Presto

Interactive SQL Query Engine for Big Data

Hadoop Conference in Japan 2014

Sadayuki Furuhashi

Founder & Software Architect
Treasure Data, inc.

TREASURE

A little about me...

- **Sadayuki Furuhashi**
  - github/twitter: @frsyuki
- **Treasure Data, Inc.**
  - Founder & Software Architect
- **Open-source hacker**
  - MessagePack - efficient object serializer
  - Fluentd - data collection tool
  - ServerEngine - Ruby framework to build multiprocess servers
  - LS4 - distributed object storage system
  - kumofs - distributed key-value data store

0. Background + Intro

What's Presto?

A distributed **SQL query engine**
for **interactive** data analisys
against **GBs to PBs of data.**

Presto's history

- **2012 Fall: Project started at Facebook**
  - Designed for interactive query
  - with **speed of commercial data warehouse**
  - and **scalability to the size of Facebook**
- **2013 Winter: Open sourced!**
- **30+ contributes in 6 months**
  - including people from outside of Facebook

What's the problems to solve?

- **We couldn't visualize data in HDFS directly using dashboards or BI tools**
  - because Hive is too slow (not interactive)
  - or ODBC connectivity is unavailable/unstable
- **We needed to store daily-batch results to an interactive DB for quick response (PostgreSQL, Redshift, etc.)**
  - Interactive DB costs more and less scalable by far
- **Some data are not stored in HDFS**
  - We need to copy the data into HDFS to analyze

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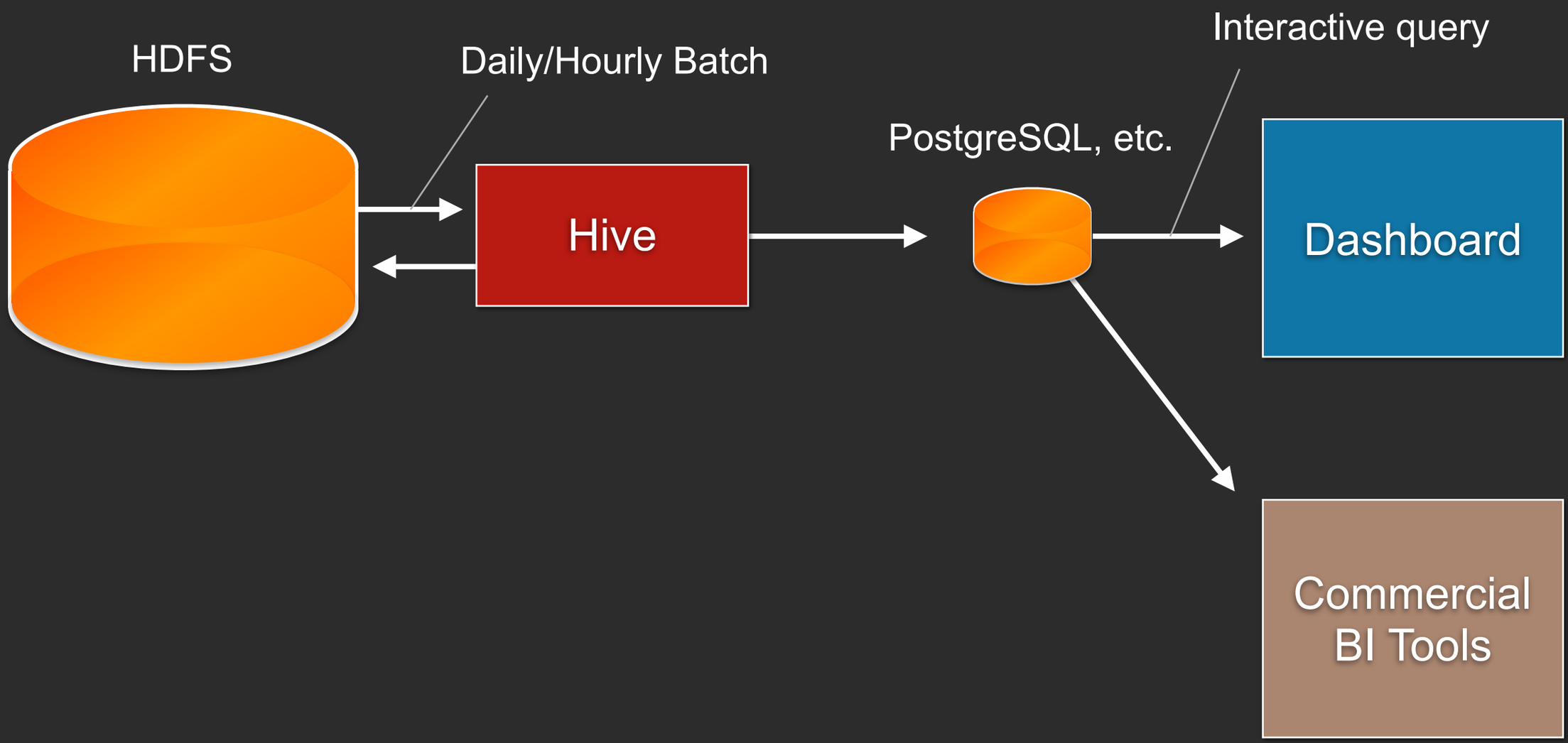
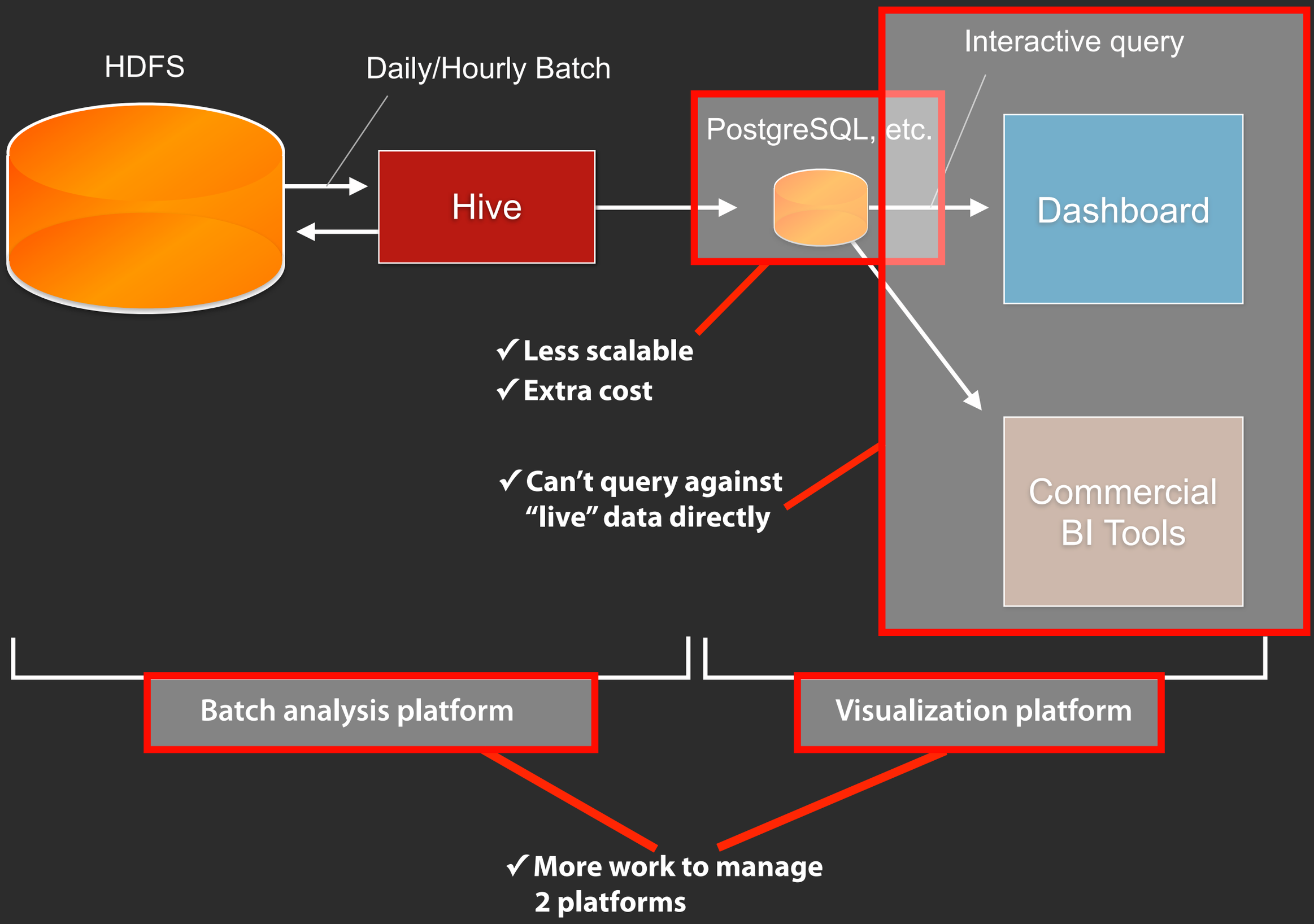
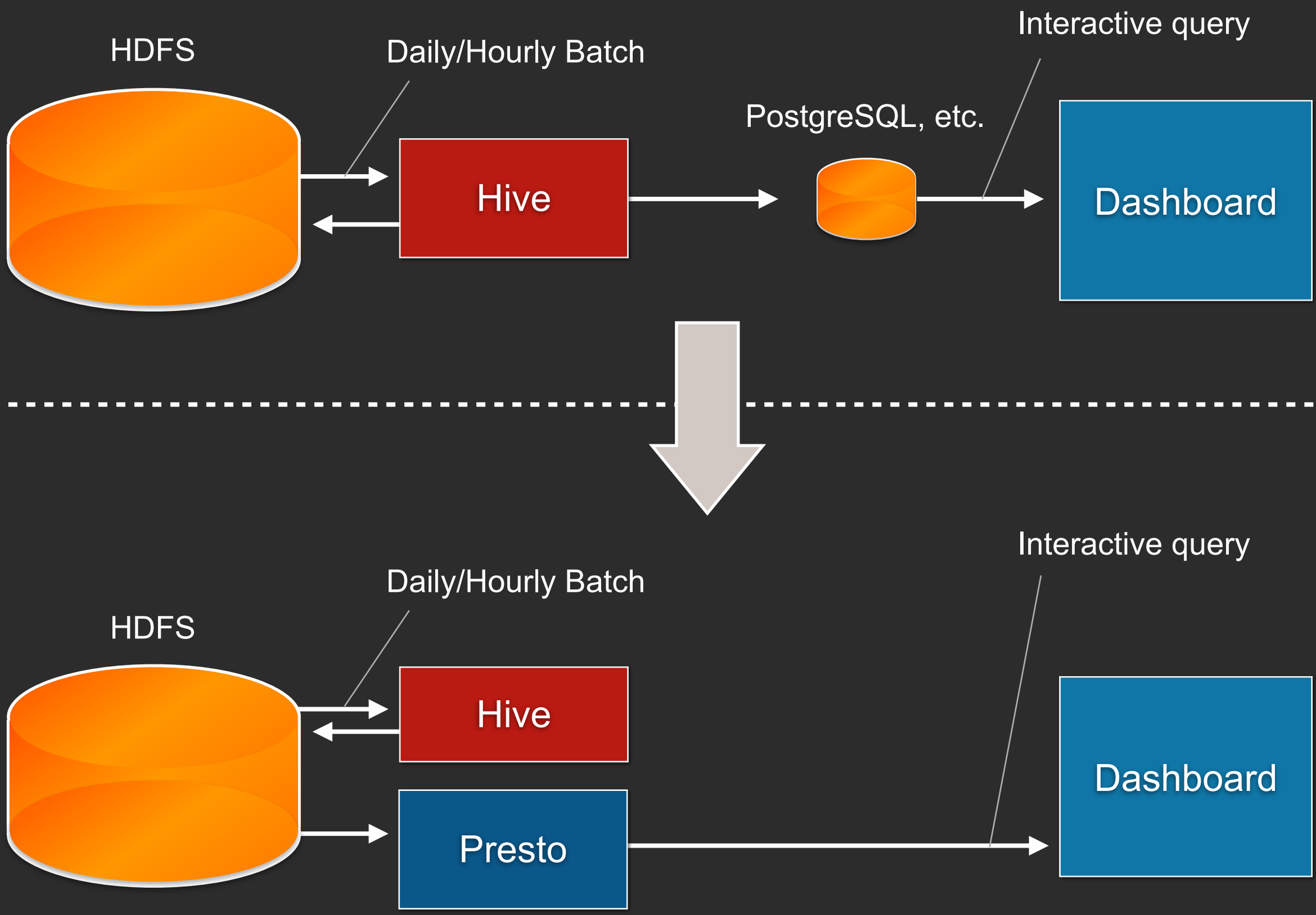

HDFS
Daily/Hourly Batch
Hive
PostgreSQL, etc.
Interactive query
Dashboard
Commercial
BI Tools
Batch analysis platform
Visualization platform


HDFS
Daily/Hourly Batch
Hive
PostgreSQL, etc.
Interactive query
Dashboard
Commercial BI Tools
✓Less scalable
✓Extra cost
✓Can't query against "live" data directly
Batch analysis platform
Visualization platform
✓More work to manage 2 platforms


