Why Do we need Container Orchestration?

Containers are Good…

- Both Linux Containers and Docker Containers
  - Isolate the application from the host

FASTER, RELIABLE, EFFICIENT, LIGHTWEIGHT, AND SCALABLE

Containers Problems!

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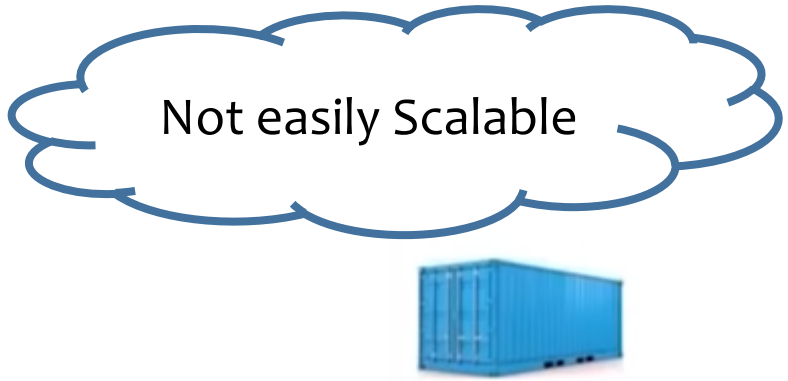
  - Isolate the application from the host



FASTER, RELIABLE, EFFICIENT, LIGHTWEIGHT, AND SCALABLE

Containers Problems!

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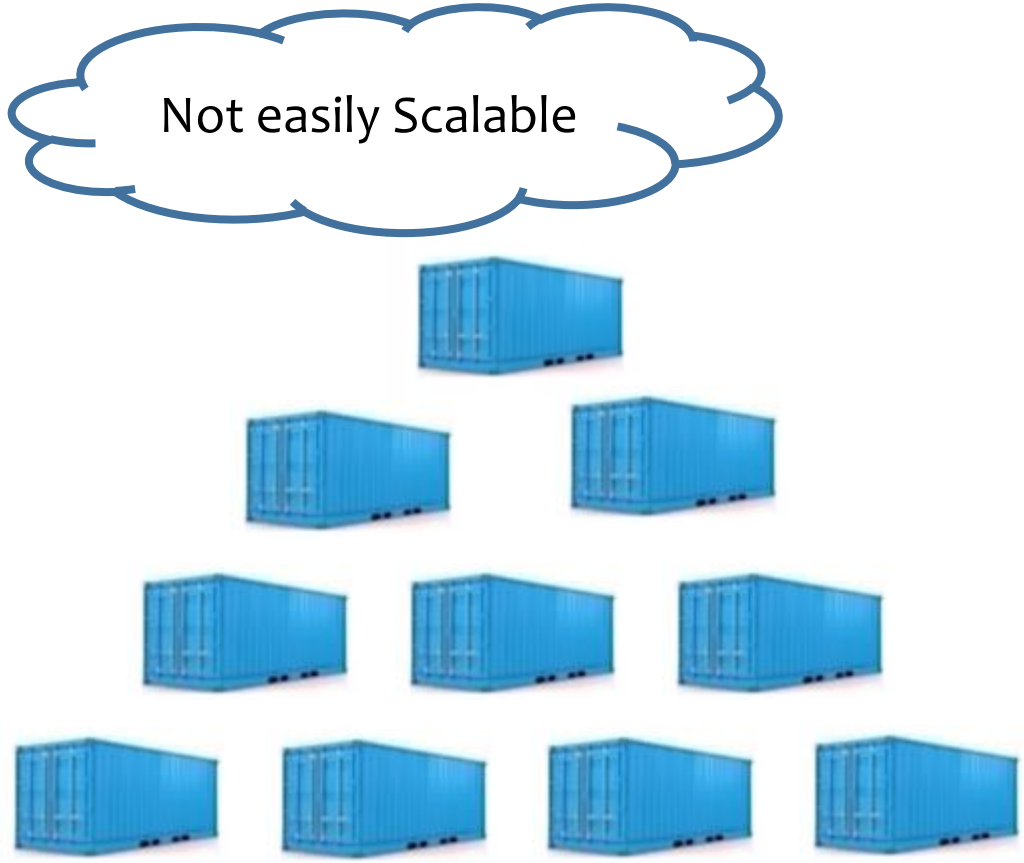
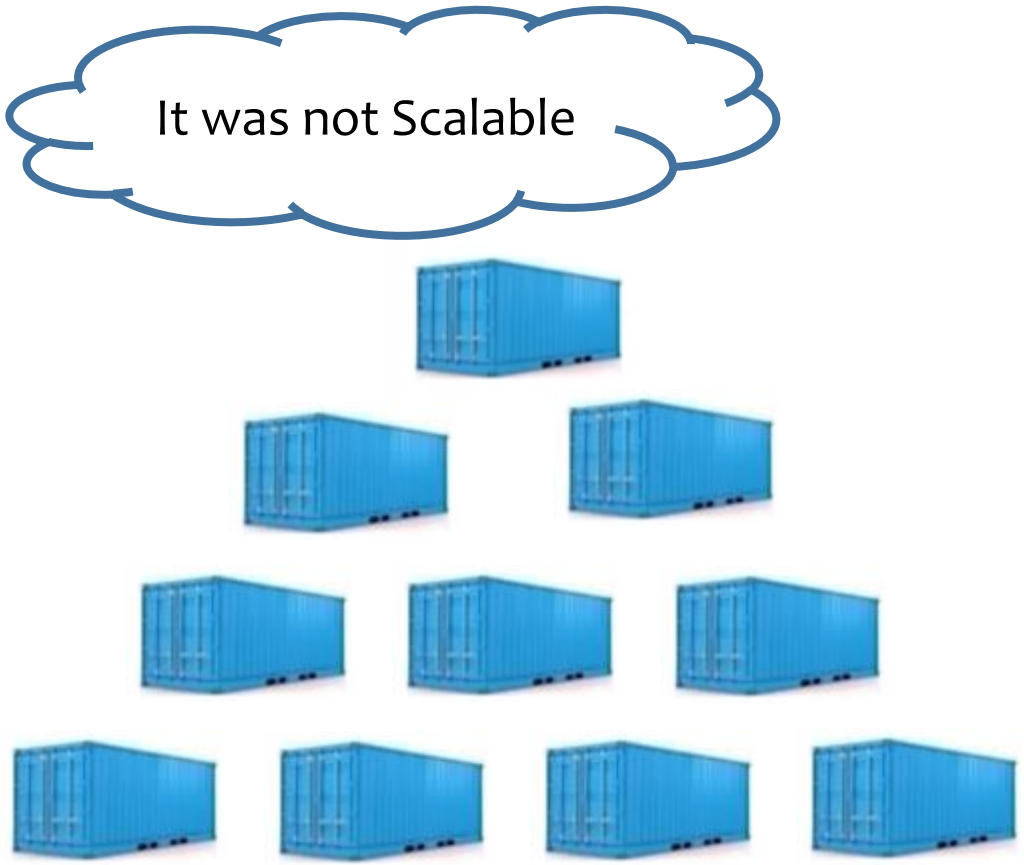


