Building stream processing applications with Apache Kafka® using KSQL

@rmoff

#KafkaMeetup

STREAM PROCESSING

PROCESSING

STREAM

PROCESSING

a

STREAM

of EVENTS

STREAMS ARE

EVERYWHERE

A Customer Experience

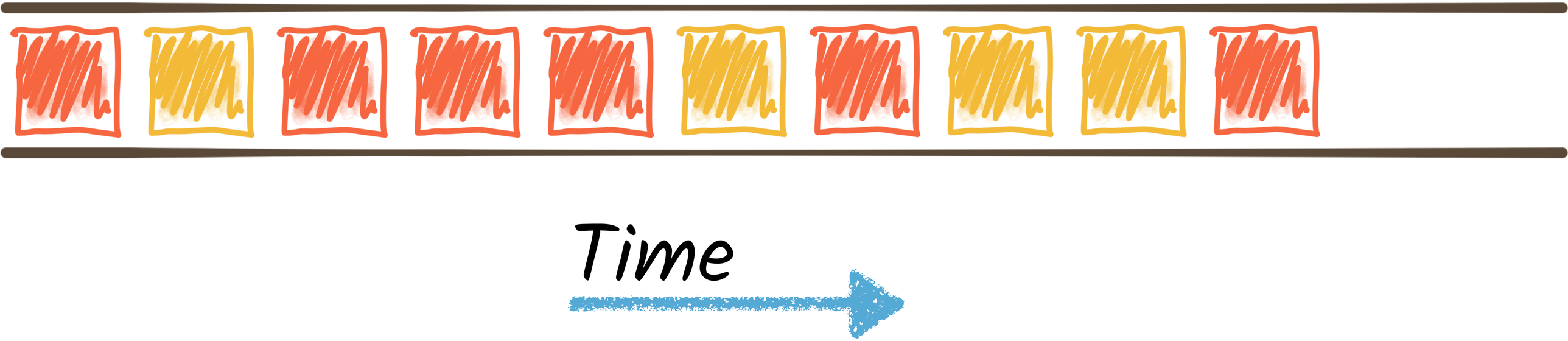
A Sale

A Sensor Reading

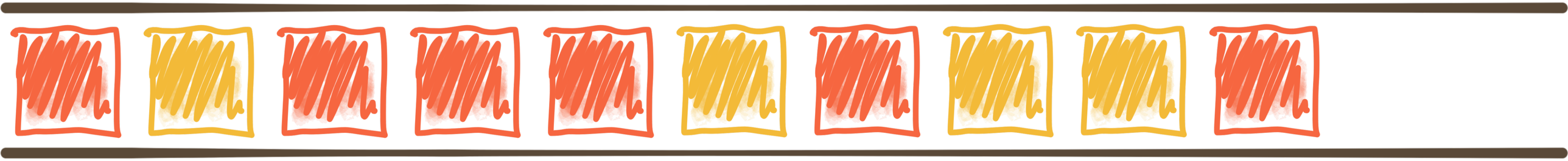
An Application Log Entry

Databases

Streams of events



Stream Processing with KSQL



Stream: `widgets`

Stream: `widgets_red`

Stream Processing with KSQL

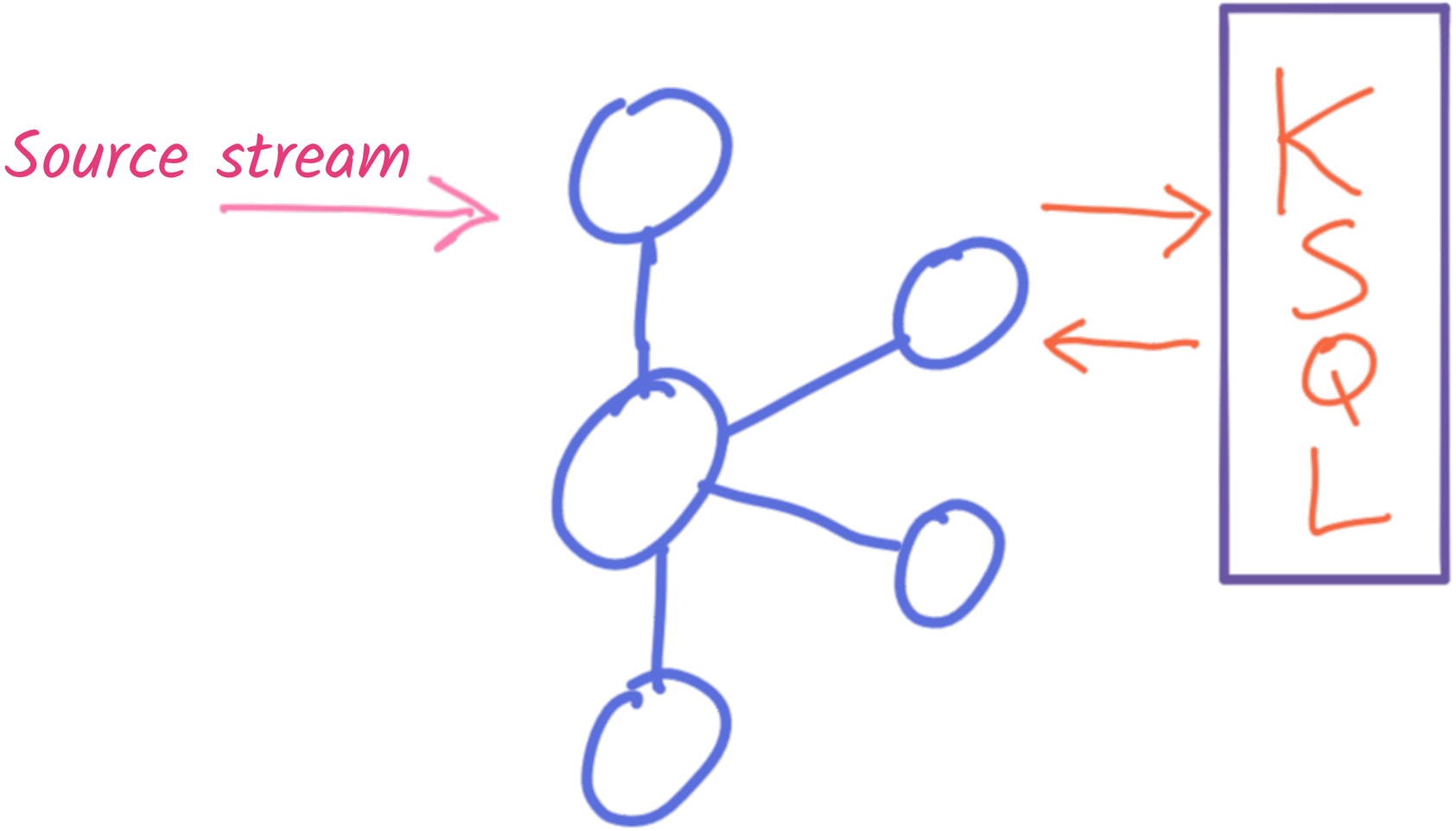
Stream:
widgets

KSQL

