World IPv6 Day - What did we learn?

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World IPv6 Day

- One single day (2011-06-08) where many content providers enabled IPv6 for everyone

- Ran for 24 hours from 00:00 UTC

- Hundreds of participants
  - Big and small
  - Many of them actually turned IPv6 on before the day
  - Many of them left IPv6 on after the day

- We were measuring the effects

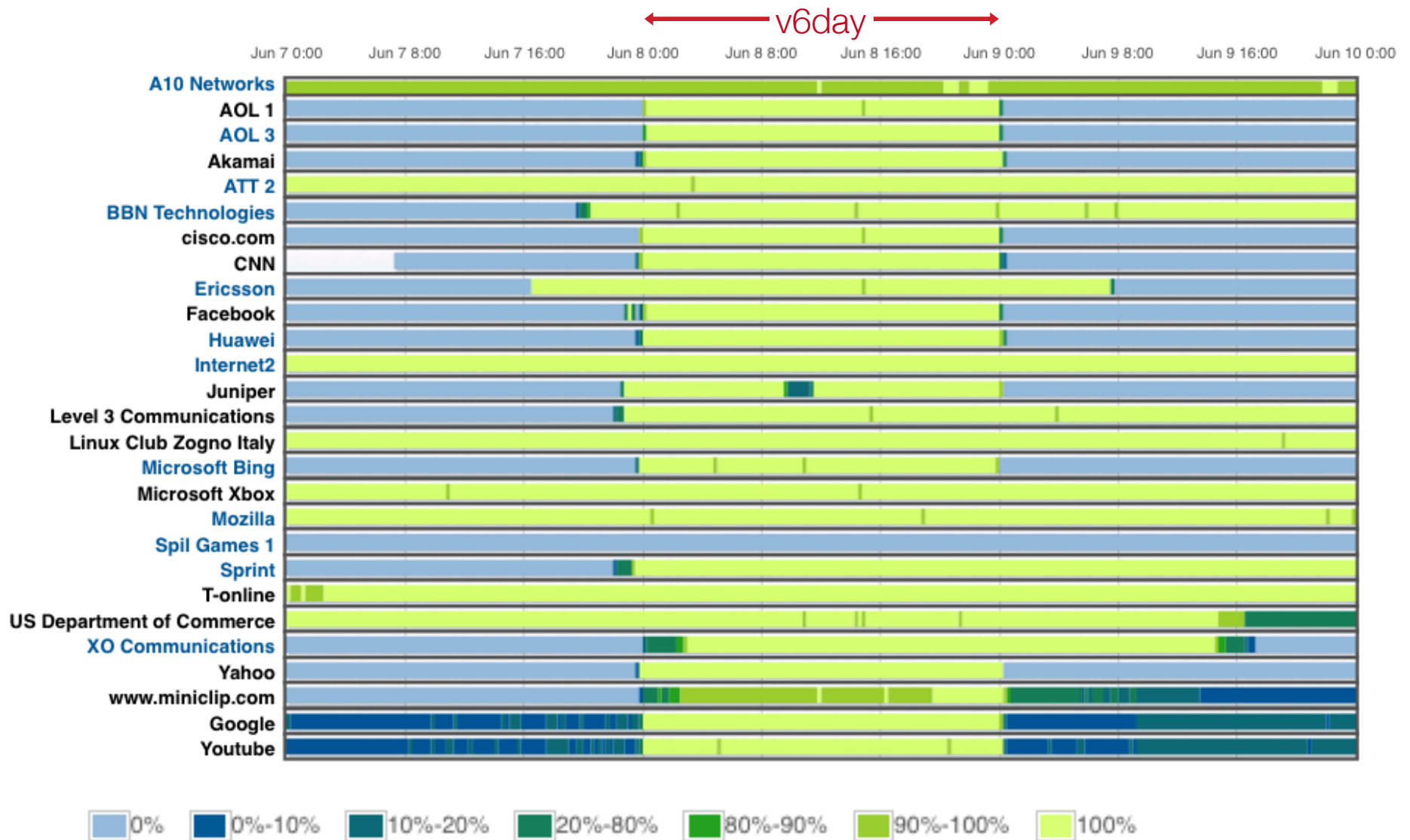# RIPE NCC Measurements - World IPv6 Day

- IPv6 Eyechart and 6to4 (not in this talk)