HDFS
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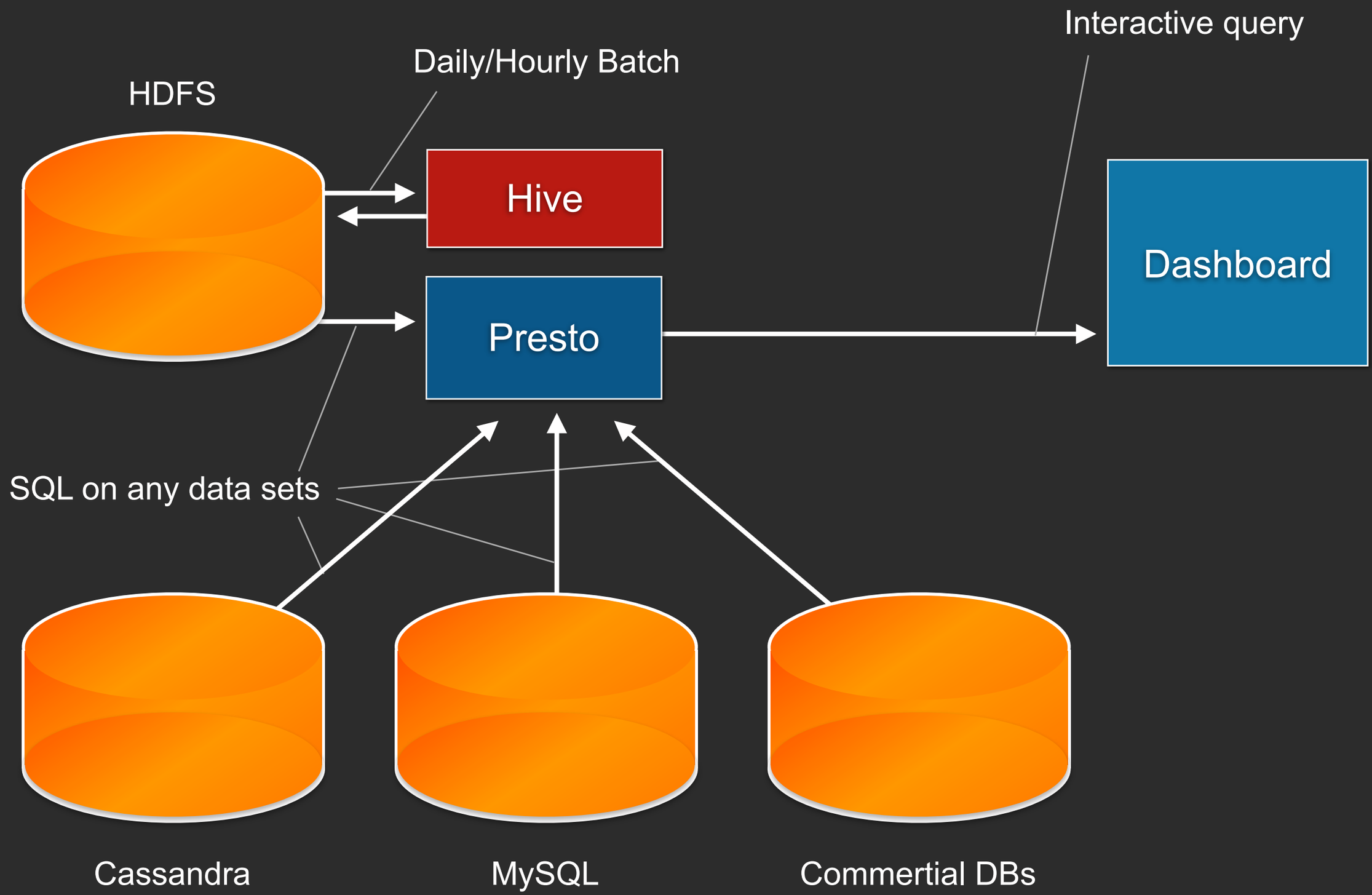
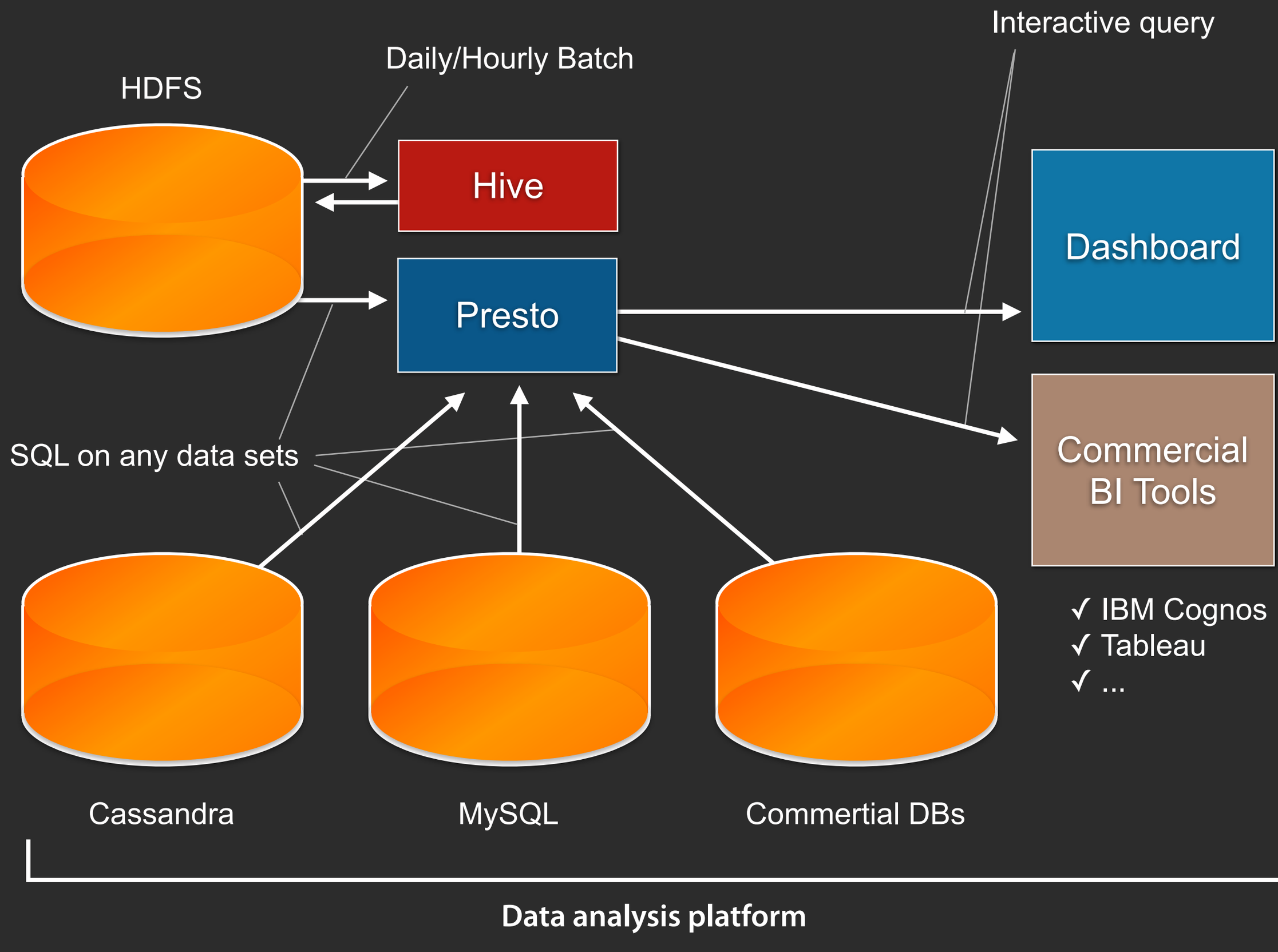
HDFS
Daily/Hourly Batch
Hive
Presto
Interactive query
Dashboard


Interactive query
Daily/Hourly Batch
HDFS
Hive
Presto
Dashboard
SQL on any data sets
Cassandra
MySQL
Commertial DBs


Interactive query
Daily/Hourly Batch
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Dashboard
SQL on any data sets
Commercial
BI Tools
✓ IBM Cognos
✓ Tableau
✓ ...
Cassandra
MySQL
Commertial DBs
Data analysis platform

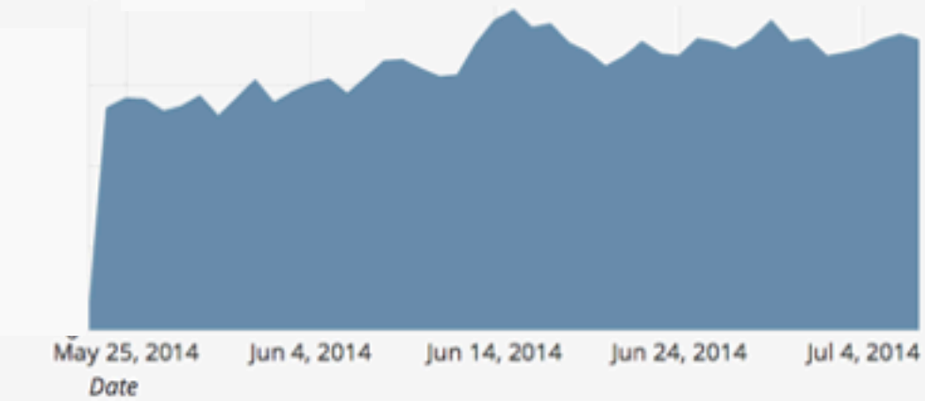
Treasure Data

Dashboards Settings Help

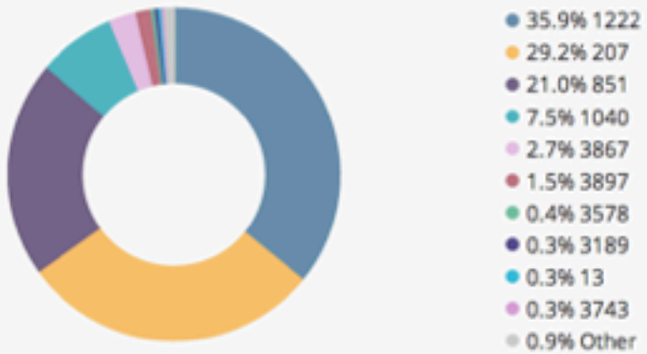
Example Presto Dashboard

Add Element Arrange Presen

Daily



Query Ratio



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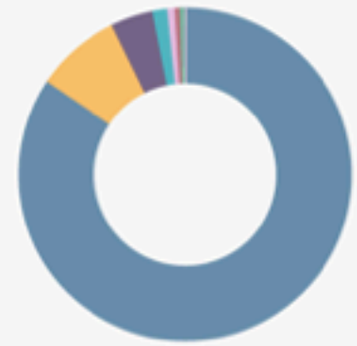
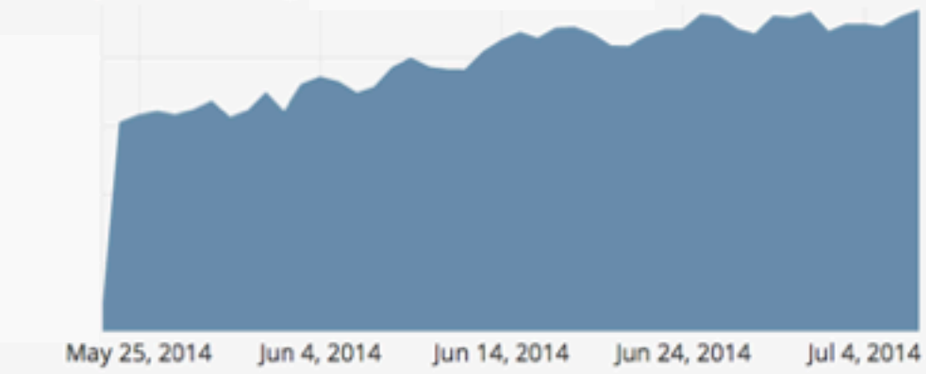
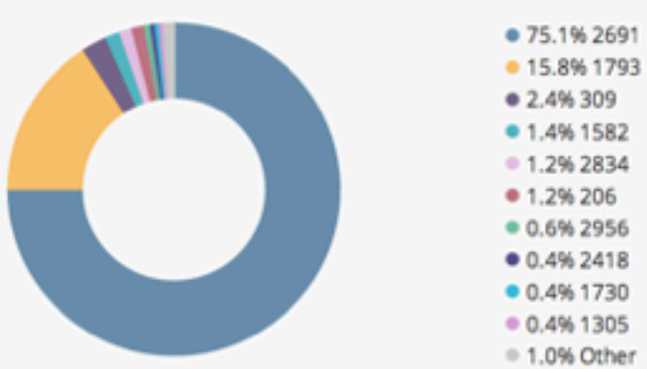


Daily Streaming

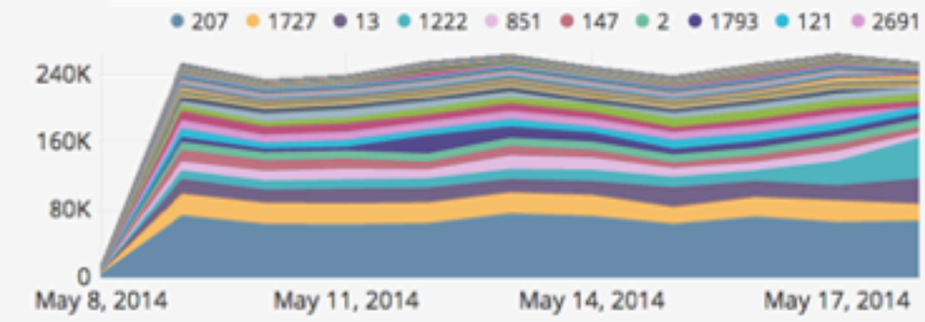


Job

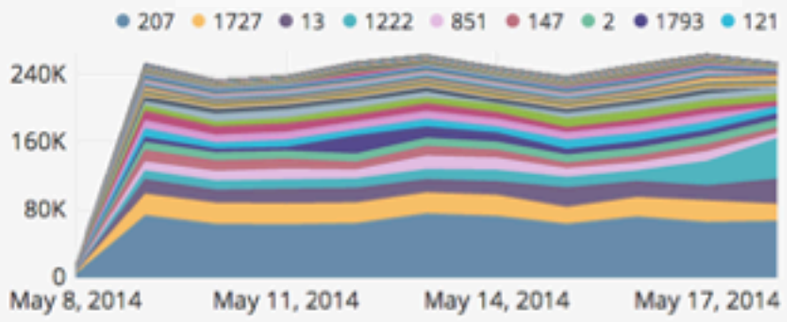


Import Counts

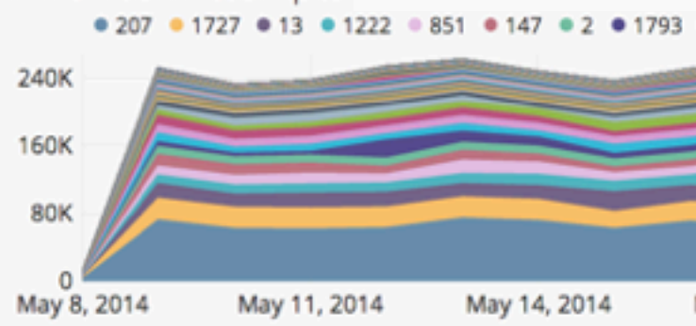
Hive



Hive Task



Hive Task Attempts



dashboard on chart.io: https://chartio.com/

What can Presto do?

