A distributed pub/sub platform: Apache Kafka (Part 1)

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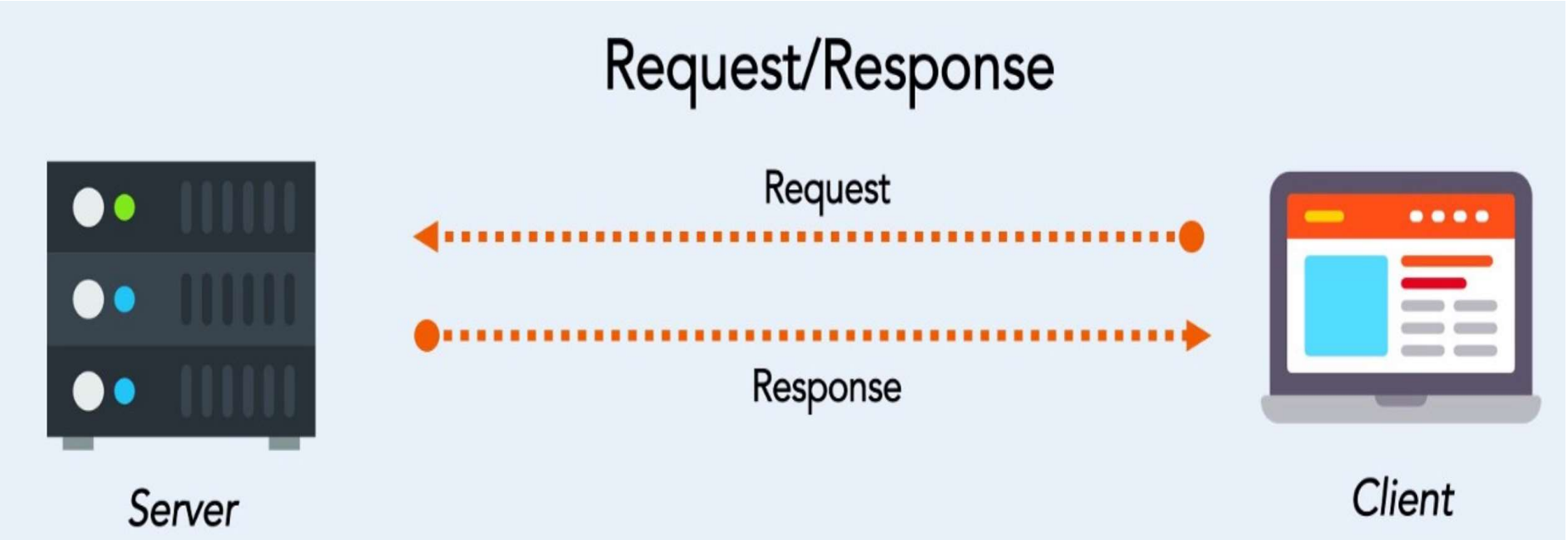
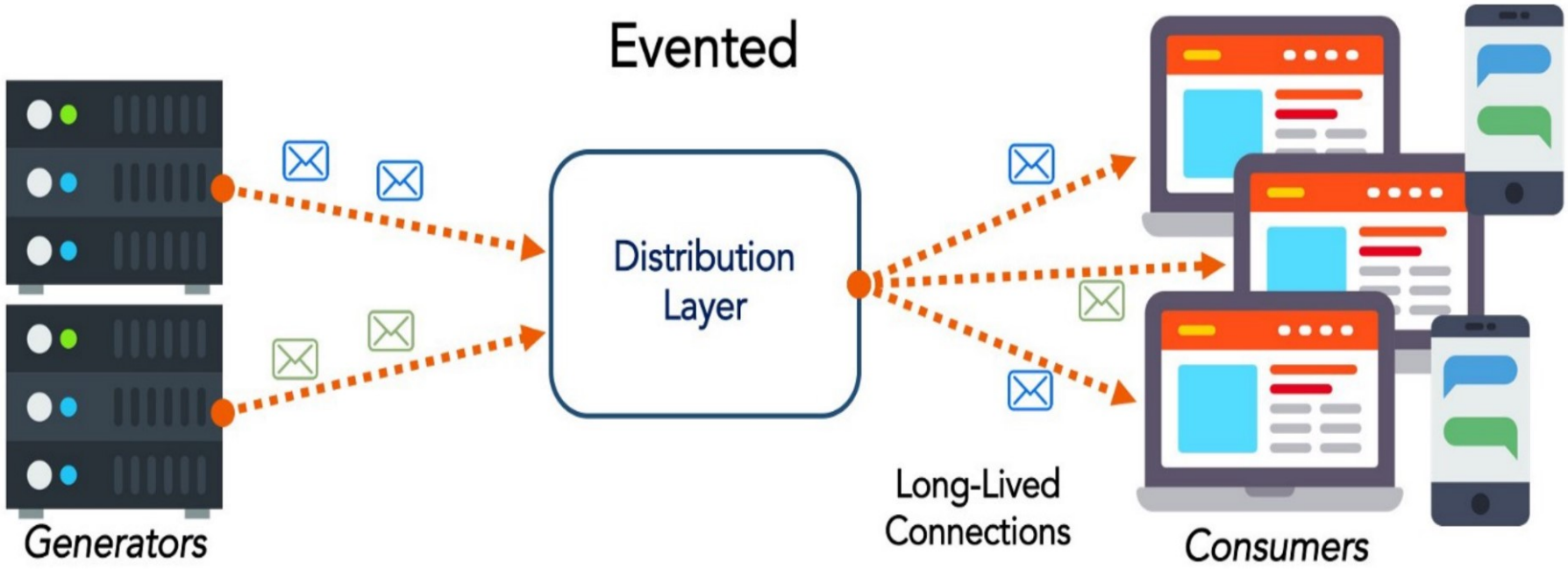
Request-Response model



