Hybrid-Cloud Streaming Workshop

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Introduction

The popularity of Hybrid and Multi cloud architectures are on the rise as organizations continue to take advantage of cloud computing.

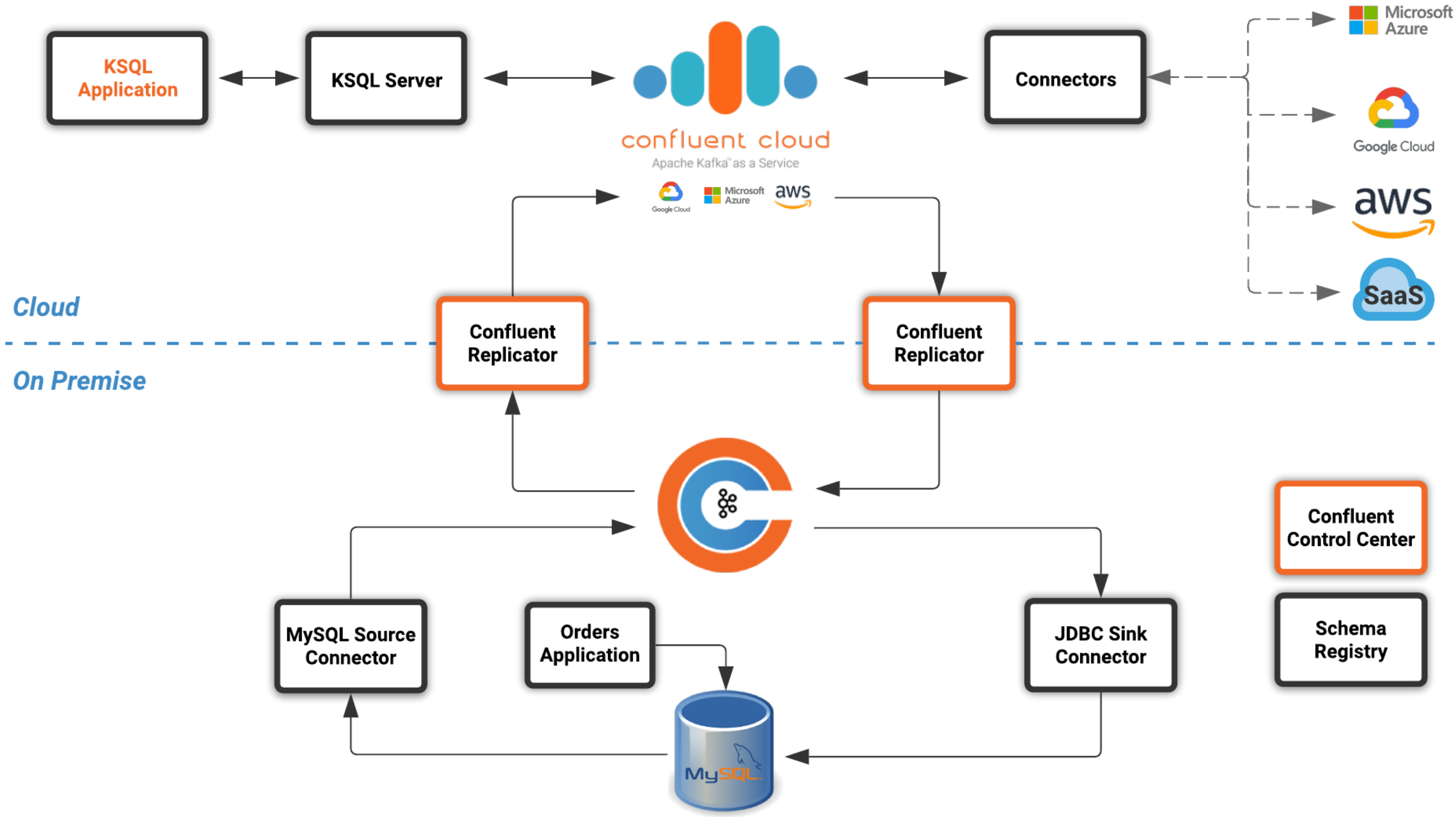
Some of the requirements driving these new modern architectures are as follows.

Organizations need to...

- Synchronize data between on-premise and the cloud
- Migrate data from on-premise into the cloud
- Synchronize data across multiple cloud providers to reduce risk
- Synchronize data across multiple cloud providers to avoid vendor lock-in
- Access the best-in-breed services across multiple cloud providers

In addition to Hybrid and Multi cloud architectures, organizations are also looking to become more event driven. The Confluent Platform is a streaming platform that can stream data, in real time, to the systems that need it, when they need it, across an entire organization. Processes that were once batch can now become real time, every event can be used to trigger other services and this can all be done using a common API with low latency and high throughput.

In this workshop we will explore how the Confluent Platform and Confluent Cloud can enable these architectures by building a real time supply and demand appplication using KSQL.



Lab 1: Connecting to your Workshop Environment

Your environment represents an on-premise data center and consists of a virtual machine hosted in the cloud running several docker containers. In a real world implementation, some of the components would be deployed differently but the logical data flow that we will be working on would remain the same.

To login to your virtual data center open a terminal session and use the credentials that were assigned to you

```
ssh dc01@34.89.105.9
```

Once logged in run the following command to confirm that you have several docker containers running

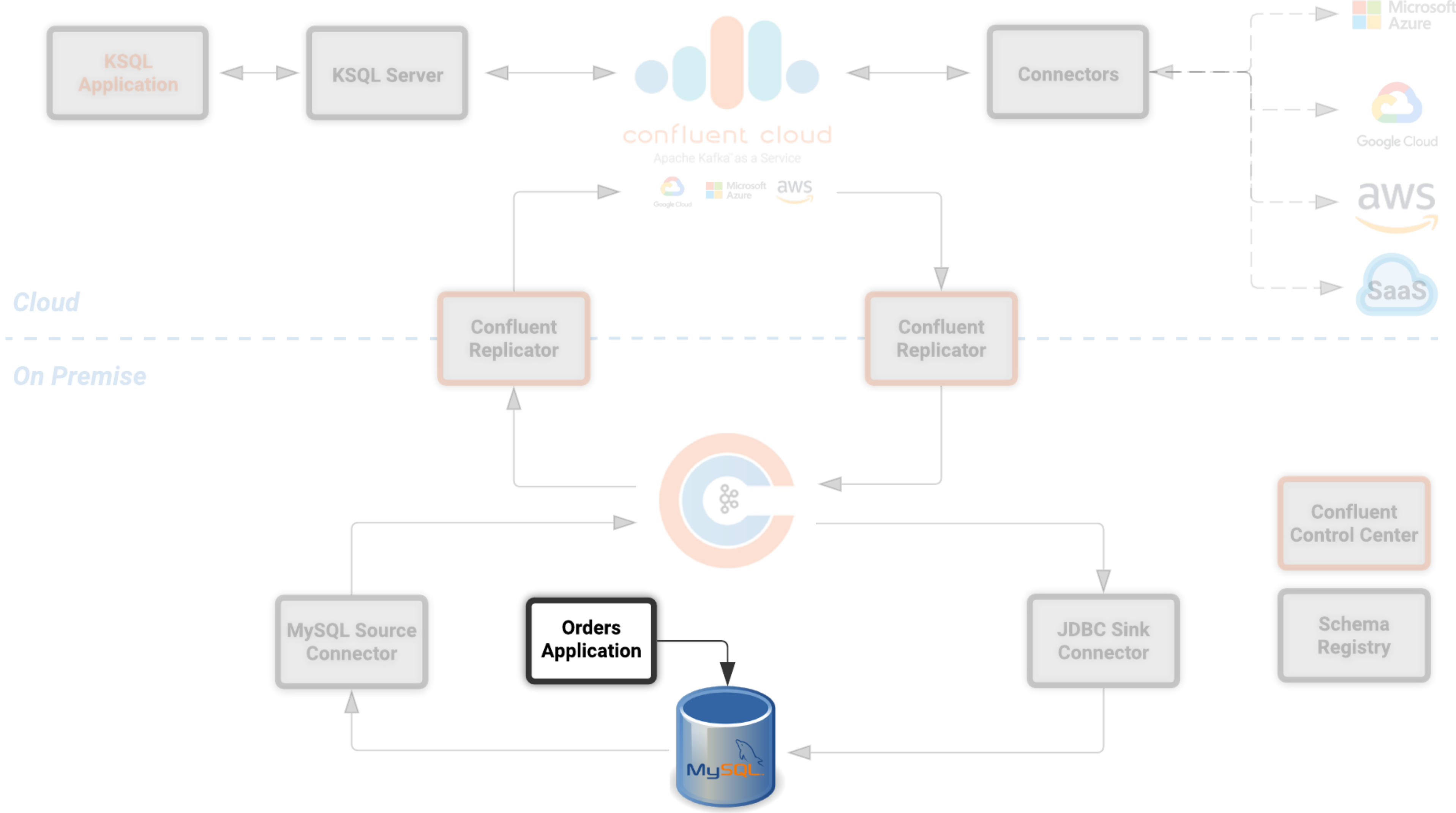
```
docker ps --format "table {{.ID}}\t{{.Names}}\t{{.RunningFor}}\t{{.Status}}"
```

You should see something similar to this:-

```
CONTAINER ID        NAMES                       CREATED             STATUS
d71e05e9b3b5        db-trans-simulator          6 minutes ago       Up 6 minutes
9100108345db        mysql                       6 minutes ago       Up 6 minutes (healthy)
e280fd878cce        ksql-cli                    7 minutes ago       Up 7 minutes
edcd99707a7a        ksql-server-ccloud          7 minutes ago       Up 7 minutes (healthy)
d6ca56beb72e        control-center              7 minutes ago       Up 7 minutes
31bf790e76e7        kafka-connect-ccloud        7 minutes ago       Up 7 minutes
8b35d343e6d6        kafka-connect-onprem        7 minutes ago       Up 7 minutes
4aa6a7cd76c3        schema-registry             7 minutes ago       Up 7 minutes
84022bbf75e5        broker                      7 minutes ago       Up 7 minutes
b0f2aefb2042        zookeeper                   7 minutes ago       Up 7 minutes
ee2983ac4bcc        workshop-docs-webserver     7 minutes ago       Up 7 minutes
```

Lab 2: Getting Started

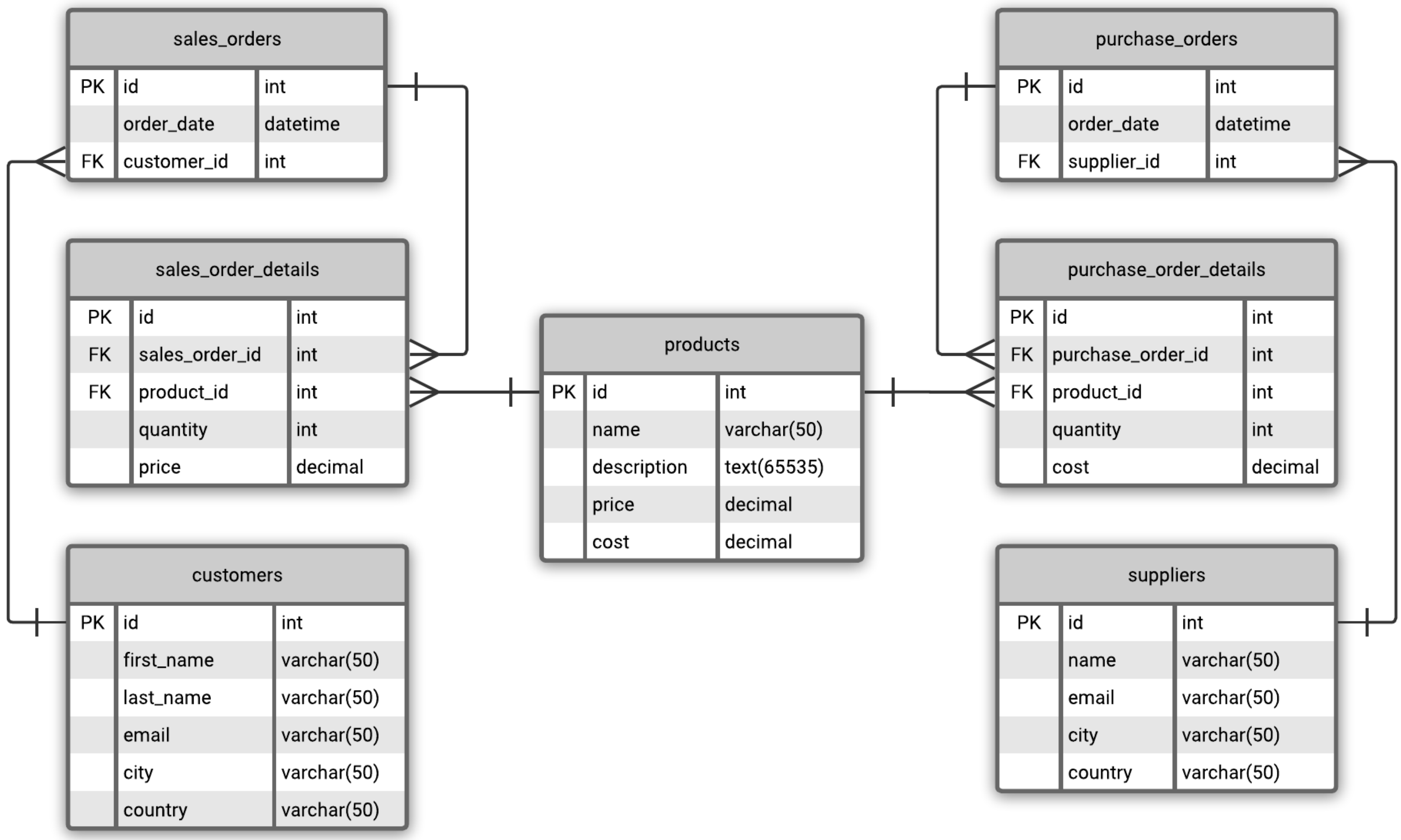
The data source for this workshop will be a MySQL database running in your data center. Connected to this database is a orders application which we will discuss shortly.



Database Schema

The MySQL database contains a simple schema that includes *Customer*, *Supplier*, *Product*, *Sales Order* and *Purchase Order* information.

The idea behind this schema is simple, customers order products from a company and sales orders get created, the company then sends purchase orders to their suppliers so that product demand can be met by maintaining sensible stock levels.



We can inspect this schema further by logging into the MySQL CLI.

```
docker exec -it mysql bash -c 'mysql -u root -p$MYSQL_ROOT_PASSWORD --database orders'
```

You should see the following

```
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 1138
Server version: 5.7.27-log MySQL Community Server (GPL)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql>
```

To view your tables.

```
show tables;
```

There's an extra table here called `dc01_out_of_stock_events` that not in the schema diagram above, we'll cover this table separately later on.

```
+--------------------------+
| Tables_in_orders         |
+--------------------------+
| customers                |
| dc01_out_of_stock_events |
| products                 |
| purchase_order_details   |
| purchase_orders          |
| sales_order_details      |
| sales_orders             |
| suppliers                |
+--------------------------+
```

...and get some row counts.

```
SELECT * from (
  SELECT 'customers' as table_name, COUNT(*) FROM customers
  UNION
  SELECT 'products' as table_name, COUNT(*) FROM products
  UNION
  SELECT 'suppliers' as table_name, COUNT(*) FROM suppliers
  UNION
  SELECT 'sales_orders' as table_name, COUNT(*) FROM sales_orders
  UNION
  SELECT 'sales_order_details' as table_name, COUNT(*) FROM sales_order_details
  UNION
  SELECT 'purchase_orders' as table_name, COUNT(*) FROM purchase_orders
  UNION
  SELECT 'purchase_order_details' as table_name, COUNT(*) FROM purchase_order_details
) row_counts;
```

As you can see, we have 30 customers, suppliers and products, 0 sales orders and 1 purchase order.

```
+------------------------+----------+
| table_name             | COUNT(*) |
+------------------------+----------+
| customers              |       30 |
| products               |       30 |
| suppliers              |       30 |
| sales_orders           |        0 |
| sales_order_details    |        0 |
| purchase_orders        |        1 |
| purchase_order_details |       30 |
+------------------------+----------+
7 rows in set (0.00 sec)
```

The single purchase order was created so we have something in stock to sell, let's have a look at what was ordered.

```
SELECT * FROM purchase_order_details;
```

```
+----+-------------------+------------+----------+------+
| id | purchase_order_id | product_id | quantity | cost |
+----+-------------------+------------+----------+------+
|  1 |                 1 |          1 |      100 | 6.82 |
|  2 |                 1 |          2 |      100 | 7.52 |
|  3 |                 1 |          3 |      100 | 6.16 |
|  4 |                 1 |          4 |      100 | 8.07 |
|  5 |                 1 |          5 |      100 | 2.10 |
|  6 |                 1 |          6 |      100 | 7.45 |
|  7 |                 1 |          7 |      100 | 4.02 |
|  8 |                 1 |          8 |      100 | 0.64 |
|  9 |                 1 |          9 |      100 | 8.51 |
| 10 |                 1 |         10 |      100 | 3.61 |
| 11 |                 1 |         11 |      100 | 2.62 |
| 12 |                 1 |         12 |      100 | 2.60 |
| 13 |                 1 |         13 |      100 | 1.26 |
| 14 |                 1 |         14 |      100 | 4.08 |
| 15 |                 1 |         15 |      100 | 3.56 |
| 16 |                 1 |         16 |      100 | 7.13 |
| 17 |                 1 |         17 |      100 | 7.64 |
| 18 |                 1 |         18 |      100 | 5.94 |
| 19 |                 1 |         19 |      100 | 2.94 |
| 20 |                 1 |         20 |      100 | 1.91 |
| 21 |                 1 |         21 |      100 | 8.89 |
| 22 |                 1 |         22 |      100 | 7.62 |
| 23 |                 1 |         23 |      100 | 6.19 |
| 24 |                 1 |         24 |      100 | 2.83 |
| 25 |                 1 |         25 |      100 | 5.51 |
| 26 |                 1 |         26 |      100 | 4.23 |
| 27 |                 1 |         27 |      100 | 8.33 |
| 28 |                 1 |         28 |      100 | 7.09 |
| 29 |                 1 |         29 |      100 | 1.75 |
| 30 |                 1 |         30 |      100 | 1.72 |
+----+-------------------+------------+----------+------+
30 rows in set (0.00 sec)
```

as you can see, we have ordered 100 of each product, this reflects our initial and current stock levels.

Type `exit` to leave the MySQL CLI

Starting the Orders Application

To start generating some sales orders we need to start the orders application. This application will continuously create new sales orders to simulate product demand. The application will also raise purchase orders when told to do so, we'll cover this aspect later on in the workshop.

Start the orders application by running the following command.

```
docker exec -dit db-trans-simulator sh -c "python -u /simulate_dbtrans.py > /proc/1/fd/1"
```

Confirm that the simulator is working as expected

```
docker logs -f db-trans-simulator
```

You should see an output like this:

```
Sales Order 1 Created
Sales Order 2 Created
Sales Order 3 Created
Sales Order 4 Created
Sales Order 5 Created
Sales Order 6 Created
Sales Order 7 Created
Sales Order 8 Created
Sales Order 9 Created
...
...
```

Press `ctrl-c` to quit

We now have sales orders being automatically created for us.

To confirm this, start the MySQL CLI again

```
docker exec -it mysql bash -c 'mysql -u root -p$MYSQL_ROOT_PASSWORD --database orders'
```

Re-run the row count script multiple times to confirm that the number of sales orders and sales order detail row counts are increasing.

```
SELECT * from (
  SELECT 'customers' as table_name, COUNT(*) FROM customers
  UNION
  SELECT 'products' as table_name, COUNT(*) FROM products
  UNION
  SELECT 'suppliers' as table_name, COUNT(*) FROM suppliers
  UNION
  SELECT 'sales_orders' as table_name, COUNT(*) FROM sales_orders
  UNION
  SELECT 'sales_order_details' as table_name, COUNT(*) FROM sales_order_details
  UNION
  SELECT 'purchase_orders' as table_name, COUNT(*) FROM purchase_orders
  UNION
  SELECT 'purchase_order_details' as table_name, COUNT(*) FROM purchase_order_details
) row_counts;
```

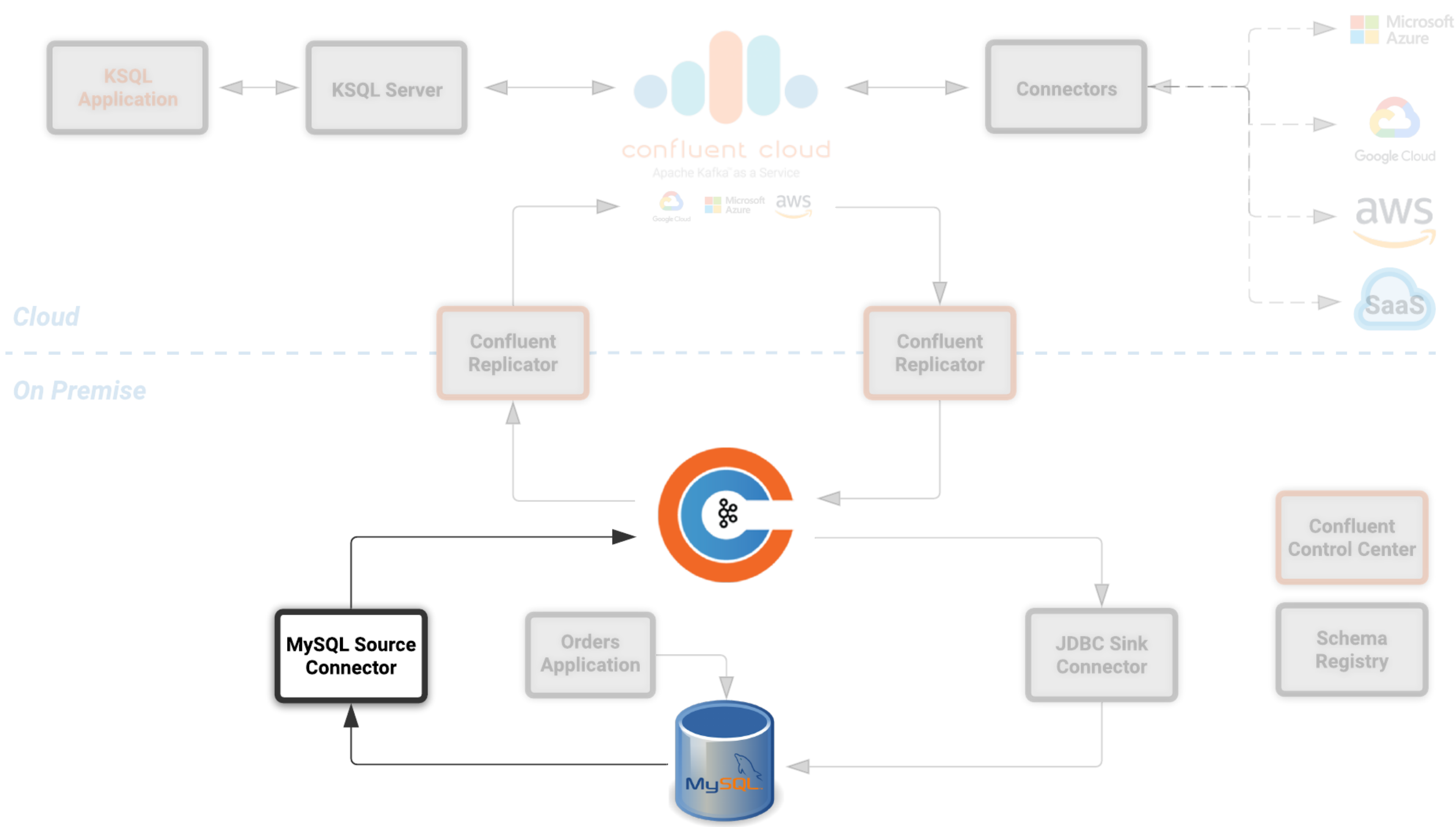
```
+------------------------+----------+
| table_name             | COUNT(*) |
+------------------------+----------+
```

```
| customers               |       30 |
| products                |       30 |
| suppliers               |       30 |
| sales_orders            |      130 |
| sales_order_details     |      392 |
| purchase_orders         |        1 |
| purchase_order_details  |       30 |
+-------------------------+----------+
```

Type `exit` to leave the MySQL CLI

Lab 3: Stream CDC events to your Local Kafka Cluster

Now that we have data being automatically created in our MySQL database it's time to stream those changes into your on-premise Kafka cluster. We can do this using the Debezium MySQL Source connector



Create the MySQL source connector

We have a Kafka Connect worker already up and running in a docker container called `kafka-connect-onprem`. This Kafka Connect worker is configured to connect to your on-premise Kafka cluster and has a internal REST server listening on port `18083`. We can create a connector from the command line using the cURL command. The cURL command allows us to send an HTTP POST request to the REST server, the '-H' option specifies the header of the request and includes the target host and port information, the `-d` option specifies the data we will send, in this case its the configuration options for the connector. You can of course create and manage connectors using any tool or language capable of issuing HTTP requests.

