

MESSAGING

Teaching Faculty: Umur INAN

Prepared by Umur INAN

REMOTING TECHNOLOGIES

- JAX-WS
 - Spring provides remoting support for web services via JAX-WS [SOAP]
- JMS
 - Remoting using JMS is supported
- AMQP
 - Remoting using AMQP as underlying protocol

JMS (JAVA MESSAGING SERVICE)

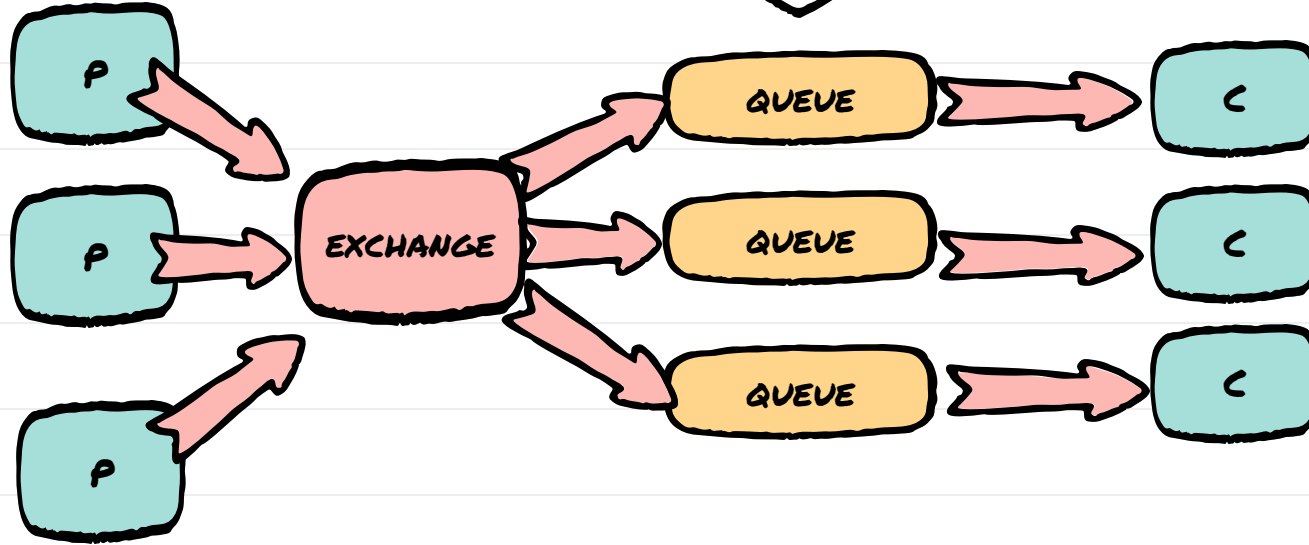
- JMS has queues and topics.
 - A message sent on a queue is consumed by no more than one client.
 - A message sent on a topic may be consumed by multiple consumers.

AMQP (ADVANCED MESSAGING QUEUE PROTOCOL)

- AMQP only has queues and exchanges.
 - Queues are only consumed by a single receiver.
 - AMQP doesn't publish directly to queues.
 - A message is published to an exchange.
 - routed to one queue or multiple queues.

AMQP

QUEUES ARE SIMPLE
FIFO QUEUES



PRODUCER VS CONSUMER

- Queues are only consumed by a single receiver.
 - If more than one consumer subscribes to the queue, the messages are dispensed in a round-robin fashion.
- Consumer defined queues.
 - Multiple queues, bound to the same exchange/routing key.
 - Emulate a broadcast message.
 - A queue per consumer.

AMQP CONCEPTS

- Exchanges
 - Message routing agents
 - Accept messages from producers routes to queues
- Bindings
 - Binds/maps a queue & exchange
- Routing Key
 - Optional attribute to customize binding/routing
- Queues
 - Message placeholders

AMQP EXCHANGES

- Direct
 - Queue binding requires a direct match based on a “simple” Routing Key.
 - Corresponds to JMS PTP.
 - Can have multiple Queues/Consumers.

