Cost effective Druid

data
TECHNOLOGY SUMMIT

Independent Big Data conference with purely technical pres

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www.bigda

Whoami

- Master Distributed Systems & Software Engineering
- Apache PPMC Member and Apache Airflow committer
- Contributer to Apache Flink, Apache Spark, Druid and more

GoDataDriven

- Consultancy company
- Amsterdam based
- Always on the lookout for Data Engineers

Mobpro

- AdTech company
- Buys ad-space for campaigns
- Performs RTB on ad-space
- Druid as a Service from Metamarkets

Druid

- Developed by Metamarkets
- Open Source Apache 2.0 license
- Druid is a distributed, column-oriented, real-time analytics data store
- Optimised for sub-second Slice-and-Dice OLAP operations
- Walmart uses Druid for analytics

https://medium.com/walmartlabs/event-stream-analytics-at-walmart-with-druid-dcf1a37ceda7

Druid history

- Developed by Metamarkets in 2011
- Open sourced, GPL 2012, Apache license 2015
- Used by Twitter, AirBnB, Netflix and many more
- Metamarkets got sold to Snap Inc in 2017

https://medium.com/engineers-optimizely/slicing-and-dicing-data-with-druid-f61cca8a63d2

Insourcing Druid on OpenStack

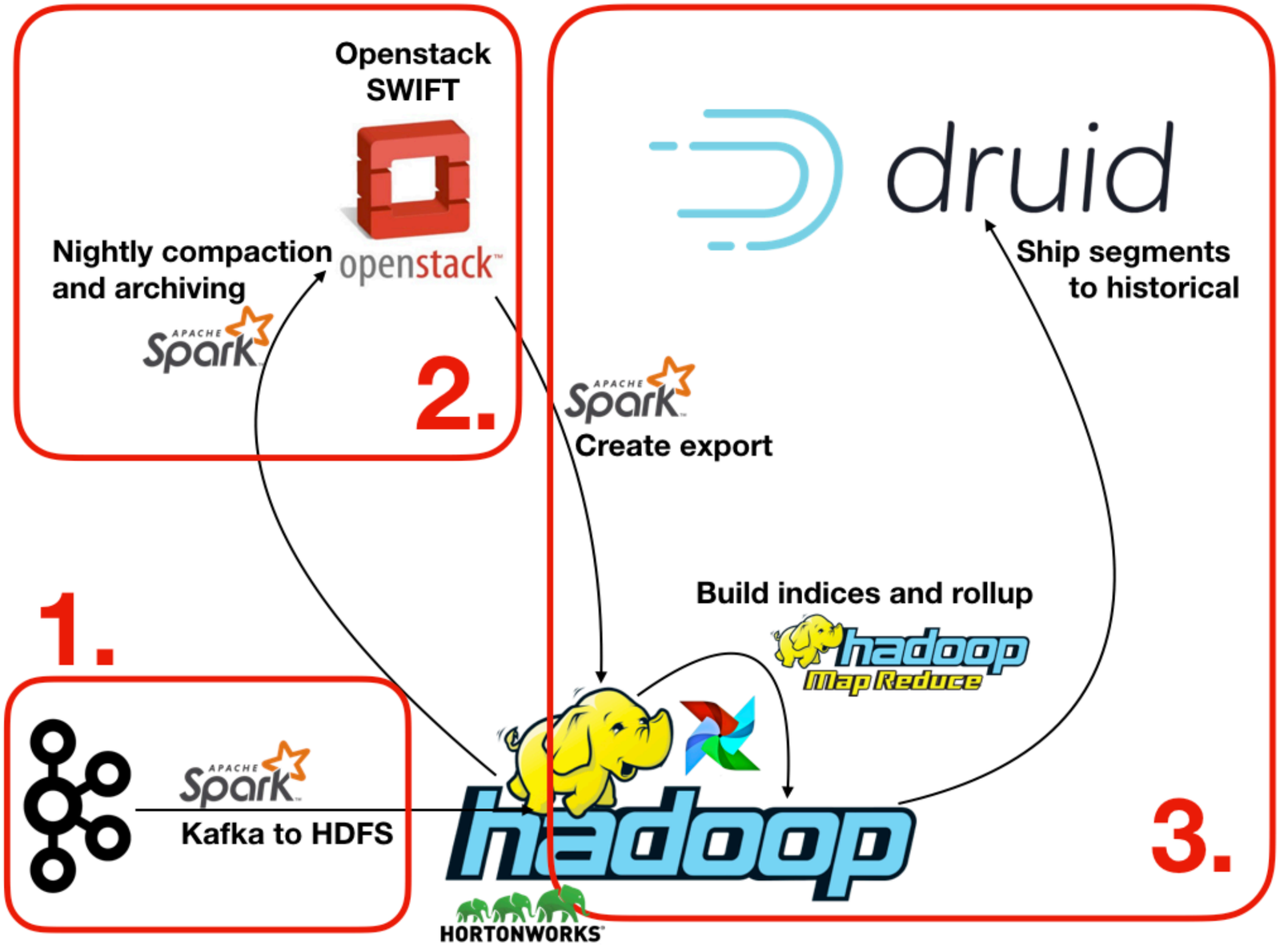
Open source software for creating clouds.

