ClickHouse

Meetup

One2N office @ Rachna Ventura

Pune, India

September 20, 2025 at 10:30 AM IST

THANK YOU TO OUR HOST!

Tech Talks

Maximising Analytics with ClickHouse and Kafka Integration

Rakesh Puttaswamy, ClickHouse Principal Solutions Architect, & Siddesh Vyavahare, Confluent Advisory Solutions Engineer

Sparse Data Storage and Query Patterns in ClickHouse

Amit Sanjay Sadafule, Co-Founder and Head of Technology @ Manthhan Software

Why ThriveStack chose ClickHouse

Ankit Gupta, Senior Software Engineer @ ThriveStack

ClickHouse for network and application analytics data for Cyber Security

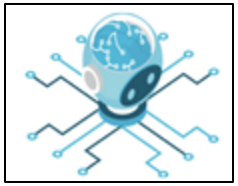
Ajit Bhat, Engineering Manager, and Afzal Khan, Principal Software Engineer @ Netscout

ClickHouse + Kafka Integration

Rakesh Puttaswamy

ClickHouse Lead Solution Architect

rakesh-p-gowda



Siddesh Vyavahare

Confluent Advisory Solutions Engineer

siddesh-vyavahare-96229b150

Travel enthusiast, Once a Devops Engineer, Siddesh now queries customer problems and joins them with tailor-made solutions.

Passionate about Kafka & real time streaming use case pivoted from building data pipelines to flexing scalable real-time architectures.

Always chasing the next big challenge, professionally and personally.

Agenda

01 Introduction

02 Apache Kafka 101

03 Integrating Kafka with ClickHouse

04 Questions

ClickHouse

Introduction: ClickHouse

ClickHouse

The Most Popular Analytics Database on the Planet

#1
Analytics DB on DB-Engines

Over
40,000
GitHub Stars

Over
200,000
Community Members

What is ClickHouse ?

ClickHouse is an **Open-Source**, columnar **OLAP** database

Designed for **Blazing fast** analytics of massive volumes of data

1. **Speaks SQL fluently**

2. **Processes data very fast**

3. **Highly efficient storage**

4. **Easily scalable to any size**

Key Features

Some of the cool things ClickHouse can do

1 Speaks SQL

Most SQL-compatible UIs, editors, applications, frameworks will just work!

2 Lots of writes

Up to several million writes per second - per server.

3 Distributed

Replicated and sharded, largest known cluster is 4000 servers.

4 Highly efficient storage

Lots of encoding and compression options - e.g. 20x from uncompressed CSV.

5 Very fast queries

Scan and process even billions of rows per second and use vectorized query execution.

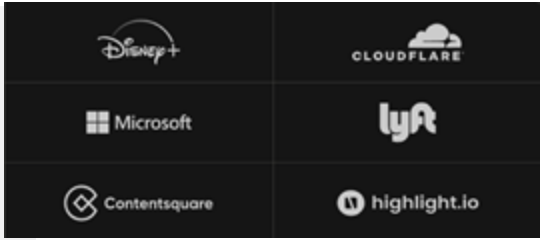
6 Joins and lookups

Allows separating fact and dimension tables in a star schema.

Use cases

Real-time Analytics

Power interactive applications and dashboards that analyze and aggregate large amounts of data on the fly. Run complex internal analytics in ms, not mins or hrs.

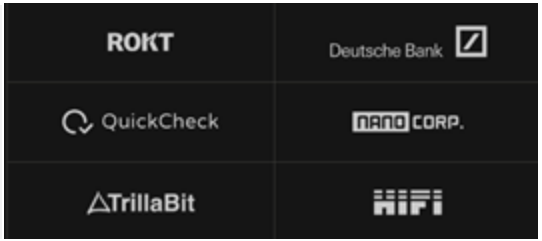


Logs, events, traces

Monitor with confidence your logs, events, and traces. Detect anomalies, fraud, network or infrastructure issues, and more.

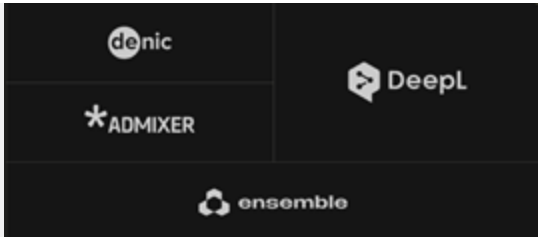
Business intelligence

Interactively slice and dice your data for analysis, reporting, and building internal applications. Evaluate user behaviors, ad and media perf, market dynamics, and more.



ML and Gen AI

Execute fast and efficient vector search. Plug-and-play Generative AI models from any provider. Use lightning-fast aggregations to power model training at petabyte scale.

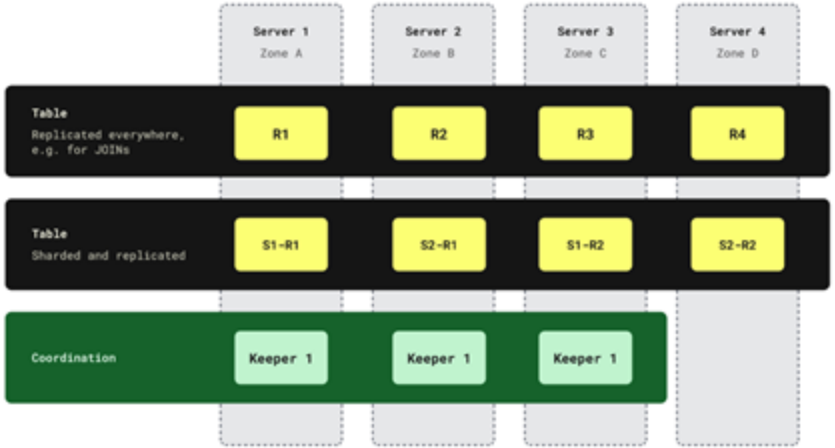


ClickHouse

Self-managed

- ✓ Open-source
- ✓ Flexible architecture
- ✓ Efficient and robust
- ✓ Support contracts available

Sample self-managed architecture

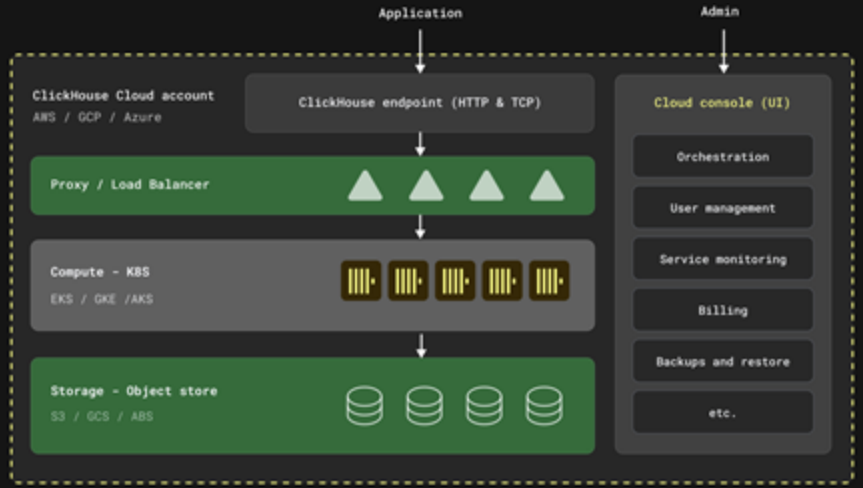


ClickHouse

Cloud

✓ Easy to use	Managed for you
✓ Feature-rich	Cloud-first features & tooling
✓ Fast	Automatically maximizes performance/efficiency
✓ Scalable	Scale seamlessly
✓ Reliable	Ensure reliability
✓ PAYG	SaaS usage and capacity based pricing

ClickHouse Cloud architecture



ClickHouse Architecture Patterns

ClickHouse

Row vs Column

Row-based

Excess disk Reads We need data in column, but it's stored in rows. So entire rows are read.

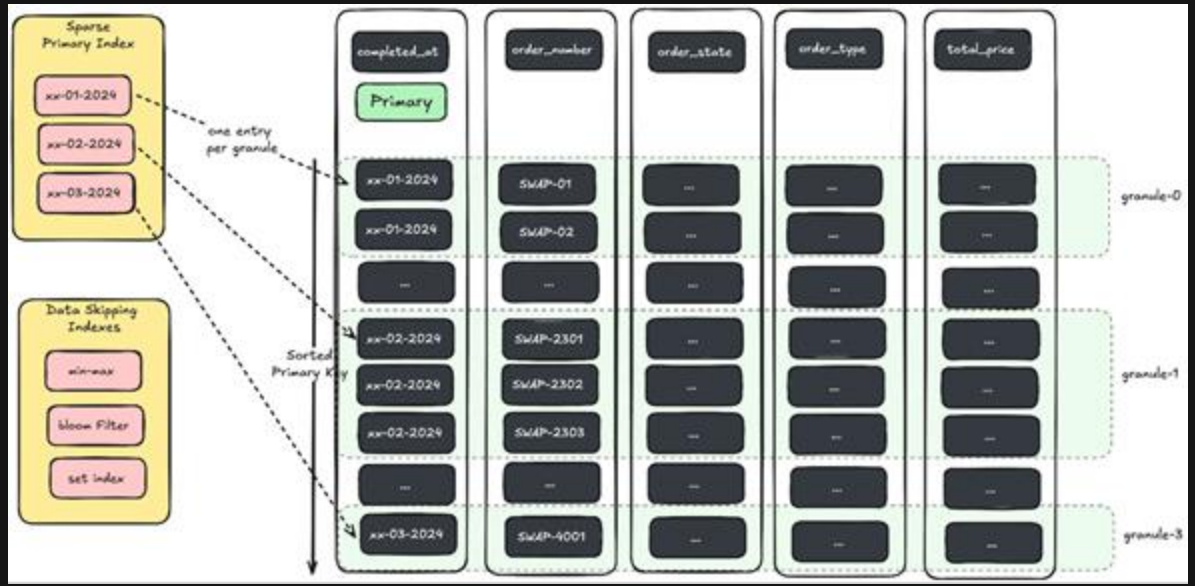
Column-Based

Column Pruning it only pick the subset of columns that are openly declared in the SQL query, thus eliminating 99% columns (990 of 1000 columns) from the disk read consideration.

Vectorized Execution
data processed in **large arrays**, which could be the entire length of the column loaded into RAM.

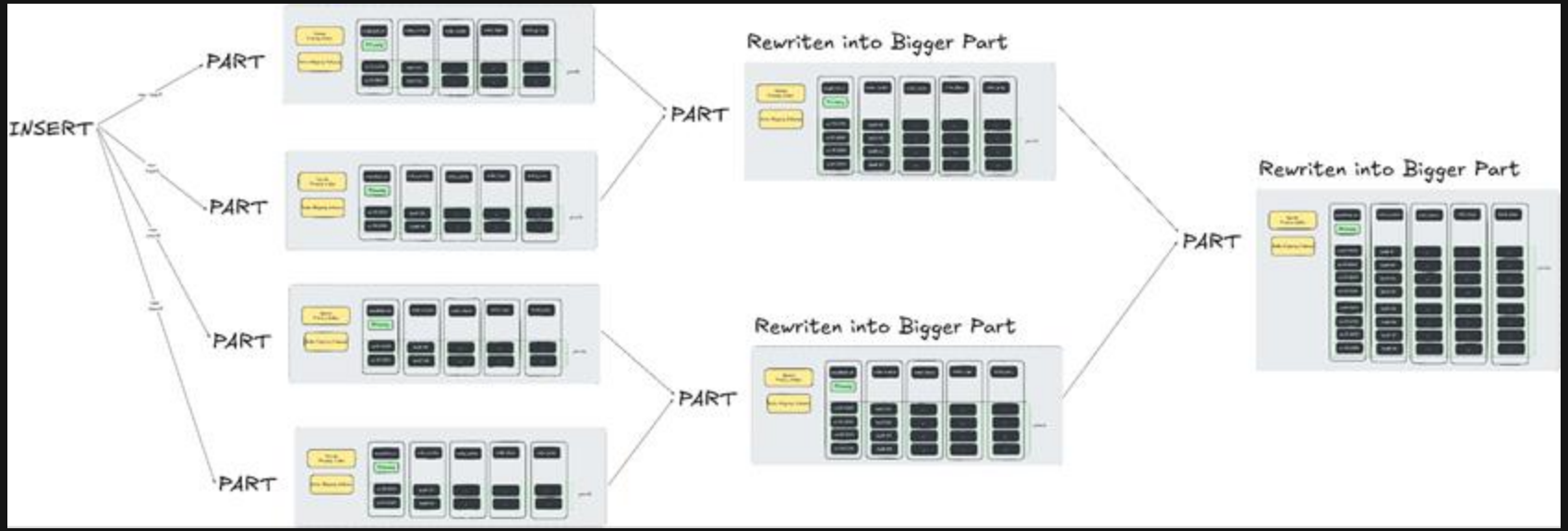
+ **reduces CPU cache miss rates**

Multiple Layers of Indexes



- **Granules** are chunks of rows, and **ClickHouse** groups rows into granules based on the index_granularity setting.
- **Sparse Primary Index**: **ClickHouse** uses the *sparse primary index* to quickly jump to the relevant granules, skipping over large portions of the data that don't need to be read.
- **Skip Indexes**: These allow **ClickHouse** to skip entire granules if it can determine from the index that no rows in the granule satisfy the query's filter.

