Story of a kubectl command

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Hi, I'm Indra

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Kinvolk

The Deep-stack Kubernetes Experts

Engineering services and products for Kubernetes, containers, process management and Linux user-space + kernel

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Email: **hello@kinvolk.io**

Your take away from this talk?

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1. What is Kubernetes?
2. What are the different components of Kubernetes?
3. What goes on behind the scenes of a kubectl command?

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What is Kubernetes?

Kubernetes

❑ Cluster manager

❑ Scheduler

❑ Orchestrator

Kubernetes

❑ Cluster manager

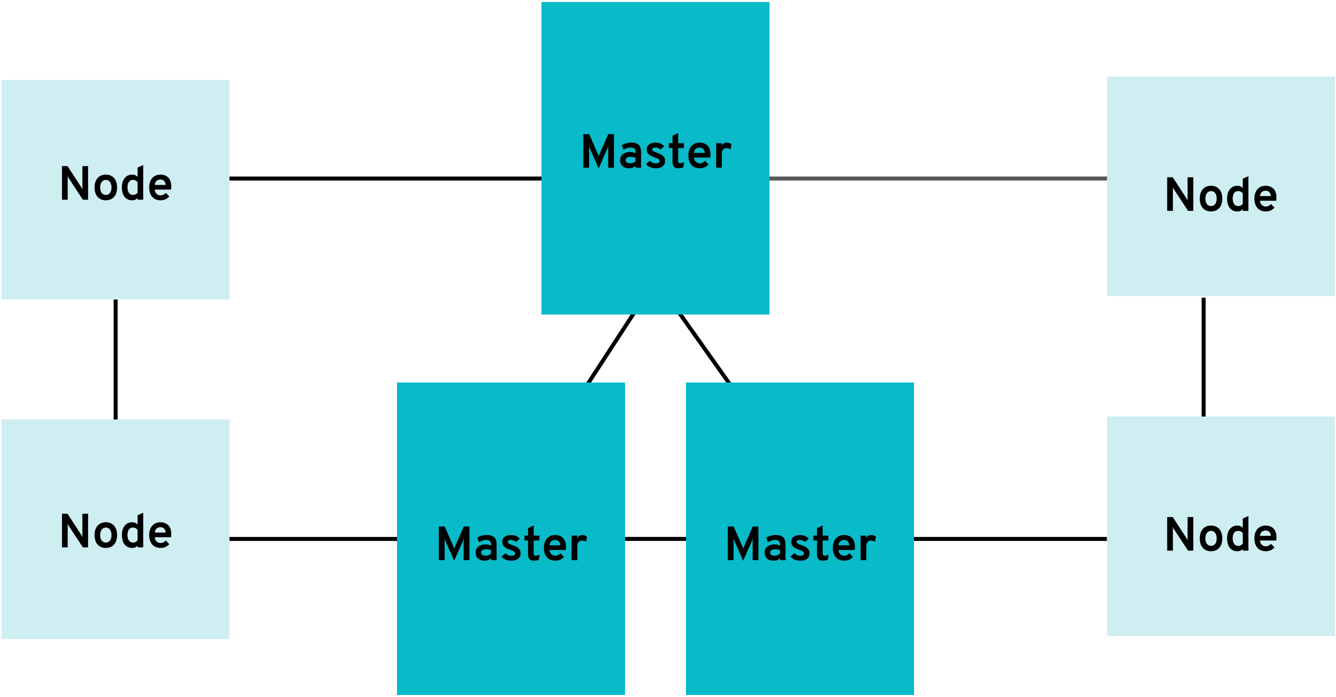
❑ Scheduler

❑ Orchestrator

...for containerized applications

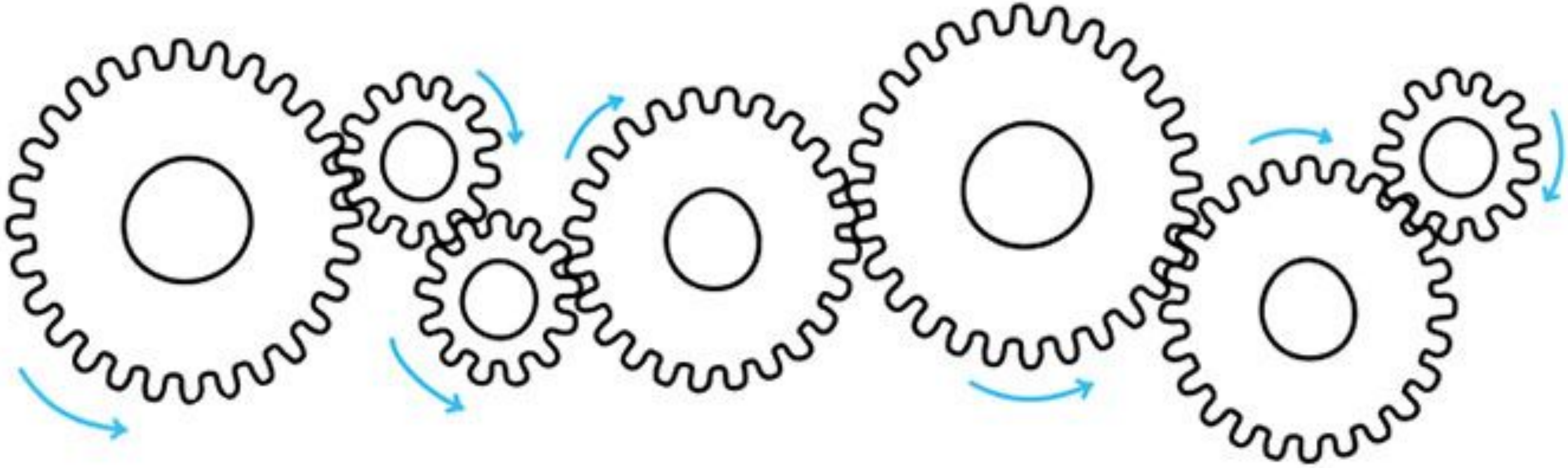
docker

A Kubernetes cluster



Kubernetes does not follow the UNIX philosophy

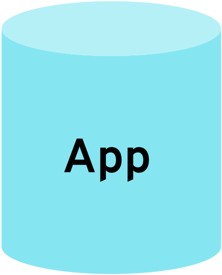
It does too many things!



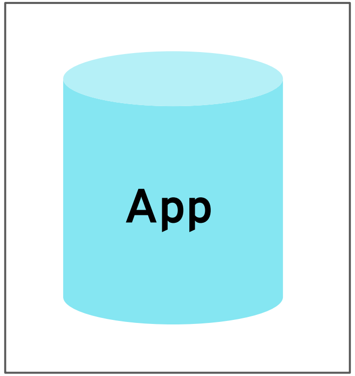
And it can be overwhelming!