FASTER, RELIABLE, EFFICIENT, LIGHTWEIGHT, AND SCALABLE

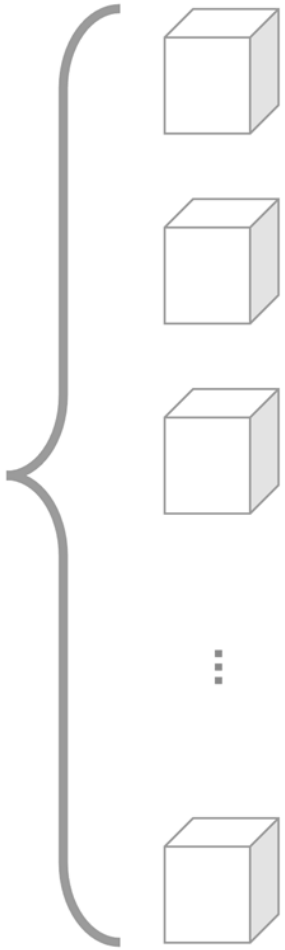
Problems with Scaling up Containers



1. Containers could communicate with each other
2. Containers had to be deployed appropriately
3. Containers had to be managed carefully
4. Auto scaling was not possible
5. Distributing traffic was still challenging

Containers Without Orchestration

run **Services** in **Containers**



without **container orchestration**

scaling up services → manual work **increases**	fixing crashing nodes → manual work **increases**
complexity for running new stuff in production **increases**	human cost for running services **increases**
scaling becomes more and more **difficult**	public cloud providers bill more and more **expensive**

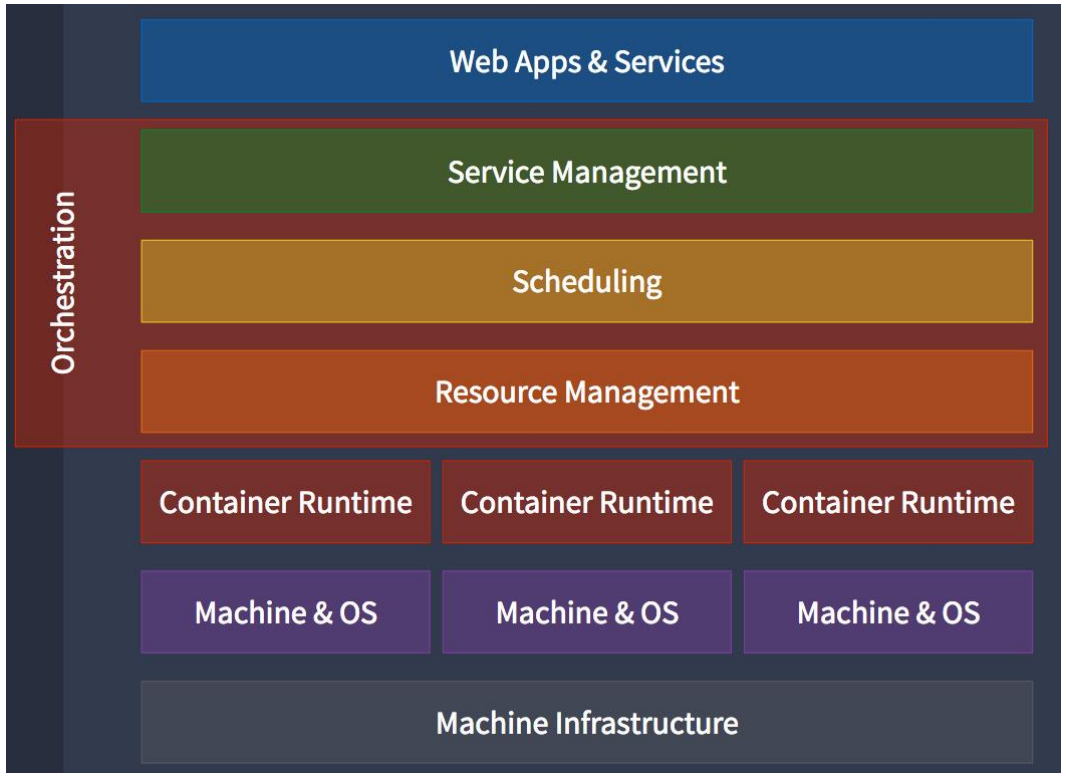
Container Orchestration

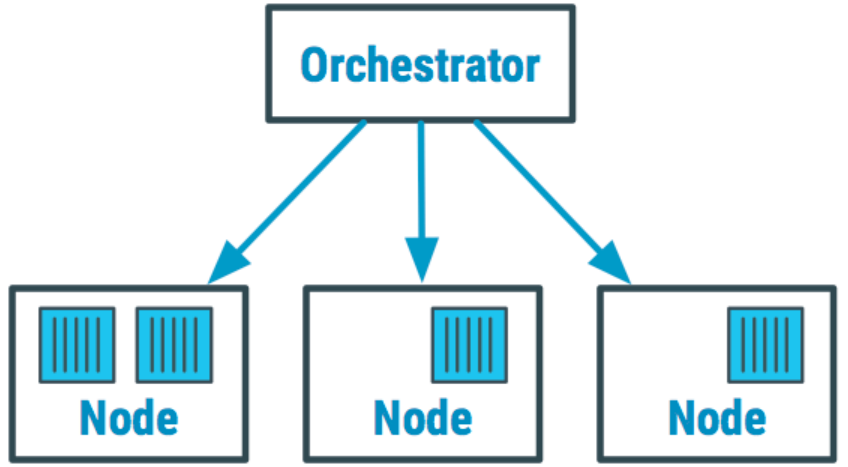
What is container orchestration?

- Container orchestration is the automation of much of the operational effort required to run containerized workloads and services.
- This includes a wide range of things software teams need to manage a container's lifecycle, including:
  - provisioning,
  - deployment,
  - scaling (up and down),
  - networking,
  - load balancing and more.

