INTRODUCTION TO SPARK

AGENDA

- Big Data Processing Challenges and Solutions
- How it is different from Hadoop MapReduce
- Introducing Spark
- Unified Platform of Spark
- Spark on Hadoop

Problems with Large scale data processing

- Data is Value. We must process it to extract value. How to store? How can we process all the data? Variety of data?
- Two Problems
  - ✓ Large-scale data storage
  - ✓ Large-scale data analysis

- Fortunately, the size and cost of storage has kept pace

Year	Capacity (GB)	Cost per GB (USD)
1997	2.1	157
2004	200	1.05
2014	3,000	0.036

- Unfortunately, transfer rates have not kept with capacity

Year	Cpacity (GB)	Transfer Rate (MB/s)	Disk Read Time
1997	2.1	16.6	126 seconds
2004	200	56.5	59 minutes
2014	3,000	210	3 hours, 58 minutes

Solutions and Trends

- Late 1990s - explosive growth e-commerce and machine data implied that workloads could not fit on a single computer anymore…

- Notable firms (Amazon, eBay, Yahoo, Google) led the shift to *horizontal scale-out* on clusters of commodity hardware, especially for machine learning use cases at scale.

- 2002 - Mitigate risk of large distributed workloads lost due to disk failures on commodity hardware…

- GFS (Google File System) and MapReduce and Hadoop

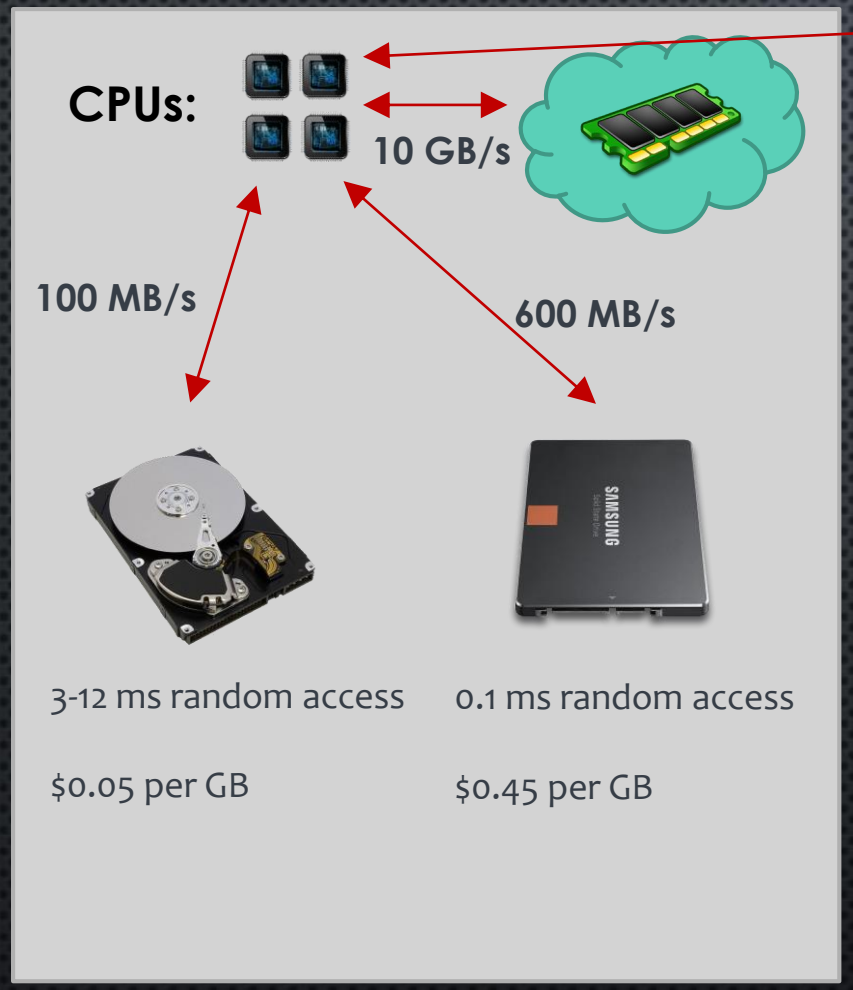
- 2010 - A unified engine for enterprise data workflows, based on commodity hardware, a decade later…

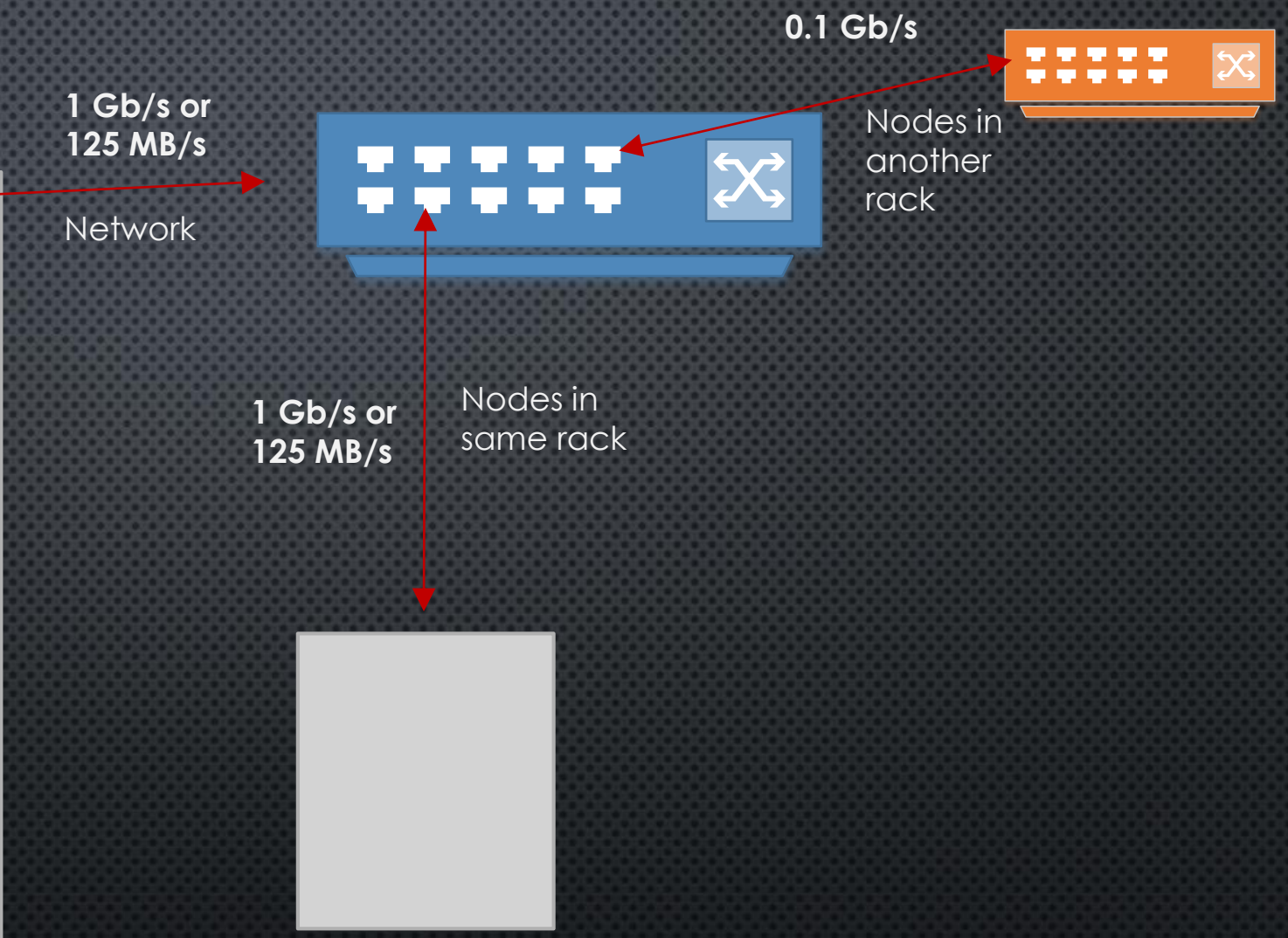
- Apache Spark and RDDs

Solutions and Trends

Cheap Network	Reference	URI
Cheap Storage	Replicate	DFS
Cheap Memory	Recompute	RDD

Why RAM?


