Confluent Cloud Overview
CC Bootcamp

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Staff Technical Trainer

Course Description

1. Confluent Cloud Overview
2. Labs
    - 2.1. Basic Cluster
    - 2.2. Clients
    - 2.3. ACLs and RBAC
    - 2.4. Managed Connectors
    - 2.5. OIDC
    - 2.6. Audit Logs and Metrics
    - 2.7. Enterprise Cluster
    - 2.8. Dedicated Cluster
    - 2.9. Audit Logs via Cluster Linking
    - 2.10. Cluster and Schema Linking
    - 2.11. Confluent Terraform Provider

Mission Statement

Cloud Native

Complete

Everywhere

What is Confluent Cloud?

- Managed Confluent Kafka Cluster
  - Deployed in AWS, GCP & Azure
  - Shared and Dedicated Cluster

- Scalable through adjustable cluster size (dedicated)
- Internal user management
  - OAuth/OIDC also supported
- Additional services
  - Schema governance
  - ksqlDB
  - Managed connectors
  - Audit Log and Metrics
  - Cluster Linking
  - Schema Linking
  - Flink SQL (preview)

Cloud providers and regions

Amazon AWS

US: 3
Canada: 1
South America: 1

Asia-Pacific: 8 + 1

Europe: 7

Middle East: 2

Africa: 1

GCP

US: 6
Canada: 2
South America: 2

Asia-Pacific: 9 + 2

Europe: 10

Israel: 1

Azure

US: 6
Canada: 1
South America: 1

Asia-Pacific: 5 + 1

Europe: 8

Middle East: 2

Africa: 1

Cluster types

Basic (Shared)

99.5% uptime SLA (2 d/year)

5 TB Storage
Single Zone only
Can be upgraded to Standard (single zone only)

You only pay for the ingress, egress, partitions, and storage
No upfront cost

Standard (Shared)

1 AZ: 99.95% uptime SLA (4 h/year)
3 AZ: 99.99% uptime SLA (1 h/year)

Unlimited Storage
Single & Multi-zone
RBAC and OAuth

Starting at $1.50 / hr

Enterprise (Shared)

Same as Standard, plus

Private Networking (Private Link)
22,500 client connections

Starts at $4.50 / hour

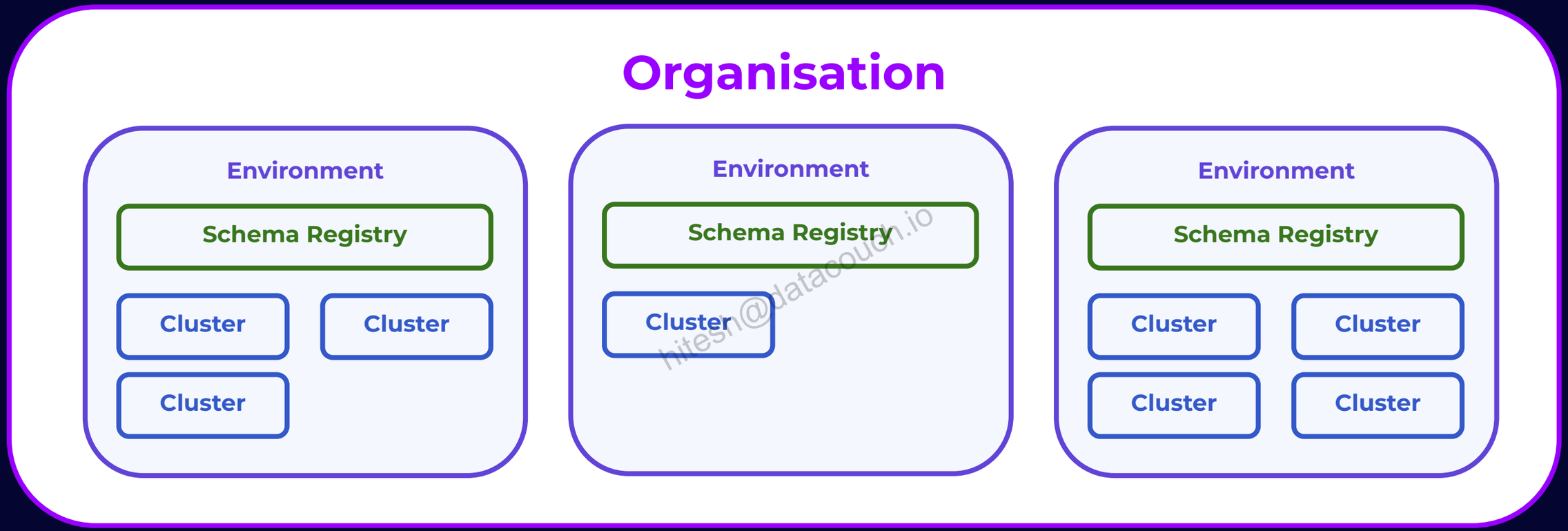
Dedicated

Same as Standard, plus

1 GB/s Ingress & Egress
Can be scaled up and down
Different private networking options
Self-managed keys

Starts at $2.66 / hr

Confluent Cloud Structure



Confluent Cloud Constructs

Organization

- Highest level abstraction
- Billing
- Support
- SSO
- User Management
- Service Accounts

- Contains Multiple Environments

Environment

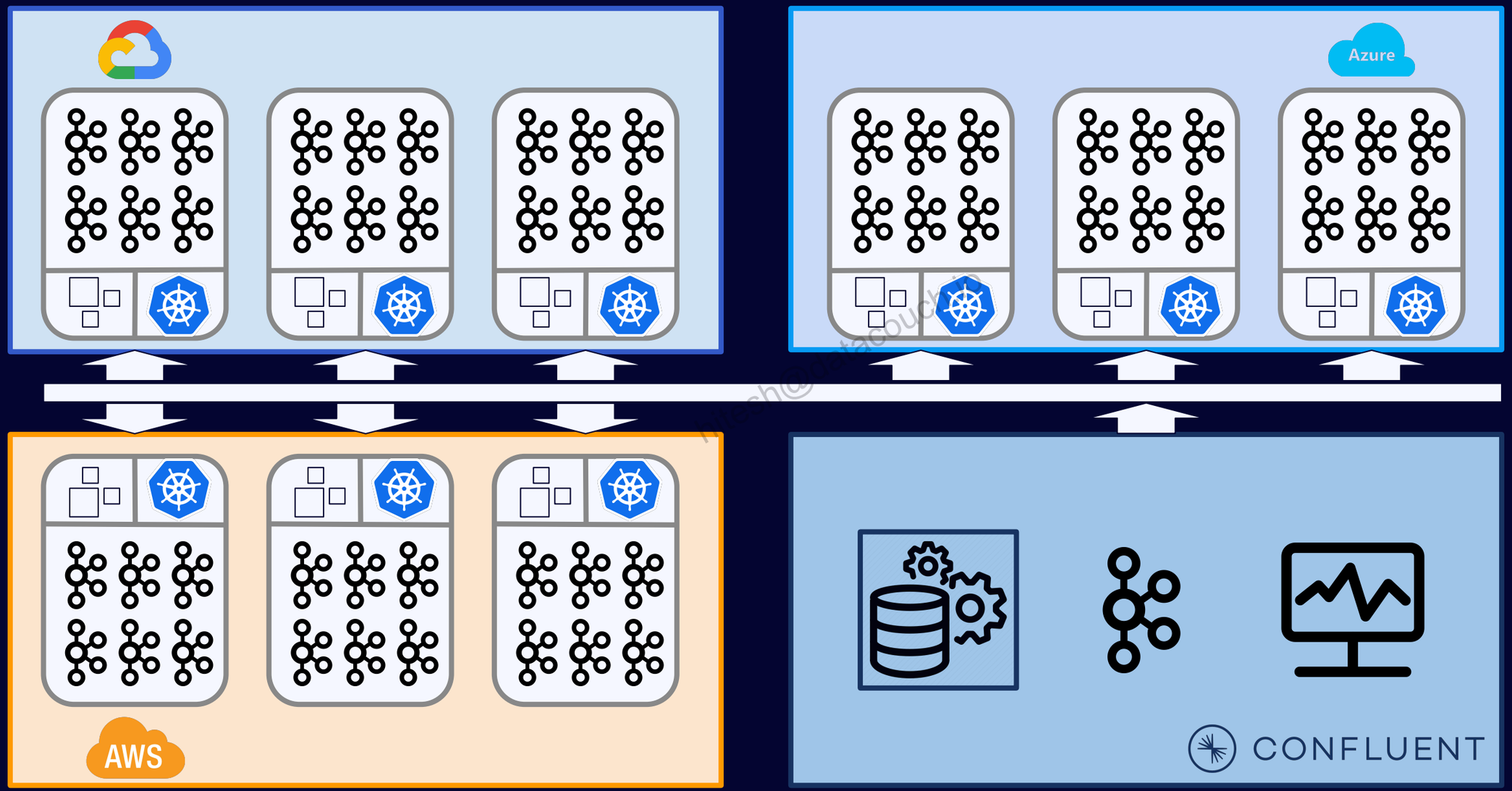
- Belongs to an organization
- Generally a logical separation of environments+region
  - dev/test/prod
  - us-west-2-prod
- Schema Registry

- Contains Multiple Clusters

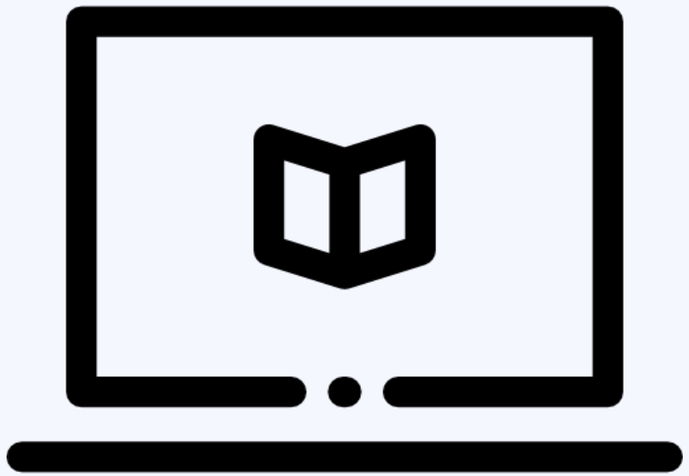
Cluster

- Belongs to an environment
- Topics
- Connectors
- ksqlDB
- Consumer Groups
- API Keys
- ACLs

Mothership and Cloud Providers



Labs overview



The lab will use a **Confluent Cloud** organisation.

- This has been either assigned to you
- Or you can create your own environment
  - For **Confluent** employees, create a new organisation using your email address with a subaddress, for example

    `username+private@confluent.io`

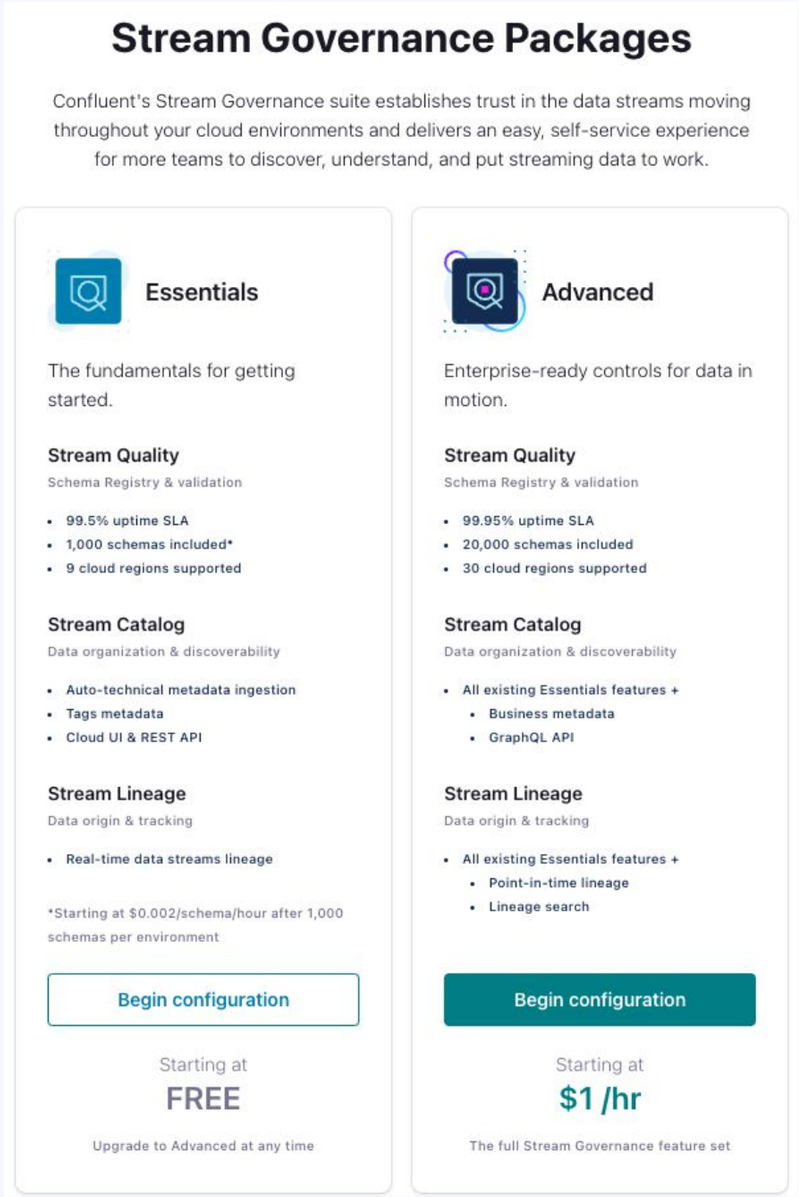
  - For **partners**, please create your own Confluent Cloud organisation. You will get $400 credits, enough for this bootcamp.