Request-Response: some problems

- Bad for multiple receivers
- Tightly coupled
- Client is waiting for response
- Web Service chaining

Event-driven model



Event-driven model: some considerations

- Loosely coupled
- Works even though client(s) is(are) offline
- Message delivery issues

Software platforms for event-driven apps

Oracle Cloud Infrastructure Streaming

Oracle Advanced Queuing

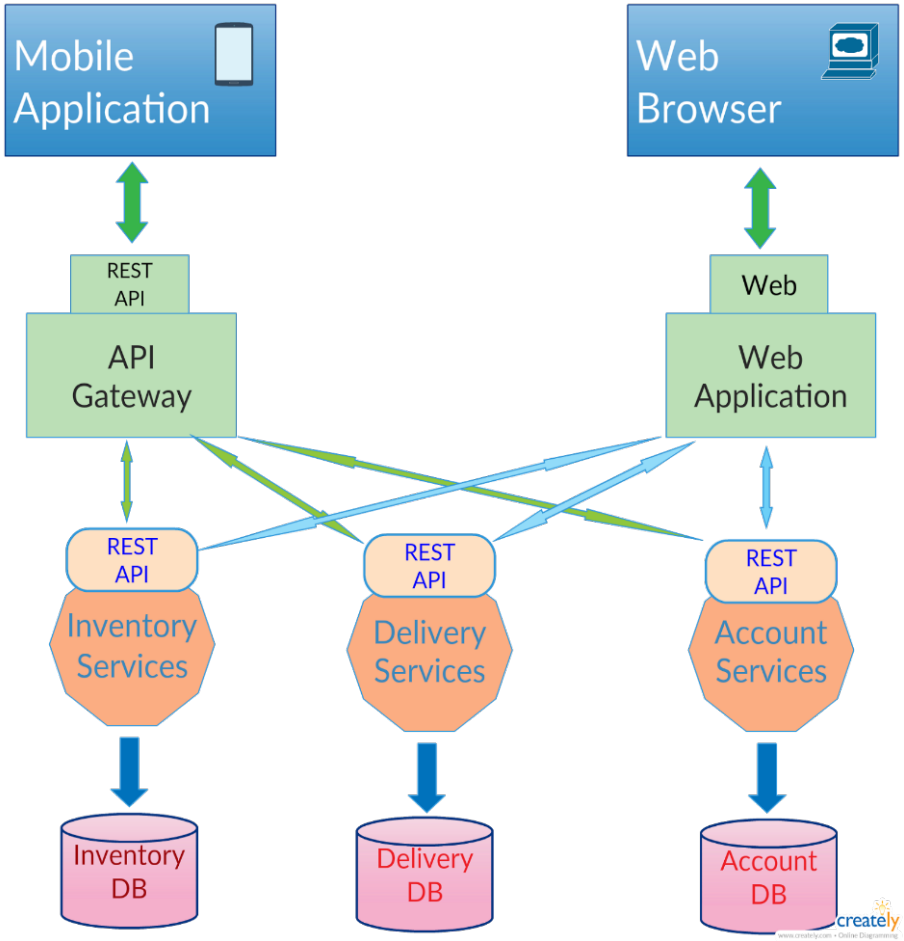
Event-driven model

Some use cases:

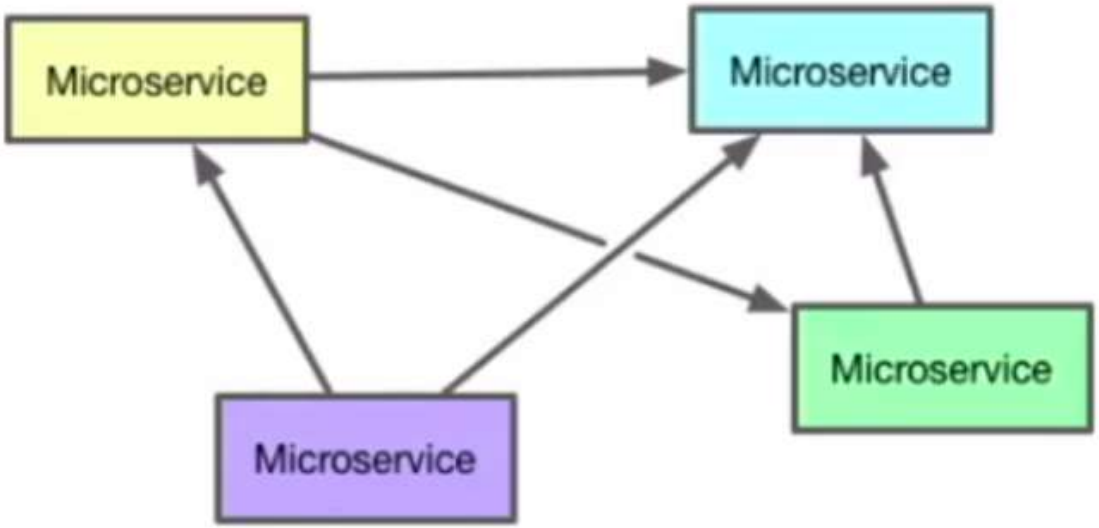
- Managing “Events”
  - Anything happened (or didn’t happen)
  - A **change in the state**
  - A condition that triggers a **notification**
- **IoT (Internet of Things)** data source
- **Change Data Capture (CDC)** for databases
- **Near real-time** data processing
- …

