From Batch to Streaming ET(L) with Apache Apex

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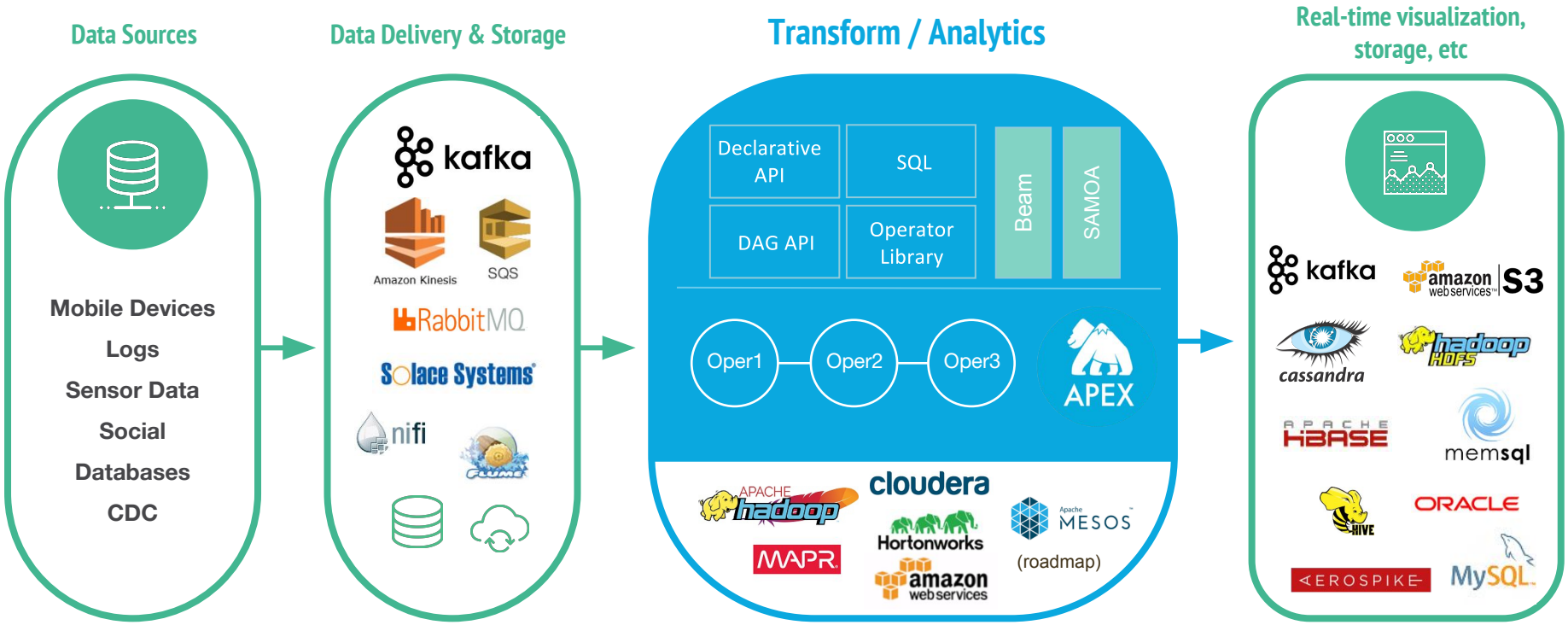
Stream Data Processing with Apache Apex



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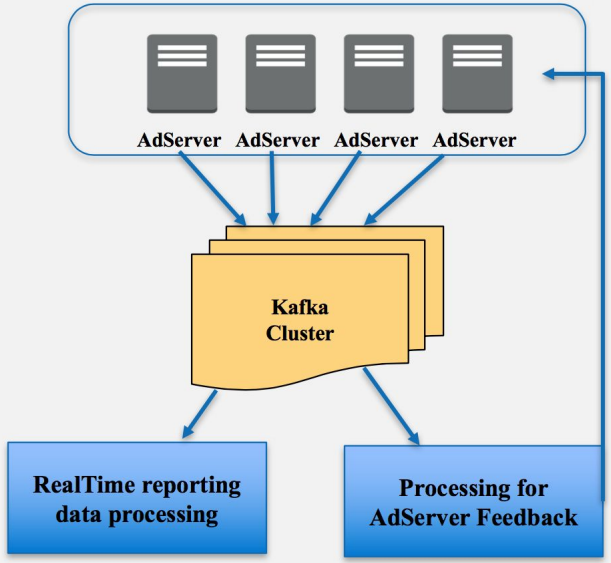
Use Case

- ✓ Real-time reporting
  - Reporting of critical metrics around campaign monetization
  - Revenue, impression & click info
  - Aggregate counters & reporting on top N metrics
  - Low latency querying using Kafka

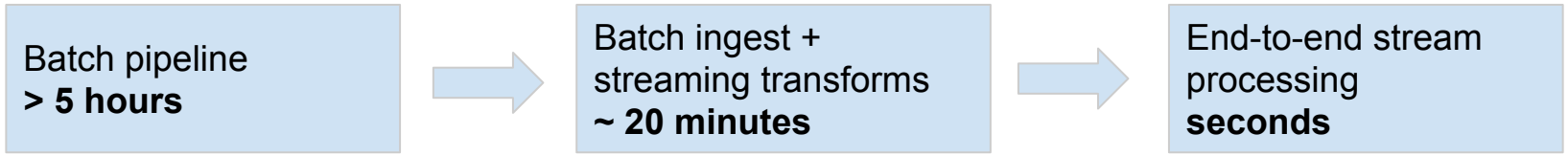
in pub-sub model.

