Deployments

Our goal: Reliable, scalable distributed systems

Many services are being deployed as API’s

If they fail part of the system crashes

Software must be available even during software maintenance, version and fix rollouts etc.

When more and more people rely on the services, they must be scalable to avoid downtime or unavailability.

Reasons to start with containerized systems

Velocity
Measured not in terms of the raw number of features you can ship per hour or day, but rather in terms of the number of things you can ship while maintaining a highly available service.

Scaling (of both software and teams)

Abstracting your infrastructure

Efficiency

Velocity through Immutability

Immutable infrastructure

Declarative Configuration

Self-Healing Systems

Scaling

Decoupling
… systems through separating API’s and services, connected by load balancers

Easy Scaling for Applications and Clusters
Independently scale parts or even whole applications. Extend computing power by adding more nodes to a cluster

Scaling Teams
Teams can be organized around services, applications, cluster-management etc.

Abstracting infrastructure

Public cloud movement
easy-to-use, self-service infrastructure for developers to consume

Focus on services and applications

Infrastructure components, like VMs, storage and physical networking are hidden with Kubernetes

Hence easy movement between on-premise clusters and different public cloud offerings

Efficiency

No/less thinking in terms of machines by developers

Multiple tasks/services can be packed tightly together on the same machine

Power usage / useful work ratio is better

Toolset, and knowledge of them, is being reused

Testing services and applications can be done in an already available cluster, no need for separate machines (isolate by namespaces)

Labels

Labels are key/value pairs that are attached to objects such as Pods

Labels are intended to be used to specify identifying attributes of objects that are meaningful and relevant to users, but do not directly imply semantics to the core system.

Labels can be used to organize and to select subsets of objects.

Applying labels from command line

Resources can have labels and annotations (metadata), more on this later.

```
kubectl label pods bar color=red

# remove label color:
kubectl label pods bar color-

kubectl annotate pods bar color
```

Applying labels to pods

```
kubectl run my-pod --image nginx \
-- labels="env=prod, app=web"

kubectl run my-pod2 --image nginx \
-- labels="env=staging, app=web"

kubectl label deployments my-prod "other=label"
```

Add labels in YAML

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name:  MYAPP
  namespace: default
  labels:
    app:  MYAPP
spec:
  selector:
    matchLabels:
      app: MYAPP
  ...
```

Label selectors

```
kubectl get pods --show-labels

kubectl get pods --selector="app=web“

# logical AND

kubectl get pods --selector="app=web,env=staging“


# in set (notin)

kubectl get pods --selector="app in (web,api)“

# has label (!)

kubectl get pods --selector="app"
```

Label selectors in API Objects (manifest)

```yaml
spec:
  selector:
    matchLabels:
      app: myapp
```

Label selectors in API Objects (manifest)

```
spec:
  selector:
    matchExpressions:
      - key: env
        operator: In
        values:
          - "staging"
```

Annotations

Labels are primarily used to identify and group objects

You can use Kubernetes **annotations** to **attach** arbitrary **non-identifying metadata** to objects. Clients such as tools and libraries can retrieve this metadata.

Object-scoped key/value store

When in doubt use an annotation and promote to label if you need a selector using it.

Deployments can use it to manage rollouts (more later)

- Track status, rollback information, previous states

Annotations

Same as label keys. For Annotations it’s more common to include ‘namespace’ information:

- deployment.kubernetes.io/revision
- kubernetes.io/change-cause

Value is free-form text

- Might contain JSON

Deployments

Provides **declarative template** for running Pods through ReplicaSets.

Describes a **desired state** in a Deployment object
the Deployment Controller changes the actual state to the desired state at a controlled rate.

Some deployment actions:

- Create a deployment to create one or more pods and manage with a ReplicaSet to allow for scaling

- Rollout a new or previous version of the pod by changing the image tag and reapply

- Tell the ReplicaSet you want more or less replicas to enable scaling

Deployments

So far we’ve created pods:

```
kubectl run nginx --image=nginx:latest
```

But we could also run a container as a deployment:

```
kubectl create deployment nginx –image=nginx:latest
```

Which creates the pod for us, but also manages it

Replicasets

Deployments manage replicasets

Replicasets manage pods

```
kubectl get replicasets --selector=app=nginx

kubectl scale deployments nginx --replicas=2
```

Replicasets

Redundancy

- Multiple running instances allow failure to be tolerated.

Scale

- Multiple running instances mean that more requests can be handled.

Sharding

- Different replicas can handle different parts of a computation in parallel.

Replicasets

Describe desired state

- How many of which containers should run?

Reconciliation loop in Kubernetes monitors and takes action

Labels are used to find the corresponding pods

Typically ReplicaSets are managed by higher-order objects like Deployment

Replicaset example

```yaml
apiVersion: extensions/v1beta1
kind: ReplicaSet
metadata:
  name: nginx
spec:
  replicas: 1
  template:
    metadata:
      labels:
        app: nginx
        version: "2"
spec:
     containers:
       - name: nginx
         image: nginx:latest
```

Replicaset – Pod templates