- Active measurements
  - Sources: 40 vantage points (RIPE TTM, CAIDA Ark, ...)
  - Destinations: 53 participant or already dual-stacked sites
  - From 2011-06-01 to 2011-06-11 we measured
    - DNS: A and/or AAAA records
    - ping(6)/traceroute(6)
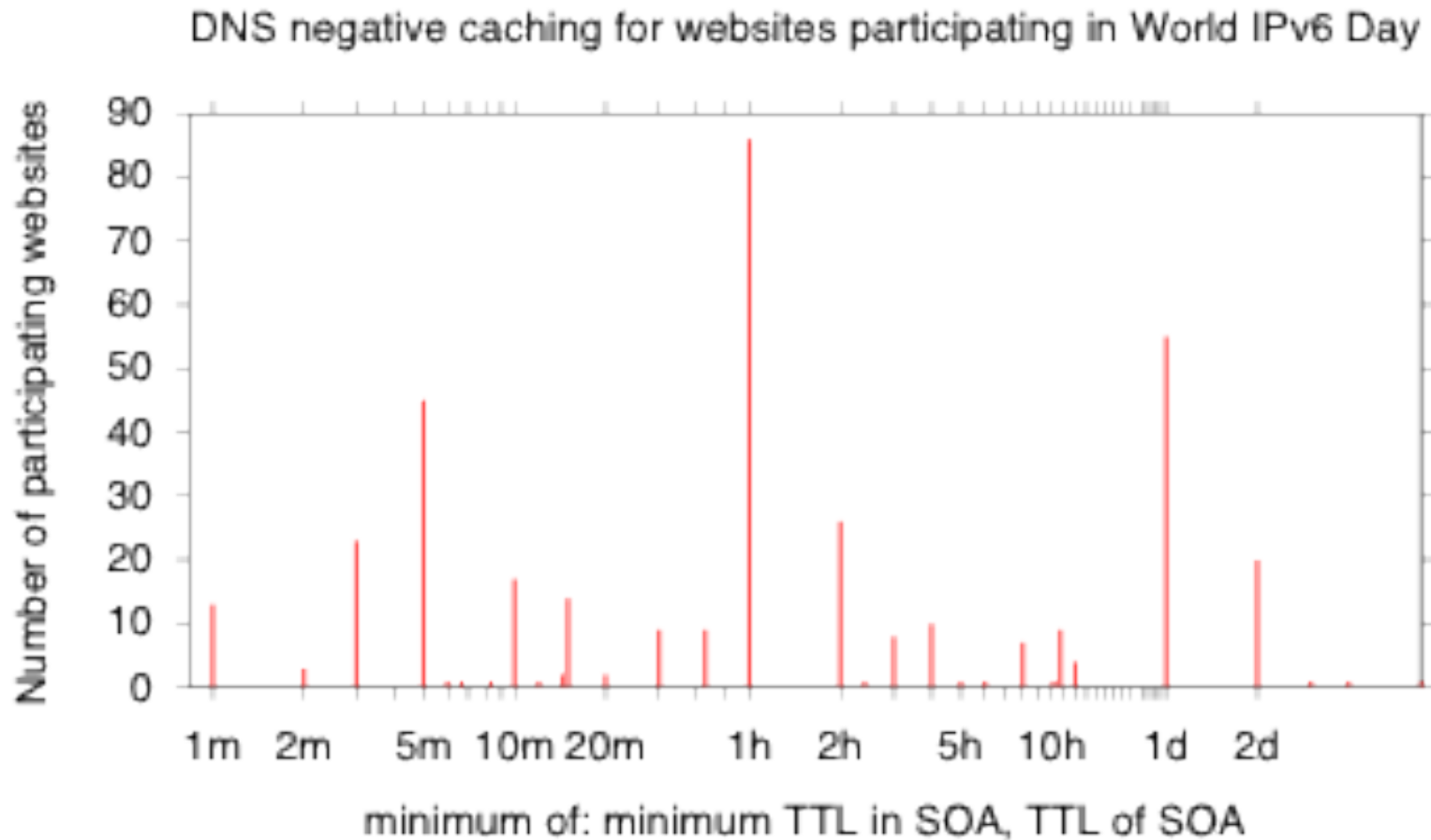   - HTTP over IPv4 and IPv6

