

Kubernetes by Example



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Kubernetes by Examples

- Motivation
- Kubernetes Revisit
 - Cluster Architecture
 - Concepts
- Activities
 - Stateless Deployment
 - Stateful Deployment
 - Pod Scaling

Problem with data center

Static Partitioning

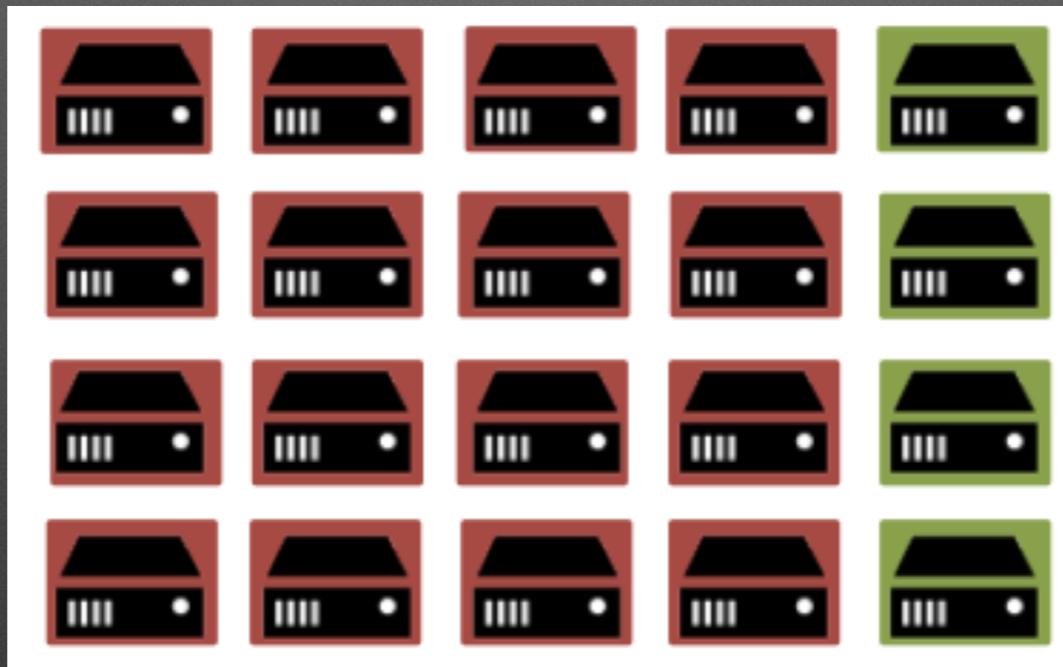


Static Partitioning is Bad



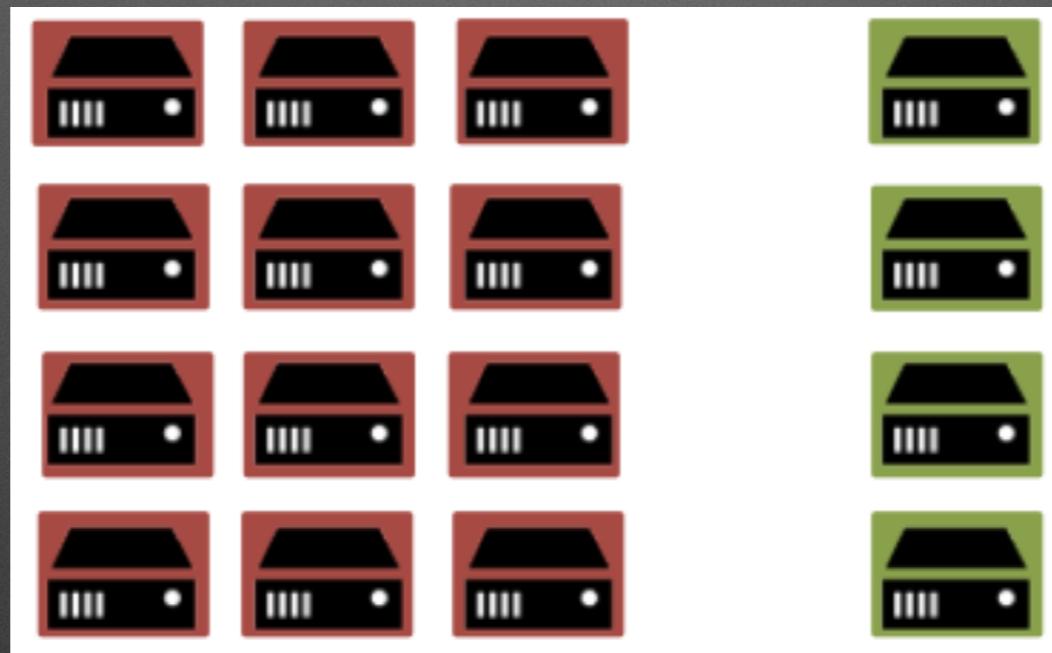
hard to utilize machines
(i.e., X GB RAM and Y CPUs)

Static Partitioning does NOT scale



hard to scale elastically
(to take advantage of
statistical multiplexing)

