Pivotal

Federated SQL on Hadoop and Beyond: Leveraging Apache Geode to Build a Poor Man's SAP HANA

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Whoami

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Query = Function (All Data)

How Compute Arbitrary Functions on Arbitrary Data

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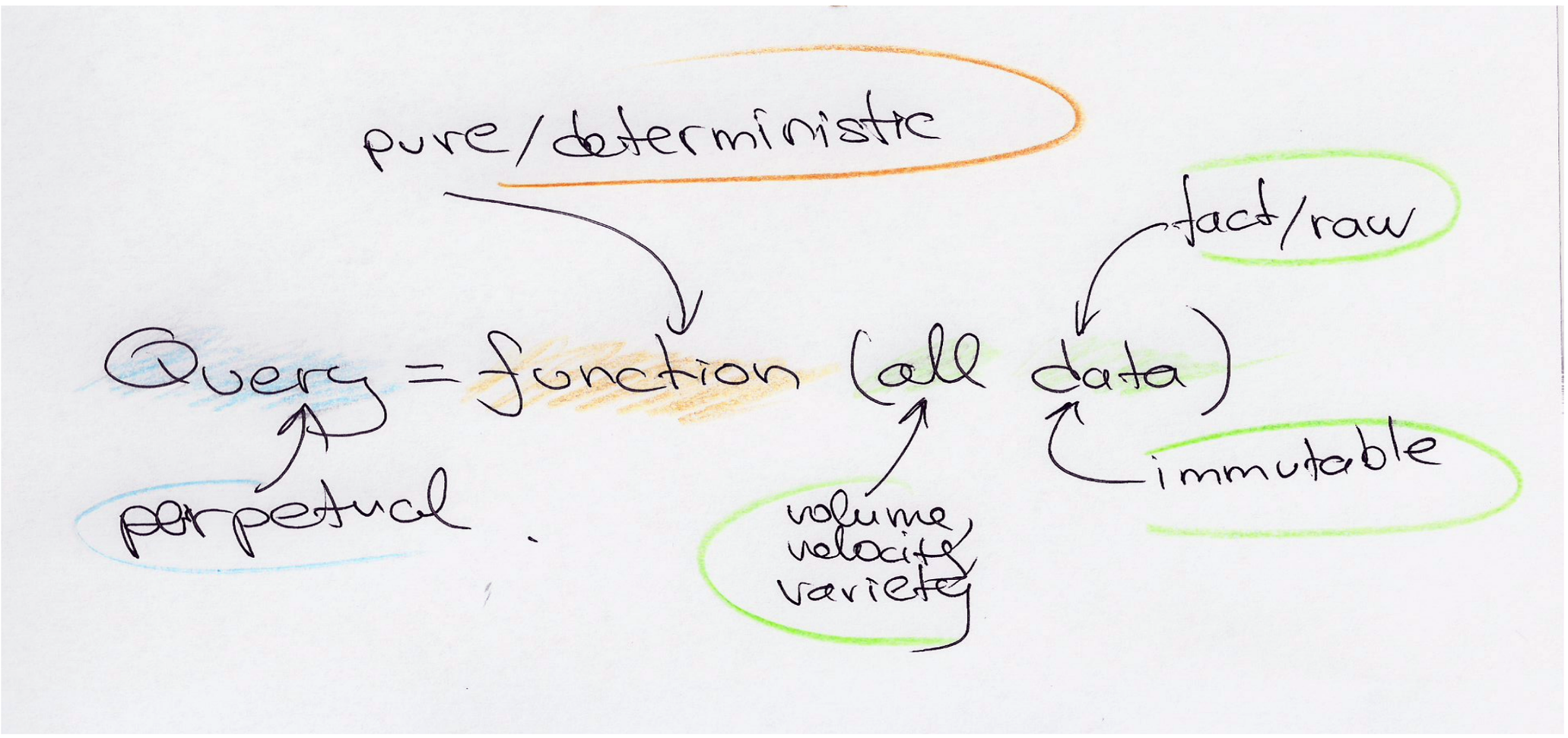
- Data Systems - Principles
- Use Case: OLTP and OLAP Data Systems Integration
- Passive Data Synchronization (Demo)
- Federated Queries With HAWQ
  - HAWQ Web Tables
  - HAWQ PXF Architecture
    - Geode PXF (Demo)

