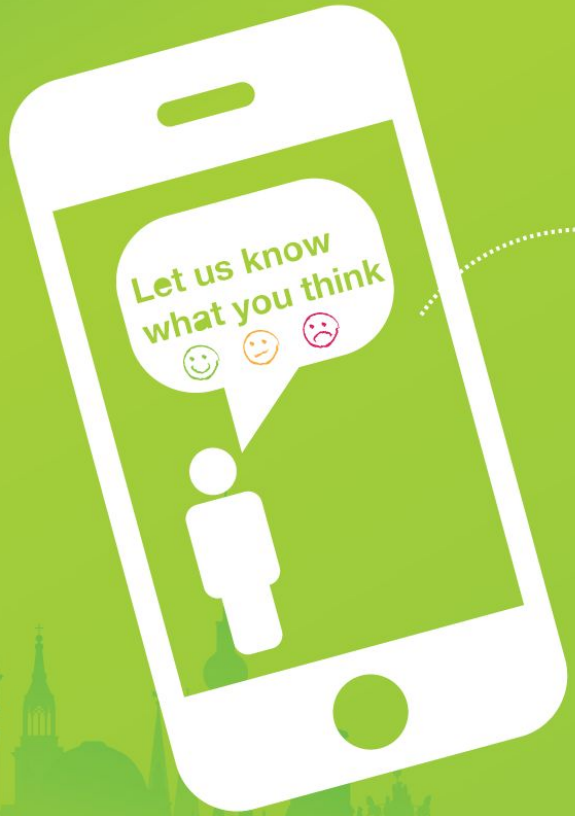
goto; conference



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Kubernetes

Changing the way we think and talk about computing

GOTO Berlin - December 2015

Google Cloud Platform

What is this talk?

Container

Brian Dorsey

Developer Advocate - Google Cloud platform

+BrianDorsey

@briandorsey

Containers? Yes/No

if yes **GOTO** slide 7;

if no **GOTO** slide 15;

Containers

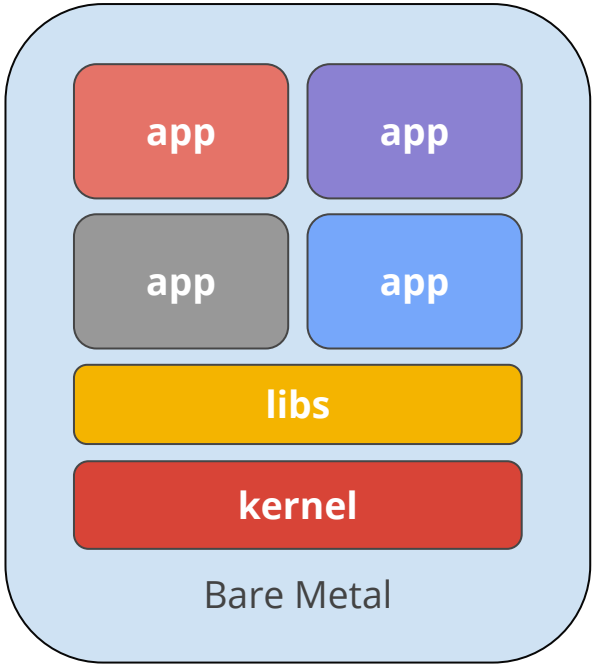
The Old Way: Shared Machines

No isolation

No namespacing

Common libs

Highly coupled apps and OS



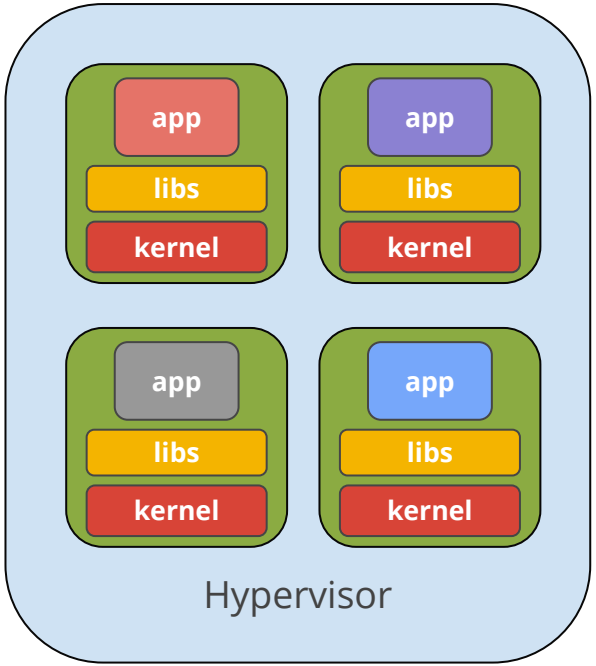
The Old Way: Virtual Machines

Some isolation

Expensive and inefficient

Still highly coupled to the guest OS

Hard to manage



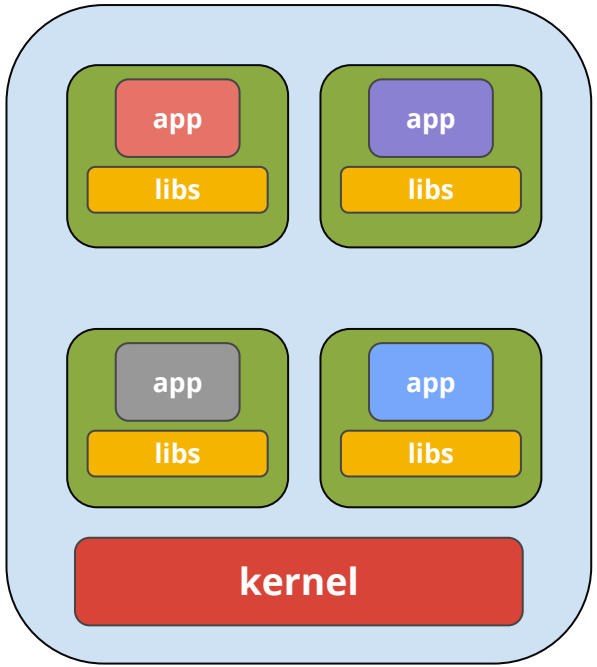
The New Way: Containers

App specific isolation

Lightweight & efficient

Independent of the host Linux distribution

… Lots of containers to manage



Container Images

- An image is a stack of Read-Only file system layers.
- Usual process:
  - build
  - push to repository
  - pull to execution host
  - start container from image

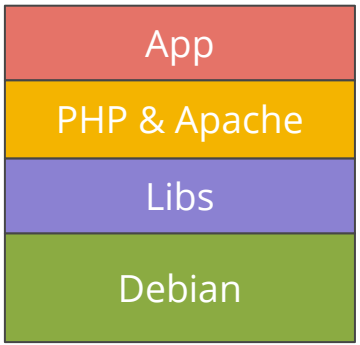
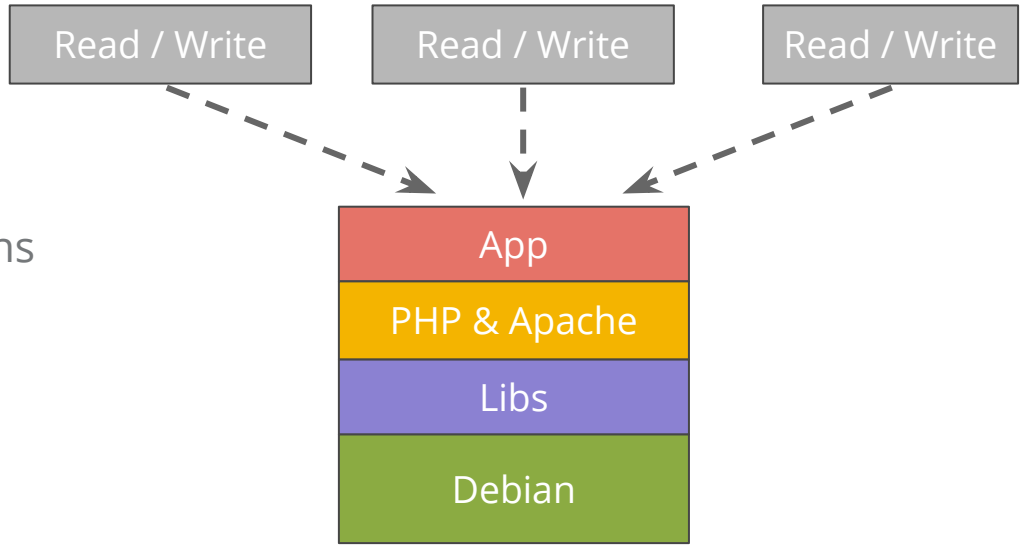


