

Trends in the DNS resolver market

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Agenda

- Introduction (Roxana)
- Context of the research paper
- Highlights and Results on consolidation
- Policy implications
- How to measure resolver market share (Michael)
- Public Information
- Passive Measurements
- Active Measurements
- What about RIPE atlas?

Introduction

- DNS market - historically highly decentralized
- Increased concentration in the hands of a few providers
- Bigger size, bigger responsibilities, bigger failures?

Context for the research paper

- Limited research and monitoring of market trends
- Journal of Cyber Policy special issue convened by Internet Society
- Understanding the regulatory gaps and informing policy
- Understanding consequences for the evolution of the Internet

Findings and highlights

1. On mobile platforms, **more than 50% of all queries handled by alternative DNS services** (H1/2019). Google and Cloudflare answered 49.7% of the DNS queries from our measurement.
2. **Longevity in the market** does not seem to matter much. Resolvers introduced after 2016 still do well (Cloudflare and Quad9 rank 2nd and 3rd)
3. **Consolidation of the two-sided market:** free Public DNS services rely on the monetization of traffic & overall internet health data
4. **Integration of DNS resolution in other services** (sharing across Google platforms & browser trends)
5. **The top alternative DNS providers operate from the US** -- data collected and processed outside the jurisdiction of their users (Quad9 moved to Switzerland recently)

Policy implications

- Better overall protections for users against malware and phishing attacks (fast adoption of security extensions)
- Unequal competition: whereas ISPs are bound by national and telecom regulations, Public DNS providers are not (less protections for users data)
- Need for adequate, long-term measurement of the DNS resolver trends

How to measure
recursive resolver
market share?

How to measure recursive resolver market share?

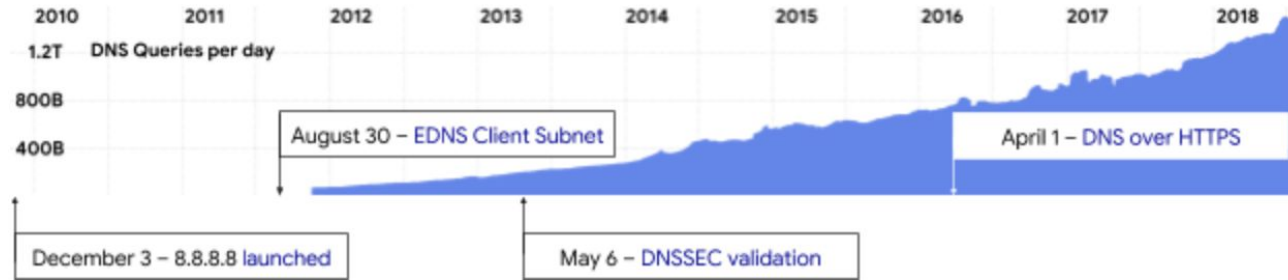
- Rely on published information
- Passive Measurements
- Active Measurements

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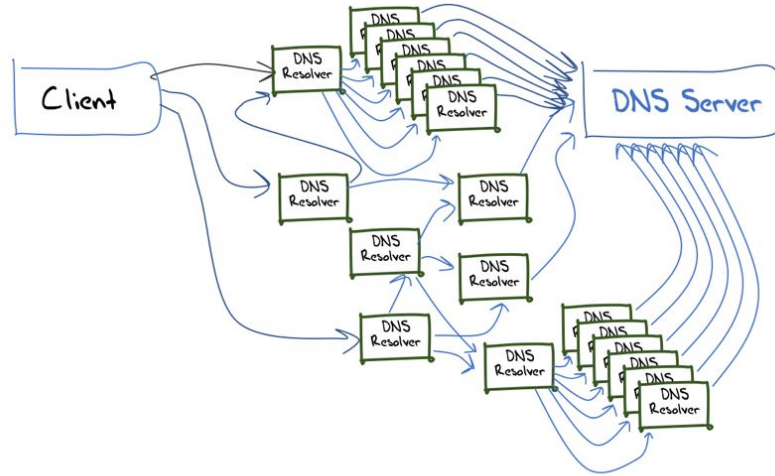
All measurements are biased

Published Information - Google Public DNS



Published Information - Research

	First (%)	All (%)
Same AS	51.19	55.97
Same CC	36.50	39.65
Different CC	0.89	2.09
Any Open Resolver	15.28	28.27
Google Public DNS	9.12	22.36
Open DNS	1.44	2.41
114 DNS	1.36	2.80
DNSPAI	1.10	1.26
OneDNS	0.93	1.07
Level 3	0.81	1.99
Cloudflare	0.74	1.15
Yandex	0.17	0.33
Quad 9	0.08	0.16
Green Team DNS	0.06	0.06
Neustar	0.05	0.08



