Building stream processing applications with Apache Kafka

@rmoff

#KafkaMeetup

Building stream processing applications with Apache Kafka

@rmoff

#KafkaMeetup

STREAM PROCESSING

PROCESSING

STREAM

PROCESSING

a

STREAM

of EVENTS

@rmoff

STREAMS ARE of EVENTS

EVERYWHERE

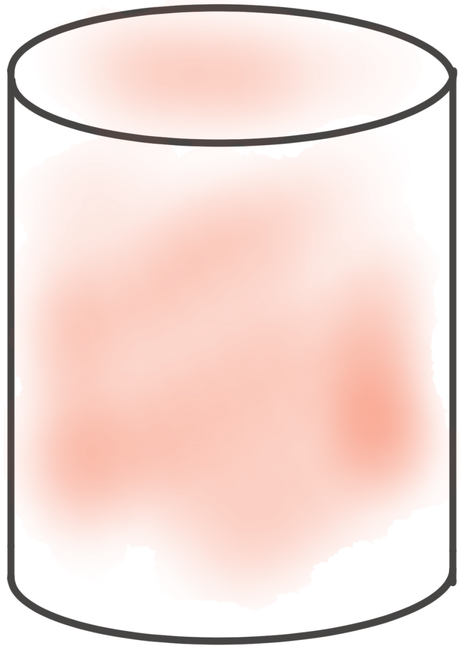
A Customer Experience

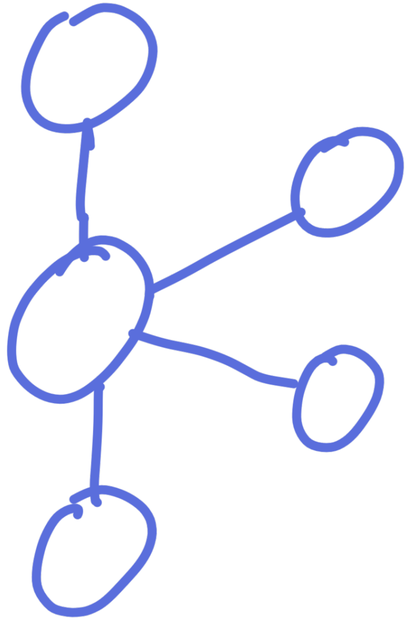
A Sale

A Sensor Reading

An Application Log Entry

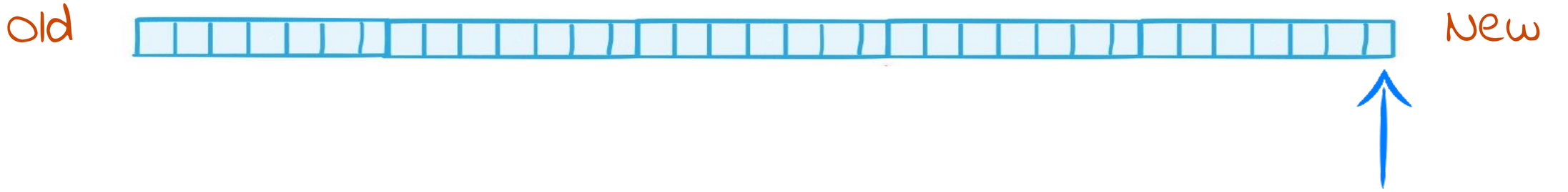
Databases





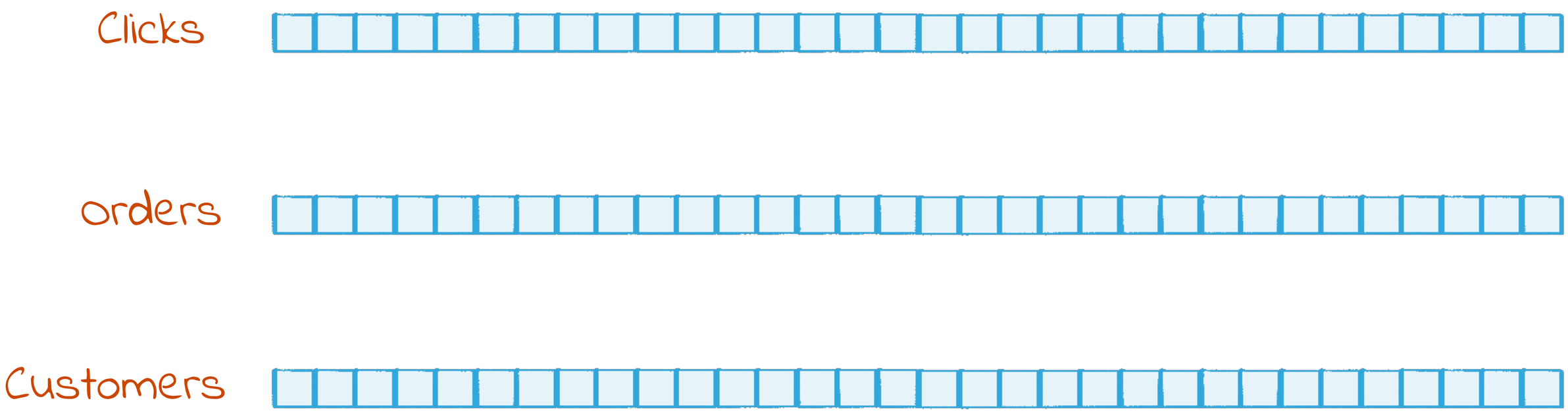
Immutable event log

Immutable Event Log



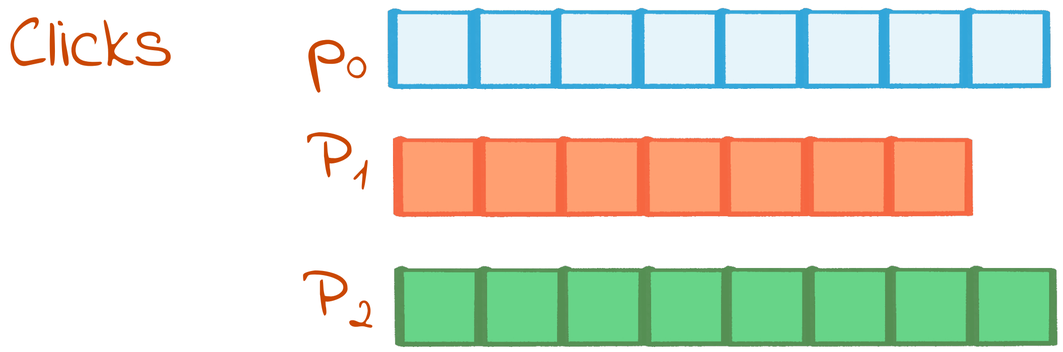
Messages are added at the end of the log

Topics



Topics are similar in concept to tables in a database

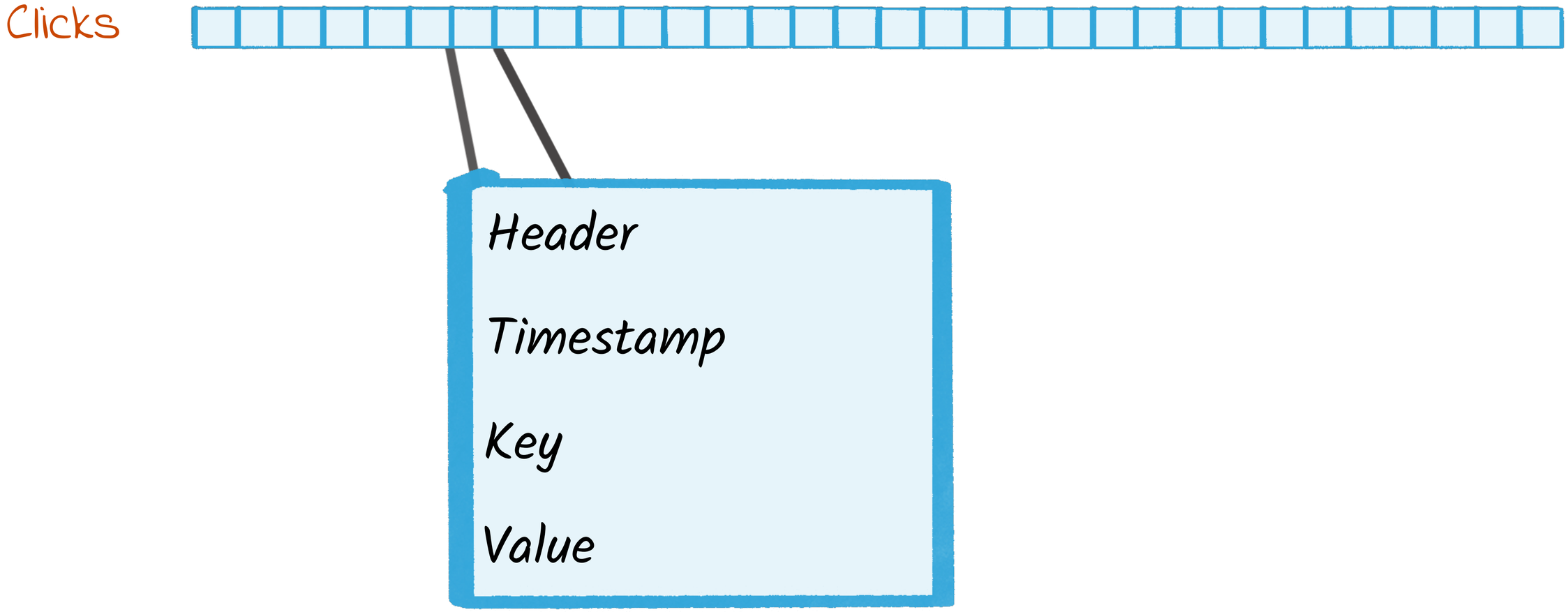
Partitions



Messages are guaranteed to be strictly ordered <u>within a partition</u>

Messages are just K/V bytes

plus headers + timestamp



Messages are just K/V bytes

With great power comes great responsibility

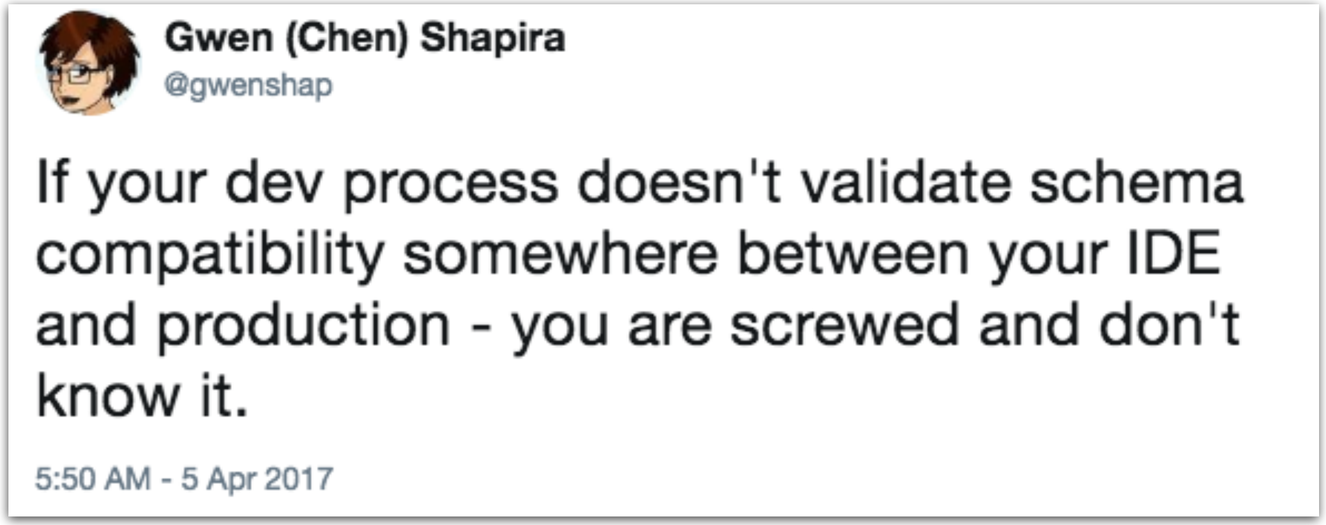
Avro

-> Confluent Schema Registry

Protobuf

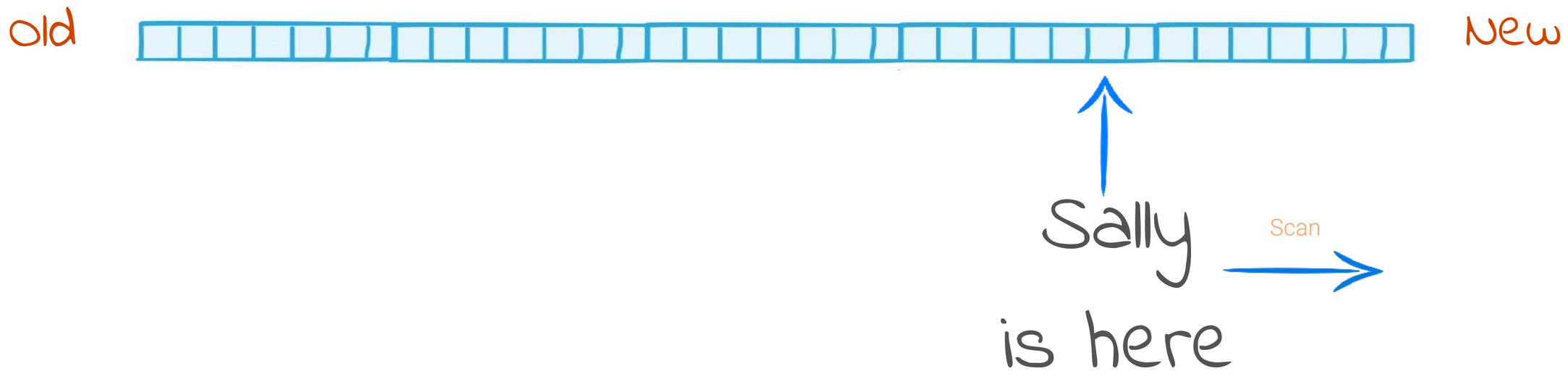
JSON

CSV

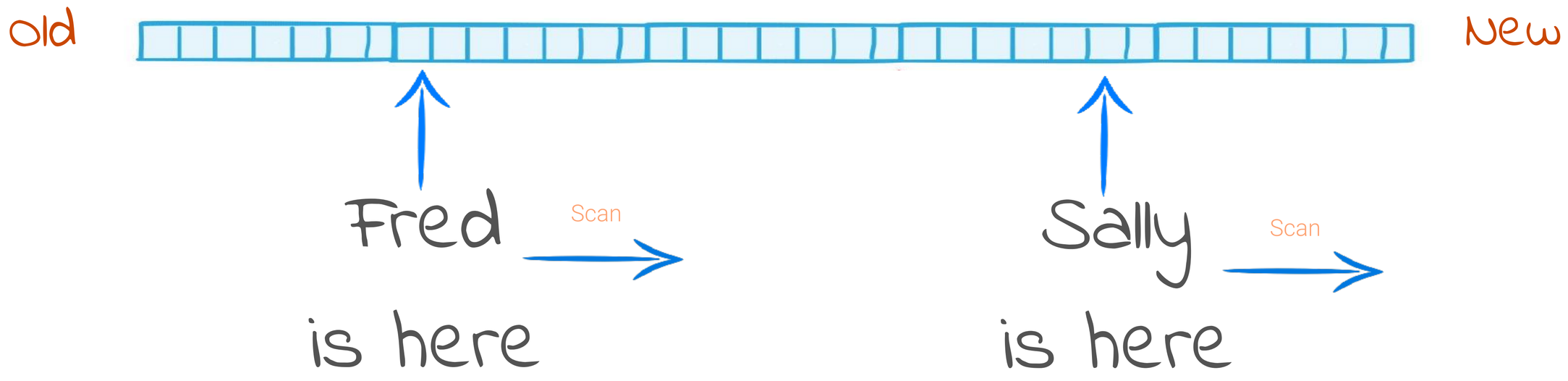


https://qconnewyork.com/system/files/presentation-slides/qcon_17_-_schemas_and_apis.pdf

