Monitoring and Optimizing Kafka Clients

An Easy Guide to Understanding the Behavior of Your Kafka Clients

Who am I? Victor Osório!

- Blue Sky: @vepo.dev
- LinkedIn: linkedin.com/in/victorosorio/
- Youtube: https://www.youtube.com/@victor.osorio
  - Software Engineer
    - Java since 2004
    - Apache Kafka since 2017
  - Master Degree
    - Data Stream Processing
    - Distributed Systems
  - Software Development Specialist @ Amdocs

Agenda

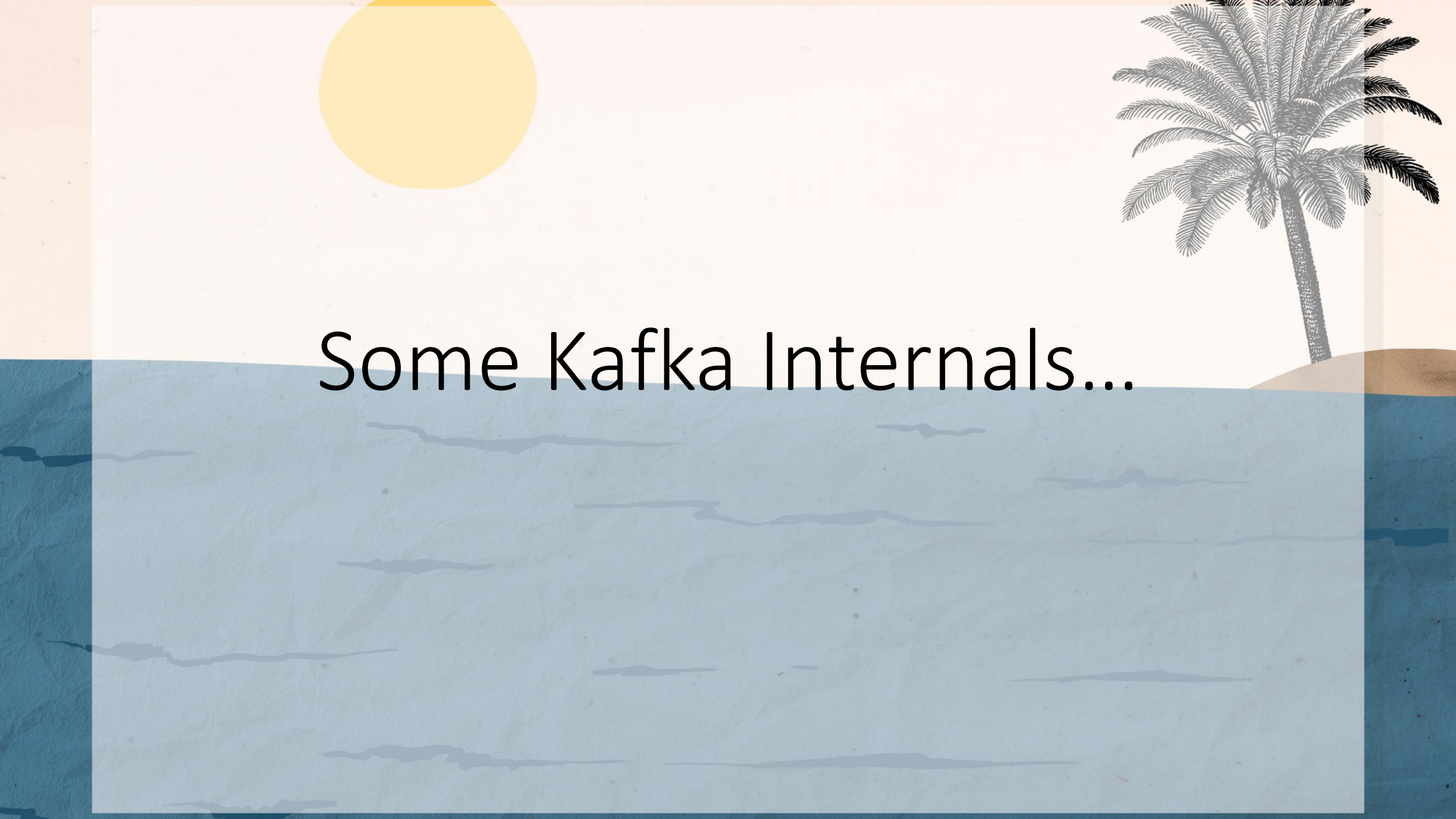
- Understand Kafka & Kafka Clients
- How Kafka export its metrics
- Linking Kafka Client Behavior, Metrics, and Configuration Parameters

Understand Kafka & Kafka Clients

Kinds of Kafka Clients

- Consumer
- Producer
- Stream
- Connector


But let’s start with the broker!


Some Kafka Internals…

Kafka is a...

Distributed Commit Log

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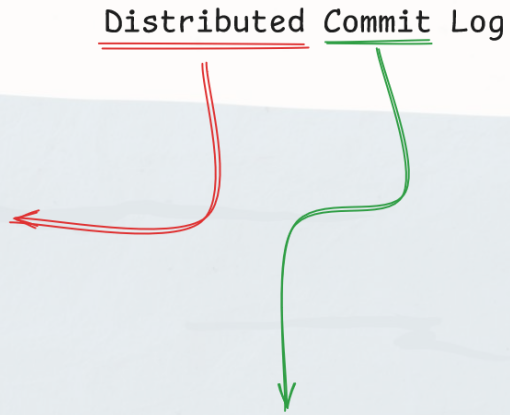
Distributed Commit Log

The cluster is the truth
A broker is part of the truth
Not all data exists in a broker
This means replication.
This means partitions.

Kafka is a...



The cluster is the truth
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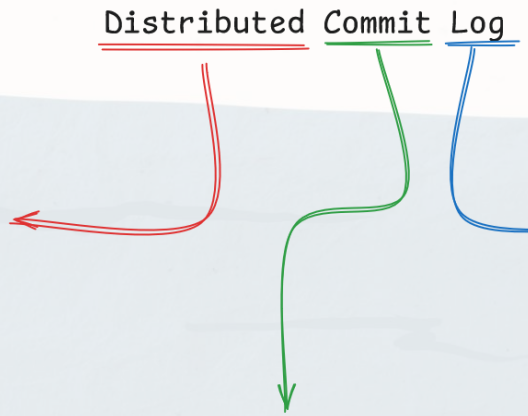
There is no Entity.
The truth is reconstructed by all messages.
All state change is a new message.

Kafka is a...



The cluster is the truth
A broker is part of the truth
Not all data exists in a broker
This means replication.
This means partitions.

