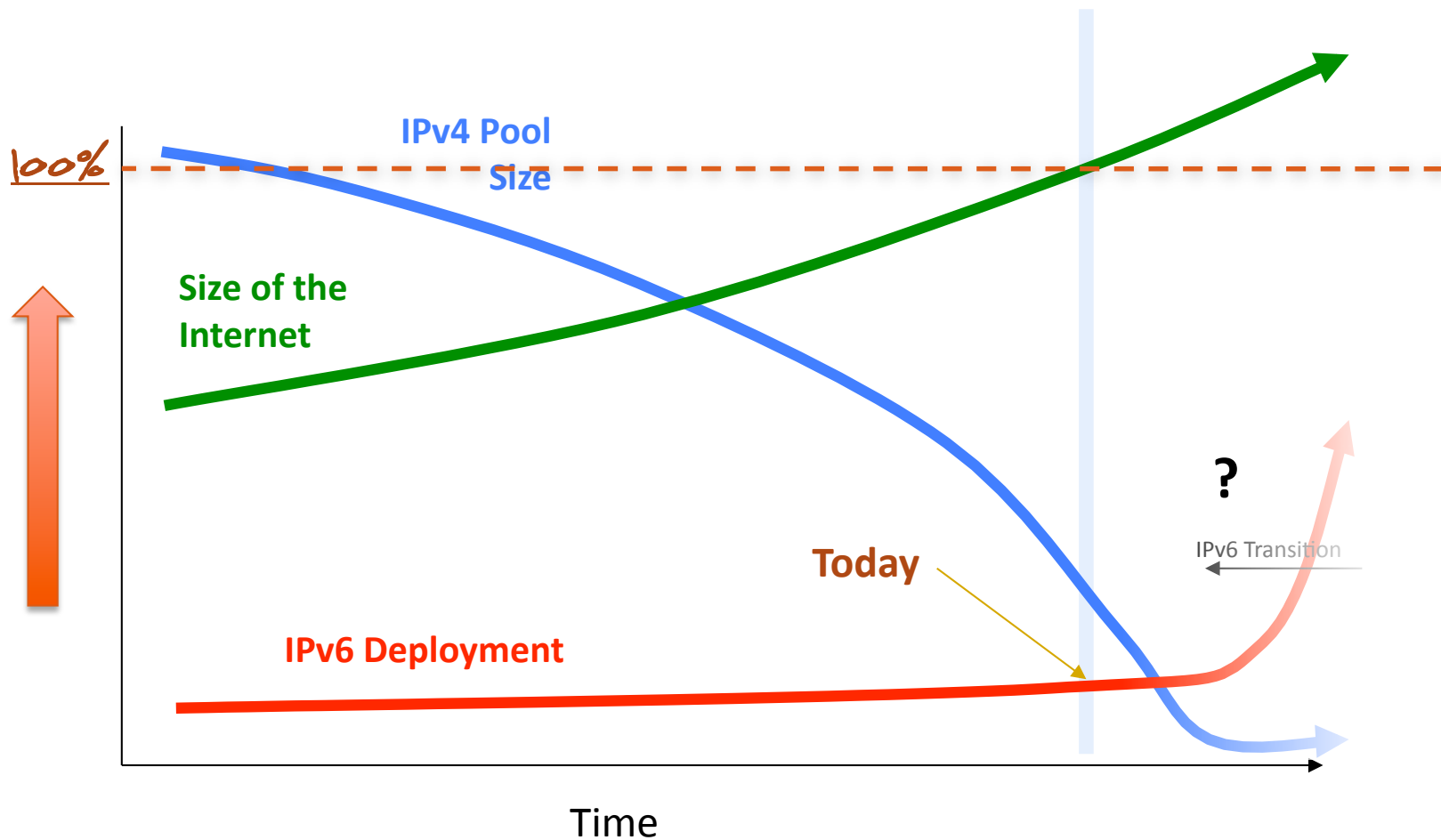
# Where are we with IPv6?

At most!

