World IPv6 Day - What did we learn?

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IETF 81

v6ops WG

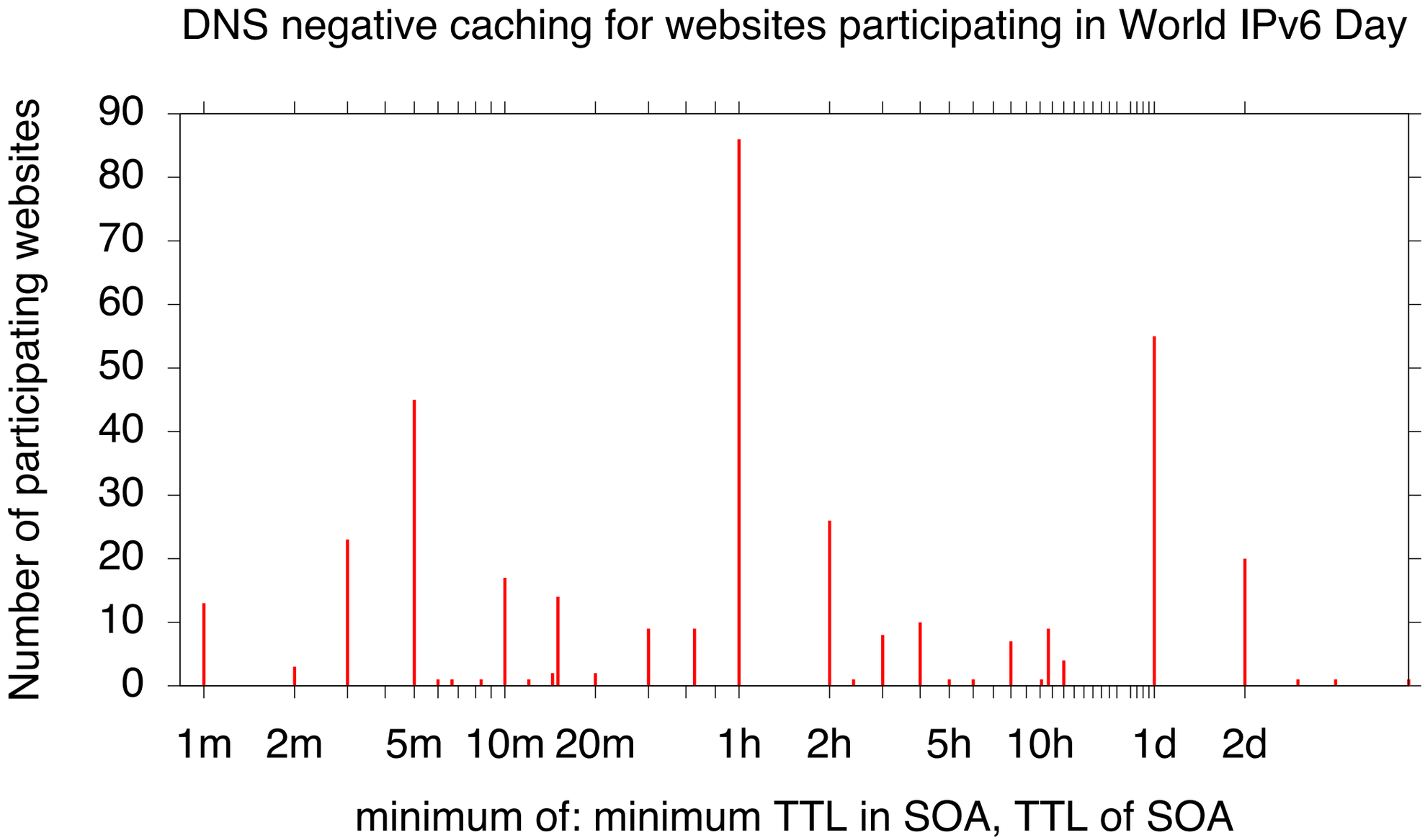
RIPE NCC Measurements - World IPv6 Day

- 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

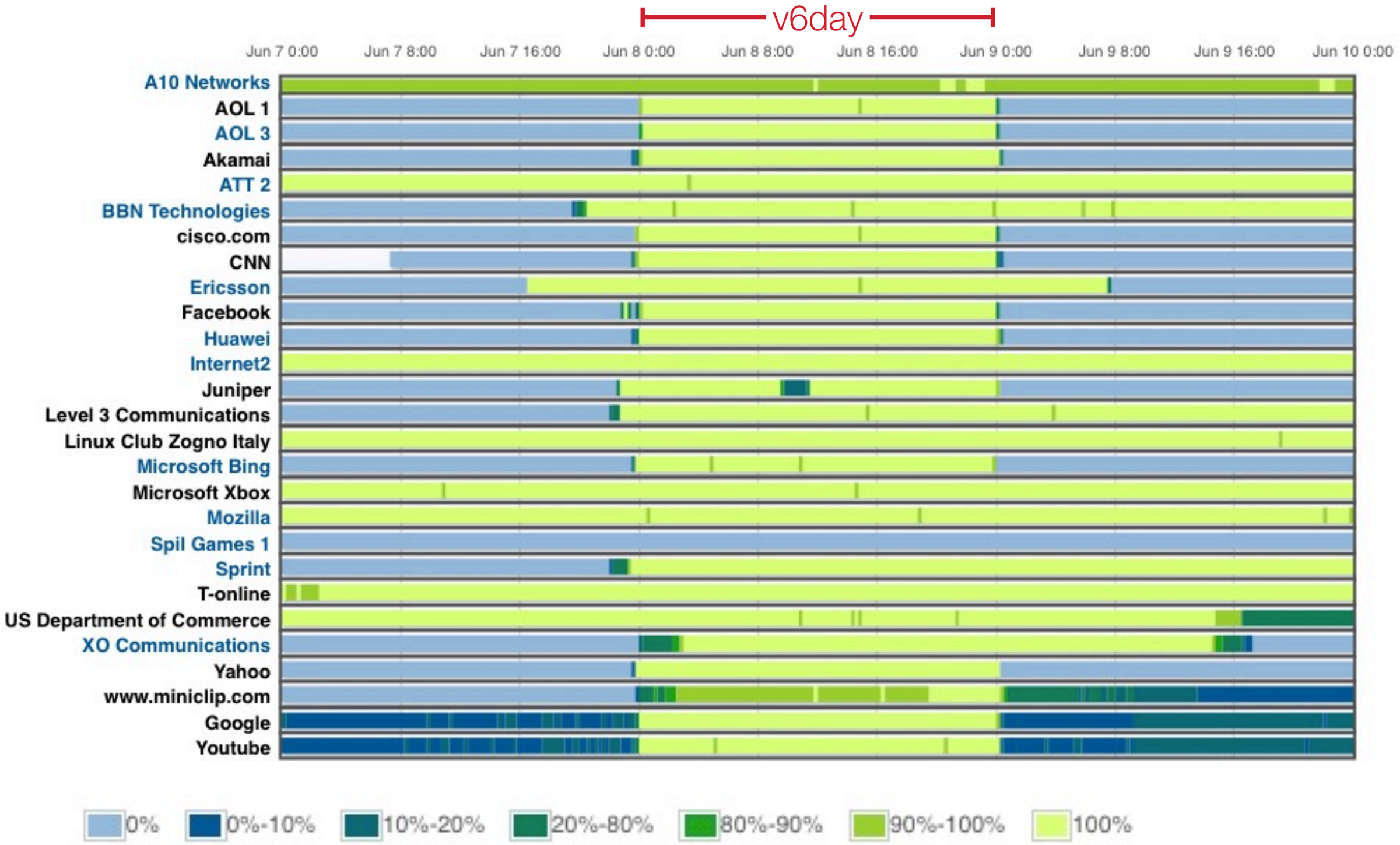
Measurement vantage points

When did World IPv6 Day start?

