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Welcome to the SustAinimal digitalization seminar no 1: Next-generation livestock farming with virtual fencing

Geofencing

FenceX: High throughput scalable geofencing framework

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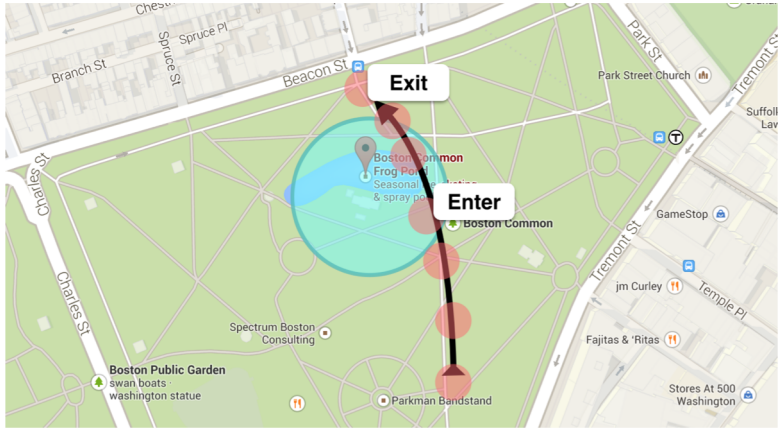
What is Geofencing?

- Geofencing uses the global positioning system (GPS) and/or radio frequency identification (RFID) to create a virtual geographic boundary around a particular area

- Possible use cases:
  - Elderly care system
  - Online taxi booking



  - **Monitor the behaviour of grazing animals**

- It is also know as High-tech animal tracking technique

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Types of Geofencing

- On-demand geofencing
  - Administrators can set new fences based on different needs
  - Example, farmer needs to set a new area for grazing
- Real-time geofencing
  - Fences automatically get created based on different requirements
  - Example: Online taxi booking system

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Pros and Cons of Geofencing

- Pros
  - Effective animal tracking for outdoor grazing
  - Accurate data collection based on the animals in forests
  - Reliable interaction traces between animals. Such datasets are helpful to study disease spreads or social interaction between animals
- Cons
  - Highly dependent on the sensor technology
  - Change of batteries can be a serious challenge
  - Security threats
  - Good communication is required

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FenceX Framework

- FenceX is an open source software framework for geofencing based on GPS based coordinate system
- It is a data stream processing framework to handle a large number of events in real-time
- The aim is to design a highly scalable, resilient and efficient software framework for geofencing

https://github.com/bmd007/statefull-geofencing-faas

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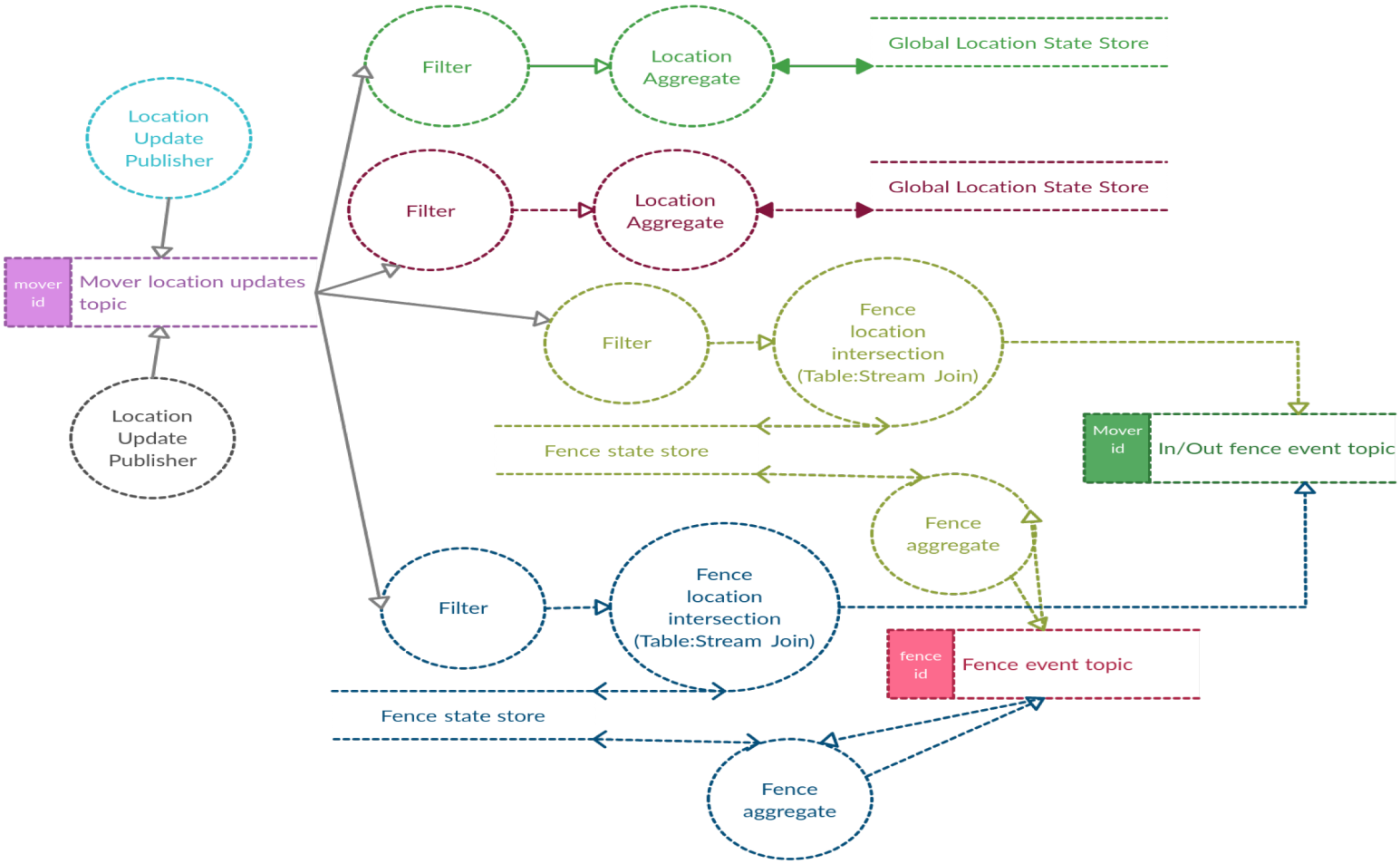
FenceX Architecture