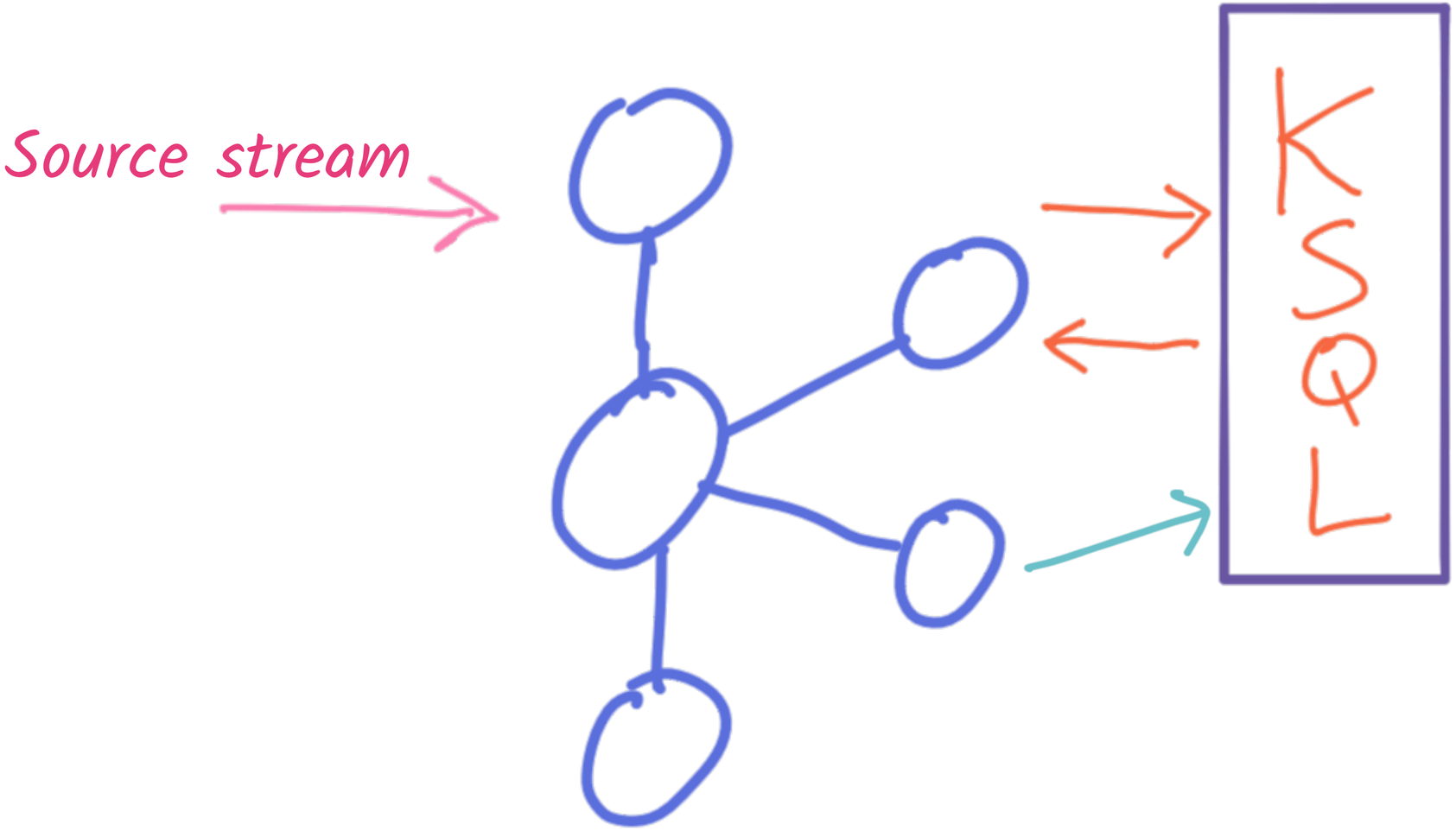
```
CREATE STREAM widgets_red AS
SELECT * FROM widgets
WHERE colour='RED';
```

Stream:
widgets_red

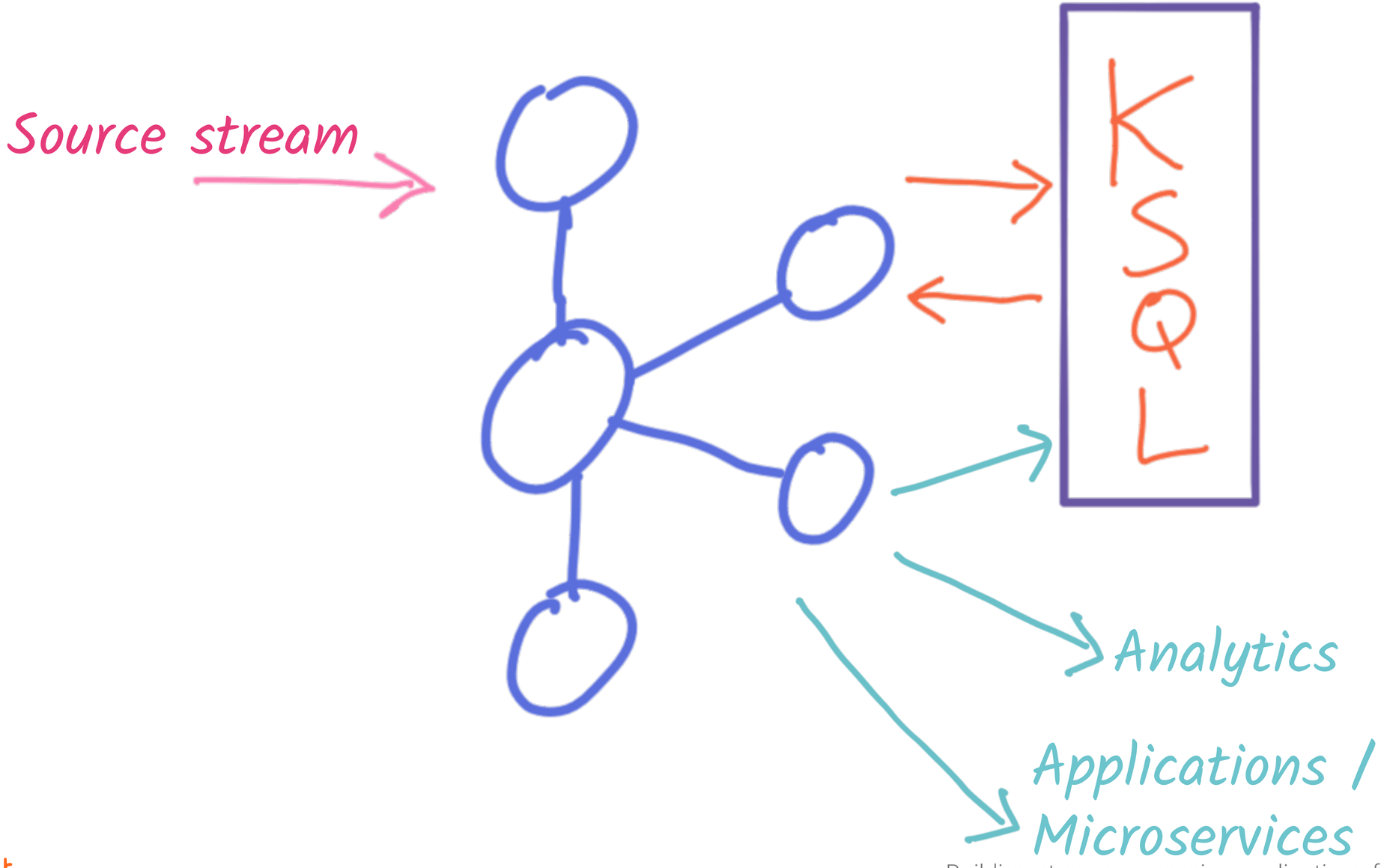
Stream Processing with KSQL



Stream Processing with KSQL



Stream Processing with KSQL



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 in action

http://rmoff.dev/ksql-intro_code

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": {
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    "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