Failures === Downtime



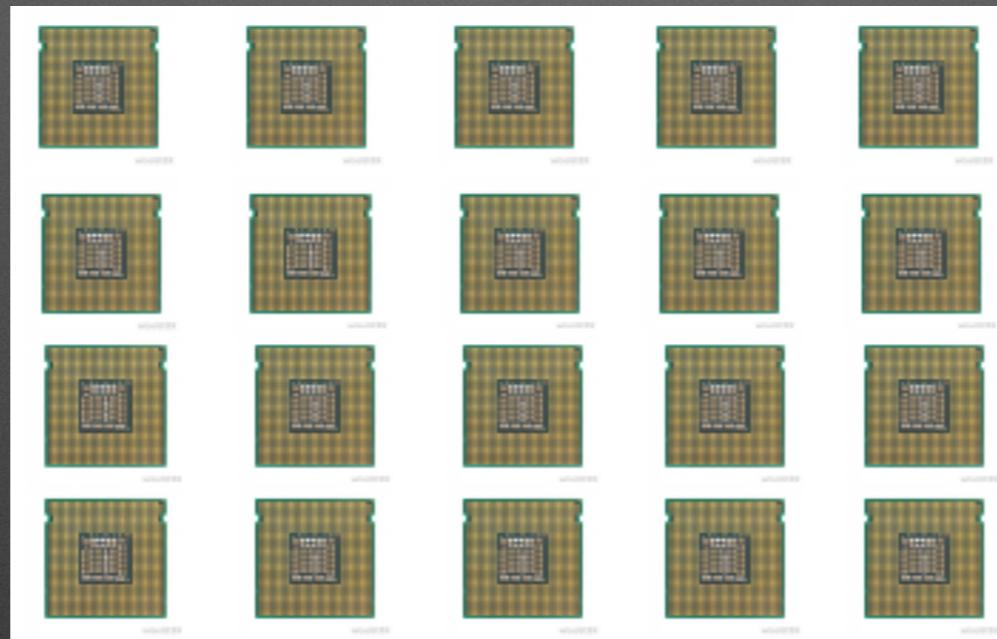
hard to deal with failures

It doesn't have to be that way



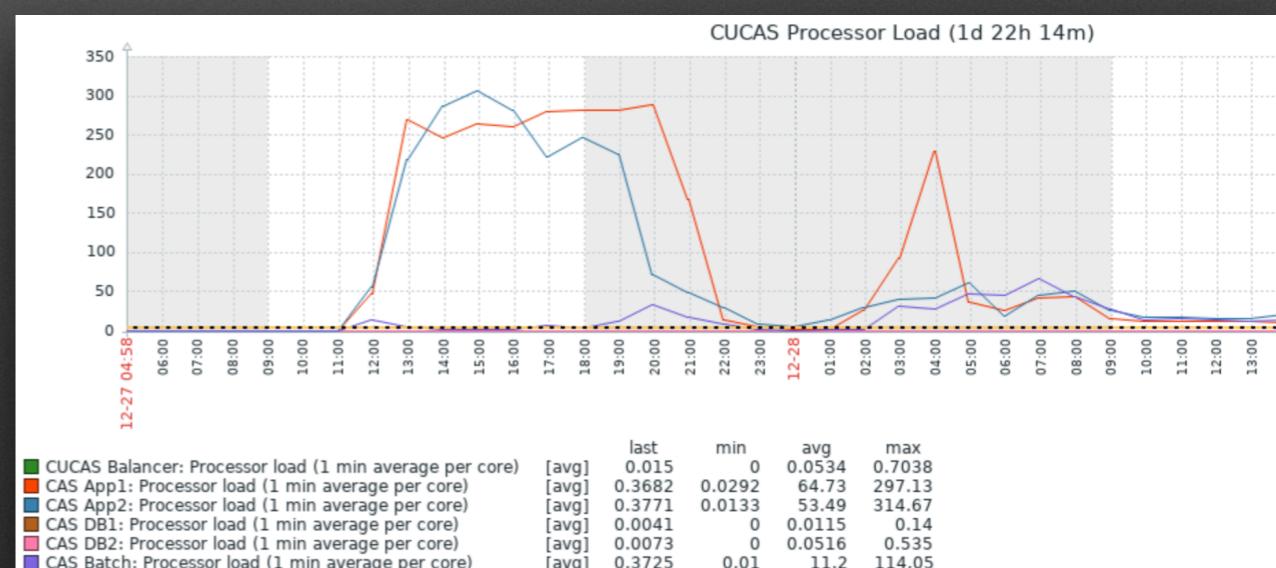
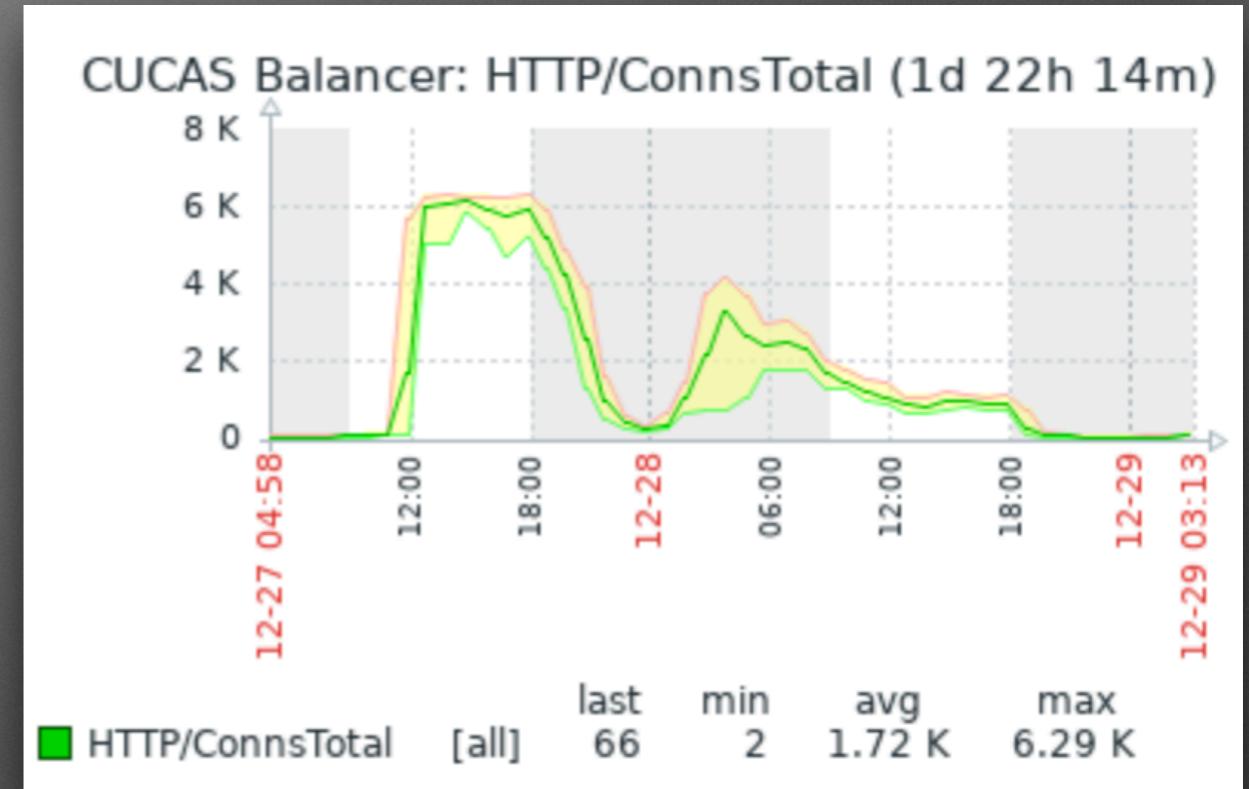
Kubernetes === Datacenter

DCOS(Mesos) === Datacenter



A case study of Chula CUCAS

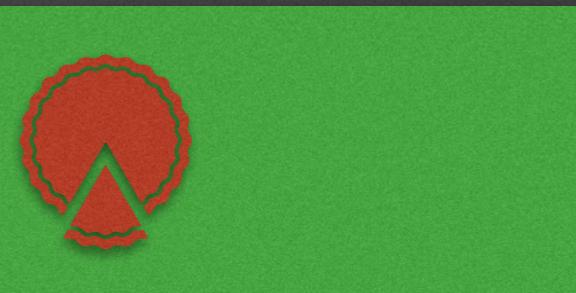
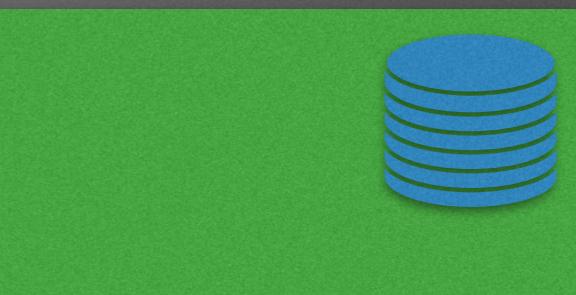
- 40,000 users throughout the campus every semesters.
- Human behaviors is a poison distribution.
(Students tend to do it on the last few days.)
 - few user through the year.
Peak at 6K users in a day.
- Limited resources
(only 5 servers with the total of 42 cores, 80 GB RAM)



