Queue Messaging Systems (QMS)

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Arjun Singhvi

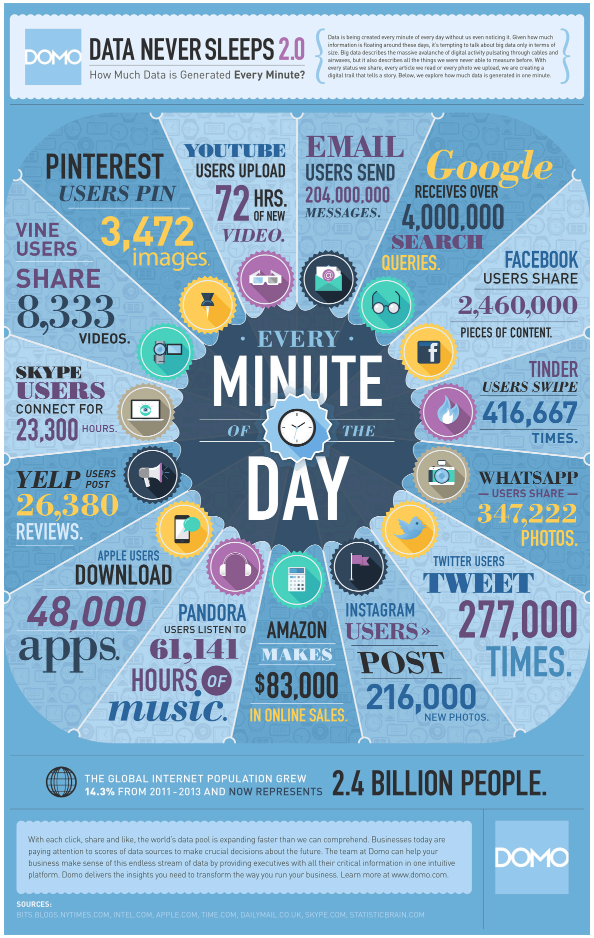
CONSULTANTS SAY THREE QUINTILLION BYTES OF DATA ARE CREATED EVERY DAY.
DilbertCartoonist@gmail.com
IT COMES FROM EVERYWHERE. IT KNOWS ALL.
ACCORDING TO THE BOOK OF WIKIPEDIA, ITS NAME IS "BIG DATA."
BIG DATA
©2012 Scott Adams, Inc./Dist. by Universal Uclick
BIG DATA LIVES IN THE CLOUD. IT KNOWS WHAT WE DO.
IN THE PAST, OUR COMPANY DID MANY EVIL THINGS.
BUT IF WE ACCEPT BIG DATA IN OUR SERVERS, WE WILL BE SAVED FROM BANKRUPTCY.
LET US PAY.
$
www.dilbert.com
7-29-12
IS IT TOO LATE TO SIDE WITH EVIL?
SHHHH! IT HEARS YOU.

Overview

- Motivation
- Initial Use Case
- QMS Architecture Choices
- Deep dive into Kafka

Motivation

- Data Explosion in the last 10 years due to emergence of IoT



DATA NEVER SLEEPS 2.0

How Much Data is Generated **Every Minute?**

Data is being created every minute of every day without us even noticing it. Given how much information is floating around these days, it's tempting to talk about big data only in terms of size. Big data describes the massive avalanche of digital activity pulsating through cables and airwaves, but it also describes all the things we were never able to measure before. With every status we share, every article we read or every photo we upload, we are creating a digital trail that tells a story. Below, we explore how much data is generated in one minute.

EVERY MINUTE OF THE DAY

PINTEREST USERS PIN 3,472 images.

YOUTUBE USERS UPLOAD 72 HRS. OF NEW VIDEO.

EMAIL USERS SEND 204,000,000 MESSAGES.

Google RECEIVES OVER 4,000,000 SEARCH QUERIES.

FACEBOOK USERS SHARE 2,460,000 PIECES OF CONTENT.

VINE USERS SHARE 8,333 VIDEOS.

SKYPE USERS CONNECT FOR 23,300 HOURS.

TINDER USERS SWIPE 416,667 TIMES.

YELP USERS POST 26,380 REVIEWS.

WHATSAPP USERS SHARE 347,222 PHOTOS.

APPLE USERS DOWNLOAD 48,000 apps.

PANDORA USERS LISTEN TO 61,141 HOURS OF music.

AMAZON MAKES $83,000 IN ONLINE SALES.

INSTAGRAM USERS» POST 216,000 NEW PHOTOS.

TWITTER USERS TWEET 277,000 TIMES.

THE GLOBAL INTERNET POPULATION GREW **14.3%** FROM 2011 - 2013 AND NOW REPRESENTS 2.4 BILLION PEOPLE.

With each click, share and like, the world's data pool is expanding faster than we can comprehend. Businesses today are paying attention to scores of data sources to make crucial decisions about the future. The team at Domo can help your business make sense of this endless stream of data by providing executives with all their critical information in one intuitive platform. Domo delivers the insights you need to transform the way you run your business. Learn more at www.domo.com.

