Apache Kylin: Speed up Cubing with Spark

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About Us

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- Sr. Architect, Kyligence Inc.

Kyligence
Unleash big data productivity

formed by the team who created Apache Kylin

http://kyligence.io

Agenda

- What is Apache Kylin
- Challenges with MapReduce
- Speed up Cubing with Spark
- Q&A

About Apache Kylin

Kylin / ˈkiːˈlɪn / 麒麟

-- n. (in Chinese art) a mythical animal of composite form

Apache Kylin

Extreme OLAP Engine for Big Data

- ✓ Leading open source OLAP on Hadoop
- ✓ Fast growing open source community
- ✓ Adopted by 200+ global organizations
- ✓ First born in China Apache Top Level Project
- ✓ InfoWorld Bossie Award:
  - Best Open Source Big Data Tool (2015)
  - Best Open Source Big Data Tool (2016)

http://kylin.apache.org

Global Users

200+ use cases in production

Yahoo! Japan

ebay

Microsoft

Expedia

exponential Advertising Intelligence

inovex

glispa

Infoworks

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oppo

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中信银行 CHINA CITIC BANK

Use Case

Apache Kylin is the best OLAP on Hadoop solution, we can't do analytics on trillion level data without Apache Kylin

-- Chaozhong Yang, Bytedance (Toutiao.com)

- Top 1 News Feed App
- 600+M Users, 8000+ DAU
- 70+ minutes /user/day

Pain Points

Huge Volume Data, 100+B rows per day

Second query latency by business requirement

Solution

Apache Kylin as OLAP platform with 60+ HBase region servers

Scenarios

#1: Video impression data, 4+ TB Cube (expansion rate < 3%)

(**Raw records: 3,000+B**, 100+TB)

#2: APP performance monitoring, **1000+ Analysts**

#3: News Log Insight, **100+ Cubes** for different products

Benefits

1. Super fast query speed: 90%+ queries in ms level

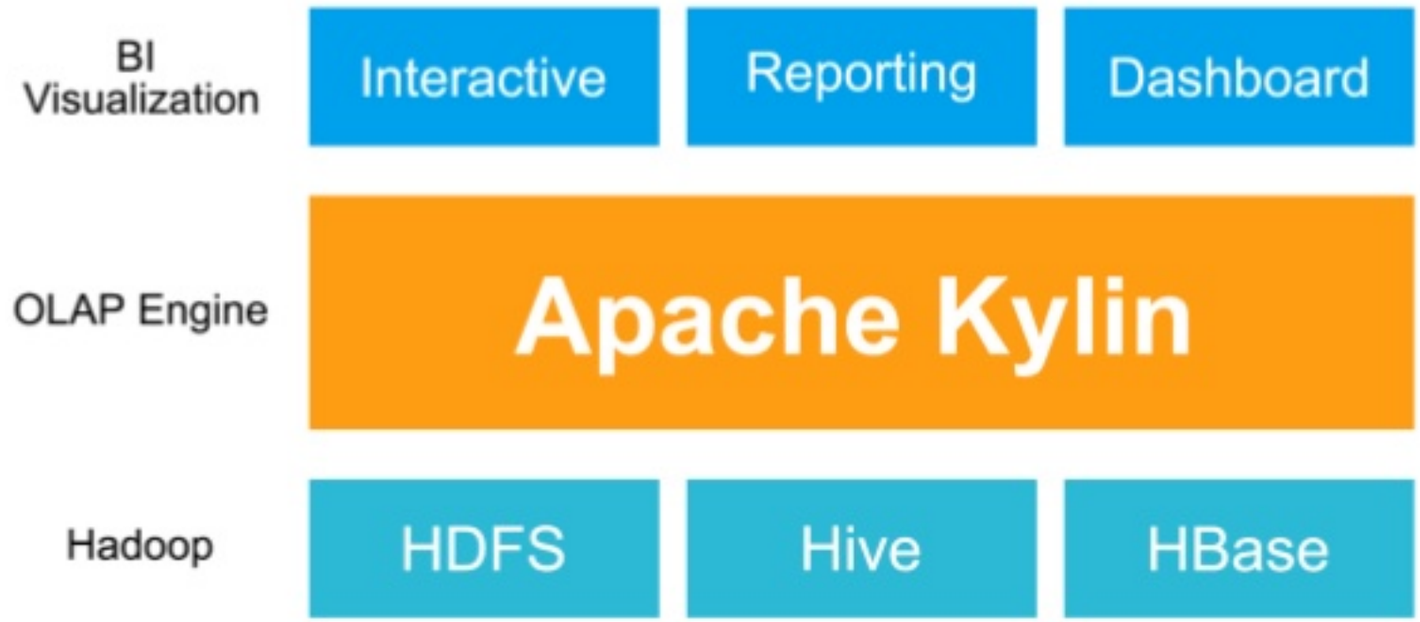
(10,000+ times fast than hive)