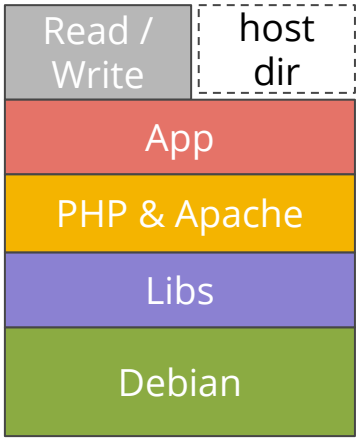
Image Layers



- A container is a process
  - started with kernel restrictions
  - a stack of shared Read-Only file system layers
  - plus a process specific Read-Write layer
- Every new container gets a new Read-Write later. All containers from the same image start from **exactly the same state!**

Mounting Host Directories

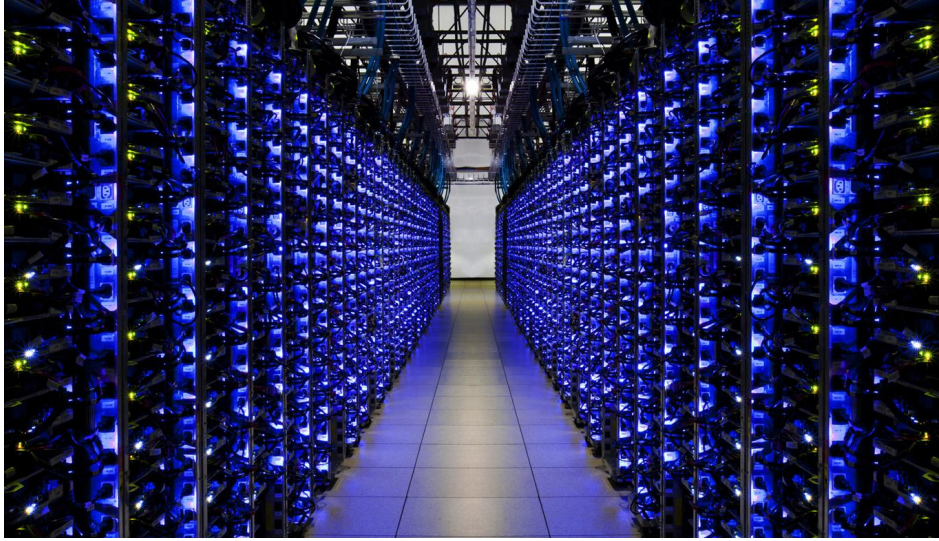
- It's possible to mount host directories into a container's filesystem.
- These are mutable and do outlive the container.
- They're **only** available on that host.

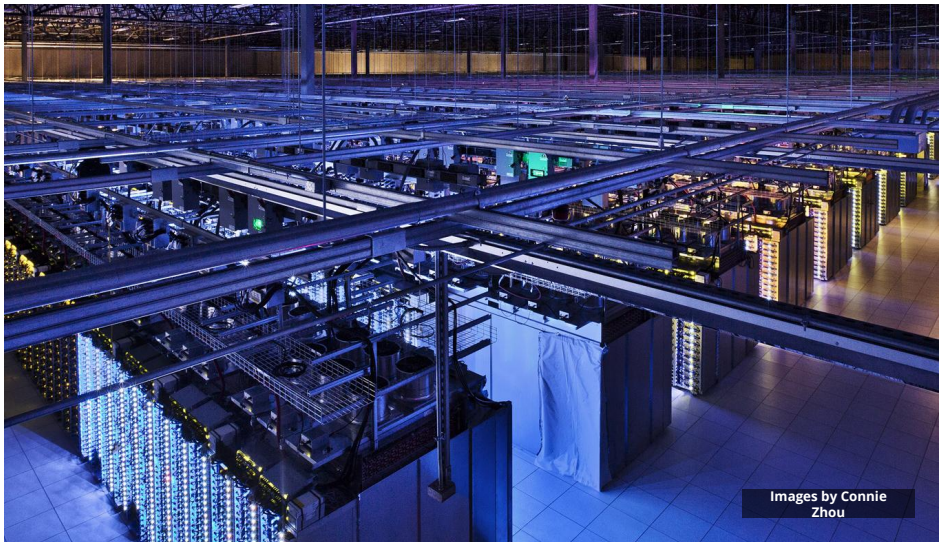


Why containers?

- Performance
- Repeatability
- Quality of service
- Accounting
- Portability

A **fundamentally different** way of managing **applications**





Containers are awesome!

Let’s run lots of them!

Kubernetes

PaaS

Virtual Machines

Physical Computers

PaaS

Container Clusters

Virtual Machines

Physical Computers

Kubernetes

Greek for *“Helmsman”*; also the root of the words *“governor”* and *“cybernetic”*

- Runs and manages containers
- Inspired and informed by Google’s experiences and internal systems
- Supports multiple cloud and bare-metal environments
- Supports multiple container runtimes
- **100% Open source**, written in Go

Manage applications, not machines

Everything at Google runs in containers:

- Gmail, Web Search, Maps, ...
- MapReduce, batch, ...
- GFS, Colossus, ...
- Even **Google's Cloud Platform:** VMs run in containers!

Shipping Containers At Clyde, by Steve Gibson

Everything at Google runs in containers:

- Gmail, Web Search, Maps, ...
- MapReduce, batch, ...
- GFS, Colossus, ...
- Even **Google's Cloud Platform:** VMs run in containers!

We launch over **2 billion** containers **per week**

Shipping Containers At Clyde, by Steve Gibson

A toolkit for running distributed systems in production

co-locating helper processes

mounting storage systems

distributing secrets

application health checking

replicating application instances

horizontal auto-scaling

naming and discovery

load balancing

rolling updates

resource monitoring

log access and ingestion

support for introspection and debugging

Start with a Cluster

Laptop to high-availability **multi-node cluster**

Hosted or **self managed**

On-Premise or **Cloud**

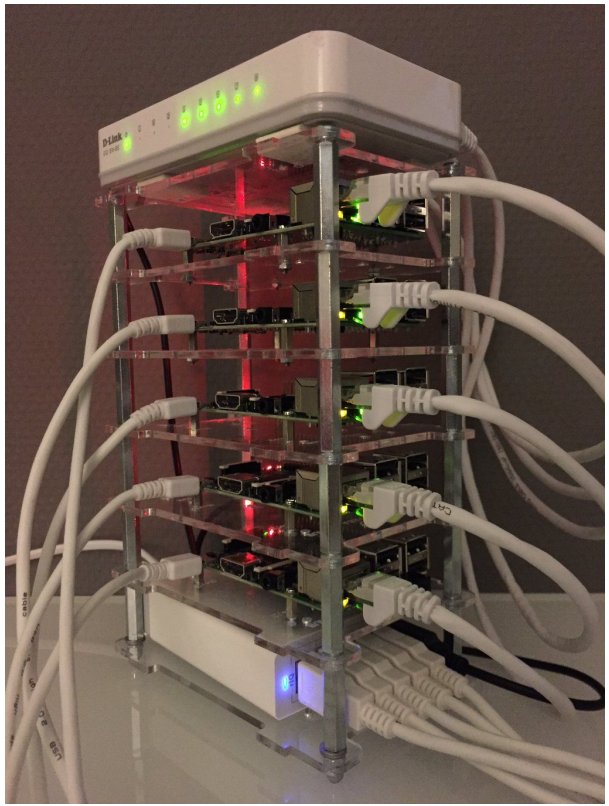
Bare Metal or **Virtual Machines**

Most OSes (inc. **RedHat Atomic**, **Fedora, CentOS**)

