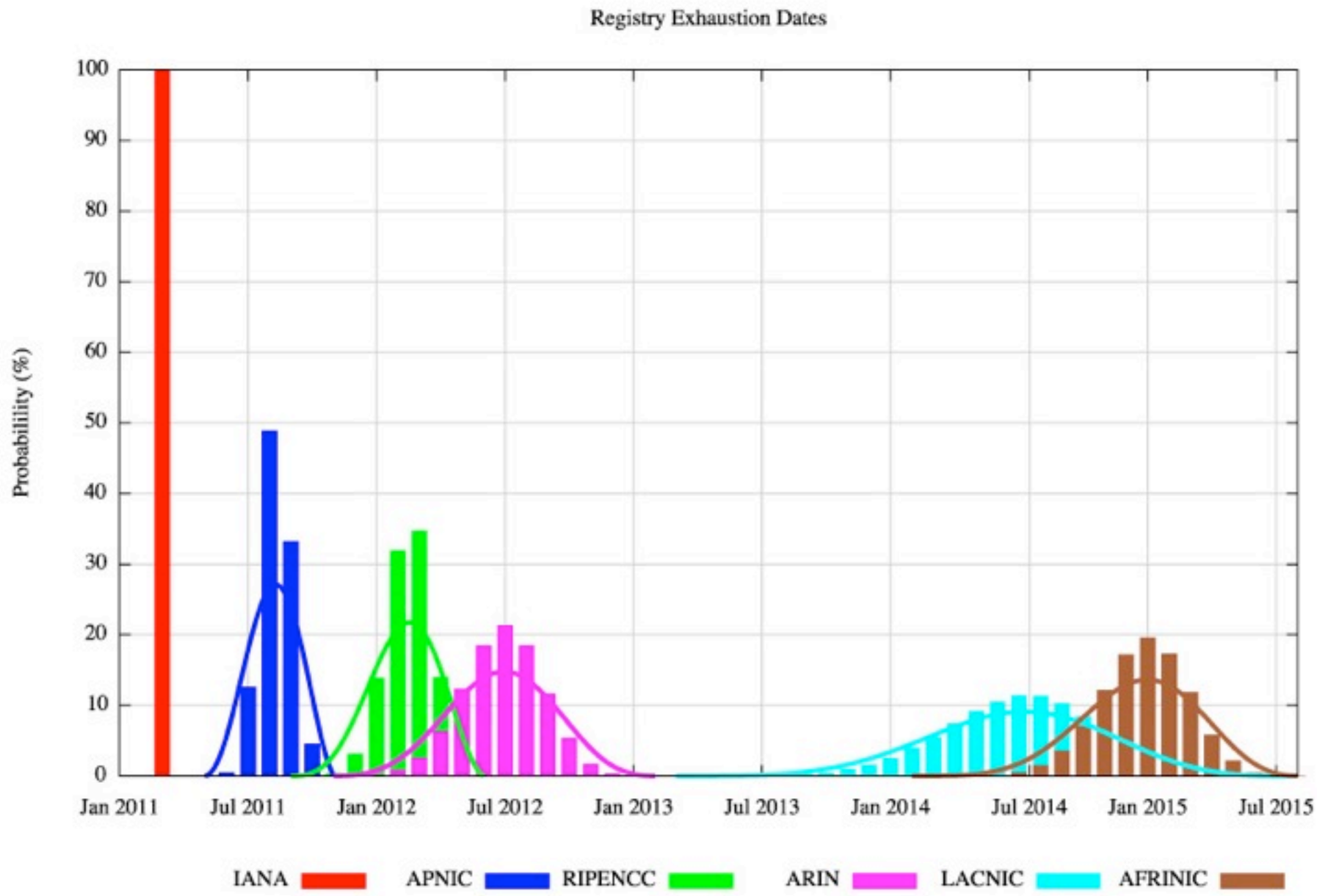
Measuring IPv6 some more

emile.aben@ripe.net
2010-02

IPv6 - why should you care?

- IPv4 address pool empty soon



Source:
potaroo.net

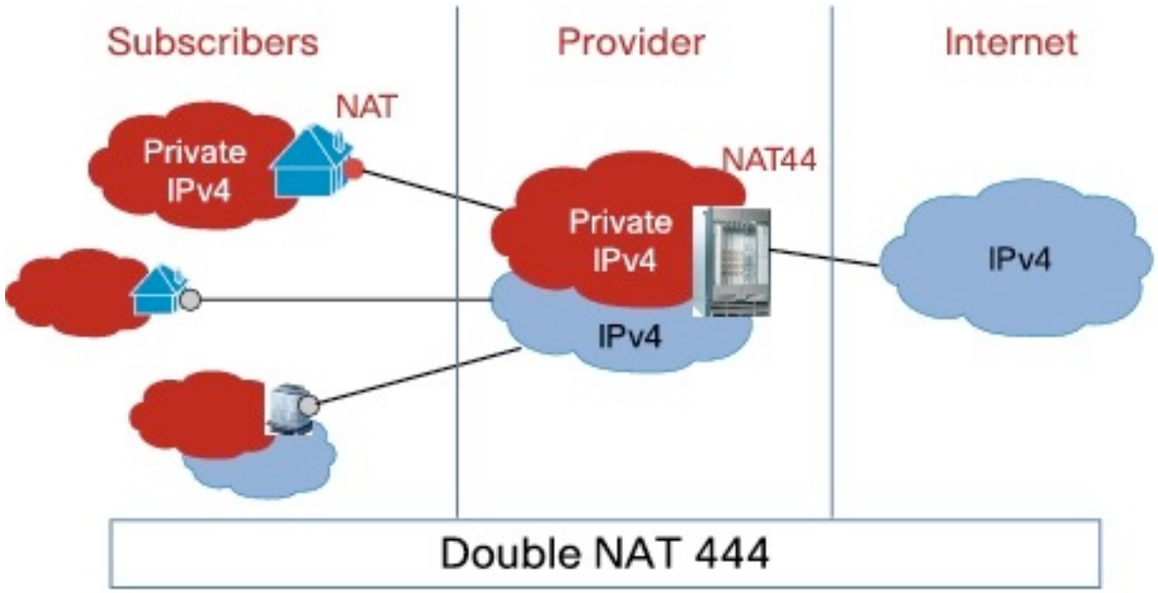
Emile Aben, 2011-02, AIMS3

IPv6 - why should you care?