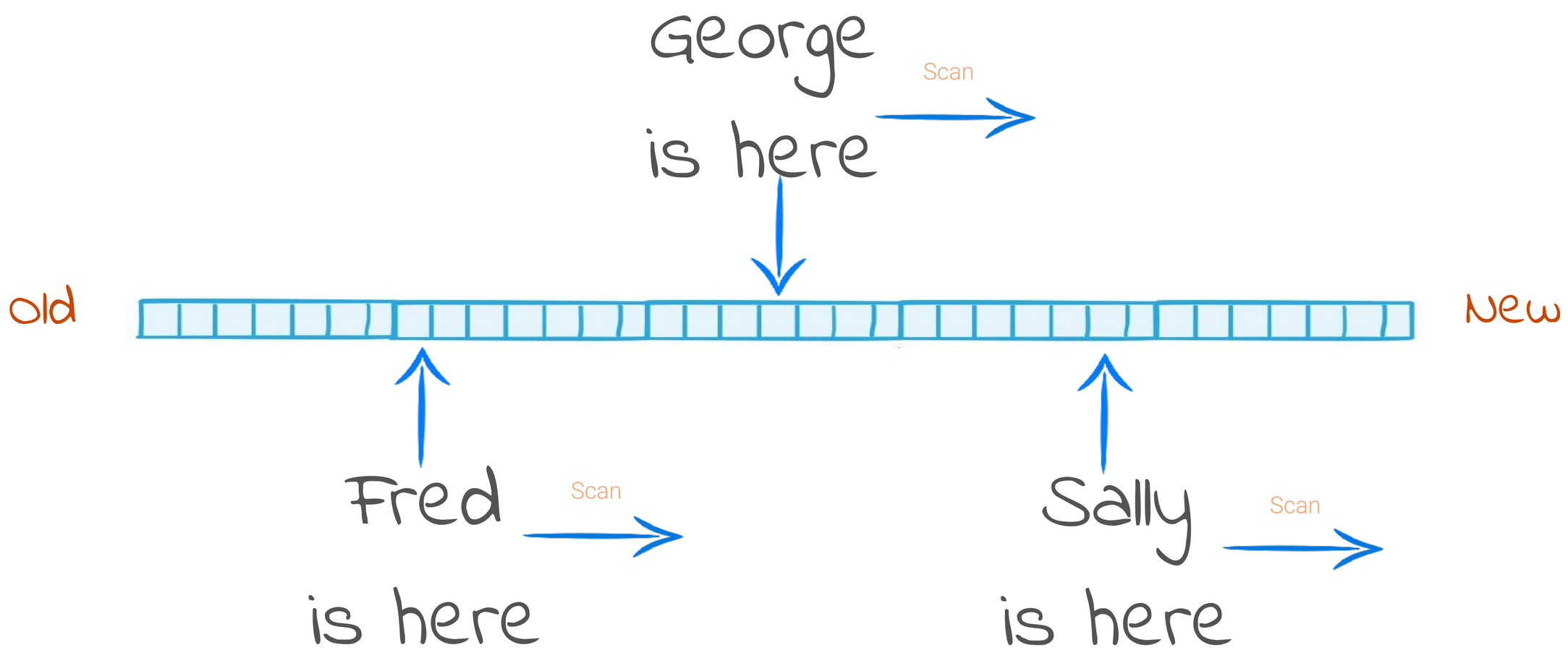
Consumers have a position all of their own



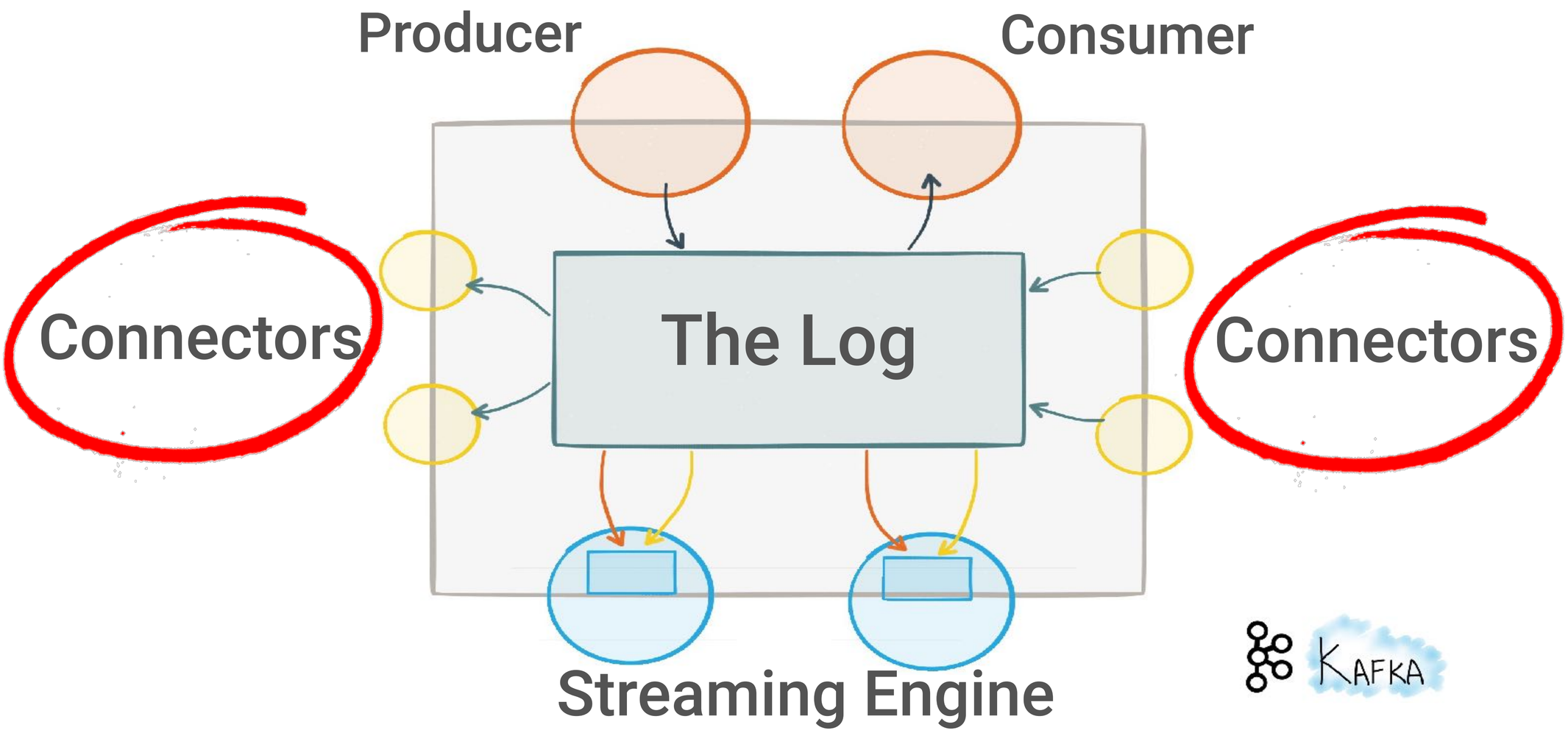
Consumers have a position all of their own



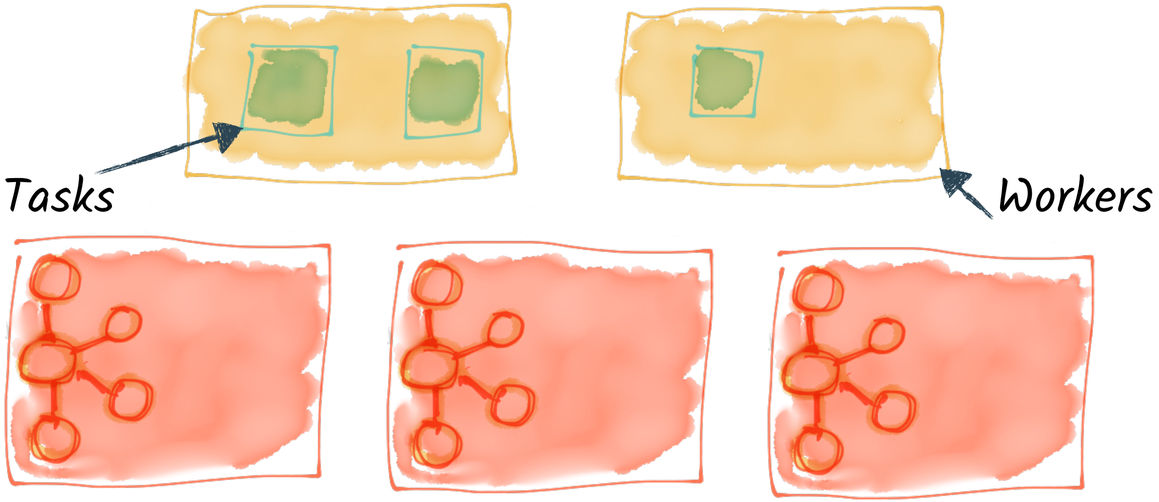
Consumers have a position all of their own



The Connect API



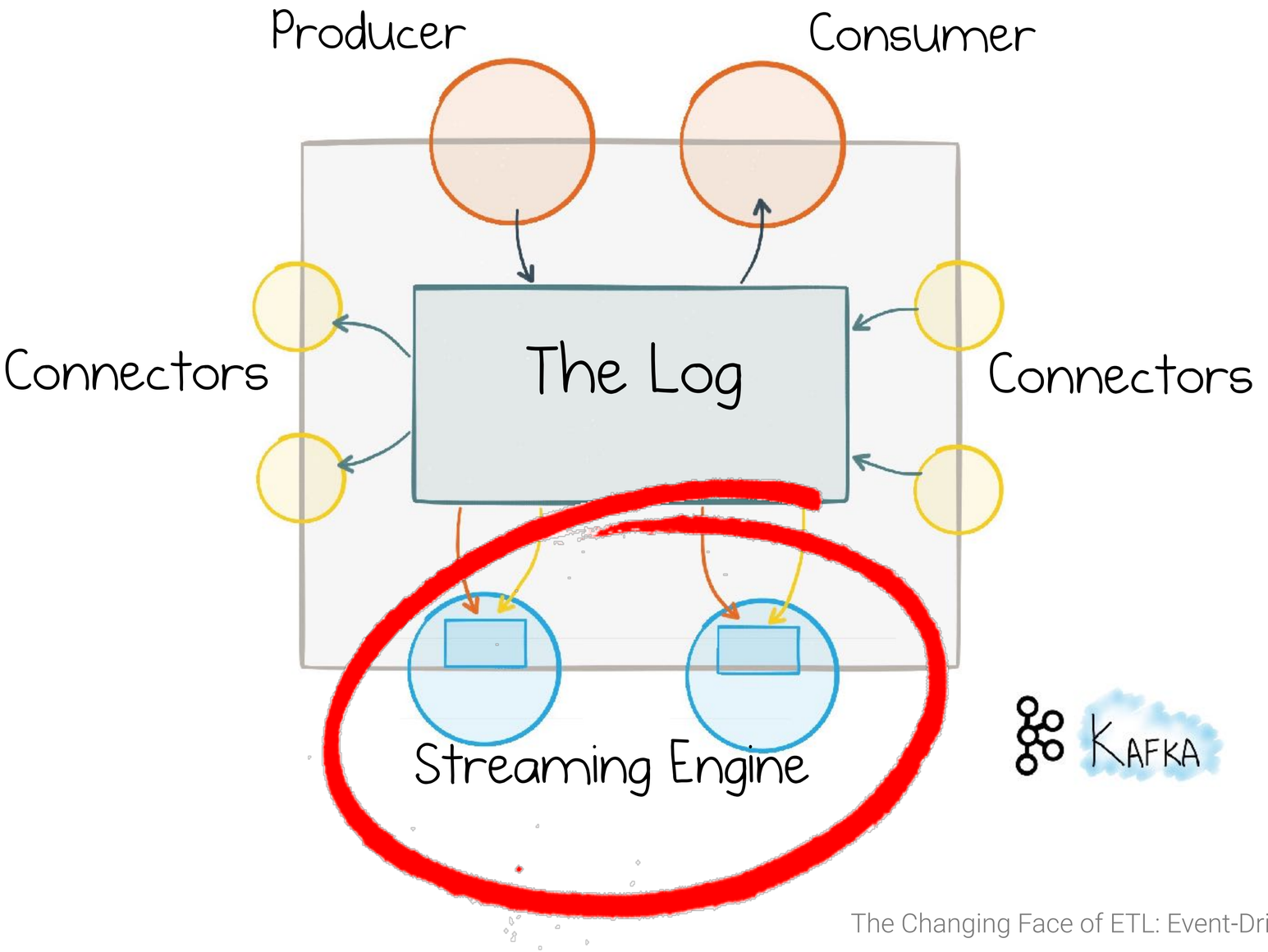
Streaming Integration with Kafka Connect