To create the Debezium MySQL Source connector instance run the following command:-

```
curl -i -X POST -H "Accept:application/json" \
  -H  "Content-Type:application/json" http://localhost:18083/connectors/ \
  -d '{
    "name": "mysql-source-connector",
    "config": {
          "connector.class": "io.debezium.connector.mysql.MySqlConnector",
          "database.hostname": "mysql",
          "database.port": "3306",
```

```
        "database.user": "mysqluser",
        "database.password": "mysqlpw",
        "database.server.id": "12345",
        "database.server.name": "dc01",
        "database.whitelist": "orders",
        "table.blacklist": "orders.dc01_out_of_stock_events",
        "database.history.kafka.bootstrap.servers": "broker:29092",
        "database.history.kafka.topic": "debezium_dbhistory" ,
        "include.schema.changes": "true",
        "snapshot.mode": "when_needed",
        "transforms": "unwrap,sourcedc,TopicRename",
        "transforms.unwrap.type": "io.debezium.transforms.UnwrapFromEnvelope",
        "transforms.sourcedc.type":"org.apache.kafka.connect.transforms.InsertField$Value",
        "transforms.sourcedc.static.field":"sourcedc",
        "transforms.sourcedc.static.value":"dc01",
        "transforms.TopicRename.type": "org.apache.kafka.connect.transforms.RegexRouter",
        "transforms.TopicRename.regex": "(.*)\\.(.*)\\.(.*)",
        "transforms.TopicRename.replacement": "$1_$3"
    }
}'
```

The output should resemble something similar to this...

```
HTTP/1.1 201 Created
Date: Thu, 20 Feb 2020 13:00:57 GMT
Location: http://localhost:18083/connectors/mysql-source-connector
Content-Type: application/json
Content-Length: 1043
Server: Jetty(9.4.20.v20190813)
...
...
```

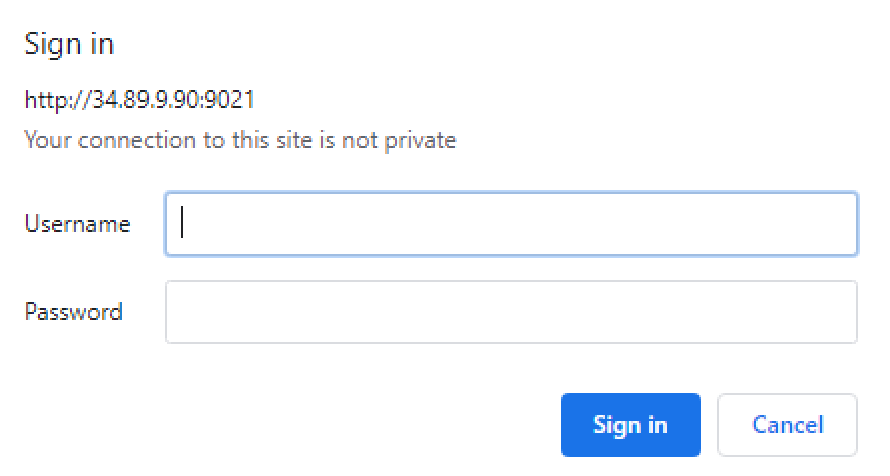
View Messages in Confluent Control Center

Now that the MySQL source connector is up and running, we will be able to see messages appear in our local Kafka cluster.

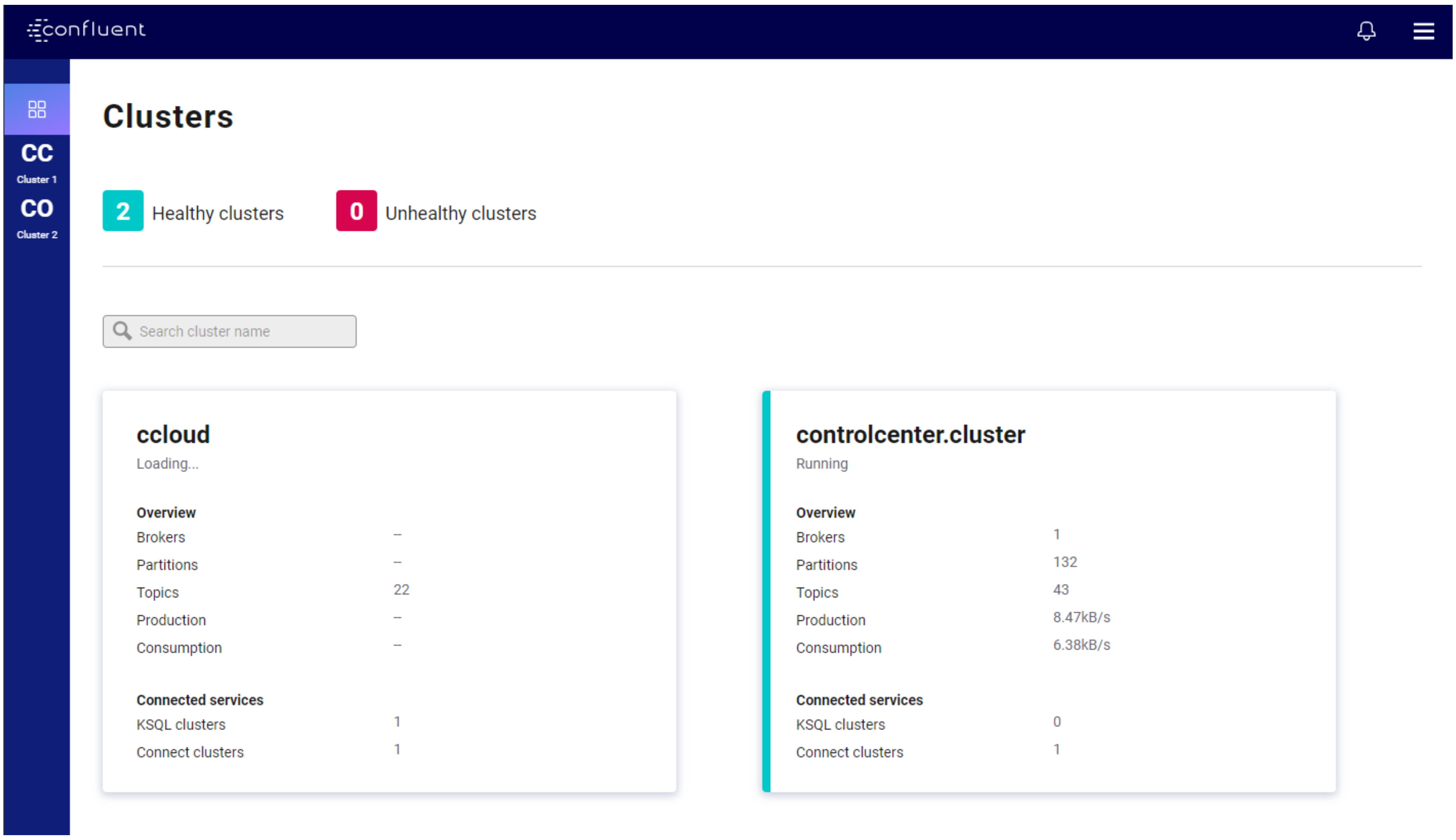
We can use Confluent Control Center to confirm this.

Use the following and username and password to authenticate to Confluent Control Center

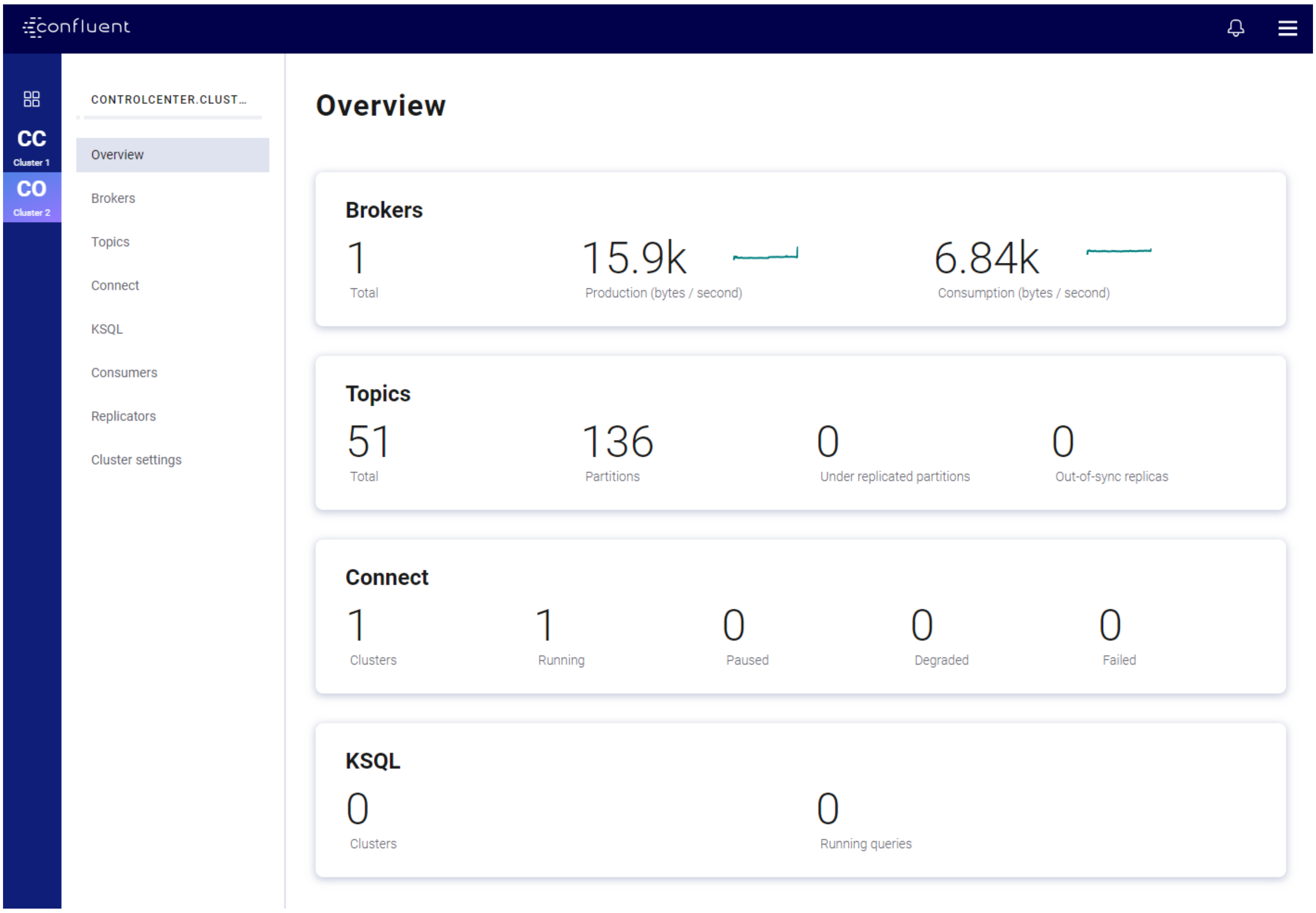
```
Username: dc01
Password:
```



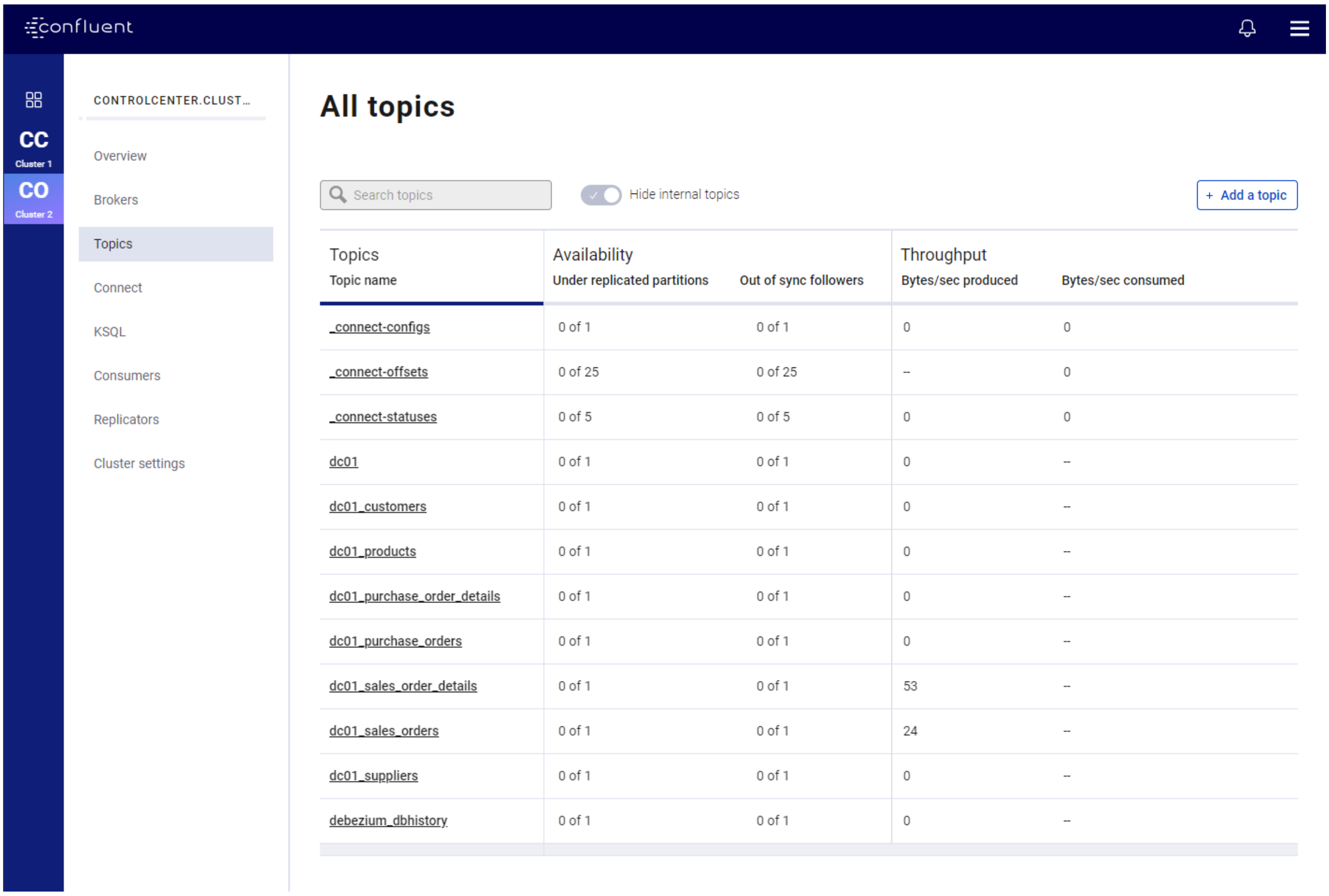
On the landing page we can see that Confluent Control Center is monitoring two Kafka Clusters, our on-premise cluster and a Confluent Cloud Cluster



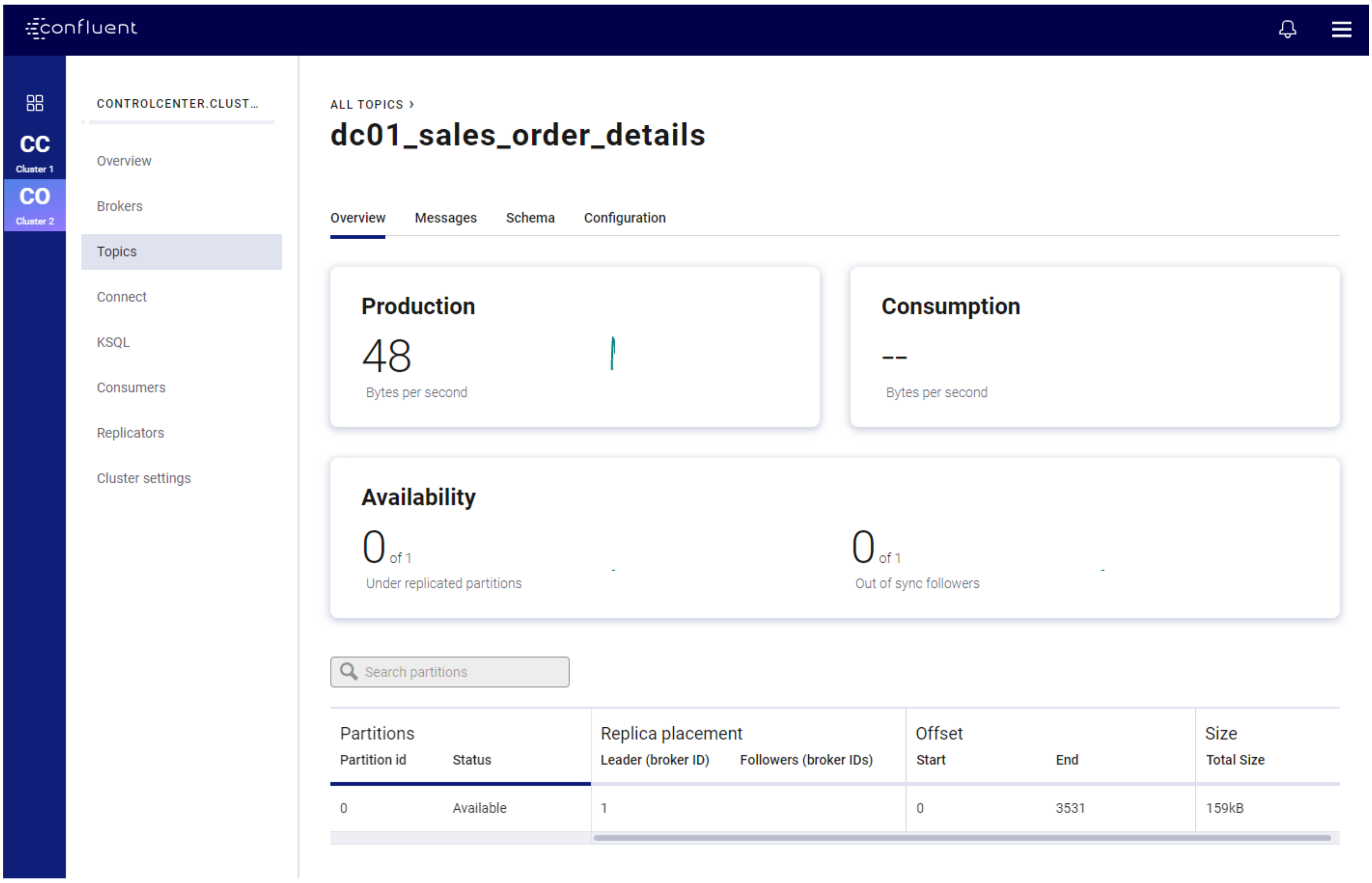
On the left hand navigation bar select "CO" (Controlcenter.cluster), this is your on-premise cluster.



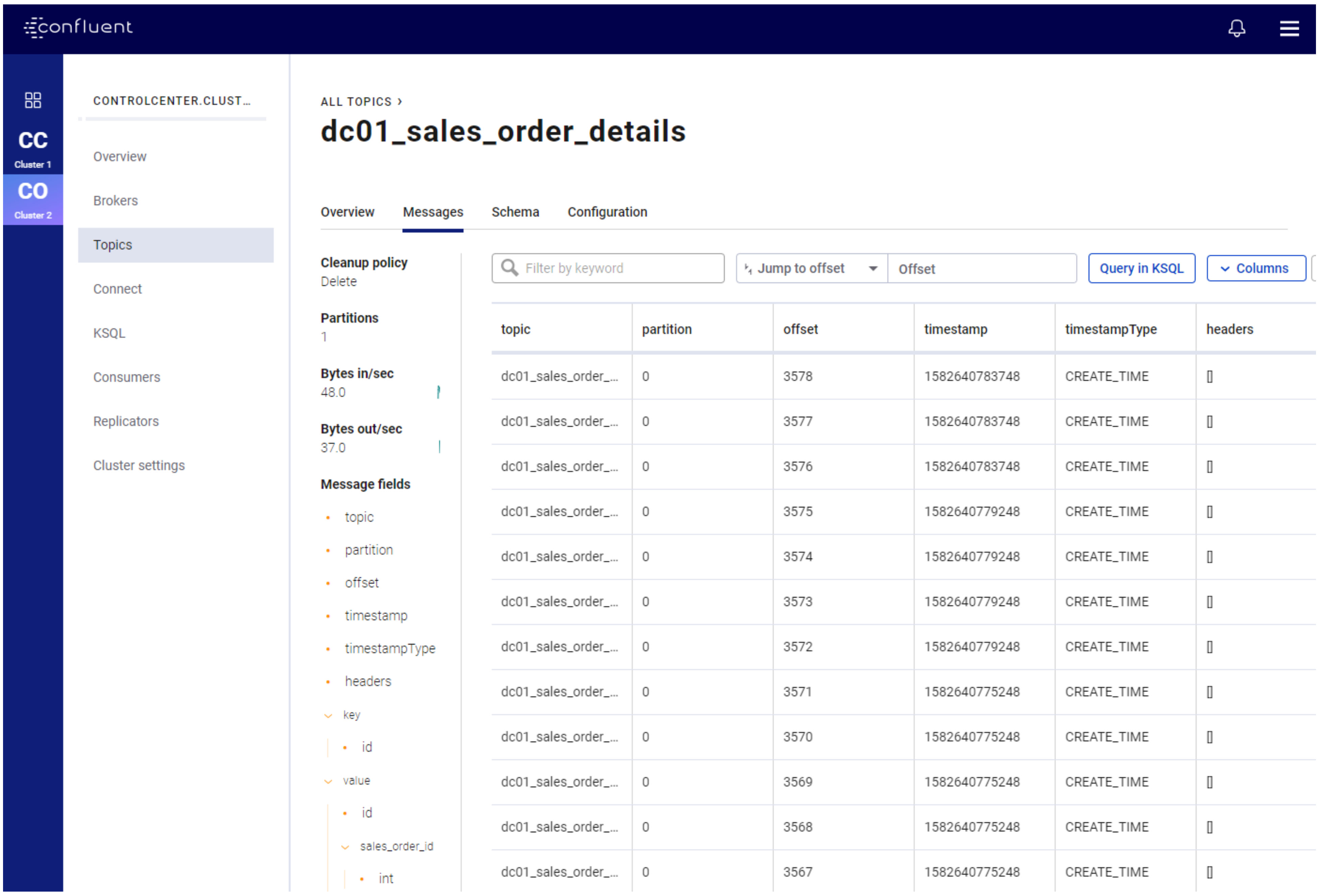
Select the Topics Menu on the left



Select the `dc01_sales_order_details` topic



Finally select the Messages tab and observe that messages are being streamed into Kafka from MySQL in real time.

