From DevOps to MLOps: Scaling ML models to 2 Million+ requests per day

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🏗️ Founder One2N (Backend and Reliability engineering)

📖 Writes stories on Pragmatic Software Engineering

❤️ Engineering 👨‍💻, Psychology 🧐, Percussion 🥁 and

Age of Empires 2

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Agenda

What is MLOps

MLOps for DevOps practitioners

Real-world production case study walkthrough

What is MLOps

Operationalizing data science

Getting ML models to production

MLOps phases - Build, Manage, Deploy, Monitor

MLOps Steps

Data extraction
Data analysis
Data preparation
Model training
Model evaluation
Model validation

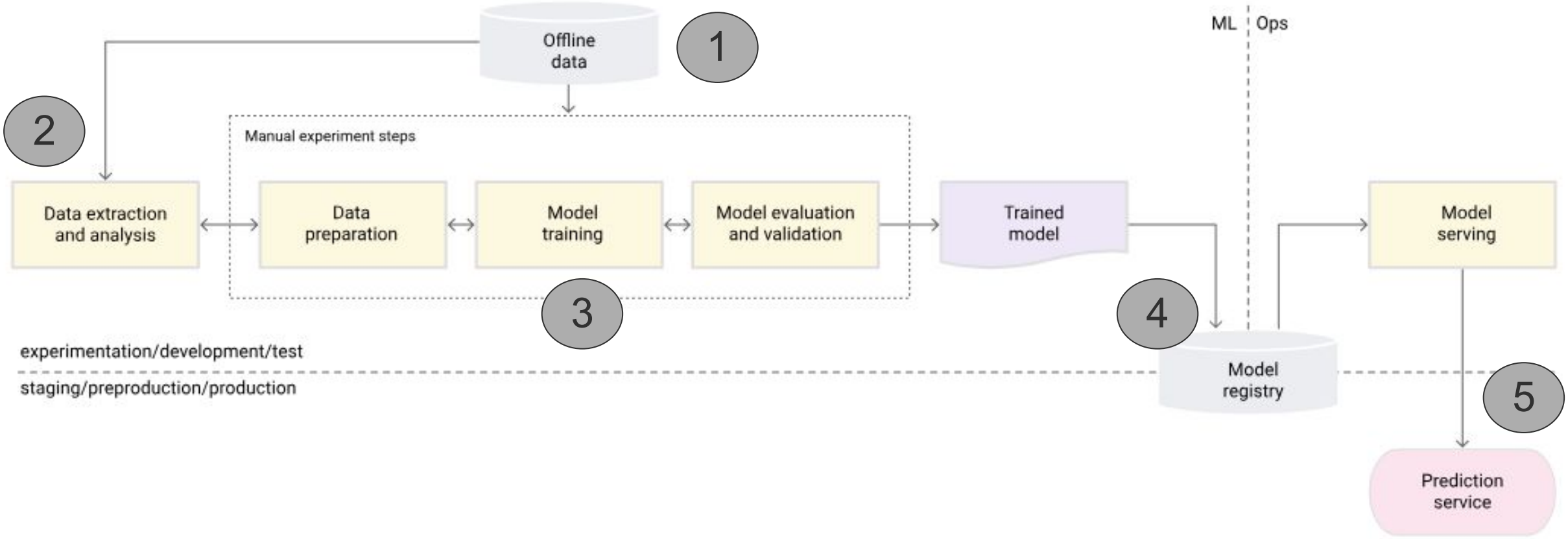
ML

Model serving
Model monitoring

Ops

Feedback loop
CI/CD/CT (Continuous Training)