Case Study

Normal Workload

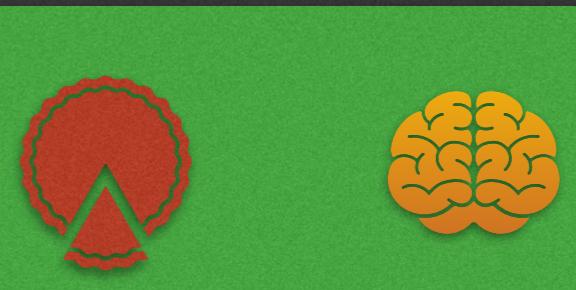
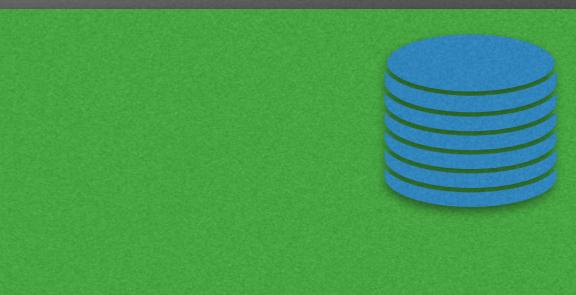
Load Balancer
Proxy



Case Study

Average Workload

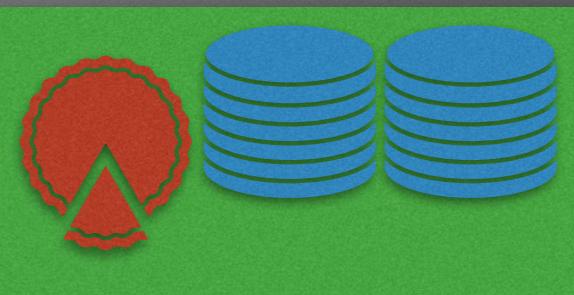
Load Balancer
Proxy



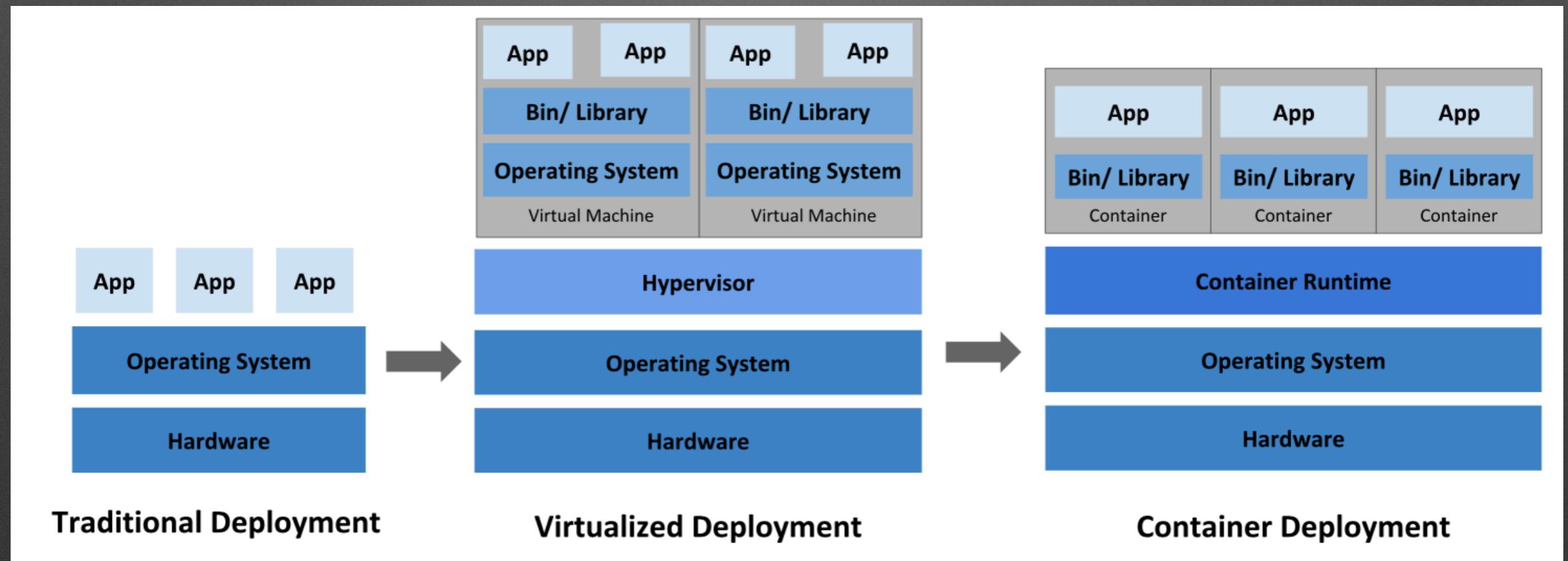
Case Study

High Workload

Load Balancer
Proxy



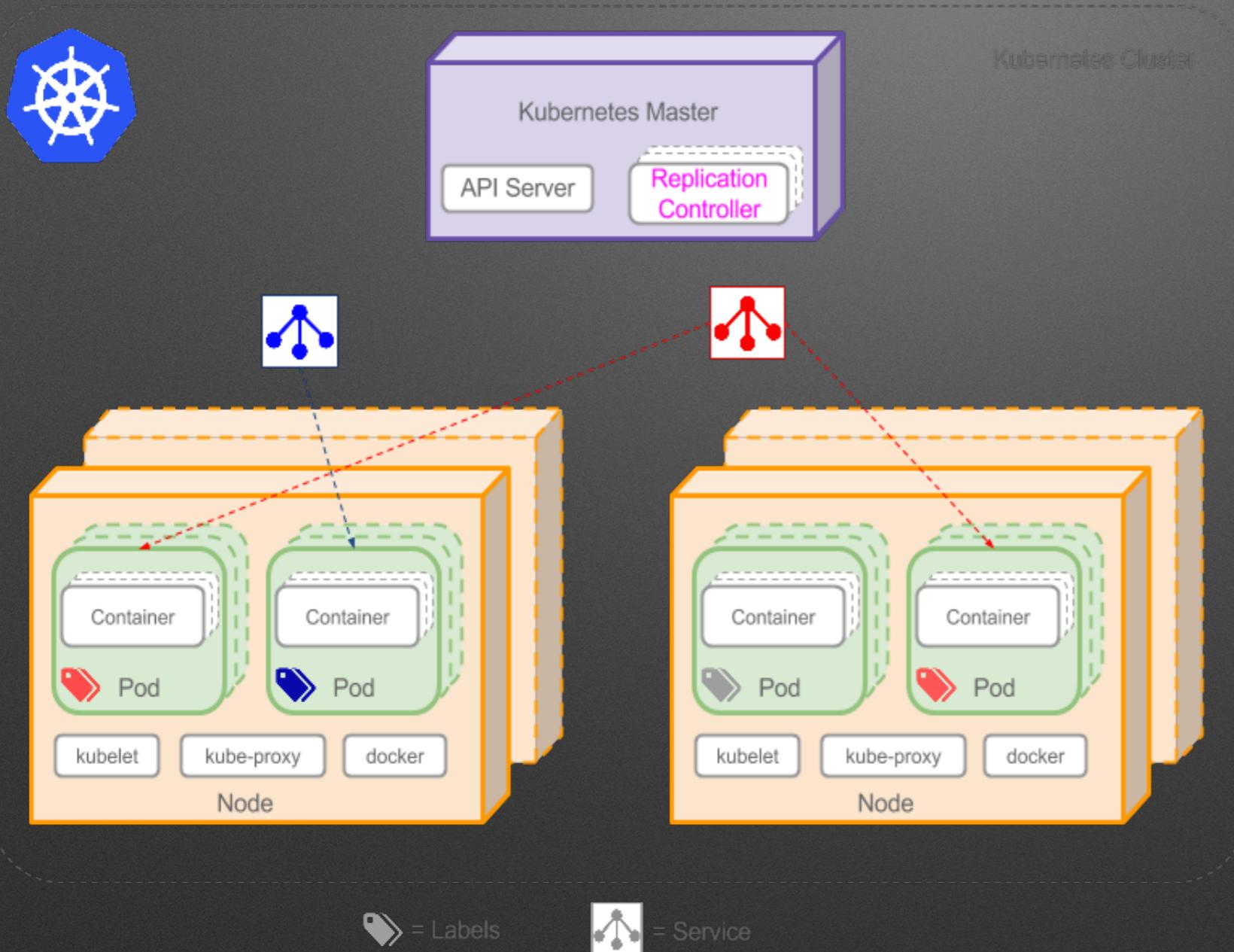
Life before Kubernetes



Kubernetes Concepts (Revisit)

