M3 and Prometheus

Monitoring at Planet Scale for Everyone

Who am I? All round monitoring nerd obsessed with graphs...

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Uber Staff Software Engineer

Creator of M3DB

Member of OpenMetrics

Let’s talk...

Monitoring an increasing number of things…

Running in many regions…

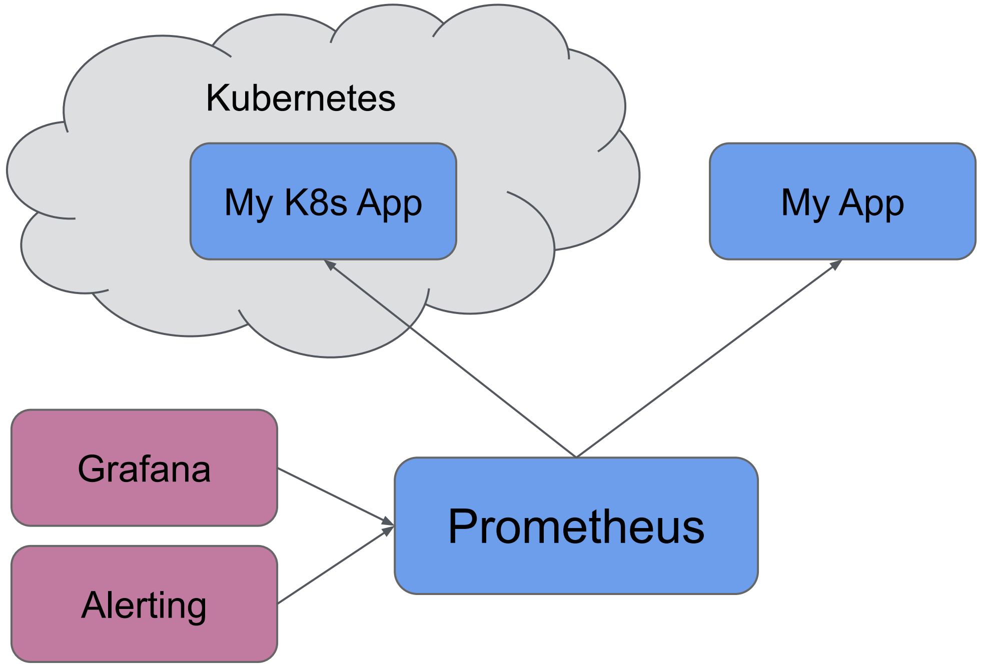
M3 and Prometheus...

What is Prometheus?

First built at SoundCloud (began 2014)

- An open source monitoring system and time series database.
- Essentially an industry standard for an all-in-one single node monitoring solution (explicitly not solving distributed storage of metrics).

What is Prometheus?



Single Region

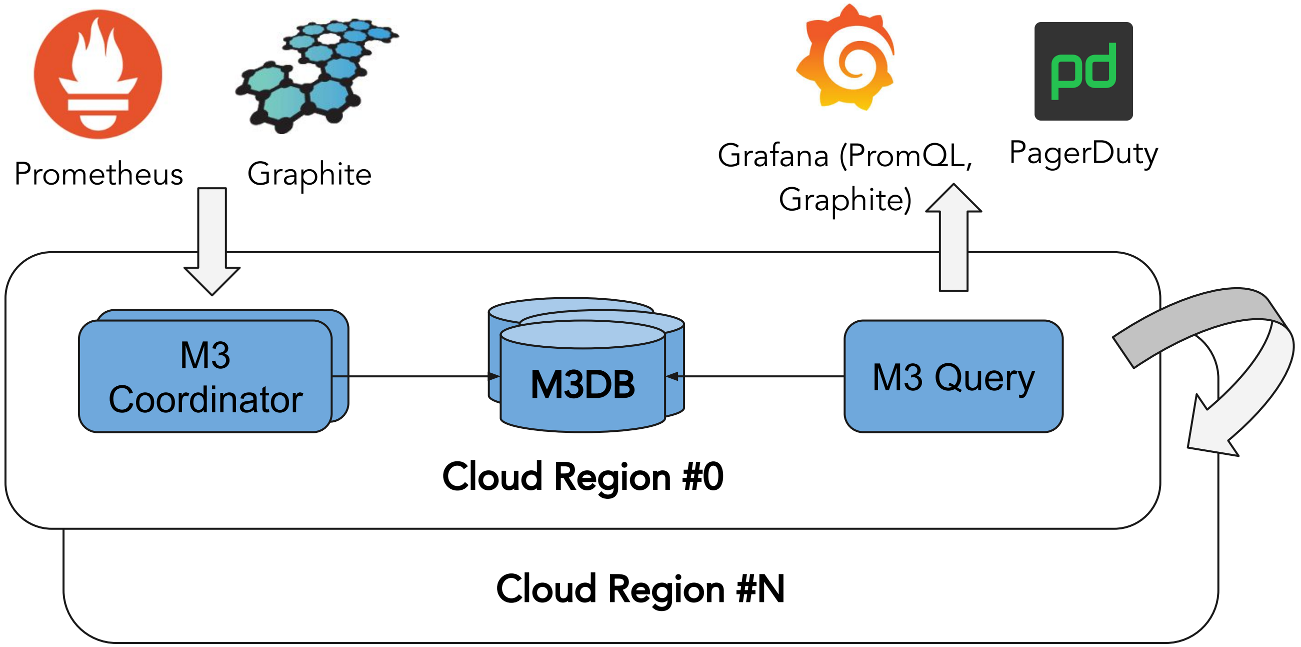
What is M3?

