Building Scalable and Extendable Data Pipeline for Call of Duty Games: Lessons Learned

ACTIVISION®

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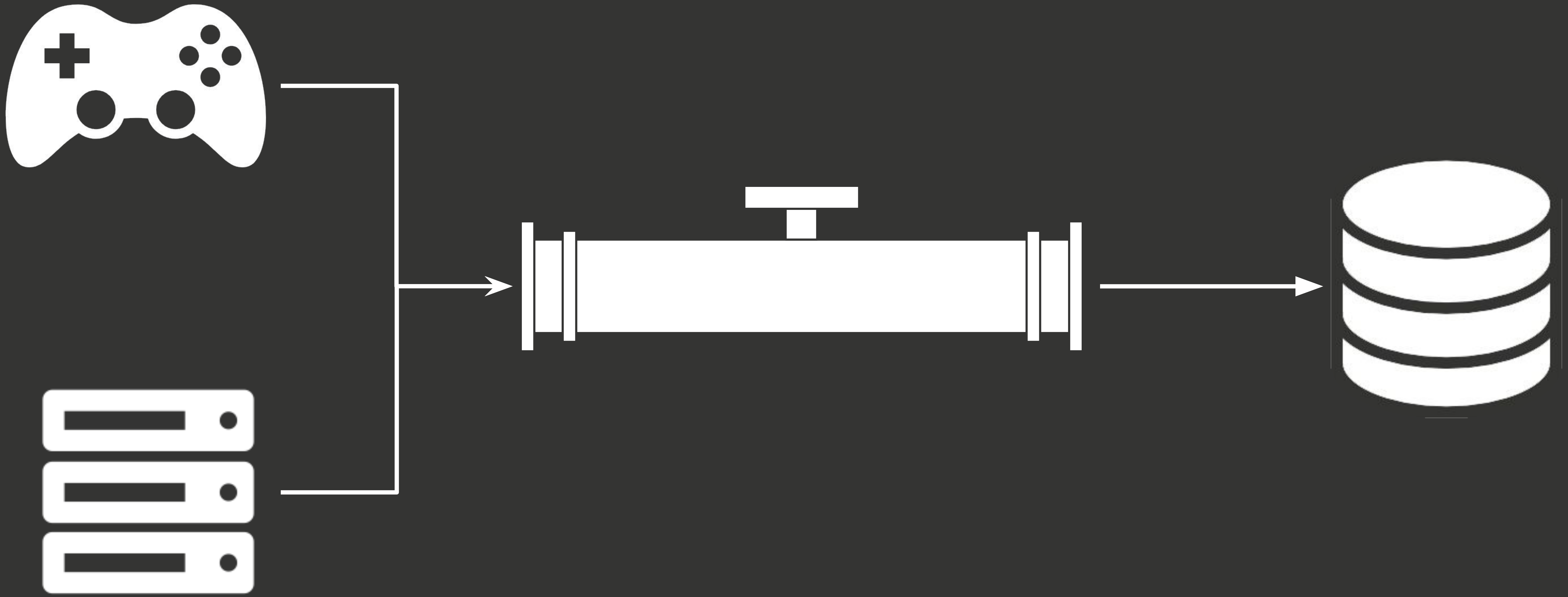
CALL OF DUTY®
BLACK OPS



1+

PB

Data lake size

(AWS S3)

Number of topics in the biggest cluster

(Apache Kafka)

500+

10k - 100k+

Messages per second

(Apache Kafka)