- ✓ Real-time Monitoring
  - Alerts on deal tracking & monetization
  - Campaign & deal health
- ✓ Real-time Learning
  - Using the lost bid insights for price recommendations.
- ✓ Allocation Engine
  - Feedback to ad serving for guaranteed delivery & line item pacing



https://www.slideshare.net/ashishtadose1/realtime-adtech-reporting-targeting-with-apache-apex

Phased Transition



Batch processing with several hours till insight:

- Available data stale, does no longer apply to current situation
- Current data stuck in batch pipeline
- Complex batch processing orchestration with many different components
- Hours of delay translate to high cost due to inability to make timely campaign adjustments.

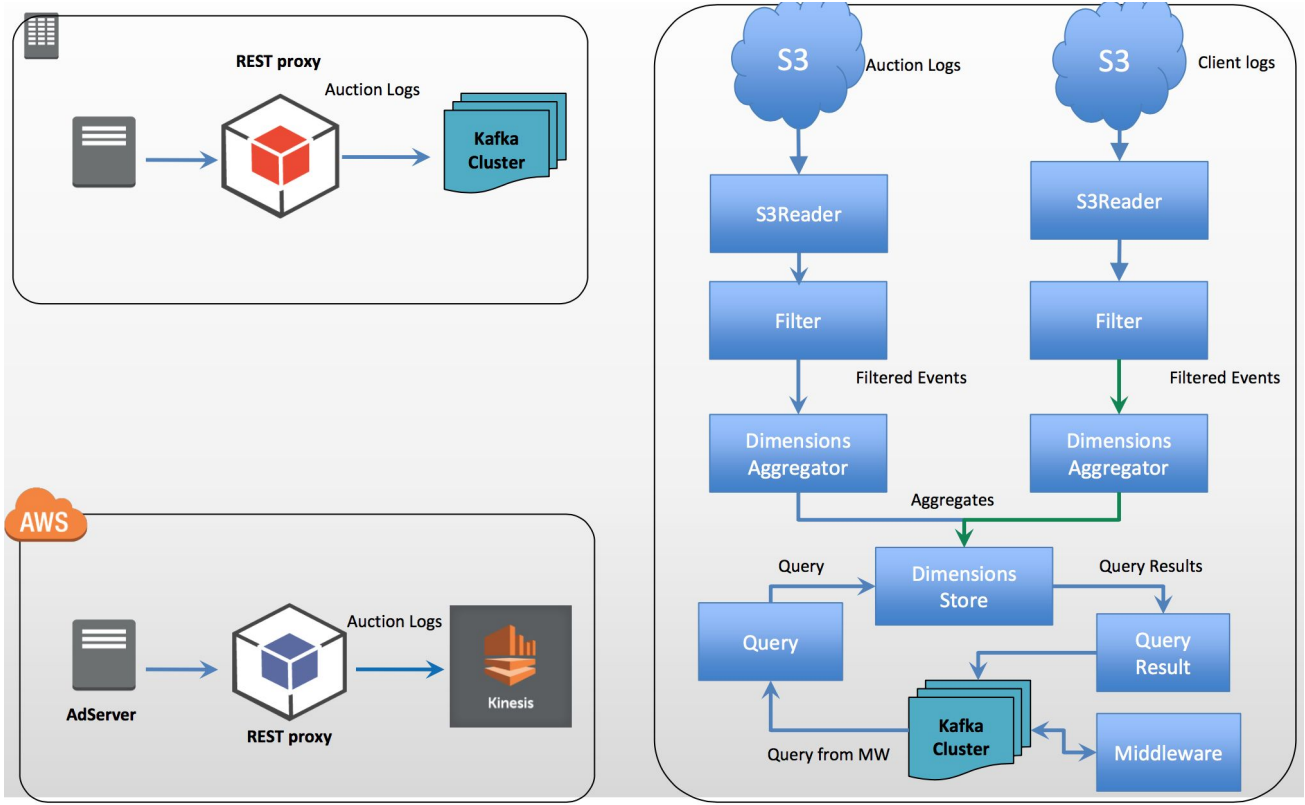
Processing with Apex, reuse batch ingestion:

- Existing ingestion mechanism (files in S3, shared with other pipelines)
- Migrate transform logic to Apex
- Enable reporting from application state (“Queryable State”)
- Reduced latency, valuable as intermediate step.

Streaming source and processing:

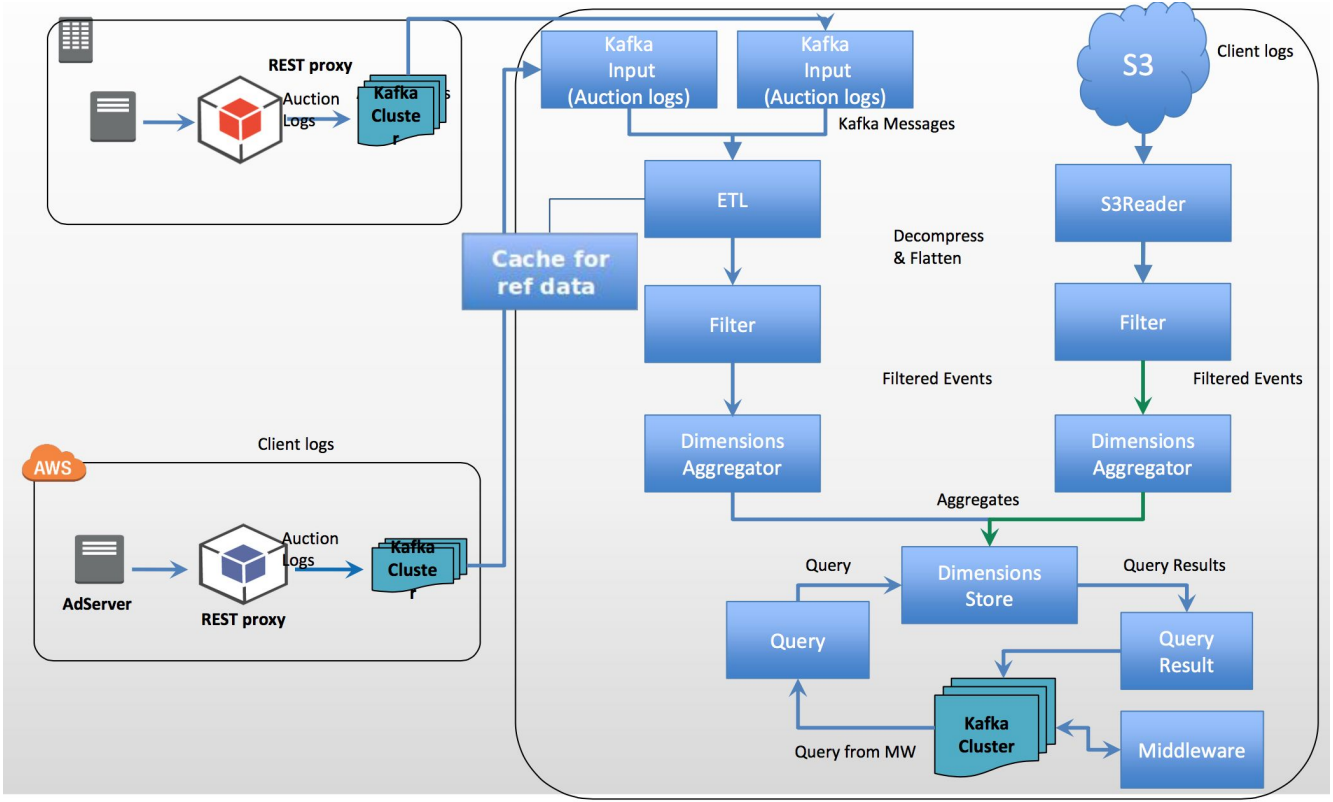
- Data comes directly from Kafka clusters
- Significantly reduced latency
- Balanced load (no ingestion spikes)
- Reduced resource consumption with Apex support for multi-cluster Kafka consumers
- Reporting meets SLA requirements

Phase 1 (batch ingest)



https://www.slideshare.net/ApacheApex/real-time-insights-for-advertising-tech

Phase 2 (hybrid)



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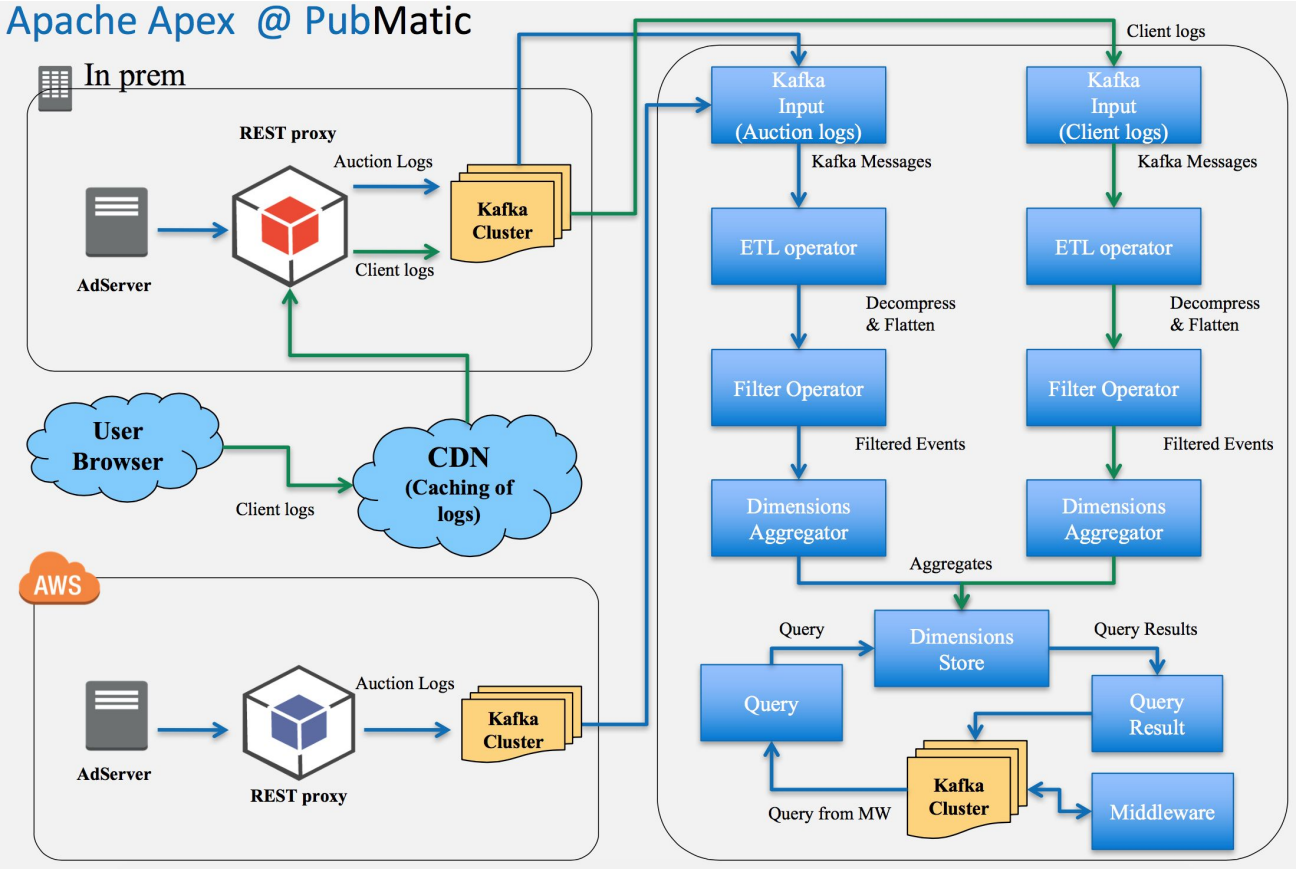
Real-time Streaming