Why Web APIs?

Web APIs as “an internal bus” for Microservices



Point to Point Pattern

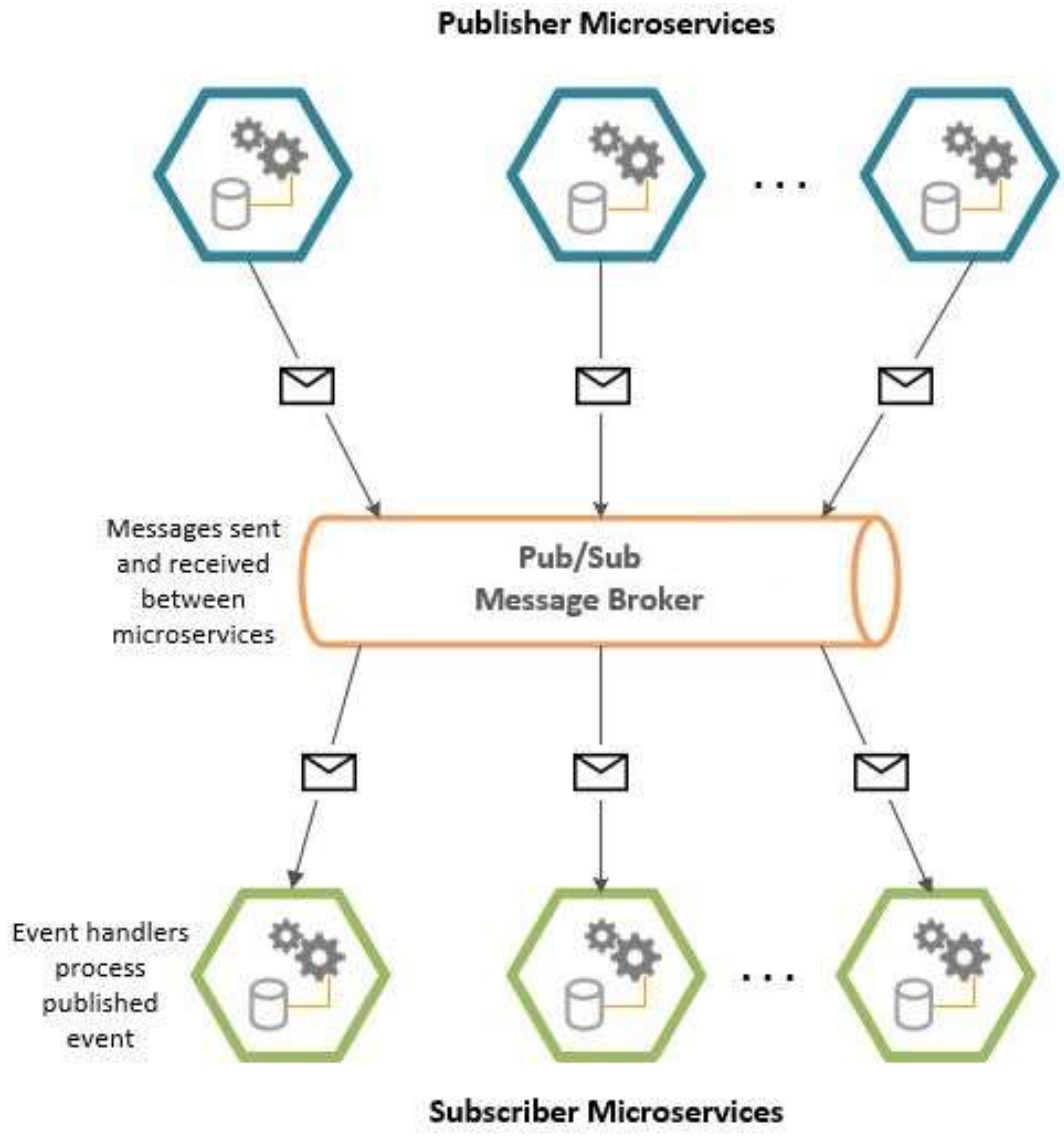


- A *point-to-point* channel delivers a message to exactly one of the consumers that is reading from the channel.
- Each service depends on other services directly.
- Services are directly coupled to each other APIs.
- Services know about and understand their dependencies.