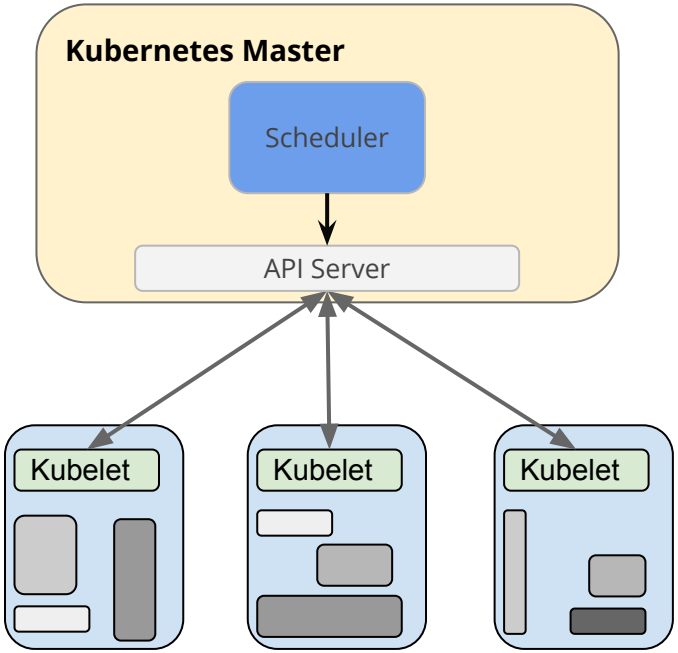
Or just a bunch of **Raspberry PIs**

Many options, See Matrix for details

Kubernetes Cluster Matrix: http://bit.ly/1MmhpMW



Start with a Cluster



Setting up a cluster

- Choose a platform: GCE, AWS, Azure, Rackspace, Ubuntu, Juju …
  - Then run:

```
export KUBERNETES_PROVIDER=<your_provider>; curl -sS https://get.k8s.io | bash
```

- Or choose a distro such as RedHat Atomic, CoreOS Tectonic, Mirantis Murano (OpenStack), Mesos
- Or use a recipes for bare metal configurations for Centos, Fedora, etc
- Use a hosted option such as Google Container Engine

Deploy containers

```
$ kubectl run my-nginx --image=nginx --replicas=2 --port=80
```


A pod of ~~whales~~ containers

The atom of scheduling for containers

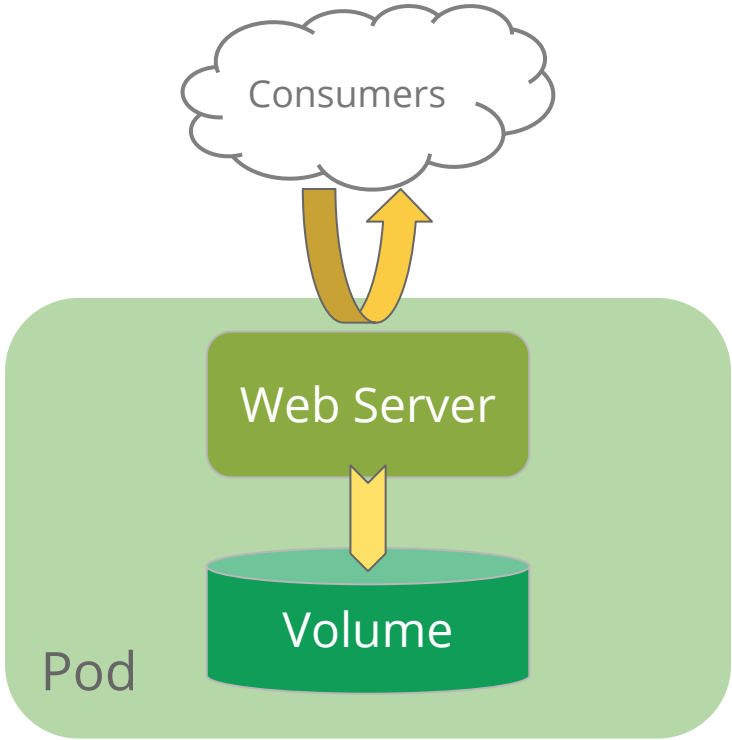
An application specific **logical host**

Hosts **containers** and **volumes**

Each has its own routable IP address (no NAT)

Ephemeral

- Pods are functionally identical and therefore ephemeral and replaceable



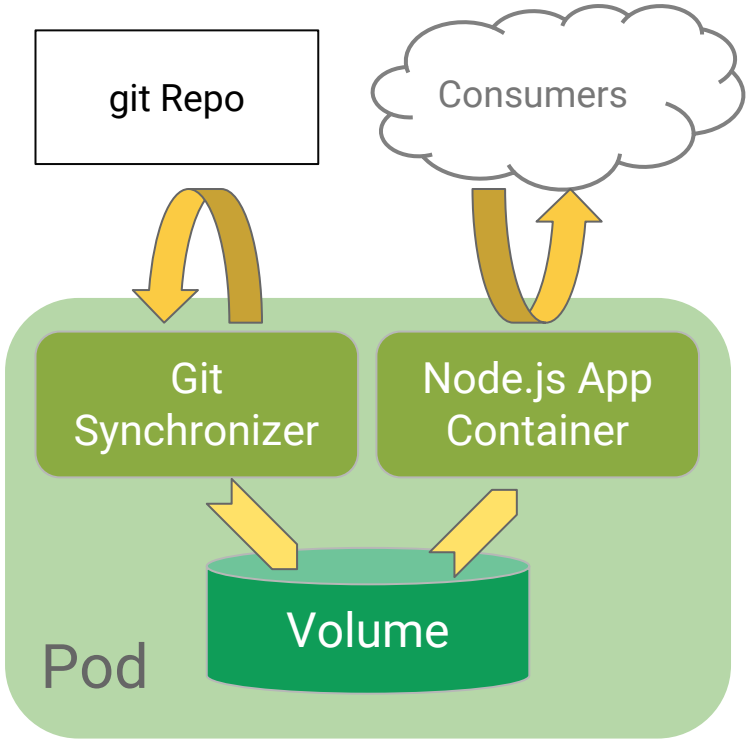
Pods

Can be used to group multiple containers & shared volumes

Containers within a pod are **tightly** coupled

Shared namespaces

- Containers in a pod share IP, port and IPC namespaces
- Containers in a pod talk to each other through localhost



Pod Networking (across nodes)

Pods have IPs which are routable

Pods can reach each other without NAT

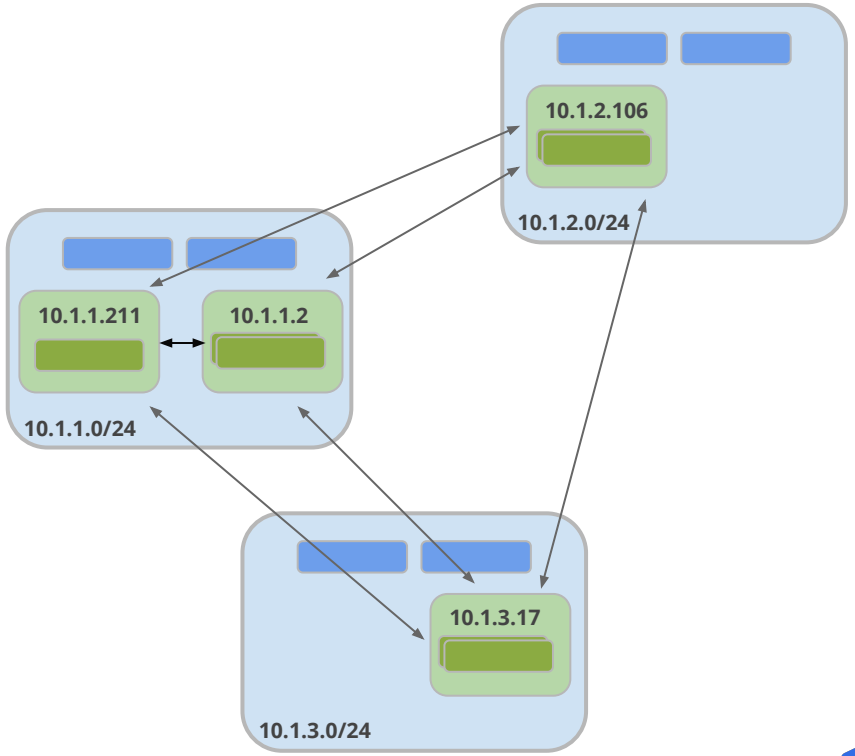
- Even across nodes

No Brokering of **Port Numbers**

These are fundamental requirements

Many solutions

- Flannel, Weave, OpenVSwitch,
- Cloud Provider



Create a service

```
$ kubectl expose rc my-nginx --port=80 --type=LoadBalancer
```