Simplest MLOps flow

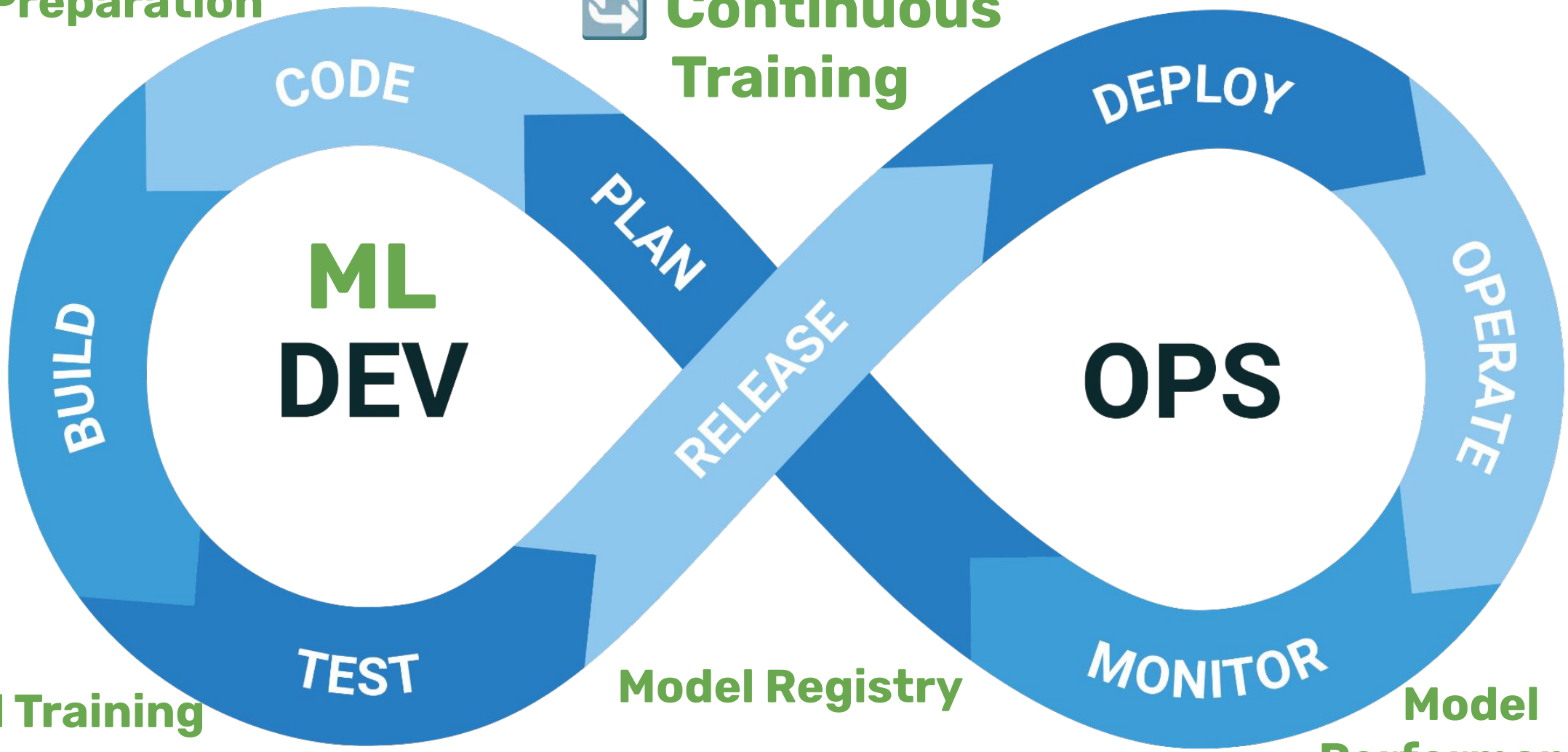


Ref: Google's ML Ops Guide

Data Preparation

Continuous Training

Model Deployment



Model Training

Model Registry

Model Performance

Production work ahead 🚧

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Case study - eKYC SaaS APIs

The company has **eKYC SaaS APIs** accessible via mobile SDKs to its B2B customers. This needed to scale upto **2 Million+ API requests per day**

ML Model APIs

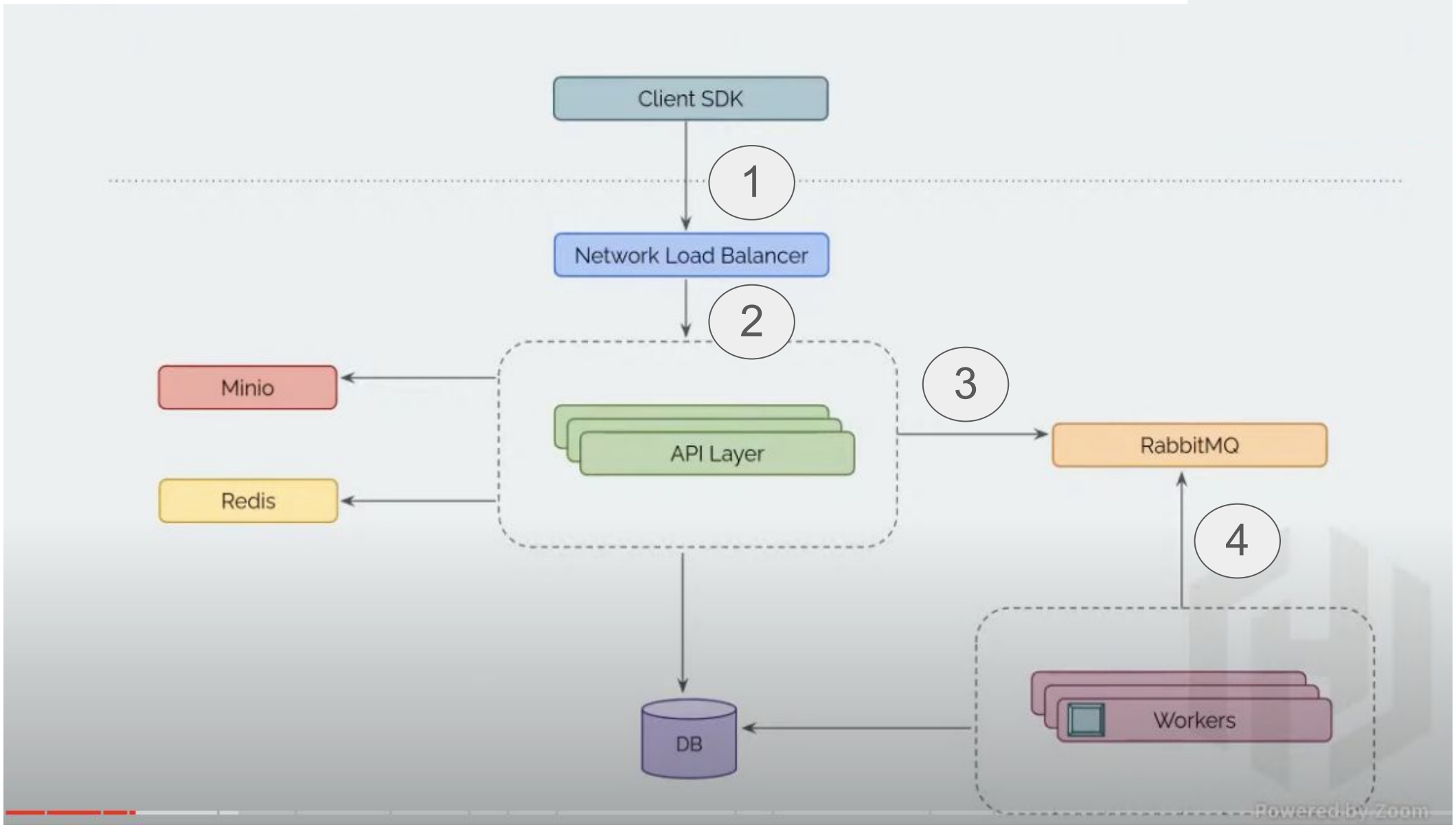
Face matching between images (score: 0 to 1)

Face Liveness detection

Optical character recognition from an image

etc..

