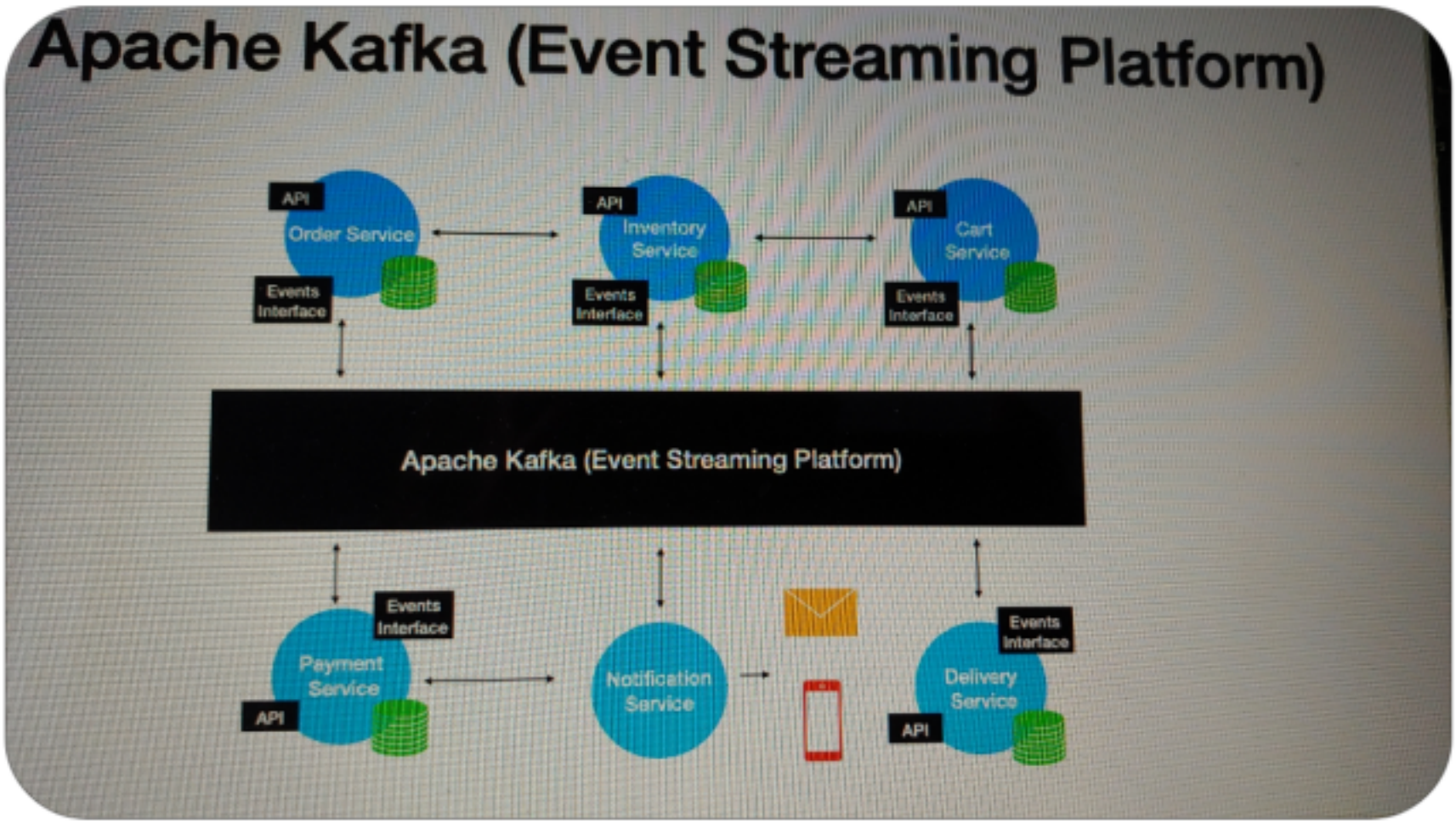
Kafka

It is a distributed messaging or streaming system.



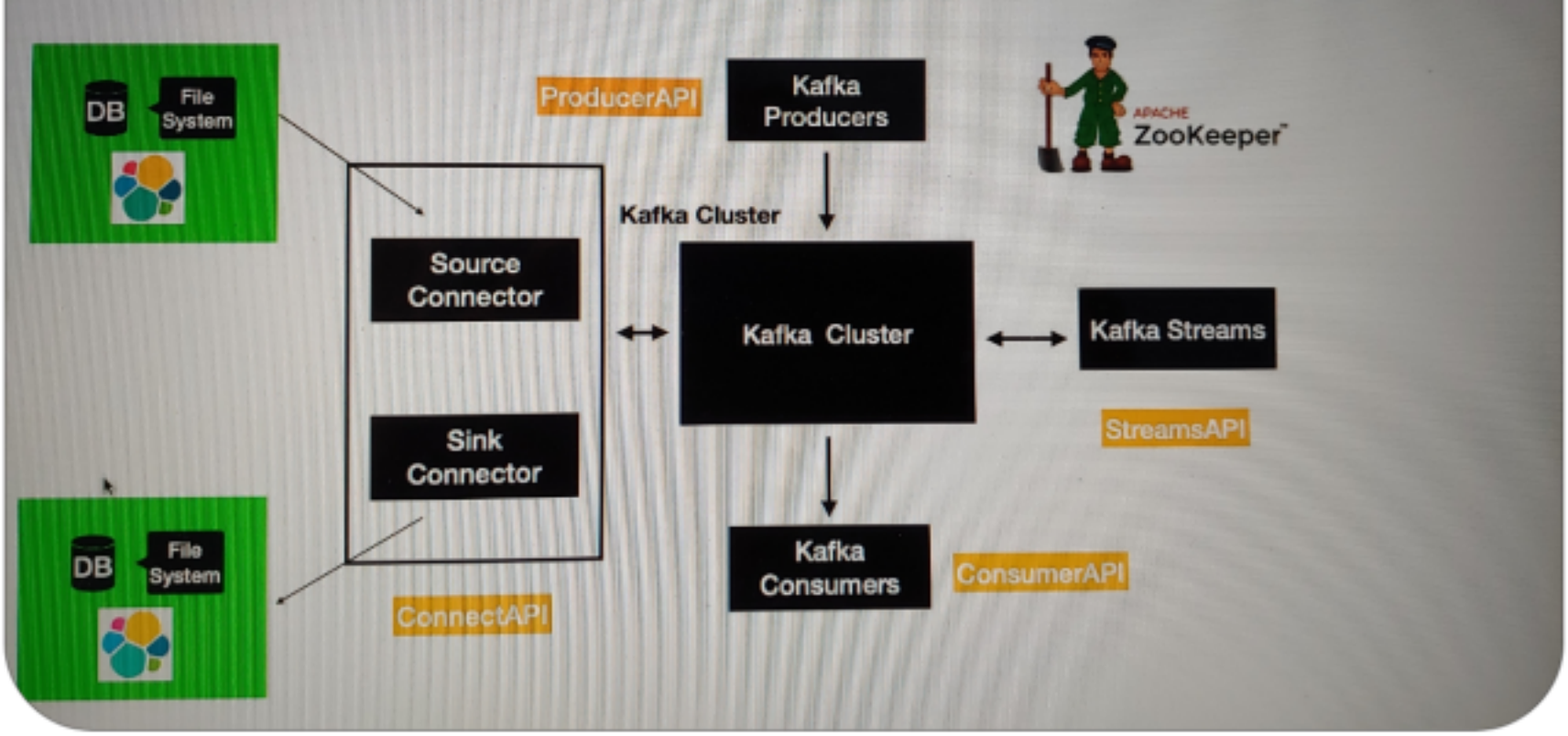
Traditional Messaging System

- Transient Message Persistance
- Brokers responsibility to keep track of consumed messages
- Target a specific Consumer
- Not a distributed system

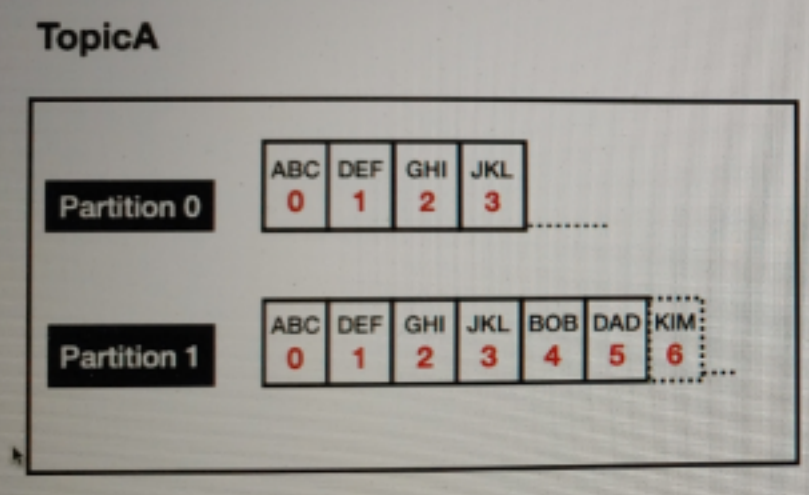
Kafka Streaming Platform

- Stores events based on a retention time. Events are Immutable
- Consumers Responsibility to keep track of consumed messages
- Any Consumer can access a message from the broker
- It's a distributed streaming system