Source:
potaroo.net

IPv6 - alternatives?

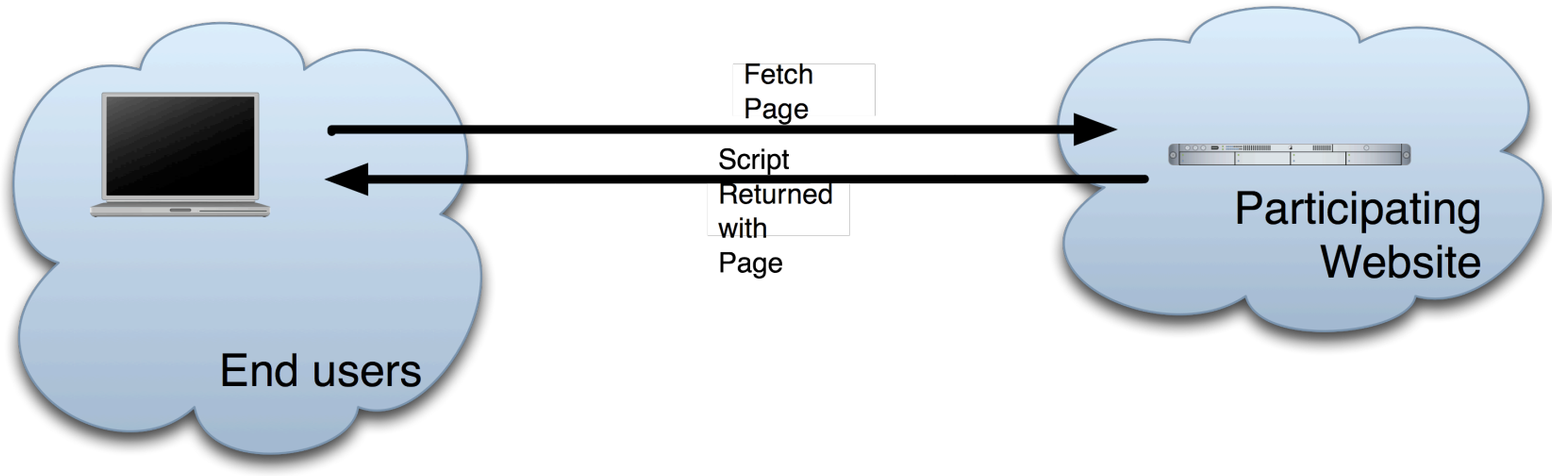
- After IPv4 depletion:
  - Stop connecting devices to the Internet?
  - Carrier Grade NAT (aka. LSN, double NAT, NAT444)?
    - $$$ for ISPs
    - Opaque Edge, barrier for:
      - LEA
      - app developers
      - researchers
  - <your idea here>



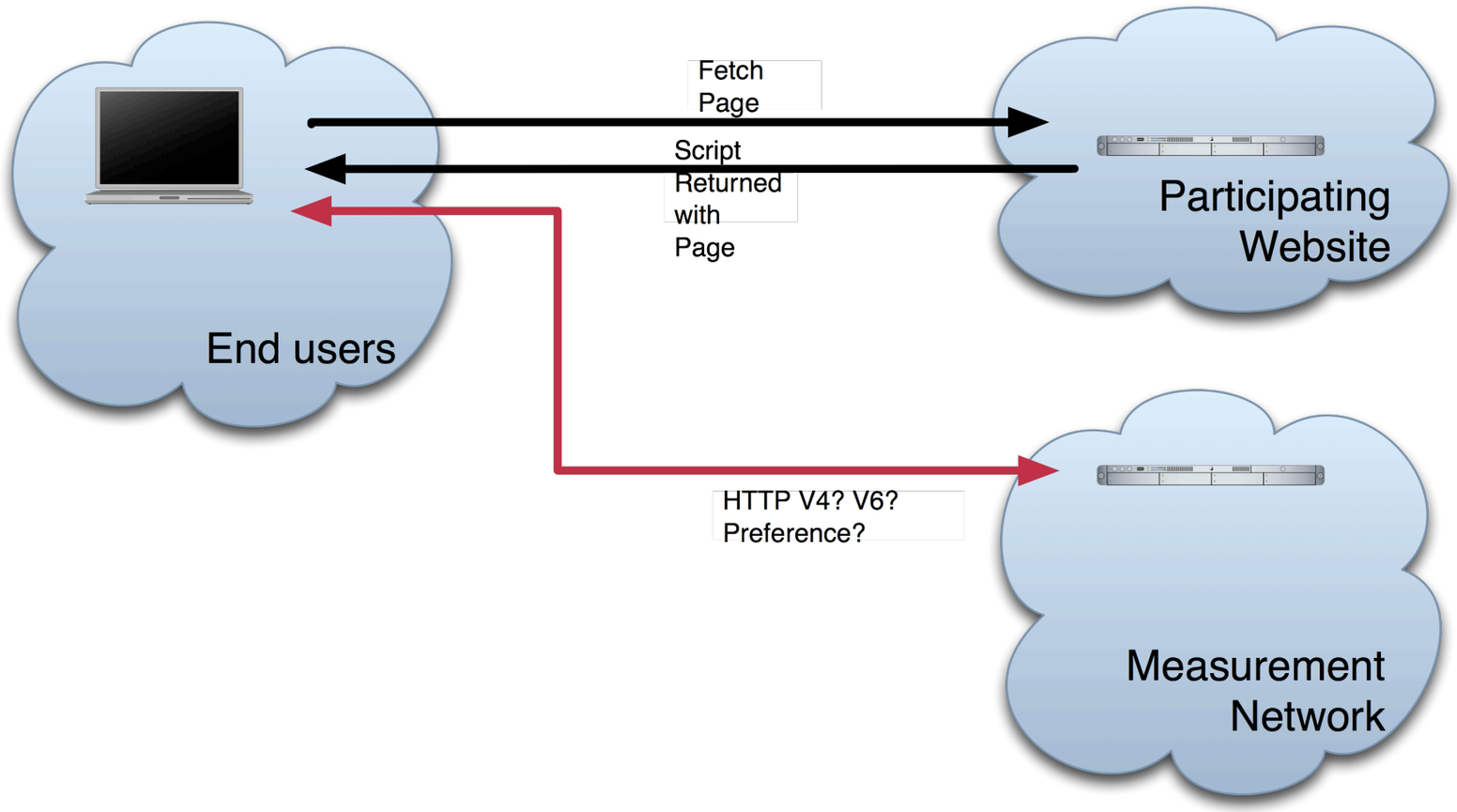
IPv6 - where are we?

