Kubernetes Basics and Troubleshooting for DBA

Chetan Shivashankar
Fernando Laudares

Chetan Shivashankar

Kubernetes Tech Lead, Percona

Fernando Lauderes

Senior Architect, Percona

This is how it started !!!

Rome was not built in a day

Turning Back

Problem in Shipping Applications in Pre Container Era

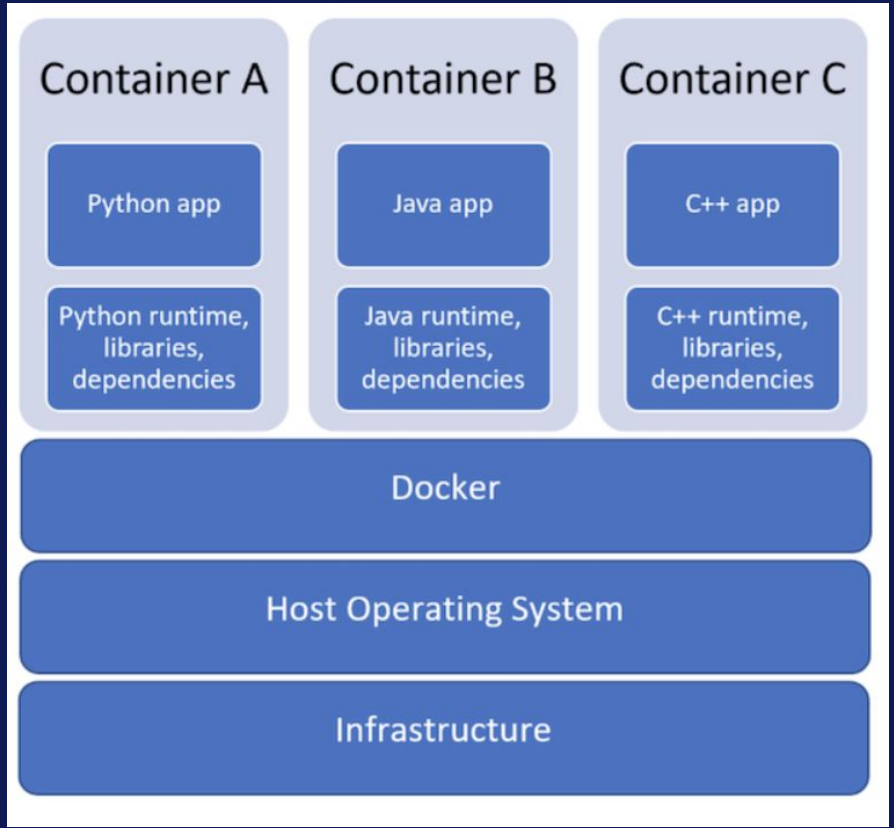
But, It’s working in my Environment

Need of the Hour

Easy way to package and ship applications

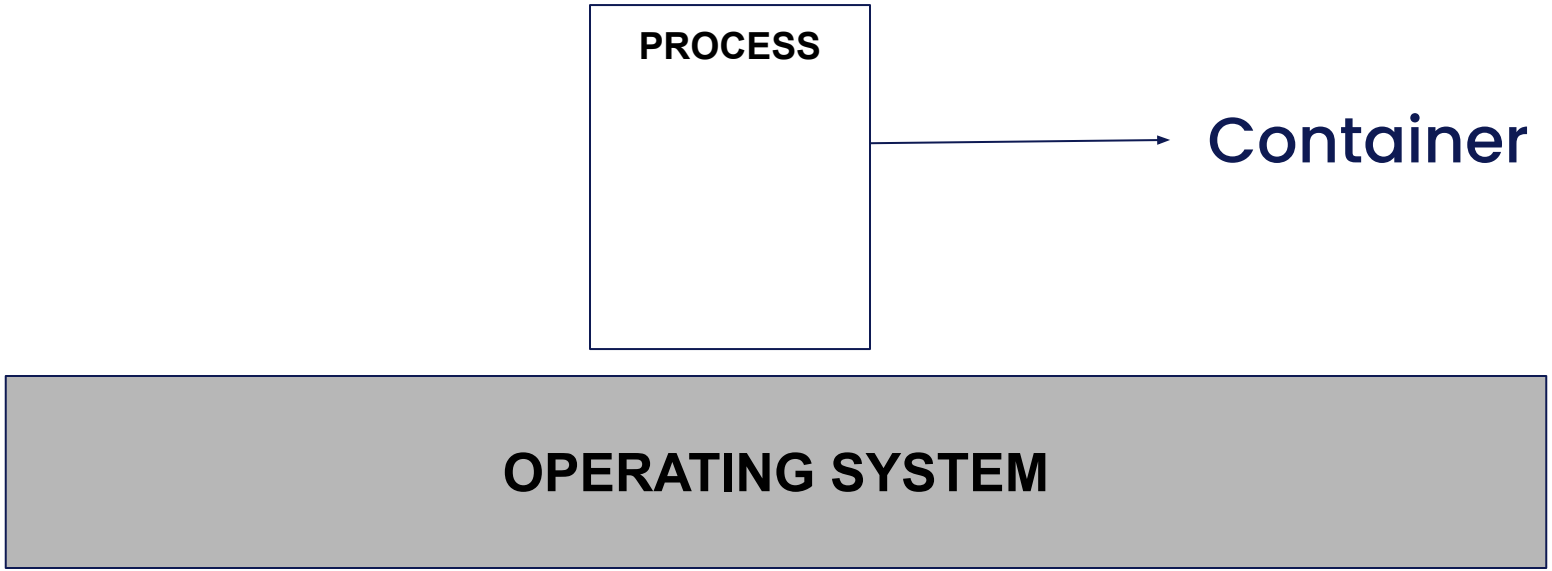
Containers

- Application
- Runtime
- Dependencies

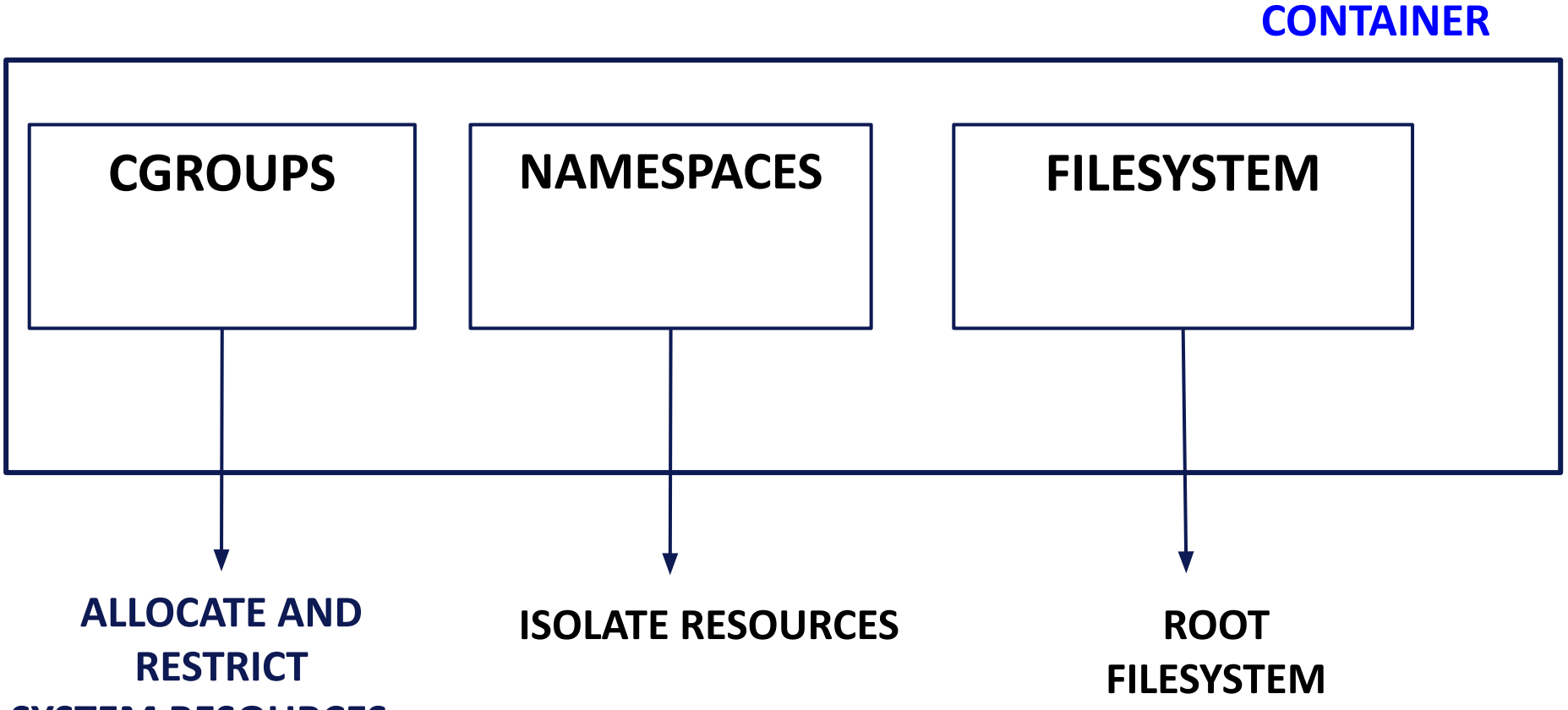


What is a Container

Oversimplifying it



What Makes a Container



PERCONA

Challenges with Containers at Scale

- Automation - Machine,Containers etc
- Manage services , Load balancing
- Efficient resource management
- Self-healing capabilities
- Provision for update and rollback

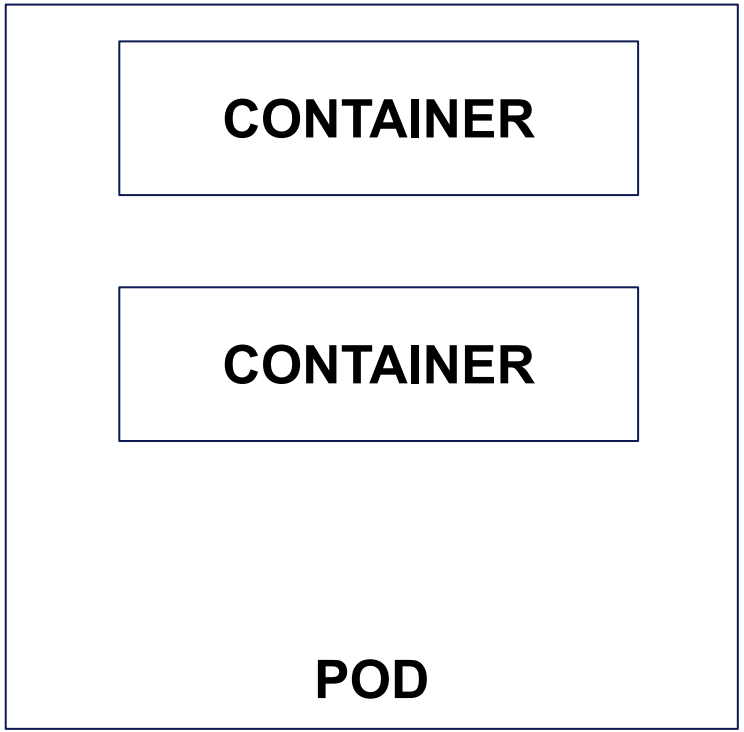
kubernetes

Advantages of Kubernetes

- Application portability
- No Vendor lock-in
- Good fit for microservices with a unified control plane
- Active community with three releases per year
- Wide adoption

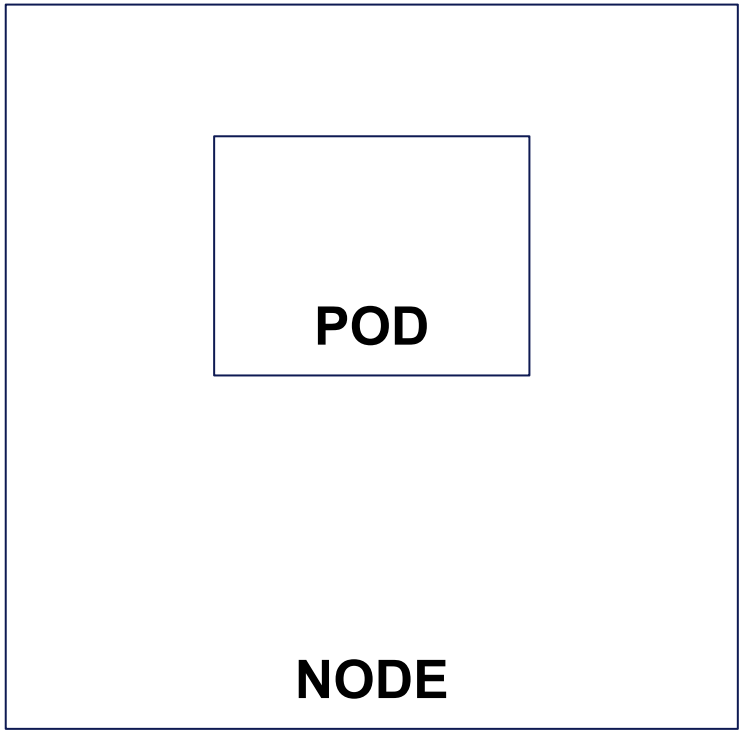
How does Kubernetes Work?

