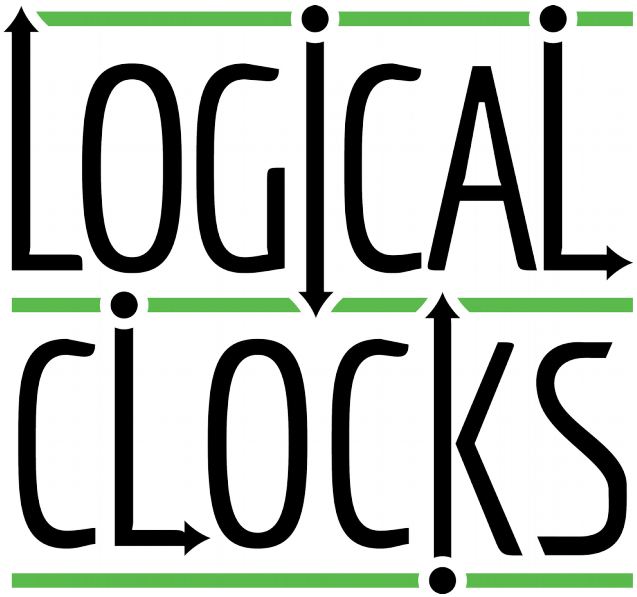
Hops

@hopshadoop

http://github.com/hopshadoop

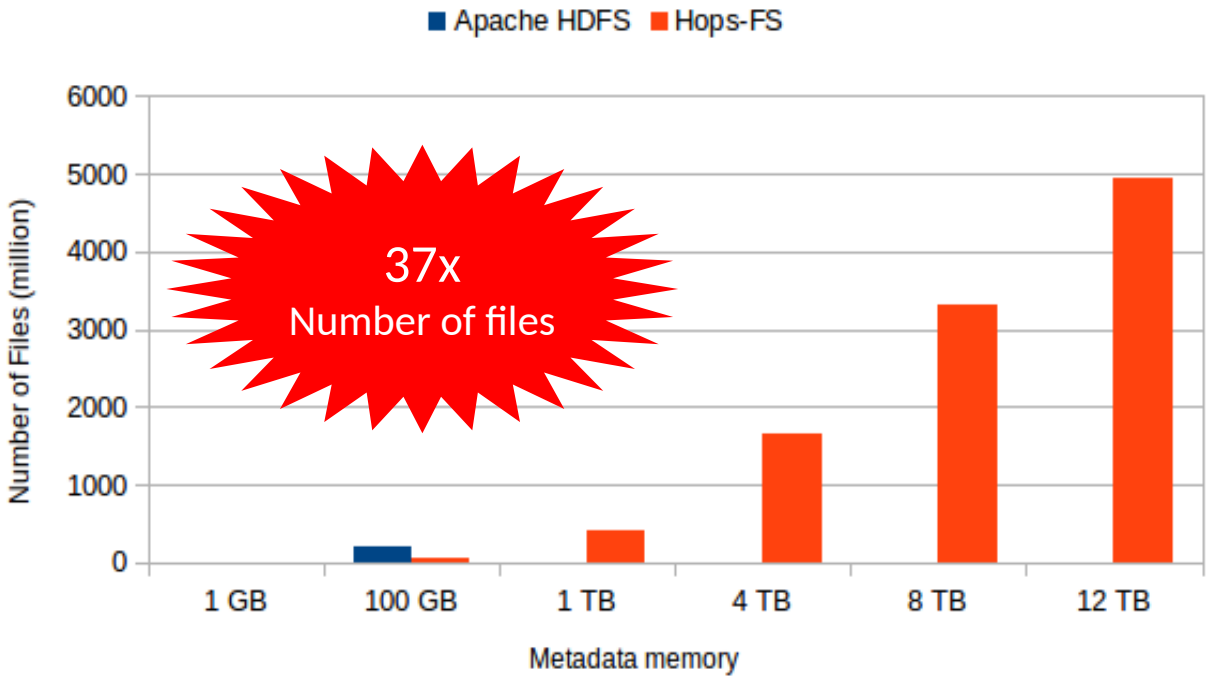
http://www.hops.io

Hopsworks: Secure Spark/Flink/Kafka-as-a-Service

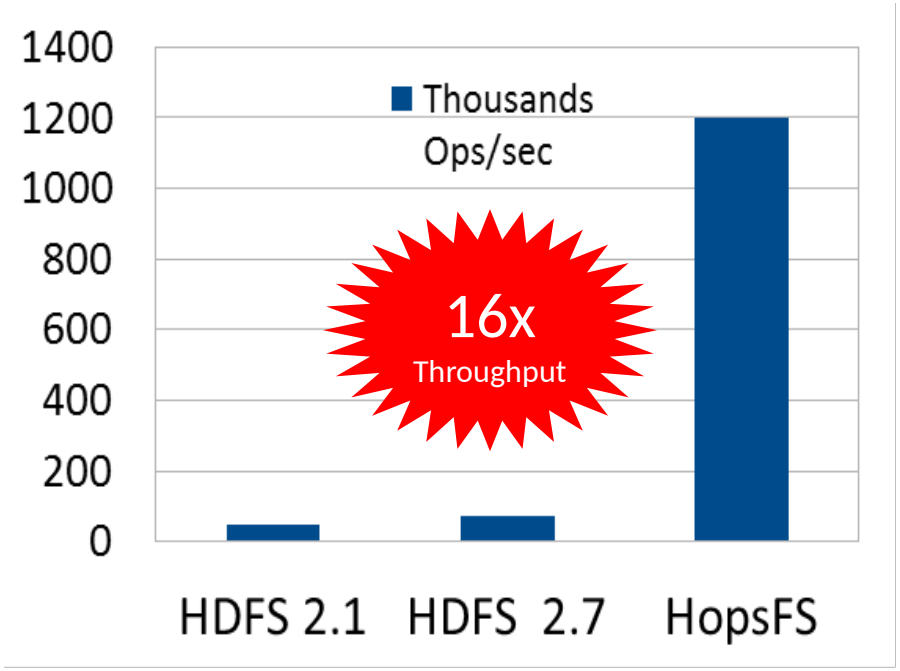


Jim Dowling
Associate Prof @ KTH
CEO @ Logical Clocks AB

HopsFS: Next Generation HDFS*



Bigger



Faster

IEEE Scale Challenge Winner (2017)

*https://www.usenix.org/conference/fast17/technical-sessions/presentation/niazi

Streaming-as-a-Service in Sweden

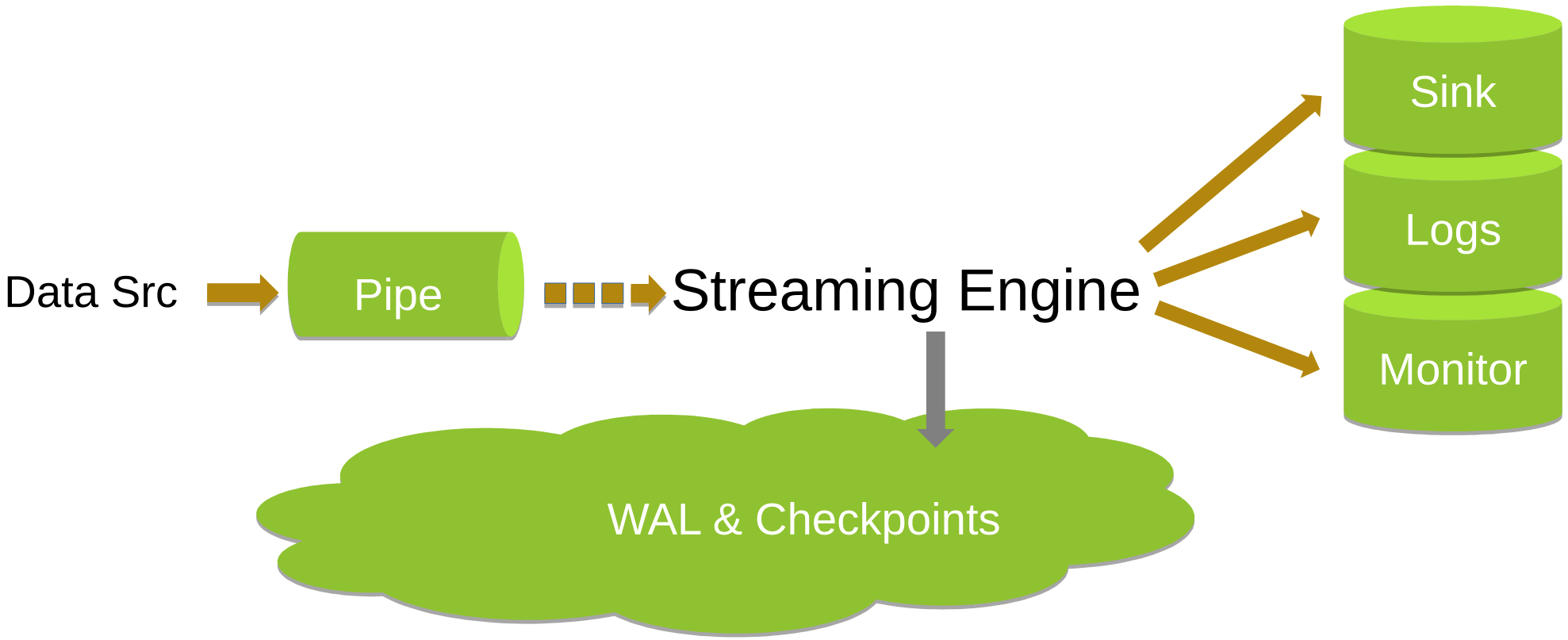
- **SICS ICE**
  - Datacenter research environment
- **Hopsworks**
  Spark/Flink/Kafka/Tensorflow-as-a-Service
  - Built on HopsFS/YARN
  - >150 active users