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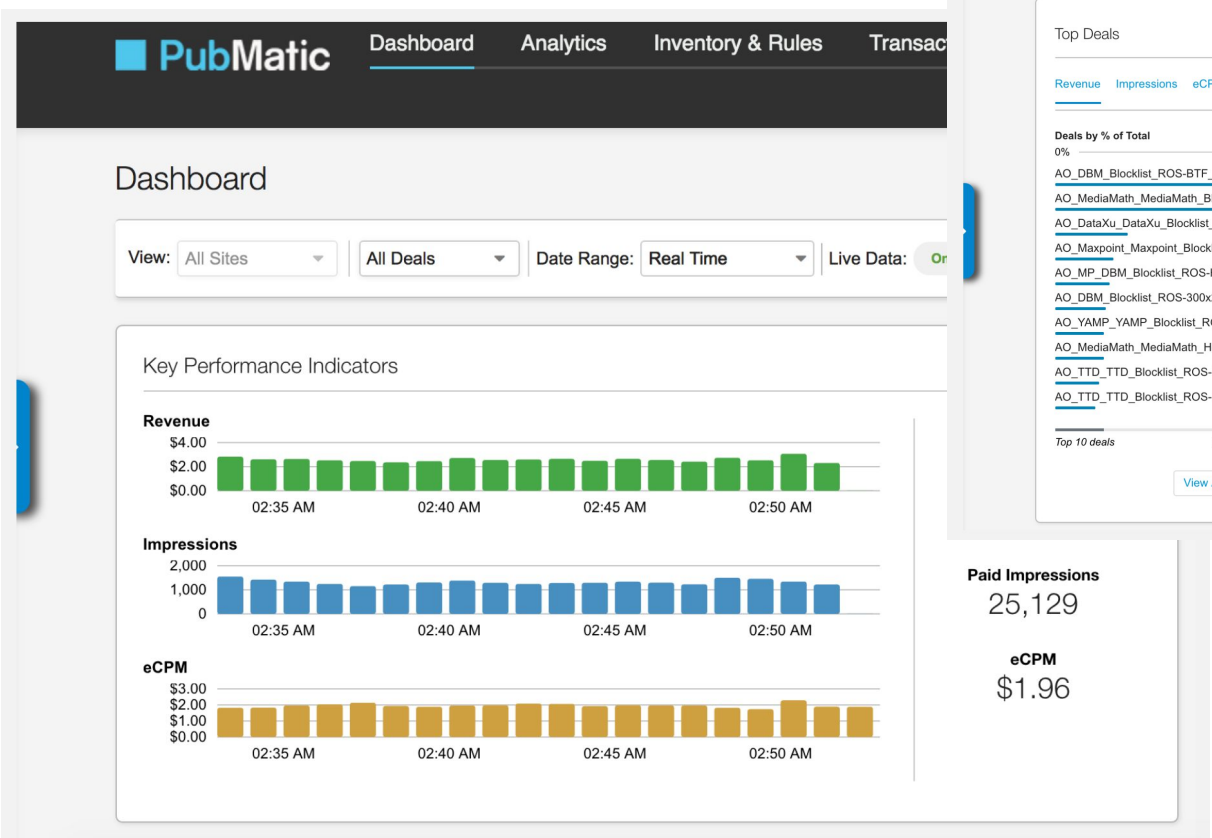
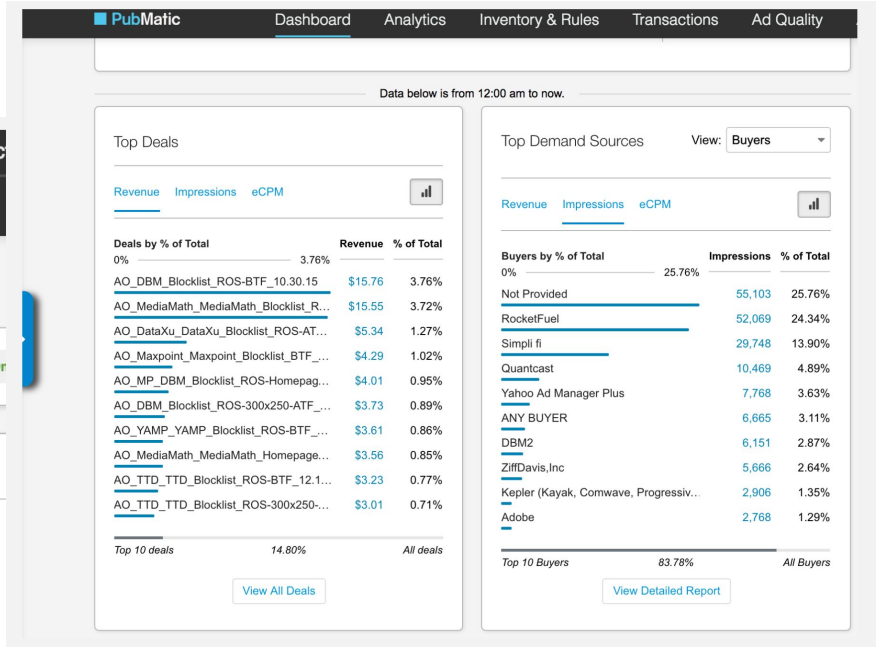
Real-time Dashboard





