Reducing cold start delays in FaaS and Serverless Environments

UG Ljubljana

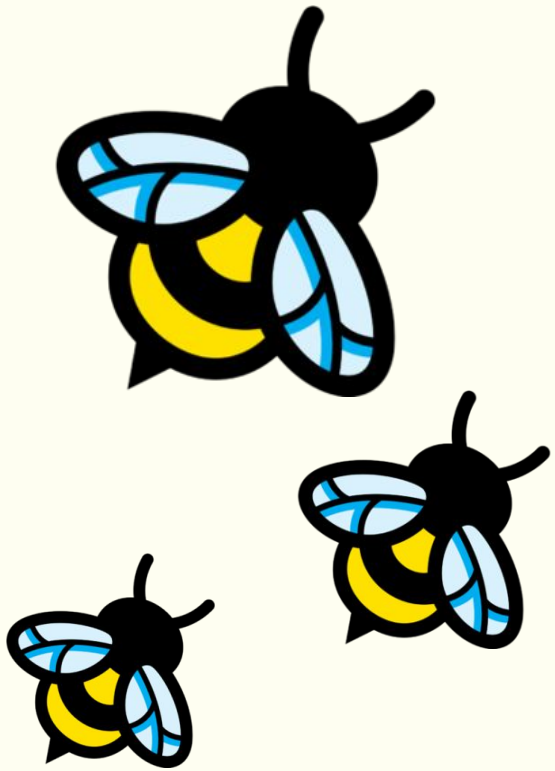
About me

- I'm **Teodor J. Podobnik** from Slovenia 🇸🇮
- **SRE** at Prewave
- **Researcher** at Faculty of Computer Science and Information Science, University of Ljubljana
- **Author** of eBPFChirp

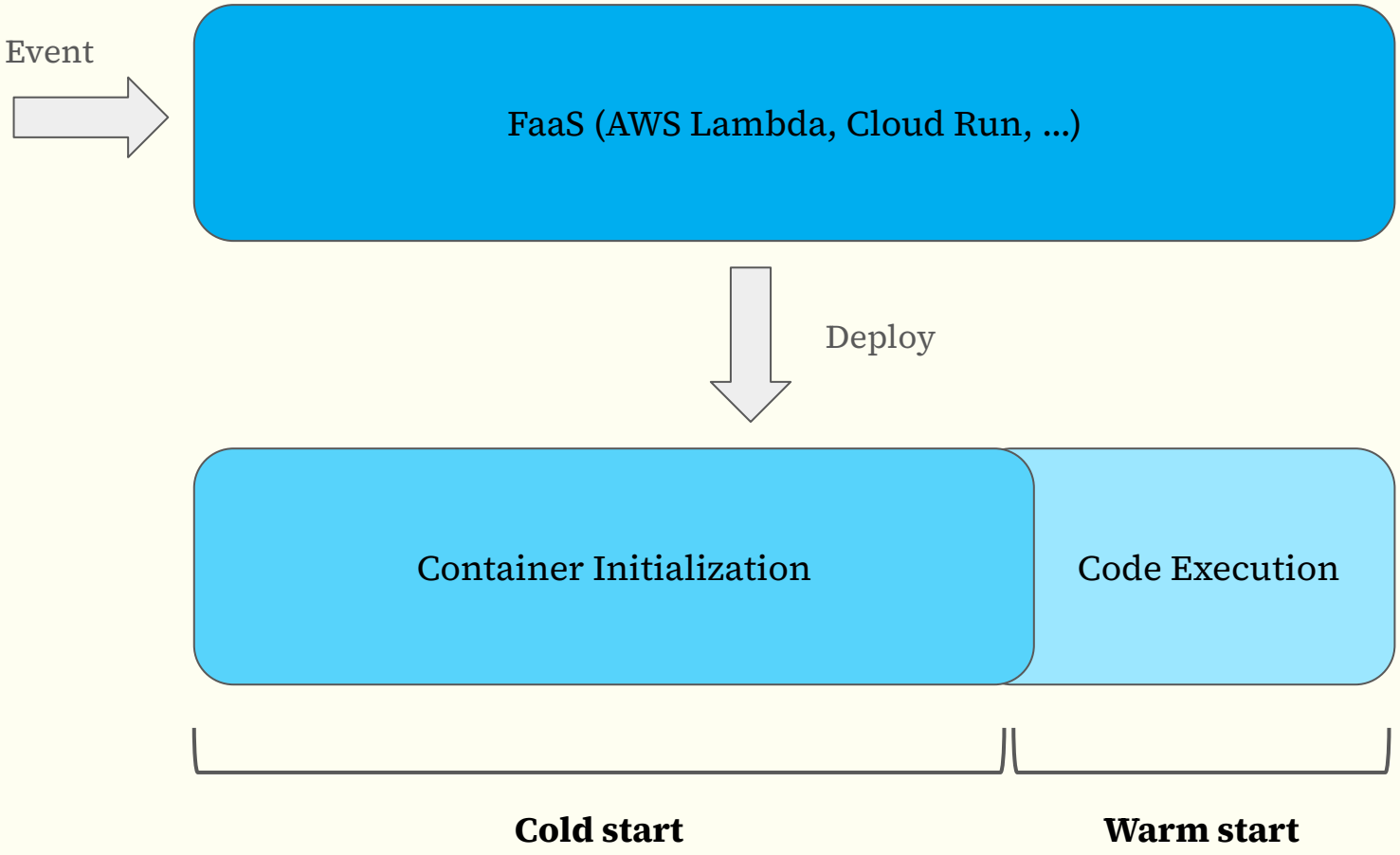
https://www.prewave.com
https://fri.uni-lj.si
https://ebpfchirp.substack.com

eBPF in Short

- Runs Directly in the Kernel
- Dynamically Attached at Runtime
- Minimal CPU Overhead
- Independent of User-Space Applications
- Use Cases:
  - Cloudflare: DDoS Protection
  - Meta: Load Balancing
  - Netflix: Net. Traffic Observability Enrichment