Kafka Terminology & Client APIs



Topic and Partitions

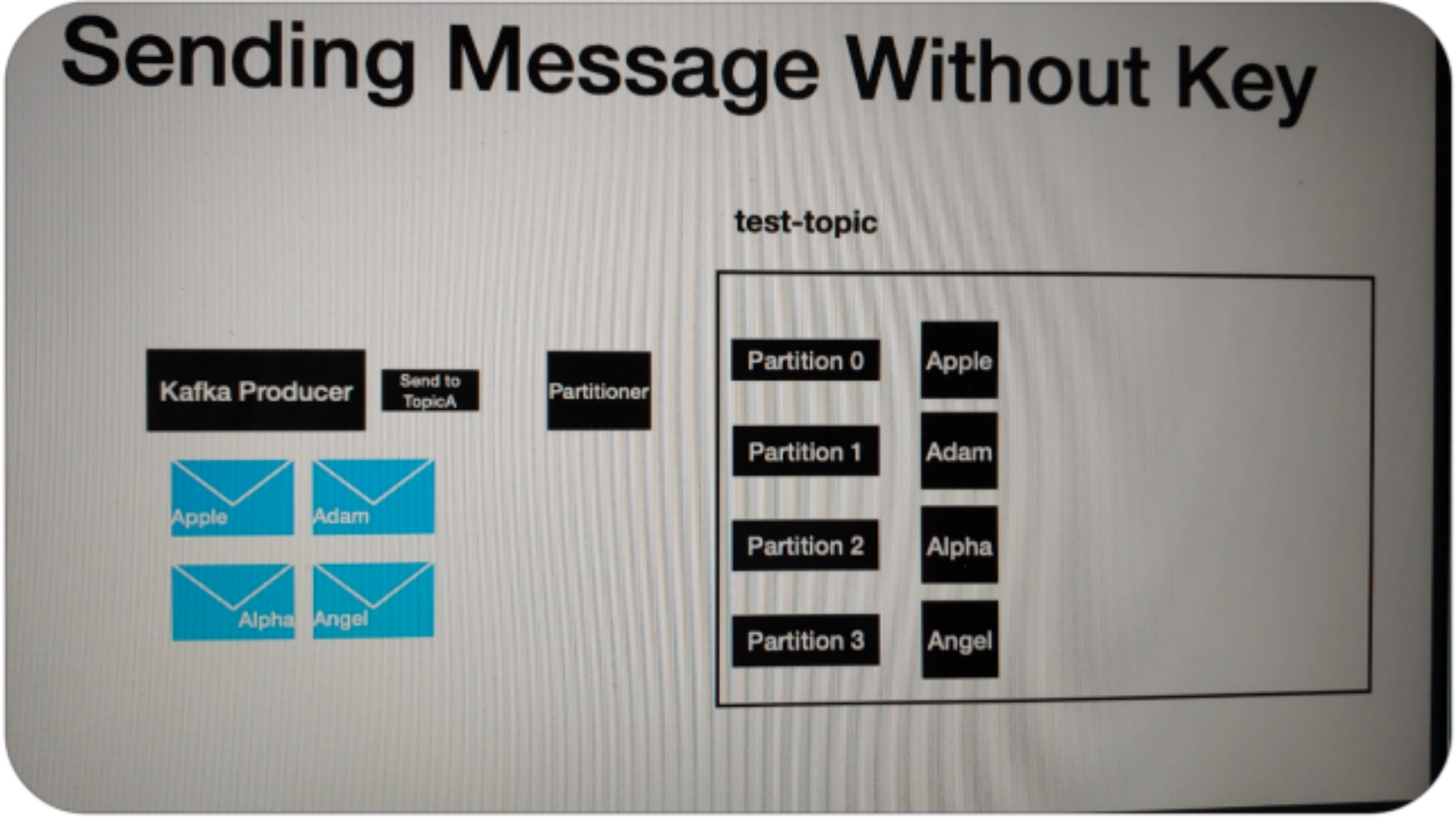


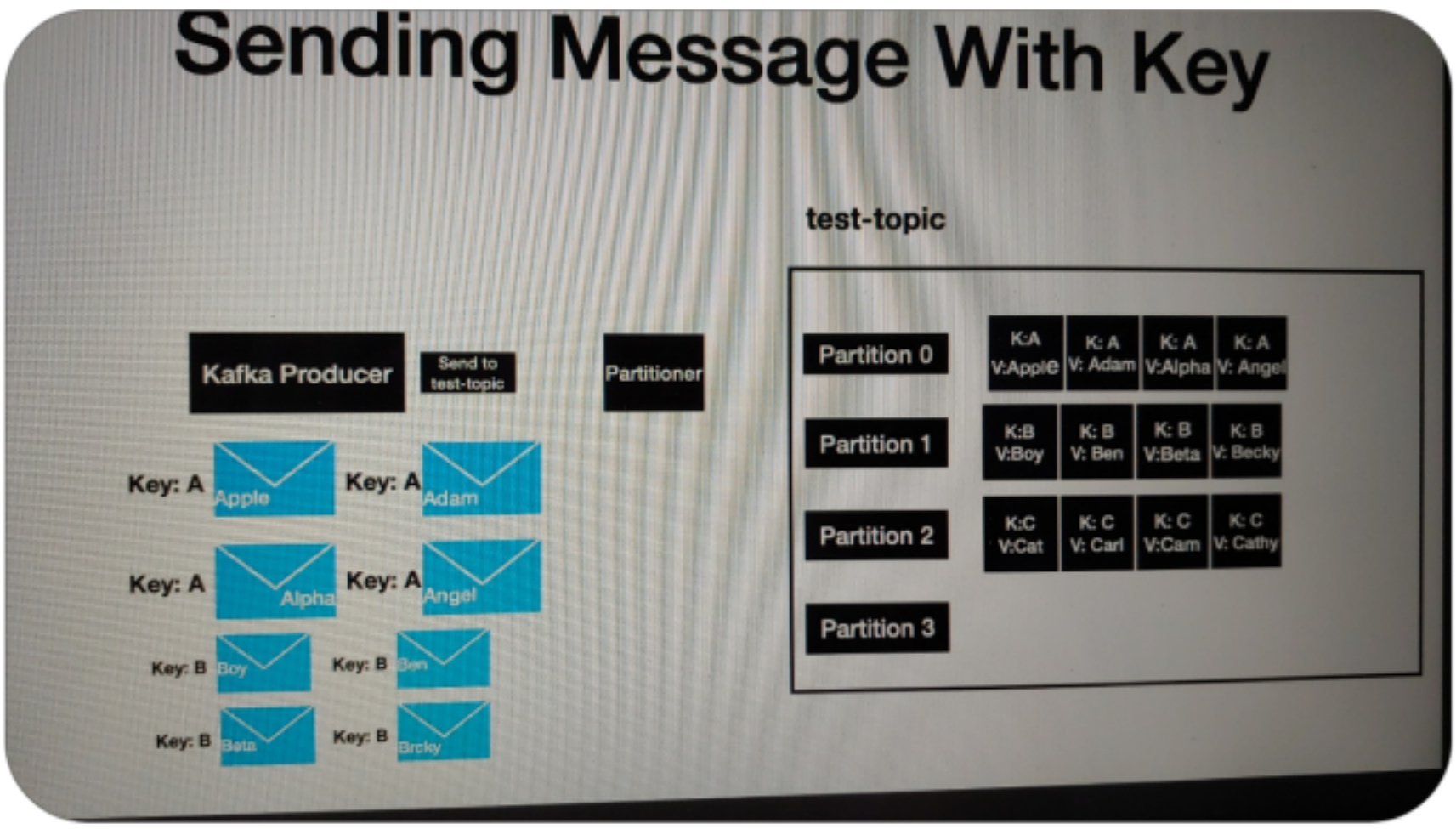
- Each Partition is an ordered , immutable sequence of records
- Each record is assigned a sequential number called ***offset***
- Each partition is independent of each other
- Ordering is guaranteed only at the partition level
- Partition continuously grows as new records are produced
- All the records are persisted in a commit log in the file system where Kafka is installed

- We can create topic and partition through script provided by kafka cli

Kafka Message

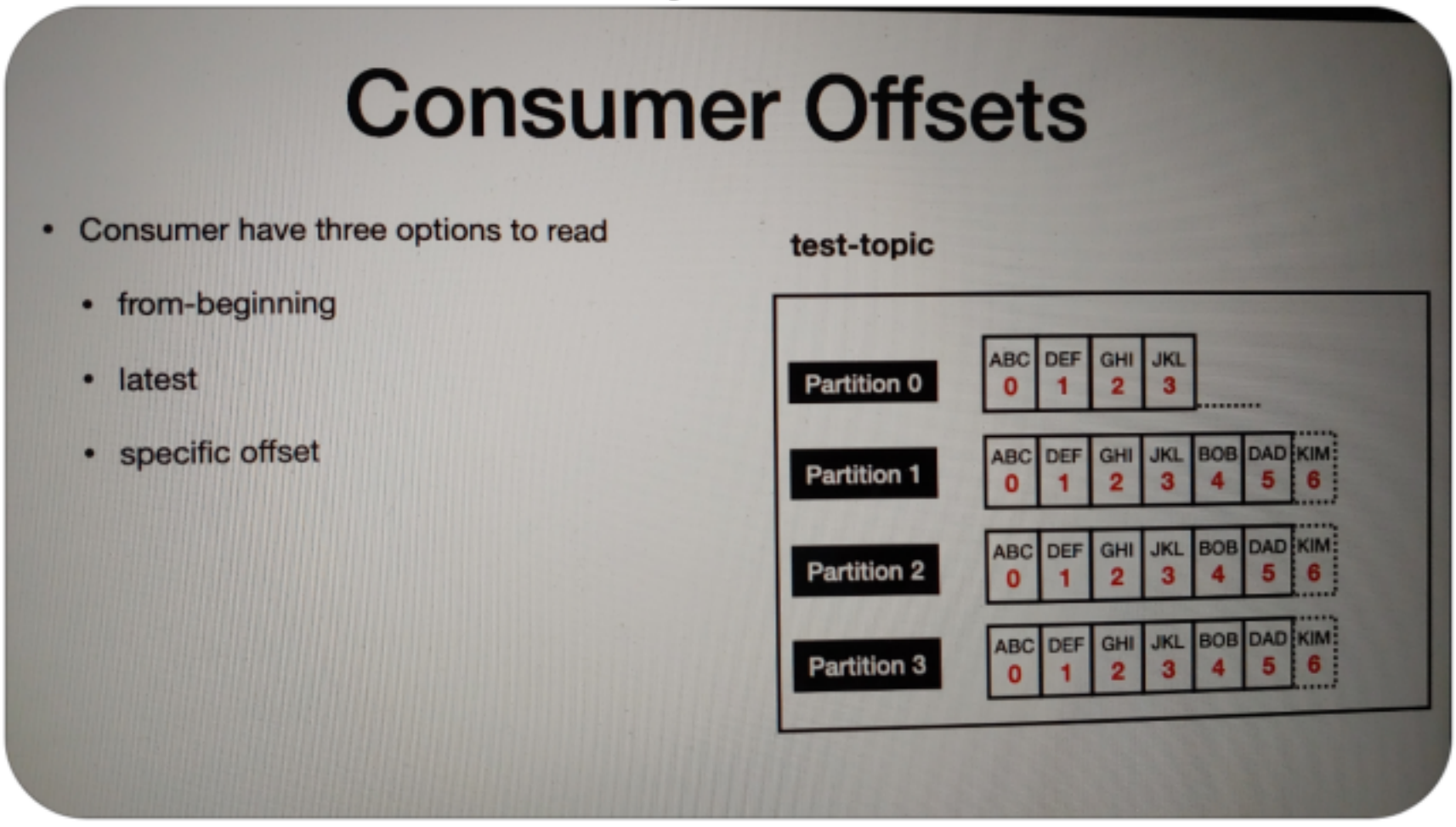
- Kafka Message these sent from producer has two properties
  - Key (optional)
  - Value





In order to maintain the order of the message which is sent to kafka topic use a specific key along with value. This will make sure the message will always

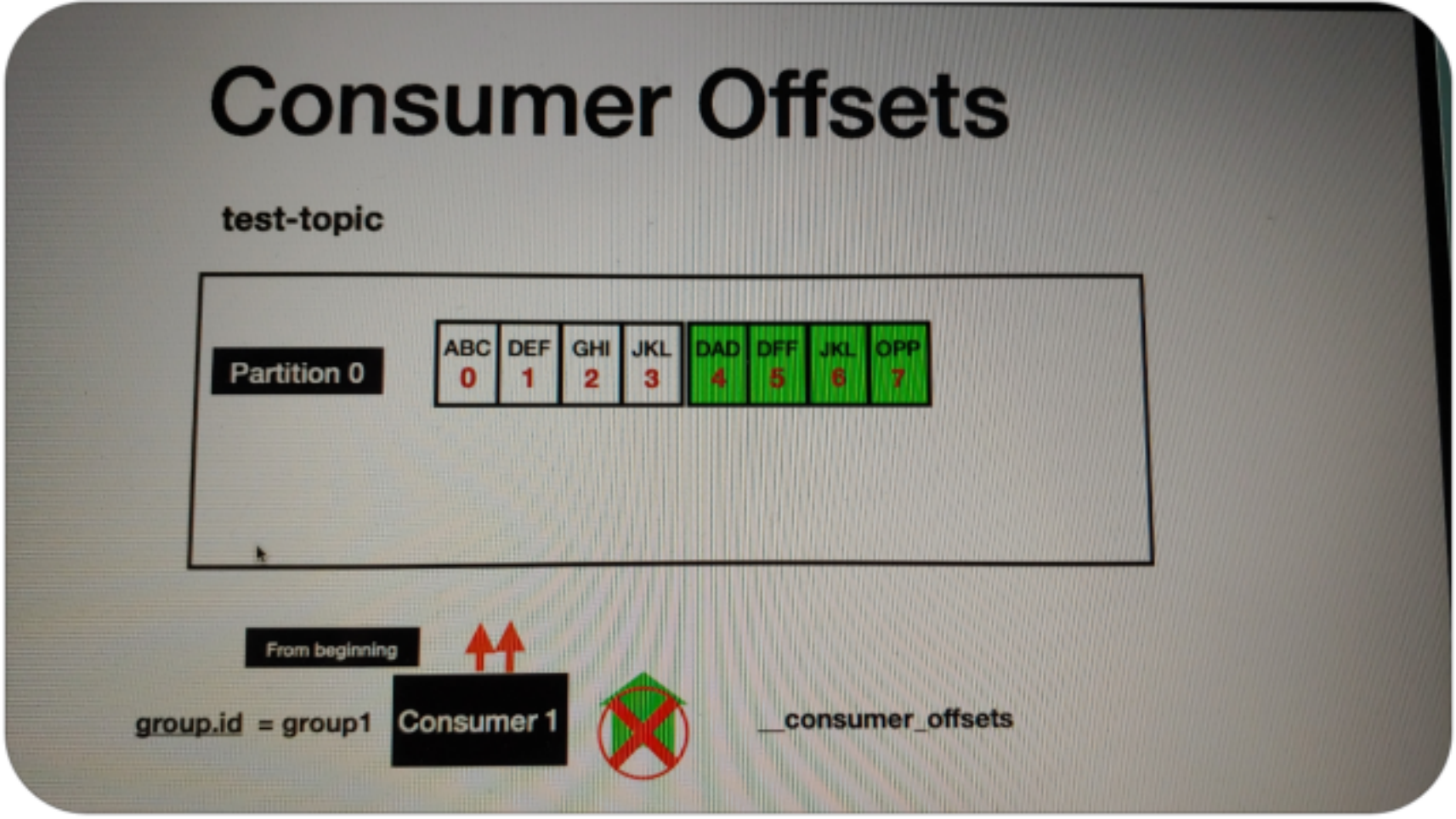
sent to the same partition with the same key