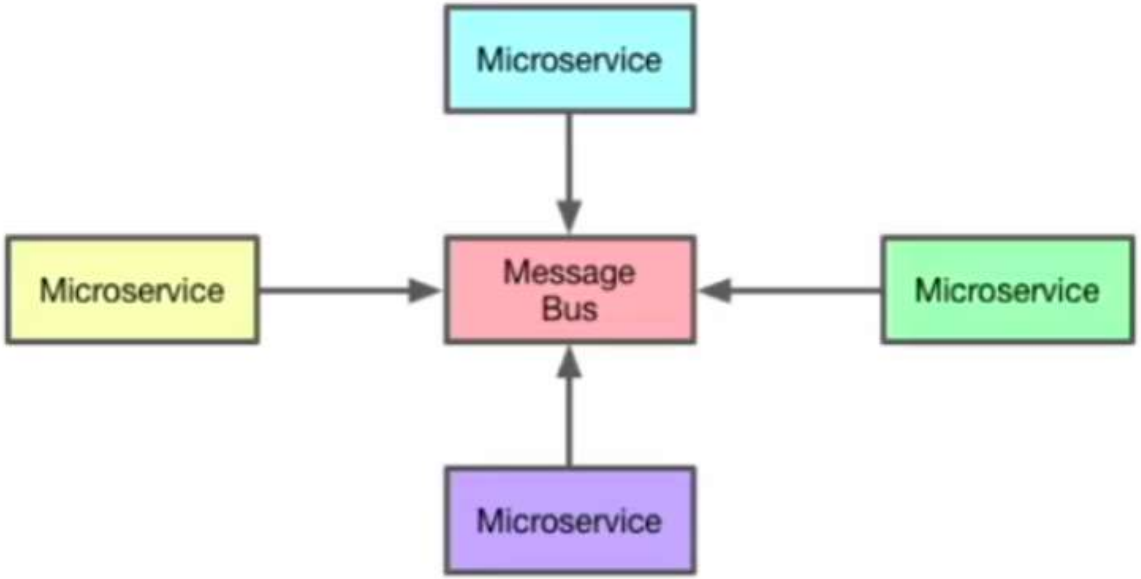
Source: https://medium.com/@knoldus/distributed-messaging-patterns-reactive-architecture-c7f0ce989fe0

Why event-driven platforms?

Event-driven (a.k.a., Message Queue, Pub/Sub) as “an internal bus” for Microservices



Publish/Subscribe Pattern



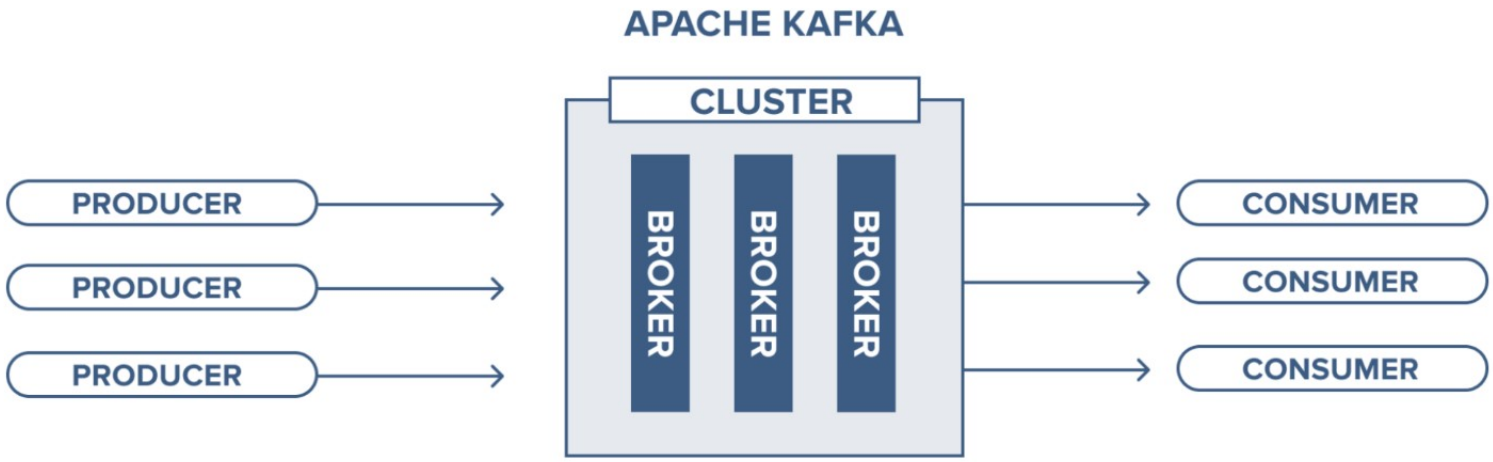
- Services publish messages to a common message bus.
- Other services subscribe to the messages.
- The publishing service has no knowledge of the subscribing services.
- Subscribing services also has no knowledge of the publishing services.
- Services are completely decoupled as they have no knowledge of each other.
- Services are coupled to only the message format.

