

# Clusters as Code

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**Scott Hughes**  
**Chris Anderley**

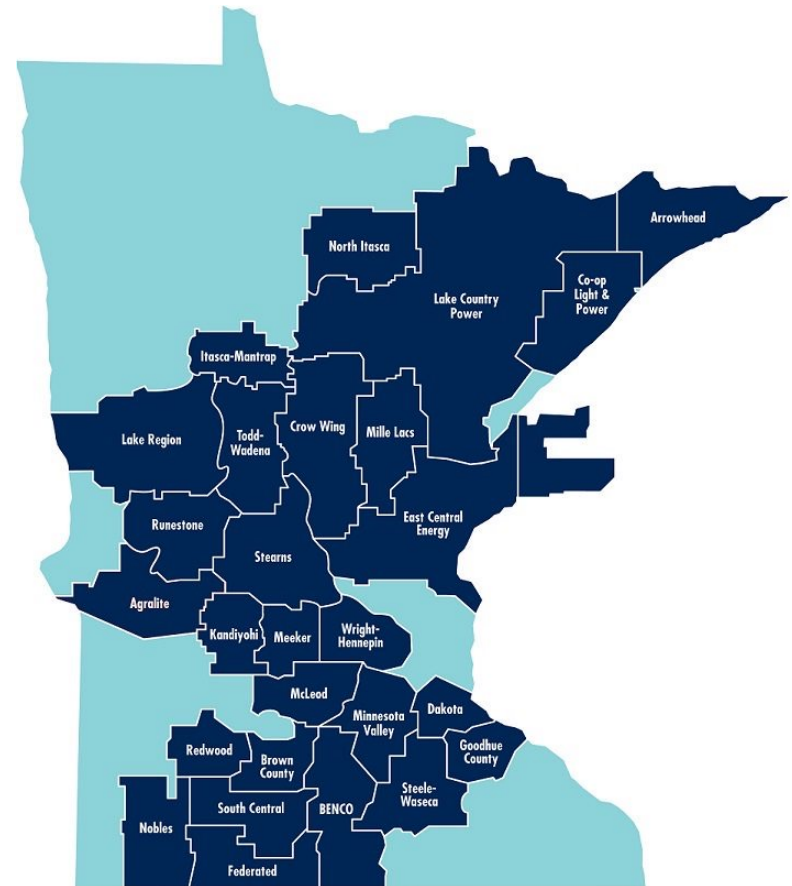
# Who are we?

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- ▶ Scott Hughes – Manager System Engineering & Architect
- ▶ Chris Anderley – Principal Systems Engineer – OpenSource & Linux

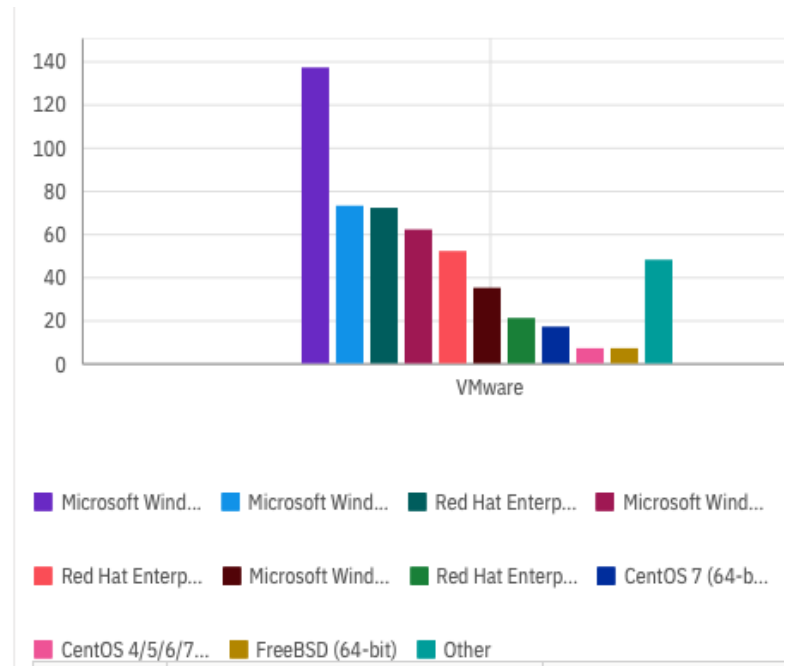
# What is GRE?

Our cooperative is owned and governed by the 27 member-owner cooperatives we serve, which means we're motivated by service, not by profit.



# Our Environment

- ▶ RHEL – 170 servers, 95% Virtualized
- ▶ Windows – 350 servers, 99% Virtualized
- ▶ Mix of other appliances



# Our Challenges

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- ▶ Small team – 5 technology specialists
- ▶ High Availability required
- ▶ Specialized regulations

# Tools we (currently) use

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- ▶ Red Hat Satellite
- ▶ Ansible Community Edition
- ▶ AWX – Upstream Ansible Tower
- ▶ OKD – Upstream Open Shift Container Platform
- ▶ GitLab – Self hosted git repository
- ▶ ManageIQ – Upstream IBM Cloud Pak for Multicloud Management – Infrastructure Management

# Open Source

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- ▶ Good testing point
- ▶ Easy solution for non-critical areas

# Code Repository

- ▶ GitLab Self Hosted
- ▶ cluster-config project

Name	Last commit
📁 cluster-bootstrap	Add maximo repository access
📁 sealed-secrets	null values
🔖 .gitignore	Add image-registry configs
{-} bootstrap-project.yml	Update bootstrap-project.yml
{-} cluster-bootstrap.yml	remove recursive app
{-} clusterconfig-repo-secret.yml	Add repo as YAML



# Our OpenShift Journey

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- ▶ Docker & Portainer
- ▶ 42 stacks
  - All containers owned by Infrastructure
  - Miscellaneous apps
  - Some automation via GitLab CI/CD and Ansible playbooks

# Our OpenShift Journey

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- ▶ OKD – Community Distribution of OpenShift
- ▶ Wanted automation & governance around our Docker containers
- ▶ High availability
- ▶ Common platform for future public cloud endeavors
- ▶ Needed to run on our existing hypervisors

# Use case for Support

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- ▶ More stability and predictability for cluster version updates
- ▶ Application teams have begun to rely on Redhat operators (e.g. OpenShift GitOps)
- ▶ Single platform for on-premise and cloud environments
- ▶ Some packaged applications are beginning to require/support OpenShift