Container Orchestration

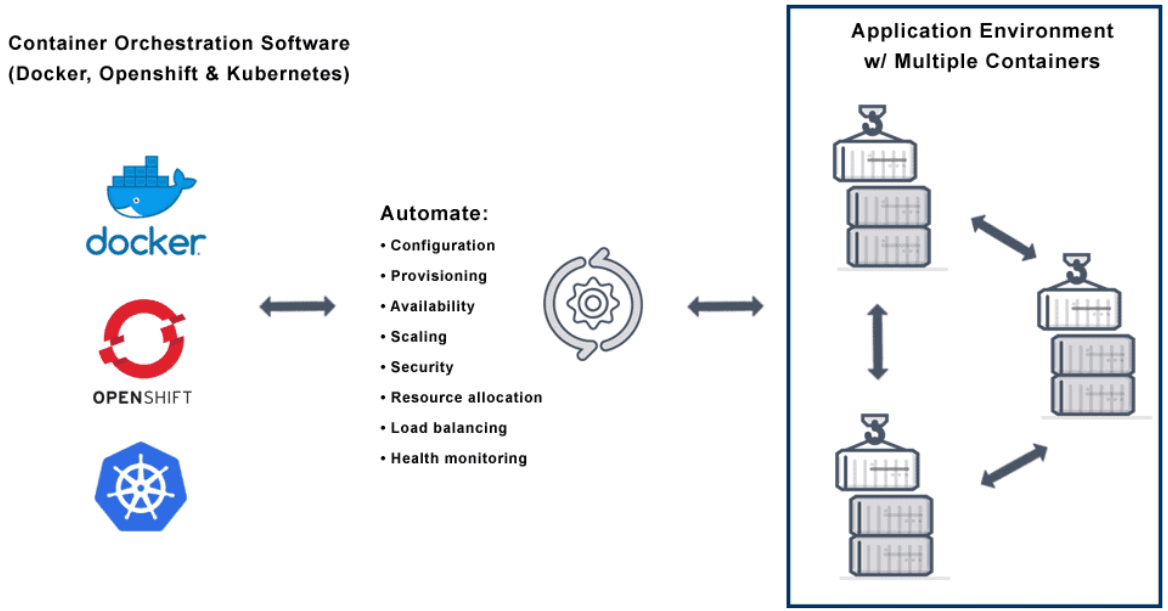
- Container orchestration automates and simplifies provisioning, and deployment and management of containerized applications.





Container Orchestration

- Container orchestration is the automatic process of managing or scheduling the work of individual containers for applications based on microservices within multiple clusters.
- The widely deployed container orchestration platforms are based on open-source versions like Kubernetes, Docker Swarm or the commercial version from Red Hat OpenShift.



Container Orchestration

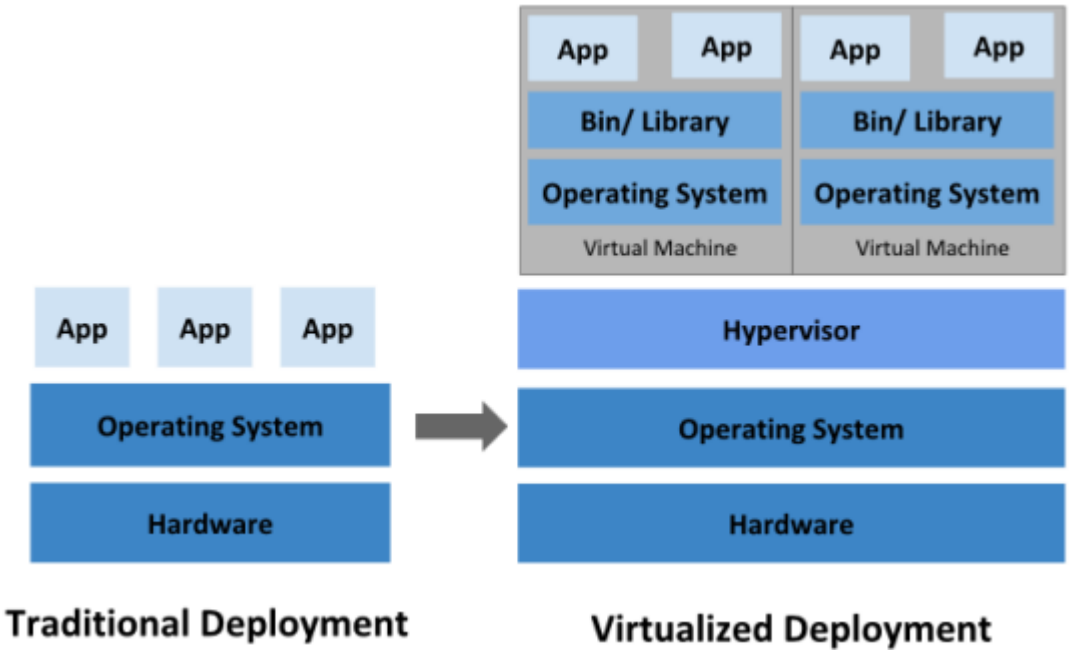
- Fault-tolerance
- On-demand scalability
- Optimal resource usage
- Auto-discovery to automatically discover and communicate with each other
- Accessibility from the outside world
- Seamless updates/rollbacks without any downtime.

Why Do We Need Container Orchestration?

- Container orchestration is used to automate the following tasks at scale:
  - Configuring and scheduling of containers
  - Provisioning and deployments of containers
  - Availability of containers
  - The configuration of applications in terms of the containers that they run in
  - Scaling of containers to equally balance application workloads across infrastructure
  - Allocation of resources between containers
  - Load balancing, traffic routing and service discovery of containers
  - Health monitoring of containers
  - Securing the interactions between containers.