RI.SE

LULEÅ TEKNISKA UNIVERSITET

Self-Service Streaming-as-a-Service

Basic Services needed for Stream Processing



Smoking Self-Service Streaming

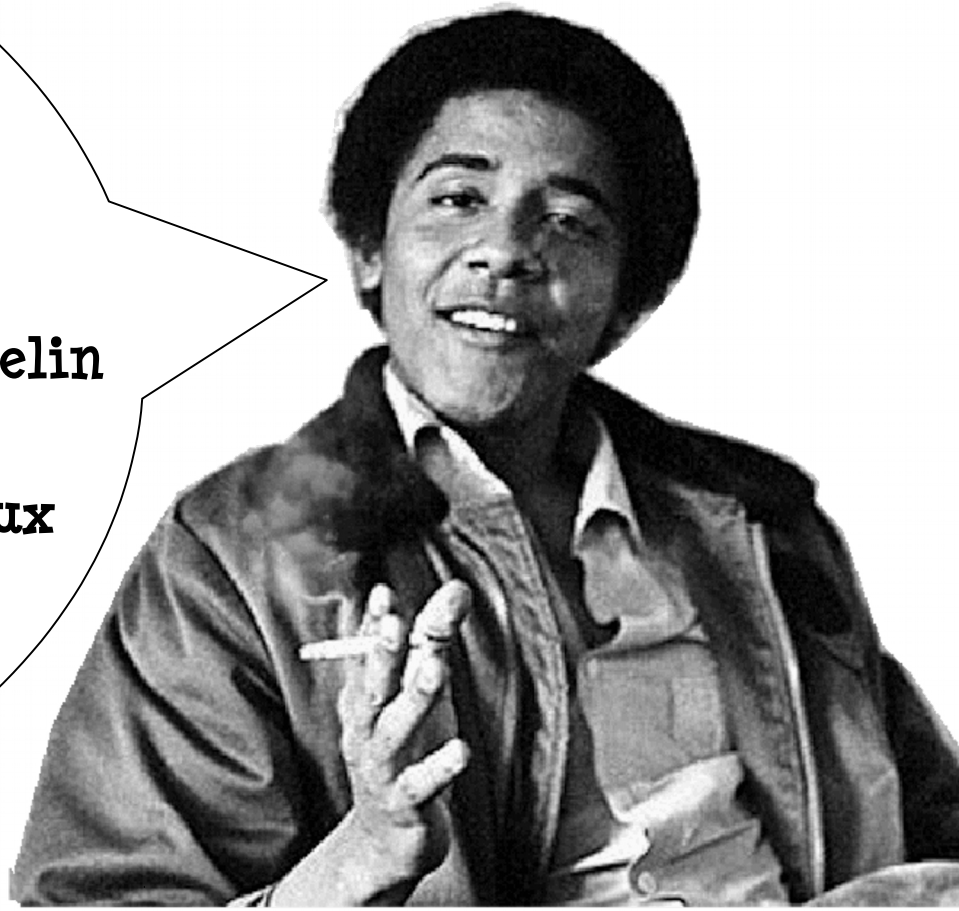
A **pipe** for my data: **Kafka**

A **cloud** for my smoke: **Hops Hadoop**

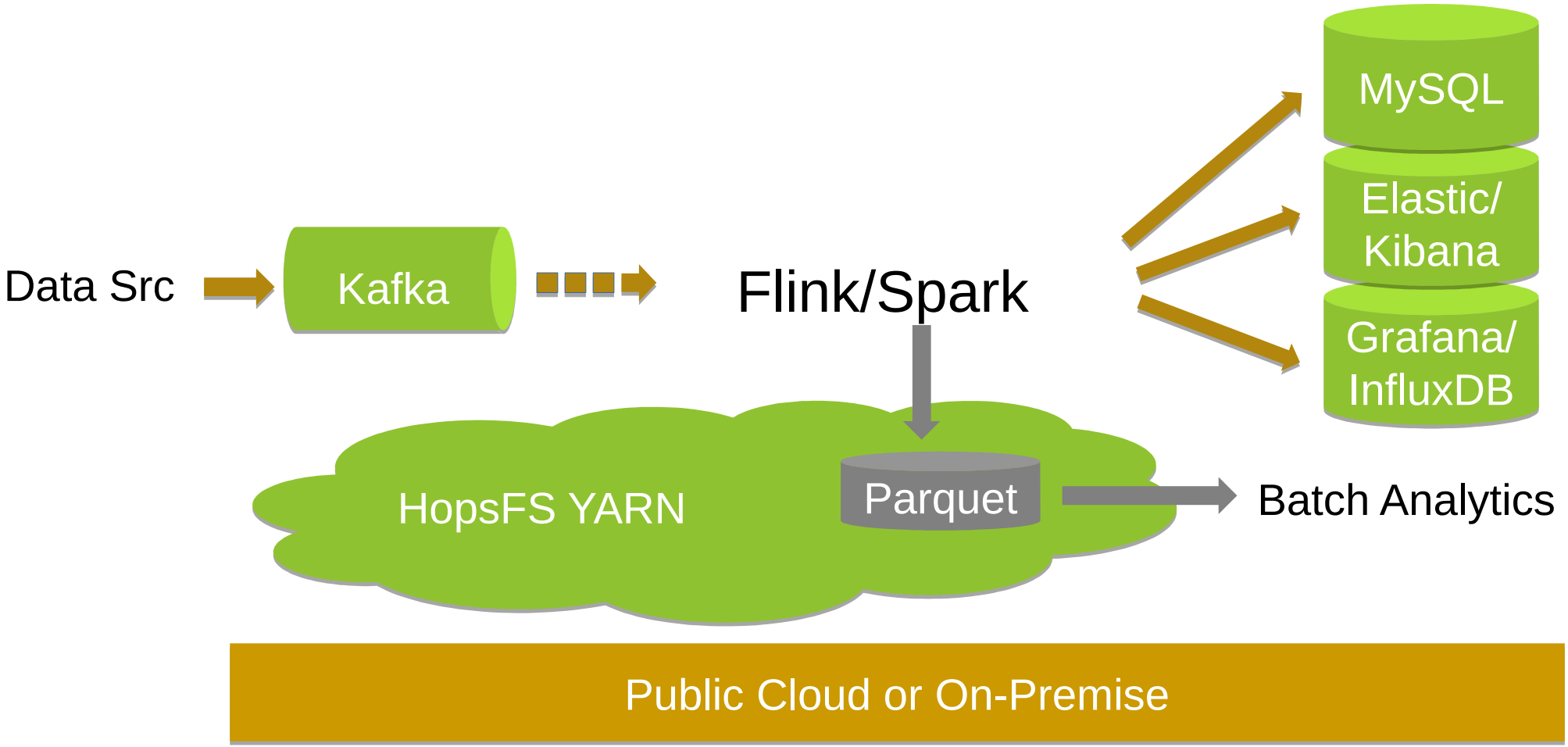
A way to **roll** A/B tests: **Jupyter/Zeppelin**

A **lookout** for trouble: **Grafana/Influx**

A **log** with evidence: **ELK Stack**



Hopsworks

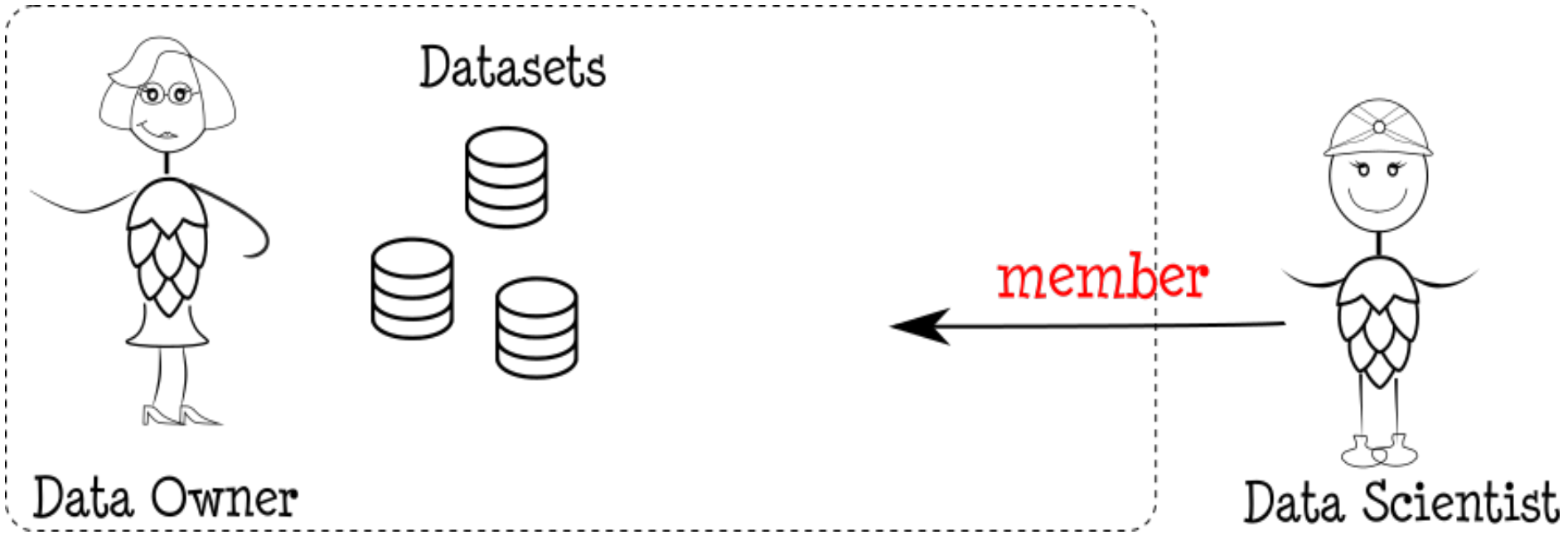

Data Src
Kafka
Flink/Spark
MySQL
Elastic/
Kibana
Grafana/
InfluxDB
HopsFS YARN
Parquet
Batch Analytics
Public Cloud or On-Premise

General Data Protection Regulation (GDPR)

