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A Kubernetes Journey

Wolfgang Ofner

kubernetes

Agenda

Docker

Kubernetes

Helm

Infrastructure as Code

Automated Database Deployment

Challenges of modern Software

Deploy 100 times a day

Versioning

Dependencies

Easy to test

Fast to set up on target machine

Monolithic software

Database deployments

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Docker

Containers

Image: blueprint

Container: Instance of this blueprint

Versioned artifact

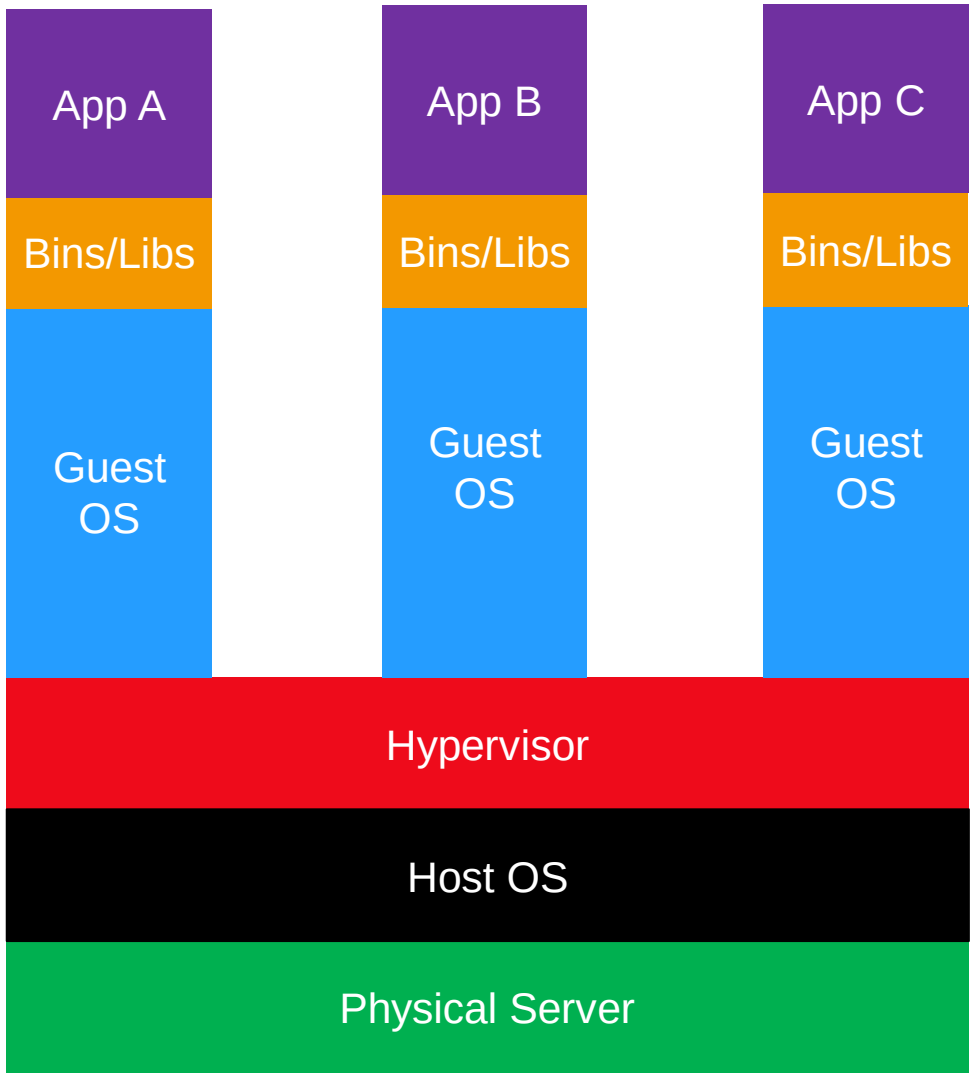
Container image always is bit by bit identical when deployed

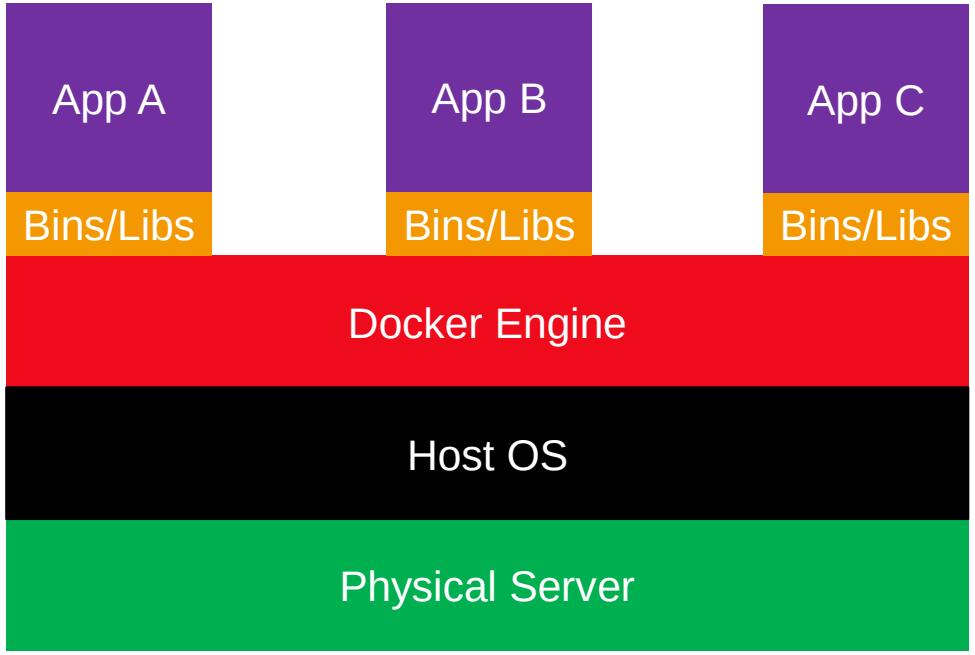
Abstracts underlying infrastructure

Fast start up times

Pet vs. Kettle

Virtual Machine vs. Container





Dockerfile

- Blueprint to build Docker Image
- Can be based on existing images
- Commands to update the base OS and install additional software
- Build artifacts to include, such as a developed application
- Command to run when the container is launched

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WORKDIR /app
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ENTRYPOINT ["dotnet", "CustomerApi.dll"]
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WORKDIR /src
RUN dotnet build "CustomerApi.Database.Build/CustomerApi.Database.Build.csproj" -c Release -o /dacpacs --no-restore

FROM build AS test
ARG BuildId=localhost
LABEL test=${BuildId}
RUN dotnet test --no-build -c Release --results-directory /testresults --logger "trx;LogFileName=test_results.trx" /p:CollectCoverage=true /p:CoverletOutputFormat=json%2cCobertura /p:CoverletOutput=
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Onion File System

Every command is a new layer

Layers can be cached

Faster builds

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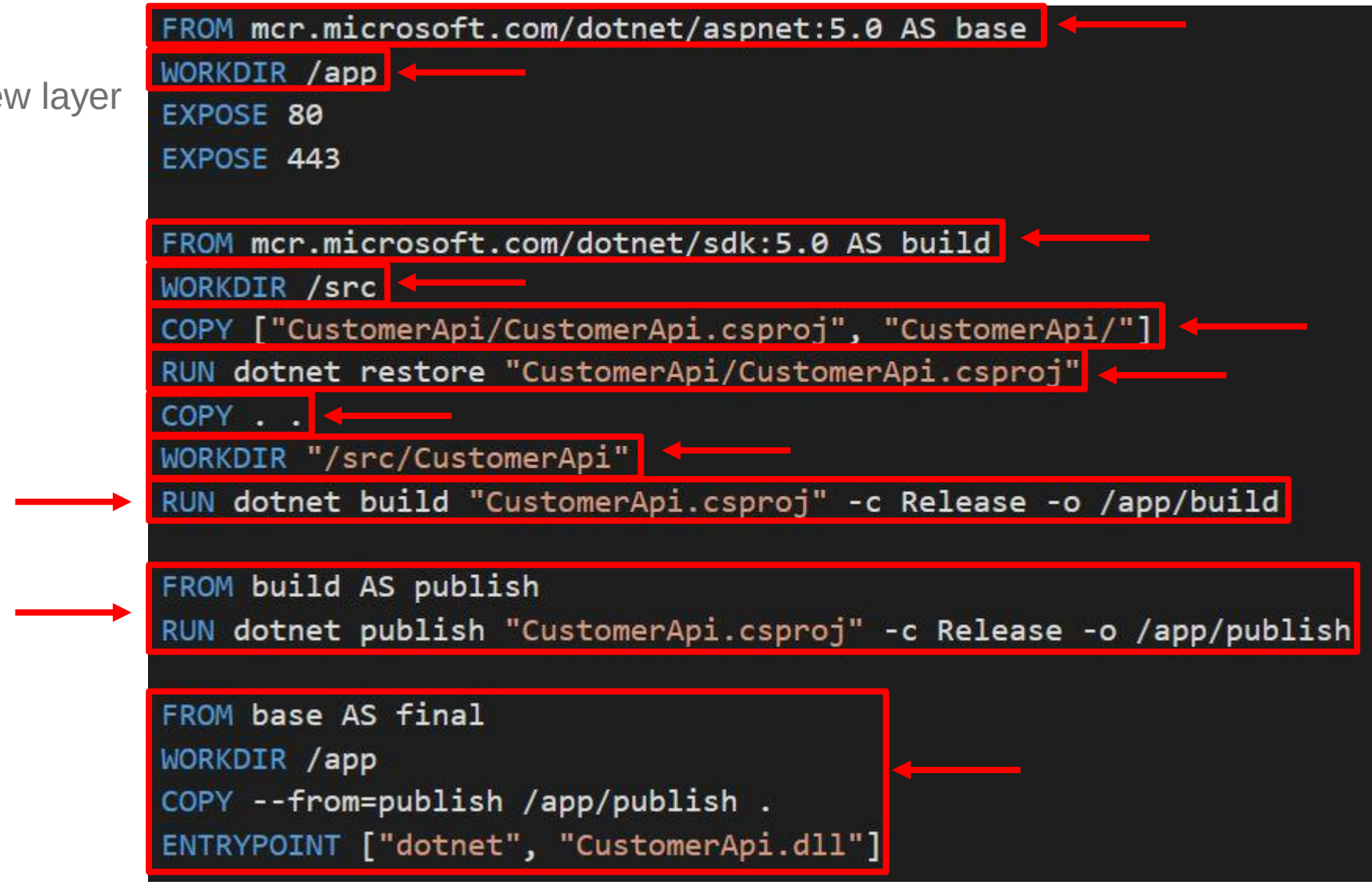

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11 Layer

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57 Layer

Tags

Decide what version you run at any given time

“Latest” by default

Used for versioning

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Used for versioning

wolfgangofner/customerapi:latest

wolfgangofner/customerapi:1.10.15

wolfgangofner/customerapi:1.10.16

How to install Docker

Windows

Docker Desktop https://docs.docker.com/desktop/windows/install

Mac

Docker Desktop https://docs.docker.com/desktop/mac/install

Linux

```
curl -fsSL https://get.docker.com -o get-docker.sh
sudo sh get-docker.sh
```

Docker Commands

List containers

docker ps

List images

docker ls

Download an image from a registry

docker pull wolfgangofner/customerapi

Build an image from a Dockerfile

docker build . [-f CustomerApi/Dockerfile]

Tag an image

docker tag customerapi wolfgangofner/customerapi

Push an image to a registry

docker push wolfgangofner/customerapi

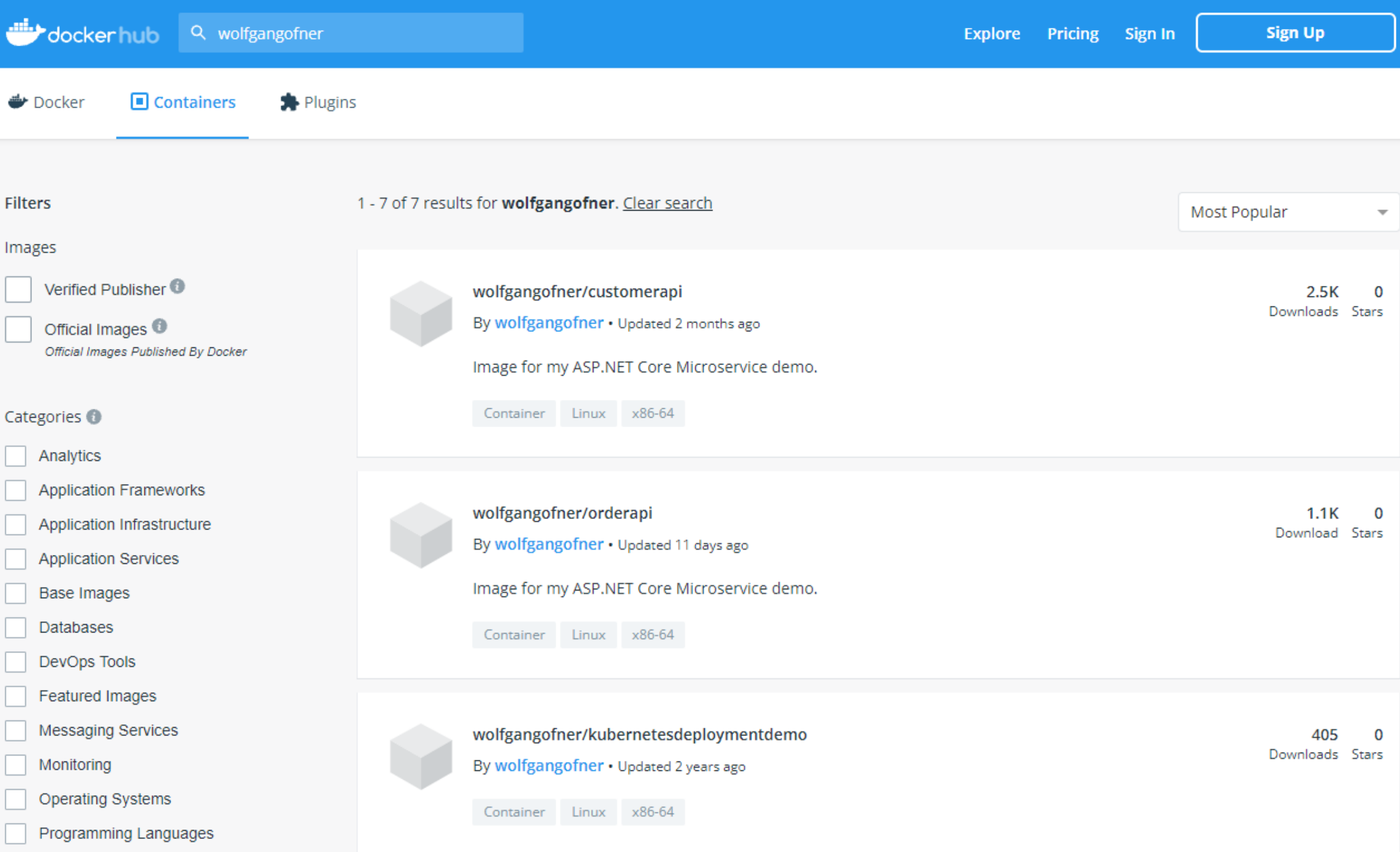
Start a container

docker run -p 32789:80 -p 32788:443 wolfgangofner/customerapi

Container Registry

Repository to store container images

Docker Hub


dockerhub
wolfgangofner
Explore
Pricing
Sign In
Sign Up
Docker
Containers
Plugins
Filters
Images
Verified Publisher
Official Images
Official Images Published By Docker
Categories
Analytics
Application Frameworks
Application Infrastructure
Application Services
Base Images
Databases
DevOps Tools
Featured Images
Messaging Services
Monitoring
Operating Systems
Programming Languages
1 - 7 of 7 results for wolfgangofner. Clear search
Most Popular
wolfgangofner/customerapi
By wolfgangofner • Updated 2 months ago
Image for my ASP.NET Core Microservice demo.
Container
Linux
x86-64
2.5K
Downloads
0
Stars
wolfgangofner/orderapi
By wolfgangofner • Updated 11 days ago
Image for my ASP.NET Core Microservice demo.
Container
Linux
x86-64
1.1K
Download
0
Stars
wolfgangofner/kubernetesdeploymentdemo
By wolfgangofner • Updated 2 years ago
Container
Linux
x86-64
405
Downloads
0
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Container Registry

Repository to store container images

Docker Hub

Azure Container Registry (ACR)

Public vs. private registry

Additional functionalities like:

- Geo-replication
- Availability zones
- Security scanning
- Automated container building and patching

Docker Compose

YAML file

Define container dependencies

Run all dependent containers

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YAML file

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Run all dependent containers

