1 Data Ingestion - Stats

Kafka Stats

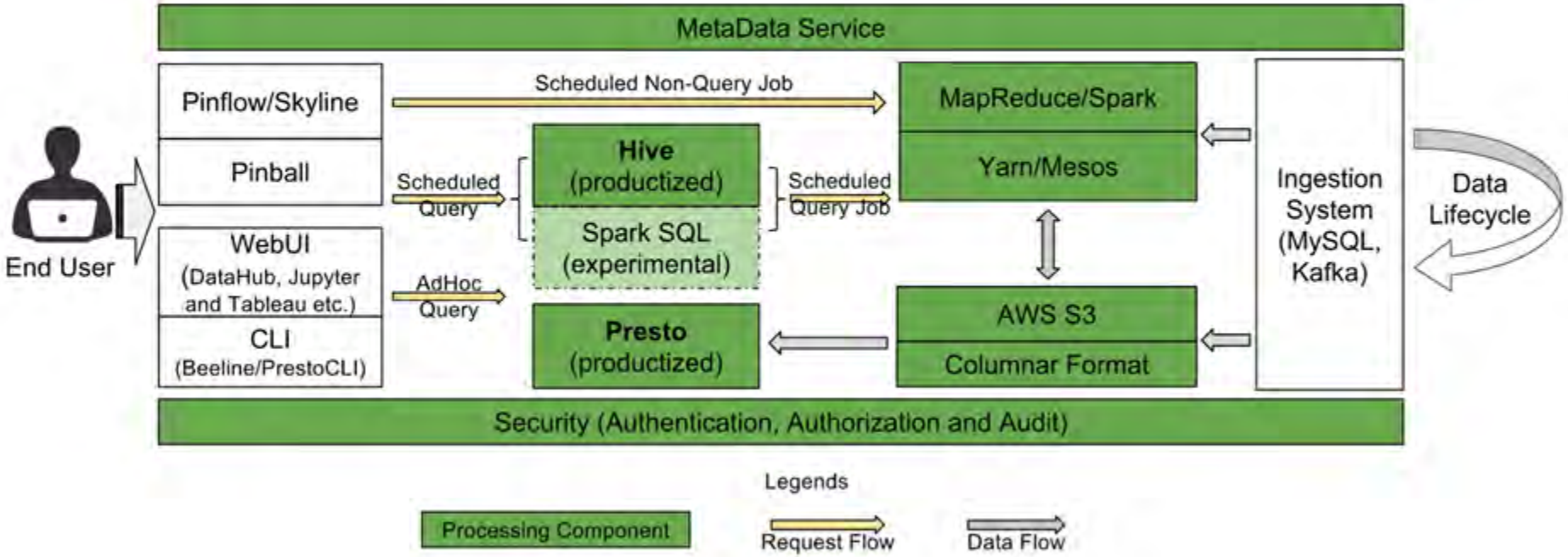
- ~150B Messages/Day
- ~400T Bytes/Day
- ~1000 Kafka Topics
- ~1400 Kafka Brokers

DB Dump Stats

- ~80 Table/Day
- ~100T Bytes/Day

Doctor Kafka https://github.com/pinterest/doctorkafka

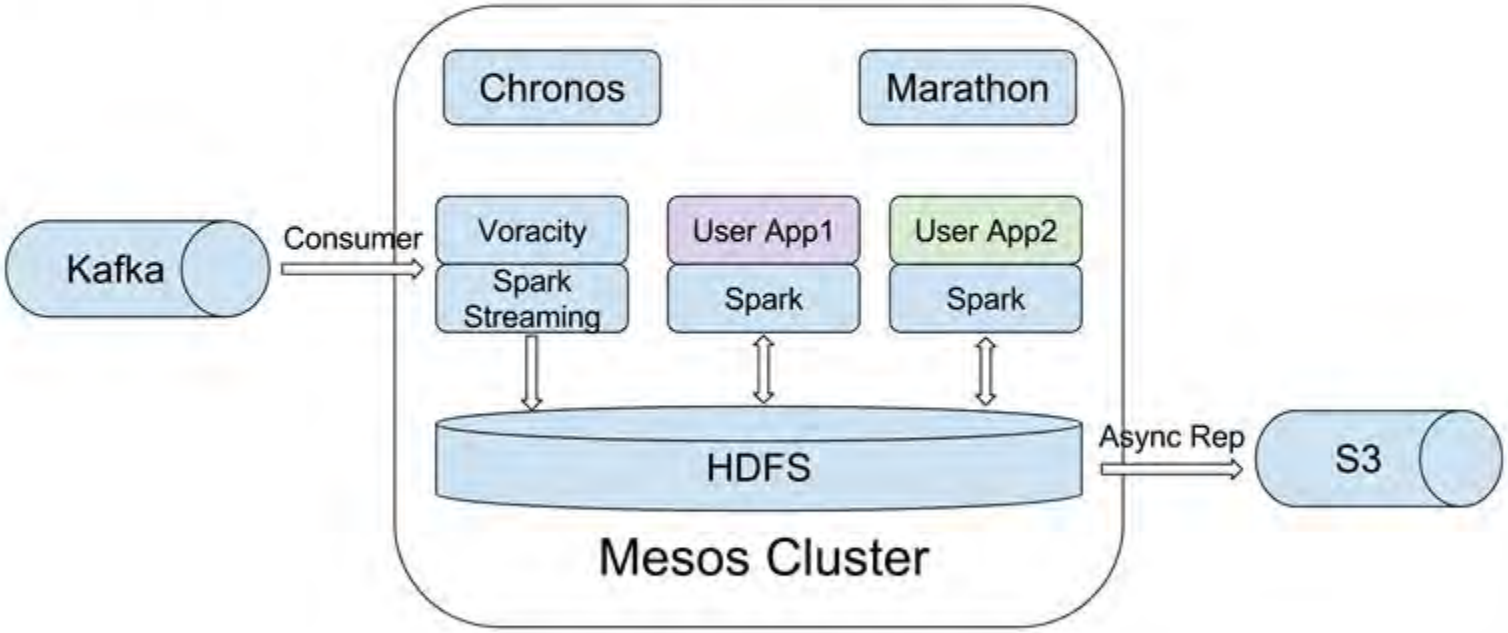
Data Processing Overview



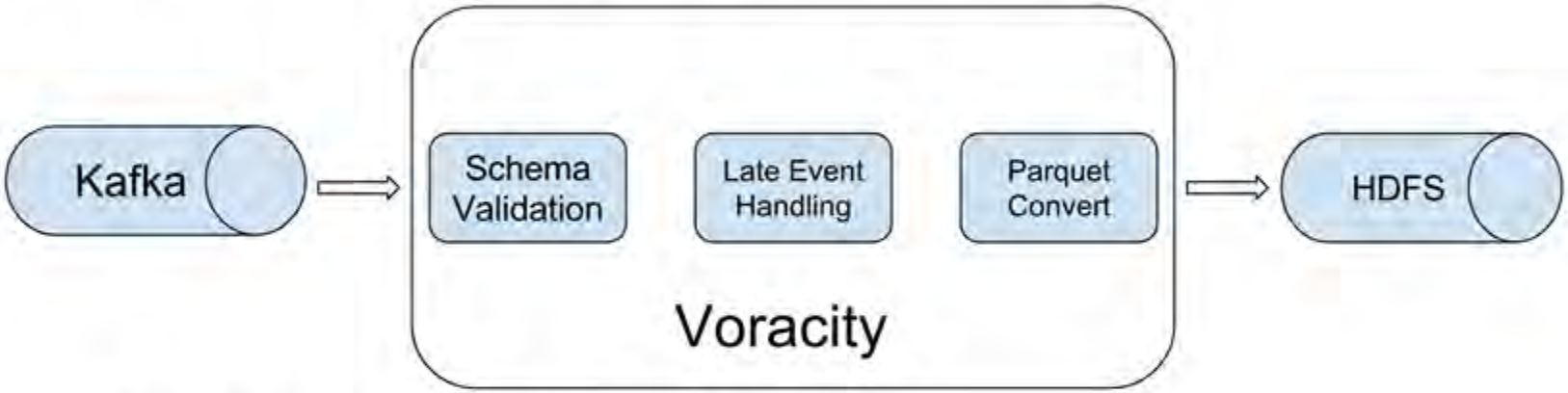
Agenda

1. Data Ingestion
2. **Streaming**
3. Hive
4. Presto
5. Workflow

2 Streaming - Overview



2 Streaming - Voracity



- Schema Validation
  - Filter out malformed records
- Late Arrival Event Handling
  - Move late event to proper bucket
- Parquet Conversion
  - Json/Thrift -> Parquet