Passive Measurements - from authoritative DNS

Results

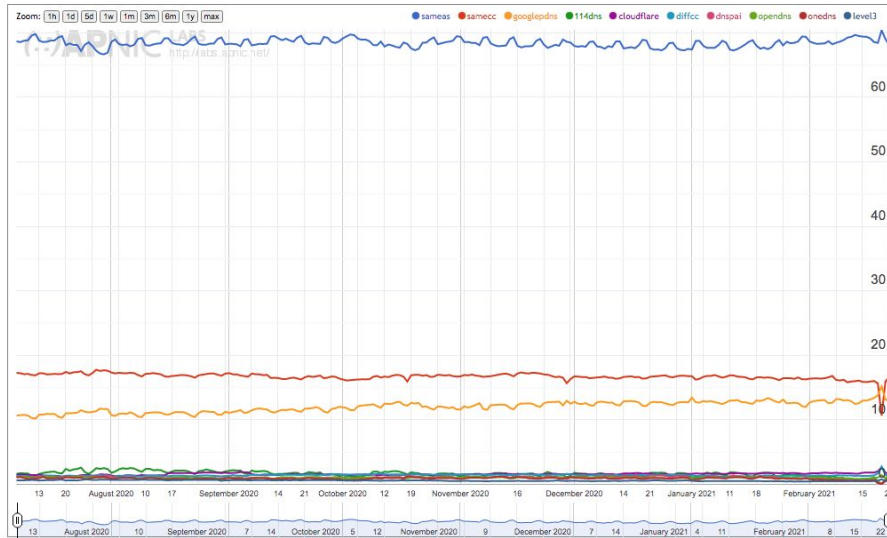
The results quite didn't match our expectations at all. First, only 15% of all DNS requests were using one of the most popular DNS providers:

- #1 **Google: 13.21%**
- #2 **OpenDNS: 1.82%**
- #3 NeuStar: 0.15%
- #4 Quad9: 0.13%
- #5 CloudFlare: 0.12%

<https://medium.com/@nykolas.z/dns-market-share-analysis-identifying-the-most-popular-dns-providers-80fefb2cfd05>

Active Measurements 1 (APNIC - Geoff Huston)

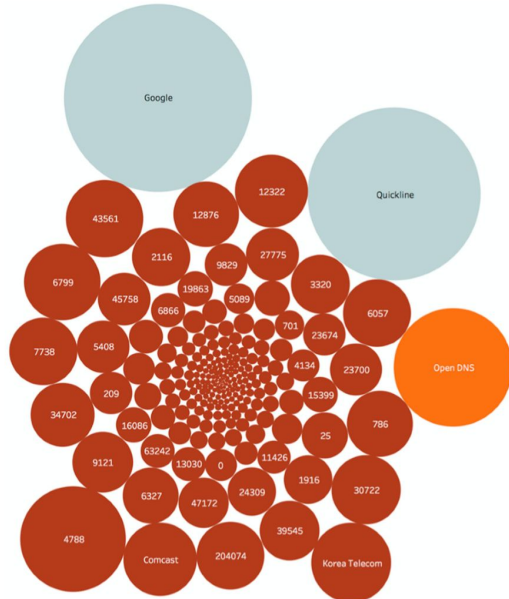
Use of DNS Resolvers for World (XA)



<https://stats.labs.apnic.net/rvrs>

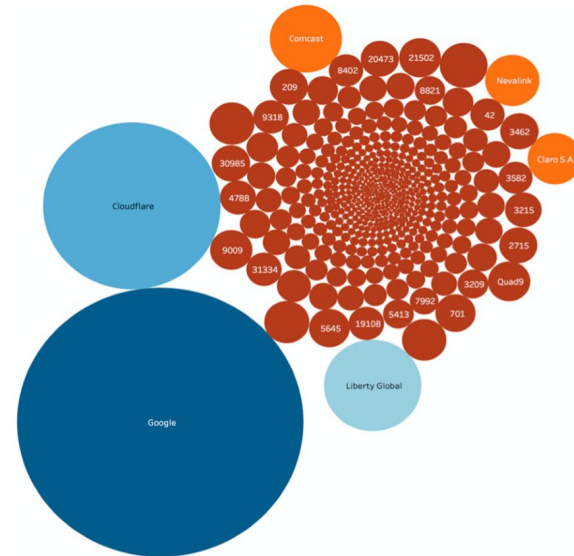
Active Measurements 2 - OONI

2016



Graph 2. Number of queries answered in 2016 by a resolver with an upstream IP from these ASNs.

2019



Graph 1. Number of queries answered in the first half of 2019 by a resolver with an upstream IP from these ASNs.

Data source: Open Observatory of Network Interference <https://ooni.org/>

Active Measurements 3 - RIPE Atlas

Settings & Status

Latest Results

Map

Latencymon

Downloads

Overview

recurring IPv4 DNS "DNS measurement to whoami.lua.po..." id 20788254

Target

No Target (Uses Resolvers configured on Probe)

DNS Specific Settings

IN TXT whoami.lua.powerdns.org.

Status & Timing

ONGOING from 2019-04-16T13:31:15Z every 86400s

Probes

1000 Requested / 282 Actually Participating

Tags & Projects

dns

Ownership & Costs

Public

whoami.lua.powerdns.org

```
% dig whoami.lua.powerdns.org TXT +short
```

```
"2001:620:0:3006:21a:4aff:fedf:4b"
```

Query returns the upstream IP of the (first or active) recursive resolver configured

Active Measurements 3 - RIPE Atlas Issues

- User measurements are limited by credits
- User measurements are limited by 1000 probes
- Measurements will not add new probes to measurement
- I couldn't find a way to convince RIPE to run a recursive resolver public measurement with all atlas probes

RIPE Atlas

Do you think RIPE Atlas is a good tool
for a long term measurement of
recursive resolver trends?

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What else can be done
to monitor trends
and increase transparency?

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Thank you!