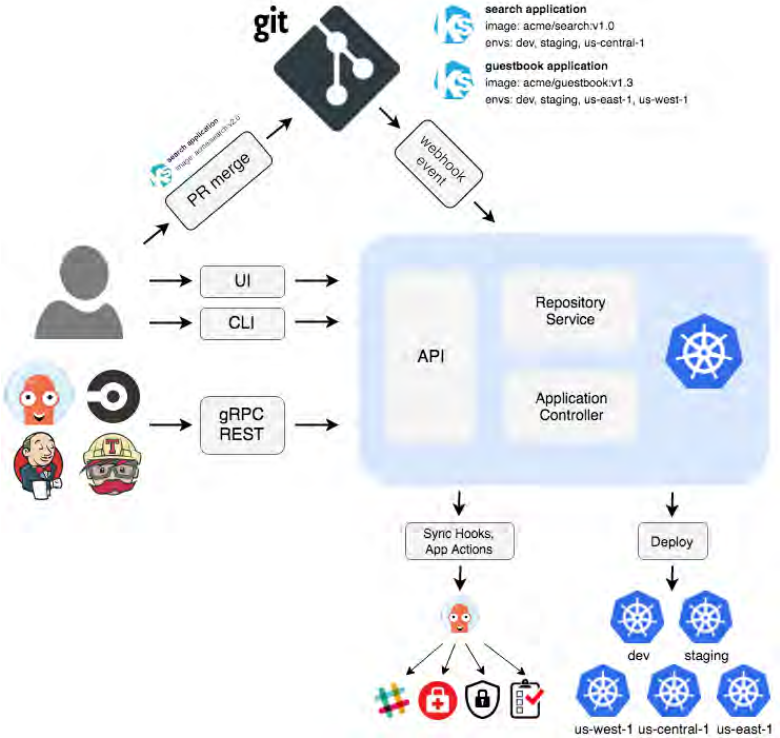
Effortless Secrets Management in Kubernetes: Streamlining App Deployment with GitOps and ArgoCD using the HashiCorp Vault Injector

Presenter:
Sam Gabrail

Intro to GitOps with ArgoCD

Intro to GitOps with ArgoCD

- **ArgoCD** is implemented as a **Kubernetes controller** which **continuously monitors** running **applications**
- It **compares** the current, **live state** against the **desired target state** (as specified in the **Git repo**)
- A deployed application whose **live state deviates** from the **target state** is considered `OutOfSync`
- ArgoCD **reports & visualizes** the **differences**, while providing facilities to automatically or manually **sync** the live state back to the desired target state
- Any **modifications** made to the **desired target state** in the **Git repo** can be **automatically** applied and reflected in the specified **target environments**