Built in Uber's New York office (began 2015)

- An open source monitoring system and distributed time series database, compatible with Prometheus as remote storage.
- First open source release in August 2018

What is M3?

- Monthly community meeting with attendees from small to large organizations
- Released every few weeks



1. Runs anywhere
2. Scalable to billions of metrics
3. Focus on simple operability

1. Runs anywhere

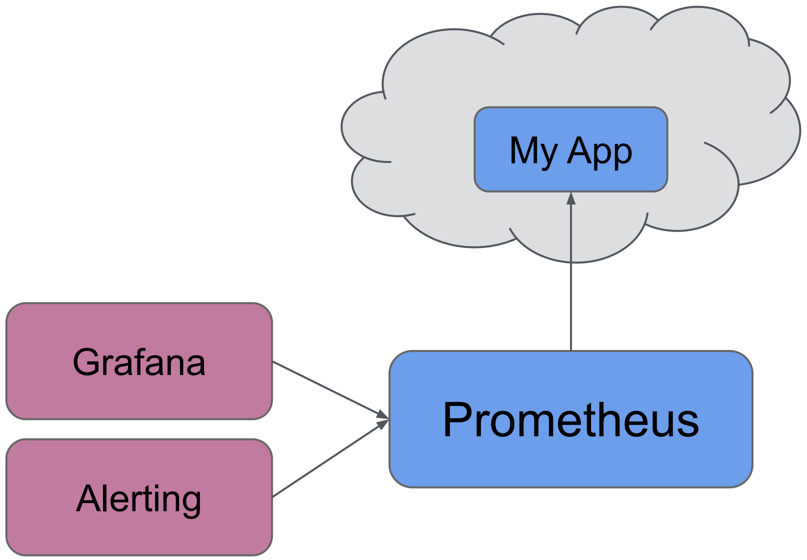
Cloud Native, Multi-Region, Prometheus and Graphite compatible

1. Runs anywhere

M3 and Prometheus

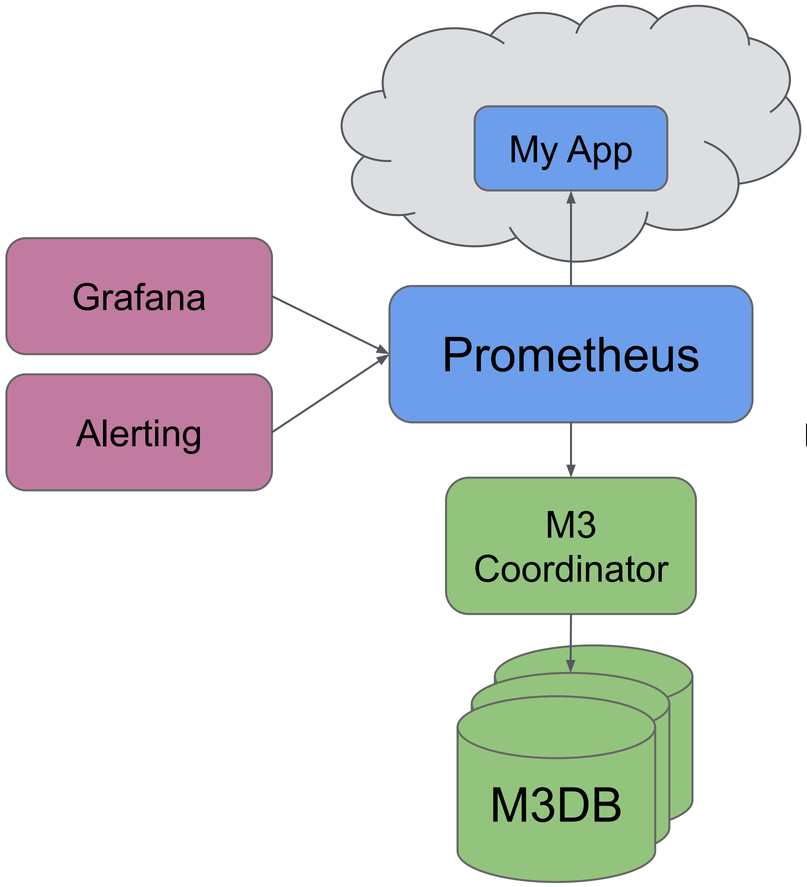
- Prometheus supports collecting metrics from Cloud Native applications
- M3 supports long term storage of Prometheus metrics

