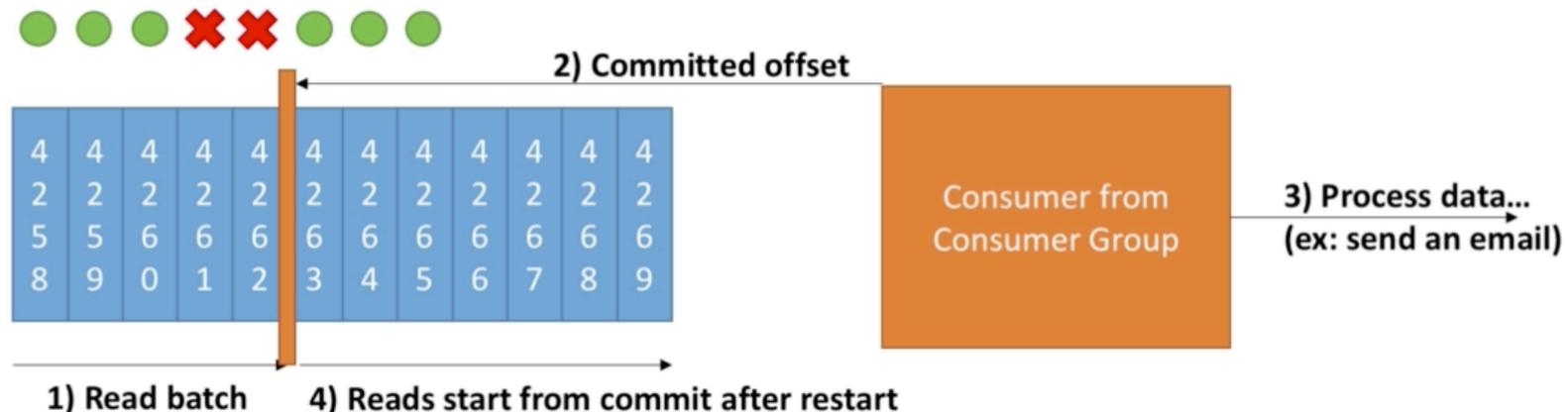




Delivery Semantics At Most Once

- **At most once:** offsets are committed as soon as the message batch is received. If the processing goes wrong, the message will be lost (it won't be read again).

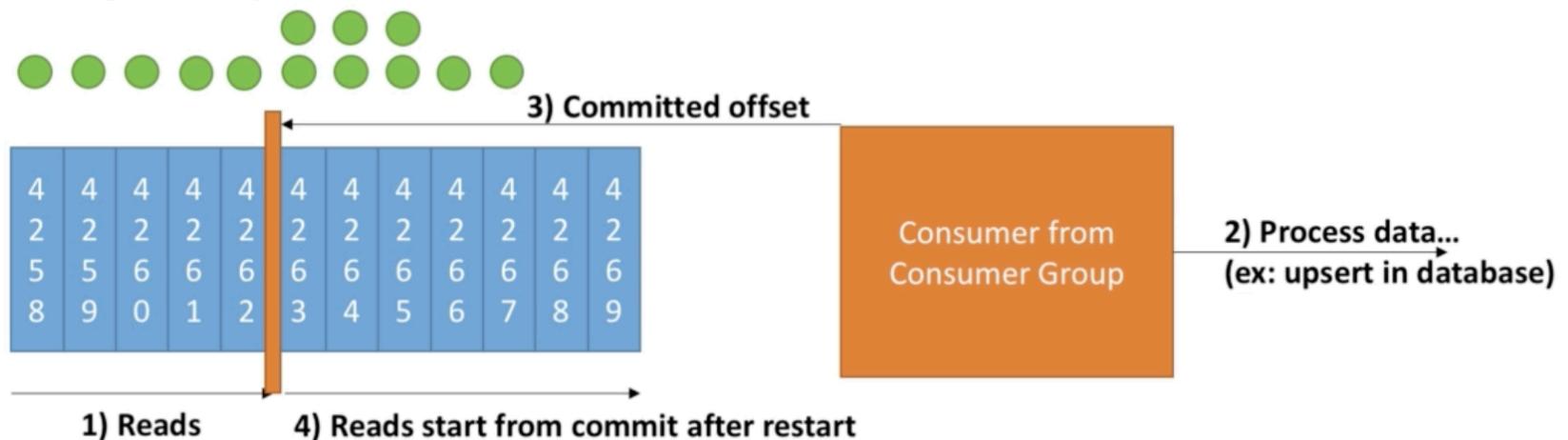


Delivery Semantics At Least Once



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- **At least once:** offsets are committed after the message is processed. If the processing goes wrong, the message will be read again. This can result in duplicate processing of messages. Make sure your processing is **idempotent** (i.e. processing again the messages won't impact your systems)





Delivery semantics for consumers

Summary

- **At most once:** offsets are committed as soon as the message is received. If the processing goes wrong, the message will be lost (it won't be read again).
- **At least once:** offsets are committed after the message is processed. If the processing goes wrong, the message will be read again. This can result in duplicate processing of messages. Make sure your processing is **idempotent** (i.e. processing again the messages won't impact your systems)
- **Exactly once:** Can be achieved for Kafka => Kafka workflows using Kafka Streams API. For Kafka => Sink workflows, use an idempotent consumer.

