Apache Doris: An Alternative Lakehouse Solution for Real-Time Analysis

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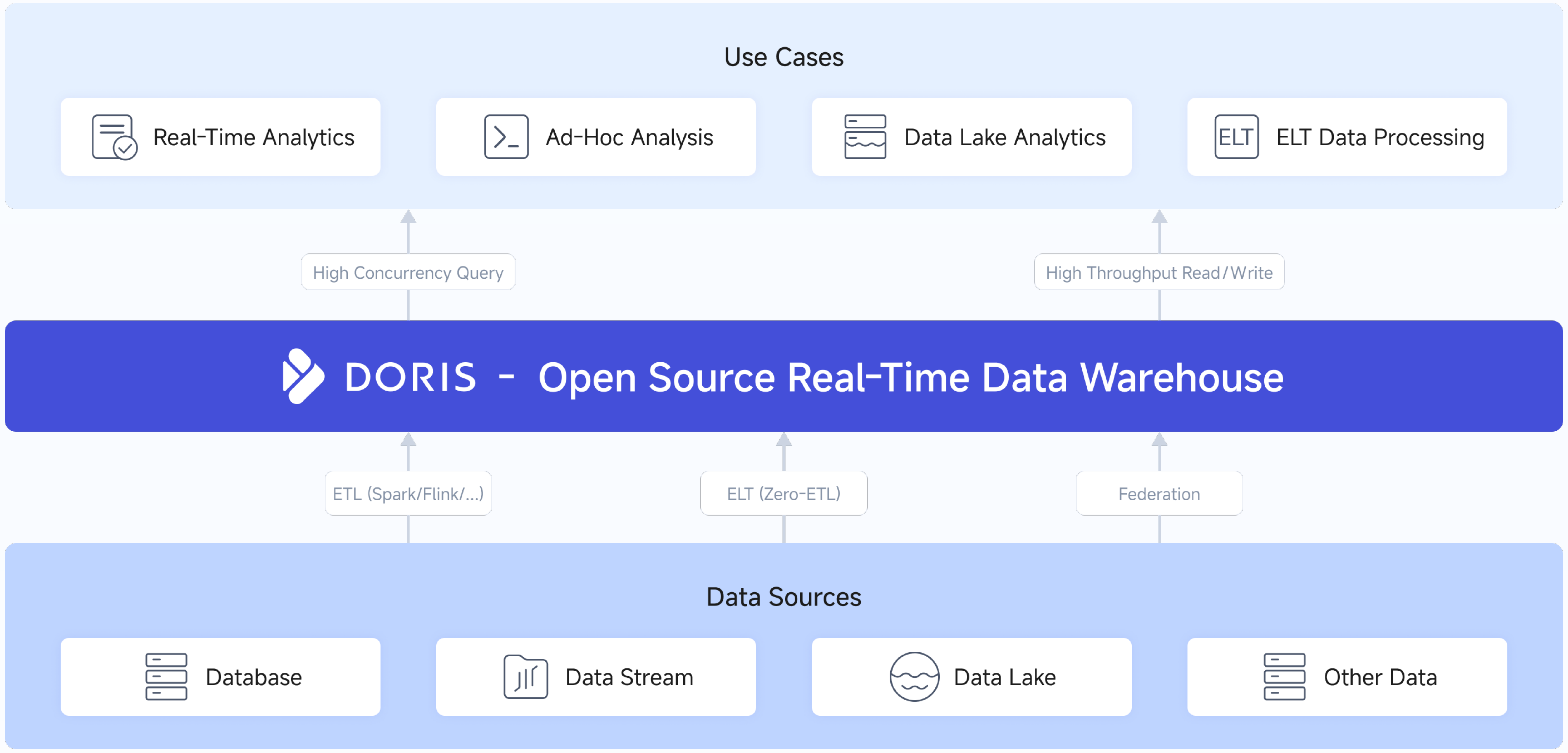
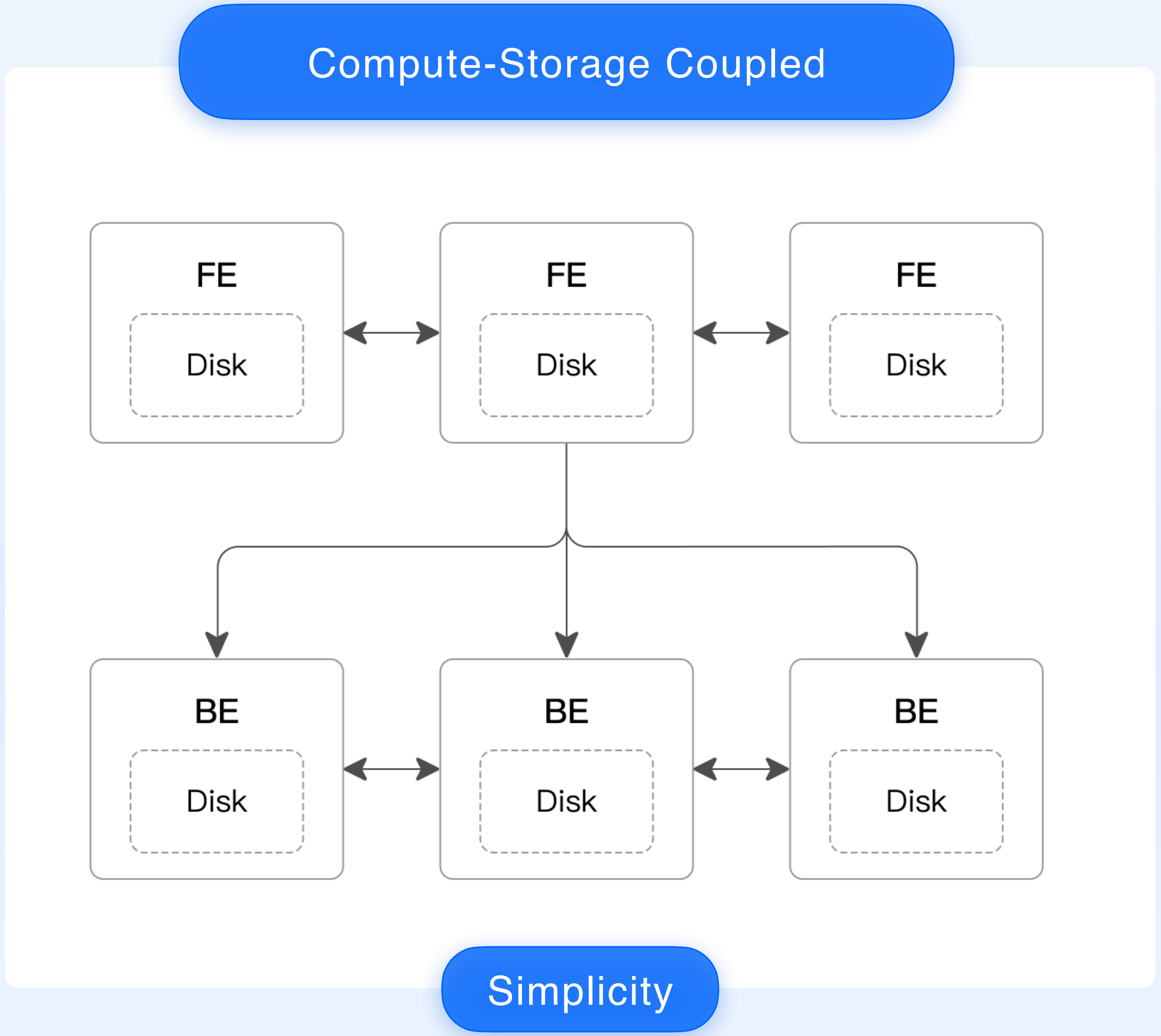
What is Apache Doris