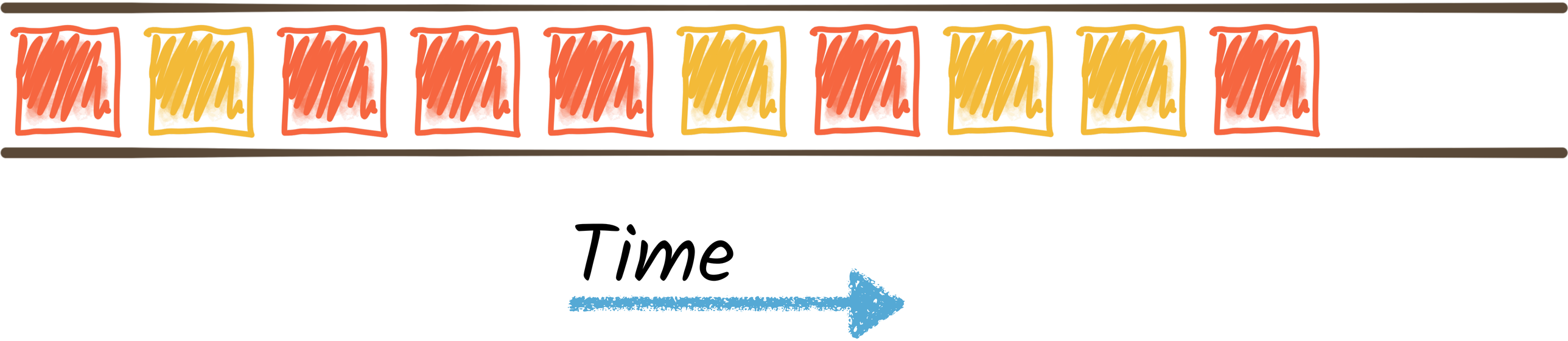
Kafka Connect

Kafka Brokers

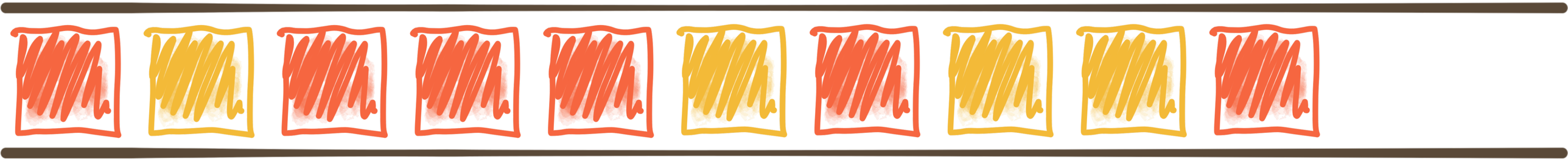
Stream Processing in Kafka



Streams of events



Stream Processing with KSQL



Stream: `widgets`

Stream: `widgets_red`

Stream Processing with KSQL

Stream:
widgets

KSQL

```
CREATE STREAM widgets_red AS
SELECT * FROM widgets
WHERE colour='RED';
```

Stream:
widgets_red

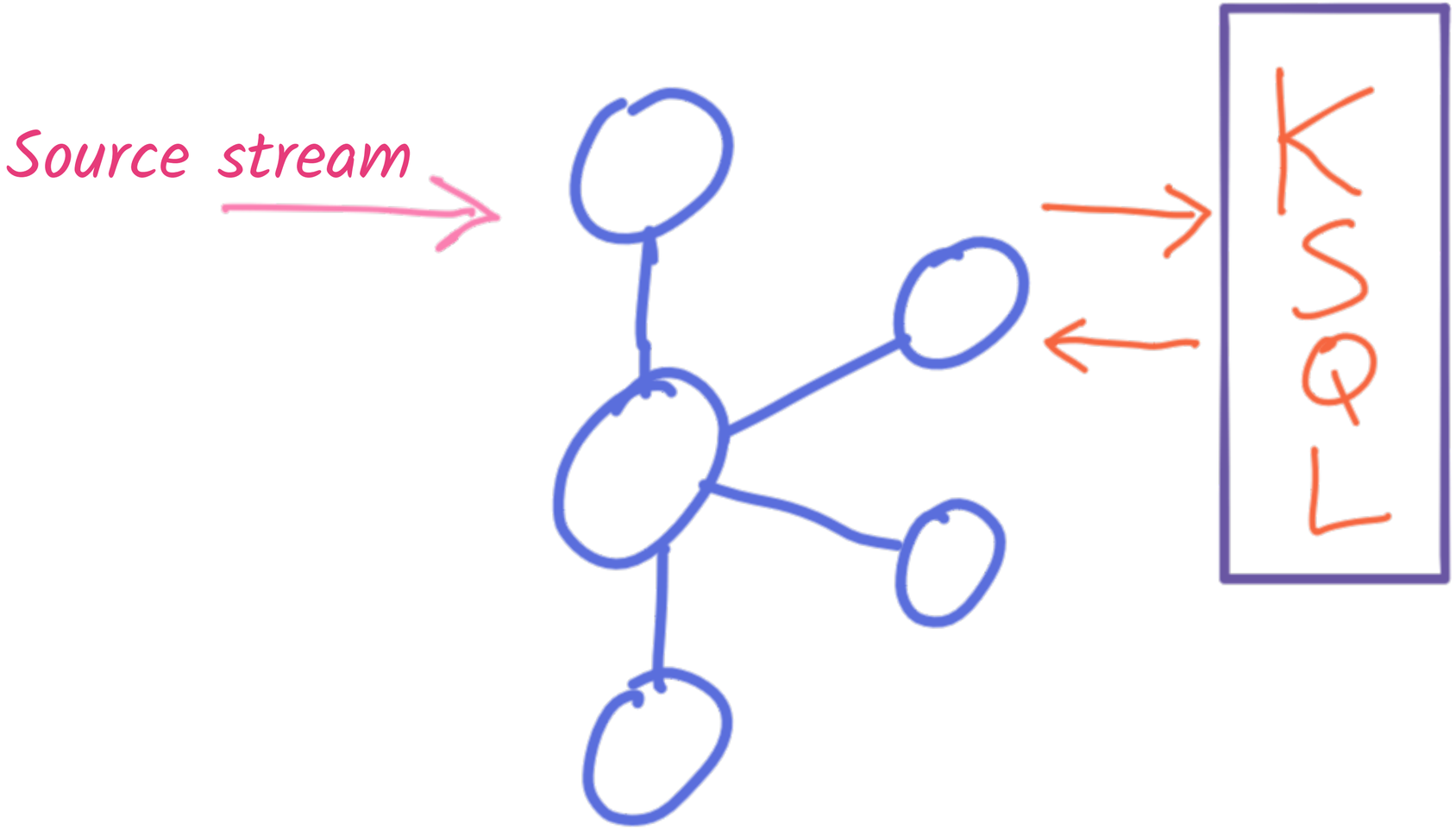
Stream Processing with Kafka Streams

Stream:
widgets

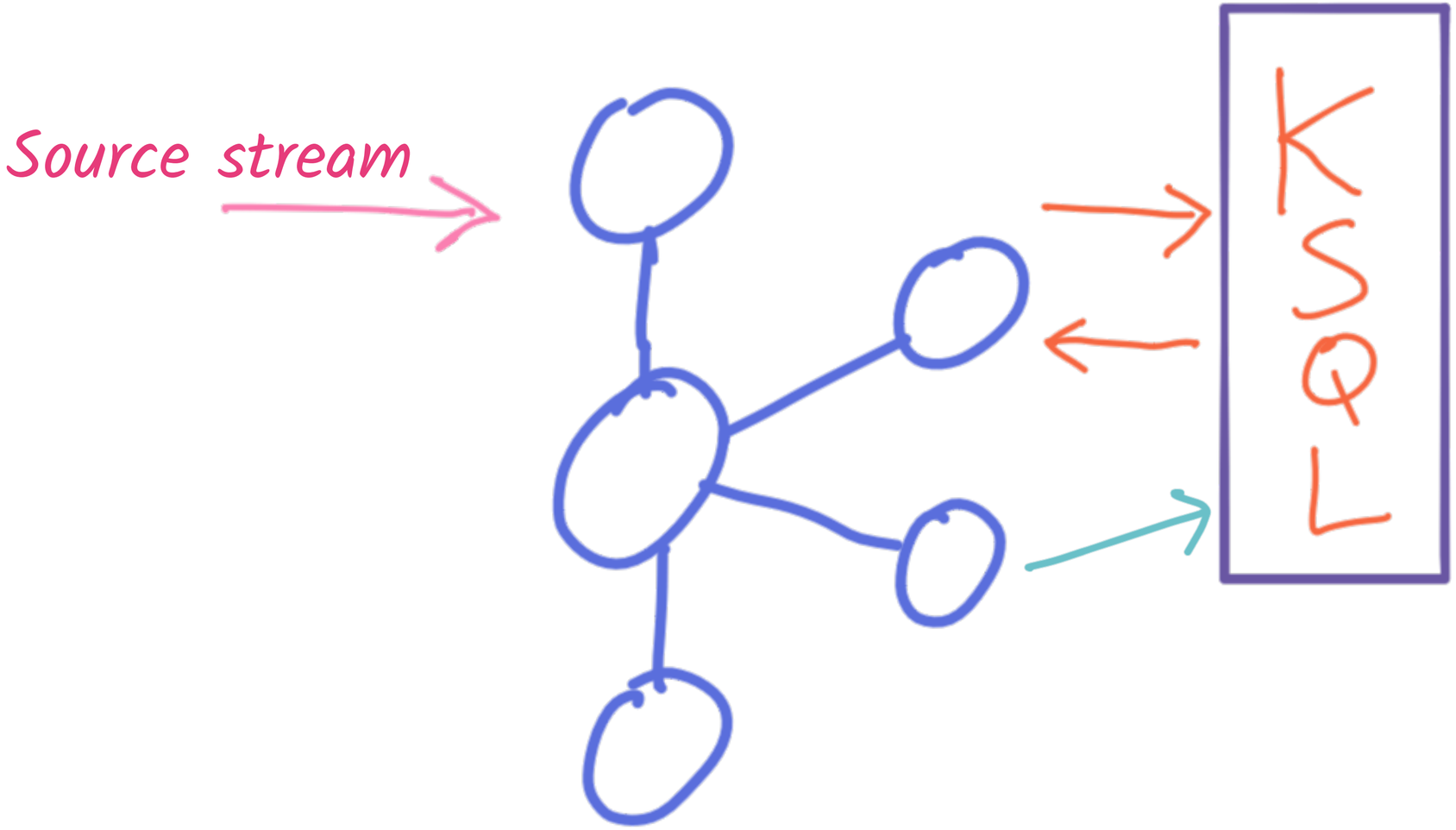
```
final StreamsBuilder builder = new StreamsBuilder()
    .stream("widgets", Consumed.with(stringSerde, widgetsSerde))
    .filter( (key, widget) -> widget.getColour().equals("RED") )
    .to("widgets_red", Produced.with(stringSerde, widgetsSerde));
```