Prometheus



Single Region

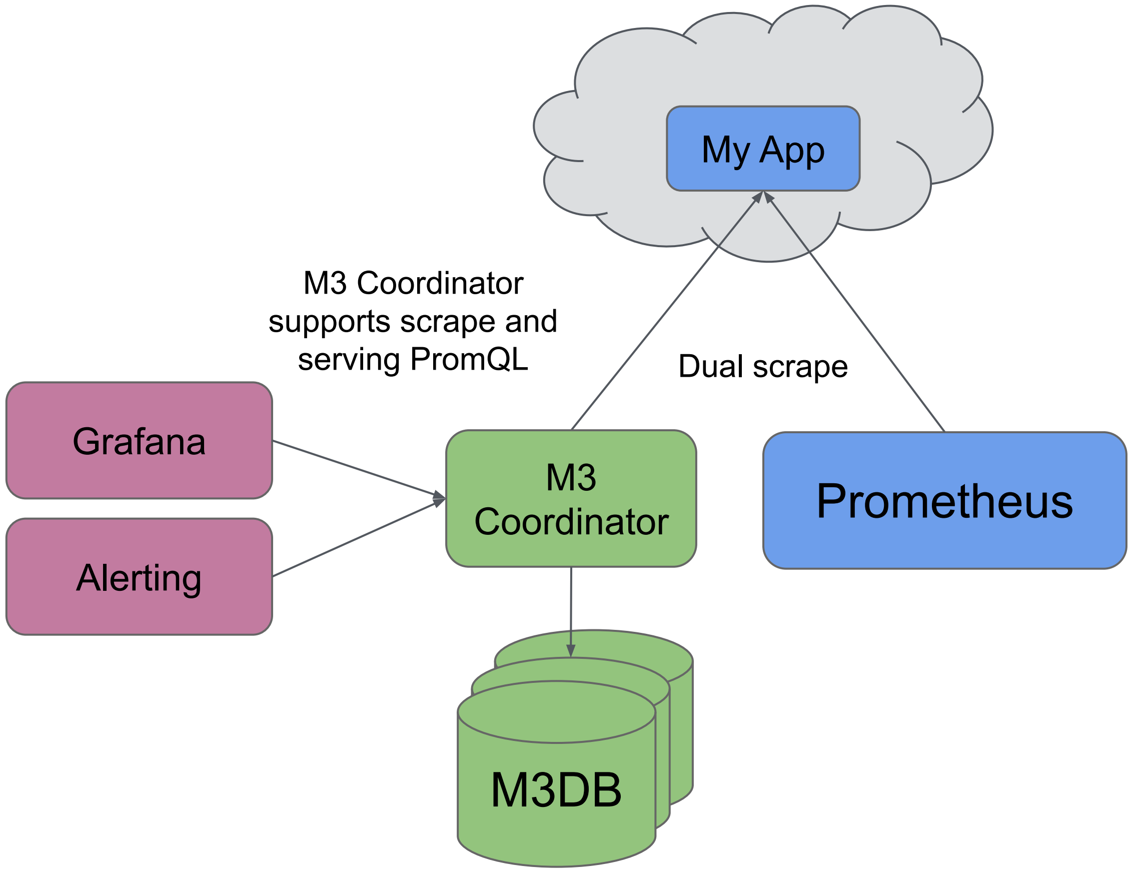
M3 and Prometheus (option 1)



