Proposal: Learning-based Scheduler over Multipath Transport Protocols

Tianfang Chang, Shirley Shu

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1 Problem

Multipath transport protocols utilize multiple network paths (e.g., WiFi and LTE) to achieve improved performance and reliability, compared with their single-path counterparts. The scheduler of a multipath transport protocol determines how to distribute the data packets onto different paths. However, multipath schedulers have many challenges to solve. It's hard for a scheduler to keep efficient all the time when dealing with heterogeneous paths with dynamic path characteristics (i.e., packet loss, fluctuation of delay). Thus, it's important to design a learning-based scheduler to adapt to real-time changes in the network, which can significantly enhance the efficiency of transport.

2 Relative Work

Research around the scheduling algorithms are getting popular in recent year. Here we introduce some typical works. [1] tackles this issue, head-of-line (HoL) blocking at the receiver, increased end-to-end delays and lower application goodput by penalizing the use of longer paths, and increasing buffer sizes. The experiment shows it performs well with bulk send but is not that good with websites or videos. [2] finds that scheduling without the recognition of the stream features can aggravate inter-stream blocking when sharing paths. Thus, it proposes Priority-Based Stream Scheduling which performs path scheduling based on the stream features. Finish test on web browsing, but not in other scenarios, like file downloading and video streaming. [3]This paper uses online learning to improve the scheduler. The speed at which the network changes can surpass the learning speed achieved through online learning. Few data, like mobility, may not help finish training and get a good schedule policy.

3 Our Approach

The traditional schedule seems like greedy algorithm, it may fall into local optimality when it finds an efficient path in the past. However, such an efficient path may not always adapt to the dynamic network in the later time. Thus, we consider using MAB (Multi-armed bandits) as the core of learning. MAB is a simple but very powerful framework for algorithms that make decisions over time under uncertainty. It's a good way to face the trade-off between "exploitation" and "exploration" when we tried to find an efficient schedule algorithm.

3.1 Future Schedule

Tasks	Duration
Proposal and Website	Feb. 7
Problem Formulation	Feb. 8 - 21
Midterm Presentation	Feb. 22 - 28
Code Realization	Mar. 1 - 14
Simulation Experiment	Mar.15 - 28
final presentation	Mar.29 - Apr.4
project report	Apr. 5 - 15

3.2 Project Website

Our website could be found at `https://579project.wordpress.com/`.

References

[1] S. Ferlin, Ö. Alay, O. Mehani, and R. Boreli, "Blest: Blocking estimation-based mptcp scheduler for heterogeneous networks," in *2016 IFIP Networking Conference (IFIP Networking) and Workshops*. IEEE, 2016, pp. 431–439.

[2] X. Shi, L. Wang, F. Zhang, B. Zhou, and Z. Liu, "Pstream: Priority-based stream scheduling for heterogeneous paths in multipath-quic," in *2020 29th International Conference on Computer Communications and Networks (ICCCN)*. IEEE, 2020, pp. 1–8.

[3] H. Wu, Ö. Alay, A. Brunstrom, S. Ferlin, and G. Caso, "Peekaboo: Learning-based multipath scheduling for dynamic heterogeneous environments," *IEEE Journal on Selected Areas in Communications*, vol. 38, no. 10, pp. 2295–2310, 2020.