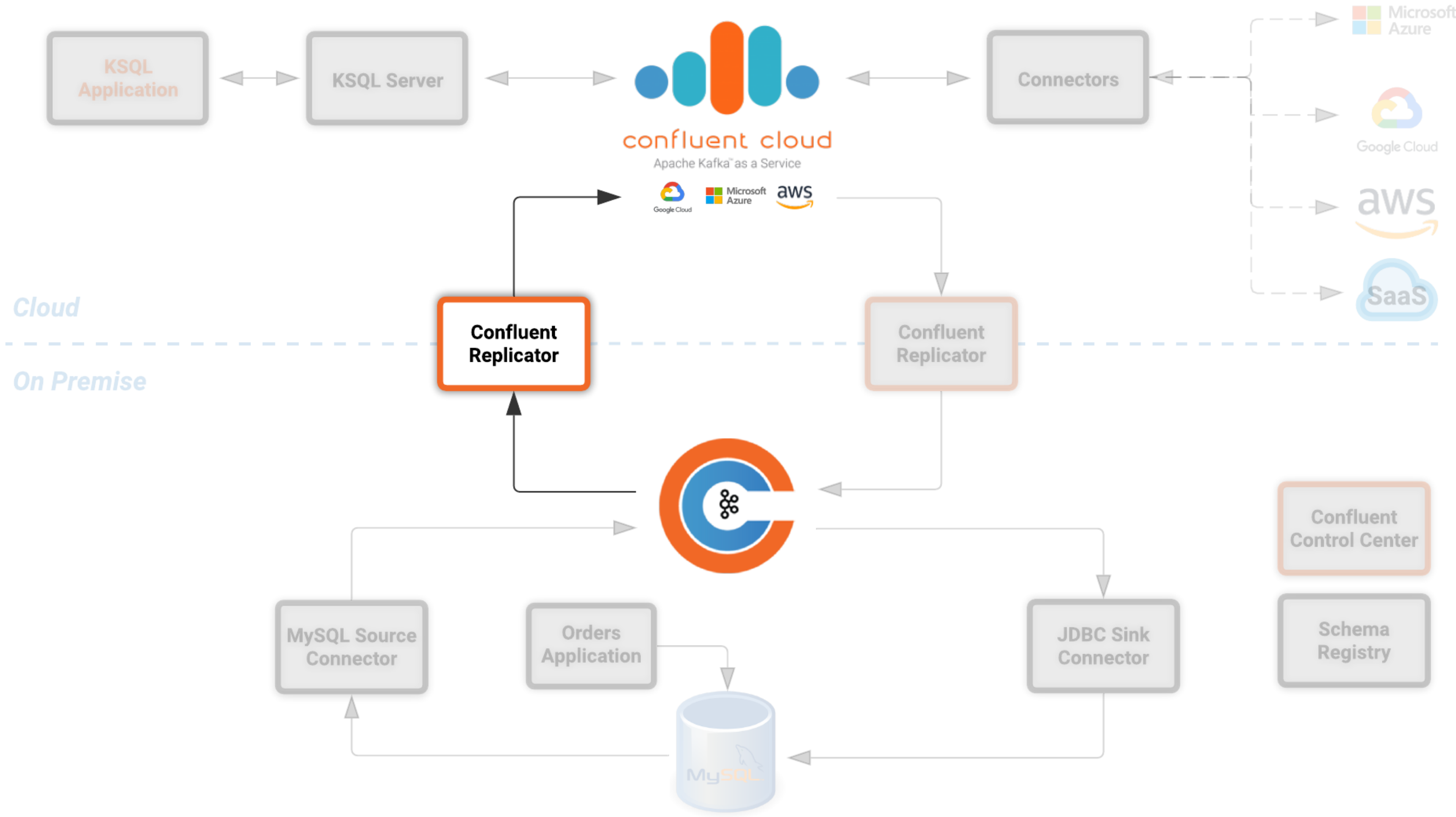


Further Reading

- Debezium MySQL Configuration Options
- Kafka Connect REST API
- cURL manpage
- Confluent Control Center Documentation

Lab 4: Stream events to Confluent Cloud

Now that your on-premise Kafka cluster is receiving events from your MySQL Database let's use Confluent Replicator to stream those messages to Confluent Cloud



Create the Replicator Connector Instance

Confluent Replicator uses Kafka Connect under the covers and can be considered a special type of connector, however, unlike other connectors, the source *and* target technology for the connector is a Kafka Cluster.

To support this connector, we have another Kafka Connect worker running in a different docker container called `kafka-connect-ccloud`. This Kafka Connect worker is configured to connect to the Confluent Cloud instance provisioned for this workshop. This Kafka Connect worker has an internal REST server listening on port `18084`.

Run the following from the command line to create the Replicator Connector instance, this connector will replicate events from you on-premise Kafka cluster to your Confluent Cloud Cluster.

```
curl -i -X POST -H "Accept:application/json" \
    -H  "Content-Type:application/json" http://localhost:18084/connectors/ \
    -d '{
        "name": "replicator-dc01-to-ccloud",
        "config": {
          "connector.class": "io.confluent.connect.replicator.ReplicatorSourceConnector",
          "key.converter": "io.confluent.connect.replicator.util.ByteArrayConverter",
          "value.converter": "io.confluent.connect.replicator.util.ByteArrayConverter",
          "topic.config.sync": false,
          "topic.regex": "dc[0-9][0-9][_].*",
          "topic.blacklist": "dc01_out_of_stock_events",
          "dest.kafka.bootstrap.servers": "${file:/secrets.properties:CCLOUD_CLUSTER_ENDPOINT}",
          "dest.kafka.security.protocol": "SASL_SSL",
          "dest.kafka.sasl.mechanism": "PLAIN",
          "dest.kafka.sasl.jaas.config": "org.apache.kafka.common.security.plain.PlainLoginModule required
username=\"${file:/secrets.properties:CCLOUD_API_KEY}\" password=\"${file:/secrets.properties:CCLOUD_API_SECRET}\";",
          "dest.kafka.replication.factor": 3,
          "src.kafka.bootstrap.servers": "broker:29092",
          "src.consumer.group.id": "replicator-dc01-to-ccloud",
          "src.consumer.interceptor.classes":
"io.confluent.monitoring.clients.interceptor.MonitoringConsumerInterceptor",
          "src.consumer.confluent.monitoring.interceptor.bootstrap.servers": "broker:29092",
          "src.kafka.timestamps.producer.interceptor.classes":
"io.confluent.monitoring.clients.interceptor.MonitoringProducerInterceptor",
```

```
        "src.kafka.timestamps.producer.confluent.monitoring.interceptor.bootstrap.servers": "broker:29092",
        "tasks.max": "1"
      }
  }'
```

You should see something similar...

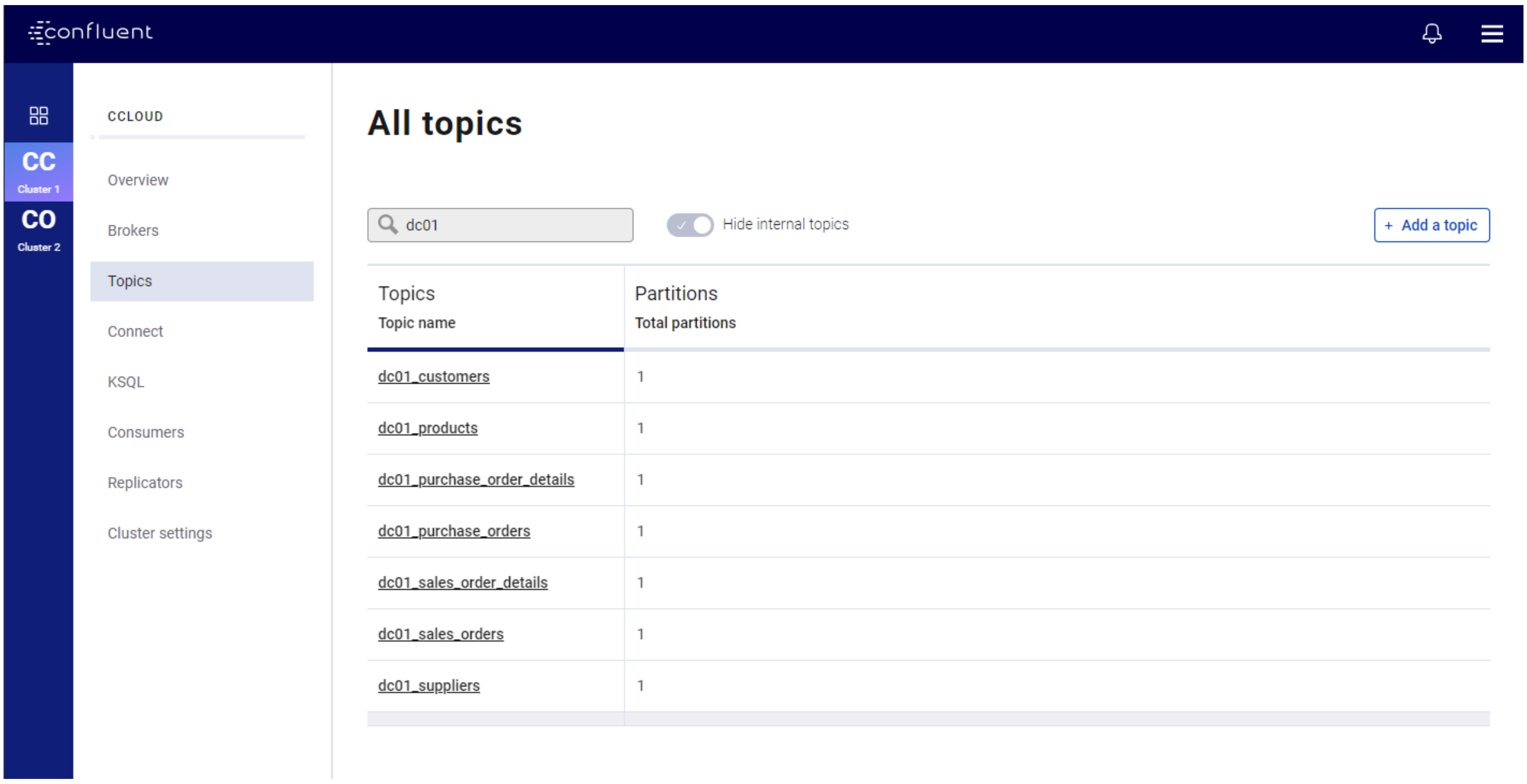
```
HTTP/1.1 100 Continue

HTTP/1.1 201 Created
Date: Sun, 09 Feb 2020 15:07:22 GMT
Location: http://localhost:18084/connectors/replicator-dc01-to-ccloud
Content-Type: application/json
Content-Length: 1342
Server: Jetty(9.4.20.v20190813)
...
...
```

Confirm that Messages are Arriving in Confluent Cloud

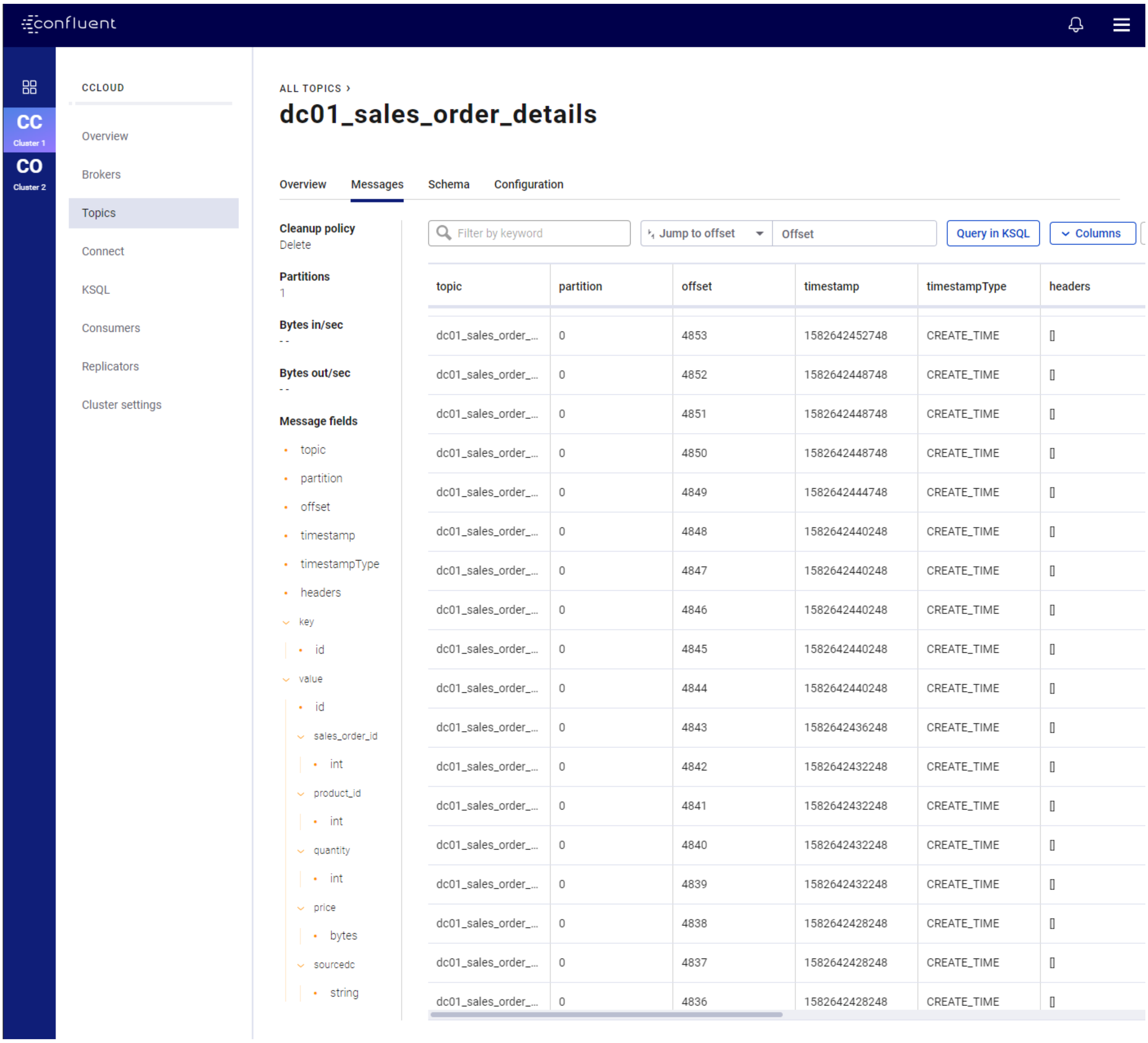
Jump back to Confluent Control Center

Select the "CC" cluster from the left-hand navigation bar and then select "Topics".

This Confluent Cloud Instance is being shared by other users of the workshop and as a result you will see topics being replicated from other data centers. To see just your topics, type your data center name, dc01, into the search box at the top to filter.



Select the `dc01_sales_order_details` topic and finally the "Messages" tab under the topic heading. You should see messages streaming in from you on-premise Kafka cluster.

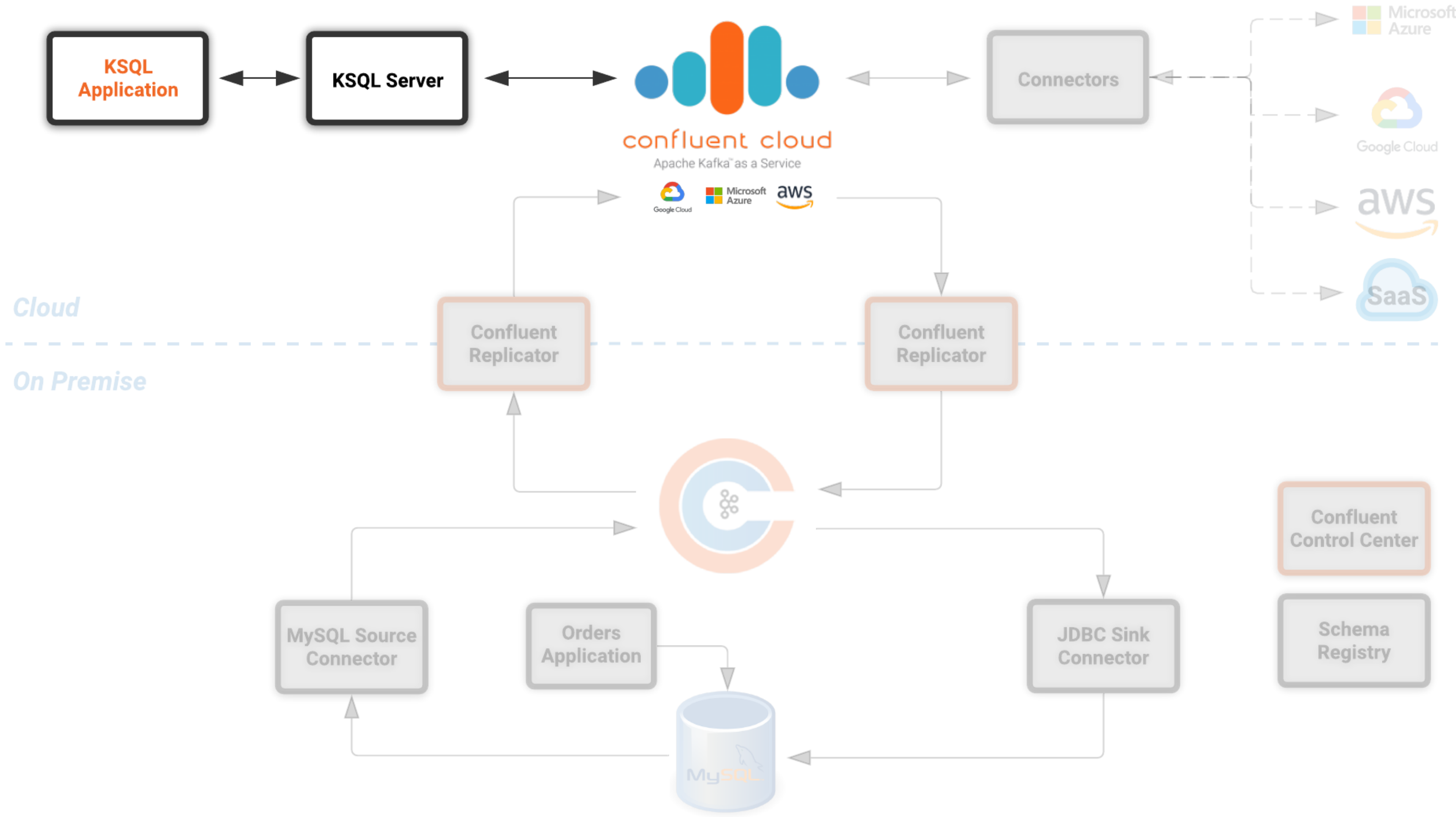


Further Reading

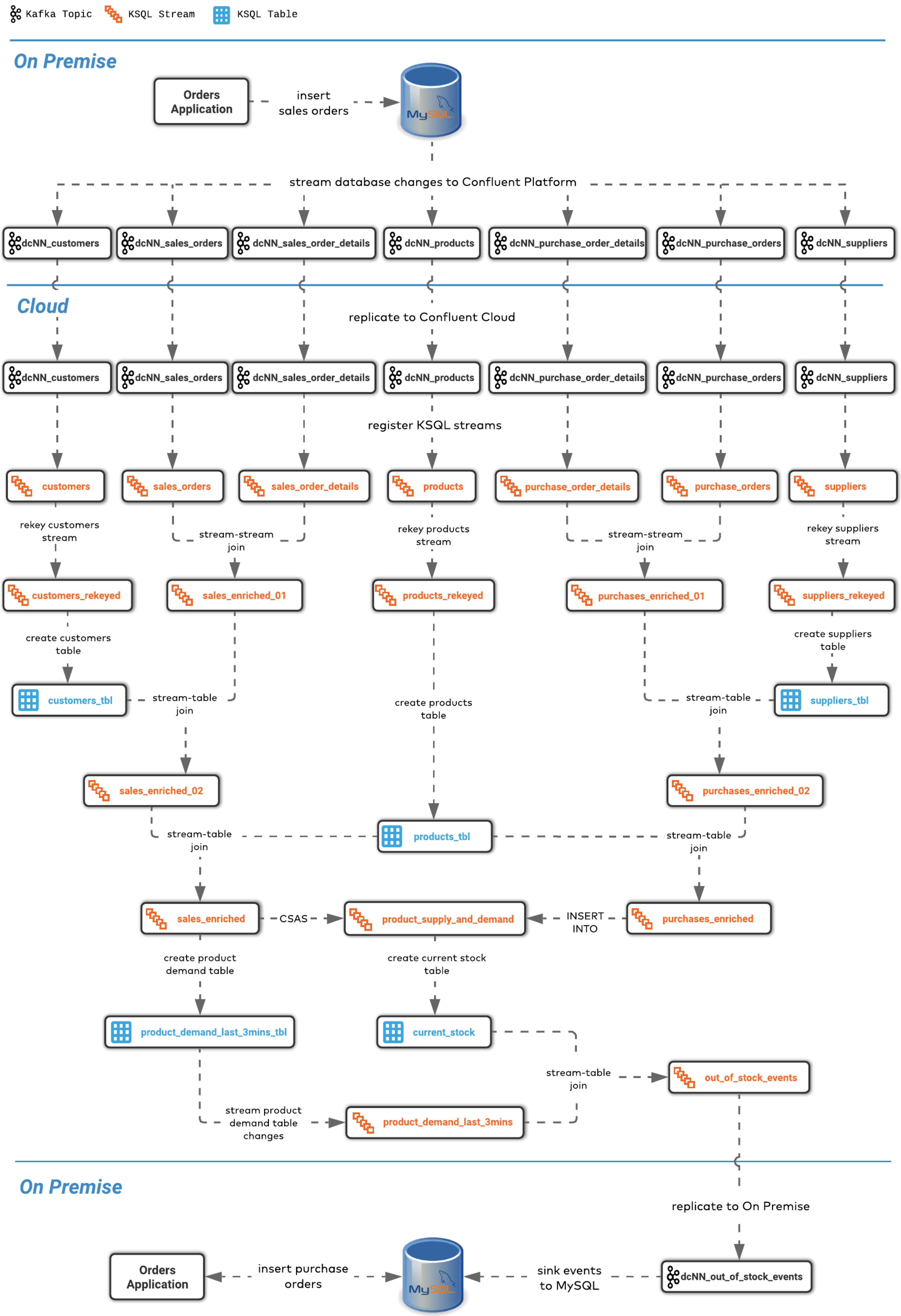
- Confluent Replicator
- Confluent Replicator Configuration Properties

Lab 5: Building a Realtime Supply & Demand Application using KSQL

We now have all the data we need being streamed, in real time, to Confluent Cloud. You have a KSQL Server running inside a docker container that is configured to point to our Confluent Cloud cluster. In a real world deployment, it is likely that this KSQL Server would be running closer to Confluent Cloud but for the purposes of this workshop it is not important.



Below is an illustration of the completed Supply & Demand KSQL Application, over the next few labs you will be building this step-by-step.