😖

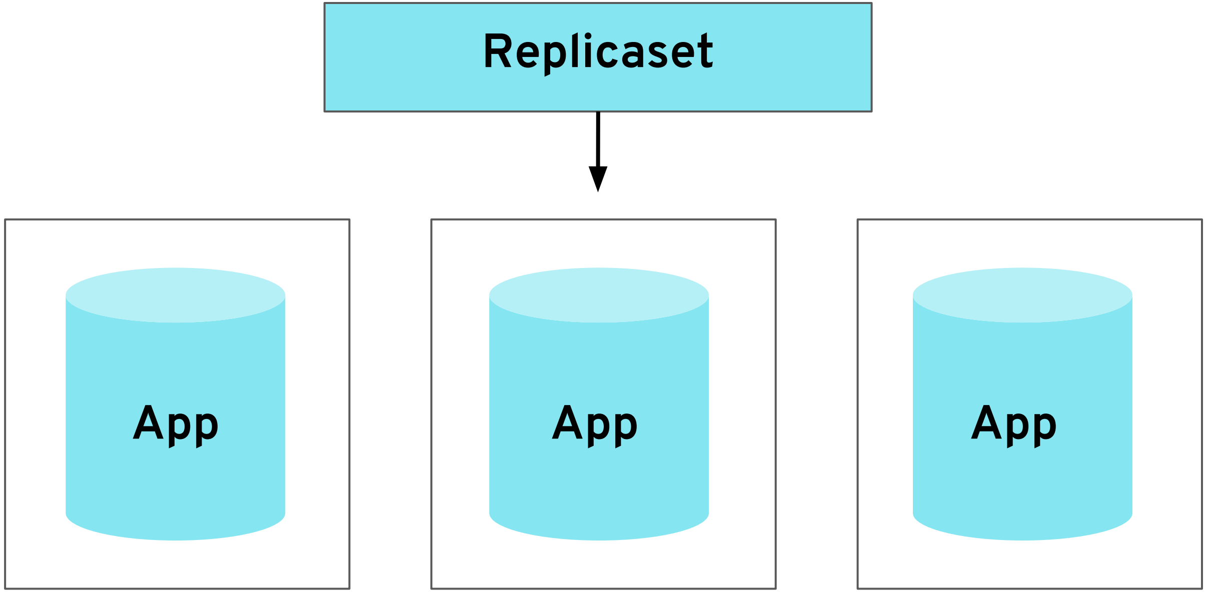
Container

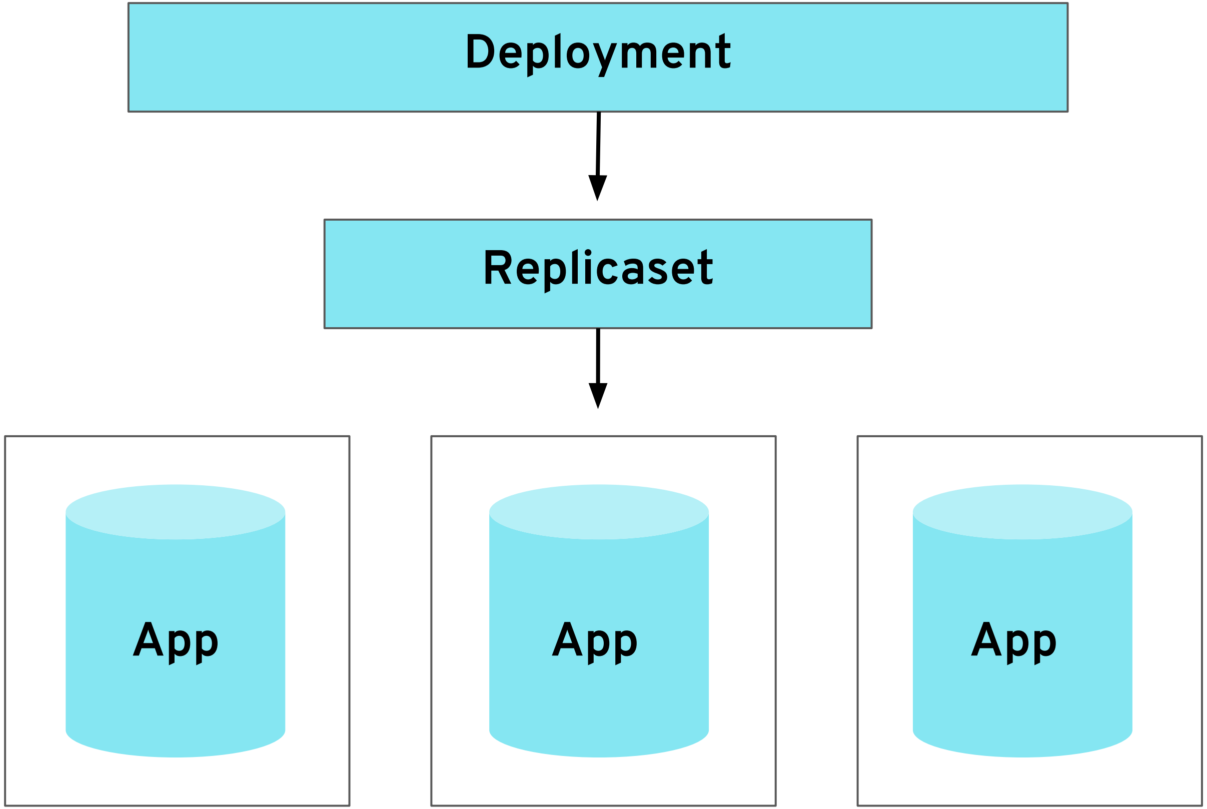


Pod

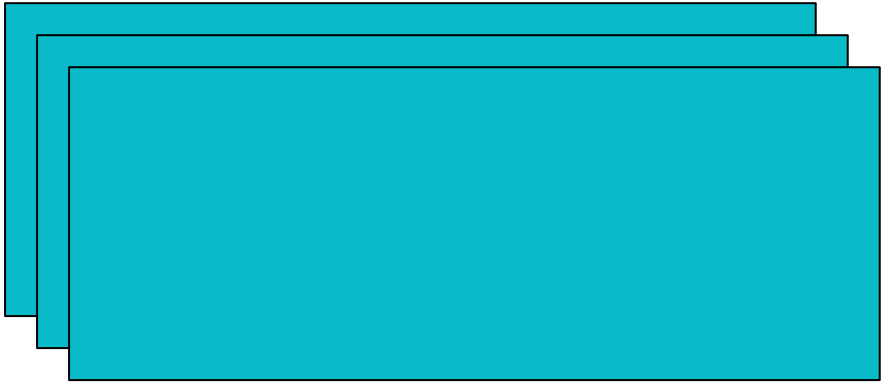


App
App
App

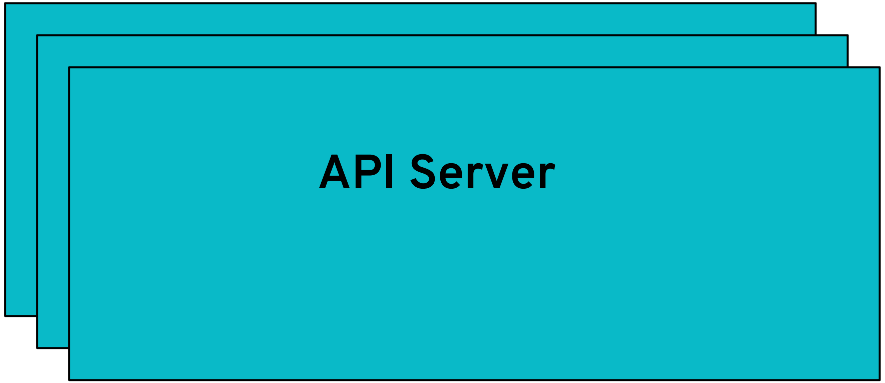

Replicaset
App
App
App


Deployment
Replicaset
App
App
App

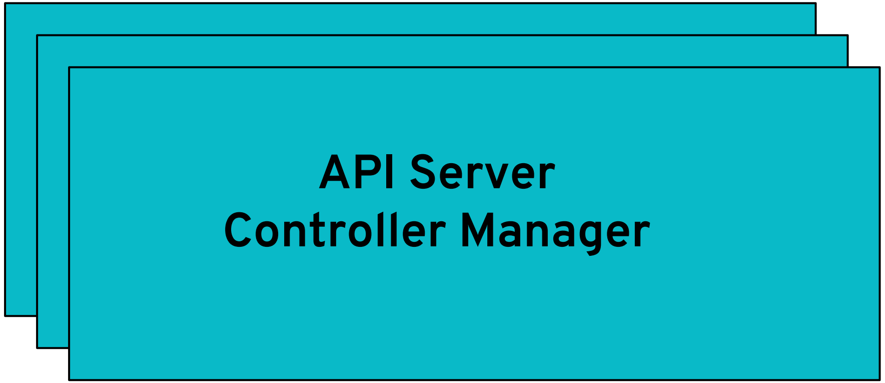
Components in Master



Components in Master

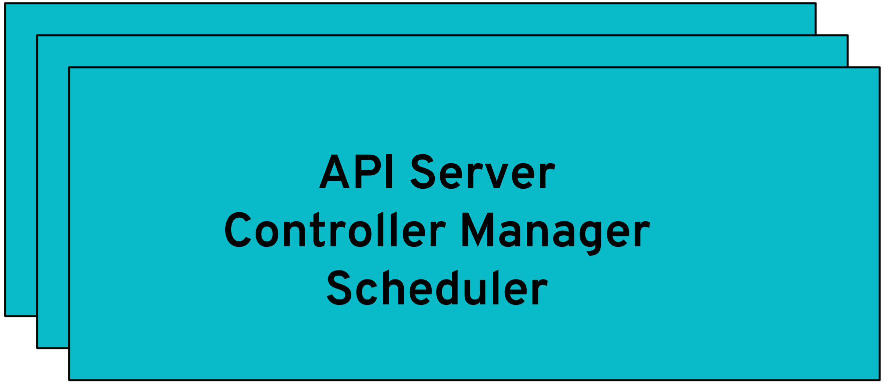


Components in Master



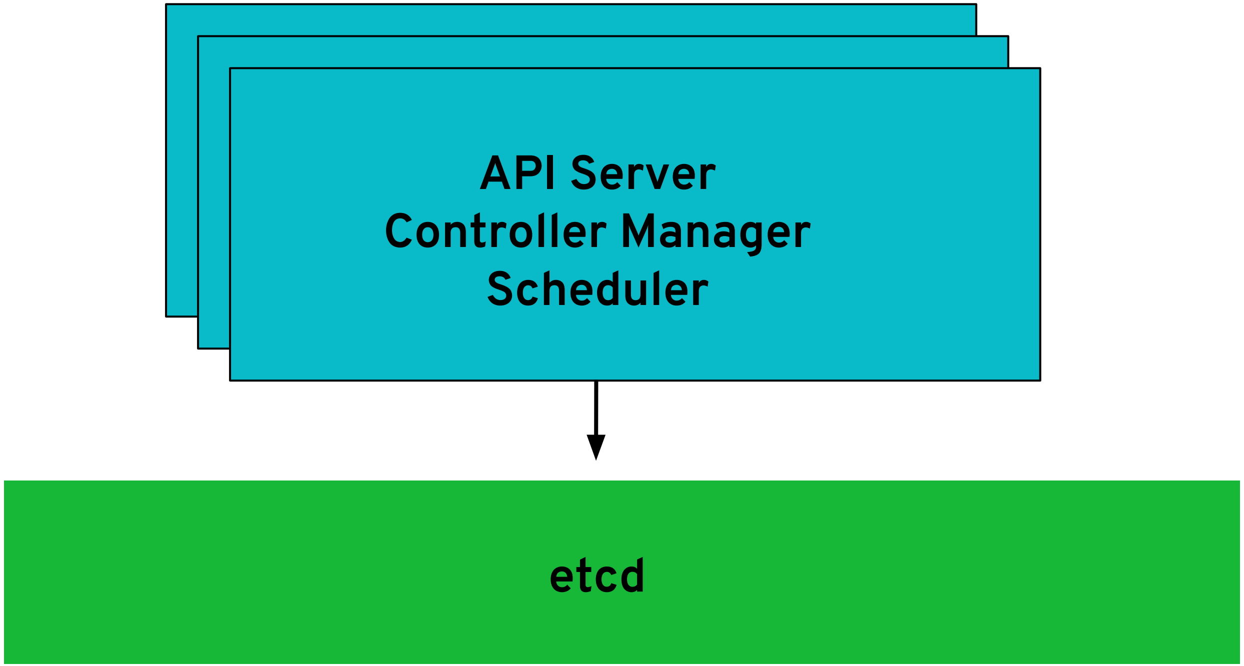
API Server
Controller Manager

Components in Master



API Server
Controller Manager
Scheduler

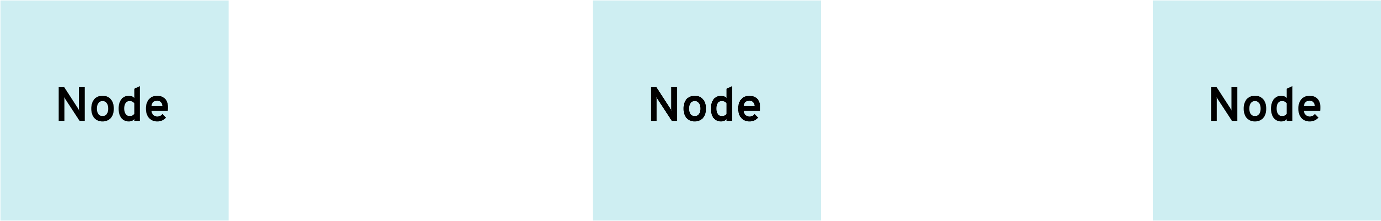
Components in Master



API Server
Controller Manager
Scheduler

etcd

Components in Worker

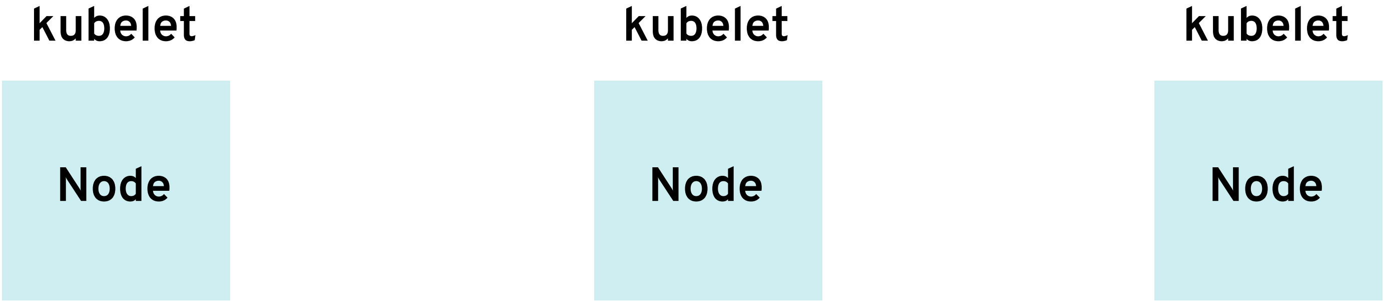


Node

Node

Node

Components in Worker



kubelet

Node

kubelet

Node

kubelet

Node

Components in Worker

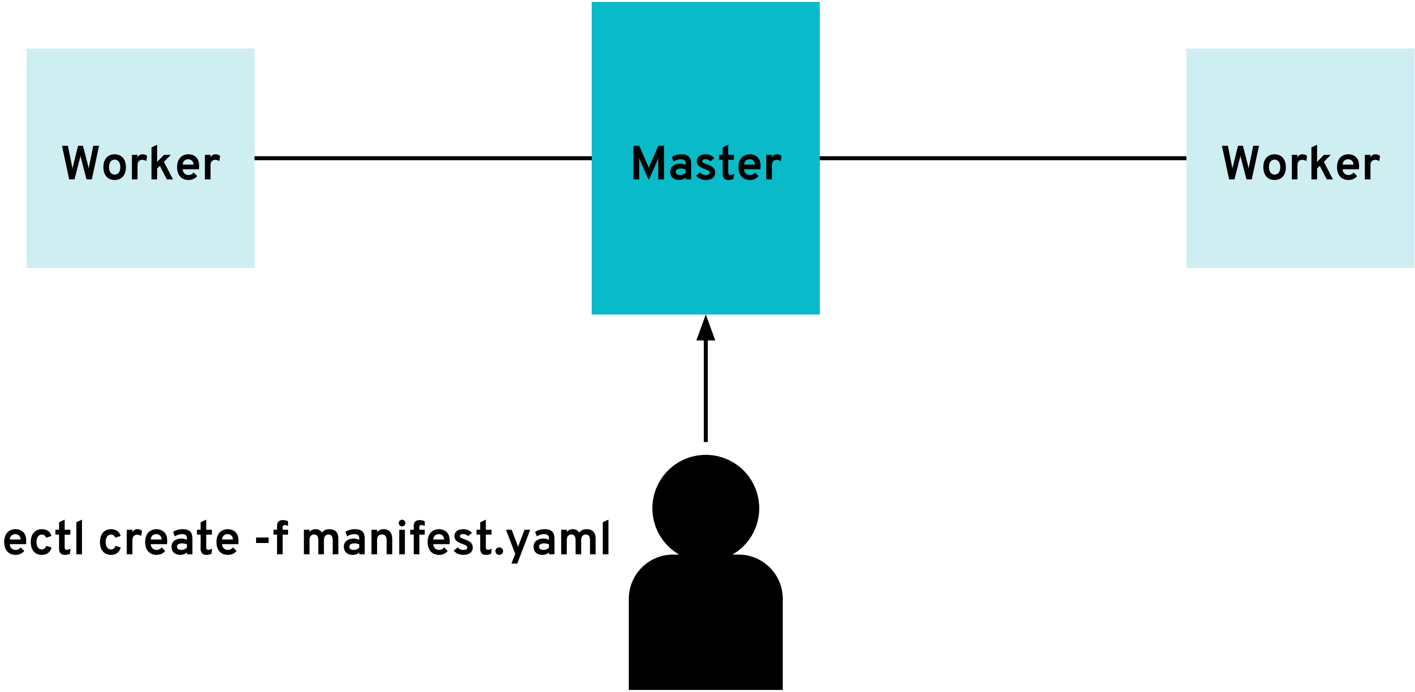
