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Agile Integration

PA Agile Integration, Kafka and Event-Streaming

Oliver Berger, Nadja Hagen

Tobias Dehn, Christopher Weiß, Uwe Eisele

Content

- Integration
- Event-Streaming Platform Kafka
- Asynchronous Communication
- Kafka Basics & Components
- Kafka APIs
- Kafka Examples
- Kafka Exercises

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Integration

..of distributed systems is a complex challenge

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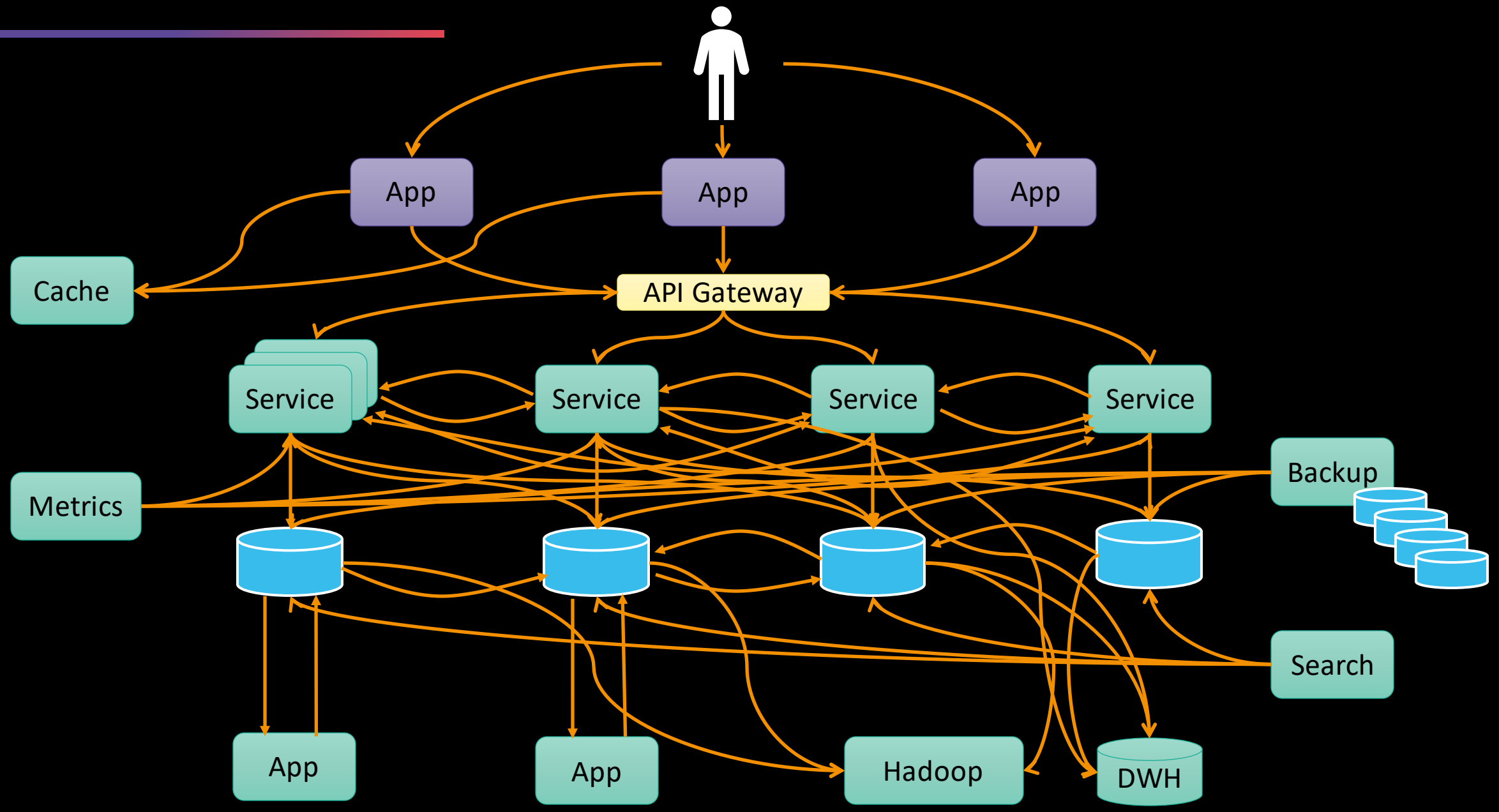
Integration in Distributed Systems, complex challenge lots of things to consider

Technologies	Programming Language	Application Architecture	Communication Paradigms
• Standards (SOAP, REST , JMS) • Data formats (JSON, XML, Avro) • Frameworks • Proprietary Interfaces	• Java • C, C#, .Net • Python • Cobol	• Client Server • Monolith • SOA • Microservices • Serverless	• Batch • Realtime • Request-Response • Pub-Sub • Fire & Forget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Cache
API Gateway
Service
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Backup
Metrics
Search
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Hadoop
DWH

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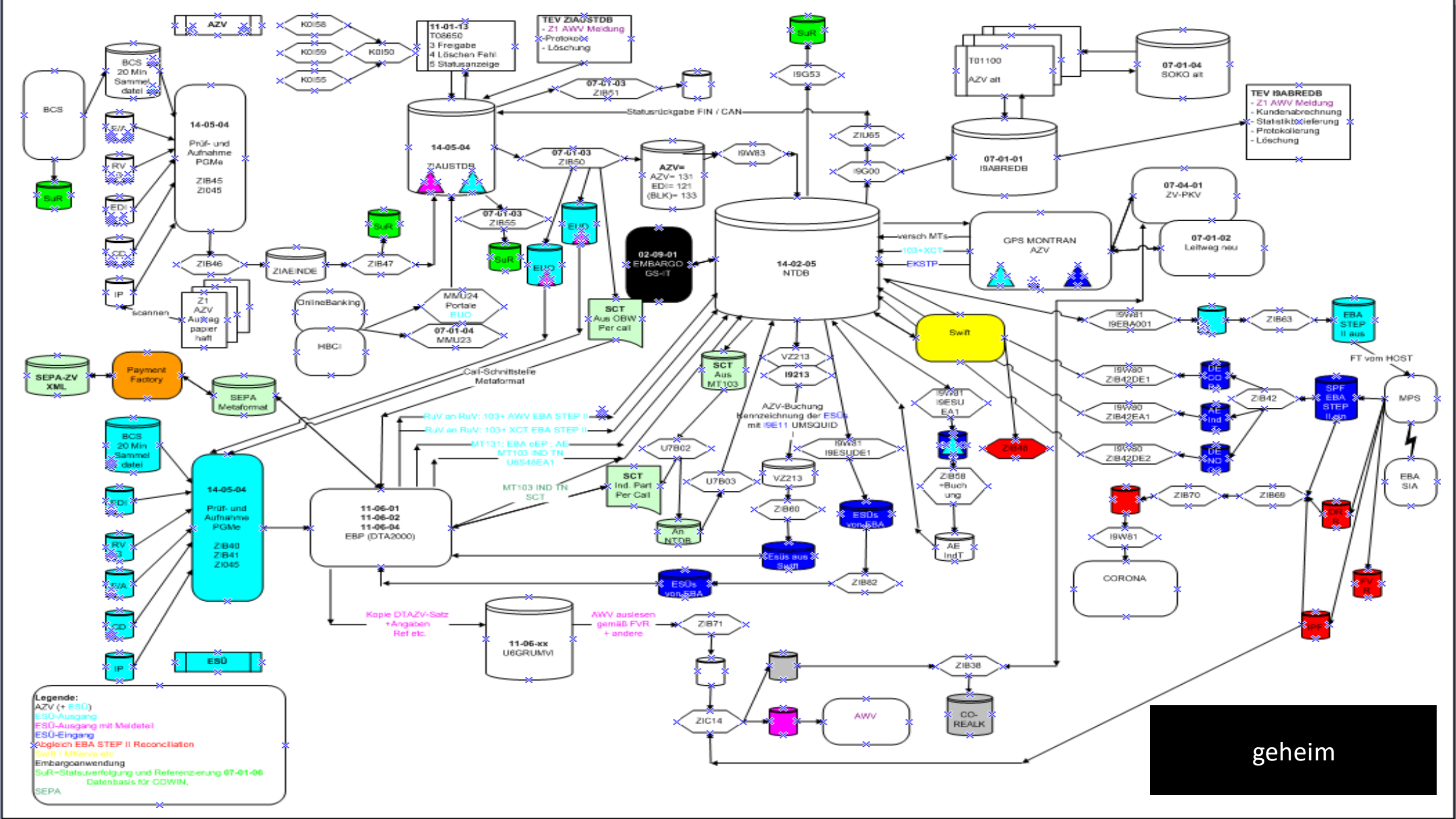
AZV
K0I58
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K0I55
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4 Löschen Fehl
5 Statusanzeige
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- Z1 AWV Meldung
- Protokoll
- Löschung
SuR
I9G53
T01100
AZV alt
07-01-04
SOKO alt
TEV I9ABREDB
- Z1 AWV Meldung
- Kundenabrechnung
- Statistiklieferung
- Protokollierung
- Löschung
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BCS
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14-05-04
Prüf- und
Aufnahme
PGMe
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ZI045
07-01-03
ZIB51
Statusrückgabe FIN / CAN
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EDI= 121
(BLK)= 133
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07-01-01
I9ABREDB
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02-09-01
EMBARGO
GS-IT
14-02-05
NTDB
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103+XCT
EKSTP
GPS MONTRAN
AZV
ZIB46
ZIAEINDE
ZIB47
Z1
AZV
Auxag
papier
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scannen
OnlineBanking
HBCI
MMU24
Portale
EUO
07-01-04
MMU23
SCT
Aus OBW
Per call
Swift
I9W81
I9EBA001
ZIB63
EBA
STEP
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Call-Schnittstelle
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I9213
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Kennzeichnung der ESÜs
mit I9E11 UMSQUID
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I9ESU
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datei
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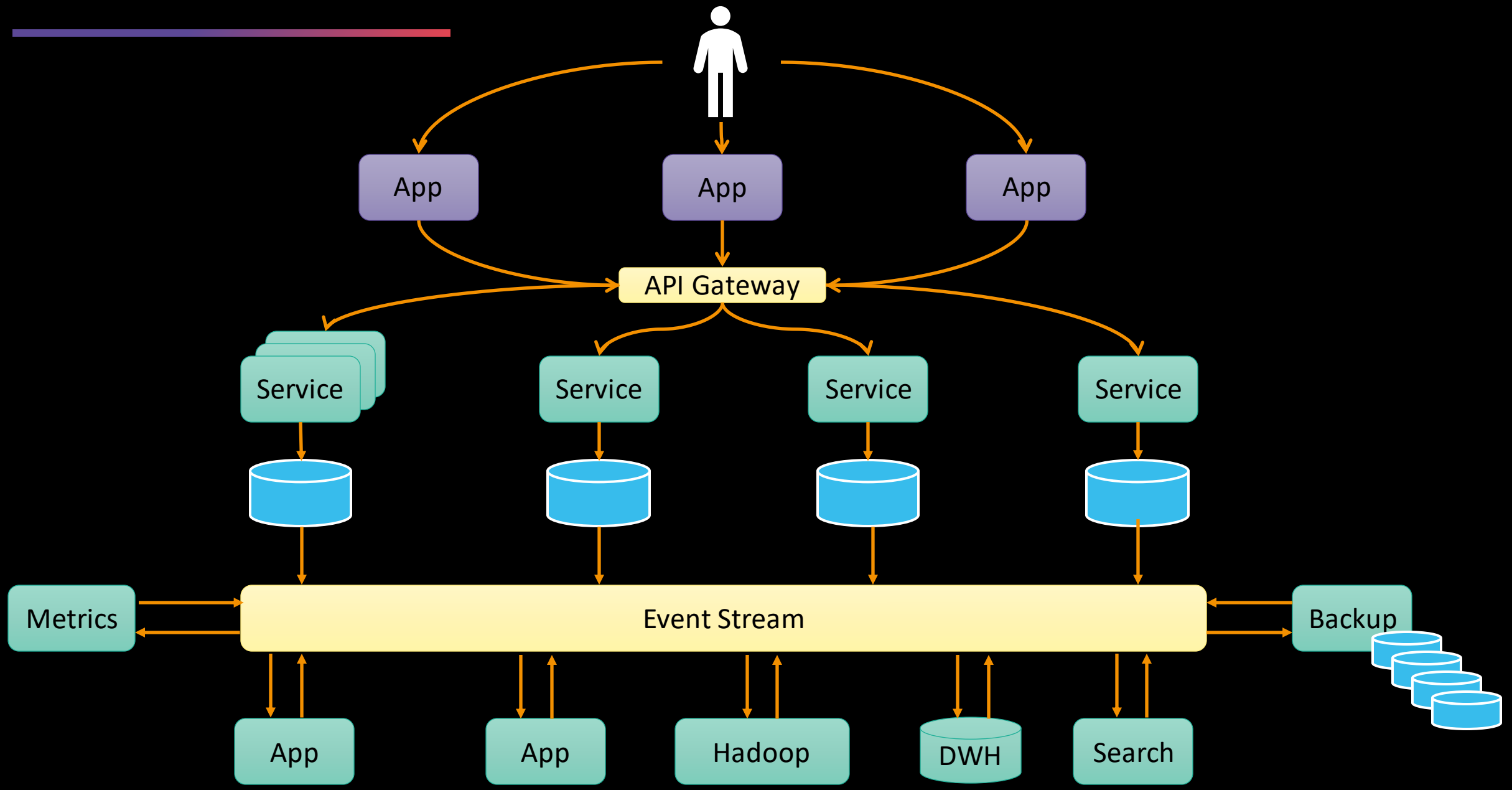
Prüf- und
Aufnahme
PGMe
ZIB40
ZIB41
ZI045
11-06-01
11-06-02
11-06-04
EBP (DTA2000)
ESÜ
Kopie DTAZV-Satz
+Angaben
Ref etc.
11-06-xx
U6GRUMVI
AWV auslesen
gemäß FVR
+ andere
ZIB71
ZIB38
ZIC14
AWV
CO-
REALK
IPF
Legende:
AZV (+ ESÜ)
ESÜ-Ausgang
ESÜ-Ausgang mit Meldetel
ESÜ-Eingang
Abgleich EBA STEP II Reconciliation
Swift / MKerva etc
Embargoanwendung
SuR=Statusverfolgung und Referenzierung 07-01-06
Datenbasis für COWIN,
SEPA
geheim


App
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Metrics
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DWH
Search

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Event-Streaming Platform Kafka

Why should you be interested?

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Apache Kafka: The Event Streaming Platform

- developed at LinkedIn in 2011 and made open source
- can process several trillion (10^12) events per day
- originally designed as a messaging queue
- based on an abstraction of a distributed commit log
- evolved from a messaging queue to a full-fledged event streaming platform
- de facto standard for Event-Streaming Platform (> 95% of Event-Streaming-Projects rely on kafka)

Thousends of Enterprises rely on Kafka and Event-Streaming

Source: https://kafka.apache.org/powered-by

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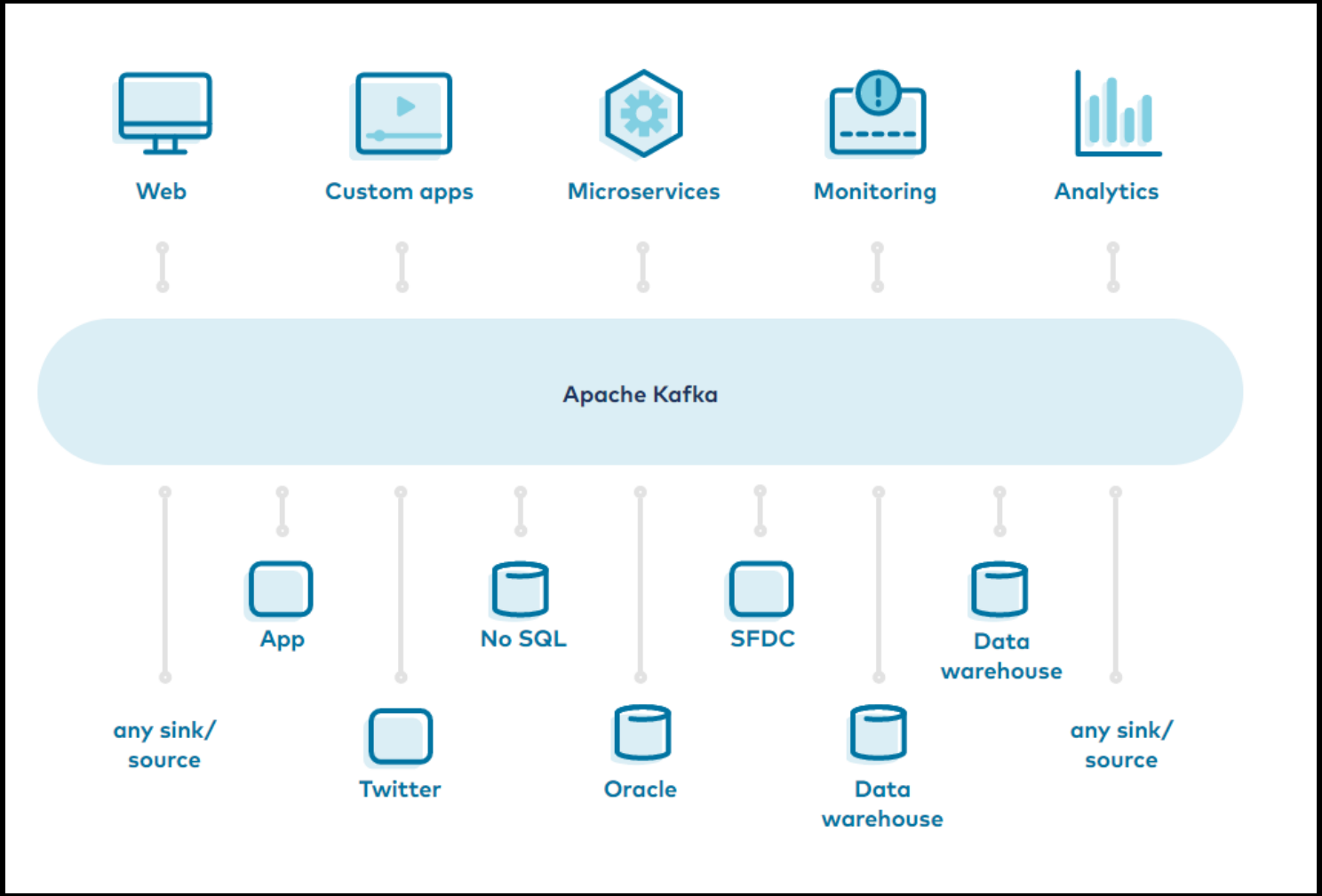
Possible Applications of Apache Kafka



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3 Key Functionalities of a Streaming Platform

Pub-Sub

Store

Process

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Asynchronous Communication

Why do you need a Messaging System?

