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CLOUD NATIVE DAYS

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Introduction to the k0s family

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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

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

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

k0sctl

- <https://github.com/k0sproject/k0sctl>
- CLI to manage k0s clusters
- Declarative cluster management
- Fine grained cluster configuration

k0sctl

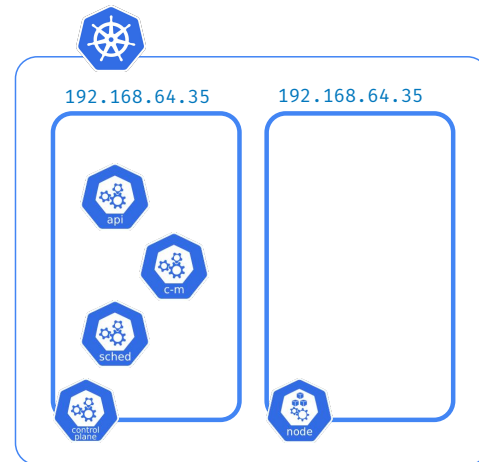
Create a configuration file and deploy your cluster

Default configuration
can be created using
k0sctl init --k0s

```
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

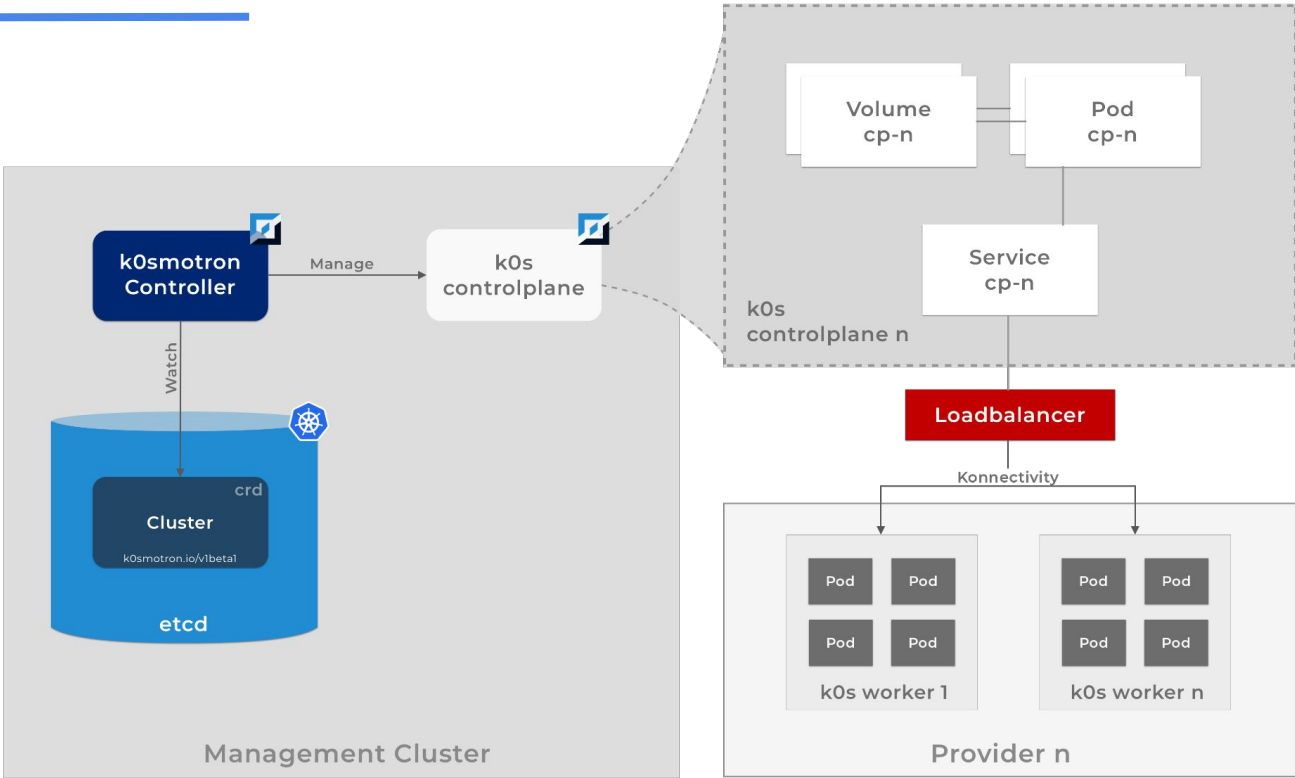
k0sctl apply



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



Source: <https://k0smotron.io>

k0smotron - CAPI

- <https://cluster-api.sigs.k8s.io/>
- Declaratively manage workload clusters from a management cluster
- Defines core CRDs and controllers
- Relies on implementations from infrastructure providers
 - cloud providers / Proxmox / Docker / k0smotron, ...

Cluster
MachineDeployment
Machine
...

k0smotron - CAPI

Overall configuration of
the Kubernetes cluster

Manages a scalable set
of worker machines