# Installation

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- ▶ `./openshift-install create cluster --dir ocpdemo`
- ▶ `? SSH Public Key /Users/u6686/.ssh/ocp.pub`
- ▶ `? Platform vsphere`
- ▶ `? vCenter ProductionVIC.internal.greenergy.com`
- ▶ `? Username ocpuser`
- ▶ `? Password [? for help] *****`
- ▶ `INFO Connecting to vCenter ProductionVIC.internal.greenergy.com`
- ▶ `? Datacenter HQ`
- ▶ `? Cluster Dev_Linux`
- ▶ `? Default Datastore Dev_Linux_08`
- ▶ `? Network OpenShift-VLAN`
- ▶ `? Virtual IP Address for API 192.TheRestOfTheIP`
- ▶ `? Virtual IP Address for Ingress 192.TheRestOfTheIP`
- ▶ `? Base Domain greenergy.com`
- ▶ `? Cluster Name ocpdemo`
- ▶ `? Pull Secret *****`
- ▶ And then you wait... ~35 minutes

# Infrastructure Nodes

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- ▶ Only host infrastructure components
  - Splunk forwarder
  - NetApp Trident
  - Red Hat GitOps (ArgoCD)
- ▶ Used a generic template and customized the memory and CPU for our workloads
- ▶ Manual Step – Updating the cluster name in the repo and pasting into OCP
- ▶ Increase the machine count to 2

# Infrastructure Node

```
apiVersion: machine.openshift.io/v1beta1
kind: MachineSet
metadata:
  creationTimestamp: null
  labels:
    machine.openshift.io/cluster-api-cluster: ocpdemo-mq5q8
  name: ocpdemo-mq5q8-infra
  namespace: openshift-machine-api
spec:
  replicas: 1
  selector:
    matchLabels:
      machine.openshift.io/cluster-api-cluster: ocpdemo-mq5q8
      machine.openshift.io/cluster-api-machineset: ocpdemo-mq5q8-infra
  template:
    metadata:
      creationTimestamp: null
      labels:
        machine.openshift.io/cluster-api-cluster: ocpdemo-mq5q8
        machine.openshift.io/cluster-api-machine-role: infra
        machine.openshift.io/cluster-api-machine-type: infra
        machine.openshift.io/cluster-api-machineset: ocpdemo-mq5q8-infra
    spec:
      metadata:
        creationTimestamp: null
        labels:
          node-role.kubernetes.io/infra: ""
```

```
node-role.kubernetes.io/infra: ""
taints:
  - key: node-role.kubernetes.io/infra
    effect: NoSchedule
providerSpec:
  value:
    apiVersion: vsphereprovider.openshift.io/v1beta1
    credentialsSecret:
      name: vsphere-cloud-credentials
    diskGiB: 120
    kind: VSphereMachineProviderSpec
    memoryMiB: 8192
    metadata:
      creationTimestamp: null
    network:
      devices:
        - networkName: OpenShift-VLAN
    numCPUs: 4
    numCoresPerSocket: 2
    snapshot: ""
    template: ocpdemo-mq5q8-rhcos
    userDataSecret:
      name: worker-user-data
    workspace:
      datacenter: Maple Grove
      datastore: Dev_Linux_08
      folder: /Maple Grove/vm/ocpdemo-mq5q8
      resourcePool: /HQ/host/Dev_Linux/Resources
      server: ProductionVIC.internal.greenergy.com
```

# Infrastructure Nodes

Red Hat OpenShift Container Platform

You are logged in as a temporary administrative user. Update the [cluster OAuth configuration](#) to allow others to log in.

Project: openshift-machine-api

## MachineSets

Create MachineSet

Name Search by name...

Name ↑	Namespace ↓	Machines ↓	Instance type ↓	CPU ↓	Memory ↓
<b>MS</b> ocptest-mq4q6-infra	<b>NS</b> openshift-machine-api	1 of 1 machine	-	4 cores	7.77 GiB
<b>MS</b> ocptest-mq4q6-worker	<b>NS</b> openshift-machine-api	3 of 3 machines	-	2 cores	

- Edit Machine count
- Create MachineAutoscaler
- Edit labels
- Edit annotations
- Edit MachineSet
- Delete MachineSet

# Red Hat OpenShift GitOps

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- ▶ Built around Argo CD project
- ▶ Uses native OpenShift authentication



# Installed Operators

The screenshot shows the Red Hat OpenShift Container Platform interface. The top navigation bar includes the Red Hat logo and the text "Red Hat OpenShift Container Platform". A notification banner at the top right states: "You are logged in as a temporary administrative user. Update the [cluster OAuth configuration](#) to a". The left sidebar contains a menu with the following items: Administrator, Home, Operators (expanded), OperatorHub (selected), Installed Operators, Workloads, Networking, Storage, Builds, Observe, Compute, and User Management. The main content area is titled "OperatorHub" and contains the following text: "Discover Operators from the Kubernetes community and Red Hat partners, curated by Red Hat. You can purchase core [Red Hat Marketplace](#). You can install Operators on your clusters to provide optional add-ons and shared services to Operator capabilities will appear in the [Developer Catalog](#) providing a self-service experience." Below this text is a list of categories under "All Items": AI/Machine Learning, Application Runtime, Big Data, Cloud Provider, Database, Developer Tools, Development Tools, Drivers and plugins, Integration & Delivery, Logging & Tracing, Modernization & Migration, Monitoring, and Networking. A search bar contains the text "red hat openshift gitops". A card for the "Red Hat OpenShift GitOps" operator is displayed, featuring the Red Hat logo and the text: "Red Hat OpenShift GitOps provided by Red Hat Inc. Enables teams to adopt GitOps principles for managing cluster configurations and application...".

# Installed Operators

**Red Hat OpenShift Container Platform**

You are logged in as a temporary administrative user. Update the [cluster OAuth configuration](#) to allow others to

OperatorHub > Operator Installation

## Install Operator

Install your Operator by subscribing to one of the update channels to keep the Operator up to date. The strategy determines either updates.