Measurement vantage points

Overview

Lesson:
Control
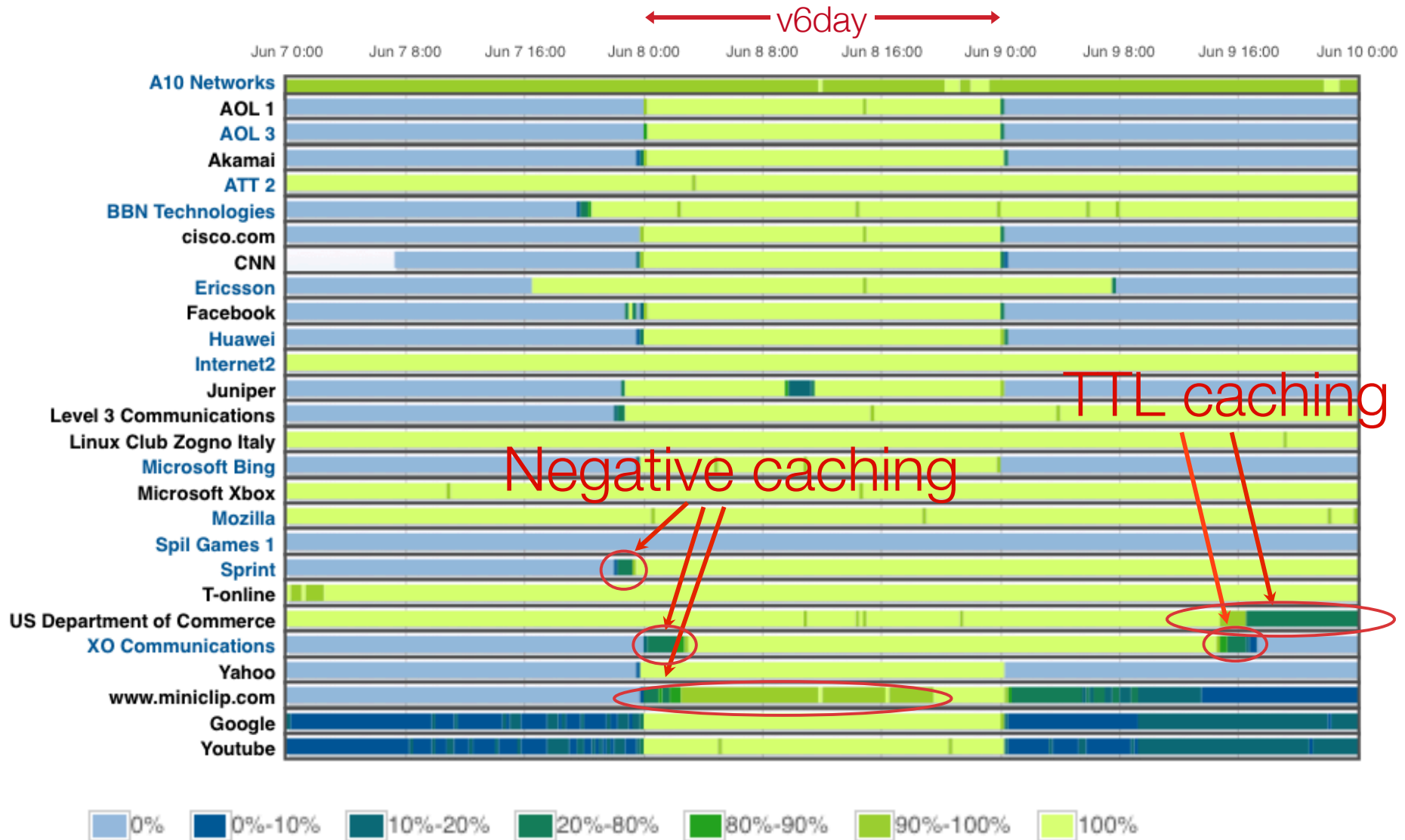
When did World IPv6 Day start?

- Less then 2 days before World IPv6 Day:

DNS negative caching for websites participating in World IPv6 Day

Percentage of vantage points seeing AAAA
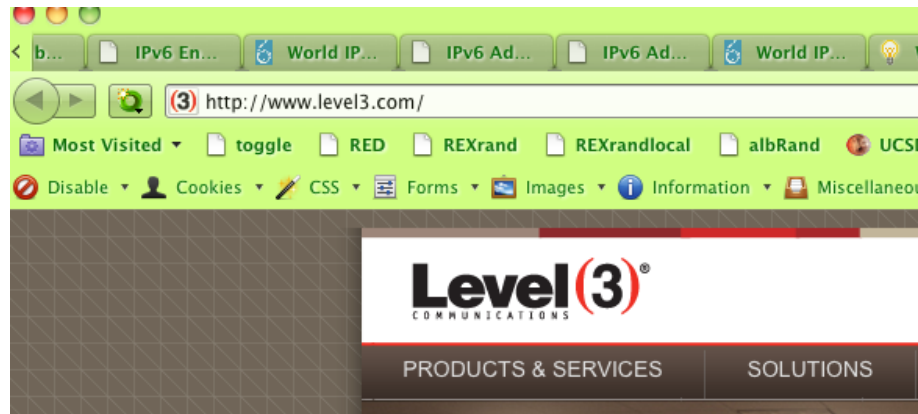
Control - lessons learned