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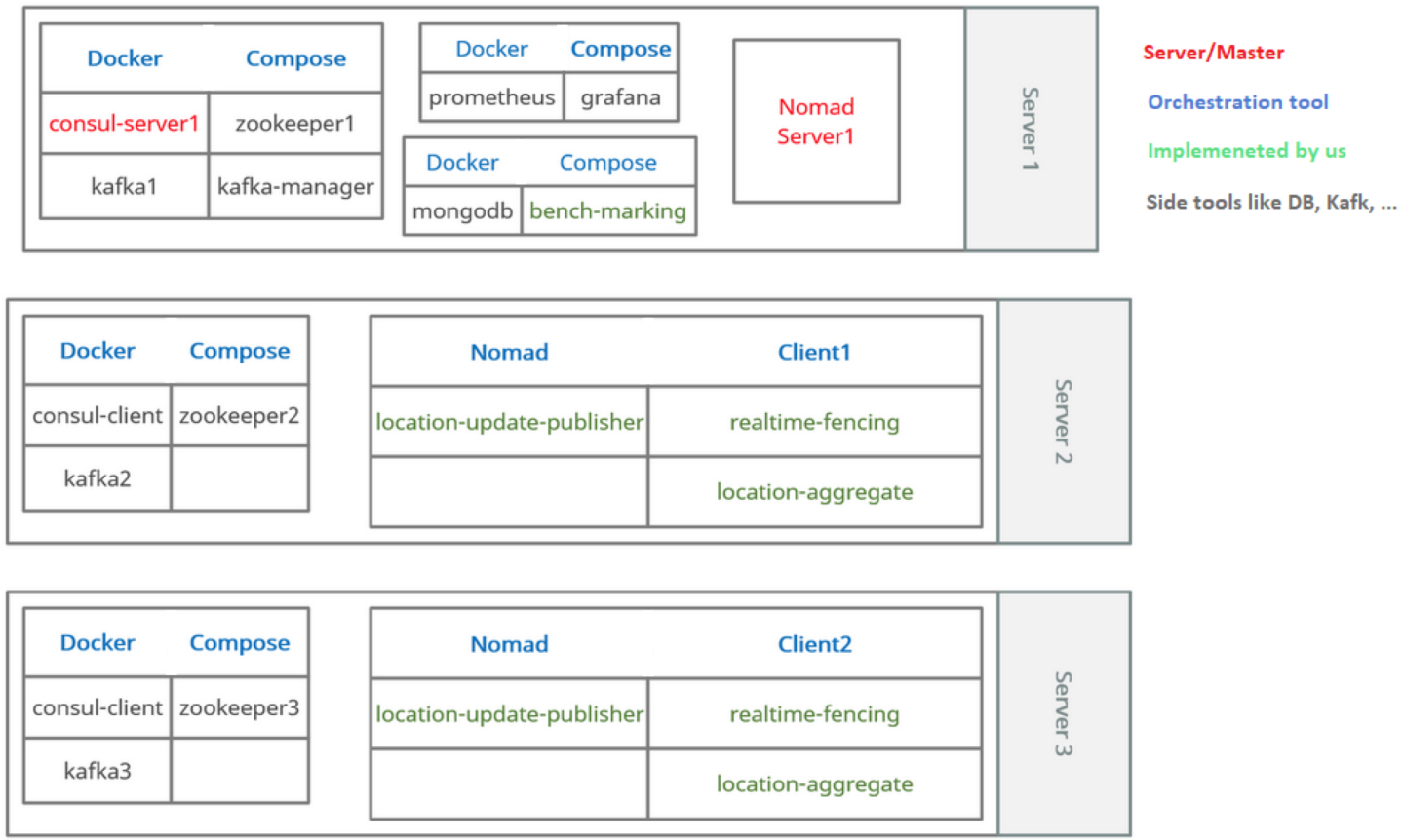
Deployment Settings

- 4 xlarge Snic cloud VMs
- +3Gbps bandwidth
- 16GB of RAM for workers
- +16GB of RAM



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Framework Evaluation

- Throughput

- Availability

- Scalability

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Throughput

System's ability to successfully run the operations and transfer data from one location to another in a given time.

