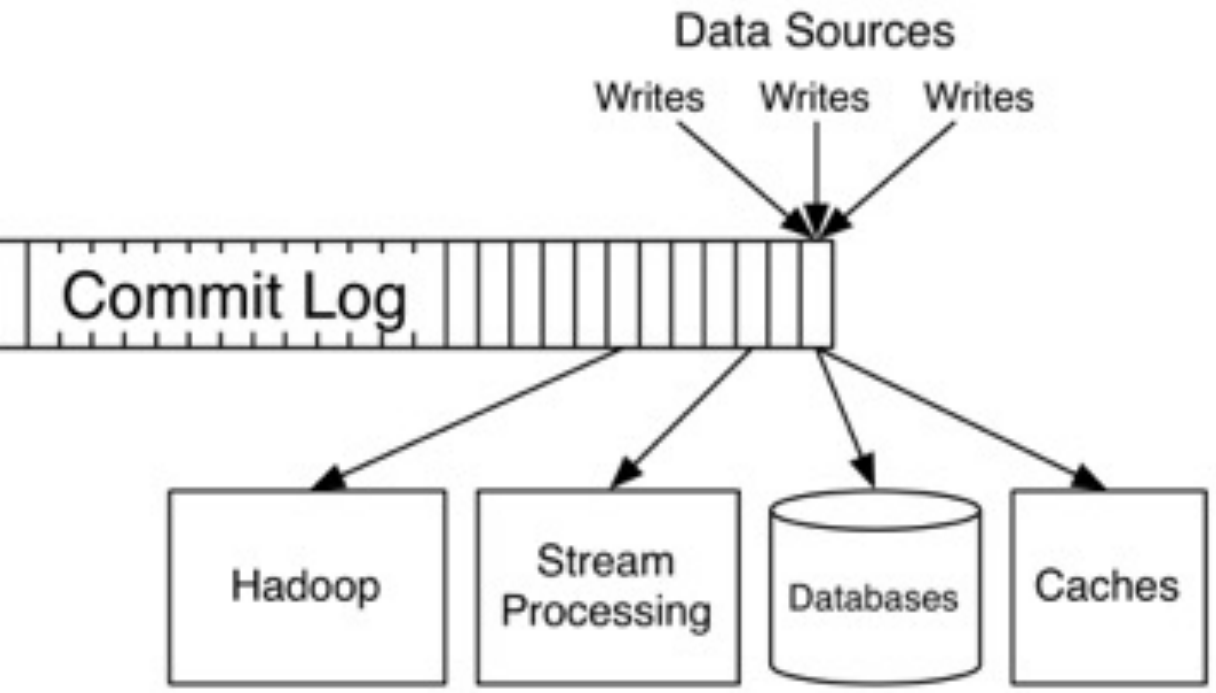
Why is My Stream Processing Job Slow?

Xavier Léauté, Software Engineer

Gwen Shapira, Principal Data Architect

Kafka 101



Distributed

Scalable

Fault-Tolerant

Partitioned + Replicated Log

Ordering guarantees

Consumers advance independently

Exactly-once delivery

Transactional commits


What people think of Stream Monitoring

What our typical experience is

Real Customer Experiences

Real Customer Experiences

Client Side

Broken Streaming Job / App

Real Customer Experiences

Client Side	**Broken Streaming Job / App**
End-to-End	**Slow Replication**

Your Kafka stream job stopped humming… now what?

What we check

- [x] Consumer Lag
- [ ] Partition Assignment
- [ ] Partition Skew
- [ ] Client Logs
- [ ] GC Log
- [ ] Metrics
  - [ ] Request Latencies
  - [ ] Commit Rates
  - [ ] Group Rebalancing
- [ ] Basic Tuning
  - [ ] Batch Sizes
  - [ ] Commit Rate
- [ ] Application Profiling

The Newbie - During an incident...

GC Logs? Metrics?
How do I get those?

I'll just change some configs
and reboot everything.

Consumer Lag

Bad Capacity Allocation

```
kafka-consumer-groups --bootstrap-server localhost:9092 --describe --group
fast-data-reader

TOPIC      PARTITION  CURRENT-OFFSET  LOG-END-OFFSET  LAG        CONSUMER-ID
fast-data 1          8661694         8703404         41710      myapp-1
fast-data 3          8577975         8616490         38515      myapp-2
fast-data 0          4902354         8741872         3839518    myapp-3
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```

Not all partitions are created equal

Important for

- Keyed topics
- Custom partitioned topics

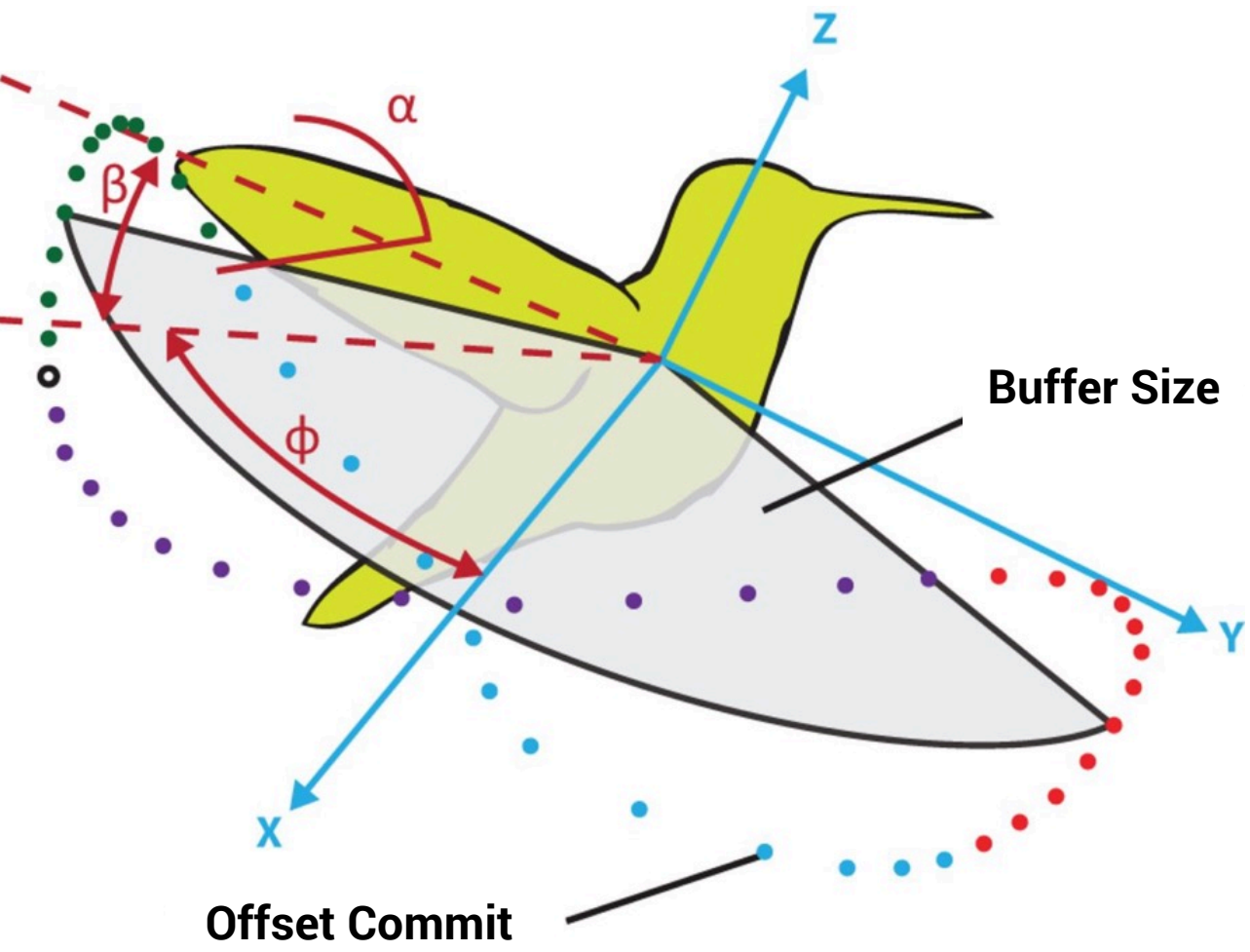
Early warning signs

- some partitions lagging
- uneven CPU / Network usage

Typical cause

- skewed key distribution in your data
- bad joins (null keys)
- imbalance across brokers

Clients have metrics too!



Start with the basics **GC / CPU / Network**

General Slowness

- Consumer or Producer Side?
- Global Request Latencies

Some partitions still lagging

- Per Broker metrics (bad node / network)
- Per Topic metrics (data / tuning)

Turn up the log level

Time for some profiling

https://github.com/jvm-profiling-tools/async-profiler
https://github.com/brendangregg/FlameGraph

```
./profiler.sh -d 30 -f flamegraph.svg <pid>
```

To impress your coworkers
https://github.com/Netflix/flamescope

Here's where your CPU cycles went

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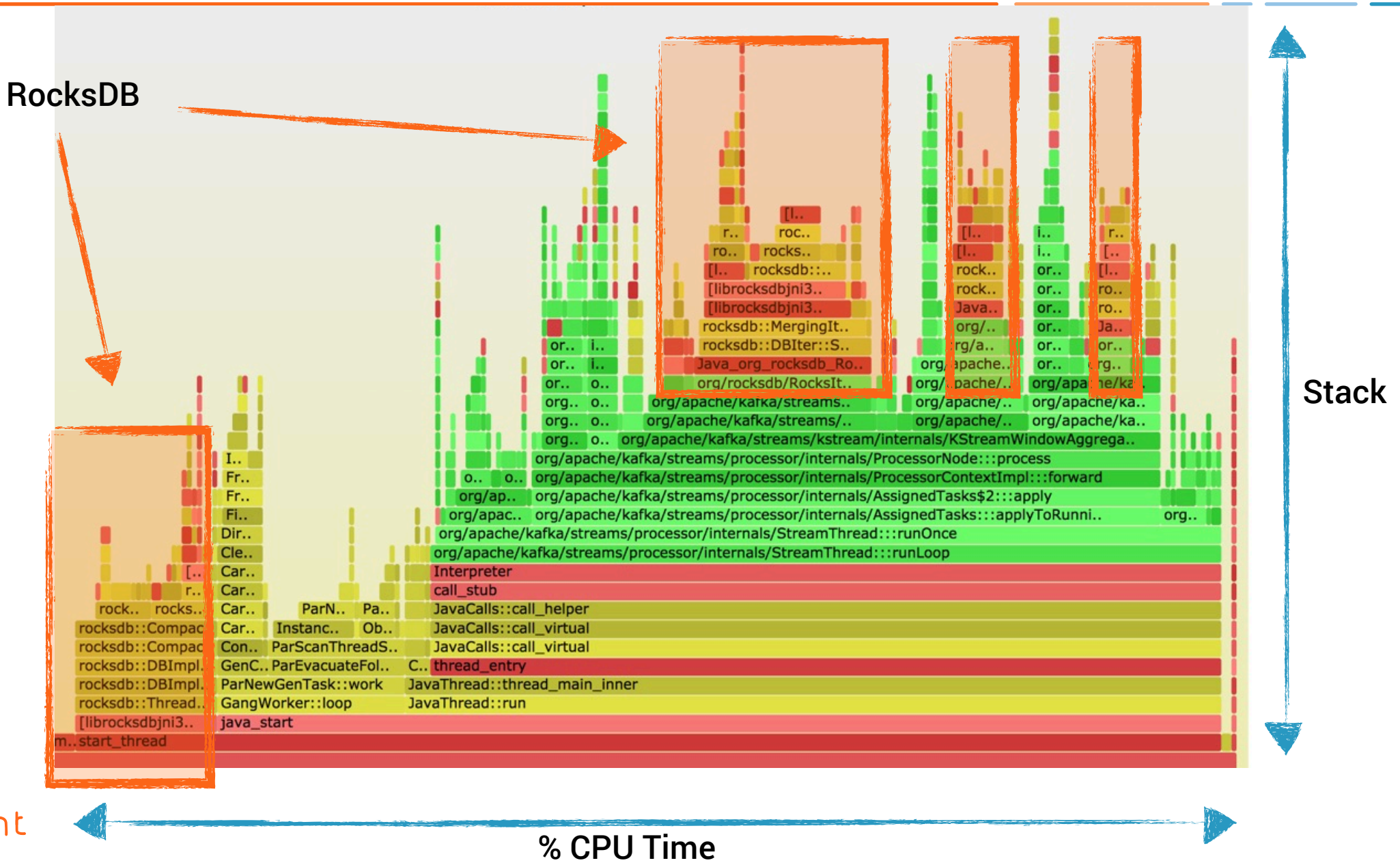

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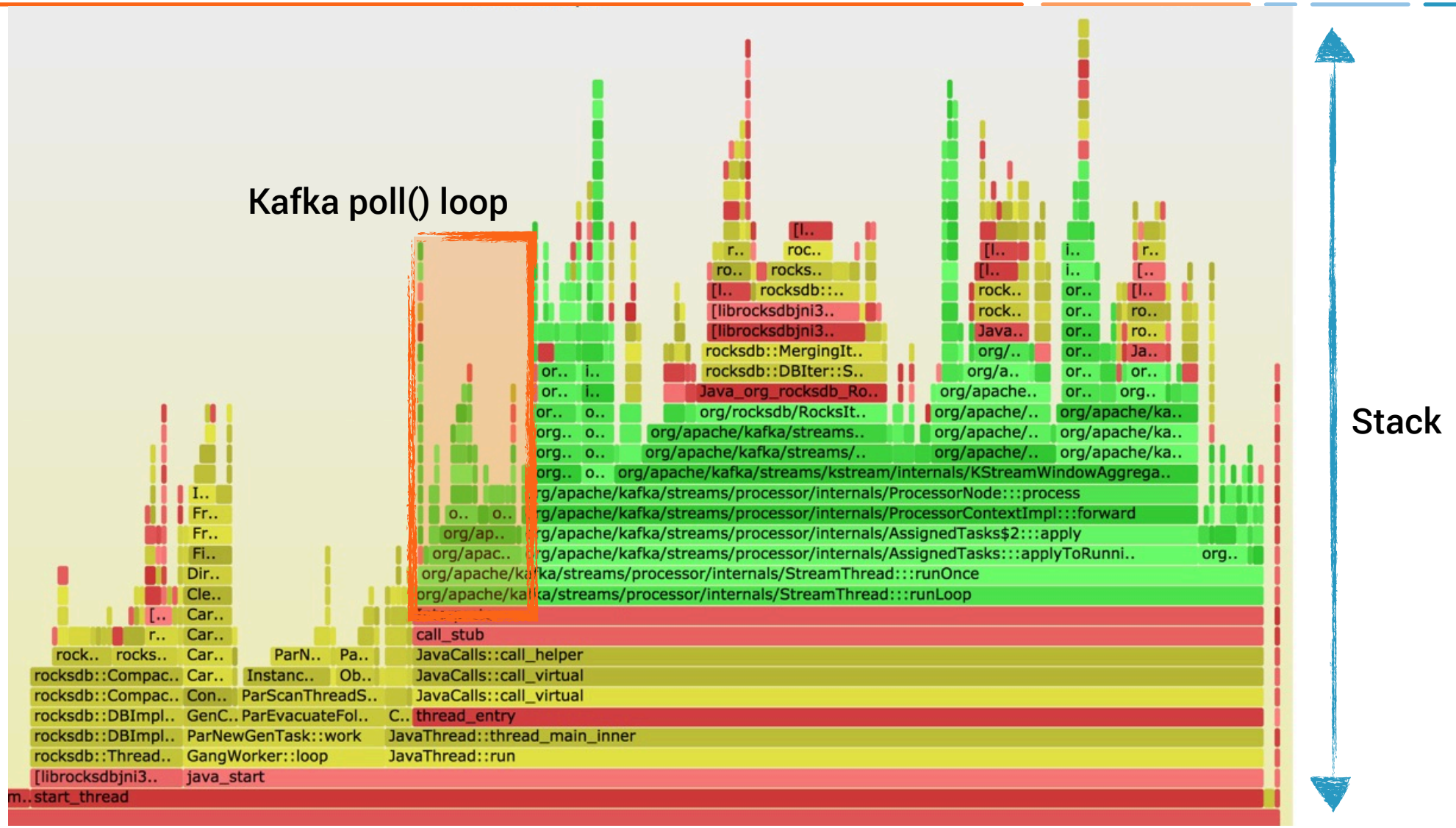

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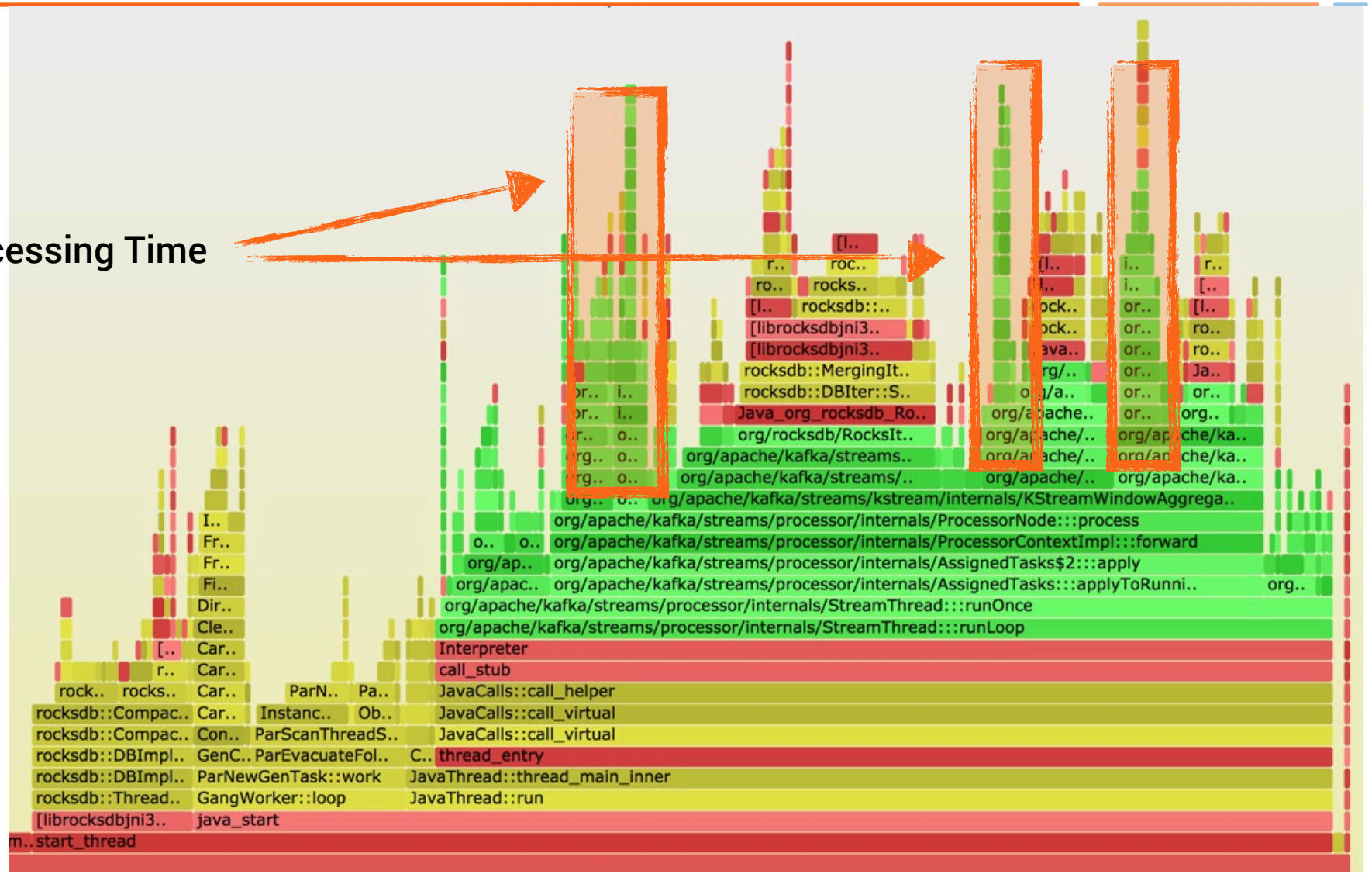
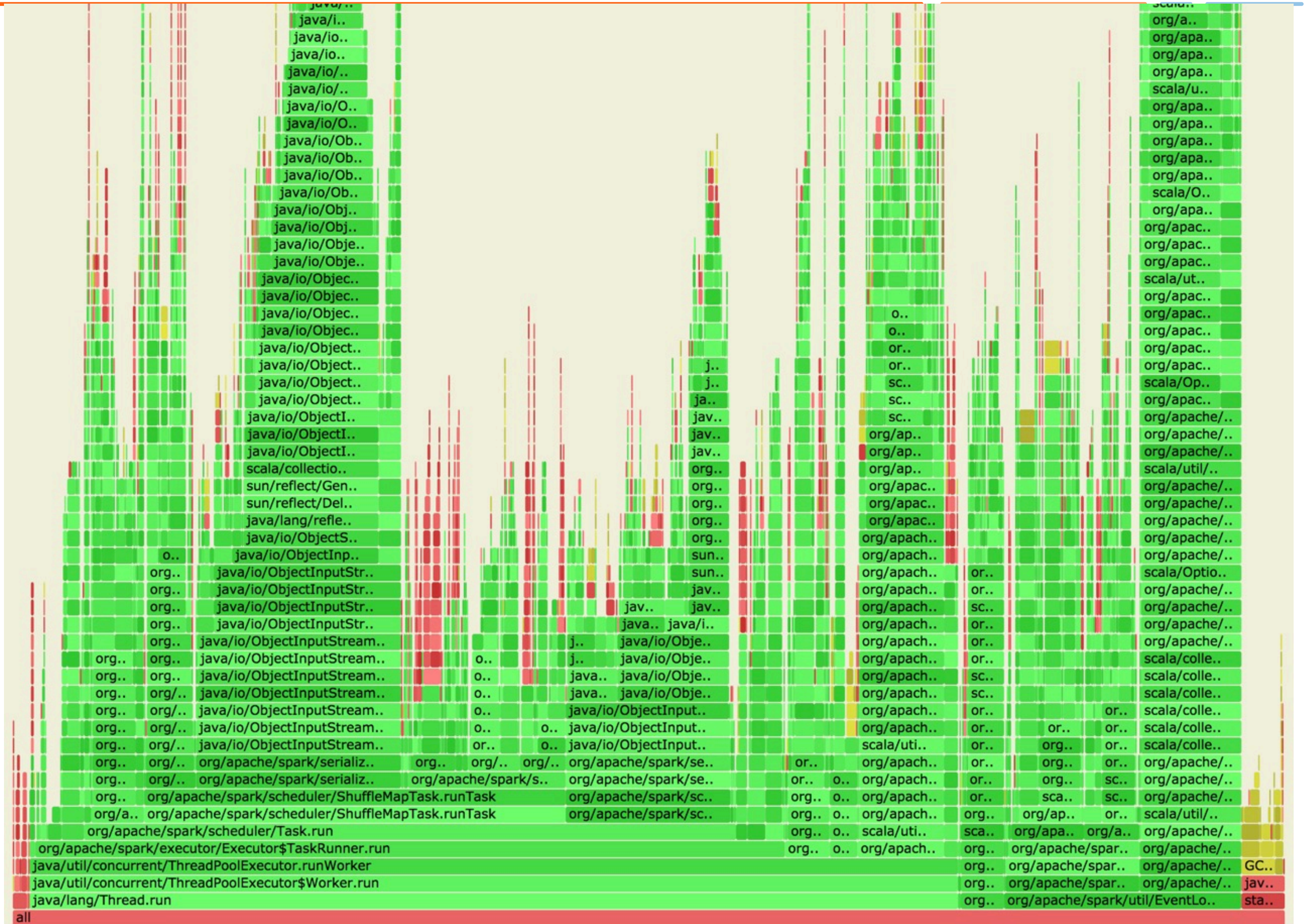


Spark Streaming Clickstream Example (using Kafka)

