RT Intro & Kafka

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2021-04-27 / Moscow

RT Intro & Kafka

- RT Intro
  - Batch -> RT
  - Approaches to RT data processing
- Kafka
  - Internal
  - CLI

RT Intro & Kafka

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  - **Batch -> RT**
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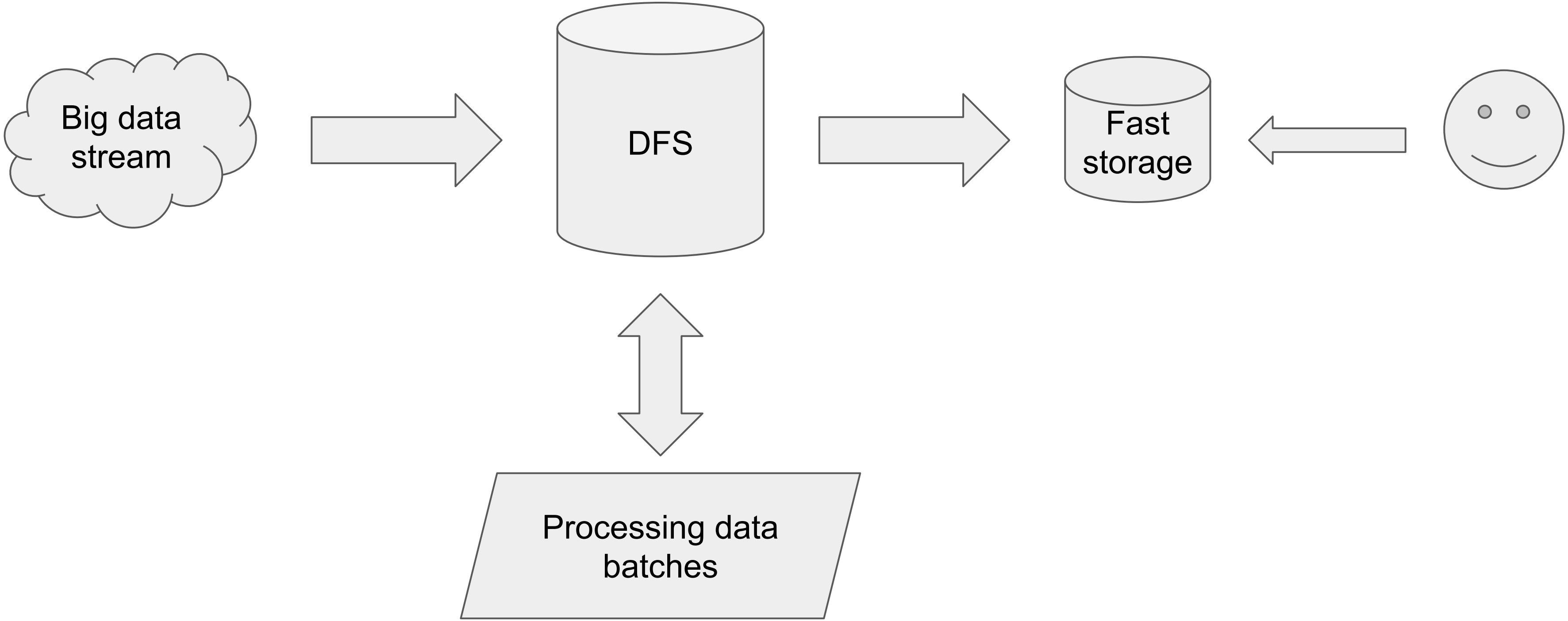
Batch approach

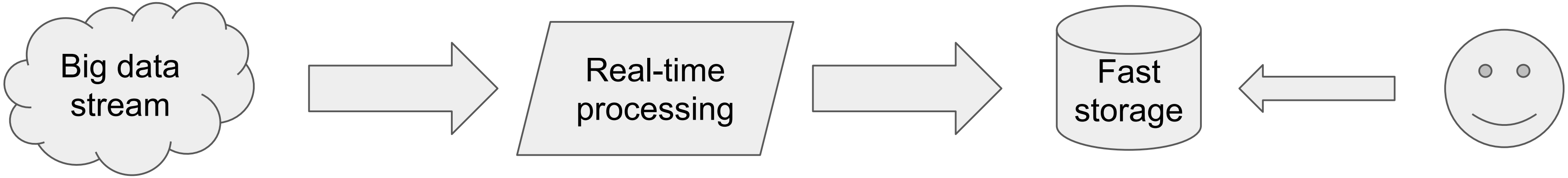


The main cons of batch approach

- In practice a batch is a big time interval like an hour or day
- The size of batch is a minimal value for a lag
- Lag (delay) is the time between the event and its recording in the results of work
- For many purposes the following rule works: less lag => more valuable data

Real-time big data

- Real-time big data - is a set of technologies to process big data with minimal lag
- Without DFS
- Work with a stream of data instead of a batch



Big data stream

Real-time processing

Fast storage

Real-time big data - lag in minutes

- Build custom recommendations (Linkedin, Facebook)
  - Billions of events per day
  - Millions of events every second
  - Minutes to build fresh recommendation

Real-time big data - lag in seconds

- Programmatic advertising (Google, Facebook)
  - Billions of events per day
  - You liked the article and saw the relevant ads already on the next page
- Credit card real-time fraud detection
  - It takes a few seconds to detect a card with suspicious activity and block it

Real-time big data - lag in ms

- Calls billing (mobile network operator)
  - Hundred millions of users
  - Less than a second to debit funds
  - Zero fault tolerance
- High-frequency trading (HFT)
  - The reaction to the change of quotations of the exchange with a delay of 10-100 milliseconds

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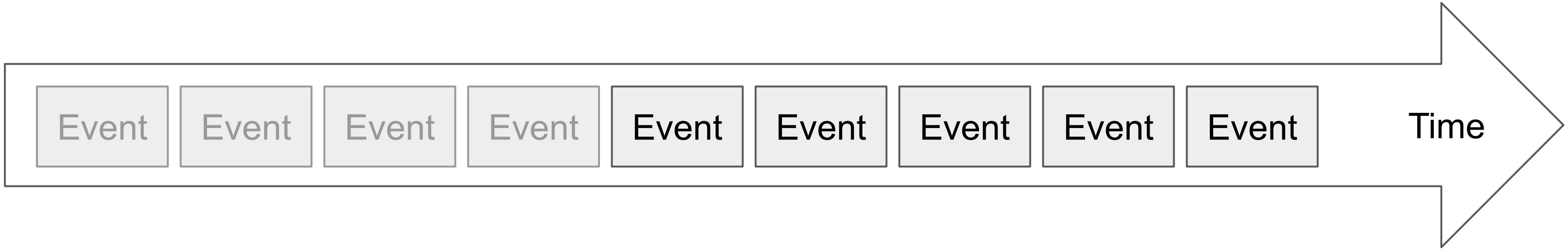
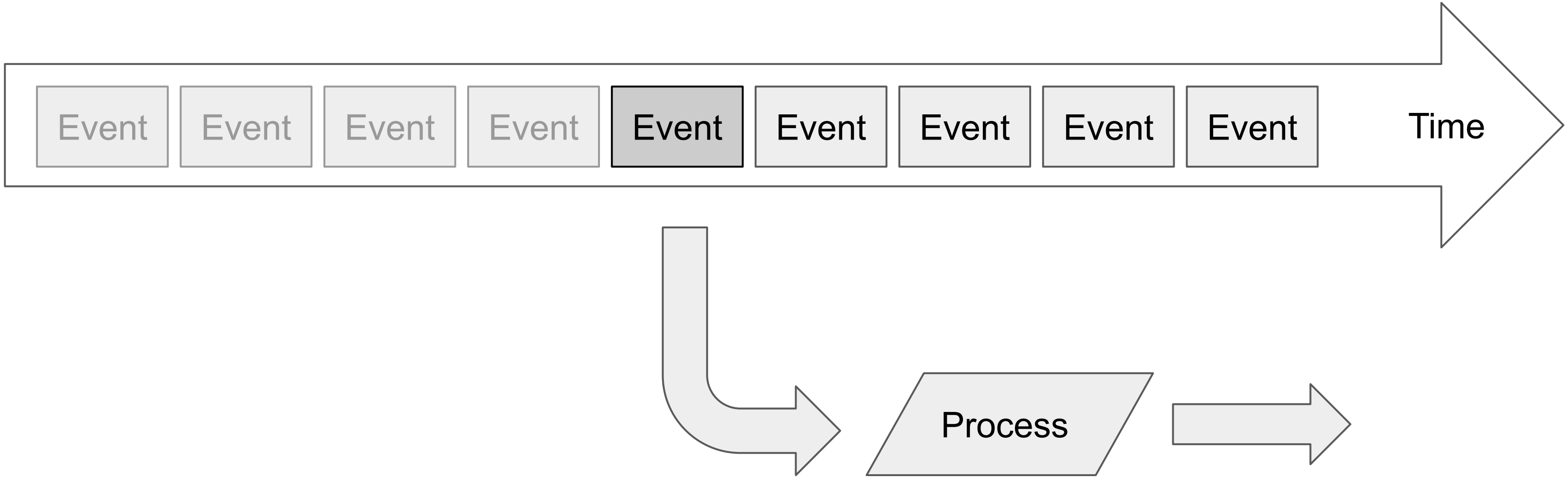
Event-based approach

