Running containers on K8S

Pods in Kubernetes

Kubernetes groups multiple containers into a single, atomic unit called a *Pod*

A Pod represents a collection of application containers and volumes running in the same execution environment.

Applications running in the same Pod share the same:

- IP-address (network port & namespace)
- Hostname
- Can communicate over System V IPC or POSIX message queues (IPC namespace)

Pods

Pods are grouped containers that run on the same machine

Different Pods can be considered as running on different machines (no-sharing-whatsoever)

"Will these containers work correctly if they land on different machines?"

- If No => they should be in the same Pod
- Otherwise: different pods

i.e. Wordpress with MySql containers in same Pod?

Running a simple pod

```
kubectl run my-pod --image nginx
```

```
kubectl get pods --selector=run=my-pod
```

```
kubectl delete deployments/my-pod
```

Debugging

```
kubectl exec -it <pod-name> -- bash

kubectl logs <pod-name>

kubectl cp <pod-name>:/path/to/remote/file /path/to/local/file
```

The Pod manifest

Text file containing *declarative configuration*

- Describing the desired state when this configuration is applied

Imperative configuration, where you simply take a series of actions (e.g., apt-get install foo) to modify the world isn't used in Kubernetes

Declarative configuration is why Kubernetes can have self-healing behavior without user action.

Pod manifest

When we look back at the run command:

```
kubectl run my-pod --image nginx
```

Actually that command doesn’t just run the pod.

It creates a declarative manifest with a deployment

Pod manifest

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: my-pod
  labels:
    name: my-pod
spec:
  containers:
  - name: my-pod
    image: nginx
    ports:
    - containerPort: 80
```

Pod manifest