**Update channel \***

- gitops-1.3
- gitops-1.4
- gitops-1.5
- gitops-1.6
- gitops-1.7
- latest
- preview
- stable

**Installation mode \***

- All namespaces on the cluster (default)  
Operator will be available in all Namespaces.
- A specific namespace on the cluster  
This mode is not supported by this Operator

**Installed Namespace \***

**PR** openshift-operators

**Red Hat OpenShift GitOps**  
provided by Red Hat Inc.

**Provided APIs**

- A Application**  
An Application is a group of Kubernetes resources as defined by a manifest.
- AS ApplicationSet**  
ApplicationSet is the representation of an ApplicationSet controller deployment.
- AP AppProject**  
An AppProject is a logical grouping of

# Installed Operators

The screenshot displays the Red Hat OpenShift Container Platform console interface. The left sidebar shows navigation options: Administrator, Home, Overview, Projects, Search, API Explorer, Events, Operators, Workloads, Networking, and Storage. The main content area shows the 'Gitops Services' page for a service named 'cluster'. The 'YAML' tab is selected, displaying the following configuration:

```
1  apiVersion: pipelines.openshift.io/v1alpha1
2  kind: GitopsService
3  metadata:
4    creationTimestamp: '2023-02-12T22:02:58Z'
5    generation: 1
6  > managedFields: ...
14  name: cluster
15  resourceVersion: '132606'
16  uid: 2923b25e-82fe-4492-92c7-de841920466f
17  spec:
18  runOnInfra: true
19  tolerations:
20    - effect: NoSchedule
21      key: node-role.kubernetes.io/infra
22
23
```

The 'runOnInfra: true' line is circled in yellow. A notification at the top indicates the user is logged in as a temporary administrative user. The 'Opt + F1' accessibility shortcut is visible in the top right corner of the code editor.

# Secret Management

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## ► Problem

- How to bootstrap cluster when many items required are secret (TLS certificates, LDAP credentials, storage credentials)

## ► Our solution

- sealed-secrets
- Encrypts secrets with a one-way process so results can be checked into code repositories

# Sealed Secrets

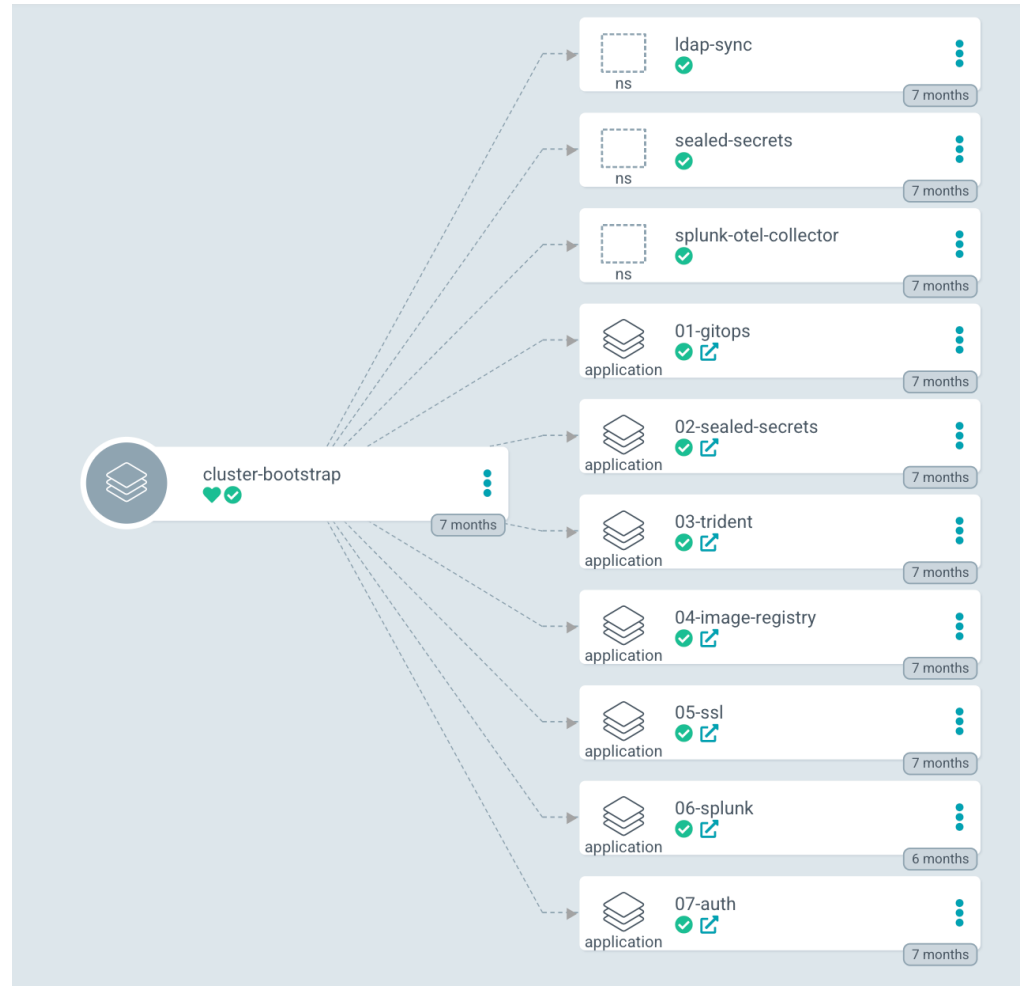
---

- ▶ Create the project
  - `oc new-project sealed-secrets`
- ▶ Create your sealing secret
  - `oc create -f super-secret-sealed-secrets-key.yml`

*(stored in separate password vault)*

# The bootstrap

- Order Matters
  - Use the ArgoCD “app of apps” pattern



# RHOSGO – Cluster Bootstrap

The screenshot displays the RHOSGO Applications management interface. On the left is a dark sidebar with navigation icons and the version number 'v2.3.144'. The main area is titled 'Applications' and includes a search bar and buttons for '+ NEW APP', 'SYNC APPS', and 'REFRESH APPS'. A 'FILTERS' section on the left contains 'FAVORITES ONLY', 'SYNC STATUS', 'HEALTH STATUS', and 'LABELS'. The 'SYNC STATUS' section shows: Unknown (0), Synced (0), and OutOfSync (1). The 'HEALTH STATUS' section shows: Unknown (0), Progressing (0), Suspended (0), Healthy (1), Degraded (0), and Missing (0). A modal window for the 'cluster-bootstrap' application is open, showing details: Project: bootstrap, Labels: (empty), Status: Healthy (green heart) and OutOfSync (yellow circle with plus), Reposi...: https://git.intra.greenergy.com/open..., Target ...: HEAD, Path: cluster-bootstrap, Destin...: in-cluster, and Names... (empty). At the bottom of the modal are buttons for SYNC, refresh, and delete.

