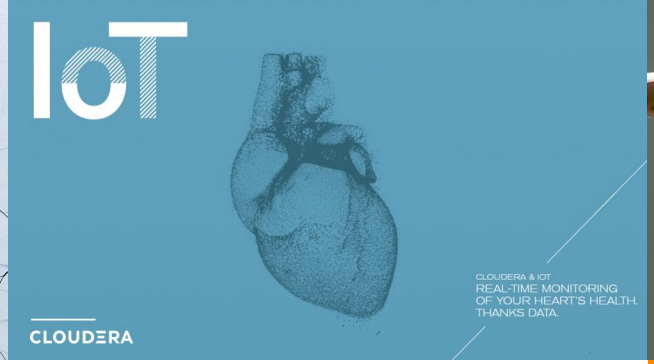
CLOUDERA

Continuous SQL with Kafka and Flink

Tim Spann
Principal Developer Advocate

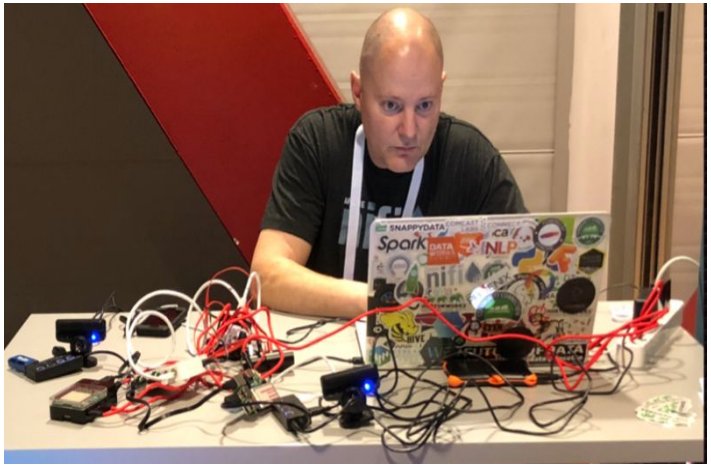
Nov-2023



CLOUDERA

EDGE
2AI
CLOUDERA

ENTERPRISE
DATA
CLOUD
CLOUDERA



Tim Spann

Twitter: @**PaasDev** // Blog: **datainmotion.dev**

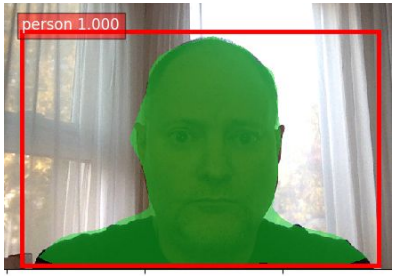
Principal Developer Advocate.

Princeton Future of Data Meetup.

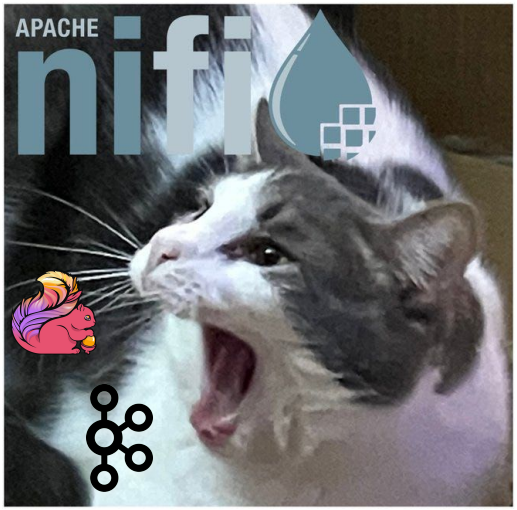
ex-Pivotal, ex-Hortonworks, ex-StreamNative, ex-PwC, ex-HPE

https://medium.com/@tspann

https://github.com/tspannhw



FLaNK Stack Weekly by Tim Spann

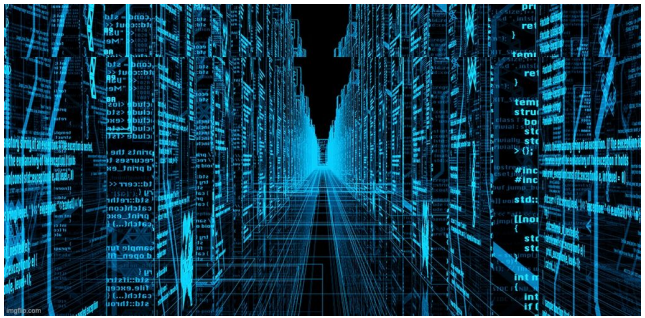


https://bit.ly/32dAJft

https://www.meetup.com/futureofdata-princeton/

This week in Apache NiFi, Apache Flink, Apache Kafka, ML, AI, Apache Spark, Apache Iceberg, Python, Java and Open Source friends.

Future of Data - NYC + NJ + Philly + Virtual



https://www.meetup.com/futureofdata-princeton/

From Big Data to AI to Streaming to Containers to Cloud to Analytics to Cloud Storage to Fast Data to Machine Learning to Microservices to ...