Stream:
widgets_red

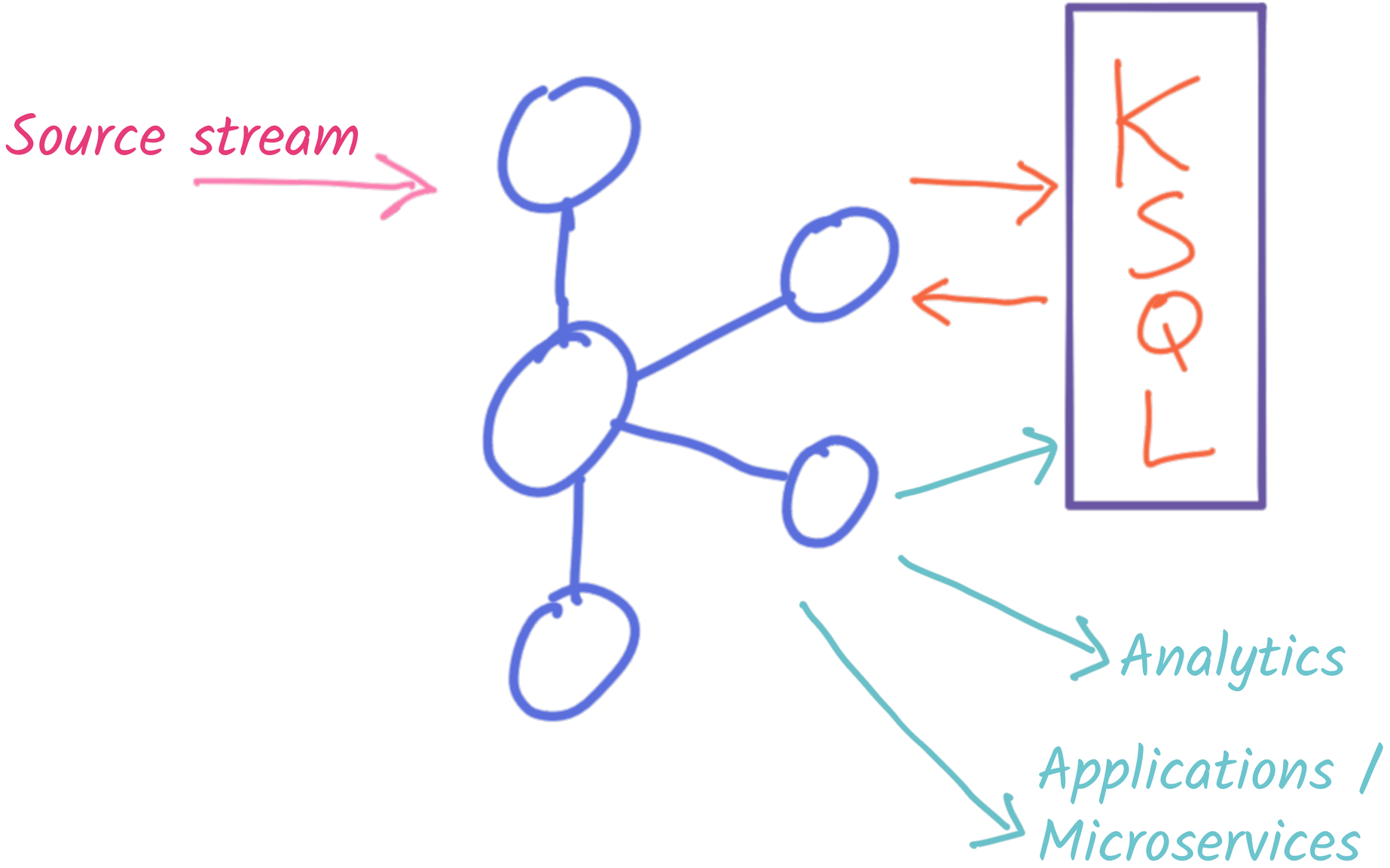
Stream Processing with KSQL



Stream Processing with KSQL

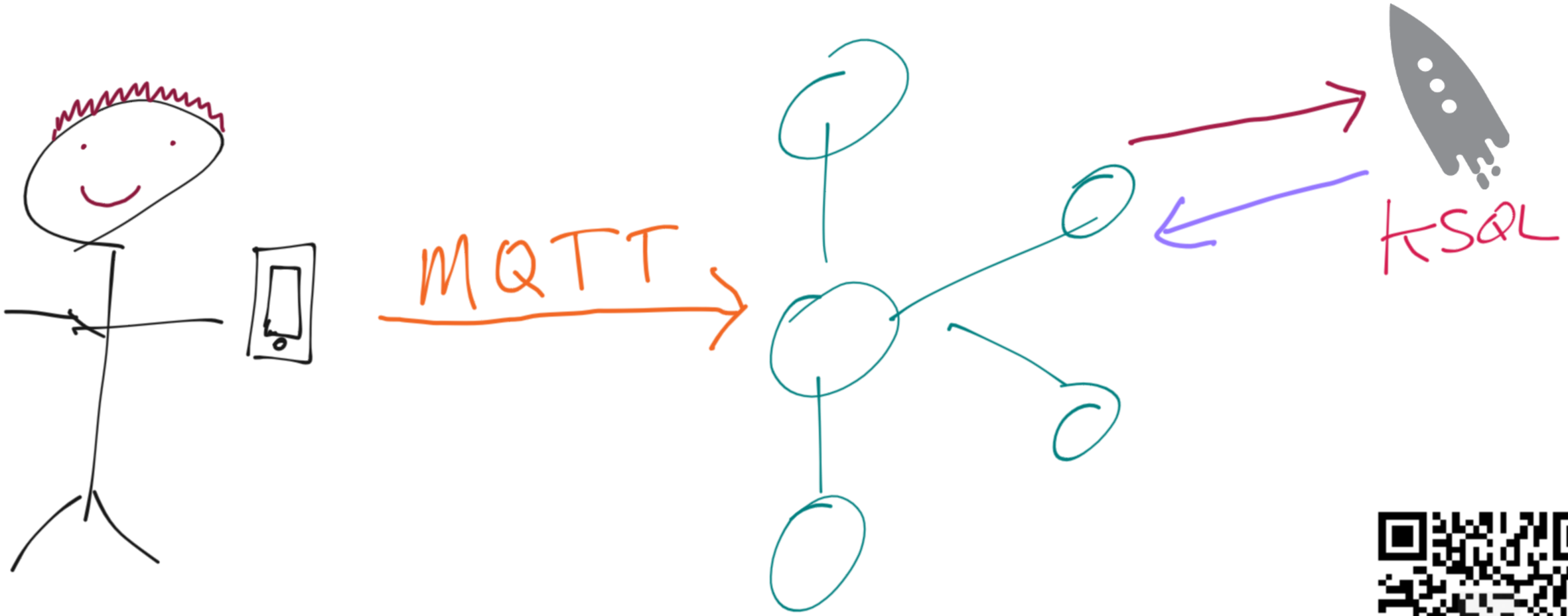


Stream Processing with KSQL



KSQL in action

https://rmoff.dev/kssf19-ksql-code



https://rmoff.dev/kssf19-ksql-code

DEMO

https://rmoff.dev/kssf19-ksql-code

Code!

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confluentinc / demo-scene

Unwatch 51 Star 190 Fork 100

Code Issues 5 Pull requests 3 Actions Security Insights Settings

Scripts and samples to support Confluent Platform talks. May be rough around the edges. For automated tutorials and QA'd code, see https://github.com/confluentinc/examples/ Edit

kafka ksql elasticsearch syslog mysql debezium kafka-streams kafka-connect Manage topics

721 commits 24 branches 0 packages 0 releases 13 contributors

Branch: master New pull request Create new file Upload files Find File Clone or download

rmoff Fix KSQL statement Latest commit d2bed6d 4 days ago

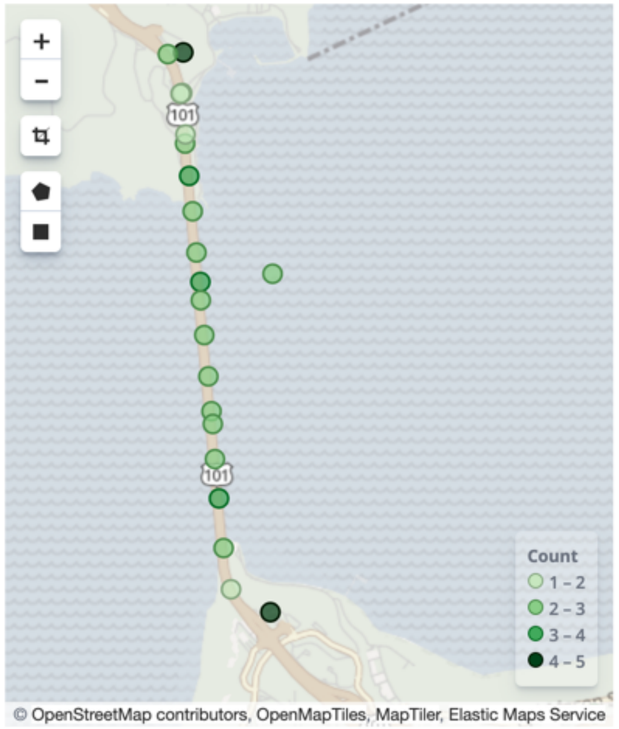
build-a-streaming-pipeline	Fix KSQL statement	4 days ago
ccloud-cube-demo	Added things to .gitignore, moved project-specific stuff down a few l...	6 months ago
community-components-only	Fix bug in Docker Compose in which HTTP status codes aren't correctly...	2 months ago
connect-5.3-improvements	Fix bug in Docker Compose in which HTTP status codes aren't correctly...	2 months ago
connect-deepdive	Change all CONTROL_CENTER_CONNECT configs to fully formed URLs (c.f. ...	2 months ago
connect-error-handling	Fix bug in Docker Compose in which HTTP status codes aren't correctly...	2 months ago