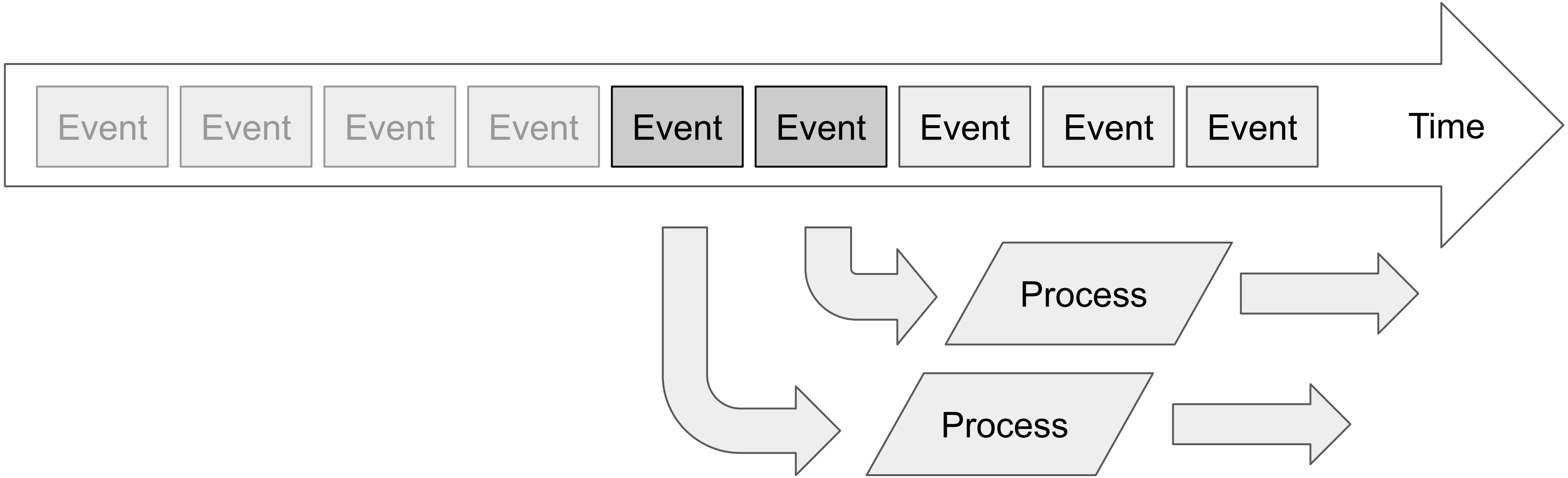


Event-based approach



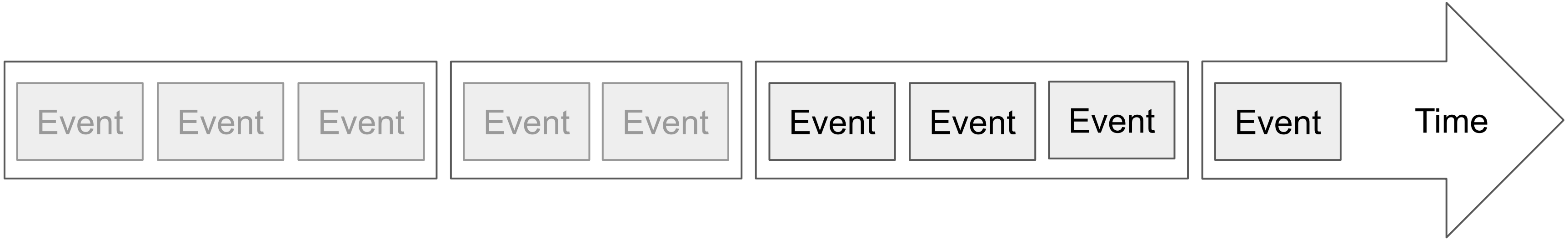
- Handling one event at a time

Event-based approach



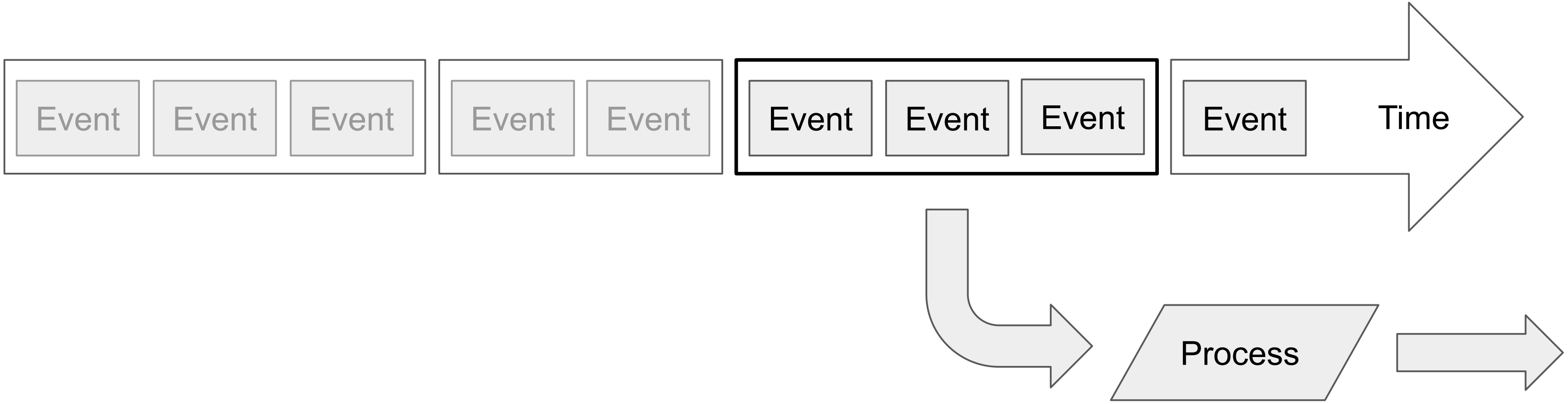
- Handling one event at a time
- Events are processed in parallel, but completely independently
- Latency ~10ms