Advantages

- Configure dependencies between containers
- Restart policy
- Easy to start

Disadvantages

- Monitoring
- Load Balancing
- Deployment
- SSL Certificate

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Docker Compose

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```yaml
version: "3.9"

services:
  wordpress:
    image: wordpress
    restart: always
    ports:
      - 8080:80
    environment:
      WORDPRESS_DB_HOST: db
      WORDPRESS_DB_USER: exampleuser
      WORDPRESS_DB_PASSWORD: examplepass
      WORDPRESS_DB_NAME: exampledb
    volumes:
      - wordpress:/var/www/html

  db:
    image: mysql:5.7
    restart: always
    environment:
      MYSQL_DATABASE: exampledb
      MYSQL_USER: exampleuser
      MYSQL_PASSWORD: examplepass
      MYSQL_RANDOM_ROOT_PASSWORD: '1'
    volumes:
      - db:/var/lib/mysql
```

Docker Recap

Small images

Fast start up and deployment

Reusable and portable

Immutable → “Works on my machine”

Containers allow you to run your software even if your infrastructure provider does not support it

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Small images

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Containers allow you to run your software even if your infrastructure provider does not support it

Docker was founded in 2013, container technology is much older

Written in Go

Open-source

Windows and Linux supported

containers don't solve all problems

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Container Orchestrator

kubernetes

Container Orchestrator

Deployment

Resource Management

Load balancing

Monitoring and Self Healing

Zero Downtime Deployments

Manage SSL certificates

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Tools

- **Kubernetes**
- Docker Swarm
- Marathon

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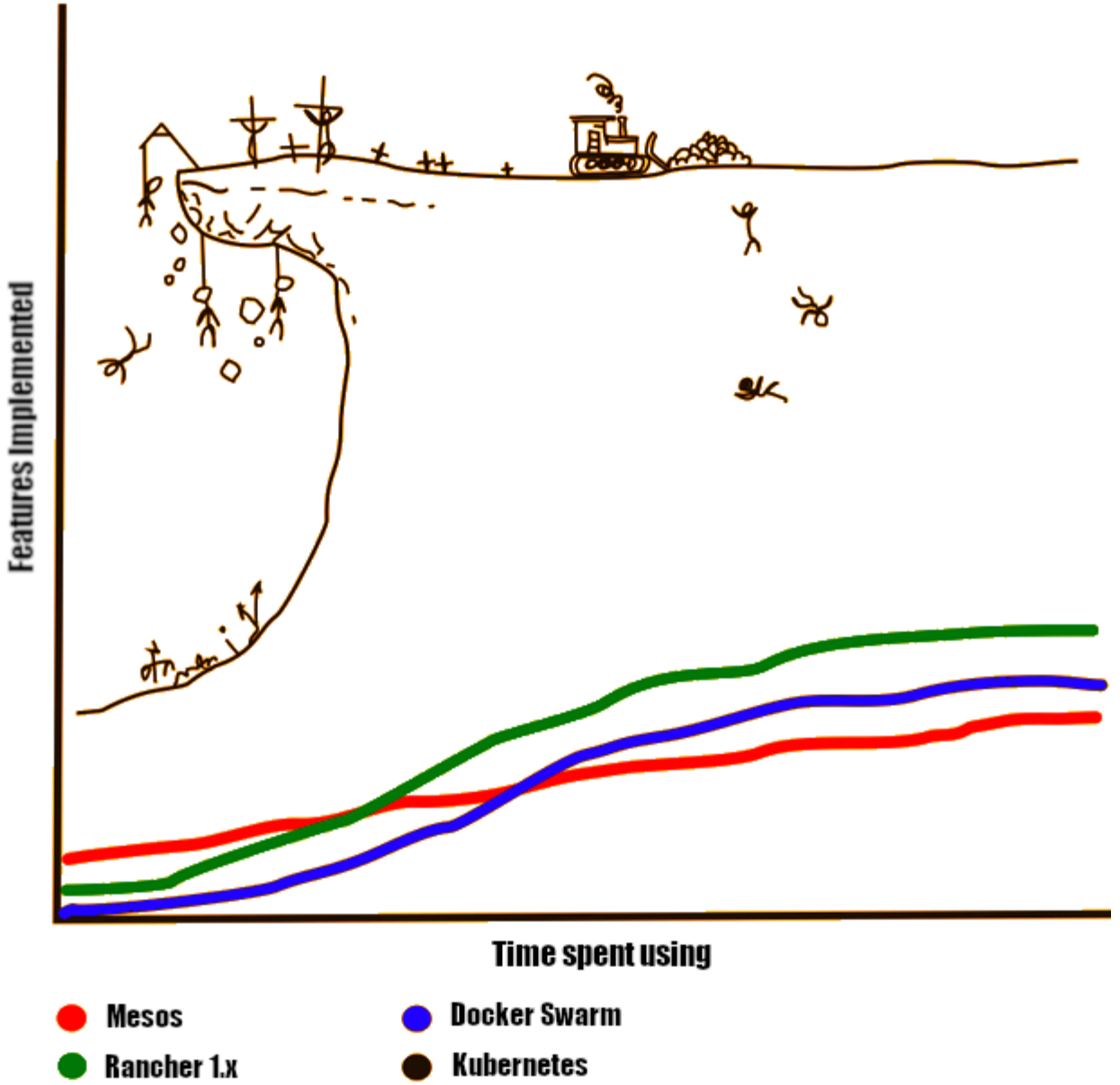
Learning curves of some Container Orchestration Engines



Kubernetes

Kubernetes is an open-source system for automating computer application deployment, scaling, and **management of container applications**

First Release on 10 July 2015

Based on Google's Borg

Designed by Google and is now maintained by the Cloud Native Computing Foundation

Written in Go

Open-source

"K8s" → K-8 character-s

Cloud solutions like Azure Kubernetes Service or Google Kubernetes Engine

Kubernetes Features

Self-healing

Service discovery and load balancing

Secret and configuration management

Horizontal scaling

Zero downtime deployments

Batch execution

Namespaces

Easily extensible

Configuration in JSON or YAML

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Self-healing demo

Kubernetes Components

Master Node (Control Plane)

- kube-apiserver
- etcd
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- kube-control-manager
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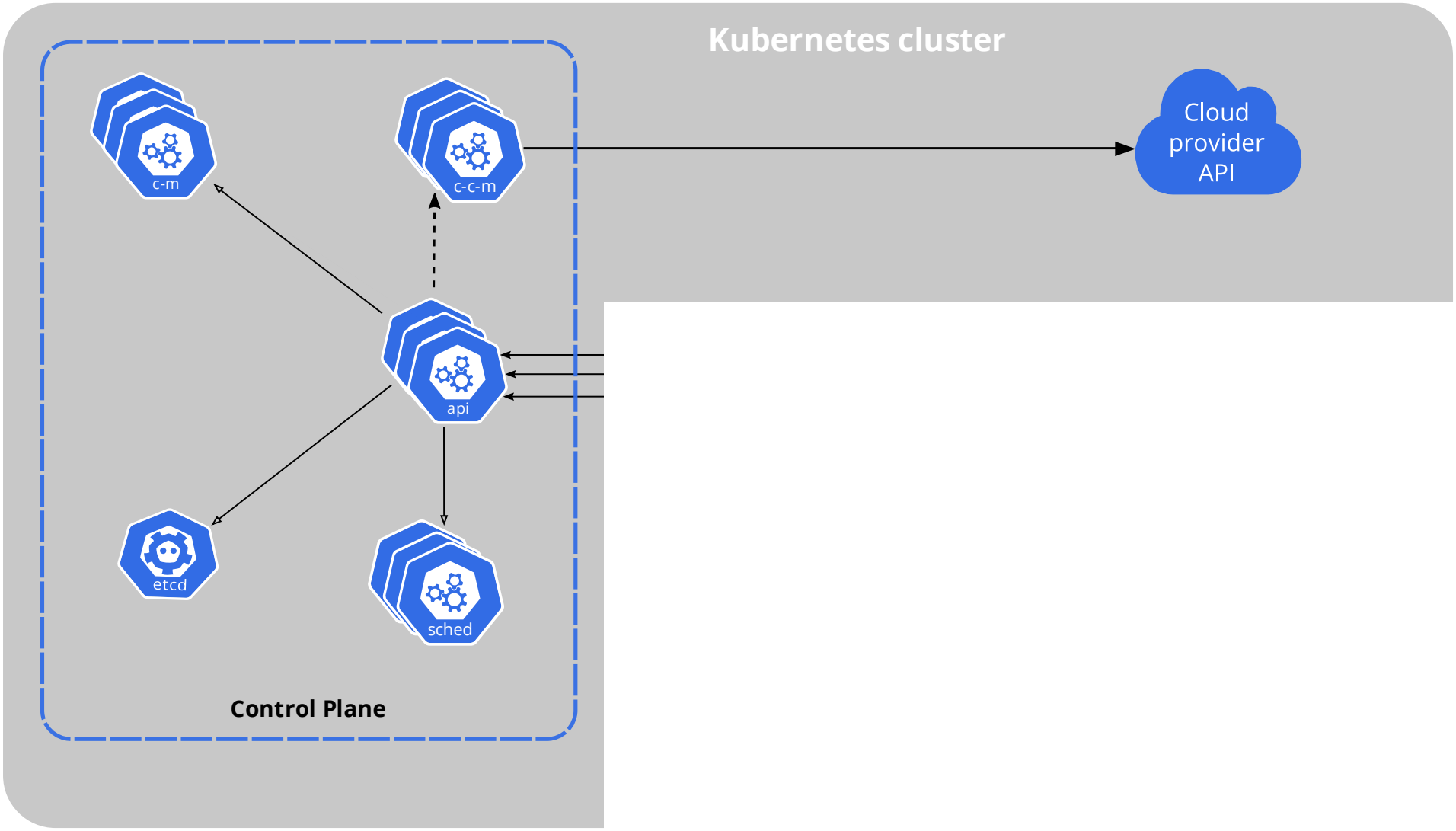
Addons

- DNS
- Dashboard
- Networking
- ...

Kubernetes Components

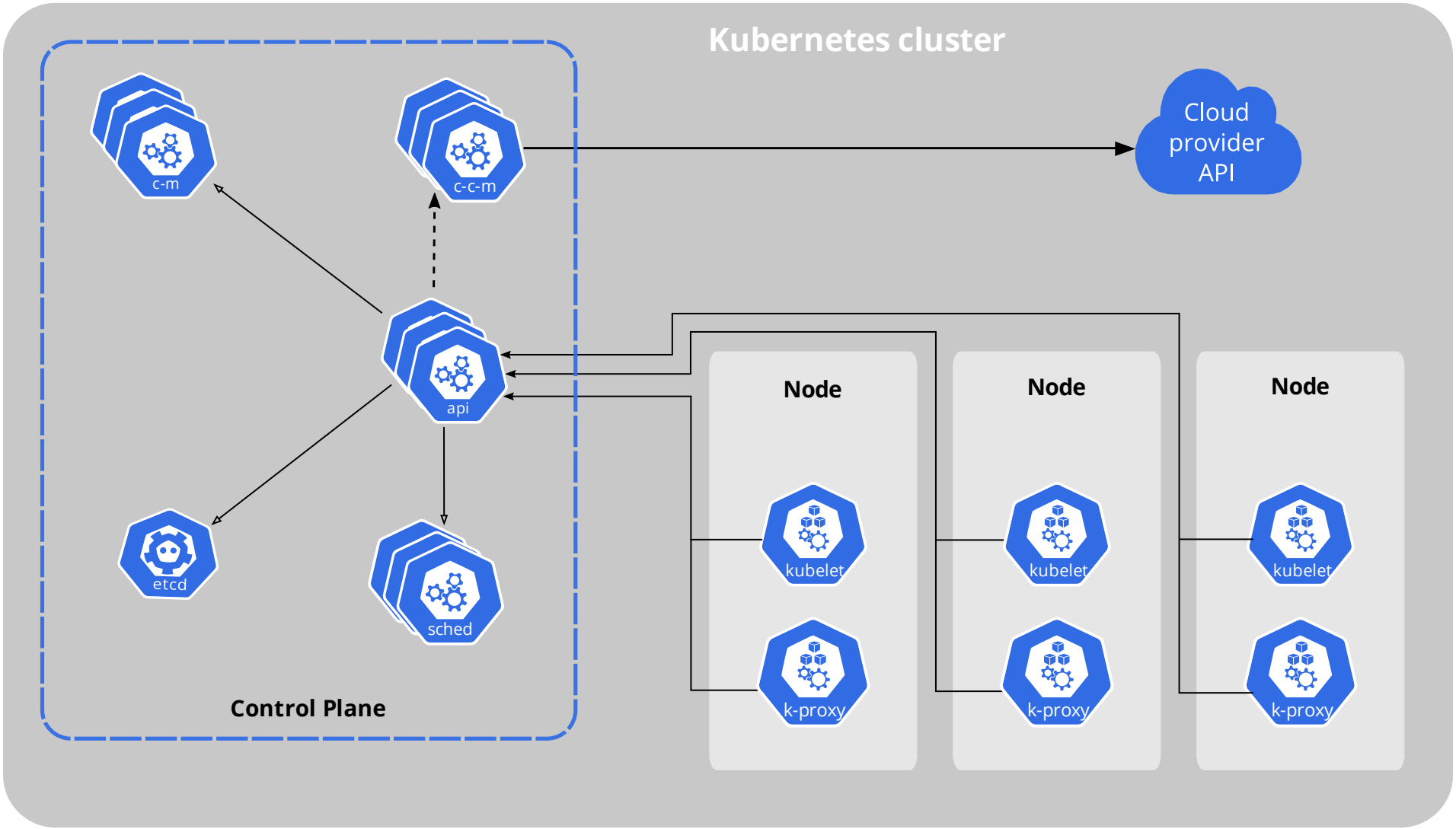


API server

Cloud controller manager ***(optional)***

Controller manager

Kubernetes Components



API server api

Cloud controller manager *(optional)* c-c-m

Controller manager c-m

etcd (persistence store) etcd

kubelet kubelet

kube-proxy k-proxy

Scheduler sched

Control plane

Node

Kubernetes Configuration

Declarative Model and Desired State

- Tell Kubernetes what you want
- Kubernetes will figure out a way to get to the desired state
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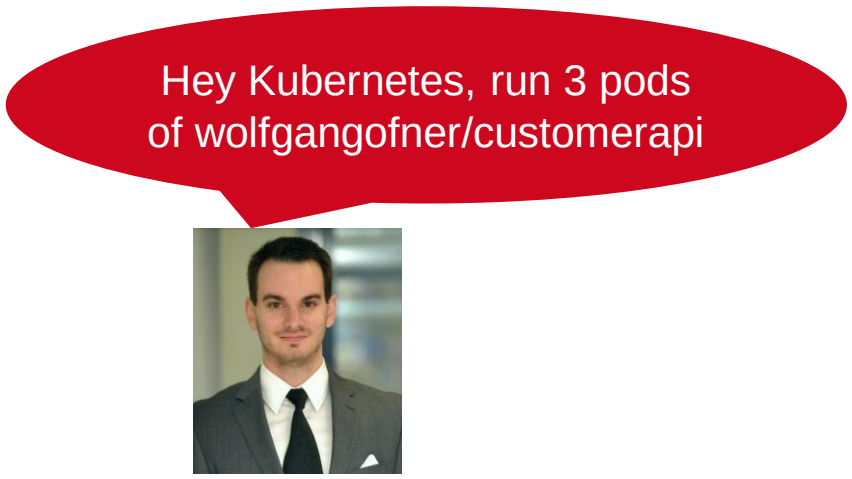

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Starting two more pods of wolfgangofner/customerapi

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Configuration Handling

- YAML or JSON files
- Kubernetes CLI called kubectl

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YAML File

```yaml
apiVersion: v1
kind: Service
metadata:
  name: kubernetesdemo-service
spec:
  type: LoadBalancer
  selector:
    app: kubernetesdemo
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: kubernetesdemo-deployment
  labels:
    app: kubernetesdemo
spec:
  replicas: 1
  selector:
    matchLabels:
      app: kubernetesdemo
  template:
    metadata:
      labels:
        app: kubernetesdemo
    spec:
      containers:
      - name: kubernetesdemo
        image: wolfgangofner/kubernetesdeploymentdemo:start
        ports:
        - containerPort: 80
```

Pod

A pod is the smallest unit in K8s

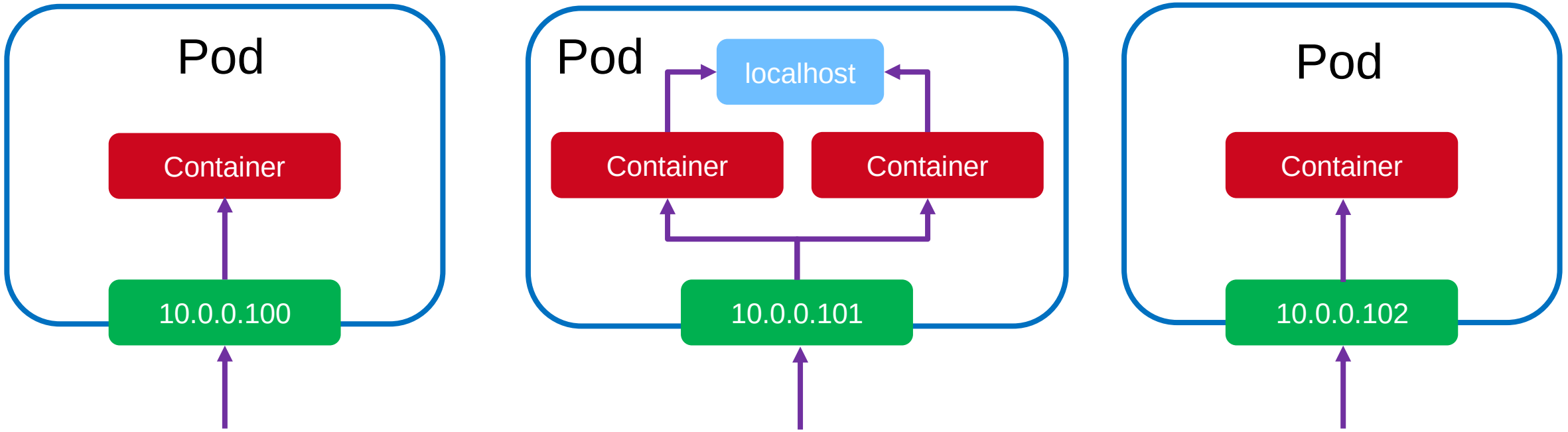
Pods wrap one ore more containers

Provides a way to set environment variables and mount storage

Containers inside a pod can communicate via localhost

Multiple containers should only combined in a pod if they are interdependent

Pods and Containers



Services

Load balancer demo

Labels and Annotations

Labels

- Key value pairs that are bound to objects like deployments or pods with a maximum of 63 character
  - app:MyAppName
- Used to filter or select objects
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```
metadata:
  creationTimestamp: "2021-10-17T11:58:22Z"
  labels:
    component: apiserver
    provider: kubernetes
```

