Running and Managing Pods

Kien Bui
DevOps & Platform Engineer

Course Overview

Using the Kubernetes API

Managing Objects with Labels, Annotations, and Namespaces

Running and Managing Pods

Overview

Understanding Pods

Controllers and Pods

Multi-container Pods

Managing Pod Health with Probes

What Is a Pod?

Wrapper around your container based application

Pod

One or more containers

Resources

What Is a Pod? (con’t)

Unit of scheduling

- Allocating work
- A process that’s running in your cluster

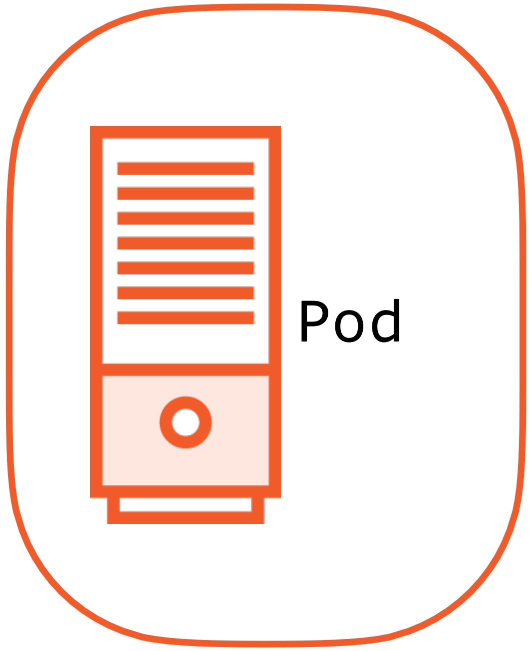
Unit of deployment

- Your application configuration
- Resources - Networking and storage

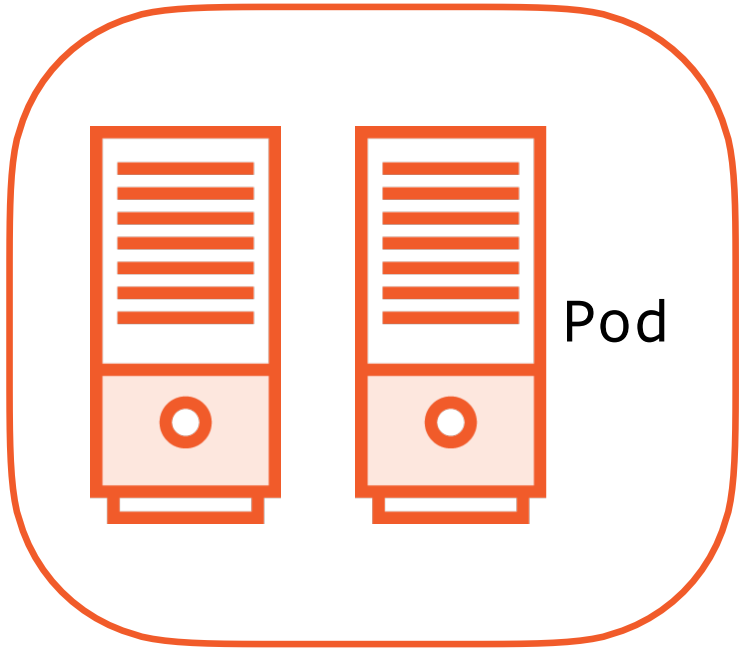
Why do we need Pods?