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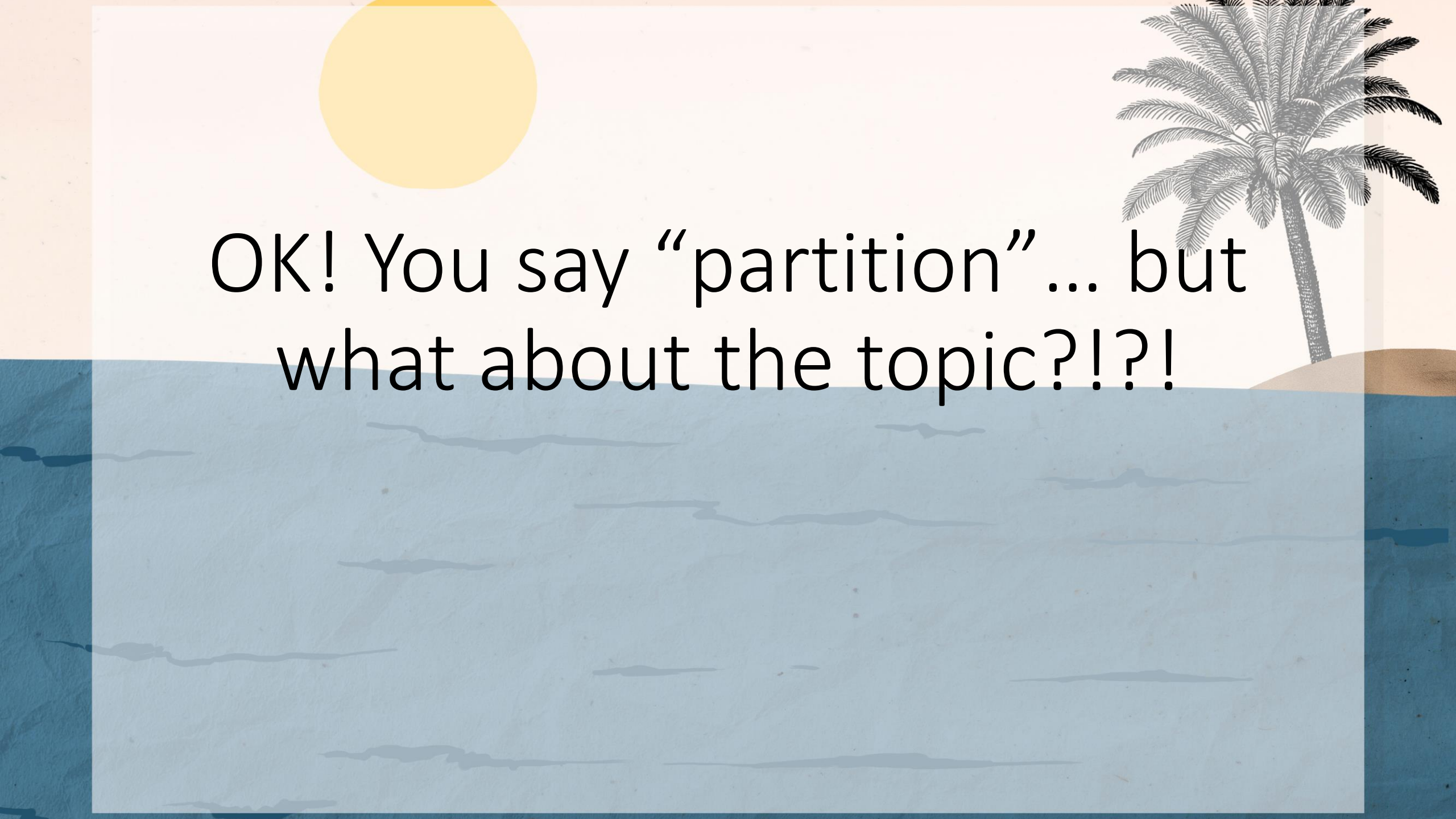
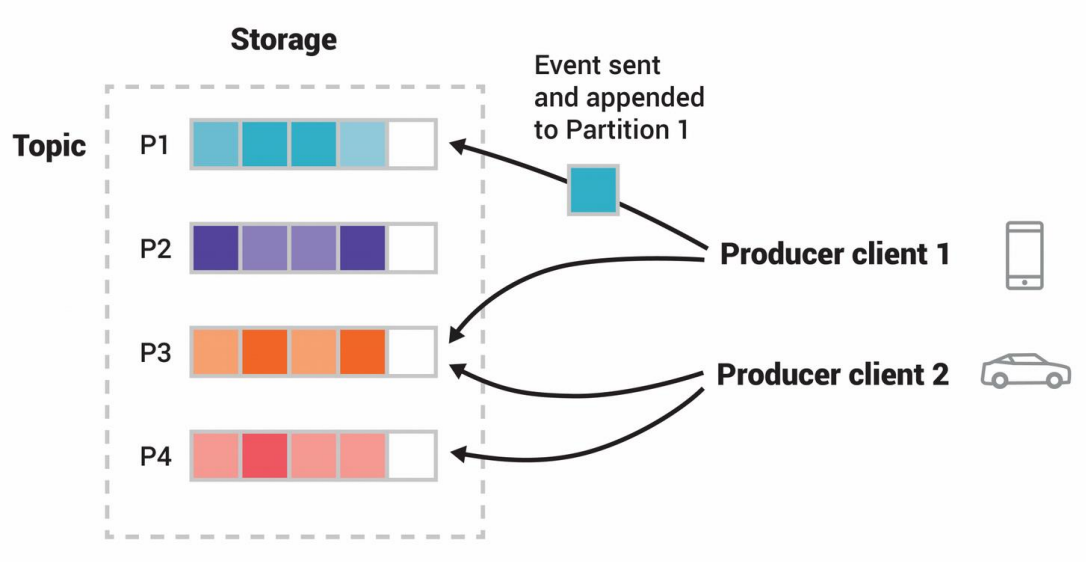
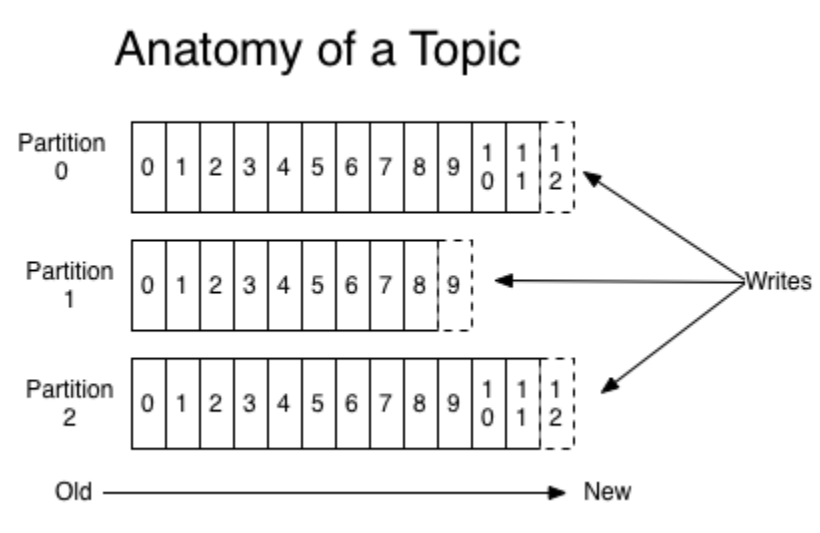
All state change is a new message.

Every data is appended at the end of a file.
All data is immutable.
We only append data at the end of a partition.

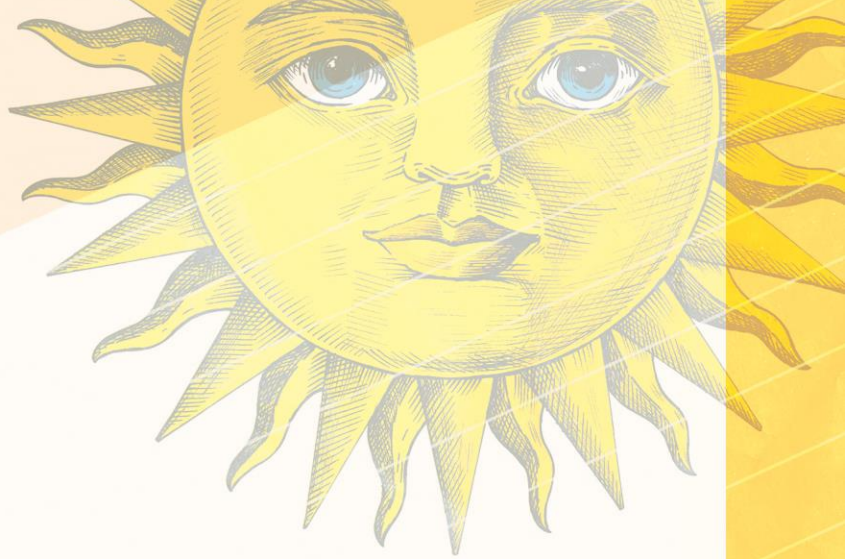

OK! You say “partition”… but what about the topic?!?!

A Topic is a set of Partitions





1st RULE



You can scale the consumer up at most to the number of partitions.


How do we monitor Kafka &
Kafka Clients?

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Kafka & Kafka Clients exports all metrics using JMX!

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https://github.com/prometheus/jmx_exporter

using

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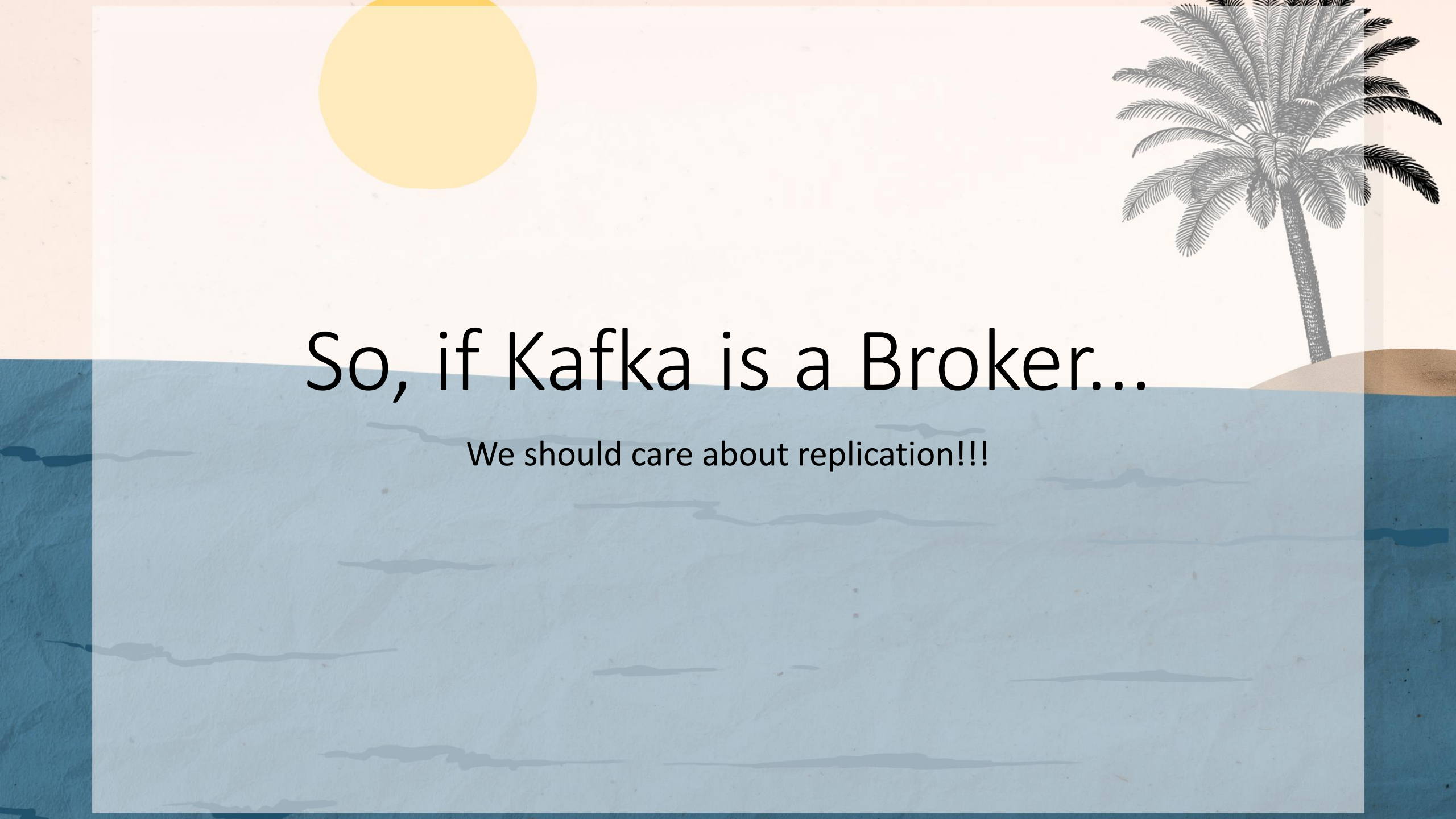
Can br grouped by:
* Broker
* Topic
* Partition
* Consumer ID