Prometheus remote
read and write

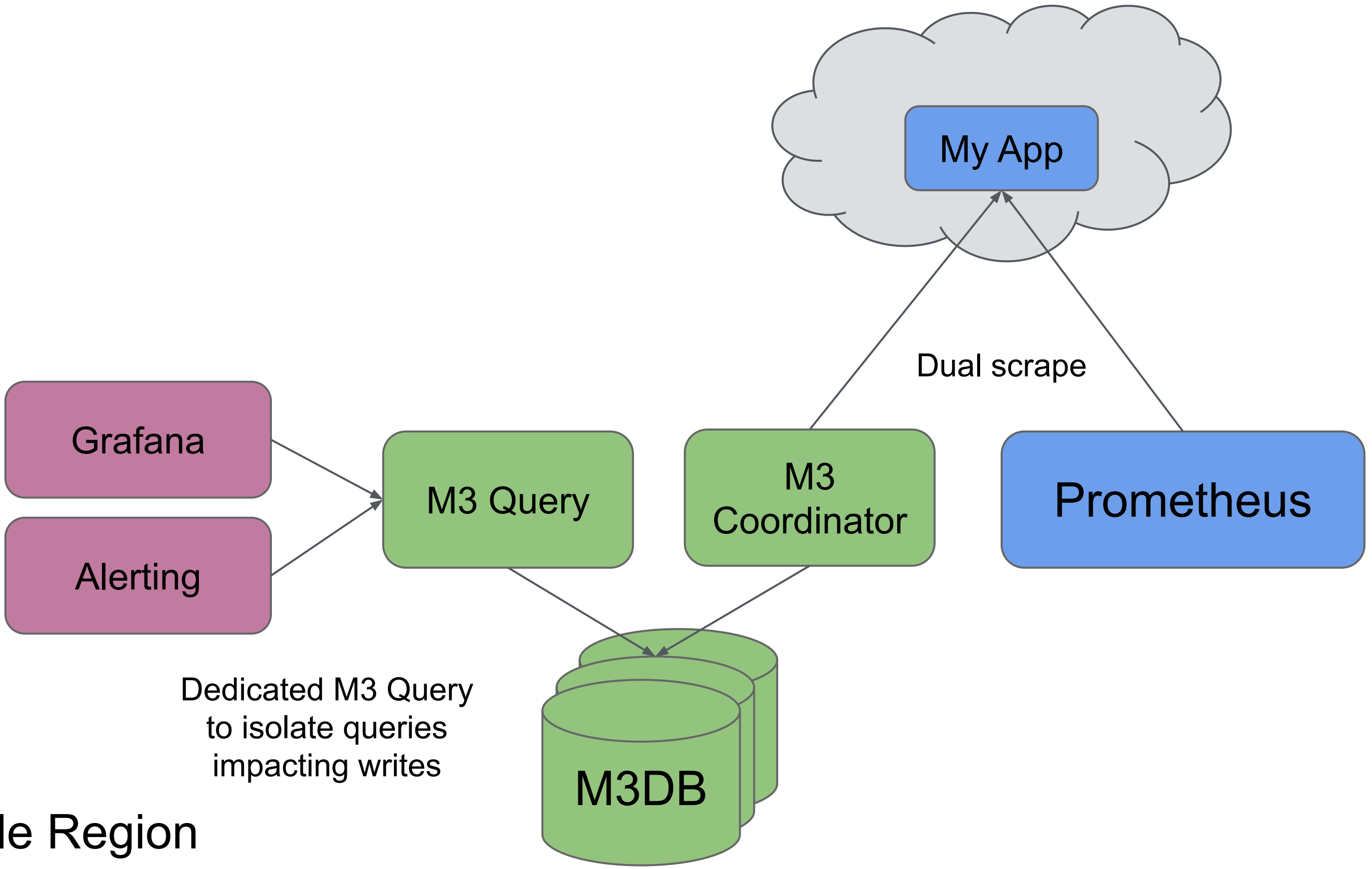
Single Region

M3 and Prometheus (option 2)



Single Region

M3 and Prometheus (option 3)



Dedicated M3 Query to isolate queries impacting writes

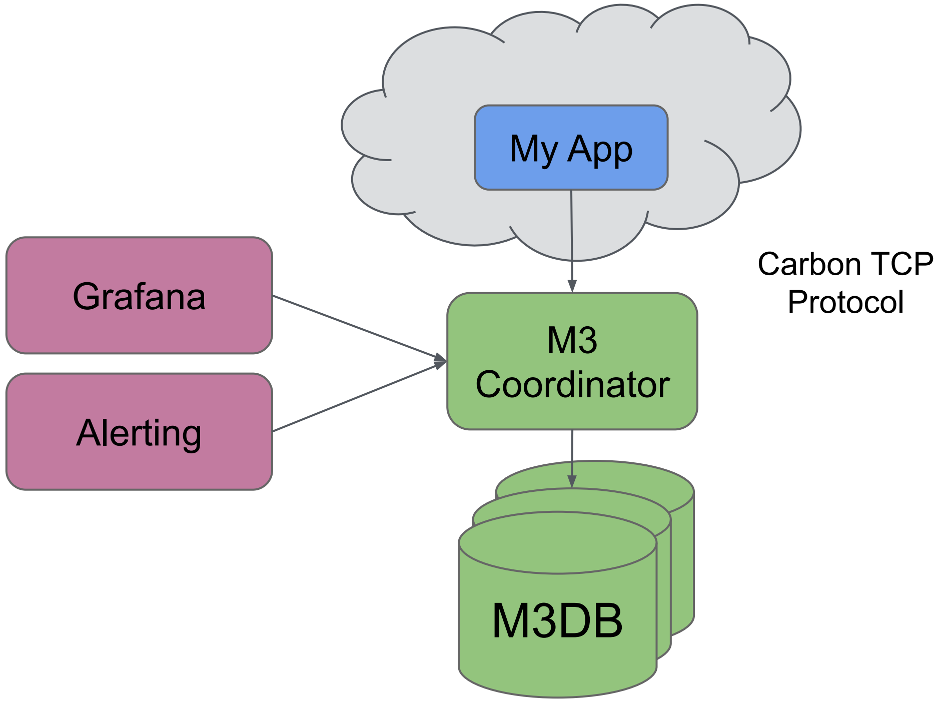
Single Region

1. Runs anywhere

M3 and Graphite

- Ingest: Carbon TCP
- Query: Graphite
- Support for both aggregated or unaggregated Carbon metrics