- Know your on/off switch
  - Control your DNS
- Set low TTL in case of roll-back
- Set low negative TTL
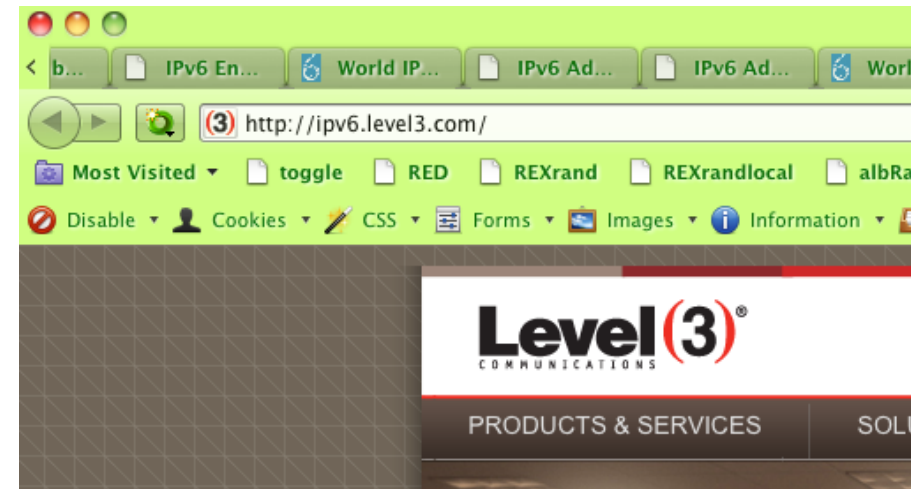 - By means of minTTL in SOA / TTL of SOA

Lesson:
Test and monitor

You don't want this to happen

On IPv4:

On IPv6:

Not Found

HTTP Error 404. The requested resource is not found.
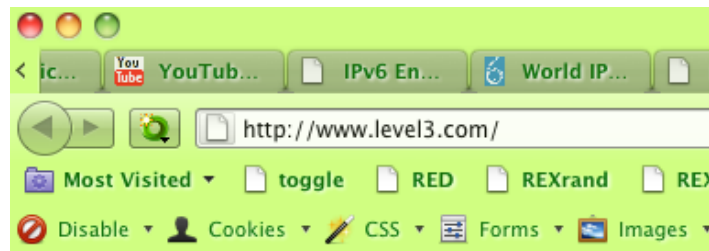
Or this ...

Comparing DNS,ping and HTTP IPv6 measurements
to www.commerce.gov from 2011-06-09 0:00 UTC to 2011-06-10 12:00 UTC

% AAAA queries returning an IPv6 address
% HTTP responses == 200
% ICMPv6 ping success
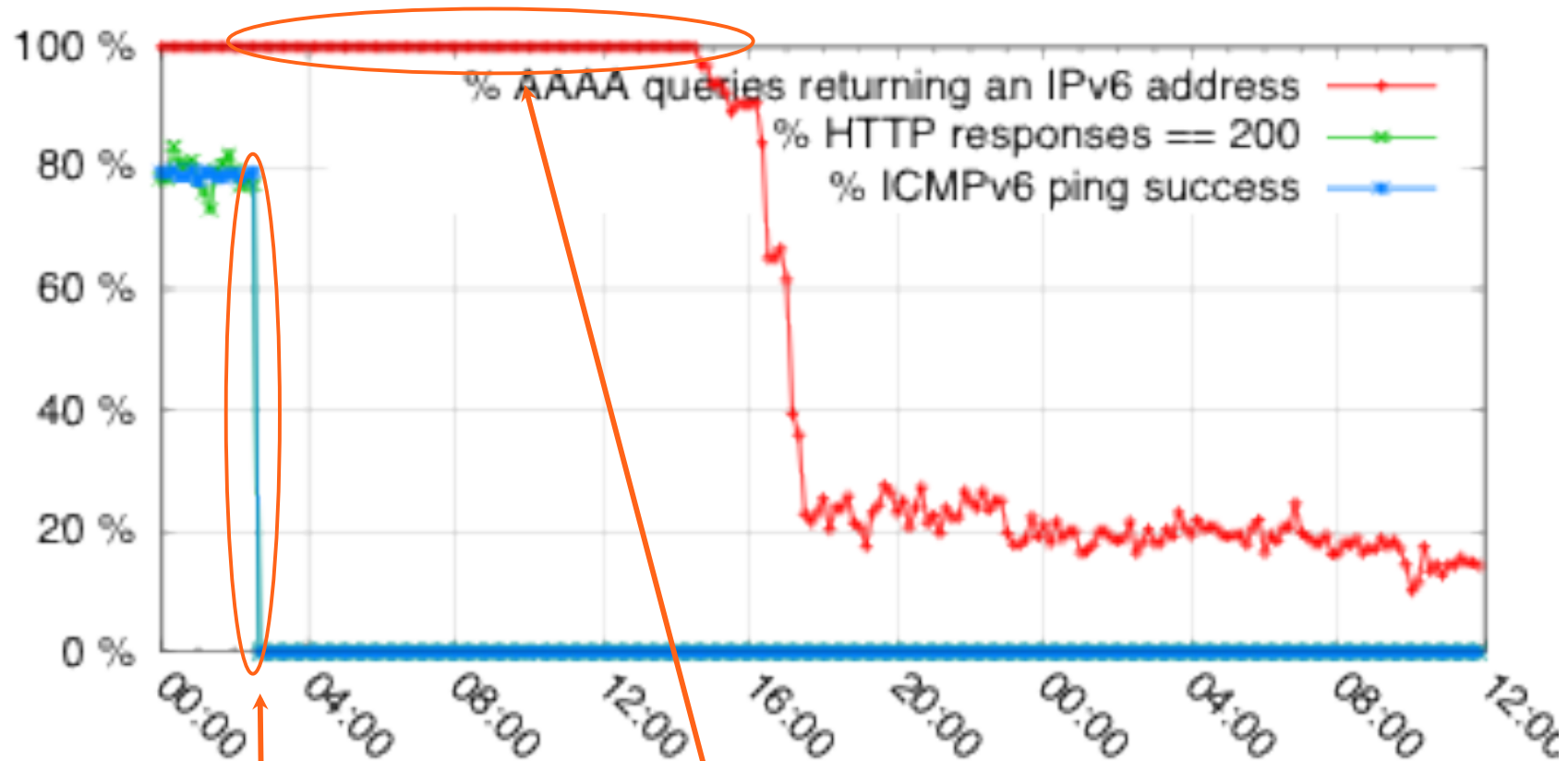
v6 on www turned off
at end of v6day

