Cloud based networks

Orchestrating the containers

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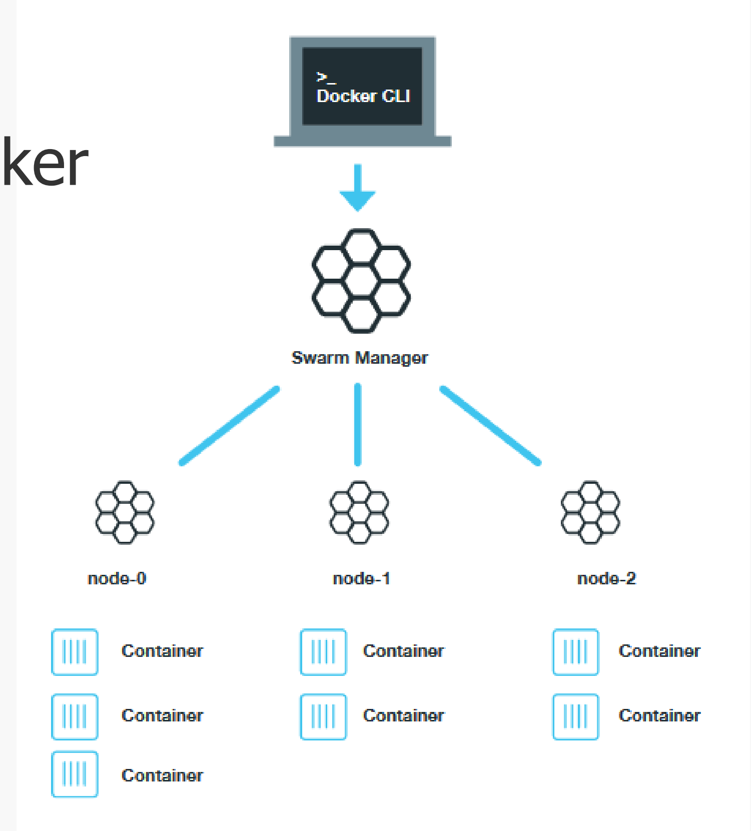
Motivation – multi host

- Docker containers handled with docker commands
  - On-host
  - Networking is cumbersome
    - docker0 bridge
  - How to connect docker containers deployed on different hosts?
    - Mult-hosting
    - Third party solutions at the beginning (e.g. serf - https://www.serf.io/)
  - Later: Docker Swarm – multi-hosting in Docker

„It turns a pool of Docker hosts into a single, virtual Docker host"

- Not the same as Docker Swarm Mode (which appeared with v1.12)

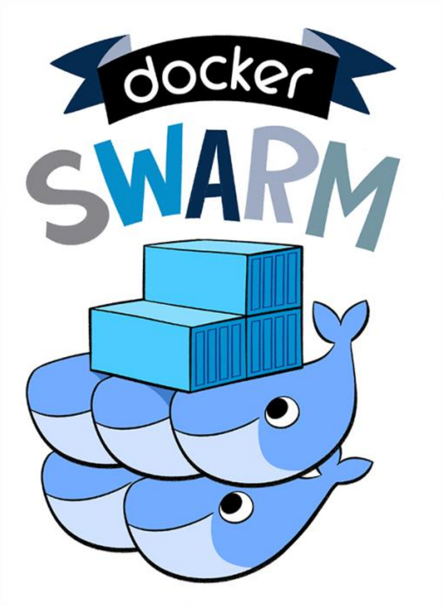


Motivation - orchestration

- What is missing from a full Docker system?
  - Orchestration
  - Similar to the services of a cloud system
  - Goal: automatized container deployment and management in multi-host environment (incl. scaling)
- Solution no. 1: Docker in public clouds
  - Amazon Web Services, Google Cloud, Microsoft Azure
- Solution no. 2: Docker + OpenStack
  - OpenStack Magnum
- Solution no. 3: Docker based orchestration frameworks
  - Apache Mesos (2010)
  - Google Kubernetes (2014)
  - Docker Swarm Mode (2016)