Architecture



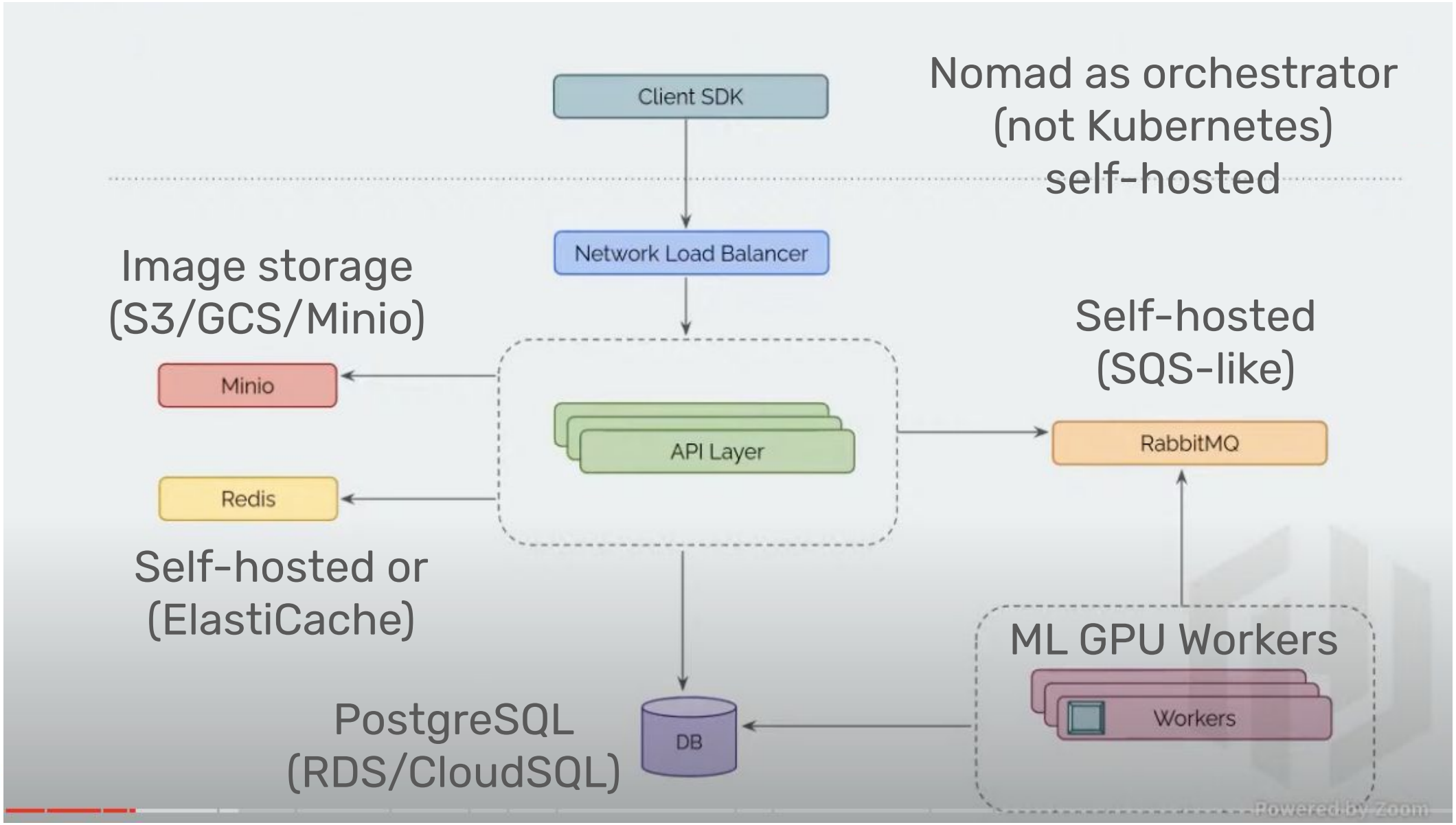
eKYC SaaS APIs - Requirements

99% availability

Cost optimizations

< 3 sec API latency for 95th percentile

Cloud Agnostic Architecture



Why Cloud Agnostic?