- We want to provide more insight into IPv6 deployment
- Explain differences:
  - Routing table: 8.5% of ASes (http://v6asns.ripe.net)
  - Web traffic: 0.3%-2% of clients
- Measure IPv6 connectivity of end-users combined with ISP infrastructure

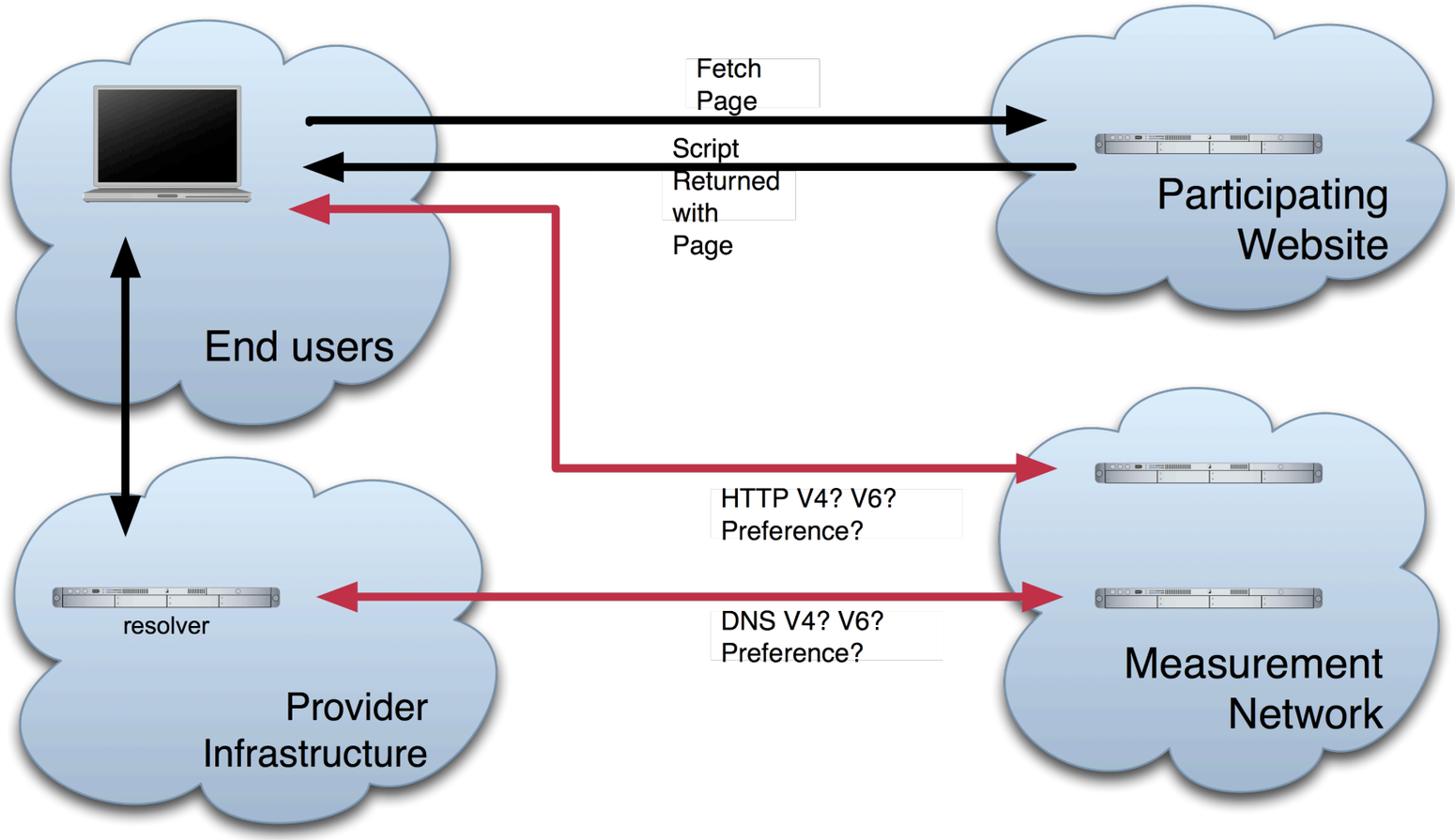
Measurement start



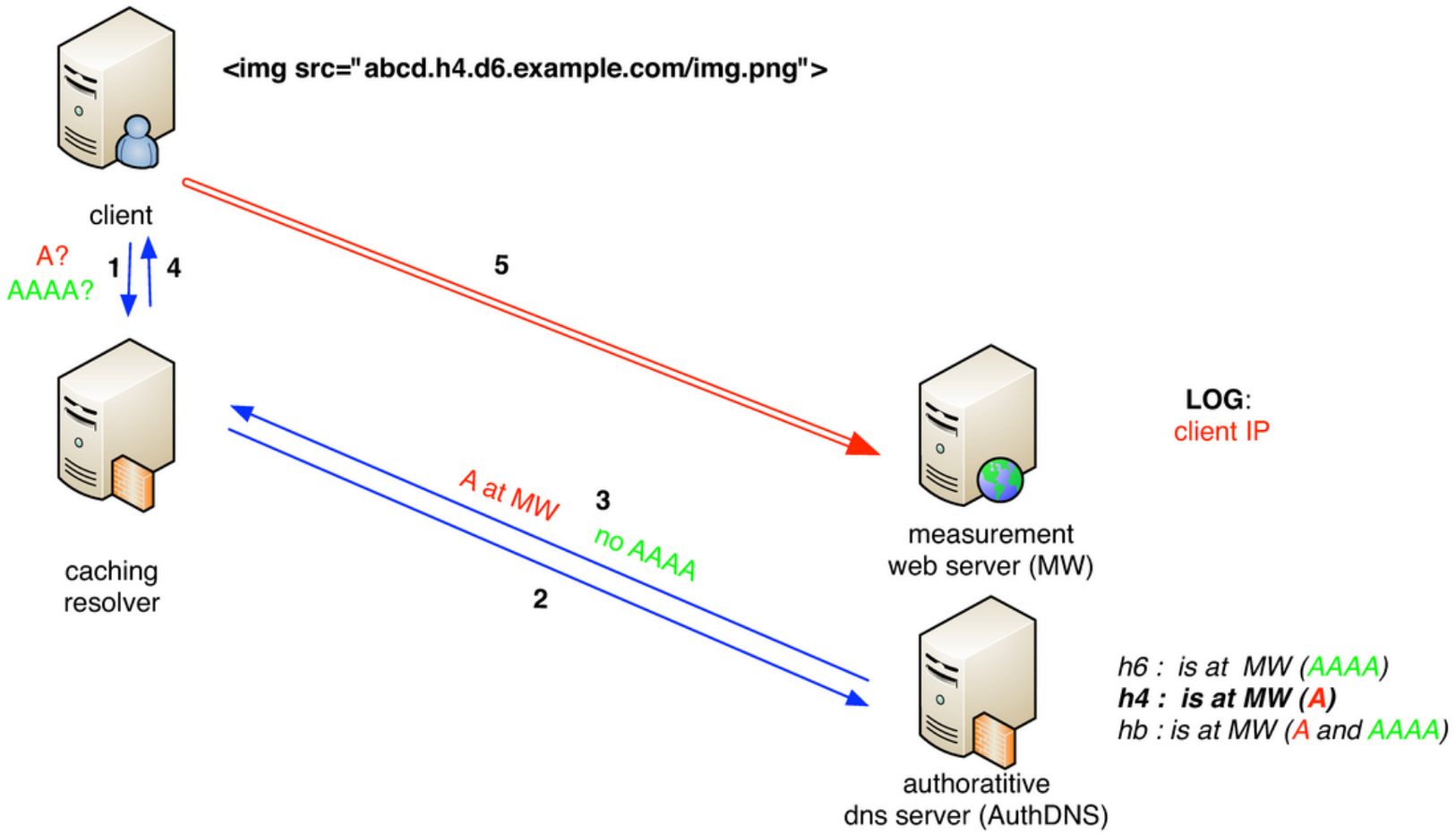
HTTP measurement



DNS measurement

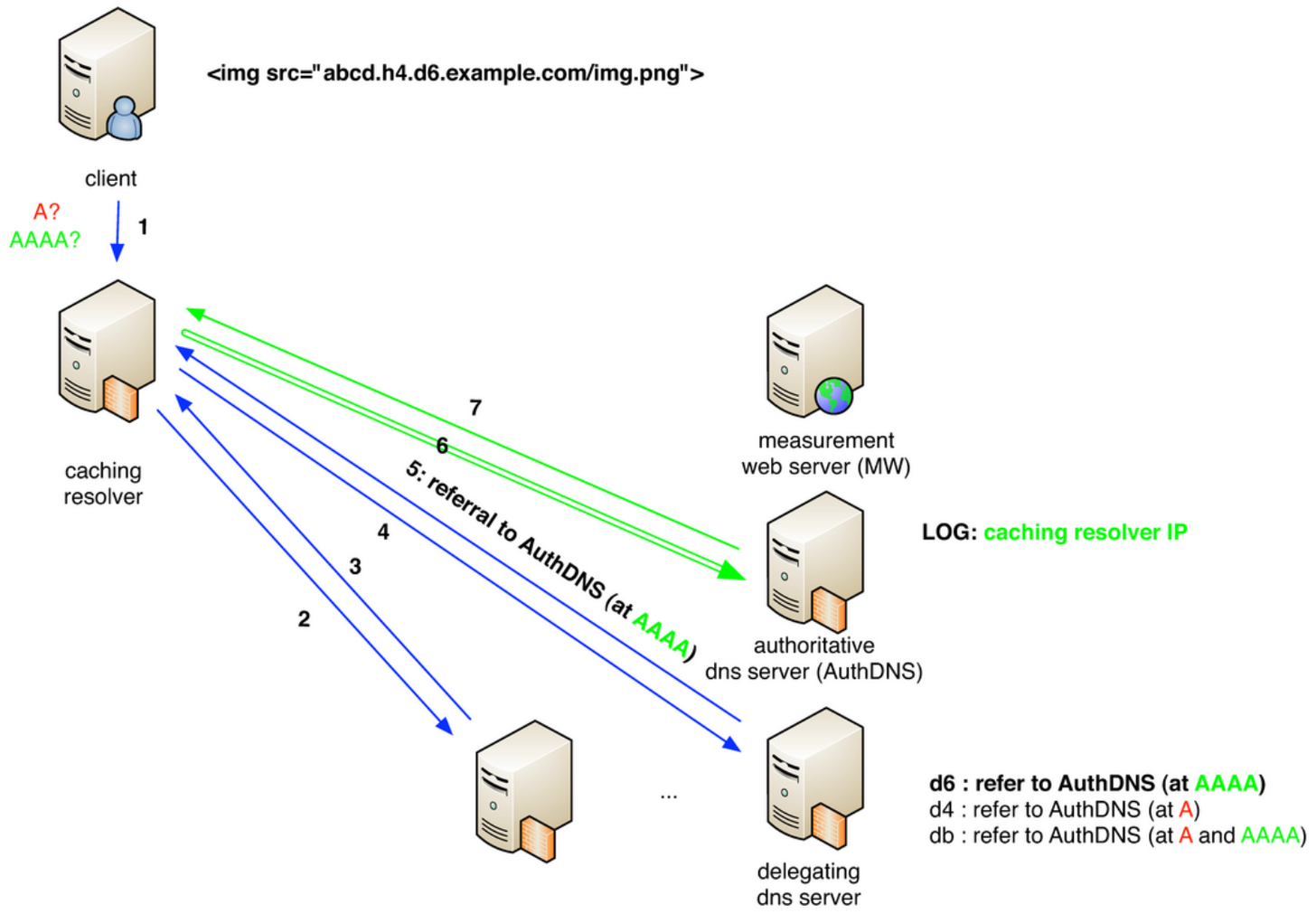


HTTP measurement - details



