Measuring the IPv6 Internet by active DNS and HTTP measurements (work in progress)

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The 2 Internets

•The IPv4 Internet

- The IPv6 Internet

- How are they different?
  - Size
  - Structure
  - Operational problems

Other IPv6 measurements

- RIR delegations (prereq for IPv6)

- BGP table sizes (prereq for IPv6)

- Traffic (backbone, IX) (very link dependent)

- Web server stats (edge)

- …

- Compilation on RIPE Labs:
  http://labs.ripe.net/content/ipv6-measurement-compilation

Problem statement

- Can we measure the IPv6 connectivity of the end users, in combination with their ISPs to provide more insight into IPv6 deployment?

  - How different is the IPv6 readiness between these groups?

  - More accurate info can influence IPv6 deployment

- We prototyped a method of looking at IPv4/IPv6 at the client and the recursive DNS resolver the client is using

 - Recursive DNS resolver usually part of ISP infrastructure

Methodology

- Make web client fetch data from a number of different URLs

- Vary the way the client can fetch data over HTTP

  - Only over IPv4, only over IPv6, or allow both

- Vary the way the DNS resolver can perform a DNS lookup

  - Only over IPv4, only over IPv6, or allow both

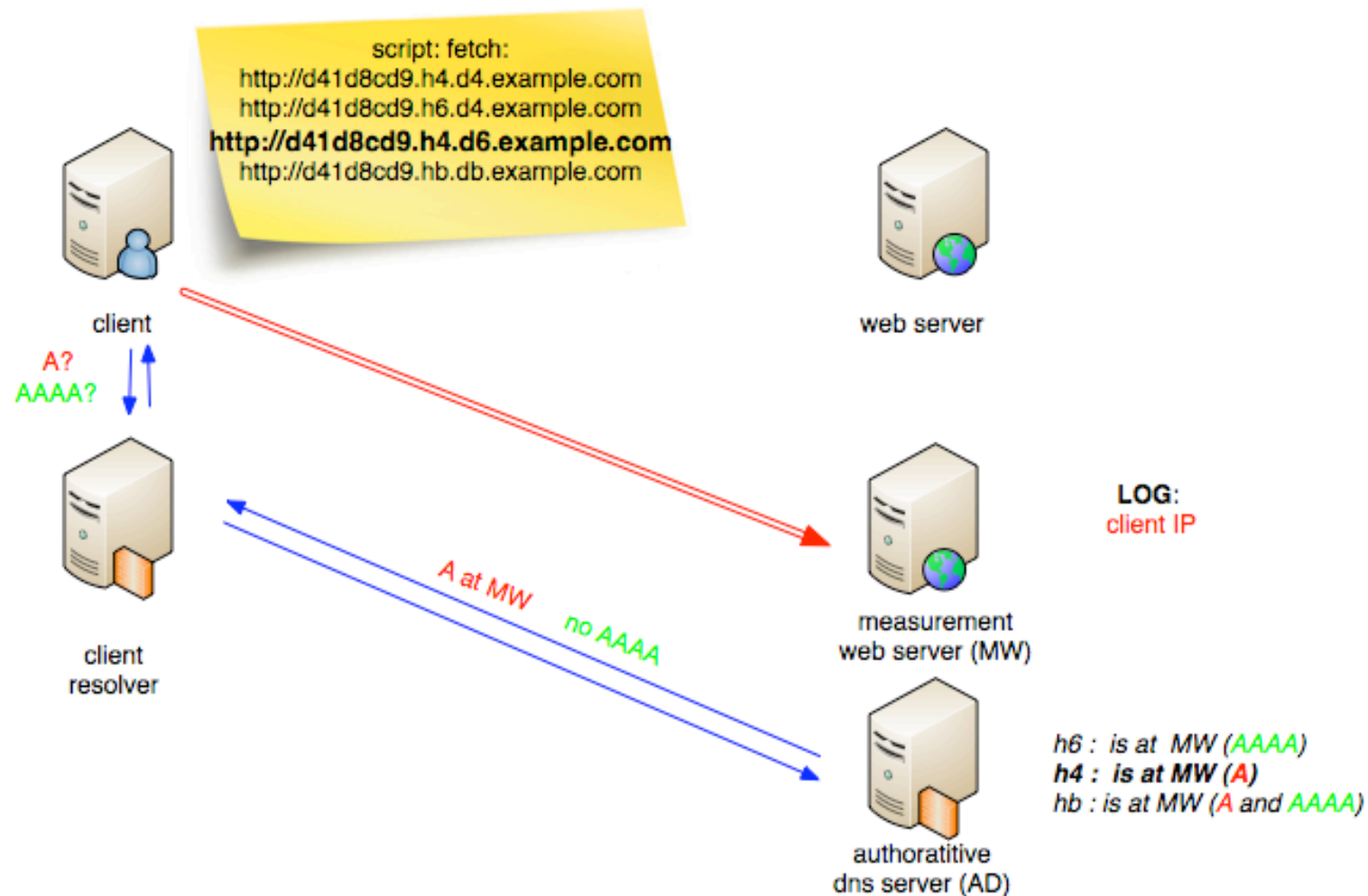- We can observe and correlate the resulting HTTP and DNS requests
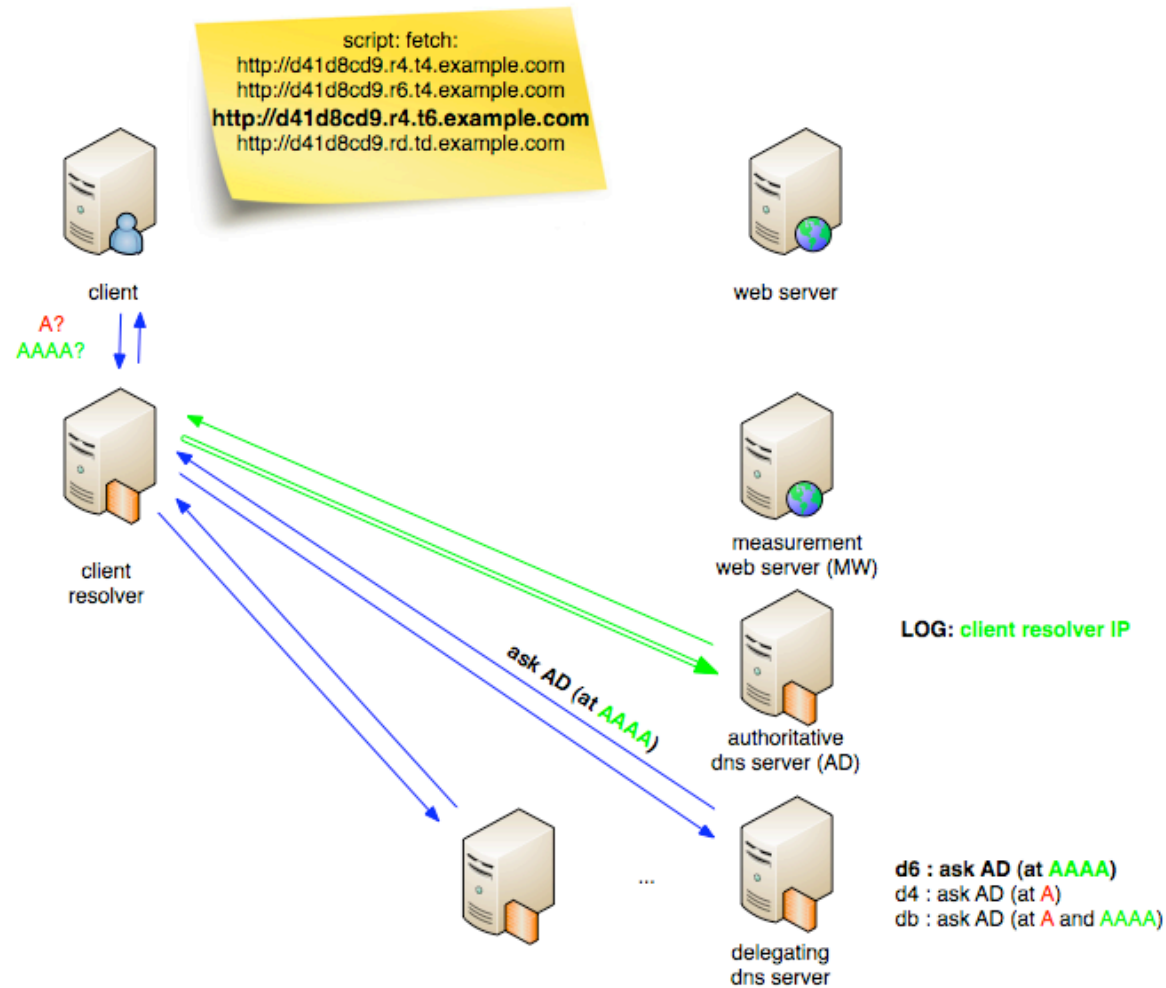
Measurement setup (step 1)
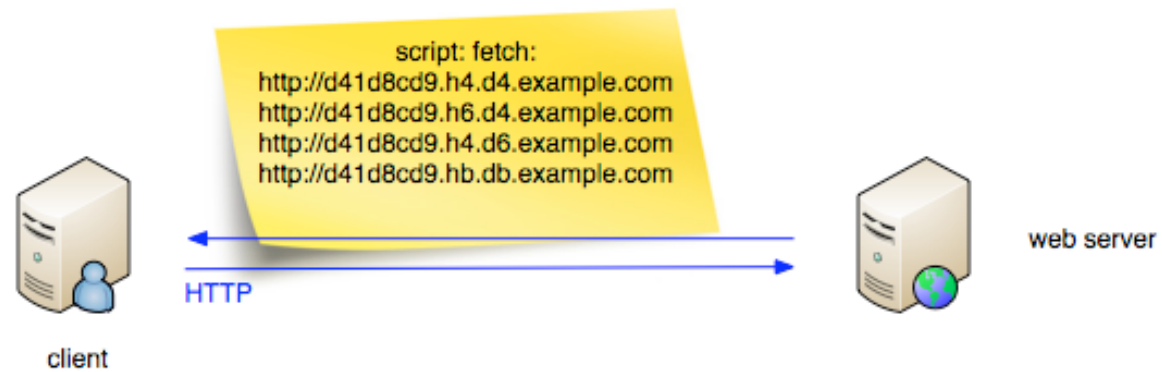
Measurement setup (step 3 HTTP)