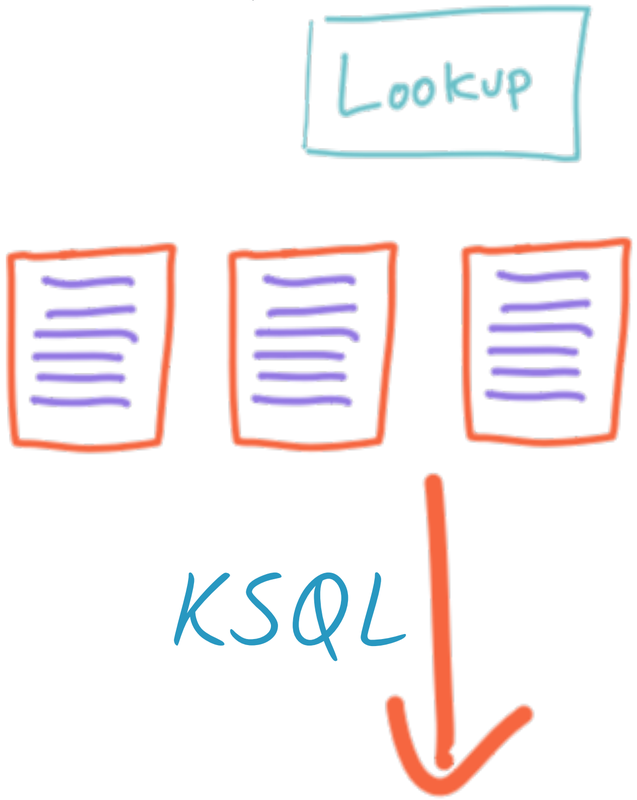
ITEMS

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}
```

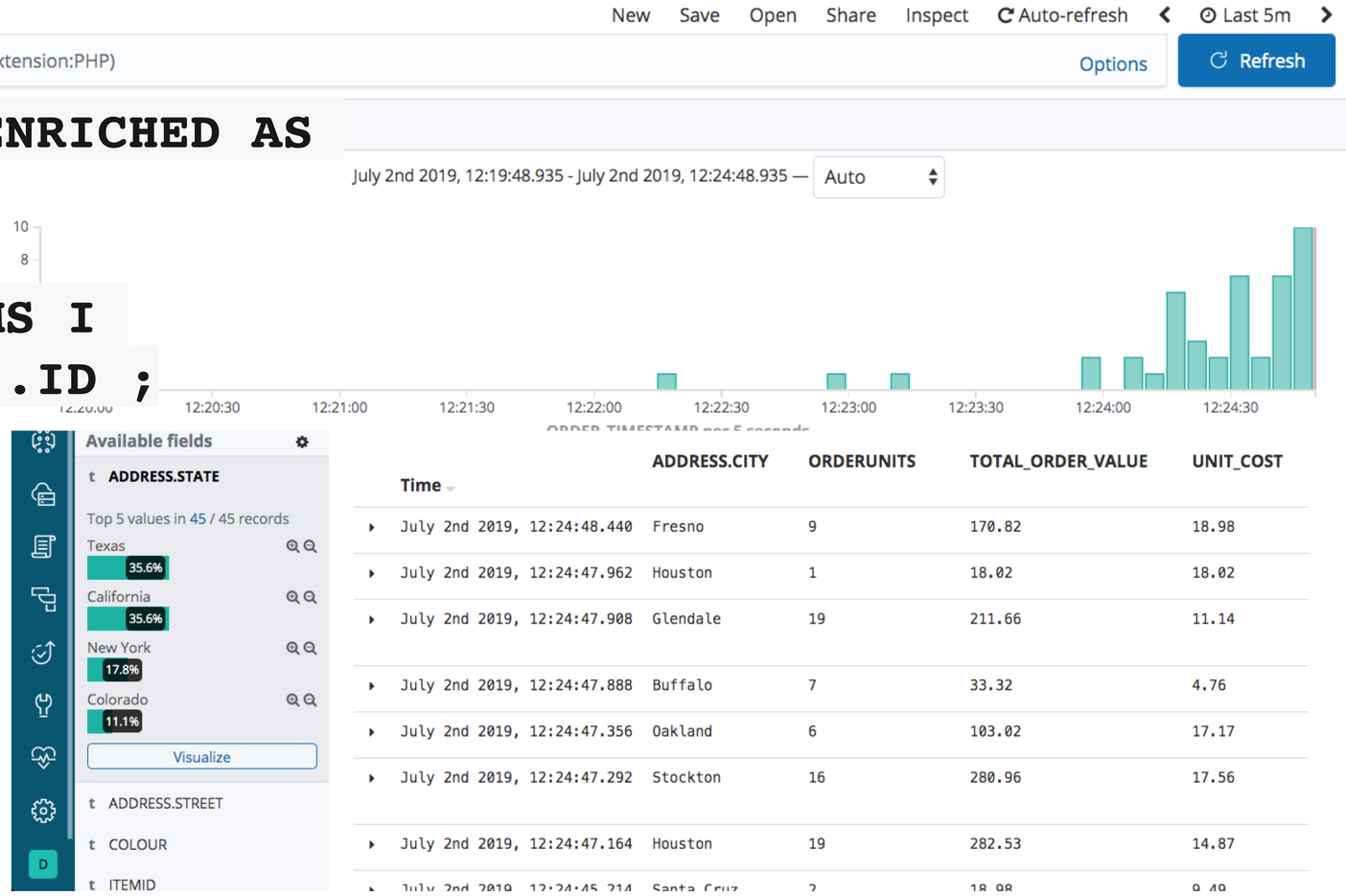
```
CREATE STREAM ORDERS_ENRICHED AS
SELECT O.*, I.*,
  O.ORDERUNITS * I.UNIT_COST
    AS TOTAL_ORDER_VALUE,
  FROM ORDERS O
       INNER JOIN ITEMS I
       ON O.ITEMID = I.ID ;
```

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

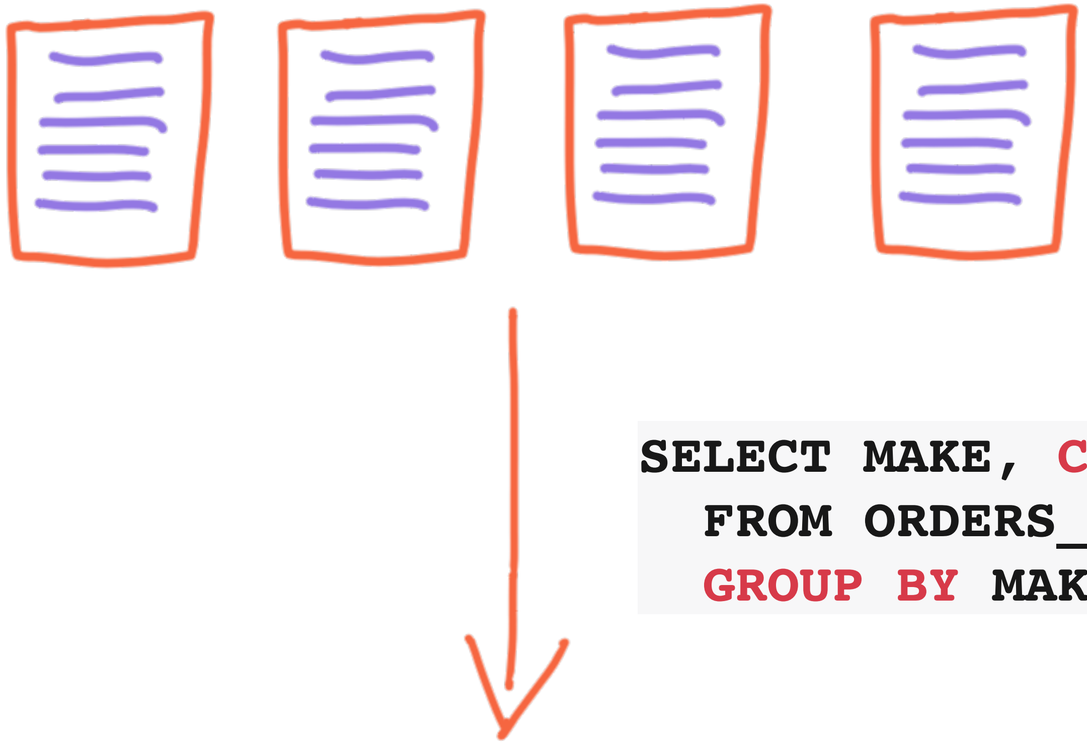

