Internship proposal 2018/2019

Topic: Passive Measurement Techniques for Monitoring Internet Application Performance

Duration: 4 to 6 months

Hosting team: MiMove, Inria Paris (https://mimove.inria.fr/)
Joint team between Inria and Princeton University, HomeNet (https://team.inria.fr/homenet/)

Apply at: https://goo.gl/forms/kmLbN5m9tlOcUkFr1

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Keywords: Passive and Active Internet measurements, Application Performance, Bottleneck Detection.

Description:
Accurate methods and tools for monitoring and diagnosing Internet performance are central to the health of the Internet ecosystem. ISPs rely on measurement results to manage and optimize their networks, applications to optimize content delivery, and users to decide which services to buy. Monitoring results also play a key role in Internet regulation and policymaking. Internet performance monitoring has long relied on active measurements, where end-hosts issue probe packets towards a destination to infer properties of network paths. For example, users often launch a "speed test"[1] when applications perform poorly to verify their network "speed". Speed tests send probes as fast as possible to infer the throughput of the access link [2]. This active approach to measure Internet performance suffers from a number of limitations. With the increase in home broadband Internet speeds, the home access may no longer be the throughput bottleneck in the end-to-end path and sending enough probe traffic to fill up the access link becomes disruptive. Speed tests may (and often will) measure paths that do not correspond to the paths of application traffic. Moreover, different applications react differently to the same network conditions. As a result, the relationship between Internet application performance and speed test results is ever more tenuous. Although existing tools (e.g., SamKnow whiteboxes [3]) do perform tests of application quality, these active tests fail to capture application quality impairments that users experience.

This project is part of a collaboration with Princeton University in the context of the NetMicroscrope project. The goal of this project is to develop the next generation of home performance measurement tools to be able to (1) account for the diverse set of possible contributors to performance bottlenecks; (2) measure the performance to a diverse set of Internet applications and services; and (3) do so at high speeds. We argue for an approach centered on passive measurements, where we observe application traffic as it traverses a network link. Passive monitoring permits observation of the conditions that real user applications are experiencing in real time and consequently fast detection of any quality degradation. Combined with targeted active measurements, passive monitoring can also pinpoint the sources of application performance bottlenecks. We already have an initial passive monitoring system to infer video quality, which is currently deployed in 50+ homes in France and the US. We have been capturing application traffic for several months.

The goal of this internship is to complement the passive monitoring modules with active measurement routines to monitor the performance of network segments and study how application quality correlates with different types of bottlenecks. The student will first learn the inner-workings of the existing system, which runs on a Raspberry Pi, and analyze the data collected from our current deployment. The data includes cross layer quality-of-service and quality-of-experience information, from home wireless conditions to network traffic patterns and service QoS metrics (e.g. [5,6]), as well as user contextual information (e.g. [4]). The student will also work on developing active measurement routines to infer properties of different segments along end-to-end path, and analyze the measured properties of Internet path along with the passive inference of end-to-end performance. This analysis will help us answer a number of open research questions: what are the main culprits of application performance degradation? And how do these sources change between different classes of applications, access types?

During the internship, the student should develop scientific skills on network systems design and development and service optimization as well as scientific writing and presentation. If the student is interested, there is a possibility of staying for the doctoral studies after the internship.

Desirable skills:
- Comfortable communicating in English
- Comfortable with at least one scripting language (e.g. python)
- Knowledge of network protocols and network development tools
- Knowledge of matlab or gnu R

References

[1]Ookla Speed Test, http://www.speedtest.net/fr
[2]Ookla Speed Test, https://support.speedtest.net/hc/en-us/articles/203845400-How-does-the-test-itself-work-How-is-the-result-calculated
[3] Sam Knows, https://www.samknows.com
[4] J. Martin and N. Feamster. **User-driven dynamic traffic prioritization for home networks.** In Proc. of W-MUST, 2012.
[5] Chen, Junyang, et al. **Client-Driven Network-level QoE fairness for Encrypted 'DASH-S'.** Proceedings of the 2016 workshop on QoE-based Analysis and Management of Data Communication Networks. ACM, 2016.
[6] Bronzino, Francesco, et al. **Exploiting network awareness to enhance DASH over wireless.** Consumer Communications & Networking Conference (CCNC), 2016 13th IEEE Annual. IEEE, 2016.