Bottom line: for most applications you should use **at least once processing** (we'll see in practice how to do it) and ensure your transformations / processing are idempotent



Consumer Offset Commits Strategies

- There are two most common patterns for committing offsets in a consumer application.
- **2 strategies:**
 - (easy) enable.auto.commit = true & synchronous processing of batches
 - (medium) enable.auto.commit = false & manual commit of offsets
- Let's dive in !



Consumer Offset Commits Strategies

- enable.auto.commit = true & synchronous processing of batches

```
while(true){  
    List<Records> batch = consumer.poll(Duration.ofMillis(100))  
    doSomethingSynchronous(batch)  
}
```

- With auto-commit, offsets will be committed automatically for you at regular interval **(auto.commit.interval.ms=5000 by default)** every-time you call .poll()
- If you don't use synchronous processing, you will be in "at-most-once" behavior because offsets will be committed before your data is processed



Consumer Offset Commits Strategies

- enable.auto.commit = false & synchronous processing of batches

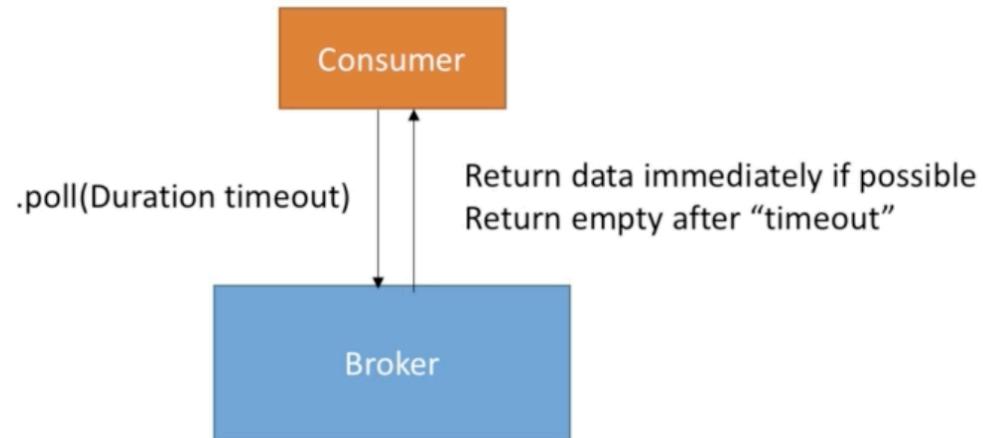
```
while(true){  
    batch += consumer.poll(Duration.ofMillis(100))  
    if isReady(batch) {  
        doSomethingSynchronous(batch)  
        consumer.commitSync();  
    }  
}
```

- You control when you commit offsets and what's the condition for committing them.
- Example: *accumulating records into a buffer and then flushing the buffer to a database + committing offsets then.*



Consumer Poll Behavior

- Kafka Consumers have a “poll” model, while many other messaging bus in enterprises have a “push” model.
- This allows consumers to control where in the log they want to consume, how fast, and gives them the ability to replay events





Consumer Poll Behaviour

- **Fetch.min.bytes (default 1):**

- Controls how much data you want to pull at least on each request
- Helps improving throughput and decreasing request number
- At the cost of latency

- **Max.poll.records (default 500):**

- Controls how many records to receive per poll request
- Increase if your messages are very small and have a lot of available RAM
- Good to monitor how many records are polled per request

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Consumer Poll Behaviour

- **Max.partitions.fetch.bytes (default 1MB):**
 - Maximum data returned by the broker per partition
 - If you read from 100 partitions, you'll need a lot of memory (RAM)
- **Fetch.max.bytes (default 50MB):**
 - Maximum data returned for each fetch request (covers multiple partitions)
 - The consumer performs multiple fetches in parallel
- Change these settings only if your consumer maxes out on throughput already