2. Saving Cluster Computing Resources: **One Build for all queries**

3. Rich API and drives, managing 100+Cube automatically

About Apache Kylin

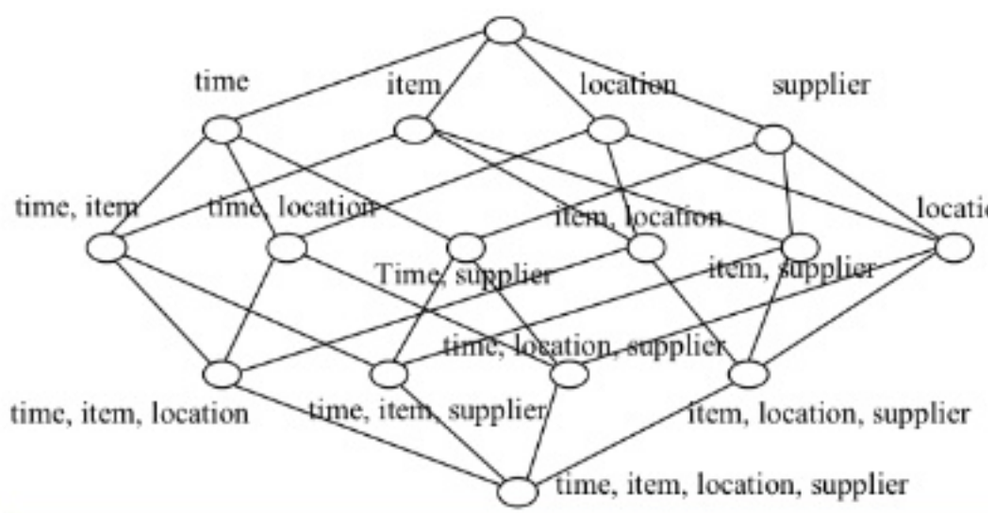
- Extreme OLAP Engine on Hadoop



- ✓ High Performance
- ✓ High Concurrency
- ✓ ANSI SQL
- ✓ Native on Hadoop
- ✓ Cloud Ready

The Basic: OLAP Cube

- Pre-calculate metrics by dimensions



0-D(apex) cuboid

1-D cuboids

2-D cuboids

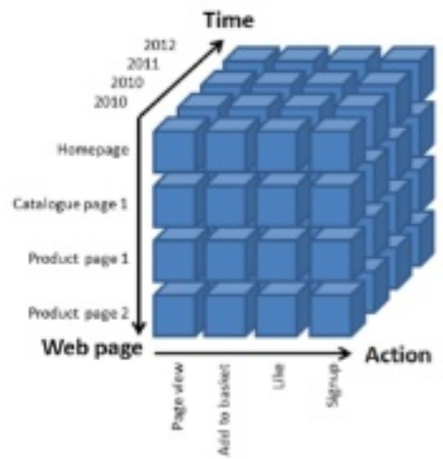
3-D cuboids

4-D(base) cuboid

- Base vs. aggregate cells,ancestor vs. descendant cells,parent vs. child cells
  1. (9/15, milk, Urbana, Dairy_land) - <time, item, location, supplier>
  2. (9/15, milk, Urbana, *) - <time, item, location>
  3. (*, milk, Urbana, *) - <item, location>
  4. (*, milk, Chicago, *) - <item, location>
  5. (*, milk, *, *) - <item>

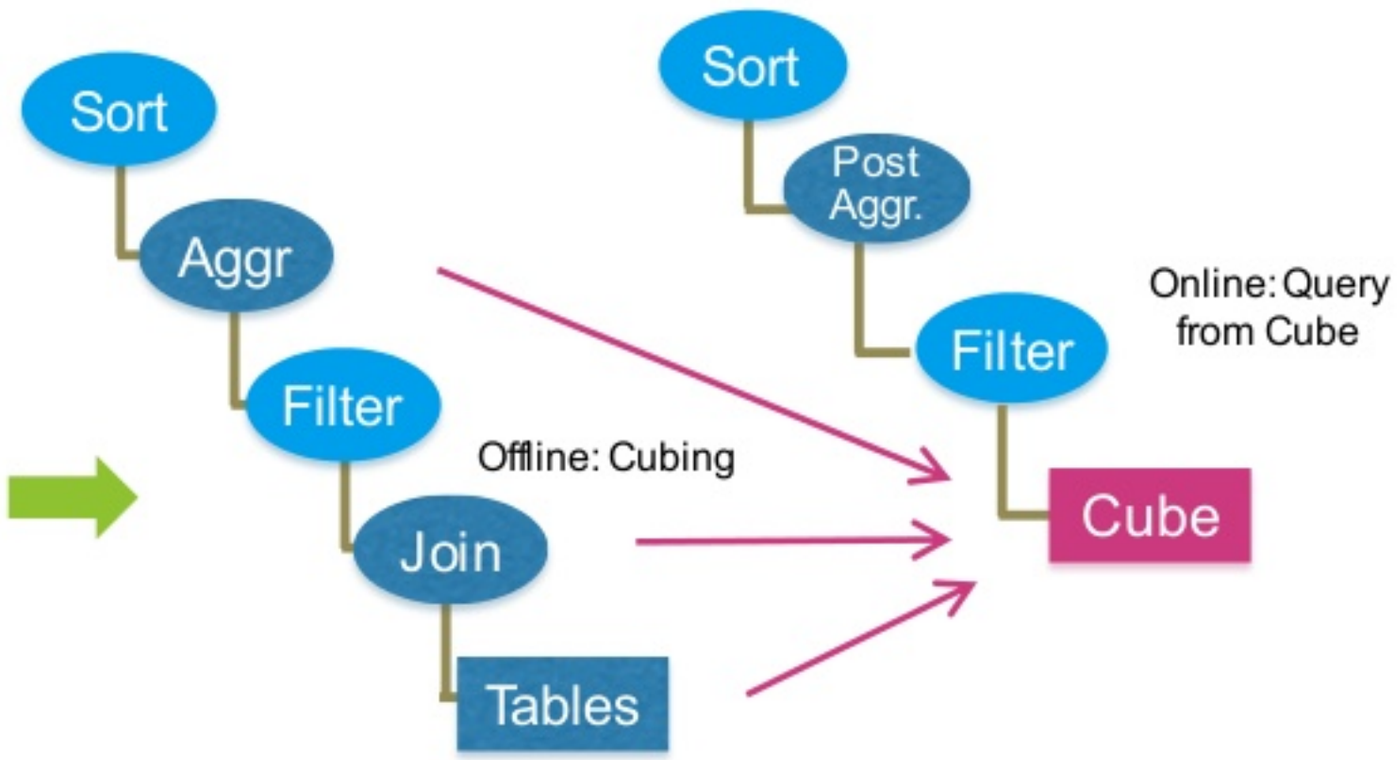
OLAP Cube

- Cuboid = one combination of dimensions
- Cube = all combination of dimensions (all cuboids)