Provide higher level abstraction over a container for manageability

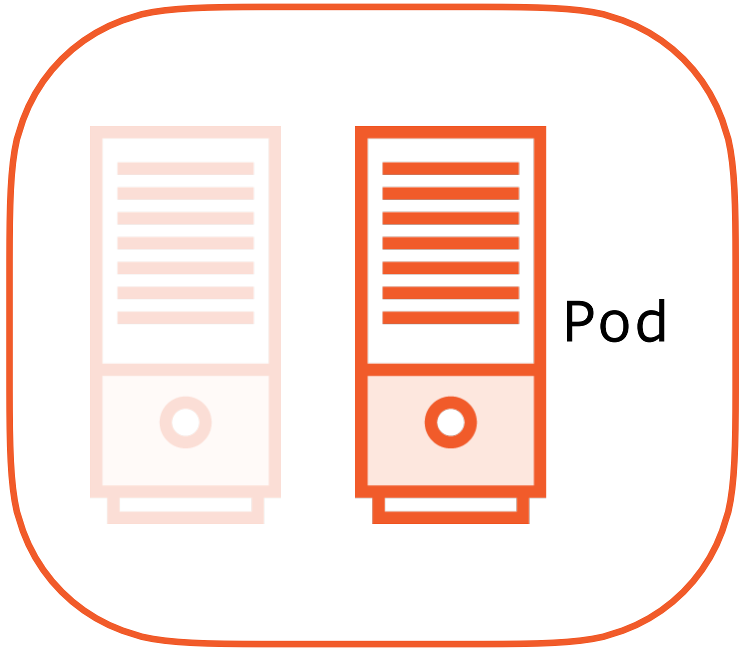
How Pods Manage Containers



Single Container
Pods



Multi-Container
Pods



Init Containers

Single Container Pods

Most common deployment scenario

Generally a single process running in a container

Often leads to easier application scaling

Controllers and Pods

Controllers keep your apps in the desired state

Responsible for starting and stopping Pods

Application scaling

Application recovery

You don’t want to run bare/naked Pods

They won’t be recreated in the event of a failure

Static Pods

Managed by the Kubelet on Nodes

Static Pod manifests

`staticPodPath` in Kubelet’s configuration

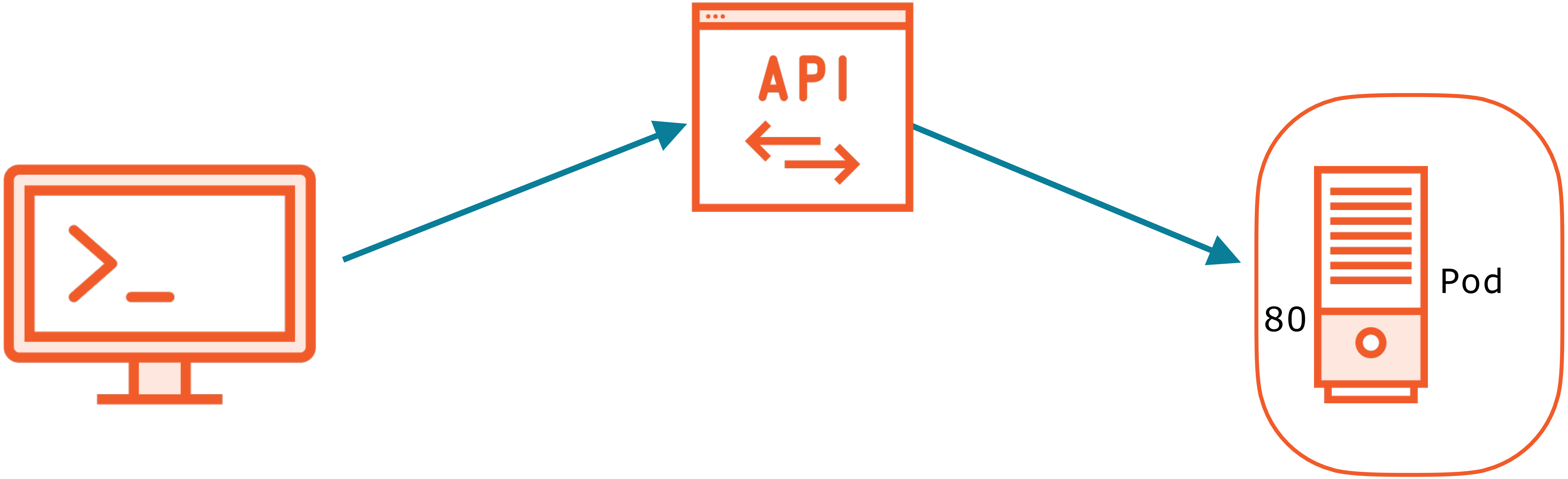
`/etc/kubernetes/manifests`

`/var/lib/kubelet/config.yaml`

`staticPodPath` is watched

Creates a ‘mirror’ Pod

Working with Pods -kubectl



```
kubectl exec -it POD1 --container CONTAINER1 -- /bin/bash
```

```
kubectl logs POD1 --container CONTAINER1
```