Kubernetes manages Containers with Pod



Pod is a group of one or more containers.

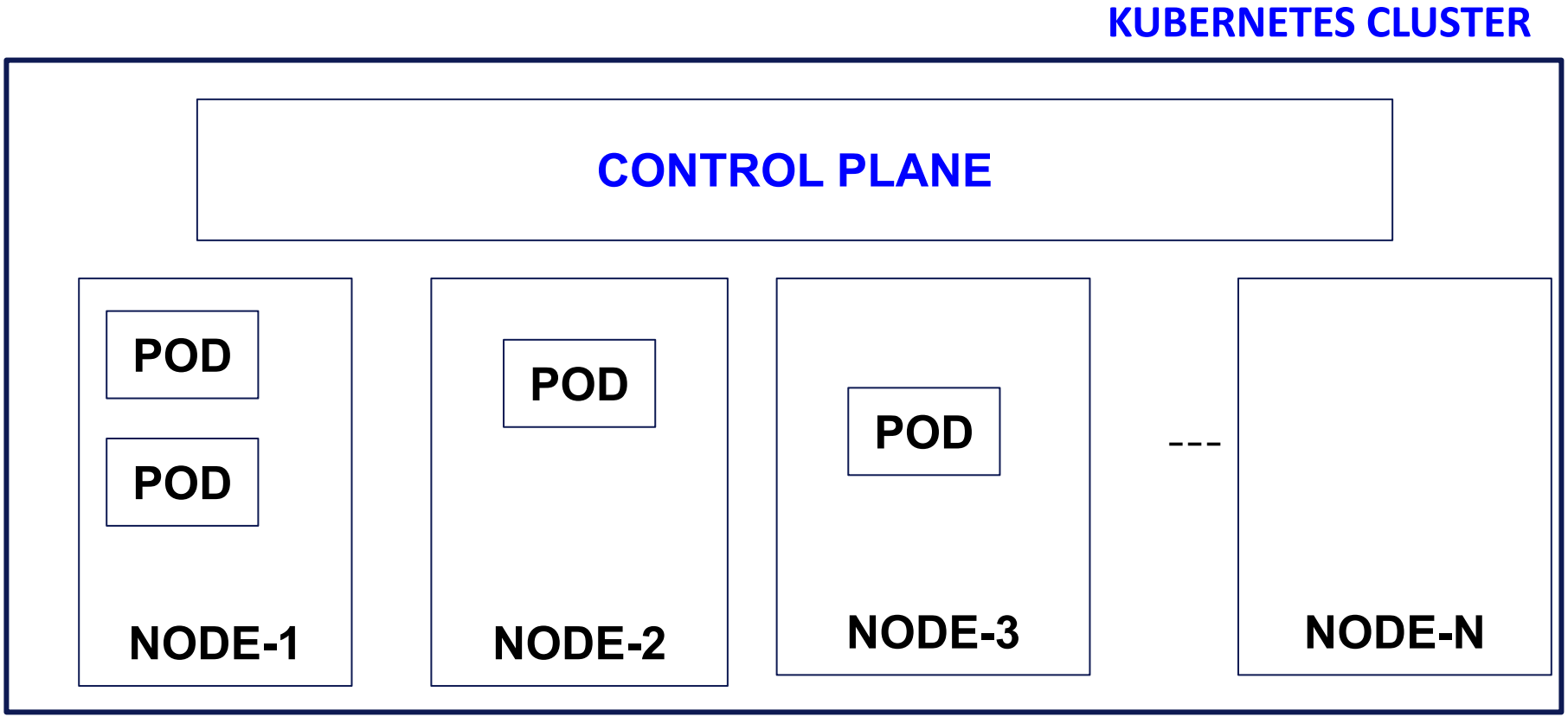
Containers or Pods runs on Machines(Nodes)



Node can run one or more Pod.

PERCONA

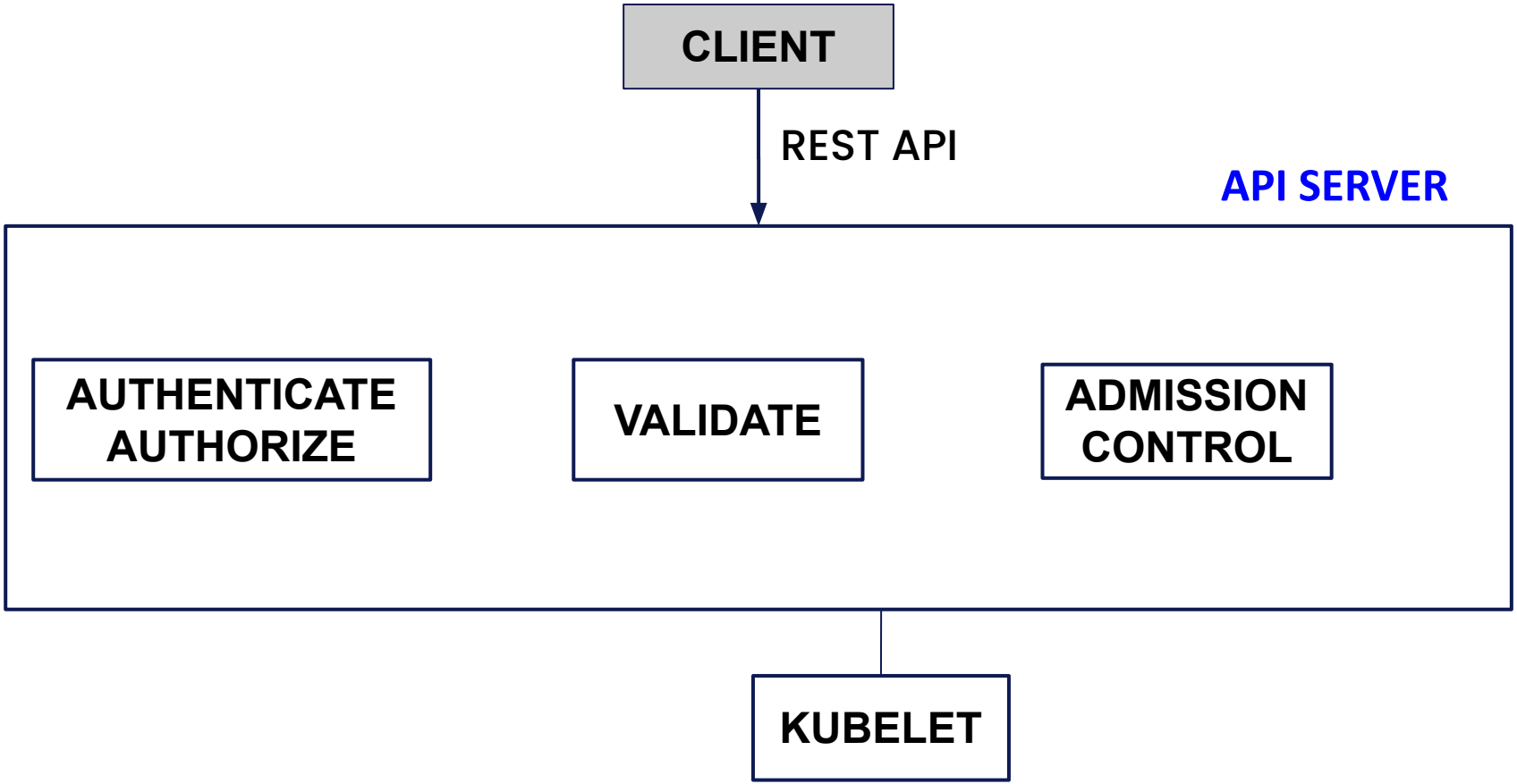
How are the Nodes and Pods managed at Scale

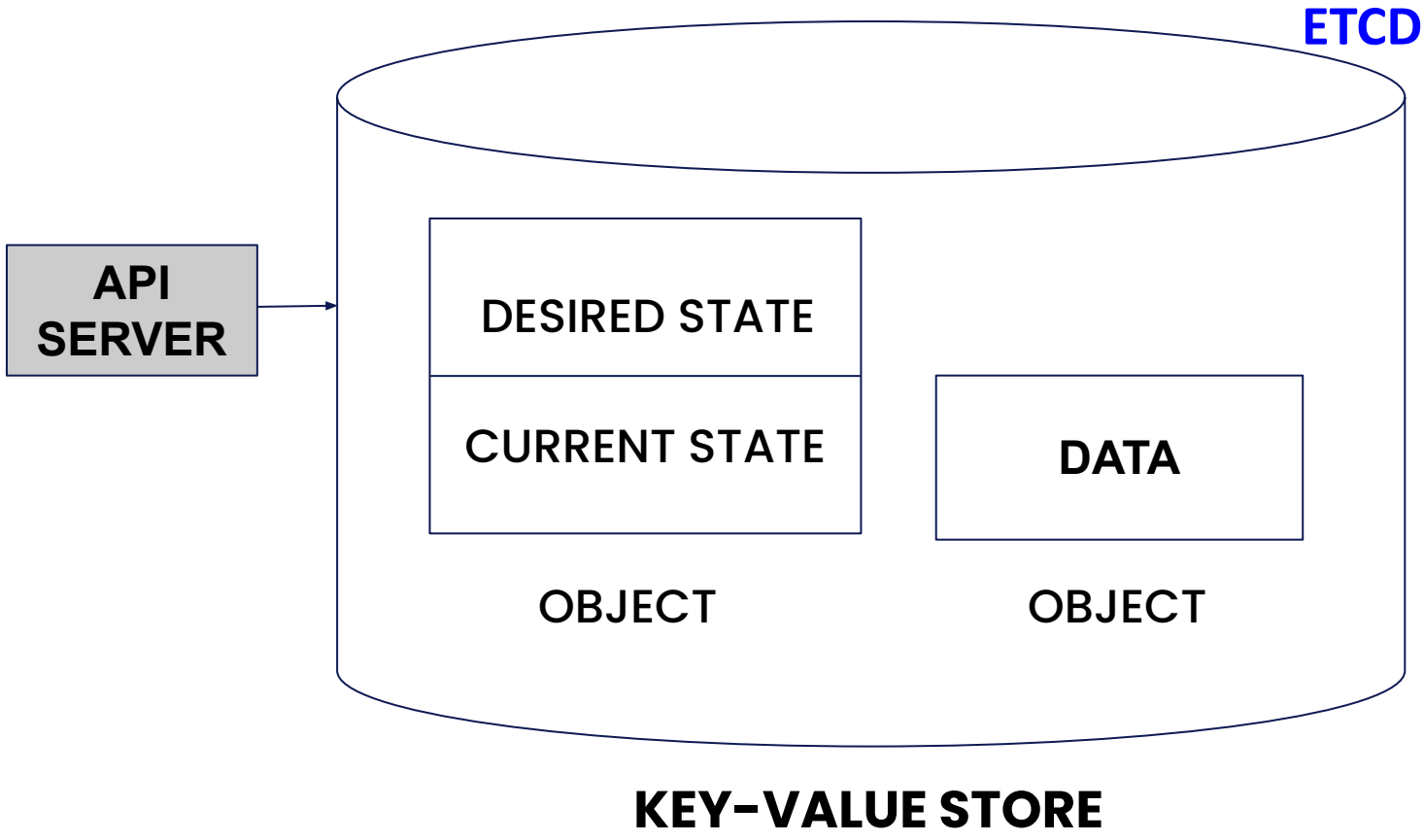


PERCONA

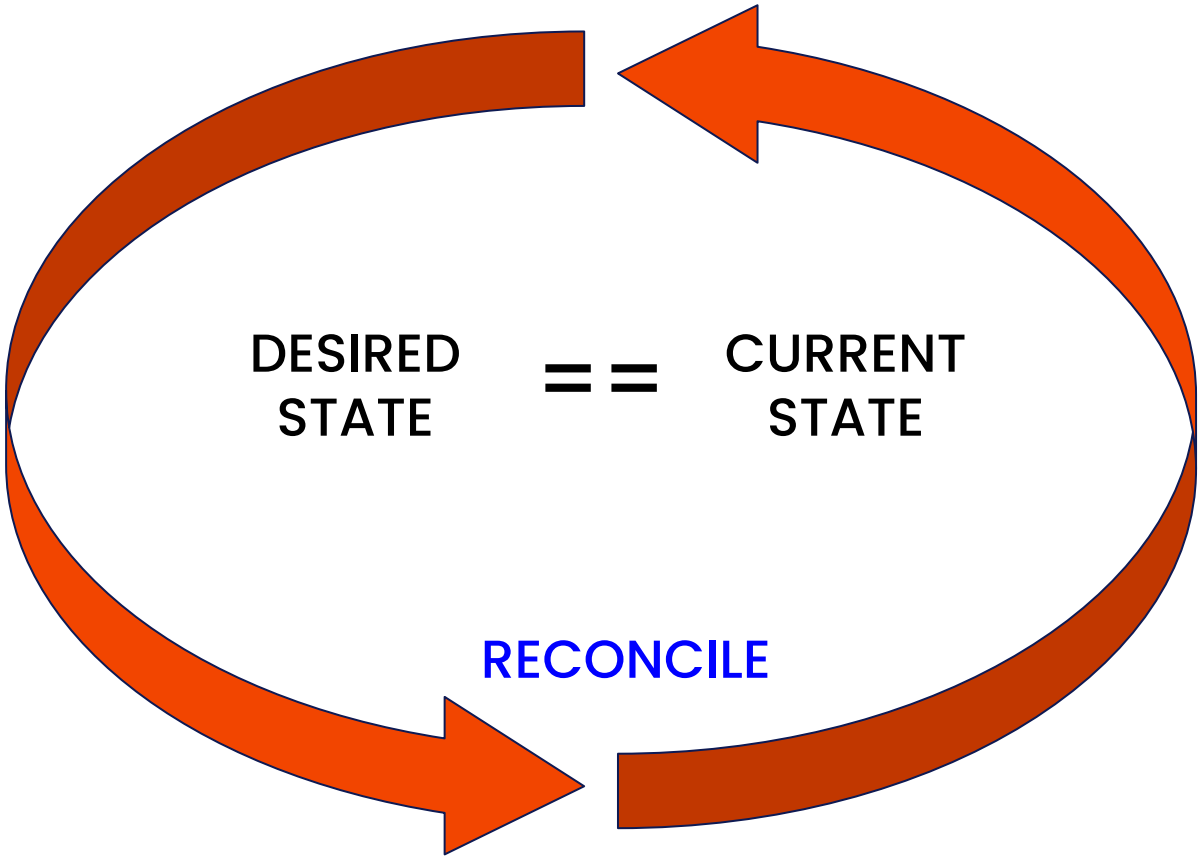
What Should the Control Plane do ?