Micro-batch approach



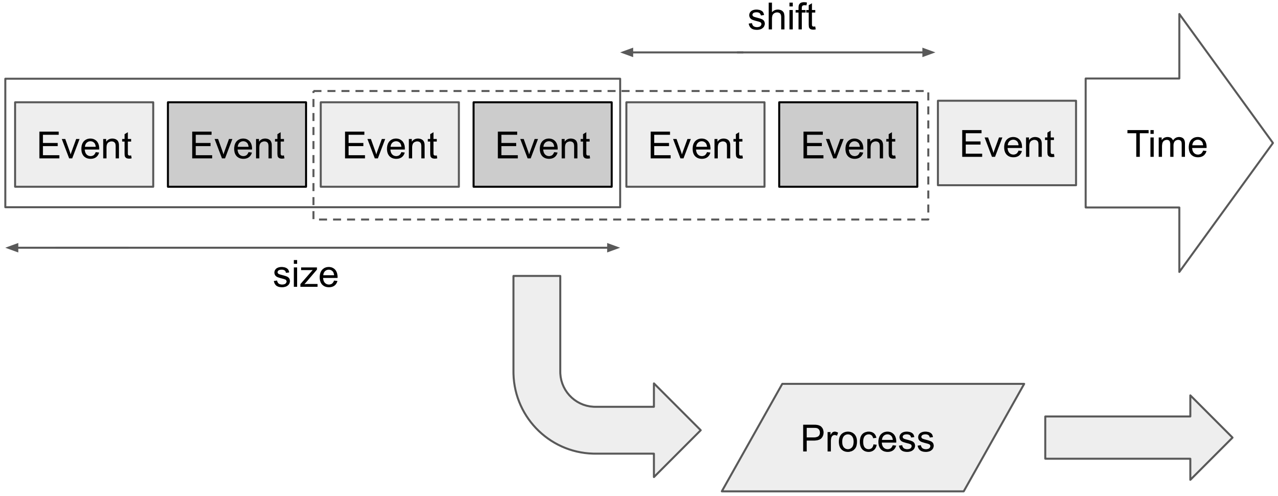
- Stream is cut to batch by time (for example 10 seconds batch)

Micro-batch approach



- Stream is cut to batch by time (for example 10 seconds batch)
- Batches are processed sequentially
- Latency >> 1s

Windowed approach



- Batch as a sliding window
- Similar to micro-batch approach

Event-based vs micro-batch

- Event-based allows you to achieve less lag
- Micro-batch allows you to save resources by reducing the common parts of each event handling/processing

Event-based vs micro-batch

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Application
DB

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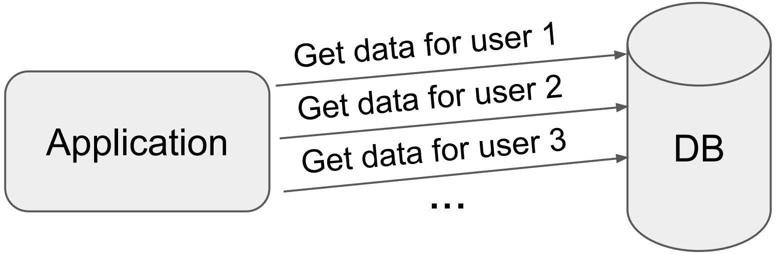

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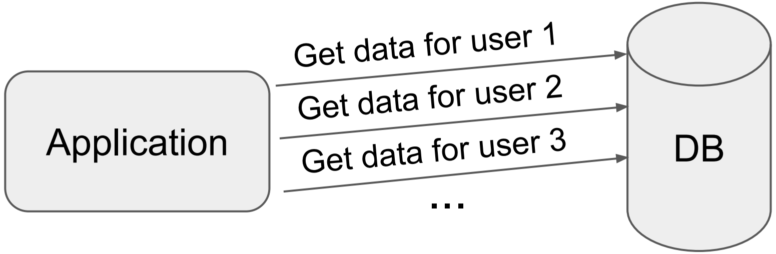

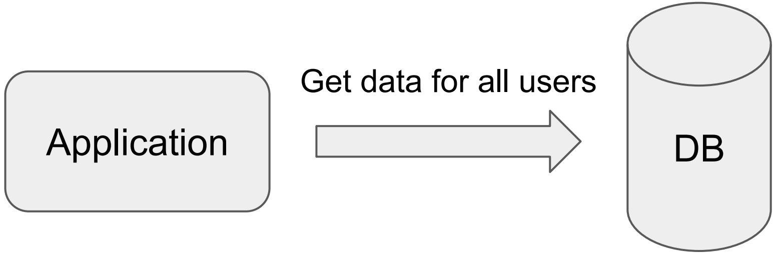

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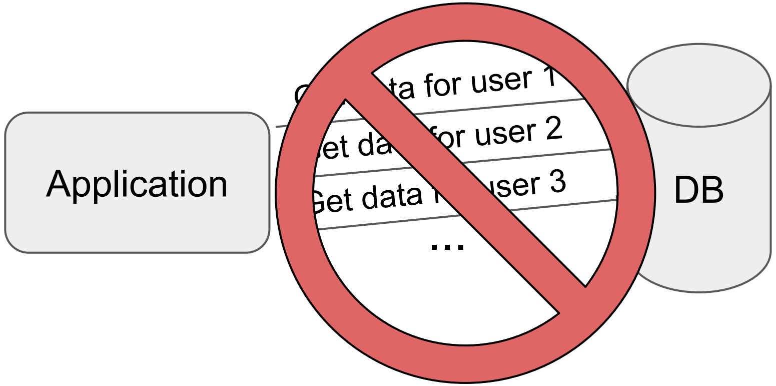

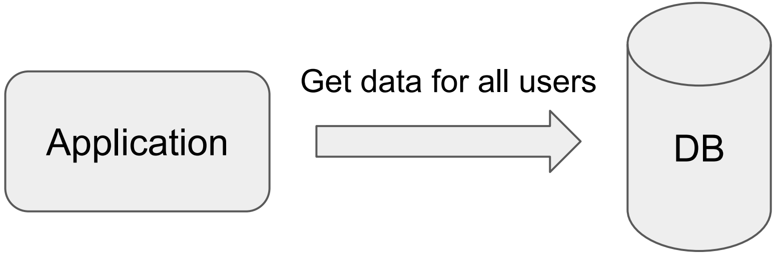

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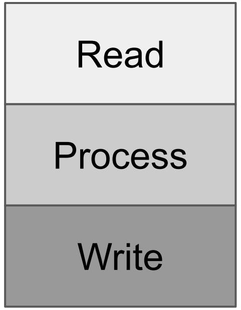

Read

Process

Write

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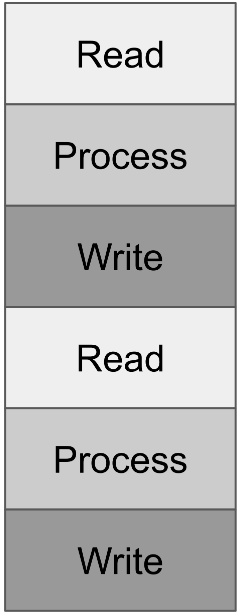

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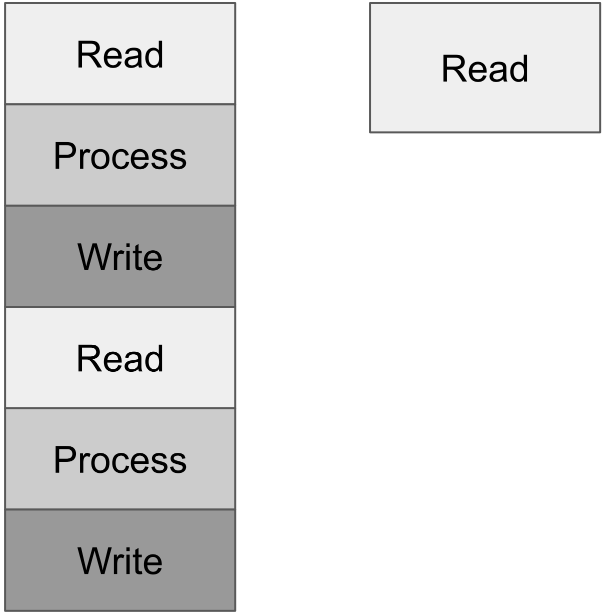