CPUs:
10 GB/s
100 MB/s
600 MB/s
SAMSUNG
3-12 ms random access
0.1 ms random access
$0.05 per GB
$0.45 per GB


1 Gb/s or
125 MB/s
Network
0.1 Gb/s
Nodes in
another
rack
1 Gb/s or
125 MB/s
Nodes in
same rack

Solutions and Trends

- Decreasing storage costs have led to an explosion of big data
- Commodity cluster software, like Hadoop, has made it 10-20x cheaper to store and process large datasets
- Broadly available from multiple vendors

Implication

Big data storage is becoming commoditized, so how will organizations get an edge?

What matters now is what you can *do* with the data.

Two Factors

Speed: how quickly can you go from data to decisions?

Sophistication: can you run the best algorithms on the data?

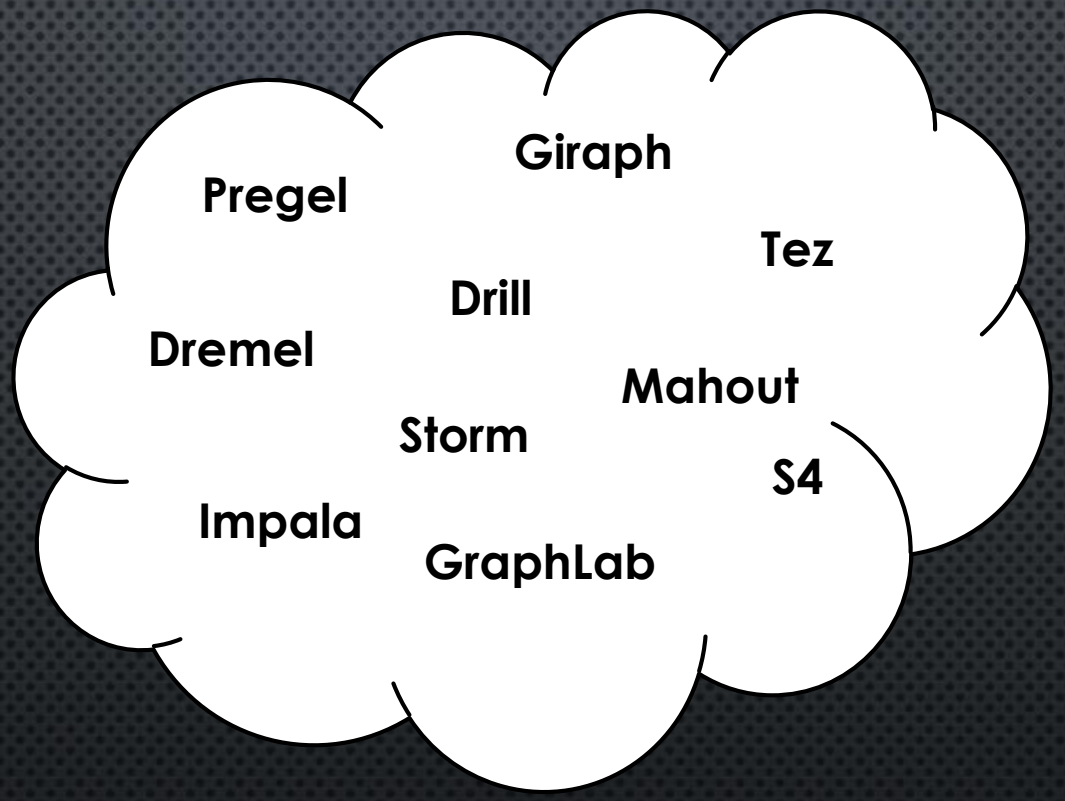
How easily you can develop apps?

How easily you can explore data?

These factors have usually required separate and non-commodity tools

(2004 – 2013)

(2007 – 2015?)



(2014 – ?)

Specialized Systems

(iterative, interactive, ML, streaming, graph, SQL, etc)

General Batch Processing

General Unified Engine

Introducing Apache Spark

- Developed in 2009 at UC Berkeley AMPLab
- Open sourced in 2010
- Feb 2014 - Top Level Project at the Apache Software Foundation
- Spark has since become one of the largest OSS communities in big data
- Over 250+ contributors in 50+ organizations