Data Systems

Arbitrary Function
All Data

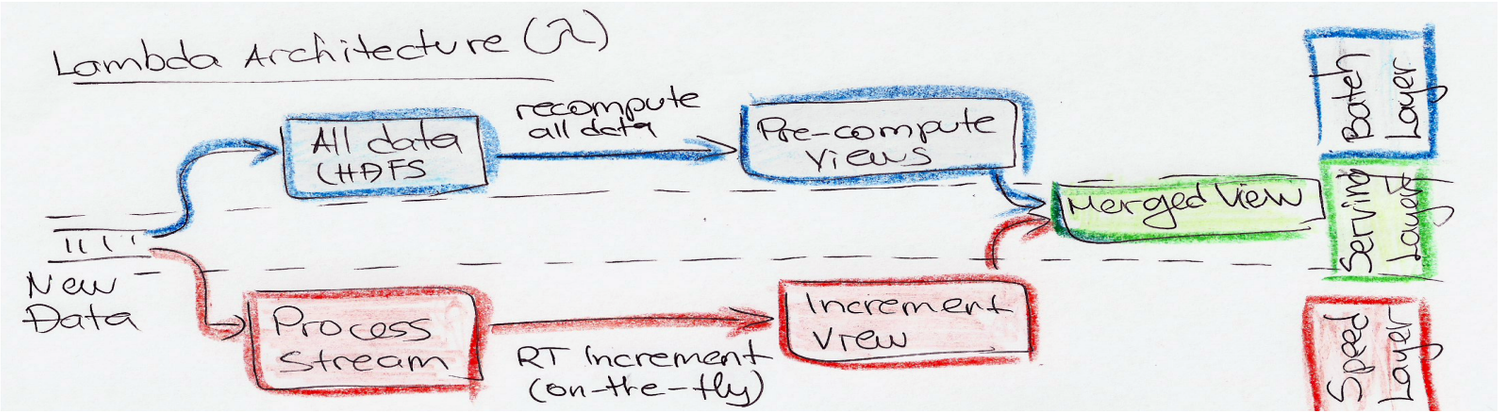


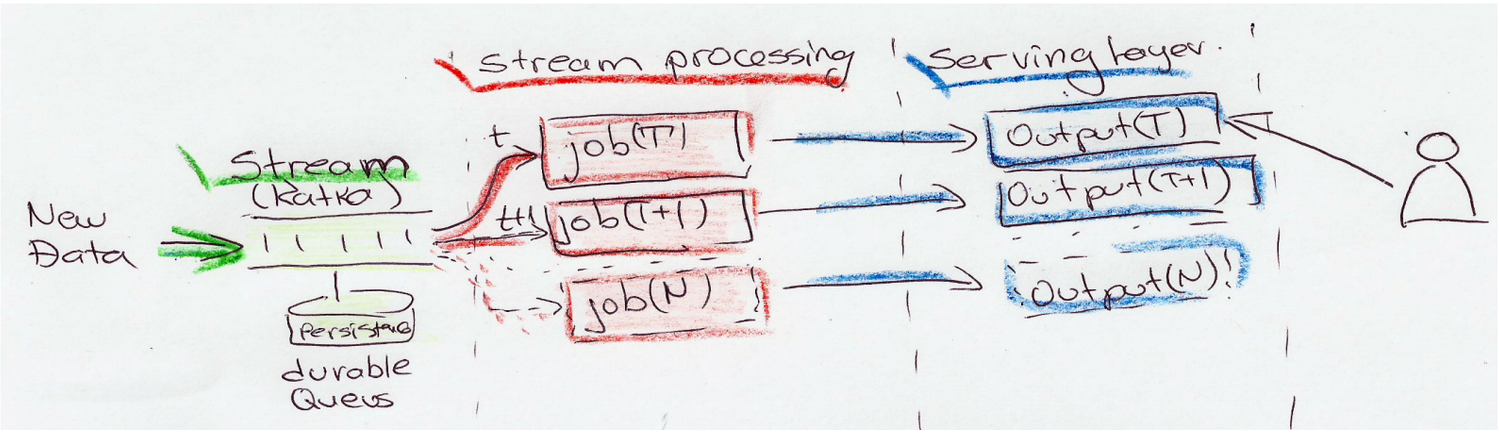
Data System Principles

- Fact Data
- Immutable Data
- Deterministic Functions
- Data-Lineage
- Data Locality - space or temporal
- All Data vs. Working Set

Architectural Patterns

- Data Lake
- Lambda
- Kappa
- Tachyon
- …





Use Case:
OLTP and OLAP Integration

Use Case

- Integrate an In-Memory Data Grid (Geode/ GemFire) with SQL-On-Hadoop analytical system (HAWQ)
- Provide an unified data view across both systems
- Use Geode as Slowly Changing Dimensions (SCDs) store for HAWQ
- Keep the Operational and Historical data in Sync

OLTP: Apache Geode

- Cache - Performance / Consistency / Resiliency
- Region - Highly available, redundant, distributed Map

China Railway Corporation

5,700 train stations
4.5 million tickets per day
20 million daily users
1.4 billion page views per day
40,000 visits per second

Indian Railways

7,000 stations
72,000 miles of track
23 million passengers daily
120,000 concurrent users
10,000 transactions per minute

OLAP: HAWQ
SQL on Hadoop

- Built around a Greenplum **MPP** DB (C and C++)
- Native on **HDFS** and **YARN**
- Storage formats: **Parquet**, **HDFS** and Avro
- **100% ANSI SQL** compliant: SQL-92/99/2003…
- **Extensible** - Web Tables, **PXF**
- **ODBC** and **JDBC** connectivity
- **MADLib** - Comprehensive **Machine Learning** library

HAWQ - TPC-DS

- **TPC-DS** benchmark in **half the wall clock time** compared to **Impala**
- Outperforms Impala by overall **454%**
- Additional of **344%** of performance improvement for **Hive** on complex queries
- **100%** of the **TPC-DS queries**. Unlike Impala or Hive
- References: http://bit.ly/1NUDcLI, https://github.com/dbbaskette/pivbench

Spring XD

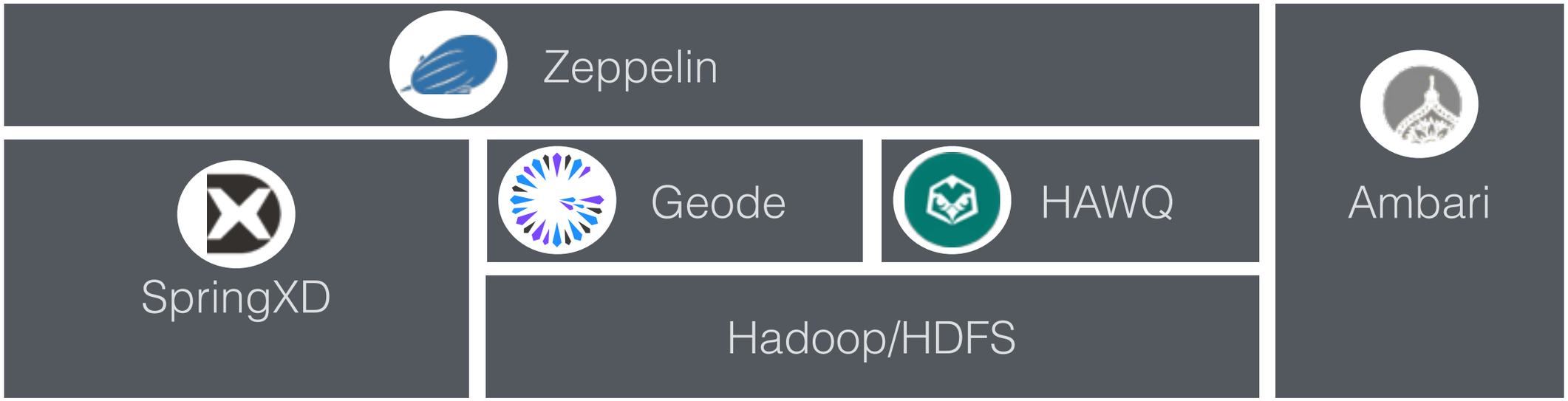
Orchestrates and automates all steps across multiple data stream pipelines

- HTTP
- Tail
- File
- Mail
- **Twitter**
- Gemfire
- Syslog
- TCP
- UDP
- JMS
- RabbitMQ
- MQTT
- **Kafka**
- Reactor TCP/UDP

- Filter
- Transformer
- Object-to-JSON
- JSON-to-Tuple
- Splitter
- Aggregator
- HTTP Client
- Groovy Scripts
- Java Code
- JPMML Evaluator
- **Spark Streaming**