The Problem of cold start delays



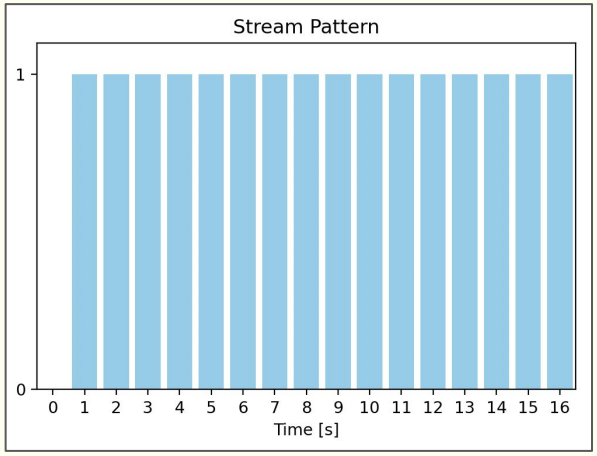
Cost vs. Latency

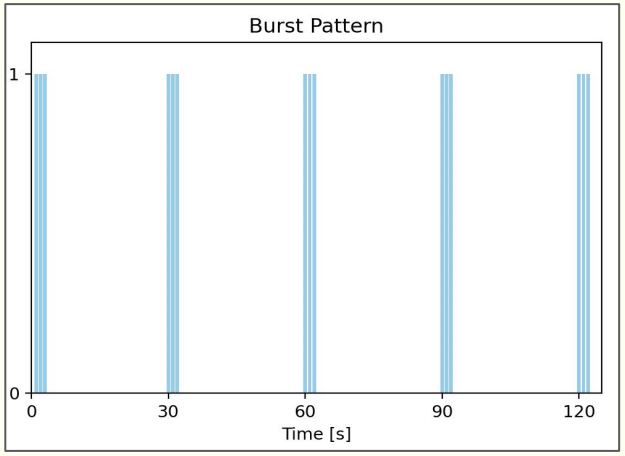
Real-time data analytics

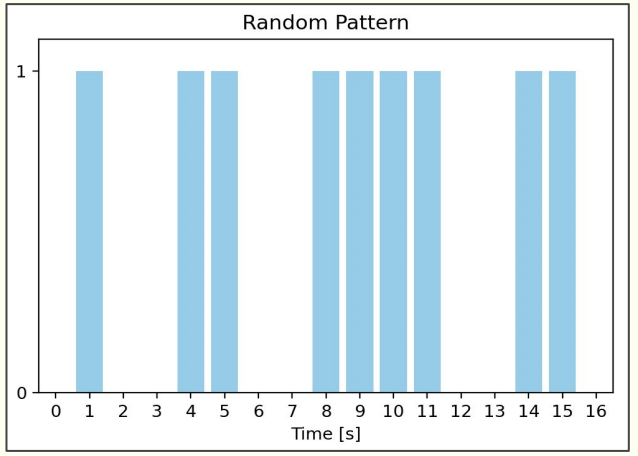
Image or video transcoding

Web API endpoints

Demand

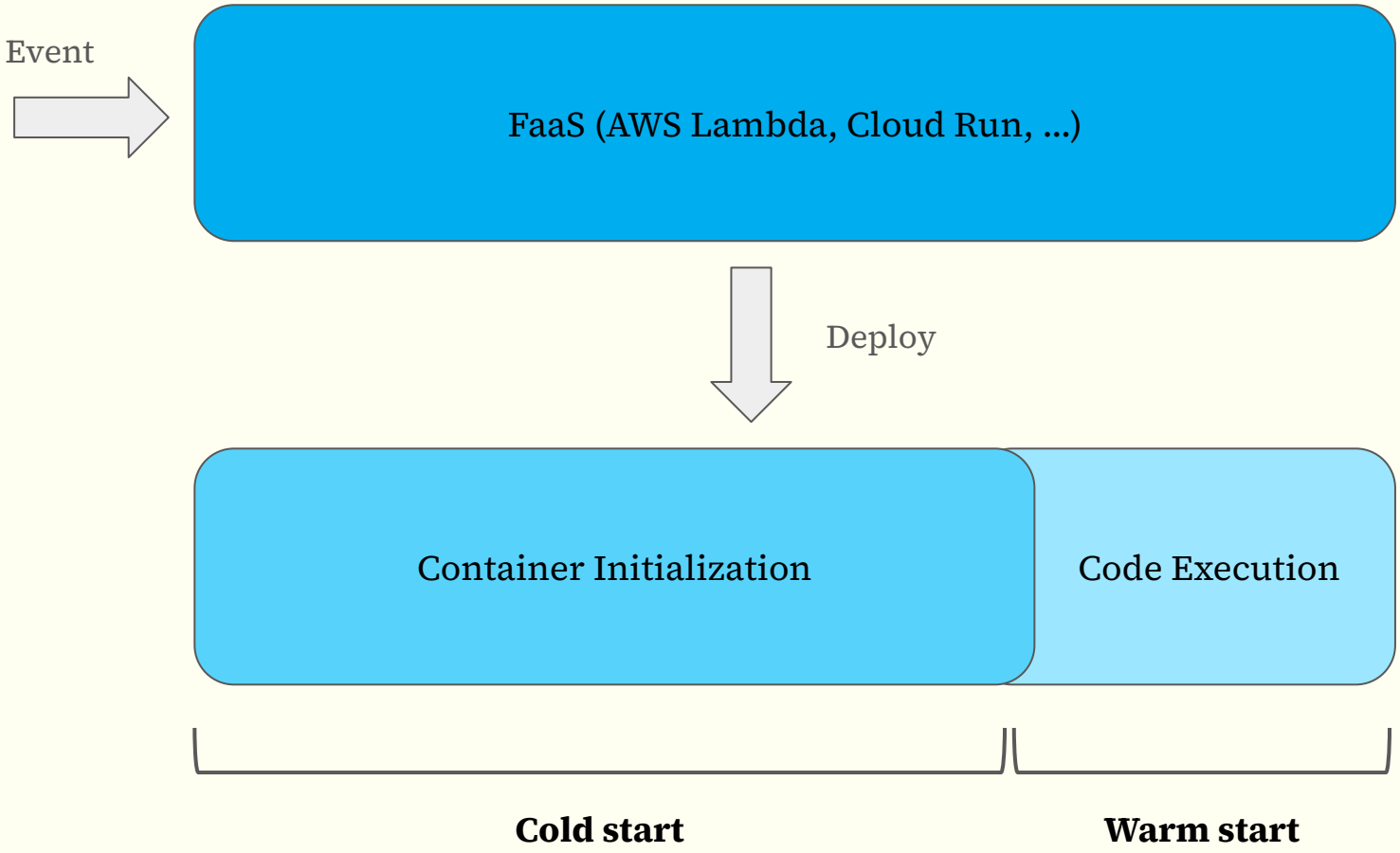