- Query **interactively** (in milli-seconds to minues)
  - MapReduce and Hive are still necessary for ETL
- Query using **commercial BI tools** or dashboards
  - Reliable ODBC/JDBC connectivity
- Query across **multiple data sources** such as Hive, HBase, Cassandra, or even commertial DBs
  - Plugin mechanism
- Integrate batch analisys + visualization into a single data analysis platform

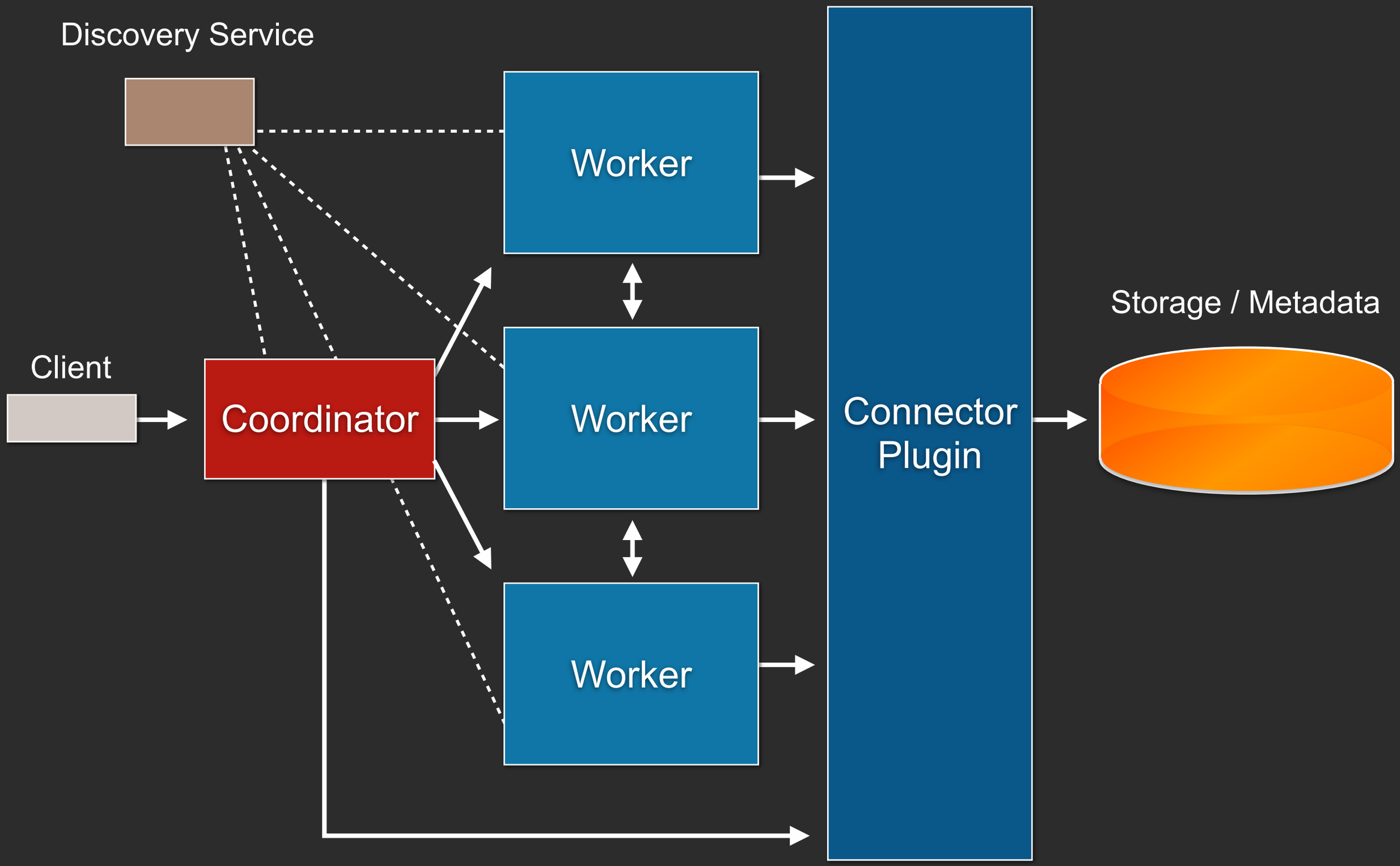
Presto's deployment

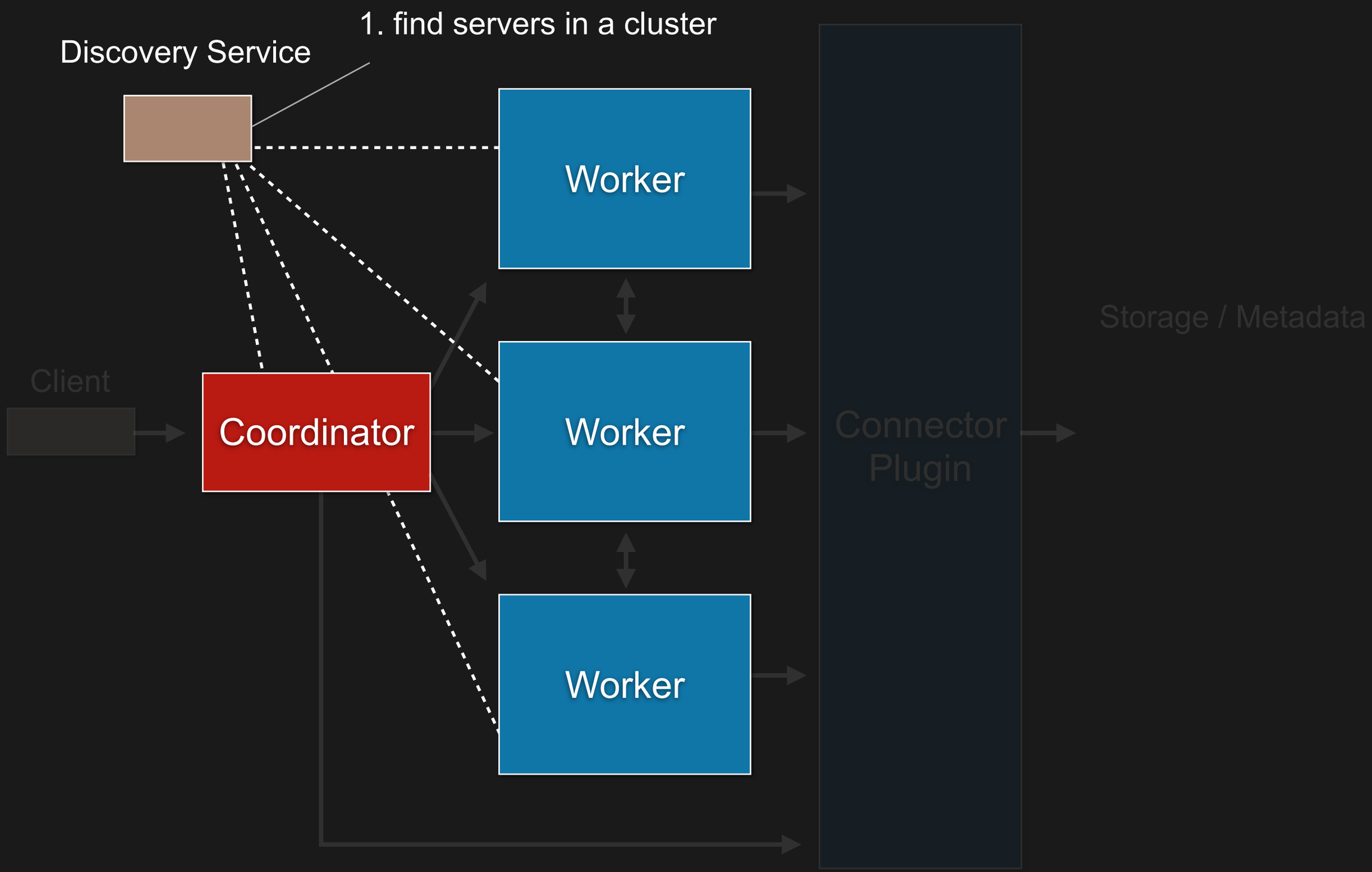
- **Facebook**
  - Multiple geographical regions
  - scaled to 1,000 nodes
  - actively used by 1,000+ employees
  - who run 30,000+ queries every day
  - processing 1PB/day
- **Netflix, Dropbox, Treasure Data, Airbnb, Qubole**
- **Presto as a Service**

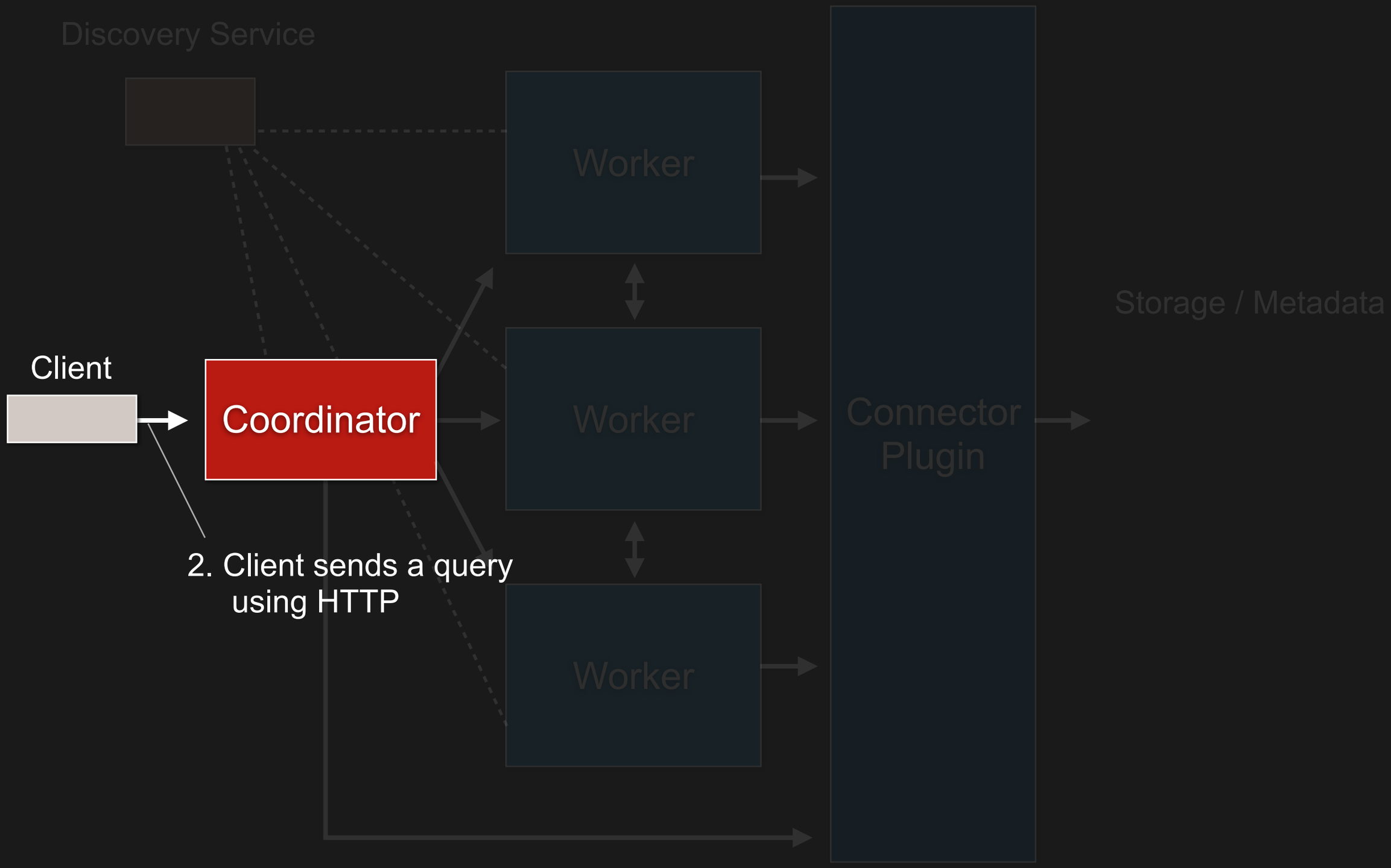
Today's talk

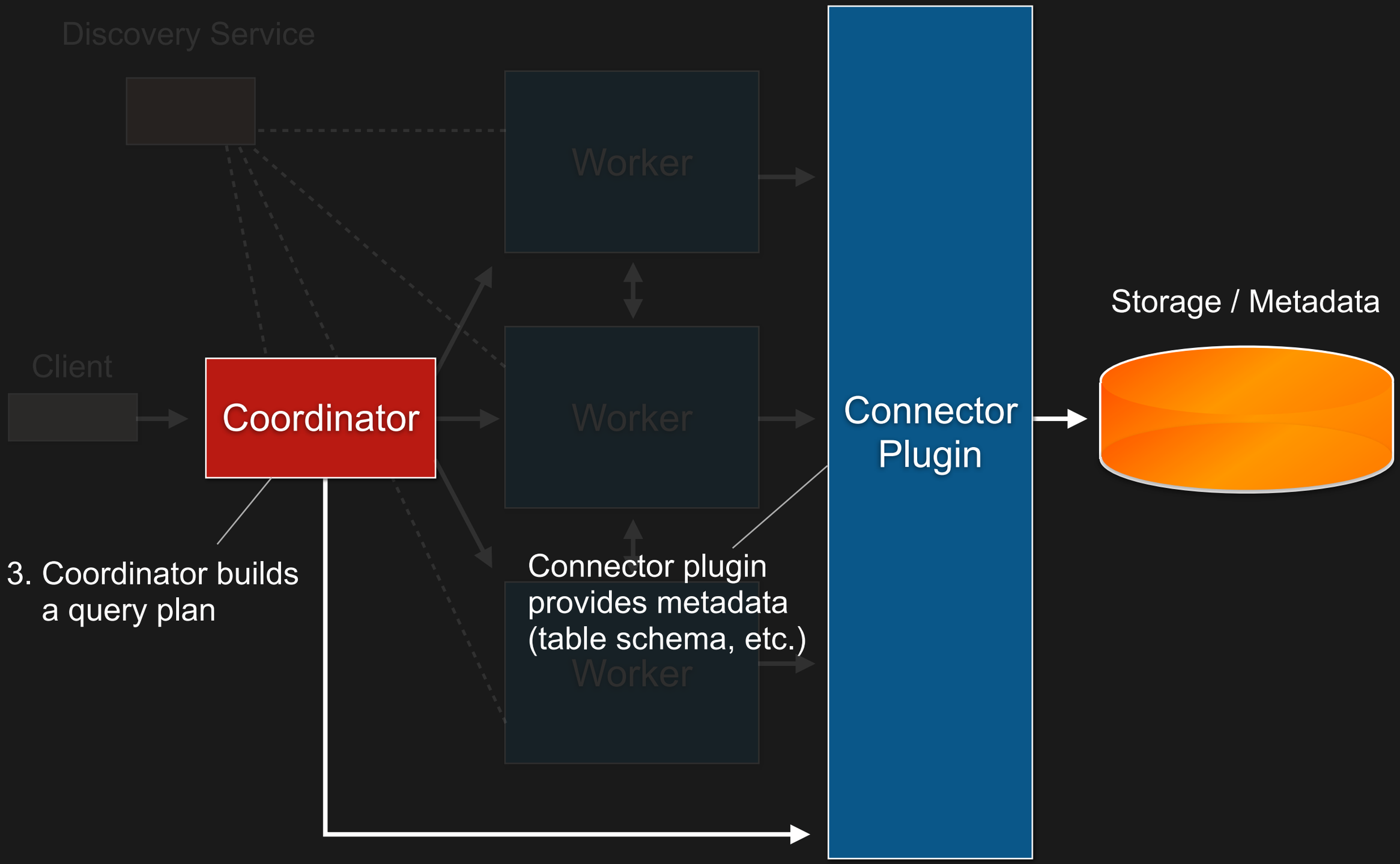
1. Distributed architecture
2. Data visualization - Demo
3. Query Execution - Presto vs. MapReduce
4. Monitoring & Configuration
5. Roadmap - the future