# RHOSGO – Cluster Bootstrap

The screenshot displays the RHOSGO web interface for managing applications. The main view shows the 'cluster-bootstrap' application details, including its project, labels, status, repository, target, path, destination, and namespace. The application is currently in a 'Healthy' state with one 'OutOfSync' item. The interface includes filters for favorites, sync status, health status, labels, projects, and clusters. A modal window is open for synchronizing the application manifests from the repository <https://git.intra.greenergy.com/openshift/cluster-config.git>. The revision is 'HEAD'. The synchronization options include checkboxes for 'PRUNE', 'DRY RUN', 'APPLY ONLY', 'FORCE', 'SKIP SCHEMA VALIDATION', 'AUTO-CREATE NAMESPACE', 'PRUNE LAST', 'APPLY OUT OF SYNC ONLY', 'RESPECT IGNORE DIFFERENCES', and 'REPLACE'. The 'PRUNE PROPAGATION POLICY' is set to 'foreground'. The 'RETRY' checkbox is also present. The 'SYNCHRONIZE RESOURCES' section lists several resources to be synchronized, all of which are checked: `/NAMESPACE//LDAP-SYNC`, `/NAMESPACE//SEALED-SECRETS`, `/NAMESPACE//SPLUNK-OTEL-COLLECTOR`, `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/01-GITOPS`, `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/02-SEALED-SECRETS`, `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/03-TRIDENT`, `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/04-IMAGE-REGISTRY`, `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/05-SSL`, `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/06-SPLUNK`, and `ARGOPROJ.IO/APPLICATION/OPENSIFT-GITOPS/07-AUTH`.



# RHOSGO – Cluster Bootstrap

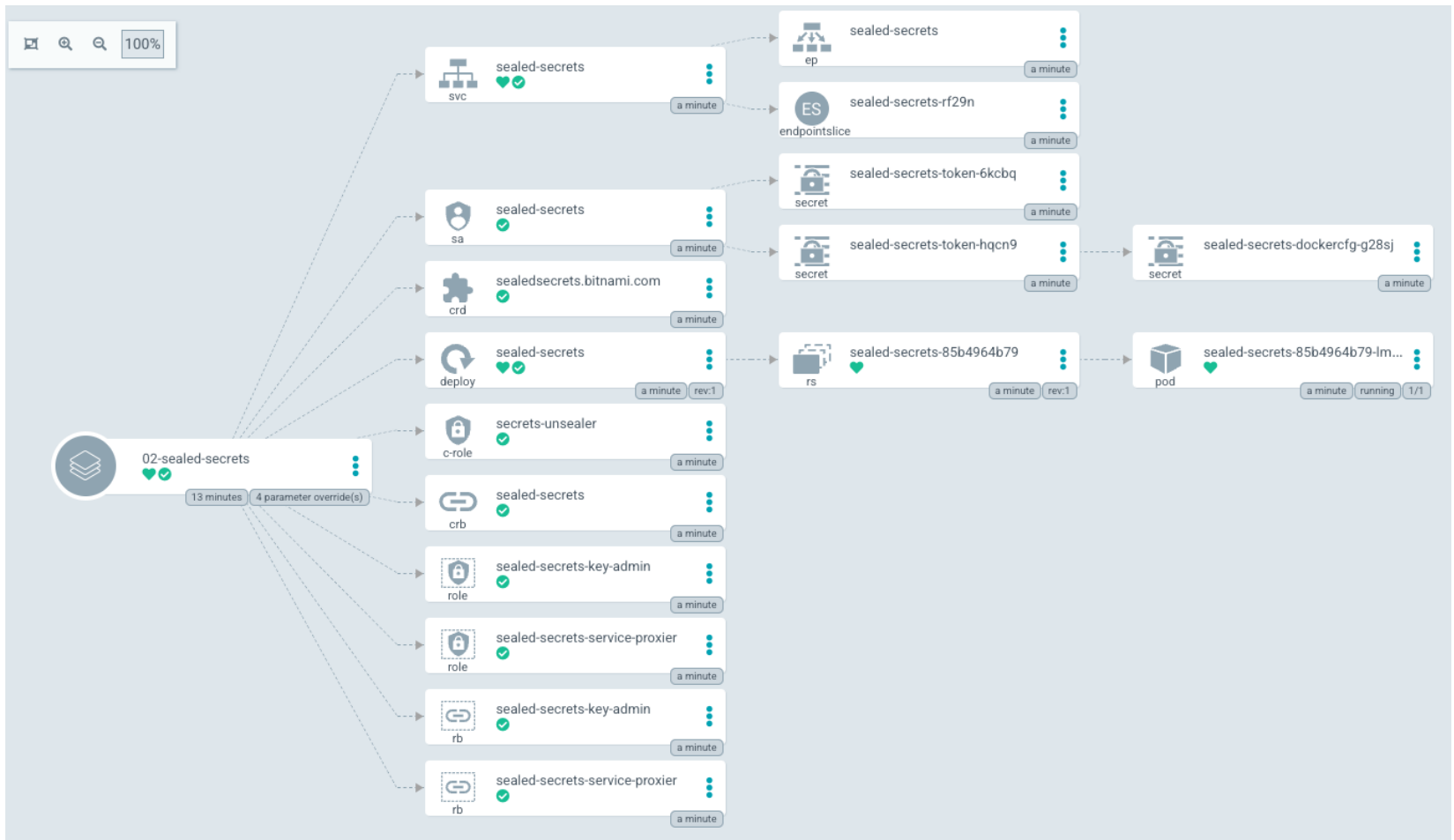
<p><b>01-gitops</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>♥ Healthy</span> <span>✔ Synced</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap/gitops</p> <p>Destina...: in-cluster</p> <p>Names...</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>	<p><b>02-sealed-secrets</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>🟡 Missing</span> <span>🟡 OutOfSync</span></p> <p>Reposit...: https://bitnami-labs.github.io/sealed-...</p> <p>Target ...: 2.1.8</p> <p>Chart: sealed-secrets</p> <p>Destina...: in-cluster</p> <p>Names...</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>	<p><b>03-trident</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>🟡 Missing</span> <span>🟡 OutOfSync</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap/trident</p> <p>Destina...: in-cluster</p> <p>Names...: trident</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>	<p><b>04-image-registry</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>🟡 Missing</span> <span>🟡 OutOfSync</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap/image-registry</p> <p>Destina...: in-cluster</p> <p>Names...: engineering</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>
<p><b>05-ssl</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>♥ Healthy</span> <span>🟡 OutOfSync</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap/ssl</p> <p>Destina...: in-cluster</p> <p>Names...</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>	<p><b>06-splunk</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>♥ Healthy</span> <span>🟡 OutOfSync</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap/splunk</p> <p>Destina...: in-cluster</p> <p>Names...</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>	<p><b>07-auth</b> ★</p> <p>Project: bootstrap</p> <p>Labels: app.kubernetes.io/instance=cluster-b...</p> <p>Status: <span>♥ Healthy</span> <span>🟡 OutOfSync</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap/auth</p> <p>Destina...: in-cluster</p> <p>Names...</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>	<p><b>cluster-bootstrap</b> ★</p> <p>Project: bootstrap</p> <p>Labels:</p> <p>Status: <span>♥ Healthy</span> <span>✔ Synced</span></p> <p>Reposit...: https://git.intra.greenergy.com/opensh...</p> <p>Target ...: HEAD</p> <p>Path: cluster-bootstrap</p> <p>Destina...: in-cluster</p> <p>Names...</p> <p><span>↻ SYNC</span> <span>🔄 REFRESH</span> <span>🗑️ DELETE</span></p>