- **Minimal TCO**
- **Flexibility**

MOBILE PROFESSIONALS

Some numbers

- ~600M requests per day
- ~70GB per day bz2 compressed
- ~400GB per day uncompressed



ELT using Spark Streaming

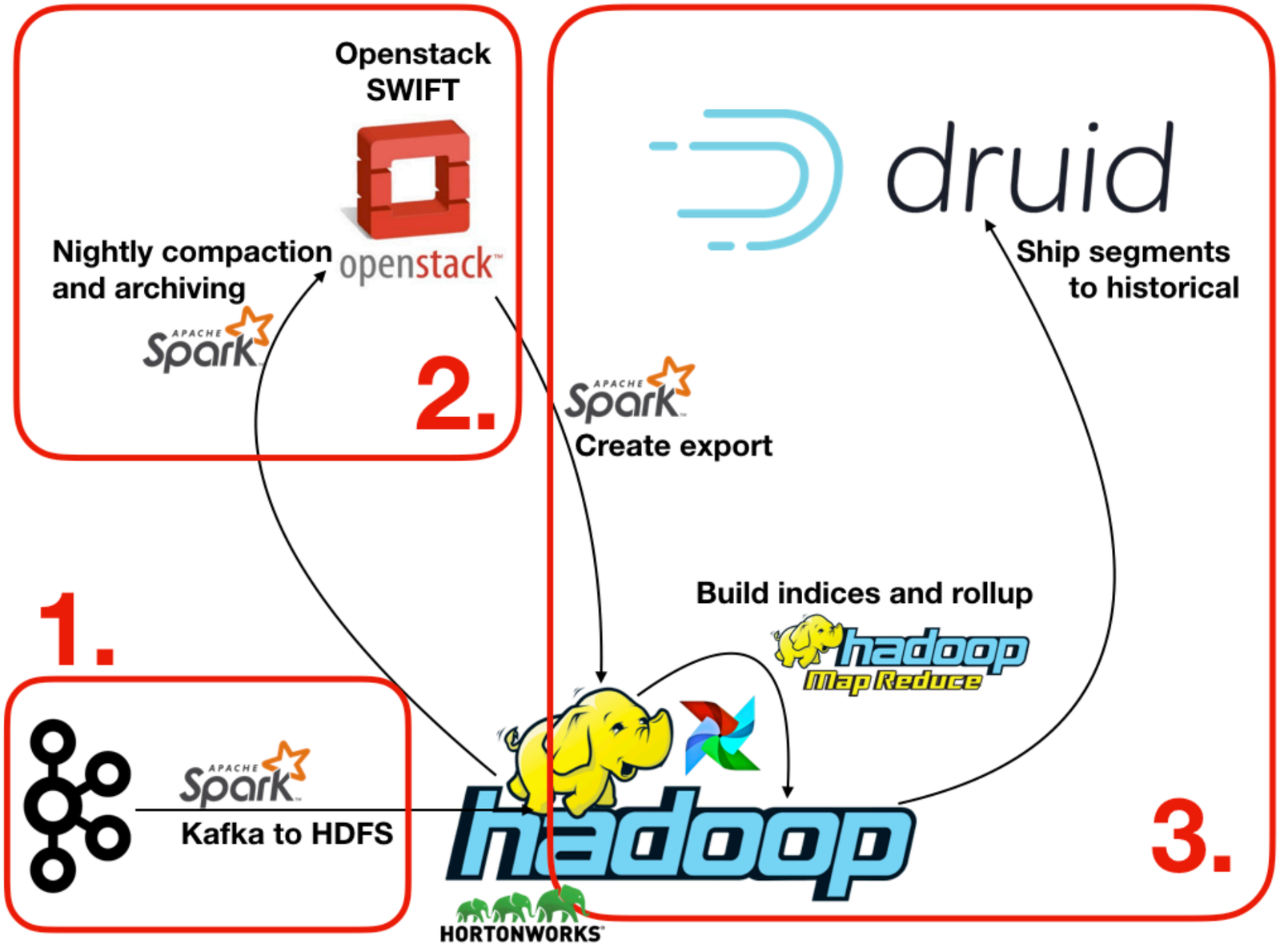
- Spark structured streaming
- Write a LOT of json to hdfs
- Raw strings and fast Snappy compression

```
root@hadoopedge01:~# hdfs dfs -ls /data/live/
Found 10 items
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 19:57 /data/live/_spark_metadata
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=bids
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=events
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=interaction_1
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=interaction_2
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=nobids
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=requested_impressions
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=served_impressions
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=viewable_impressions
drwxr-xr-x   - hdfs hdfs          0 2018-02-15 05:11 /data/live/topic=wins
```

```
root@hadoopedge01:~# hdfs dfs -ls -h /data/live/topic=bids/date=2018-02-15 | head -n 10
Found 1610 items
-rw-r--r--   3 hdfs hdfs      7.5 M 2018-02-15 10:45 /data/live/topic=bids/date=2018-02-15/part-00003-01460dad-9cef-4e8f-94a9-77bf5b1623fe.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      6.7 M 2018-02-15 10:20 /data/live/topic=bids/date=2018-02-15/part-00003-02b57165-cb4a-44af-a12a-b08adeffa880.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      7.6 M 2018-02-15 10:05 /data/live/topic=bids/date=2018-02-15/part-00003-02bcd4bd-618e-43c9-9c3e-93b3f99004e5.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      9.7 M 2018-02-15 18:20 /data/live/topic=bids/date=2018-02-15/part-00003-0450853b-042e-4c1a-8e08-c45524e9dfb1.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      7.4 M 2018-02-15 10:50 /data/live/topic=bids/date=2018-02-15/part-00003-066b49f7-a79a-4a30-8031-82b07414a5c4.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      8.6 M 2018-02-15 08:00 /data/live/topic=bids/date=2018-02-15/part-00003-0806973a-53c4-4fa1-ae77-6d0dac8b6503.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      7.5 M 2018-02-15 10:55 /data/live/topic=bids/date=2018-02-15/part-00003-0836b8a1-c172-4f91-9782-2e15ceaa76cb.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs     28.9 M 2018-02-15 19:03 /data/live/topic=bids/date=2018-02-15/part-00003-0aaead9c-1486-43b7-8551-d490528e0dce.c000.txt.snappy
-rw-r--r--   3 hdfs hdfs      7.8 M 2018-02-15 11:05 /data/live/topic=bids/date=2018-02-15/part-00003-0b98db4e-8ba0-4501-a8c6-70caa8040481.c000.txt.snappy
```