Services

Pods come and go

IP addresses will change

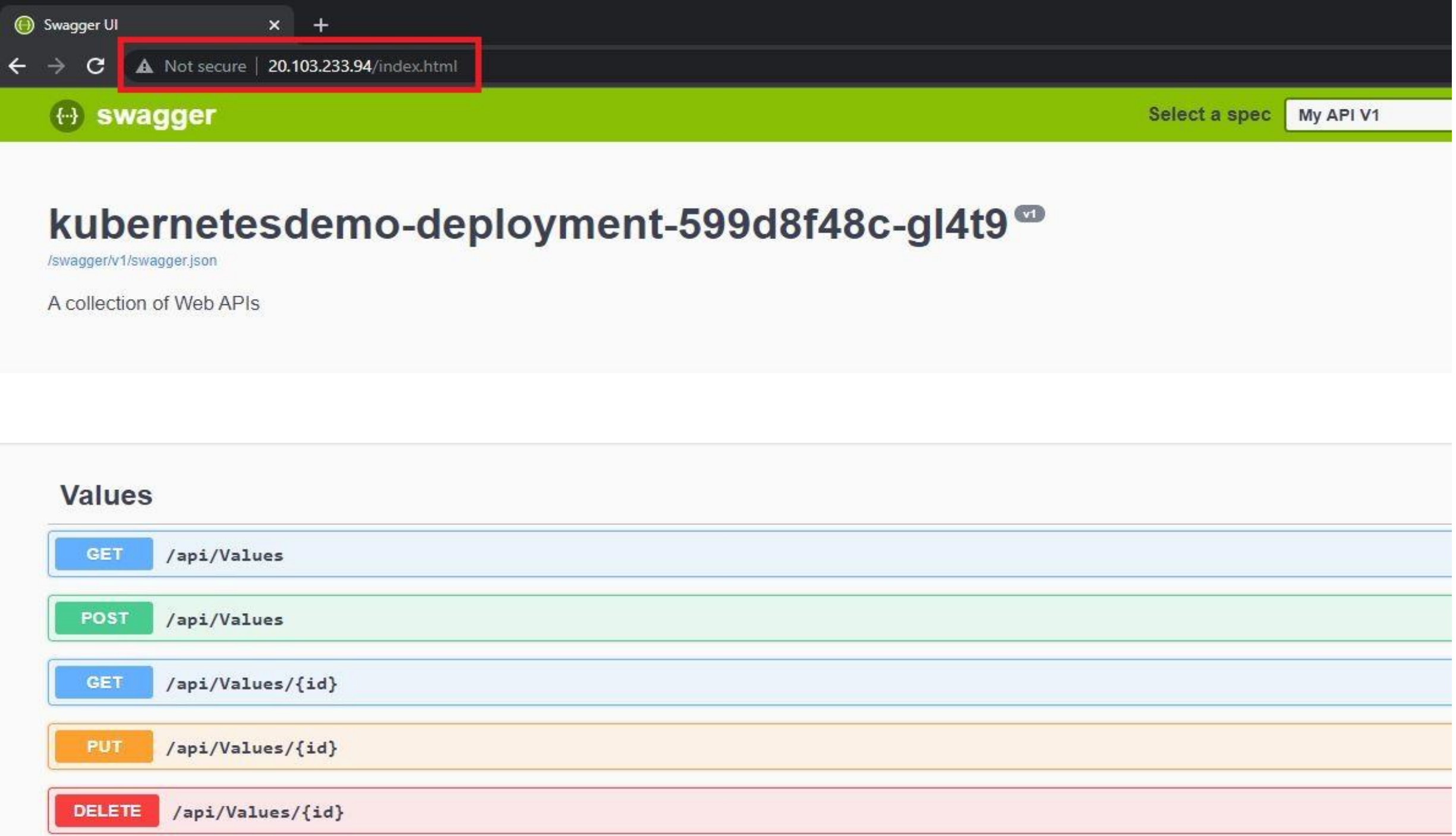
Service stay for the entire lifetime of the application

- Persistent entry point
- Fixed IP address
- Load Balancing

Pods and Services are matched using Labels

Two types

- LoadBalancer
- ClusterIP


Swagger UI
Not secure | 20.103.233.94/index.html
swagger
Select a spec
My API V1
kubernetesdemo-deployment-599d8f48c-gl4t9
v1
/swagger/v1/swagger.json
A collection of Web APIs
Values
GET /api/Values
POST /api/Values
GET /api/Values/{id}
PUT /api/Values/{id}
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Secrets

Base64 encoded

Automatically decrypted when attached to pod

Can be used in config file or environment variable

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Cert-Issuer

Kubernetes resource

Handles certificate requests

Supported sources:

- Let’s Encrypt
- HashiCorp Vault
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- private PKI (Public Key Infrastructure)

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```yaml
apiVersion: cert-manager.io/v1
kind: ClusterIssuer
metadata:
  name: letsencrypt
spec:
  acme:
    server: https://acme-v02.api.letsencrypt.org/directory
    email: <Your Email>
    privateKeySecretRef:
      name: letsencrypt
    solvers:
    - http01:
        ingress:
          class: nginx
          podTemplate:
            spec:
              nodeSelector:
                "kubernetes.io/os": linux
```

Cert-Manager

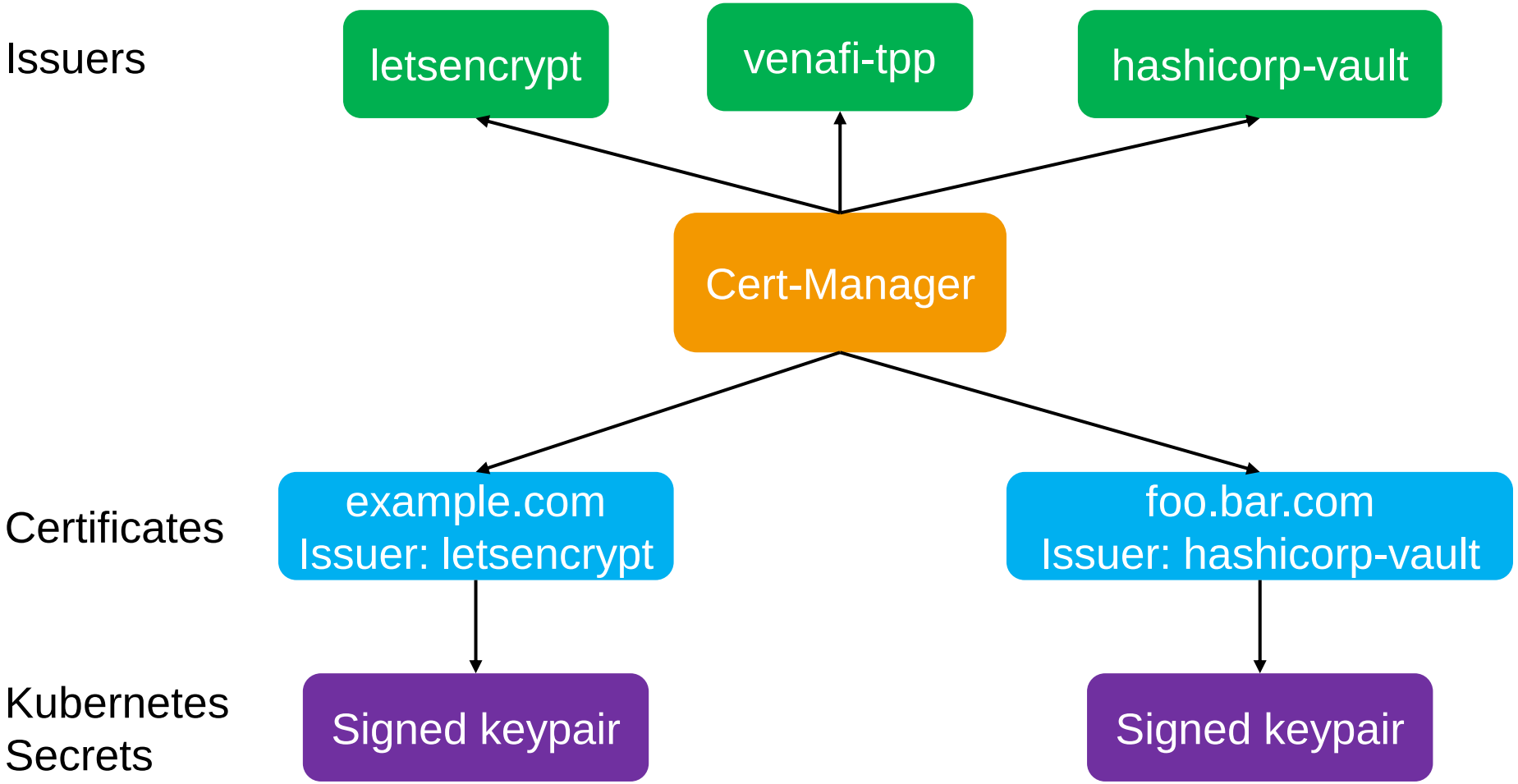
Manages obtaining and renewing of certificates

Can use variety of CAs like Let’s Encrypt, HashiCorp Vault, and Venafi

Updates certificates at a configured time before expiry

Uses Cert Issuer to issue certificates

Cert-Manager



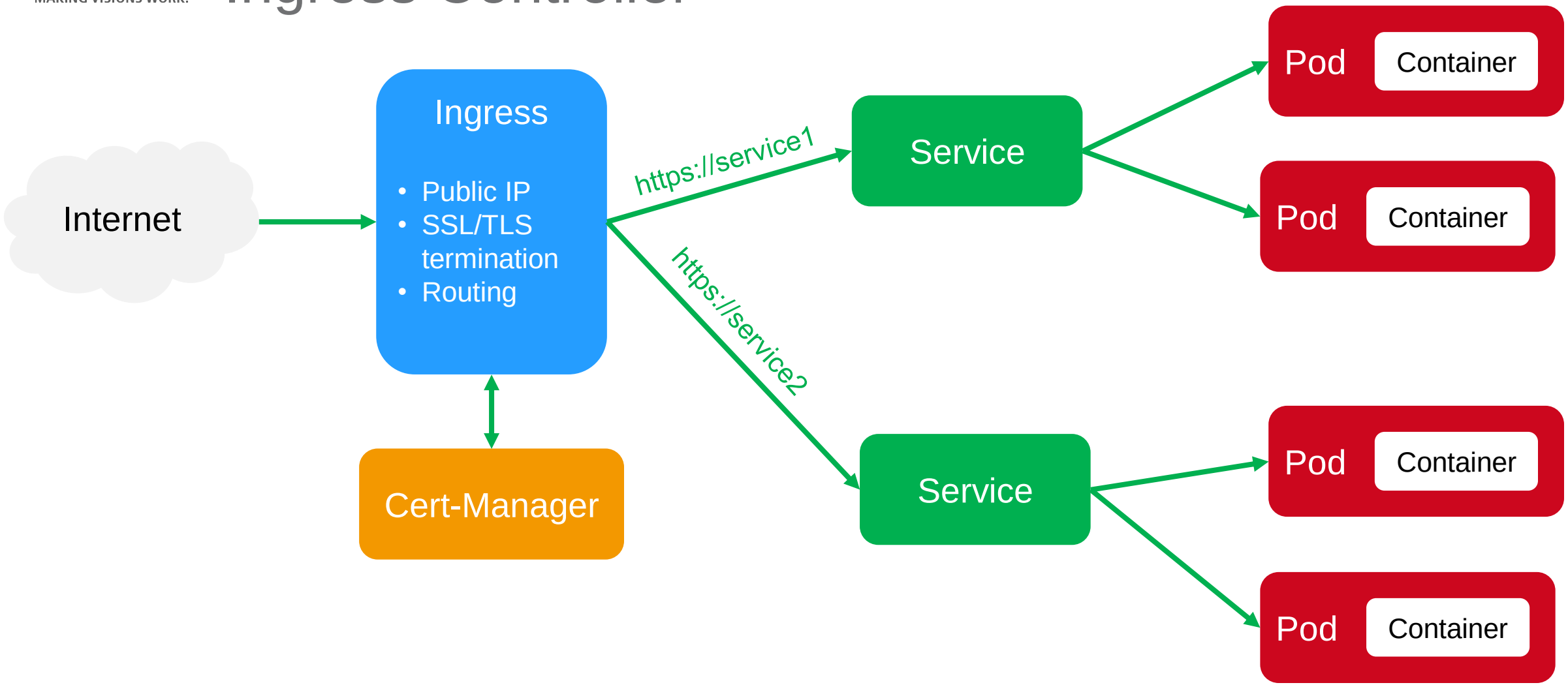
Config and Storage > Secrets > kedademoapi-tls

kedademoapi-tls

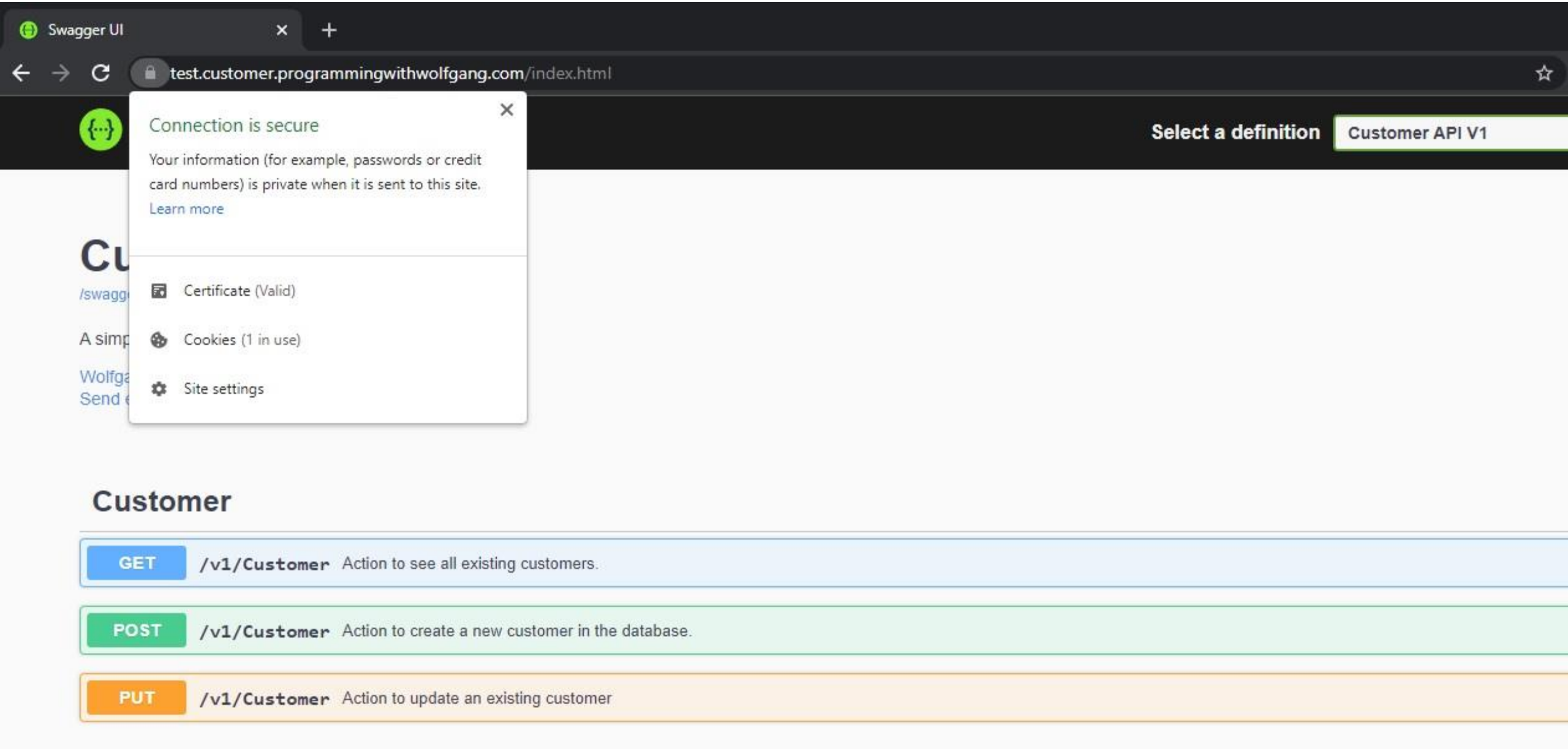
Summary | Metadata | Resource Viewer | YAML