SOURCES:
BITS.BLOGS.NYTIMES.COM, INTEL.COM, APPLE.COM, TIME.COM, DAILYMAIL.CO.UK, SKYPE.COM, STATISTICBRAIN.COM

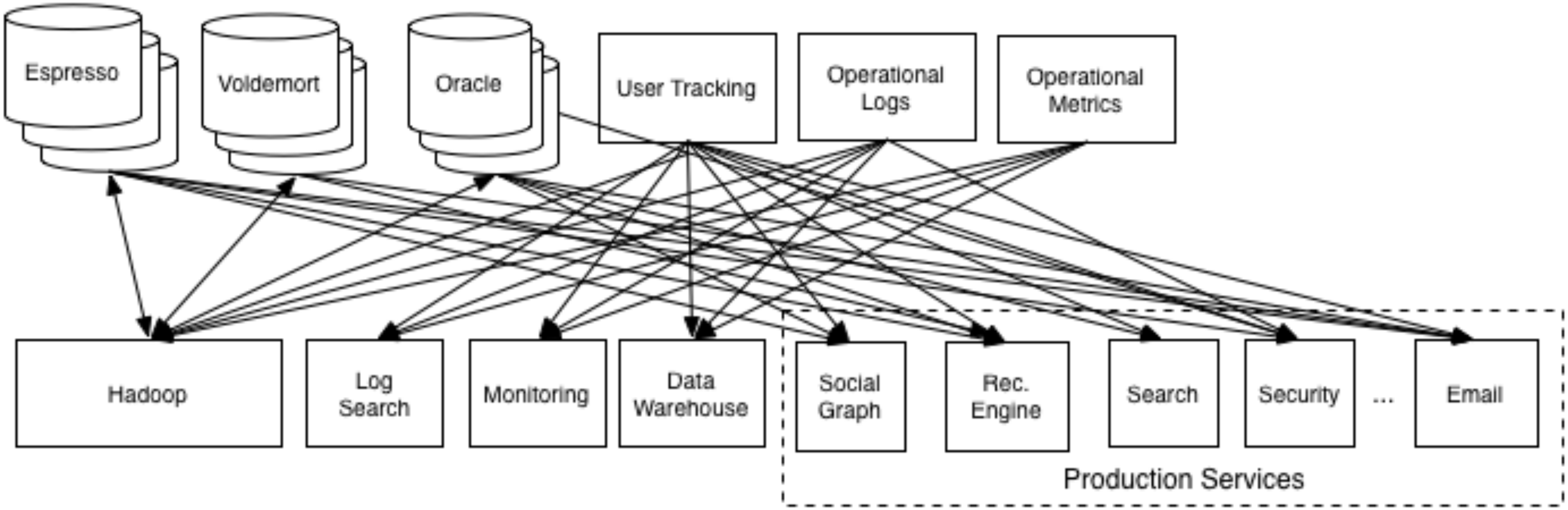
Motivation

- Sheer volume of these datasets lead to the emergence of Big Data systems

Motivation

- Need an efficient way to deal with this heterogeneous data coming in from different sources
- Need to process the same data in various ways
  - Real-time analytics
  - Batch analytics

Motivation - Pre-QMS Era



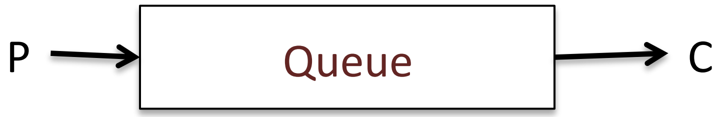
- Custom data pipeline for each unique source-destination pair
- Does not scale well

Motivation

- Efficiently aggregate all types of data and provide at –
  - High throughput
  - Low latency
  - Real time
- Lead to emergence of various QMS

QMS Architecture Choices

- Message Queues
  - ActiveMQ
  - RabbitMQ



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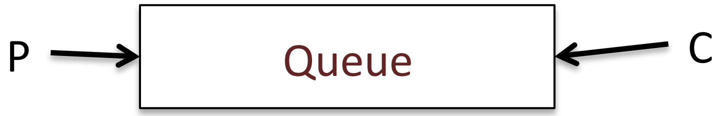
- Publish-Subscribe Systems
  - Kafka
  - Kestrel



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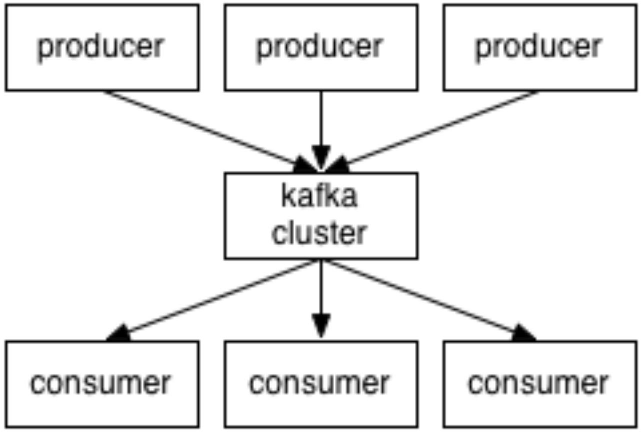
Initial Use Case