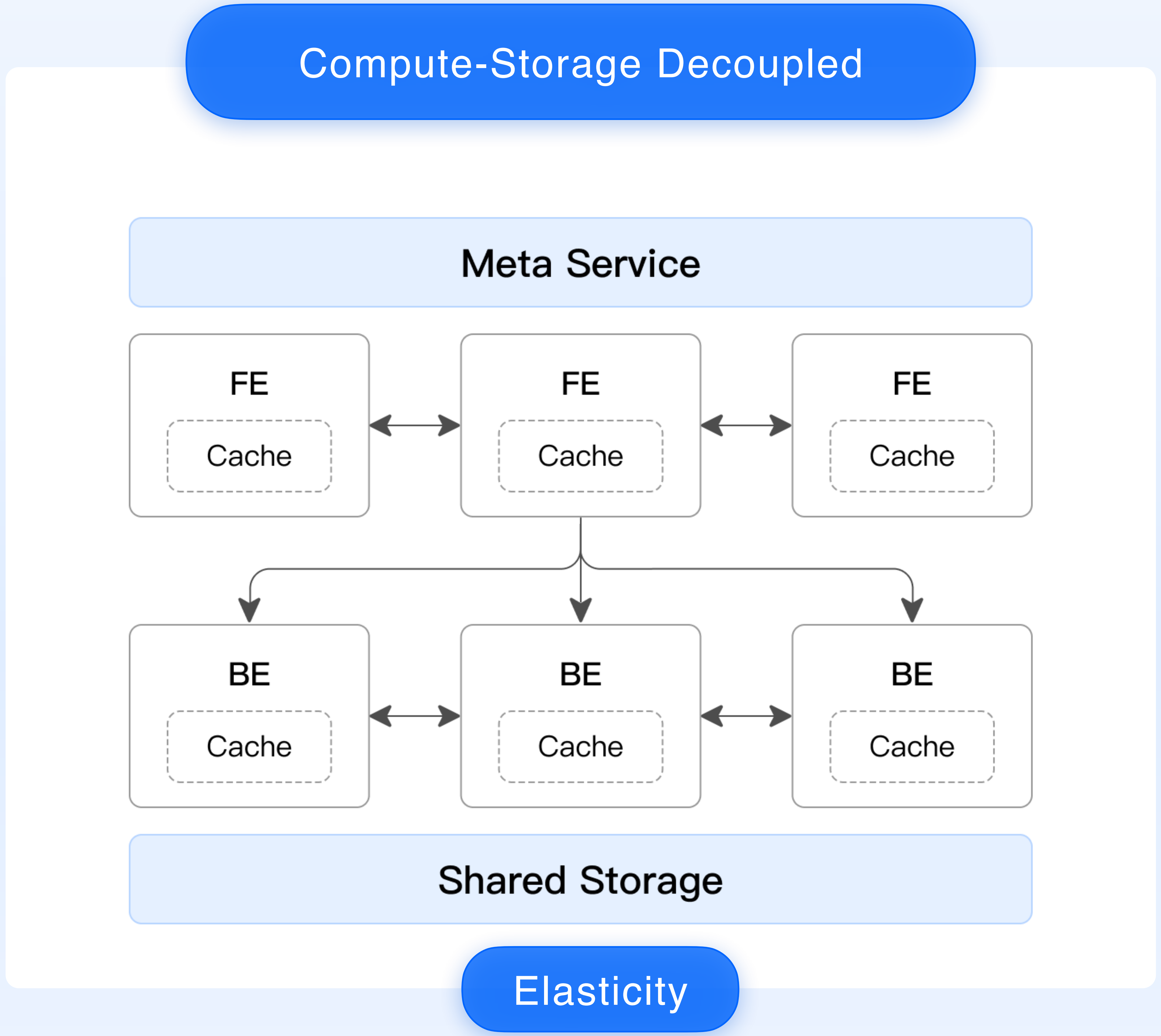
A Modern Data Warehouse

Offering Lightning-Fast Analysis on Large-Scale, Real-Time Data



Architecture





Core Features of Apache Doris

Lightning Fast

- One of the world’s fastest SQL query engines

Easy to Use

- Friendly for first-time user
- Low operational costs as a distributed system
- Flexible deployment options for various environments

Multi-Scenario

- Reporting & ad-hoc
- Semi-structured data analysis
- Lakehouse

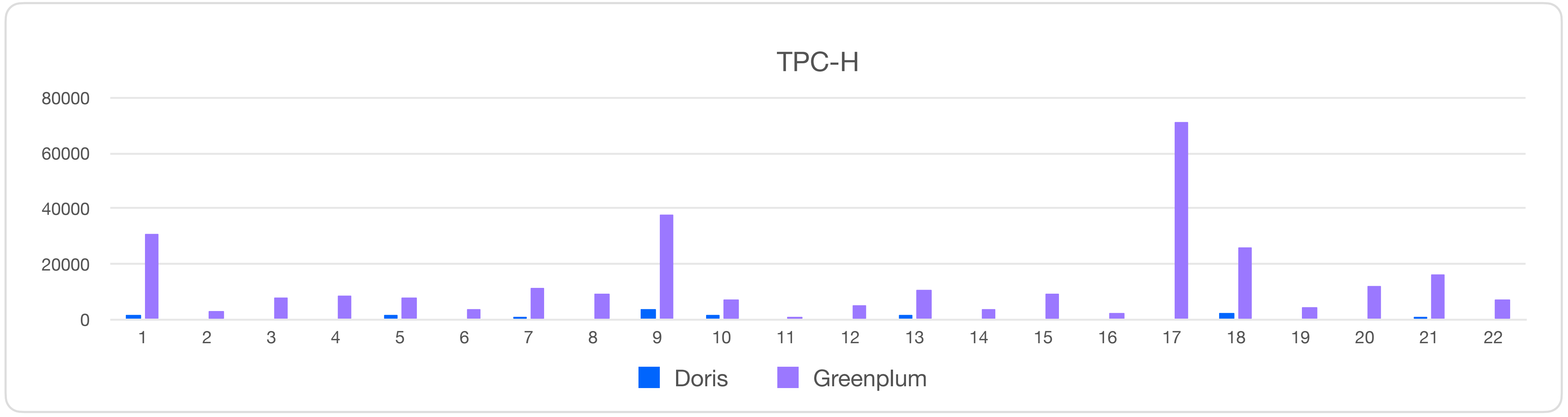
Lightning Fast SQL Query Engine

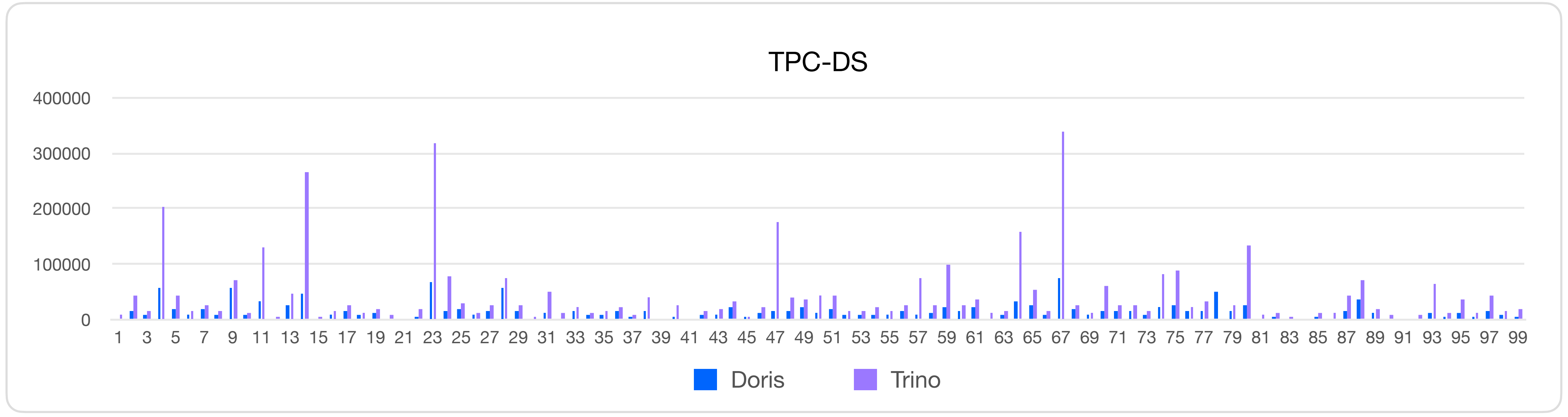
ClickBench

- benchmark.clickhouse.com

System & Machine	Relative time (lower is better)
Umbra (c6a.metal, 500gb gp2):	x 1.61
ClickHouse (tuned, memory) (c6a.metal, 500gb gp2):	x 1.95
ClickHouse (tuned) (c6a.metal, 500gb gp2):	x 2.04
Apache Doris (c6a.metal, 500gb gp2):	x 2.15
ClickHouse (c6a.metal, 500gb gp2):	x 2.21
StarRocks (c6a.metal, 500gb gp2):	x 2.38
Umbra (c6a.4xlarge 500gb gp2):	x 2.40

TPC-H & TPC-DS





Behind the Lightning Fast SQL Query Engine

Cost-Based Optimizer

- Cost-based join reorder, runtime filter
- Short circuit plan for high-concurrency queries

Full Vectorization

- Reduce virtual function calls and cache miss
- Efficient use of SIMD instructions, supports X86 and ARM

Massively Parallel Processing Architecture

- Parallelism within and between nodes to give full play to machines and cores
- Supports distributed join of large tables and operator materialization

Pipeline Execution

- Data-driven, no blocking of threads, fine-grained concurrency
- Self-adjusted parallelism level

Indexes

- BloomFilter, Min / Max / Sum
- Prefix Sorted Index
- Inverted Index

Materialized Views

- Consistent single-table materialized views, support general aggregation functions
- Multi-table materialized views

Smart Caching

- Caching of query results, data, metadata, and intermediate data
- Caching of internal and external tables

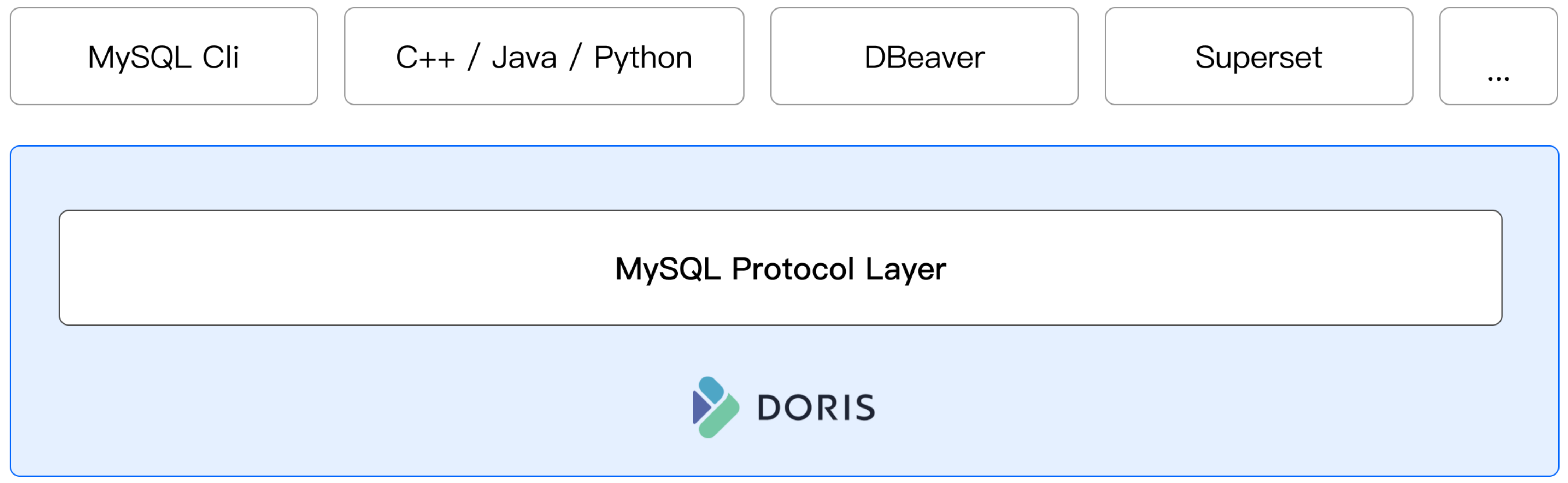
Columnar Storage & Hybrid Storage

- Columnar storage for efficient encoding, compression, and data sharding
- Row and columnar hybrid storage for flat tables to reduce IOPS amplification

