Kafka Monitoring: What Matters!

Amrit Sarkar

THIS IS NOT A CONTRIBUTION

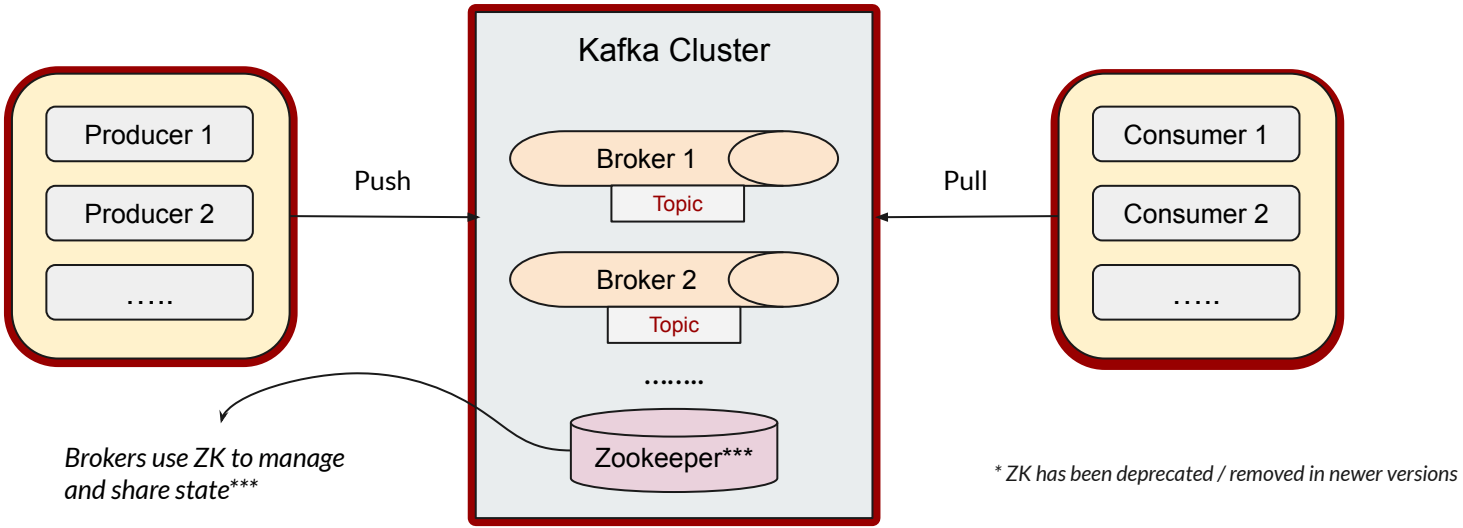
Agenda

- Kafka Basics
- Performance Areas
- Need for Observability
  - Monitoring Options
- Performance classification around Components
- Kafka Consumer Lag evaluation
  - absolute to relative
- Trend Analysis

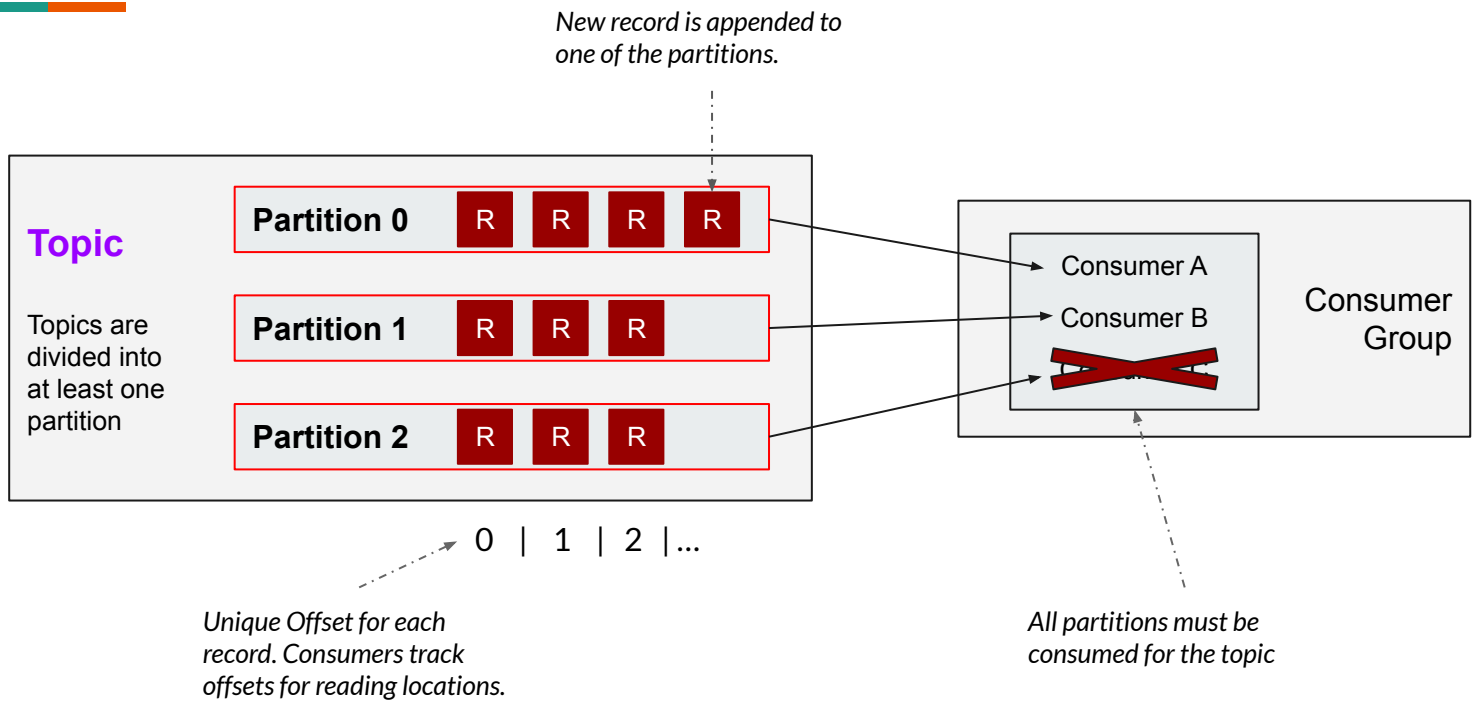
Kafka Basics

Kafka moves data between producers (writers) and consumers (readers),
with data protection, high availability, low latency at high scale!