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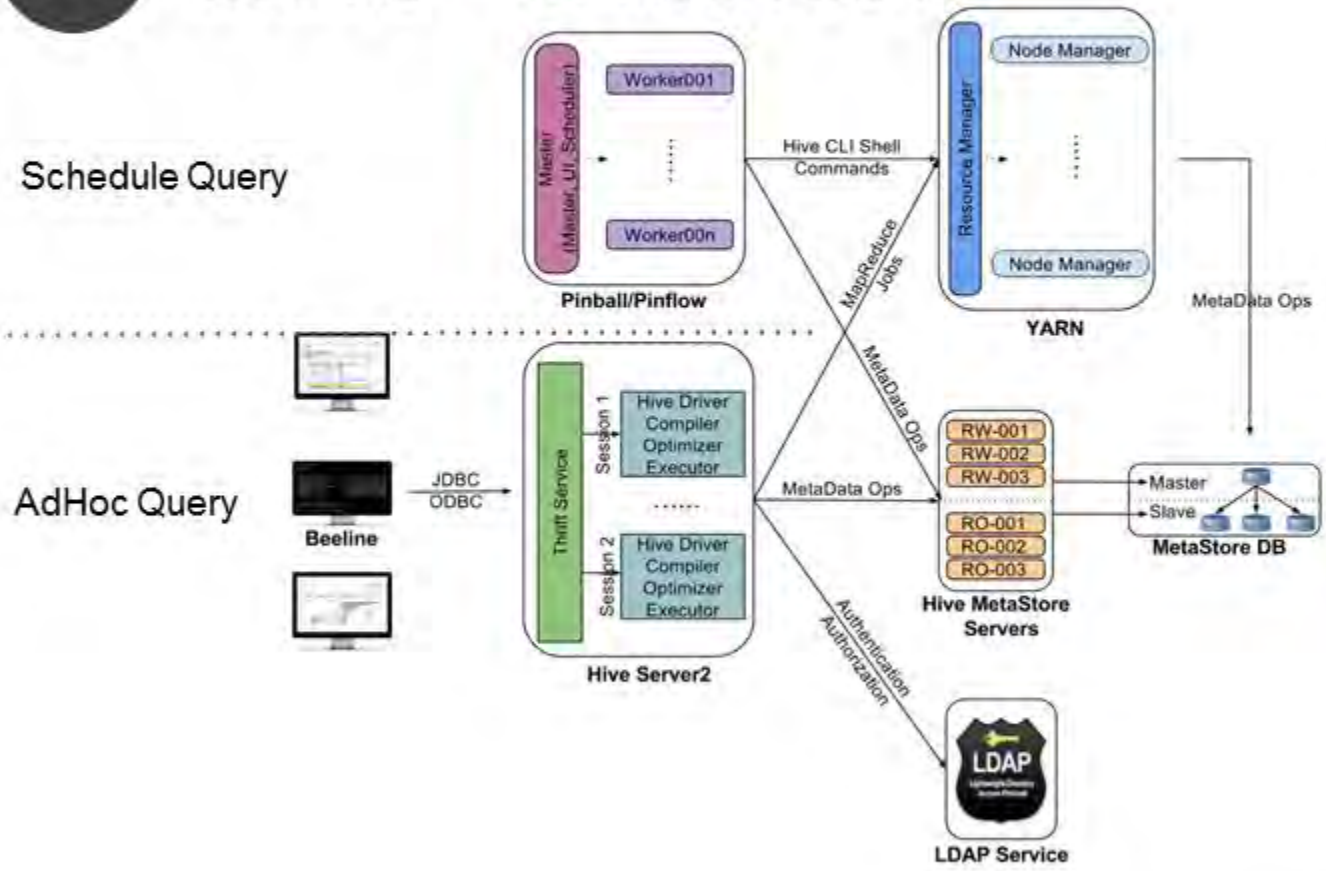
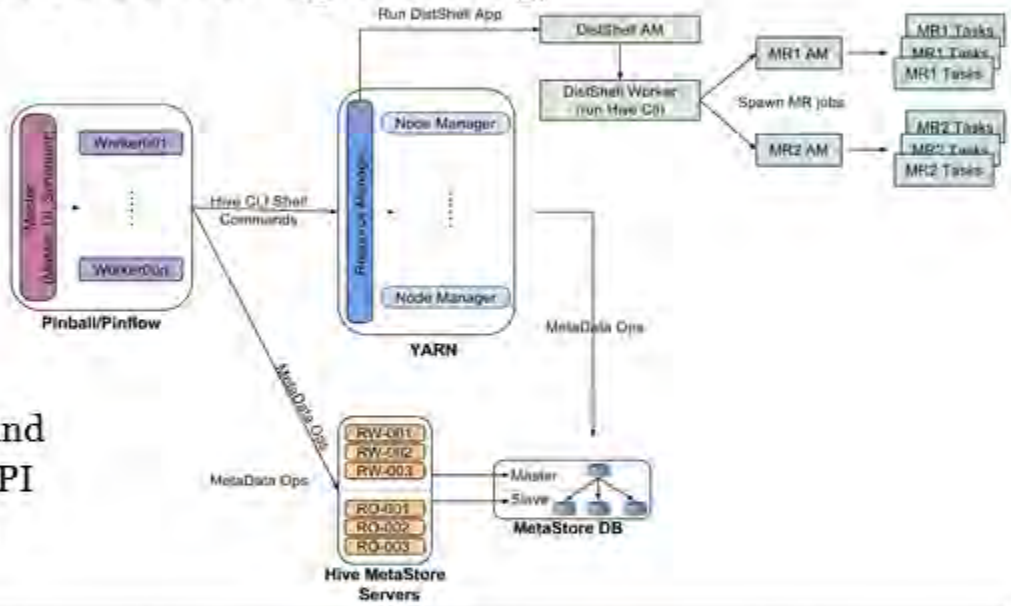
3 Hive - Overview



3 Hive - Scheduled Query

- Query is submitted by System
- Based on Hive CLI
- Talking to MetaStore (MySQL)
- YARN REST API
  - DistShell: AppMaster + Worker
    - Hive CLI as pure shell command
  - Get stdout/stderr from NM REST API
  - Rewrite select query to insert to s3
    - Container log is not stable



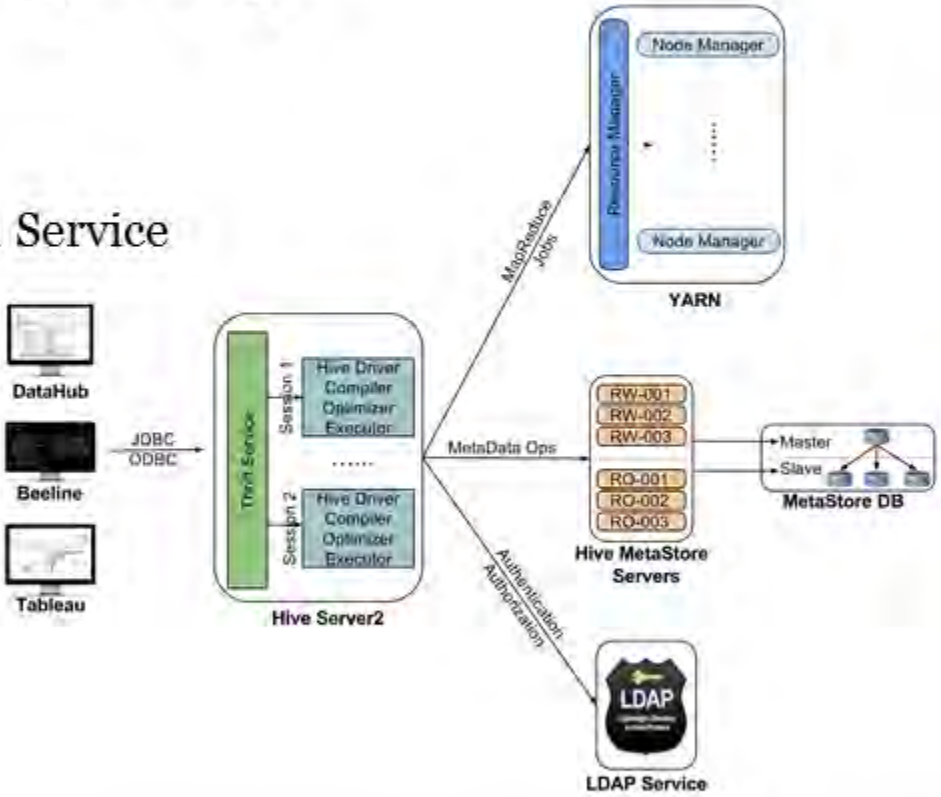

```
SELECT country, count(*)
FROM db_users
GROUP BY country
```

Rewrite

```
INSERT OVERWRITE DIRECTORY 's3://hive_query_output/cluster_name/20171019/application_1508263025827_2301/0'
 ROW FORMAT DELIMITED
   FIELDS TERMINATED BY '\001'
   COLLECTION ITEMS TERMINATED BY '\002'
   MAP KEYS TERMINATED BY '\003'
   LINES TERMINATED BY '\n'
 STORED AS TEXTFILE
SELECT country, count(*)
FROM db_users
GROUP BY country
```

3 Hive - AdHoc Query

- Query is Submitted by Human
  - Through beeline/tabeau etc
- HiveServer2 is the Query Submission Service
  - via JDBC/ODBC
  - Zookeeper based HA
- Talking to Hive MetaStore Server
  - HiveServer2 is a shared resource
- LDAP for Authentication
  - Impersonation for 3rd party tool
- Hive hook to Audit all queries



3 Hive - Cloud Integration

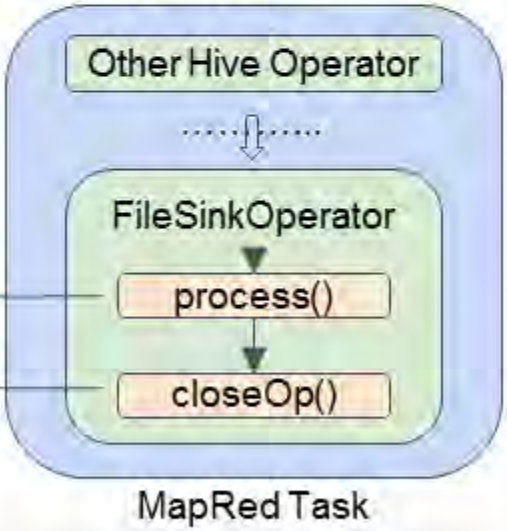
FileSinkOperator - Where S3 doesn't fit

- Kind of "2-phase commit"
- Phase 1 - each task attempt will write to a unique tmp output path

hdfs://${staging_dir}_${**query_id**}/

_task_tmp.-ext-${**stage_id**}/_tmp.${**task_id**}_${**attpt_id**}

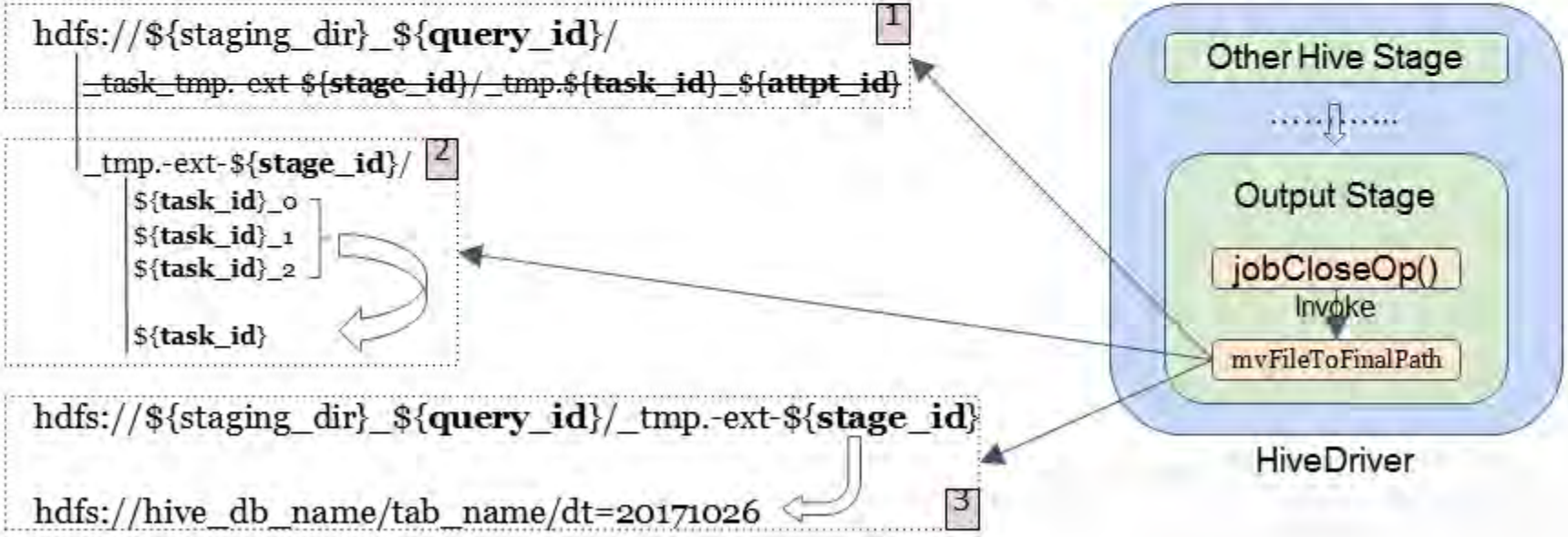
_tmp.-ext-${**stage_id**}/${**task_id**}_${**attempt_id**}