Features	Input	Throughput
Push	Location update report	Number of fence-point intersections /sec
Pull	Query by fence request	Number of successfully answered queries /sec

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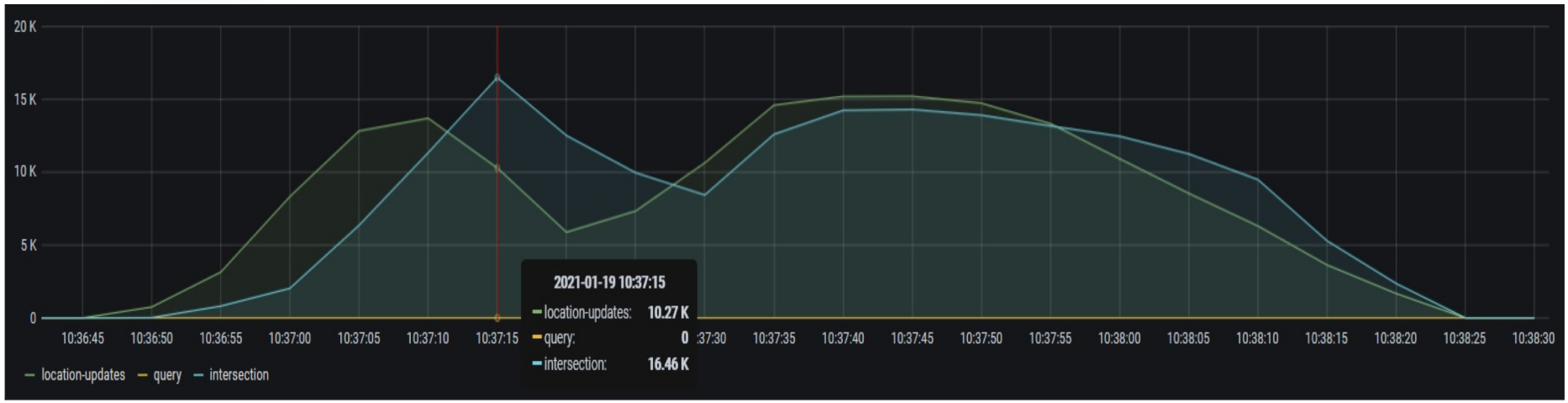
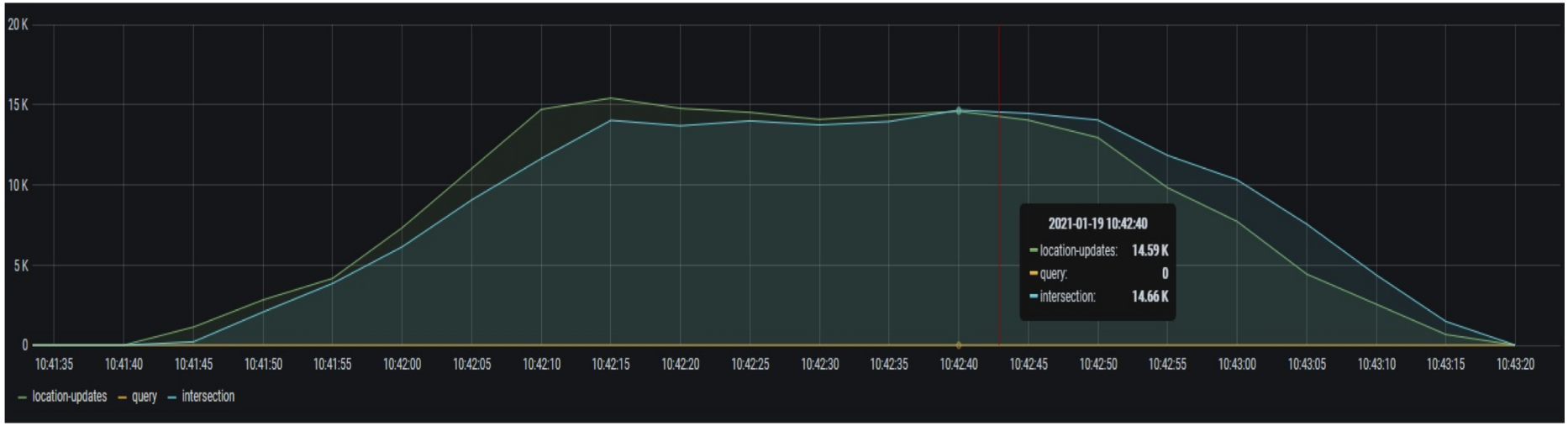
Throughput Push case