spark.apache.org

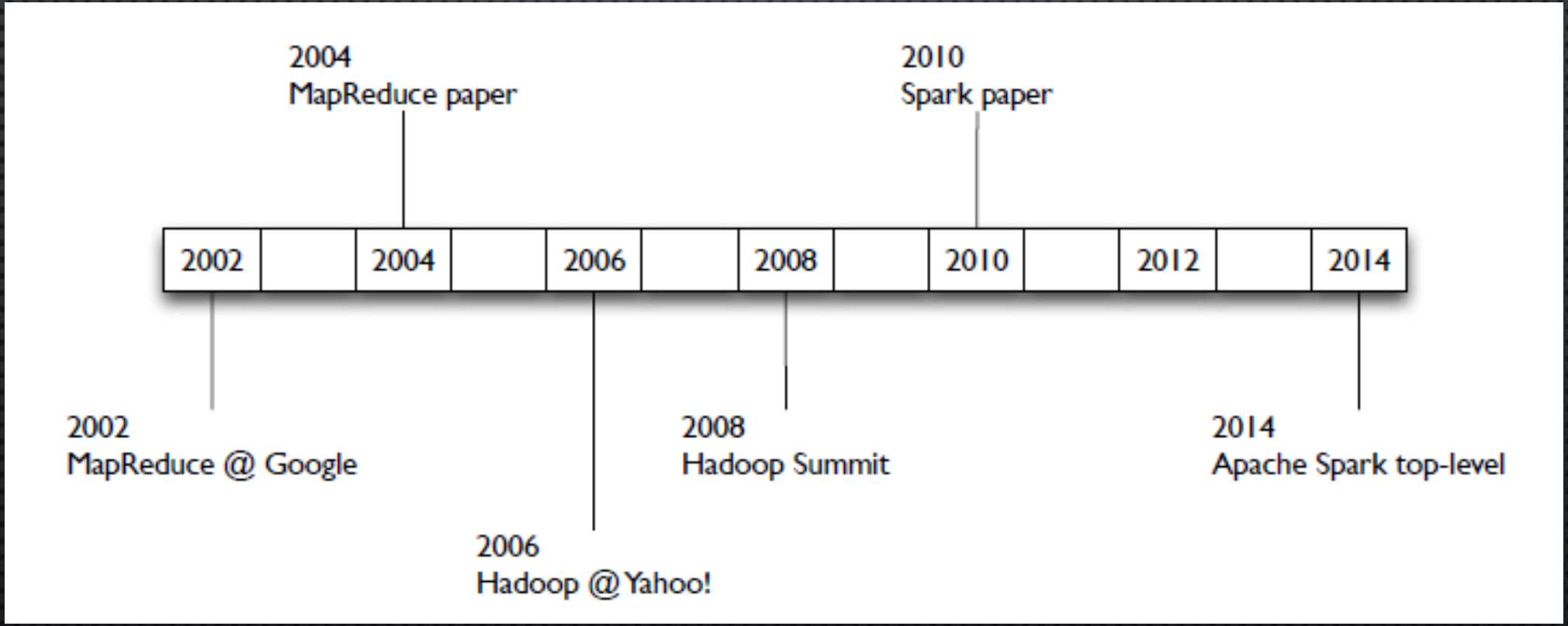
github.com/apache/spark

user@spark.apache.org

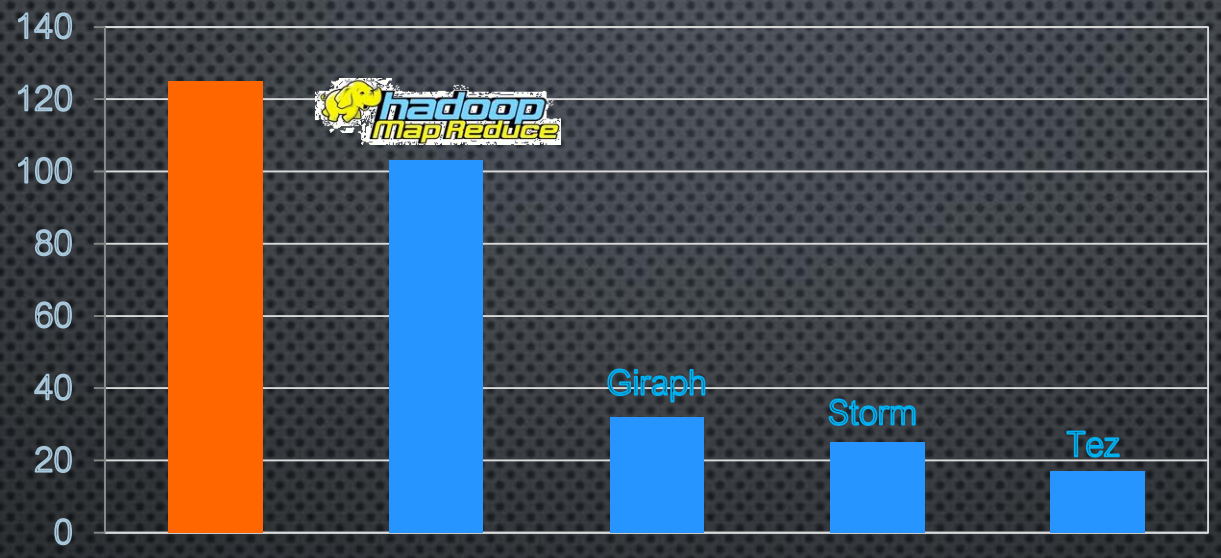
Introducing Apache Spark

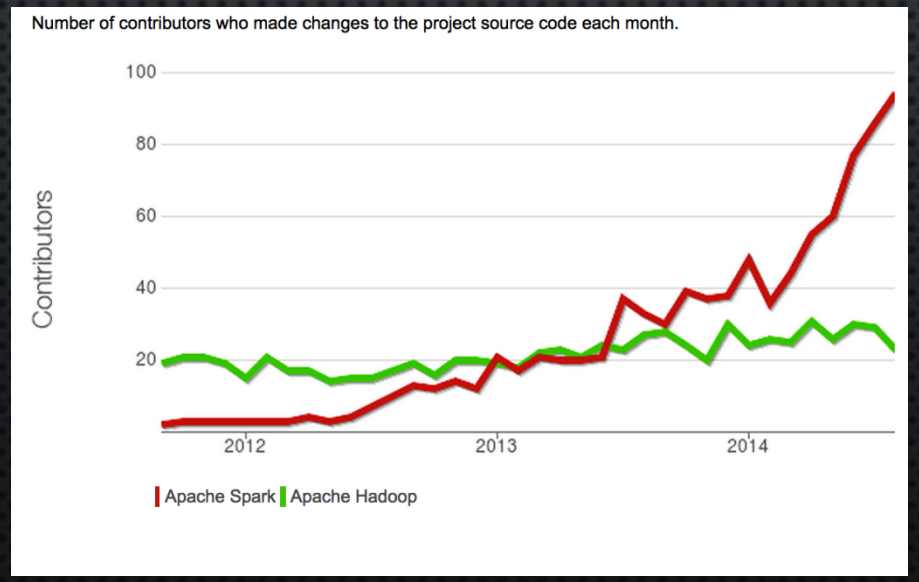
- Apache Spark is a fast and expressive cluster computing system interoperable with Apache Hadoop.
- **Written in Scala**
  - Functional programming language that runs in a JVM
- **100% Open Source**
- **Key Concepts**
  - ✓ Avoid the data bottleneck by distributing data when it is stored
  - ✓ Bring the processing to the data
  - ✓ In-memory computing capabilities deliver speed
  - ✓ General execution model supports wide variety of use cases
  - ✓ Ease of development – native APIs in Java, Scala, Python (+ SQL, Clojure, R)
  - ✓ Compatible with Hadoop's storage API's (HDFS, S3, Avro…)
  - ✓ Useful for large datasets and Iterative algorithms.
  - ✓ Up to 100x faster that Hadoop
  - ✓ Interactive Shell
  - ✓ Often 2-10× less code

Brief History



Most active open source project in Big Data





Hadoop MapReduce Issues

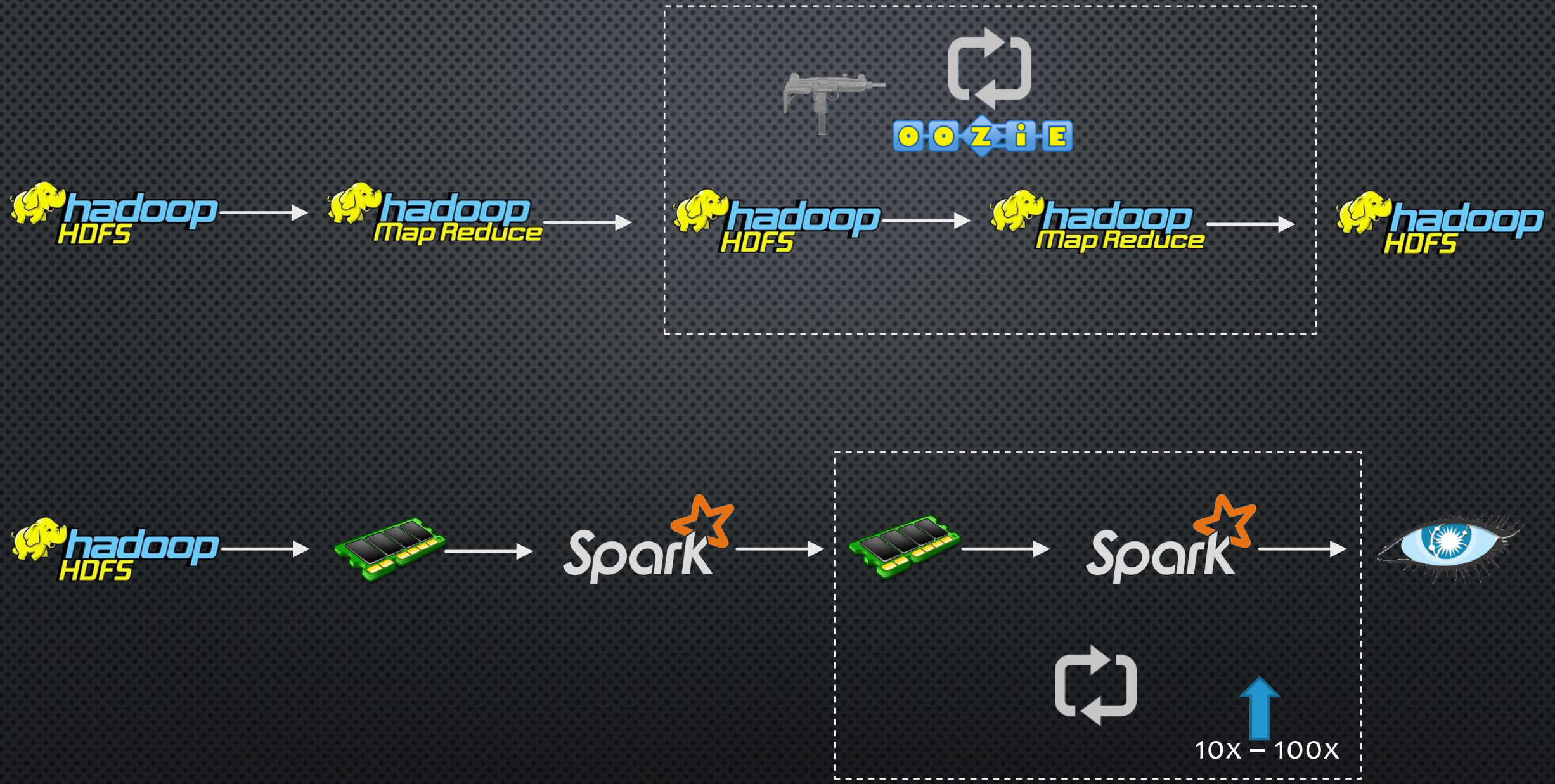
- Launching Mappers and Reducers takes time
- One MR job can rarely do a full computation
- Writing to disk (in triplicate!) between each job
- Going back to queue between jobs
- No in-memory caching
- No iterations
- Very high latency
- Not the greatest of APIs either