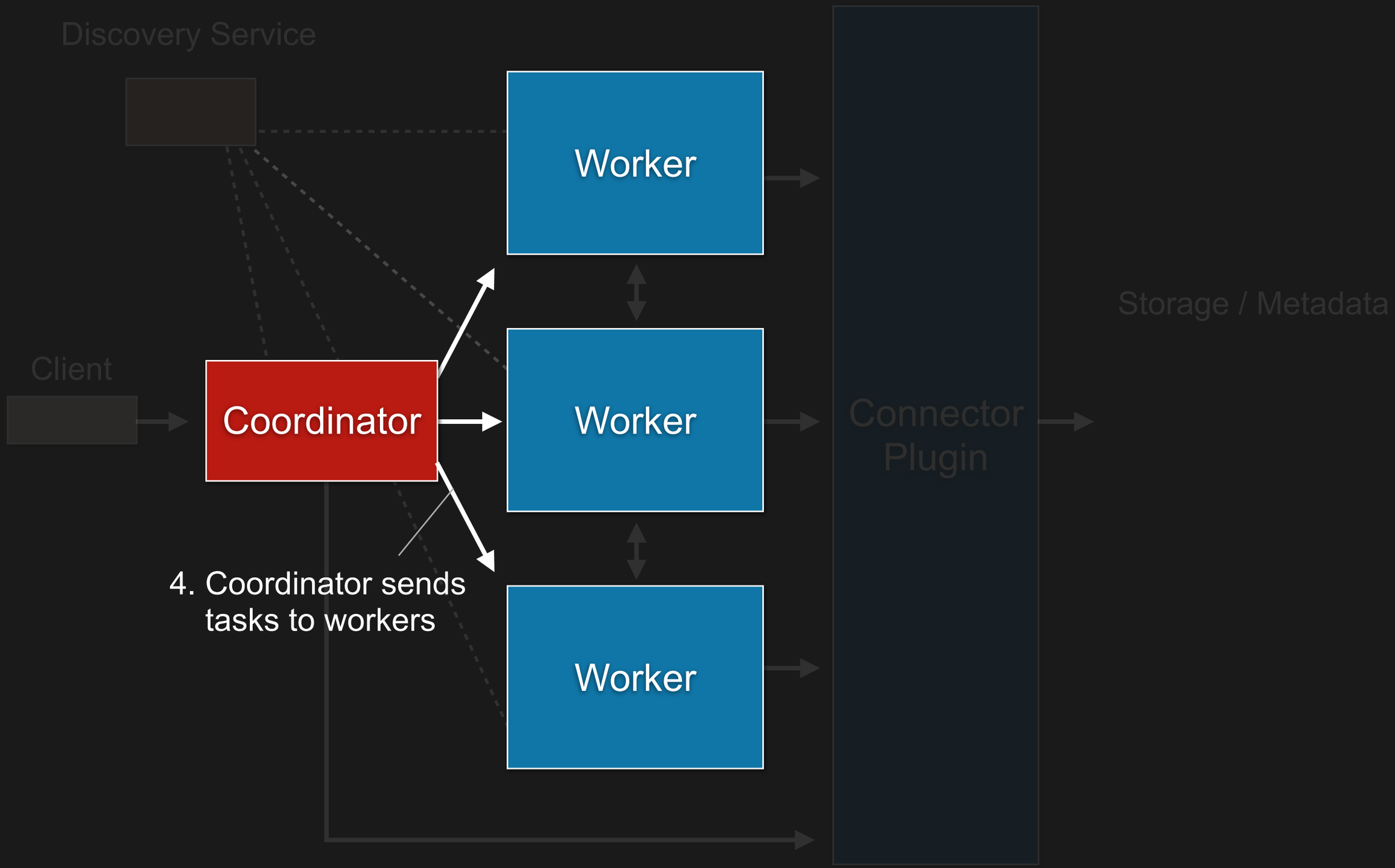
1. Distributed architecture

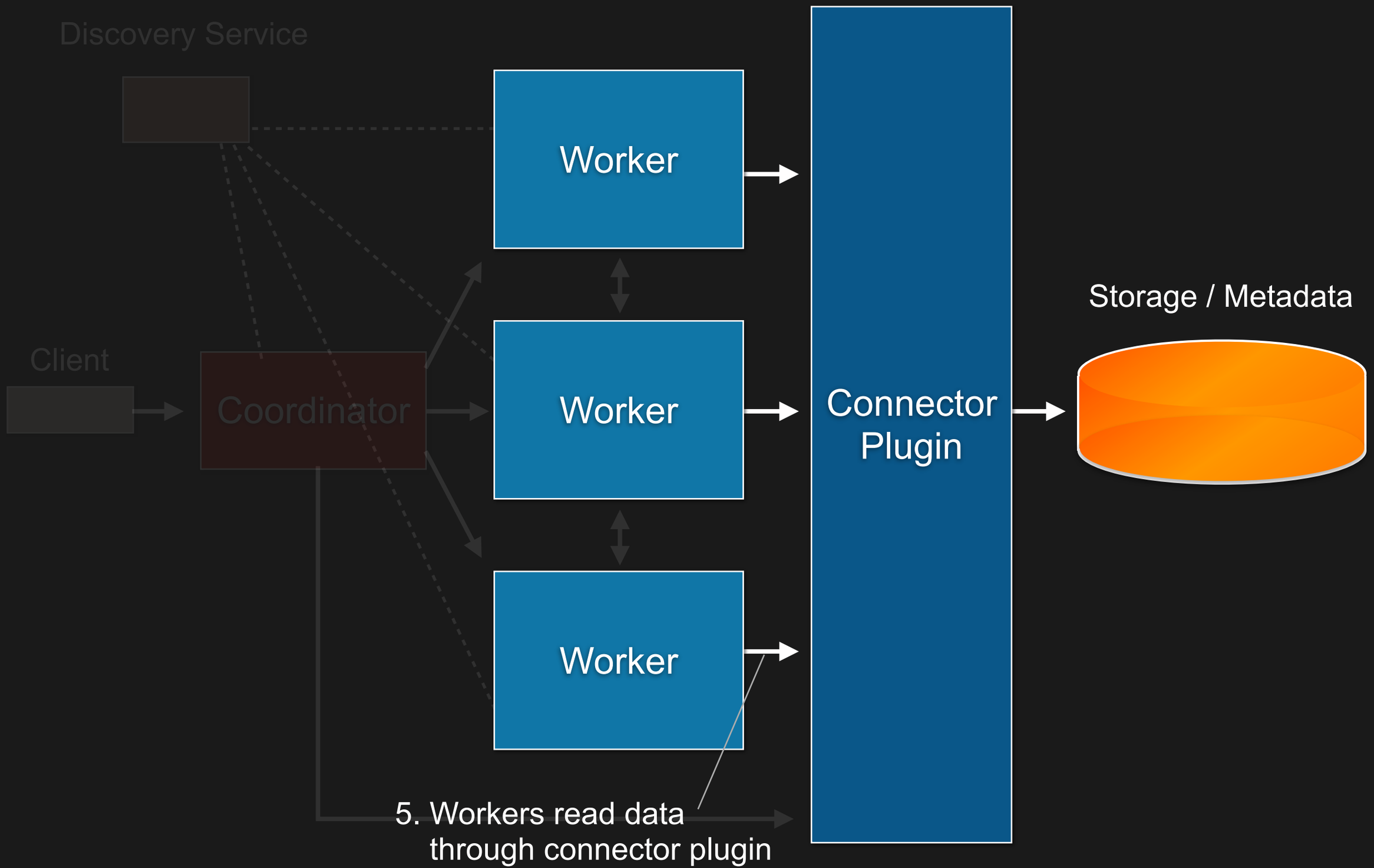

Discovery Service
Client
Coordinator
Worker
Worker
Worker
Connector Plugin
Storage / Metadata


1. find servers in a cluster
Discovery Service
Worker
Storage / Metadata
Client
Coordinator
Worker
Connector
Plugin
Worker


Discovery Service
Worker
Storage / Metadata
Client
Coordinator
Worker
Connector Plugin
Worker
2. Client sends a query using HTTP


Discovery Service
Worker
Client
Coordinator
Worker
Connector Plugin
Storage / Metadata
3. Coordinator builds a query plan
Connector plugin provides metadata (table schema, etc.)
Worker


Discovery Service
Worker
Storage / Metadata
Client
Coordinator
Worker
Connector
Plugin
4. Coordinator sends
tasks to workers
Worker


Discovery Service
Client
Coordinator
Worker
Worker
Worker
Connector Plugin
Storage / Metadata
5. Workers read data through connector plugin