❏ kube-proxy

Components in Worker

- kube-proxy

- kube-dns

kubectl



kubectl create -f manifest.yaml

```
$ kubectl   create   deployment   nginx   --image=nginx
$ kubectl create deployment nginx --image=nginx
$ kubectl create deployment nginx --image=nginx
$ kubectl create deployment nginx --image=nginx
$ kubectl create deployment nginx --image=nginx

deployment.apps/nginx created
```

```
$ kubectl   create   deployment   nginx   --image=nginx

deployment.apps/nginx created
```

Imperative approach. Please don’t do this in production :)

```
$ kubectl  get  deployments

NAME   DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE

nginx  1        0        0           0          0s
```

```
$ kubectl  get  deployments

NAME    DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE

nginx   1         1         1            1           10s
```

```
$ kubectl get pods
$ kubectl get pods
NAME                     READY  STATUS             RESTARTS  AGE
nginx-65899c769f-58xbc   0/1    ContainerCreating  0         5s
```

```
$ kubectl get pods
NAME                    READY   STATUS    RESTARTS   AGE
nginx-65899c769f-58xbc  1/1     Running   0          16s
```

kubectl

Client side validation

❑ Arguments

❑ Image name

❑ Manifest

Client side validation

❏ Arguments

❏ Image name

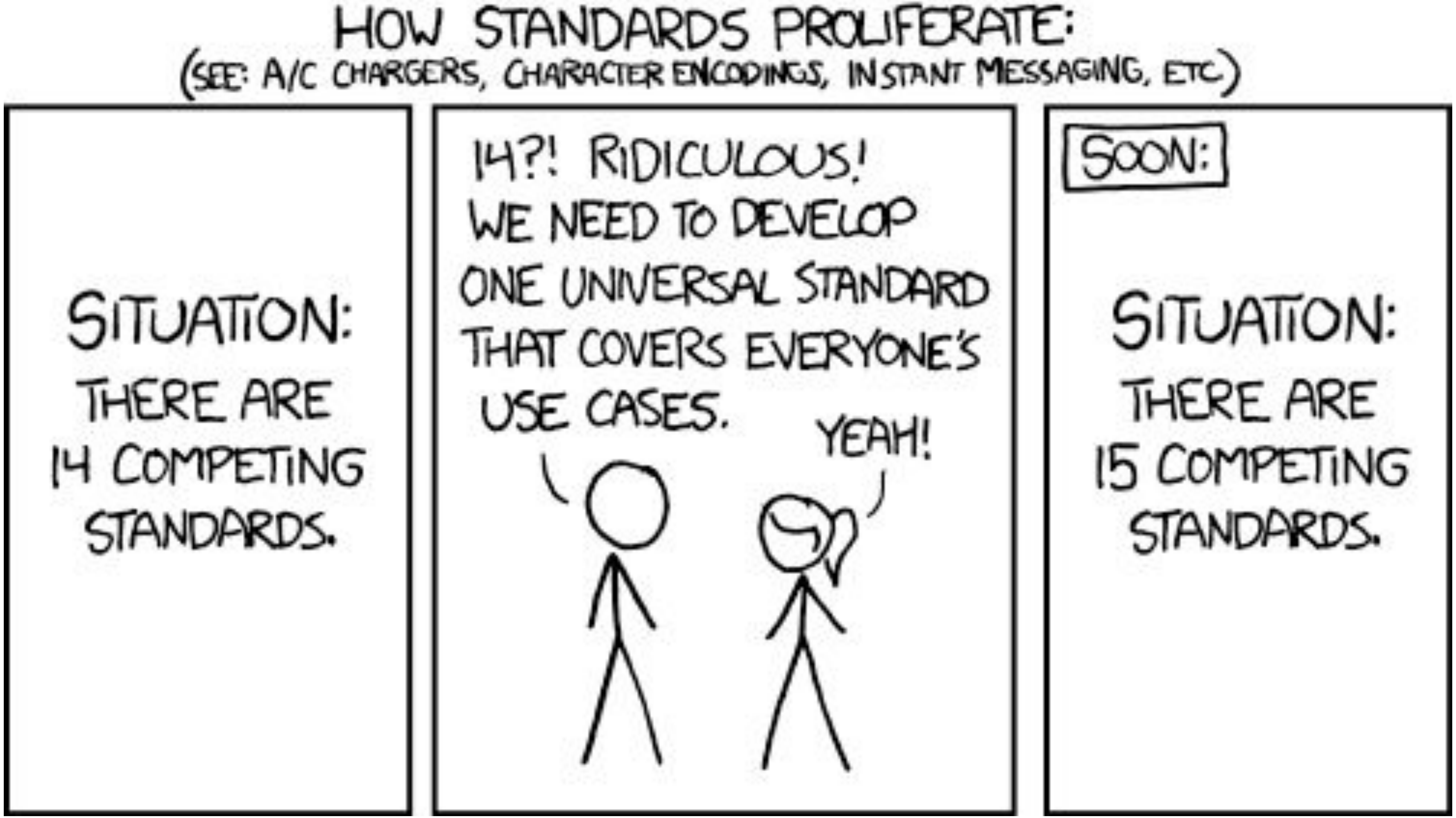
❏ Manifest **(kubectl create -f)**

And it’s time to send the request! 🚀

But where? 🤔

API discovery

❏ OpenAPI schema


HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC)
SITUATION: THERE ARE 14 COMPETING STANDARDS.
14?! RIDICULOUS! WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE'S USE CASES.
YEAH!
SOON:
SITUATION: THERE ARE 15 COMPETING STANDARDS.