Apache Kafka

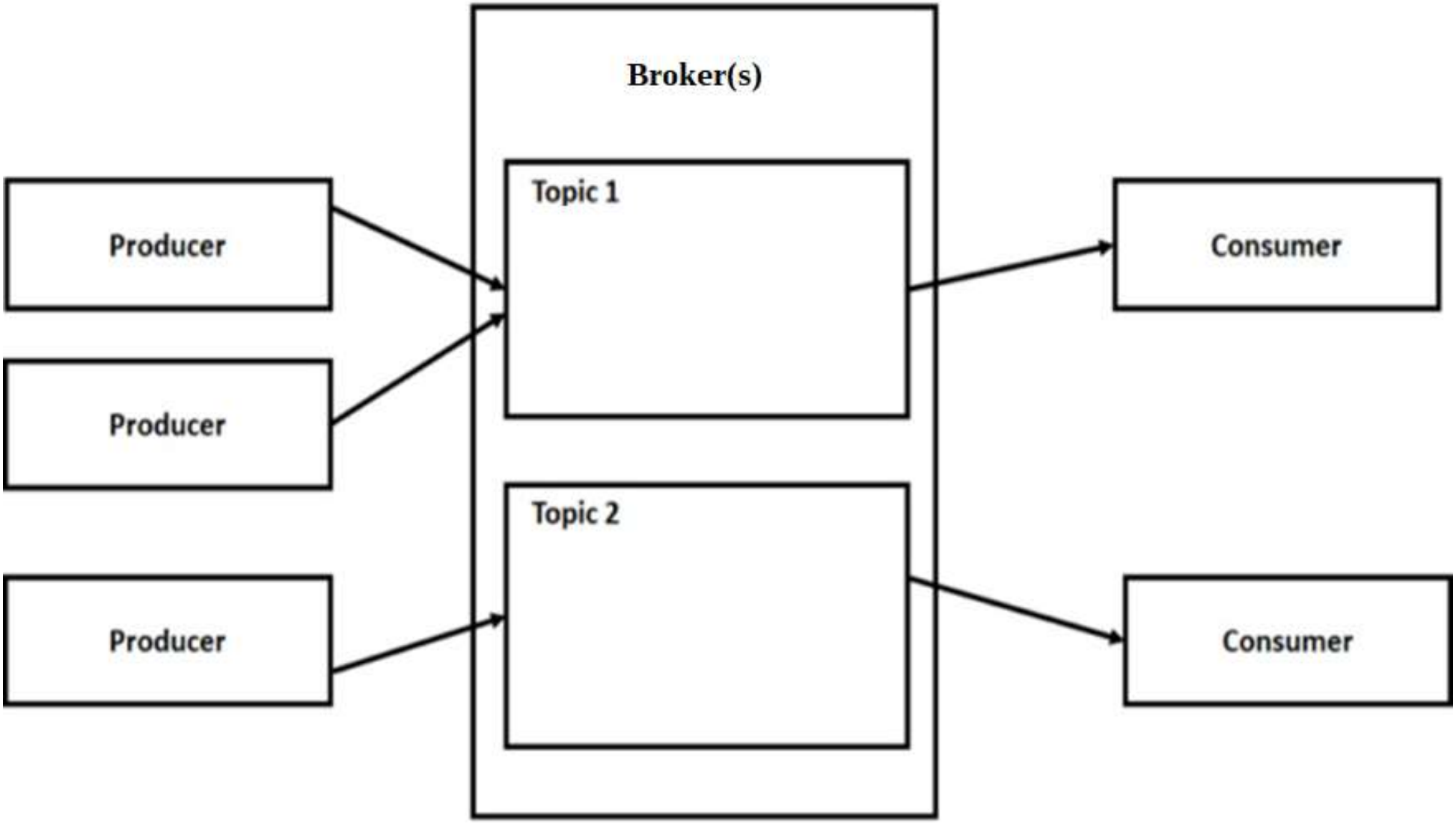
- Distributed publish-subscribe messaging system
- Designed for processing of real time activity stream data (log, metrics, collections, social media streams,…..)
- Does not use **JMS (Java Messaging Service)** API and standards
- Kafka maintains feeds of message in **topics**
- Initially developed at Linkedin, then part of Apache
- Current commercial version by Confluent

Main Components

- A **Producer** is an entity/application that publishes data to a Kafka cluster, which is made up of **brokers.**
- A **Broker** is responsible for receiving and storing the data when a producer publishes.
- A **Consumer** then consumes data from a broker at a specified offset, i.e. position.