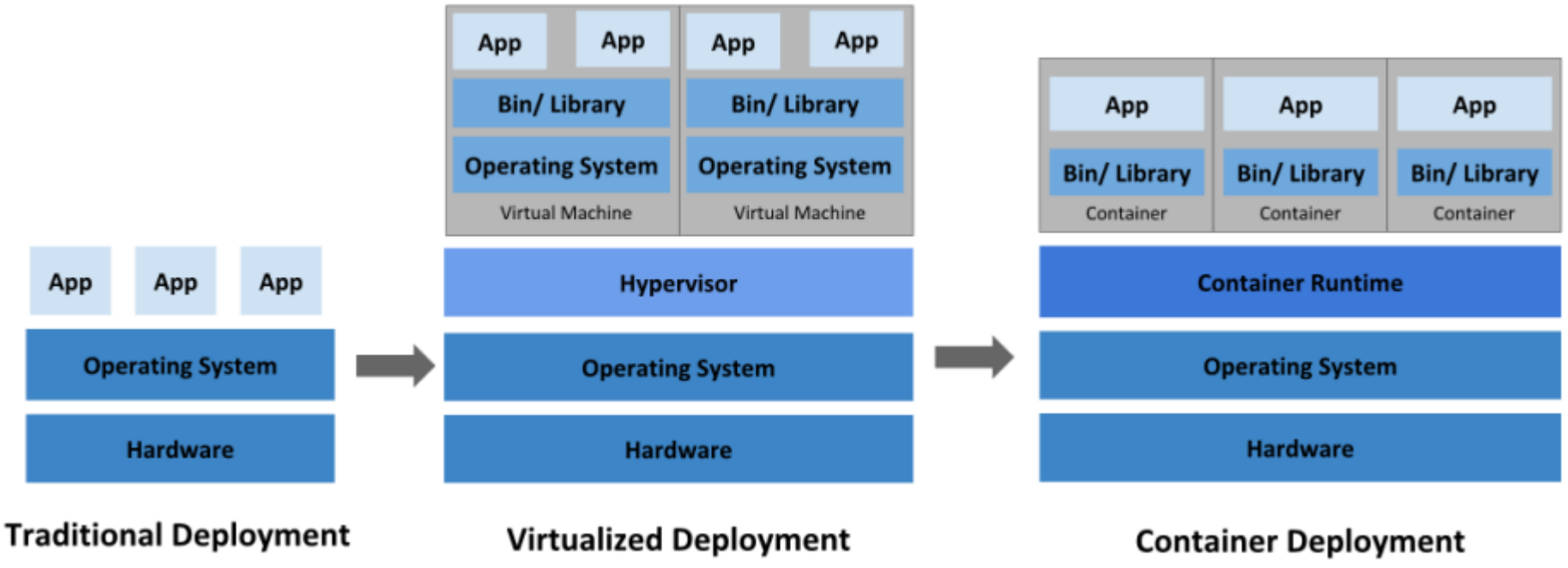
Cloud Orchestration

- Infrastructure-as-a-Service (IaaS)
  - Provisioning virtual machines from a cloud service provider (CSP)



Container Orchestration

- Application containers
  - Lightweight OS-virtualization
  - Application packaging for portable, reusable software



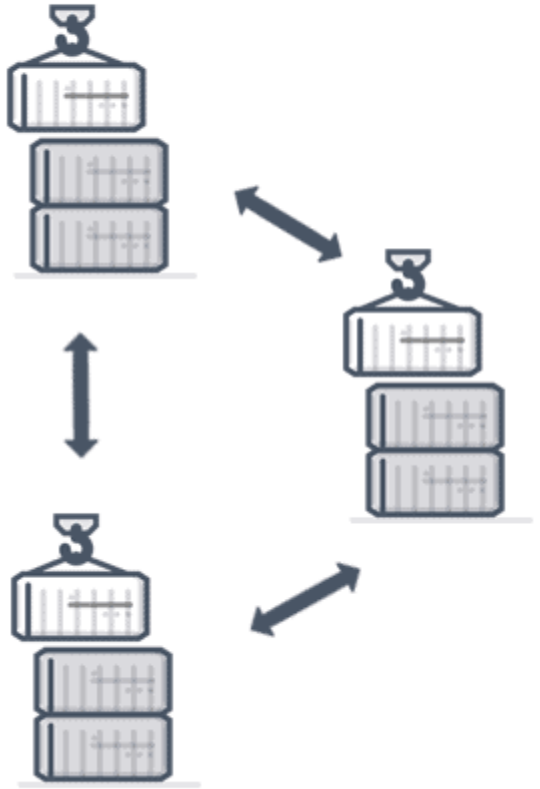
Container Orchestration

Container Orchestration Software
(Docker, Openshift & Kubernetes)

Automate:

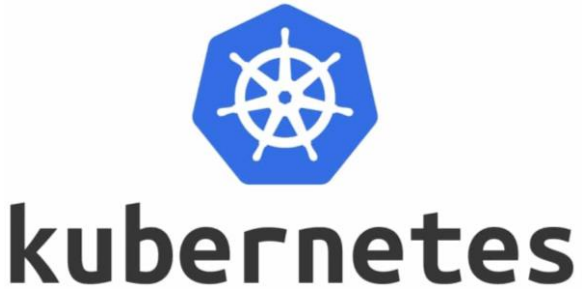
- Configuration
- Provisioning
- Availability
- Scaling
- Security
- Resource allocation
- Load balancing
- Health monitoring

Application Environment
w/ Multiple Containers



Container Orchestration Tools

Container Orchestration Tools



What is Kubernetes and How it works

Kubernetes

Kubernetes is an open-source container management tool which automates container deployment, container (de)scaling and container load balancing

- Benefits (Works with all cloud vendors (Public, Private (on-premises), and Hybrid))