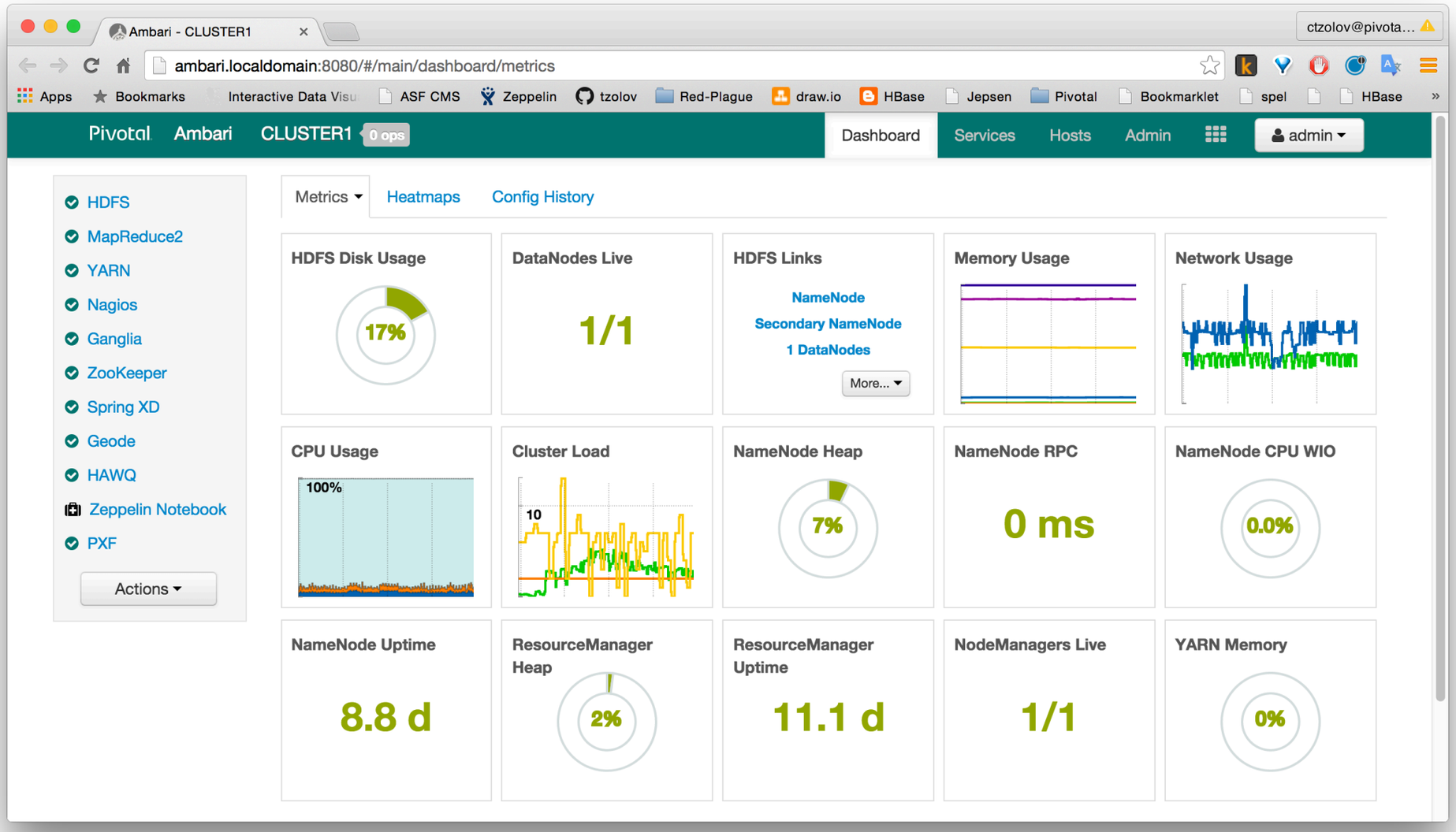
- File
- HDFS
- JDBC
- TCP
- Log
- Mail
- RabbitMQ
- Gemfire
- Splunk
- MQTT
- **Kafka**
- Dynamic Router
- Counters

Integration Stack



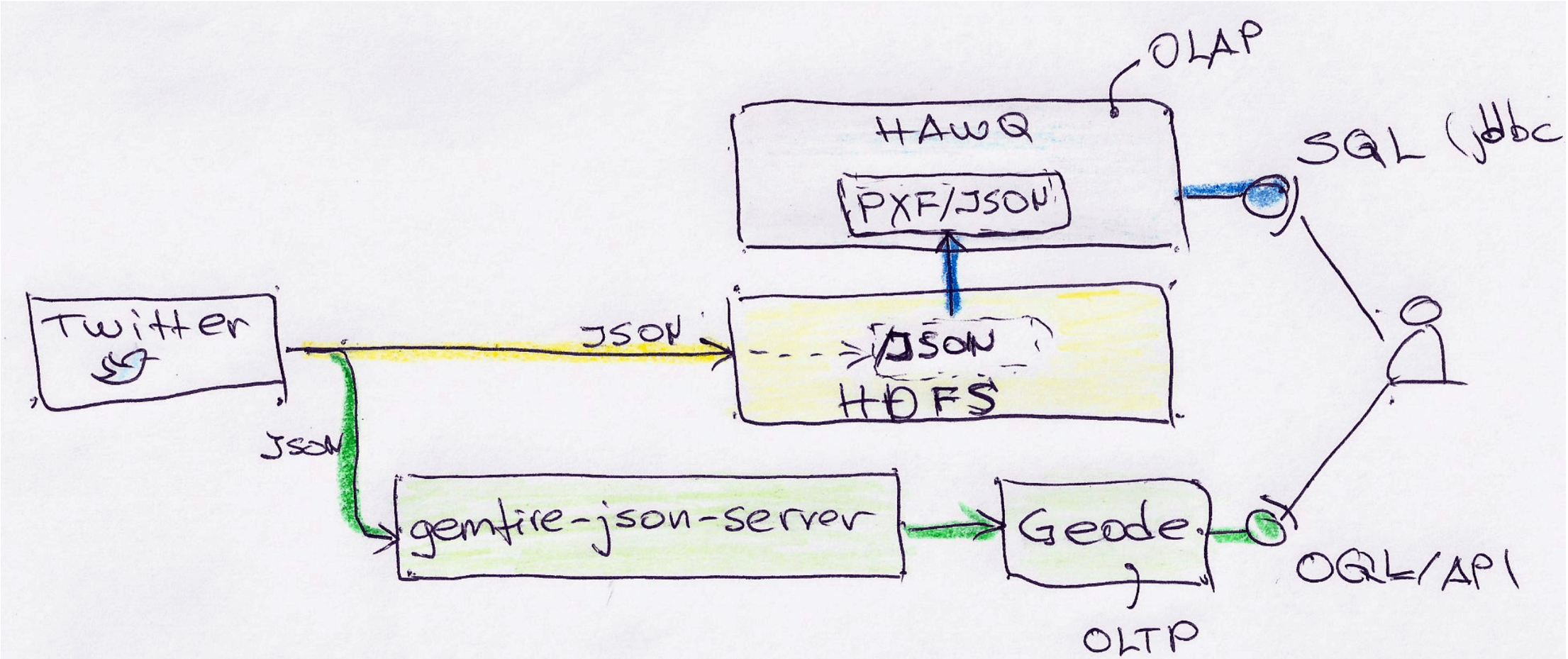
Apache HDFS	Data Lake - PHD or HDP Hadoop
Apache HAWQ	SQL on Hadoop (OLAP)
Apache Geode	In-memory data grid (OLTP)
Spring XD	Integration and Streaming Runtime
Apache Ambari	Manages All Clusters
Apache Zeppelin	Web UI for interaction with Data Systems