So, if Kafka is a Broker...
We should care about replication!!!

We should care about “In-sync replicas”!!!

- Producer
  - `acks`
- Broker and Topic
  - `min.insync.replicas`

Broker/Topic Config!!!

min.insync.replicas

When a producer sets acks to "all" (or "-1"), `min.insync.replicas` specifies the minimum number of replicas that must acknowledge a write for the write to be considered successful. If this minimum cannot be met, then the producer will raise an exception (either `NotEnoughReplicas` or `NotEnoughReplicasAfterAppend`).
When used together, `min.insync.replicas` and acks allow you to enforce greater durability guarantees. A typical scenario would be to create a topic with a replication factor of 3, set `min.insync.replicas` to 2, and produce with acks of "all". This will ensure that the producer raises an exception if a majority of replicas do not receive a write.

Type:	int
Default:	1
Valid Values:	[1,...]
Importance:	high
Update Mode:	cluster-wide

Producer Config!!!

acks

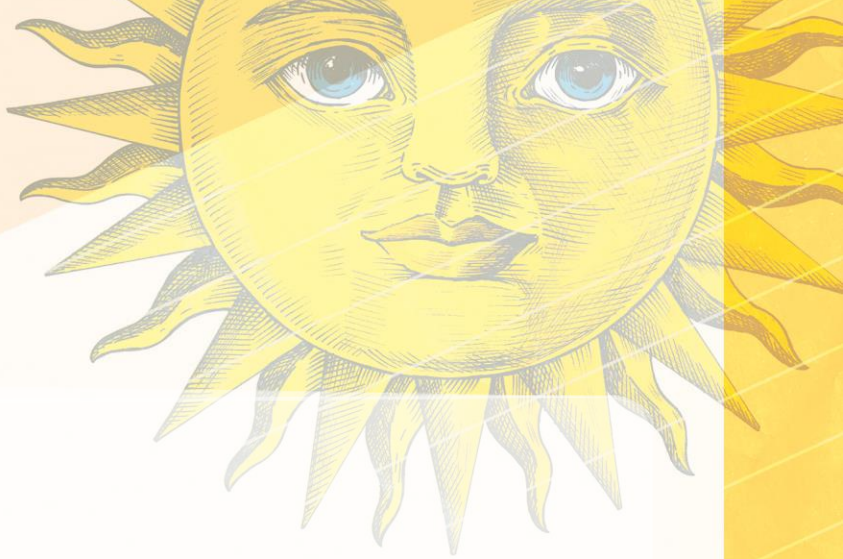
The number of acknowledgments the producer requires the leader to have received before considering a request complete. This controls the durability of records that are sent. The following settings are allowed:

- `acks=0` If set to zero then the producer will not wait for any acknowledgment from the server at all. The record will be immediately added to the socket buffer and considered sent. No guarantee can be made that the server has received the record in this case, and the `retries` configuration will not take effect (as the client won't generally know of any failures). The offset given back for each record will always be set to `-1`.
- `acks=1` This will mean the leader will write the record to its local log but will respond without awaiting full acknowledgement from all followers. In this case should the leader fail immediately after acknowledging the record but before the followers have replicated it then the record will be lost.
- `acks=all` This means the leader will wait for the full set of in-sync replicas to acknowledge the record. This guarantees that the record will not be lost as long as at least one in-sync replica remains alive. This is the strongest available guarantee. This is equivalent to the acks=-1 setting.

Note that enabling idempotence requires this config value to be 'all'. If conflicting configurations are set and idempotence is not explicitly enabled, idempotence is disabled.

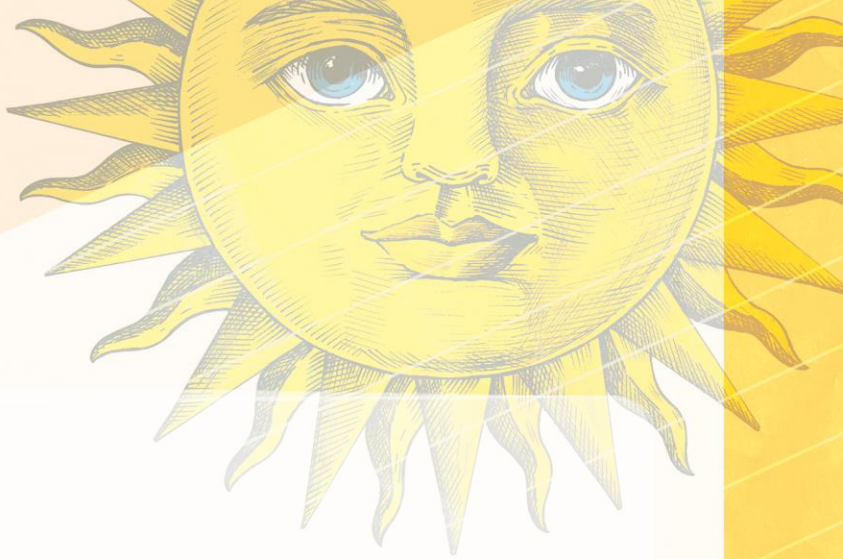
Type:	string
Default:	all
Valid Values:	[all, -1, 0, 1]
Importance:	low

1st Metrics



```
kafka.server:type=ReplicaManager,name=UnderMinIsrPartitionCount
kafka.server:type=ReplicaManager,name=AtMinIsrPartitionCount
```

1st Metrics



kafka.server:type=ReplicaManager,name=UnderMinIsrPartitionCount
kafka.server:type=ReplicaManager,name=AtMinIsrPartitionCount

✅ Replicated!!!!

1st Metrics

Not replicated yet!!!

kafka.server:type=ReplicaManager,name=UnderMinIsrPartitionCount

kafka.server:type=ReplicaManager,name=AtMinIsrPartitionCount

Replicated!!!!

What about the data?!?!

What about the data?!?!

- Key
- Headers
- Message

What about the data?!?!

- Key → Partition & Identify
- Headers
- Message

What about the data?!?!

Key → Partition & Identify

Headers → Metadata

Message

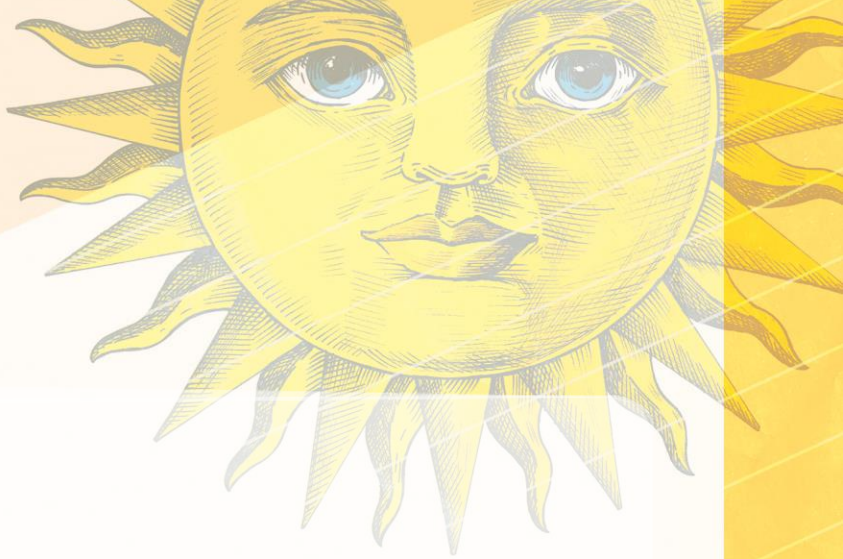
What about the data?!?!