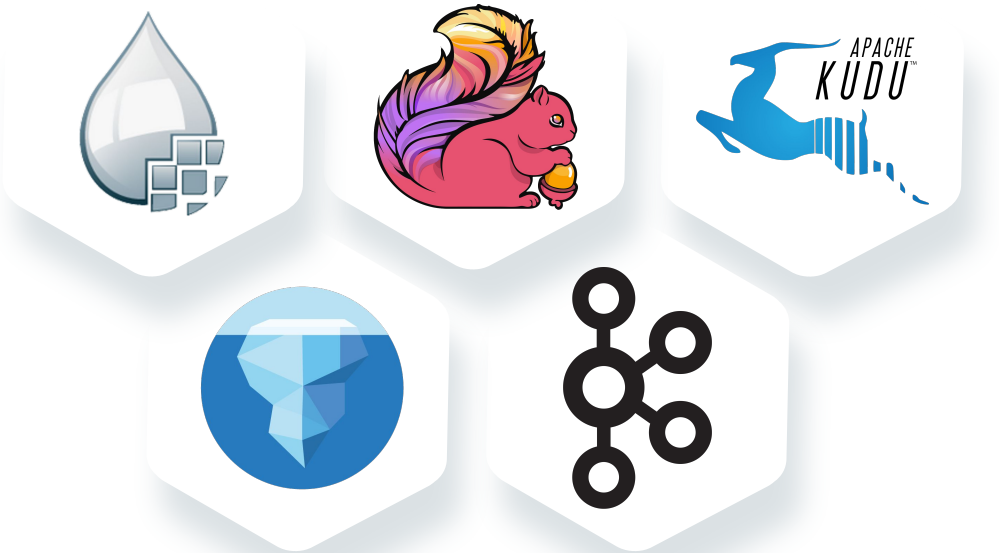
ICEBERG

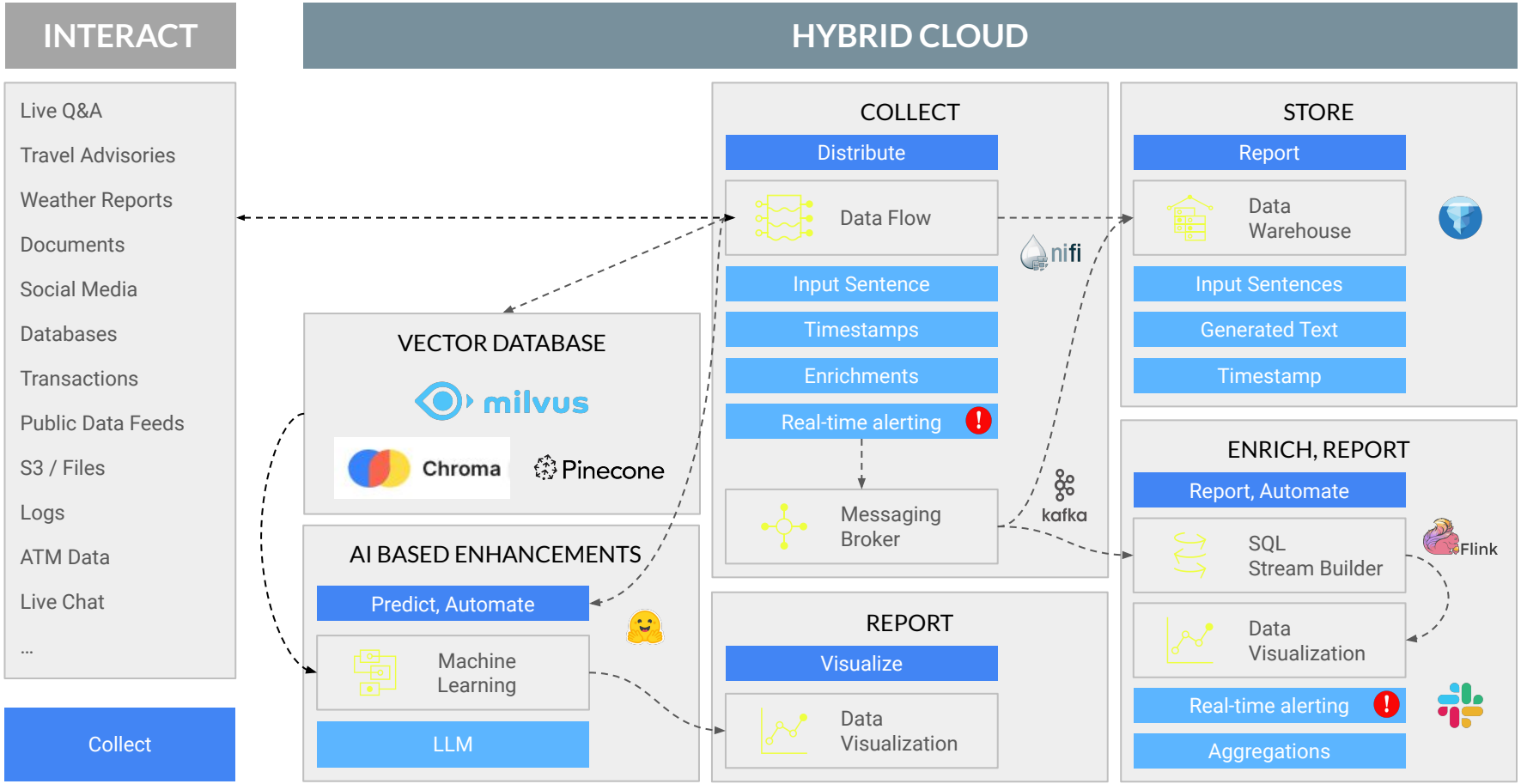
@PaasDev

FLANK

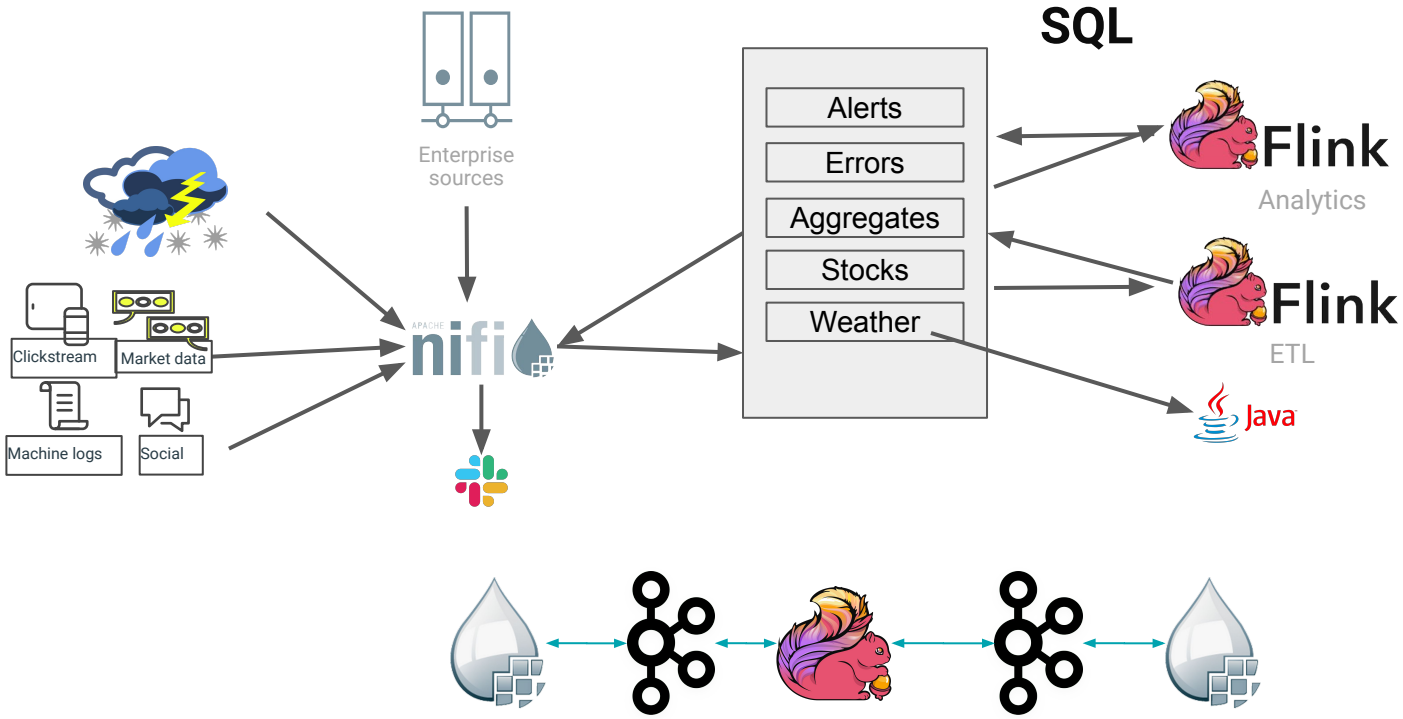

CUNK ON FLANK
THEY SAY IT'S FOR FAST DATA
IS IT SO FAST THAT IT ARRIVES BEFORE I ASKED FOR IT
imgflip.com

BUILDING REAL-TIME REQUIRES A TEAM

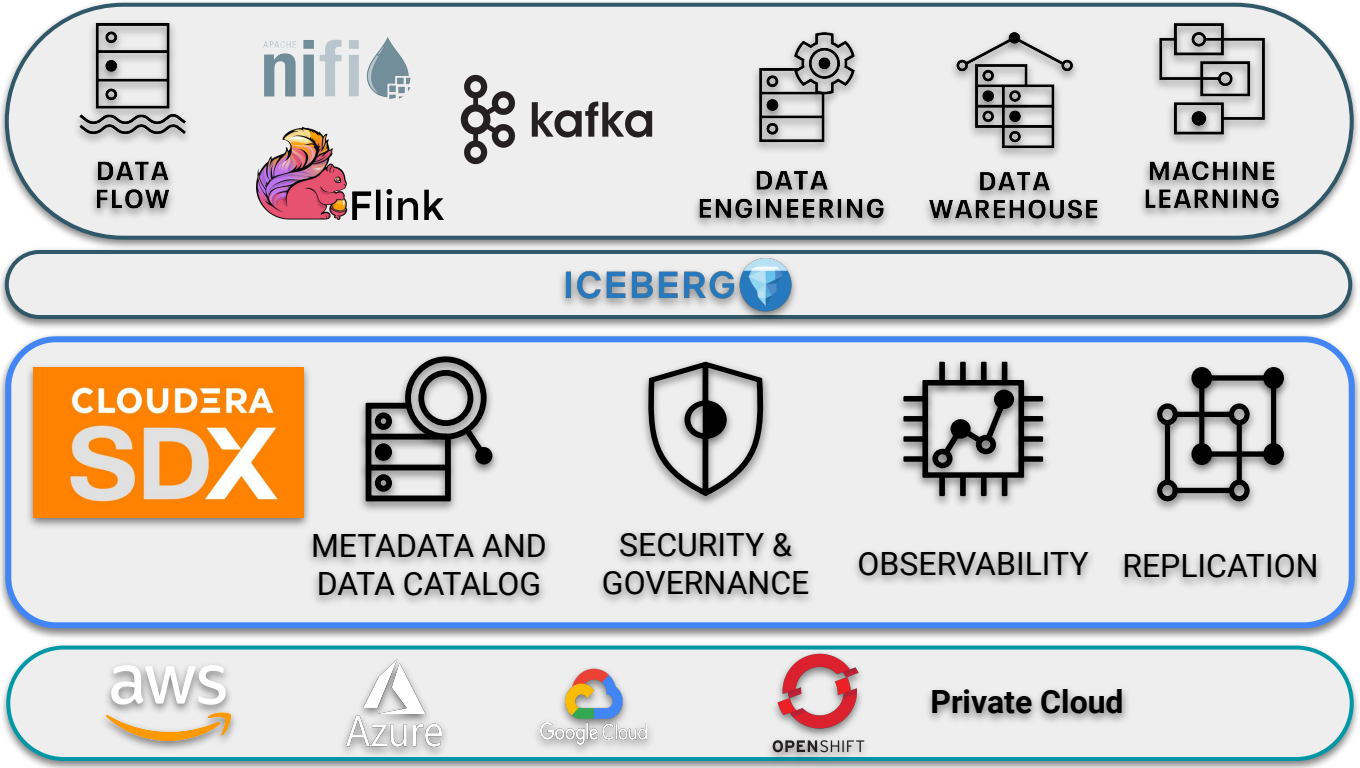



INTERACT
HYBRID CLOUD
Live Q&A
Travel Advisories
Weather Reports
Documents
Social Media
Databases
Transactions
Public Data Feeds
S3 / Files
Logs
ATM Data
Live Chat
...
Collect
COLLECT
Distribute
Data Flow
nifi
Input Sentence
