Graphion

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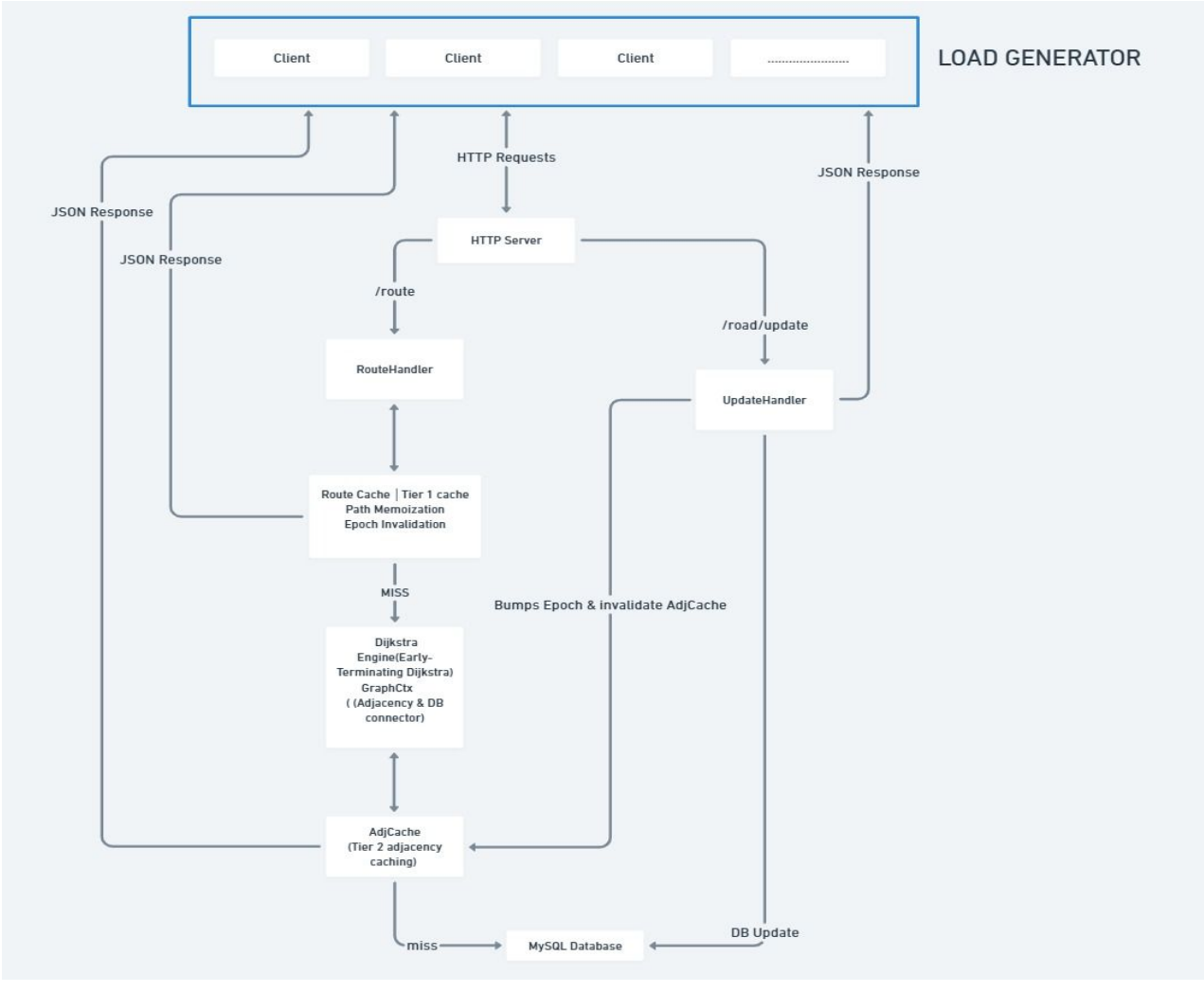
System Architecture



System Overview

Graphion follows a three-tier architecture:

1. Client Tier (Load Generator)
2. Server Tier (HTTP Routing + (Route Cache + Adjacency Cache) + Algorithms)
3. Database Tier (MySQL Graph Storage)

Development Process

1. **Load Generation:** Built a high-concurrency Go-based load generator to stress-test the system with configurable workloads.
2. **Route Cache:** Added a fast in-memory cache to store previously computed routes and reduce repeated processing.
3. **Dijkstra Engine (Early-Stopping):** Implemented an optimized Dijkstra algorithm that stops once the target node is reached, improving performance.
4. **Adjacency Cache for Dijkstra:** Cached adjacency lists to avoid repeated graph lookups and accelerate shortest-path computations.
5. **Server in Go (net/http):** Developed the backend service using Go's high-performance `net/http` package for low-latency request handling.
6. **MySQL Backend:** Used MySQL as the persistent datastore to ensure durability and reliable storage of route and graph data.
7. **REST API:** Exposed all system functionality through clean REST endpoints for easy integration and testing.