Scaling the data pipeline even further

Volume

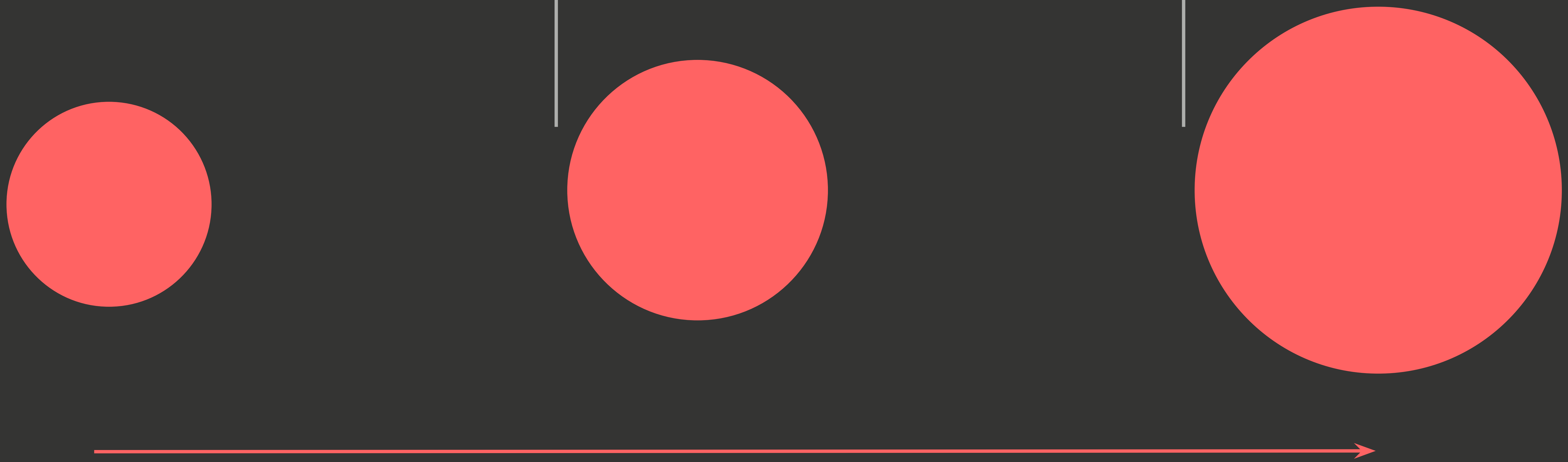
Industry best practices

Games

Using previous experience

Use-cases

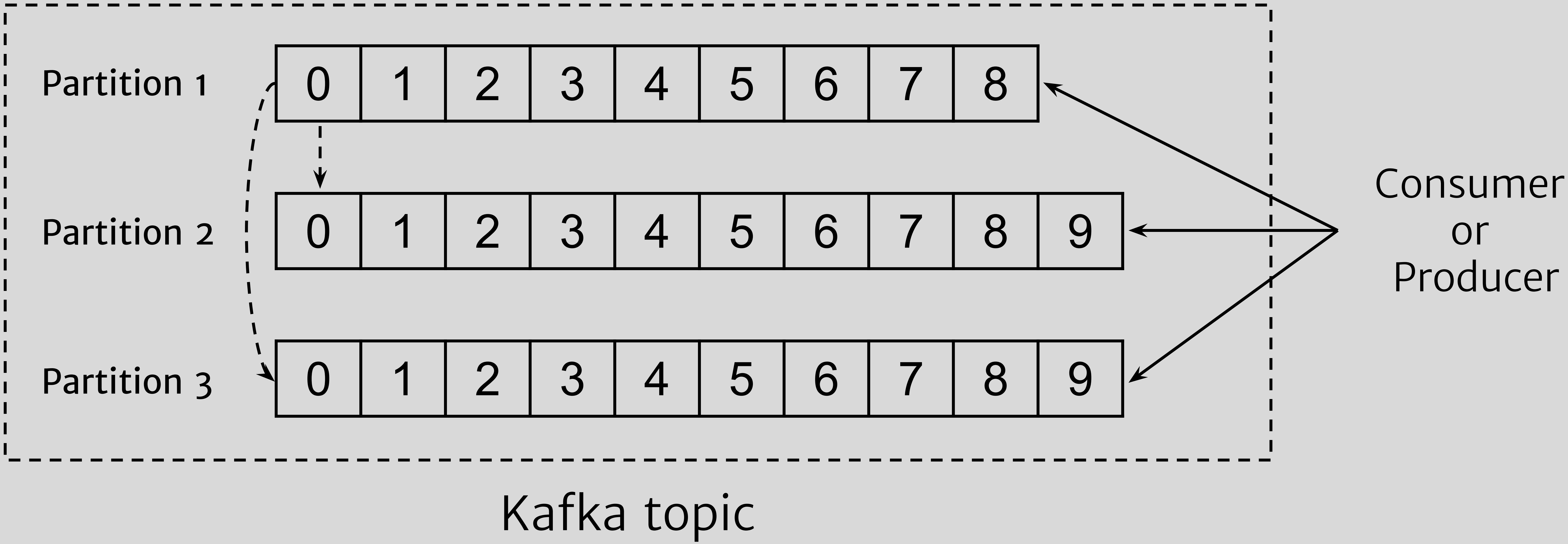
Completely unpredictable



Complexity

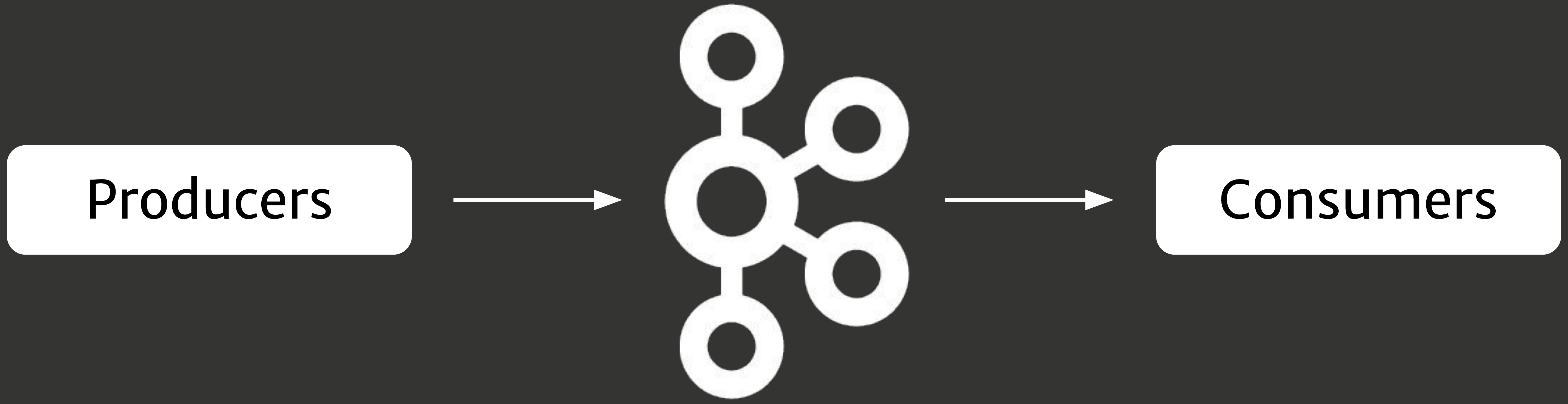
kafka

Kafka topics are partitioned and replicated



Partition 1	0	1	2	3	4	5	6	7	8	