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Scaling Journey

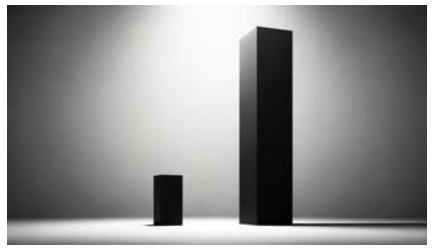
Eliminate single points of failure

Capacity Planning

Cost optimization and Autoscaling

Rolling deployments, Observability, etc

Production incidents



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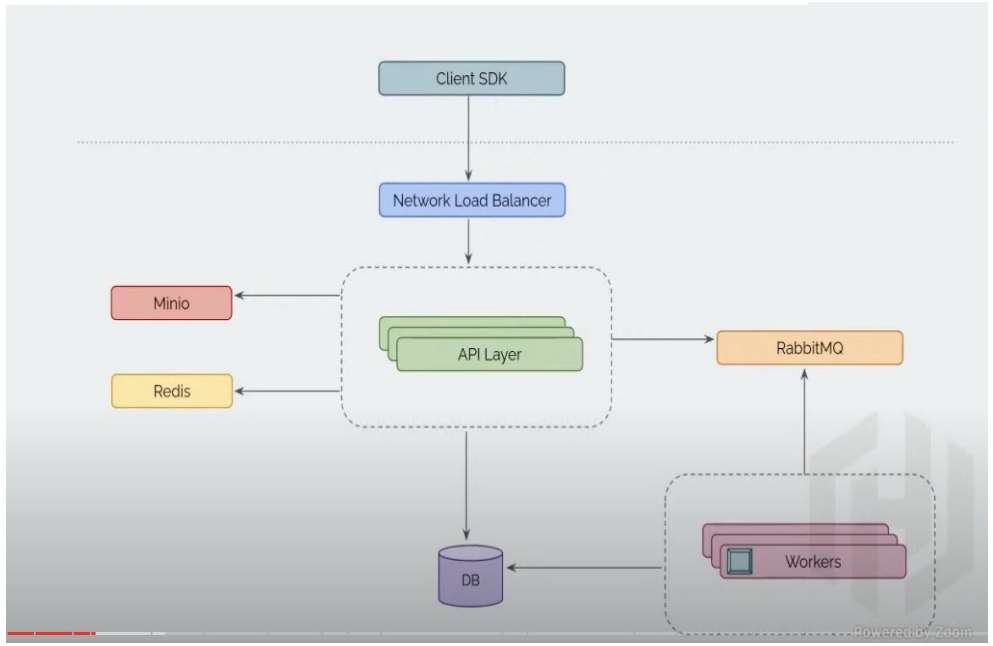
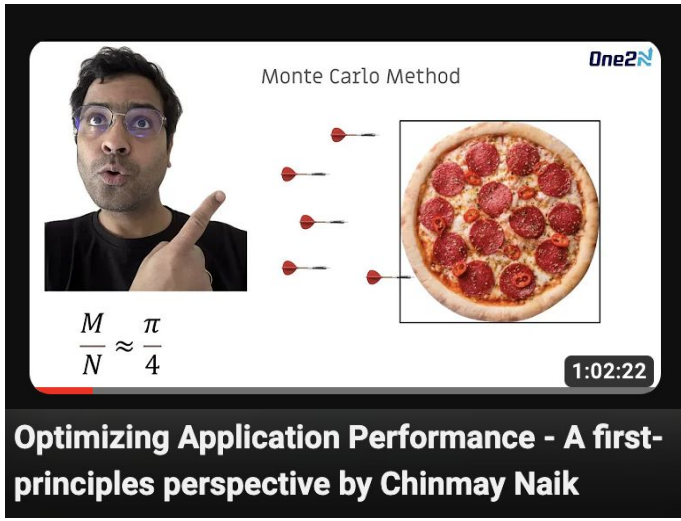
Eliminate single points of failure

- High Availability mode for RabbitMQ
  - Queue replication
  - Cross AZ deployment
  - (alternative was SQS, etc.)
- Split ML workers across AZs
  - Fix Autoscaling
  - Fix Deployment automation
- SaaS offering for Redis and Database
  - Stateless = easy, Stateful = hard



Capacity Planning



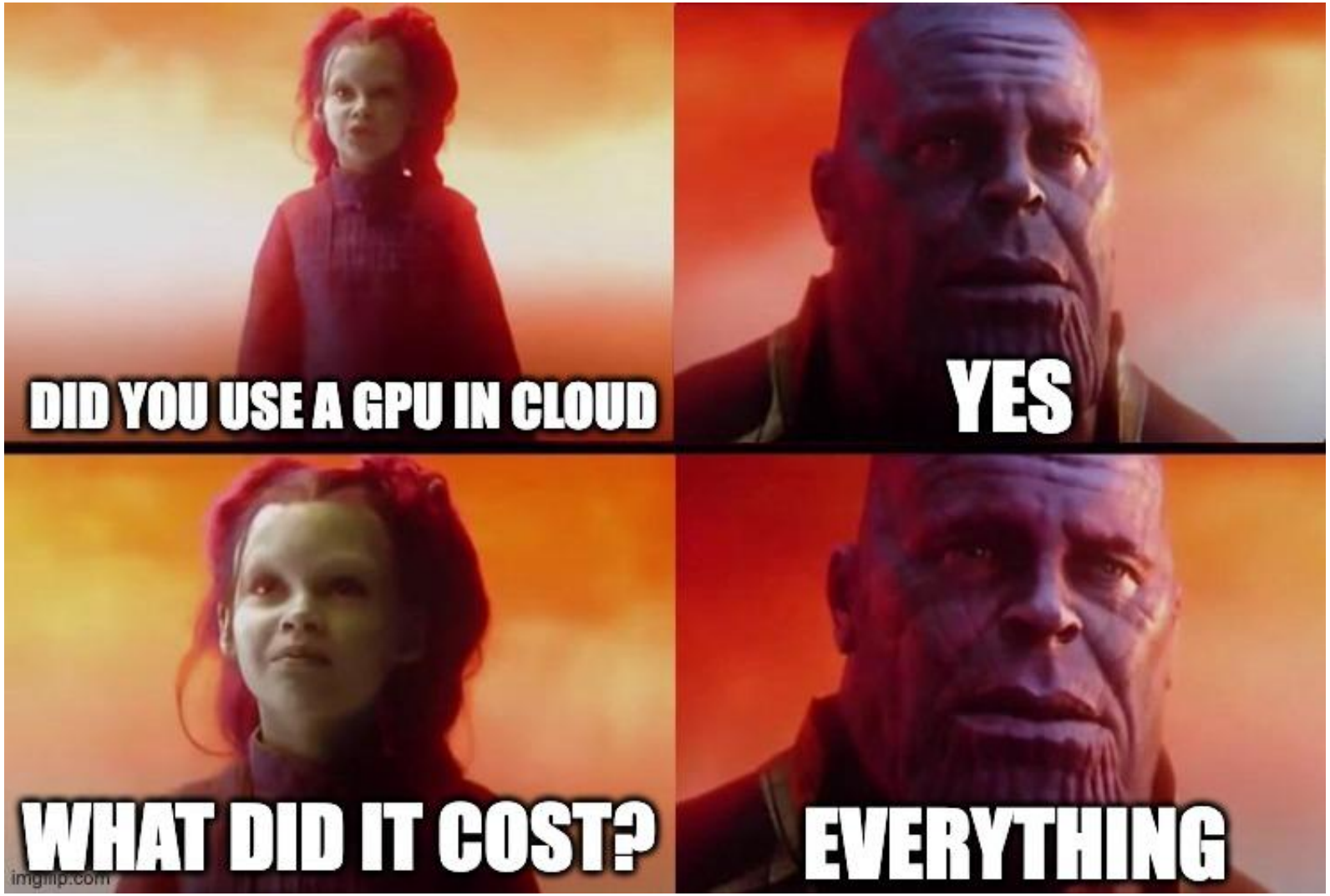
Where's the bottleneck?