Efficient Merging

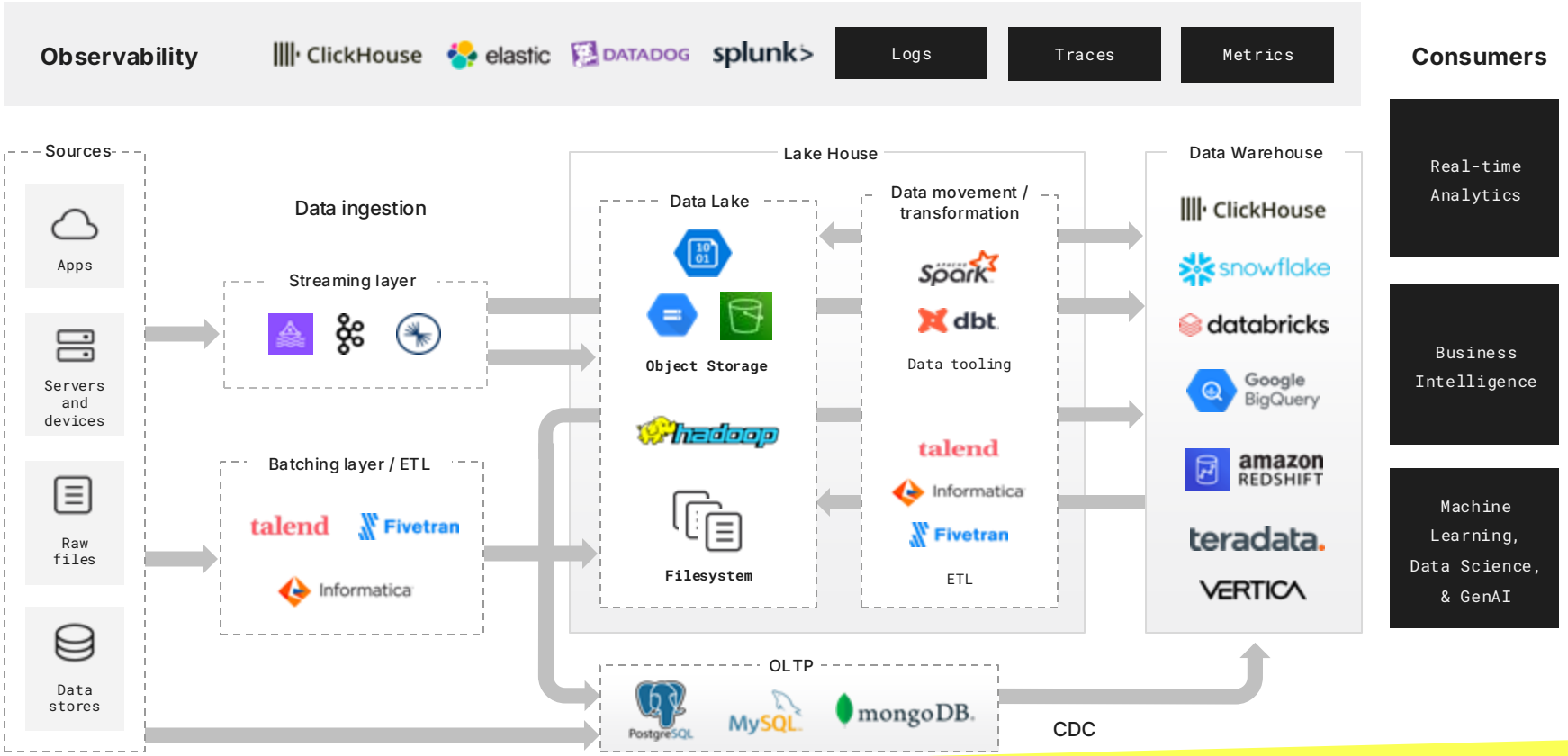


Parts: Each time data is inserted, a new part is created. Multiple parts can accumulate over time, which can slow down query performance.

To improve performance and reduce the number of parts, **ClickHouse** periodically runs merging operations.

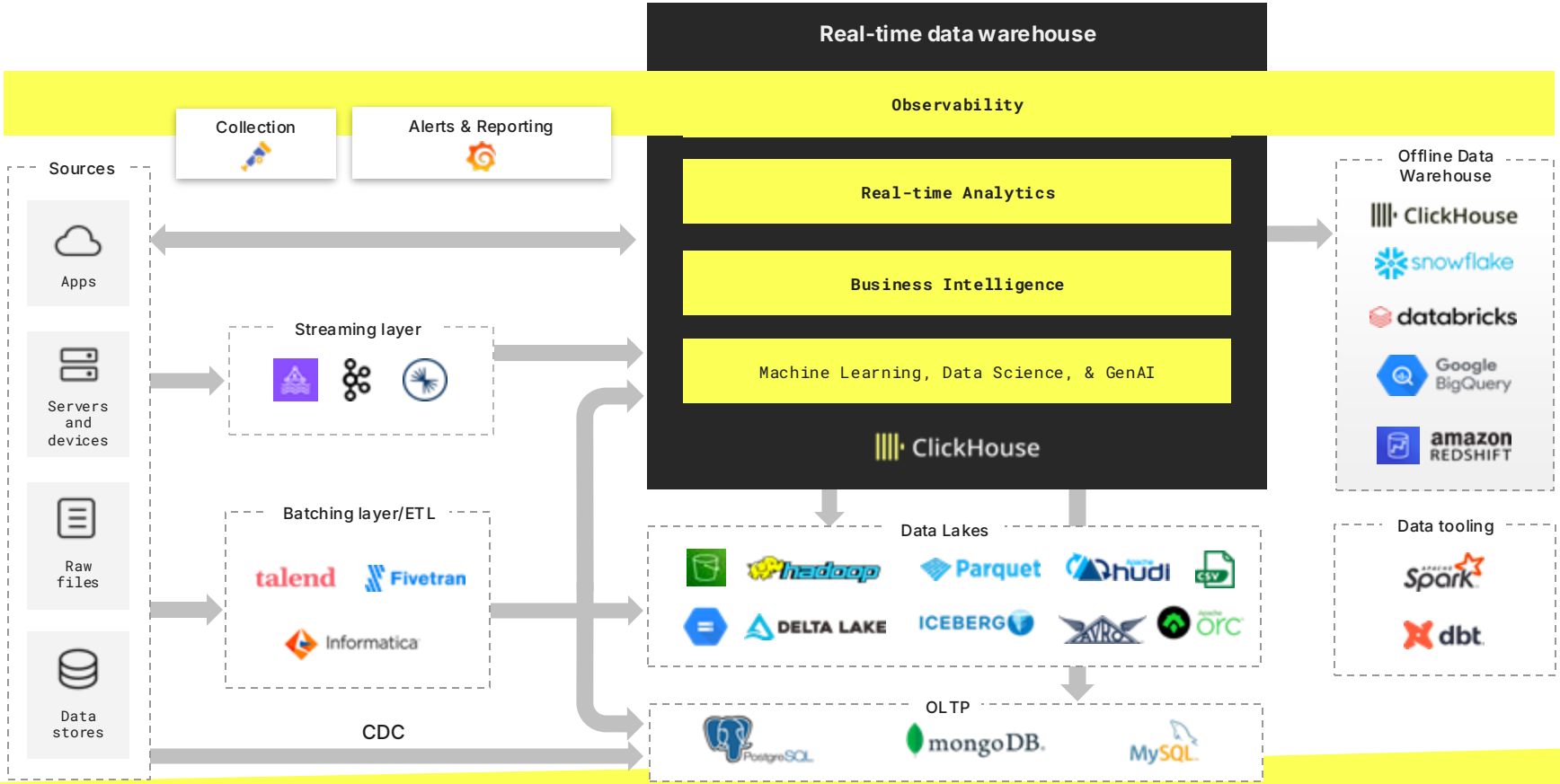
Traditional Data Architecture

Operationally complex with skyrocketing expense



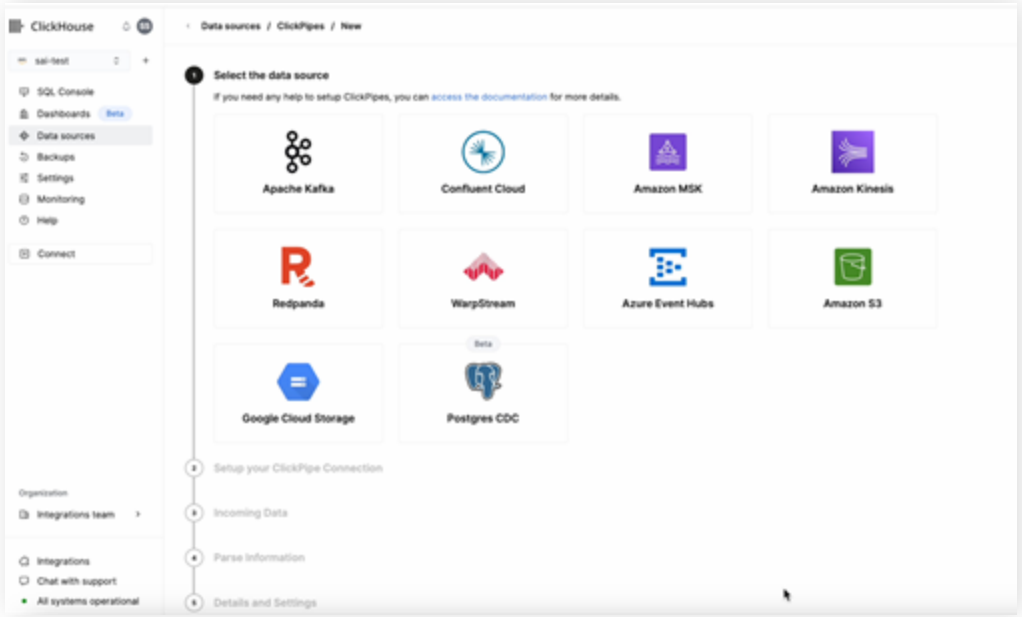
Modern Data Architecture

Reduces system bloat and increases resource efficiency



ClickPipes

- An integration engine that makes ingesting massive volumes of data from a diverse set of sources as simple as clicking a few buttons.
- Simplifies data ingestion from a variety of sources, including Kafka, Kinesis, Postgres, Amazon S3, and Google Cloud Storage.
- Scalable architecture ensures high throughput and low latency, ideal for demanding workloads.



ClickHouse

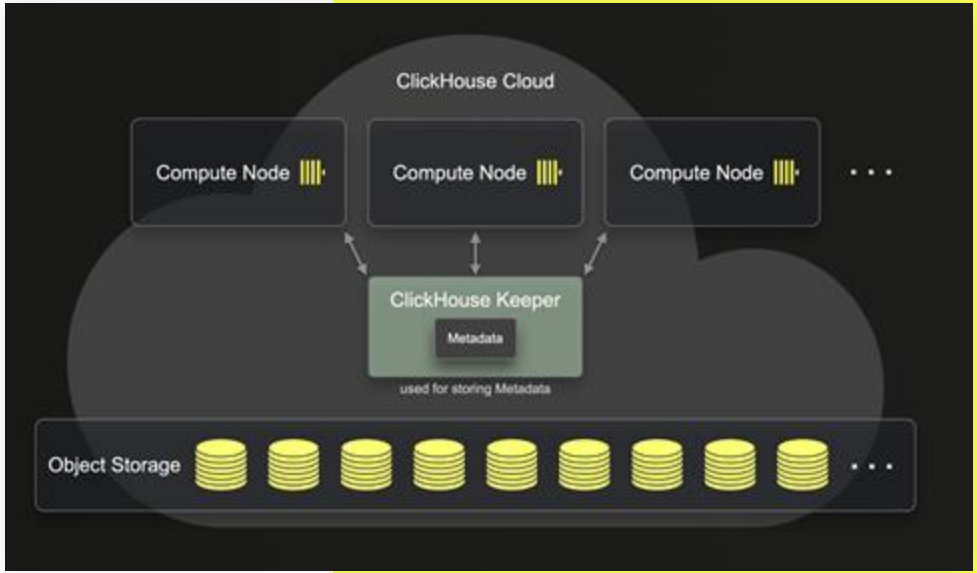
Separation of compute and storage

ClickHouse Cloud uses SharedMergeTree table engine, which allows storage and compute to be decoupled and scaled independently.

Object storage is used as the primary store for data and local disks only for caching, metadata, and temporary storage. This provides uncompromised TCO and reliability guarantees.

Benefits include:

- 1 Shard/Replica - no manual rebalancing
- Virtually limitless storage
- Higher insert throughput
- Improved throughput of merges and mutations
- Faster scale-up and scale-down operations
- More lightweight consistency for selects
- ...and more!