Partition 2	0	1	2	3	4	5	6	7	8	9
Partition 3	0	1	2	3	4	5	6	7	8	9

Scaling the pipeline in terms of **Volume**

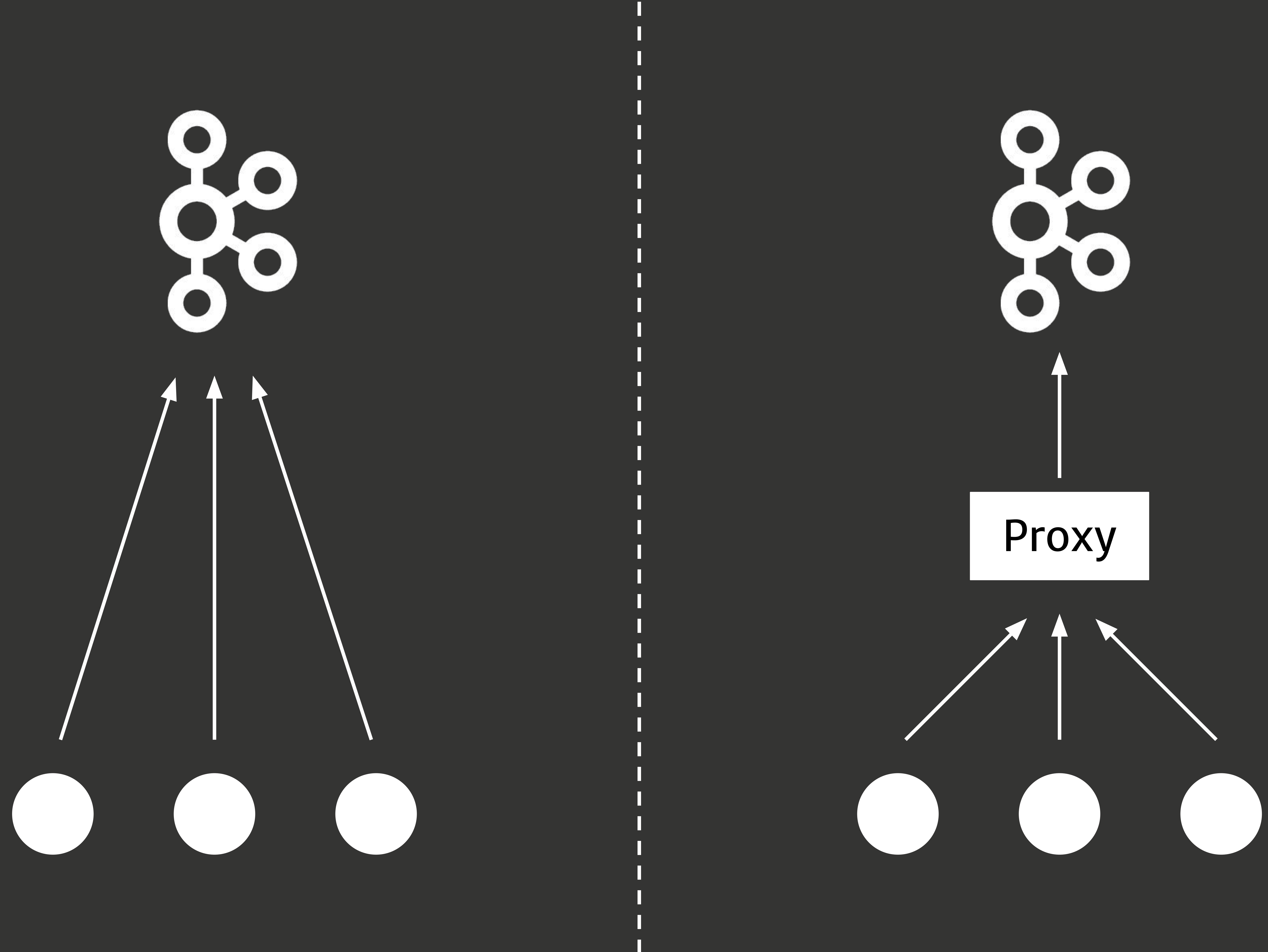


Producers

Consumers

Scaling producers

- Asynchronous / non-blocking writes (default)
- Compression and batching
- Sampling
- Throttling
- Acks? 0, 1, -1
- Standard Kafka producer tuning: batch.size, linger.ms, buffer.memory, etc.