- Cluster Architecture
- Workloads
 - Pod
 - A set of containers
 - Controllers
 - Deployments
 - ReplicaSet
 - DaemonSet
 - StatefulSets
 - CronJob
 - Job (batch)
- Services
- Ingress (Reverse Proxy)
- Storage
- Volumes/Claims

Cluster Architecture



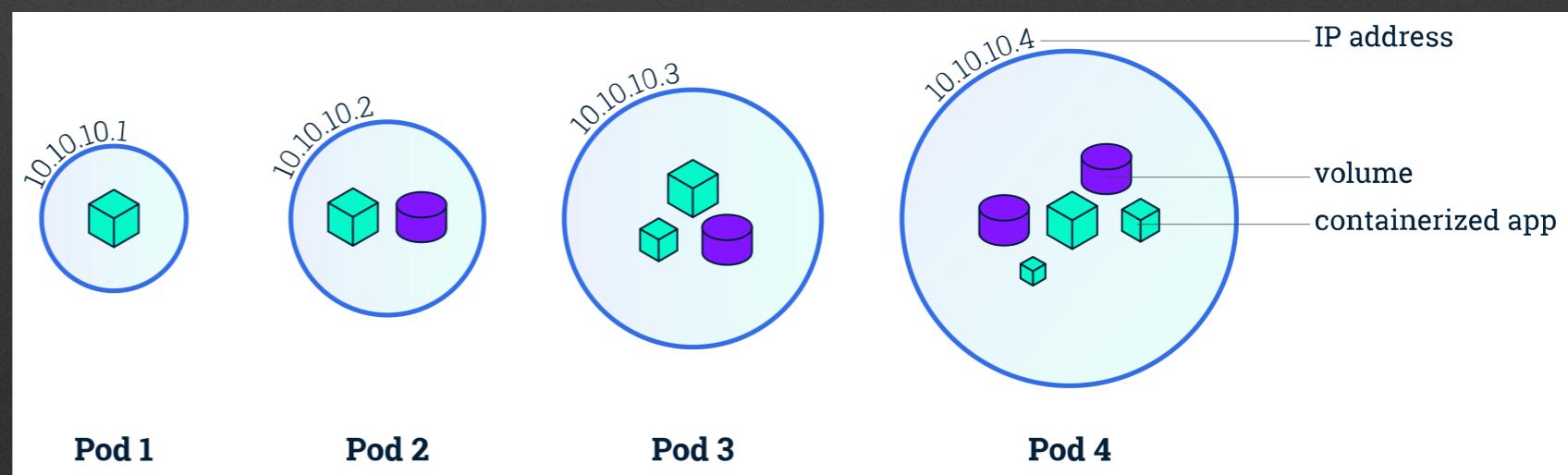
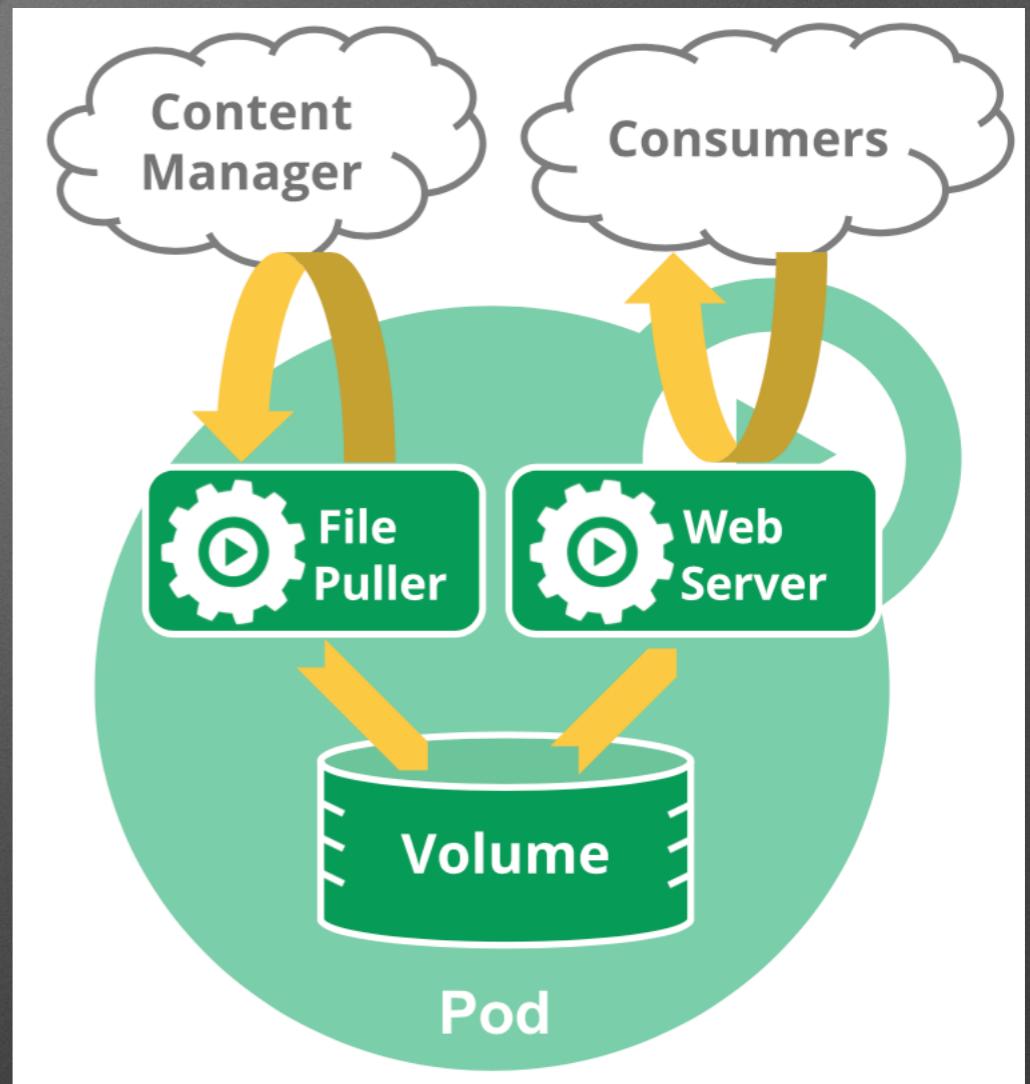
Kubernetes provides:

- Service Discovery and load balancing
- Storage Orchestration
- DevOps Operation
 - Rolling update
- Self Healing
- Secret and Configuration Management
- scheduling
(container placement)