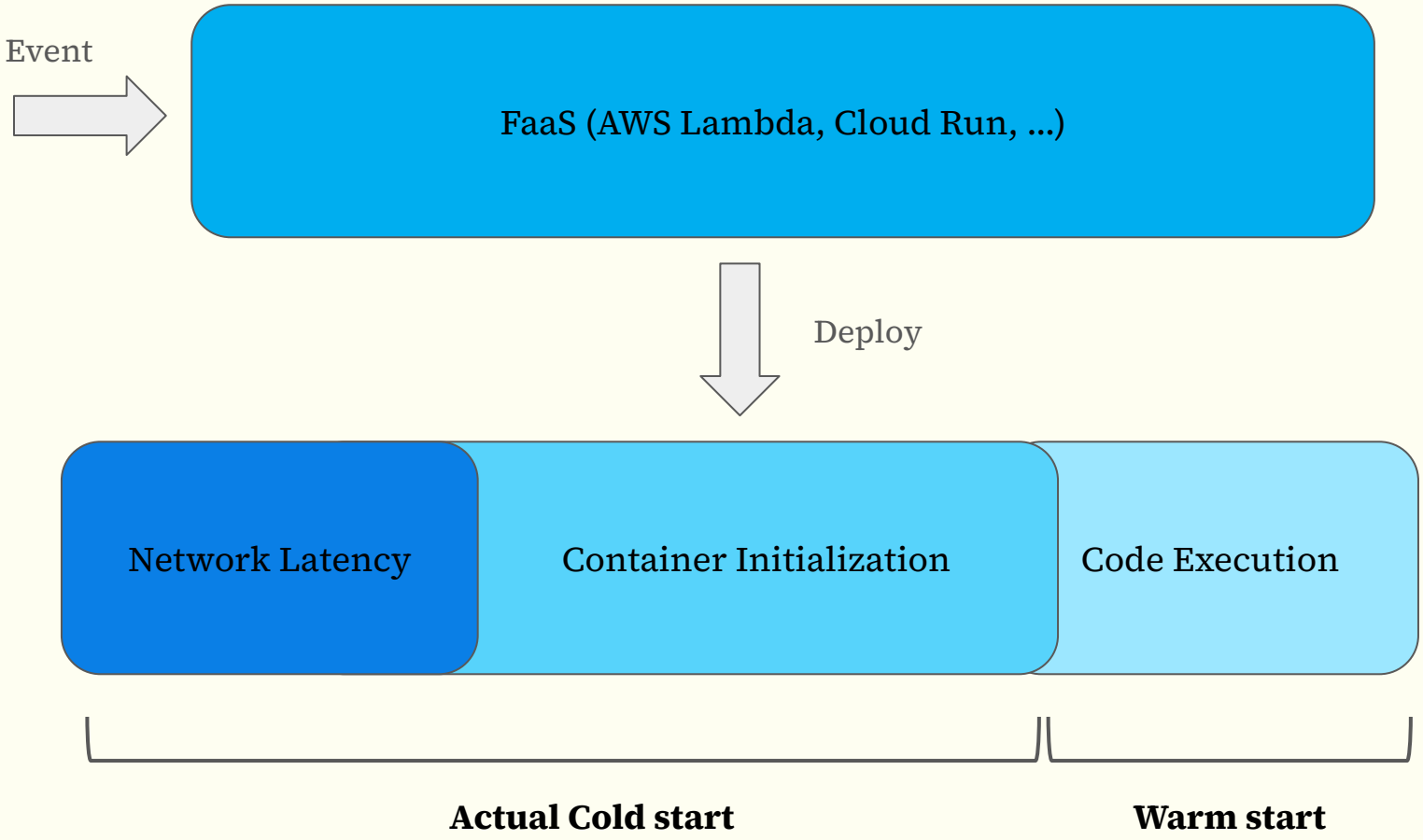


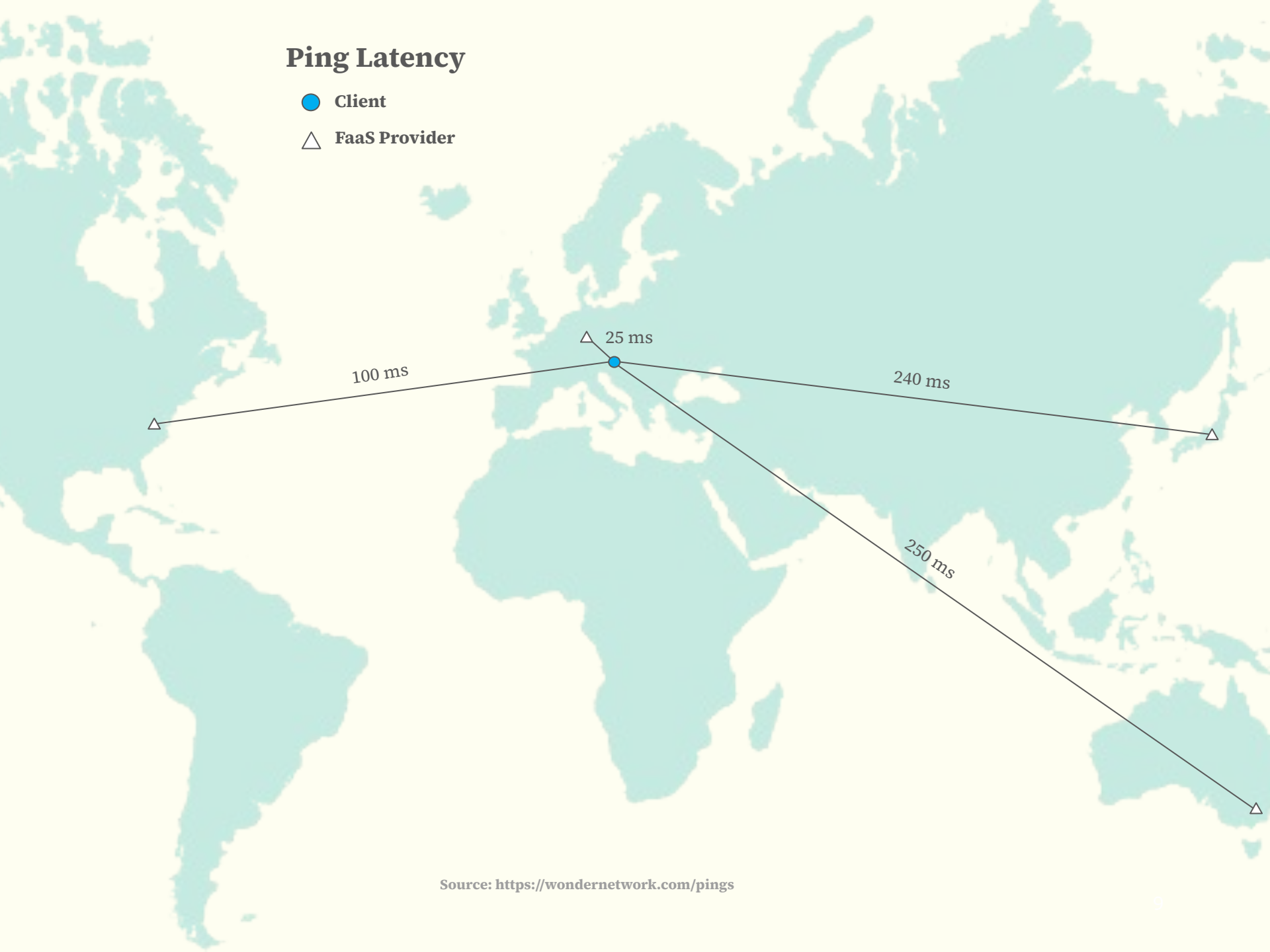


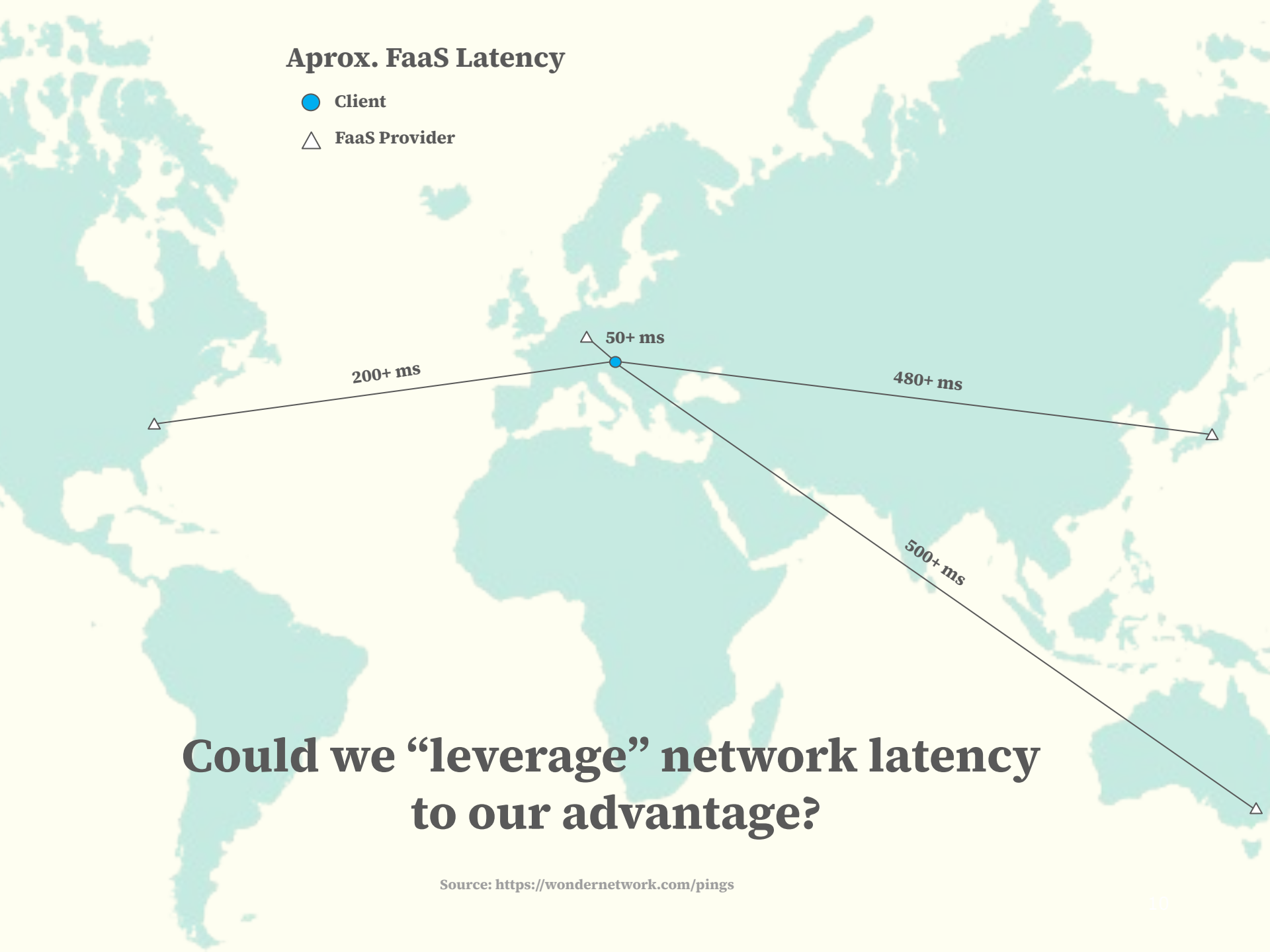
Constant demand, no cold starts

Predictable demand, no cold starts


Event
FaaS (AWS Lambda, Cloud Run, ...)
Deploy
Container Initialization
Code Execution
Cold start
Warm start


Event
FaaS (AWS Lambda, Cloud Run, ...)
Deploy
Network Latency
Container Initialization
Code Execution
Actual Cold start
Warm start


Ping Latency
Client
FaaS Provider
25 ms
100 ms
240 ms
250 ms
Source: https://wondernetwork.com/pings