Services

A logical grouping of pods that perform the same function

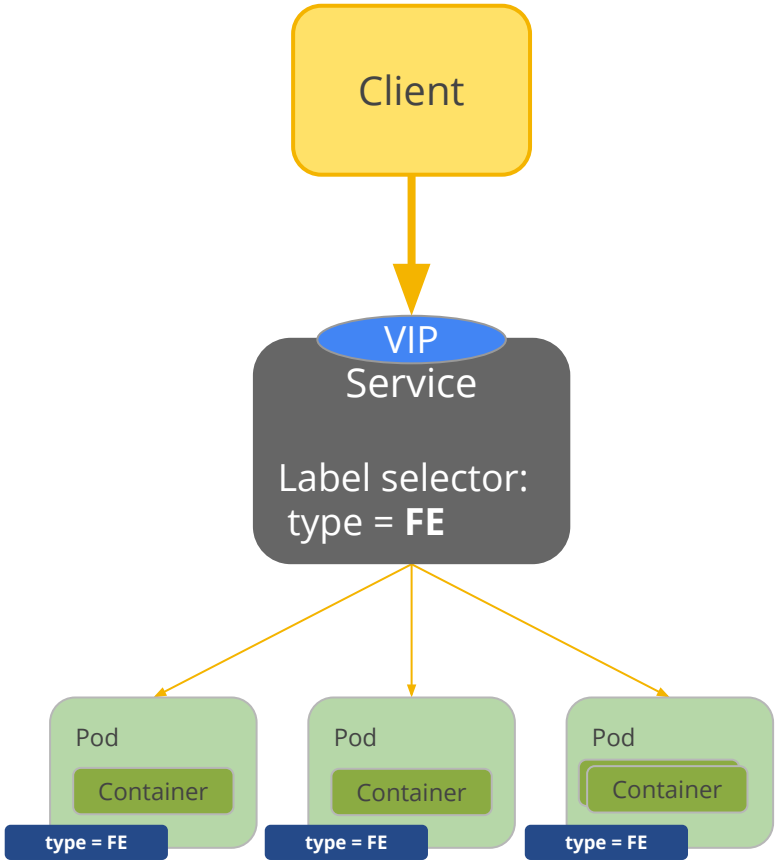
- grouped by label selector

Load balances incoming requests across constituent pods

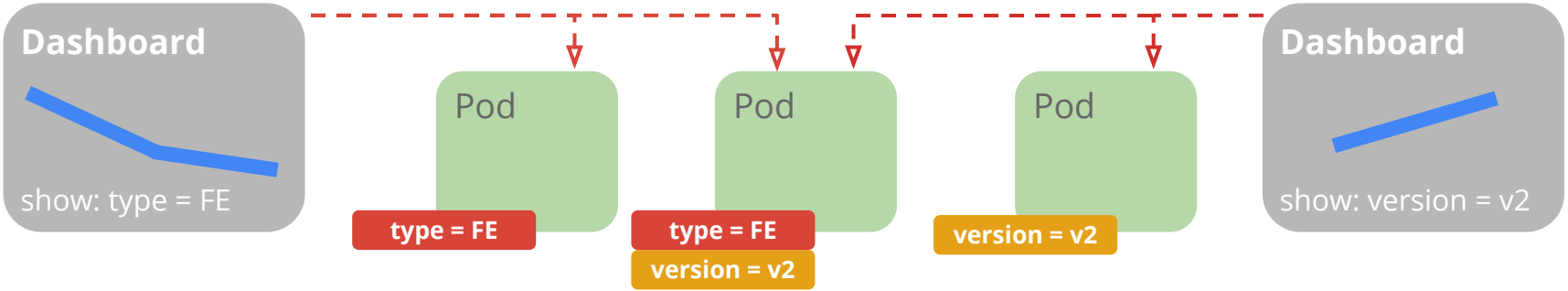
Choice of pod is random but supports session affinity (ClientIP)

Gets a **stable** virtual IP and port

- also a DNS name



Labels ← These are important



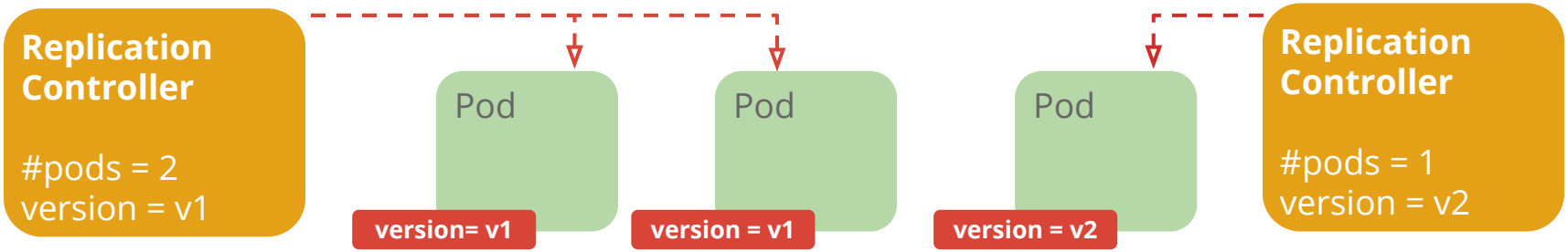
Behavior

- Metadata with semantic meaning
- Membership identifier
- The only Grouping Mechanism

Benefits

➔ Allow for intent of many users (e.g. dashboards)
➔ Build higher level systems ...
➔ Queryable by Selectors

Replication Controllers



Behavior

- Keeps Pods running
- Gives direct control of Pod #s
- Grouped by Label Selector

Benefits

- ➔ Recreates Pods, maintains desired state
- ➔ Fine-grained control for scaling
- ➔ Standard grouping semantics