```yaml
---
apiVersion: v1
data:
  tls.crt: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSUZXVENDQkVHZ0F3SUJBZ0lTQS
  tls.key: LS0tLS1CRUdJTiBSU0EgUFJJVkFURSBLRVktLS0tLQpNSUlFb2dJQkFBS0NBUUVBNG
kind: Secret
metadata:
  annotations:
    cert-manager.io/alt-names: test.kedademo.programmingwithwolfgang.com
    cert-manager.io/certificate-name: kedademoapi-tls
    cert-manager.io/common-name: test.kedademo.programmingwithwolfgang.com
    cert-manager.io/ip-sans: ""
    cert-manager.io/issuer-group: cert-manager.io
    cert-manager.io/issuer-kind: ClusterIssuer
    cert-manager.io/issuer-name: letsencrypt
    cert-manager.io/uri-sans: ""
  creationTimestamp: "2021-10-17T12:07:46Z"
```

Ingress Controller



SSL Certificate



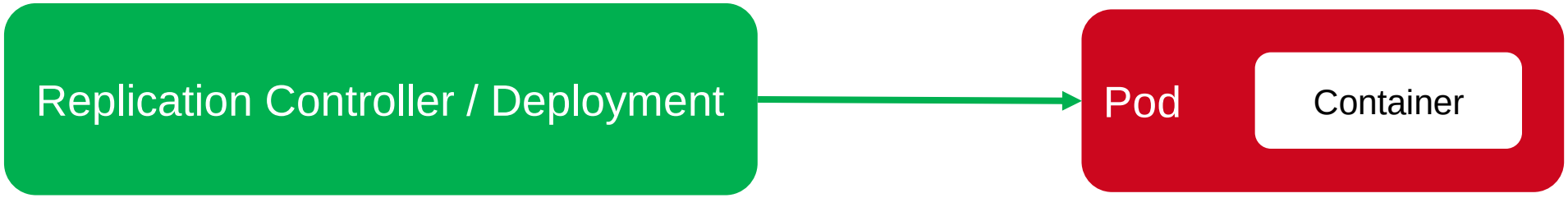
SSL Certificate

Pull request deployment demo

Pod Deployment

Pods are not directly deployed

Deployment / Replicate Set create pods



Pod Deployment

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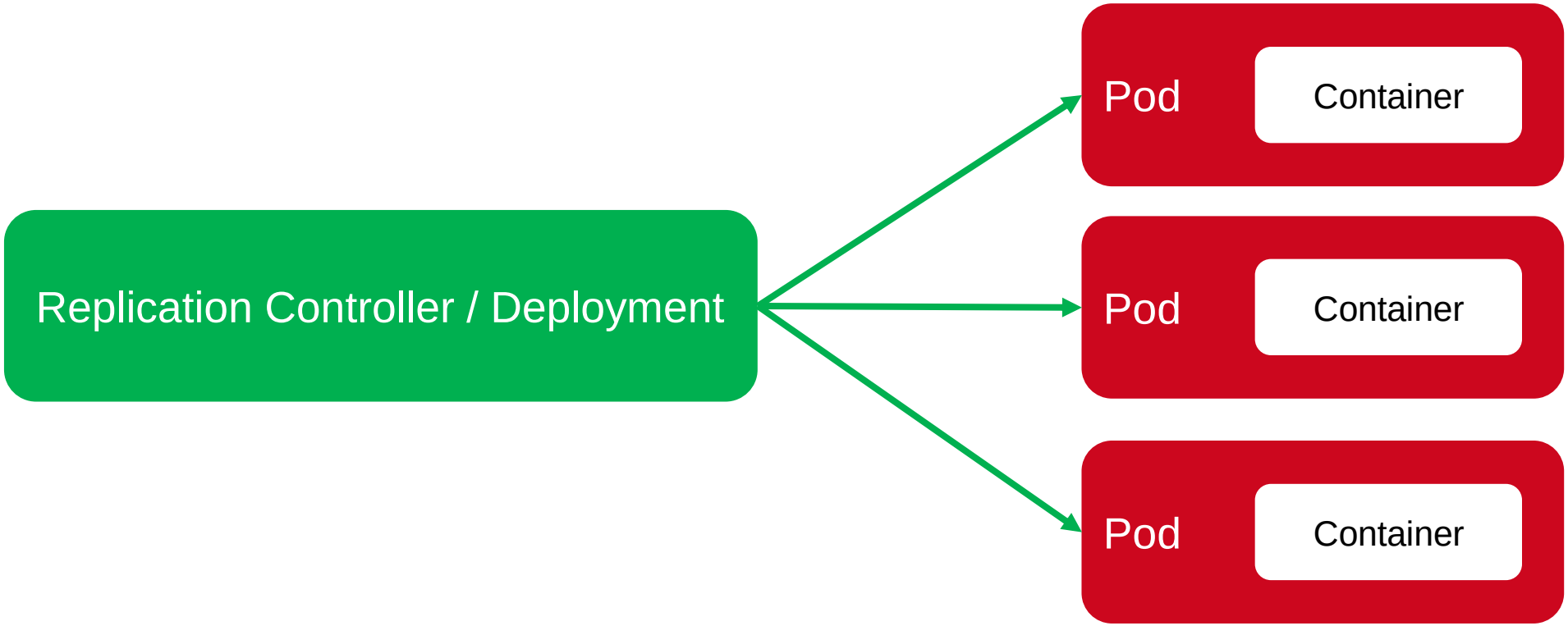

Deployment and ReplicaSet

Deployments define the desired state of an object

ReplicaSets ensure that the desired amount of pods is running on the cluster

Deployment and ReplicaSet

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Deployments manage ReplicaSets

Manages stateless applications

DaemonSet,CronJob, StatefullSet

Alternatively to Deployments, pods can be run using DaemonSets, CronJobs, and StatefullSets

CronJobs can be scheduled to start pods

StatefullSets manage stateful applications

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- Logging
- Monitoring
- Backup
- Reports
- Automated testing

Horizontal Pod Autoscaler (HPA)

Queries resource utilization, e.g. CPU and RAM usage

Instructs ReplicationSet to scale out or scale in

Configures minimum and maximum number of pods

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Auto-scaling demo

Horizontal Pod Autoscaler (HPA)

Queries resource utilization, e.g. CPU and RAM usage

Instructs ReplicationSet to scale out or scale in

Configures minimum and maximum number of pods

```yaml
apiVersion: autoscaling/v1
kind: HorizontalPodAutoscaler
metadata:
  name: customerapi
spec:
  maxReplicas: 10
  minReplicas: 1
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: customerapi
  targetCPUUtilizationPercentage: 50
```

Horizontal Pod Autoscaler (HPA)

```
PS C:\Users\Wolfgang> kubectl get pods -n customerapi-test
NAME                           READY   STATUS    RESTARTS   AGE
customerapi-ccc4c74dd-prpq2    1/1     Running   0          19m
```

Horizontal Pod Autoscaler (HPA)

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```
PS C:\Users\Wolfgang> kubectl get pods -n customerapi-test
NAME                           READY   STATUS    RESTARTS   AGE
customerapi-ccc4c74dd-6ks4q    0/1     Running   0          18s
customerapi-ccc4c74dd-ldkqs    0/1     Pending   0          18s
customerapi-ccc4c74dd-pr4ff    0/1     Pending   0          3s
customerapi-ccc4c74dd-prpq2    1/1     Running   0          22m
customerapi-ccc4c74dd-zxvmp    0/1     Running   0          18s
```

Horizontal Pod Autoscaler (HPA)

```
PS C:\Users\Wolfgang> kubectl get pods -n customerapi-test
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customerapi-ccc4c74dd-6ks4q    0/1     Running   0          18s
customerapi-ccc4c74dd-ldkqs    0/1     Pending   0          18s
customerapi-ccc4c74dd-pr4ff    0/1     Pending   0          3s
customerapi-ccc4c74dd-prpq2    1/1     Running   0          22m
customerapi-ccc4c74dd-zxvmp    0/1     Running   0          18s
```

```
PS C:\Users\Wolfgang> kubectl get pods -n customerapi-test
NAME                           READY   STATUS    RESTARTS   AGE
customerapi-ccc4c74dd-bmrqz    1/1     Running   0          2m17s
```

Liveness Probe

Checks if pod is alive

Sends HTTP request to check pod

Alive if answer >= HTTP 200 & < HTTP 400

Pod will be restarted if dead

Configuration part of the Deployment

Liveness Probe

Checks if pod is alive

Sends HTTP request to check pod

Alive if answer >= HTTP 200 & < HTTP 400

Pod will be restarted if dead

Configuration part of the Deployment

```
livenessProbe:
  httpGet:
    path: /health
    port: http
  initialDelaySeconds: 15
```

Readiness Probe

Checks if pod is ready to receive traffic

Sends HTTP request to check pod

Alive if answer >= HTTP 200 & < HTTP 400

Traffic will be routed to the pod when ready

Configuration part of the Deployment

Readiness Probe

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Configuration part of the Deployment

```
readinessProbe:
  httpGet:
    path: /health
    port: http
  initialDelaySeconds: 15
```

Deployment Modes

Blue Green deployment

Start all new pods and then switch

Deployment Modes

Blue Green deployment

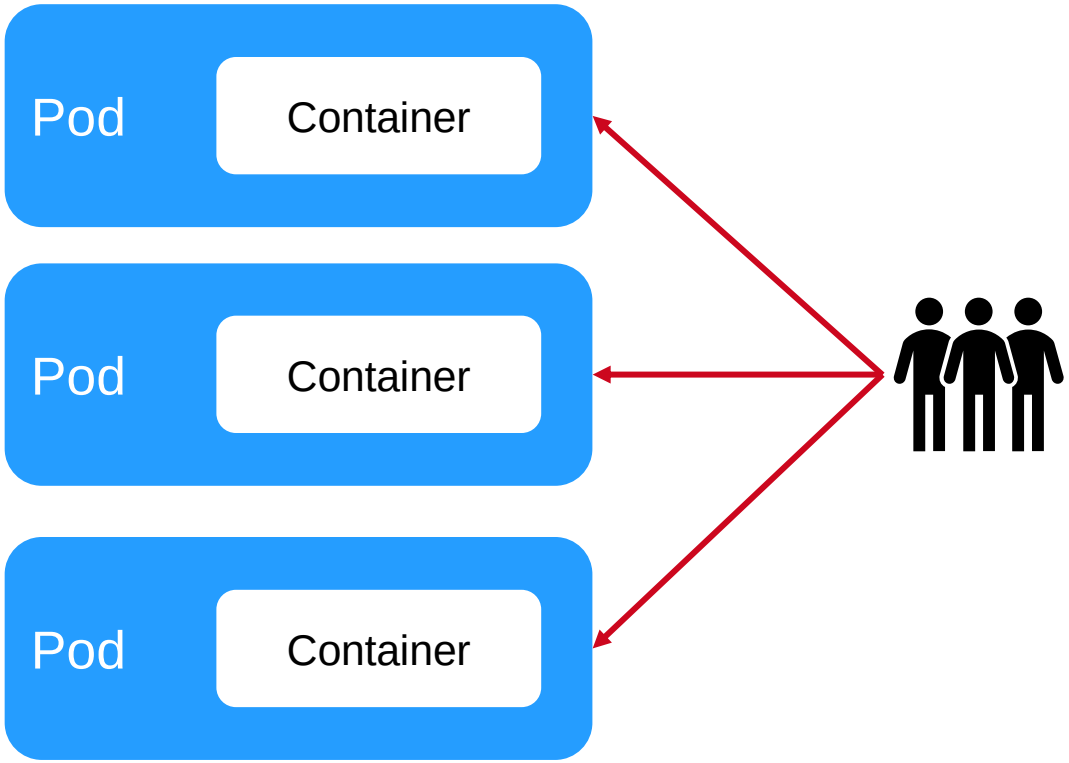
Start all new pods and then switch

Zero downtime deployment demo

Deployment Modes

Blue Green deployment

Start all new pods and then switch



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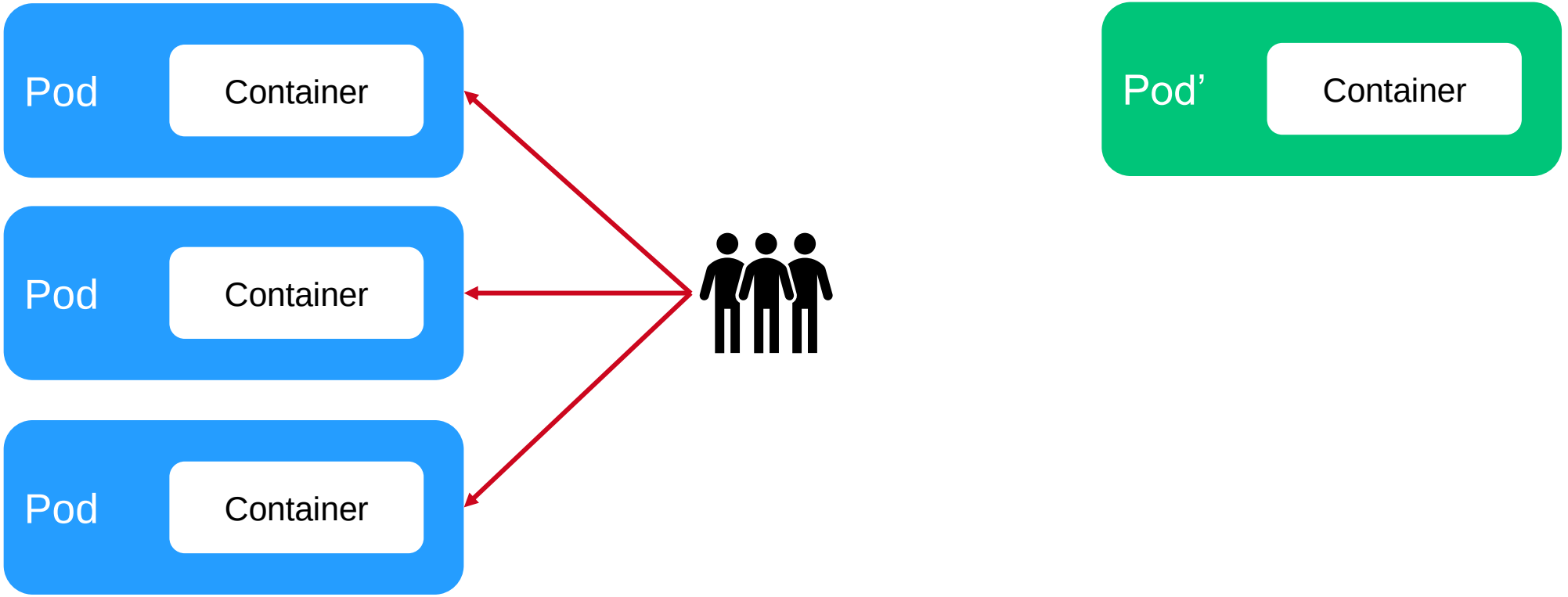

Deployment Modes

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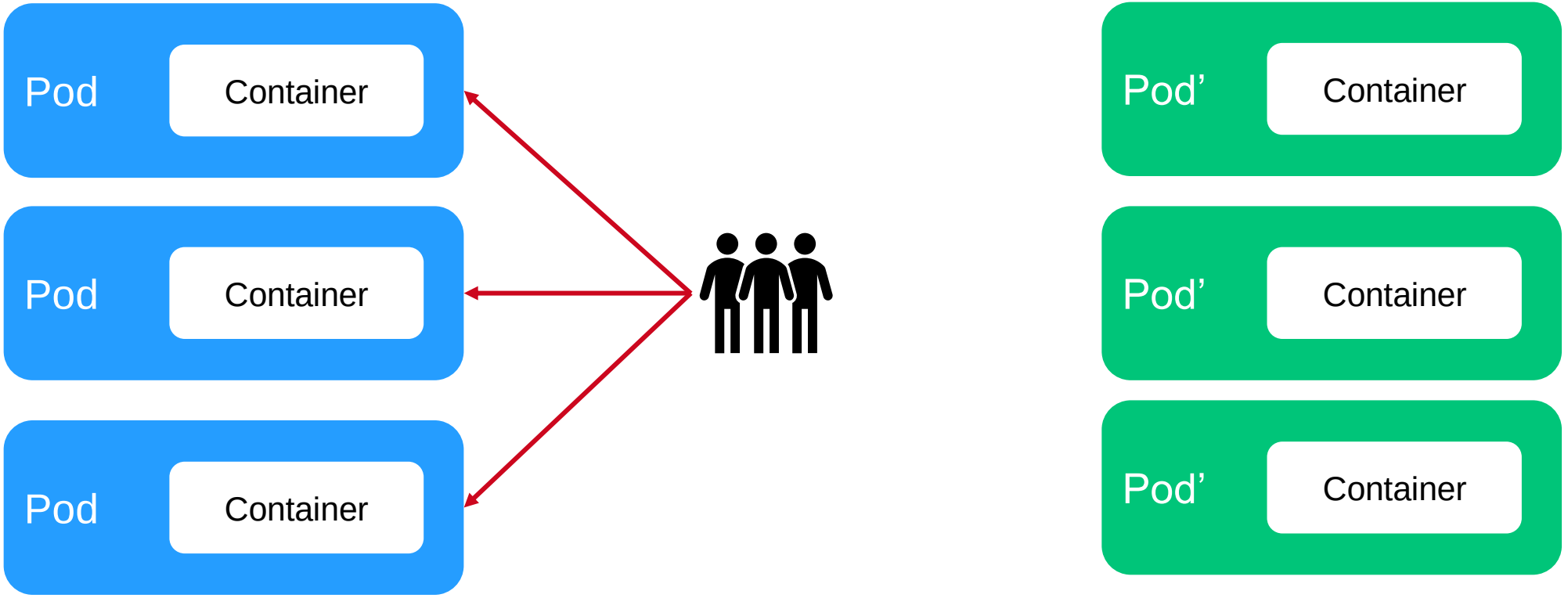

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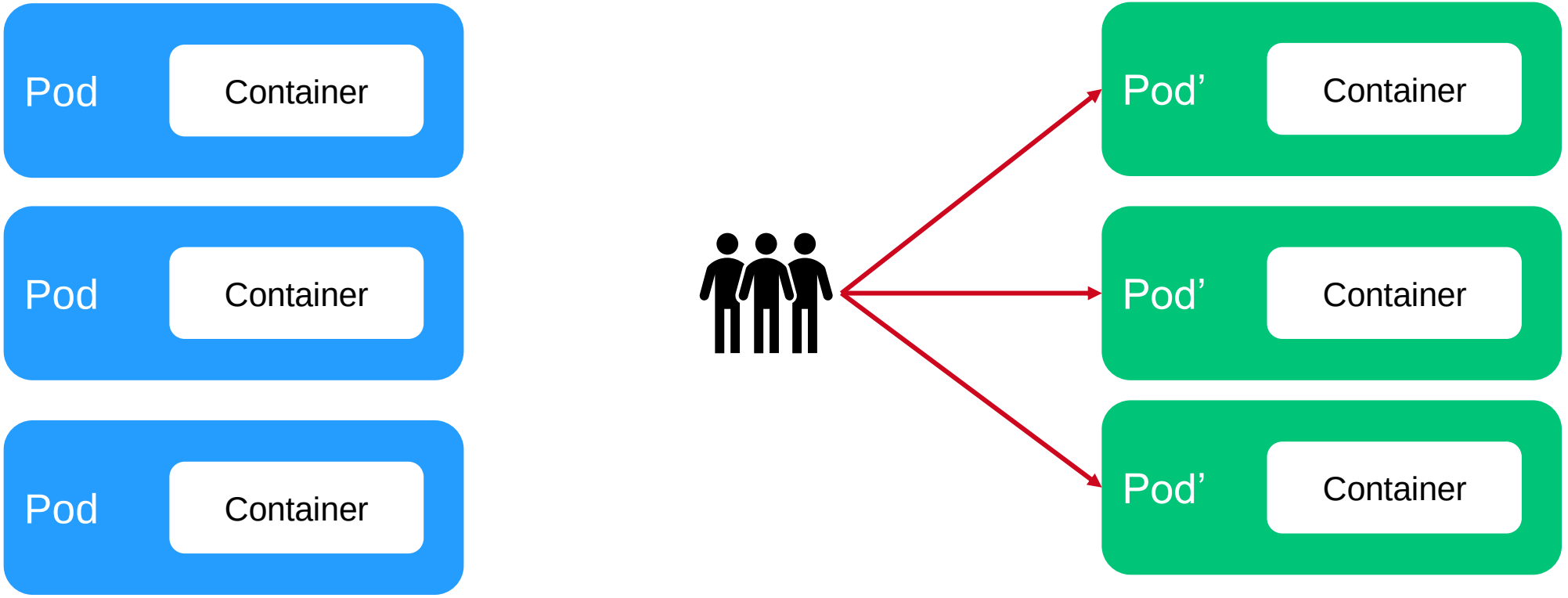