- API
- DB (Redis/RabbitMQ/PostgreSQL/Minio)
- ML workers
- Something else?

How many ML model requests can a single node handle?

Talk link: https://www.youtube.com/watch?v=HRKUd0pDh8w

Cost Optimization and Autoscaling



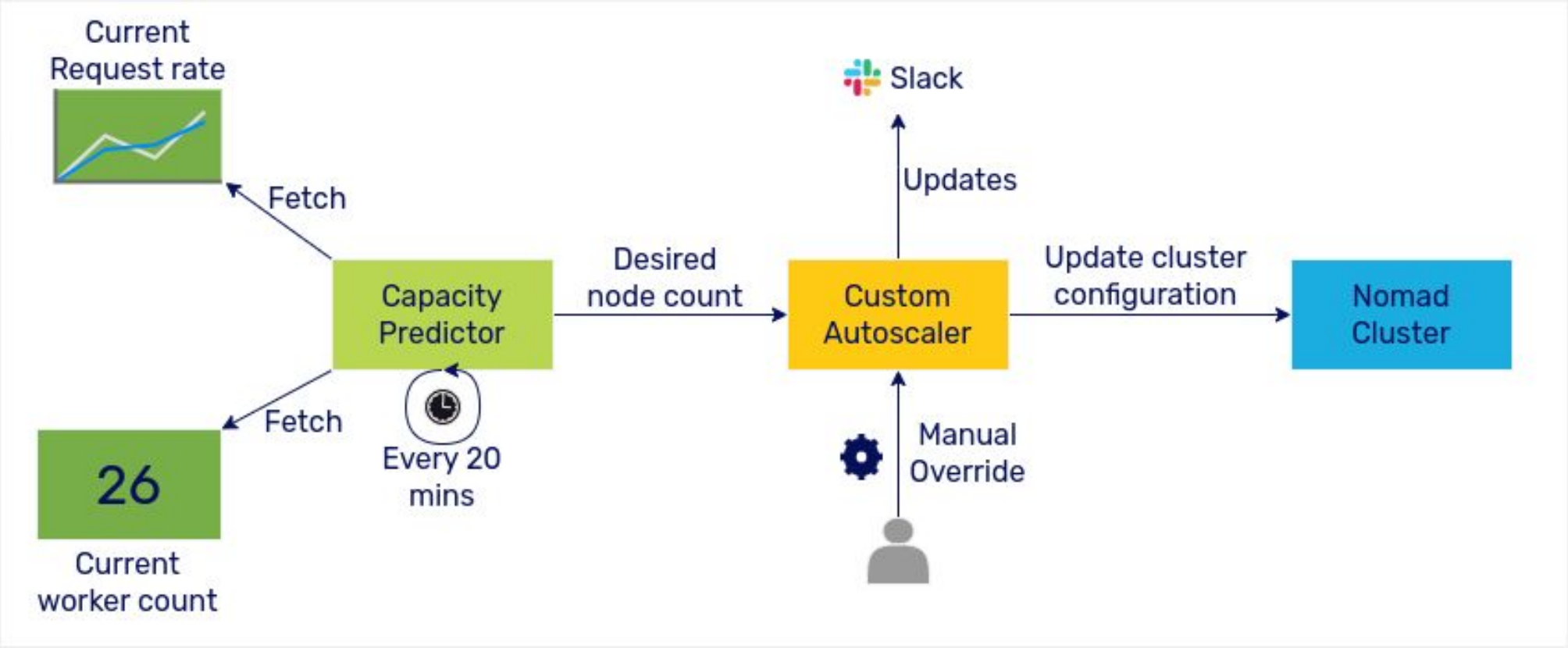
Cost Optimization and Autoscaling

What metric should we autoscale on?

- CPU/GPU utilization
- Memory utilization
- Incoming requests
- Queue depth
- Something else?