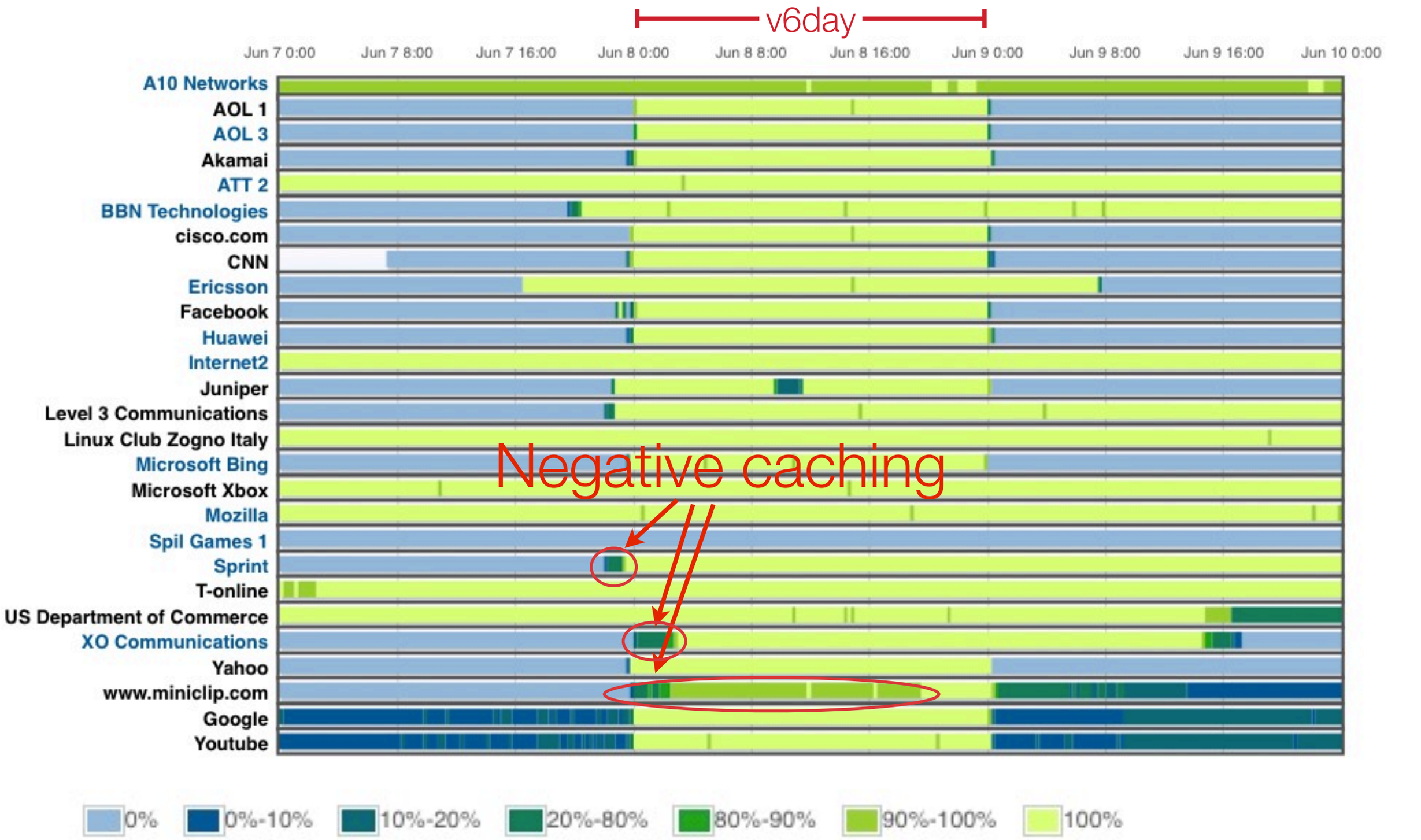
- Less then 2 days before World IPv6 Day:



Percentage of vantage points seeing AAAA



Percentage of vantage points seeing AAAA



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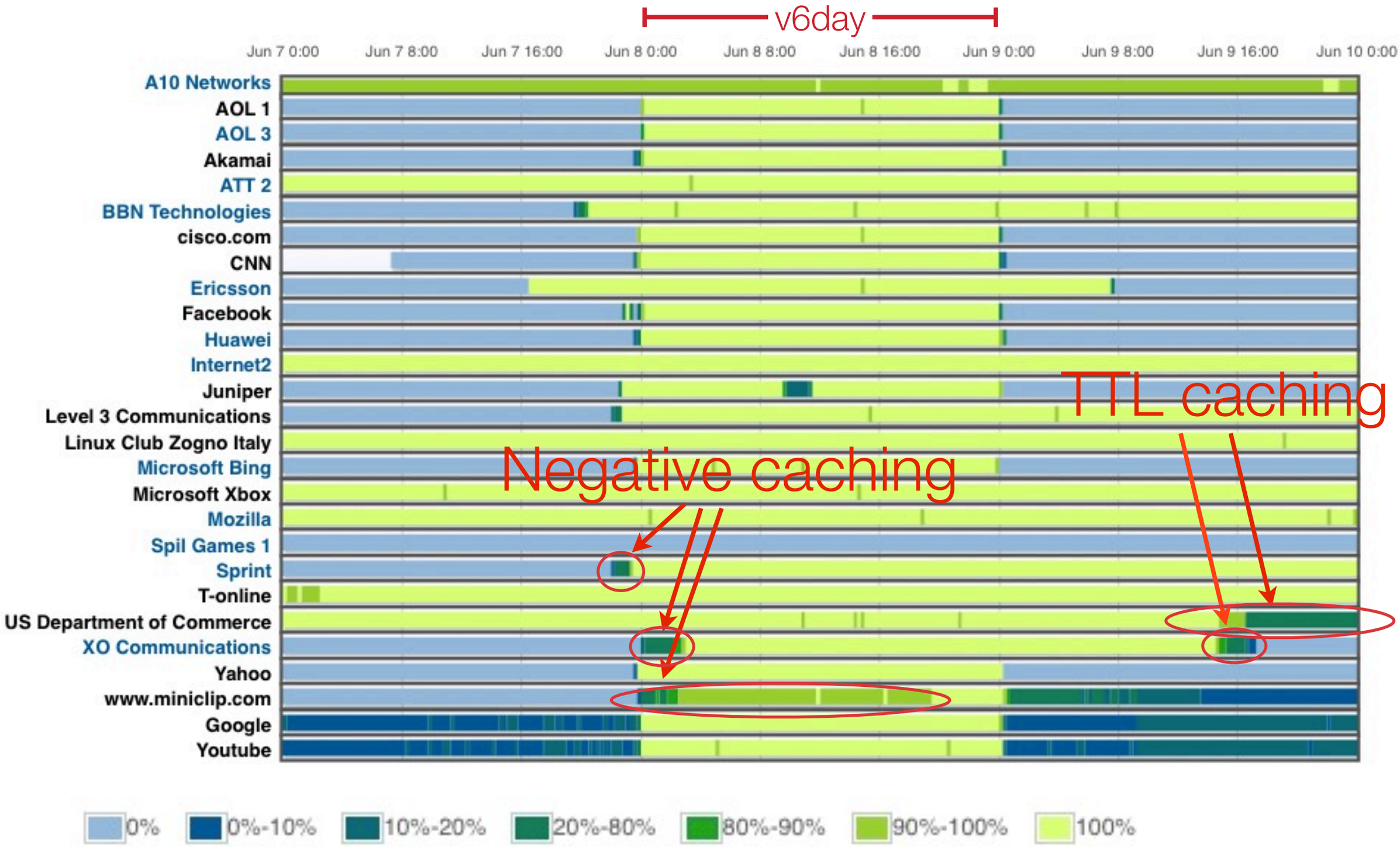