https://xkcd.com/927/

API discovery

❑ OpenAPI schema

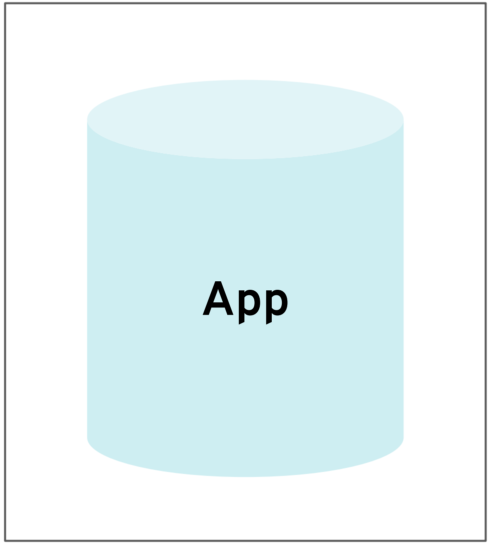
❑ https://www.openapis.org/about

API discovery

❏ Resources

  ❏ Group

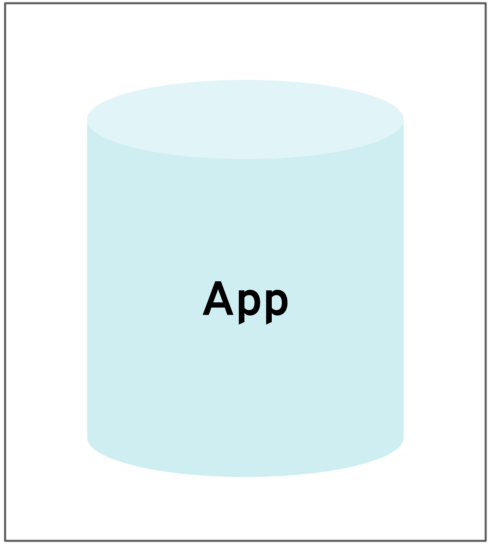
  ❏ Version



App

Pod

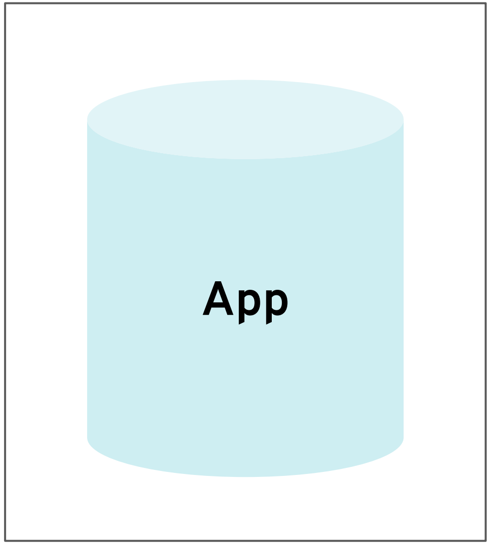
Group: core



Pod

Group: core

Version: v1



Pod

```
$ kubectl get deployment nginx   -o yaml
$ kubectl get deployment nginx -o yaml
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apiVersion:  extensions  /  v1beta1

kind: Deployment

....
```

```
$ kubectl get deployment nginx   -o yaml

apiVersion: extensions / v1beta1

kind: Deployment

....
```

```
$ kubectl get deployment nginx   -o yaml

apiVersion: extensions / v1beta1

kind: Deployment

....
```

```
$ kubectl get deployment nginx   -o yaml

apiVersion:  extensions / v1beta1

kind: Deployment

....
```

Let’s take a verbose look at a request 🔍

```
$ kubectl get deployments -v 6
$ kubectl get deployments -v 6
```

```
I1021 08:53:04.617134 8299 loader.go:359] Config loaded from file /home/dhanush/.kube/config
```

```
$ kubectl get deployments -v 6

I1021 08:53:04.617134 8299 loader.go:359] Config loaded from file
/home/dhanush/.kube/config

I1021 08:53:04.646041       8299 round_trippers.go:405] GET
https://192.168.99.100:8443/apis?timeout=32s 200 OK in 4 milliseconds
```

```
$ kubectl get deployments -v 6

I1021 08:53:04.617134 8299 loader.go:359] Config loaded from file
/home/dhanush/.kube/config

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https://192.168.99.100:8443/apis?timeout=32s 200 OK in 4 milliseconds

I1021 08:53:04.897745       8299 round_trippers.go:405] GET
https://192.168.99.100:8443/apis/extensions/v1beta1/namespaces/default
/deployments?limit=500 200 OK in 3 milliseconds
```

```
$ kubectl get deployments  -v 6

I1021 08:53:04.617134 8299 loader.go:359] Config loaded from file
/home/dhanush/.kube/config

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https://192.168.99.100:8443/apis/extensions/v1beta1/namespaces/default/
deployments?limit=500 200 OK in 3 milliseconds

NAME   DESIRED  CURRENT  UP-TO-DATE  AVAILABLE  AGE

nginx  1        1        1           1          2m
```

API discovery

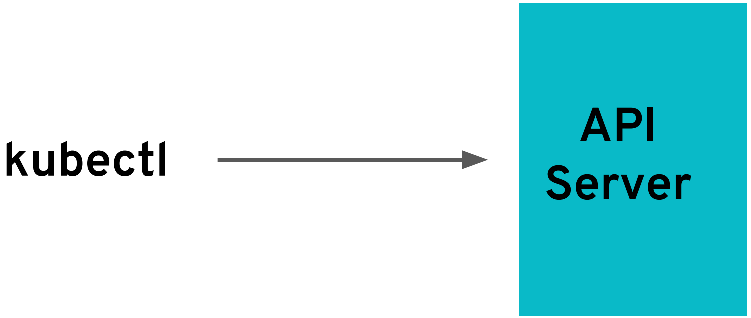
- ❏ Cached at **~/.kube/cache**

```
kubectl get pods -v 10
```

BOOM!

Client authentication

- ❑ Credentials from **$KUBECONFIG**
- ❑ Client certificates
- ❑ Bearer Tokens
- ❑ Username / Password