AMQP EXCHANGES

- FanOut
 - Queue is bound directly to exchange no Routing Key.
 - Publisher / Subscriber

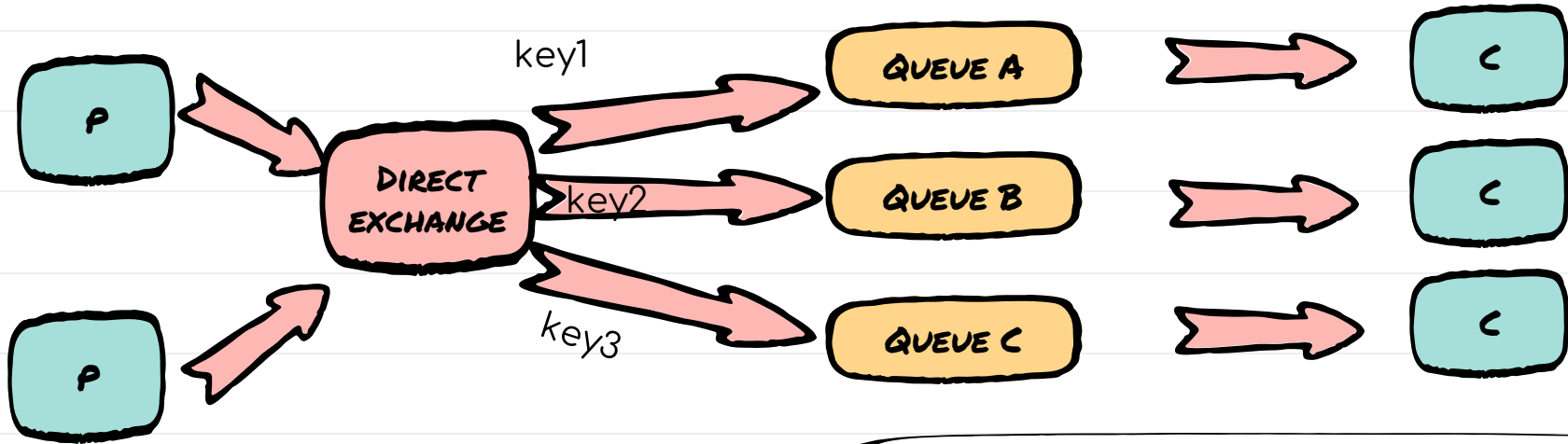
AMQP EXCHANGES

- Topic
 - Queue binding requires a direct match based on a “complex” Routing Key
 - Beyond Pub / Sub

AMQP EXCHANGES

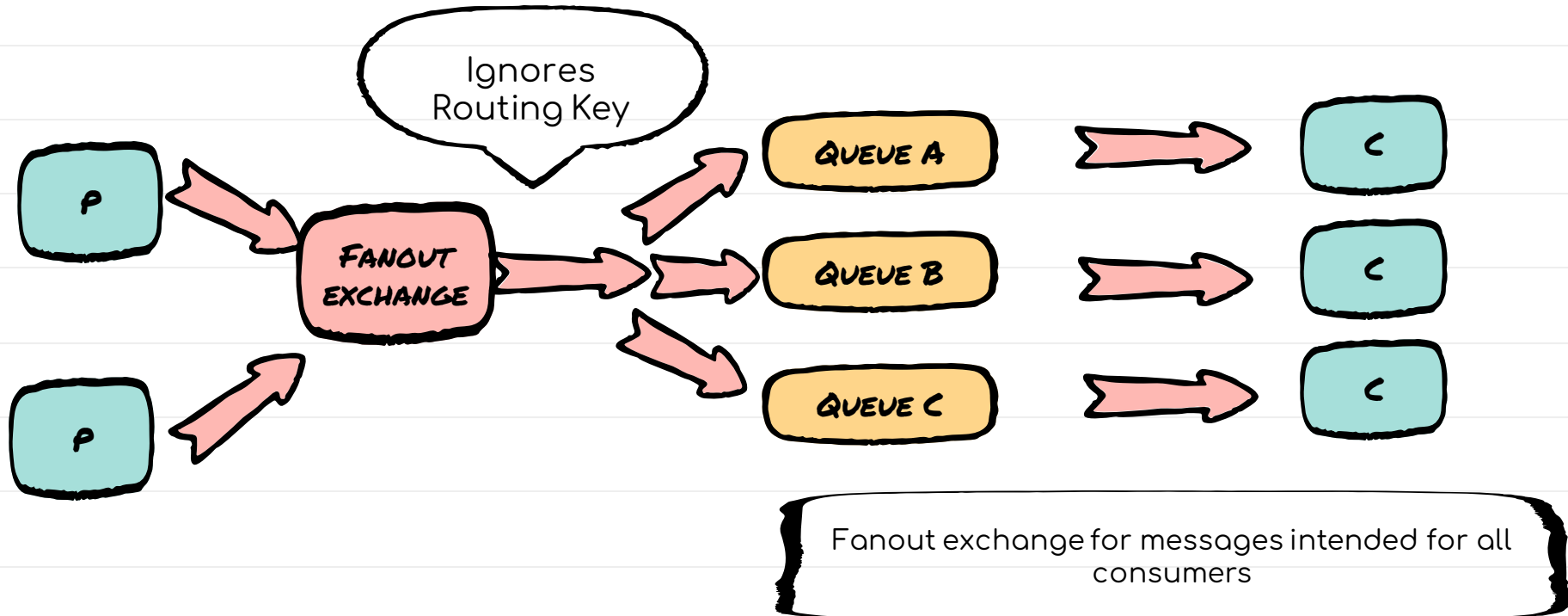
- Header
 - Similar to Topic only uses message headers instead of explicit Routing Key