Lab 1: Basic Cluster

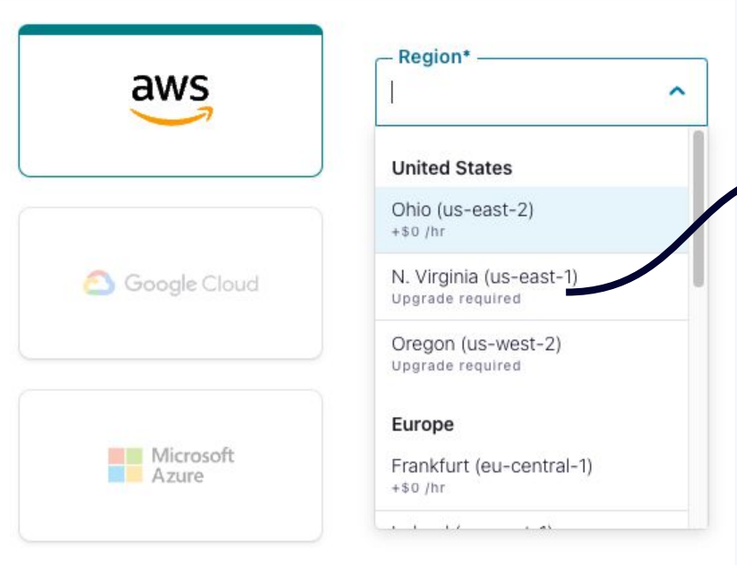
(Managed) Schema Registry

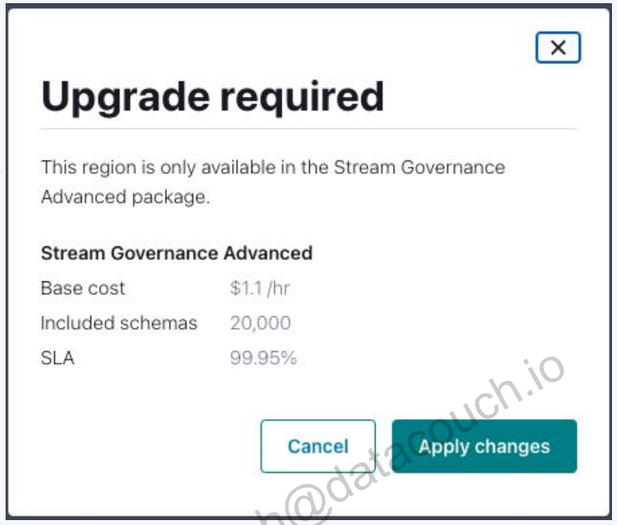
Stream Governance Packages

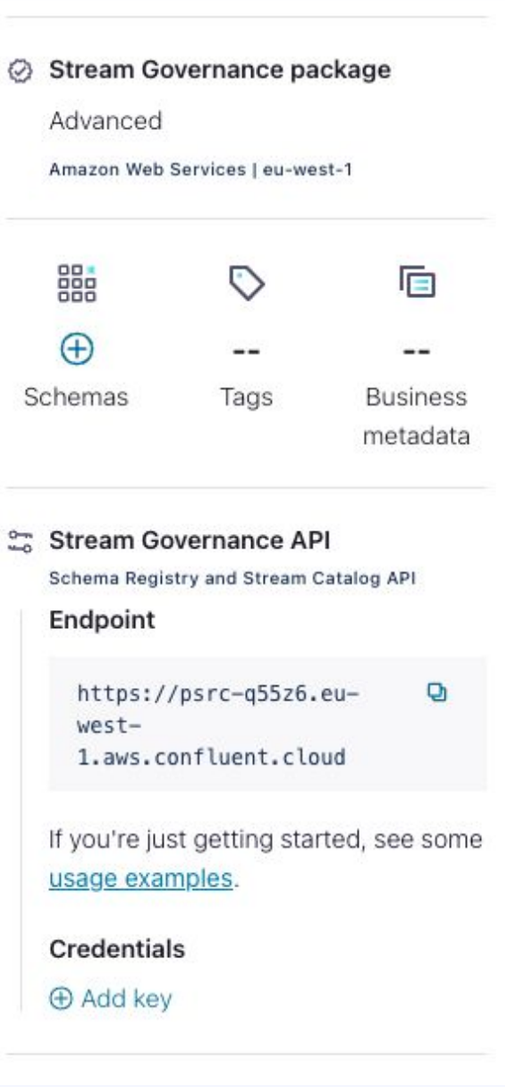
- Shared Kafka cluster instance
  - Essentials package only available in certain regions
- Single Schema Registry for a whole environment
- Only via public Internet
- Separate API Keys
- Essentials limit of 1,000 schema versions
  - $0.002 / schema-hr after that
  - Can be upgraded to Advanced
- Advanced limit of 20,000 schema versions



Enable Stream Governance Essentials







API Keys

Cloud API Keys

For use with CLI, REST Interface or Terraform

Resource API Keys

For applications

Schema registry

For accessing the (managed) schema registry.

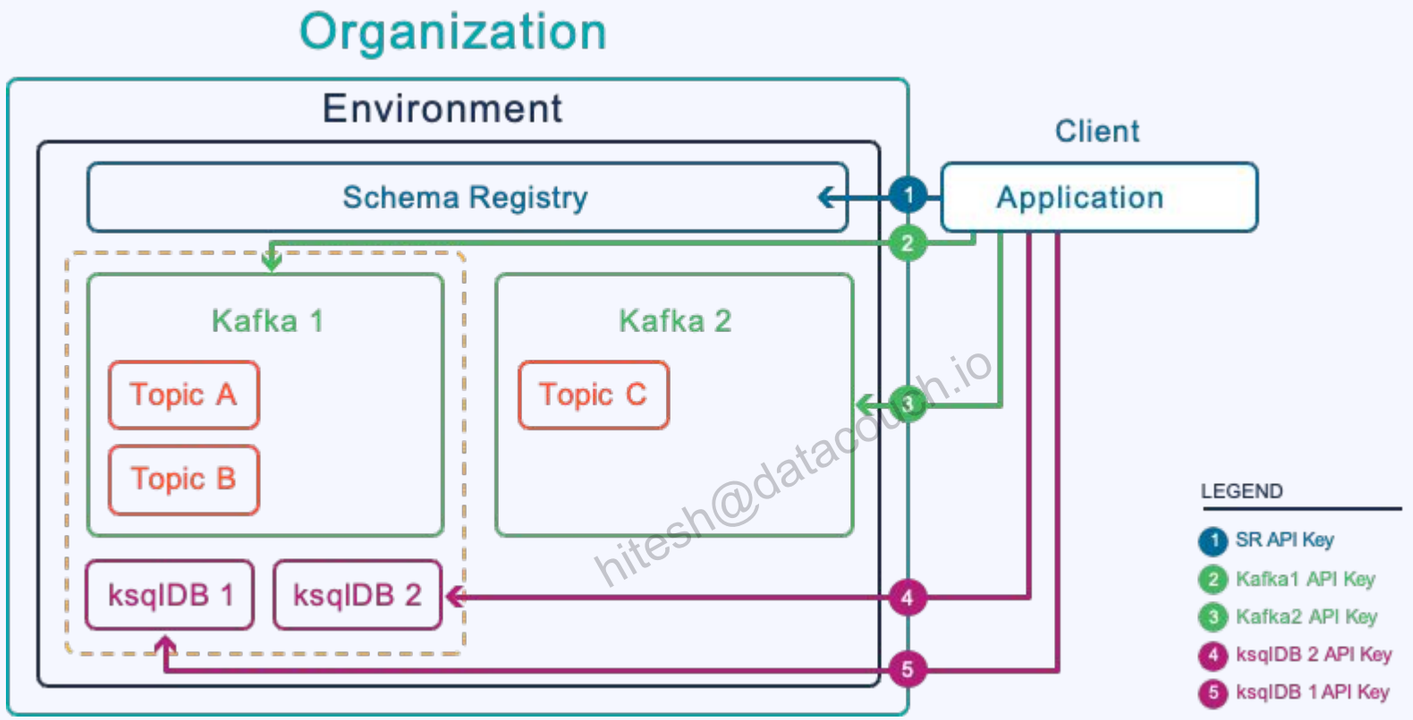
ksqlDB

For accessing ksqlDB through REST interface

Audit log and Metrics

For accessing the audit logs and metrics

API Keys Details




```
$ confluent api-key list
$ confluent api-key create --resource  lksqlc-xxxxx --service-account  sa-xxxxx
$ confluent api-key delete ESP4OMLMFQRNEXOC
$ confluent api-key list --service-account  sa-xxxxx
```

Basic Cluster Lab Goals and Hints

Understand the UI of Confluent Cloud and use it to create an environment and a “basic” cluster.

- Use Lab 1: Basic Cluster
  - Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the Confluent Cloud UI to create
  - An environment
  - An **Essentials** Schema Registry
  - A Basic Cluster
- Familiarize yourself with the features and configuration of your new cluster

Target time: 1 hour

Lab 2: Clients

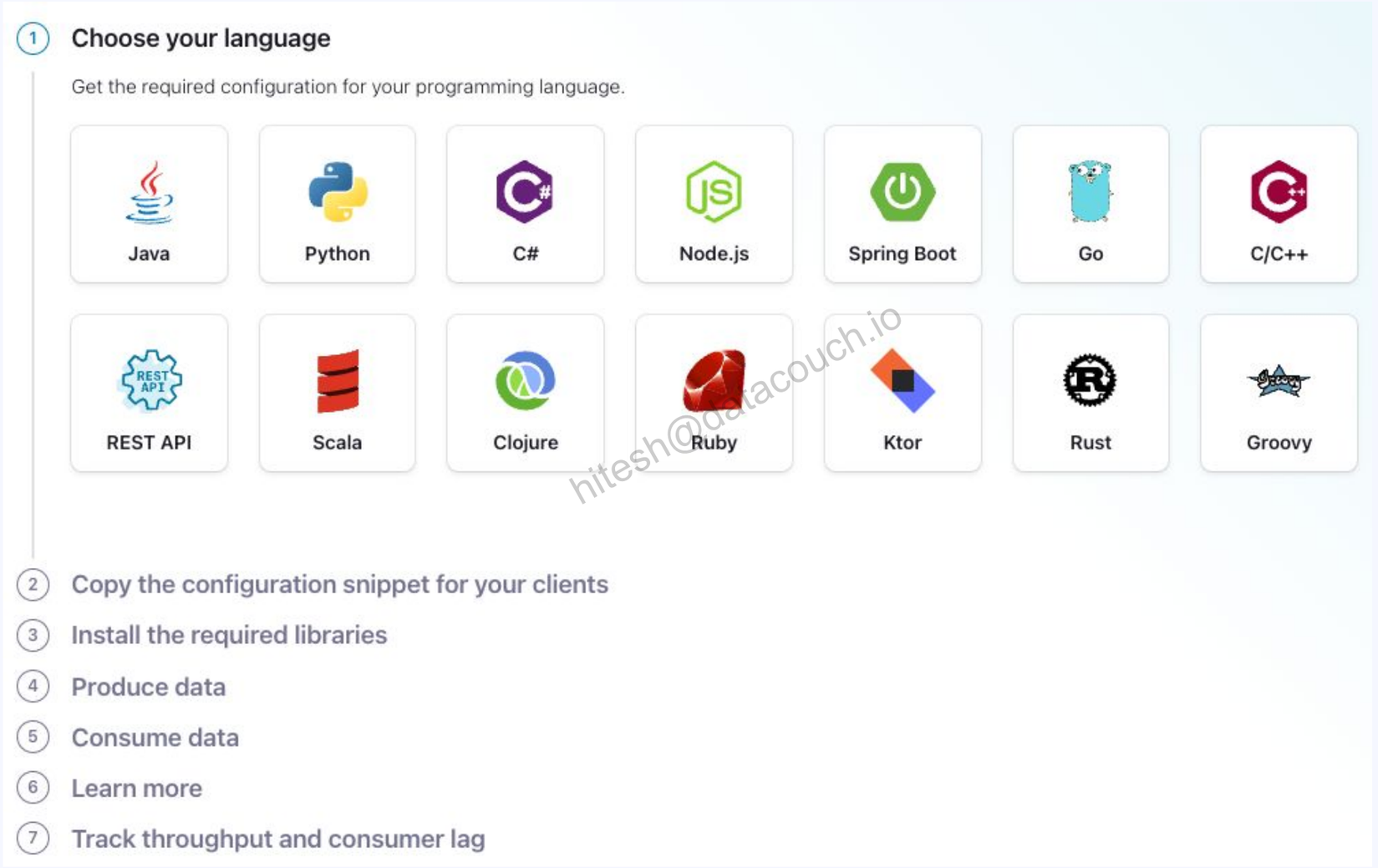
Configuring client applications

Confluent CLI

- Confluent CLI basic setup
  - `confluent login`
  - To avoid future cluster selection, you can do:

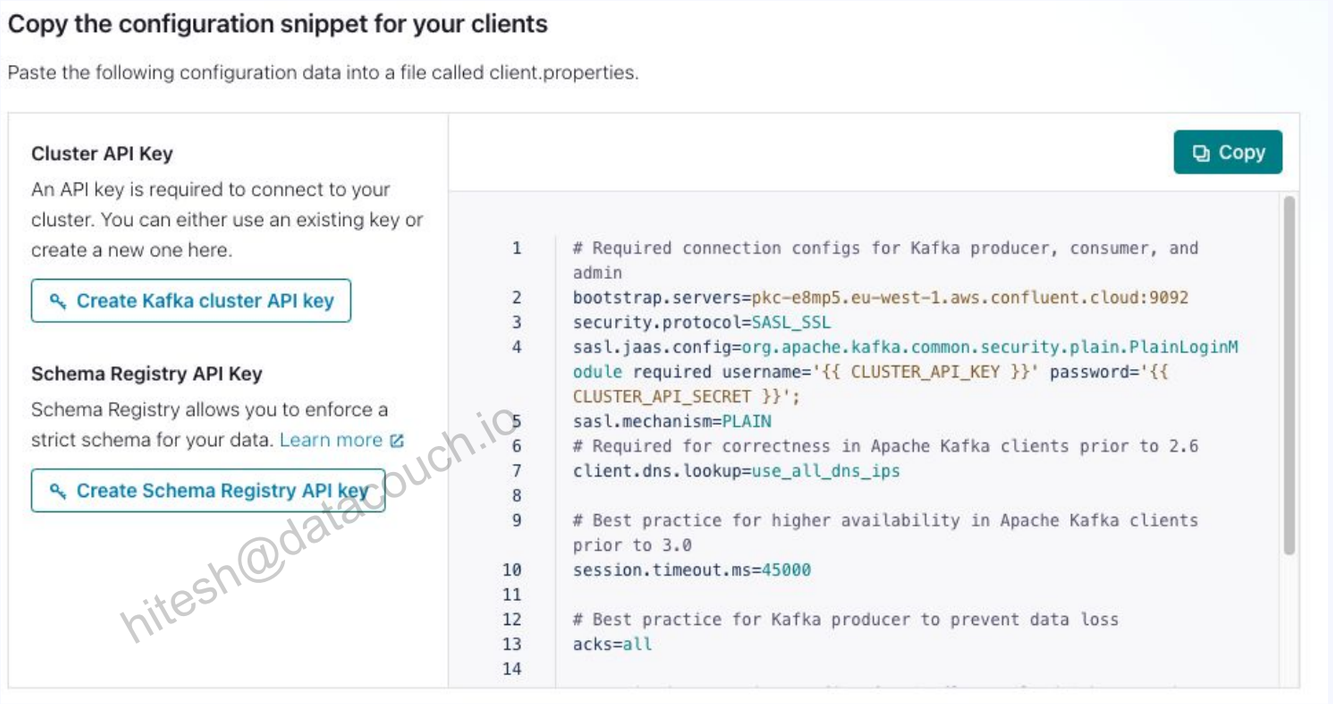
    ```
    confluent environment use <environment-id>

    confluent kafka cluster use <cluster-id>
    ```
- Your confluent cli configuration will be saved under ~/.confluent/config.json.
- Confluent CLI can be used to perform any admin tasks and to produce and consume from topics
  - `confluent kafka topic produce/consume`

New client



Create the client configuration

Java-based clients



C-based clients

Note there is no setting for the schema registry.