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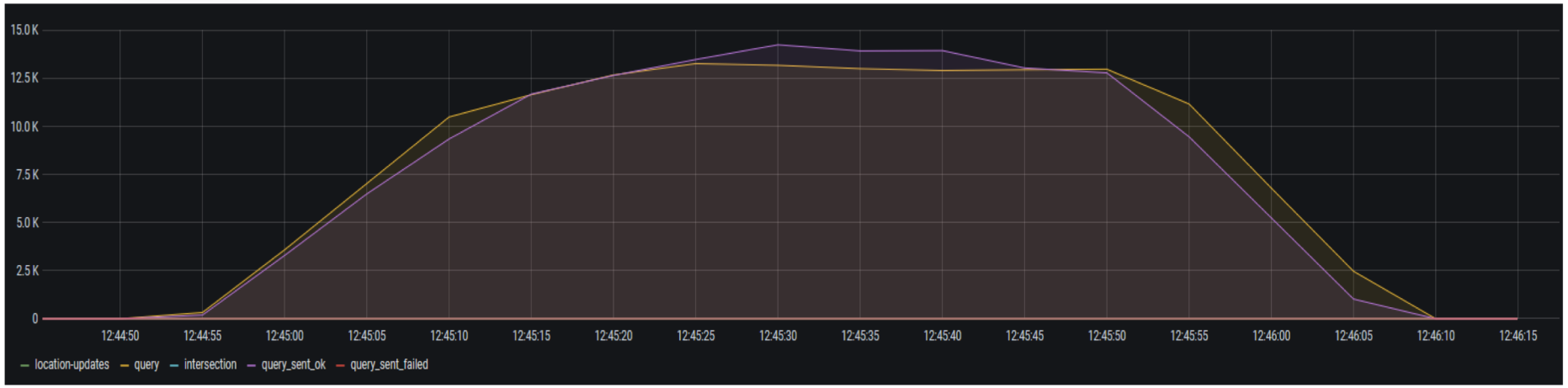
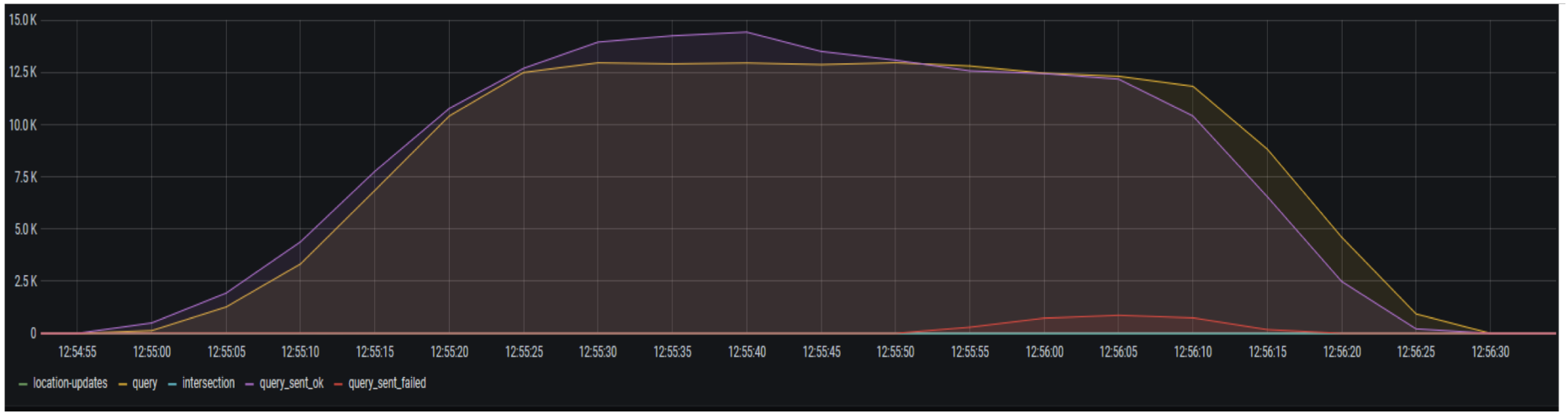
Throughput Pull case





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Availability

The probability that the system does not experience many failures in a given time.