```
val pageViews = KafkaUtils.createDirectStream[String, String](
  streamingContext, LocationStrategies.PreferConsistent,
  ConsumerStrategies.Subscribe[String, String](topicsSet, kafkaParams))
  .map { record => PageView.fromString(record.value) }
// Return the rate of error pages (a non 200 status) in each zip code over the last 30 seconds
val statusesPerZipCode = pageViews.window(Seconds(30), Seconds(2))
                                  .map(view => (view.zipCode, view.status))
                                  .groupByKey()
val errorRatePerZipCode = statusesPerZipCode.map{
  case(zip, statuses) =>
    val normalCount = statuses.count(_ == 200)
    val errorCount = statuses.size - normalCount
    val errorRatio = errorCount.toFloat / statuses.size
    if (errorRatio > 0.05) {
      "%s: **%s**".format(zip, errorRatio)
    } else {
      "%s: %s".format(zip, errorRatio)
    }
}
errorRatePerZipCode.print()
```

Spark Streaming Clickstream Example (using Kafka)



Spark Streaming Clickstream Example (using Kafka)

Scheduler
Event Loop

Spark Streaming Clickstream Example (using Kafka)

Shuffle Writes

Scheduler Event Loop

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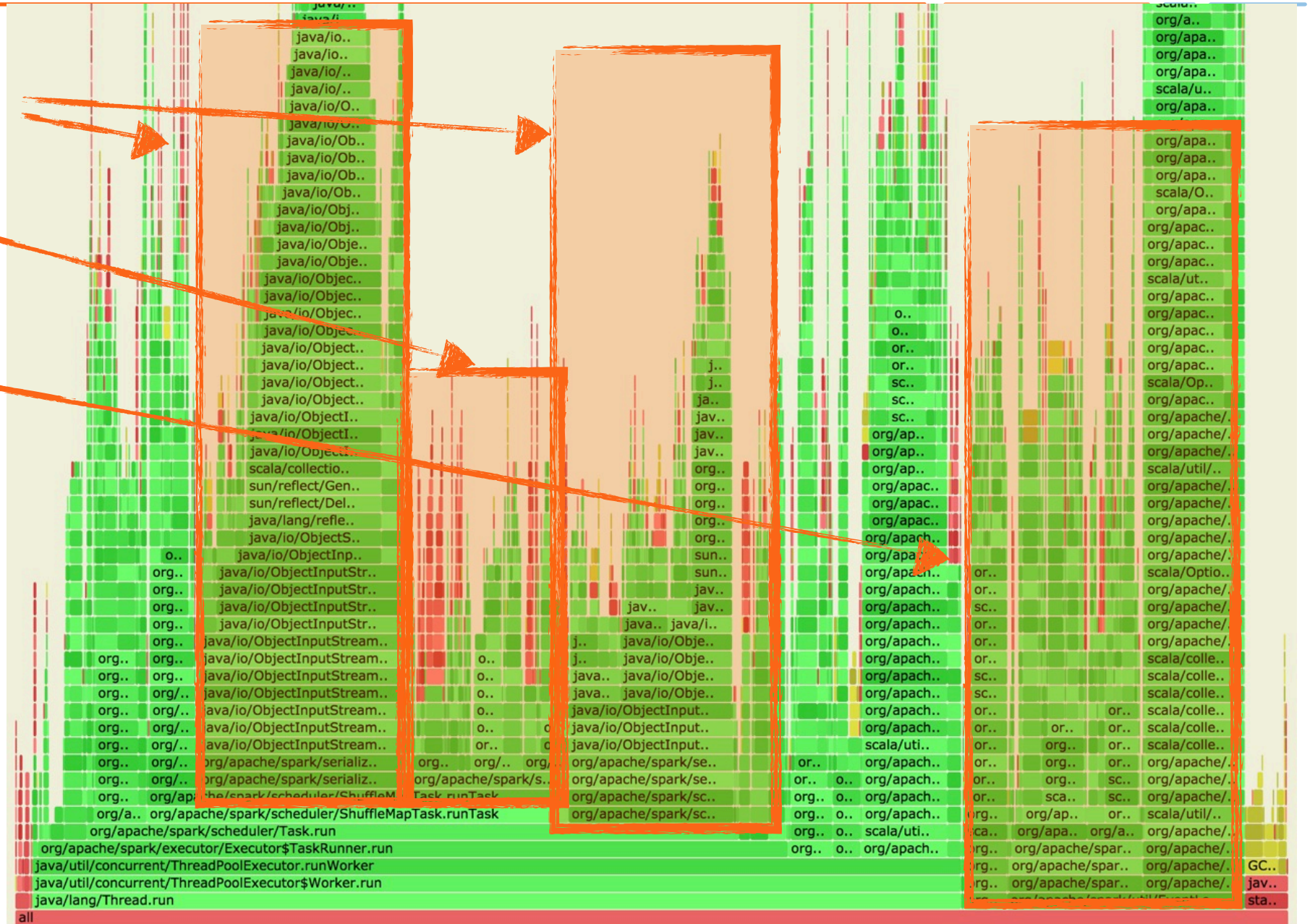
30% deserialization

Shuffle Writes

Scheduler
Event Loop



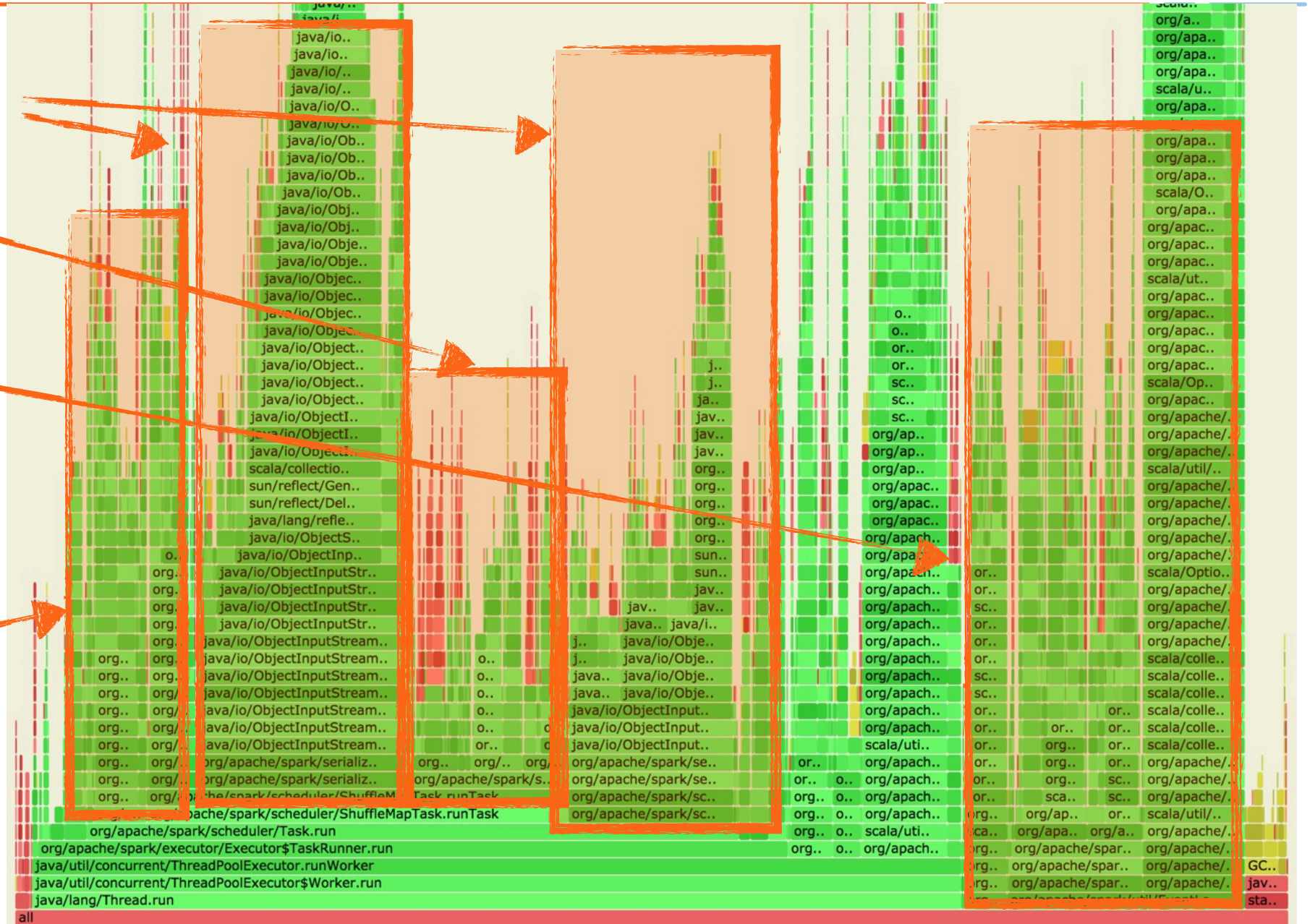
Spark Streaming Clickstream Example (using Kafka)

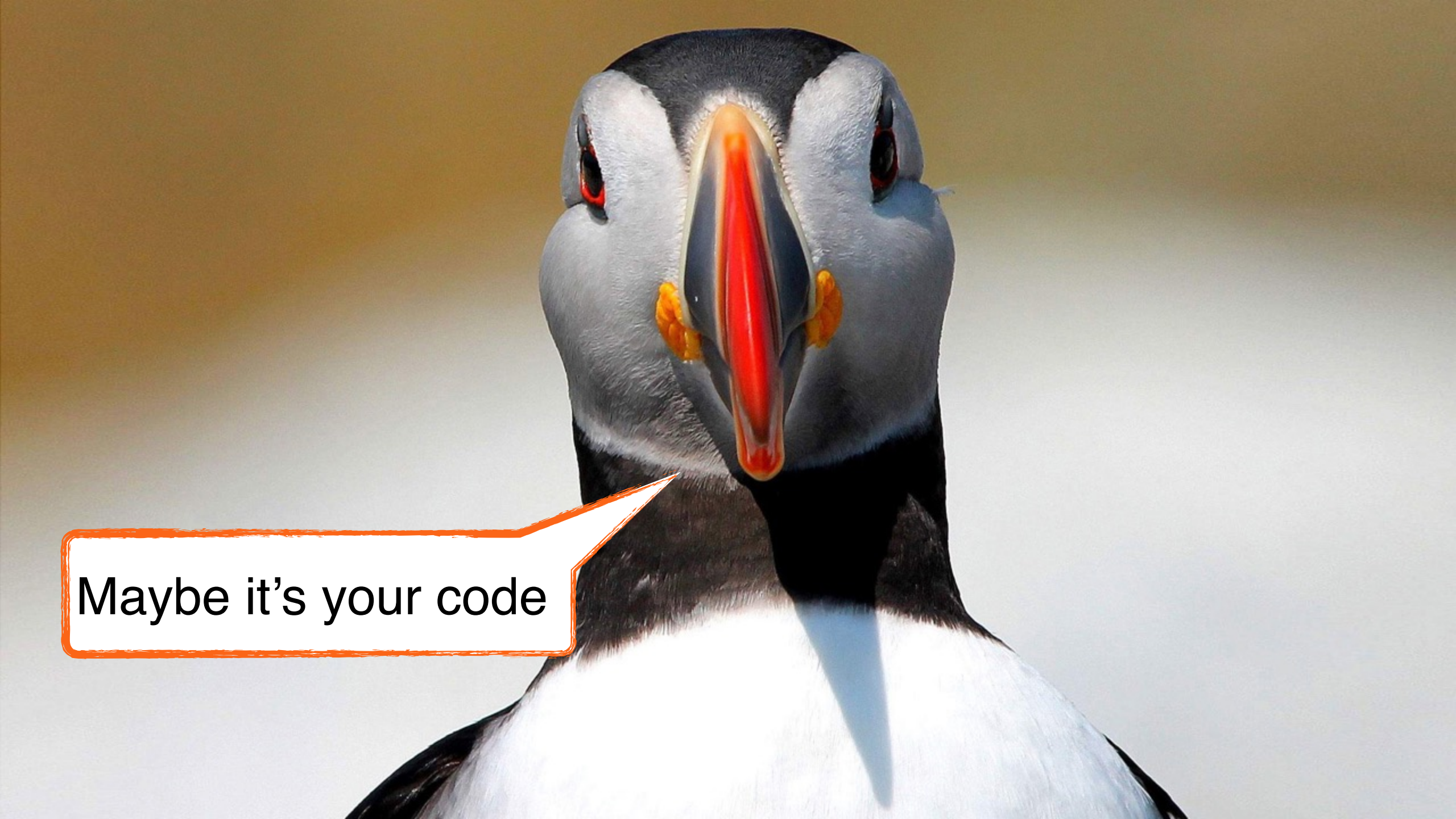
30% deserialization

Shuffle Writes

Scheduler
Event Loop

Read from Kafka
& Processing




Maybe it’s your code

Let's commit, just to be safe, right?

Common beginner mistake

Commit only as needed
- keep recovery short
- maximize throughput

Metrics to validate
- commit-rate
- commit-latency-avg

Right-size your batches

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Bigger Batches

- increase throughput
- improve compression