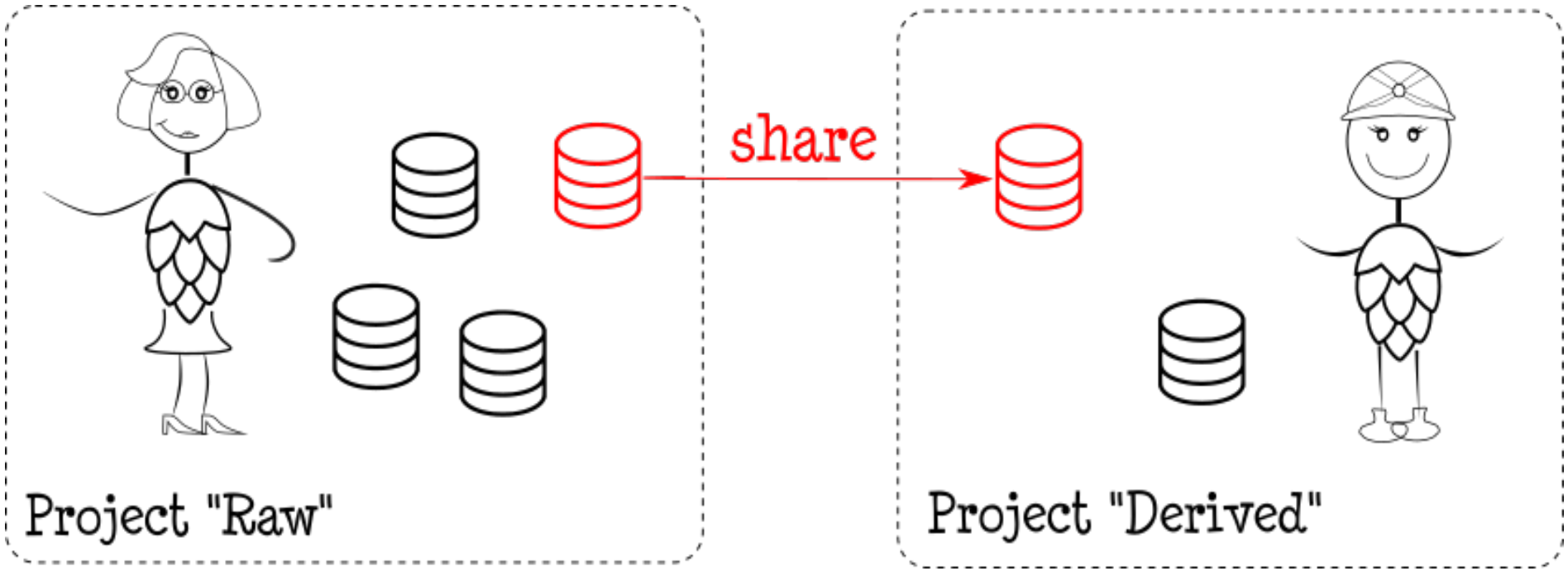
Ostrich Day: 2018-05-25

http://www.computerweekly.com/news/450295538/D-Day-for-GDPR-is-25-May-2018

Manage Projects like GitHub

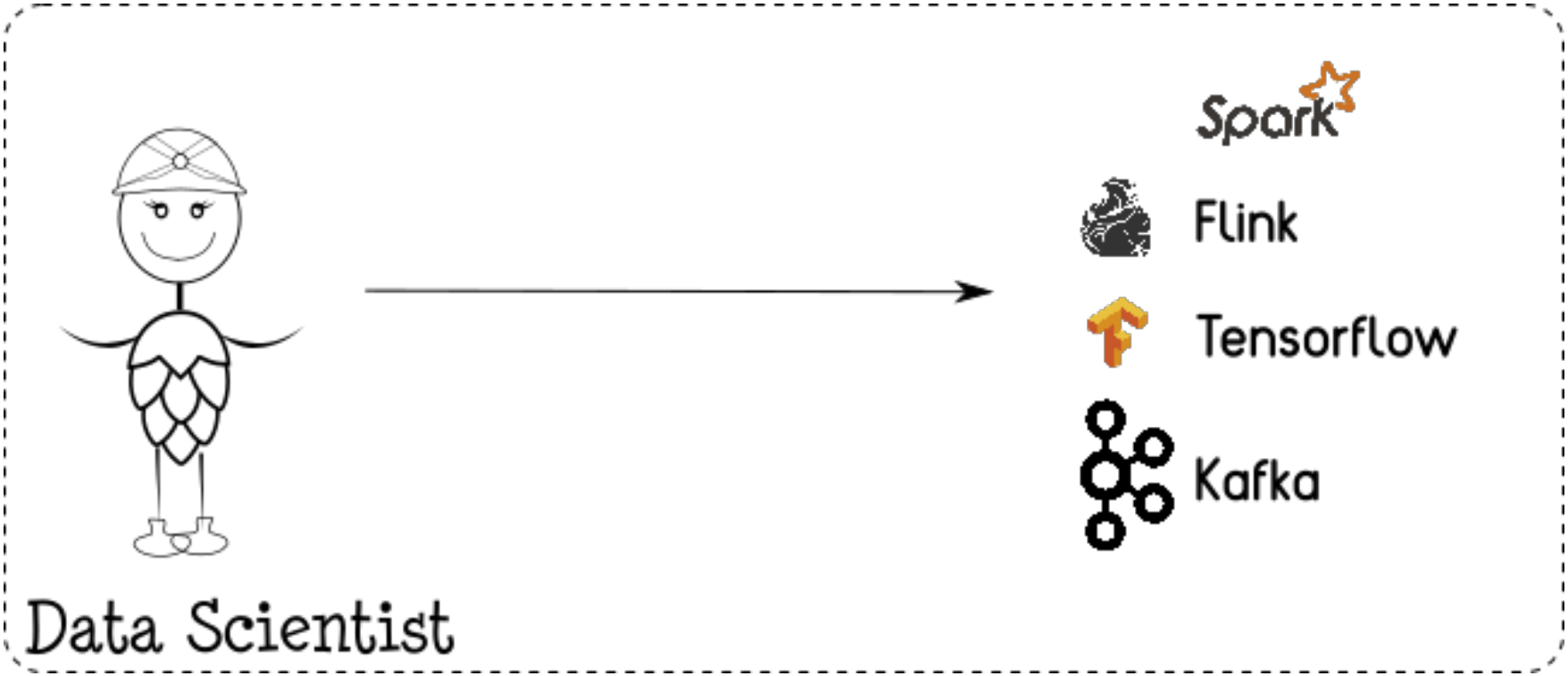


Share like in Dropbox

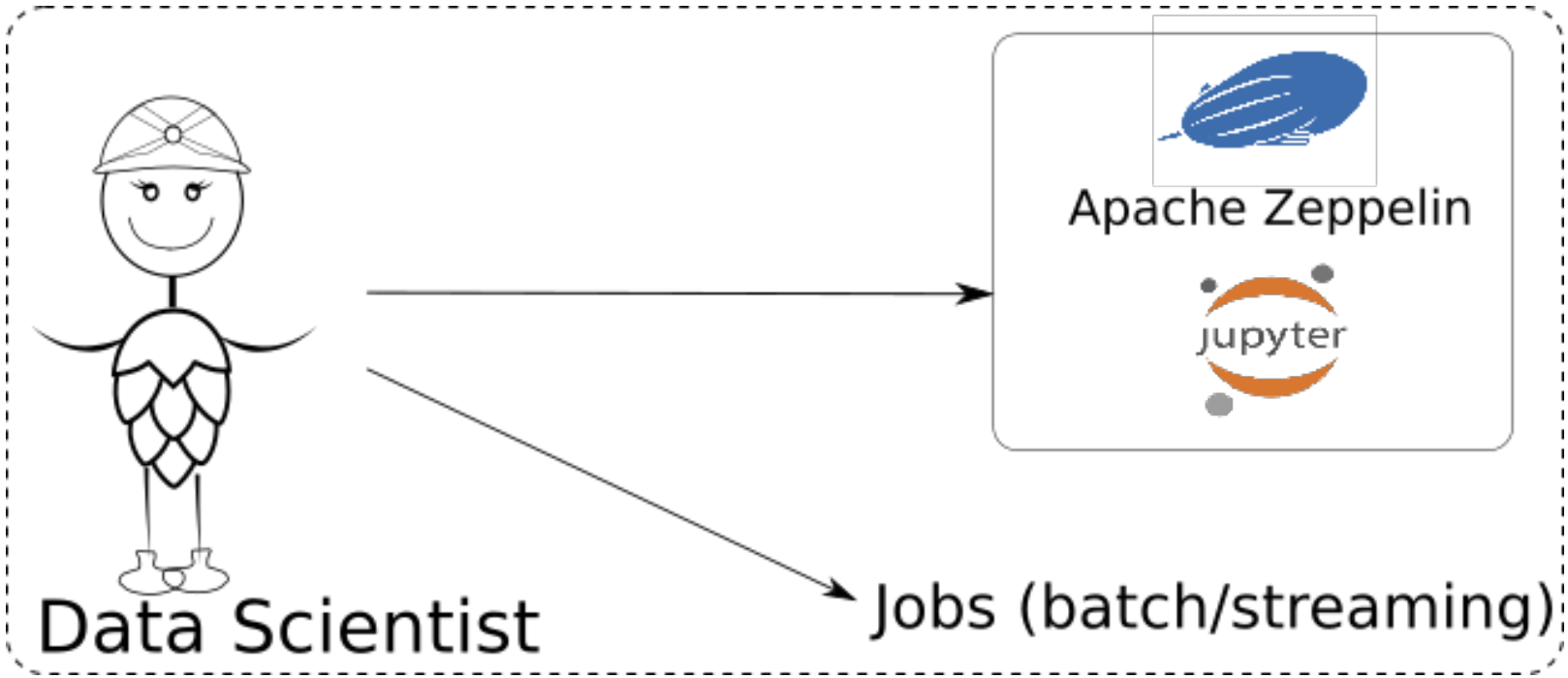


Share any Data Source/Sink: HDFS Datasets, Kafka Topics, etc

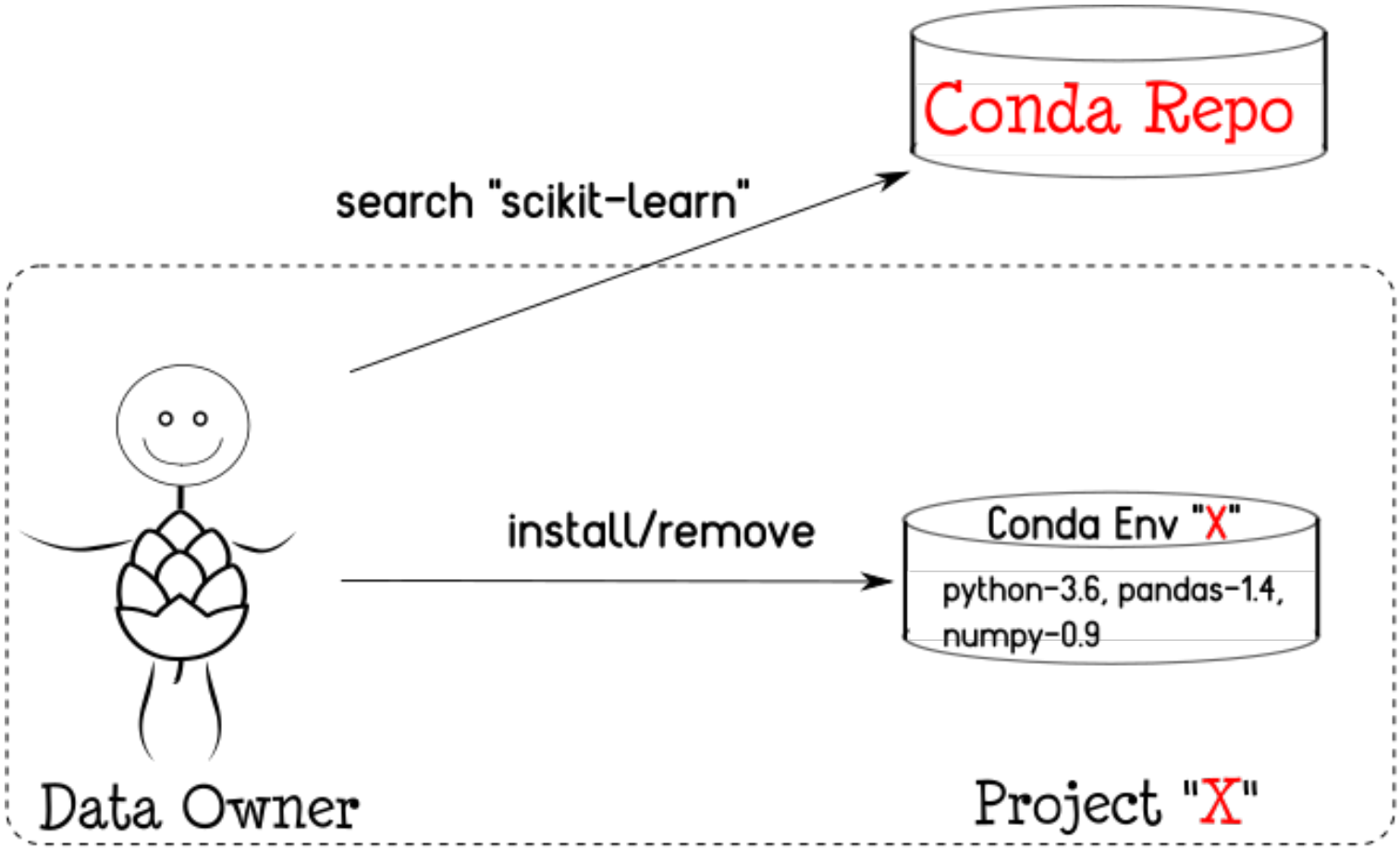
Only Modern Data Parallel Platforms



Workflow/Jobs and Notebook Support



Custom Python Environments with Conda

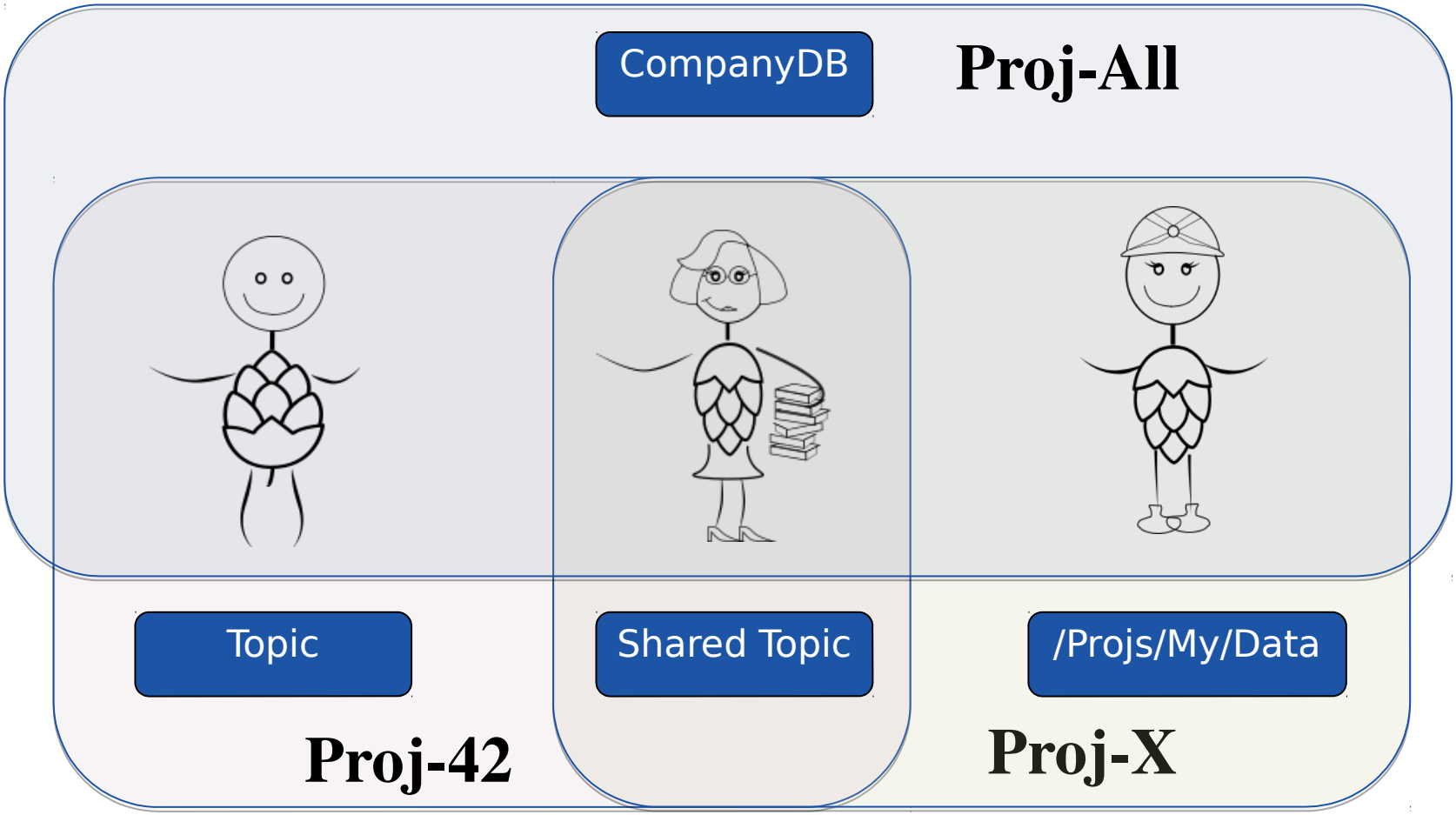


Python libraries are usable by Spark/Tensorflow

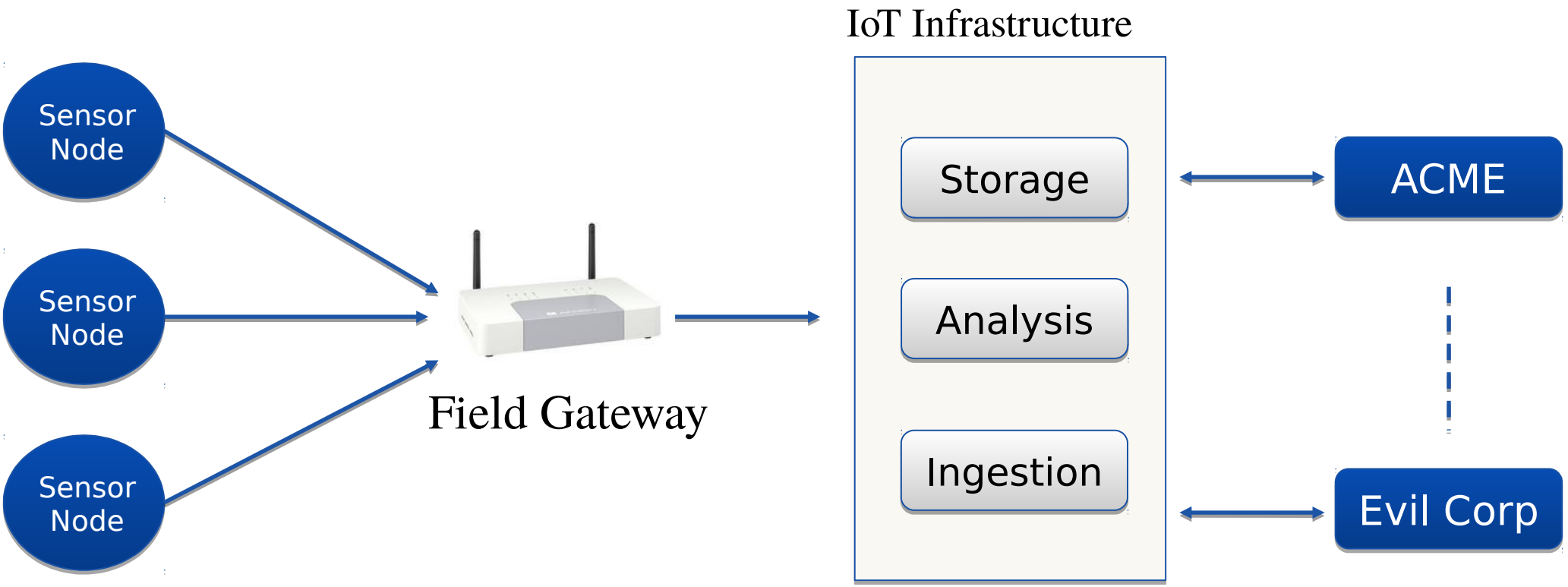
Privacy-by-Design with Projects, Data, Users

Projects for Software-as-a-Service

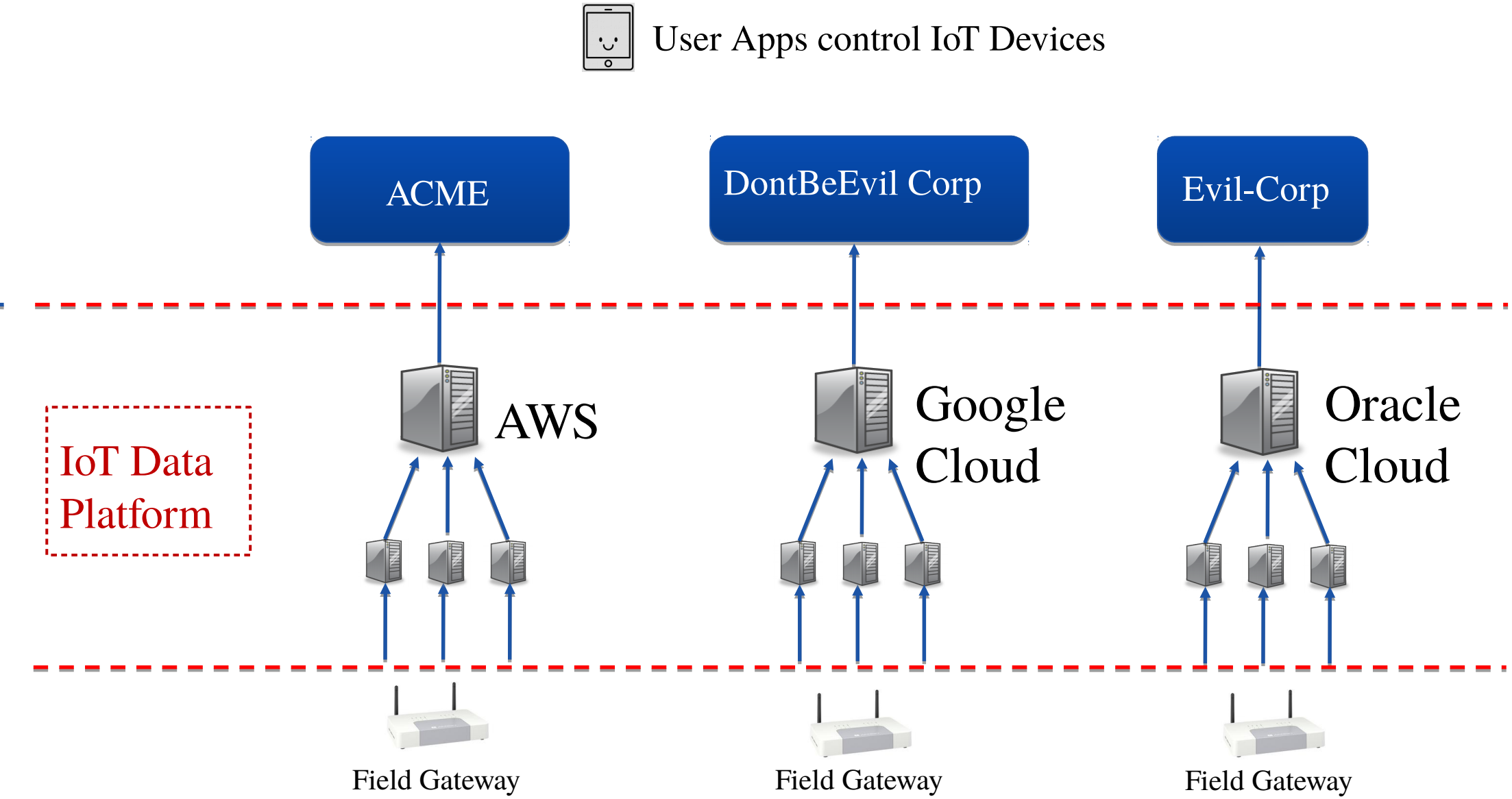
