

Processing 10M samples/second to drive smart maintenance in complex IIoT systems

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cognite iot core



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Tips: Bare søk etter **norske** resultater. Du kan spesifisere søkespråket ditt i [Innstillinger](#)

Videoer



From Edge to Cloud:
How Cloud IoT Core Is
Supporting Industrial
IoT ...

Google Cloud Platform
[YouTube](#) - 12. apr. 2019



Cognitive IoT: Where
digital meets physical

IBM Watson Internet of
[YouTube](#) - 18. des. 2015



Configure a Raspberry
Pi and connect it to
Watson IoT Platform

IBM Watson Internet of
[YouTube](#) - 14. mar. 2016





DEMO

Charting library you just saw is open-sourced

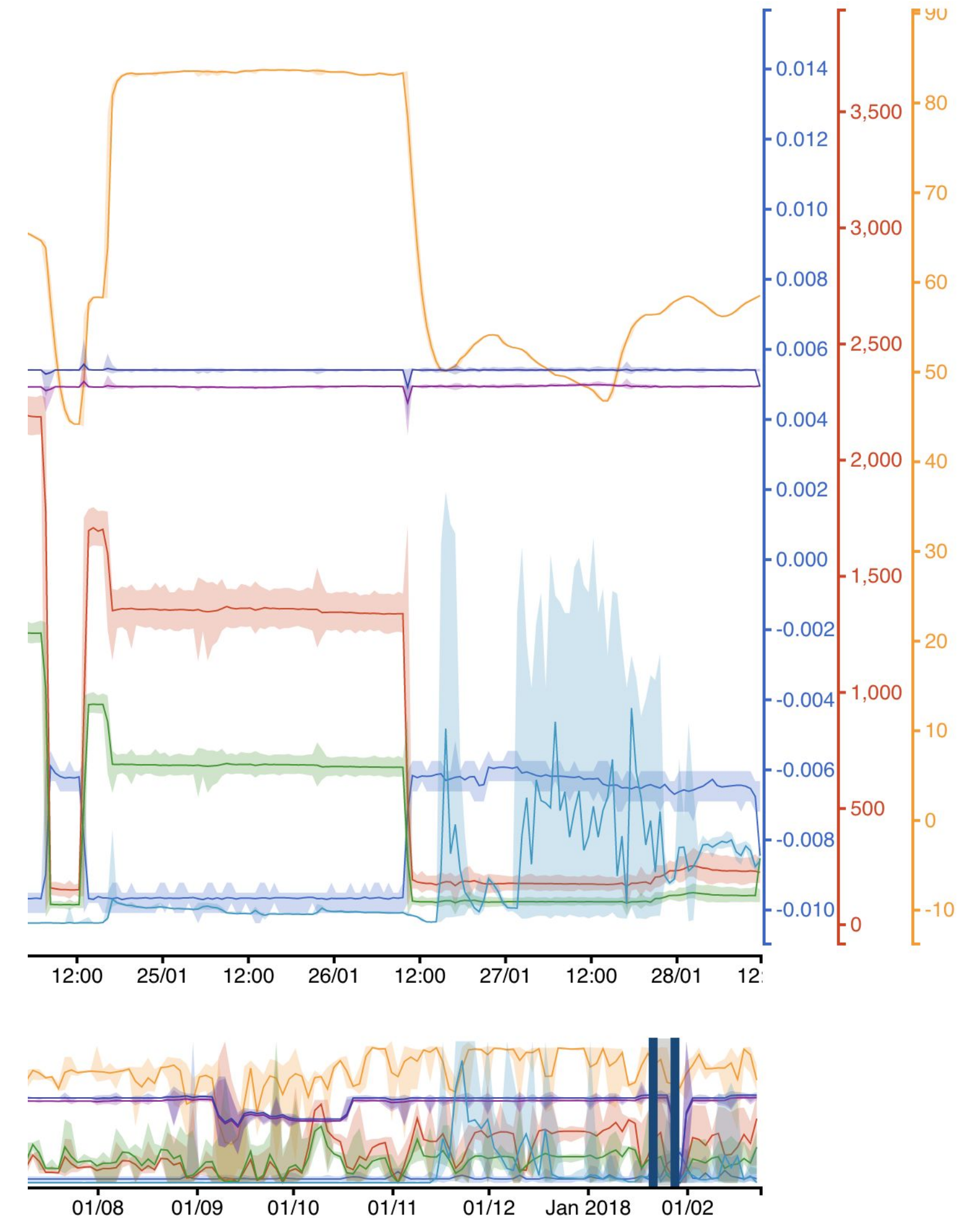
<https://github.com/cognitedata/griff-react>

- High performance charting of large time series
- Dynamic data loading
- No tight coupling to Cognito TSDB
- Uses React and d3

```
yarn add @cognite/griff-react
```

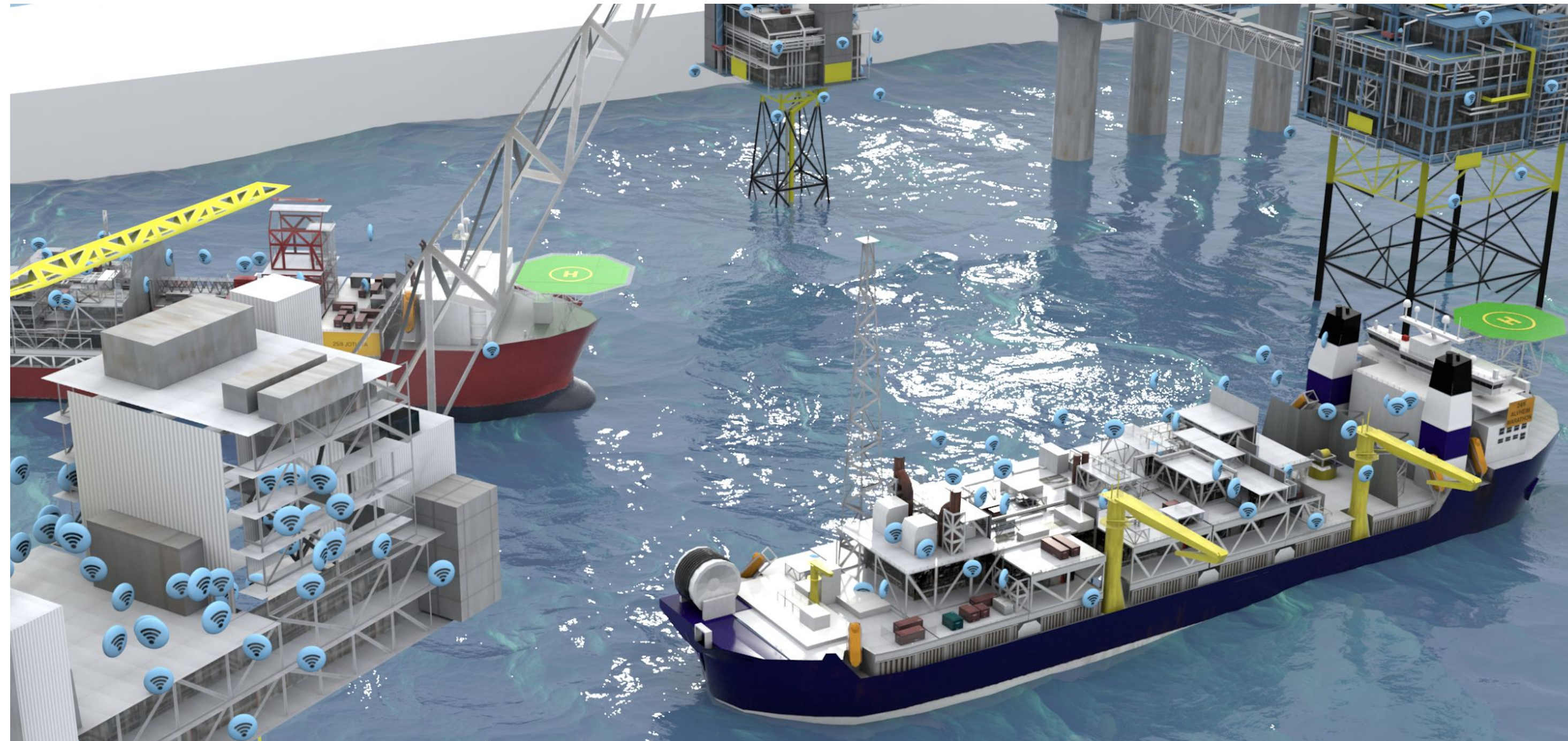
Or

```
npm i @cognite/griff-react
```



IoT & the data explosion

50 billion devices connected to internet by 2023 according to Statista (2018) [1]. Cognite currently covers 500 000 sensors, each producing one GB every two years



[1] <https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/> (2018)