More about Kubernetes

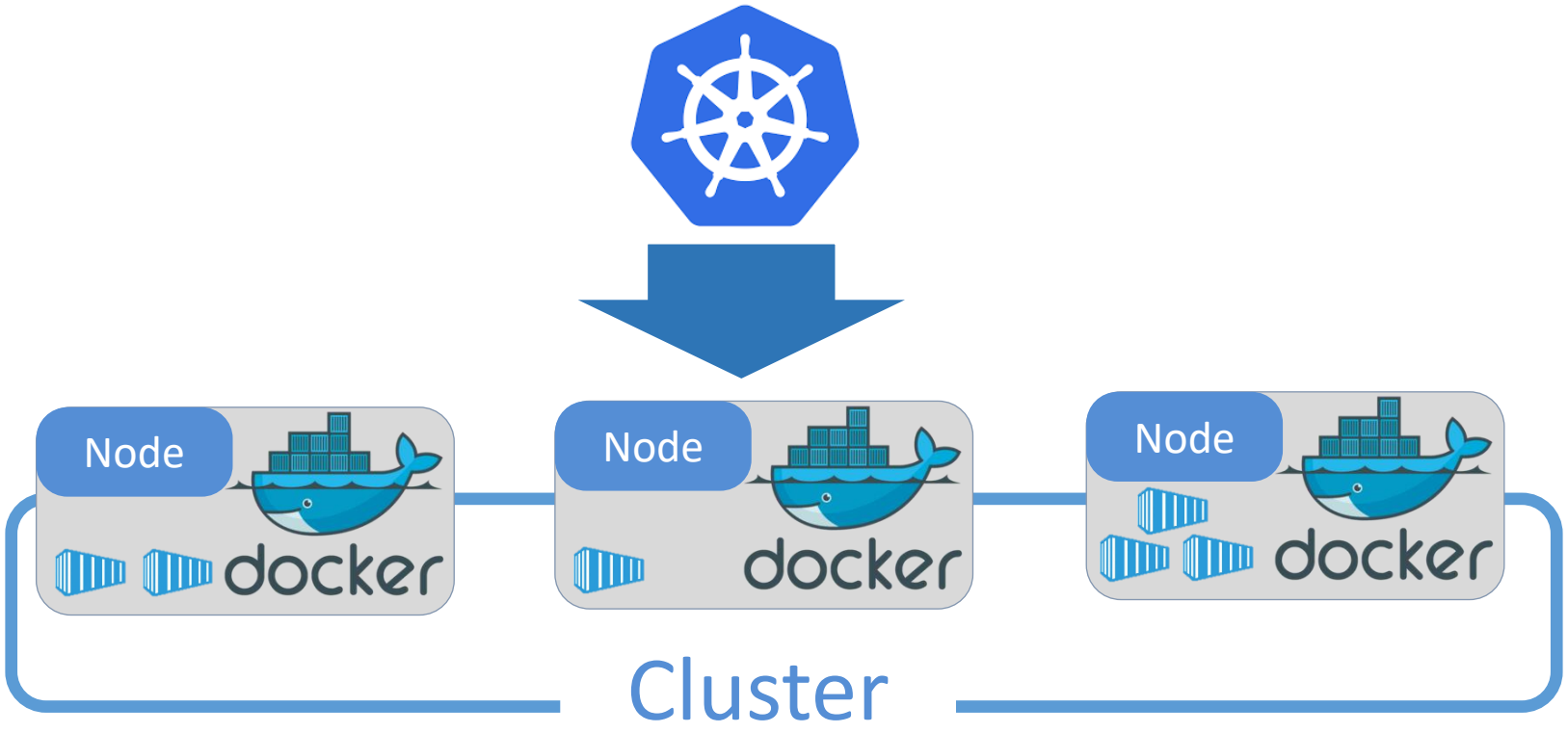
- Developed by Google and written in Golang with a huge community
- Can group ‘n’ containers into one logical unit for managing and deploying them

Kubernetes

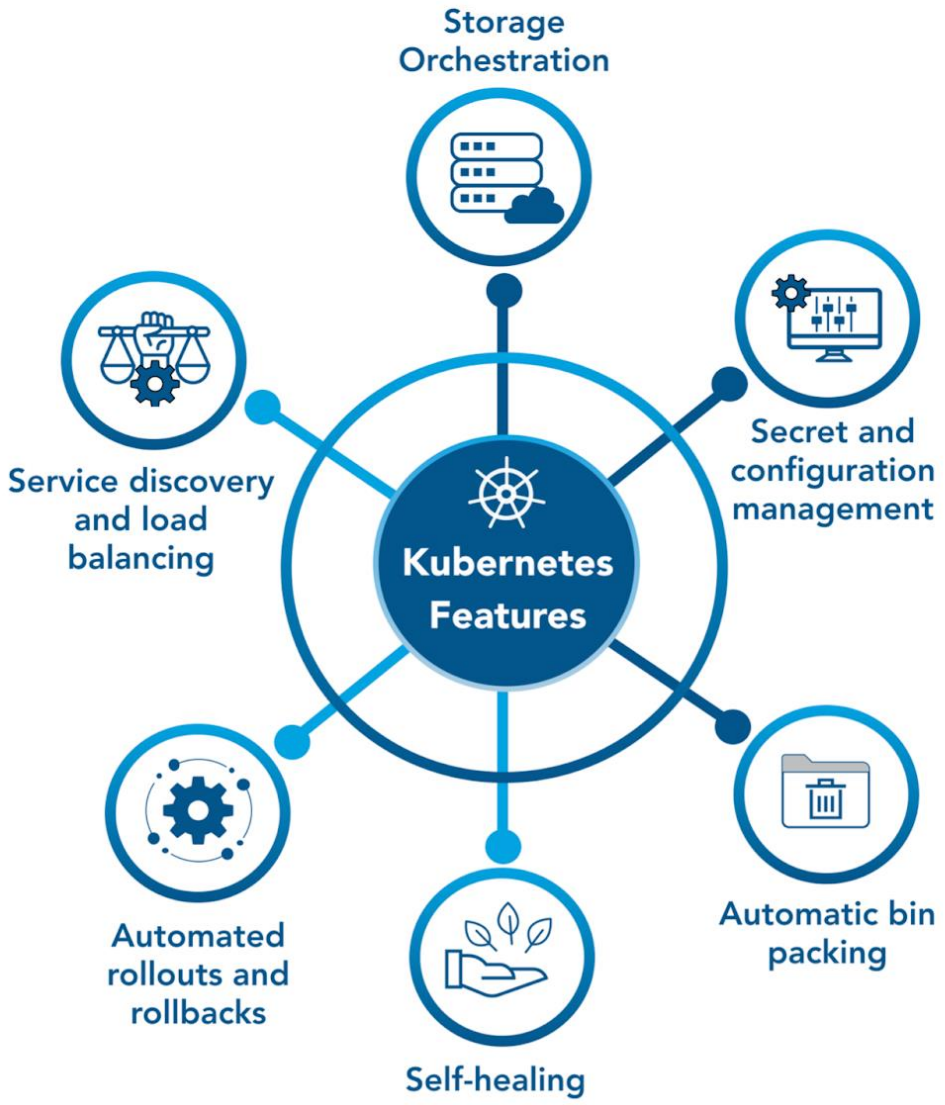
- Kubernetes is an open source container orchestration engine for automating deployment, scaling, and management of containerized application.
- Originally an open source project launched by Google and now part of the Cloud Native Computing Foundation (CNCF).
- Kubernetes is highly **extensible** and **portable**
- Kubernetes is considered **highly declarative**
- Kubernetes initial release (**7 June 2014**)
- Releases every 3 months

kubernetes

Kubernetes

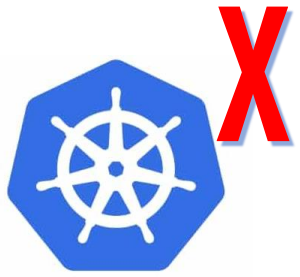


Kubernetes Features



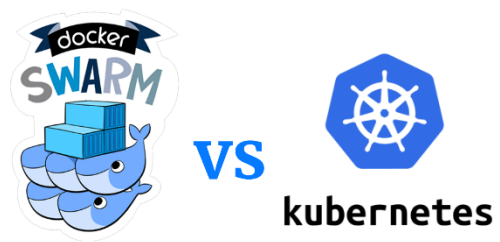
Kubernetes Myths

- Kubernetes is not:
  - To be compared with Docker
  - For containerizing apps
  - For apps with simple architecture