1. Which Pod should run on which Node? — SCHEDULER
2. Store the Current State and the Desired State. — ETCD
3. Ensure the Current State and the Desired State are the same. — CONTROLLER MANAGER
4. Provide a doorway for clients to Interact and manage the cluster. — API SERVER





Controller Manager

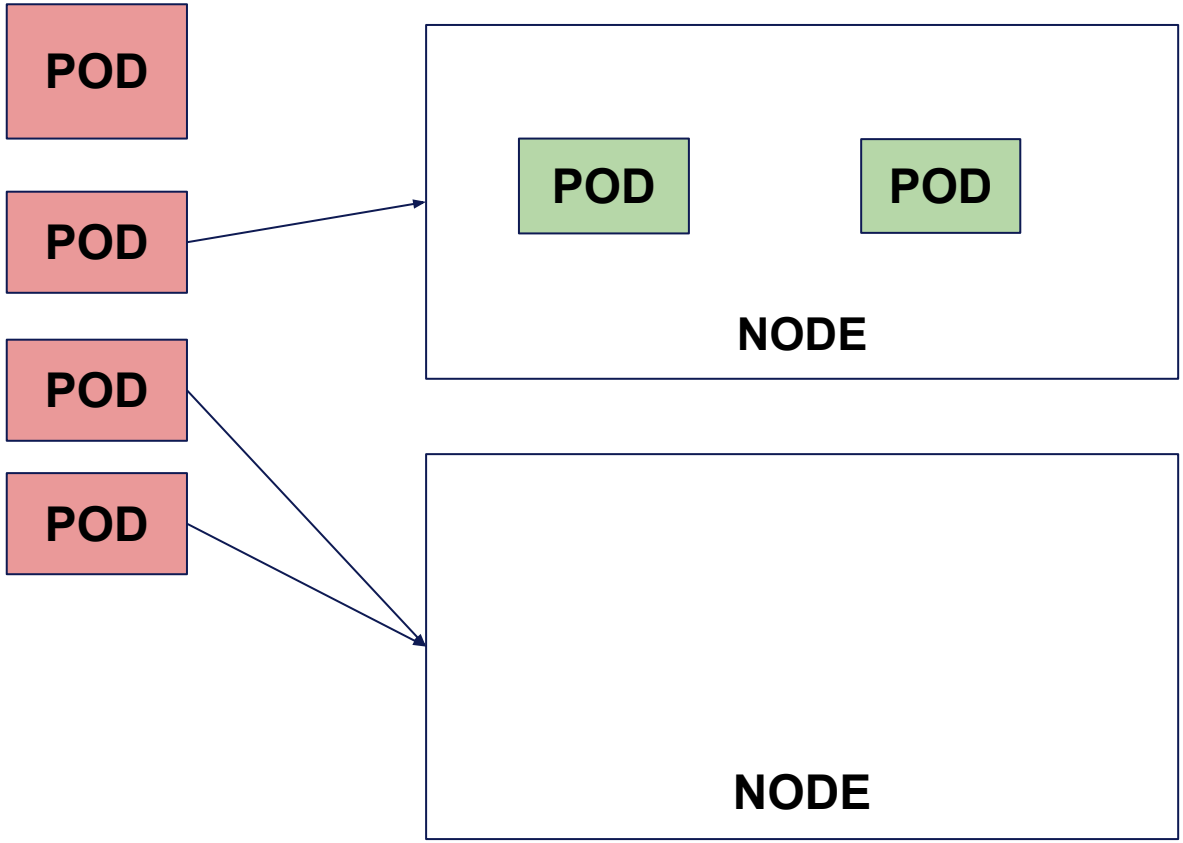


PERCONA

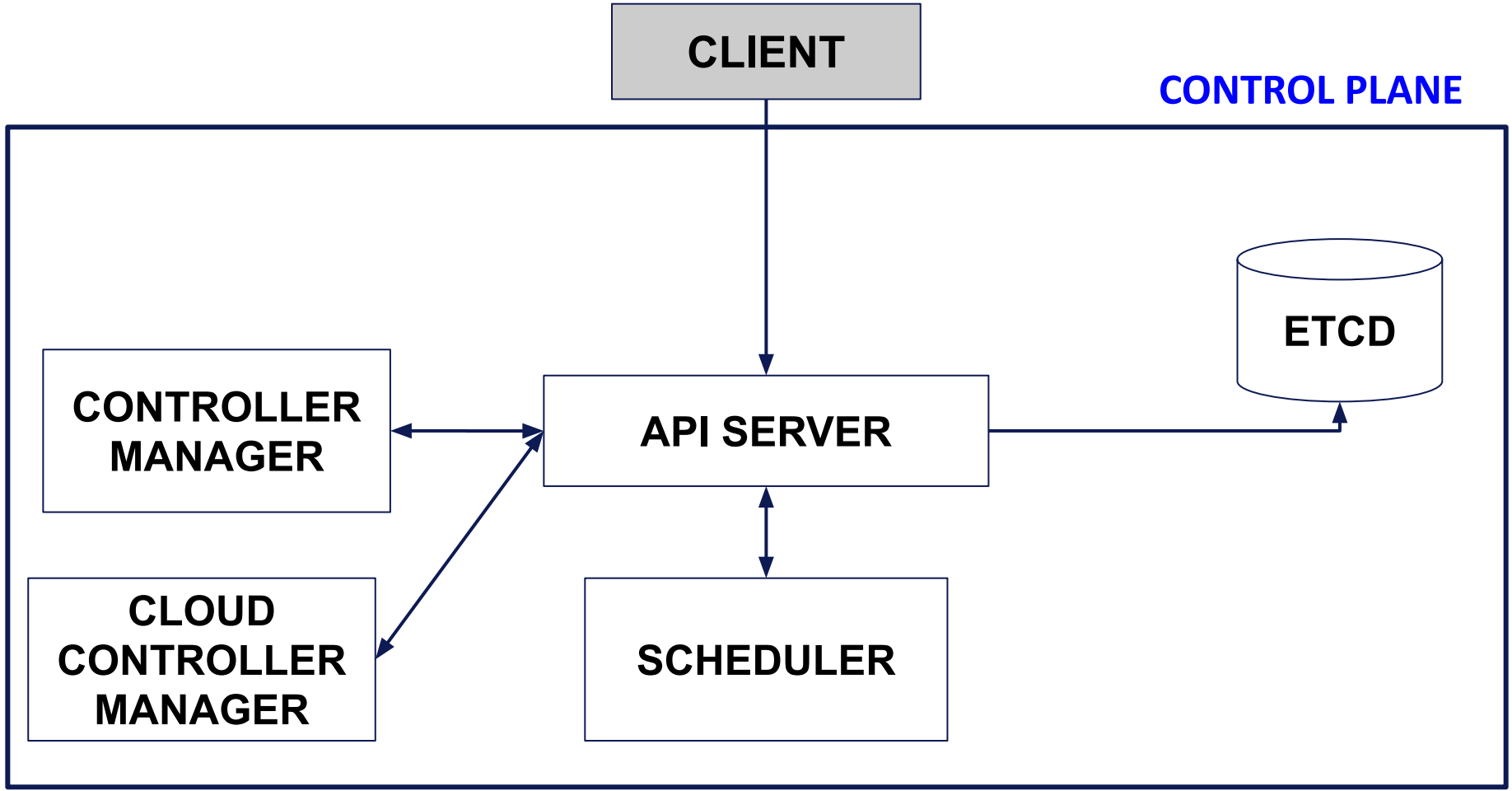
Controller Managers

CONTROLLER MANAGER	CLOUD CONTROLLER MANAGER
CORE KUBERNETES OBJECT	CLOUD SPECIFIC OBJECTS
POD NODE DEPLOYMENT CONFIGMAP	LOAD BALANCER NODE NODE LIFECYCLE