Clients Lab Goals and Hints

Run different producers and consumers against your new cluster.

Use API Keys, Service Users, ACLs and RBAC to secure access to the cluster and its resources.

- Use Lab 2: Clients
  - Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the Confluent Cloud UI to create
  - Some topics
  - Client configurations
  - API Key
- Run different clients as producers and consumers

Target time: 1 hour

Lab 3: ACLs and RBAC

User Accounts, Service Accounts and API Keys

Accounts

User Accounts

- Associated with an email address
  - Users are not created, they are *invited*
- Can access the Confluent Cloud services and log into the Confluent Cloud UI
- API Keys created for a User Account (**Global Access**) have superuser powers and can access all resources, if the correct RBAC role has been assigned.
- Can be created via
  - CCloud UI
  - **confluent** CLI
  - REST API
  - terraform provider (>= 1.37.0)

Service Accounts

- Not associated with a human user
  - Meant for applications and connectors
- Can only access the Confluent Cloud service
- Can have roles assigned (Standard/Dedicated)
- API Keys created for a service account (**Granular Access**) can have ACLs assigned
  - In addition or instead of roles
- Can be created via
  - CCloud UI
  - **confluent** CLI
  - REST API
  - terraform provider

Role-based Access Control (RBAC)

Can control access to:

- Organization
- Environment
- Kafka cluster
- Schema Registry
- ksqlDB cluster
- Pipelines
- Network
- ...

Predefined Roles:

- OrganizationAdmin
- EnvironmentAdmin
- CloudClusterAdmin
- Operator
- KsqlAdmin
- NetworkAdmin
- MetricsViewer
- ResourceOwner
- DeveloperRead
- DeveloperWrite
- ...

Access Control Lists (ACLs)

- Lower Level Access Control
- Applies to Service Accounts (via REST) or API Keys (via UI)

ACLs and RBAC Lab Goals and Hints

Learn how to assign permissions in Confluent Cloud via ACLs and RBAC.

Use different setups, and understand how to use authorization effectively.

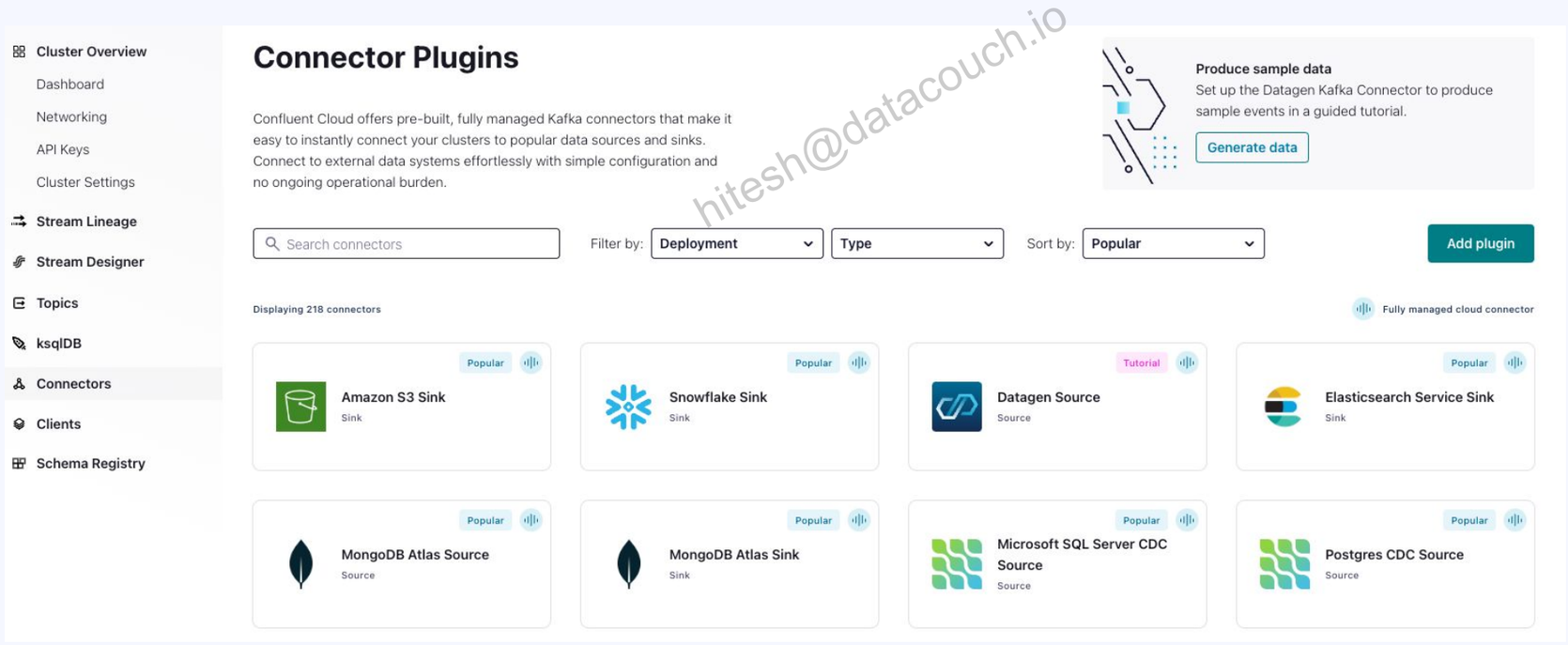
- Use Lab 3: ACLs and RBAC
  - Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the Confluent Cloud UI to create
  - Another API Key with specific ACLs
  - Service users with specific roles using RBAC
- Test different clients with specific permissions
  - Verify your assumptions - can you block a user/API key from having access to a resource?

Target time: 1 hour

Lab 4: Managed Connectors

Connect cluster

- Managed connectors (subset but growing number of existing connectors)
  - New: you can also upload your own connector plugins
- Networking access only possible for
  - Publicly available sources and sinks
  - VPC Peering or AWS Transit Gateway (which enables two-way communication)



Managed Connectors Lab Goals and Hints

Understand how to set up and configure a managed connector, here a Datagen Connector.

Ensure the connector has the correct permissions to access just the topics it needs.

- Use Lab 4: Managed Connectors
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the Confluent Cloud UI to create
  - A (managed) Datagen connector with global access (JSON format)
  - A Datagen connector with access to specific topics only (AVRO format)
- Use the CLI to create 3rd connector
- Verify your topics: are your connectors producing data?

Target time: 1 hour

Lab 5: OIDC

OpenID Connect (OIDC) Definition

What is OpenID Connect (OIDC)?

OpenID Connect (OIDC) is an identity layer built on top of the OAuth 2.0 framework. It allows **third-party applications** to verify the identity of the end-user and to obtain basic user profile information. OIDC uses JSON web tokens (JWTs), which you can obtain using flows conforming to the OAuth 2.0 specifications.

OpenID vs. OAuth2

While OAuth 2.0 is about resource access and sharing, **OIDC is about user authentication**. Its purpose is to give you one login for multiple sites. Each time you need to log in to a website using OIDC, you are redirected to your OpenID site where you log in, and then taken back to the website. For example, if you chose to sign in to Auth0 using your Google account then you used OIDC. Once you successfully authenticate with Google and authorize Auth0 to access your information, Google sends information back to Auth0 about the user and the authentication performed. This information is returned in a JWT. You'll receive an access token and if requested, an ID token.

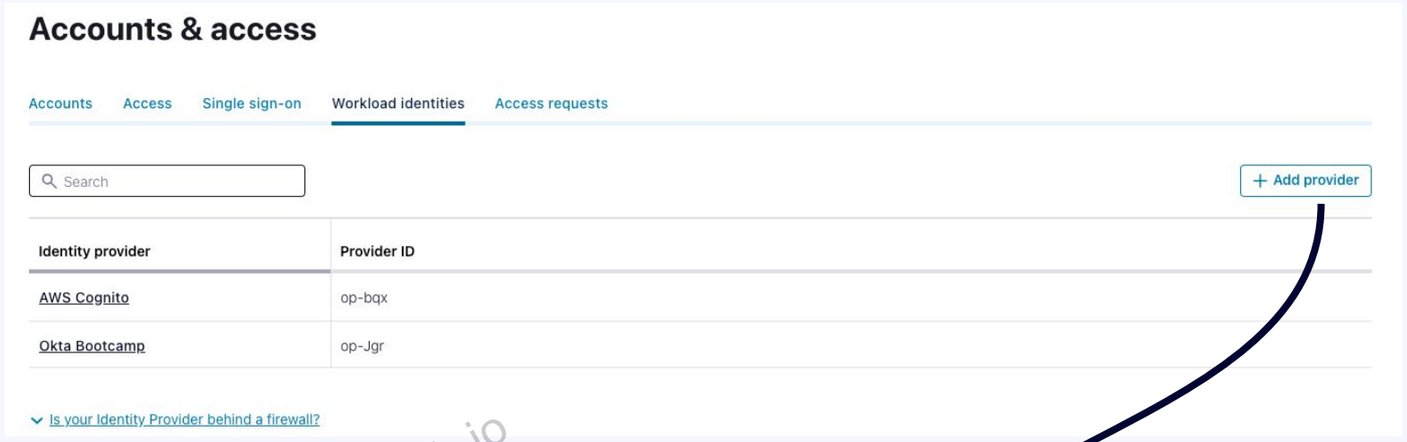
OpenID and JWTs

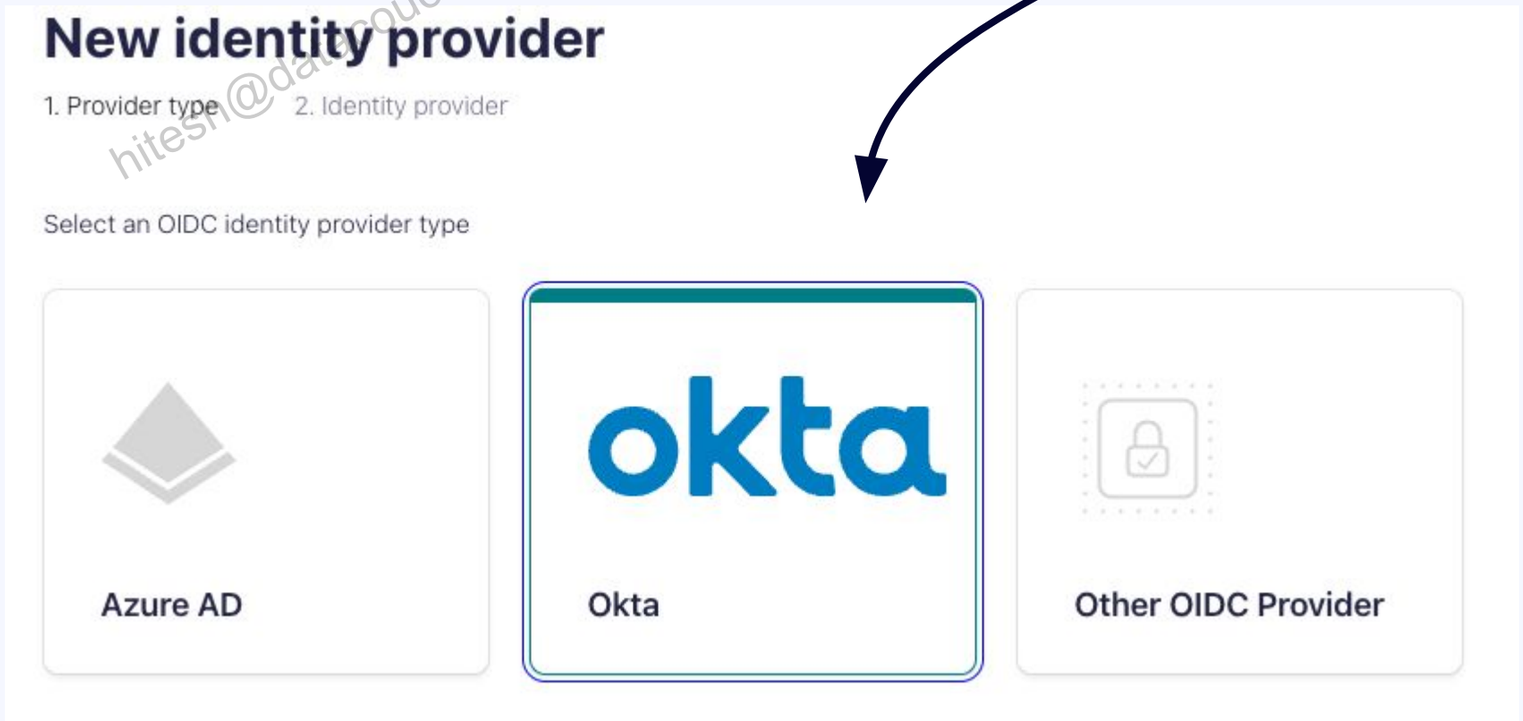
JWTs contain claims, which are statements (such as name or email address) about an entity (typically, the user) and additional metadata. The OpenID Connect specification defines a set of standard claims. The set of standard claims include name, email, gender, birth date, and so on. However, if you want to capture information about a user and there currently isn't a standard claim that best reflects this piece of information, you can create custom claims and add them to your tokens.

https://auth0.com/docs/authenticate/protocols/openid-connect-protocol#openid-vs-oauth2