DIRECT EXCHANGE

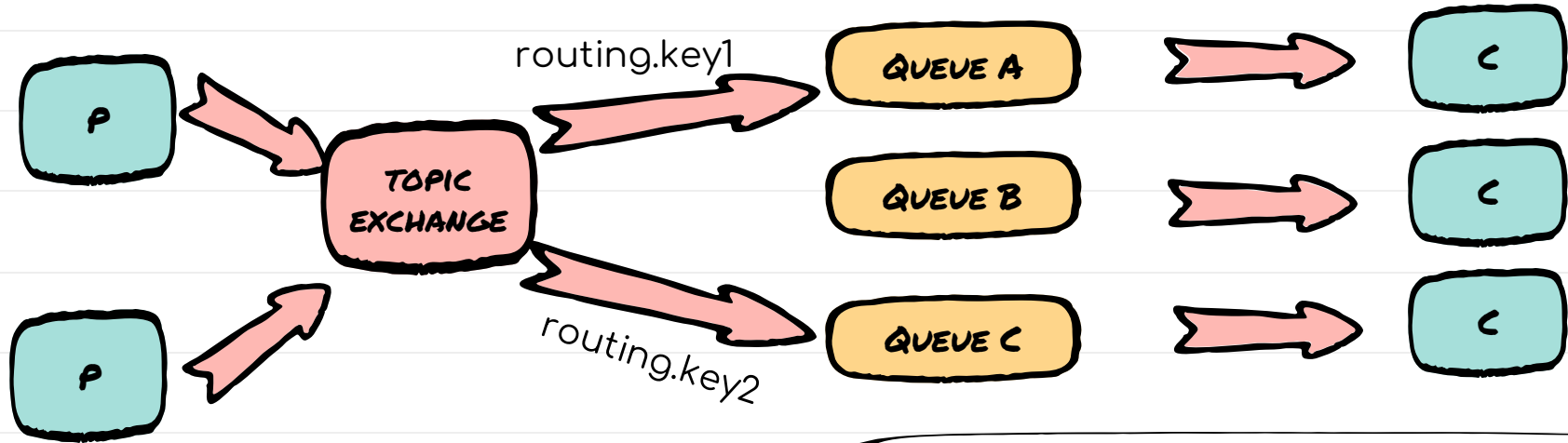


A Direct exchange will be used to route messages intended for a specific customer directly to that customer.

FANOUT EXCHANGE



TOPIC EXCHANGE



A Topic exchange will be used to route messages that might apply to some consumers but not others.

RABBITMQ

- RabbitMQ is an open-source messaging server that makes use of the AMQP.
- Rabbit is compatible with many programming languages and allows you to handle message traffic simply and reliably.

SPRING AMQP

- AMQP entities
 - Are created entities with the Message, Queue, Binding, and Exchange classes.
- Connection Management
 - CachingConnectionFactory is used to connect to RabbitMQ broker.
- Message Publishing
 - RabbitTemplate is to send messages.
- Message Consumption
 - @RabbitListener is used to read messages from a queue.