Key → Partition & Identify

Headers → Metadata

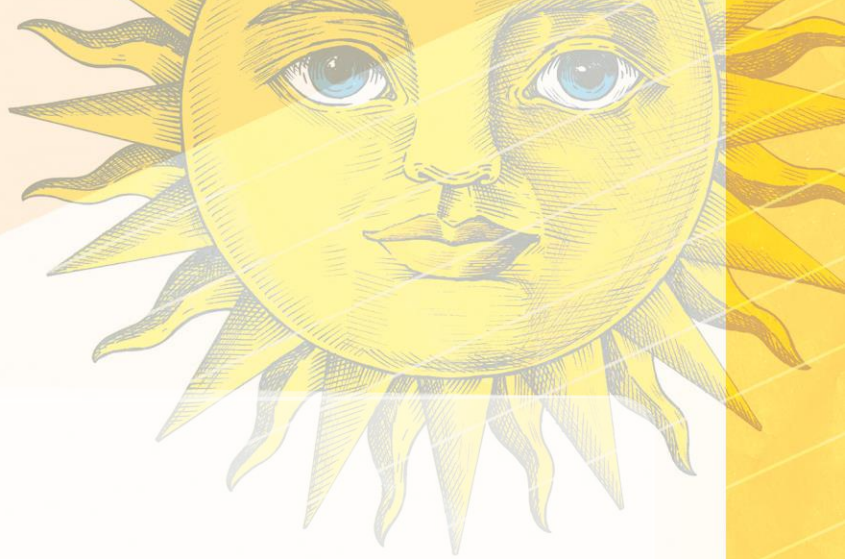
Message → Application (RAW)

2nd Metrics



```
kafka.server:type=BrokerTopicMetrics,name=MessagesInPerSec,topic=([-.\w]+)
kafka.server:type=BrokerTopicMetrics,name=BytesInPerSec,topic=([-.\w]+)
kafka.server:type=BrokerTopicMetrics,name=ReplicationBytesInPerSec
```

2nd Metrics



How many messages are written per topic?

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```

2nd Metrics

How many bytes are written per topic?

How many messages are written per topic?

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kafka.server:type=BrokerTopicMetrics,name=MessagesInPerSec,topic=([-.\w]+)
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```

How many bytes are being replicated?

How do we produce data?

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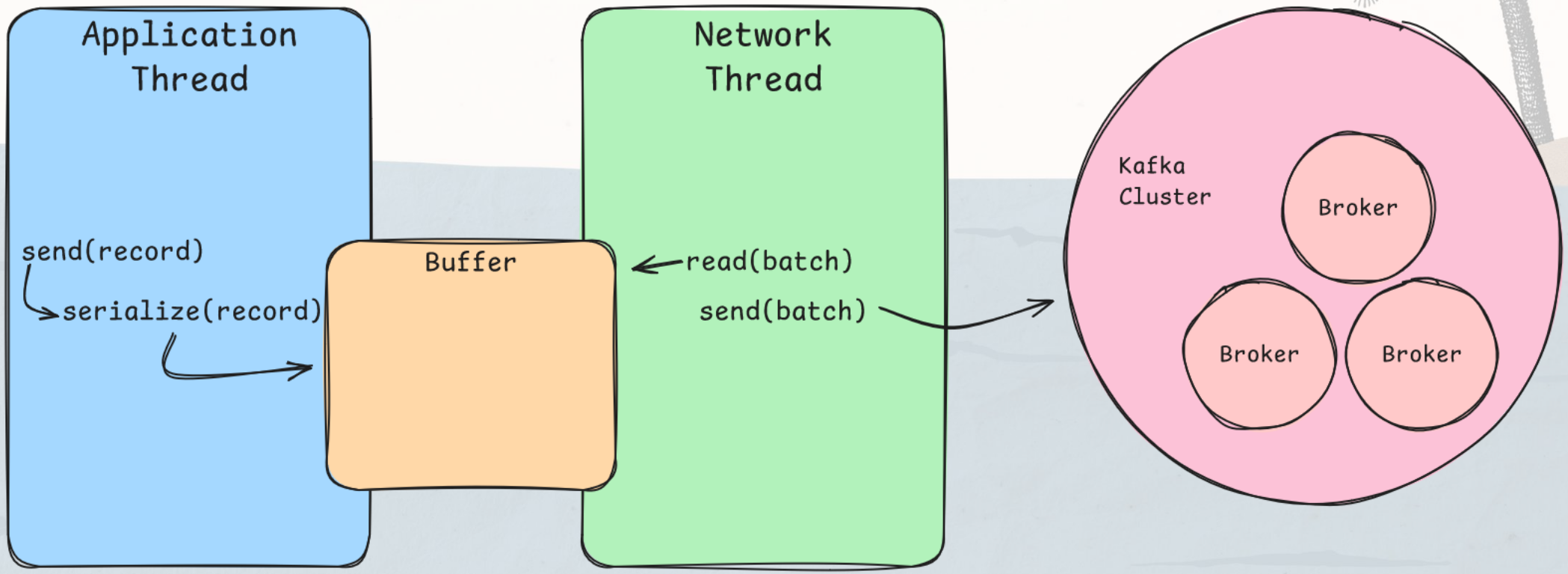

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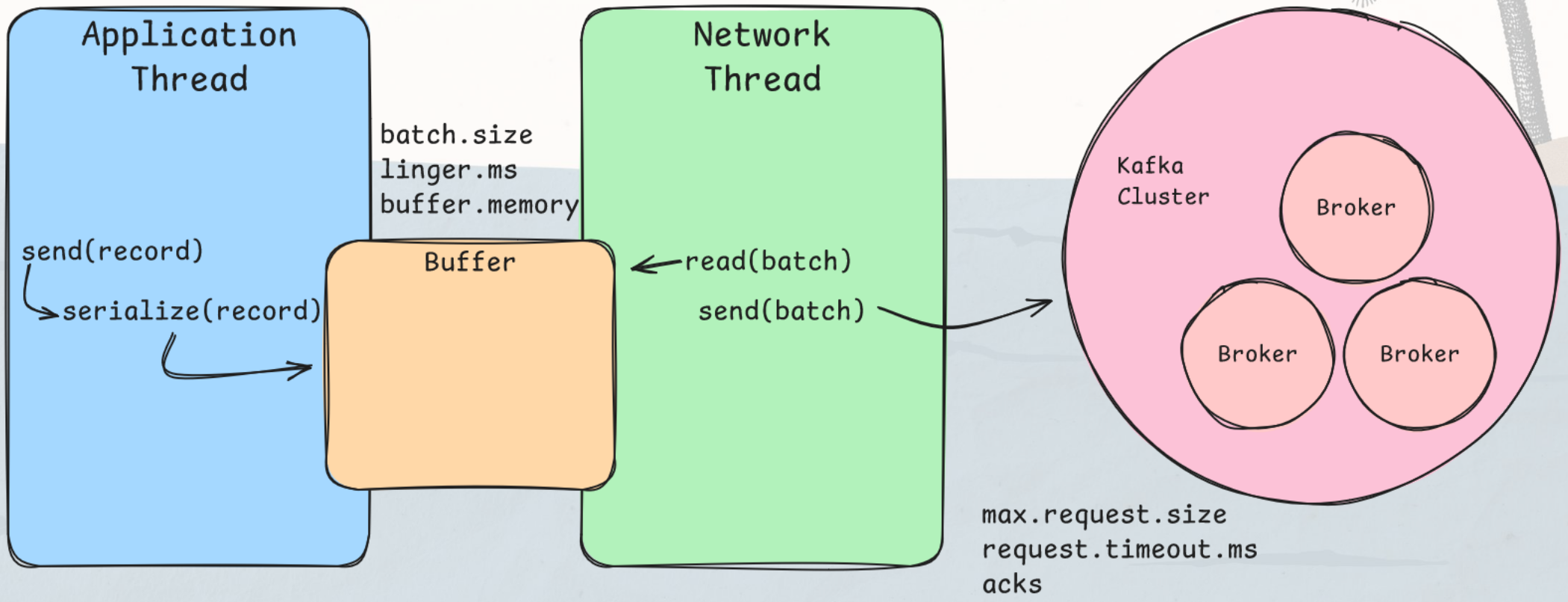
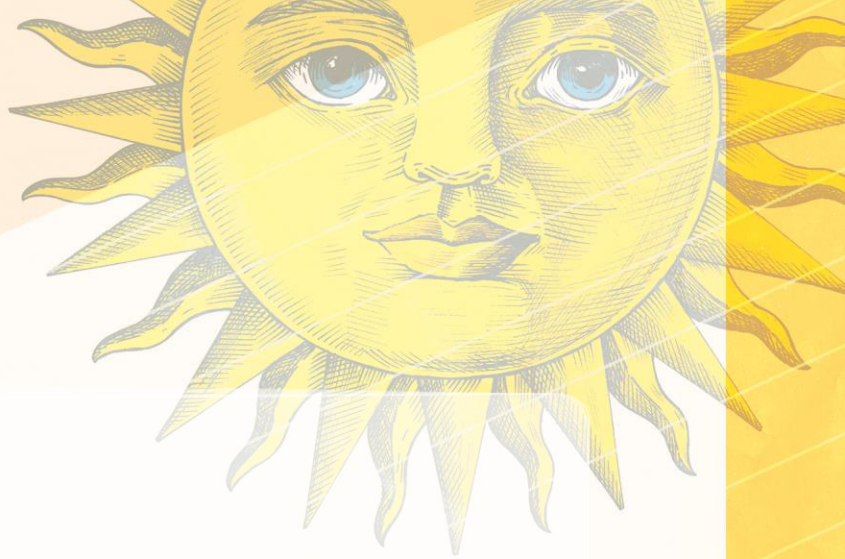


