ULAM LABS

KUBERNETES FROM SCRATCH

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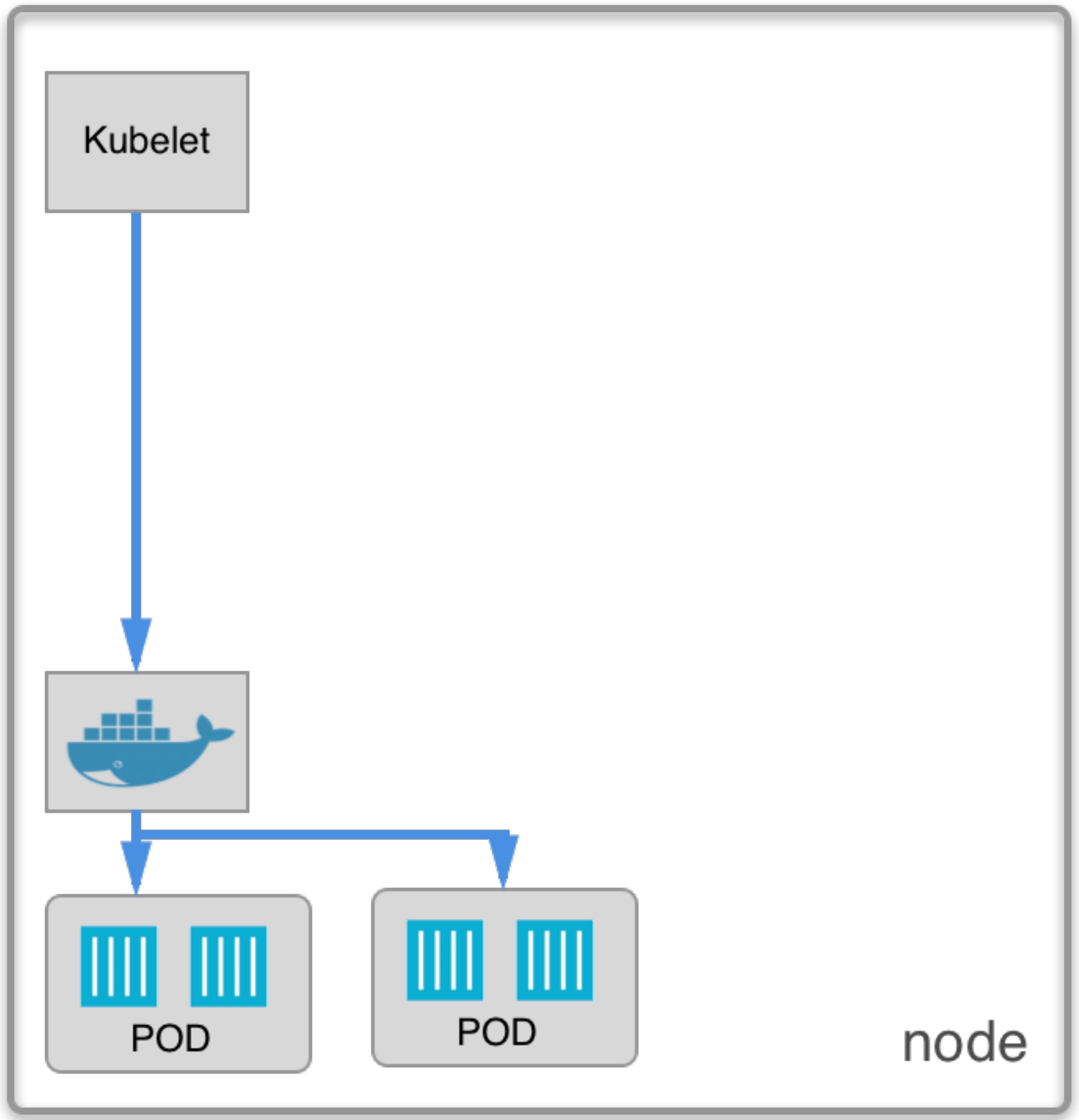
AGENDA

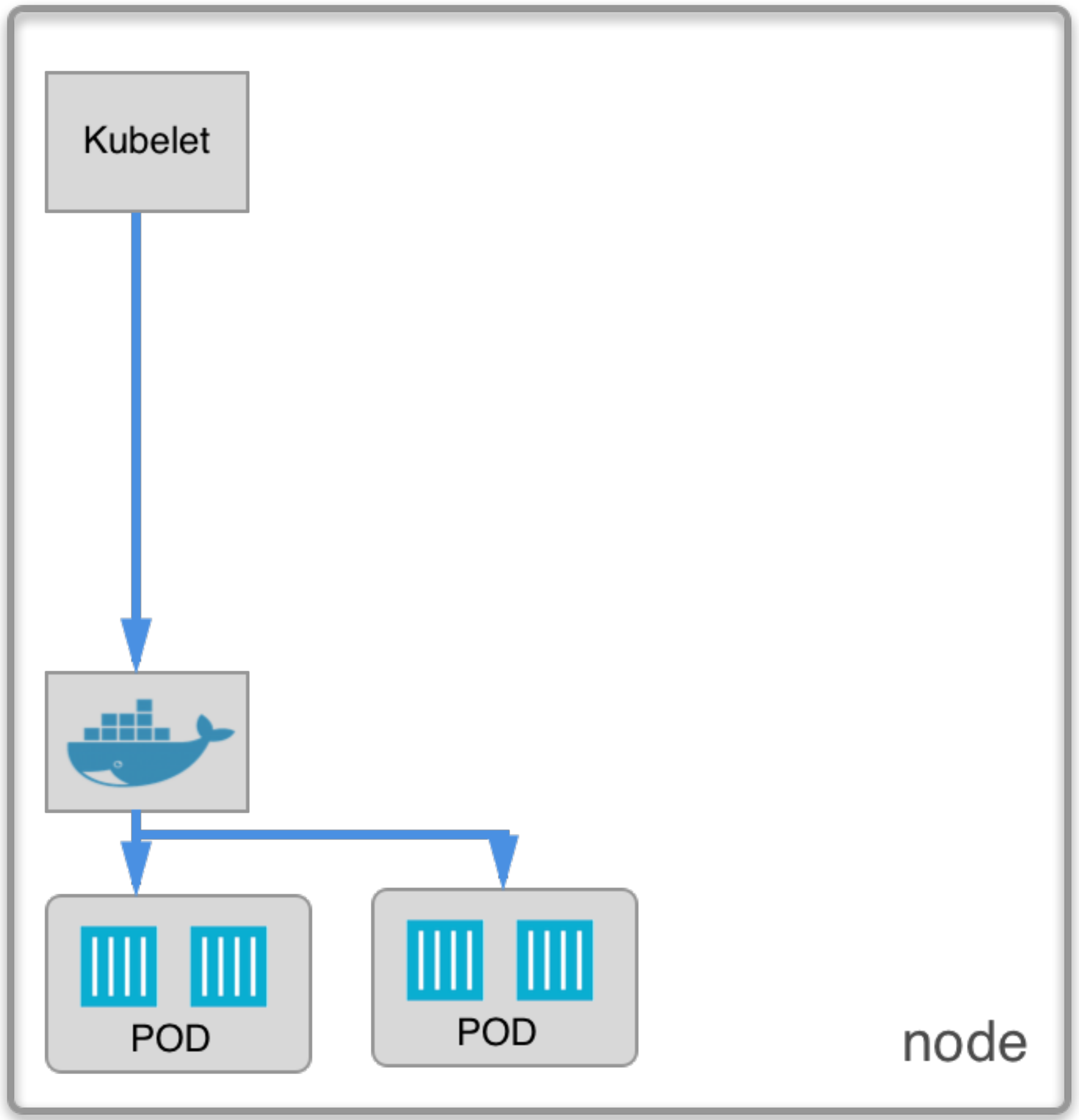
- kubelet
- api server
- etcd
- scheduler
- controller manager
- proxy
- networking
- IaaS integration
- Q&A

KUBELET



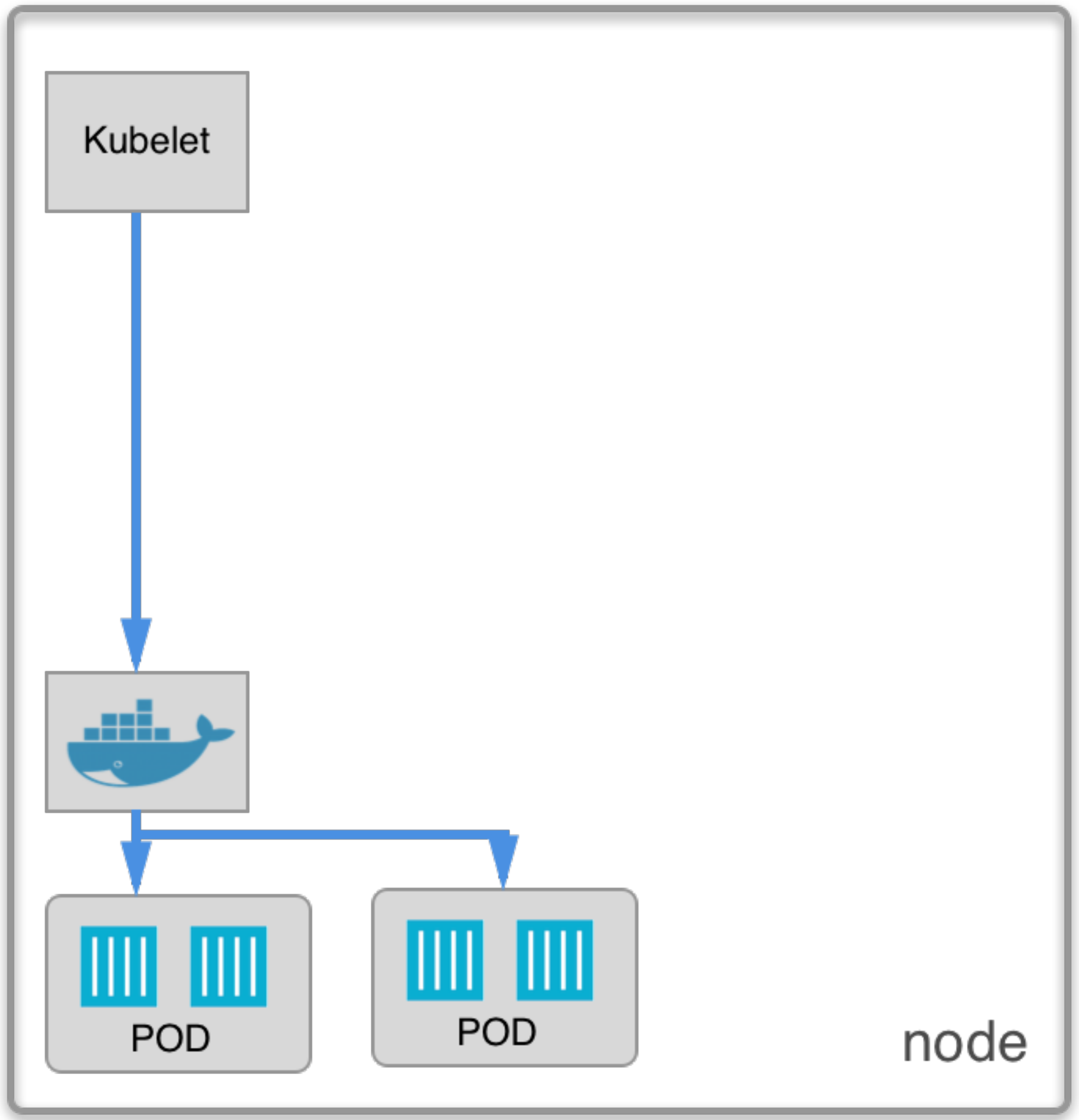
KUBELET

- the “worker”



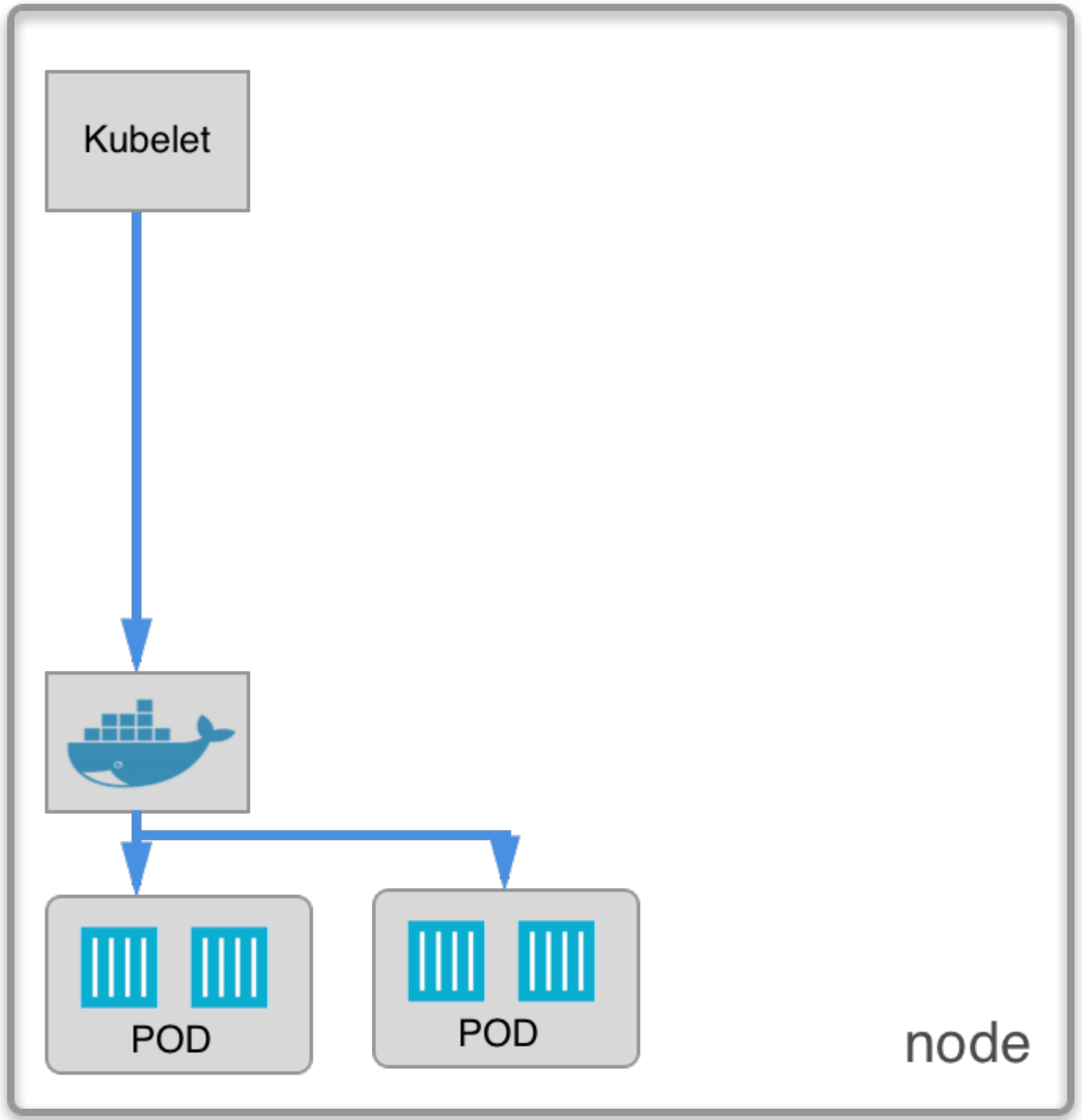
KUBELET

- the “worker”
- reads pod’s specification in YAML/JSON (from directory, own api or etcd)



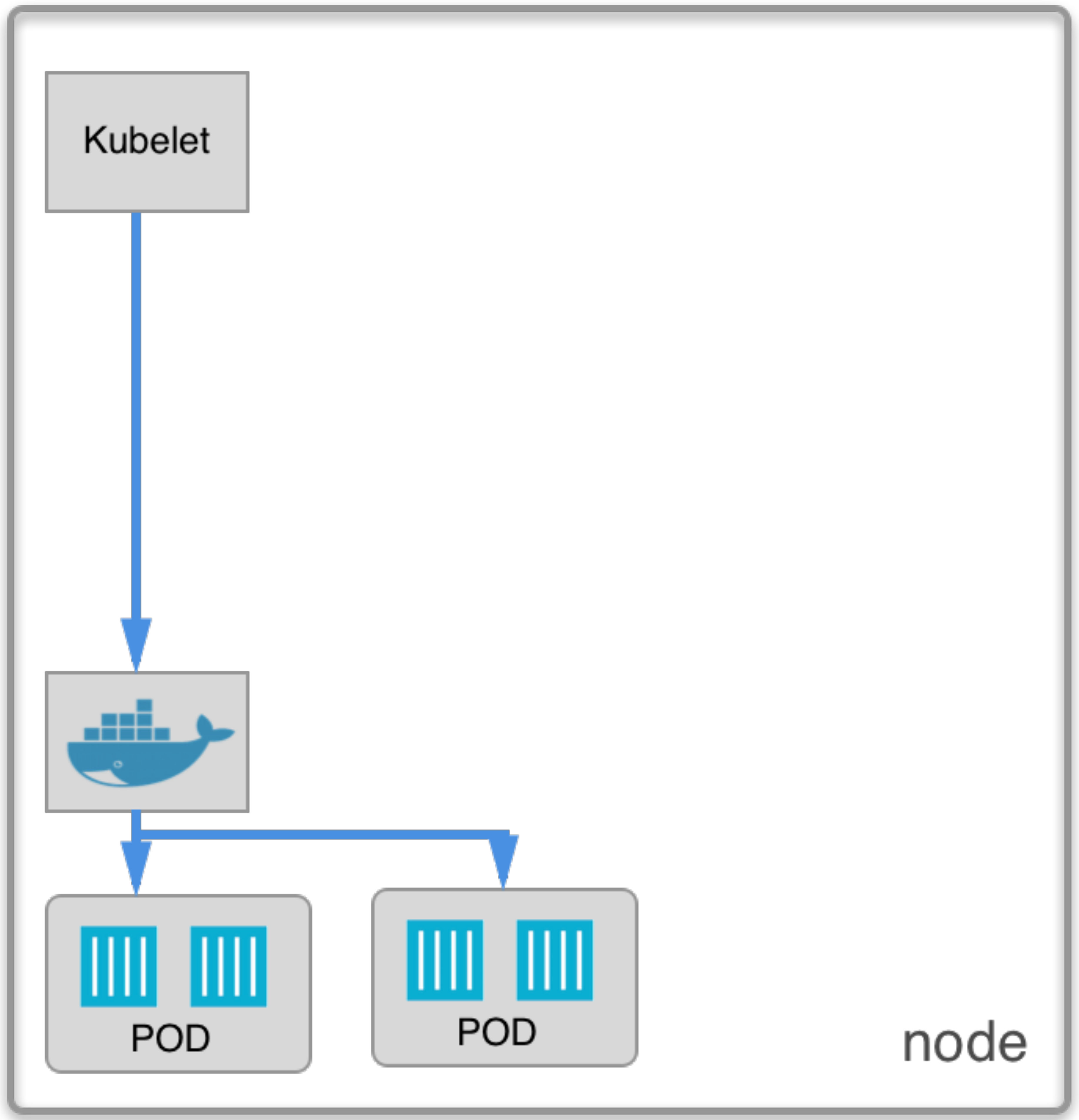
KUBELET

- the “worker”
- reads pod’s specification in YAML/JSON (from directory, own api or etcd)
- talks to the Docker



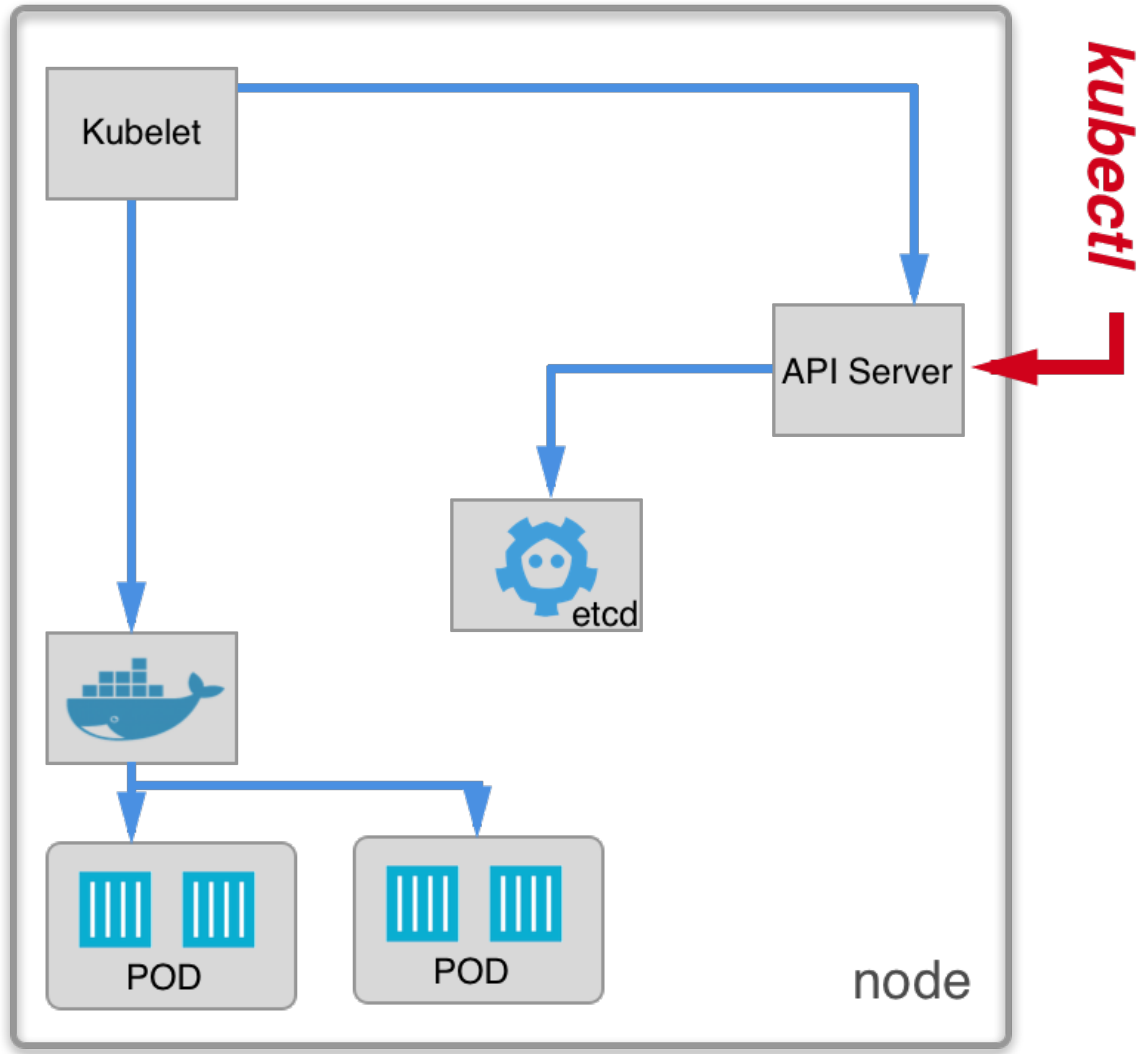
KUBELET

- the “worker”
- reads pod’s specification in YAML/JSON (from directory, own api or etcd)
- talks to the Docker
- creates pods / containers



ETCD + API SERVER

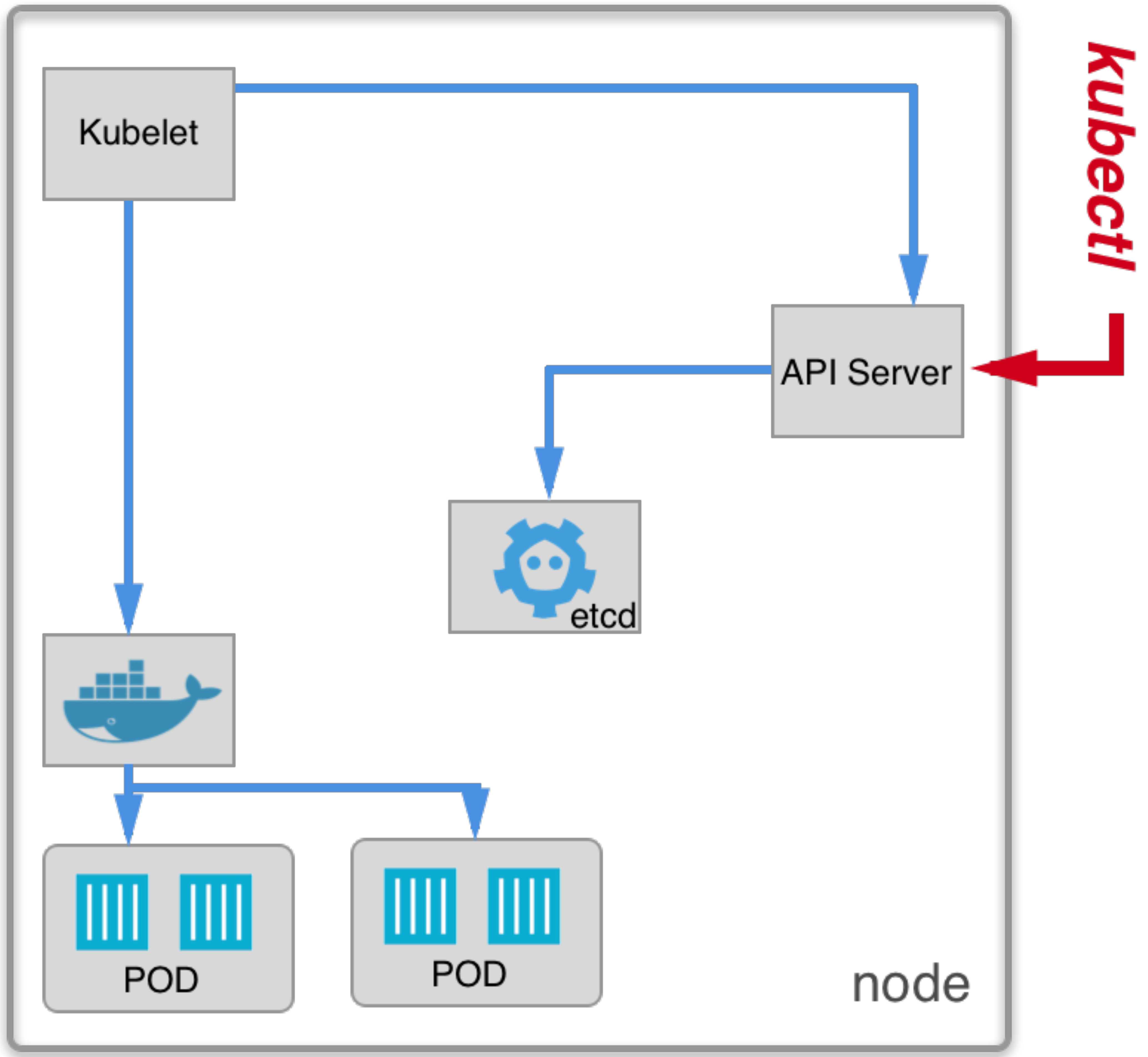
etcd



ETCD + API SERVER

etcd

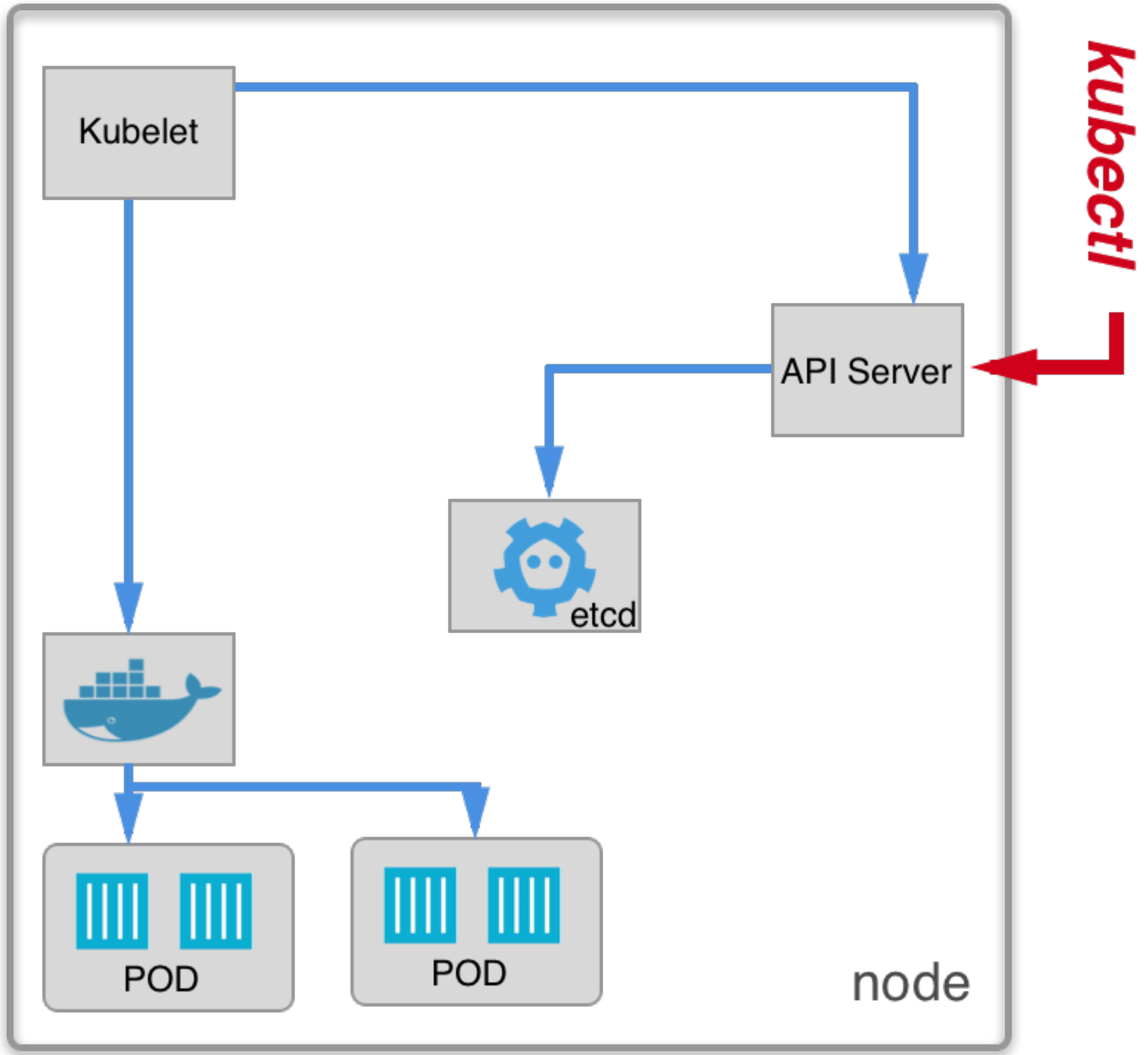
- key-value distributed database



ETCD + API SERVER

etcd

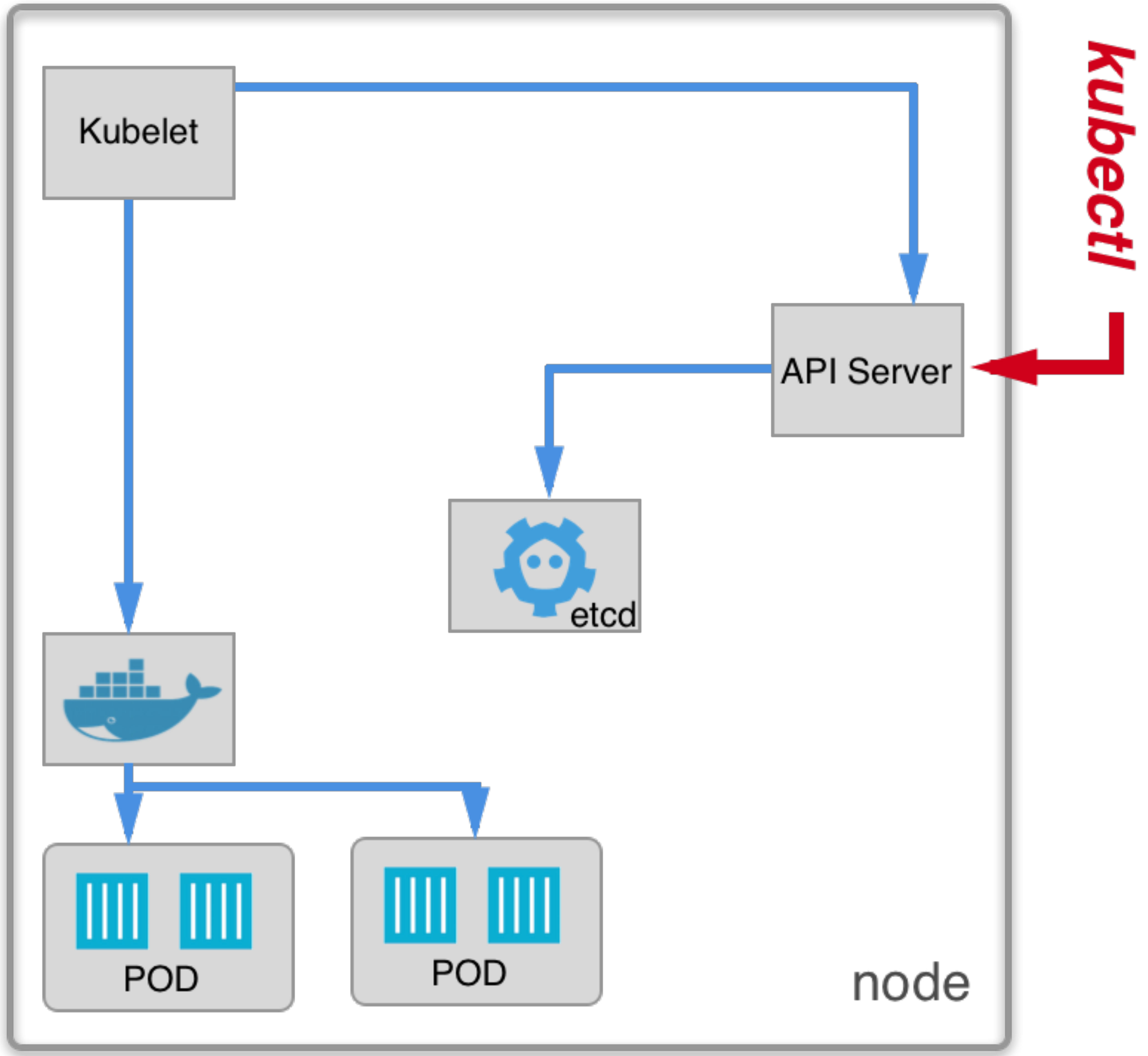
- key-value distributed database
- keys can be watchable