Replication Controllers

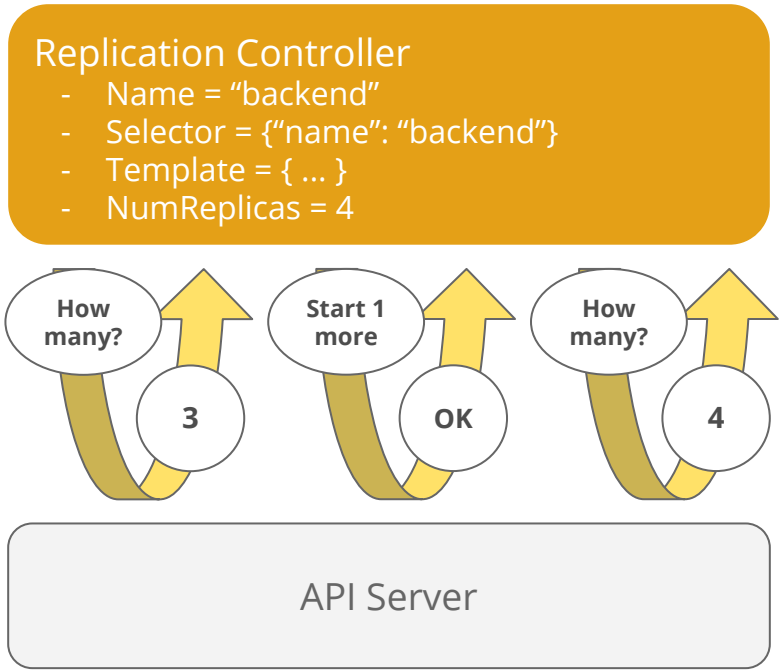
Canonical example of control loops

Have one job: ensure N copies of a pod

- if too few, start new ones
- if too many, kill some
- group == selector

Replicated pods are fungible

- No implied order or identity

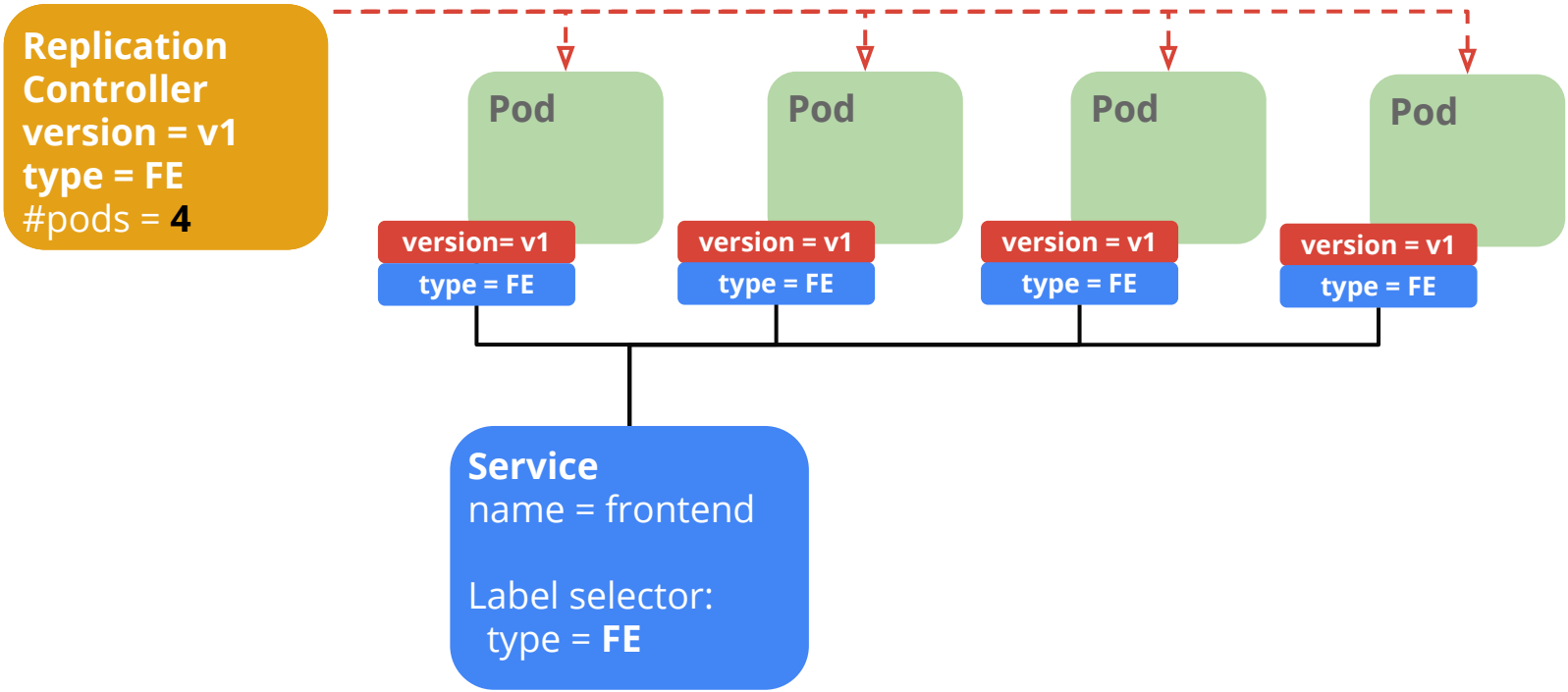


Managing Deployments

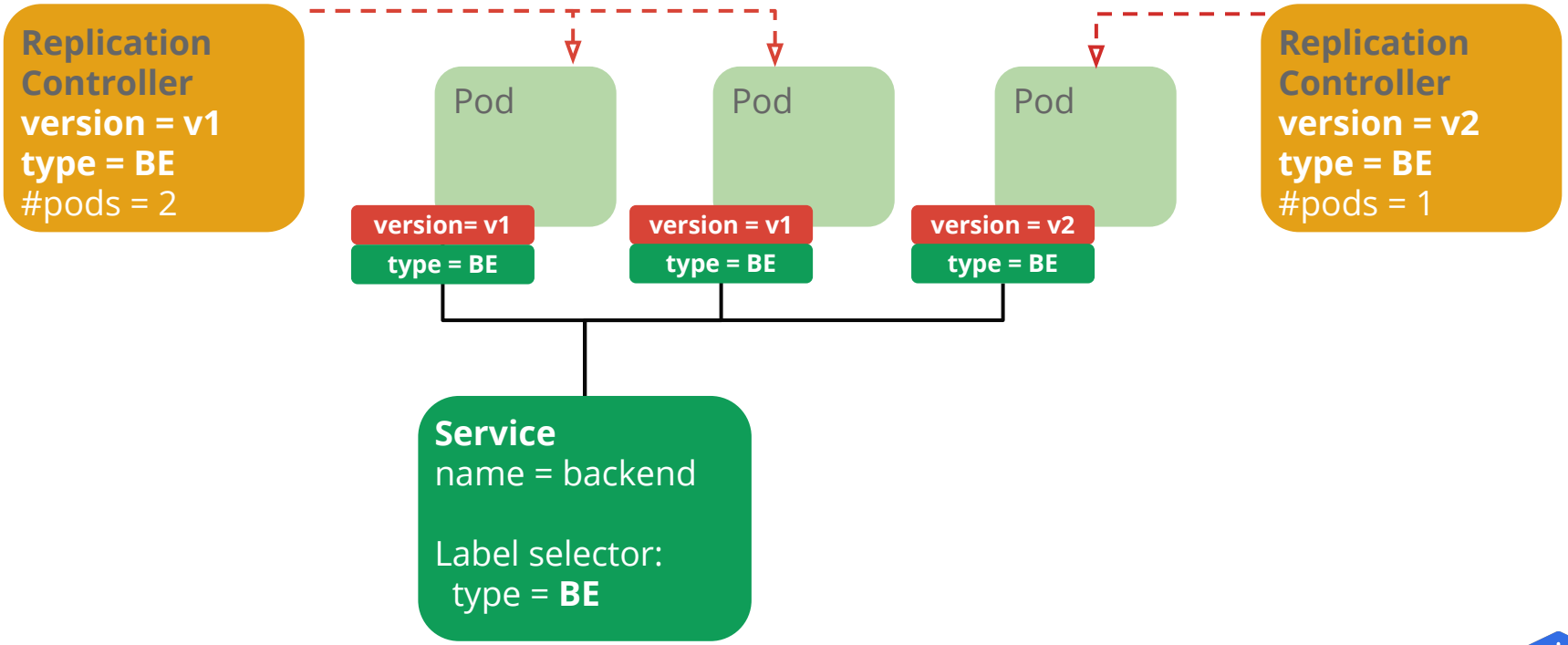
Scale

```
$ kubectl scale rc my-nginx --replicas=5
```