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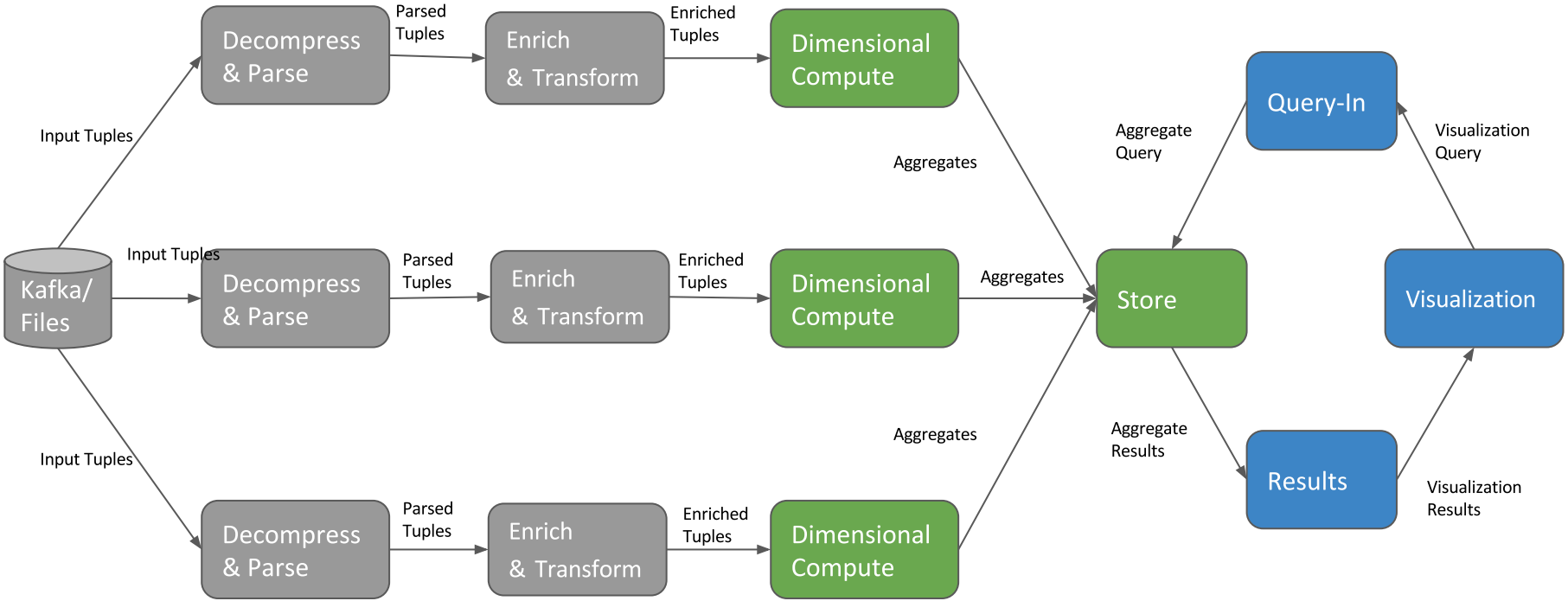
Pipeline Transformations



https://www.slideshare.net/ApacheApex/actionable-insights-with-apache-apex-at-apache-big-data-2017-by-devendra-tagare

Dimension Computation

Advertiser: Subway
Location: WA
Cost: 2
Revenue: 1
Impressions: 5
Clicks: 1
Time: 10:15:30

hour	advertiser	location	cost	revenue	impr	clicks
10:00			6	9 => 10	22	3
10:00	Burger King		4	6	12	2
10:00	Subway		2	3 => 4	10	2
10:00		CA	4	6	15	3
10:00		WA	2	3 => 4	7	1
10:00	Burger King	CA	2	3	5	1
10:00	Burger King	WA	2	3	7	1
10:00	Subway	CA	2	3	10	2
10:00	Subway	WA		0 => 1		