Scheduler



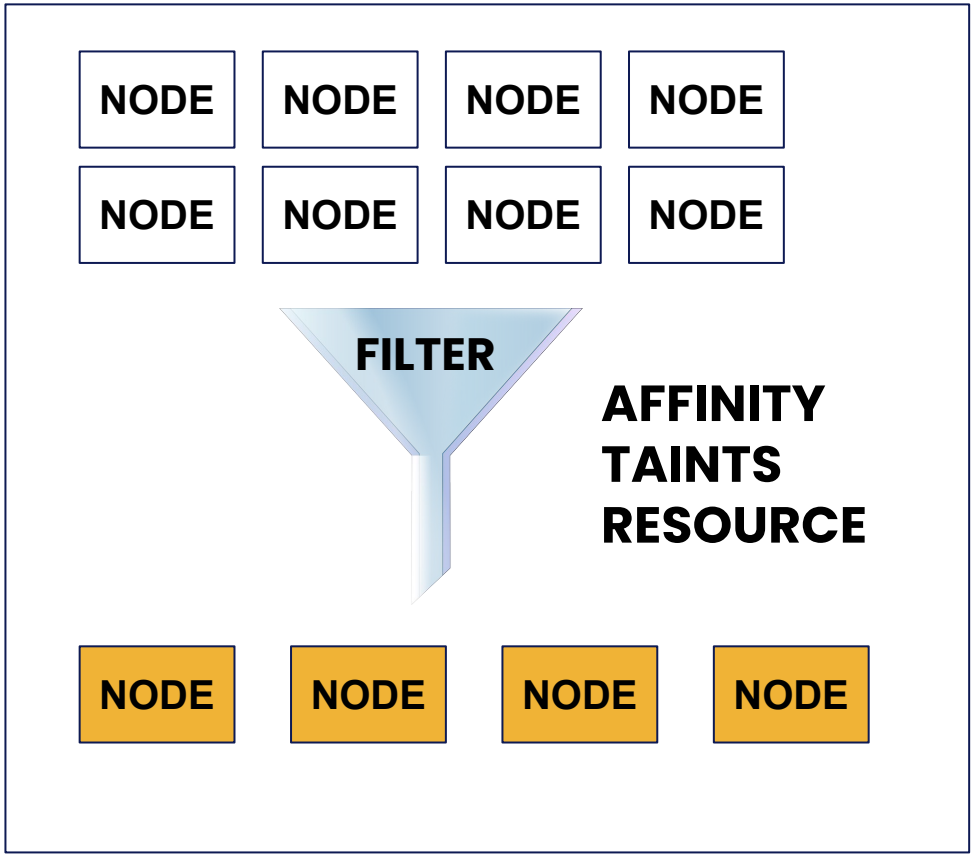
ASSIGN POD TO NODES



Scheduling - Filter

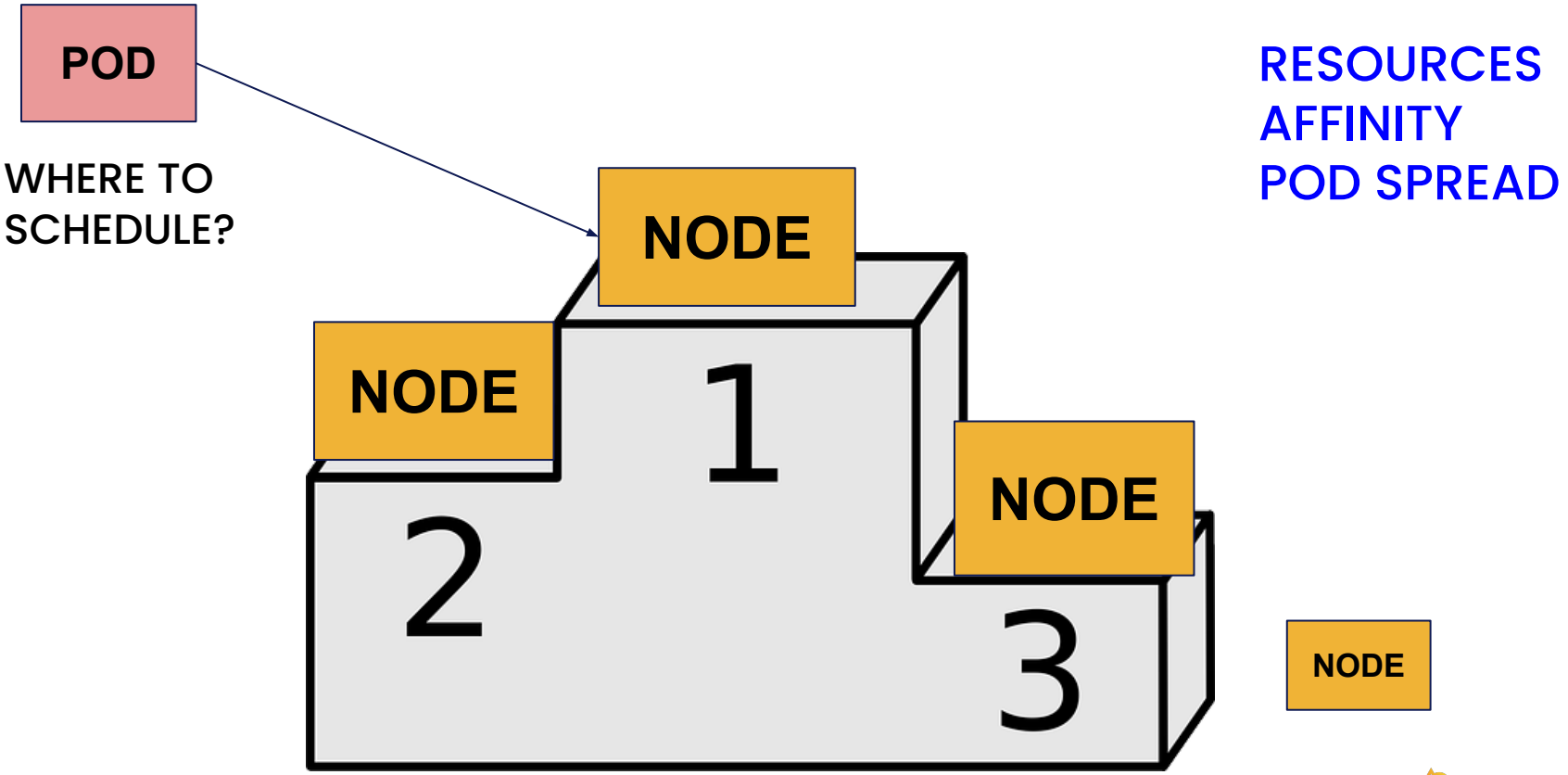
POD

WHERE TO SCHEDULE?



PERCONA

Scheduling - Score



RESOURCES
AFFINITY
POD SPREAD

PERCONA

Playtime or Runtime

Clone the repo

https://github.com/cshiv/PL2023-k8s

Command:

git clone https://github.com/cshiv/PL2023-k8s.git

Setup your Kubernetes Cluster

1. Use your Cluster
2. SSH to the machine (Refer docs/env.md)

Kubeconfig

All the Information you need to connect to a K8s Cluster !!!

Ways to use Kubeconfig

Based on precedence

1. kubectl --kubeconfig <Config-File-Location>
2. Environment Variable KUBECONFIG
3. File $HOME/.kube/config

Lets walk through your Kubeconfig !!!

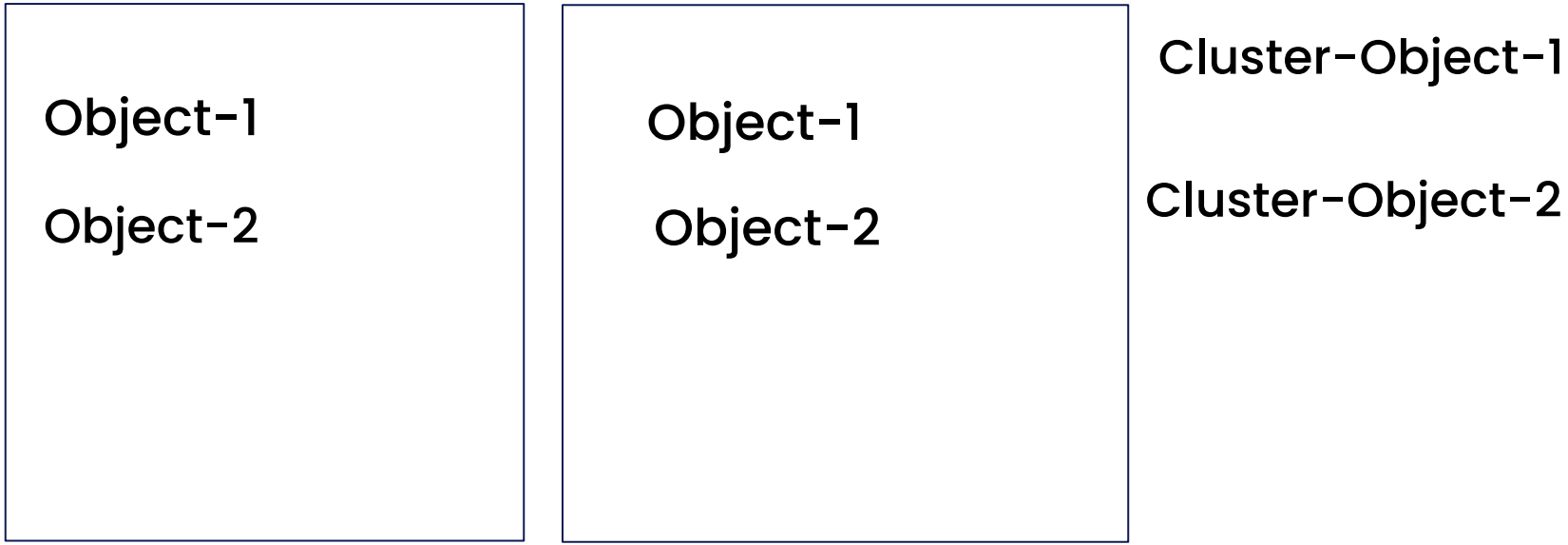
```
apiVersion: v1
kind: Config
clusters:
- cluster:
    certificate-authority-data:        -> CA Certificate
    server:                            -> API Server Endpoint
  name: k8s_id_long_name               -> Cluster Identifier
users:
- name: k8s_user                       -> User details for authentication
  Depends on authentication method
contexts:
- context:
    cluster: k8s_id_long_name          -> Cluster Identifier
    namespace: test                    -> Namespace to access with this context
    user: k8s_user                     -> User details for authentication
  name: k8s                            -> Alias / Cluster Identifier
current-context: k8s                   -> Current context being used
```

Let’s dive into some Kubernetes Objects

K8s Cluster

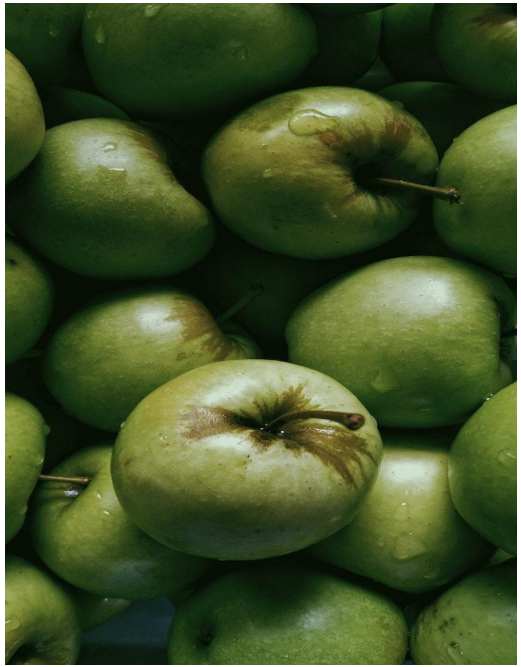
Namespace

Isolation of resources and objects



PERCONA

Why Namespaces are Required



Prevent a bad apple spoiling a bunch

Access Control

Namespace Scope or Cluster Scope?

```
$ kubectl api-resources
```

Run your First Pod

```
$ kubectl run
```

Refer [docs/pod.md]

Breaking Down a k8s Manifest

apiVersion: v1 -> Version for the K8s object
kind: Pod -> Which k8s object
metadata: -> Metadata of k8s object

spec: -> Specifications of the object(Desired State)
status: -> Status of the object (Current State)

PERCONA

How Do I Know the Details of Fields?

How do I Manage Pods?

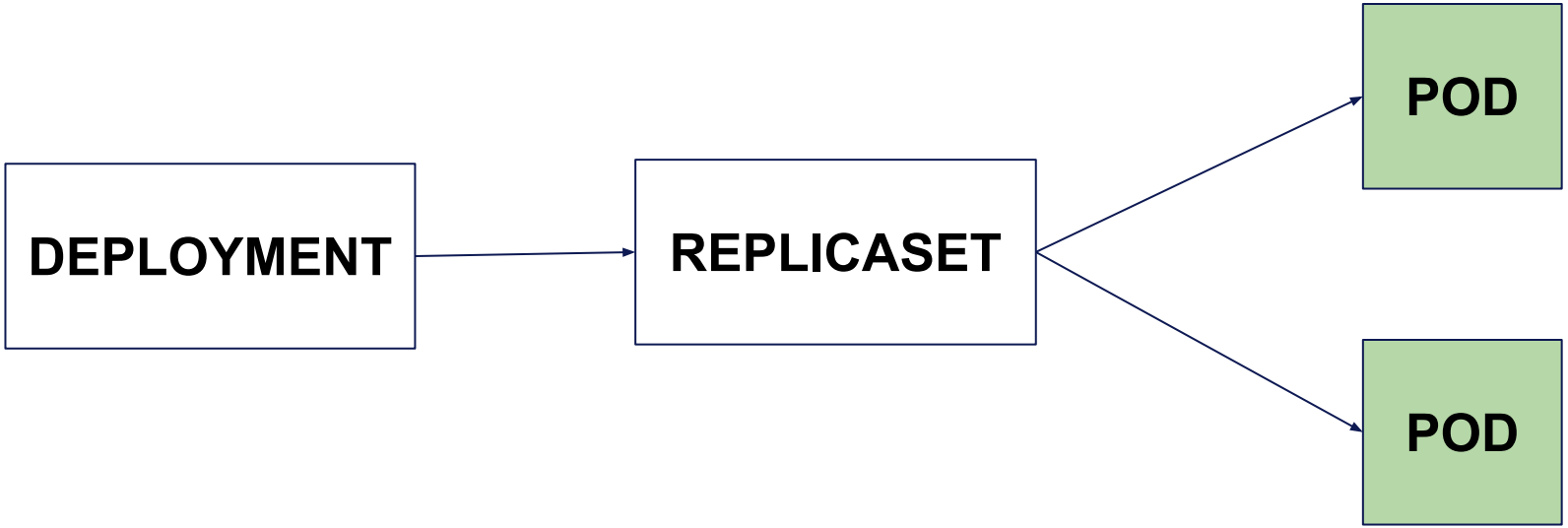
IMMUTABLE

REPLICATE

MODIFY PROPERTIES

SCALE

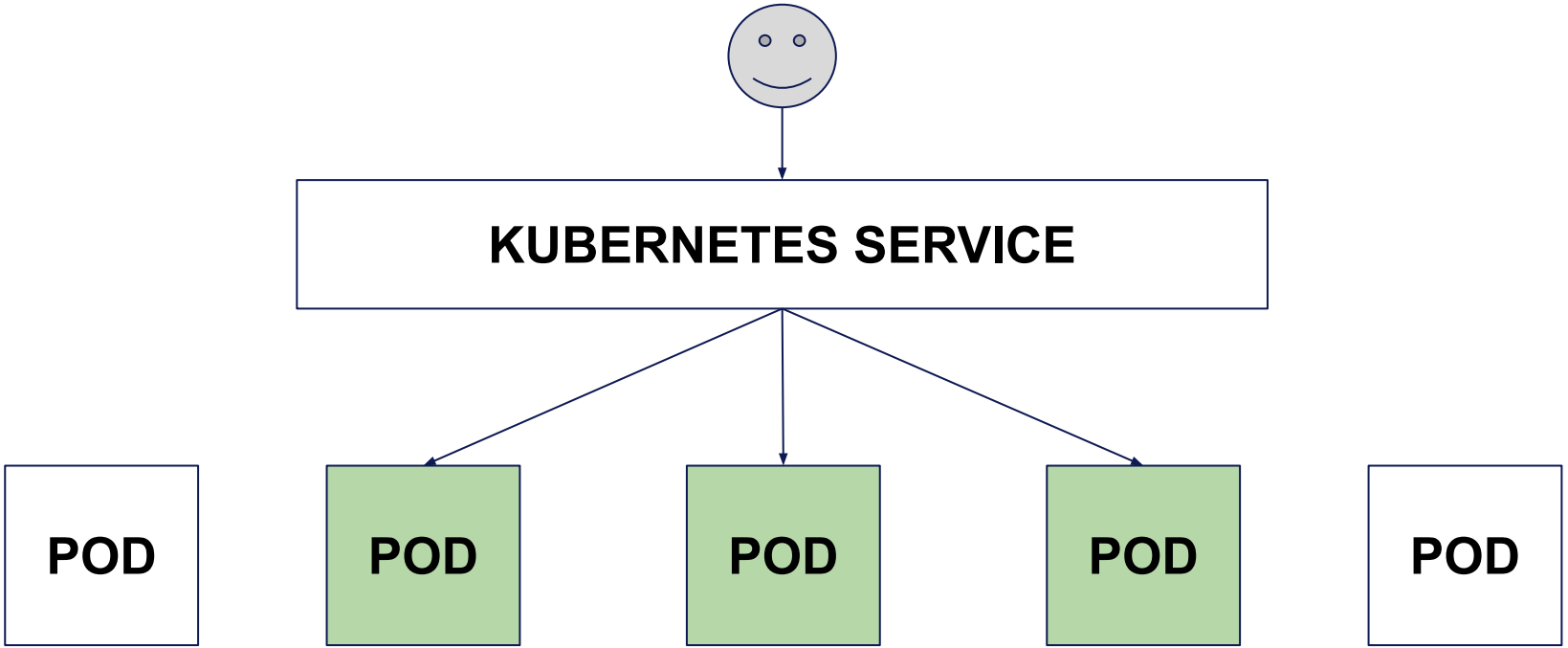
Deployment



Deploy your Deployment

Refer doc/deploy.md

How Can I Route Traffic?