DEPENDENCIES

```
<dependency>  
  <groupId>org.springframework.boot</groupId>  
  <artifactId>spring-boot-starter-amqp</artifactId>  
</dependency>
```

KAFKA

- Apache Kafka is an open-source distributed event streaming platform.
- It is an open-source software platform developed by the Apache Software Foundation written in Scala and Java.
- Kafka uses a binary TCP-based protocol that is optimized for efficiency and relies on a "message set" abstraction that naturally groups messages together to reduce the overhead of the network roundtrip.

EVENT STREAMING

- Event streaming is the practice of capturing data in real-time from event sources like
 - Databases
 - Sensors
 - Mobile devices
 - Cloud services
 - Software applicationsin the form of streams of events;

EVENT STREAMING

- storing these event streams durably for
 - Later retrieval
 - Manipulating
 - Processing
 - Reacting

to the event streams in real-time as well as retrospectively; and

- routing the event streams to different destination technologies as needed.

EVENT STREAMING

- Event streaming thus ensures a continuous flow and interpretation of data so that the right information is at the right place, at the right time.

EVENT STREAMING USE CASES

- To process payments and financial transactions in real-time.
 - Stock exchanges, banks, and insurances.
- To track and monitor cars, trucks, fleets, and shipments in real-time.
 - Logistics and the automotive industry.
- To continuously capture and analyze sensor data from IoT devices or other equipment.
 - factories and wind parks.

EVENT STREAMING USE CASES

- To collect and immediately react to customer interactions and orders.
 - Retail, the hotel and travel industry, and mobile applications.
- To monitor patients in hospital care and predict changes in condition to ensure timely treatment in emergencies.
- To connect, store, and make available data produced by different divisions of a company.
- To serve as the foundation for data platforms, event-driven architectures, and microservices.

EVENT STREAMING PLATFORM

- Kafka combines three key capabilities
 - To publish (write) and subscribe to (read) streams of events, including continuous import/export of data from other systems.
 - To store streams of events durably and reliably for as long as wanted.
 - To process streams of events as they occur or retrospectively.

EVENT STREAMING PLATFORM

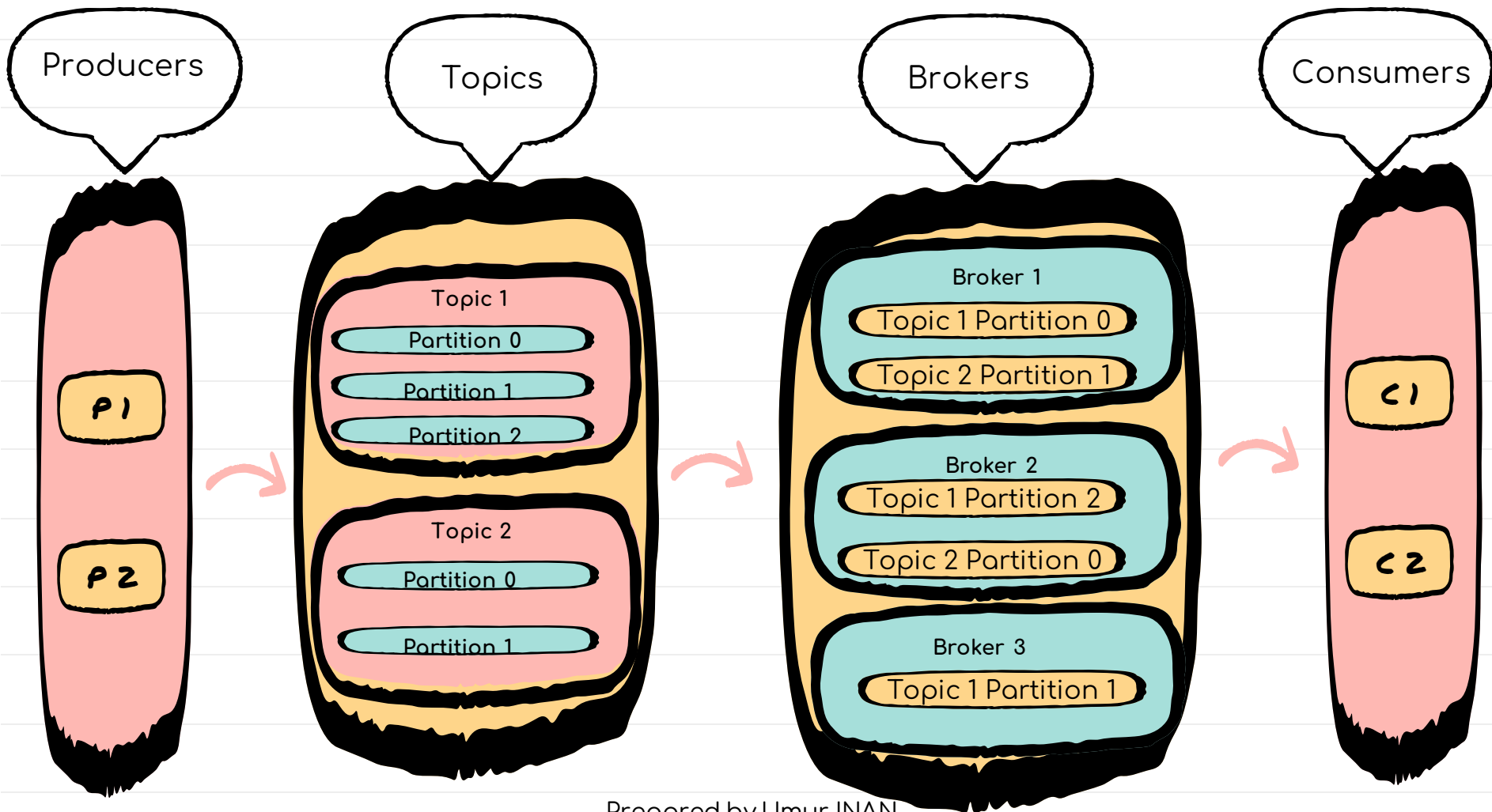
- All this functionality is provided in a
 - Distributed
 - Highly scalable
 - Elastic
 - Fault-tolerant
 - Secure manner