Pub/Sub paradigm

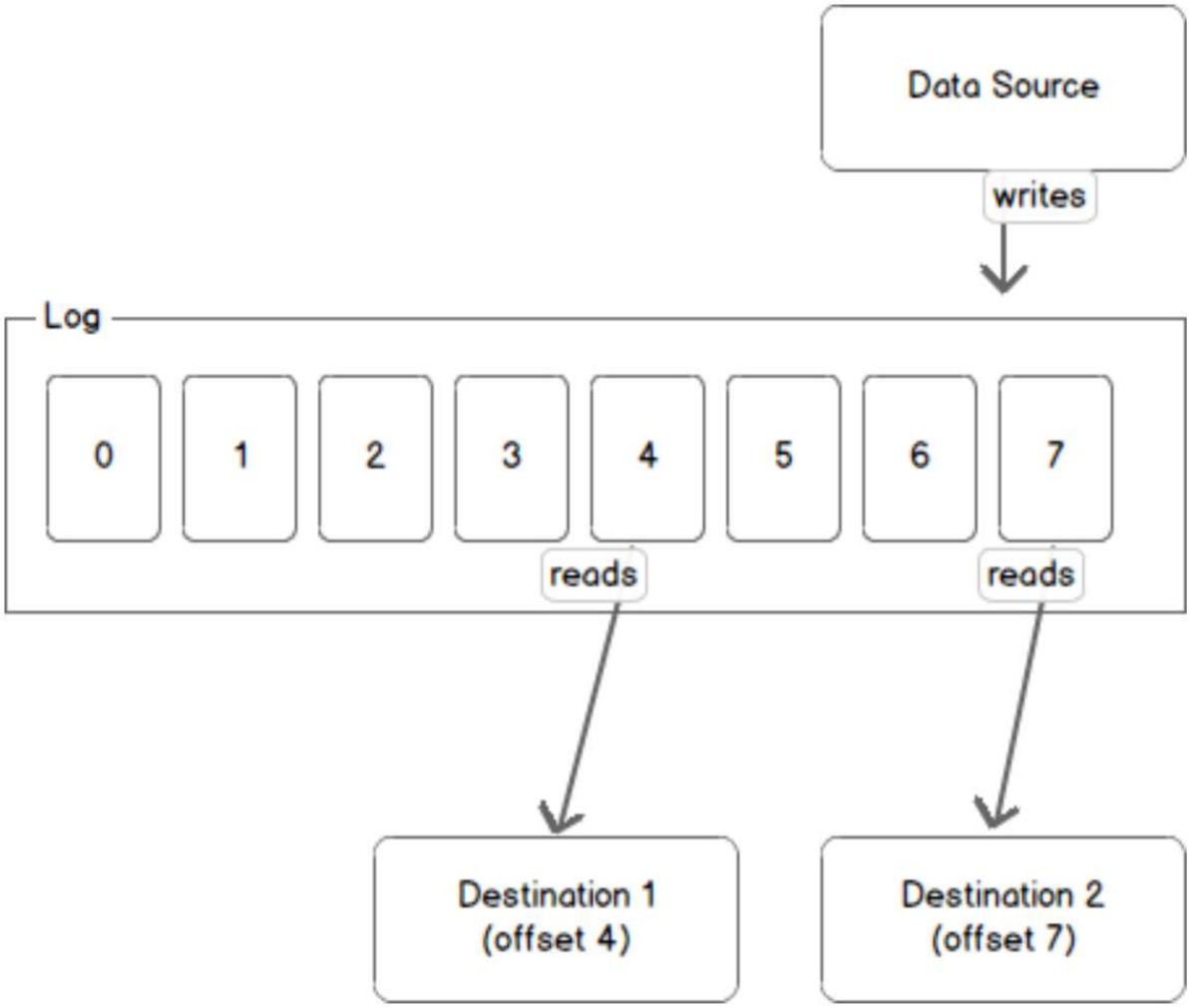


Key Concepts

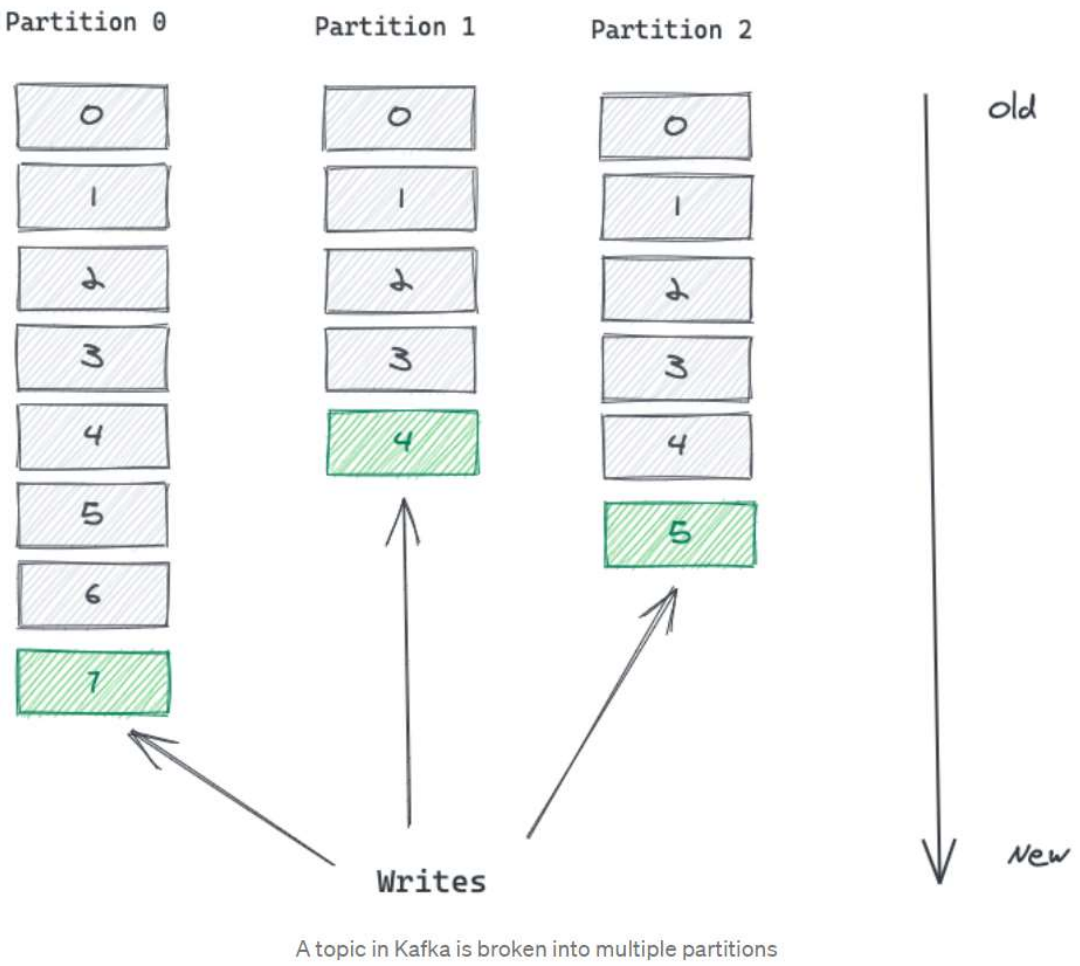
- A **Topic** is a category/feed name to which records are stored and published.
- Each **Topic** is divided in **partitions**.
- Each partition is an ordered, immutable sequence of messages that is **continually appended to**.
- **The message order is only guarantee inside a partition** (i.e., the FIFO property is only guarantee inside a partition).
- A message in a partition is identified by a sequence number called **offset**.

