# Kubernetes

Under the hood journey

**Marcos Vallim** • Developer Master • mvallim@ciandt.com

# Agenda

- Objective
- Networking
- Virtualization
- Components Setup
    - Network Principal (Gateway, DNS, DHCP, NAT, etc.)
    - Cluster HAProxy
    - Kubernetes: Master
    - Kubernetes: Worker
    - Kubernetes Dashboard
    - MetalLB: Extension for Kubernetes Load Balancer
    - Storage: GlusterFS
    - Heketi: Extension for Kubernetes Storage

# Objective

# Objective

The purpose of this presentation is to walk you through the steps for installing and configuring a **Kubernetes** cluster and all its components as well as the care and planning involved.

# Technologies

HAPROXY

dnsmasq

LVM

kubernetes

debian

cloud-init

GLUSTER

Pacemaker

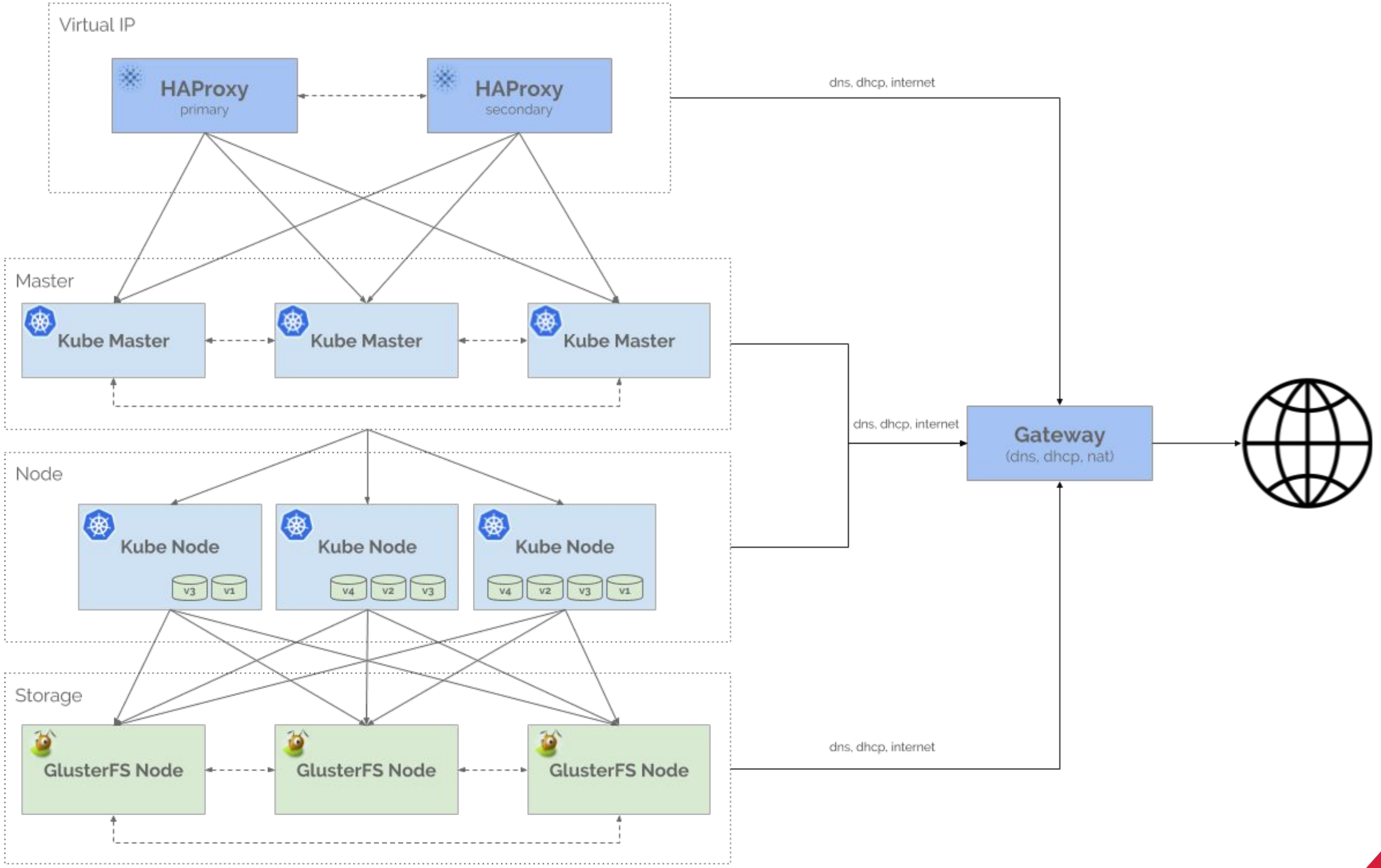
VirtualBox

Corosync
The Corosync Cluster Engine

XFS
Filesystem

docker

# Common Cluster

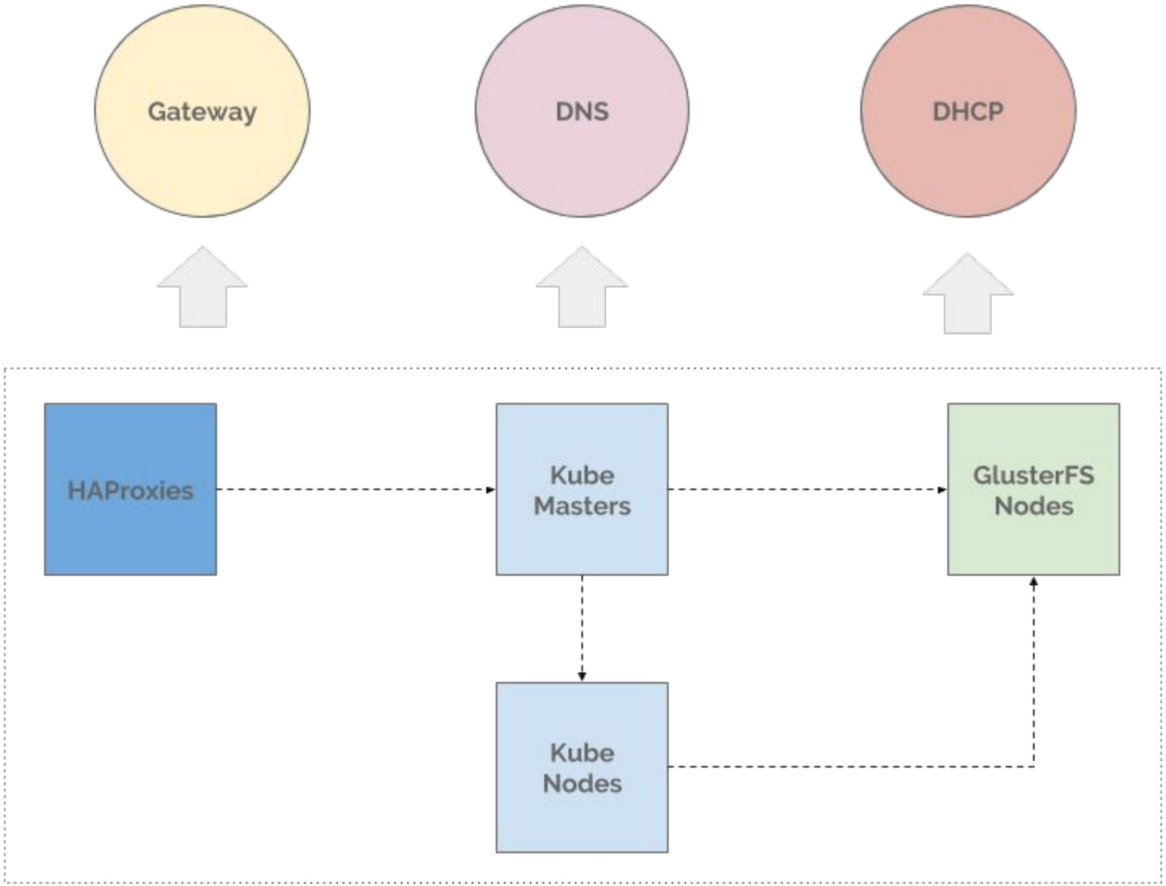


# Networking

# Network

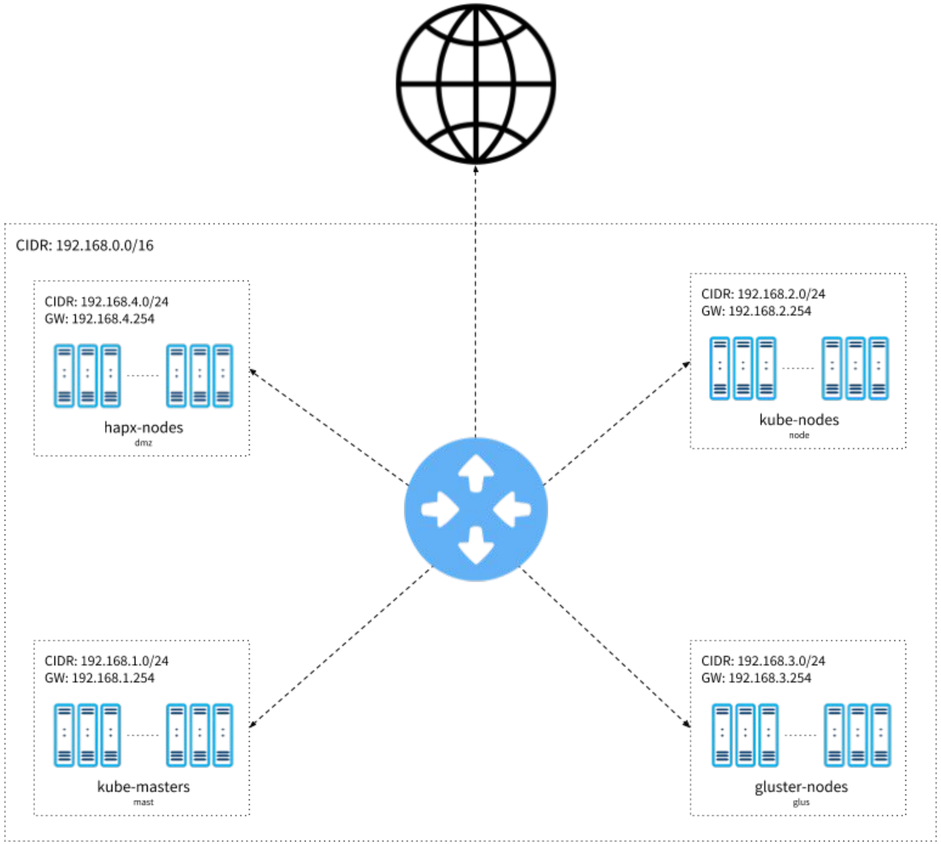
For everything to work as expected, proper network planning is required, as are network services - **DNS**, **DHCP**, **Router**, and **NAT**.

# Network Services



# Networking Diagram

| | |
|---|---|
| **CIDR** | 192.168.0.0/16 |
| **POD CIDR** | 10.244.0.0/16 |
| **Subnet - mast** | 192.168.1.0/24 |
| **Subnet - node** | 192.168.2.0/24 |
| **Subnet - glus** | 192.168.3.0/24 |
| **Subnet - dmz** | 192.168.4.0/24 |
| **DHCP - mast** | 192.168.1.50 - 192.168.1.200 |
| **DHCP - node** | 192.168.2.50 - 192.168.2.200 |
| **DHCP - glus** | 192.168.2.50 - 192.168.2.200 |
| **DHCP - dmz** | 192.168.4.50 - 192.168.4.200 |
| **DNS/Gateway - mast** | 192.168.1.254 |
| **DNS/Gateway - node** | 192.168.2.254 |
| **DNS/Gateway - glus** | 192.168.3.254 |
