(PAPER: "Measuring DNS-over-HTTPS Performance Around the World")

SUMMARY 1

People conducting research in the domain of computer networks have found that the DNS Protocol (unencrypted, based over UDP over port 53 hence also known as Do53) being majorly used, has privacy, security, and a few other concerns associated with it. Hence, they suggest considering an option to switch to another protocol called DoH which stands for DNS-over-HTTPS. There are a lot of existing studies on this topic but the problem with them is that either they are incomplete or the measurements are from single countries or the comparisons aren't accurate representations of real-life scenarios. Proceeding with this switch from Do53 to DoH can have serious implications and can affect many clients/ countries disproportionately. The authors of the paper have hence decided to research the effect of this switch from traditional DNS to DoH, by measuring the performance of one method relative to the other method.

The authors measure the performance of DoH and Do53 client behaviours using which they perform a direct comparison between them. Authors try to quantify the results into numbers which will make it easy to interpret the results of the research and help in identifying the decision for rolling out the new DoH protocol. For measurement and covering global vantage points, the authors using the BrightData proxy network, first performed data collection from 22052 clients who are distributed over locations in 224 countries such that each country has a representation of at least 10 clients. This would be one of the major contributions, as it provides valuable data for further research on the topic. Additionally, during the measurements, the caching is avoided by employing the cache miss performance strategy to be able to view the worst-case results, for better analysis of the implications the switch from traditional DNS to DoH would have globally. The authors have made use of explanatory variables to show the difference between DoH and Do53 which makes it easier for a reader to analyze the effect of using DoH instead of Do53. Adding on to the above contributions, the authors try to enlist, explain and prove what are the external factors that result in the asymmetries in the performance of protocols under observation.

The authors mainly conclude that the switch to DoH would be beneficial for some regions but have an adverse effect on the rest of the regions. During the experiments, 4 major DoH providers were considered and Cloudfare was concluded to have performed the best with about 36% more Points of presence (PoP) and a 21% faster query resolution rate. The authors went on to conclude that most of the countries are not able to get the speedup on switching to DoH and only 8.8% of the countries are going to derive benefit from the switch to DoH. Although there is an advantage of using BrightData network is that it allows extracting data from the residential network, mirroring real-time situations, one of the downsides of the use of BrightData services as it introduces bias into the data and restricts 11 countries from being considered for the study, some of which are important. The experiments are repeated several times and the median of all the results is considered for the final measurement. It is observed that there is a negligible deviation of the medians from the ground truth validation values (highly accurate values run on small-scale experiments first) which shows that the values can be trusted. From the results, the authors conclude that the if the clients connect to the nearest PoP, they would have a speedup in resolution time, as in most of the cases they are not routed to the nearest PoPs. Regression analysis for representing the impact of latent variables shows that the client country's investment in internet infrastructure has a large impact on the DoH resolution slowdown (shown by Linear Modelling) and the switch to DoH would have a disproportionate impact on the developing nations considering their GDP and Internet speed as the measurement for their economic position and internet infrastructure respectively (shown by Logistic Modelling). Finally, the authors go on to conclude that the clients should have an option to opt for the DoH services and if they choose to do so, they should be provided with detailed information on the same.

I have never gone this deep into computer networks and getting to know such beautifully working protocols and concepts is interesting. Although it is a little complex to understand, it is completely worth the effort. I was extremely fascinated after learning about the BrightData proxy fetching data from residential networks, that has been used in the experiment. As I have never imagined it to be possible to mirror a real-world situation to gather this amount data of rich data for research in networking. Additionally, the data that has been collected is so extensive and rich in information that it not only aids this experiment but will serve useful for future experiments. I would love to follow the progress of this research as it has been adopted by tech giants like Google.

One of the aims of computer networks is to move towards decentralization and DoH is a centralized protocol, which violates this principle, hence there could be opposition to this. Although the research is interesting, decentralization in my opinion is more important and should be prioritized. In the research, there is a large reliance on the BrightData super proxy network for collecting data. In my opinion, this can affect the data if there is a breach in the network. Lastly, there is a bias in data toward tech-savvy people, which skews the data and can hurt the performance measurement.