https://rmoff.dev/kssf19-ksql-code

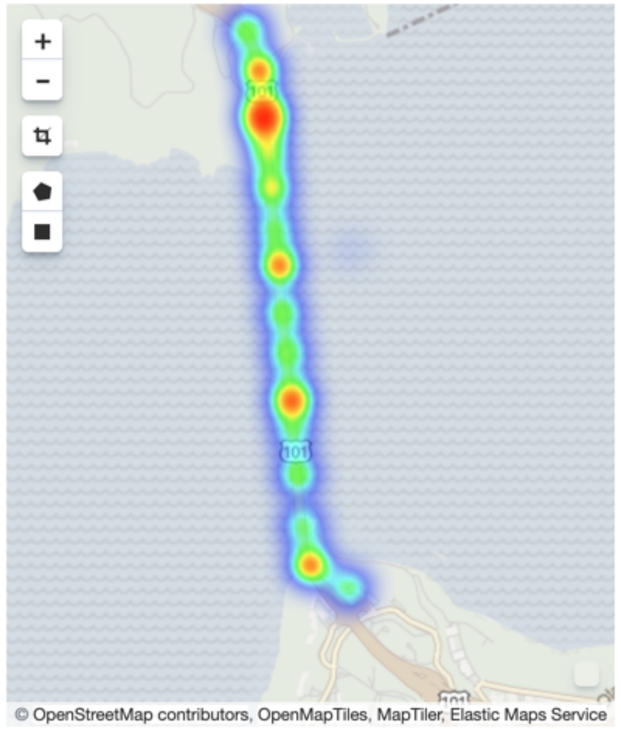
@rmoff #KafkaMeetup

MQTT + Kafka + KSQL + Elastic = ❤️

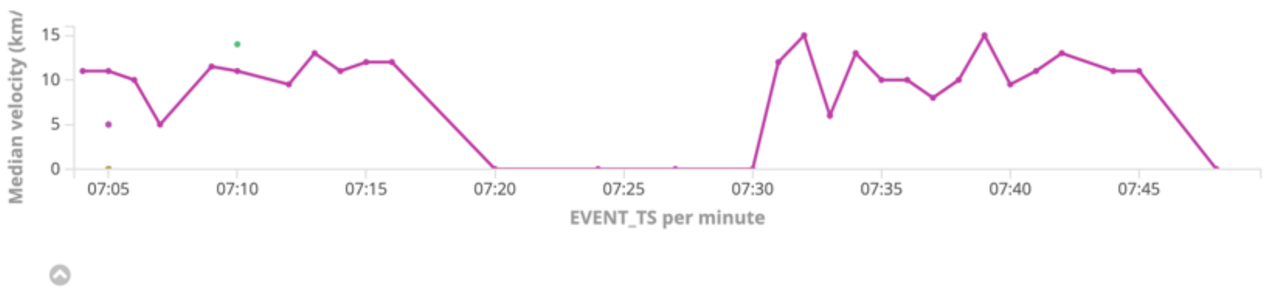
Map



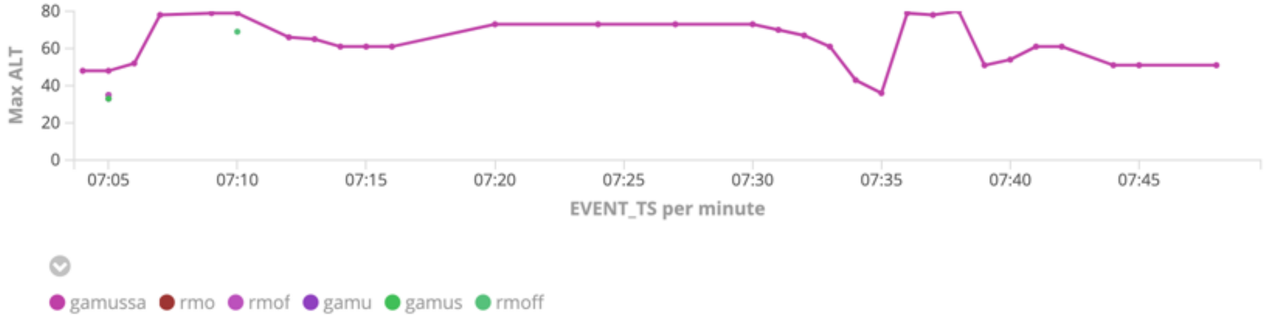
Velocity map



Speed



Altitude

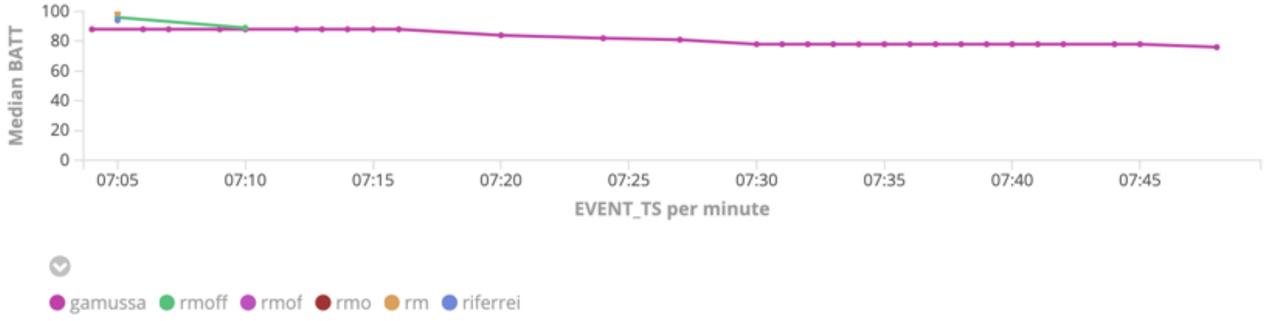


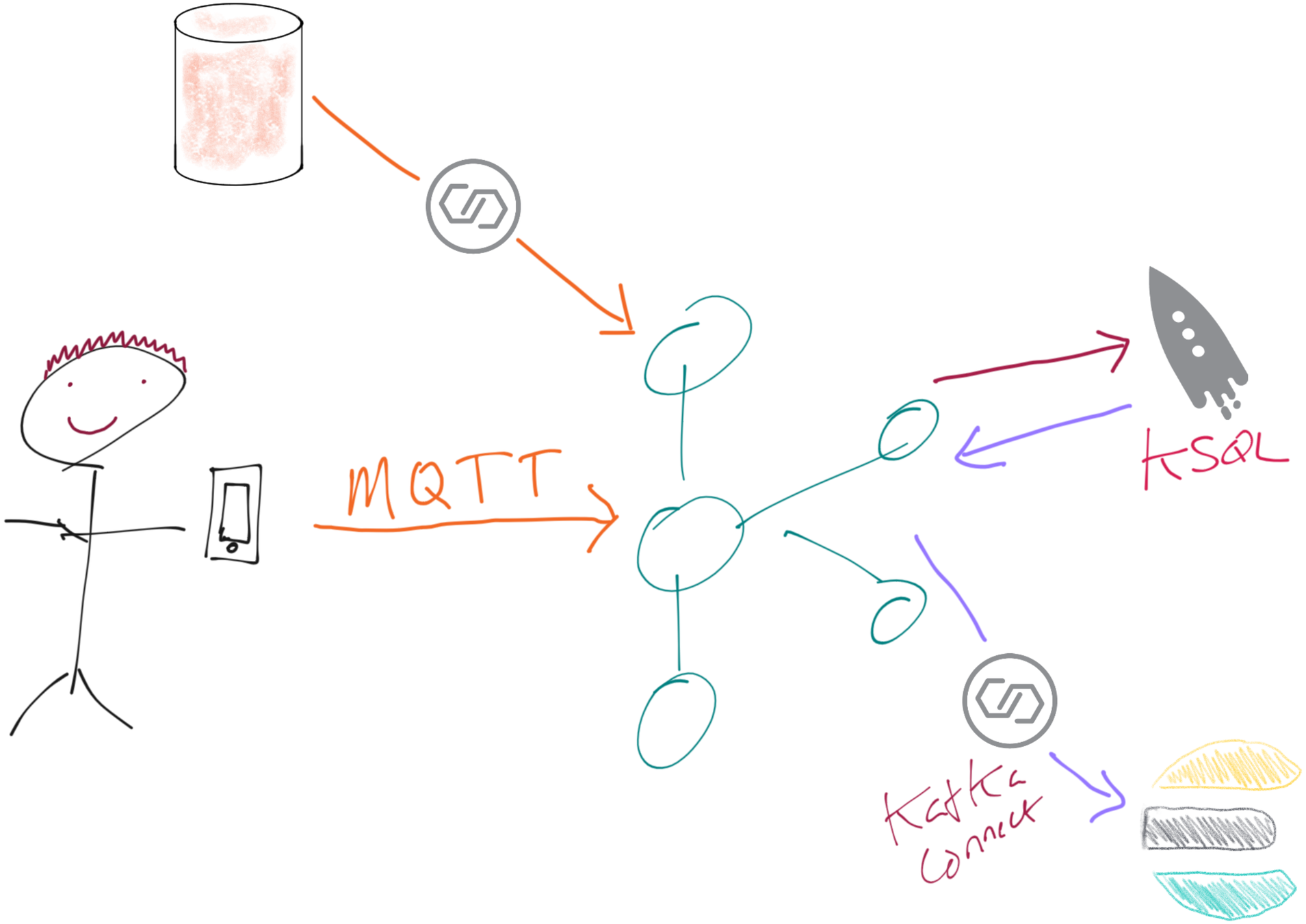
Location

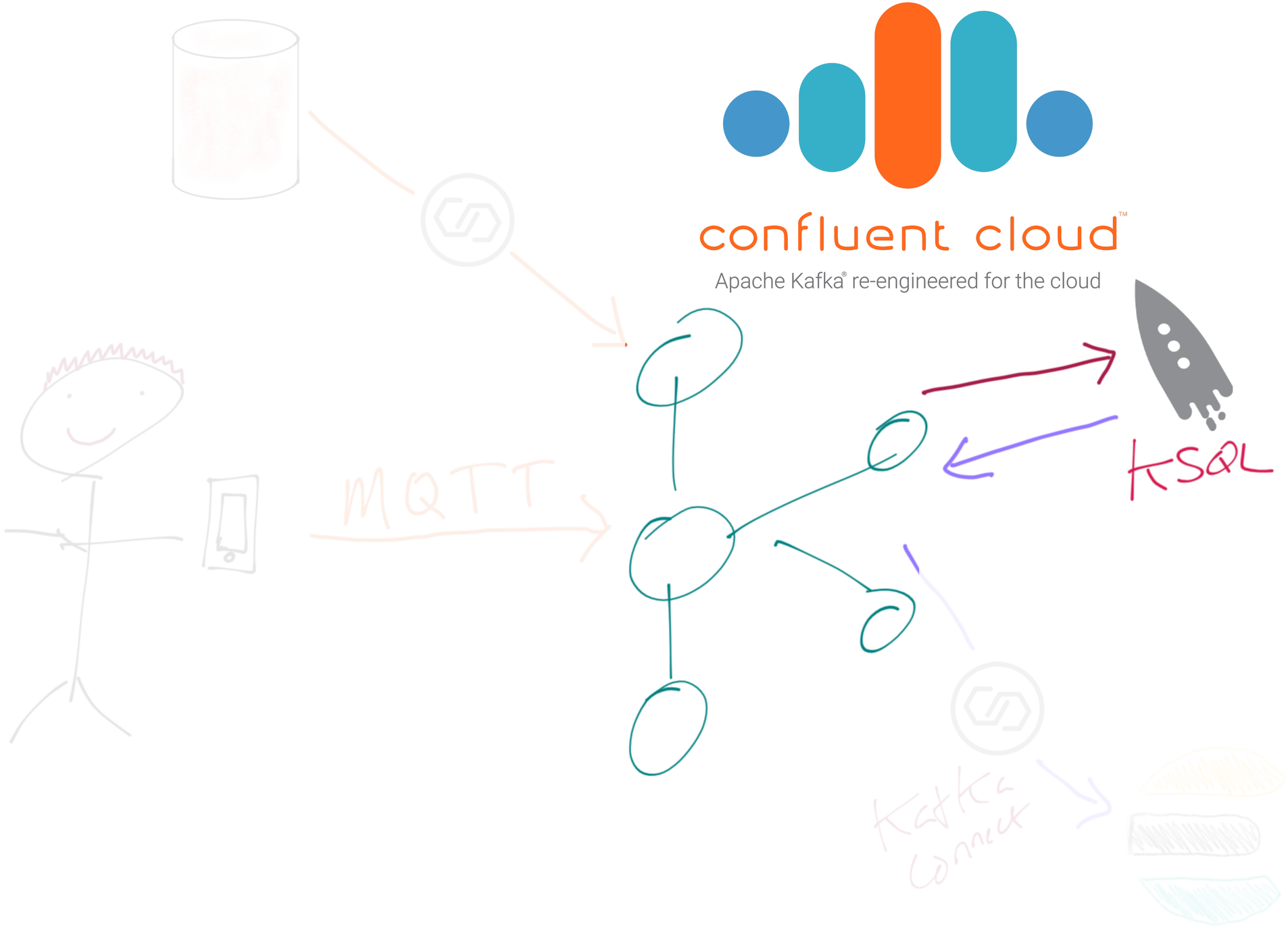
1–50 of 59

Time	WHO	TID	P	CONN	BS	ALT	BATT	VEL
October 1st 2019, 07:48:47.523	gamussa	VG	100.969	m	1	48	76	0
October 1st 2019, 07:48:47.283	gamussa	VG	100.969	m	1	48	76	0
October 1st 2019, 07:48:21.059	gamussa	VG	100.972	m	1	51	76	11

Battery




MQTT
KSQL
Kafka Connect


confluent cloud™
Apache Kafka® re-engineered for the cloud
MQTT
KSQL
Kafka Connect

http://confluent.cloud/signup

Interacting with KSQL

KSQL - Confluent Control Center

confluent

CO
Cluster 1

Query 1

```
SELECT TIMESTAMPTOSTRING(ROWTIME, 'yyyy-MM-dd HH:mm:ss') AS TS,
       ORDERID,
       ITEMID,
       ORDERUNITS,
       ADDRESS->STREET
  FROM ORDERS ;
```

Add query properties

Running... Run Stop

Data structure
STREAM

Total messages
594

Messages/sec
3.94

Total message bytes
40896

Message fields

- TS
- ORDERID
- ITEMID
- ORDERUNITS

Filter by keyword

TS	ORDERID	ITEMID	ORDERUNITS	ADDRESS__STREET
2019-09-16 08:05:46	4905	Item_0	11	640 Fair Oaks Junction
2019-09-16 08:05:46	4904	Item_0	4	58 Meadow Vale Trail
2019-09-16 08:05:46	4903	Item_36	14	957 Parkside Court
2019-09-16 08:05:45	4902	Item_0	16	13210 Rieder Hill
2019-09-16 08:05:45	4901	Item_5	8	1 Park Meadow Junction
2019-09-16 08:05:45	4900	Item_22	19	2 Columbus Court

Editor | Flow | Streams | Tables | Running queries

KSQL - CLI

```
CLI v5.2.2, Server v5.2.2 located at http://ksql-server:8088

Having trouble? Type 'help' (case-insensitive) for a rundown of how things work!

ksql>
ksql> CREATE STREAM ORDERS_NO_ADDRESS_DATA AS
>  SELECT TIMESTAMPTOSTRING(ROWTIME, 'yyyy-MM-dd HH:mm:ss') AS ORDER_TIMESTAMP,
>         ORDERID,
>         ITEMID,
>         ORDERUNITS
>    FROM ORDERS;

 Message
----------------------------
 Stream created and running
----------------------------
ksql> select * from ORDERS_NO_ADDRESS_DATA;
1562059702636 | 0 | 2019-07-02 09:28:22 | 0 | Item_48 | 16
1562059703535 | 0 | 2019-07-02 09:28:23 | 0 | Item_45 | 16
1562059703638 | 1 | 2019-07-02 09:28:23 | 1 | Item_18 | 15
1562059703804 | 2 | 2019-07-02 09:28:23 | 2 | Item_11 | 2
1562059703836 | 3 | 2019-07-02 09:28:23 | 3 | Item_0 | 6
```

KSQL - REST API

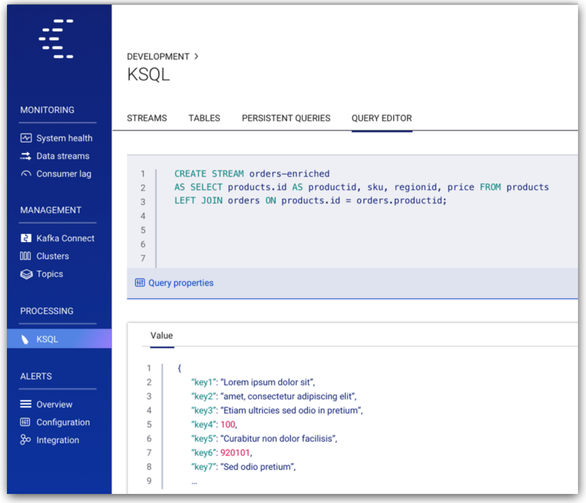
```
$ echo '{"ksql":"SELECT ORDERID, ITEMID, ADDRESS FROM ORDERS LIMIT 5;", "streamsProperties":
        "ksql.streams.auto.offset.reset": "earliest"}}' | \
  http http://localhost:8088/query
HTTP/1.1 200 OK
Content-Encoding: gzip
Content-Type: application/json
Date: Tue, 02 Jul 2019 12:46:25 GMT
Server: Jetty(9.4.14.v20181114)
Transfer-Encoding: chunked
Vary: Accept-Encoding, User-Agent

{"row":{"columns":[0,"Item_0",{"STREET":"377 Maryland Place","CITY":"Beaumont","STATE":"Texas
l,"terminal":false}
{"row":{"columns":[0,"Item_0",{"STREET":"072 Butternut Lane","CITY":"Grand Junction","STATE":
sage":null,"terminal":false}
{"row":{"columns":[1,"Item_0",{"STREET":"703 Hoffman Place","CITY":"Mountain View","STATE":"C
sage":null,"terminal":false}
{"row":{"columns":[2,"Item_0",{"STREET":"0 Dorton Circle","CITY":"Brooklyn","STATE":"New York
l,"terminal":false}
{"row":{"columns":[3,"Item_0",{"STREET":"404 Mayer Park","CITY":"Lubbock","STATE":"Texas"}]},
rminal":false}
{"row":null,"errorMessage":null,"finalMessage":"Limit Reached","terminal":true}
```

KSQL operations and deployment

KSQL in Development and Production

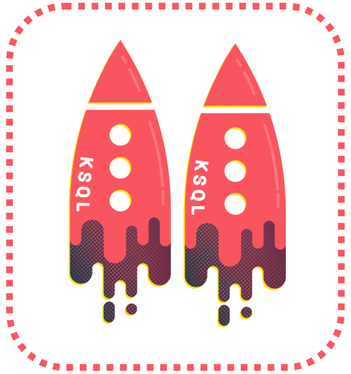
Interactive KSQL
for development and testing

Headless KSQL
for Production

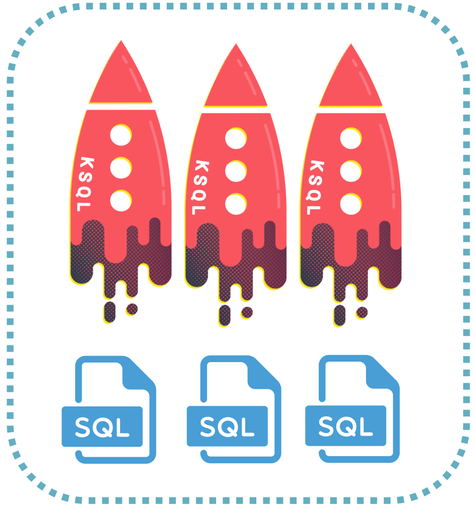


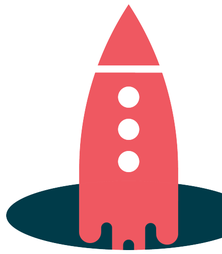
"Hmm, let me try out this idea..."