| **DNS/Gateway - dmz** | 192.168.4.254 |
| **Control Plane** | 192.168.4.20 |
| **MetalLB** | 192.168.2.10 - 192.168.2.49 |



# Virtualization

# Virtualization

We will use **VirtualBox** as a virtualization tool. Let's take advantage of the ability to create an OS base image with some already pre-installed and configured software, and configure the others using **cloud-init**.

# Base Image

| | |
|---|---|
| **SO** | **Debian 9 (stretch)** |
| **Packages** | build-essential |
| | module-assistant |
| | resolvconf |
| | ntp |
| | sudo |
| | cloud-init |
| | VirtualBox Guest OS |

| **Resources** | |
|---|---|
| **RAM** | 512Mb |
| **CPU** | 1 |
| **NIC** | 1 (Host-Only) |
| **HDD** | 50Gb |

# Gateway Image

| | | |
|---|---|---|
| **SO** | **Debian 9 (stretch)** |
| **Packages** | dnsmasq |
| | iptables |
| | ntopng |

| **Resources** | |
|---|---|
| **RAM** | 512Mb |
| **CPU** | 1 |
| **NIC** | 1 (NAT) |
| | 1 (Internal Network - **dmz**) |
| | 1 (Internal Network - **mast**) |
| | 1 (Internal Network - **node**) |
| | 1 (Internal Network - **glus**) |
| **HDD** | 50Gb |

# HAProxy Image

| | |
|---|---|
| **SO** | **Debian 9 (stretch)** |
| **Packages** | pacemaker |
| | corosync |
| | crmsh |
| | haproxy |

| **Resources** | |
|---|---|
| **RAM** | 512Mb |
| **CPU** | 1 |
| **NIC** | 1 (Internal Network - **dmz**) |
| **HDD** | 50Gb |

# Kube Master Image

| | |
|---|---|
| **SO** | **Debian 9 (stretch)** |
| **Packages** | docker-ce |
| | containerd.io |
| | kubectl |
| | kubelet |
| | kubeadm |
| | glusterfs-client |
| | bridge-utils |
| | iptables |

| **Resources** | |
|---|---|
| **RAM** | 2048Mb |
| **CPU** | 2 |
| **NIC** | 1 (Internal Network - **mast**) |
| **HDD** | 50Gb |