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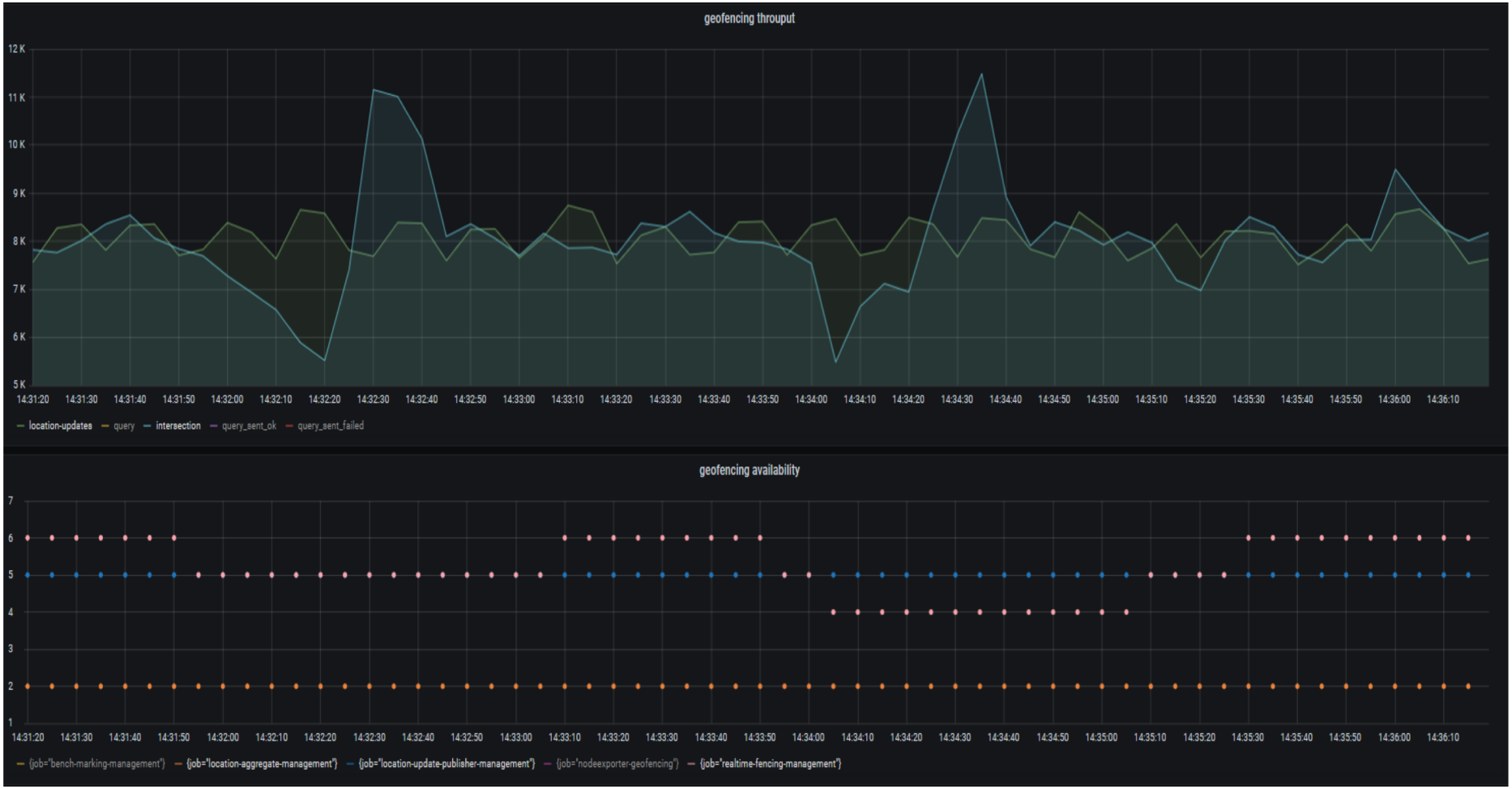
Availability Push case