Kafka Topic
KSQL Stream
KSQL Table
On Premise
Orders Application
insert sales orders
stream database changes to Confluent Platform
dcNN_customers
dcNN_sales_orders
dcNN_sales_order_details
dcNN_products
dcNN_purchase_order_details
dcNN_purchase_orders
dcNN_suppliers
Cloud
replicate to Confluent Cloud
register KSQL streams
customers
sales_orders
sales_order_details
products
purchase_order_details
purchase_orders
suppliers
rekey customers stream
stream-stream join
rekey products stream
stream-stream join
rekey suppliers stream
customers_rekeyed
sales_enriched_01
products_rekeyed
purchases_enriched_01
suppliers_rekeyed
create customers table
create suppliers table
customers_tbl
stream-table join
create products table
stream-table join
suppliers_tbl
sales_enriched_02
purchases_enriched_02
stream-table join
products_tbl
stream-table join
sales_enriched
CSAS
product_supply_and_demand
INSERT INTO
purchases_enriched
create product demand table
create current stock table
product_demand_last_3mins_tbl
current_stock
stream-table join
out_of_stock_events
stream product demand table changes
product_demand_last_3mins
On Premise
replicate to On Premise
Orders Application
insert purchase orders
sink events to MySQL
dcNN_out_of_stock_events

Lab 6: Getting Started with KSQL

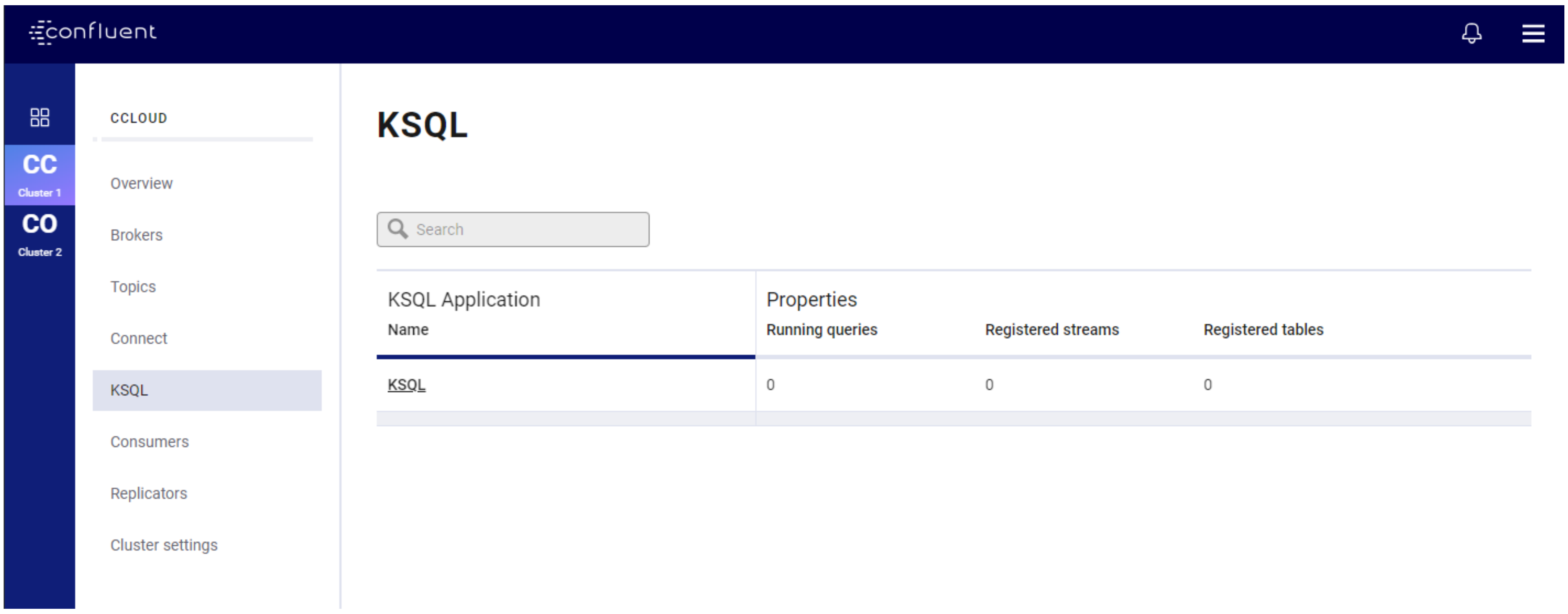
You can interact with KSQL Server using either the KSQL CLI, Confluent Control Center or the REST API. This workshop will focus on the KSQL CLI but if you'd rather use Confluent Control Center then read the next section.

Using KSQL with Confluent Control Center

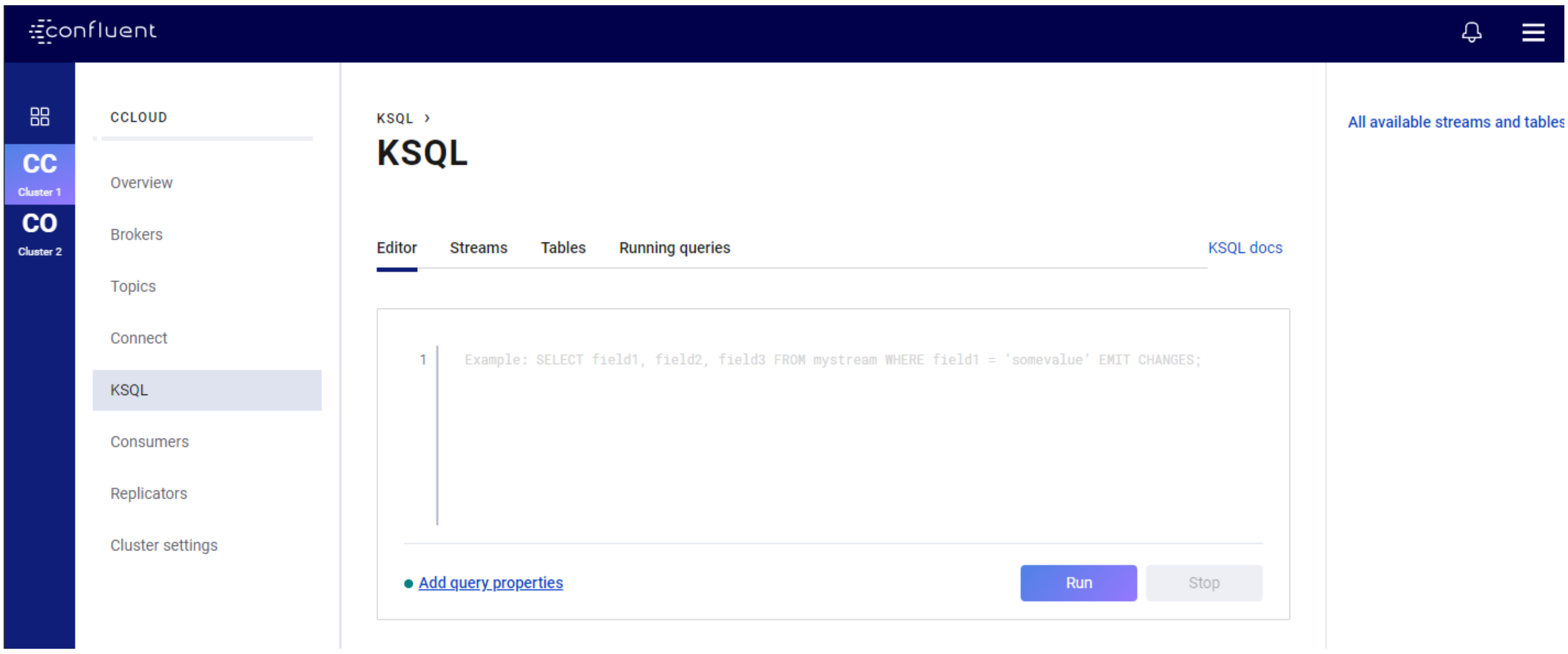
If you'd rather use Confluent Control Center then follow the instructions below, otherwise skip this section.

Open Confluent Control Center

Click the "CC" Cluster on the left-hand navigation bar, Select "KSQL" and finally click on the "KSQL" application.



You will now be able to use the "Editor" tab instead of the CLI



This workshop will focus on the KSQL CLI

Start the KSQL CLI

To start the KSQL CLI run the following command:-

```
docker exec -it ksql-cli ksql http://ksql-server-ccloud:8088
```

You should see something like this:-

```
                  ===========================================
                  =       _  __ _____  ____  _               =
                  =      | |/ // ____|/ __ \| |              =
                  =      | \' /| (___ | |  | | |              =
                  =      |  <  \___ \| |  | | |              =
                  =      | . \ ____) | |__| | |____          =
                  =      |_|\_\_____/ \___\_\______|         =
                  =                                           =
                  =  Streaming SQL Engine for Apache Kafka® =
                  ===========================================

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CLI v5.4.0, Server v5.4.0 located at http://ksql-server-ccloud:8088

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

ksql>
```

The KSQL CLI is pointing at a KSQL Server connected to your Confluent Cloud instance.

To view a list of all topics in Confluent Cloud run the following command:-

`show topics;`

You should see your own topics, `dc01_*`, along with topics from other workshop users.

```
ksql> show topics;

 Kafka Topic                 | Partitions | Partition Replicas
---------------------------------------------------------------
 _confluent-command          | 1          | 3
 _dc01-connect-configs       | 1          | 3
 _dc01-connect-offsets       | 1          | 3
 _dc01-connect-statuses      | 1          | 3
 _dc02-connect-configs       | 1          | 3
 _dc02-connect-offsets       | 1          | 3
 _dc02-connect-statuses      | 1          | 3
 dc01_customers              | 1          | 3
 dc01_products               | 1          | 3
 dc01_purchase_order_details | 1          | 3
 dc01_purchase_orders        | 1          | 3
 dc01_sales_order_details    | 1          | 3
 dc01_sales_orders           | 1          | 3
 dc01_suppliers              | 1          | 3
 dc02_customers              | 1          | 3
 dc02_products               | 1          | 3
 dc02_purchase_order_details | 1          | 3
 dc02_purchase_orders        | 1          | 3
 dc02_sales_order_details    | 1          | 3

...
```

Inspect a topic's contents

To inspect the contents of a topic run the following:-

`PRINT dc01_sales_orders;`

You should see something similar:-

```
ksql> PRINT dc01_sales_orders;
Format:AVRO
2/20/20 1:23:55 PM UTC,
�, {"id": 466, "order_date": 1582205036000, "customer_id": 12, "sourcedc": "dc01"}
2/20/20 1:23:59 PM UTC,
�, {"id": 467, "order_date": 1582205040000, "customer_id": 27, "sourcedc": "dc01"}
2/20/20 1:24:03 PM UTC,
�, {"id": 468, "order_date": 1582205044000, "customer_id": 20, "sourcedc": "dc01"}
2/20/20 1:24:07 PM UTC,
�, {"id": 469, "order_date": 1582205048000, "customer_id": 7, "sourcedc": "dc01"}
2/20/20 1:24:11 PM UTC,
�, {"id": 470, "order_date": 1582205052000, "customer_id": 30, "sourcedc": "dc01"}
2/20/20 1:24:15 PM UTC,
�, {"id": 471, "order_date": 1582205056000, "customer_id": 27, "sourcedc": "dc01"}
2/20/20 1:24:20 PM UTC,
�, {"id": 472, "order_date": 1582205060000, "customer_id": 8, "sourcedc": "dc01"}
2/20/20 1:24:24 PM UTC,
�, {"id": 473, "order_date": 1582205064000, "customer_id": 8, "sourcedc": "dc01"}
```

Press `ctrl-c` to stop

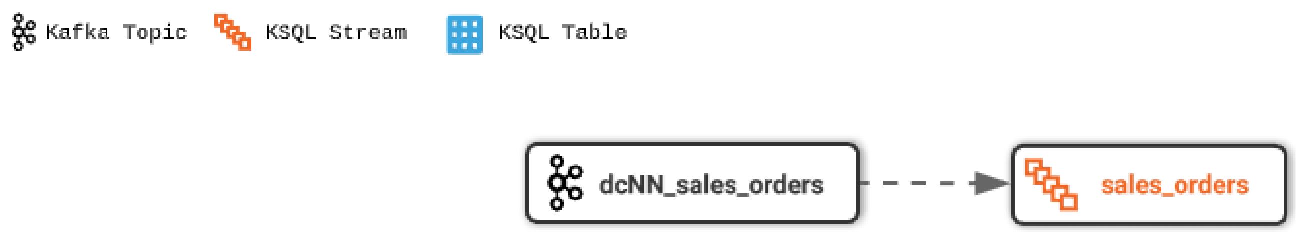
> The events streaming from the MySQL database are serialized with Avro and as a result you will see some special characters in the above output, this is because the "PRINT TOPIC" command uses the String deserializer.

KSQL Streams

In order to work with a stream of data in KSQL we first need to register a KSQL Stream over an existing topic.

We can do this using a `CREATE STREAM` statement. Run the following command to create your first KSQL stream:-

```
CREATE STREAM sales_orders WITH (KAFKA_TOPIC='dc01_sales_orders', VALUE_FORMAT='AVRO');
```



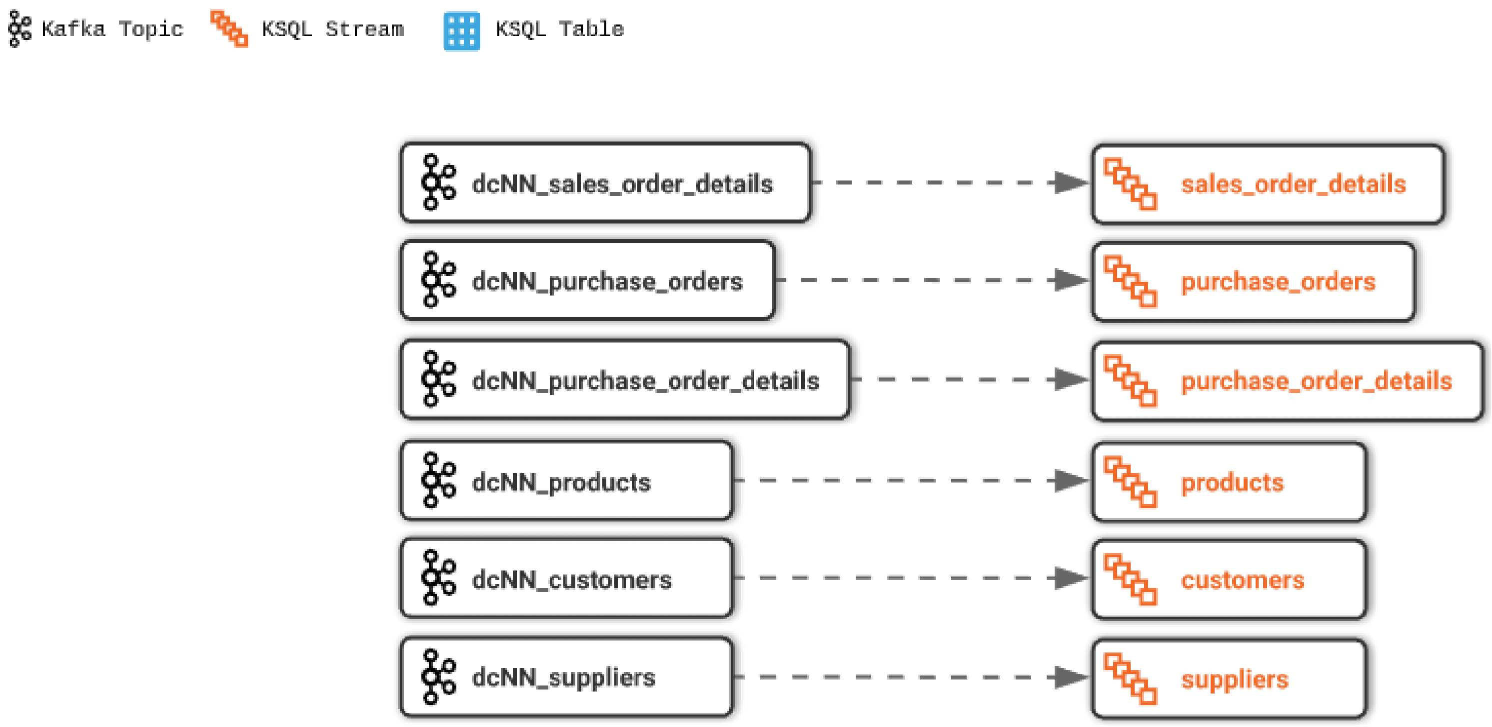
You should see the following output

```
ksql> CREATE STREAM sales_orders WITH (KAFKA_TOPIC='dc01_sales_orders', VALUE_FORMAT='AVRO');

 Message
----------------
 Stream created
----------------
```

Create streams for each of your remaining topics

```
CREATE STREAM sales_order_details WITH (KAFKA_TOPIC='dc01_sales_order_details', VALUE_FORMAT='AVRO');
CREATE STREAM purchase_orders WITH (KAFKA_TOPIC='dc01_purchase_orders', VALUE_FORMAT='AVRO');
CREATE STREAM purchase_order_details WITH (KAFKA_TOPIC='dc01_purchase_order_details', VALUE_FORMAT='AVRO');
CREATE STREAM products WITH (KAFKA_TOPIC='dc01_products', VALUE_FORMAT='AVRO');
CREATE STREAM customers WITH (KAFKA_TOPIC='dc01_customers', VALUE_FORMAT='AVRO');
CREATE STREAM suppliers WITH (KAFKA_TOPIC='dc01_suppliers', VALUE_FORMAT='AVRO');
```



To view your current streams run the following command:-

```
SHOW STREAMS;
```

Notice that each stream is mapped to an underlying Kafka topic and that the format is AVRO.

```
 Stream Name              | Kafka Topic                 | Format
---------------------------------------------------------------
 CUSTOMERS                | dc01_customers              | AVRO
 PRODUCTS                 | dc01_products               | AVRO
 PURCHASE_ORDERS          | dc01_purchase_orders        | AVRO
 PURCHASE_ORDER_DETAILS   | dc01_purchase_order_details | AVRO
 SALES_ORDERS             | dc01_sales_orders           | AVRO
 SALES_ORDER_DETAILS      | dc01_sales_order_details    | AVRO
 SUPPLIERS                | dc01_suppliers              | AVRO
---------------------------------------------------------------
```

To view the details of an individual topic you can you can use the `describe` command:-

```
DESCRIBE sales_order_details;
```

Notice that all the columns have been created for us and we didn't need to explicitly set their names and data types when we created the stream, this is one of the advantages of using AVRO and the Schema Registry.

Also notice that KSQL adds the implicit columns `ROWTIME` and `ROWKEY` to every stream and table, which represent the corresponding Kafka message timestamp and message key, respectively. The timestamp has milliseconds accuracy.

```
Name                 : SALES_ORDER_DETAILS
 Field          | Type
---------------------------------------------
 ROWTIME        | BIGINT           (system)
 ROWKEY         | VARCHAR(STRING)  (system)
 ID             | INTEGER
 SALES_ORDER_ID | INTEGER
 PRODUCT_ID     | INTEGER
 QUANTITY       | INTEGER
 PRICE          | DECIMAL
 SOURCEDC       | VARCHAR(STRING)
---------------------------------------------
For runtime statistics and query details run: DESCRIBE EXTENDED ;
```

Further Reading

- KSQL Overview
- KSQL Streams
- CREATE STREAM Syntax

Lab 7: Querying Streams using KSQL

There are two types of query in KSQL, **Push** queries and **Pull** queries.

- Push Queries enable you to subscribe to a result as it changes in real-time. You can subscribe to the output of any query, including those that return a stream or a materialized aggregate table. The `EMIT CHANGES` clause is used to indicate a query is a push query.
- Pull Queries are a preview feature with KSQL 5.4 and enable you to look up information at a point in time.

Another important point to understand is where within a topic a query starts to read from. You can control this behaviour using the `ksql.streams.auto.offset.reset` property. This property can either be set to `earliest` where data is consumed from the very beginning of the topic or `latest` where only new data is consumed.

To see the current values for *all* properties run the following command

```
SHOW PROPERTIES;
```

Look out for a property called `ksql.streams.auto.offset.reset`, it should be set to `latest` as this is the default setting configured on the KSQL server.

```
 Property                                           | Default override | Effective Value
--------------------------------------------------------------------------------------------
 ...
 ksql.streams.auto.offset.reset                     |                  | latest
 ...
--------------------------------------------------------------------------------------------
ksql>
```

You can override this setting to suit you needs:-

```
SET 'ksql.streams.auto.offset.reset'='earliest';
SET 'ksql.streams.auto.offset.reset'='latest';
```

Or preferably, using the abbreviated property names:-

```
SET 'auto.offset.reset' = 'latest';
SET 'auto.offset.reset' = 'earliest';
```

Let's start by running a Push query and consume all messages from the beginning of a stream.

```
SET 'auto.offset.reset'='earliest';
SELECT  id,
        sales_order_id,
        product_id,
        quantity,
        price
FROM  sales_order_details
EMIT CHANGES;
```

You should see something similar to this:-

```
ksql> SELECT id, sales_order_id, product_id, quantity, price FROM dc01_sales_order_details EMIT CHANGES;
+-----------------+-----------------+-----------------+-----------------+-----------------+
|ID               |SALES_ORDER_ID   |PRODUCT_ID       |QUANTITY         |PRICE            |
+-----------------+-----------------+-----------------+-----------------+-----------------+
|1                |1                |1                |10               |2.68             |
|2                |1                |23               |1                |9.01             |
|3                |1                |14               |6                |5.84             |
|4                |2                |12               |7                |4.00             |
|5                |2                |9                |4                |9.83             |
|6                |2                |5                |1                |8.81             |
|7                |2                |3                |8                |9.99             |
|8                |2                |1                |9                |2.68             |
|9                |3                |21               |5                |9.90             |
|10               |3                |2                |1                |8.23             |
|11               |3                |4                |2                |9.78             |
|12               |4                |15               |2                |6.16             |
...
...
|480              |157              |26               |5                |9.03             |
|481              |158              |2                |2                |8.23             |
|482              |159              |10               |4                |5.32             |
|483              |160              |25               |8                |9.00             |
```

Press `ctrl-c` to stop

Notice that events continue to stream to the console until you explicitly cancel the query, this is because when we are working with streams in KSQL the data set is unbounded and could theoretically continue forever.

To inspect a bounded set of data, you can use the `LIMIT` clause.

```
SELECT  id,
        sales_order_id,
        product_id,
        quantity,
        price
FROM  sales_order_details
EMIT CHANGES
LIMIT 10;
```

Here we are seeing the first 10 messages that were written to the topic. Notice that the query automatically terminates when the limit of 10 events is reached.

```
+-----------------+-----------------+-----------------+-----------------+-----------------+
|ID               |SALES_ORDER_ID   |PRODUCT_ID       |QUANTITY         |PRICE            |
+-----------------+-----------------+-----------------+-----------------+-----------------+
|1                |1                |1                |10               |2.68             |
|2                |1                |23               |1                |9.01             |
|3                |1                |14               |6                |5.84             |
|4                |2                |12               |7                |4.00             |
|5                |2                |9                |4                |9.83             |
|6                |2                |5                |1                |8.81             |
|7                |2                |3                |8                |9.99             |
|8                |2                |1                |9                |2.68             |
|9                |3                |21               |5                |9.90             |
|10               |3                |2                |1                |8.23             |
Limit Reached
Query terminated
ksql>
```

Filtering Streams

Since KSQL is based on SQL, you can do many of the standard SQL things you'd expect to be able to do, including predicates and projections. The following query will return a stream of you the latest sales orders where the `quantity` column is greater than 3.

```
SET 'auto.offset.reset'='latest';
SELECT  id,
        product_id,
        quantity
FROM    sales_order_details
WHERE   quantity > 3
EMIT CHANGES;
```

You should only see events where the `quantity` column value is greater than `3`.

```
+----------------------------+----------------------------+----------------------------+
|ID                          |PRODUCT_ID                  |QUANTITY                    |
+----------------------------+----------------------------+----------------------------+
|3153                        |22                          |8                           |
|3154                        |4                           |6                           |
|3155                        |9                           |4                           |
|3156                        |25                          |10                          |
|3158                        |24                          |8                           |
|3159                        |7                           |4                           |
|3161                        |28                          |8                           |
|3162                        |22                          |7                           |
|3163                        |24                          |6                           |
|3165                        |5                           |8                           |
|3167                        |21                          |9                           |
```

Press `ctrl-c` to stop

Further Reading

- Push Query Syntax
- Pull Query Syntax
- KSQL Offset Management

Lab 8: Creating KSQL tables

KSQL tables allow you to work the data in topics as key/value pairs, with a single value for each key. KSQL tables can be created from an existing topic or from the query results from other tables or streams. You can read more about this here.

We want to create tables over the `customers`, `suppliers` and `products` streams so we can look up the current state for each customer, supplier and product. Later in the workshop we will want to join these tables to other streams. To successfully join to a table in KSQL you need to ensure that the table is keyed on the column you are going to use in the join. To achieve this, we need to make sure the stream that we are creating a table from is keyed correctly.