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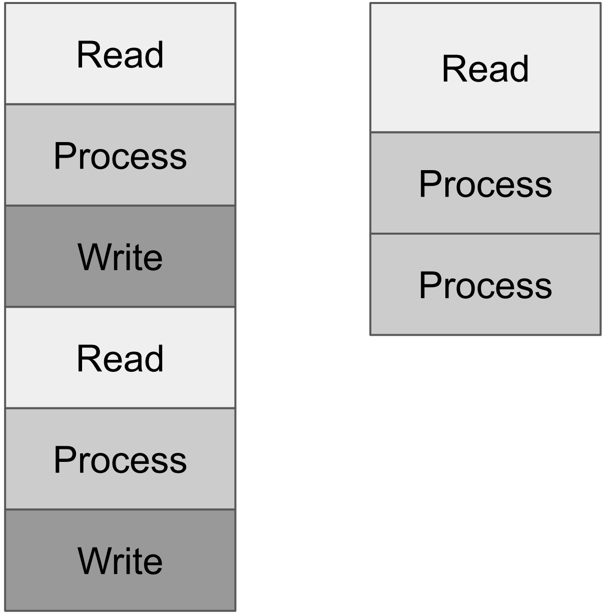

Read

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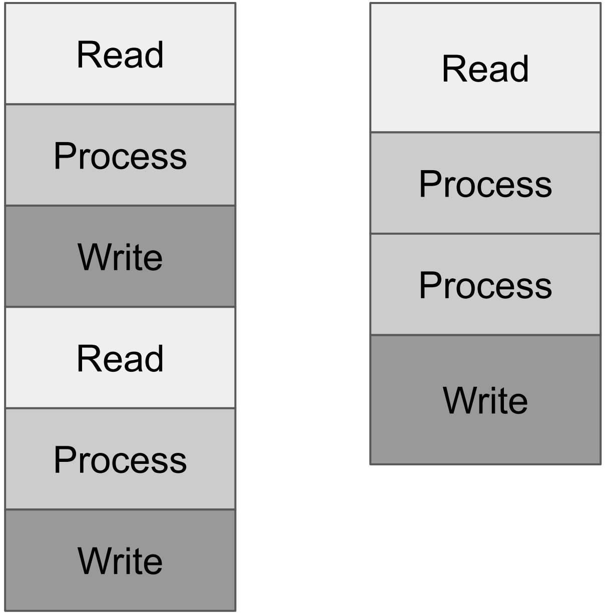

Read
Process
Write
Read
Process
Write

Read
Process
Process
Write

Event-based vs micro-batch

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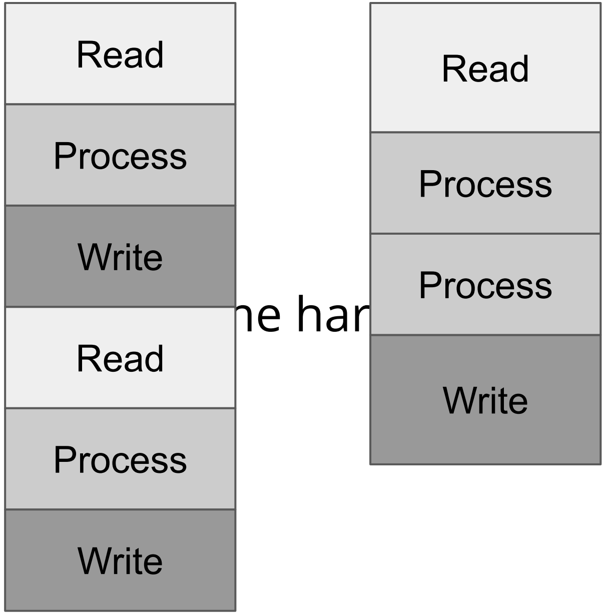
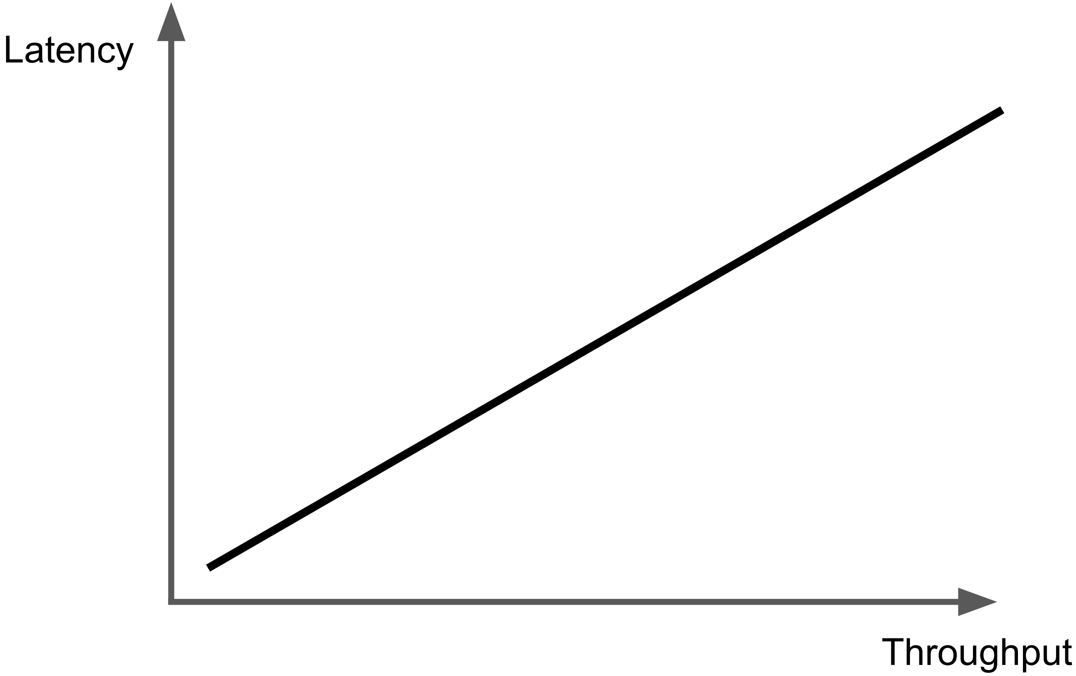
- Micro-batch allows you to process more data ne har



Throughput vs latency

- In real world resources are restricted
- Big data needs a huge throughput => in most cases we a choosing micro-batch
- There is no right answer - you should choose the approach by task

Throughput vs latency



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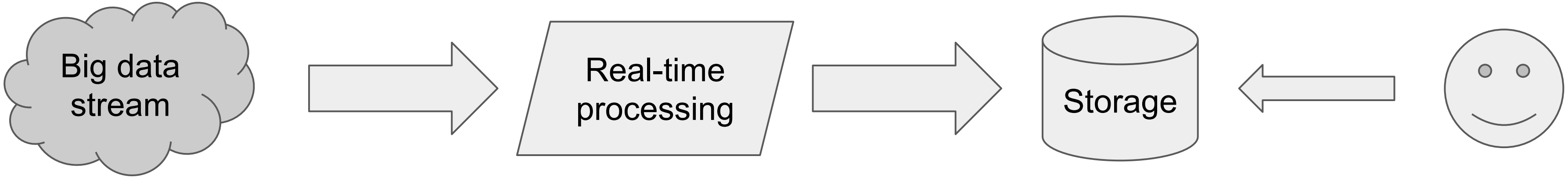
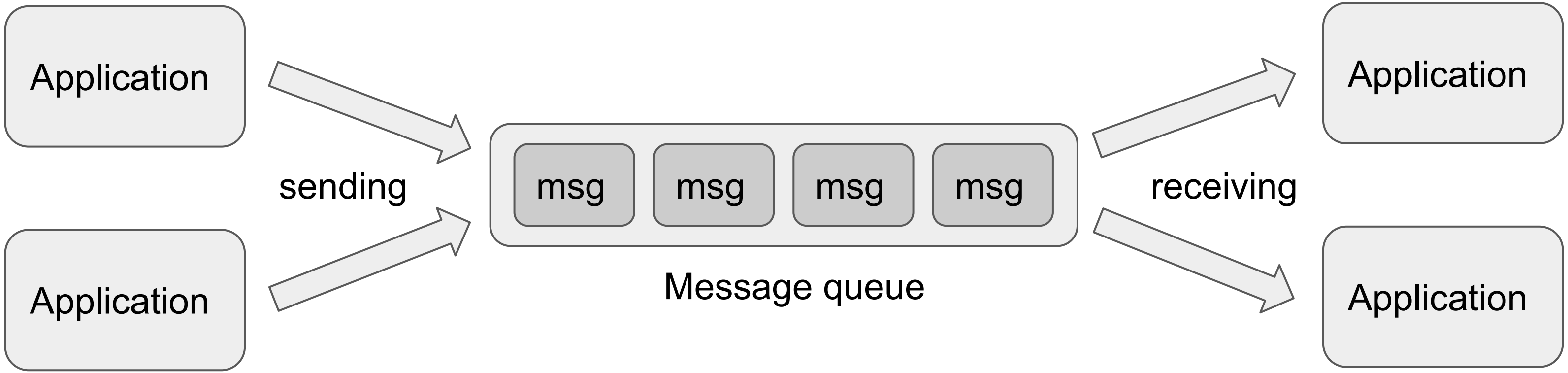
Requirements of storage for input data