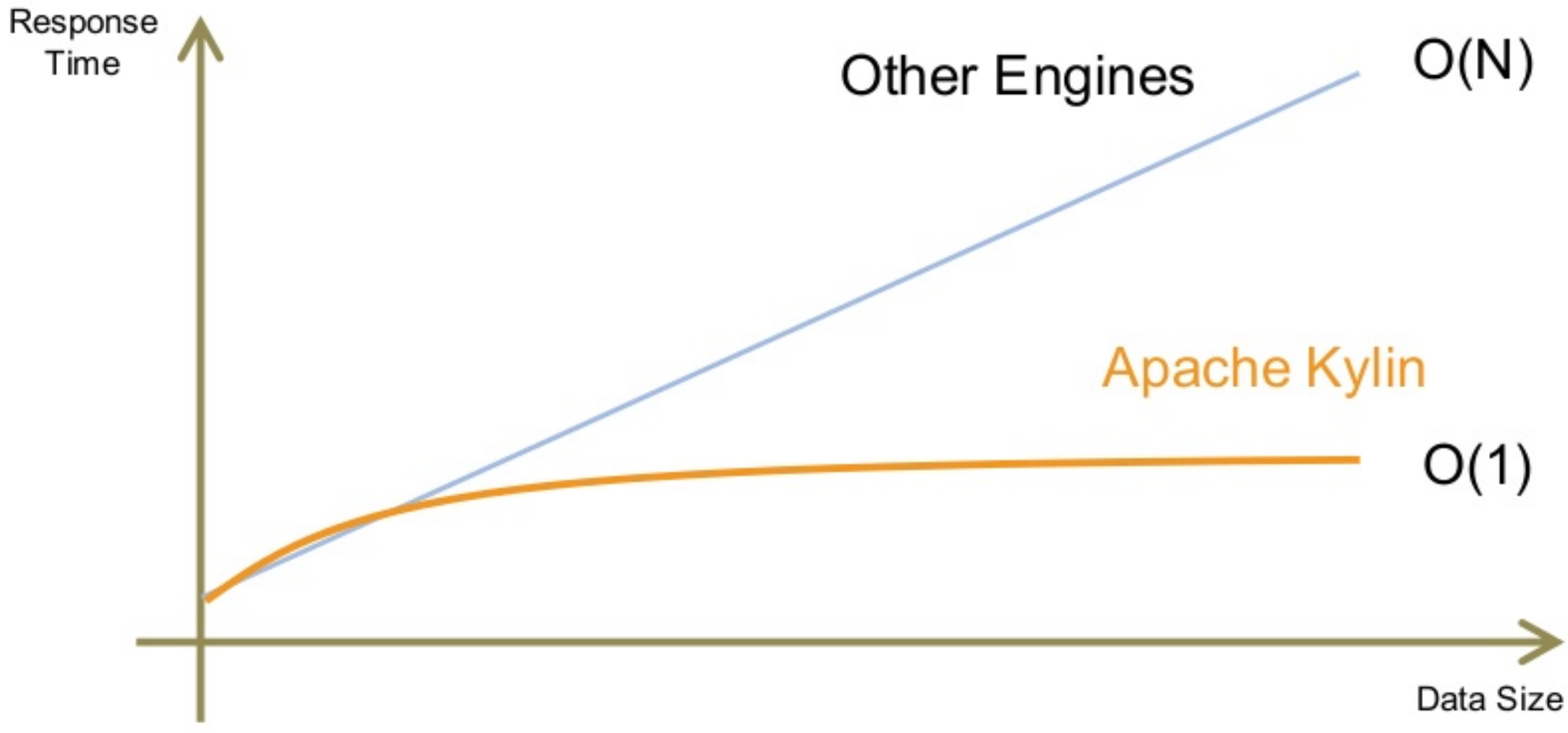


The Magic: Pre-Calculation

```
SELECT
    returned,
    status,
    sum(quantity),
    sum(price)
FROM
    lineitem INNER JOIN orders
        on l_orderkey = o_orderkey
WHERE
    shipdate = '2016-09-16'
GROUP BY
    returned, status
ORDER BY
    returned, status;
```

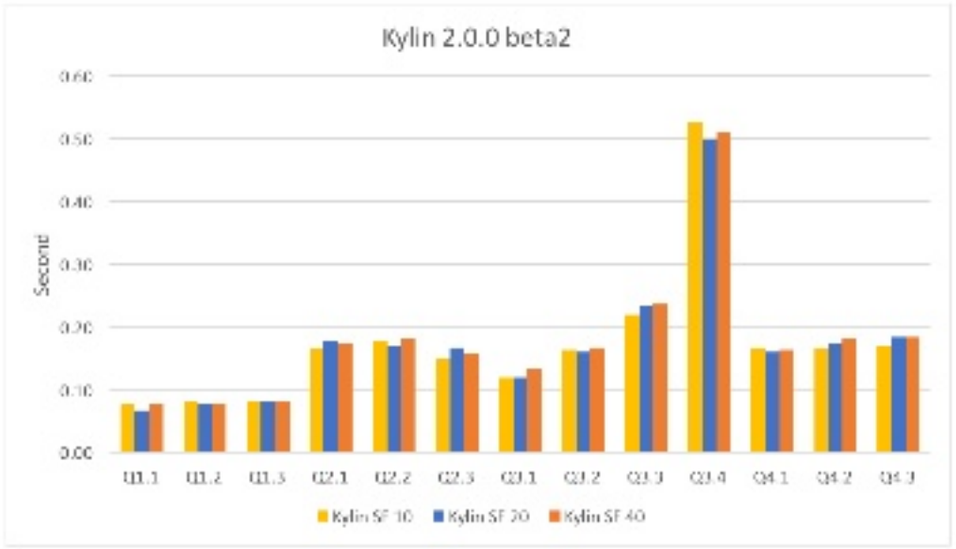


Apache Kylin: O(1)