Combination of these

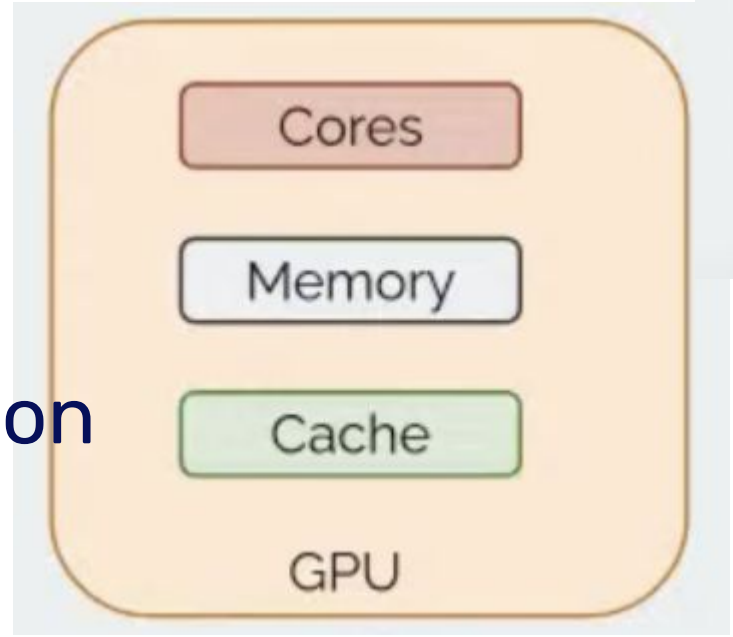
Cost Optimization and Autoscaling



https://one2n.in/case-studies/auto-scaling-machine-learning-ekyc-workloads/

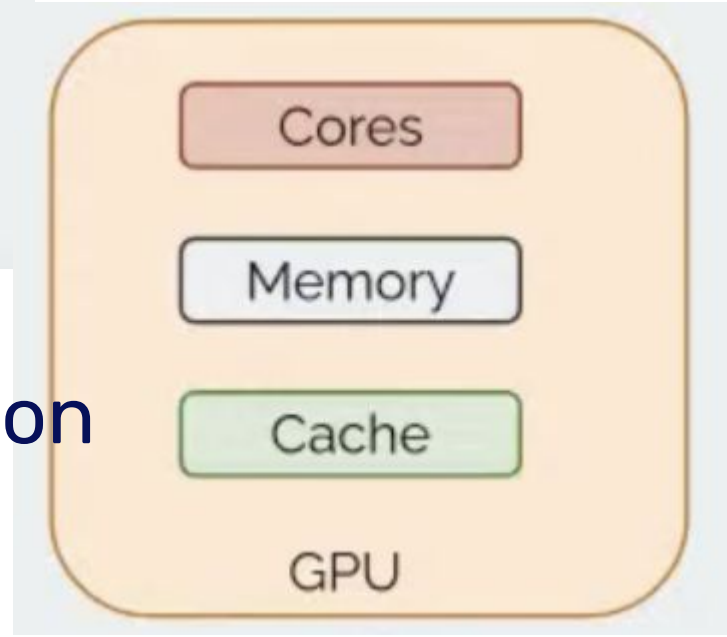
Production Issue 1 - GPU utilization in Nomad