Discovery Service

Client

Coordinator

Worker

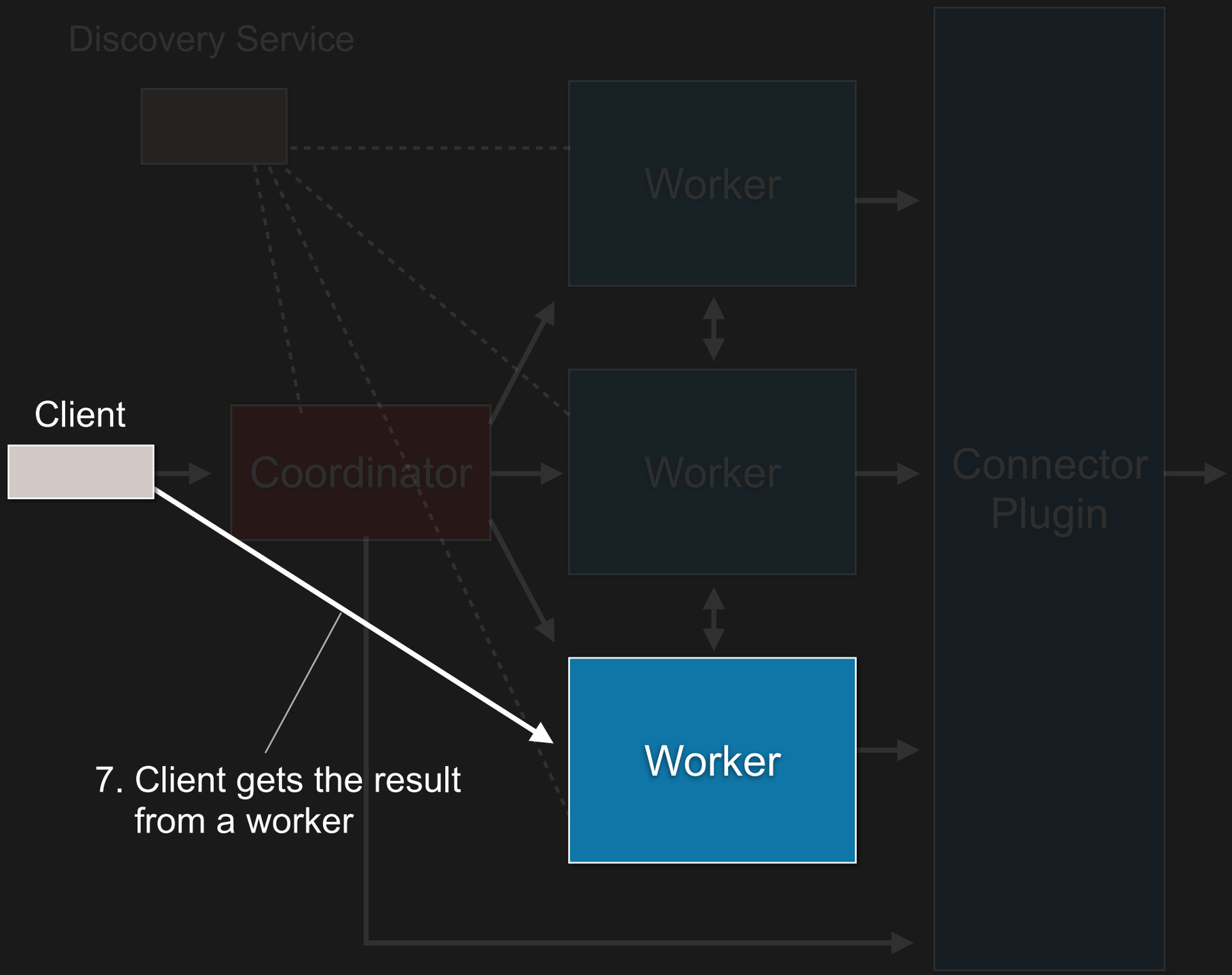
Worker

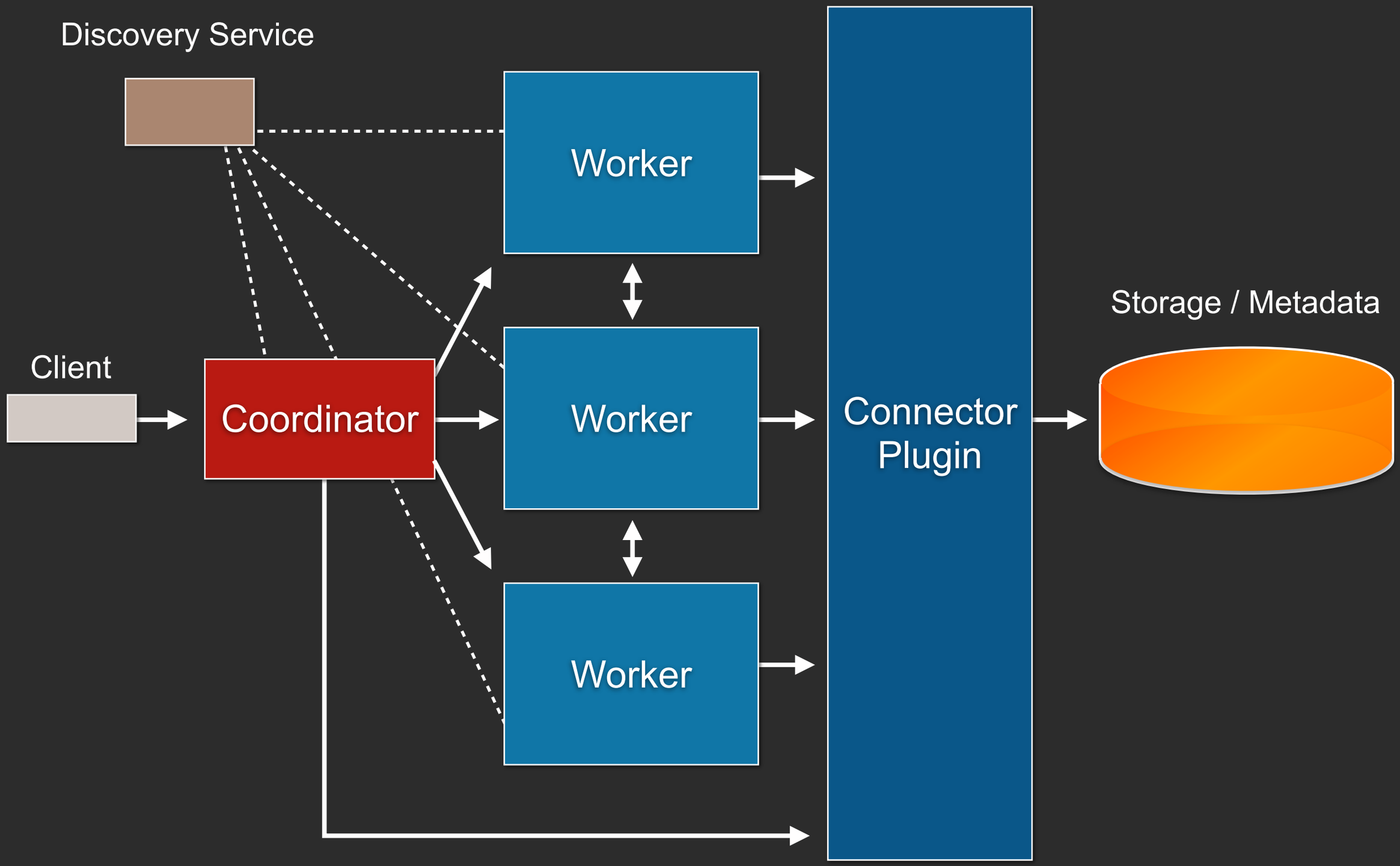
Worker

Connector Plugin

Storage / Metadata

6. Workers run tasks in memory

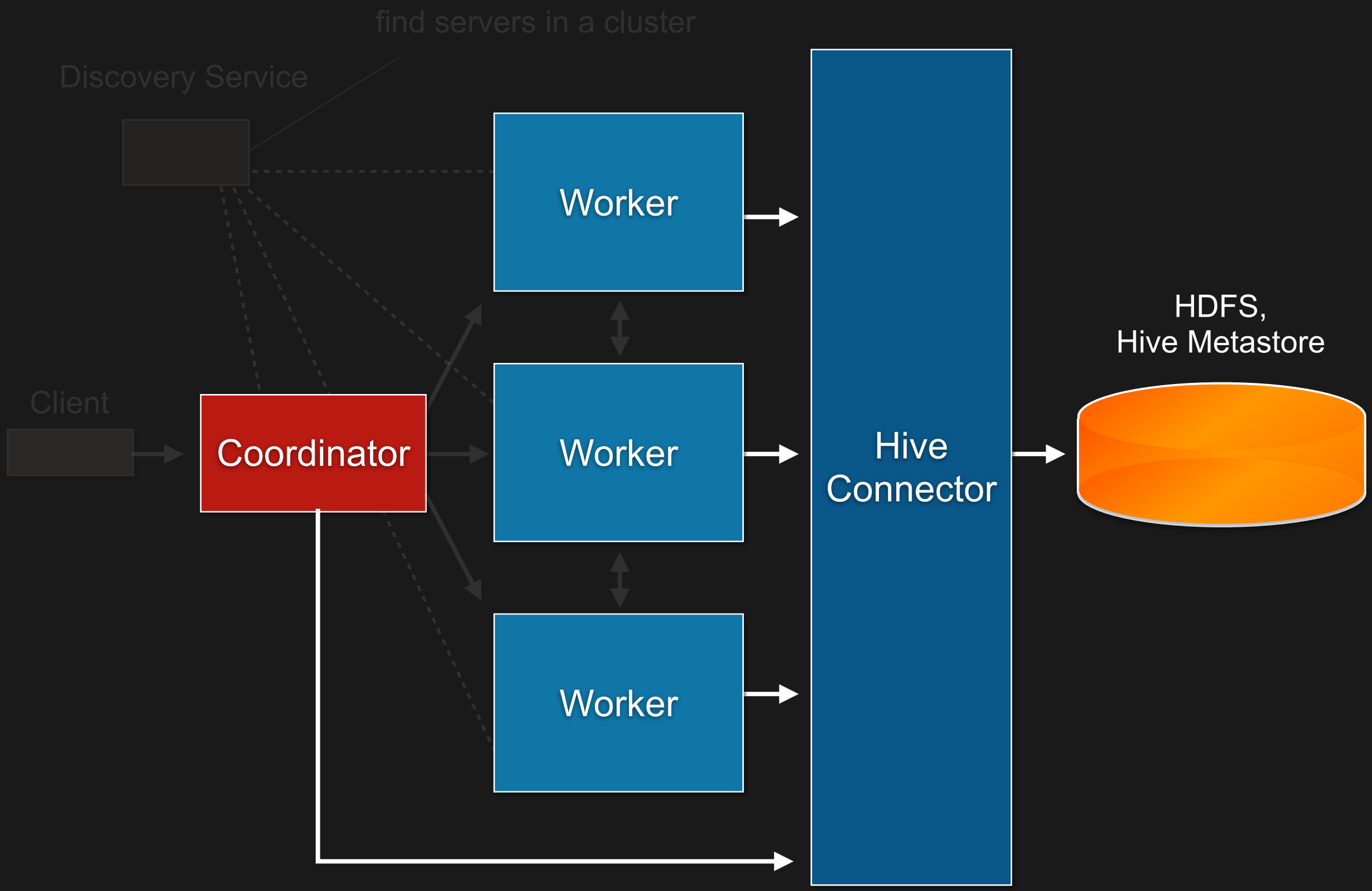

Discovery Service
Worker
Storage / Metadata
Client
Coordinator
Worker
Connector Plugin
Worker
7. Client gets the result from a worker


Discovery Service
Client
Coordinator
Worker
Worker
Worker
Connector Plugin
Storage / Metadata

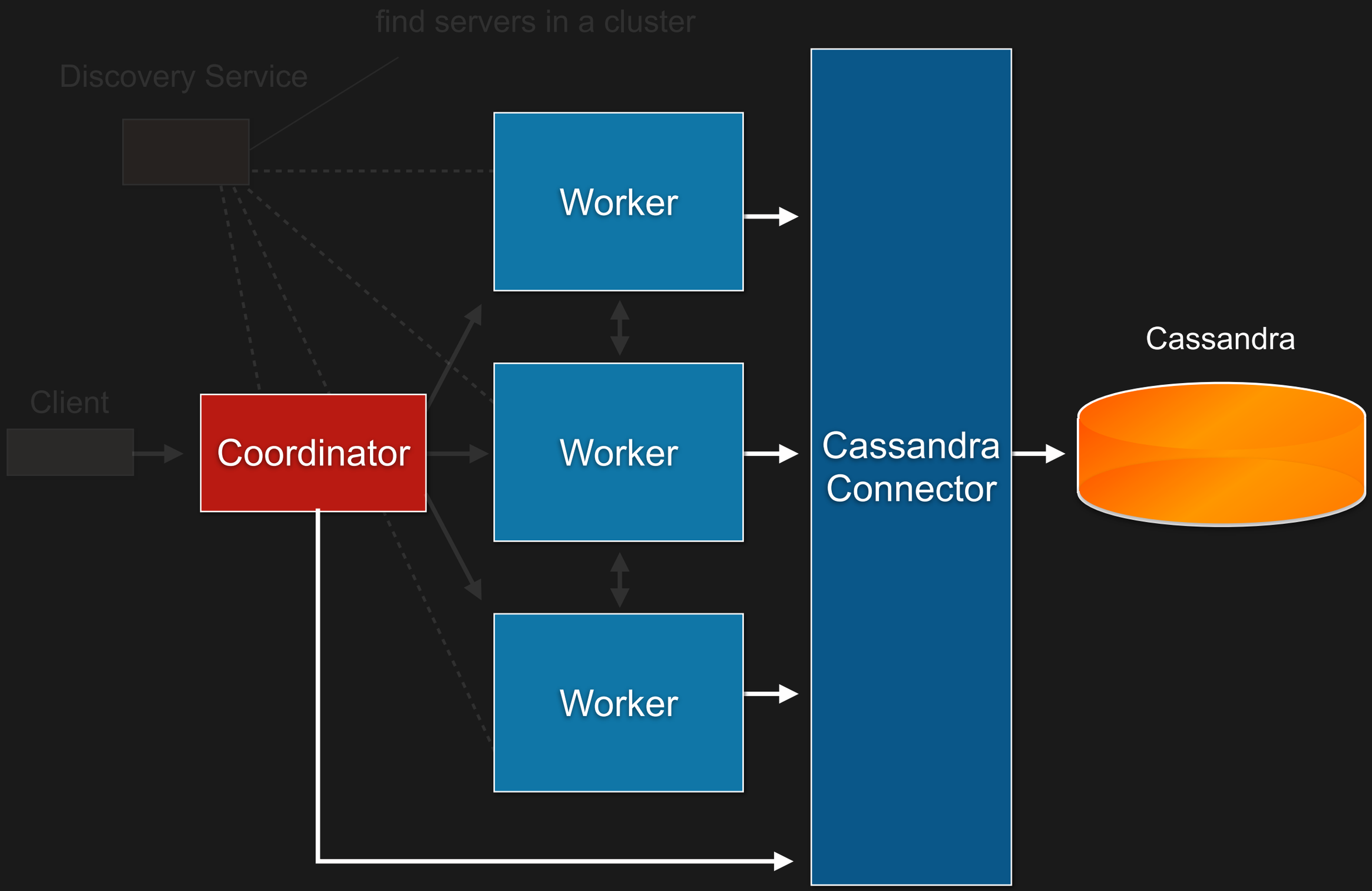
What's Connectors?

- **Connectors are plugins to Presto**
  - written in Java
- **Access to storage and metadata**
  - provide table schema to coordinators
  - provide table rows to workers
- **Implementations:**
  - Hive connector
  - Cassandra connector
  - MySQL through JDBC connector (prerelease)
  - Or your own connector