Proxy

Each approach has pros and cons

- Simple
- Low-latency connection
- Number of TCP connections per broker starts to look scary
- Really hard to do maintenance on Kafka clusters

- Flexible
- Possible to do basic enrichment
- Easier to manage Kafka clusters

Simple rule for high-performant producers? Just write to Kafka, nothing else[1].

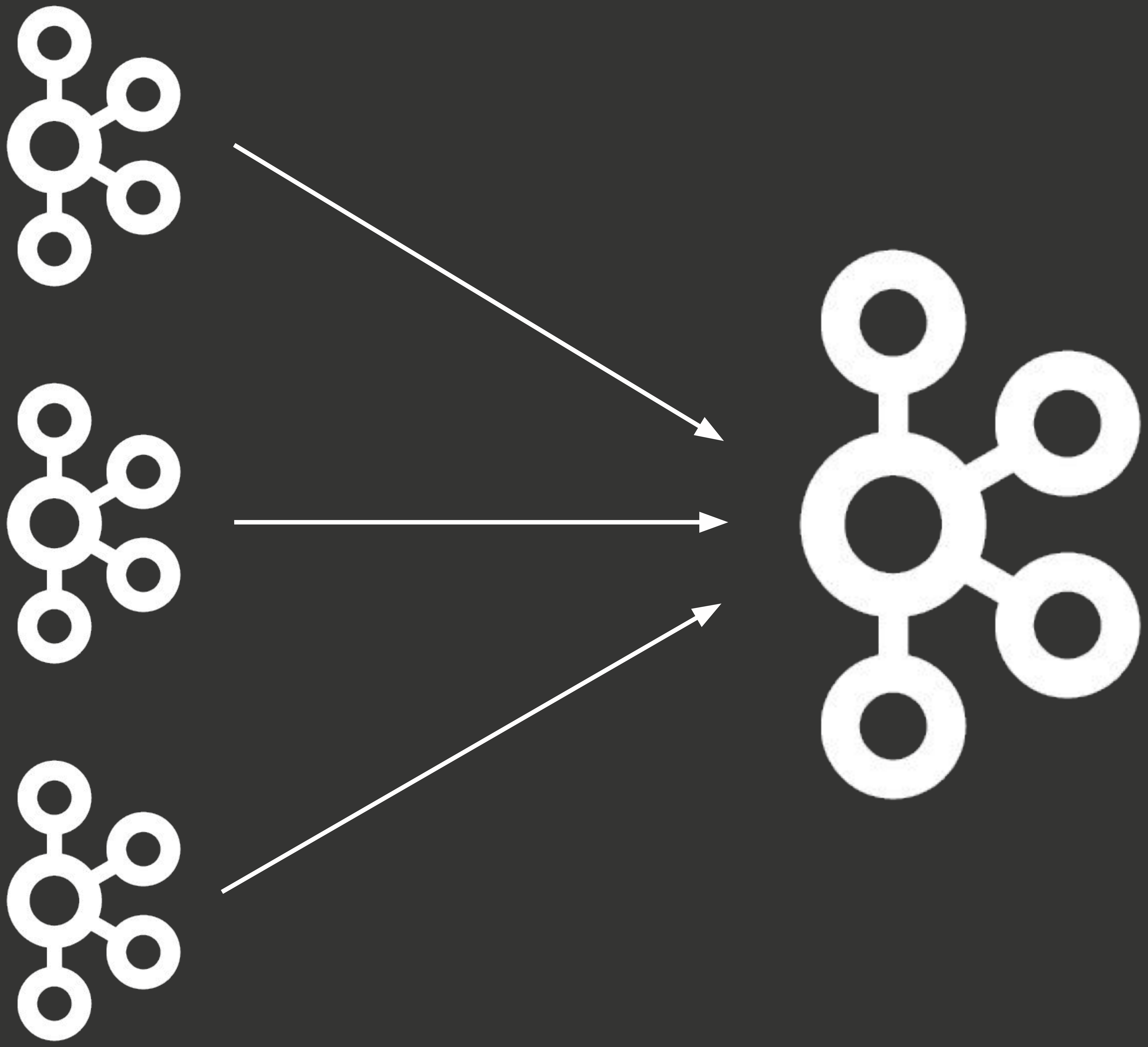
[1] Not even auth?