OIDC Identity Provider

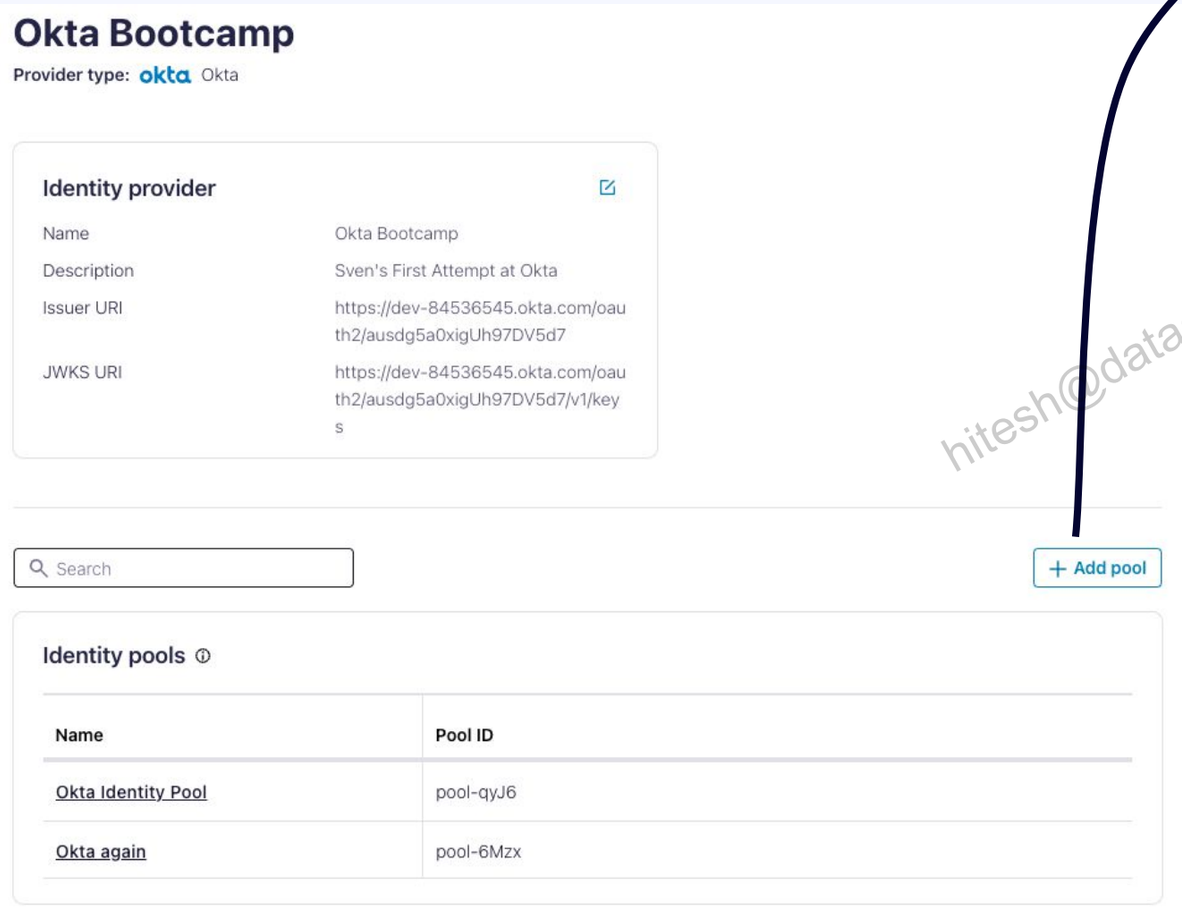
- External authentication via
  - Azure
  - Okta
  - Any other OIDC provider

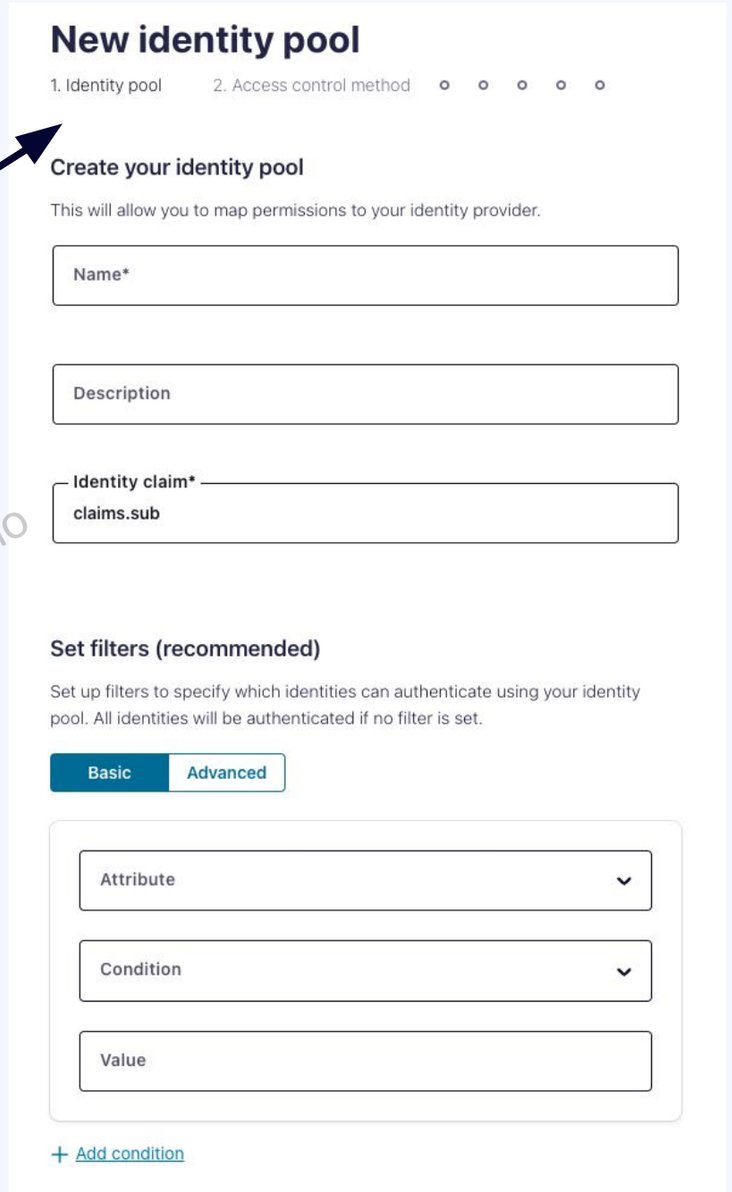




OIDC Identity Pool

- Identity Pool
  - Connects providers to permissions





OIDC Lab Goals and Hints

Learn to set up and configure an OIDC provider, and use it to authenticate a client.

- Use Lab 5: OIDC
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the Confluent Cloud UI to set up
  - A Workload Identity Provider
  - An identity pool with a filter
- Create a client configuration to use that pool.
- Verify your access. Can you produce and consume with these credentials?

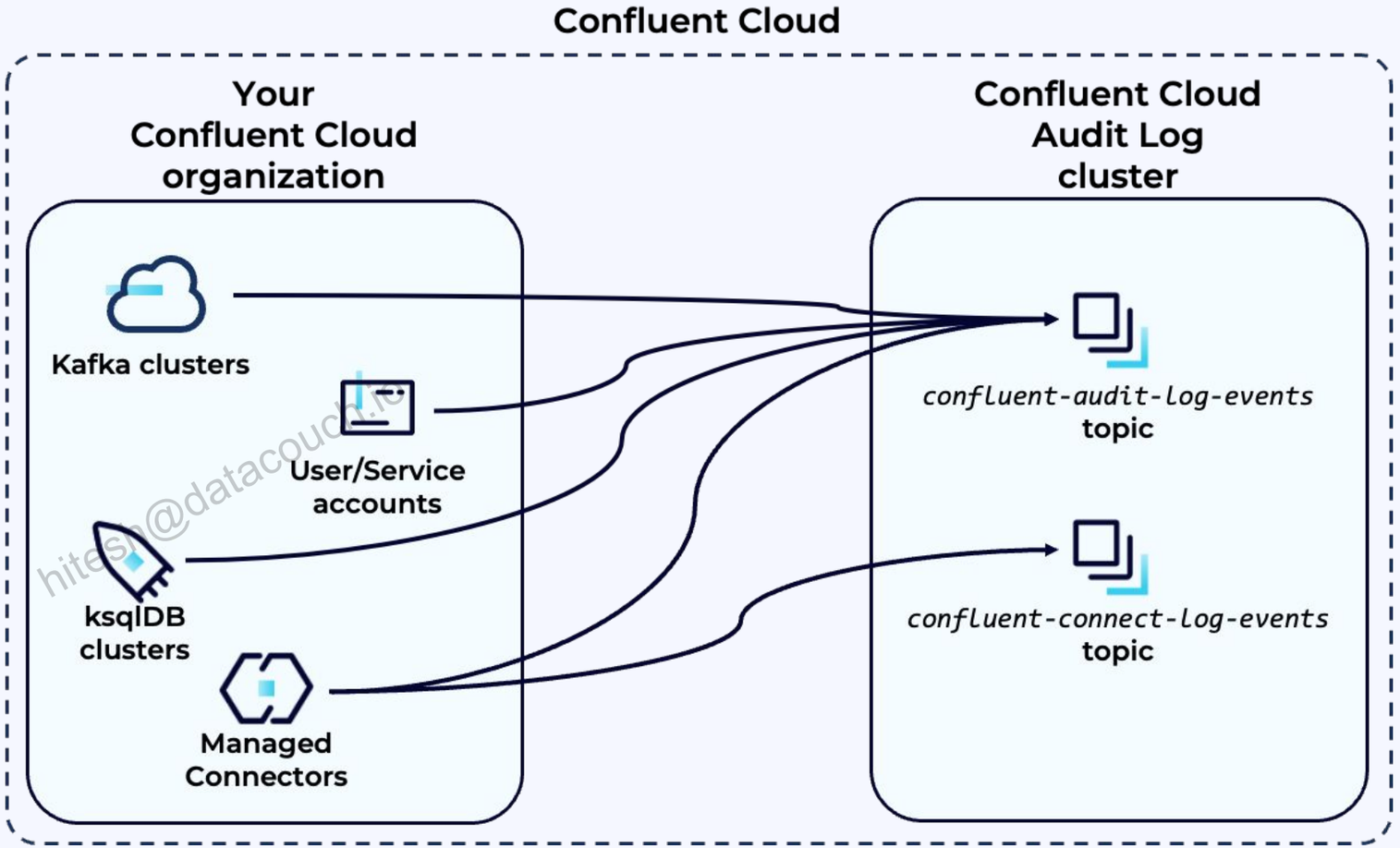
Target time: 1 hour

Lab 6: Audit Logs and Metrics

Audit logs in a separate Kafka cluster

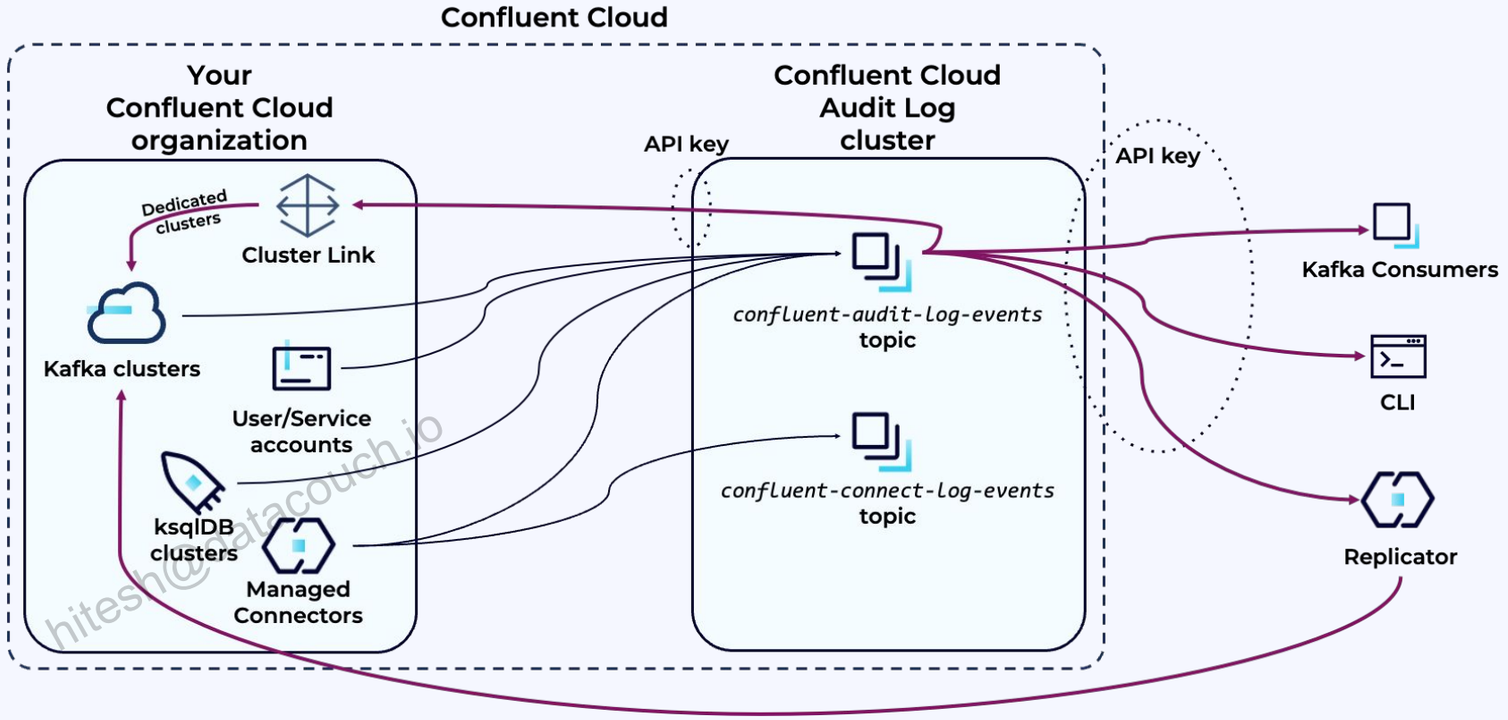
- Audit log events are stored centrally in a separate Audit Log cluster
- Managed connector logs follow the same pattern
- Retained for seven days

- Need a separate API Key to be able to access the audit log
  - Limited to 2 API Keys per organisation



Accessing Audit logs

- Can use a standard Kafka consumer
- Alternatively, use the Replicator to transfer data to another cluster
- In a later lab, we will use a Cluster Link to mirror the audit logs into your own (dedicated) cluster.



Accessing Metrics

- First-class integrations with third-party monitoring providers:
  - Datadog
  - Dynatrace
  - **Grafana Cloud**
  - Prometheus
  - New Relic OpenTelemetry
  - Directly querying the Confluent Cloud Metrics API

- Create a new Service Account:
  - Cloud API Key (Authentication)
  - MetricsViewer role (Authorization)

- **Metrics are retained for seven days**

Audit Log and Metrics Lab Goals and Hints

Learn how to set up and use audit logs and metrics.