DOCKER SWARM MODE

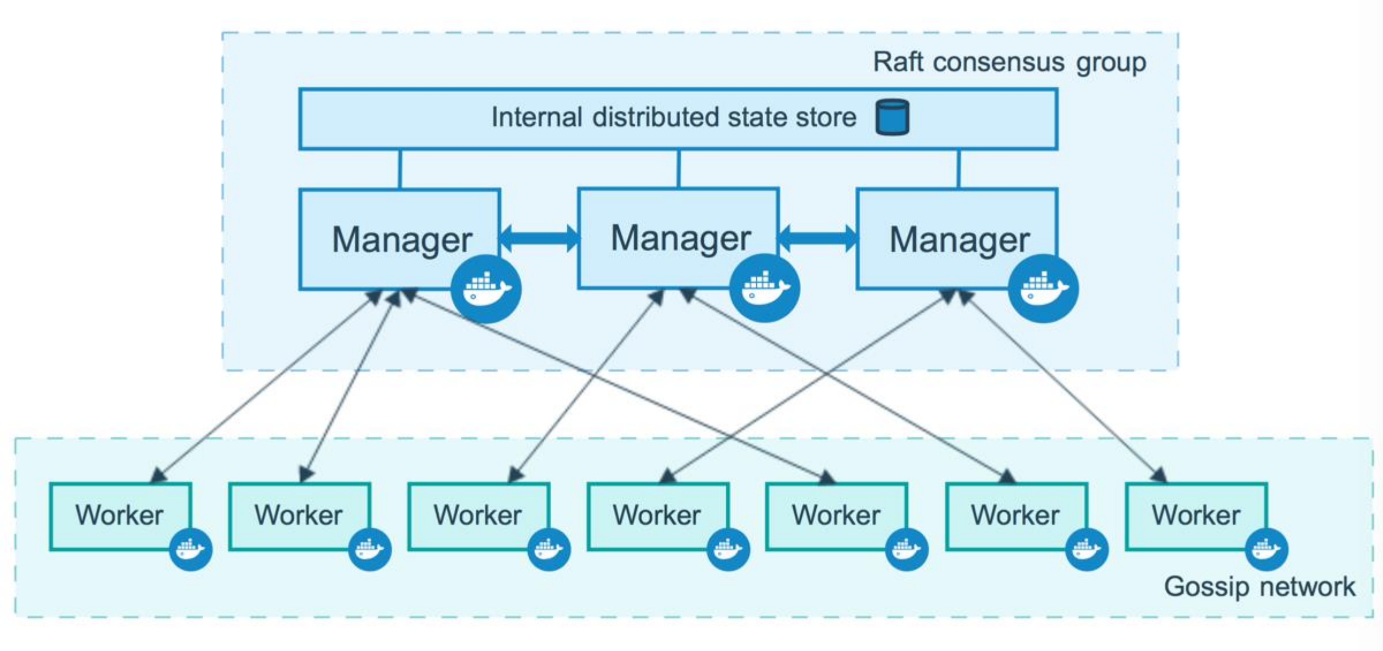
Docker Swarm Mode



- Swarm mode = Docker engine running mode
- The Docker engines organized in the same cluster
    - One Docker engine = one node
  - Swarm = this cluster above
    - Goal: running services in this cluster
- One physical machine may run multiple nodes
  - In runtime environment typically Docker engine / phy machine
    - Practically hosts running a Docker engine are grouped into a cluster
- Service model: users reach a service
  - Service = executes replicated tasks and defines the environment (network, resources, replication level and policy)
    - Tasks run on multiple node handled as a single service
  - Task = function (= docker container), which are handled by a single service
    - Atomic resource unit, runs on a node