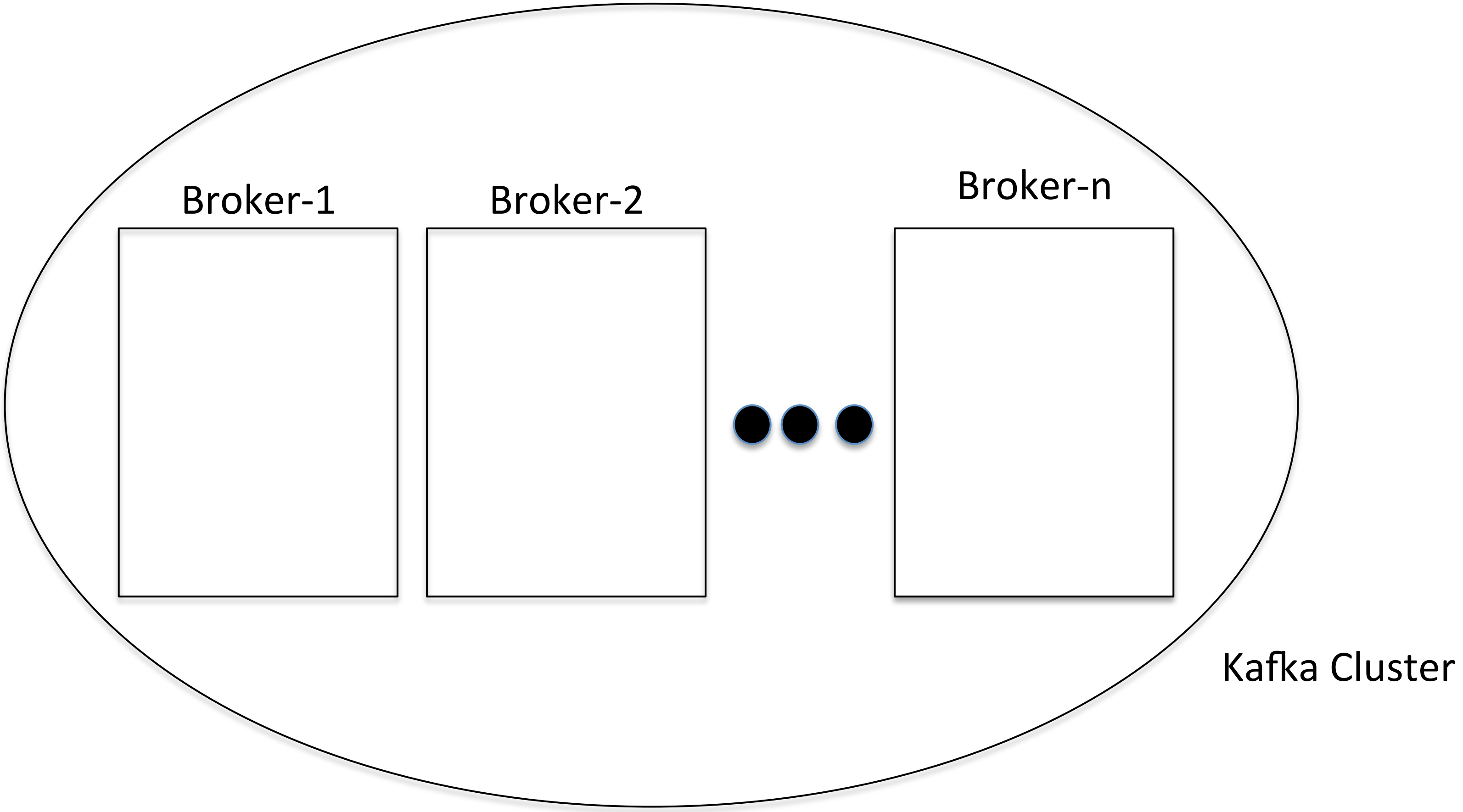
- Mainly used in the data processing pipelines for data ingestion or aggregation
- Envisioned mainly to be used at the beginning or end of a data processing pipeline
- Example –
  - Incoming data from various sensors
  - Ingest this data into a streaming system for real-time analytics or a distributed file system for batch analytics

Kafka: Introduction



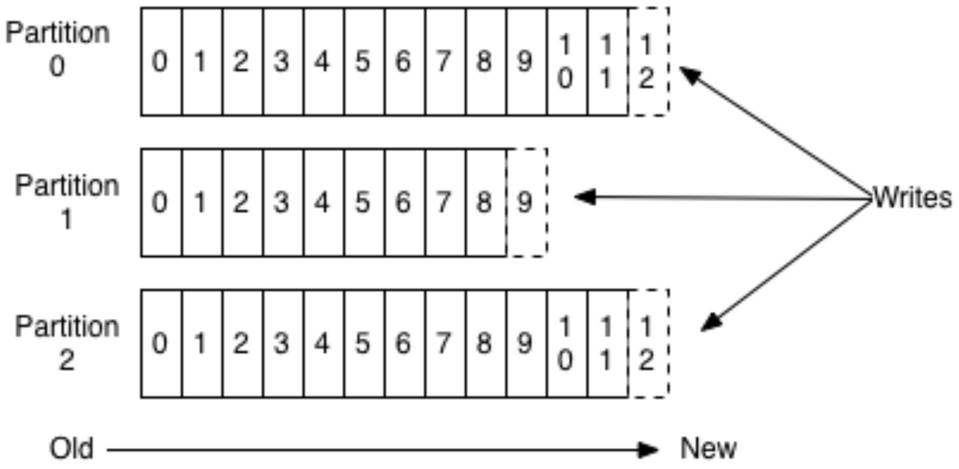
- Producers – Publish data streams to Kafka cluster
- Consumers – Subscribe to one or more data streams
- Kafka Cluster – Distributed log of data over serves known as brokers