M3 and Graphite

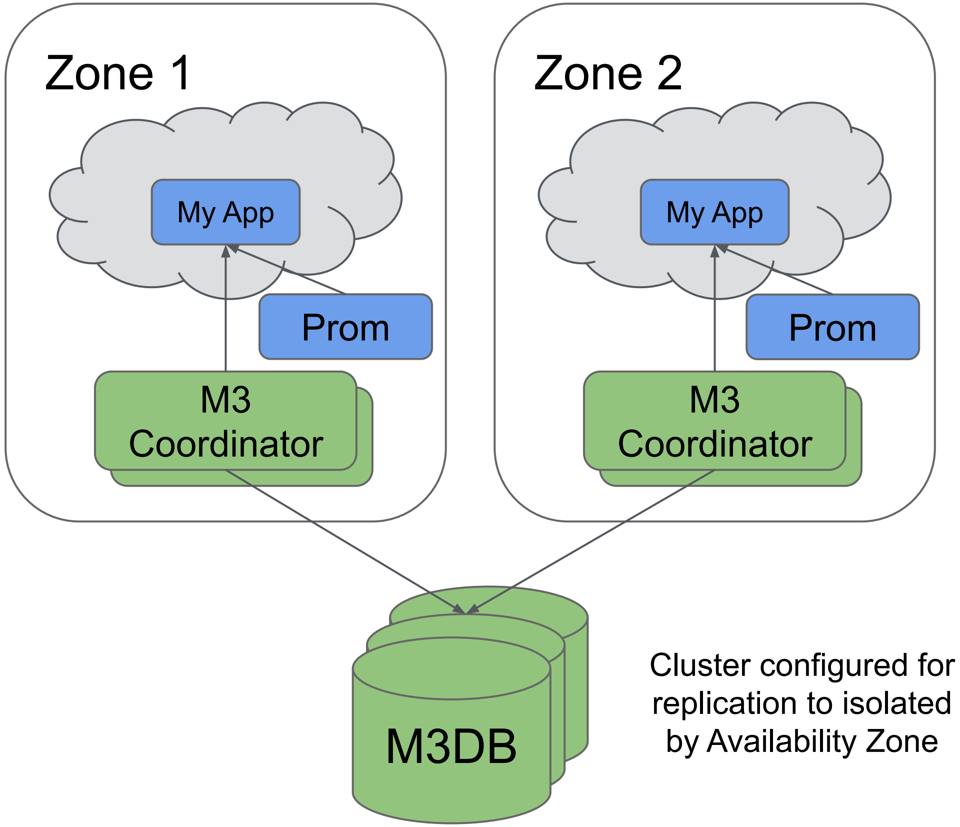


1. Runs anywhere

M3 Multi-Region

- Global metrics collection and query
- Zero cross-region traffic
- Replication across Availability Zones as soon as metric collected

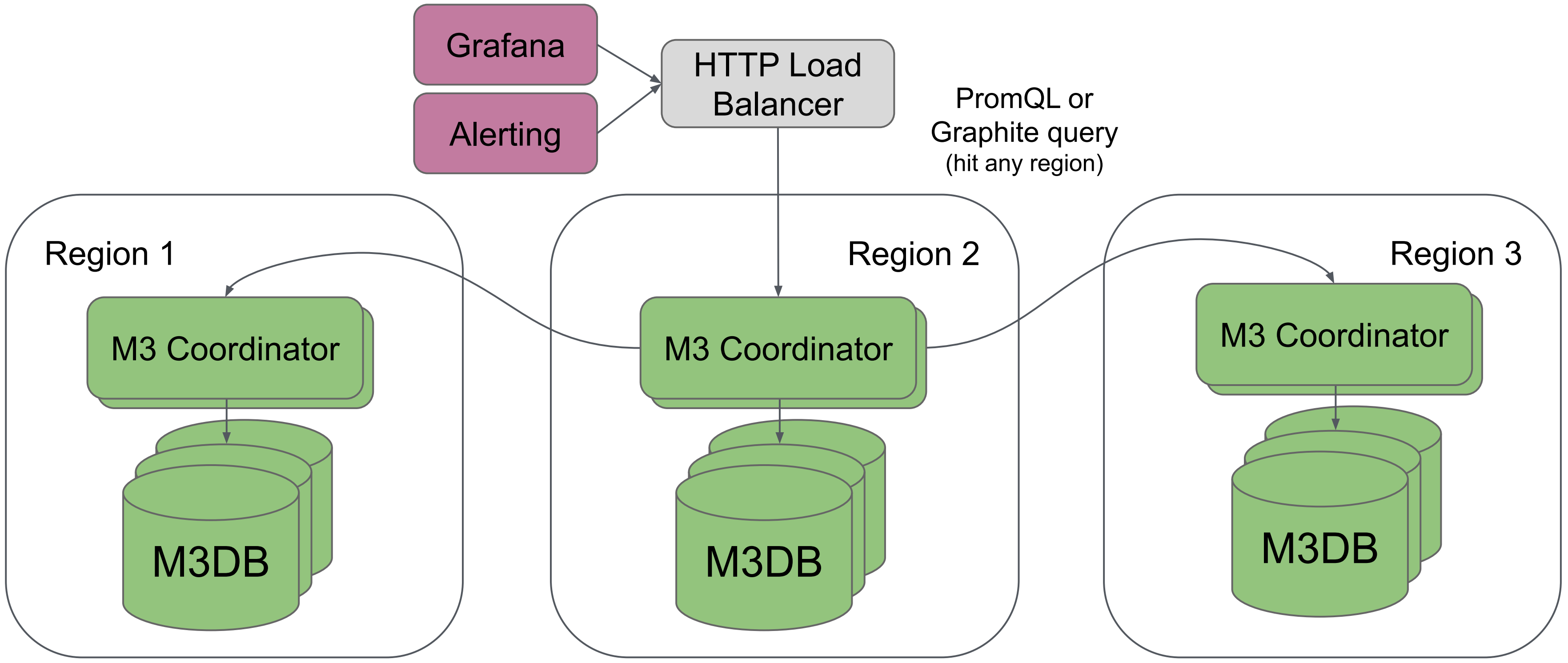
M3 Ingestion (Region Local)