Scale

- 6 geographically distributed data centers
- 10 PB of data under management
- 50 TB/day of data generated from auction & client logs
- 40+ billion ad impressions and 350+ billion bids per day
- Average data inflow of 450K events/sec
- 64 Kafka Input partitions, 32 instances of in-memory distributed store
- 1.2 TB of memory for the Apex application

Why Apex

- State Management & Fault tolerance
  - Exactly-once, Checkpointing and Windowing
  - Fine grained recovery, low-latency SLA support
  - Queryable state
- Processing based on event time
  - Accuracy, Repeatable/Replay
- Native Streaming
  - Low latency + high throughput, efficient resource utilization
  - Pipelined processing (data in motion)
- Scalability
  - Process more data by adding compute resources, no platform/architecture limits
  - Dynamic scaling and resource allocation, elasticity
- Library of connectors and transformations
  - Time to value

Apex Library

Messaging
- Kafka
- JMS (ActiveMQ etc.)
- Kinesis, SQS
- Flume, NiFi
- MQTT

File Systems
- HDFS / Hive
- Local File
- S3
- FTP

NoSQL
- Cassandra, HBase
- Aerospike, Accumulo
- Couchbase, CouchDB
- Redis, MongoDB
- Geode, Kudu

RDBMS
- JDBC
- MySQL
- Oracle
- MemSQL

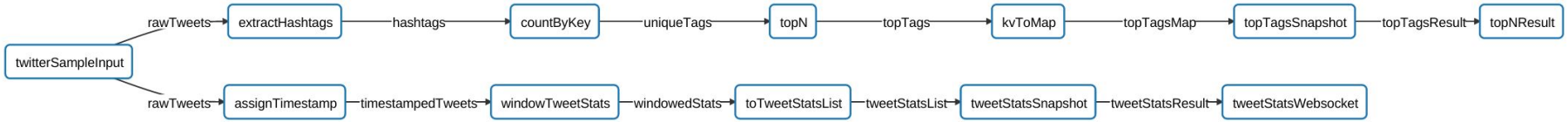
Other
- Elastic Search
- Solr
- Twitter
- WebSocket / HTTP
- SMTP

Stateless Transformations
- Parsers: XML, JSON, CSV, Avro
- Filter
- Enrich
- Configurable POJO schema
- Map, FlatMap (custom Java function)
- Script (JavaScript, Jython)

Stateful Transformations
- Windowing: sliding, tumbling, session
- Accumulations: sum, merge, join, sort, top n, …
- Triggering, Watermarks
- Dimensional Aggregations (with state management for historical data + query)
- Deduplication

How to build it

Example Application (Twitter)



- Top N hashtags
- Tweet stats time series
- Queryable state
- WebSocket Pub/Sub
- Visualization with Grafana

Source code: https://github.com/tweise/apex-samples/tree/master/twitter

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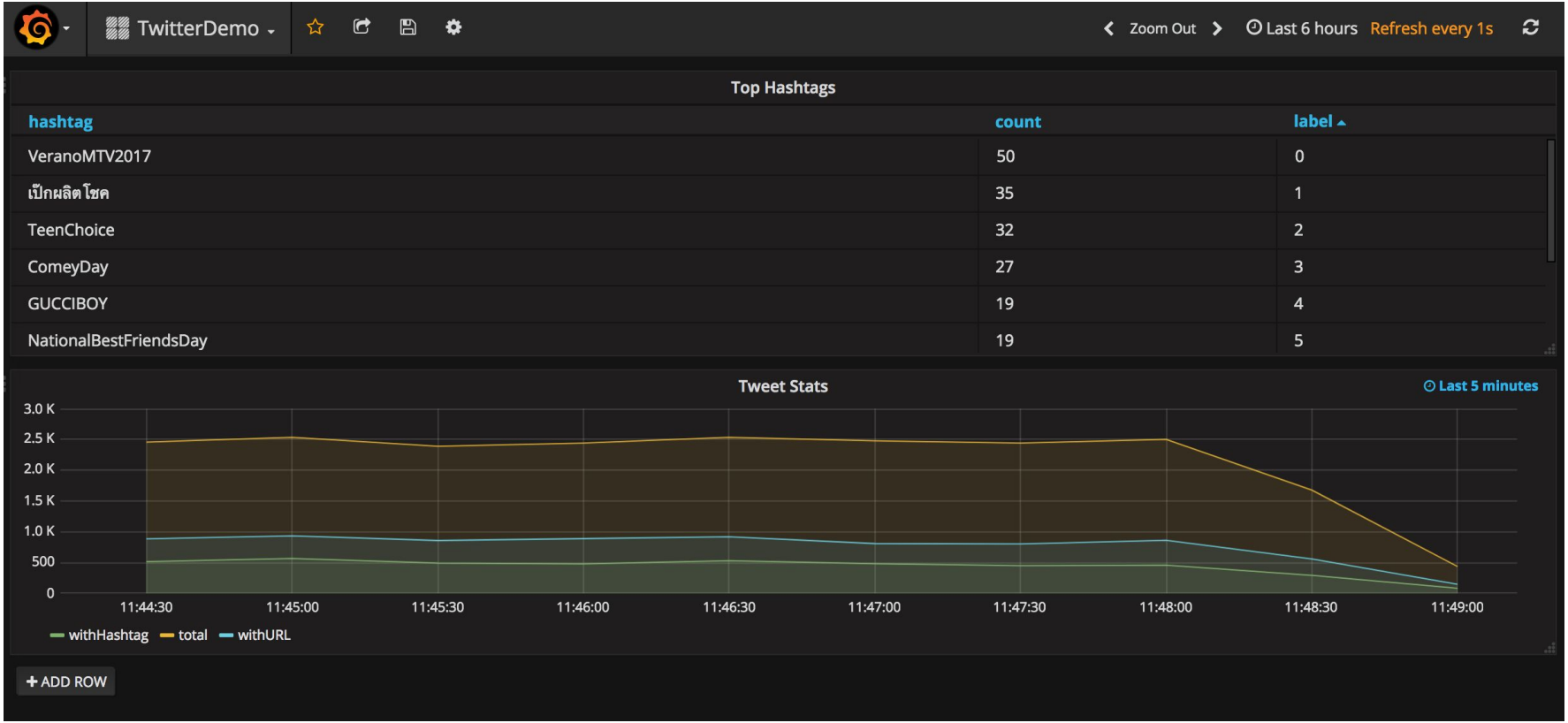
Real-time Visualization