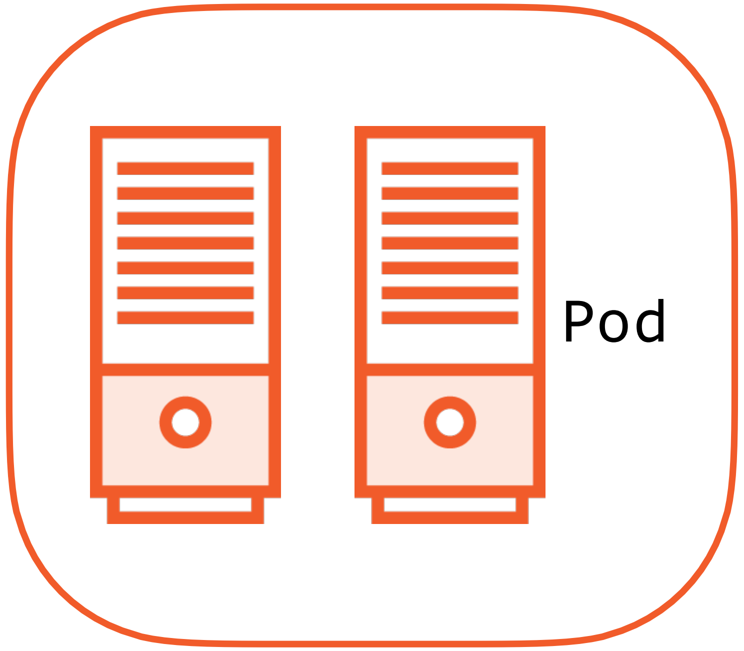
```
kubectl port-forward pod POD1 LOCALPORT:CONTAINERPORT
```

Demo

Running Pods

- Bare Pods
- Creating Pods ina Deployment
- Using port-forward to access a Pod’s application
- Static Pods

Multi-container Pods



Tightly coupled applications

Scheduling processes together

Requirement on some shared resource

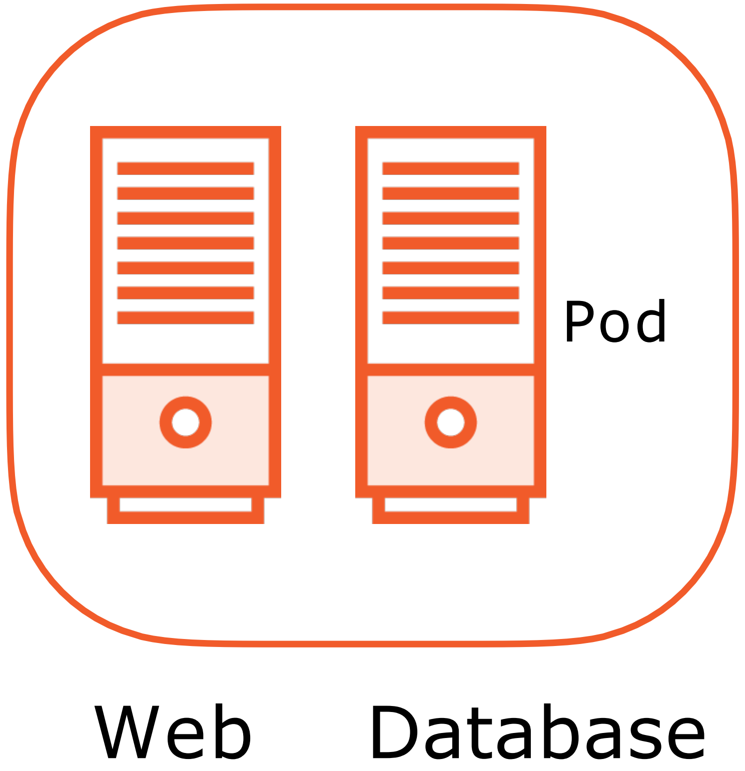
Usually something generating data while the other process consumes

Don’t use this to influence scheduling, we use other techniques for that!