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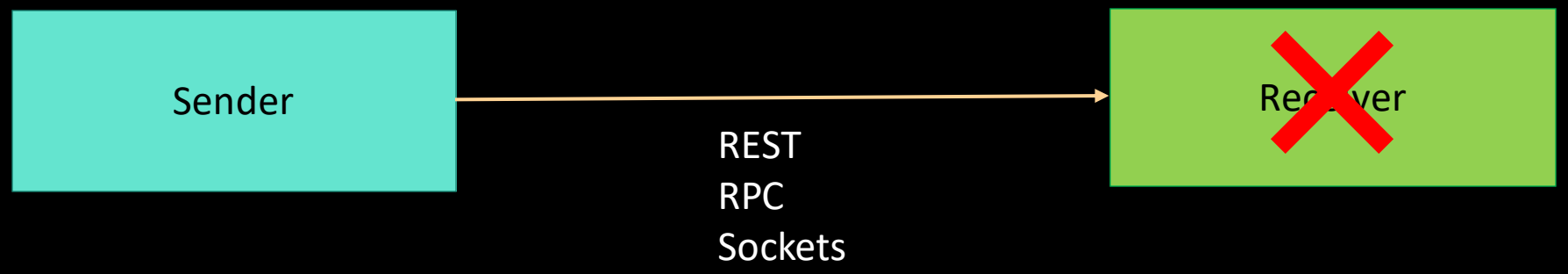
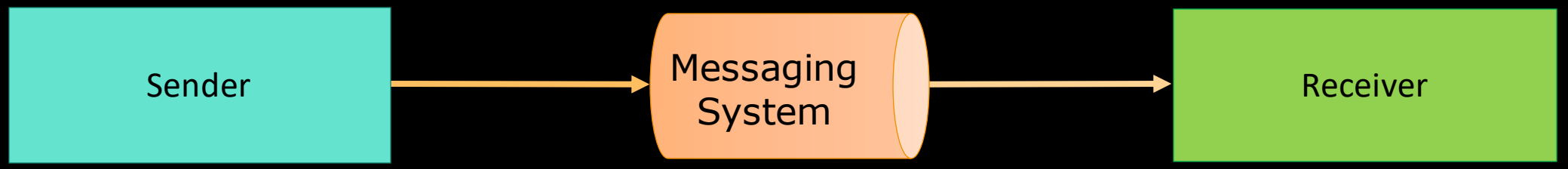
Why do you need a Messaging System ?



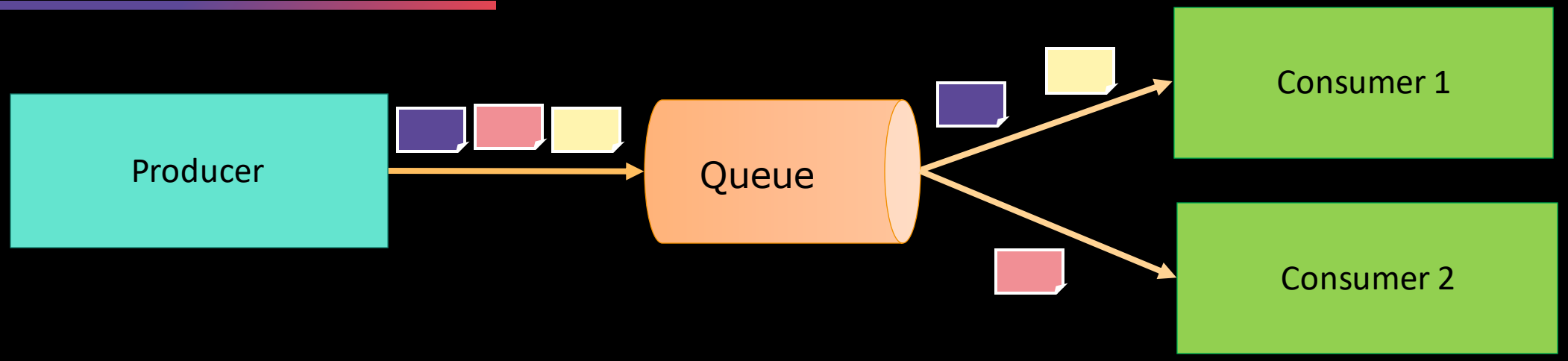
- Challenge 1: Availability
- Challenge 2: Processing Velocity
- Challenge 3: Processing Acknowledgement

Solution: Messaging



- Decoupling via Messaging
- Examples for Messaging-Systems:
  - MQ-Series,
  - JMS-Messaging (ActiveMQ, Rabbit-MQ),
  - Kafka.
- Transfermode: Queue or Topic

Queue Mode
1 to 1 Topologie



- each message gets processed exactly once

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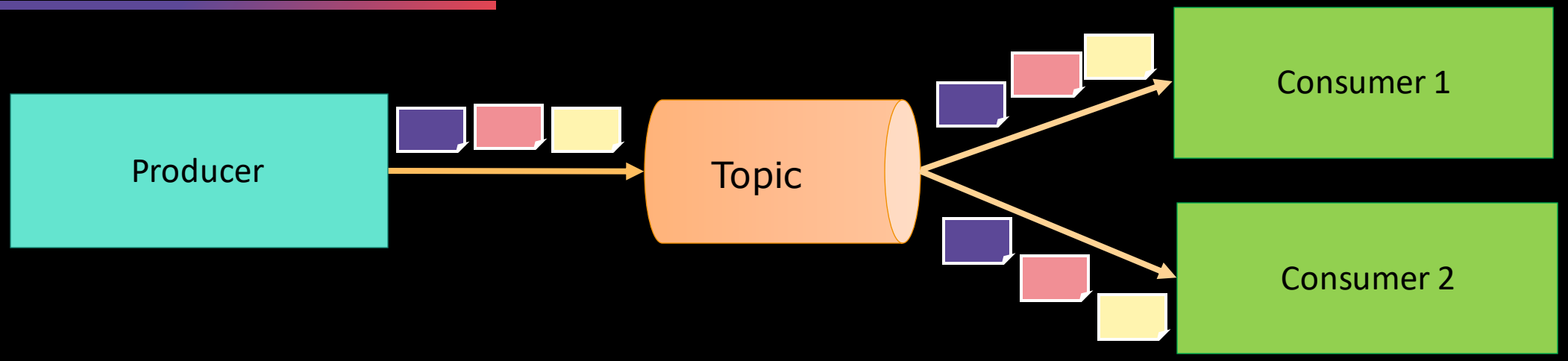
Topic Mode
1 to n Topologie



- each message can be consumed by independeant consumers
- each consumer receives all messages after subscription
- sequence of messages is guaranteed
- only new messages are delivered

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Kafka

Basics & Components

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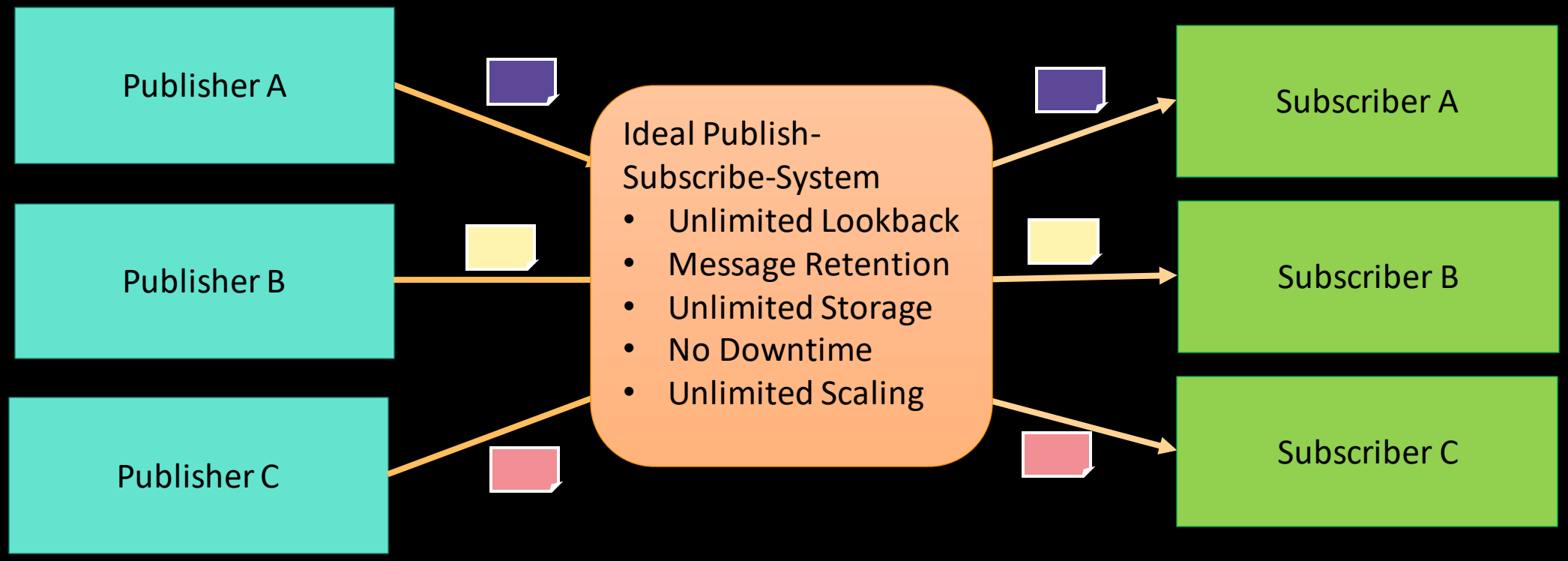
How would an ideal Publish-Subscribe System look like?



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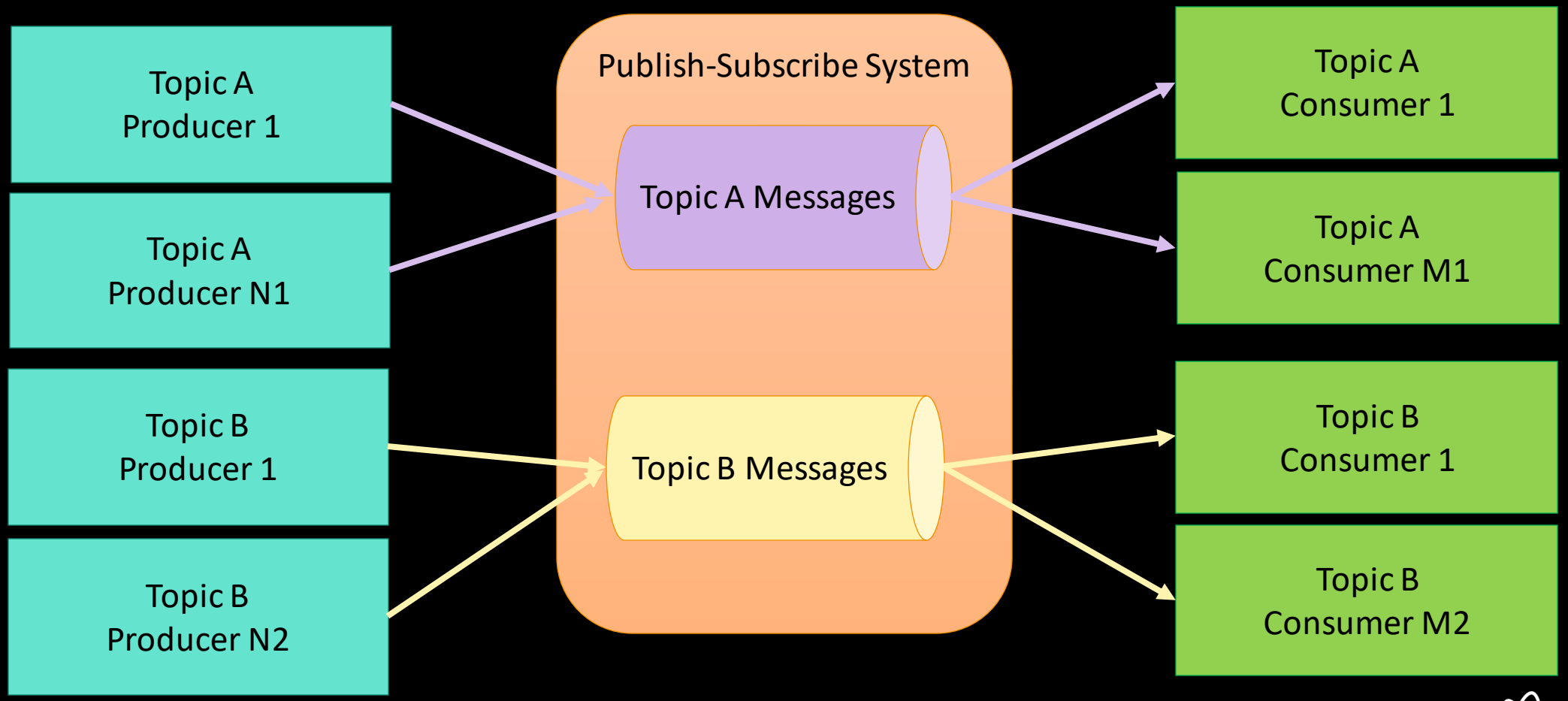
Kafka Architecture in Comparison to the ideal Pub-Sub System

- Key Differences
  - Messaging is implemented on top of a replicated, distributed unmutable commit log.
  - The client has more functionality and, therefore, more responsibility.
  - Messaging is optimized for batches instead of individual messages.
  - Messages are retained even after they are consumed; they can be consumed again.
- Consequences of these Design Decisions
  - extreme horizontal scalability
  - very high throughput
  - high availability
  - but different semantics and message delivery guarantees

Topics in a Publish-Subscribe System



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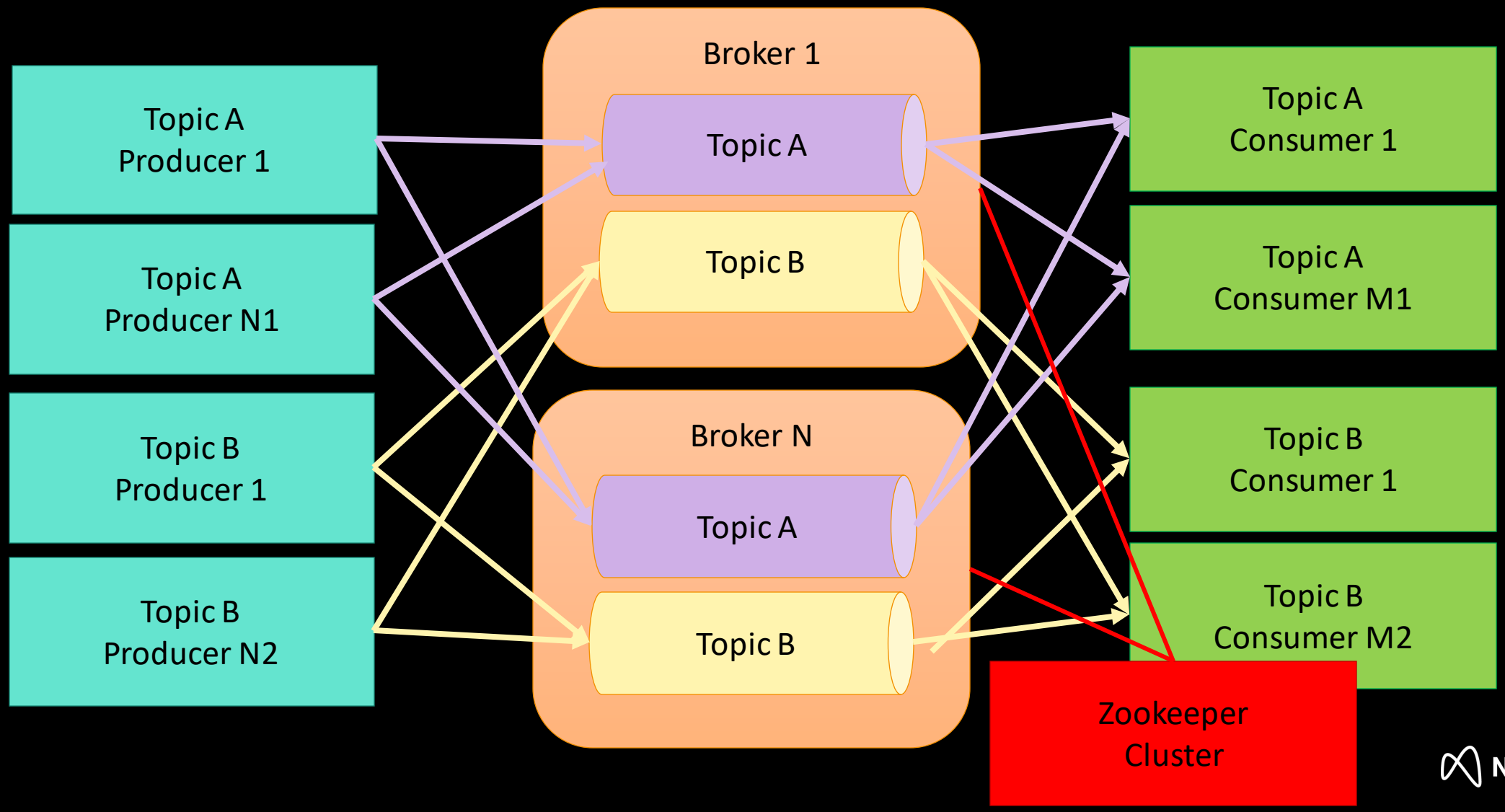
Broker in a Publish-Subscribe System



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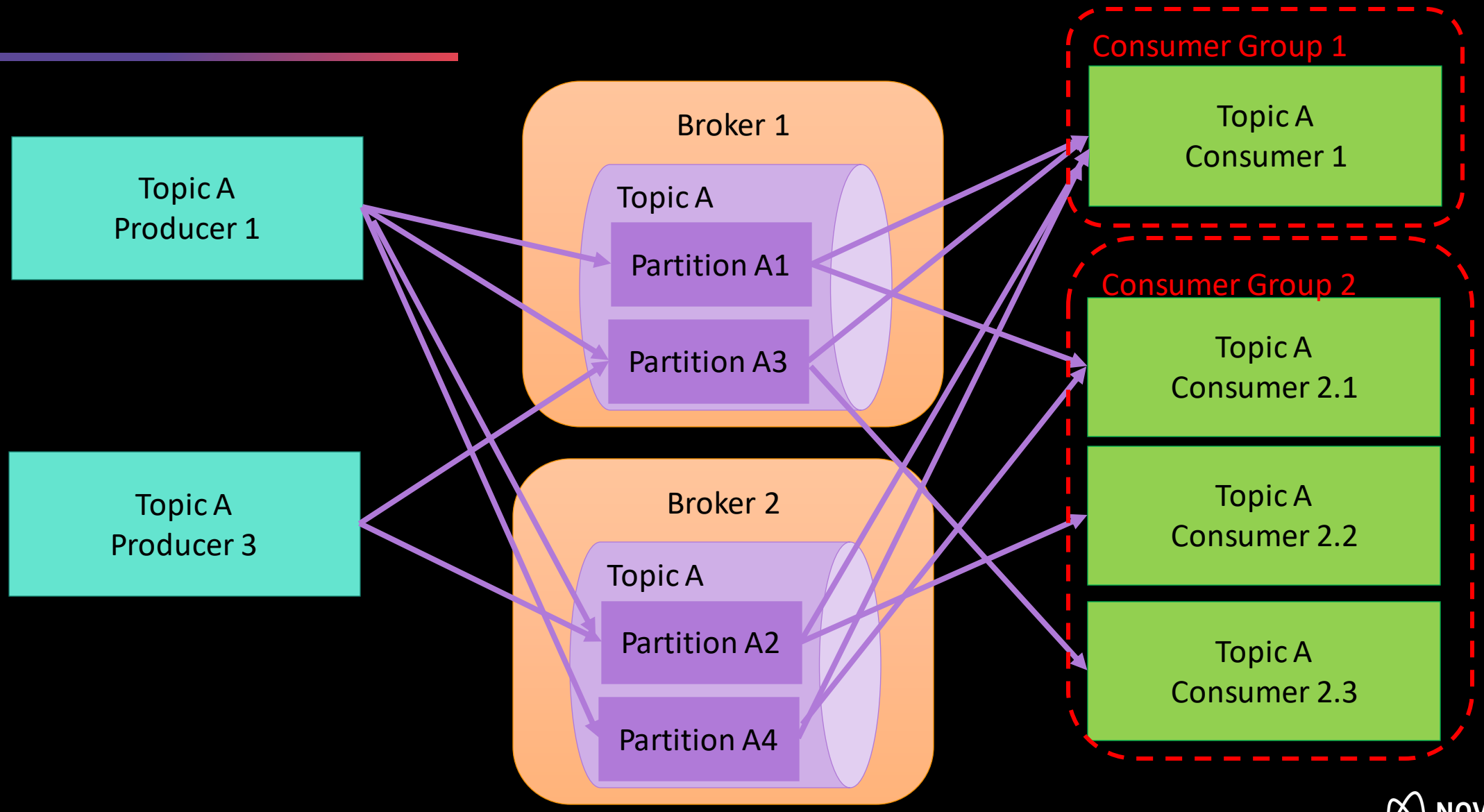
Partitions: Partition Count 4