ETCD + API SERVER

etcd

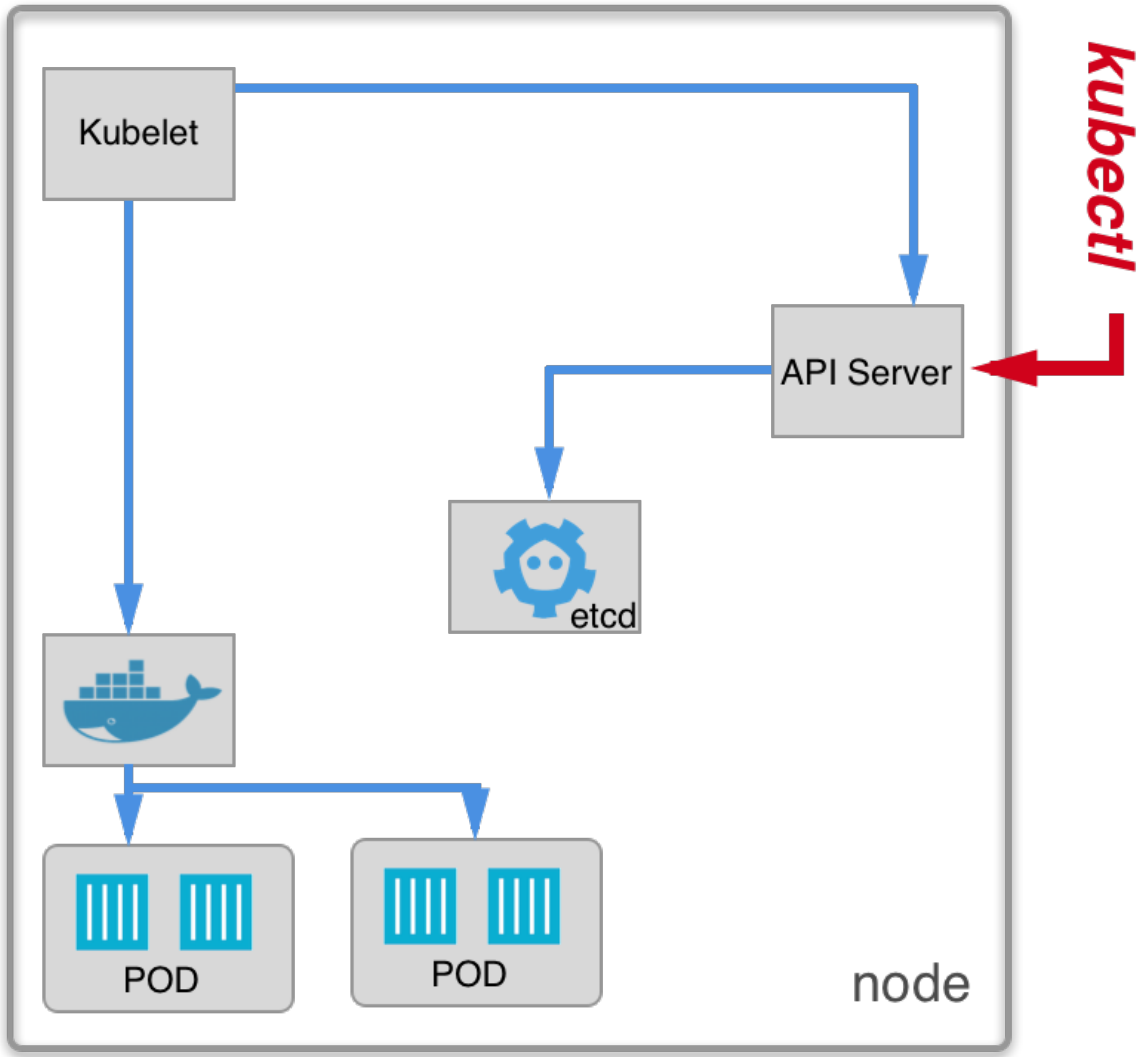
- key-value distributed database
- keys can be watchable
- “similar” to zookeeper or consul



ETCD + API SERVER

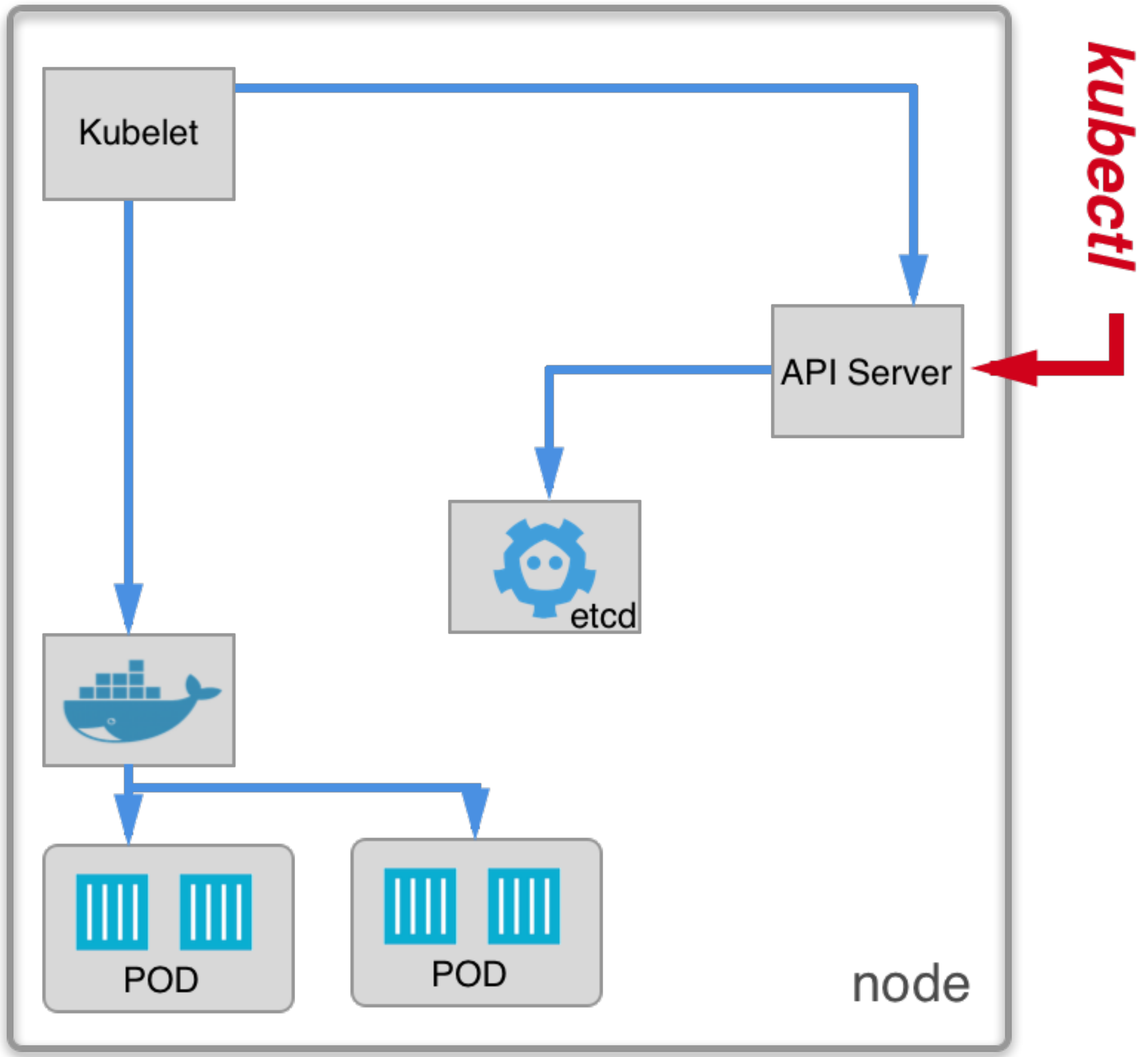
etcd

- key-value distributed database
- keys can be watchable
- “similar” to zookeeper or consul
- stores state of the cluster



ETCD + API SERVER

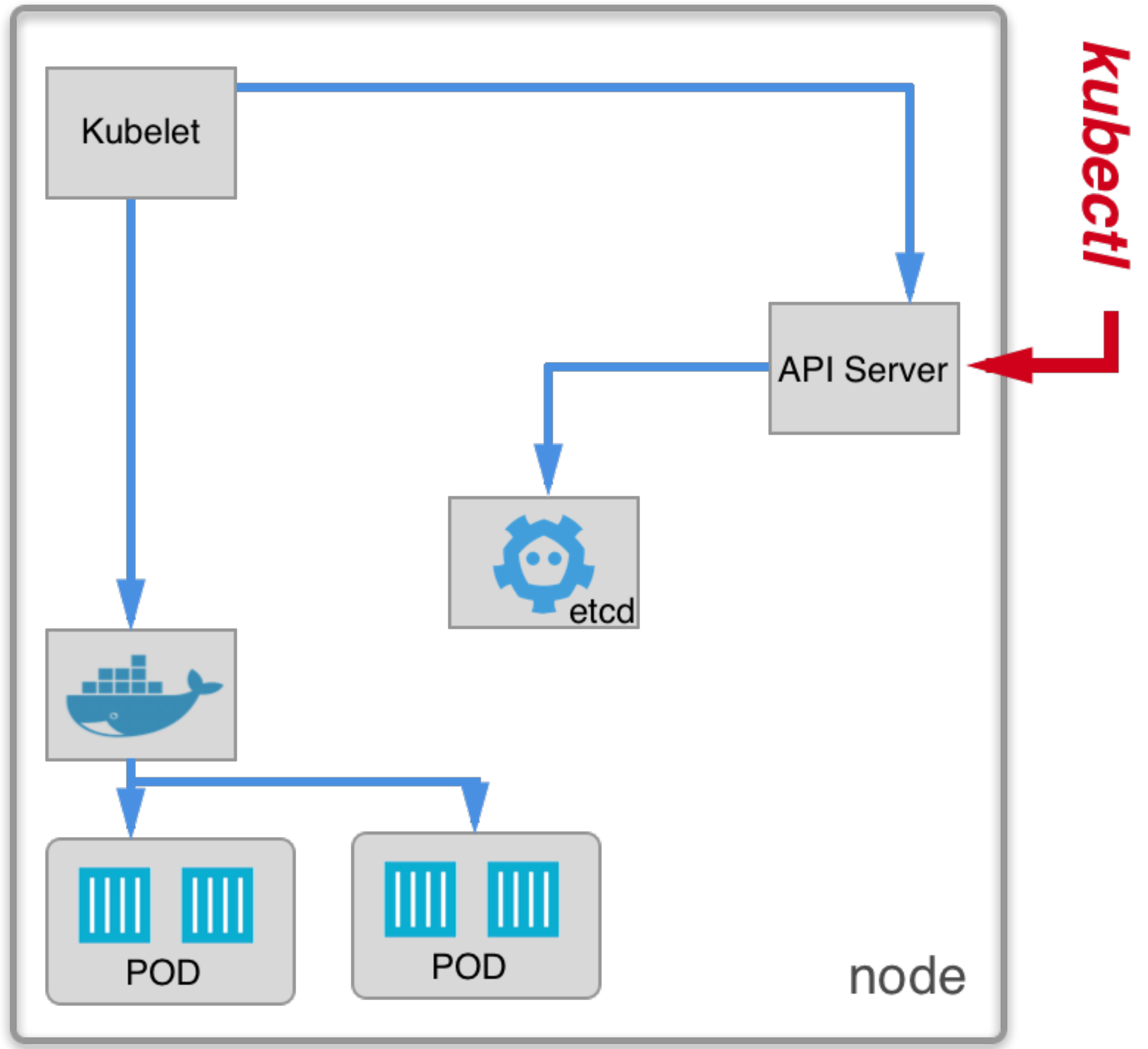
API Server



ETCD + API SERVER

API Server

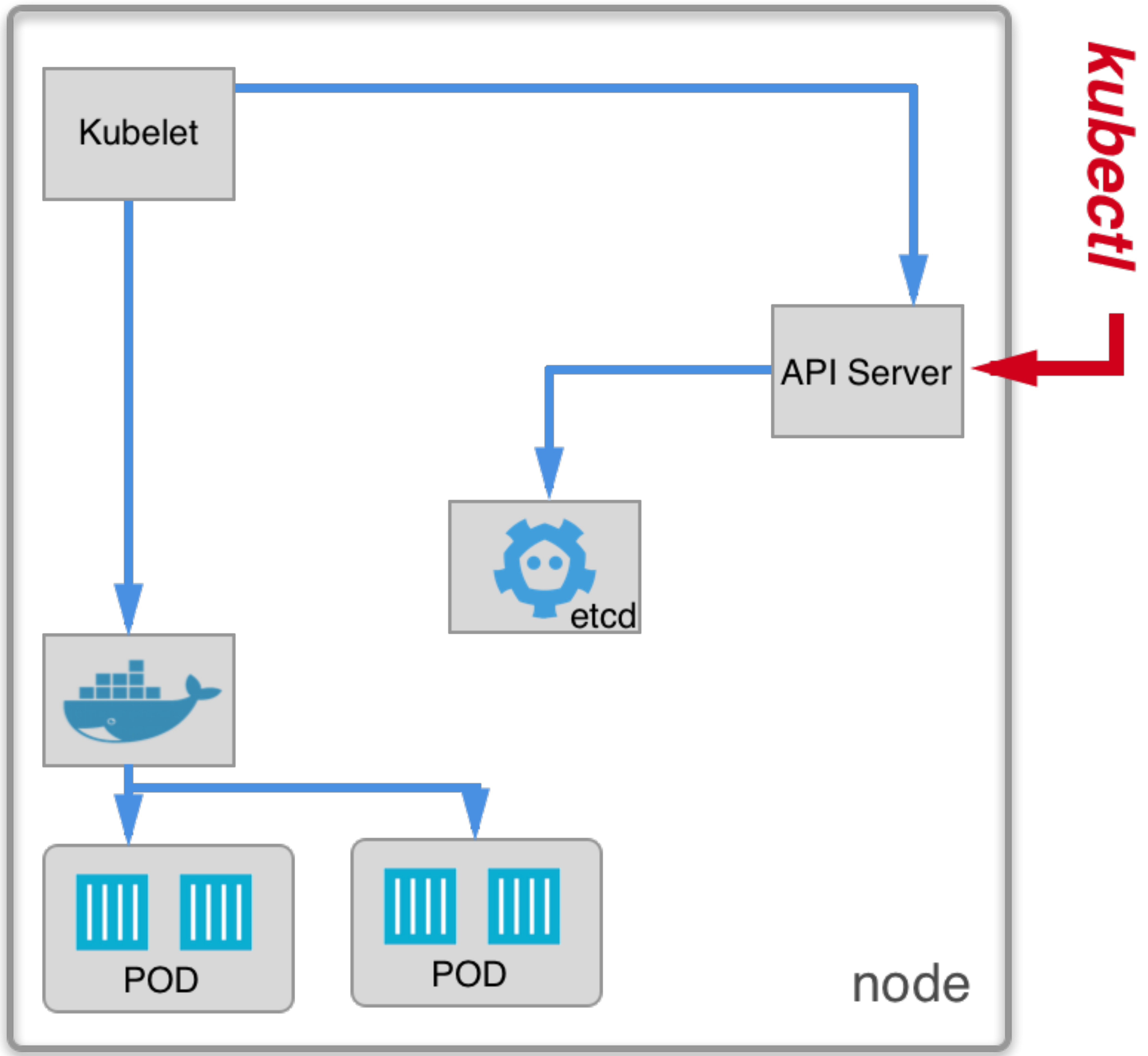
- “gateway” to etcd



ETCD + API SERVER

API Server

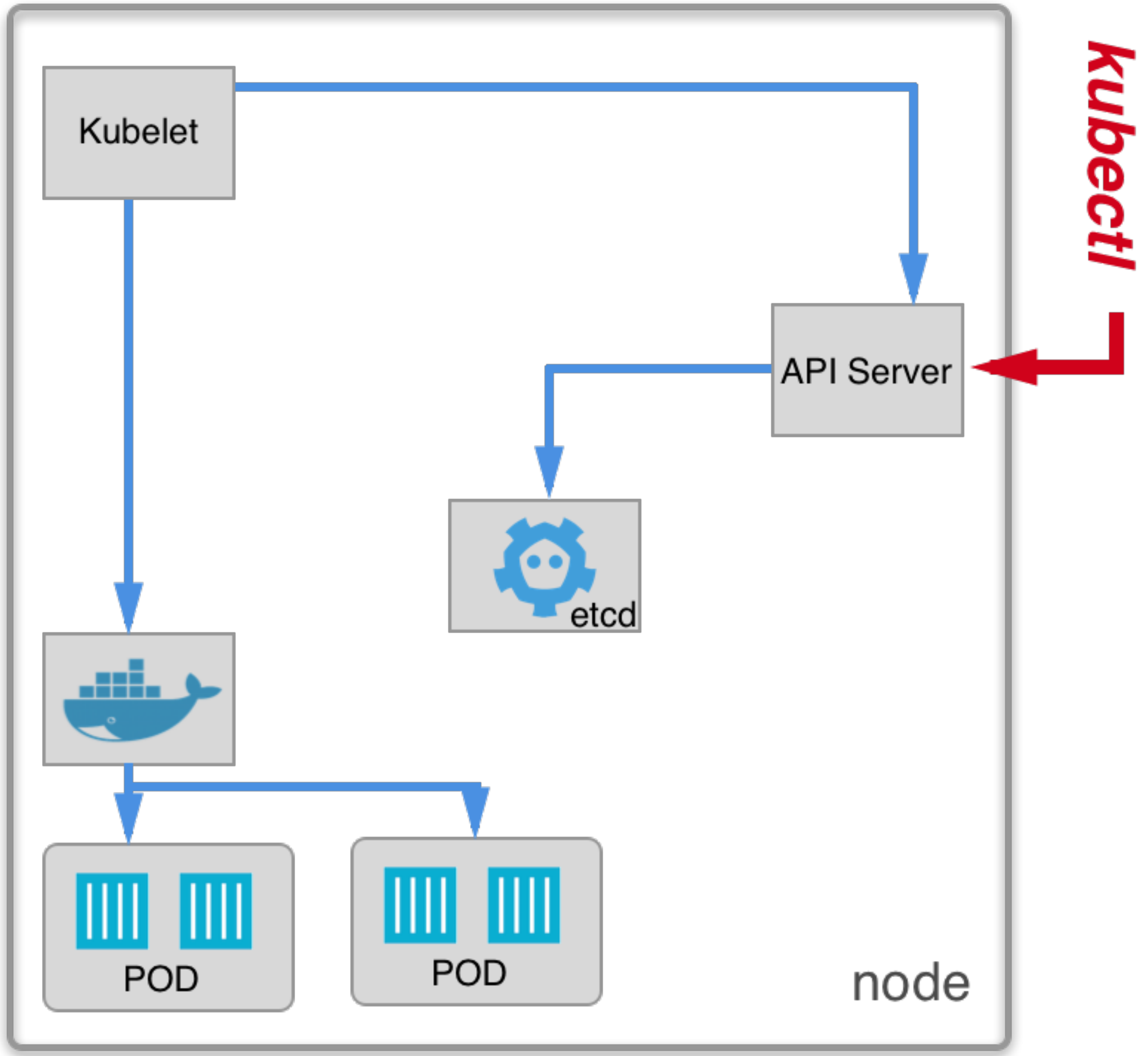
- "gateway" to etcd
- authenticates and authorizes requests



ETCD + API SERVER

API Server

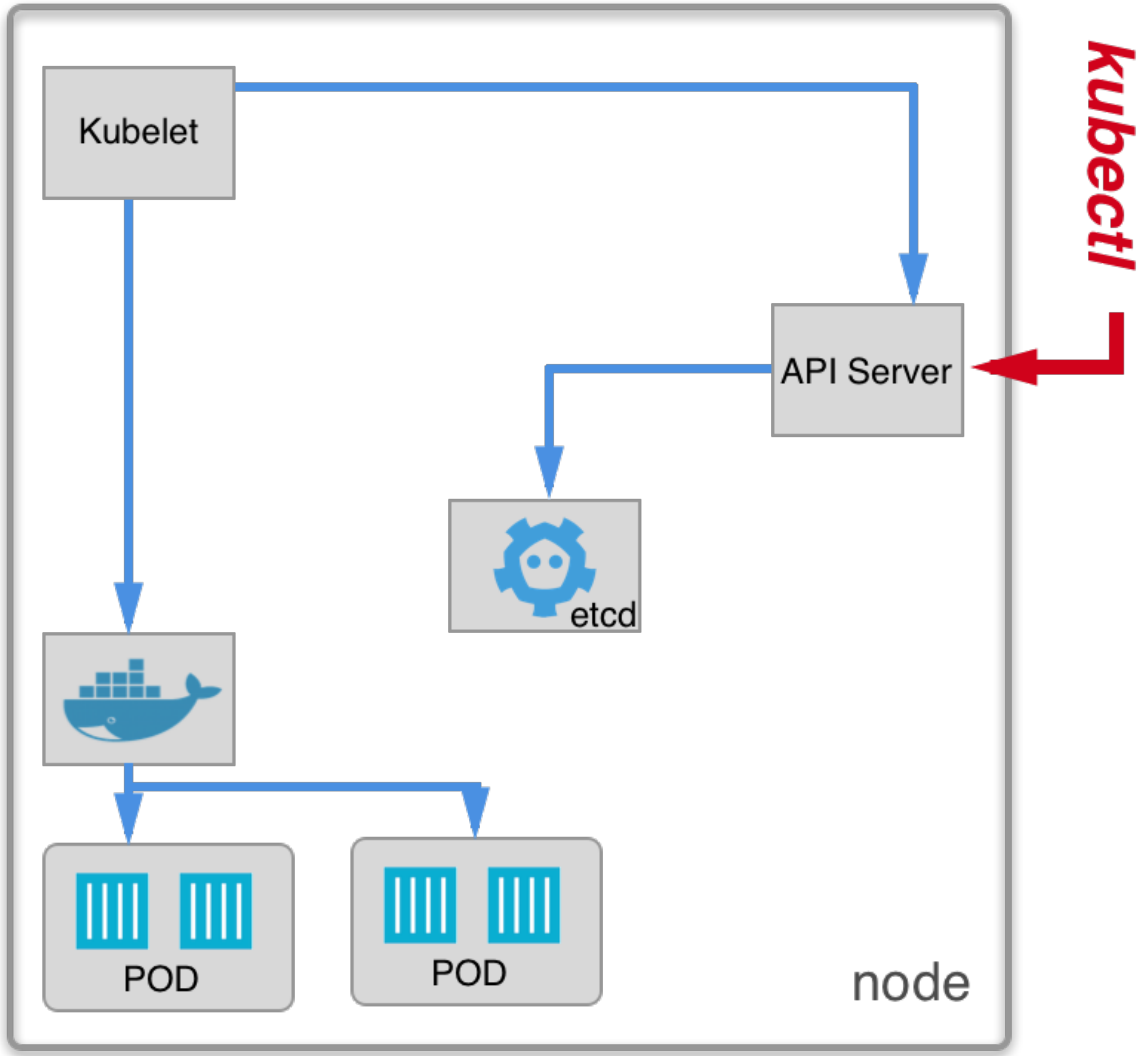
- "gateway" to etcd
- authenticates and authorizes requests
- all k8s components talk to it



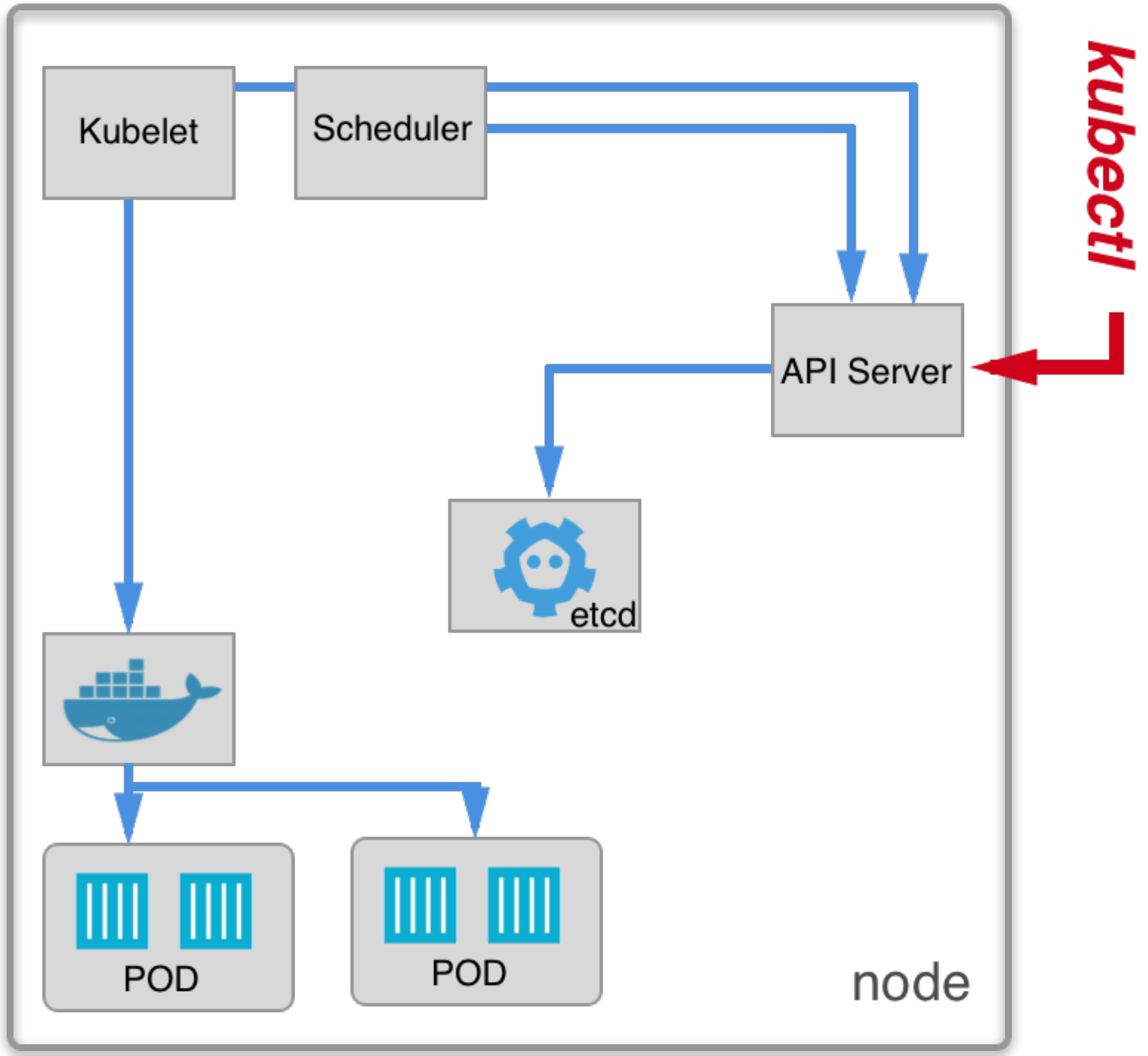
ETCD + API SERVER

API Server

- "gateway" to etcd
- authenticates and authorizes requests
- all k8s components talk to it
- kubectl talks to it