- Use Lab 6: Audit Log and Metrics
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the Confluent Cloud UI to get access to the Audit Log for your cluster
- Use a free Grafana Cloud account to display metrics about your cluster

Target time: 1 hour

End of Day 1

Begin of Day 2

Summary of Day 1

We have

- Created an Environment, Schema Registry and Basic Cluster
- Connected various clients
- Set up authentication and authorization (API Keys and OIDC)
- Created managed connectors
- Investigated the audit log and metrics

Deep Dive: Networking

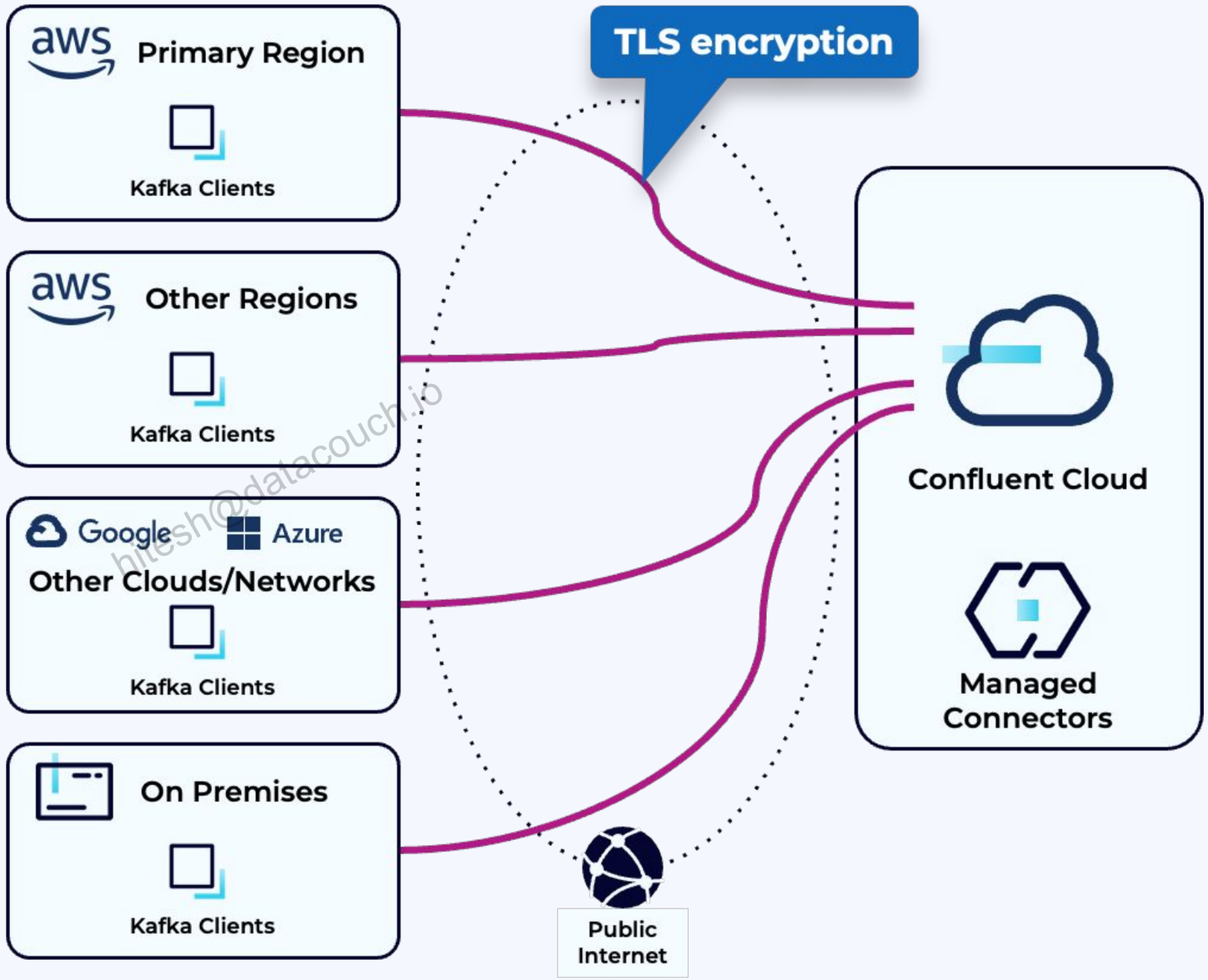
Public endpoints

Shared clusters (Basic and Standard) only have public endpoints.

A dedicated cluster can choose to use a public endpoint.

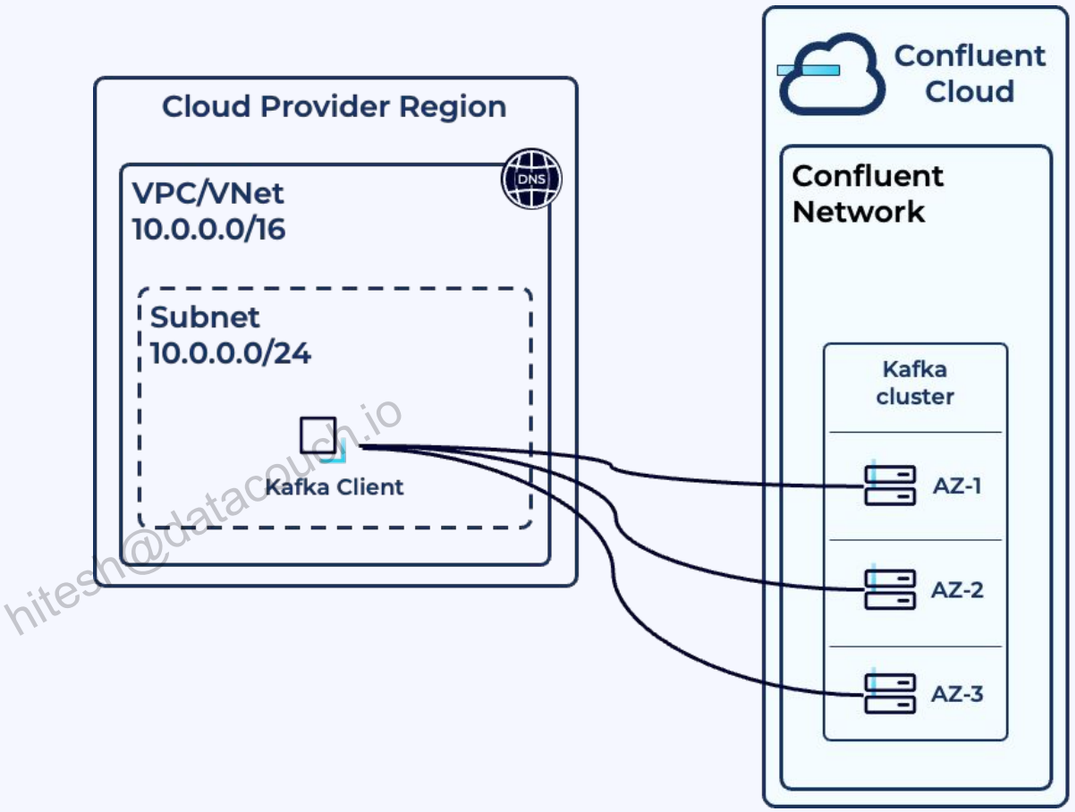
Public endpoints are visible to anyone who knows the DNS name, and are only protected via the API Key and secret.

All access to a Confluent Cloud instance is always encrypted.



Private networking options

- Only accessible from private VPC
- Requires separate networking step to configure the cluster

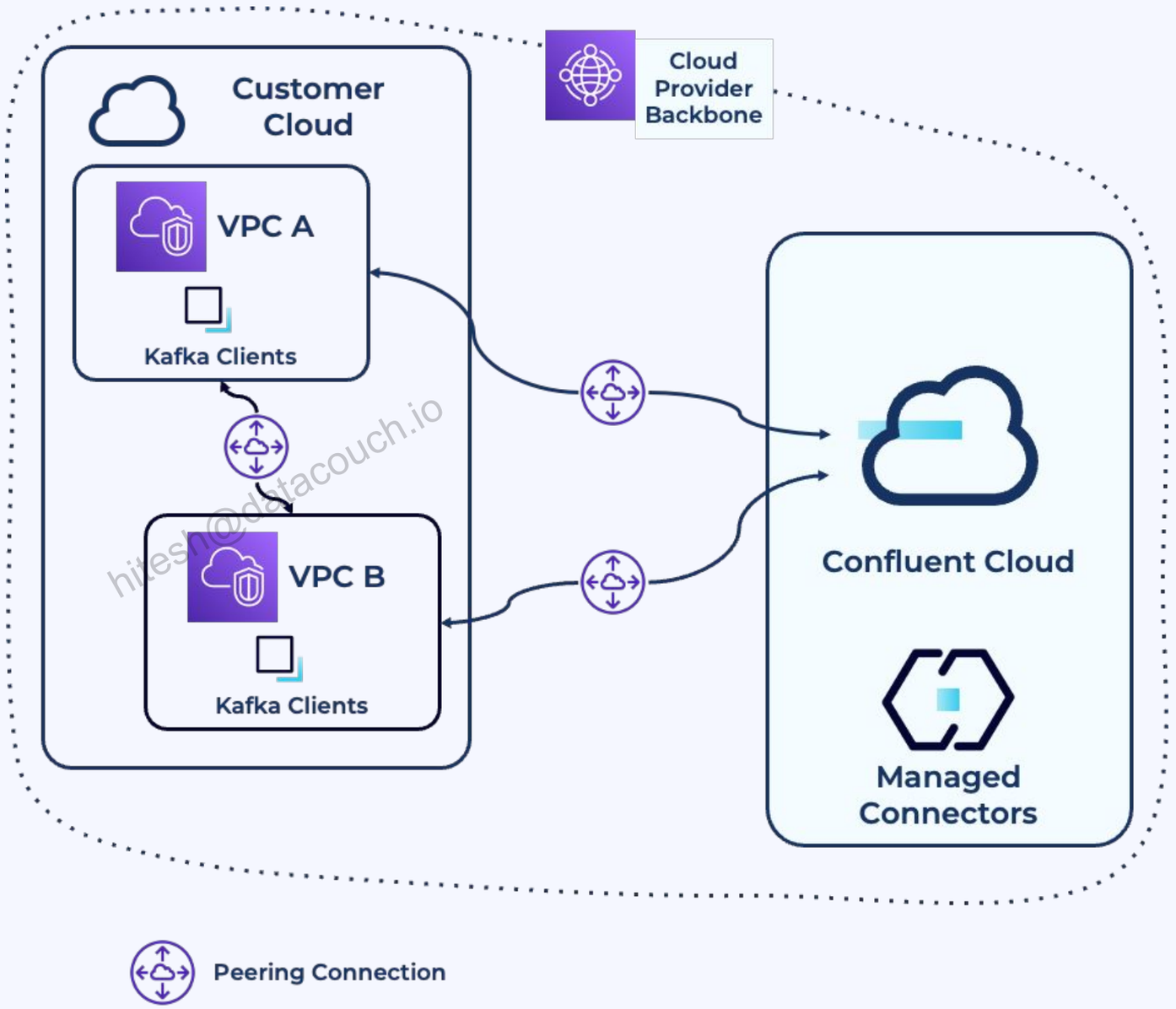


VPC Peering

VPC Peering connects two VPCs so that resources in each network can communicate with each other. It is **bi-directional**.

Ensure that the IP address ranges of CCloud and Customer VPC do not overlap.

Only the customer VPC can access CCloud.

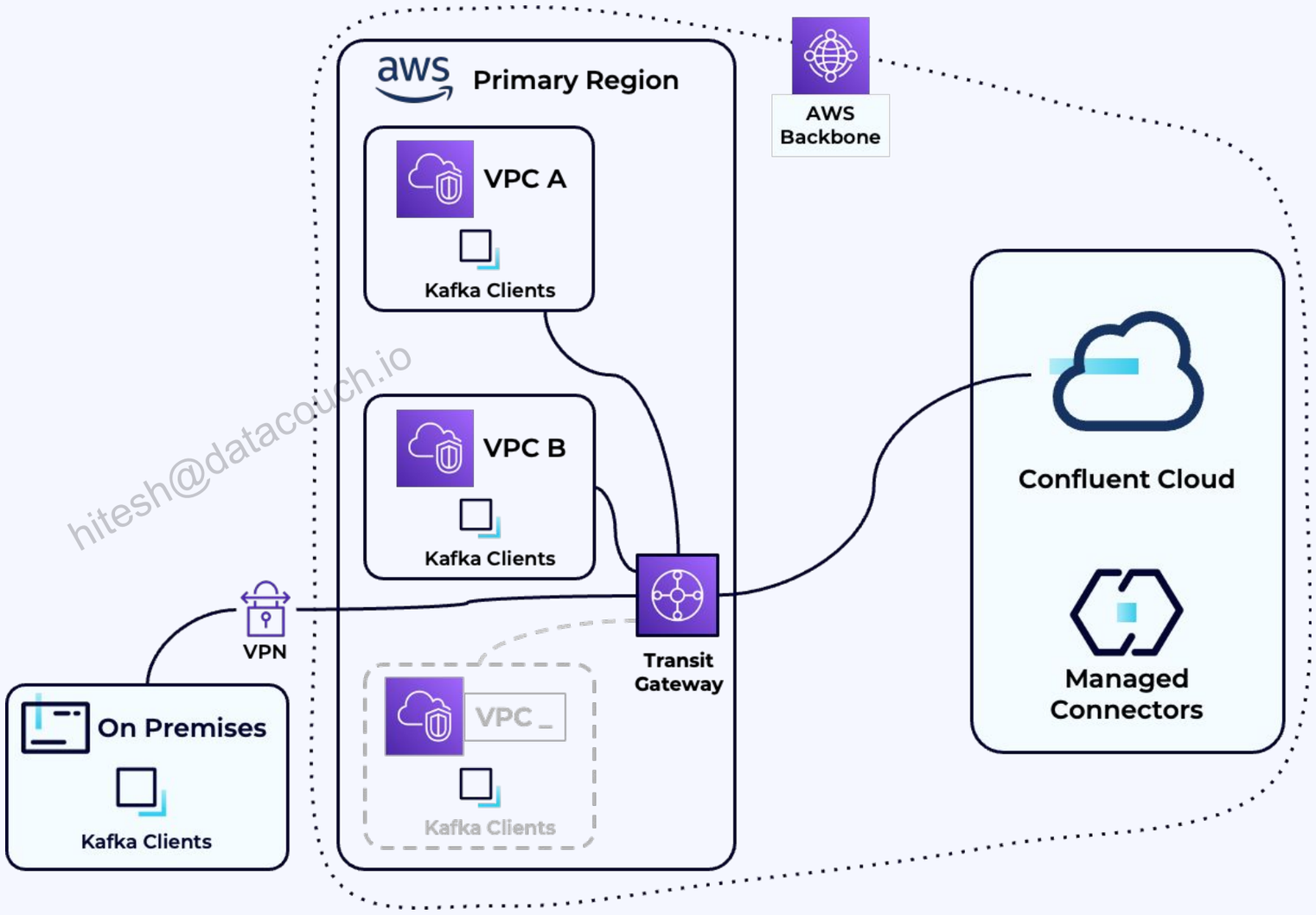


AWS Transit Gateway

AWS Transit Gateway connects VPCs and on-premises networks through a central hub.