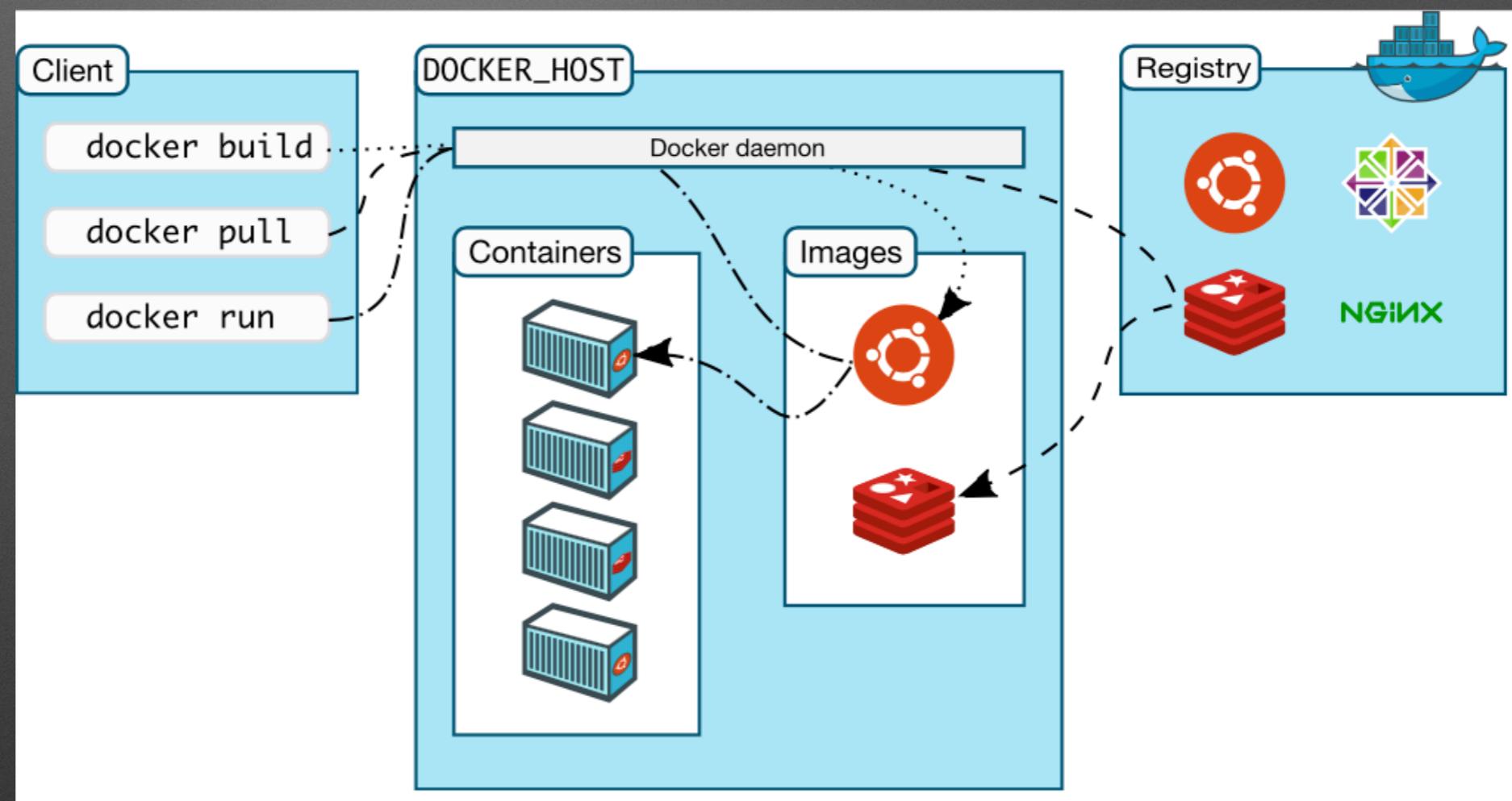
Pods

- A pod is a single set of containers.
- A container is an instance of image from registry.
- One IP per pod (think of it as a machine)
- Pod
 - App Container(s)
 - Sidecar Container
 - Init Container
 - Adapter



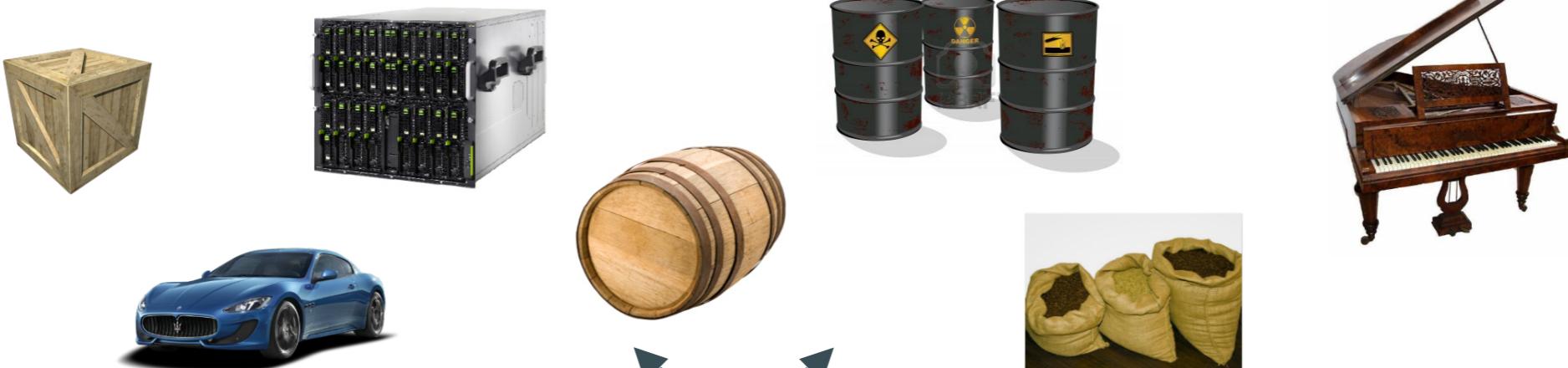
Containers

- Same as docker containers.
- An instance of predefined image pulling from registry.



