Next-Gen Big Data Analytics using the Spark stack

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Agenda

Overview

- Apache Spark stack
- Next-gen big data analytics
- Our vision and efforts

Highlights of our work on Spark stack

- Reliability of Spark Streaming
- SQL processing on Spark
- Spark Stream-SQL
- Tachyon hierarchical storage
- Analytics & SparkR
- …

Next-Gen Big Data Analytics

Volume

- Massive scale & exponential growth

Variety

- Multi-structured, diverse sources & inconsistent schemas

Value

- Simple (SQL) – descriptive analytics
- Complex (non-SQL) – predictive analytics

Velocity

- Interactive – the speed of thought
- Streaming/online – drinking from the firehose

The Spark stack

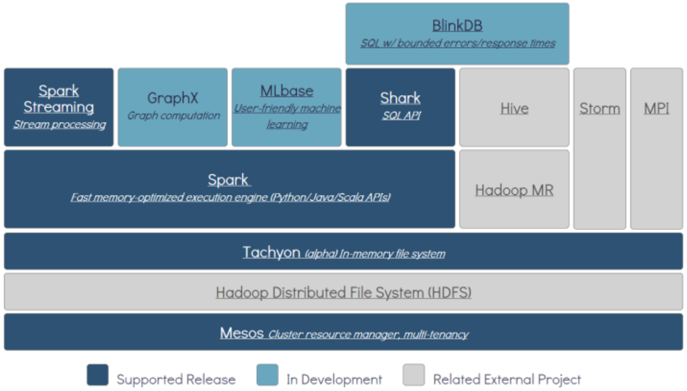
Project Overview

Research & open source projects initiated by AMPLab in UC Berkeley

Intel closely collaborating with AMPLab & community on open source development

- Started in 2012 when still a research project
- Intel among top 3 Spark contributors
  - Multiple Intel committers since the start of the project
  - Many critical contributions
    - Netty based shuffle, FairScheduler, metrics system, “yarn-client” mode, …

BDAS: Berkeley Data Analytics Stack
(Ref: https://amplab.cs.berkeley.edu/software/)


BlinkDB
SQL w/ bounded errors/response times
Spark Streaming
Stream processing
GraphX
Graph computation
MLbase
User-friendly machine learning
Shark
SQL API
Hive
Storm
MPI
Spark
Fast memory-optimized execution engine (Python/Java/Scala APIs)
Hadoop MR
Tachyon (alpha) In-memory file system
Hadoop Distributed File System (HDFS)
Mesos Cluster resource manager, multi-tenancy
Supported Release
In Development
Related External Project

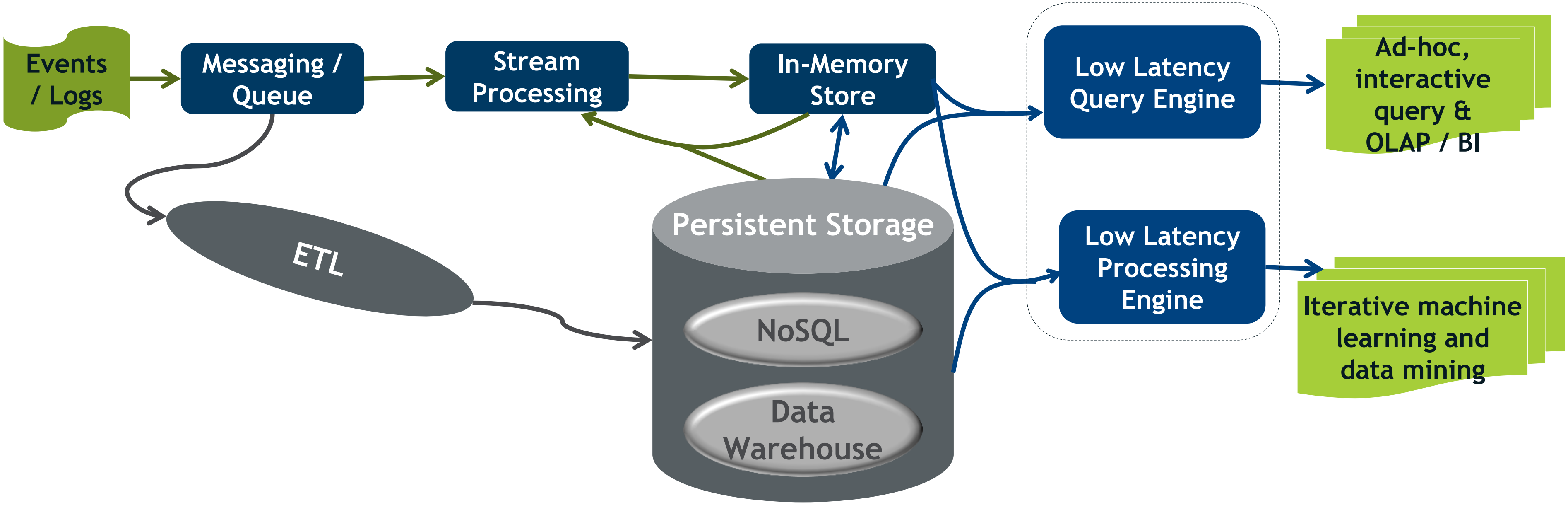
Continuous collaborations with AMPLab on new innovations in BDAS