Easy to Use

MySQL Protocol & ANSI SQL

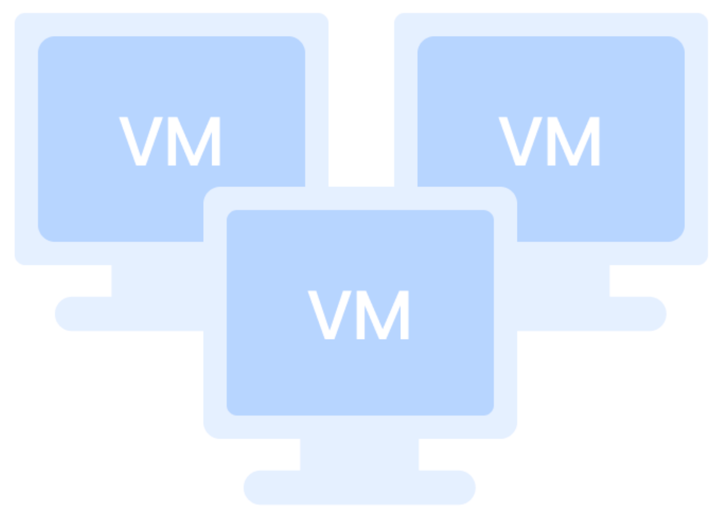
```
CREATE TABLE doris
(
    col1 int,
    col2 string
) DISTRIBUTED BY RANDOM BUCKETS 10;


SELECT * FROM doris WHERE col1 like "%kkey%";
```