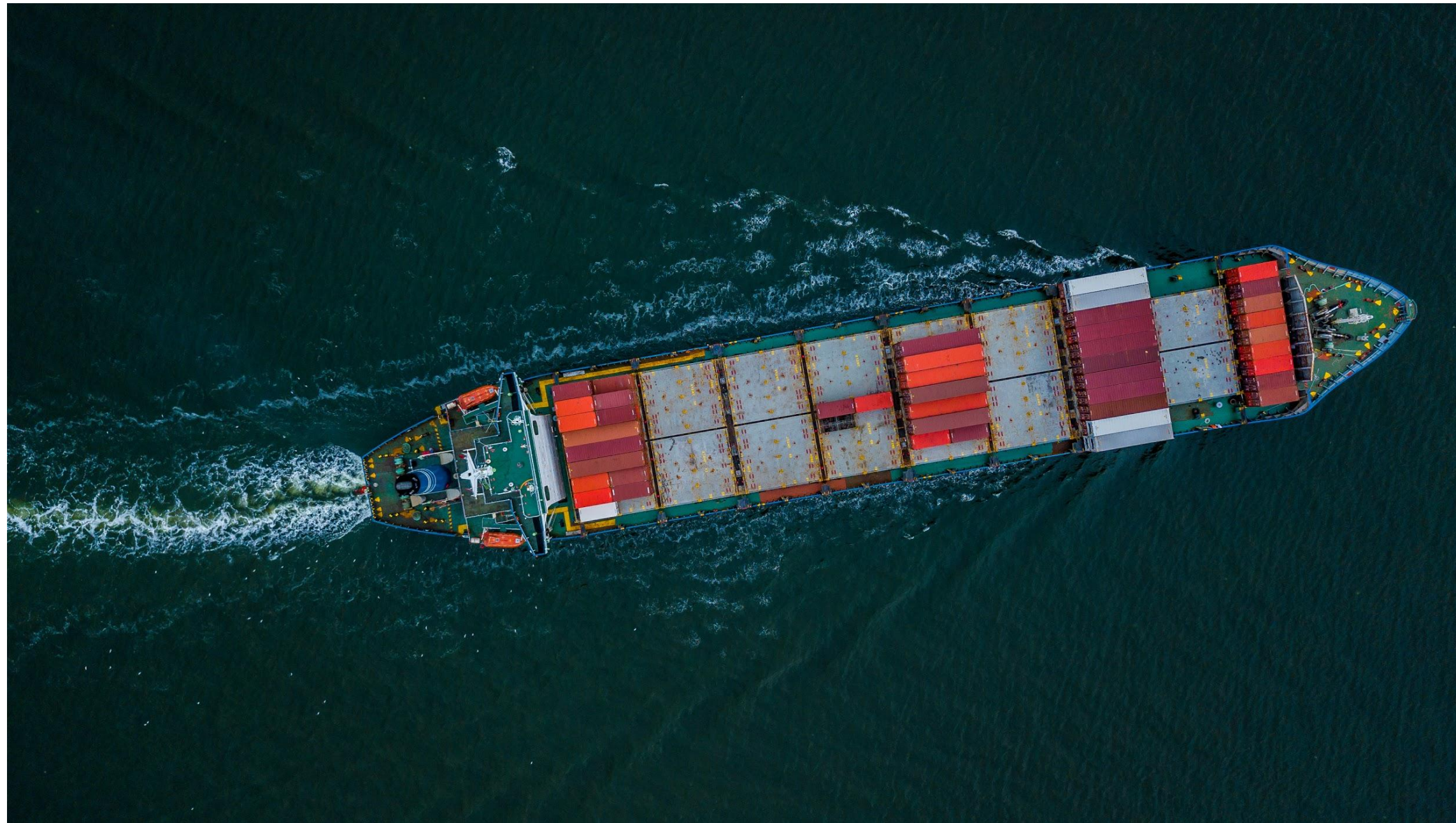
Time series requirements

- Robustness
- High volume of reads and writes
- Low latency
- Arbitrary granularity aggregates
- Efficient backfill
- Efficient sequential reads

Surely there must be an off-the-shelf solution that satisfies this!

Databases for IoT - two approaches

Single node*



Horizontally scaling



* Often does master - slave, or other read-only replication, but not partitioning

OpenTSDB experiments

- No limit parameter on queries
- No batch inserts, so slow backfills
- Can lose incoming data points
- Aggregates not pre-computed on write

Disclaimer: OpenTSDB experiments from summer 2017 on version 2.3.0

The case for Cloud Bigtable

- Fully managed
- 10k writes/s per node (SSD)
- Scalable to 100s of PBs
- Can scan forward efficiently
- Column families and versioning



A brief introduction to Google Cloud Bigtable

Achieve your
performance goals



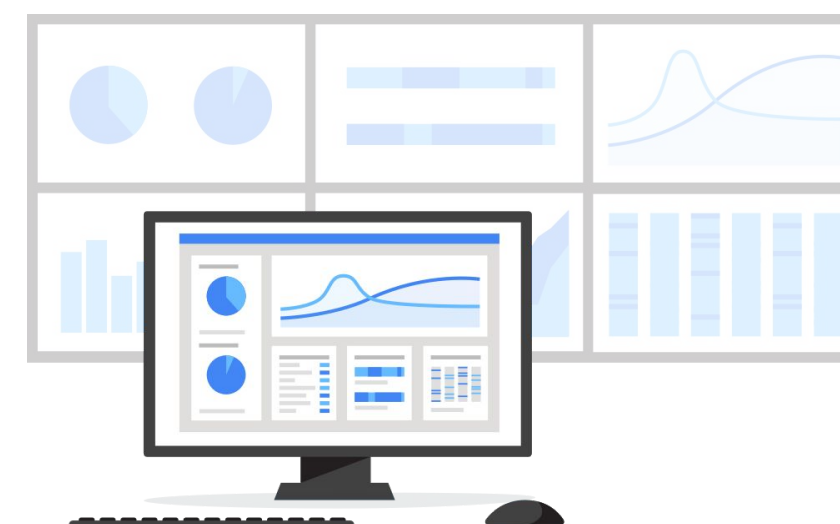
Single digit ms
write latency for
performance-critical apps

Serve global
audiences



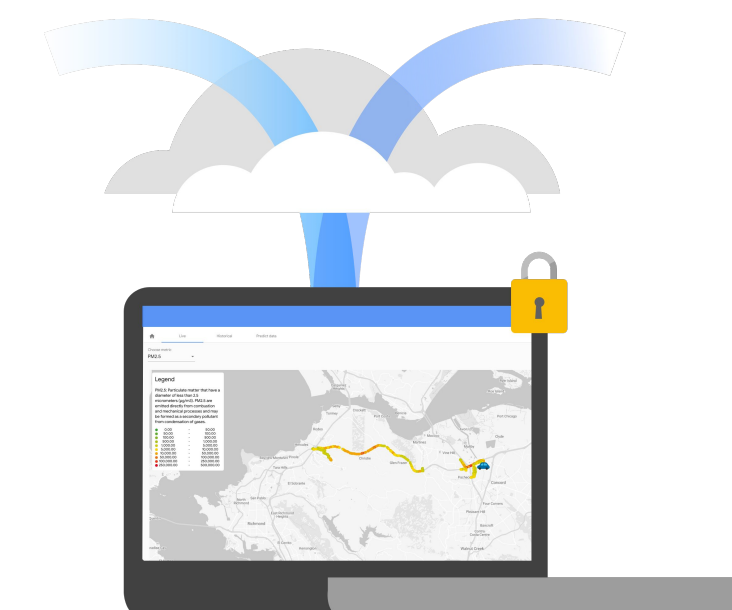
99.99% availability
across Google's
dedicated network

From DevOps
to NoOps



Reduce management
effort from weeks
to minutes

Supercharge your
applications



Stream, secure,
analyze and drive ML/AI

Wide-columnar data model

NoSQL (no-join)
distributed key-value store,
designed to scale-out
Has only **one index** (the
row-key)
Supports atomic
single-row transactions
Sparse: Unwritten cells do
not take up any space

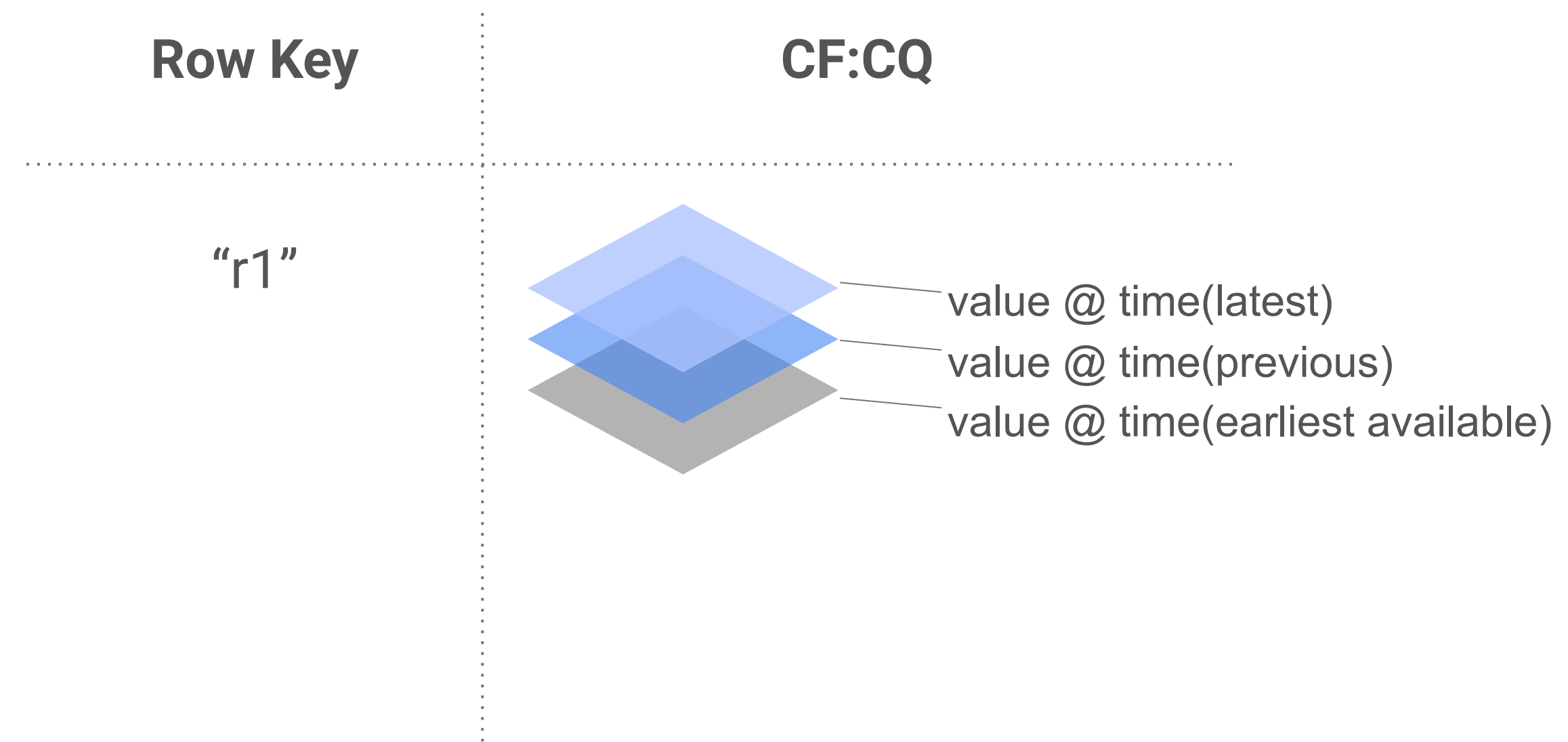
Row Key	Column-Family-1		Column-Family-2	
	<i>Column- Qualifier-1</i>	<i>Column- Qualifier-2</i>	<i>Column- Qualifier-1</i>	<i>Column- Qualifier-2</i>
r1	r1, cf1:cq1	r1, cf1:cq2	r1, cf2:cq1	r1, cf2:cq2
r2	r2, cf1:cq1	r2, cf1:cq2	r2, cf2:cq1	r2, cf2:cq2

Three-dimensional data space

Every cell is **versioned** (default is timestamp on server)