Scaling Kafka clusters

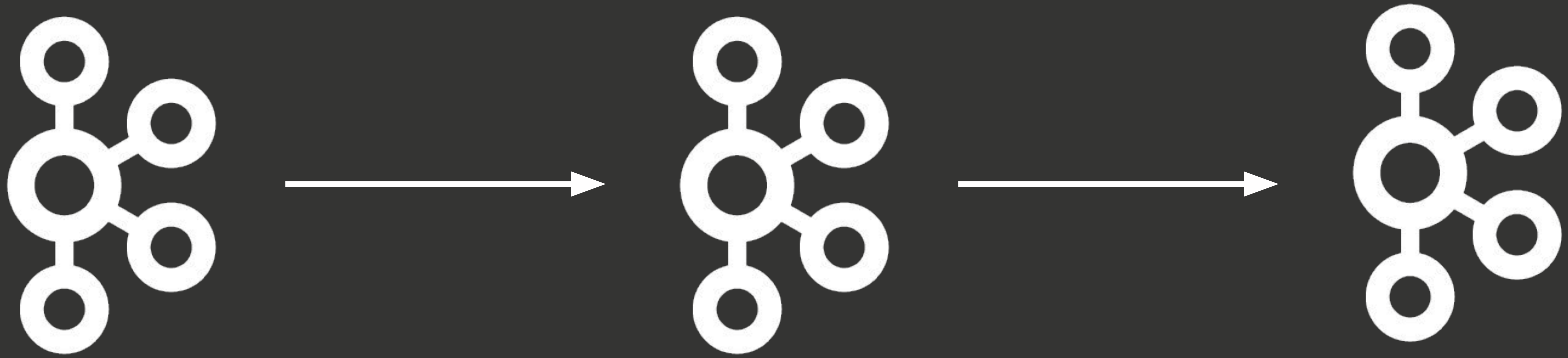
- Just add more nodes!
- Disk IO is extremely important
- Tuning *io.threads* and *network.threads*
- Retention
- For more: "Optimizing Your Apache Kafka Deployment" whitepaper from Confluent

It’s not always about tuning. Sometimes we need more than one cluster.

Different workloads require different topologies.