A **Project** is a Grouping of **Users** and **Data**



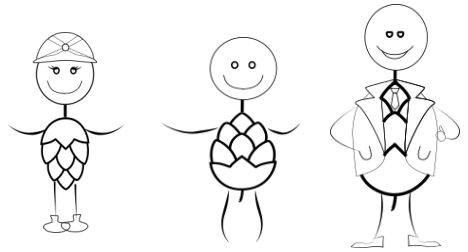
SaaS IoT Data Platform



Multi-Cloud SaaS IoT Data Platform



SaaS IoT Platform: Project per Customer



ACME manage membership

Shared

Generic Analytics

Custom Analytics

ACME HDFS Dataset

ACME Topic

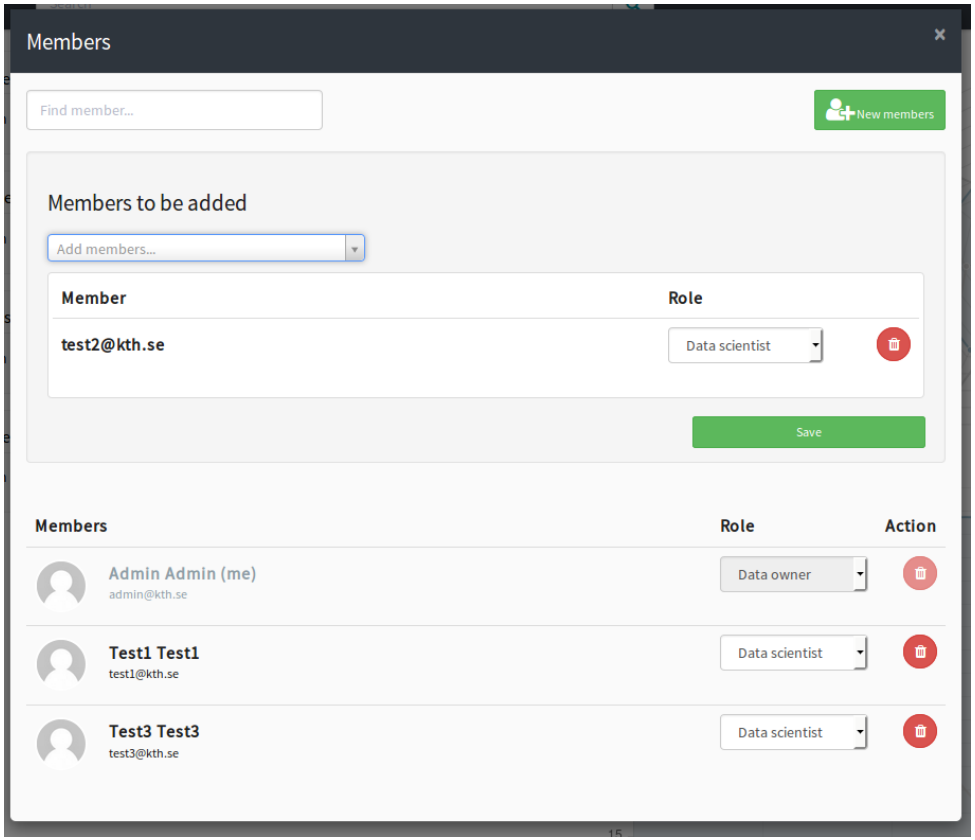
Data Stream

Kafka Topic

IoT Project

ACME Project

Project Roles



- Data Owner Privileges
  - Import/Export data
  - Manage Membership
  - Share DataSets,Topics
- Data Scientist Privileges
  - Write and Run code

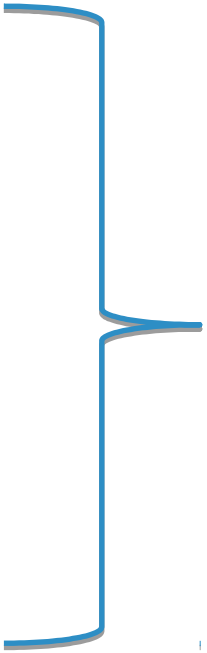
We delegate administration of privileges to users

Project Quotas

- Per-Project quotas
  - Storage in HDFS
  - CPU in YARN (Uber-style Pricing)
- Sharing is not Copying
  - Datasets/Topics