PERCONA

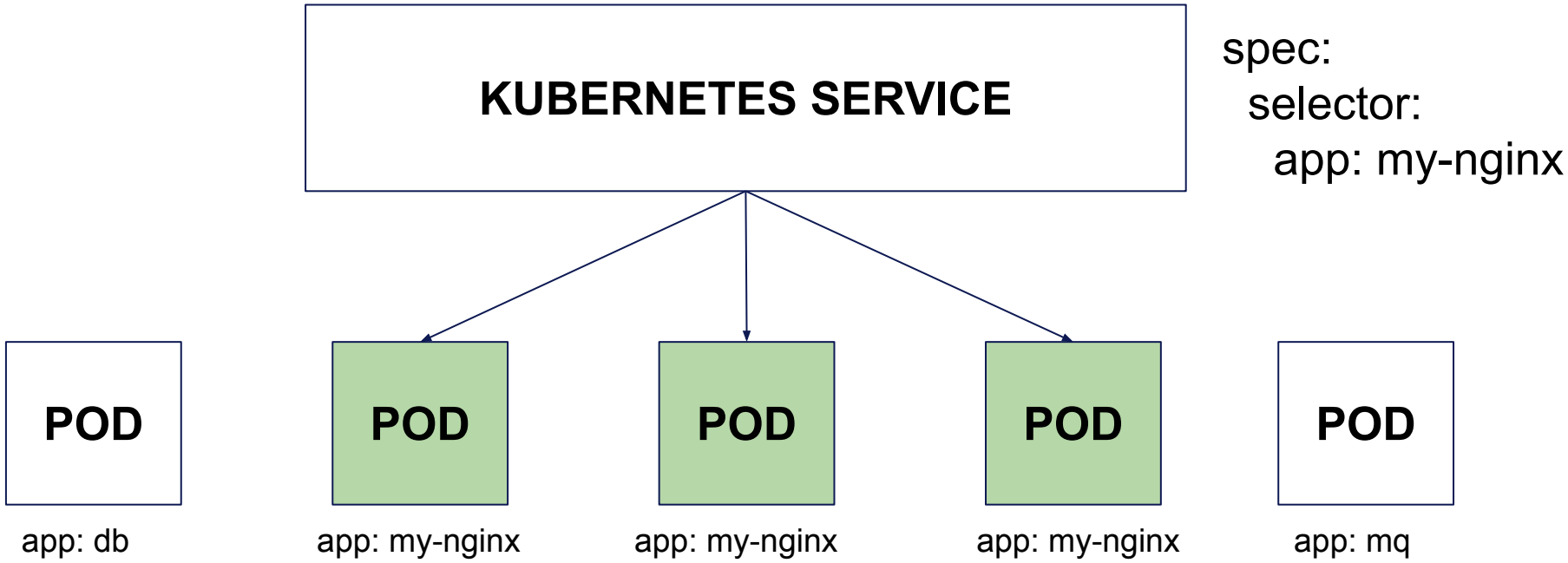
How is Services to Pod Mapping Done?

LABELS , LABELS, LABELS !!!

Metadata Section of a K8s Object

```
apiVersion:
kind:
metadata:        -> Metadata of k8s object
  name:          -> Name of k8s object
  namespace:     -> Namespace of k8s object ( Namespace scoped)
  labels:        -> Labels of the object
spec:
status:
```

Simplified View



PERCONA

Let's Check a Service

```
apiVersion: v1
kind: Service
metadata:
  name: service-nginx

 spec:
   selector:
     app: my-nginx          -> Route to all Pods with Labels "app: my-nginx"
   ports:
   - port: 80               -> Port of the Service (Mandatory)
     targetPort: 80         -> Port of the Container (Optional)
     name: port-80          -> Name for the port (Optional)
```

Let’s Try !!!

Refer docs/service.md

Service Deserves Better Exposure

kind: Service
spec:
  type:

Cluster IP

- Reachable within k8s cluster
- Default Service Type

LoadBalancer

- Uses Loadbalancer of Cloud
- Reachable outside k8s cluster

NodePort

- Uses IP of nodes with a static port from Node
- Default port range used (30000-32767)
- K8s Nodes should also be reachable outside clus

ExternalName

- Uses External FQDN instead of label selector
- Reachable outside k8s cluster

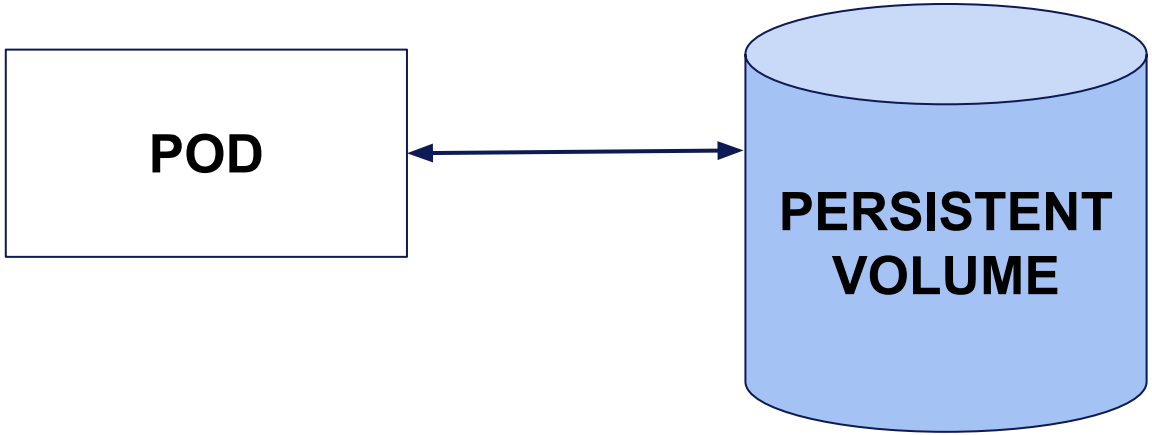
Million Dollar Question, Can I Run DB on K8s?

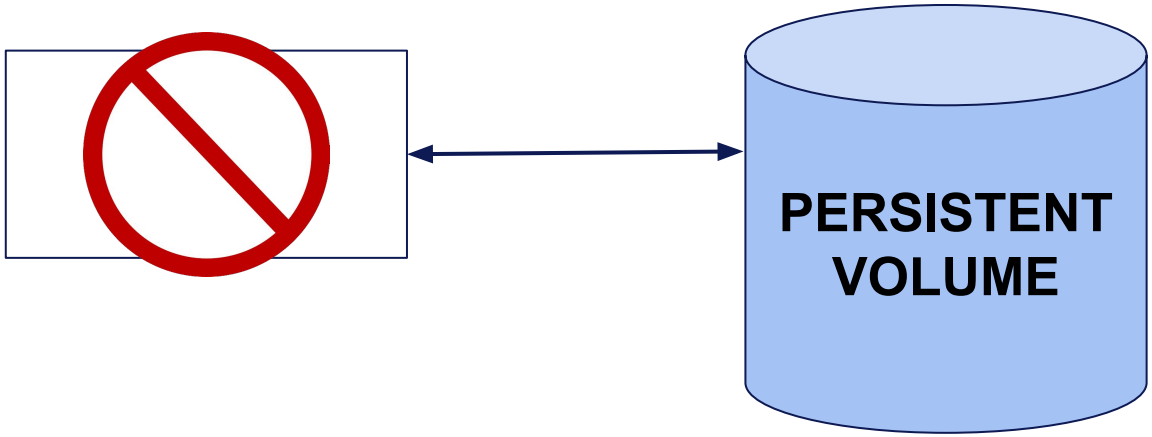
But, I need Stability

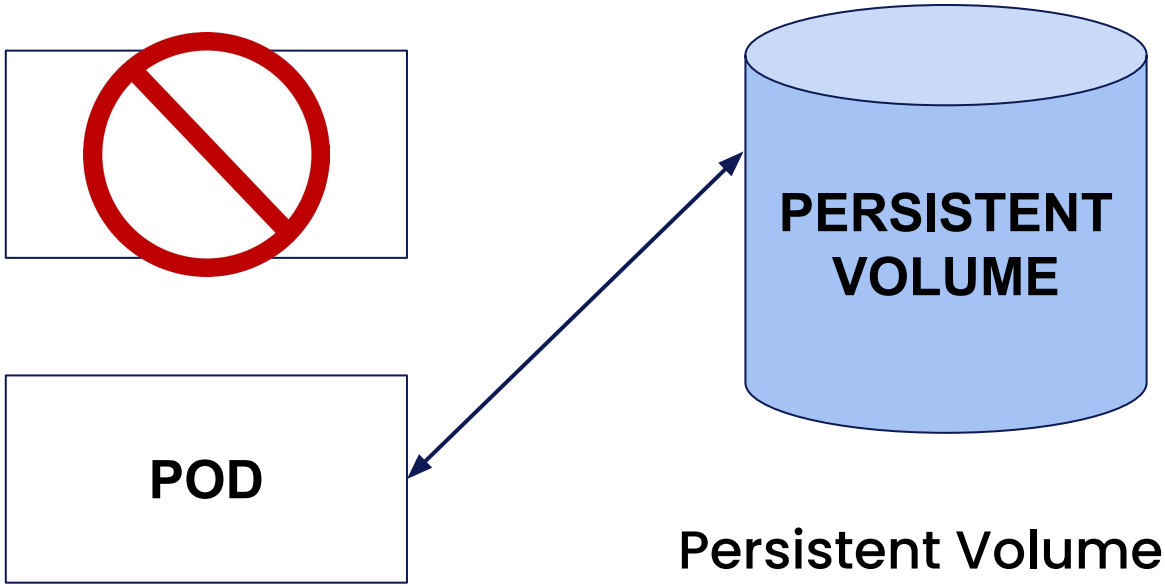
```
$ uptime
My Love, I am barely alive. Please save me :(
```

- K8s Nodes can run for a long time
- Pods can run for a long time without getting evicted or killed
- Service is eternal even when underlying is ephemeral

But, I Cannot Lose Data







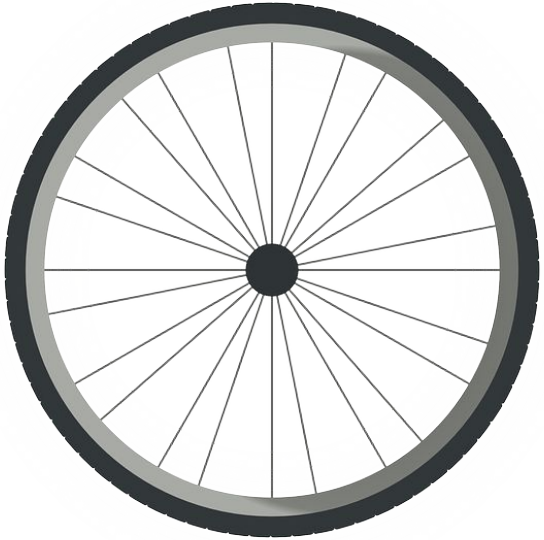
Persistent Volume Outlives a Pod

But, DB is my Pet, not all Pods are same

Constant Identity		StatefulSet
No Load Balancing, I need to hit the Primary		Headless Service

PERCONA

But, I don’t need K8s, I have all the automation



- No need to reinvent the wheel
- No need to maintain your automations
- K8s is widely used by community

Is k8s the ultimate solution for everything

Wish there was a crystal ball which can solve everything.