You don't want this to happen

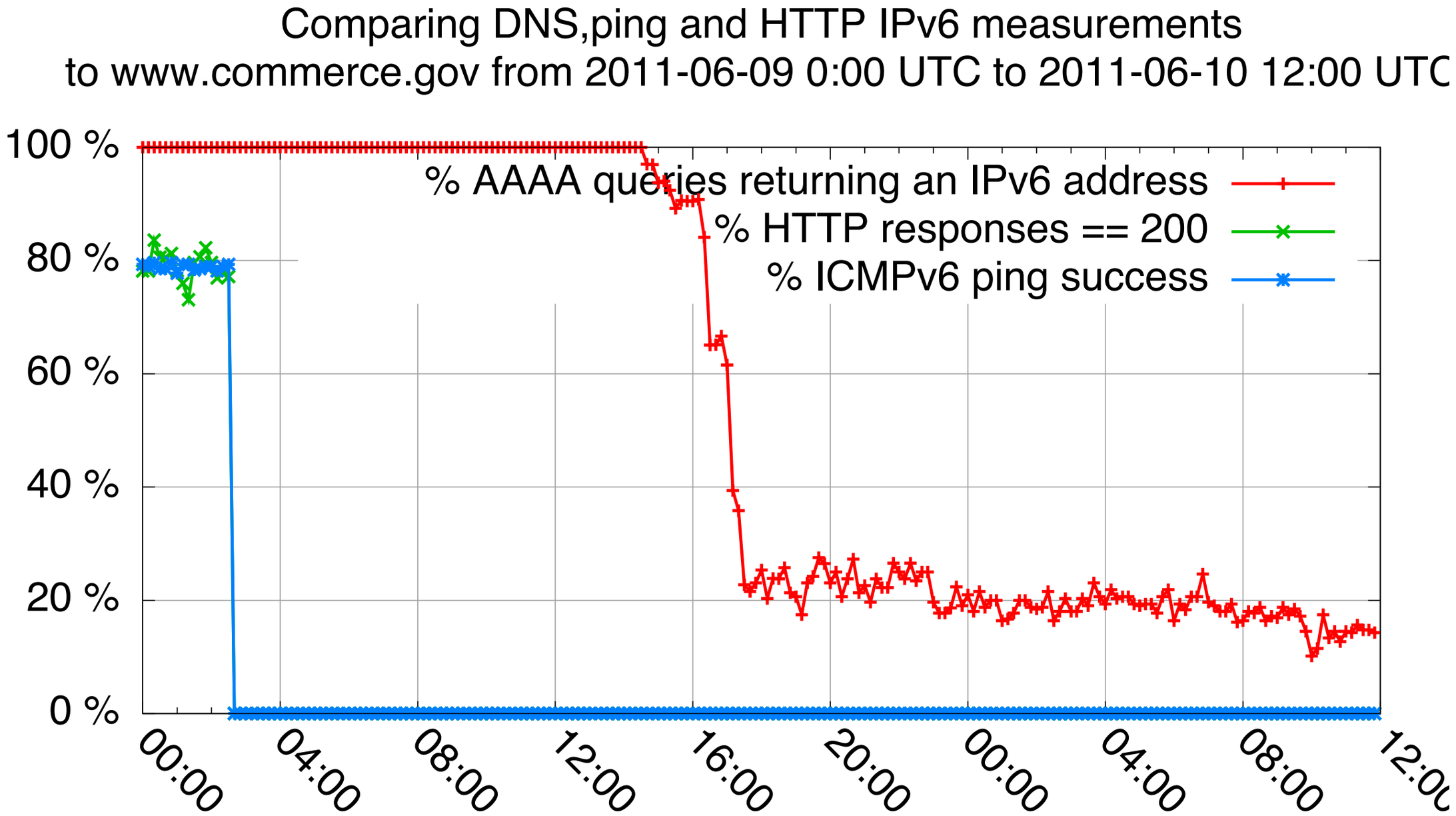
On IPv4:

On IPv6:

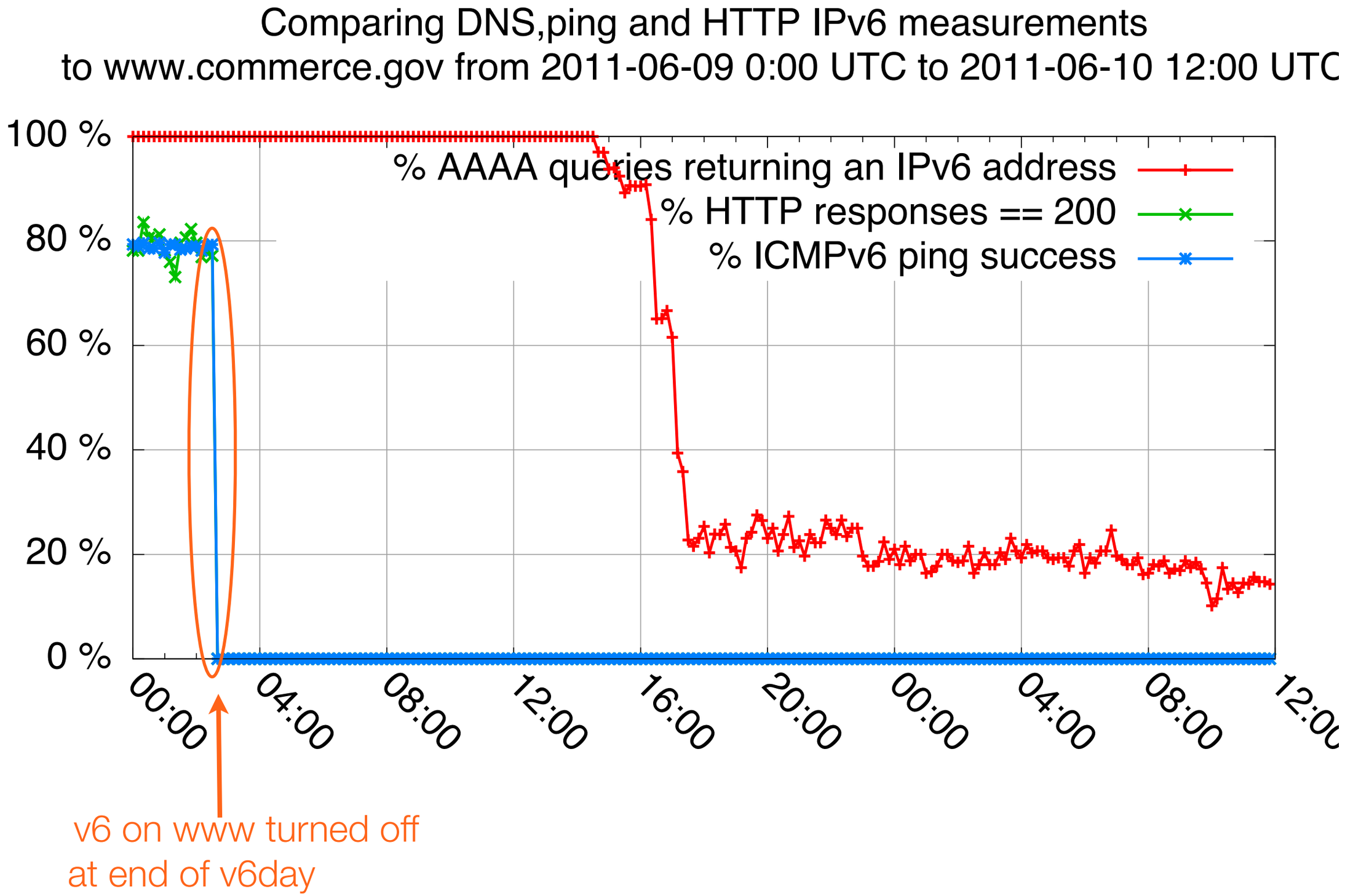
Not Found

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
100 %
80 %
60 %
40 %
20 %
0 %
00:00
04:00
08:00
12:00
16:00
20:00
00:00
04:00
08:00
12:00

Or this ...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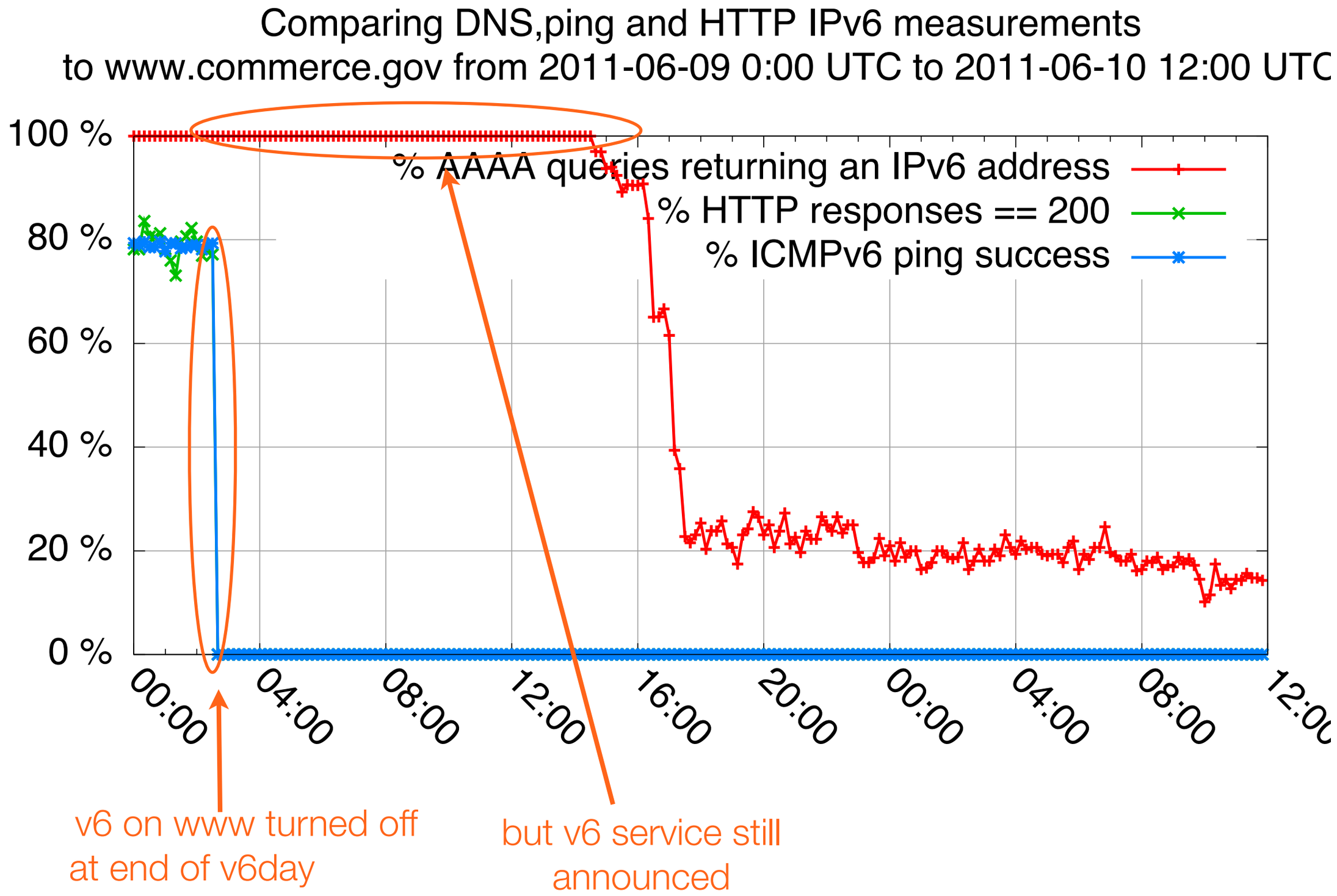
v6 on www turned off
at end of v6day