3rd Metrics



```
kafka.producer:type=producer-metrics,client-id=([-.w]+),name=waiting-threads
kafka.producer:type=producer-metrics,client-id=([-.w]+),name=buffer-available-bytes
kafka.producer:type=producer-metrics,client-id=([-.w]+),name=batch-size-avg
kafka.producer:type=producer-metrics,client-id=([-.w]+),name=record-size-avg
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```

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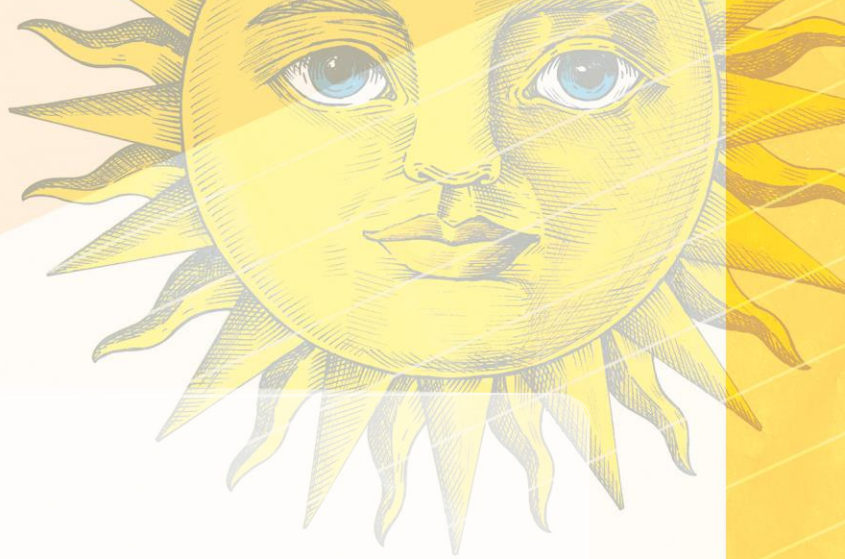

How many threads are waiting for a buffer to become available?

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3rd Metrics

How many bytes of the buffer are available?

How many threads are waiting for a buffer to become available?

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kafka.producer:type=producer-metrics,client-id=([-.w]+),name=waiting-threads
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How many bytes are being sent per batch?

3rd Metrics

How many bytes of the buffer are available?

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kafka.producer:type=producer-metrics,client-id=([-.w]+),name=waiting-threads
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What the average size of a record?

How many bytes are being sent per batch?

3rd Metrics

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```

How many records are being sent?

What the average size of a record?

How many bytes are being sent per batch?

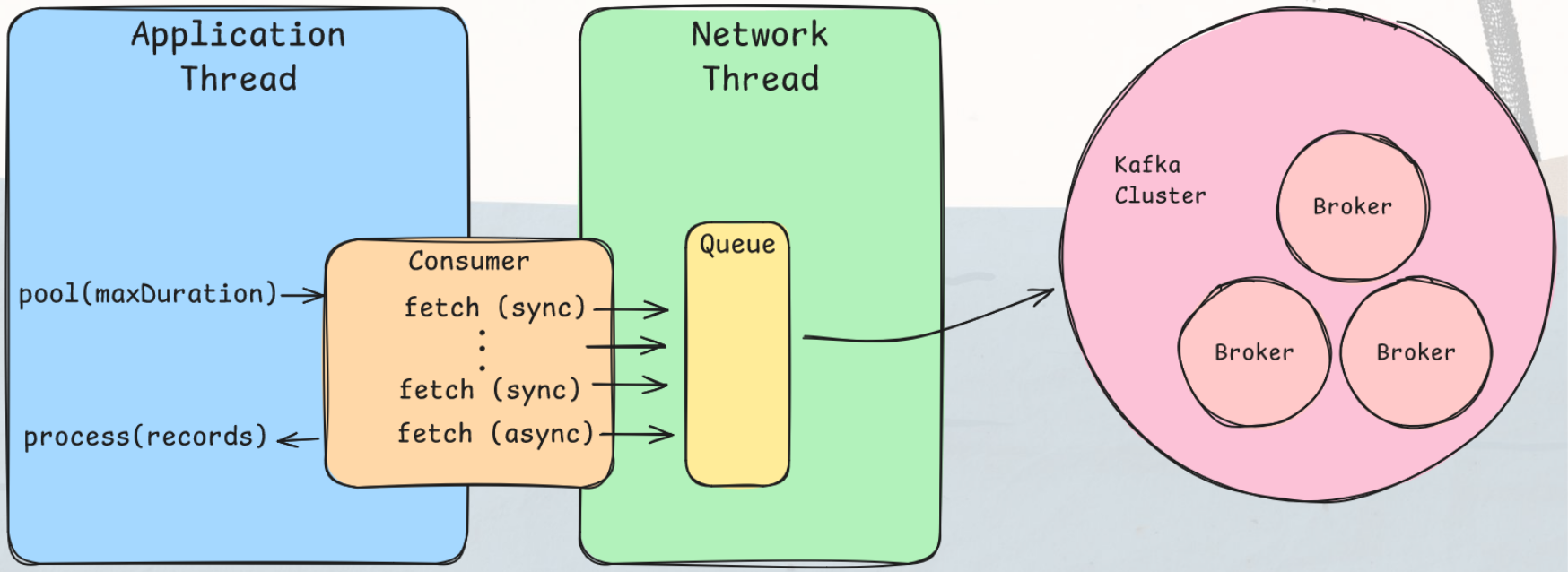
How do we consume data?

How do we consume data?

- Each message is consumed once by a consumer group
- The consumer offset is managed by the consumer group
- Each consumer group operates independently
- Each consumer send heatbeat messages

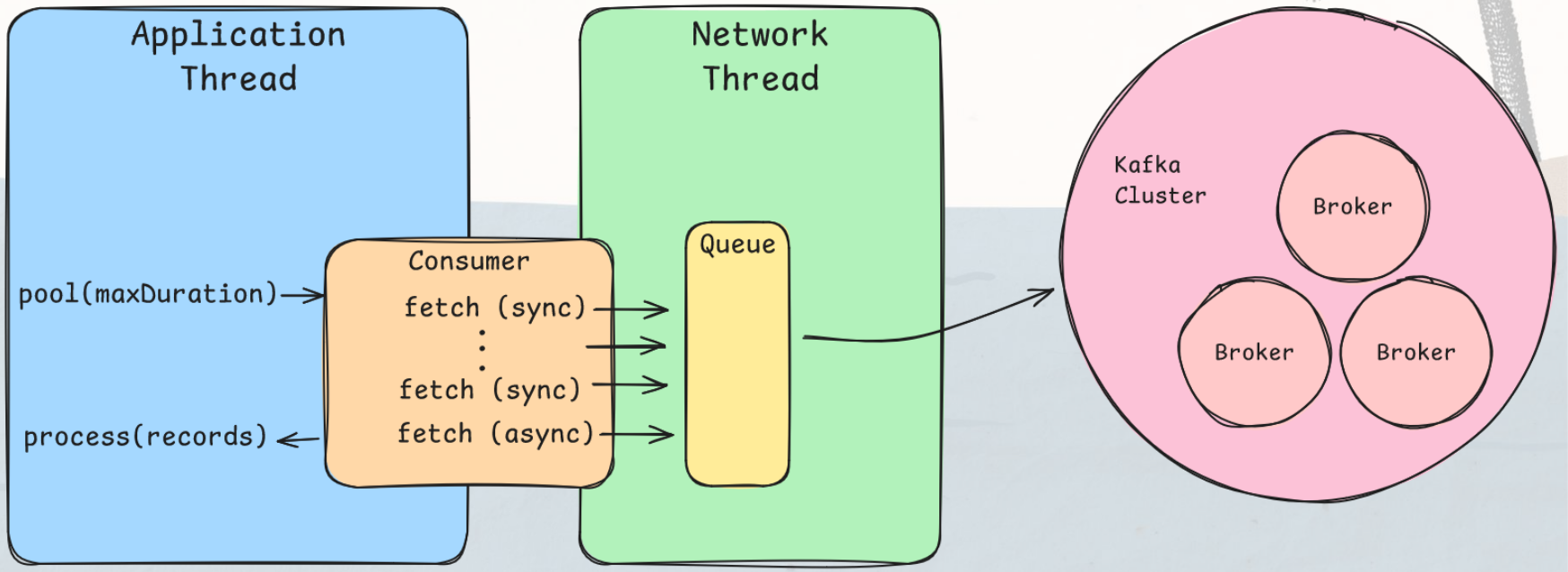
If the consumer does not poll, it will be considered unhealthy and removed from the consumer group (triggering a rebalance).

How do we consume data?



How do we consume data?