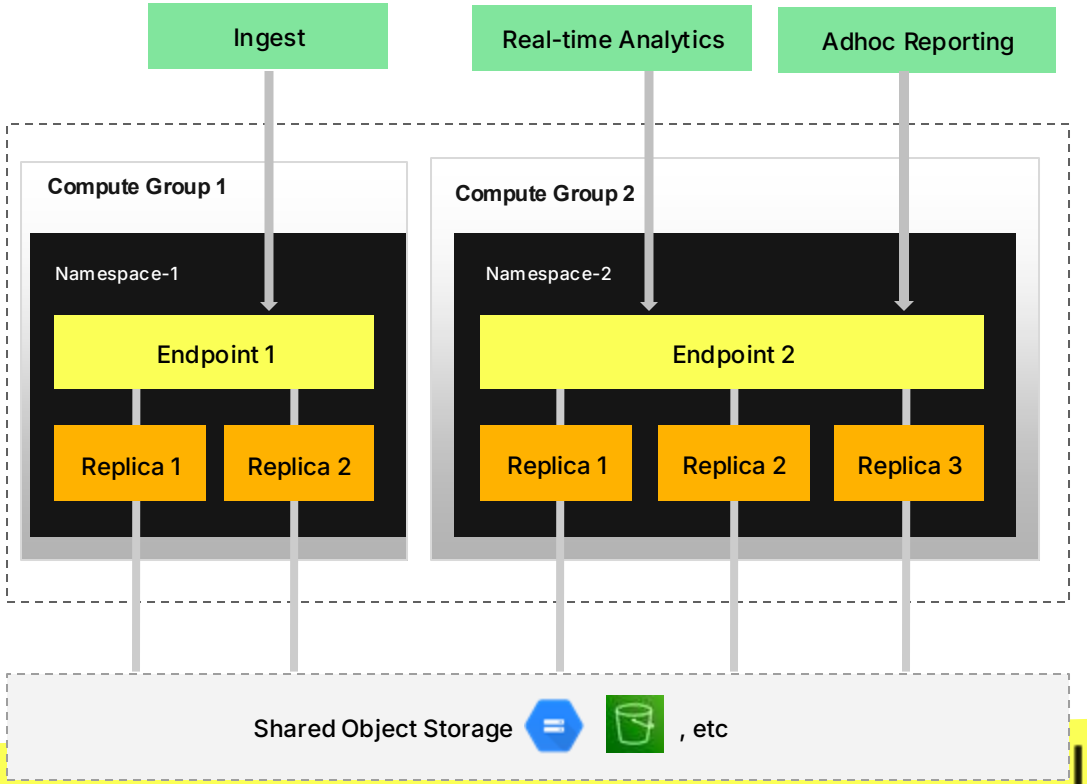


ClickHouse

Compute-Compute Separation

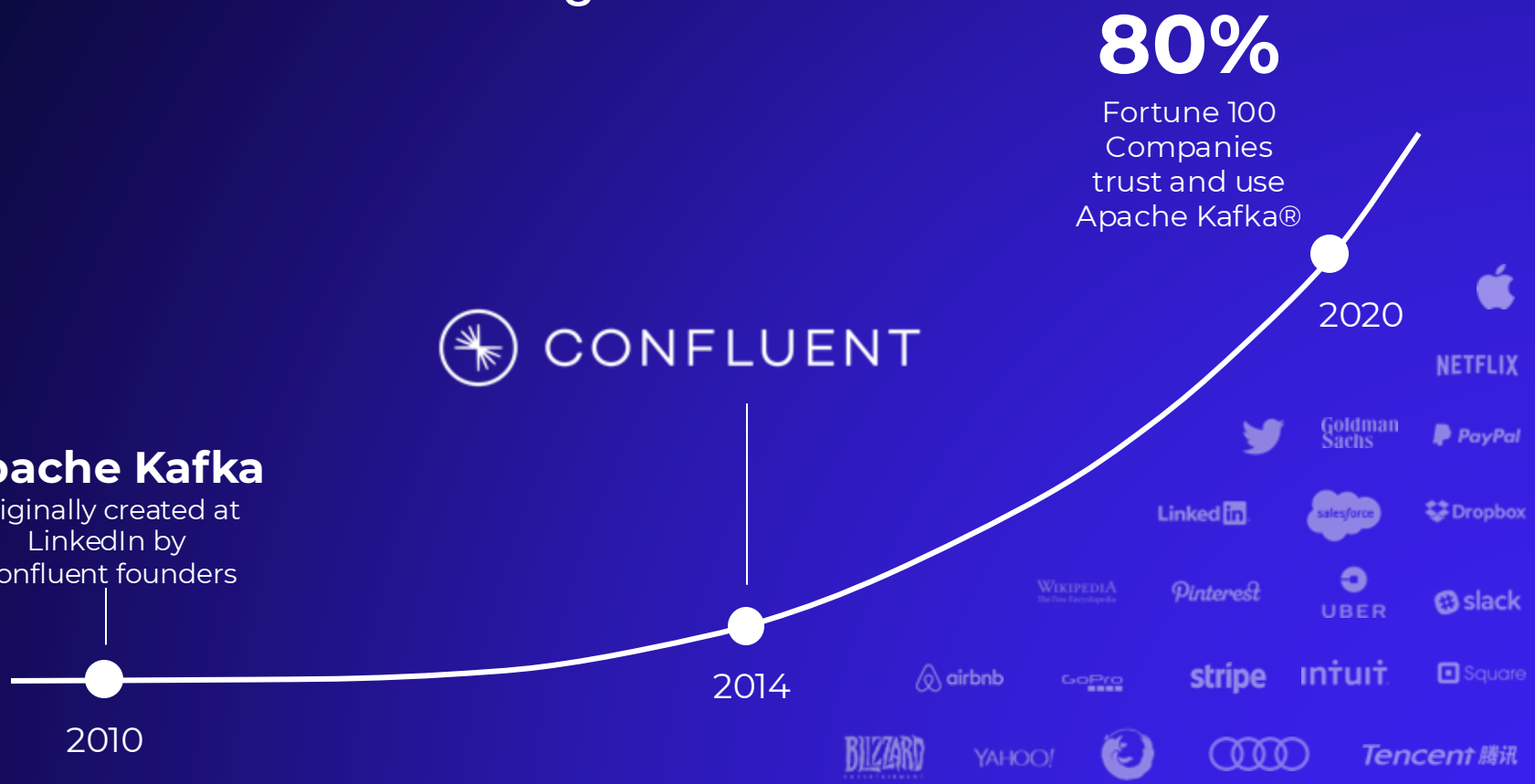
With Compute-Compute separation, services can allocate dedicated compute for specific operations - eg: Streaming Ingest vs Adhoc Reporting, while sharing the same storage

- Compute units can be scaled independently
- Eliminates bottlenecks due to resource contention



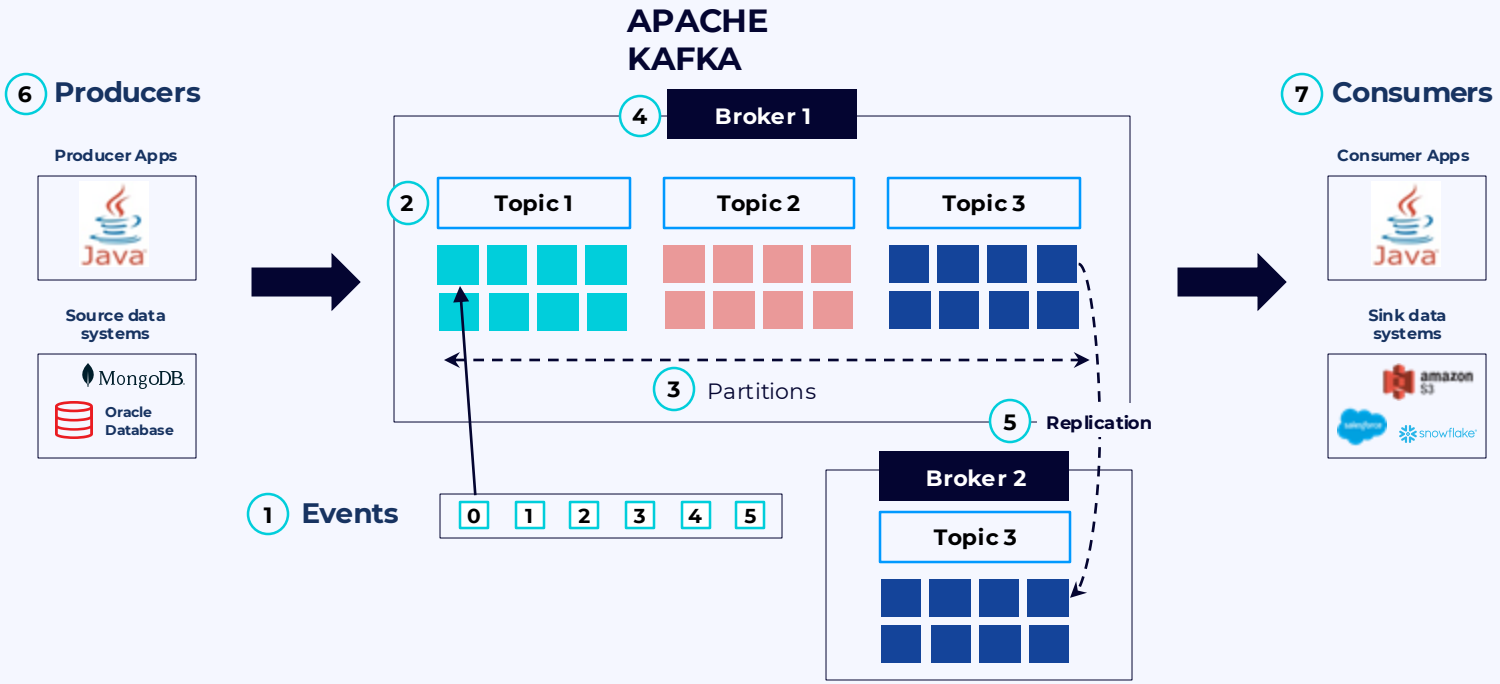
Introduction to Confluent

The Rise of Event Streaming



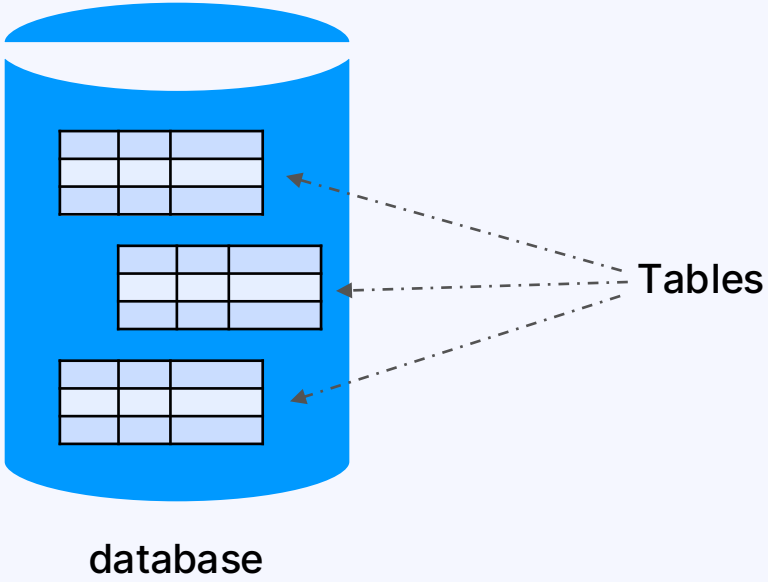
Introducing Apache Kafka®

Key components of Apache Kafka

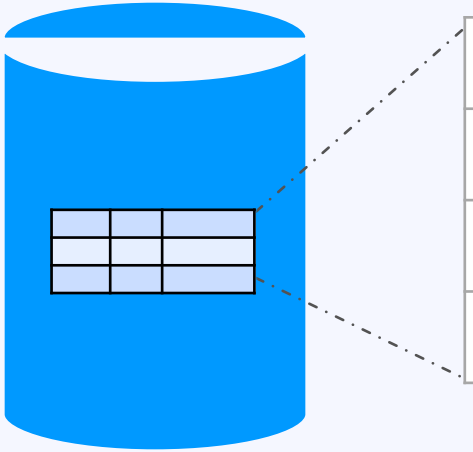


Apache Kafka is a data streaming system that allows developers to react to new events as they occur in real time.

