About me

Luc Juggery

Developer Relations @ Exoscale

https://luc.run

Previous

- Co-founder IoT startup

- Devops / Cloud architect

- Docker / Kubernetes trainer

The members of the k0s family

k0s: lightweight Kubernetes distribution

k0sctl: manages k0s clusters lifecycles

k0smotron: runs control planes inside Pods

k0rdent: manage multiple Kubernetes clusters

* each component is under Apache License 2.0

k0s

- https://k0sproject.io

- Certified Kubernetes distribution originally created by Mirantis

- CNCF Sandbox project

- Single binary without any OS dependencies

- Production-grade

k0s

Get a local cluster in a couple of easy steps

```
# Download the binary
curl -sSf https://get.k0s.sh | sudo sh

# Install the service (acting as control-plane and worker)
sudo k0s install controller --single

# Start the service
sudo k0s start

# Acces the cluster
sudo k0s kubectl get node
```

k0sctl

- https://github.com/k0sproject/k0sctl

- CLI to manage k0s clusters

  - create / upgrade / backup & restore

- Declarative cluster management

- Fine grained cluster configuration

k0sctl

Create a configuration file and deploy your cluster

Default configuration can be created using
k0sctl init --k0s

```yaml
apiVersion: k0sctl.k0sproject.io/v1beta1
kind: Cluster
metadata:
 name: k0s-cluster
 user: admin
spec:
 hosts:
 - ssh:
     address: 192.168.64.35
     user: ubuntu
     port: 22
     keyPath: /tmp/k0s
   role: controller
 - ssh:
     address: 192.168.64.36
     user: ubuntu
     port: 22
     keyPath: /tmp/k0s
   role: worker
 k0s:
   version: v1.34.1+k0s.0
   config:
     …
```
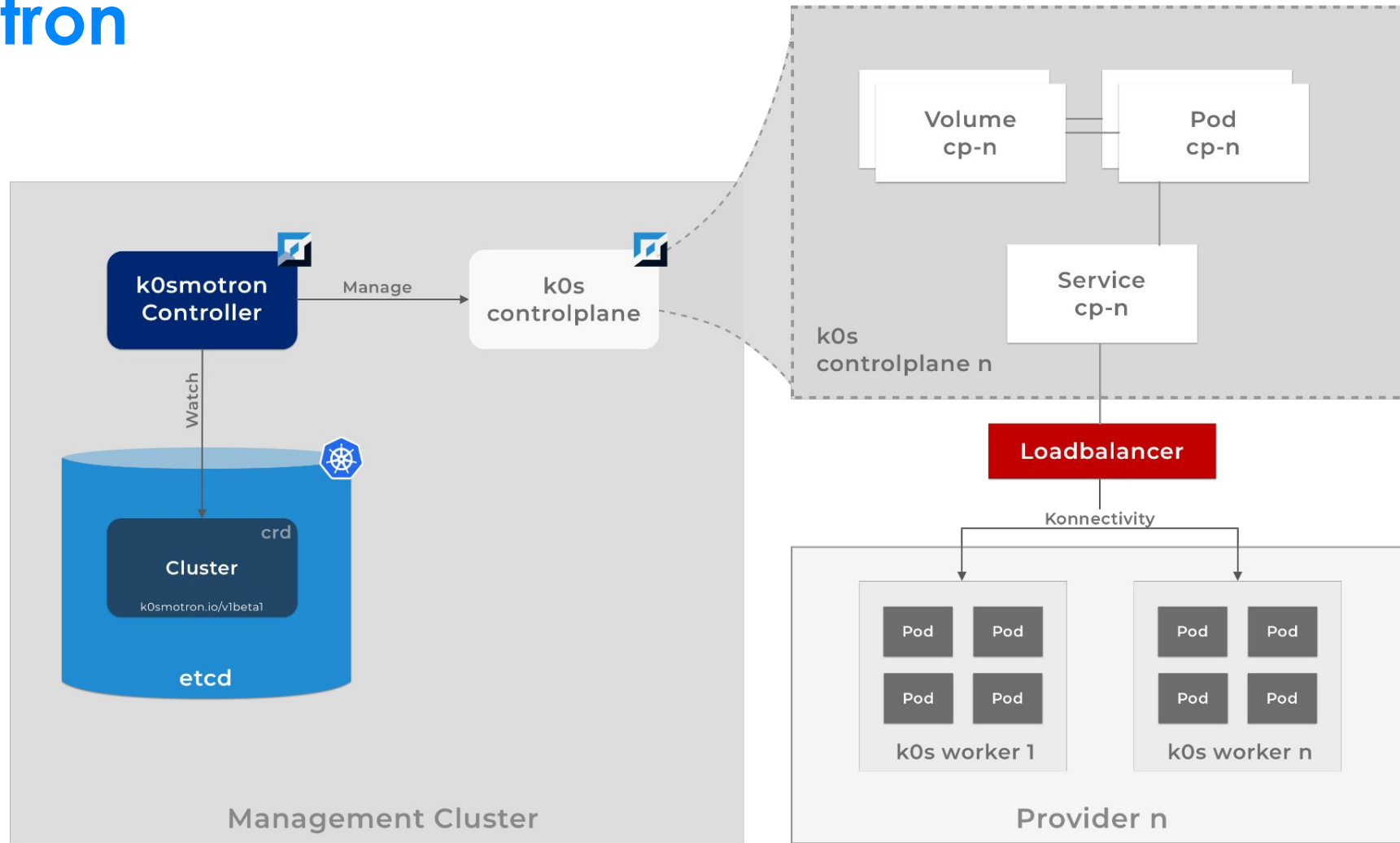
cluster.yaml