kubectl

API Server

Server side authentication

❑ Client certificates

❑ Bearer Tokens

❑ Username / Password

Authorization chain

❑ Attribute Based Access Control

Authorization chain

- ❑ Attribute Based Access Control
- ❑ Role Based Access Control

Authorization chain

❏ Attribute Based Access Control

❏ Role Based Access Control

❏ Node

Authorization chain

❑ Attribute Based Access Control

❑ Role Based Access Control

❑ Node

❑ Webhook

Admission controllers

- Not a chain

Admission controllers

- Not a chain
- Modify or reject requests

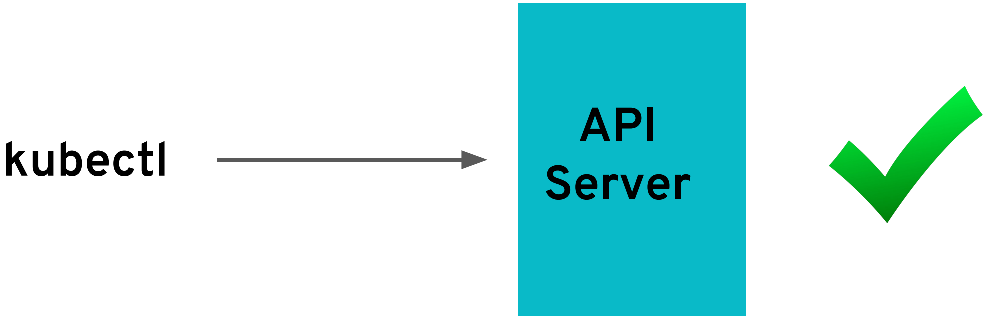
Admission controllers

- ❑ Not a chain
- ❑ Modify or reject requests
- ❑ No role in read requests

Examples: Admission controllers

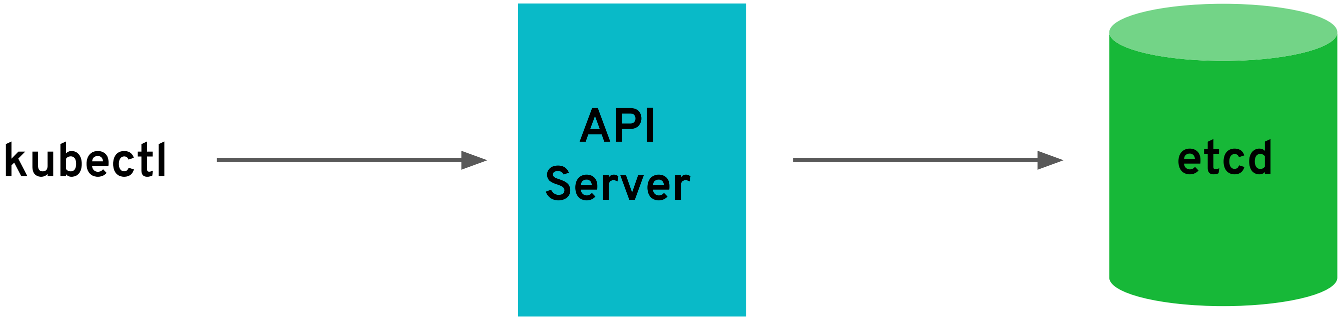
❑ `AlwaysPullImages`

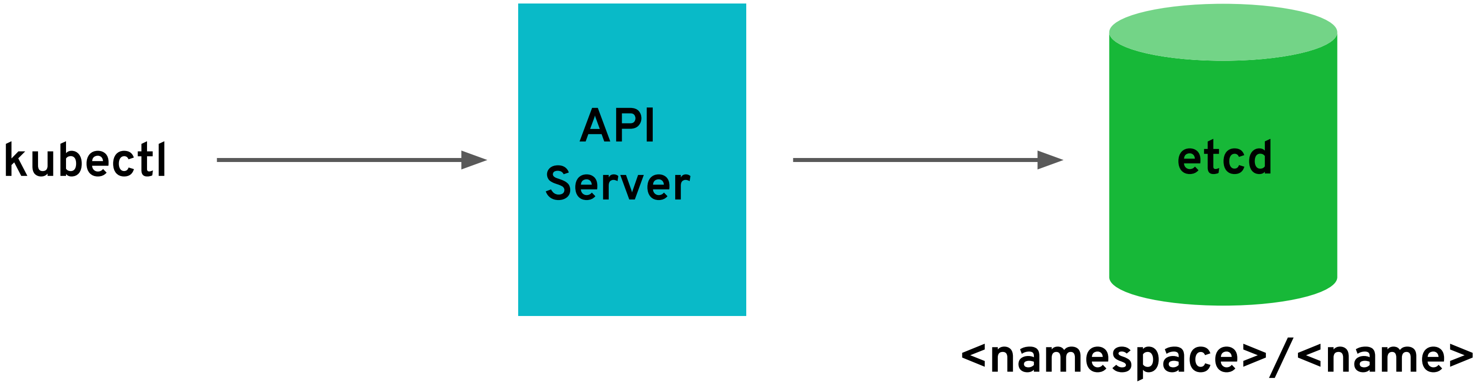
❑ `PodSecurityPolicy`



kubectl

API Server


kubectl
API Server
etcd



kubectl

API Server

etcd

<namespace>/<name>

Initializers

❑ Dynamic controller

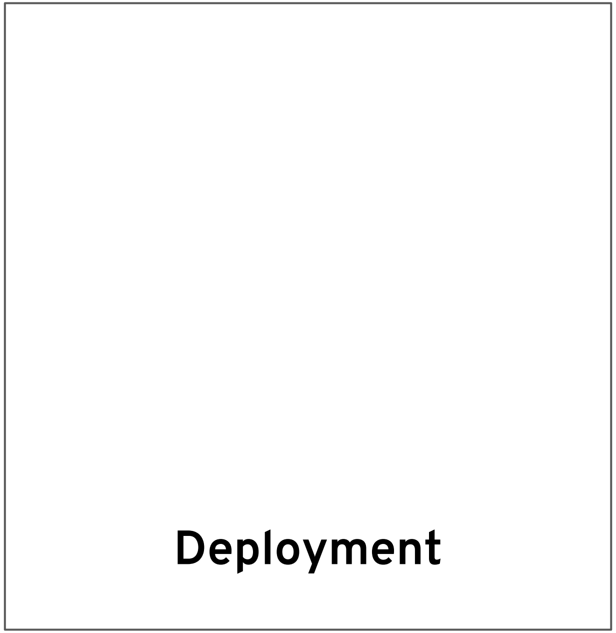
❑ Intercepts resource before creation

❑ Context specific logic

Initializers

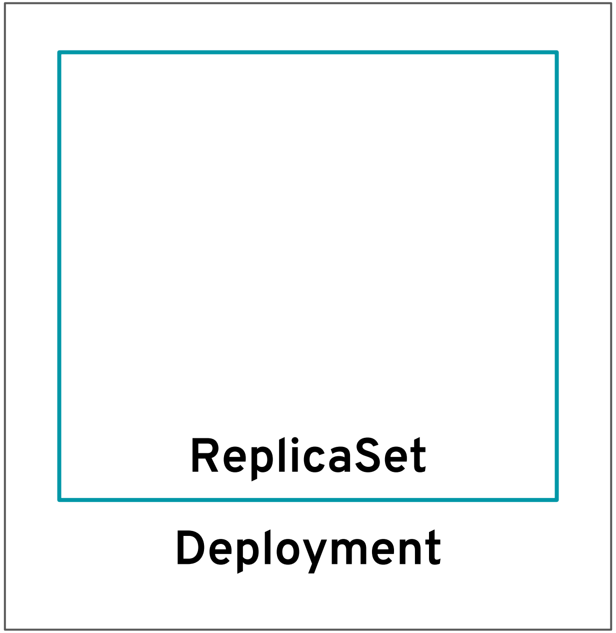
```
$ kubectl get pods --include-uninitialized
```