Have you found one yet ?

Search the Crystal Ball

5 mins

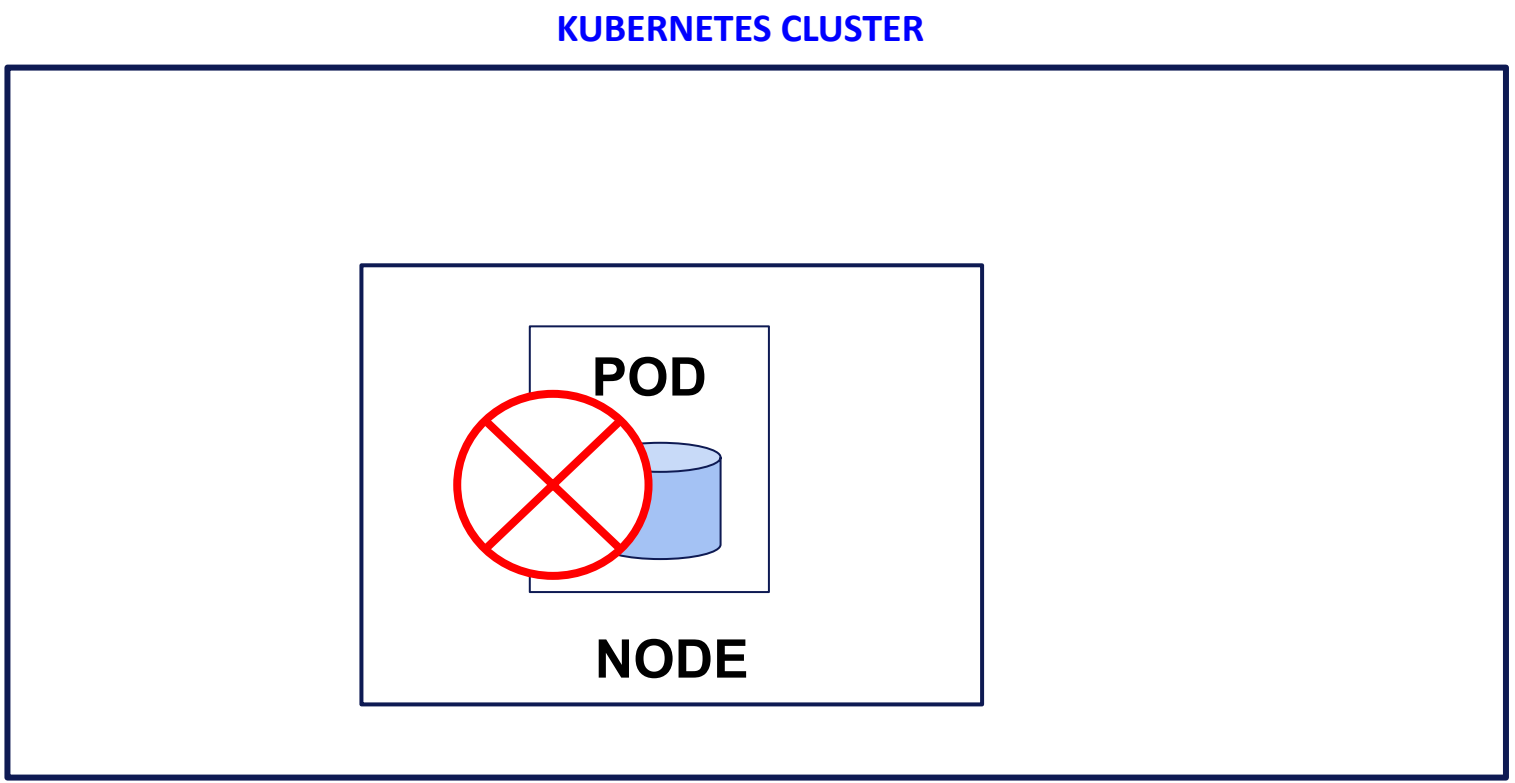
Unpack the Blackbox

- DATA PERSISTENCE
- IDENTITY
- STABILITY
- AUTOMATION

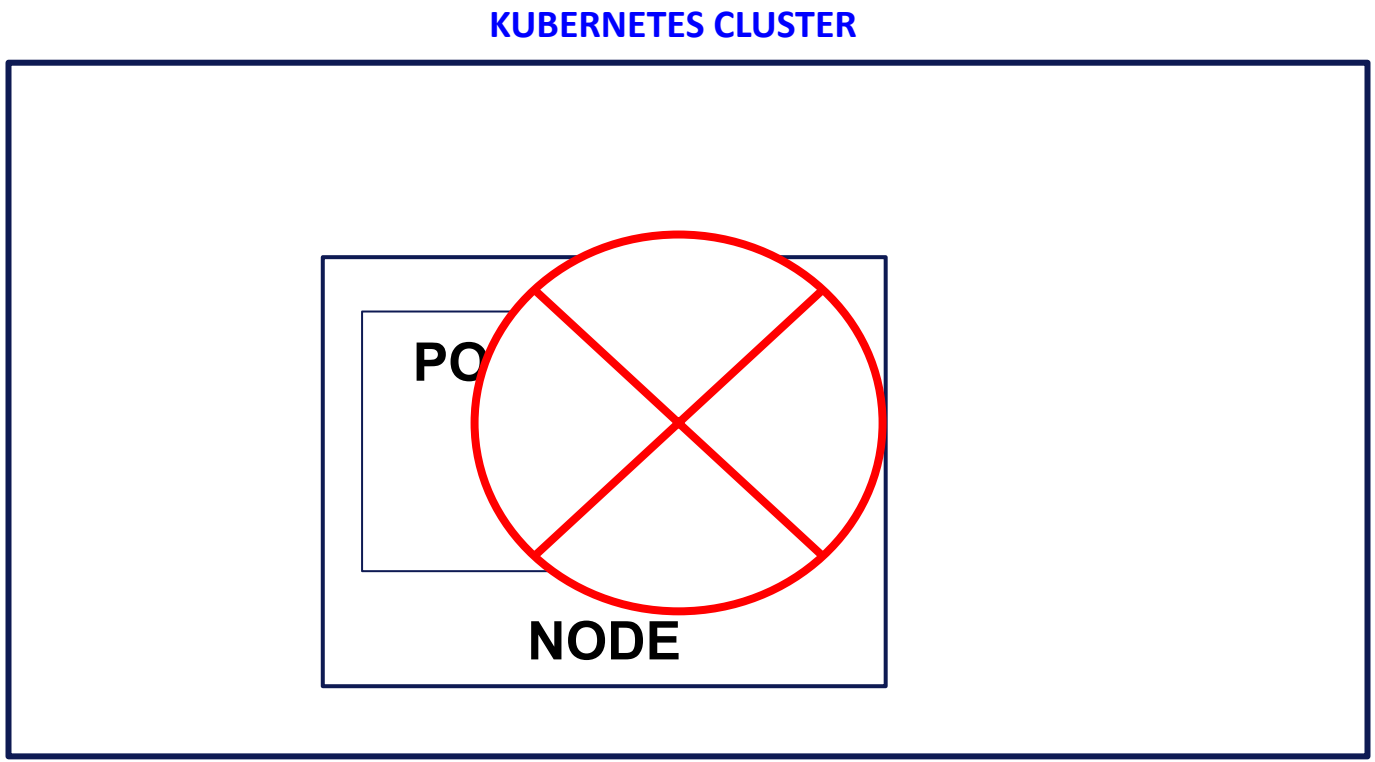
DATA PERSISTENCE

I cannot lose the Data

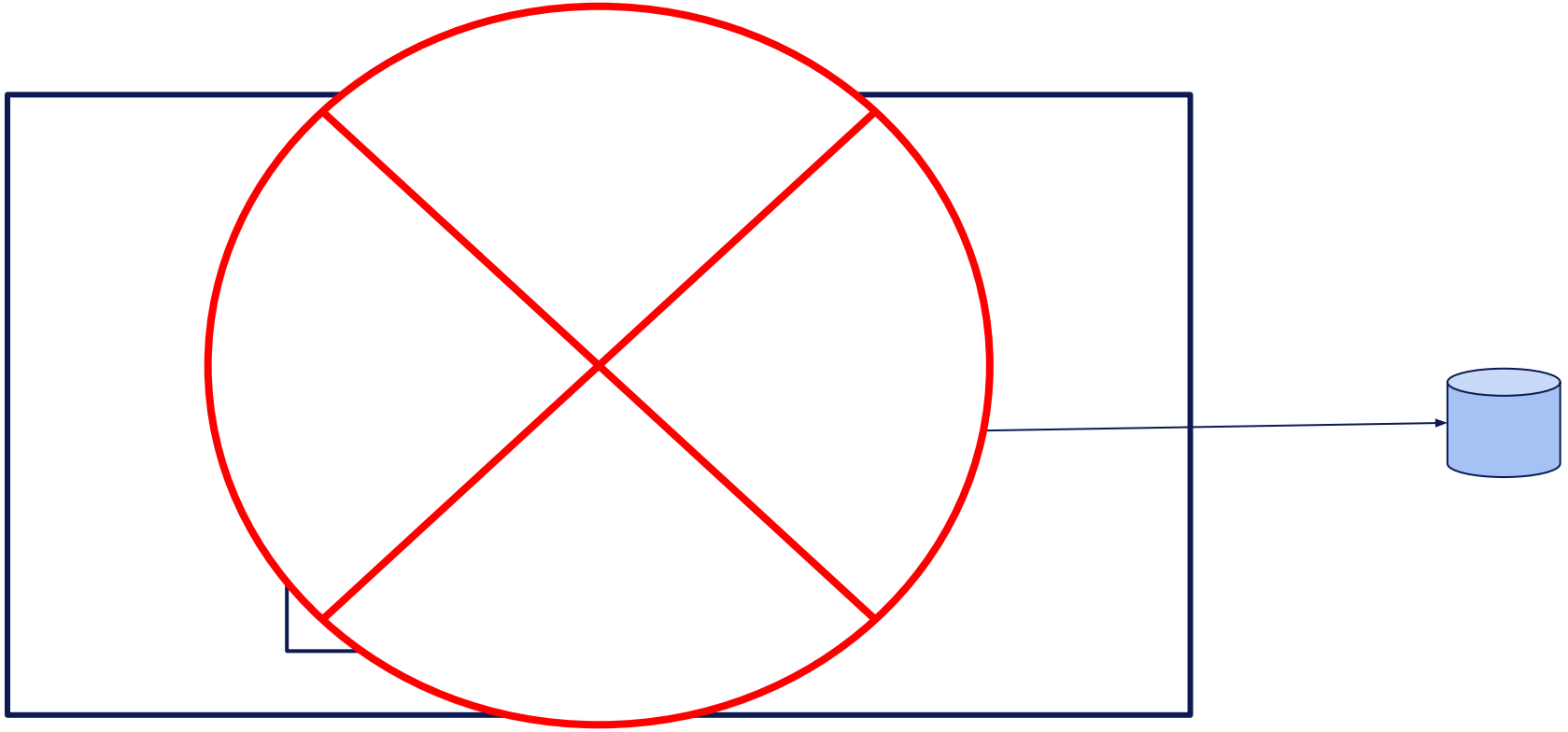
Data tied to the lifecycle of Pod



Data tied to the lifecycle of Node



Data independent of any component of K8s



Some of the Persistent Volumes

Azure Disk Storage

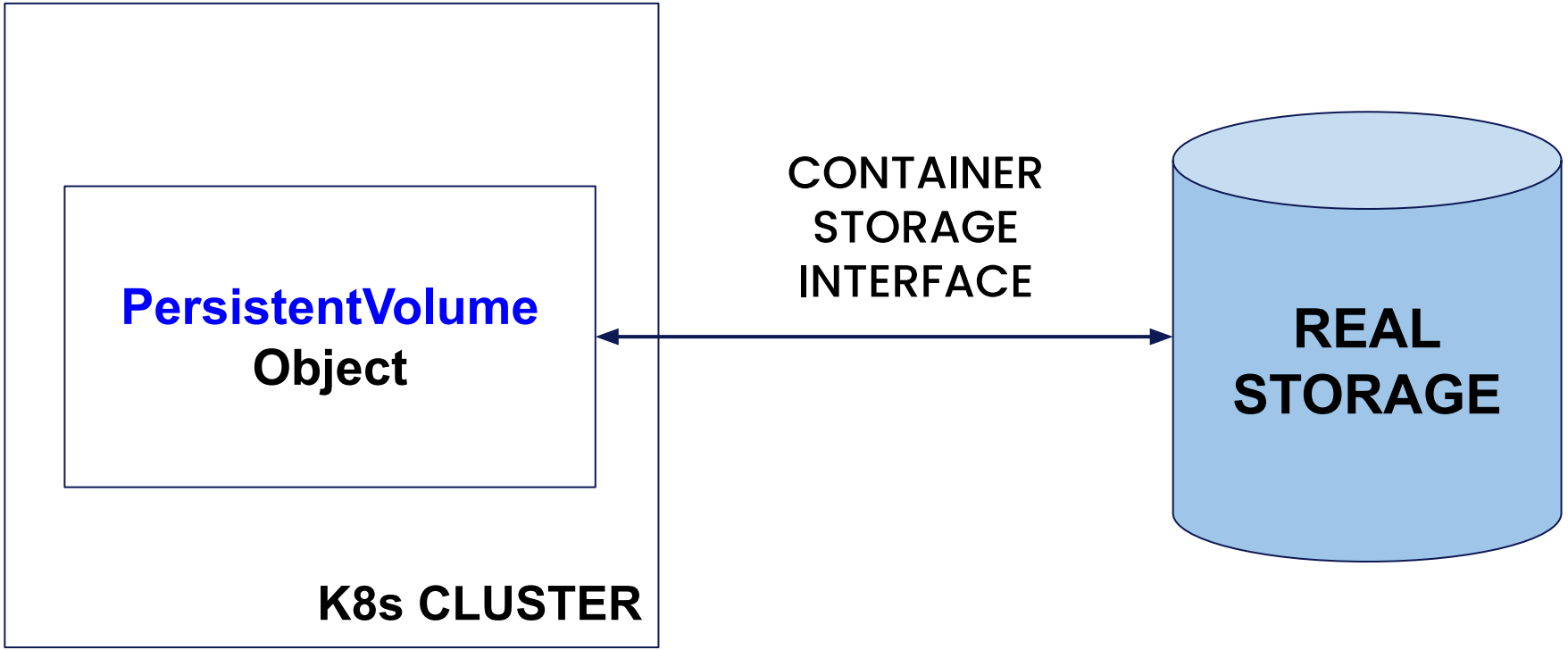
GCP Persistent Disk

AWS EBS

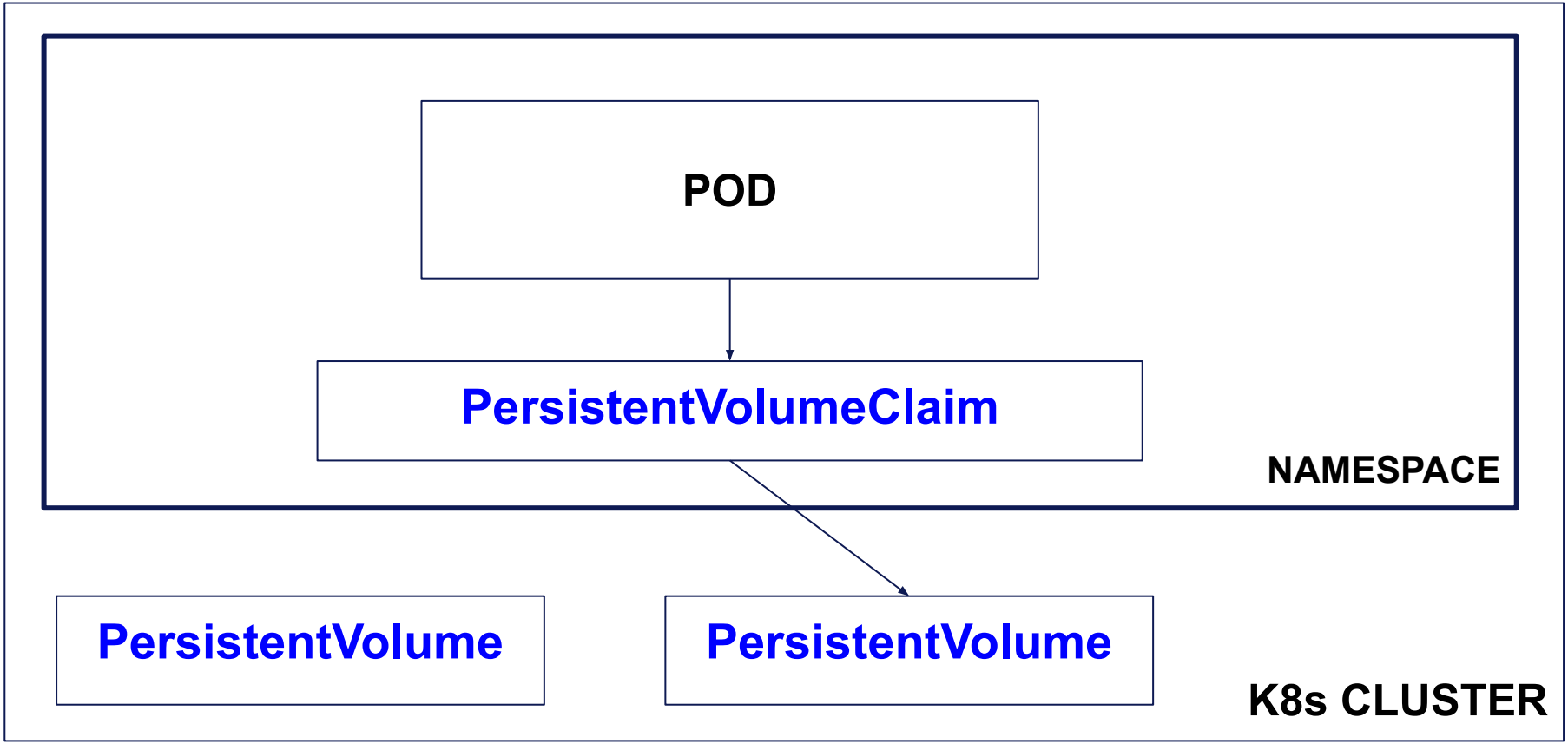
Ceph Storage

Object Storage

Mapping Volume from Storage to K8s



Using Persistent Volume in a Pod



My Claim is Bigger

PersistentV

I need 40 G

Volume

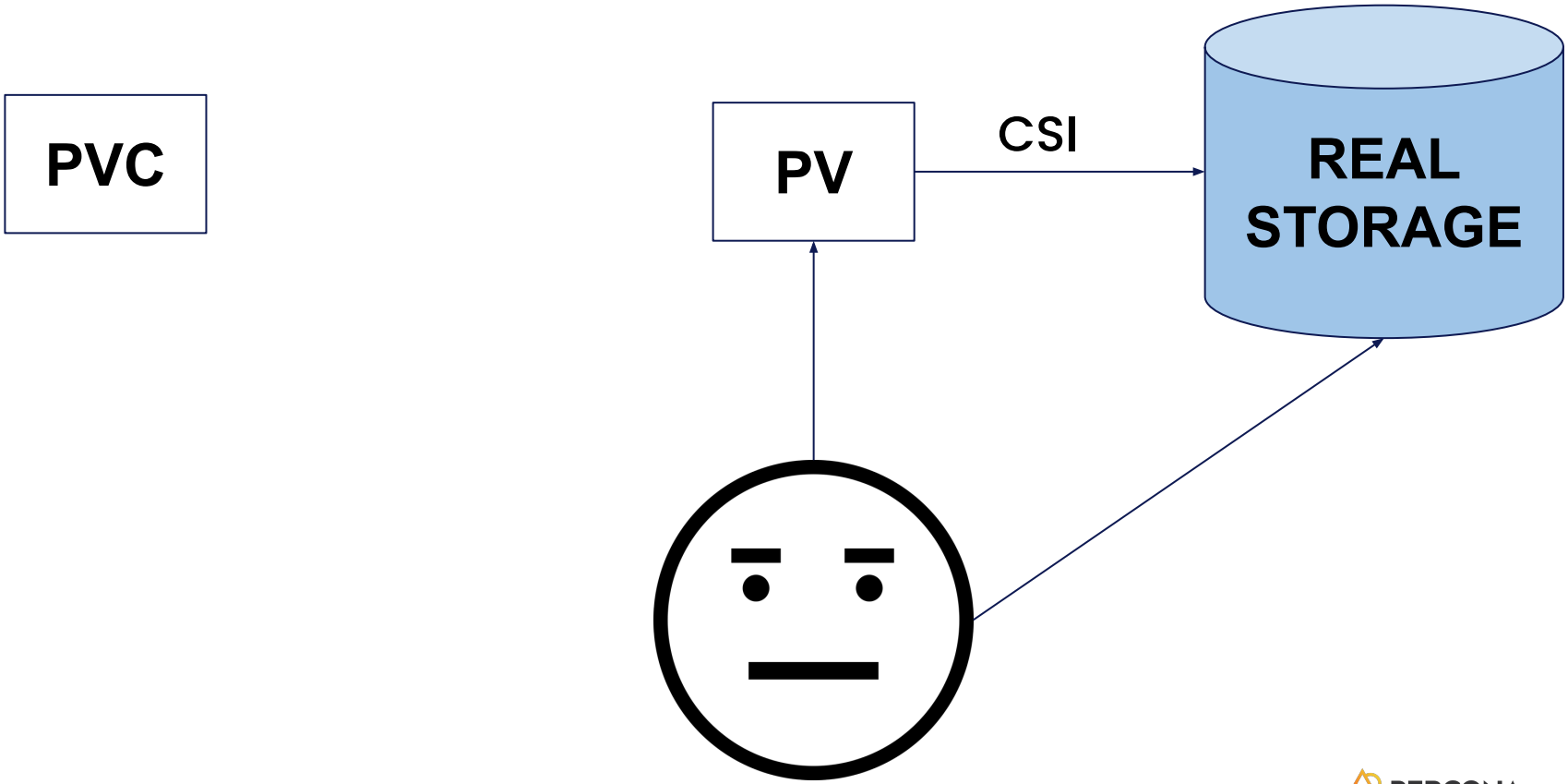