```
auto.commit.interval.ms
auto.offset.reset
enable.auto.commit
heartbeat.interval.ms
isolation.level
session.timeout.ms
```



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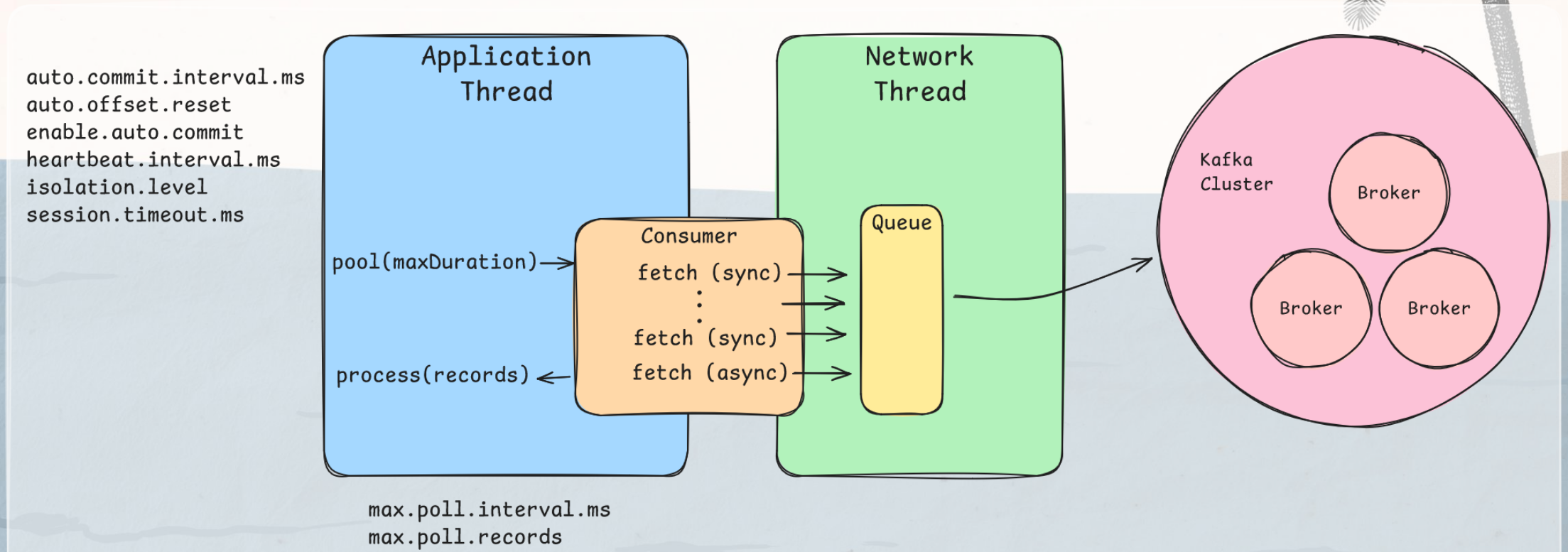

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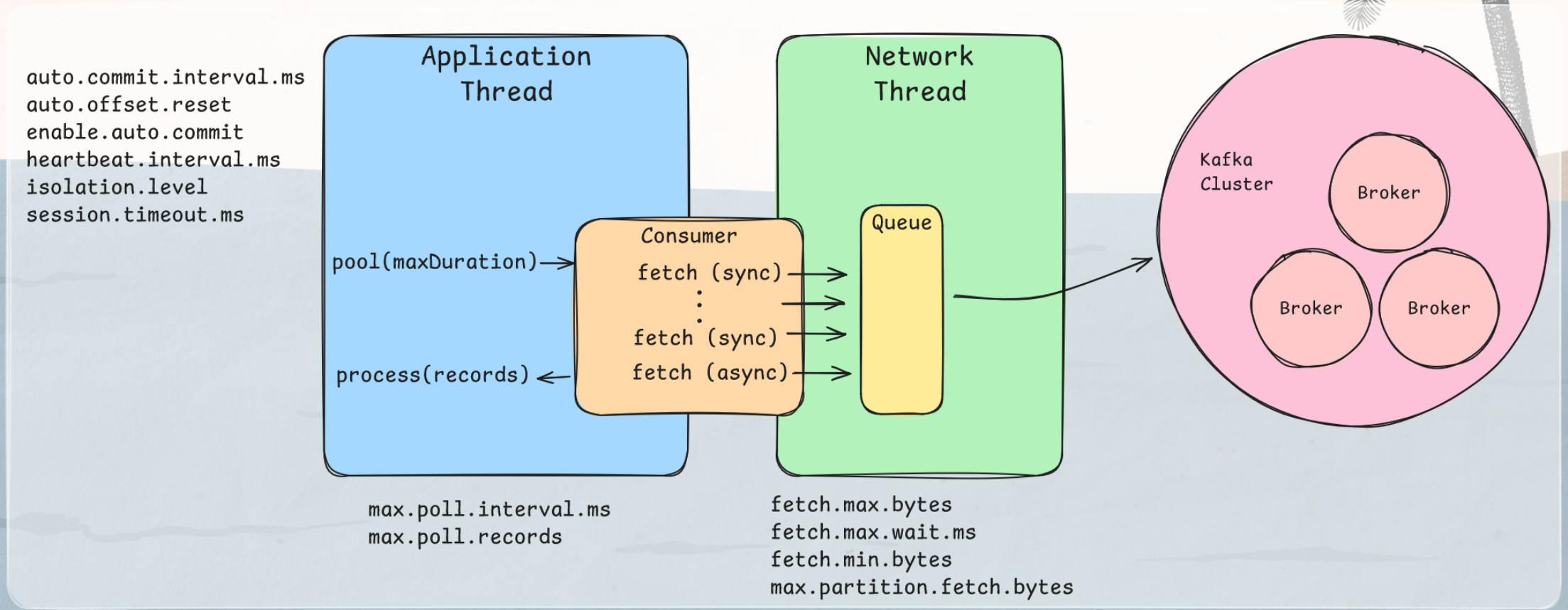
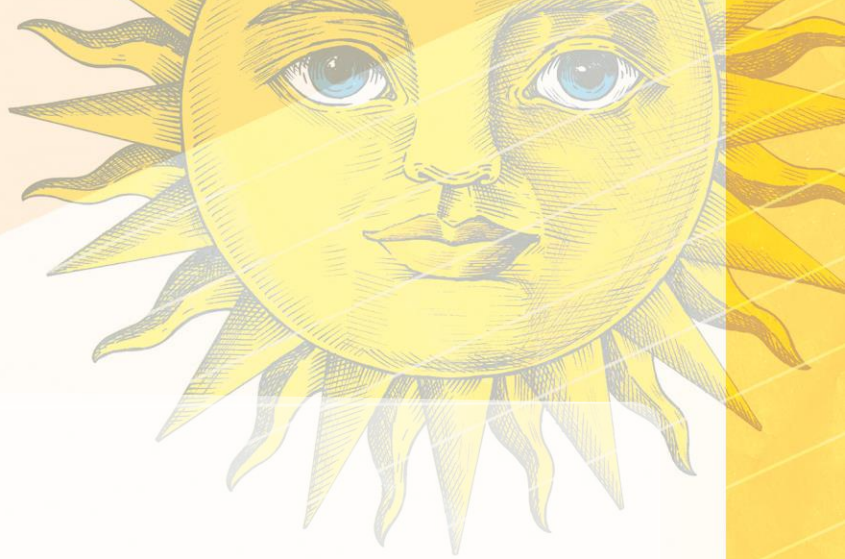


4th Metrics