Multi-container Pods

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: multicontainer-pod
spec:
  containers:
  - name: nginx
    image: nginx
    ports:
    - containerPort: 80
  ...
  - name: alpine
    image: alpine
```

Common Anti-Pattern for Multi-containerPods



Recovery Options

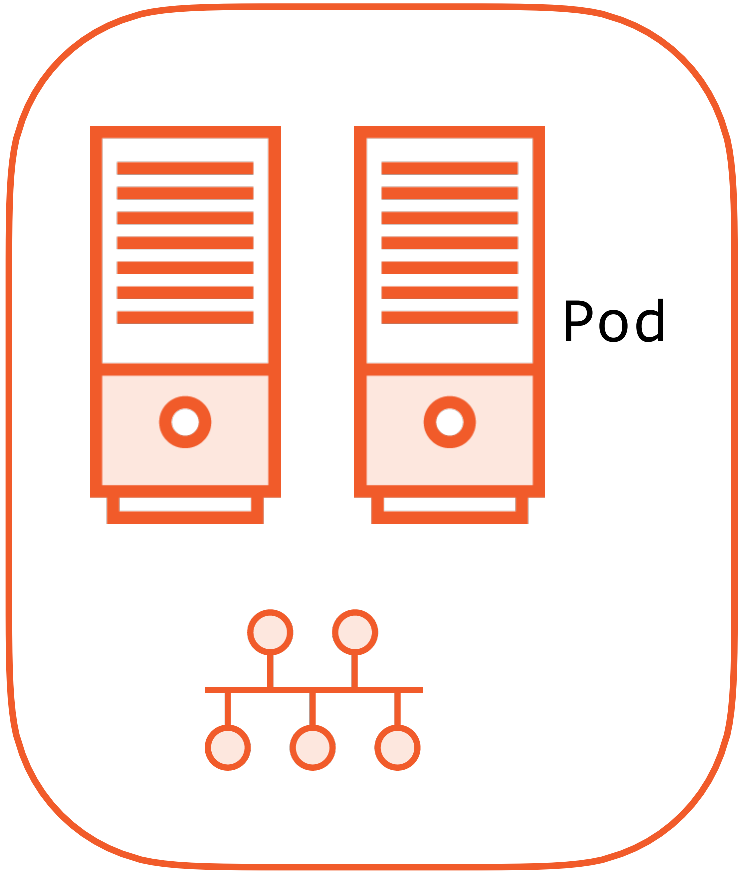
Limits Scaling

Shares Resources Inside a Pod

Networking

Storage

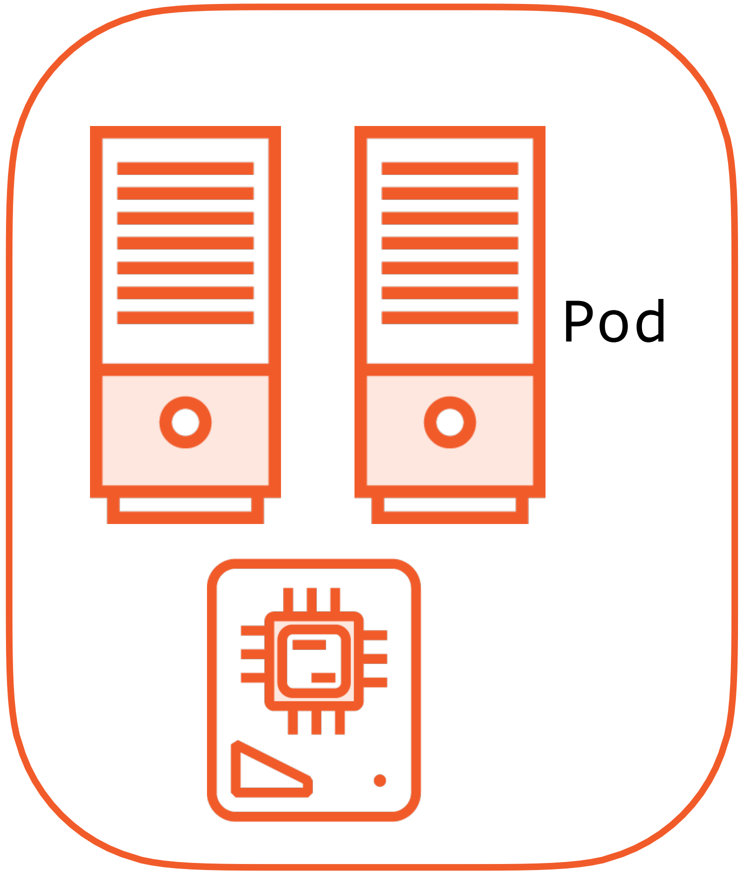
Shared Resources Inside a Pod - Networking



Shared loopback interface, used for communication over localhost

Be mindful of application port conflicts

Shared Resources Inside a Pod - Storage



Each container image has its own file syster