ne-1

:Volume

ne-2

PERCONA

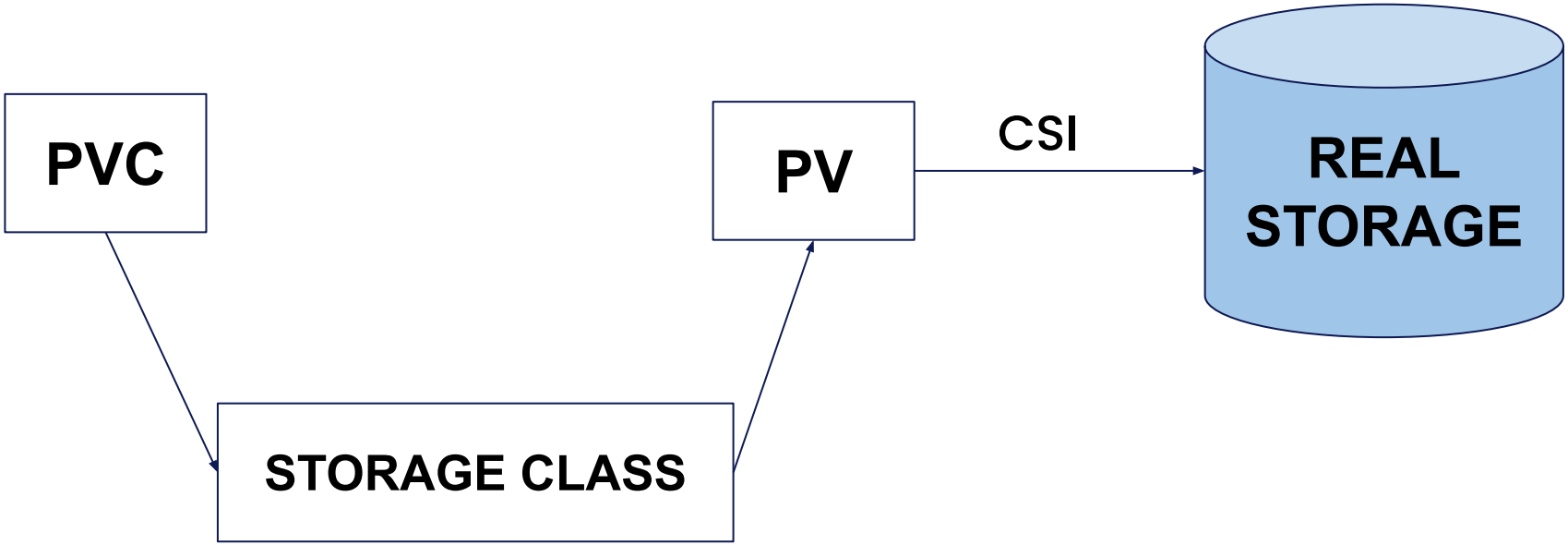
Static Way



PERCONA

Imagine managing this at scale !!!

Welcome to StorageClass



PERCONA

Let’s Persist Data !!!

Refer doc/volume.md

IDENTITY

I need to differentiate primary or any other pod by unique name

Problems

Pods managed by Deployment object don’t have a consistent name across restarts. A random hash follows the deployment name.

Get IP of all the pods managed by Deployment, not the clusterIP or loadbalancer IP.

StatefulSet and Headless Service

STATEFULSET

Maintains the identity of pods

Pod Name:
<statefulset-name>-<ordinal>

HEADLESS SERVICE

Provides IP of all the pods matching the labels.

Provides DNS entry for all the pods matching the label.