3 Hive - Cloud Integration

FileSinkOperator - Where S3 doesn't fit

- Kind of "2-phase commit" protocol
- Phase 2 - stage controller (HiveDriver) rename query temp to final path



3 Hive - Cloud Integration

FileSinkOperator - Where S3 doesn't fit

- Fast & Atomic file/dir **rename** operation is the key
- Unfortunately, rename on s3 is copy & delete

3 Hive - Direct Committer @ S3

Direct Output Committer

- Each task attempt writes to final output directly
  - {target folder}/{task_id}

- Consequences
  - Query Level Failure -> partial output in target folder
    - Cleanup target folder in the very beginning of each query
    - Disable INSERT INTO (using INSERT OVERWRITE Q1 UNION ALL Q2)
  - Task Level Failure -> FileAlreadyExistsException
    - File open mode CREATE -> OVERWRITE (ORC & Parquet)
  - Speculative Execution -> corrupted task output
    - Cause: outWriter.close() in killed task attempt
      - S3A write to local disk first and then upload to s3 in close()
    - Solution: Disable speculative execution

3 Hive - Speculative Exec @ S3

Direct Committer with Speculative Execution

- S3A Staging Committer (originated from Netflix)
  - Based on S3 multipart uploading[1]
  - Decouple upload & commit, simulate write to tmp & rename to final
  - Being actively worked in Apache: HADOOP-13786

- S3A Hive Committer (originated from Pinterest, on-going)
  - Ignore the MapReduce commit protocol
  - Allow different task attempts to commit at the same time
  - Stage controller (HiveDriver) dedup multiple attempts for the same task

3 Hive - Dynamic Partition @ S3

New Challenges

- Target folder path is only known at runtime
- Race condition among multiple FinkSinkOperators
- Discover new dynamic partitions to update Metastore

Solutions

- Encode the ts into output file name: {target_part_folder}/{dpCtx.queryStartTs}_{task_id}
- New dynamic partition: folders that
  - Modification time > query start time
  - Contains files starting with query_start_ts

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4. **Presto**
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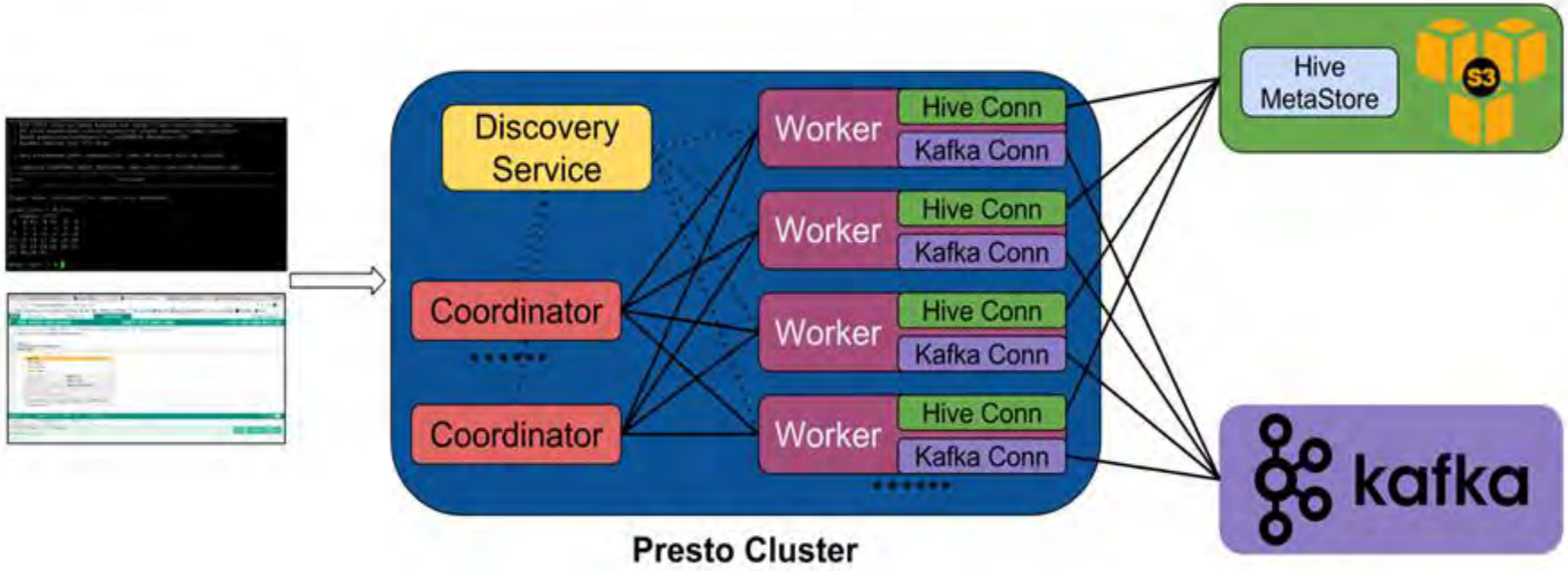
4 Presto - Overview



4 Presto - Cluster & Stats

Cluster Management

- Instance type: r3.8xl
- Computing only, no local data
- Using AWS ASG
- Managed by Terraform

Presto Stats

- ~800 users
- ~10k queries daily
- 5X ~ 50X faster than Hive
- AdHoc (250 node): P90: 4min, P99: 30min
- App (150 node): P90: 2min, P99: 20min

4 Presto - Feature Challenges

Concurrency Bug in ObjectInspector library

- Hive runtime is for single thread env
- Presto is highly concurrent and shared

Thrift Table Support

- Presto Hive MetaStore client doesn't support "dynamic" table
- Deeply nested table will hang in planning phase

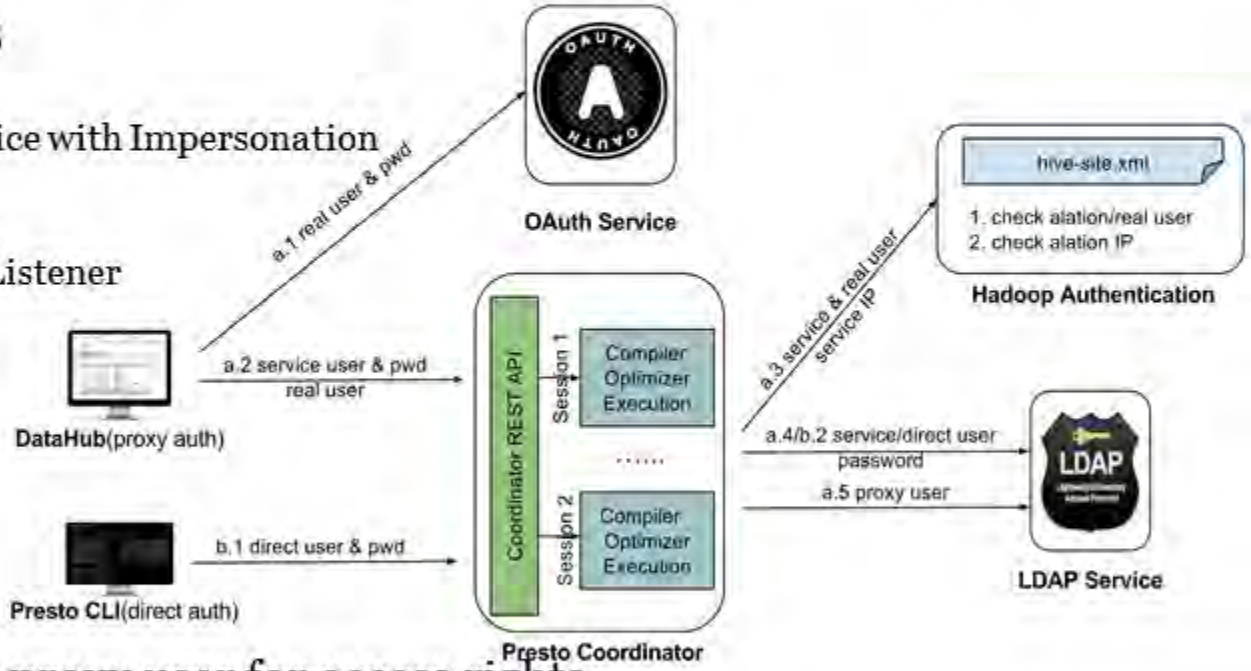
Schema Evolution Support

- Historical partition schema mismatch
- Small int -> big int
- Parquet table column rename

4 Presto - Security Enhancement

Security Features

- Authentication
  - Integrated middle service with Impersonation
- Audit
  - Every Query is Logged
  - Plugin based on EventListener



Access Control

- Check LDAP group for proxy user for access rights
- Data Level Access is controlled by IAM role

4 Presto - Cluster Operations

Separate AdHoc & Application Cluster

- Adhoc cluster is generally less stable
- App cluster only run well known queries

Bad Query Monitor

- Detected by bot based on runtime and splits #
- Kill the query and send slack message to end user

Bad Node Monitor

- Detected by bot based on query failure due to node issue stats
  - Bad node - 3 query failed on it in last 5 min
- Specially important when the cluster is scaled up & down on a daily basis