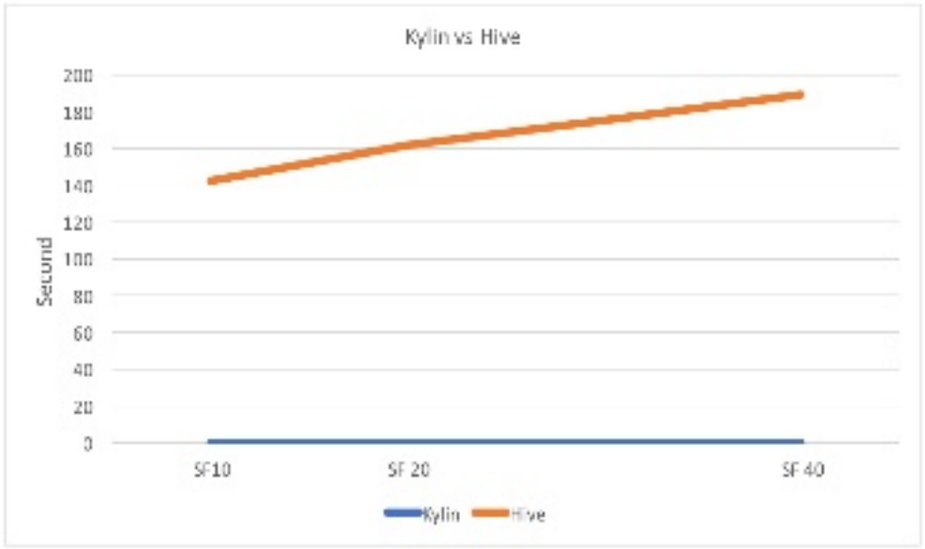


Star-Schema Benchmark

Run SSB at 10, 20 and 40 million-row scales,
Kylin's response time keep stable

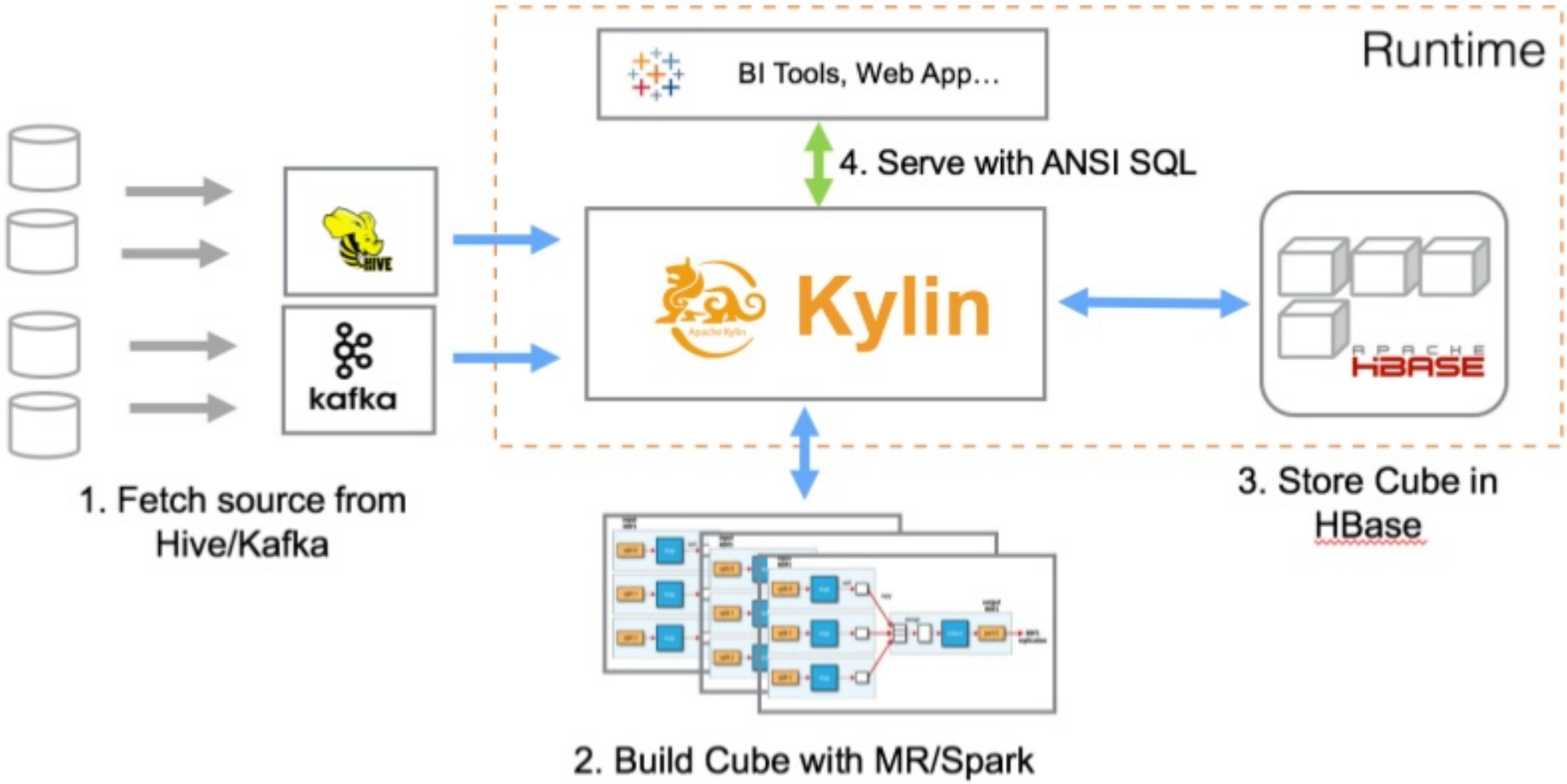


Kylin vs Hive, O(1) : O(N)