Deployment Modes

Rolling deployment

Replace old pods with new ones until all are updated

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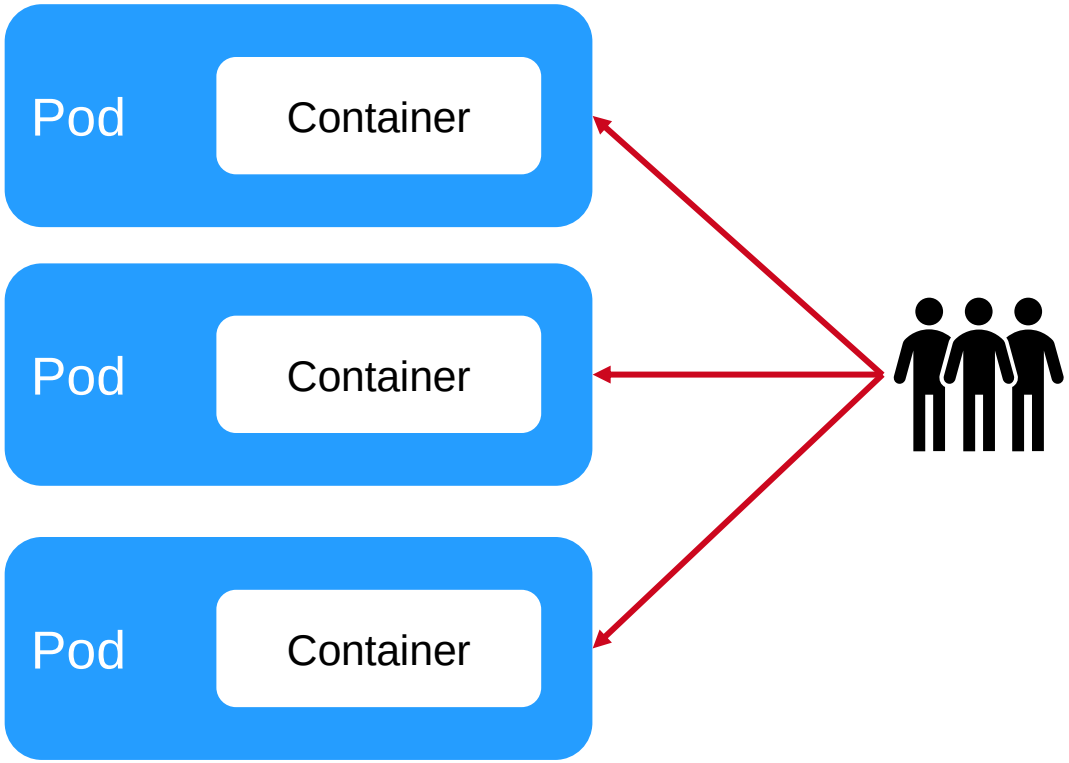

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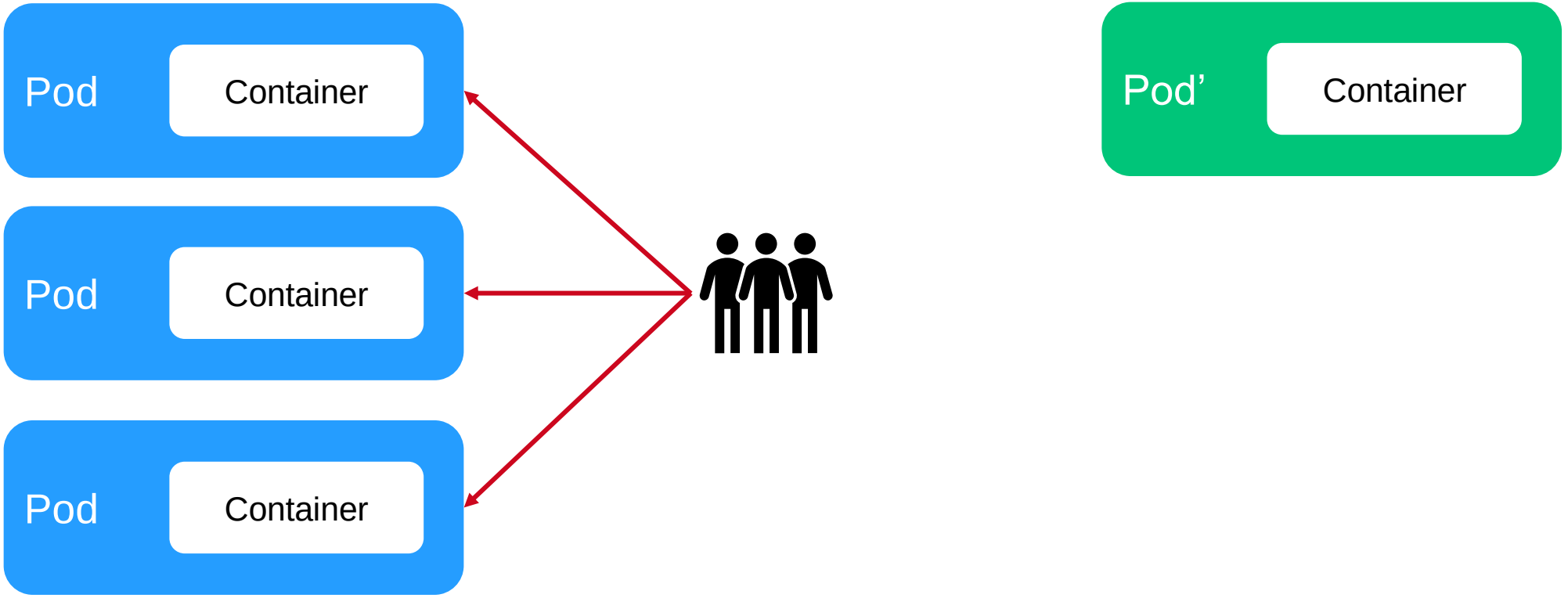
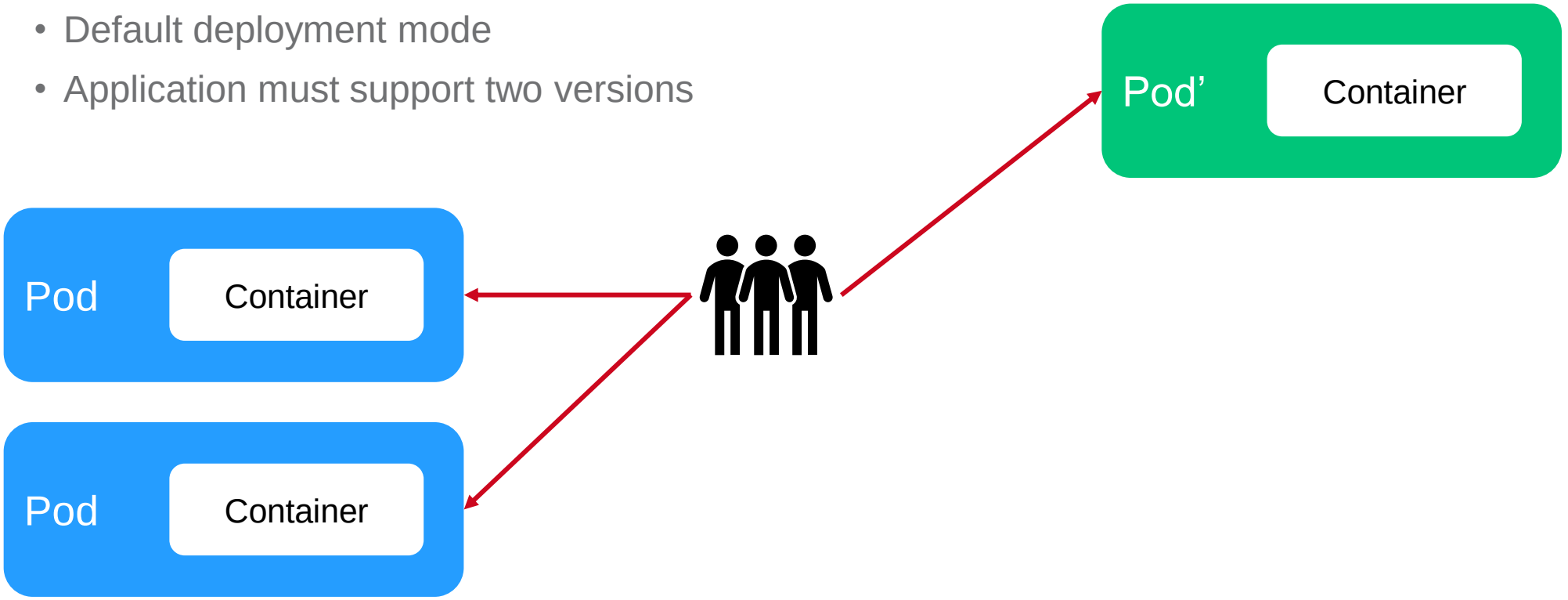


Deployment Modes

Rolling deployment

Replace old pods with new ones until all are updated

- Default deployment mode
- Application must support two versions



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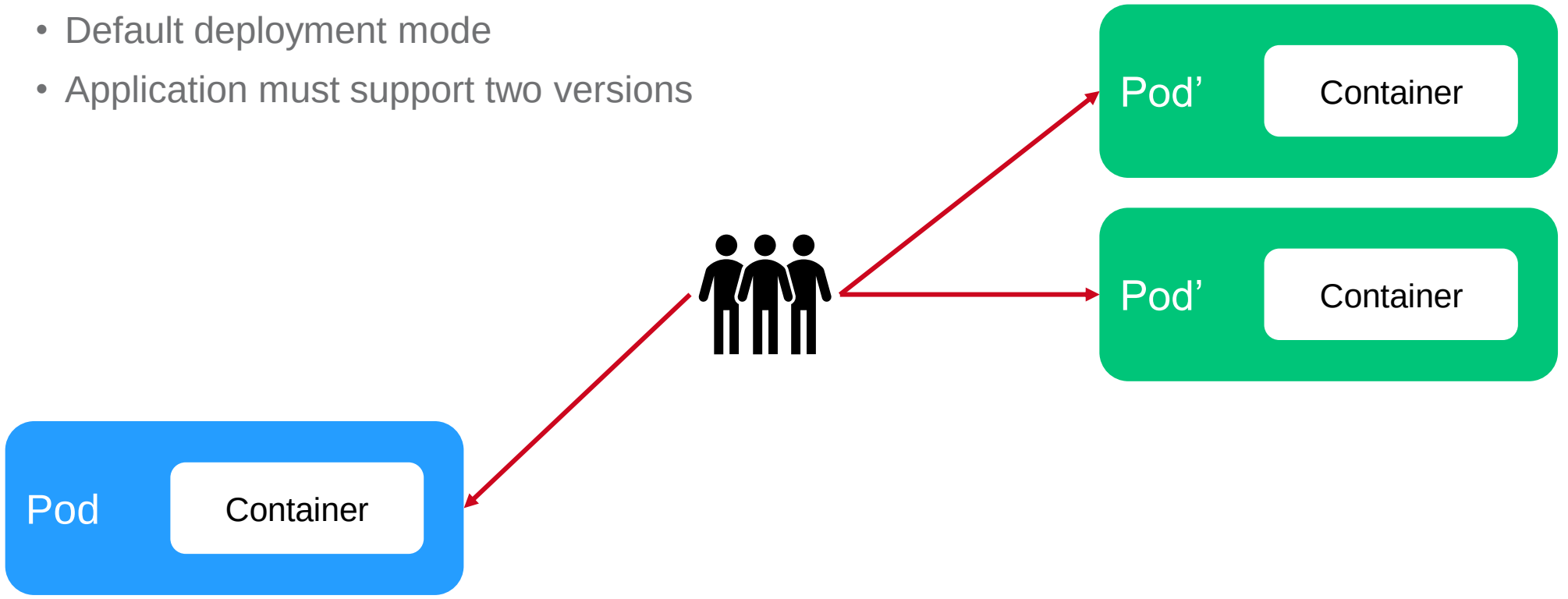

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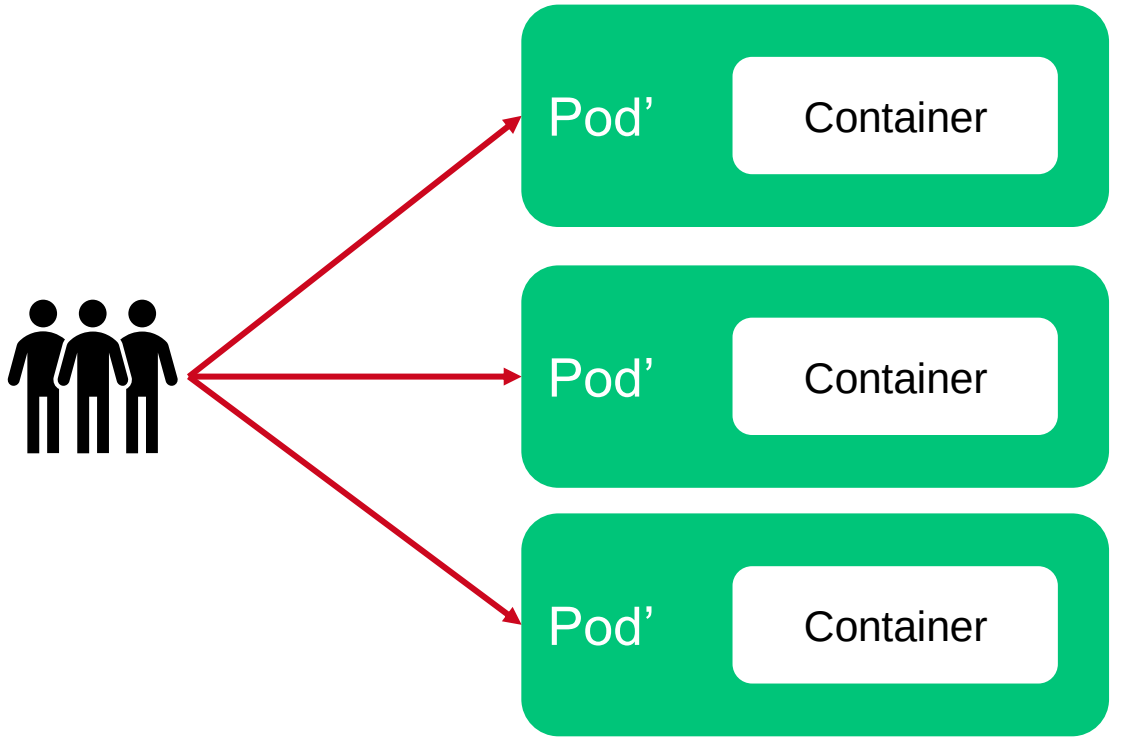

Deployment Modes

Rolling deployment

- Default deployment mode
- Application must support two versions
- maxSurge:
  - Max number of pods that can be created at a time
  - Absolut number or percentage
  - Default: 25%
- maxUnavailable:
  - Max number of pods that can be available during the deployment
  - Absolut number or percentage
  - Default: 25%

Resource Requests & Resource Limits

1000 Millicores = 1 Core

Memory is defined in bytes

Mebibyte = ~1MB

Configured in Deployment

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Resource Requests

- Describe how many resources a node has to have
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- Maximum resources a pod is allowed to use
- Pods gets throttled when it uses too many resources
- CPU and/or RAM

Resource Requests & Resource Limits

1000 Millicores = 1 Core

Memory is defined in bytes

Mebibyte = ~1MB

Configured in Deployment

```
resources:
  limits:
    cpu: 0.3
    memory: 128Mi
  requests:
    cpu: 100m
    memory: 64Mi
```

Resource Requests

- Describe how many resources a node has to have
- CPU and/or RAM

Resource Limits

- Maximum resources a pod is allowed to use
- Pods gets throttled when it uses too many resources
- CPU and/or RAM