KAFKA ADVANTAGES

- Low Latency
- High Throughput
- Fault tolerance
- Durability
- Easily accessible
- Real-Time handling
- Scalability

KAFKA DISADVANTAGES

- Message tweaking issues.
- Clumsy Behavior.
- Do not have complete set of monitoring tools.
- Lack some message paradigms.



TERMINOLOGY

- Topic
 - A stream of messages belonging to a particular category is called a topic.
 - Data is stored in topics.
 - Topics are split into partitions.
 - For each topic at least 1 partition.

TERMINOLOGY

- Partition
 - Partition contains messages in an immutable ordered sequence.
 - Topics may have many partitions.
 - it can handle an arbitrary amount of data.
- Partition Offset
 - Each partitioned message has a unique sequence id called as offset.

TERMINOLOGY

- Brokers
 - Brokers are simple system responsible for maintaining the published data.
 - Each broker may have zero or more partitions per topic.
- Kafka Cluster
 - Kafka's having more than one broker are called as Kafka cluster.
 - clusters are used to manage the persistence and replication of message data.

TERMINOLOGY

- Producers
 - Producers are the publisher of messages to one or more Kafka topics.
 - Producers send data to Kafka brokers.
 - Producer can also send messages to a partition of their choice.

TERMINOLOGY

- Consumers
 - Consumers read data from brokers.
 - Consumers subscribes to one or more topics and consume published messages by pulling data from the brokers.
 - A consumer also knows that from which broker, it should read the data.
 - The consumer reads the data within each partition in an orderly manner.