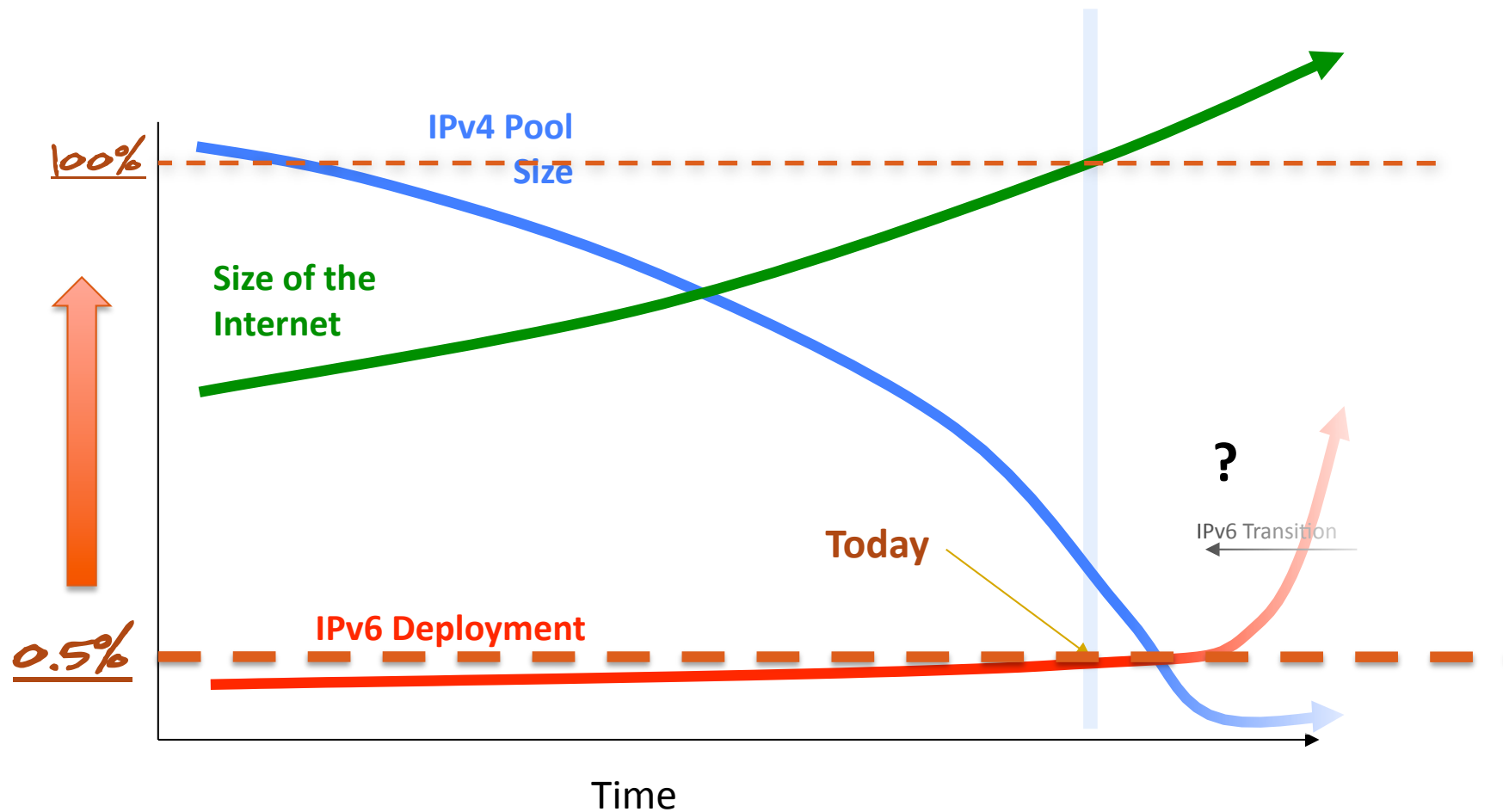
This may be too optimistic:

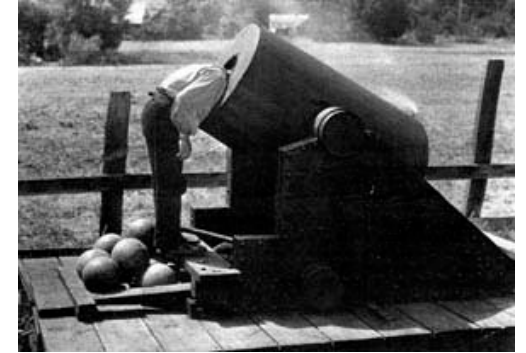
- Widespread NAT use in IPv4 undercounts IPv4 host counts
- These web sites are tech weenie web sites. More general sites may have less IPv6 clients
- So perhaps the current IPv6 deployment level for end users may be closer to 5 - 7 per thousand

# What's the revised plan?



# What's the revised plan?





Thank You!

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