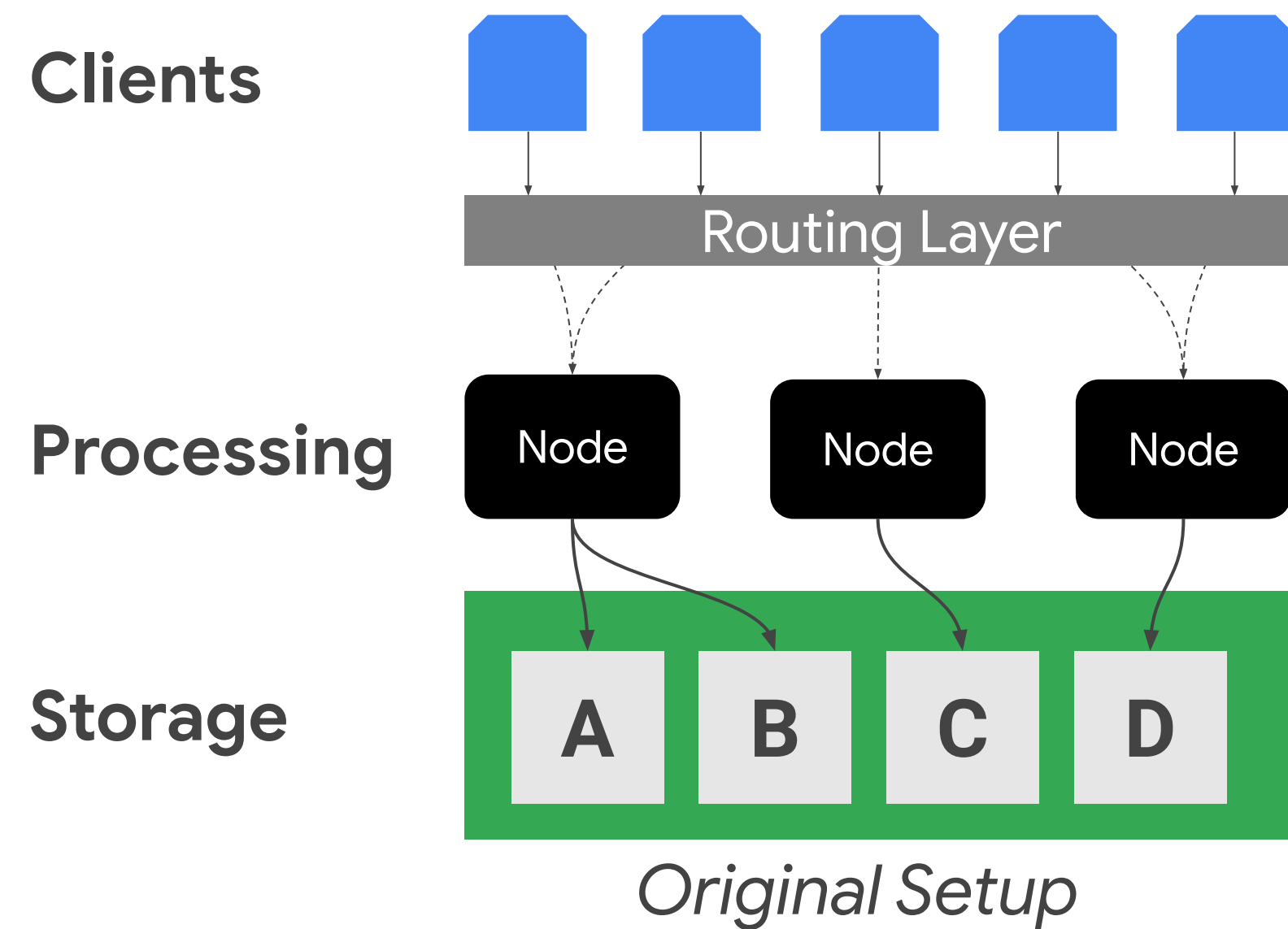
Configurable **garbage collection** retains latest N versions (or after TTL)

Expiration can be set at **column-family level**

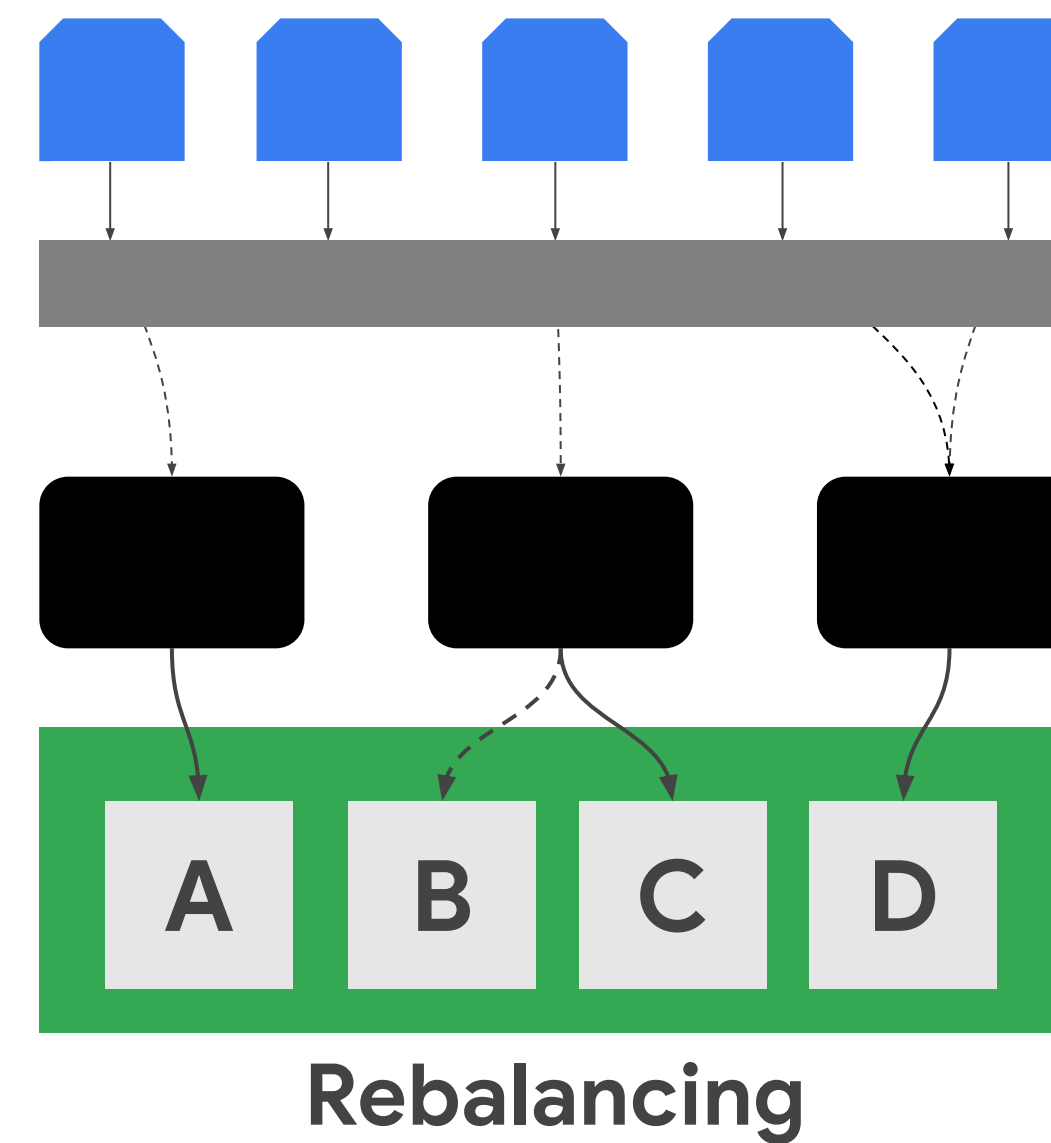


Cloud Bigtable - Optimizing throughput

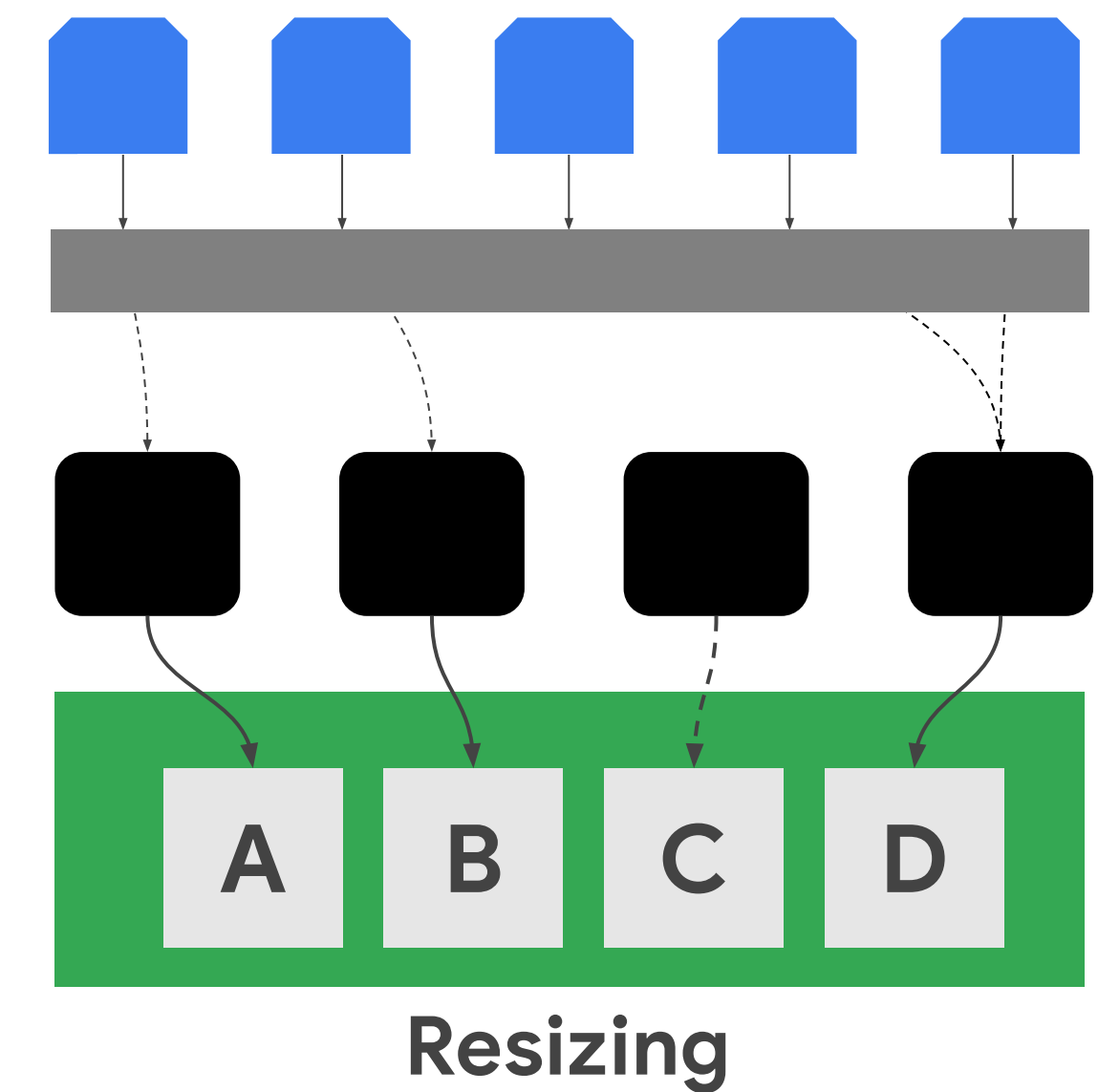
Cloud Bigtable separates processing from storage through use of nodes, each of which provides access to a group of database rows