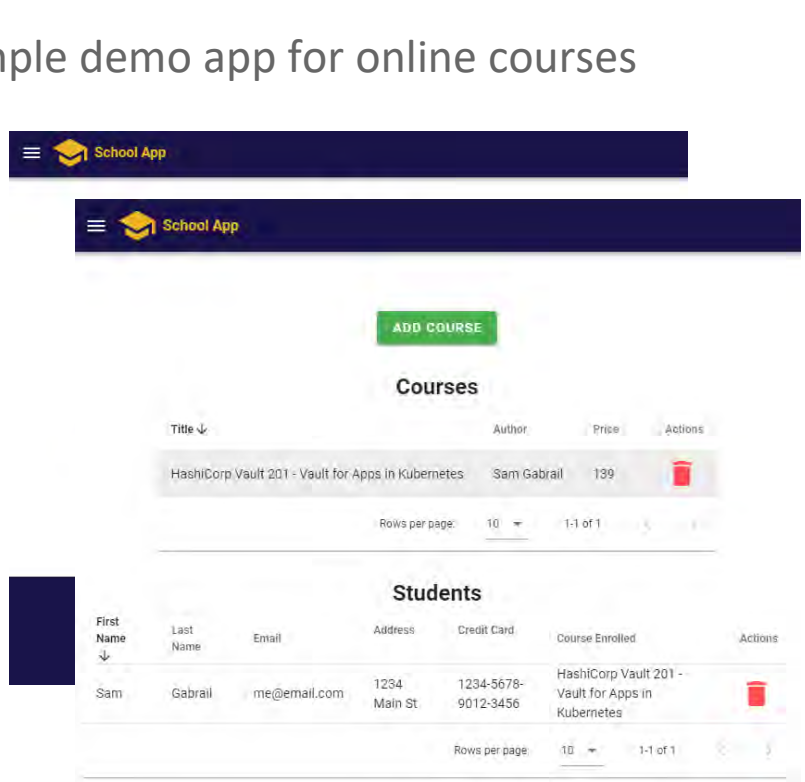


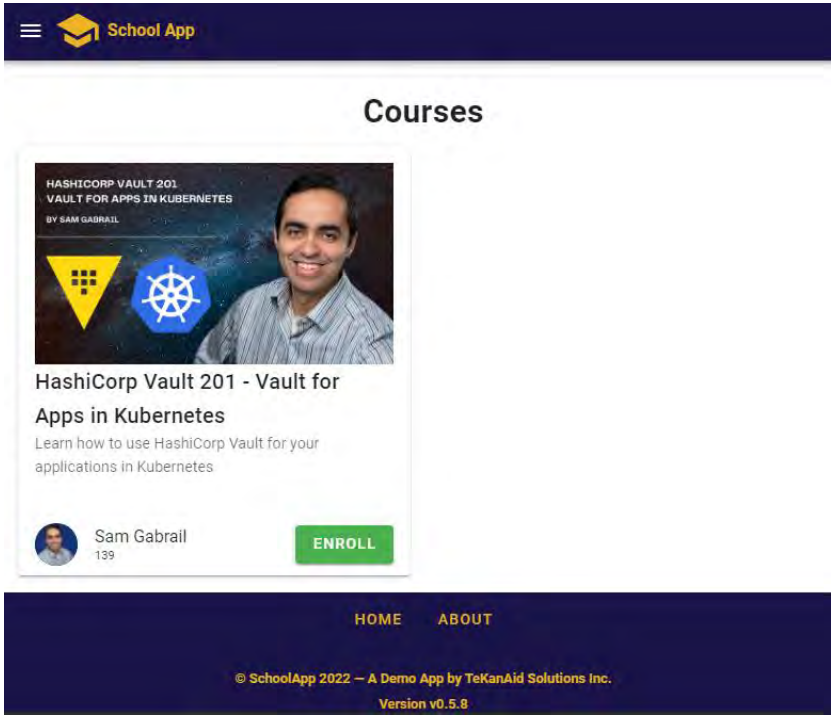
Taken from the official docs https://argo-cd.readthedocs.io/en/stable/