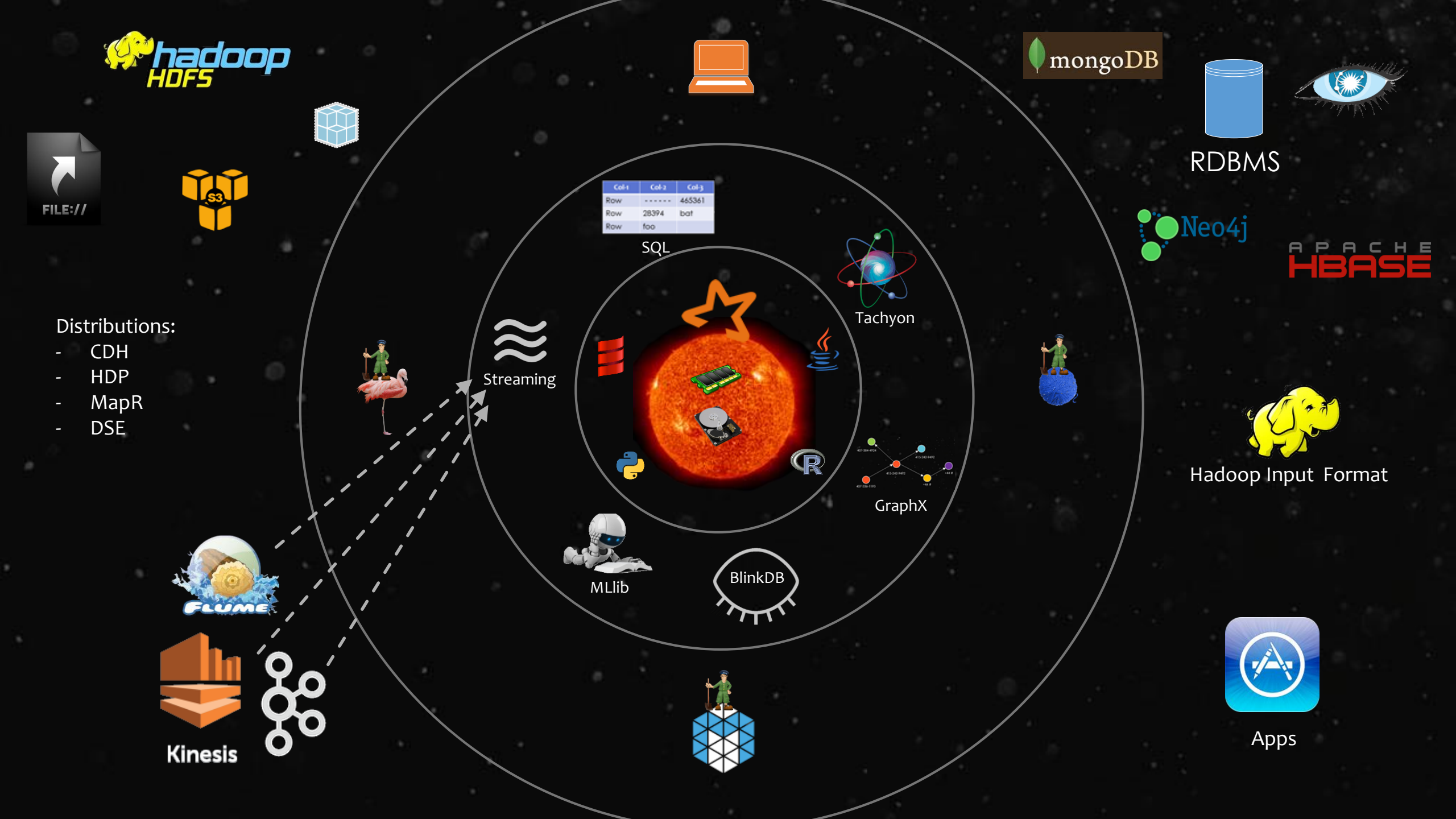
- MapReduce is dying….Hive, Pig and Mahout on Spark

https://cwiki.apache.org/confluence/display/Hive/Hive+on+Spark%3A+Getting+Started

http://blog.cloudera.com/blog/2014/09/pig-is-flying-apache-pig-on-apache-spark/

https://www.mapr.com/blog/making-mahout-fast-and-easy#.VHc1X4vF_DI


hadoop
HDFS
hadoop
Map Reduce
OOZIE
hadoop
HDFS
hadoop
Map Reduce
hadoop
HDFS
hadoop
HDFS
Spark
Spark
10x – 100x


hadoop
HDFS
FILE://
S3
mongoDB
RDBMS
Neo4j
APACHE
HBASE
Col-1 Col-2 Col-3
Row ------ 465361
Row 28394 bat
Row foo
SQL
Tachyon
Streaming
GraphX
MLlib
BlinkDB
Hadoop Input Format
Apps
FLUME
Kinesis
Distributions:
- CDH
- HDP
- MapR
- DSE

What it means to users?

Spark:

Interactive analysis

HDFS

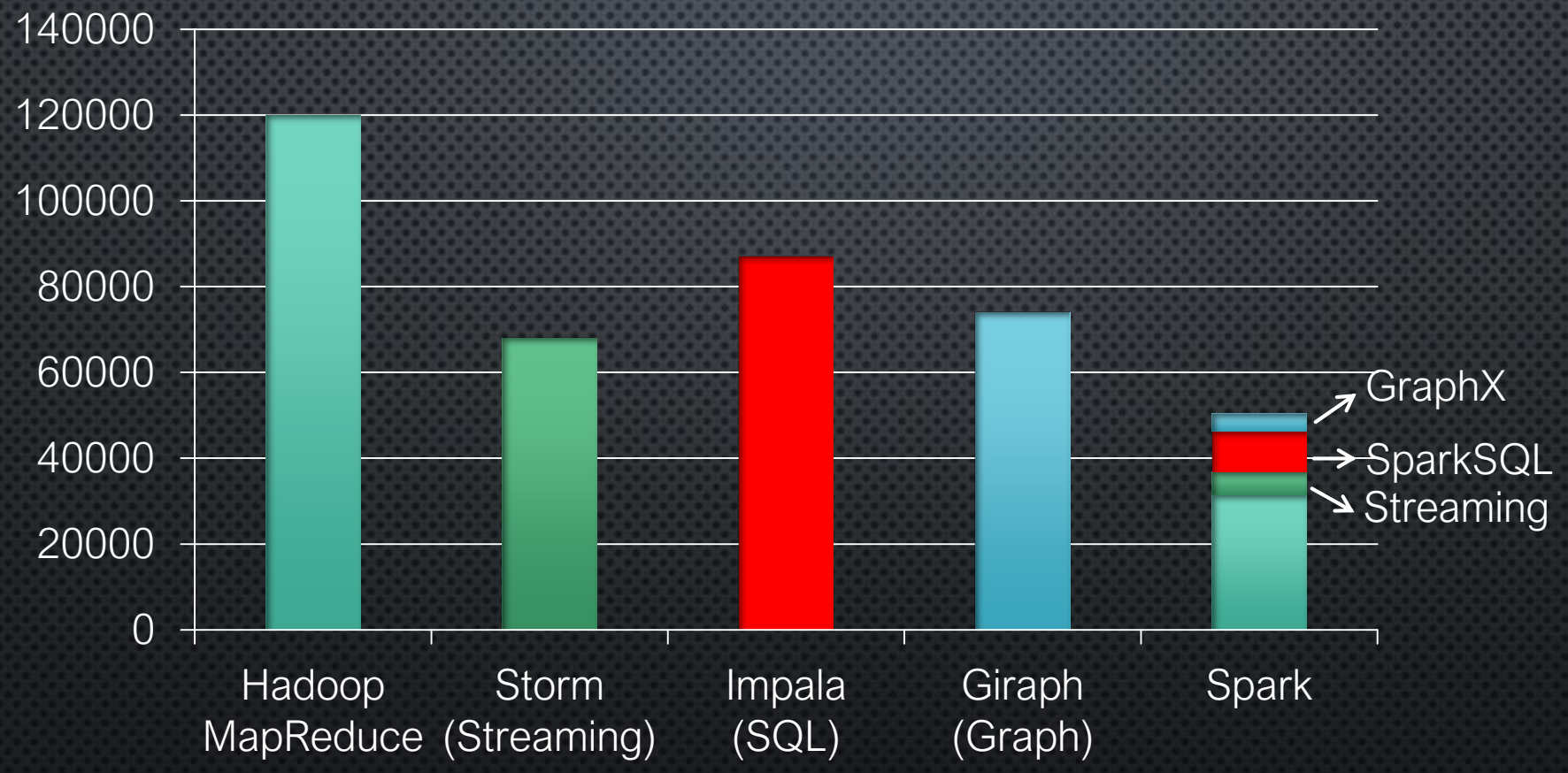
Combine Processing Types…

```
val points = sqlContext.sql(
  “SELECT latitude, longitude FROM historic_tweets”)

val model = KMeans.train(points, 10)

sc.twitterStream(...)
   .map(t => (model.closestCenter(t.location), 1))
   .reduceByWindow(“5s”, _ + _)
```

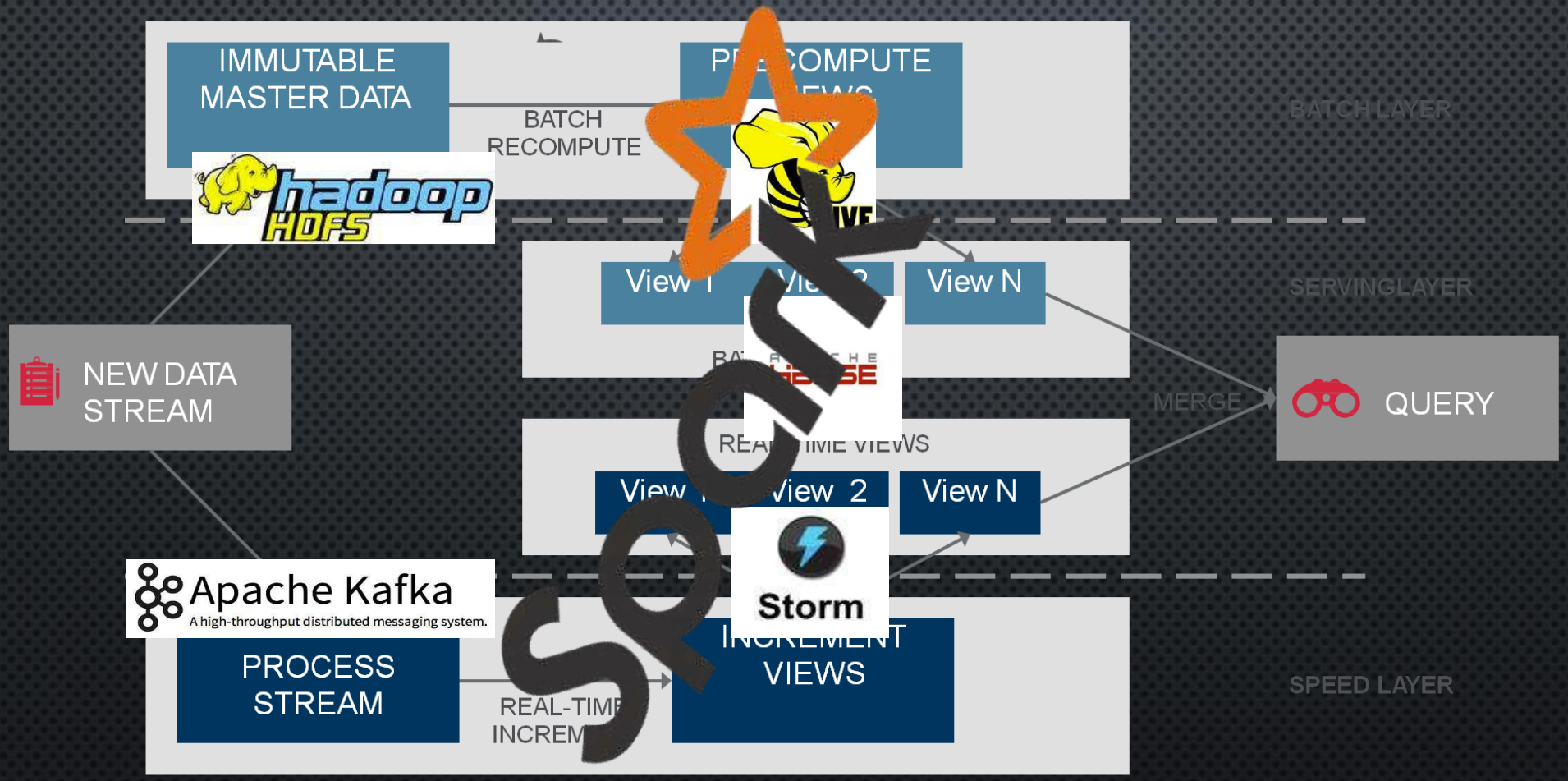
Benefits of Unification

- No need for copying or ETL of data between systems
- Combines processing types in one program
- Code reuse
- One system to learn
- One system to maintain