Rebalancing automatically reduces the load on highly active nodes (in this case there is a lot of activity for data group A)



User-driven resizing as needed to match data throughput targets, with no downtime



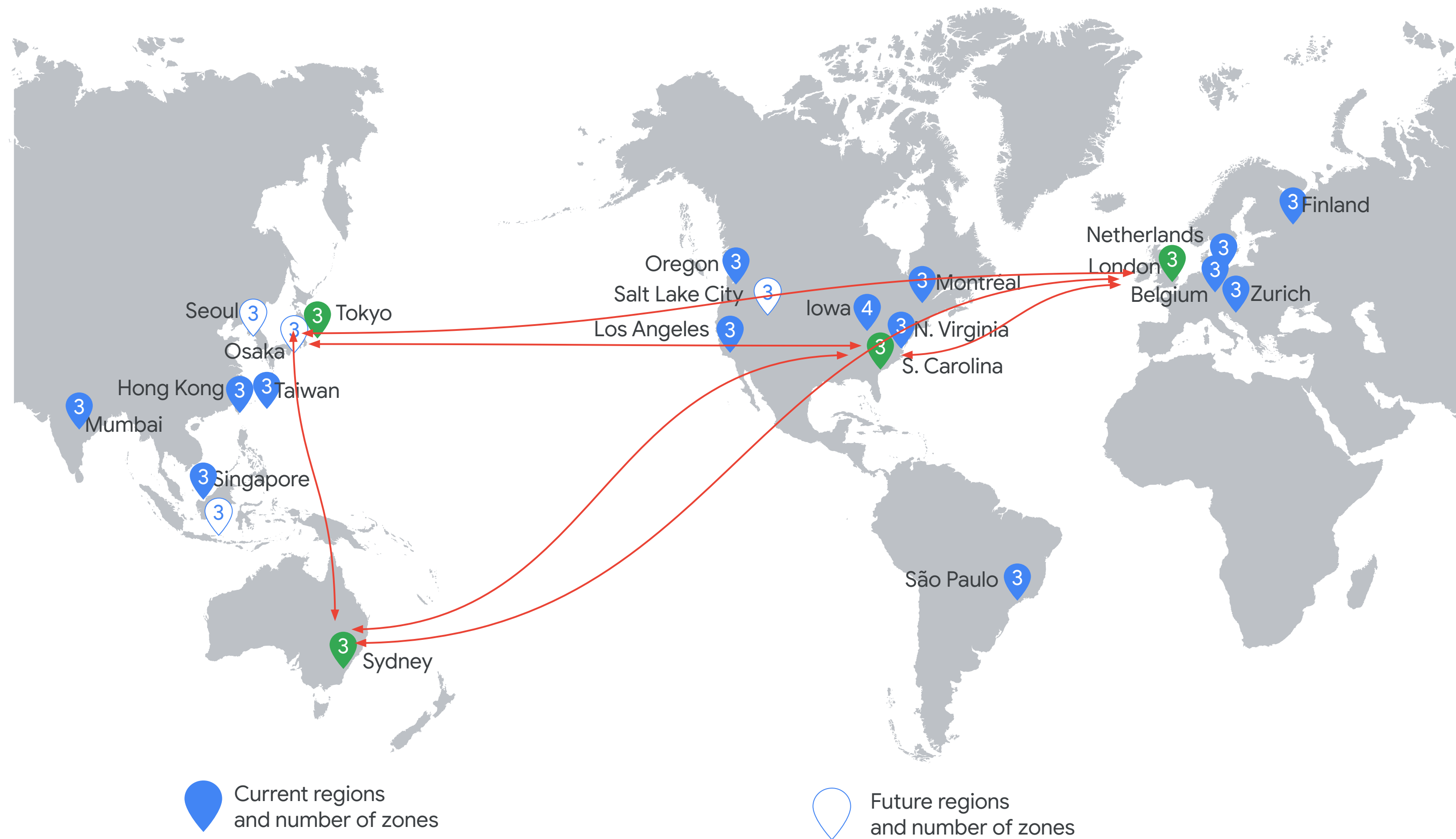
Cloud Bigtable replication

Regional replication

- SLA increased to 99.99%
- Isolate serving and analytics
- Independently scale clusters
- Automatic failover in case of a zonal failure

Global replication

- Increases durability/availability beyond one region
- Fastest region-specific access
- Option for DR replica for regulated customers



Cloud Bigtable for IoT - best practices

Recommendations for row key design	Recommendations for data column design
Use tall and narrow tables	Rows can be big but are not infinite (1000 timestamp/value pairs per row is a good rule of thumb)
Prefer rows to column versions	Keep related data in the same table; keep unrelated data in different tables
Design your row key with your queries in mind	Store data you will access in a single query in a single column family
Ensure that your row key avoids hotspotting	Don't exploit atomicity of single rows
Reverse timestamps only when necessary	

How Cognite stores data in Cloud Bigtable

Row key

This is the only thing you can lookup,
but can also scan **forward**

Group by
customer ID,
sensor ID
first

Then
chronologically

“Customer1-Sensor1-2018-07-24-01”

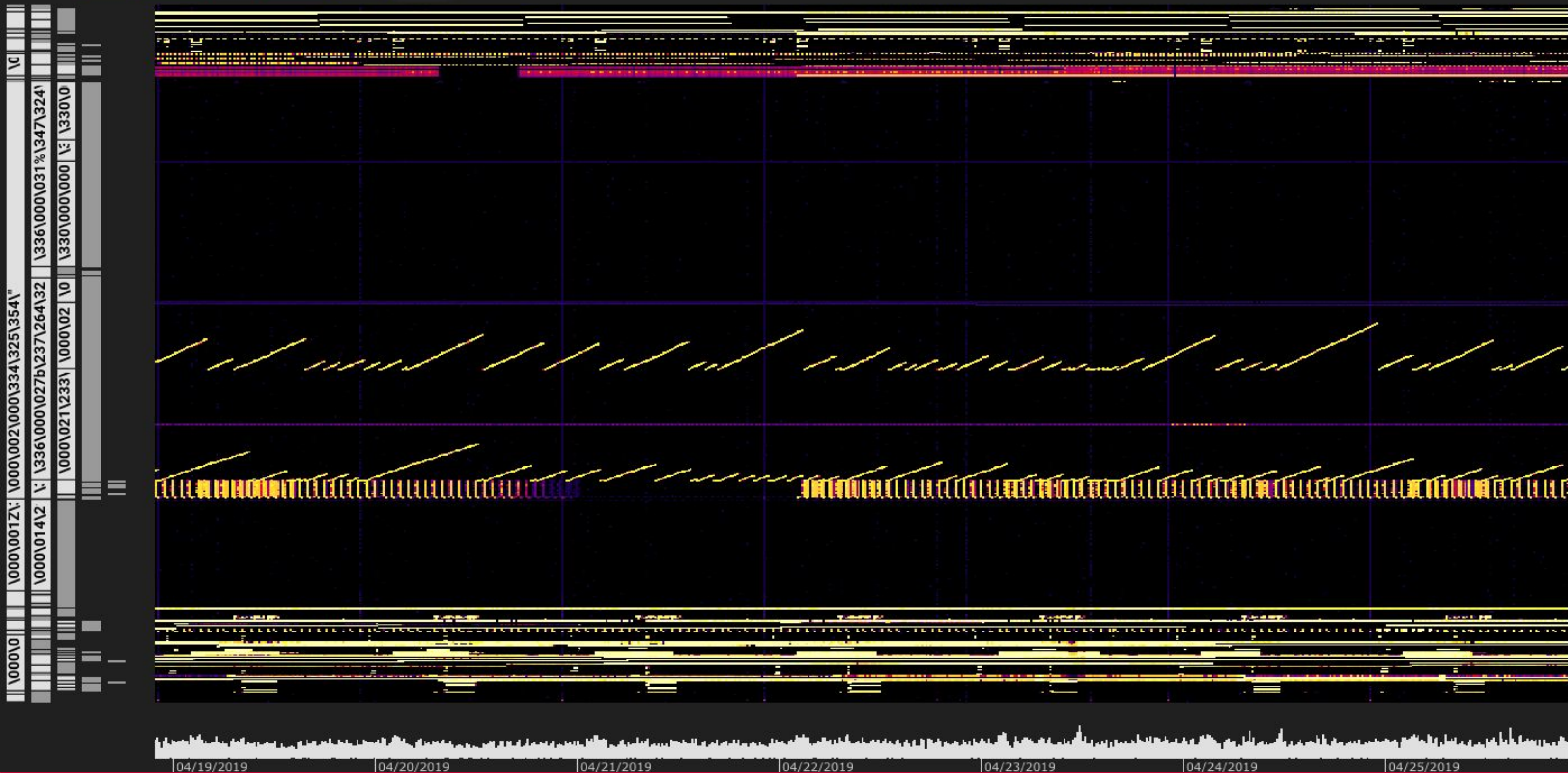
“Customer1-Sensor1-2018-07-24-02”

“Customer1-Sensor2-2018-01-01-01”

“Customer1-Sensor2-2018-01-01-02”