Poor compression

```
root@hadoopedge:~# hdfs dfs -du -s -h /tmp/compressiontest/*
4.7 G  /tmp/compressiontest/bzip2, ratio 5.65957447
9.6 G  /tmp/compressiontest/lz4, ratio 2.77083333
26.6 G  /tmp/compressiontest/none, ratio 1.0
10.6 G  /tmp/compressiontest/snappy, ratio 2.50943396
```

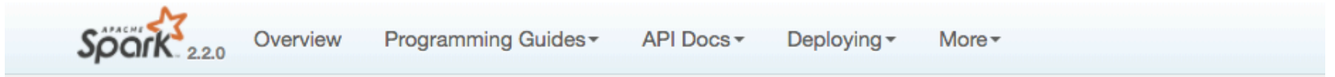


SWIFT as Storage (TCO)

Openstack platform

- 225€ per TB normal volumes (inc. replication)
- 50€ per TB SWIFT object storage
- 23$ per TB at Amazon S3

SWIFT SUPPORT BY SPARK 😄



Accessing OpenStack Swift from Spark

Spark's support for Hadoop InputFormat allows it to process data in OpenStack Swift using the same URI formats as in Hadoop. You can specify a path in Swift as input through a URI of the form `swift://container.PROVIDER/path`. You will also need to set your Swift security credentials, through `core-site.xml` or via `SparkContext.hadoopConfiguration`. Current Swift driver requires Swift to use Keystone authentication method.

Configuring Swift for Better Data Locality

Although not mandatory, it is recommended to configure the proxy server of Swift with `list_endpoints` to have better data locality. More information is available here.

Dependencies

The Spark application should include `hadoop-openstack` dependency. For example, for Maven support, add the following to the `pom.xml` file:

```
<dependencyManagement>
  ...
  <dependency>
    <groupId>org.apache.hadoop</groupId>
    <artifactId>hadoop-openstack</artifactId>
    <version>2.3.0</version>
  </dependency>
  ...
</dependencyManagement>
```

Bad news 😒

```
Caused by: java.net.SocketTimeoutException: COPY https://intern...0a2acc3577a-c000.json failed on exception: ...
    java.net.SocketTimeoutException: Read timed out; For more details see:  http://wiki.apache.org/hadoop/SocketTimeout
at sun.reflect.NativeConstructorAccessorImpl.newInstance0(Native Method)
at sun.reflect.NativeConstructorAccessorImpl.newInstance(NativeConstructorAccessorImpl.java:62)
at sun.reflect.DelegatingConstructorAccessorImpl.newInstance(DelegatingConstructorAccessorImpl.java:45)
at java.lang.reflect.Constructor.newInstance(Constructor.java:423)
at org.apache.hadoop.fs.swift.http.ExceptionDiags.wrapWithMessage(ExceptionDiags.java:90)
at org.apache.hadoop.fs.swift.http.ExceptionDiags.wrapException(ExceptionDiags.java:76)
... 22 more
Caused by: java.net.SocketTimeoutException: Read timed out
at java.net.SocketInputStream.socketRead0(Native Method)
at java.net.SocketInputStream.socketRead(SocketInputStream.java:116)
... 27 more
```

To the dark side

Stocator: A High Performance Object Store Connector for Spark

Gil Vernik[1], Michael Factor[1], Elliot K. Kolodner[1]
Pietro Michiardi[2], Effi Ofer[1] and Francesco Pace[2]
[1]*IBM Research – Haifa* [2]*Eurecom*
[1]{*gilv,factor,kolodner,effio*}*@il.ibm.com* [2] {*michiardi,pace*}*@eurecom.fr*

Submission Type: Research

Abstract

We present Stocator, a high performance object store connector for Apache Spark, that takes advantage of object store semantics. Previous connectors have assumed file system semantics, in particular, achieving fault tolerance and allowing speculative execution by creating temporary files to avoid interference between worker threads executing the same task and then renaming these files. Rename is not a native object store operation; not only is it not the storage and processing are co-located in the same server cluster. Moving data from object storage to HDFS in order to process it and then moving the results back to object storage for long term storage is inefficient. In this paper we present Stocator[22], a high performance storage connector, that enables Hadoop-based analytics engines to work directly on data stored in object storage systems. Here we focus on Spark; our work can be extended to work with the other parts of the Hadoop ecosystem.