Ambari Management



Passive Data Synchronization

Passive Sync Architecture



Passive Sync - Demo

Zeppelin Notebook Interpreter Connected

[Geode] Tweets Count FINISHED

[SpringXD] Create Tweet Search To Geode Stream FINISHED

```
%xd
tweets = twittersearch --query=Obama --outputType=application/json | hdfs --fsUri=hdfs://phd1.localdomain:8020 --directory=/user/zeppelin/xd/tweets --rollover=200
geodeTap = tap:stream:tweets > gemfire-json-server --useLocator=true --host=ambari.localdomain --port=10334 --regionName=regionTweet1 --keyExpression=payload.getField('id_str')
```

[HAWQ] Create Tweet JSON PXF Table FINISHED

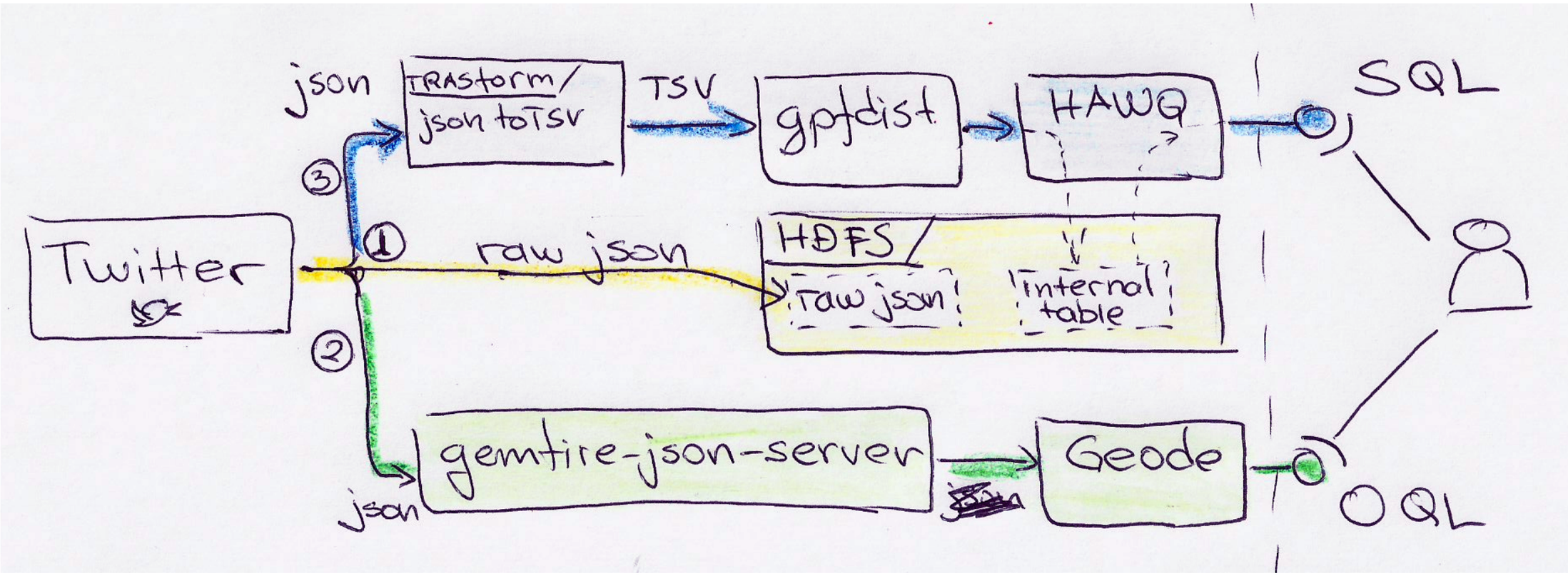
```
%psql.sql
DROP EXTERNAL TABLE IF EXISTS hdfs_json_pxf;
CREATE EXTERNAL TABLE hdfs_json_pxf (
   created_at TEXT,
   id_str TEXT,
   text TEXT,
   source TEXT,
   "user.id" INTEGER,
   "user.location" TEXT,
   "coordinates.coordinates[0]" DOUBLE PRECISION,
   "coordinates.coordinates[1]" DOUBLE PRECISION
)
LOCATION('pxf://phd1.localdomain:50070/user/zeppelin/xd/tweets?PROFILE=JSON') FORMAT 'CUSTOM' (FORMATTER='pxfwritable_import');
```

[HAWQ] Aggregate Tweet Query FINISHED

```
%psql.sql select created_at, id_str, text, "user.id", "user.location" from hdfs_json_pxf limit 10;
```

created_at	id_str	text	user.id	user.location
Mon Sep 07 13:19:13 +0000 2015	640,876,981,123,457,024	Presume Obama mejoramiento laboral de Estados Unidos http://t.co/aJjDPla7Wo	-1,928,666,176	Queretaro

Passive Sync Improved (gpfdist)