- Event stream
- Big throughput (hundreds of thousands message per second)
- Small latency (less than 1s)

Stream handling - message queue



- Message queue provides an asynchronous communications protocol between applications or between processes/threads inside a single application

Key features of classical message queue

- Complex schemes of message delivery
  - Reduces the throughput
- Per-message state
  - Reduces the throughput
- Stores the data in RAM
  - Not persistent storage
  - Strongly limits the amount of stored data

Storage of events in big data world

- Simplify the message delivery scheme
- Per message state not tracked by queue
- High throughput
- Persistent storage for a big amount of data

APACHE kafka®

Google Cloud Pub/Sub

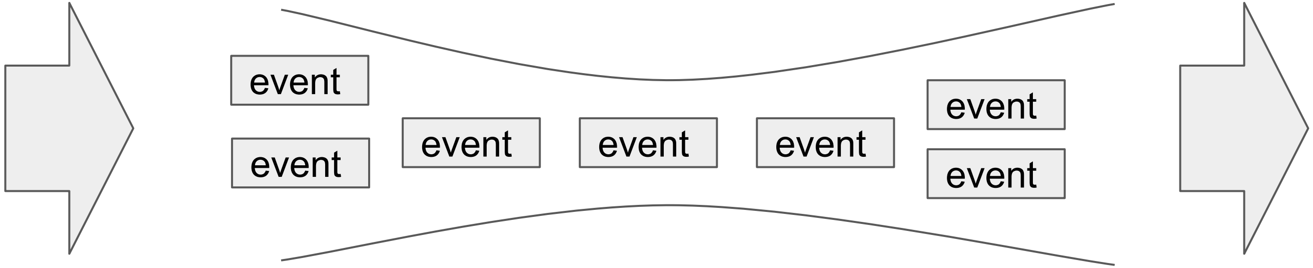
PULSAR

Amazon Kinesis

Kafka

- Kafka is a unified, high-throughput, low-latency platform for handling real-time data feeds
- Kafka is a data bus for big data
- Kafka is an input events storage for real-time processing
- Kafka is an event-based real-time processing engine (Kafka Streams)

Kafka



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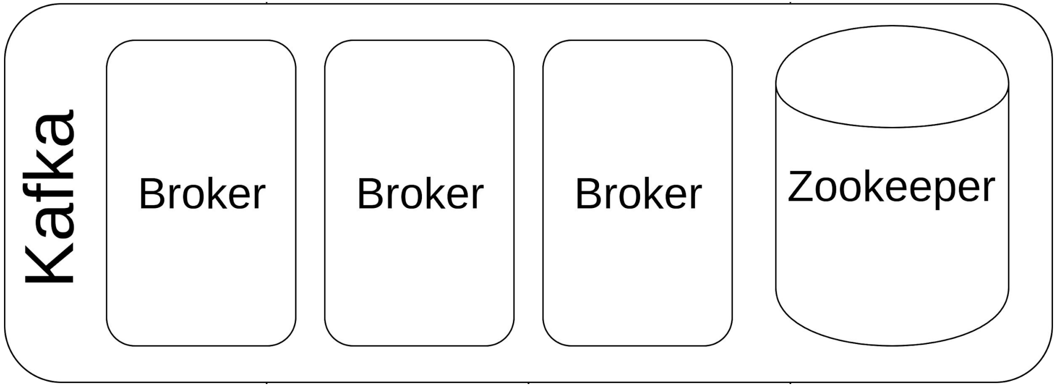
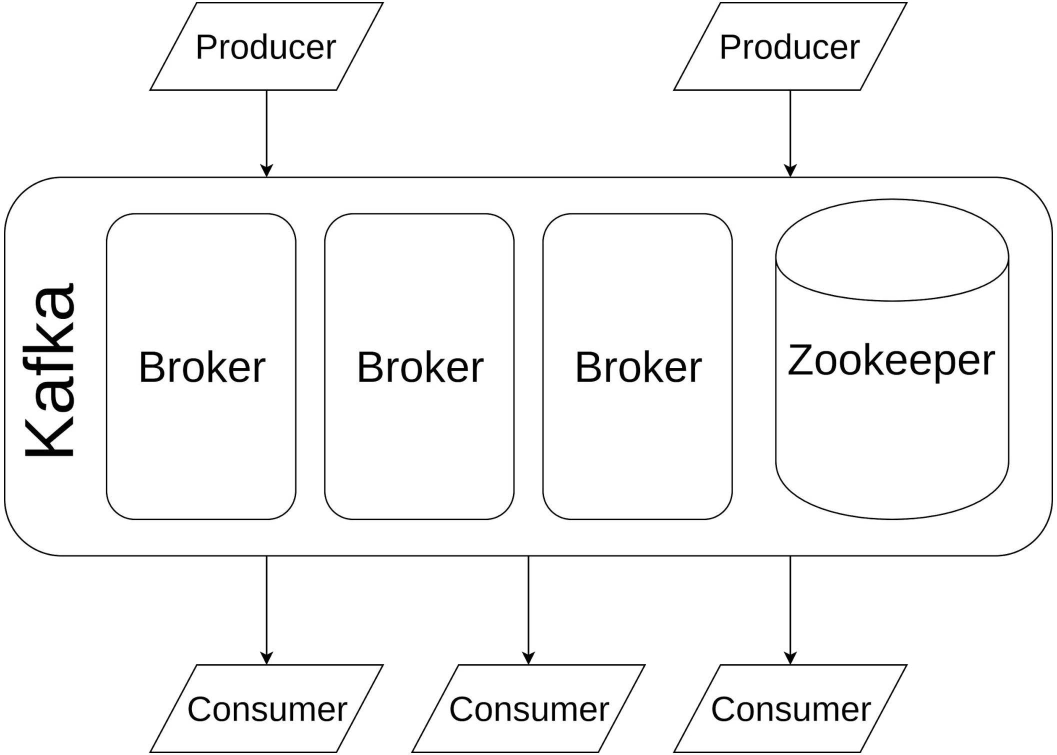
Kafka architecture