```
CREATE STREAM ORDERS_ENRICHED AS
SELECT […]
  FROM ORDERS O
       INNER JOIN ITEMS I
       ON O.ITEMID = I.ID ;
```



Stateful Aggregation with KSQL

ORDERS

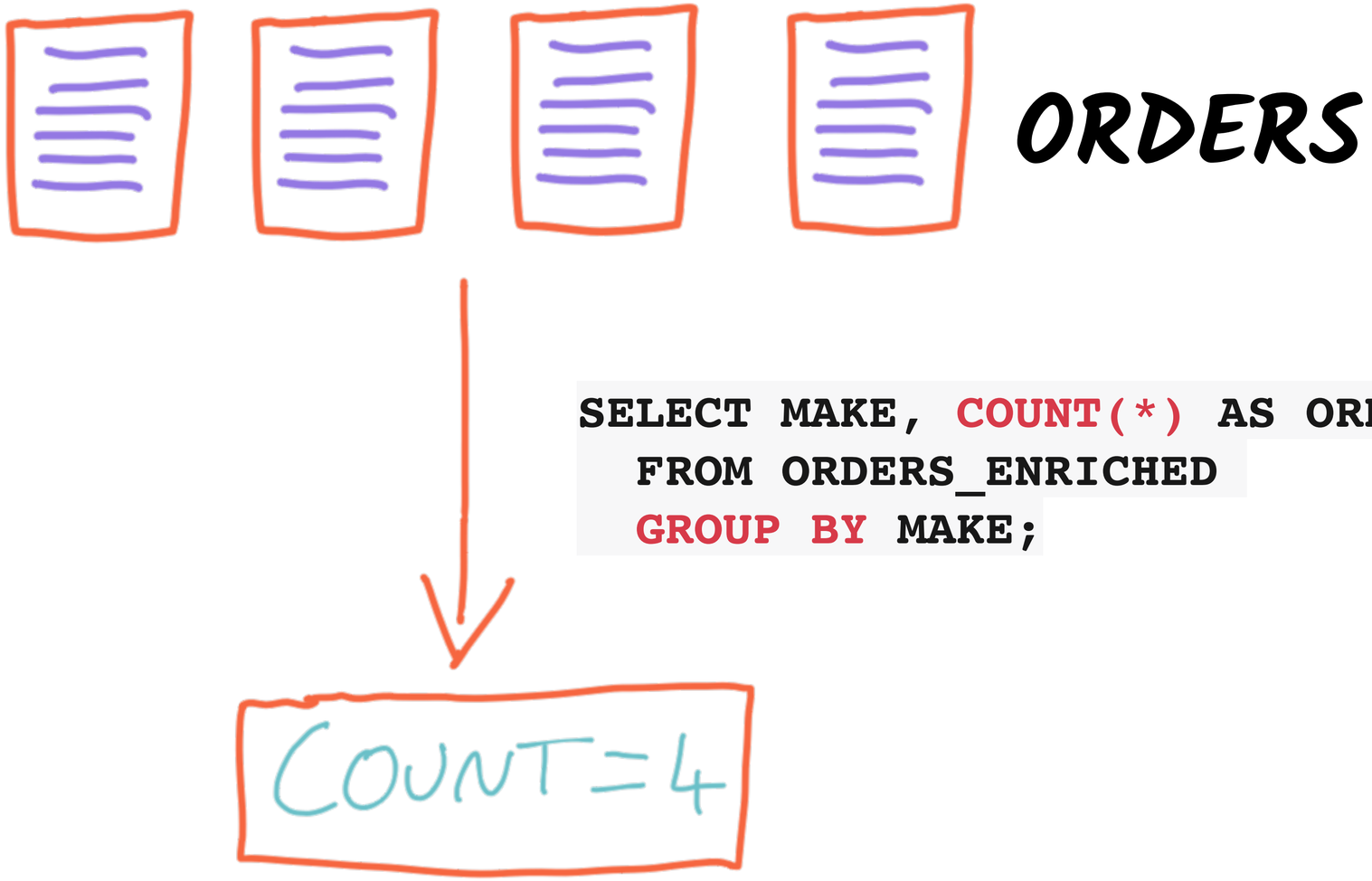
Stateful Aggregation with KSQL



ORDERS

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