```
kubectl apply –f nginx.yml
```

```
PS >kubectl apply -f .\nginx.yml
pod/my-pod created
```

```
kubectl get pods
```

```
kubectl delete –f nginx.yml / kubectl delete pods/my-pod
```

```
PS >kubectl delete -f .\nginx.yml
pod "my-pod" deleted
```

```
kubectl describe pods/my-pod
```

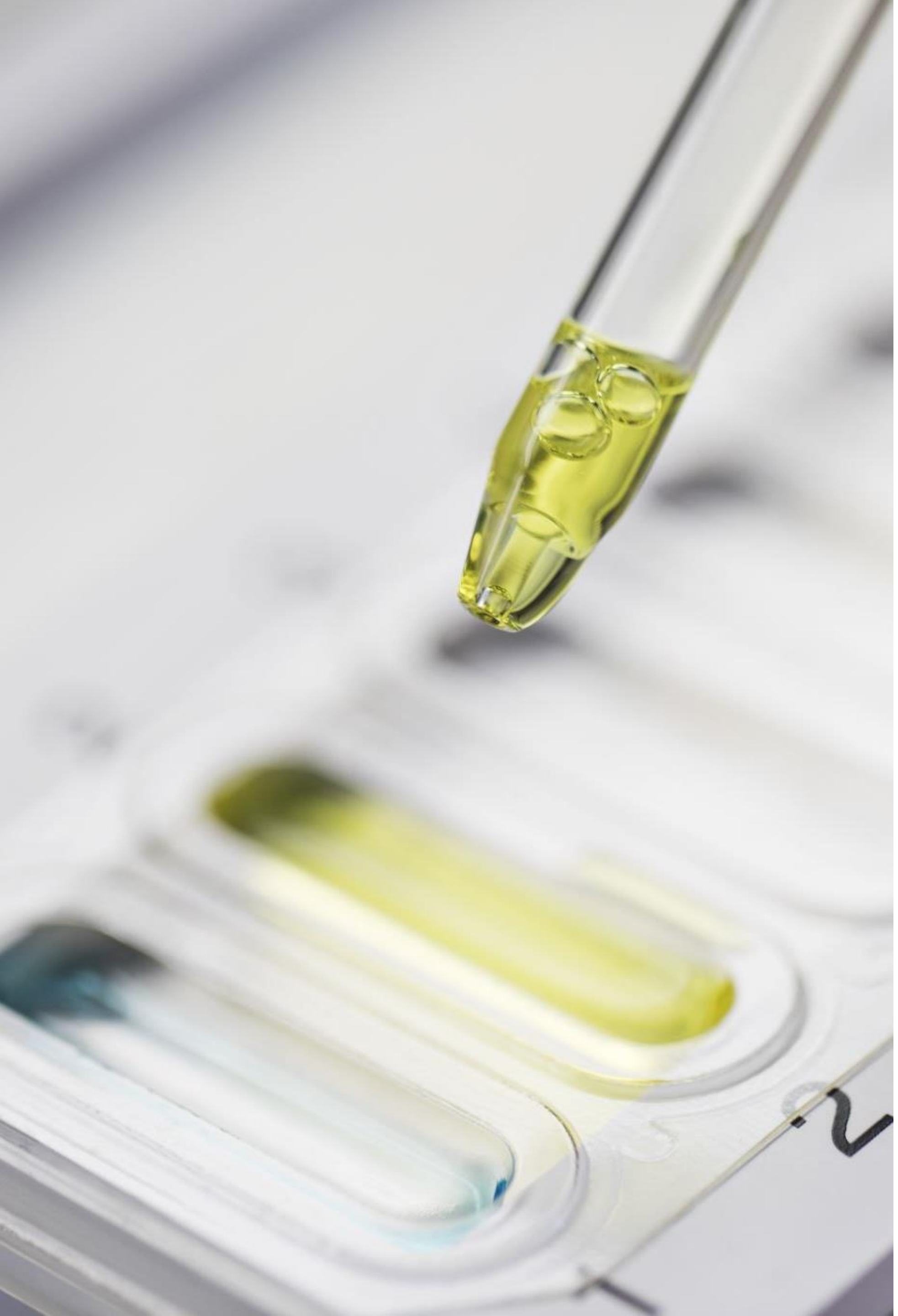
Port forwarding

Creating a secure tunnel from your localmachine -> K8S master -> pod

```
kubectl port-forward my-pod 8080:80
```

Connect via http://localhost:8080

```
kubectl logs my-pod
kubectl logs my-pod --previous
```



Healthchecks

Kubernetes keeps your pod alive with *process health checks*

Liveness probes

Readiness probes

Liveness probe

Simple process check is not enough

Kubernetes can check if your application inside the container is alive by doing a liveness check.

These need to be added manually into the manifest

```
livenessProbe:
  httpGet:
    path: /
    port: "80"
  initialDelaySeconds: 5
  timeoutSeconds: 1
  periodSeconds: 10
  failureTreshold: 3
  successThreshold: 1
```

Liveness probe

HTTP type:

Checks periodically by polling at the given path and portnumber

Result should be statuscode between 200 and 400

If it fails <failureTreshold> times the container will be restarted

Readiness probe

Describes when a container is ready to handle user requests

Configured just like liveness probes

Combination of readiness and liveness probes makes sure only healthy containers are running

Types

- HTTP check
- tcpSocket (tests if port can be opened)
- Exec (runs a command, 0 resultcode is success)

Resource management

In addition to simplified distributed application deployment we want to increase overall utilization of our compute nodes

Basic cost of operating a machine is constant, regardless of being idle or fully loaded

With Kubernetes managing resource packing we can go up well over 50%

To do this Kubernetes needs to know what can be expected from your application in terms of resource requirements, so packing can be optimal across the cluster

Resource management

Based on 2 different resource metrics

- Requested resources
  - Minimum required:
  - CPU (i.e. 500m is half a cpu)
  - Memory (i.e. 128Mi is 128MB of memory)
  - Expressed in container section(s) of manifest file
- Resource limits
  - Same settings, but maximizing/capping to the configured level

Resource management