Scaling Example



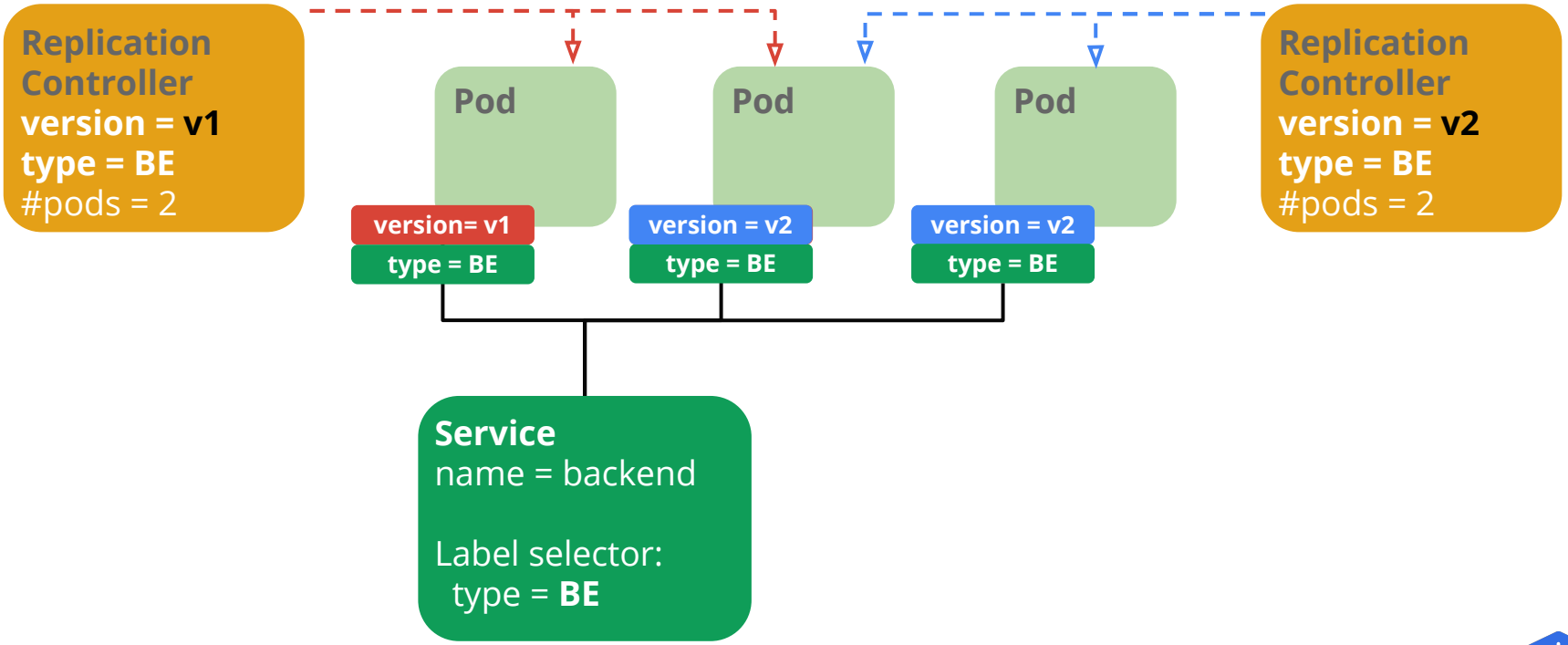
Canary


Replication Controller
version = v1
type = BE
#pods = 2
Pod
Pod
Pod
version= v1
type = BE
version = v1
type = BE
version = v2
type = BE
Replication Controller
version = v2
type = BE
#pods = 1
Service
name = backend
Label selector:
type = BE

Rolling Update

```
$ kubectl rolling-update frontend --image=frontend:v2
```

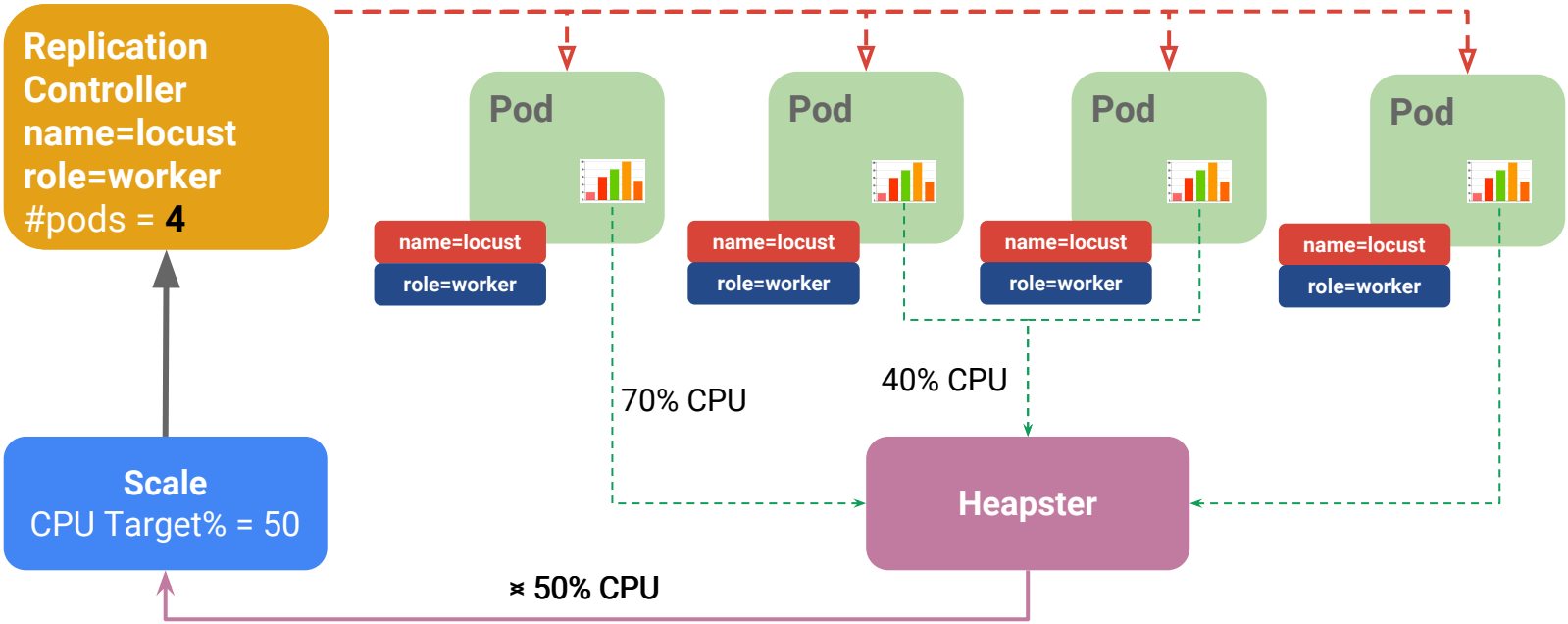
Rolling Update



Autoscale

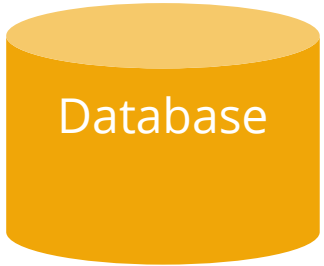
```
$ kubectl autoscale rc frontend --min=1 --max=20
```

Pod Horizontal Autoscaling Beta (1.1)



Managing State

I still have questions about state!