This simplifies your network and puts an end to complex peering relationships.

It acts as a cloud router – each new connection is only made once.

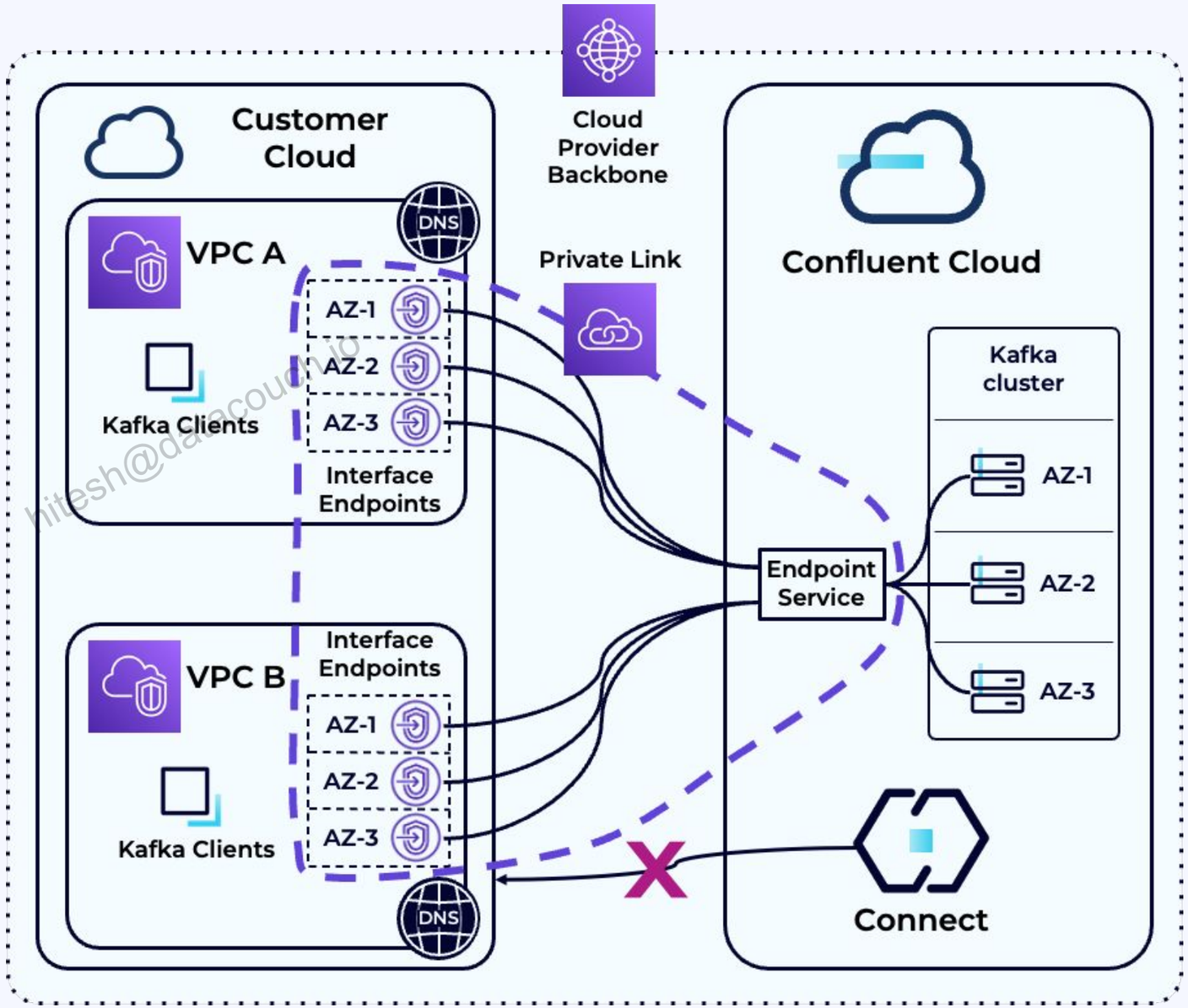


Private Link (all clouds)

PrivateLink offers **one-way** connectivity from your VPC to a Confluent Cloud cluster, without any coordination of CIDR ranges.

PrivateLink connections to Confluent Cloud can only be made from VPCs in registered customer cloud accounts.

Managed connectors **cannot** route into resources in the Customer Cloud.



Lab 7: Enterprise Cluster

Setting up an Enterprise Cluster

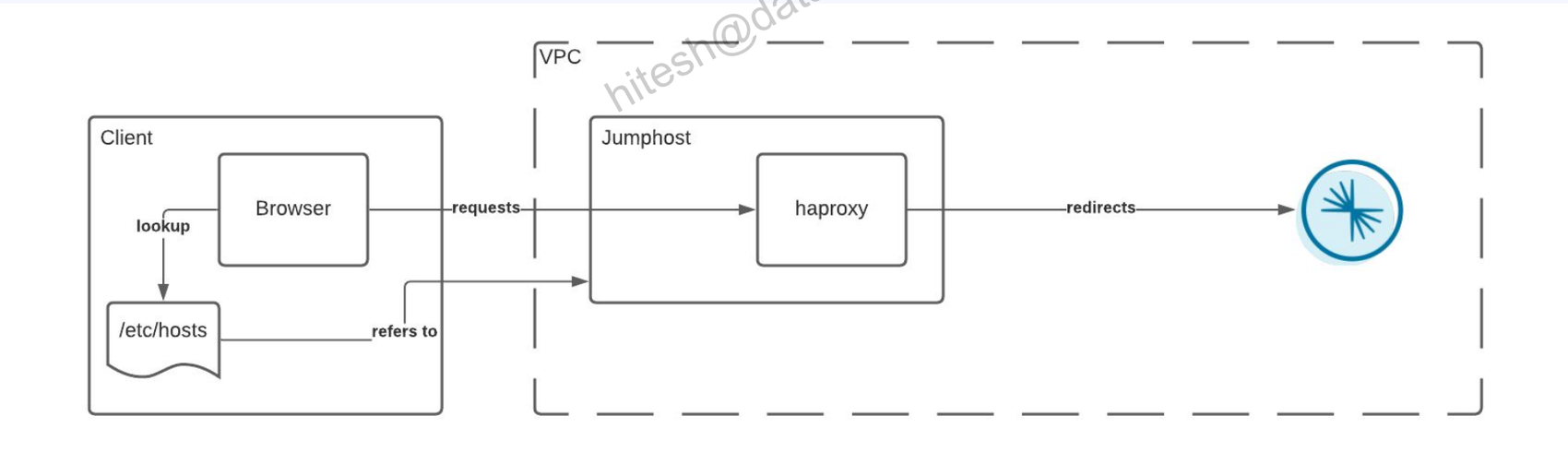
- An Enterprise cluster will always use a Private Link for networking
- Limited access via UI
  - Cannot see or modify topics or KSQL queries
  - Either:
    - Access via CLI only
  - Alternative:
    - Use a Proxy
- After creating the Enterprise Cluster, need to set up the Private Link Connection to your VPC

Proxy Setup

haproxy

- When private networking is set up for CCloud, you cannot access topics anymore through the GUI.
  - Same is true for ksqlDB queries

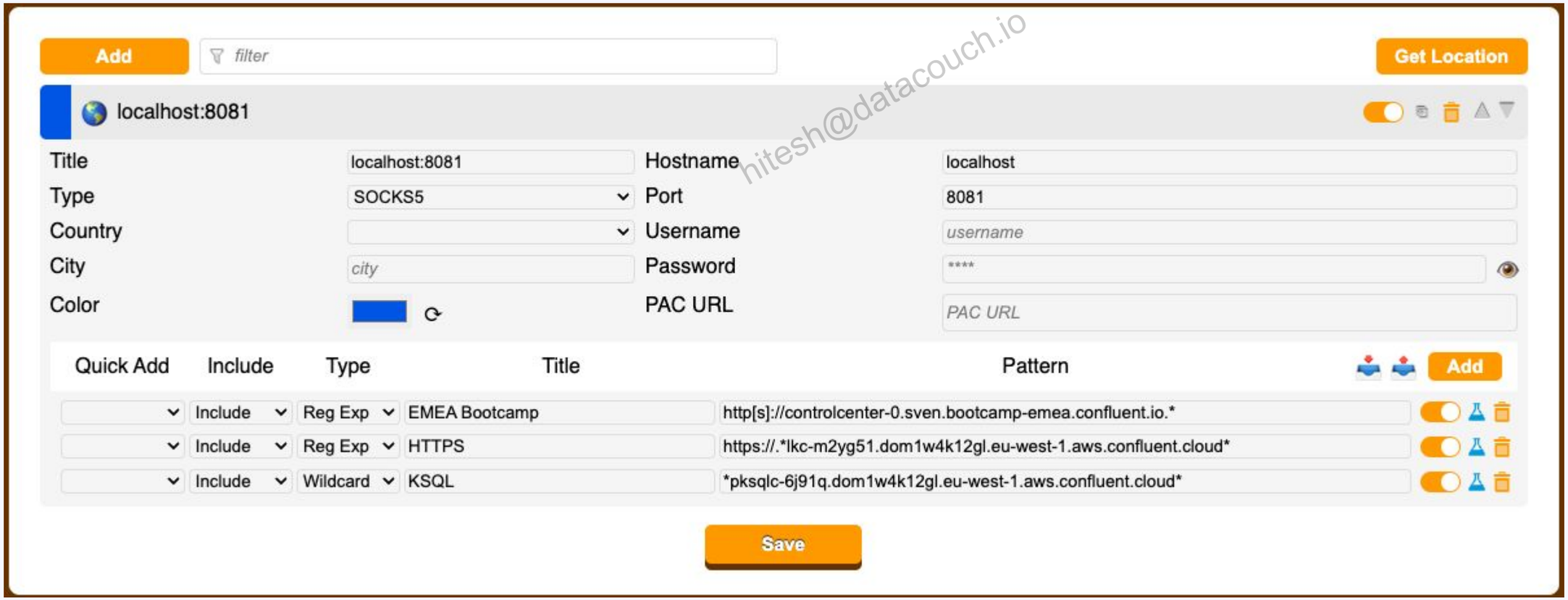
- We need to set up a proxy and redirect your request to CCloud in order to use the UI correctly.
- Can use **haproxy**, **nginx**, or any other Proxy technology



- Customers will do this using their networking team

Alternative: dynamic (SOCKS5) proxy

- Connect to your jumphost with the option -D <portnumber>, for example
  - ssh -D 8081 -i ~/.ssh/bootcamp.pem ubuntu@63.33.215.171
- Set up a Proxy in your browser, for example FoxyProxy
  - Configure a proxy connection to localhost:8081
  - Configure an URL for which the proxy should redirect, your CCloud instance (shown in a red banner)



Enterprise Cluster Lab Goals and Hints

Create an Enterprise cluster and connect it via a private link to an AWS VPC.

- Use Lab 7: Enterprise Cluster
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Create an AWS VPC
- Use the Confluent Cloud UI to create an Enterprise Cluster
- Configure a private link to your VPC
- Test the cluster
- Create a Proxy solution to enable topics management from the UI

Target time: 1 hour

Lab 8: Dedicated Cluster

CKU - Confluent Unit for Kafka

Unit	Limit
MBps ingress	50
MBps egress	150
TB storage	Infinite
Partitions	4,500
Connections	3,000
Connections/sec	500
Requests/sec	15,000

CKUs	Brokers
1	4
2	6
3	9
N (N>1)	3 * N

At least 2 CKU are required for multizone clusters.

For organizations with credit card billing, the upper limit is 4 CKUs per dedicated cluster. Clusters up to 100 CKUs are available by request.

For organizations with integrated cloud provider billing or payment using an invoice, the upper limit is 24 CKUs per dedicated cluster. Clusters up to 100 CKUs are available by request

Dedicated Cluster Lab Goals and Hints

Create an dedicated cluster and connect it via a private link to an AWS VPC.

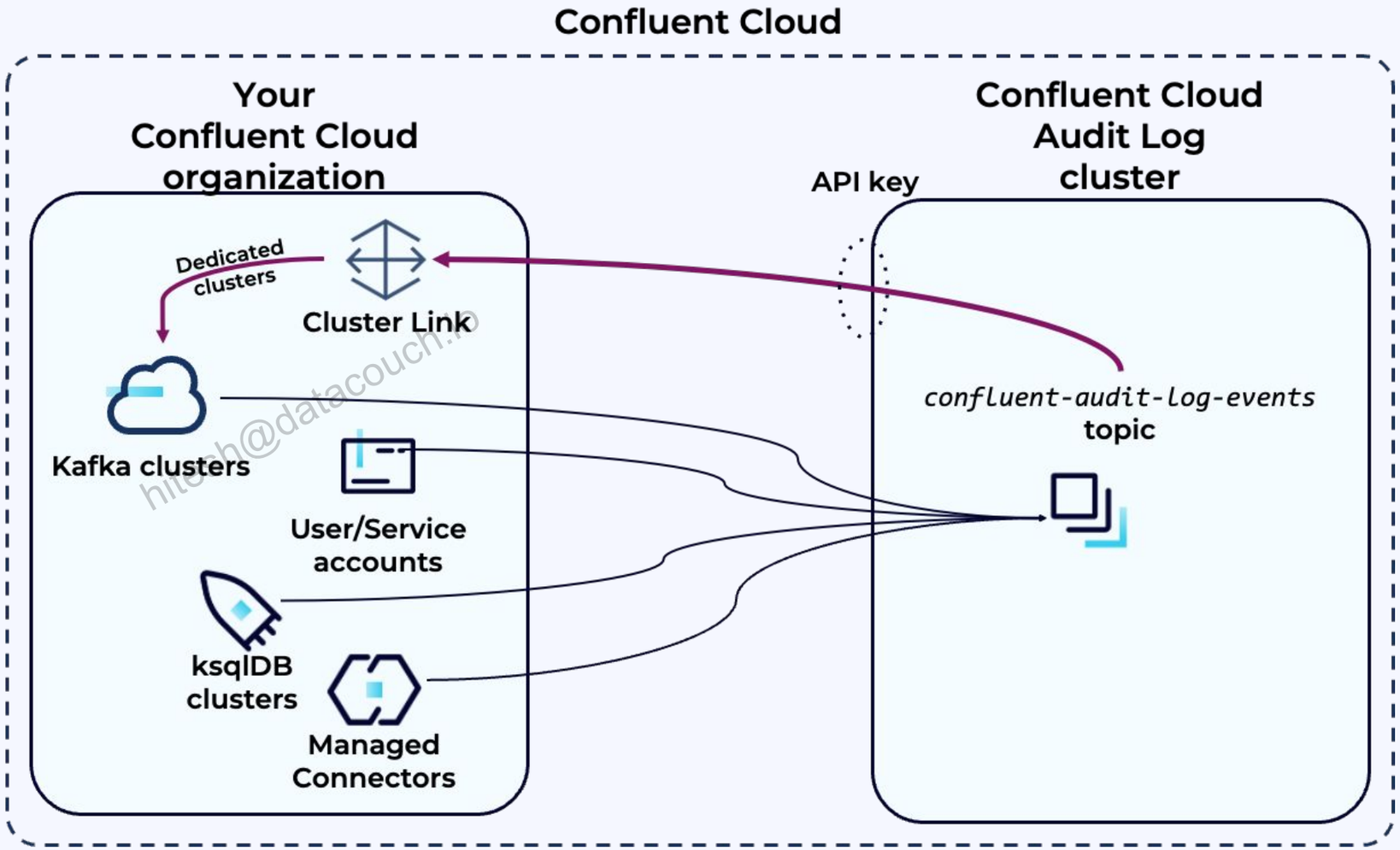
- Use Lab 8: Dedicated Cluster and Private Links
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the VPC and dedicated cluster you used in the previous (Enterprise Cluster) lab
- Configure a private link to your VPC
- Test the cluster
- Use your proxy solution to enable topics management from the UI