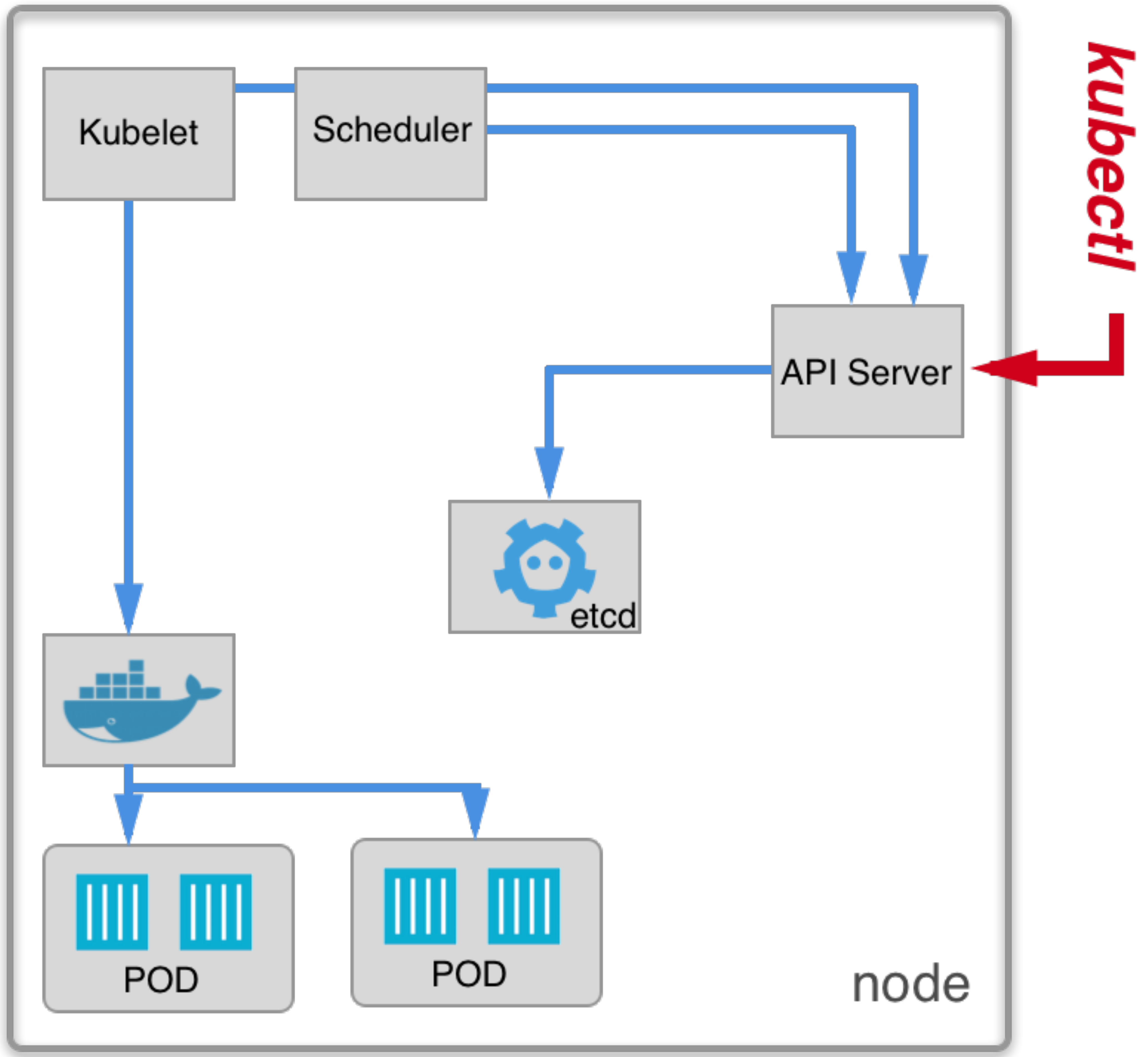


SCHEDULER



SCHEDULER

- responsible for scheduling pods on nodes



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- responsible for scheduling pods on nodes
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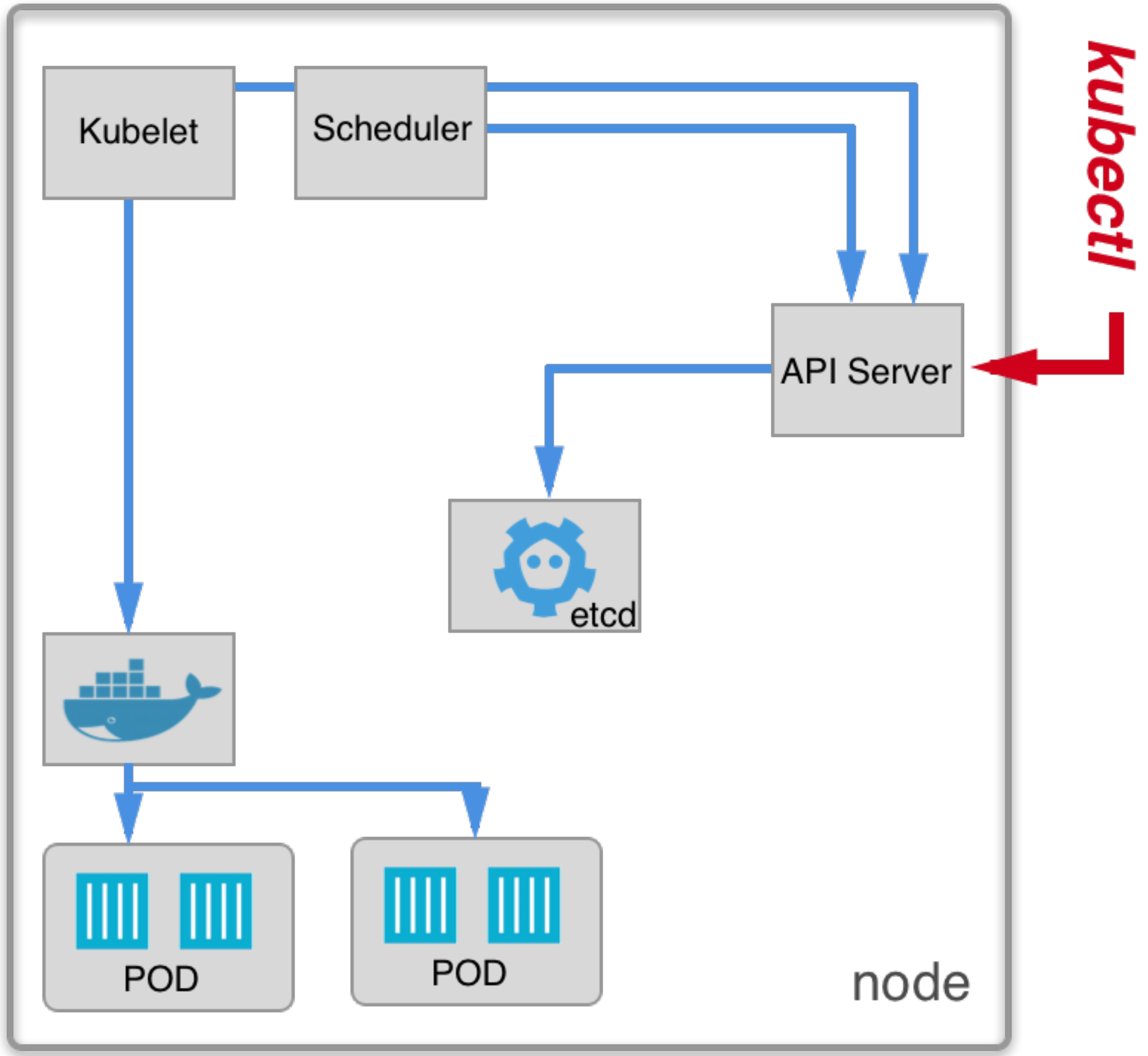
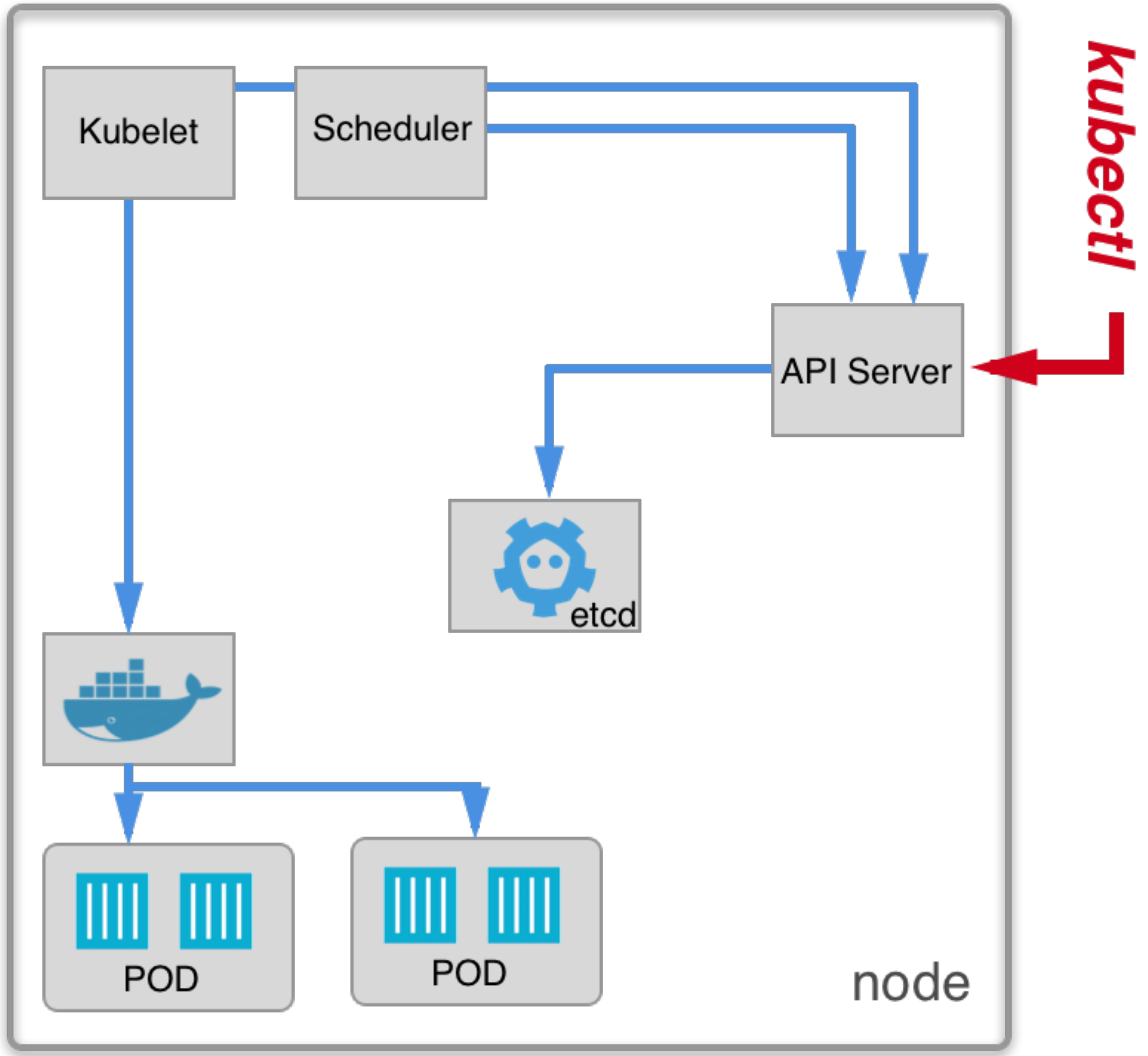
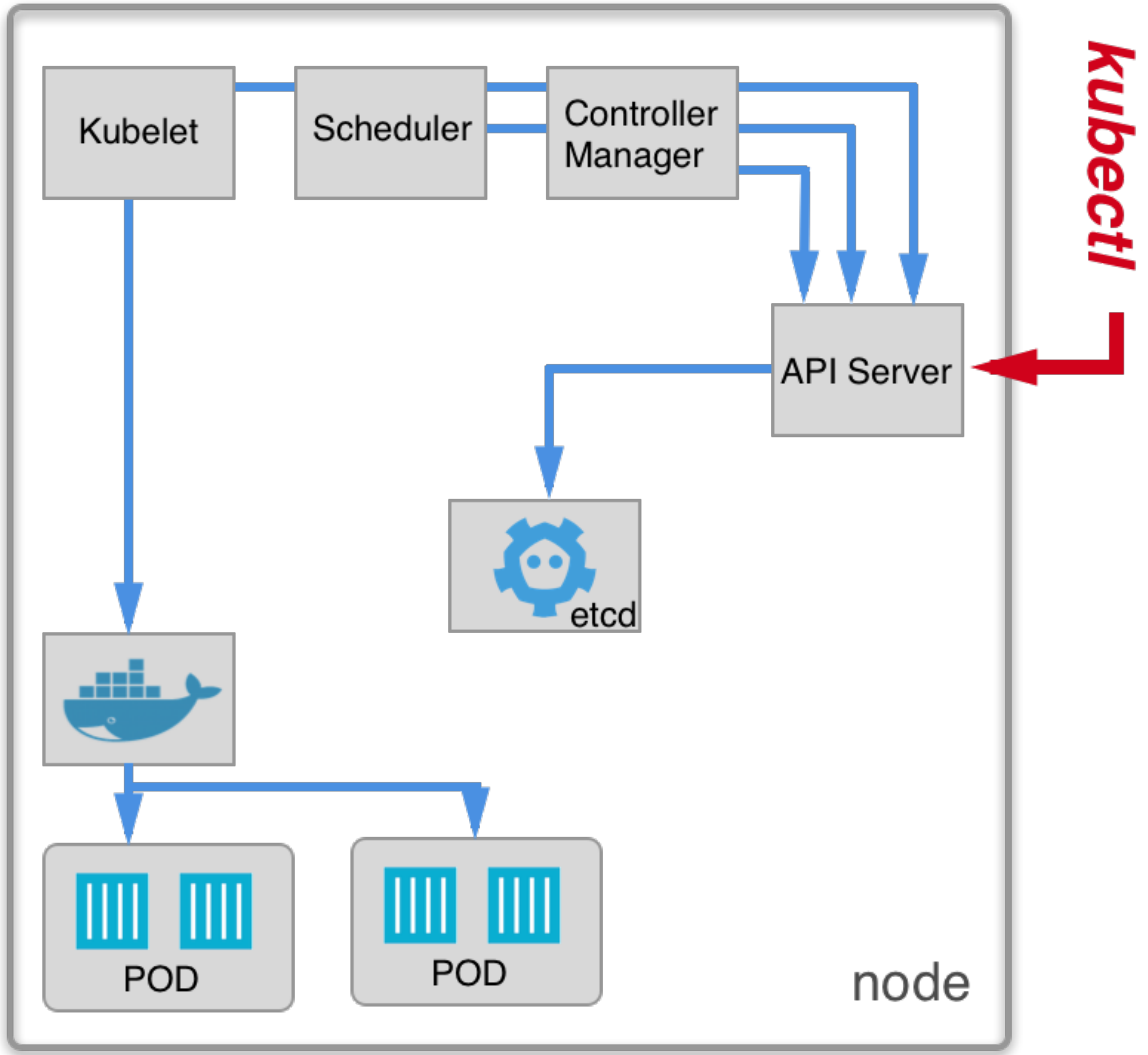


SCHEDULER

- responsible for scheduling pods on nodes
- connects to API Server
- watches for pods that aren't bound to a node and assigns one

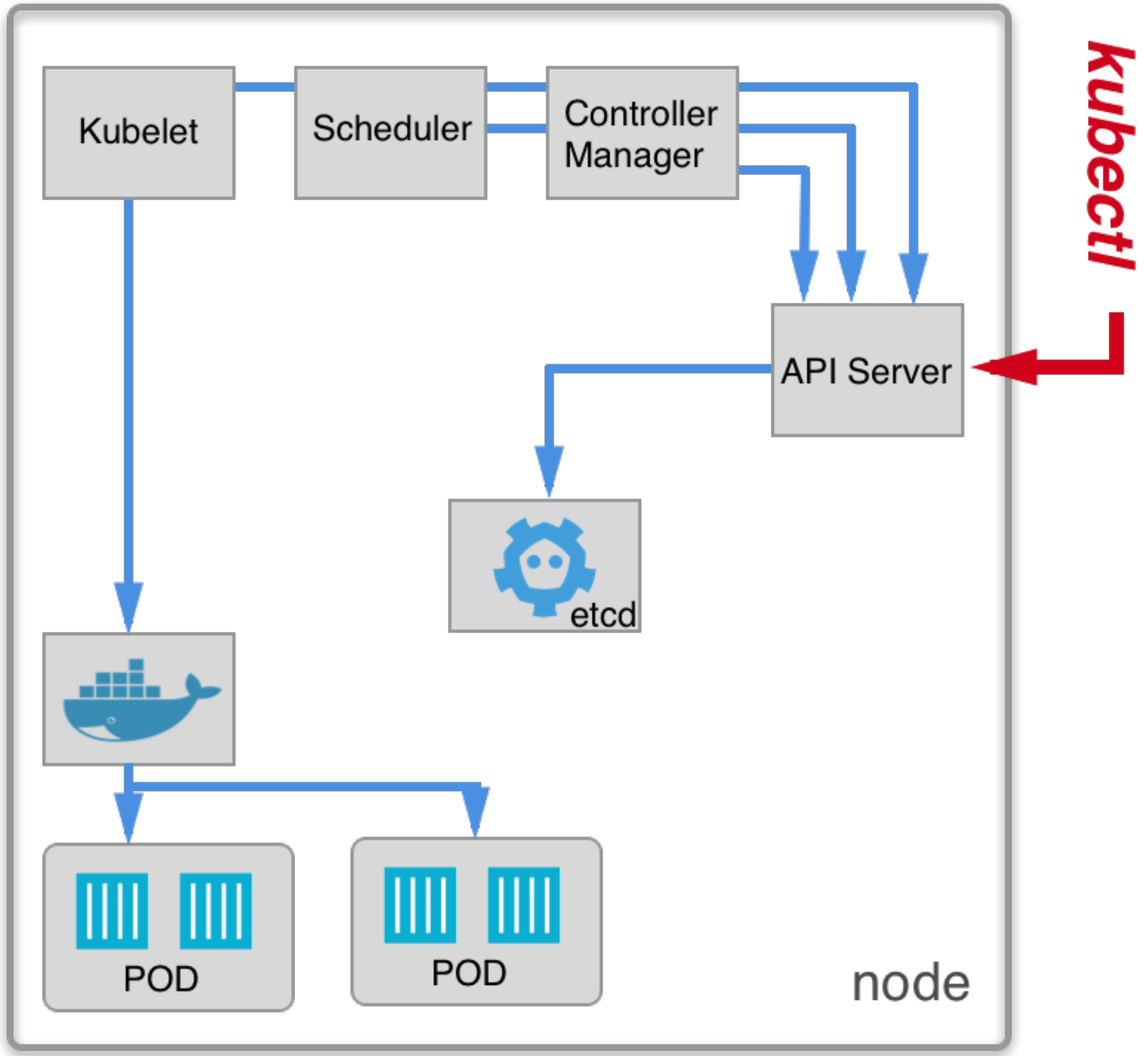


CONTROLLER MANAGER



CONTROLLER MANAGER

- responsible for managing Deployments and ReplicaSets



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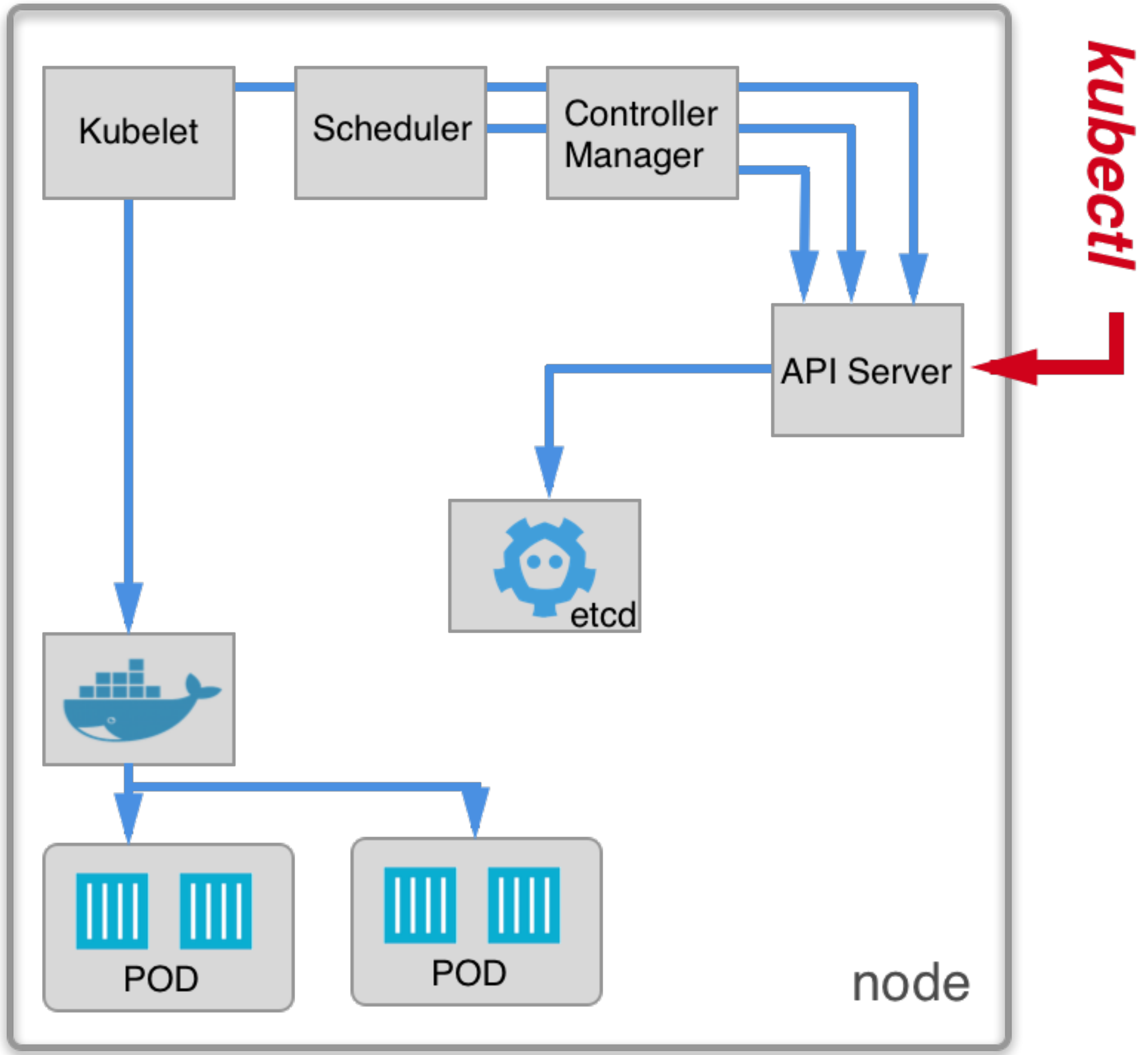
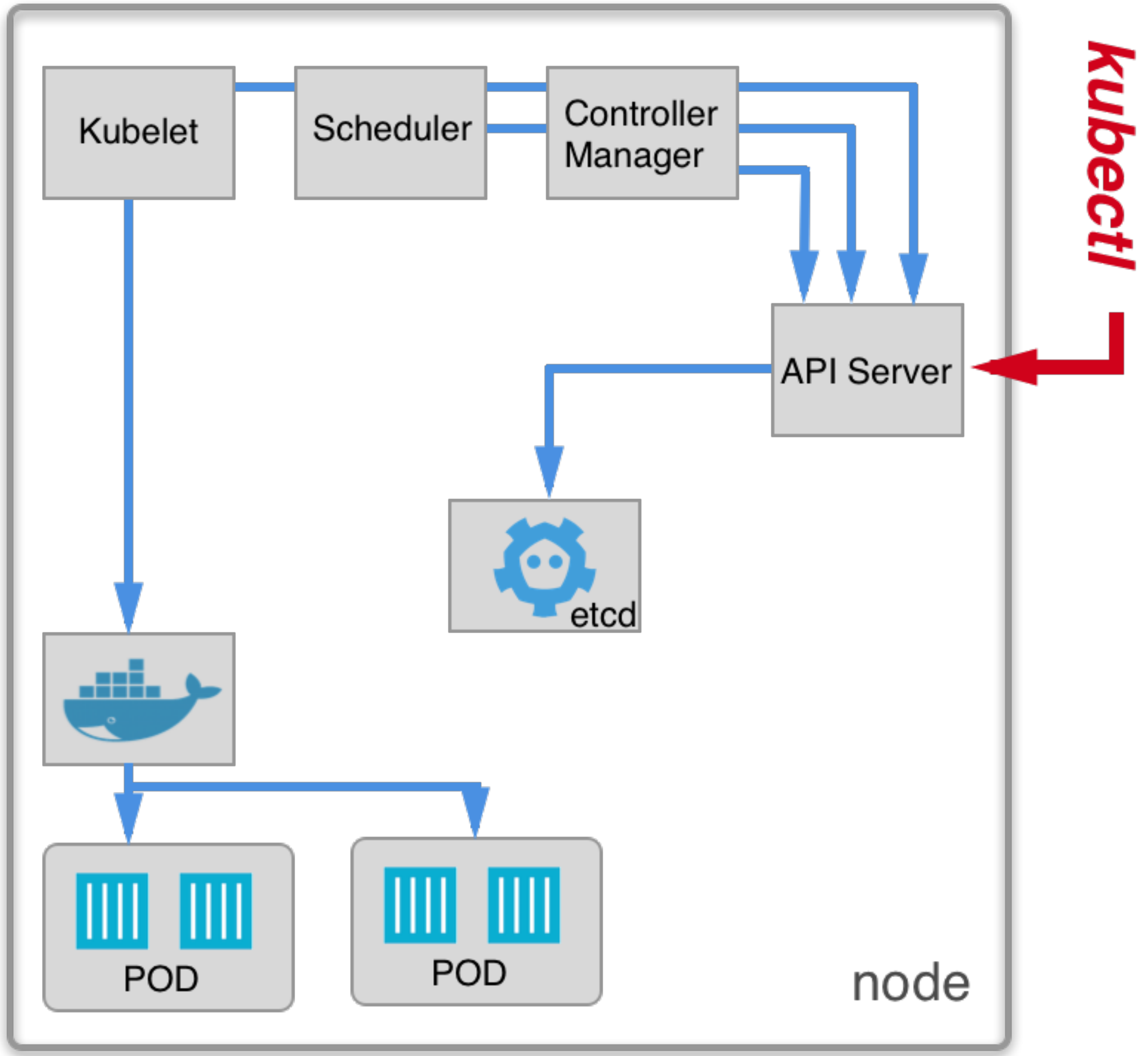
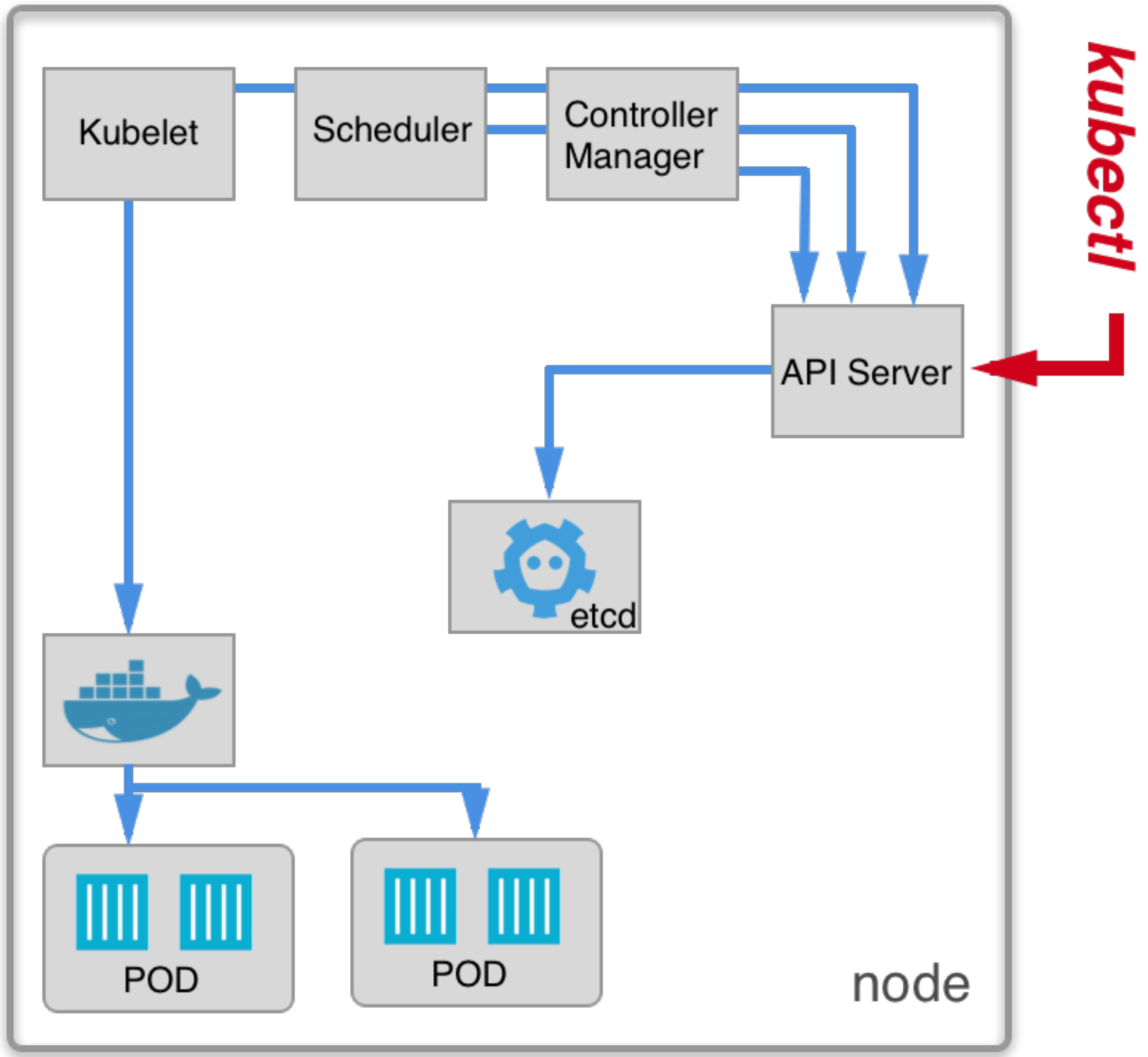


CONTROLLER MANAGER

- responsible for managing Deployments and ReplicaSets
- connects to API Server
- takes care of keeping pods counts at given number

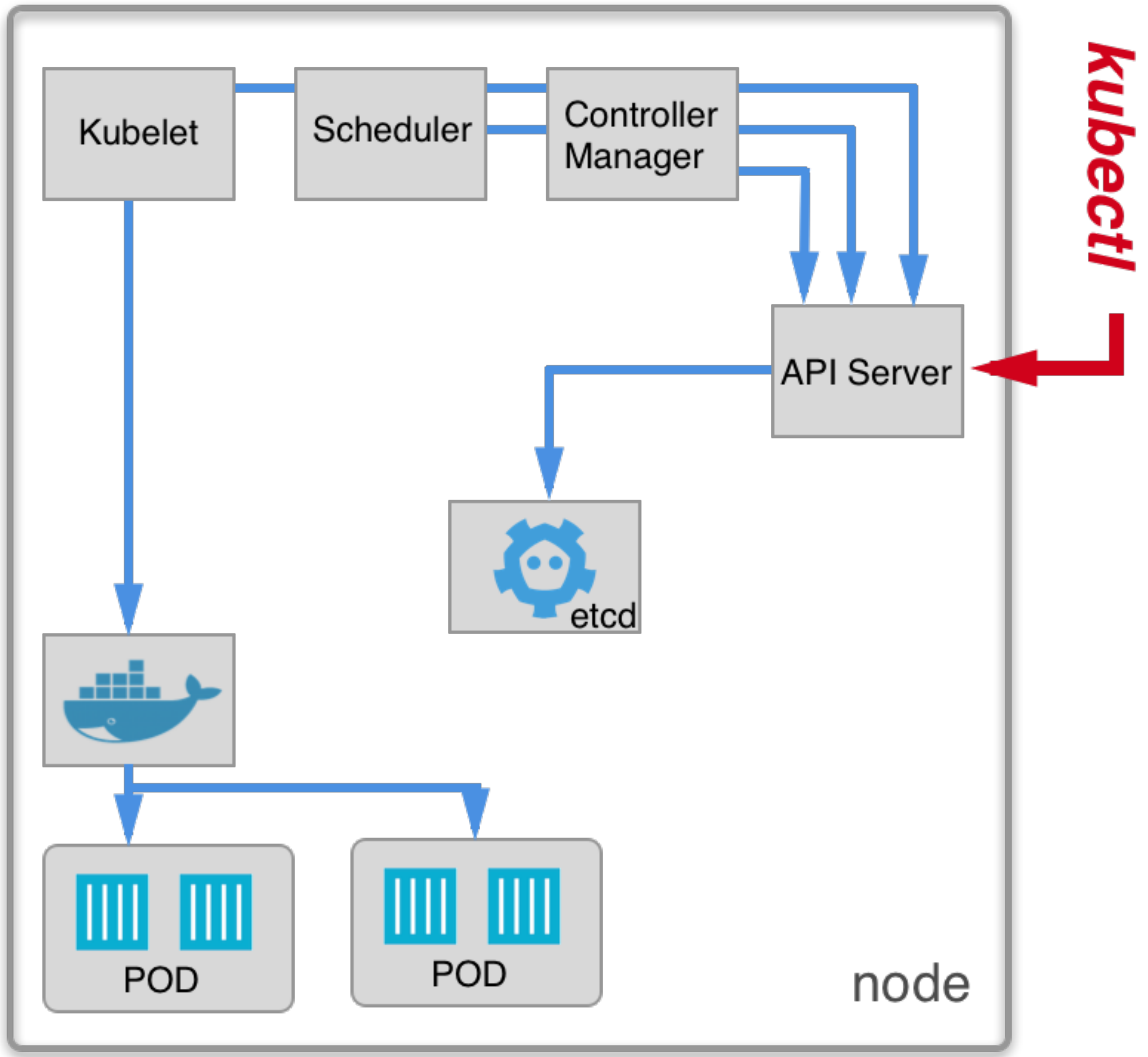


BASIC FLOW


Kubelet
Scheduler
Controller Manager
kubectl
API Server
etcd
POD
POD
node

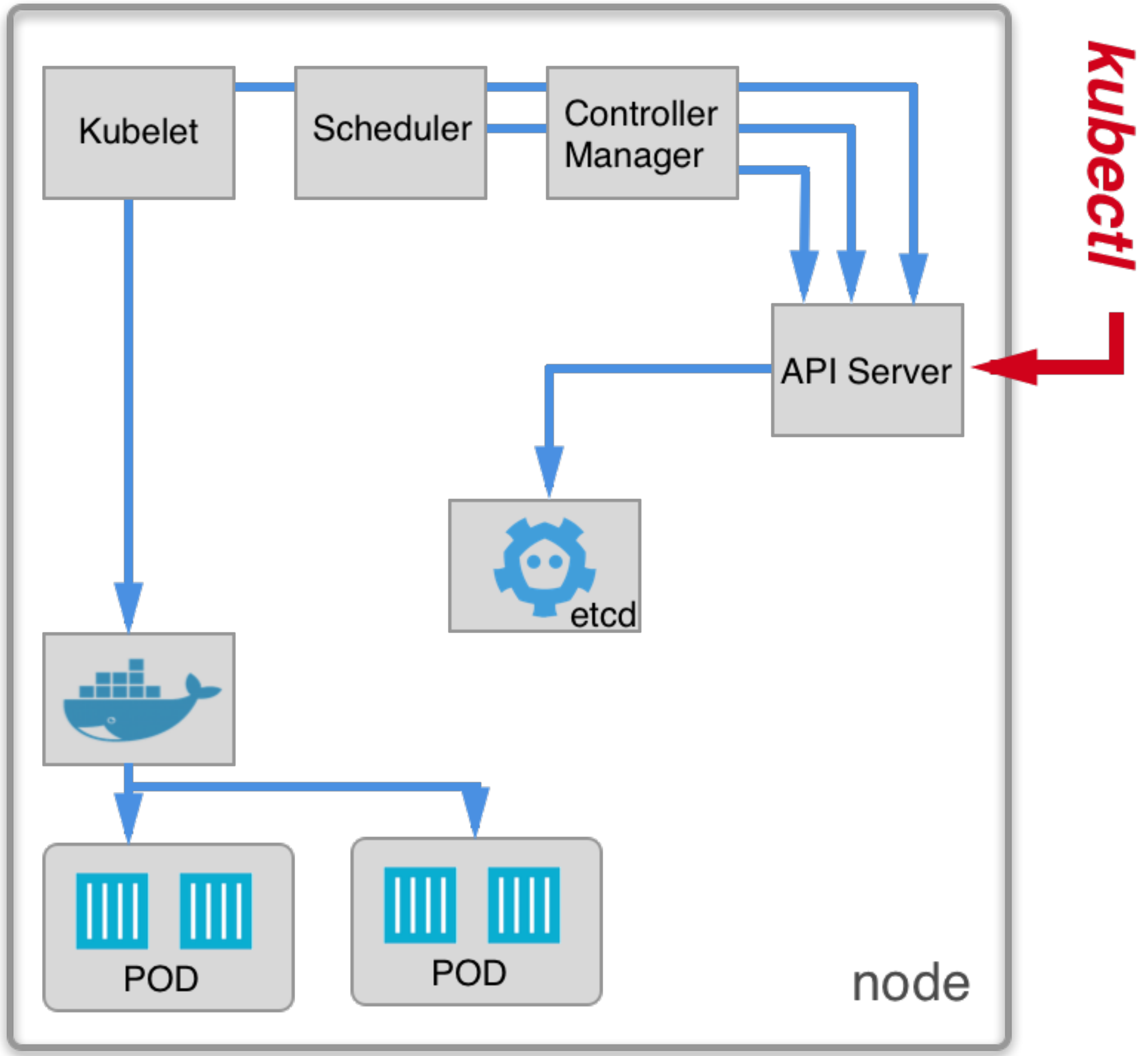
BASIC FLOW

- kubectl apply -f deploy.yaml (5 replicas)



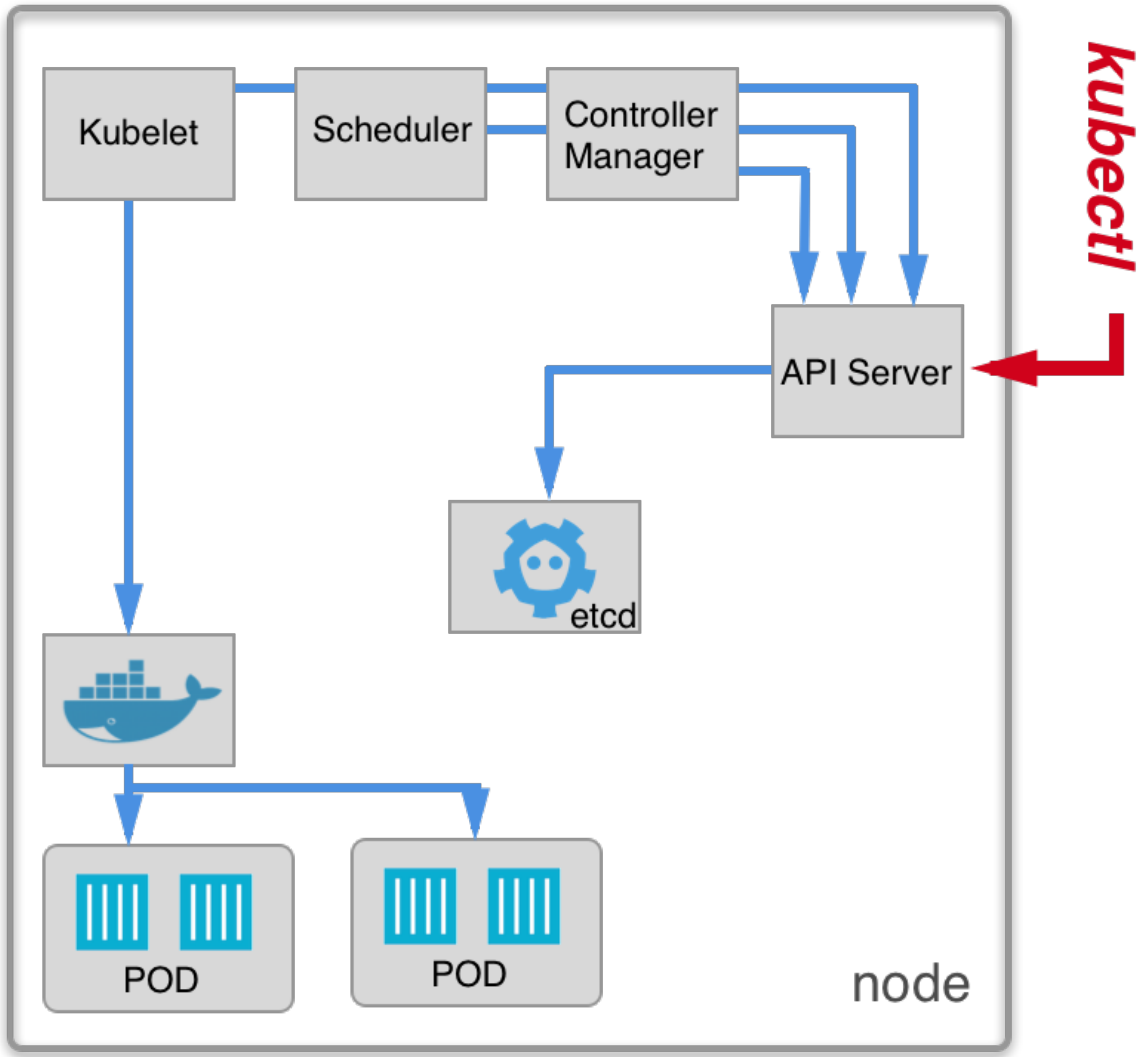
BASIC FLOW

- kubectl apply -f deploy.yaml (5 replicas)
- CM creates replicaset object



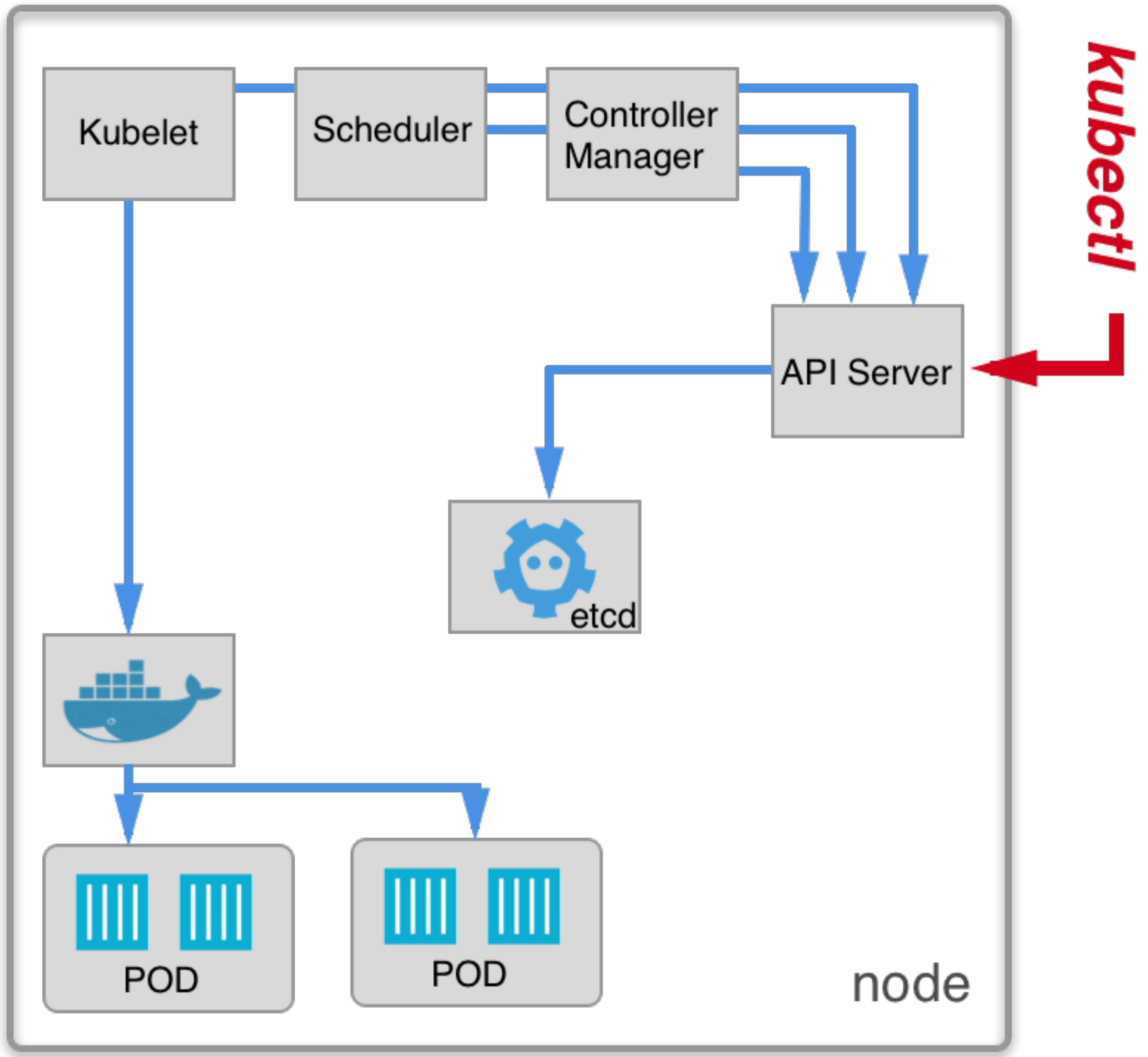
BASIC FLOW

- kubectl apply -f deploy.yaml (5 replicas)
- CM creates replicaset object
- CM creates 5 pods' objects