Or this ...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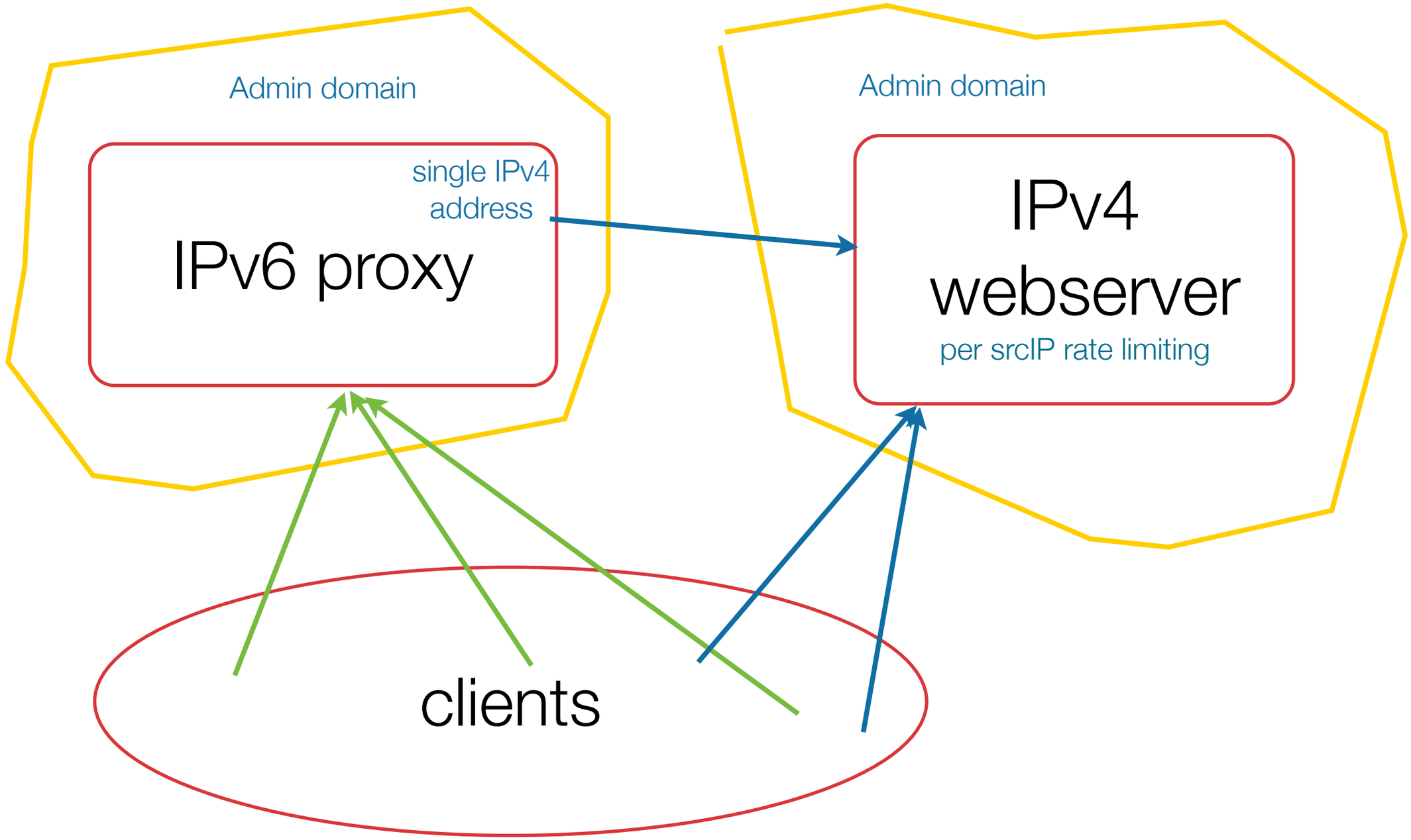
12:00
v6 on www turned off
at end of v6day
but v6 service still
announced

Partial Reachability

- Internet is a collection of interconnecting networks, and can be different on IPv4/IPv6
- For some of our vantage points, not all destinations were reachable
  - Are our vantage points representative?
  - Network partitioning, examples we encountered:
    - Level3 - Hurricane Electric
    - Cogent - Hurricane Electric
      - See http://en.wikipedia.org/wiki/Comparison_of_IPv6_support_by_major_transit_providers

Case: Content-NAT Issue (1)



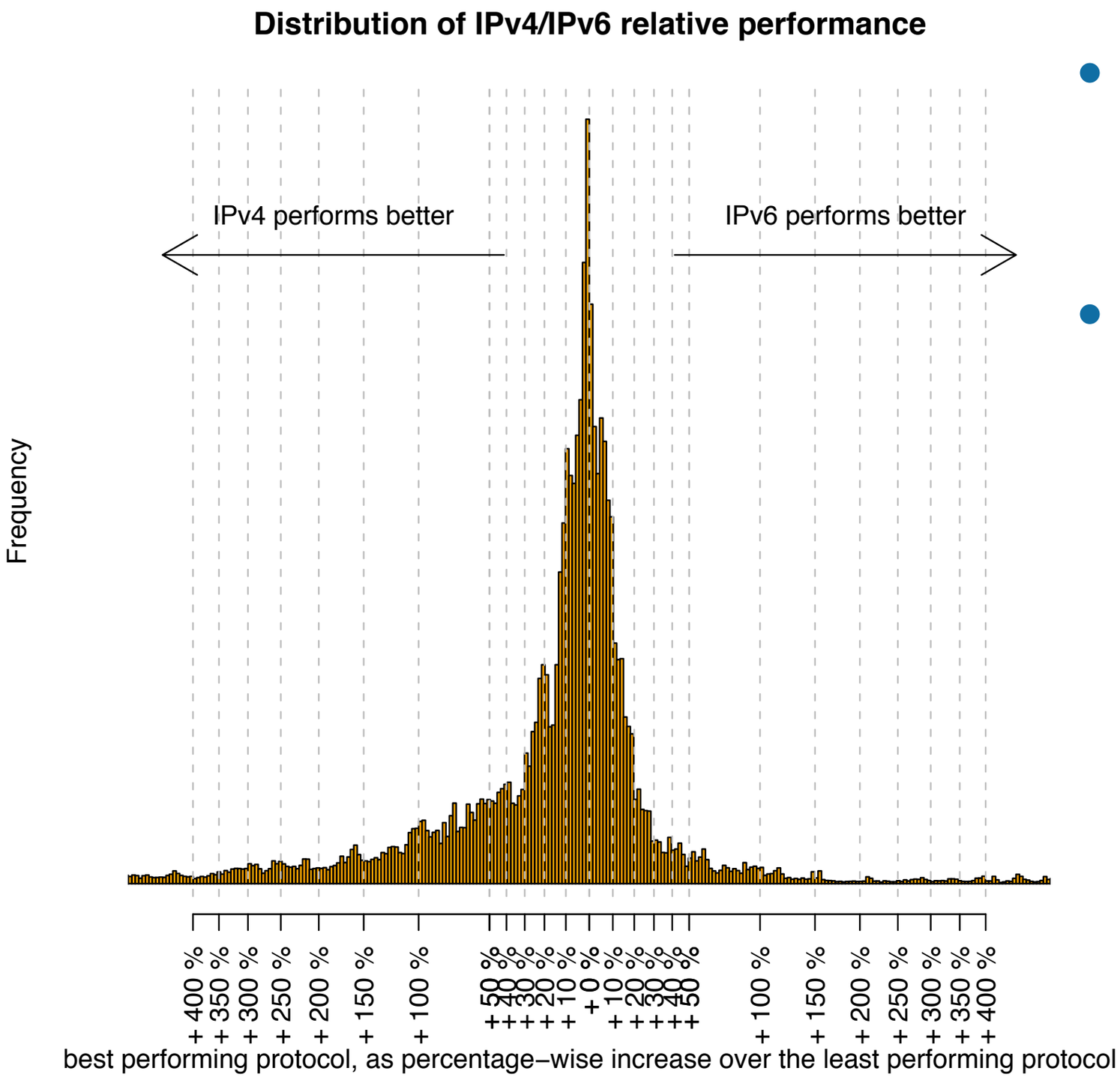
Case: Content-NAT Issue (2)

- 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 (no NAT!)