No rename 👍

	HEAD Object	PUT Object	COPY Object	DELETE Object	GET Cont.	Total
Hadoop-Swift	25	7	3	8	5	48
S3a	71	5	2	4	35	117
Stocator	4	3	–	–	1	8

Table 2: Breakdown of REST operations by type for the Spark program that creates an output consisting of a single object.

https://arxiv.org/pdf/1709.01812.pdf

Still not happy 😭

```
[13/Dec/2017:23:12:12 +0000] 408 - "PUT https://../part-00022.json.bz2" "tx67f0c939e070417aad7e8-005a31b390" 60.0027
```

408 Request Timeout, why?

Steps of writing Parquet

- First write the magic `PAR1`
- Then write the schema
- Finally write the actual content

In a busy environment..

SparkTC / stocator

Watch 20

Code | Issues 16 | Pull requests 11 | Projects 0 | Wiki | Insights

[SWIFT] Buffer first 64k before sending the data #158

Closed **Fokko** wants to merge 2 commits into `SparkTC:master` from `Fokko:reconnect-after-timeout`

Conversation 16 | Commits 2 | Files changed 5

Fokko commented on 18 Dec 2017 — Contributor

At initializing the SwiftOutputStream class the connection is opened, however it could take some time before the actual data is transmitted over the HTTP connection. If there is no data within 60 seconds, SWIFT will close the connection with a HTTP 408 status. Therefore open the connection when the actual data is send to avoid having an idle connection hanging around.

Tested against the SWIFT service of CloudVPS. Had a lot of timeouts when having very data intensive jobs. After the proposed change, the timeouts where gone.

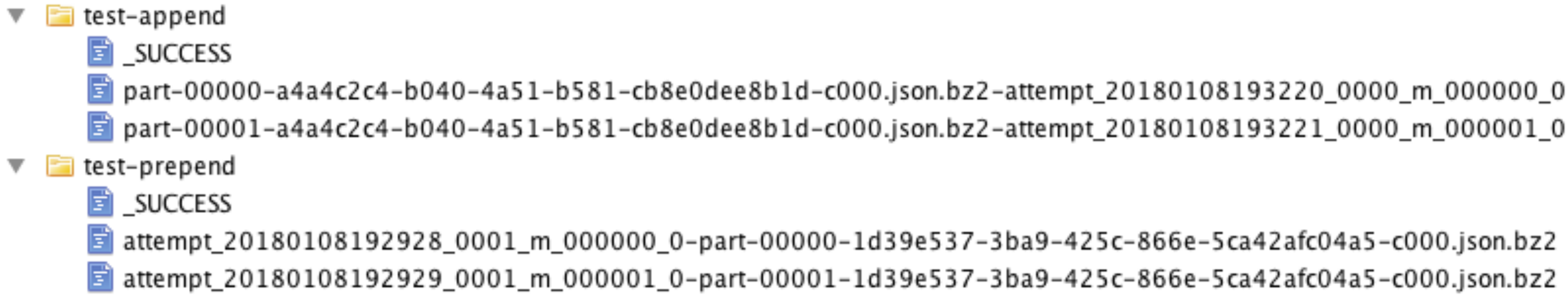
Developer's Certificate of Origin 1.1

https://github.com/SparkTC/stocator/pull/158

Writing works, but after reading

```
scala> val data = "Very long string"

scala> val arr = data.split(" ")
arr: Array[String] = Array( "Very", "long", "string" )

scala> val distData = sc.parallelize(arr)
distData: org.apache.spark.rdd.RDD[String] = ParallelCollectionRDD[0] at parallelize at <console>:28

scala> val df = distData.toDF("word")
df: org.apache.spark.sql.DataFrame = [word: string]

scala> df.write.option("compression", "bzip2").json("swift2d://druid.mobpro/test-append/")

scala> spark.read.json("swift2d://druid.mobpro/test-append/").show()
+--------------------+
|     _corrupt_record|
+--------------------+
|BZh91AY&SY{ΣK]...|
+--------------------+
```

Invalid extension of the filenames 😭



Prepend the attempt to keep the valid extension #165

Open **Fokko** wants to merge 2 commits into `SparkTC:master` from `Fokko:fd-prepend-attempt`