Timestamps
Enrichments
Real-time alerting
Messaging Broker
kafka
STORE
Report
Data Warehouse
Input Sentences
Generated Text
Timestamp
VECTOR DATABASE
milvus
Chroma
Pinecone
AI BASED ENHANCEMENTS
Predict, Automate
Machine Learning
LLM
REPORT
Visualize
Data Visualization
ENRICH, REPORT
Report, Automate
SQL Stream Builder
Flink
Data Visualization
Real-time alerting
Aggregations

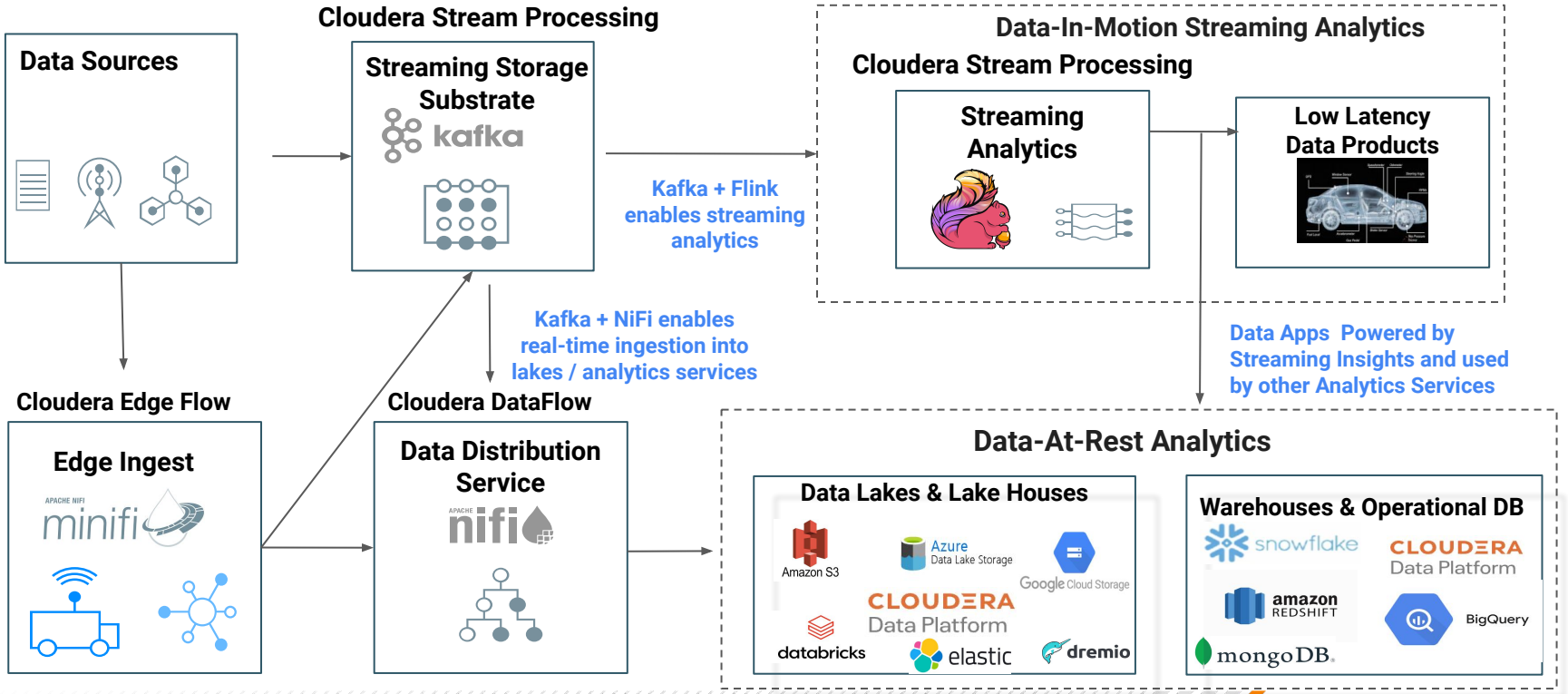
End to End Streaming Pipeline Example



CDP: AN OPEN DATA LAKEHOUSE



Analytics-in-Stream



APACHE KAFKA

What is Can You Do With Apache Kafka?