Authoritative DNS server determines IP protocol choices for HTTP request

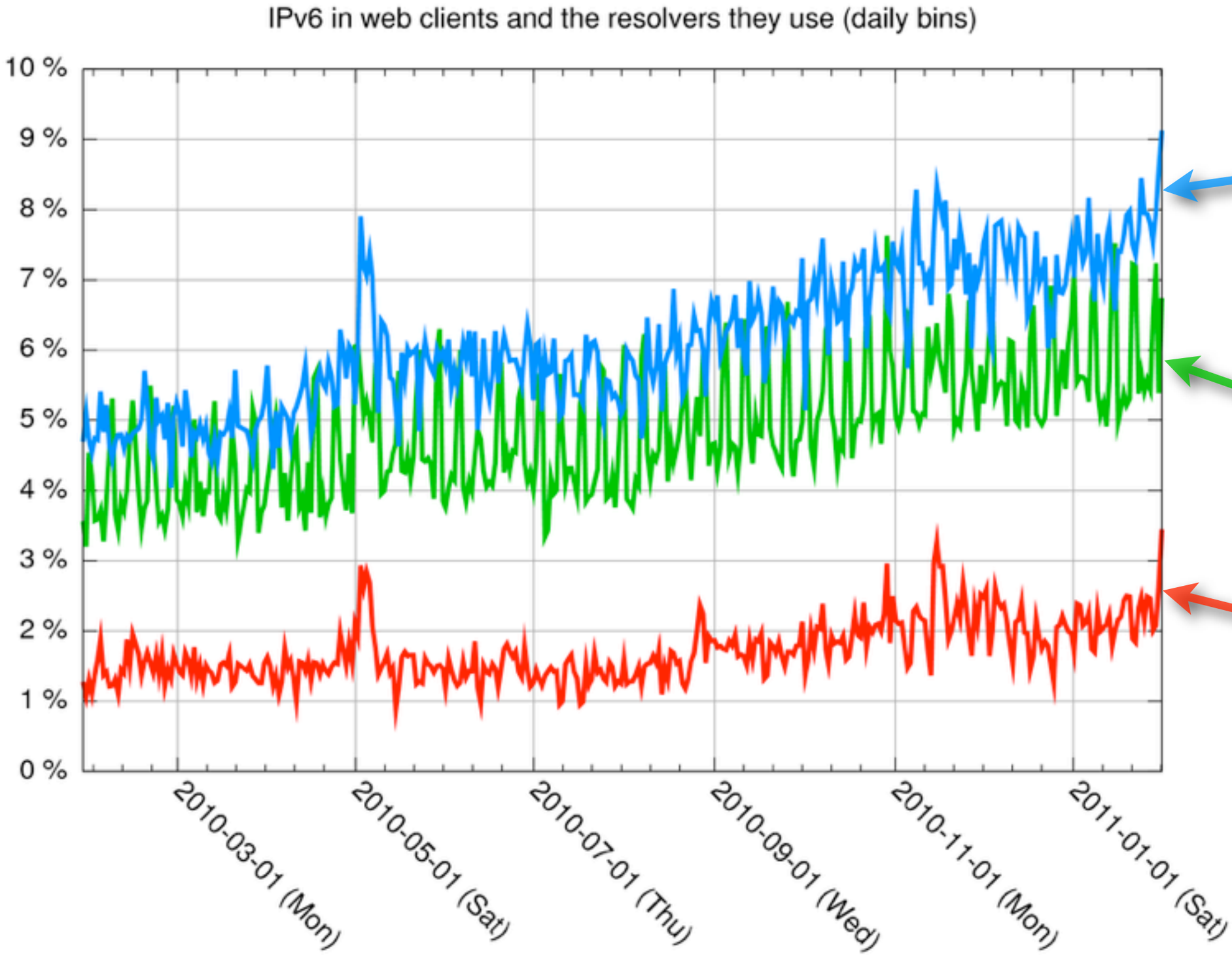
DNS measurement - details



Delegating DNS server determines IP protocol choices for DNS request from resolver to authoritative DNS server