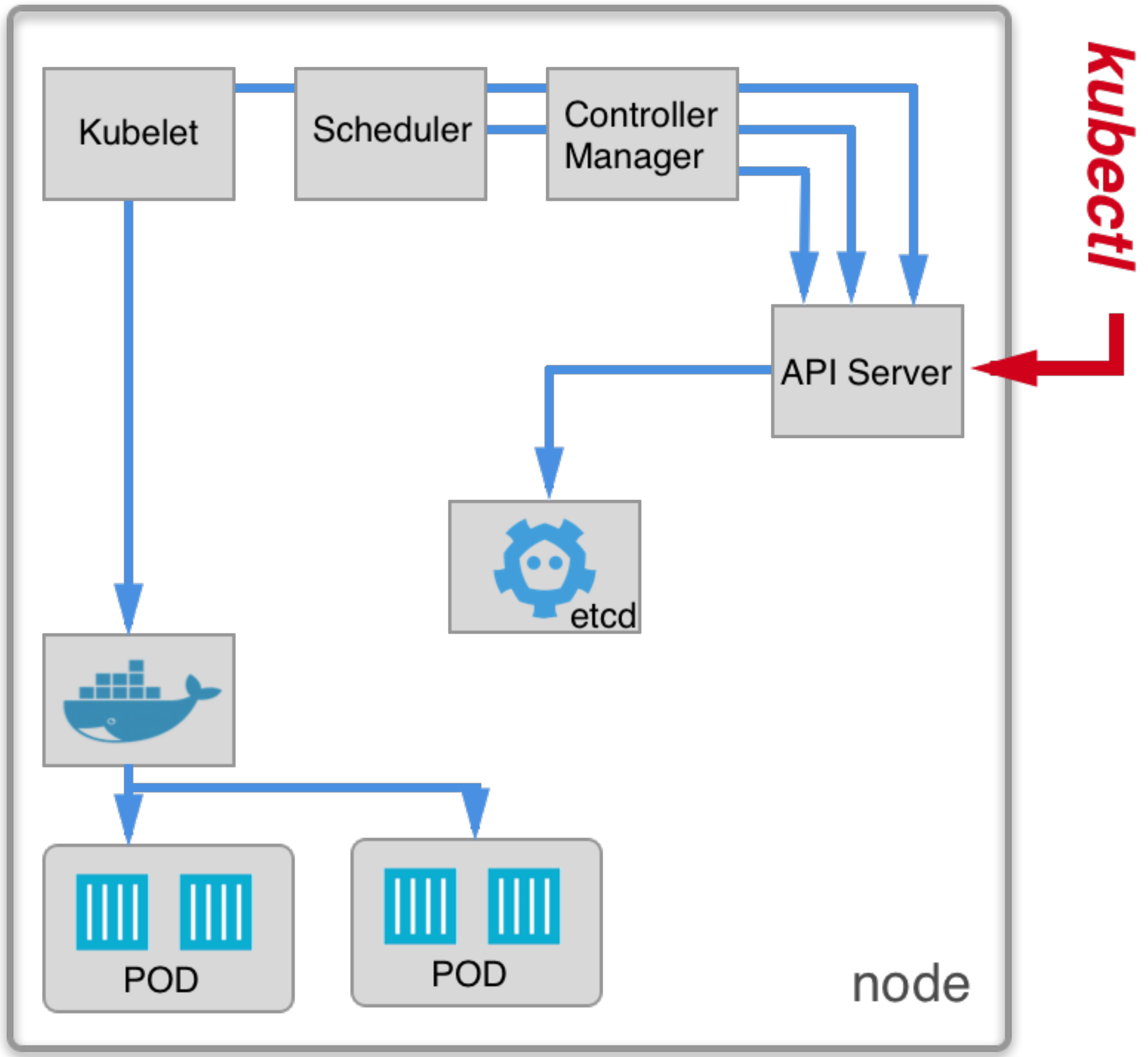
BASIC FLOW

- kubectl apply -f deploy.yaml (5 replicas)
- CM creates replicaset object
- CM creates 5 pods' objects
- Scheduler assigns nodes

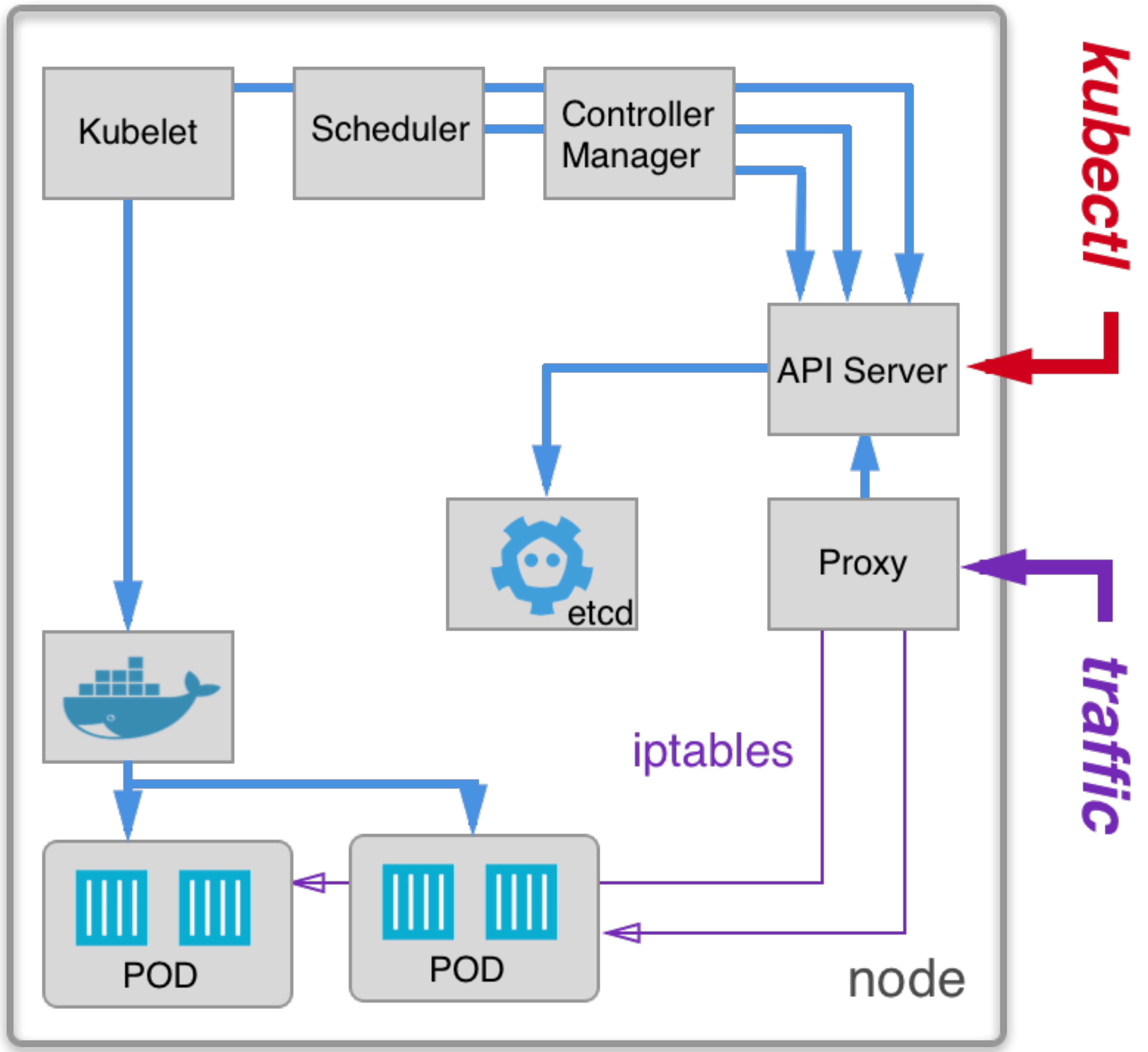


BASIC FLOW

- kubectl apply -f deploy.yaml (5 replicas)
- CM creates replicaset object
- CM creates 5 pods' objects
- Scheduler assigns nodes
- Kubelets create containers



PROXY


Kubelet
Scheduler
Controller Manager
kubectl
API Server
etcd
Proxy
traffic
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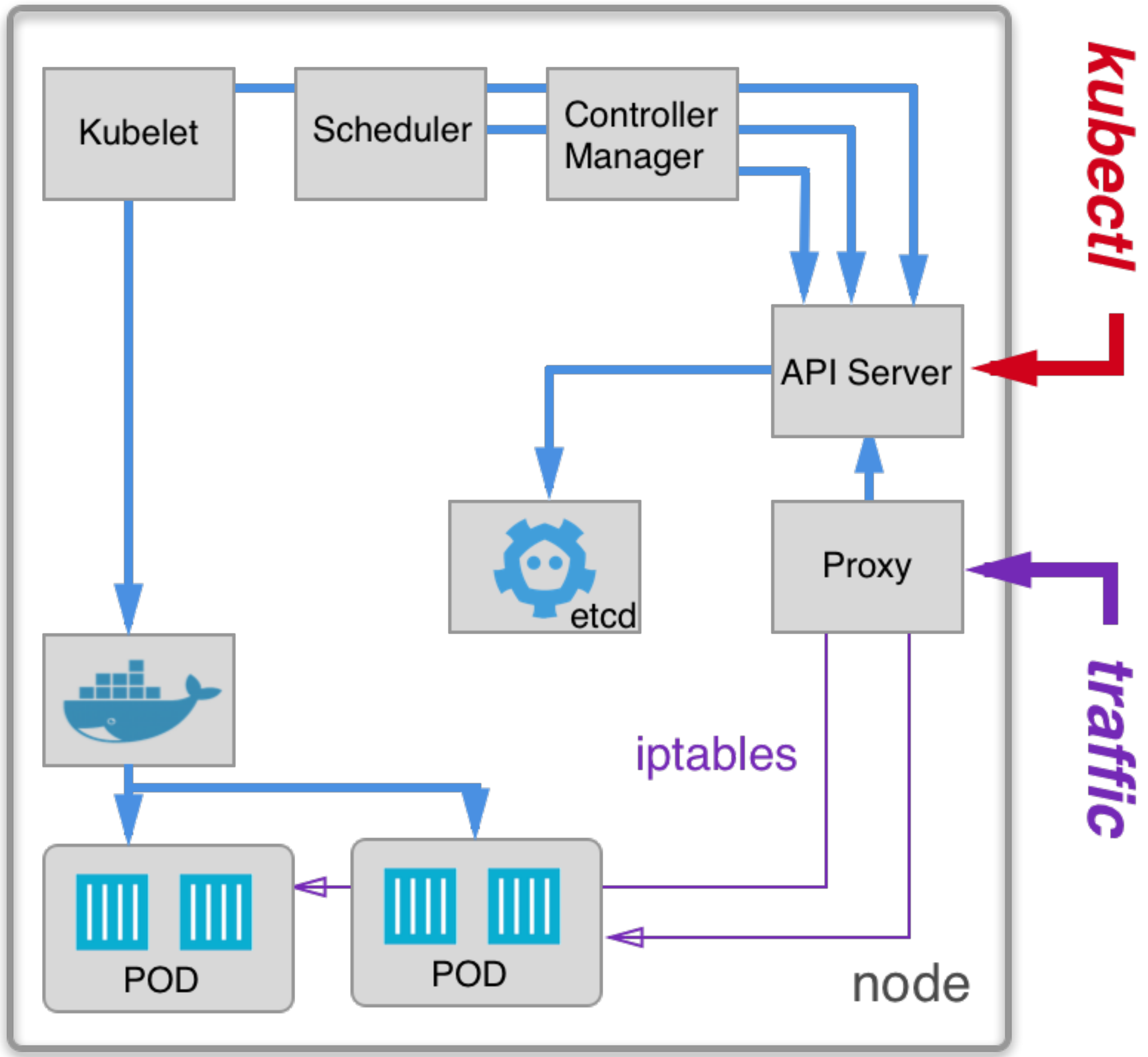
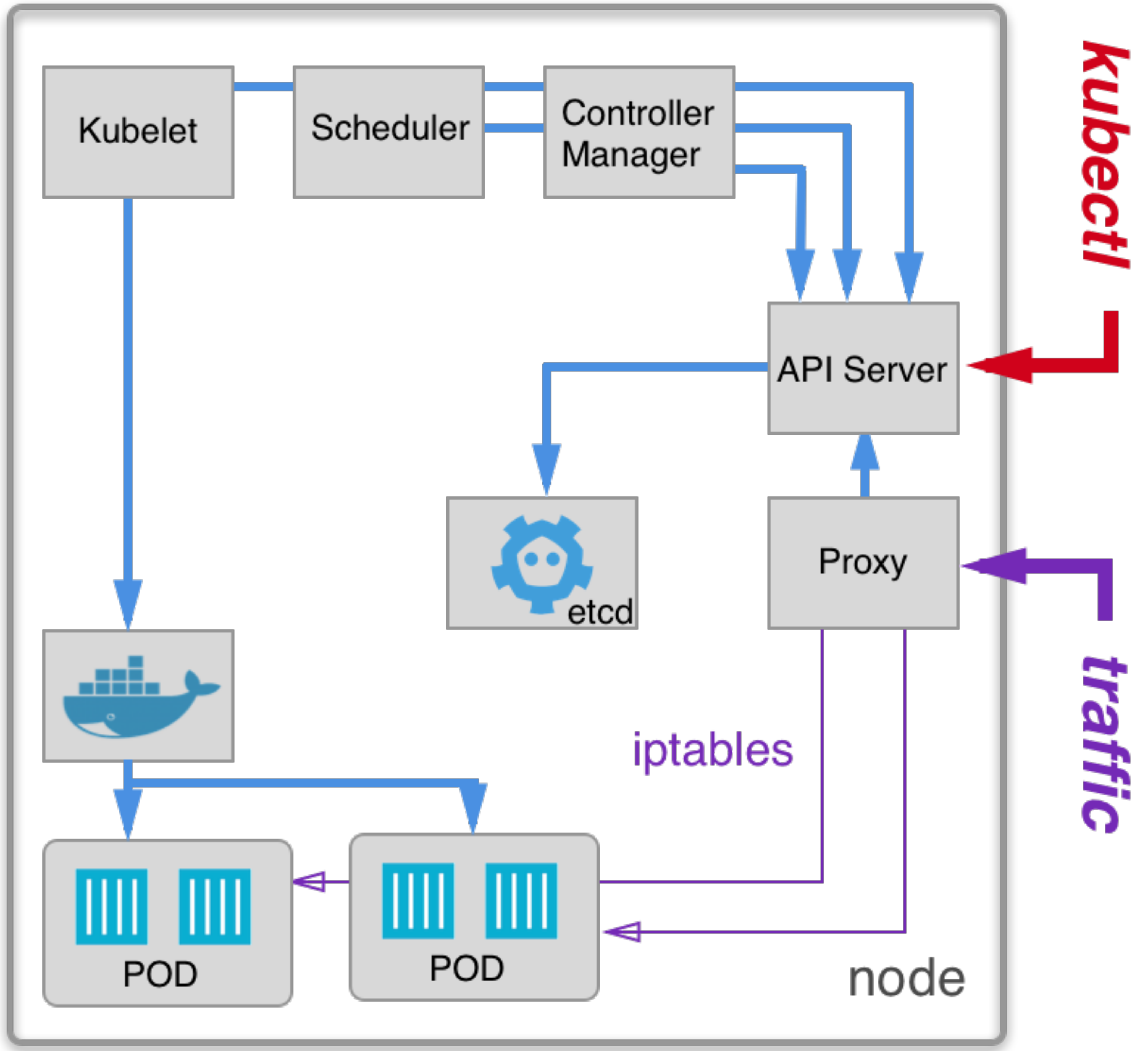
PROXY

- responsible for managing Services



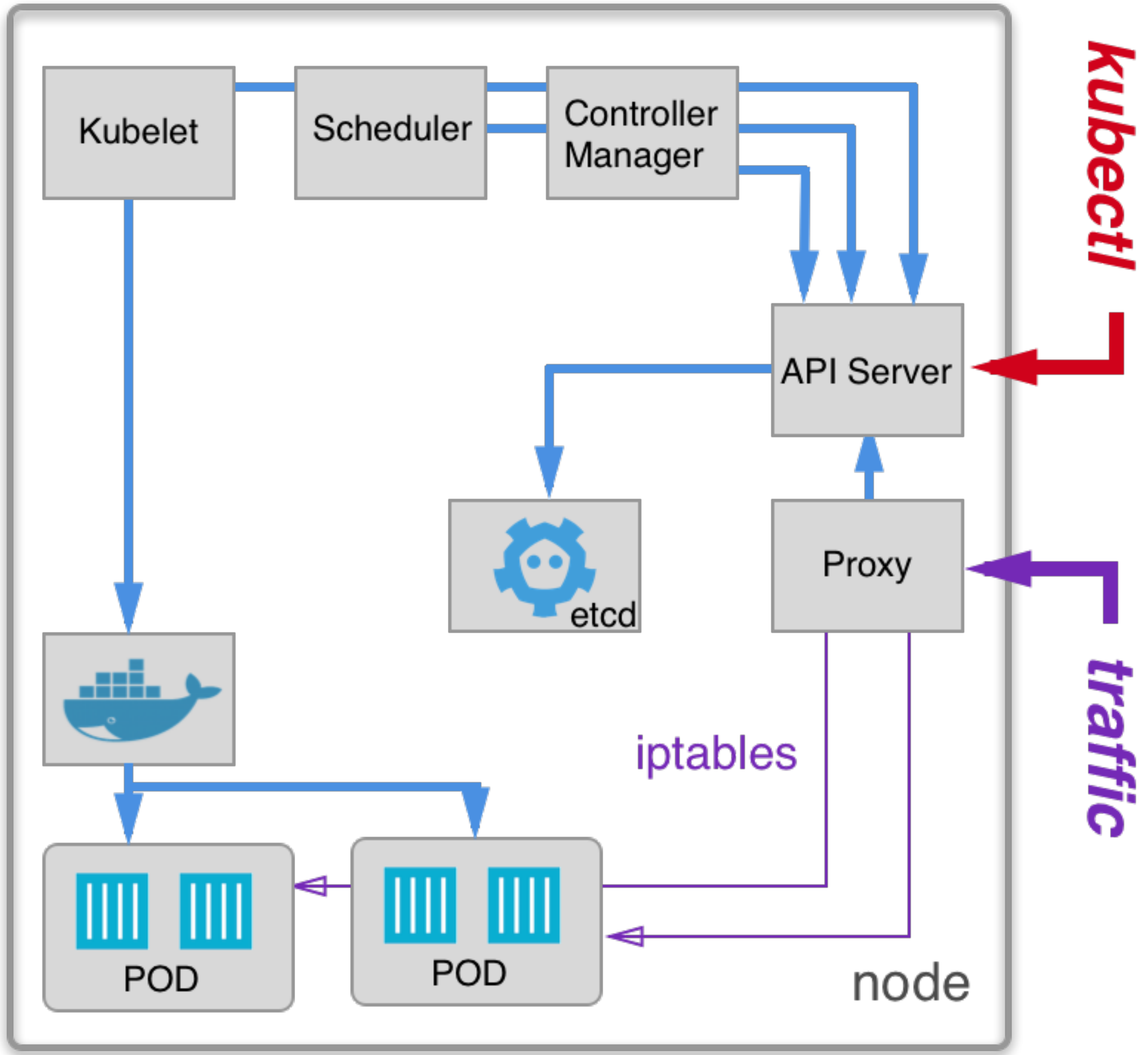
PROXY

- responsible for managing Services
- accepts external traffic on NodePorts and distributes it to pods



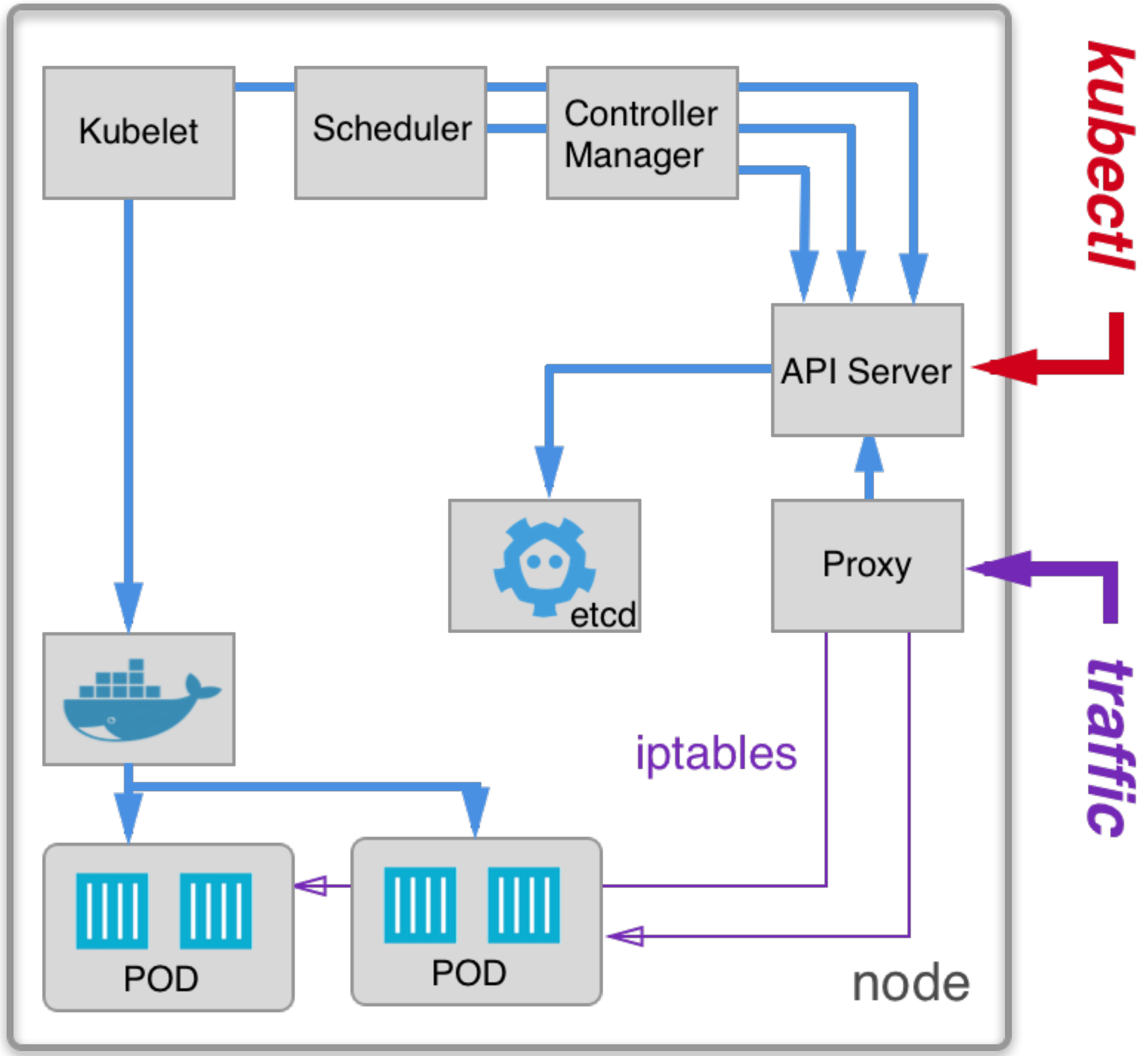
PROXY

- responsible for managing Services
- accepts external traffic on NodePorts and distributes it to pods
- load balances traffic between Service's pods



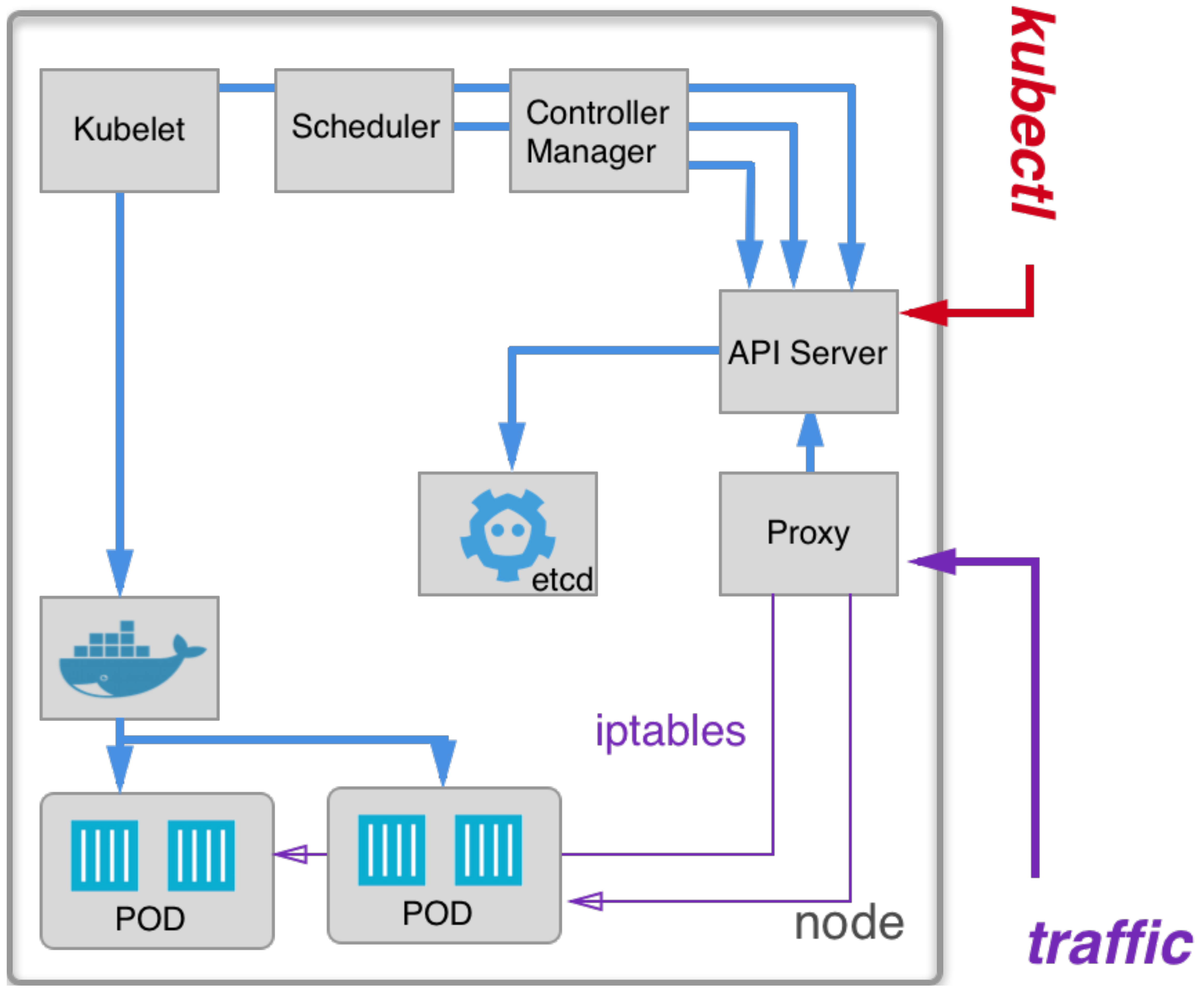
PROXY

- responsible for managing Services
- accepts external traffic on NodePorts and distributes it to pods
- load balances traffic between Service’s pods
- everything is done using *iptables*