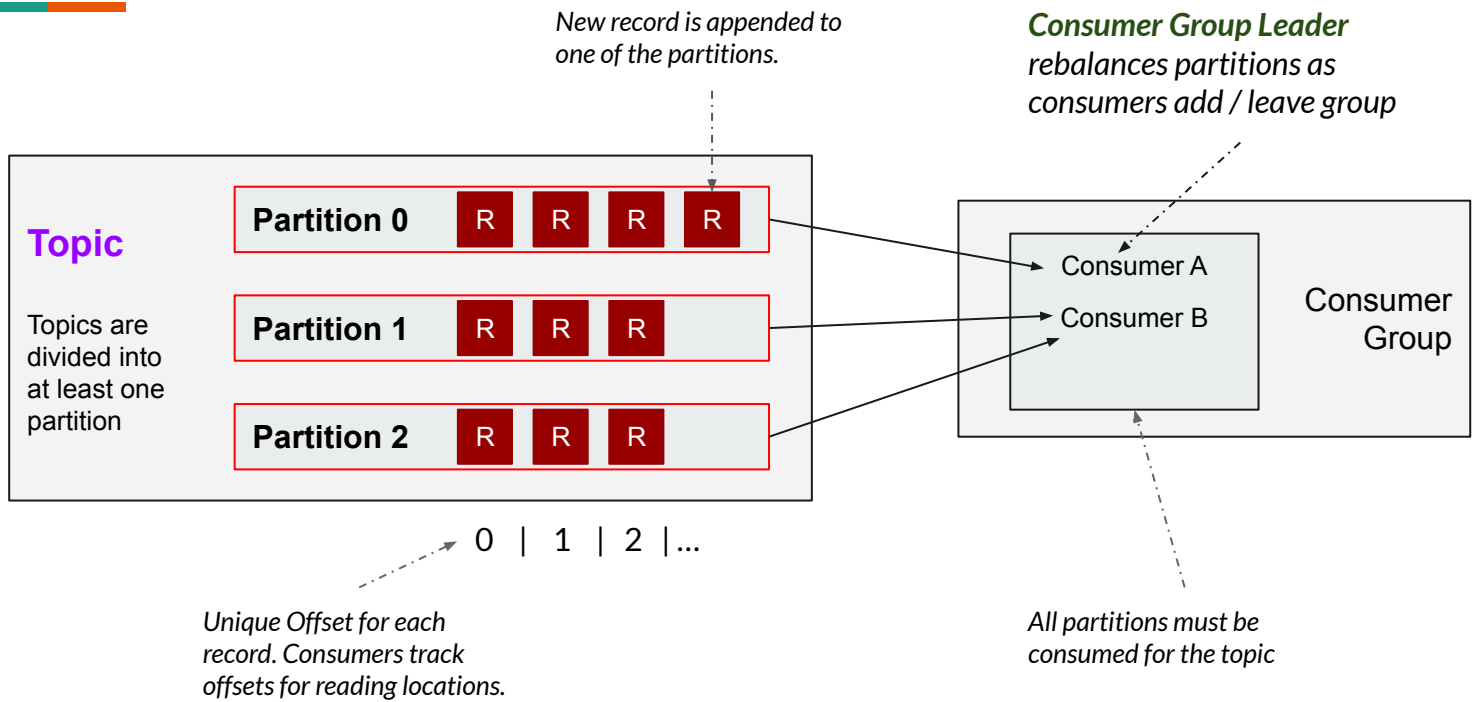
Use cases: Metrics, Log Aggregation Solution & Stream Processing