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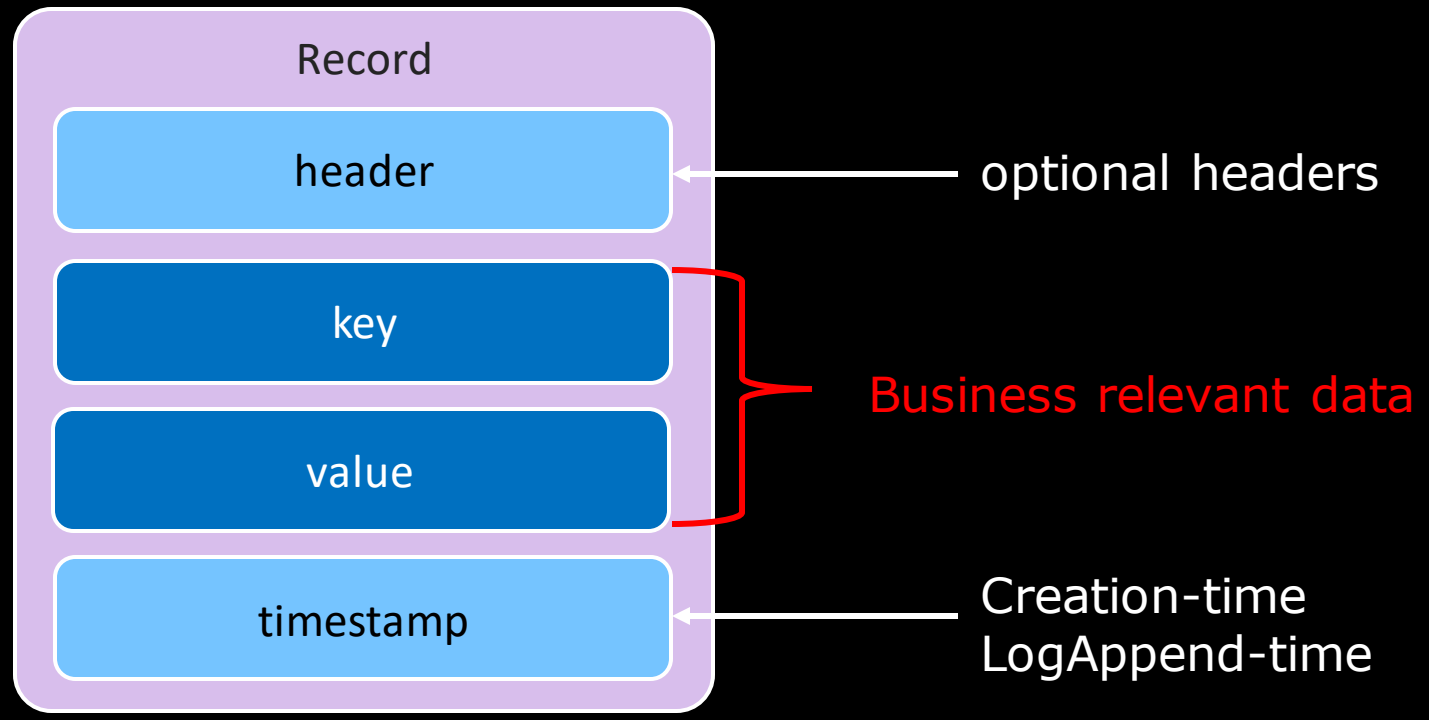
The Record – The Atomic Unit of Kafka
Synonyms: Message or Event



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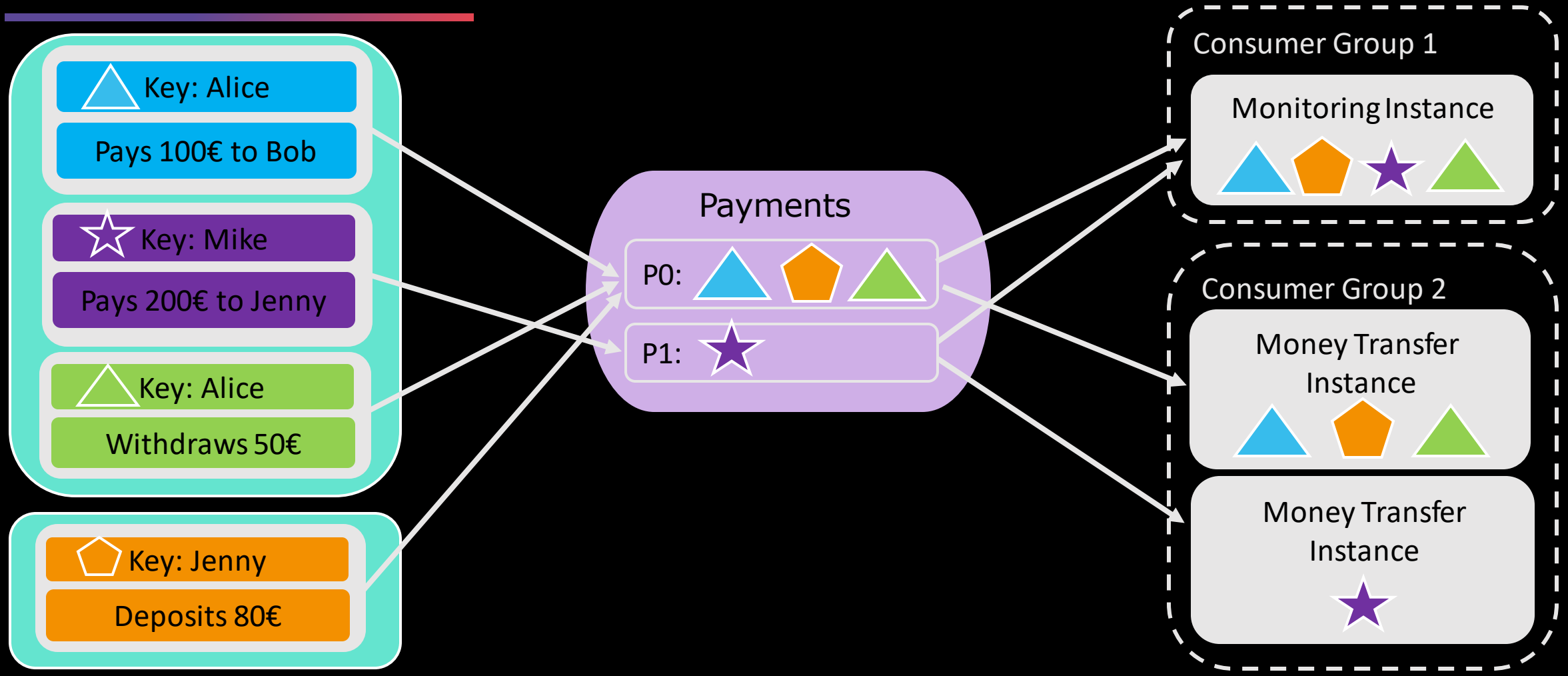
Example: Payment Processing



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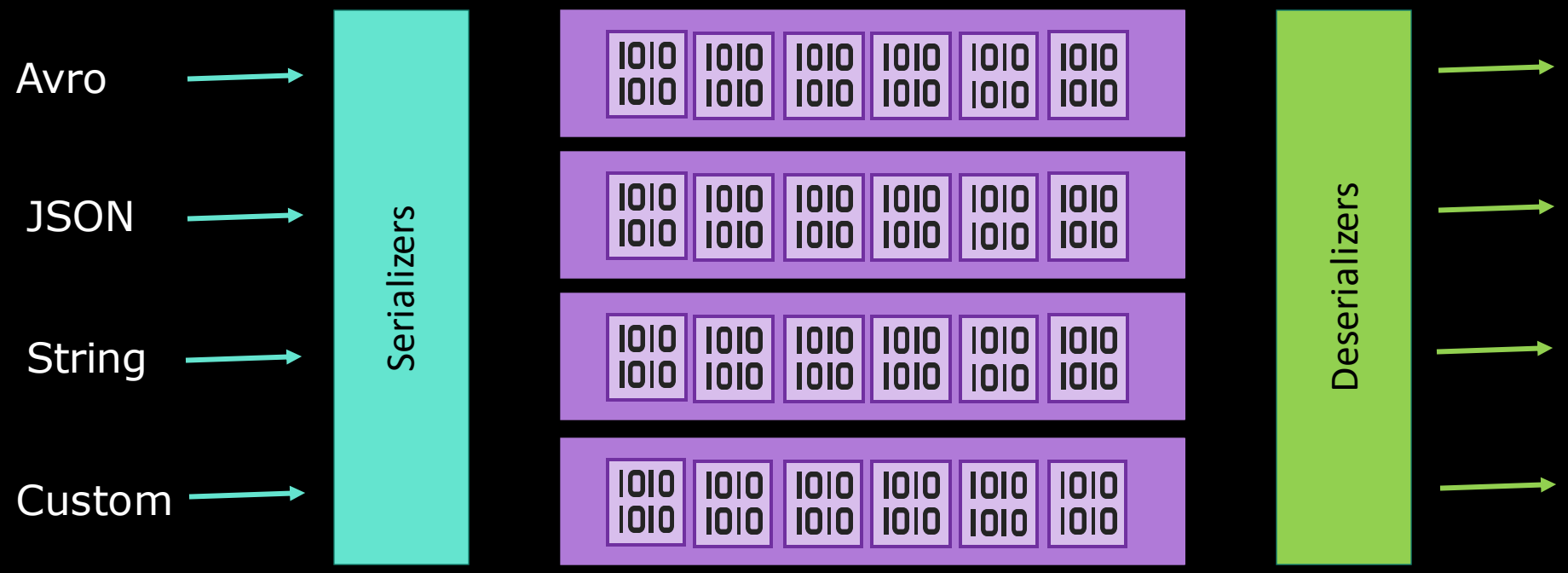
Serialisation
Kafka stores Byte Arrays



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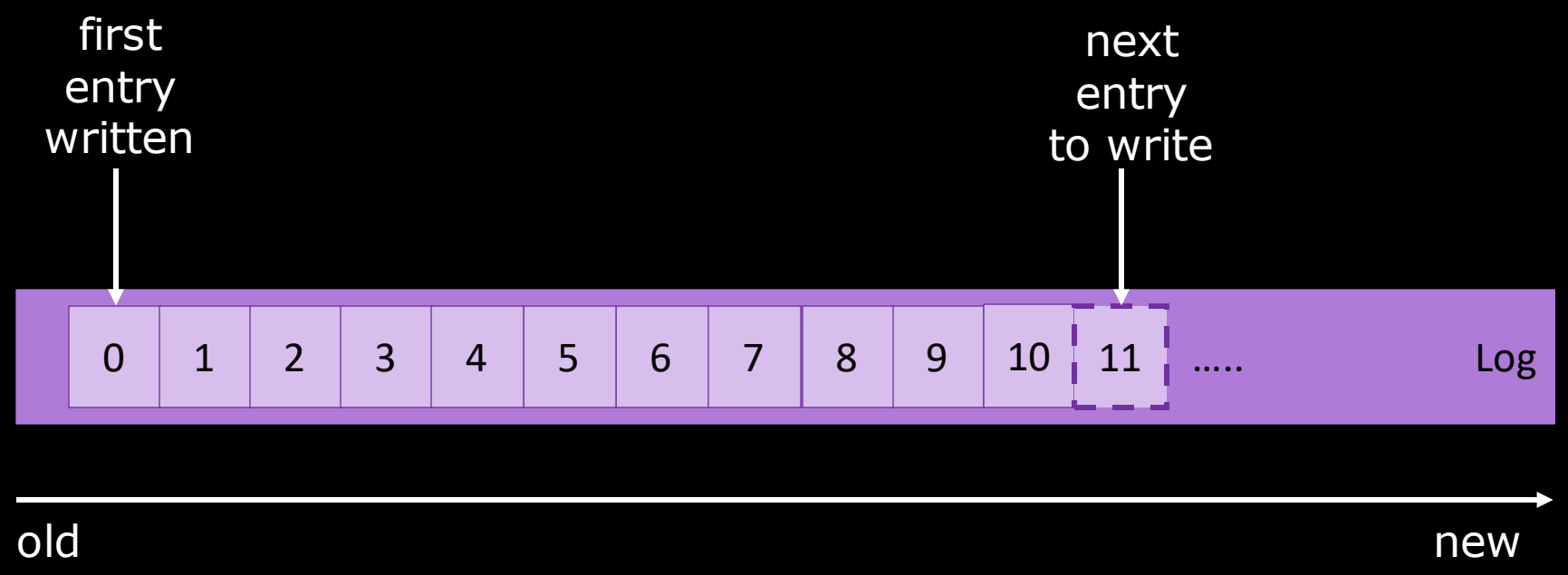
Kafka Commit Log
Abstraction to understand Streaming

- Immutable, append-only data structure (record,event)
- Offset: the position of the record/event in the log



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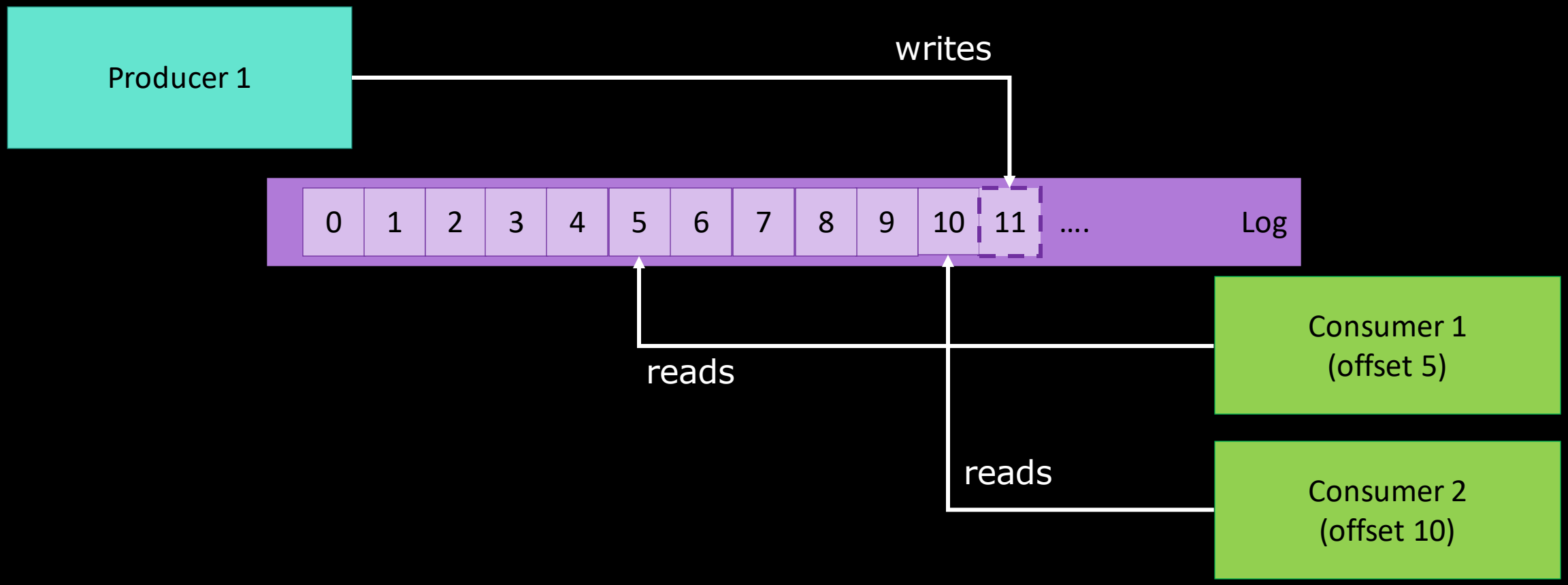
Decoupling Data Producers from Data Consumers



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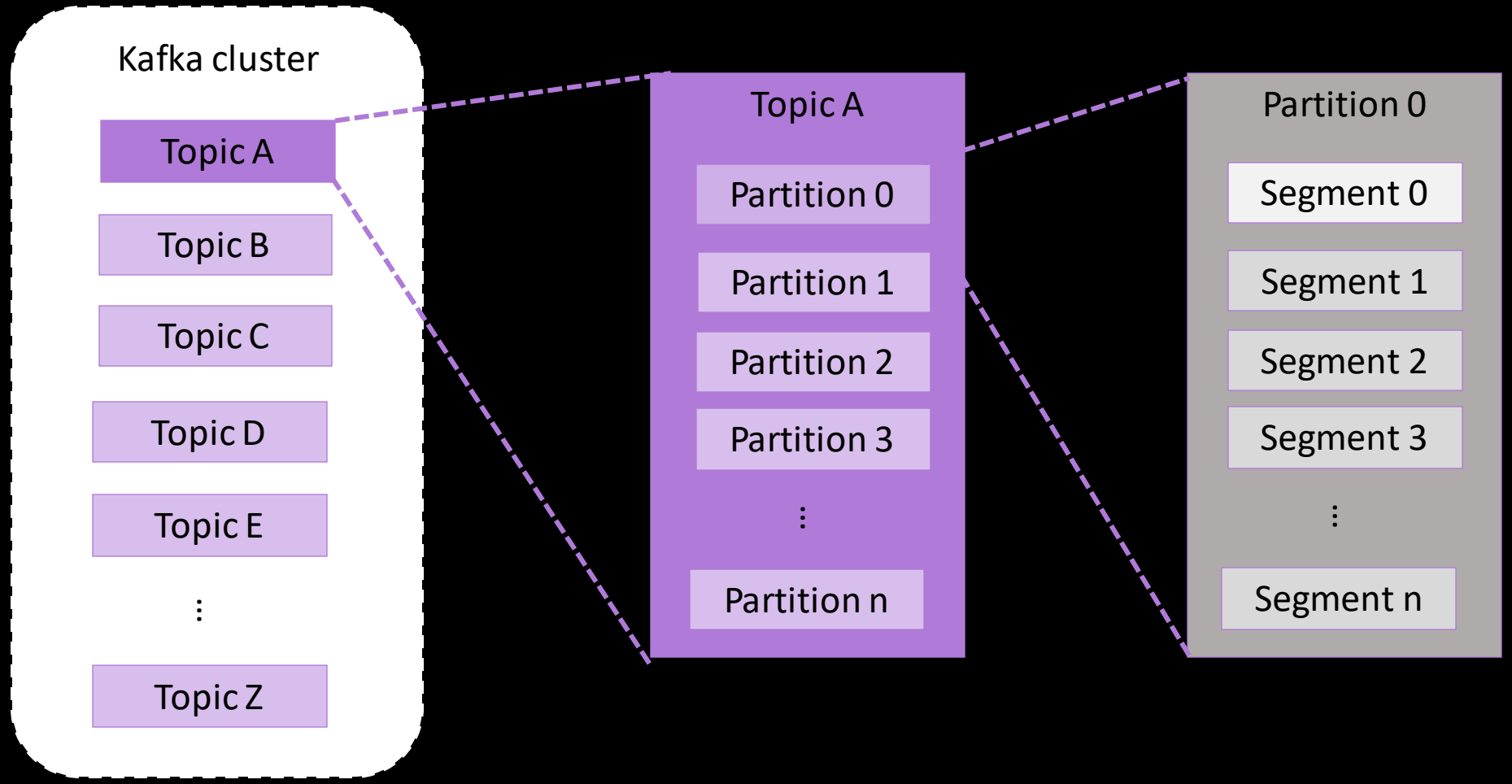
Logical View of Topics, Partitions & Segments
Each Partition is a Commit Log