Tooling for Streaming

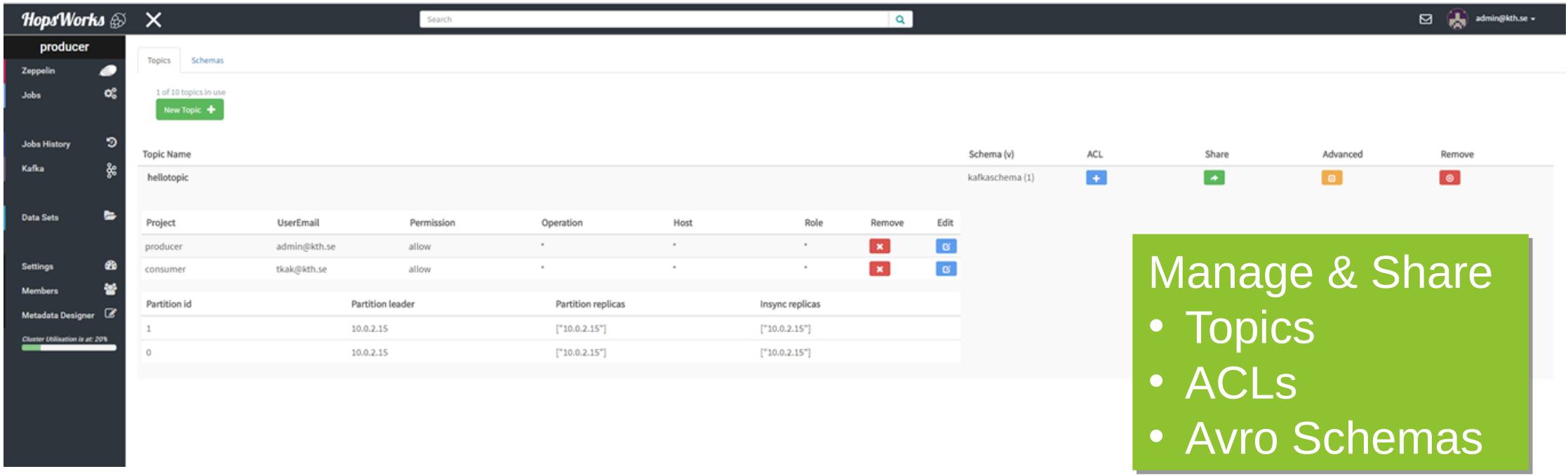
- Hops Hadoop
- Apache Kafka
- ELK Stack
- Grafana/InfluxDB
- Jupyter/Apache Zeppelin



Hopsworks

Self-Service

Kafka Self-Service UI



Manage & Share

- Topics
- ACLs
- Avro Schemas

Tuning Kafka/Spark Streaming

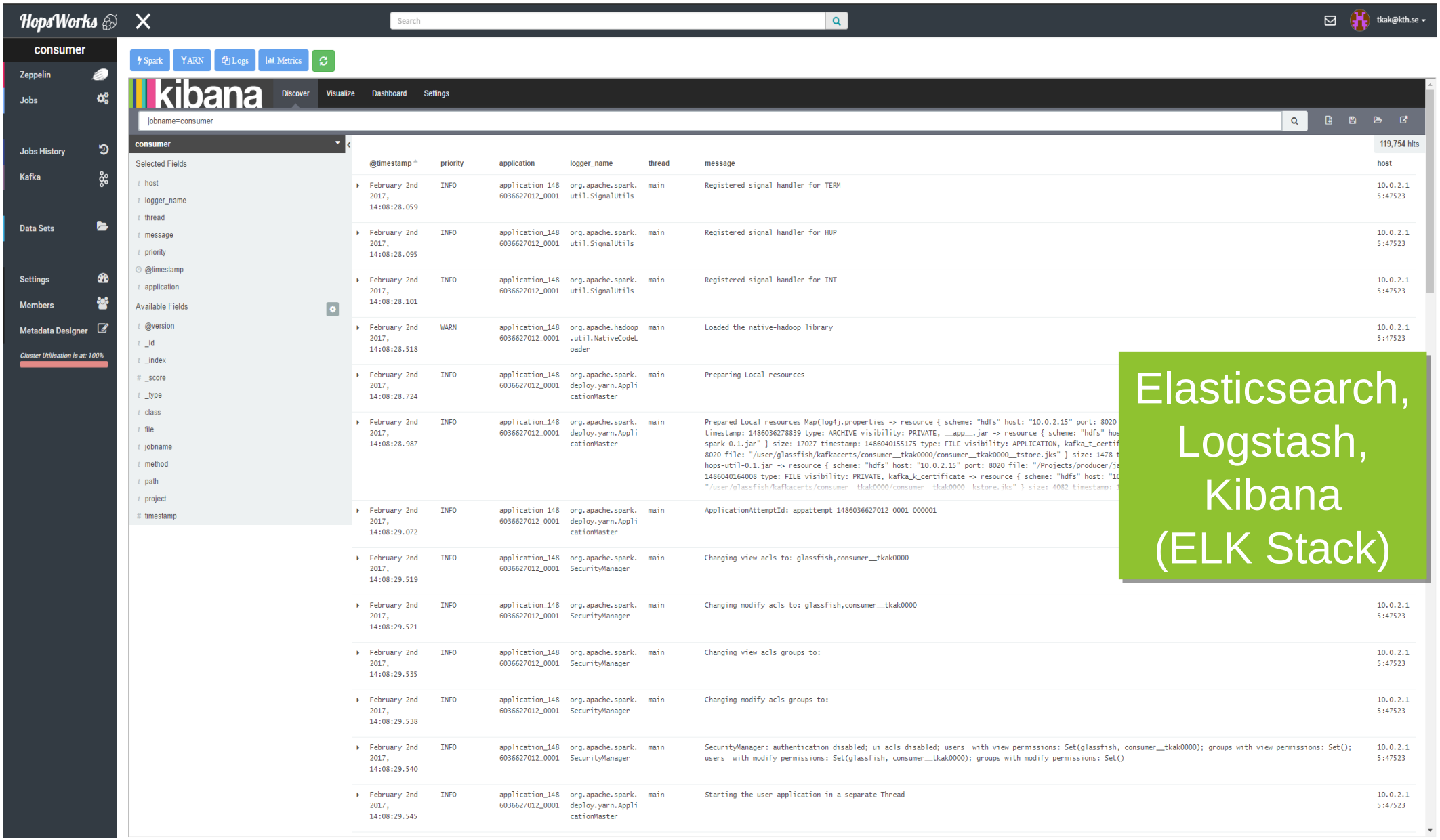
- Key Kafka Tuning Parameters
  - Number of Topics
  - Number of Partitions per Topic
- Spark Streaming Tuning Considerations
  - Match # of Executors to the # of Partitions
  - Ensure balanced data across partitions

Realtime Logs

- YARN aggregates logs on job completion
  - No good to us for Streaming
- Collect logs and make them searchable in real-time using Logstash, Elasticsearch, and Kibana
  - Log4j auto-configured to write to Logstash