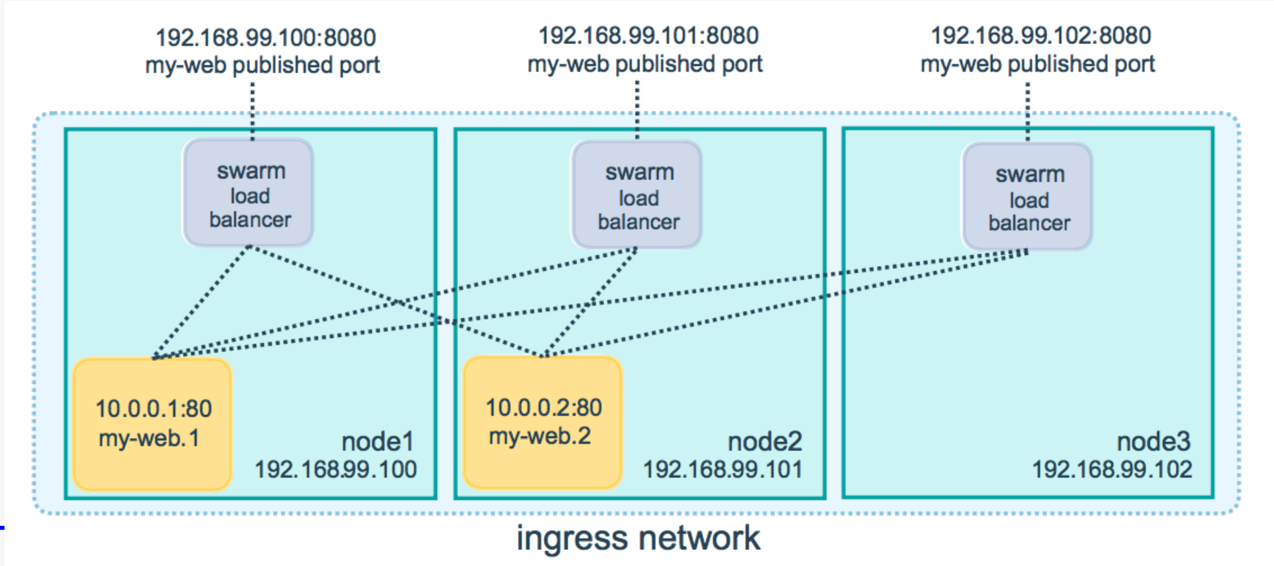
Swarm Mode architecture

- Docker Swarm Mode nodes controlled by a Manager
  - Role: cluster mgmt, offering an API, scheduling
  - More Managers provide a distributed redundant operation (high availability)
- Worker node = runs the tasks (Manager can be a worker, too)
  - Worker node can be promoted to Manager (and vice-versa)
  - Worker nodes join a mesh network