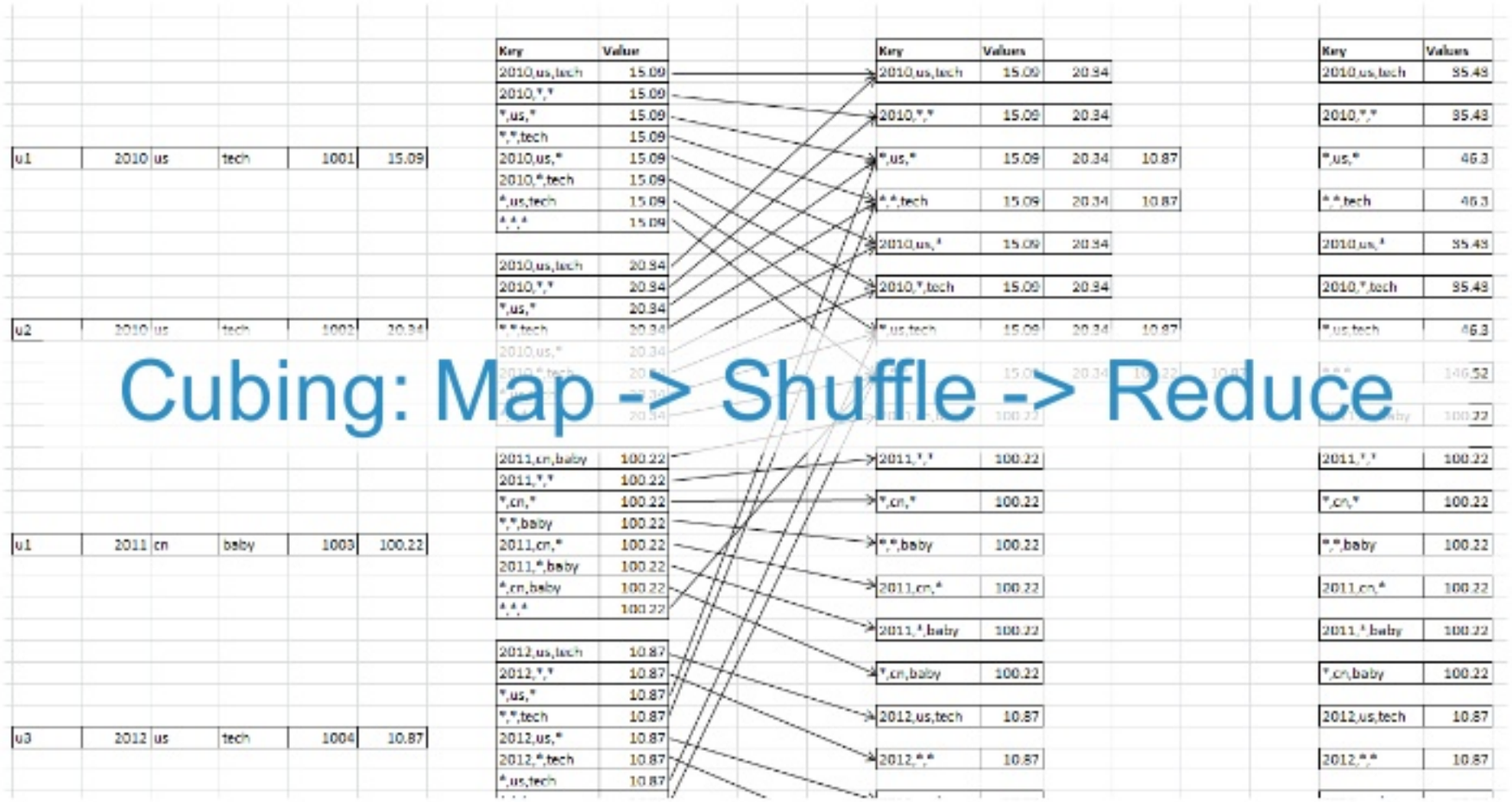


Read more at: https://github.com/kyligence/ssb-kylin

Architecture



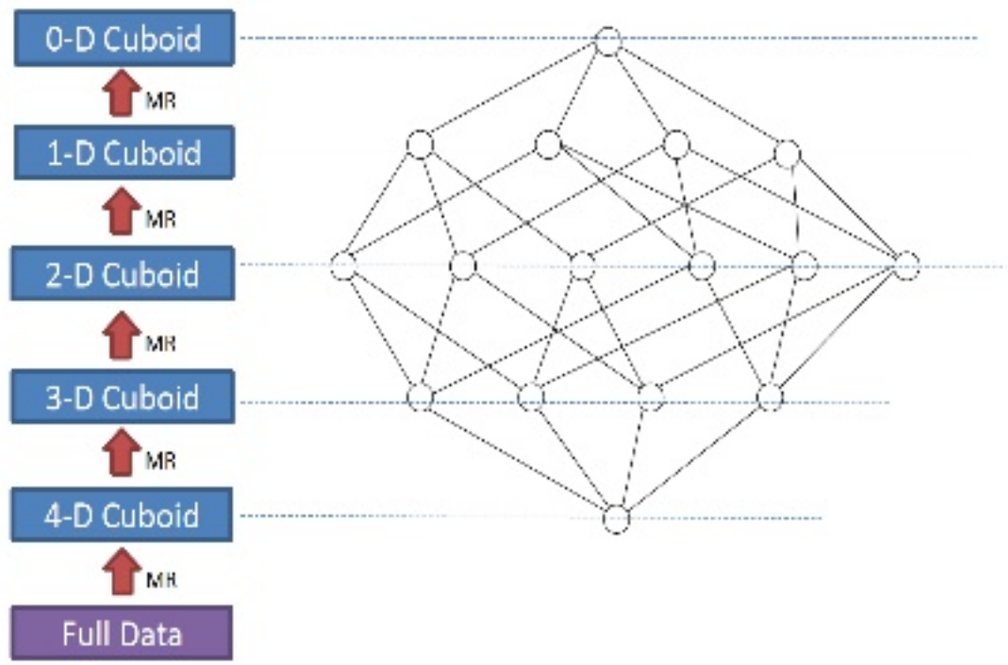
Cubing Process



Cubing: Map -> Shuffle -> Reduce

Build Cube with MapReduce

- Calculate Cuboids by layer :N dim (Base cuboid), N-1 dim, N-2…, 1, 0
- Reuse previous layer's result
- HDFS used for data sharing
- Totally need N round MR;