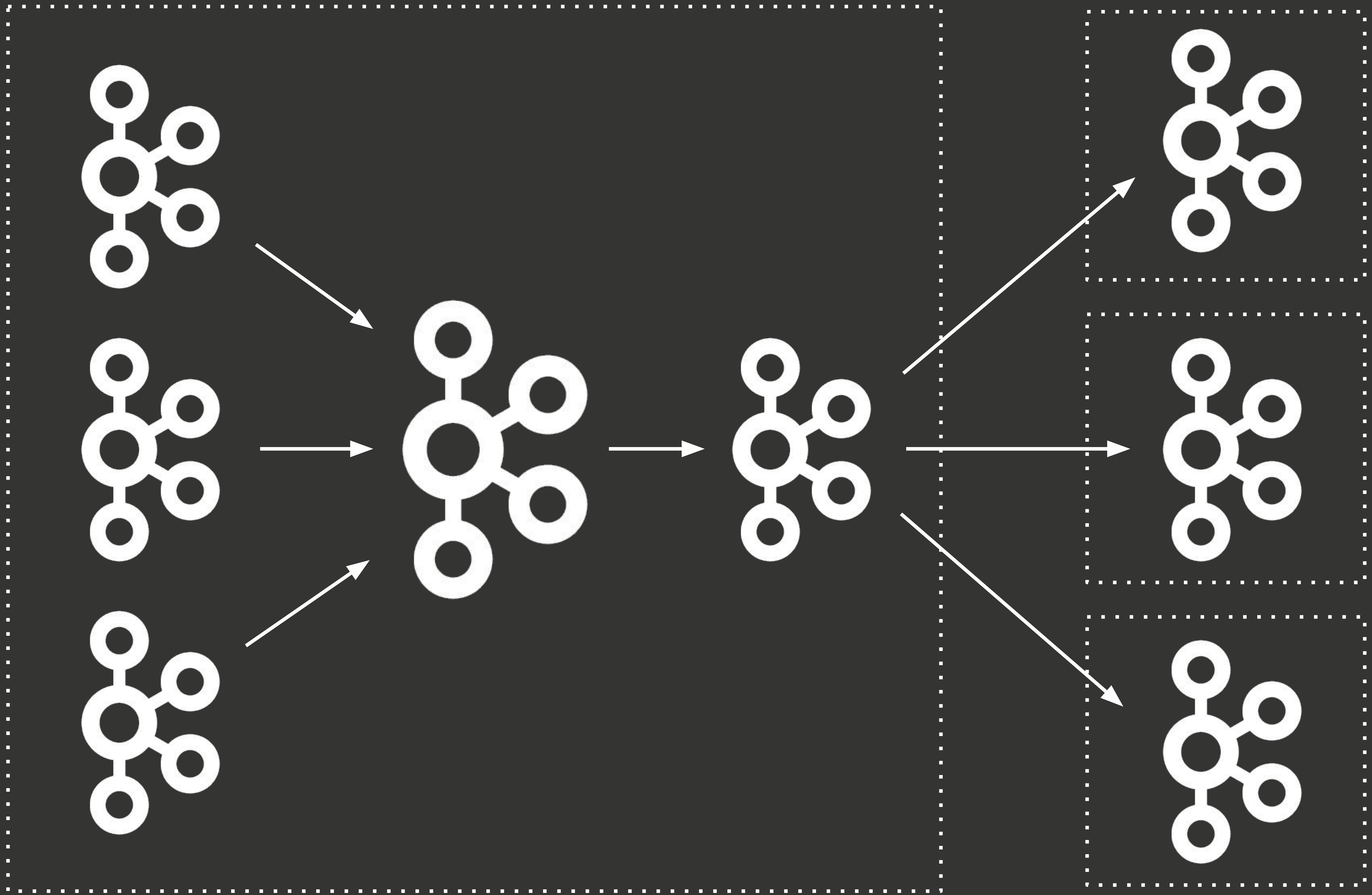


- Stream processing
- Short retention
- More partitions



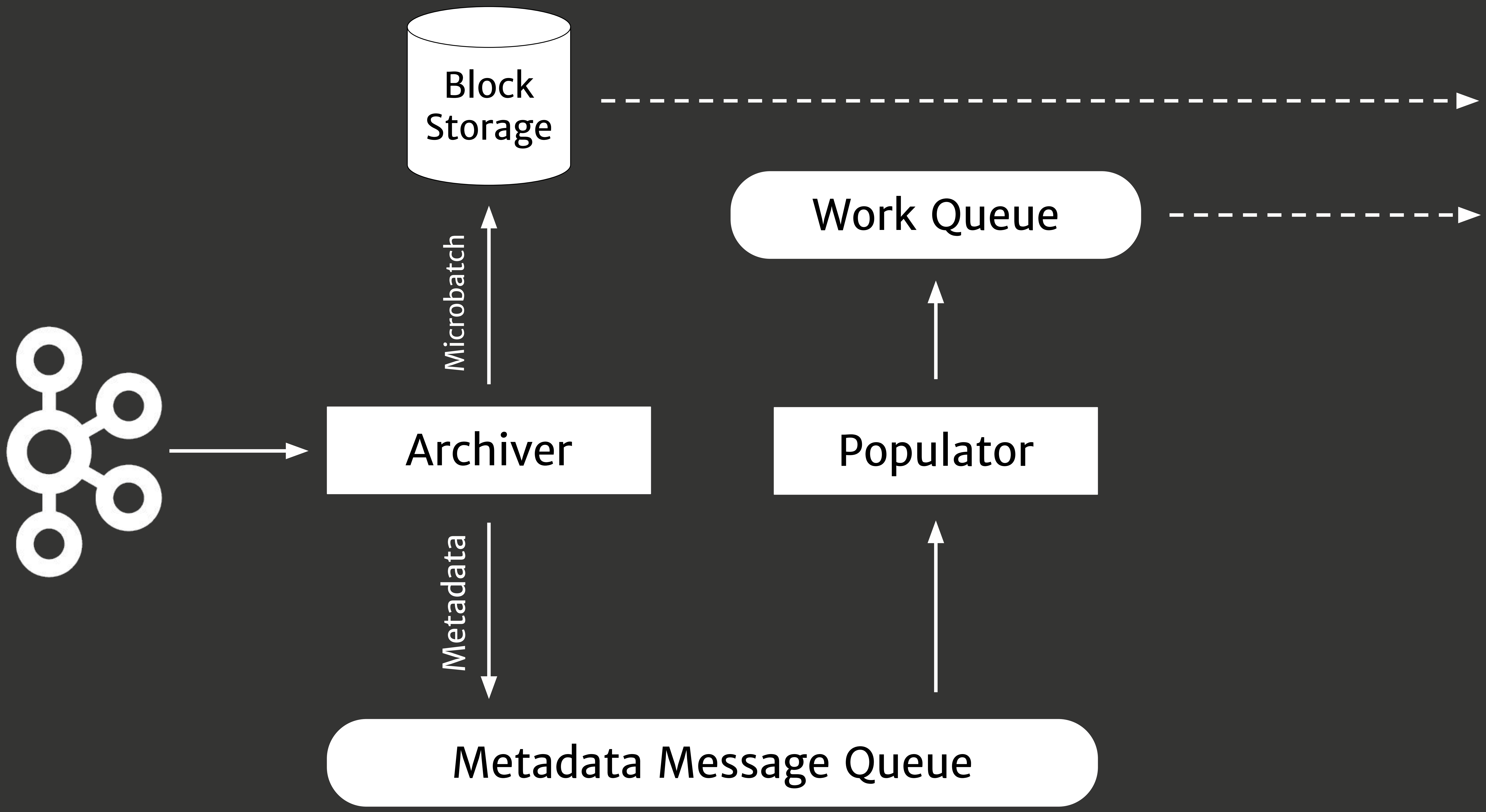
- Ingestion (HTTP Proxy)
- Long retention
- High SLA

- Lots of consumers
- Medium retention
- ACL



Scaling consumers is usually pretty trivial - just increase the number of partitions.

Unless… you can’t. What then?


Block Storage
Work Queue
Microbatch
Archiver
Populator
Metadata
Metadata Message Queue

Even if you can add more partitions

- Still can have bottlenecks within a partition (large messages)
- In case of reprocessing, it’s really hard to quickly add A LOT of new partitions AND remove them after
- Also, number of partitions is not infinite

You can’t be sure about any improvements without load testing.

Not only for a cluster, but producers and consumers too.

Scaling and *extending* the pipeline in terms of **Games** and **Use-cases**

We need to keep the number of topics and partitions low

- More topics means more operational burden
- Number of partitions in a fixed cluster is not infinite
- Autoscaling Kafka is impossible, scaling is hard

Topic naming convention

Producer

Unique game id
“CoD WW2 on PSN”

$env.$source.$title.$category-$version

prod.glutton.1234.telemetry_match_event-v1

A proper solution has been invented decades ago.

Think about databases.

Messaging system IS a form of a database

Data topic = Database + Table.

= Namespace + Data type.