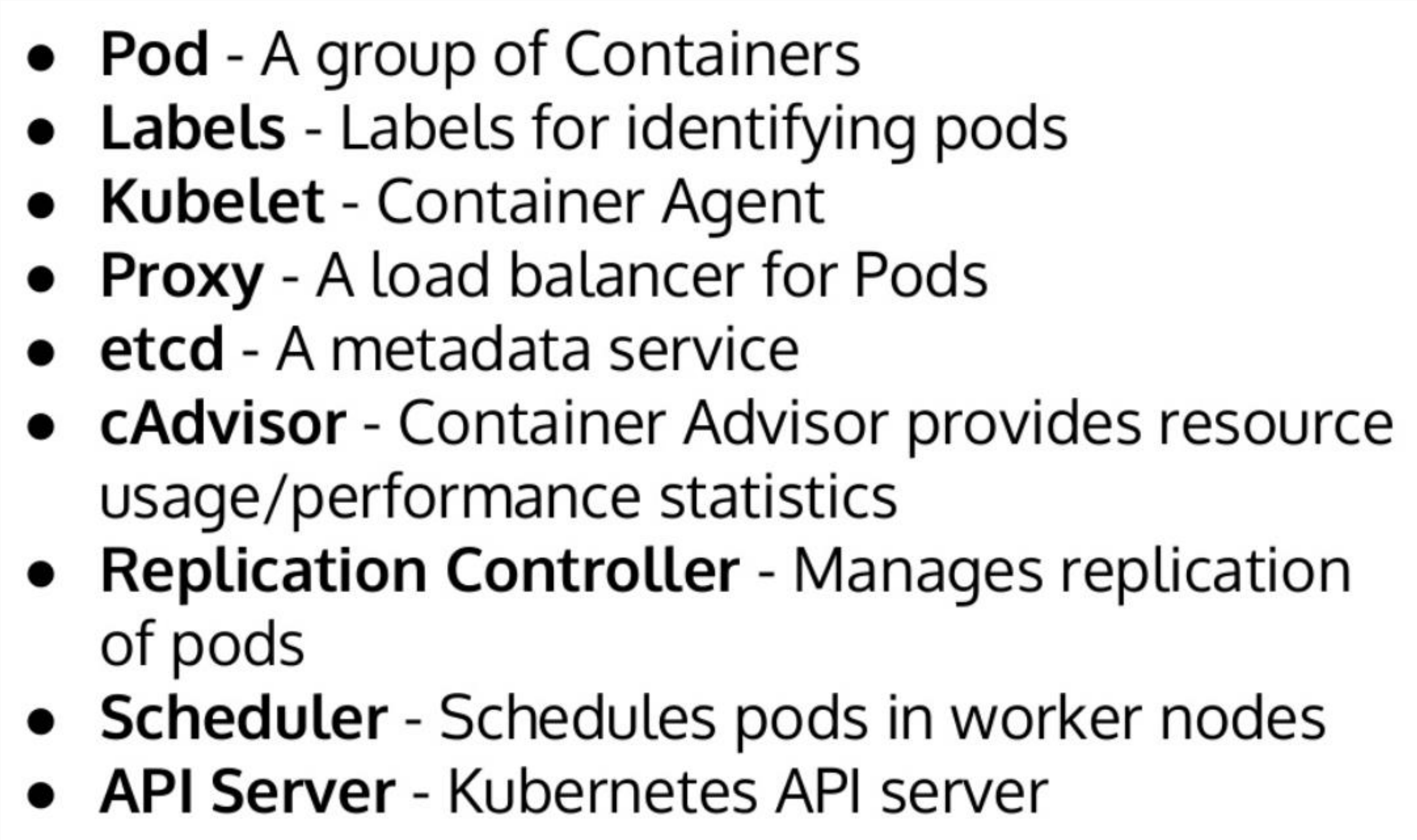
Swarm mode networking

- Assign ports to services
  - Handling requests arriving to the Swarm (ingress nw)
  - The nodes must be the members of a *Swarm mode routing mesh*
- Each node must run a load balancer module
  - Part of the Swarm mode routing mesh
  - Forwards the requests to a proper active container
  - Even if that container runs on a different host
  - Even if that on the node/host that recieved the request does not run such a container