Web site activity: track page views, searches, etc. in real time

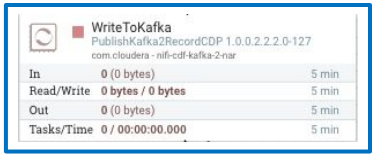
Events & log aggregation: particularly in distributed systems where messages come from multiple sources

Monitoring and metrics: aggregate statistics from distributed applications and build a dashboard application

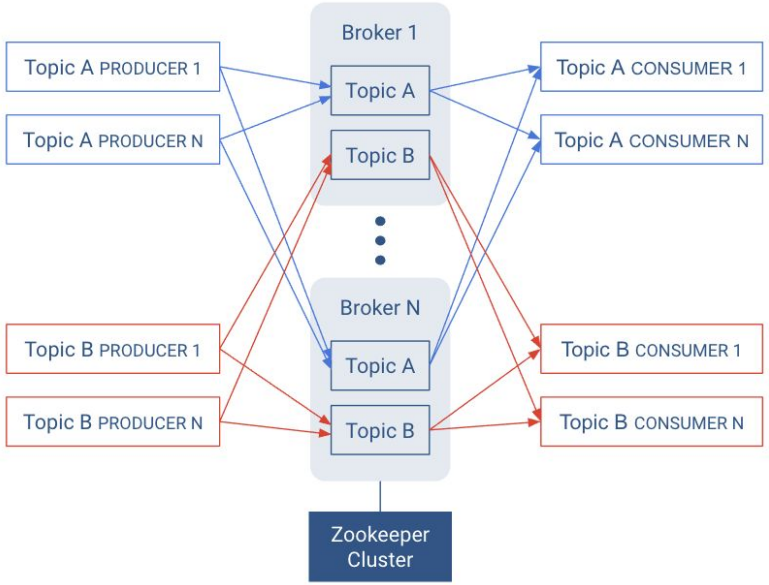
Stream processing: process raw data, clean it up, and forward it on to another topic or messaging system

Real-time data ingestion: fast processing of a very large volume of messages

STREAMS MESSAGING WITH KAFKA



- Highly reliable distributed messaging system.
- Decouple applications, enables many-to-many patterns.
- Publish-Subscribe semantics.
- Horizontal scalability.
- Efficient implementation to operate at speed with big data volumes.
- Organized by topic to support several use cases.

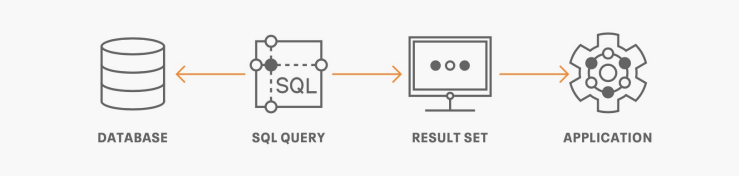


APACHE FLINK

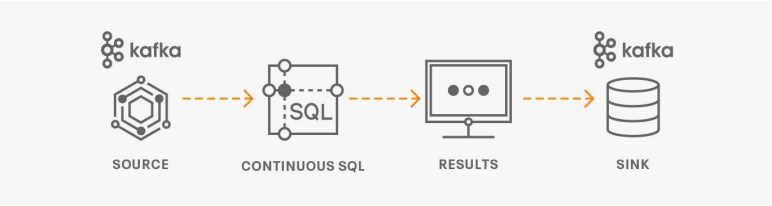
CONTINUOUS SQL

- SSB is a Continuous SQL engine
- It's SQL, but a slightly different mental model, but with big implications

Traditional Parse/Execute/Fetch model



Continuous SQL Model



Hint: The query is boundless and never finishes, and time matters

AKA: `SELECT * FROM foo WHERE 1=0 -- will run forever`

Flink SQL

Key Takeaway: Rich SQL grammar with advanced time and aggregation tools

```
-- specify Kafka partition key on output
SELECT foo AS _eventKey FROM sensors

-- use event time timestamp from kafka
-- exactly once compatible
SELECT eventTimestamp FROM sensors

-- nested structures access
SELECT foo.'bar' FROM table; -- must quote nested
column

-- timestamps
SELECT * FROM payments
WHERE eventTimestamp > CURRENT_TIMESTAMP-interval
'10' second;

-- unnest
SELECT b.*, u.*
FROM bgp_avro b,
UNNEST(b.path) AS u(pathitem)
```

```
-- aggregations and windows
SELECT card,
MAX(amount) as theamount,
TUMBLE_END(eventTimestamp, interval '5' minute) as
ts
FROM payments
WHERE lat IS NOT NULL
AND lon IS NOT NULL
GROUP BY card,
TUMBLE(eventTimestamp, interval '5' minute)
HAVING COUNT(*) > 4  -- >4==fraud

-- try to do this ksql!
SELECT us_west.user_score+ap_south.user_score
FROM kafka_in_zone_us_west us_west
FULL OUTER JOIN kafka_in_zone_ap_south ap_south
ON us_west.user_id = ap_south.user_id;
```

SQL STREAM BUILDER (SSB)

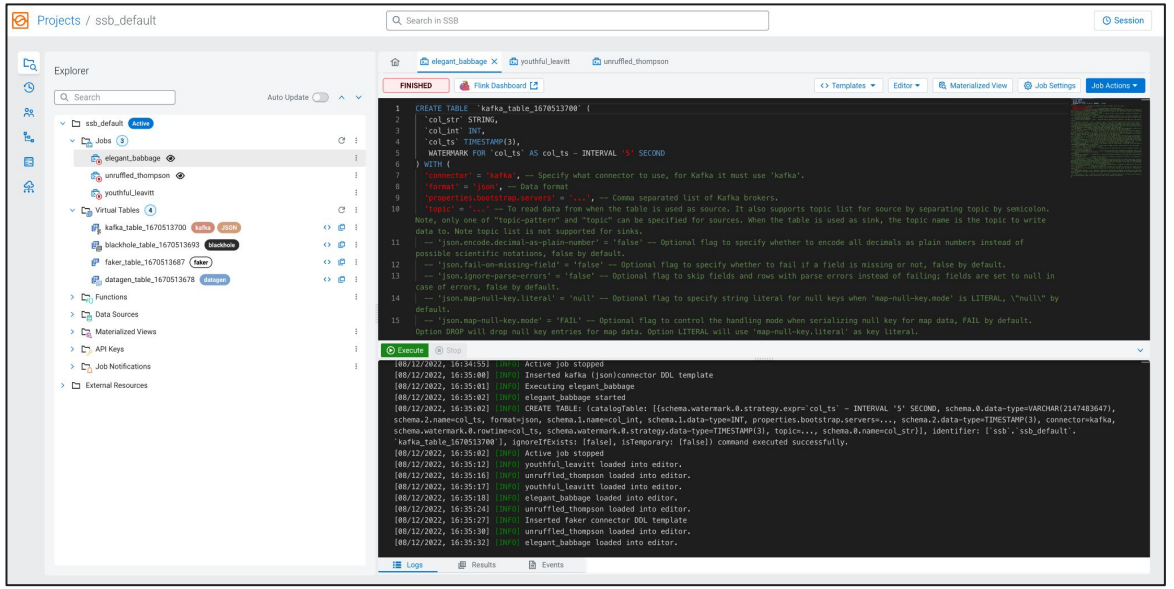
Democratize access to real-time data with just SQL

SQL STREAM BUILDER allows developers, analysts, and data scientists to **write streaming applications** with industry standard **SQL**.