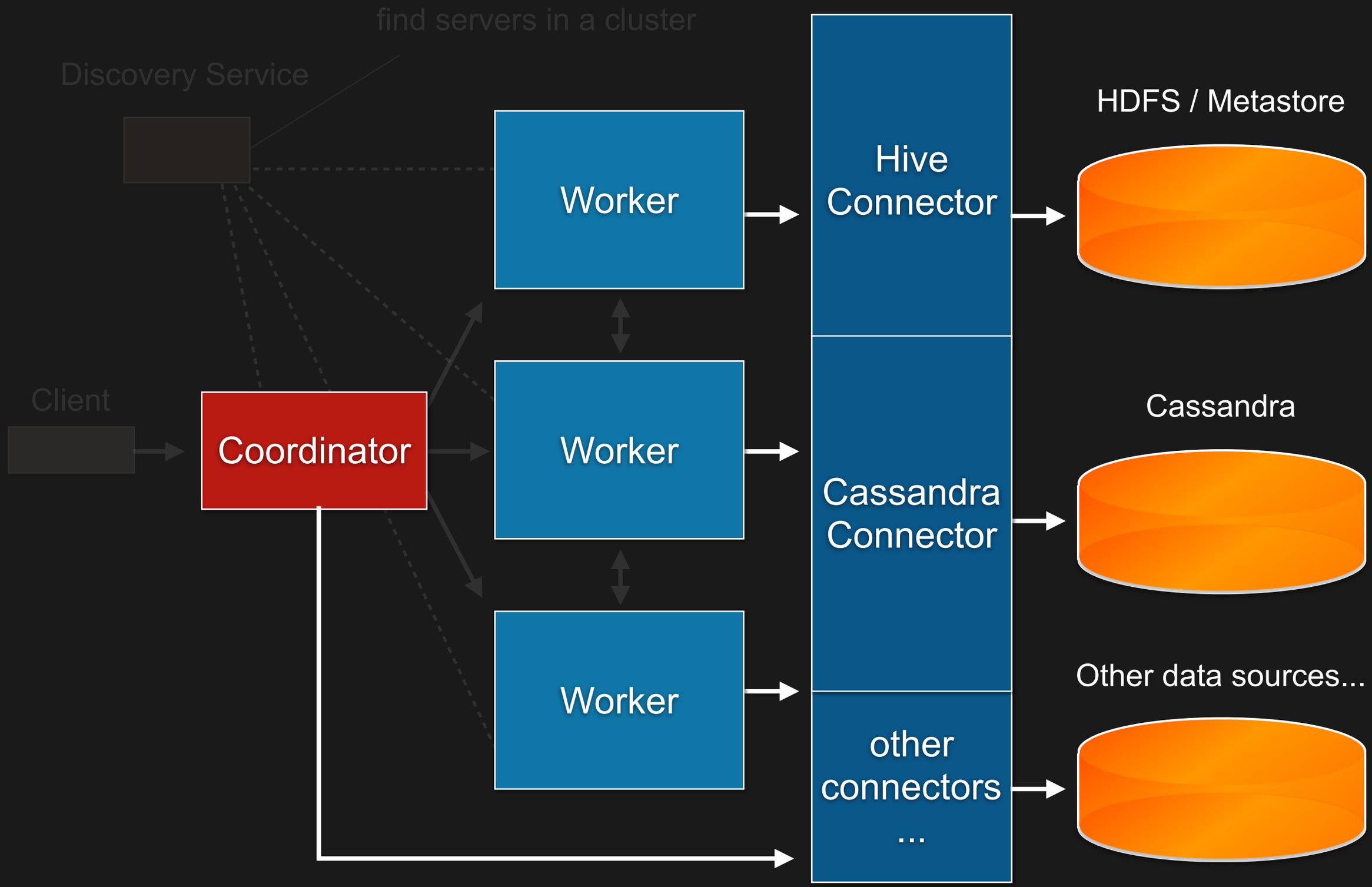
Hive connector



Cassandra connector



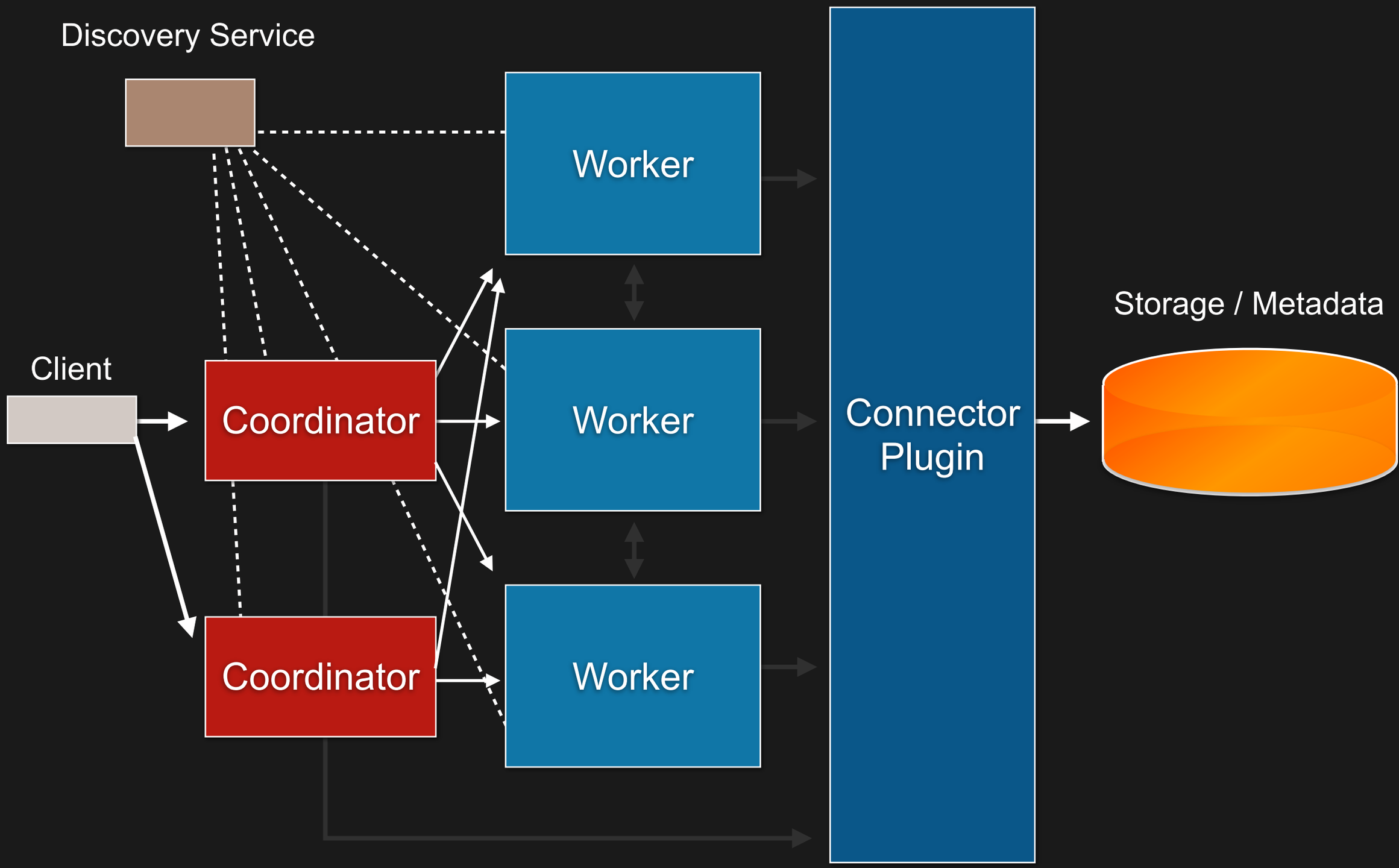
Multiple connectors in a query



1. Distributed architecture

- **3 type of servers:**
  - Coordinator, worker, discovery service
- **Get data/metadata through connector plugins.**
  - Presto is NOT a database
  - Presto provides SQL to existent data stores
- **Client protocol is HTTP + JSON**
  - Language bindings:
    Ruby, Python, PHP, Java (JDBC), R, Node.JS...

Coordinator HA



2. Data visualization

The problems to use BI tools

- **BI tools need ODBC or JDBC connectivity**
  - Tableau, IBM Cognos, QlickView, Chart.IO, ...
  - JasperSoft, Pentaho, MotionBoard, ...
- **ODBC/JDBC is VERY COMPLICATED**
  - Matured implementation needs LONG time

A solution: PostgreSQL protocol

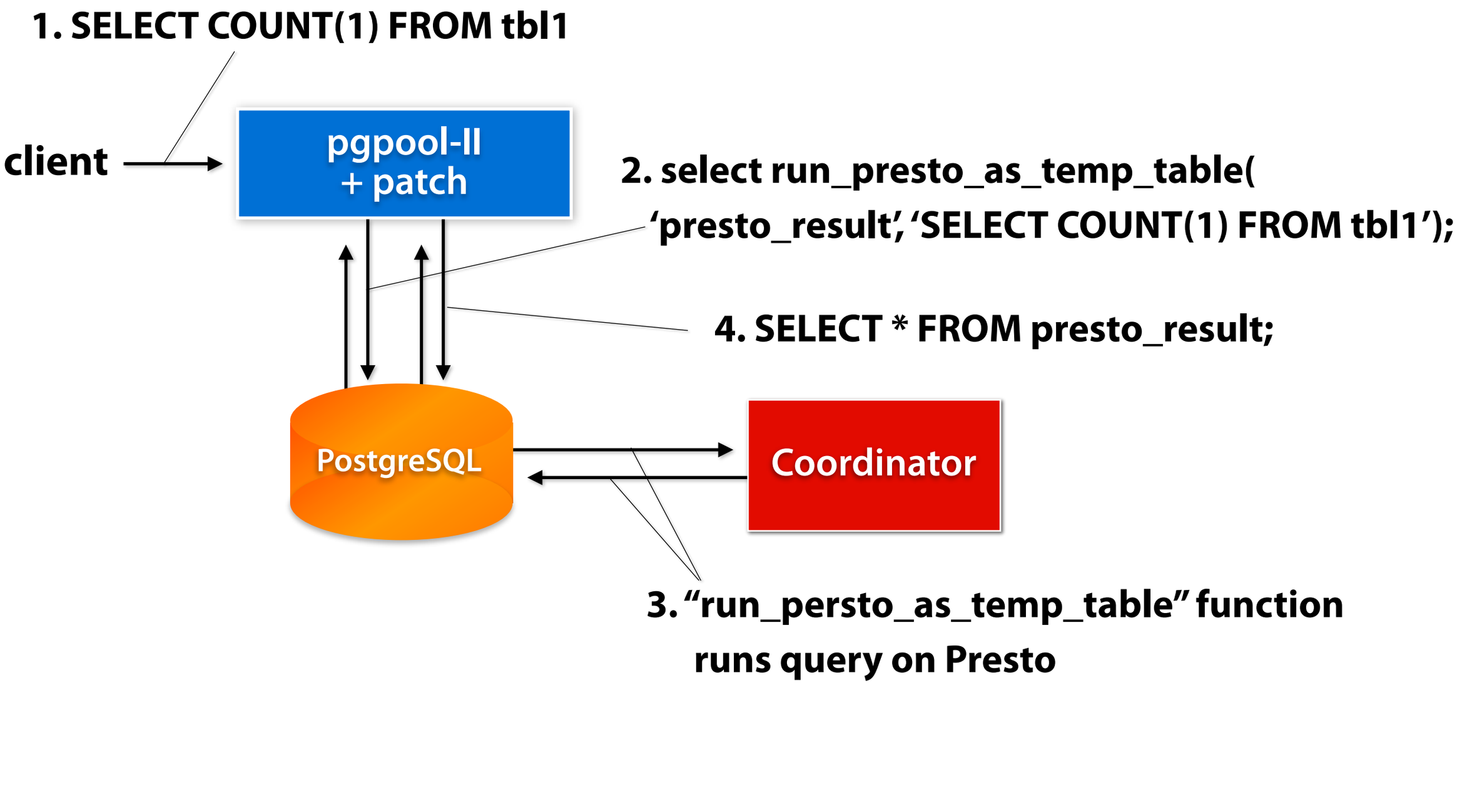
- Creating a PostgreSQL protocol **gateway**
- Using PostgreSQL's **stable** ODBC / JDBC driver

Prestogres

PostgreSQL protocol gateway for Presto

https://github.com/treasure-data/prestogres

How Prestogres works?



Demo

2. Data visualization with Presto

- **Data visualization tools need ODBC/JDBC driver**
  - but implemetation takes LONG time
- **A solution is to use PostgreSQL protocol**
  - and use PostgreSQL's ODBC/JDBC driver
- **Prestogres is already confirmed to work with some commertial BI tools**

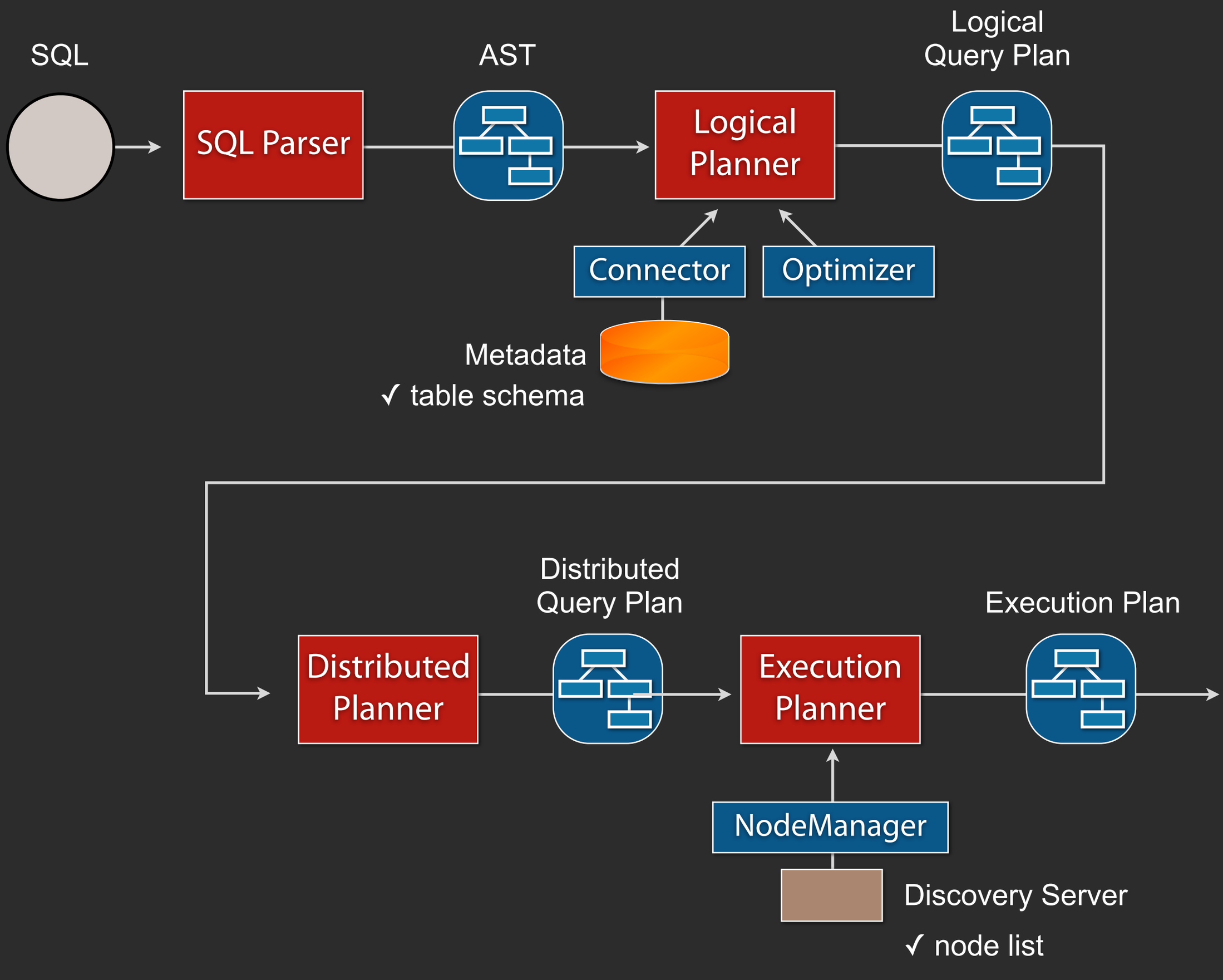
3. Query Execution

Presto's execution model

- **Presto is NOT MapReduce**
- **Presto's query plan is based on DAG**
  - more like Apache Tez or traditional MPP databases

How query runs?