0 2.95 5.9 8.85 11.8 59 118 μ Ops/row/min - +

Average: 10.77 μ Ops/row/min Total (avg over time): 10.1 KOps



Improved key schema

Row key

Group by
sensor ID
first

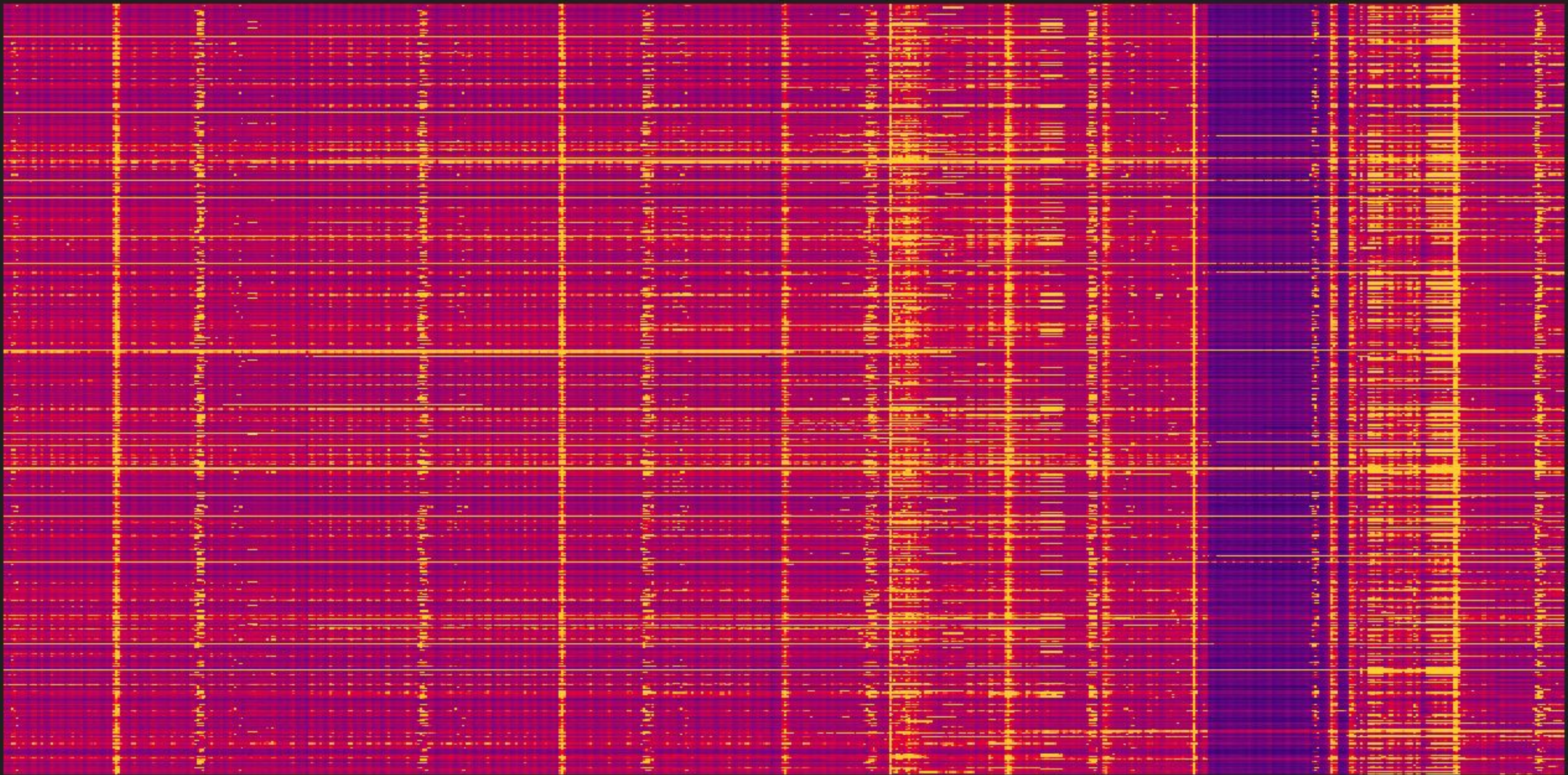
<hash of sensor id><customer id><sensor id><time bucket>

Then
chronologically

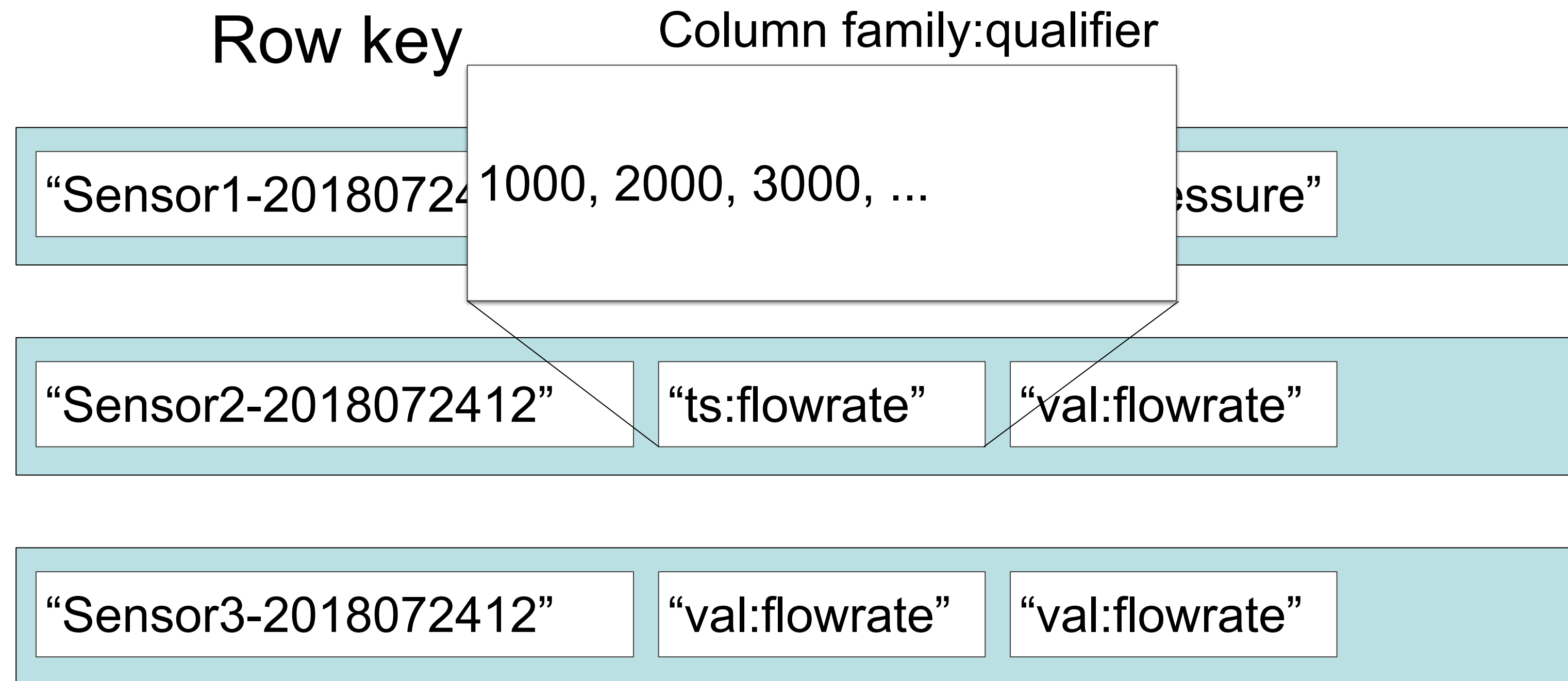
0 40.5 81 121 162 810 1620 μ Ops/row/min



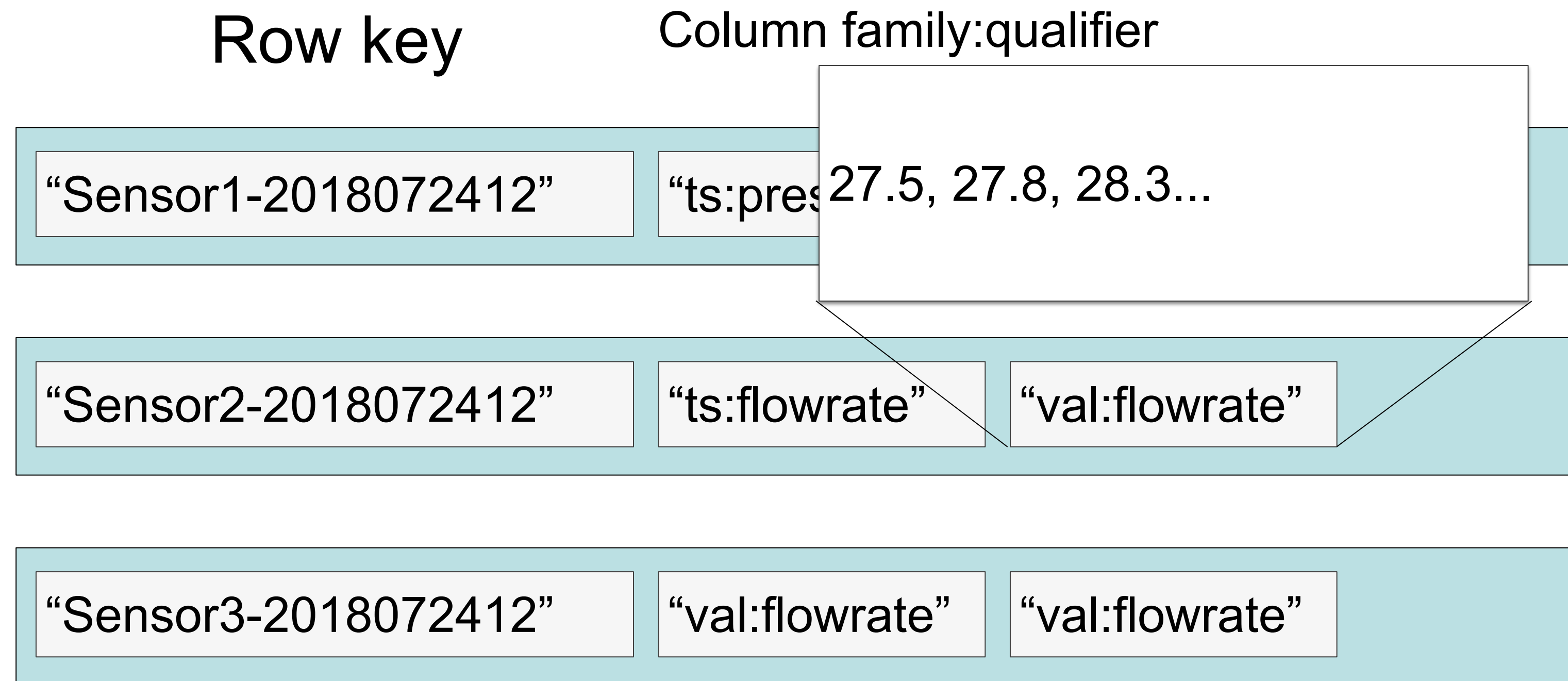
Average: 106.95 μ Ops/row/min Total (avg over time): 549.03 KOps