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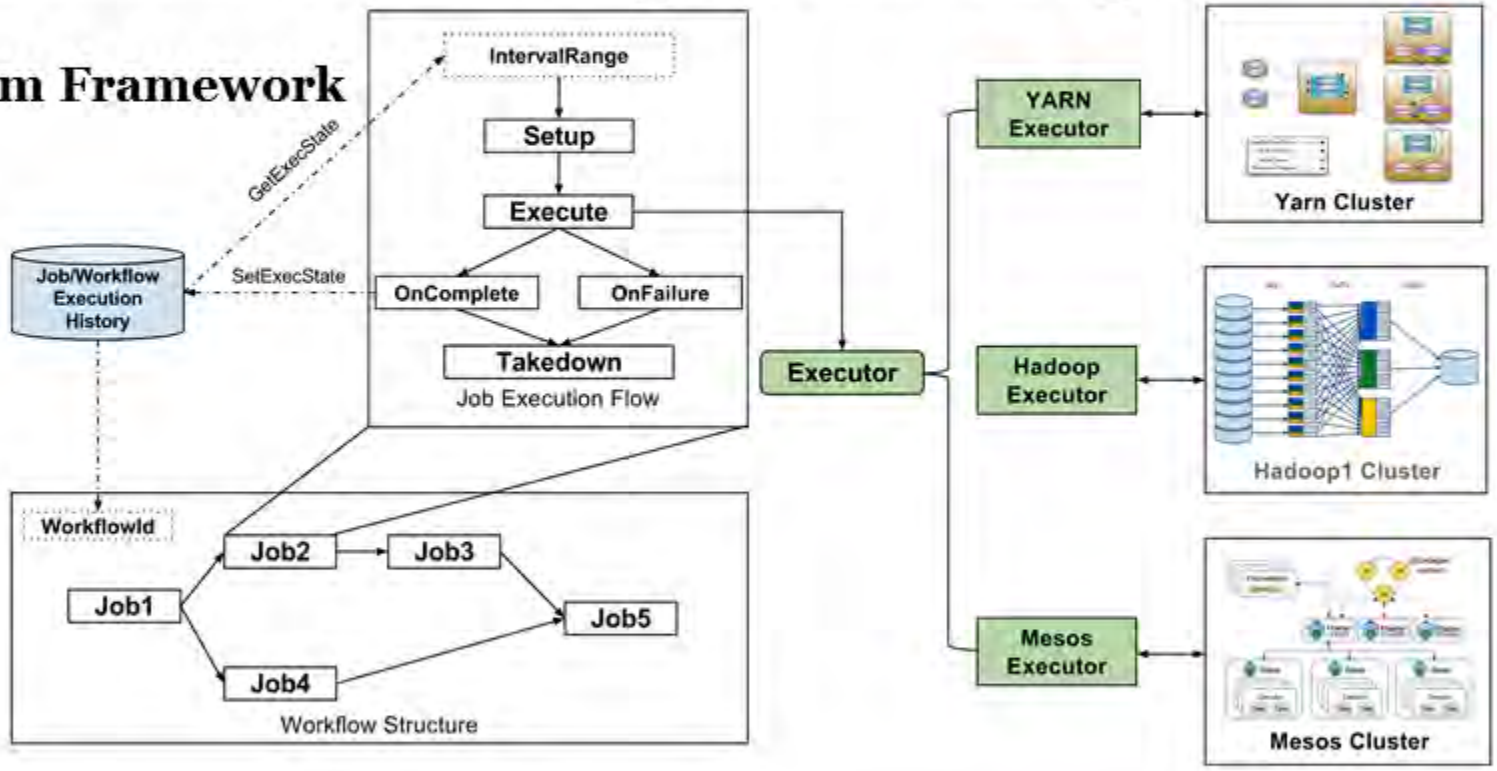
5 Workflow - Programming

Workflow Prgm Framework

- Skyline
- DataJob
- Pinflow



5 Data Architecture - Manager

Workflow Manager

- Pinball
- https://github.com/pinterest/pinball

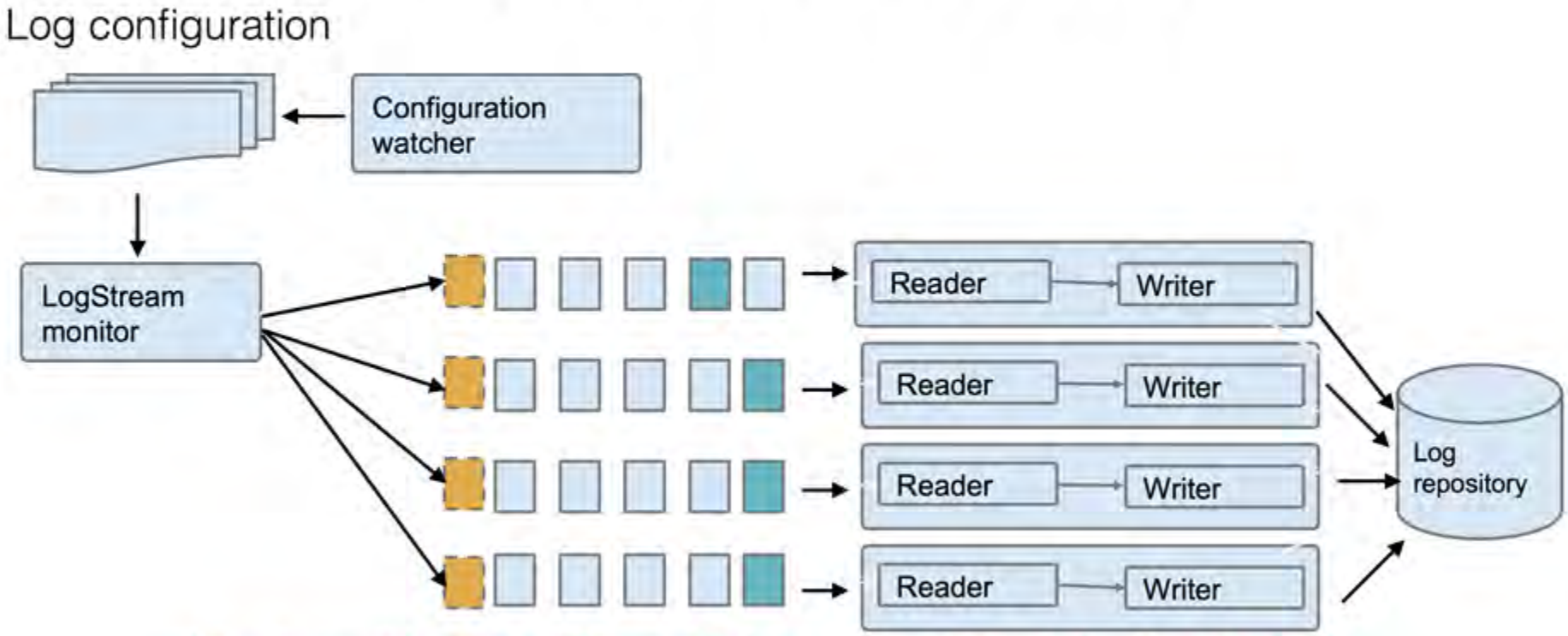
Workflow Stats

- 2000+ Workflows
- 60k+ Jobs
- ~80% Hive
- ~15% Cascading/Spark
- ~5% Python

The World's Catalog of Ideas

Discover Ideas

Singer Architecture

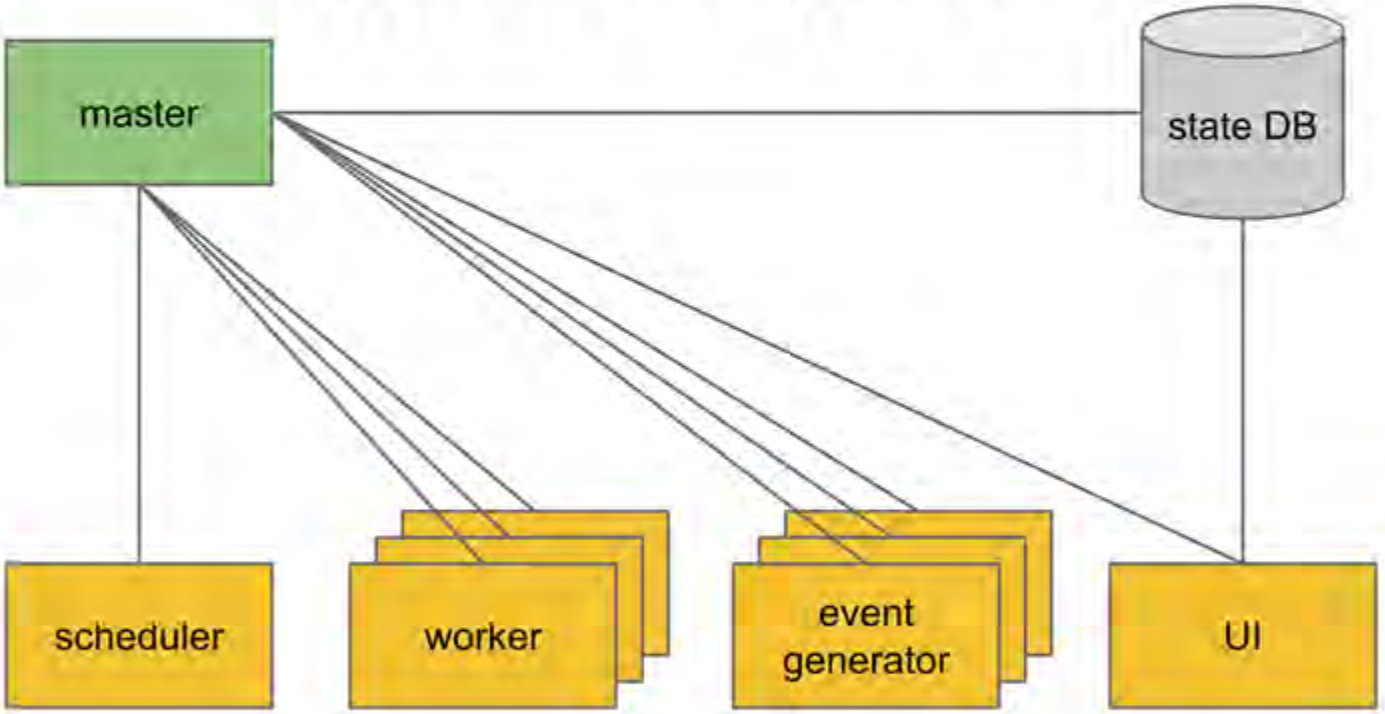


https://www.slideshare.net/DiscoverPinterest/singer-pinterests-logging-infrastructure