- Kubernetes is actually:
  - Robust and reliable
  - A container orchestration platform
  - A solution for scaling up Containers
  - Backed by huge community

Kubernetes vs Docker Swarm



Docker Swarm

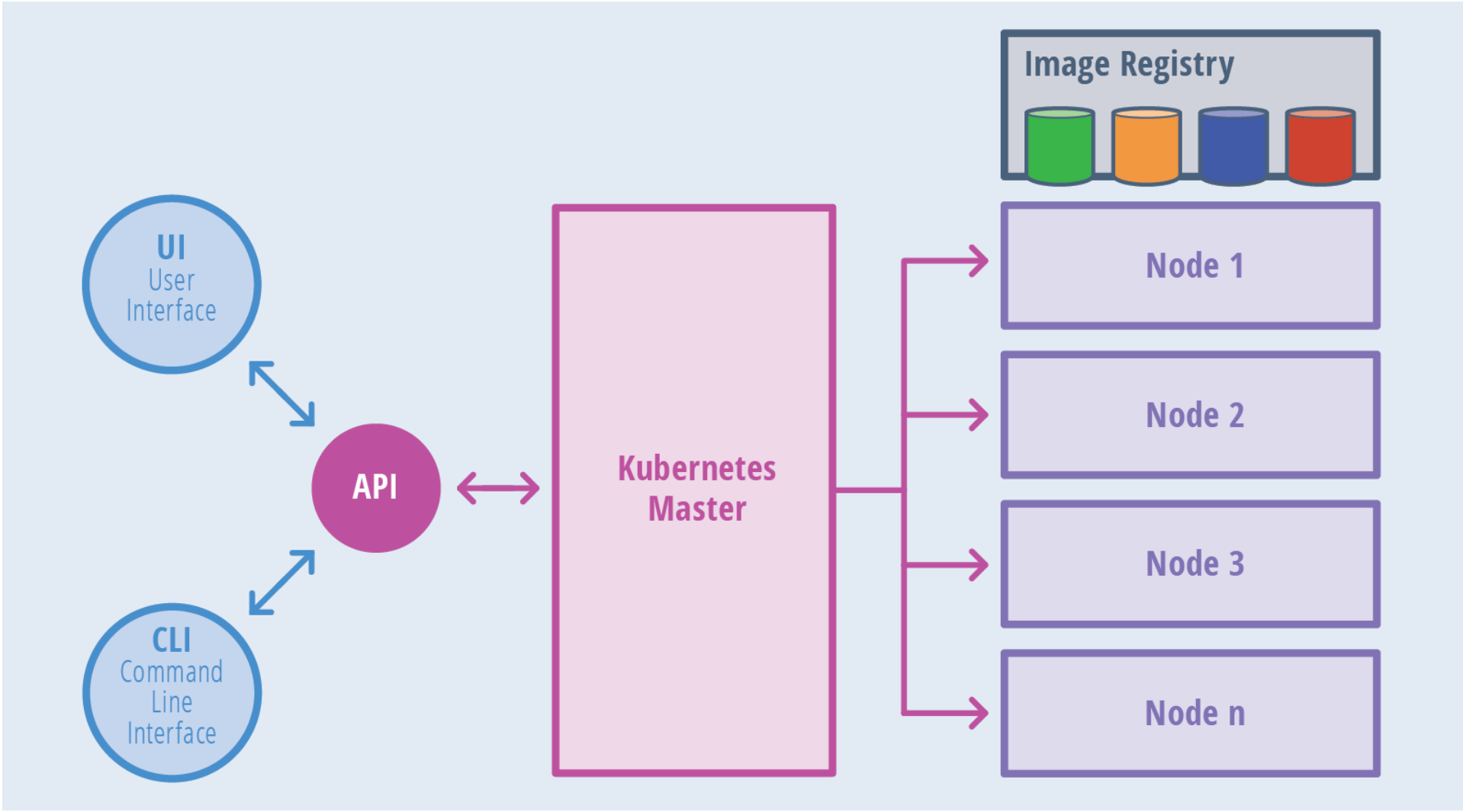
1. No Auto Scaling
2. Good community
3. Easy to start a cluster
4. Limited to the Docker API's capabilities
5. Does not have as much experience with production deployments at scale

Kubernetes

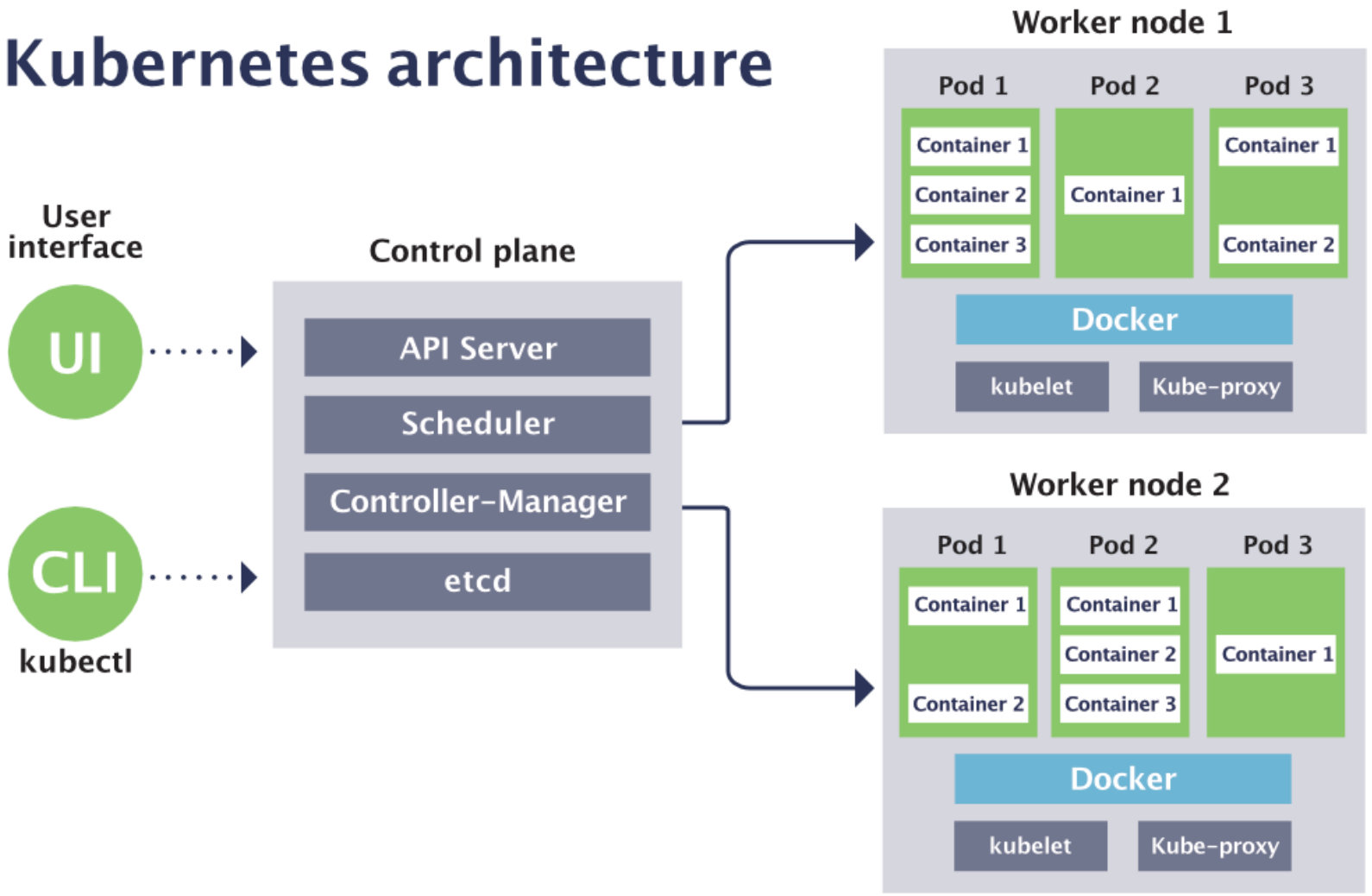
1. Auto Scaling
2. Great active community
3. Difficult to start a cluster
4. Can overcome constraints of Docker and Docker API
5. Deployed at scale more often among organizations