Conversation 20 | Commits 2 | Files changed 7

Fokko commented on 8 Jan • edited ▾ Contributor

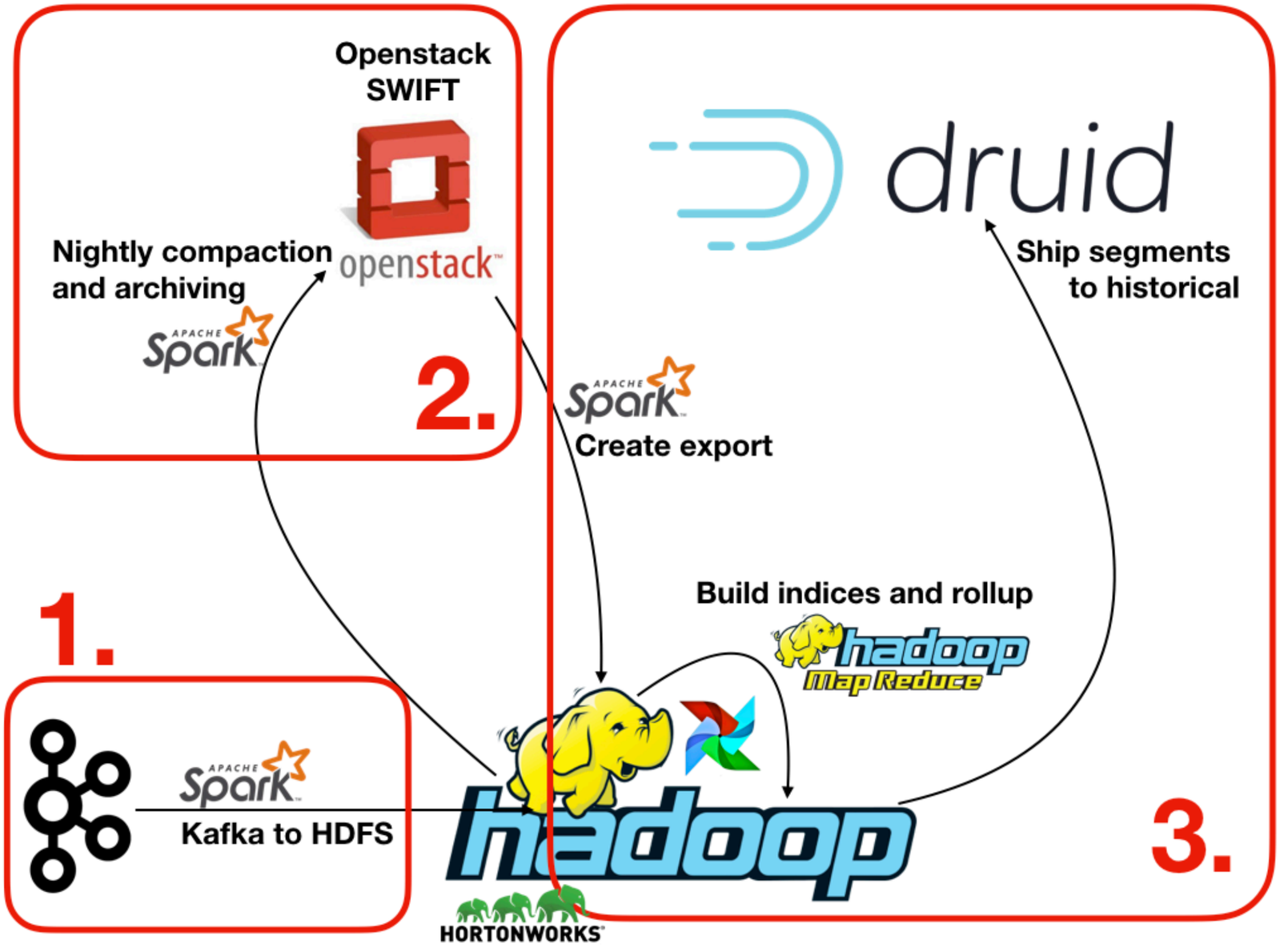
Hi Gil,

I've patched some issues with writing files other than Parquet. We've discussed this earlier, but when writing json/csv, the compression is ignored upon reading. This is because the `attempt_` is appended and therefore the extension isn't picked up anymore.

As from http://comphadoop.weebly.com/

If the input files are compressed, they will be decompressed automatically as they are read by MapReduce, using the filename extension to determine which codec to use. For example, a file ending in .gz can be identified as gzip-compressed file and thus read with GzipCodec.

https://github.com/SparkTC/stocator/pull/165



Druid on SWIFT?

- Rackspace Cloudfiles plugin
- Seems unmaintained
- Druid data is small anyway

Roll-up of data

timestamp	publisher	advertiser	gender	country	clicks	price
2011-01-01T01:01:35Z	bieberfever.com	google.com	Male	USA	0	0.65
2011-01-01T01:03:63Z	bieberfever.com	google.com	Male	USA	0	0.62
2011-01-01T01:04:51Z	bieberfever.com	google.com	Male	USA	1	0.45
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Female	UK	0	0.87
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Female	UK	1	0.99
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Female	UK	1	1.53

Roll-up:

timestamp	publisher	advertiser	gender	country	clicks	price
2011-01-01T01:04:51Z	bieberfever.com	google.com	Male	USA	1	1.72
2011-01-01T01:00:00Z	ultratrimfast.com	google.com	Female	UK	2	3.39