but v6 service still
announced

Case: Content-NAT Issue (1)

Admin domain

Admin domain

single IPv4
address

IPv6 proxy

IPv4
webserver

per srcIP rate limiting

clients
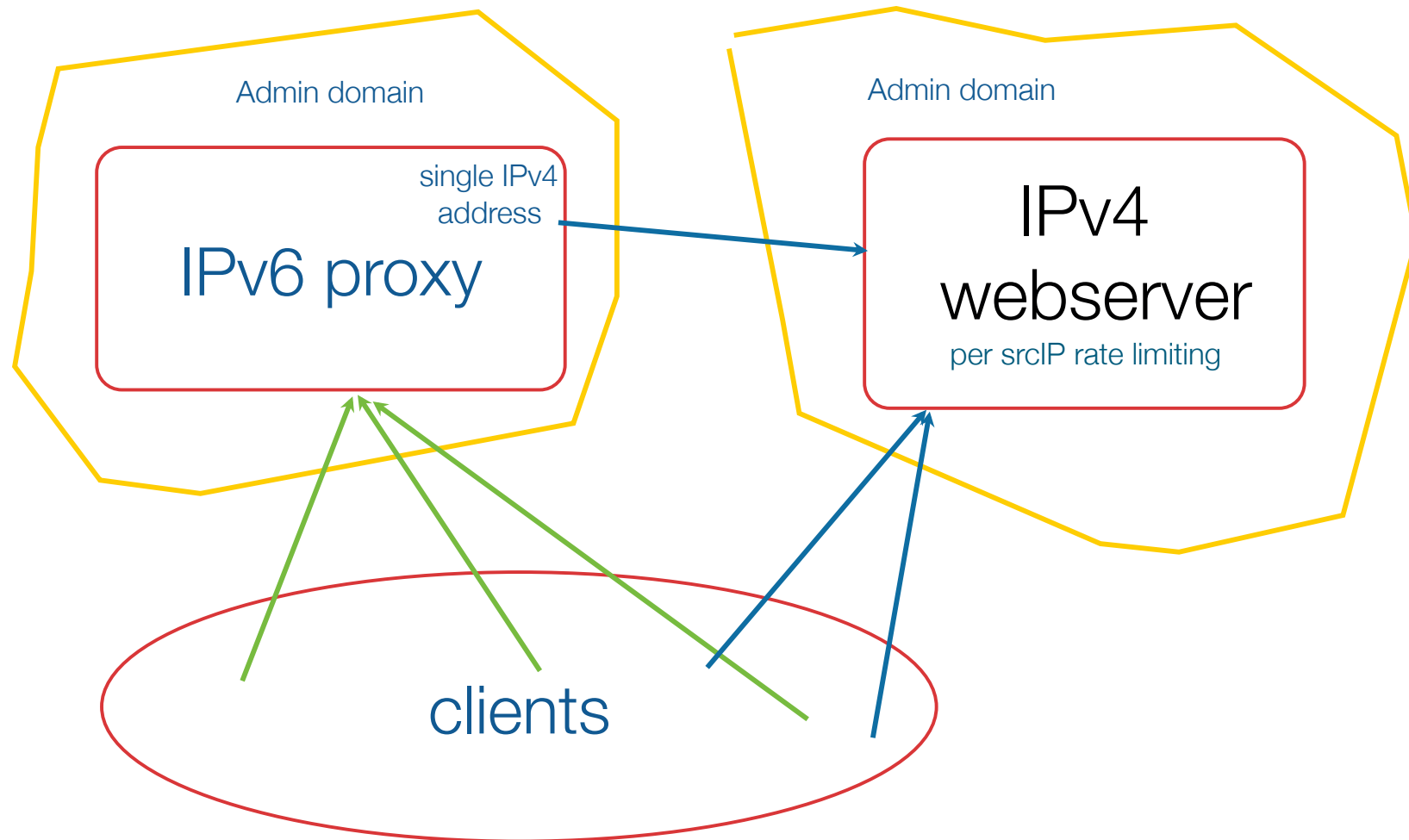
Case: Content-NAT Issue (2)