```
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:
        ...
...

```

k0smotron - CAPI

Overall configuration of the Kubernetes cluster

Manages a scalable set of worker machines

```
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

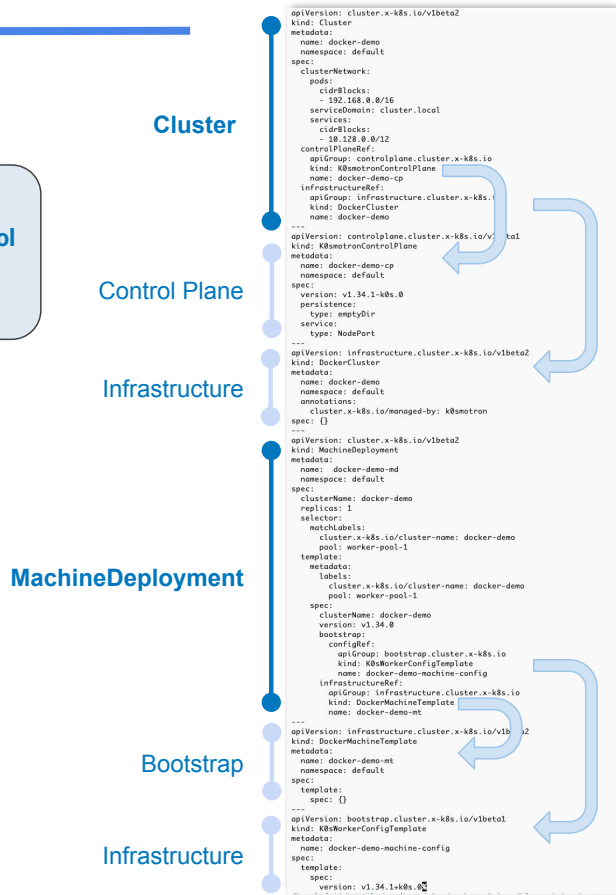
Infrastructure provider that specifies the high-level configuration of the cluster (VPC, subnets, ...)