Dashboard

Octant

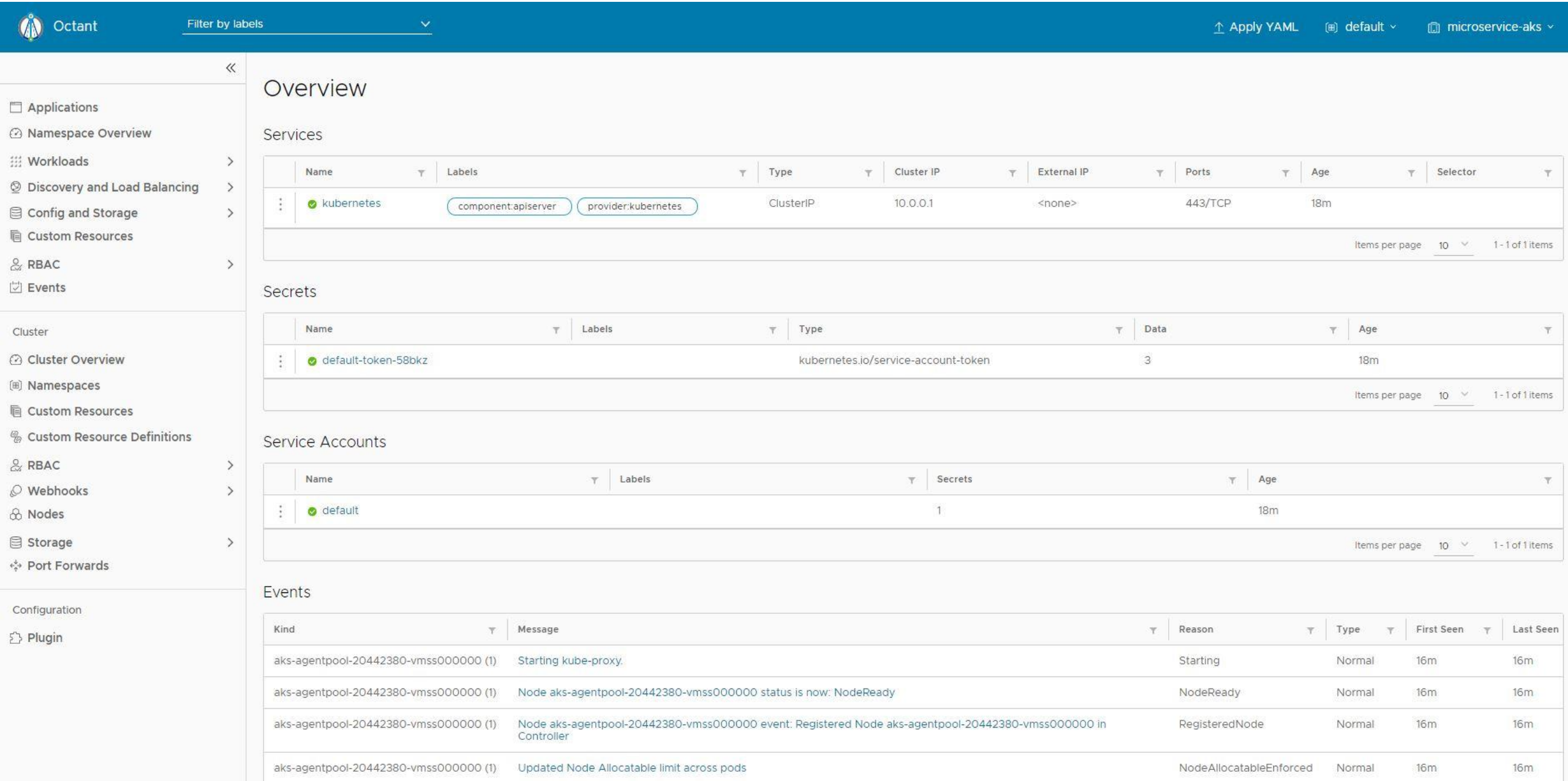
- choco install octant –confirm

Dashboard

Octant

- choco install octant –confirm

Dashboard demo


Octant
Filter by labels
Apply YAML
default
microservice-aks
Applications
Namespace Overview
Workloads
Discovery and Load Balancing
Config and Storage
Custom Resources
RBAC
Events
Cluster
Cluster Overview
Namespaces
Custom Resources
Custom Resource Definitions
RBAC
Webhooks
Nodes
Storage
Port Forwards
Configuration
Plugin
Overview
Services
Name Labels Type Cluster IP External IP Ports Age Selector
kubernetes component:apiserver provider:kubernetes ClusterIP 10.0.0.1 <none> 443/TCP 18m
Items per page 10 1 - 1 of 1 items
Secrets
Name Labels Type Data Age
default-token-58bkz kubernetes.io/service-account-token 3 18m
Items per page 10 1 - 1 of 1 items
Service Accounts
Name Labels Secrets Age
default 1 18m
Items per page 10 1 - 1 of 1 items
Events
Kind Message Reason Type First Seen Last Seen
aks-agentpool-20442380-vmss000000 (1) Starting kube-proxy. Starting Normal 16m 16m
aks-agentpool-20442380-vmss000000 (1) Node aks-agentpool-20442380-vmss000000 status is now: NodeReady NodeReady Normal 16m 16m
aks-agentpool-20442380-vmss000000 (1) Node aks-agentpool-20442380-vmss000000 event: Registered Node aks-agentpool-20442380-vmss000000 in Controller RegisteredNode Normal 16m 16m
aks-agentpool-20442380-vmss000000 (1) Updated Node Allocatable limit across pods NodeAllocatableEnforced Normal 16m 16m

Dashboard

Octant

- choco install octant –confirm

Azure Portal

microservice-aks | Workloads

Kubernetes service

Search (Ctrl+/)

Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Security

Kubernetes resources
Namespaces
Workloads
Services and ingresses
Storage
Configuration

Settings
Node pools
Cluster configuration
Networking
Deployment center (preview)
Policies
Properties
Locks

Monitoring
Insights
Alerts
Metrics
Diagnostic settings

Add | Delete | Refresh | Show labels | Give feedback

Deployments | Pods | Replica sets | Stateful sets | Daemon sets | Jobs | Cron jobs

Filter by deployment name: Enter the full deployment name

Filter by label selector: foo=bar,key!=value

Filter by namespace: All namespaces

Name	Namespace	Ready	Up-to-date	Available	Age
coredns	kube-system	2/2	2	2	16 minutes
coredns-autoscaler	kube-system	1/1	1	1	16 minutes
metrics-server	kube-system	1/1	1	1	16 minutes
tunnelfront	kube-system	1/1	1	1	16 minutes
cert-manager	cert-manager	1/1	1	1	14 minutes
cert-manager-cainjector	cert-manager	1/1	1	1	14 minutes
cert-manager-webhook	cert-manager	1/1	1	1	14 minutes
ingress-nginx-controller	ingress-basic	2/2	2	2	13 minutes
loki-grafana	loki-grafana	1/1	1	1	13 minutes
loki-kube-state-metrics	loki-grafana	1/1	1	1	13 minutes
loki-prometheus-alertmanager	loki-grafana	1/1	1	1	13 minutes
loki-prometheus-pushgateway	loki-grafana	1/1	1	1	13 minutes
loki-prometheus-server	loki-grafana	1/1	1	1	13 minutes
keda-operator	keda	1/1	1	1	11 minutes
keda-operator-metrics-apiserver	keda	1/1	1	1	11 minutes
kedademoapi	kedademoapi-test	3/3	3	3	8 minutes
orderapi	orderapi-test	1/1	1	1	7 minutes
customerapi	customerapi-test	1/1	1	1	7 minutes
kedademoapi	kedademoapi-prod	3/3	3	3	5 minutes

Dashboard

Octant

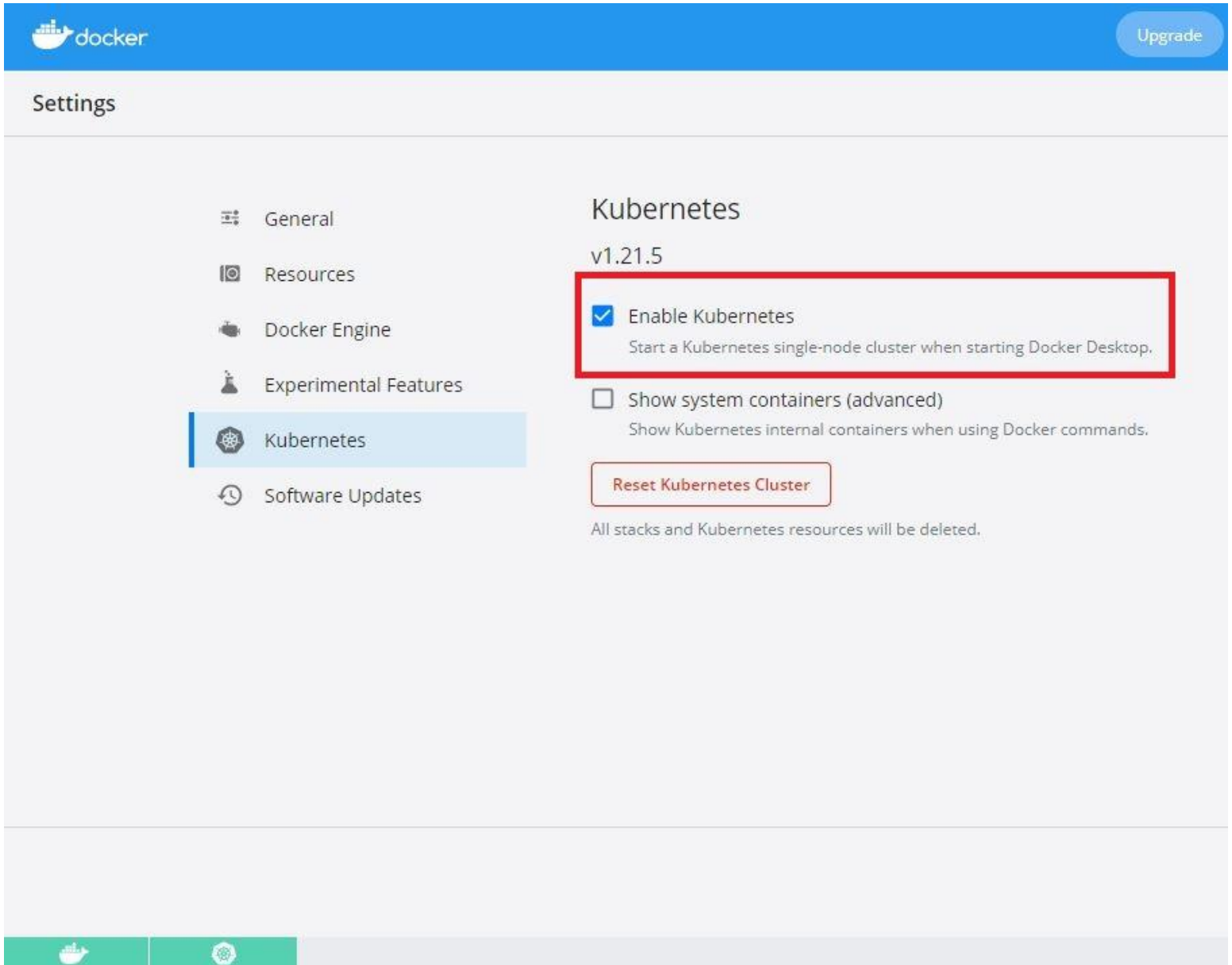
- choco install octant –confirm

Azure Portal

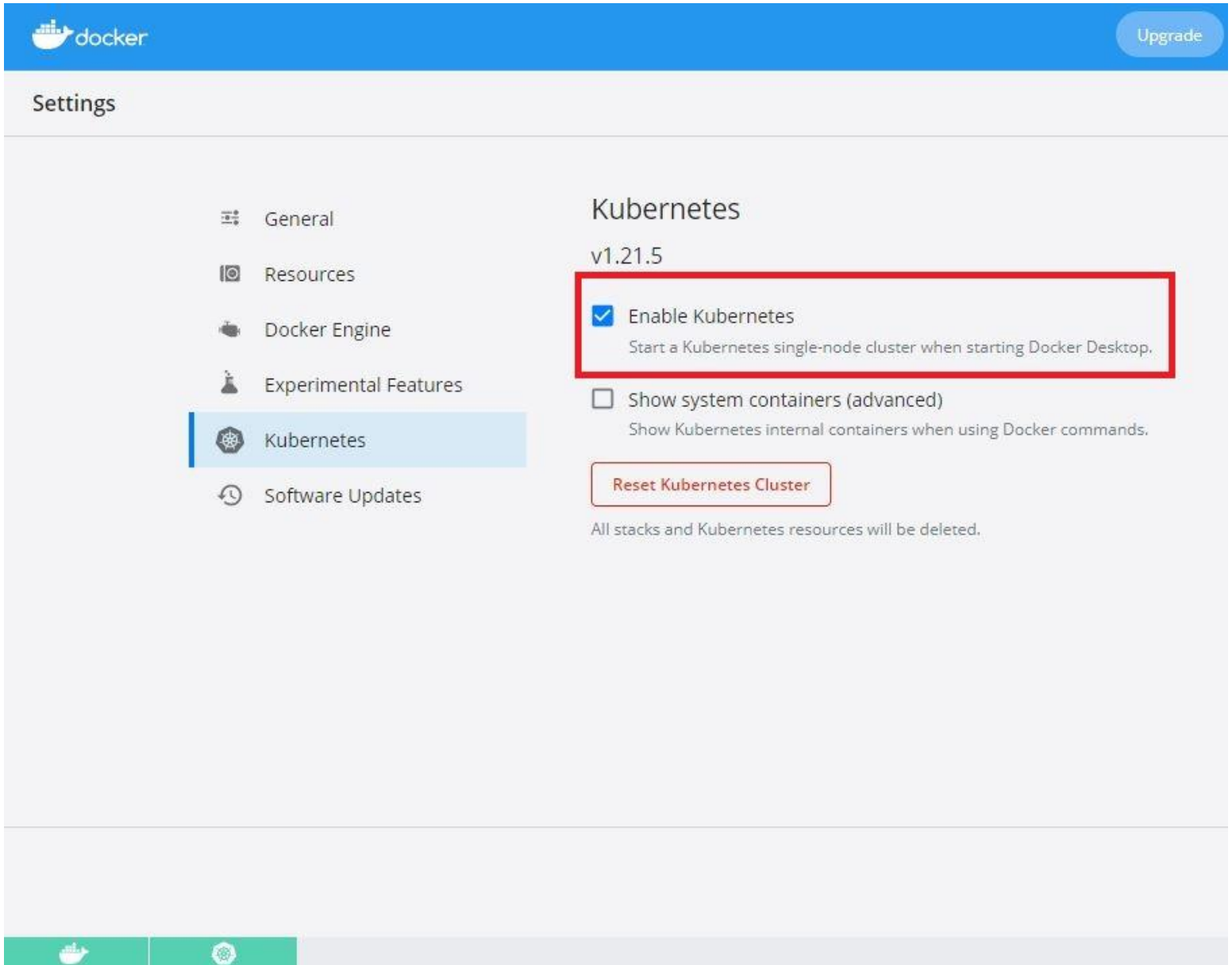
Kubernetes

- kubectl apply -f https://raw.githubusercontent.com/kubernetes/dashboard/v2.3.1/aio/deploy/recommended.yaml

K8s locally


docker
Upgrade
Settings
General
Resources
Docker Engine
Experimental Features
Kubernetes
Software Updates
Kubernetes
v1.21.5
Enable Kubernetes
Start a Kubernetes single-node cluster when starting Docker Desktop.
Show system containers (advanced)
Show Kubernetes internal containers when using Docker commands.
Reset Kubernetes Cluster
All stacks and Kubernetes resources will be deleted.

K8s locally


docker
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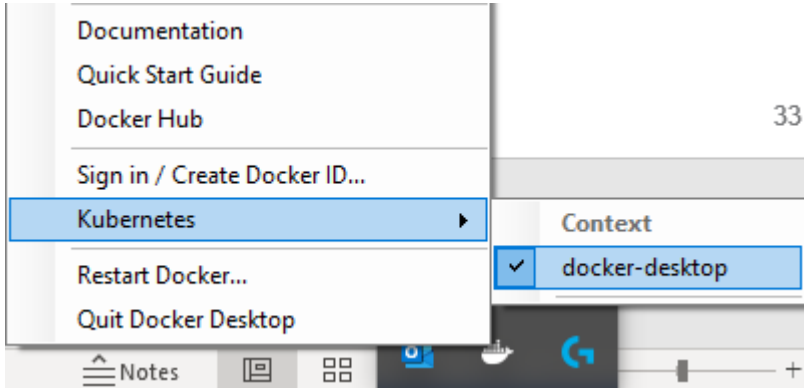

Documentation
Quick Start Guide
Docker Hub
Sign in / Create Docker ID...
Kubernetes
Restart Docker...
Quit Docker Desktop
Context
docker-desktop
Notes

Kubectl Commands

Get resource

kubectl get pods/services/deployment

Delete resource

kubectl delete pods/services/deployment

Display information about resource

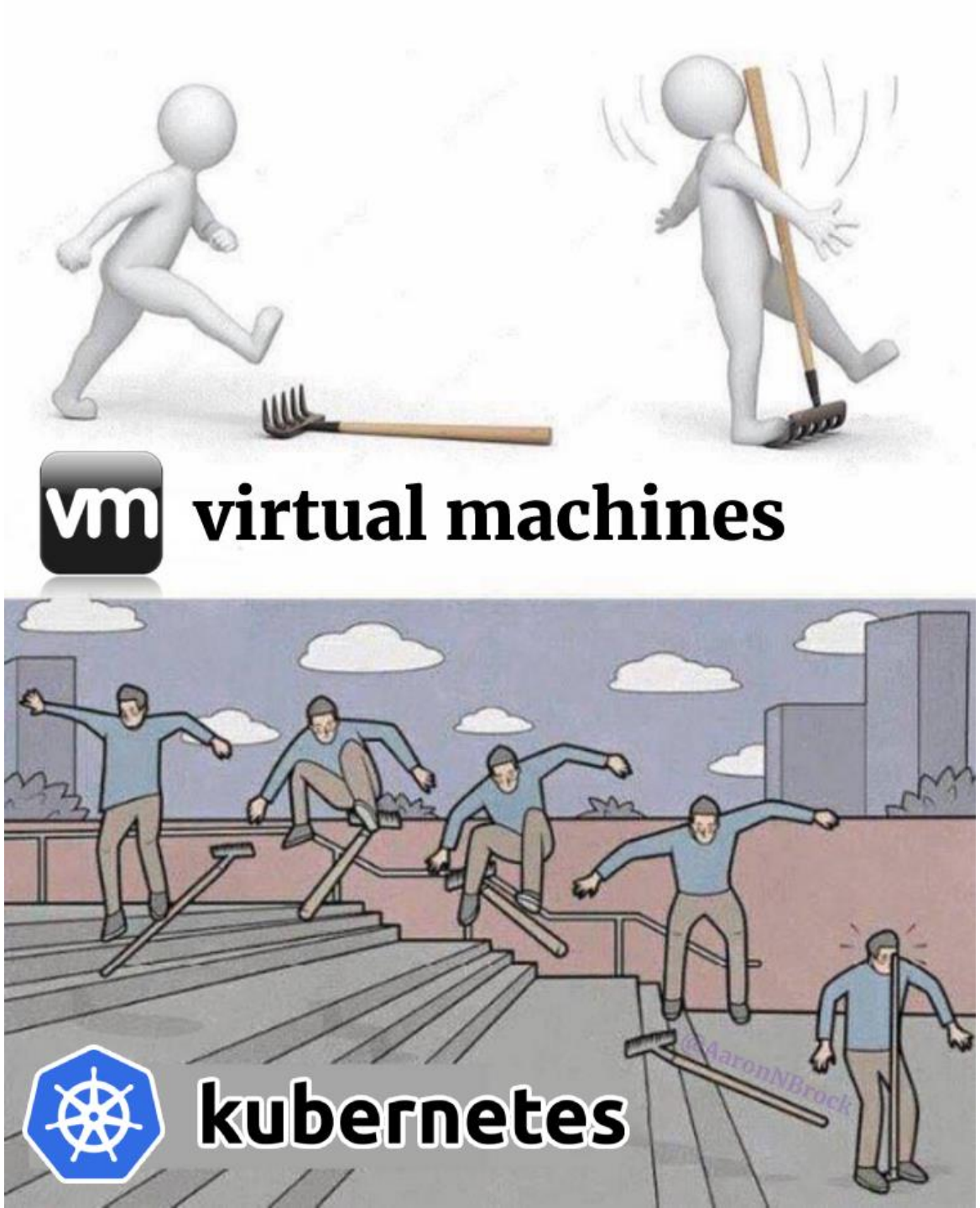
kubectl describe pods/nodes/services my-resource

Add/update new object

kubectl apply –f myfile.yaml [--namespace=my-namespace]

Set current namespace

kubectl config-set-context –current my-namespace


virtual machines
kubernetes

Considerations when using K8s

Cloud-native architecture

Microservices

.NET Full Frameworks vs .NET Core

DevOps process and culture

Deploy fast and often

Fast paced development and deployment

When not to use Kubernetes

Skills and experience of the team

Application that will be barely change

Databases

Big monolithic applications

Quick results

Very simple applications


@AaronNBrock
kubernetes
My Static Website

bbv
MAKING VISIONS WORK.