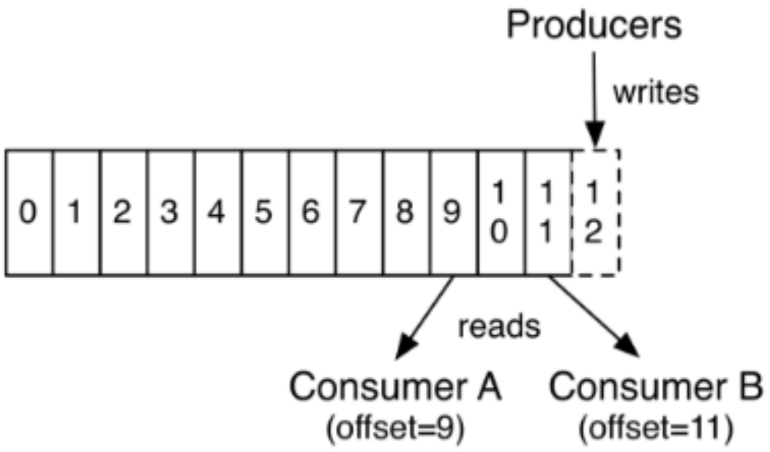
Kafka: Introduction



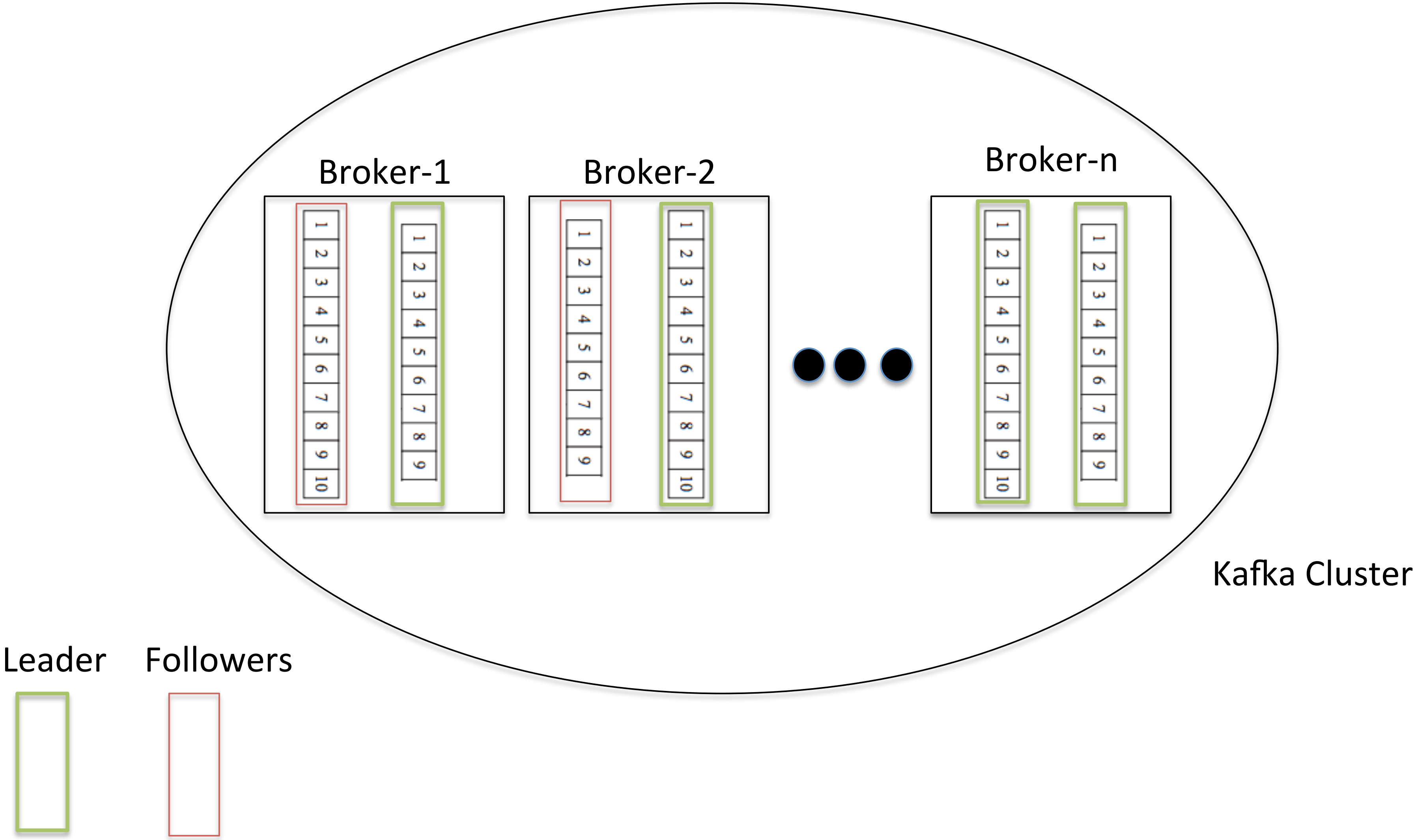
Kafka: Topics

- Category to which the messages are published
- For each topic, the Kafka cluster maintains a partitioned log