No Java or Scala code development required.

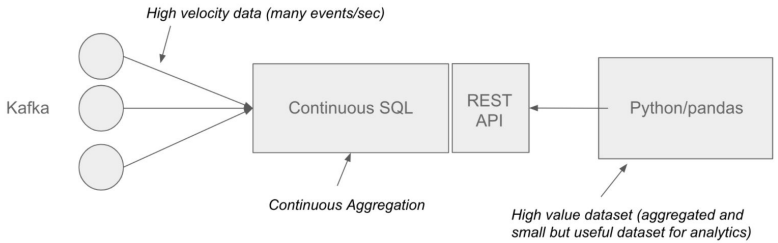
Simplifies access to data in Kafka & Flink. Connectors to batch data in HDFS, Kudu, Hive, S3, JDBC, CDC and more

Enrich streaming data with batch data in a single tool



SSB MATERIALIZED VIEWS

Key Takeaway; MV's allow data scientist, analyst and developers consume data from the firehose




```
SELECT userid,
max(amount) as max_amount,
sum(amount) as sum_amount,
count(*) as thecount,
tumble_end(eventTimestamp, interval '5' second) as ts
FROM authorizations
GROUP BY userid, tumble(eventTimestamp, interval '5' second)
HAVING count(*) > 1
```

```
[90]: import pandas as pd
[91]: mv = "https://xxxyyyyzzz"
[92]: df = pd.read_json(mv)
[93]: len(df.keys())
[93]: 5
[95]: df['ts'] = pd.to_datetime(df['ts'])
[97]: df.dtypes
[97]: max_amount              int64
      sum_amount              int64
      thecount                int64
      ts             datetime64[ns]
      userid                  int64
      dtype: object
[98]: df.set_index('userid').sort_values(by=['thecount'], ascending=False).head()
```

[98]:

userid	max_amount	sum_amount	thecount	ts
787	34911	57304	10	2020-06-16 19:52:15
744	77407	95407	9	2020-06-16 19:52:15
78	86761	330397	9	2020-06-16 19:52:15
541	78762	282682	8	2020-06-16 19:52:15
926	85636	129728	8	2020-06-16 19:52:15

```
[ ]:
```

ICEBERG INTEGRATION

Robust Next Generation Architecture for Data Driven Business

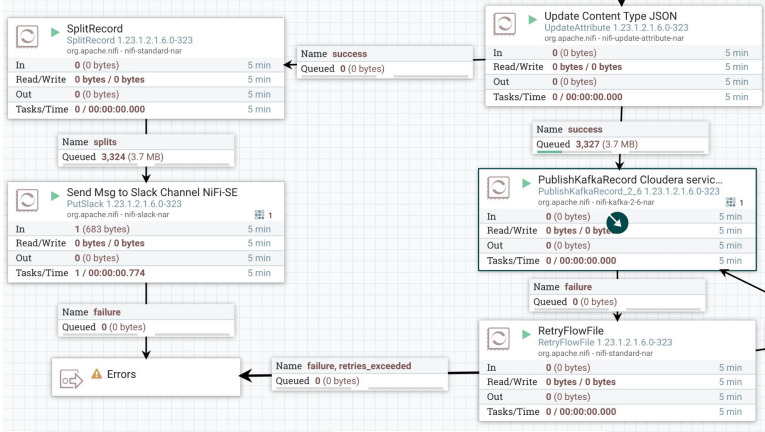
Unified Processing Engine

Massive Open table format

- Maximally open
- Maximally flexible
- Ultra high performance for MASSIVE data

Iceberg Support for Flink APIs through SSB

Feature support	Flink	Notes
SQL create catalog	✔	
SQL create database	✔	
SQL create table	✔	
SQL create table like	✔	
SQL alter table	✔	Only support altering table properties, column and partition changes are not supported
SQL drop_table	✔	
SQL select	✔	Support both streaming and batch mode
SQL insert into	✔	Support both streaming and batch mode
SQL insert overwrite	✔	
DataStream read	✔	
DataStream append	✔	
DataStream overwrite	✔	
Metadata tables		Support Java API but does not support Flink SQL
Rewrite files action	✔	



FREE LEARNING ENVIRONMENT

CSP Community Edition

- Kafka, KConnect, SMM, SR, Flink, and SSB in Docker
- Runs in Docker
- Try new features quickly
- Develop applications locally

- Docker compose file of CSP to run from command line w/o any dependencies, including Flink, SQL Stream Builder, Kafka, Kafka Connect, Streams Messaging Manager and Schema Registry
  - `$>docker compose up`
- Licensed under the Cloudera Community License
- **Unsupported**
- Community Group Hub for CSP
- Find it on docs.cloudera.com under Applications

CSP Community Edition

A readily available, dockerized deployment of Apache Kafka and Apache Flink that allows you to test the features and capabilities of Cloudera Stream Processing.

Learn More

https://www.cloudera.com/downloads/cdf/csp-community-edition.html

Open Source Edition

- Apache NiFi in Docker
- Runs in Docker
- Try new features quickly
- Develop applications locally

- Docker NiFi
  - `docker run --name nifi -p 8443:8443 -d -e SINGLE_USER_CREDENTIALS_USERNAME=admin -e SINGLE_USER_CREDENTIALS_PASSWORD=ctsBtRBKHRAx69EqUghvvgEvjnaLjFEB apache/nifi:latest`