Databases have tables



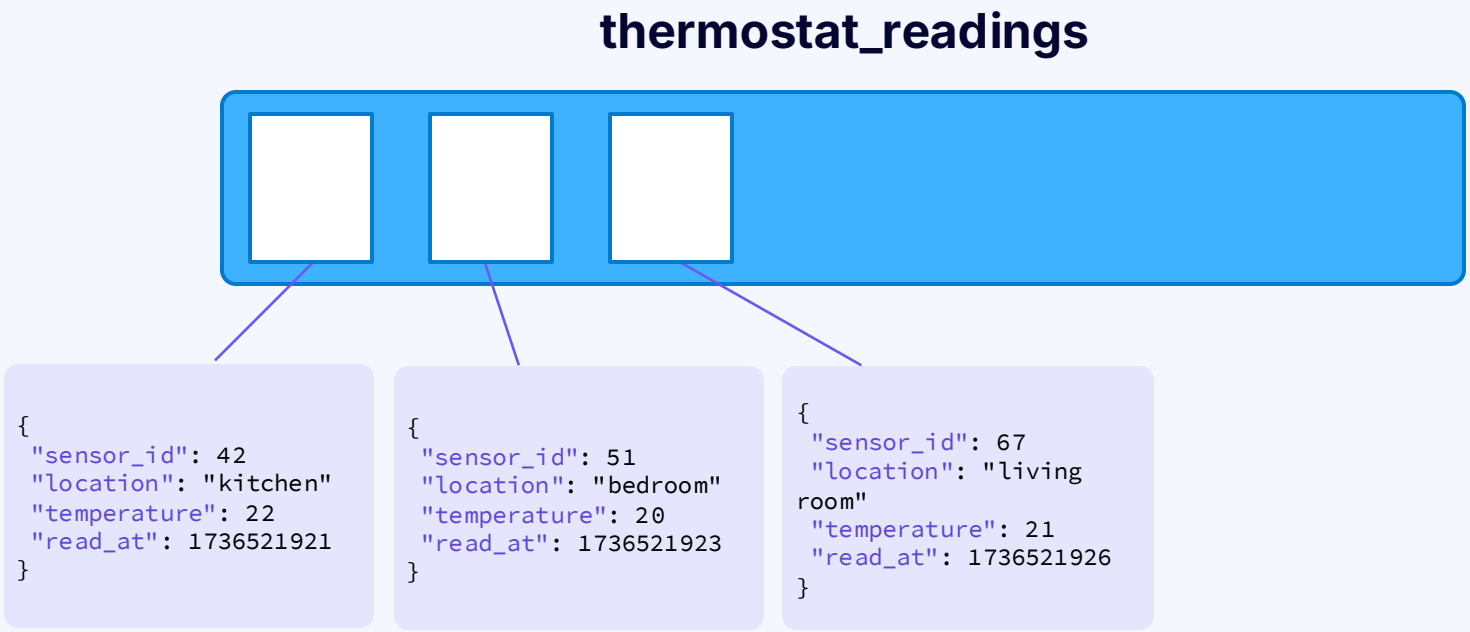
Tables have rows and columns



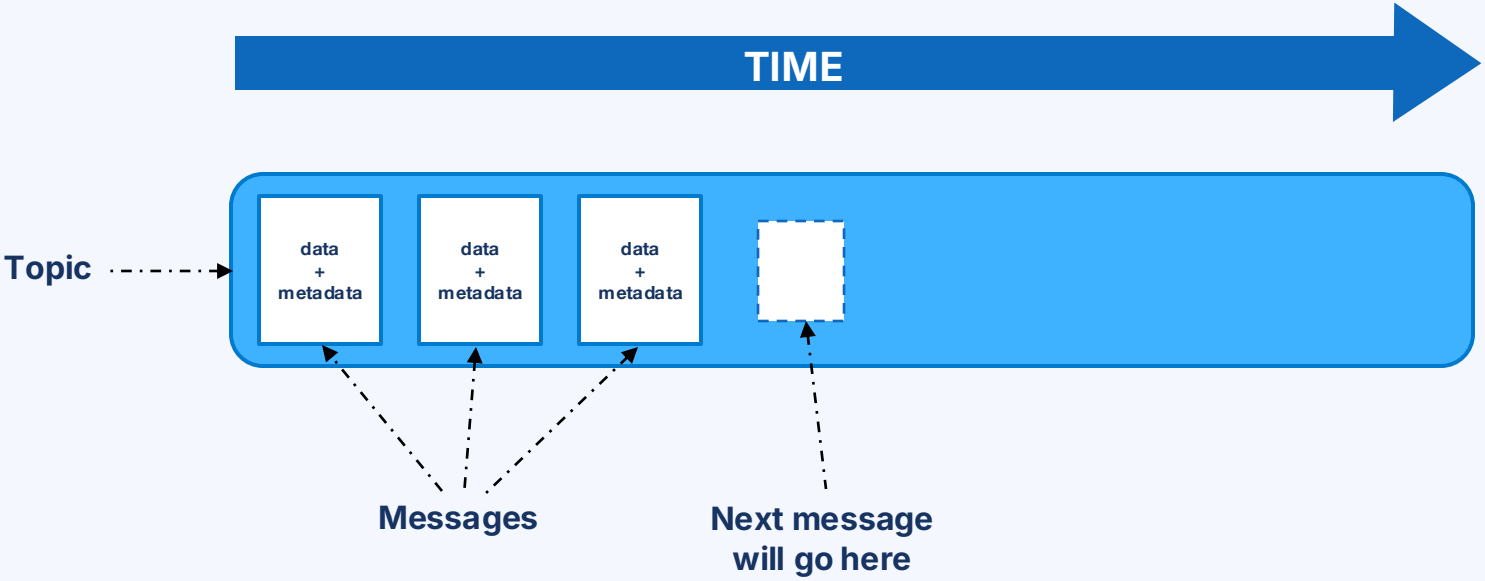
thermostat_readings

sensor_id	location	temperature	read_at
42	kitchen	22	1736521921
51	bedroom	20	1736521923
67	living Room	21	1736521926