Rekeying Streams

We can see what the current key for stream or table is by using the `DESCRIBE EXTENDED` command.

```
DESCRIBE EXTENDED customers;
```

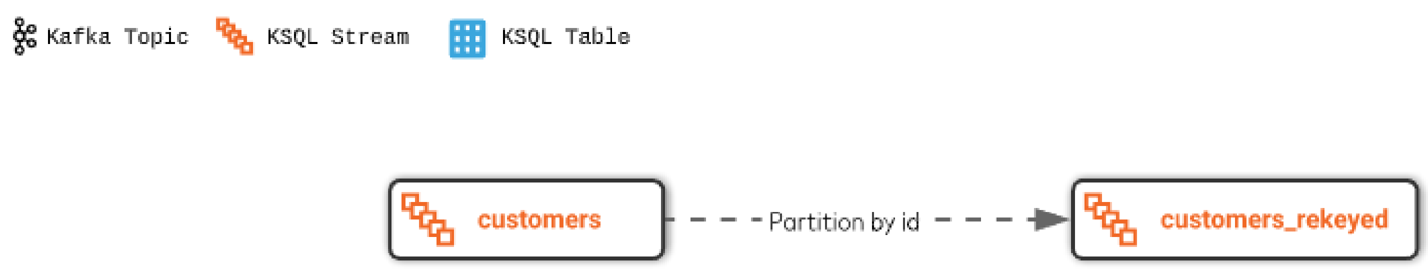
You can see in the output that the `Key Field` is *not* set.

```
Name                 : CUSTOMERS
Type                 : STREAM
Key field            :
Key format           : STRING
Timestamp field      : Not set - using
Value format         : AVRO
Kafka topic          : dc01_customers (partitions: 1, replication: 3)

 Field      | Type
----------------------------------------
 ROWTIME    | BIGINT           (system)
 ROWKEY     | VARCHAR(STRING)  (system)
 ID         | INTEGER
 FIRST_NAME | VARCHAR(STRING)
 LAST_NAME  | VARCHAR(STRING)
 EMAIL      | VARCHAR(STRING)
 CITY       | VARCHAR(STRING)
 COUNTRY    | VARCHAR(STRING)
 SOURCEDC   | VARCHAR(STRING)
----------------------------------------
```

We can fix this by creating a derived stream that has the correct key.

```
SET 'auto.offset.reset'='earliest';
CREATE STREAM customers_rekeyed WITH (KAFKA_TOPIC='dc01_customers_rekeyed', PARTITIONS=1) AS
SELECT * FROM customers
PARTITION BY id;
```



This method of creating a derived topic is frequently referred to by the acronym `CSAS` → `CREATE STREAM … AS SELECT` where we create a new topic based on the contents of another. Unlike CSAS statements in a traditional RDBMS, CSAS statments in KSQL create *continuous queries* where data is continuosly streamed from the source topic into the target topic.

We can confirm that the new stream has the correct key by running the `DESCRIBE EXTENDED` command again

```
DESCRIBE EXTENDED customers_rekeyed;
```

You can see in the output that the `Key Field` is now set correctly.

```
Name                 : CUSTOMERS_REKEYED
Type                 : STREAM
Key field            : CUSTOMERS_REKEYED.ID
Key format           : STRING
Timestamp field      : Not set - using
Value format         : AVRO
Kafka topic          : dc01_customers_rekeyed (partitions: 1, replication: 3)

 Field      | Type
----------------------------------------
 ROWTIME    | BIGINT           (system)
 ROWKEY     | VARCHAR(STRING)  (system)
```

```
 ID         | INTEGER          (key)
 FIRST_NAME | VARCHAR(STRING)
 LAST_NAME  | VARCHAR(STRING)
 EMAIL      | VARCHAR(STRING)
 CITY       | VARCHAR(STRING)
 COUNTRY    | VARCHAR(STRING)
 SOURCEDC   | VARCHAR(STRING)
----------------------------------------

Queries that write from this STREAM
-----------------------------------
CSAS_CUSTOMERS_REKEYED_10 : CREATE STREAM CUSTOMERS_REKEYED WITH (KAFKA_TOPIC='dc01_customers_rekeyed', PARTITIONS=1,
REPLICAS=3) AS SELECT *
FROM CUSTOMERS CUSTOMERS
EMIT CHANGES
PARTITION BY ID;

For query topology and execution plan please run: EXPLAIN

Local runtime statistics
------------------------
messages-per-sec:      0.30   total-messages:        30     last-message: 2020-02-26T12:11:31.227Z

(Statistics of the local KSQL server interaction with the Kafka topic dc01_customers_rekeyed)
```

In the above output also notice the `Queries that write from this STREAM` section, here you can see the query you just ran, this a called a persistant query and runs in the background continuously streaming messages until it is terminated.

You can view the current persistant queries that are running using the following command:-

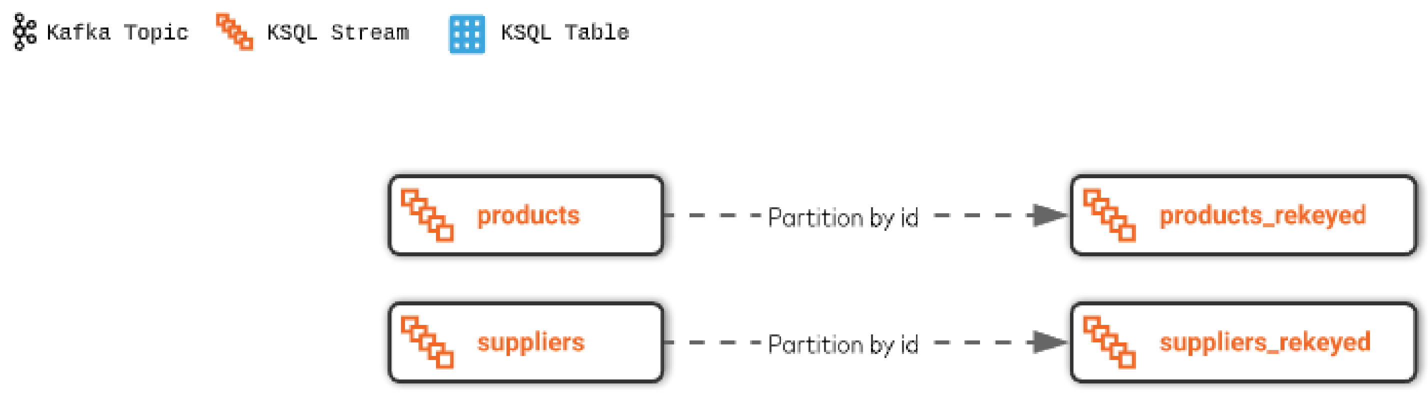
```
SHOW QUERIES;
```

```
 Query ID                  | Kafka Topic       | Query String
--------------------------------------------------------------------------------------------------------------
 CSAS_CUSTOMERS_REKEYED_10 | CUSTOMERS_REKEYED | CREATE STREAM CUSTOMERS_REKEYED WITH
(KAFKA_TOPIC='dc01_customers_rekeyed', PARTITIONS=1, REPLICAS=3) AS SELECT *
FROM CUSTOMERS CUSTOMERS
EMIT CHANGES
PARTITION BY ID;
--------------------------------------------------------------------------------------------------------------
For detailed information on a Query run: EXPLAIN ;
```

Now that we have our `customers_rekeyed` stream created let's rekey the `supplier` and `products` streams.

```
SET 'auto.offset.reset'='earliest';
CREATE STREAM products_rekeyed WITH (KAFKA_TOPIC='dc01_products_rekeyed', PARTITIONS=1) AS
SELECT * FROM products
PARTITION BY id;

CREATE STREAM suppliers_rekeyed WITH (KAFKA_TOPIC='dc01_suppliers_rekeyed', PARTITIONS=1) AS
SELECT * FROM suppliers
PARTITION BY id;
```



Another way to confirm a stream is keyed correctly, is to query it and compare the system `ROWKEY` column to your join column, they should be identical.

```
SELECT rowkey, id FROM customers_rekeyed EMIT CHANGES LIMIT 3;
SELECT rowkey, id FROM products_rekeyed EMIT CHANGES LIMIT 3;
SELECT rowkey, id FROM suppliers_rekeyed EMIT CHANGES LIMIT 3;
```

You can see in the output that the `ROWKEY` and `ID` columns have identical values for each stream.

```
ksql> SELECT rowkey, id FROM customers_rekeyed EMIT CHANGES LIMIT 3;
+------------------------------------------+------------------------------------------+
|ROWKEY                                    |ID                                        |
+------------------------------------------+------------------------------------------+
|1                                         |1                                         |
|2                                         |2                                         |
|3                                         |3                                         |
Limit Reached
Query terminated
```

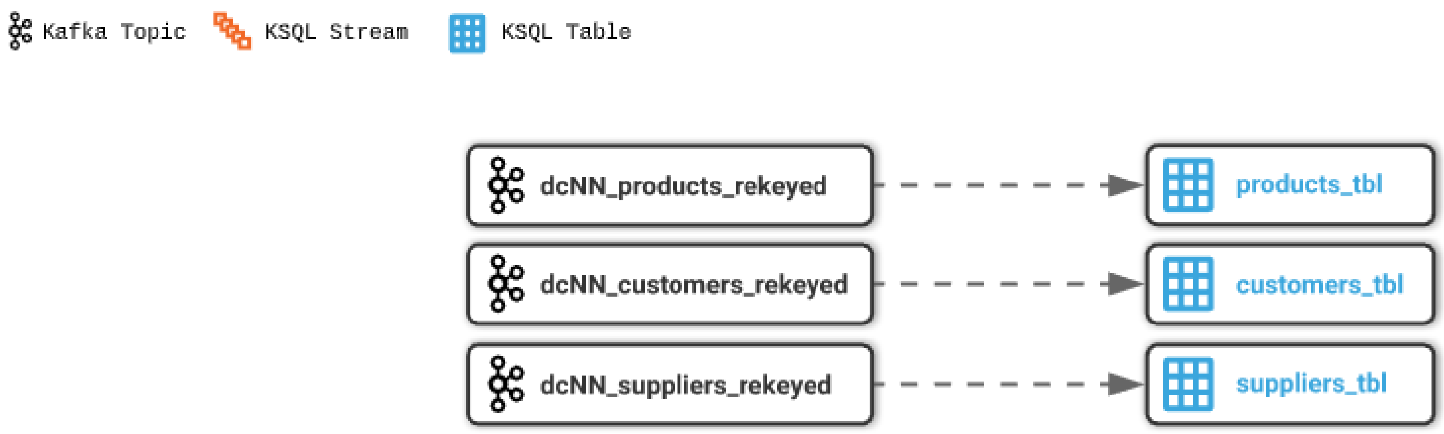
```
ksql> SELECT rowkey, id FROM suppliers_rekeyed EMIT CHANGES LIMIT 3;
+------------------------------------------+------------------------------------------+
|ROWKEY                                    |ID                                        |
+------------------------------------------+------------------------------------------+
|1                                         |1                                         |
|2                                         |2                                         |
|3                                         |3                                         |
Limit Reached
Query terminated
```

```
ksql> SELECT rowkey, id FROM products_rekeyed EMIT CHANGES LIMIT 3;
+------------------------------------------+------------------------------------------+
|ROWKEY                                    |ID                                        |
+------------------------------------------+------------------------------------------+
|1                                         |1                                         |
|2                                         |2                                         |
|3                                         |3                                         |
Limit Reached
Query terminated
```

Creating Tables

We are now in a position where we can create our first KSQL tables. To do this we need to register tables with KSQL over the newly re-keyed topics.

```
CREATE TABLE customers_tbl WITH (KAFKA_TOPIC='dc01_customers_rekeyed', VALUE_FORMAT='AVRO', key='id');
CREATE TABLE products_tbl WITH (KAFKA_TOPIC='dc01_products_rekeyed', VALUE_FORMAT='AVRO', key='id');
CREATE TABLE suppliers_tbl WITH (KAFKA_TOPIC='dc01_suppliers_rekeyed', VALUE_FORMAT='AVRO', key='id');
```



We can view our current tables using the following command:-

```
SHOW TABLES;
```

```
 Table Name     | Kafka Topic             | Format | Windowed
-------------------------------------------------------------
 CUSTOMERS_TBL  | dc01_customers_rekeyed | AVRO   | false
 PRODUCTS_TBL   | dc01_products_rekeyed  | AVRO   | false
 SUPPLIERS_TBL  | dc01_suppliers_rekeyed | AVRO   | false
-------------------------------------------------------------
```

We'll use these tables soon and join them to our streams.

Further Reading

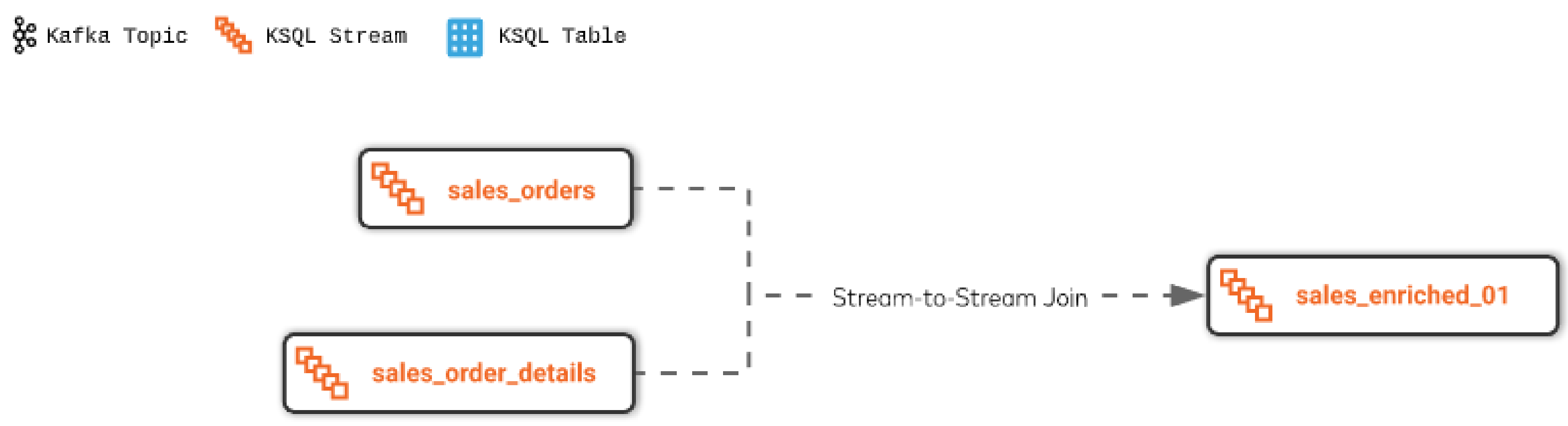
- CREATE TABLE Syntax
- DESCRIBE Syntax
- CREATE STREAM AS SELECT Syntax
- Message Key Requirements

Lab 9: KSQL Stream-to-Stream Joins

We can join two streams together in KSQL using a windowed join. When using a windowed join, you must specify a windowing scheme by using the `WITHIN` clause. A new input record on one side produces a join output for each matching record on the other side, and there can be multiple such matching records within a join window.

In the example below you can see that we have specified a window of 1 seconds using the `WITHIN` clause. The source application creates sales orders and their associated sales order detail rows at the same time, so a second will be plenty of time to ensure that a join takes place.

```
CREATE STREAM sales_enriched_01 WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_sales_enriched_01') AS SELECT
    o.id order_id,
    od.id order_details_id,
    o.order_date,
    o.customer_id,
    od.product_id,
    od.quantity,
    od.price
FROM sales_orders o
INNER JOIN sales_order_details od WITHIN 1 SECONDS ON (o.id = od.sales_order_id);
```



If we query this new stream…

```
SELECT  order_id o_id,
        order_details_id od_id,
        timestamptostring(order_date,'dd-MM-YY') order_date,
        customer_id,
        product_id,
        quantity,
        price
FROM  sales_enriched_01
EMIT CHANGES
LIMIT 10;
```

…we can see that we have combined the data from both the `sales_order` and `sales_order_details` streams.

```
+-----------+-----------+-----------+-----------+-----------+-----------+-----------+
|O_ID       |OD_ID      |ORDER_DATE |CUSTOMER_ID|PRODUCT_ID |QUANTITY   |PRICE      |
+-----------+-----------+-----------+-----------+-----------+-----------+-----------+
|1          |1          |28-02-20   |23         |21         |2          |9.90       |
|1          |2          |28-02-20   |23         |14         |10         |5.84       |
|1          |3          |28-02-20   |23         |9          |10         |9.83       |
|2          |4          |28-02-20   |20         |19         |3          |3.38       |
|2          |5          |28-02-20   |20         |12         |6          |4.00       |
|2          |6          |28-02-20   |20         |6          |6          |8.24       |
|2          |7          |28-02-20   |20         |15         |5          |6.16       |
|2          |8          |28-02-20   |20         |22         |10         |8.19       |
|3          |9          |28-02-20   |9          |11         |3          |4.65       |
|4          |10         |28-02-20   |12         |20         |6          |4.86       |
Limit Reached
Query terminated
```

Further Reading

- Stream-Stream Joins

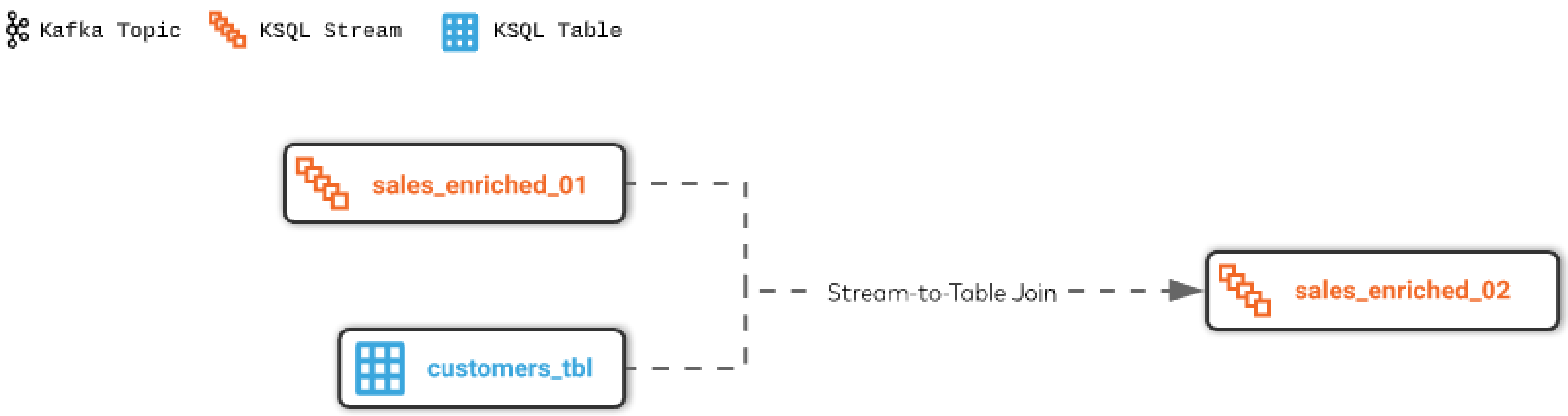
Lab 10: KSQL Stream-to-Table Joins

We can take this a step further by joining this new stream to a couple of the KSQL tables we created earlier.

To do this we'll need to create a new stream, `sales_enriched_02`, that'll stream the result of joining the `sales_enriched_01` stream to the `customers_tbl` table.

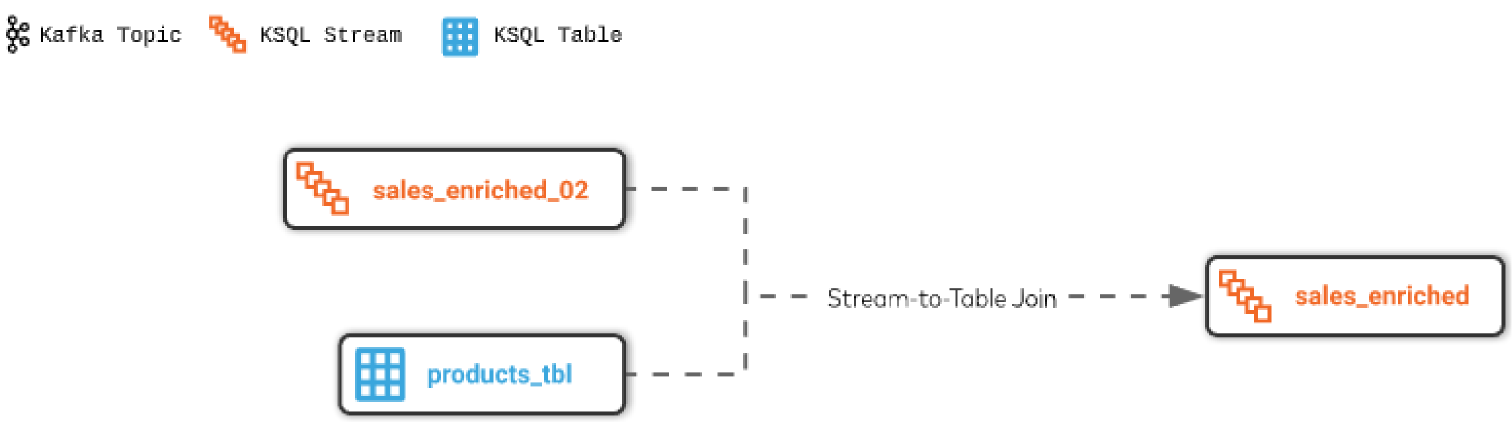
```
CREATE STREAM sales_enriched_02 WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_sales_enriched_02') AS SELECT
    se.order_id,
    se.order_details_id,
    se.order_date,
    se.customer_id,
```

```
    se.product_id,
    se.quantity,
    se.price,
    ct.first_name,
    ct.last_name,
    ct.email,
    ct.city,
    ct.country
FROM sales_enriched_01 se
INNER JOIN customers_tbl ct ON (se.customer_id = ct.id);
```



And last but not least we can join to our products table by creating our final stream `sales_enriched` which will be the result of joining the `sales_enriched_02` stream to the `products_tbl` table.

```
CREATE STREAM sales_enriched WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_sales_enriched') AS SELECT
    se.order_id,
    se.order_details_id,
    se.order_date,
    se.product_id product_id,
    pt.name product_name,
    pt.description product_desc,
    se.price product_price,
    se.quantity product_qty,
    se.customer_id customer_id,
    se.first_name customer_fname,
    se.last_name customer_lname,
    se.email customer_email,
    se.city customer_city,
    se.country customer_country
FROM sales_enriched_02 se
INNER JOIN products_tbl pt ON (se.product_id = pt.id);
```



If we run a describe on this stream...

```
DESCRIBE sales_enriched;
```

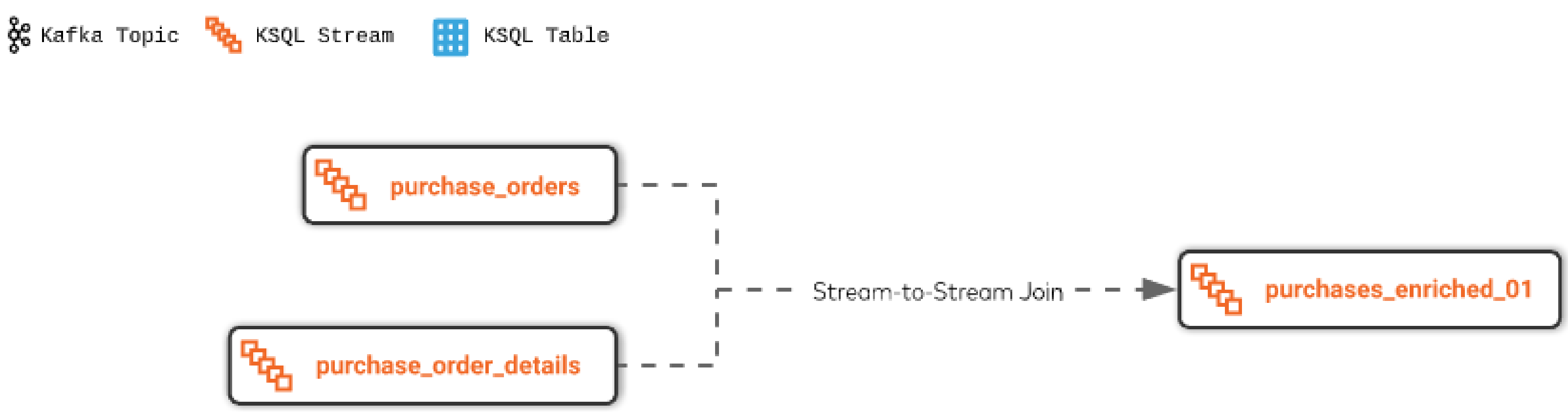
...you'll see that we have effectively denormalized the `sales_orders`, `sales_order_details`, `customers` and `products` streams/tables into a single event stream.

```
 Field            | Type
----------------------------------------------
 ROWTIME          | BIGINT           (system)
 ROWKEY           | VARCHAR(STRING)  (system)
 ORDER_ID         | INTEGER
 ORDER_DETAILS_ID | INTEGER
 ORDER_DATE       | BIGINT
 PRODUCT_ID       | INTEGER
 PRODUCT_NAME     | VARCHAR(STRING)
 PRODUCT_DESC     | VARCHAR(STRING)
 PRODUCT_PRICE    | DECIMAL
 PRODUCT_QTY      | INTEGER
 CUSTOMER_ID      | INTEGER
 CUSTOMER_FNAME   | VARCHAR(STRING)
 CUSTOMER_LNAME   | VARCHAR(STRING)
 CUSTOMER_EMAIL   | VARCHAR(STRING)
 CUSTOMER_CITY    | VARCHAR(STRING)
 CUSTOMER_COUNTRY | VARCHAR(STRING)
----------------------------------------------
```

We now need to create an equivilent `purchases_enriched` stream that combines the `purchase_orders`, `purchase_order_details`, `suppliers` and `products` streams/tables. Since the purchases data model is very similar to that of the sales data model the process is the same.