- Combine

  - v6-to-v4 proxy, srcNAT to single IPv4 address

  - Webserver with per-source IP rate-limiting

- Hard to catch if not tested under real-life load

- Violating e2e principle can make solutions brittle

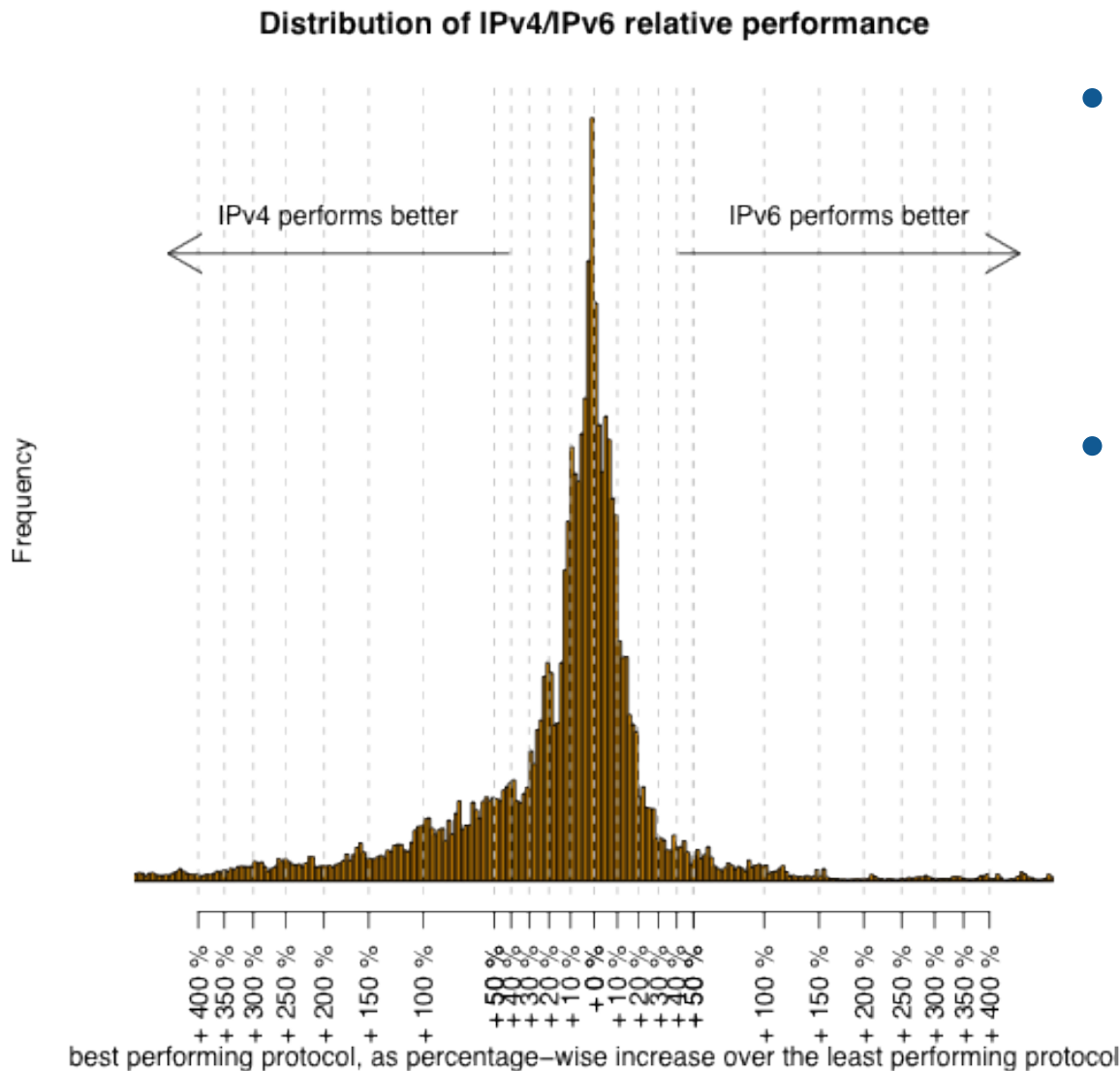- Solution: Keep it simple

Test and monitor - lessons learned

- Test when deploying something
  - The more real-life, the less likely you have issues

- Monitor your infrastructure

- People2people reachability
  - Avoidable situations like Level3 and Dept. Commerce
  - Contact info up to date in RIR databases like RIPE DB (whois)
  - Monitor the other sources (NANOG, *NOG, Twitter, ...)