Test and monitor - lessons learned

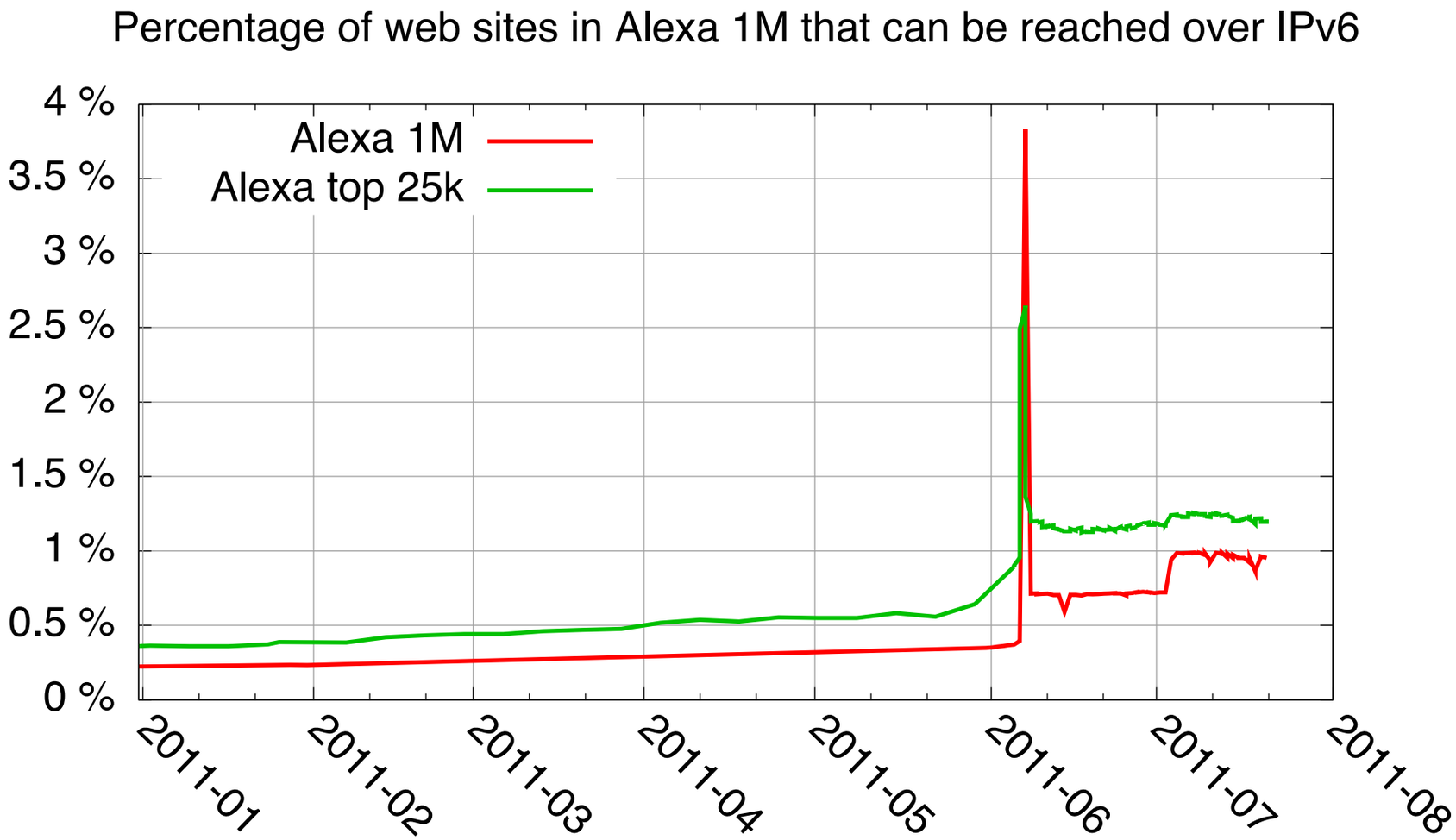
- Test when deploying something
  - The more real-life, the less likely you !@#$-ed up
- Monitor your infrastructure
- People2people reachability
  - Avoidable situations like Level3 and Dept. Commerce
  - Contact info up to date in RIR databases (whois)
  - Monitor the web (NANOG, Twitter, ...)

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



- Bell-shaped
  - with fatter IPv4-side
- Dual-stack = two chances for best performance!
  - Real-time apps can exploit this
    - voice
    - gaming

