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Feasibility study on MPTCP ACK via alternative path in real network environment

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Improving network performance is a key for grid computing system consisting of computational resources and data sources. There have been studies about network performance between them such as file transfer schedulers and network protocols. MPTCP is one of network protocols which has the potential to improve network performance. This protocol treats one TCP flow as one subflow and handles two or more TCP flows as one MPTCP flow. If there are multiple network paths between machines, it can be expected high network performance by MPTCP. These days, cloud computing services such as Azure, AWS and GCP are popular for deploying system instead of adopting on-premises system. These providers have been deployed all over the world, and they have many computational resources and data storages in various regions. Therefore, it can be also expected to compose a high-performance computer system by clustering them using multiple network paths in various countries.

Morikoshi et al. proposed MPTCP with HayACK for the purpose of improving data transfer throughput when multiple network paths are available, whose RTTs are quite different. In original MPTCP, the sender transmits a data packet via a path and the receiver transmits ACK packet via the same path. In MPTCP with HayACK, the sender can select an appropriate path, regardless of which path the data packets came through. In that study, they simulated HayACK by comparing to original MPTCP. As a result, HayACK improved MPTCP throughput when RTTs of the paths are quite different.

However, there are concerns about using HayACK in real network environment. According to a study by Honda et al. in 2011, it was confirmed that 33% of packets had inconsistent sequence number and ACK number were discarded by middlebox which exists between a source and a destination. Middlebox includes various devices such as NAT (Network Address Translators) router and FW(Firewall). Middlebox not only relays packets, but also changes or discards the contents of packets for the purposes of improving performance, changing destination, or hardening security. When MPTCP with HayACK using an alternative subflow, HayACK returns MPTCP ACK without modification from receiver. Therefore, HayACK packets may be discarded by middlebox in the real network environment.

The purpose of this study is to support the usefulness of HayACK for high-performance network which has multiple paths. Particularly, we focus on how middlebox affect HayACK packets.

Our investigation conducted comprehensively via various network paths by preparing many IP address clients and one server. The influence from the middlebox is decided by checking probe packets passed through, changed or discarded. Assuming HayACK response, we crafted some packets such as TCP SYN packets and TCP ACK packets.

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