CONSUMERS

Reading data in order

Broker 1

Topic 1
Partition 0

CONSUMER 1

Broker 2

Topic 1
Partition 1

Reading data simultaneously
in order

Broker 3

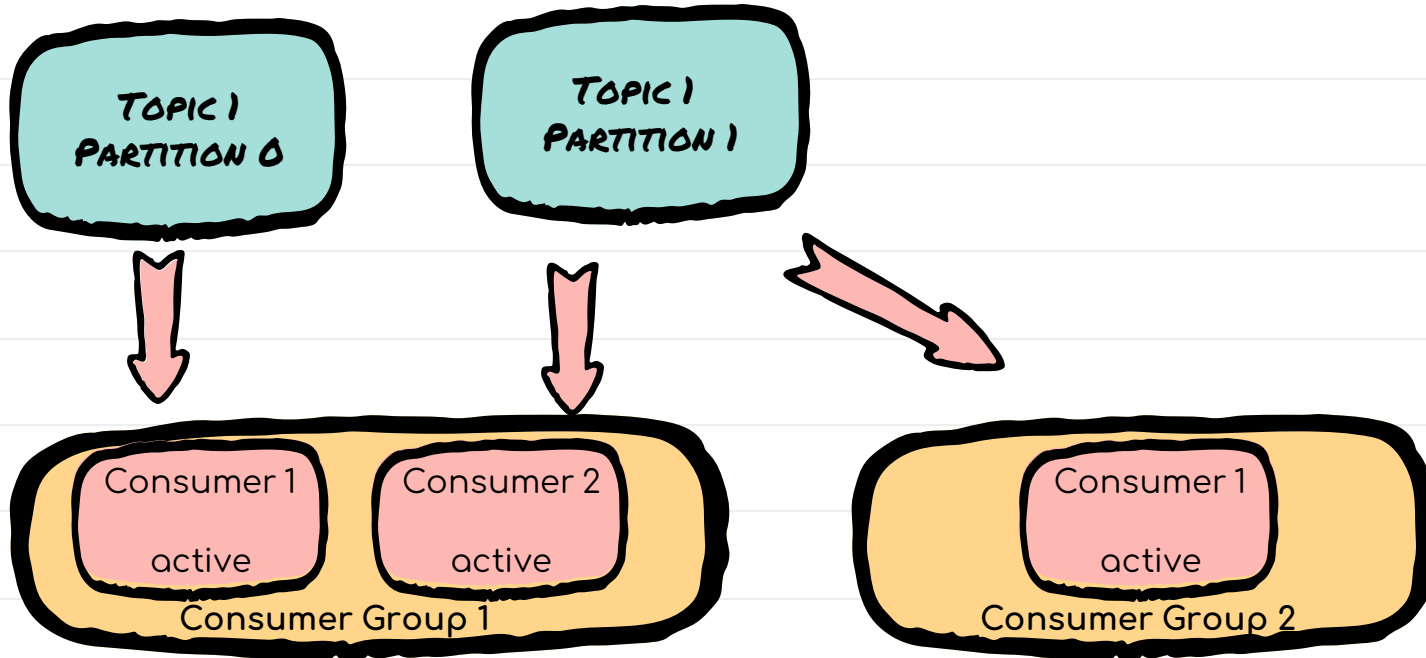
Topic 1
Partition 2

CONSUMER 2

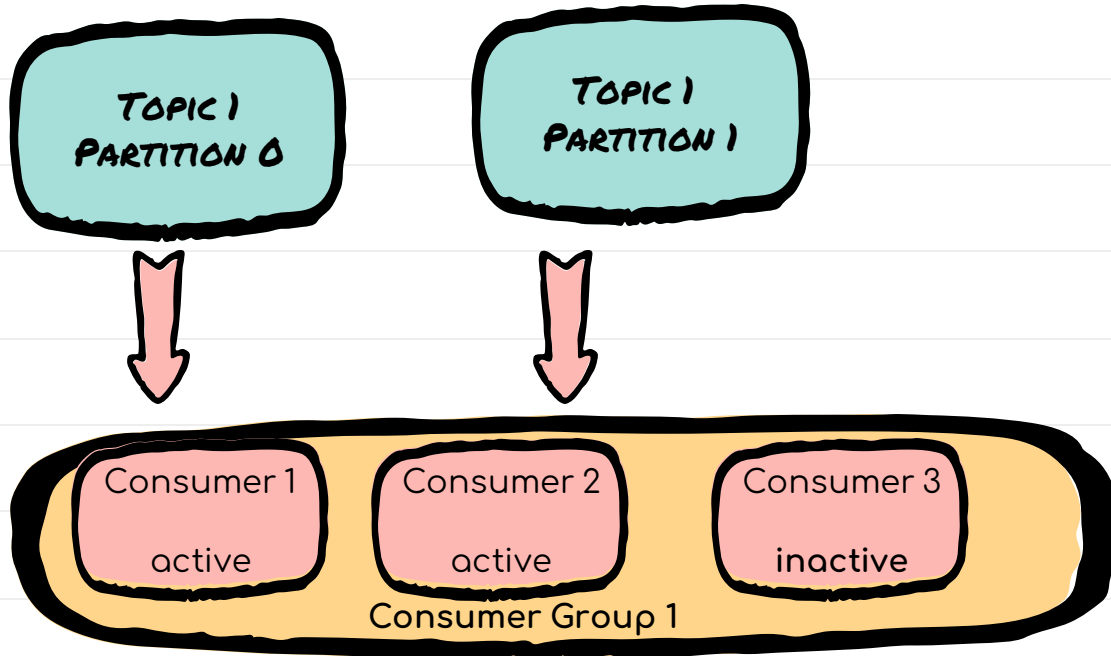
TERMINOLOGY

- Consumer Groups
 - A consumer group is a group of multiple consumers which subscribes to an application.
 - Each consumer present in a group reads data directly from the exclusive partitions.
 - In case, the number of consumers are more than the number of partitions, some of the consumers will be in an inactive state.

CONSUMERS



CONSUMERS

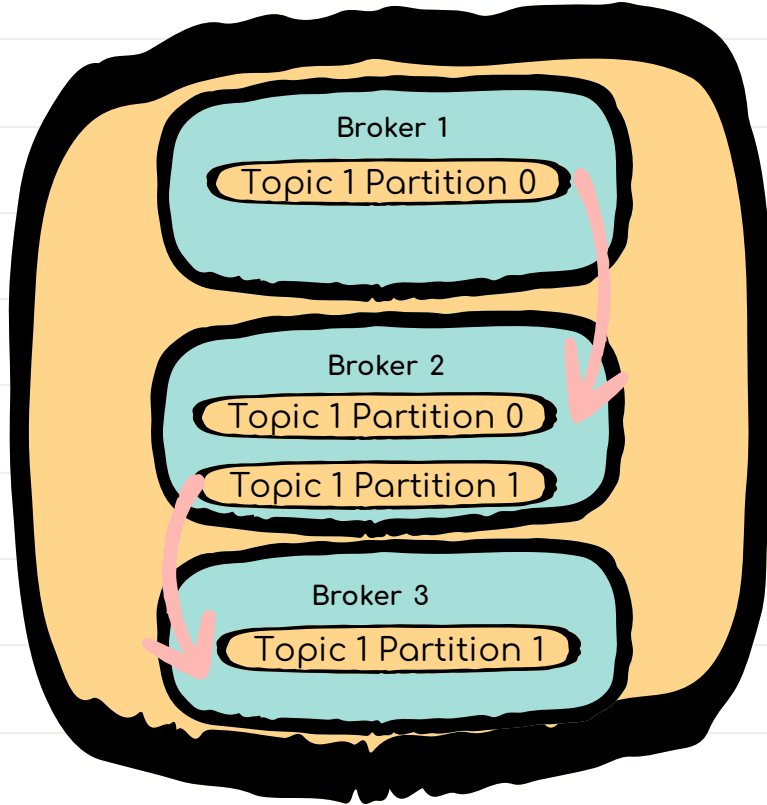


TERMINOLOGY

- Leader
 - Leader is the node responsible for all reads and writes for the given partition.
 - Every partition has one server acting as a leader.
- Follower
 - Node which follows leader instructions are called as follower.
 - If the leader fails, one of the follower will automatically become the new leader.
 - A follower acts as normal consumer, pulls messages and updates its own data store.

REPLICATION FACTOR

- A replication factor is the number of copies of data over multiple brokers.
- A replication factor is created for the topics contained in any particular broker.
- The replication factor value should be greater than 1 always (between 2 or 3).
- It supports data replication at the partition level.



Topic with 2 partitions and replication factor 2

REPLICATION

- At any time only 1 broker can be a leader for a given partition.
- Only that leader can receive and serve data for a partition.
- The other brokers will synchronize the data.
- Each partition has 1 leader and multiple ISR (in-sync replica)

SPRING BOOT KAFKA

```
<dependency>  
    <groupId>org.springframework.kafka</groupId>  
    <artifactId>spring-kafka</artifactId>  
</dependency>
```

MAIN POINTS

- AMQP integrates heterogeneous systems through the introduction of a basic wire protocol.
- Acting from the level of Transcendental Consciousness, thoughts and actions are more integrated and harmonious.
- Messaging oriented services guarantee a reliable communication and simplify the complexity of the applications.
- Pure Consciousness is simple, reliable, efficient and precise.