Measurement results

Measurements from www.ripe.net

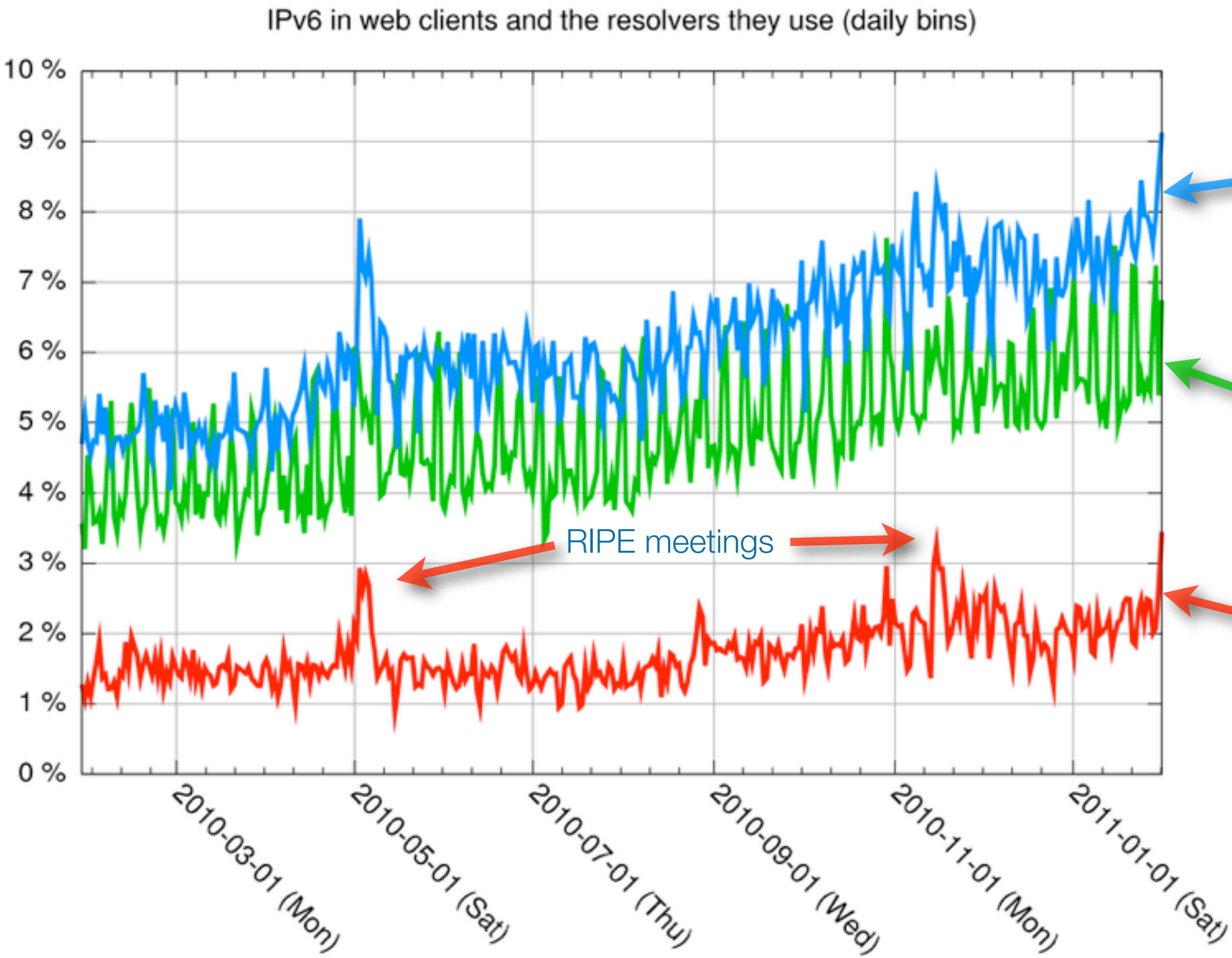


% Web clients with v6 capable DNS resolvers

% Web clients v6 capable (dual stack + transition tech)

% Web clients v6 preference (dual stack)