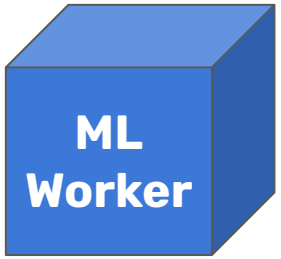
~20% utilization



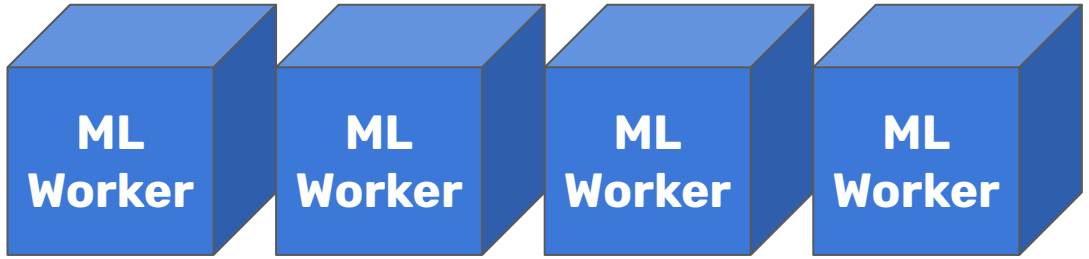
4x $

~80% utilization



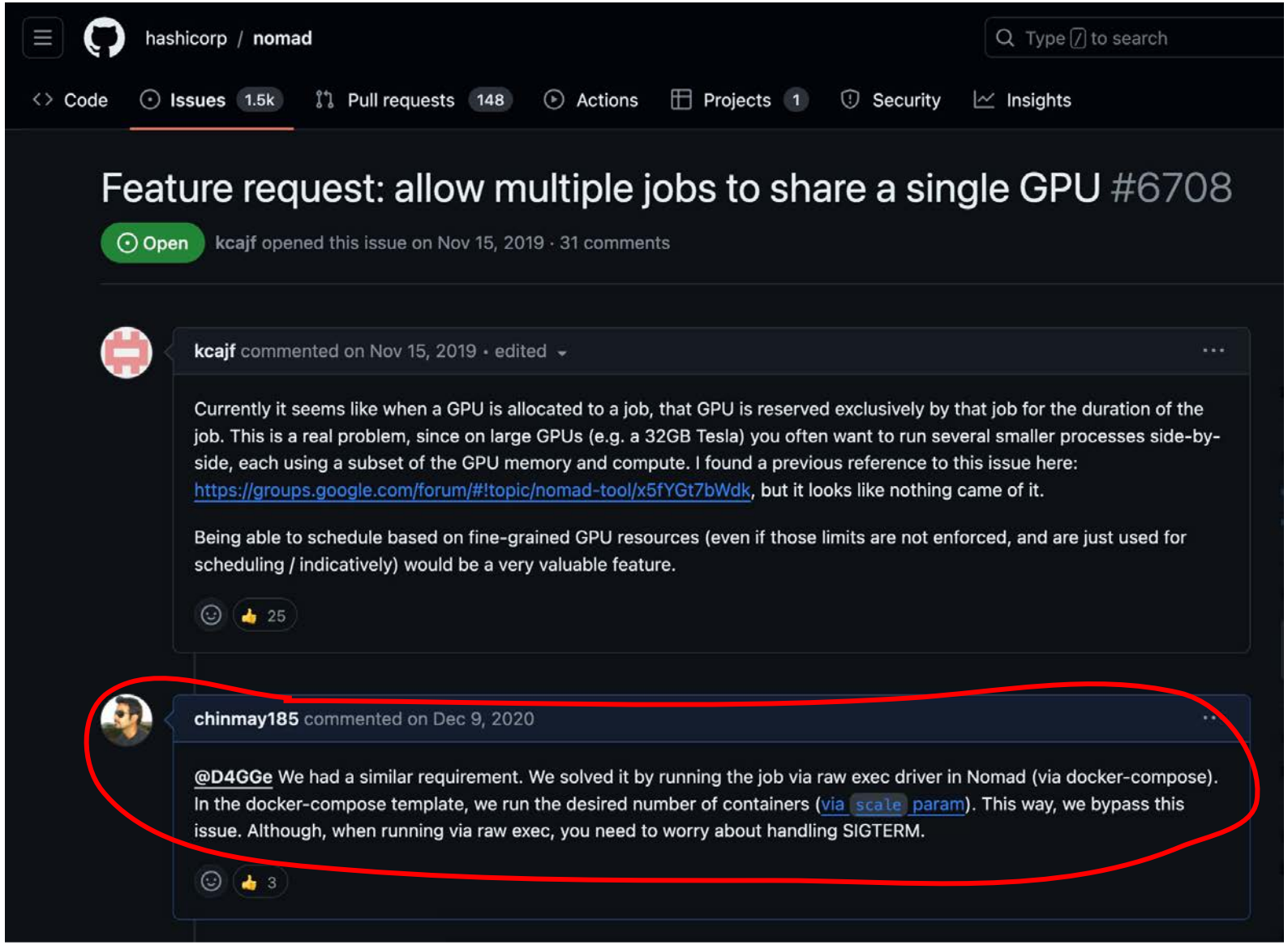


Docker Driver



Raw-exec Driver

Production Issue 1 - GPU utilization in Nomad



hashicorp / nomad

Type / to search

Code | Issues 1.5k | Pull requests 148 | Actions | Projects 1 | Security | Insights

Feature request: allow multiple jobs to share a single GPU #6708

Open kcajf opened this issue on Nov 15, 2019 · 31 comments

kcajf commented on Nov 15, 2019 · edited

Currently it seems like when a GPU is allocated to a job, that GPU is reserved exclusively by that job for the duration of the job. This is a real problem, since on large GPUs (e.g. a 32GB Tesla) you often want to run several smaller processes side-by-side, each using a subset of the GPU memory and compute. I found a previous reference to this issue here: https://groups.google.com/forum/#!topic/nomad-tool/x5fYGt7bWdk, but it looks like nothing came of it.

Being able to schedule based on fine-grained GPU resources (even if those limits are not enforced, and are just used for scheduling / indicatively) would be a very valuable feature.

25

chinmay185 commented on Dec 9, 2020

@D4GGe We had a similar requirement. We solved it by running the job via raw exec driver in Nomad (via docker-compose). In the docker-compose template, we run the desired number of containers (via `scale` param). This way, we bypass this issue. Although, when running via raw exec, you need to worry about handling SIGTERM.

