ETH

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Meta Congestion Control.

Semester thesis proposal

When it comes to congestion control (CC), there is no silver bullet. Depending on the underlying network, one algorithm might beat another, while it is worse in a different environment, as algorithms typically make many assumptions about network behaviour. For example, one protocol might work well in a network with large buffers, while another might be able to cope with long delays. Pantheon [2], a recent benchmark for CC algorithms shows drastically different performance depending on the network conditions. Most importantly, there is no single protocol that excels in every situation.

Consequently, connections might benefit from using a *meta-protocol* for communication, which selects the optimal CC protocol for the current network conditions. Ideally, this meta protocol can be extended to include additional algorithms.

However, there are several challenges to this approach. First of all, the meta protocol must be able to reliably learn the performance of different CC algorithms. The performance can be influenced by many different factors, which may differ in each network along the path. Additionally, some or many of these factors might only be transient, and change over time. Thus, we need to investigate over which time span the learned performance is accurate, and when we need to re-learn. Aside from that, it can be difficult to switch algorithms at any time during a connection as CC algorithms are often tighly coupled with transport protocols. For example, multiple CC algorithms exists for TCP, and could be switched during the same TCP connection, but it is not possible to switch from TCP-style CC to BBR [1]-style CC during an active connection.

The goal of this thesis is to design, implement, and test such a meta congestion control protocol. The complete thesis may be structured as follows:

1. Review literature and benchmarks for CC algorithms to determine a set of algorithms to focus on for this thesis. Different flavors of TCP might be a good start, but other algorithms might be valuable to consider, too.
2. Verify in real scenarios that these algorithms perform better or worse depending on the type of network. In particular, verify that there is not one best-in-class algorithm and that switching can be benefitial. This could be done in different networks around ETH and using a world-wide platform such as PlanetLab[1].
3. Propose and implement a meta congestion control algorithms that is able to switch between the set of algorithms.
4. Verify the performance of the meta algorithm.

Requirements

- Some familiarity with communication networks, in particular with the basics of congestion control.
- Programming skills in C/C++.

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[1] `https://www.planet-lab.org`

References

[1] N. Cardwell, Y. Cheng, C. S. Gunn, S. H. Yeganeh, and Van Jacobson. BBR: Congestion-based congestion control. *Communications of the ACM*, 60(2):58–66, Jan. 2017. `http://dl.acm.org/citation.cfm?doid=3042068.3009824`.

[2] F. Y. Yan, J. Ma, G. D. Hill, D. Raghavan, R. S. Wahby, P. Levis, and K. Winstein. Pantheon: The training ground for Internet congestion-control research. In *2018 {USENIX} Annual Technical Conference ({USENIX} {ATC} 18)*, pages 731–743, 2018. `https://www.usenix.org/conference/atc18/presentation/yan-francis`.