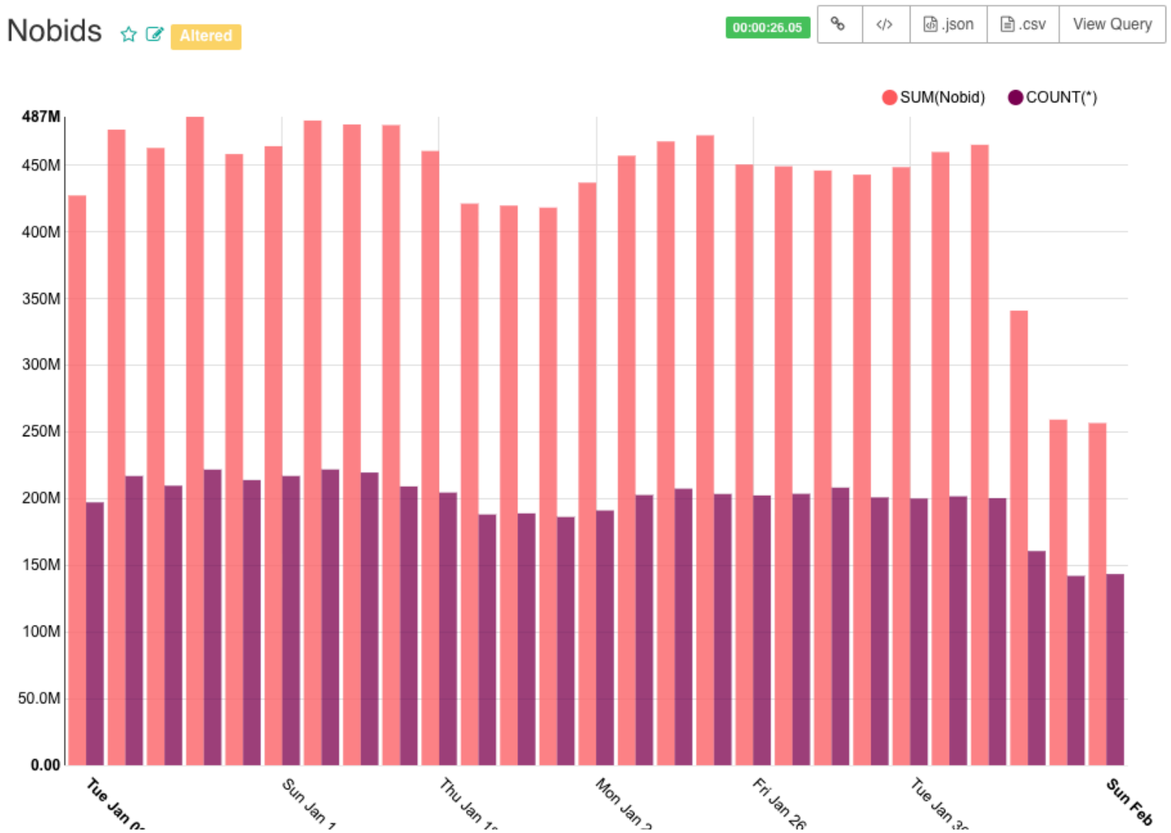
Configurable on index time

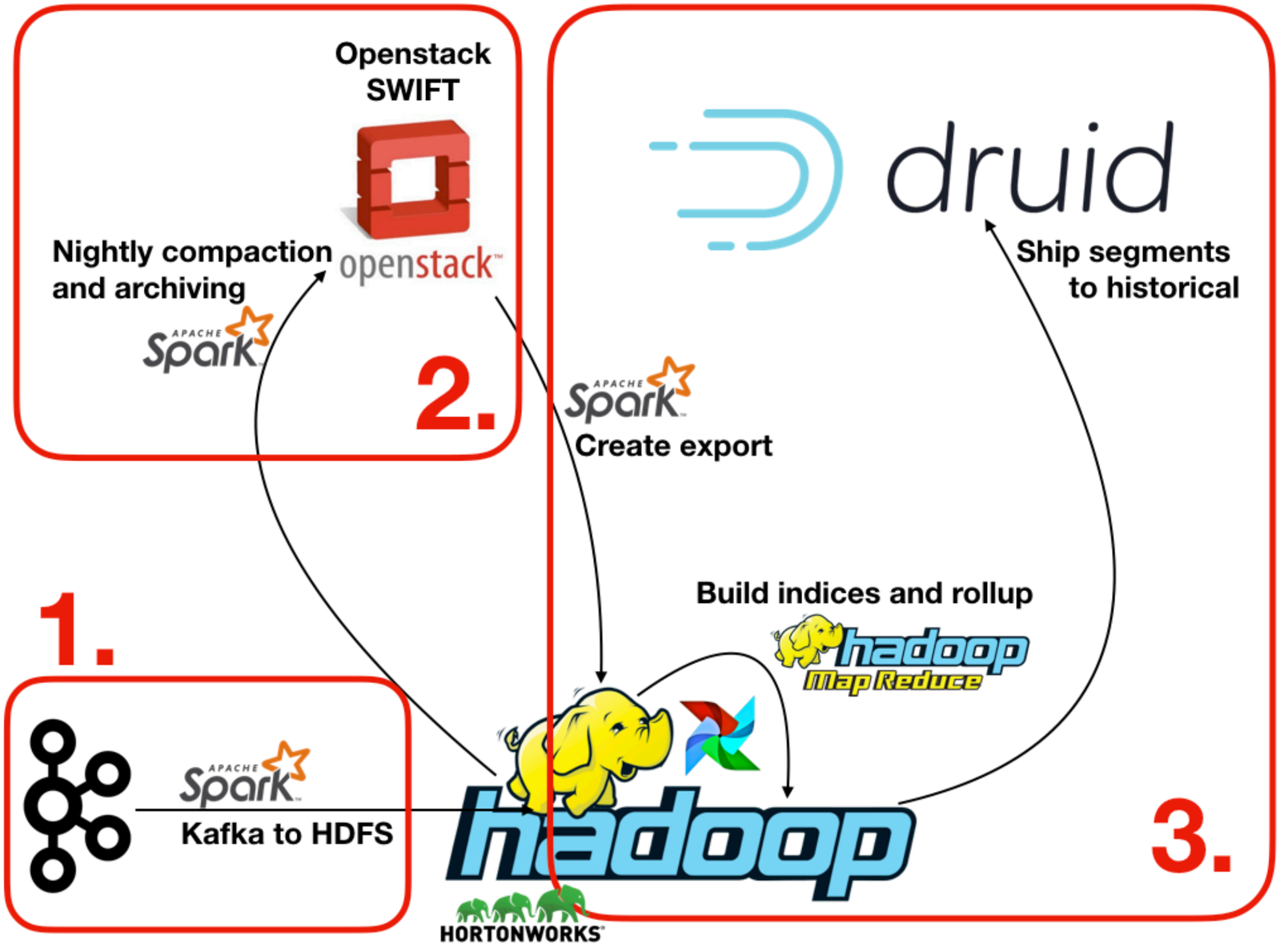
One day of Bids data

```
root@hadoopedge01:/tmp/druid#hdfs dfs -get /druid/data/datasources/Bids/20171211.../0_index.zip /tmp/druid
root@hadoopedge01:/tmp/druid# unzip 0_index.zip
root@hadoopedge01:/tmp/druid# ls -lah
total 712M
drwxr-xr-x  3 root root 4.0K Jan 22 11:00 .
drwxrwxrwt 31 root root 4.0K Jan 22 11:00 ..
-rw-r--r--  1 root root 452M Jan 22 12:17 00000.smoosh
-rw-r--r--  1 root root 261M Jan 22 11:00 0_index.zip
drwxr-xr-x  3 root root 4.0K Jan 22 10:58 20171211T000000.000Z_20171212T000000.000Z
-rw-r--r--  1 root root   29 Jan 22 12:17 factory.json
-rw-r--r--  1 root root 2.3K Jan 22 12:17 meta.smoosh
-rw-r--r--  1 root root    4 Jan 22 12:17 version.bin
```