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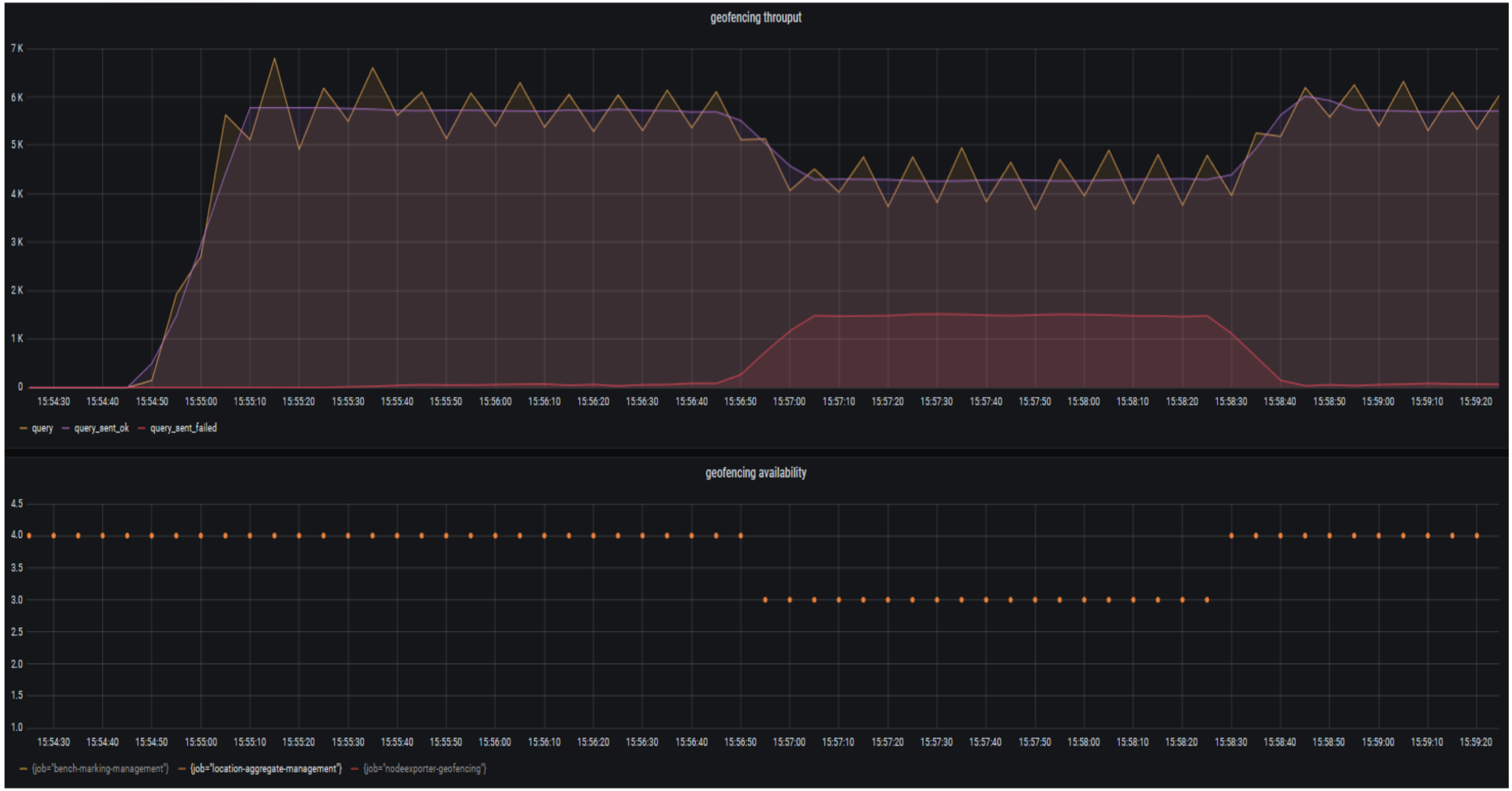
Availability
Pull case



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Strong Scalability

The ability of a system to efficiently handle the growing amount of workload.

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Strong Scalability Push case

Processing nodes = 1

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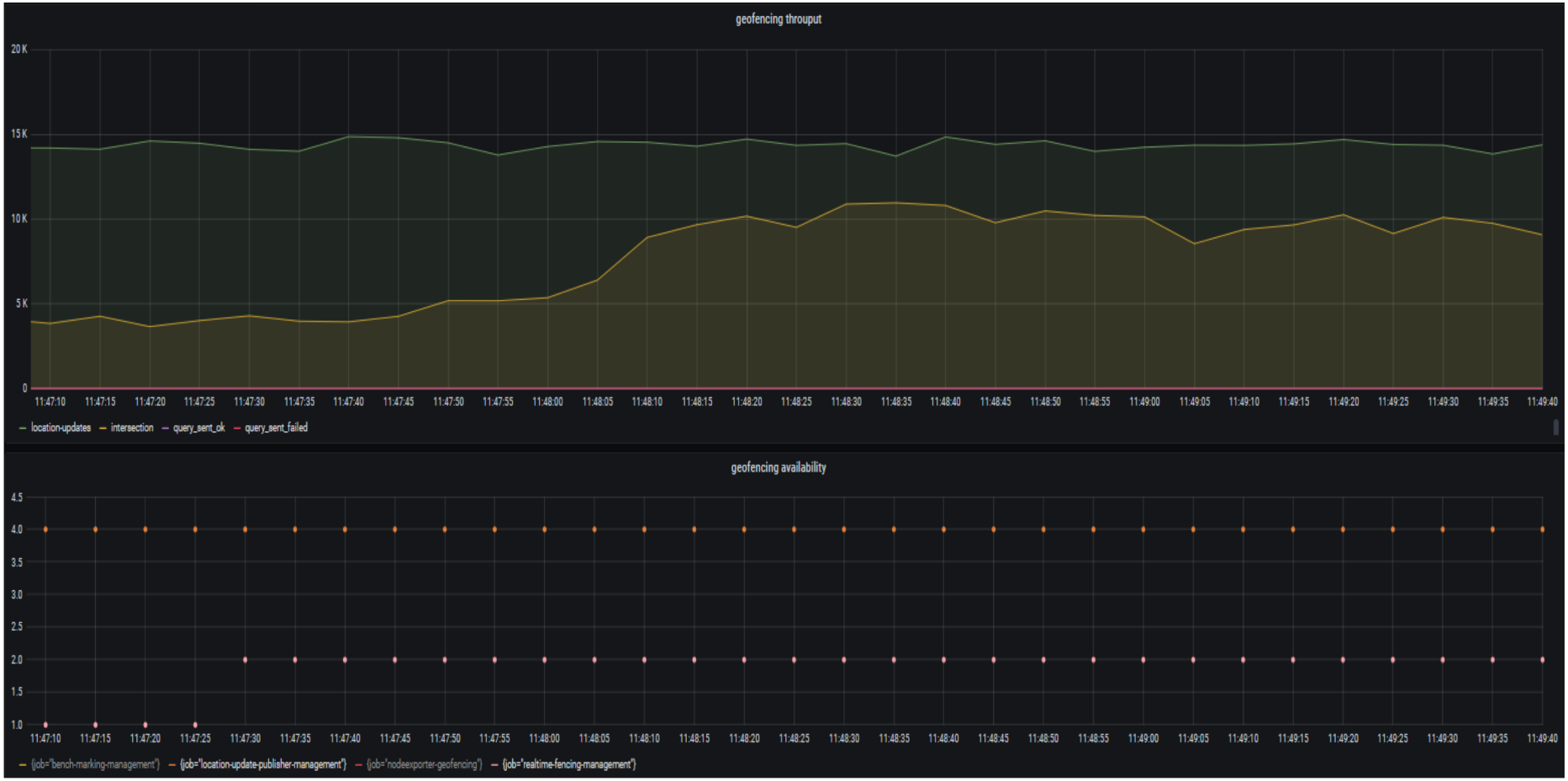
Strong Scalability Push case