k0sctl apply

192.168.64.35   192.168.64.35

k0smotron

- https://k0smotron.io
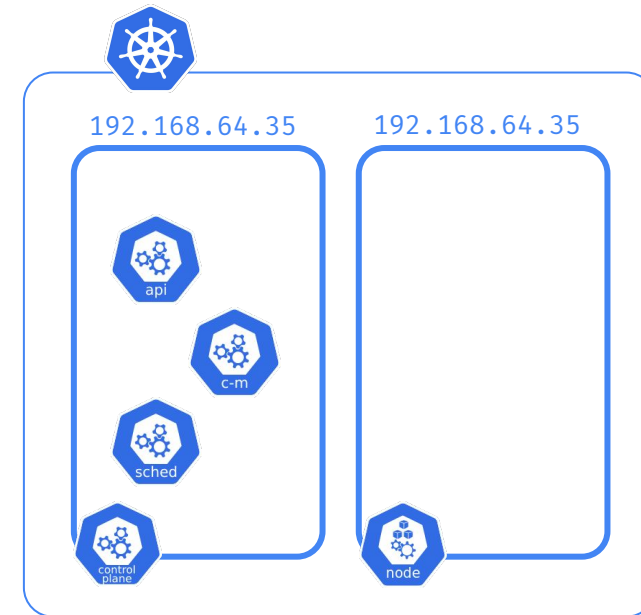
- Manage hosted k0s control plane

- Attach worker nodes from any infrastructure

- Control plane and workers are separated

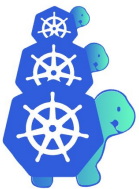- Cluster API (CAPI) provider

k0smotron

k0smotron - CAPI

- https://cluster-api.sigs.k8s.io/

- Declaratively manage workload clusters from a management cluster

- Defines core CRDs and controllers ----------
```
Cluster
MachineDeployment
Machine
…
```

- Relies on implementations from infrastructure providers

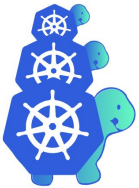   - cloud providers / Proxmox / Docker / k0smotron, …

k0smotron - CAPI

Overall configuration of the Kubernetes cluster

Manages a scalable set of worker machines

```yaml
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
 name: demo
 namespace: default
spec:
 clusterNetwork:
   pods:
     cidrBlocks:
     - 192.168.0.0/16
   serviceDomain: cluster.local
   services:
     cidrBlocks:
     - 10.128.0.0/12
 controlPlaneRef:

   …

 infrastructureRef:
   …
---
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
 name:  demo-md
 namespace: default
spec:
 clusterName: demo
 replicas: 1
 selector:
   matchLabels:
     cluster.x-k8s.io/cluster-name: demo
     pool: worker-pool-1
 template:
   metadata:
     labels:
       cluster.x-k8s.io/cluster-name: demo
       pool: worker-pool-1
   spec:
     clusterName: demo
     version: v1.34.0
     bootstrap:
       configRef:

         …
     infrastructureRef:
       …
---
…
```