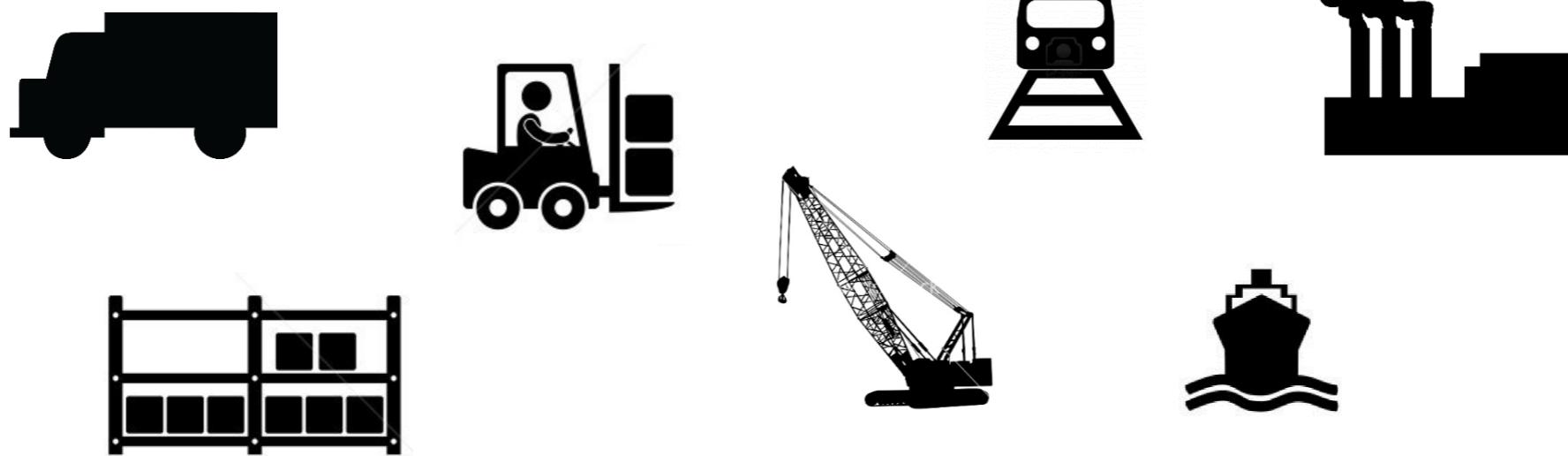
Cargo Transport Pre-1960

Multiplicity of Goods



Do I worry about how goods interact (e.g. coffee beans next to spices)

Multiplicity of methods for transporting/storing



Can I transport quickly and smoothly (e.g. from boat to train to truck)