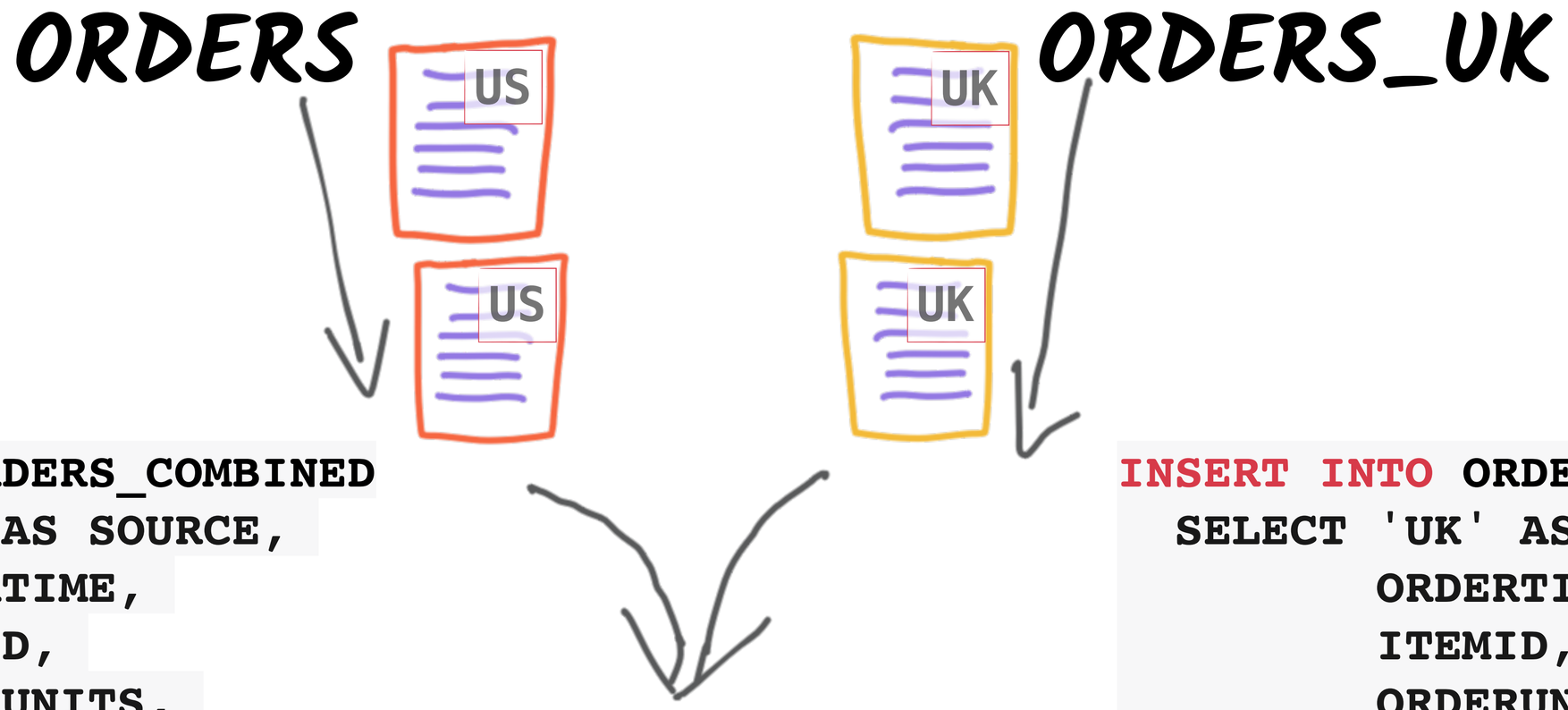
Stateful Aggregation with KSQL




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

Transform data with KSQL - merge streams

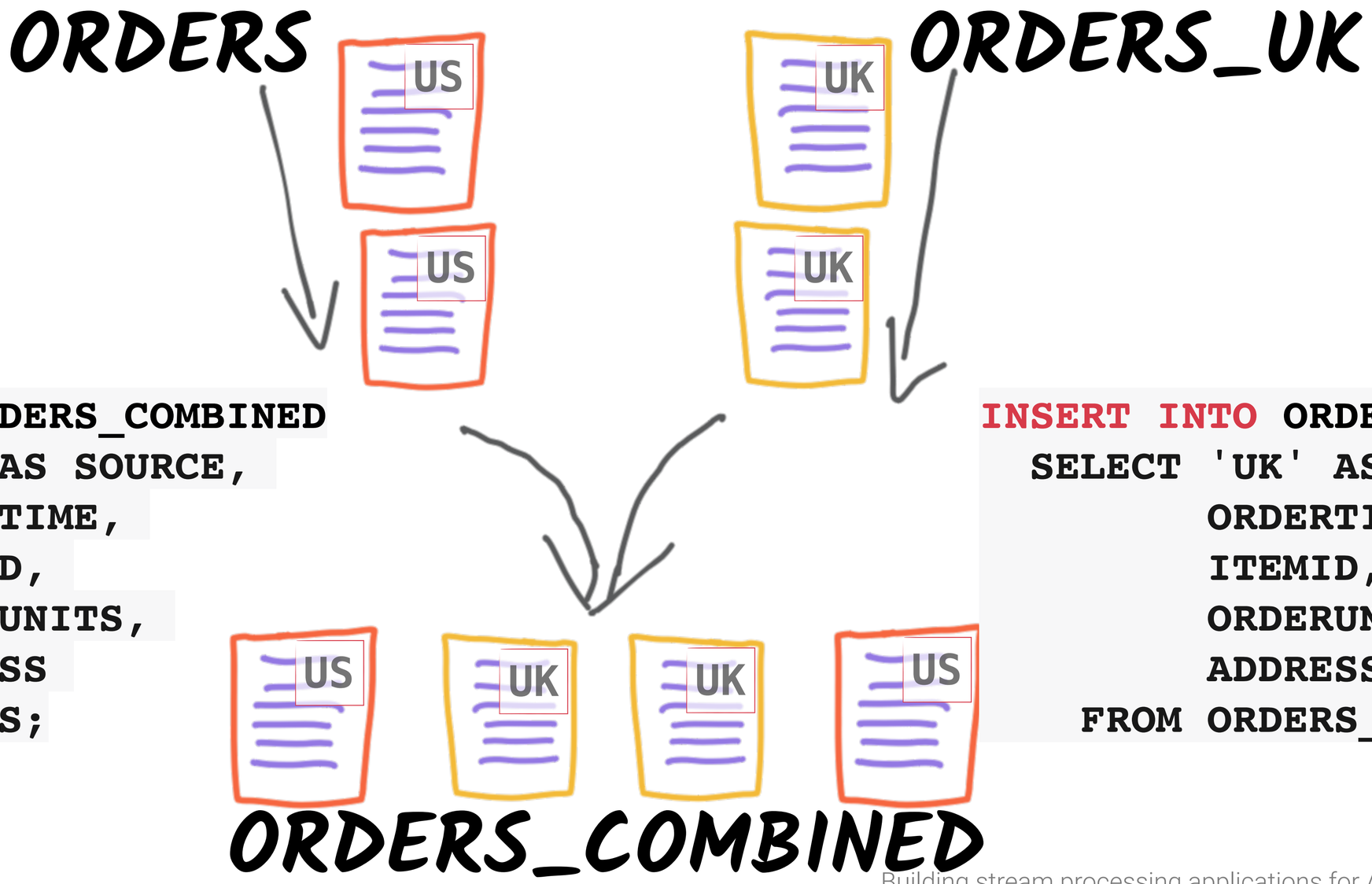
Transform data with KSQL - merge streams