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k0smotron - CAPI

Overall configuration of the Kubernetes cluster

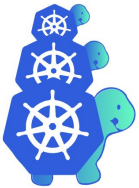Manages a scalable set of worker machines

```yaml
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
 name: demo
 namespace: default
spec:
 clusterNetwork:
   pods:
     cidrBlocks:
     - 192.168.0.0/16
   serviceDomain: cluster.local
   services:
     cidrBlocks:
     - 10.128.0.0/12
 controlPlaneRef:
   …
 infrastructureRef:
   …
---
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
 name:  demo-md
 namespace: default
spec:
 clusterName: demo
 replicas: 1
 selector:
   matchLabels:
     cluster.x-k8s.io/cluster-name: demo
     pool: worker-pool-1
 template:
   metadata:
     labels:
       cluster.x-k8s.io/cluster-name: demo
       pool: worker-pool-1
   spec:
     clusterName: demo
     version: v1.34.0
     bootstrap:
       configRef:
         …
     infrastructureRef:
       …
---
…
```

Control plane provider responsible for creating and managing control plane nodes

Infrastructure provider that specifies the high-level configuration of the cluster (VPC, subnets, …)

Bootstrap provider that specifies how each worker machine is initialized (cloud-init)

Infrastructure provider responsible for creating the worker machines

k0smotron - CAPI

Overall configuration of the Kubernetes cluster

Manages a scalable set of worker machines

k0smotron can act as a **control plane**, **bootstrap**, and **infrastructure** (RemoteMachine) CAPI provider
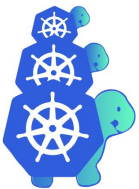
```
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
 name: demo
 namespace: default
spec:
 clusterNetwork:
   pods:
     cidrBlocks:
     - 192.168.0.0/16
     serviceDomain: cluster.local
     services:
       cidrBlocks:
       - 10.128.0.0/12
 controlPlaneRef:
   …
 infrastructureRef:
   …
---
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
 name:  demo-md
 namespace: default
spec:
 clusterName: demo
 replicas: 1
 selector:
   matchLabels:
     cluster.x-k8s.io/cluster-name: demo
     pool: worker-pool-1
 template:
   metadata:
     labels:
       cluster.x-k8s.io/cluster-name: demo
       pool: worker-pool-1
   spec:
     clusterName: demo
     version: v1.34.0
     bootstrap:
       configRef:
         …
     infrastructureRef:
       …
---
…
```

Control plane provider responsible for creating and managing control plane nodes

Infrastructure provider that specifies the high-level configuration of the cluster (VPC, subnets, …)

Bootstrap provider that specifies how each worker machine is initialized (cloud-init)

Infrastructure provider responsible for creating the worker machines

k0smotron - CAPI

Example of a specification using k0smotron as the **control plane provider** and Docker as the **infrastructure provider**
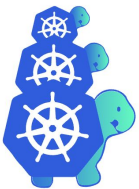
Cluster