Global view

Performance of src/dst pairs on 2011-06-08

Distribution of IPv4/IPv6 relative performance

IPv4 performs better   IPv6 performs better

Frequency

400 % 350 % 300 % 250 % 200 % 150 % 100 % 50 % 400 % 300 % 200 % 100 % 50 % +0 % +100 % +200 % +300 % +50 % 100 % 150 % 200 % 250 % 300 % 350 % 400 %

best performing protocol, as percentage-wise increase over the least performing protocol
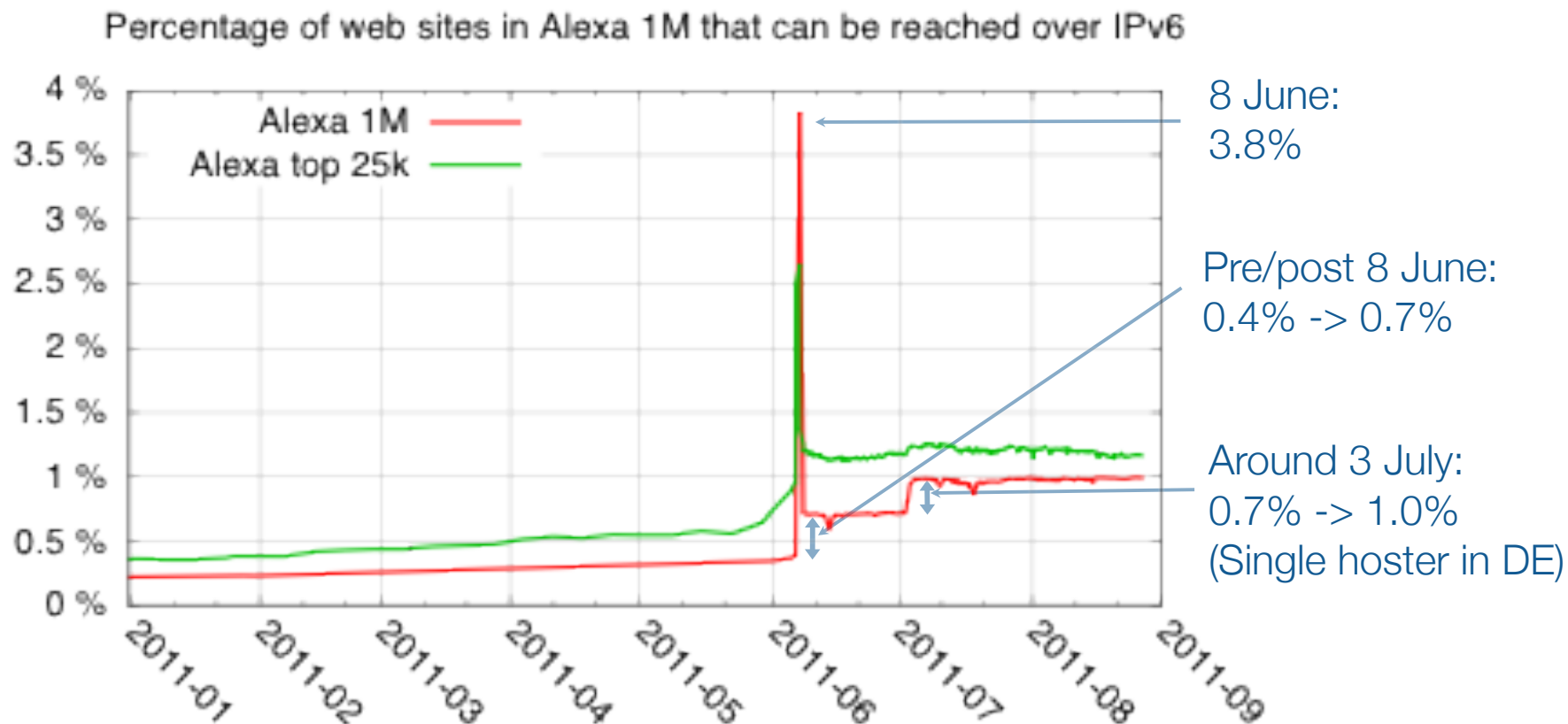
- Bell-shaped
  - centered around 0
  - with fatter IPv4-side
- Dual-stack = two chances for best performance!
  - Real-time apps can exploit this (voice, gaming)

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Partial Reachability

- Internet is a collection of interconnecting networks, and can be different on IPv4/IPv6

- Some vantage points couldn't reach all dests.

  - Are our vantage points representative?