DEMO

NETWORKING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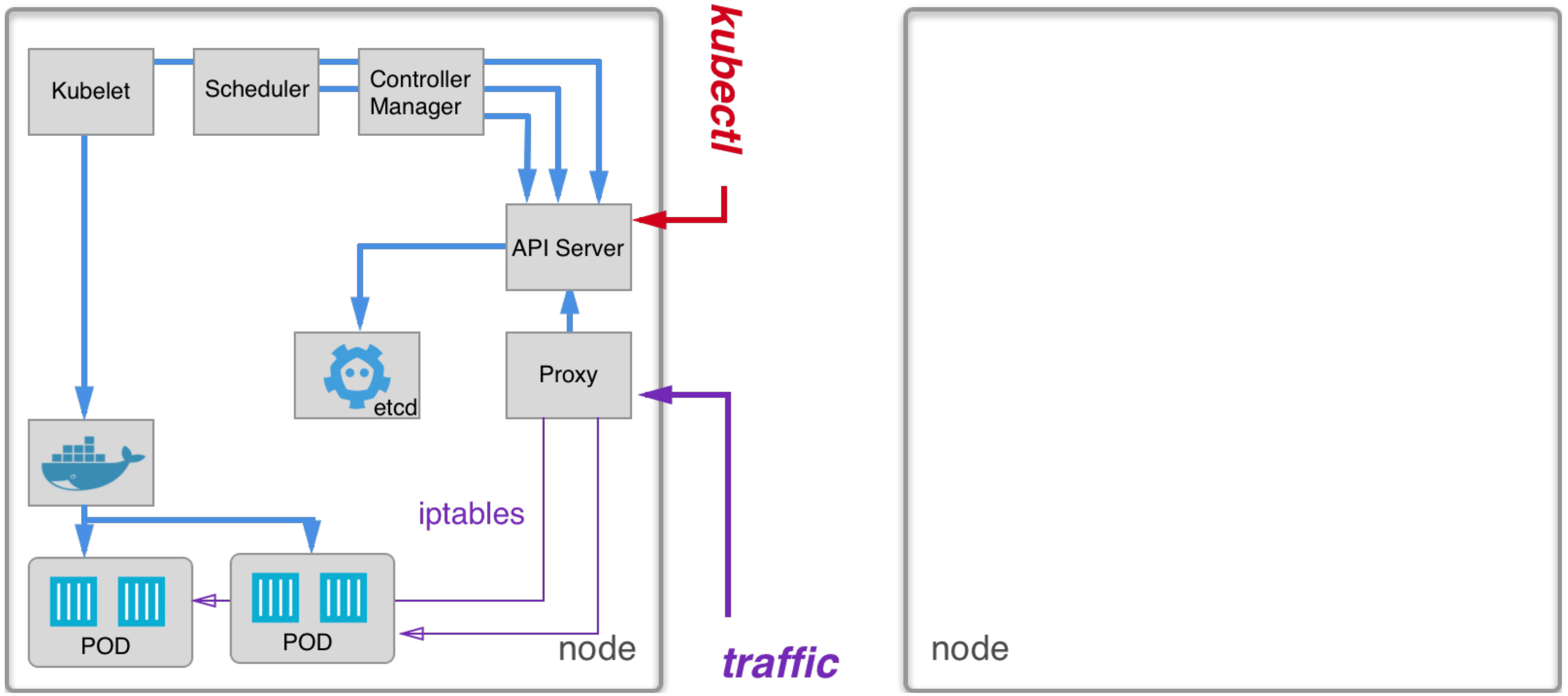
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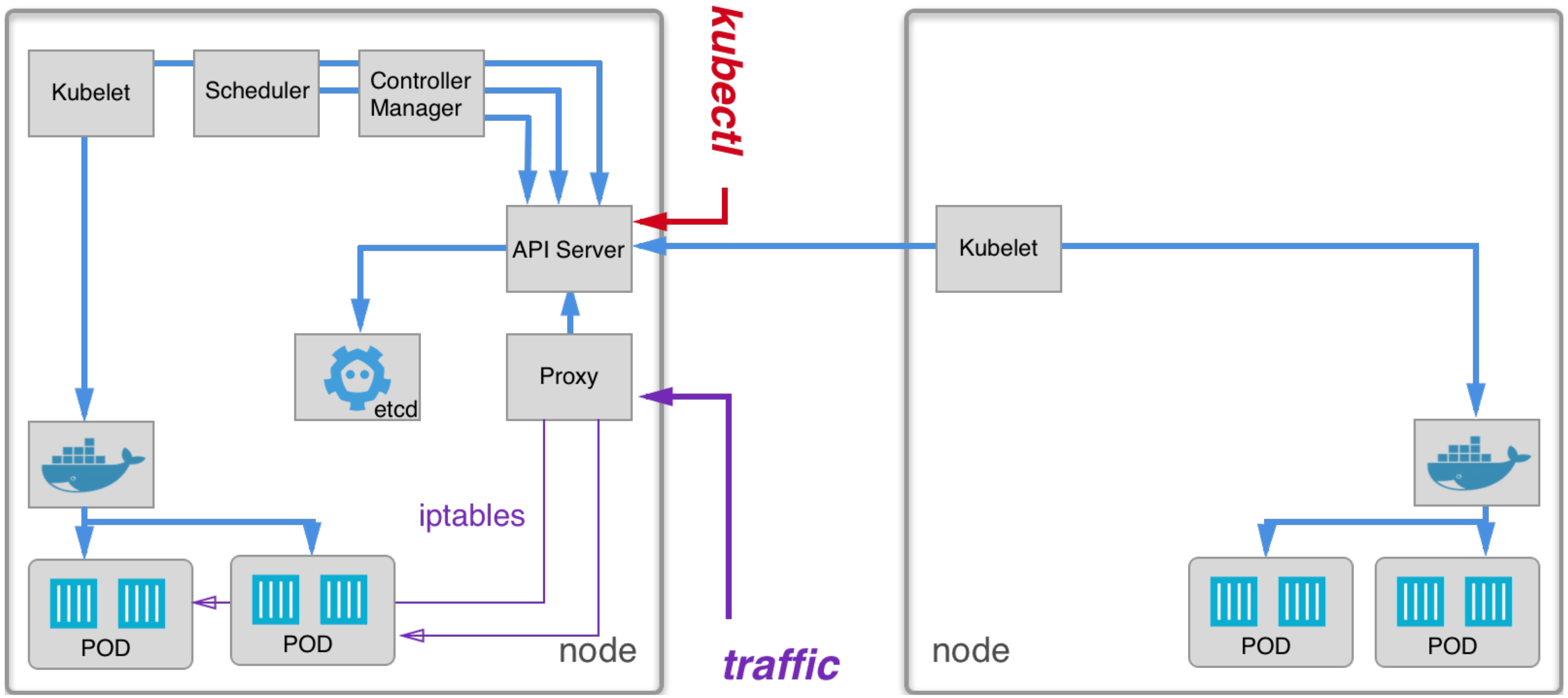
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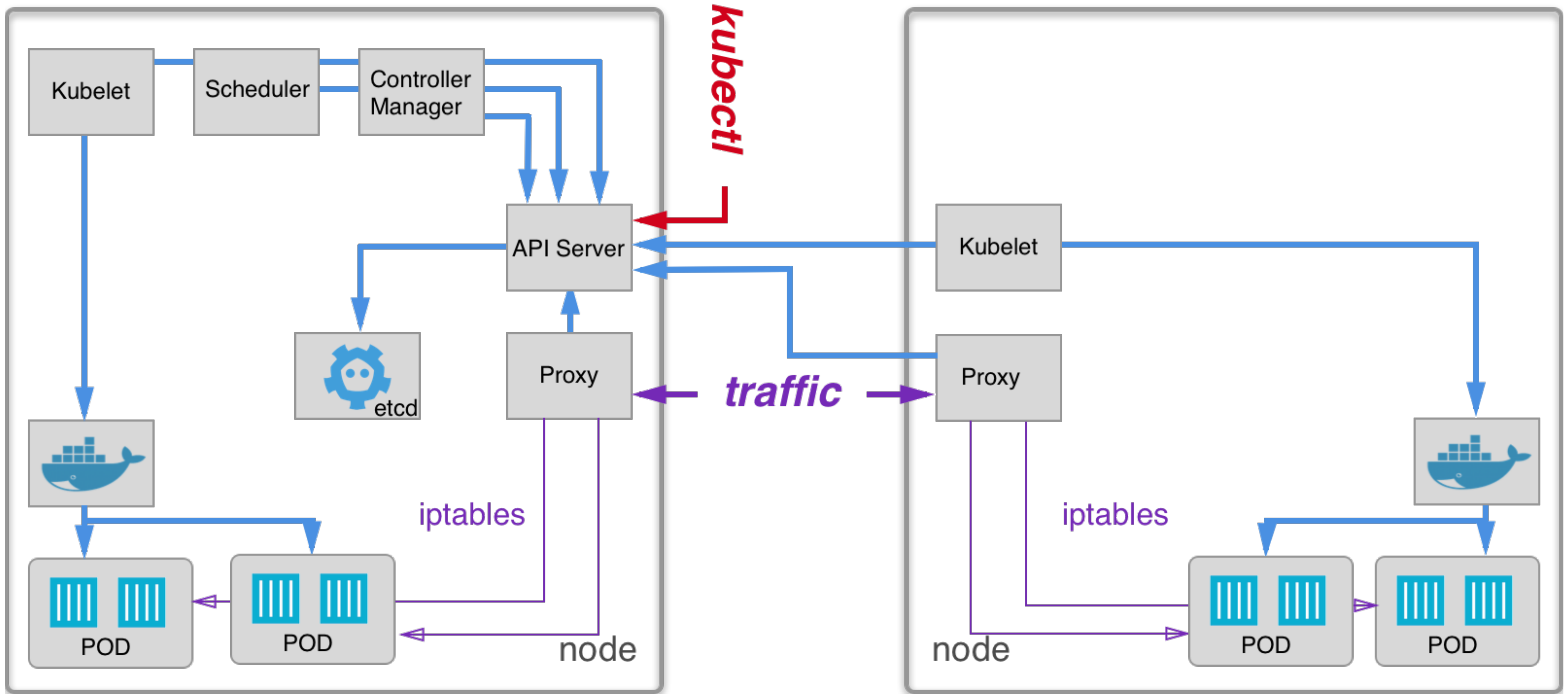
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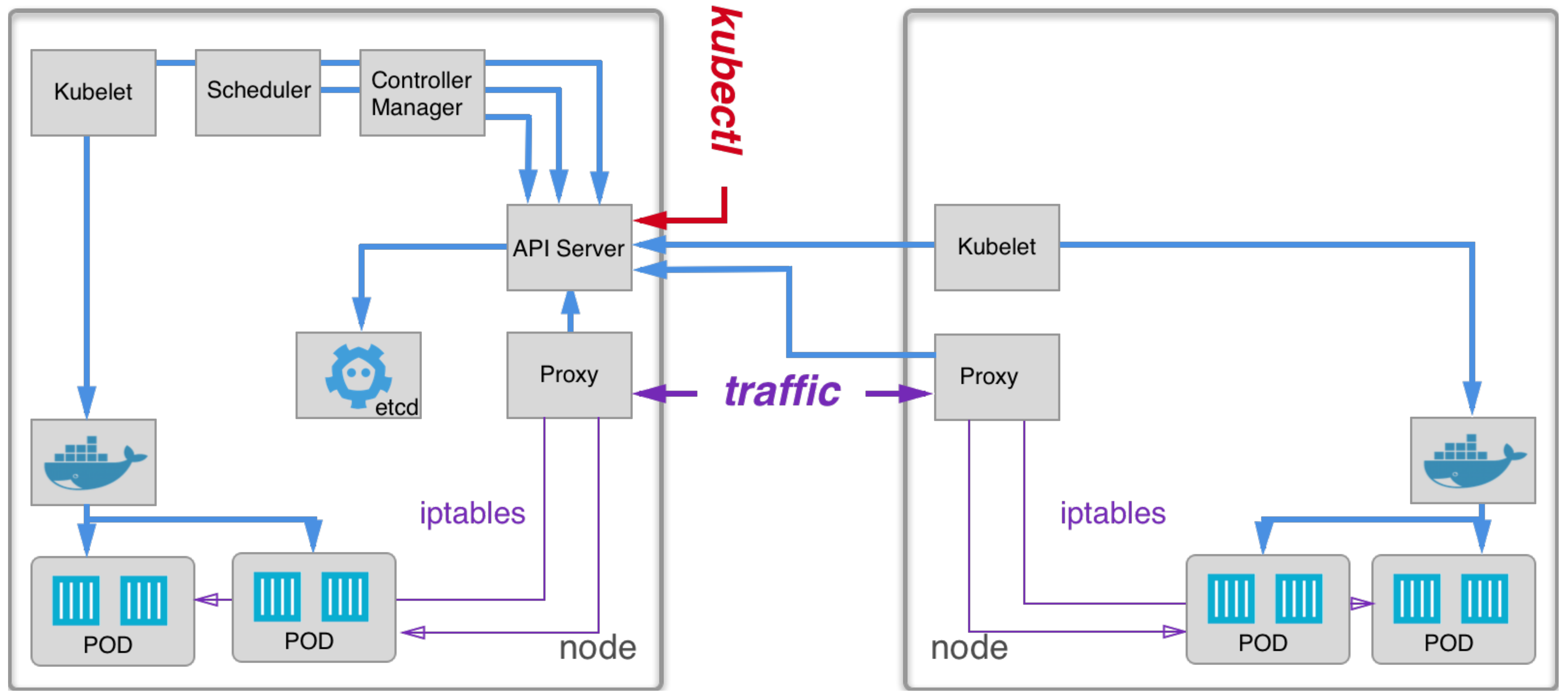
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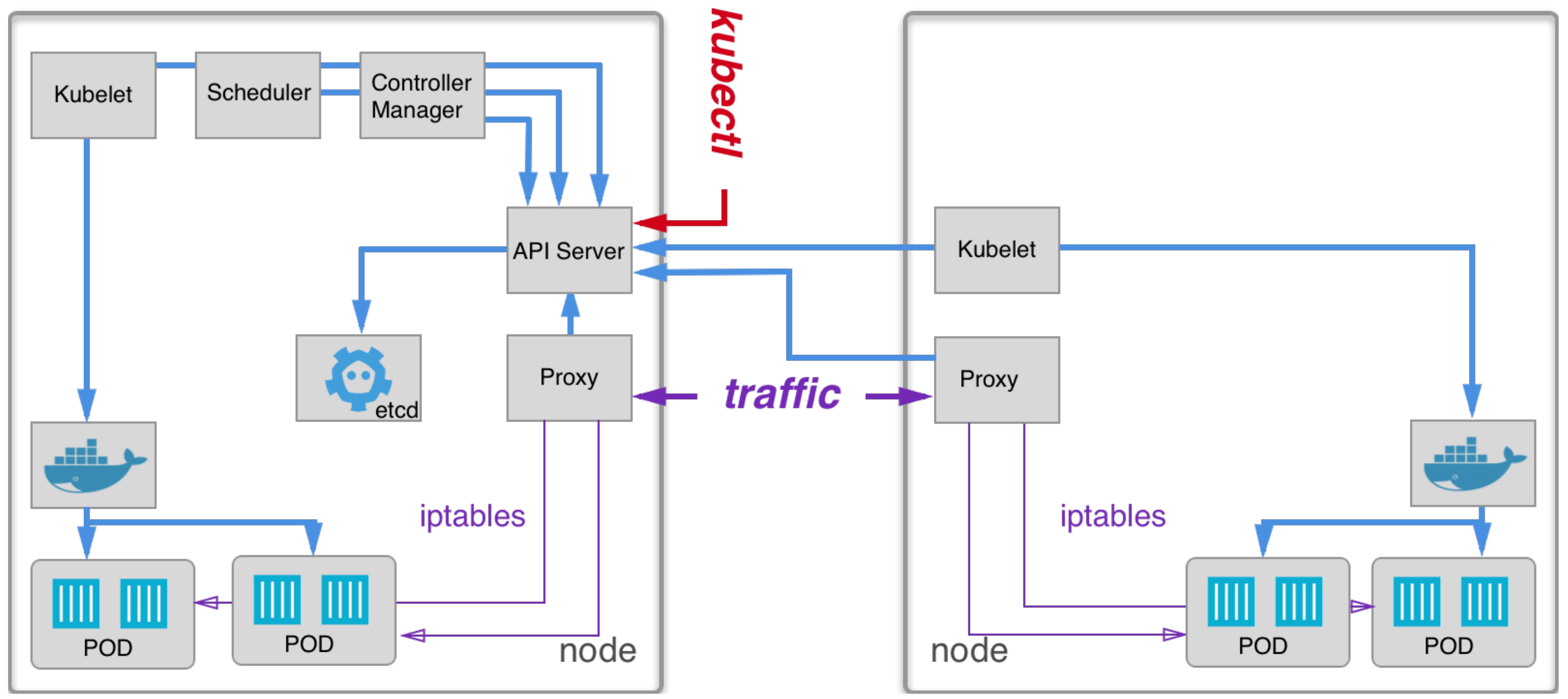
NETWORKING

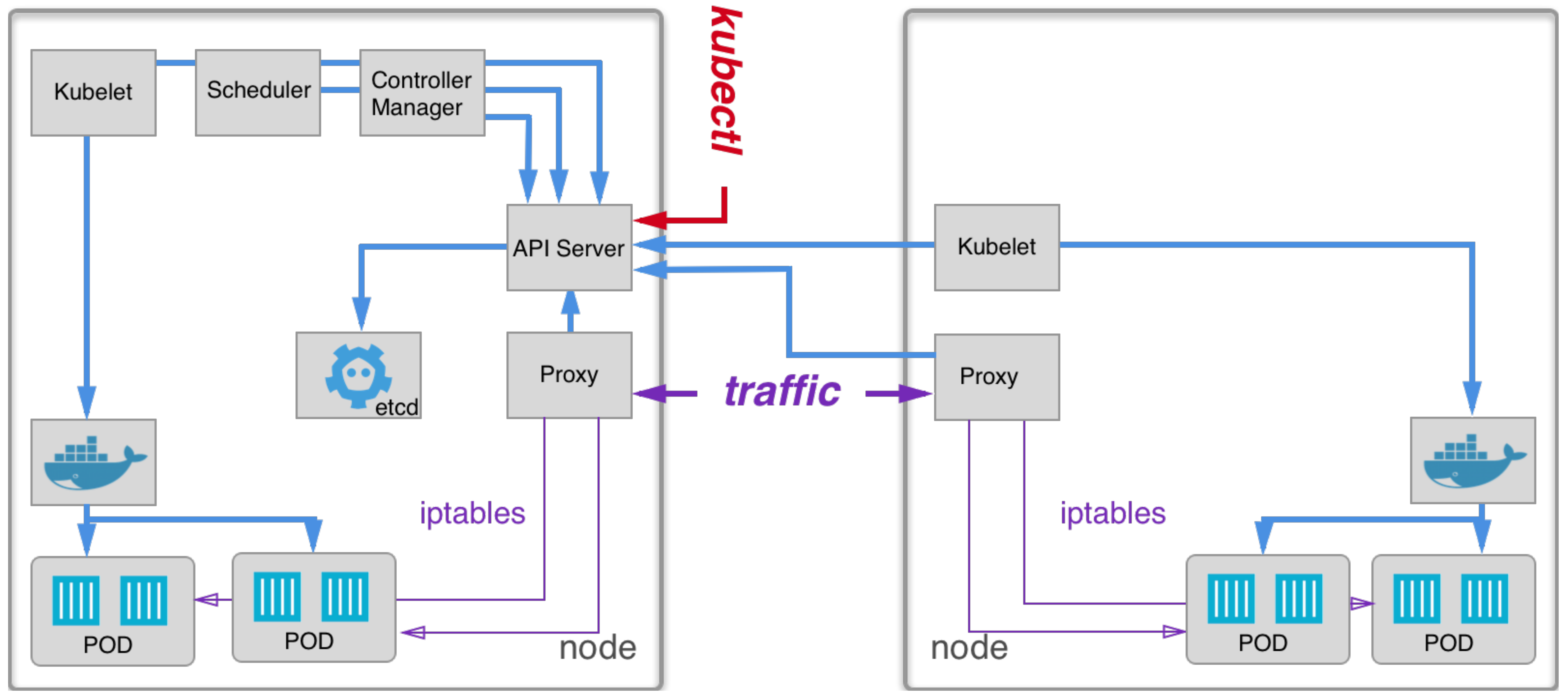
PROBLEMS:



NETWORKING

PROBLEMS:

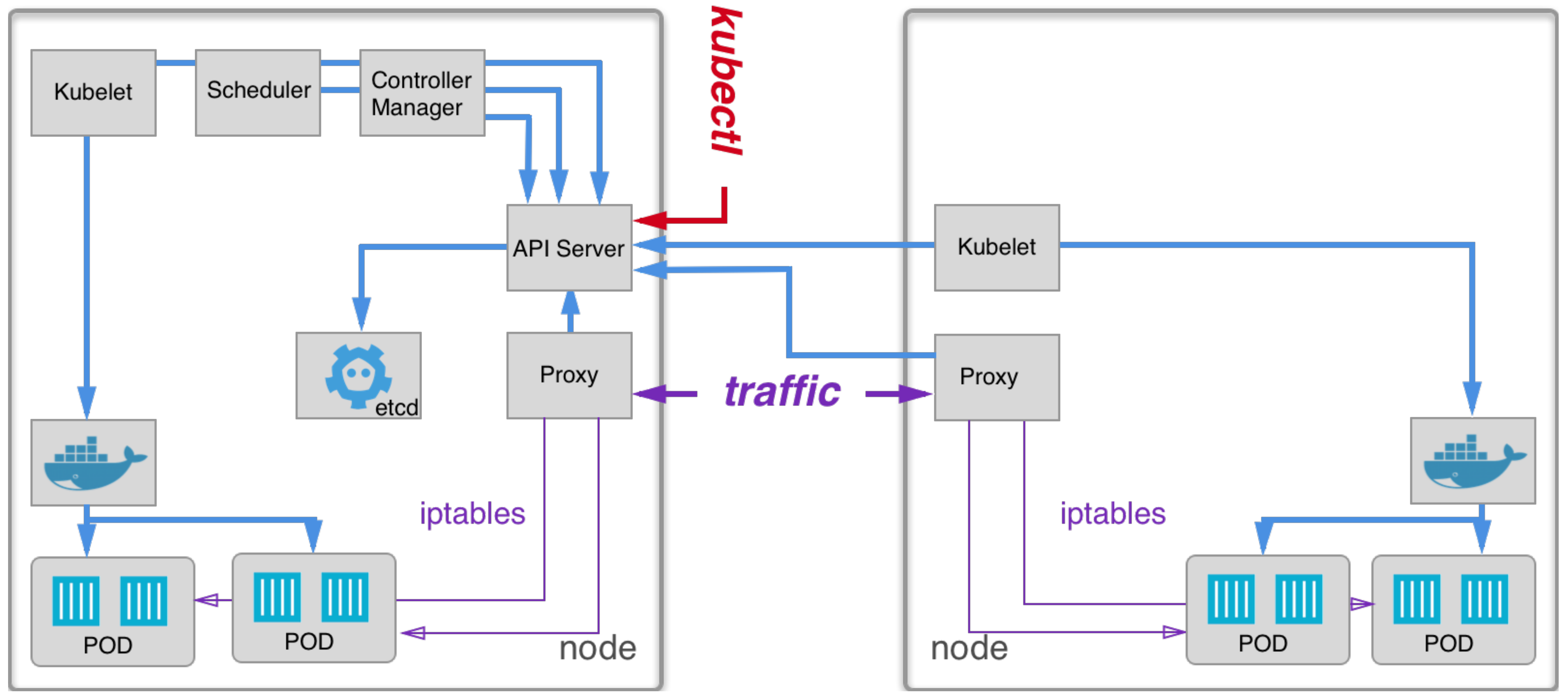
- no POD to POD communication



NETWORKING

PROBLEMS:

- no POD to POD communication
- traffic cannot be routed between nodes



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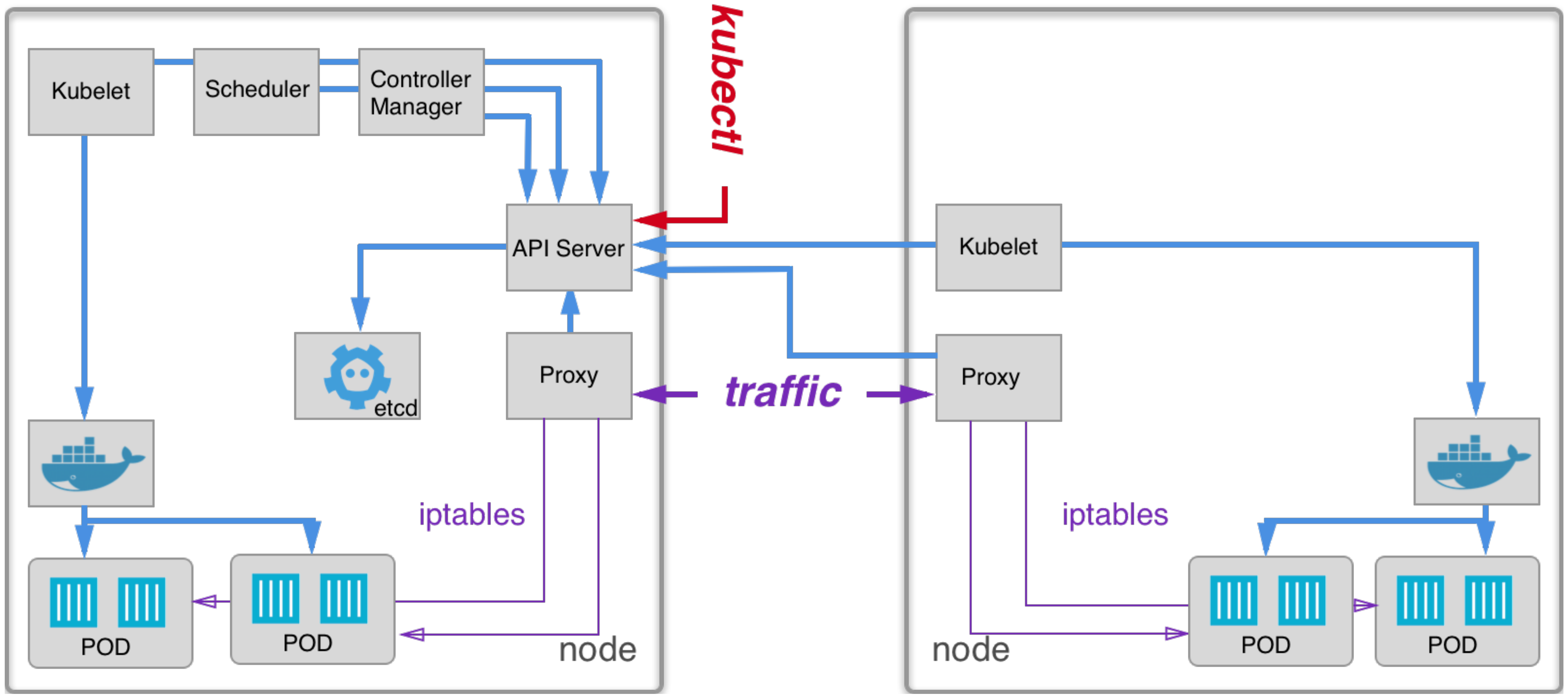
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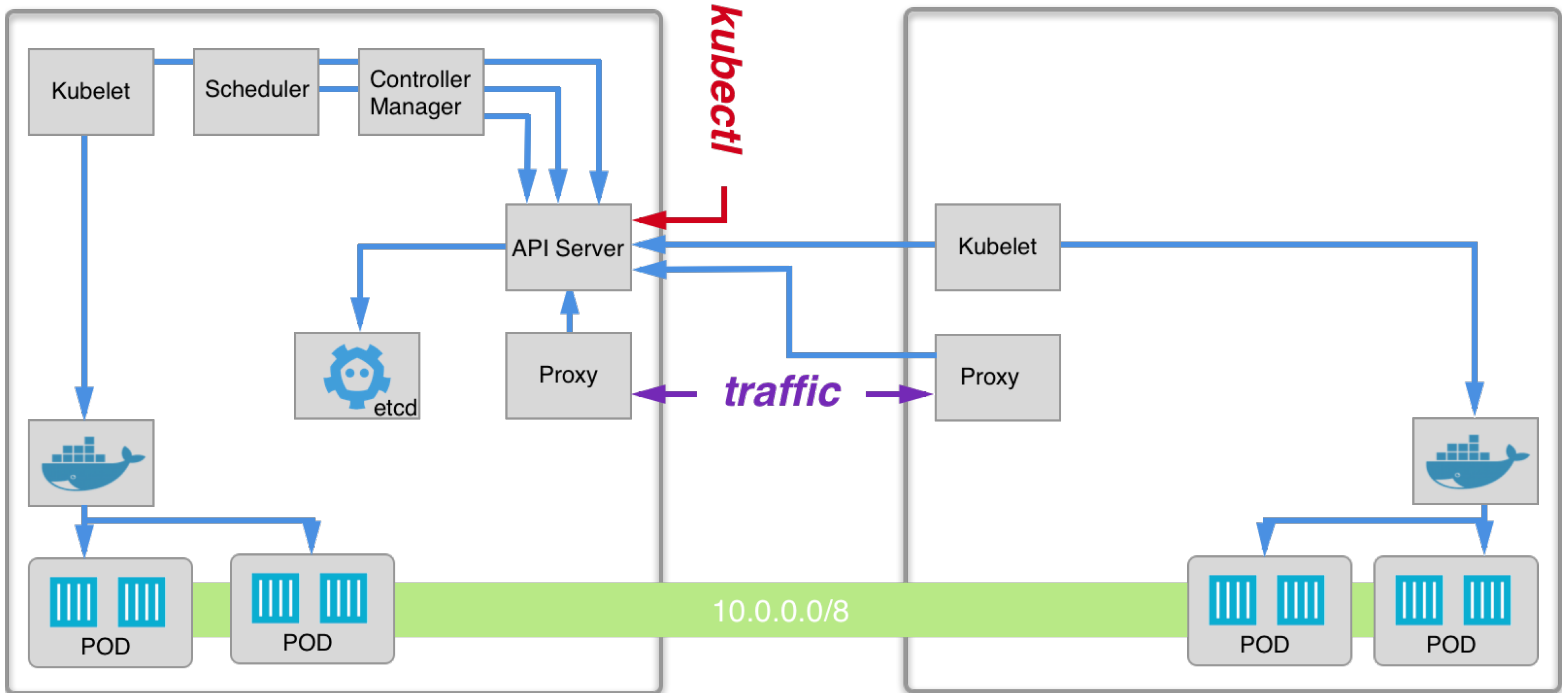
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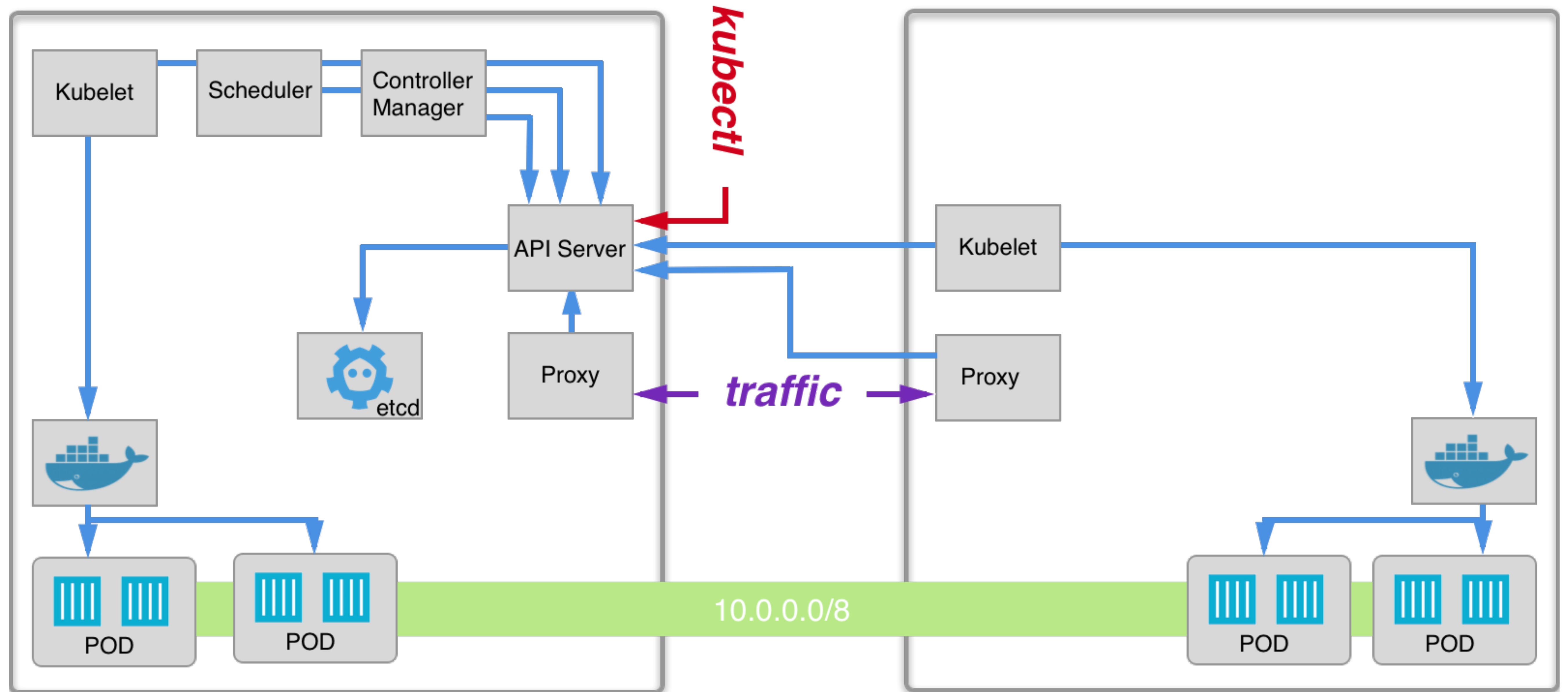
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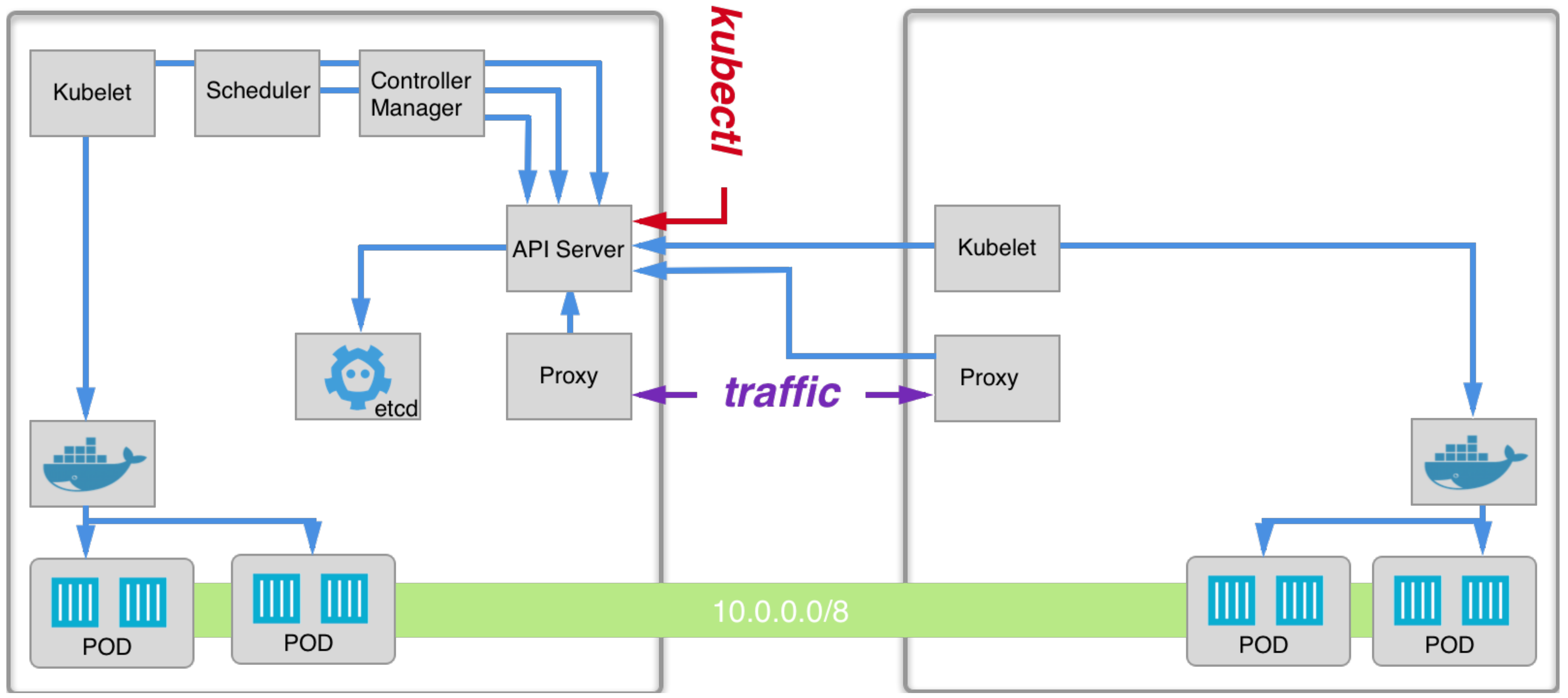
NETWORKING

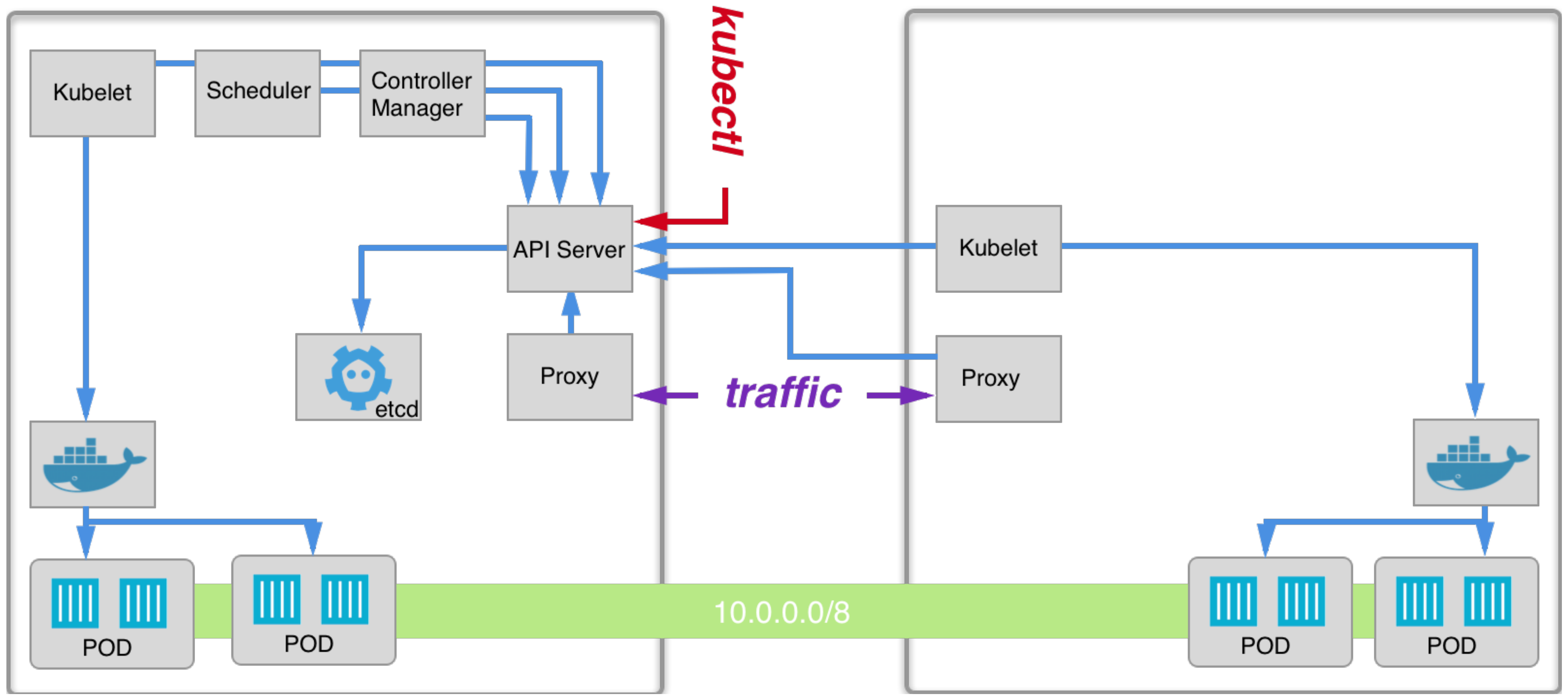
Kubernetes requirements:



NETWORKING

Kubernetes requirements:

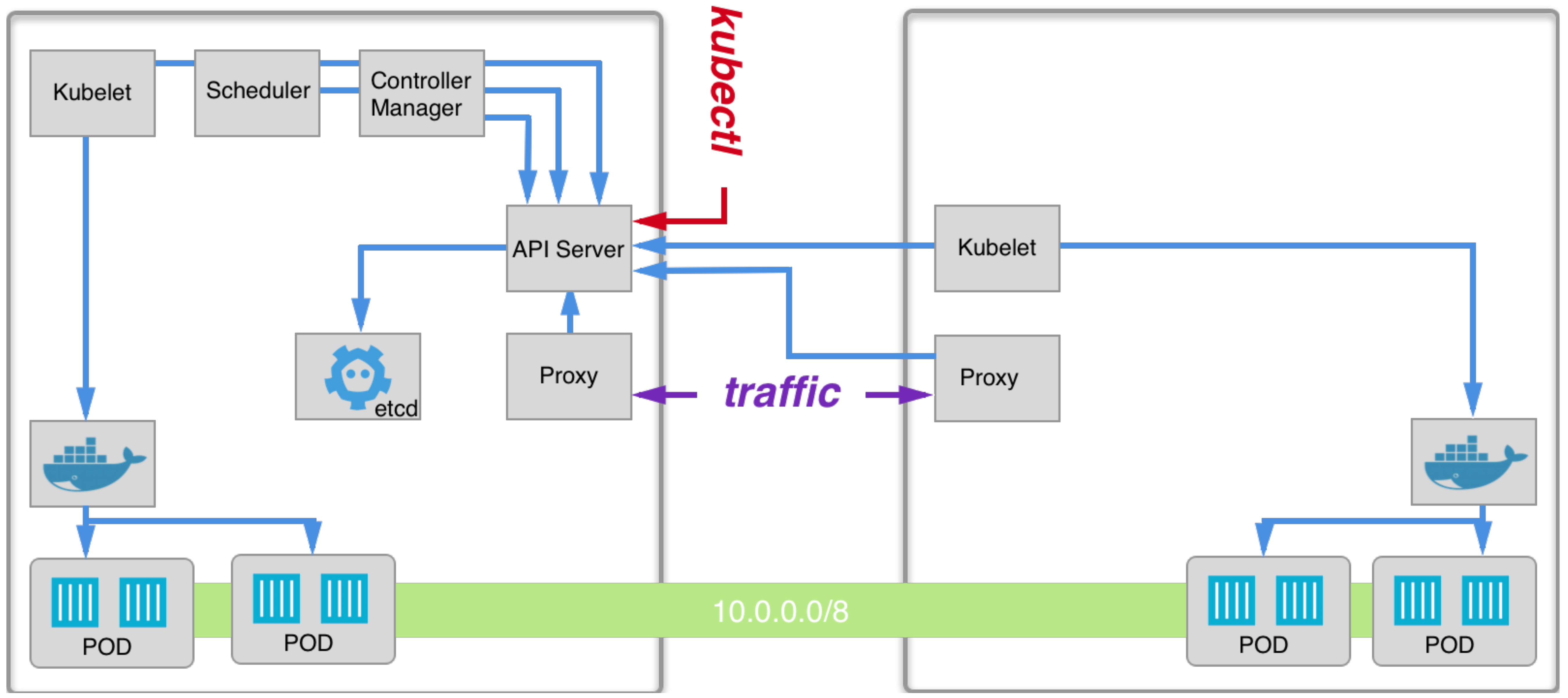
- each pod has it’s own IP



NETWORKING

Kubernetes requirements:

- each pod has it’s own IP
- all containers can communicate with all other containers using their IPs



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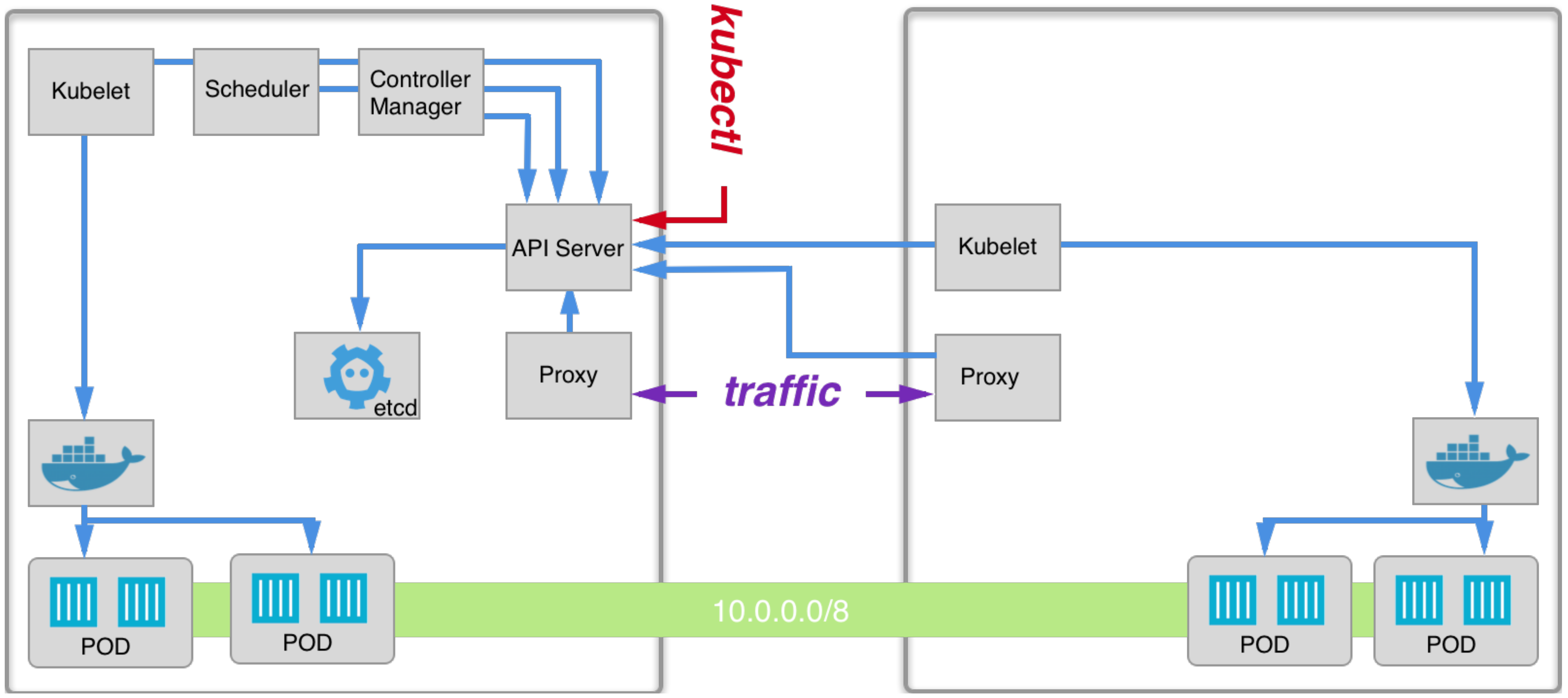
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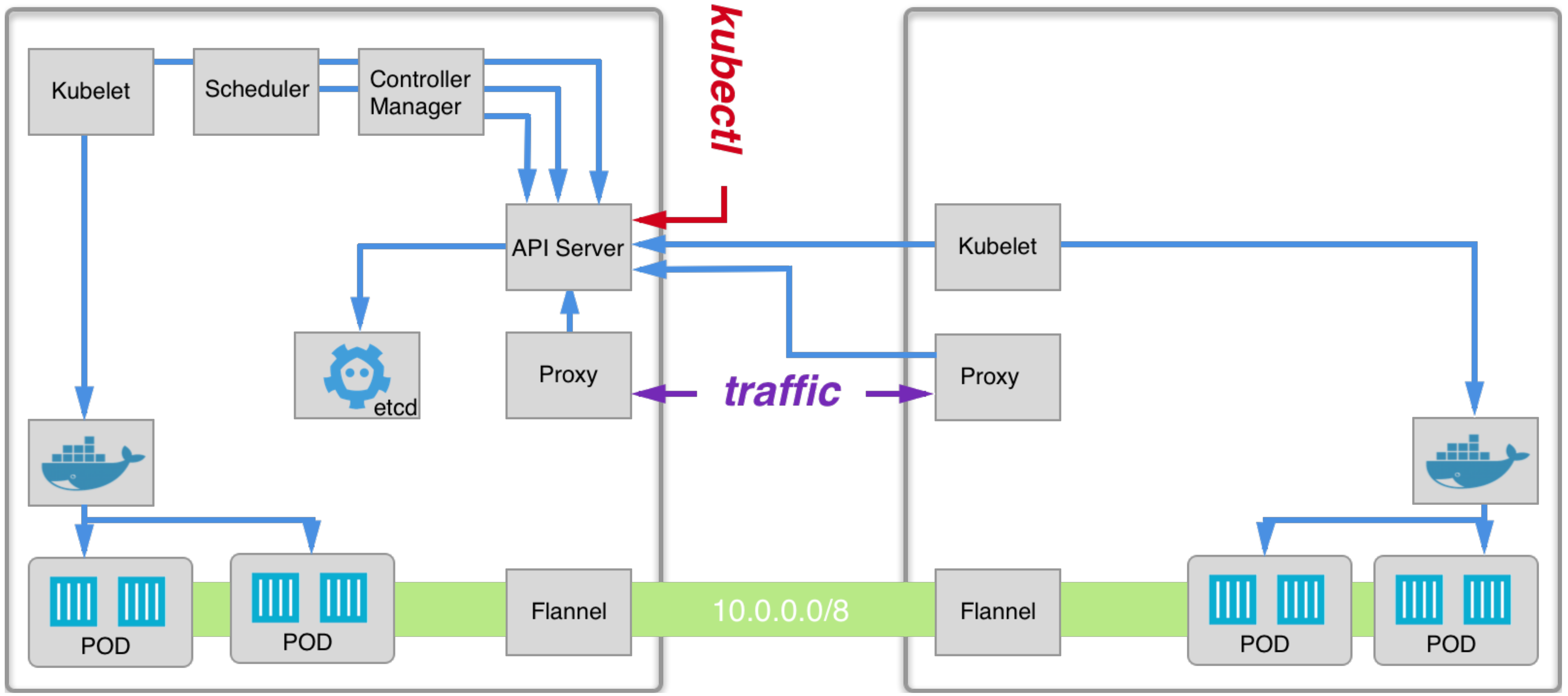
NETWORKING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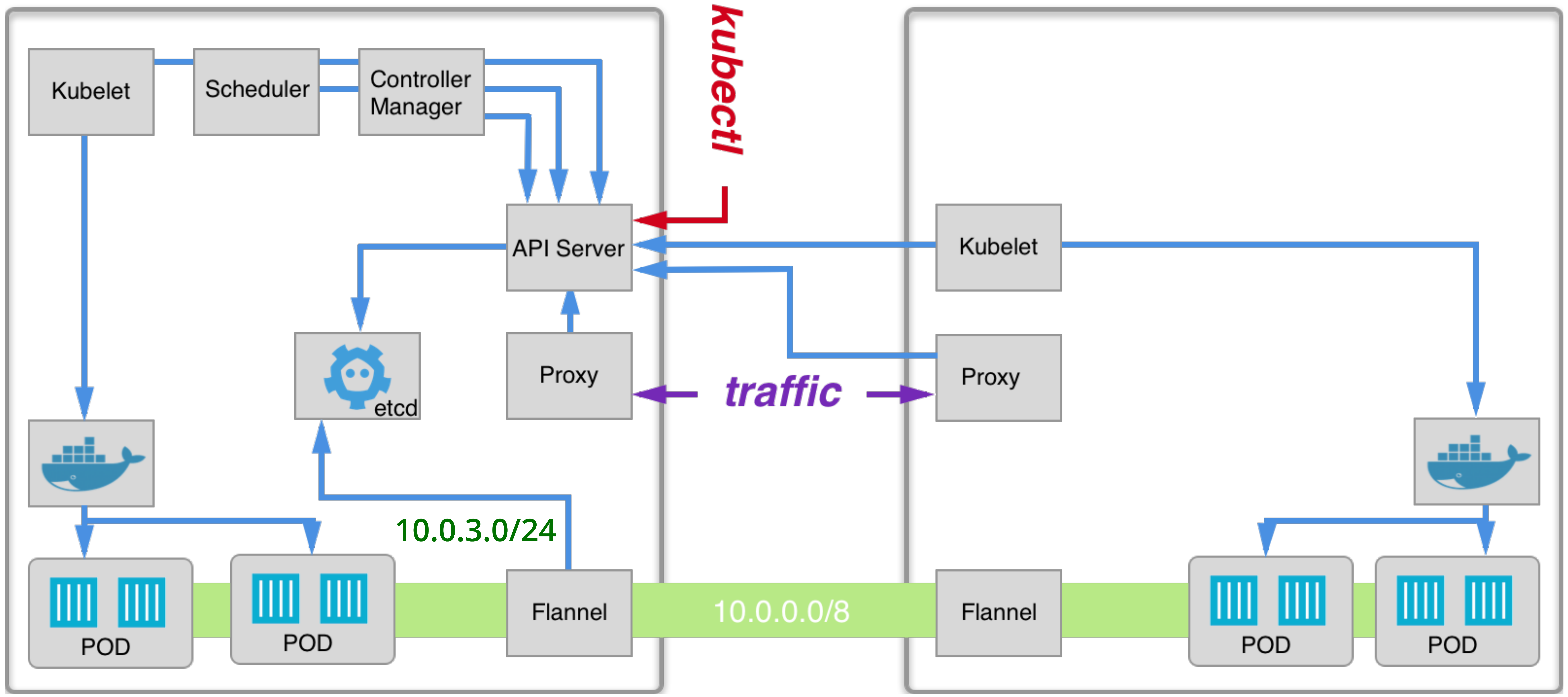
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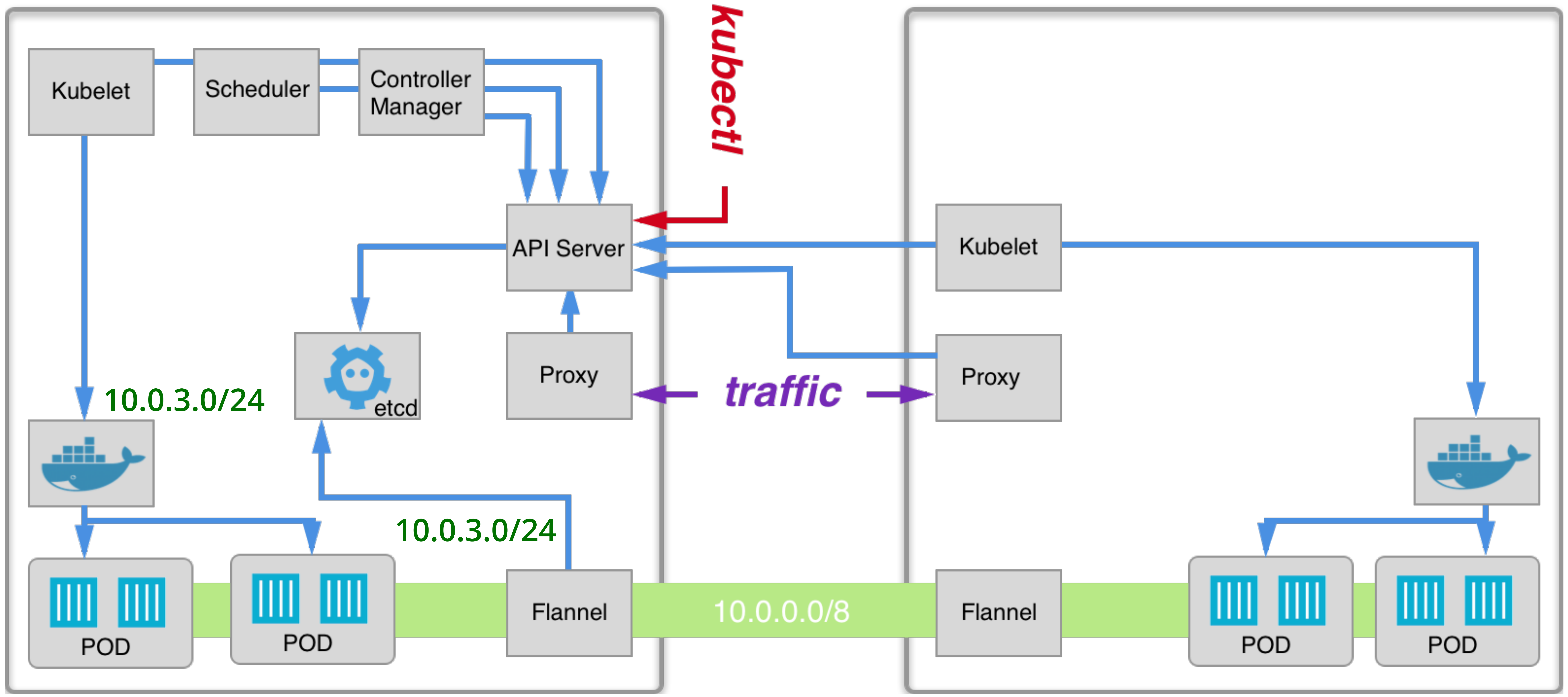
NETWORKING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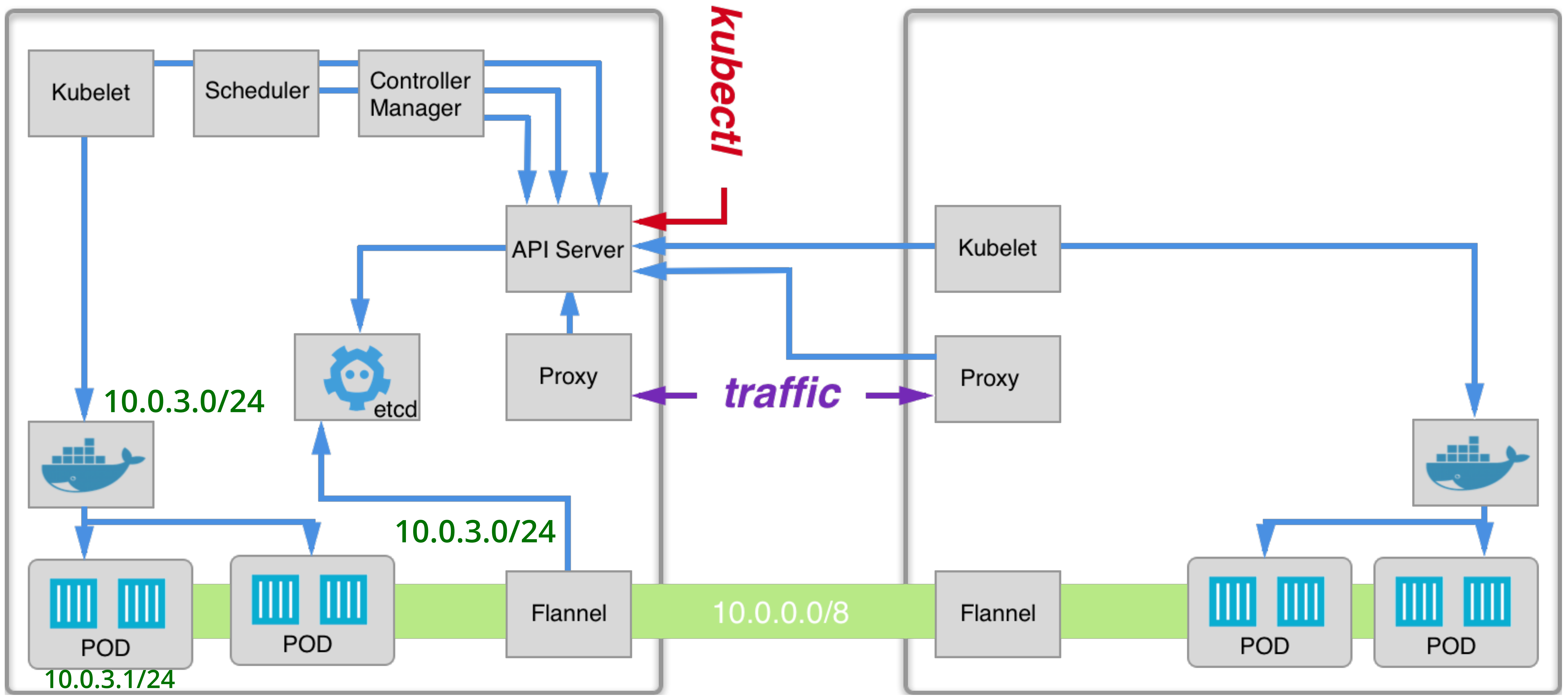
NETWORKING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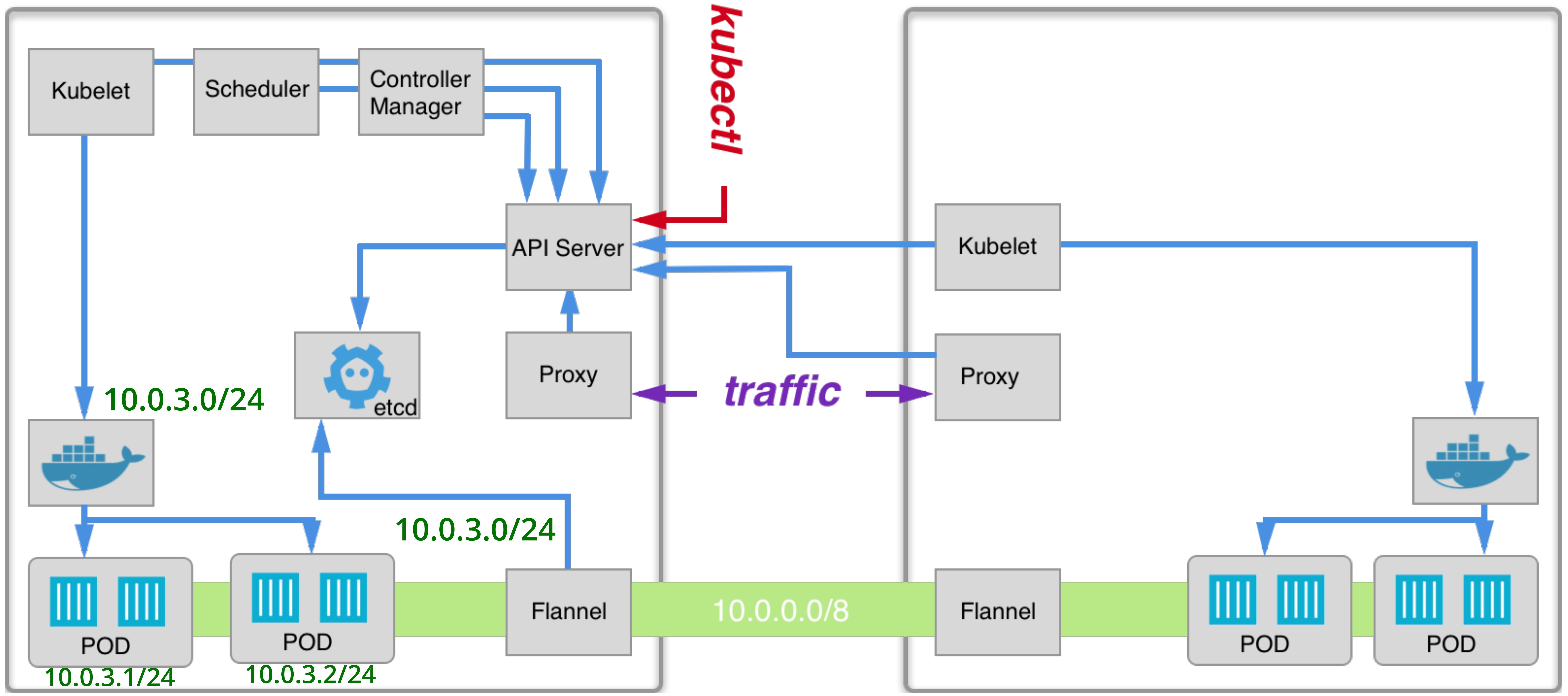
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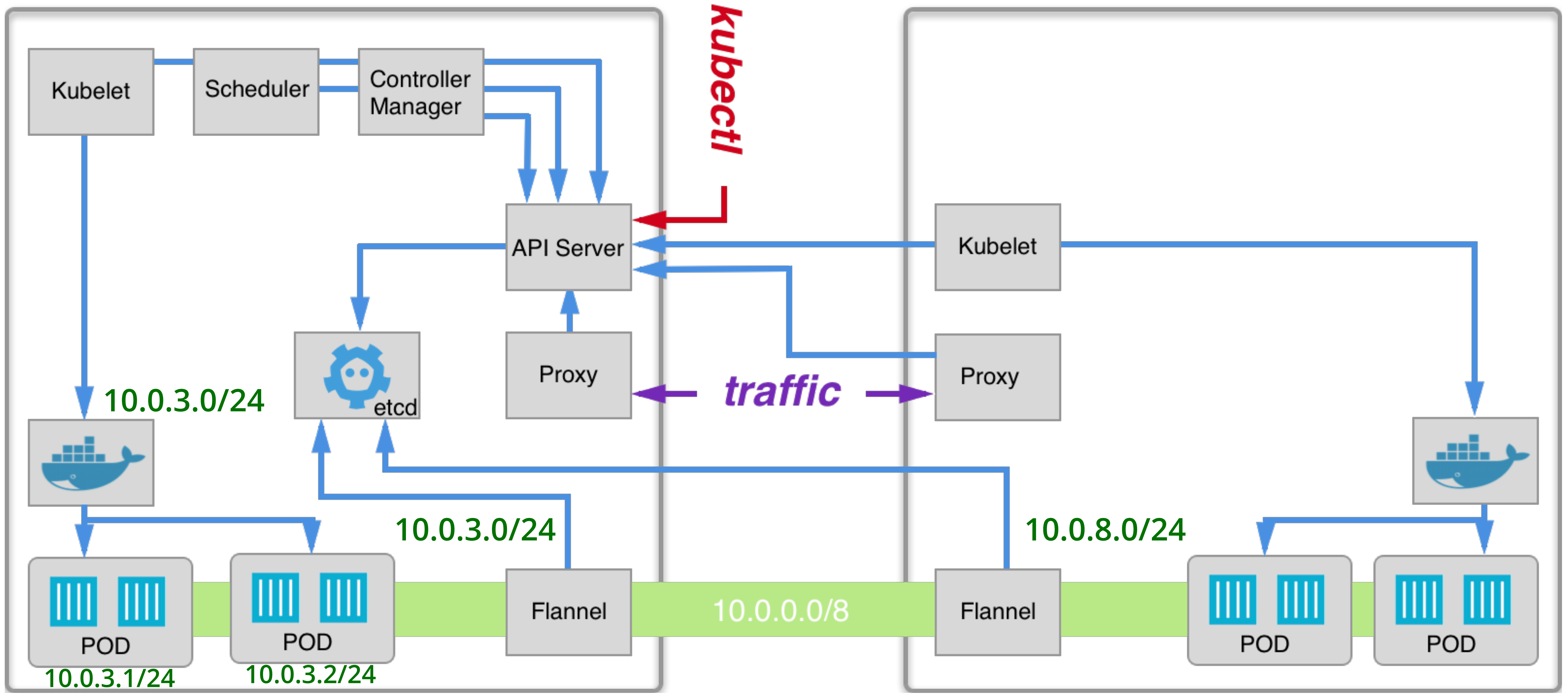
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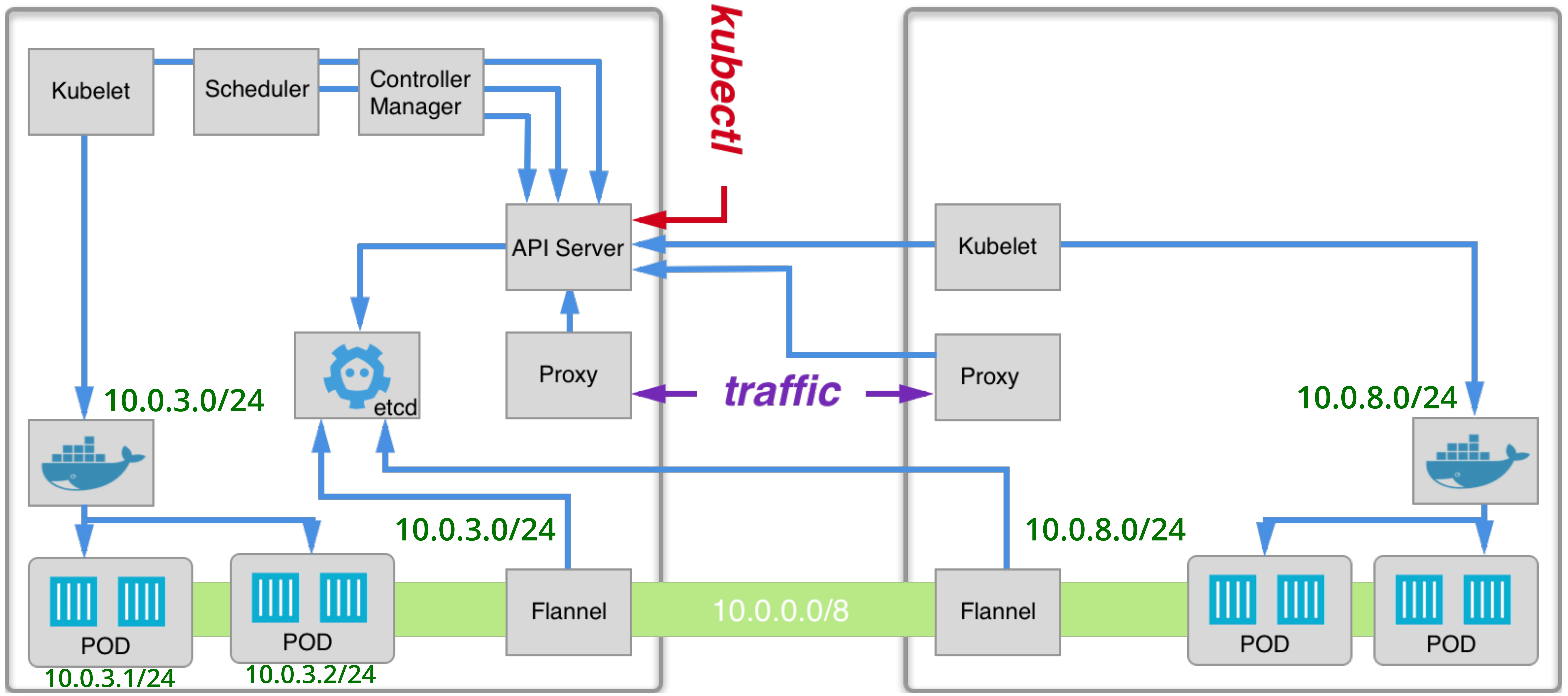
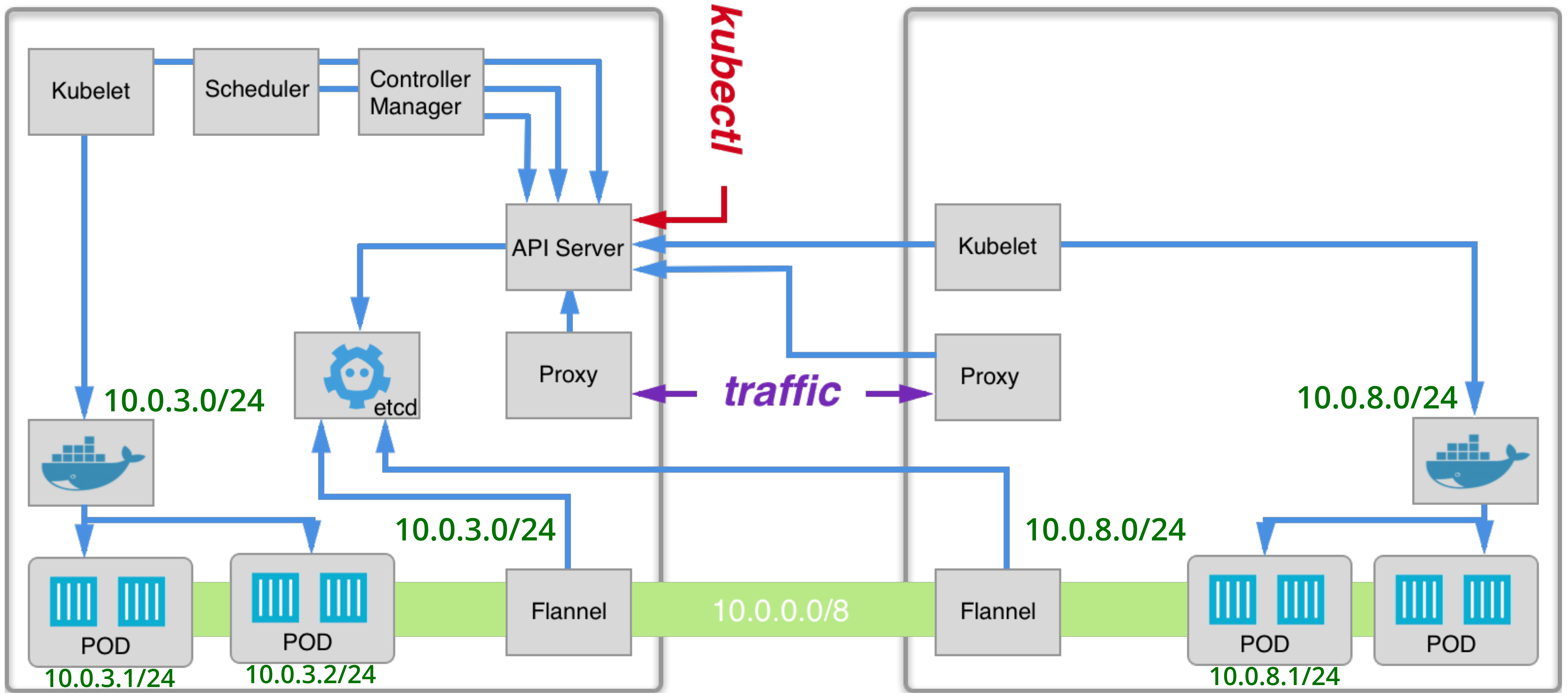
Proxy
traffic
10.0.3.0/24
10.0.3.0/24
POD
POD
10.0.3.1/24
10.0.3.2/24
Flannel
10.0.0.0/8
Kubelet
Proxy
10.0.8.0/24
Flannel
POD
POD