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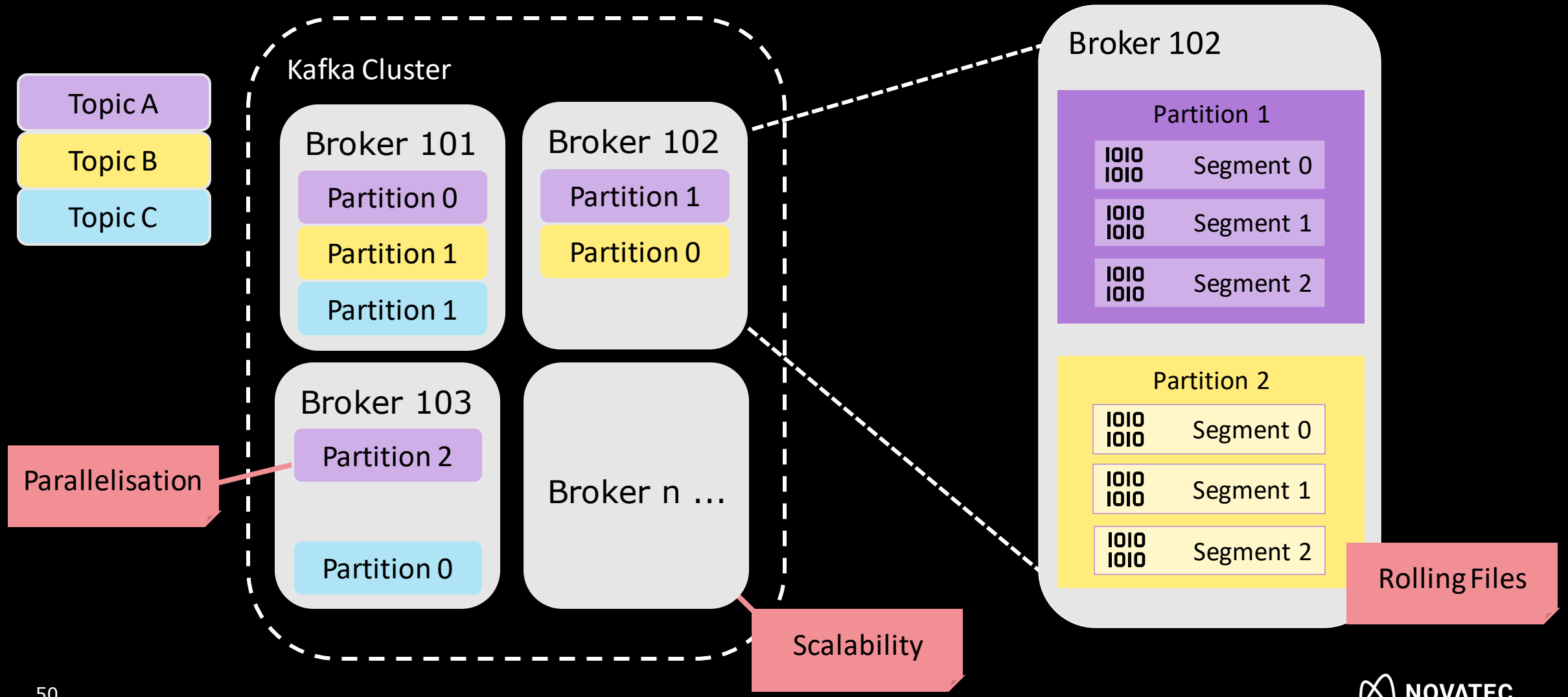
Physical View of Topics, Partitions & Segments



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Brokers in several Data Centers

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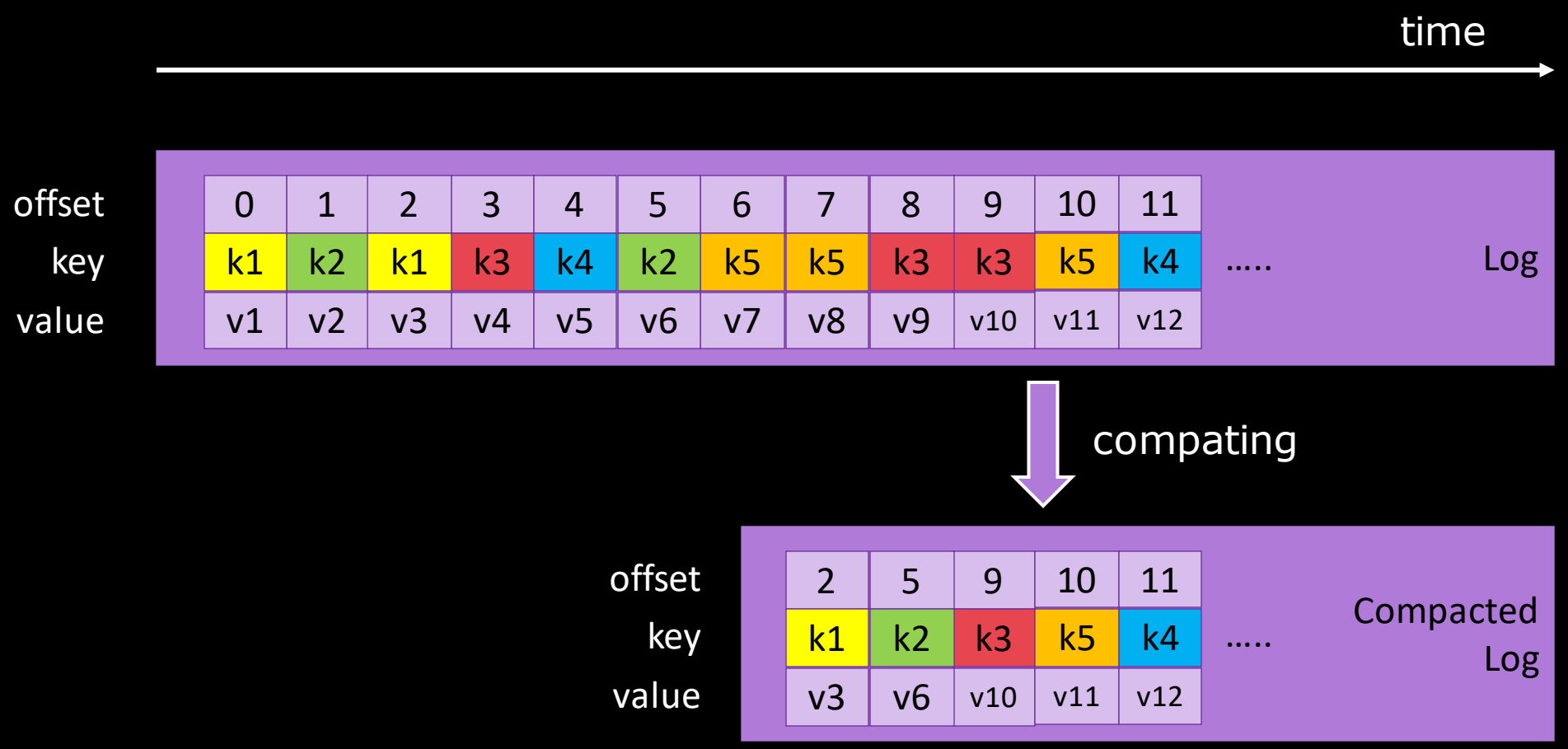
Managing Log File Growth Retention-Policies

- Cleanup.policy
  - delete (default)
    - Segments too old: retention.ms (default 7 days)
    - Partitions too large: retention.bytes (default: -1 unlimited)
  - compact (keep only the freshest value
  - delete and compact (Example: Order – Management)
- Cleanup applies to Segment-Files.
  - messages are guaranteed to live at least as long as retention time
  - only non-active segment files get deleted upon Cleanup

Log Compaction



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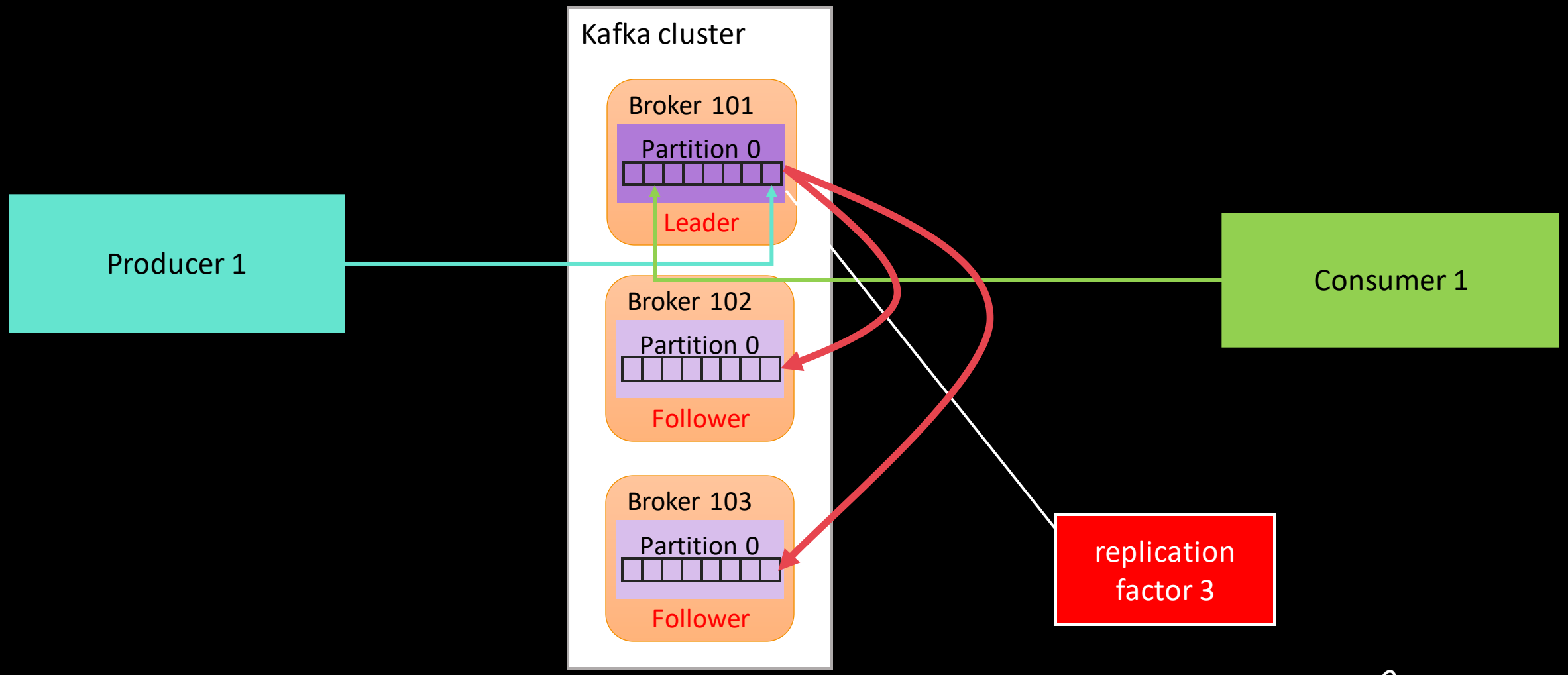
Reliability & Durability: Replication of Partitions



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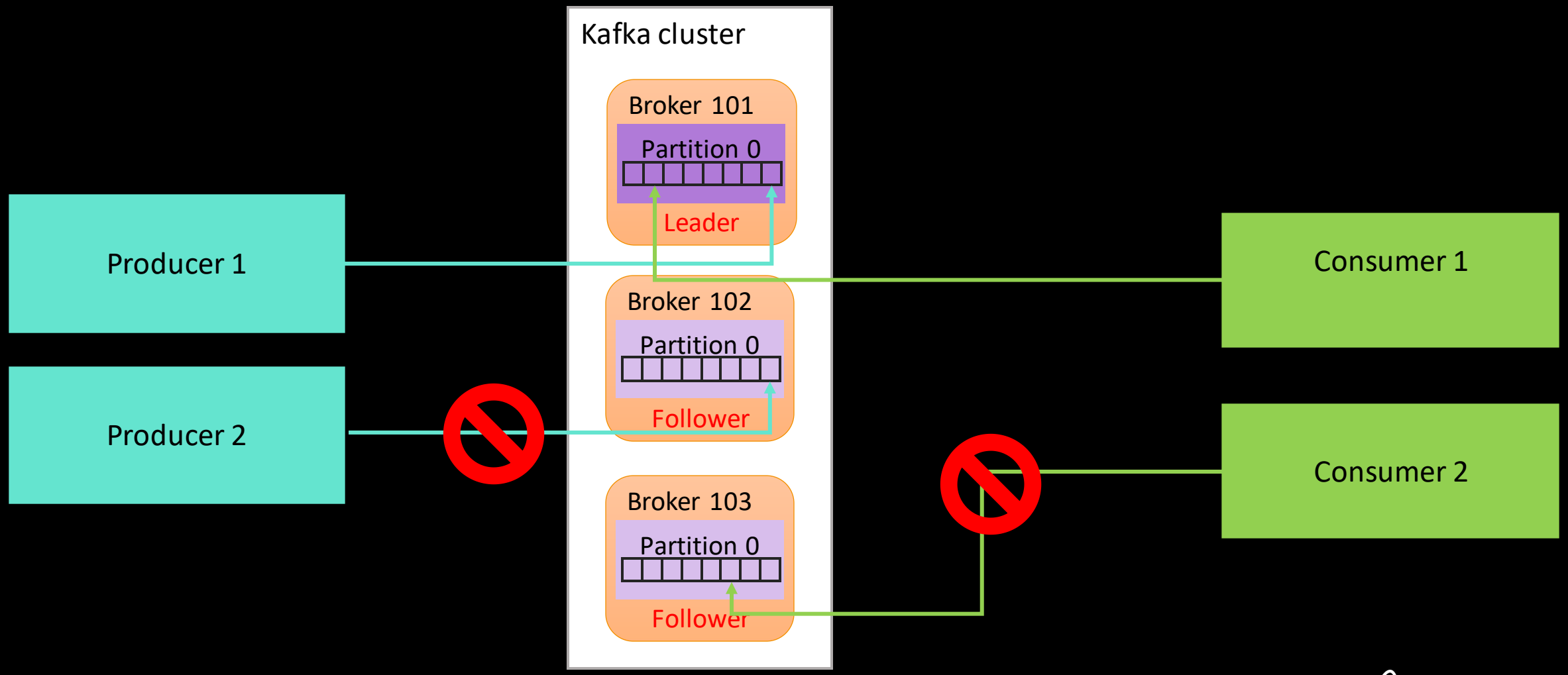
Clients interact with Leaders



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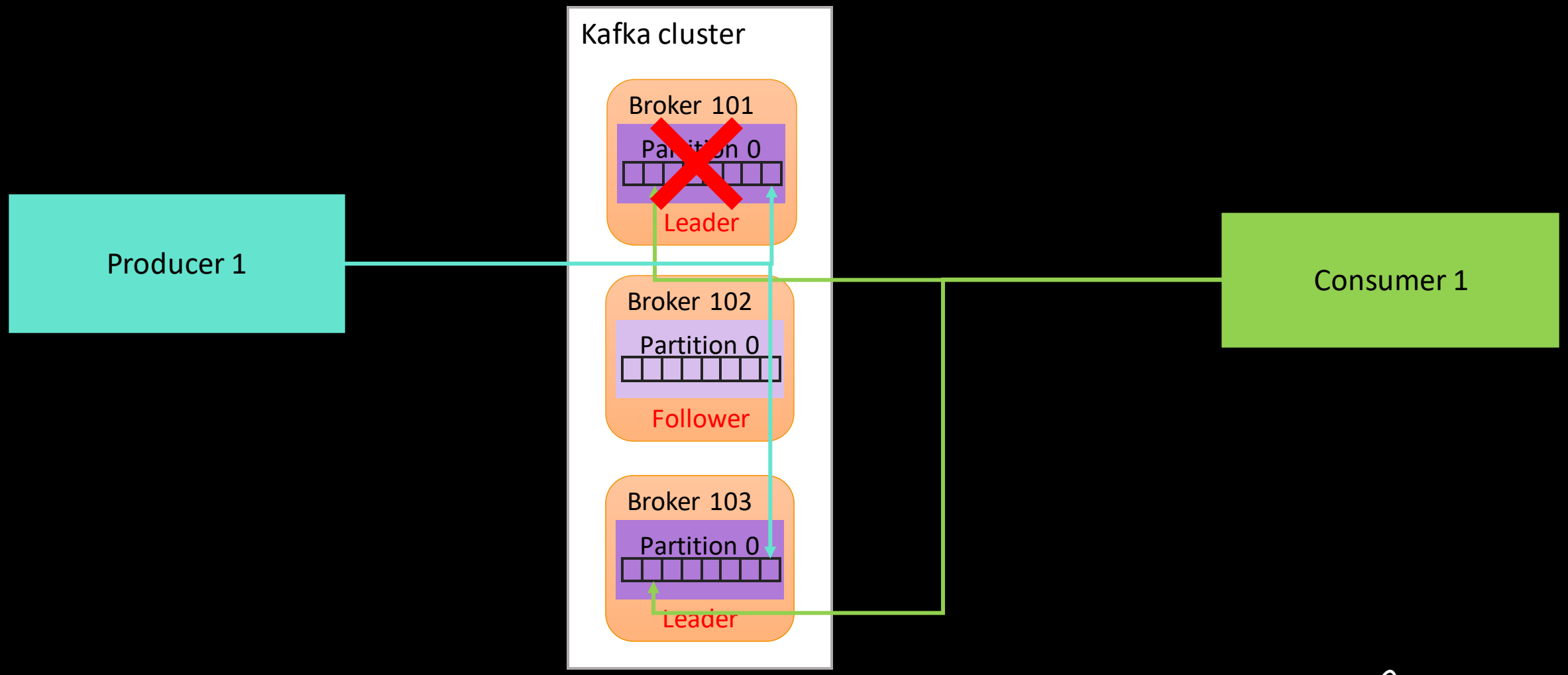
Leader Failover