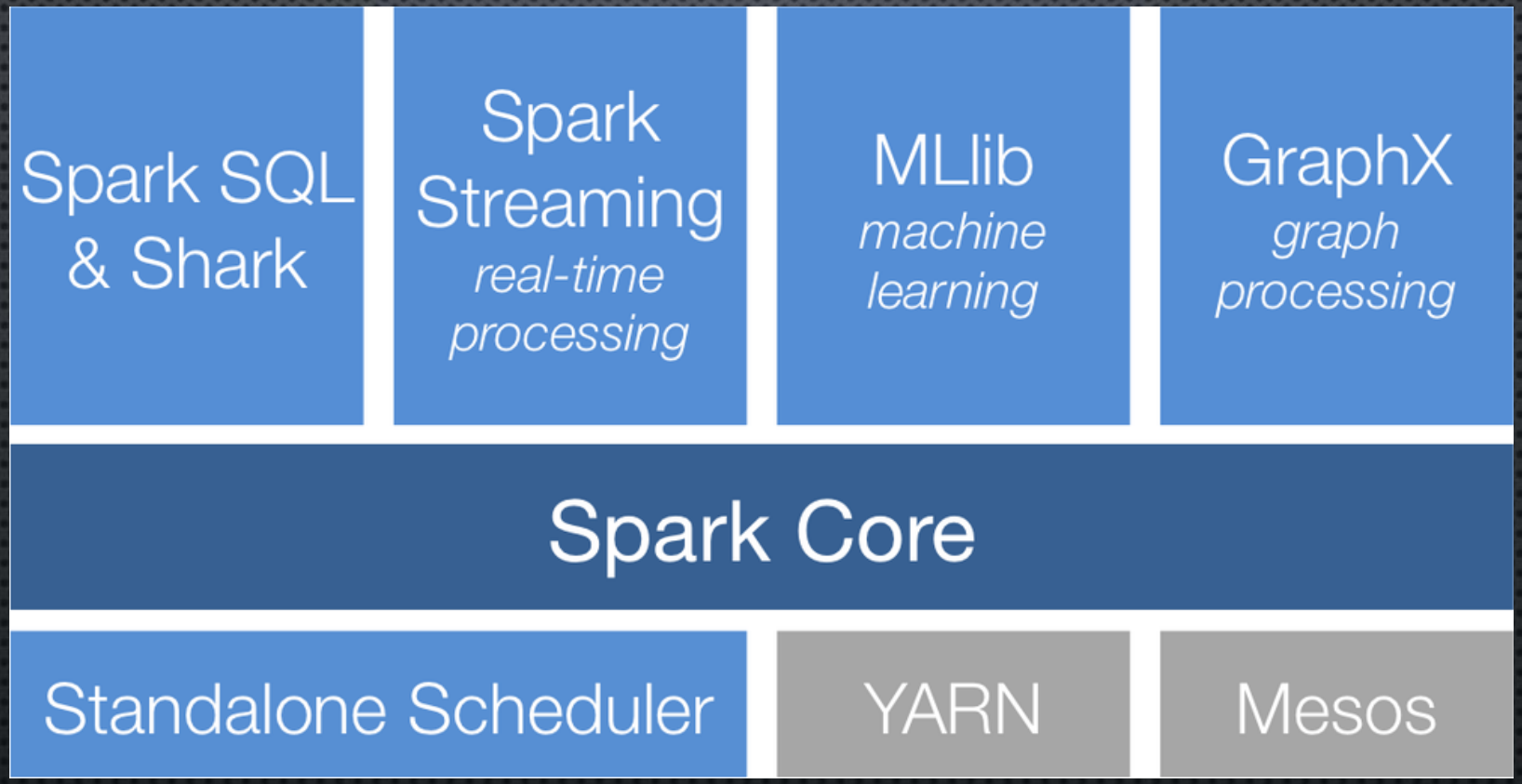
Benefits of Unification : Code Size



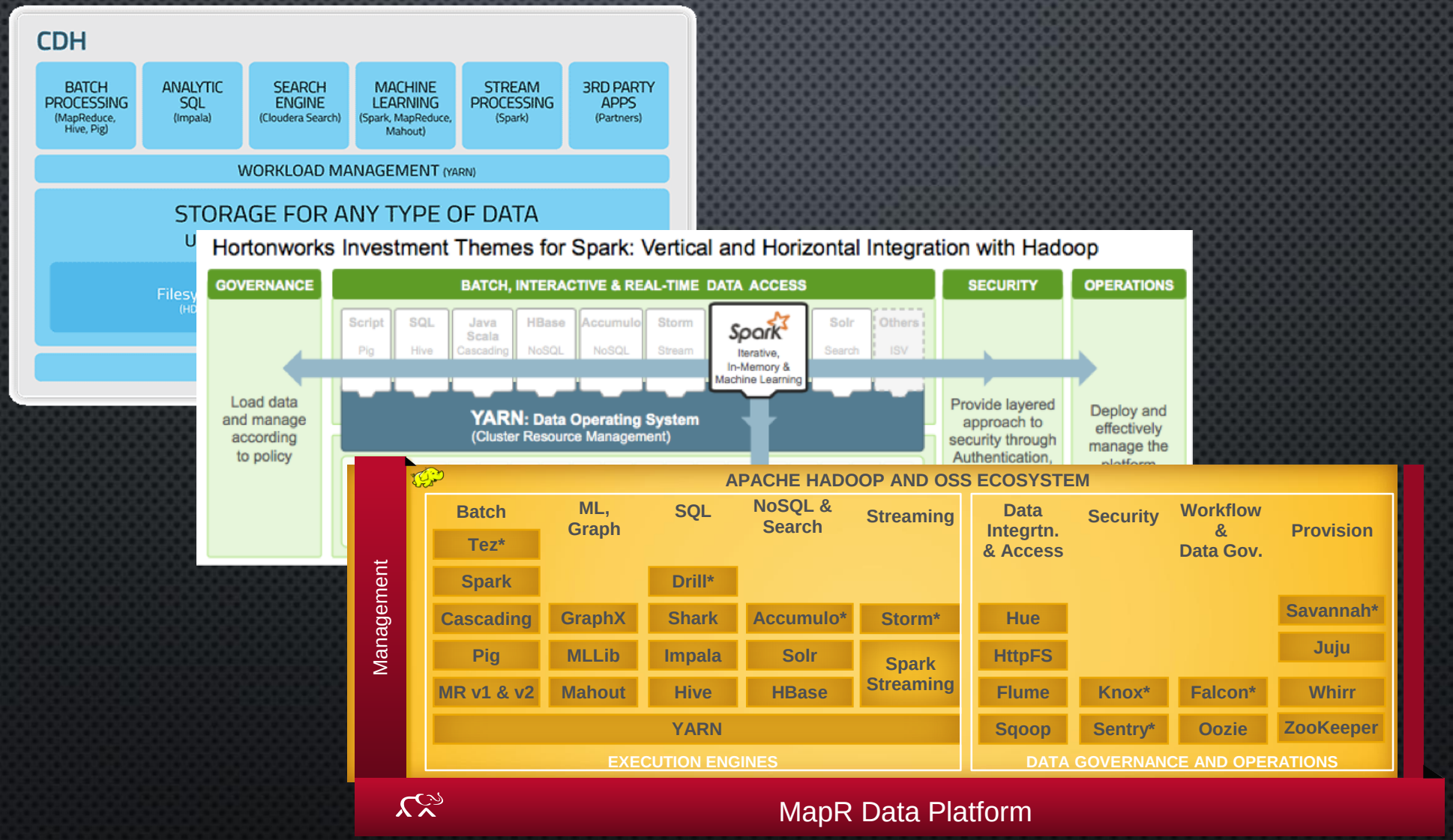
Building Lambda Architecture with Spark



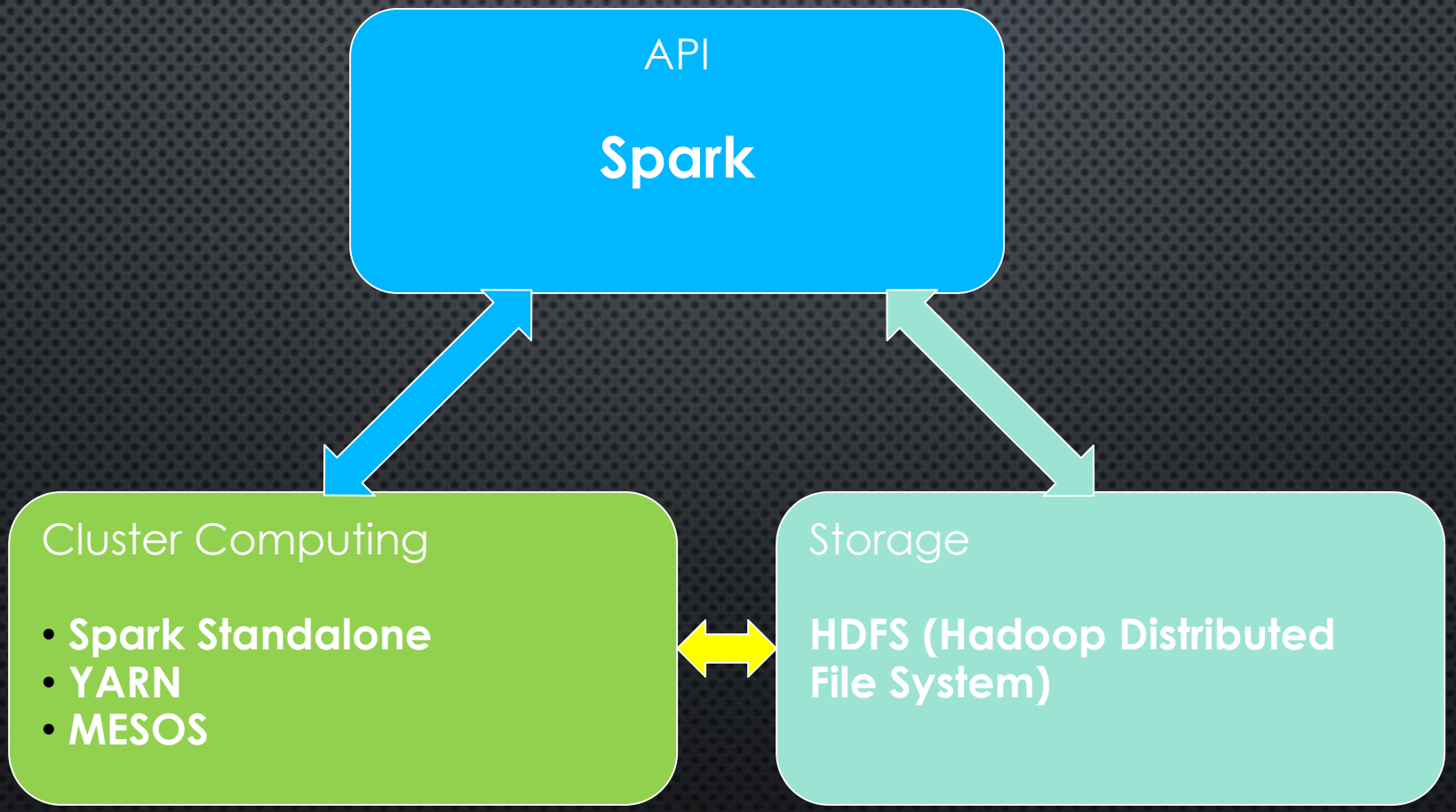
Spark Deployment Options



Spark on Hadoop Distributions



Distributed processing framework with Spark



Spark Advantages

- Easier APIs
- Python, Scala, Java

EASE OF DEVELOPMENT

IN-MEMORY PERFORMANCE

- RDDs
- DAGs Unify Processing

- SQL, ML, Streaming, Graph and Batch

COMBINE WORKFLOWS

Hadoop Advantages

UNLIMITED SCALE

- Multiple data sources
- Multiple applications
- Multiple users

ENTERPRISE PLATFORM

- Reliability
- Multi-tenancy
- Security

WIDE RANGE OF APPLICATIONS

- Files
- Databases
- Semi-structured

Hadoop + Spark Advantages

UNLIMITED SCALE

EASE OF DEVELOPMENT

IN-MEMORY PERFORMANCE

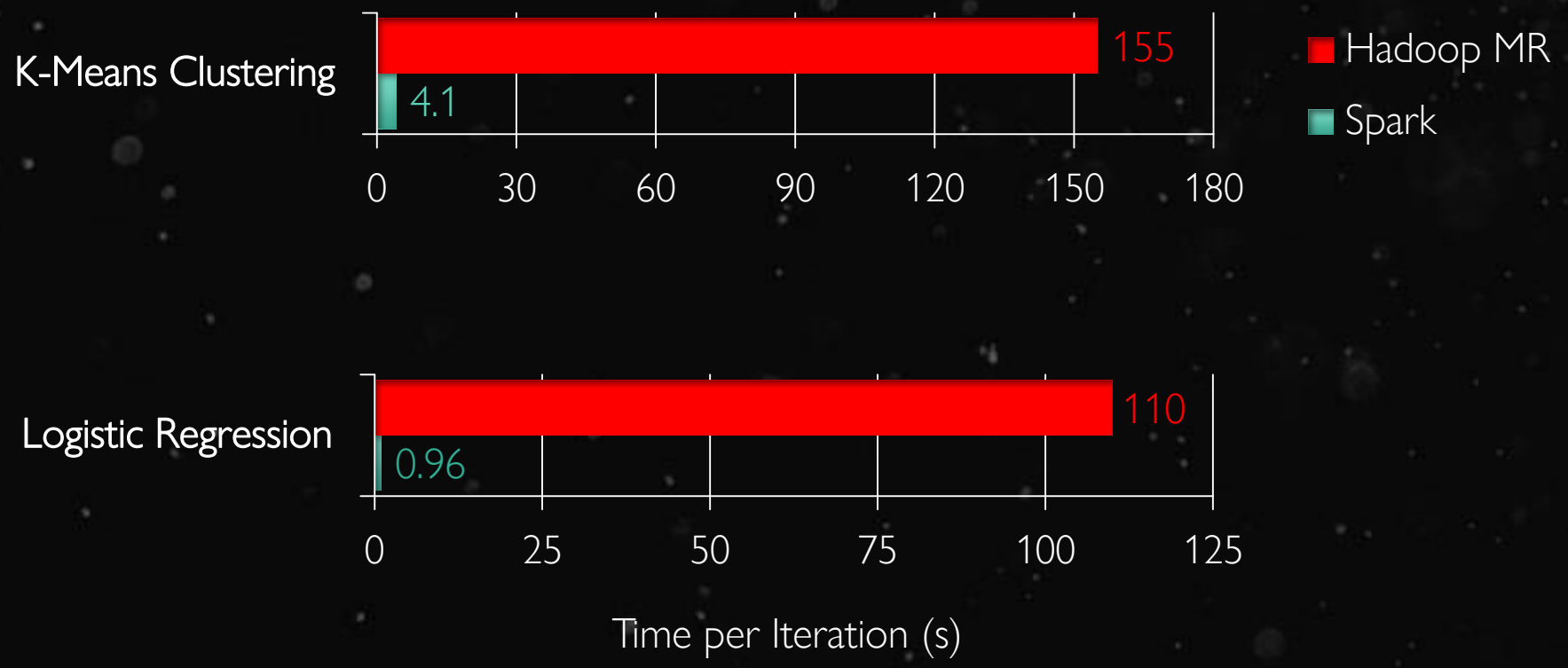
ENTERPRISE PLATFORM

WIDE RANGE OF APPLICATIONS

COMBINE WORKFLOWS