How Cognite stores data in Cloud Bigtable



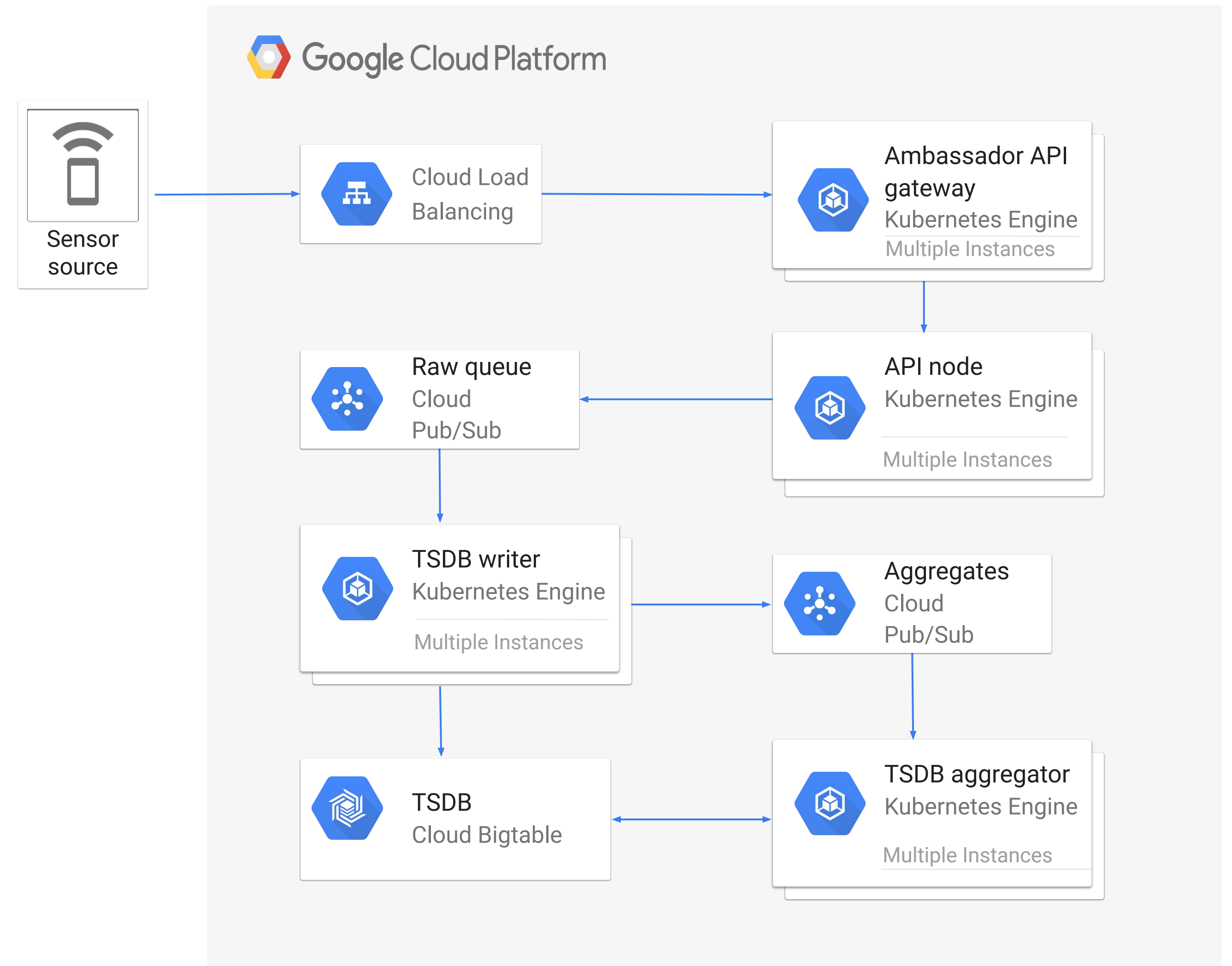
How Cognite stores data in Cloud Bigtable



System performance

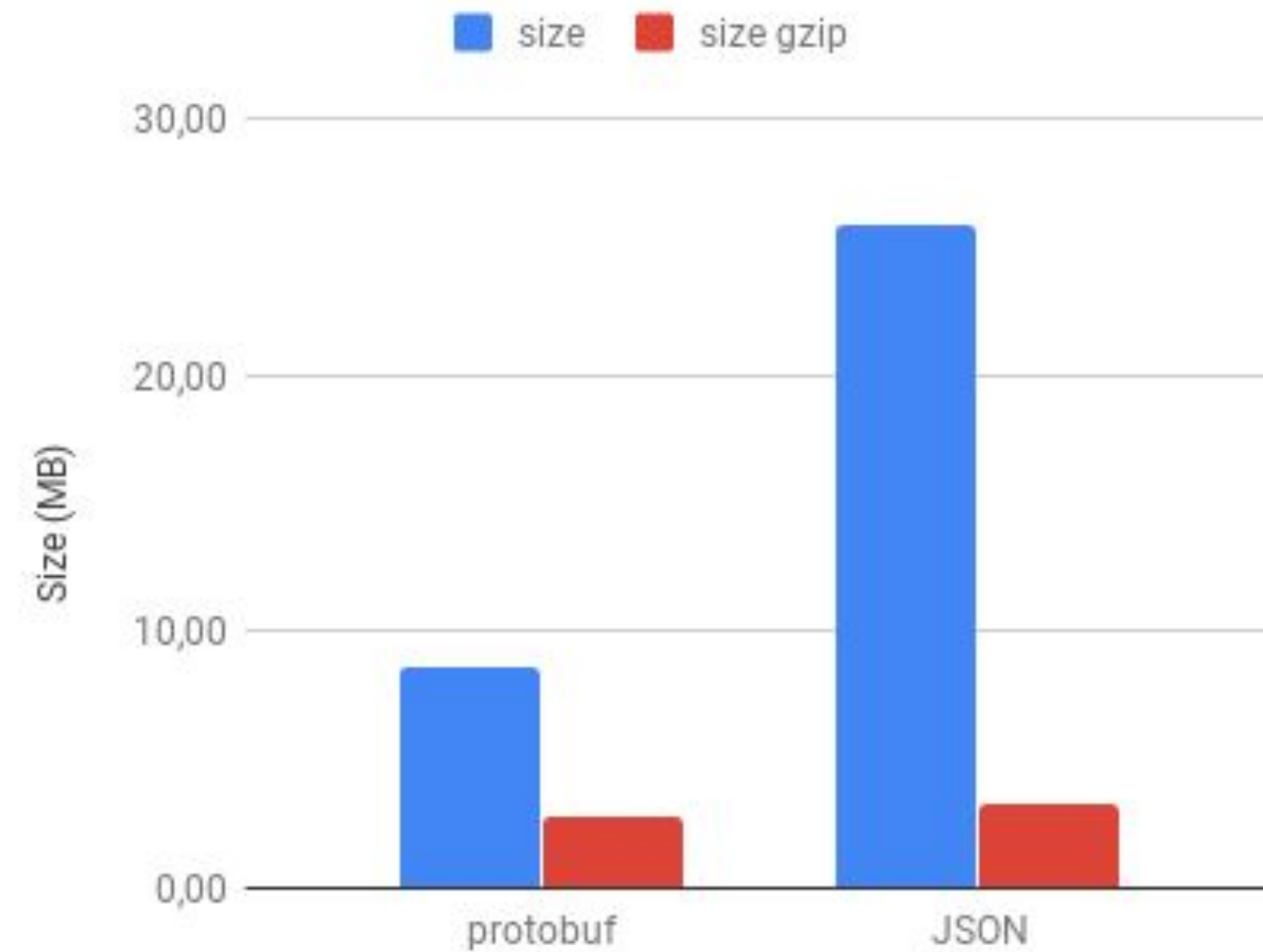
Performance:

- **Throughput:** Handles up to 10M data points per second
- **Latency:** Data queryable after 200ms (99th percentile)