Merced Architecture

https://github.com/pinterest/secor

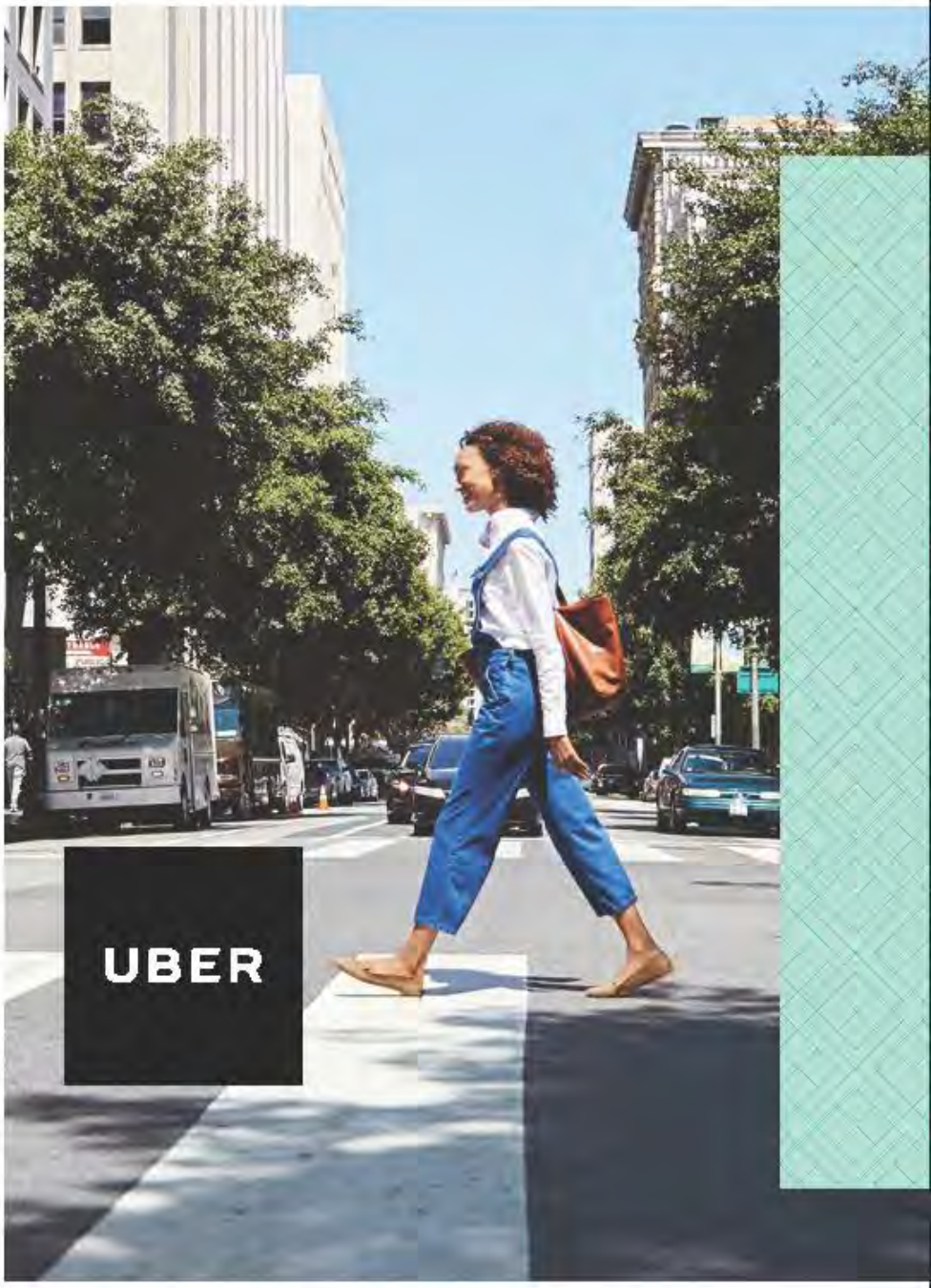
Pinball Architecture



https://github.com/pinterest/pinball

Uber实时处理系统的演化

袁泳@Uber

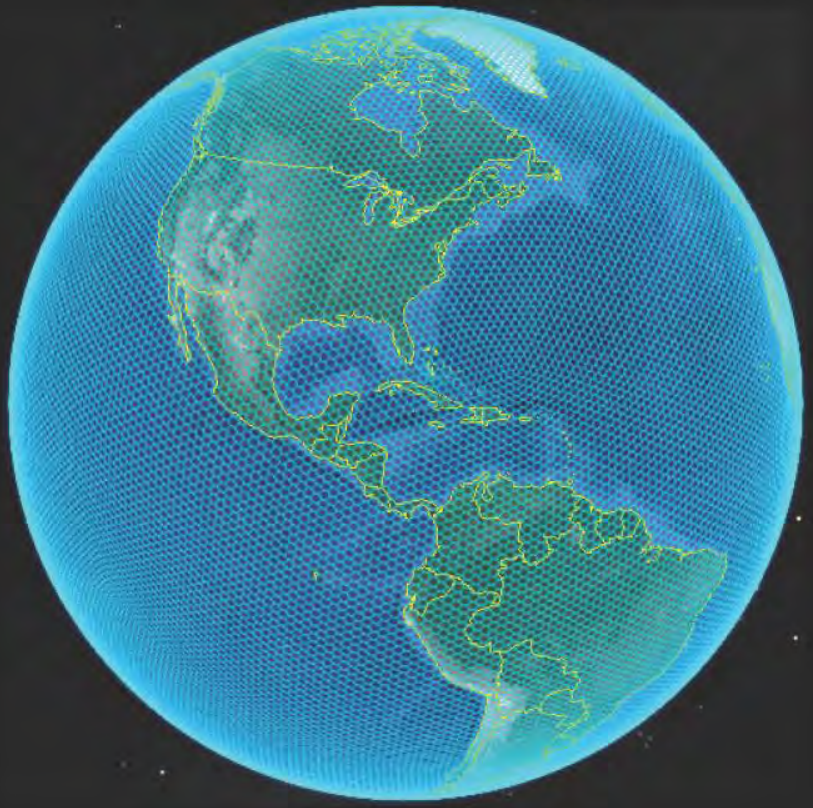


Four Kinds of Analytics

- On demand aggregation and pattern detection
- Clustering
- Forecasting
- Pattern detection on geo-temporal data

Two Ingredients

Geo/Spatial



Time

Real-time aggregation and pattern matching

Complex Event Processing

Examples

How many cars enter and exit a user defined area in past 5 minutes

CEP with full historical context

Notify me if a partner completed her 100th trip in a given area just now?

Patterns in the future

How many first-time riders will be dropped off in a given area in the next 5 minutes?

Patterns in the future

How many first-time riders will be dropped off in a given area in the next 5 minutes?

Geo: user flexibility is important

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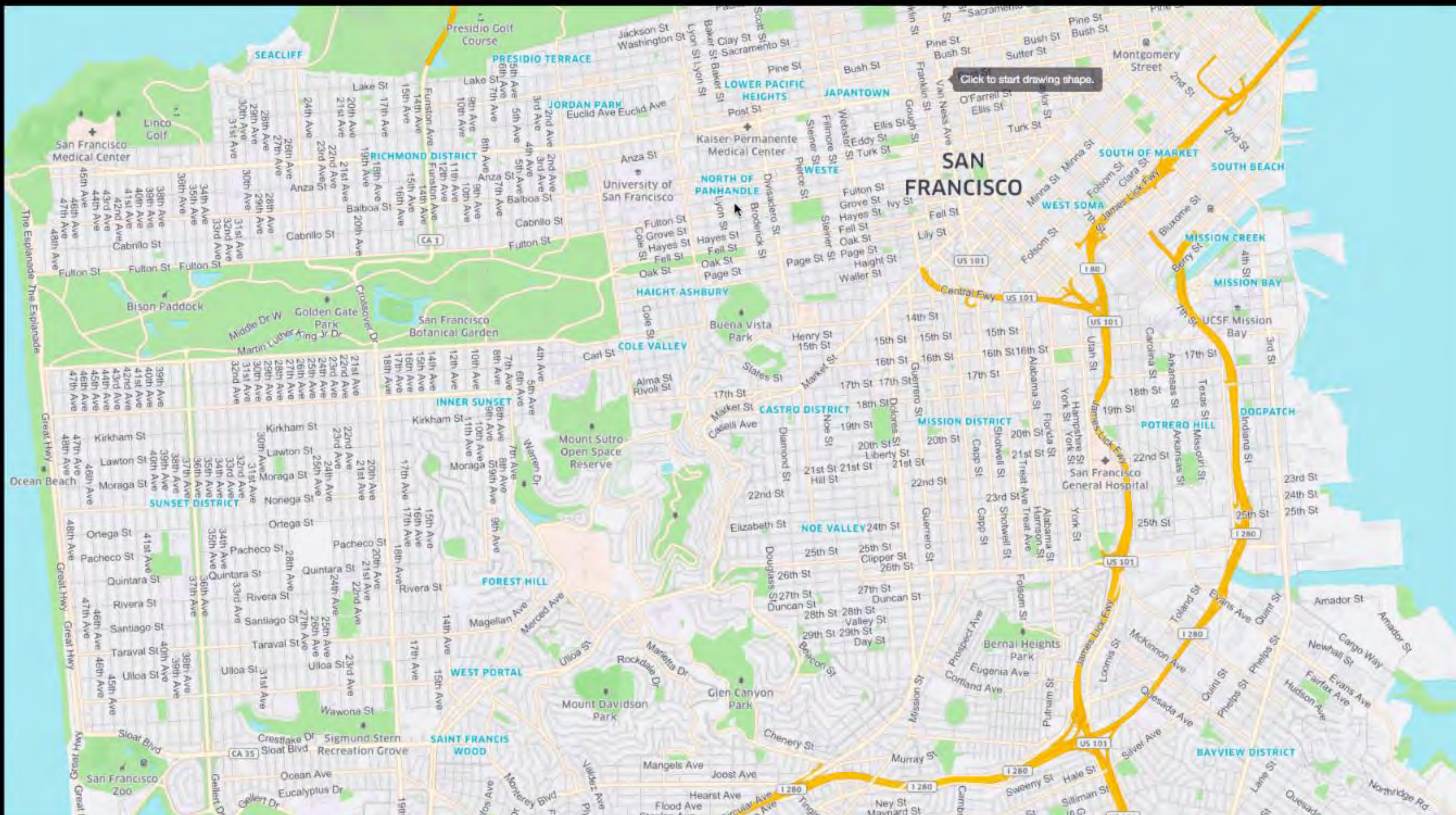