DNS record of a Service

<Service>.<Namespace>.svc.<Domain>

test.default.svc.cluster.local

Let’s see a constant identity

Refer doc/stateful.md

All the replicas are in Standalone mode !!!

STABILITY

AUTOMATION

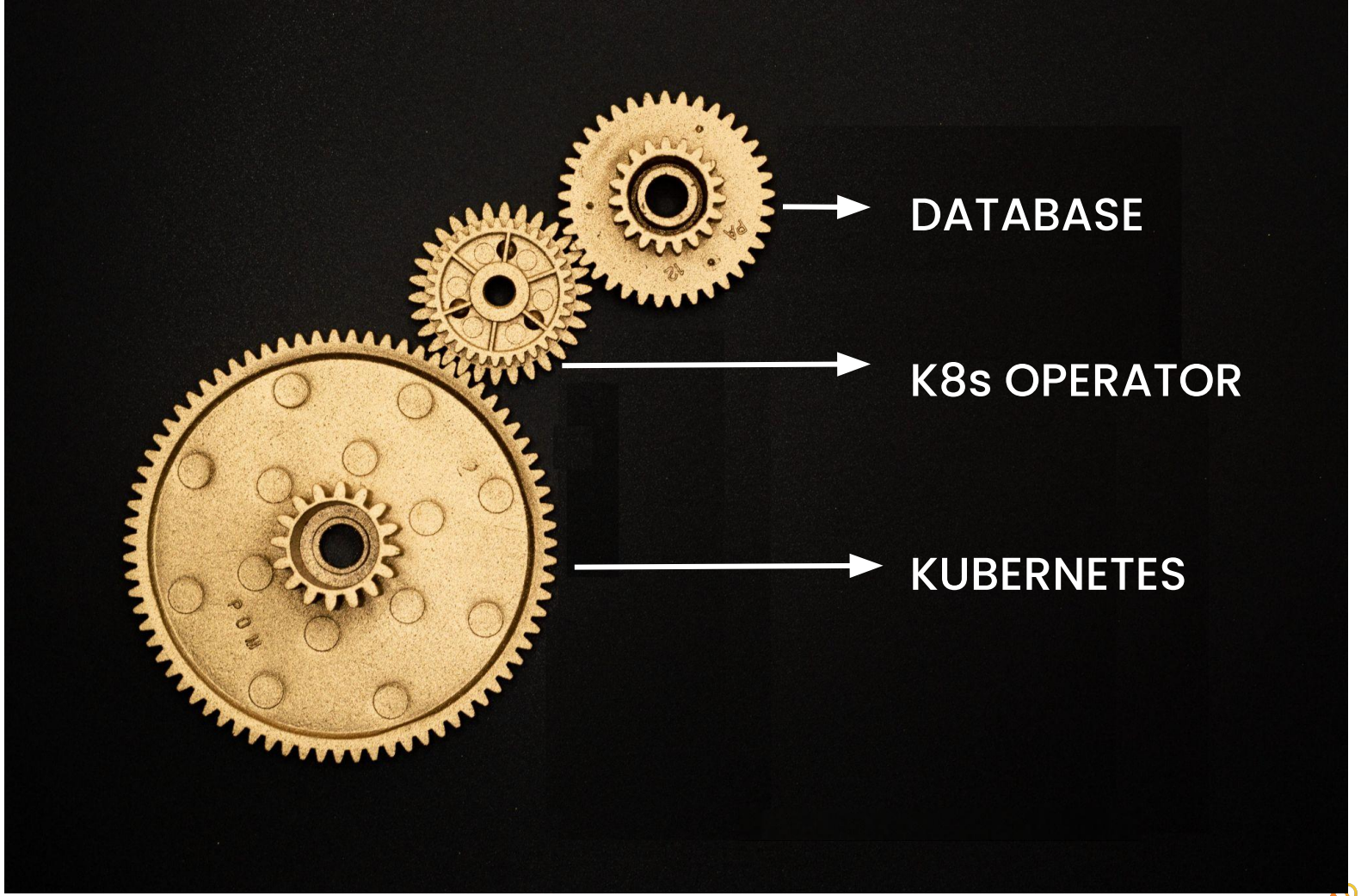
Tried and Tested

SYSTEM ADMIN

I will take care of the infra

DB ADMIN

I will take care of the DB



What is an Operator

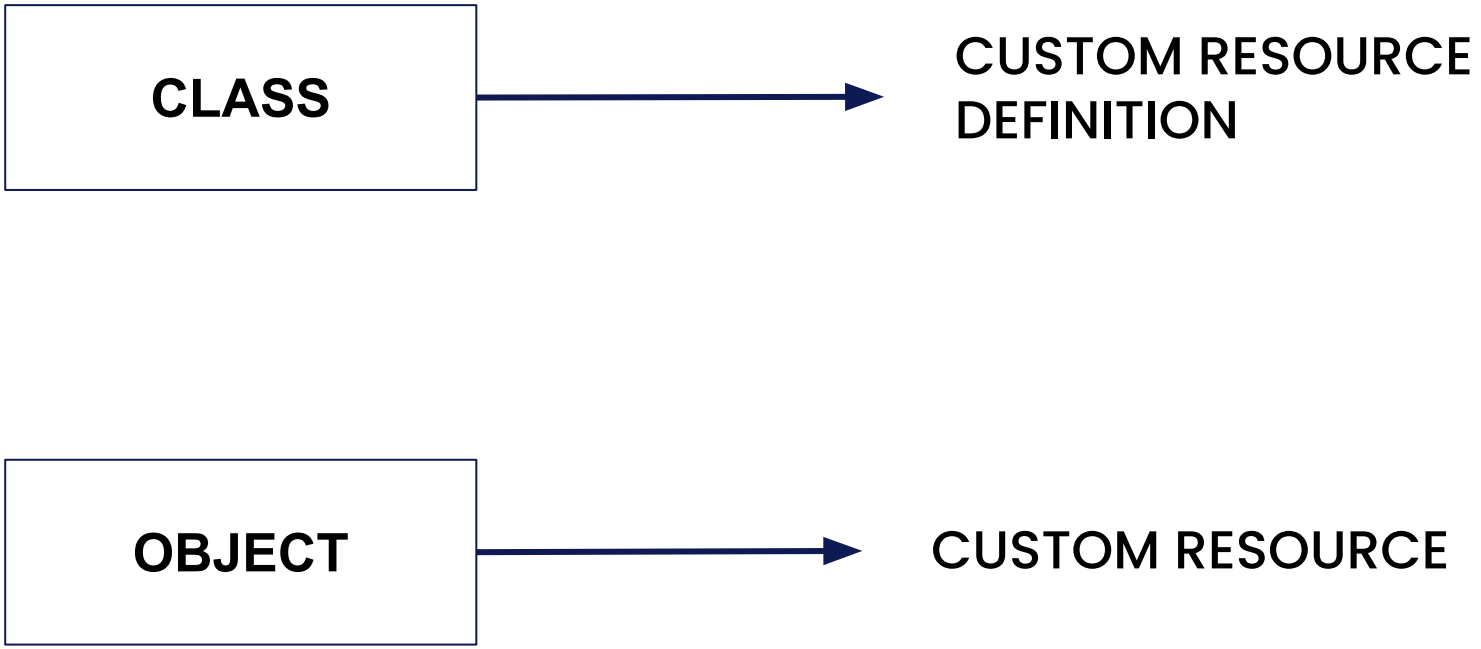
Code which runs on kubernetes and tries to mimic the human managing an application.

Components of an Operator

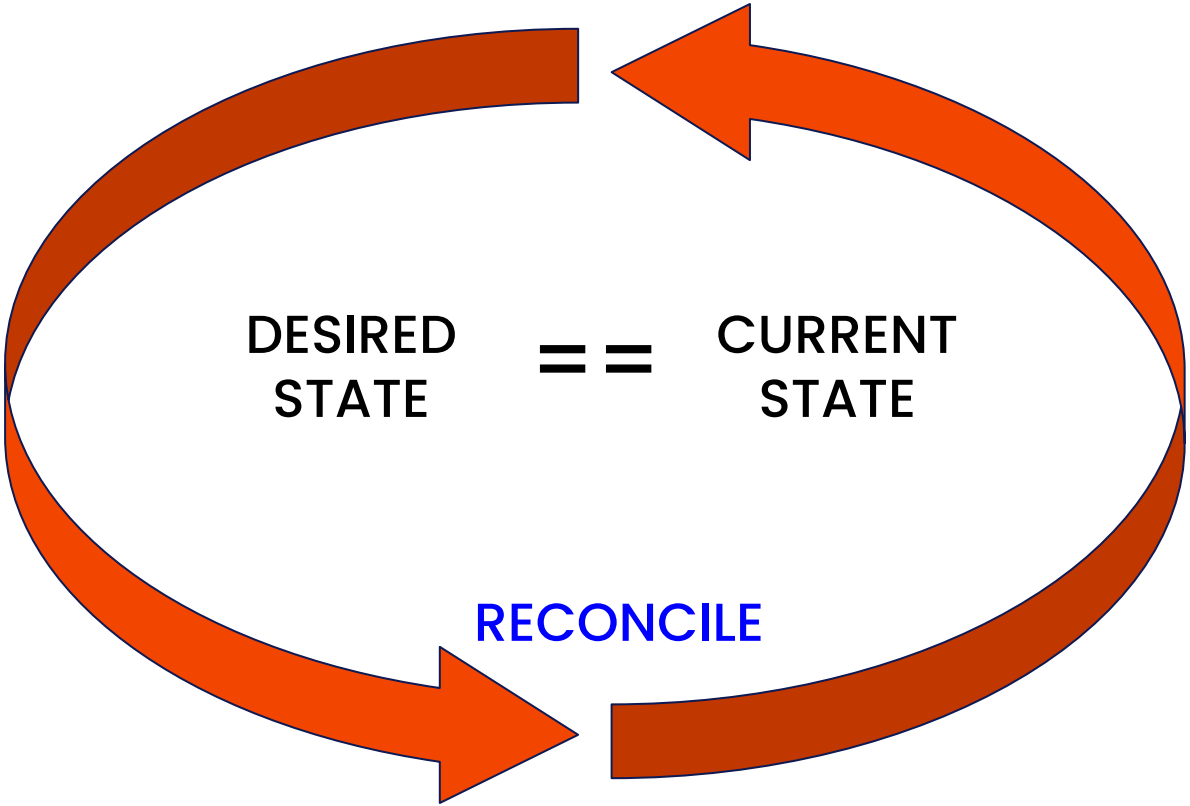
CUSTOM RESOURCES

CUSTOM CONTROLLER

A Vague Comparison from the Java World



Custom Controller



Custom Resource

Optionally Modify

Other K8s objects

PERCONA

Database Operator

Tool to manage Databases leveraging power of kubernetes

PERCONA

For deploying operators

Join Fernando at 1.30 PM for talk on

“Deploying MySQL on Kubernetes with the Percona Operator”

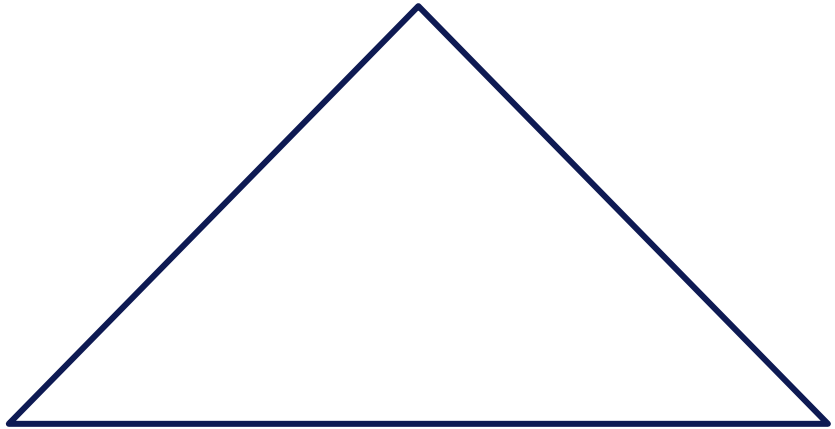
PERCONA

Three important tools for Debugging

Check current state

kubectl get --help

kubectl describe --help



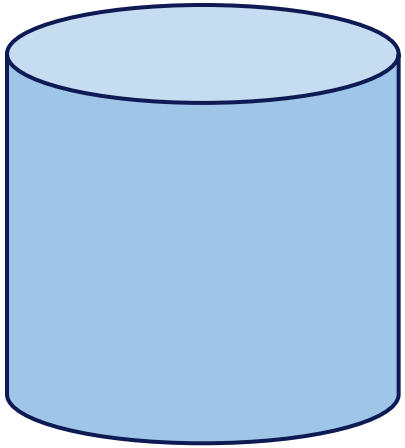
Check the logs

kubectl logs --help

Check the events

kubectl events --help

Future is today



Production DB on K8s is a
~~VISION~~ REALITY

Source: [DoK Reports]

PERCONA

Rome was not built in a day

Thank You

Q & A

Chetan Shivashankar
chetan.shivashankar@percona.com

Fernando
fernando.laudares@percona.com