# 1 - GitOps

- ▶ Sets ArgoCD up for accessing our internal GitLab repository
- ▶ Sets up projects and grants access to development teams
  - Access management as code in git repo

```
spec:  
  rbac:  
    policy: |  
      g, system:cluster-admins, role:admin  
      g, cluster-admins, role:admin  
      g, AP_OpenShift_Admin, role:admin  
      p, role:devsvcs, applications, create, devsvcs/*, allow  
      p, role:devsvcs, applications, delete, devsvcs/*, allow  
      p, role:devsvcs, applications, override, devsvcs/*, allow  
      p, role:devsvcs, applications, sync, devsvcs/*, allow  
      p, role:devsvcs, applications, get, devsvcs/*, allow  
      p, role:devsvcs, applications, update, devsvcs/*, allow  
      p, role:devsvcs, logs, get, devsvcs/*, allow  
      p, role:devsvcs, exec, create, devsvcs/*, allow  
      p, role:devsvcs, projects, get, devsvcs, allow  
      p, role:devsvcs, repositories, get, devsvcs/*, allow  
      p, role:devsvcs, repositories, create, devsvcs/*, allow  
      p, role:devsvcs, repositories, delete, devsvcs/*, allow  
      p, role:devsvcs, repositories, update, devsvcs/*, allow  
      g, AP_OpenShift_DevOps, role:devsvcs
```

# 2 - Sealed Secrets

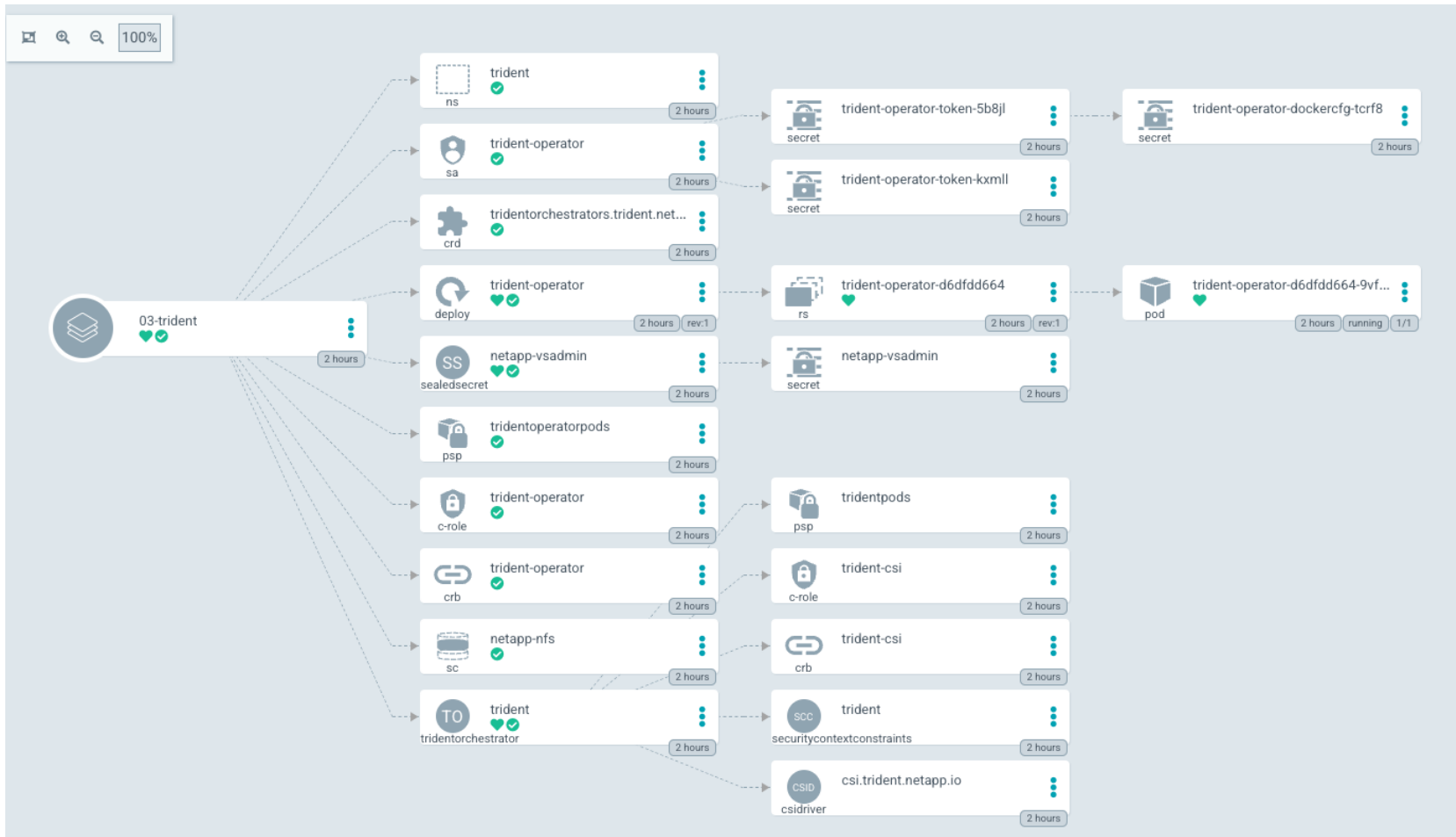


# 3 – Storage (Trident)

---

- Installs NetApp Trident
- Automates our persistent storage volumes
- Needs a backend config pointing to your LIFs and credentials
  