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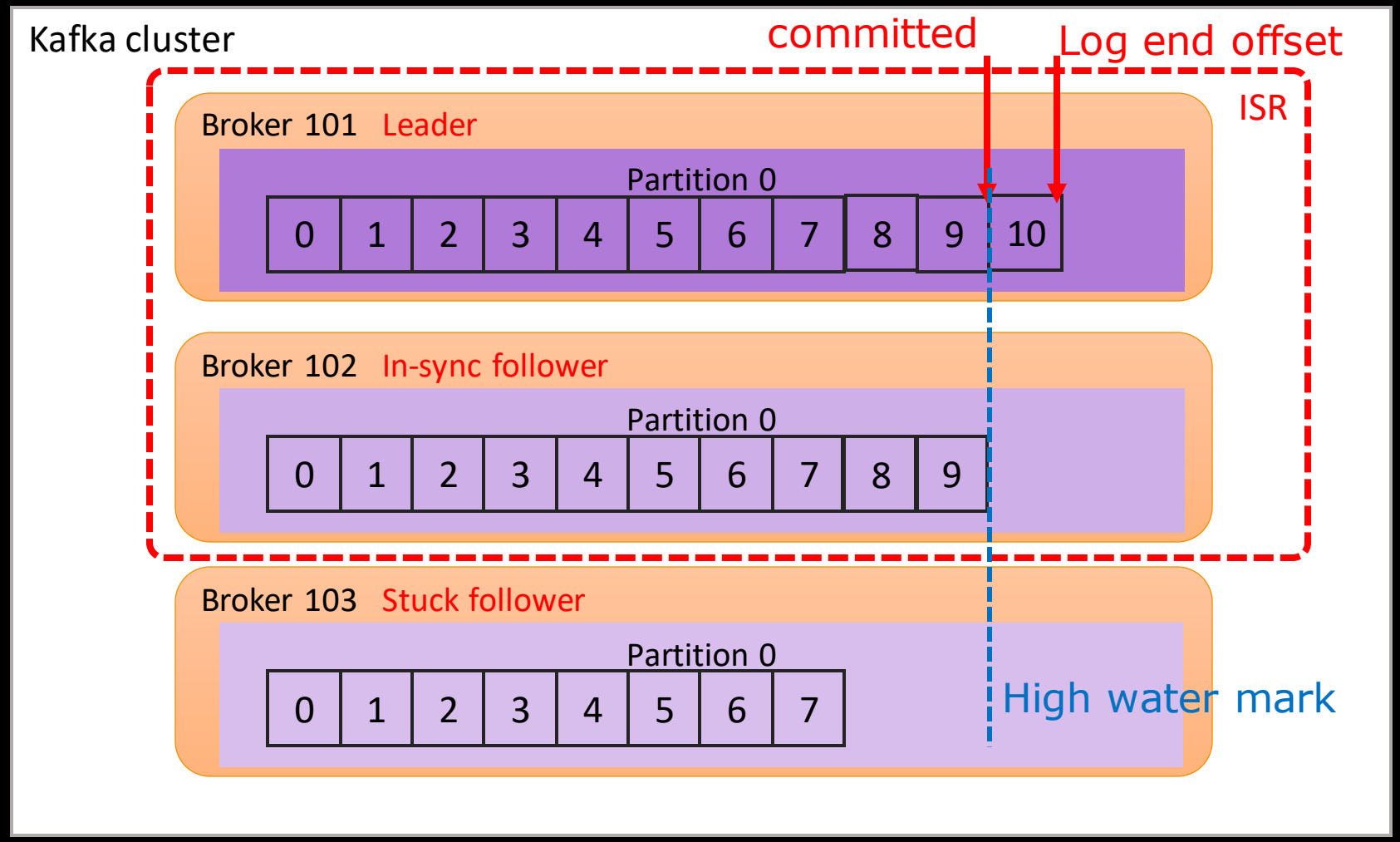
In-Sync Replicas



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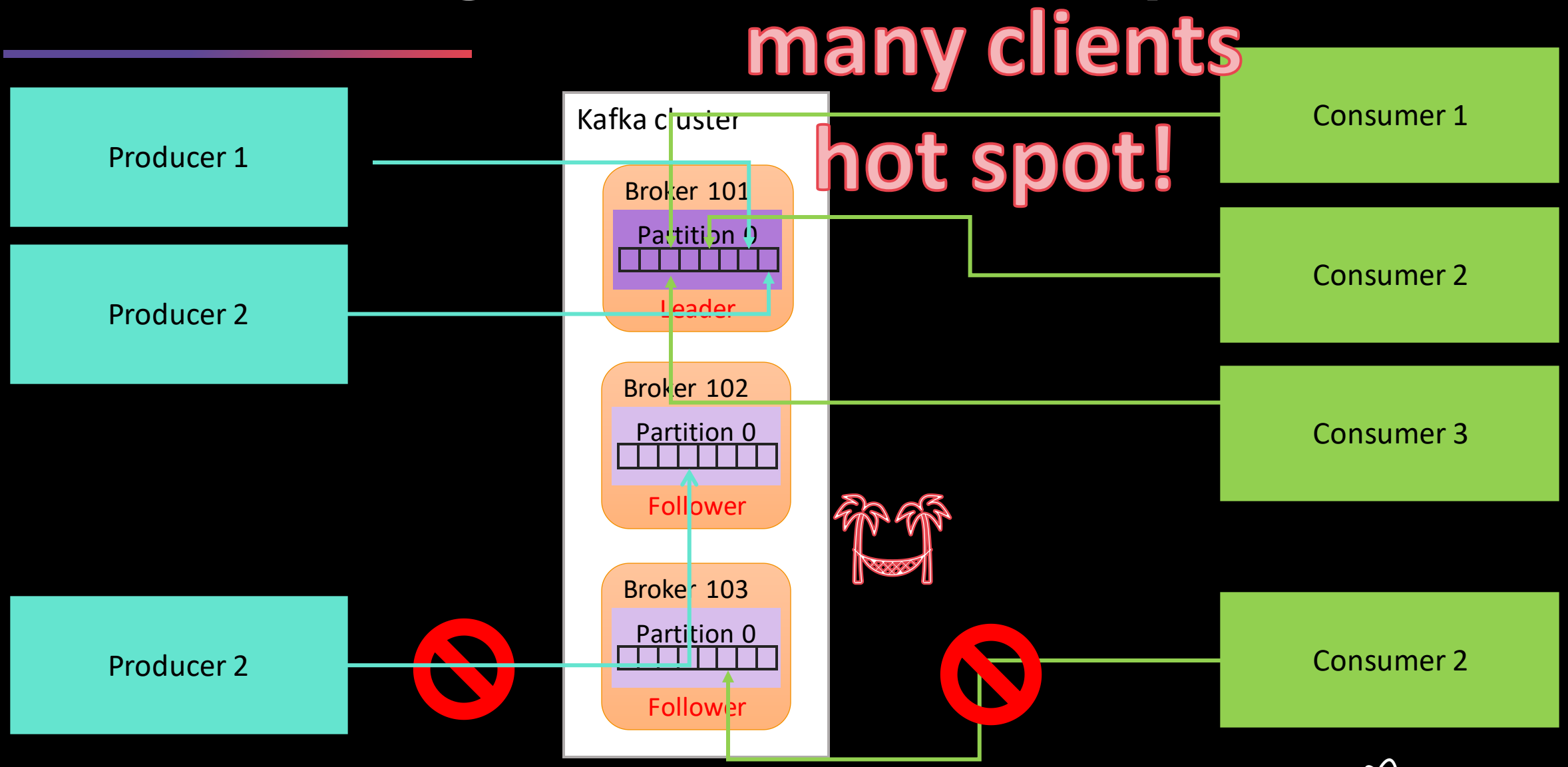
Load Balancing: Partition Leadership



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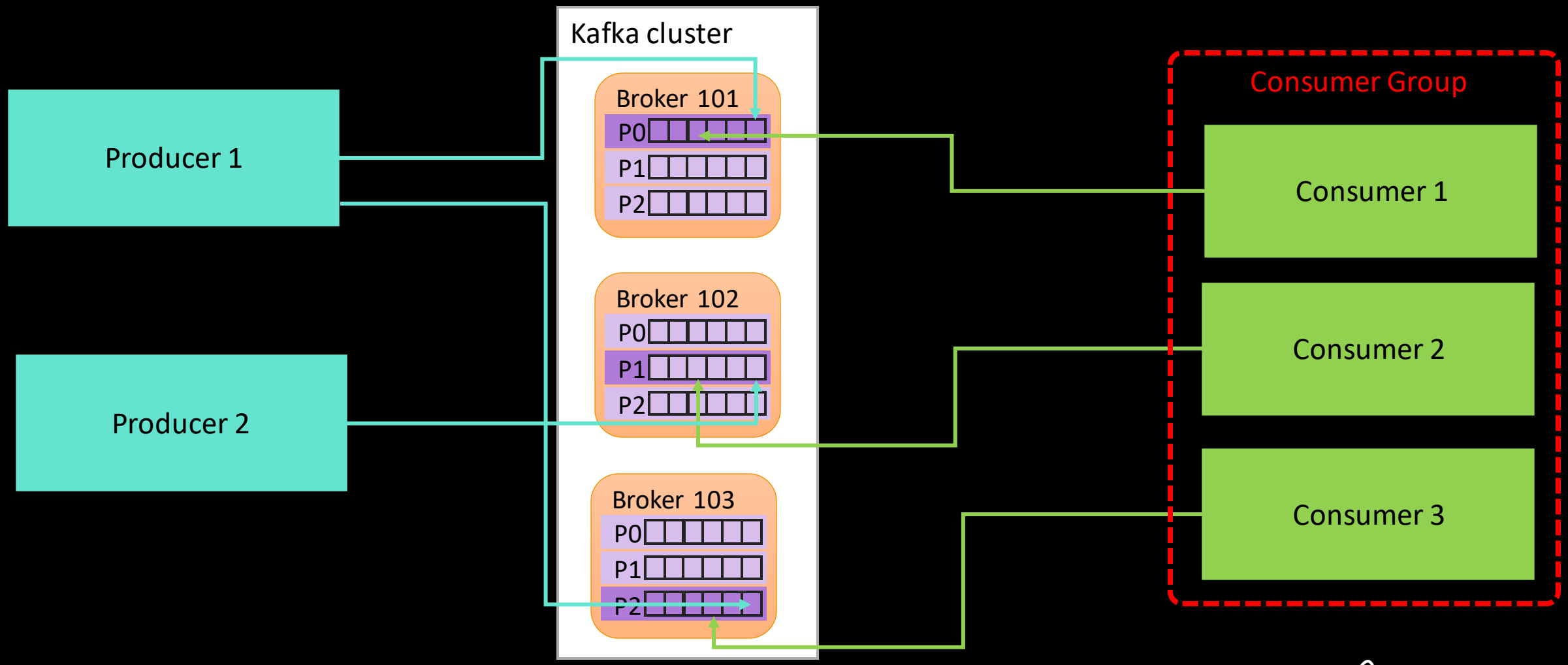
Load Balancing Partitions Leadership (2)



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Zookeeper: What is it good for?

- Controller Election
- Cluster Membership
- Topic Configuration
- Quotas
- Access Control Lists

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Kafka APIs

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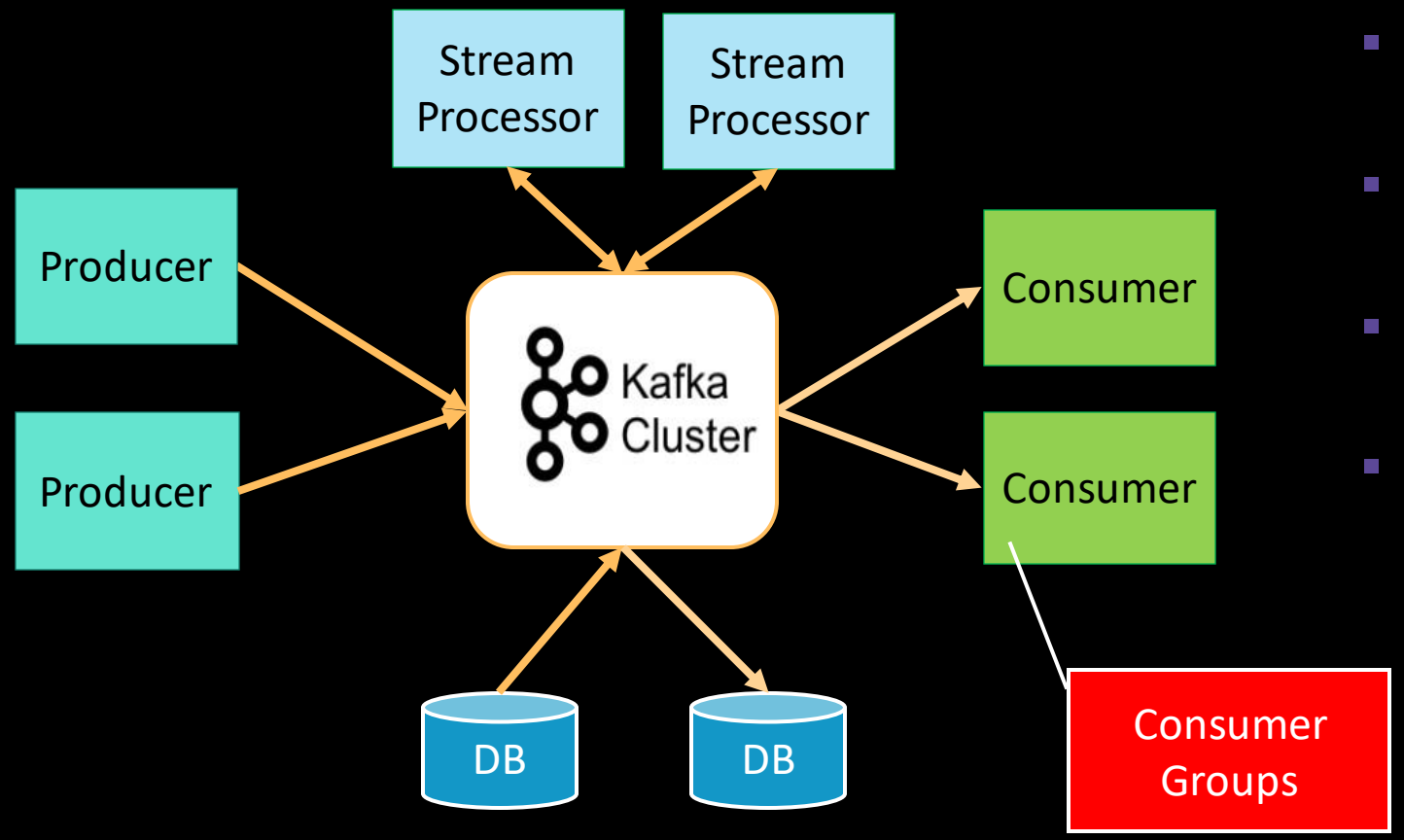
Kafka Core Components: 4 Core-APIs

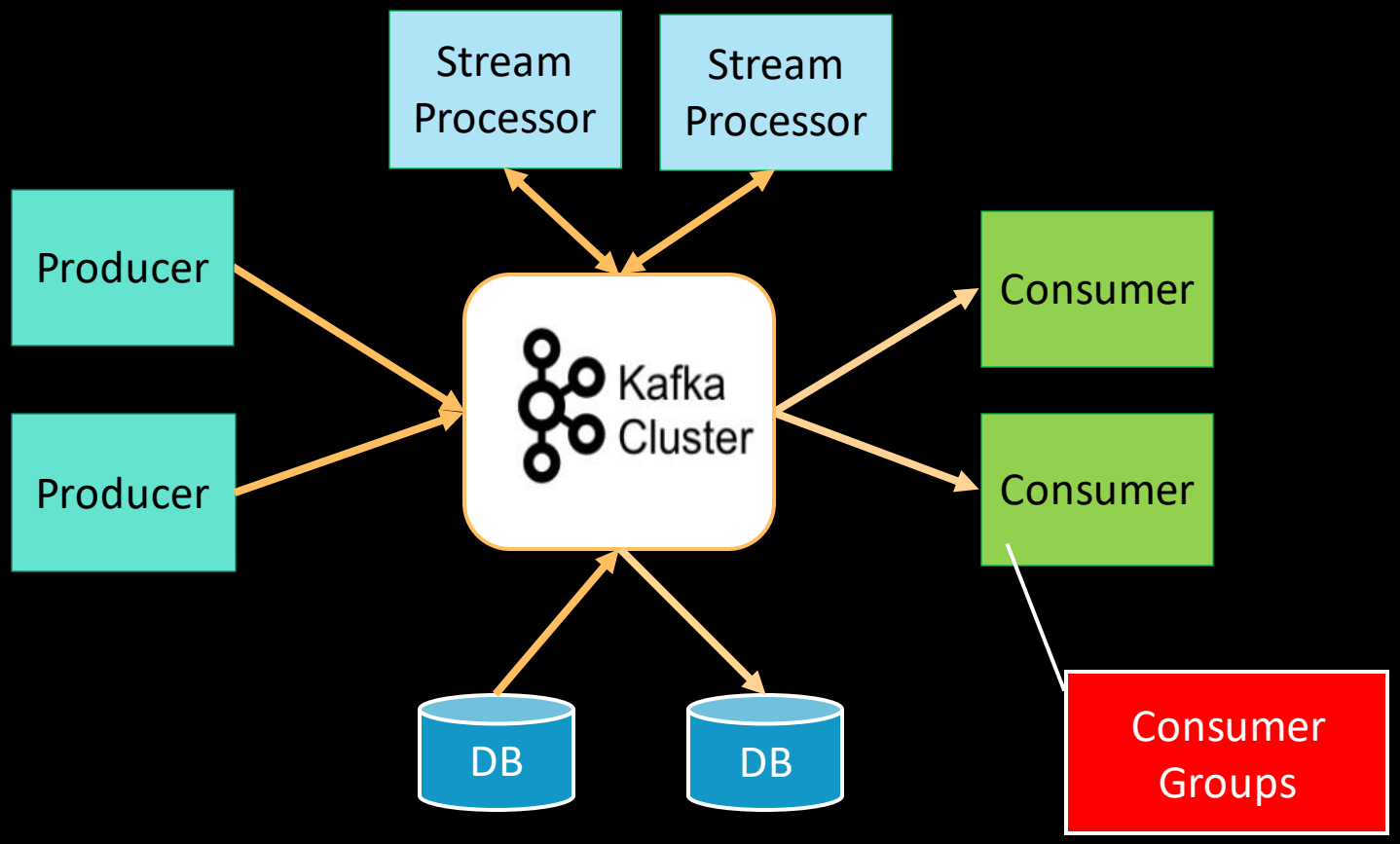


- Producer API: Enables to write messages
- Consumer API: Enables to read messages
- Streams API: Enables to analyze and transform messages
- Connect API: Enables the creation of reusable Clients

Kafka Clients supported by Confluent

- https://github.com/confluentinc/examples/tree/5.3.1-post/clients/cloud
- client code in many languages
- JVM: Java, Groovy, Scala, Kotlin, Clojure
- C-Library: C, C#, Go, NodeJS, Python, Ruby,

Kafka Core Components: Producer API



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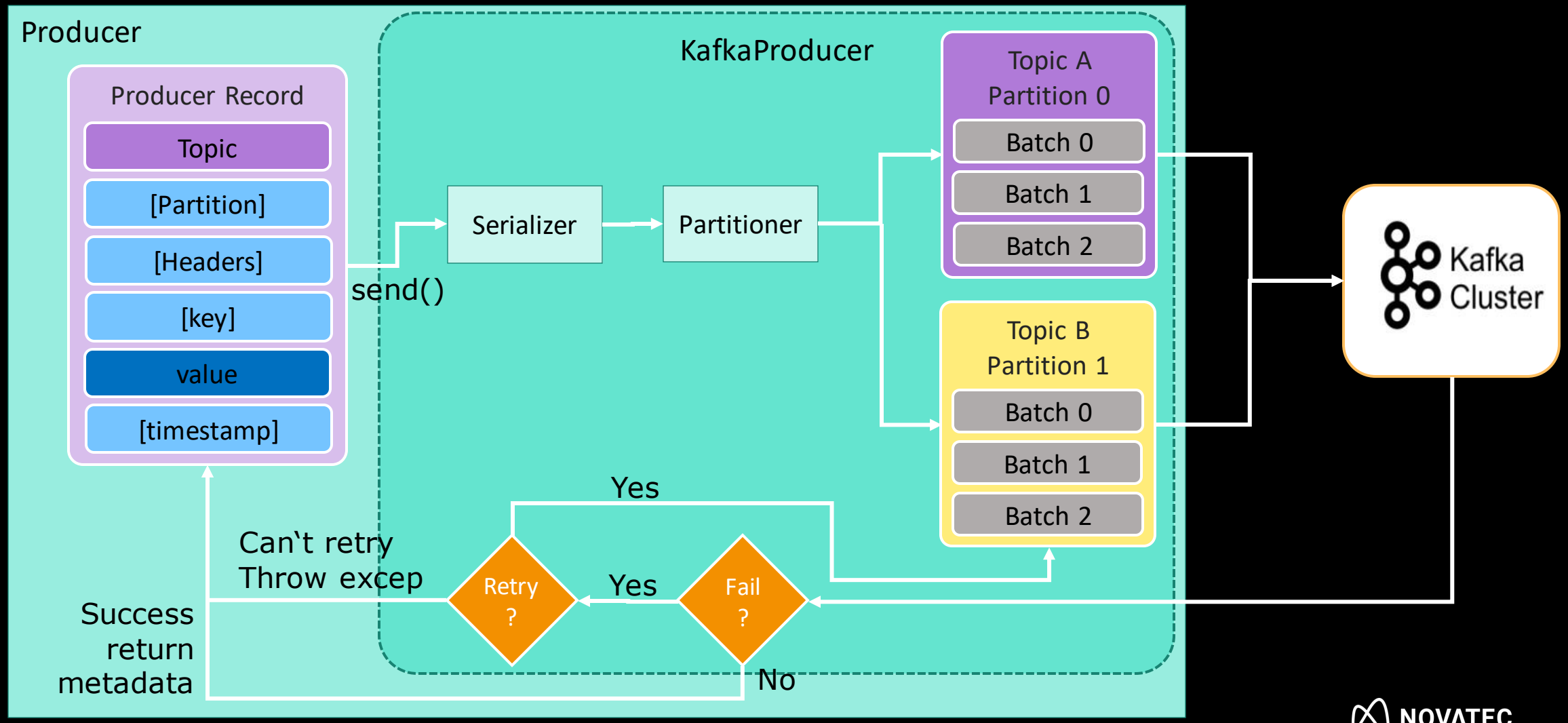
Producer API: High Level Architecture & Design