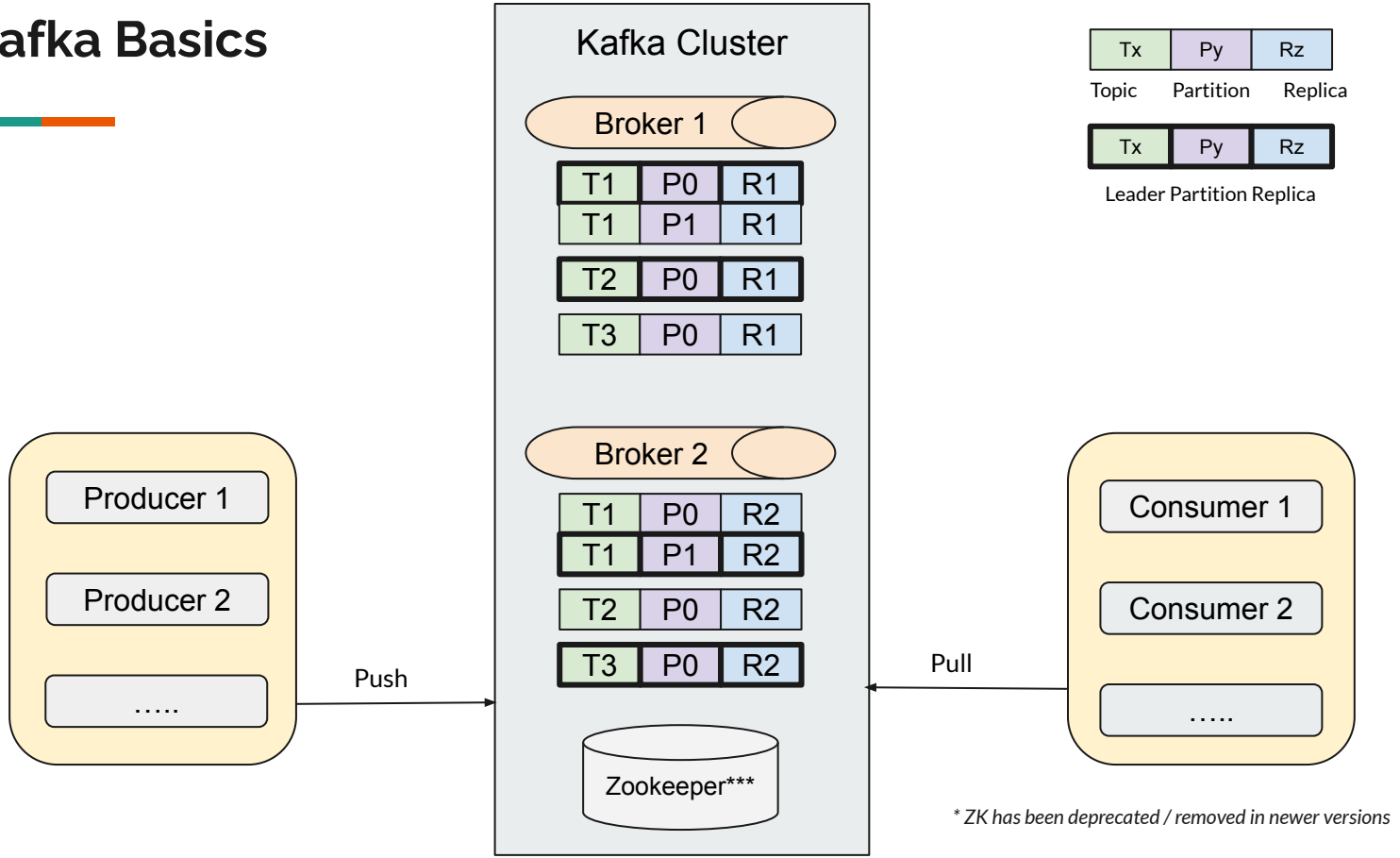
Kafka Basics



Kafka Basics

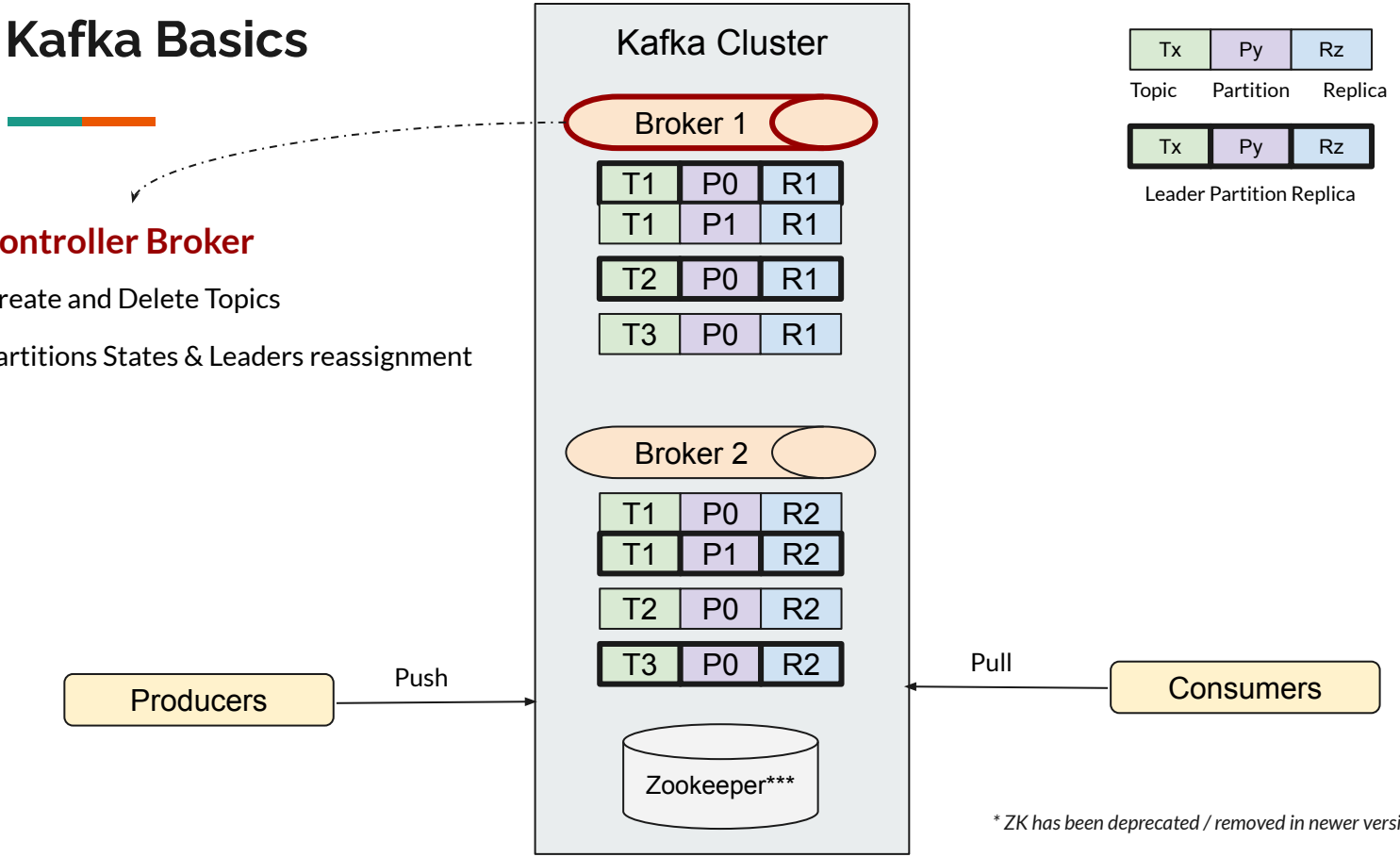


Kafka Basics



** ZK has been deprecated / removed in newer versions*

Kafka Basics



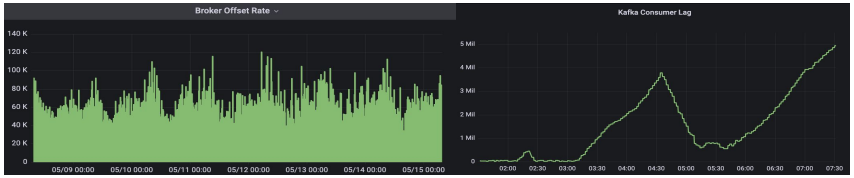
Controller Broker

* Create and Delete Topics
* Partitions States & Leaders reassignment

** ZK has been deprecated / removed in newer versions*

Performance Areas

- Throughput & Latency
  - Production Rates
  - Consumption Rates
  - Consumers' Lag
- Data Integrity
  - Reads Confirmation
  - Writes Confirmation
- Fault Tolerance
  - No business impact on failure
- Resource Usage

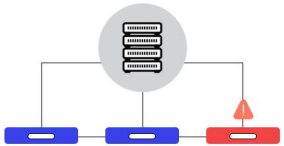


Broker Ack

0 Acks — Low Latency, Weak Durability

1 Ack — Med Latency, Better Durability

All Acks — High Latency, Best Durability

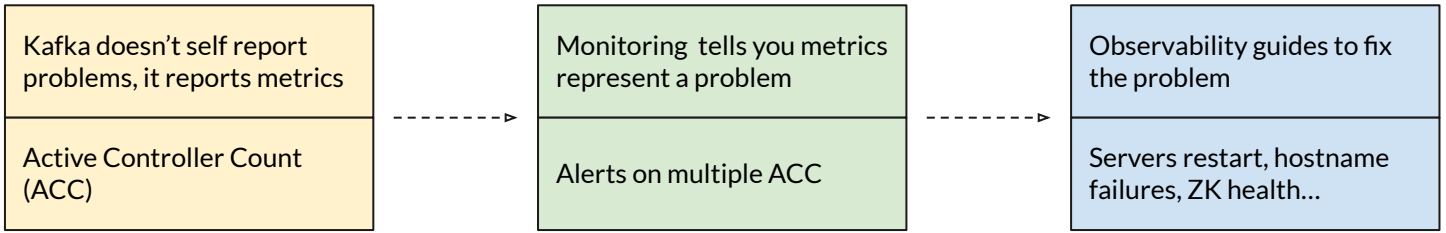


CPUs | Memory | Storage | Network Bandwidth | ....

Why do we need Observability?