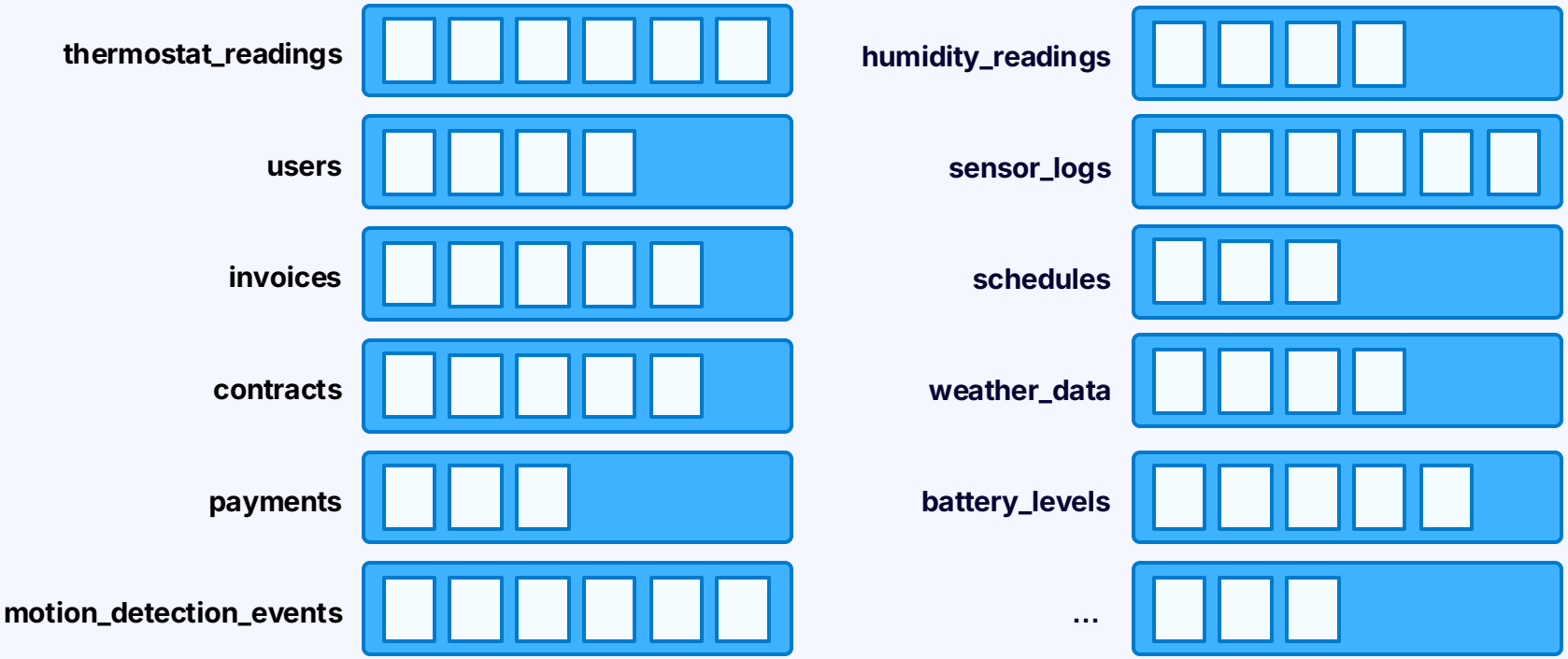
Messages stored in receiving order



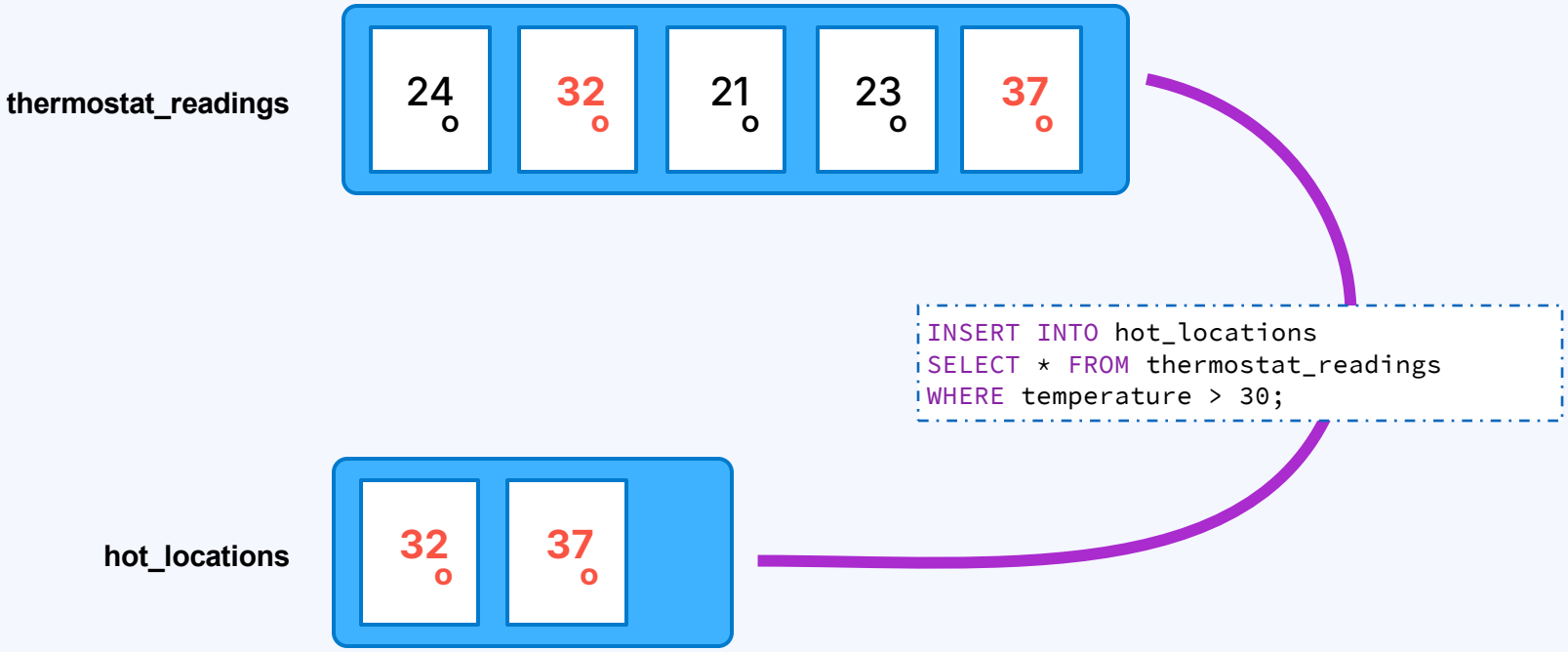
Topics store data in logs



Topics organize your data

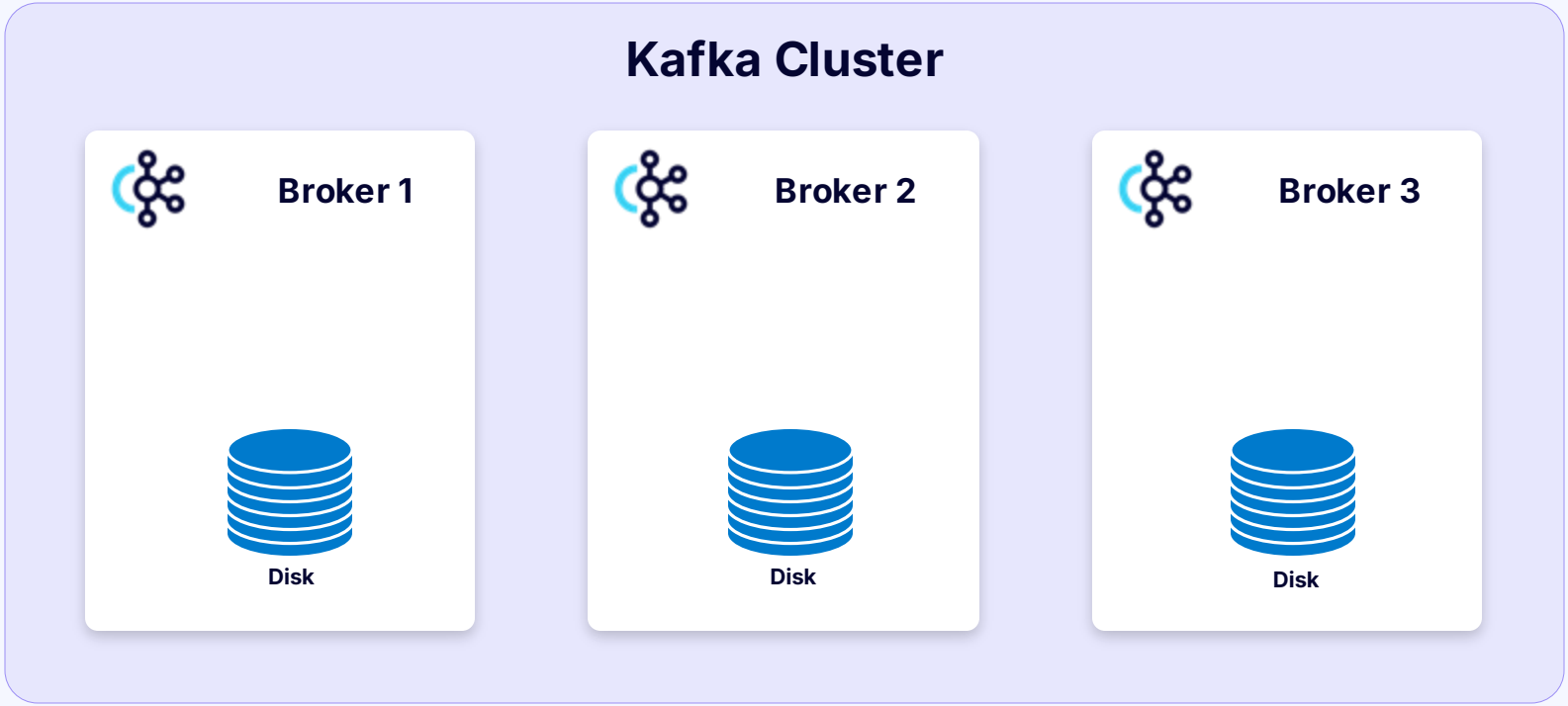


Derive topics from other topics

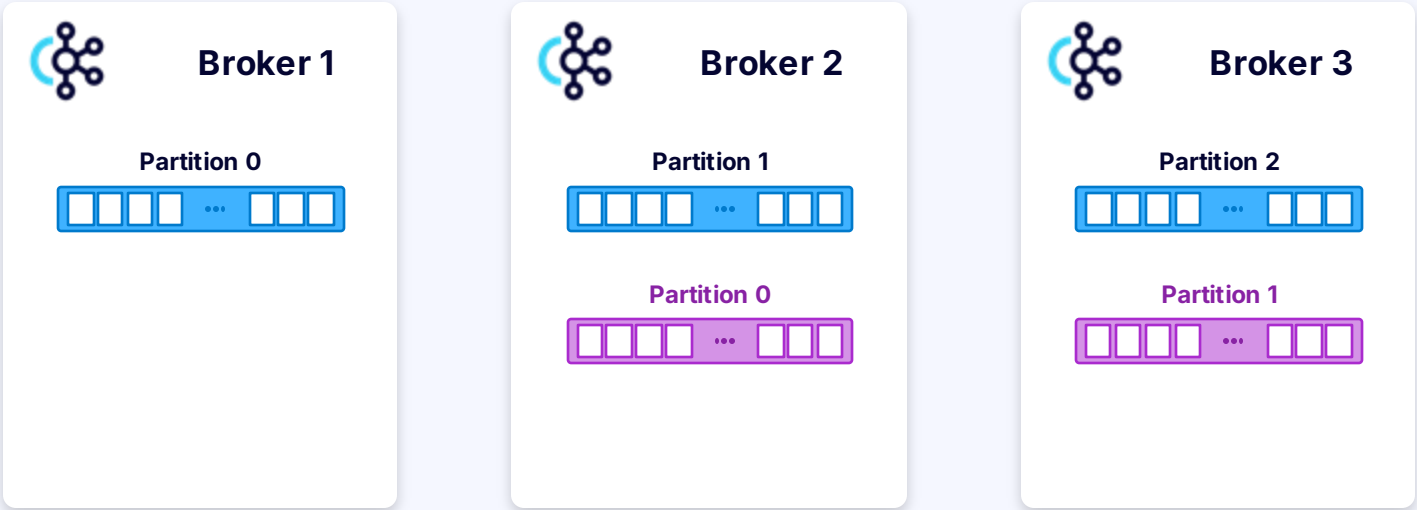


Brokers

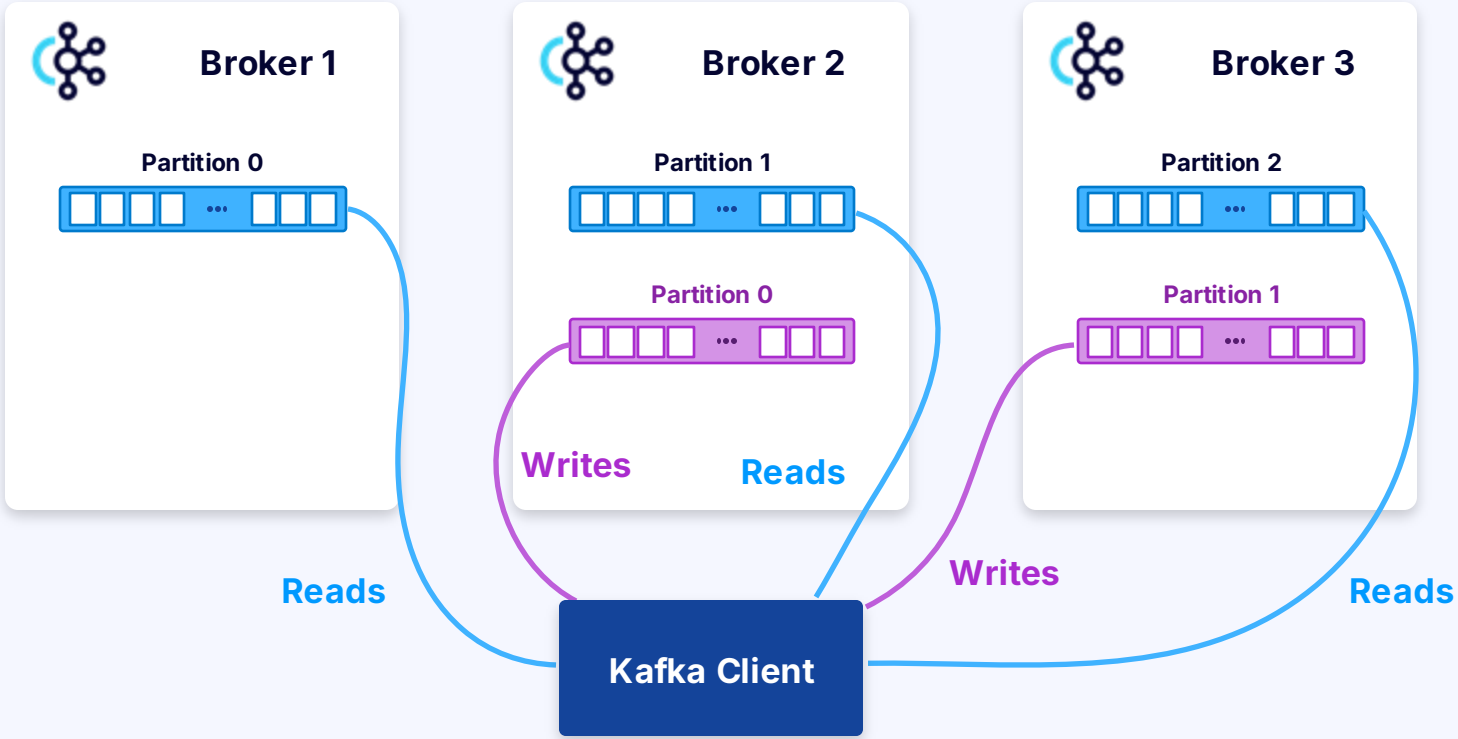
Cluster



Brokers host partitions

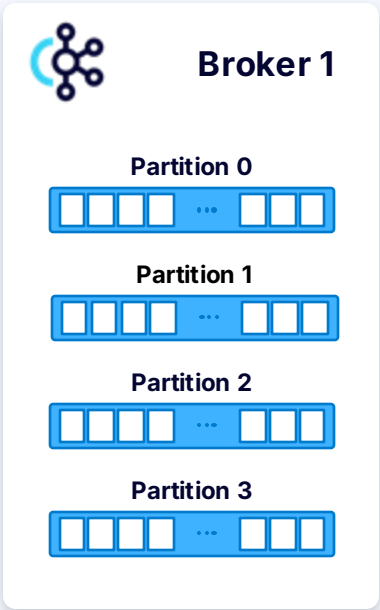


Brokers handle reads and writes

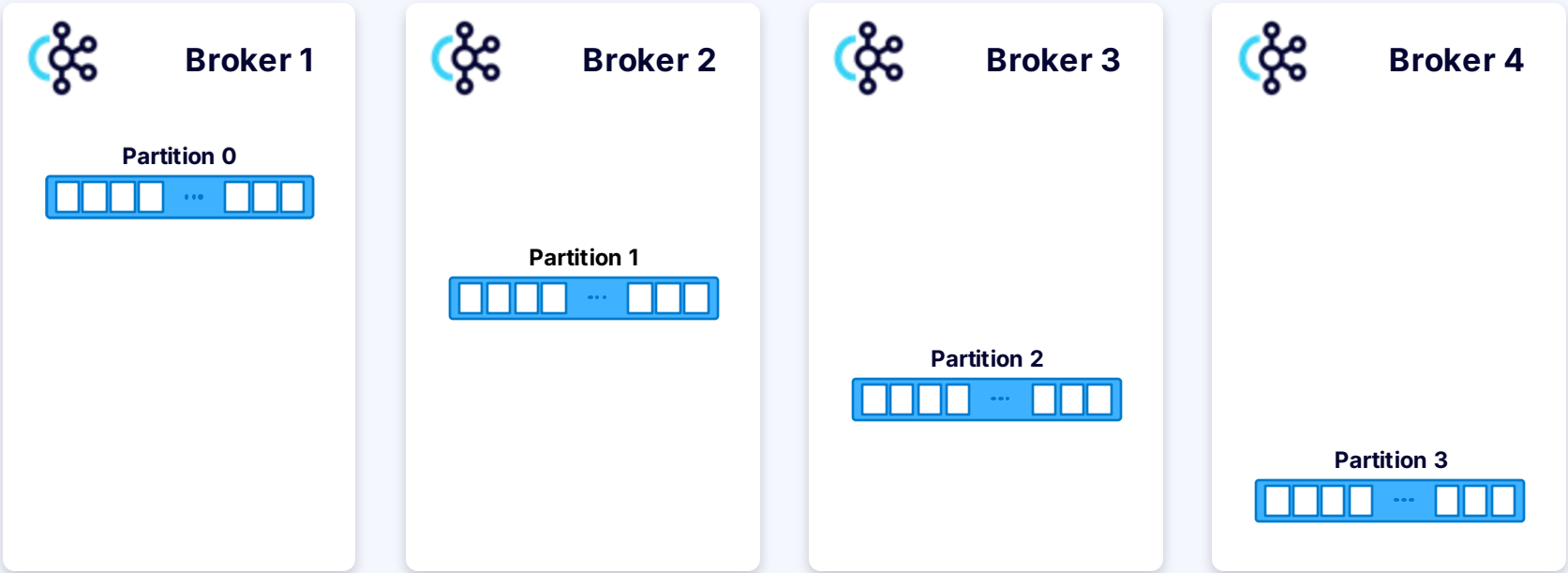


Replication

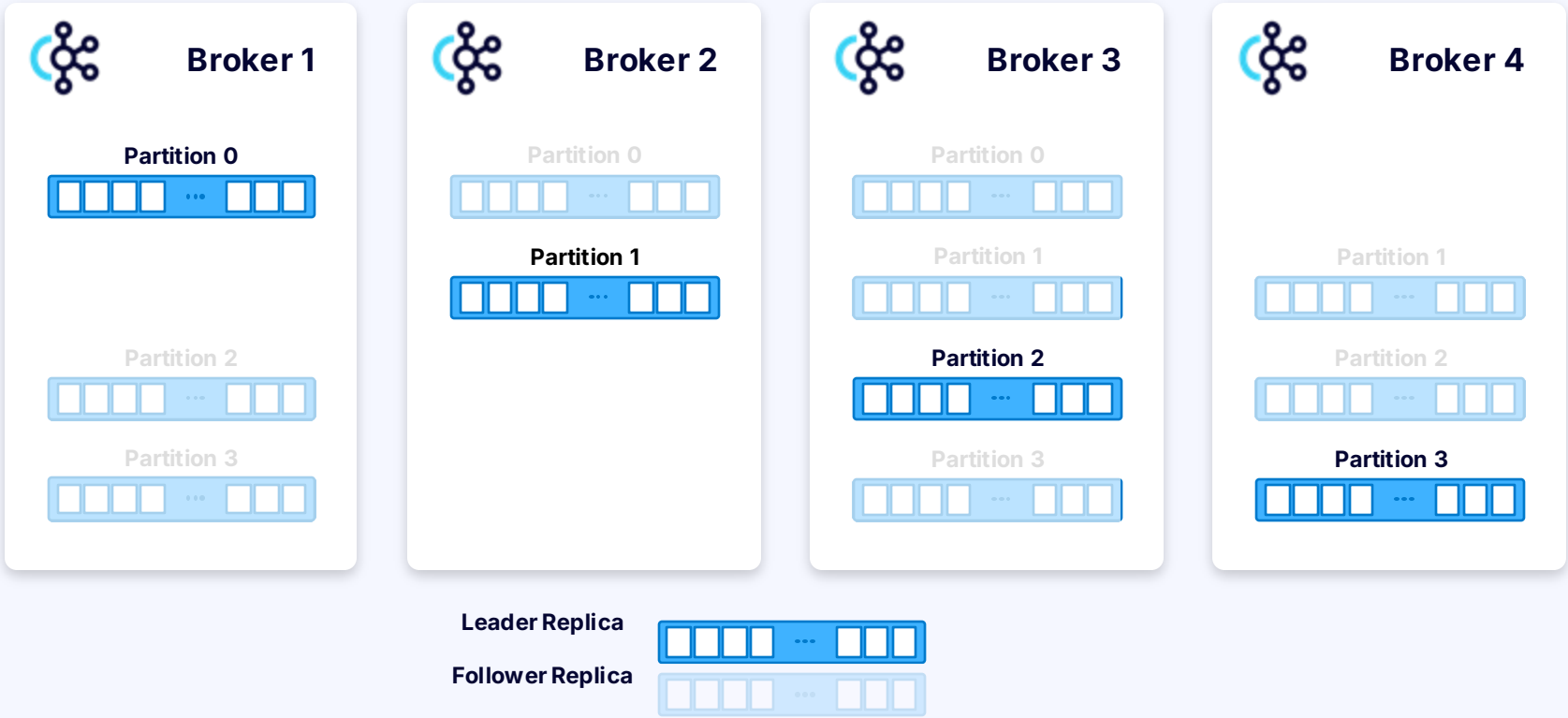
Kafka replicates partitions across brokers



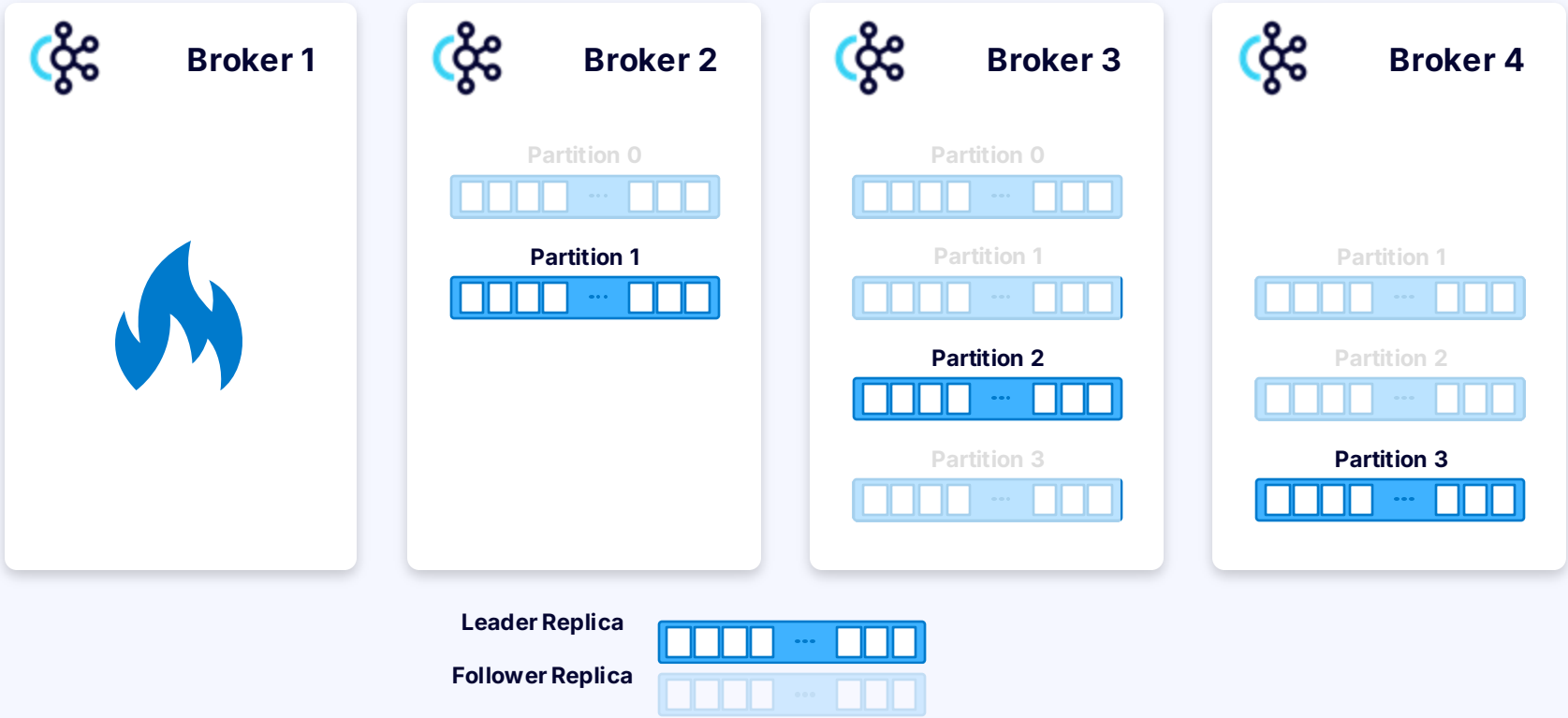
Kafka replicates partitions across brokers