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Top Hashtags

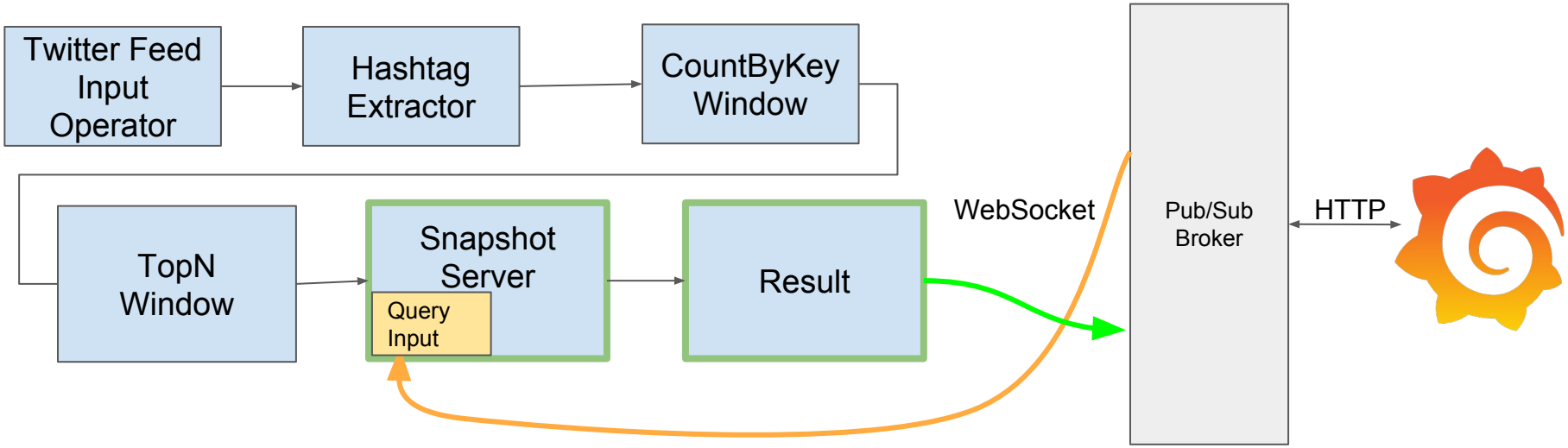
- Keyed sum accumulation (5 minute window, count trigger)
- TopN accumulation of upstream windowed counts

```
KeyedWindowedOperatorImpl<String, Long, MutableLong, Long> countByKey =
    new KeyedWindowedOperatorImpl<>();
countByKey.setAccumulation(new SumLong());
countByKey.setDataStorage(new InMemoryWindowedKeyedStorage<String, MutableLong>());
countByKey.setWindowOption(new WindowOption.TimeWindows(Duration.standardMinutes(5)));
countByKey.setWindowStateStorage(new InMemoryWindowedStorage<WindowState>());
countByKey.setTriggerOption(TriggerOption.AtWatermark().
    withEarlyFiringsAtEvery(25).accumulatingFiredPanes());

TopNByKey<String, Long> topNByKey = new TopNByKey<>();
topNByKey.setN(10);
WindowedOperatorImpl<KeyValPair<String, Long>, Map<String, Long>, List<KeyValPair<String, Long>>>
  topN = new WindowedOperatorImpl<>();
topN.setAccumulation(topNByKey);
topN.setDataStorage(new InMemoryWindowedStorage<Map<String, Long>>());
topN.setWindowStateStorage(new InMemoryWindowedStorage<WindowState>());
topN.setTriggerOption(TriggerOption.AtWatermark()
    .withEarlyFiringsAtEvery(1).accumulatingFiredPanes());
```

Queryable State

A set of operators in the library that support real-time queries of operator state.