- **Consumers** subscribes to topics.
- Consumers with different group-id receives all messages of the topics they subscribe to. They consume the messages at their own speed.
- Consumer offsets are persisted by Kafka with a commit/auto-commit mechanism.

Log Anatomy


Data Source
writes
Log
0
1
2
3
4
5
6
7
reads
reads
Destination 1
(offset 4)
Destination 2
(offset 7)

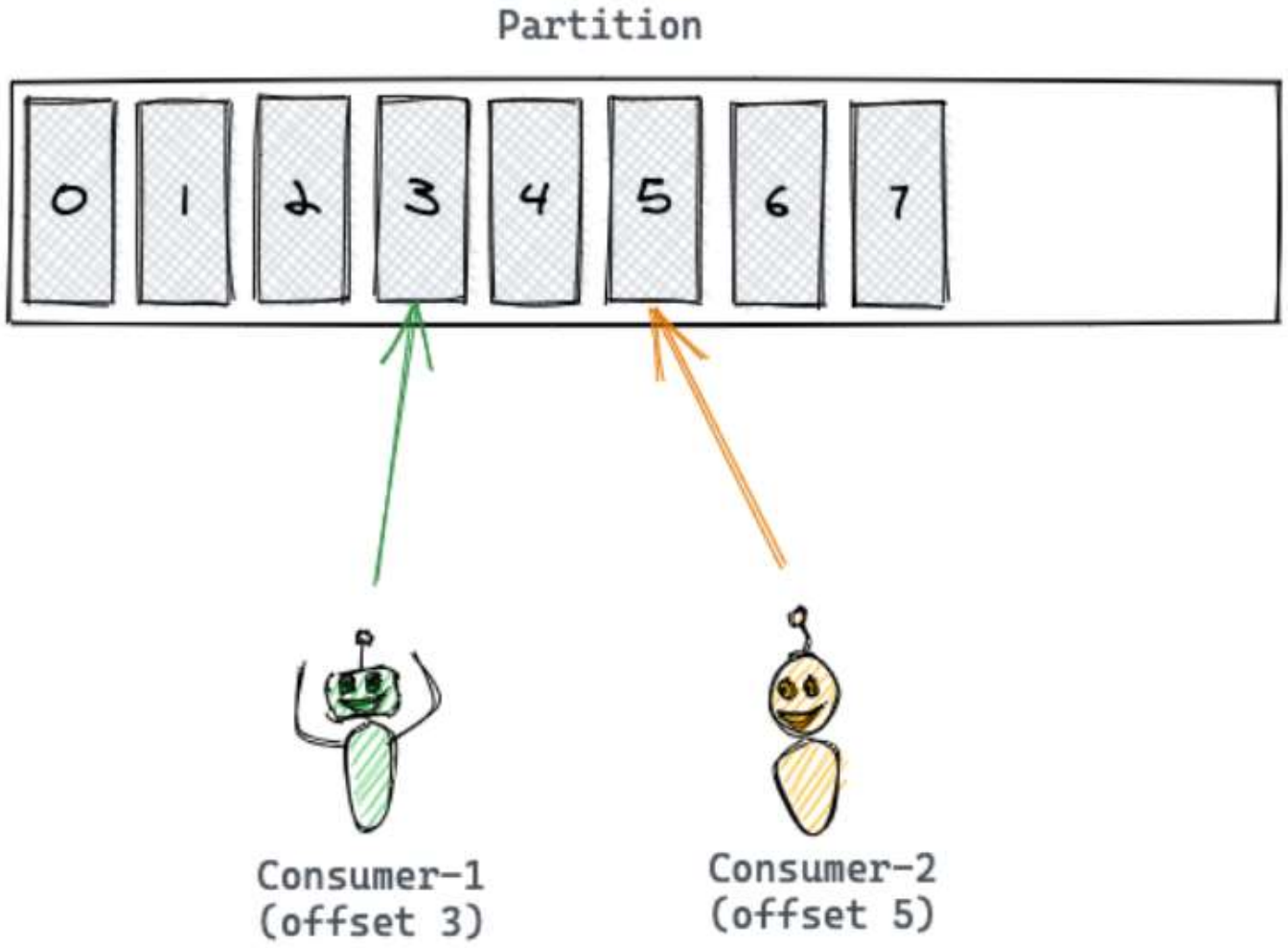
Log Anatomy – Producer side



A topic in Kafka is broken into multiple partitions

Partitions are the way that Kafka provides scalability and redundancy

Log Anatomy – Consumer side



Each consumer has its own view about the partition.

Kafka Messages

- A message contains
  - key-value pair (the key is optional)
  - timestamp
  - headers (optional)

- All data is stored in Kafka as byte arrays
- Producer provides serializers to convert the key and value to byte arrays
- Key and value can be any data type

Producers

The partitioning strategy is specified by the Producer

– Default strategy is a hash of the message key