Picture from docker public presentation

Also a matrix from hell

	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
							

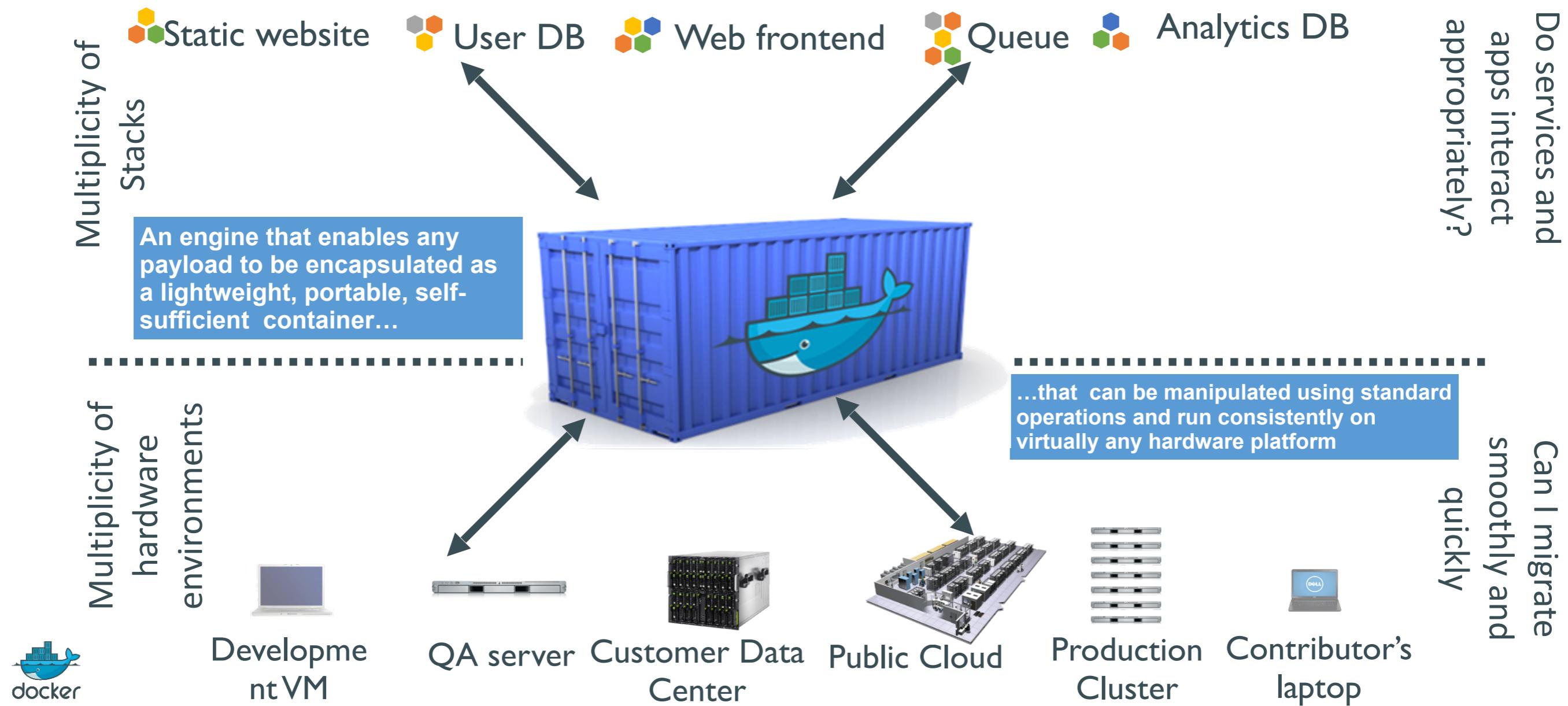


Picture from docker public presentation

Solution: Intermodal Shipping Container



Docker is a shipping container system for code



Picture from docker public presentation

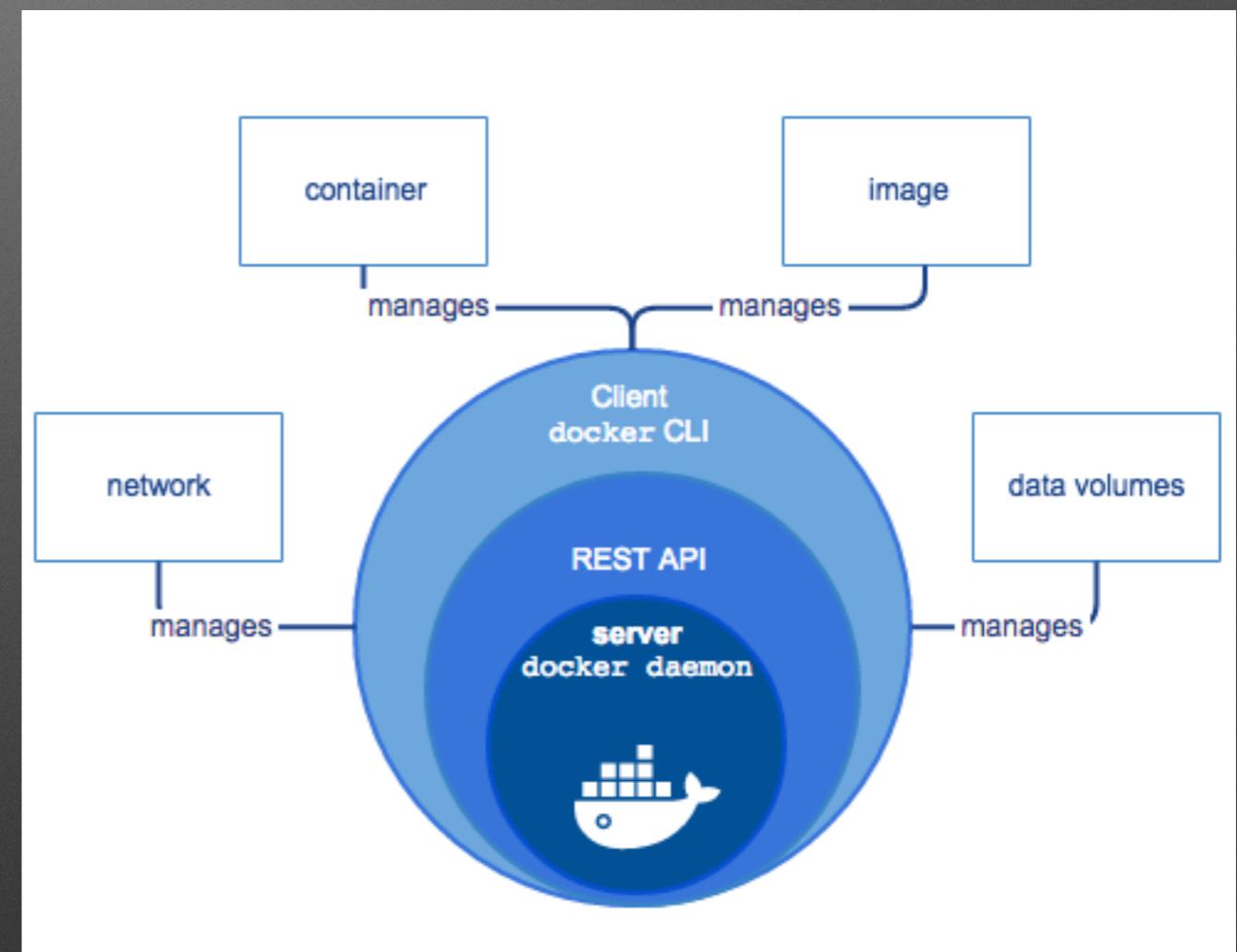
Docker eliminates the matrix from Hell

	Static website							
	Web frontend							
	Background workers							
	User DB							
	Analytics DB							
	Queue							
	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor's laptop	Customer Servers	
								

Picture from docker public presentation

Containers

- Docker/Container Abstraction
 - Storage
 - Network
 - Management (start/stop)



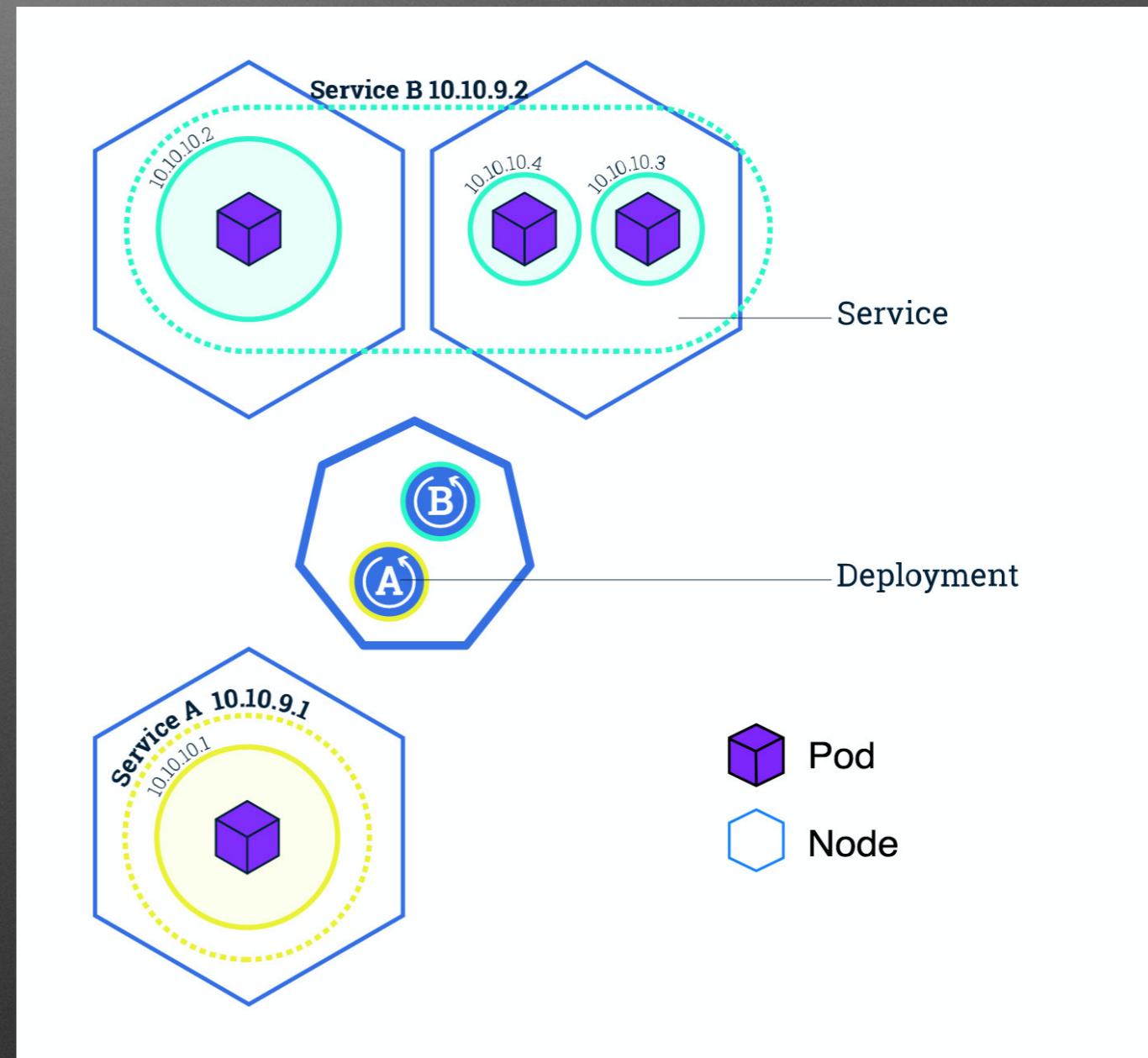
Controllers

- Deployments
 - ReplicaSet + Pod
- StatefulSet
 - Deployments with naming scheme (e.g. pod-0, pod-1,)
- DaemonSet
 - One pod per node
- Job - run until complete
- CronJob - Scheduled Job
(similar to cron on Linux/Unix)

Services

Group deployments together as a unit of service

- Expose a deployment to the network for others to use.
- Headless Service - use internally in the cluster
- Standard Service - associated with a cluster IP or nodes port or host port. (port map)



Ingress/Load Balancing

Smart uses of resources (network)

- Manage external access to services (HTTP, HTTPS)
- 2 features
 - Share IPs with several host name (named virtual host)
 - Map several services to different paths of a host
 - **www.example.com (10.0.0.1) - sample-service**
 - **/app1/ - to app1-service**
 - **/app2/ - to app2-service**
 - **www.test.com (10.0.0.1) - test-service**

Storage

- Volume - a storage drive
 - attached to a pod,
(deleted when the pod is deleted)
- Persistent Volumes
 - Persist without POD
 - Static - local disk, network fs
 - Dynamic - provisioning on demand