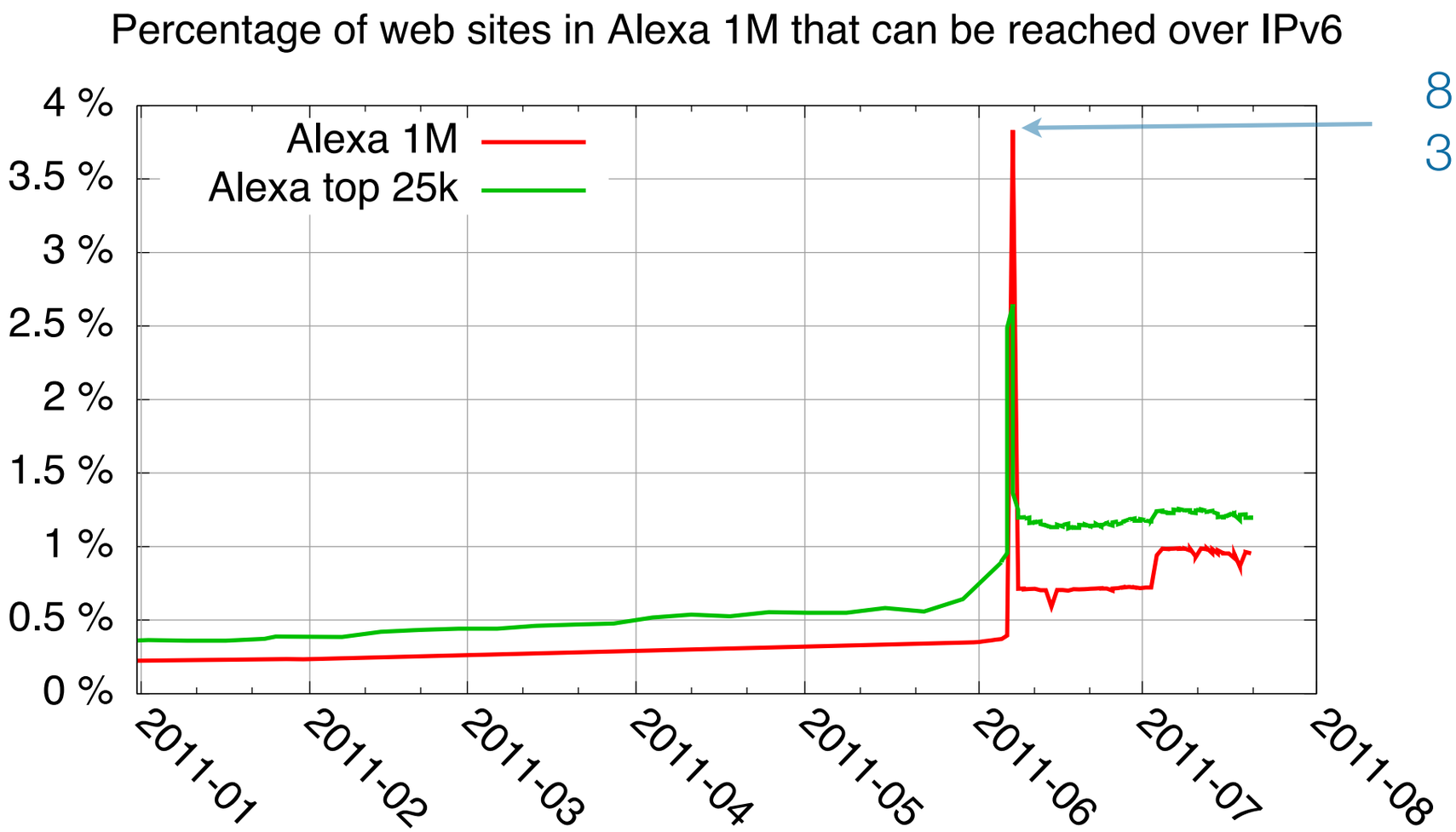
Long term effects - Content



Raw data: Dan Wing

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

Long term effects - Content



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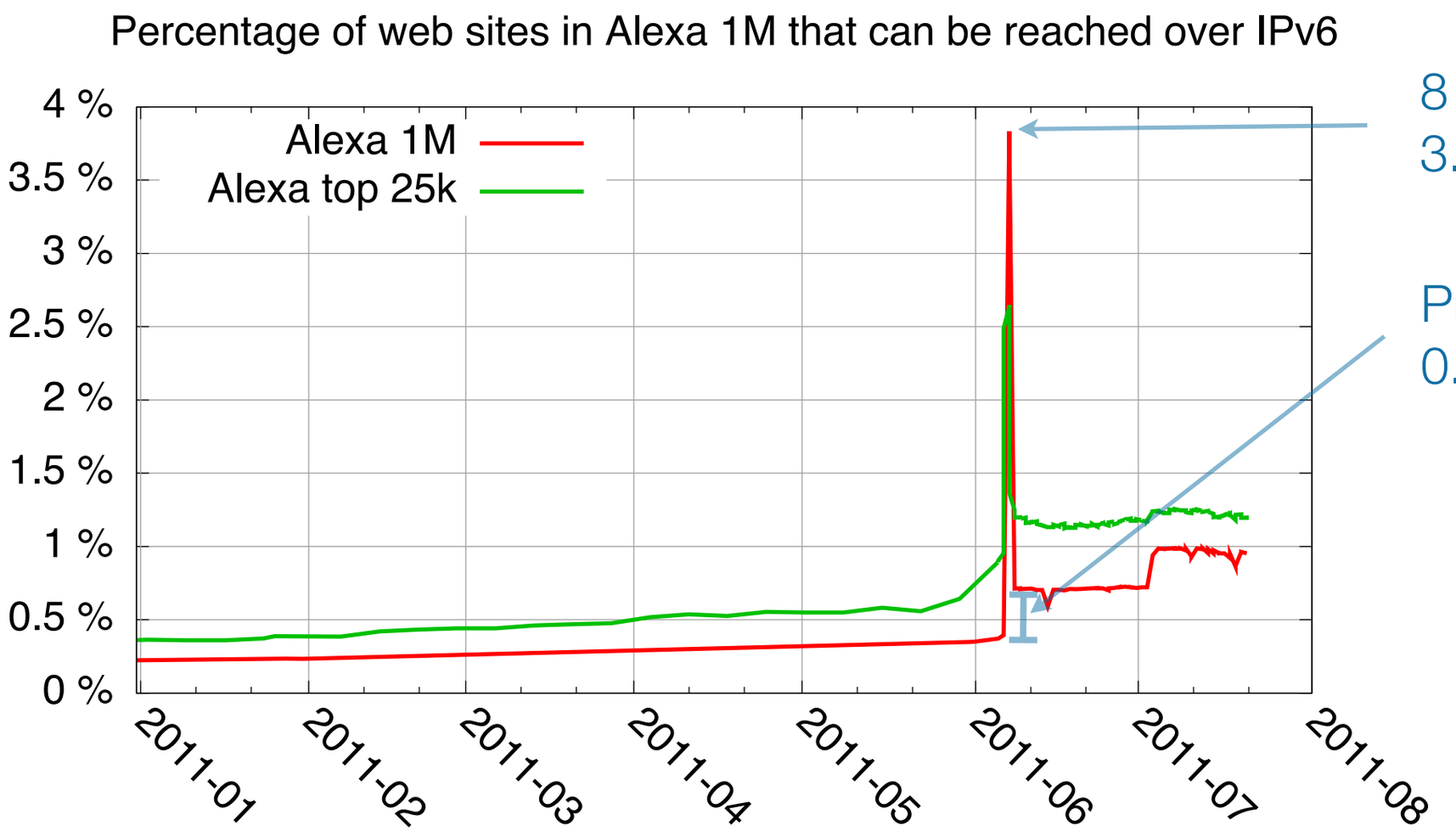