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Small enough (<< 10MB) to keep GC low

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batch.size + **linger.ms**

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don't forget!

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Small enough (<< 10MB) to keep GC low

batch.size + **linger.ms**

don't forget!

Watch

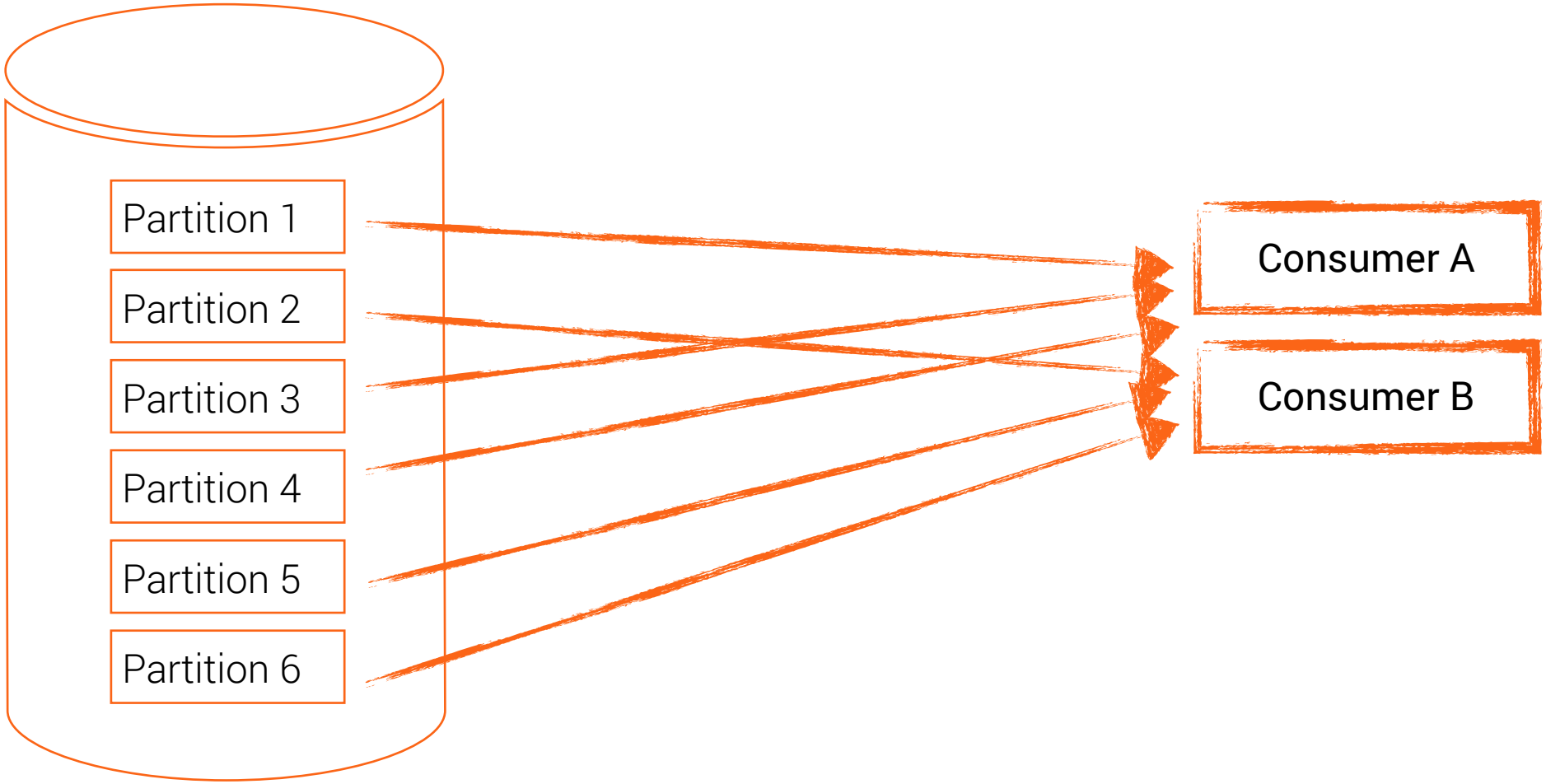
- request-rate
- request-latency-avg
- compression-rate

My app keeps rebalancing

Symptoms

- low throughput
- high network chatter
- consumer logs galore
- no progress
- hanging

Kafka Consumer Group Rebalancing 101



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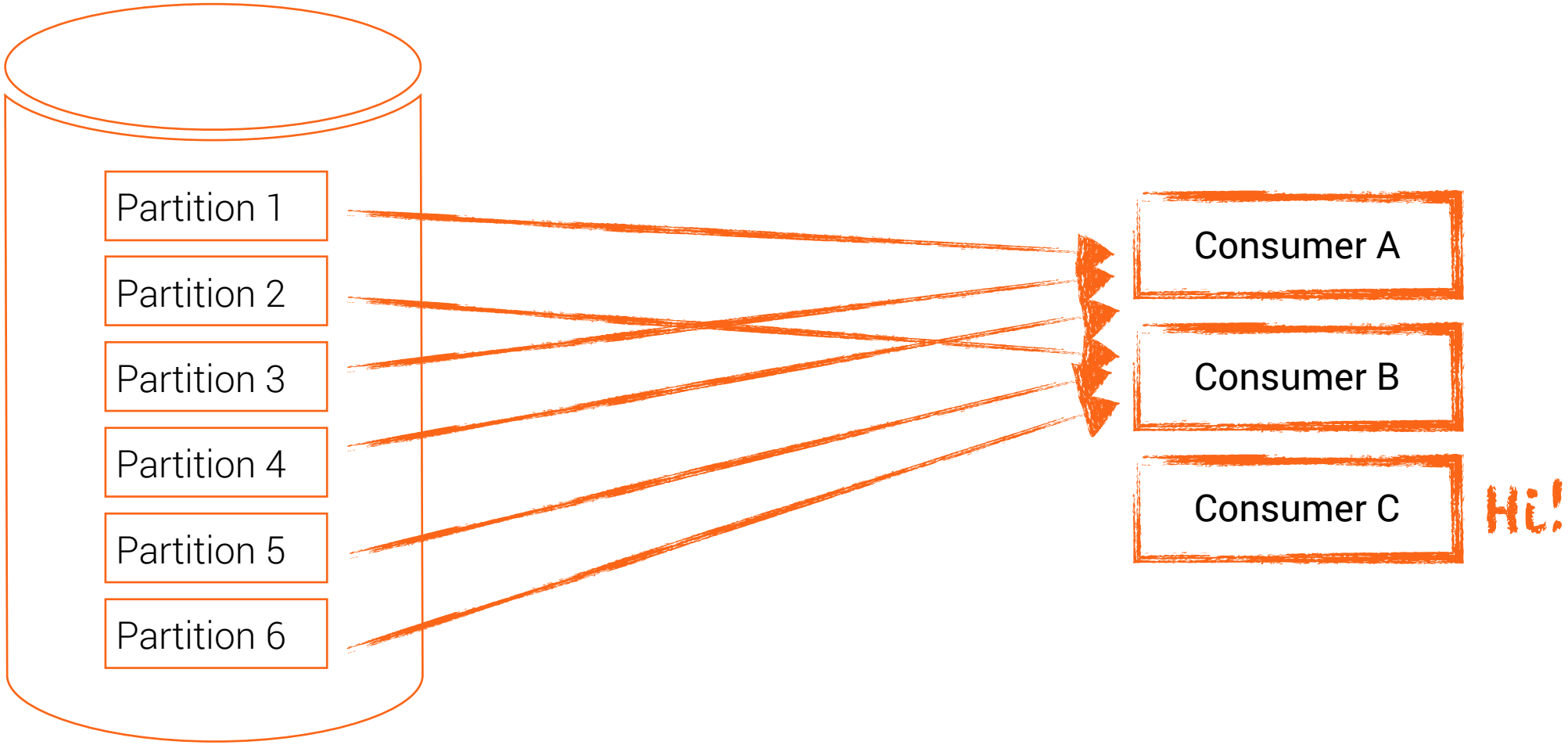

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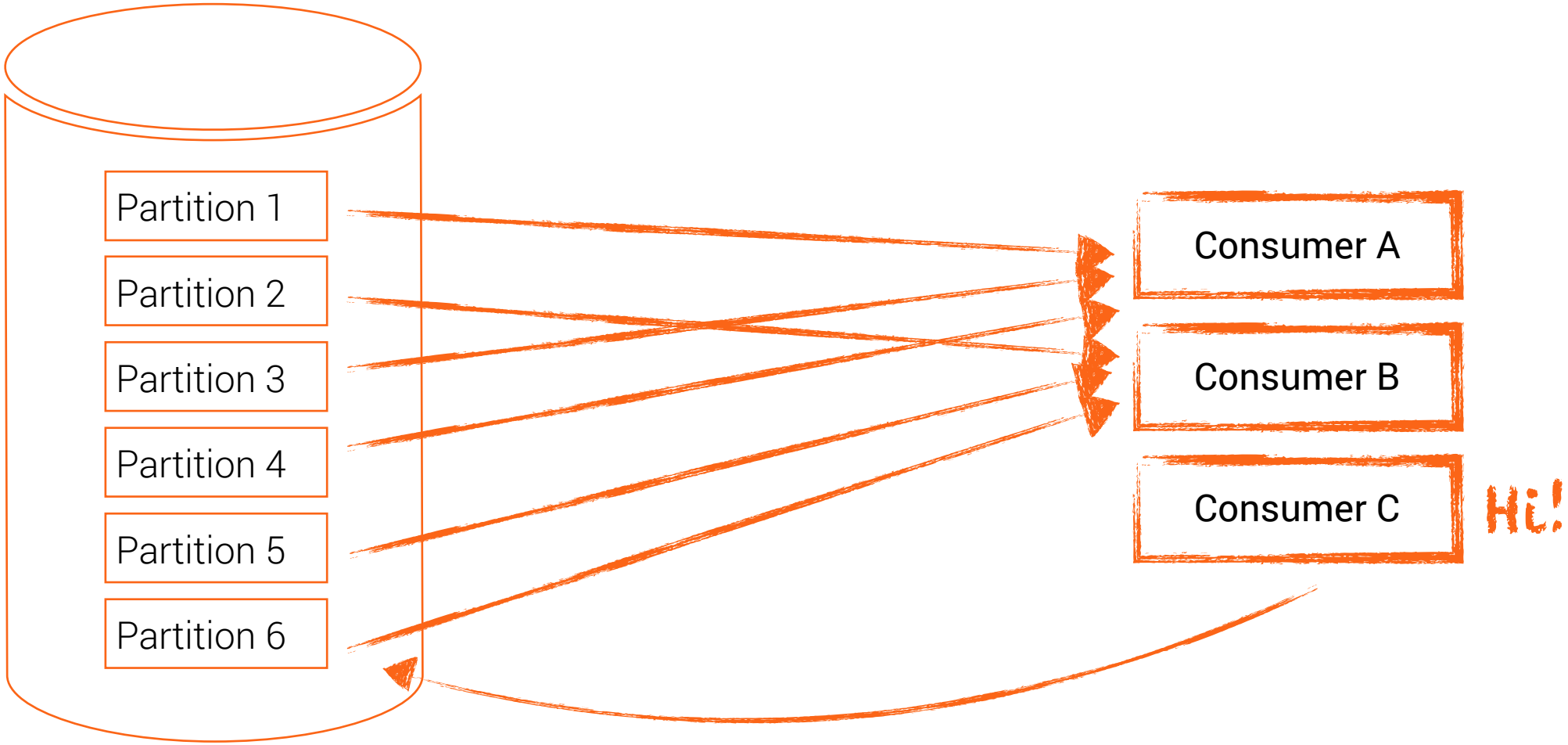

Join Group

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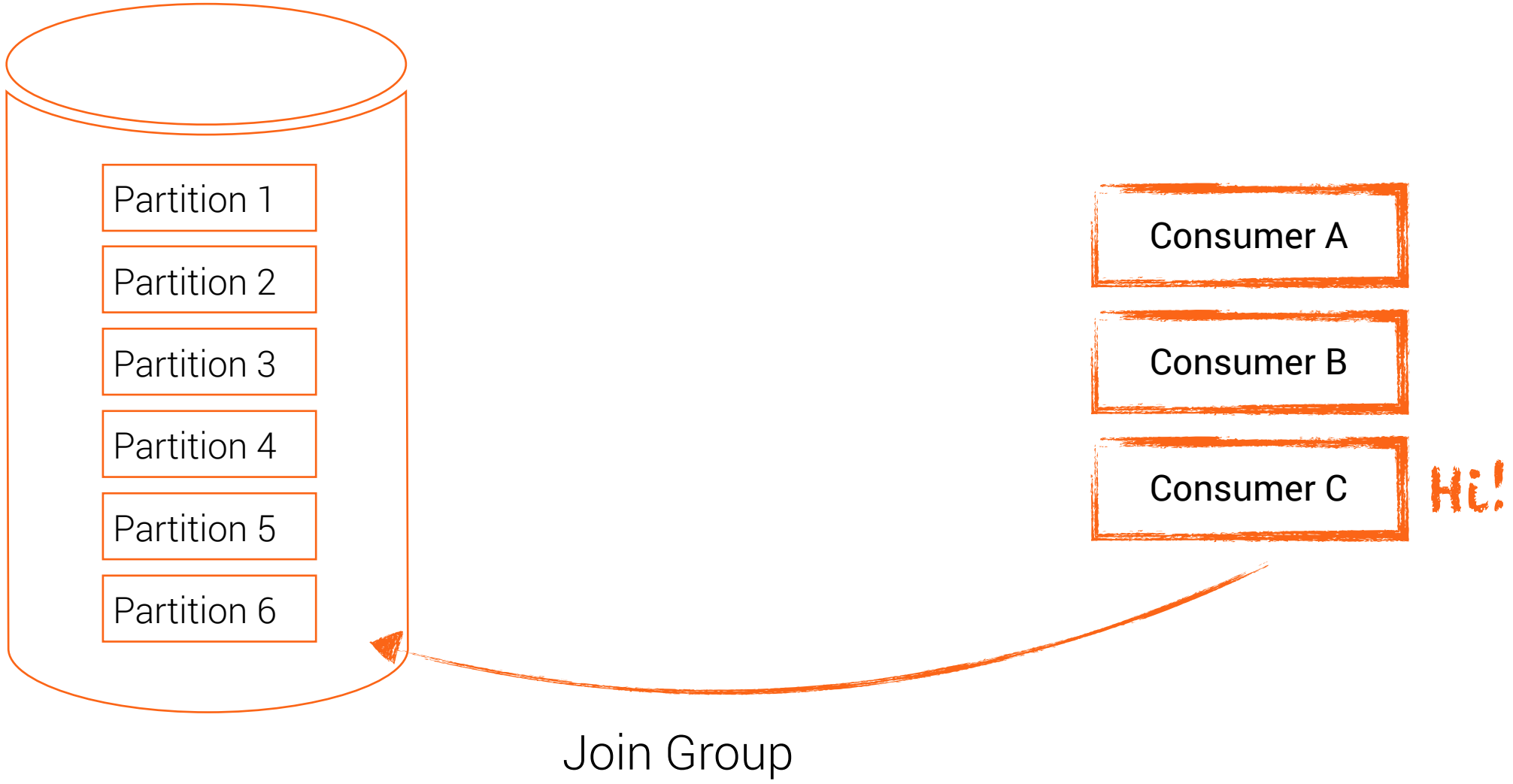

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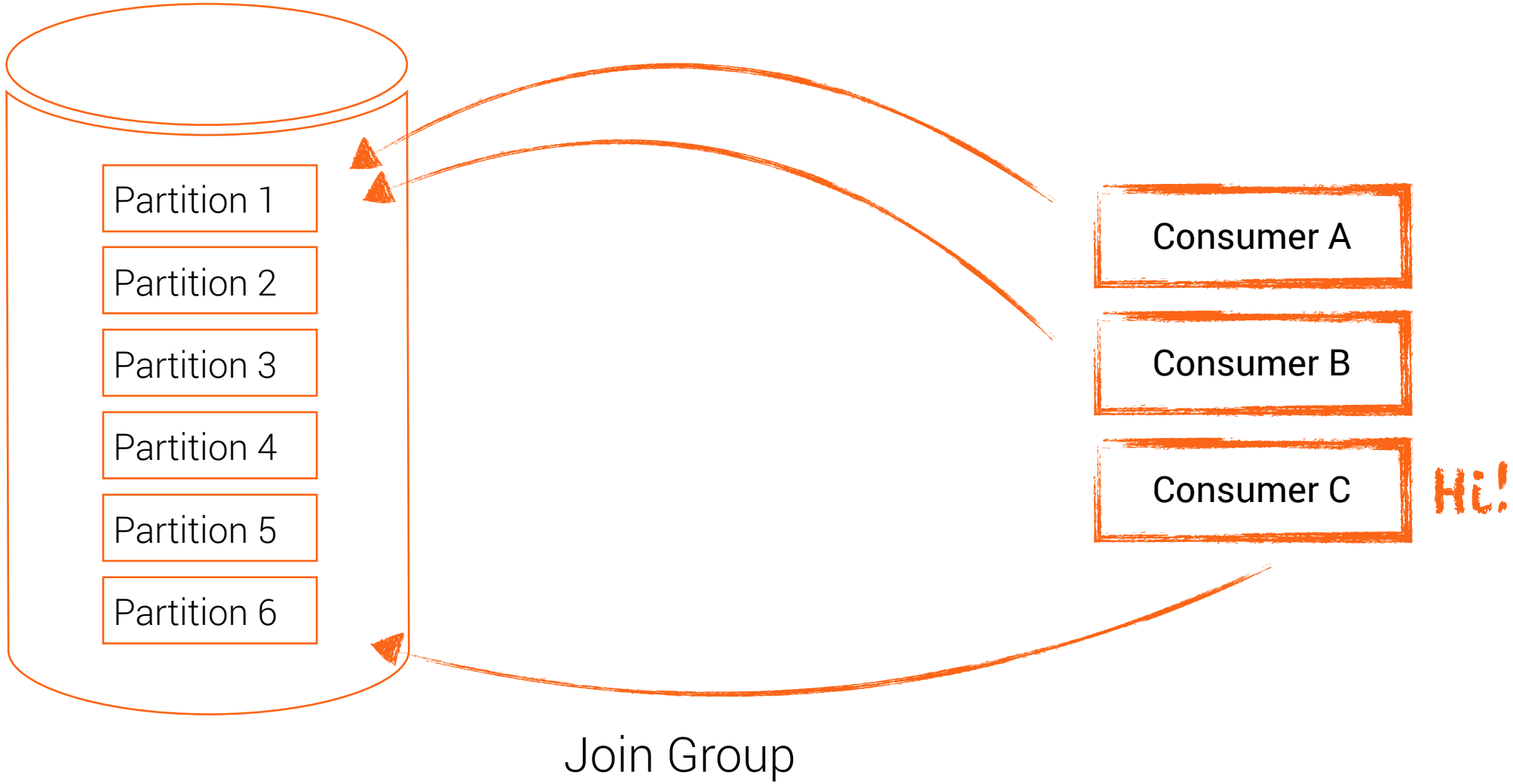