In a cluster of ephemeral containers

Application state must exist outside of the container

Volumes

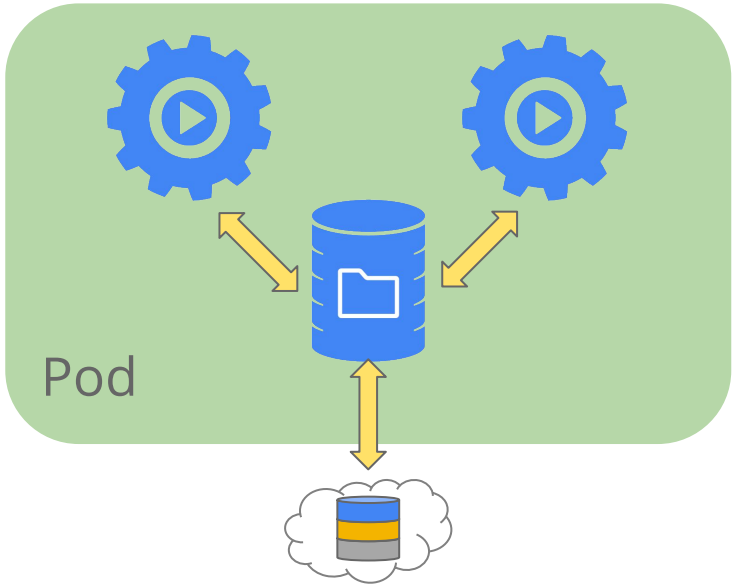
Bound to the Pod that encloses it

Look like Directories to Containers

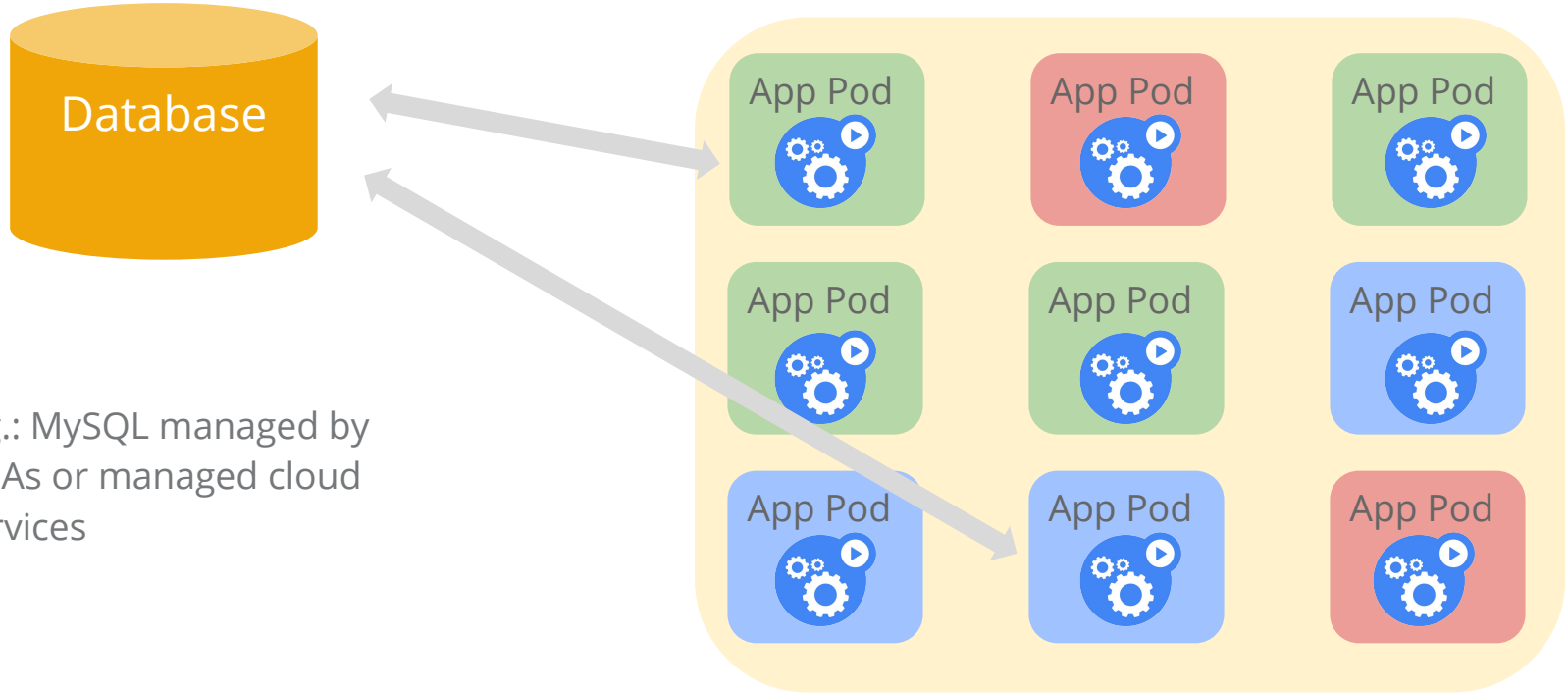
What and where they are determined by Volume Type

Many Volume options

- EmptyDir
- HostPath
- nfs, iSCSI (and similar services)
- **Cloud Provider Block Storage**