- Packaged as a cluster operator provided by NetApp

# 3 - Storage

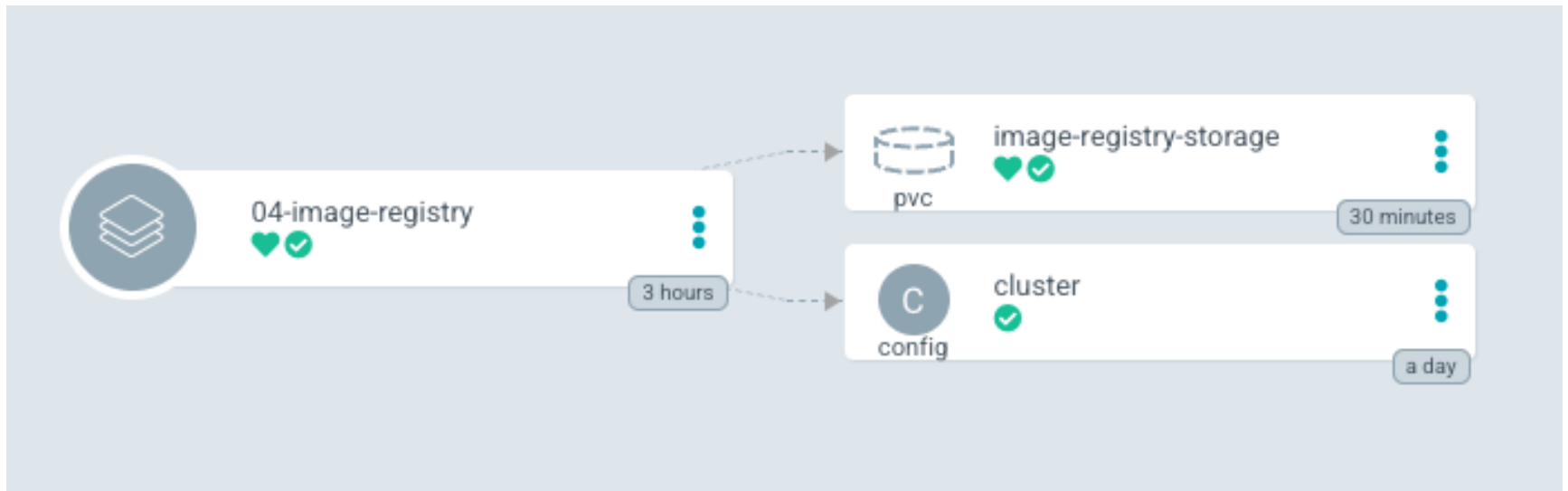


# 4 - Images

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- Configures image registry to use NetApp storage for persistent storage

# 4 - Images



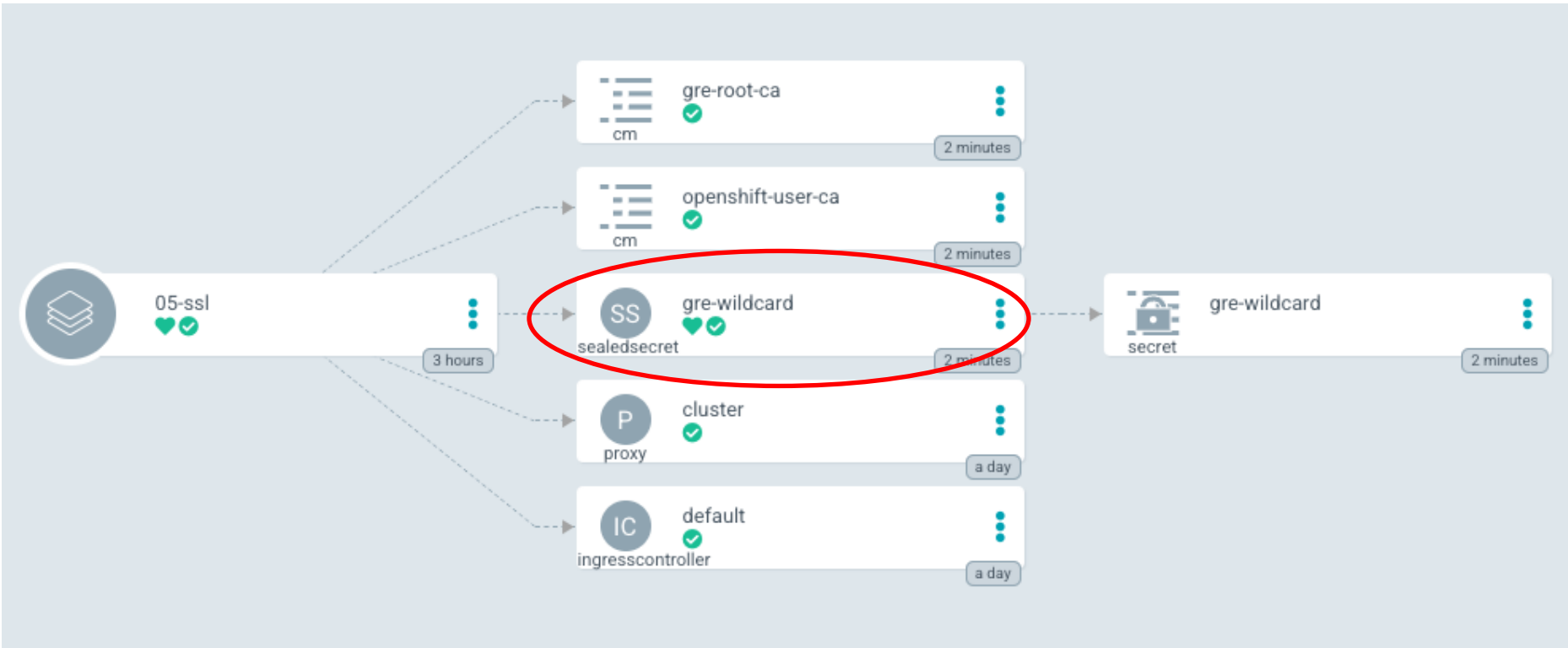
# 5 - SSL

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- ▶ Internally-trusted SSL certificates for easy app development