Volumes are defined at the Pod level Share

containers in a Pod Mounted into the conta

Common way forcontainers to exchange da

Demo

Running Multi-container Pods

Sharing data between containers in a Pod

Init Containers

Runs before main application container

Contain utilities or setup for apps

Run to completion

Can have more than one per Pod

Each is run sequentially

All init containers must run to successful completion for the Pod to start

When an init container fails…

Container `restartPolicy` applies

When to Use InitContainers

Run Tools or Utilities

Separation of Duties

Block Container Startup

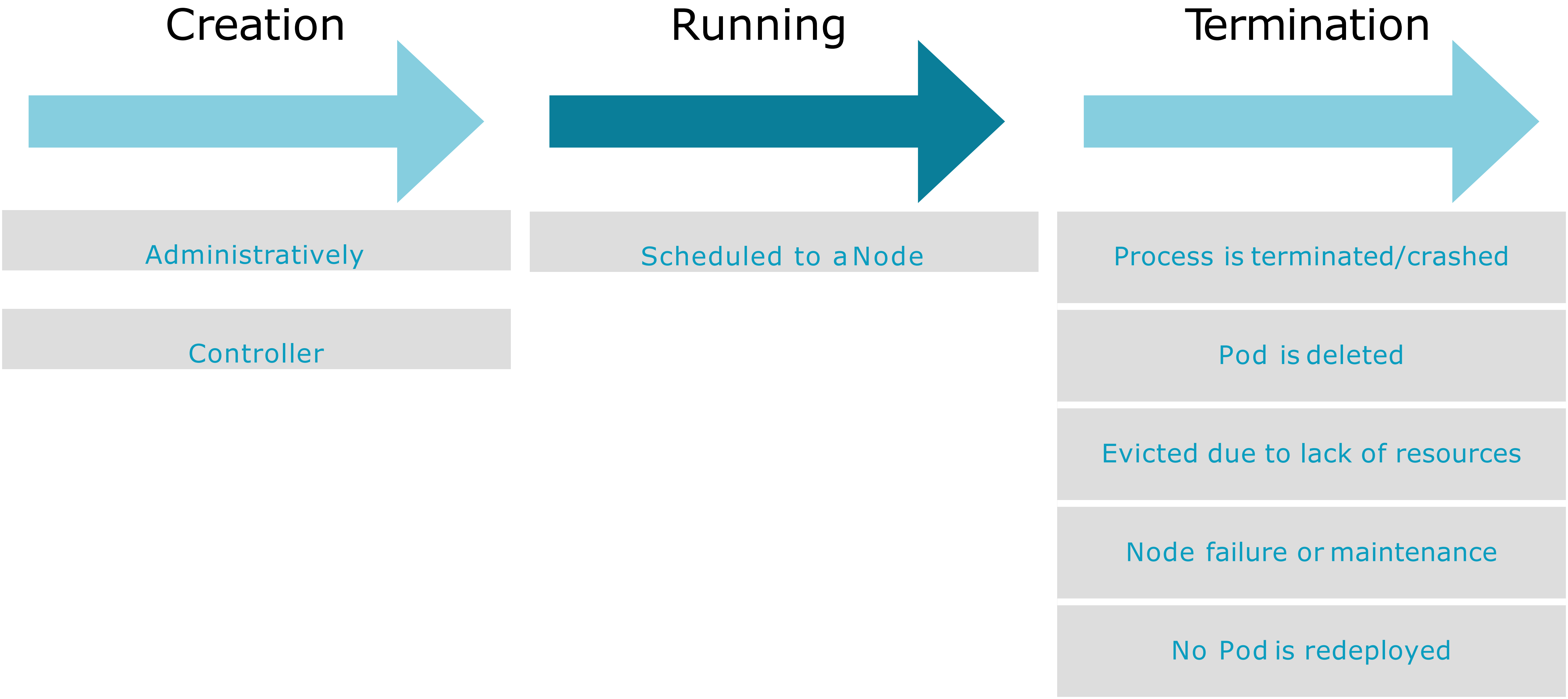
Pod with InitContainers

