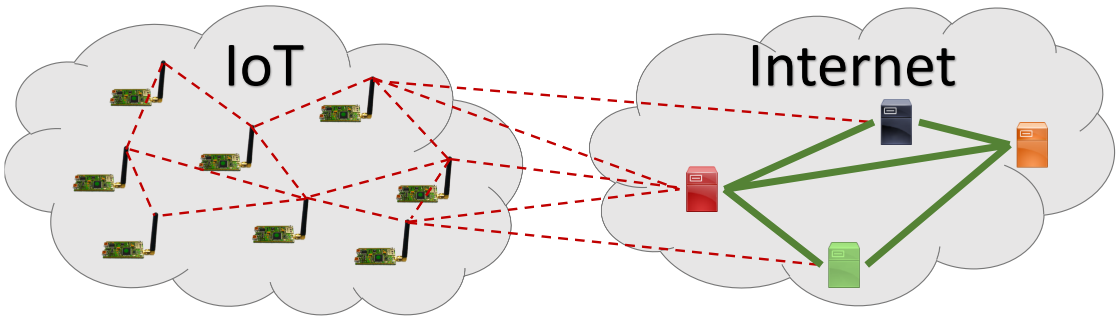
Master Thesis
Making CoAP QUIC: High Throughput and Low Latency Communication Using CoAP



While HTTP is the dominant protocol in the Internet, CoAP is the best choice for the IoT
The Constrained Application Protocol (CoAP) [1] brings the core concepts of the Web to the IoT: Features like the proven request/response model used in HTTP as well as URIs, methods and status codes are adopted. This allows transparent communication between web services and IoT devices by employing cross protocol proxies.
The HTTP/TCP stack [2, 3, 4] has been developed with potent computers in mind and recently received a major upgrade with the HTTP3/QUIC stack, that has been written with low latency and high throughput as explicit design goals. CoAP on the other hand is written with the most constrained devices in mind. As a result, CoAP's congestion control strictly prefers simplicity and low resource requirements over performance. In many IoT scenarios latency and throughput requirements are minimal, making CoAP an excellent choice for them. Other IoT scenarios like IP-Cameras, smart speakers, or robots can greatly profit from low latency. The goal of this thesis is to figure out whether using QUIC [6] to transport CoAP enables its use for performance demanding use cases.

Required Skills

- Python programming experience
- Network programming experience
- Ideally having attended one of the ComSys software projects

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Goals of the Thesis

- Discuss the Herrero's analysis [5] of using QUIC to transport CoAP [1]
- Extend the CoAP library `aiocoap` to support QUIC
  - `aiocoap` already supports[1] alternative transports, e.g. TCP [4]
  - The TCP transport should be a good starting point to integrate QUIC support as well
- Experimentally evaluate the performance of CoAP depending on the transport used
  - Consider the following transports: the default UDP transport, TCP, and QUIC
  - Consider at least the following metrics: latency, throughput, overhead, and packet loss

References

[1] **Z. Shelby, K. Hartke, C. Bormann**. The Constrained Application Protocol (CoAP). `https://tools.ietf.org/html/rfc7252`

[2] **R. Fielding, J. Reschke**. Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing. `https://tools.ietf.org/html/rfc7230`

[3] **R. Fielding, J. Reschke**. Hypertext Transfer Protocol (HTTP/1.1): Information Sciences Institute. `https://tools.ietf.org/html/rfc7231`

[4] **Information Sciences Institute, University of Southern California**. Transmission Control Protocol. `https://tools.ietf.org/html/rfc793`

[5] **Rolando Herrero**. Analysis of QUIC Transported CoAP. `https://doi.org/10.1007/s42979-021-00468-0`

[6] **J. Iyengar, Ed., M. Thomson, Ed.**. QUIC: A UDP-Based Multiplexed and Secure Transport. `https://tools.ietf.org/html/draft-ietf-quic-transport-34`

[1] `https://aiocoap.readthedocs.io/en/latest/module/aiocoap.transports.tcp.html`

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