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**



k0smotron - CAPI

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

Cluster

Control Plane

Infrastructure

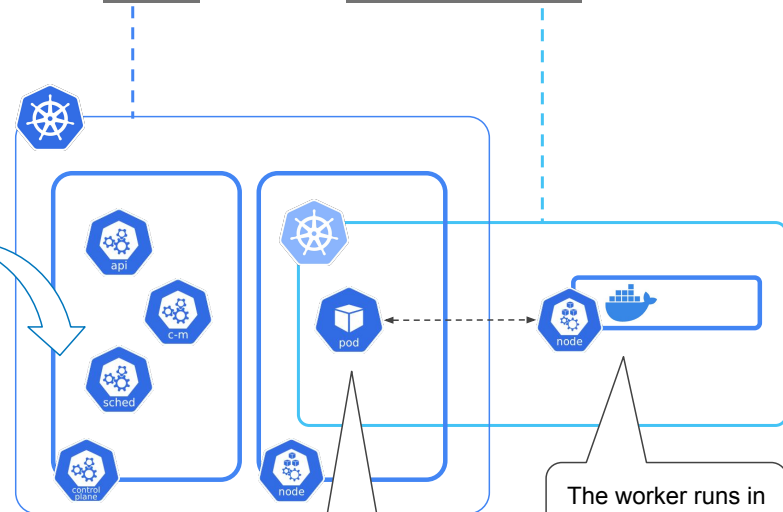
MachineDeployment

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.io
    kind: DockerCluster
    name: docker-demo
---
apiVersion: controlplane.cluster.x-k8s.io/v1alpha1
kind: K0smotronControlPlane
metadata:
  name: docker-demo-cp
  namespace: default
spec:
  version: v1.34.1-k8s.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/v1beta2
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-k8s.0
```

Applying the manifest to the management cluster creates a workload cluster



The control plane runs in a Pod in the management cluster

The worker runs in a Docker container

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

- application management

```
ClusterTemplates
ClusterTemplateChains
ProviderTemplates
Credentials
ClusterDeployments
...
```

```
ServiceTemplates
ServiceTemplateChains
MultiClusterServices
...
```


k0rdent

Specification using
k0smotron as the
control plane provider
and Docker as the
infrastructure
provider

Cluster

Control Plane

Infrastructure

MachineDeployment

Bootstrap

Infrastructure

Configuration of various clusters
embedded in ClusterTemplates

```
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.io
    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-k8s.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-nt
---
apiVersion: infrastructure.cluster.x-k8s.io/v1beta2
kind: DockerMachineTemplate
metadata:
  name: docker-demo-nt
  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-k8s.0
```

```
apiVersion: k0rdent.mirantis.com/v1beta1
kind: ClusterDeployment
metadata:
  name: docker-demo
  namespace: k8s-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

Specification using
k0smotron as the
control plane provider
and Docker as the
infrastructure
provider

Cluster

Control Plane

Infrastructure

MachineDeployment

Bootstrap

Infrastructure

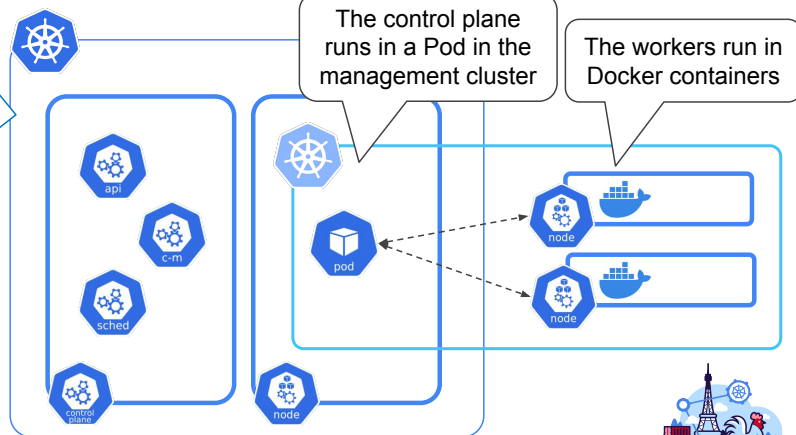
```
apiVersion: cluster.x-k8s.io/v1beta2
kind: Cluster
metadata:
  name: docker-demo
  namespace: default
spec:
  clusterNetwork:
    pods:
      cidrBlocks:
        - 192.168.0.0/16
      serviceDomain: cluster.local
    services:
      cidrBlocks:
        - 10.128.0.0/12
  controlPlaneRef:
    apiGroup: controlplane.cluster.x-k8s.io
    kind: K0smotronControlPlane
    name: docker-demo-cp
  infrastructureRef:
    apiGroup: infrastructure.cluster.x-k8s.io
    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-k8s.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/v1beta2
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-k8s.0
```