Processing nodes = 2

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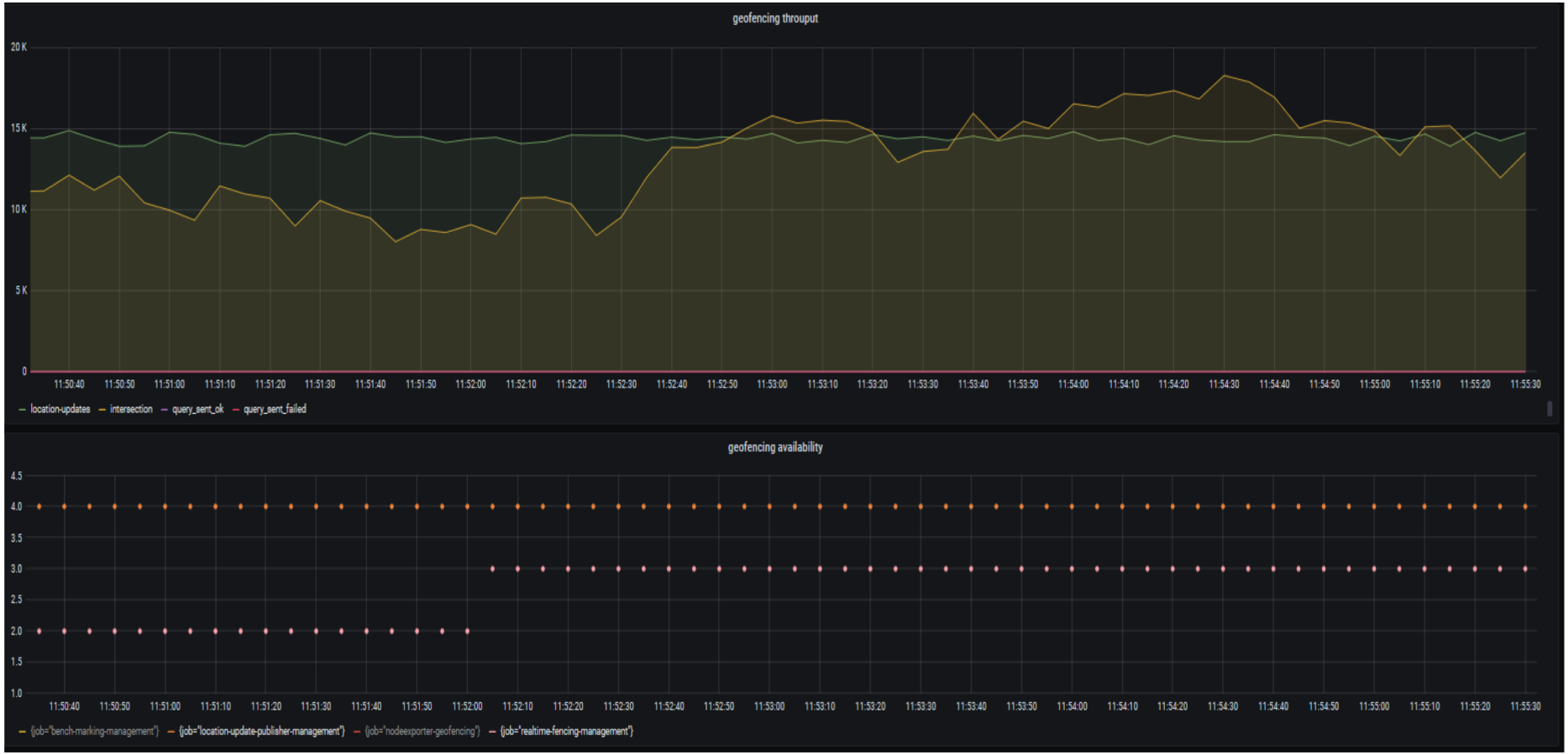
Strong Scalability Push case