Helm

Complex Configuration

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  annotations:
    deployment.kubernetes.io/revision: "1"
    meta.helm.sh/release-name: customerapi-customerapi-test
    meta.helm.sh/release-namespace: customerapi-test
  creationTimestamp: "2021-11-01T15:10:45Z"
  generation: 4
  labels:
    app: customerapi
    app.kubernetes.io/managed-by: Helm
    chart: customerapi-0.1.126
    draft: draft-app
    heritage: Helm
    release: customerapi-customerapi-test
    manager: kube-controller-manager
    operation: Update
    time: "2021-11-01T15:13:51Z"
  name: customerapi
  namespace: customerapi-test
  resourceVersion: "19234"
  uid: f45511b7-7599-41fb-a129-4973a5926ca2
spec:
  progressDeadlineSeconds: 600
  replicas: 1
  revisionHistoryLimit: 0
  selector:
    matchLabels:
      app: customerapi
      release: customerapi-customerapi-test
  strategy:
    rollingUpdate:
      maxSurge: 25%
      maxUnavailable: 25%
    type: RollingUpdate
  template:
    metadata:
      annotations:
        buildID: ""
      creationTimestamp: null
      labels:
        app: customerapi
        draft: draft-app
        release: customerapi-customerapi-test
    spec:
      containers:
      - env:
        - name: AzureServiceBus__ConnectionString
          valueFrom:
            secretKeyRef:
              key: AzureServiceBus__ConnectionString
              name: customerapi-connectionstrings
```

Helm

Packet Manager for Kubernetes

Helps to manage Kubernetes applications

Template Engine

Bundle of YMAL files is called Helm charts

Helm charts describe applications

Simple sharing of Helm charts via ArtifactHub.io

Helm

Packet Manager for Kubernetes

Helps to manage Kubernetes applications

Template Engine

Bundle of YMAL files is called Helm charts

Helm charts describe applications

Simple sharing of Helm charts via ArtifactHub.io

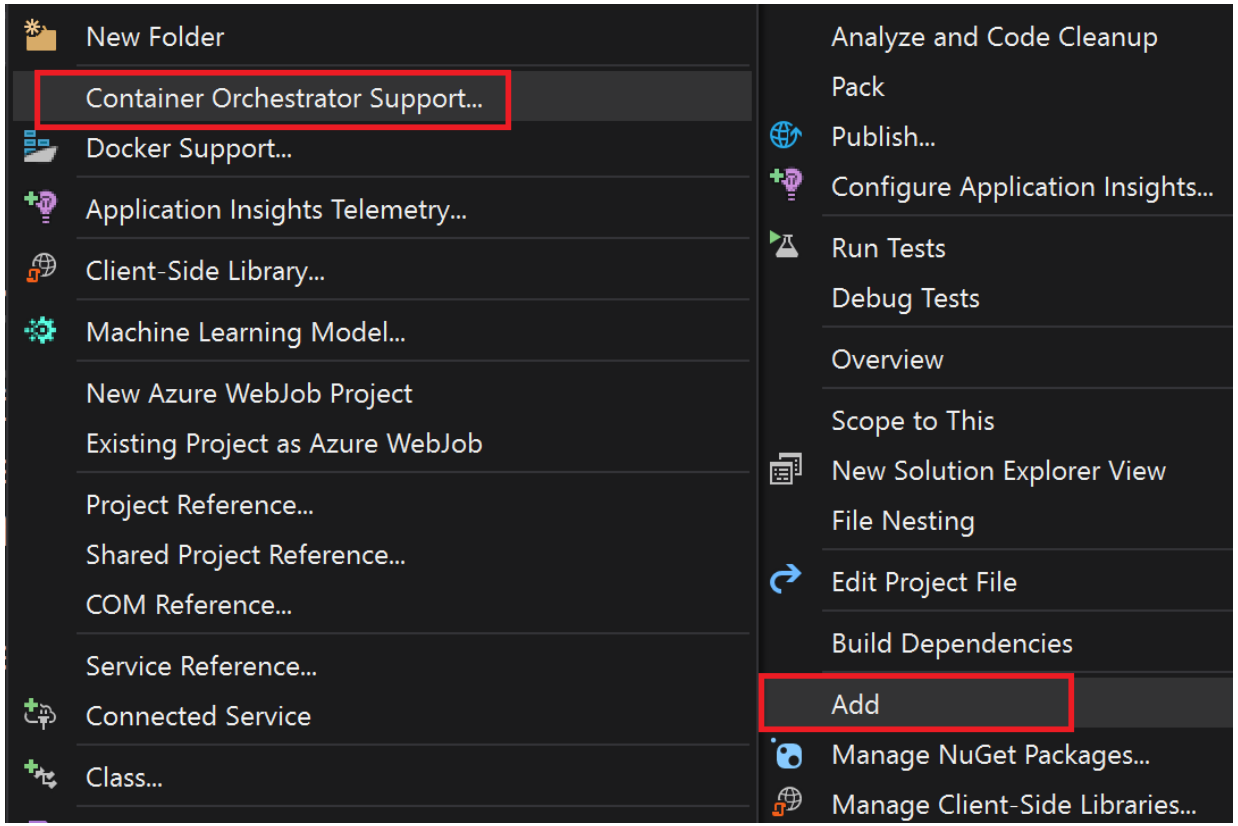
Install Helm

- Linux: curl https://raw.githubusercontent.com/helm/helm/main/scripts/get-helm-3 | bash
- Windows: choco install kubernetes-helm
- Mac: brew install helm

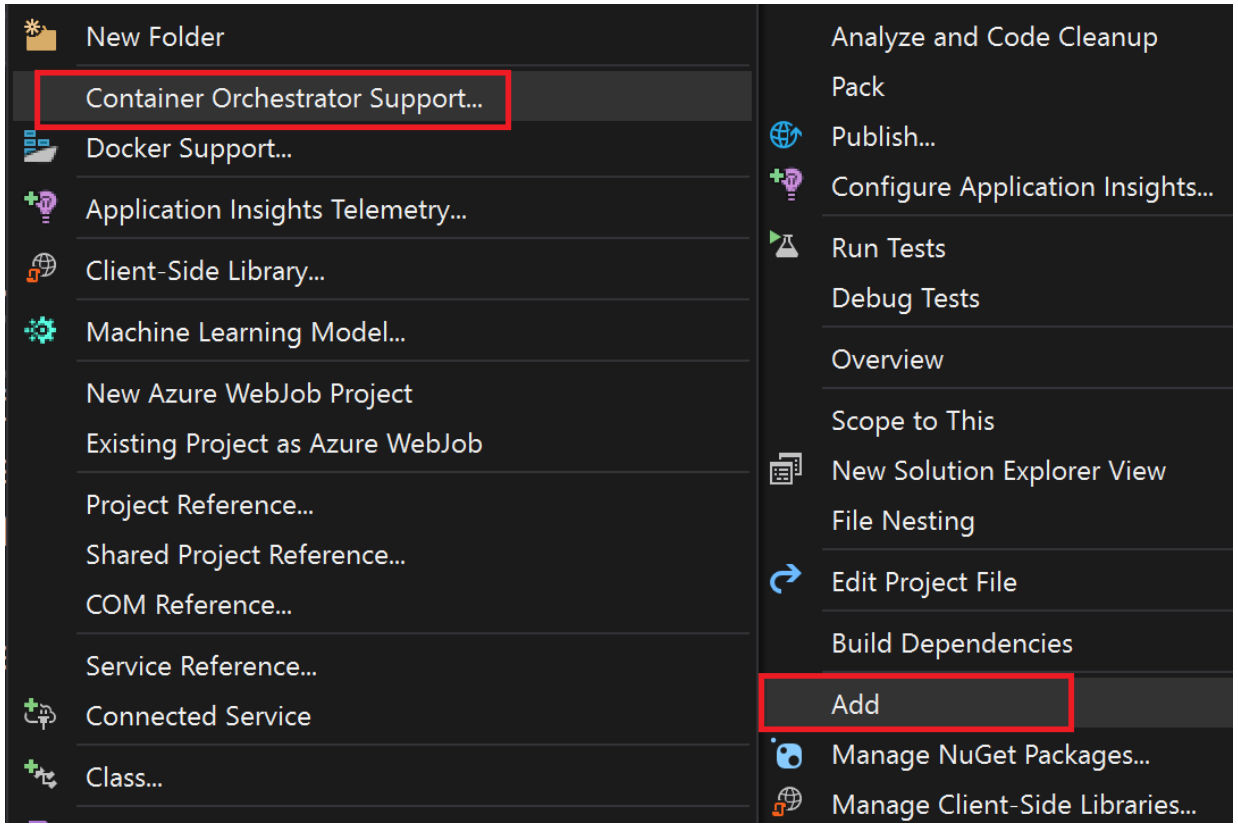
Helm Charts

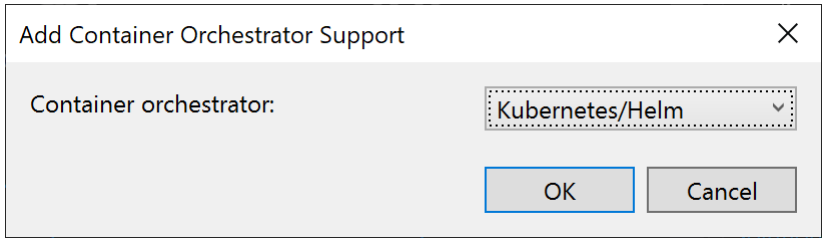
chartname/	
Chart.yaml	A YAML file containing information about the chart
LICENSE	OPTIONAL: A plain text file containing the license for the chart
README.md	OPTIONAL: A human-readable README file
values.yaml	The default configuration values for this chart
charts/	A directory containing any charts upon which this chart depends.
templates/	A directory of templates that, when combined with values, will generate valid Kubernetes manifest files.
templates/NOTES.txt :	OPTIONAL: A plain text file containing short usage notes

Add Helm Charts in Visual Studio

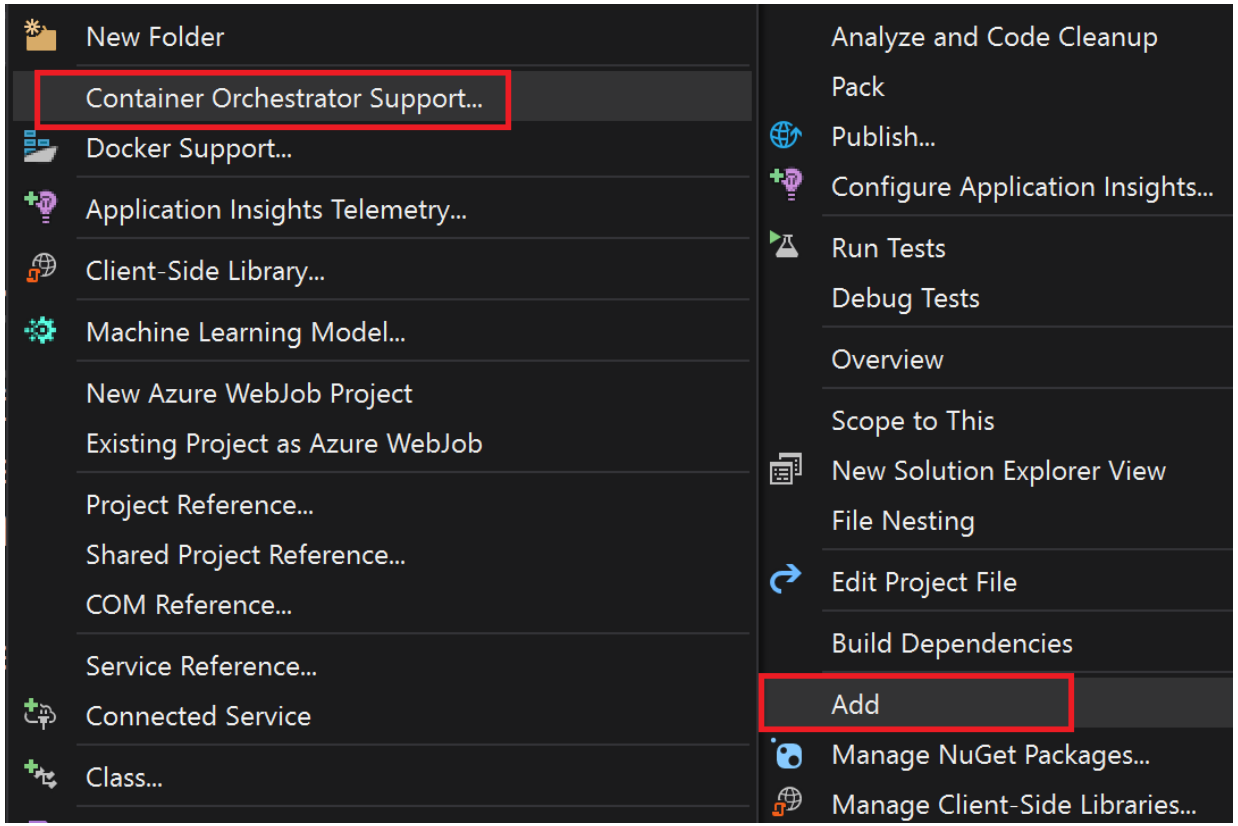


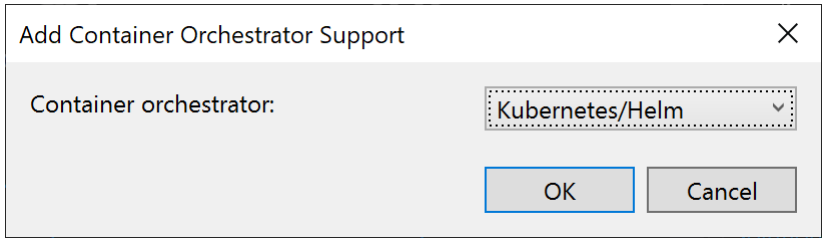
Add Helm Charts in Visual Studio

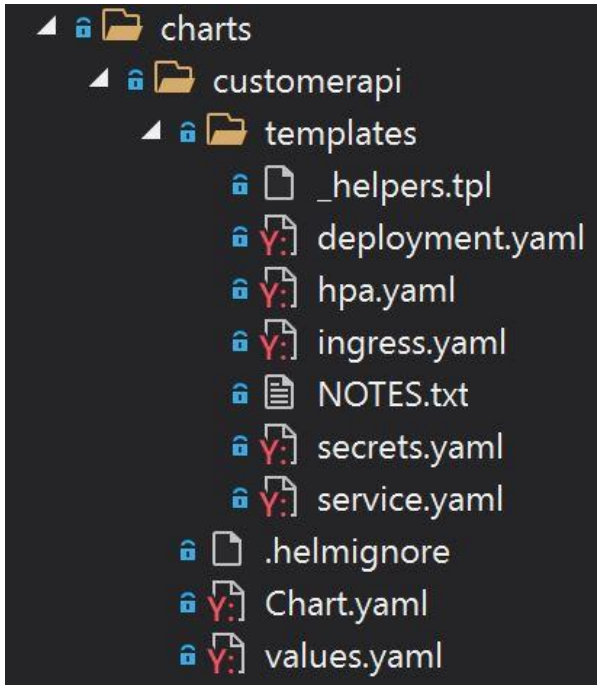




Add Helm Charts in Visual Studio







Add Helm Charts with CLI

mkdir charts

cd charts

helm create <ChartName>

helm create customerapi

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Helm Charts

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: {{ template "customerapi.fullname" . }}
  labels:
    app: {{ template "customerapi.name" . }}
    chart: {{ template "customerapi.chart" . }}
    draft: {{ .Values.draft | default "draft-app" }}
    release: {{ .Release.Name }}
    heritage: {{ .Release.Service }}
spec:
  revisionHistoryLimit: 0
  replicas: {{ .Values.replicaCount }}
  selector:
    matchLabels:
      app: {{ template "customerapi.name" . }}
      release: {{ .Release.Name }}
  template:
    metadata:
      labels:
        app: {{ template "customerapi.name" . }}
        draft: {{ .Values.draft | default "draft-app" }}
        release: {{ .Release.Name }}
      annotations:
        buildID: {{ .Values.buildID | default "" | quote }}
    spec:
      containers:
        - name: {{ .Chart.Name }}
          image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
          imagePullPolicy: {{ .Values.image.pullPolicy }}
          ports:
            - name: http
              containerPort: {{ .Values.deployment.containerPort }}
              protocol: TCP
          {{- if .Values.probes.enabled }}
          livenessProbe:
            httpGet:
              path: /health
              port: http
            initialDelaySeconds: 15
```