Operational Applications Augmented by In-Memory Performance

SPARK IS IN-MEMORY AND FAST



SPARK IS IN-MEMORY AND FAST

2013 Record: Hadoop

2100 machines

72 minutes

2014 Record: Spark

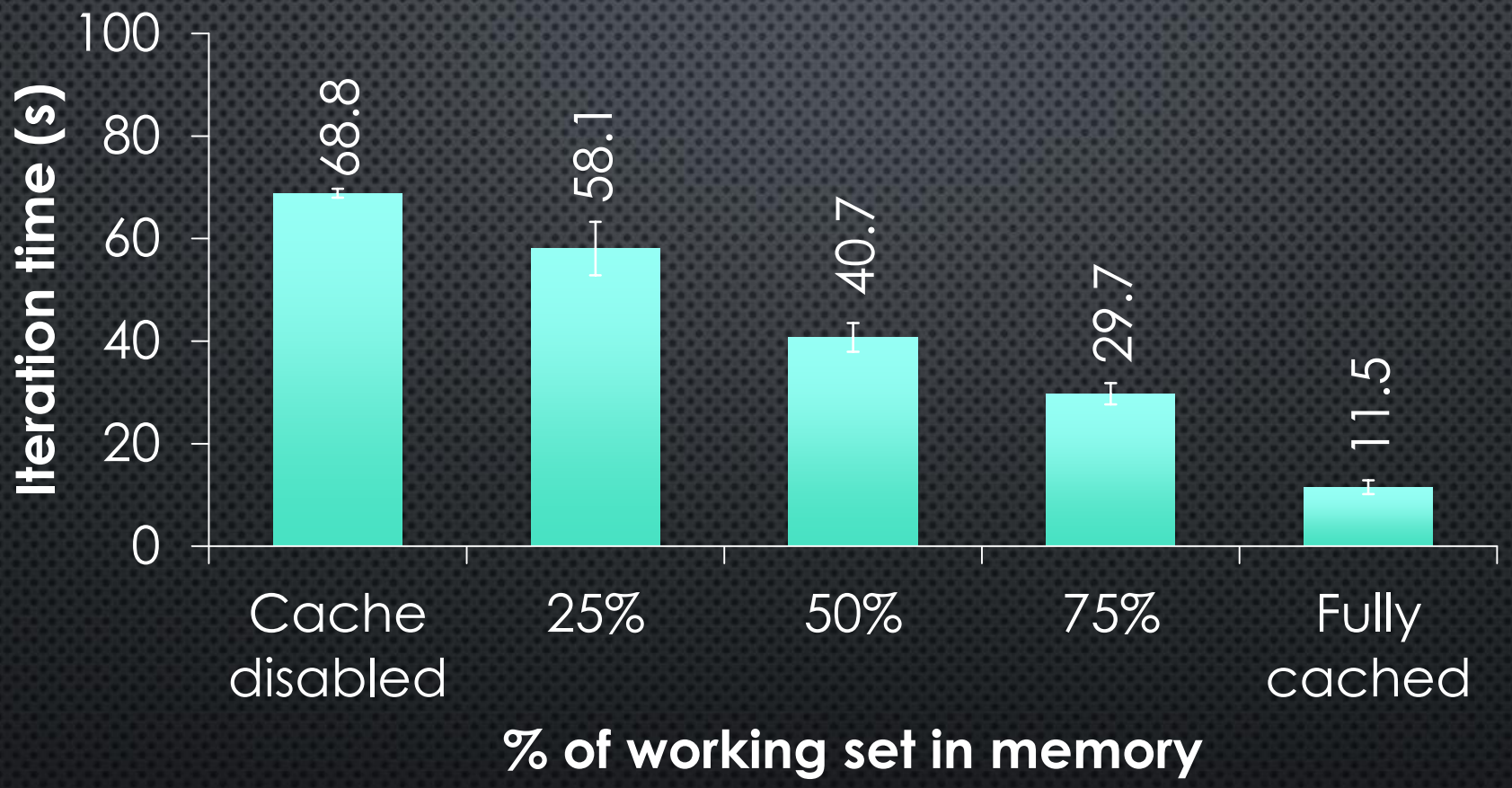
207 machines

23 minutes

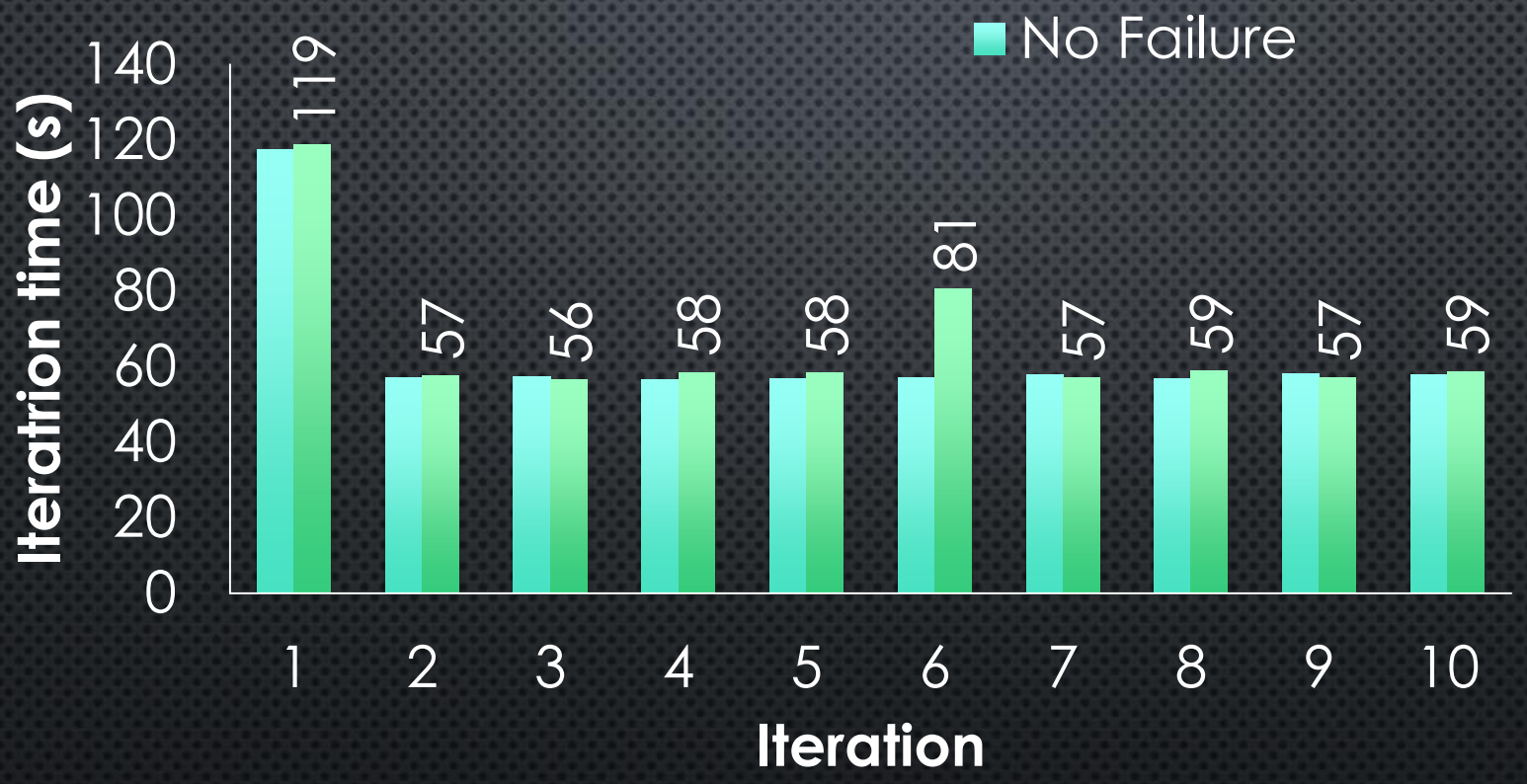
Also sorted 1PB in 4 hours

Source: Daytona GraySort benchmark, sortbenchmark.org

Not Enough RAM? – No Problem



Fault Recovery Results



Resources

Download and Documentation: https://spark.apache.org/

Slides/Videos: http://spark-summit.org/2013 http://spark-summit.org/2014

Source Code and examples : https://github.com/apache/spark/

Books: Learning Spark, Spark in Action and Fast Data Processing with Spark

Databricks Developer Resources: https://databricks.com/spark/developer-resources

Mailing List: **user@spark.apache.org**

MOOCs: **https://databricks.com/blog/2014/12/02/announcing-two-spark-based-moocs.html**

Events and Meetups: **https://spark.apache.org/community.html**

Spark Packages

spark-packages.org

Spark Packages

Feedback Register a package Login Find a package

A community index of packages for Apache Spark.

33 packages

databricks/spark-avro

Integration utilities for using Spark with Apache Avro data

@pwendell / Latest release: 0.1 (11/27/14) / Apache-2.0 / (5)

3 sql 3 input 2 library

dibbhatt/kafka-spark-consumer

Low Level Kafka-Spark Consumer

@dibbhatt / No release yet / (3)

2 streaming 1 kafka

sigmoidanalytics/spork

Pig on Apache Spark

Spark Packages is a community site hosting modules that are not part of Apache Spark. Your use of and access to this site is subject to the terms of use.
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NEW

Conclusions

- Big data will be standard: everyone will have it
- Organizations will gain an edge through speed of action and sophistication of analysis
- Apache Spark brings these to Hadoop clusters