http://mkuthan.github.io/blog/2016/09/30/spark-streaming-on-yarn/

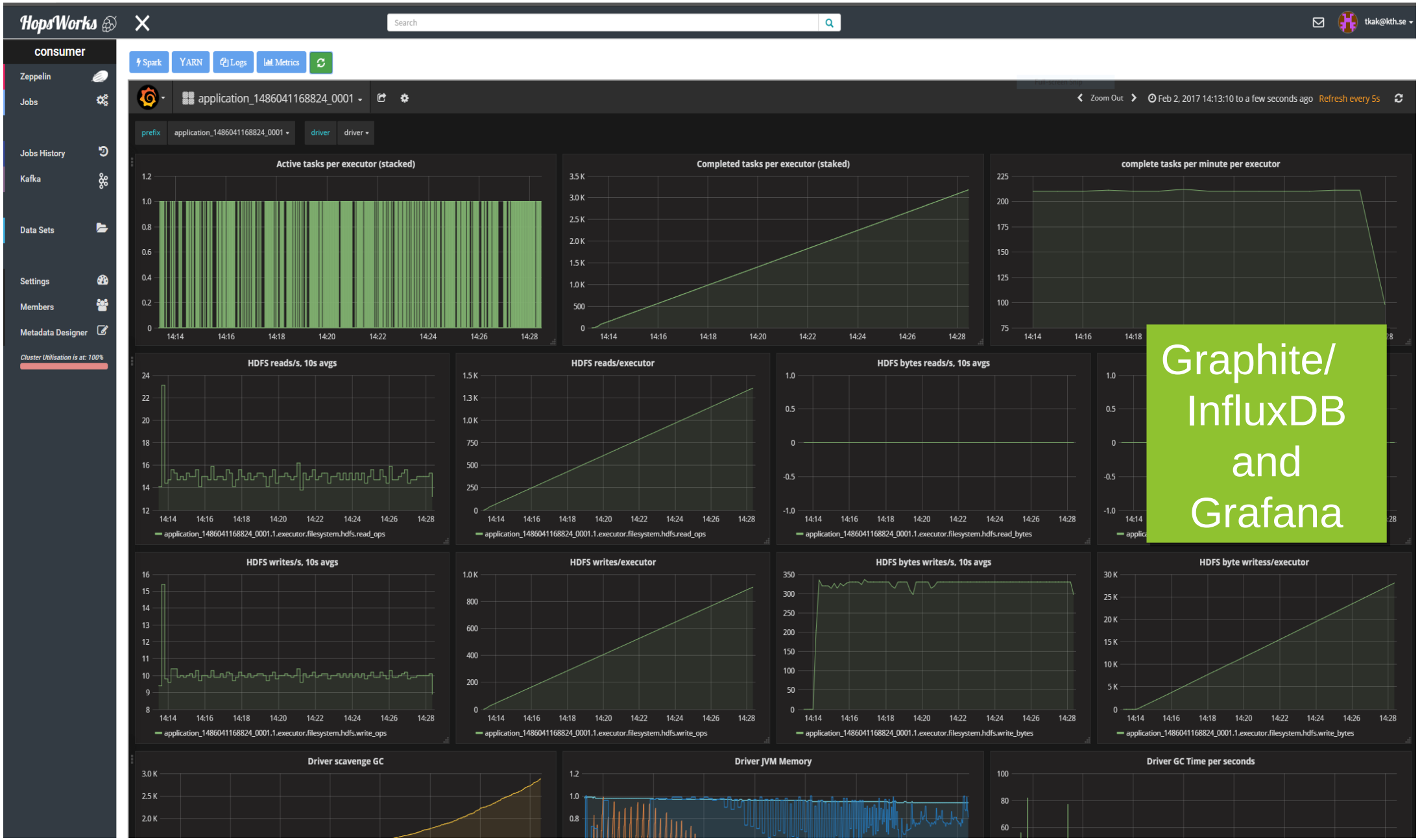
Realtime Logs



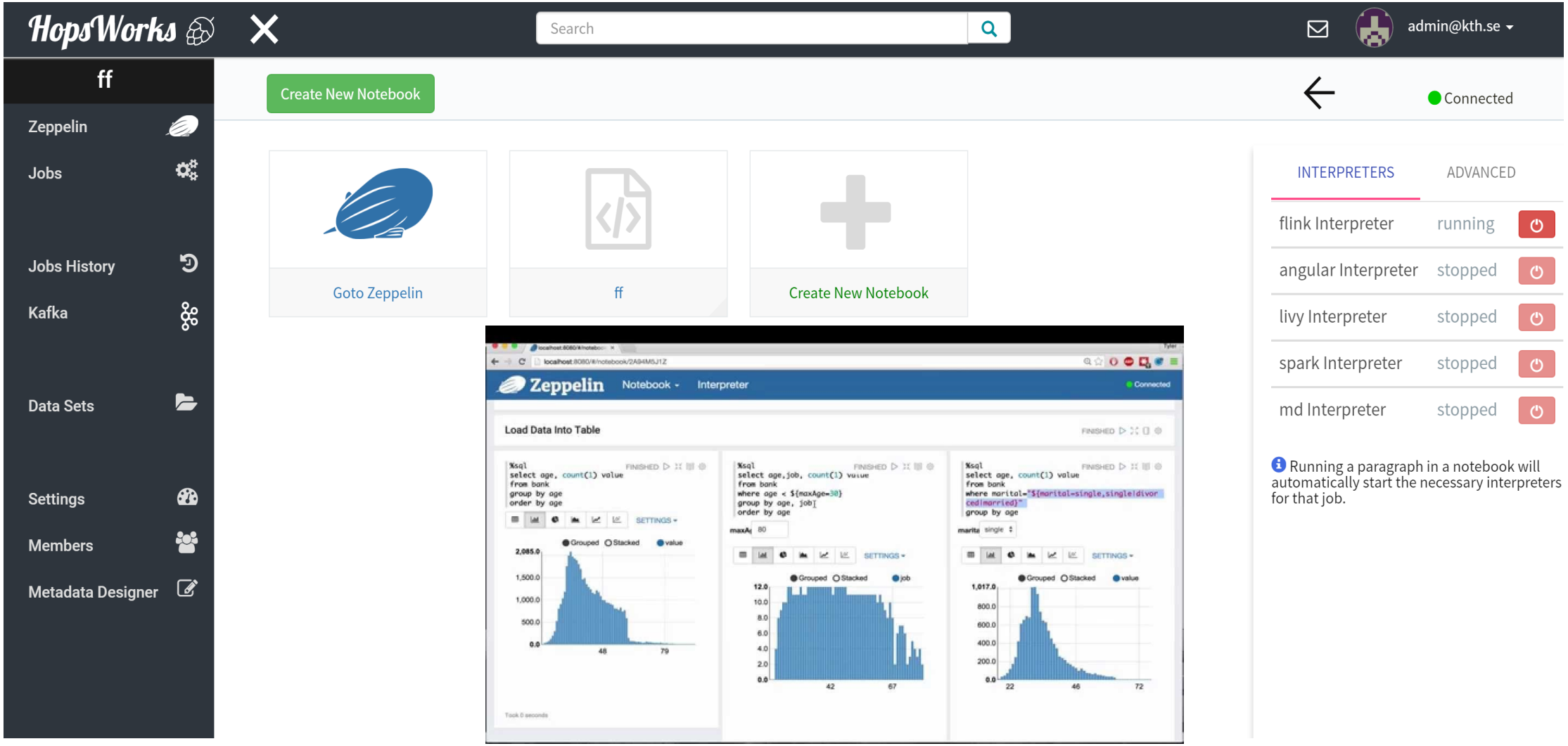
Resource Monitoring/Alerting

- $SPARK_HOME/conf/metrics.properties
  - Different sinks supported
    - JMX, **Graphite**, Servlet/JSON, CSV, Console, Slf4j
- StructuredQueryListener
  - Send query progress to a Kafka topic for inspection
- StreamingQueryListener
  - Asynchronous Monitoring of all queries for a Spark session

Resource Monitoring/Alerting



Zeppelin Notebooks



Jupyter Notebooks

HopsWorks

Search

Demo

- Jupyter
- Zeppelin
- Jobs
- Kafka
- Data Sets
- Settings
- Members
- Metadata Designer

Cluster Utilization is low

jupyter Demo Last Checkpoint: 2 hours ago (autosaved)

Logout

File Edit View Insert Cell Kernel Widgets Help PySpark

Code CellToolbar

In [5]:
```
df = spark.read.csv('hdfs://192.168.56.101:8020/Projects/Demo/DemoData/mcs_201611.csv', \
                    sep=';', schema=schema, ignoreLeadingWhiteSpace=True, \
                    ignoreTrailingWhiteSpace=True, \
                    timestampFormat='yyyy-MM-dd HH:mm:ss.SSS')
```

In [6]:
```
df.count()
```

85275962

In [7]:
```
df.createOrReplaceTempView("FlowData")
```

In [9]:
```
%%sql -o query1
SELECT Timestamp, Ds_Reference, Detector_Number, Flow_In, Average_Speed FROM FlowData WHERE Status == 3
```

Type: Table Pie Scatter Line Area Bar

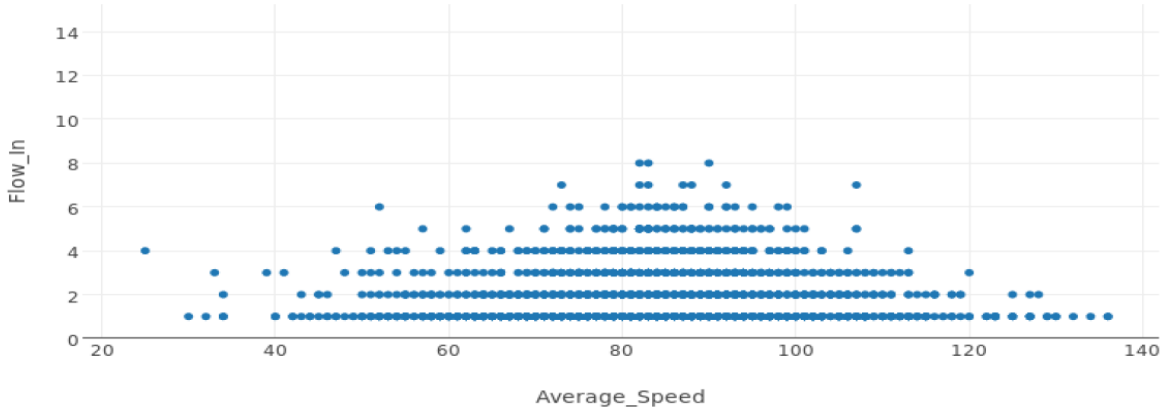
Encoding:

X Average_Speed

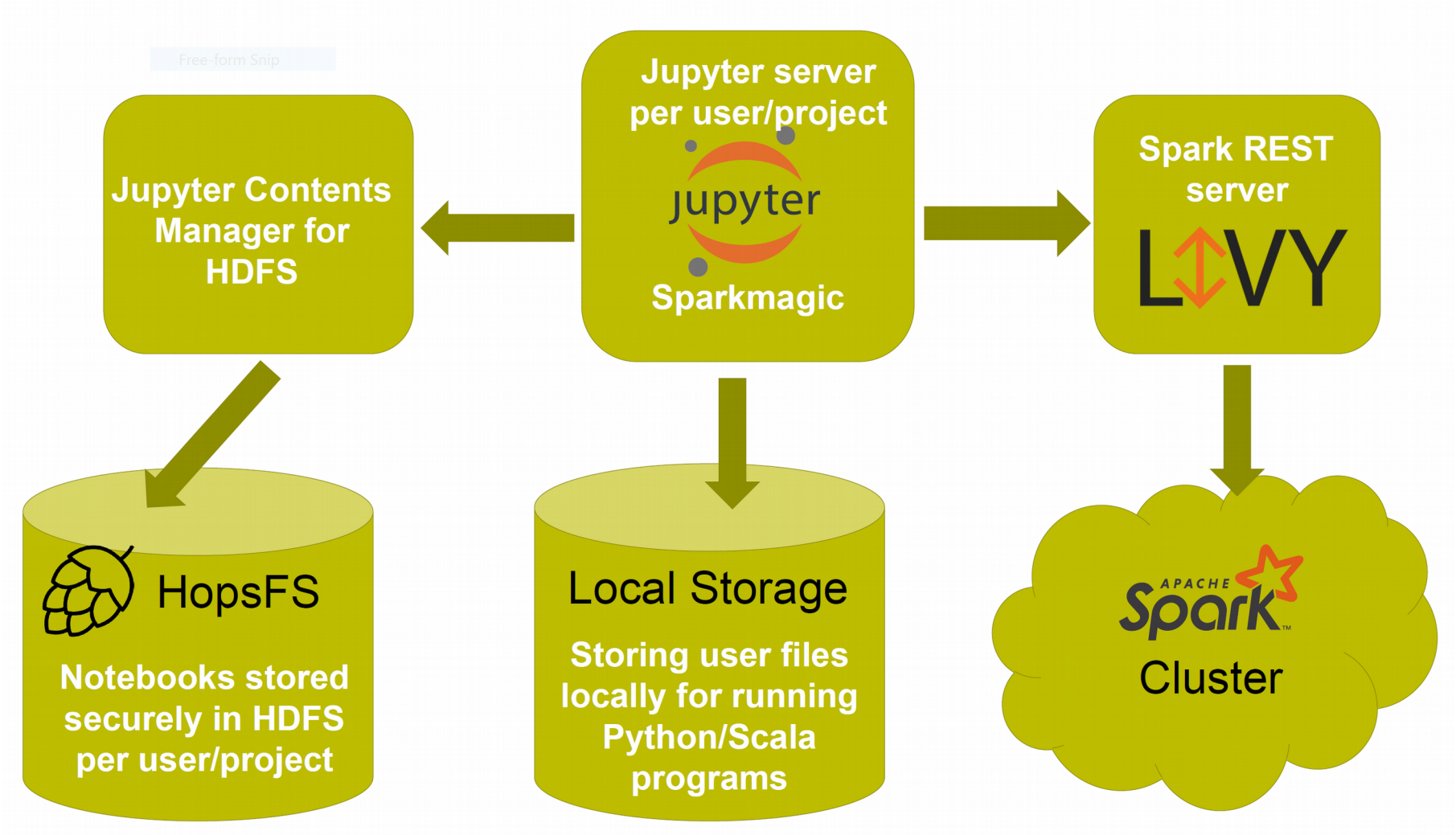
Y Flow_In Func. -

Log scale X

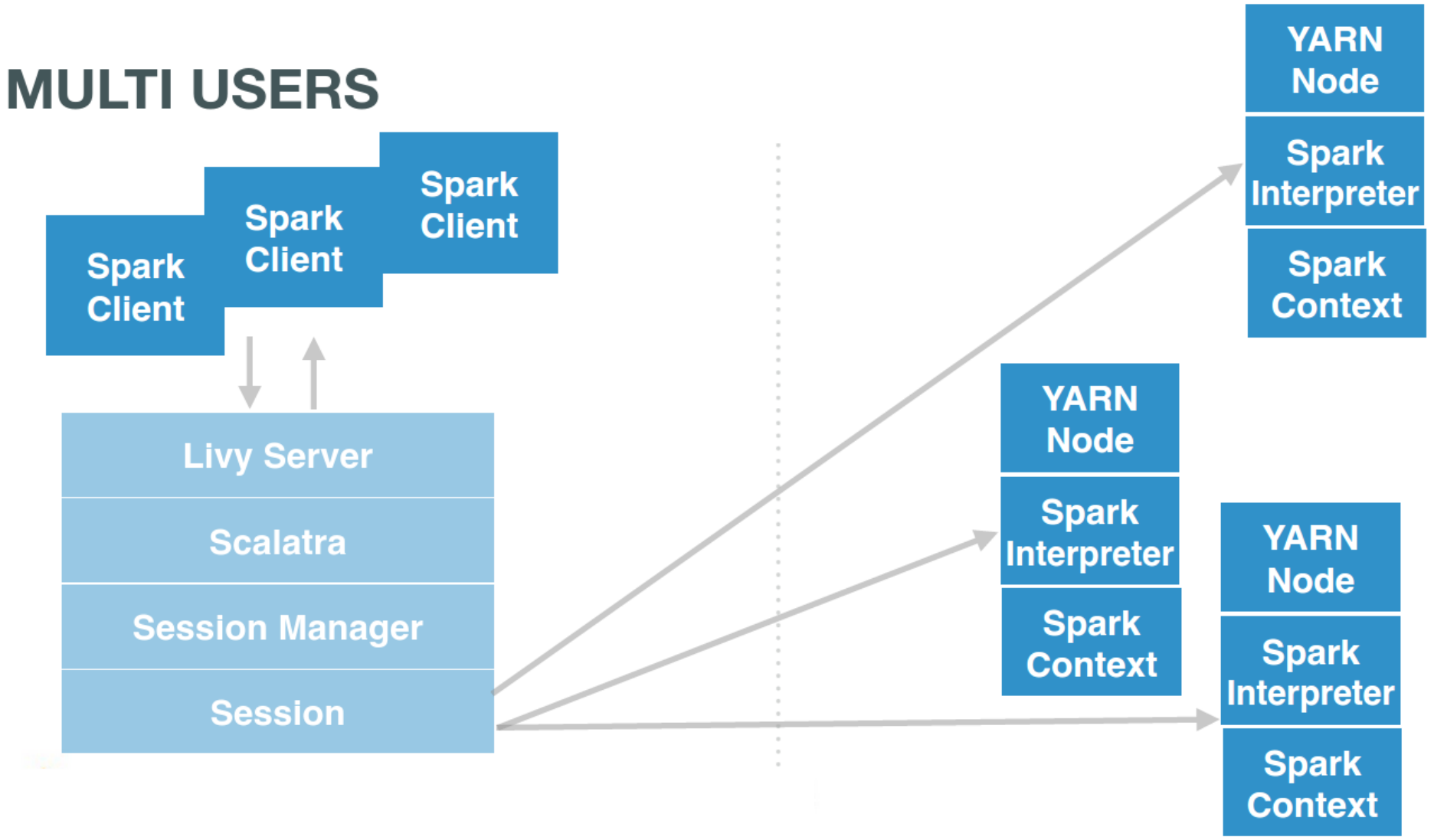
Log scale Y



Jupyter Support



Livy REST Server for Spark



[Image from: http://gethue.com]