Measurement setup (step 2, DNS)

Submeasurements

	DNS v4	DNS v6	DNS both
HTTP v4	h4.d4	h4.d6	-
HTTP v6	h6.d4	-	-
HTTP both	-	-	hb.db

Methodology details

- Unique ID allows for correlation between the 4 sub-measurements

- Low DNS RR TTL makes caching a no-op

- Measurements are limited to 1 run of the script per day per client

- Aggregate results over 1 day (DHCP)

- Measurement bias on clients:

  - Only visitors to site with measurement-script

  - Clients that use javascript (>95%)

Data collected

- Client IPv6 preference:

  - hb.db test resulted in client using IPv6

- Client IPv6 capable:

  - h6.d4 test resulted in client using IPv6

- Resolver IPv6 capable:

  - h4.d6 test resulted in DNS resolver using IPv6

- AAAA queries seen:

  - Any test resulted in AAAA queries being directed at measurement DNS server

Initial results (Labs)

- Script served from on RIPE Labs (n=768):

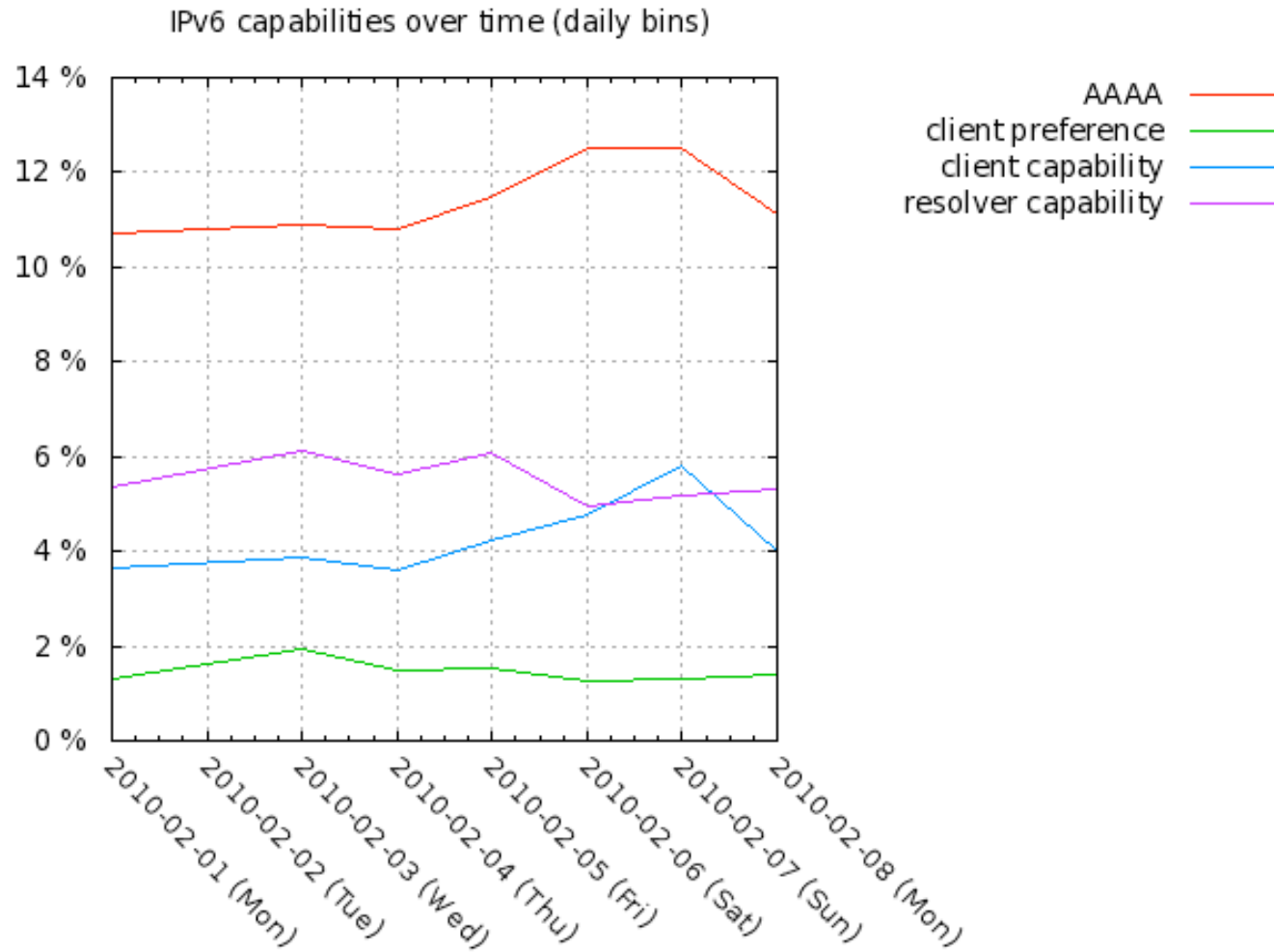|	
Client prefers IPv6	7.2%
Client has IPv6	9.2%
Resolver has IPv6	11.0%
AAAA observed	29.4%

- Caveat:

  - Teredo connectivity problems

Initial results (www)

- Script served from RIPE www (n=8707, 1d):

Client prefers IPv6	1.4%
Client has IPv6	3.5%
Resolver has IPv6	5.6%
AAAA observed	10.8%

Initial results (www)

IPv6 capabilities over time (daily bins)

Initial results at AS level