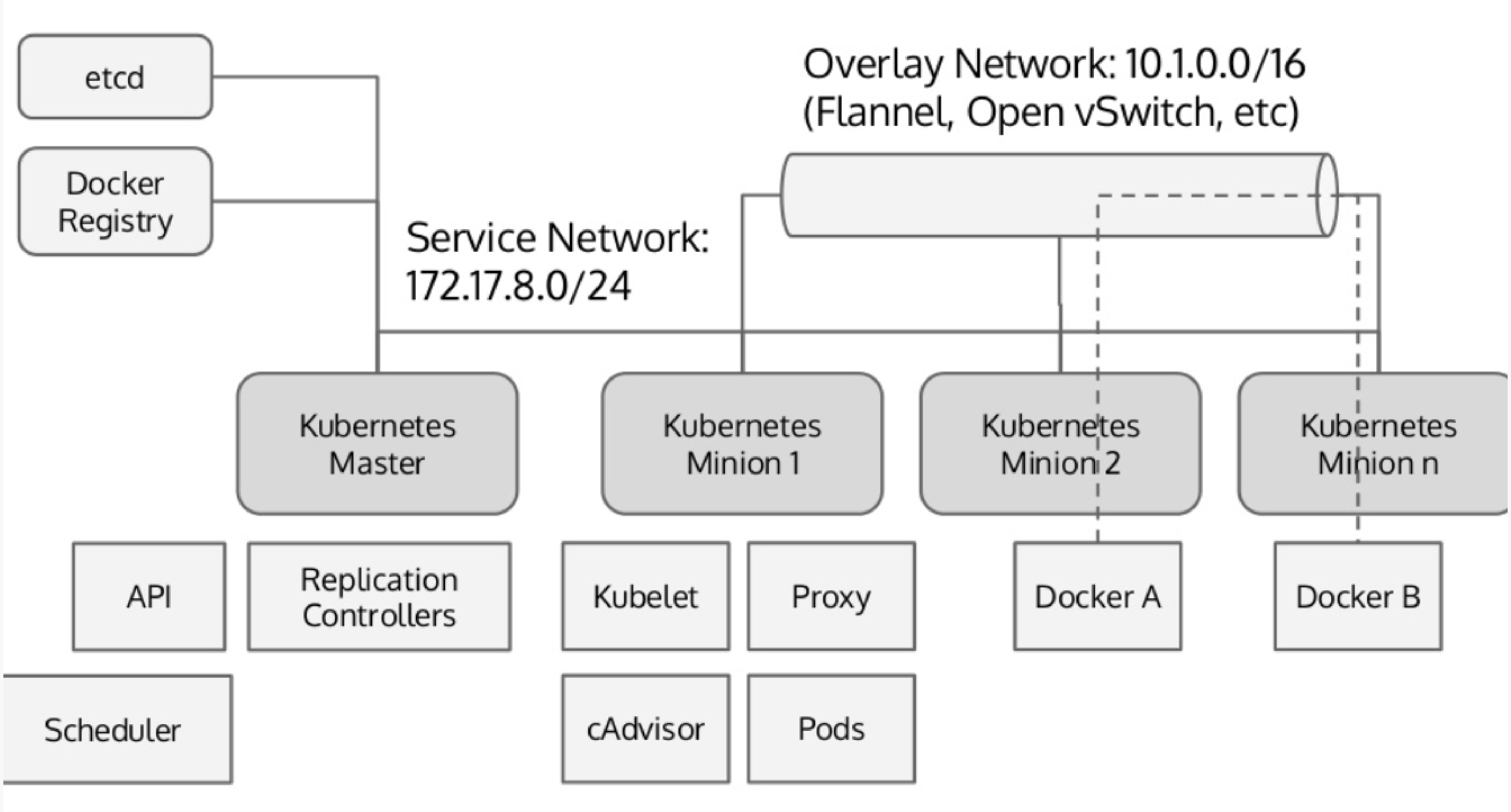
KUBERNETES

Kubernetes – main components

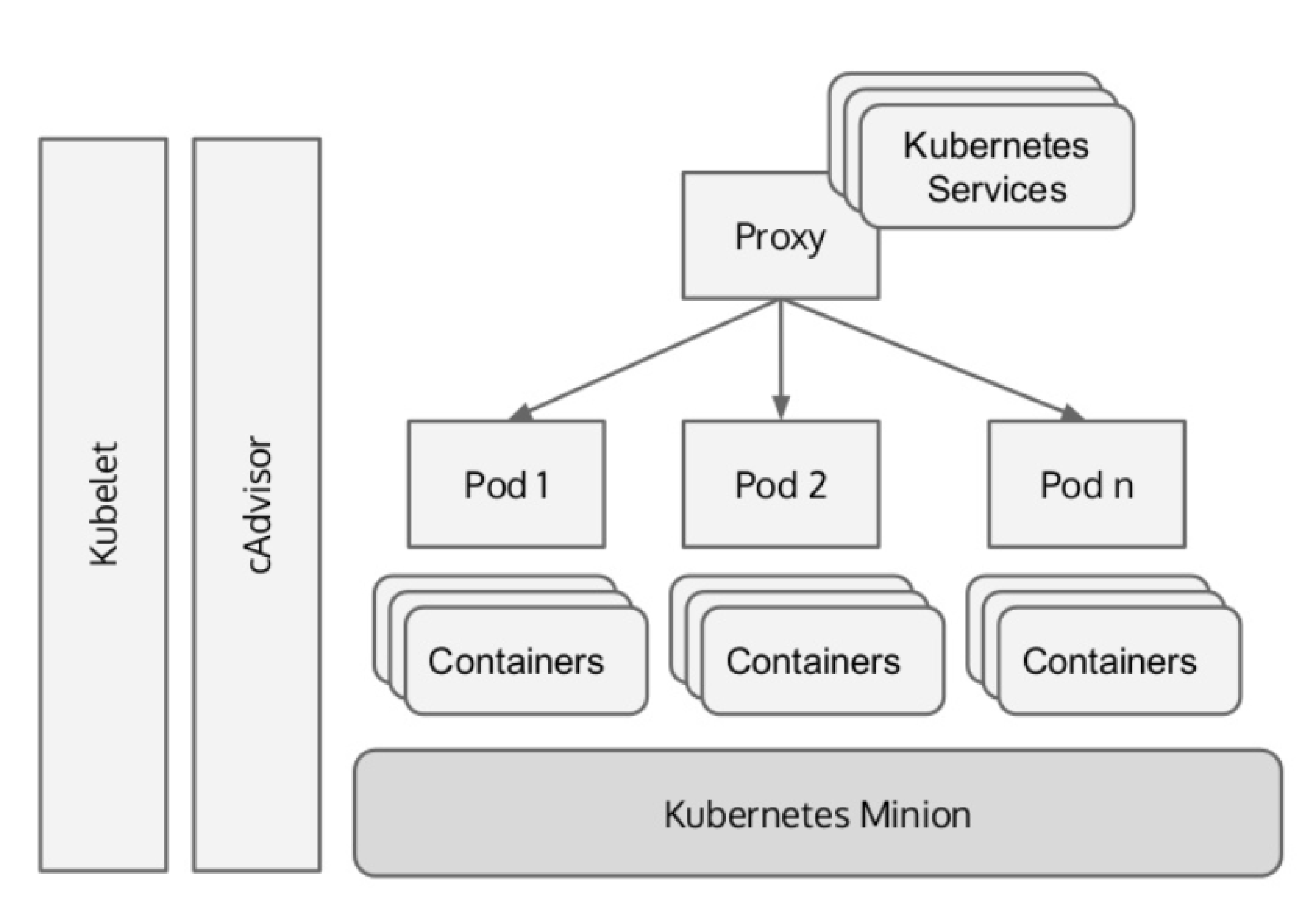


- **Pod** - A group of Containers
- **Labels** - Labels for identifying pods
- **Kubelet** - Container Agent
- **Proxy** - A load balancer for Pods
- **etcd** - A metadata service
- **cAdvisor** - Container Advisor provides resource usage/performance statistics
- **Replication Controller** - Manages replication of pods
- **Scheduler** - Schedules pods in worker nodes
- **API Server** - Kubernetes API server