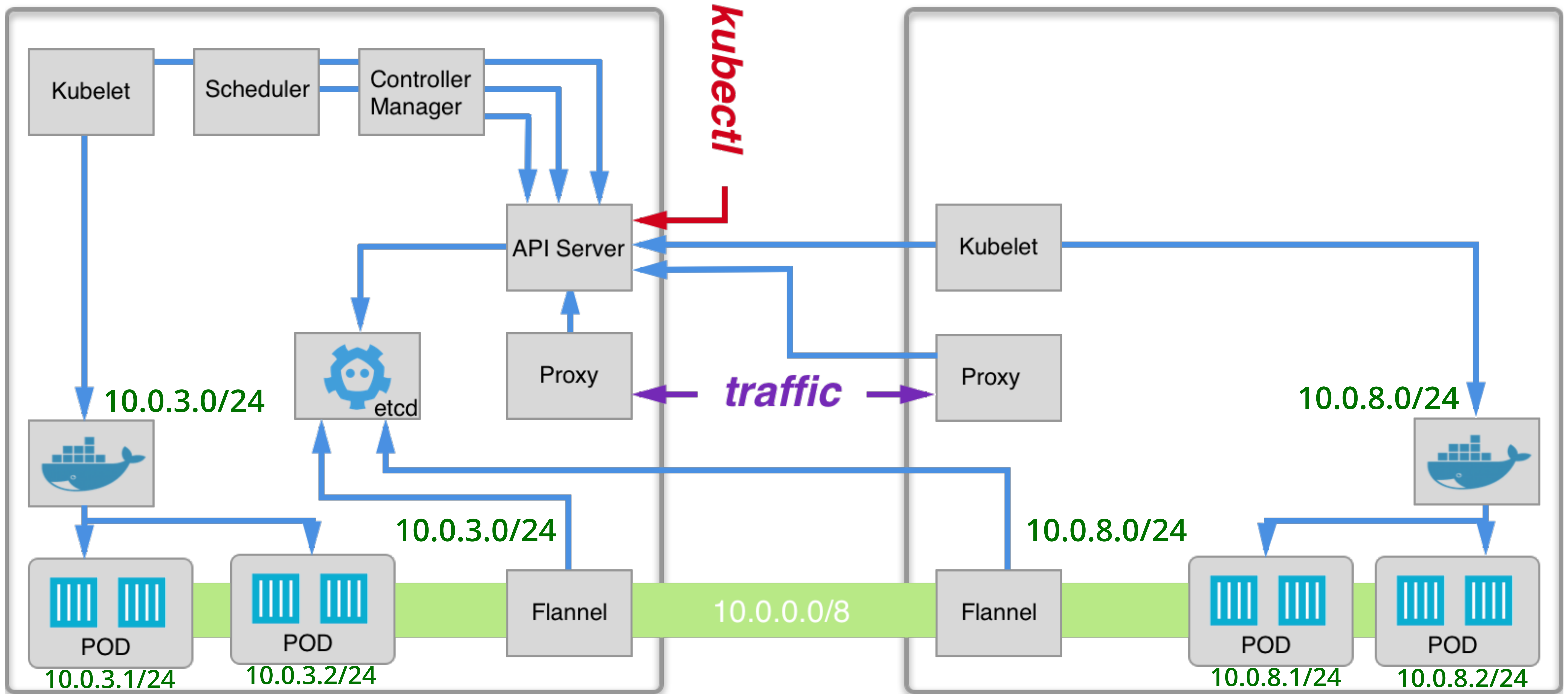
NETWORKING


Kubelet
Scheduler
Controller Manager
kubectl
API Server
etcd
Proxy
10.0.3.0/24
traffic
10.0.3.0/24
POD
POD
10.0.3.1/24
10.0.3.2/24
Flannel
10.0.0.0/8
Kubelet
Proxy
10.0.8.0/24
10.0.8.0/24
Flannel
POD
POD

NETWORKING


Kubelet
Scheduler
Controller Manager
kubectl
API Server
etcd
Proxy
traffic
Proxy
Kubelet
10.0.3.0/24
10.0.8.0/24
10.0.3.0/24
10.0.8.0/24
POD
POD
Flannel
10.0.0.0/8
Flannel
POD
POD
10.0.3.1/24
10.0.3.2/24
10.0.8.1/24

NETWORKING


Kubelet
Scheduler
Controller Manager
kubectl
API Server
Kubelet
etcd
Proxy
traffic
Proxy
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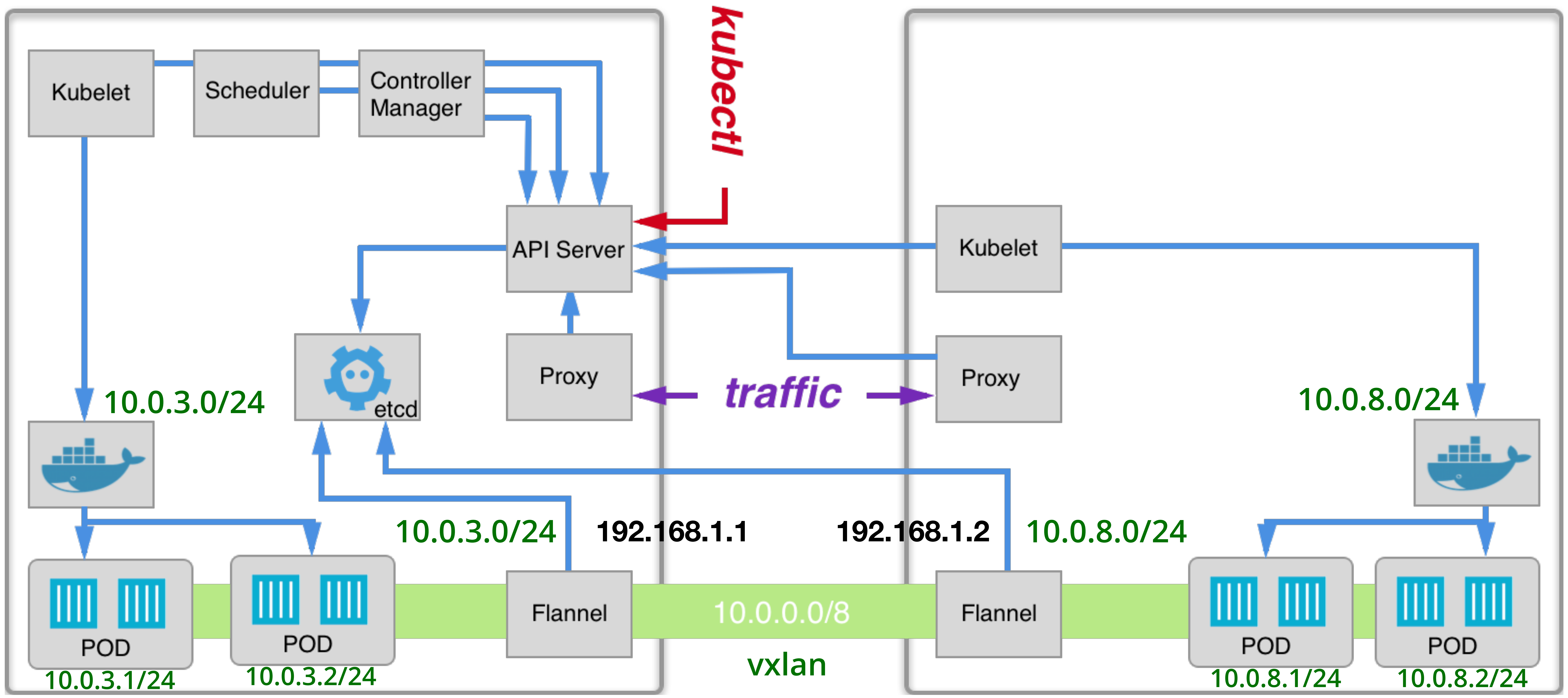
10.0.8.0/24
10.0.3.0/24
10.0.8.0/24
POD
POD
Flannel
10.0.0.0/8
Flannel
POD
POD
10.0.3.1/24
10.0.3.2/24
10.0.8.1/24
10.0.8.2/24

NETWORKING


Kubelet
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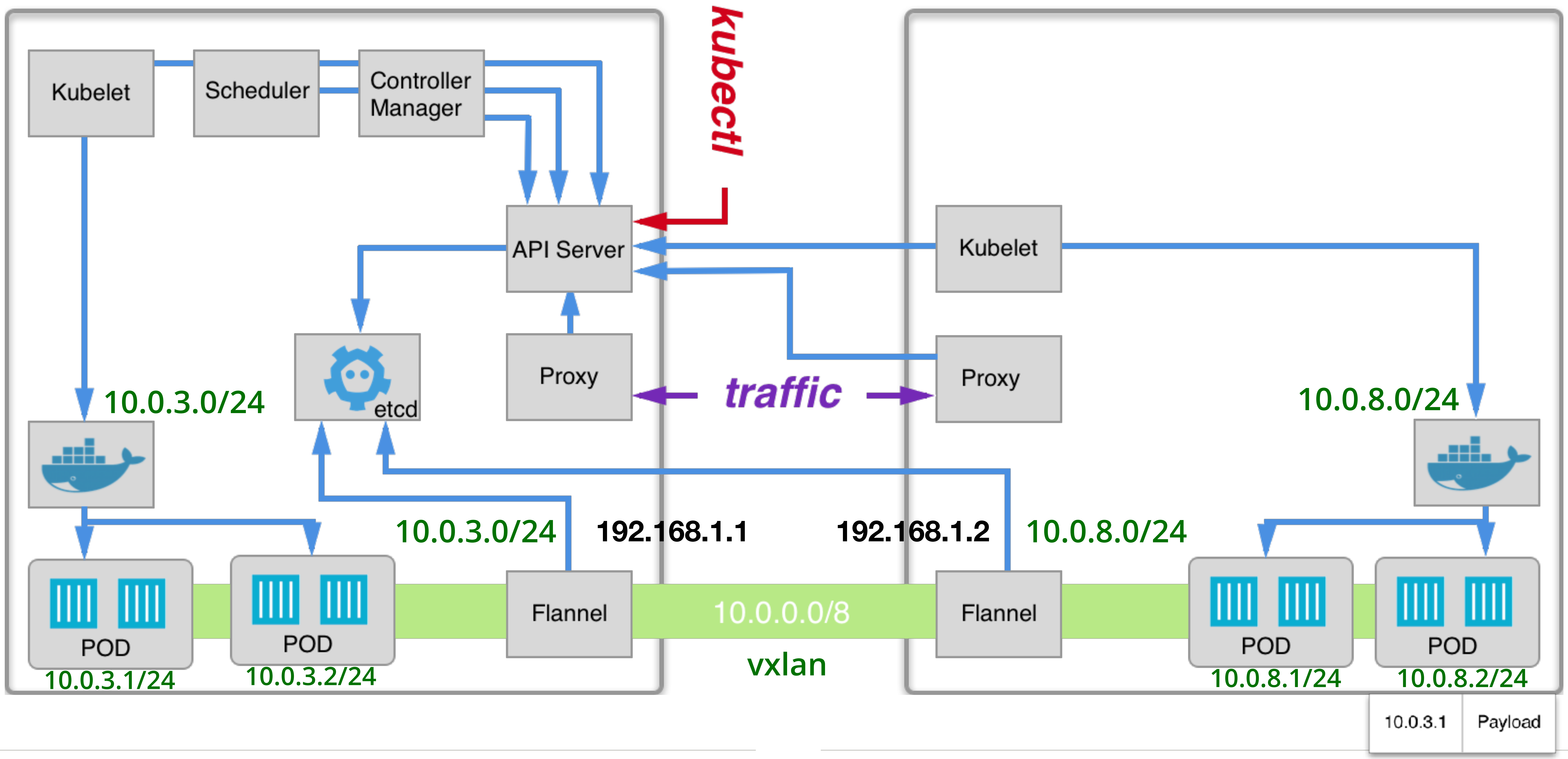
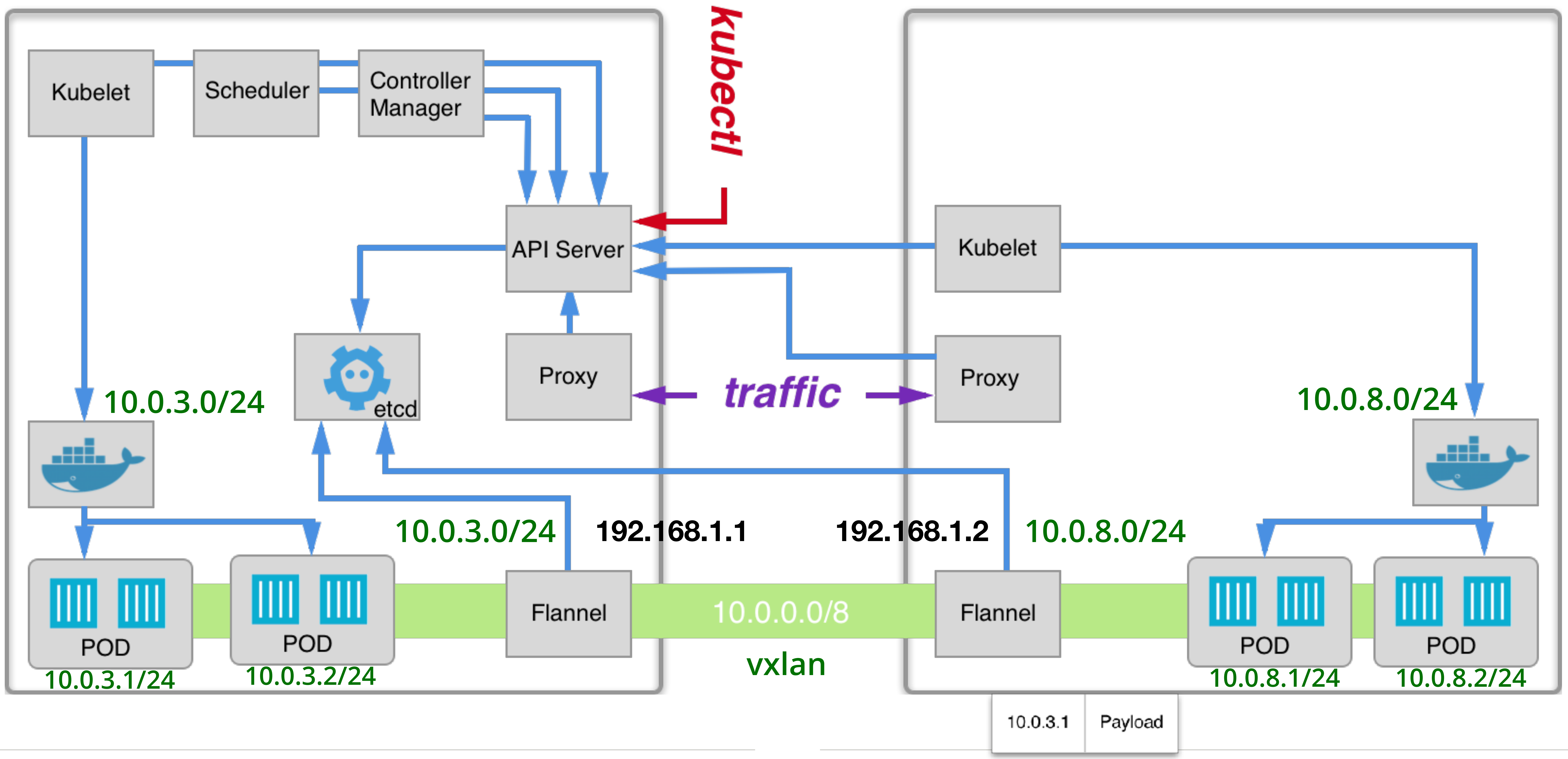
Controller Manager
kubectl
API Server
etcd
Proxy
traffic
Kubelet
Proxy
10.0.3.0/24
10.0.8.0/24
10.0.3.0/24
192.168.1.1
192.168.1.2
10.0.8.0/24
POD
POD
Flannel
10.0.0.0/8
Flannel
POD
POD
10.0.3.1/24
10.0.3.2/24
vxlan
10.0.8.1/24
10.0.8.2/24

NETWORKING


kubectl
Kubelet
Scheduler
Controller Manager
API Server
etcd
Proxy
10.0.3.0/24
10.0.3.0/24
192.168.1.1
POD
POD
10.0.3.1/24
10.0.3.2/24
Flannel
traffic
10.0.0.0/8
vxlan
Kubelet
Proxy
10.0.8.0/24
192.168.1.2
10.0.8.0/24
Flannel
POD
POD
10.0.8.1/24
10.0.8.2/24
10.0.3.1
Payload

NETWORKING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Controller Manager
kubectl
API Server
etcd
Proxy
traffic
Kubelet
Proxy
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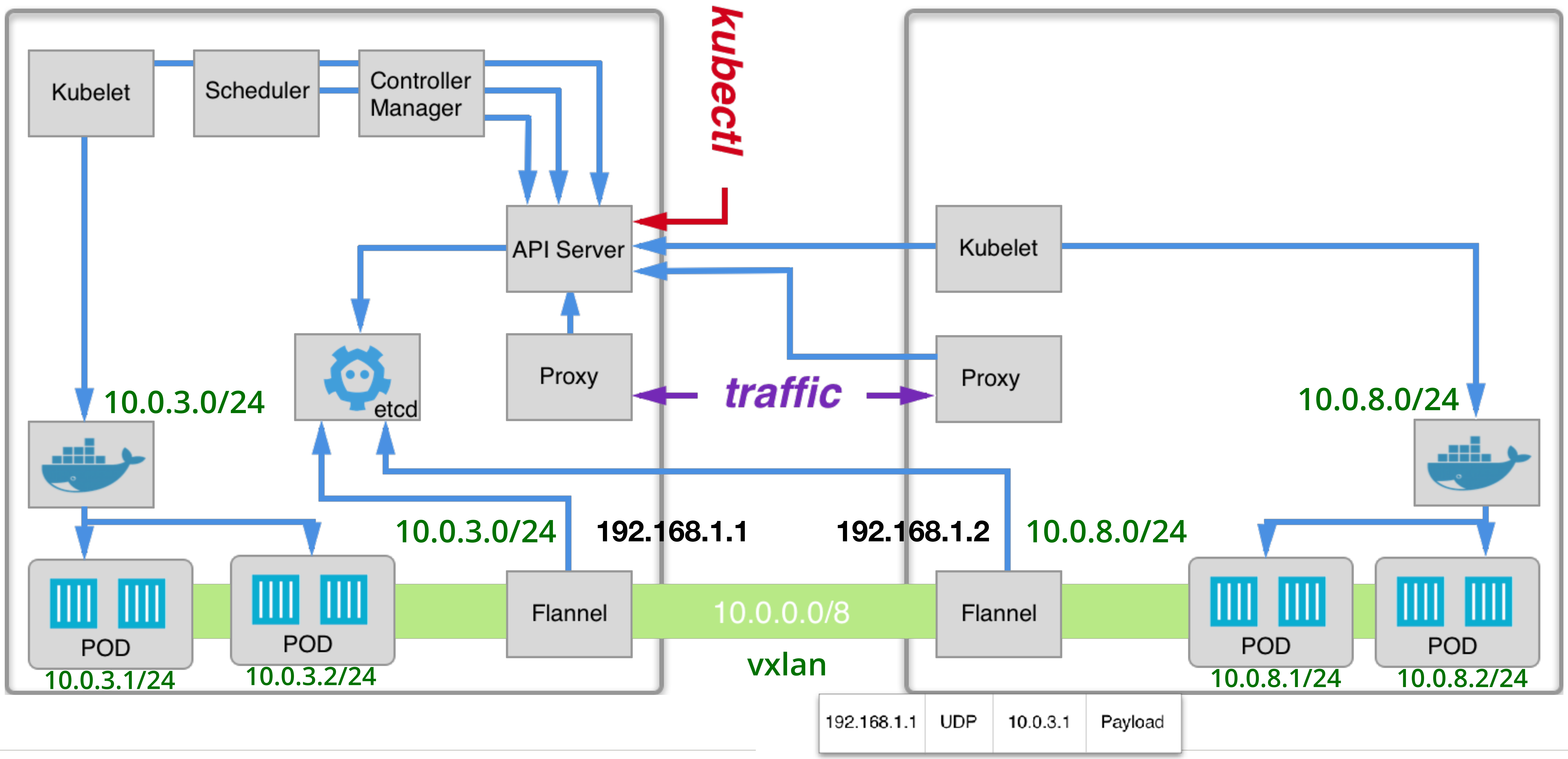
10.0.8.0/24
10.0.3.0/24
192.168.1.1
192.168.1.2
10.0.8.0/24
POD
POD
Flannel
10.0.0.0/8
Flannel
POD
POD
10.0.3.1/24
10.0.3.2/24
vxlan
10.0.8.1/24
10.0.8.2/24
10.0.3.1
Payload

NETWORKING


Kubelet
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Controller Manager
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API Server
etcd
Proxy
traffic
Kubelet
Proxy
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10.0.8.0/24
10.0.3.0/24
192.168.1.1
192.168.1.2
10.0.8.0/24
POD
POD
Flannel
10.0.0.0/8
Flannel
POD
POD
10.0.3.1/24
10.0.3.2/24
vxlan
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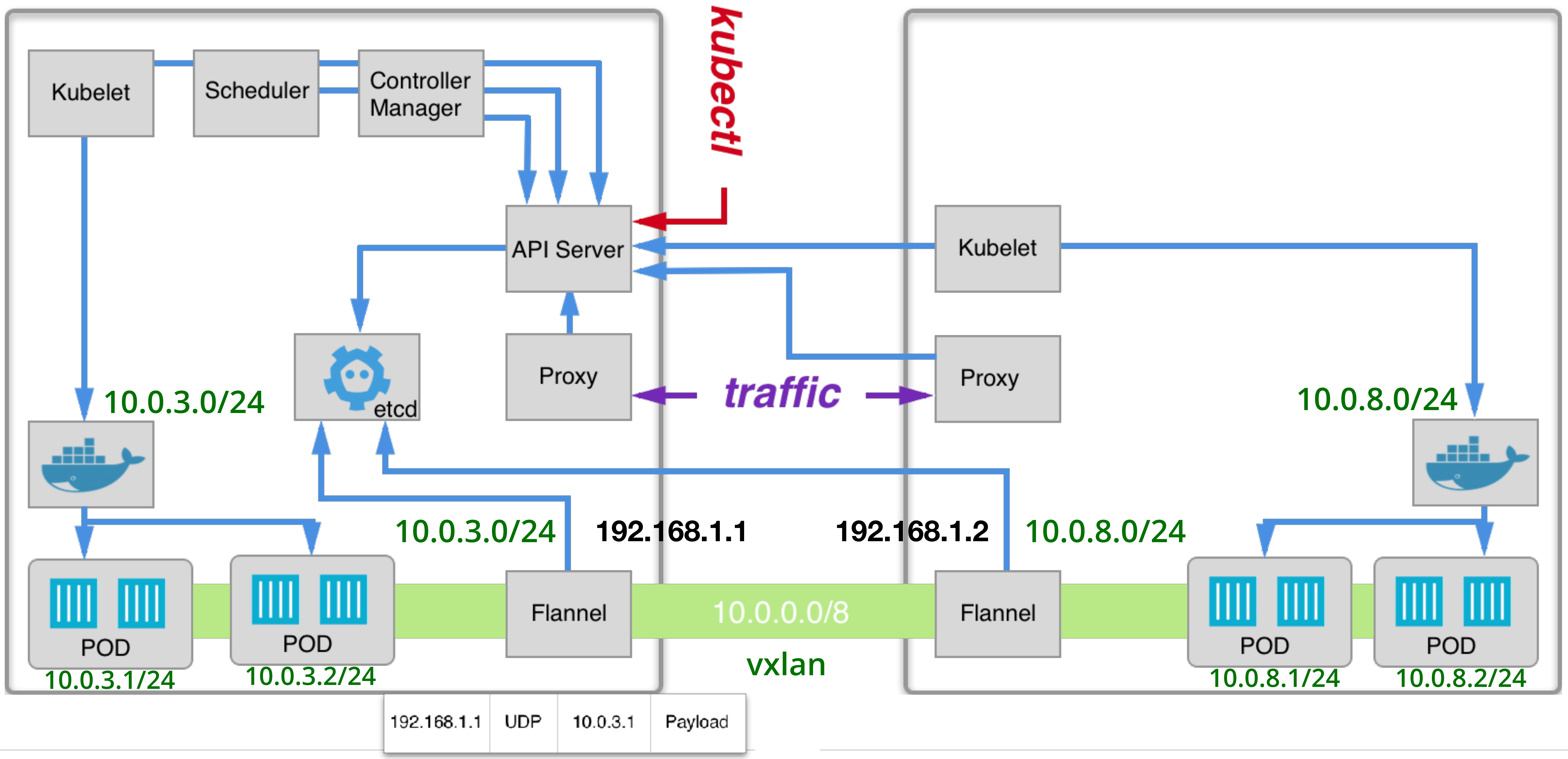
10.0.8.2/24
192.168.1.1
UDP
10.0.3.1
Payload

NETWORKING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API Server
etcd
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Kubelet
Proxy
10.0.8.0/24
10.0.3.0/24
192.168.1.1
192.168.1.2
10.0.8.0/24
POD
POD
Flannel
10.0.0.0/8
Flannel
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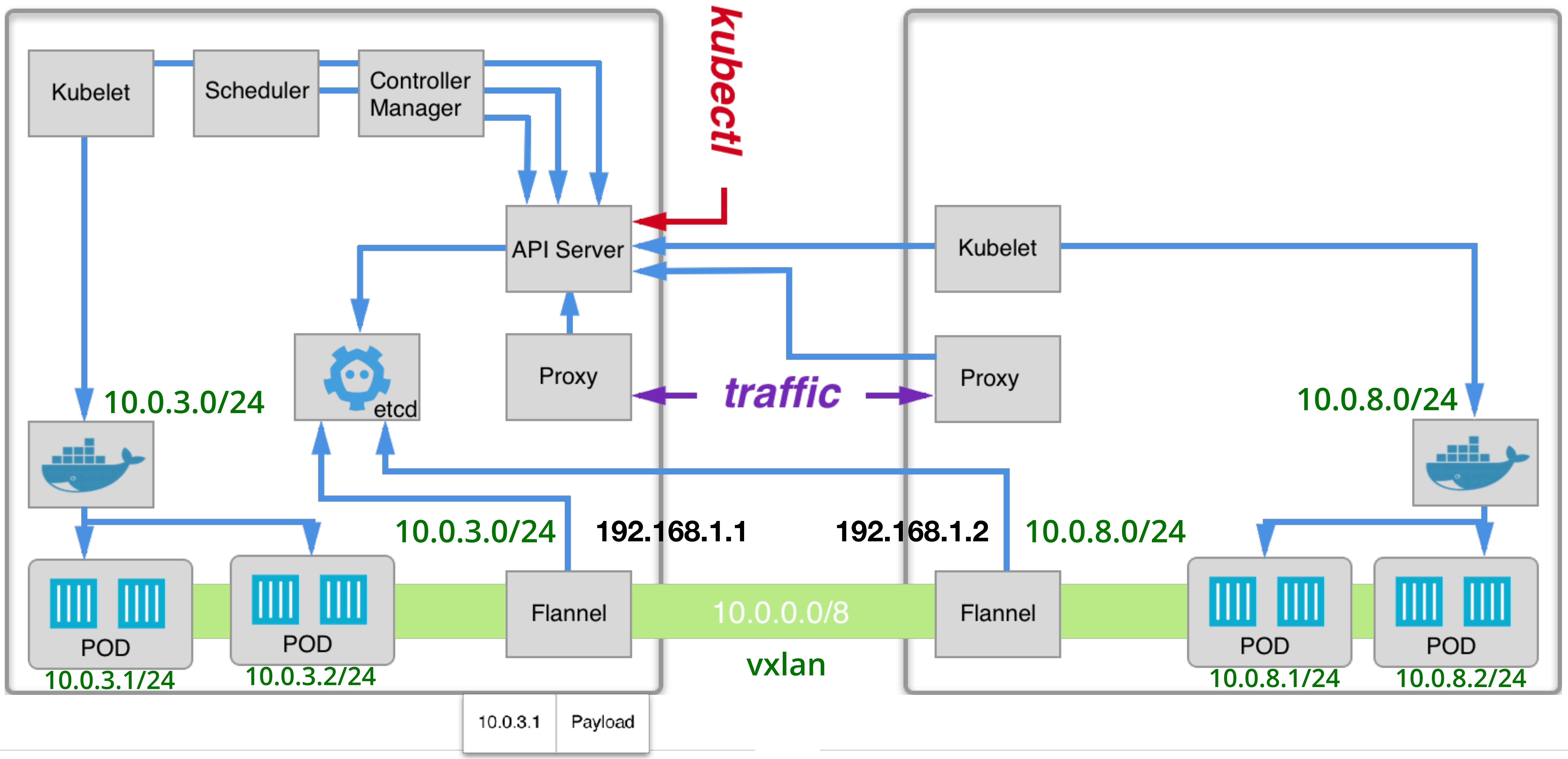
POD
10.0.3.1/24
10.0.3.2/24
vxlan
10.0.8.1/24
10.0.8.2/24
192.168.1.1
UDP
10.0.3.1
Payload

NETWORKING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Scheduler
Controller Manager
kubectl
API Server
etcd
Proxy
traffic
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Proxy
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10.0.8.0/24
10.0.3.0/24
192.168.1.1
192.168.1.2
10.0.8.0/24
POD
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Flannel
10.0.0.0/8
Flannel
POD
POD
vxlan
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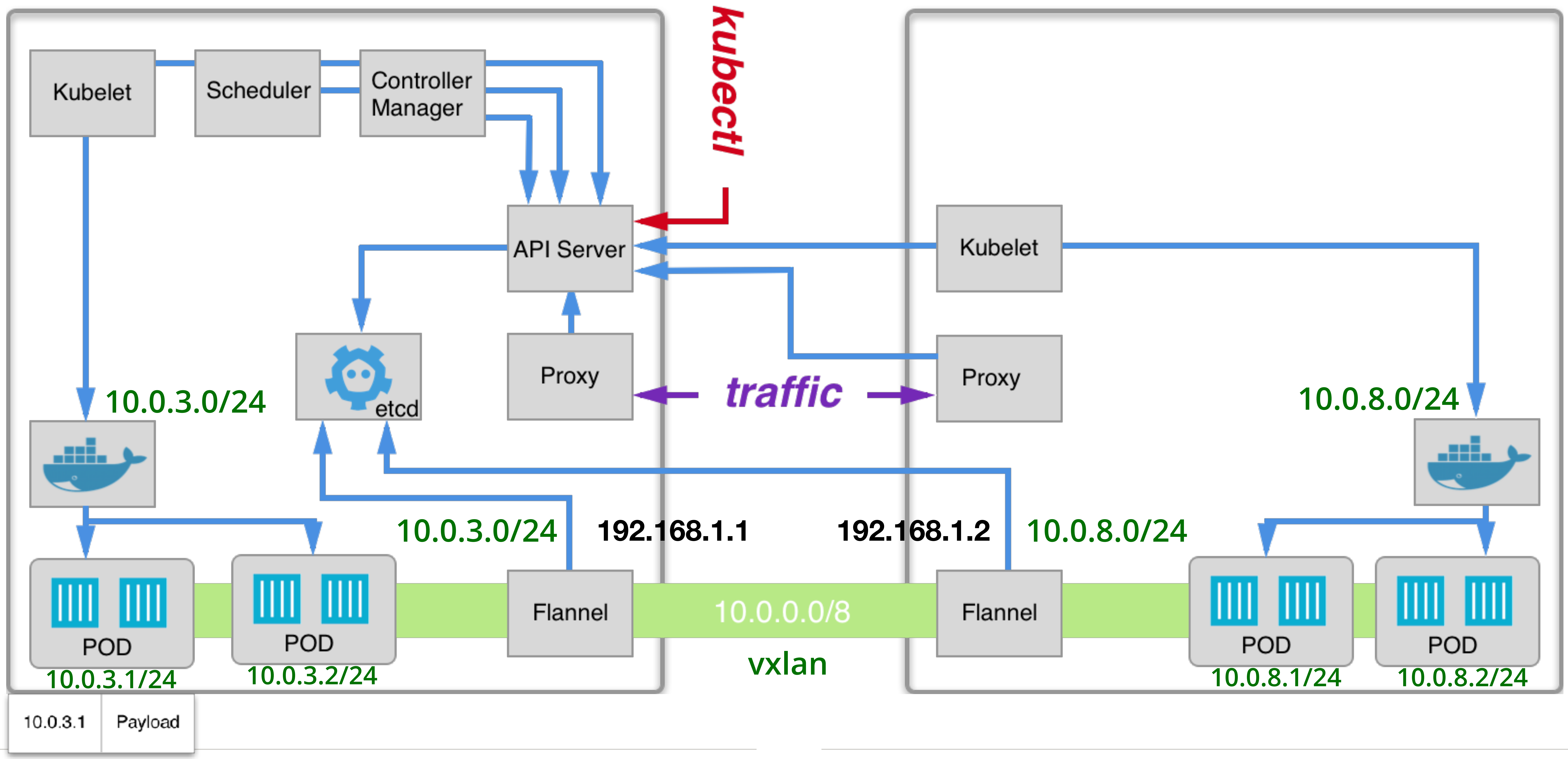
10.0.3.2/24
10.0.8.1/24
10.0.8.2/24
10.0.3.1
Payload

NETWORKING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Scheduler
Controller Manager
kubectl
API Server
Kubelet
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Proxy
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traffic
10.0.3.0/24
10.0.8.0/24
10.0.3.0/24
192.168.1.1
192.168.1.2
10.0.8.0/24
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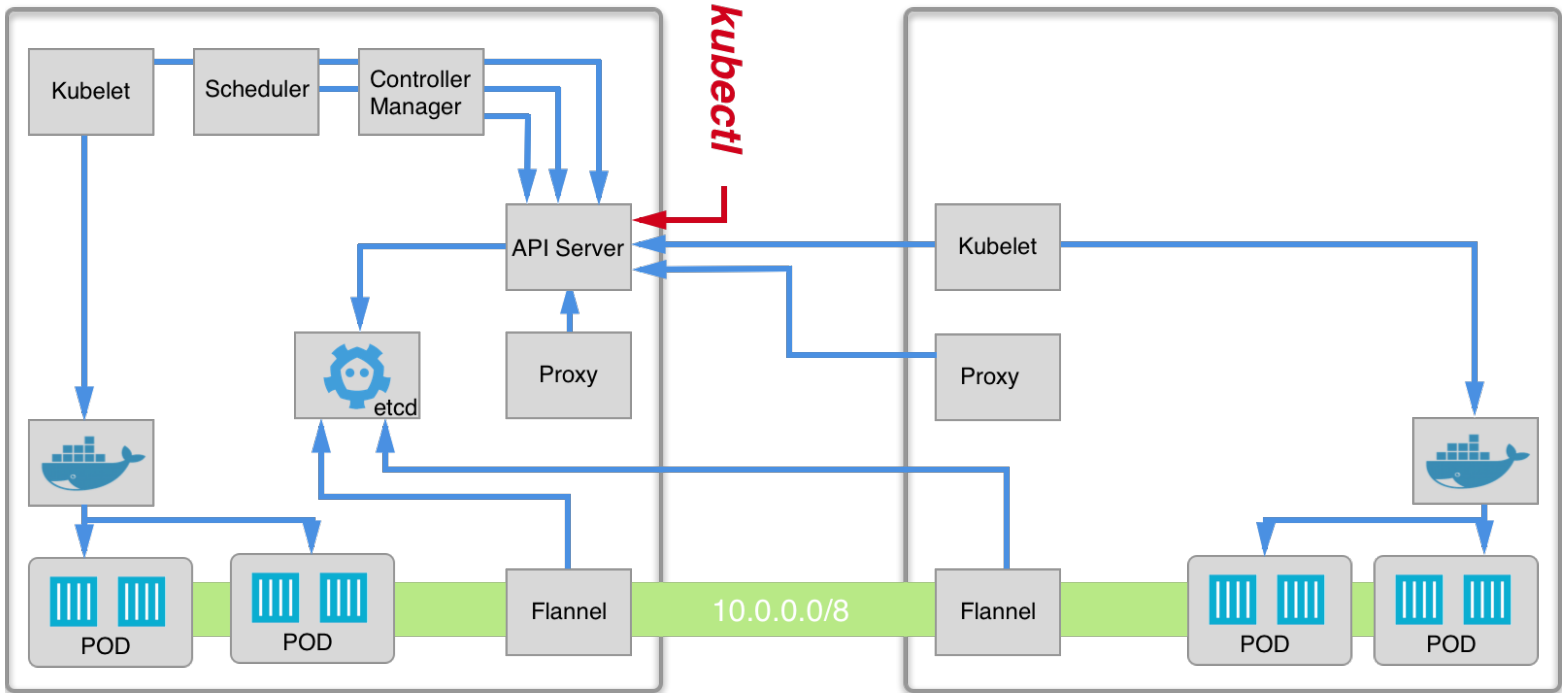
10.0.0.0/8
Flannel
POD
POD
10.0.3.1/24
10.0.3.2/24
vxlan
10.0.8.1/24
10.0.8.2/24
10.0.3.1
Payload