8 June:
3.8%

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

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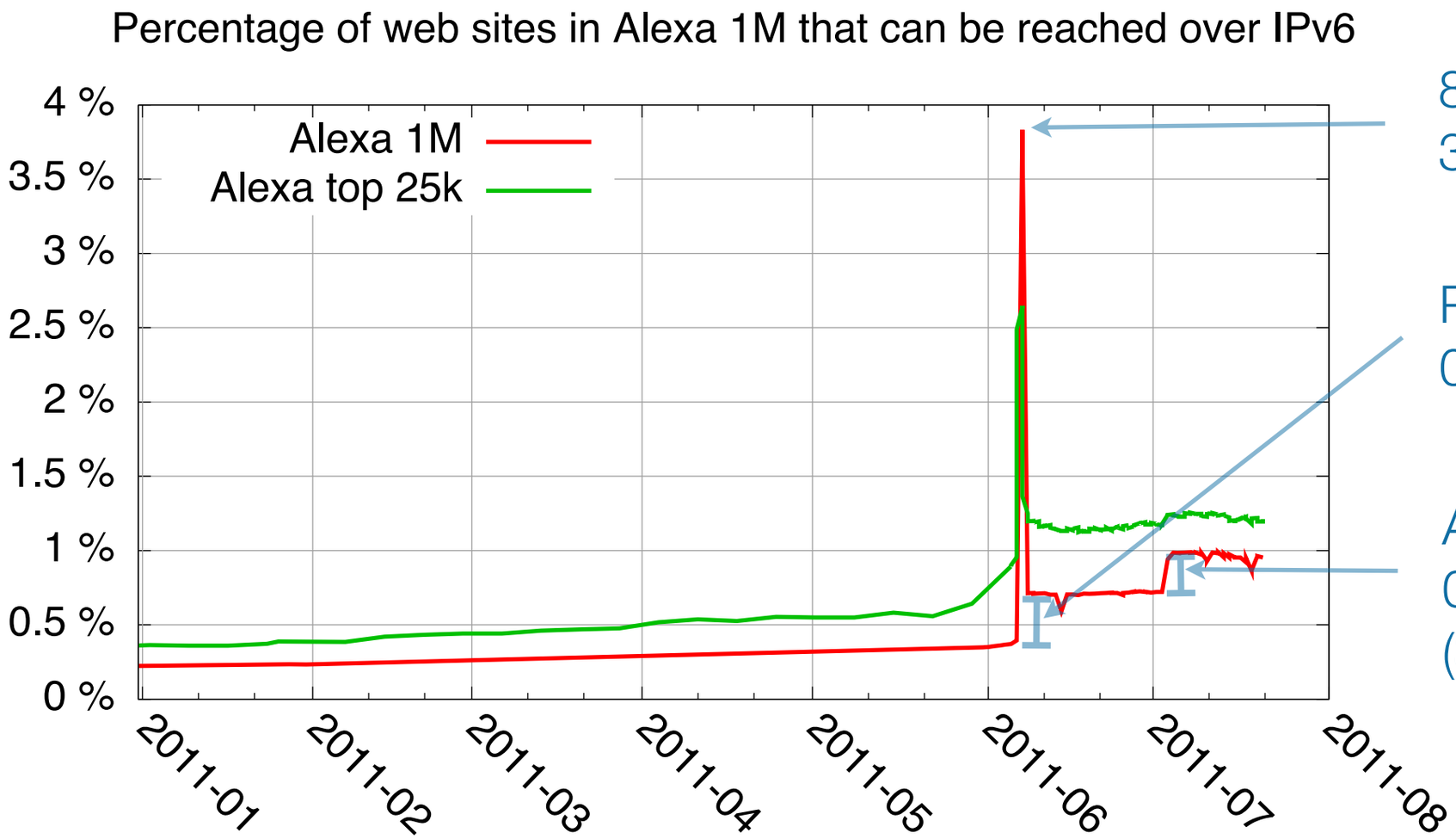

8 June:
3.8%

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 - Content

- Linear extrapolation:
  - ~ an IPv6 year needed to get to 100%
- Exponential extrapolation:
  - ~ an IPv6 week needed to get to 100%

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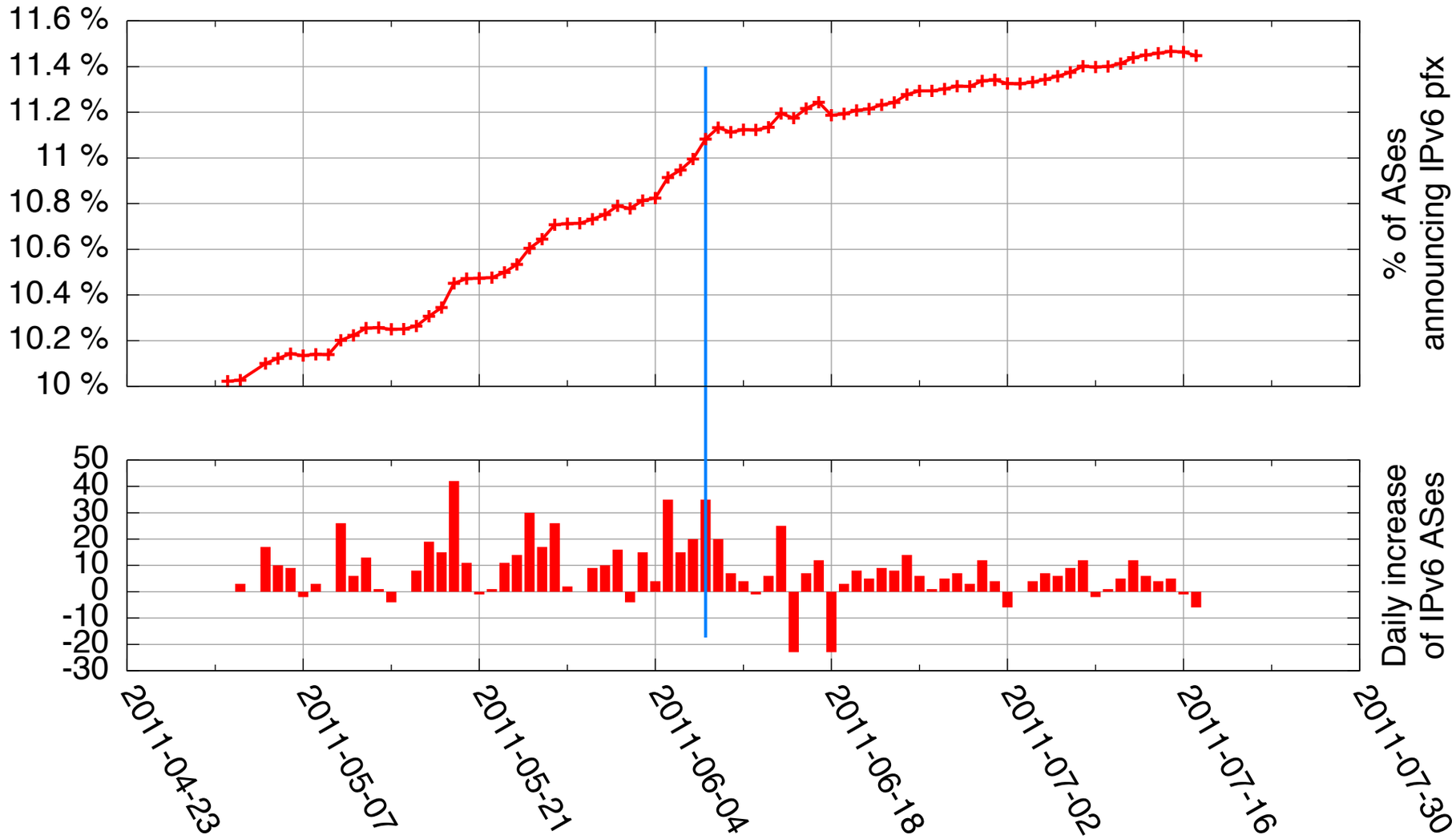
- Note: extrapolation based on two data points is dangerous and can get you lynched :)

Long term effects - IPv6 ASes



- 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?