```
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';
```

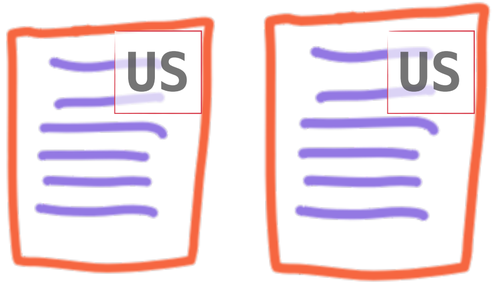
```
CREATE STREAM ORDERS_UK AS
  SELECT *
    FROM ORDERS_COMBINED
   WHERE SOURCE ='UK';
```

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

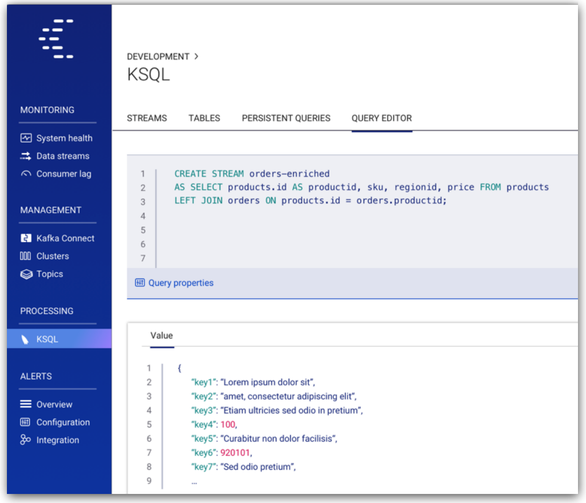
ORDERS_UK

KSQL operations and deployment

KSQL in Development and Production

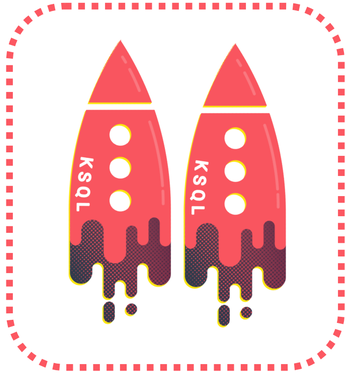
Interactive KSQL
for development and testing

Headless KSQL
for Production

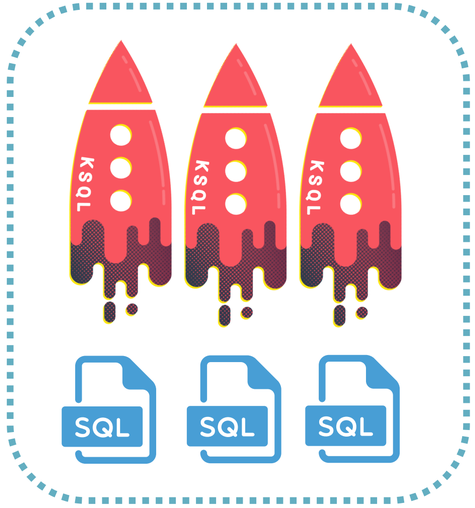


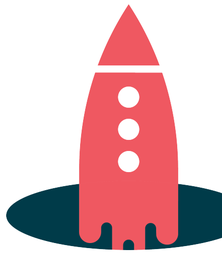
"Hmm, let me try out this idea..."

REST



Desired KSQL queries have been identified





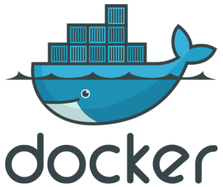
How to run KSQL

KSQL Server
(JVM process)

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

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


Physical

