Master Thesis Project Description

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Temporary Title

DNS-Based Traffic Steering for IPv6 Enabled Edge Microservices

Temporary Thesis Statement

This thesis investigates whether DNS-based traffic steering combined with direct IPv6 addressing of microservices can function as a viable alternative to traditional Layer 7 ingress proxies and service meshes. This work includes both a systematization of existing solutions to proxy scalability, and an experimental evaluation comparing the Layer 7 based traffic steering with different configurations of DNS-based traffic steering.

Methodology

We will analyze the problem of proxy scalability and look at the principal approaches to proxy based traffic steering. This includes Layer 7 proxies, service meshes and client-side load balancing. The goal is to identify common design patterns and tradeoffs in these systems. This will allow us to identify the criteria best suited to comparing these systems with each other and with our DNS-based approach. This systematization of knowledge will assist in choosing paradigms to test.

We will design and implement a minimal DNS-server tailored to function as a Kubernetes ingress controller. Because each pod is assigned its own globally routable IPv6 address, the proposed design removes the need for all Layer 7 ingress proxies, performing traffic steering only through DNS. The DNS-server will be tailored for efficient traffic steering based on pod metrics. We will create dummy microservices and client simulators. Implement best practice configurations for our selected baseline paradigms. The number of pods will remain constant while the number of simulated clients will vary. Metrics like RTT, throughput, CPU utilization and failover behavior after simulated node and pod crashes will be analyzed and compared between the different paradigms.

Progress Plan and Milestones

Spring 2026

- Systematization of knowledge and literature study
- Write and submit mandatory essay on the state of proxy scalability and the tradeoffs involved
- Restructure essay into a draft of systematization of knowledge
- Start development of DNS server

Autumn 2026

- Finish development of DNS server
  The DNS server is now finished, and we can start working on the custom ingress controller to enable dynamic traffic steering based on pod metrics.
- Implement client simulator and dummy microservices
  Now we can start building our cluster around the dummy microservices and client simulators, which will be used to simulate a realistic distributed system to test the different paradigms.
- Select baseline paradigms
- Start developing the experiments
  We will use what we have learned from the systematization of knowledge and work so far to select a set of baseline paradigms.
- Begin writing thesis background and methodology chapters

Spring 2027

- Perform the experiments
  The baseline experiments are now finished and we can start collecting results.
- Analyze the results
- Write article on DNS-based traffic steering incorporating results from the experiments
- Finish master thesis by incorporating the findings

Relevant Curriculum

AUTUMN25 - IN4070 - Logic - 10 ECTS
AUTUMN25 - IN5020 - Distributed Systems - 10 ECTS
AUTUMN25 - IN5060 - Quantitative Performance Analysis - 10 ECTS
AUTUMN25 - IN5060 - Recent Advancements in Internet Protocols - 10 ECTS
SPRING26 - IN4000 – Operating Systems - 20 ECTS
AUTUMN26 - IN5031 - Protocols and AI for Future Internet - 10 ECTS