    - Working on this: RIPE Atlas

  - Network partitioning, examples we encountered:

    - Level3 - Hurricane Electric   (fixed as of Aug 31)

    - Cogent - Hurricane Electric

      - See http://en.wikipedia.org/wiki/Comparison_of_IPv6_support_by_major_transit_providers
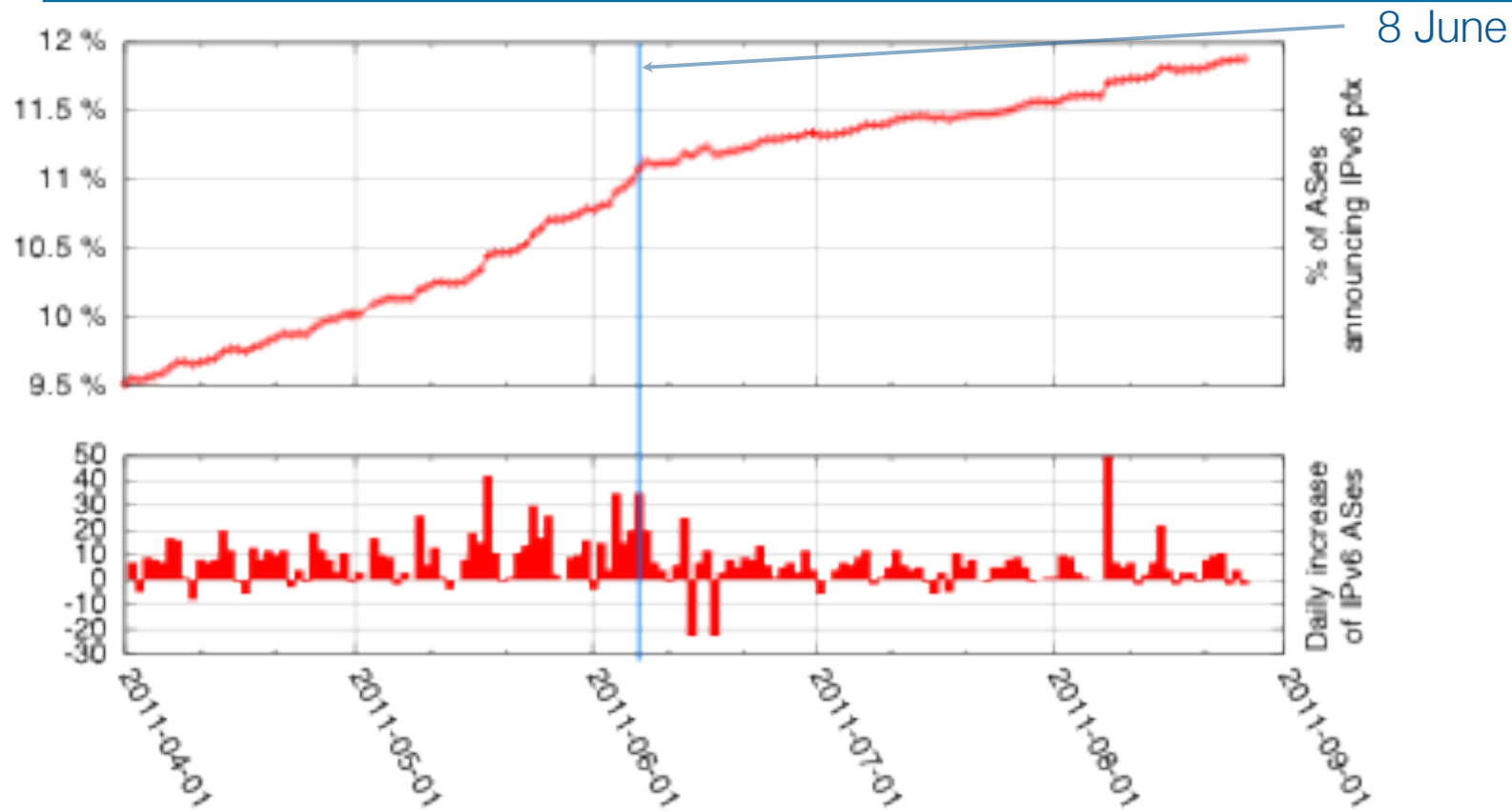
Long term effects - Content

Percentage of web sites in Alexa 1M that can be reached over IPv6

8 June:
3.8%

Pre/post 8 June:
0.4% -> 0.7%

Around 3 July:
0.7% -> 1.0%
(Single hoster in DE)

Raw data: Dan Wing

(http://banjo.employees.org/~dwing/aaaa-stats.html)

Long term effects - IPv6 ASes

8 June

- Higher growth before v6d: Deployments pushed earlier?

- Lower growth after v6d: Summer-vacation?

- http://v6asns.ripe.net

More information

- Web interface to the measurements

  - http://v6day.ripe.net/

- Analysis on RIPE Labs

  - http://labs.ripe.net/ipv6day

- Raw data availability

  - http://labs.ripe.net/datarepository/data-sets/ripe-ncc-active-measurements-of-world-ipv6-day-dataset

Conclusions - what we learned

- IPv6/dual-stack works just fine, but make sure that

  – It is properly tested and monitored (like IPv4)

  – Your network can reach all others (like IPv4)

- Dual-stack = Two chances for best performance

- Days like this 'work'

  – Raise awareness

  – Give people a target to work towards

  – We're ready for a next IPv6(day|week|month|year|∞)

Questions?