Passive Sync Improved Demo

Zeppelin Notebook Interpreter Connected

Transform JSON Tweets Into TSV Rows (TweetJsonToTsv.Groovy) FINISHED

[GEODE] (Re)Create Tweet Region ERROR

[HAWQ] (Re)Create XDSINK Table FINISHED

[Spring XD] Create Ingestion Pipelines FINISHED

```
%xd.stream
tweets = twittersearch --query=${tweetQuery=Obama} --outputType=application/json | hdfs --fsUri=hdfs://phd1.localdomain:8020 --directory=/user/zeppelin/xd/tweets --rollover=200

geodeTap = tap:stream:tweets > gemfire-json-server --useLocator=true --host=ambari.localdomain --port=10334 --regionName=regionTweet --keyExpression=payload.getField('id_str')

hawqTap =  tap:stream:tweets > transform --script=file:/vagrant/tweetJsonToTsv.groovy  | gpfdist --dbHost=phd1.localdomain --dbPort=5532 --table=xdsink --batchTimeout=5 --batchCount
=111 --batchPeriod=0 --flushCount=100 --flushTime=2 --rateInterval=200
```

regionName regionTweet

tweetQuery SpringOne

[tweets, geodeTap, hawqTap] : DESTROYED

Took 23 seconds. (outdated)

[GEODE] Explore Tweet Region FINISHED

```
%geode.oql
-- select created_at, user.name, text  from /regionTweet
select count(*) from /regionTweet
```

Federated Queries With HAWQ

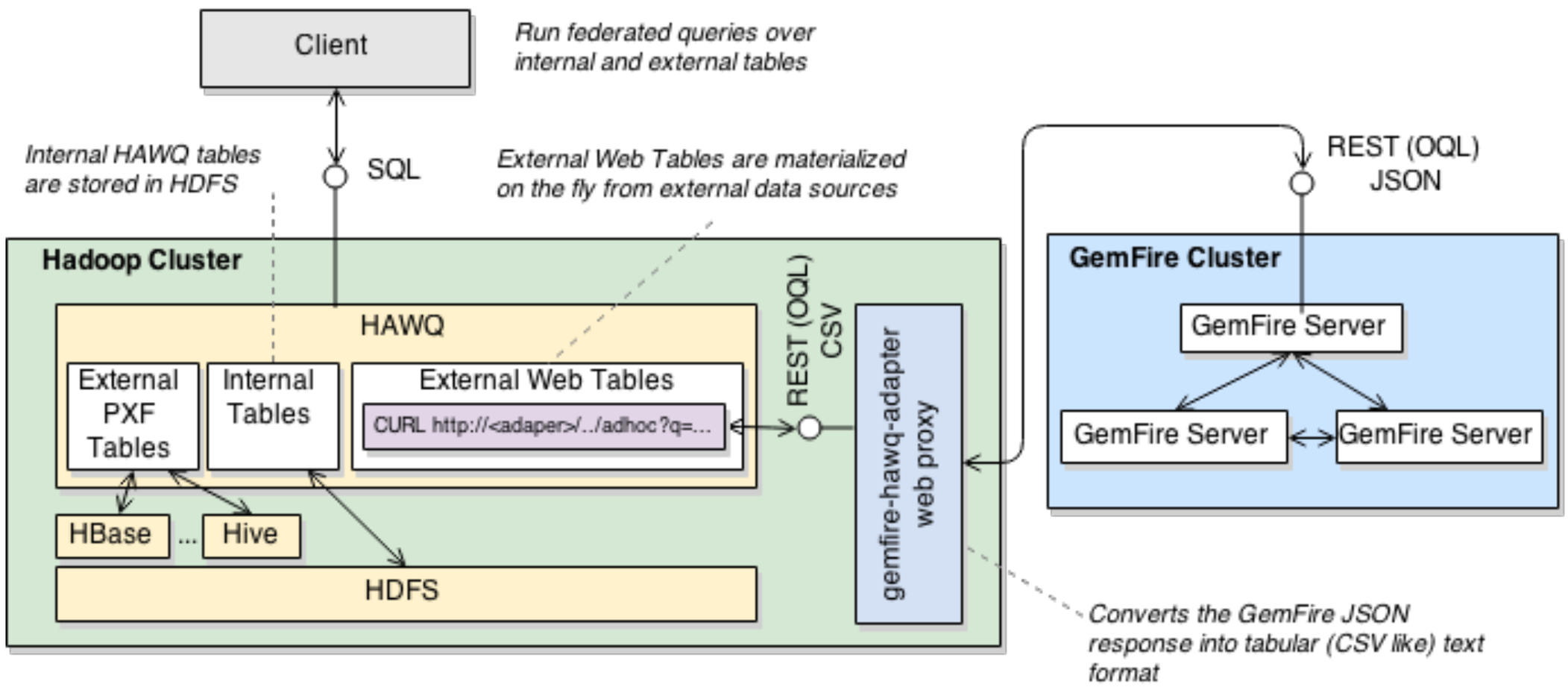
HAWQ Web Tables

- HAWQ **Web Table** - access dynamic data sources on a web server or by executing OS scripts
- Leverage **Geode REST** API and **OQL**
- SpringBoot Controller to convert JSON into TSV

```
CREATE EXTERNAL WEB TABLE EMPLOYEE_WEB_TABLE (...)
EXECUTE E'curl http://<adapter proxy>/gemfire-api/v1/
  queries/adhoc?q=<URLencoded OQL statement>'
ON MASTER FORMAT 'text' (delimiter '|' null 'null' escape E'\\');
```

HAWQ Web Tables Architecture

Access dynamic data sources on a web server or by executing OS scripts.