- Licensed under the ASF License
- **Unsupported**

https://hub.docker.com/r/apache/nifi

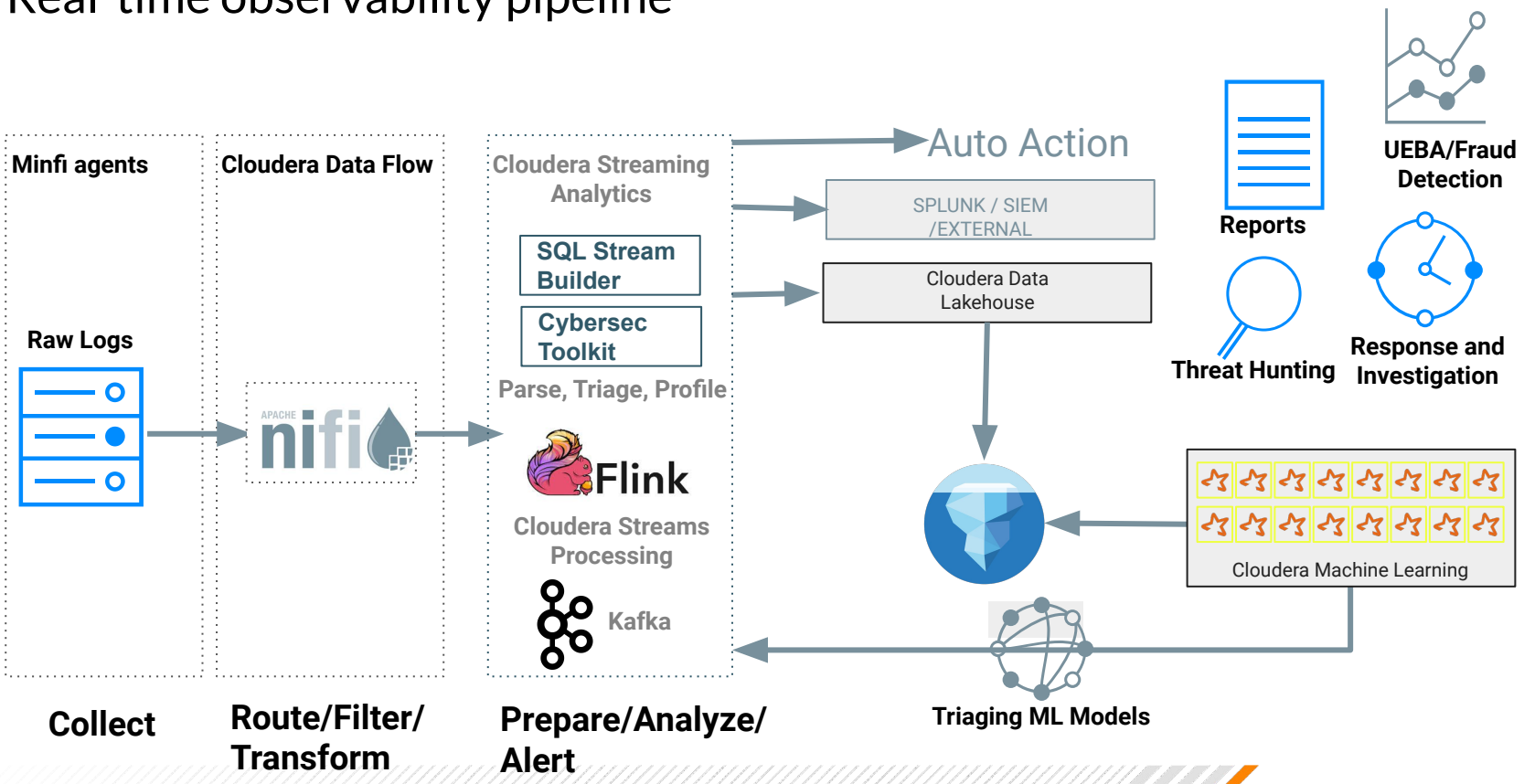
DEMO AND CODE

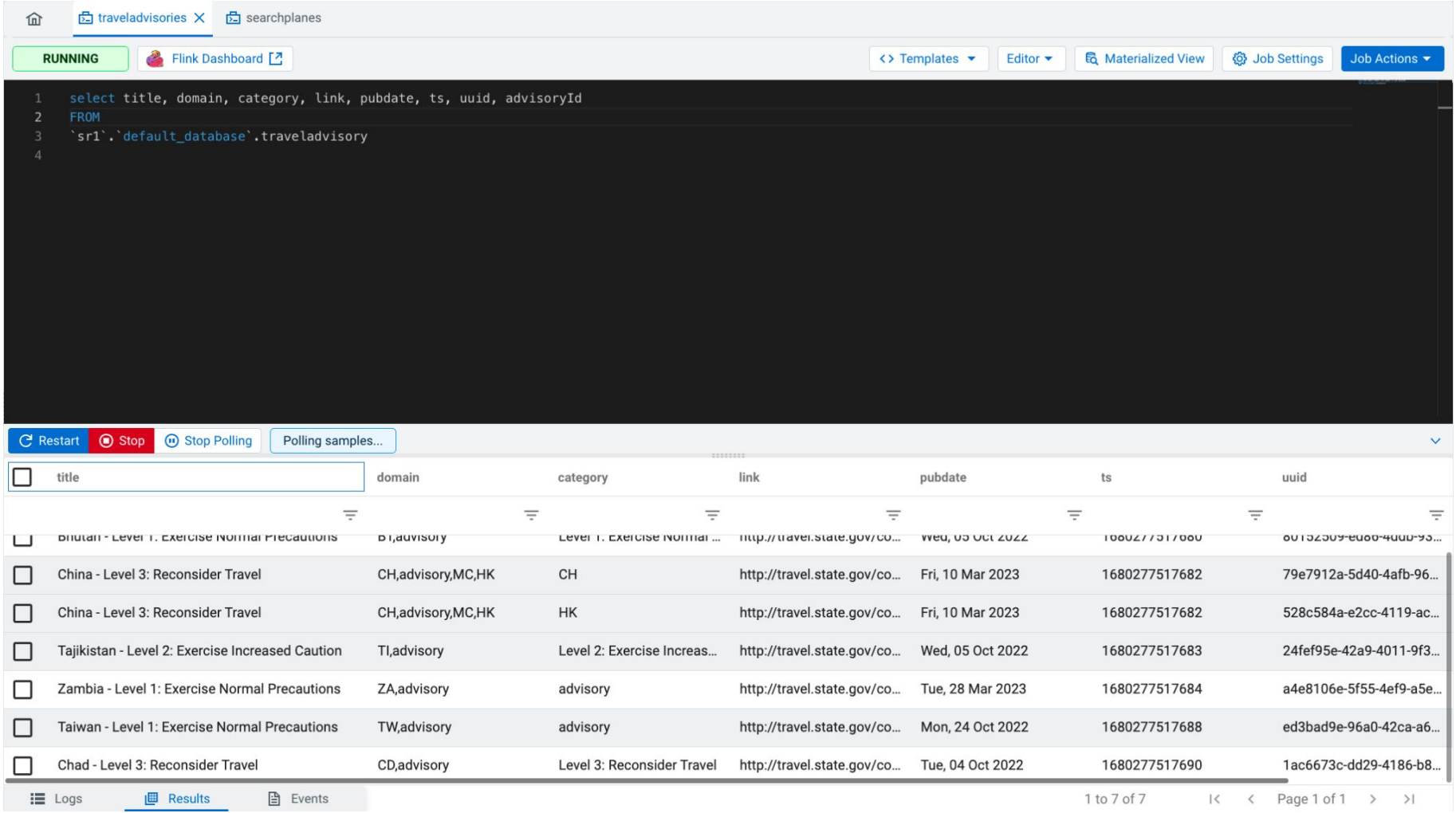
Continuous SQL

```
select max(alt_baro) as MaxAltitudeFeet, min(alt_baro) as MinAltitudeFeet, avg(alt_baro) as AvgAltitudeFeet,
      max(alt_geom) as MaxGAltitudeFeet, min(alt_geom) as MinGAltitudeFeet, avg(alt_geom) as AvgGAltitudeFeet,
      max(gs) as MaxGroundSpeed, min(gs) as MinGroundSpeed, avg(gs) as AvgGroundSpeed,
      count(alt_baro) as RowCount,
      hex as ICAO, flight as IDENT
from `sr1`.`default_database`.`adsb`
group by flight, hex;
```

```
select transcom.title, transcom.description,  mta.VehicleRef,
DISTANCE_BETWEEN(CAST(transcom.latitude as STRING), CAST(transcom.latitude as STRING), mta.VehicleLocationLatitude, mta.VehicleLocationLongitude) as miles,
mta.StopPointName, mta.Bearing, mta.DestinationName, mta.ExpectedArrivalTime, mta.VehicleLocationLatitude, mta.VehicleLocationLongitude,
mta.ArrivalProximityText, mta.DistanceFromStop, mta.AimedArrivalTime, mta.`Date`, mta.ts, mta.uuid, mta.EstimatedPassengerCapacity, mta.EstimatedPassengerCount
from  `schemareg1`.`default_database`.`mta`  /*+ OPTIONS('scan.startup.mode' = 'earliest-offset') */ mta
FULL OUTER JOIN `schemareg1`.`default_database`.`transcom`  /*+ OPTIONS('scan.startup.mode' = 'earliest-offset') */ transcom
ON (transcom.latitude >= CAST(mta.VehicleLocationLatitude as float) - 0.3)
AND (transcom.longitude >= CAST(mta.VehicleLocationLongitude as float) - 0.3)
AND (transcom.latitude <= CAST(mta.VehicleLocationLatitude as float) + 0.3)
AND (transcom.longitude <= CAST(mta.VehicleLocationLongitude as float) + 0.3)
WHERE  mta.VehicleRef is not null
AND transcom.title is not null
AND DISTANCE_BETWEEN(CAST(transcom.latitude as STRING), CAST(transcom.latitude as STRING), mta.VehicleLocationLatitude, mta.VehicleLocationLongitude) <= 120
```