Control Plane

Infrastructure

MachineDeployment

Bootstrap

Infrastructure

```yaml
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
  name: docker-demo
  namespace: default
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
        - 192.168.0.0/16
      serviceDomain: cluster.local
    services:
      cidrBlocks:
        - 10.128.0.0/12
  controlPlaneRef:
    apiGroup: controlplane.cluster.x-k8s.io
    kind: K0smotronControlPlane
    name: docker-demo-cp
  infrastructureRef:
    apiGroup: infrastructure.cluster.x-k8s.i
    kind: DockerCluster
    name: docker-demo
---
apiVersion: controlplane.cluster.x-k8s.io/v    ta1
kind: K0smotronControlPlane
metadata:
  name: docker-demo-cp
  namespace: default
spec:
  version: v1.34.1-k0s.0
  persistence:
    type: emptyDir
  service:
    type: NodePort
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerCluster
metadata:
  name: docker-demo
  namespace: default
  annotations:
    cluster.x-k8s.io/managed-by: k0smotron
spec: {}
---
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
  name:  docker-demo-md
  namespace: default
spec:
  clusterName: docker-demo
  replicas: 1
  selector:
    matchLabels:
      cluster.x-k8s.io/cluster-name: docker-demo
      pool: worker-pool-1
  template:
    metadata:
      labels:
        cluster.x-k8s.io/cluster-name: docker-demo
        pool: worker-pool-1
    spec:
      clusterName: docker-demo
      version: v1.34.0
      bootstrap:
        configRef:
          apiGroup: bootstrap.cluster.x-k8s.io
          kind: K0sWorkerConfigTemplate
          name: docker-demo-machine-config
      infrastructureRef:
        apiGroup: infrastructure.cluster.x-k8s.io
        kind: DockerMachineTemplate
        name: docker-demo-mt
---
apiVersion: infrastructure.cluster.x-k8s.io/v1b    a2
kind: DockerMachineTemplate
metadata:
  name: docker-demo-mt
  namespace: default
spec:
  template:
    spec: {}
---
apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
kind: K0sWorkerConfigTemplate
metadata:
  name: docker-demo-machine-config
spec:
  template:
    spec:
      version: v1.34.1+k0s.0
```

k0smotron - CAPI

Example of a specification using k0smotron as the **control plane provider** and Docker as the **infrastructure provider**
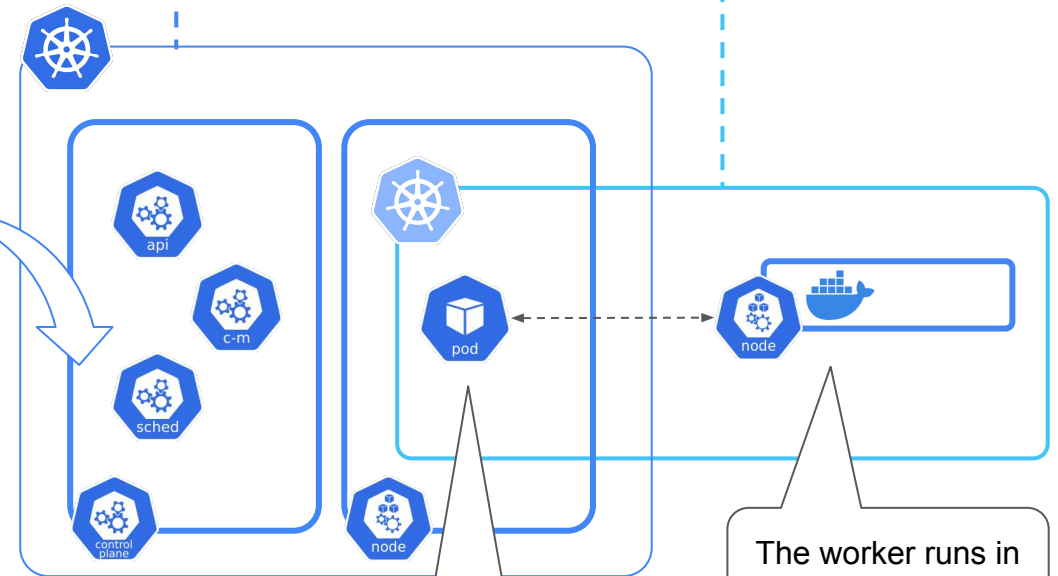
Cluster