# Kube Node Image

| SO | **Debian 9 (stretch)** |
| --- | --- |
| Packages | docker-ce |
| | containerd.io |
| | kubectl |
| | kubelet |
| | kubeadm |
| | glusterfs-client |
| | bridge-utils |
| | iptables |

| Resources | |
| --- | --- |
| RAM | 2048Mb |
| CPU | 2 |
| NIC | 1 (Internal Network - **node**) |
| HDD | 50Gb |

# Gluster Image

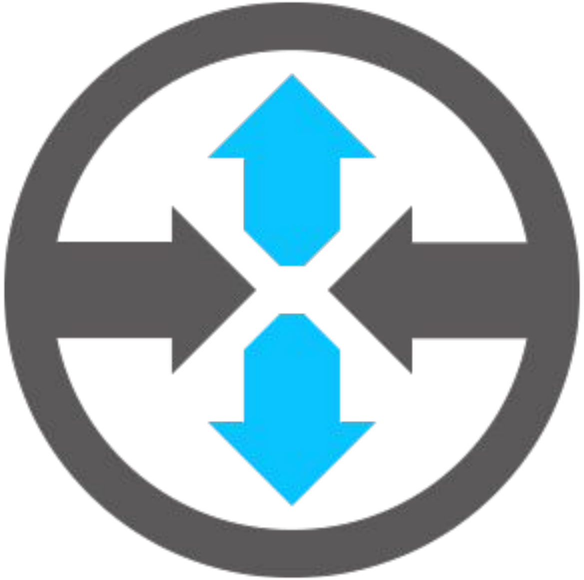
| SO | Debian 9 (stretch) |
|---|---|
| Packages | gluster-server |
| | gluster-common |
| | gluster-client |
| | thin-provisioning-tools |
| | xfsprogs |

| Resources | |
|---|---|
| RAM | 2048Mb |
| CPU | 2 |
| NIC | 1 (Internal Network - **glus**) |
| HDD | 50Gb - SO |
| | 500Gb - store |

# Network Principal

# Components Setup: Network Principal

Basic resource that will provide routing between networks and vital services - **DNS**, **DHCP** and **NAT** / **Routing**.



# Network Principal: NAT

/etc/sysctl.d/10-gateway.conf

```
net.ipv4.ip_forward=1
```

```
#iptables -A FORWARD -i enp0s8 -j ACCEPT
#iptables -A FORWARD -o enp0s8 -j ACCEPT

#iptables -A FORWARD -i enp0s9 -j ACCEPT
#iptables -A FORWARD -o enp0s9 -j ACCEPT

#iptables -A FORWARD -i enp0s10 -j ACCEPT
#iptables -A FORWARD -o enp0s10 -j ACCEPT

#iptables -A FORWARD -i enp0s16 -j ACCEPT
#iptables -A FORWARD -o enp0s16 -j ACCEPT

#iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE
```

# Network Principal: DNS

/etc/dnsmasq.d/dns

```
domain-needed
bogus-priv
bind-interfaces
domain=kube.local
```

/etc/dnsmasq.d/resolv-file

```
server=208.67.222.222
server=208.67.220.220
```

# Network Principal: DHCP / Routing

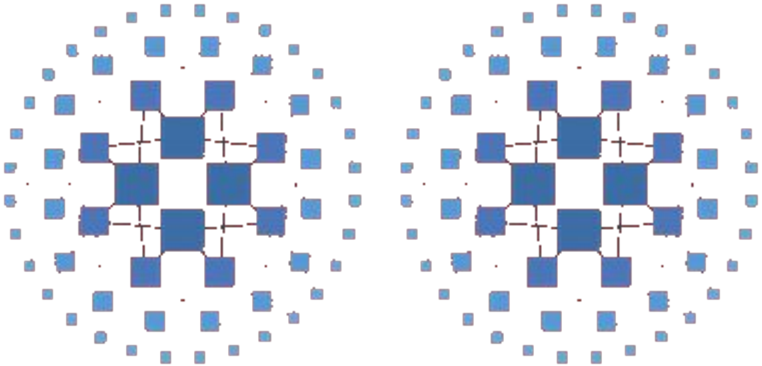
/etc/dnsmasq.d/dhcp

```
dhcp-range=enp0s8,192.168.1.50,192.168.1.100,12h
dhcp-range=enp0s9,192.168.2.50,192.168.2.200,12h
dhcp-range=enp0s10,192.168.3.50,192.168.3.200,12h
dhcp-range=enp0s16,192.168.4.50,192.168.4.200,12h

dhcp-option=enp0s8,option:dns-server,192.168.1.254
dhcp-option=enp0s9,option:dns-server,192.168.2.254
dhcp-option=enp0s10,option:dns-server,192.168.3.254
dhcp-option=enp0s16,option:dns-server,192.168.4.254

dhcp-option=enp0s8,option:router,192.168.1.254
dhcp-option=enp0s9,option:router,192.168.2.254
dhcp-option=enp0s10,option:router,192.168.3.254
dhcp-option=enp0s16,option:router,192.168.4.254

dhcp-option=enp0s8,option:classless-static-route,0.0.0.0/0,192.168.1.254
dhcp-option=enp0s9,option:classless-static-route,0.0.0.0/0,192.168.2.254
dhcp-option=enp0s10,option:classless-static-route,0.0.0.0/0,192.168.3.254
dhcp-option=enp0s16,option:classless-static-route,0.0.0.0/0,192.168.4.254
```

# Load Balancer: HAProxy

# Components Setup: Cluster HAProxy

Resource that will be responsible for the high availability of the **HAProxy** service which in turn is responsible for load balancing for the **Master Nodes**.



# Components Setup: Cluster

/etc/corosync/corosync.conf

```
totem {
  version: 2
  cluster_name: debian
  token: 3000
  token_retransmits_before_loss_const: 10
  clear_node_high_bit: yes
  crypto_cipher: aes256
  crypto_hash: sha256
  interface {
    ringnumber: 0
    bindnetaddr: 192.168.4.0
    mcastaddr: 239.255.1.1
    mcastport: 5405
    ttl: 1
  }
}
```

# Components Setup: Cluster

/etc/corosync/corosync.conf

```
logging {
  fileline: off
  to_stderr: no
  to_logfile: yes
  logfile: /var/log/corosync/corosync.log
  to_syslog: yes
  syslog_facility: daemon
  debug: off
  timestamp: on
  logger_subsys {
    subsys: QUORUM
    debug: off
  }
}

quorum {
  provider: corosync_votequorum
  two_node: 1
  expected_votes: 2
}
```

# Components Setup: Load Balancer HAProxy

/etc/haproxy/haproxy.cfg

```
defaults
  timeout client 20s
  timeout server 20s
  timeout connect 4s
  default-server init-addr last,libc,none

resolvers dns
  nameserver dns-01 192.168.4.254:53
  resolve_retries 3
  timeout retry 1s
  hold other 30s
  hold refused 30s
  hold nx 30s
  hold timeout 30s
  hold valid 10s
```