- Map IP to AS using INRDB

  - Special treatment for 6to4 and Teredo

- At AS level (total routing table ~ 33k)

  - Web clients:

    - 2311 ASes seen

    - 77 ASes with IPv6 activity (3.3%)

  - Resolvers:

    - 2199 ASes seen

    - 144 ASes IPv6 activity (6.5%)

DNS relationships

- Are client and resolver in the same AS?

	n	Same AS	Different AS	Mixed AS
v4 HTTP v4 DNS	8260	78.7%	19.6%	1.7%
v6 HTTP v4 DNS	297	21.2%	78.5%	0.3%
v4 HTTP v6 DNS	415	63.9%	36.1%	0.0%

DNS relationships

- ASes providing DNS service to other Ases:
  - Open resolver
    - unintentional
    - DNS service, high indegree (Open DNS, Google)
  - Business relationship (c2p, other?)

# clients	# client ASes	ASN	Name
206	130	36692	OpenDNS
170	113	15169	Google
97	59	3356	Level3
38	16	3269	Telecom Italia
32	21	702	Verizon EMEA

Possible next steps

- Move out from feasibility-study phase

- Scale up (can you host a javascript?)

- Track over longer time

- Use in IPv6 geo-location

Initial Conclusions

- This method works and can be used to study the relationship between populations of web clients and the DNS resolvers they use

  - We want more data!

- In 3.6% of measurements we see IPv6 capable clients

- In 5.3% of measurements we see IPv6 capable resolvers

- Significant number of clients use a resolver not in their own AS

Questions?