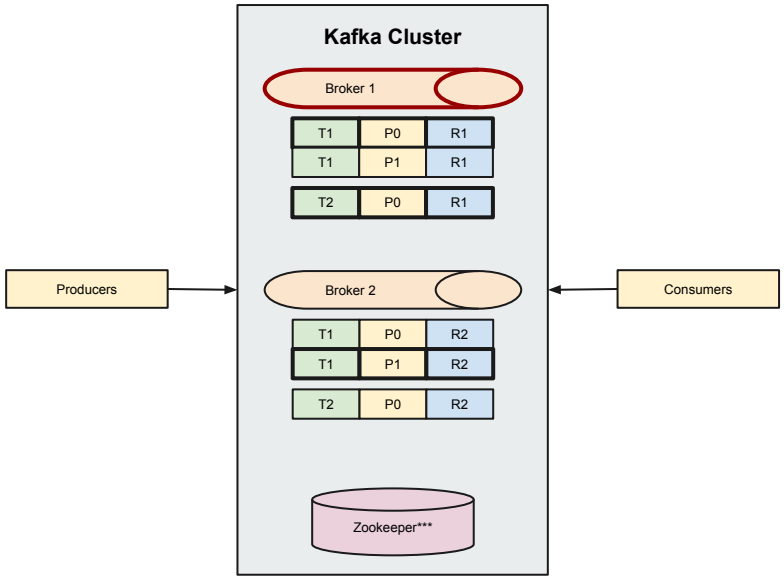
Pre-built dashboards monitor and alert for anticipated future performance issues.

Explore and quickly identify unanticipated issue root causes in an observability scenario.



Performance classification around Components

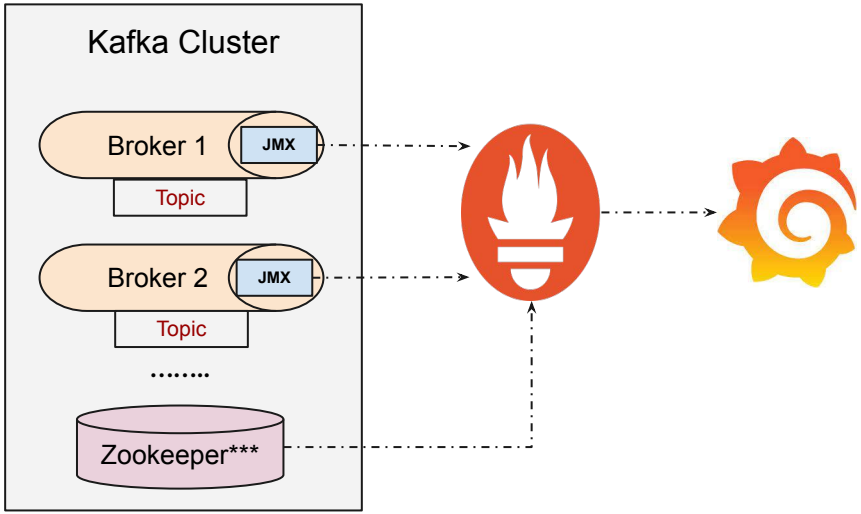
Each component act as potential factor in the performance of Kafka messaging system.



** ZK has been deprecated / removed in newer versions*

- Producers
  - Rate
- Brokers
  - Topics Health
  - Load Distribution
- Topics
  - Partition Health
  - Load Distribution
- Consumers
  - Rate
  - ***Lag***
- Generic
  - Transmission (Network) health
  - Capacity

Monitoring Options - Getting Metrics In



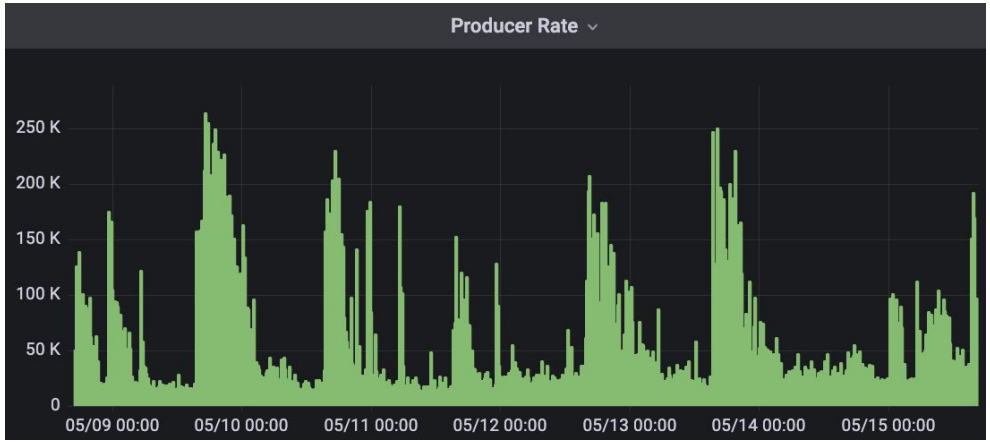
- Confluent Control Center
- KafDrop
- Yahoo Kafka Manager
- Cruise Control
- Kafka Monitor
- Kafka Tool

... and more

Producer: Rate

- **send()** function call (or similar) to push data → ***RecordMetadata*** object
    - **offset()** function returns a **LONG** → offset of the the record in the topic-partition.

Offset value can be pushed to metrics store for visualisation.



Producer: Compression & Latency

- Bigger batches →
  - higher throughput
  - less compression
  - Small enough to keep GC ⏚ *(<< 10mb)*

Ideally

- Batch Size in Bytes → **Optimally High**

  kafka.producer:type=producer-metrics,client-id="{client-id}" ***batch-size-avg***

- Compression Rate → **LOW**

  kafka.producer:type=producer-metrics,client-id="{client-id}" ***compression-rate-avg***

- Request Latency → **LOW**

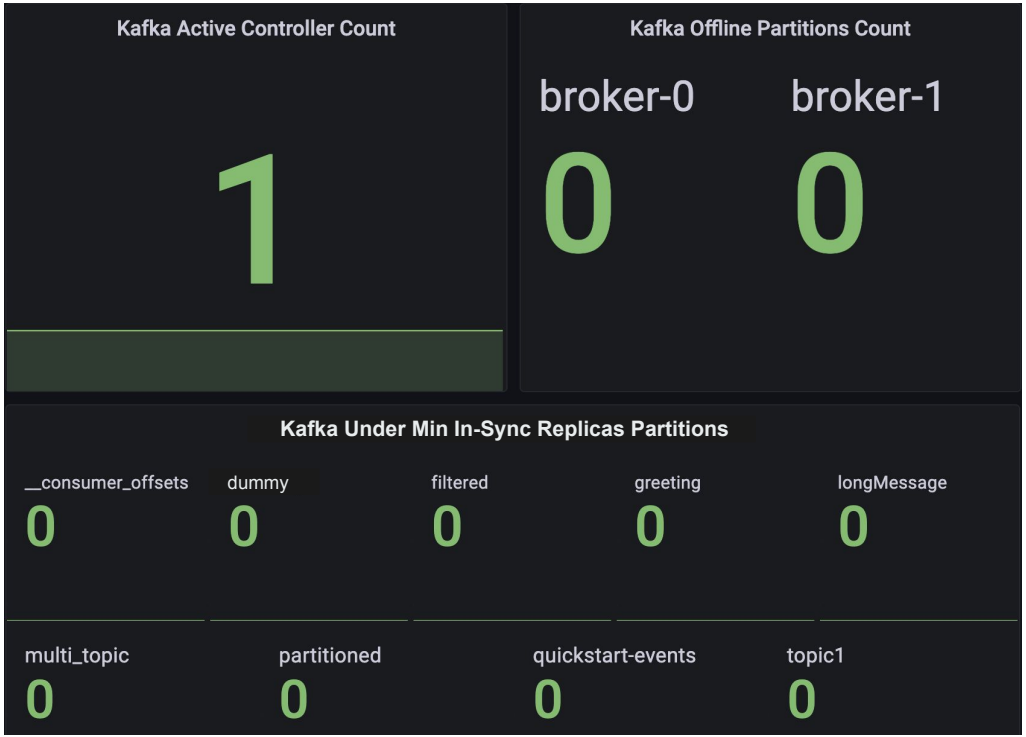
  kafka.producer:type=producer-metrics,client-id="{client-id}" ***request-latency-avg***