It needs to be scalable

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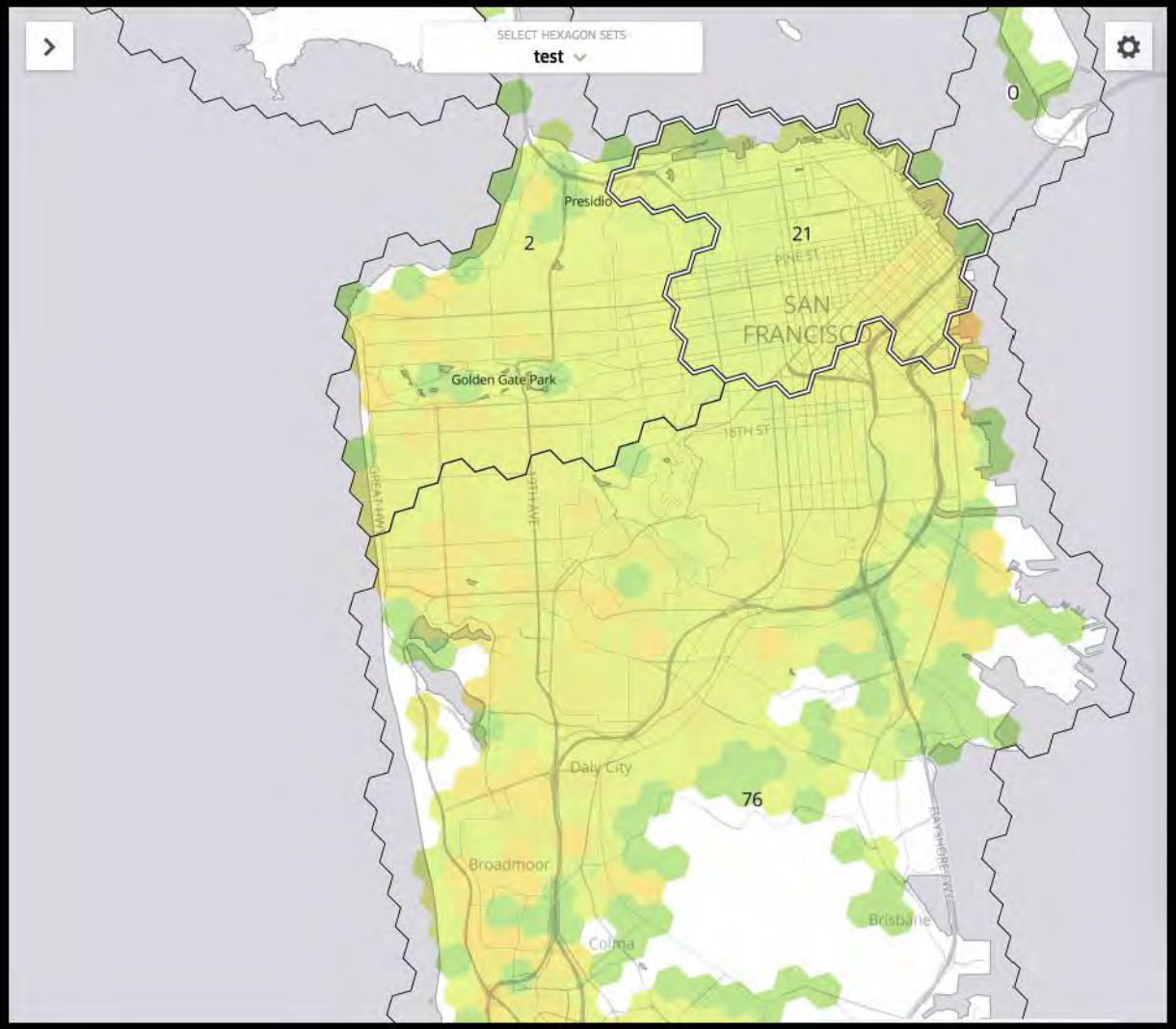

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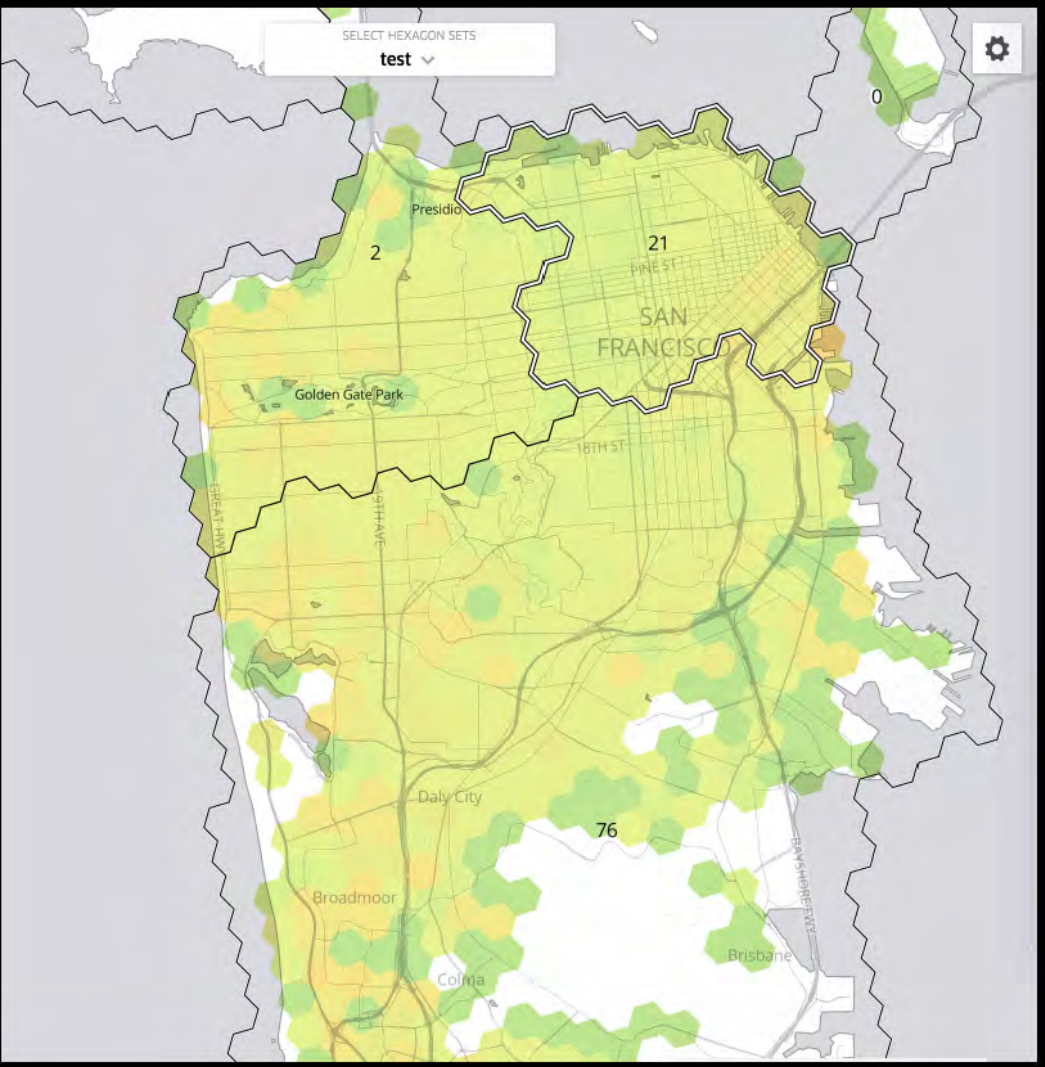
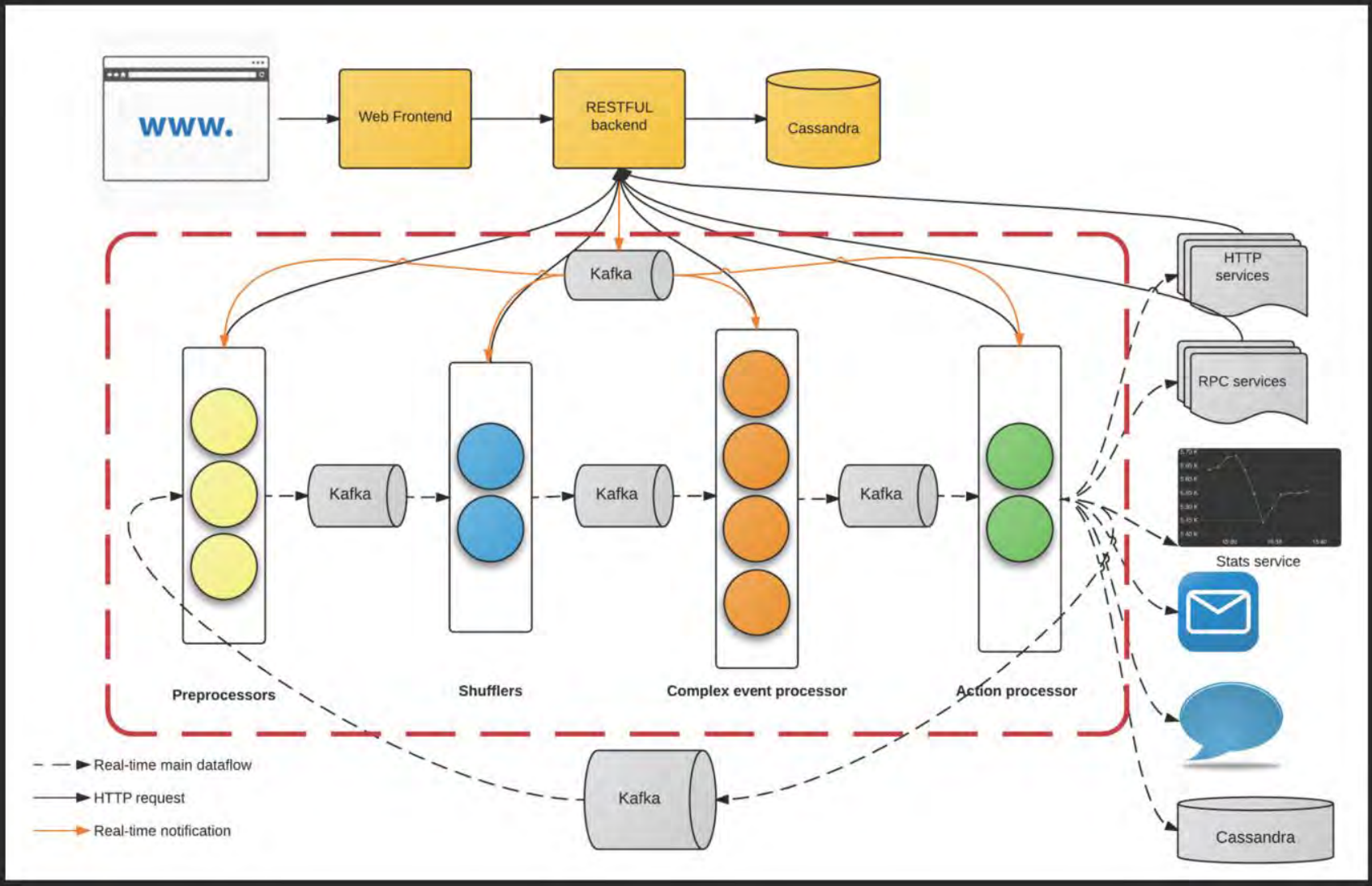