Configuration of various clusters
embedded in ClusterTemplates

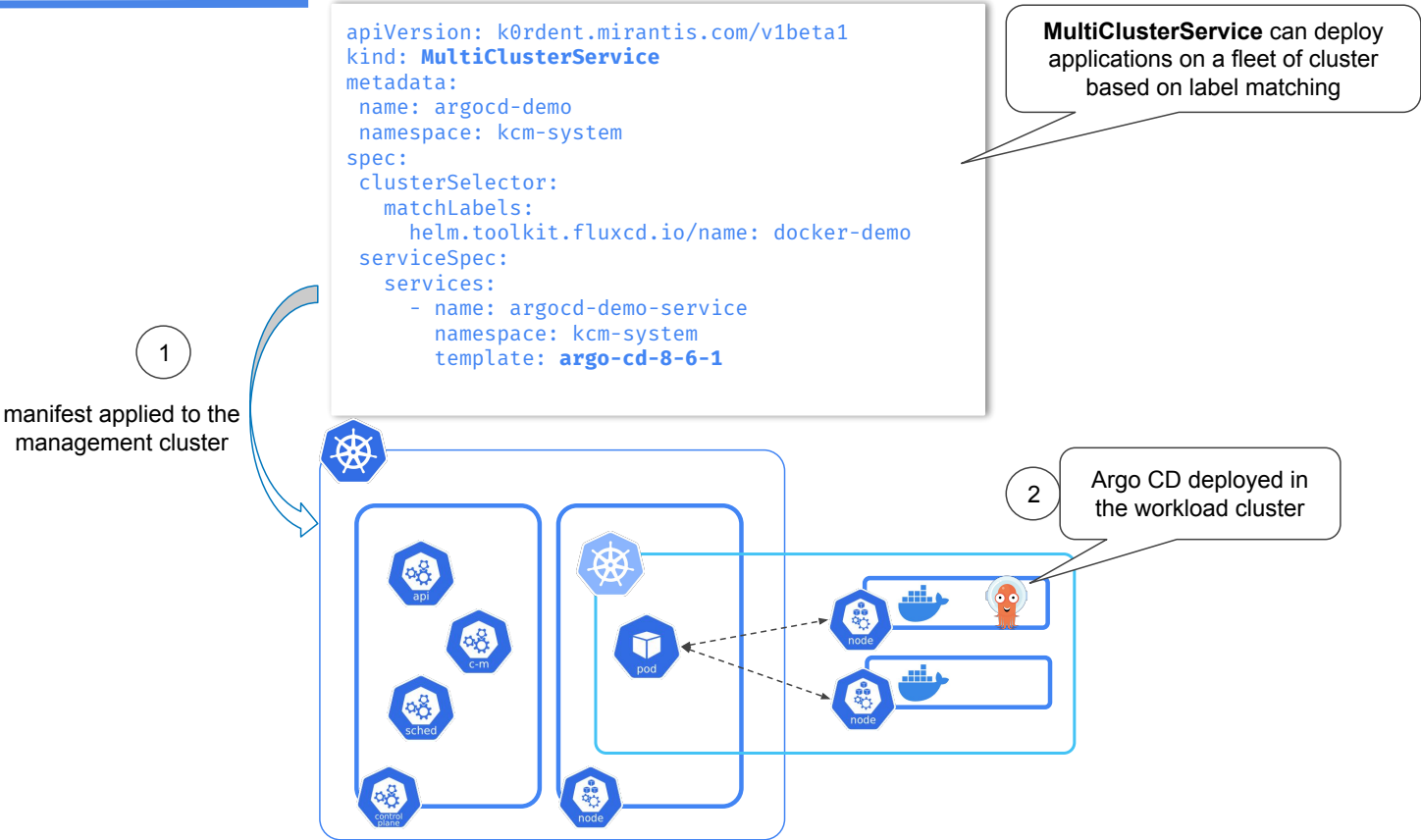
manifest applied in the
management cluster

```
apiVersion: k0rdent.mirantis.com/v1beta1
kind: ClusterDeployment
metadata:
  name: docker-demo
  namespace: k8m-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



Want to try it ?

- Documentation ⇒ k0sproject.io / k0smotron.io / k0rdent.io
- Self-paced workshop to get started ⇒ <https://k0s-family.luc.run>
- Slides: <https://luc.run/k0s-family-cnd.pdf>

Thanks



Feedback :



Get in touch:



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<https://luc.run>

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