# Components Setup: Load Balancer HAProxy

/etc/haproxy/haproxy.cfg

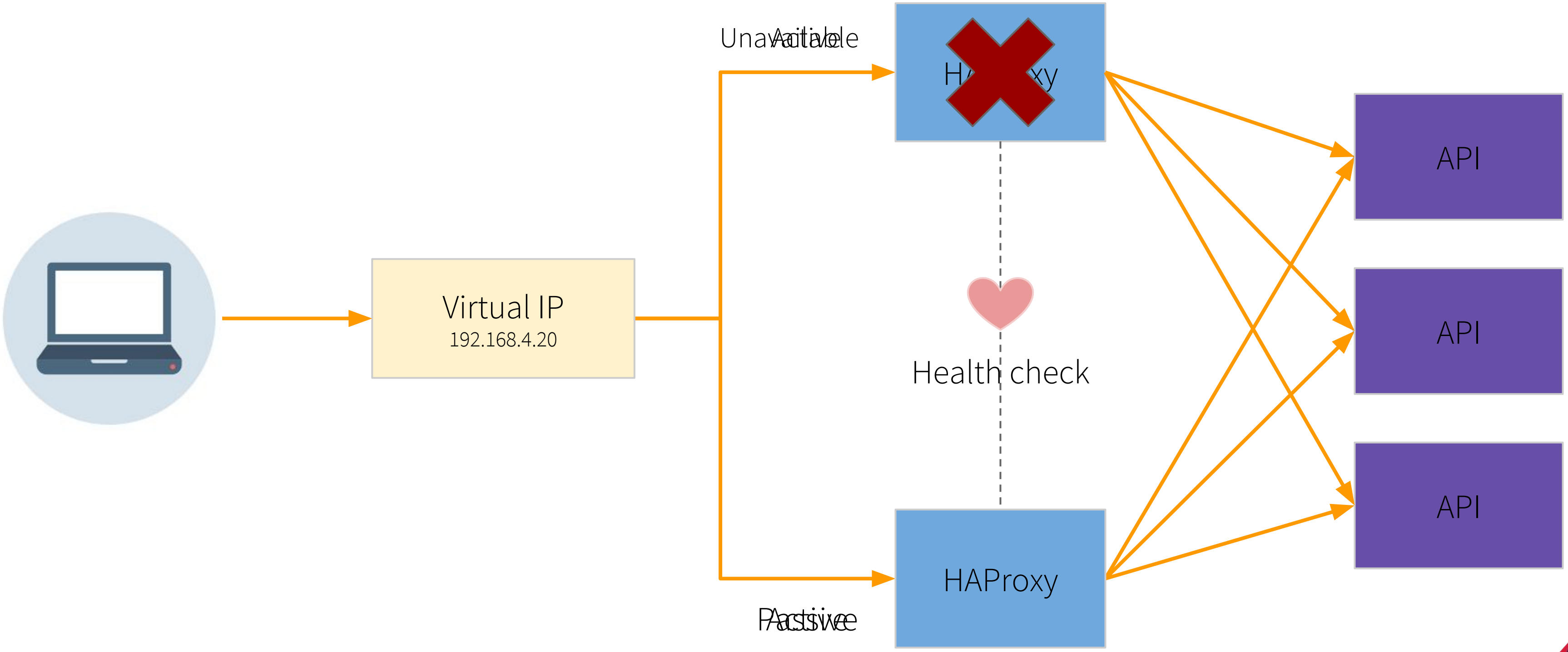
```
frontend kubernetes-apiserver-https
  bind *:6443
  mode tcp
  default_backend kubernetes-master-nodes

backend kubernetes-master-nodes
  mode tcp
  option tcp-check
  balance roundrobin
  server kube-mast01 kube-mast01:6443 check resolvers dns fall 3 rise 2
  server kube-mast02 kube-mast02:6443 check resolvers dns fall 3 rise 2
  server kube-mast03 kube-mast03:6443 check resolvers dns fall 3 rise 2

listen stats
  bind *:32700
  stats enable
  stats uri /
  stats hide-version
  stats auth admin:admin
```

# Components Setup: Pacemaker/Corosync

#crm configure

```
property stonith-enabled=no
property no-quorum-policy=ignore
property default-resource-stickiness=100
primitive virtual-ip-resource ocf:heartbeat:IPaddr2 params ip="192.168.4.20" nic="enp0s3"
cidr_netmask="32" meta migration-threshold=2 op monitor interval=20 timeout=60
on-fail=restart
primitive haproxy-resource ocf:heartbeat:haproxy op monitor interval=20 timeout=60
on-fail=restart
colocation loc inf: virtual-ip-resource haproxy-resource
order ord inf: virtual-ip-resource haproxy-resource
commit
bye
```

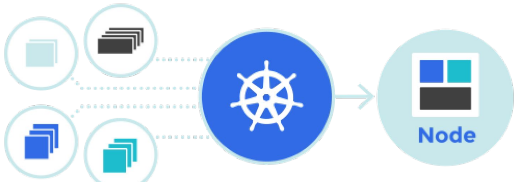
# Cluster HAProxy

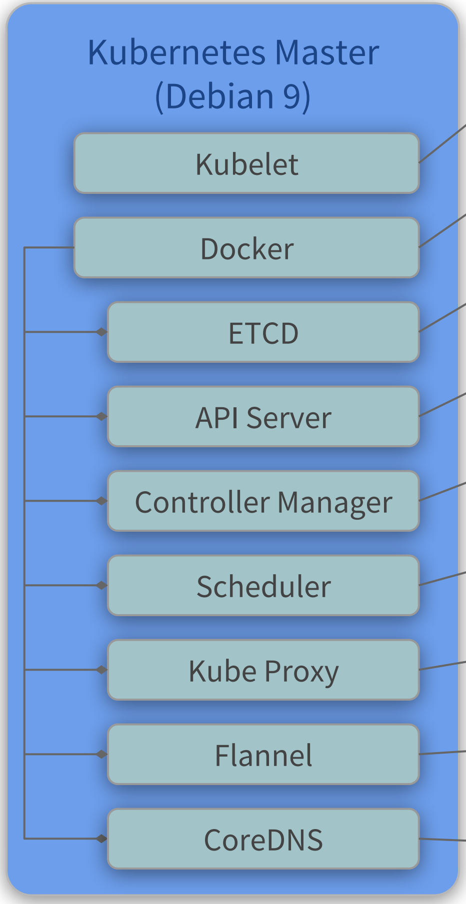


# DEMO
# High Availability

# Kubernetes

# Components Setup: Kubernetes Master




Kubelet gets the configuration of a pod from the API Server and ensures that the described containers are up and running.

It takes care of downloading the images and starting the containers.

The etcd reliably stores the configuration data of the Kubernetes cluster, representing the state of the cluster (what nodes exist in the cluster, what pods should be running, which nodes they are running on, and a whole lot more) at any given point of time.