Load Generator

- **Closed-Loop Route Load Generator** : Continuously sends /route requests using a closed-loop model, scaling the number of concurrent clients. Measures average latency and throughput. Pure read-only, CPU/cache-bound workload.

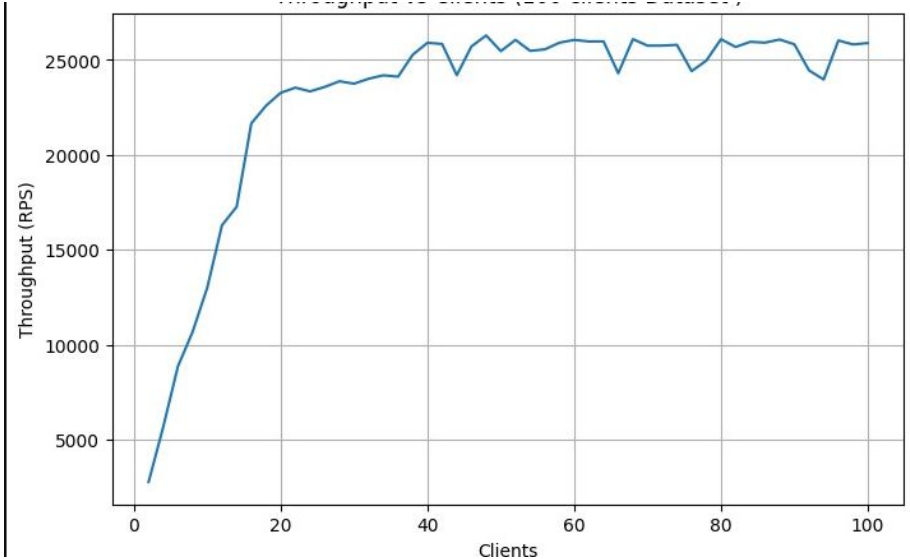
- **DB-Bound Write Load Generator** : Fetches random edges from MySQL, then issues /road/update writes (speed or closed updates). Measures latency percentiles, throughput, and error rates. Represents a heavy database-dependent write workload.

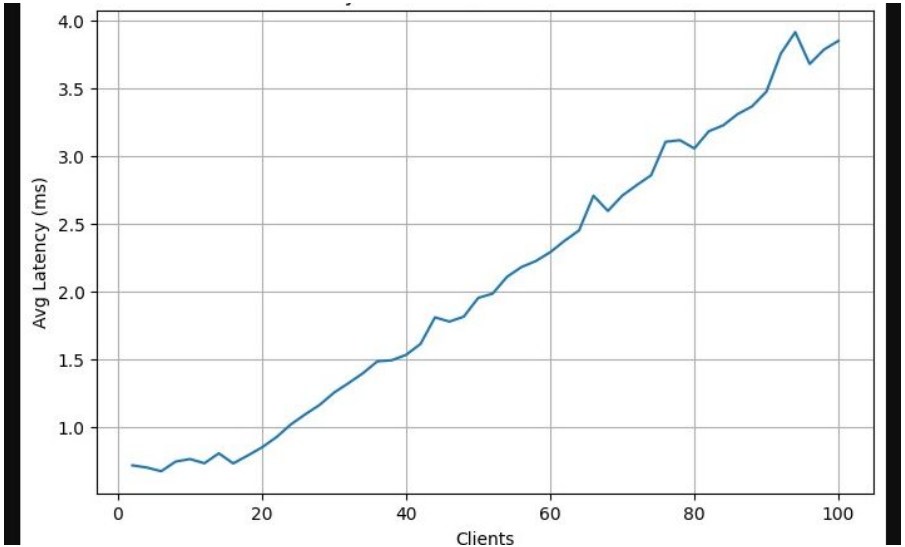
- **Mixed Read/Write Load Generator (80/20)** : Generates traffic with an 80/20 split between /route reads and /road/update writes. Simulates realistic production-like mixed read/write behavior, tracking latency and throughput.