Kafka replicates partitions across brokers



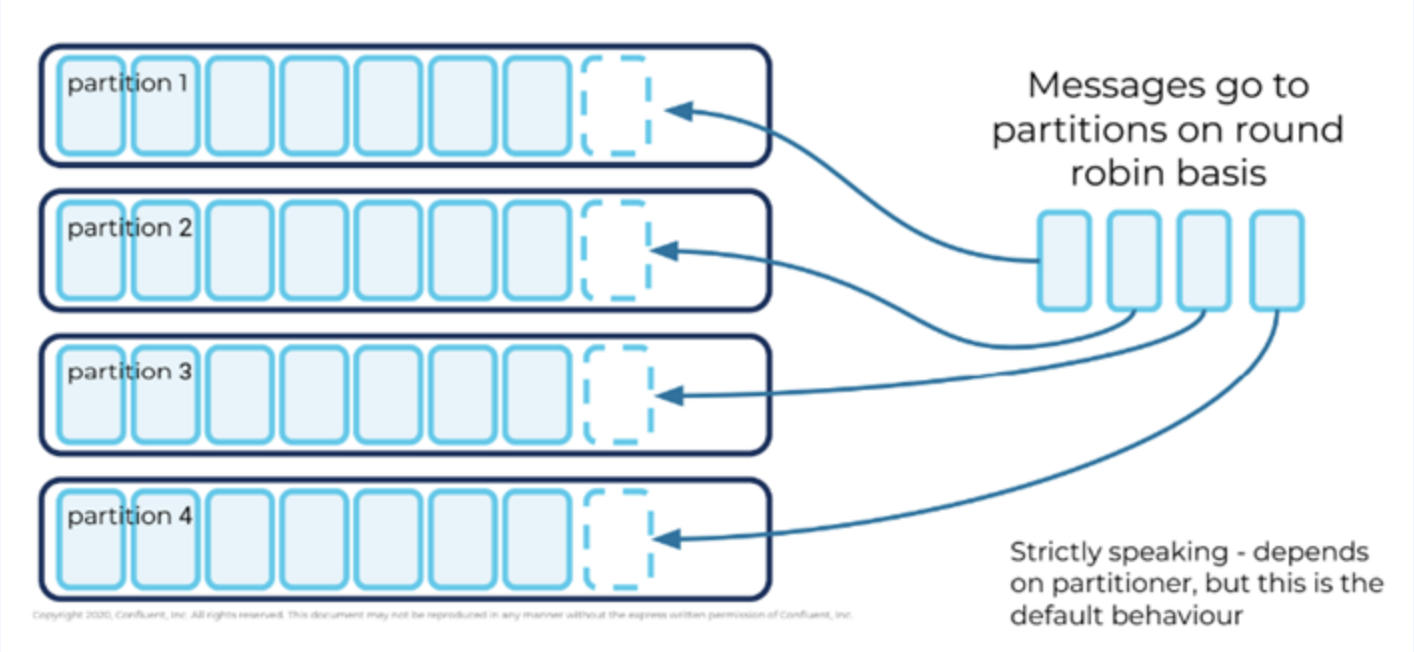
Kafka replicates partitions across brokers



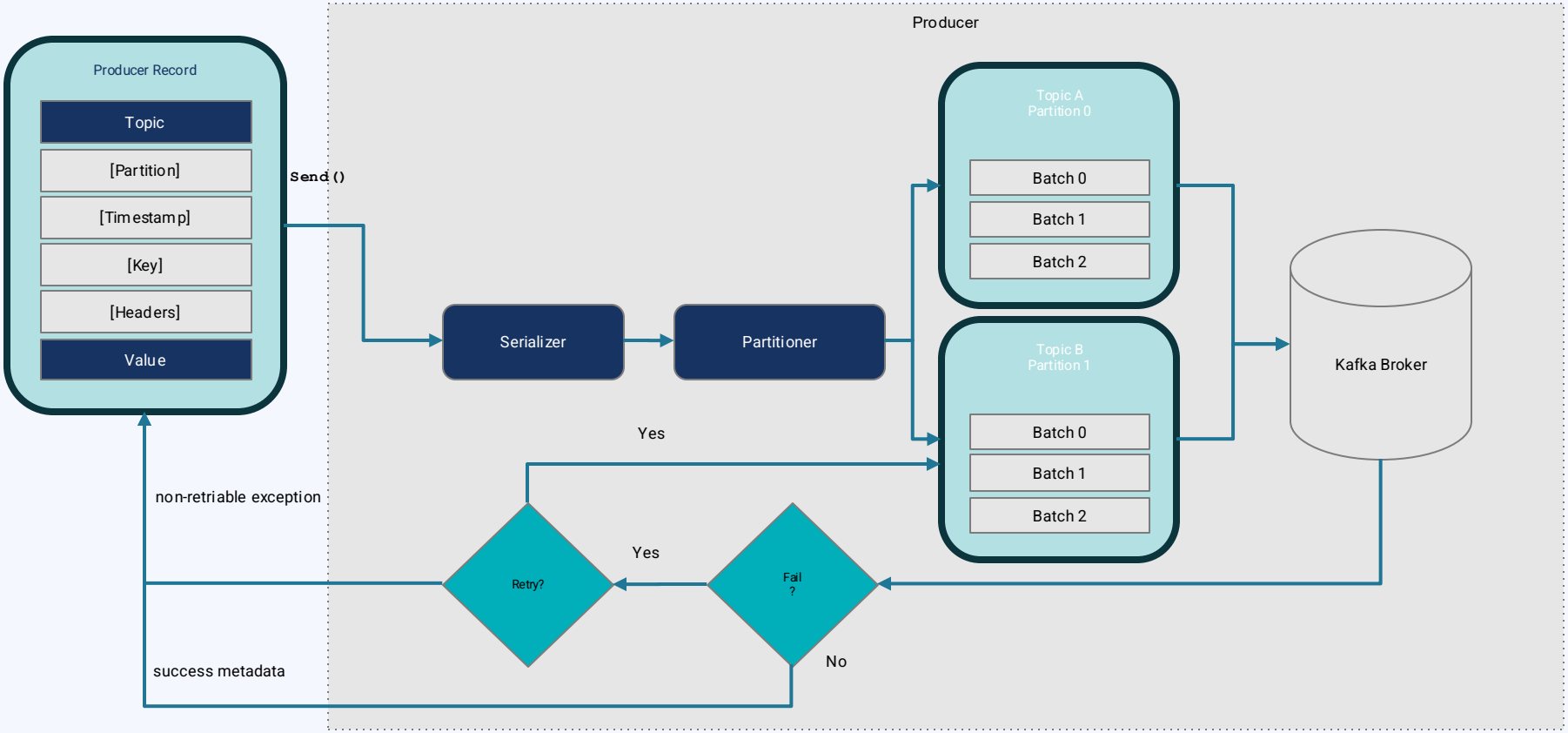
Kafka Producer API

Kafka Producer API

Producers are the entry gate to Kafka, they don’t just send messages they batch, retry, and ensure delivery semantics such as at-most-once, at-least-once, or exactly-once.



What happens inside a producer?



Key Configurations for Better Resiliency

Pro Tips

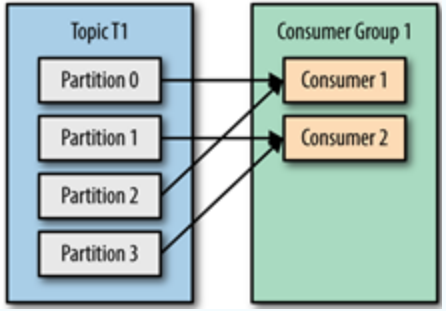
- Always use acks=all unless absolutely OK with potential data loss
- Combine with min.insync.replicas ≥2 and appropriate retry settings
- For strict ordering under retries, enforce idempotence and limit in-flight requests
- Understand that Kafka acknowledgements don’t coat-to-disk, they’re just memory-based unless FS is forced

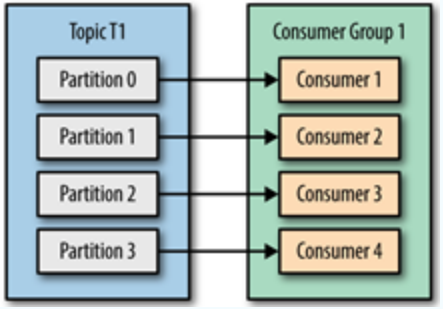
Consuming from Kafka

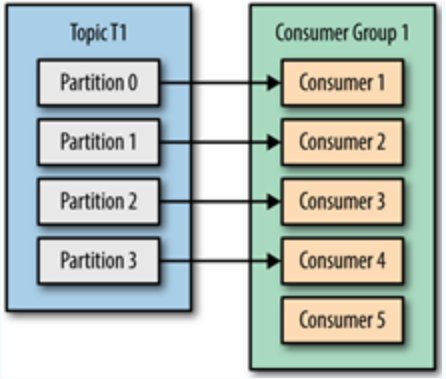
Consumers

Partitions

- Basis for scalability
- No partition will be assigned to more than one consumer in the same group





