Chair of Network Architectures and Services
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Introductory talk for the Bachelor's Thesis

Available Bandwidth Estimation

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Topic

Observing the rapid development in technology such as realtime systems or the popularity of streaming services, the internet's penetration rate increased tenfold in the last 20 years. [1] Thus, it is essential to have knowledge about the available bandwidth to enhance the quality-of-service (QoS) by selecting the optimal route for a designated service. As a consequence, there are a lot of end-to-end tools for available-bandwidth estimation such as Pathload. Since they require access at both ends, the applicability is limited. Additionally, they rely on UDP/ICMP which is often blocked or rate limited. [2] Of more interest are single-ended tools based on TCP such as abget or fabprobe. As a result of TCP, it is more complicated to estimate the available-bandwidth because packets can take different routes from host to host.

Approach

One approach to this problem is Abget an iterative algorithm, based on the idea of pathload which transmits periodic TCP instead of UDP packet streams. In order to send packets at a certain rate R the client sends ”fake” ACKs over to the TCP server, through a raw IP socket interface to emulate the TCP protocol. [2] Because of this, it is possible to determine the available-bandwidth through an increasing or decreasing trend in the One-Way-Delay (OWD). This implies the probing rate R is higher or lower than the available-bandwidth.

An alternative to solve the problem is fabprobe, that uses a binary search-like algorithm. [3] First the path is probed with a fleet of packets at an initial rate R. The available-bandwidth can be derived from the packet's RTT. If the RTT shows an increasing trend, the rate R is reduced, thus meaning the rate is greater than the available-bandwidth. Consequently, a decreasing trend results in increasing R. Fabprobe's main focus is the trade-off between efficiency and accuracy, with fewer numbers of samples to achieve the highest accuracy possible.

Since fabprobe is designed for large scale measurement, we will focus on it. First, fabprobe will be implemented and tested in Mininet, a small testbed, under control. The results will be evaluated according to performance, stability and overhead. If the results are promising, a test on the internet will follow and be tested against an active end-to-end tool such as pathload to verify the previous results.

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Goal

The goal of this thesis is to implement fabprobe, estimate the available bandwidth by testing and in the end evaluate the results.

Following research questions are to be considered:

1. How good is the performance of fabprobe?
2. Trade-off between accuracy and efficiency?
3. What limitations and restrictions constraint the usage of fabprobe on the internet?

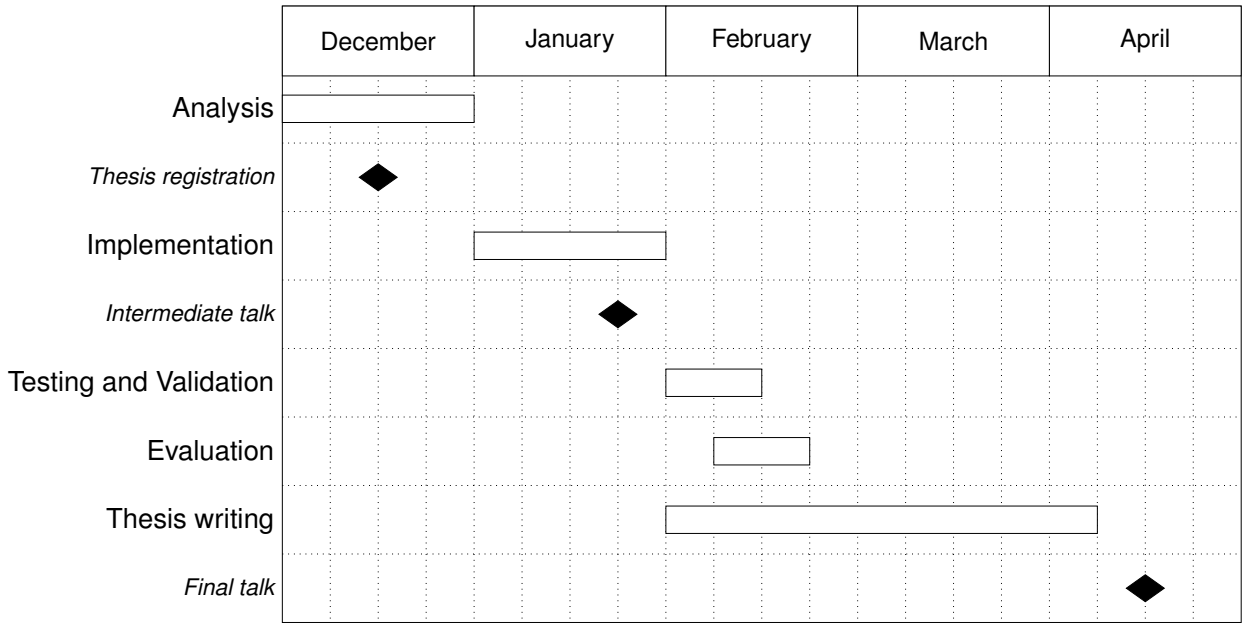
Related work

ABwProbe: The predecessor of fabprobe which was implemented by EURECOM. ABwProbe sends TCP ACKs as probes and except the other host to answer with the corresponding ACKs. [4]

Pathload: A well-known active end-to-end tool for available bandwidth estimation based on UDP. abwProbe or abget are based on pathload's approach and redesigned for estimation with TCP. [5]

Mininet: Actively developed network emulation tool with wide range of usage in software defined networking (SDN). [6]

Schedule



References

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[2] D. A. et al., "Available bandwidth measurement as simple as running wget," in *Proceeding of the Passive and Active Measurement Conference*, M. Allman and M. Roughan, Eds., 2006, pp. 61–70.

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[5] M. Jain and C. Dovrolis, "Pathload: A measurement tool for end-to-end available bandwidth," *Proceedings of Passive and Active Measurement Workshop*, 03 2002.

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