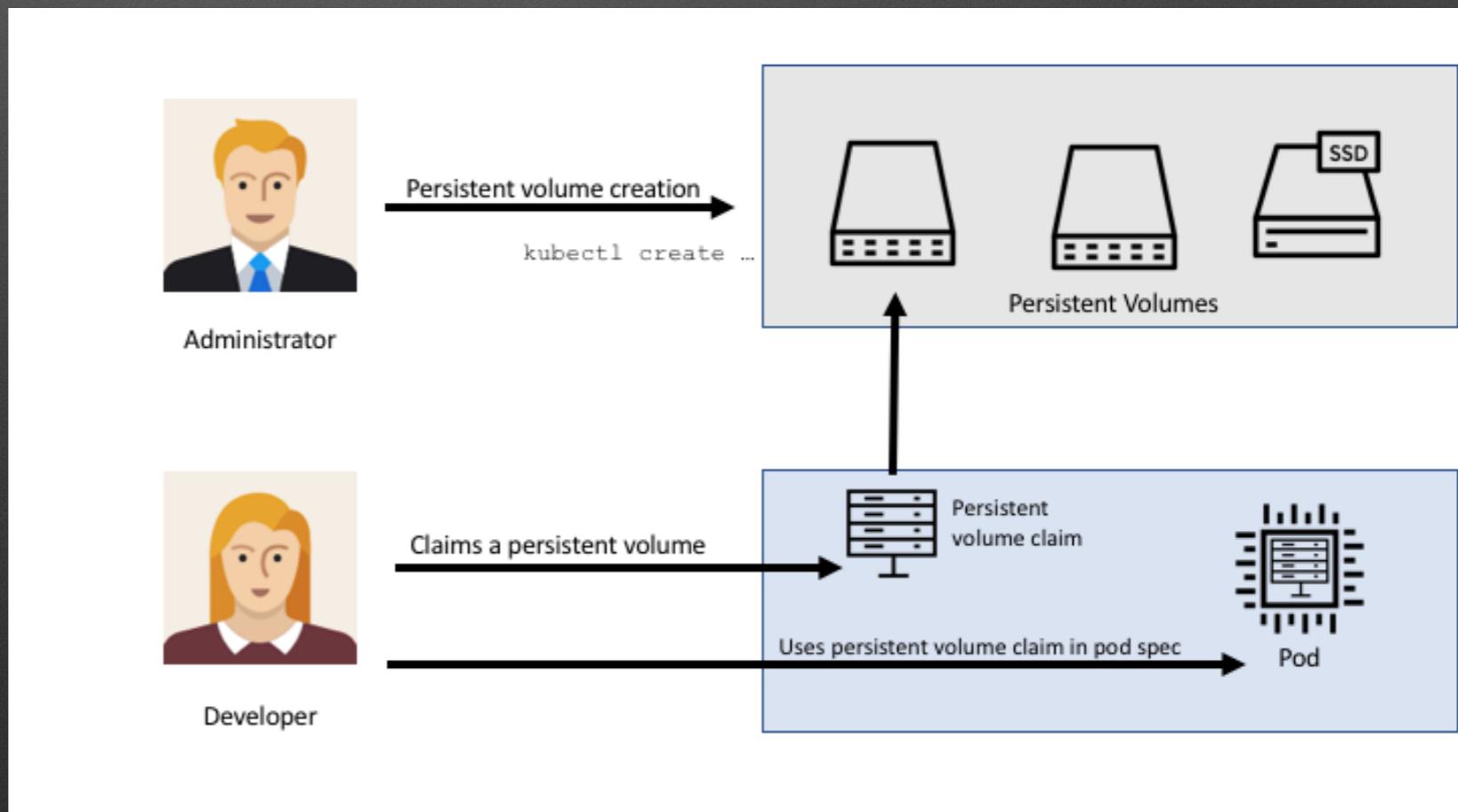
Types of Volumes

Kubernetes supports several types of Volumes:

- awsElasticBlockStore
- azureDisk
- azureFile
- cephfs
- cinder
- configMap
- csi
- downwardAPI
- emptyDir
- fc (fibre channel)
- flexVolume
- flocker
- gcePersistentDisk
- gitRepo (deprecated)
- glusterfs
- hostPath
- iscsi
- local
- nfs
- persistentVolumeClaim
- projected
- portworxVolume
- quobyte
- rbd
- scaleIO
- secret
- storageos
- vsphereVolume

Dynamic Volumes

- Dynamically claim (using Persistent Volume Claim) from storage class (a storage lot for allocation units)
- Pods view the claims as volumes.



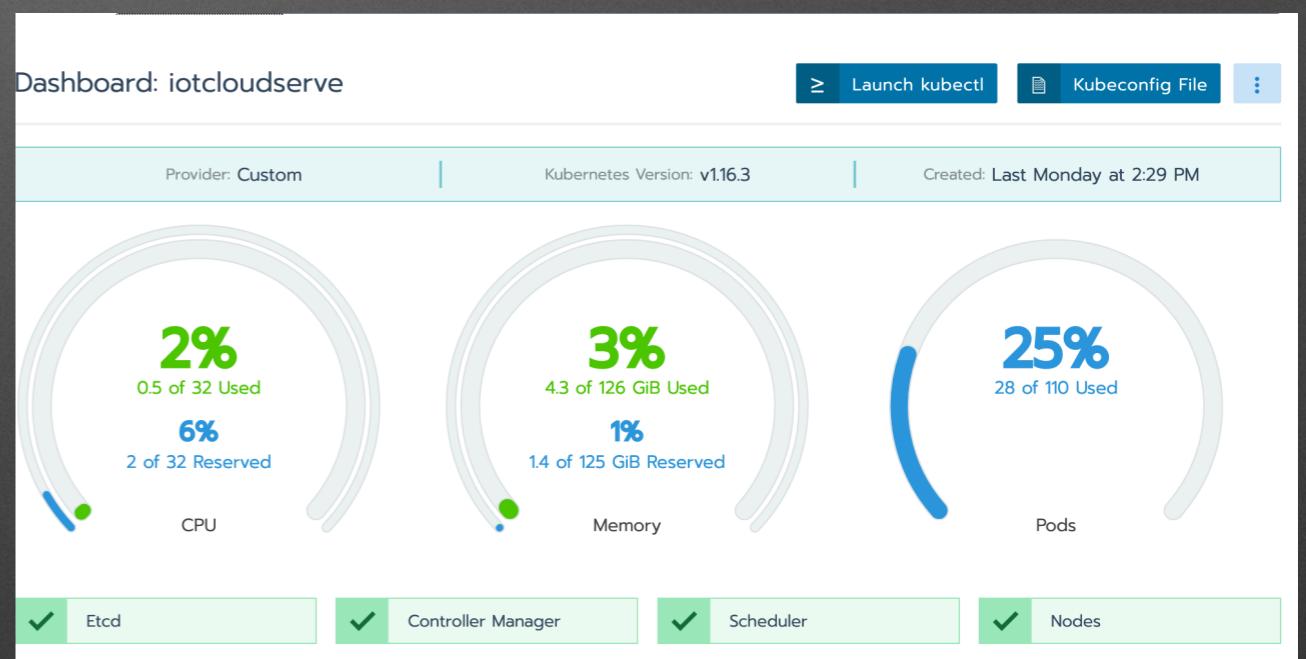
Picture from <https://portworx.com/tutorial-kubernetes-persistent-volumes/>

Horizontal Pod Autoscaling

- Monitor the resources of the POD
- Scaling according to rules (CPU, Memory)

Rancher

- An open-source CNCF certified kubernetes distribution. Jointly developed by RedHat and Rancher Labs.
- Easy GUI for Kubernetes.



Let's try it.