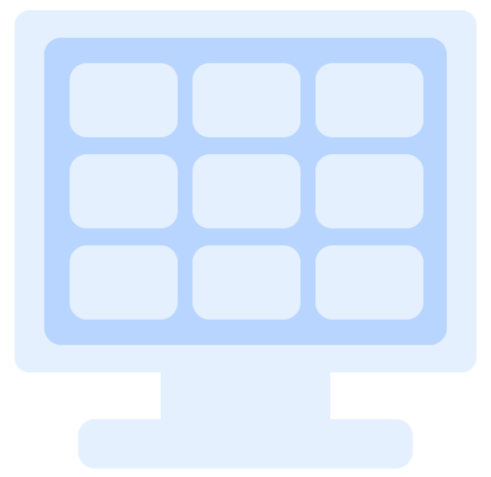
Deployed Everywhere

- Bare metal
- EC2
- K8s
- BYOC / SaaS

Bare Metal



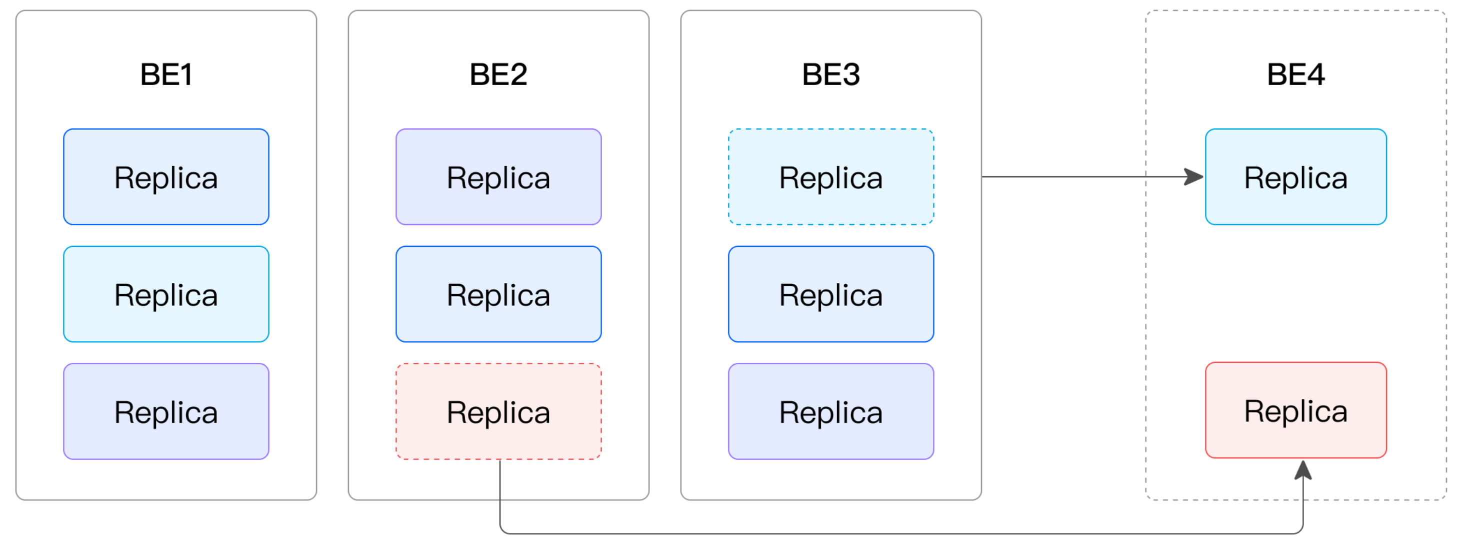
Virtual Machines

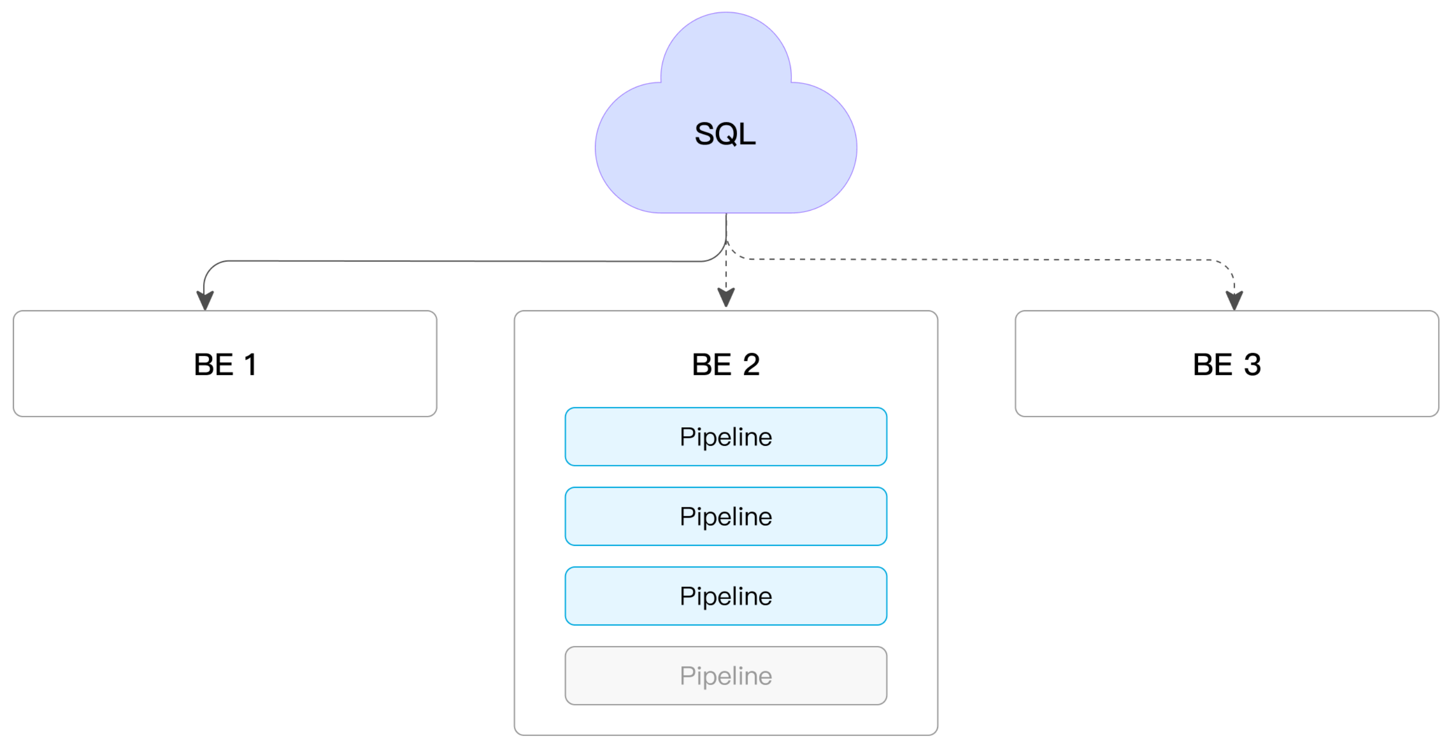

Containers

Easy to Use

Easy Operation and Maintenance

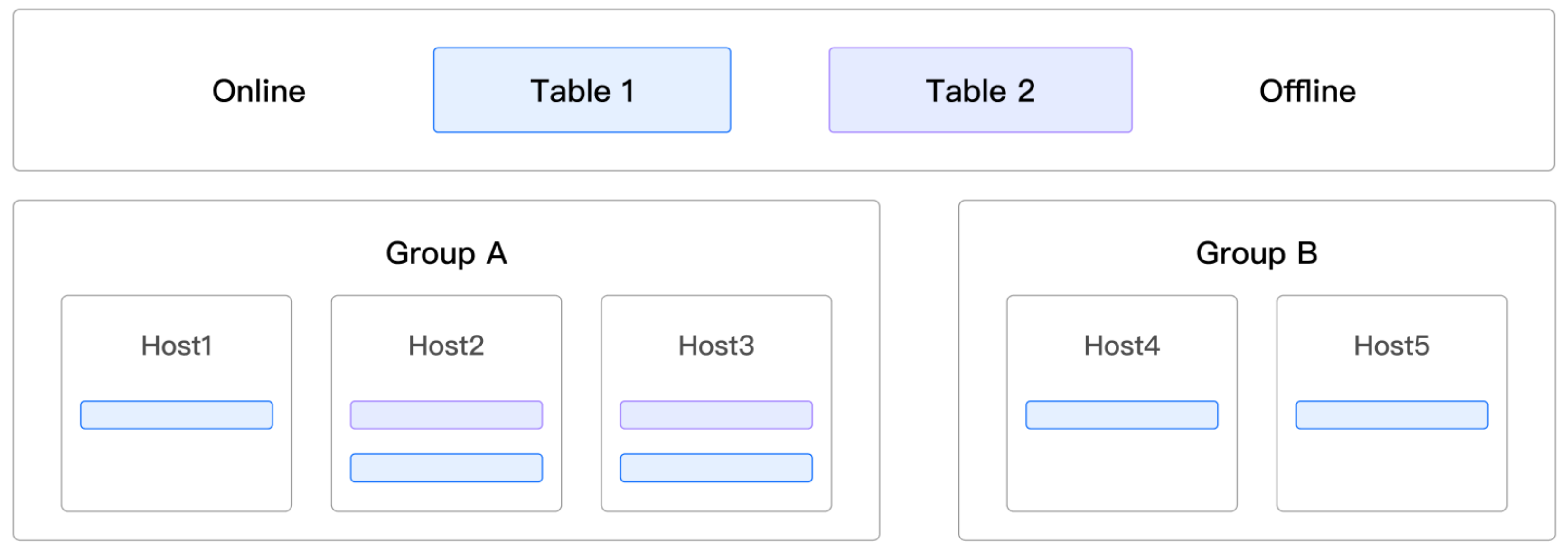
- Auto Balance
- Auto Replica Repair
- Adaptive Concurrency
- Fault Tolerant

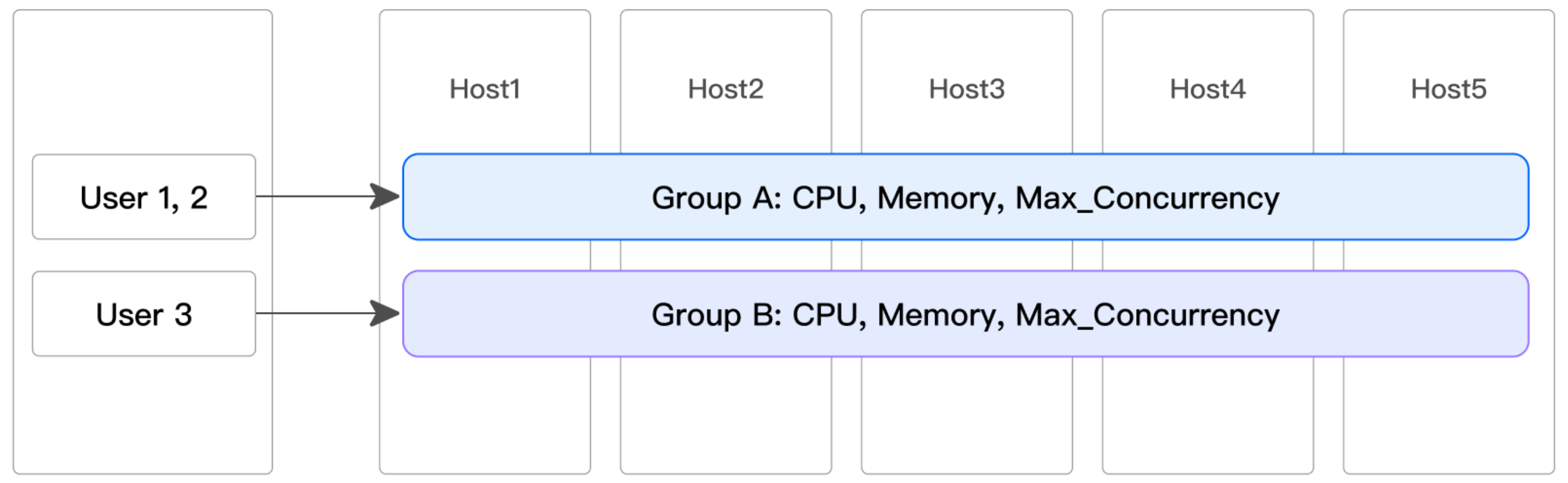




Multi-Tenancy and Resource Isolation

- Resource Group
- Workload Group
- Virtual Cluster
- Query Fuse




Host1
Host2
Host3
Host4
Host5
User 1, 2
Group A: CPU, Memory, Max_Concurrency
User 3
Group B: CPU, Memory, Max_Concurrency

Multi-Scenario

Reporting

- Pre-aggregation data model (Rollup)
- Query Cache

```
SELECT Department, SUM (Salary)
FORM EMPLOYEE
GROUP BY Department
```

Department	SUM (Salary)
RD	38000
QA	19000

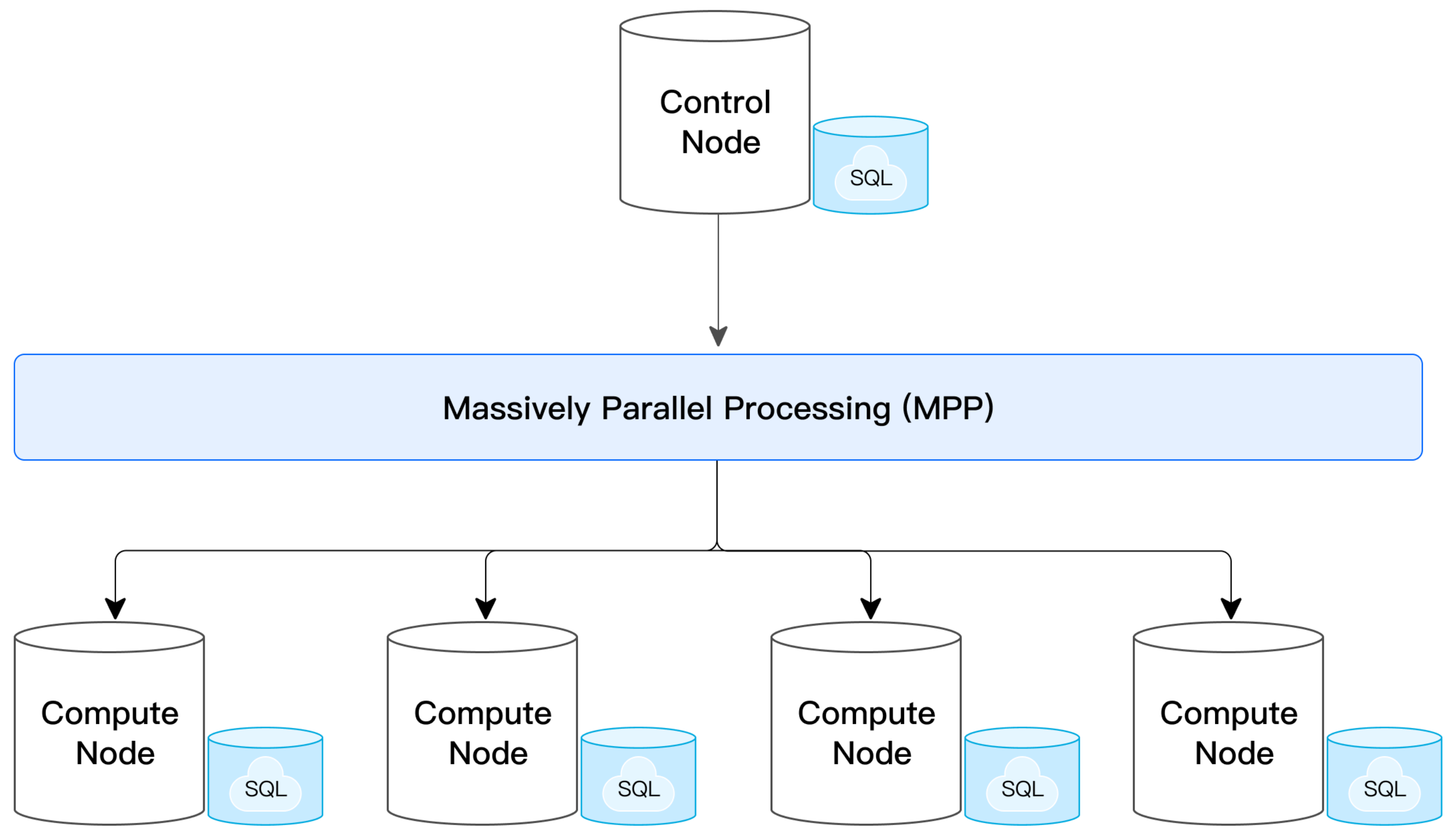
↑

Name	Department	Salary
John	RD	20000
Bob	RD	18000
Alice	QA	19000

Result Cache	Partition Cache	Page Cache

Ad-Hoc Query

- Massively parallel processing
- Adaptive pipeline execution engine
- Spill to disk