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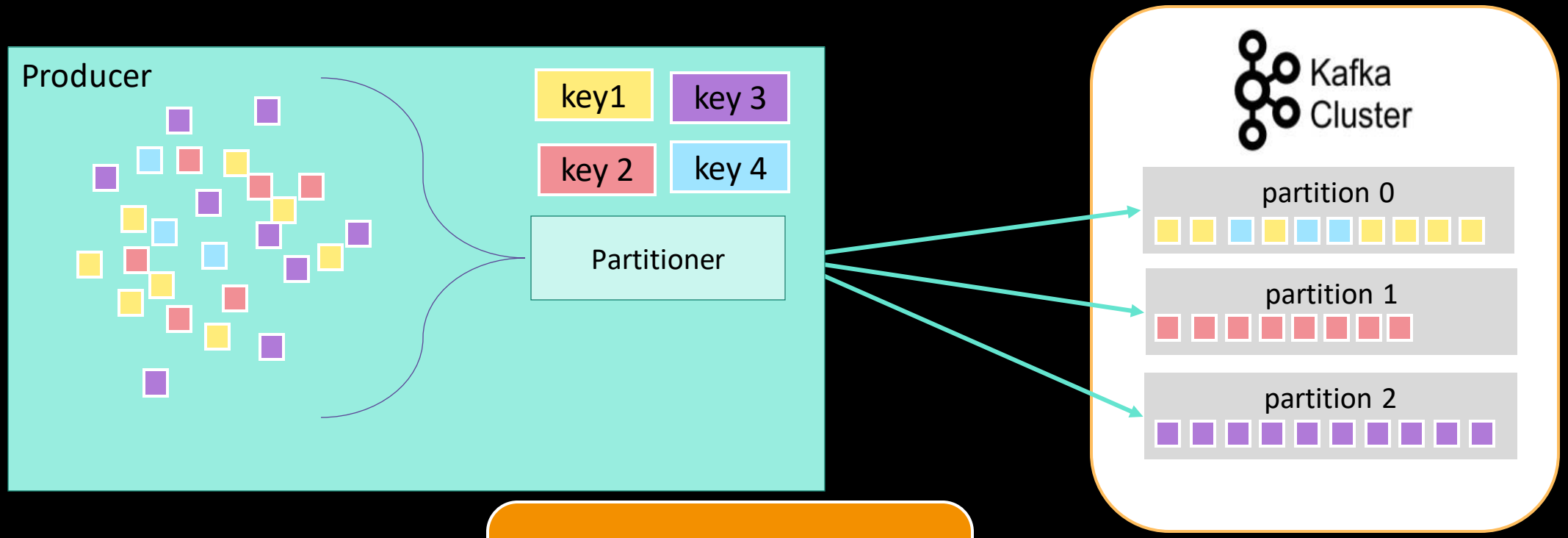
Default Partitioner



Partition = hash(key) % # partitions

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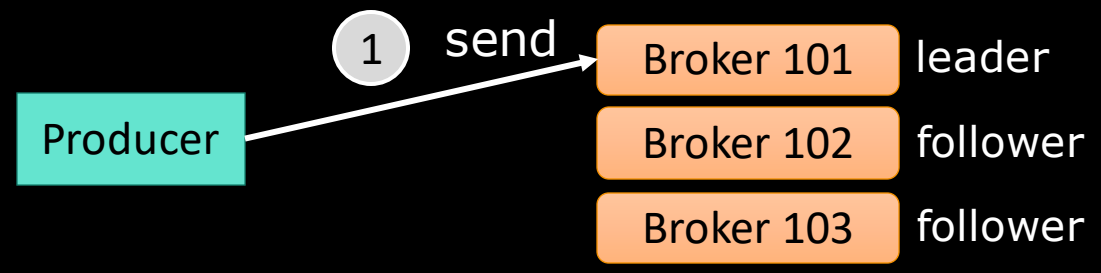
Acknowledgement



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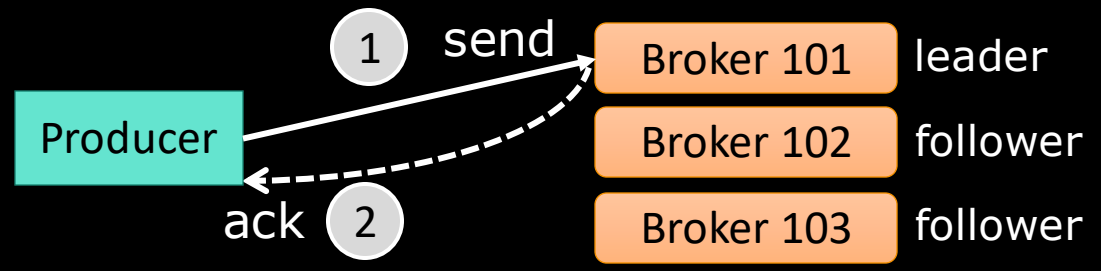

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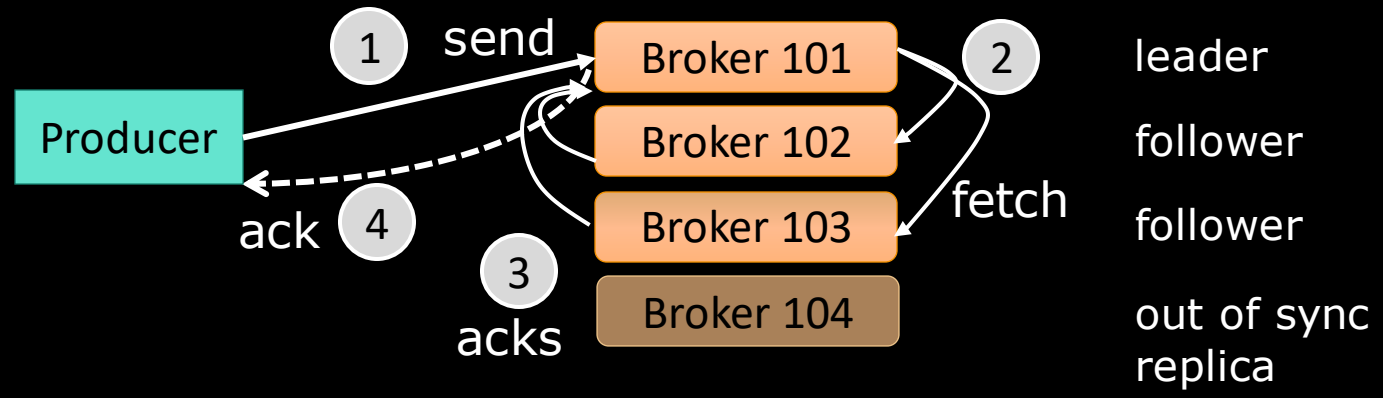

acks=all (-1)

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Development: A Basic Producer in Java

BasicProducer.java ×

```java
package clients;

import java.util.Properties;
import org.apache.kafka.clients.producer.KafkaProducer;
import org.apache.kafka.clients.producer.ProducerRecord;

public class BasicProducer {
    public static void main(String[] args) {
        System.out.println("*** Starting Basic Producer ***");

        Properties settings = new Properties();
        settings.put("client.id", "basic-producer-v0.1.0");
        settings.put("bootstrap.servers", "kafka-1:9092,kafka-2:9092");
        settings.put("key.serializer", "org.apache.kafka.common.serialization.StringSerializer");
        settings.put("value.serializer", "org.apache.kafka.common.serialization.StringSerializer");

        final KafkaProducer<String, String> producer = new KafkaProducer<>(settings);

        Runtime.getRuntime().addShutdownHook(new Thread(() -> {
            System.out.println("### Stopping Basic Producer ###");
            producer.close();
        }));

        final String topic = "hello_world_topic";
        for(int i=1; i<=5; i++){
            final String key = "key-" + i;
            final String value = "value-" + i;
            final ProducerRecord<String, String> record = new ProducerRecord<>(topic, key, value);
            producer.send(record);
        }
    }
}
```

configuration

create producer

shutdown behaviour

sending data

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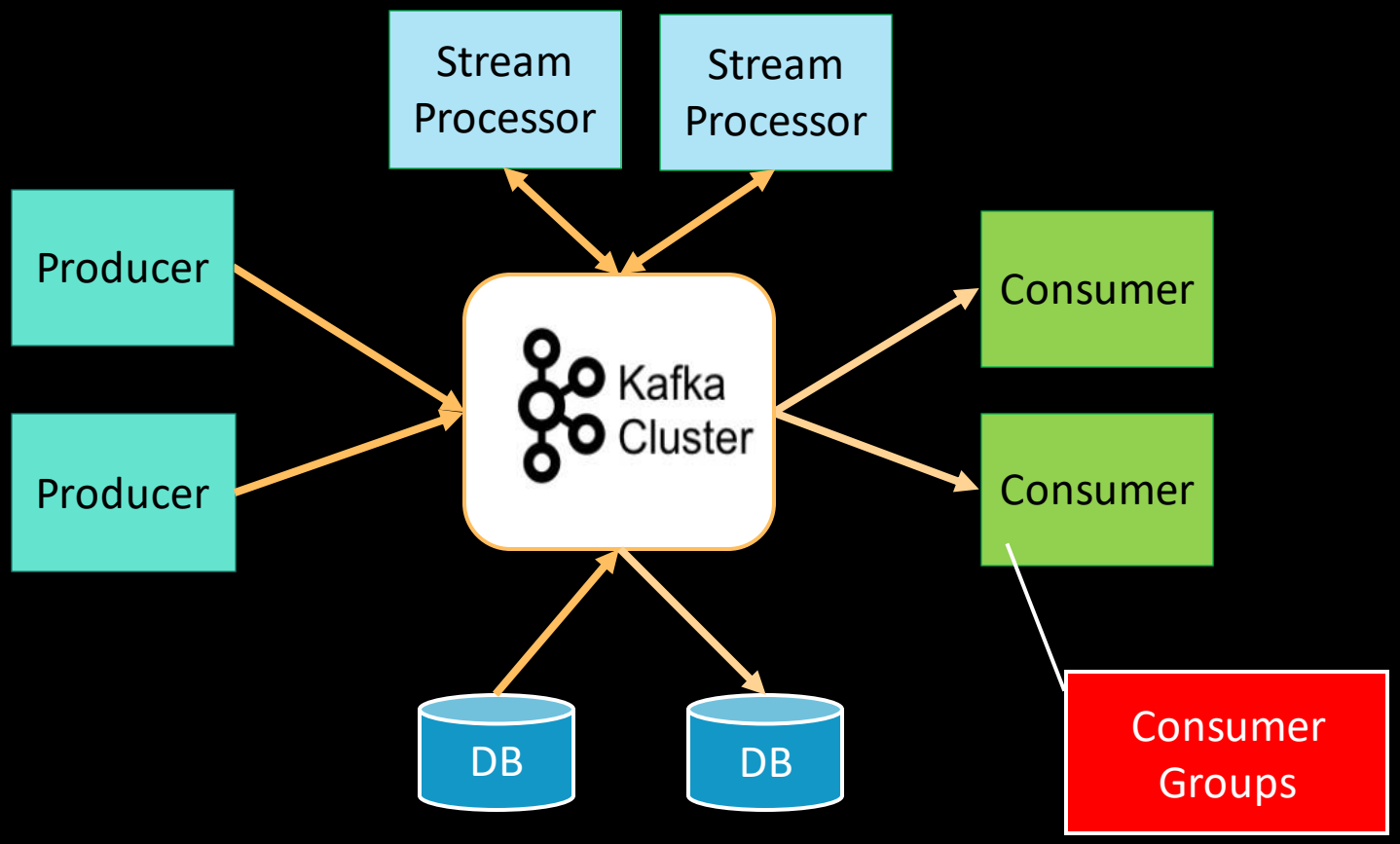
Kafka Core Components: Consumer API



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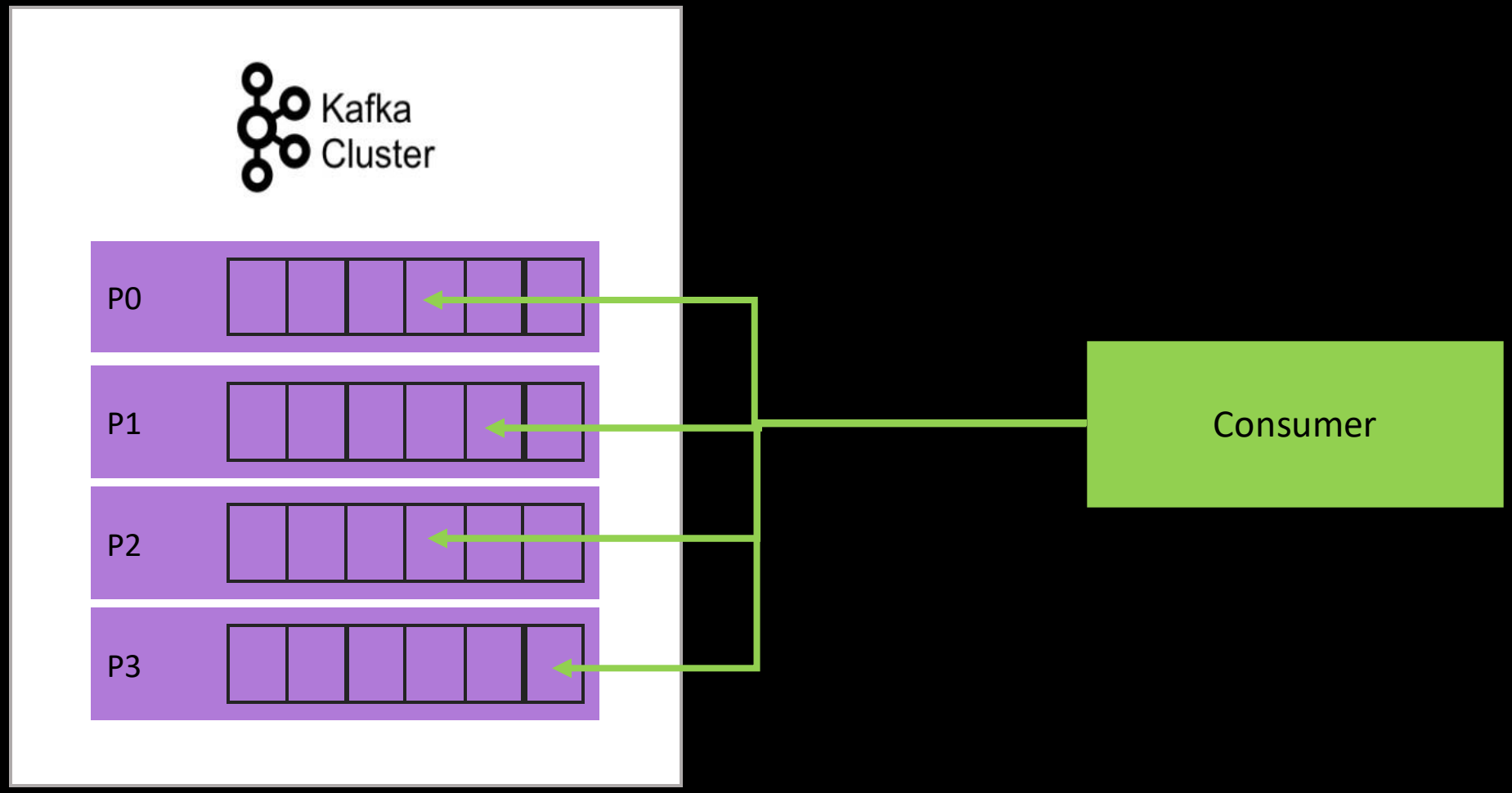
Consuming from Kafka: Single Consumer



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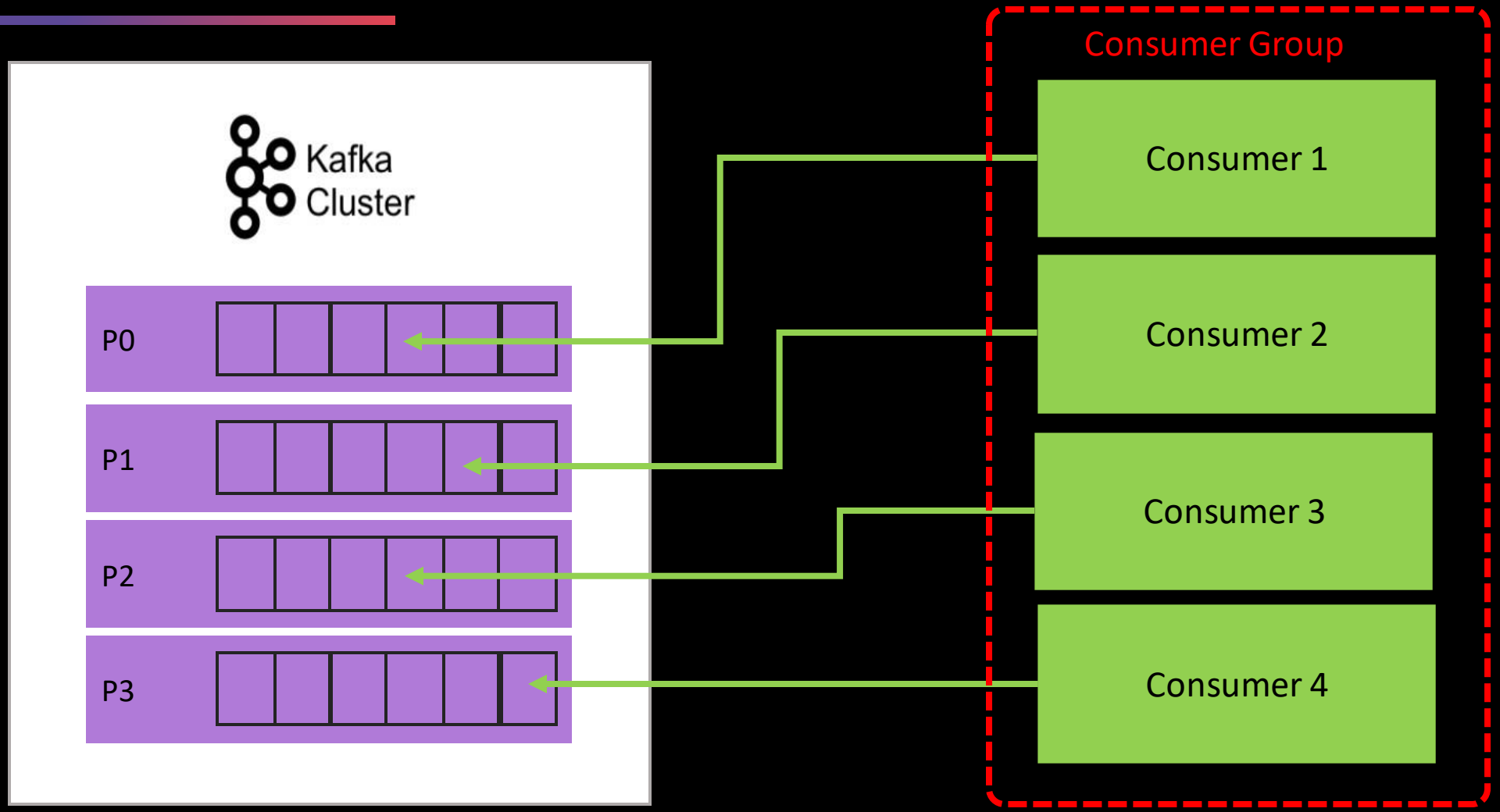
Consuming from Kafka: Consumer Group