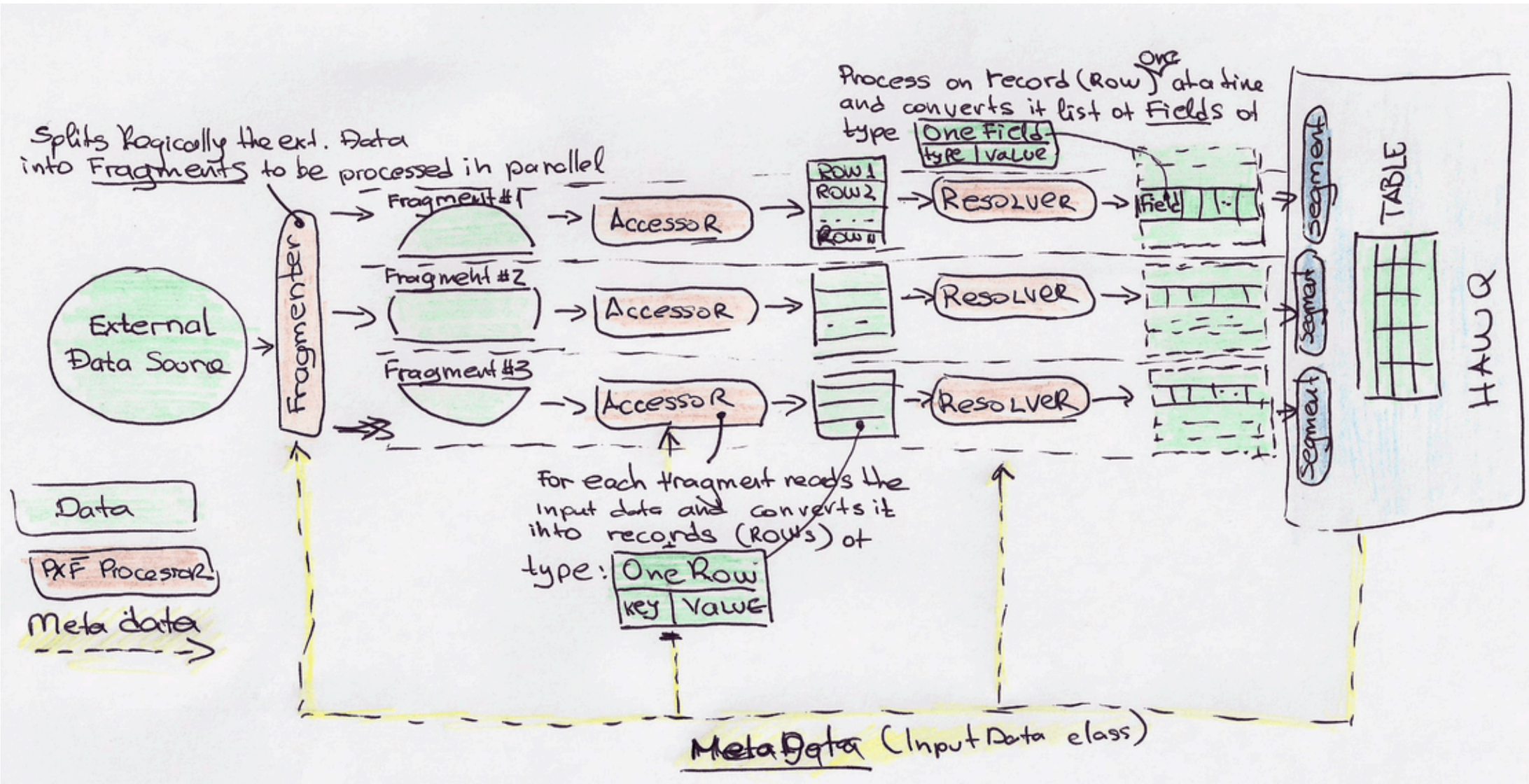
HAWQ Web Tables Limitations

- Not Scalable
- No **Push Down Filters**
- Static
- No Compression
- Requires Additional Components

Pivotal Extension Framework (PXF)

- Java-Based
- Parallel, High Throughput Data Access
- Heterogeneous Data Sources.
- ANSI-compliant SQL On Any Dataset
- Wide variety of PXF plugins