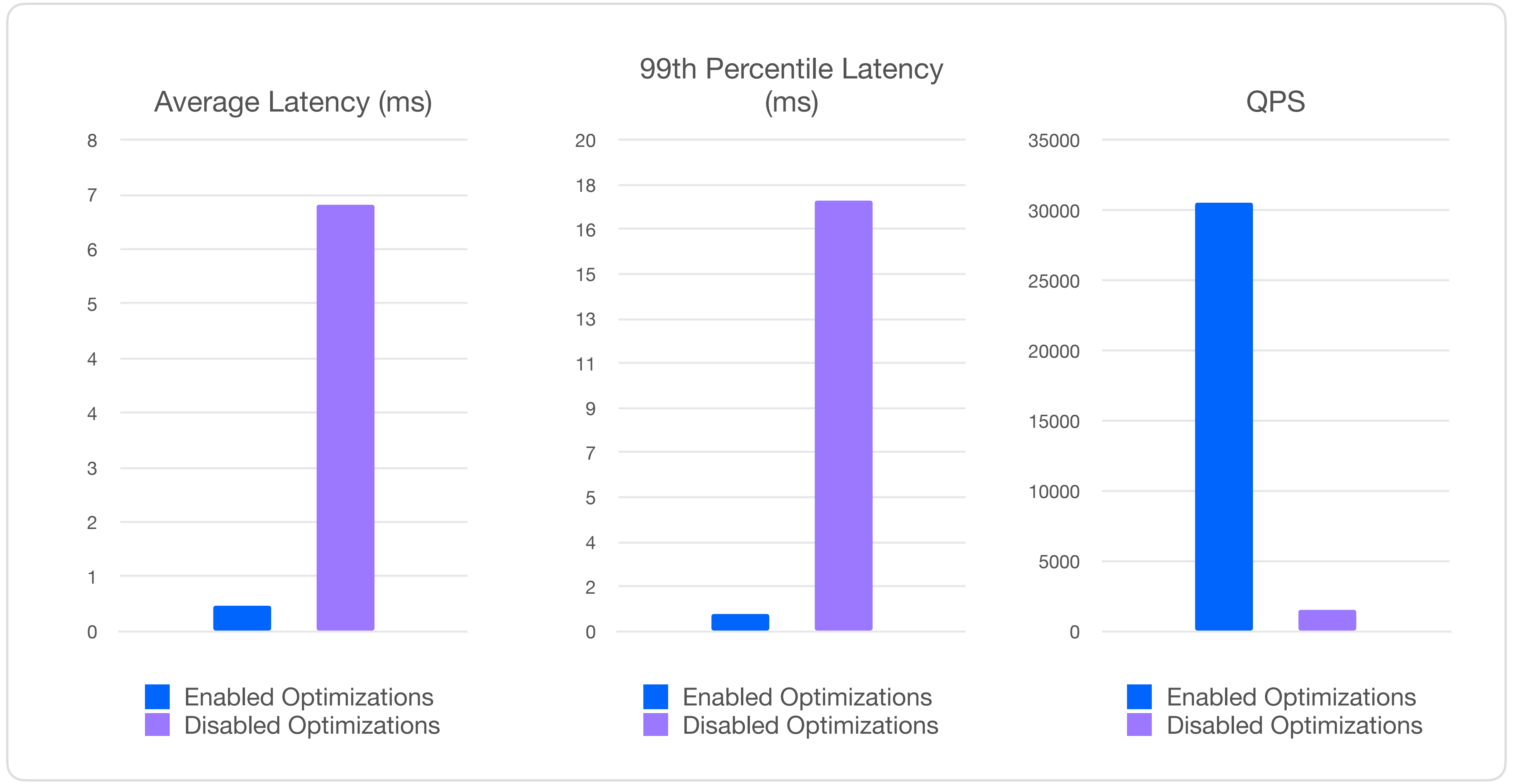


Multi-Scenario

High Concurrency Point Query

Small amount of data retrieved from a massive dataset

SELECT * FROM billing WHERE user_id=123

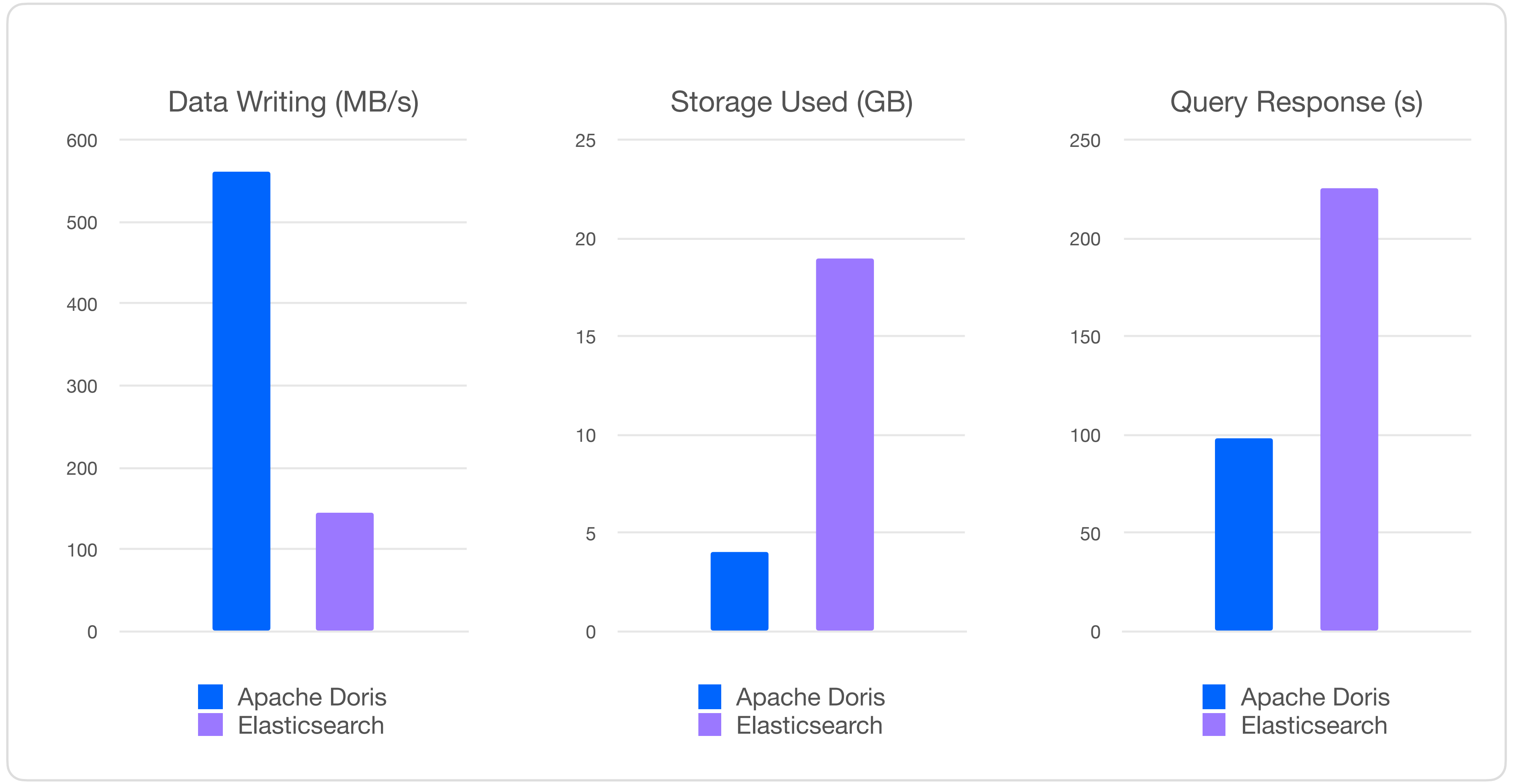


- Row storage
- Prepared statement
- Short circuit query plan

Semi-Structured Data Analysis

Log Management

Compared to Elasticsearch



- Inverted index
- Full-text search
- JSON / VARIANT data type

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Lakehouse Challenges

Performance

- How to speed up the query on lake data?