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```yaml
template:
  metadata:
    annotations:
      buildID: ""
    creationTimestamp: null
    labels:
      app: customerapi
      draft: draft-app
      release: customerapi-customerapi-test
  spec:
    containers:
    - env:
      - name: AzureServiceBus__ConnectionString
        valueFrom:
          secretKeyRef:
            key: AzureServiceBus__ConnectionString
            name: customerapi-connectionstrings
      - name: ConnectionStrings__CustomerDatabase
        valueFrom:
          secretKeyRef:
            key: ConnectionStrings__CustomerDatabase
            name: customerapi-connectionstrings
      image: wolfgangofner/customerapi:0.1.402
      imagePullPolicy: IfNotPresent
      livenessProbe:
        failureThreshold: 3
        httpGet:
          path: /health
          port: http
          scheme: HTTP
        initialDelaySeconds: 15
        periodSeconds: 10
        successThreshold: 1
        timeoutSeconds: 1
      name: customerapi
      ports:
      - containerPort: 80
        name: http
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: {{ template "customerapi.fullname" . }}
  labels:
    app: {{ template "customerapi.name" . }}
    chart: {{ template "customerapi.chart" . }}
    draft: {{ .Values.draft | default "draft-app" }}
    release: {{ .Release.Name }}
    heritage: {{ .Release.Service }}
spec:
  revisionHistoryLimit: 0
  replicas: {{ .Values.replicaCount }}
  selector:
    matchLabels:
      app: {{ template "customerapi.name" . }}
      release: {{ .Release.Name }}
  template:
    metadata:
      labels:
        app: {{ template "customerapi.name" . }}
        draft: {{ .Values.draft | default "draft-app" }}
        release: {{ .Release.Name }}
      annotations:
        buildID: {{ .Values.buildID | default "" | quote }}
    spec:
      containers:
        - name: {{ .Chart.Name }}
          image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
          imagePullPolicy: {{ .Values.image.pullPolicy }}
          ports:
            - name: http
              containerPort: {{ .Values.deployment.containerPort }}
              protocol: TCP
          {{- if .Values.probes.enabled }}
          livenessProbe:
            httpGet:
              path: /health
              port: http
            initialDelaySeconds: 15
```

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```yaml
template:
  metadata:
    annotations:
      buildID: ""
    creationTimestamp: null
    labels:
      app: customerapi
      draft: draft-app
      release: customerapi-customerapi-test
  spec:
    containers:
    - env:
      - name: AzureServiceBus__ConnectionString
        valueFrom:
          secretKeyRef:
            key: AzureServiceBus__ConnectionString
            name: customerapi-connectionstrings
      - name: ConnectionStrings__CustomerDatabase
        valueFrom:
          secretKeyRef:
            key: ConnectionStrings__CustomerDatabase
            name: customerapi-connectionstrings
      image: wolfgangofner/customerapi:0.1.402
      imagePullPolicy: IfNotPresent
      livenessProbe:
        failureThreshold: 3
        httpGet:
          path: /health
          port: http
          scheme: HTTP
        initialDelaySeconds: 15
        periodSeconds: 10
        successThreshold: 1
        timeoutSeconds: 1
      name: customerapi
      ports:
      - containerPort: 80
        name: http
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: {{ template "customerapi.fullname" . }}
  labels:
    app: {{ template "customerapi.name" . }}
    chart: {{ template "customerapi.chart" . }}
    draft: {{ .Values.draft | default "draft-app" }}
    release: {{ .Release.Name }}
    heritage: {{ .Release.Service }}
spec:
  revisionHistoryLimit: 0
  replicas: {{ .Values.replicaCount }}
  selector:
    matchLabels:
      app: {{ template "customerapi.name" . }}
      release: {{ .Release.Name }}
  template:
    metadata:
      labels:
        app: {{ template "customerapi.name" . }}
        draft: {{ .Values.draft | default "draft-app" }}
        release: {{ .Release.Name }}
      annotations:
        buildID: {{ .Values.buildID | default "" | quote }}
    spec:
      containers:
        - name: {{ .Chart.Name }}
          image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
          imagePullPolicy: {{ .Values.image.pullPolicy }}
          ports:
            - name: http
              containerPort: {{ .Values.deployment.containerPort }}
              protocol: TCP
          {{- if .Values.probes.enabled }}
          livenessProbe:
            httpGet:
              path: /health
              port: http
            initialDelaySeconds: 15
```

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Values.yaml

```yaml
fullnameOverride: customerapi
replicaCount: 1
image:
  repository: __Repository__
  tag: __BuildNumber__
  pullPolicy: IfNotPresent
imagePullSecrets: []
service:
  type: LoadBalancer
  port: 80

deployment:
  containerPort: 80

probes:
  enabled: false
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: {{ template "customerapi.fullname" . }}
  labels:
    app: {{ template "customerapi.name" . }}
    chart: {{ template "customerapi.chart" . }}
    draft: {{ .Values.draft | default "draft-app" }}
    release: {{ .Release.Name }}
    heritage: {{ .Release.Service }}
spec:
  revisionHistoryLimit: 0
  replicas: {{ .Values.replicaCount }}
  selector:
    matchLabels:
      app: {{ template "customerapi.name" . }}
      release: {{ .Release.Name }}
  template:
    metadata:
      labels:
        app: {{ template "customerapi.name" . }}
        draft: {{ .Values.draft | default "draft-app" }}
        release: {{ .Release.Name }}
      annotations:
        buildID: {{ .Values.buildID | default "" | quote }}
    spec:
      containers:
        - name: {{ .Chart.Name }}
          image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
          imagePullPolicy: {{ .Values.image.pullPolicy }}
          ports:
            - name: http
              containerPort: {{ .Values.deployment.containerPort }}
              protocol: TCP
          {{- if .Values.probes.enabled }}
          livenessProbe:
            httpGet:
              path: /health
              port: http
            initialDelaySeconds: 15
```

Values.yaml Demo

```yaml
fullnameOverride: customerapi
replicaCount: 1
image:
  repository: __Repository__
  tag: __BuildNumber__
  pullPolicy: IfNotPresent
imagePullSecrets: []
service:
  type: LoadBalancer
  port: 80

deployment:
  containerPort: 80

probes:
  enabled: false
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: {{ template "customerapi.fullname" . }}
  labels:
    app: {{ template "customerapi.name" . }}
    chart: {{ template "customerapi.chart" . }}
    draft: {{ .Values.draft | default "draft-app" }}
    release: {{ .Release.Name }}
    heritage: {{ .Release.Service }}
spec:
  revisionHistoryLimit: 0
  replicas: {{ .Values.replicaCount }}
  selector:
    matchLabels:
      app: {{ template "customerapi.name" . }}
      release: {{ .Release.Name }}
  template:
    metadata:
      labels:
        app: {{ template "customerapi.name" . }}
        draft: {{ .Values.draft | default "draft-app" }}
        release: {{ .Release.Name }}
      annotations:
        buildID: {{ .Values.buildID | default "" | quote }}
    spec:
      containers:
        - name: {{ .Chart.Name }}
          image: "{{ .Values.image.repository }}:{{ .Values.image.tag }}"
          imagePullPolicy: {{ .Values.image.pullPolicy }}
          ports:
            - name: http
              containerPort: {{ .Values.deployment.containerPort }}
              protocol: TCP
          {{- if .Values.probes.enabled }}
          livenessProbe:
            httpGet:
              path: /health
              port: http
            initialDelaySeconds: 15
```

Override Values in CI/CD Pipeline

```yaml
fullnameOverride: customerapi
replicaCount: 1
image:
  repository: __Repository__
  tag: __BuildNumber__
  pullPolicy: IfNotPresent
imagePullSecrets: []
service:
  type: LoadBalancer
  port: 80

deployment:
  containerPort: 80

probes:
  enabled: false
```

Override Values in CI/CD Pipeline

```yaml
fullnameOverride: customerapi
replicaCount: 1
image:
  repository: __Repository__
  tag: __BuildNumber__
  pullPolicy: IfNotPresent
imagePullSecrets: []
service:
  type: LoadBalancer
  port: 80

deployment:
  containerPort: 80

probes:
  enabled: false
```

```yaml
variables:
  ApiName: 'customerapi'
  BuildNumber: $(GitVersion.FullSemVer)
  Repository: 'wolfgangofnerbbv/$(ApiName)'
```

Override Values in CI/CD Pipeline

```yaml
fullnameOverride: customerapi
replicaCount: 1
image:
  repository: __Repository__
  tag: __BuildNumber__
  pullPolicy: IfNotPresent
imagePullSecrets: []
service:
  type: LoadBalancer
  port: 80

deployment:
  containerPort: 80

probes:
  enabled: false
```

```yaml
variables:
  ApiName: 'customerapi'
  BuildNumber: $(GitVersion.FullSemVer)
  Repository: 'wolfgangofnerbbv/$(ApiName)'
```

```yaml
steps:
  - task: Tokenizer@0
    displayName: 'Run Tokenizer'
```

Helm Commands

List all deployments

helm ls

Install Helm Chart

helm install my-release-name my-helm-chart-name

helm install customer customerapi

Update Release

helm upgrade customer customerapi

Uninstall Release

helm uninstall customerapi

Rollback Release

helm rollback customerapi

Release Management

Install or upgrade Charts

Helm will only update components that have changed since the last release

Release Management

Install or upgrade Charts

Helm will only update components that have changed since the last release

```
PS C:\Users\Wolfgang> helm ls --all-namespaces
NAME                            NAMESPACE               REVISION        UPDATED                                 STATUS CHART                    APP VERSION
cert-manager                    cert-manager            1               2021-10-17 12:00:51.12066323 +0000 UTC  deployecert-manager-v1.5.4      v1.5.4
customerapi-customerapi-test    customerapi-test        1               2021-10-17 12:08:31.037732341 +0000 UTC deployecustomerapi-0.1.402      1.0
ingress-nginx                   ingress-basic           1               2021-10-17 12:01:25.840929561 +0000 UTC deployeingress-nginx-4.0.6      1.0.4
keda                            keda                    1               2021-10-17 12:04:21.520467691 +0000 UTC deployekeda-2.4.0               2.4.0
kedademoapi-kedademoapi-prod    kedademoapi-prod        1               2021-10-17 12:09:50.399832095 +0000 UTC deployekedademoapi-0.1.417      1.0
kedademoapi-kedademoapi-test    kedademoapi-test        1               2021-10-17 12:06:59.357610554 +0000 UTC deployekedademoapi-0.1.417      1.0
loki                            loki-grafana            1               2021-10-17 12:02:10.25707972 +0000 UTC  deployeloki-stack-2.0.3         v2.0.0
orderapi-orderapi-test          orderapi-test           1               2021-10-17 12:08:05.018913511 +0000 UTC failed orderapi-0.1.421         1.0
```

Helm Demo

- New .NET 5 application
- Add Docker support
- Add Helm chart
- Deploy Helm chart
- Update Helm chart

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Solved all your problems. You're welcome.

Infrastructure as Code (IaC)

```
variable "base_network_cidr" {
  default = "10.0.0.0/8"
}

resource "google_compute_network" "example" {
  name                    = "test-network"
  auto_create_subnetworks = false
}

resource "google_compute_subnetwork" "example" {
  count = 4

  name          = "test-subnetwork"
  ip_cidr_range = cidrsubnet(var.base_network_cidr, 4, count.index)
  region        = "us-central1"
  network       = google_compute_network.custom-test.self_link
}
```

```
# Create Azure SQL Server
Settings
- task: AzureCLI@2
  displayName: "Create SQL Server"
  inputs:
    azureSubscription: '$(AzureSubscription)'
    scriptType: 'pscore'
    scriptLocation: 'inlineScript'
    inlineScript: |
      az sql server create `
      --location $(ResourceGroupLocation) `
      --resource-group $(ResourceGroupName) `
      --name $(SqlServerName) `
      --admin-user $(SqlServerAdminUser) `
      --admin-password "$(SqlServerAdminPassword)"
```

```
Settings
- task: AzureCLI@2
  displayName: "Create SQL Server Firewall rule"
  inputs:
    azureSubscription: '$(AzureSubscription)'
    scriptType: 'pscore'
    scriptLocation: 'inlineScript'
    inlineScript: |
      az sql server firewall-rule create `
      --resource-group $(ResourceGroupName) `
      --server $(SqlServerName) `
      --name AllowAzureServices `
      --start-ip-address 0.0.0.0 `
      --end-ip-address 0.0.0.0
```

Infrastructure as Code (IaC)

Describe your infrastructure as code

YAML or JSON

Fast and reliable deployments

Decrease error rate

The definition can be reviewed and saved in version control

Infrastructure can be deployed fast and reliable

Deployments can be repeated as often as needed

No (less) communication problems due to developers writing the configuration themselves

Many tools available

IaC Tools

- Terraform
- Ansible
- Chef
- Puppet
- **Azure CLI**
- PowerShell
- Arm
- Biceps

IaC in Azure DevOps

```yaml
steps:
  Settings
- task: HelmInstaller@0
  displayName: Install Helm
  inputs:
    helmVersion: '$(HelmVersion)'
    checkLatestHelmVersion: false
    installKubectl: true
    kubectlVersion: '$(KubectlVersion)'
    checkLatestKubectl: false

  Settings
- task: AzureCLI@2
  displayName: "Create resource group"
  inputs:
    azureSubscription: '$(AzureSubscription)'
    scriptType: 'pscore'
    scriptLocation: 'inlineScript'
    inlineScript: |
      az group create -g "$(ResourceGroupName)" -l "$(ResourceGroupLocation)"

# Create AKS
  Settings
- task: AzureCLI@2
  displayName: "Create AKS cluster"
  inputs:
    azureSubscription: '$(AzureSubscription)'
    scriptType: 'pscore'
    scriptLocation: 'inlineScript'
    inlineScript: |
      az aks create `
          --resource-group "$(ResourceGroupName)" `
          --location "$(ResourceGroupLocation)" `
          --name "$(AksClusterName)" `
          --network-plugin $(NetworkPlugin) `
          --kubernetes-version $(KubernetesVersion) `
          --node-vm-size Standard_B2s `
          --node-osdisk-size 0 `
          --node-count $(NodeCount)` 
          --load-balancer-sku standard `
          --max-pods 110 `
          --dns-name-prefix microservice-aks-dns `
          --generate-ssh-keys
```

```yaml
# Create Azure SQL Server
  Settings
- task: AzureCLI@2
  displayName: "Create SQL Server"
  inputs:
    azureSubscription: '$(AzureSubscription)'
    scriptType: 'pscore'
    scriptLocation: 'inlineScript'
    inlineScript: |
      az sql server create `
      --location $(ResourceGroupLocation) `
      --resource-group $(ResourceGroupName) `
      --name $(SqlServerName) `
      --admin-user $(SqlServerAdminUser) `
      --admin-password "$(SqlServerAdminPassword)"
```

```yaml
  Settings
- task: AzureCLI@2
  displayName: "Create SQL Server Firewall rule"
  inputs:
    azureSubscription: '$(AzureSubscription)'
    scriptType: 'pscore'
    scriptLocation: 'inlineScript'
    inlineScript: |
      az sql server firewall-rule create `
      --resource-group $(ResourceGroupName) `
      --server $(SqlServerName) `
      --name AllowAzureServices `
      --start-ip-address 0.0.0.0 `
      --end-ip-address 0.0.0.0
```

Database Deployment

“If you deploy something manually, you do it wrong”

Entity Framework Migrations

Tools like FluentMigrator

Database Deployment

“If you deploy something manually, you do it wrong”

Entity Framework Migrations

Tools like FluentMigrator

```
[Migration(20180430121800)]
public class AddLogTable : Migration
{
    public override void Up()
    {
        Create.Table("Log")
            .WithColumn("Id").AsInt64().PrimaryKey().Identity()
            .WithColumn("Text").AsString();
    }

    public override void Down()
    {
        Delete.Table("Log");
    }
}
```

Database Deployment

“If you deploy something manually, you do it wrong”

Entity Framework Migrations

Tools like FluentMigrator

SQS Server Data Tools (SSDT)

- Schema comparison
- Set up database locally
- Execution of SQL scripts
  - Pre-deployment
  - Post-deployment
- Deploy database in DevOps pipeline
- Generates dacpac package to deploy to SQL Server

Database Deployment Challenges

Breaking changes

- Removing a column will break your application
- Solution: Split changes into two steps:
  - Make column nullable
  - Remove column
  - Allows rollback
- More planning required

Azure DevOps only supports dacpac deployments on Windows agents

- Change is on the feature request list since 2018
- Use Windows agent to deploy dacpac to SQL Server
- Use Docker container z.B. wolfgangofner/linuxsqlpackage:1.0

Further Resources

https://programmingwithwolfgang.com/microservice-series-from-zero-to-hero/

https://docs.microsoft.com/en-us/azure/aks/

https://azure.microsoft.com/mediahandler/files/resourcefiles/phippy-goes-to-the-zoo/Phippy%20Goes%20To%20The%20Zoo_MSFTonline.pdf?ocid=AID3041042