Measurements from www.ripe.net

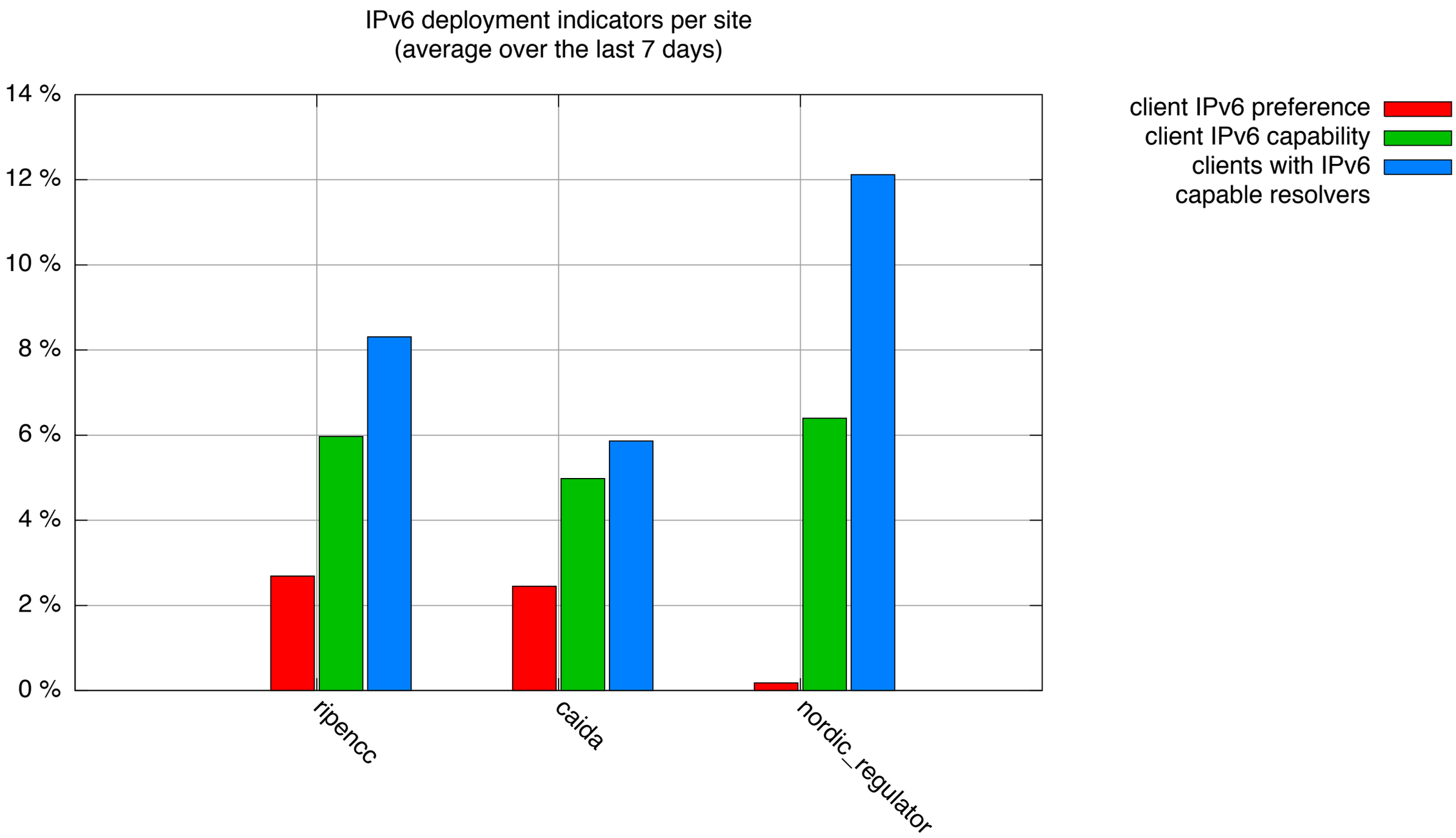


% Web clients with v6 capable DNS resolvers

% Web clients v6 capable (dual stack + transition tech)

% Web clients v6 preference (dual stack)

Compare to other hosting sites



Compare to Google 0.2% client IPv6 preference

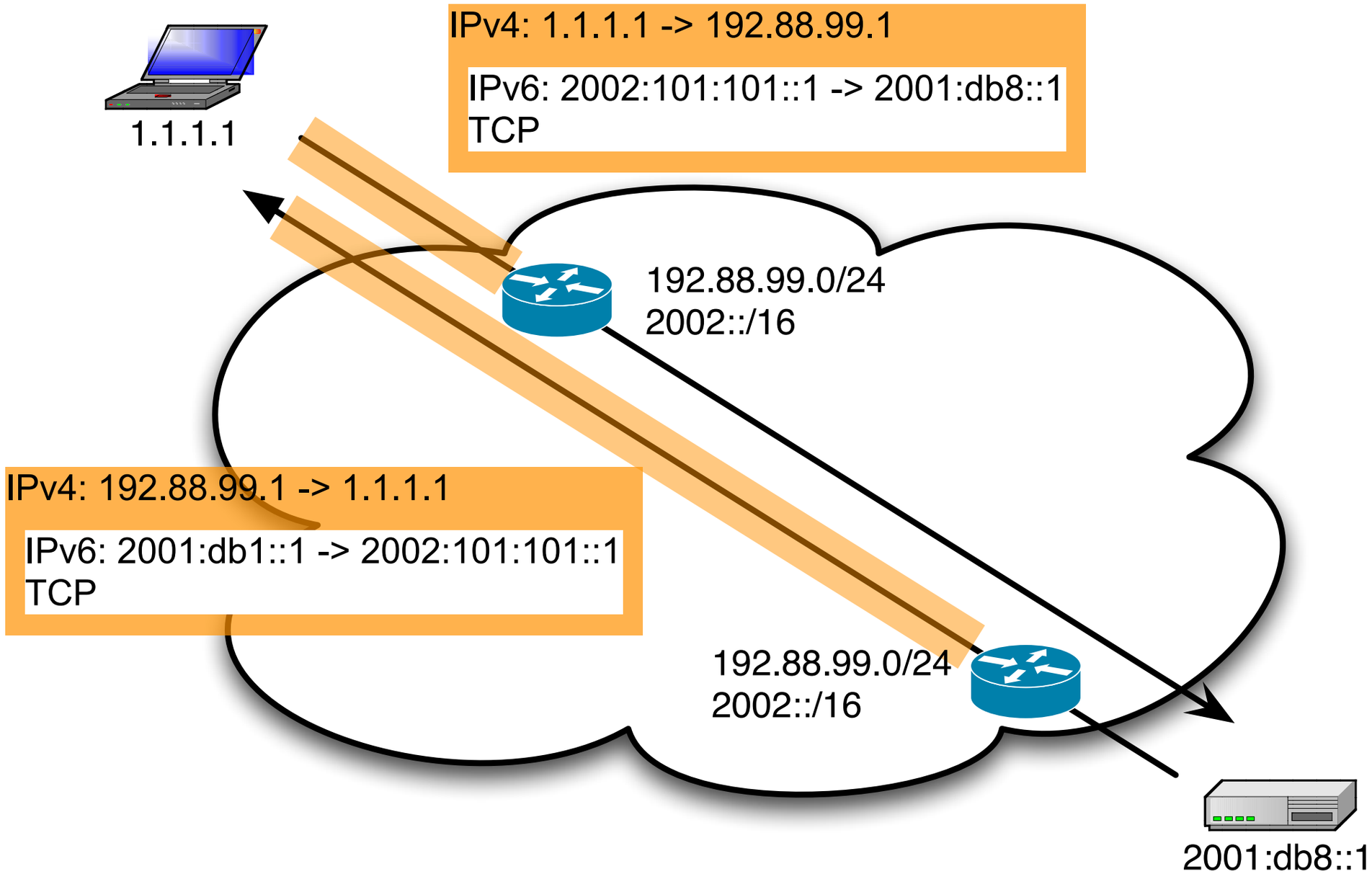
Conclusions from measurements

- Measuring specific populations
- Strong Weekday-weekend pattern in preference
- DNS infrastructure far more IPv6 capable then the clients using it
  - Indicates deployment problems near the edge
- Significant fraction of end-hosts don't have native IPv6 but can use transition technologies