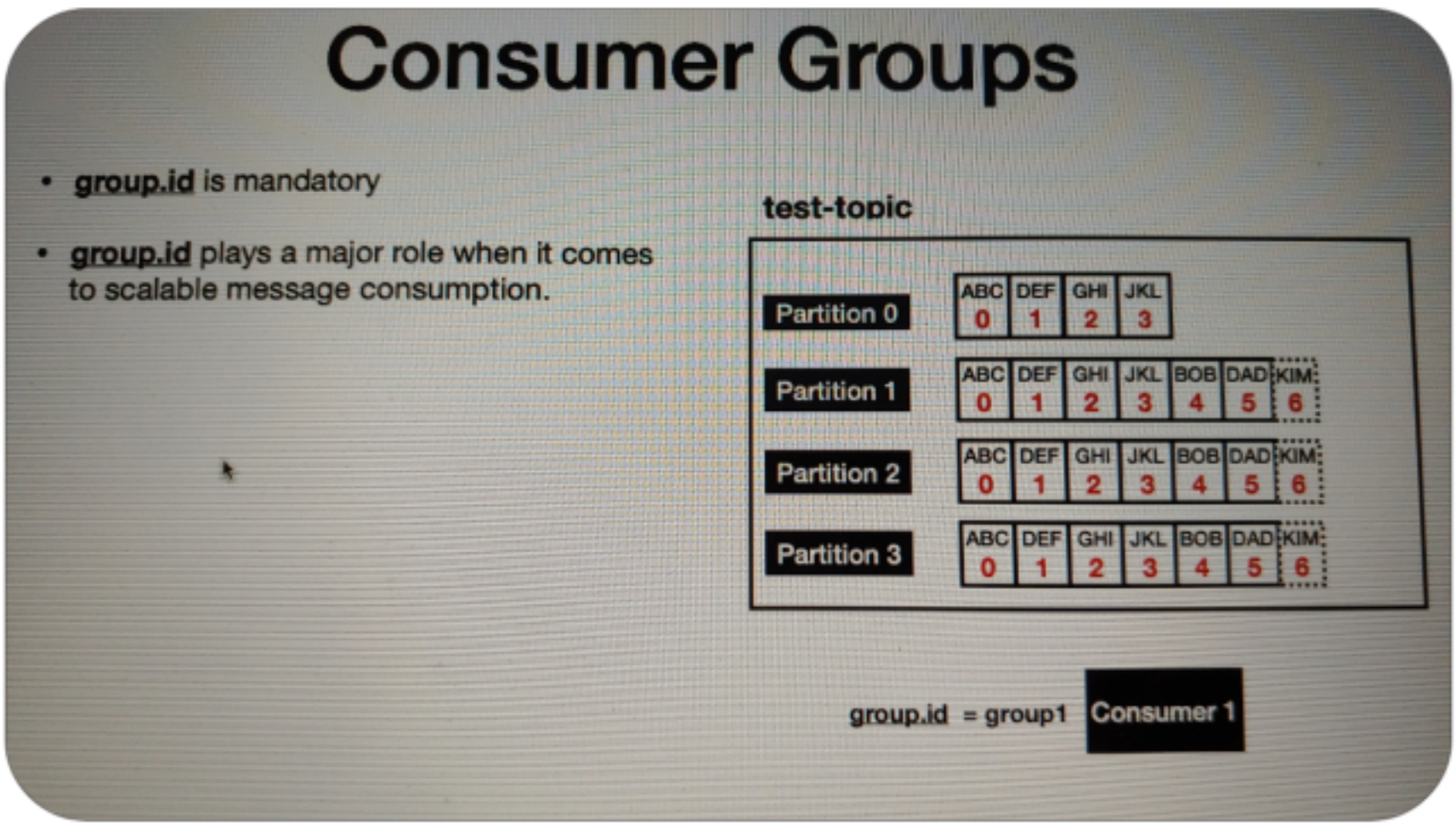
≡ ○ Any message produced to topic has unique id called offset.

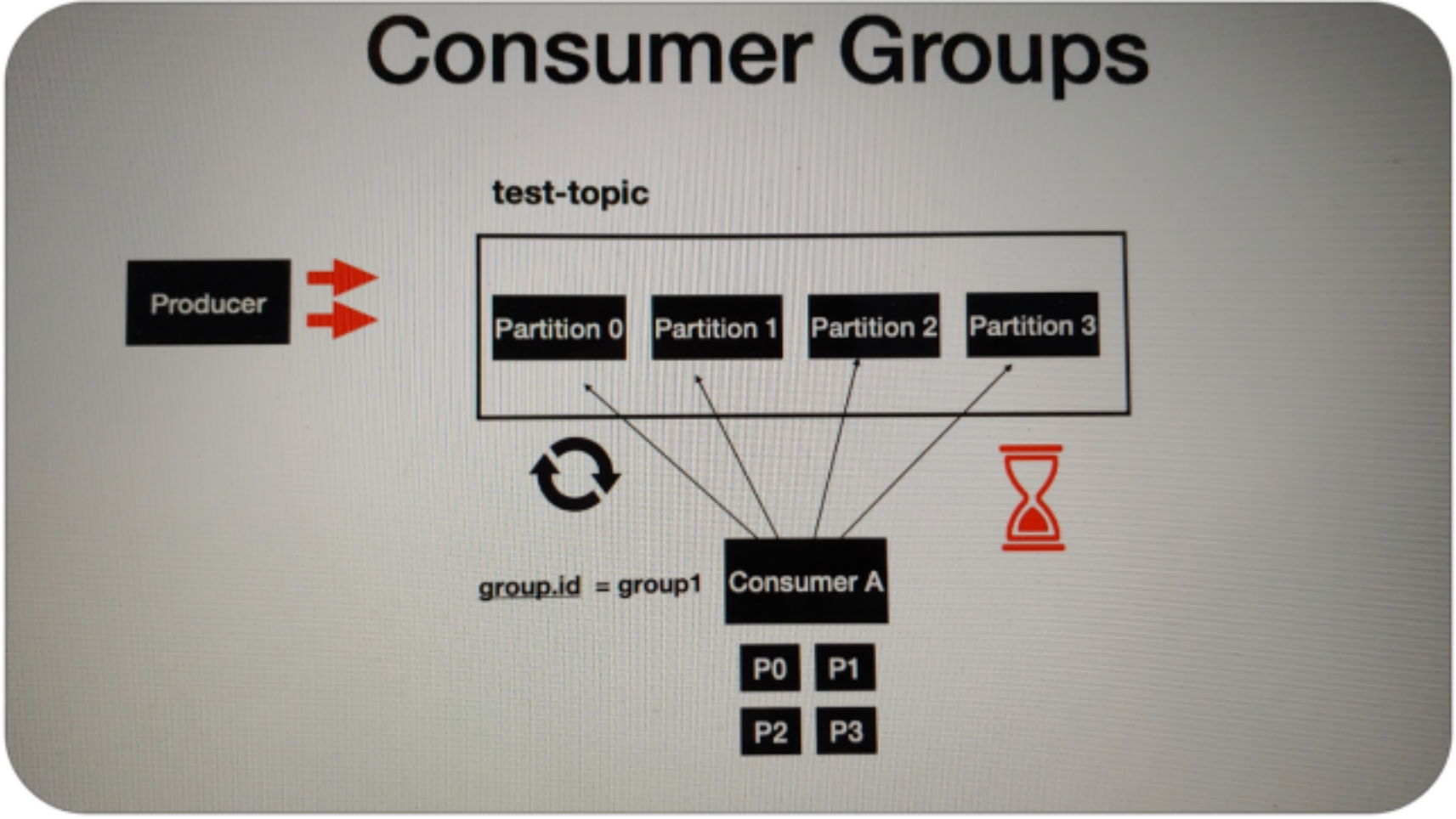
≡ ○ Consumer will use this offset information while reading any message

≡ ○ Consumer offset behaves like a bookmark for the consumer to start reading the message from the point it left off

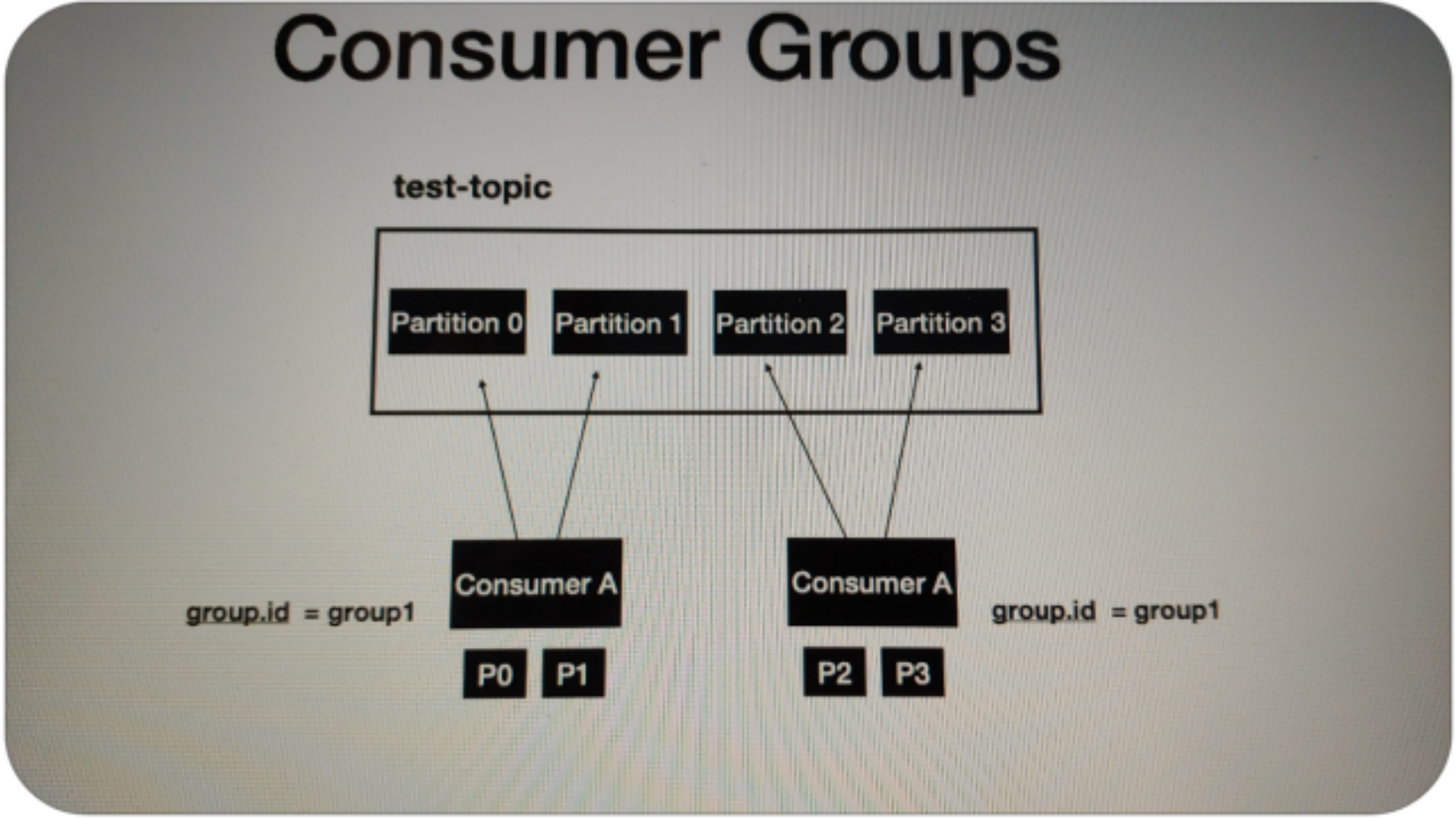


- For each consumer, the offset information will be stored in an internal kafka topic called __consumer_offsets



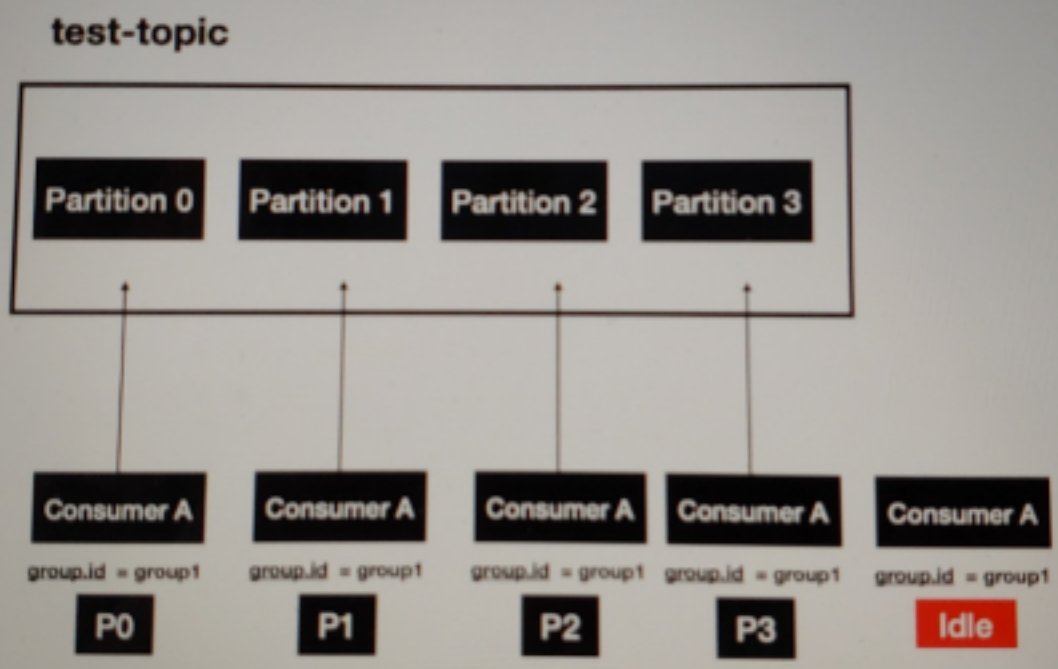


- If producer is producing records at higher rate and we have only one consumer per consumer group which is consuming records from all existing 4 partitions, then there will be lag at the consumer end in processing these records as each consumer ll be running in a single thread