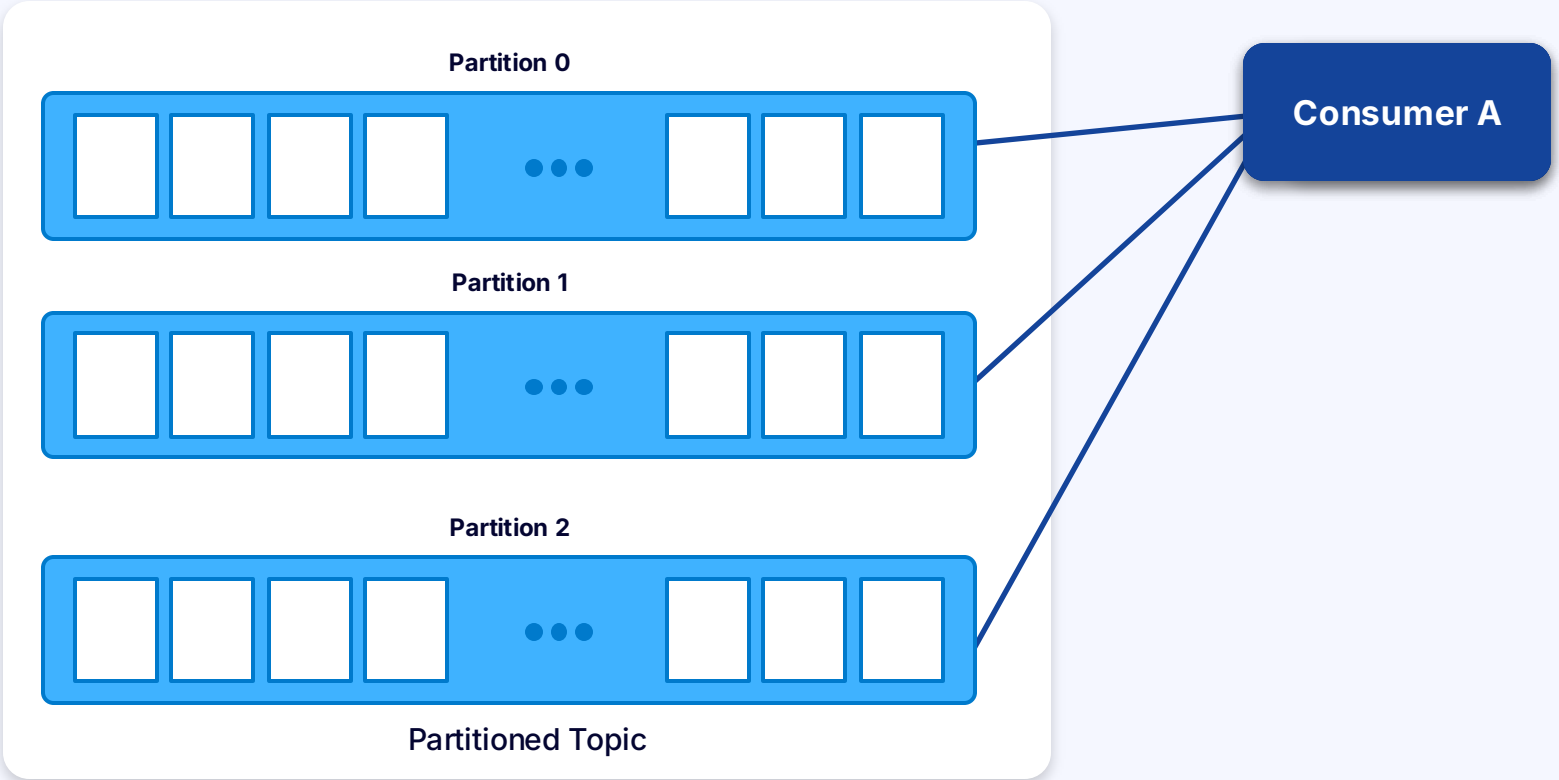


Key parameters

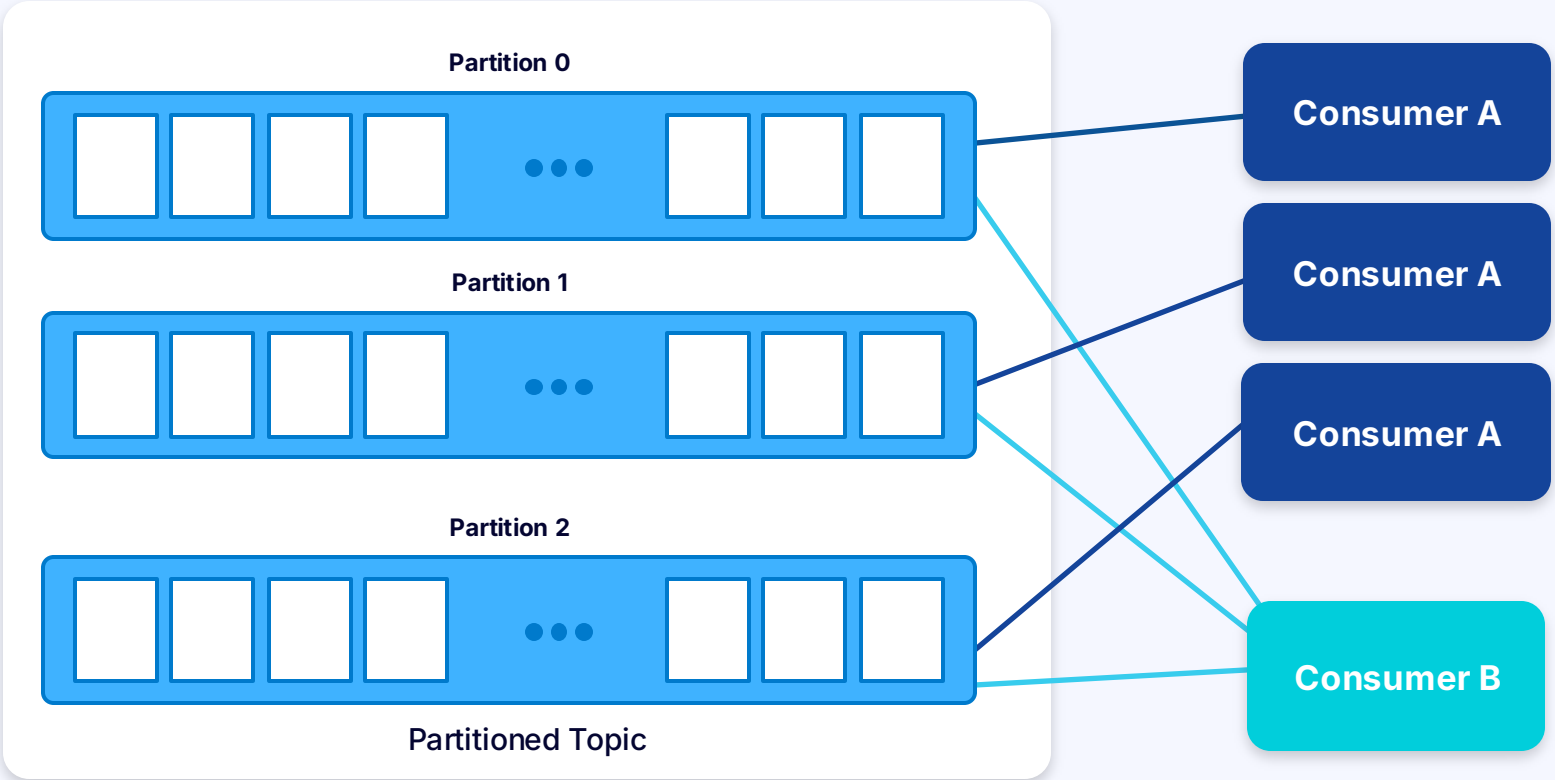
```
# of partitions
fetch.min.bytes=1
fetch.max.wait.ms=500ms
max.partition.fetch.bytes=10MB
```

```
fetch.max.bytes=50MB
max.poll.records=500
max.poll.interval.ms=5min
auto.commit.interval.ms=5s (if being used)
```

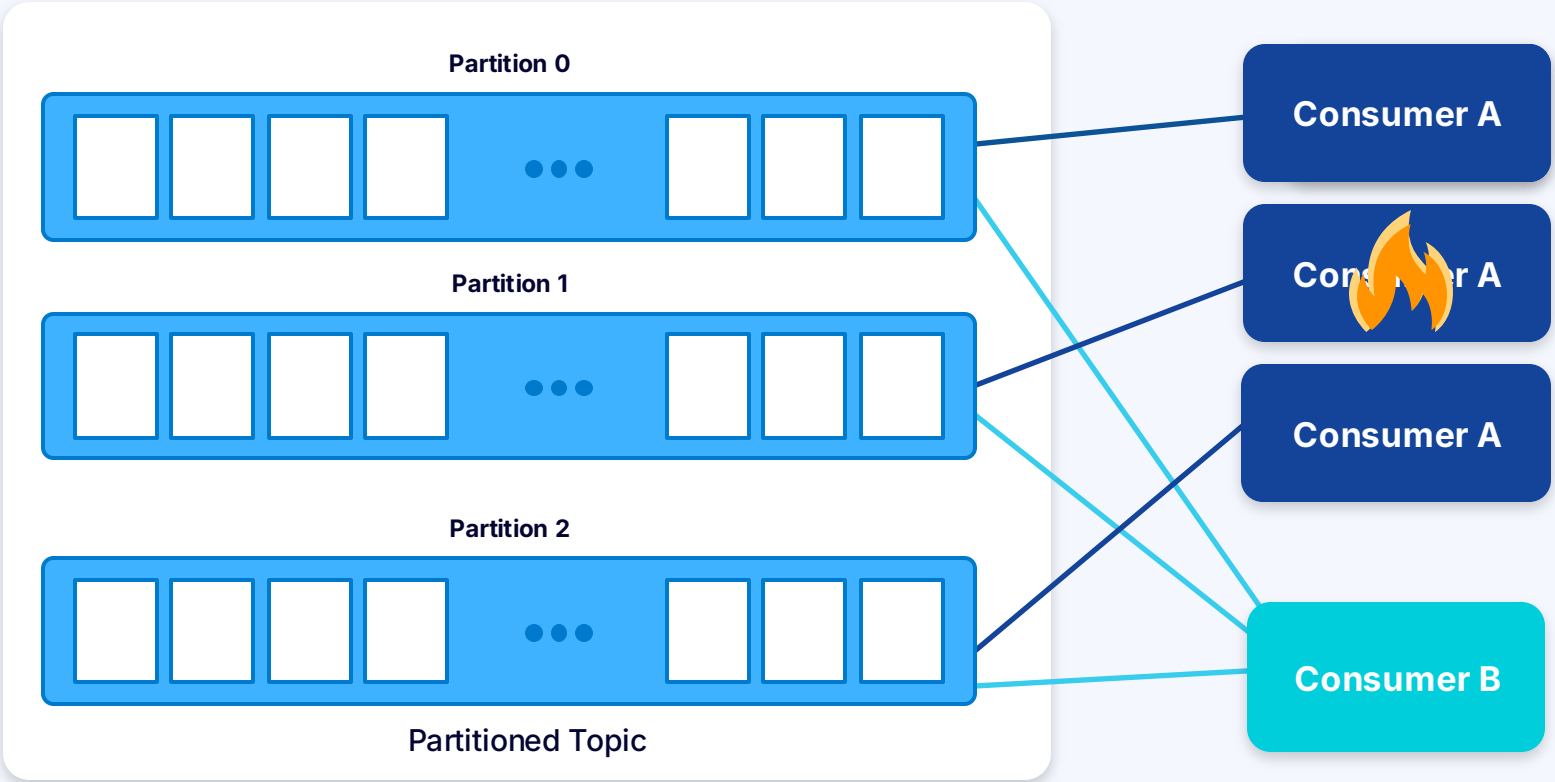
Scaling with Consumer Groups



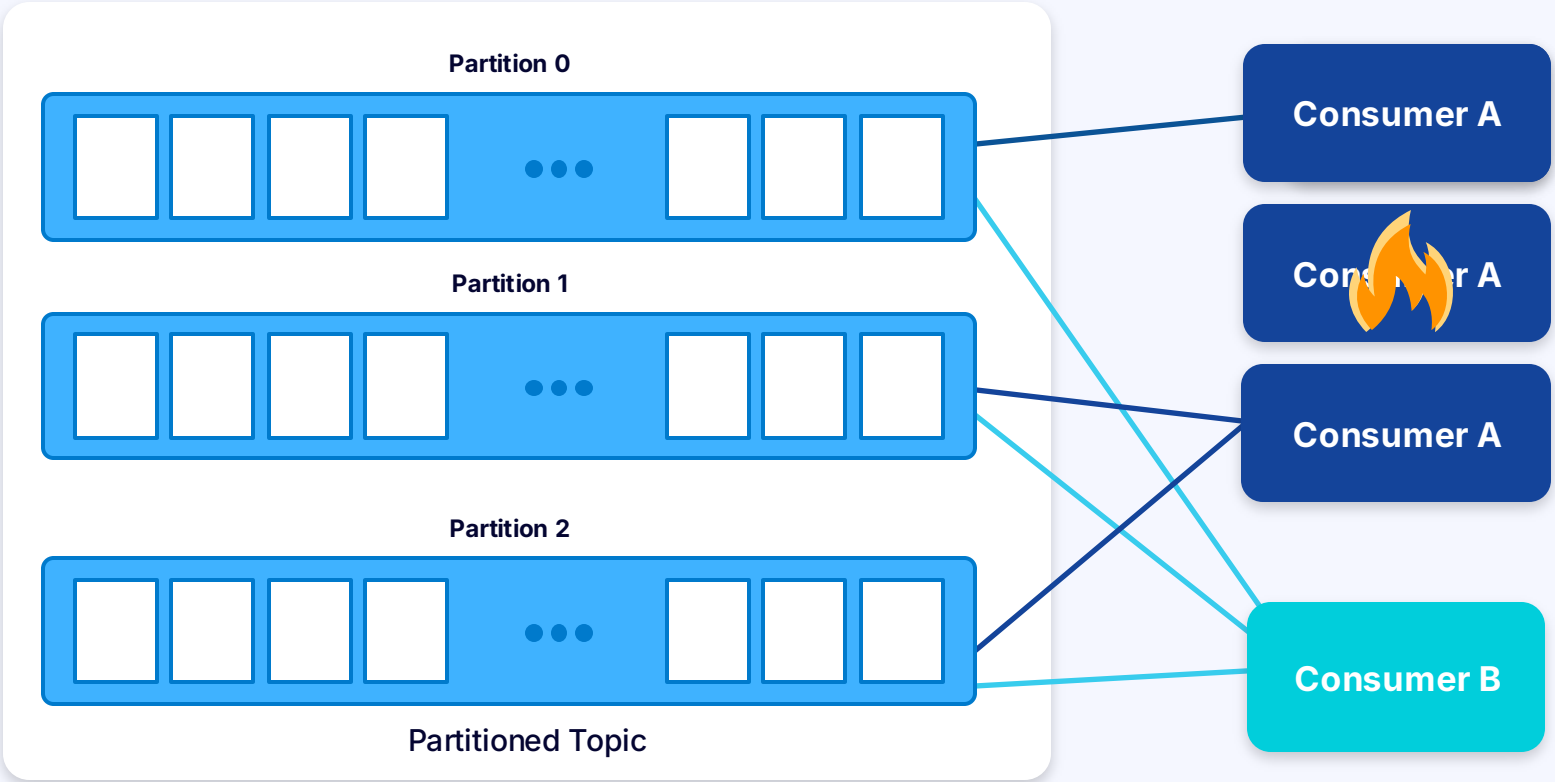
Scaling with Consumer Groups



Rebalancing



Rebalancing



Key Configurations and Concepts

Key Concepts to Highlight:

- poll() loop fundamentals
- Consumer group membership & partition assignment
- Offsets: when/how to commit (commitSync() vs commitAsync())
- Heartbeat vs processing heartbeat intervals
- Critical configs: max.poll.interval.ms, session.timeout.ms, heartbeat.interval.ms, max.poll.records

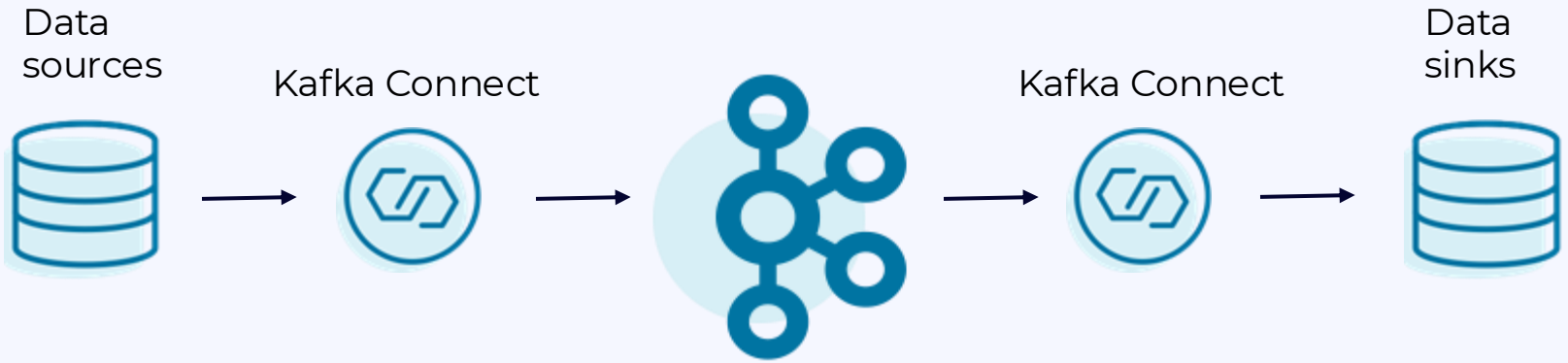
Kafka Connect

No/Low Code connectivity to many systems

Kafka Connect

No-Code way of connecting known systems (databases, object storage, queues, etc) to Apache Kafka

Some code can be written to do custom transforms and data conversions though maybe out of the box Single Message Transforms and Converters exist



Kafka Connect

Convert between the **source and sink record** objects and the **binary format** used to persist them in Kafka.