```
containers:
 - name: my-pod
   image: nginx
   resources:
       requests:
         cpu: 100m
         memory: 128Mi
       limits:
         cpu: 500m
         memory: 256Mi
```

Persisting data with Volumes

Containers are stateless by default

During runtime we will get a temporary write-layer on top of our image

After removing (or restarting!) a container all stored data will be lost

Sometimes we need to store data that survives this.

Kubernetes has the concept of volumes to support that.

Persistent volumes

Add a `spec.volumes` section to the manifest

This contains an array of volume definitions

Not all containers in the pod are required to mount these volumes

We can control which containers mount by adding the `volumeMounts` section to the declaration

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: my-pod
  labels:
    name: my-pod
spec:
  volumes:
    - name: "my-pod-data"
      hostPath:
        path: "/var/lib/data"
  containers:
  - name: my-pod
    image: nginx
    volumeMounts:
      - mountPath: "/var/lib/data"
        name: "my-pod-data"
```

Volumes

Communication / synchronization

Cache

Persistent data

Mounting host file system (i.e. /dev)

- hostPath variable in manifest
- Local storage

Binding remote disks

- NFS
- iSCSI
- Cloud provider based solutions (Azure Files,

Persistent Volumes

A piece of storage made available in the cluster

Provisioned by an administrator

Or

Dynamic provisioning through Storage Classes

Have a lifecycle independent of any individual Pod

Persistent Volume (local)

```yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: example-pv
spec:
  capacity:
    storage: 100Gi
  volumeMode: Filesystem
  accessModes:
  - ReadWriteOnce
  persistentVolumeReclaimPolicy: Delete
  storageClassName: local-storage
  local:
    path: /mnt/disks/ssd1
  nodeAffinity:
    required:
      nodeSelectorTerms:
      - matchExpressions:
        - key: kubernetes.io/hostname
          operator: In
          values:
          - example-node
```

Persistent Volume (nfs)

```yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: pv0003
spec:
  capacity:
    storage: 5Gi
  volumeMode: Filesystem
  accessModes:
    - ReadWriteOnce
  persistentVolumeReclaimPolicy: Recycle
  storageClassName: slow
  mountOptions:
    - hard
    - nfsvers=4.1
  nfs:
    path: /tmp
    server: 172.17.0.2
```

Persistent Volume (Custom)

```yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: external-data
  namespace: production
spec:
  capacity:
    storage: 10Gi
  volumeMode: Filesystem
  accessModes:
    - ReadWriteMany
  persistentVolumeReclaimPolicy: Recycle
  flexVolume:
    driver: "fstab/cifs"
    fsType: "cifs"
    secretRef:
      name: "cifs-secret"
    options:
      networkPath: "//10.70.10.10/data$"
      mountOptions:
"noperm,rw,nounix,nobrl,cache=none,file_mode=0777,dir_mode=0777,sec=ntlmsspi"
```

Persistent Volume Claims

Typically created by a user and mapped to a pod or container

Controller will bind the claim to a persistent volume (if possible)

When using dynamic persistent volumes through Storage Classes, it will create the volume or reuse an already created volume

In case of a pre-configured PV it simply binds to the storage

Persistent Volume Claim

```yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: myapp-pv-claim
  labels:
    app: myapp-pv-claim
spec:
  storageClassName: local-storage
  accessModes:
  - ReadWriteOnce
  resources:
    requests:
      storage: 2Gi
```

Usage

```yaml
apiVersion: v1
kind: Pod
metadata:
    name: pod-example-pv
spec:
  volumes:
    - name: my-pv-storage
      persistentVolumeClaim:
        claimName: myapp-pv-claim
  containers:
    - name: pod-example-pv
      image: nginx
      ports:
        - containerPort: 80
          name: "http-server"
      volumeMounts:
        - mountPath: "/usr/share/nginx/html"
          name: my-pv-storage
```