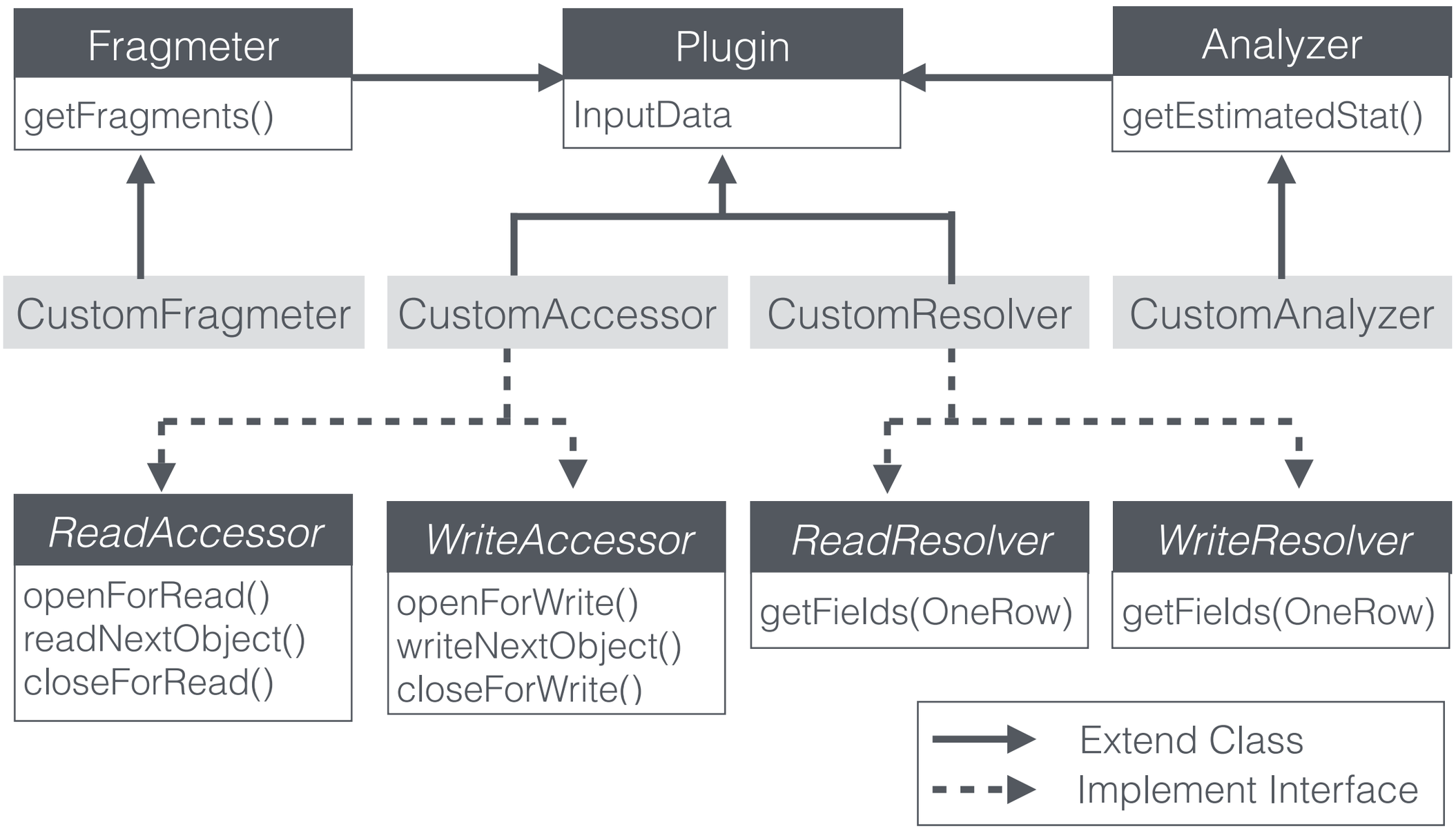
PXF Architecture



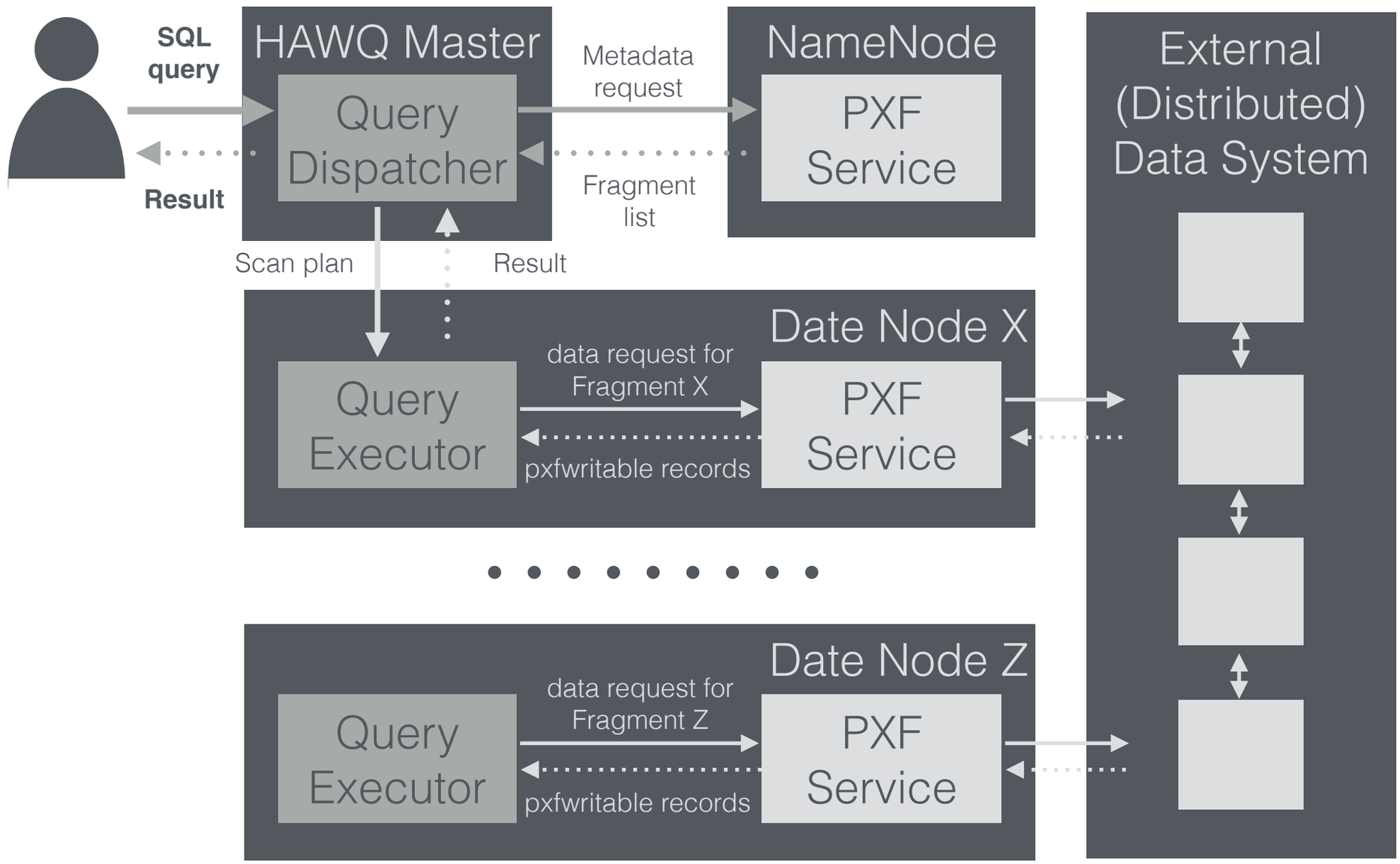
PXF Data Model

- **Data Source** is modeled as a collection of one or more **Fragments**.
- Each **Fragment** consists of many **Rows** that in turn are split into typed **Fields**.
- **Analyzer** (optional) provides PXF statistical data for the HAWQ query optimizer
- **Metadata** about the data source locations, access attributes, table schemas formats, SQL queries filters, etc

PXF Processors



PXF Deployment Model



PXF External Tables

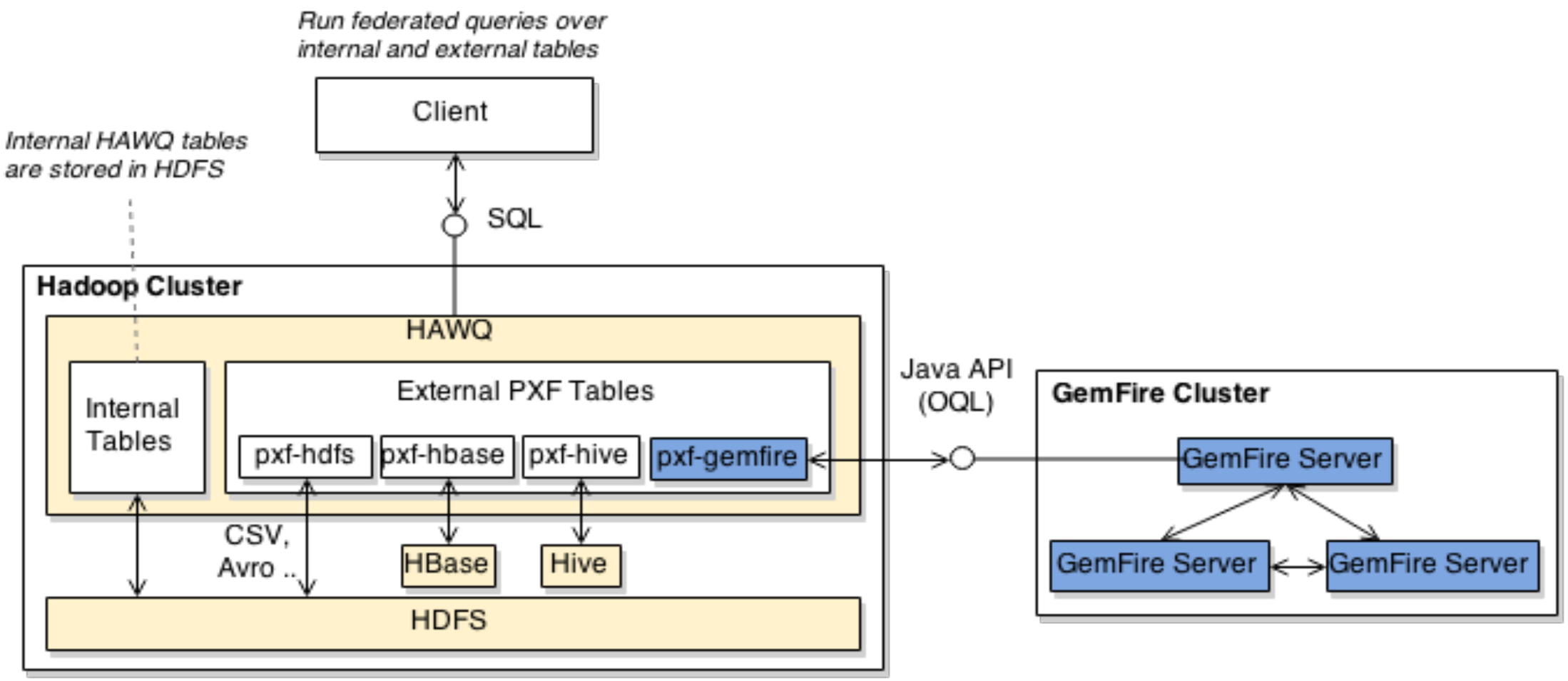
```
CREATE EXTERNAL TABLE ext_table_name
    <Attribute list, …>

LOCATION('pxf://<host>:<port>/path/to/data?
    FRAGMENTER=package.name.FragmenterForX&
    ACCESSOR=package.name.AccessorForX&
    RESOLVER=package.name.ResolverForX&
    <Other custom user options>=<Value>’
)
FORMAT ‘custom'(formatter='pxfwritable_import');
```