Kubernetes Architecture

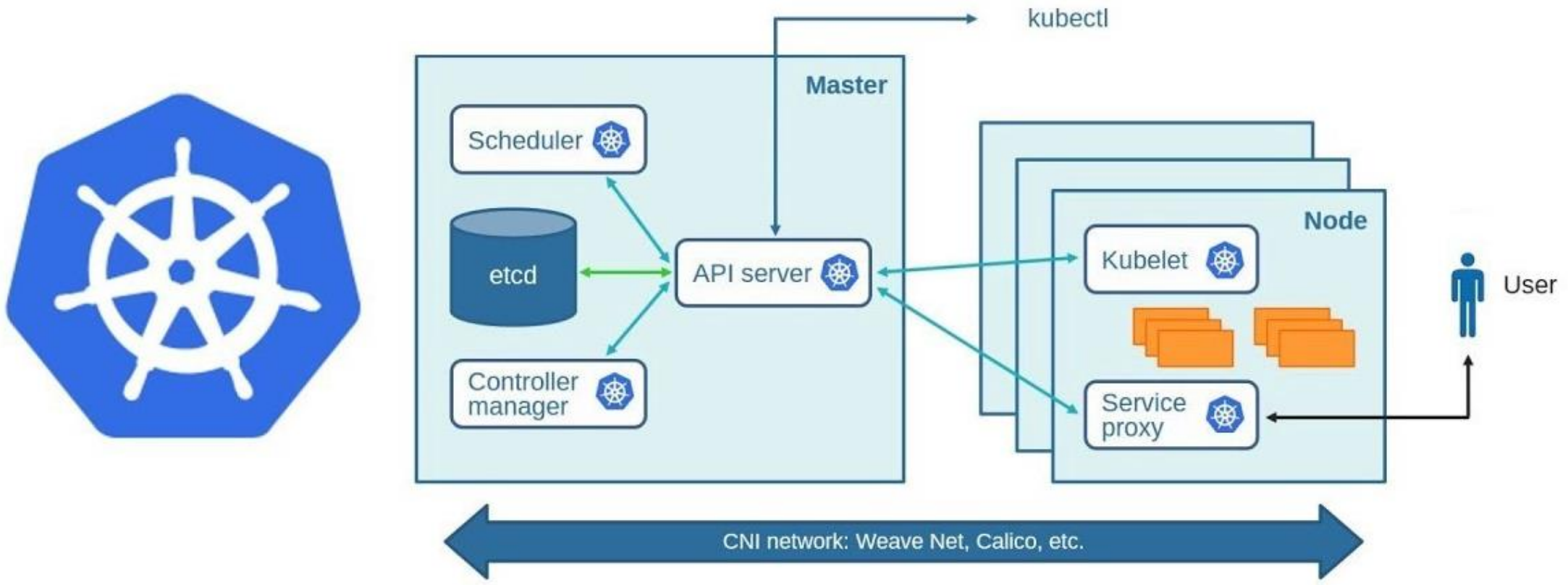
Kubernetes Architecture



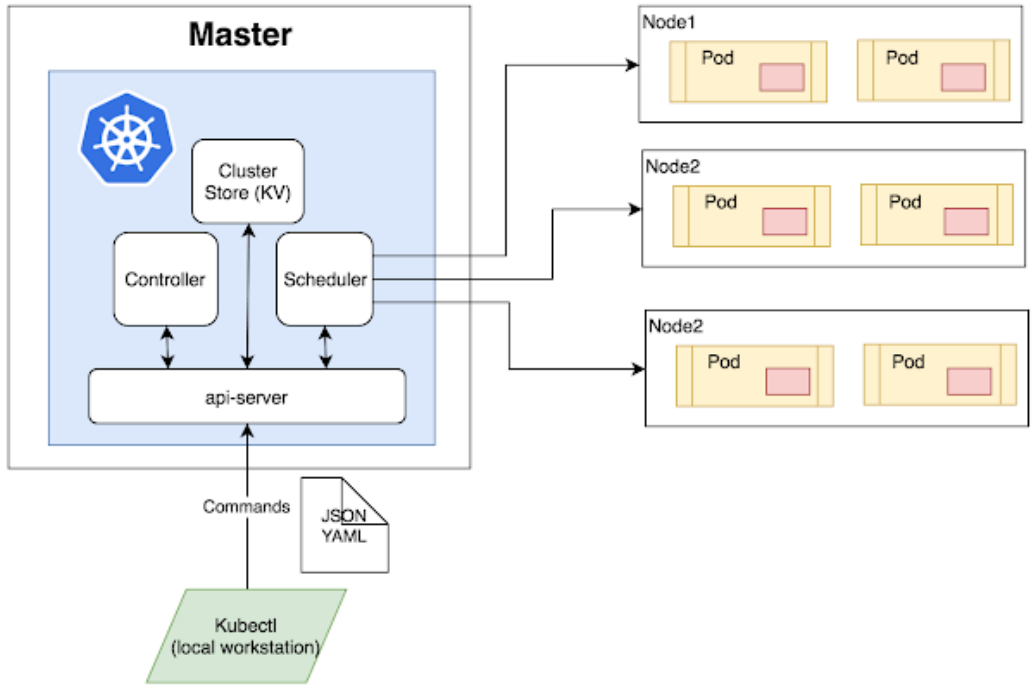
Kubernetes Architecture



Kubernetes Architecture



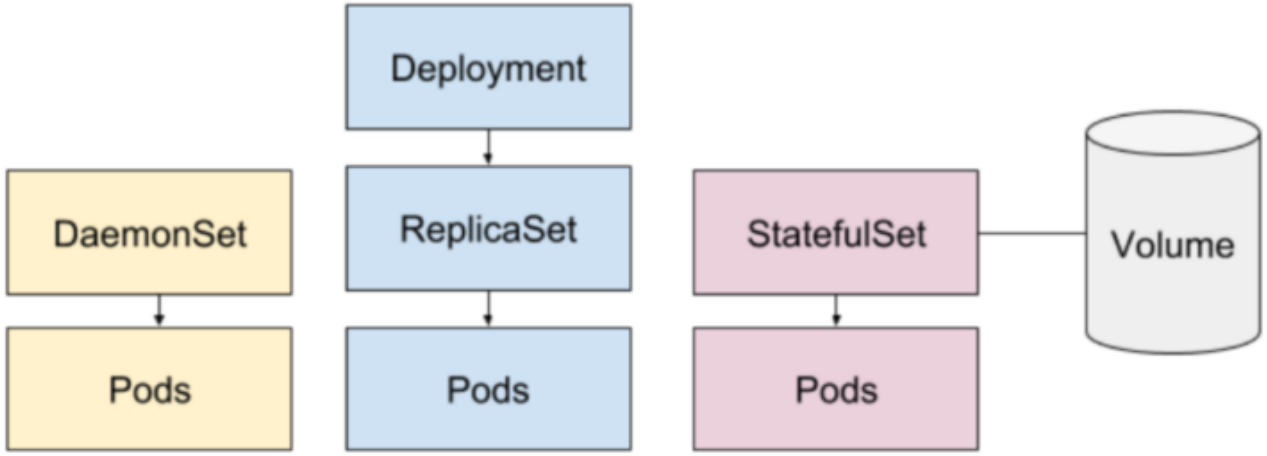
Kubernetes Components



- Cluster:
  - A collection of hosts(servers) that aggregates their available resources.
- Master:
  - A collection of components which make up the control panel of Kubernetes.
- Node:
  - A single host which is capable of running on a physical or virtual machine.
- Namespace:
  - A logical cluster or environment.

Basic Kubernetes Objects

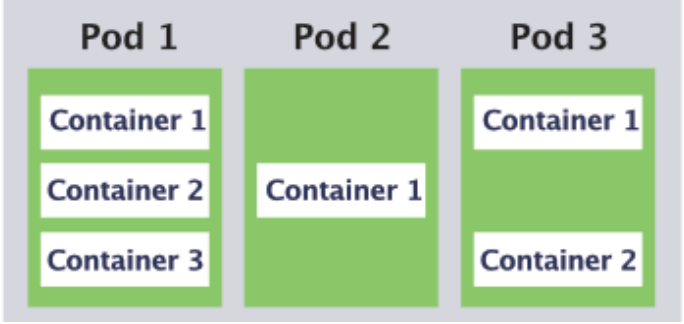
- Pod
- Deployment, ReplicaSet
- DaemonSet
- StatefulSet
- Service
- Secret



Pods

- Pods are the smallest deployable units of computing that you can create and manage in Kubernetes.
- A Pod is a group of one or more containers, with shared storage/network resources, and a specification for how to run the containers.
- A Pod's contents are always co-located and co-scheduled.

- To create and manage multiple Pods, Kubernetes defines multiple resource types:
  - Deployment
  - StatefulSet
  - DaemonSet



Deployment

- Deployment: represents a set of multiple, identical Pods with no unique identities.
  - It runs multiple replicas Pods and automatically replaces any instances that fail or become unresponsive.
  - Deployments ensure that one or more instances of Pods are available to serve user requests.
- PodTemplates are specifications for creating Pods, and are included in resource objects such as Deployment object.
- A ReplicaSet is the next-generation of ReplicationControllers
  - It ensures that a specified number of pod replicas are running at any given time.

Pod Management

- StatefulSet: manages deployment and scaling of a set of Pods, with durable storage and persistent identifiers for each pod.
  - Unlike a Deployment, a StatefulSet maintains a sticky identity for each of its Pods.