- Every hexagon
- Every driver/rider

CEP Pipeline Built on Samza

- No hard-coded CEP rules
- Applying CEP rules per individual entity: topic, driver, rider, cohorts, and etc
- Flexible checkpointing and statement management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RESTFUL backend
Cassandra
Kafka
HTTP services
RPC services
Stats service
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Complex event processor
Action processor
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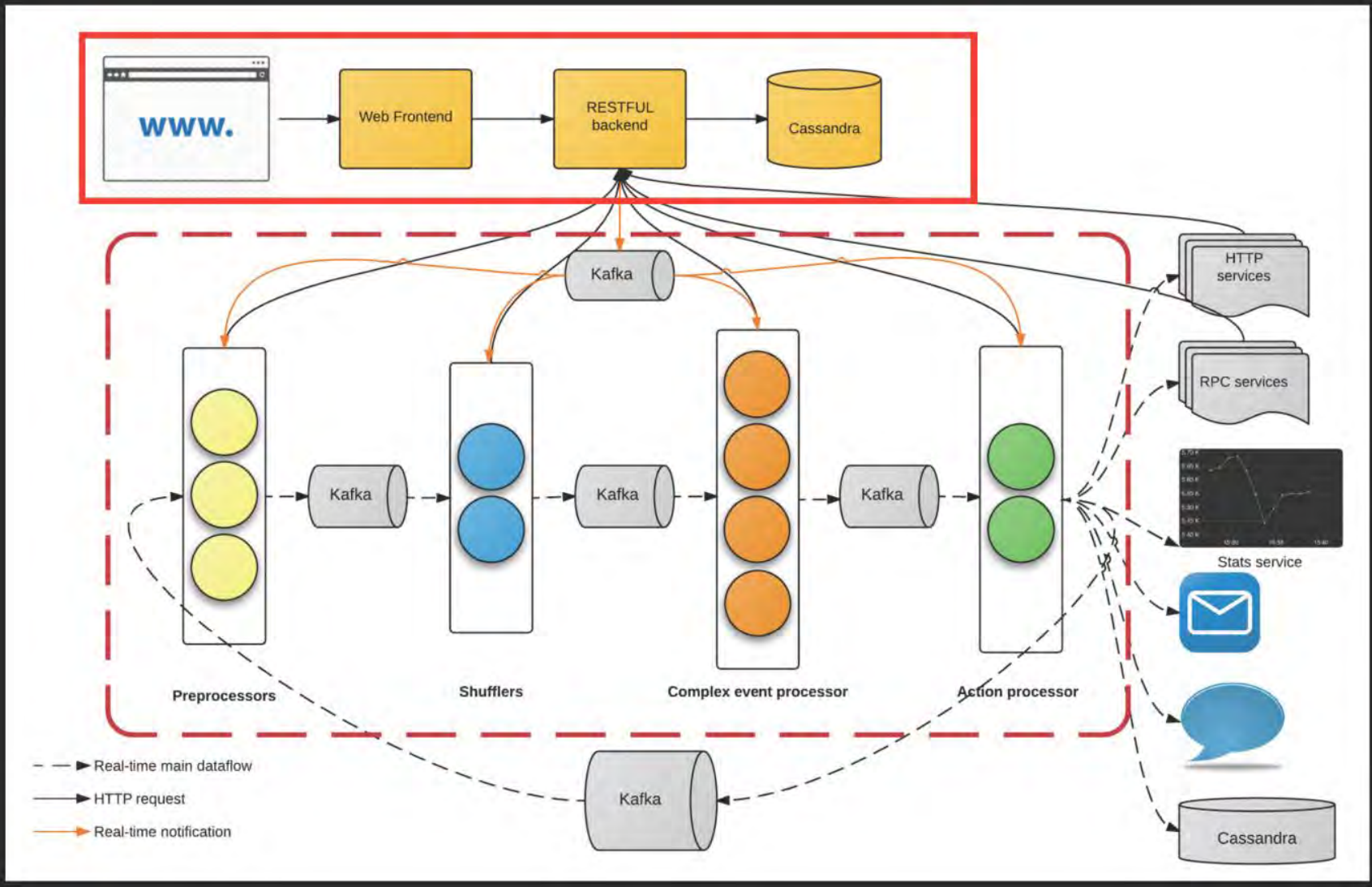
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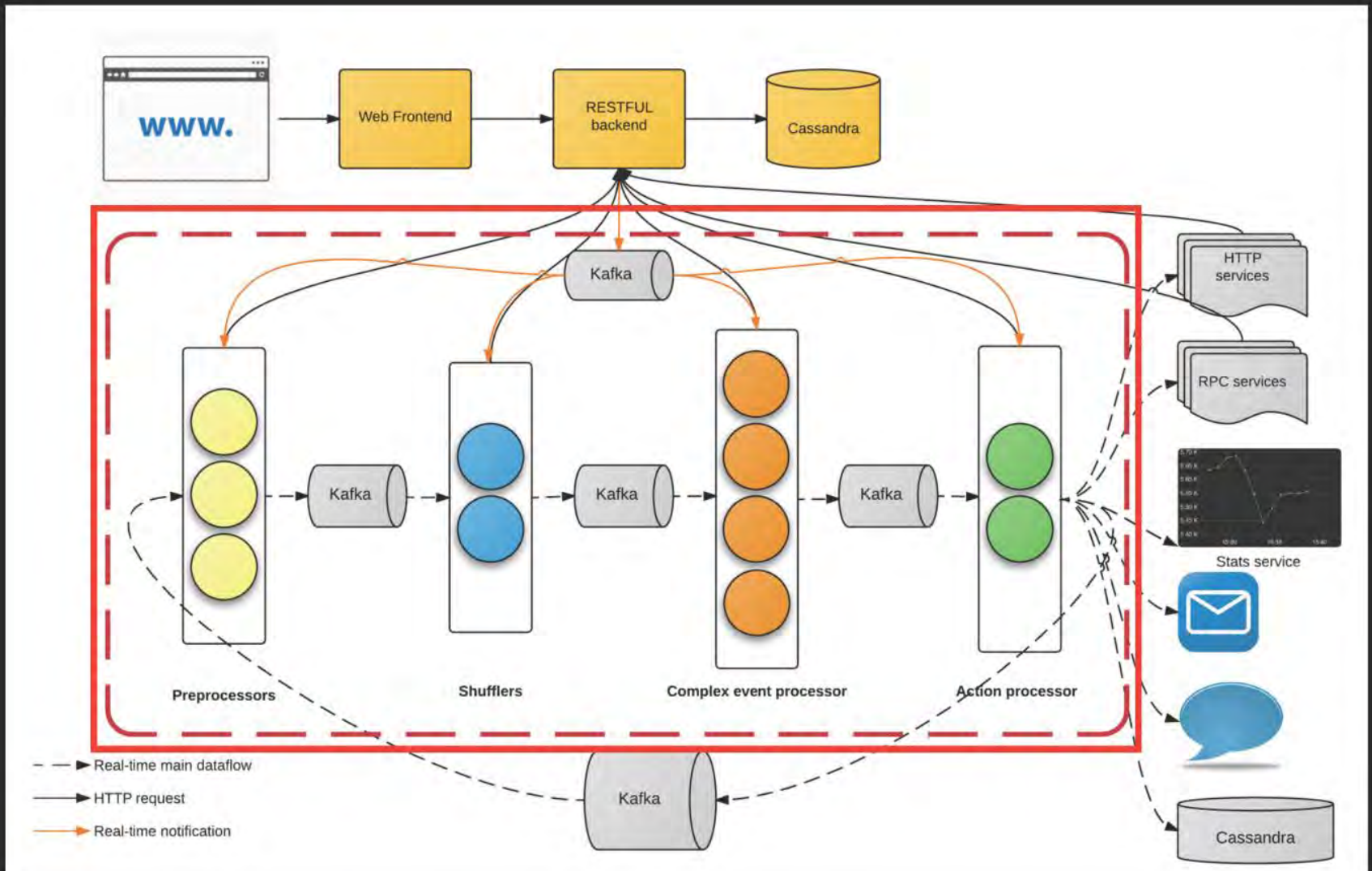
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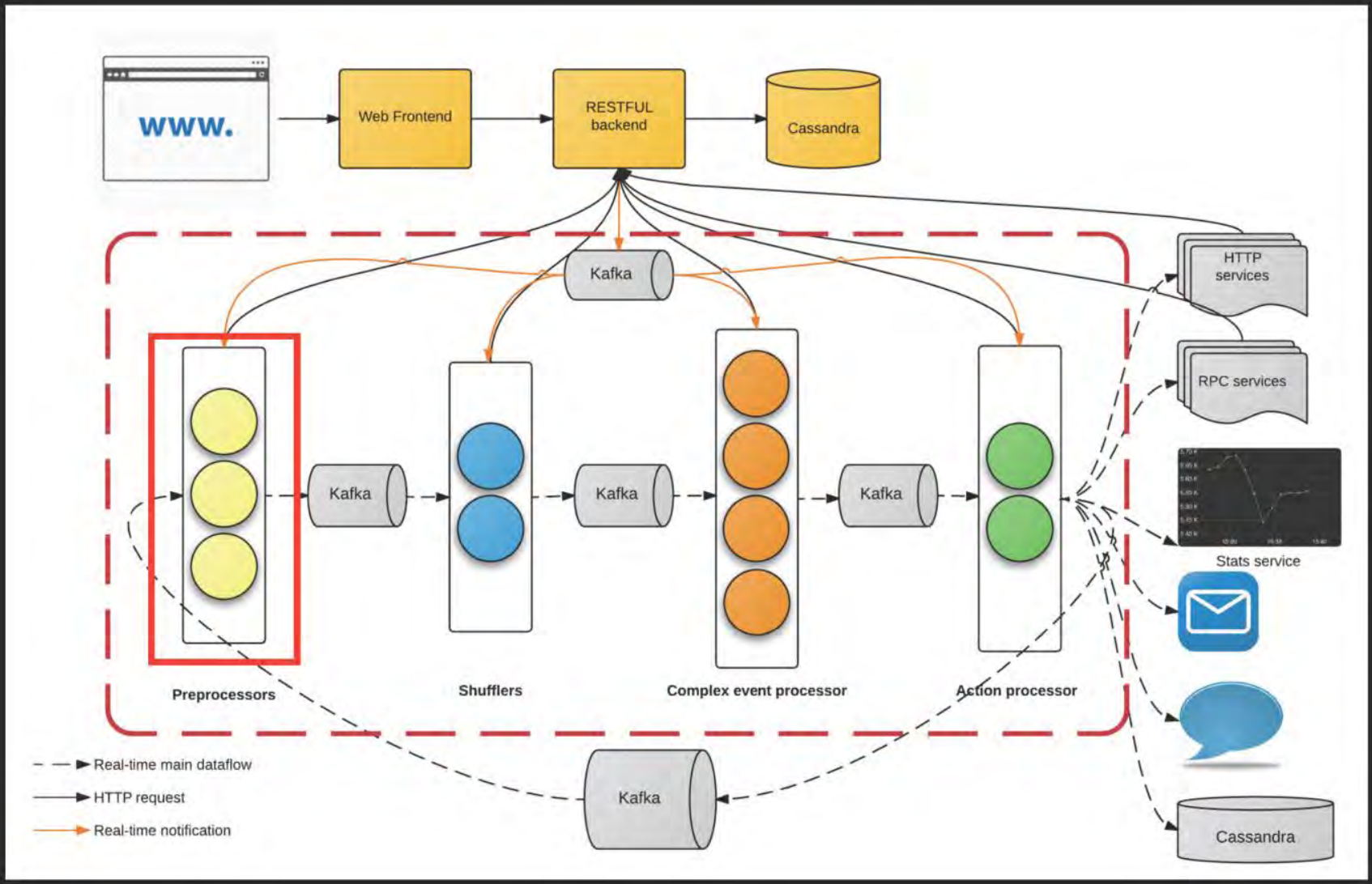
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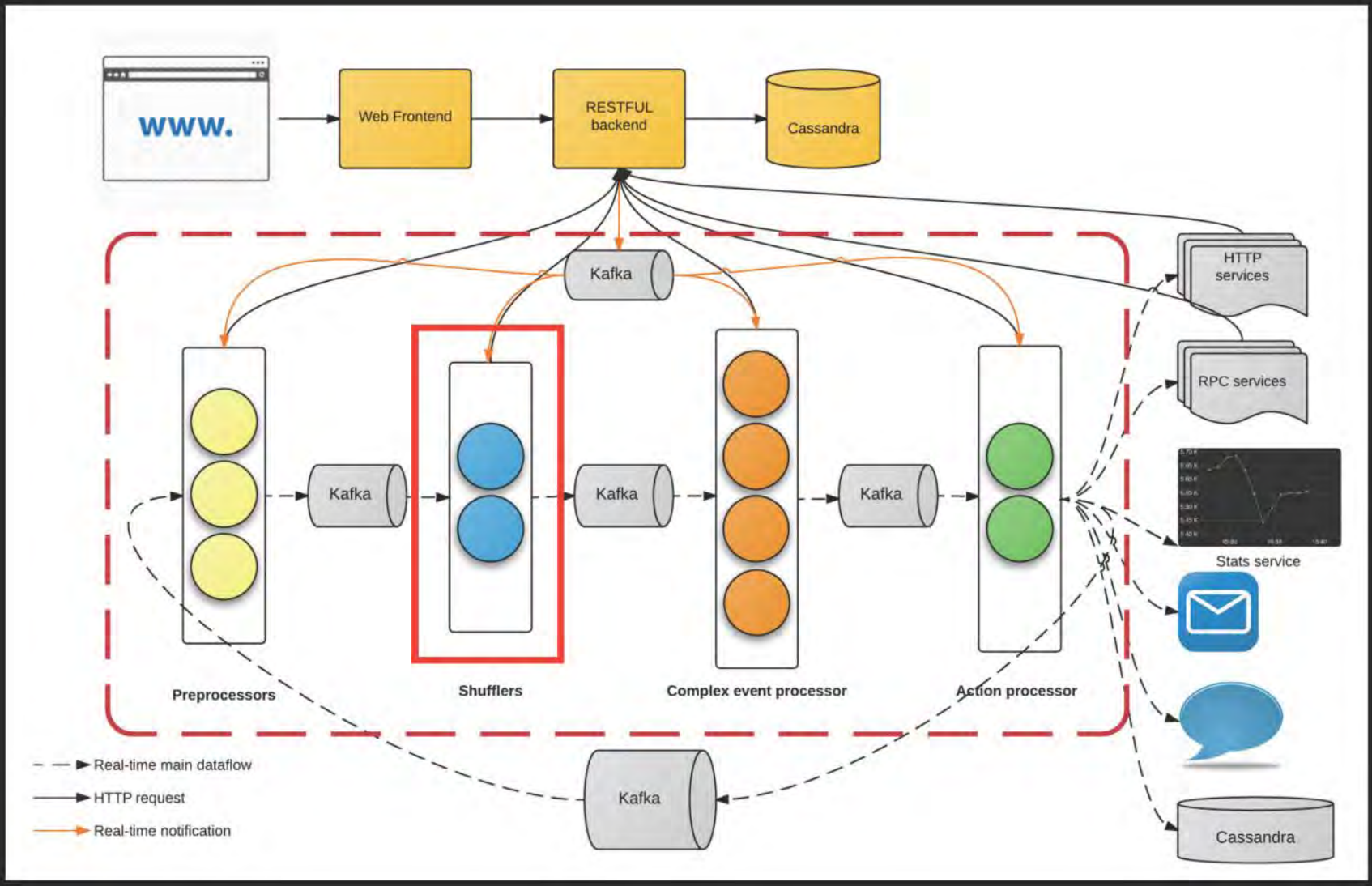
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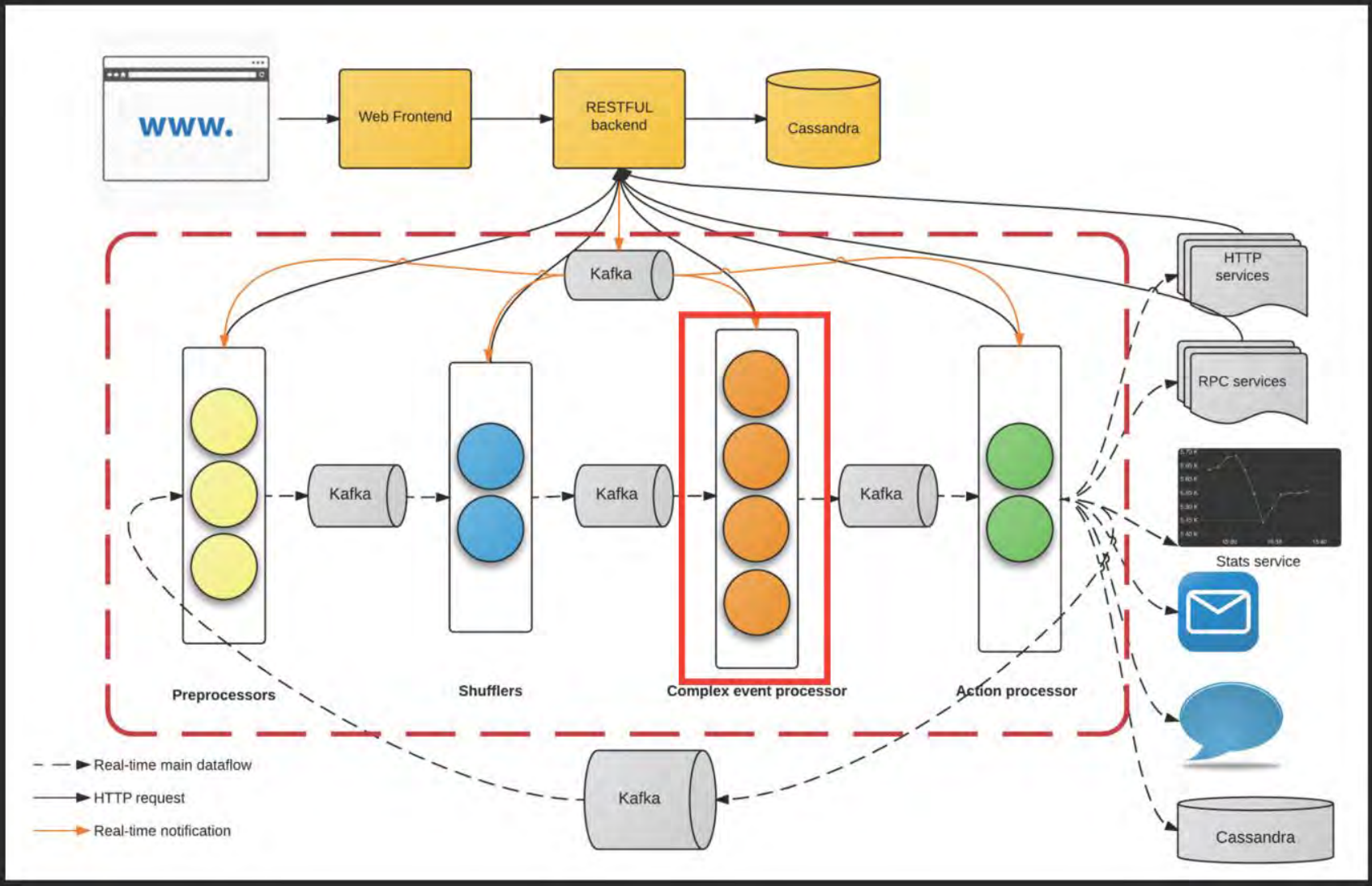
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