Deployments controller

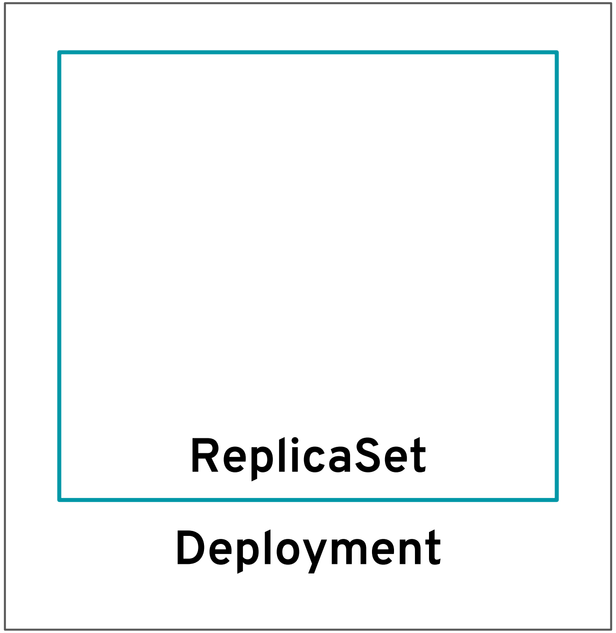


Deployment

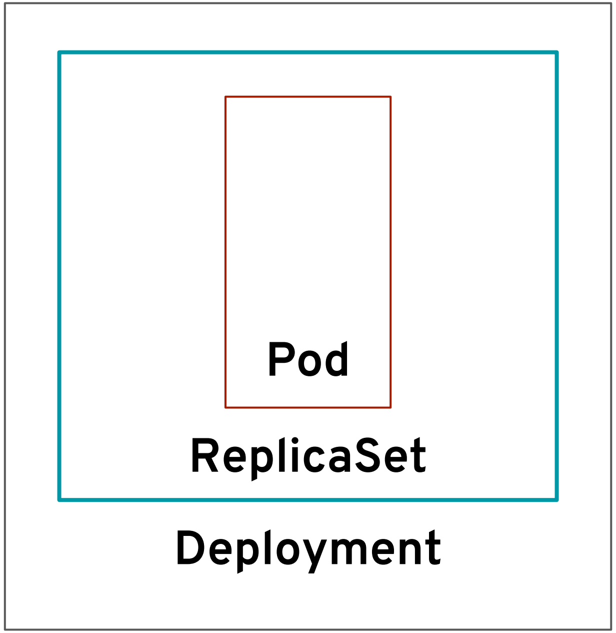
Deployments controller



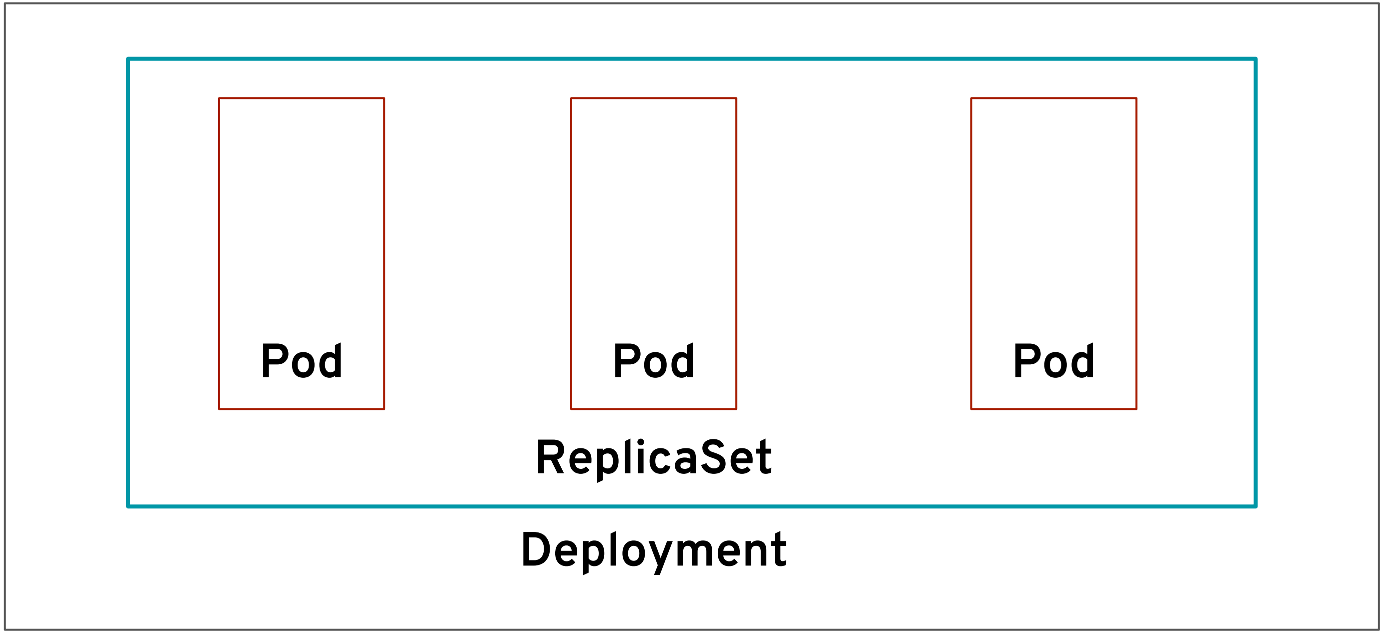
Replicasets controller



Replicasets controller

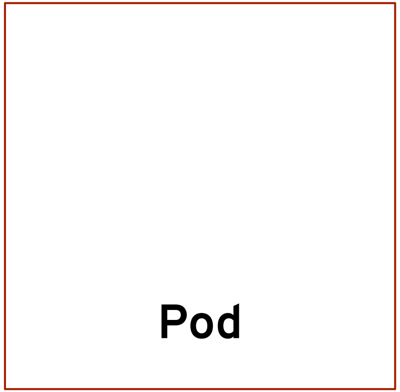


Replicas = 3



State: Pending

NodeName: empty



Scheduler

- Filters pods with empty **NodeName**

Scheduler

❏ Filters pods with empty **NodeName**

❏ Filter worker nodes based on resources and affinity

Scheduler

- ❏ Filters pods with empty **NodeName**
- ❏ Filter worker nodes based on resources and affinity
- ❏ Prioritizes filtered worker nodes