Kubernetes deployment

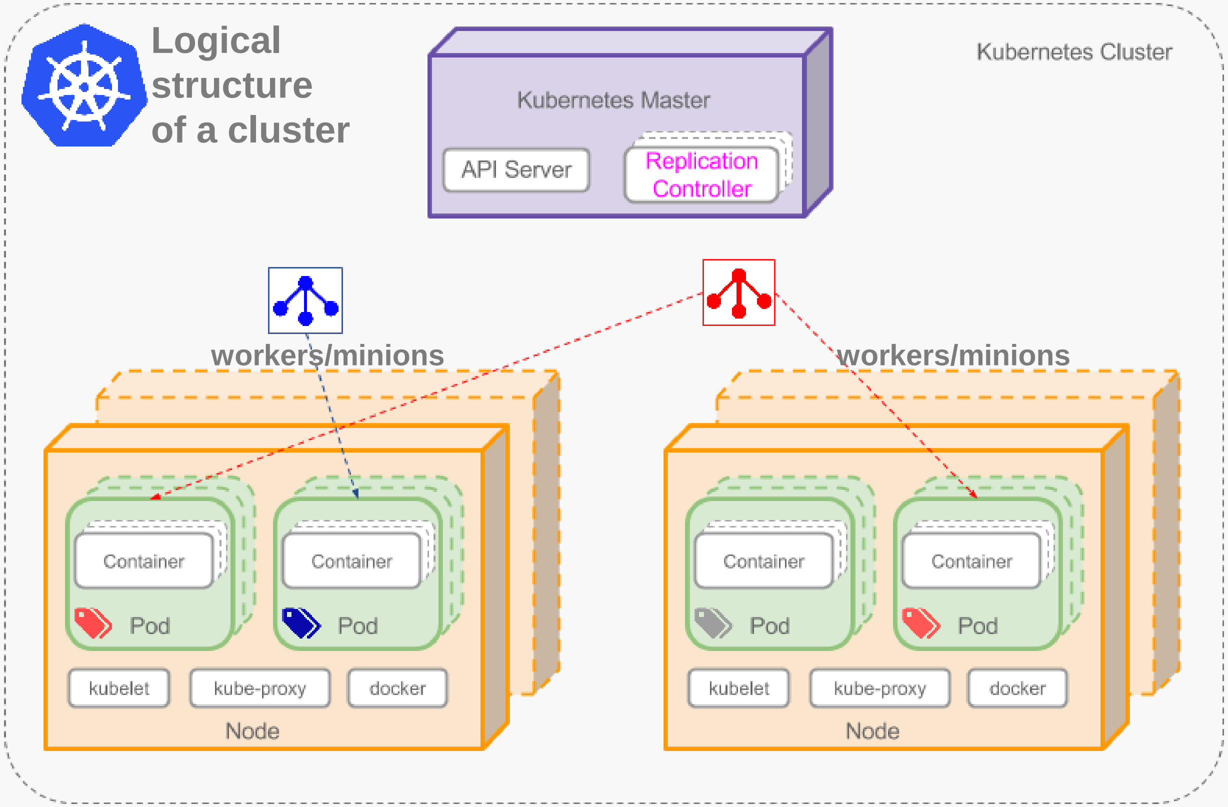


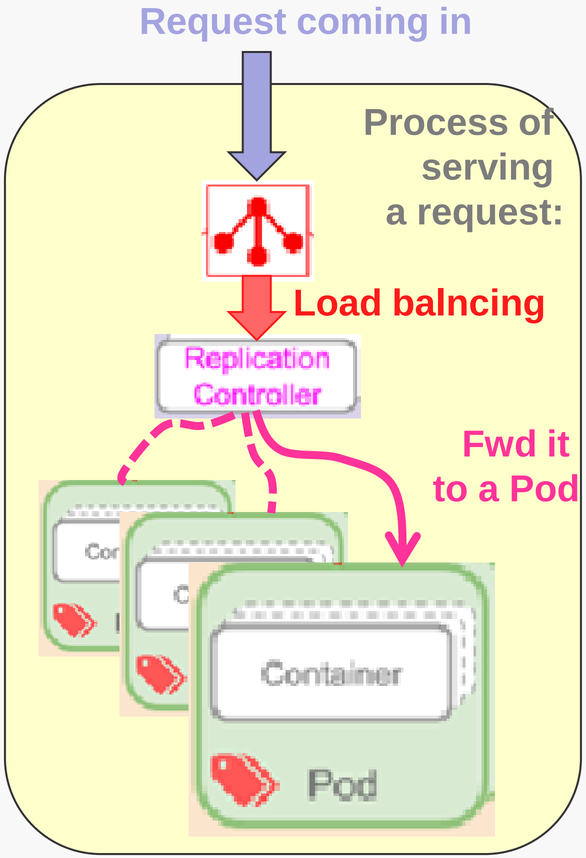
Worker node = minion



Logical structure of a Kubernetes cluster

- Control by the master
- Service offers access to users
  - Handled by a load balancer (the Replication Controller)
  - The request is answered by one Pod