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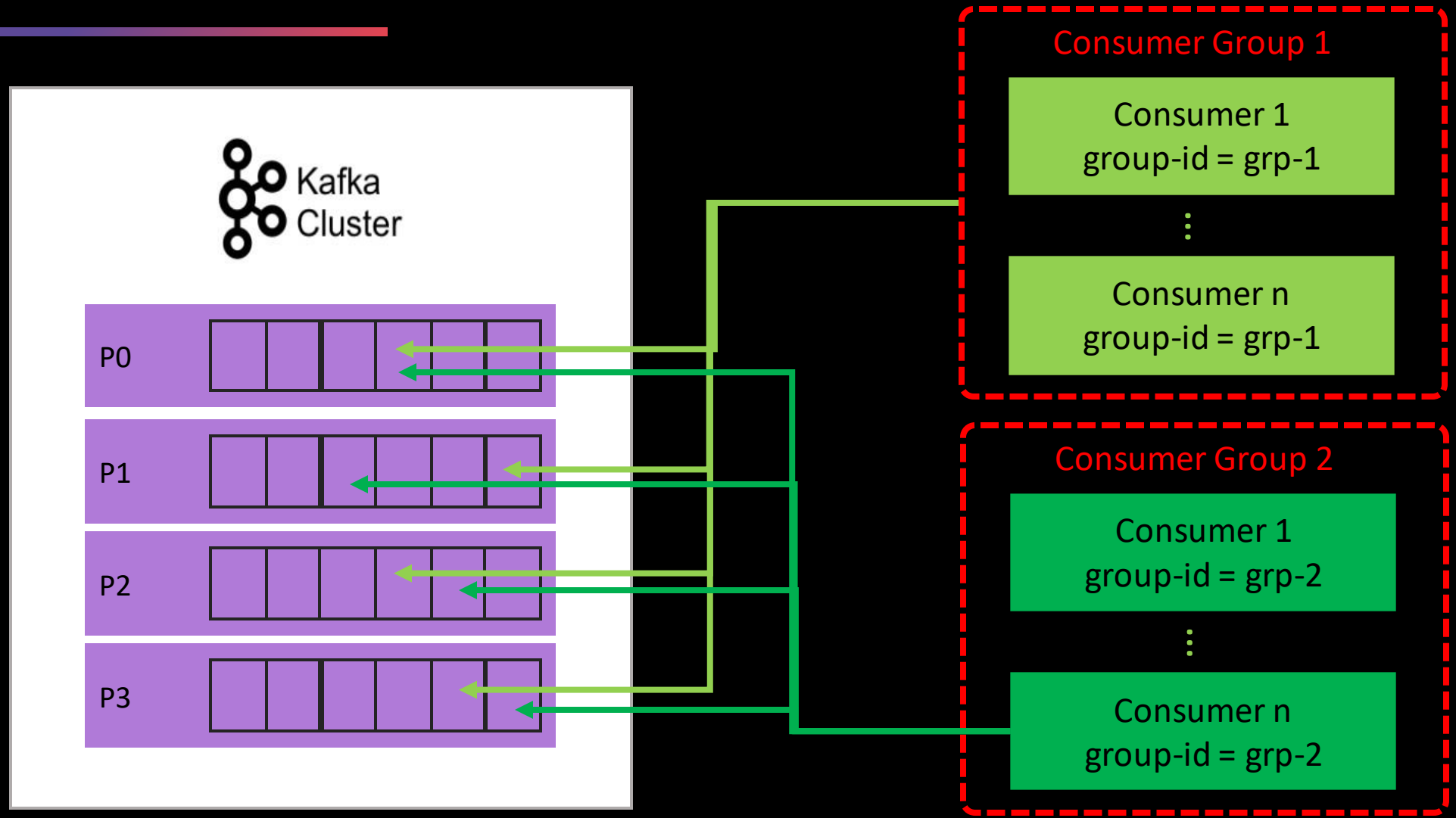
Consuming from Kafka: Multiple Groups



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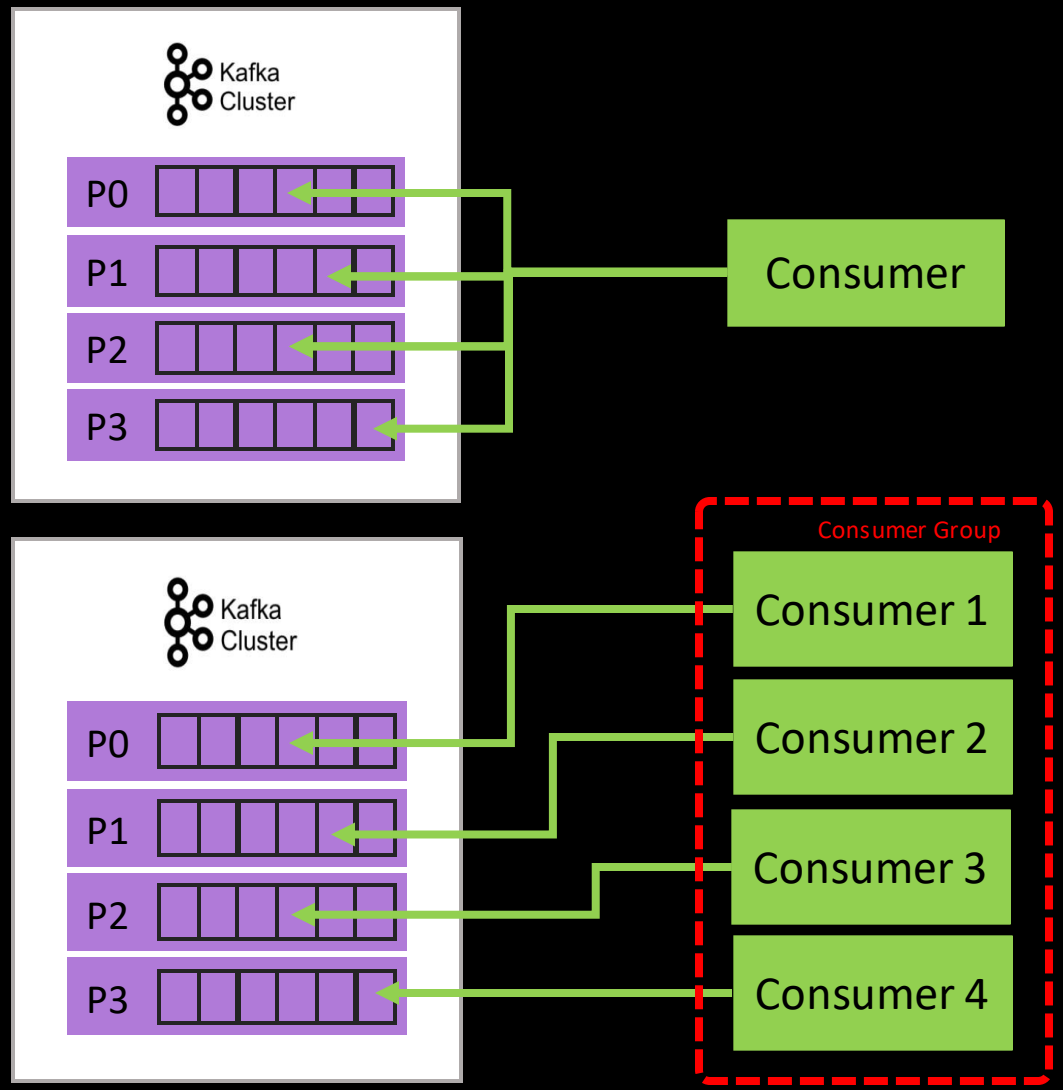
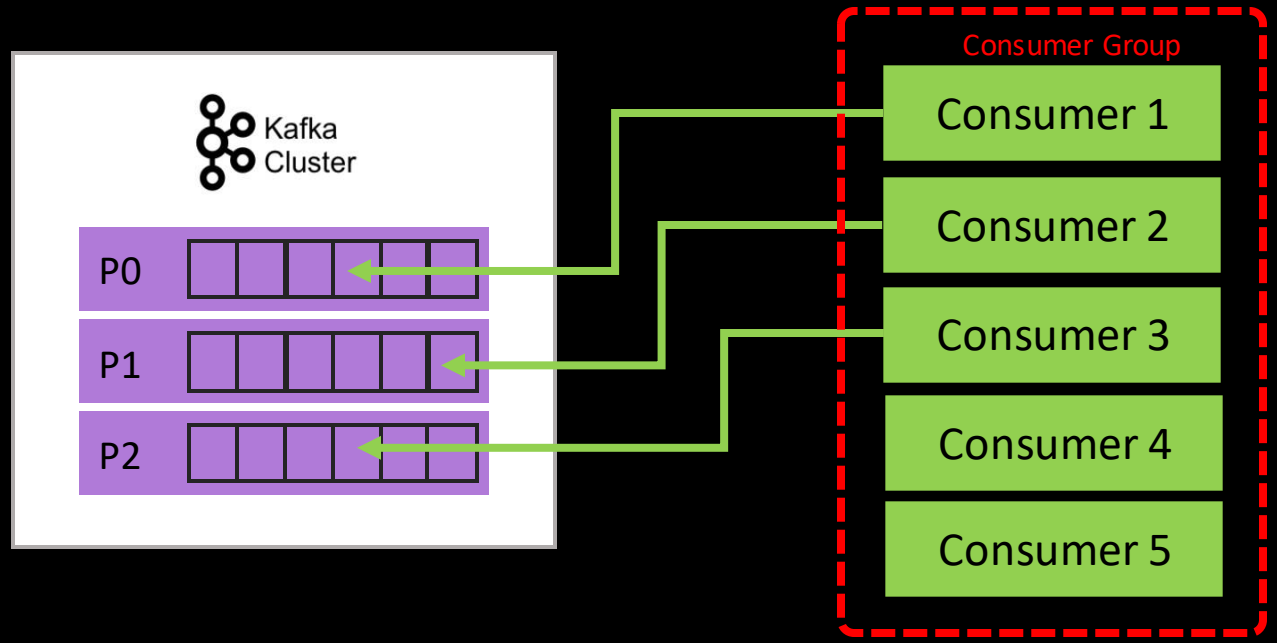
Scalability is limited by Number of Partitions



- number of useful consumers in a group is constrained by the number of partitions



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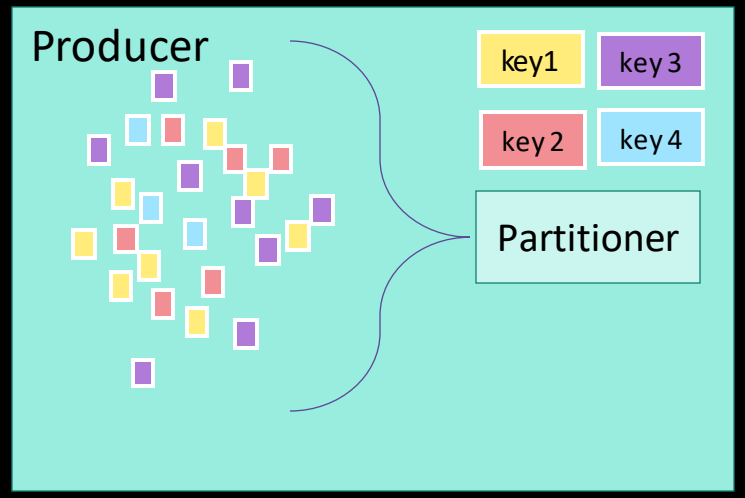
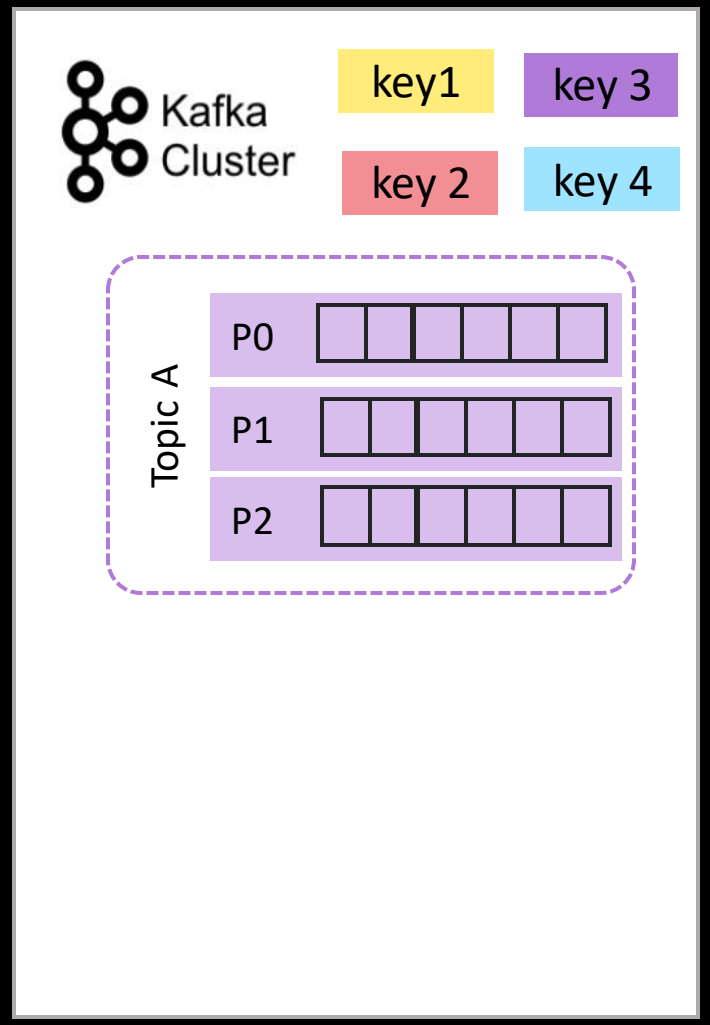
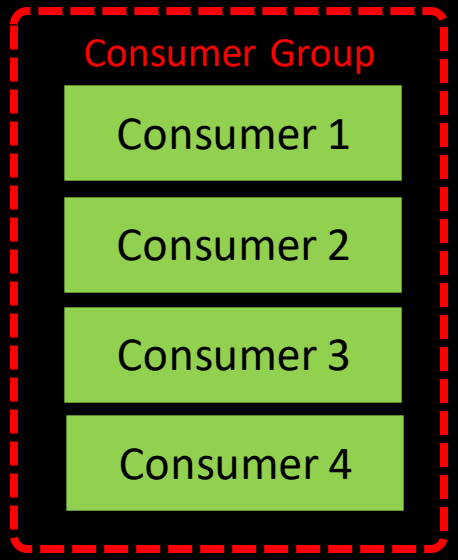
How are Partitions assigned to Consumers 1







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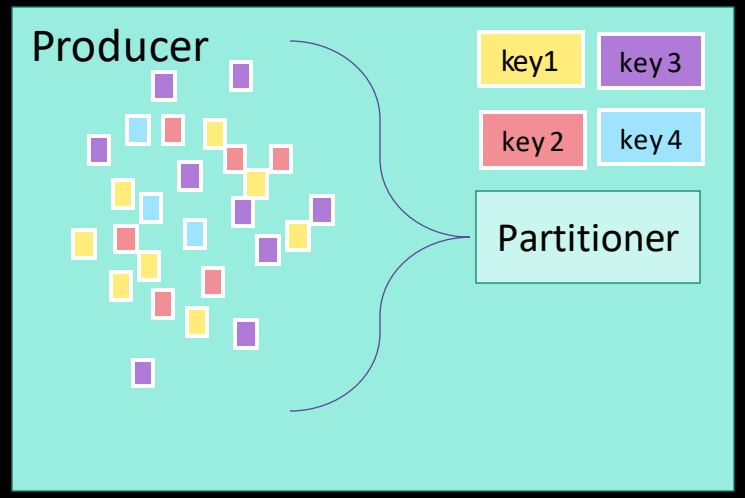
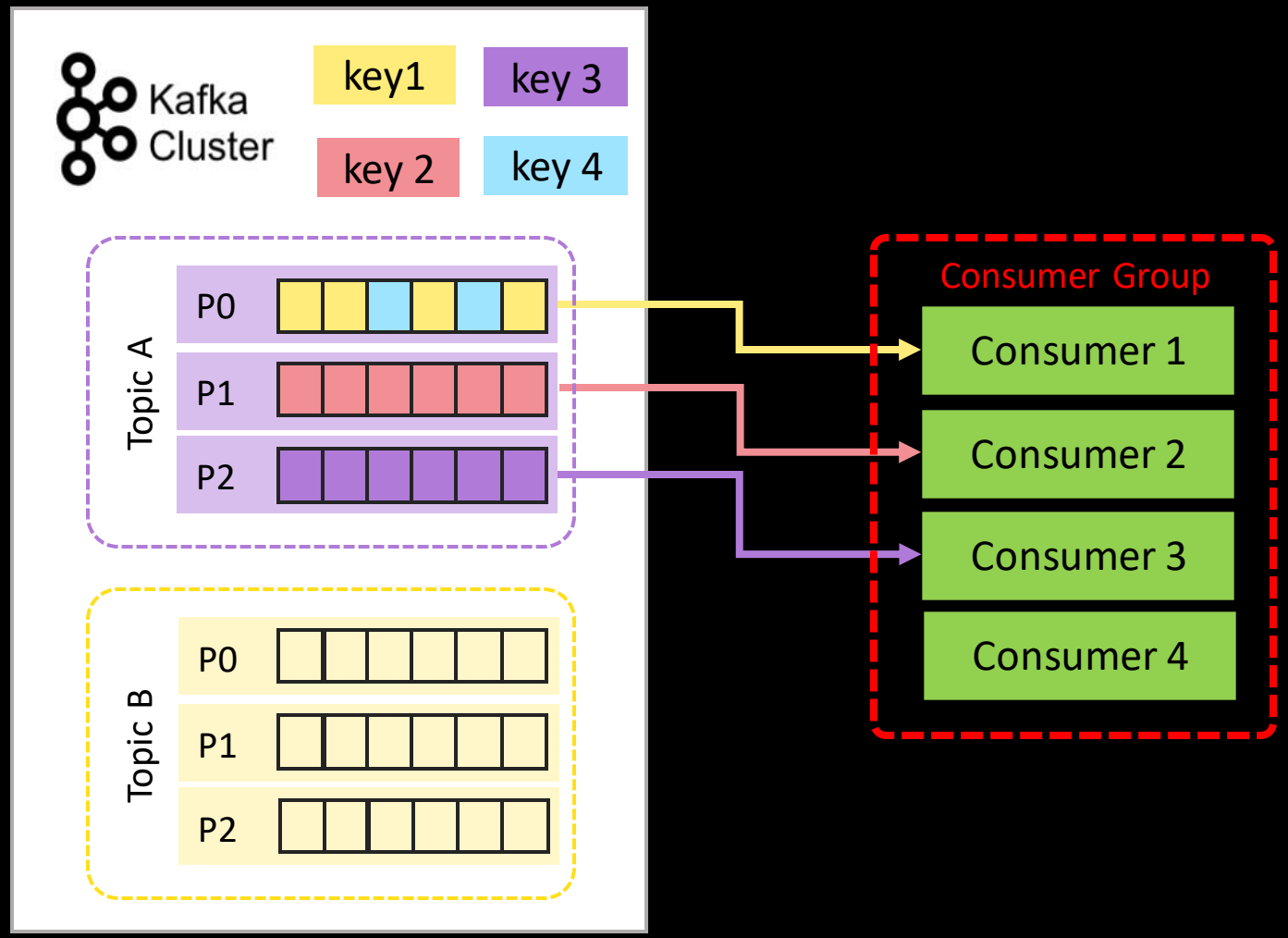
How are Partitions assigned to Consumers 2