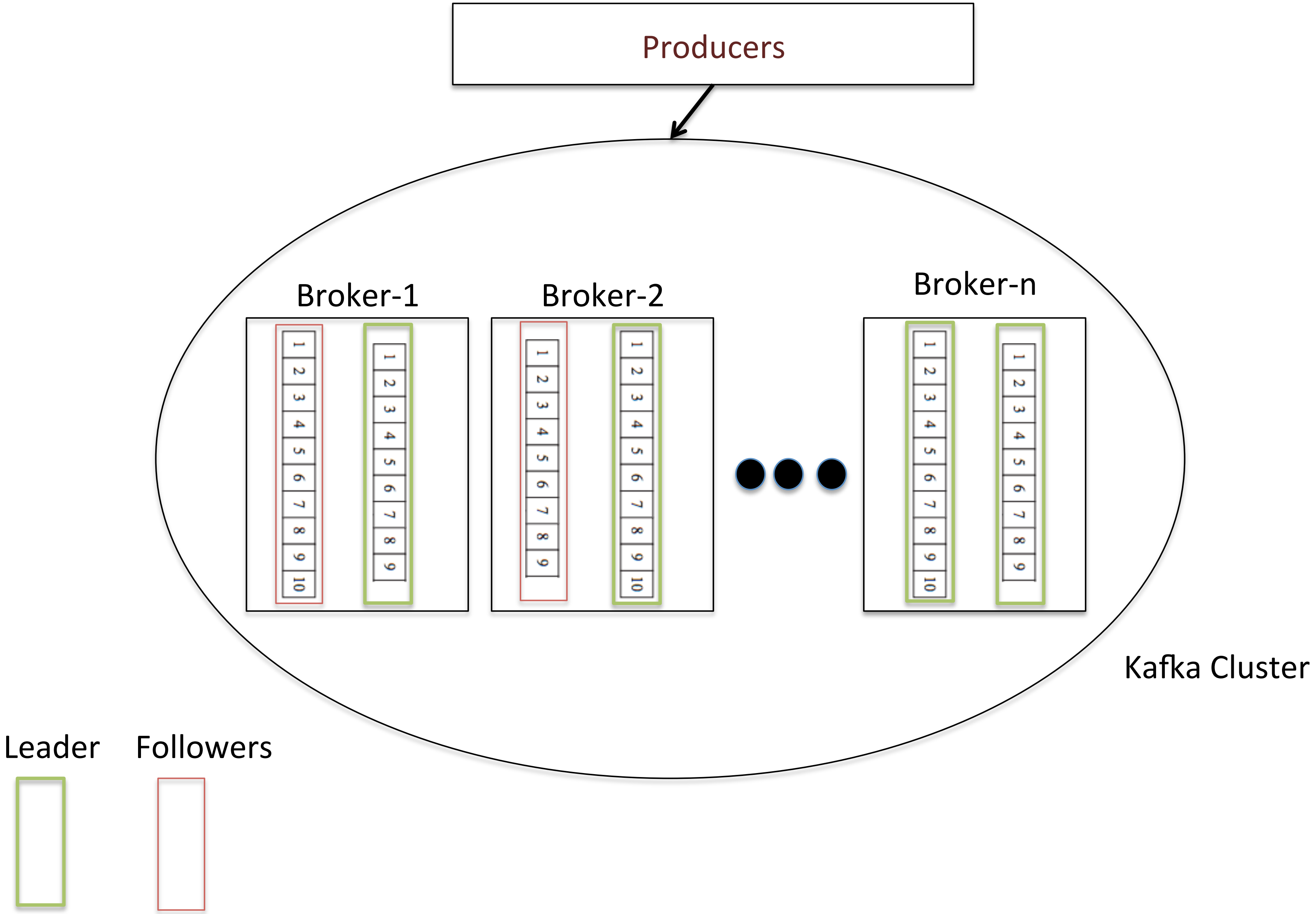
Kafka: Partitions



Kafka: Partitions

- Ordered, immutable sequence of records that is continually appended to
- Each record is associated with a sequential id number called as offset
- Partitions are distributed over the servers in Kafka
- Each partition is replicated for fault tolerance
- Partition and replicas follow the leader-followers pattern

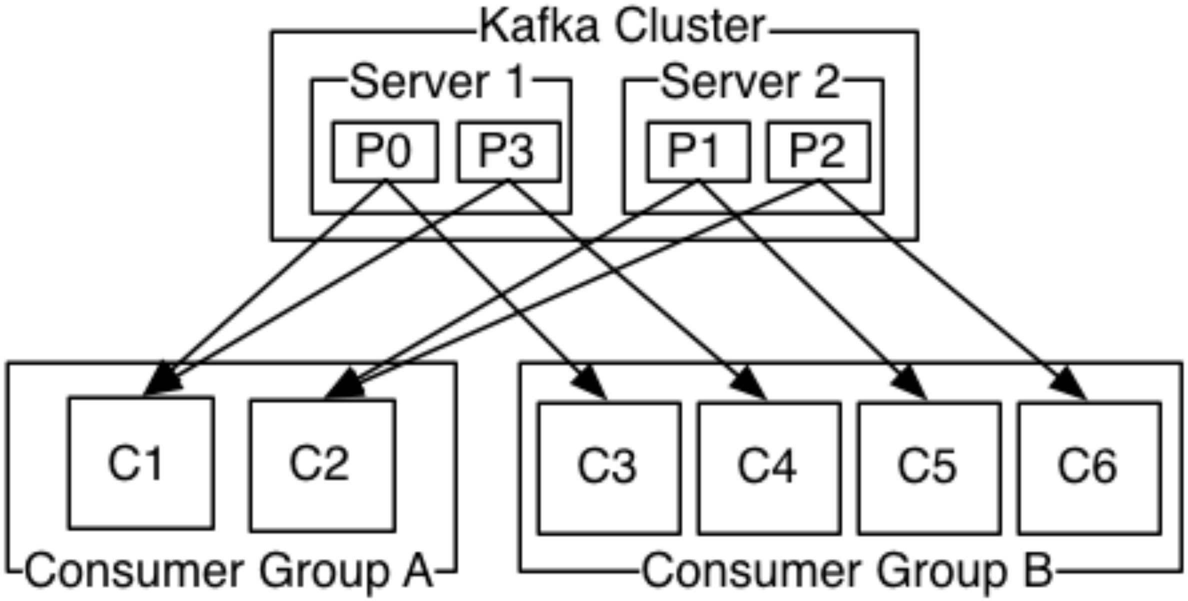
Kafka: Producers



Kafka: Producer

- Publishes data to topics of their choice
- In fact also responsible for choosing which record to assign to which partition within the topic
- Think of publishers as data sources