= Labels = Service

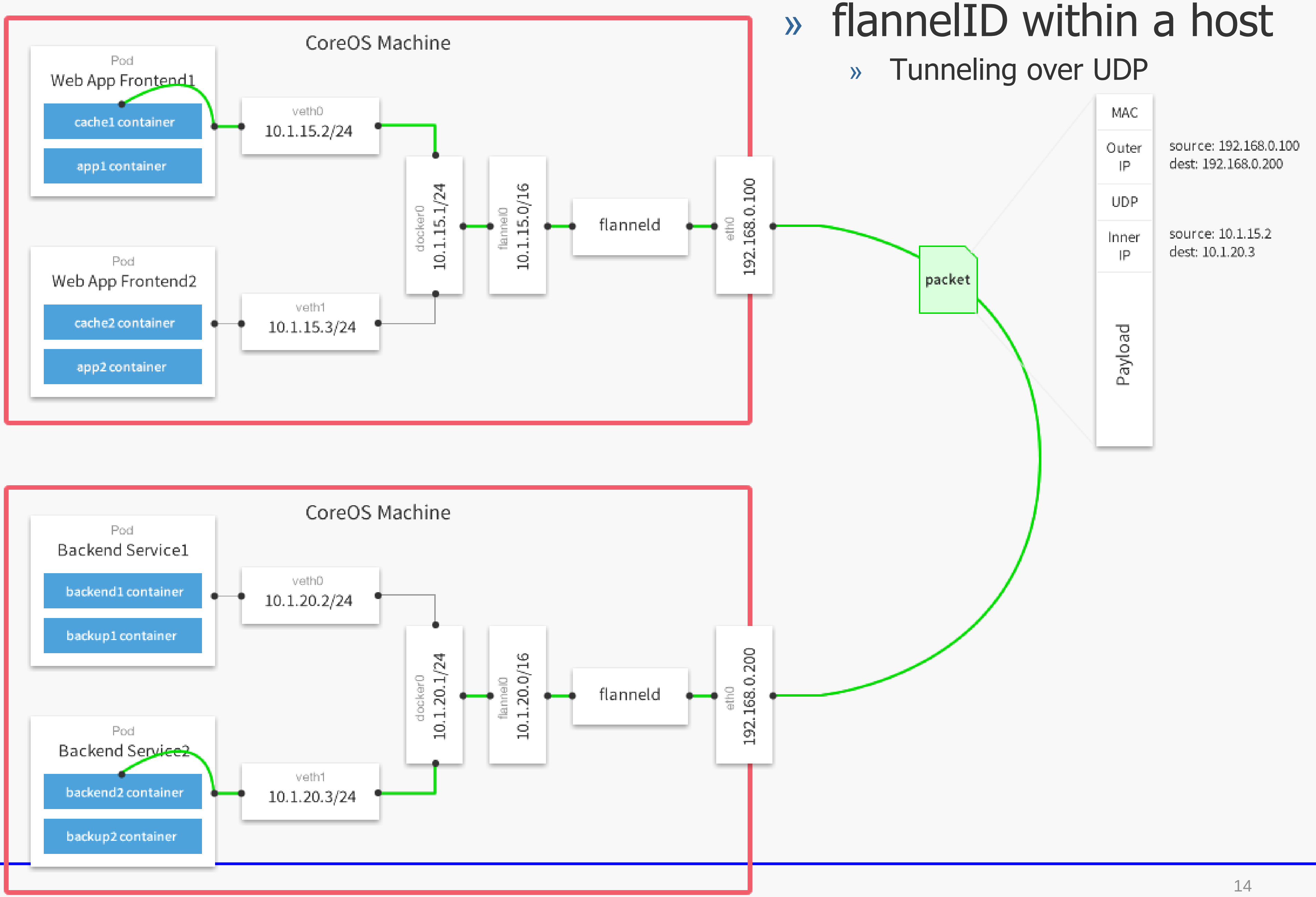
Kubernetes network

- At Pod level every container is in the same namespace
  - Pro: can reach each other via localhost
  - Consequence: mind the port assigment within a Pod (2 containers cannot use the same port)
- Hosts must communicate with containers without NATs
- Typical solutions:
  - Flannel: own solution, flat overlay
  - OVS: Open VSwitch – generic solution, widely used in the industry
  - Lots of alternatives:

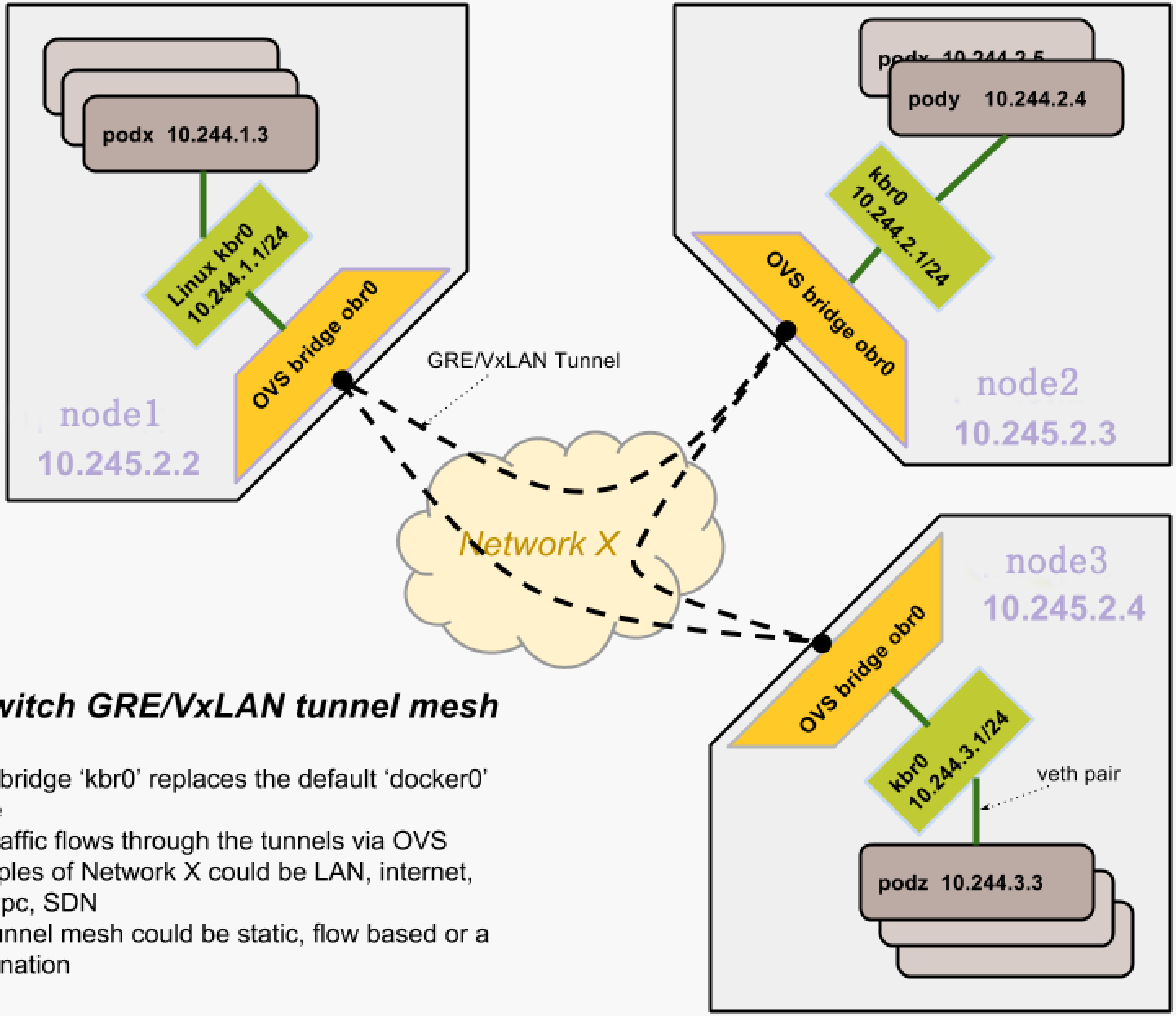
https://kubernetes.io/docs/concepts/cluster-administration/networking/#how-to-achieve-this

Kubernetes Flannel

- flannelD within a host
  - Tunneling over UDP



OVS bridging



OpenVSwitch GRE/VxLAN tunnel mesh

- Linux bridge ‘kbr0’ replaces the default ‘docker0’ bridge
- Pod traffic flows through the tunnels via OVS
- Examples of Network X could be LAN, internet, EC2 vpc, SDN
- The tunnel mesh could be static, flow based or a combination

Demo

- Kubernetes on-line demo
  - Starting a Pod, handling in cli

https://kubernetes.io/docs/tutorials/kubernetes-basics/