School App Introduction

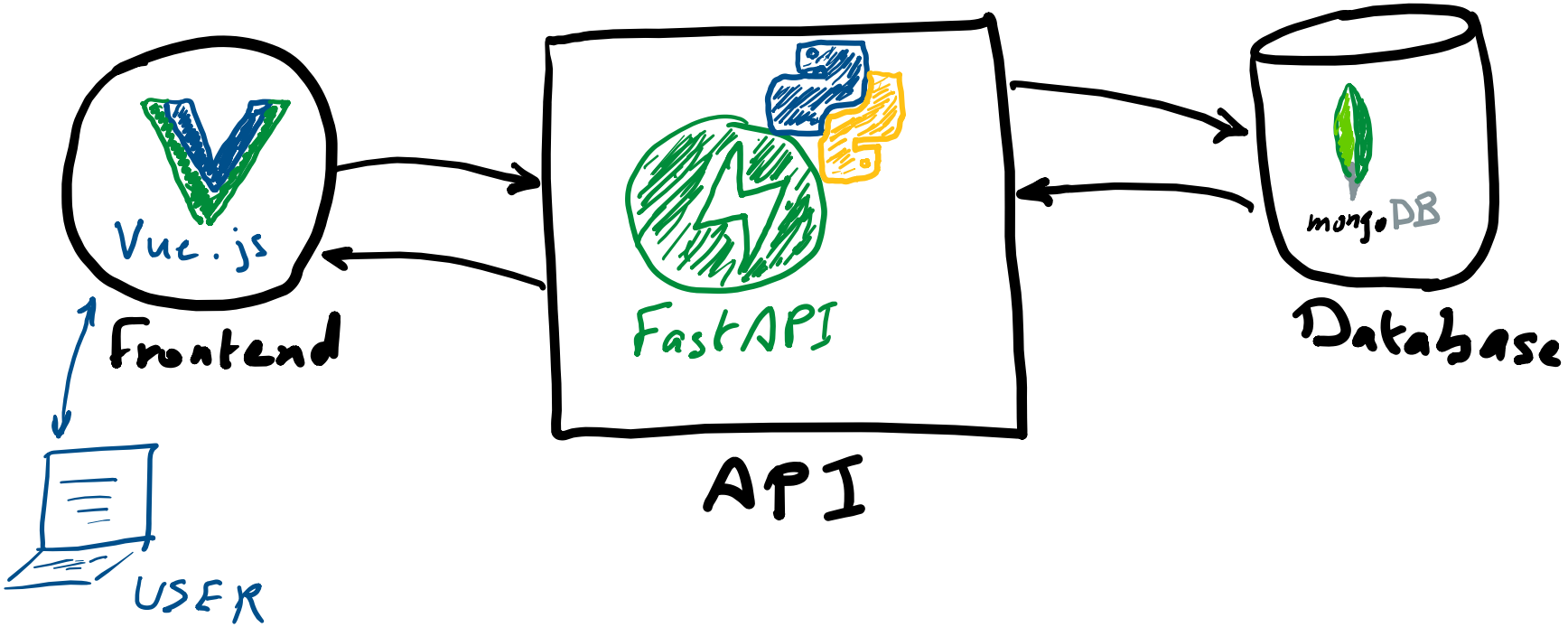
School App Introduction

A simple demo app for online courses





School App Components

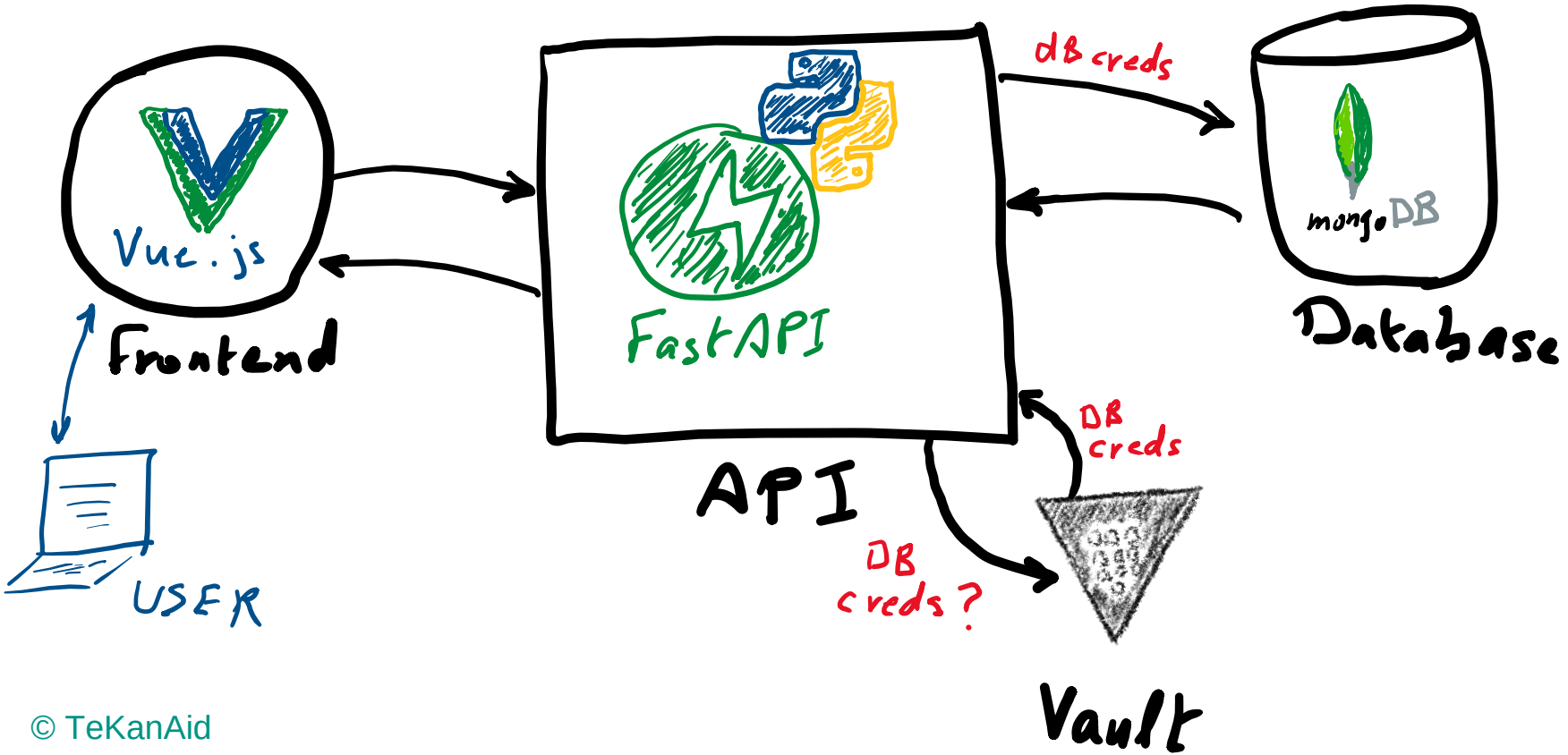


School App K8s Output

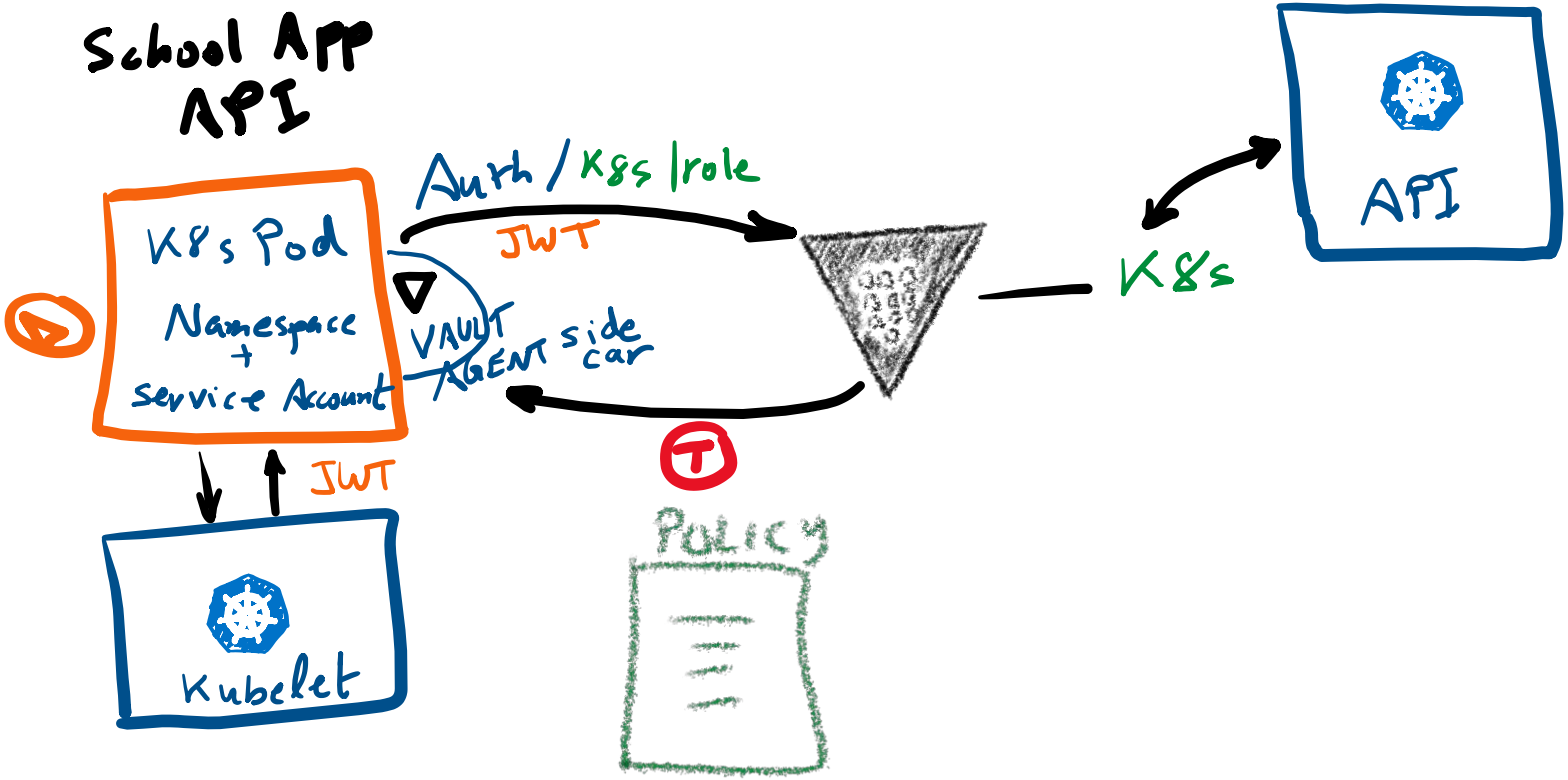
```
(⎈ |docker-desktop:schoolapp)
Gabrail-Windows:sam:~$kubectl get all
NAME                                    READY   STATUS    RESTARTS        AGE
pod/api-64f45f88f7-5tfst                1/1     Running   0               4m41s
pod/frontend-7fd5f756f5-md2x8           1/1     Running   0               4m16s
pod/schoolapp-mongodb-6cdf54d797-crs9f  1/1     Running   6 (7d23h ago)   32d

NAME                        TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)     AGE
service/api                 ClusterIP   10.98.188.115   <none>        5000/TCP    32d
service/frontend            ClusterIP   10.107.27.89    <none>        8080/TCP    32d
service/schoolapp-mongodb   ClusterIP   10.99.91.72     <none>        27017/TCP   32d

NAME                                READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/api                 1/1     1            1           32d
deployment.apps/frontend            1/1     1            1           32d
deployment.apps/schoolapp-mongodb   1/1     1            1           32d

NAME                                           DESIRED   CURRENT   READY   AGE
replicaset.apps/api-64f45f88f7                 1         1         1       4m41s
replicaset.apps/frontend-7fd5f756f5            1         1         1       4m16s
replicaset.apps/schoolapp-mongodb-6cdf54d797   1         1         1       32d
```