Join the `purchase_orders` stream to the `purchase_order_details` stream

```
CREATE STREAM purchases_enriched_01 WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_purchases_enriched_01') AS SELECT
    o.id order_id,
    od.id order_details_id,
    o.order_date,
    o.supplier_id,
    od.product_id,
    od.quantity,
    od.cost
FROM purchase_orders o
INNER JOIN purchase_order_details od WITHIN 1 SECONDS ON (o.id = od.purchase_order_id);
```



If we query this new stream...

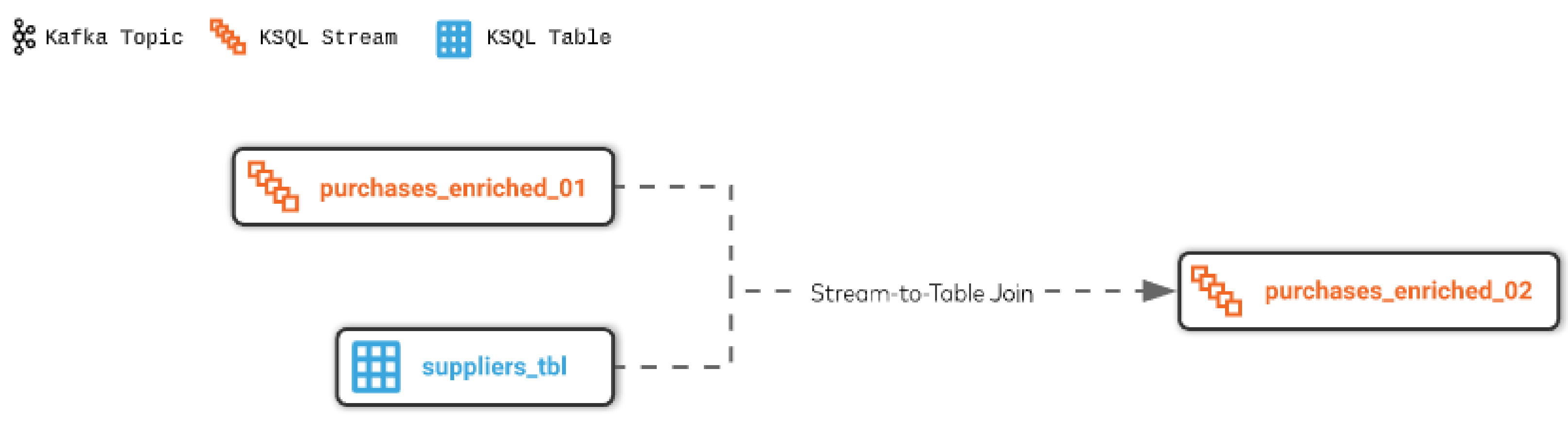
```
SELECT  order_id o_id,
        order_details_id od_id,
        timestamptostring(order_date,'dd-MM-YY') order_date,
        supplier_id,
        product_id,
        quantity,
        cost
FROM  purchases_enriched_01
EMIT CHANGES
LIMIT 10;
```

...we can see that we have combined the data from both the `purchase_order` and `purchase_order_details` streams.

```
+------------+------------+------------+------------+------------+------------+------------+
|O_ID        |OD_ID       |ORDER_DATE  |SUPPLIER_ID |PRODUCT_ID  |QUANTITY    |COST        |
+------------+------------+------------+------------+------------+------------+------------+
|1           |1           |02-03-20    |1           |1           |100         |6.82        |
|1           |2           |02-03-20    |1           |2           |100         |7.52        |
|1           |3           |02-03-20    |1           |3           |100         |6.16        |
|1           |4           |02-03-20    |1           |4           |100         |8.07        |
|1           |5           |02-03-20    |1           |5           |100         |2.10        |
|1           |6           |02-03-20    |1           |6           |100         |7.45        |
|1           |7           |02-03-20    |1           |7           |100         |4.02        |
|1           |8           |02-03-20    |1           |8           |100         |0.64        |
|1           |9           |02-03-20    |1           |9           |100         |8.51        |
|1           |10          |02-03-20    |1           |10          |100         |3.61        |
Limit Reached
Query terminated
```

Join the `purchases_enriched_01` stream to the `suppliers_tbl` table...

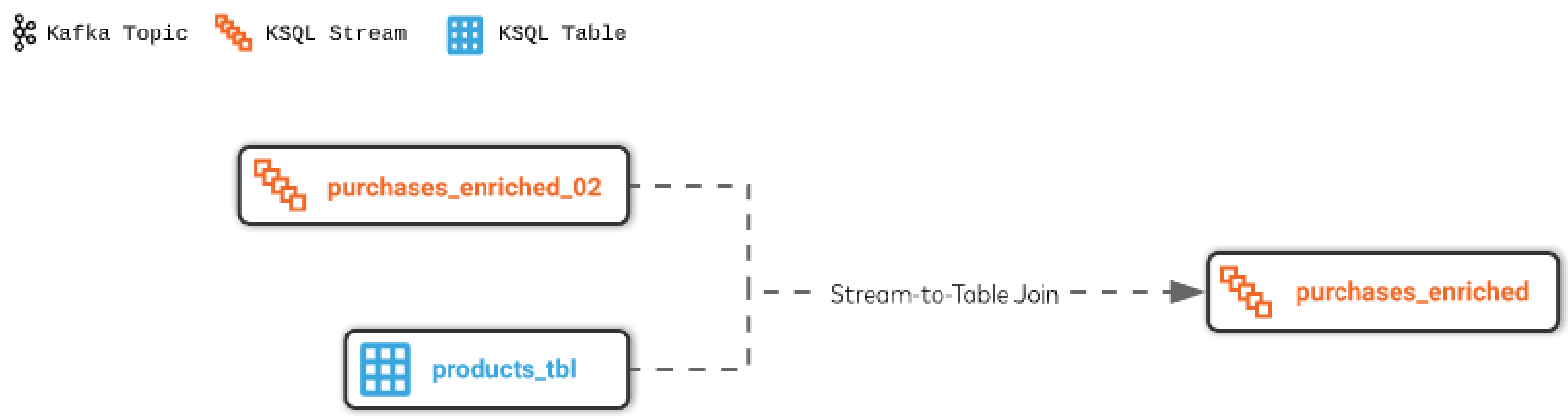
```
CREATE STREAM purchases_enriched_02 WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_purchases_enriched_02') AS SELECT
    pe.order_id,
    pe.order_details_id,
    pe.order_date,
    pe.supplier_id,
    pe.product_id,
    pe.quantity,
    pe.cost,
    st.name,
    st.email,
    st.city,
    st.country
FROM purchases_enriched_01 pe
INNER JOIN suppliers_tbl st ON (pe.supplier_id = st.id);
```



...and finally join to the `products_tbl` table

```
CREATE STREAM purchases_enriched WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_purchases_enriched') AS SELECT
    pe.order_id,
    pe.order_details_id,
    pe.order_date,
    pe.product_id product_id,
    pt.name product_name,
    pt.description product_desc,
    pe.cost product_cost,
    pe.quantity product_qty,
    pe.supplier_id supplier_id,
    pe.name supplier_name,
```

```
    pe.email supplier_email,
    pe.city supplier_city,
    pe.country supplier_country
FROM purchases_enriched_02 pe
INNER JOIN products_tbl pt ON (pe.product_id = pt.id);
```



If we run a describe on this stream...

```
DESCRIBE purchases_enriched;
```

```
Name                 : PURCHASES_ENRICHED
 Field            | Type
-----------------------------------------------
 ROWTIME          | BIGINT           (system)
 ROWKEY           | VARCHAR(STRING)  (system)
 ORDER_ID         | INTEGER
 ORDER_DETAILS_ID | INTEGER
 ORDER_DATE       | BIGINT
 PRODUCT_ID       | INTEGER
 PRODUCT_NAME     | VARCHAR(STRING)
 PRODUCT_DESC     | VARCHAR(STRING)
 PRODUCT_COST     | DECIMAL
 PRODUCT_QTY      | INTEGER
 SUPPLIER_ID      | INTEGER
 SUPPLIER_NAME    | VARCHAR(STRING)
 SUPPLIER_EMAIL   | VARCHAR(STRING)
 SUPPLIER_CITY    | VARCHAR(STRING)
 SUPPLIER_COUNTRY | VARCHAR(STRING)
-----------------------------------------------
```

...you'll see that we have also denormalized the `purchase_orders`, `purchase_order_details`, `suppliers` and `products` streams/tables into a single event stream.

Let's query the `purchases_enriched` stream from the very beginning

```
SET 'auto.offset.reset'='earliest';
SELECT product_id,
       product_name,
       product_qty
FROM purchases_enriched
EMIT CHANGES;
```

Notice that the query returns the first 30 purchase order lines and then stops; this is because no purchase orders are being created by our orders application. The orders application will raise purchase orders for us when we send it some out of stock events.

```
+------------------------+--------------------------------+------------------------+
|PRODUCT_ID              |PRODUCT_NAME                    |PRODUCT_QTY             |
+------------------------+--------------------------------+------------------------+
|1                       |Yogurt - Assorted Pack          |100                     |
|2                       |Ostrich - Fan Fillet            |100                     |
|3                       |Fish - Halibut, Cold Smoked     |100                     |
|4                       |Tomatoes Tear Drop Yellow       |100                     |
|5                       |Pasta - Fettuccine, Egg, Fresh  |100                     |
|6                       |Plastic Wrap                    |100                     |
|7                       |Pineapple - Regular             |100                     |
|8                       |Quail - Eggs, Fresh             |100                     |
|9                       |Pork - Ground                   |100                     |
|10                      |Lamb Shoulder Boneless Nz       |100                     |
|11                      |Sausage - Meat                  |100                     |
|12                      |Herb Du Provence - Primerba     |100                     |
|13                      |Bread - Kimel Stick Poly        |100                     |
|14                      |Food Colouring - Red            |100                     |
|15                      |Cheese - Grie Des Champ         |100                     |
|16                      |Longos - Lasagna Veg            |100                     |
|17                      |Beets - Golden                  |100                     |
|18                      |Bread - Dark Rye                |100                     |
|19                      |Pepperoni Slices                |100                     |
|20                      |Glass - Wine, Plastic, Clear 5 Oz|100                    |
|21                      |Soup - Campbells, Beef Barley   |100                     |
|22                      |Bread - Kimel Stick Poly        |100                     |
|23                      |Plate - Foam, Bread And Butter  |100                     |
|24                      |Parsley - Fresh                 |100                     |
|25                      |Cookie - Oreo 100x2             |100                     |
|26                      |Bread - Crusty Italian Poly     |100                     |
|27                      |Wine - Chateauneuf Du Pape      |100                     |
|28                      |Country Roll                    |100                     |
|29                      |Wine - Redchard Merritt         |100                     |
|30                      |Doilies - 5, Paper              |100                     |
```

Further Reading

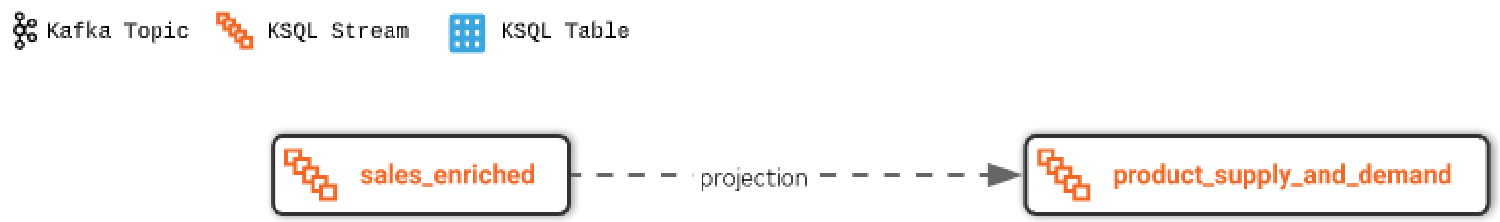
- Stream-Table Joins

Lab 11: Streaming Stock Levels

Before we can create an out of stock event stream, we need to work out the current stock levels for each product. We can do this by combining the `sales_enriched` stream with the `purchases_enriched` stream and summing the `sales_enriched.quantity` column (stock decrements) and the `purchases_enriched.quantity` column (stock increments).

Let's have a go at this now by creating a new stream called `product_supply_and_demand`. This stream is consuming messages from the `sales_enriched` stream and included the `product_id` and `quantity` column converted to a negative value, we do this because sales events are our *demand* and hence decrement stock.

```
SET 'auto.offset.reset'='earliest';
CREATE STREAM product_supply_and_demand WITH (PARTITIONS=1, KAFKA_TOPIC='dc01_product_supply_and_demand') AS SELECT
  product_id,
  product_qty * -1 "QUANTITY"
FROM sales_enriched;
```



Let's have a quick look at the first few rows of this stream

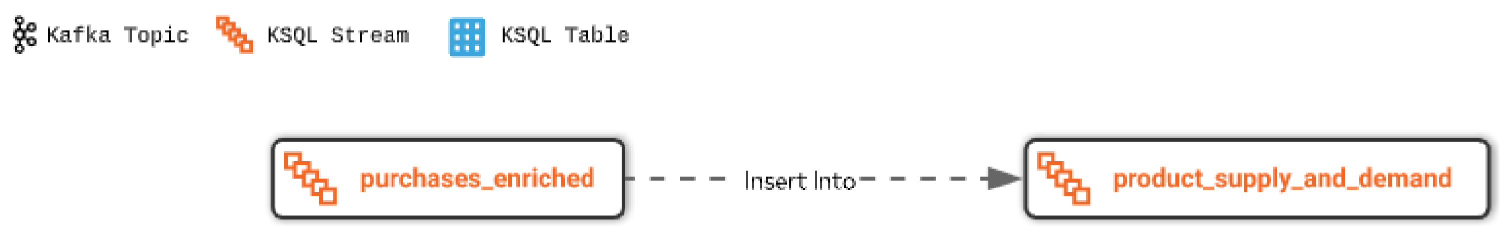
```
SET 'auto.offset.reset'='earliest';
SELECT  product_id,
        quantity
FROM    product_supply_and_demand
EMIT CHANGES
LIMIT 20;
```

This query shows a history of all sales and their affect on stock levels.

```
+------------------------------------------+------------------------------------------+
|PRODUCT_ID                                |QUANTITY                                  |
+------------------------------------------+------------------------------------------+
|1                                         |-6                                        |
|15                                        |-3                                        |
|14                                        |-7                                        |
|23                                        |-3                                        |
|13                                        |-10                                       |
|4                                         |-9                                        |
|10                                        |-9                                        |
|15                                        |-8                                        |
|10                                        |-2                                        |
|27                                        |-7                                        |
|6                                         |-2                                        |
|5                                         |-6                                        |
|25                                        |-8                                        |
|24                                        |-1                                        |
|2                                         |-8                                        |
|26                                        |-10                                       |
|13                                        |-9                                        |
|16                                        |-9                                        |
|28                                        |-8                                        |
|4                                         |-9                                        |
Limit Reached
Query terminated
```

What we need to do now is also include all product purchases in the same stream. We can do this using an `INSERT INTO` statement. The `INSERT INTO` statement streams the result of a SELECT query into an existing stream and its underlying topic.

```
INSERT INTO product_supply_and_demand
  SELECT  product_id,
          product_qty "QUANTITY"
  FROM    purchases_enriched;
```



Our `product_supply_and_demand` now includes all product sales as stock decrements and all product purchases as stock increments.

We can see the demand for a single product by filtering on the `product_id` and including only events where the `quantity` is less than zero.

```
SET 'auto.offset.reset'='earliest';
SELECT  product_id,
        quantity
FROM    product_supply_and_demand
WHERE product_id = 1
AND   quantity < 0
EMIT CHANGES;
```

```
+------------------------------------------+------------------------------------------+
|PRODUCT_ID                                |QUANTITY                                  |
+------------------------------------------+------------------------------------------+
|1                                         |-6                                        |
|1                                         |-9                                        |
|1                                         |-7                                        |
|1                                         |-5                                        |
|1                                         |-1                                        |
|1                                         |-7                                        |
|1                                         |-7                                        |
|1                                         |-10                                       |
|1                                         |-8                                        |
|1                                         |-4                                        |
|1                                         |-2                                        |
...
...
...
```

We can also see the supply for a single product by filtering on the `product_id` and including only events where the `quantity` is greater than zero.

```
SET 'auto.offset.reset'='earliest';
SELECT  product_id,
        quantity
FROM    product_supply_and_demand
WHERE product_id = 1
AND   quantity > 0
EMIT CHANGES;
```

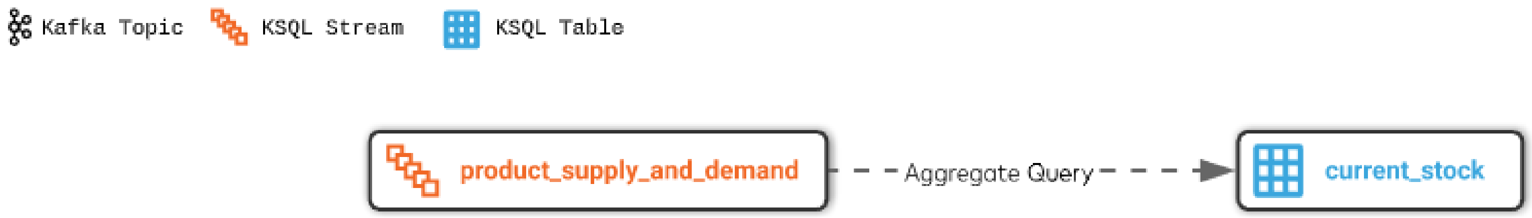
This query will only return a single event and reflects the initial purchase order line that was raised for this product.

```
+------------------------------------------+------------------------------------------+
|PRODUCT_ID                                |QUANTITY                                  |
+------------------------------------------+------------------------------------------+
|1                                         |100                                       |
```

We're now is a position where we can calculate the current stock level for each product. We can do this by creating a table that groups by the `product_id` and sums up the `quantity` column which contains both stock decrements and stock increments.

```
SET 'auto.offset.reset'='earliest';
CREATE TABLE current_stock WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_current_stock') AS SELECT
      product_id
    , SUM(quantity) "STOCK_LEVEL"
```

```
FROM product_supply_and_demand
GROUP BY product_id;
```



When we query this table with a Push query...

```
SET 'auto.offset.reset'='latest';
SELECT  product_id,
        stock_level
FROM  current_stock
EMIT CHANGES;
```

...each new event that is displayed on the console reflects the current stock level for the associated product, a new event will be emitted each time a product's stock level changes. Depending on how long it took you to get to this point in the workshop, you may see that all your stock levels are negative. This is because, apart from the initial purchase order for 100 of each product, we have not created any more purchase orders and our customers will have their orders on hold until we acquire more stock, not good, but we'll fix that soon.

Further Reading

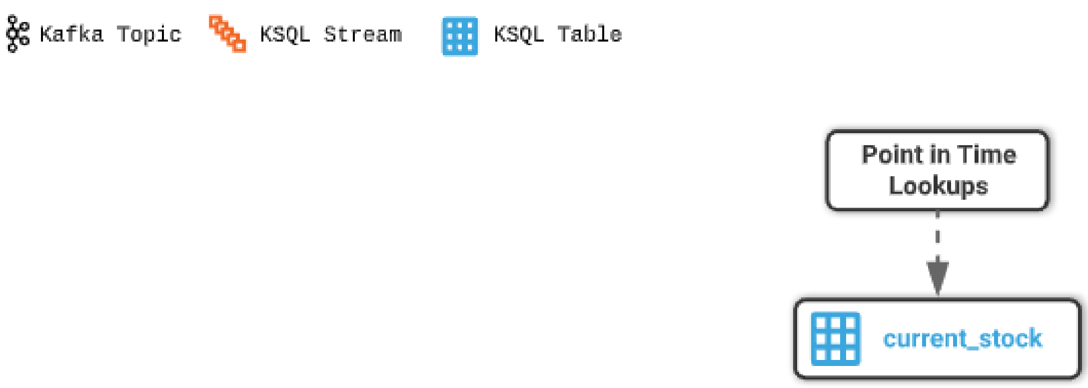
- INSERT INTO Syntax
- CREATE TABLE AS SELECT Syntax
- KSQL Aggregate Functions

Lab 12: Pull Queries

We can now run our first Pull query. Pull queries are a preview feature in KSQL 5.4 and currently can only be used against tables with aggregates and can only query a single key.

To run a Pull query we just query the table as normal but drop the `EMIT CHANGES` clause. In this query we are asking "**what is the *current* stock level for product id 1?**"

```
select product_id, stock_level from current_stock where rowkey='1';
```



The query will return the current stock level and immediatly terminate.

```
+------------------------------------------------------+------------------------------------------------------+
|PRODUCT_ID                                            |STOCK_LEVEL                                           |
+------------------------------------------------------+------------------------------------------------------+
|1                                                     |-67                                                   |
Query terminated
```

We can also use the KSQL Server's REST endpoint to make Pull queries.

Exit from the KSQL CLI and run the following from the command line.

```
curl -s -X "POST" "http://localhost:8088/query" -H "Content-Type: application/vnd.ksql.v1+json; charset=utf-8" -d $'{
"ksql": "select product_id, stock_level from current_stock where rowkey=\'1\';" }'| jq .
```

As you can see, the KSQL Server's REST endpoint will return a JSON message with the `product_id` and its current `stock_level`. This is useful for applications that want access to the current state of the world using a request/response type pattern.

```
[
  {
    "header": {
      "queryId": "query_1582892390468",
      "schema": "`PRODUCT_ID` INTEGER, STOCK_LEVEL INTEGER"
    }
  },
  {
    "row": {
      "columns": [
        1,
        -76
      ]
    }
  }
]
```

Further Reading

- Pull Queries
- KSQL REST API

Lab 13: Streaming Recent Product Demand

Now that we know the current stock level is for each product, we can use this information to send an event to the orders application and ask it to create purchase orders to replenish the stock, but how much should we stock should we order? we could just order enough to satisfy the current backlog but we'd quickly run out of stock again.

What we really want to do is order enough to satisfy the backlog *and* enough to meet future demand, we can make an attempt at predicting what the future demand will be by looking at the past.

In the following query we are creating a table that will calculate the demand for each product over the last 3 minutes using a `WINDOW HOPPING` clause.