- **Coordinator**
  - SQL Parser
  - Query Planner
  - Execution planner
- **Workers**
  - Task execution scheduler


SQL
AST
Logical
Query Plan
SQL Parser
Logical
Planner
Connector
Optimizer
Metadata
✓ table schema
Distributed
Query Plan
Execution Plan
Distributed
Planner
Execution
Planner
NodeManager
Discovery Server
✓ node list

(today's talk)

SQL

SQL Parser

Logical Query Plan

Query Planner

Connector

Optimizer

Metadata

✓ table schema

Query Plan

Distributed Planner

Execution Planner

Execution Plan

NodeManager

Discovery Service

✓ node list

Query Planner

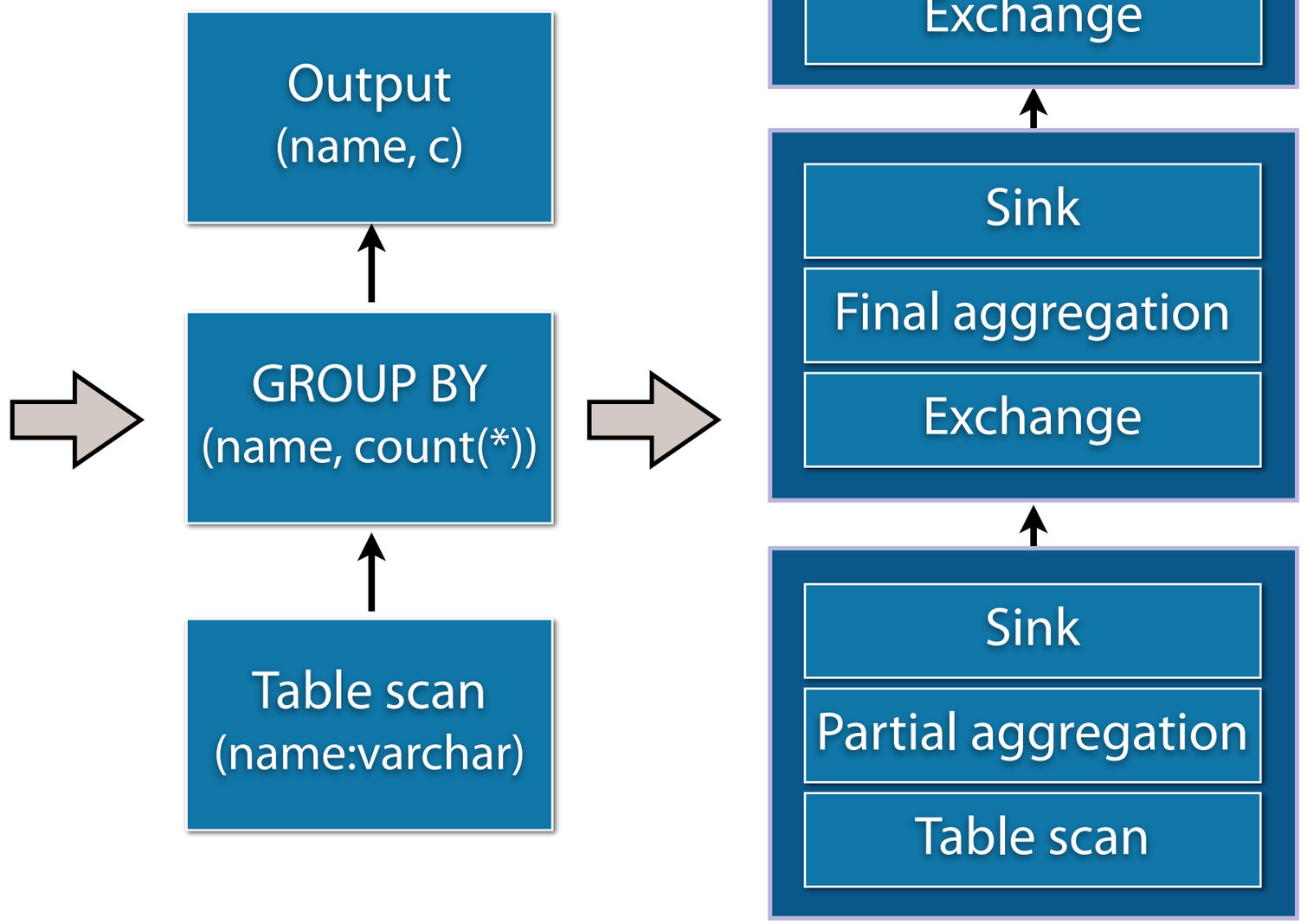
SQL

```
SELECT
   name,
   count(*) AS c
FROM impressions
GROUP BY name
```

+

Table schema

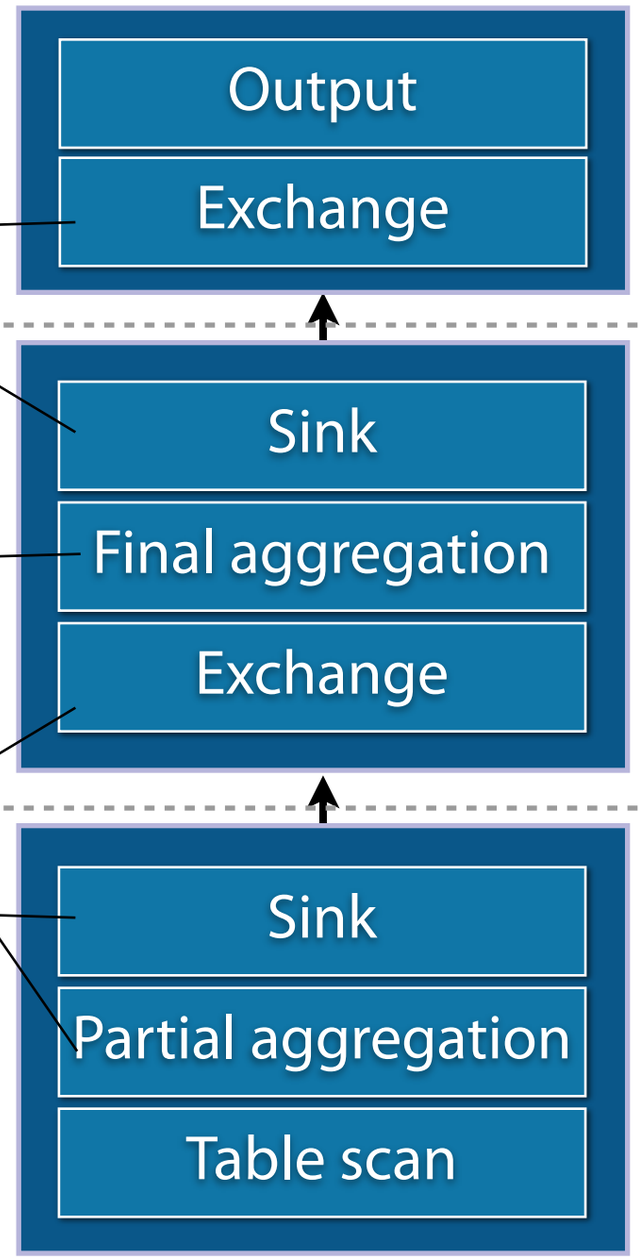
```
impressions (
   name varchar
   time bigint
)
```