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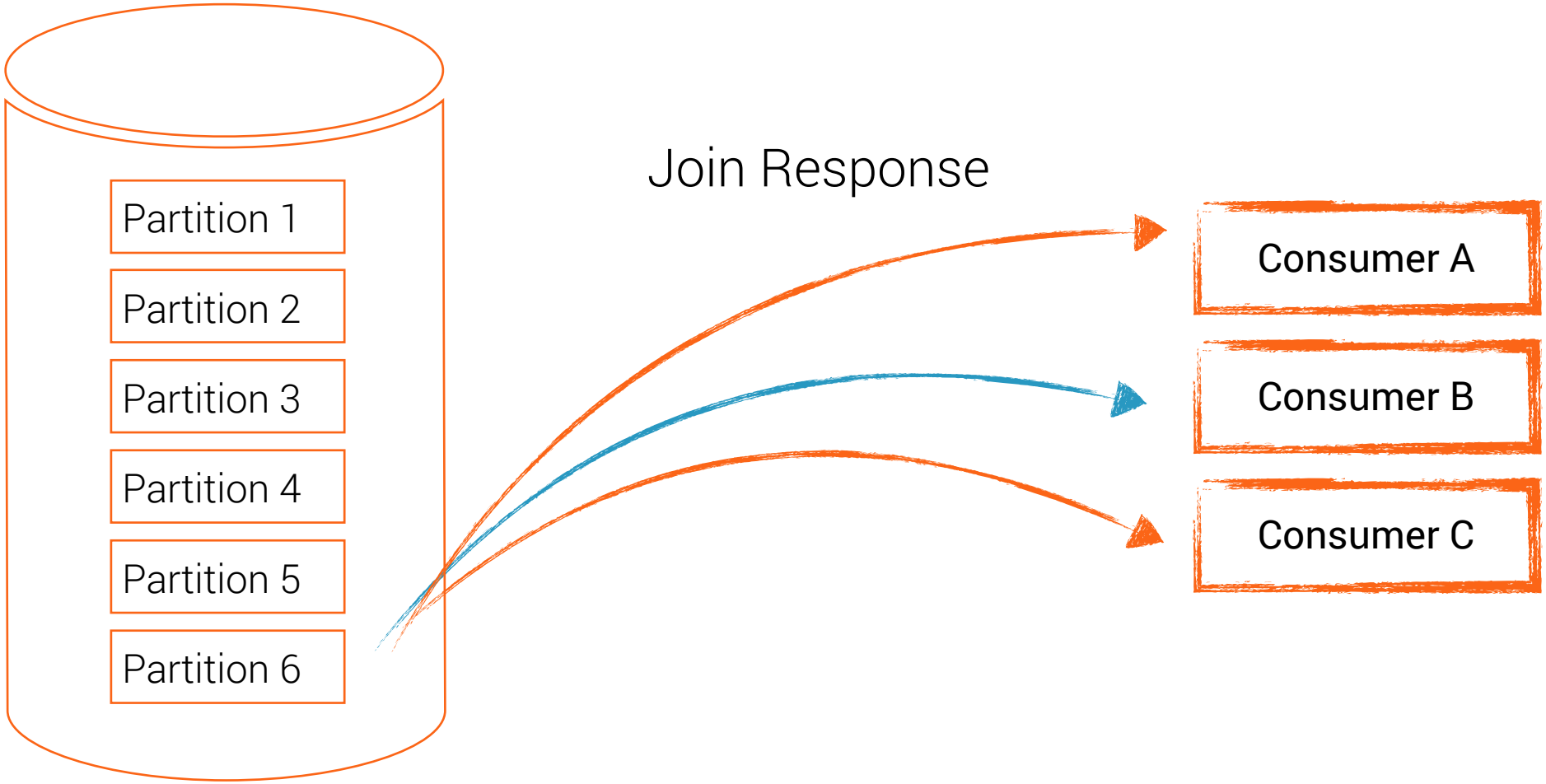

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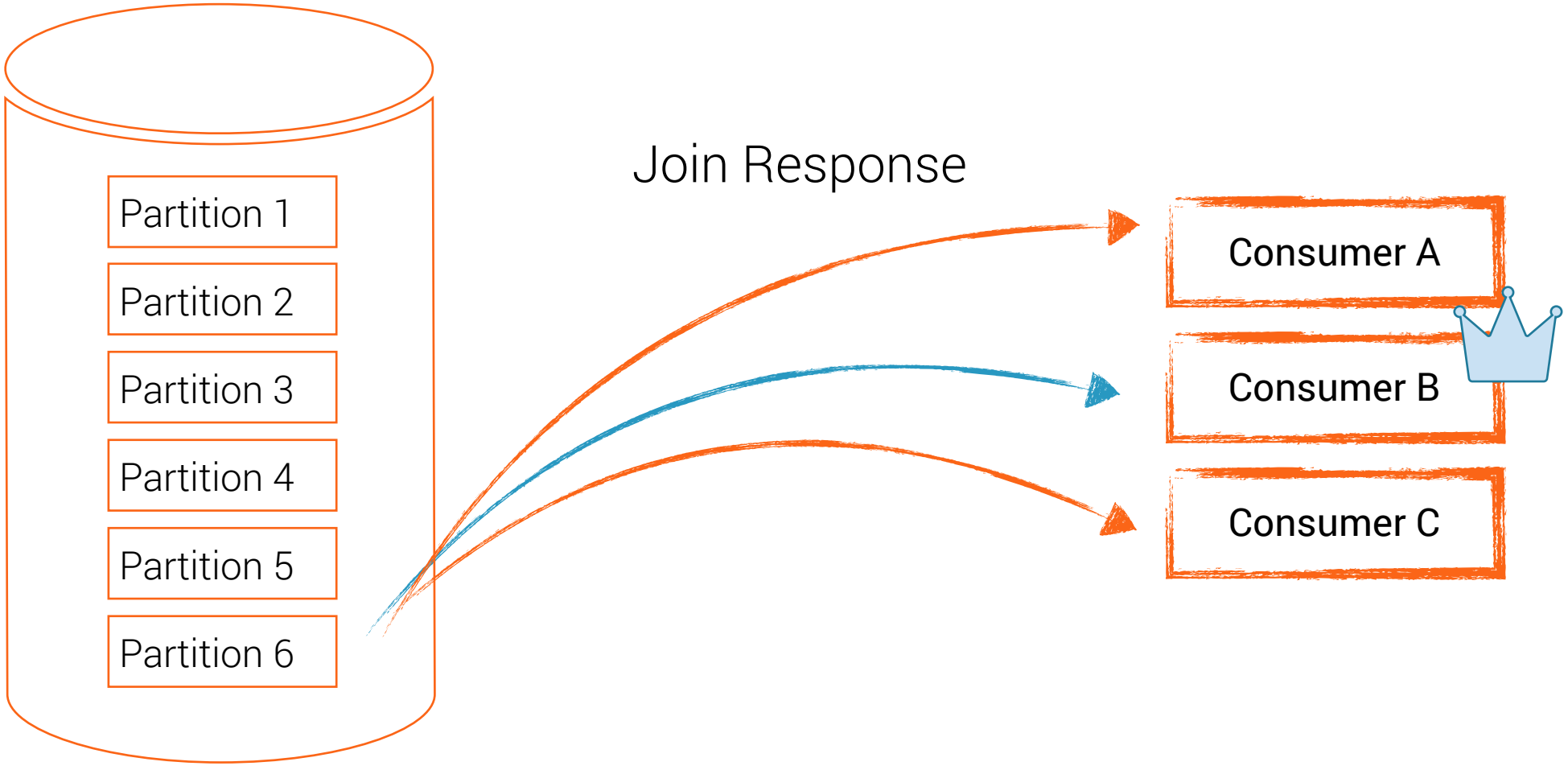

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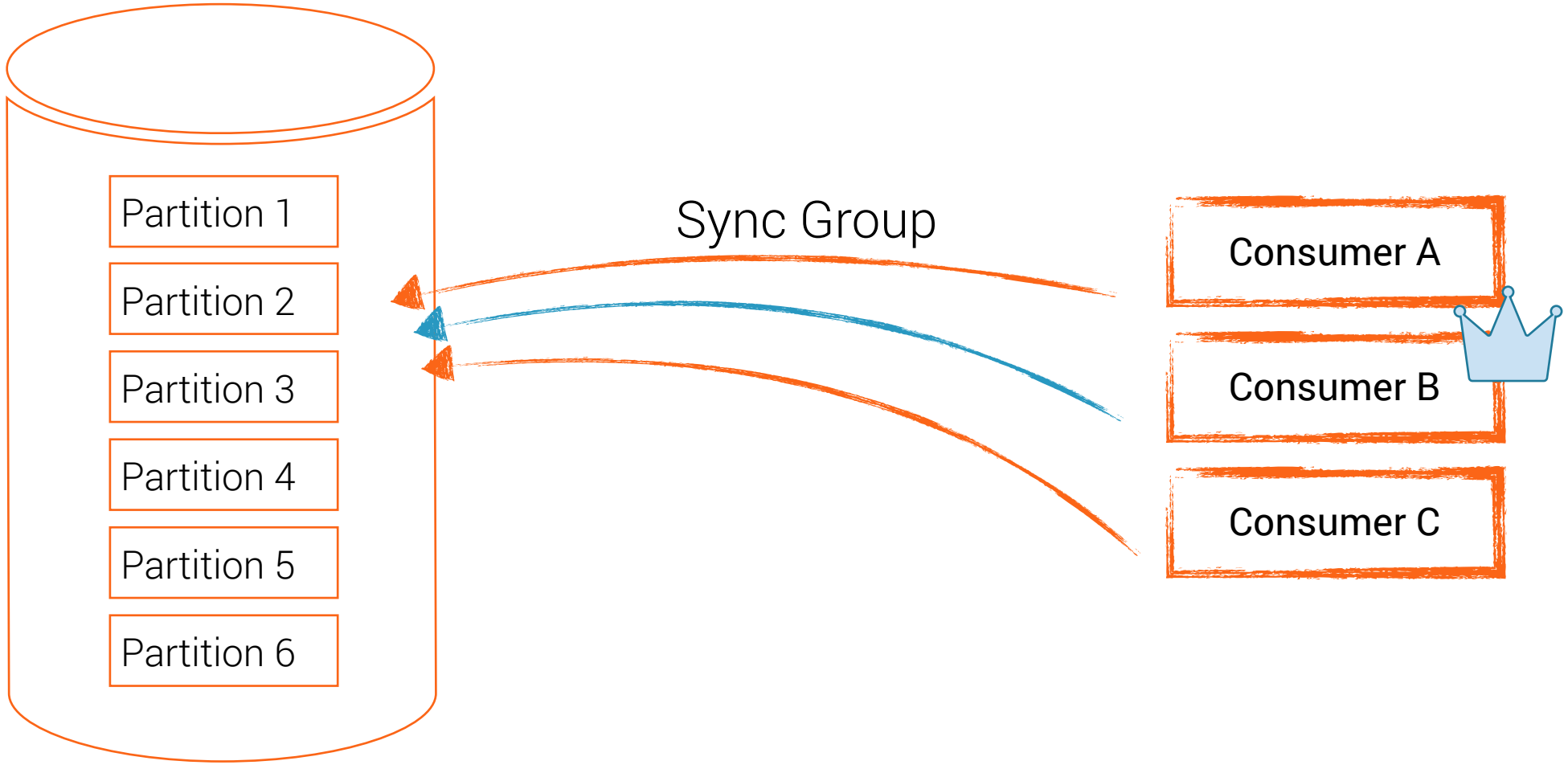

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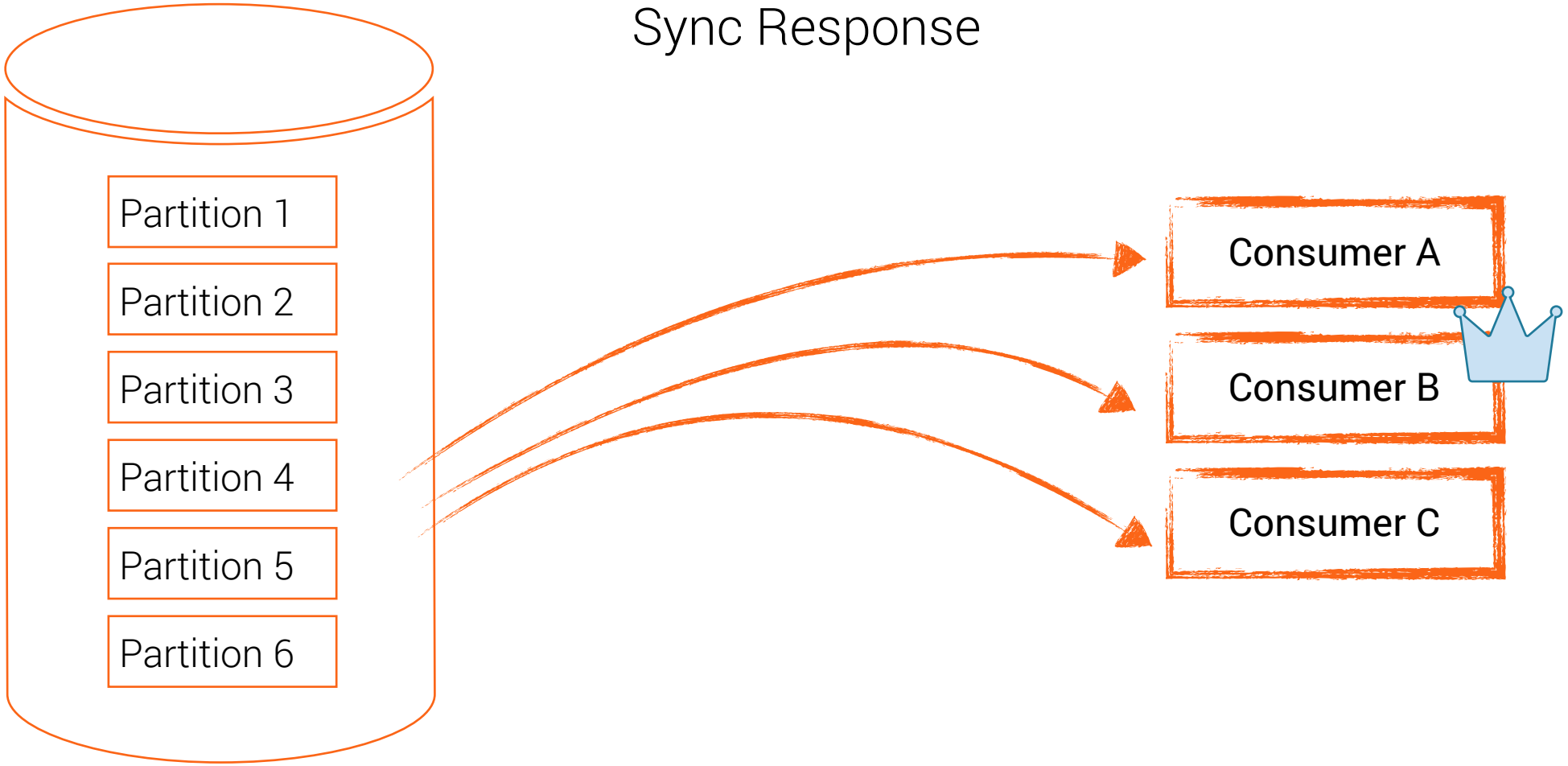

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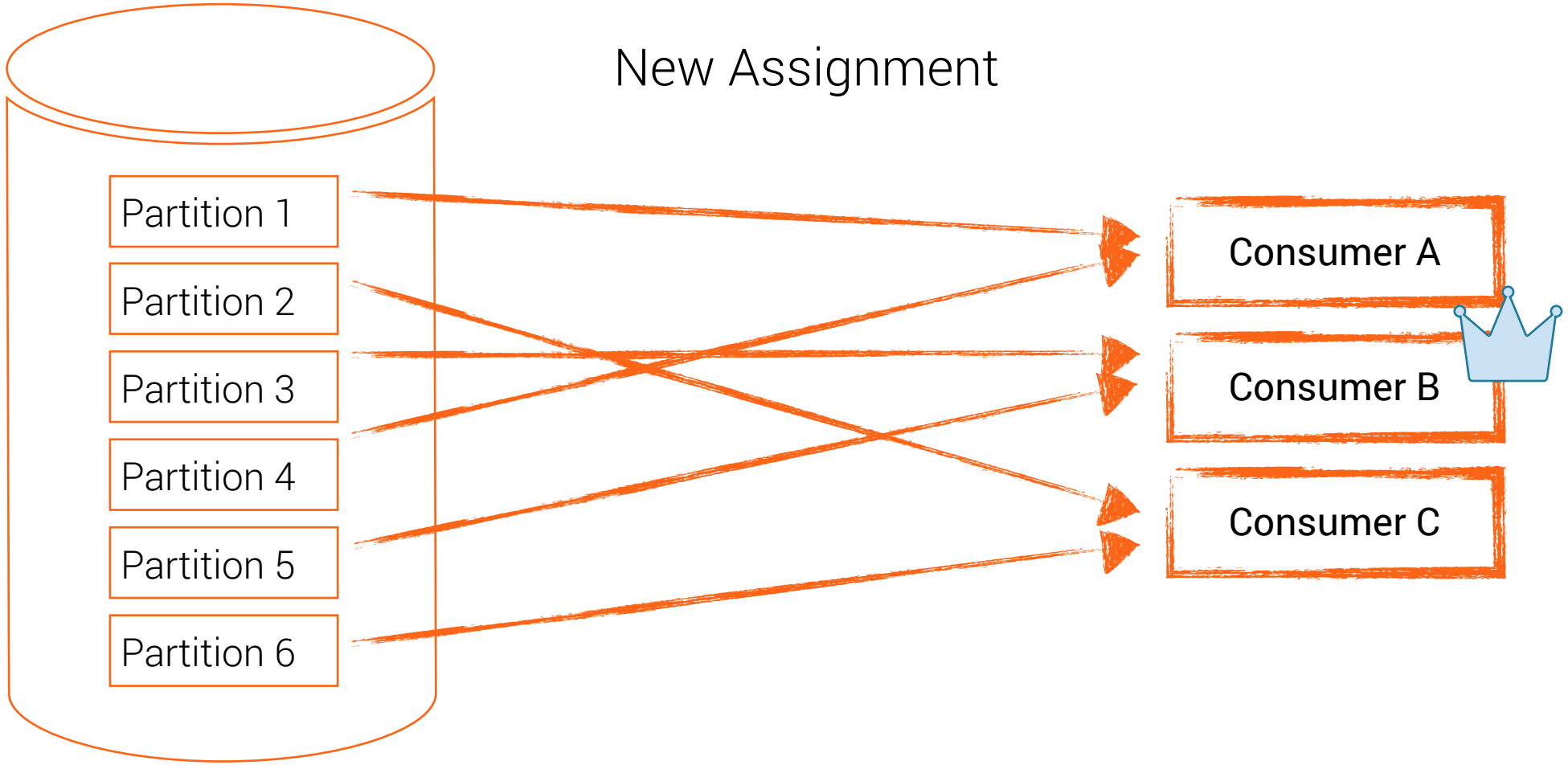
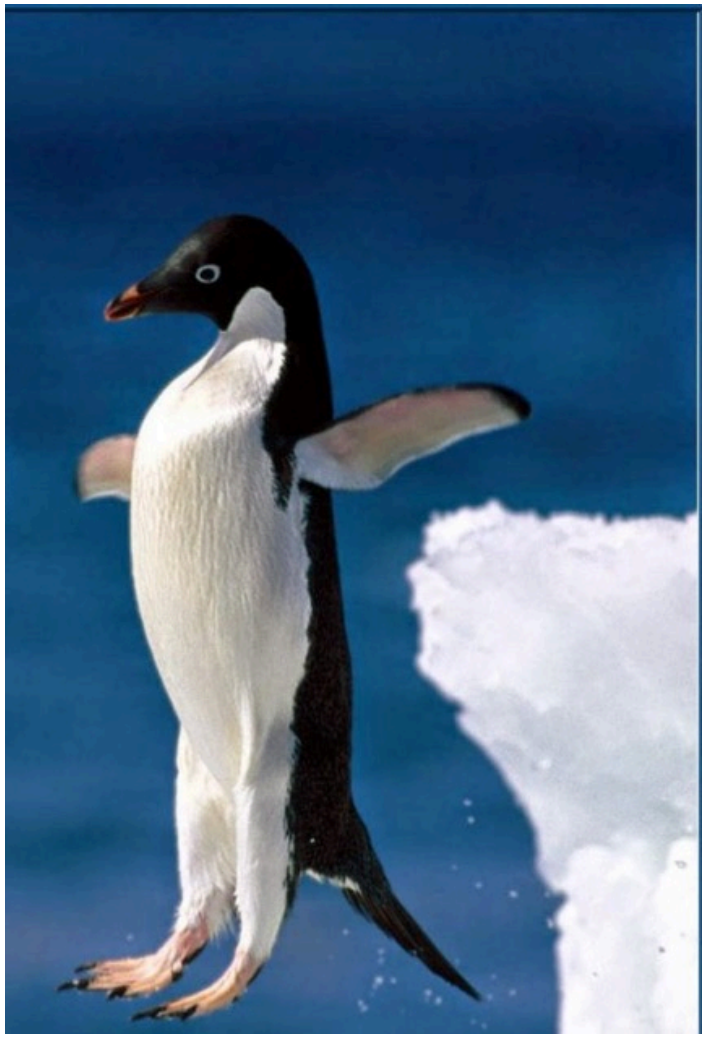


Restoring a Happy Balance



Timing Issues

- long GC pauses (tens of seconds)
- infrequent calls to `poll()`
- timeouts too short?

- flaky network
- 1 bad machine affects the entire group

Watch

- join-rate
- sync-rate

Competent Users

- Monitor Consumer Lag
- Lookout for Partition Skew
- Commit Offsets Sparingly
- Collect Logs
- Understand how to tune Batch Sizes

Kafka Pros