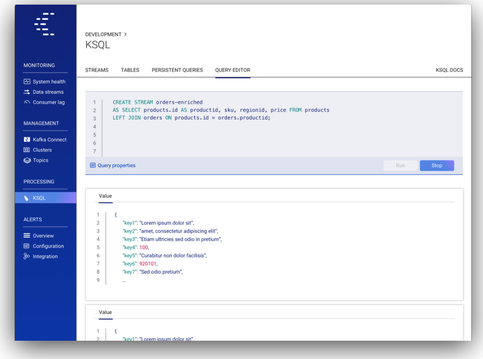


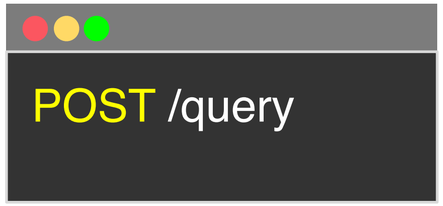
Google Cloud Platform

…and many more…

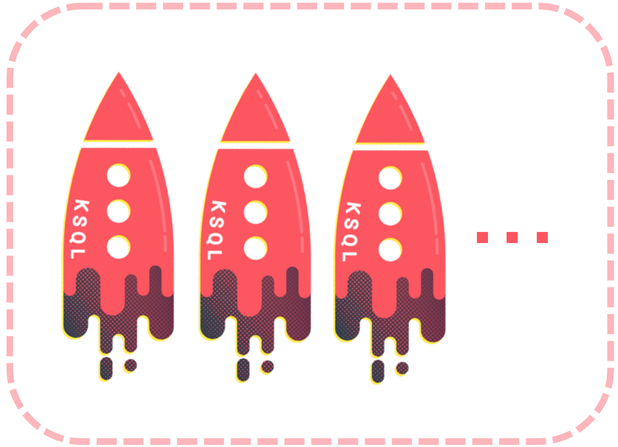
How to run KSQL

#1 Interactive KSQL, for development & testing





KSQL Cluster
(processing)

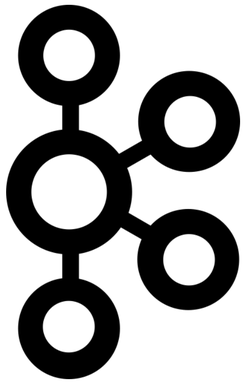


KSQL does not run
on Kafka brokers!

read,
write

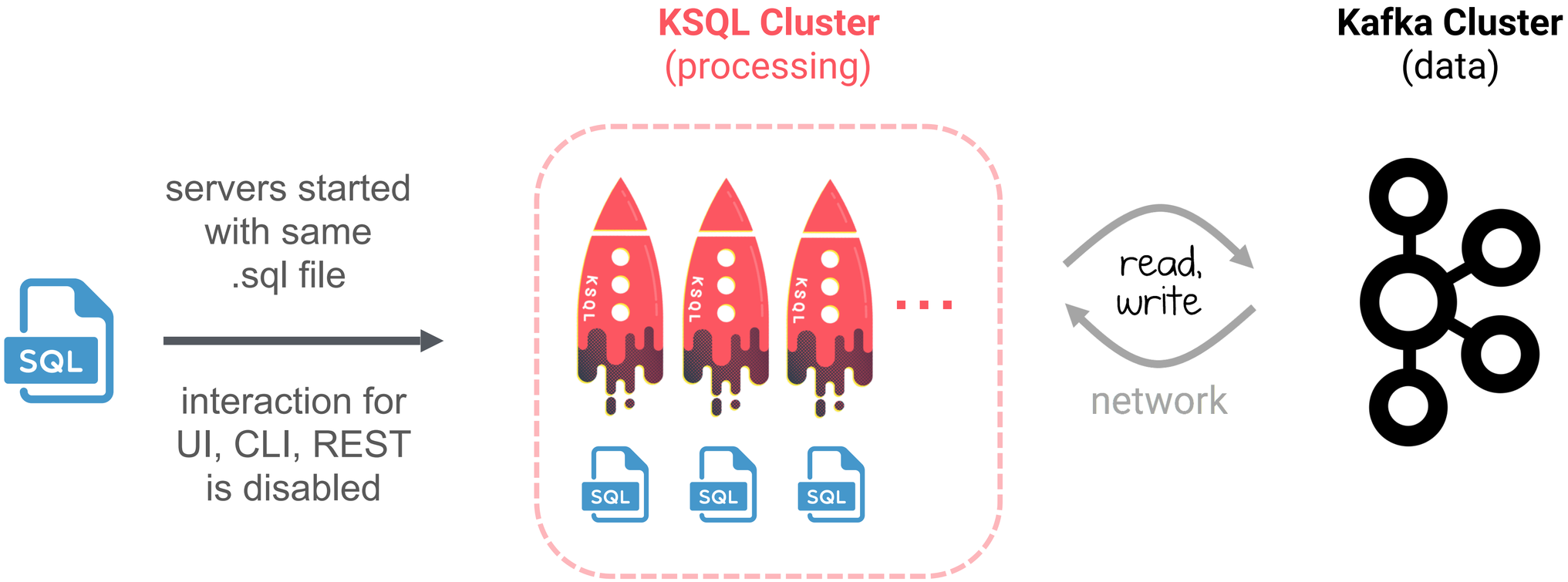
network

Kafka Cluster
(data)



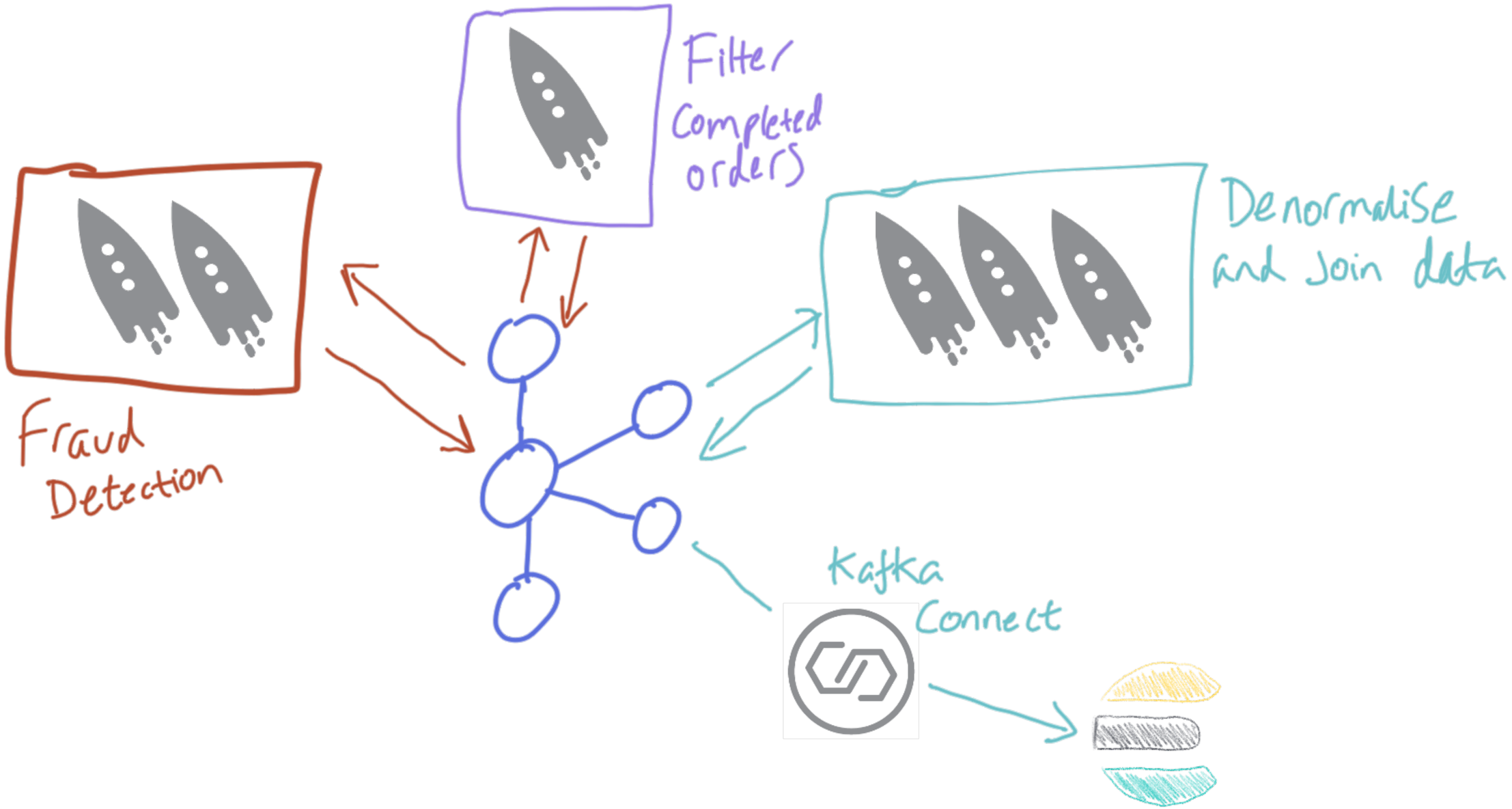
How to run KSQL

#2 Headless KSQL, for production



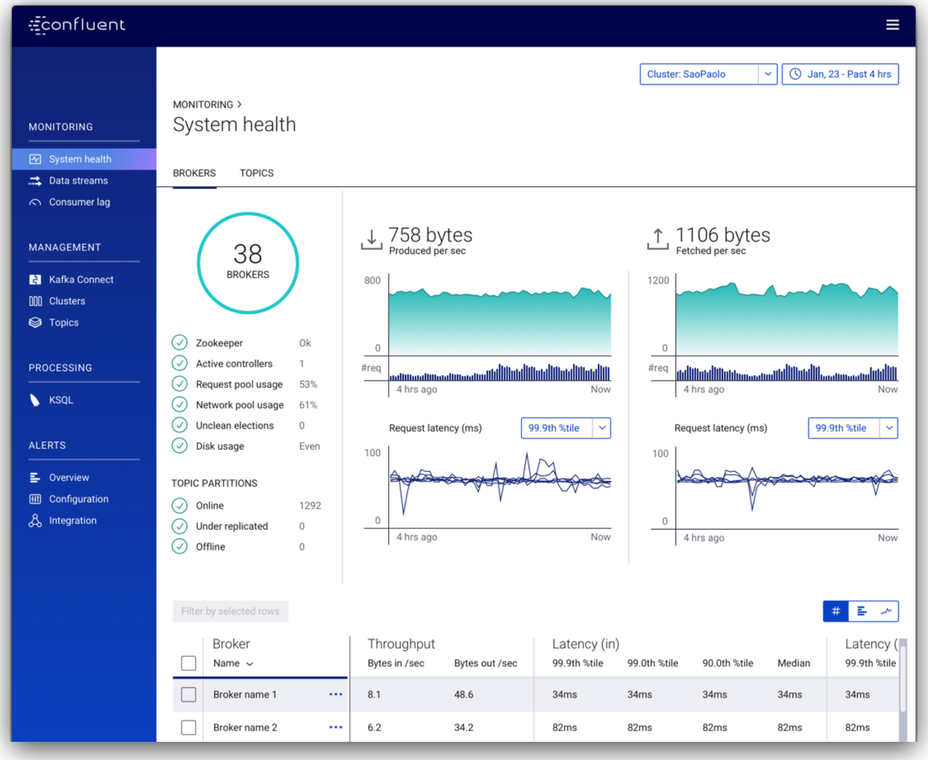

ONE DOES NOT SIMPLY RUN
A SINGLE KSQL CLUSTER

Think Applications, not database instances



Monitoring KSQL

Confluent Control Center

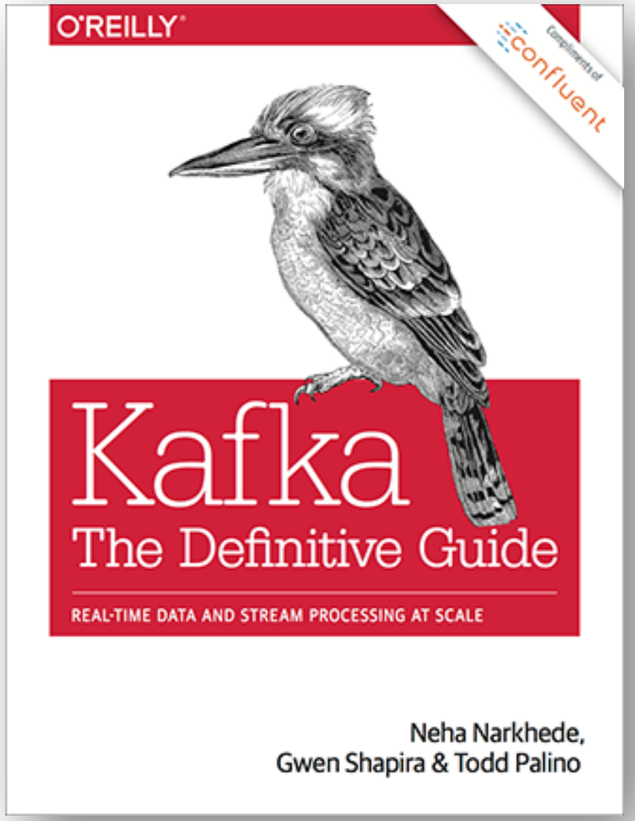


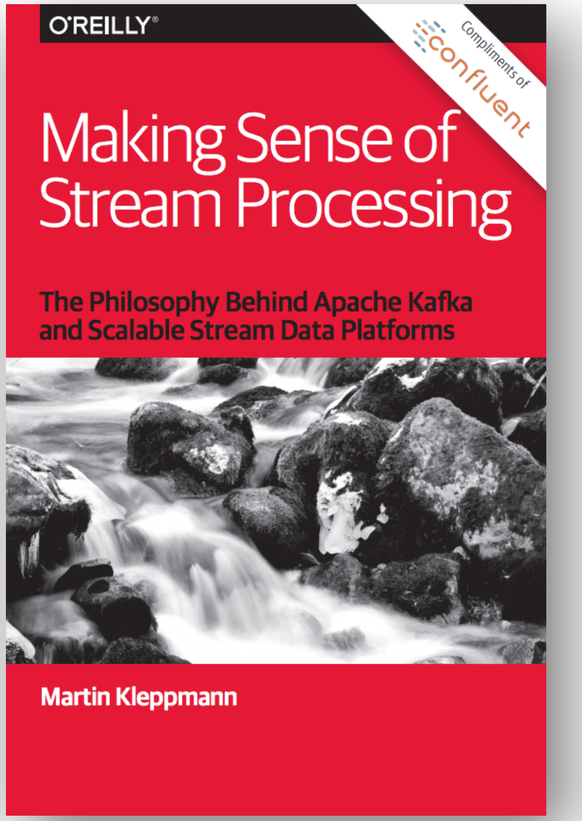
JMX

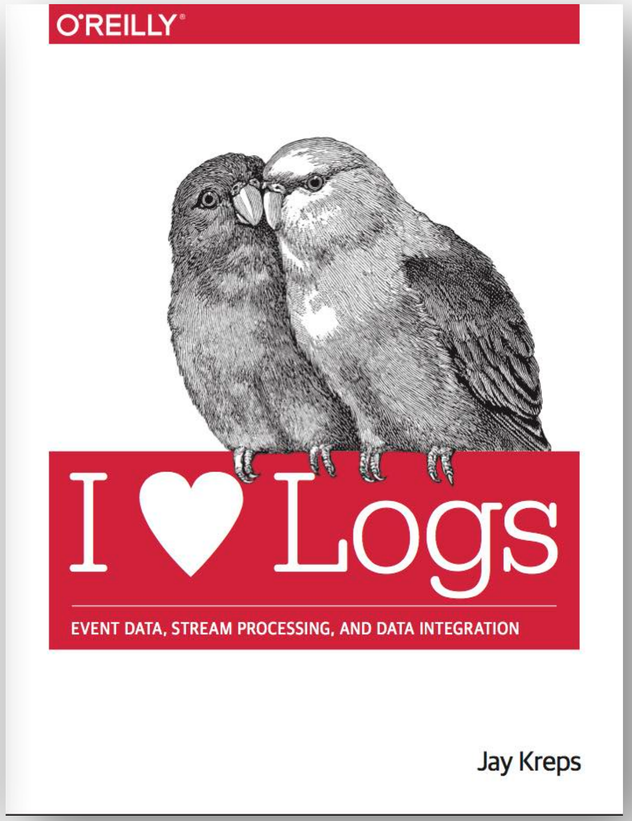
https://www.confluent.io/blog/troubleshooting-ksql-part-2