About 1% of the original (decompressed)

Roll-up in Superset

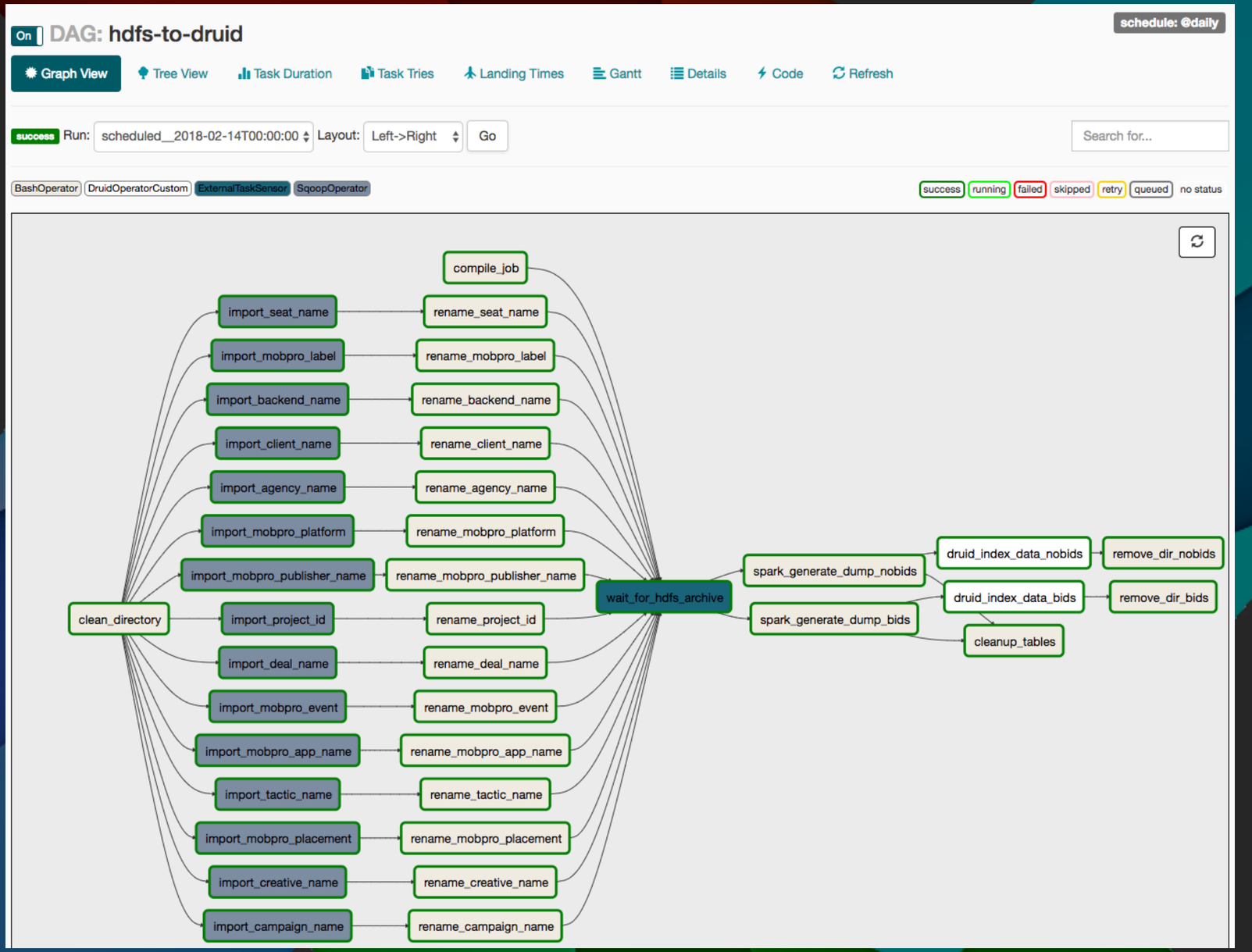


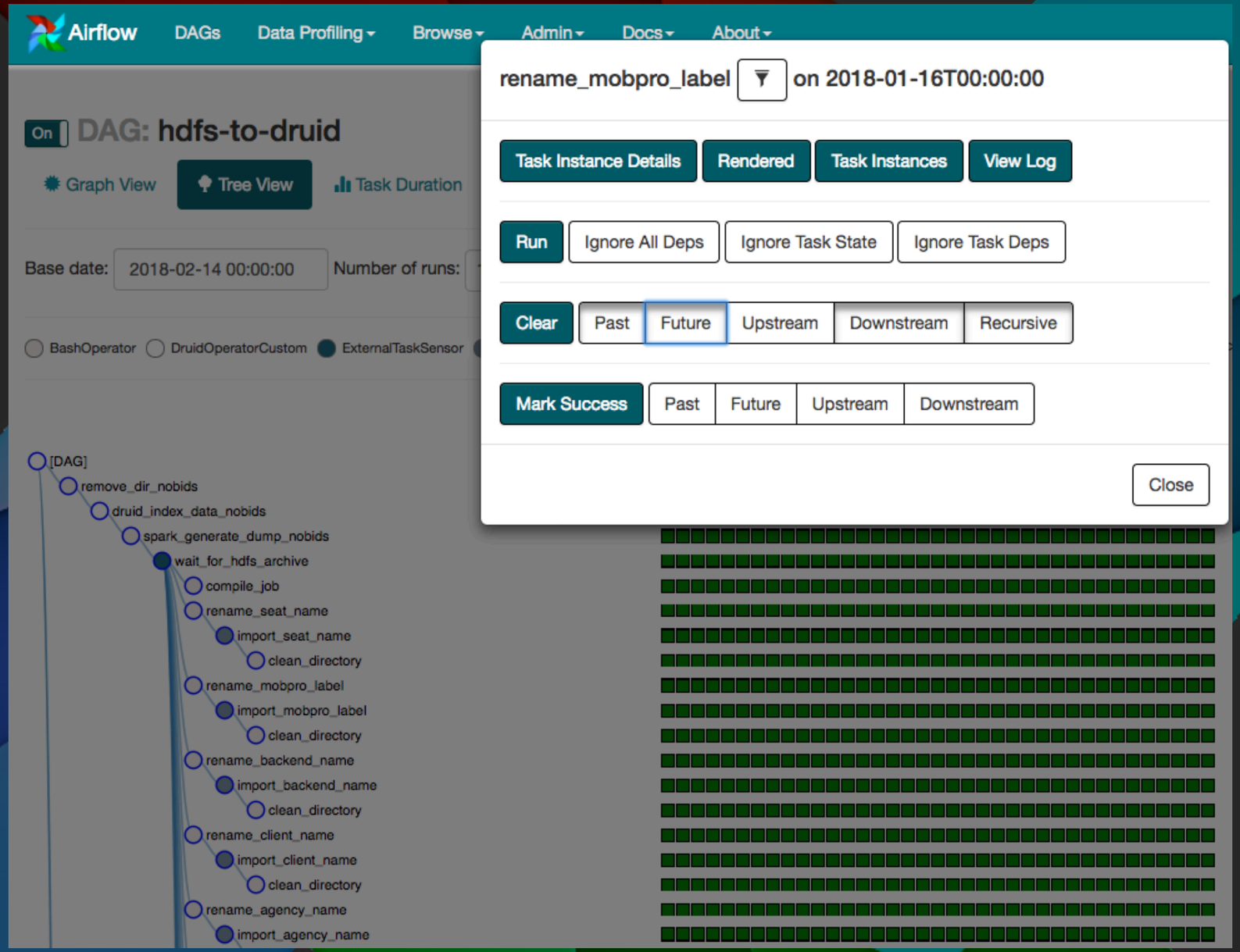


Update schema and reindex the data

Airflow to the rescue

- Monitor the indexing process
- Changes to the Druid schema
- Easy rebuilding of the data





Future music 

- Ingesting on Spark
- Replace Sqoop by SparkJDBC
- Add streaming ingestion

Thank you for your attention

Any questions?