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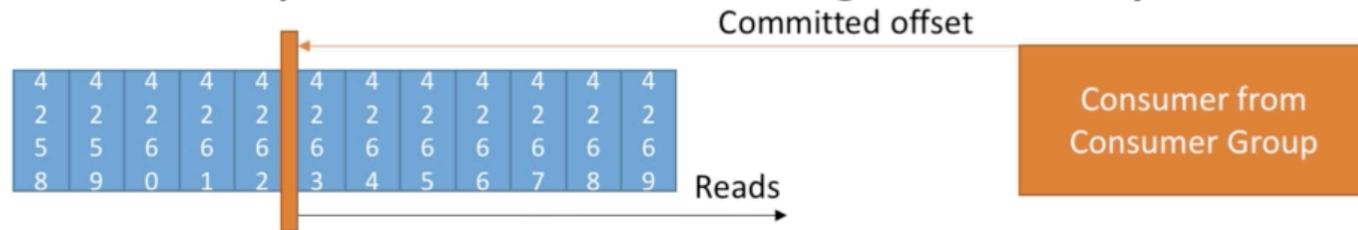
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- Example: accumulating records into a buffer and then flushing the buffer to a database + committing offsets then.



Consumer Offset Reset Behaviour

- A consumer is expected to read from a log continuously.



- But if your application has a bug, your consumer can be down
- If Kafka has a retention of 7 days, and your consumer is down for more than 7 days, the offsets are “invalid”



Consumer Offset Reset Behaviour

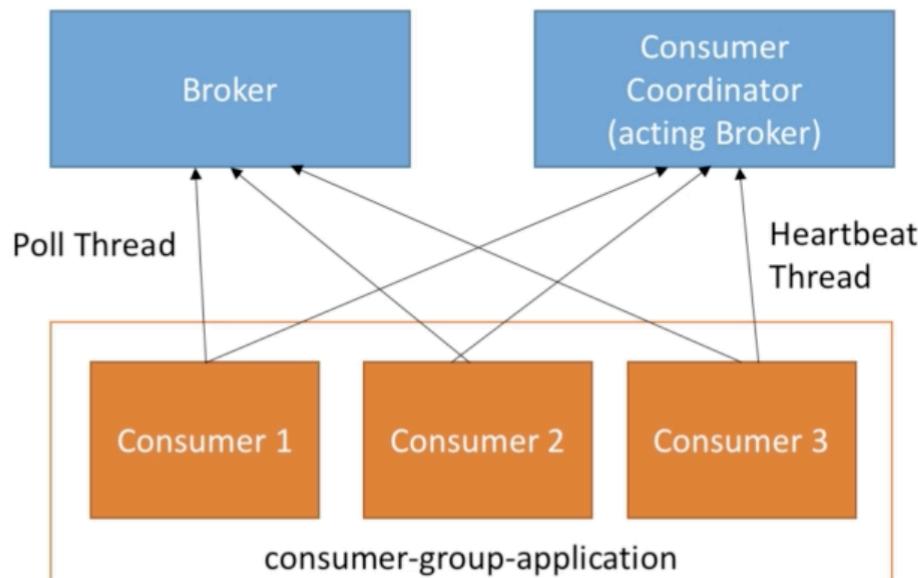
- The behavior for the consumer is to then use:
 - `auto.offset.reset=latest`: will read from the end of the log
 - `auto.offset.reset=earliest`: will read from the start of the log
 - `auto.offset.reset=None`: will throw exception if no offset is found
- Additionally, consumer offsets can be lost:
 - If a consumer hasn't read new data in 1 day (Kafka < 2.0)
 - If a consumer hasn't read new data in 7 days (Kafka >= 2.0)
- This can be controlled by the broker setting `offset.retention.minutes`



Replaying data for Consumers

- To replay data for a consumer group:
 - Take all the consumers from a specific group down
 - Use `kafka-consumer-groups` command to set offset to what you want
 - Restart consumers
- Bottom line:
 - Set proper data retention period & offset retention period
 - Ensure the auto offset reset behavior is the one you expect / want
 - Use replay capability in case of unexpected behaviour

Controlling Consumer Liveliness



- Consumers in a Group talk to a Consumer Groups Coordinator
- To detect consumers that are “down”, there is a “heartbeat” mechanism and a ”poll” mechanism
- To avoid issues, consumers are encouraged to process data fast and poll often

Note: heartbeats and poll() are decoupled since Kafka 0.10.1



Consumer Heartbeat Thread

- **Session.timeout.ms (default 10 seconds):**
 - Heartbeats are sent periodically to the broker
 - If no heartbeat is sent during that period, the consumer is considered dead
 - Set even lower to faster consumer rebalances
- **Heartbeat.interval.ms (default 3 seconds):**
 - How often to send heartbeats
 - Usually set to 1/3rd of session.timeout.ms
- Take-away: This mechanism is used to detect a consumer application being down



Consumer Poll Thread

- **max.poll.interval.ms (default 5 minutes):**
 - Maximum amount of time between two .poll() calls before declaring the consumer dead
 - This is particularly relevant for Big Data frameworks like Spark in case the processing takes time
- Take-away: This mechanism is used to detect a data processing issue with the consumer