- Major industry partners for Tachyon, GraphX & other machine learning efforts

Next Generations of Big Data Analytics

Next-gen big data analytics paradigm

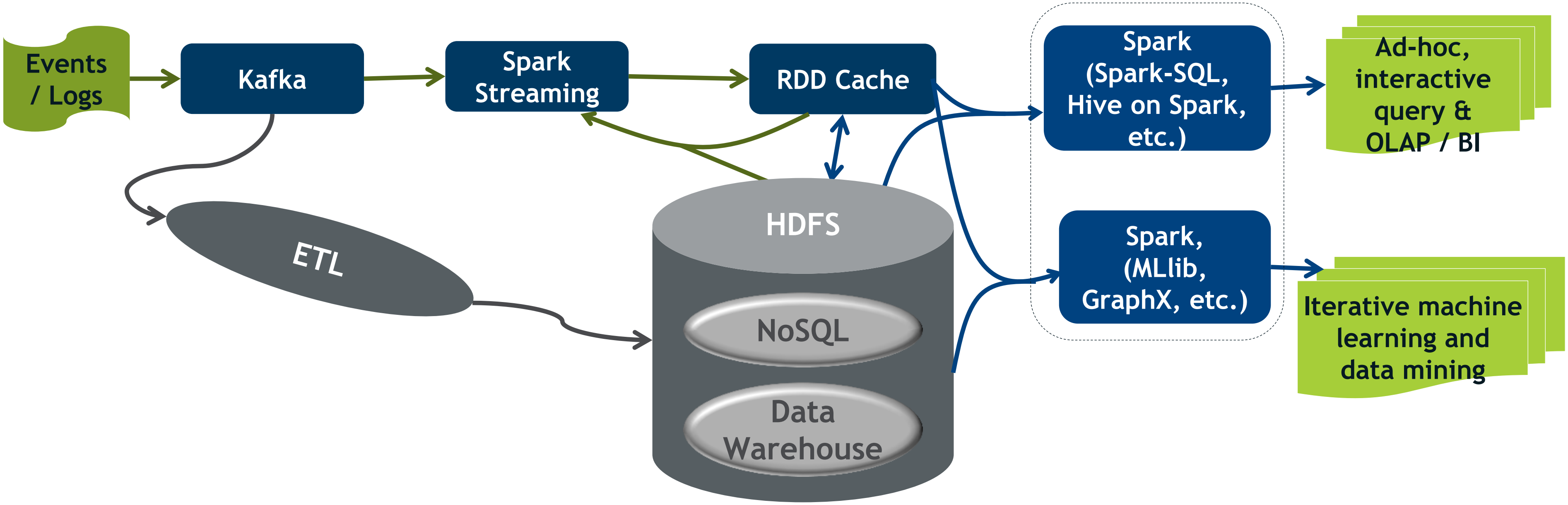
- Data captured & processed in a (semi-) real-time / streaming fashion
- Data mined using SQL queries as well as large-scale advanced analytics (e.g., machine learning, graph analysis, etc.)
- Interactive and iterative computations leveraging distributed in-memory data cache



Next-Gen Big Data Analytics using the Spark stack

Build next-gen Big Data analytics with the Spark stack

- *Analysis on streaming data*: “real-time” decisions
- *Interactive analysis*: faster decisions
- *Advanced analytics*: “better” decisions


Events / Logs
Kafka
Spark Streaming
RDD Cache
Spark (Spark-SQL, Hive on Spark, etc.)
Ad-hoc, interactive query & OLAP / BI
ETL
HDFS
NoSQL
Data Warehouse
Spark, (MLlib, GraphX, etc.)
Iterative machine learning and data mining

For more details, see our talk “*Real-Time Analytical Processing (RTAP) using Spark and Shark*” at Strata Conference + Hadoop World NYC 2013