Cluster configured for replication to isolated by Availability Zone

Single Region

M3 Queries (Global)



Multi-Region

2. Scalable to billions of metrics

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M3 at Uber

- 4,000 plus microservices 🤣
- No onboarding to monitoring or provisioning of servers (just add storage nodes as required)

What’s it used for (and why are there so many metrics)

Used for all manner of things:

- Real-time alerting using application metrics (e.g., p99 response time)
- Tracking business metrics (e.g., number of Uber rides in Berlin)
    - Why? So easy to get started
    - *metrics.Tagged(Tags{“region”: “berlin”}).Counter(“ride_start”).Inc(1)*
- Network fabric bandwidth/latency and datacenter device temperatures
- Capacity planning for compute clusters and storage infrastructure (e.g., container load average, disk space in use, disk failure rate)
- And much more …

Workload

35M

Writes per second

50Gbps

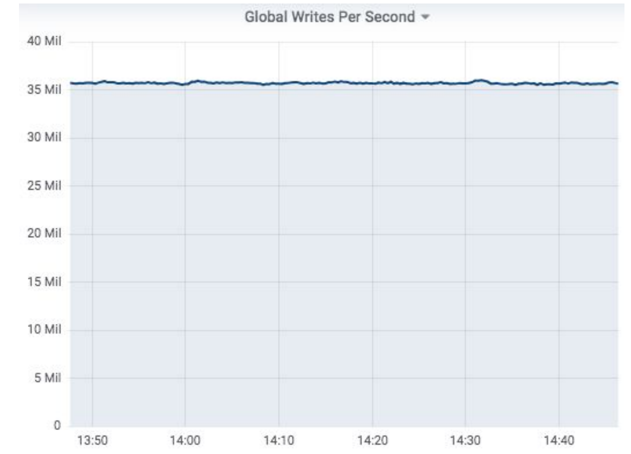
Gigabits per second network

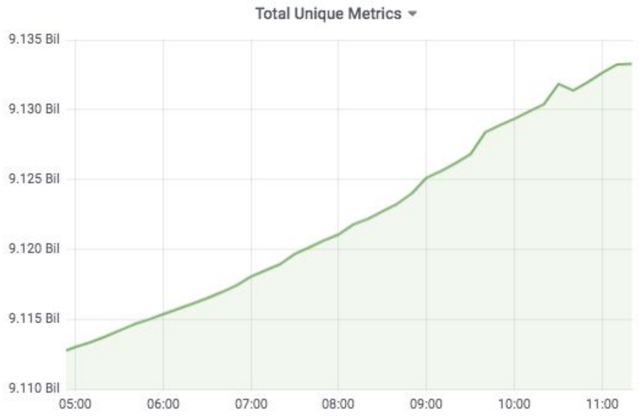
1000+

Instances running M3DB

9B

Unique Metric IDs



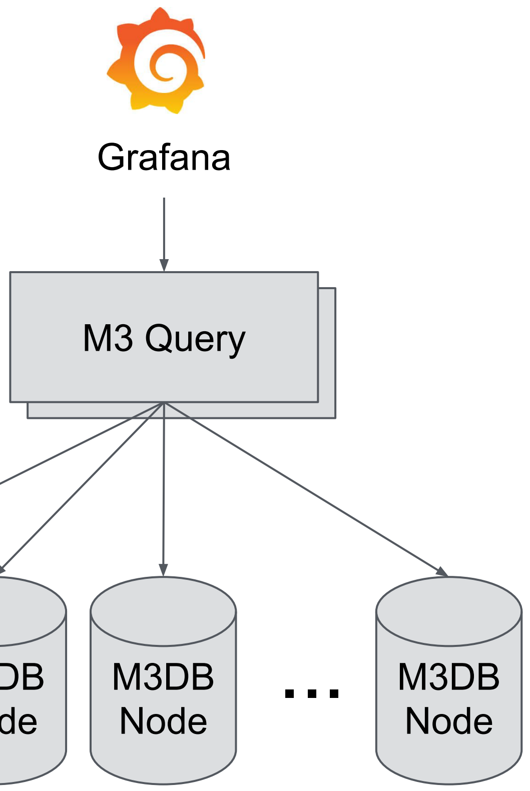


2. Scalable to billions of metrics

Architected for Reliability and Scale

- Each component designed to run across Availability Zones in a Region
- Low inter-region network bandwidth, data always kept in region