Add Vault to the School App

Add Vault to the School App

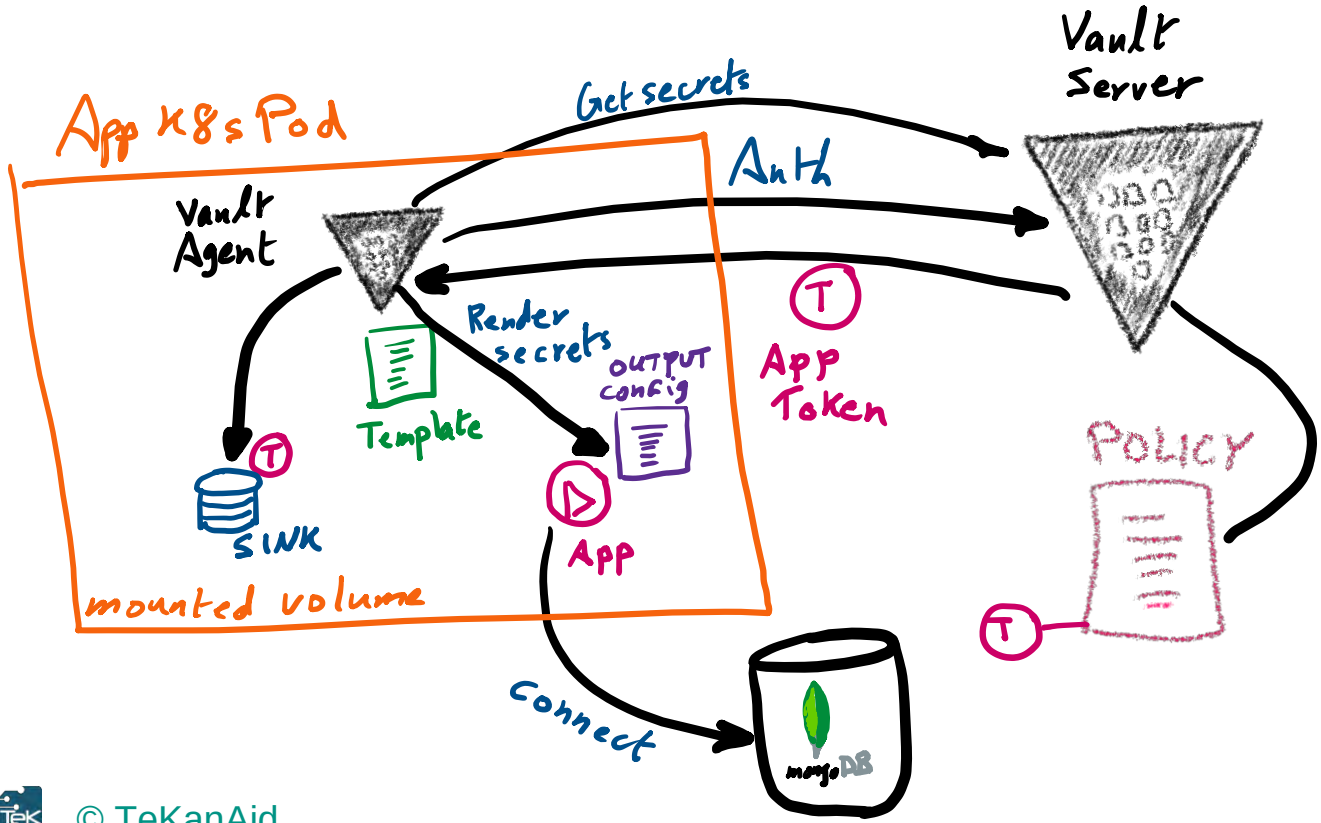


Kubernetes Auth Method



The Vault Agent Sidecar Injector Overview

Vault Agent Workflow in K8s

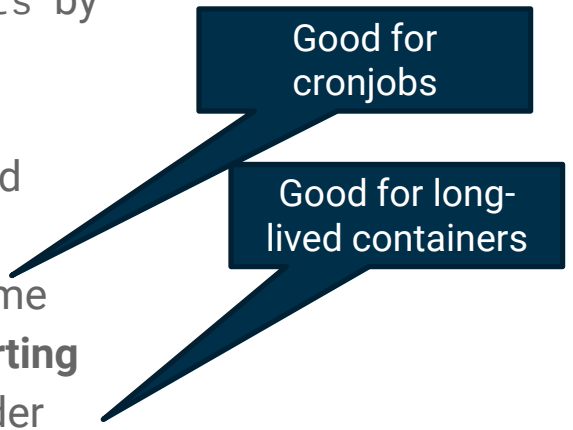


The Vault Agent Sidecar Injector Overview

- The Vault Agent Injector **alters pod specifications** to include **Vault Agent containers** that render **Vault secrets** to a **shared memory volume** using **Vault Agent Templates**
- **App containers** within the pod can **consume Vault secrets from the shared volume** without being Vault aware
- The injector is a Kubernetes Mutation Webhook Controller
- It works by **intercepting** pod **CREATE** and **UPDATE** events in Kubernetes
- The controller parses the event and looks for the metadata **annotation** `vault.hashicorp.com/agent-inject: true`
- If found, the controller will **alter** the pod specification based on **other annotations** present

Mutation Effects

- **Every container** in the **pod** will be configured to **mount** a **shared memory volume.** This volume is mounted to `/vault/secrets` by default and will be used by the Vault Agent containers for **sharing secrets** with the **other containers** in the **pod**
- Two types of Vault Agent containers can be injected: **init** and **sidecar**
- The **init** container will **prepopulate** the shared memory volume with the requested secrets **prior** to the other **containers starting**
- The **sidecar** container will continue to authenticate and render secrets to the same location as the pod runs
- Using **annotations**, the **init** and **sidecar** containers **may be disabled**



Vault Agent Config to Render Secrets

- There are **two methods** of configuring the Vault Agent containers to render secrets:
    - the `vault.hashicorp.com/agent-inject-secret` **annotation**, or
    - a **configuration map** containing Vault Agent configuration files
- Only **one** of these methods may be used **at any time**
- The **configuration map** can provide **more details** for configuration beyond the annotations

School App Annotations Example

```
annotations:
    vault.hashicorp.com/agent-inject: "true"
    vault.hashicorp.com/agent-inject-token: "true"
    vault.hashicorp.com/agent-inject-status: "update"
    vault.hashicorp.com/role: "schoolapp"
    vault.hashicorp.com/secret-volume-path: "/app/secrets/"
```

Configures Vault Agent to share the Vault token with other containers in the pod. This is helpful for Vault aware apps that need to communicate directly with Vault but require auto-authentication provided by Vault Agent

Blocks further mutations by adding the value injected to the pod after a successful mutation.

Will render the Vault token in the file called: /app/secrets/token

- Full list of Annotations:

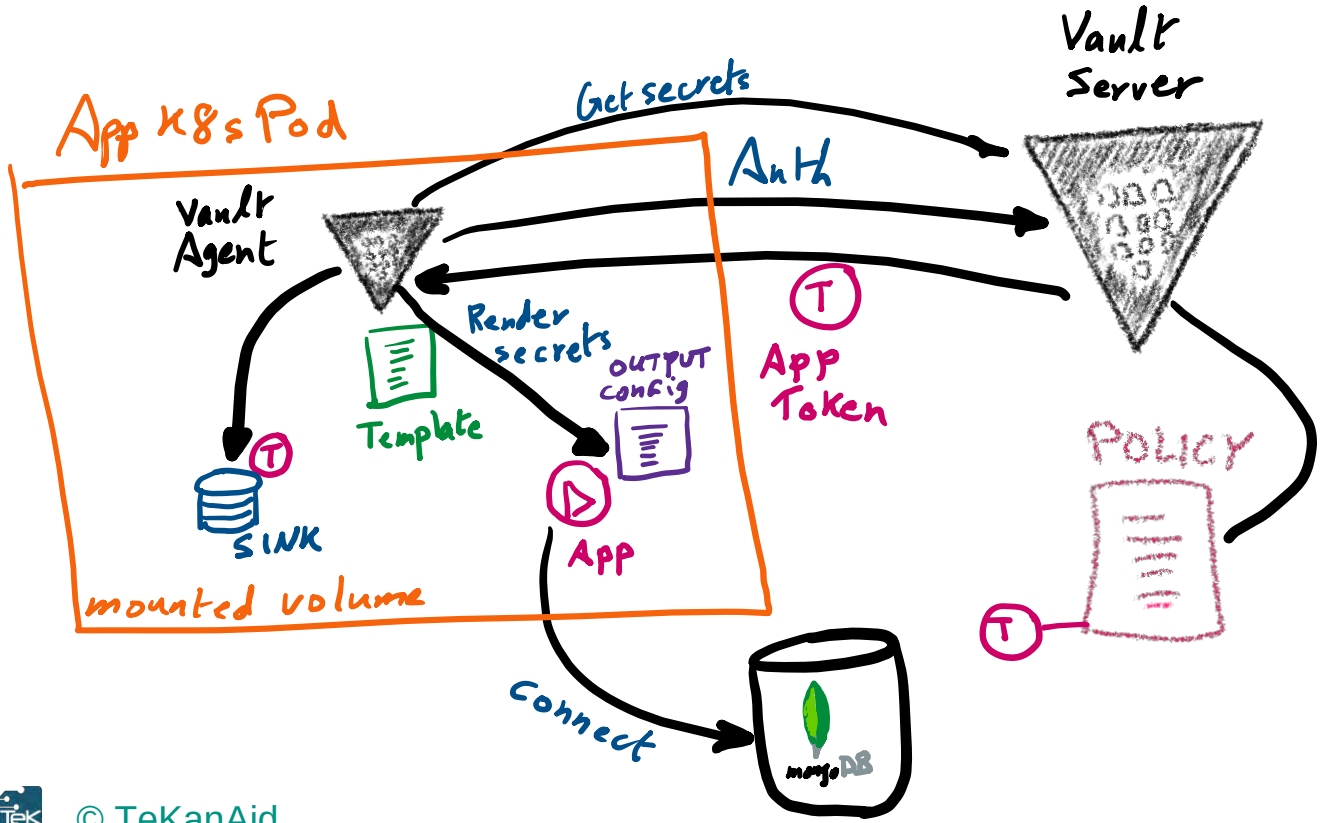
https://www.vaultproject.io/docs/platform/k8s/injector/annotations

Vault Agent Templates

Vault Agent Templates Overview

- **Vault Agent** uses the **Consul Template** project to render secrets
- This is useful for **Vault unaware apps**
- The **app's file system** has the **secrets dropped** in by **Vault**
- The **app doesn't talk** to **Vault** directly
- All it needs to know is what **files to find the secrets** in

Vault Agent Templates Workflow



Vault Agent Templates with Annotations

```
  annotations:
    vault.hashicorp.com/agent-inject: "true"
    vault.hashicorp.com/agent-inject-token: "true"
    vault.hashicorp.com/agent-inject-status: "update"
    vault.hashicorp.com/role: "schoolapp"
    vault.hashicorp.com/secret-volume-path: "/app/secrets/"
    vault.hashicorp.com/agent-inject-secret-schoolapp-mongodb-username:
"internal/data/schoolapp/mongodb"
    vault.hashicorp.com/agent-inject-secret-schoolapp-mongodb-password:
"internal/data/schoolapp/mongodb"
    vault.hashicorp.com/agent-inject-template-schoolapp-mongodb-username: |
      {{- with secret "internal/data/schoolapp/mongodb" -}}
      {{ .Data.data.schoolapp_DB_USERNAME }}
      {{- end -}}
    vault.hashicorp.com/agent-inject-template-schoolapp-mongodb-password: |
      {{- with secret "internal/data/schoolapp/mongodb" -}}
      {{ .Data.data.schoolapp_DB_PASSWORD }}
      {{- end -}}
```

Expected Output in Container:

```
cat /app/secrets/schoolapp-mongodb-username
schoolapp
cat /app/secrets/schoolapp-mongodb-password
mongoRootPass
```

Demo