Control Plane

Infrastructure

MachineDeployment
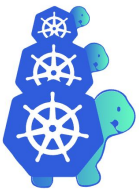
Bootstrap

Infrastructure

```
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
  name: docker-demo
  namespace: default
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
      - 192.168.0.0/16
    serviceDomain: cluster.local
    services:
      cidrBlocks:
      - 10.128.0.0/12
  controlPlaneRef:
    apiGroup: controlplane.cluster.x-k8s.io
    kind: K0smotronControlPlane
    name: docker-demo-cp
  infrastructureRef:
    apiGroup: infrastructure.cluster.x-k8s.i
    kind: DockerCluster
    name: docker-demo
---
apiVersion: controlplane.cluster.x-k8s.io/v1beta1
kind: K0smotronControlPlane
metadata:
  name: docker-demo-cp
  namespace: default
spec:
  version: v1.34.1-k0s.0
  persistence:
    type: emptyDir
  service:
    type: NodePort
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerCluster
metadata:
  name: docker-demo
  namespace: default
  annotations:
    cluster.x-k8s.io/managed-by: k0smotron
spec: {}
---
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
  name:  docker-demo-md
  namespace: default
spec:
  clusterName: docker-demo
  replicas: 1
  selector:
    matchLabels:
      cluster.x-k8s.io/cluster-name: docker-demo
      pool: worker-pool-1
  template:
    metadata:
      labels:
        cluster.x-k8s.io/cluster-name: docker-demo
        pool: worker-pool-1
    spec:
      clusterName: docker-demo
      version: v1.34.0
      bootstrap:
        configRef:
          apiGroup: bootstrap.cluster.x-k8s.io
          kind: K0sWorkerConfigTemplate
          name: docker-demo-machine-config
      infrastructureRef:
        apiGroup: infrastructure.cluster.x-k8s.io
        kind: DockerMachineTemplate
        name: docker-demo-mt
---
apiVersion: infrastructure.cluster.x-k8s.io/v1b   2
kind: DockerMachineTemplate
metadata:
  name: docker-demo-mt
  namespace: default
spec:
  template:
    spec: {}
---
apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
kind: K0sWorkerConfigTemplate
metadata:
  name: docker-demo-machine-config
spec:
  template:
    spec:
      version: v1.34.1+k0s.0
```

Applying the manifest to the <u>management cluster</u> creates a <u>workload cluster</u>

The worker runs in a Docker container

The control plane runs in a Pod in the management cluster

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k0rdent

- https://k0rdent.io/

- Built on top of Cluster API and k0smotron

- Declarative way to manage a fleet of workload clusters and the
  services running on them

  - cluster lifecycle ....

    ```
    ClusterTemplates
    ClusterTemplateChains
    ProviderTemplates
    Credentials
    ClusterDeployments
    …
    ```

  - application management

    ```
    ServiceTemplates
    ServiceTemplateChains
    MultiClusterServices
    …
    ```

k0rdent

Cluster

```
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
  name: docker-demo
  namespace: default
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
      - 192.168.0.0/16
    serviceDomain: cluster.local
    services:
      cidrBlocks:
      - 10.128.0.0/12
  controlPlaneRef:
    apiGroup: controlplane.cluster.x-k8s.io
    kind: K0smotronControlPlane
    name: docker-demo-cp
  infrastructureRef:
    apiGroup: infrastructure.cluster.x-k8s.i
    kind: DockerCluster
    name: docker-demo
---
```

Control Plane

```
apiVersion: controlplane.cluster.x-k8s.io/v1beta1
kind: K0smotronControlPlane
metadata:
  name: docker-demo-cp
  namespace: default
spec:
  version: v1.34.1-k0s.0
  persistence:
    type: emptyDir
  service:
    type: NodePort
---
```

Infrastructure

```
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerCluster
metadata:
  name: docker-demo
  namespace: default
  annotations:
    cluster.x-k8s.io/managed-by: k0smotron
spec: {}
---
```

MachineDeployment

```
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
  name:  docker-demo-md
  namespace: default
spec:
  clusterName: docker-demo
  replicas: 1
  selector:
    matchLabels:
      cluster.x-k8s.io/cluster-name: docker-demo
      pool: worker-pool-1
  template:
    metadata:
      labels:
        cluster.x-k8s.io/cluster-name: docker-demo
        pool: worker-pool-1
    spec:
      clusterName: docker-demo
      version: v1.34.0
      bootstrap:
        configRef:
          apiGroup: bootstrap.cluster.x-k8s.io
          kind: K0sWorkerConfigTemplate
          name: docker-demo-machine-config
      infrastructureRef:
        apiGroup: infrastructure.cluster.x-k8s.io
        kind: DockerMachineTemplate
        name: docker-demo-mt
---
```

Bootstrap

```
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerMachineTemplate
metadata:
  name: docker-demo-mt
  namespace: default
spec:
  template:
    spec: {}
---
```