```
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=bytes-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-latency-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-rate
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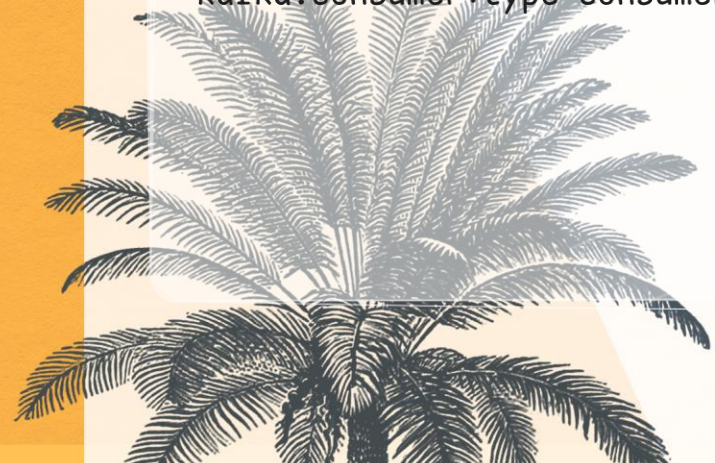
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-lag-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-per-request-avg
```



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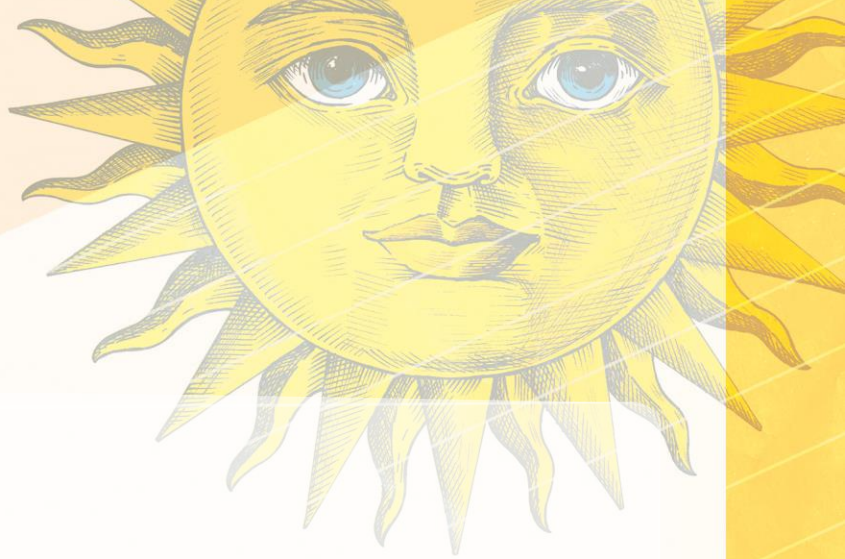

How many bytes are being consumed per second?

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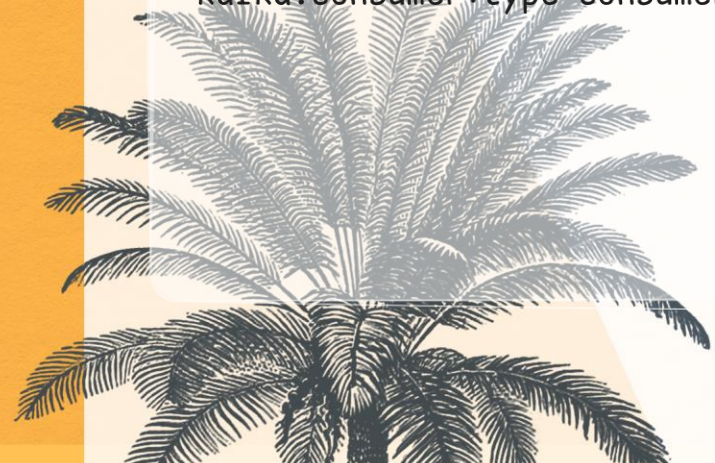

4th Metrics

What is the average fetch latency?

How many bytes are being consumed per second?

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kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=bytes-consumed-rate
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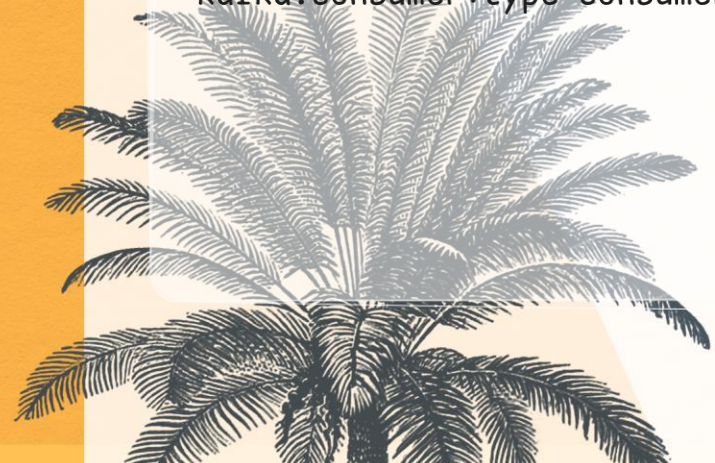

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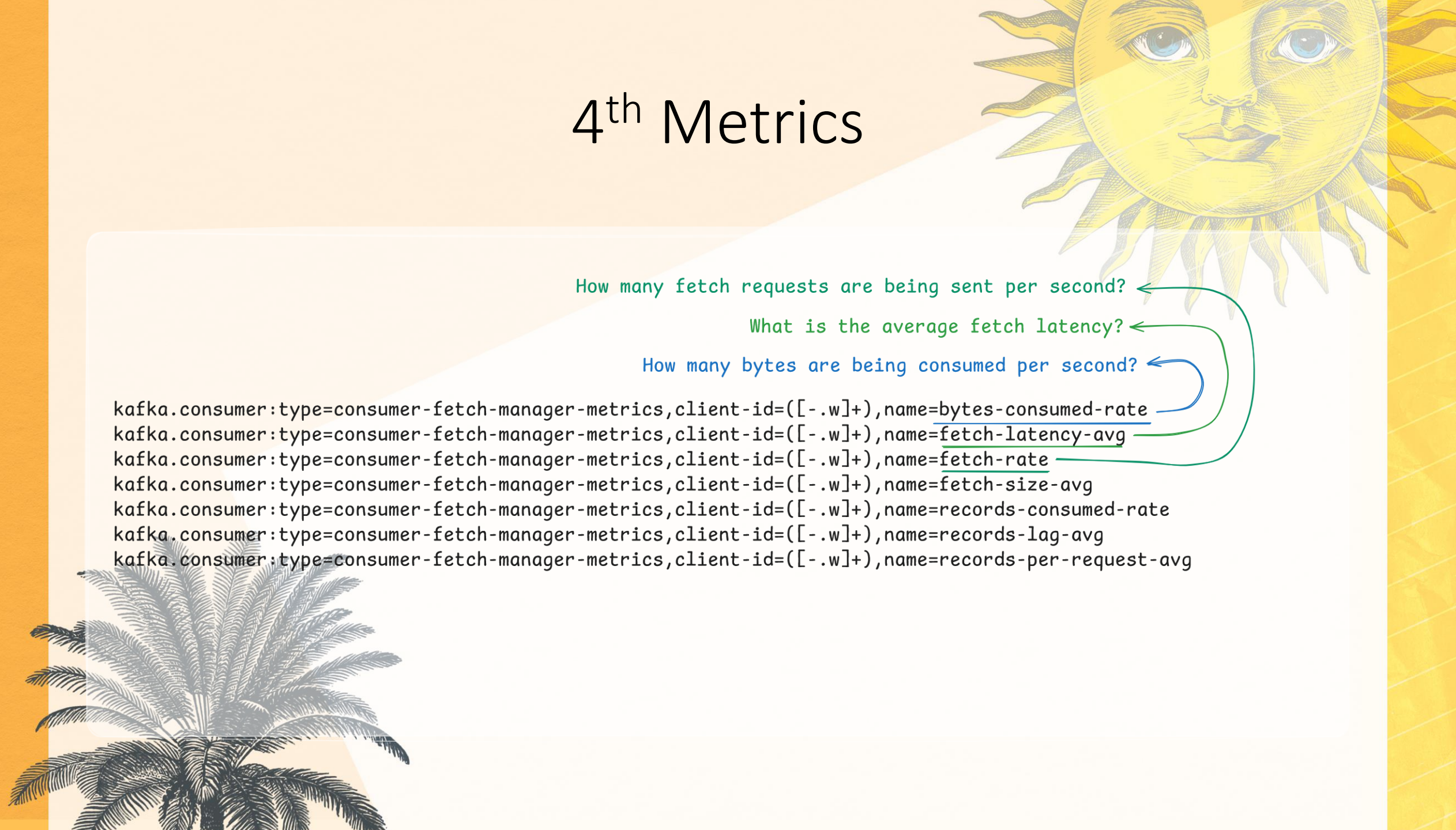

How many fetch requests are being sent per second?

What is the average fetch latency?

How many bytes are being consumed per second?

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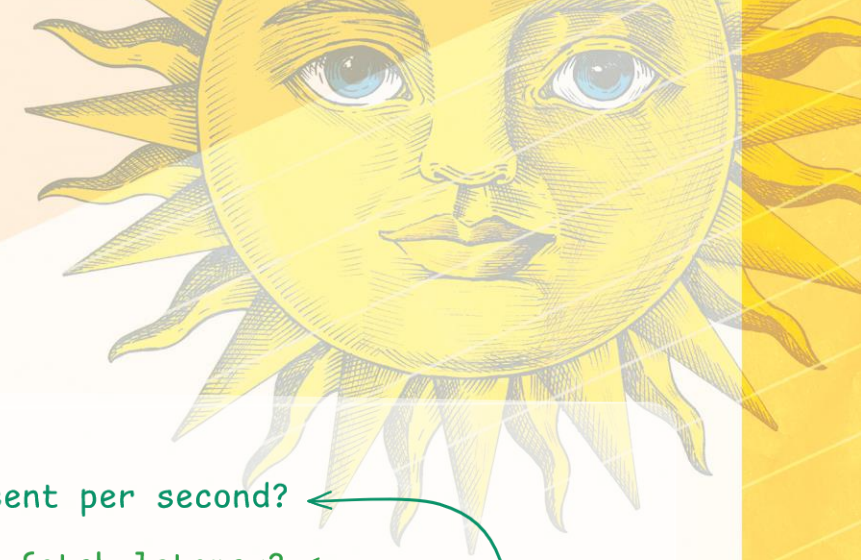
4th Metrics



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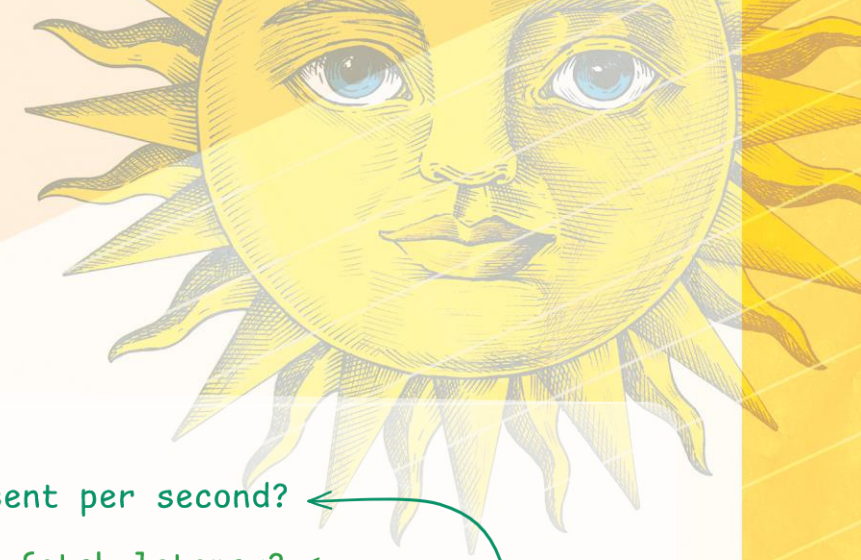
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-lag-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-per-request-avg
```