The Big Four - Key Metrics (JMX)

- Number of active controllers, **must be = 1**
  kafka.controller:name=ActiveControllerCount, type=KafkaController
- Number of under min ISR partitions, **must be = 0**
  kafka.server:name=UnderMinIsrPartitionCount, type=ReplicaManager

  *Checkout: '**UnderReplicatedPartitions**' metric too*
- Number of offline partitions, **must be = 0**
  kafka.controller:name=OfflinePartitionsCount, type=KafkaController
- Consumer Lag (per partition)
  kafka.consumer:name=MaxLag, type=ConsumerFetcherManager,clientId=([-.w]+)

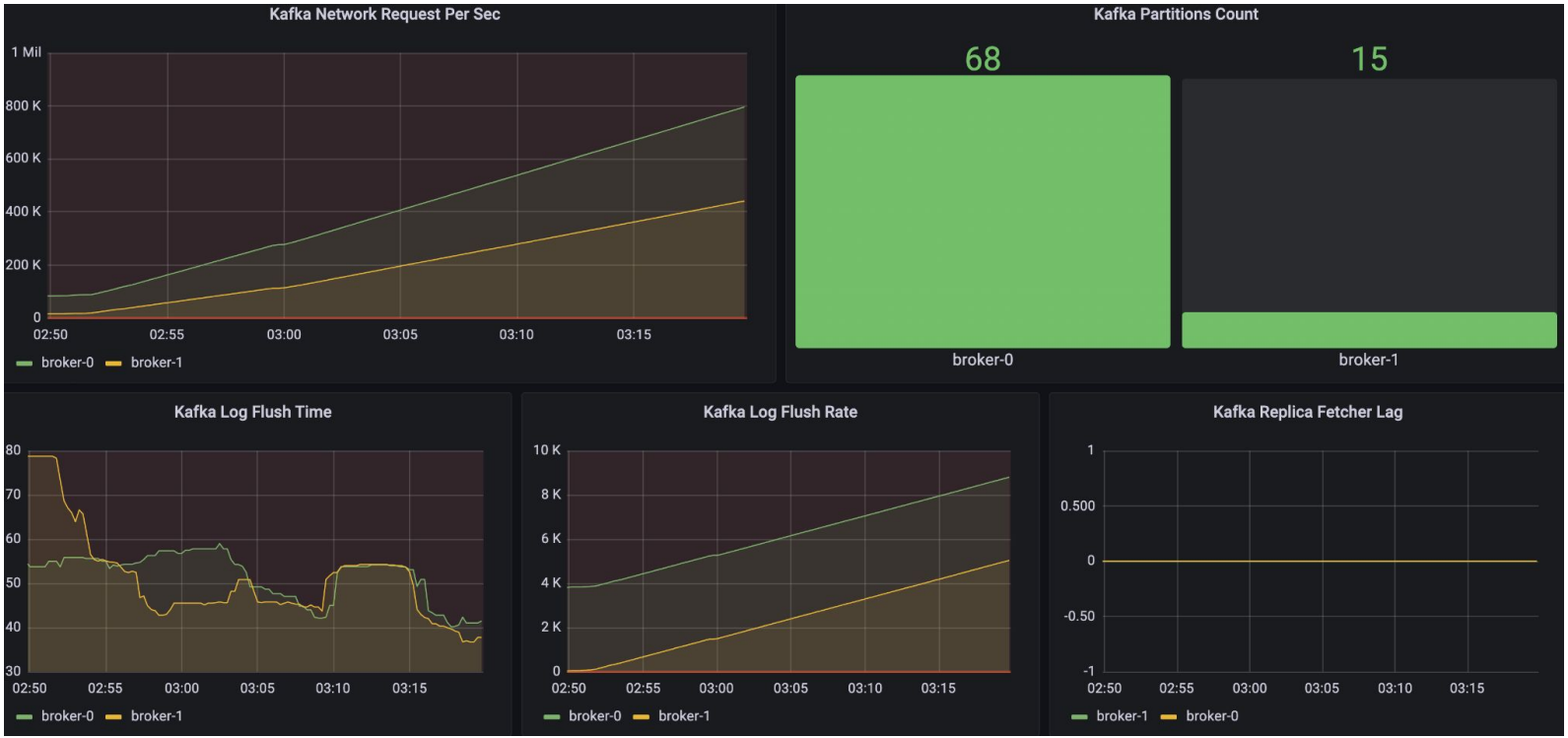
The Big Four - Key Metrics (JMX)