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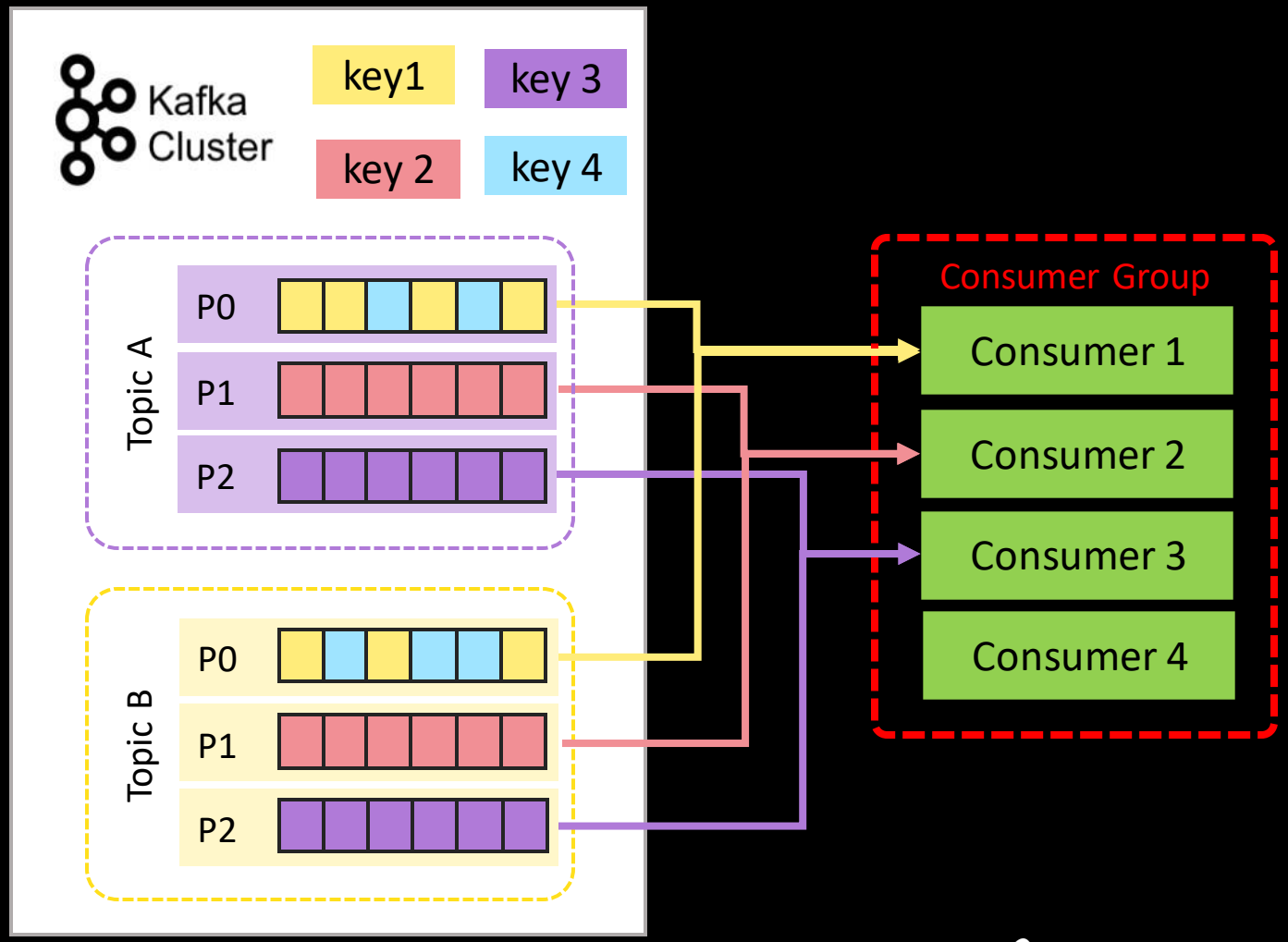
How are Partitions assigned to Consumers 3

- partition.assignment.strategy consumer property:
  - RangeAssignor (used in stream-processing for co-partitioned topics)
  - RoundRobinAssignor
  - StickyAssignor



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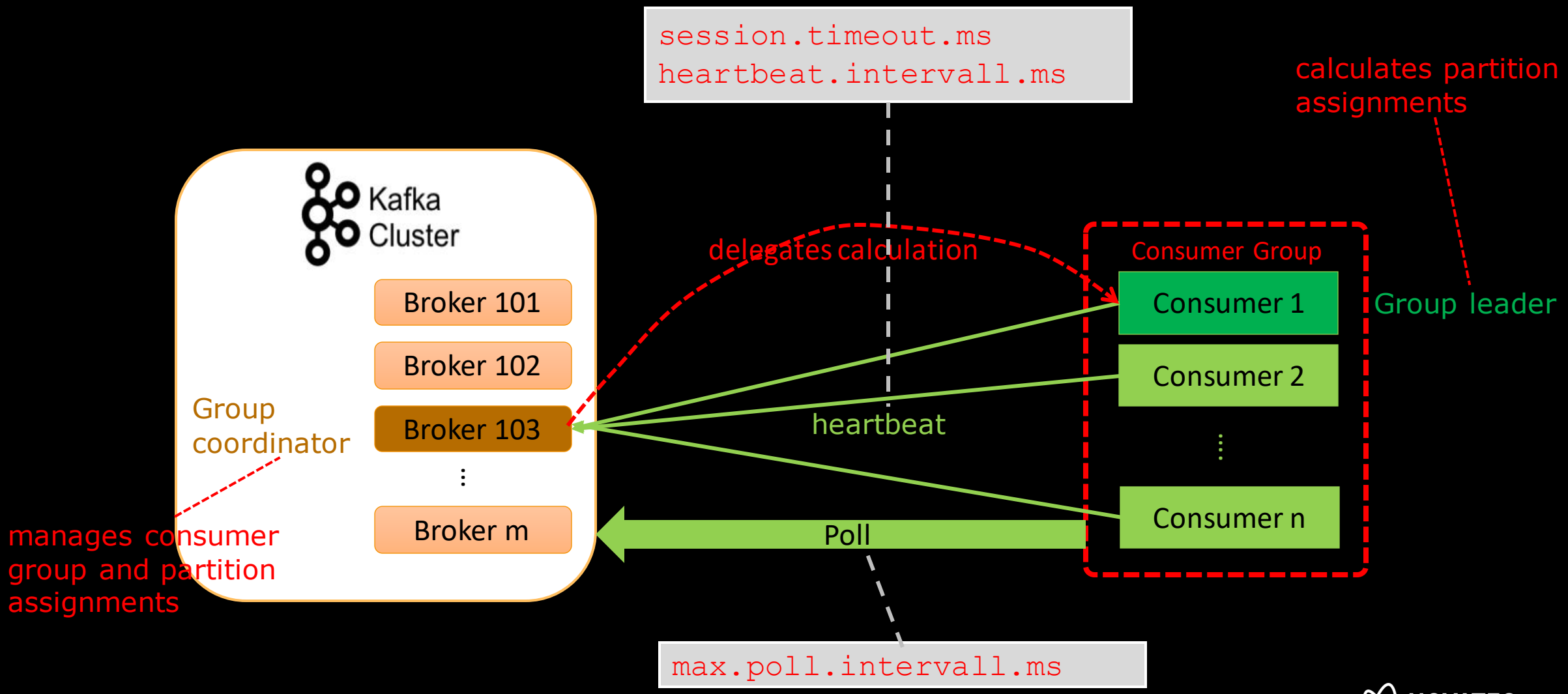
Consumer Liveliness 1-3



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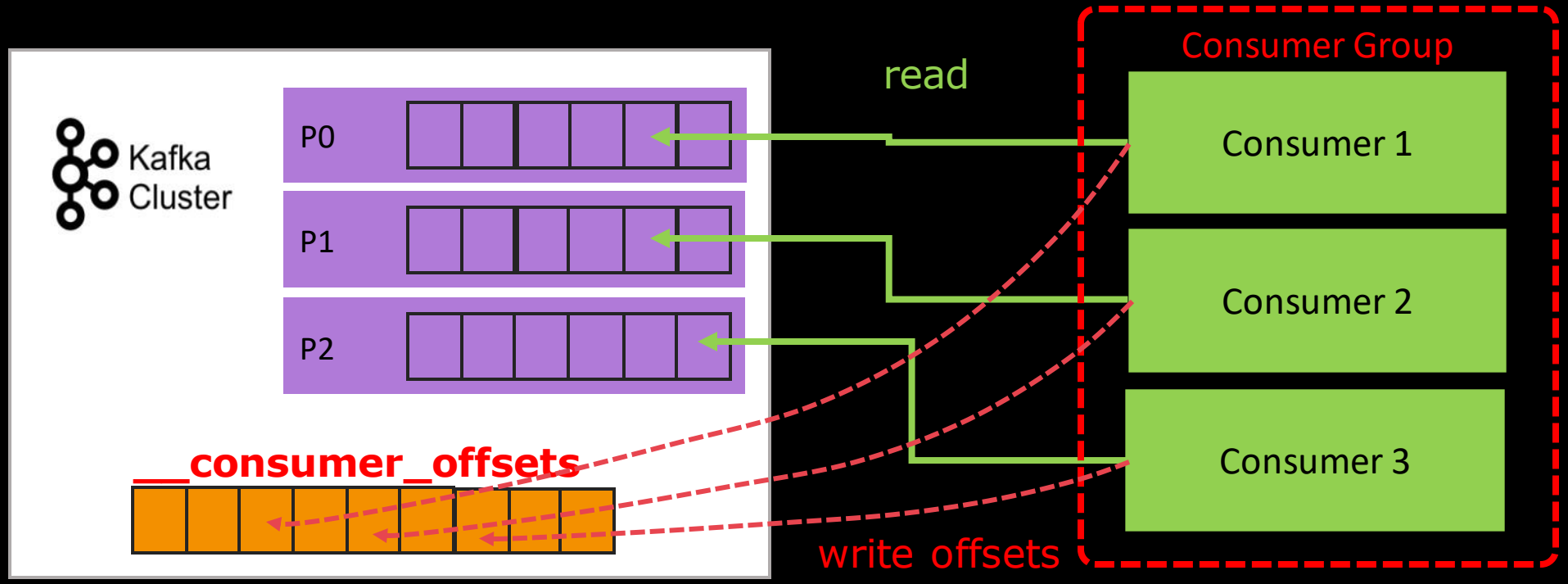
Consumers and Offsets

- Offset: Position of a record in the partition
- Group_id, topic, partition is tracked in topic: __consumer_offsets
- Consumer Offset Topic tracks which message should be read next



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Development: Basic Consumer in .NET/C#

```
8   namespace consumer_net {
        0 references
9       class Program {
            0 references
10          static void Main (string[] args) {
11              Console.WriteLine ("Starting Consumer!");
12              var config = new Dictionary<string, object> {
13                  { "group.id", "dotnet-consumer-group" },
14                  { "bootstrap.servers", "kafka-1:9092" },
15                  { "auto.commit.interval.ms", 5000 },
16                  { "auto.offset.reset", "earliest" }
17              };
18
19              var deserializer = new StringDeserializer (Encoding.UTF8);
20              using (var consumer = new Consumer<string, string> (config, deserializer, deserializer)) {
21                  consumer.OnMessage += (_, msg) =>
22                      Console.WriteLine ($"Read ('{msg.Key}', '{msg.Value}') from: {msg.TopicPartitionOffset}");
23
24                  consumer.OnError += (_, error) =>
25                      Console.WriteLine ($"Error: {error}");
26
27                  consumer.OnConsumeError += (_, msg) =>
28                      Console.WriteLine ($"Consume error ({msg.TopicPartitionOffset}): {msg.Error}");
29
30                  consumer.Subscribe ("hello_world_topic");
31
32                  while (true) {
33                      consumer.Poll (TimeSpan.FromMilliseconds (100));
34                  }
35              }
36          }
37      }
38  }
```

configuration

subscribing to topic

message handling

error handling

polling data

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Content

- Integration
- Event-Streaming Platform Kafka
- Asynchronous Communication
- Kafka Basics & Components
- Kafka APIs
- Kafka Examples
- Kafka Exercises

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Kafka Examples

Bosch Powertools & Deutsche Bahn Passenger Information

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Todays Ecosystems are pretty big

- 2.2 X 10^12 messages per day (6 x 10^15 Byte Petabyte)
- up to 400 Microservices per cluster
- 20 – 200 Broker per cluster

NETFLIX

BOSCH

EN

Projects > Neubau Klinik > Tasks

Create Assign Send

10 20 50

1 2 3 4 5 ... 128

1-10/1279

Task Title	Location	Start	Due	Craft	Company	State	News
4.OG Technikzentrale, Stahlbau	-	07/07/20	07/14/20	Rohbauarbeiten	Company B1 Anne Esch		
Abbau Kran klein	-	09/12/20	09/12/20	Rohbauarbeiten	Company B1 Anne Esch		
Abbruch Kanal in Baufeld	-	09/11/19	11/09/19	Erdbauarbeiten	Company B1 Anne Esch		
Abbruch Verbindungsgang	-	08/06/19	08/17/19	Erdbauarbeiten	Company B1 Anne Esch		
Abdichtung	-	01/11/21	01/16/21	Fliesen	Assign now		
Abdichtung	-	01/25/21	01/30/21	Fliesen	Assign now		
Abdichtung	-	12/28/20	01/02/21	Fliesen	Assign now		
Abdichtung + Dämmung Achse P-O...	-	05/13/20	05/14/20	Rohbauarbeiten	Company B1		

RefinemySite: Lean Construction SaaS

Kafka as Single Source of Truth

Confluent Cloud

Kafka as Event-Sourcing Backbone

Replication of Data between Microservices via Topics

Simple Bootstrapping of new Services by reprocessing the Event Stream

Real-Time & Near Realtime Notifications of Users

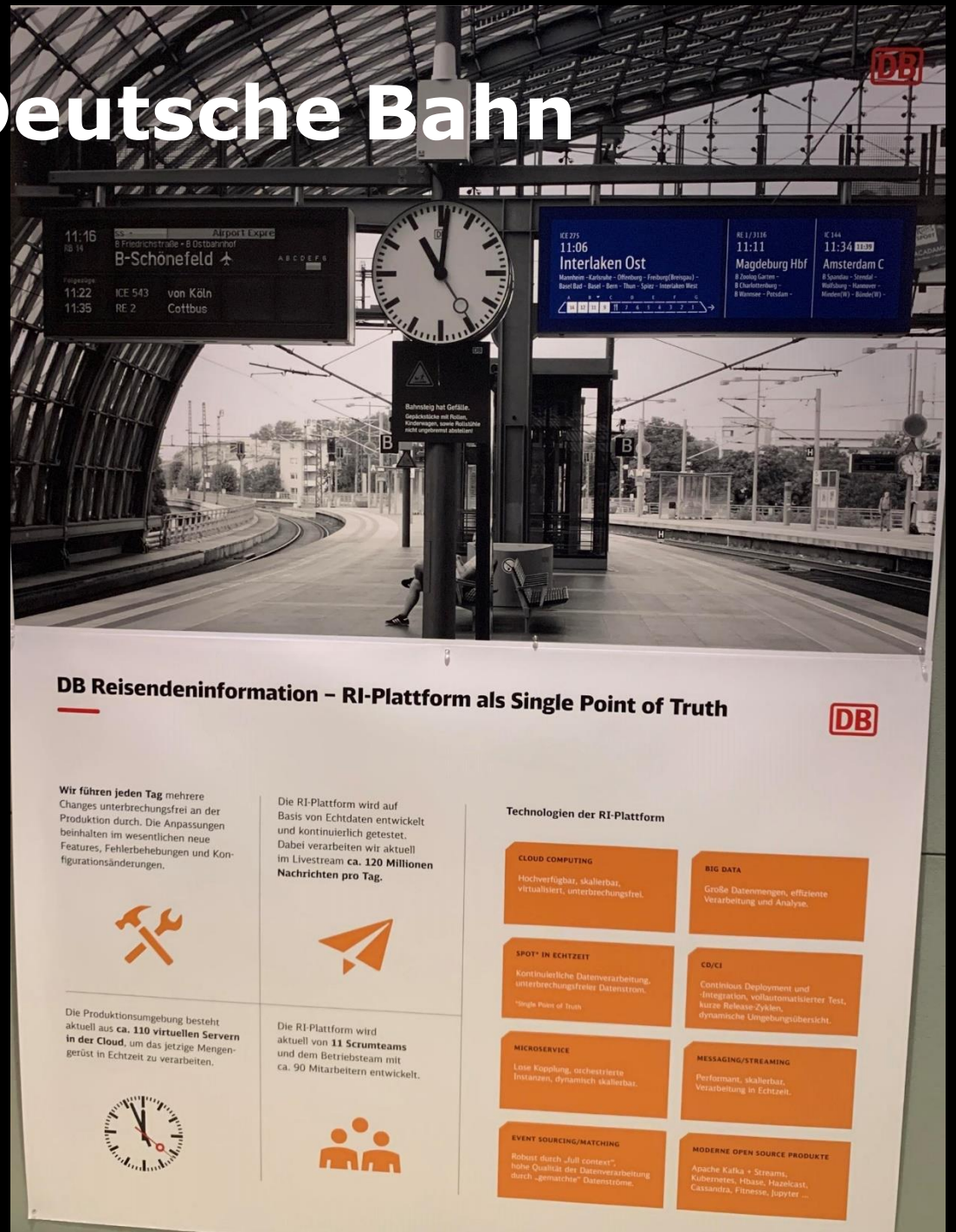
19 independently deployable Units

29 People across Europe, started in 2016

Topics with different Avro-Schemas

Passenger Information of Deutsche Bahn

- Talk at Confluent Streaming event 11.11.2019



Kafka-Project: DB Passenger Information

Facts and Figures

- ~100 persons in 12 Scrum Teams
- 24/7 running (DevOps)
- multiple daily deployments in production
- ~100 virtual servers
- ~100 Microservices

Kafka

Broker	Msg In	Volume In
6 in 3 AZs	**300M /day**	**1TB /day**

Topic/ Partition	Msg In (Avg)	Volume In
320 /3,3k	**4k /sec**	**13MB /sec**

February 2020 (OOP Talk DB/Novatec)

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Kafka Exercises

Introduction and preparation of the next unit

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Sources

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Sources

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Christopher Uldack
Senior Consultant

Christopher.Uldack@novatec-gmbh.de

Oliver Berger
Senior Managing Consultant

Oliver.Berger@novatec-gmbh.de

Novatec Consulting GmbH
Dieselstraße 18/1
D-70771 Leinfelden-Echterdingen

T. +49 711 22040-700
info@novatec-gmbh.de
www.novatec-gmbh.de