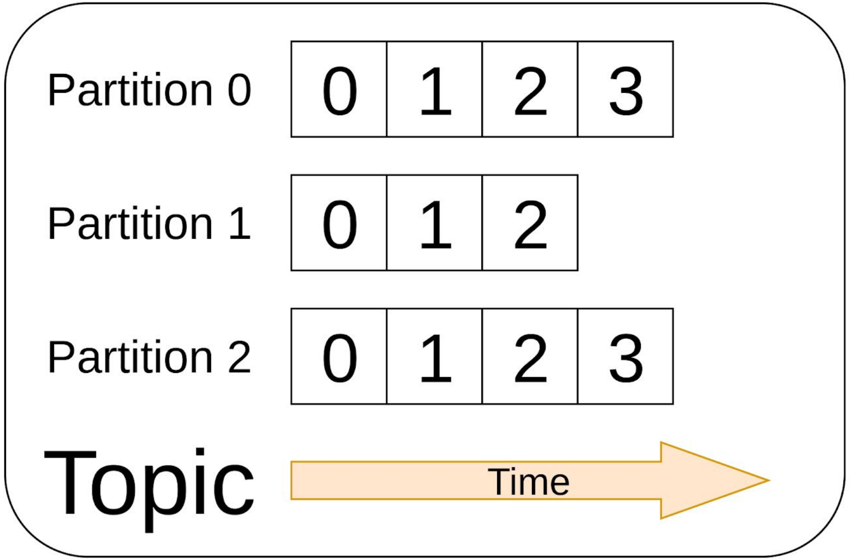
Kafka architecture



Topic

Topic

Topic



Partition 0 | 0 | 1 | 2 | 3

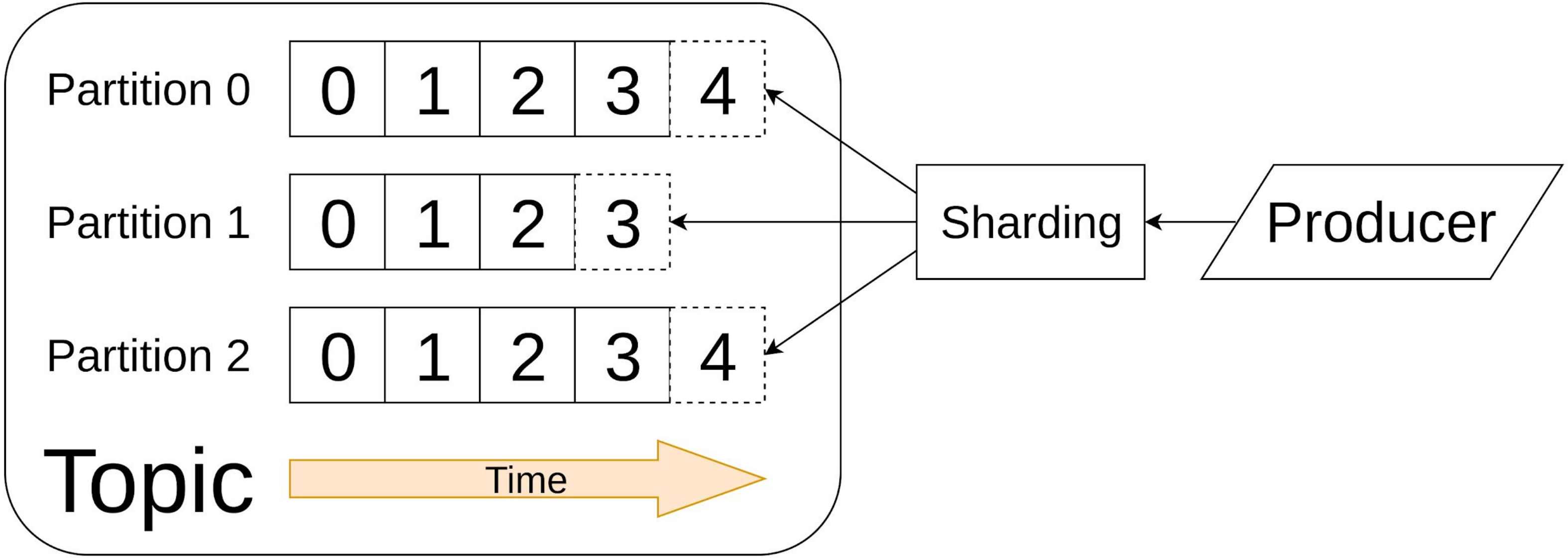
Partition 1 | 0 | 1 | 2

Partition 2 | 0 | 1 | 2 | 3

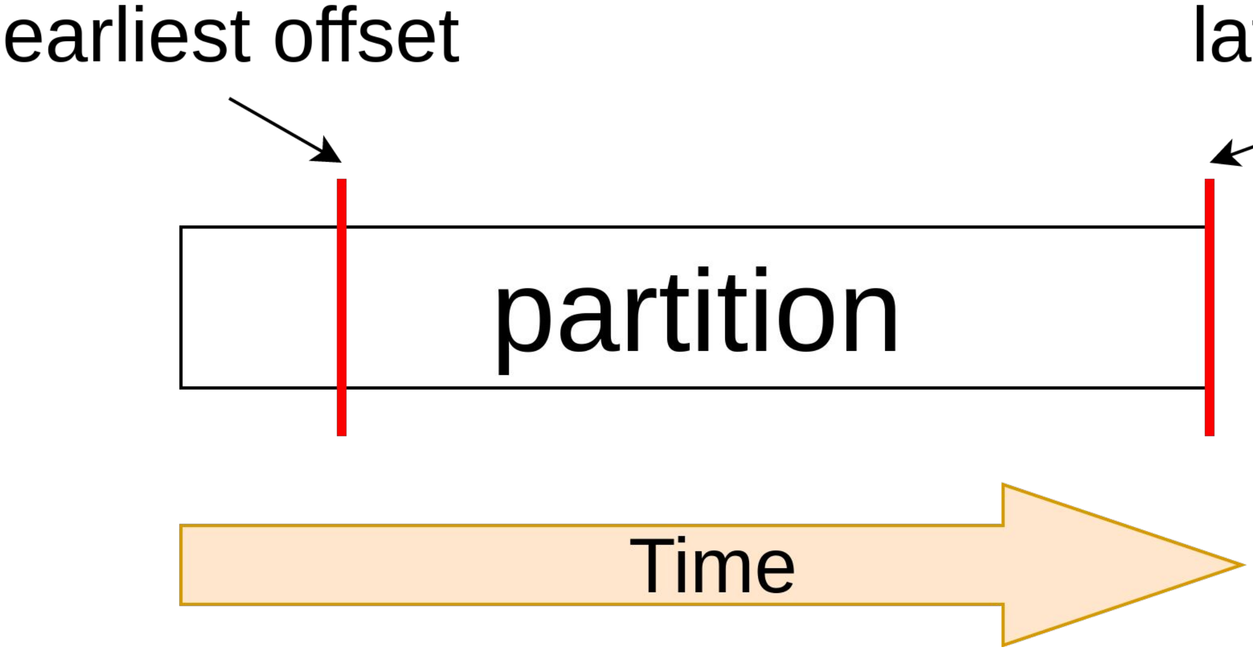
Topic

Time

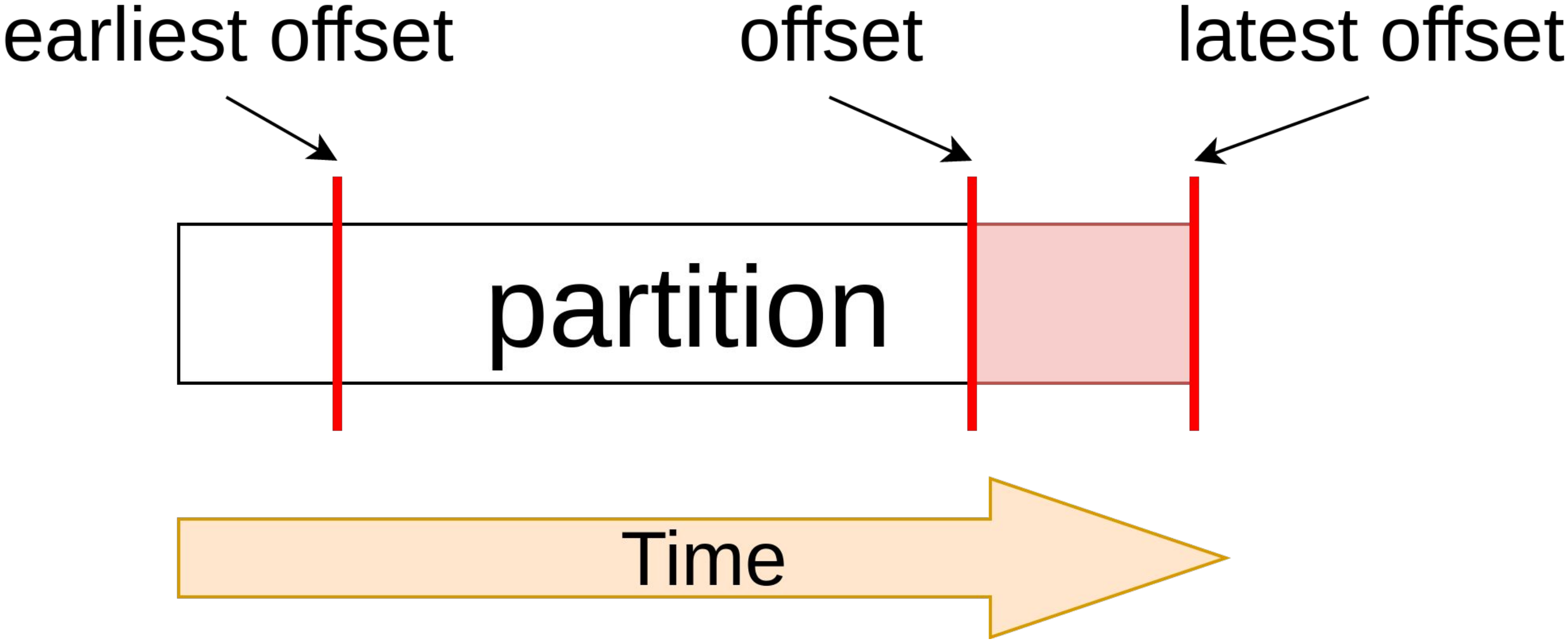
Topic & Write


Partition 0
0 1 2 3 4
Partition 1
0 1 2 3
Partition 2
0 1 2 3 4
Topic
Time
Sharding
Producer