The API Server validates and configures data for the api objects which include pods, services, replicationcontrollers, and others. The API Server services REST operations and provides the frontend to the cluster's shared state through which all other components interact.

The Controller Manager watches the state of the cluster through the API Server watch feature and, when it gets notified, it makes the necessary changes attempting to move the current state towards the desired state. Besides, the Controller Manager performs lifecycle of as namespace, event, terminated-pod, cascading-deletion, node, etc.

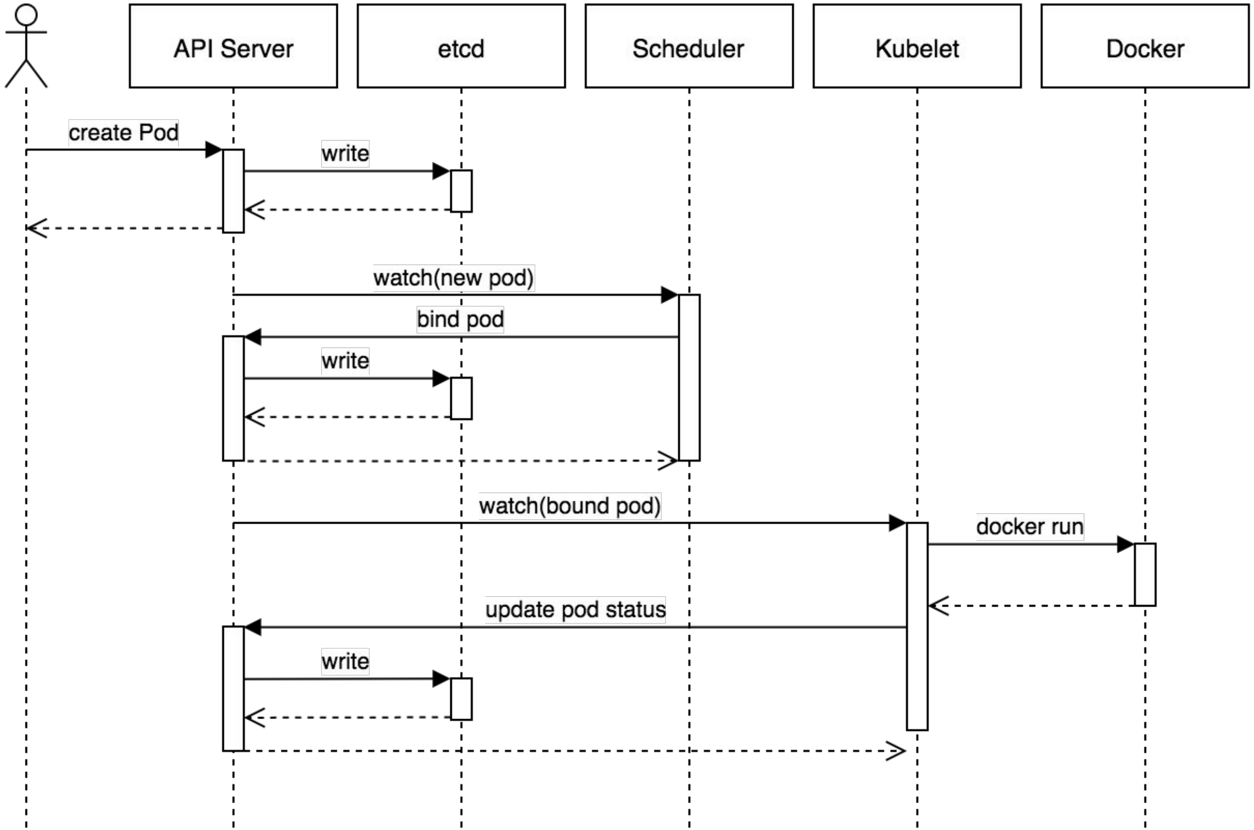
The Scheduler watches for unscheduled pods and binds them to nodes via the binding pod subresource API, according to the availability of the requested resources, quality of service requirements, affinity and anti-affinity specifications, and other constraints. Once the pod has a node assigned, the regular behavior of the Kubelet is triggered and the pod and its containers are created.

Kube Proxy acts as a network proxy and a load balancer for a service on a single worker node. It takes care of the network routing for TCP and UDP packets.

It is a layer 3 network fabric designed for Kubernetes.

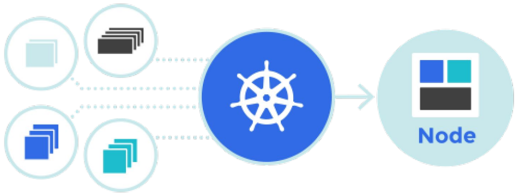
It is the DNS Server of the Kubernetes cluster.

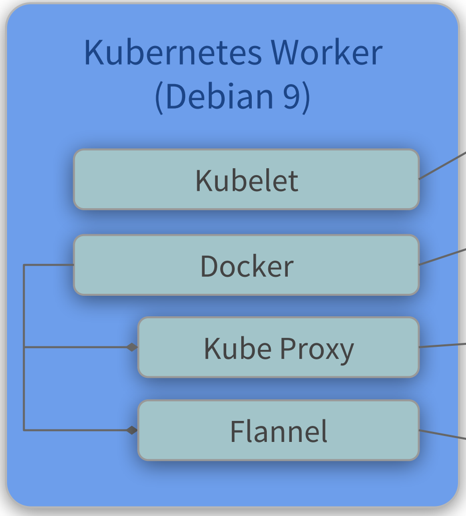
# Components Setup: Pod creation flow




**Source: heptio.com**

# Components Setup: Kubernetes Worker




Kubelet gets the configuration of a pod from the API Server and ensures that the described containers are up and running.

It takes care of downloading the images and starting the containers.

Kube Proxy acts as a network proxy and a load balancer for a service on a single worker node. It takes care of the network routing for TCP and UDP packets.

It is a layer 3 network fabric designed for Kubernetes.

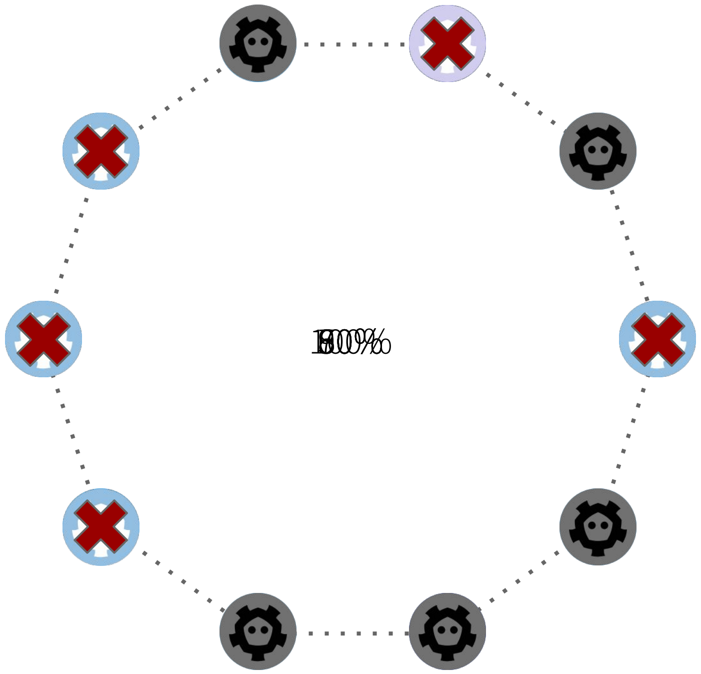
# Components Setup: etcd

*"**etcd** is a distributed key value store that provides a reliable way to store data across a cluster of machines. It's open-source and available on GitHub. etcd gracefully handles leader elections during network partitions and will tolerate machine failure, including the leader."*