```
apiVersion: v1
kind: Pod
...
spec:
  initContainers:
  - name: init-service
    image: ubuntu
    command: ['sh', '-c', "echo waiting for service; sleep 2"]
  - name: init-database
    image: ubuntu
    command: ['sh', '-c', "echo waiting for database; sleep 2”]
containers:
  - name: app-container
    image: nginx
```

Demo

Working with init containers

Pod Lifecycle



Creation

- Administratively
- Controller

Running

- Scheduled to a Node

Termination

- Process is terminated/crashed
- Pod is deleted
- Evicted due to lack of resources
- Node failure or maintenance
- No Pod is redeployed

Stopping/Terminating Pods

Grace Period Timer (30 sec default)

Pods changes to Terminating

SIGTERM

Service Endpoints and Controllers updated

IF >Grace Period

SIGKILL

API and etcd are updated

```
kubectl delete pod <name> --grace-period=<seconds>
```

Force Deletion - Immediately delete records in API and etcd

```
kubectl delete pod <name> --grace-period=0 --force
```

Pods

Pod Termination Grace Period

```
apiVersion: v1
kind: Pod
metadata:
  name: hello-world-pod
spec:
  terminationGracePeriodSeconds: 10
  containers:
  - name: hello-world
    image: gcr.io/google-samples/hello-app:1.0
    ports:
    - containerPort: 80
```

Persistency of Pods

A Pod is never redeployed

If a Pod stops, a new one is created based on its Controller

Go back to the original container image(s) in the Pod definition

Persistency of Pods

Configuration is managed externally

- Pod Manifests, secrets and `ConfigMaps`

Passing environment variables into containers

Data Persistency is managed externally

- `PersistentVolume`
- `PersistentVolumeClaim`

Container Restart Policy

A container in a Pod can restart independent of the Pod

Applies to containers inside a Pod and defined inside the Pod's Spec

The Pod is the environment the container runs in

Not rescheduled to another Node, but restarted by the Kubelet on that Node

Restarts with an exponential backoff, 10s, 20s, 40s capped at 5m and reset to 0 after 10m of successful runtime

Container Restart Policy

`Always` (default) - will restart all containers inside a Pod

`OnFailure` - Non-graceful termination

`Never`

```
metadata:
  name: nginx-pod
spec:
  containers:
  - name: nginx
    image: nginx
  restartPolicy: OnFailure
```

Pod with Container Restart Policy

```
kubectl apply -f nginx.yaml
```

Demo

Pod lifecycle

Killing a container process

Container Restart Policy

Defining Pod Health

A Pod is considered `Ready` when all containers are `Ready`

But we'd like to be able to understand a little more about ourapplications

We can add additional intelligence to our Pod's state and health

Container Probes

`livenessProbe`

`readinessProbe`

`startupProbe`

livenessProbes

Runs a diagnostic check on a container

Per container setting

On failure, the kubelet restarts the contain

Container Restart Policy

Give Kubernetes a better understanding of

readinessProbes

Runs a diagnostic check on the container

Per container setting

Won’t receive traffic from a Service until it succeeds

On failure, removes Pod from load balancing

Applications that temporarily can’t respond to a request

Prevents users from seeing errors

startupProbes

Runs a diagnostic check on the container

Ensuring all containers in a Pod are `Ready`

Per container setting

On startup, all other probes are disabled until the `startupProbe` succeeds

On failure, the kubelet restarts the container according to the container restart policy

Applications have long startup times

Compliments liveness and readiness probes

Types of Diagnostic Checks for Probes

Exec	tcpSocket	httpGet
Process exit code	Successfully Open a Port	Return Code 200 => and < 400

Success	Failure	Unknown

Configuring Container Probes

`initialDelaySeconds` - number of seconds after the container has started before running container probes, default 0

`periodSeconds` – probe interval, default 10 seconds

`timeoutSeconds` Probe timeout 1seconds

`failureThreshold` - number of missed checks before reporting failure, default 3

`successThreshold` - number of probes to be considered successful and live, default 1

livenessProbes and readinessProbes

```
containers:
  ...
  livenessProbe:
    tcpSocket:
      port: 8080
    initialDelaySeconds: 15
    periodSeconds: 20
```

```
  readinessProbe:
    tcpSocket:
      port: 8080
    initialDelaySeconds: 5
    periodSeconds: 10
  containers:
    ...
    startupProbe:
      tcpSocket:
        port: 8080
      initialDelaySeconds: 10
      periodSeconds: 5
```

startupProbes

Demo

Implementing container probes

- livenessProbes
- readinessProbes
- startupProbes

Summary

Understanding Pods

Controllers and Pods

Multi-container Pods

Managing Pod Health with Probes