# 5 - SSL

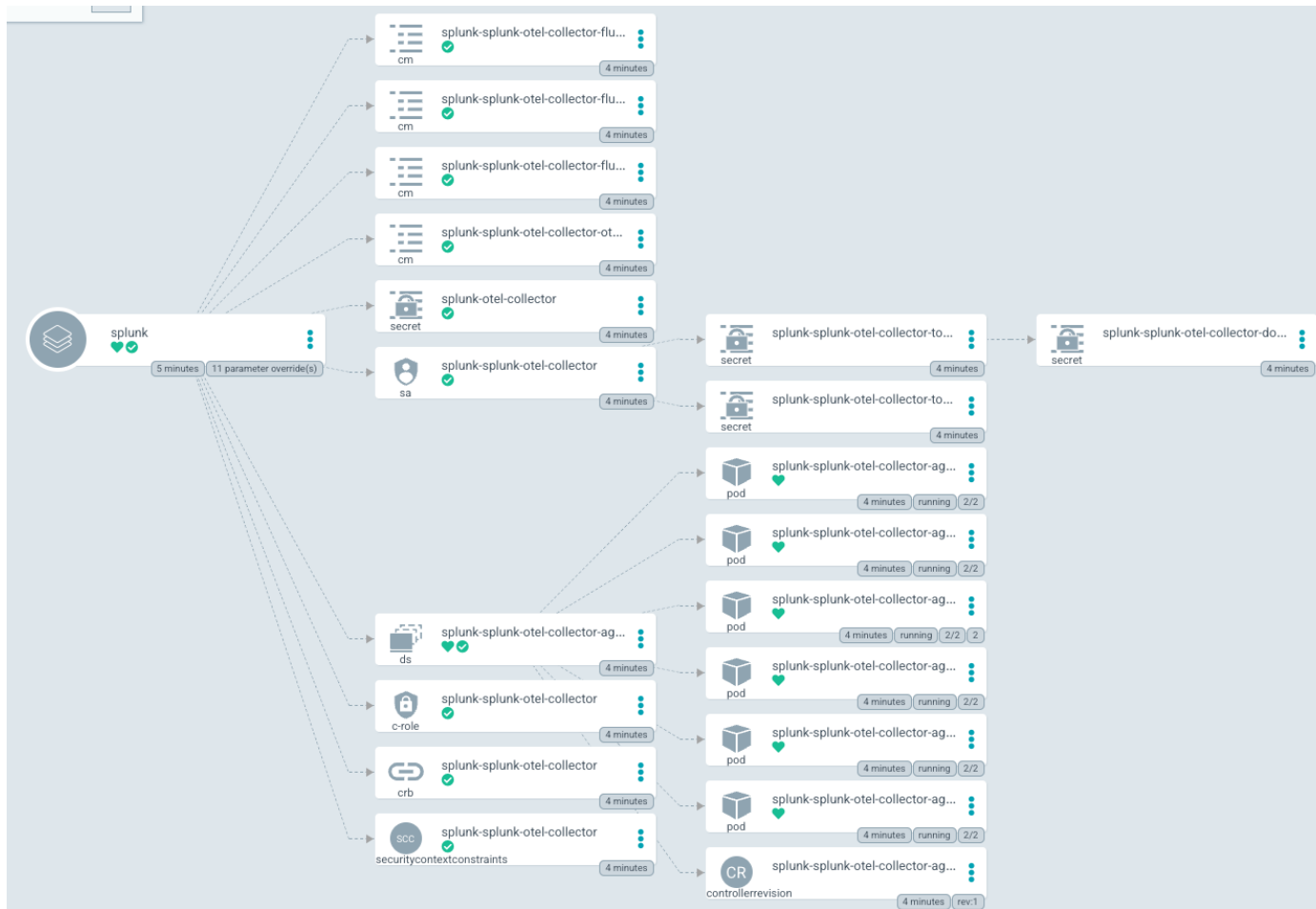


# 6 - SIEM

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- ▶ Send all our OpenShift cluster and container logs to Splunk
- ▶ Uses a collector published by Splunk as a Helm chart. Imported easily/directly into ArgoCD
- ▶ ArgoCD allows us to store & deploy Helm chart parameters from our git repo.