Real-time observability pipeline




traveladvisories
searchplanes
RUNNING
Flink Dashboard
Templates
Editor
Materialized View
Job Settings
Job Actions
select title, domain, category, link, pubdate, ts, uuid, advisoryId
FROM
`sr1`.`default_database`.traveladvisory
Restart
Stop
Stop Polling
Polling samples...
title
domain
category
link
pubdate
ts
uuid
China - Level 3: Reconsider Travel
CH,advisory,MC,HK
CH
http://travel.state.gov/co...
Fri, 10 Mar 2023
1680277517682
79e7912a-5d40-4afb-96...
China - Level 3: Reconsider Travel
CH,advisory,MC,HK
HK
http://travel.state.gov/co...
Fri, 10 Mar 2023
1680277517682
528c584a-e2cc-4119-ac...
Tajikistan - Level 2: Exercise Increased Caution
TI,advisory
Level 2: Exercise Increas...
http://travel.state.gov/co...
Wed, 05 Oct 2022
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24fef95e-42a9-4011-9f3...
Zambia - Level 1: Exercise Normal Precautions
ZA,advisory
advisory
http://travel.state.gov/co...
Tue, 28 Mar 2023
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Taiwan - Level 1: Exercise Normal Precautions
TW,advisory
advisory
http://travel.state.gov/co...
Mon, 24 Oct 2022
1680277517688
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Chad - Level 3: Reconsider Travel
CD,advisory
Level 3: Reconsider Travel
http://travel.state.gov/co...
Tue, 04 Oct 2022
1680277517690
1ac6673c-dd29-4186-b8...
Logs
Results
Events
1 to 7 of 7
Page 1 of 1

Materialized View

Configuration

Primary Key

uuid

Retention (Seconds)