- DaemonSet: ensures that all (or some) nodes run a copy of a Pod.
  - As nodes are added to the cluster, Pods are added to them.
  - As nodes are removed from the cluster, those Pods are garbage collected.
  - Deleting a DaemonSet will clean up the Pods it created.

Controller

- Controllers are control loops that watch the state of the cluster, then make or request changes where needed.
- A controller tracks at least one Kubernetes resource object.
- The controller(s) for that resource are responsible for making the current state come closer to that desired state (specified in the spec field).
- Kubernetes comes with a set of controllers that run inside the kubecontroller-manager
- The Deployment controller is an example of controller that come as part of Kubernetes itself ("built-in" controllers).

Service

- The services model relies upon the most basic, though most important, aspect of services: ***discovery***.
- a Service is an abstraction which defines a logical set of Pods and a policy by which to access them.
- The set of Pods targeted by a Service is usually determined by a ***selector***.
- Services ensure that traffic is always routed to the appropriate Pod within the cluster, regardless of the node on which it is scheduled.
- Each service exposes an **IP address**, and may also expose a **DNS endpoint**, both of which will never change.
  - Internal or external consumers that need to communicate with a set of pods will use the service's IP address, or its more generally known DNS endpoint.

Secret

- Secrets are secure objects which store sensitive data, such as passwords, OAuth tokens, and SSH keys, in your clusters.
- Storing sensitive data in Secrets is more secure than plaintext in Pod specifications.
- Using Secrets gives you control over how sensitive data is used, and reduces the risk of exposing the data to unauthorized users.

Kubernetes Cluster