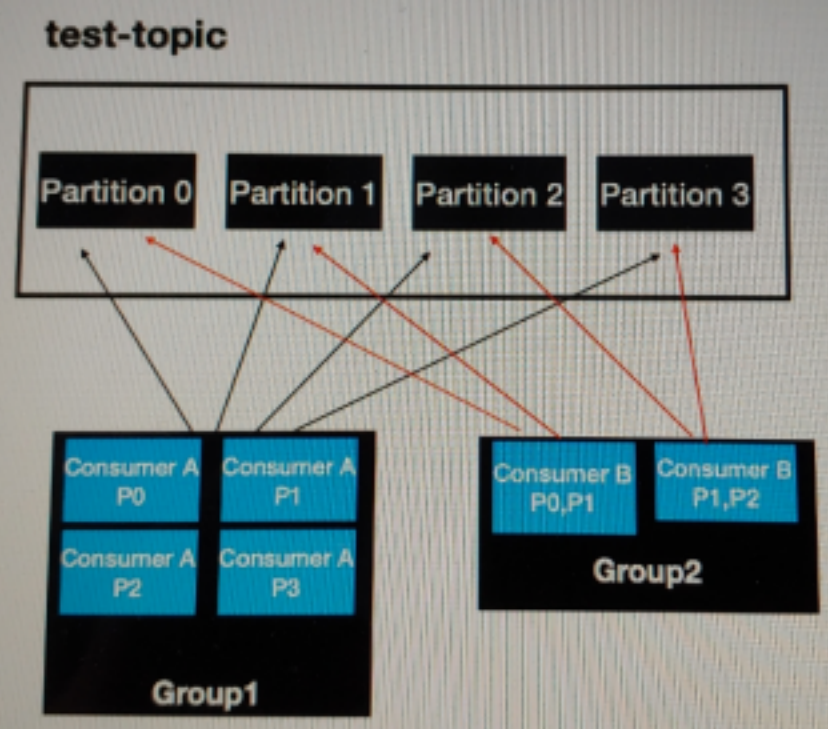


- Now if we increase number of consumer to 2 per same consumer group, each consumer will be consume and process the records from 2 partitions each which will increase the processing rate as both consumer will be executing parallely

Consumer Groups



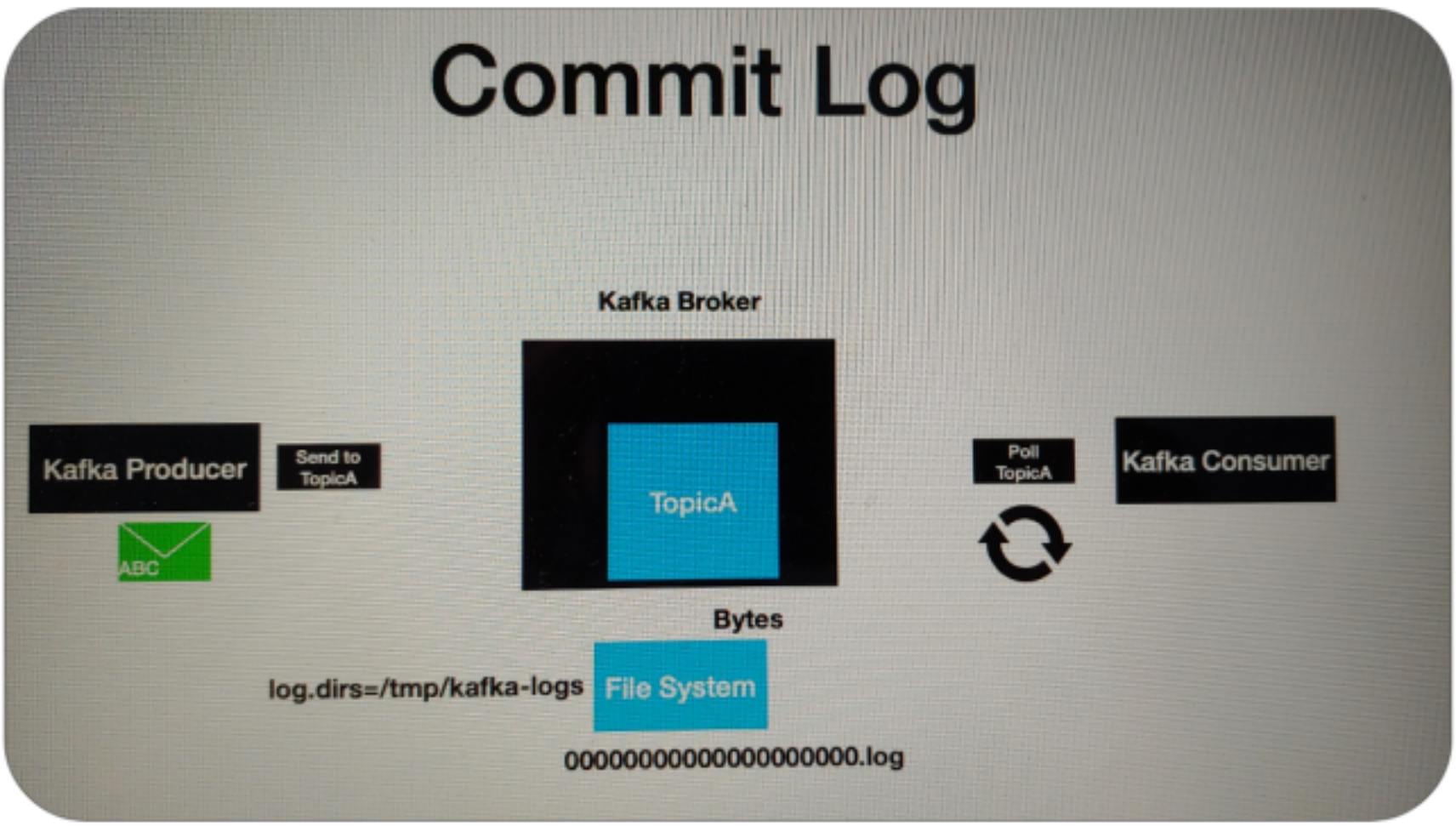
Consumer Groups



Consumer Groups : Summary

- Consumer Groups are used for scalable message consumption
- Each different application will have a unique consumer group
- Who manages the consumer group?
  - Kafka Broker manages the consumer-groups
  - Kafka Broker acts as a Group Co-ordinator

Commit Log



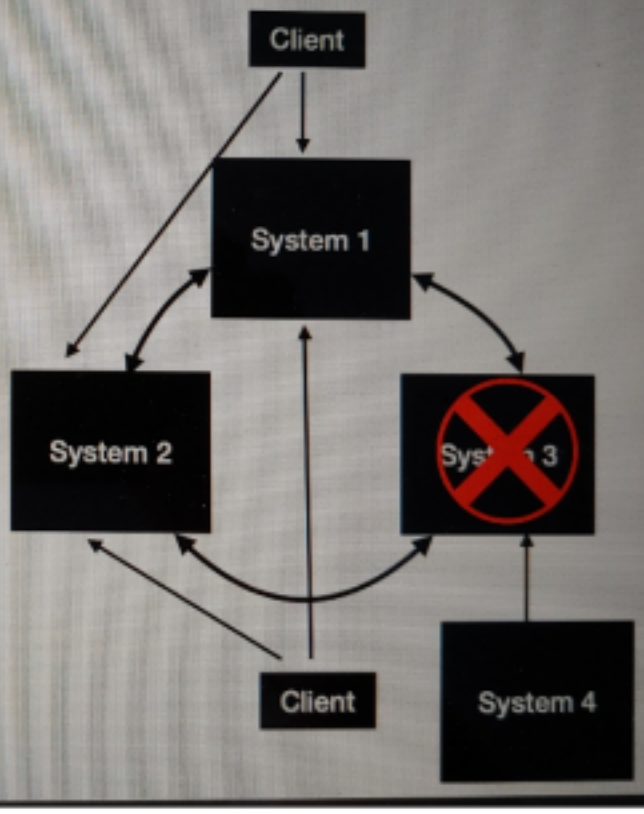
- Each partition has its own commit log in the local file system. Consumers can see these records only after those are committed into commit log.