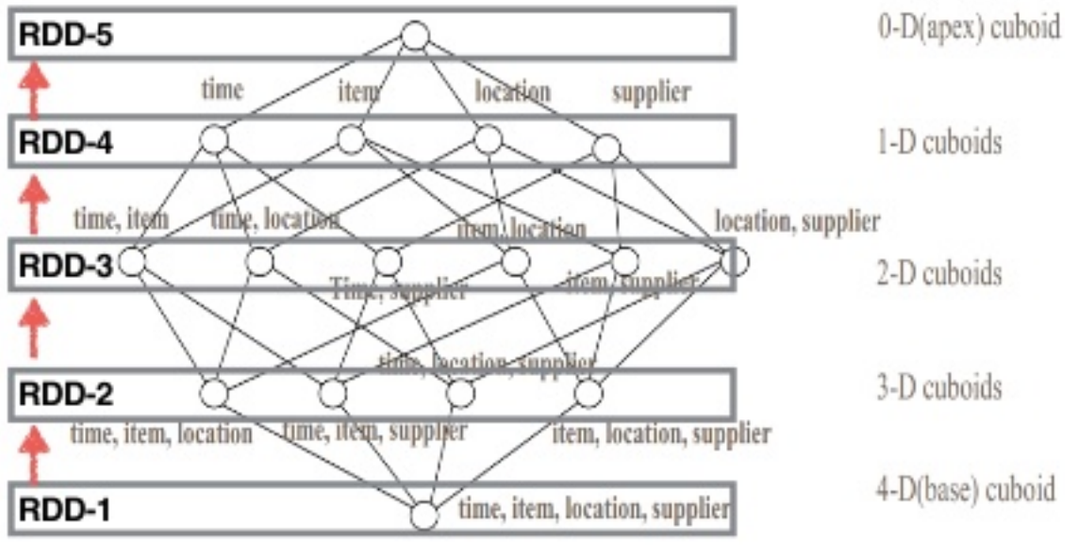
Challenges with MapReduce

- Slow data sharing
  - ✓ Serialization, Replication, Deserialization…
- Repeated job submission
  - ✓ Submit dependent jar/files repeatedly
  - ✓ Re-queue when cluster is busy
- Short of streaming support
  - ✓ Couldn't support low latency data processing
- Limited storage support
  - ✓ Couldn't ingest data from non-HDFS