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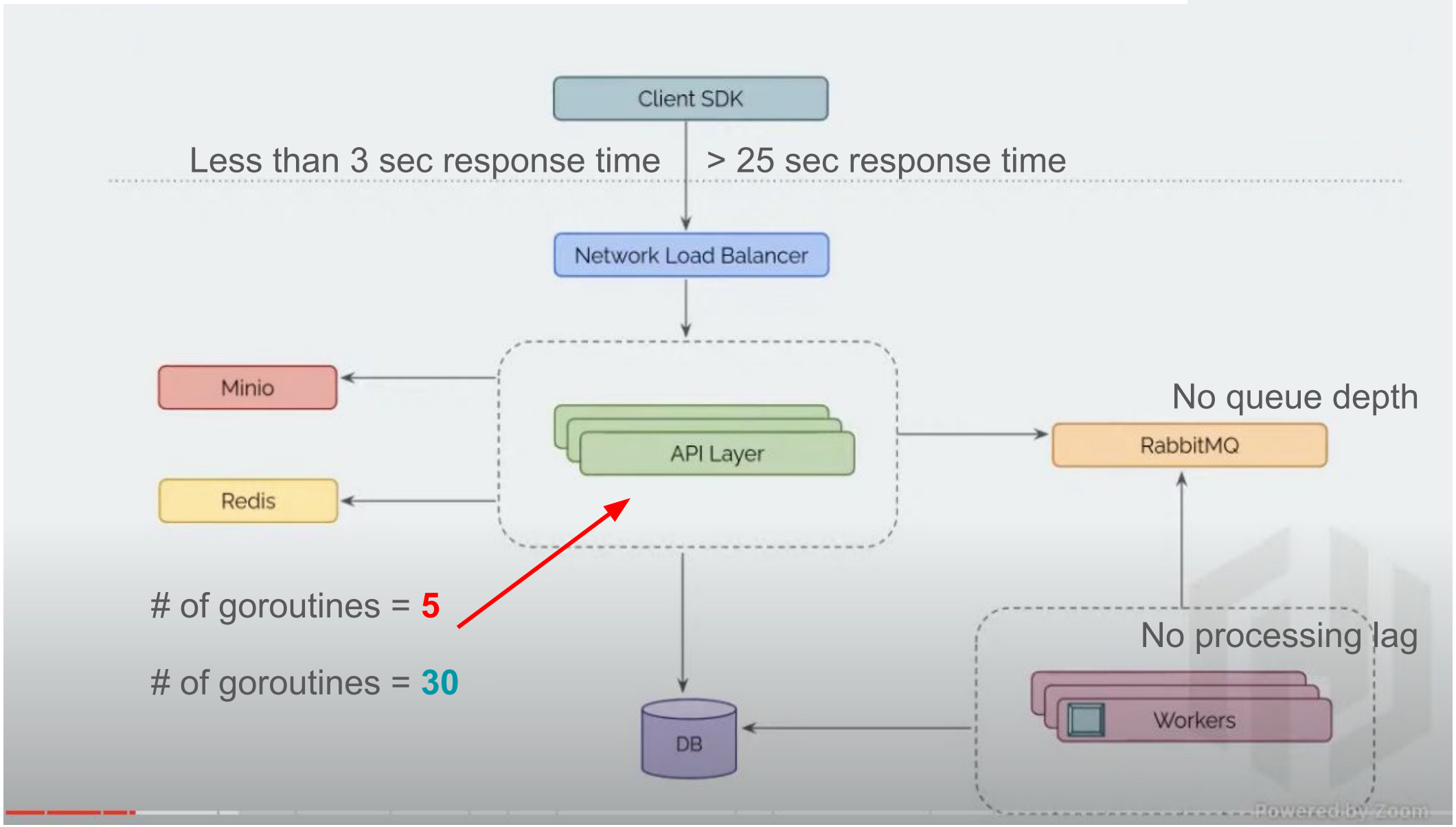
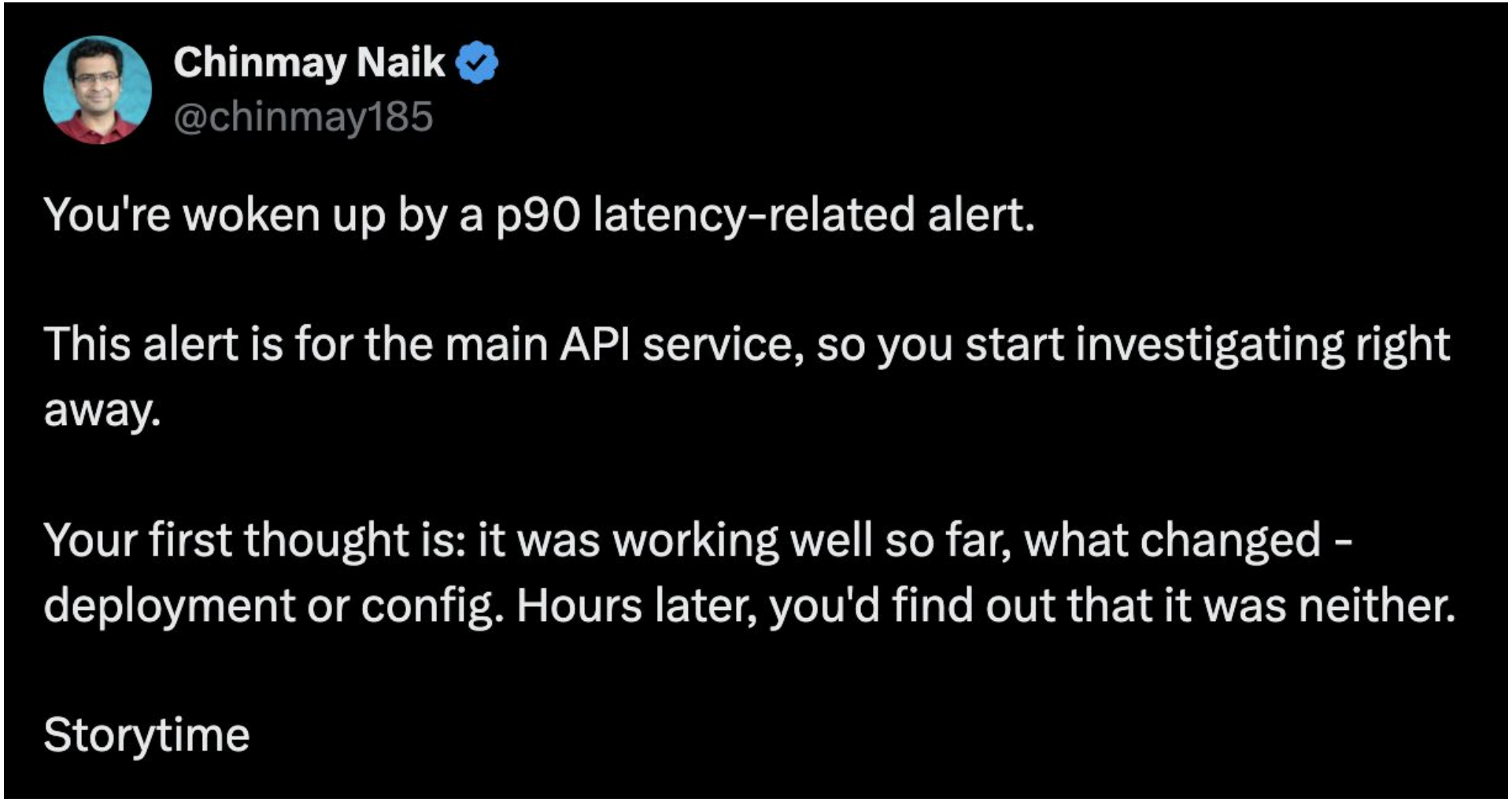
Issue: https://github.com/hashicorp/nomad/issues/6708

Production Issue 2 - High latency issue



Production Issue 2 - High latency issue



Story link (Twitter): https://twitter.com/chinmay185/status/1729911773405352030

Lessons

- Data quality and training is super important
- Cloud agnostic architecture FTW
- Treat Operations-work as first class citizen
- Ensure close collaboration across Data Scientist, Backend engineers, Business teams and SREs

Keep learning

Connect with me @chinmay185 on Twitter, LinkedIn, etc.

Check out Go and SRE bootcamps along with the Pragmatic Software Engineering stories

https://playbook.one2n.in