JSON, Avro, Protobuf and Others

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with Confluent

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meetup.com/pune-kafka/

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ClickHouse

Integrating Kafka with ClickHouse

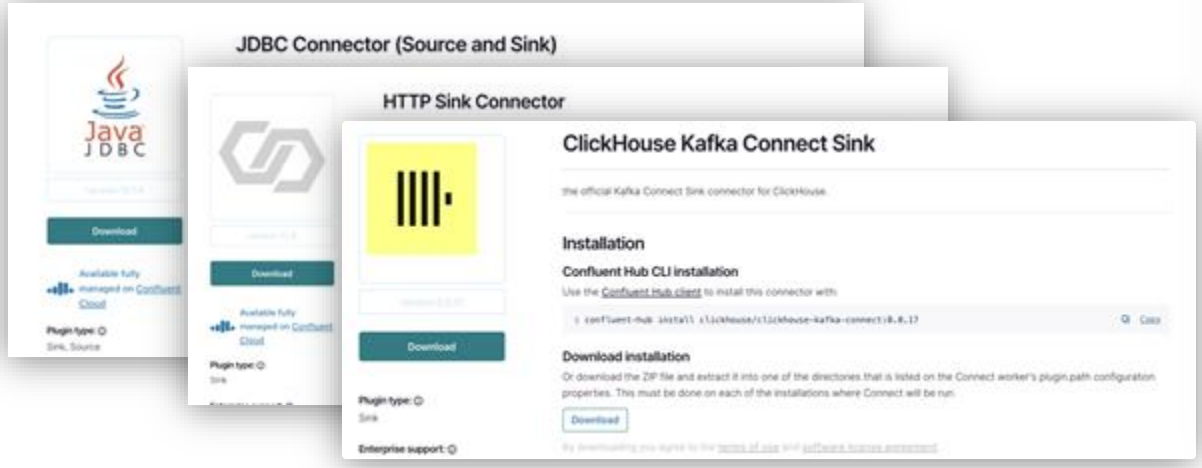
$(\text{real-time})^2$

Existing Kafka Integration Options

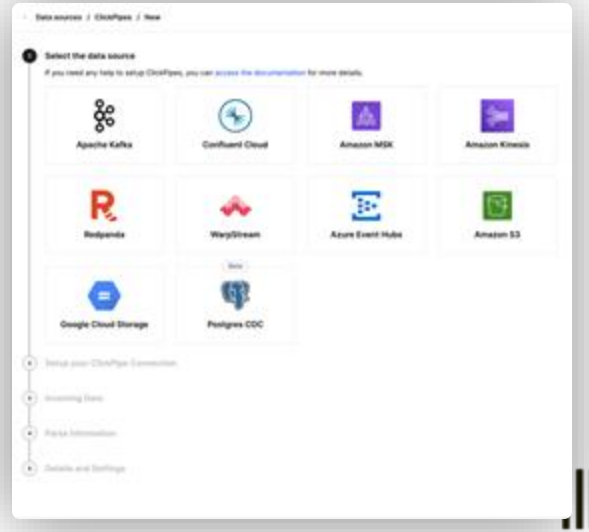
01 Kafka Table Engine

```
CREATE TABLE queue (
        timestamp UInt64,
        level String,
        message String
    )
ENGINE = Kafka('localhost:9092', 'topic', 'group1', 'JSONEachRow');
```

02 ClickHouse Kafka Connect Sink



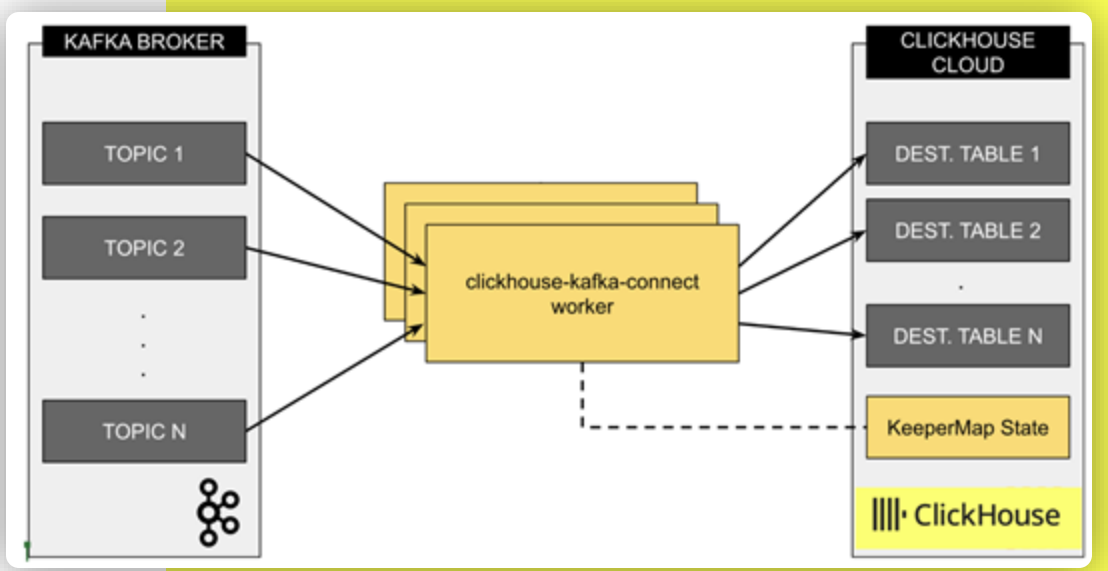
03 ClickPipes



ClickHouse

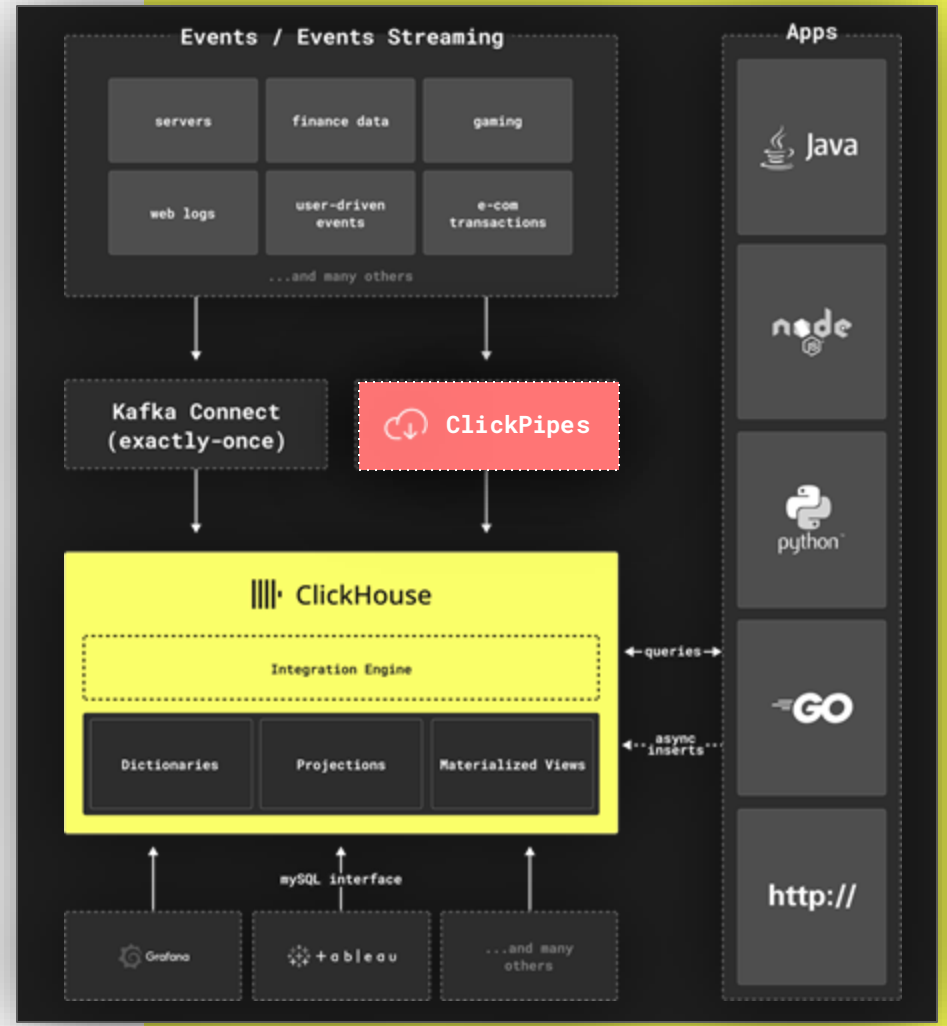
ClickHouse Kafka Connect Sink

- Shipped with out-of-the-box **exactly-once semantics** powered by ClickHouse core feature named **KeeperMap** (table engine used as a state store by the connector) and allows for minimalistic architecture
- **Core integration**: Built, maintained, and **supported by ClickHouse**
- Tested **continuously** against ClickHouse Cloud.
- Data inserts with a **declared schema** (schema-based data, e.g. Avro, Protobuf, etc.) and **schemaless** (e.g. JSON)
- Support for all data types of ClickHouse

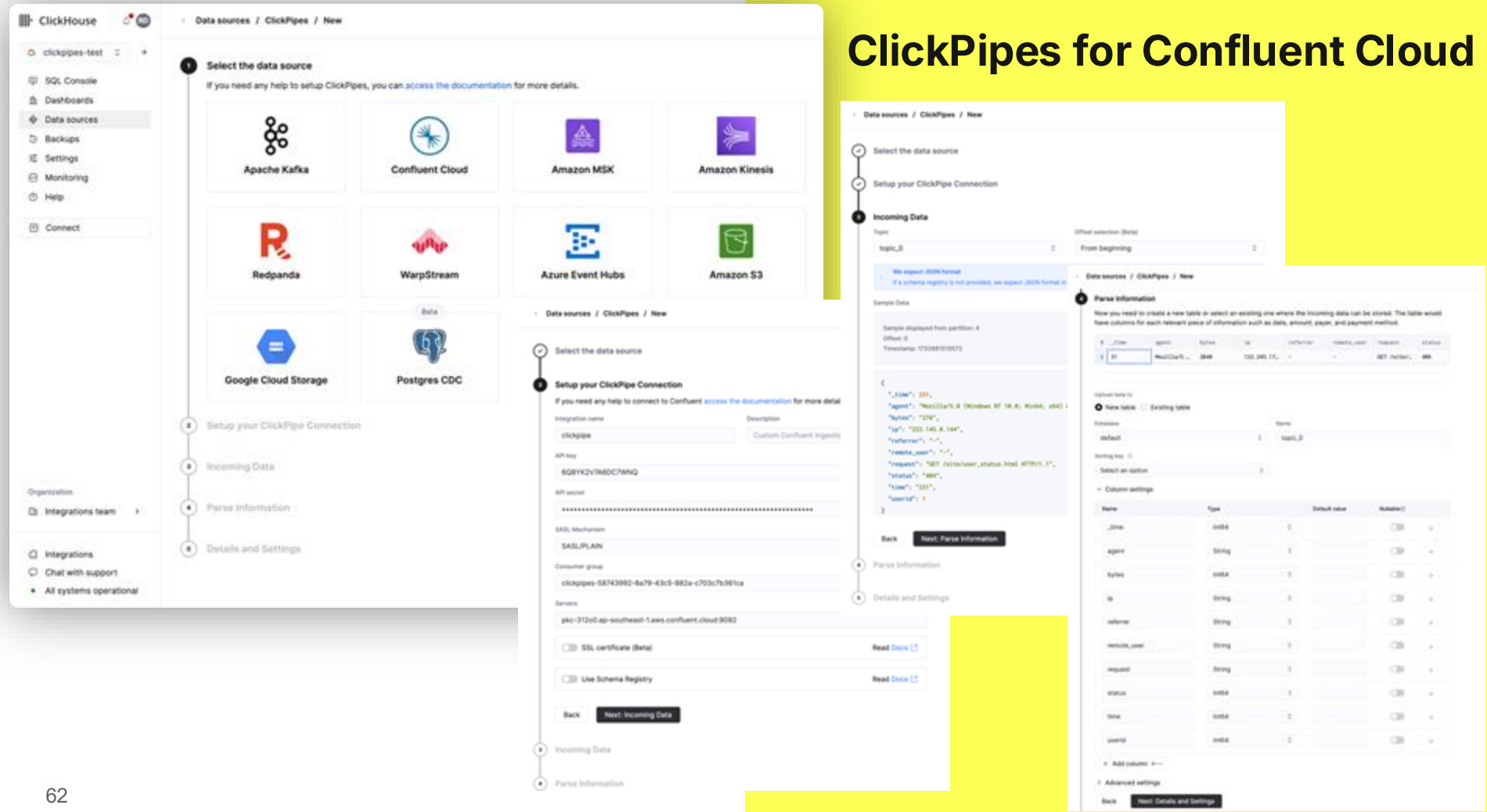


ClickPipes *noun*
/klɪk paɪps/

Cloud-Native experience to ingest data from remote data sources to ClickHouse Cloud



ClickPipes for Confluent Cloud



ClickHouse

Connect with ClickHouse

slack

GitHub

ClickHouse Academy

ClickHouse Cloud free trial

$100 additional credits
(total $400 trial credits for 30 days)

Try ClickHouse for your use case

- ClickHouse Cloud
- Download open source

Learn

- Academy / certifications
- Blogs / YouTube

Engage with our community

- Community Slack
- Monthly Community calls
- Meetups / events

We are Hiring. Come Work with Us!

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ClickHouse + CONFLUENT

Questions