Scheduler

❏ Filters pods with empty **NodeName**

❏ Filter worker nodes based on resources and affinity

❏ Prioritizes filtered worker nodes

❏ Choose node with highest priority

Scheduler

❑ Filters pods with empty **NodeName**

❑ Filter worker nodes based on resources and affinity

❑ Prioritizes filtered worker nodes

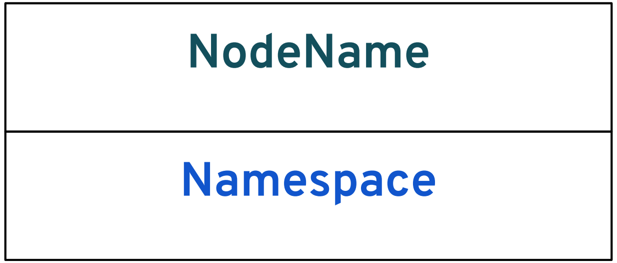
❑ Choose node with highest priority

❑ Creates **Binding** resource

Binding

NodeName

Binding

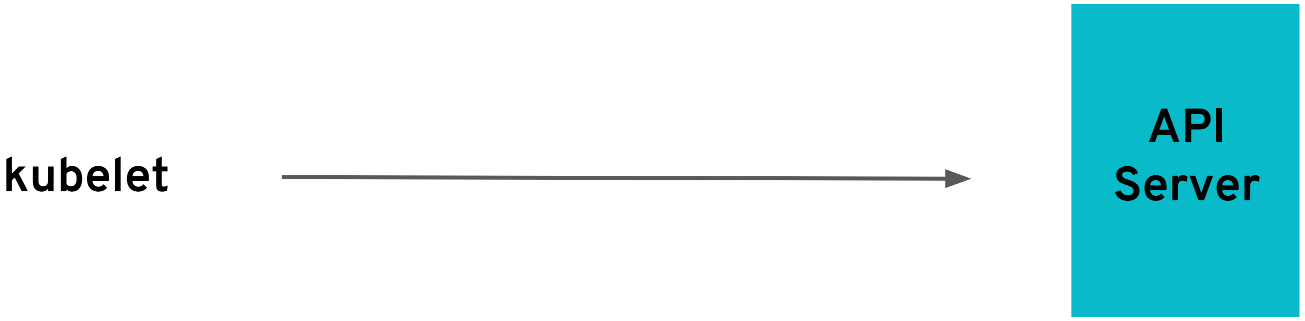


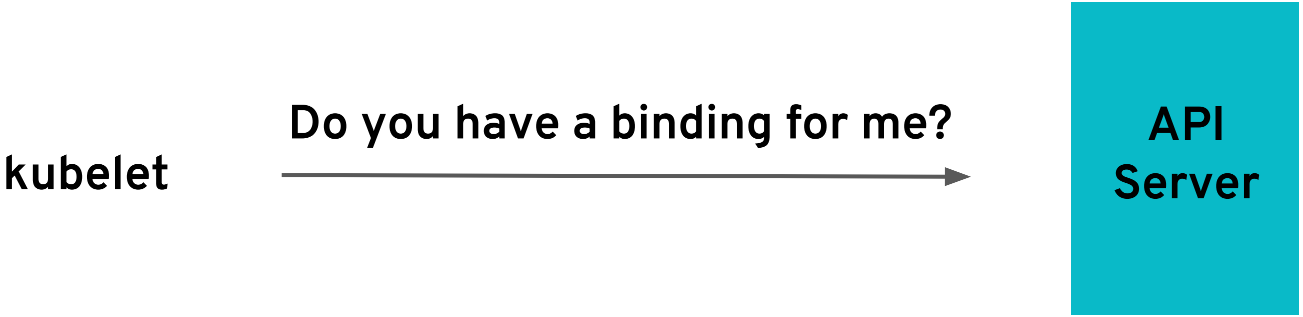
NodeName

Namespace

Binding

NodeName
Namespace
Pod Name & UID

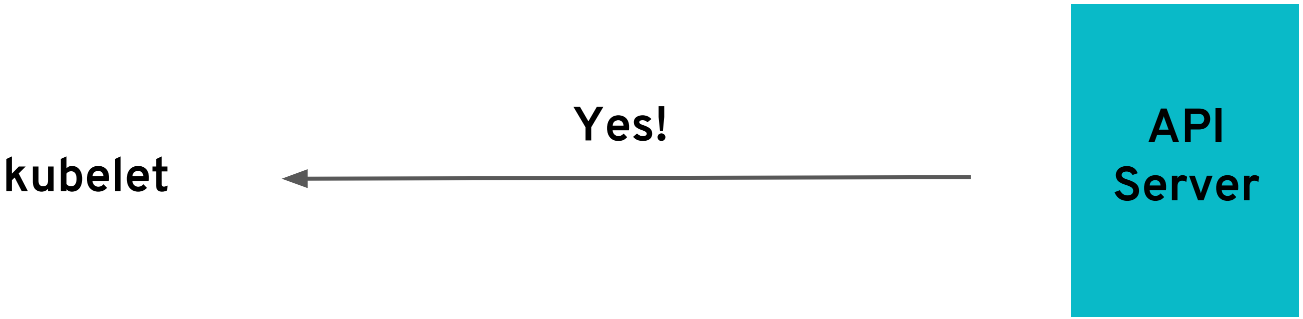

kubelet
API Server



kubelet

Do you have a binding for me?

API Server

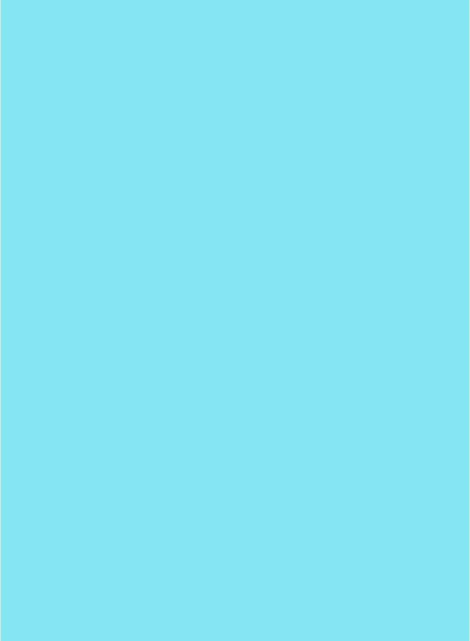


Yes!

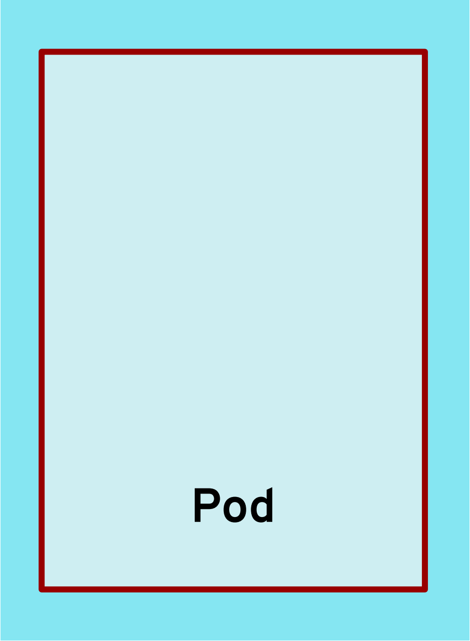
kubelet

API Server

kubelet

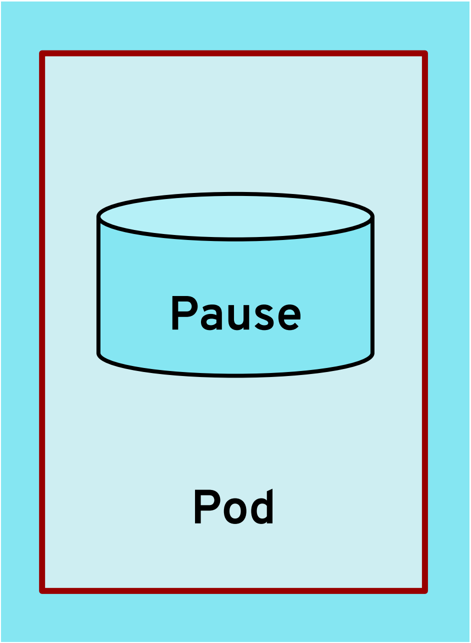


kubelet



Pod

kubelet



Pause container (almost there!)

```
$ docker ps


CONTAINER ID    IMAGE                          COMMAND    ...

fccc6b7a99a     k8s.gcr.io/pause-amd64:3.1     "/pause"   ...
```

Pause container

- Holds namespace for all containers of the pod

Pause container

❏ Holds namespace for all containers of the pod

❏ All application containers share the same namespaces

Pause container

❑ Holds namespace for all containers of the pod

❑ All application containers share the same namespaces

❑ Simplified intra pod networking

Pause container

❏ Holds namespace for all containers of the pod

❏ All application containers share the same namespaces

❏ Simplified intra pod networking

❏ Reap zombies if PID namespace sharing is enabled

Containers

❏ Pull the image

❏ Create the container

❏ Update Pod status

Summary

- ❏ Client side
    - ❏ Validation and Authentication

Summary

- ❑ Client side
  - ❑ Validation and Authentication

- ❑ Server side
  - ❑ Authentication
  - ❑ Authorization ⛓

Summary

❏ Admission controllers

Summary

❑ Admission controllers

❑ Write to etcd! 💾

Summary

- ❑ Wait for Initializers 😴

Summary

- ❑ Wait for Initializers 😴
- ❑ Deployments controller
  - ❑ Create ReplicaSet

Summary

- ❏ ReplicaSets controller
  - ❏ Create Pod

Summary

- ❏ Scheduler assigns a Node

Summary

- ❑ Scheduler assigns a Node
- ❑ Kubelet
  - ❑ Pause container
  - ❑ Application container

Thank you!

Indradhanush Gupta

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Twitter: **kinvolkio**
Email: **hello@kinvolk.io**