# Components Setup: etcd failure tolerance

| CLUSTER SIZE<br>N | FAILURE TOLERANCE<br>T = (N-1) / 2 | MAJORITY<br>M = (N/2) + 1 |
|---|---|---|
| 1 | **0** | 1 |
| 2 | **0** | 2 |
| 3 | **1** | 2 |
| 4 | **1** | 3 |
| 5 | **2** | 3 |
| 6 | **2** | 4 |
| 7 | **3** | 4 |
| 8 | **3** | 5 |
| 9 | **4** | 5 |
| 10 | **4** | 5 |

# Components Setup: etcd consensus (raft)



Leader

Follower

Unhealthy

# Components Setup: Kubernetes Network Model

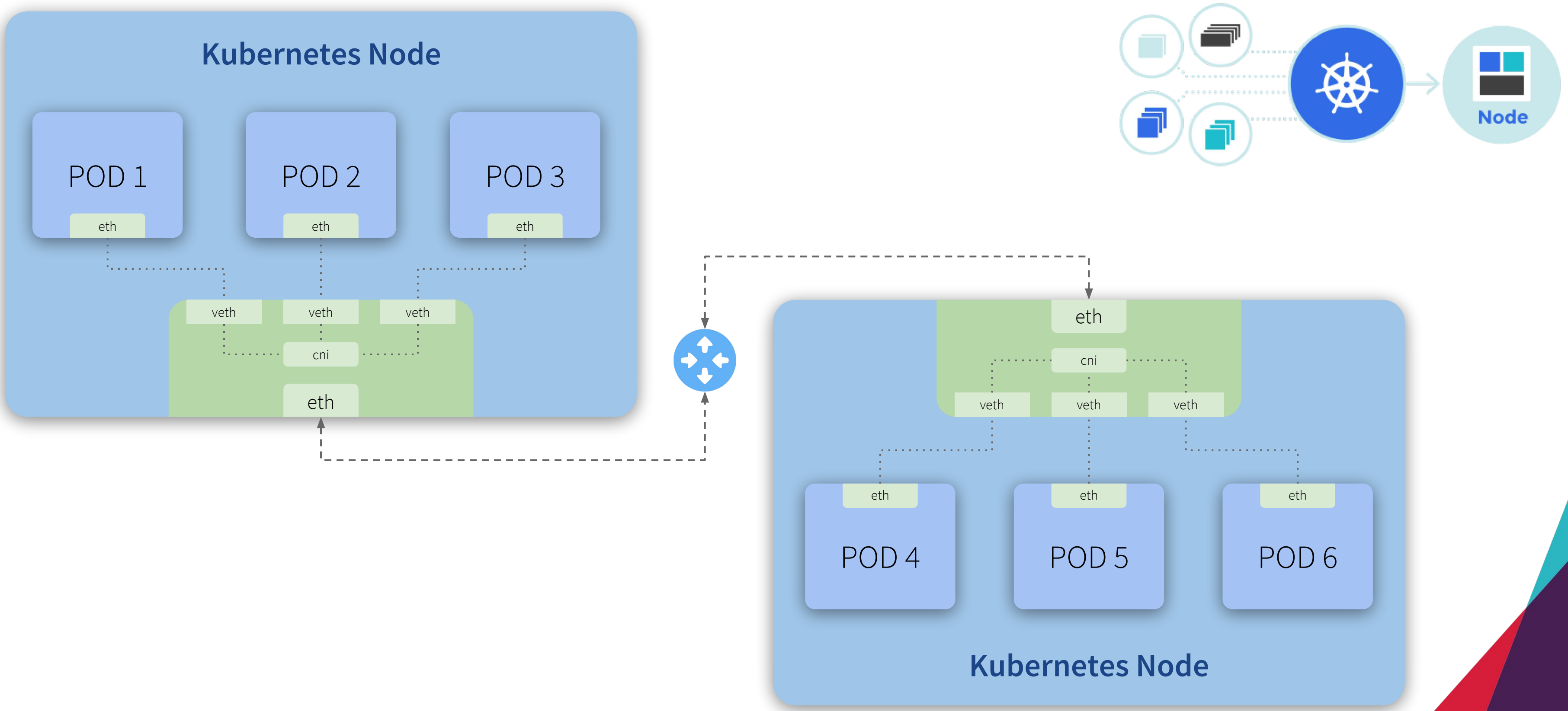
## Assumptions:

- Pods are all able to communicate with one another without the need to use network address translation (NAT).
- Nodes are the machines that run the Kubernetes cluster. These can be either virtual or physical machines, or indeed anything else that is able to run Kubernetes. These nodes are also able to communicate with all the Pods, without the need for NAT.
- Each Pod will see itself with the same IP that other Pods see it as having.