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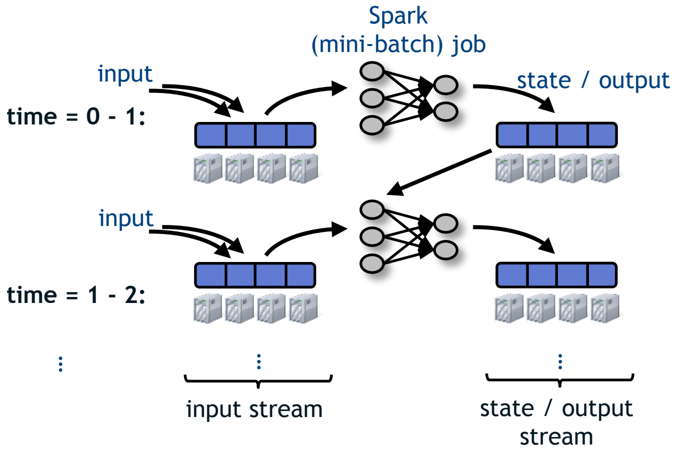
Spark Streaming

Spark Streaming: discrete stream (DStream)

- Run streaming computation as a series of very small, deterministic (mini-batch) Spark jobs
  - As frequent as ~1/2 second
- Better fault tolerance, straggler handling & state consistency



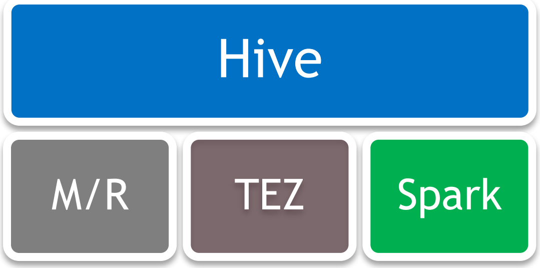
High reliability of Spark Streaming

- Collaborations between Databricks, Cloudera and Intel
- Improving Spark driver reliability through WAL
  - https://issues.apache.org/jira/browse/SPARK-3129
- Improving Kafka receiver reliability by better managing Kafka offset tacking & WAL operations
  - https://issues.apache.org/jira/browse/SPARK-4062

SQL Processing on Spark: Hive on Spark

Hive on Spark

- Spark as a new execution engine for Hive
- Combine the strength of Hive and Spark
  - Support full Hive feature set
  - Utilize Spark as the powerful execution engine, greatly boost SQL performance
- Smooth migration for existing Hive users



Community efforts

- https://issues.apache.org/jira/browse/HIVE-7292
- Collaborations among Cloudera, Intel, MapR, Databricks, IBM, etc.
- Current plan
  - Merge back to Hive trunk in February 2015
  - Community Beta release in 1H’2015

SQL Processing on Spark: Spark SQL

Spark SQL

- Structured data analysis using SQL queries on Spark
  - Hive tables, Parquet files, etc.
- Integration with analytics pipelines

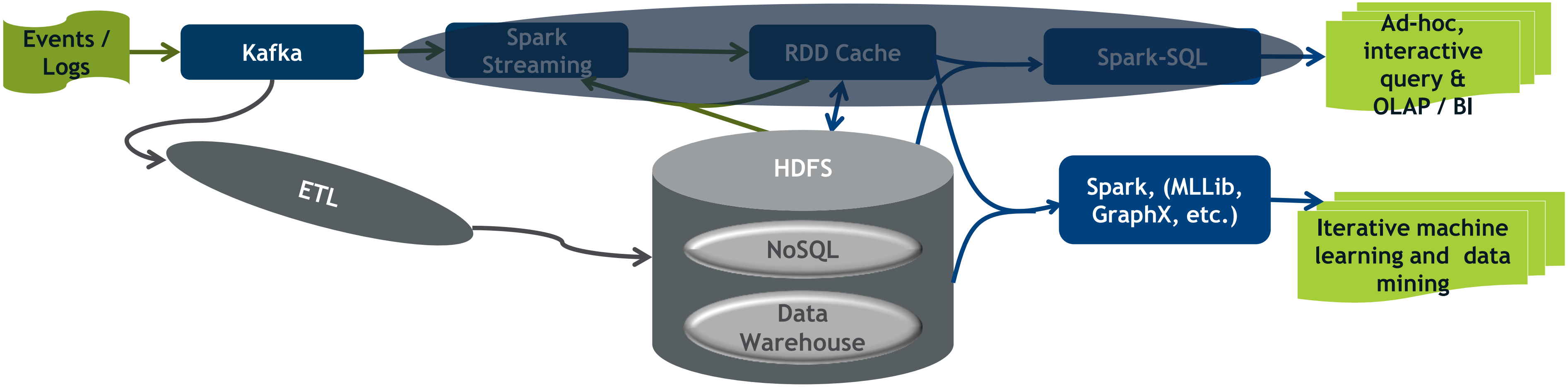
Intel’s efforts

- Functionalities (e.g., HiveQL compatibility)
  - Data types (Timestamp, Date, Union, etc.)
  - GroupingSet/ROLLUP/CUBE (https://issues.apache.org/jira/browse/SPARK-2663)
  - …
- Performance (esp. complex queries)
  - Join performance (https://issues.apache.org/jira/browse/SPARK-2211)
  - Aggregation performance (https://issues.apache.org/jira/browse/SPARK-4366)
  - Hive UDF performance (https://issues.apache.org/jira/browse/SPARK-4093)
  - …