Min Row Retention Count

10000

API Key

traveladvisory1

Enable MV

Recreate on Job Start

Ignore NULLs

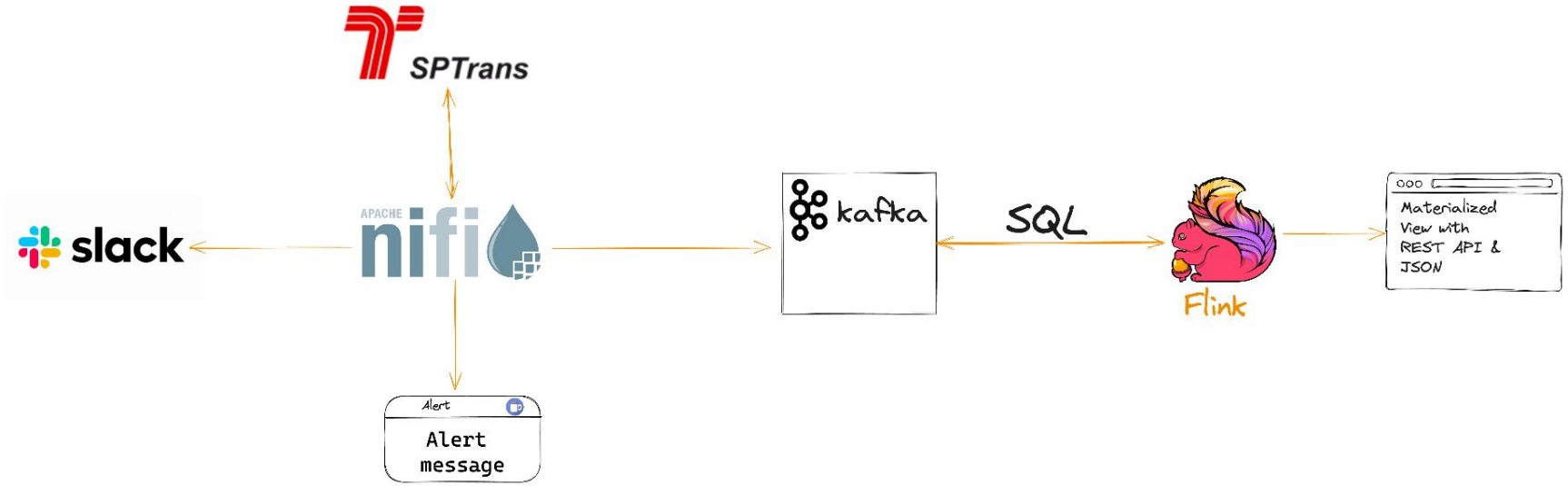
Queries

Add New Query

/api/v1/query/5201/travel?key=66ba91a9-507f-422c-bbb4-86250a9f7bb1&limit=100

Data in Motion: Overview e Novidades do NiFi, Kafka e Flink

Apresentador: Tim Spann - Principal DIM Specialist and Developer Advocate



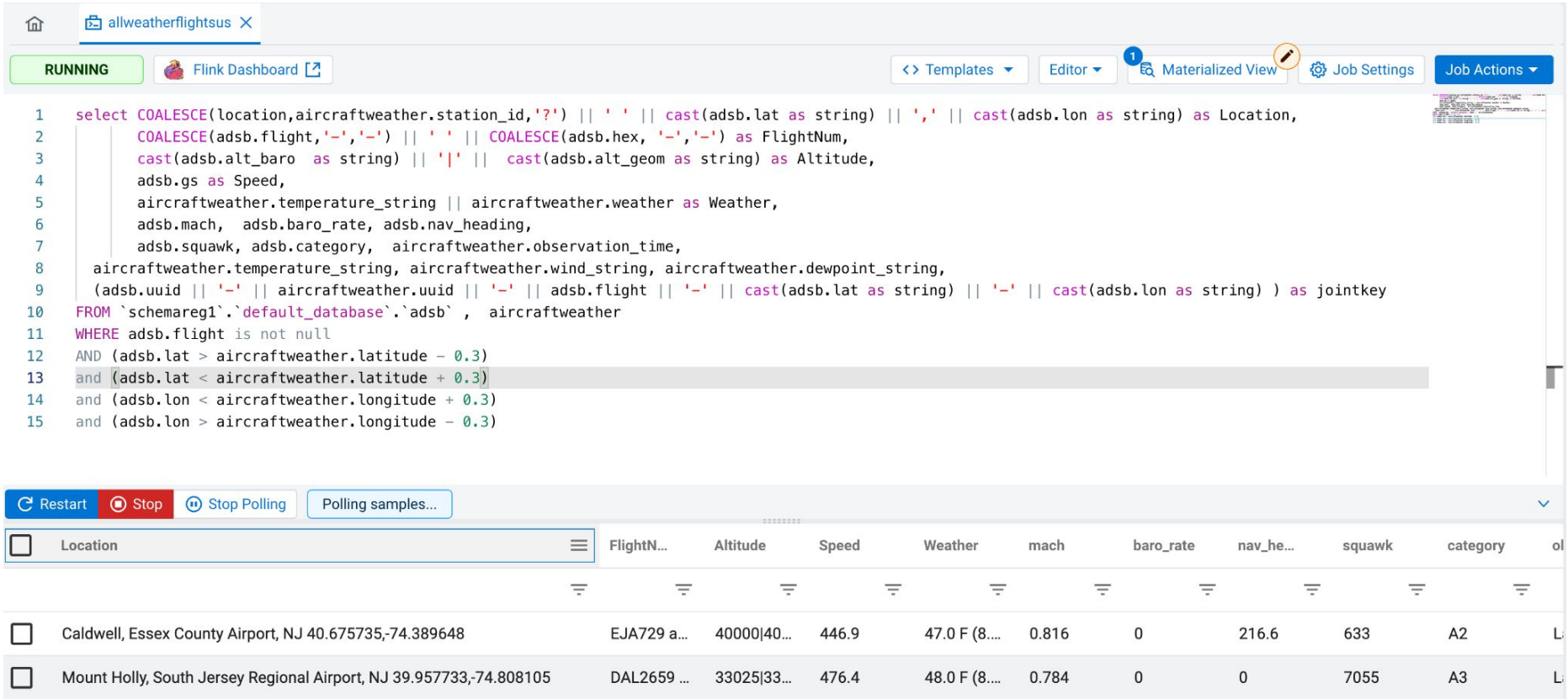
https://medium.com/cloudera-inc/transit-in-sao-paulo-brasil-flank-style-eaec6753cc63

NiFi/Kafka/Flink - Data Tables - Brazil SPTrans

Show 10 entries

Search:

HR	Vehicle	Line ID	Line Origin	Line Destination	Lat/Long	Date/Time
17:08	21434	33462	PQ. EDU CHAVES	PÇA. DO CORREIO	-23.537837,-46.6328475	2023-09-08T20:07:30Z
17:08	21243	33462	PQ. EDU CHAVES	PÇA. DO CORREIO	-23.529571,-46.5984615	2023-09-08T20:07:31Z
17:08	61677	32840	PQ. RES. COCAIA	PQ. IBIRAPUERA	-23.6532785,-46.7017075	2023-09-08T20:07:35Z
17:08	61683	32840	PQ. RES. COCAIA	PQ. IBIRAPUERA	-23.718092,-46.699059	2023-09-08T20:07:20Z
17:08	61517	32840	PQ. RES. COCAIA	PQ. IBIRAPUERA	-23.58114725,-46.6574995	2023-09-08T20:07:28Z
17:08	41014	33514	VL. DALILA	TERM. PQ. D. PEDRO II	-23.5383225,-46.563772	2023-09-08T20:08:04Z
17:08	41019	33514	VL. DALILA	TERM. PQ. D. PEDRO II	-23.5443805,-46.5217695	2023-09-08T20:07:45Z


allweatherflightsus
RUNNING
Flink Dashboard
Templates
Editor
1
Materialized View
Job Settings
Job Actions
select COALESCE(location,aircraftweather.station_id,'?') || ' ' || cast(adsb.lat as string) || ',' || cast(adsb.lon as string) as Location,
COALESCE(adsb.flight,'-','-') || ' ' || COALESCE(adsb.hex, '-','-') as FlightNum,
cast(adsb.alt_baro as string) || '|' || cast(adsb.alt_geom as string) as Altitude,
adsb.gs as Speed,
aircraftweather.temperature_string || aircraftweather.weather as Weather,
adsb.mach, adsb.baro_rate, adsb.nav_heading,
adsb.squawk, adsb.category, aircraftweather.observation_time,
aircraftweather.temperature_string, aircraftweather.wind_string, aircraftweather.dewpoint_string,
(adsb.uuid || '-' || aircraftweather.uuid || '-' || adsb.flight || '-' || cast(adsb.lat as string) || '-' || cast(adsb.lon as string)) as jointkey
FROM `schemareg1`.`default_database`.`adsb` , aircraftweather
WHERE adsb.flight is not null
AND (adsb.lat > aircraftweather.latitude - 0.3)
and (adsb.lat < aircraftweather.latitude + 0.3)
and (adsb.lon < aircraftweather.longitude + 0.3)
and (adsb.lon > aircraftweather.longitude - 0.3)
Restart
Stop
Stop Polling
Polling samples...
Location
FlightN...
Altitude
Speed
Weather
mach
baro_rate
nav_he...
squawk
category
Caldwell, Essex County Airport, NJ 40.675735,-74.389648
EJA729 a...
40000|40...
446.9
47.0 F (8....
0.816
0
216.6
633
A2
Mount Holly, South Jersey Regional Airport, NJ 39.957733,-74.808105
DAL2659 ...
33025|33...
476.4
48.0 F (8....
0.784
0
0
7055
A3

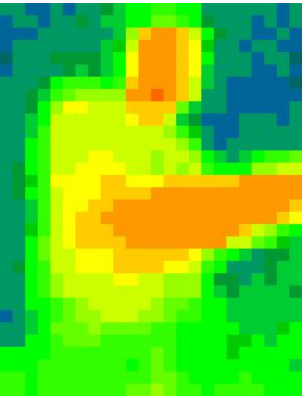
RESOURCES/WRAP-UP

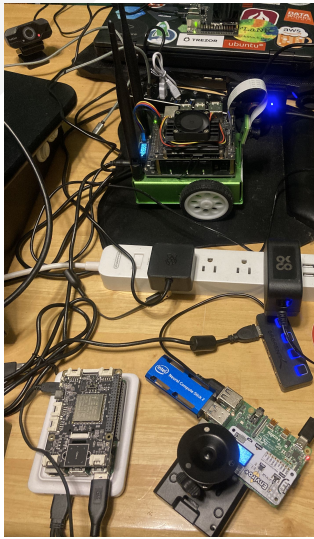
https://medium.com/@tspann/cdc-not-cat-data-capture-e43713879c03

https://events.dzone.com/dzone/Data-Pipelines-Investigating-the-Modern-Day-Stack

Resources

https://medium.com/cloudera-inc/finding-the-best-way-around-7491c76ca4cb





THANK YOU