Target time: 1 hour

Lab 9: Audit Log via Cluster Linking

Connect audit log via Cluster Linking

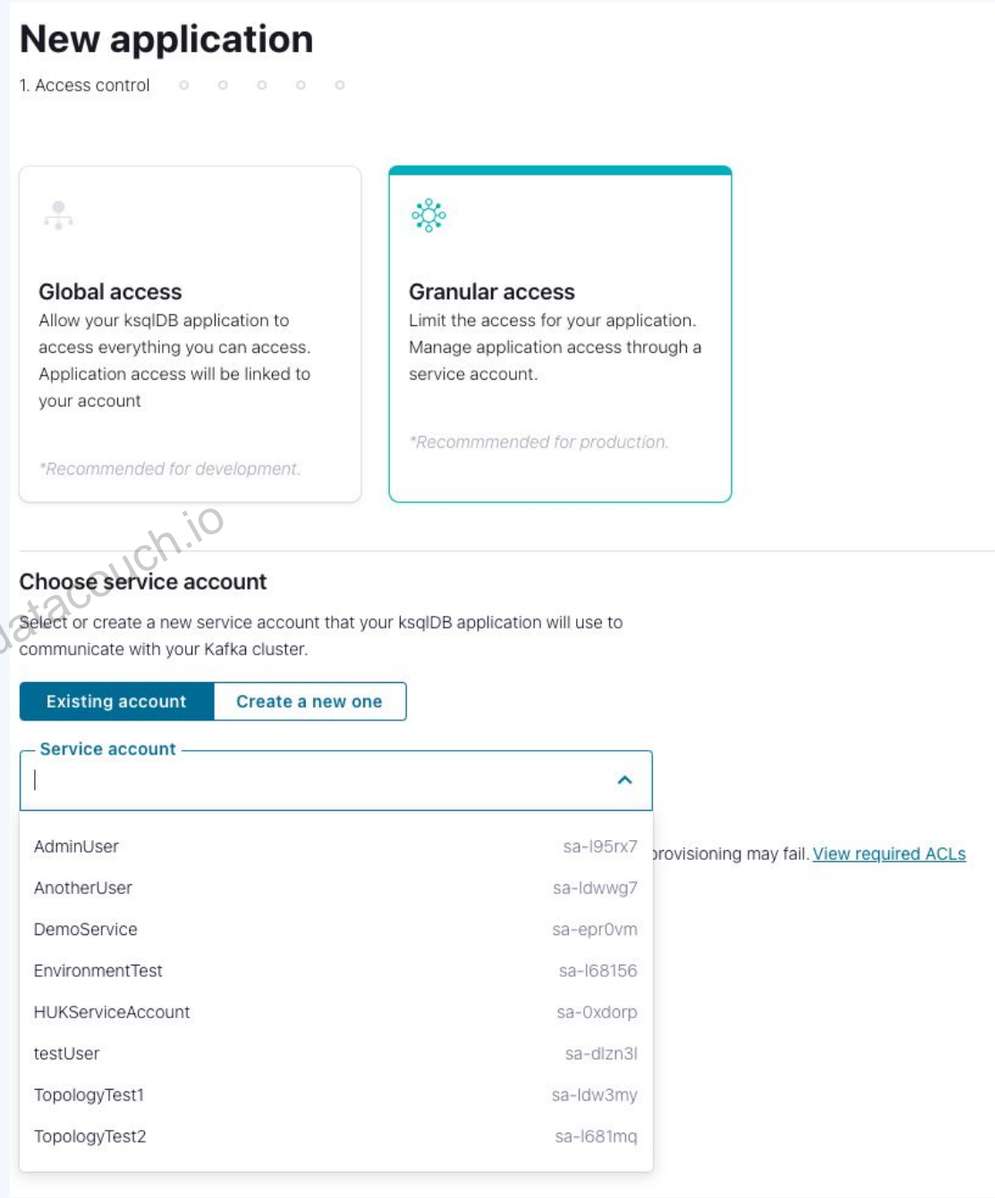
- Use Cluster Linking to mirror audit log topic into your own cluster
- Allows you to analyse events via managed ksqlDB



ksqlDB

- Hosted ksqlDB
- Limitations?
  - UDAF & UDTF are not possible on the Cloud.
  - 20 Persistent Queries
  - You can have a maximum of 10 ksqlDB clusters per environment
  - Some limitations on pull queries

- Alternative: self-hosted ksqlDB
  - Full flexibility



Dedicated Cluster Lab Goals and Hints

Use Cluster Linking to bring the audit logs for your organization into your dedicated cluster.

Use ksqlDB to shape, filter, and analyse the data.

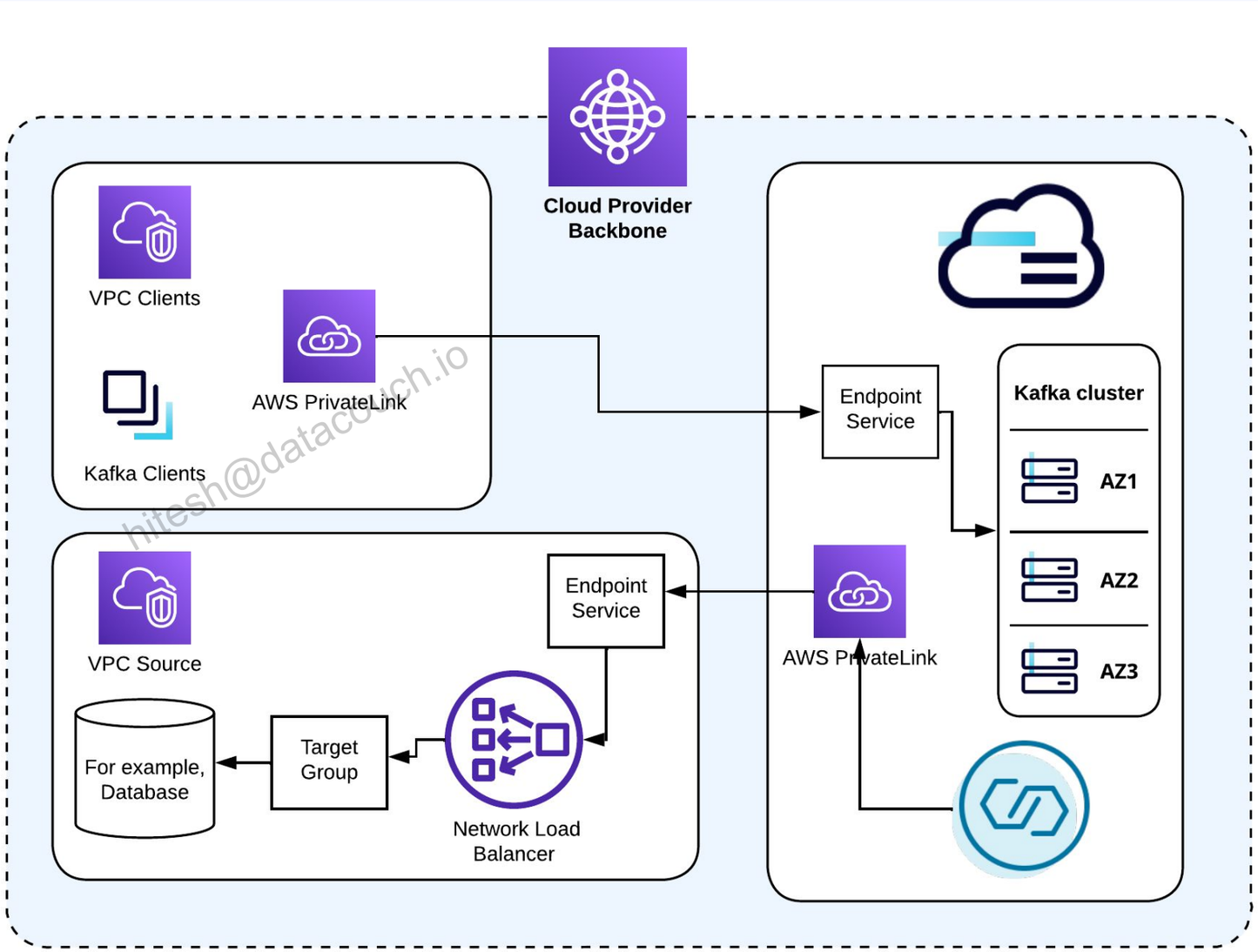
- Use Lab 9: Audit Logs revisited
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the dedicated cluster from the previous lab
- Configure a cluster link to the audit log data
- Create a ksqlDB cluster and use it to analyse your audit data
  - You will have to use your proxy solution to enable ksqlDB management from the UI

Target time: 1 hour

Lab 9a: Egress Access Points

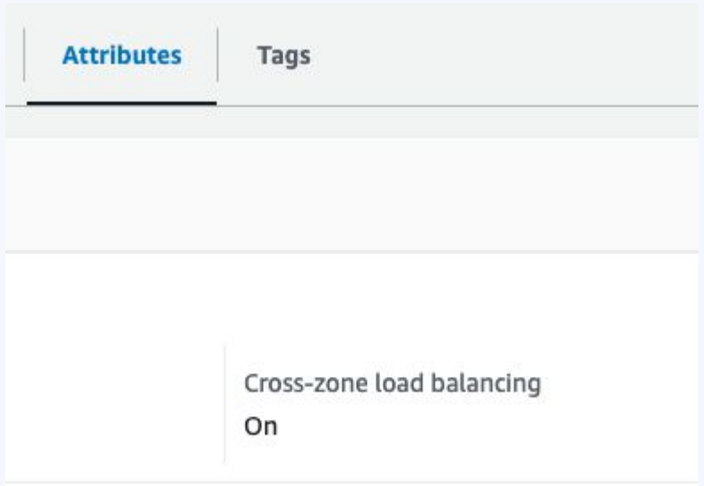
Egress Access Points

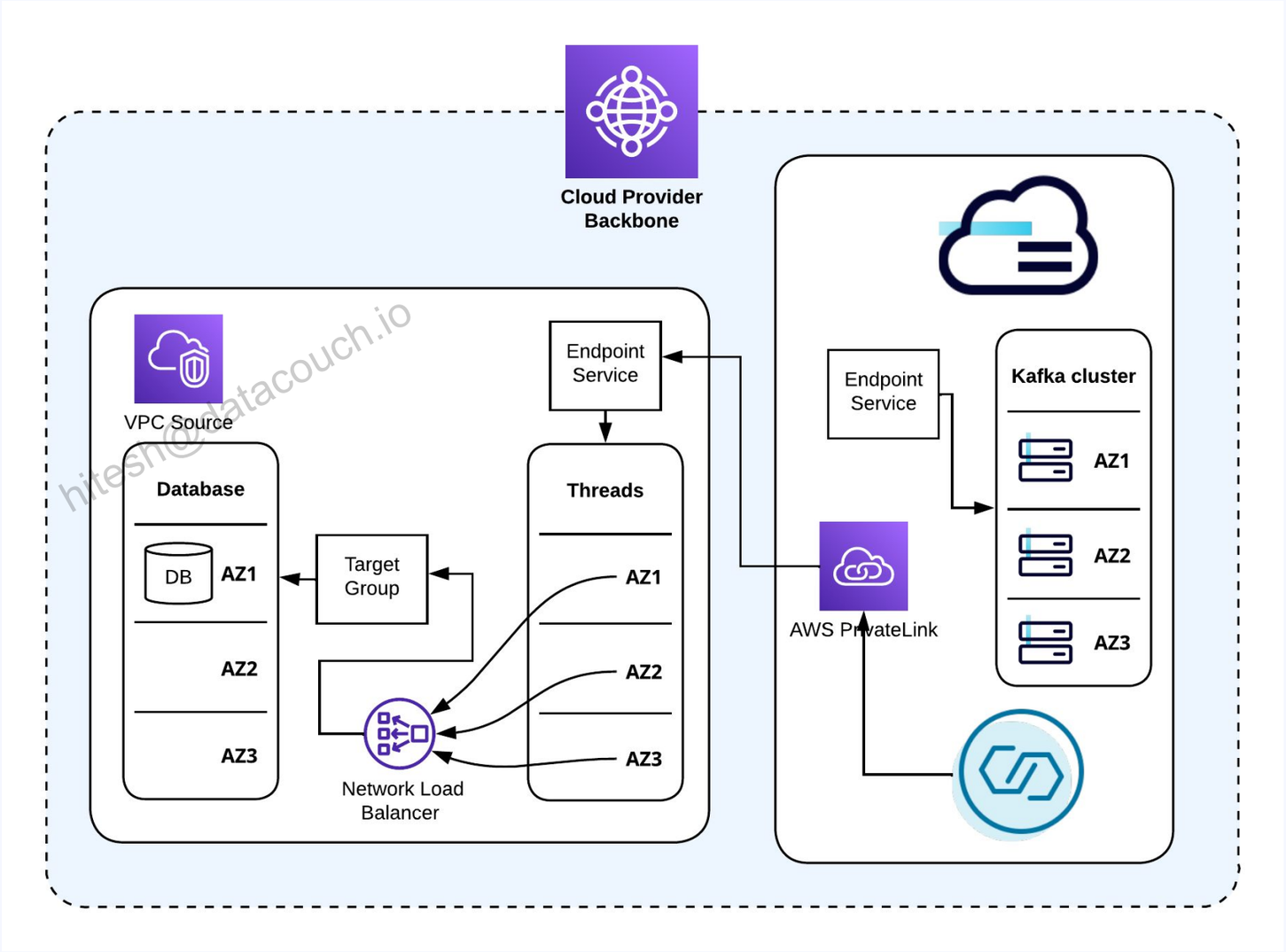
- PrivateLink Connection to instances in public and private subnets
- Enables customers to use managed connectors against secured sources and sinks