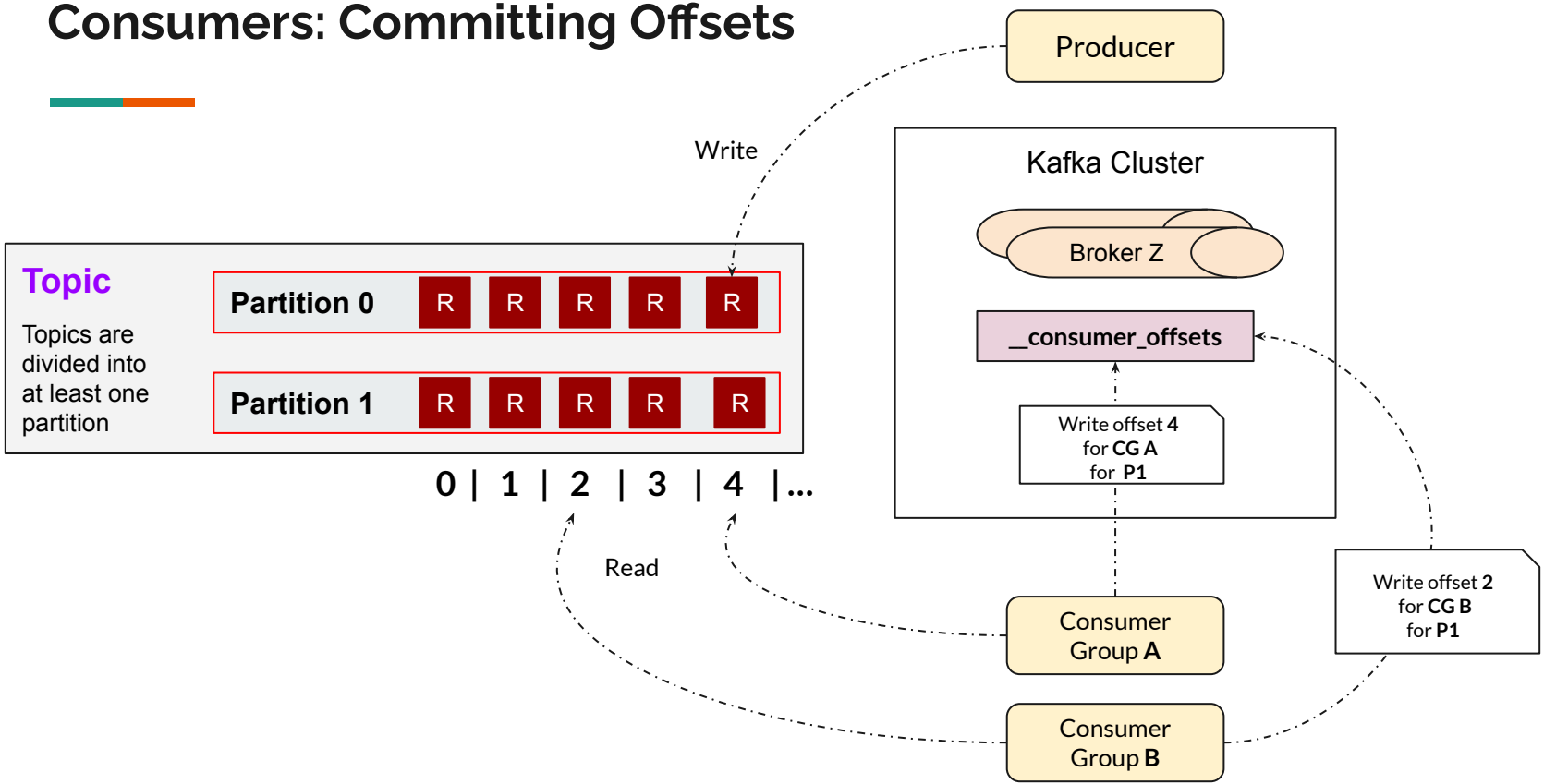
Brokers' Health

- Load Skewness (number of partitions on a broker)
  kafka.server:name=PartitionCount, type=ReplicaManager
- Log Flush Latency
  kafka.log:name=LogFlushRateAndTimeMs, type=LogFlushStats
- Network Request & Error Rate
  kafka.network:name=RequestsPerSec/ErrorsPerSec, type=RequestMetrics
- Fetcher Lag (per topic per partition)
  kafka.server:name=ConsumerLag, type=FetcherLagMetrics,clientId=([-.\w]+),topic=([-.\w]+), partition=([0-9]+)

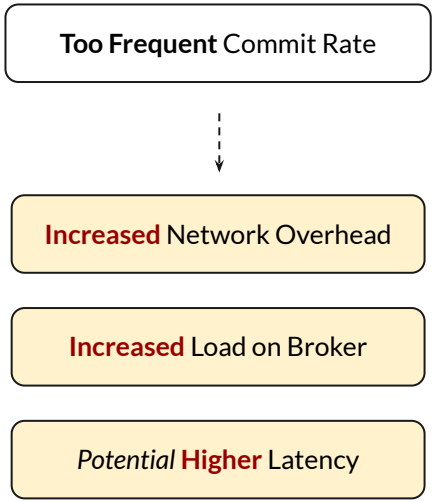
Brokers' Health

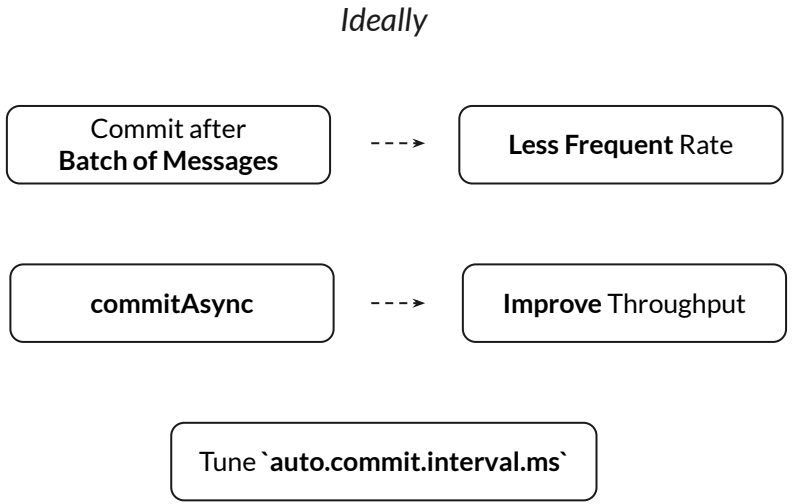


Consumers: Committing Offsets



Consumers: Commit Rate

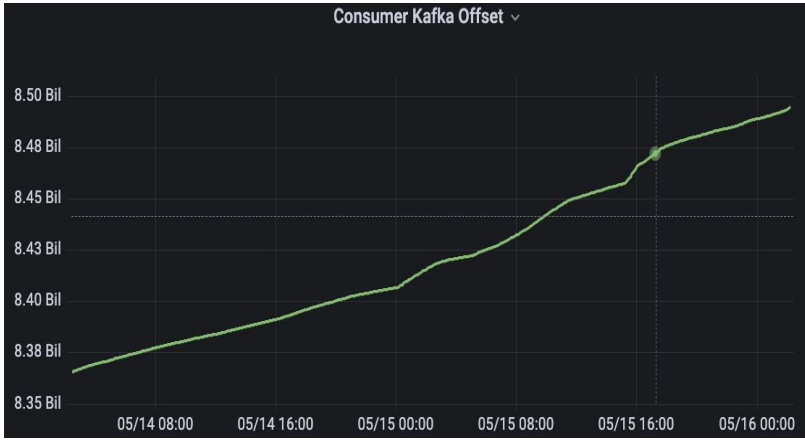


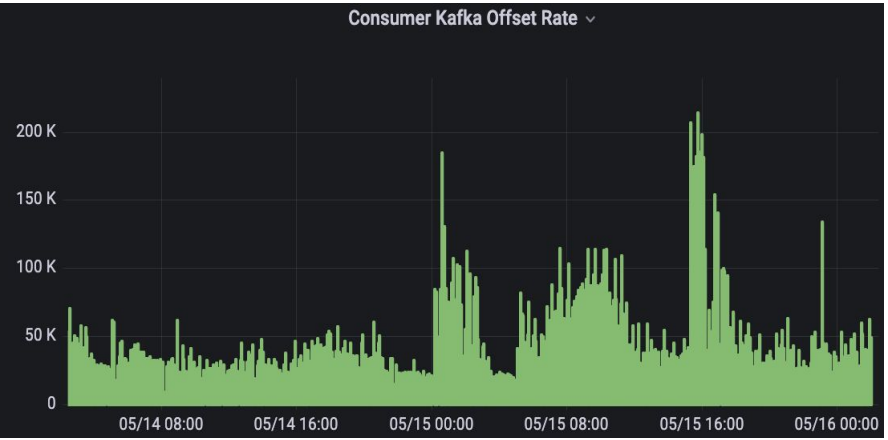


Consumption Rate

__consumer_offsets topic can be consumed;
offset long value emitted as metric to visualise **every consumer-partition's committed offset** in near real-time.