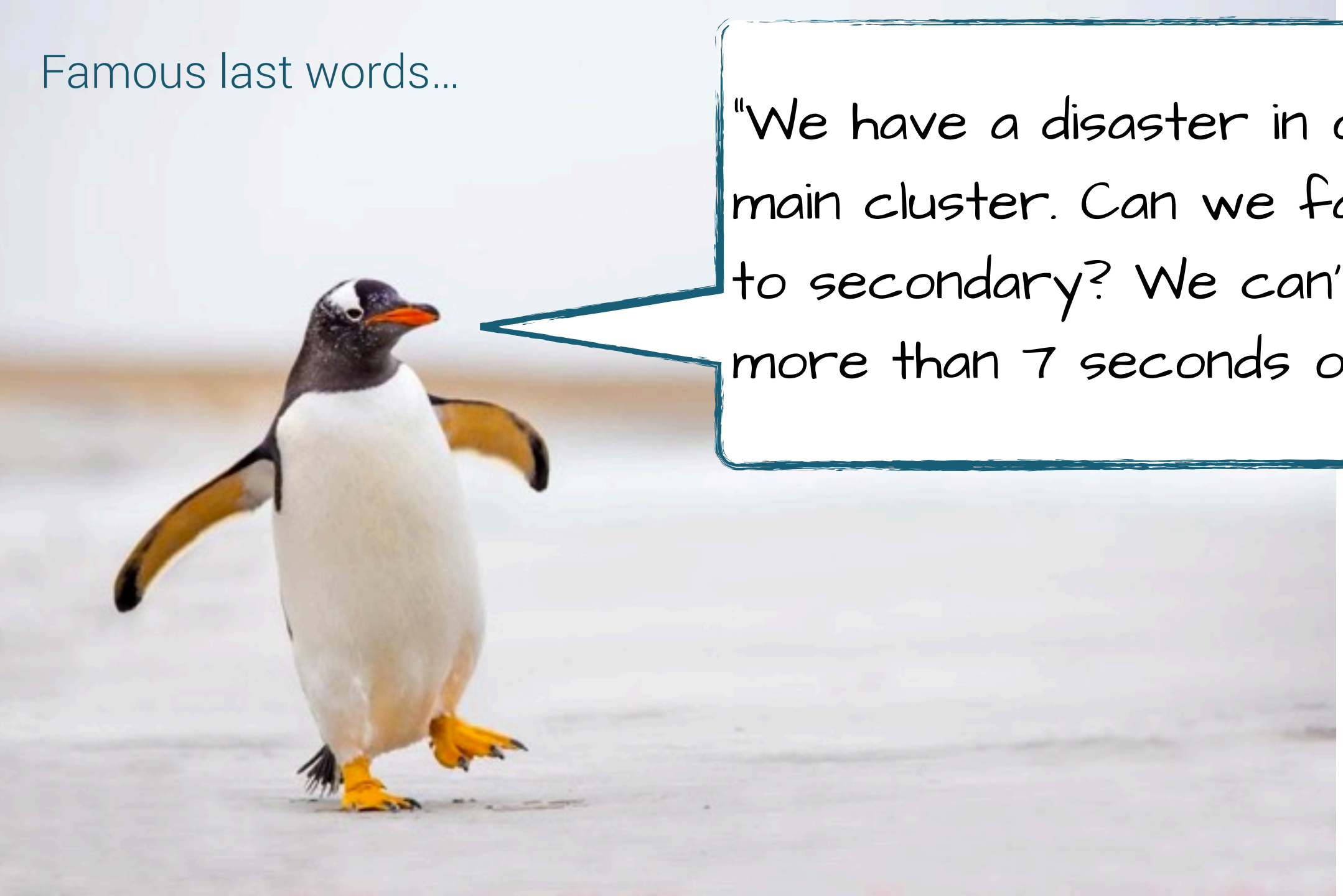
- Watch Group Partition Assignment
- Monitor Client Metrics
- Understand Consumer Rebalancing
- Profile their applications
- Distinguish Client/App/Broker problems

~~Replication~~ Everything is Slow

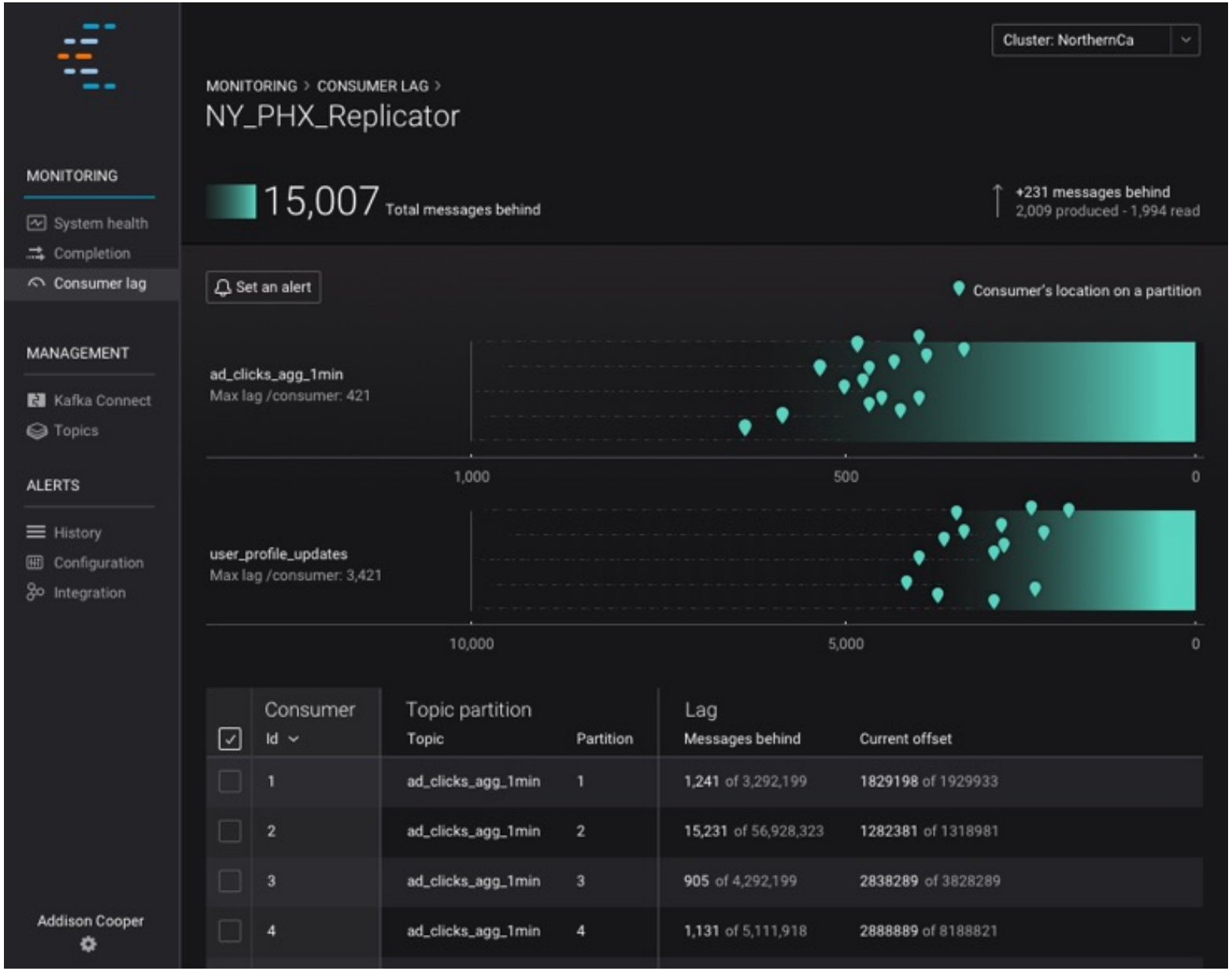
Famous last words…

"You just consume, and produce. How hard can this be?"

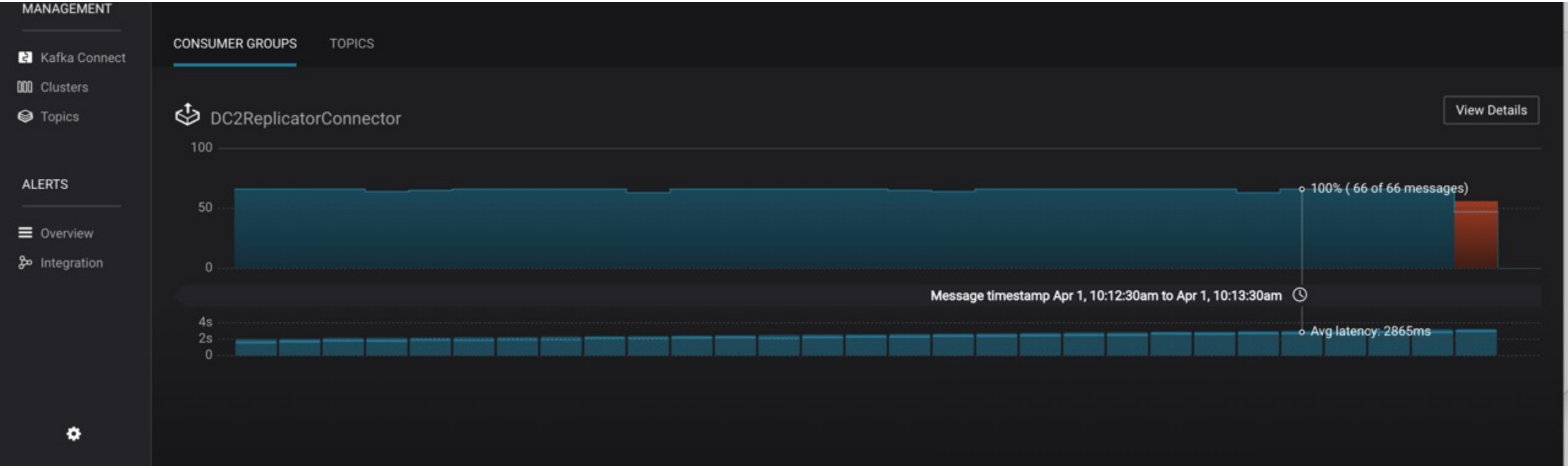
Famous last words…



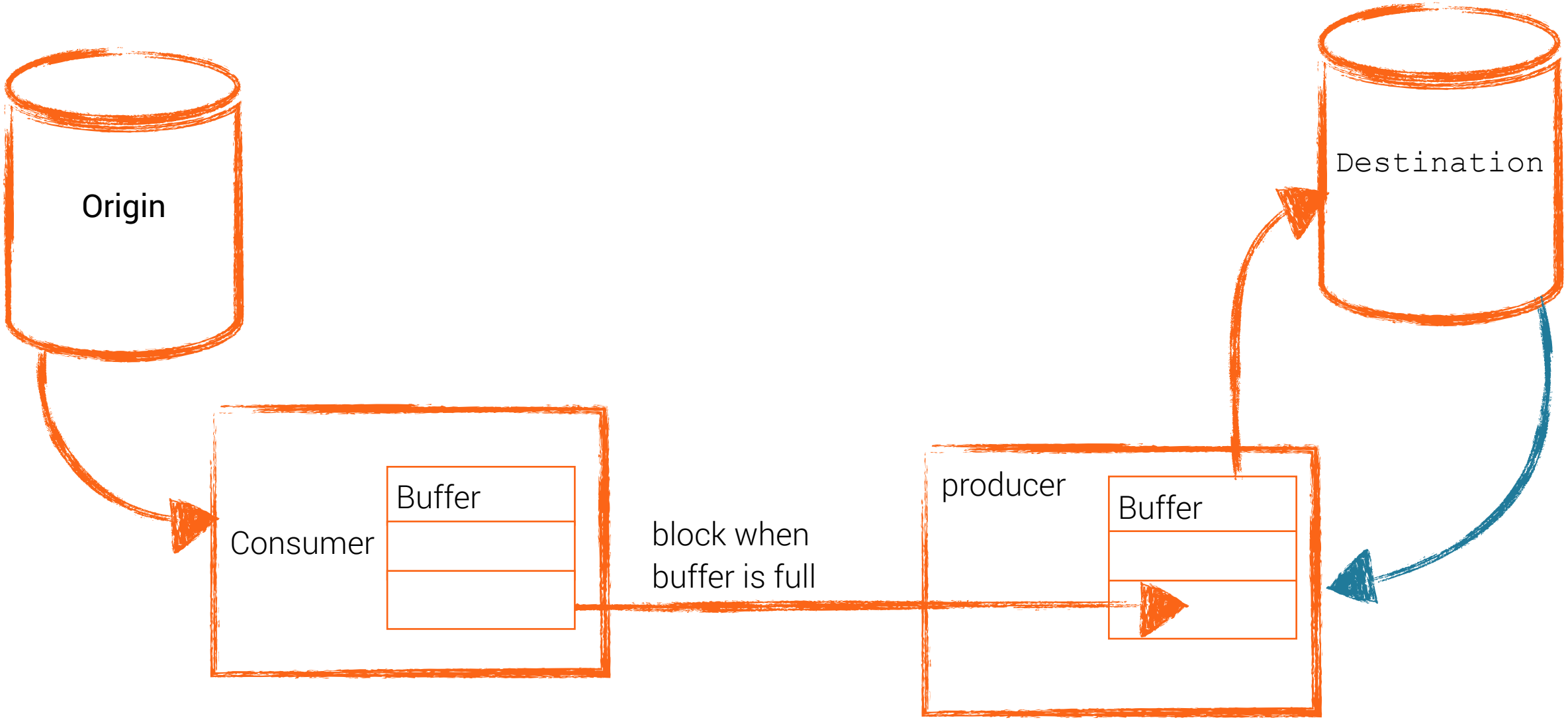
Monitor Replication Lag - In messages



Monitor Replication Lag - or in seconds…



Simple and elegant design



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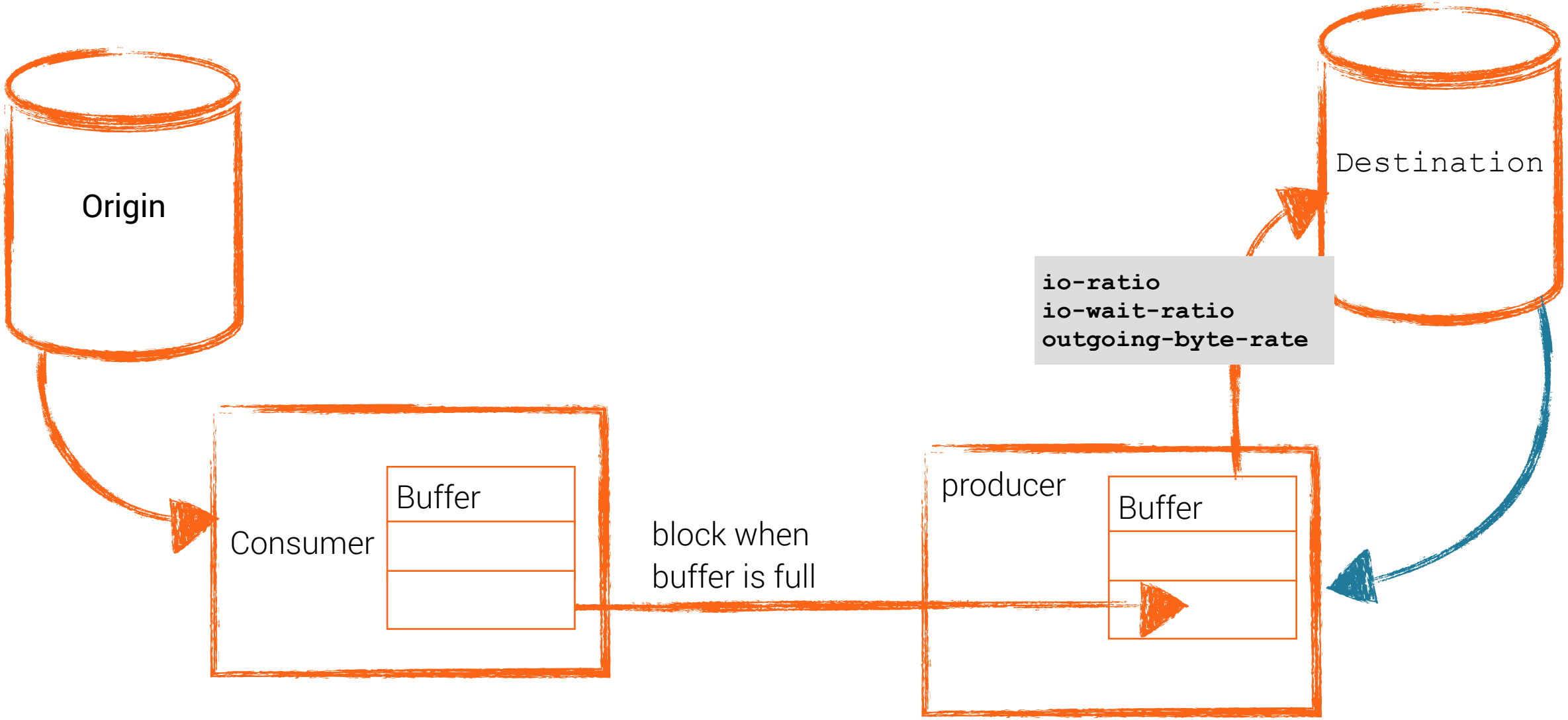

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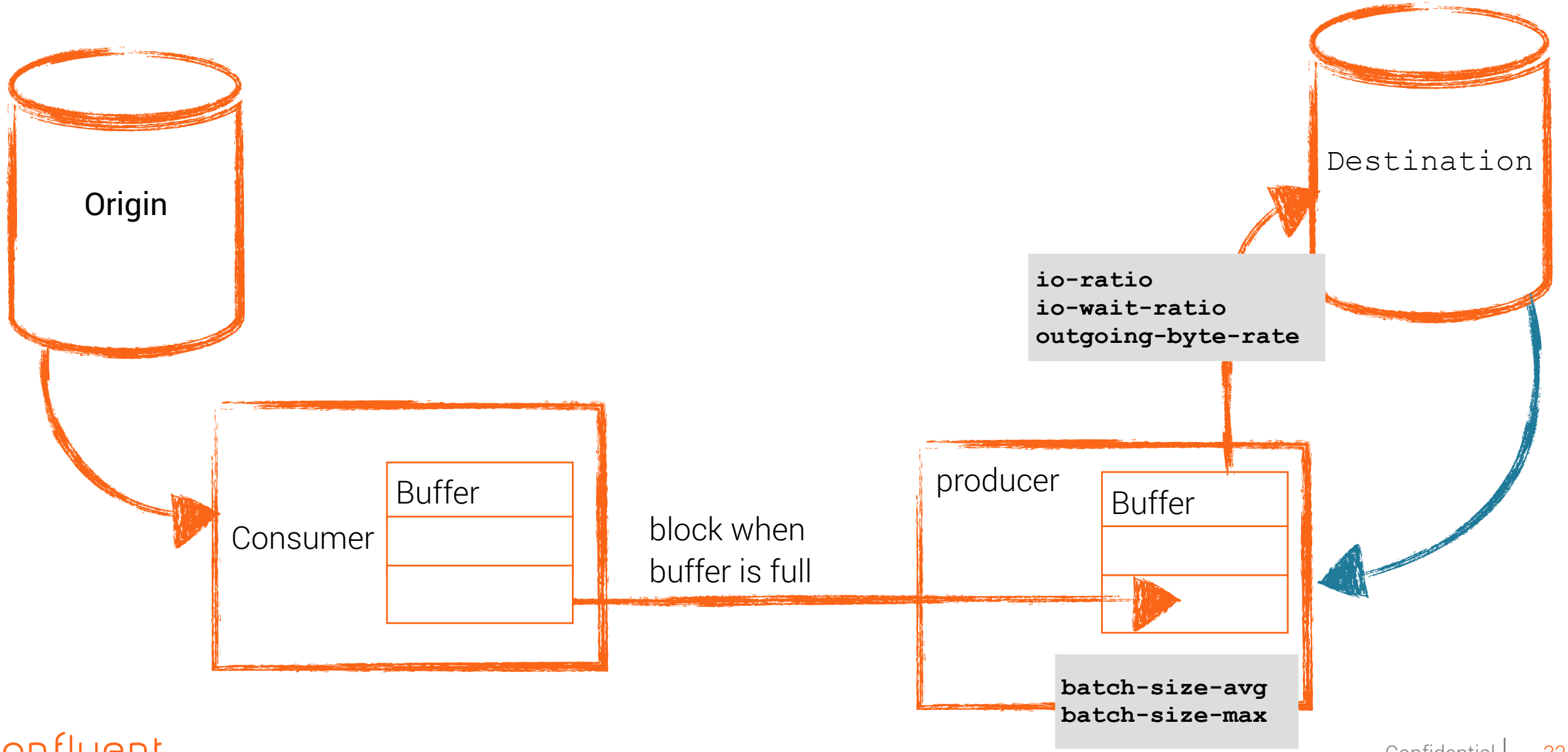

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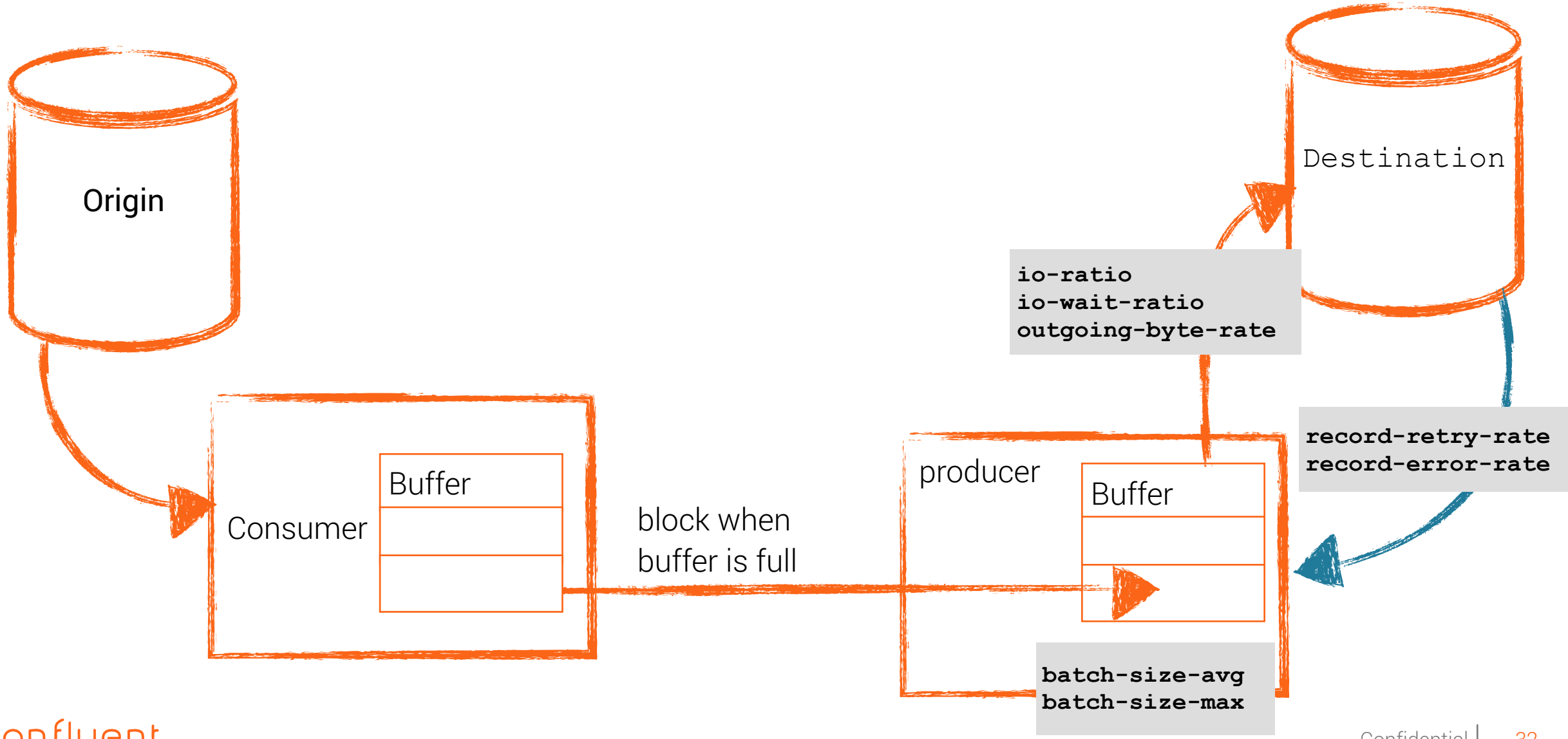

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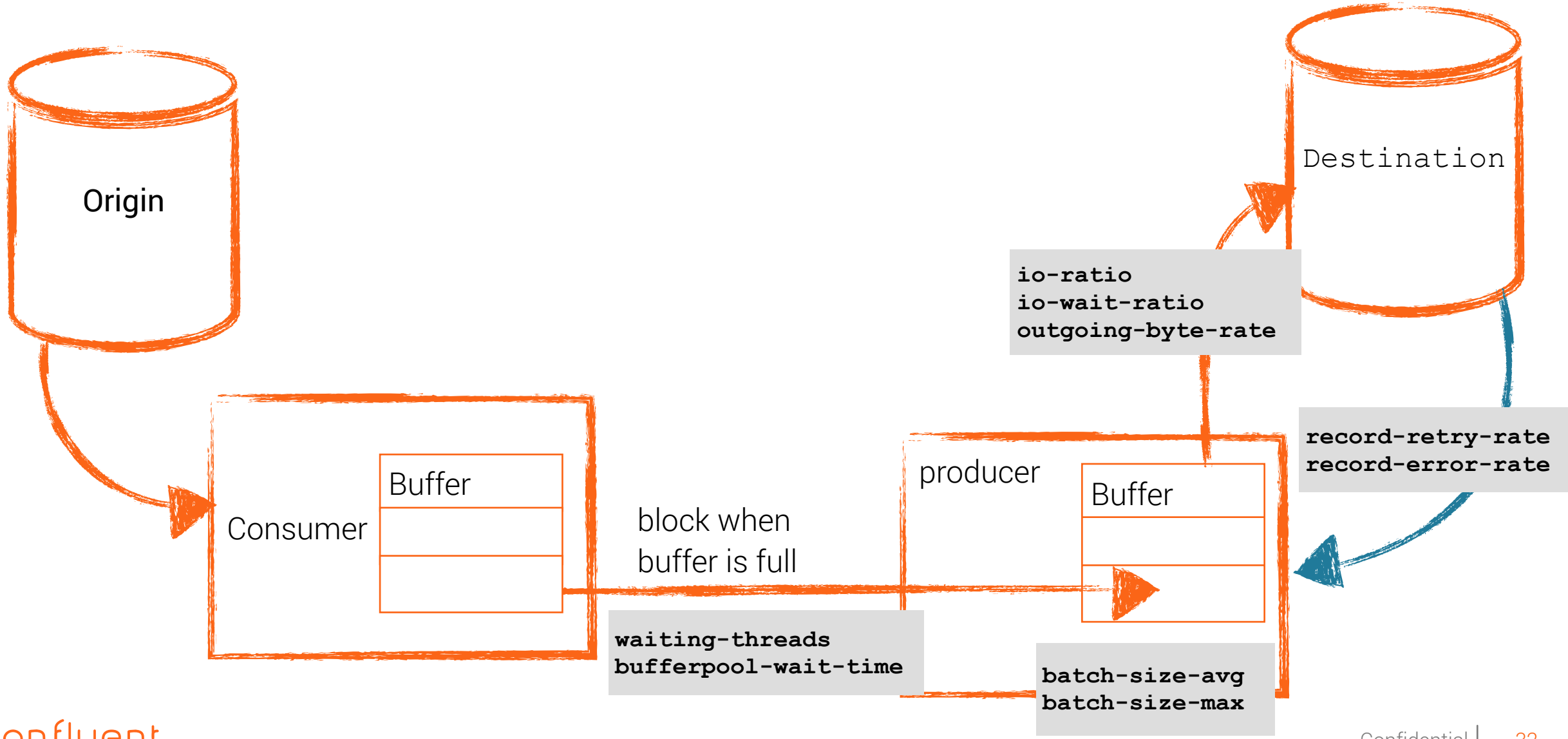