Kafka: Consumer



- Consumer Group maps to a logical subscriber
- Each group consists of consumer instances for scalability and fault tolerance
- Advantages of both queuing as well as publish-subscribe

Kafka: ZooKeeper

- ZooKeeper is a distributed, open-source coordination service for distributed applications
- Kafka uses it to coordinate between the producers, consumers and brokers
- ZooKeeper stores metadata
  - List of brokers
  - List of consumers and their offsets
  - List of producers
- ZooKeeper runs several algorithms
  - Consumer registration algorithm
  - Consumer rebalancing algorithm

Kafka: Design Choices

- Push vs. Pull model for Consumers
  - Push model
    - Challenging for the broker to deal with diverse consumers as it controls the rate at which data is transferred
    - Need to decide whether to send a message immediately for accumulate more data and send
  - Pull model
    - In case broker has no data, consumer may end up busy-waiting for data to arrive

Kafka: Ordering Guarantees

- Messages sent by a producer to a particular topic partition will be appended in the order they are sent
- Consumer instance sees records in the order they are stored in the log
- Provides a total order over records within a partition, not between different partitions in a topic. Per-partition ordering combined with the ability to partition data by key is sufficient for most applications.

Kafka: Fault Tolerance

- Replicates partitions for fault tolerance
- Kafka makes a message available for consumption only after all the replicas acknowledge to the leader replica a successful write
- Implies that a message may not be immediately available for consumption

Kafka: Producer Batching

Kafka: Limitations

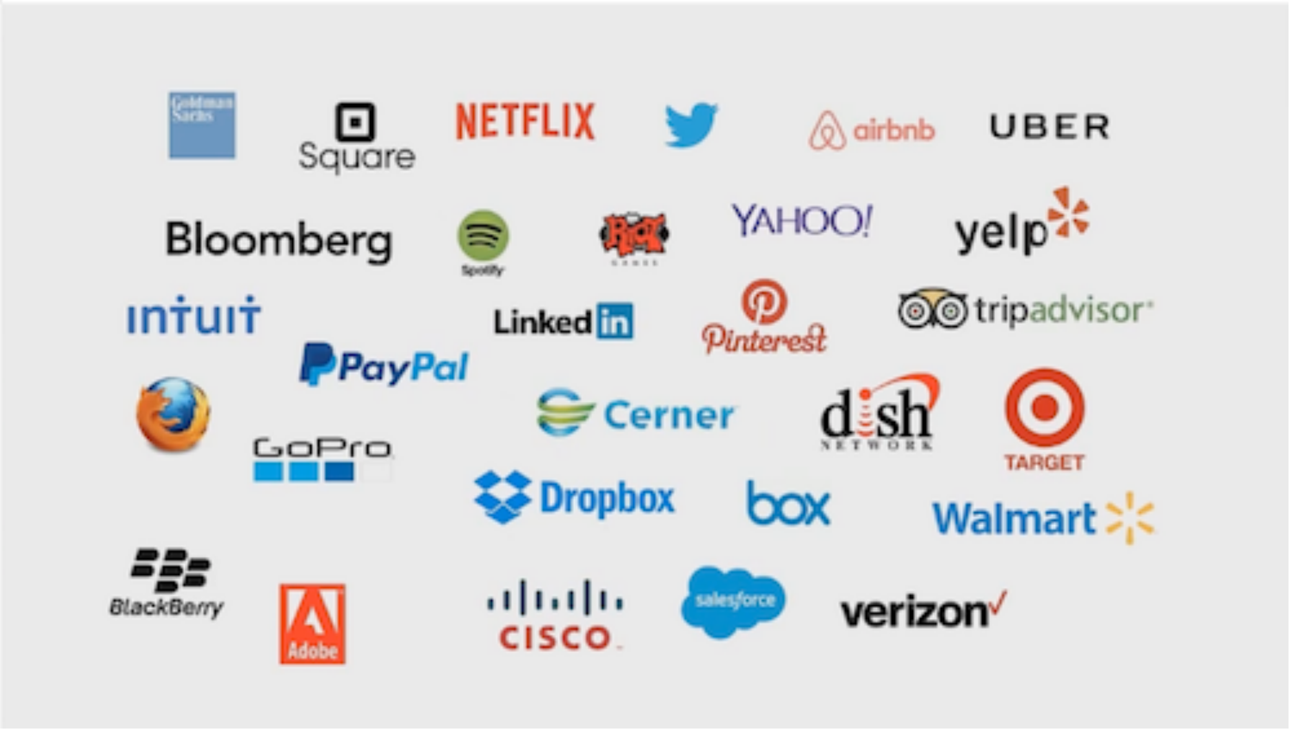
- Kafka follows the pattern of active-backup with the notion of “leader” partition replica and “follower” partition replicas
- Kafka stores a partition on a single disk