Reference Burrow (discussed later) which already does it.





Lag, Evaluations & Alerts: Burrow

Monitoring tool provides **consumer lag check as a service**

Exposes **offset lag** for all consumer-partition combination as **Prometheus metrics .**

Monitors committed offsets and **calculates the status of those consumers** on demand.

- Able to send alerts

Lag - Offsets Trend Evaluation

Lag = Head Offset of the Broker - Consumer's Offset

Store metrics locally in TSDB format. Evaluation runs on a sliding window periodically.

Status of consumer: **OK**

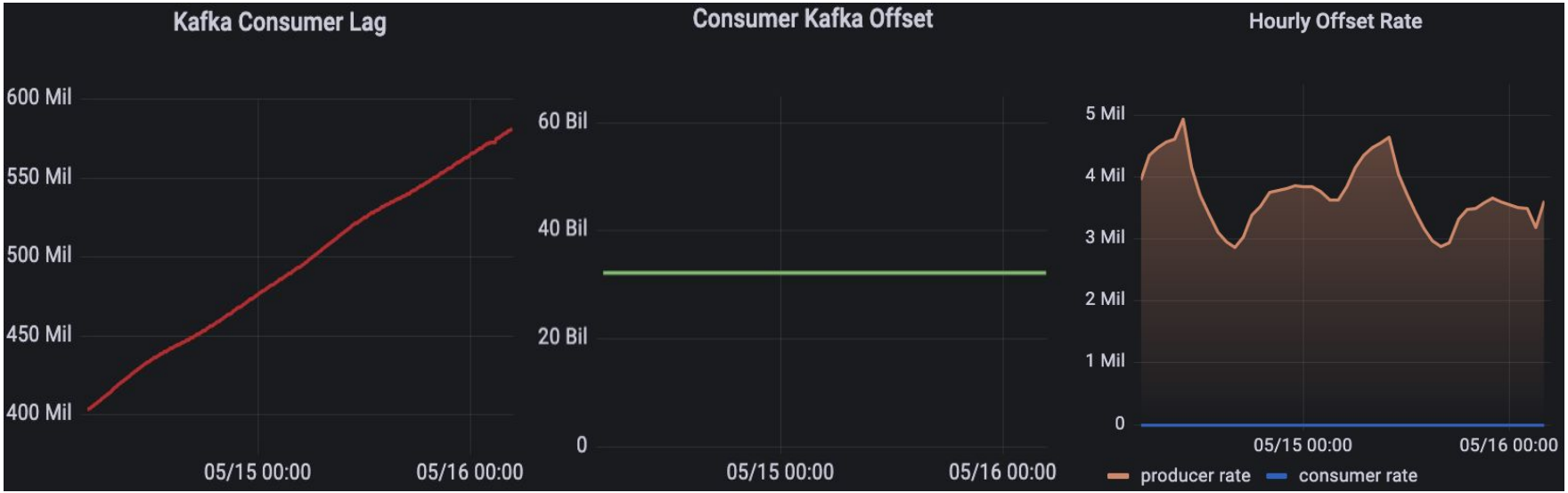
Lag Series with no Uptrend & Consumer Offset Series not Stalled

Lag - Consumer is Slow!