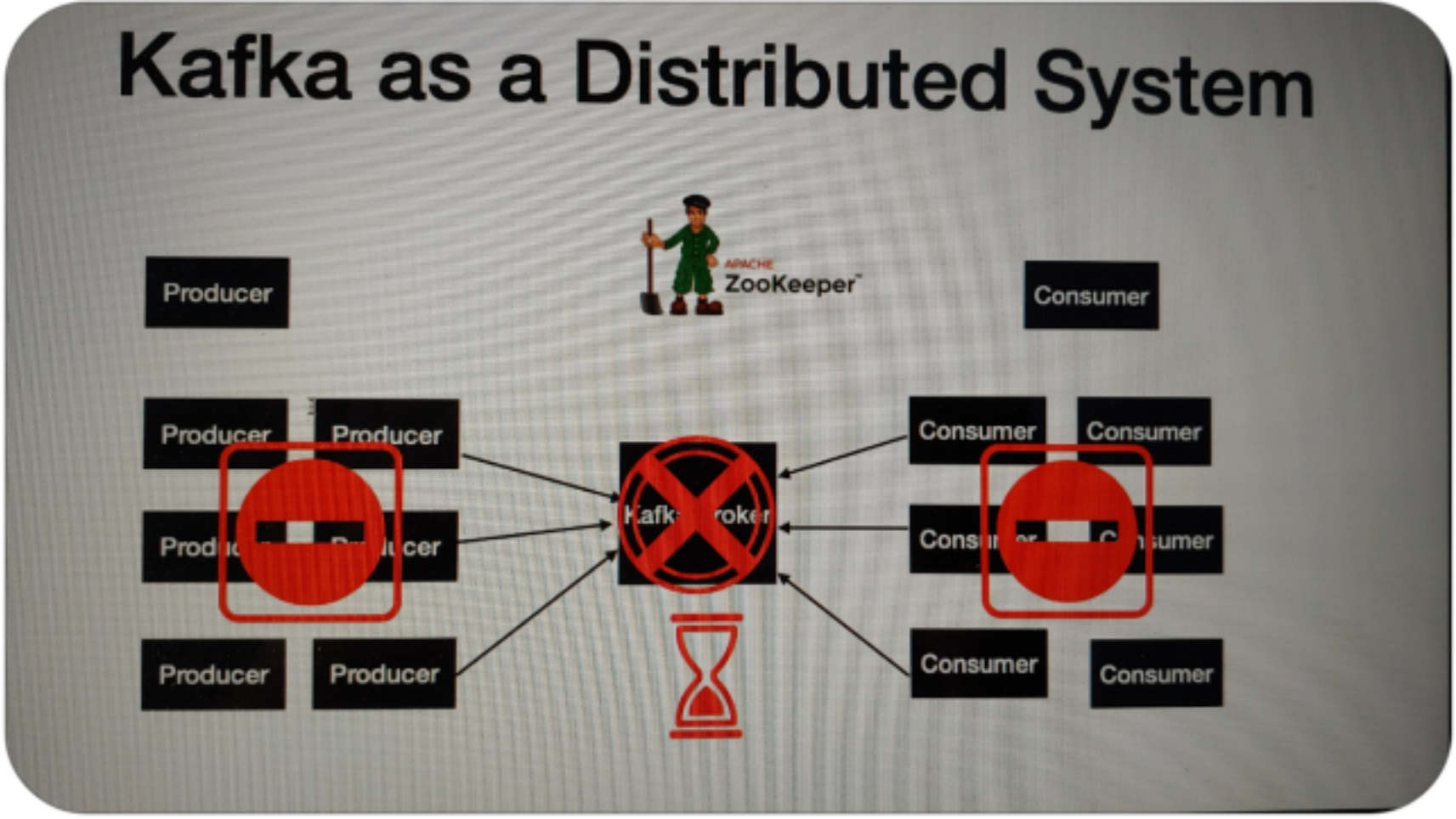
Retention Policy

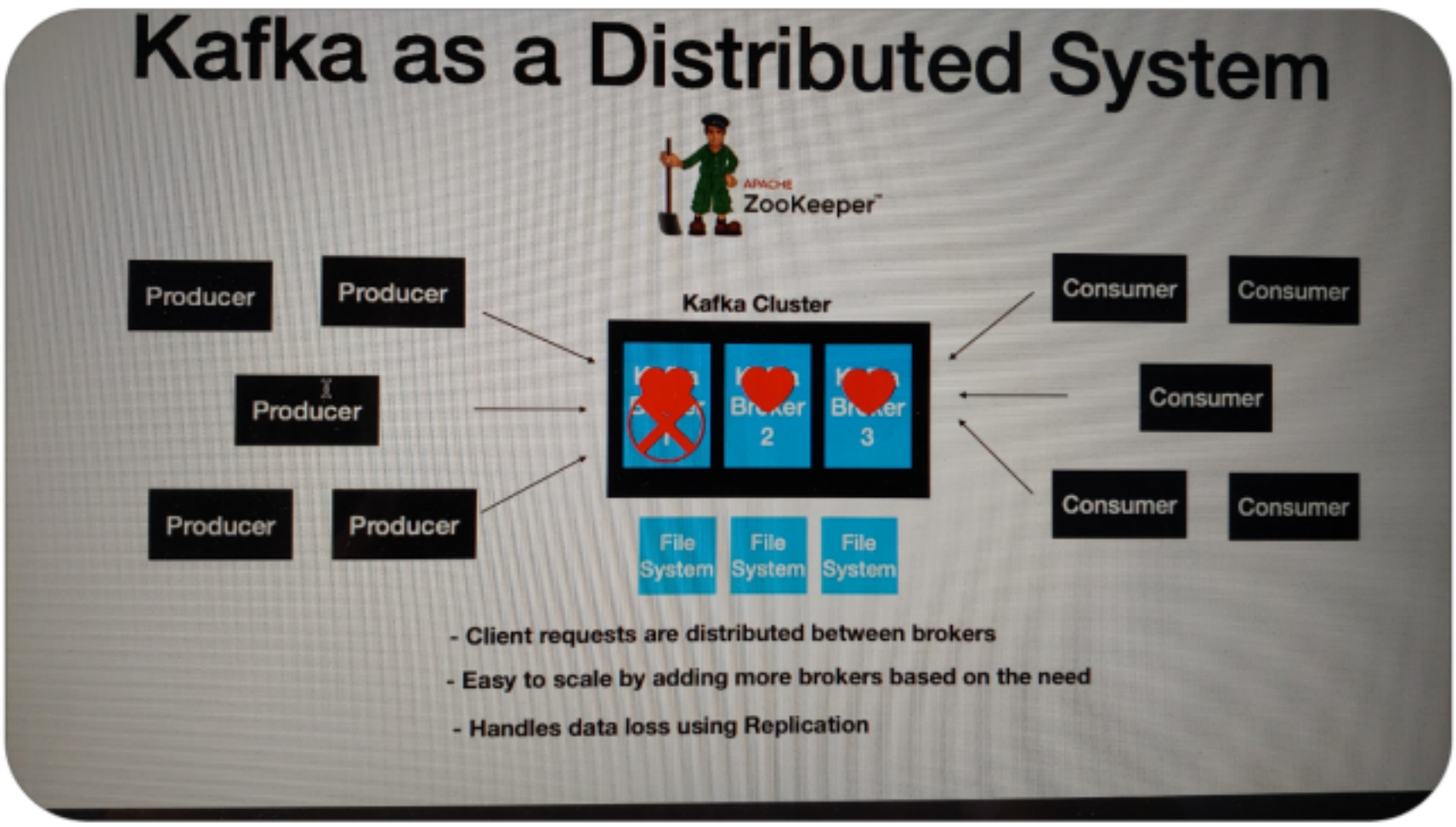
- Determines how long the message is retained ?
- Configured using the property **log.retention.hours** in **server.properties** file
- Default retention period is **168 hours** (7 days)

Characteristics of Distributed System

- Availability and Fault Tolerance
- Reliable Work Distribution
- Easily Scalable
- Handling Concurrency is fairly easy

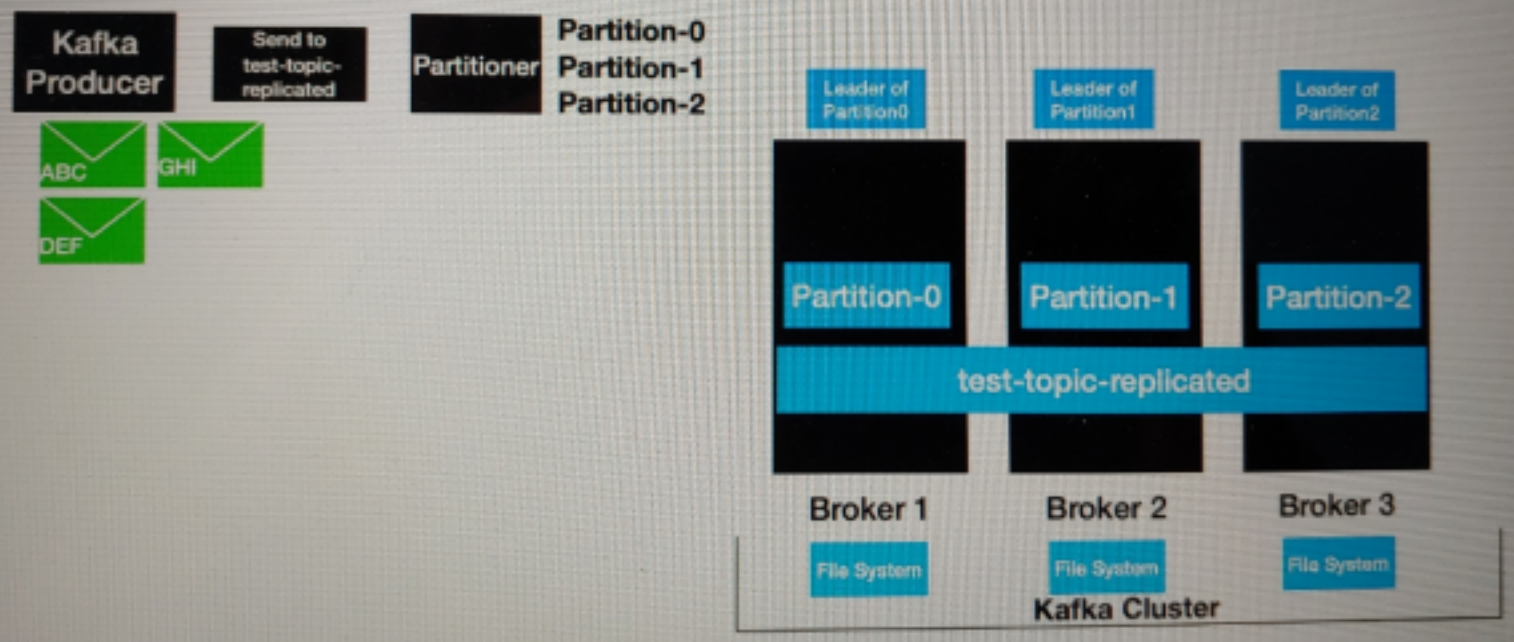




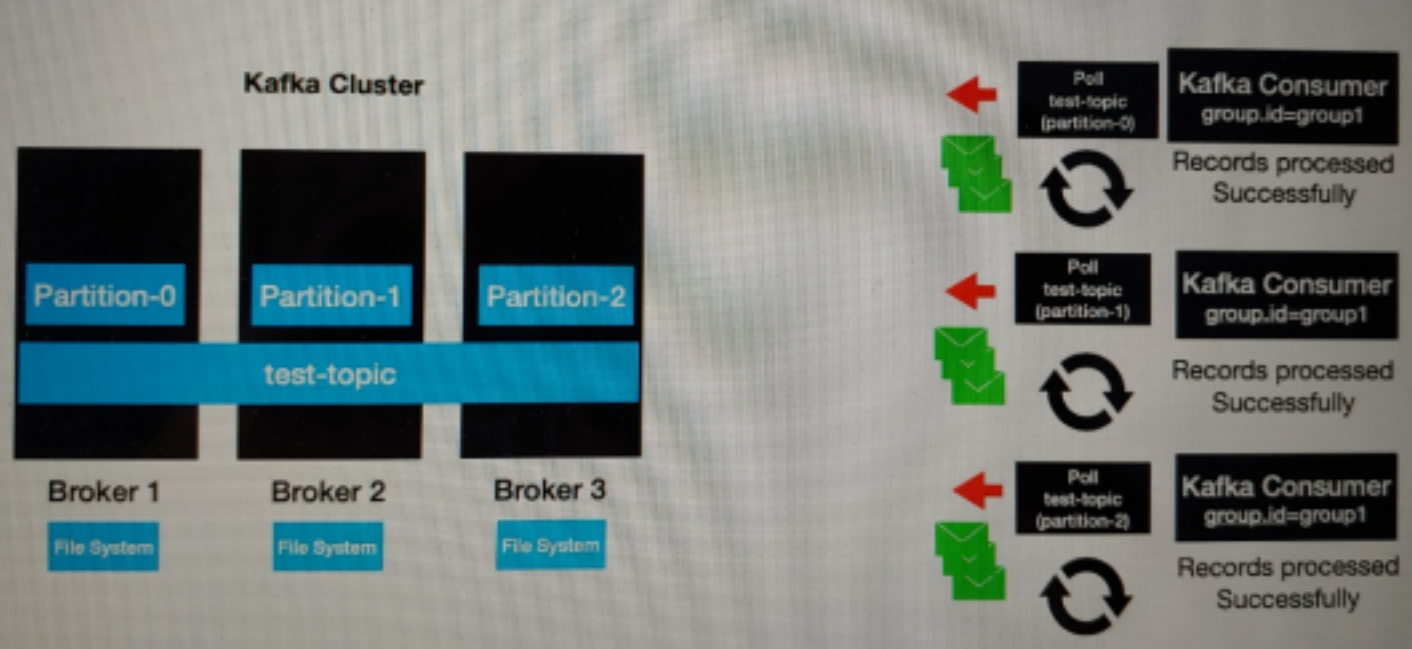


≡ ○ Distributing the available partition of a topic into available brokers of a kafka cluster is called leader assignments.

How Kafka Distributes Client Requests?
Kafka Producer



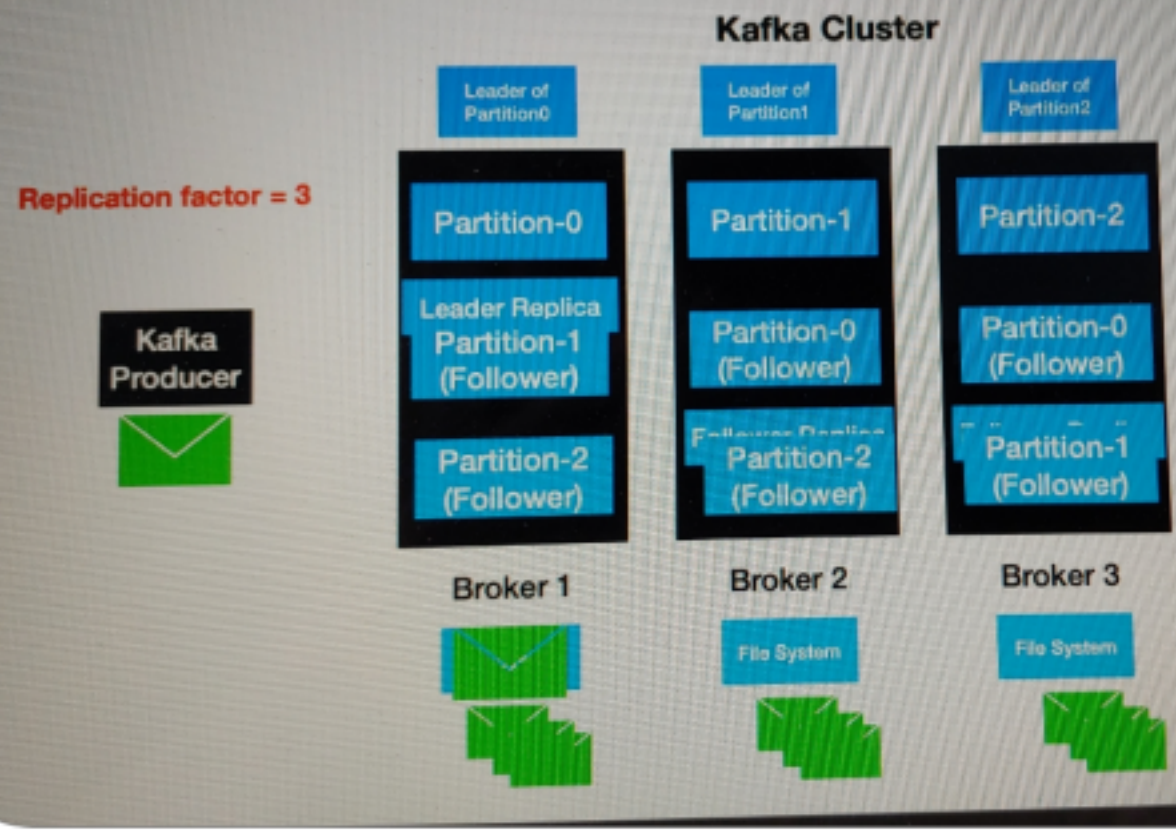
How Kafka Distributes Client Requests?
Kafka Consumer Groups

