SUMMARY 1 Notes:

Page 1:

Ground Truth validation is used to backup the measurements for Doh and Do53 for global residential clients. which are closest exact measurements with minimal error.

Page 2:

DoH means compared to default client resolve behaviour. It send over TLS

For 19.1% peeps time for first DoH resoltuin speedsup significantly despite TLS handshake. Most clients and countries do not enjoy sopeedup eg Sudan even after accounting for TLS handshake.

DoH providers fail to resolve a significant number of clients to closest closest Pop. (page 2 result)

Countries with low economic development and low internet infra usually slow for DoH

Trends significant even when multiple request using single TLS session for DoH queries

Conclude implications of Doh rollout an DoH deployment

Contribute using dataset for future research

8.8% of countries benefit from switch from DoH to Do53

Explanatory variables used to show performance of DoH vs Do53

IETF proposed 5 major protocols for issues in Do53

DoH fewer problems with port oriented firewalls

DoH has API restrictions

AIM: cover vantage pounts from diff countries

Study impact (is it proportionate) of transition from Do53 to DoH

Study client resolver behaviour relative to DoH and obtain absolute query latency from both DoH and Do53

Page 3:

Questions answered: on page 3

Bright data routes traffic globally via exit nodes (having HolaVPN installed). Advantage of BrightData: allows measurements via machine located in residential network.

Exit node: can be specified country for behaving global residential, multiple requests via same exit node

DoH: Unique subdomain for each request to avoid caching, Super Proxy itself does not implement any code to perform DoH resolutions. It is implemented by measurement client.

Do53: exit nodes may be configured using a variety of DNS resolvers. This setting allows to check the performance of Do53 under the default configuration of each exit node.

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We don’t have full control over exit nodes

The strategies to calculate DoH query time

3 majors sections:

TCP connection establishment

TLS connection establishment

To mimic reality time spent with Super Proxy is excluded

2 assumptions validated in ground truth experiment

1. RTT betwn client and Node stable
2. TCP tunnel establishment 1to8 takes max time rest is negligible.

Contri: Calculate TDoH

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Validate reliability of Super Proxy’s header information

DoHR: reuse the same TCP connection and as we are using the old connection

TDoHR represents performance of subsequent queries.

Measurement works for major countries. Where it does not work is for Do53

For 11 countries of exception use RIPE Atlas

In BrightData mapping of country to exit node not always that accurate, contribute by performing checks on the country, using Maximind Geolocation Service

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Small scale experiments before running full measurements

Set own machines behave as exit nodes compare values to the method used for calculating

Ec2 machines and HolaVPN for each, repetedly query for our machine to be selected as exit node

Query time is considered as the ground truth

Repeated 10times and median value is taken

Assumption: Deafult DNS protocol is Do53, used exit nodes under our control

Use wireshark to capture the packets

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Ground truth expt suggests that methodology is sound and can be used to closely approximate actual resolution values for Doh and Do53

DoHR time taken to make request over single connection

DoHN number of request over the single connection

Contri: approximate potential improvement by difference between the clients actual position and what would it be to the nearest PoPof same DoH provider

Discuss results for each resolver

Cloudfare has large number of points of presence PoP

Raise questions on googles PoPs inspite of having Low PoP

Quad9 resolvers are distinct outliers and has a significant room for improvement

compare our DoH and Do53 measurements within countries by calculating the delta between the medians of country-wide resolution times

For 8.8% countries switch to DoH reduces time taken for single DNS query

For most the time taken increases

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In the section 5.3 they have said that for 8.8% of countries time reduces and for the rest of them it increases.I did not like this as the reason for this reason is not given

Page 10:

For developing nations GDP is considered

For developing Internet Infra Ookla speedtest is considered

Regression analysis is done to measure the impact of latent variables on the performance measurements

Have performed logistic modelling: switch would disproportionately impact countries in developing stage(infra and GDP)

Linear Modeling: Client countries investment has a lrge influence on the DoH resolution slow down

Minor variable affecting is the distance of the client from the authoritative name server

Resolver deployment strategy and efficient routing will play a role on equitable DoH performance

Consider an impact on the clients gloabally and tailor the deployment strategy accordingly t make the transition smooth

Page 12:

Solutions for equitable DoH deploy but implications for DoH resolution services and software vendors

Suggest:

Clients should have the option for opting DoH and be provided with information

Invest in small Pops in areas with little development. Optimal assignment. Nationwide bandwidth is still an issue should be considered

The results don’t reflect real world client performance. Cache hit and miss interesting venue for future

DoH centralized

Limitation of STUDY:

Bias due to single proxy service towards tech savy peeps

Due to BrightData could not study 11 countries

Could give skewed results as the number of clients per country taken was 10. But it can vary from 10 to 282

Used single authoritative name server, but in real life they are in large number located throughout the world

Use TLS 1.3, not a major impact though!

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Conclusion:

A switch to DoH would be beneficial for for few regions where as would result in slowdowns for others.

Countries with high internet infra and higher gdp more likely to be available to the benefit from the switch to DoH.