DistributedLog from Twitter claims to solve these issues

DISTRIBUTEDLOG

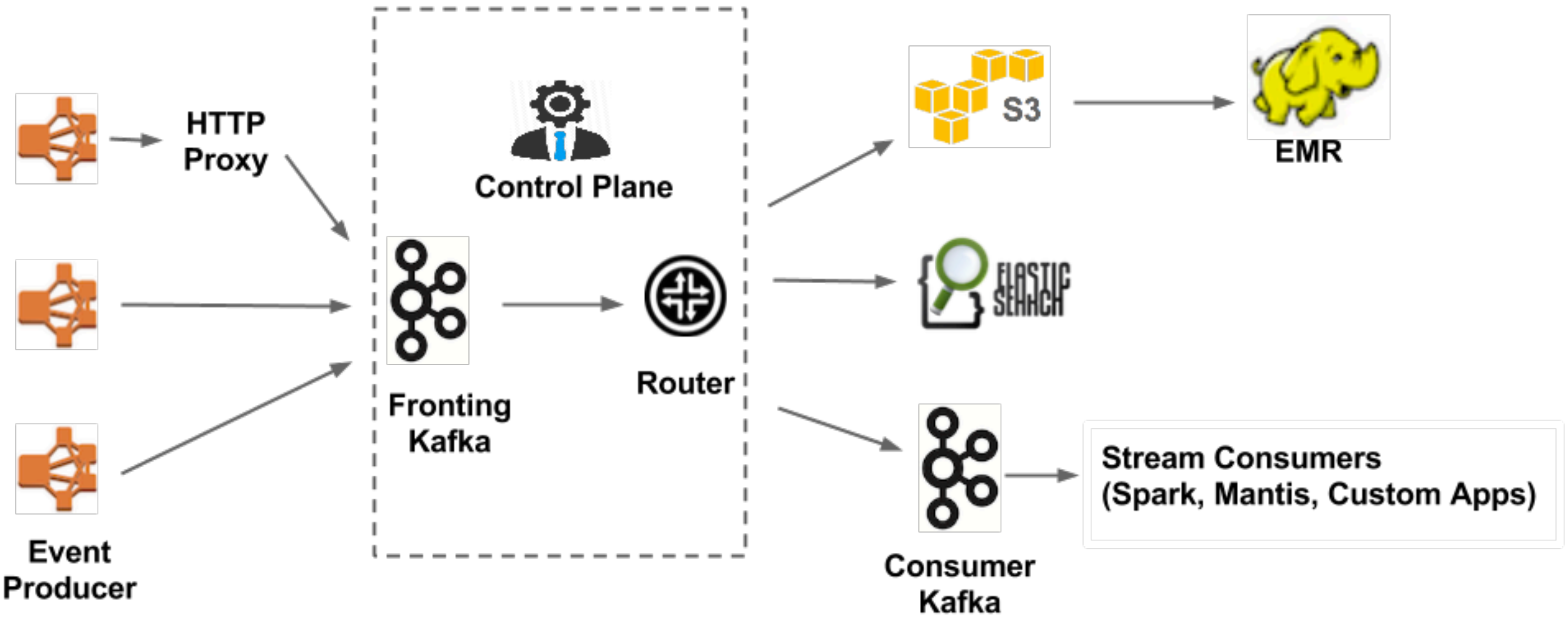
Kafka: In Real World

- 50+ companies are using Kafka as their primary infrastructure to handle data and make it available in real-time