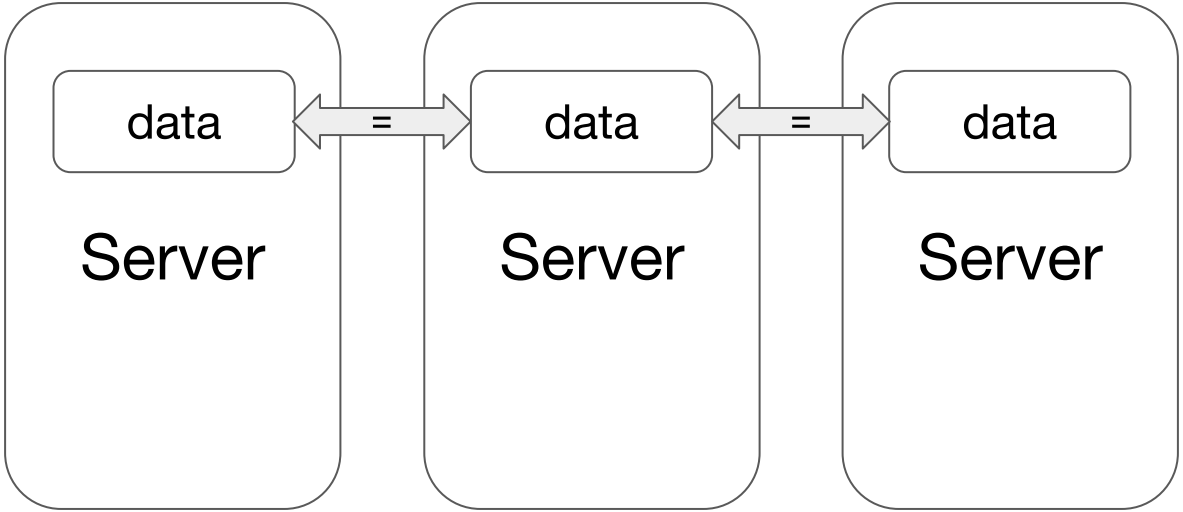
Offsets



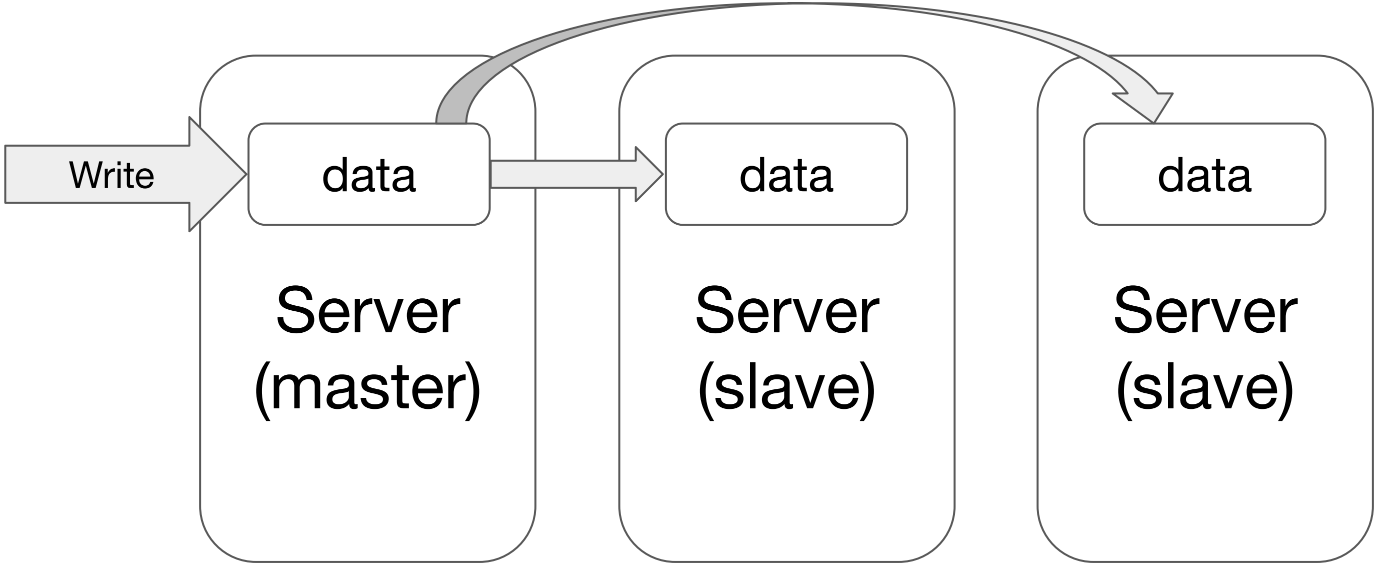
Offsets & Read



Replication



Replication



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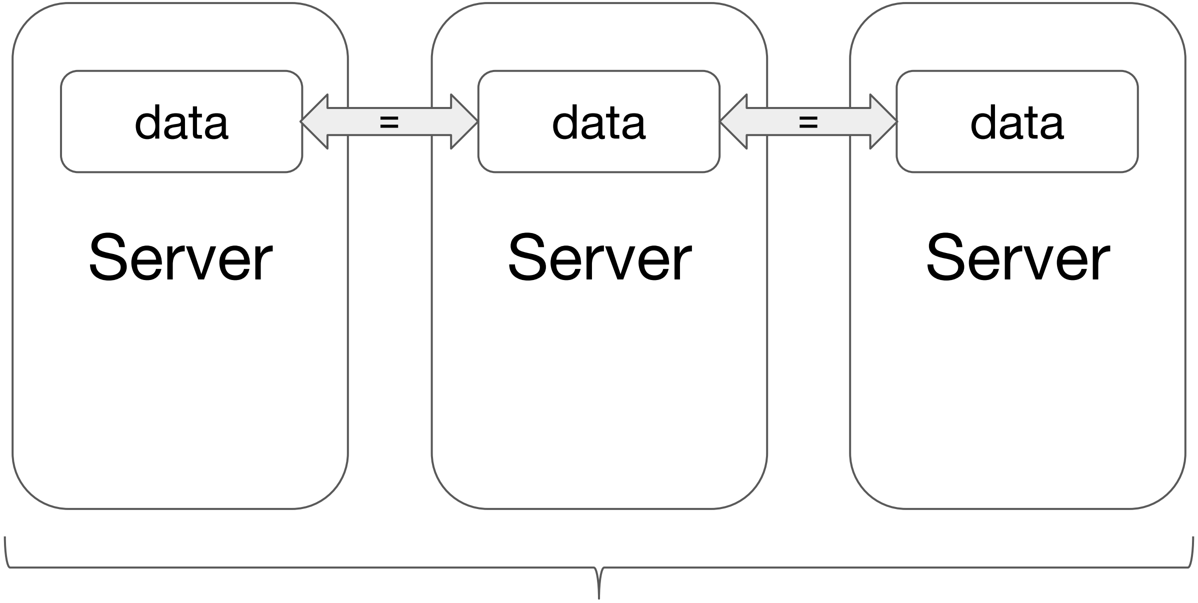
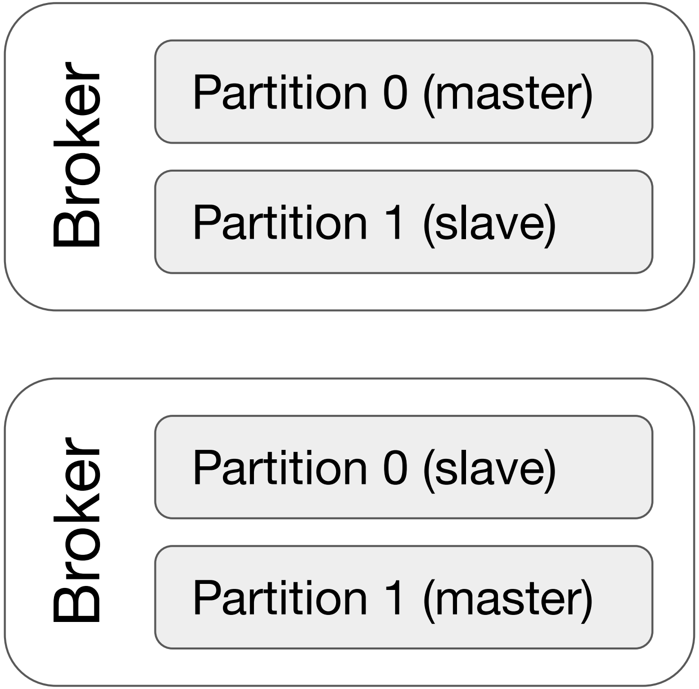


