

Master thesis project: HTTP3 in cluster networking

Pod-to-pod communication in a Kubernetes-based cluster is realized via HTTP communication using the HTTP2 protocol (RFC7540). However, the HTTP landscape is evolving with the introduction of HTTP3. With HTTP3 (RFC9114) being standardized, the underlying transport protocol supporting HTTP will also change: While HTTP2 runs atop TCP, QUIC (RFC9000) will be the protocol underneath HTTP3¹. QUIC is an UDP based transport protocol implemented in user space adopting many features from TCP and improving several others. It is expected that with the features available in QUIC, such as faster connection establishment, handling the sensitivity to packet loss, connection migration or multi-streaming, HTTP3 will better handle head-of-line blocking and thus improve end-to-end latency. QUIC already makes a good portion of Internet traffic on both server and client sides, showing real latency benefits to end users^{2,3}. However, how will it play out in a different environment such as pod-to-pod communication in cluster networking?

This master thesis project involves replacing the HTTP2 stack in a Openshift cluster by HTTP3 and evaluating its characteristics with a set of already existing tools at Red Hat when it comes to performance and scalability tests.

The scope of the thesis can be adjusted according to the student's abilities and interests, but is as a starting point expected to involve the following:

- Involvement in the Kubernetes open source community;
- Selection and discussion around a HTTP3 stack;
- Identify API endpoints in Kubernetes and how to replace the stack for communication of both control- and data-plane operations;

A significant part of the project will involve testing and validation of the implementation as well as performance testing and comparison with a HTTP2 based cluster as baseline.

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¹ <https://github.com/kubernetes/kubernetes/issues/106864>

² <https://blog.apnic.net/2022/07/11/a-look-at-quic-use/>

³ <https://blog.apnic.net/2022/09/07/a-second-look-at-quic-use/>