Diversity

- Semi-structured data support
- Insertion, deletion and update

Openness

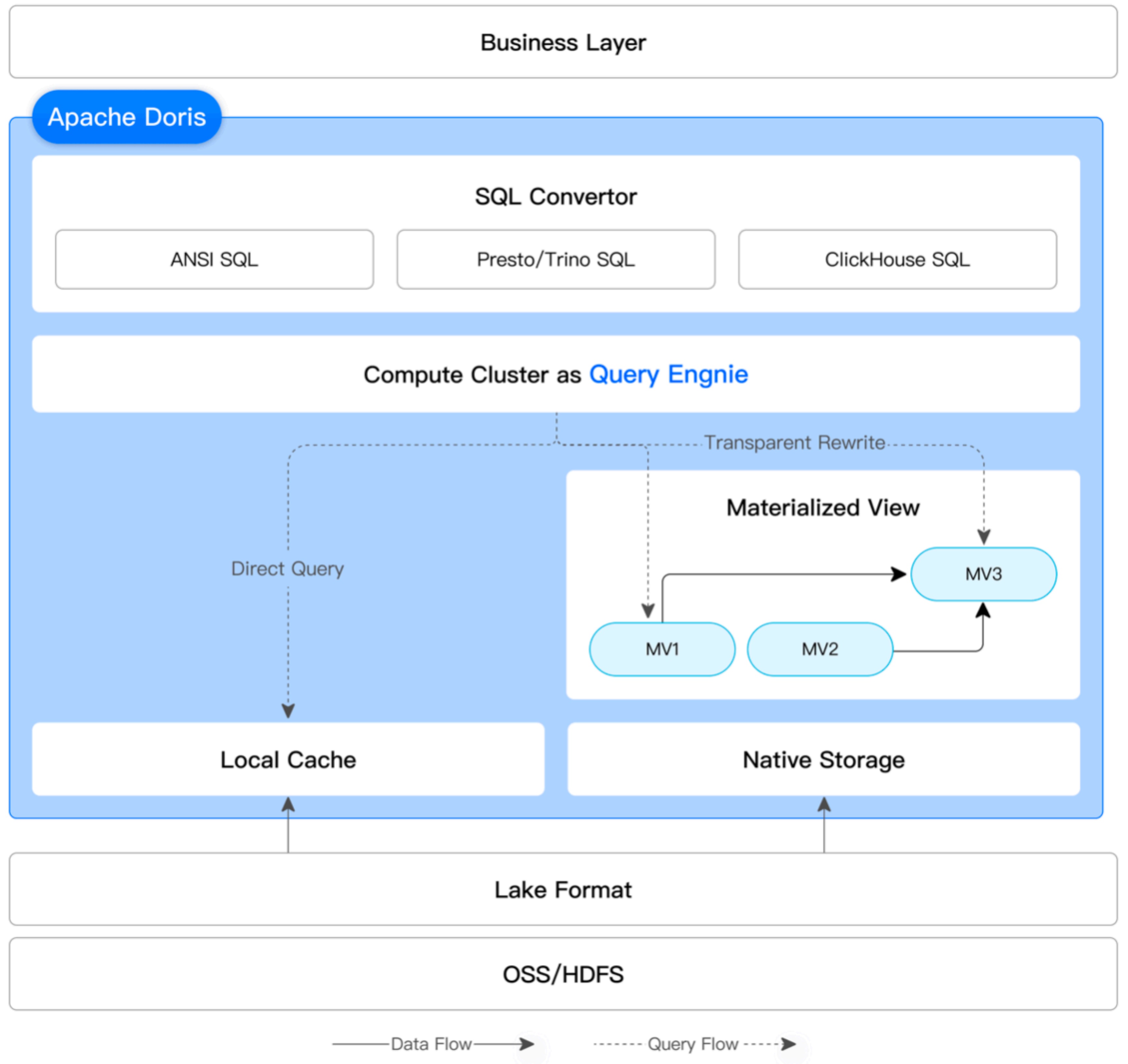
- No vendor lock-in
- Support various engine

Apache Doris Lakehouse Solution

Scenario 1: Query Engine

Query Engine

- Hive, Iceberg, Hudi
- Materialized view
- File Caching
- Query rewriting



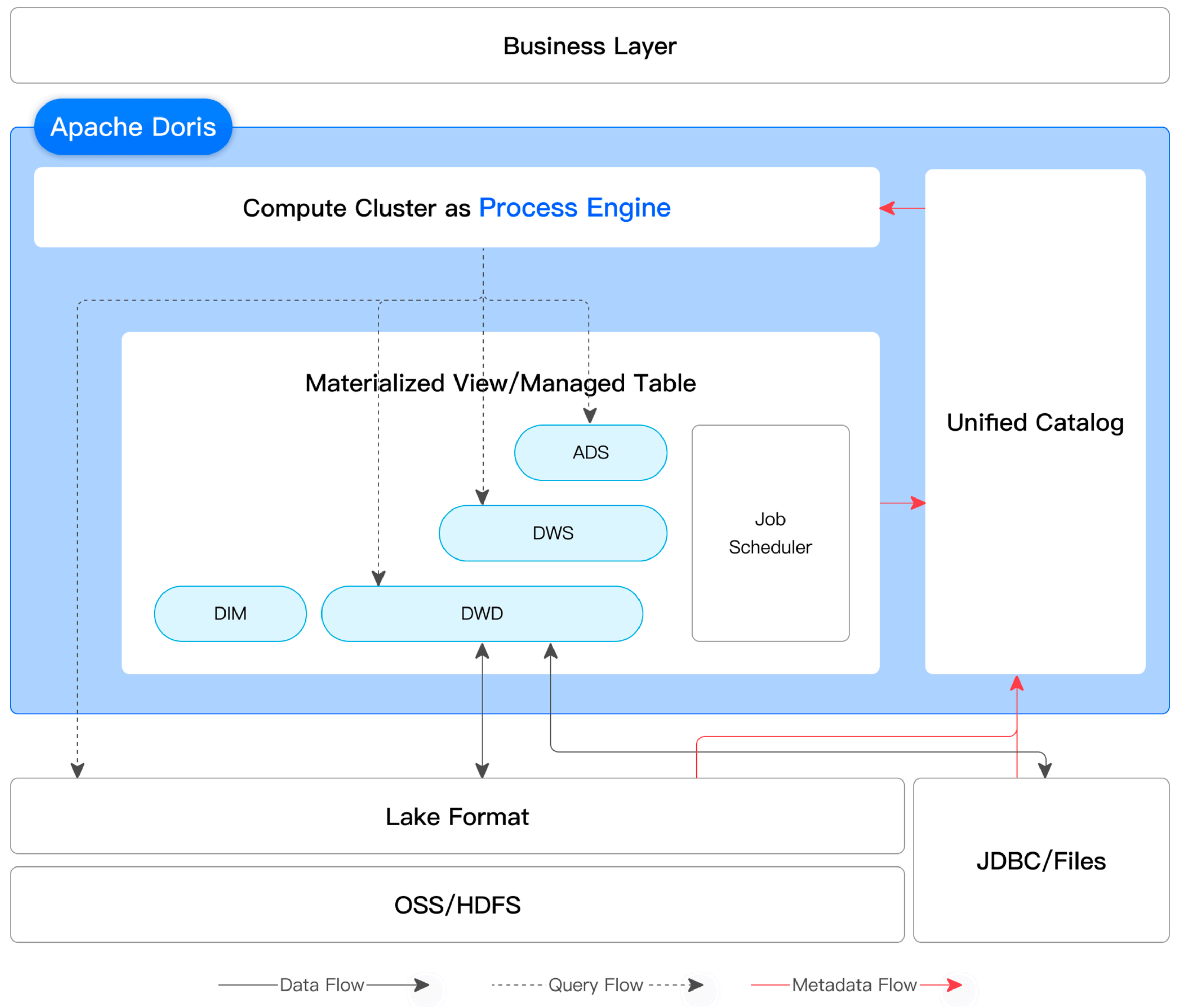
Apache Doris Lakehouse Solution

Scenario 2: Process Engine

Data Process Engine

- Write data to Hive/Iceberg
- Job scheduler
- Spill to disk

```
CREATE JOB my_job
ON SCHEDULE EVERY 1 DAY STARTS '2024-11-18 00:00:00' DO
INSERT INTO hive.db1.table1 SELECT * FROM doris.db.table2
WHERE create_time >= days_add(now(),-1);
```