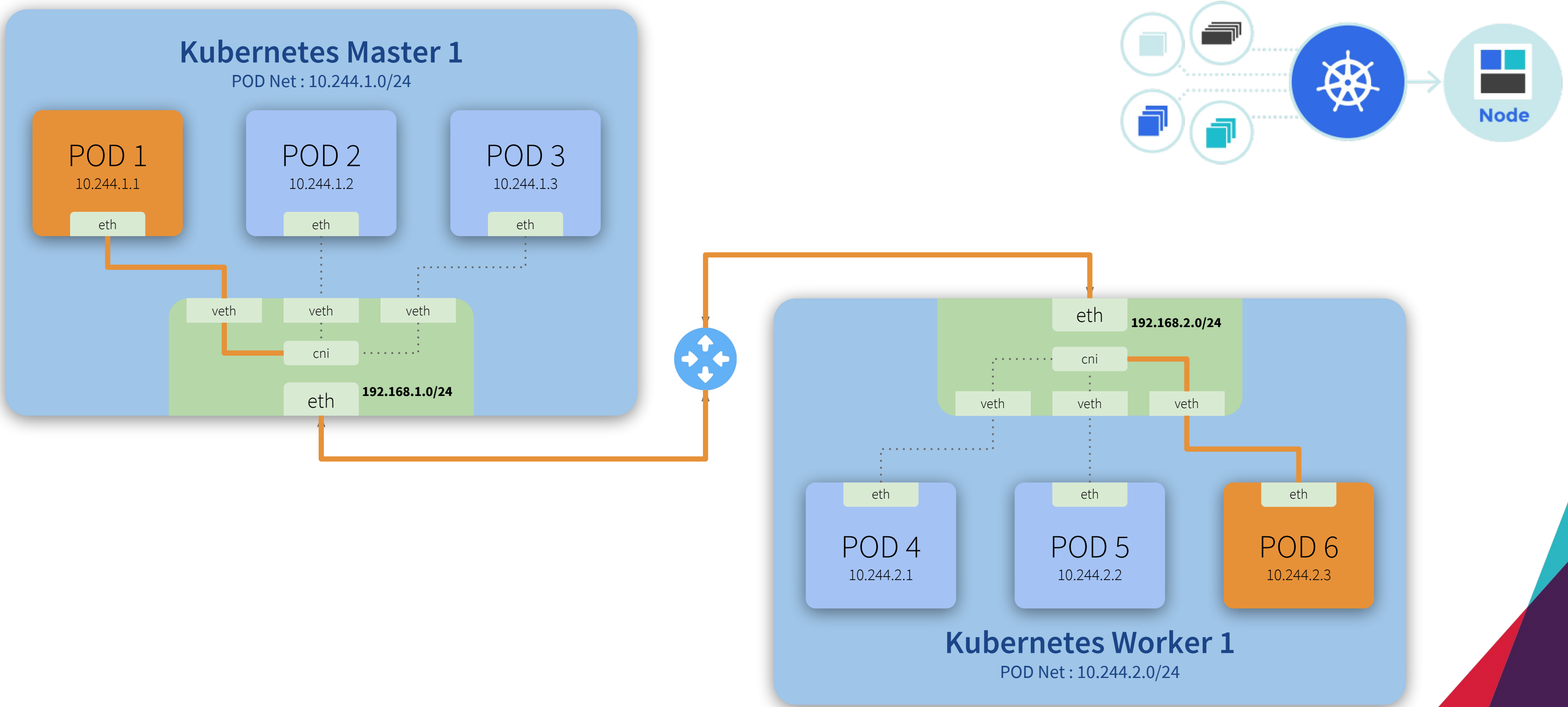
# Components Setup: Kubernetes Backend Network

*“Flannel is a simple and easy way to configure a layer 3 network fabric designed for Kubernetes.*
*Flannel runs a small, single binary agent called flanneld on each host, and is responsible for allocating a subnet lease to each host out of a larger, preconfigured address space. Flannel uses either the Kubernetes API or etcd directly to store the network configuration, the allocated subnets, and any auxiliary data (such as the host's public IP). Packets are forwarded using one of several backend mechanisms including VXLAN and various cloud integrations.”*

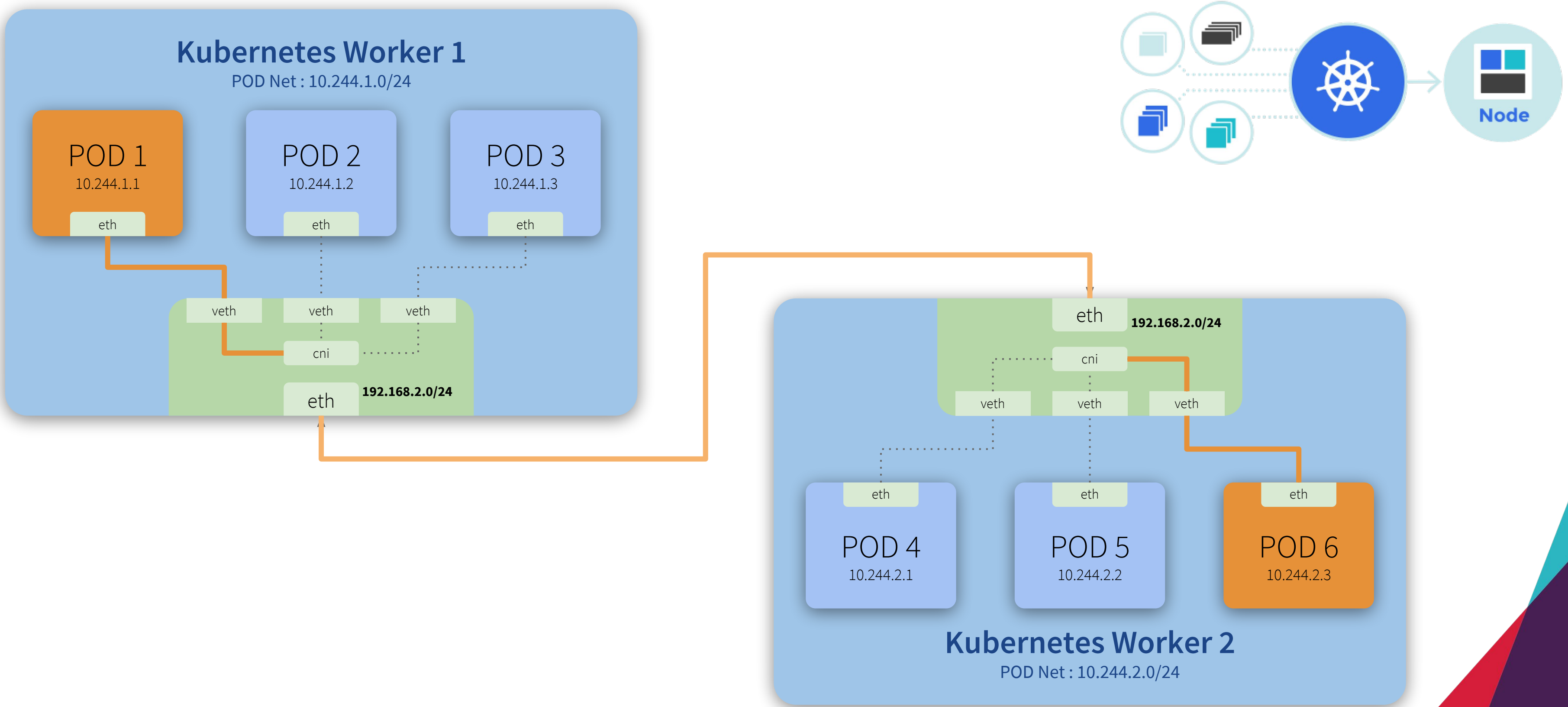
# Components Setup: Kubernetes Network Model



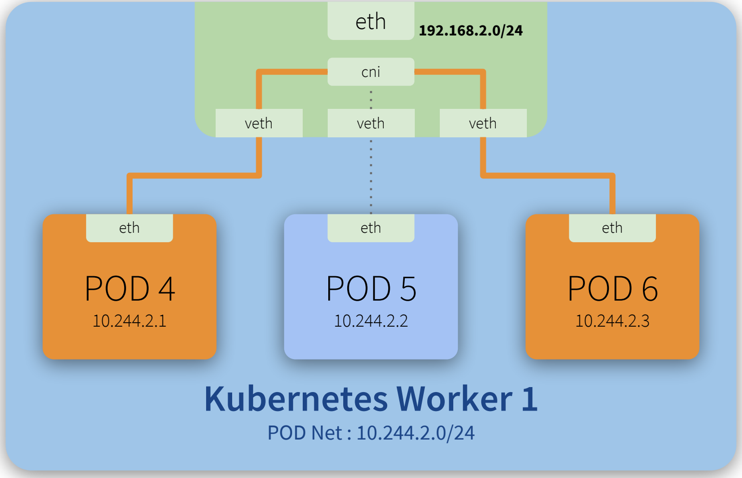
# Components Setup: Communication - Master-to-Worker