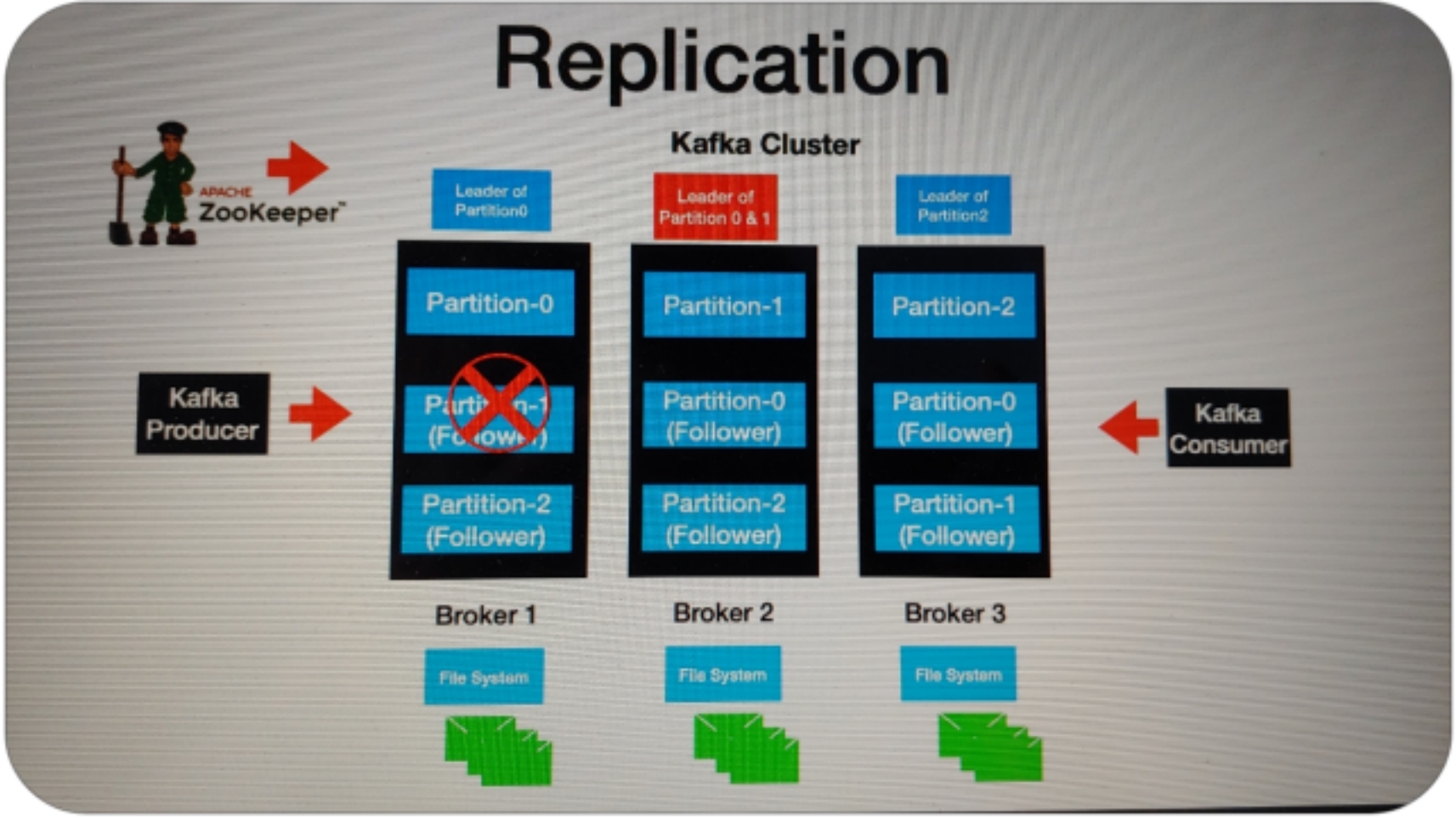


Summary : How Kafka Distributes the Client Requests?

- Partition leaders are assigned during topic Creation
- Clients will only invoke leader of the partition to produce and consume data
    - Load is evenly distributed between the brokers

Replication



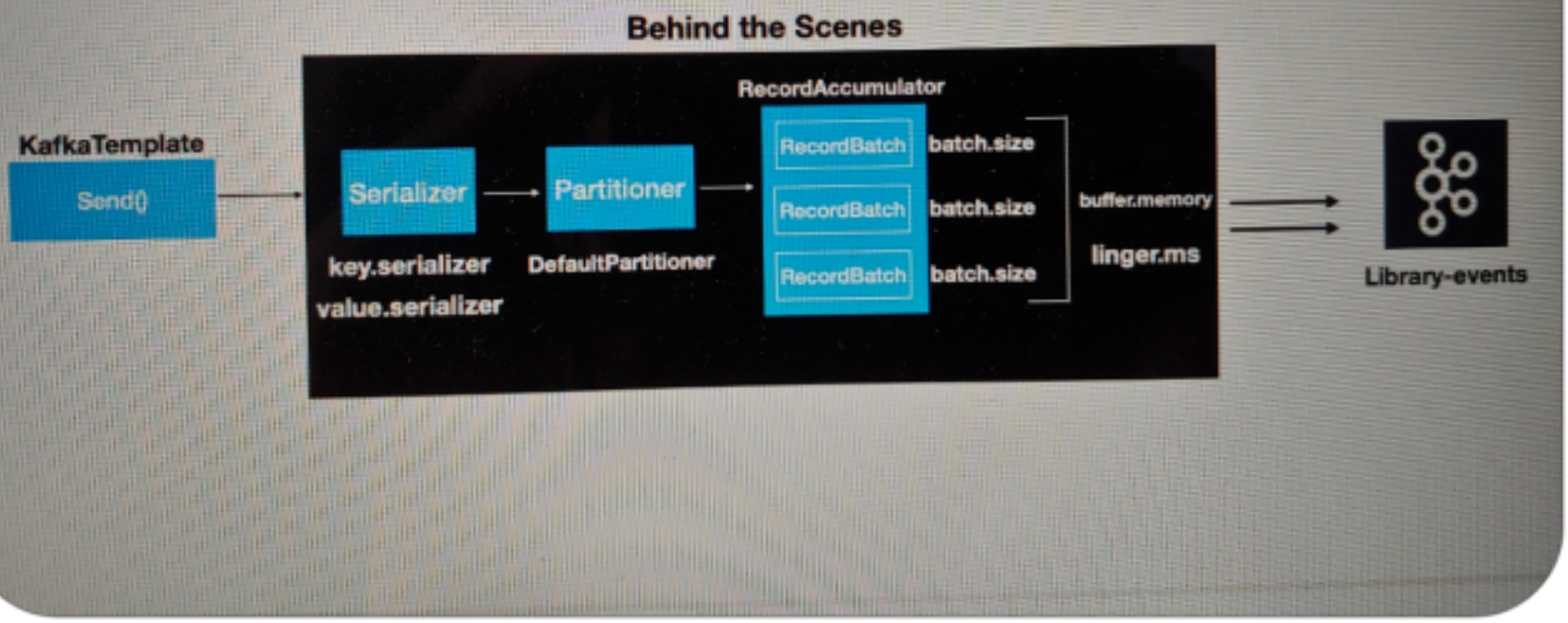


In-Sync Replica(ISR)

- Represents the number of replica in sync with each other in the cluster
  - Includes both **leader** and **follower** replica
- Recommended value is always greater than 1
- Ideal value is **ISR == Replication Factor**
- This can be controlled by **min.insync.replicas** property
  - It can be set at the **broker** or **topic** level

≡ ○ Replication factor is equal to number of copies of same mesage

KafkaTemplate.send()



- linger.ms to send batch of records to consumer before batch.size limit reaches

KafkaAdmin

- Create topics Programmatically
- Part of the **SpringKafka**
- How to Create a topic from Code?
  - Create a Bean of type **KafkaAdmin** in SpringConfiguration
  - Create a Bean of type **NewTopic** in SpringConfiguration

@KafkaListener

- This is the easiest way to build Kafka Consumer
- KafkaListener Sample Code

```
@KafkaListener(topics = {"${spring.kafka.topic}"})
public void onMessage(ConsumerRecord<Integer, String> consumerRecord) {
    log.info("OnMessage Record : {} ", consumerRecord);
}
```

- Configuration Sample Code

```
@Configuration
@EnableKafka
@Slf4j
public class LibraryEventsConsumerConfig {
```

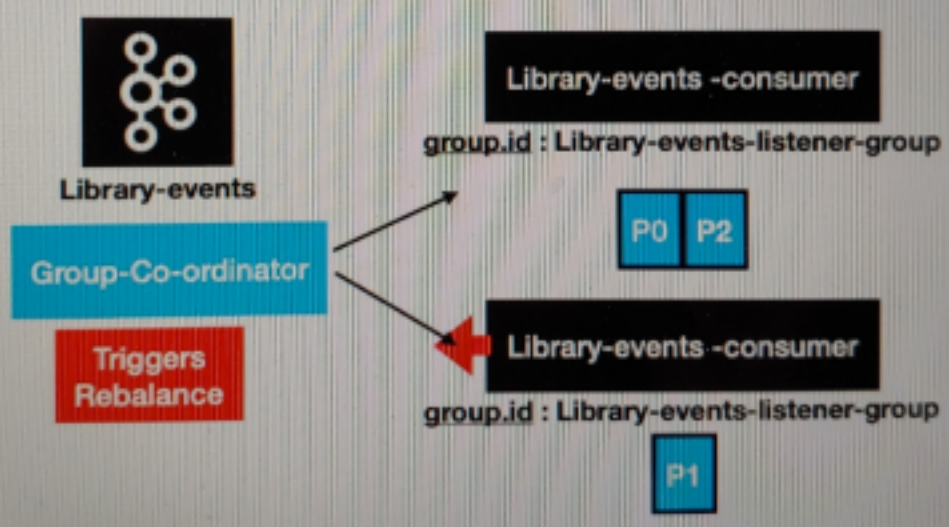
KafkaConsumer Config

```
key-deserializer: org.apache.kafka.common.serialization.IntegerDeserializer
value-deserializer: org.apache.kafka.common.serialization.StringDeserializer
group-id: library-events-listener-group
```

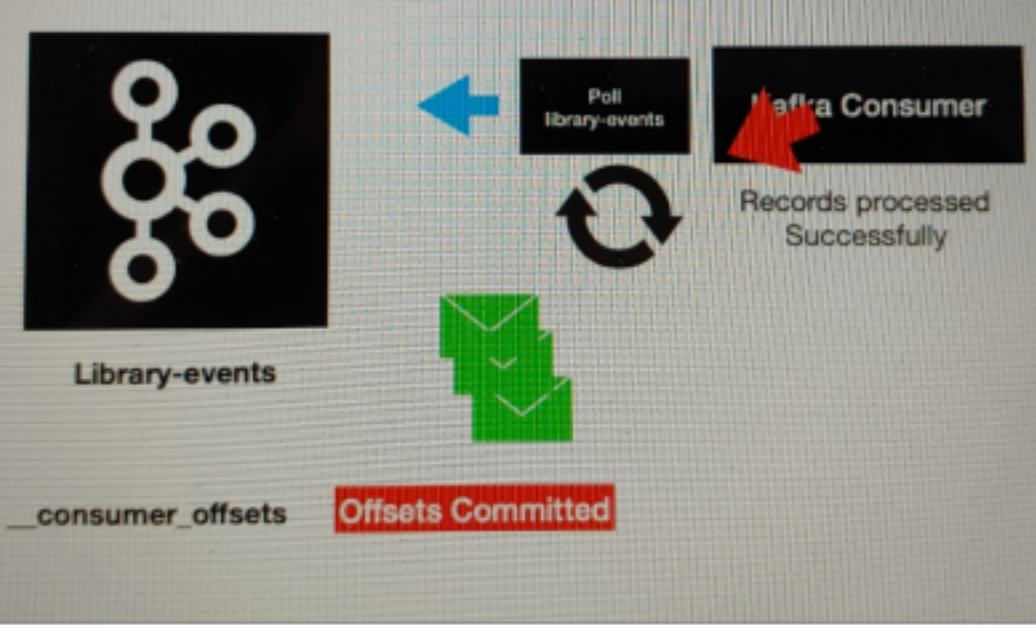
≡ ○ Consumer groups: multiple instances of same application with the same.group id