Infrastructure

```
apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
kind: K0sWorkerConfigTemplate
metadata:
  name: docker-demo-machine-config
spec:
  template:
    spec:
      version: v1.34.1+k0s.0
```

Configuration of various clusters embedded in ClusterTemplates

```
apiVersion: k0rdent.mirantis.com/v1beta1
kind: ClusterDeployment
metadata:
  name: docker-demo
  namespace: kcm-system
spec:
  template: docker-hosted-cp-1-0-4
  credential: docker-default
  config:
    kubernetesVersion: v1.34.1-k0s.0
    controlPlane:
      replicas: 1
    worker:
      replicas: 2
```
cluster.yaml

k0rdent

Cluster

```
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
  name: docker-demo
  namespace: default
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
      - 192.168.0.0/16
    serviceDomain: cluster.local
    services:
      cidrBlocks:
      - 10.128.0.0/12
  controlPlaneRef:
    apiGroup: controlplane.cluster.x-k8s.io
    kind: K0smotronControlPlane
    name: docker-demo-cp
  infrastructureRef:
    apiGroup: infrastructure.cluster.x-k8s.
    kind: DockerCluster
    name: docker-demo
---
```

Control Plane

```
apiVersion: controlplane.cluster.x-k8s.io/v1beta1
kind: K0smotronControlPlane
metadata:
  name: docker-demo-cp
  namespace: default
spec:
  version: v1.34.1-k0s.0
  persistence:
    type: emptyDir
  service:
    type: NodePort
---
```

Infrastructure

```
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerCluster
metadata:
  name: docker-demo
  namespace: default
  annotations:
    cluster.x-k8s.io/managed-by: k0smotron
spec: {}
---
```

MachineDeployment

```
apiVersion: cluster.x-k8s.io/v1beta2
kind: MachineDeployment
metadata:
  name:  docker-demo-md
  namespace: default
spec:
  clusterName: docker-demo
  replicas: 1
  selector:
    matchLabels:
      cluster.x-k8s.io/cluster-name: docker-demo
      pool: worker-pool-1
  template:
    metadata:
      labels:
        cluster.x-k8s.io/cluster-name: docker-demo
        pool: worker-pool-1
    spec:
      clusterName: docker-demo
      version: v1.34.0
      bootstrap:
        configRef:
          apiGroup: bootstrap.cluster.x-k8s.io
          kind: K0sWorkerConfigTemplate
          name: docker-demo-machine-config
      infrastructureRef:
        apiGroup: infrastructure.cluster.x-k8s.io
        kind: DockerMachineTemplate
        name: docker-demo-mt
---
```

Bootstrap

```
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerMachineTemplate
metadata:
  name: docker-demo-mt
  namespace: default
spec:
  template:
    spec: {}
---
```

Infrastructure

```
apiVersion: bootstrap.cluster.x-k8s.io/v1beta1
kind: K0sWorkerConfigTemplate
metadata:
  name: docker-demo-machine-config
spec:
  template:
    spec:
      version: v1.34.1+k0s.0
```

Configuration of various clusters embedded in ClusterTemplates

```
apiVersion: k0rdent.mirantis.com/v1beta1
kind: ClusterDeployment
metadata:
  name: docker-demo
  namespace: kcm-system
spec:
  template: docker-hosted-cp-1-0-4
  credential: docker-default
  config:
    kubernetesVersion: v1.34.1-k0s.0
    controlPlane:
      replicas: 1
    worker:
      replicas: 2
```