Compare this

prod.glutton.1234.telemetry_match_event-v1

dev.user_login_records.4321.all-v1

prod.marketplace.5678.purchase_event-v1

telemetry.matches

user.logins

marketplace.purchases

Each approach has pros and cons

- Topics that use metadata for their names are obviously easier to track and monitor (and even consume).
- As a consumer, I can consume exactly what I want, instead of consuming a single large topic and extracting required values.

- These dynamic fields can and *will* change. Producers (sources) and consumers *will* change.
- Very efficient utilization of topics and partitions.
- Finally, it’s impossible to enforce any constraints with a topic name. And you can always end up with dev data in prod topic and vice versa.

After removing necessary metadata from the topic names stream processing becomes mandatory.

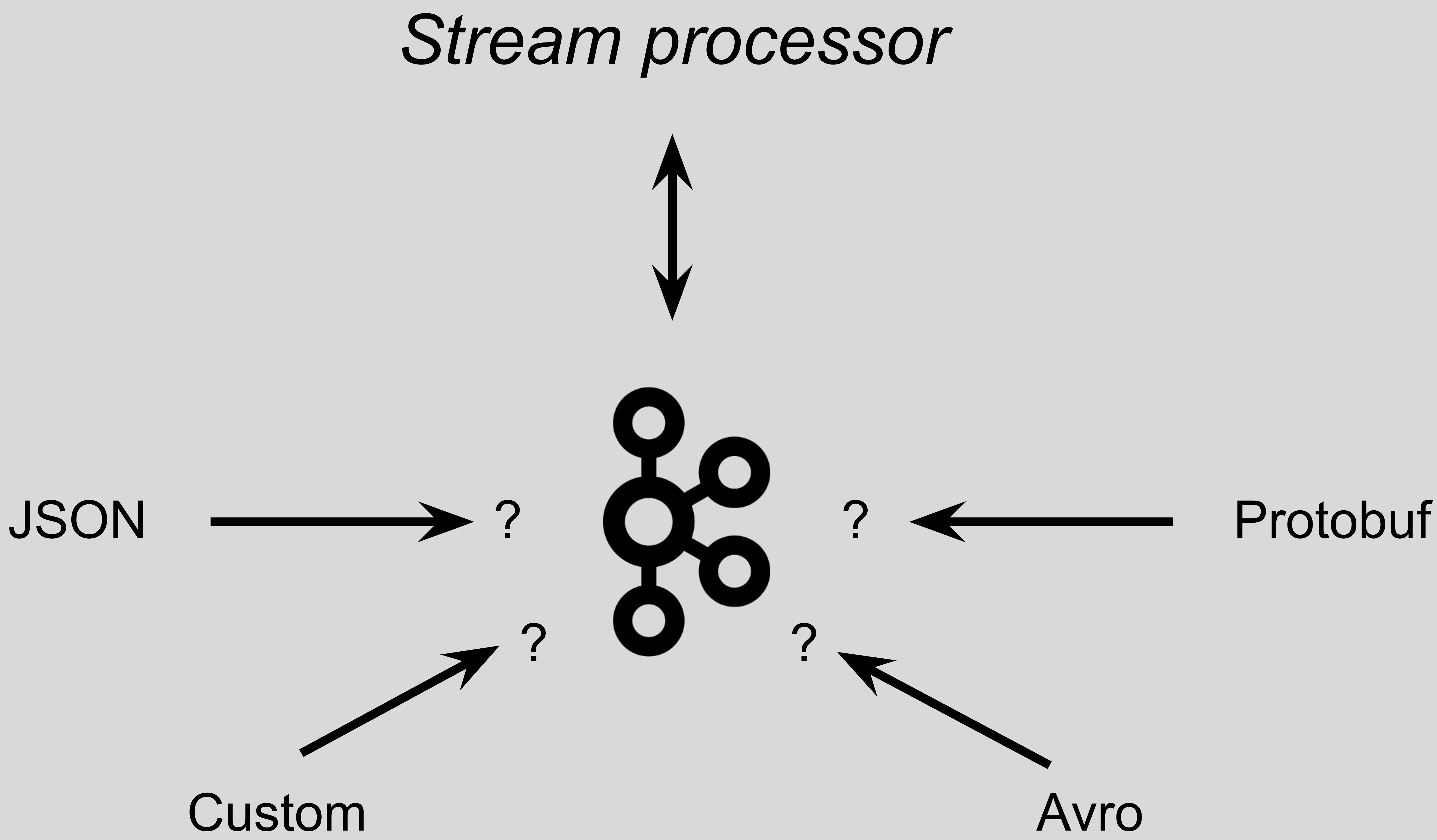
Stream processing becomes mandatory

Measuring → Validating → Enriching → Filtering & routing

Having a single message schema for a topic is more than just a nice-to-have.

Number of supported message formats

8



Stream processor

JSON ?

? Protobuf

?

?