Rebalance

- Changing the partition ownership from one consumer to another



Committing Offsets



Summary

- Use KafkaTemplate<Long,String> to send messages.
  KafkaTemplate.send(topicname,

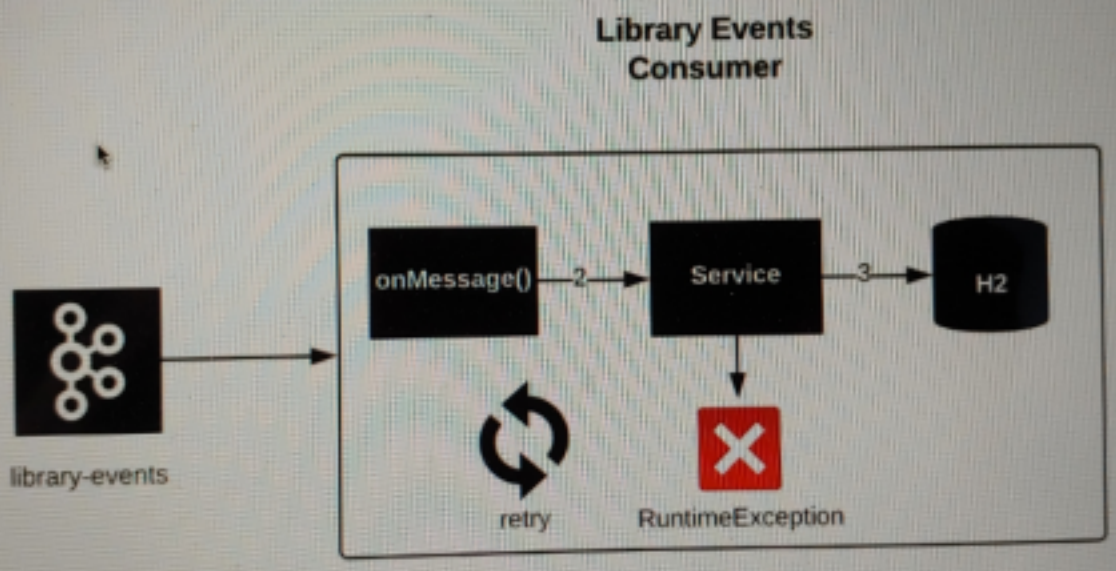
key, value)

- ○ Wrap KafkaTemplate with configuration of producer
- ○ Use ProducerRecord api provided by plugin to wrap topic, key, value and any RecordHeader details
- ○ Add callback handler for both success and failure in KafkaTemplate.send()
- ○ Use@KafkaListener with a single or multiple topic names which can consume the ConsumerRecord<Long,String>
- ○ By default consumer will use auto commit with batch option. So as soon as consumer reads the data offset will be committed in kafka and moves to next offset.
- ○ To make manul commit use the below approach

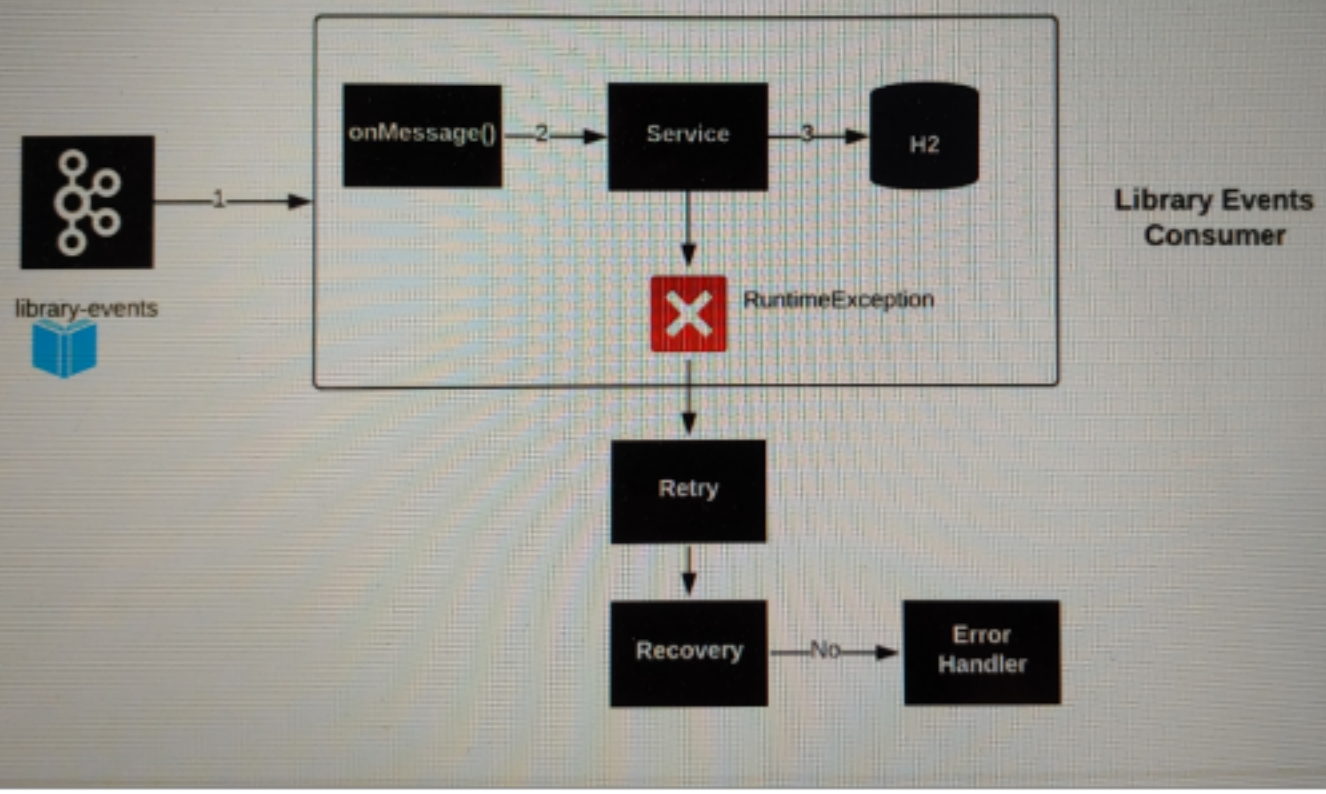
```java
//@Component
@Slf4j
public class LibraryEventsConsumerManualOffset implements AcknowledgingMessageListener<Integer,String> {

    @Override
    @KafkaListener(topics = {"library-events"})
    public void onMessage(ConsumerRecord<Integer, String> consumerRecord, Acknowledgment acknowledgment) {
        log.info("ConsumerRecord : {} ", consumerRecord );
        acknowledgment.acknowledge();
    }
}
```

- We can also configure error handler, retry all or specific exception(through spring retry RetryTemplate) and recovery(in case all retry are done bit still exception throws) in kafka consumer and producer
- kafka consumer