Processing nodes = 3

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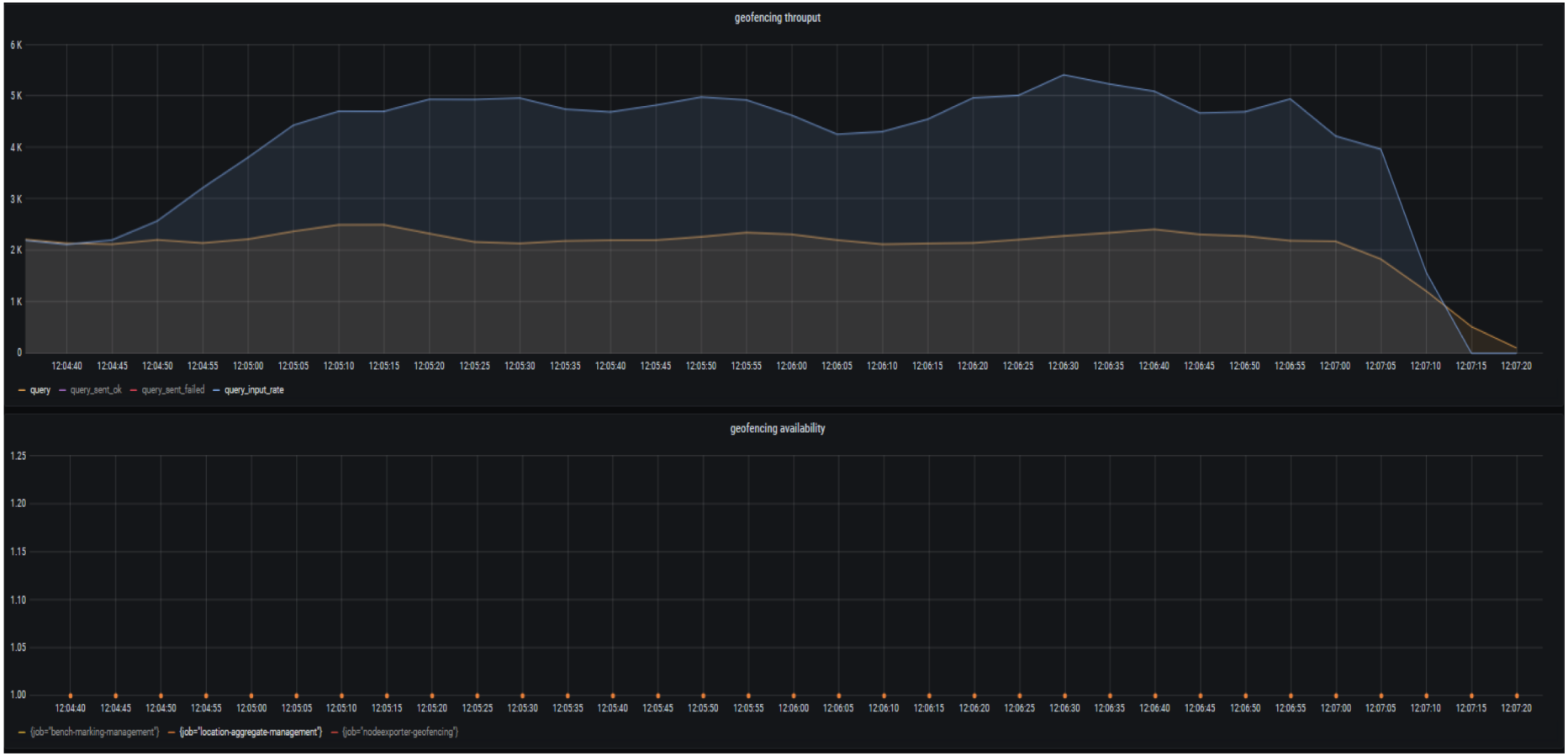
Strong Scalability Pull case



Processing nodes = 1

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Strong Scalability Pull case

Processing nodes = 2

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Why are these features important for the domain experts?

- A number of commercial companies offer frameworks for herd management using geofencing
- It is important to have an easy-to-use platform with accessibility based on different devices (mobiles, tablets and laptops). At the same time, it is also important to understand the underlying technical solution in terms of the following features:
  - Data storage and availability plan
  - Resource usage of the platform
  - Comparison with similar platforms based on
    - scalability (horizontal and vertical)
    - throughput
    - high availability
    - and security
- All these factors affect the cost of using a framework
- Good understanding of these features will help to better estimate the yearly budget

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Thanks!

Questions