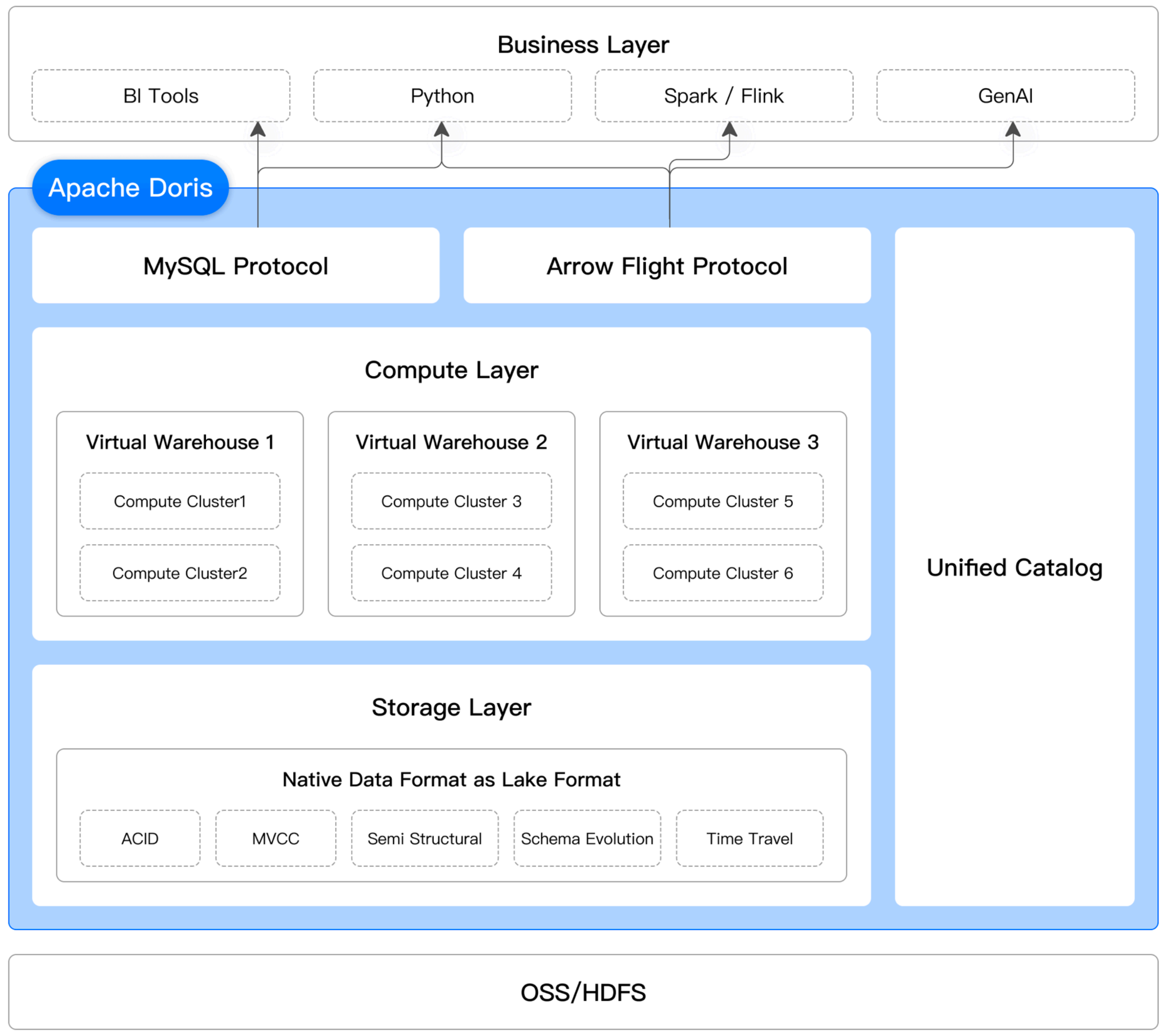


Apache Doris Lakehouse Solution

Scenario 3: Lakehouse Engine

Open Lake Format

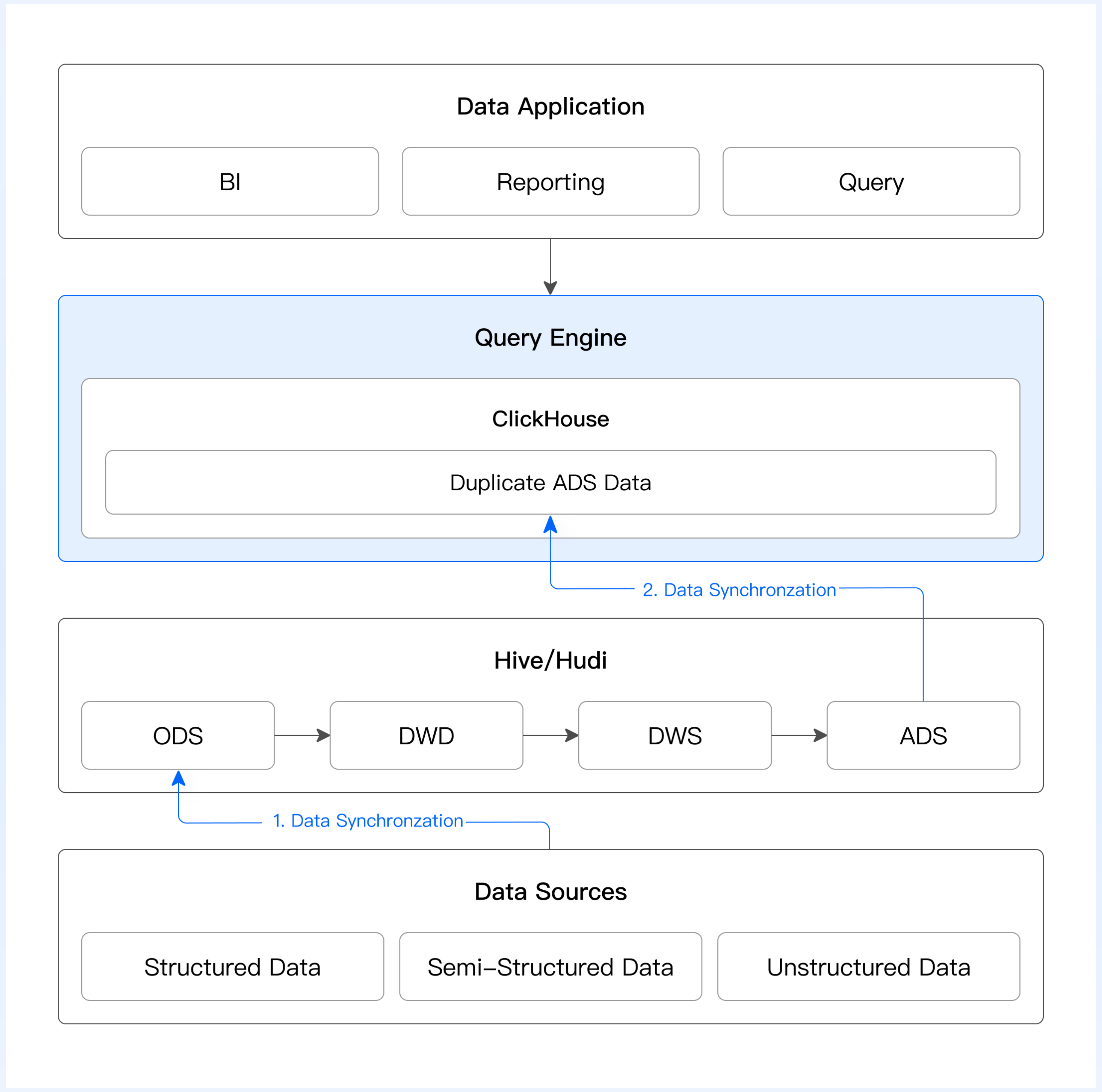
- MVCC
- Data insert/delete/update
- Open Storage API
- Unified Catalog