Basic Structured Spark Streaming Program

- Query
- Input source
- Output sink
  - Mode: append/complete/update
- Trigger Interval
- Checkpoint Location

```
val cloudtrailEvents = …

val streamingETLQuery =
 cloudtrailEvents
  .withColumn("date",
    $"timestamp".cast("date")
  .writeStream
  .trigger(ProcessingTime
    ("10 seconds"))
  .format("parquet")
  .partitionBy("date")
  .option("path", "/cloudtrail")
  .option("checkpointLocation",
    "/cloudtrail.checkpoint/")
  .start()
```

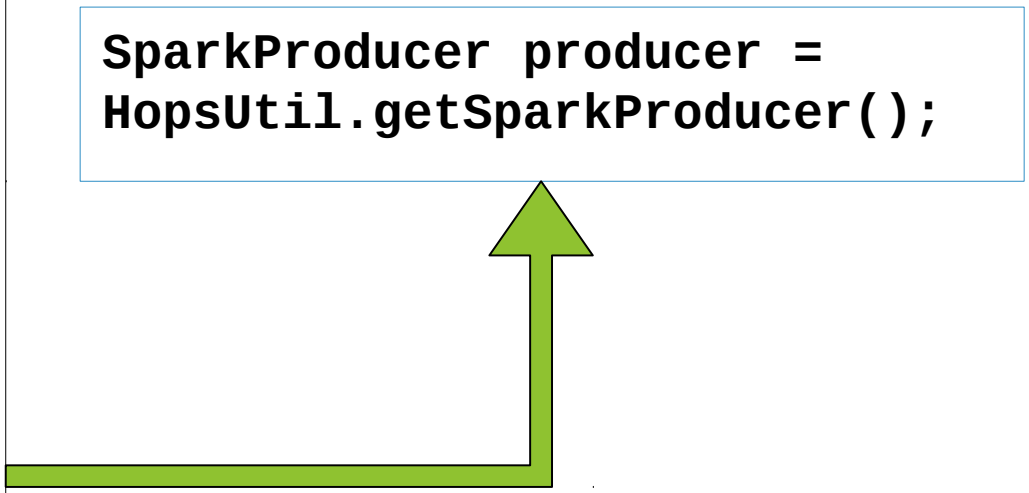
https://databricks.com/blog/2017/01/19/real-time-streaming-etl-structured-streaming-apache-spark-2-1.html

Secure Structured Spark Streaming App

- Real Streaming Apps are more complex:
  - Credentials, Endpoints
  - monitoring.properties
  - How to shutdown gracefully
- The **HopsUtil API** hides this complexity.

HopsUtil simplifies Secure Spark/Kafka

```
Properties props = new Properties();
props.put(ProducerConfig.BOOTSTRAP_SERVERS_CONFIG, brokerList);
props.put(SCHEMA_REGISTRY_URL, restApp.restConnect);
props.put(ProducerConfig.KEY_SERIALIZER_CLASS_CONFIG,
org.apache.kafka.common.serialization.StringSerializer.class);
props.put(ProducerConfig.VALUE_SERIALIZER_CLASS_CONFIG,
io.confluent.kafka.serializers.KafkaAvroSerializer.class);
props.put("producer.type", "sync");
props.put("serializer.class","kafka.serializer.StringEncoder");
props.put("request.required.acks", "1");
props.put("ssl.keystore.location","/var/ssl/kafka.client.keystore.jks"
)
props.put("ssl.keystore.password","test1234")
props.put("ssl.key.password","test1234")
ProducerConfig config = new ProducerConfig(props);
String userSchema =
"{\"namespace\": \"example.avro\", \"type\": \"record\", \"name\": \"U
ser\"," +
                        "\"fields\":
[{\"name\": \"name\", \"type\": \"string\"}]}";
Schema.Parser parser = new Schema.Parser();
Schema schema = parser.parse(userSchema);
GenericRecord avroRecord = new GenericData.Record(schema);
avroRecord.put("name", "testUser");
Producer<String, String> producer = new Producer<String,
String>(config);
ProducerRecord<String, Object> message = new
ProducerRecord<>(“topicName”, avroRecord );
producer.send(data);
```



https://github.com/hopshadoop/hops-kafka-examples

Kafka Producer in HopsWorks

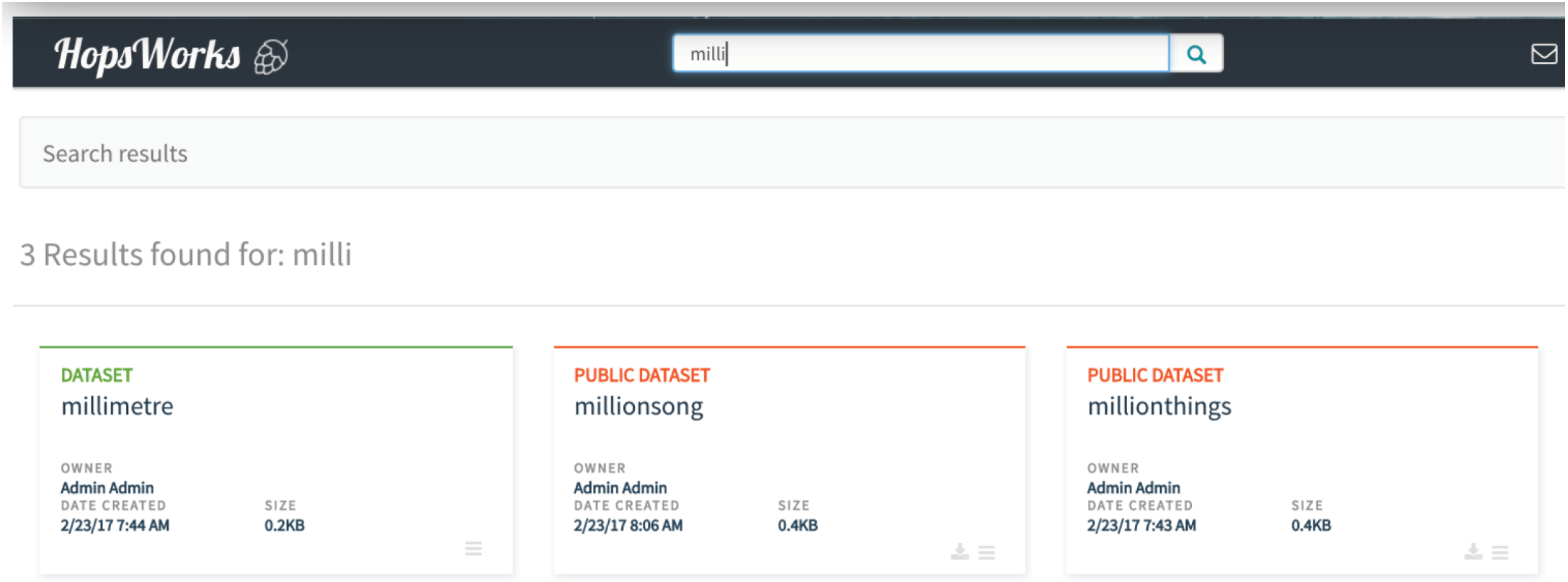
```
SparkConf sparkConf = new SparkConf().setAppName(HopsUtil.getJobName());
JavaSparkContext jsc = new JavaSparkContext(sparkConf);
...
SparkProducer producer = HopsUtil.getSparkProducer();
...
producer.produce(message);
...
HopsUtil.shutdownGracefully(jsc);
```

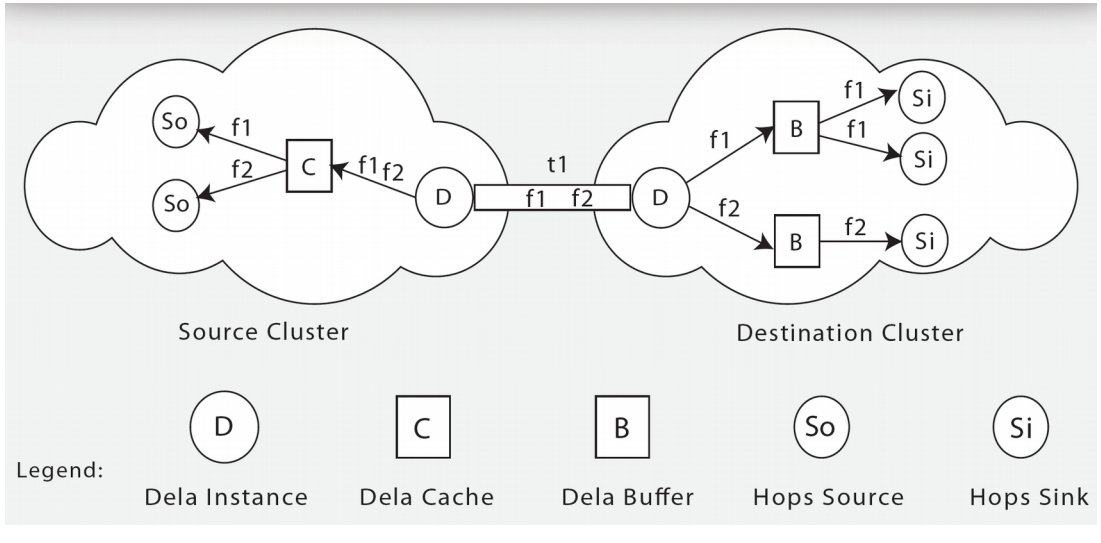
Streaming Consumer in HopsWorks

```
SparkConf sparkConf = new SparkConf().setAppName(HopsUtil.getJobName());
JavaSparkContext jsc = new JavaSparkContext(sparkConf);
...
DataStreamReader dsr = HopsUtil.getSparkConsumer().getKafkaDataStreamReader();
Dataset<Row> lines = dsr.load();
...
StreamingQuery queryFile = logEntries.writeStream()
...
HopsUtil.shutdownGracefully(queryFile);
```