Replication factor

Kafka replication



Broker

Partition 0 (master)

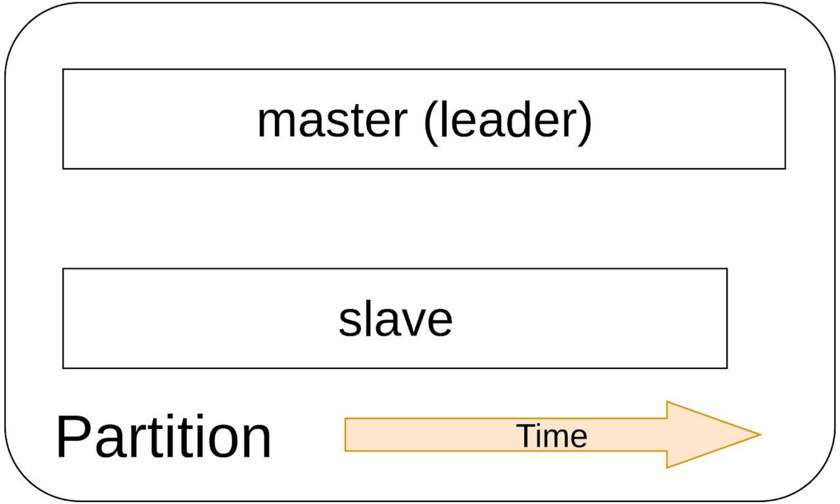
Partition 1 (slave)

Broker

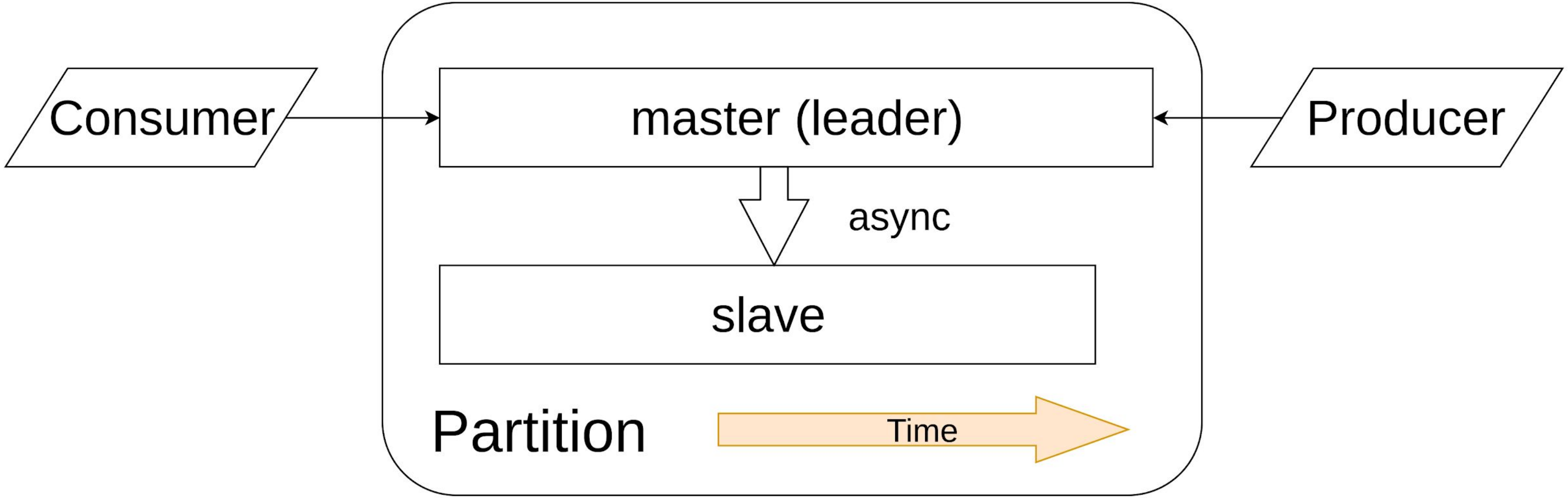
Partition 0 (slave)

Partition 1 (master)

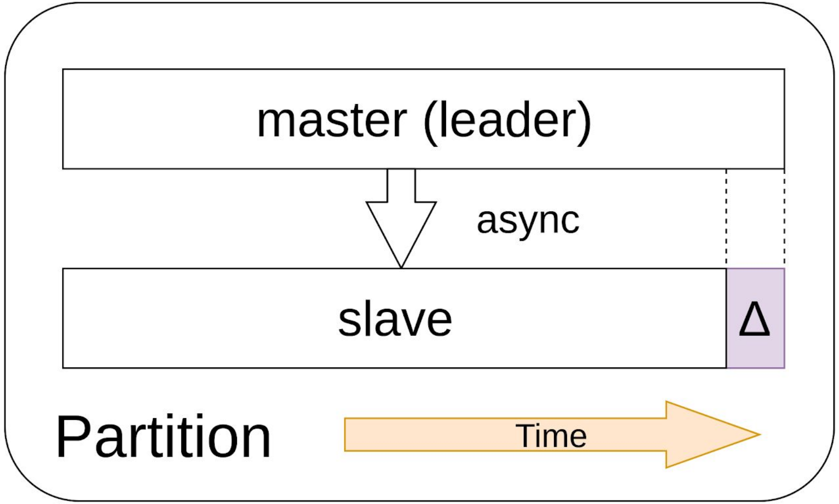
Kafka replication



Kafka replication



Kafka replication delay



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  - **CLI**

Kafka CLI: kafka-topics

- It is the utility to create, delete, describe or change the topic
-
  ```
  kafka-topics.sh --bootstrap-server $BROKERS --create
  --topic test_topic --partitions 3 --replication-factor 2
  ```
-
  ```
  kafka-topics.sh --bootstrap-server $BROKERS --describe
  --topic test_topic
  ```
-
  ```
  kafka-topics.sh --bootstrap-server $BROKERS --list
  ```

Kafka CLI: kafka-console-producer

- It is utility to send data from standard input and to Kafka topic
- `kafka-console-producer.sh --broker-list $BROKERS --topic test_topic`

Kafka CLI: kafka-console-consumer

- It is utility to read data from Kafka topic
-
```
kafka-console-consumer.sh --bootstrap-server $BROKERS
--topic test_topic --from-beginning
```

Kafka CLI: kafka-run-class

- It is entry point to run any class in the Kafka environment

-
  ```
  kafka-run-class.sh kafka.tools.GetOffsetShell
  --broker-list $BROKERS --topic test_topic --time -1
  ```

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Thank you! Questions?

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