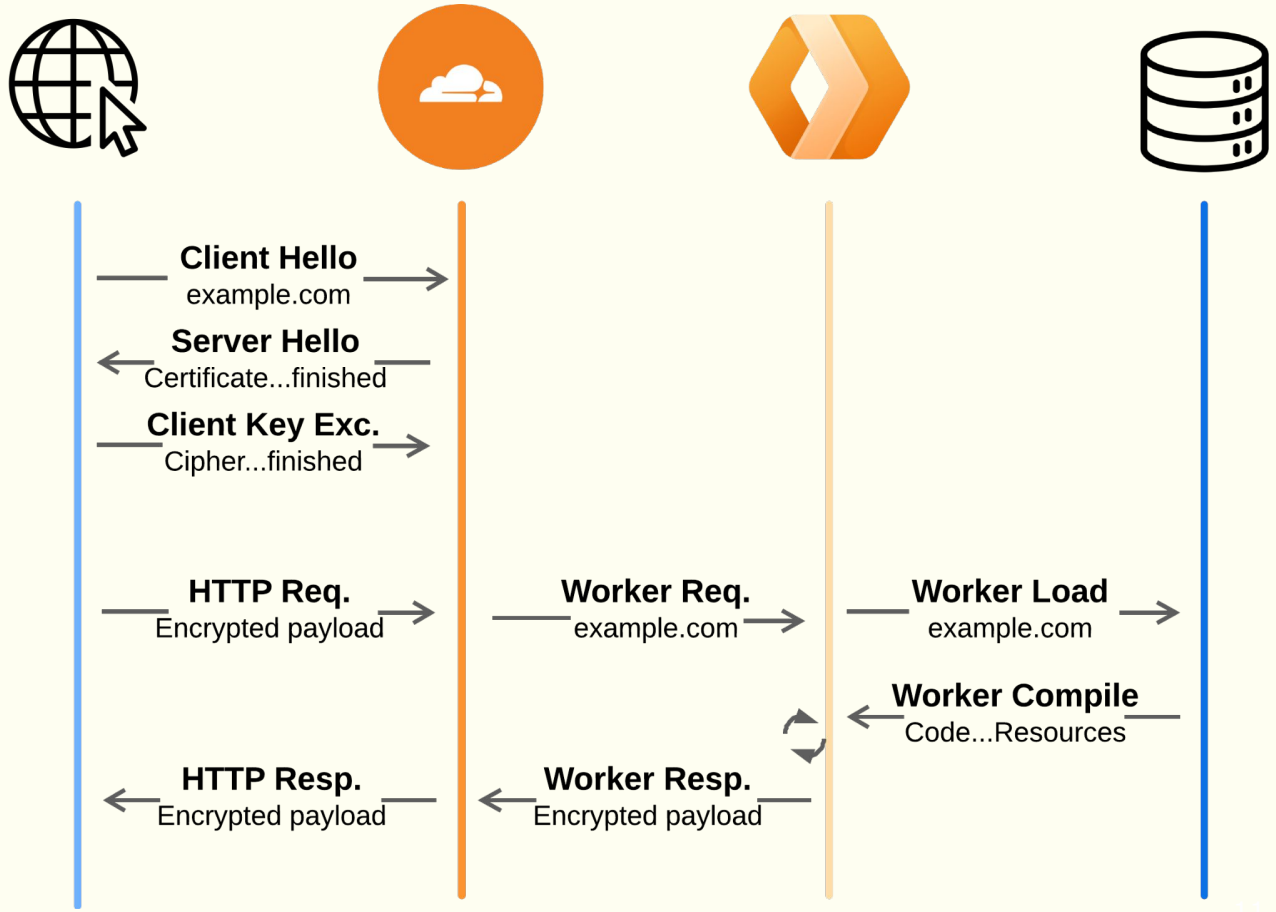


Could we “leverage” network latency to our advantage?

Source: https://wondernetwork.com/pings

Cloudflare Solution

- “Pre-warming” during TLS handshake -> hostname from SNI
- CloudFlare Workers (NOT containers!)
- Not open-source



Source: https://blog.cloudflare.com/eliminating-cold-starts-with-cloudflare-workers/

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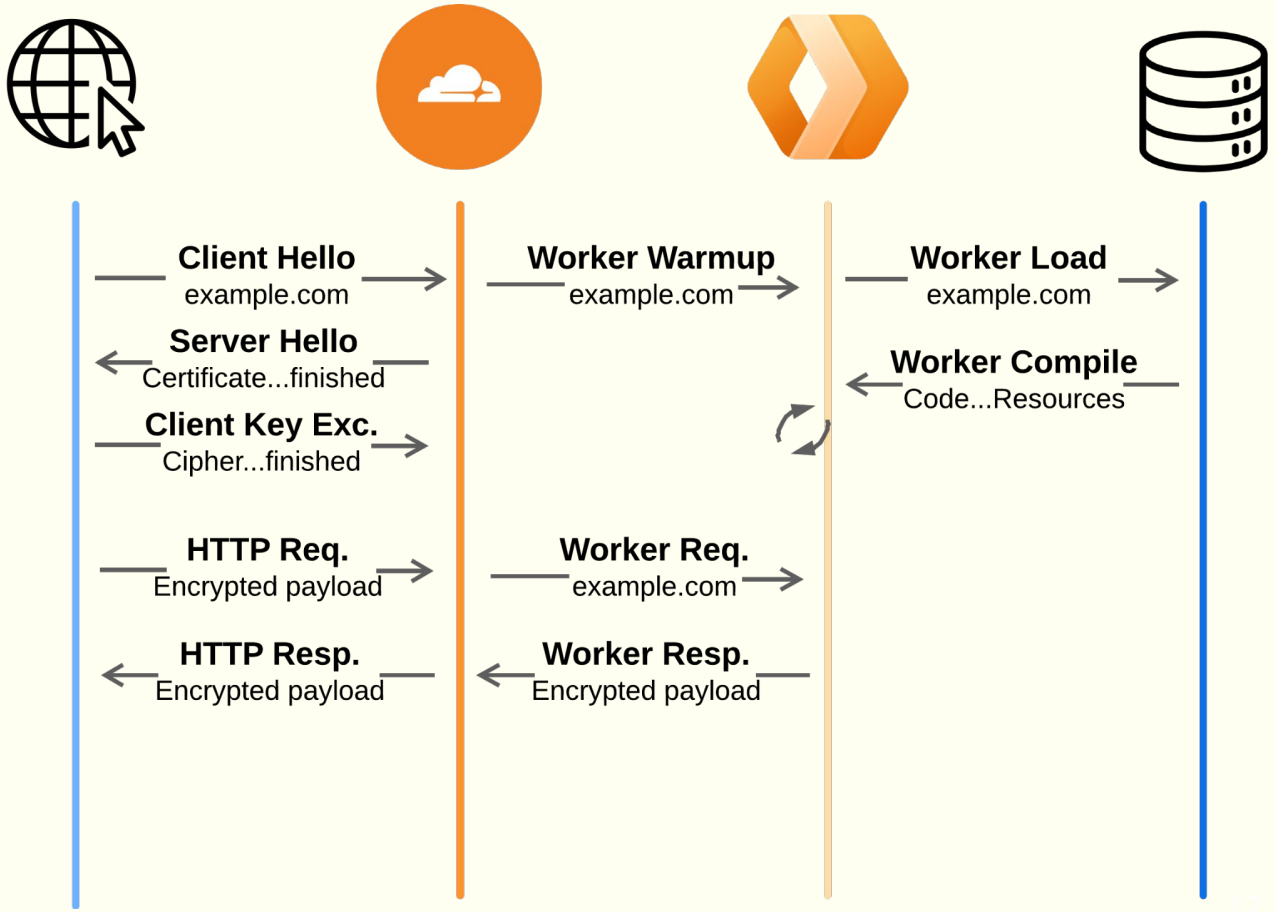