Custom

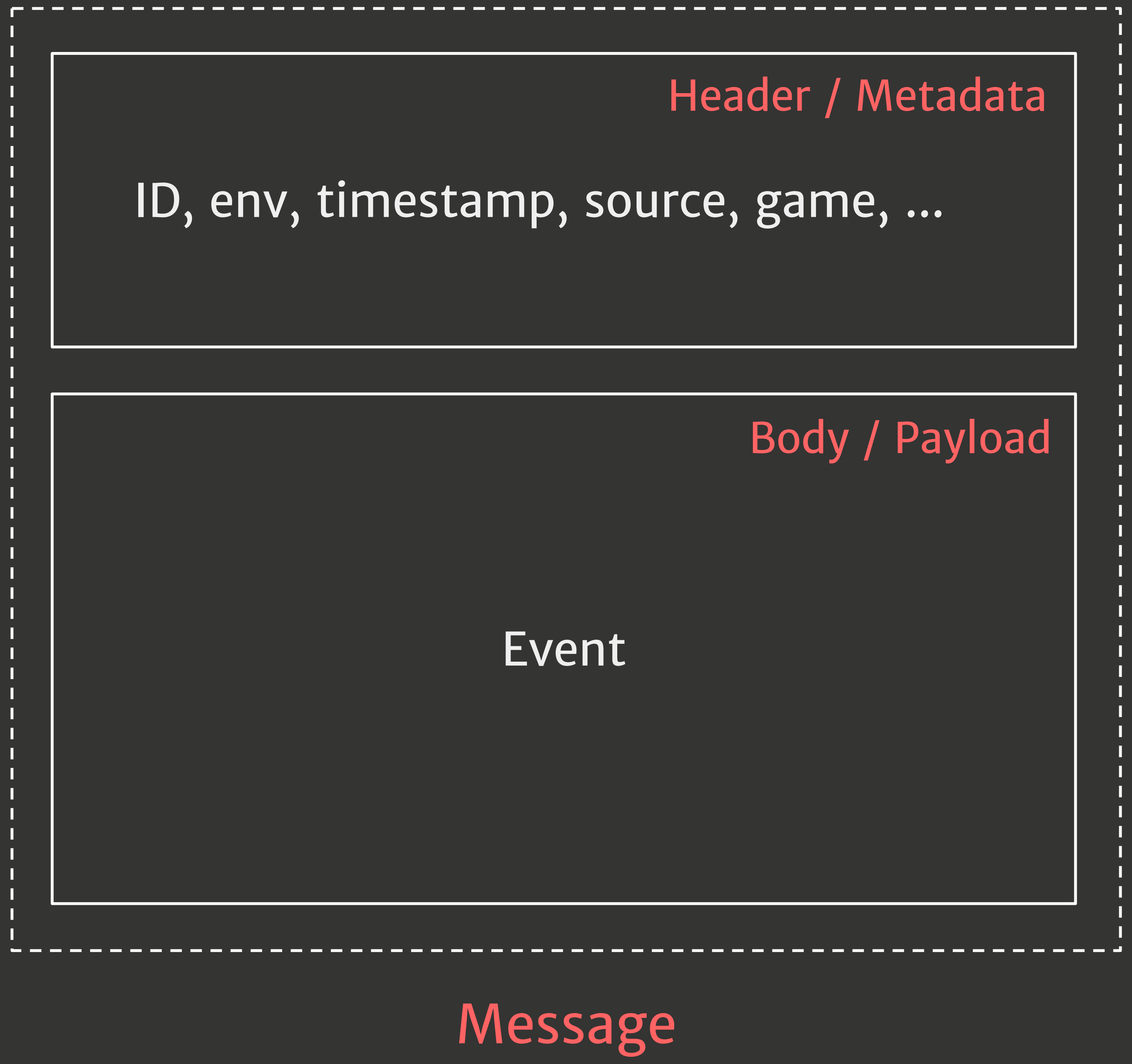
Avro

Custom deserialization

```
// Application.java
props.put("value.deserializer", "com.example.CustomDeserializer");

// CustomDeserializer.java
public class CustomDeserializer implements Deserializer<???> {
  @Override
  public ??? deserialize(String topic, byte[] data) {
    ???
  }
}
```

Message envelope anatomy



Header / Metadata

ID, env, timestamp, source, game, ...

Body / Payload

Event

Message

Unified message envelope

```
syntax = "proto2";

message MessageEnvelope {
   optional bytes message_id = 1;
   optional uint64 created_at = 2;
   optional uint64 ingested_at = 3;
   optional string source = 4;
   optional uint64 title_id = 5;
   optional string env = 6;
   optional UserInfo resource_owner = 7;
   optional SchemaInfo schema_info = 8;
   optional string message_name = 9;
   optional bytes message = 100;
}
```

Schema Registry

- API to manage message schemas
- Single source of truth for all producers and consumers
- It should be impossible to send a message to the pipeline without registering its schema in the Schema Registry!
- Good Schema Registry supports immutability, versioning and basic validation
- Activision uses custom Schema Registry implemented with Python and Cassandra

Summary

- Kafka tuning and best practices matter
- Invest in good SDKs for producing and consuming data
- Unified message envelope and topic names make adding a new game almost effortless
- “Operational” stream processing makes it possible. Make sure you can support adhoc filtering and routing of data
- Topic names should express data types, not producer or consumer metadata
- Schema Registry is a must-have

Thanks!

@sap1ens