Hopping windows are based on time intervals. They model fixed-sized, possibly overlapping windows. A hopping window is defined by two properties: the window's duration and its advance, or "hop", interval. The advance interval specifies how far a window moves forward in time relative to the previous window. In our query we we have a window with a duration of three minutes and an advance interval of one minute. Because hopping windows can overlap, a record can belong to more than one such window.

```
SET 'auto.offset.reset'='earliest';
CREATE TABLE product_demand_last_3mins_tbl WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_product_demand_last_3mins')
AS SELECT
      timestamptostring(windowStart(),'HH:mm:ss') "WINDOW_START_TIME"
    , timestamptostring(windowEnd(),'HH:mm:ss') "WINDOW_END_TIME"
    , product_id
```

```
    , SUM(product_qty) "DEMAND_LAST_3MINS"
FROM sales_enriched
WINDOW HOPPING (SIZE 3 MINUTES, ADVANCE BY 1 MINUTE)
GROUP BY product_id EMIT CHANGES;
```

If we query this table for a single product...

```
SET 'auto.offset.reset'='latest';
SELECT  window_start_time,
        window_end_time,
        product_id,
        demand_last_3mins
FROM  product_demand_last_3mins_tbl
WHERE product_id = 15
EMIT CHANGES
;
```

...you'll see the start and end times for each three minute window, along with the product demand for those 3 minutes. Notice how the window start times are staggered by one minute, this is the advance interval in action. As new sales events occur a new message will be displayed with an update to the window(s) total.

```
+-----------------+-----------------+-----------------+-----------------+
|WINDOW_START_TIME|WINDOW_END_TIME  |PRODUCT_ID       |DEMAND_LAST_3MINS|
+-----------------+-----------------+-----------------+-----------------+
|13:33:00         |13:36:00         |1                |10               |
|13:34:00         |13:37:00         |1                |10               |
|13:35:00         |13:38:00         |1                |1                |
|13:33:00         |13:36:00         |1                |11               |
|13:34:00         |13:37:00         |1                |11               |
|13:35:00         |13:38:00         |1                |2                |
|13:34:00         |13:37:00         |1                |21               |
|13:35:00         |13:38:00         |1                |12               |
|13:36:00         |13:39:00         |1                |10               |
|13:34:00         |13:37:00         |1                |26               |
|13:35:00         |13:38:00         |1                |17               |
|13:36:00         |13:39:00         |1                |15               |
|13:35:00         |13:38:00         |1                |22               |
|13:36:00         |13:39:00         |1                |20               |
|13:37:00         |13:40:00         |1                |5                |
|13:36:00         |13:39:00         |1                |28               |
|13:37:00         |13:40:00         |1                |13               |
|13:38:00         |13:41:00         |1                |8                |
```

We will now create a stream from this table and then join it to the `current_stock` table

Create a stream from the table's underlying topic...

```
CREATE STREAM product_demand_last_3mins WITH (KAFKA_TOPIC='dc01_product_demand_last_3mins', VALUE_FORMAT='AVRO');
```

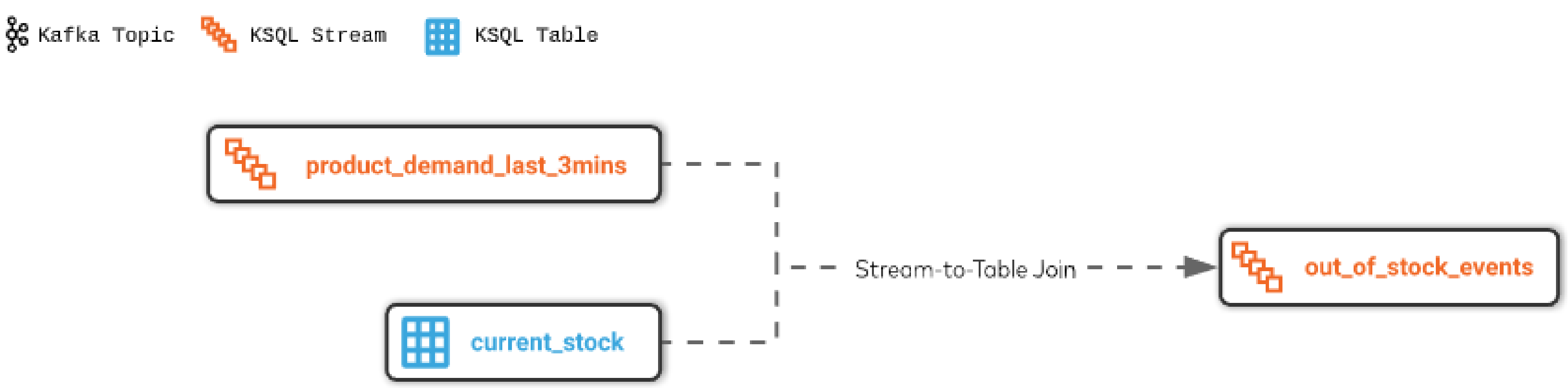
Further Reading

- Windows in KSQL Queries

Lab 14: Streaming *"Out of Stock"* Events

Now that we have the `current_stock` table and `product_demand_last_3mins` stream, we can create a `out_of_stock_events` stream by joining the two together and calculating the required purchase order quantity. We calculate the `purchase_qty` from adding the inverse of the current stock level to the last 3 minutes of demand. The stream is filtered to only include products that have no stock and therefore need purchase orders raising for them.

```
SET 'auto.offset.reset' = 'latest';
CREATE STREAM out_of_stock_events WITH (PARTITIONS = 1, KAFKA_TOPIC = 'dc01_out_of_stock_events')
AS SELECT
  cs.product_id "PRODUCT_ID",
  pd.window_start_time,
  pd.window_end_time,
  cs.stock_level,
  pd.demand_last_3mins,
  (cs.stock_level * -1) + pd.DEMAND_LAST_3MINS "QUANTITY_TO_PURCHASE"
FROM product_demand_last_3mins pd
INNER JOIN current_stock cs ON pd.product_id = cs.product_id
WHERE stock_level <= 0;
```



When we query the `out_of_stock_events` stream...

```
SET 'auto.offset.reset' = 'latest';
SELECT product_id,
       window_start_time,
       window_end_time,
       stock_level,
       demand_last_3mins,
       quantity_to_purchase
FROM out_of_stock_events
EMIT CHANGES;
```

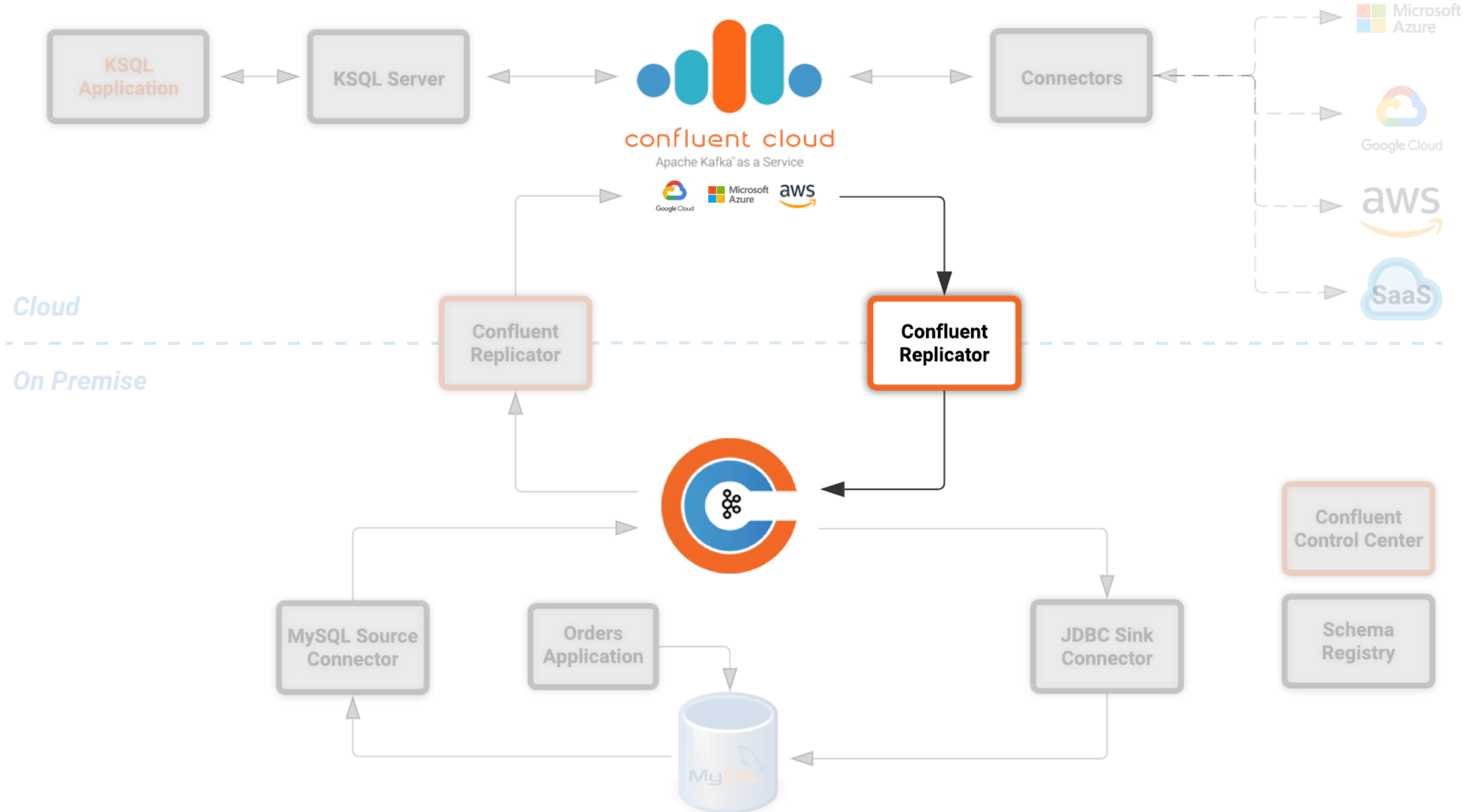
...you'll see a constant stream of *out of stock products* and the predicted purchase quantity that should be ordered to satisfy any current backlog and also meet the next 3 minutes demand.

```
+----------------+-----------------+---------------+------------+-----------------+-------------------+
|PRODUCT_ID      |WINDOW_START_TIME |WINDOW_END_TIME |STOCK_LEVEL  |DEMAND_LAST_3MINS|QUANTITY_TO_PURCASE|
```

```
+----------------+-----------------+----------------+-------------+-----------------+------------------+
|28              |13:53:00         |13:56:00        |-85          |12               |97                |
|28              |13:54:00         |13:57:00        |-85          |1                |86                |
|28              |13:55:00         |13:58:00        |-85          |1                |86                |
|4               |13:53:00         |13:56:00        |-128         |26               |154               |
|4               |13:54:00         |13:57:00        |-128         |11               |139               |
|4               |13:55:00         |13:58:00        |-128         |11               |139               |
|5               |13:53:00         |13:56:00        |-73          |15               |88                |
|5               |13:54:00         |13:57:00        |-73          |15               |88                |
|5               |13:55:00         |13:58:00        |-73          |15               |88                |
|28              |13:53:00         |13:56:00        |-85          |18               |103               |
|28              |13:54:00         |13:57:00        |-91          |7                |98                |
|28              |13:55:00         |13:58:00        |-91          |7                |98                |
|14              |13:53:00         |13:56:00        |-156         |31               |187               |
|14              |13:54:00         |13:57:00        |-156         |15               |171               |
|14              |13:55:00         |13:58:00        |-156         |6                |162               |
|5               |13:53:00         |13:56:00        |-73          |25               |98                |
|5               |13:54:00         |13:57:00        |-83          |25               |108               |
|5               |13:55:00         |13:58:00        |-83          |25               |108               |
|12              |13:53:00         |13:56:00        |-197         |25               |222               |
|12              |13:54:00         |13:57:00        |-197         |21               |218               |
|12              |13:55:00         |13:58:00        |-200         |3                |203               |
...
...
```

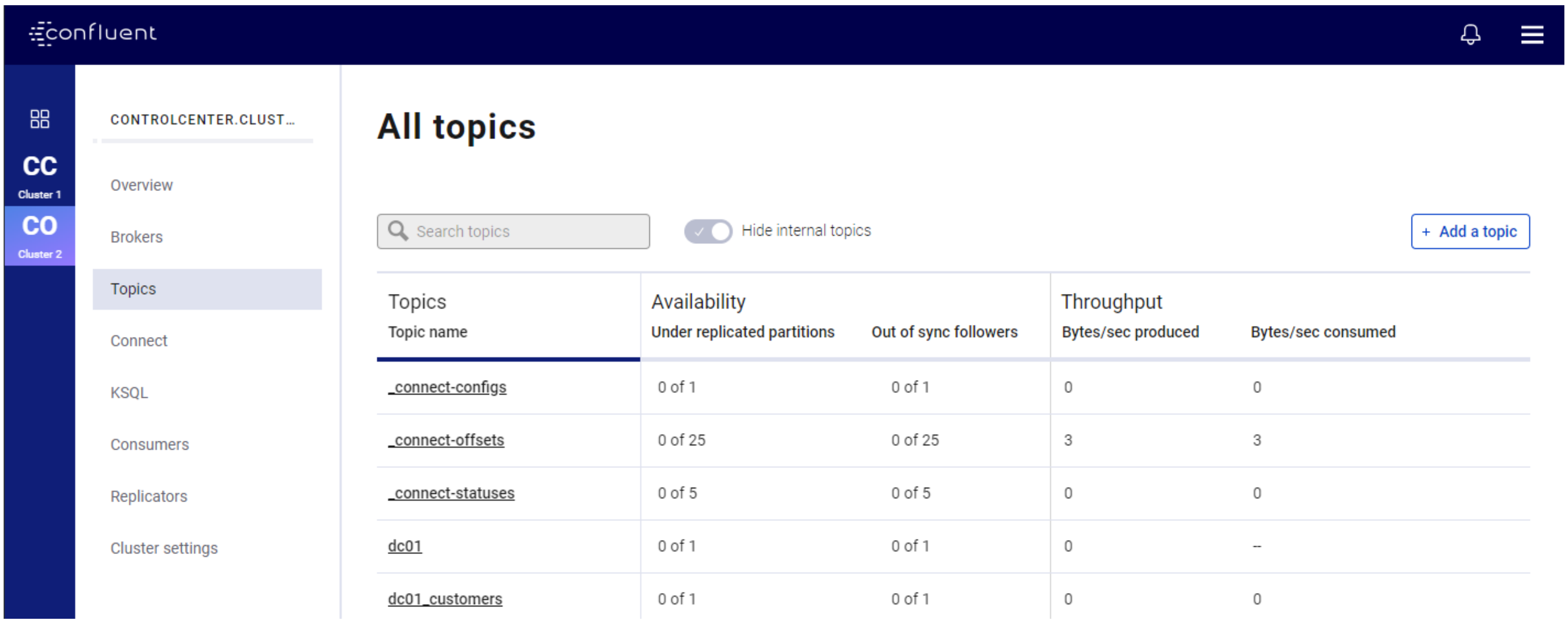
Lab 15: Replicate Events to On-Premise Kafka

The next step is to push the `out_of_stock_events` stream to our application so it can create some purchase orders for us. To do this we'll need to replicate the `dc01_out_of_stock_events` topic from Confluent Cloud back to our on-premise Kafka cluster.

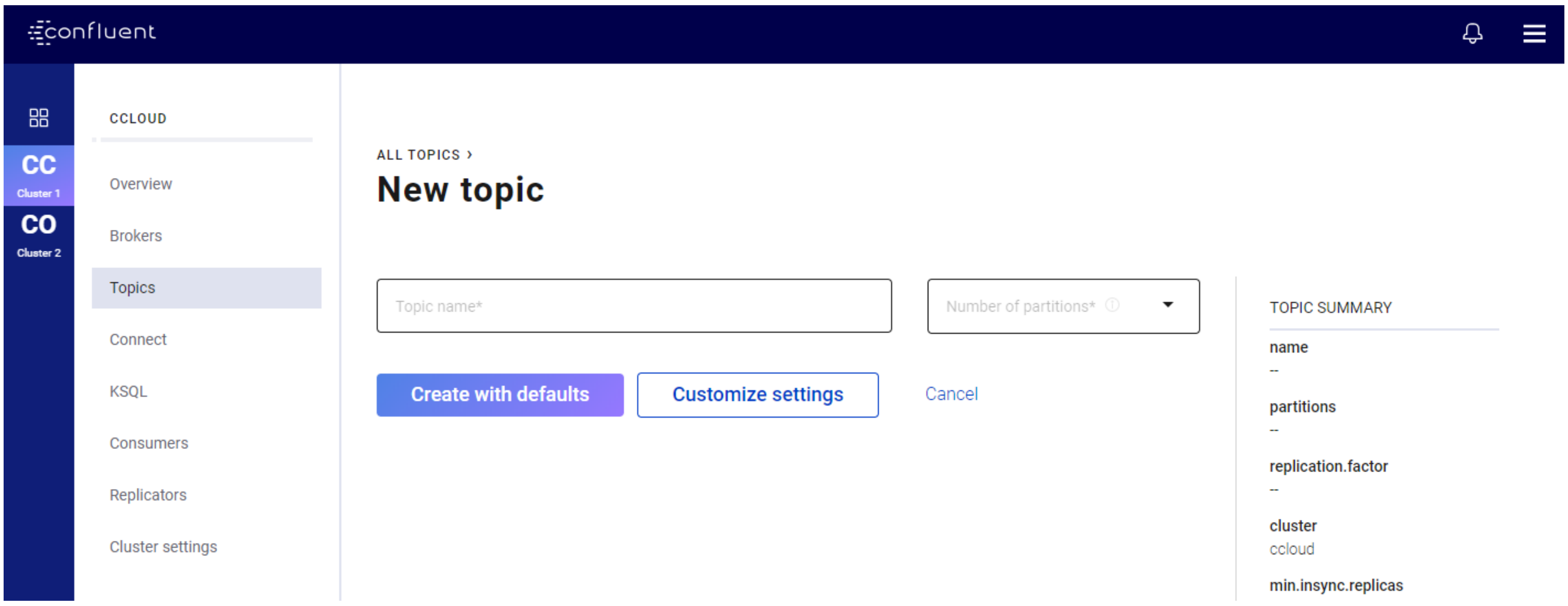


Before we do that, let's create the target topic in our on-premise Kafka cluster using Confluent Control Center

Select your on-premise cluster from the left-hand navigation bar, select *"topics"* and then click on *"Add a Topic"*.



Name the topic `dc01_out_of_stock_events` and click *"Create with defaults"*



We are now ready to replicate this topic from Confluent Cloud to you on-premise cluster.

Submit the Replicator Connector Config

Execute the following from the command line to create the Replicator Connector. You can see that we have asked to only replicate the `dc01_out_of_stock_events` topic by configuring `"topic.whitelist": "dc01_out_of_stock_events"`

```
curl -i -X POST -H "Accept:application/json" \
    -H  "Content-Type:application/json" http://localhost:18083/connectors/ \
    -d '{
        "name": "replicator-ccloud-to-dc01",
        "config": {
          "connector.class": "io.confluent.connect.replicator.ReplicatorSourceConnector",
          "key.converter": "io.confluent.connect.replicator.util.ByteArrayConverter",
          "value.converter": "io.confluent.connect.replicator.util.ByteArrayConverter",
          "topic.config.sync": "false",
          "topic.whitelist": "dc01_out_of_stock_events",
          "dest.kafka.bootstrap.servers": "broker:29092",
          "dest.kafka.replication.factor": 1,
          "src.kafka.bootstrap.servers": "${file:/secrets.properties:CCLOUD_CLUSTER_ENDPOINT}",
          "src.kafka.security.protocol": "SASL_SSL",
          "src.kafka.sasl.mechanism": "PLAIN",
          "src.kafka.sasl.jaas.config": "org.apache.kafka.common.security.plain.PlainLoginModule required
username=\"${file:/secrets.properties:CCLOUD_API_KEY}\" password=\"${file:/secrets.properties:CCLOUD_API_SECRET}\";",
          "src.consumer.group.id": "replicator-ccloud-to-dc01",
          "src.consumer.interceptor.classes":
"io.confluent.monitoring.clients.interceptor.MonitoringConsumerInterceptor",
```

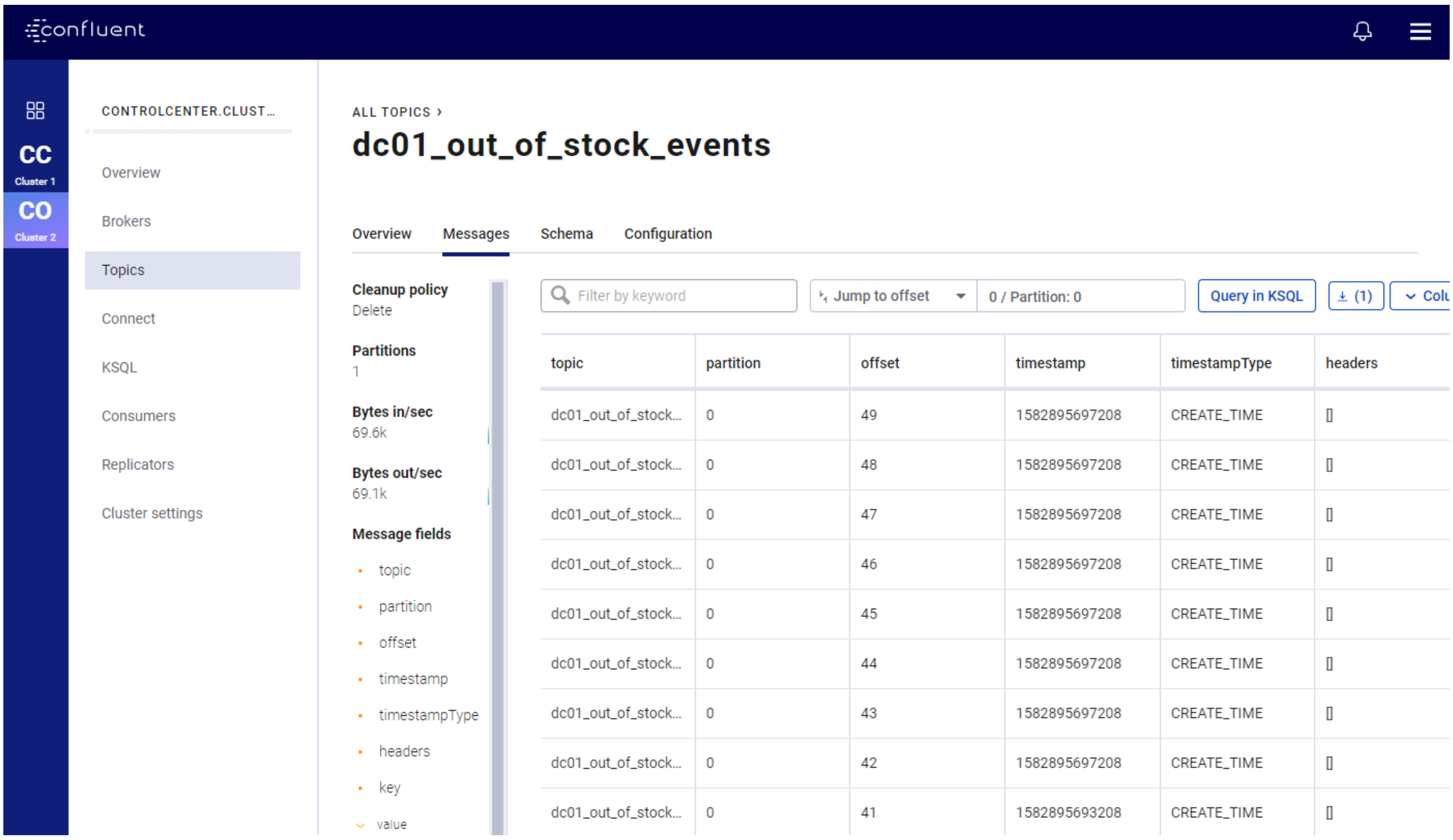
```
          "src.consumer.confluent.monitoring.interceptor.bootstrap.servers":
"${file:/secrets.properties:CCLOUD_CLUSTER_ENDPOINT}",
          "src.kafka.timestamps.producer.interceptor.classes":
"io.confluent.monitoring.clients.interceptor.MonitoringProducerInterceptor",
          "src.kafka.timestamps.producer.confluent.monitoring.interceptor.bootstrap.servers":
"${file:/secrets.properties:CCLOUD_CLUSTER_ENDPOINT}",
          "tasks.max": "1"
        }
    }'
```

You should see something similar...

```
HTTP/1.1 100 Continue

HTTP/1.1 201 Created
Date: Sun, 09 Feb 2020 15:07:22 GMT
Location: http://localhost:18084/connectors/replicator-dc01-to-ccloud
Content-Type: application/json
Content-Length: 1342
Server: Jetty(9.4.20.v20190813)
...
...
```

We can confirm that the `dc01_out_of_stock_events` is being replicated from Confluent Cloud to our on-premise cluster by checking for messages in Confluent Control Center