NETWORKING


Kubelet
Scheduler
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10.0.0.0/8
Flannel
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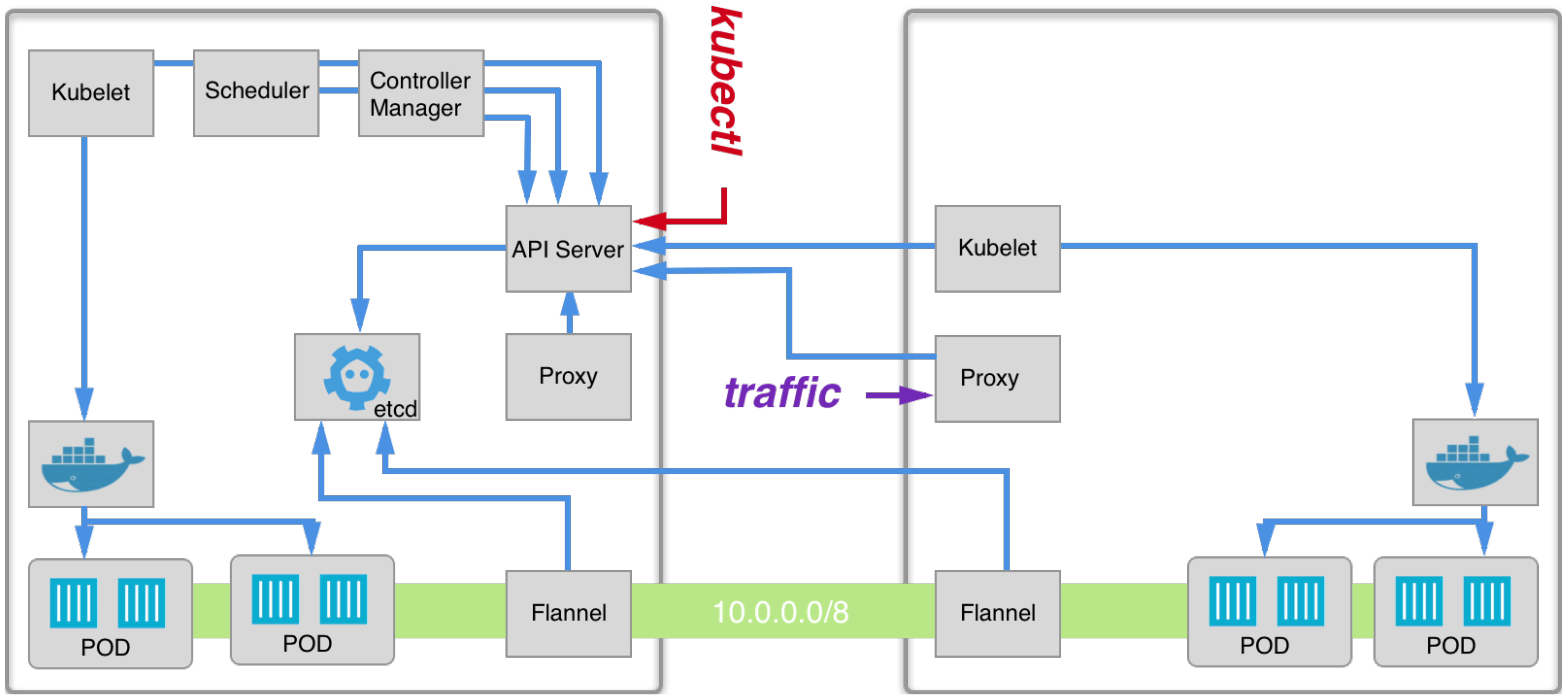
POD

NETWORKING


kubectl
Kubelet
Scheduler
Controller Manager
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Kubelet
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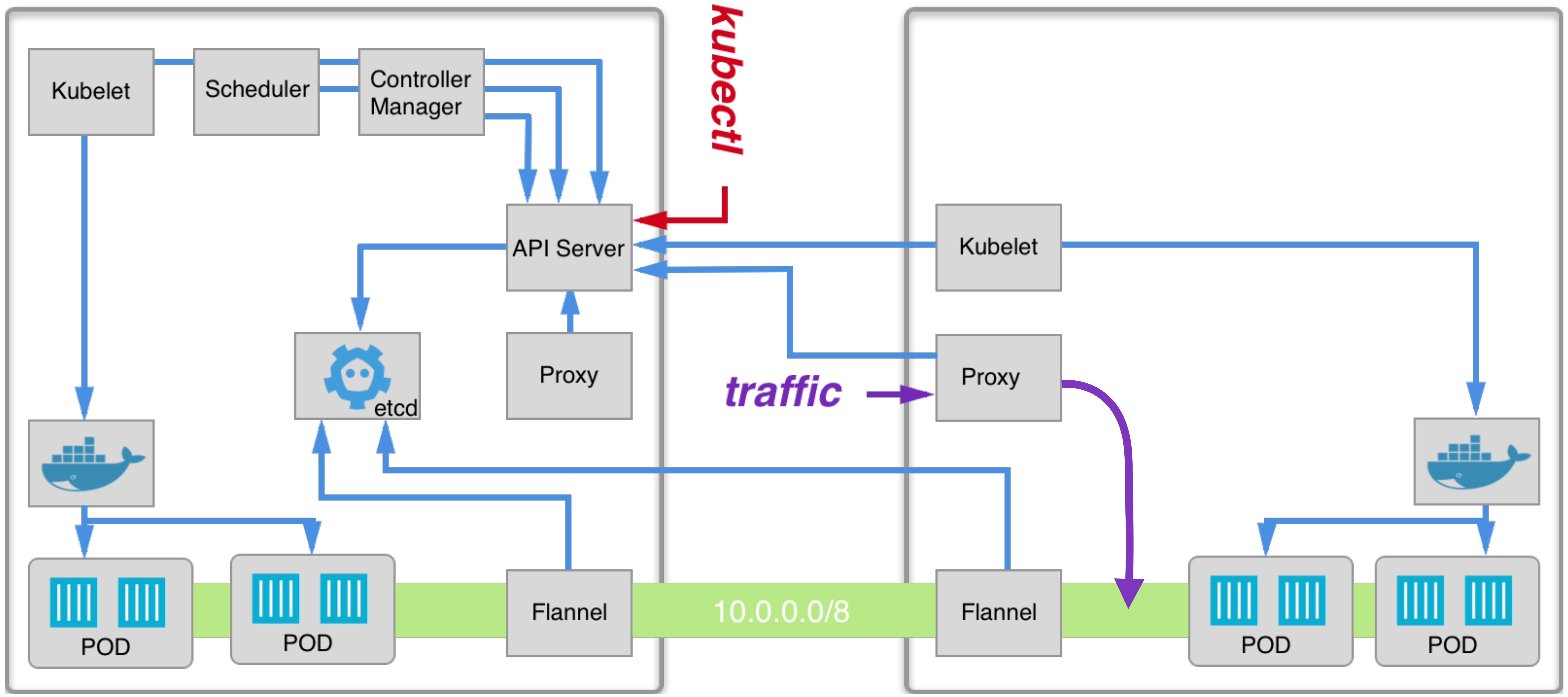
Flannel
POD
POD

NETWORKING



kubectl
Kubelet
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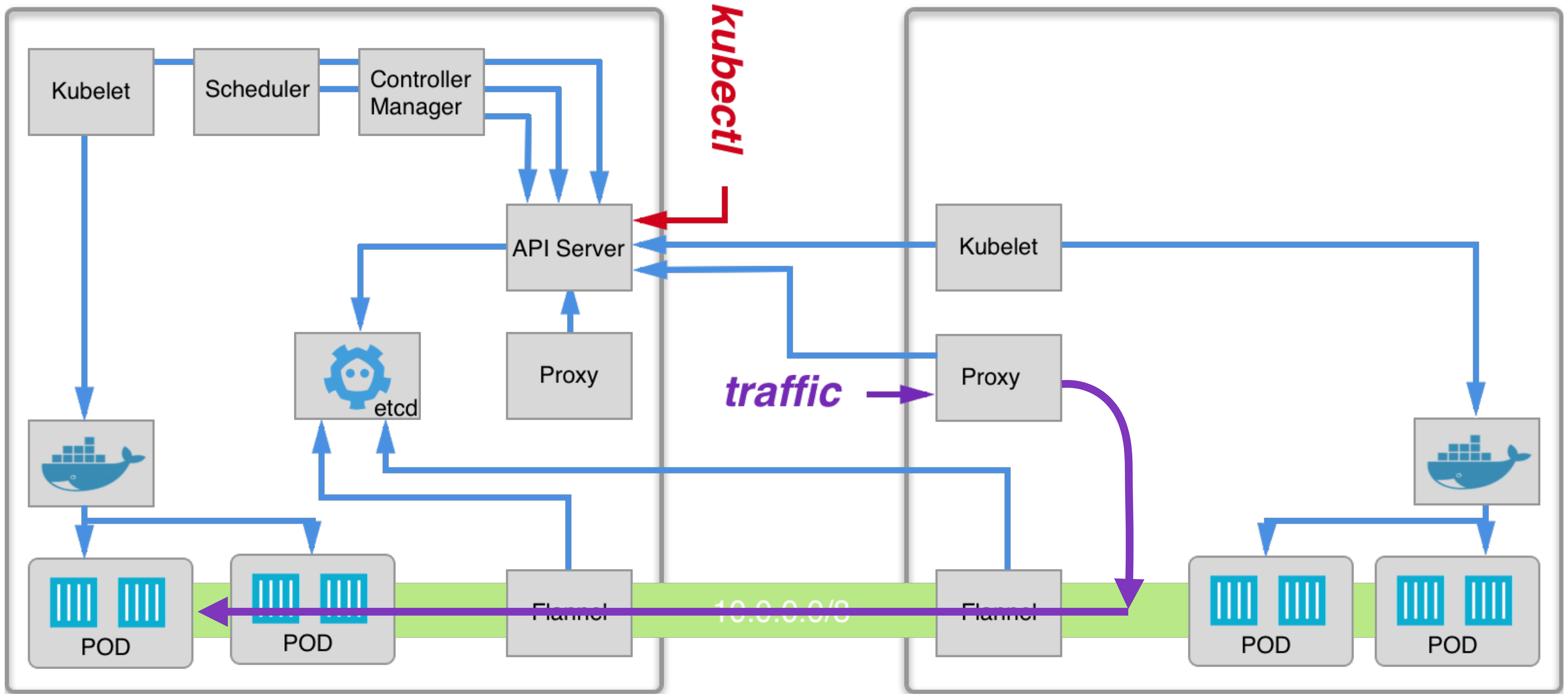
POD
POD

NETWORKING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Kubelet
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API Server
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Flannel
10.0.0.0/8
Flannel
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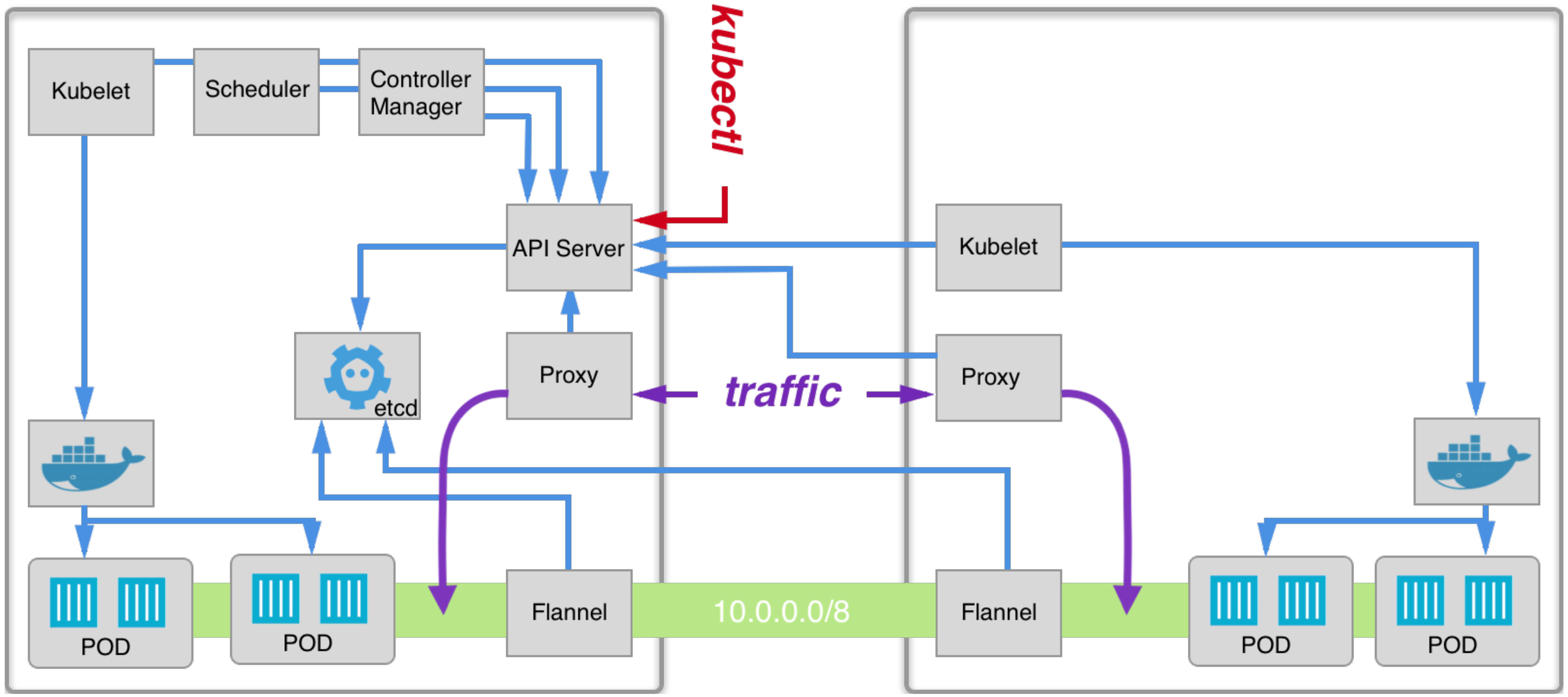
NETWORKING


Kubelet
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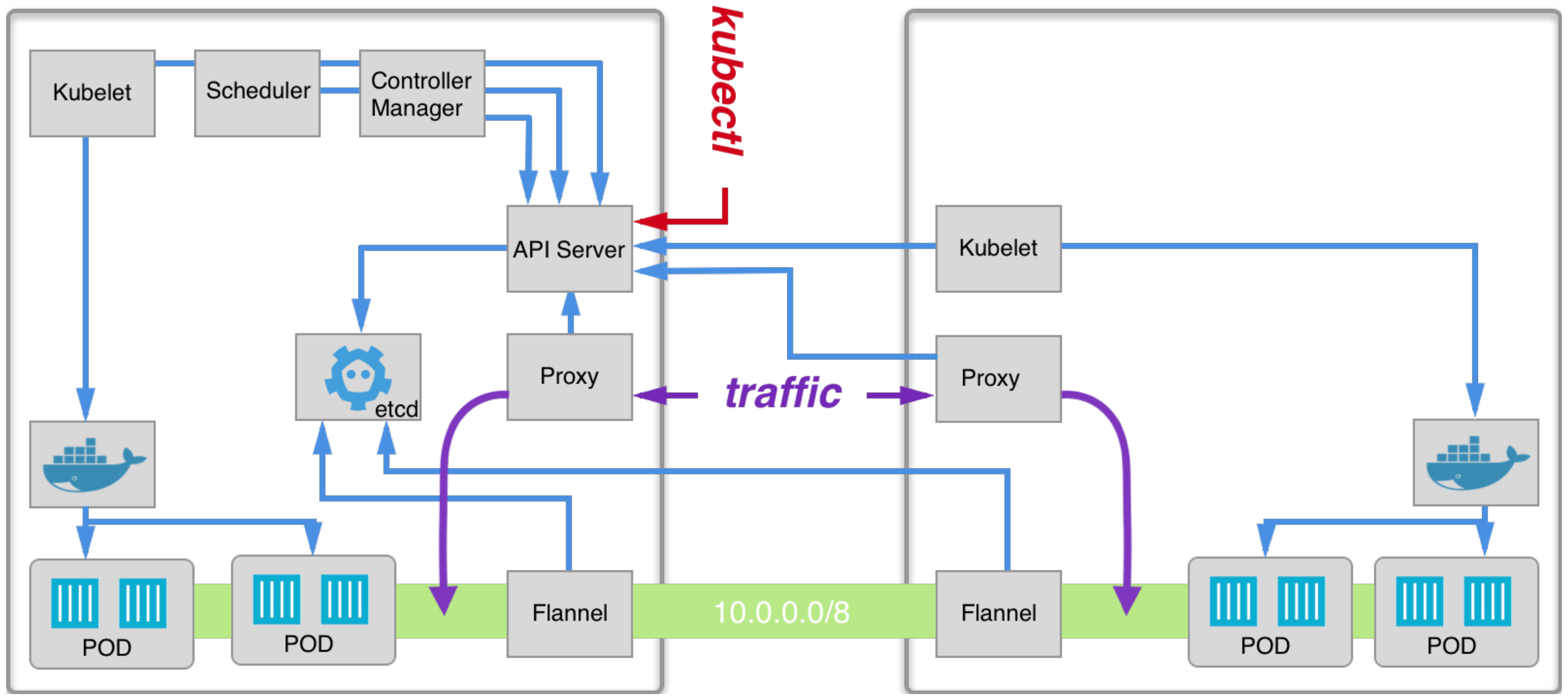
NETWORKING


Kubelet
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Controller Manager
kubectl
API Server
etcd
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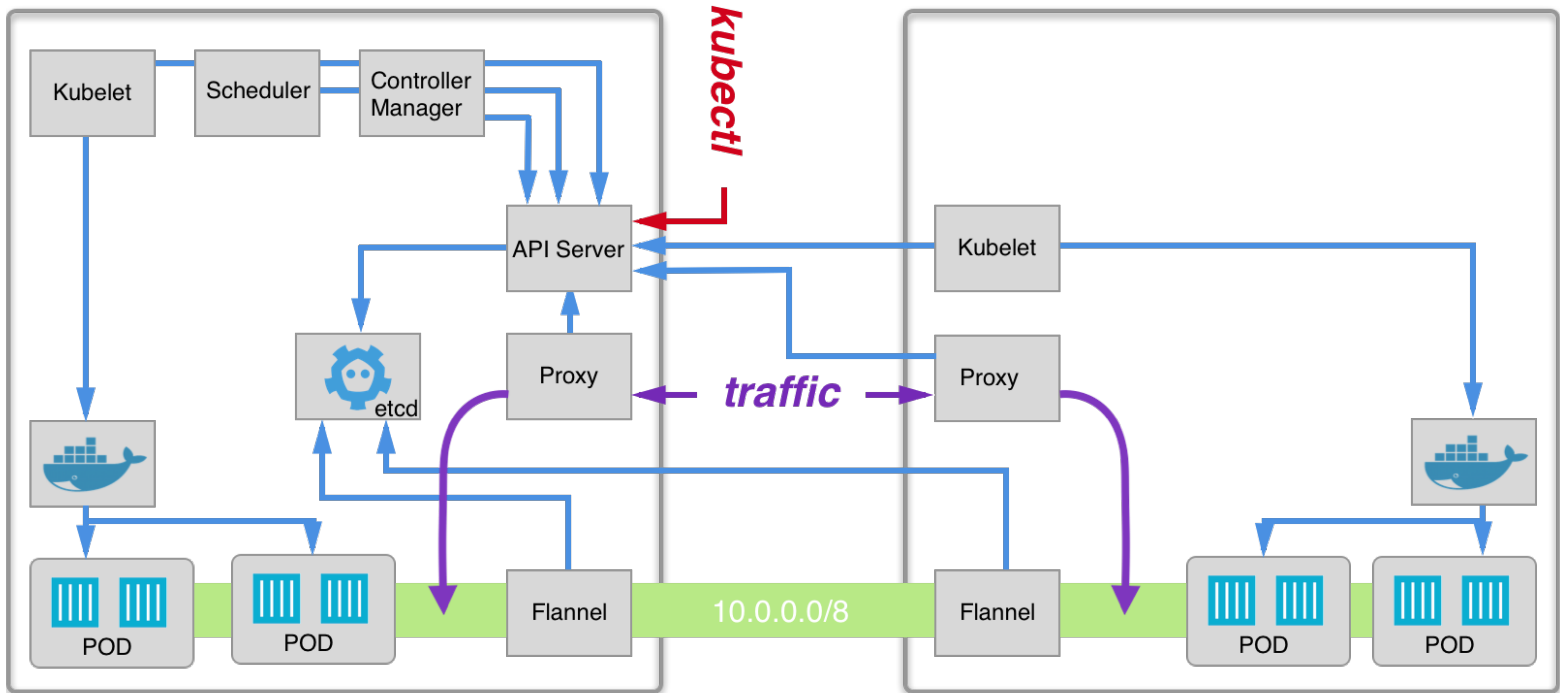
traffic
Kubelet
Proxy
POD
POD
Flannel
10.0.0.0/8
Flannel
POD
POD

NETWORKING

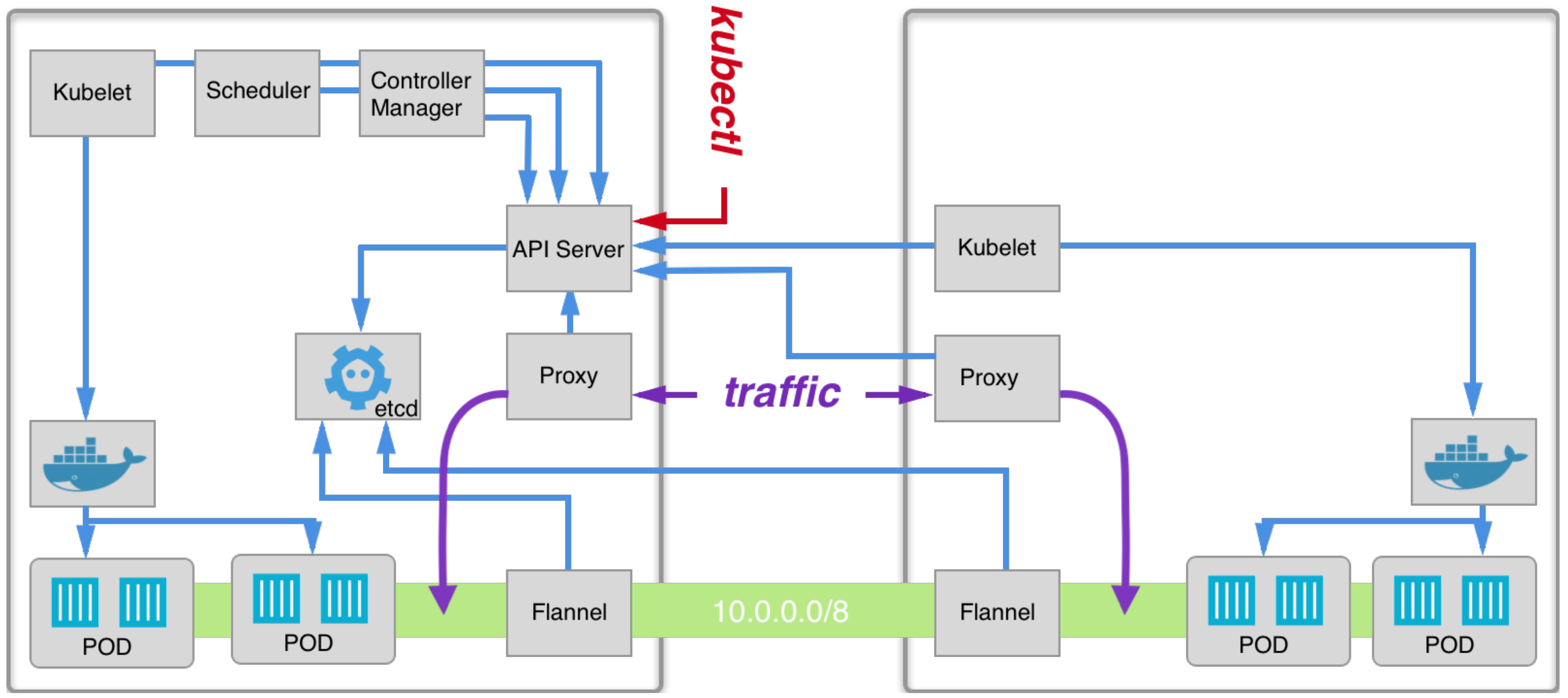
Flannel:



NETWORKING

Flannel:

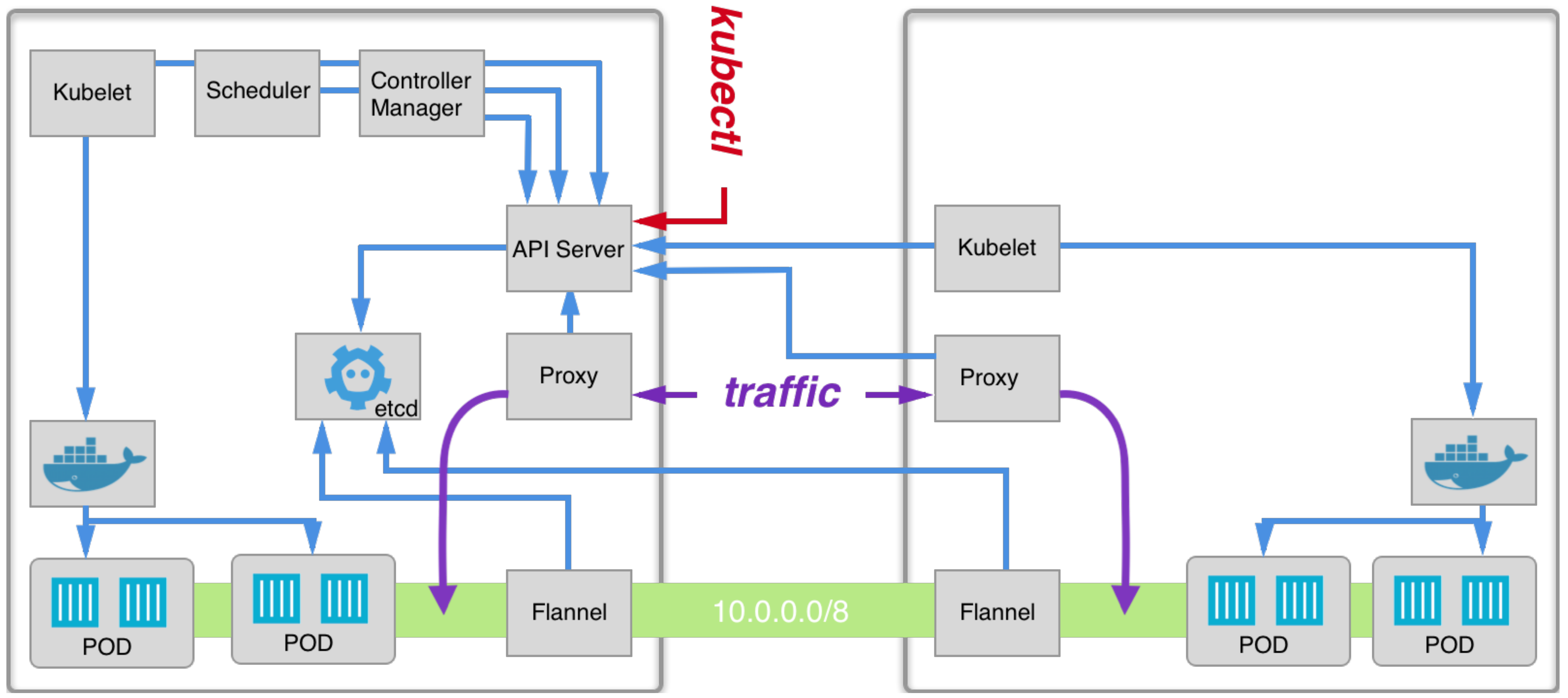
- uses etcd as a database



NETWORKING

Flannel:

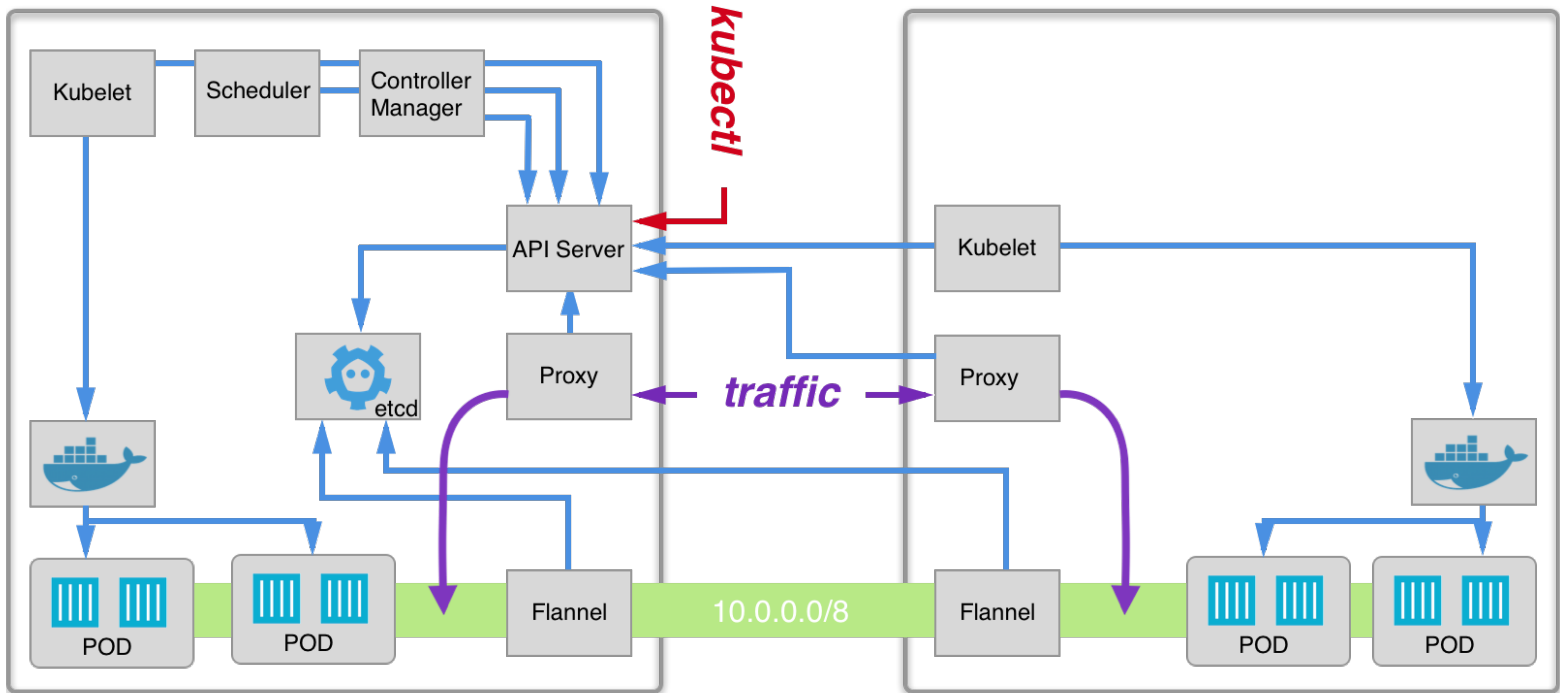
- uses etcd as a database
- agent allocates a subnet for a node out of larger address space



NETWORKING

Flannel:

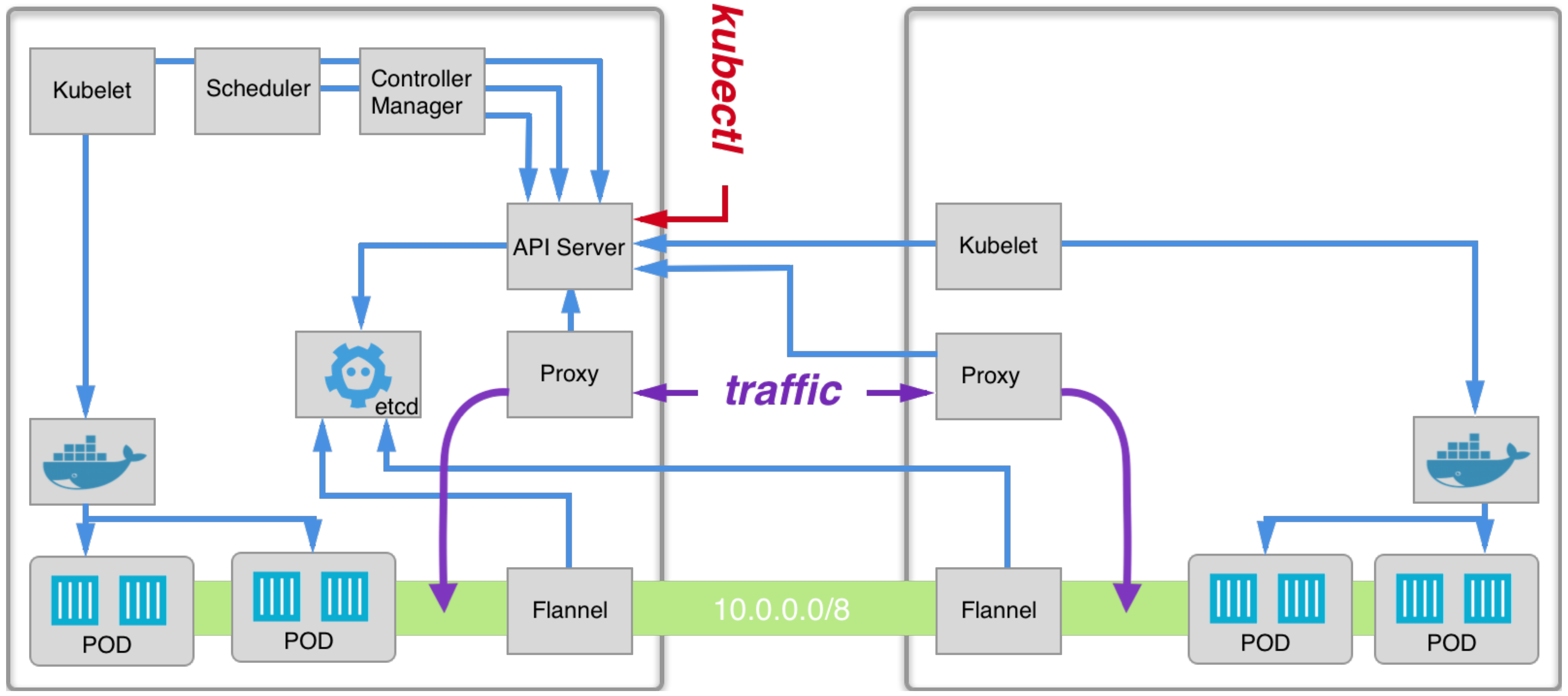
- uses etcd as a database
- agent allocates a subnet for a node out of larger address space
- tells docker to use that subnet



NETWORKING

Flannel:

- uses etcd as a database
- agent allocates a subnet for a node out of larger address space
- tells docker to use that subnet
- uses vxlan to encapsulate and foward packages between nodes



DEMO

Q&A

THANK YOU