Hops Roadmap

Dela – A Global Ecosystem for Datasets



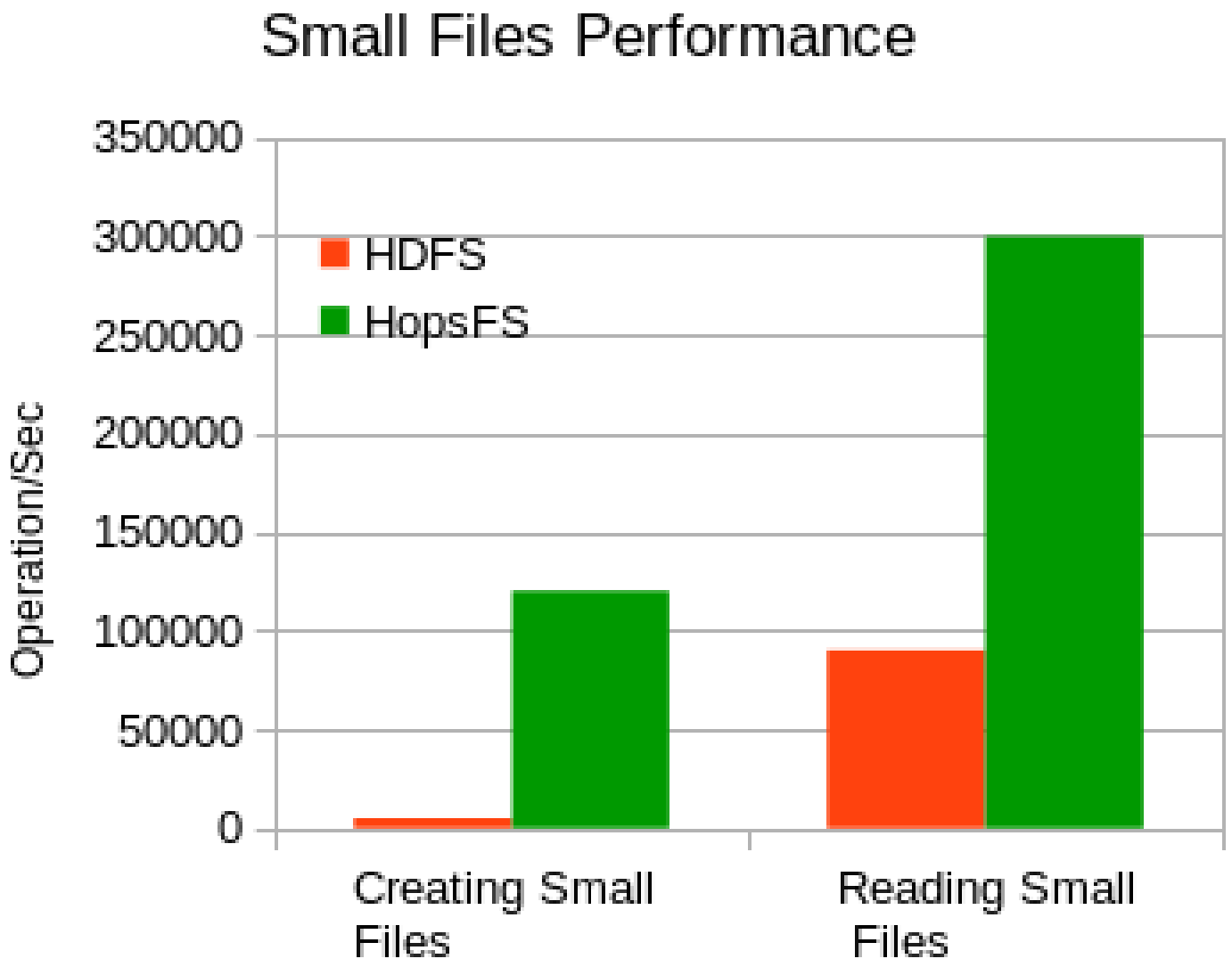


Distributed Tensorflow on YARN

1. GPU-as-a-resource in Hops-YARN
2. Tensorflow-on-Spark
3. Native Tensorflow-on-YARN with Infiniband Support

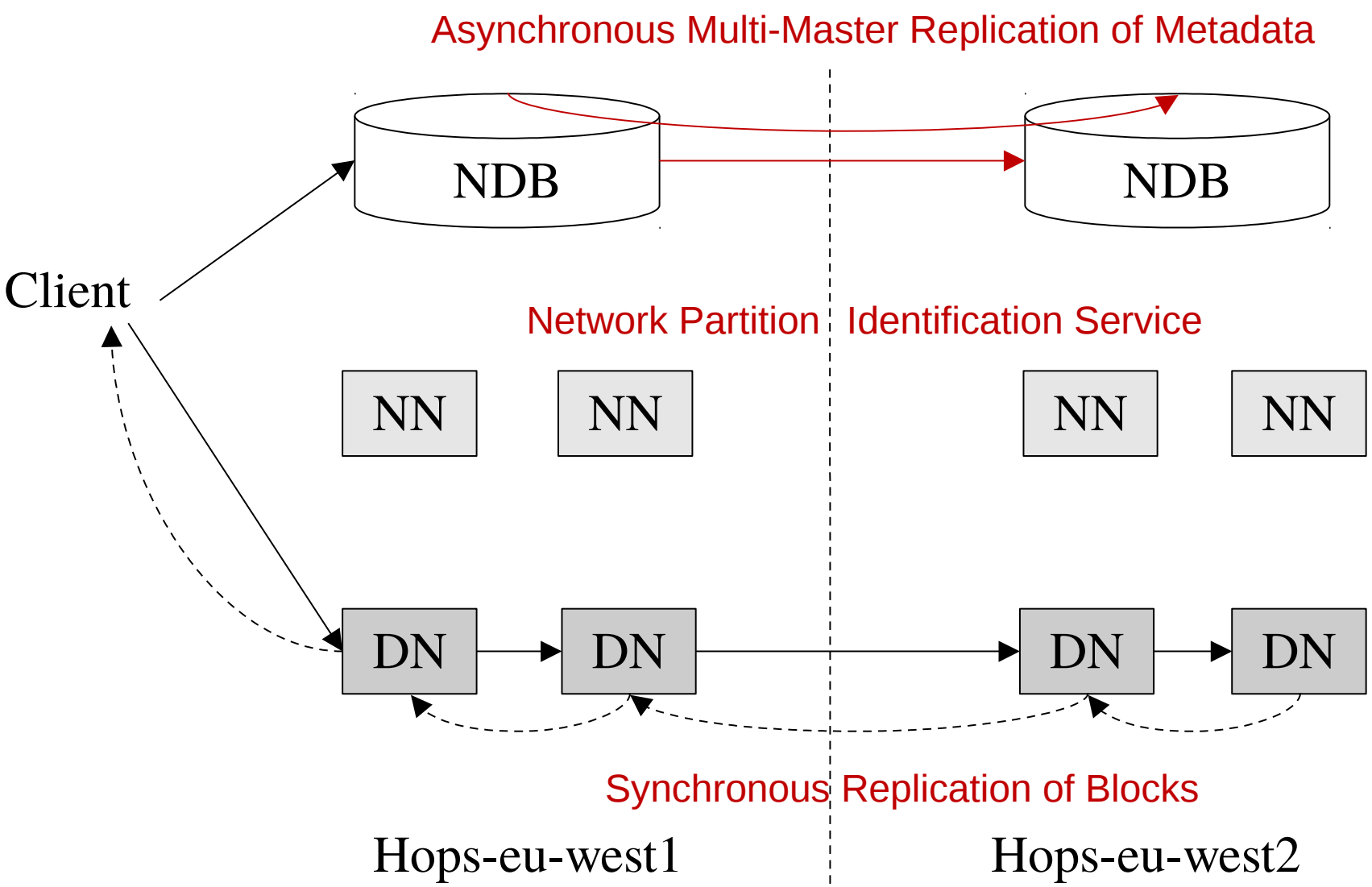
https://github.com/hopshadoop/hops-tensorflow

HopsFS Small Files Performance (Early Results)



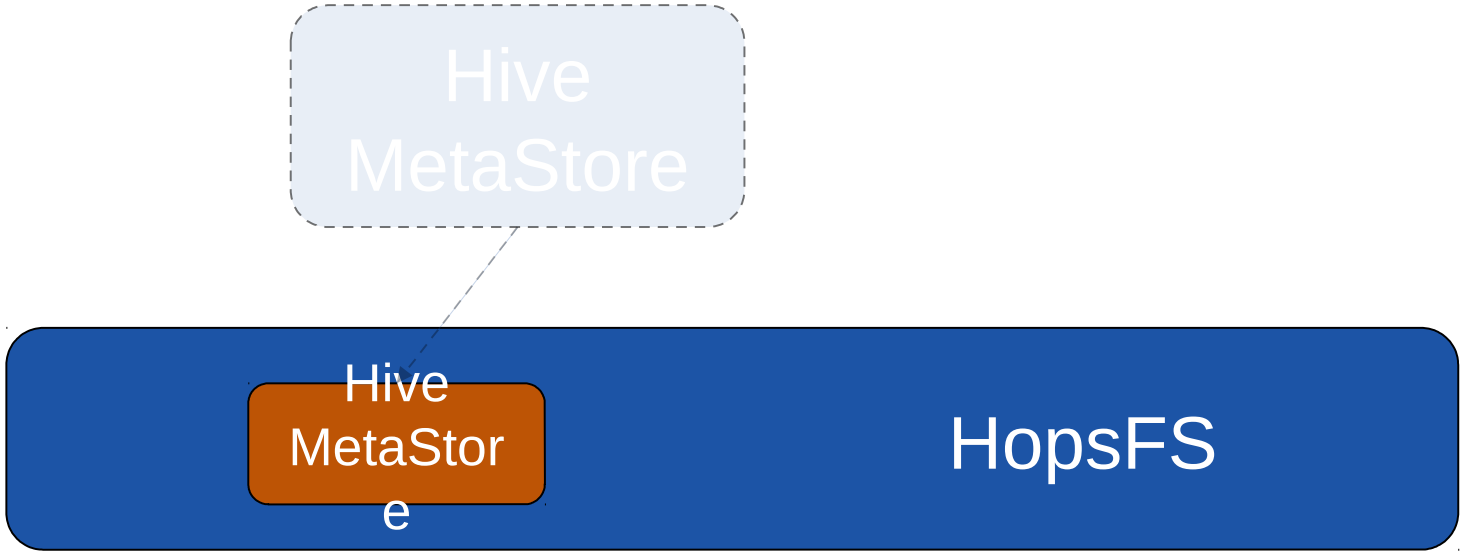
30 namenodes/datanodes and 6 NDB nodes were used. Small file size was 4 KB. HopsFs files were stored on Intel 750 Series SSDs

Multi-Data-Center HopsFS



Hive Metastore is Moving in with HopsFS

Hive Metastore is Moving in with HopsFS



Strongly Consistent Hive Metadata

1.

```
0: jdbc:hive2://localhost:9084> show tables;
+-----------+
| tab_name  |
+-----------+
| web_sales |
| web_site  |
+-----------+
2 rows selected (0.141 seconds)
0: jdbc:hive2://localhost:9084>
```

2.

```
$ hdfs dfs -rm -r /user/glassfish/2/web_sales
```

3.

```
0: jdbc:hive2://localhost:9084> show tables;
+-----------+
| tab_name  |
+-----------+
| web_site  |
+-----------+
1 row selected (0.155 seconds)
0: jdbc:hive2://localhost:9084>
```

Removing the HDFS backing directory removes the Table from the Hive Metastore

Summary

- Europe’s Only Hadoop Distribution – Hops Hadoop
  - Fully Open-Source
- Hops supports larger/faster Hadoop Clusters
  - More scalable, tinker-friendly, and fully open-source.
- Hopsworks is a new Data Platform built on HopsFS with first-class support for Streaming
  - Spark or Flink

Hops Heads

Active:

Jim Dowling, Seif Haridi, Tor Björn Minde, Gautier Berthou, Salman Niazi, Mahmoud Ismail, Theofilos Kakantousis, Ermias Gebremeskel, Antonios Kouzoupis, Alex Ormenisan, Roberto Bampi, Fabio Buso, Fanti Machmount Al Samisti, Braulio Grana, Zahin Azher Rashid, Robin Andersson, ArunaKumari Yedurupaka, Tobias Johansson, August Bonds, Filotas Siskos.

Alumni:

Vasileios Giannokostas, Johan Svedlund Nordström,Rizvi Hasan, Paul Mälzer, Bram Leenders, Juan Roca, Misganu Dessalegn, K “Sri” Srijeyanthan, Jude D’Souza, Alberto Lorente, Andre Moré, Ali Gholami, Davis Jaunzems, Stig Viaene, Hooman Peiro, Evangelos Savvidis, Steffen Grohsschmiedt, Qi Qi, Gayana Chandrasekara, Nikolaos Stanogias, Daniel Bali, Ioannis Kerkinos, Peter Buechler, Pushparaj Motamari, Hamid Afzali, Wasif Malik, Lalith Suresh, Mariano Valles, Ying Lieu.

Hops

Thank You.

Follow us: @hopshadoop

Star us: http://github.com/hopshadoop/hopsworks

Join us: http://www.hops.io