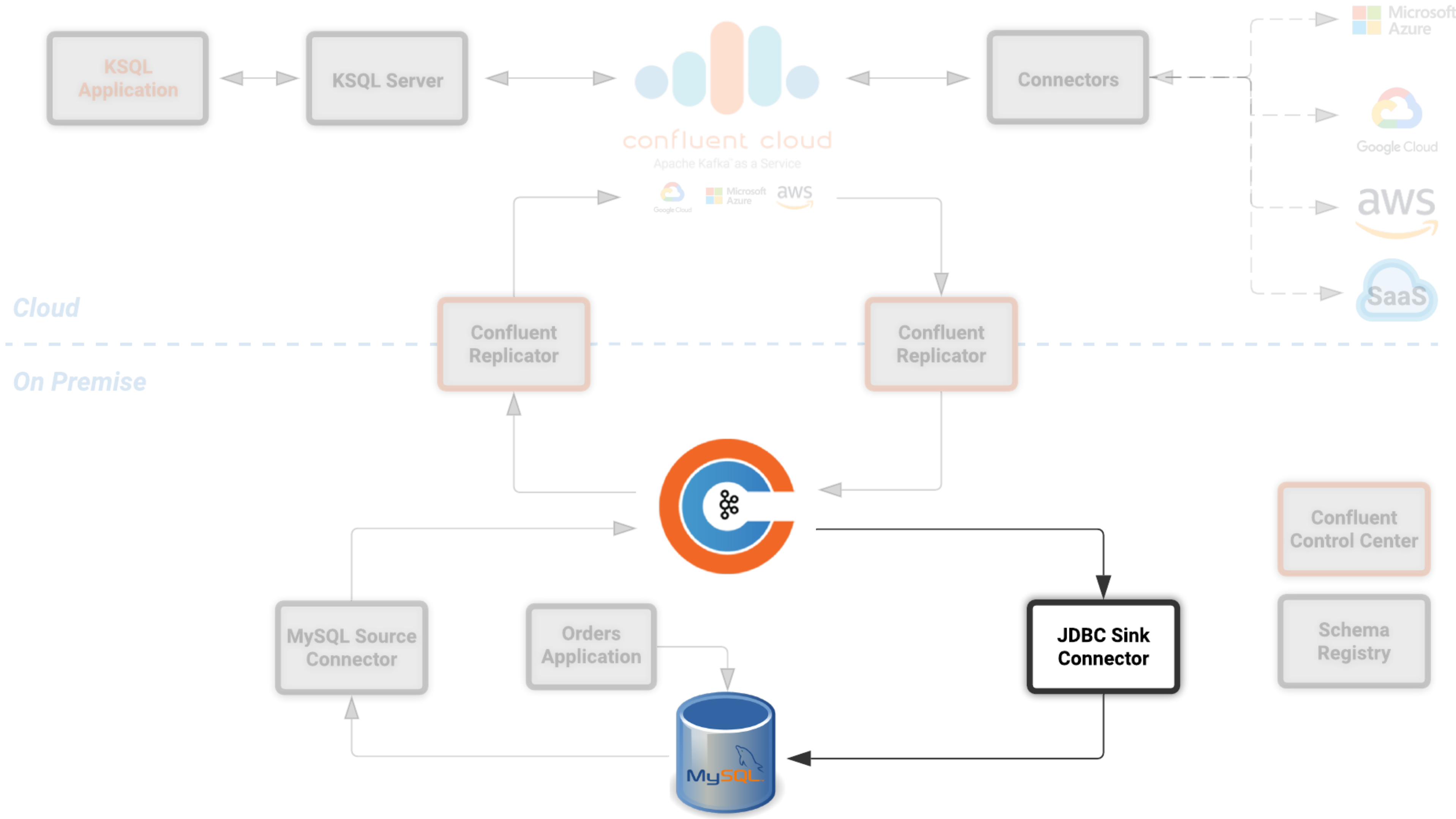


Further Reading

- Confluent Replicator
- Confluent Replicator Configuration Properties

Lab 16: Sink Events into MySQL

Finally we need to sink the `dc01_out_of_stock_events` topic into a MySQL database table, the on-premise application will then process these events and create purchase order for us.



But before we do that, let's open a couple more terminal sessions and start the KSQL CLI in each.

```
ssh dc01@34.89.105.9
```

```
docker exec -it ksql-cli ksql http://ksql-server-ccloud:8088
```

Execute the following query in the 1st session...

```
SET 'auto.offset.reset'='latest';
SELECT  product_id,
        stock_level
FROM  current_stock
EMIT CHANGES;
```

...and this query in the 2nd session

```
SET 'auto.offset.reset'='latest';
SELECT  product_id,
        product_qty
FROM  purchases_enriched
EMIT CHANGES;
```

You now have a real time view of the current product stock levels in the first KSQL session and the purchases being made to replenish the stock in second. Not that the second query isn't returning anything yet.

Let's now sink the *out of stock events* to the MySQL database using the JDBC Connector. Once the events start arriving in the database, the orders application will process them and start generating the required purchase orders.

In a third terminal session, create the JDBC Sink Connector by running the following from the command line.

```
curl -i -X POST -H "Accept:application/json" \
    -H  "Content-Type:application/json" http://localhost:18083/connectors/ \
```

```
    -d '{
        "name": "jdbc-mysql-sink",
        "config": {
          "connector.class": "io.confluent.connect.jdbc.JdbcSinkConnector",
          "topics": "dc01_out_of_stock_events",
          "connection.url": "jdbc:mysql://mysql:3306/orders",
          "connection.user": "mysqluser",
          "connection.password": "mysqlpw",
          "insert.mode": "INSERT",
          "batch.size": "3000",
          "auto.create": "true",
          "key.converter": "org.apache.kafka.connect.storage.StringConverter"
       }
    }'
```

Observe the current stock query in the first KSQL session, when a product has zero or less stock you should see a purchase event appear in the second KSQL session and then the new stock level reflected in the first session. In theory, given a constant demand, each product should run out of stock and get replenished roughly every 3 minutes.

Further Reading

- JDBC Sink Connector
- JDBC Sink Connector Configuration Properties

Optional Lab: Stream Sales & Purchases to Google Cloud Storage

We can use the Google Cloud Storage Sink Connector to stream changes from a topics to Google Cloud Storage, from here the data can be consumed other Google Cloud Platform services.

Another preview feature of KSQL 5.4 is the ability to create connectors directly within KSQL.

Start a KSQL CLI session

```
docker exec -it ksql-cli ksql http://ksql-server-ccloud:8088
```

And run the following `CREATE SINK CONNECTOR` command. This will create a connector that will sink the `dc01_sales_enriched` and the `dc01_purchases_enriched` topics to Google Cloud Storage.

```
CREATE SINK CONNECTOR dc01_gcs_sink WITH (
  'connector.class' = 'io.confluent.connect.gcs.GcsSinkConnector',
  'tasks.max'= '1',
  'gcs.bucket.name' = '${file:/secrets.properties:GCS_BUCKET_NAME}',
  'gcs.part.size' = '5242880',
  'gcs.credentials.path' = '${file:/secrets.properties:GCS_CREDENTIALS_PATH}',
  'flush.size'= '50',
  'storage.class'= 'io.confluent.connect.gcs.storage.GcsStorage',
  'format.class'= 'io.confluent.connect.gcs.format.avro.AvroFormat',
  'partitioner.class'= 'io.confluent.connect.storage.partitioner.DefaultPartitioner',
  'schema.compatibility'= 'NONE',
  'topics' = 'dc01_sales_enriched,dc01_purchases_enriched',
  'confluent.topic.bootstrap.servers'= '${file:/secrets.properties:CCLOUD_CLUSTER_ENDPOINT}',
  'confluent.topic.security.protocol' = 'SASL_SSL',
  'confluent.topic.sasl.mechanism' = 'PLAIN',
  'confluent.topic.sasl.jaas.config' = 'org.apache.kafka.common.security.plain.PlainLoginModule required
username=\"${file:/secrets.properties:CCLOUD_API_KEY}\" password=\"${file:/secrets.properties:CCLOUD_API_SECRET}\";',
  'confluent.topic.replication.factor'= '3',
  'producer.interceptor.classes' = 'io.confluent.monitoring.clients.interceptor.MonitoringProducerInterceptor',
  'key.converter'= 'org.apache.kafka.connect.storage.StringConverter'
);
```

We can list our current connectors using the following command

```
show connectors;
```

```
 Connector Name             | Type   | Class
------------------------------------------------------------------------------------------------
 DC01_GCS_SINK              | SINK   | io.confluent.connect.gcs.GcsSinkConnector
 replicator-dc01-to-ccloud | SOURCE | io.confluent.connect.replicator.ReplicatorSourceConnector
------------------------------------------------------------------------------------------------
```

We can also describe a connector and view its status using the `describe connector` statement.

```
describe connector DC01_GCS_SINK;
```

```
Name                 : DC01_GCS_SINK
Class                : io.confluent.connect.gcs.GcsSinkConnector
Type                 : sink
State                : RUNNING
WorkerId             : kafka-connect:18084

 Task ID | State   | Error Trace
---------------------------------
 0       | RUNNING |
---------------------------------
```

Depending on who's hosting the workshop, you may or may not have access to the GCP account where the storage bucket is held.

Further Reading

- Google Cloud Storage Sink Connector
- Google Cloud Storage Sink Connector Configuration Properties

Optional Lab: Stream Sales & Purchases to Google Big Query

We can use the BigQuery Sink Connector to stream changes from a topics to Google BigQuery.

Another preview feature of KSQL 5.4 is the ability to create connectors directly within KSQL.

Start a KSQL CLI session

```
docker exec -it ksql-cli ksql http://ksql-server-ccloud:8088
```

And run the following `CREATE SINK CONNECTOR` command. This will create a connector that will stream the following topics to Google BigQuery:-

```
dc01_sales_orders
dc01_sales_order_details
dc01_purchase_orders
dc01_purchase_order_details
dc01_products
dc01_customers
dc01_suppliers
```

```
CREATE SINK CONNECTOR dc01_gbq_sink WITH (
  'connector.class'='com.wepay.kafka.connect.bigquery.BigQuerySinkConnector',
  'schemaRetriever'='com.wepay.kafka.connect.bigquery.schemaregistry.schemaretriever.SchemaRegistrySchemaRetriever',
  'schemaRegistryLocation'= 'http://schema-registry:8081',
  'topics'=
'dc01_sales_orders,dc01_sales_order_details,dc01_purchase_orders,dc01_purchase_order_details,dc01_products,dc01_custo
mers,dc01_suppliers',
  'tasks.max'='1',
  'sanitizeTopics'='true',
  'autoCreateTables'='true',
  'autoUpdateSchemas'='true',
  'project'='${file:/secrets.properties:GBQ_PROJECT}',
  'datasets'='.*=${file:/secrets.properties:GBQ_DATASET}',
  'keyfile'='${file:/secrets.properties:GBQ_CREDENTIALS_PATH}'
);
```

We can list our current connectors using the following command

```
show connectors;
```

```
 Connector Name             | Type   | Class
-------------------------------------------------------------------------------------------------
 DC01_GBQ_SINK              | SINK   | com.wepay.kafka.connect.bigquery.BigQuerySinkConnector
 replicator-dc01-to-ccloud | SOURCE | io.confluent.connect.replicator.ReplicatorSourceConnector
-------------------------------------------------------------------------------------------------
```

We can also describe a connector and view its status using the `describe connector` statement.

```
describe connector DC01_GBQ_SINK;
```

```
Name                 : DC01_GBQ_SINK
Class                : com.wepay.kafka.connect.bigquery.BigQuerySinkConnector
Type                 : sink
State                : RUNNING
WorkerId             : kafka-connect:18084

 Task ID | State   | Error Trace
---------------------------------
 0       | RUNNING |
---------------------------------
```

Depending on who's hosting the workshop, you may or may not have access to the GCP account where the BigQuery dataset is held.

Visualize your Data in Google Data Studio

Now that your Data is in BigQuery, you can use Google Datastudio to visualize it.

Open Goodle Data Studio and create a new Report. Add new Datasources and select BigQuery. You can use the queries below for your convenience (look for the Custom Query in the left sidebar).

In the queries replace the following according to your environment:

- `gcp-project-id`: your GCP project ID, where BigQuery stores the data
- `bigquery_dataset`: Your Big Query dataset name

Product Query

```
SELECT
  SUM(OD.quantity) as order_quantity,
  AVG(P.price) as avg_product_price,
  P.name as product_name
FROM `gcp-project-id.bigquery_dataset.dc01_sales_order_details` OD
INNER JOIN `gcp-project-id.bigquery_dataset.dc01_products` P ON OD.product_id = P.id and P.sourcedc="dc01"
WHERE
OD.sourcedc="dc01"
GROUP BY  P.name
```

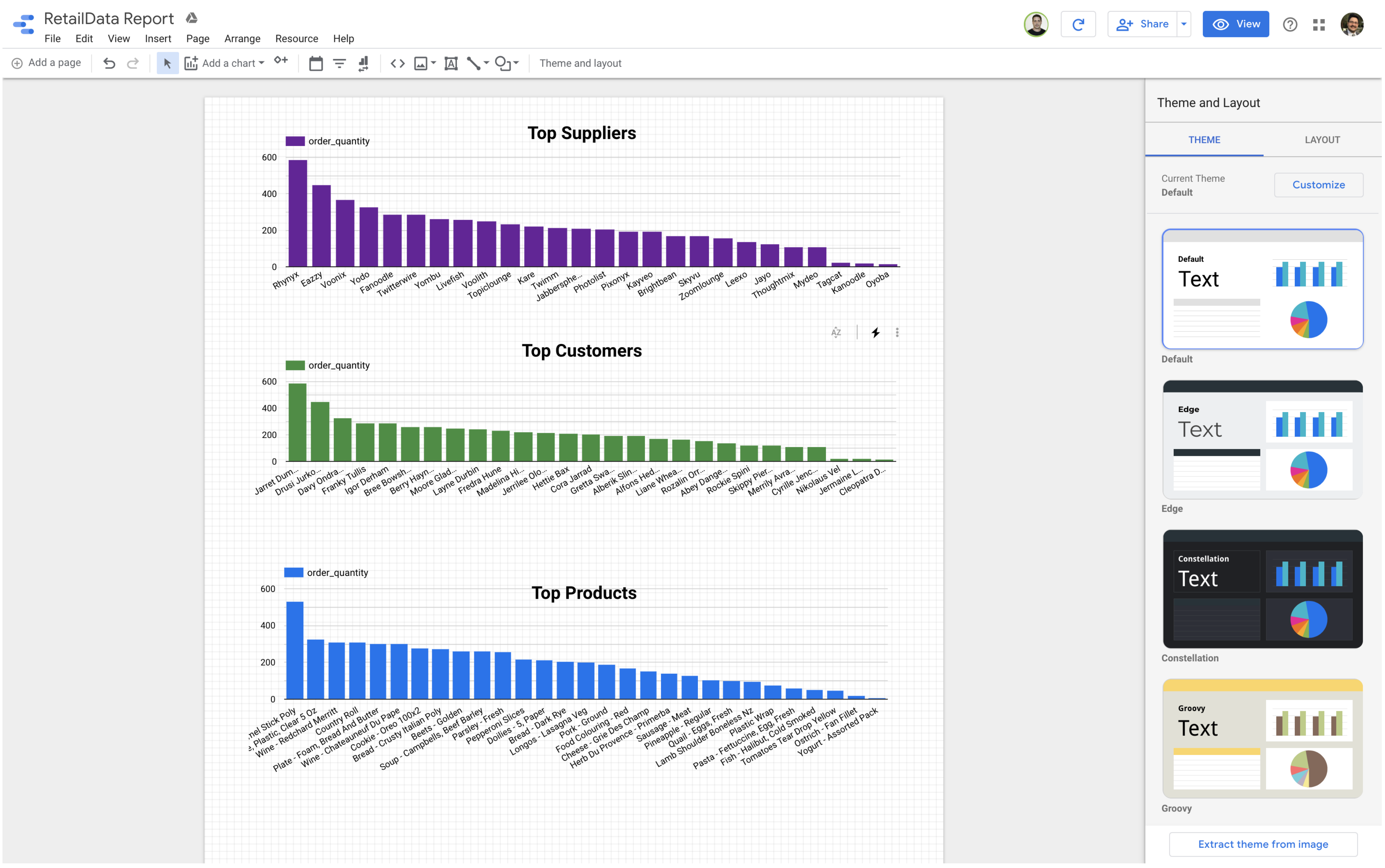
Top customers

```
SELECT
  COUNT(DISTINCT O.id) as order_count,
  SUM(OD.quantity) as order_quantity,
  SUM(OD.price) as order_price,
  C.first_name || " " || C.last_name as customer_name
FROM `gcp-project-id.bigquery_dataset.dc01_sales_orders` O
INNER JOIN `gcp-project-id.bigquery_dataset.dc01_sales_order_details` OD ON O.id = OD.sales_order_id and
OD.sourcedc="dc01"
INNER JOIN `gcp-project-id.bigquery_dataset.dc01_customers` C ON O.customer_id = C.id and C.sourcedc="dc01"
WHERE
O.sourcedc="dc01"
GROUP BY customer_name
```

Top suppliers

```
SELECT
  COUNT(DISTINCT O.id) as order_count,
  SUM(OD.quantity) as order_quantity,
  SUM(OD.price) as order_price,
  S.name AS supplier_name
FROM `gcp-project-id.bigquery_dataset.dc01_sales_orders` O
INNER JOIN `gcp-project-id.bigquery_dataset.dc01_sales_order_details` OD ON O.id = OD.sales_order_id and
OD.sourcedc="dc01"
INNER JOIN `gcp-project-id.bigquery_dataset.dc01_suppliers` S ON O.customer_id = S.id and S.sourcedc="dc01"
WHERE
O.sourcedc="dc01"
GROUP BY supplier_name
```

This is an example of a report you can build:



Further Reading

- Google BigQuery Sink Connector
- Google BigQuery Sink Connector Configuration Properties

Optional Lab: Stream Sales & Purchases to MongoDB Atlas

We can use the MongoDB Sink Connector to stream changes from Confluent Cloud to MongoDB Atlas, from here the data can be leveraged in the wider MongoDB ecosystem.

Another preview feature of KSQL 5.4 is the ability to create connectors directly within KSQL.

Start a KSQL CLI session

```
docker exec -it ksql-cli ksql http://ksql-server-ccloud:8088
```

And run the following `CREATE SINK CONNECTOR` command. This will create a connector that will sink the `dc01_sales_enriched` and the `dc01_purchases_enriched` topics to MongoDB.

```
CREATE SINK CONNECTOR dc01_mongodb_sink WITH (
  'connector.class'='com.mongodb.kafka.connect.MongoSinkConnector',
  'tasks.max'='1',
  'topics'='dc01_sales_enriched,dc01_purchases_enriched',
  'connection.uri'='${file:/secrets.properties:MONGODBATLAS_SRV_ADDRESS}',
  'database'='demo',
  'collection'='dc01',
  'topic.override.dc01_sales_enriched.collection'='dc01_sales',
  'topic.override.dc01_purchases_enriched.collection'='dc01_purchases',
  'key.converter'='org.apache.kafka.connect.storage.StringConverter',
  'transforms'='WrapKey',
  'transforms.WrapKey.type'='org.apache.kafka.connect.transforms.HoistField$Key',
  'transforms.WrapKey.field'='ROWKEY',
  'document.id.strategy'='com.mongodb.kafka.connect.sink.processor.id.strategy.UuidStrategy',
```

```
  'post.processor.chain'='com.mongodb.kafka.connect.sink.processor.DocumentIdAdder',
  'max.batch.size'='20'
);
```

We can list our current connectors using the following command

```
show connectors;
```

```
 Connector Name             | Type   | Class
-------------------------------------------------------------------------------------------------
 dc01_MONGODB_SINK          | SINK   | com.mongodb.kafka.connect.MongoSinkConnector
 replicator-dc01-to-ccloud | SOURCE | io.confluent.connect.replicator.ReplicatorSourceConnector
-------------------------------------------------------------------------------------------------
```

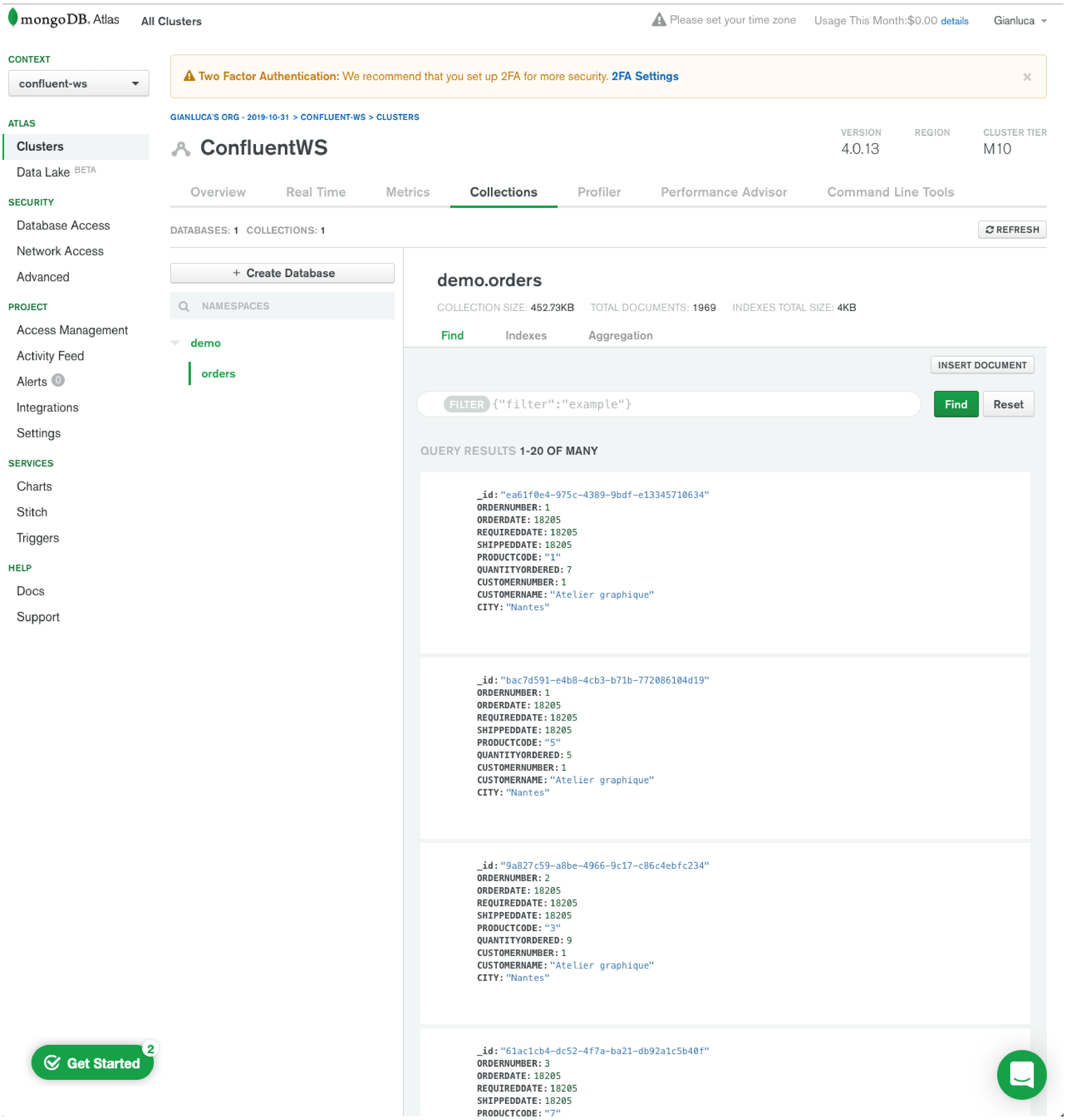
We can also describe a connector and view its status using the `describe connector` statement.

```
describe connector dc01_MONGODB_SINK;
```

```
Name                 : dc01_MONGODB_SINK
Class                : com.mongodb.kafka.connect.MongoSinkConnector
Type                 : sink
State                : RUNNING
WorkerId             : kafka-connect:18084

 Task ID | State   | Error Trace
---------------------------------
 0       | RUNNING |
---------------------------------
```

Depending on who's hosting the workshop, you may or may not have access to the MongoDB Atlas account where the database is held.



Further Reading

- MongoDB Atlas
- MongoDB Kafka Connector

Wrapping up

During this workshop we have seen how the Confluent Platform and Confluent Cloud can be used to build event driven, real time applications that span the data center and public cloud.