Status of consumer: **WARNING**

Lag Series with Uptrend & Consumer Offset Series not Stalled

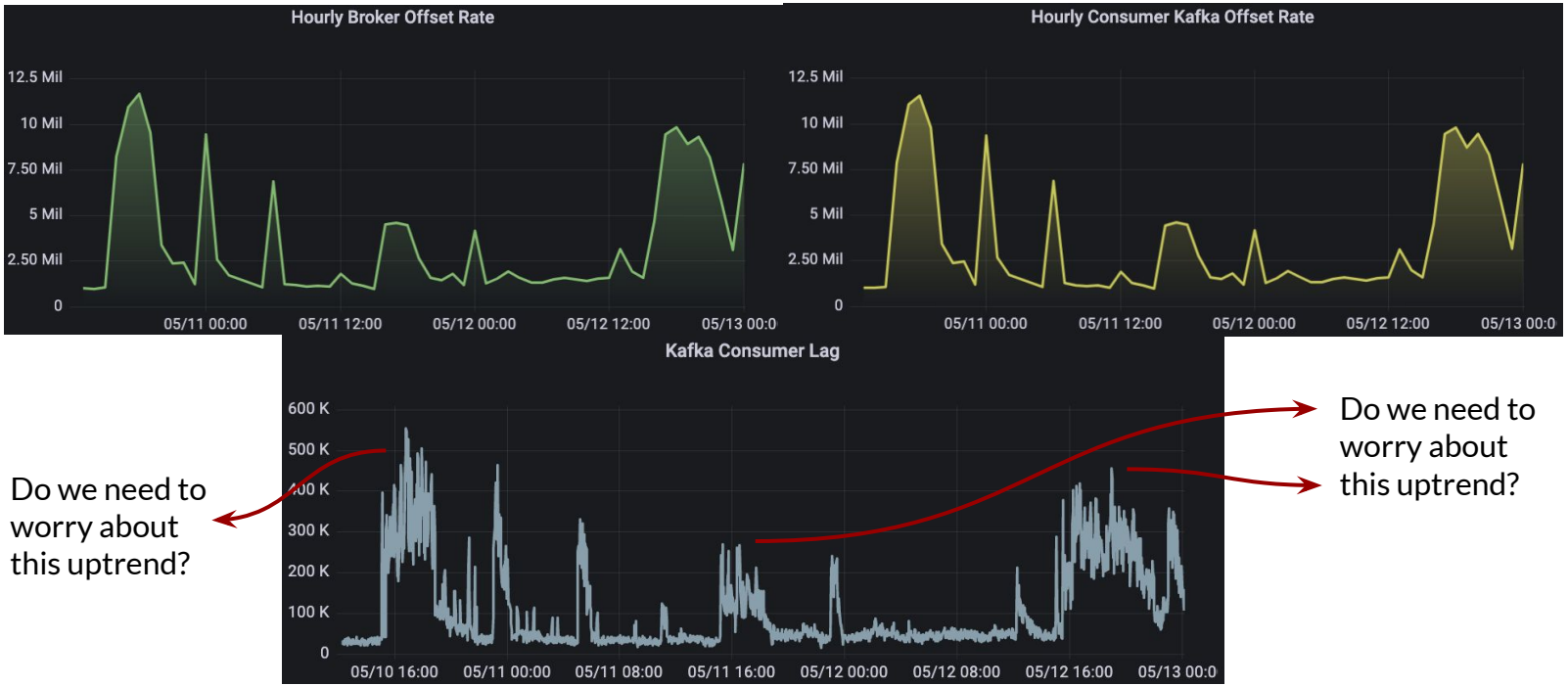
Lag - Consumer Stalled



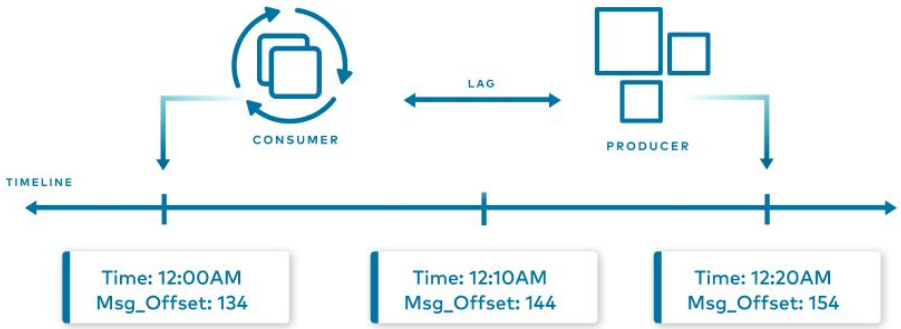
Status of consumer: **STALLED**

Lag Series with Uptrend & Consumer Offset Series Stalled

Lag - Observability



Lag - Time Based



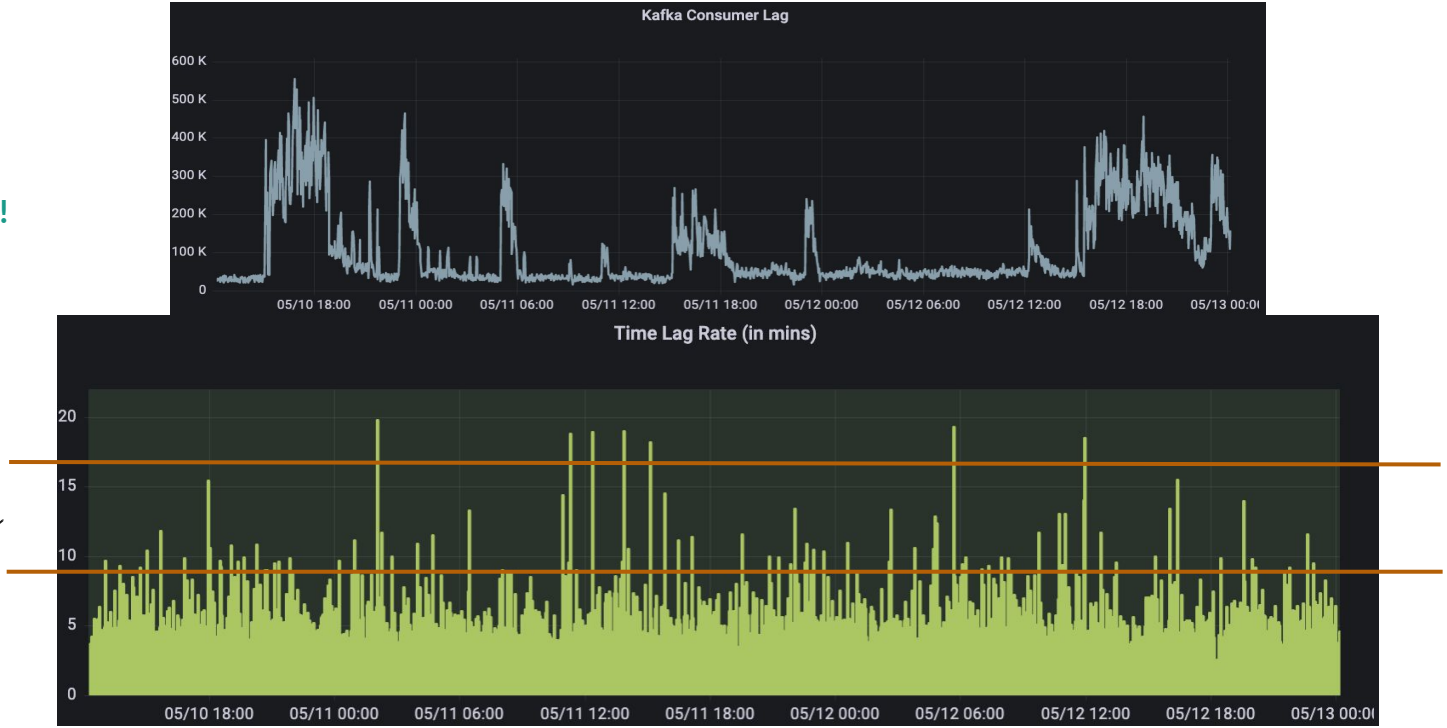
$$\frac{154 - 134}{1} \rightarrow 20 \text{ time-minute-units}$$

$$\frac{\text{Diff (Last Consumed Offset, Last Produced Offset)}}{\text{Producer Rate}}$$

https://www.confluent.io/blog/kafka-lag-monitoring-and-metrics-at-appsflyer/#:~:text=Kafka%20basics&text=Lag%20is%20simply%20the%20delta,save%20offsets%20in%20ZooKeeper%20itself.

Lag - Time Based

Normal Trend!



Trend Analysis

Keep track of high-level metrics for:

• Rate of Topic Growth	→ Do we need more partitions?
• Weekly / Monthly / Periodic Producer / Consumer Rate	→ Keeping tabs on abnormal spikes!
• TTL / Retention data long enough to hold data for consumption	→ If time lag for consumer-partition goes beyond control!
• Infrastructure supporting Kafka cluster requirements	→ CPU, Memory, Network, IO capacity, GC Activity
• *Zookeeper supporting Kafka cluster requirements*	→ *How many topics / partitions state can be kept?*

** ZK has been deprecated / removed in newer versions*

References

- Kafka Documentation - https://docs.confluent.io/platform/current/kafka/monitoring.html
- Kafka Architecture - https://www.projectpro.io/article/apache-kafka-architecture-/442
- Blog Posts & Talks
  - Peppredata - https://www.youtube.com/watch?v=R6OKibnXpBs&t=385s
  - https://medium.com/quantyca/how-to-monitor-your-kafka-cluster-efficiently-d45ce37c02f1
  - Stephan Meraak - https://www.youtube.com/watch?v=XXLe0KNEbR4
- Confluent Center - https://docs.confluent.io/platform/current/control-center/index.html
- Burrow - https://github.com/linkedin/Burrow
- Prometheus (https://prometheus.io/) & Grafana (https://grafana.com/)
- Need for Observability
  - https://cloud.google.com/architecture/devops/devops-measurement-monitoring-and-observability

Thank You!

@sarkaramrit2