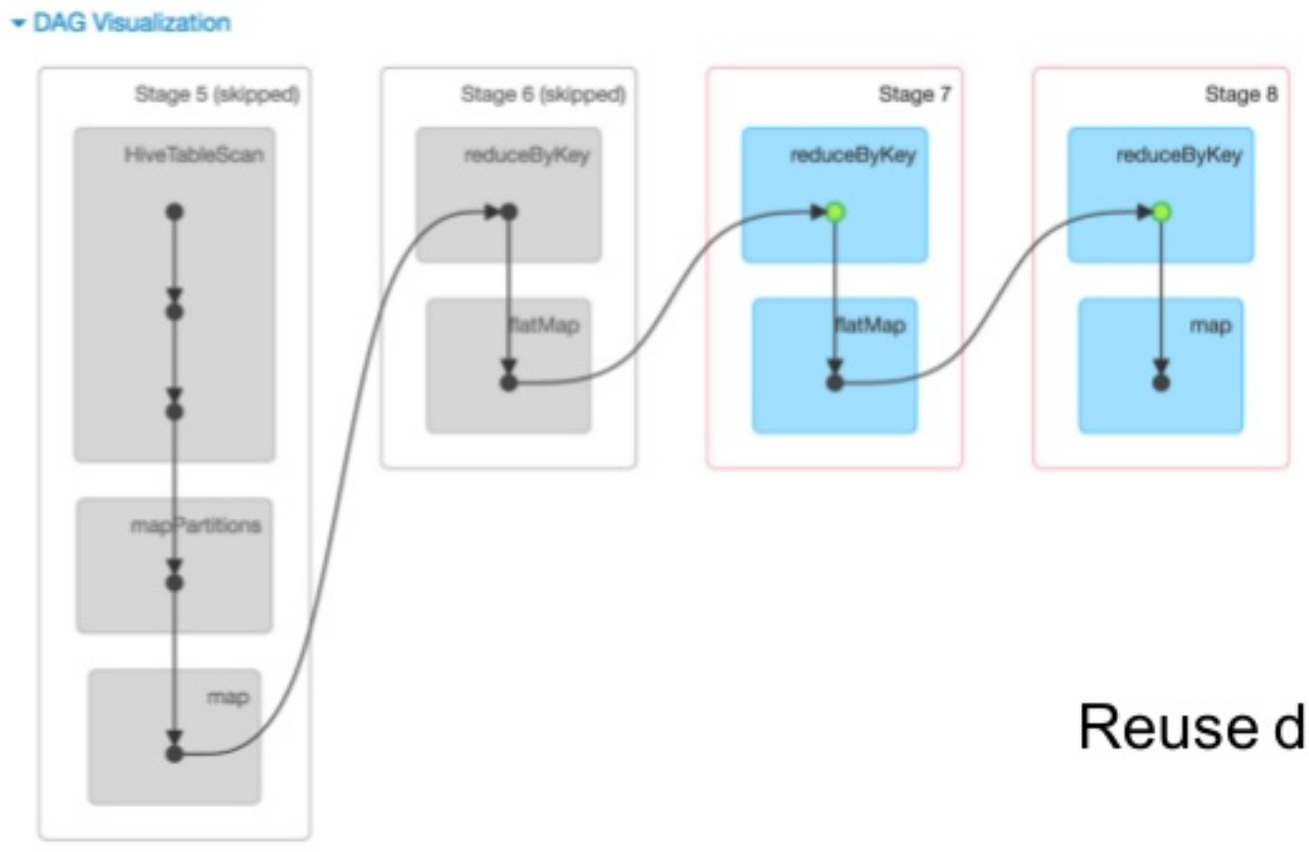

APACHE
Spark
TM

Speed up Cubing with Spark

- Abstract each layer cuboids as a RDD
- Cache parent RDD to generate Child RDD
- Export RDD when Child be generated
- As-is measure aggregators can be reused with Spark Java API



Speed up Cubing with Spark



Reuse data in memory

Speed up Cubing with Spark

Spark Jobs (?)

Total Uptime: 5.0 min
Scheduling Mode: FIFO
Active Jobs: 1
Completed Jobs: 6

▸ Event Timeline

One job finishes all layers aggregation!

Active Jobs (1)

Job Id	Description	Submitted	Duration	Stages: Succeeded/Total	Tasks (for all stages): Succeeded/Total
6	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:13:57	47 s	1/8	502/1603

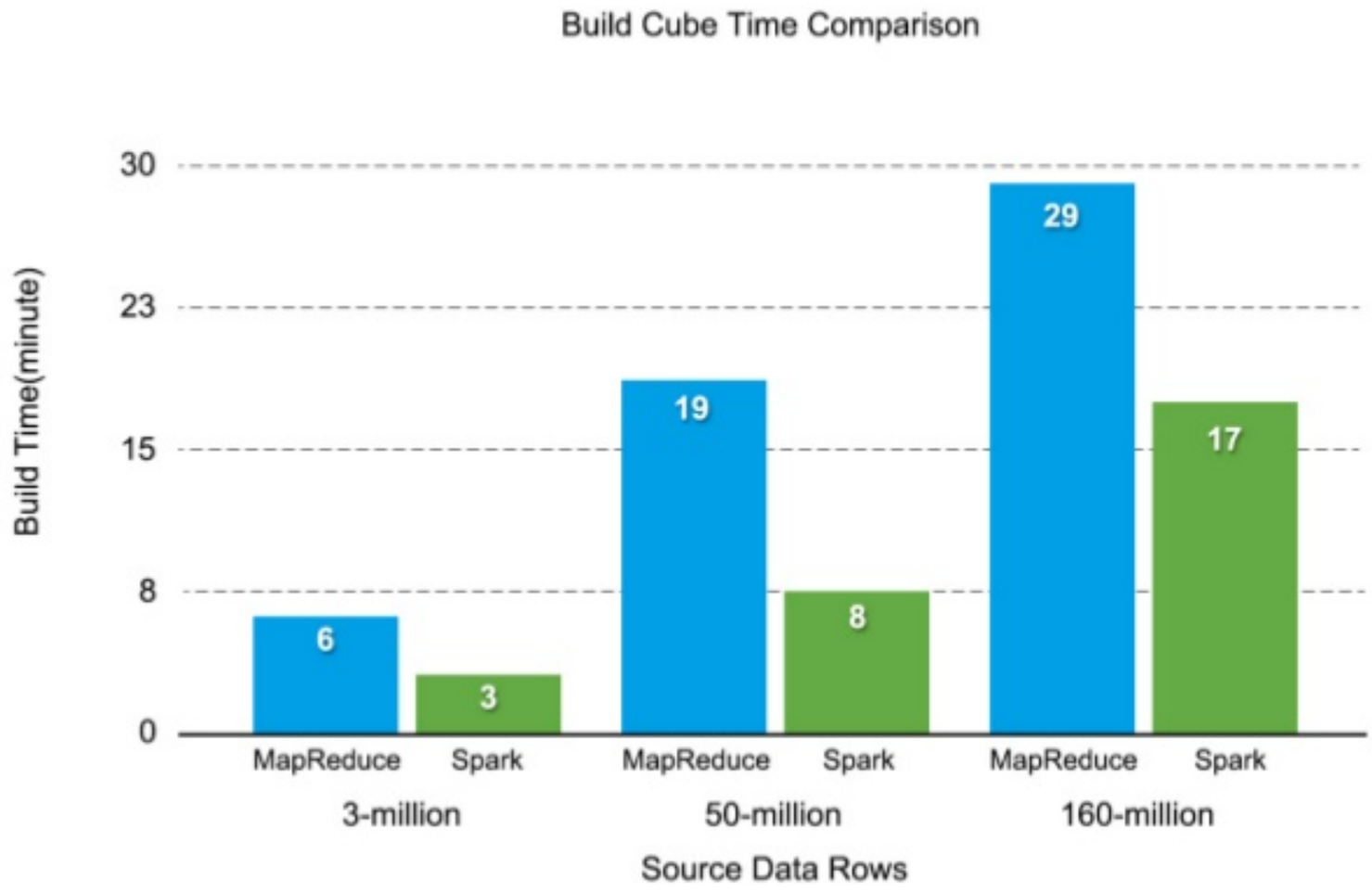
Completed Jobs (6)