REST



Desired KSQL queries have been identified





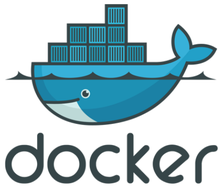
How to run KSQL

KSQL Server
(JVM process)

DEB, RPM, ZIP, TAR downloads
http://confluent.io/ksql

Docker images
confluentinc/cp-ksql-server
confluentinc/cp-ksql-cli


Physical

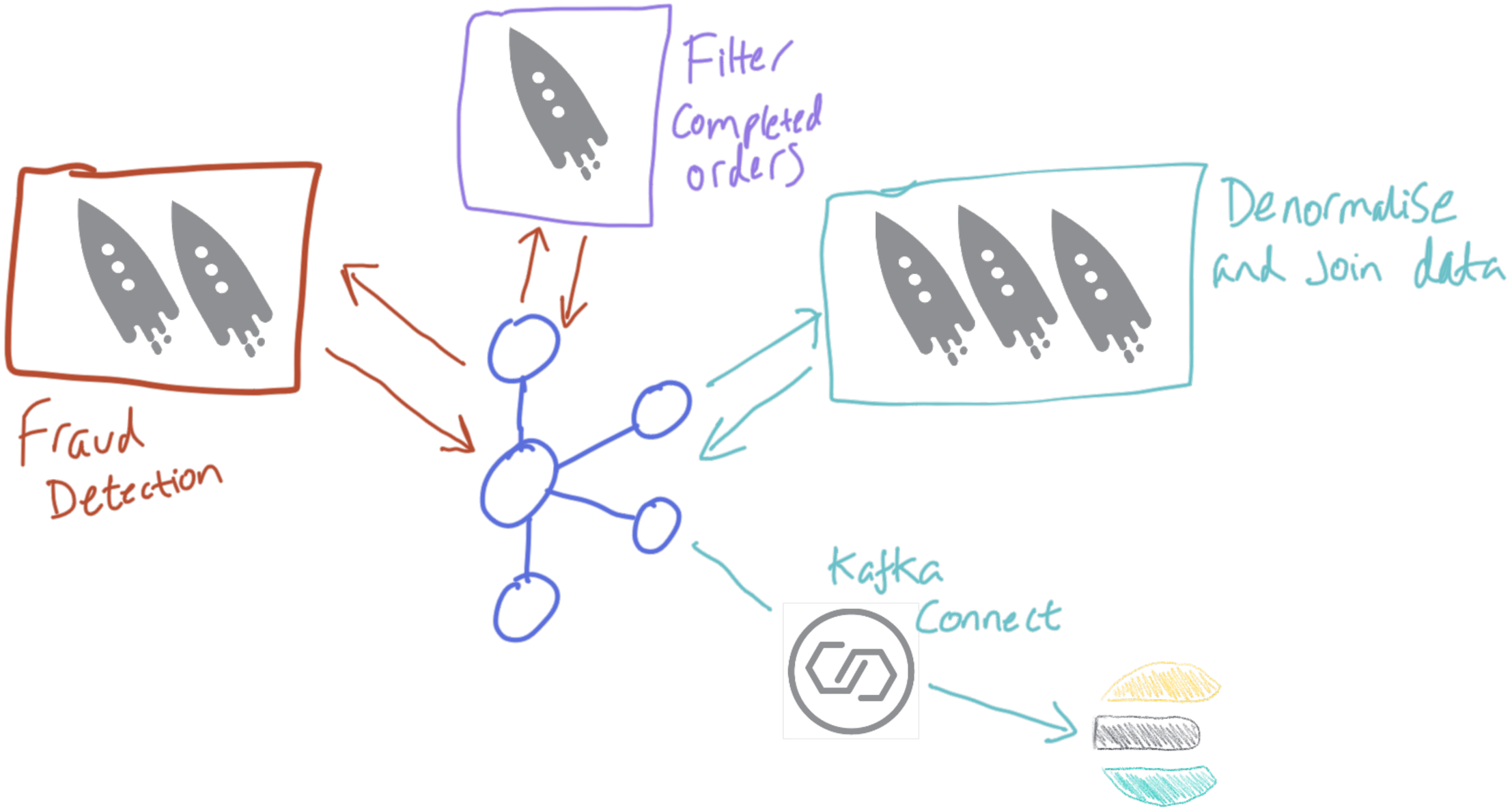


Google Cloud Platform

…and many more…

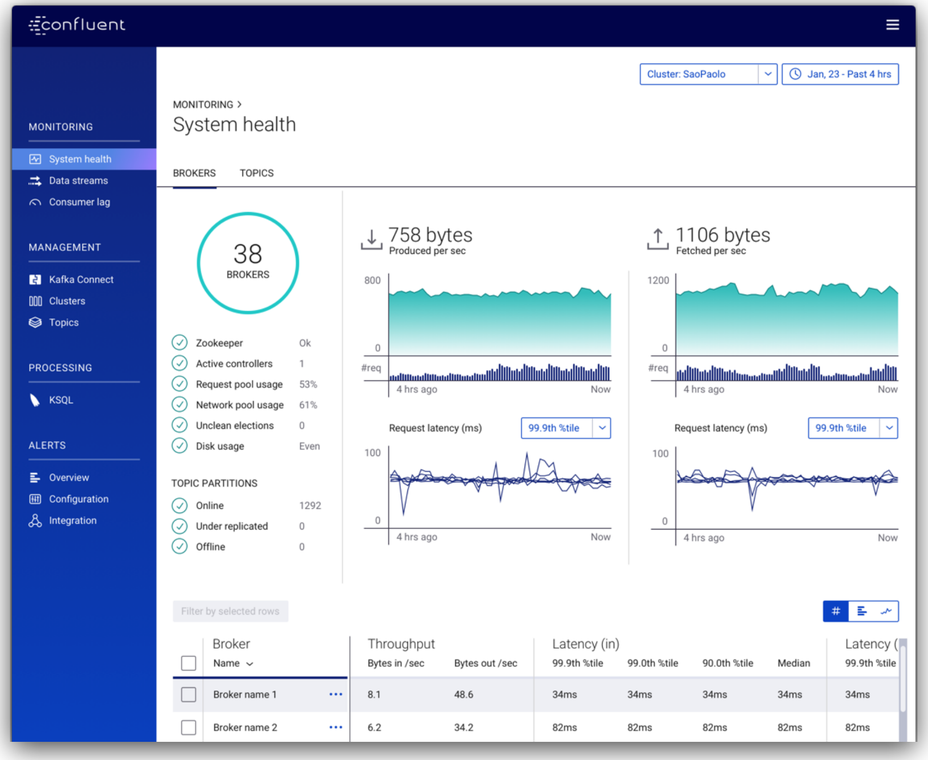

ONE DOES NOT SIMPLY RUN
A SINGLE KSQL CLUSTER

Think Applications, not database instances



Monitoring KSQL

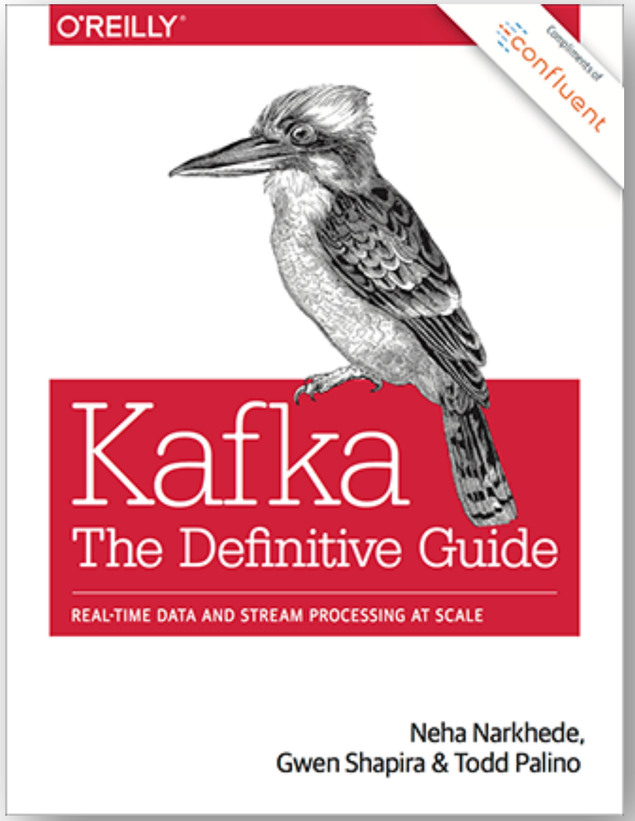
Confluent Control Center

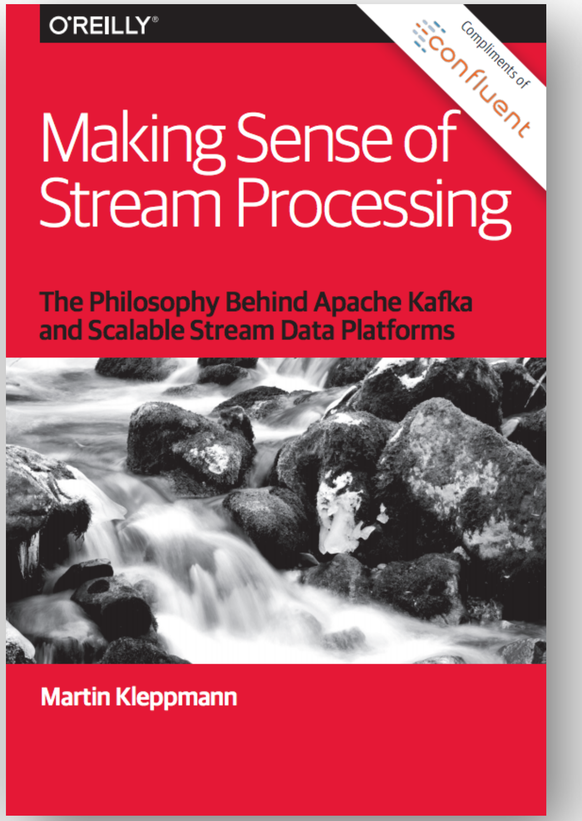


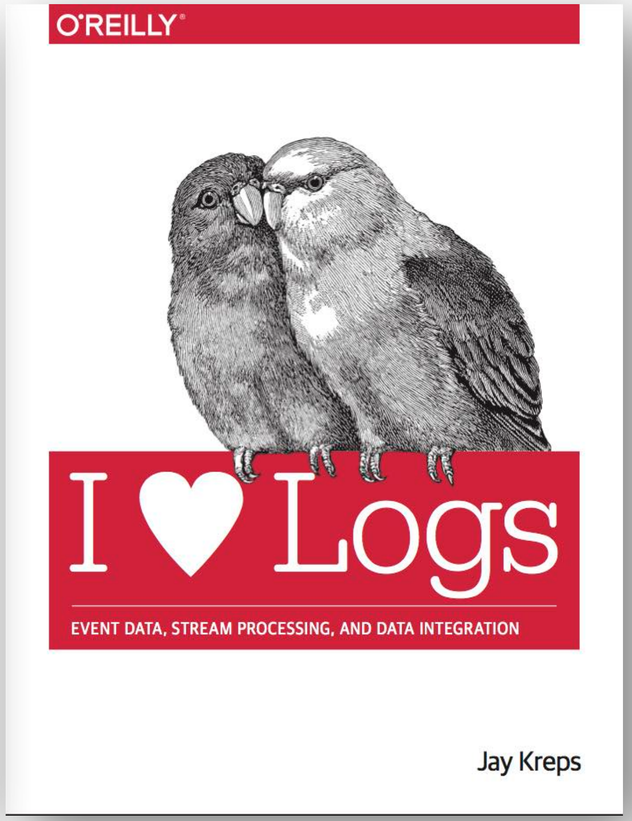
JMX

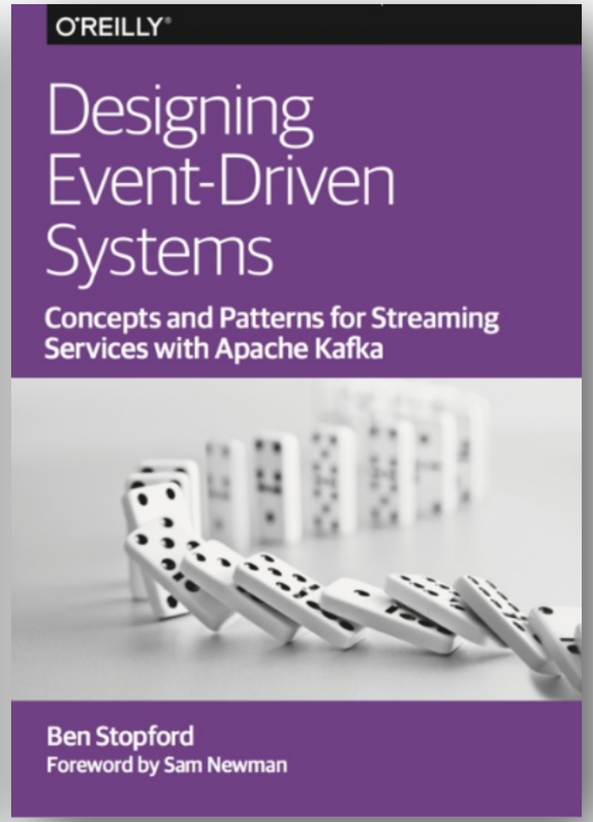
https://www.confluent.io/blog/troubleshooting-ksql-part-2

http://cnfl.io/book-bundle









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#EOF

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https://talks.rmoff.net

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  - 📖 Slides
  - 📽️ Recording
- ATM Fraud detection with Kafka and KSQL
  - 📖 Slides
  - 👾 Code
  - 📽️ Recording
- Embrace the Anarchy: Apache Kafka's Role in Modern Data Architectures
  - 📖 Slides
  - 📽️ Recording
- Apache Kafka and KSQL in Action : Let's Build a Streaming Data Pipeline!
  - 📖 Slides
  - 👾 Code
  - 📽️ Recording
- No More Silos: Integrating Databases and Apache Kafka
  - 📖 Slides
  - 👾 Code (MySQL)
  - 👾 Code (Oracle)
  - 📽️ Recording

Bonus content!