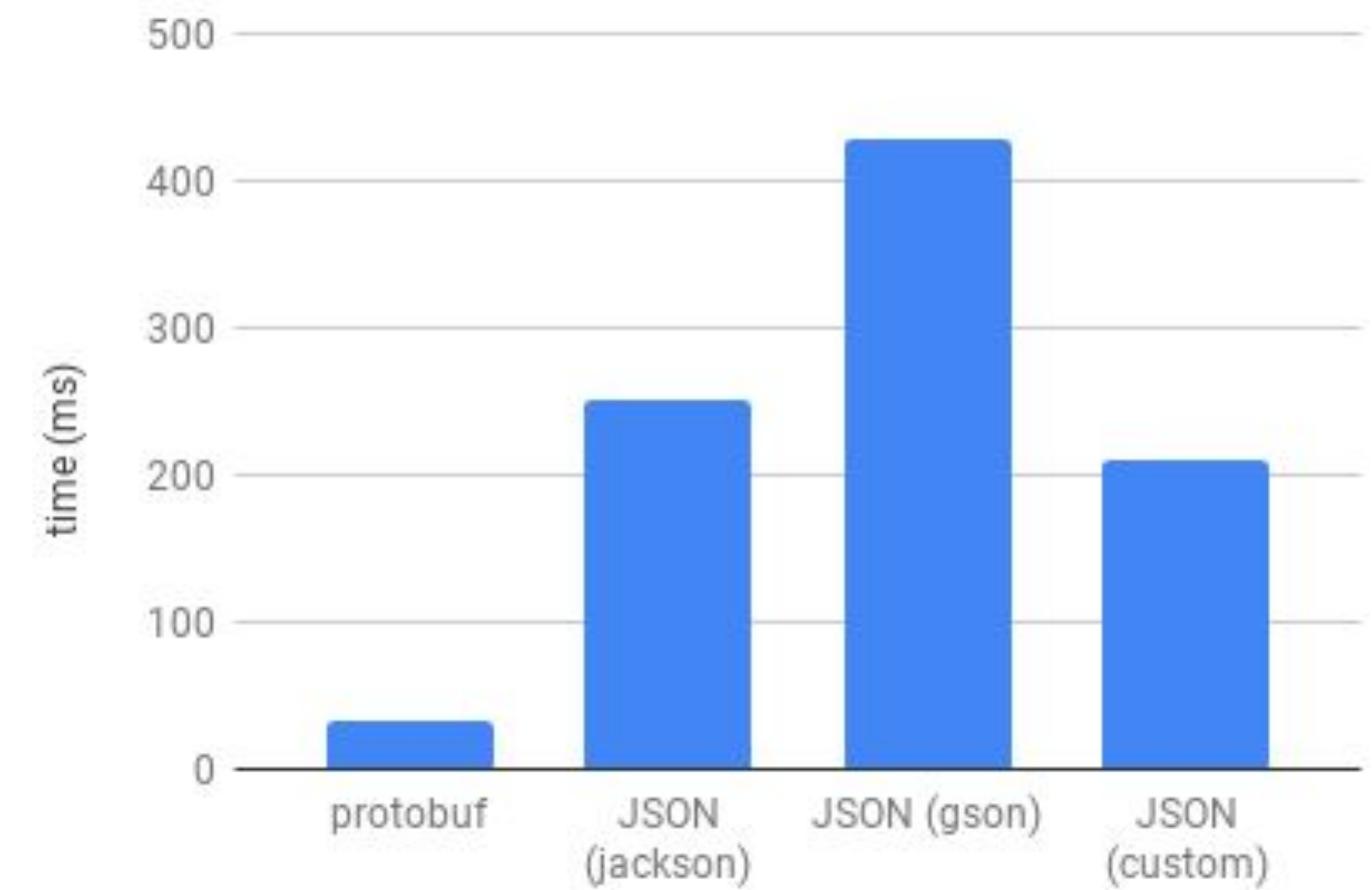


Protobuf vs JSON

Size of 100k data points



Time to de-serialize 100k data points

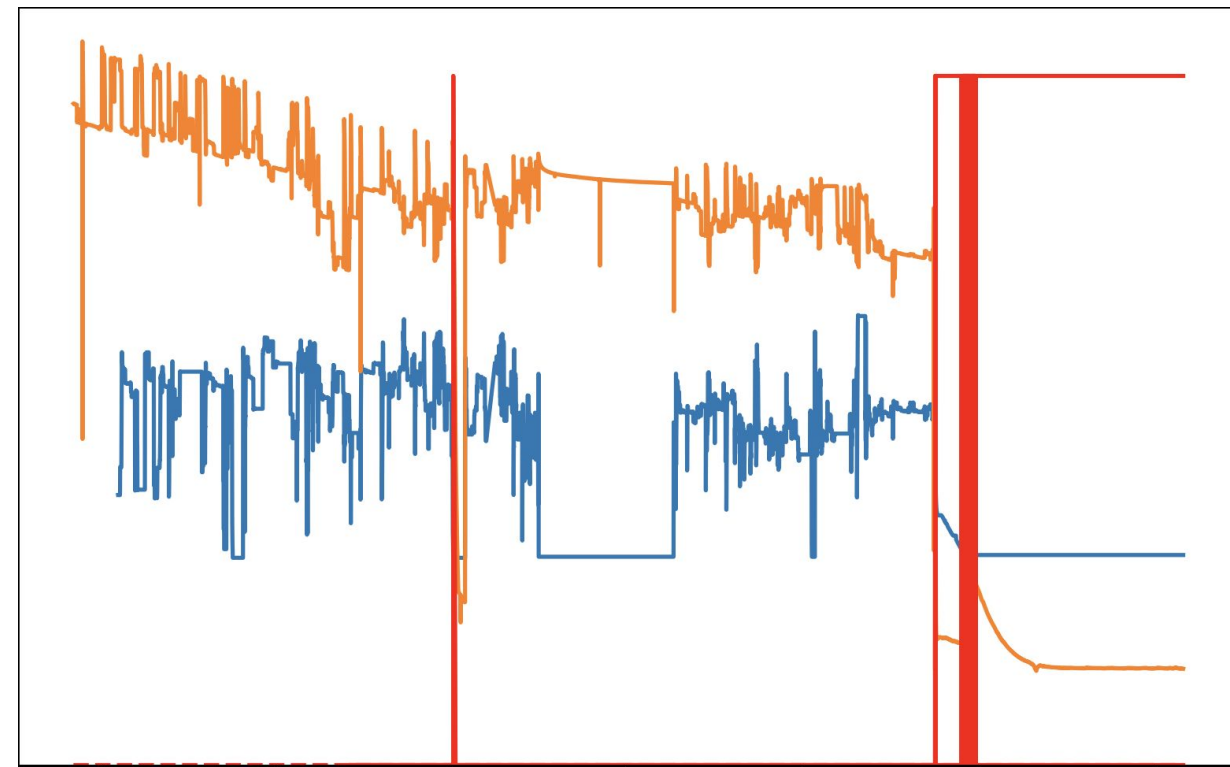




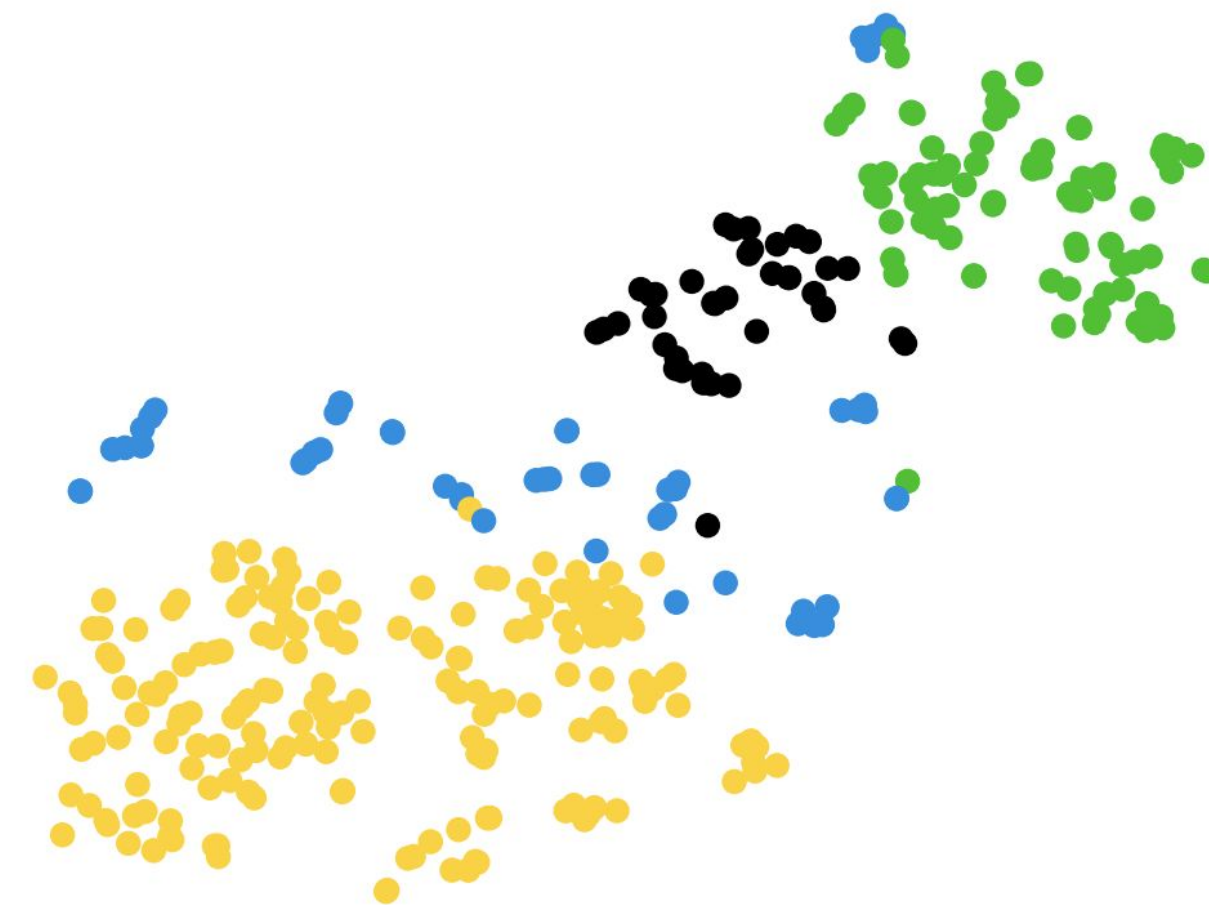
Machine learning

Unsupervised anomaly detection

Forecasting

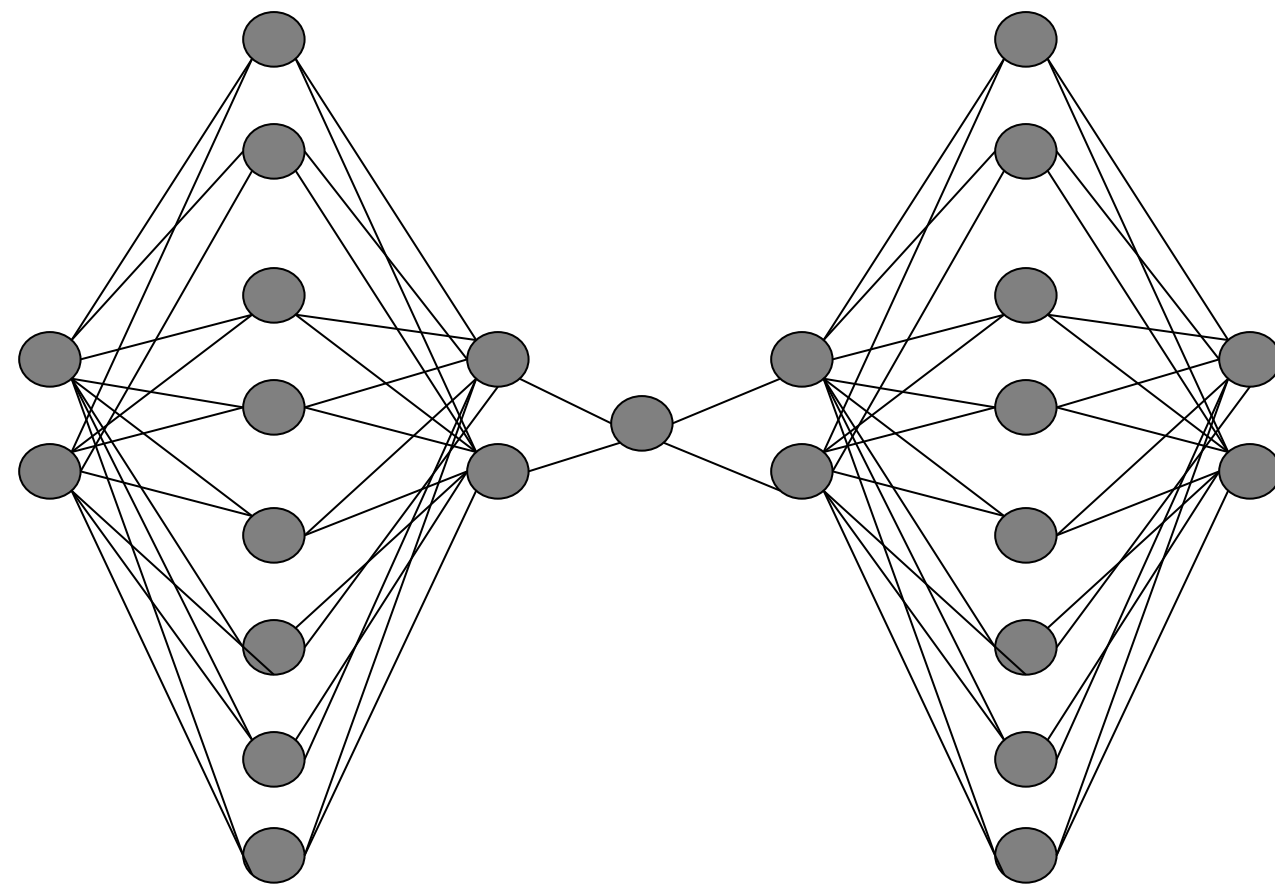


Clustering

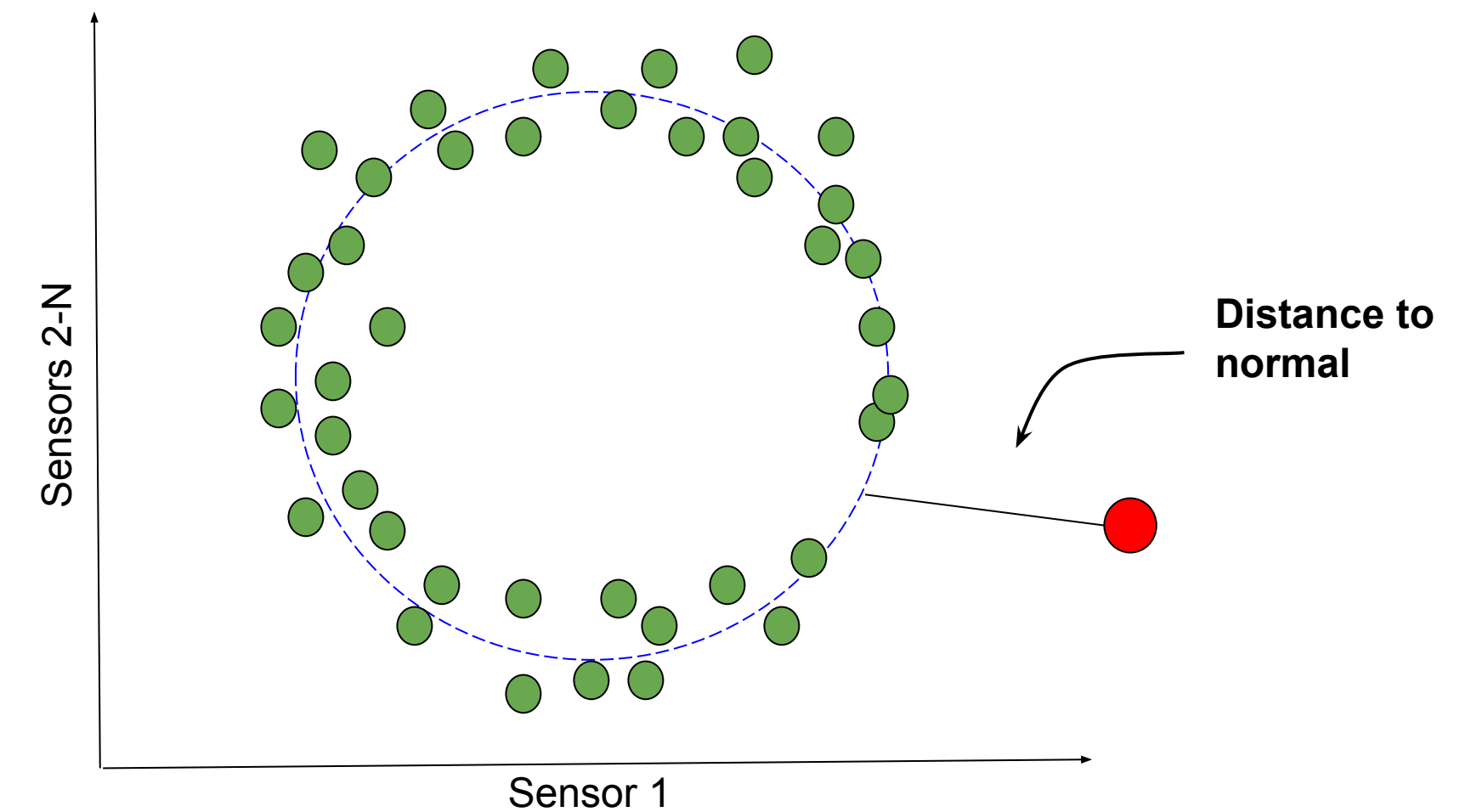


Unsupervised detection with AutoEncoders

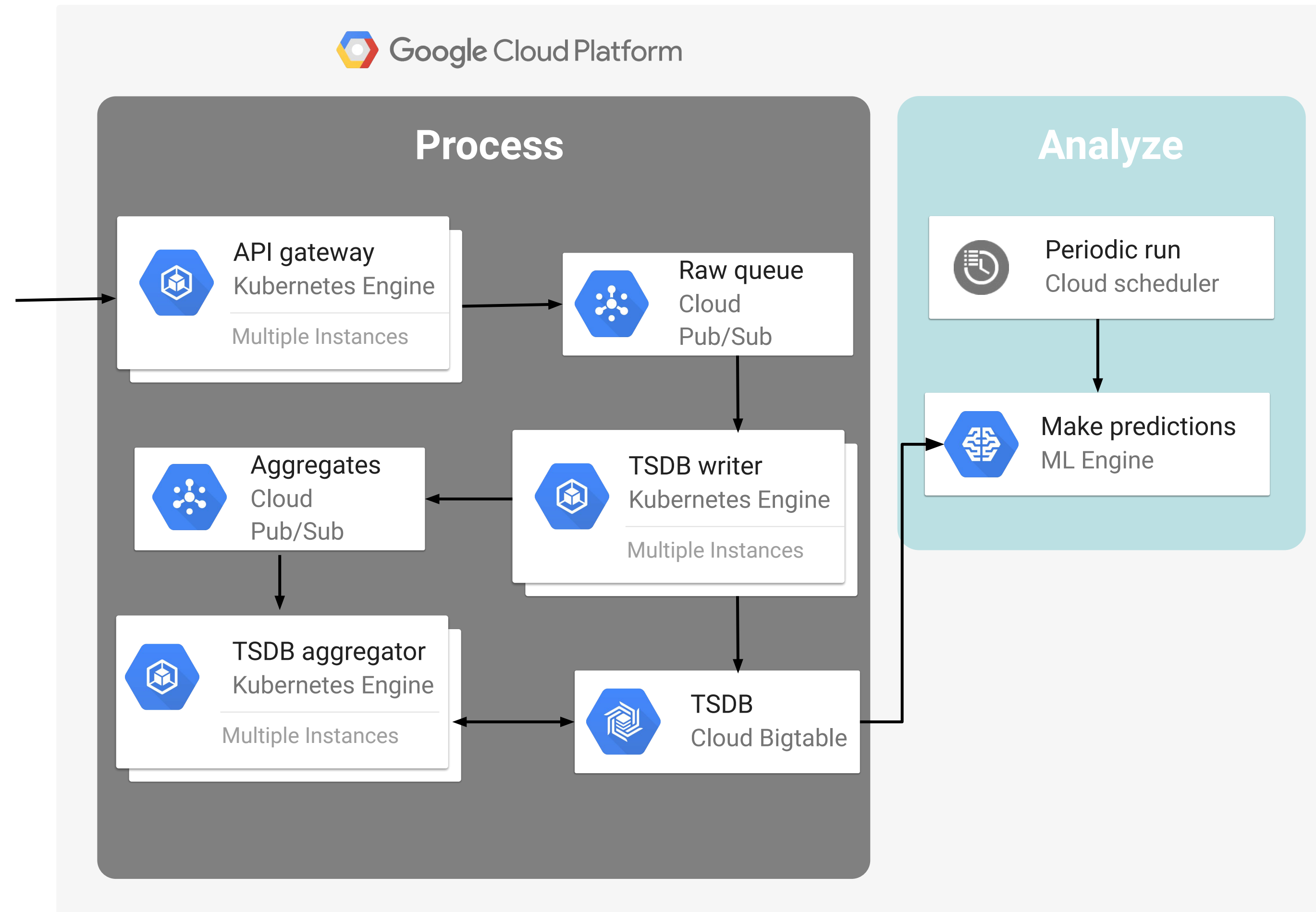
Architecture search....



... to learn a parameterization of normality



Machine learning architecture



Future improvements

- Ability to query consistent snapshots back in time
- High frequency time series
- Efficient latest data point query

Next steps

Cloud Bigtable

- cloud.google.com/bigtable
- cloud.google.com/bigtable/docs/schema-design-time-series

Machine learning

- cloud.google.com/products/ai

Q&A

Rate today's session

Cyberconflict: A new era of war, sabotage, and fear

See passes & pricing

David Sanger (The New York Times)
9:55am-10:10am Wednesday, March 27, 2019
Location: Ballroom
Secondary topics: [Security and Privacy](#)

Rate This Session

We're living in a new era of constant sabotage, misinformation, and fear, in which everyone is a target, and you're often the collateral damage in a growing conflict among states. From crippling infrastructure to sowing discord and doubt, cyber is now the weapon of choice for democracies, dictators, and terrorists.