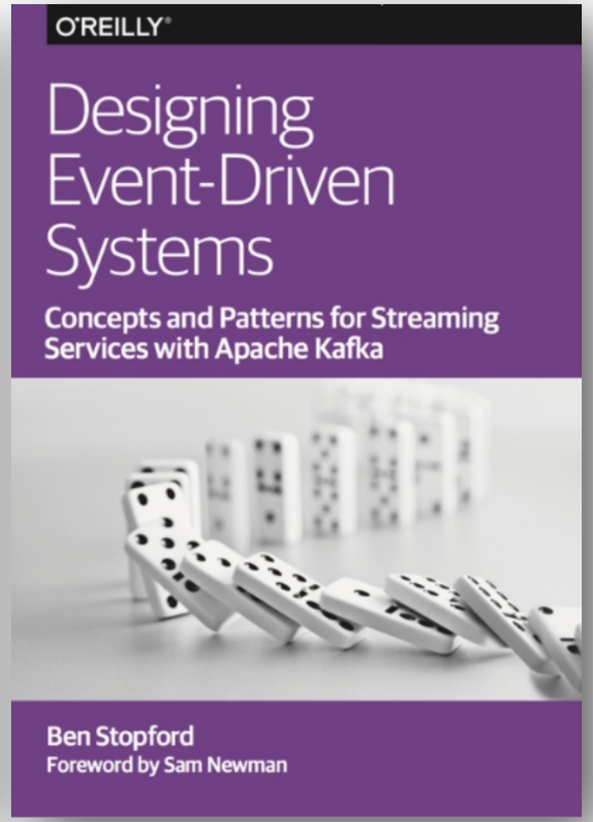

NEXT STOP
SAN FRANCISCO
SEPT 30-OCT 1
CONFLUENT COMMUNITY DISCOUNT CODE
KS19Meetup
25% OFF*
kafka
summit
*Standard Priced Conference pass

http://cnfl.io/book-bundle









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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

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rmoff Fix KSQL statement Latest commit d2bed6d 4 days ago

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connect-5.3-improvements	Fix bug in Docker Compose in which HTTP status codes aren't correctly...	2 months ago
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connect-jdbc	Bump to 5.4 preview	6 days ago
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https://rmoff.dev/ksql-intro_code

@rmoff #KafkaMeetup

#EOF

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