KSQL in action

Filtering with KSQL

Filtering with KSQL


```
CREATE STREAM ORDERS_NY AS
  SELECT *
    FROM ORDERS
   WHERE ADDRESS->STATE='New York';
```

Filtering with KSQL

ORDERS

KSQL

```
CREATE STREAM ORDERS_NY AS
  SELECT *
    FROM ORDERS
   WHERE ADDRESS->STATE='New York';
```

ORDERS_NY

Schema manipulation with KSQL

ORDERS


```
{ "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address": {
    "street": "243 Utah Way",
    "city": "Orange",
    "state": "California"
  }
}
```

Schema manipulation with KSQL

ORDERS


```
{ "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address": {
    "street": "243 Utah Way",
    "city": "Orange",
    "state": "California"
  }
```


KSQL

```
CREATE STREAM ORDERS_NO_ADDRESS_DATA AS
  SELECT ORDERTIME, ORDERID, ITEMID, ORDERUNITS
    FROM ORDERS;
```

Schema manipulation with KSQL

ORDERS

```
{ "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address": {
    "street": "243 Utah Way",
    "city": "Orange",
    "state": "California"
```

KSQL

```
CREATE STREAM ORDERS_NO_ADDRESS_DATA AS
  SELECT TIMESTAMPTOSTRING(ROWTIME, 'yyyy-MM-dd HH:mm:ss')
         AS ORDER_TIMESTAMP,
         ORDERID, ITEMID, ORDERUNITS
    FROM ORDERS;
```

ORDERS_NO_ADDRESS_DATA

```
{ "order_ts": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5
}
```

Schema manipulation with KSQL

ORDERS


```
{
  "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address": {
    "street": "243 Utah Way",
    "city": "Orange",
    "state": "California"
  }
}
```

Schema manipulation with KSQL

ORDERS

```
{
  "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address": {
    "street": "243 Utah Way",
    "city": "Orange",
    "state": "California"
  }
}
```

KSQL

```
CREATE STREAM ORDERS_FLAT AS
  SELECT […]
        ADDRESS->STREET AS ADDRESS_STREET,
         ADDRESS->CITY AS ADDRESS_CITY,
         ADDRESS->STATE AS ADDRESS_STATE
    FROM ORDERS;
```

Schema manipulation with KSQL

ORDERS


```
{
  "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address": {
    "street": "243 Utah Way",
    "city": "Orange",
    "state": "California"
  }
}
```


KSQL

```
CREATE STREAM ORDERS_FLAT AS
  SELECT […]
        ADDRESS->STREET AS ADDRESS_STREET,
         ADDRESS->CITY AS ADDRESS_CITY,
         ADDRESS->STATE AS ADDRESS_STATE
    FROM ORDERS;
```

ORDERS_FLAT


```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address-street": "243 Utah Way",
  "address-city": "Orange",
  "address-state": "California"}
```

Reserialising data with KSQL

ORDERS


```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address-street": "243 Utah Way",
  "address-city": "Orange",
  "address-state": "California"}
```

Reserialising data with KSQL

ORDERS


```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address-street": "243 Utah Way",
  "address-city": "Orange",
  "address-state": "California"}
```


KSQL

```
CREATE STREAM ORDERS_CSV
  WITH (VALUE_FORMAT='DELIMITED') AS
  SELECT * FROM ORDERS_FLAT;
```

Reserialising data with KSQL

ORDERS


```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "address-street": "243 Utah Way",
  "address-city": "Orange",
  "address-state": "California"}
```


KSQL

```
CREATE STREAM ORDERS_CSV
  WITH (VALUE_FORMAT='DELIMITED) AS
  SELECT * FROM ORDERS_FLAT;
```

ORDERS_CSV


```
1560045914101,24644,Item_0,1,43078 De
1560047305664,24643,Item_29,3,209 Mon
1560057079799,24642,Item_38,18,3 Autu
1560088652051,24647,Item_6,6,82893 Ar
1560105559145,24648,Item_0,12,45896 W
1560108336441,24646,Item_33,4,272 Hef
1560123862235,24641,Item_15,16,0 Dort
1560124799053,24645,Item_12,1,71 Knut
```

Lookups and Joins with KSQL

ORDERS


```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5}
```

Lookups and Joins with KSQL

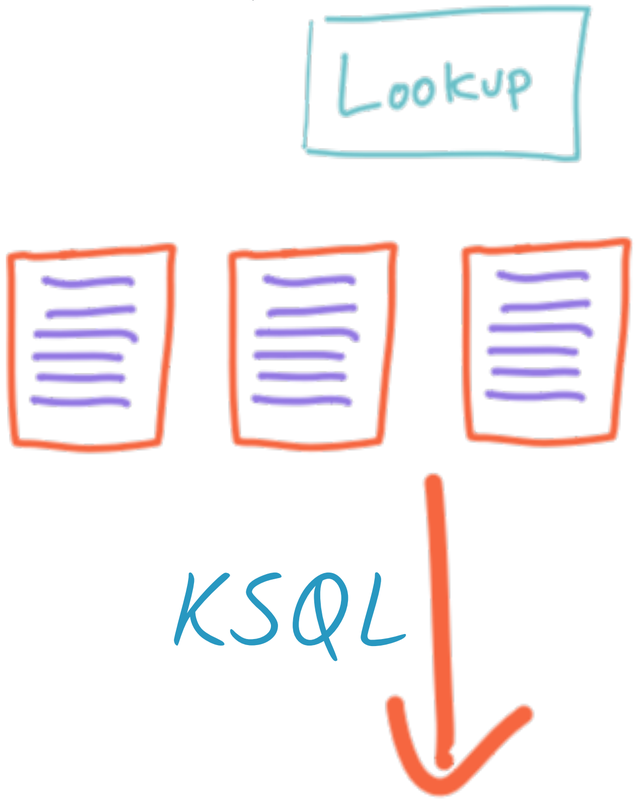
ITEMS

ORDERS


```
{
  "id": "Item_9",
  "make": "Boyle-McDermott",
  "model": "Apiaceae",
 "unit_cost": 19.9
}
```

```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5}
```

Lookups and Joins with KSQL



ITEMS

```
{
  "id": "Item_9",
  "make": "Boyle-McDermott",
  "model": "Apiaceae",
 "unit_cost": 19.9
}
```

ORDERS

```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5}
```

```
CREATE STREAM ORDERS_ENRICHED AS
SELECT O.*, I.*,
  O.ORDERUNITS * I.UNIT_COST
    AS TOTAL_ORDER_VALUE,
  FROM ORDERS O
       INNER JOIN ITEMS I
       ON O.ITEMID = I.ID ;
```

Lookups and Joins with KSQL

ITEMS

```
{
  "id": "Item_9",
  "make": "Boyle-McDermott",
  "model": "Apiaceae",
 "unit_cost": 19.9
}
```

ORDERS

```
{"ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5}
```

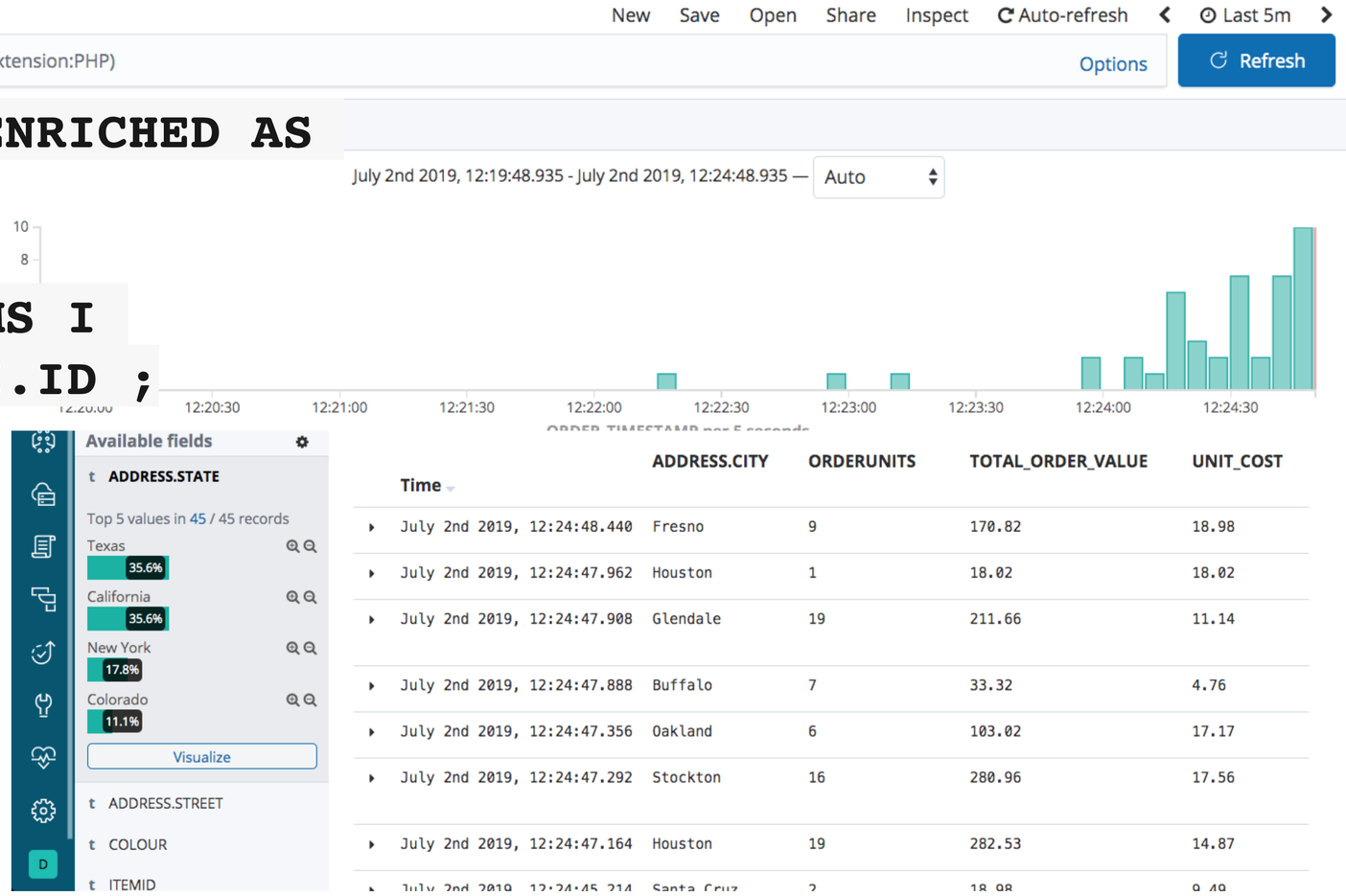
```
CREATE STREAM ORDERS_ENRICHED AS
SELECT O.*, I.*,
  O.ORDERUNITS * I.UNIT_COST
    AS TOTAL_ORDER_VALUE,
  FROM ORDERS O
       INNER JOIN ITEMS I
       ON O.ITEMID = I.ID ;
```

ORDERS_ENRICHED

```
{
  "ordertime": 1560070133853,
  "orderid": 67,
  "itemid": "Item_9",
  "orderunits": 5,
  "make": "Boyle-McDermott",
  "model": "Apiaceae",
  "unit_cost": 19.9,
  "total_order_value": 99.5
}
```

Connecting to other systems with Kafka Connect

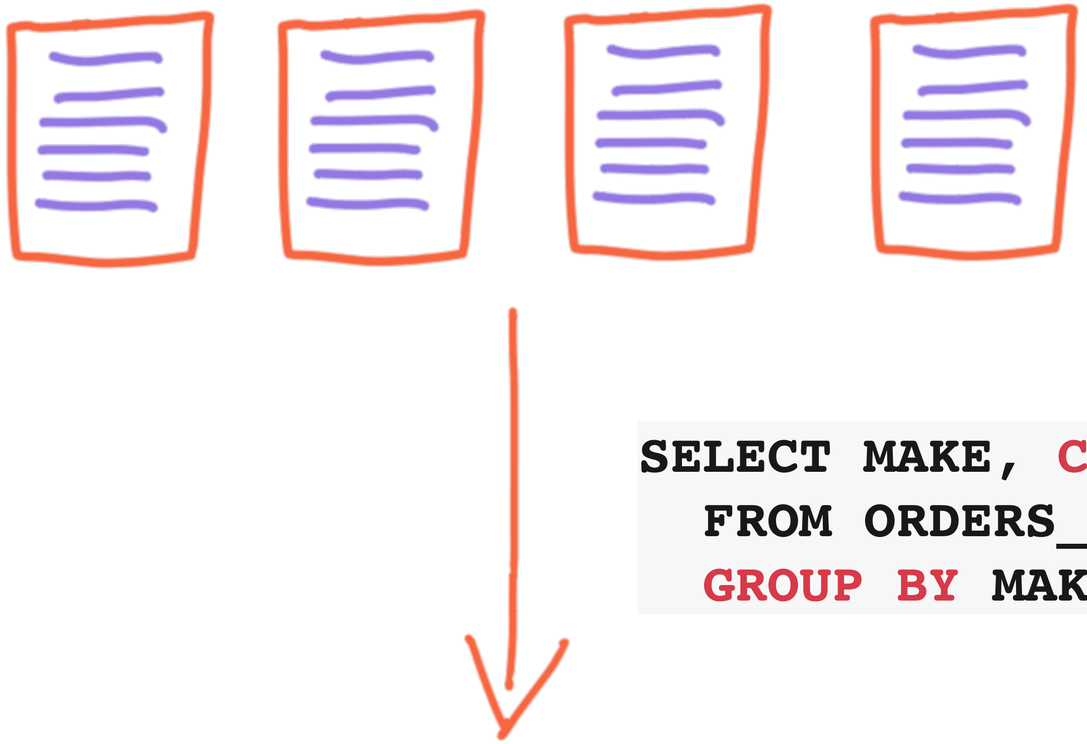

```
CREATE STREAM ORDERS_ENRICHED AS
SELECT […]
  FROM ORDERS O
       INNER JOIN ITEMS I
       ON O.ITEMID = I.ID ;
```