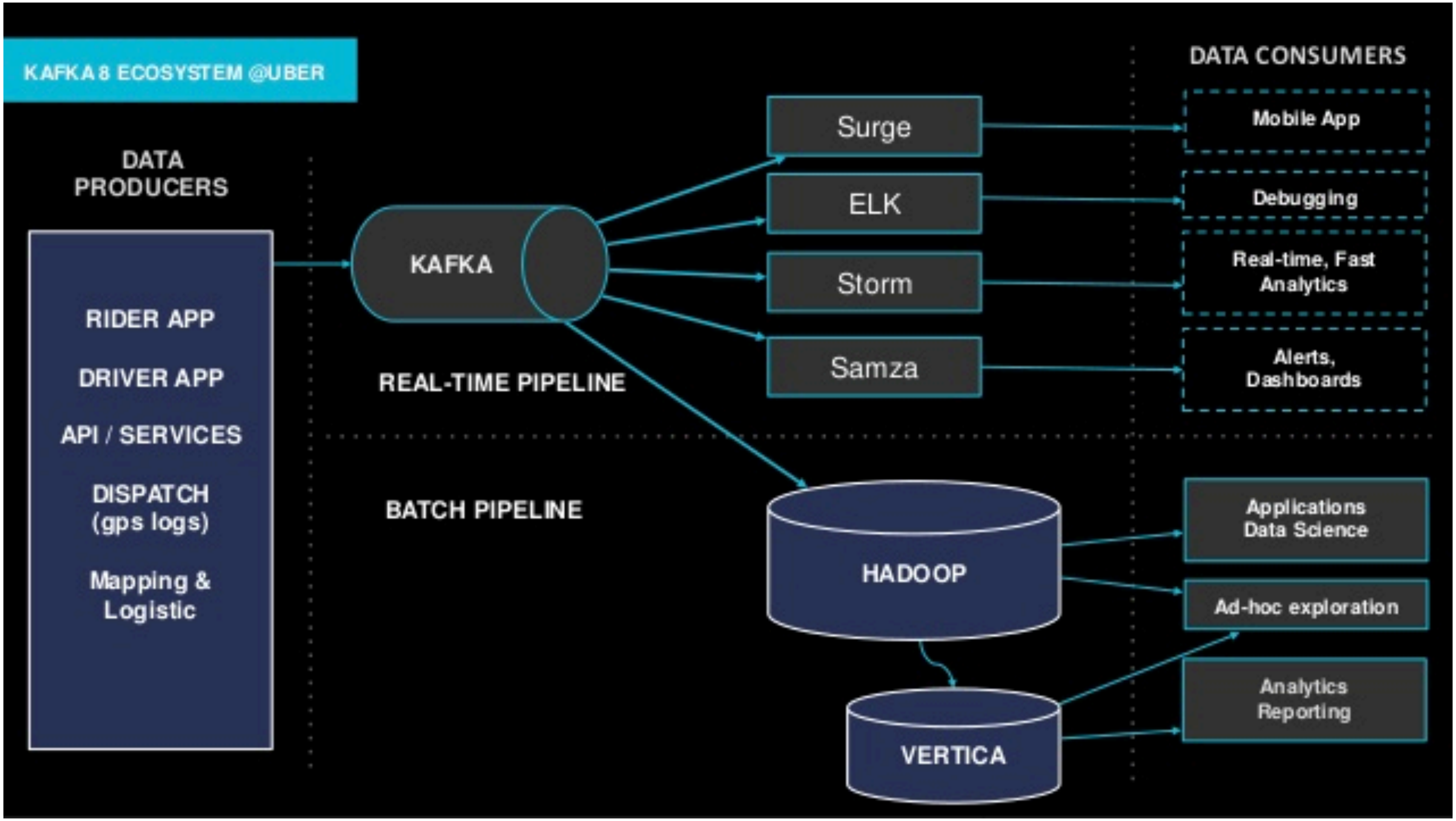
Kafka: In Real World

- Netflix uses Kafka for data collection and buffering so that it can be used by downstream systems



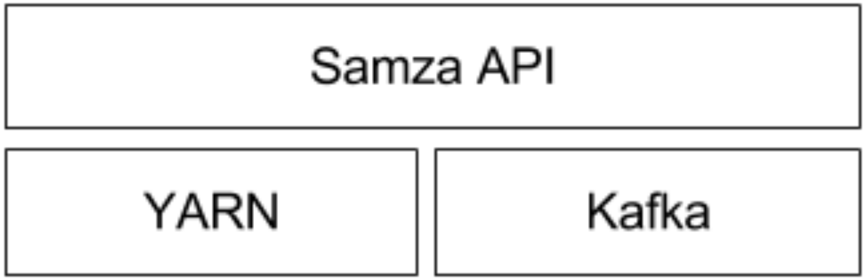
Kafka: In Real World

- Uber uses Kafka for real-time business driven decisions (For example – Surge)



Kafka: Only for data ingestion?

- Samza is a distributed stream processing framework
- It uses Kafka for data management layer for the streaming system
- Kafka being used even within a data processing pipeline

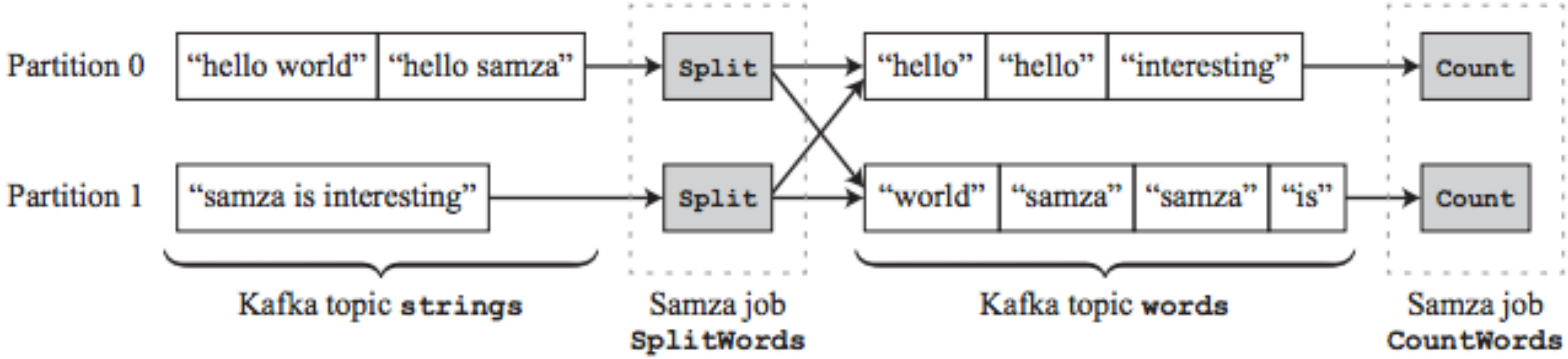


Samza API

YARN

Kafka

Kafka: Only for data ingestion?



- A Samza job consists of
  - Kafka consumer, an event loop that calls application code to process incoming messages
  - Kafka producer that sends output messages back to Kafka

Summary – QMS Era

- QMS are an essential part of the entire big data processing pipeline
- No longer just used for data ingestion and aggregation