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eBPF Solution

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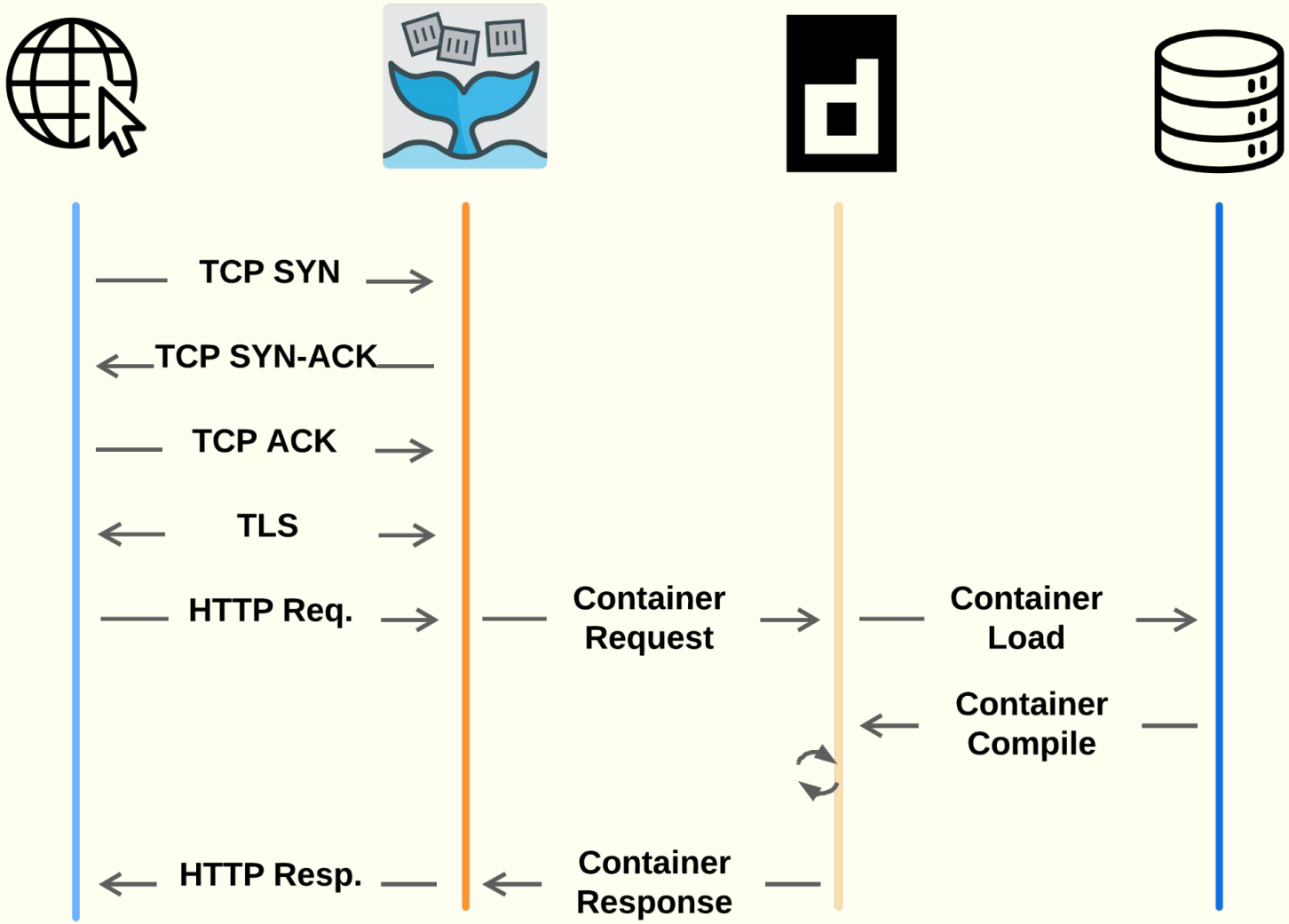
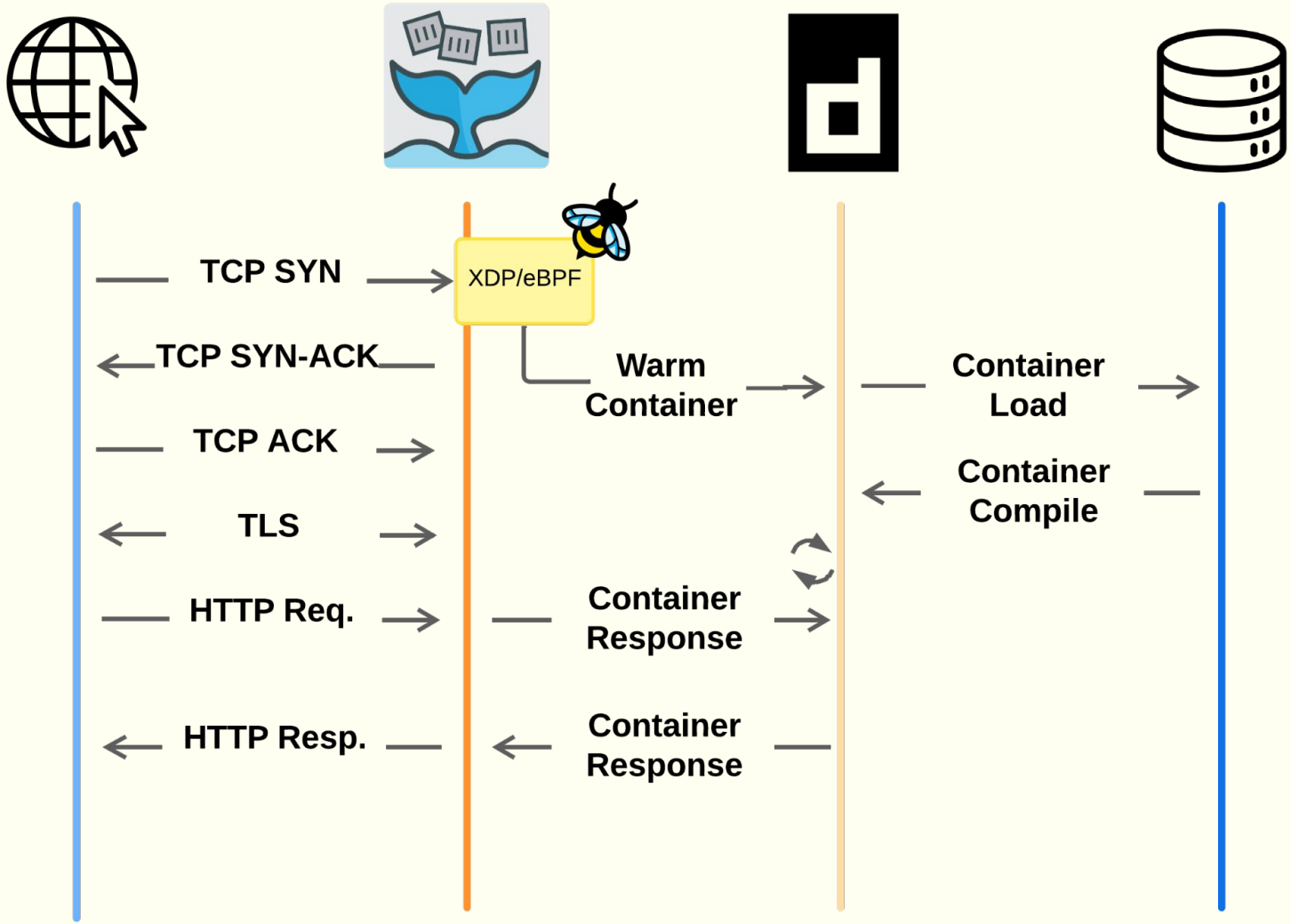
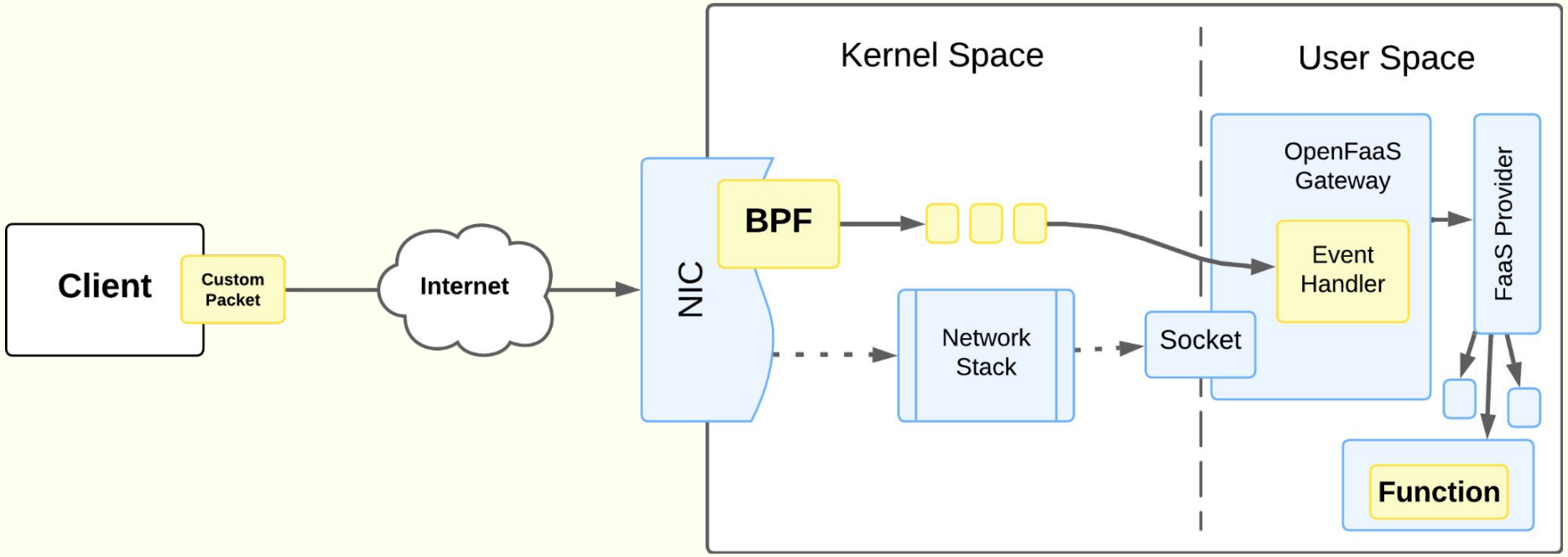