Transition Technologies

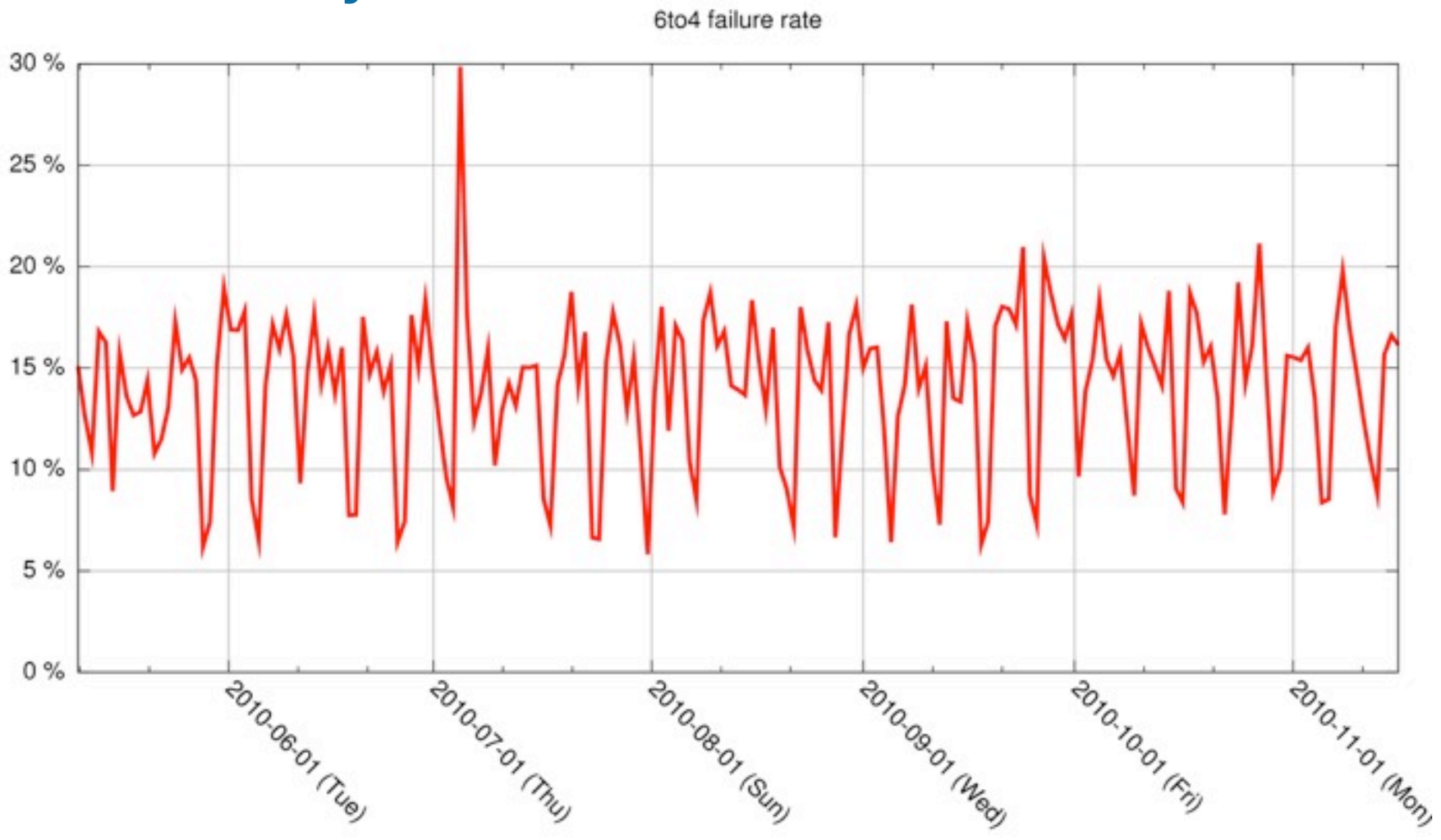
- Make IPv4 <-> IPv6 communication possible
- Most used IPv4 -> IPv6:
  - 6to4
  - Teredo
- Rumor: 6to4 quite often broken
  - why not measure?

Anycast 6to4



6to4 failing connections

- Capture TCP/IP headers to 2002::/16 (6to4)
  - combined active/passive measurement
- Look for any traffic after SYN+ACK => success



Why 6to4 fails

- Depending on the kindness of strangers
  - 6to4 relay overload
- Firewalls
  - Blocking IPv6-in-IPv4 (IP proto 41)
    - unknowingly even, with bad failure mode

```
allow outbound (tcp|udp|icmp) keep-state
allow inbound established

deny inbound
allow outbound (implicit)
```

Final thoughts

- Keep the Internet measurable:
  - IPv6 the only viable alternative to a murky edge
- IPv6 deployment is happening
  - slowly but surely
- Transition is going to be interesting
  - Problematic transition technologies
  - Measurement opportunities
    - World IPv6 day (June 8 2011)

Further reading - RIPE Labs

- https://labs.ripe.net/Members/emileaben/6to4-how-bad-is-it-really
- https://labs.ripe.net/Members/emileaben/interesting-graph-ipv6-performance
- https://labs.ripe.net/Members/emileaben/content-measuring-ipv6-web-clients-and-caching-resolvers-part-1
- https://labs.ripe.net/Members/emileaben/content-measuring-ipv6-web-clients-and-caching-resolvers-part-2-country-level-and-other-statistics
- http://labs.ripe.net/content/measuring-ipv6-web-clients-and-caching-resolvers-part-3-methodology

Questions?