Spark Stream-SQL: SQL + Streaming

Spark Stream-SQL

- Processing and analyzing input data stream (potentially combined with history/reference data) using SQL queries
- Built on top of Spark Streaming and Spark SQL frameworks



Events / Logs
Kafka
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Iterative machine learning and data mining

```
CREATE STREAM IF NOT EXISTS people_stream1 (name STRING, age INT)
STORED AS LOCATION 'kafka://…';

CREATE STREAM IF NOT EXISTS people_stream2 (name STRING, zipcode INT)
STORED AS LOCATION 'kafka://…';

SELECT zipcode, AVG(age)
FROM people_stream1 JOIN people_stream2 ON people_stream1.name = people_stream2.name
GROUPBY zipcode;
```

Spark Stream-SQL: SQL + Streaming

Open sourced under Apache 2.0 license

- https://github.com/intel-spark/stream-sql
- Developer preview (based on Spark 0.7) available

Currently under active development

- An update based on latest Spark version will be available soon
- Many more features & optimizations are being added
- Plan to contribute back to the main Spark project

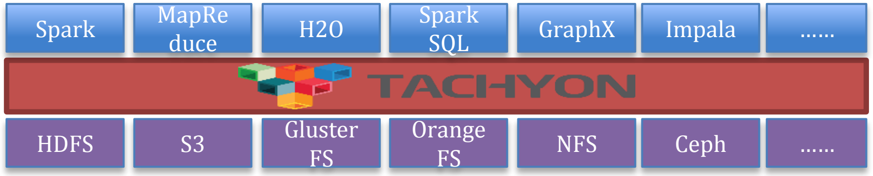
Welcome Collaboration!

Tachyon Hierarchical Storage

Tachyon

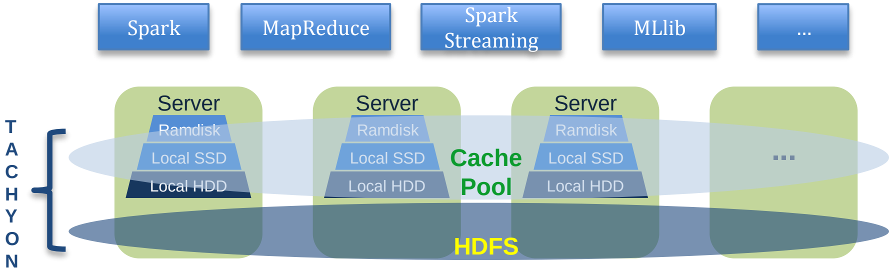
- Distributed, reliable in-memory file system unifying different underlying storage systems
  - Memory across different servers organized as a cache pool for memory-speed data sharing

(Source: http://www.slideshare.net/haoyuanli/tachyon20141121ampcamp5-41881671)



Tachyon hierarchical storage

- The cache pool manages multiple storage tiers for memory-speed data sharing
  - Efficient support for flash/SSD, cloud, and/or HPC environment
- Currently under active development
  - https://tachyon.atlassian.net/browse/TACHYON-33
- Will be available soon in Tachyon 0.6 release
  - https://github.com/amplab/tachyon



Analytics & SparkR

SparkR

- Distributed R frontend for analytics on Spark
  - RDD → Distributed list in R
- Alpha developer release from UC Berkeley
  - https://github.com/amplab-extras/SparkR-pkg

Our efforts/plans

- Complete SparkR RDD APIs
- Analytics performance improvements
- Better integrations of SparkR and Spark analytics frameworks
  - MLlib, GraphX, etc.
- Distributed DataFrame support
  - Leveraging Spark SQL (SchmeRDD, optimizer, etc.)

Summary

Driving next generations of Big Data Analytics with Spark Stack

- *Analysis on streaming data*: “real-time” decisions
- *Interactive analysis*: faster decisions
- *Advanced analytics*: “better” decisions

Partnering with open source community

- BDAS (Berkeley Data Analytics Stack)
- Apache Spark project
- Tachyon project
- SparkR project
- …

Welcome Collaboration!

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