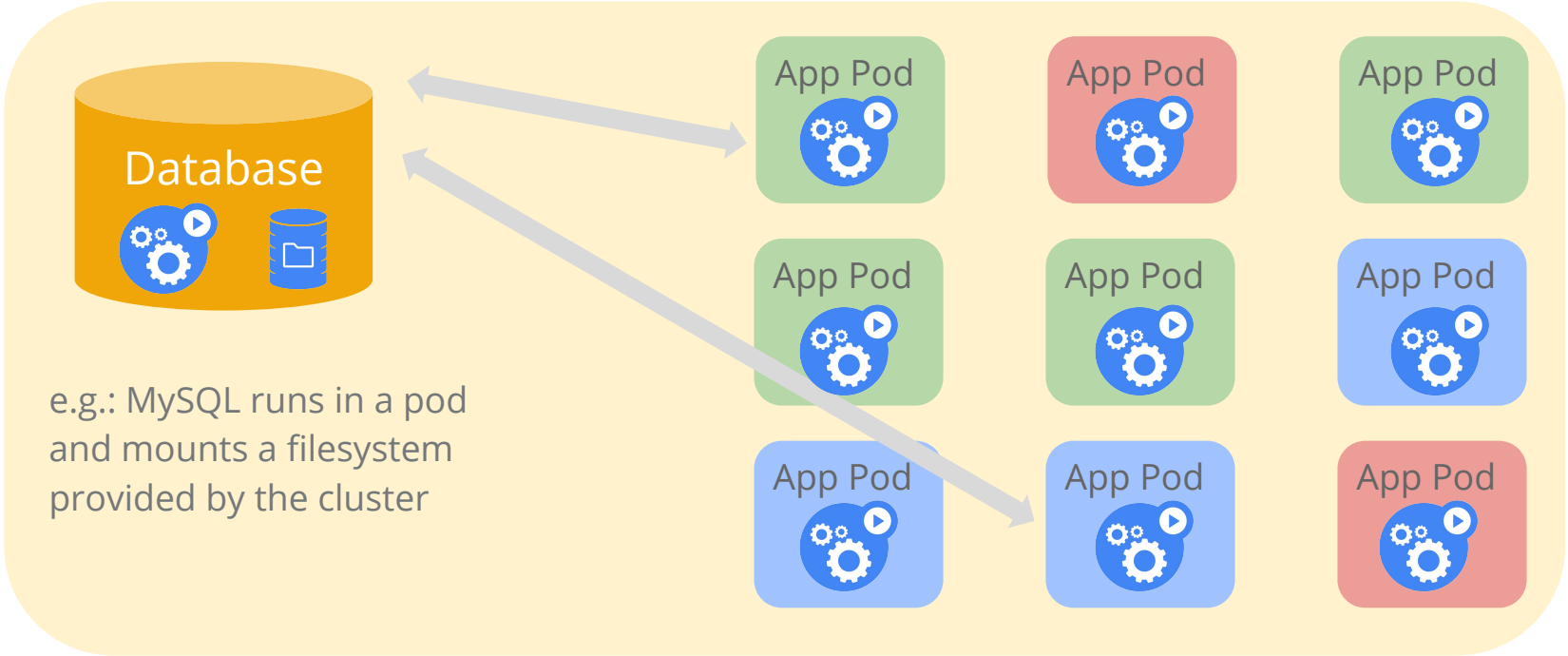


Outside the Cluster



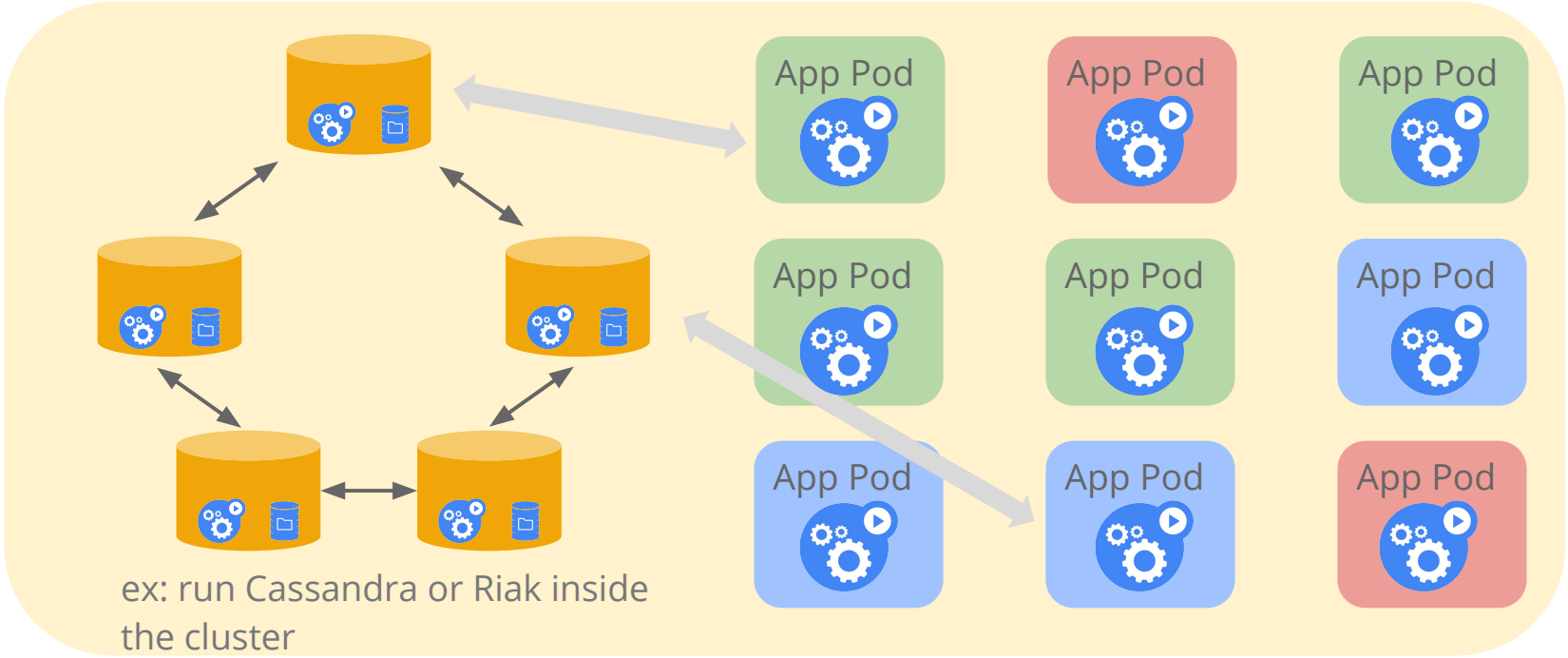
e.g.: MySQL managed by DBAs or managed cloud services

Adapt to run in the Cluster



e.g.: MySQL runs in a pod and mounts a filesystem provided by the cluster

Cluster Native



Cluster native - MySQL on Vitess

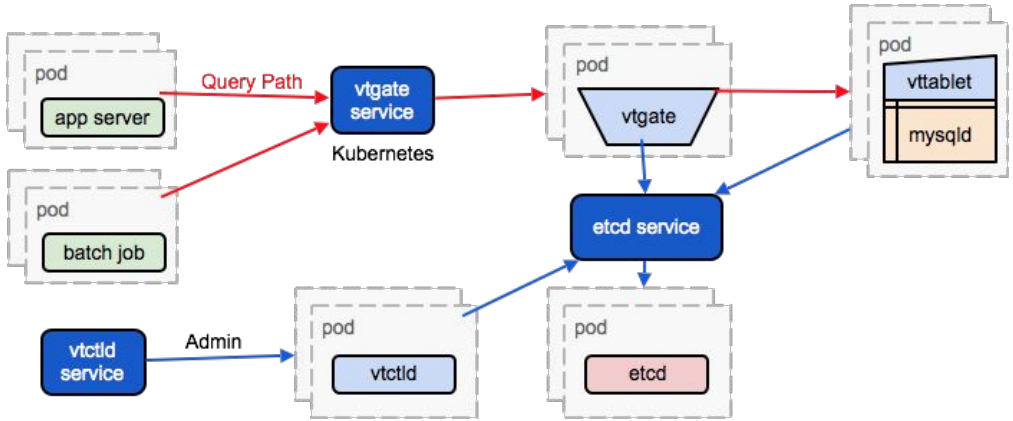
Open source MySQL scaling solution

Vitess has been serving all YouTube database traffic since 2011

Replication, dynamic sharding, caching and more

Designed for a distributed, containerized world

Kubernetes configs included



http://vitess.io/

Secrets

Problem: how to grant a pod access to a secured something?

- don’t put secrets in the container image!

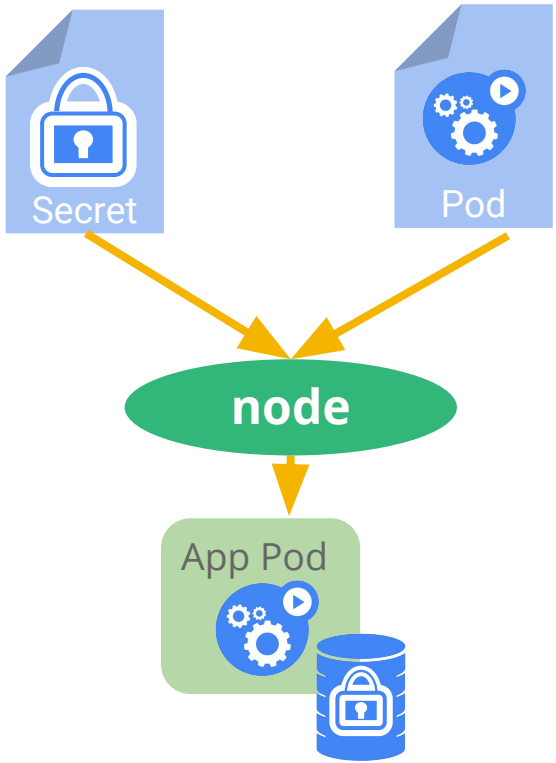
12-factor says: config comes from the **environment**

- Kubernetes is the environment

Manage secrets via the Kubernetes API

Inject them as virtual volumes into Pods

- late-binding
- tmpfs - never touches disk



Wrap-up

Kubernetes status & plans

Open sourced in June, 2014

v1.0 in July, 2015, v1.1 in November 2015

Google Container Engine (GKE)

- hosted Kubernetes - don't think about cluster setup
- GA in August, 2015

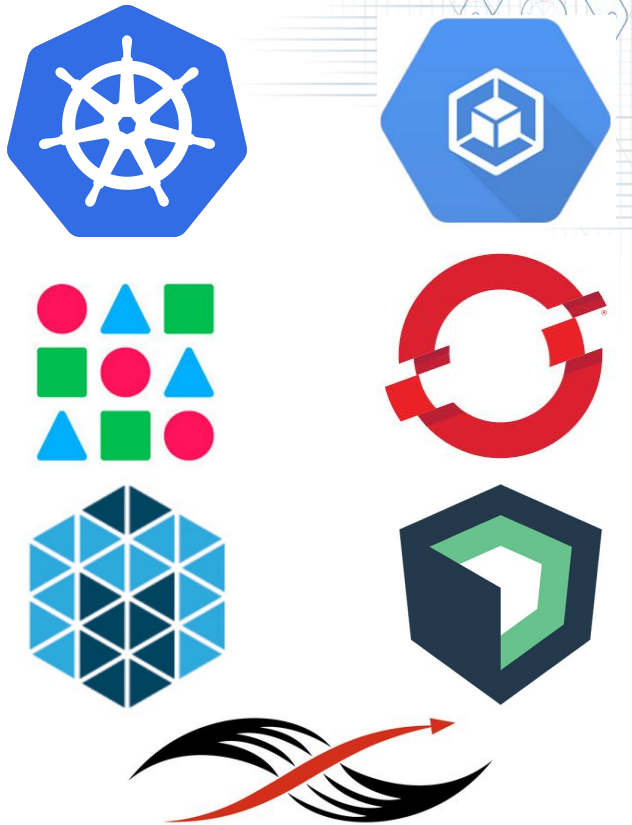
PaaSes:

- RedHat OpenShift, Deis, Stratos

Distros:

- CoreOS Tectonic, Mirantis Murano (OpenStack), RedHat Atomic, Mesos

Working towards a 1.2 release



Google Container Engine (GA) -- Demo

Managed Kubernetes (Kubernetes v1.1)

Manages Kubernetes master uptime

Manages Updates

Cluster Resize via Managed Instance Groups

Cluster Node Autoscaling

Centralized Logging

Google Cloud VPN support

Kubernetes is **Open Source**

We want your help!

http://kubernetes.io

https://github.com/GoogleCloudPlatform/kubernetes

Slack: #kubernetes-users

@kubernetesio

PaaS

Container Clusters

Virtual Machines

Physical Computers

Your app?

Tweet questions afterwards to:
@briandorsey

Slides: goo.gl/NI1GaM

Questions

goto; conference

Please

Remember to rate session

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