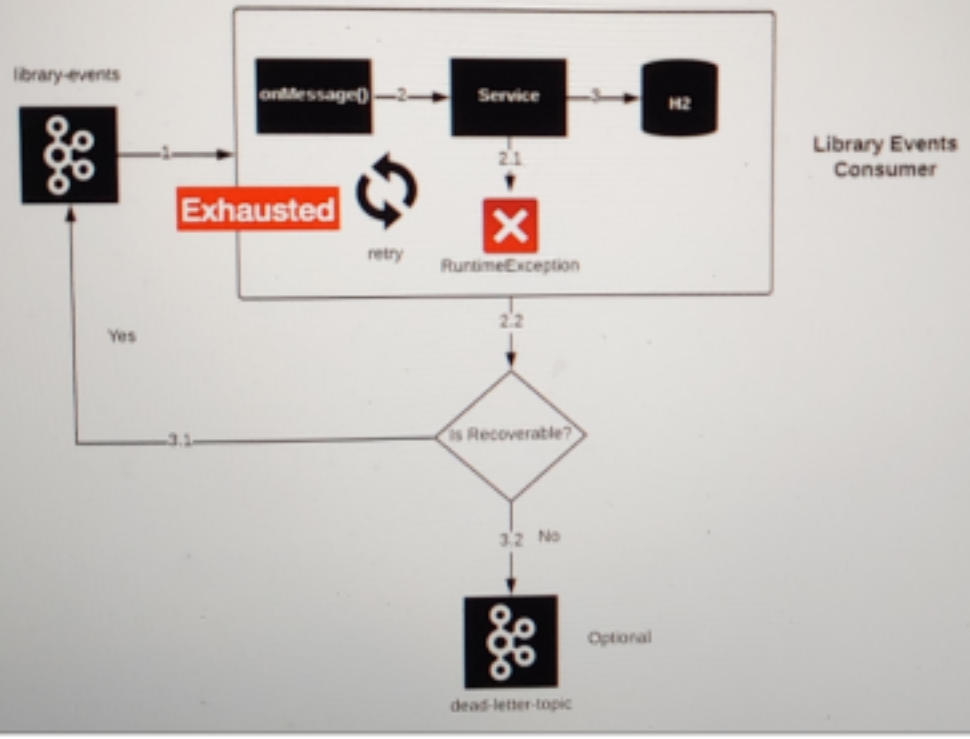
Retry in Kafka Consumer



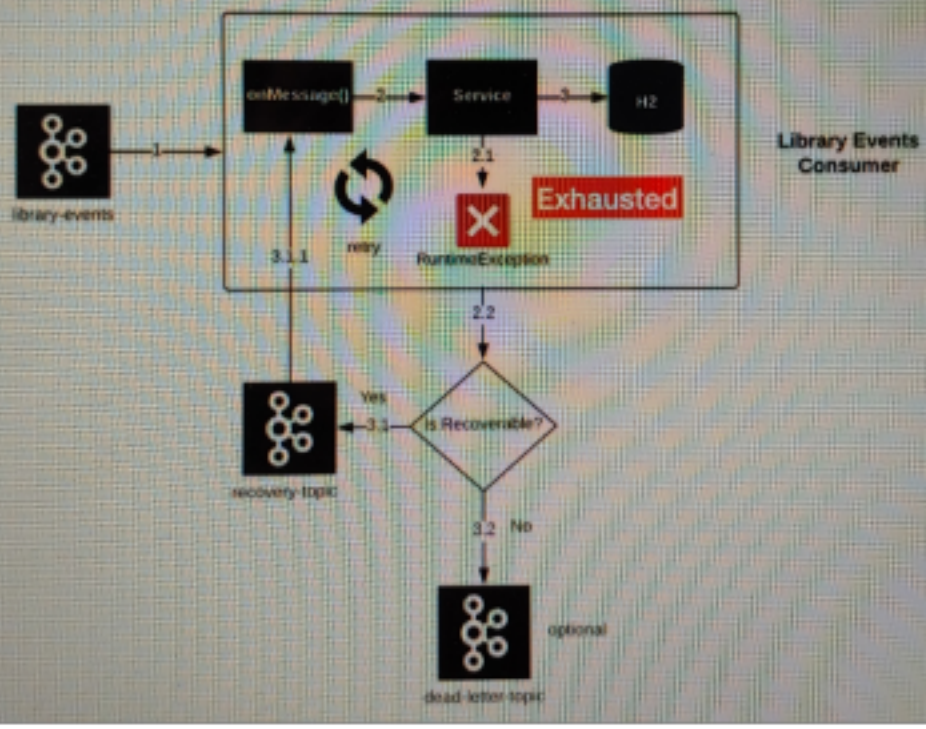
Retry and Recovery

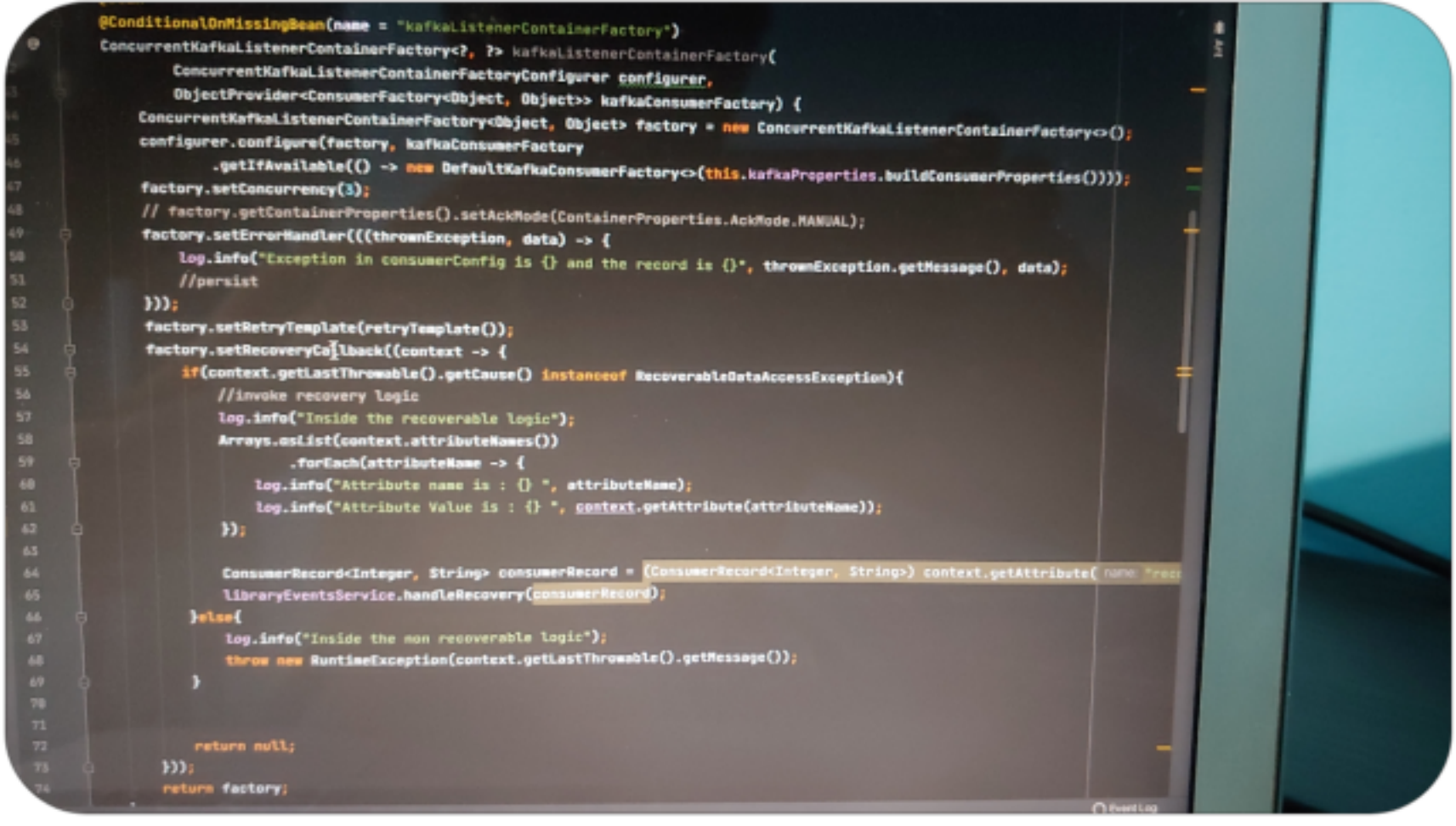


Recovery - Type 1



Recovery - Type 2



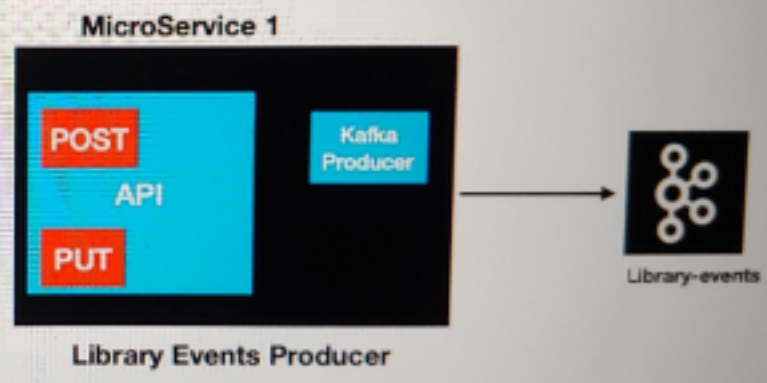


≡ ○ Kafka producer

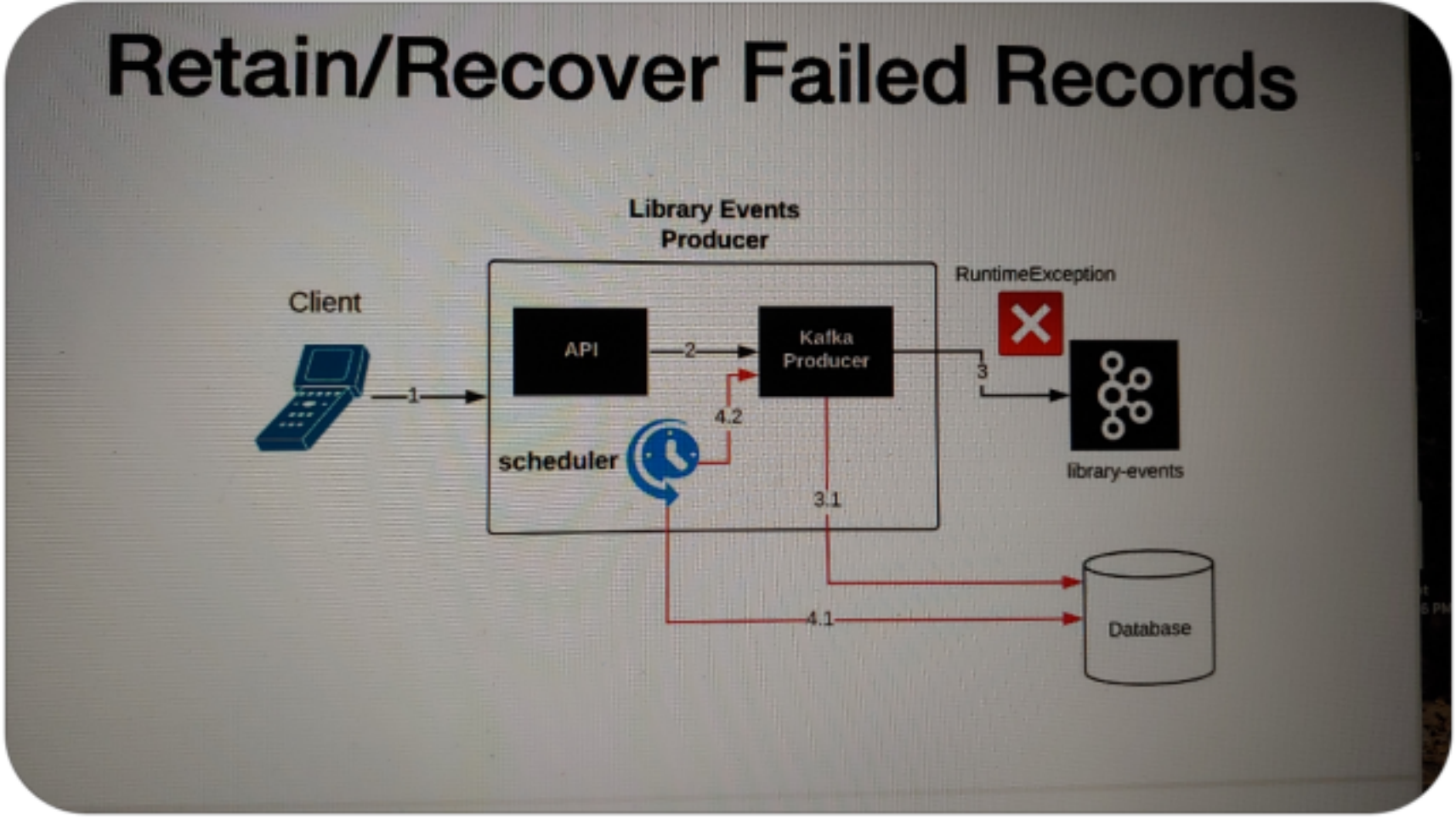
Kafka producer can wait continuously until any one of the broker is available and then send the message to it without stopping the server

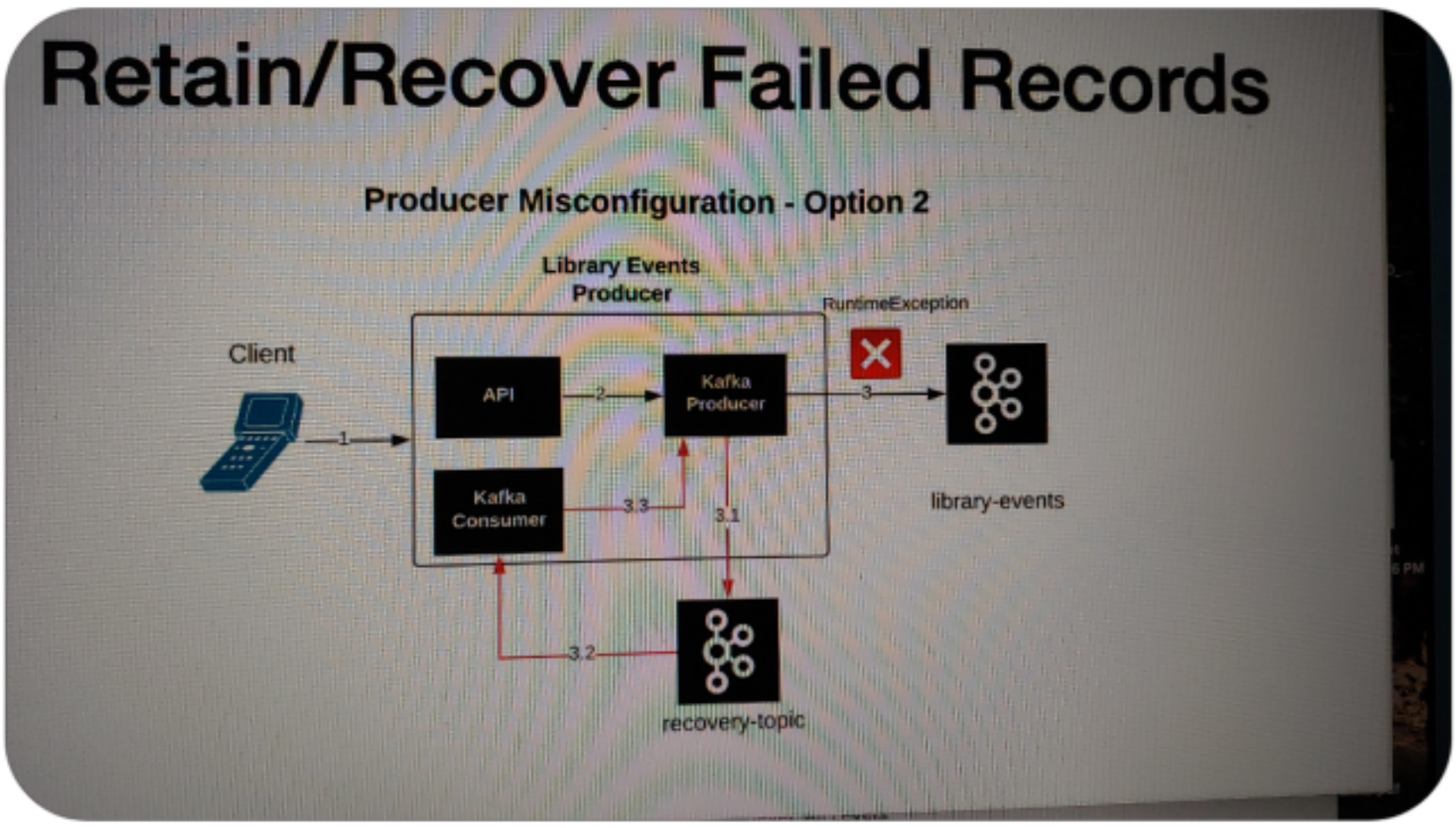
Kafka Producer Errors

- Kafka Cluster is not available
- If **acks= all ,** some brokers are not available
- **min.insync.replicas** config
  - **Example : min.insync.replicas = 2**, But only one broker is available



- To retain or recover the records if it failed to send to kafka topic we can save it any database and then through scheduler we can resend it to kafka topic or else we can publish those records into other kafka topics


Retain/Recover Failed Records
Library Events Producer
Client
API
Kafka Producer
RuntimeException
scheduler
library-events
Database
1
2
3
4.1
4.2
3.1


Retain/Recover Failed Records
Producer Misconfiguration - Option 2
Library Events Producer
Client
API
Kafka Producer
RuntimeException
Kafka Consumer
library-events
recovery-topic
1
2
3
3.1
3.2
3.3

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MongoDB