hash(key) % number_of_partitions

– If a key is not specified, messages are sent to Partitions on a round-robin basis

– Developers can provide a custom partitioner class

Consumers and Consumer Groups

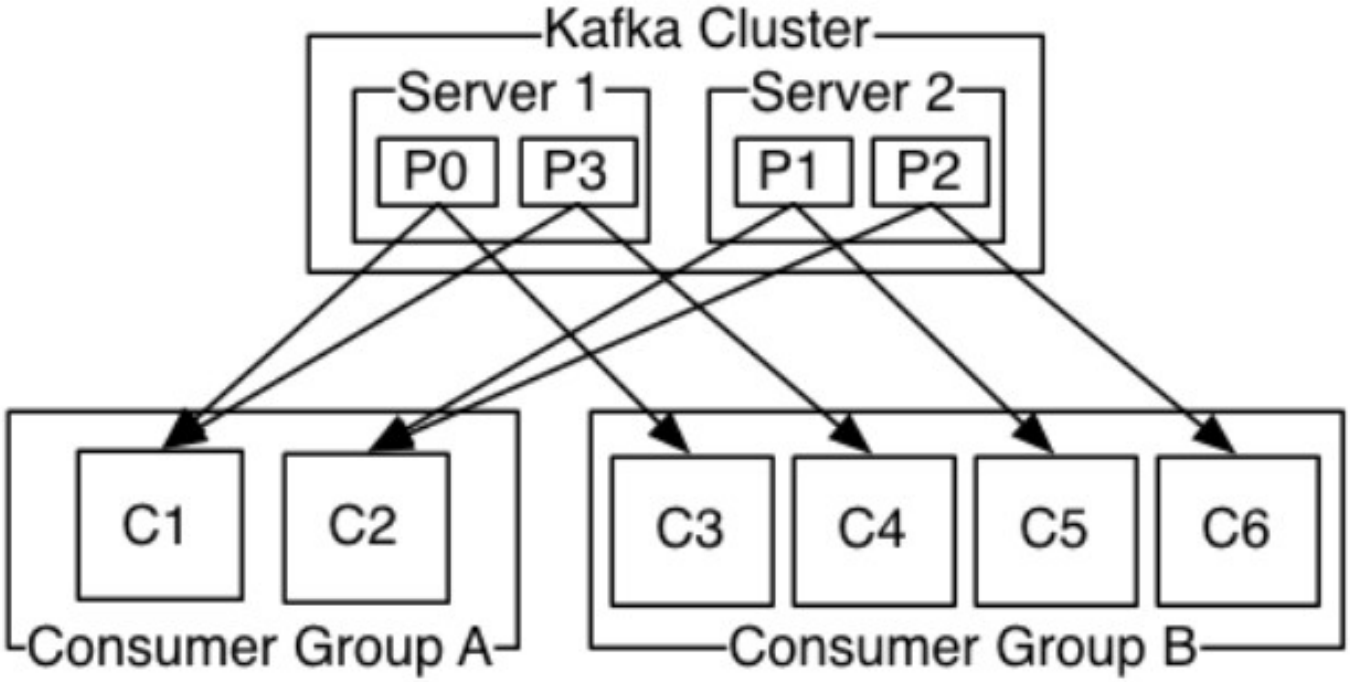
Consumers sharing the same group-id will be assigned to one (or several) partition of the topics they subscribe. They only receive messages from their partitions. So a constraint appears here: the number of partitions in a topic gives the maximum number of parallel consumers.

The assignment of partitions to consumer can be automatic and performed by Kafka (through Zookeeper). If a consumer stops polling or is too slow, a process call “re-balancing” is performed and the partitions are re-assigned to other consumers.

Consumers and Consumer Groups

When a consumer group consumes the partitions of a topic, Kafka makes sure that each partition is consumed by exactly one consumer in the group.

Consumers and Consumer Groups



Consumers and Consumer Groups