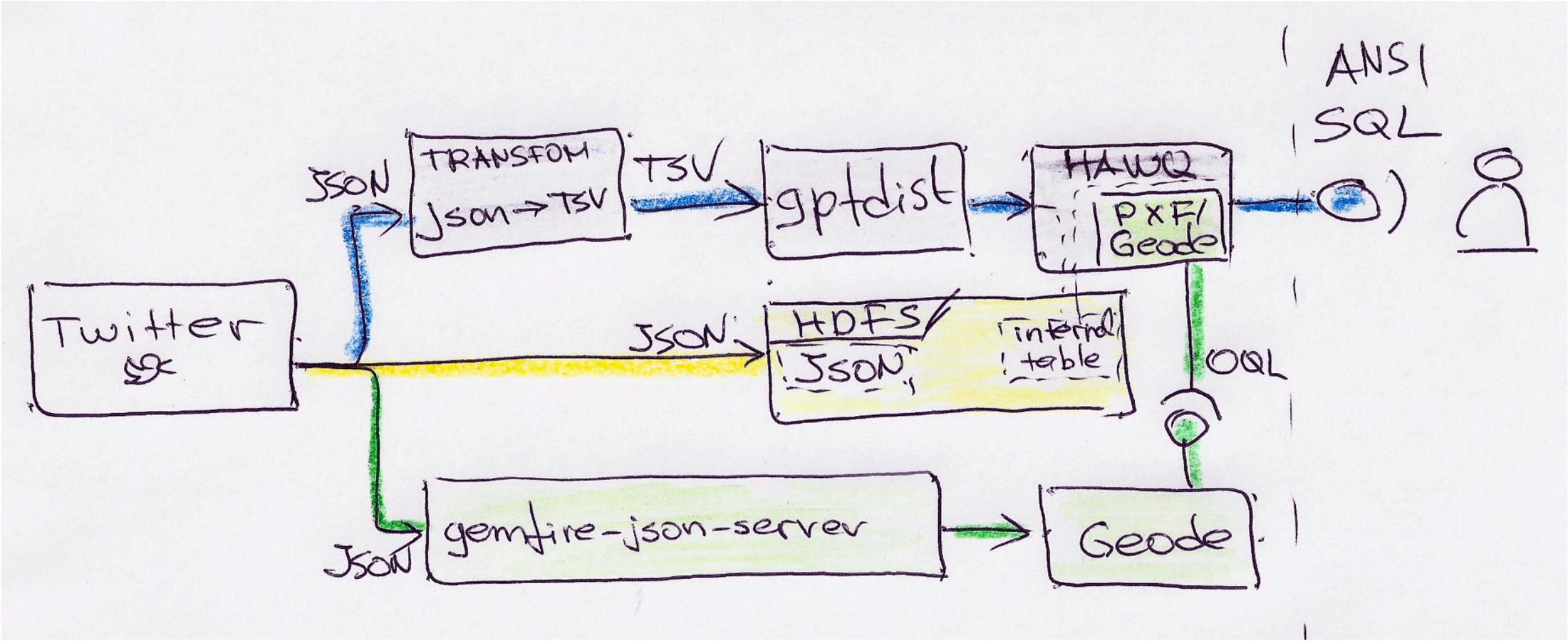
PXF Gallery

- HdfsTextSimple
- HdfsTextMulti
- Hive
- HiveRC
- HiveText
- Hbase
- Avro
- Accumulo
- Casandra
- JSON
- Redis
- Geode/Gemfire
- Pipes

HAWQ PXF/Geode



Federated Queries with PXF/ Geode - Architecture



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   id_str TEXT,
   text TEXT,
   source TEXT,
   "user.id" INTEGER,
   "user.location" TEXT,
   "coordinates.coordinates[0]" DOUBLE PRECISION,
   "coordinates.coordinates[1]" DOUBLE PRECISION
)
LOCATION('pxf://phd1.localdomain:50070/user/zeppelin/xd/tweets?PROFILE=JSON') FORMAT 'CUSTOM' (FORMATTER='pxfwritable_import');
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```

created_at	id_str	text	user.id	user.location
Mon Sep 07 13:19:13 +0000 2015	640,876,981,123,457,024	Presume Obama mejoramiento laboral de Estados Unidos http://t.co/aJjDPla7Wo	-1,928,666,176	Queretaro

Stay Connected

- PXF Maven Repository: https://bintray.com/big-data/maven/pxf/view
- PXF Community Plugins: https://bintray.com/big-data/maven/pxf-plugins/view
- Apache HAWQ: https://github.com/apache/incubator-hawq
- Apache Geode: https://github.com/apache/incubator-geode
- Apache Zeppelin: https://zeppelin.incubator.apache.org
- Spring XD: http://projects.spring.io/spring-xd/