Stateful Aggregation with KSQL

ORDERS

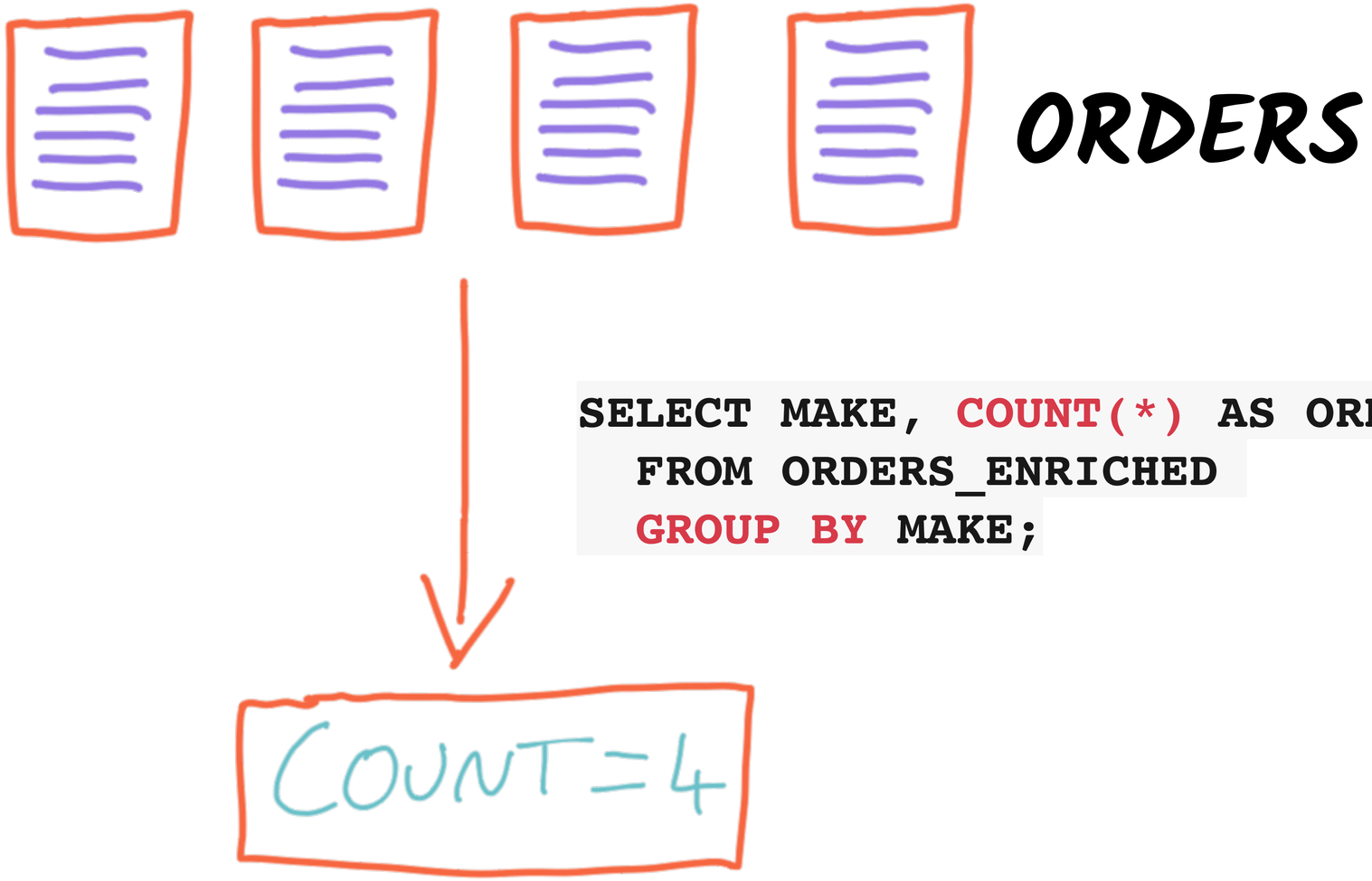
Stateful Aggregation with KSQL



ORDERS

```
SELECT MAKE, COUNT(*) AS ORDER_COUNT
  FROM ORDERS_ENRICHED
  GROUP BY MAKE;
```

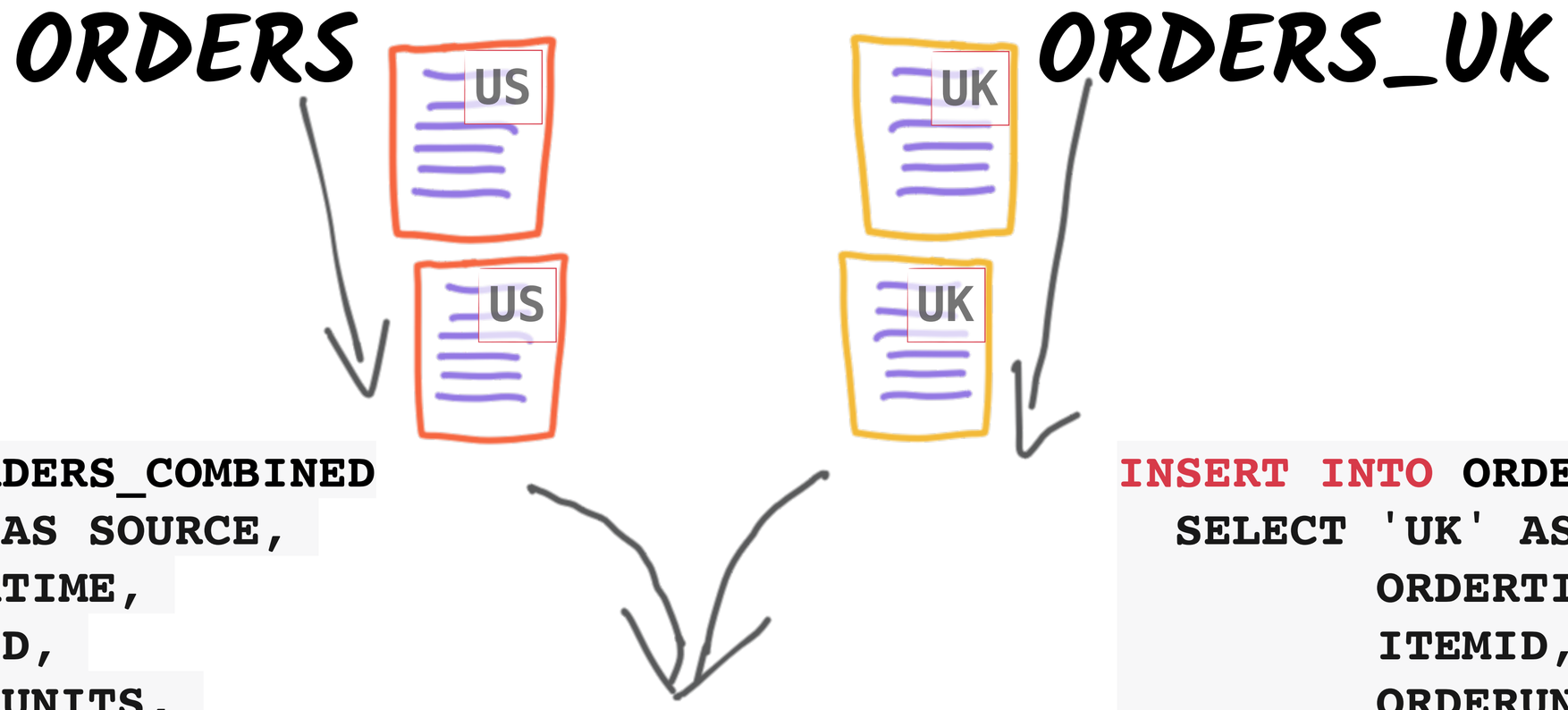
Stateful Aggregation with KSQL




```
SELECT MAKE, COUNT(*) AS ORDER_COUNT
  FROM ORDERS_ENRICHED
  GROUP BY MAKE;
```

Transform data with KSQL - merge streams

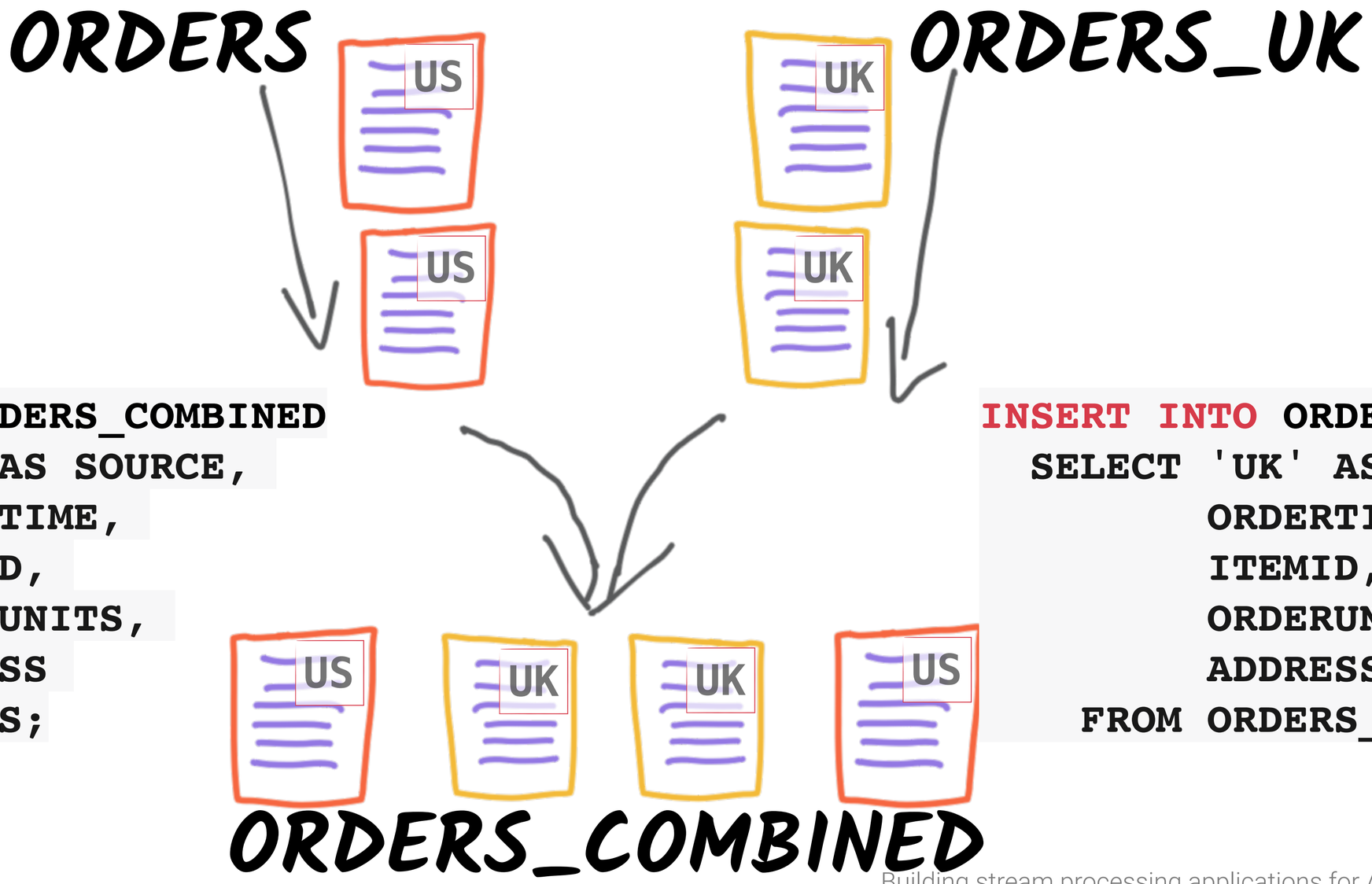
Transform data with KSQL - merge streams




```
INSERT INTO ORDERS_COMBINED
  SELECT 'US' AS SOURCE,
         ORDERTIME,
         ITEMID,
         ORDERUNITS,
         ADDRESS
    FROM ORDERS;
```

```
INSERT INTO ORDERS_COMBINED
  SELECT 'UK' AS SOURCE,
         ORDERTIME,
         ITEMID,
         ORDERUNITS,
         ADDRESS
    FROM ORDERS_UK;
```

Transform data with KSQL - merge streams




```
INSERT INTO ORDERS_COMBINED
  SELECT 'US' AS SOURCE,
         ORDERTIME,
         ITEMID,
         ORDERUNITS,
         ADDRESS
    FROM ORDERS;
```

```
INSERT INTO ORDERS_COMBINED
  SELECT 'UK' AS SOURCE,
         ORDERTIME,
         ITEMID,
         ORDERUNITS,
         ADDRESS
    FROM ORDERS_UK;
```

Transform data with KSQL - split streams

ORDERS_COMBINED

Transform data with KSQL - split streams

ORDERS_COMBINED

```
CREATE STREAM ORDERS_US AS
  SELECT *
    FROM ORDERS_COMBINED
   WHERE SOURCE ='US';
```

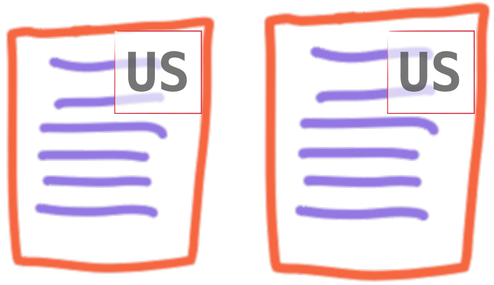
```
CREATE STREAM ORDERS_UK AS
  SELECT *
    FROM ORDERS_COMBINED
   WHERE SOURCE ='UK';
```

Transform data with KSQL - split streams

ORDERS_COMBINED

```
CREATE STREAM ORDERS_US AS
  SELECT *
    FROM ORDERS_COMBINED
   WHERE SOURCE ='US';
```

```
CREATE STREAM ORDERS_UK AS
  SELECT *
    FROM ORDERS_COMBINED
   WHERE SOURCE ='UK';
```



ORDERS_US

ORDERS_UK