cluster.yaml

manifest applied in the management cluster

The control plane runs in a Pod in the management cluster

The workers run in Docker containers
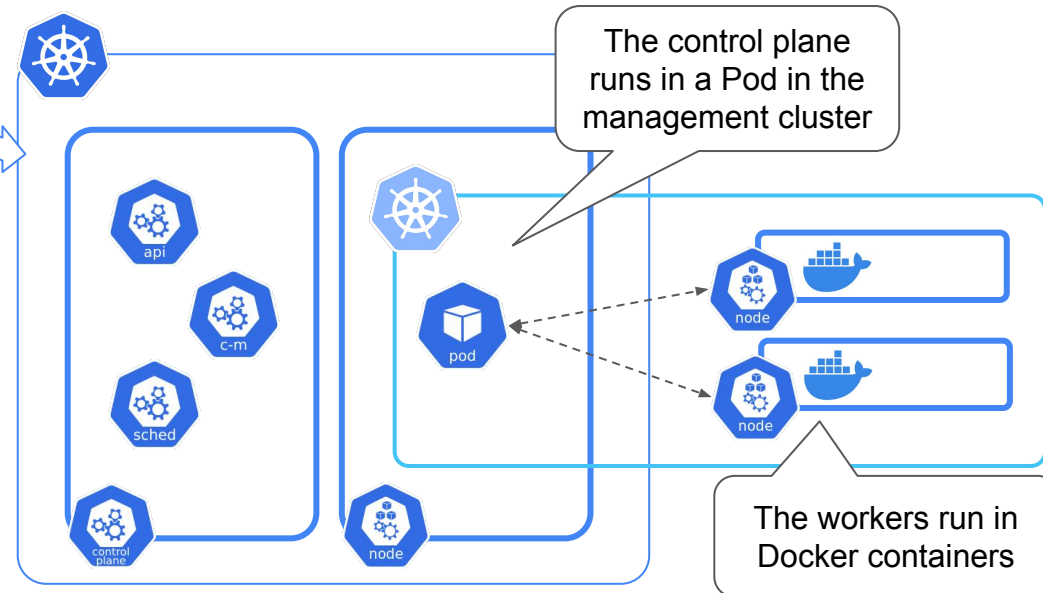
k0rdent

```yaml
apiVersion: k0rdent.mirantis.com/v1beta1
kind: MultiClusterService
metadata:
 name: argocd-demo
 namespace: kcm-system
spec:
 clusterSelector:
   matchLabels:
     helm.toolkit.fluxcd.io/name: docker-demo
 serviceSpec:
   services:
     - name: argocd-demo-service
       namespace: kcm-system
       template: argo-cd-8-6-1
```

MultiClusterService can deploy applications on a fleet of cluster based on label matching

1 manifest applied to the management cluster
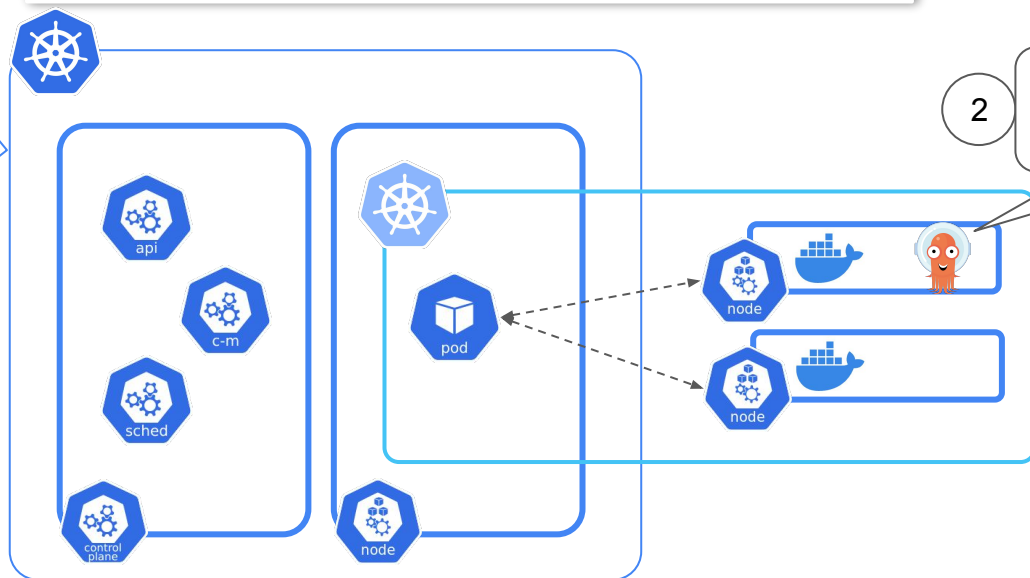
2 Argo CD deployed in the workload cluster

Want to try it ?

- Documentation: k0sproject.io / k0smotron.io / k0rdent.io

- Self-paced workshop: https://k0s-family.luc.run

- Slides: https://luc.run/k0s-family.pdf

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Thank you!

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