# 6 - SIEM

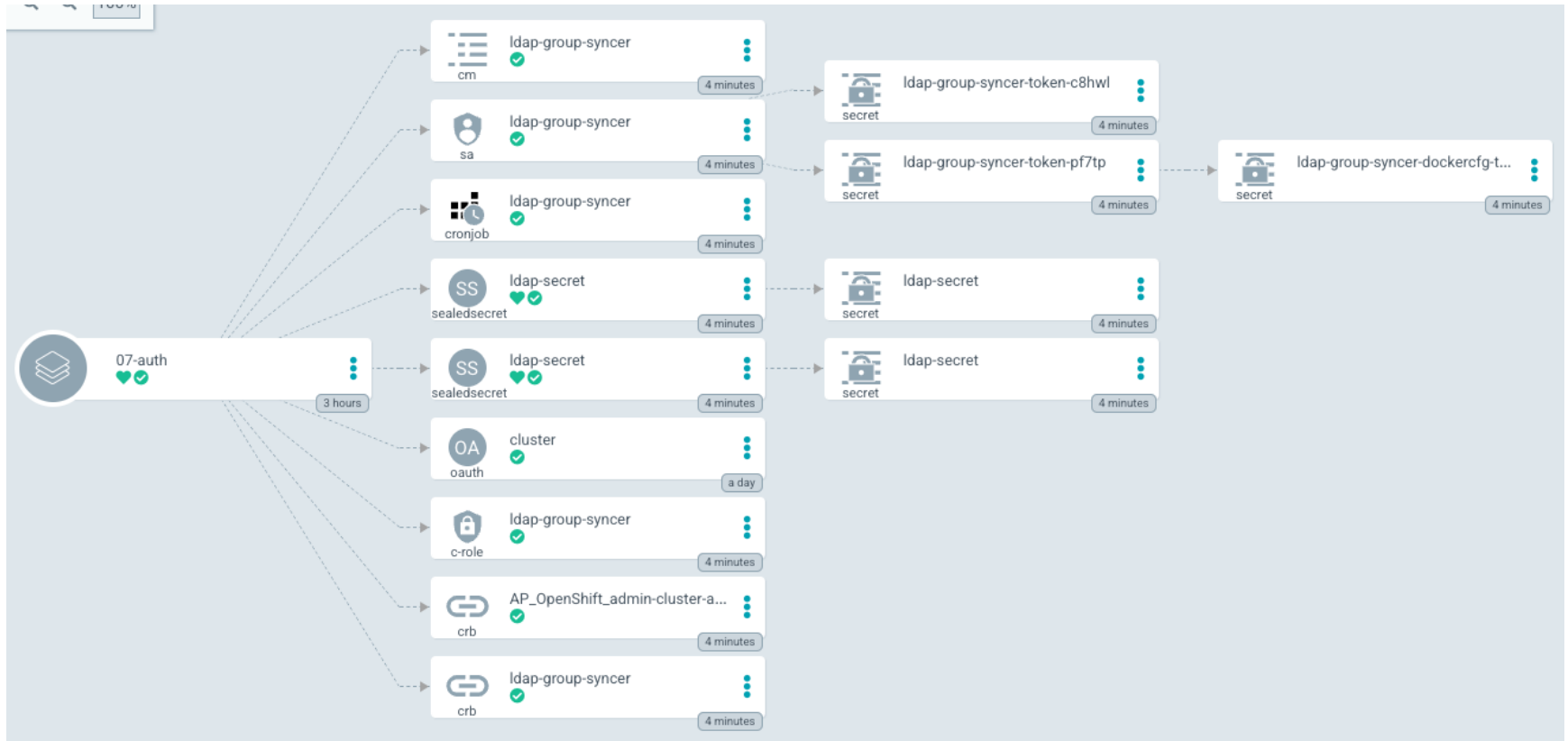


# 7 - Authentication

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- ▶ Syncs to Active Directory
  - Groups and Authentication
  - Cron within OCP syncing regularly

# 7 - Authentication



# 7 – Authentication – Cron!

```
1 kind: CronJob
2 apiVersion: batch/v1beta1
3 metadata:
4   name: ldap-group-syncer
5   namespace: ldap-sync
6 spec:
7   schedule: '*/*/30 * * * *'
8   concurrencyPolicy: Forbid
9   suspend: false
10  jobTemplate:
11    spec:
12      backoffLimit: 0
13      template:
14        metadata:
15          creationTimestamp: null
16        spec:
17          restartPolicy: Never
18          activeDeadlineSeconds: 500
19          serviceAccountName: ldap-group-syncer
20          schedulerName: default-scheduler
21          terminationGracePeriodSeconds: 30
22          securityContext: {}
23
24
25 containers:
26   - name: ldap-group-sync
27     image: 'registry.redhat.io/openshift4/ose-cli:latest'
28     command:
29       - /bin/bash
30       - '-c'
31       - |
32         oc adm groups sync --sync-config=/etc/config/sync.yaml
33         --whitelist=/etc/config/whitelist.txt --confirm
34     resources: {}
35     volumeMounts:
36       - name: ldap-sync-volume
37         mountPath: /etc/config
38       - name: ldap-bind-password
39         mountPath: /etc/secrets
40     terminationMessagePath: /dev/termination-log
41     terminationMessagePolicy: File
42     imagePullPolicy: Always
43     serviceAccount: ldap-group-syncer
44     volumes:
45       - name: ldap-sync-volume
46         configMap:
47           name: ldap-group-syncer
48           defaultMode: 420
49       - name: ldap-bind-password
50         secret:
51           secretName: ldap-secret
52           defaultMode: 420
53     dnsPolicy: ClusterFirst
54     successfulJobsHistoryLimit: 3
55     failedJobsHistoryLimit: 1
```

# Ready to go

<p><b>01-gitops</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap/gitops Destination: in-cluster Namespace:</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>	<p><b>02-sealed-secrets</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://bitnami-labs.github.io/sealed-secrets Target Revi... 2.1.8 Chart: sealed-secrets Destination: in-cluster Namespace:</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>	<p><b>03-trident</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap/trident Destination: in-cluster Namespace: trident</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>
<p><b>04-image-registry</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap/image-registry Destination: in-cluster Namespace: engineering</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>	<p><b>05-ssl</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap/ssl Destination: in-cluster Namespace:</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>	<p><b>06-splunk</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap/splunk Destination: in-cluster Namespace:</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>
<p><b>07-auth</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=cluster-bootstrap Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap/auth Destination: in-cluster Namespace:</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>	<p><b>cluster-bootstrap</b> ★</p> <p>Project: bootstrap Labels: Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://git.intra.greenergy.com/openshift/cluster-... Target Revi... HEAD Path: cluster-bootstrap Destination: in-cluster Namespace:</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>	<p><b>splunk</b> ★</p> <p>Project: bootstrap Labels: argocd.argoproj.io/instance=06-splunk Status: <span>♥ Healthy</span> <span>✔ Synced</span> Repository: https://signalfx.github.io/splunk-otel-collector-c-... Target Revi... 0.55.0 Chart: splunk-otel-collector Destination: in-cluster Namespace: splunk-otel-collector</p> <p><a>↻ SYNC</a> <a>🔄 REFRESH</a> <a>🗑️ DELETE</a></p>

# App & Dev Teams

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- ▶ Have started aggressively using OpenShift
- ▶ Have embraced Red Hat GitOps for their deployments
- ▶ Are really working more closely with our Infrastructure team



# Future Considerations

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- ▶ Geo-redundancy
  - Global load balancing, MetalLB, etc.
- ▶ Image management & vulnerability management (Insights)
- ▶ Backup & recovery of persistent volumes
  - (NetApp, Cohesity, and procedures)
- ▶ Upgrade & maintenance processes
  - We've done minor updates, no major version (yet)
- ▶ Firewalls & Isolation
- ▶ Multiple physical networks

# Questions?

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- ▶ Chris Anderley
- ▶ Scott Hughes