Load Test Setup

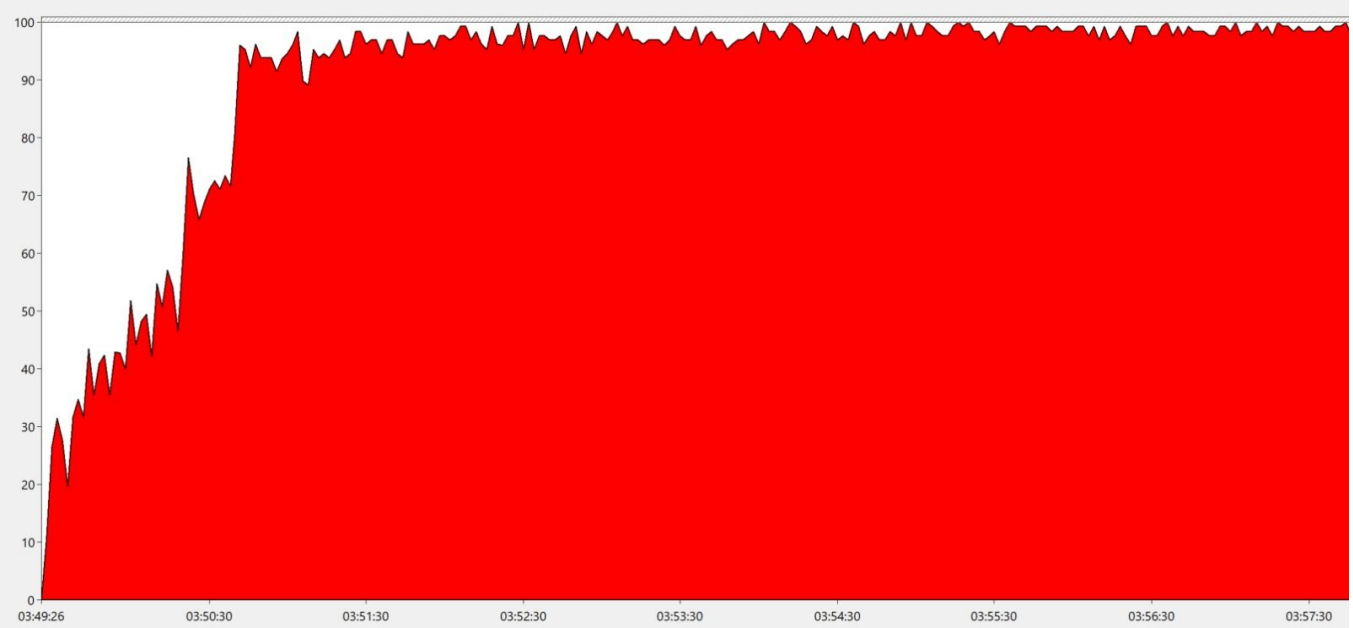
- Server pinned to CPU cores 12
- Load generator pinned to cores 13-15
- Metrics: throughput, latency, rps , P99

Workload : Cache Hit Heavy (CPU Bound)

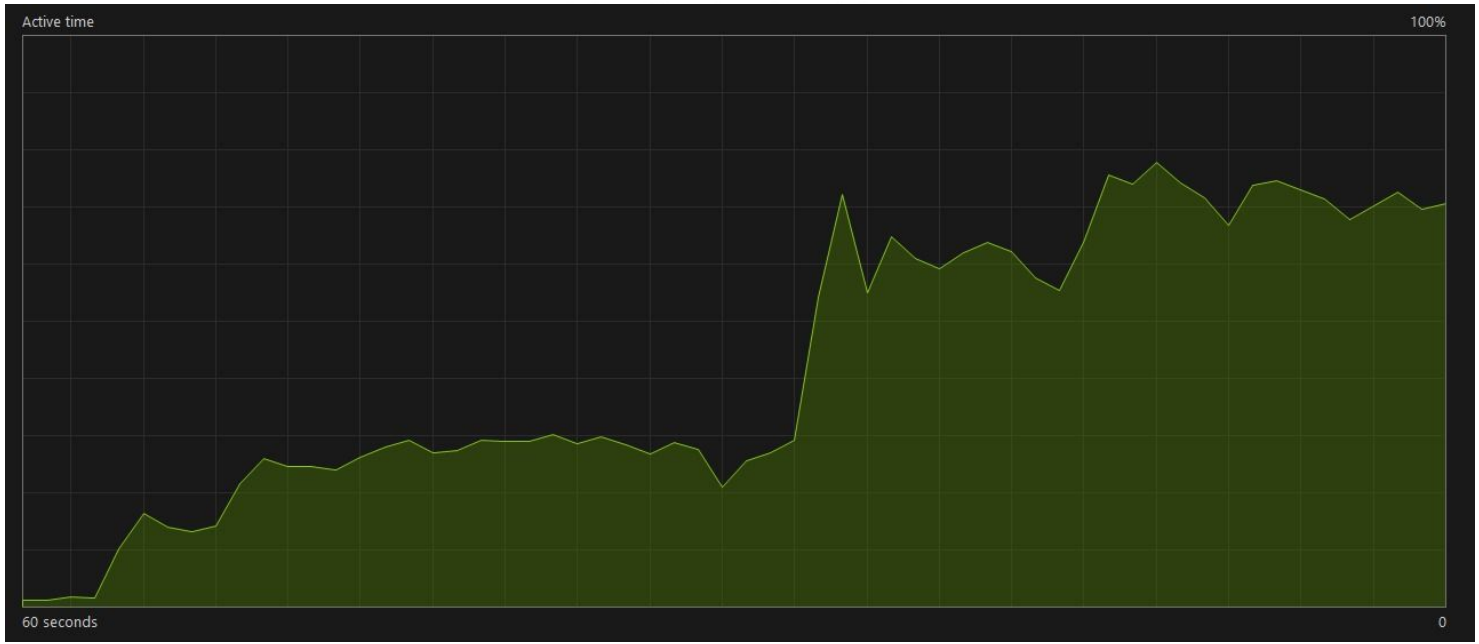




Workload : Cache Hit Heavy (CPU Utilization)



Workload : DB-bound writes (Disk Utilization)



Workload : DB-bound writes