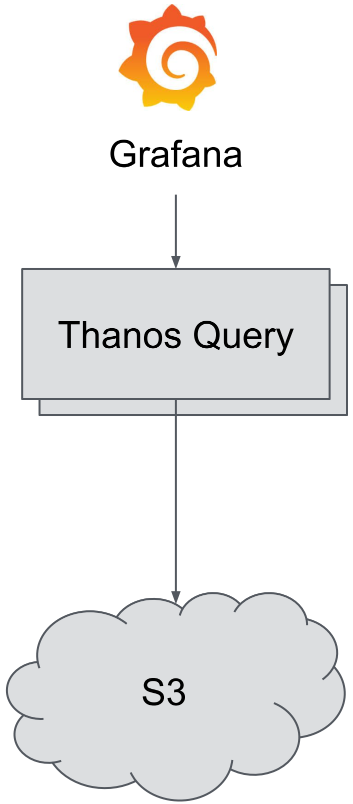
Queries executed in distributed and parallel



Each storage node
Find metrics matching query and return in parallel knowing exactly where to extract series data from local store

As opposed to fetch archived data to single node

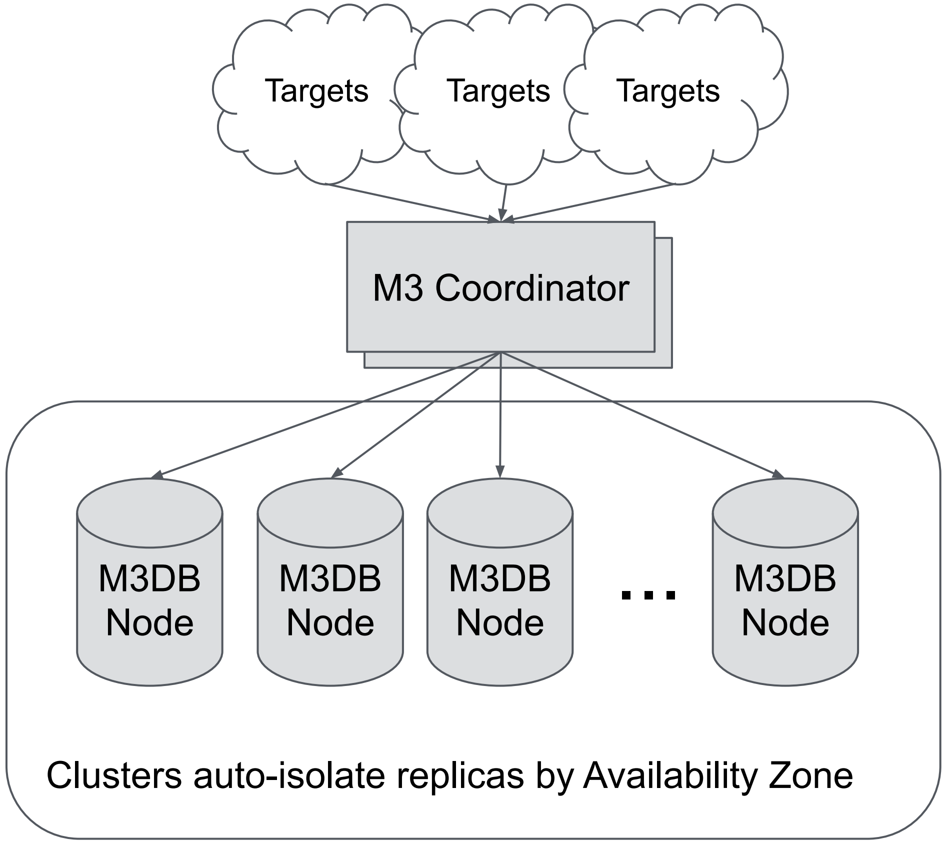
Single query node
Read all index and data chunks for time windows included by query, if too much index data then can't hold it entirely in memory.



Run single set of scaled stateful nodes

Q: High Availability?
A: Operator makes sure to run at least **two stateless** M3 Coordinators in each Availability Zone.

Q: Replication?
A: Replication across Availability Zones as soon as metric collected.