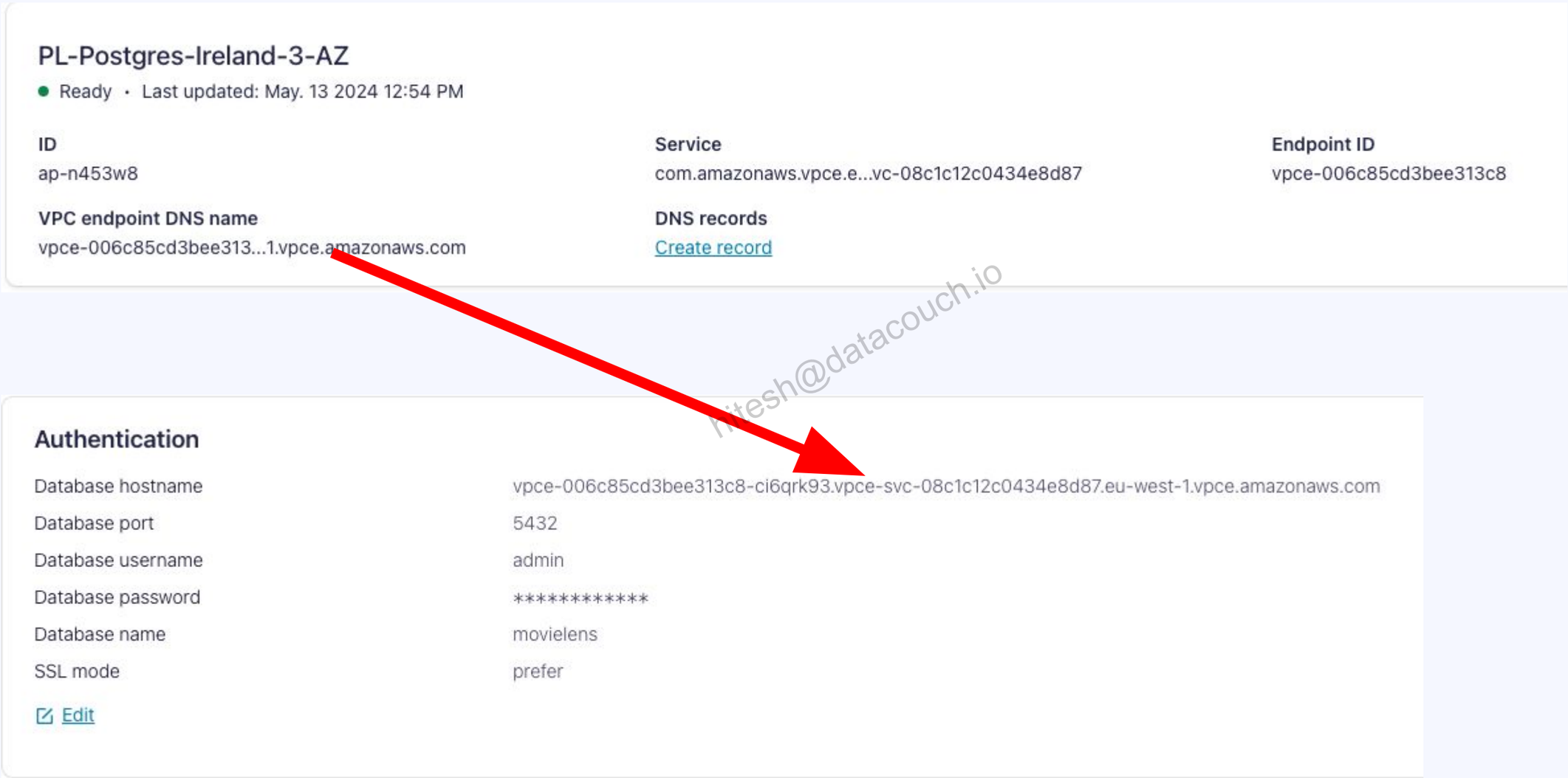
Load balancers for Multi-AZ

- Endpoint services can be configured for multiple AZ using the same load balancer
- The load balancer needs to be configured for **cross-zone load balancing** to make that possible





Connectors use endpoint DNS name as URL



Egress Access Point Lab Goals and Hints

Configure an Endpoint Service for your VPC to enable access to a private database

Use an Egress access point to connect to the endpoint service and set up the connector

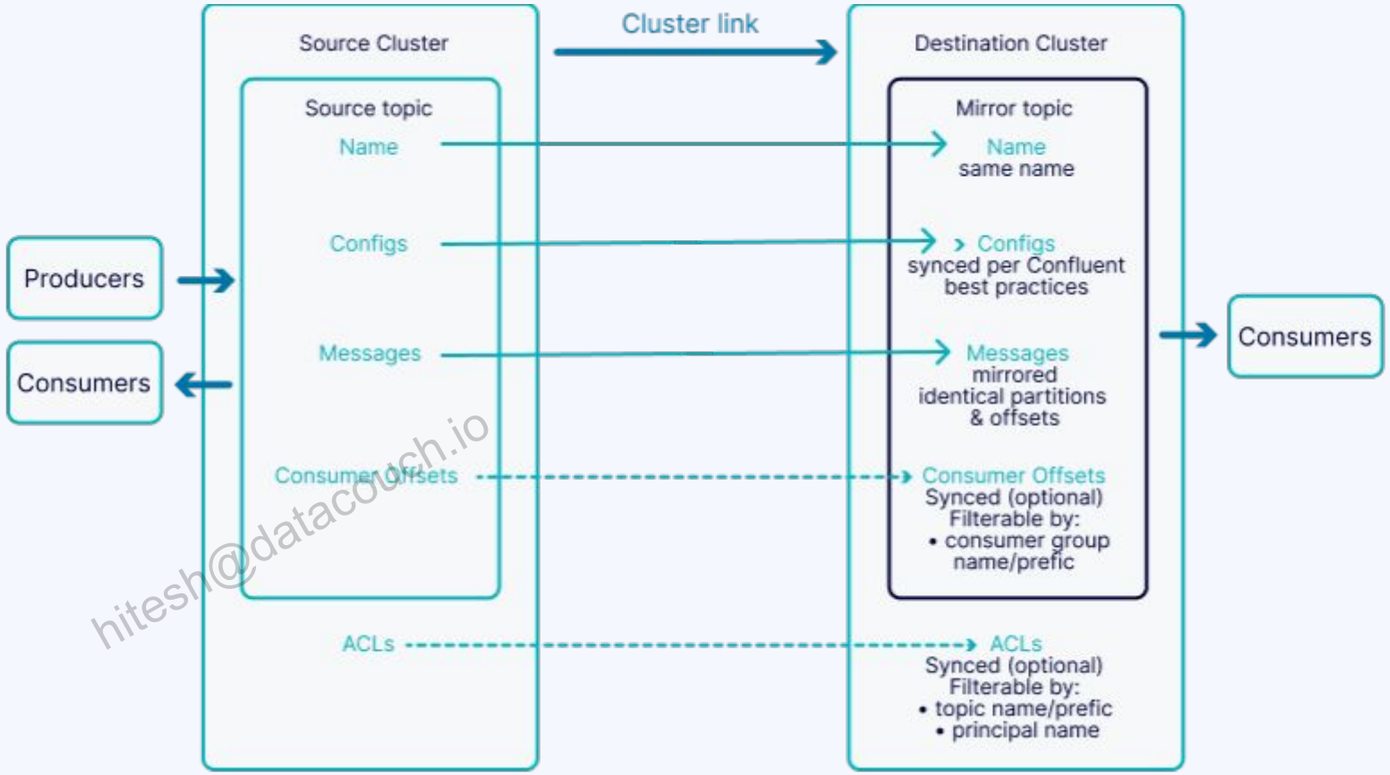
- Use Lab 9 Alternative: Private Link for Managed Connectors
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the dedicated cluster from the previous lab
- Configure an endpoint service in your VPC
- Configure an Egress access point for your Confluent Cloud dedicated cluster
- Configure a Managed CDC Source Connector to retrieve data from the database

Target time: 1 hour

Lab 10: Cluster and Schema Linking

Cluster linking

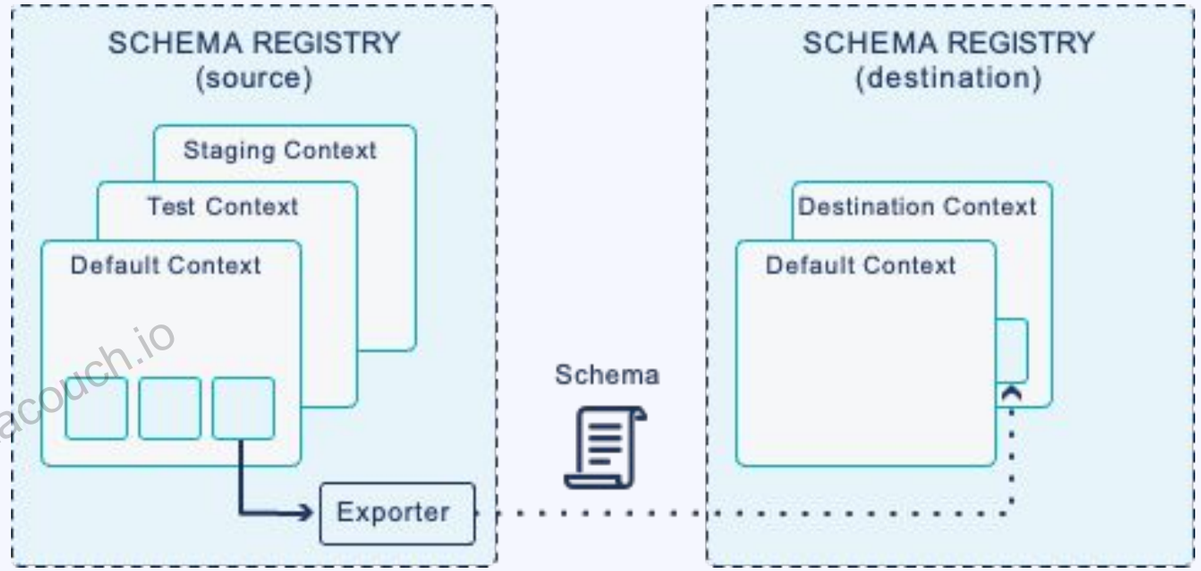
- Mirror topics from source to destination
- Optionally sync:
  - Consumer offsets
  - Acls
- Can add prefix to mirror topic
- Mirror topics are read-only



- Cluster linking uses byte-for-byte copy
  - Preserves the offsets
- Cluster link is created and resides on the destination cluster
  - **Must be a dedicated cluster**

Schema Linking

- Schema linking requires an **exporter** in the source
- Schemas are grouped into contexts
  - Preserves schema ids



Useful REST API Calls to read schemas and contexts

```
curl -u <api-key:api-secret> <schema-registry>/subjects
curl -u <api-key:api-secret> <schema-registry>/schemas
curl -u <api-key:api-secret> <schema-registry>/contexts
curl -u <api-key:api-secret> <schema-registry-url>/contexts/<context>/schemas
curl -u <api-key:api-secret> <schema-registry-url>/contexts/<context>/schemas/ids/<schema-id>
```

Cluster and Schema Linking Lab Goals and Hints

Learn more about cluster and schema linking and gain practical experience using these techniques.

- Use Lab 10: Cluster and Schema Linking
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Use the dedicated cluster from the previous two labs
- Configure a cluster link to some or all of the topics in your Basic Cluster
- Create a second environment with its own schema registry
- Use schema linking to link the schema registry of both environments together and use it

Target time: 1 hour

Lab 11: Confluent Terraform Provider

Confluent Terraform Provider

Confluent Terraform provider

- Infrastructure as code:
  - Cluster
  - Networking
  - Schema registry
  - User accounts
  - Service accounts
  - Topics
  - ACLs
  - ...
- Constantly evolving and improving
- Repeatable, complete provisioning of cluster infrastructure without the need of human interaction
- Details here: https://registry.terraform.io/providers/confluentinc/confluent/latest/docs

Code example

- Choose the correct provider
  - Fixing the version provides code stability
- The API key and secret should be injected via variables
- This example creates a STANDARD cluster in AWS in a defined region

```
terraform {
 required_providers {
   confluent = {
     source  = "confluentinc/confluent"
     version = "1.35.0"
   }
 }
}

provider "confluent" {
 cloud_api_key    = var.confluent_api_key
 cloud_api_secret = var.confluent_api_secret
}

resource "confluent_environment" "stream_bootcamp" {
 display_name = var.confluent_environment
}

locals {
 env_id = confluent_environment.stream_bootcamp.id
}

resource "confluent_kafka_cluster" "bootcamp-cluster" {
 display_name = "bootcamp-cluster"
 availability = "SINGLE_ZONE"
 cloud        = "AWS"
 region       = var.confluent_region
 standard {}

 environment {
   id = local.env_id
 }
}
```

Client authentication to run terraform

Set environment variables with the API Key and Secret.
The code on the previous page expects this values to be set.

```
$ export TF_VAR_confluent_api_key="XXXXXXXXXXXXXXXX"
$ export TF_VAR_confluent_api_secret="YYY+YYY+YYY+YYY+YYY+YYY+YYY+YYY+YYY+YYY+YYY+YYY"
$ terraform apply
```

Do not store the the API Key and Secret in your Terraform file (and *definitely* do not push it to github)

Confluent Terraform Provider Lab Goals and Hints

Build up a set of Terraform scripts to create a production-ready environment.

- Use Lab 11: Confluent Terraform Provider
- Make a copy of the document
  - Use the checkboxes to mark your own progress
- Follow the lab to slowly build up a set of terraform scripts that will create
  - An environment and a schema registry
  - A Kafka cluster
  - Topics, API Keys and authorizations
  - Managed Connectors
  - ksqlDB cluster

Target time: 4 hours

Well done, you have successfully completed the labs of the Confluent Cloud bootcamp.

Please do not forget to give us feedback on ...

Good luck with the exams to complete your certification.