How many bytes are being fetched on average?

4th Metrics



How many fetch requests are being sent per second?

What is the average fetch latency?

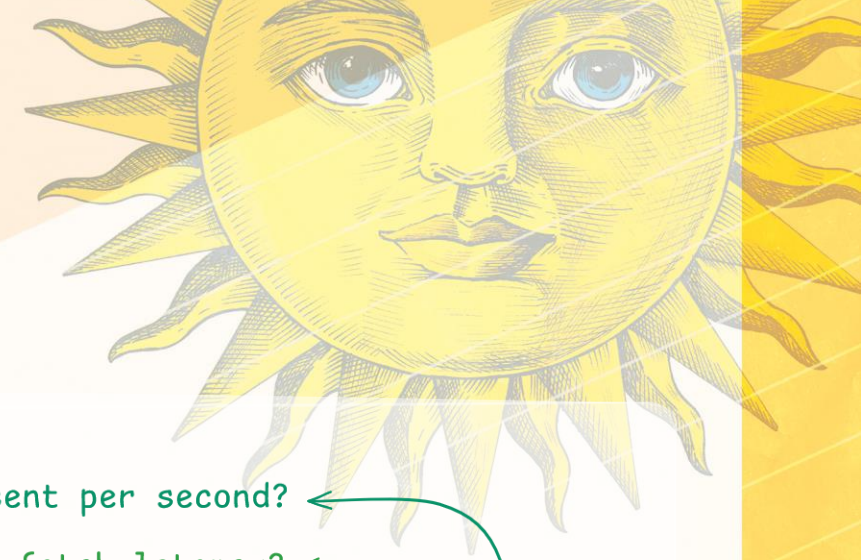
How many bytes are being consumed per second?

```
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=bytes-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-latency-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-size-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-lag-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-per-request-avg
```

How many records are being consumed per second?

How many bytes are being fetched on average?

4th Metrics



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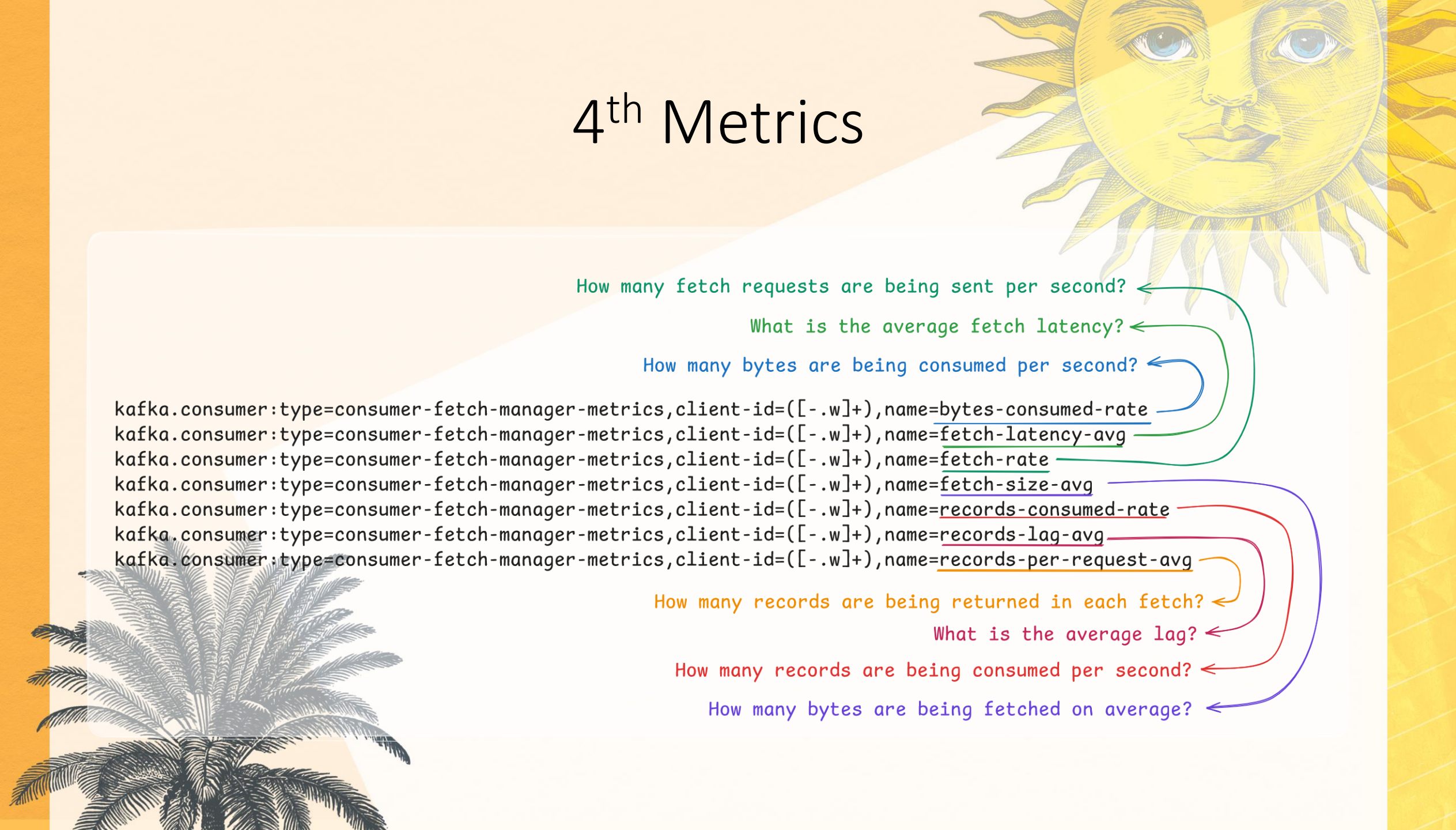
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-size-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-lag-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-per-request-avg
```

What is the average lag?

How many records are being consumed per second?

How many bytes are being fetched on average?

4th Metrics



How many fetch requests are being sent per second?

What is the average fetch latency?

How many bytes are being consumed per second?

```
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=bytes-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-latency-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=fetch-size-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-consumed-rate
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-lag-avg
kafka.consumer:type=consumer-fetch-manager-metrics,client-id=([-.w]+),name=records-per-request-avg
```

How many records are being returned in each fetch?

What is the average lag?

How many records are being consumed per second?

How many bytes are being fetched on average?

Conclusion

- Kafka exposes a lot of metrics

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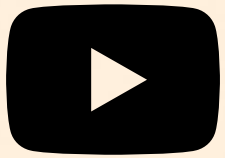
- We can measure everything Kafka and its clients are doing

Conclusion

- Kafka exposes a lot of metrics
- We can measure everything Kafka and its clients are doing
- But we need to KNOW what Kafka and its clients are doing

Questions?!?!!?!?

@vepo.dev



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