Job Id	Description	Submitted	Duration	Stages: Succeeded/Total	Tasks (for all stages): Succeeded/Total
5	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:12:32	1.4 min	2/2 (5 skipped)	816/816 (345 skipped)
4	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:11:23	1.1 min	2/2 (4 skipped)	602/602 (116 skipped)
3	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:10:40	41 s	2/2 (3 skipped)	315/315 (30 skipped)
2	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:10:28	12 s	2/2 (2 skipped)	100/100 (16 skipped)
1	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:10:22	5 s	2/2 (1 skipped)	28/28 (2 skipped)
0	saveAsNewAPIHadoopFile at SparkCubingByLayer.java:287	2017/03/06 14:10:08	14 s	2/2	16/16

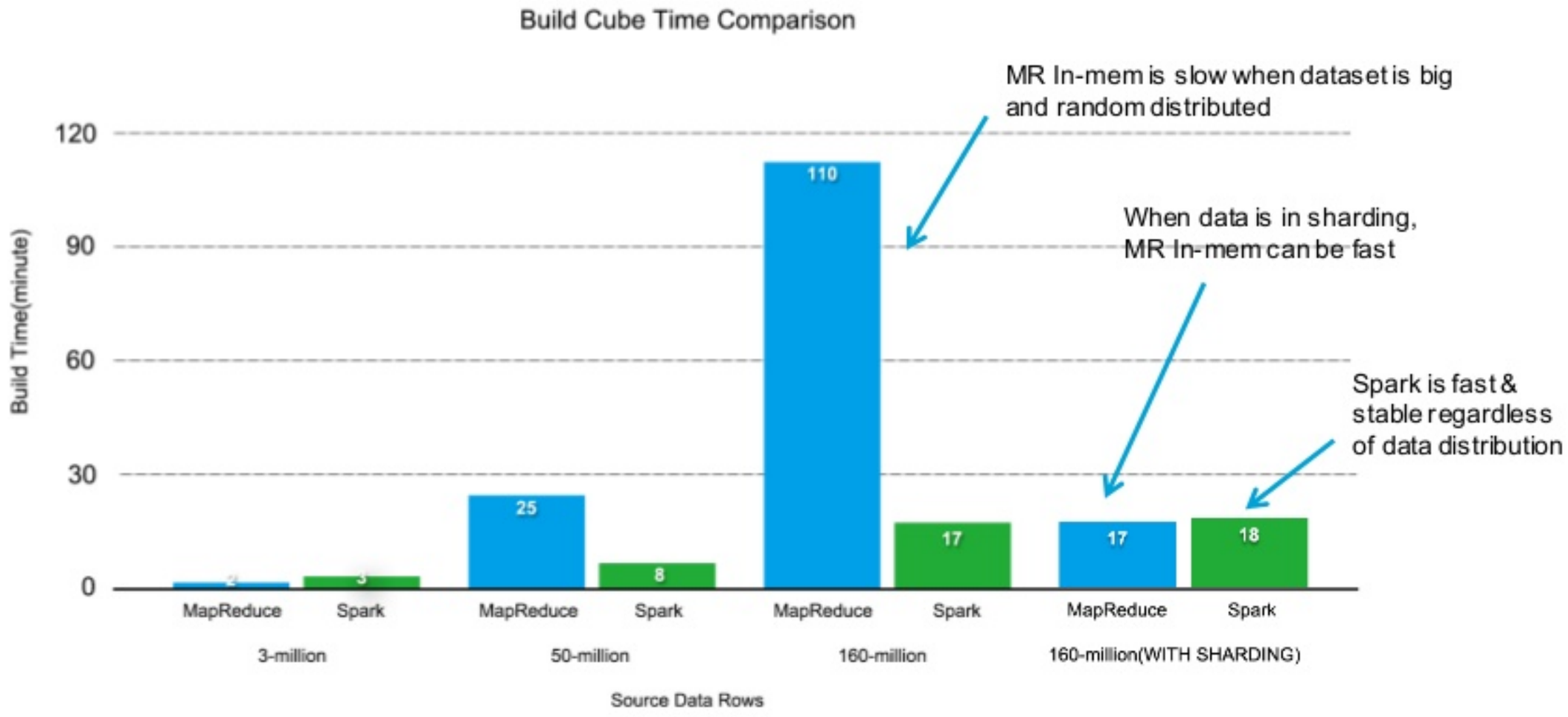
Performance Benchmark

- Environment
  - ✓ 4 nodes Hadoop cluster; each has 28 GB RAM and 12 cores
  - ✓ CDH 5.8, Apache Kylin 2.0
- Spark
  - ✓ Spark 1.6.3 on YARN
  - ✓ 6 executors, each has 4 cores, 5GB memory
- Test Data
  - ✓ Airline data of US DoT, totally 160 million rows
  - ✓ Cube:10 dimensions, 5 measures (SUM)
- Test Scenarios
  - ✓ Build the cube at different scale: 3 million, 50 million and 160 million rows

Spark Cubing vs. MR Cubing



Spark Cubing vs. MR In-Mem Cubing



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Benefits with Spark

- Spark speeds up Cubing at 1x
  - ✓ Half time be saved
- Spark simplifies Kylin's development
  - ✓ More functions, less codes
- Spark brings Kylin to a new era
  - ✓ Real-time OLAP, Ad hoc query, Cloud integration

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Thank You.

Join Apache Kylin community

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