Query Planner - Stages

Stage-0

inter-worker data transfer



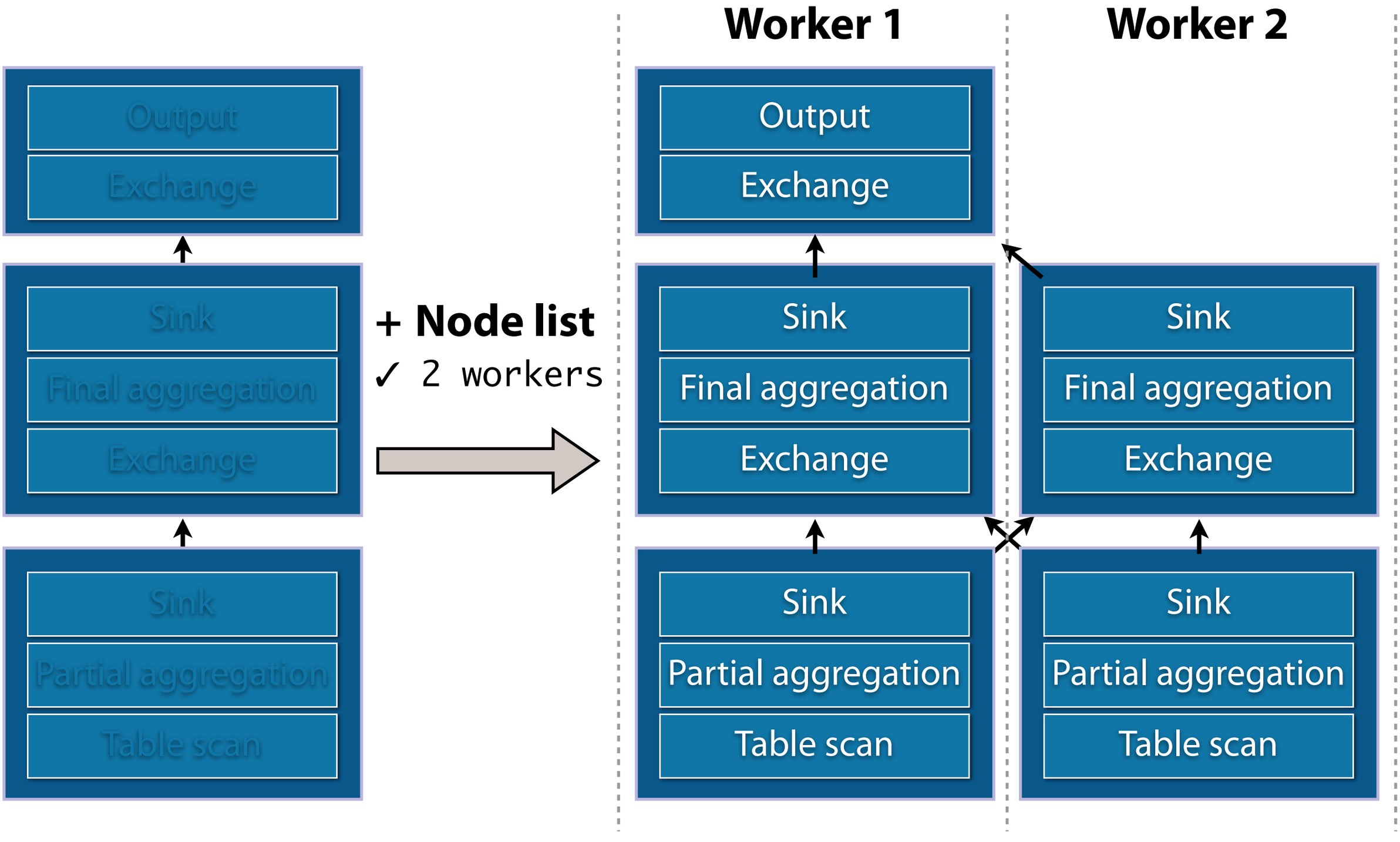
Stage-1

pipelined aggregation

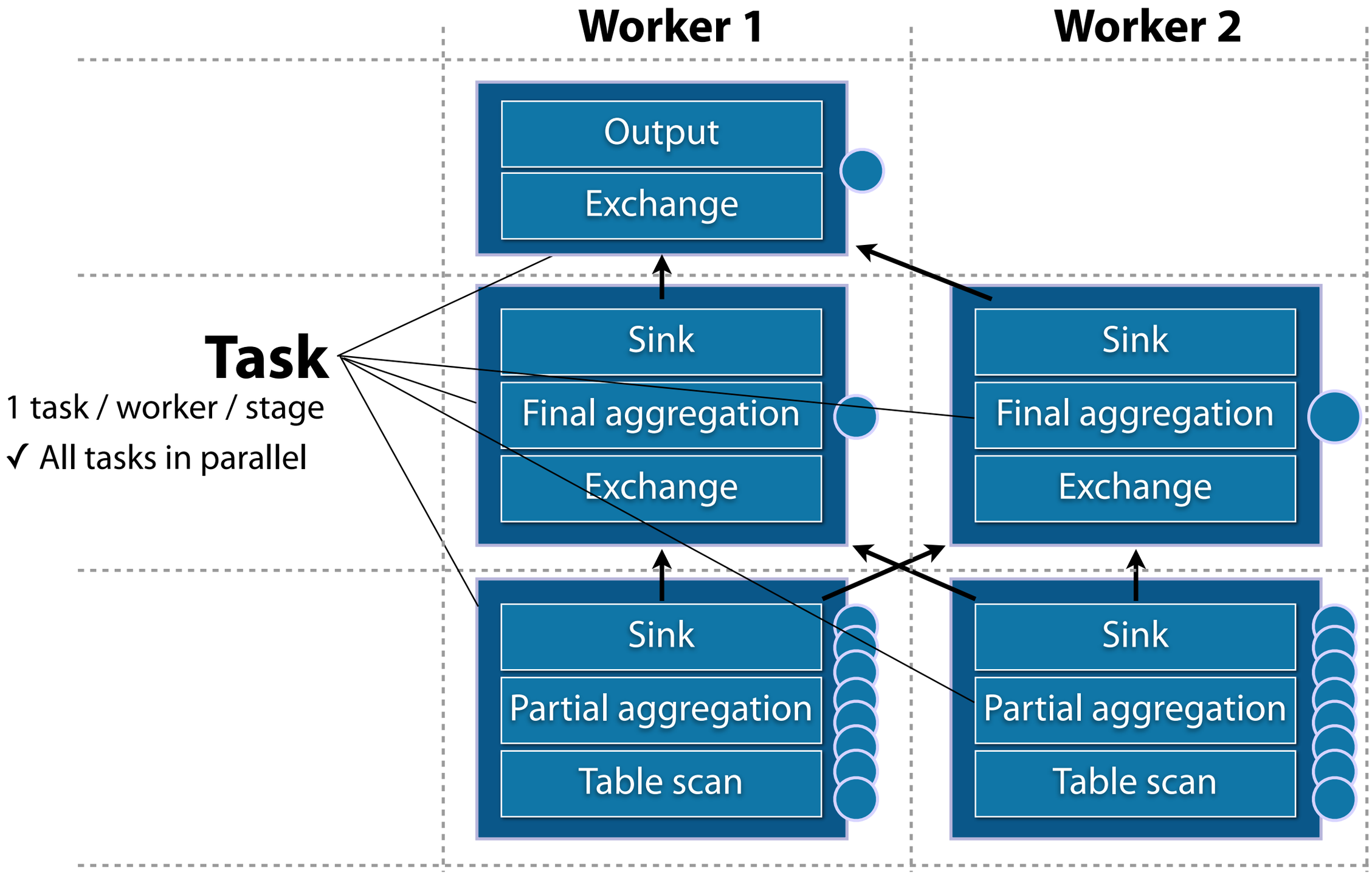
Stage-2

inter-worker data transfer

Execution Planner



Execution Planner - Tasks

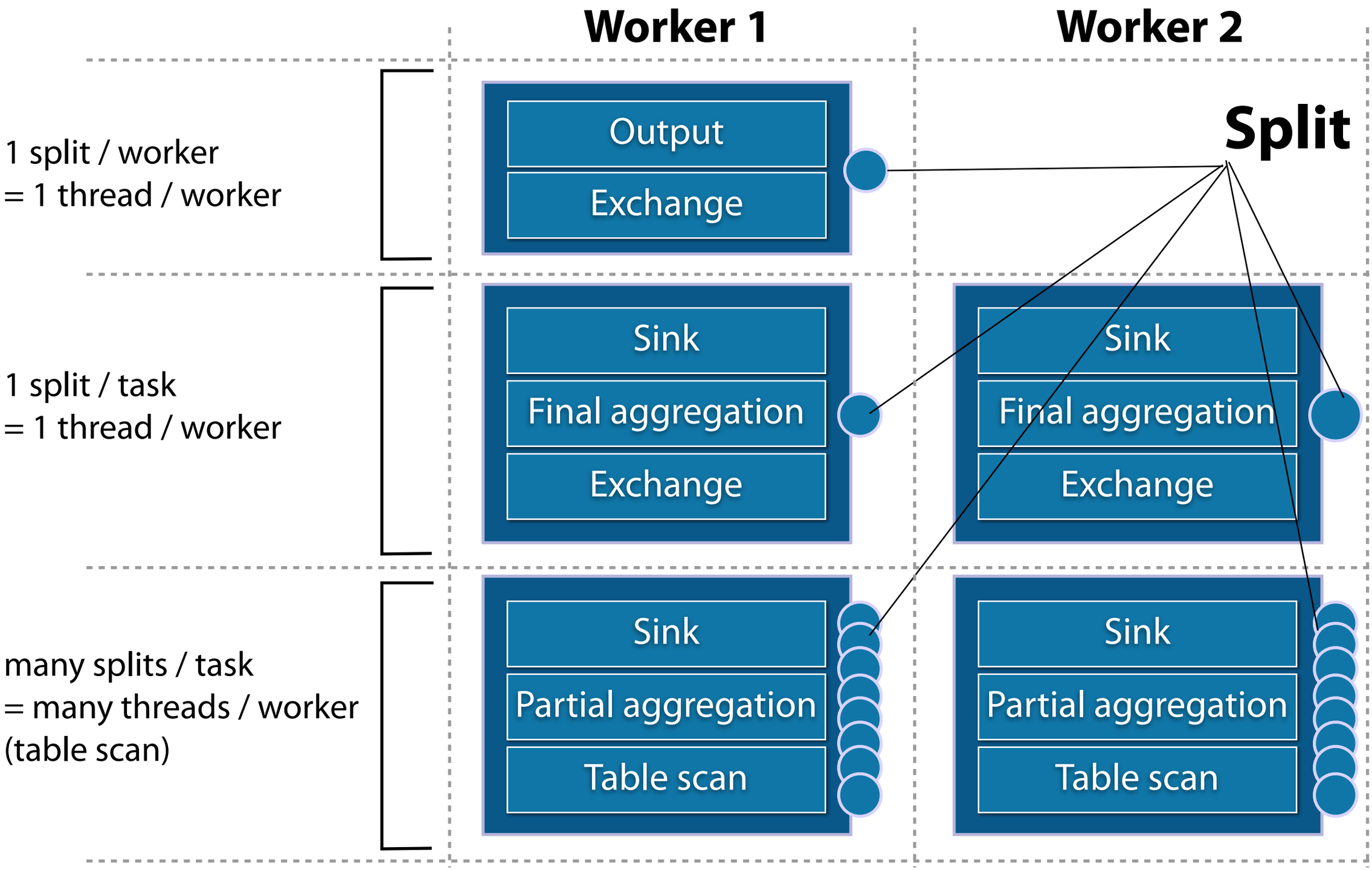


Task

1 task / worker / stage

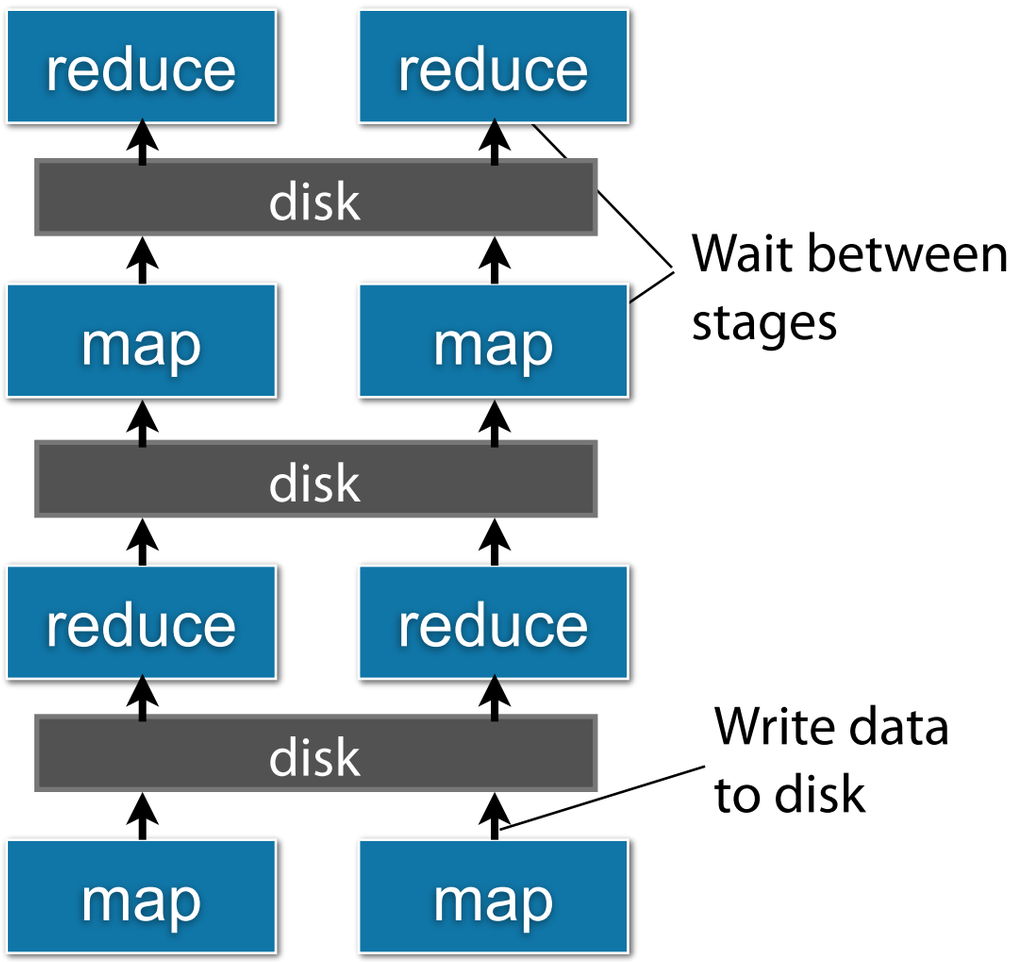
✓ All tasks in parallel

Execution Planner - Split

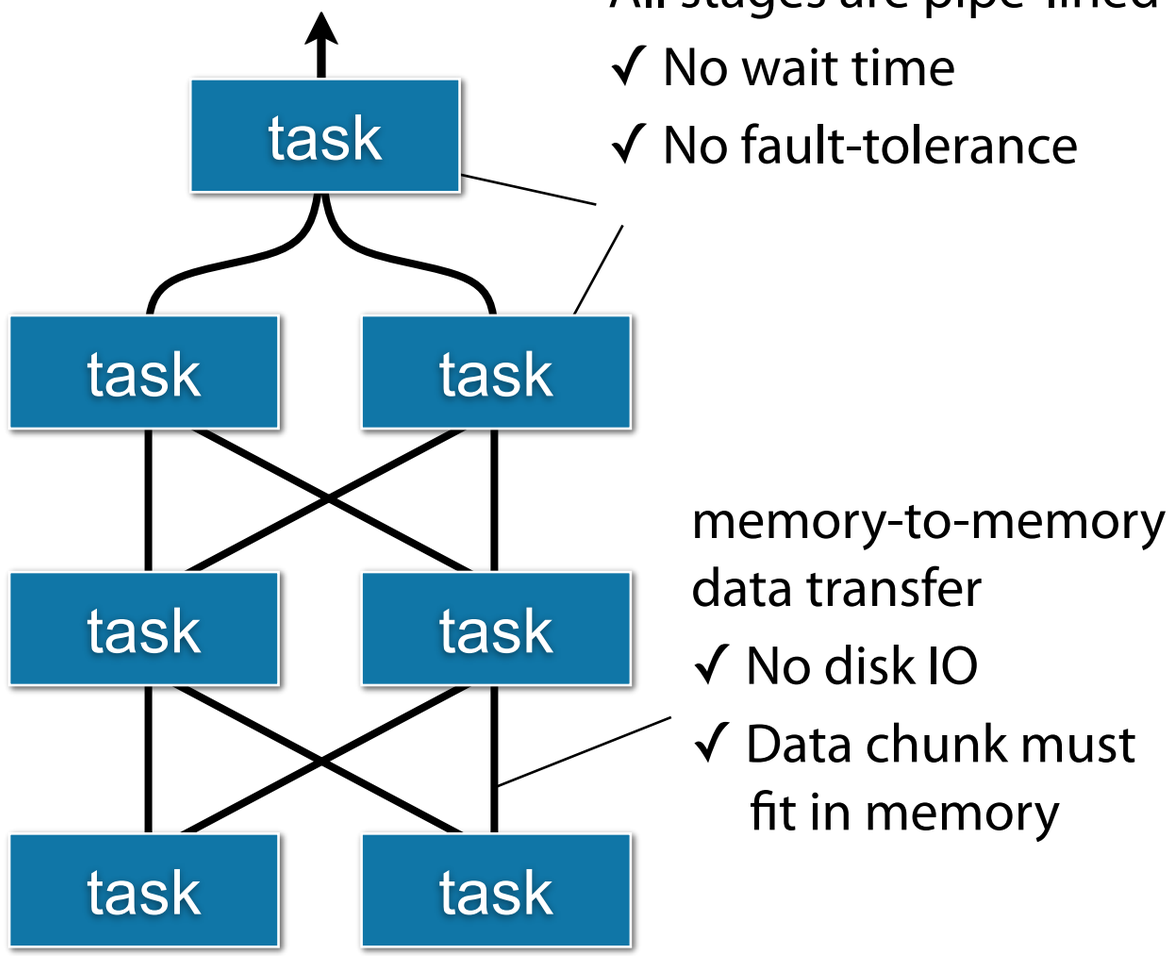


MapReduce vs. Presto

MapReduce



Presto



3. Query Execution

- **SQL is converted into stages, tasks and splits**
- **All tasks run in parallel**
  - No wait time between stages (pipelined)
  - If one task fails, all tasks fail at once (query fails)
- **Memory-to-memory data transfer**
  - No disk IO
  - If aggregated data doesn't fit in memory, query fails
    - Note: query dies but worker doesn't die. Memory consumption of all queries is fully managed

4. Monitoring & Configuration

Monitoring

- **Web UI**
  - basic query status check
- **JMX HTTP API**
  - GET /v1/jmx/mbean[/{objectName}]
    - com.facebook.presto.execution:name=TaskManager
    - com.facebook.presto.execution:name=QueryManager
    - com.facebook.presto.execution:name=NodeScheduler
- **Event notification (remote logging)**
  - POST http://remote.server/v2/event
    - query start, query complete, split complete

Configuration

- **Execution planning (for coordinator)**
  - query.initial-hash-partitions
    - max number of hash buckets (=tasks) of a GROUP BY (default: 8)
  - node-scheduler.min-candidates
    - max number of workers to run a stage in parallel (default: 10)
  - node-scheduler.include-coordinator
    - whether run tasks only on workers or include coordinator
  - query.schedule-split-batch-size
    - number of splits of a stage to start at once

Configuration

- **Task execution (for workers)**
  - task.cpu-timer-enabled
    - enable detailed statistics (causes some overhead) (default: true)
  - task.max-memory
    - memory limit of a task especially for hash tables used by GROUP BY and JOIN operations (default: 256MB)
    - enlarge if you get “Task exceeded max memory size” error
  - task.shard.max-threads
    - max number of threads of a worker to run active splits (default: number of CPU cores * 4)

5. Roadmap

A report of Presto Meetup 2014

"Presto, Past, Present, and Future" by Dain Sundstrom at Facebook

http://www.slideshare.net/dain1/presto-meetup-20140514-34731104

Presto's future

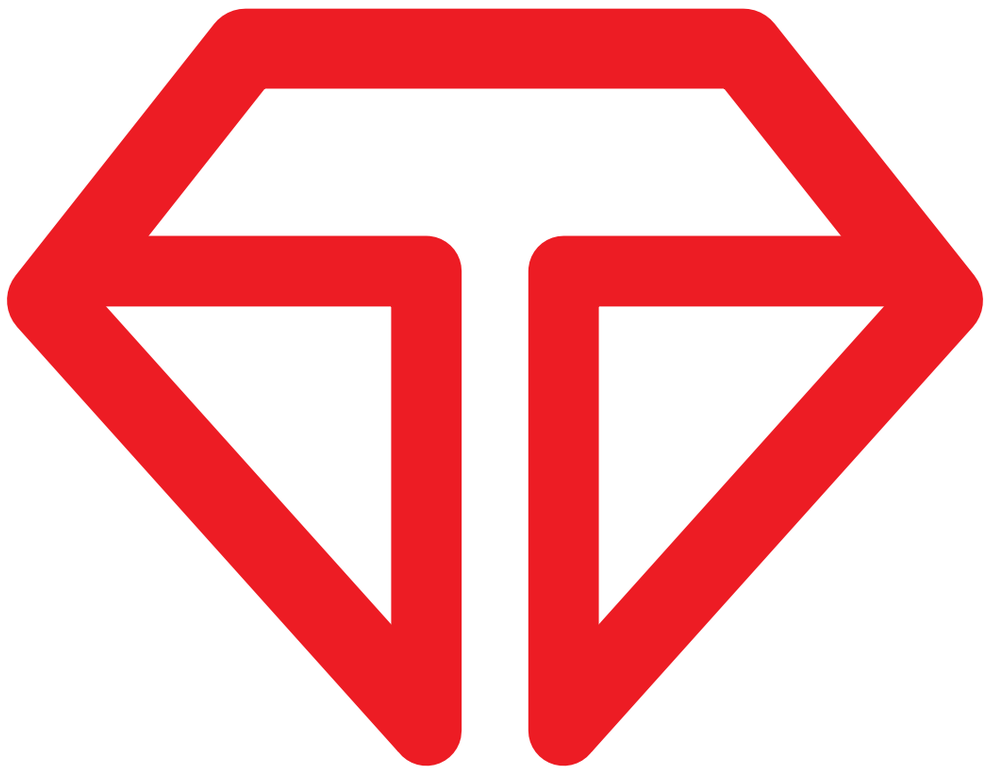
- **Huge JOIN and GROUP BY**
  - Spill to disk
- **Task recovery**
- **CREATE VIEW (※implemented)**
- **Native store (※implemented)**
  - Fast data store in Presto workers
  - to cache hot data
- **Authentication and permissions**

Presto's future

- **DDL/DML statements**
  - CREATE TABLE with partitioning
  - DELETE and INSERT
- **Plugin repository**
- **CLI plugin manager**
- **JOIN and aggregation pushdown**
- **Custom optimizers**

Links

- **Web site & document**
  - http://prestodb.io
- **Mailing list**
  - https://groups.google.com/group/presto-users
- **Github**
  - https://github.com/facebook/presto
- **Guidelines for contribution**
  - https://github.com/facebook/presto/blob/master/CONTRIBUTING.md



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