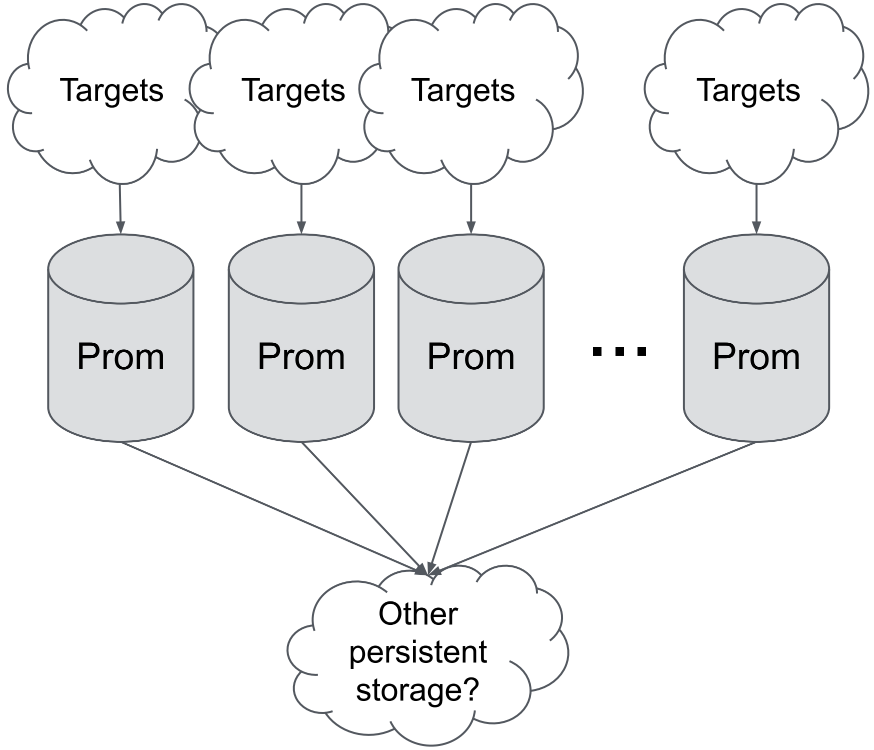


Cloud Region

As opposed to many individual Prometheus

Q: High Availability?
A: An operator needs to place a Prometheus in each Availability Zone, and if they want redundancy (able to withstand single Prometheus failure) need to place **two stateful** Prometheus in each Availability Zone.

Q: Replication?
A: Replication and de-duplication after upload from Prometheus persistent storage.



Cloud Region

3. Focus on simple operability

Powerful with focus on simple operation

- M3 can be deployed on premise without any dependencies.
- M3 also can run on Kubernetes and the M3DB k8s operator can manage your cluster.
  - See more at https://github.com/m3db/m3db-operator
- Clustered version open source and can scale to billions of time series.

Fewer roles, complexity pushed into role

1. Can get started with just two roles, M3 Coordinator and M3DB.
2. No background tasks requiring monitoring (uploads/downsampling/etc).
3. K8s operator handles scaling up and down instances as requested.
4. Fast low latency access to all indexed and stored metrics, no single node bottleneck on scaling queries.

~~1. Runs anywhere~~

~~2. Scalable to billions of metrics~~

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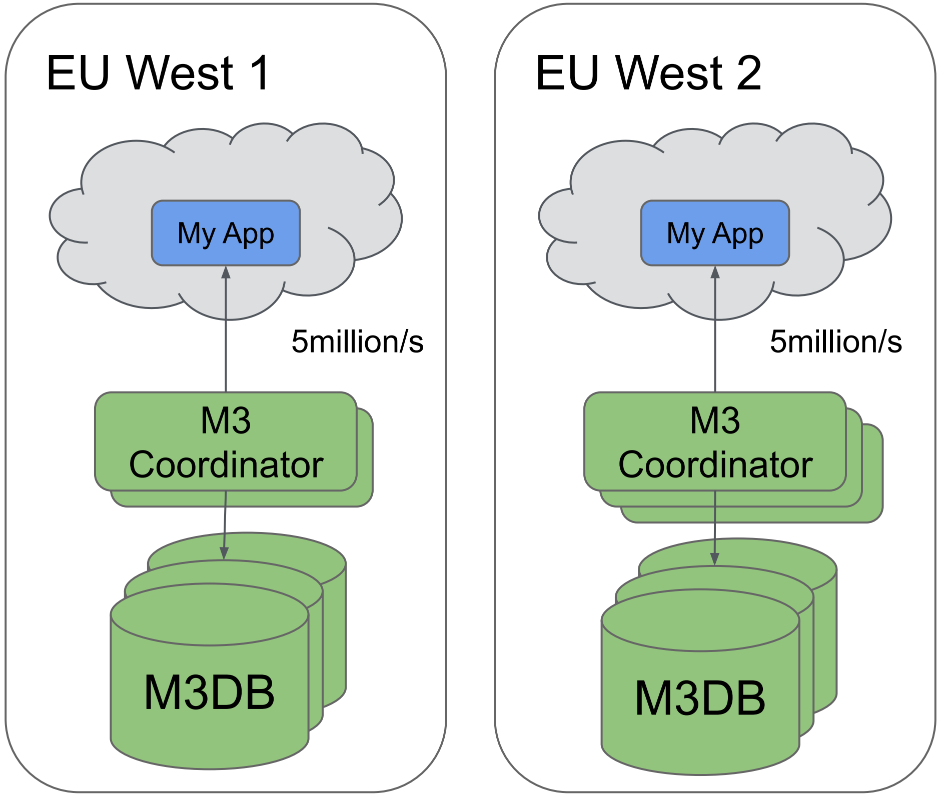
Let’s try it out?

Demo



Multi-Region

Roadmap

Next

1. Bring the Kubernetes operator out of Alpha with further lifecycle management
2. Arbitrary out of order writes for writing data into the past and backfilling
3. Asynchronous cross region replication (for disaster recovery)
4. M3QL query language support
5. Evolving M3DB into a generic time series database (think event store)
    a. Efficient compression of events in the form of Protobuf messages

Thank you

M3 License: Apache 2

Website: https://www.m3db.io

Repo: https://github.com/m3db/m3

Docs: https://docs.m3db.io

Gitter (chat): https://gitter.im/m3db/Lobby

Mailing list: https://groups.google.com/forum/#!forum/m3db

Blog post: https://eng.uber.com/m3