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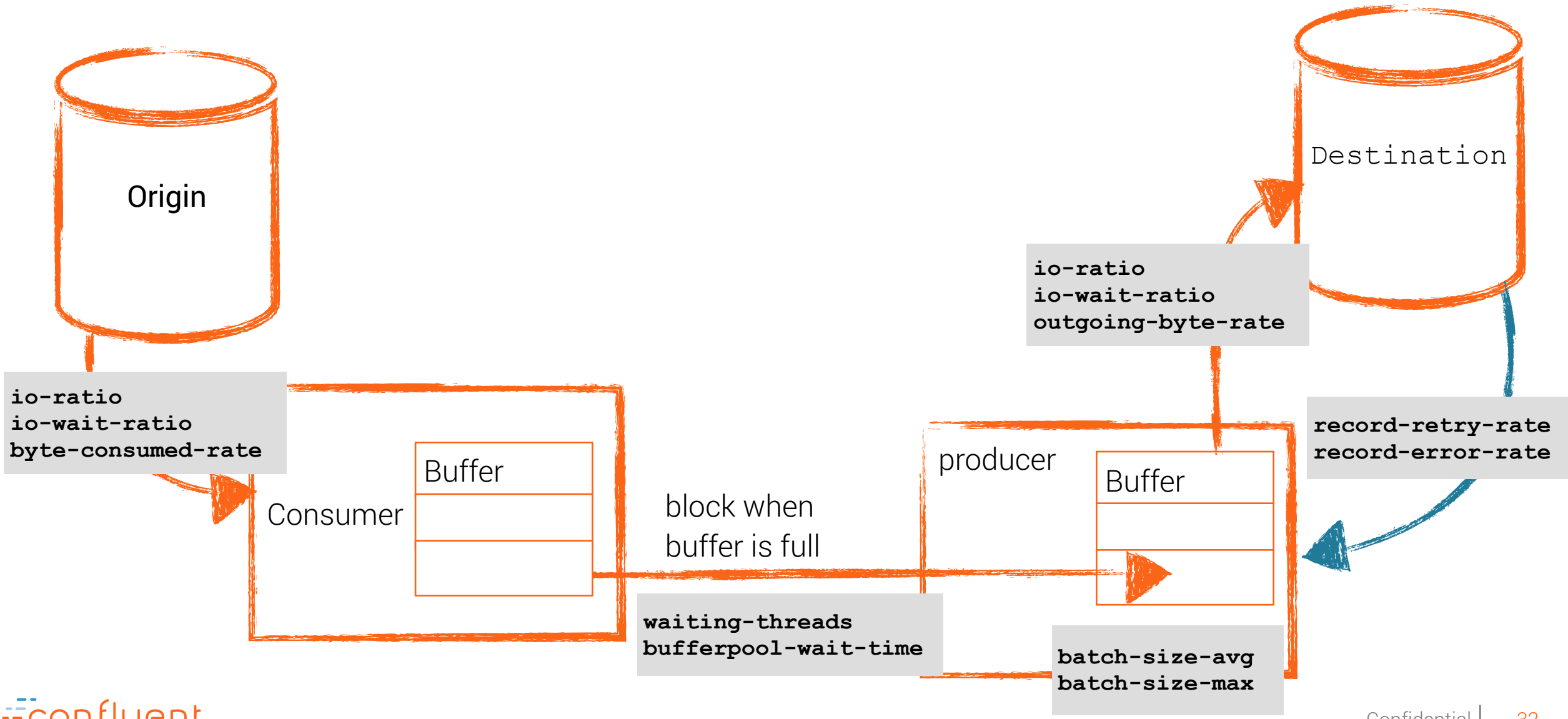

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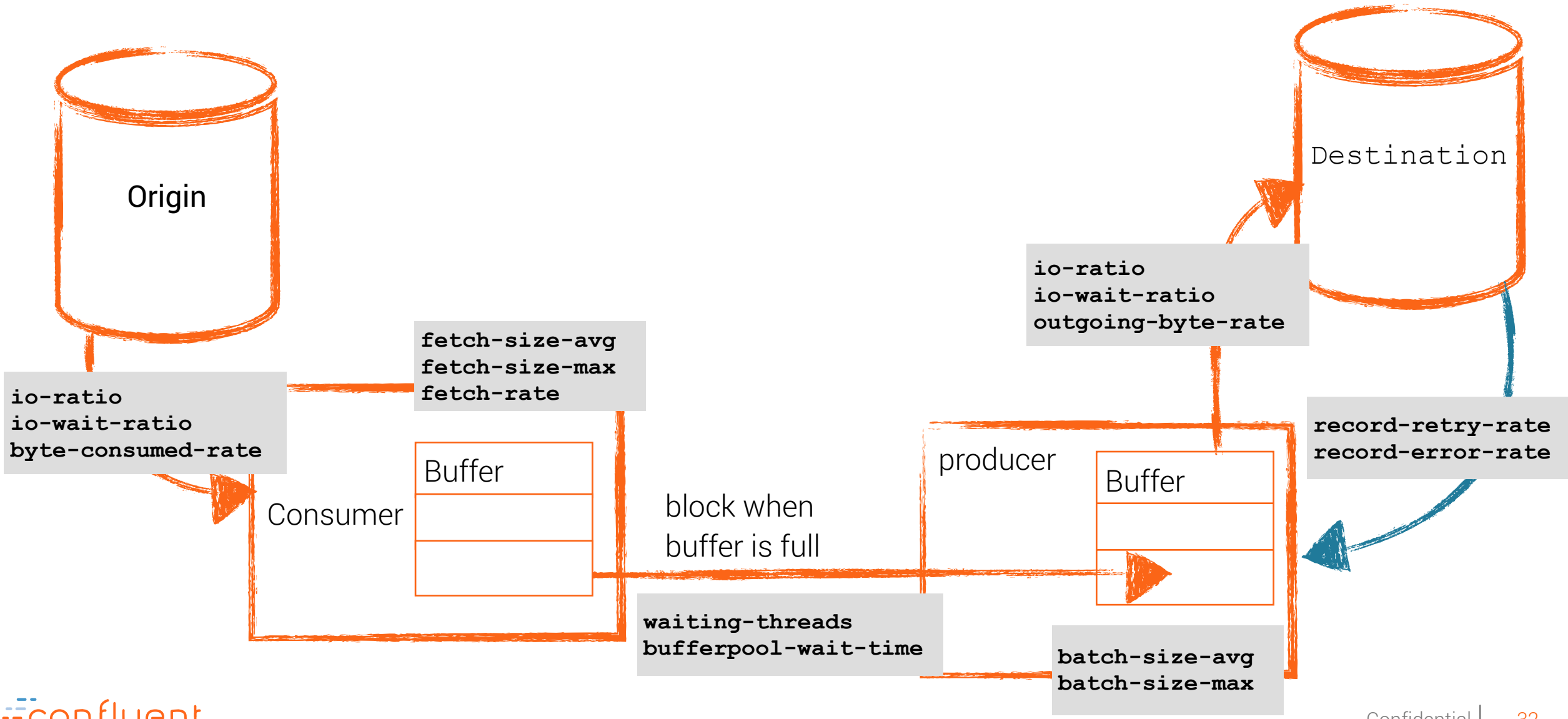

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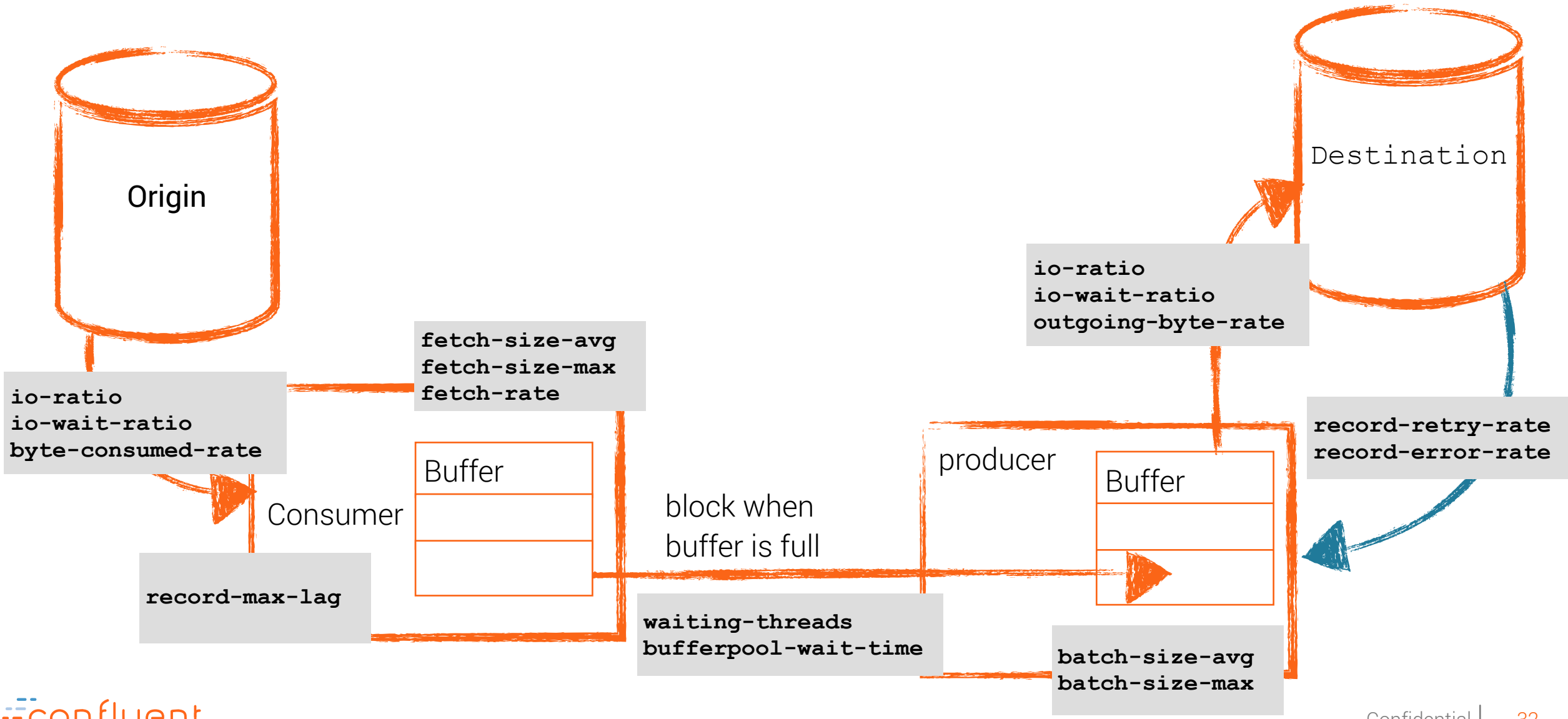

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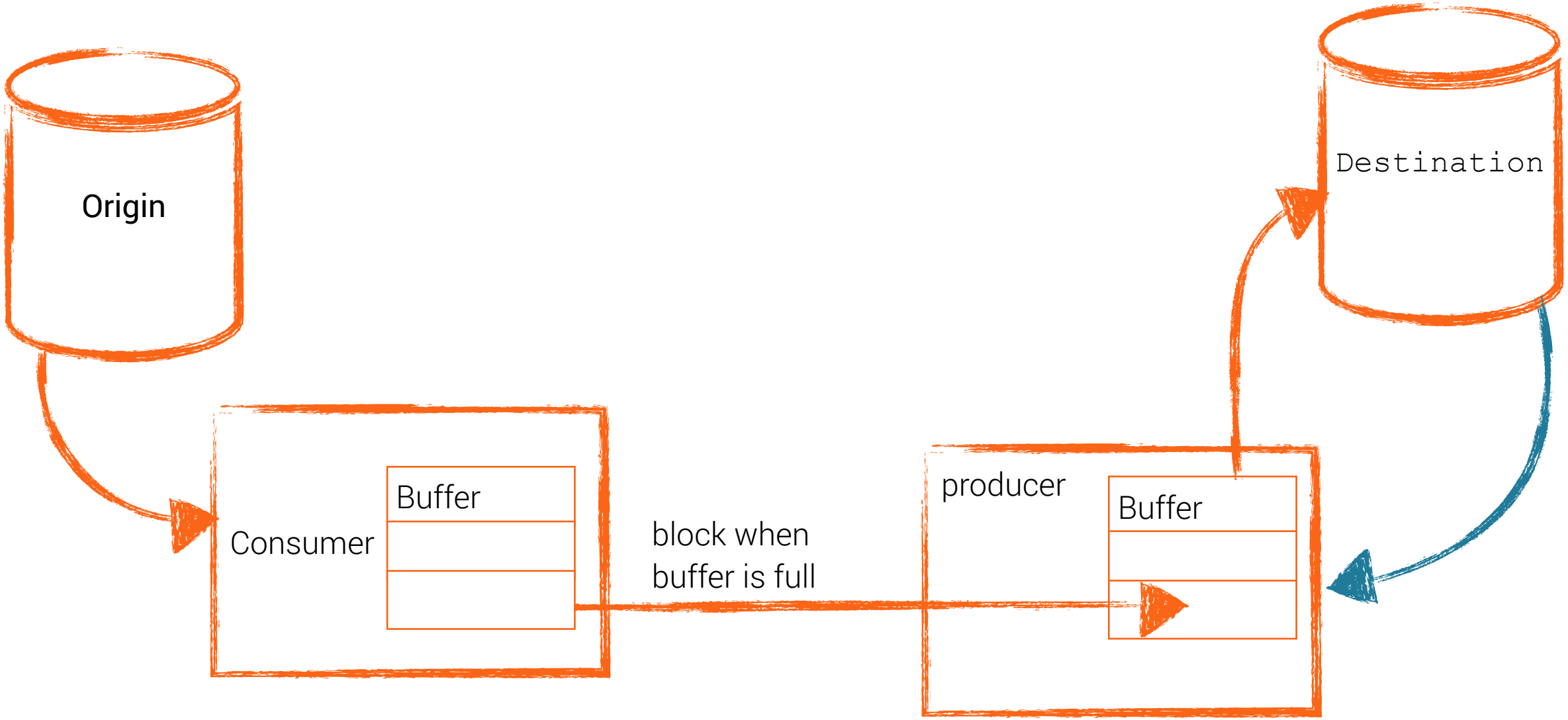

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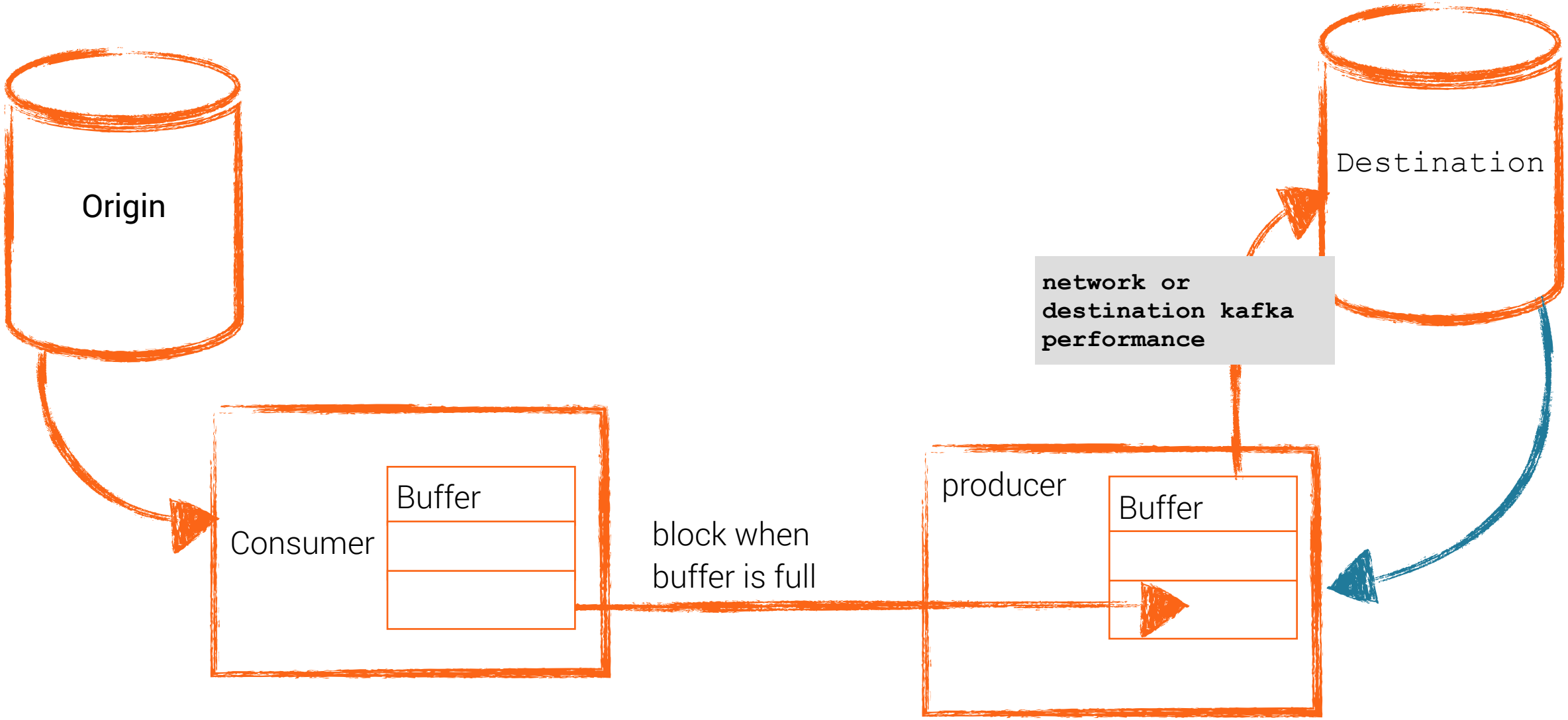

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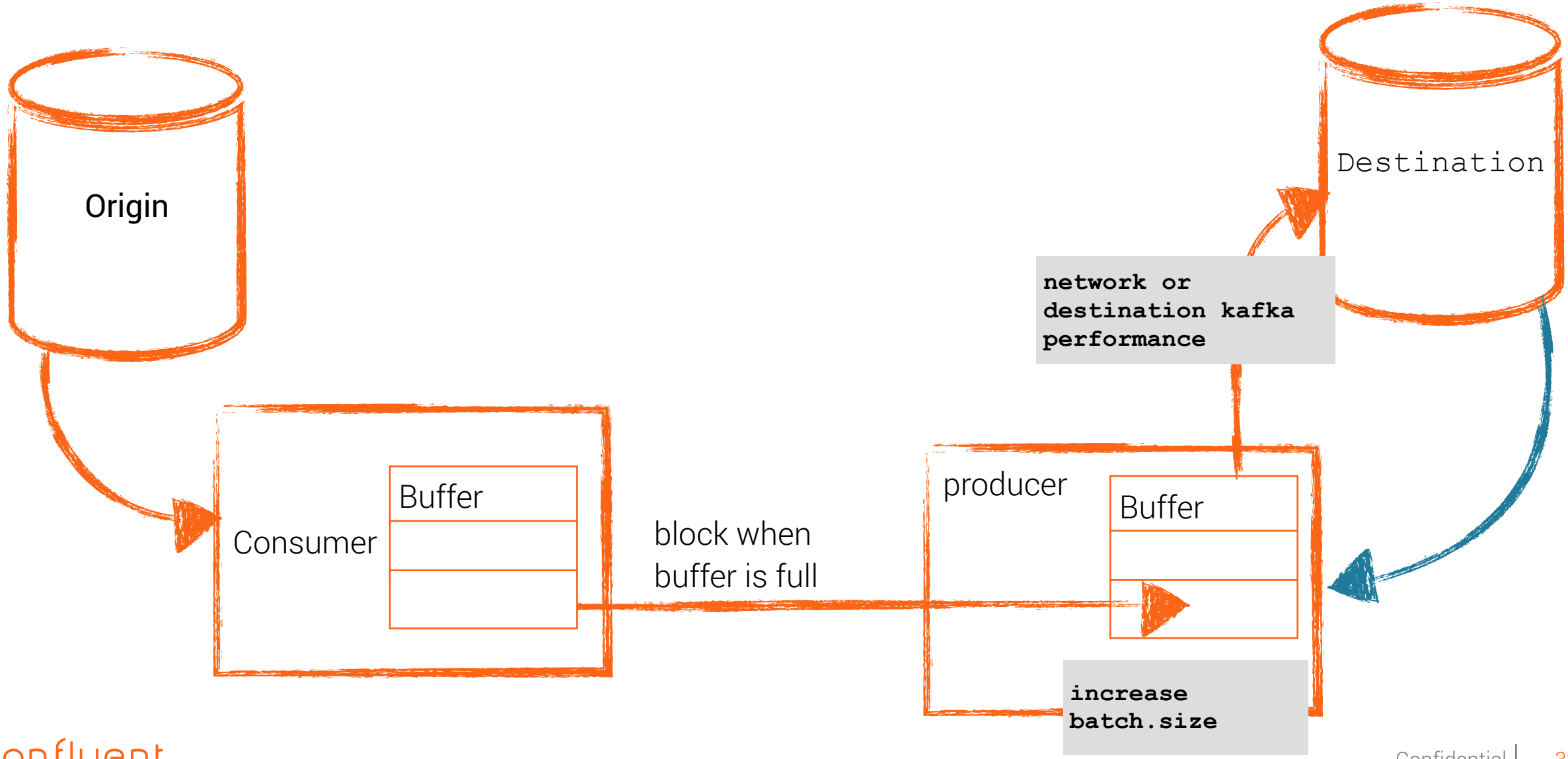

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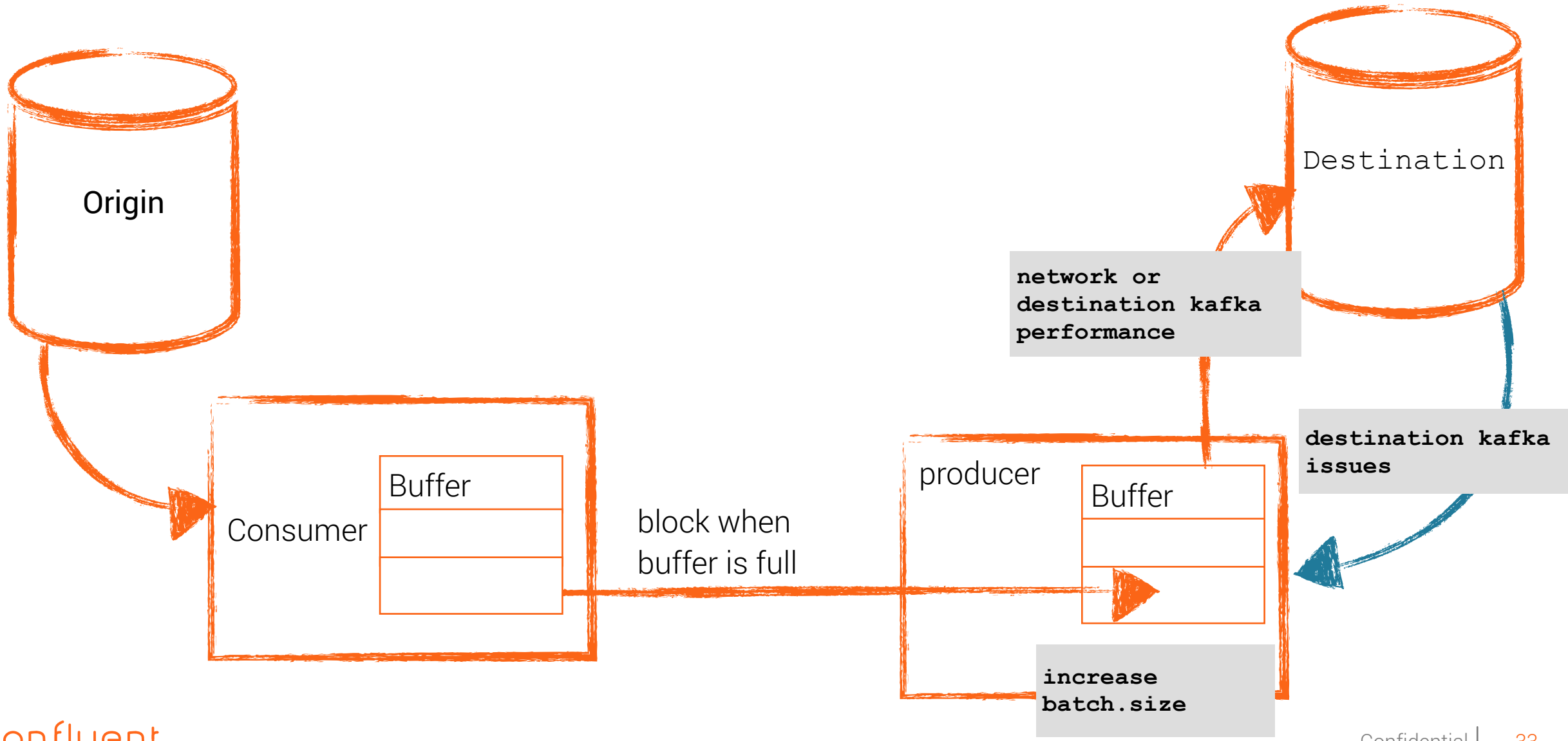

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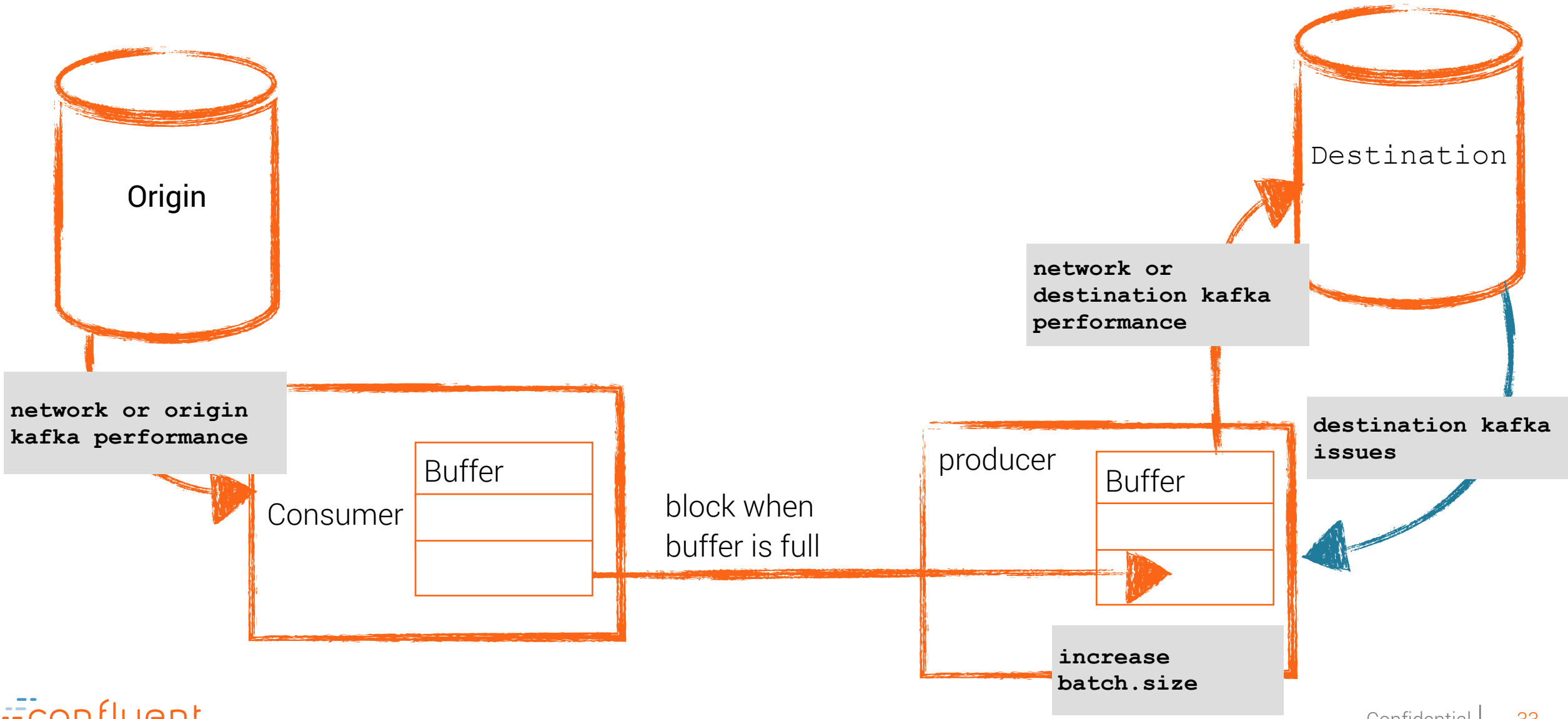

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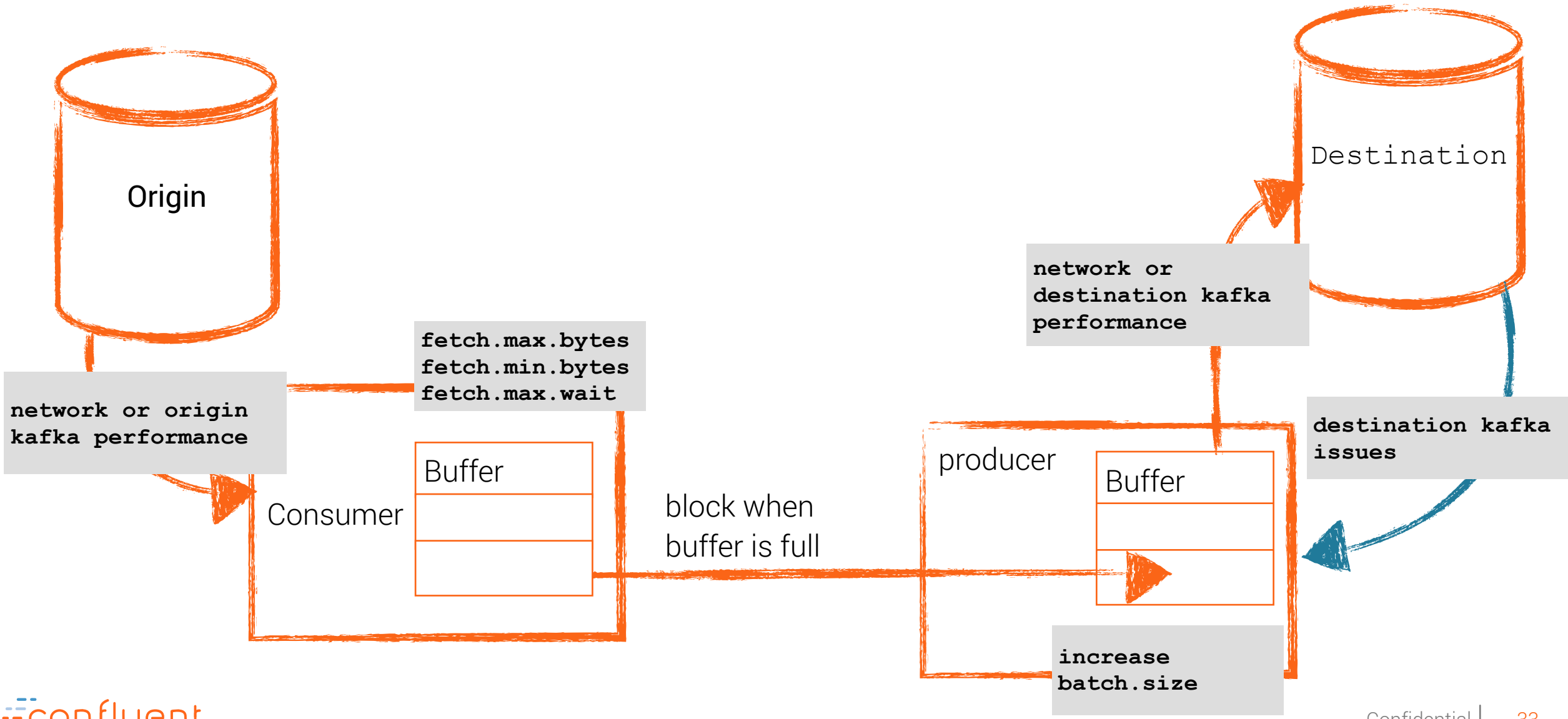


Network Tuning

- WAN has high latency. We deal with it.
- Compute buffer size to match: https://www.switch.ch/network/tools/tcp_throughput/
- `send.buffer.bytes` and `receive.buffer.bytes` on producer, consumer, brokers
- OS tuning: https://wwwx.cs.unc.edu/~sparkst/howto/network_tuning.php

  `net.core.rmem_default, net.core.rmem_max, net.core.wmem_default, net.core.wmem_max`
- Enable logging to check if this had any effect:

  `log4j.logger.org.apache.kafka.common.network.Selector=DEBUG`
- Additional tips in our docs

Competent users

- Monitor consumer lag
- Add processes when things are slow
- Automate deployment

Kafka Pros

- Monitor time lag
- Collect client metrics
- Knows which side to blame
- Know which configs to tune
- Tunes the network over the WAN

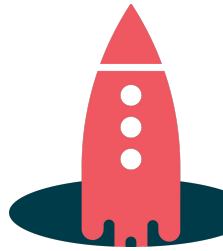
Resources and Next Steps

https://github.com/confluentinc/cp-demo

https://www.confluent.io/download/

https://www.confluent.io/blog

https://slackpass.io/confluentcommunity



Thank you!

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