David Sanger explains how the rise of cyberweapons has transformed geopolitics like nothing since the invention of the atomic bomb. Moving from the White House Situation Room to the dens of Chinese, Russian, North Korean, and Iranian hackers to the boardrooms of Silicon Valley, David reveals a world coming face-to-face with the perils of technological revolution—a conflict that the United States helped start when it began using cyberweapons against Iranian nuclear plants and North Korean missile launches. But now we find ourselves in a conflict we're uncertain how to control, as our adversaries exploit vulnerabilities in our hyperconnected nation and we struggle to figure out how to deter these complex, short-of-war attacks.

David Sanger
The New York Times

David E. Sanger is the national security correspondent for the *New York Times* as well as a national security and political contributor for CNN and a frequent guest on *CBS This Morning*, *Face the Nation*, and many PBS shows.




Session page on conference website

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Cyberconflict: A new era of war, sabotage, and fear

🕒 9:55 AM - 10:10 AM, Wed, Mar 27, 2019

Speakers




David Sanger
National Security Correspondent
The New York Times

📍 Ballroom

Keynotes

David Sanger explains how the rise of cyberweapons has transformed geopolitics like nothing since the invention of the atomic bomb. From crippling infrastructure to sowing discord and doubt, cyber is now the weapon of choice for democracies, dictators, and terrorists.

 **SESSION EVALUATION**

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