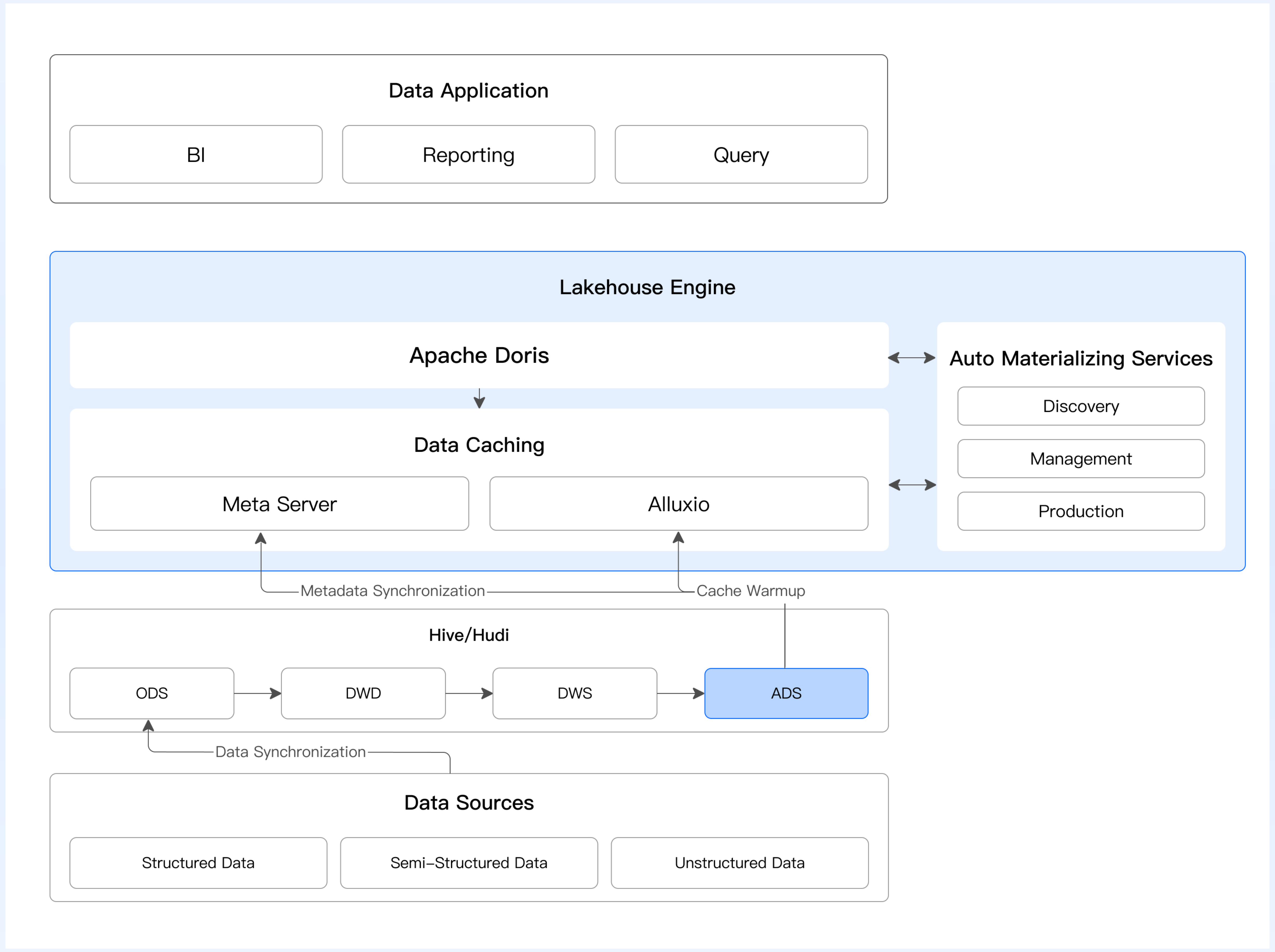


User Case: Building Lakehouse Engine on Doris

Kwai: a leading short-video app provider

Lakehouse Query Engine & Auto Materialized Data Management





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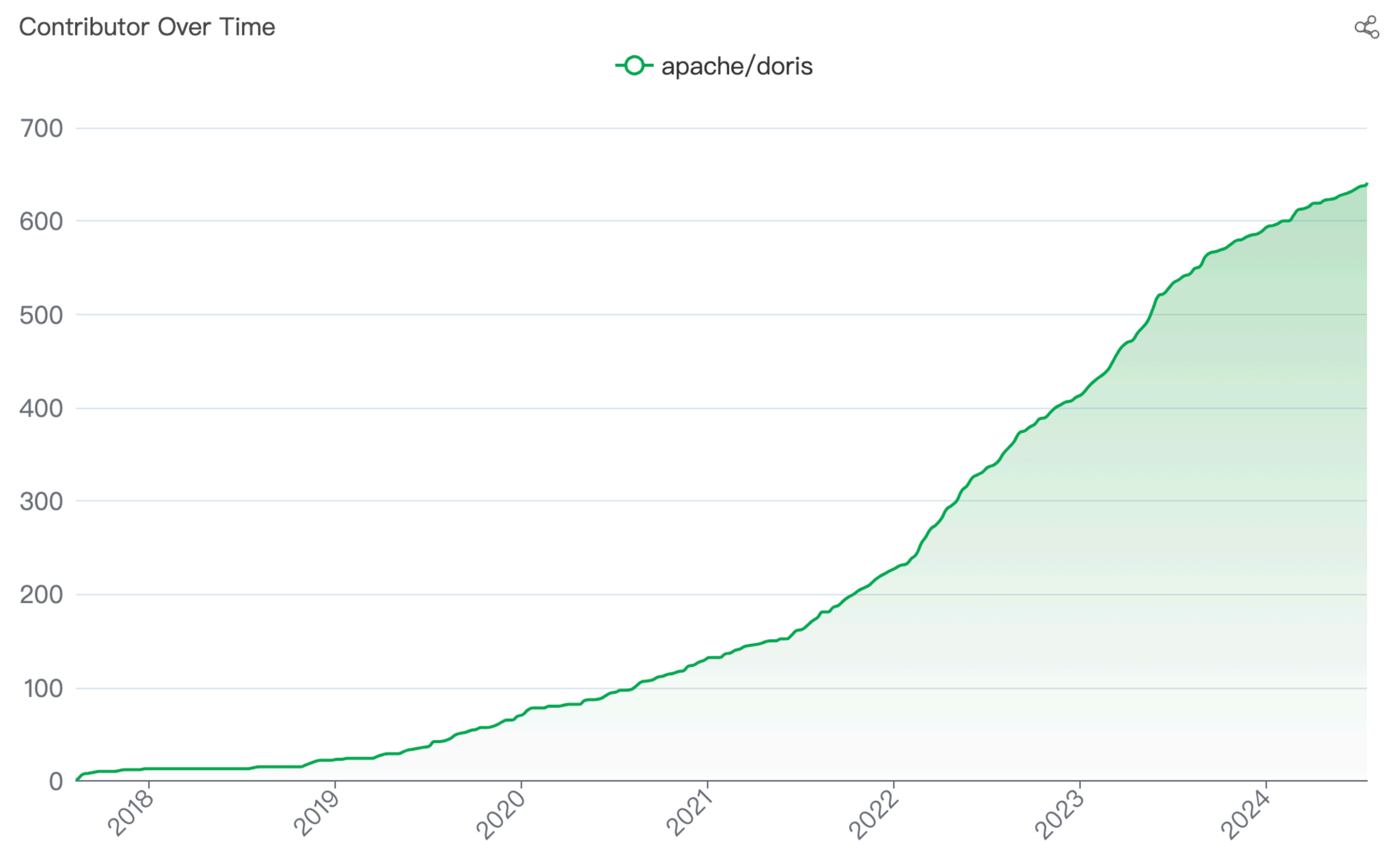
One of the world's most active open source communities in big data

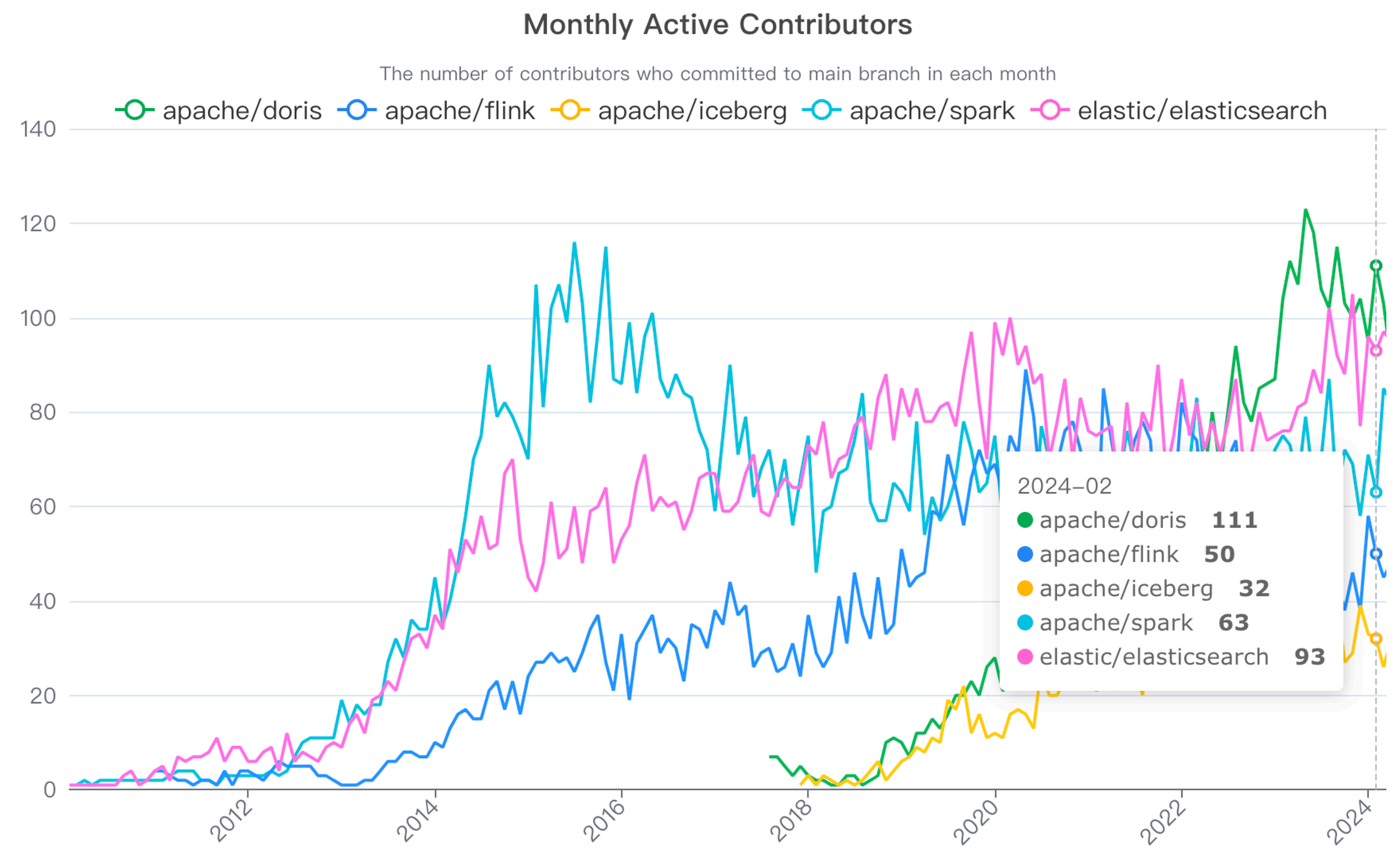
The data is current as of March 2024

Total Contributors



650+ Total Contributors

Monthly Active Contributors



100+ 100+ monthly active contributors

Trusted by over 5000 enterprises worldwide for online analytics

Apache Doris is used worldwide in industries like Retail, Finance, Internet, Gaming, Telecommunications, etc.

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FUSE	China unicom	lifewit	TEMU	HCFC	jjworld		LeetCode	aftership
LOTUS NYO			ADVANCE INTELLIGENCE GROUP				WeLab	
ZTE	AISPEECH	CISCO	ByteDance	ENVISION	ZTO	China Mobile	miHoYo TECH OTAKUS SAVE THE WORLD	Linkedcare
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luckin coffee	CHANGAN	Ford	VOLVO		NIO	SF EXPRESS	keep	TikTok

It’s never too late to join the Apache Doris Community

- Subscribe to our mailing list and join our discussion: dev@doris.apache.org
- Get technical support on Slack apachedoriscommunity.slack.com
- Give us a star on GitHub: apache/doris
- Follow us on Linkedin, Twitter and YouTube @ApacheDoris @VeloDB

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Thanks !