- Pub/Sub server: https://github.com/atrato/pubsub-server
- Grafana data source: https://github.com/atrato/apex-grafana-datasource-server

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Queryable State

- Snapshot server
  - Stateful operator that holds last received list of objects
  - Receives query and emits the list as JSON formatted query result
- Source schema configured, result fields via query
- Predefined schemas (Apex library): “Snapshot”, “Dimensional”

```
TopNSnapshotServer topTagsSnapshot = new TopNSnapshotServer();
String JSON = SchemaUtils.jarResourceFileToString(SCHEMA);
topTagsSnapshot.setSnapshotSchemaJSON(JSON);
```

```
{
  "values": [
    {"name": "hashtag",    "type": "string"},
    {"name": "count",      "type": "long"},
    {"name": "label",      "type": "string"}
  ]
}
```

```
PubSubWebSocketAppDataResult wsResult = dag.addOperator("topNResult",
    new PubSubWebSocketAppDataResult());
wsResult.setUri(uri);
wsResult.setTopic(topic);
```


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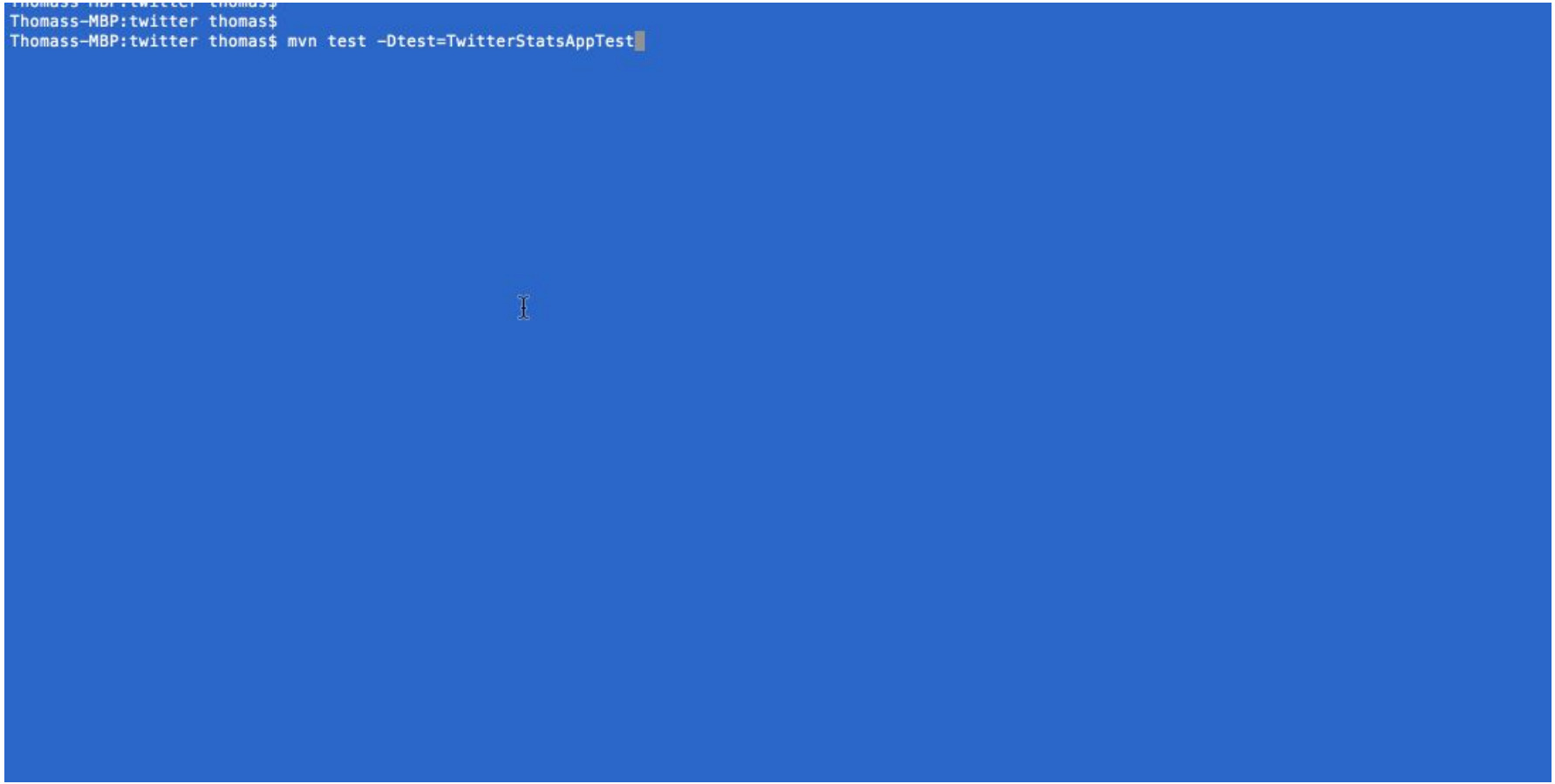
Demo


Thomass-MBP:twitter thomas$
Thomass-MBP:twitter thomas$ mvn test -Dtest=TwitterStatsAppTest

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Apex - Recent Additions & Roadmap

- Apex runner in Apache Beam
- Iterative processing
- Integrated with Apache Samoa, opens up ML
- Integrated with Apache Calcite, enables SQL
- Scalable, incremental state management
- User defined control tuples (watermarks, batch control, …)

- Enhanced support for Batch Processing
- Support for Mesos and Kubernetes
- Encrypted Streams
- Support for Python

Resources

- http://apex.apache.org/
- Powered by Apex - http://apex.apache.org/powered-by-apex.html
- Learn more - http://apex.apache.org/docs.html
- Getting involved - http://apex.apache.org/community.html
- Download - http://apex.apache.org/downloads.html
- Follow @ApacheApex - https://twitter.com/apacheapex
- Meetups - https://www.meetup.com/topics/apache-apex/
- Examples - https://github.com/apache/apex-malhar/tree/master/examples
- Slideshare - http://www.slideshare.net/ApacheApex/presentations