```
# Pods are recreated based on the Pod template supplied:
template:
  metadata:
    labels:
      app: helloworld
      version: v1
  spec:
    containers:
      - name: helloworld
        image: kelseyhightower/helloworld:v1
        ports:
          - containerPort: 80
```

Replicasets

```
kubectl get pods -l app=nginx,version=2
# imperative scaling
kubectl scale replicasets nginx --replicas=4

kubectl autoscale rs nginx-<id> --min=2 --max=5 --cpu-percent=80

kubectl get horizontalpodautoscalers
kubectl get hpa
kubectl delete rs nginx-<id> --cascade=false
```

Deployments

Get the deployment:

```
kubectl get deployments nginx --export -o yaml > nginx-
deployment.yaml

kubectl replace -f nginx-deployment.yaml --save-config
```

Deployment example

```yaml
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  annotations:
    deployment.kubernetes.io/revision: "1"
  labels:
    run: nginx
  name: nginx
  namespace: default
spec:
  replicas: 2
```

```yaml
strategy:
  rollingUpdate:
    maxSurge: 1
    maxUnavailable: 1
  type: RollingUpdate
 template:
  metadata:
    labels:
      run: nginx
  spec:
    containers:
```

Manage deployments

```
kubectl apply –f nginx-deployment.yml

kubectl rollout status deployments nginx

kubectl rollout pause deployments nginx

kubectl rollout resume deployments nginx
```

Manage deployments

```
kubectl rollout history deployment nginx

kubectl rollout undo deployments nginx --to-revision=3

kubectl rollout restart deployment nginx
```

Deployment strategies

Recreate

- Simpler version
- Changes replicaset
- Terminates pods
- Re-creates pods with new version

RollingUpdate

- Incrementally updates pods to newer version
- No downtime
- Slower

Rolling update

With rollingupdates we have some control with the following settings:

maxUnavailable

- How many pods can the update take down?
- Set to fixed number or percentage

maxSurge

- How many additional resources might be used during update?
- maxUnavailable = 0%, maxSurge = 25%

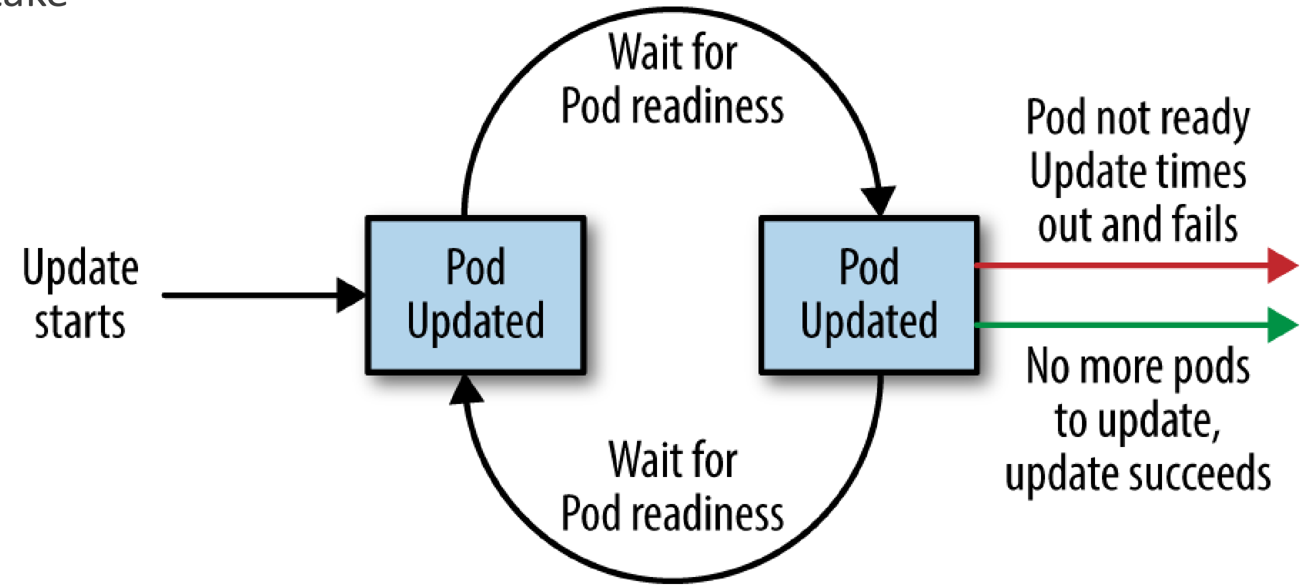
Rolling update

minReadySeconds

- Time to wait between updating pods
- Useful to slow down migration process

progressDeadlineSeconds

- Maximum time updating one pod may take



Deleting deployment

```
kubectl delete deployments nginx
```

```
kubectl delete -f nginx-deployment.yaml
```