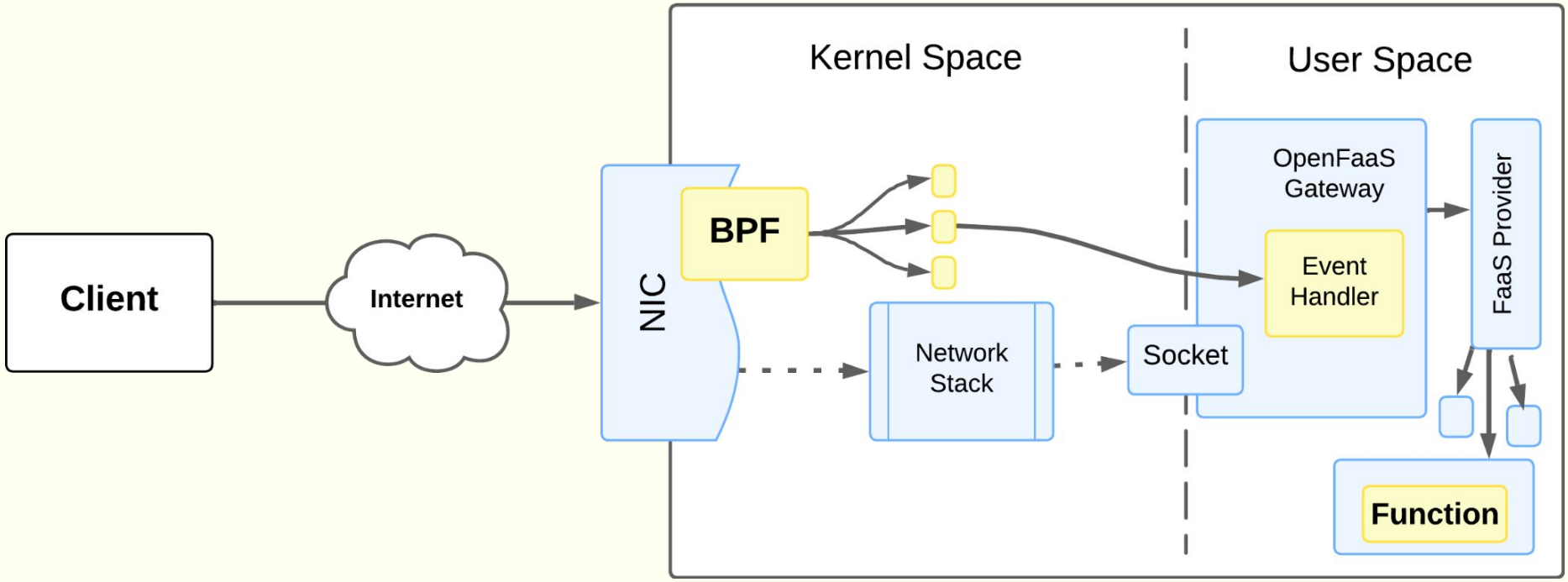
eBPF Solution



TCP Packet Custom Payload



FaaS Function per TCP Port

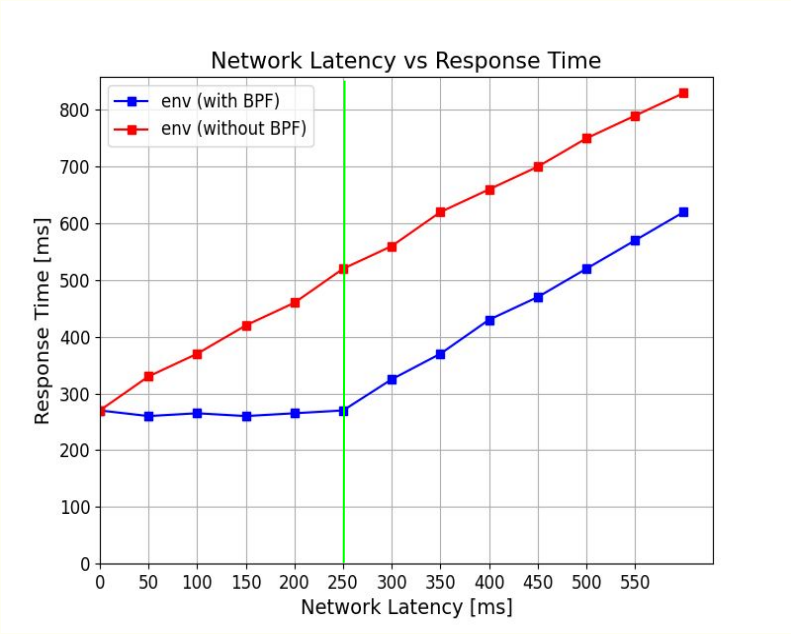


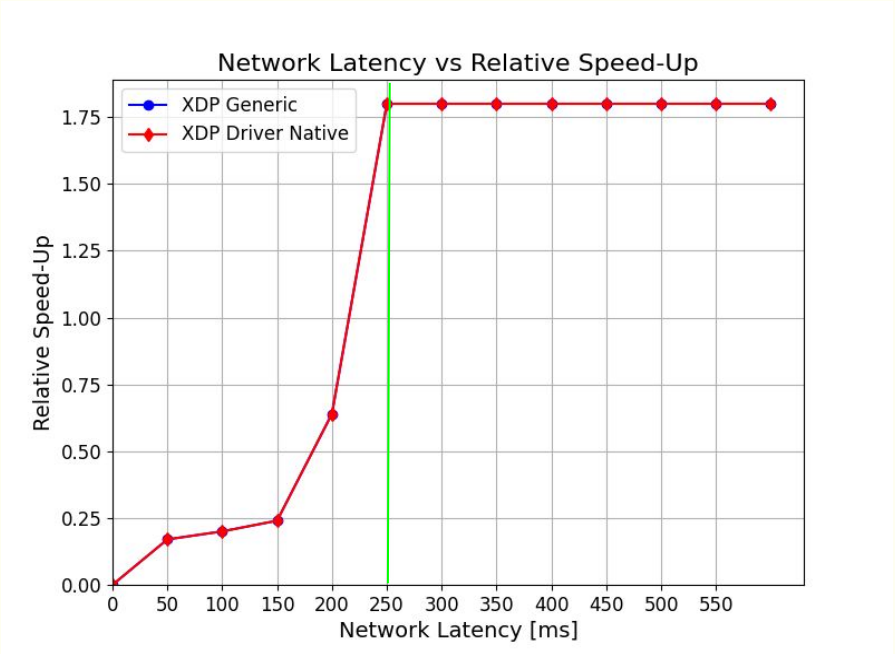
Results

- Optimal Speed-Up:

Acc. Network latency >= Container initialization time

- Container “warm start” is the limit





Q&A