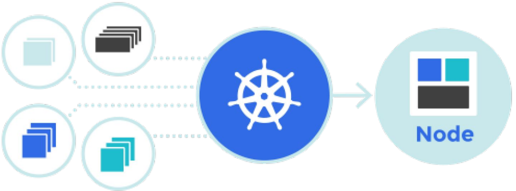


# Components Setup: Communication - Worker-to-Worker

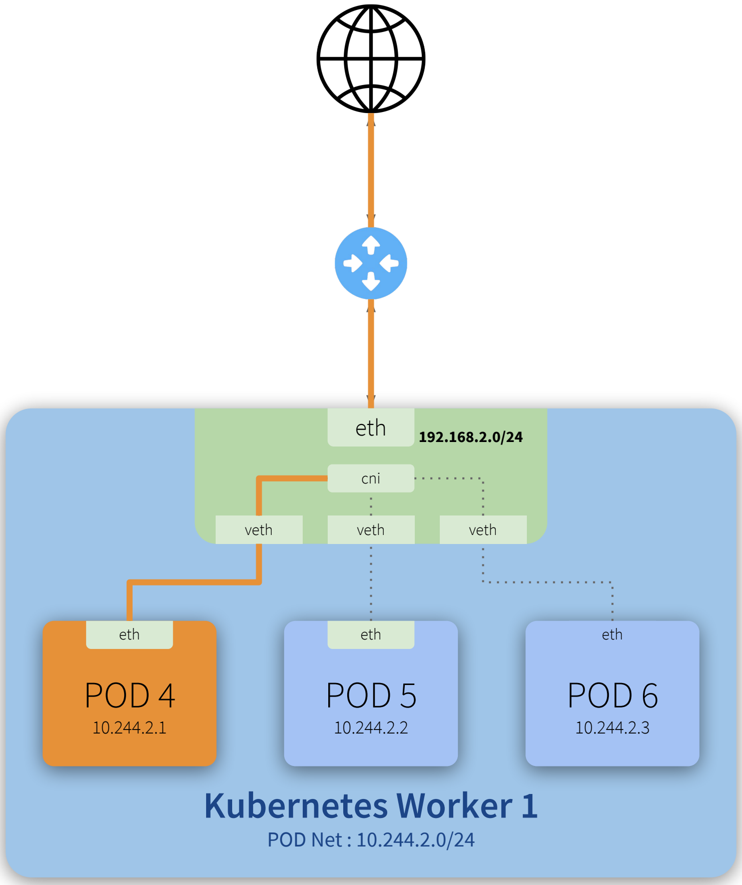


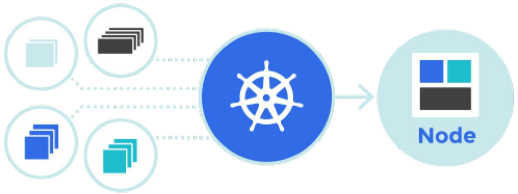
# Components Setup: Communication - Intra Node - Pod-To-Pod



# Components Setup: Communication - Pod-To-Internet



# Components Setup: Kubernetes DNS

CoreDNS

*"CoreDNS is a fast and flexible DNS server. The keyword here is flexible: with CoreDNS you are able to do what you want with your DNS data by utilizing plugins. If some functionality is not provided out of the box you can add it by writing a plugin."*

# Components Setup: Forward and Bridge

/etc/modules-load.d/bridge.conf

```
br_netfilter
```

/etc/sysctl.d/10-kubernetes.conf

```
net.ipv4.ip_forward=1
net.bridge.bridge-nf-call-iptables=1
net.bridge.bridge-nf-call-arptables=1
```

# Components Setup: Tools

~/bin/copy-certificates.sh

```
USER=debian
CONTROL_PLANE_IPS="kube-mast02 kube-mast03"
for host in ${CONTROL_PLANE_IPS}; do
  scp /etc/kubernetes/pki/ca.crt "${USER}"@$host:
  scp /etc/kubernetes/pki/ca.key "${USER}"@$host:
  scp /etc/kubernetes/pki/sa.key "${USER}"@$host:
  scp /etc/kubernetes/pki/sa.pub "${USER}"@$host:
  scp /etc/kubernetes/pki/front-proxy-ca.crt "${USER}"@$host:
  scp /etc/kubernetes/pki/front-proxy-ca.key "${USER}"@$host:
  scp /etc/kubernetes/pki/etcd/ca.crt "${USER}"@$host:etcd-ca.crt
  scp /etc/kubernetes/pki/etcd/ca.key "${USER}"@$host:etcd-ca.key
  scp /etc/kubernetes/admin.conf "${USER}"@$host:
done
```

~/bin/move-certificates.sh

```
USER=debian
mkdir -p /etc/kubernetes/pki/etcd
mv /home/${USER}/ca.crt /etc/kubernetes/pki/
mv /home/${USER}/ca.key /etc/kubernetes/pki/
mv /home/${USER}/sa.pub /etc/kubernetes/pki/
mv /home/${USER}/sa.key /etc/kubernetes/pki/
mv /home/${USER}/front-proxy-ca.crt /etc/kubernetes/pki/
mv /home/${USER}/front-proxy-ca.key /etc/kubernetes/pki/
mv /home/${USER}/etcd-ca.crt /etc/kubernetes/pki/etcd/ca.crt
mv /home/${USER}/etcd-ca.key /etc/kubernetes/pki/etcd/ca.key
mv /home/${USER}/admin.conf /etc/kubernetes/admin.conf
```

# Components Setup: Kubernetes Master Init

vi kubeadm-config.yaml

```
apiVersion: kubeadm.k8s.io/v1beta1
kind: ClusterConfiguration
kubernetesVersion: stable
apiServer:
  certSANs:
  - "192.168.4.20"
controlPlaneEndpoint: "192.168.4.20:6443"
networking:
  podSubnet: 10.244.0.0/16
```

**Only on first master node**

```
#kubeadm init --config=kubeadm-config.yaml

#ssh-keygen -t rsa -b 4096

#ssh-copy-id debian@kube-mast02
#ssh-copy-id debian@kube-mast03

#~/bin/copy-certificates.sh
```

# Components Setup: Kubernetes Backend Network

**Only on first master node**

```
#kubectl apply -f
https://raw.githubusercontent.com/coreos/flannel/a70459be0084506e4ec919aa1c114638878db11b/Docu
mentation/kube-flannel.yml
```

# Components Setup: Kubernetes Master Replica Join

**Only on first master node**

```
#kubeadm token create --print-join-command
```

**Only on master replicas**

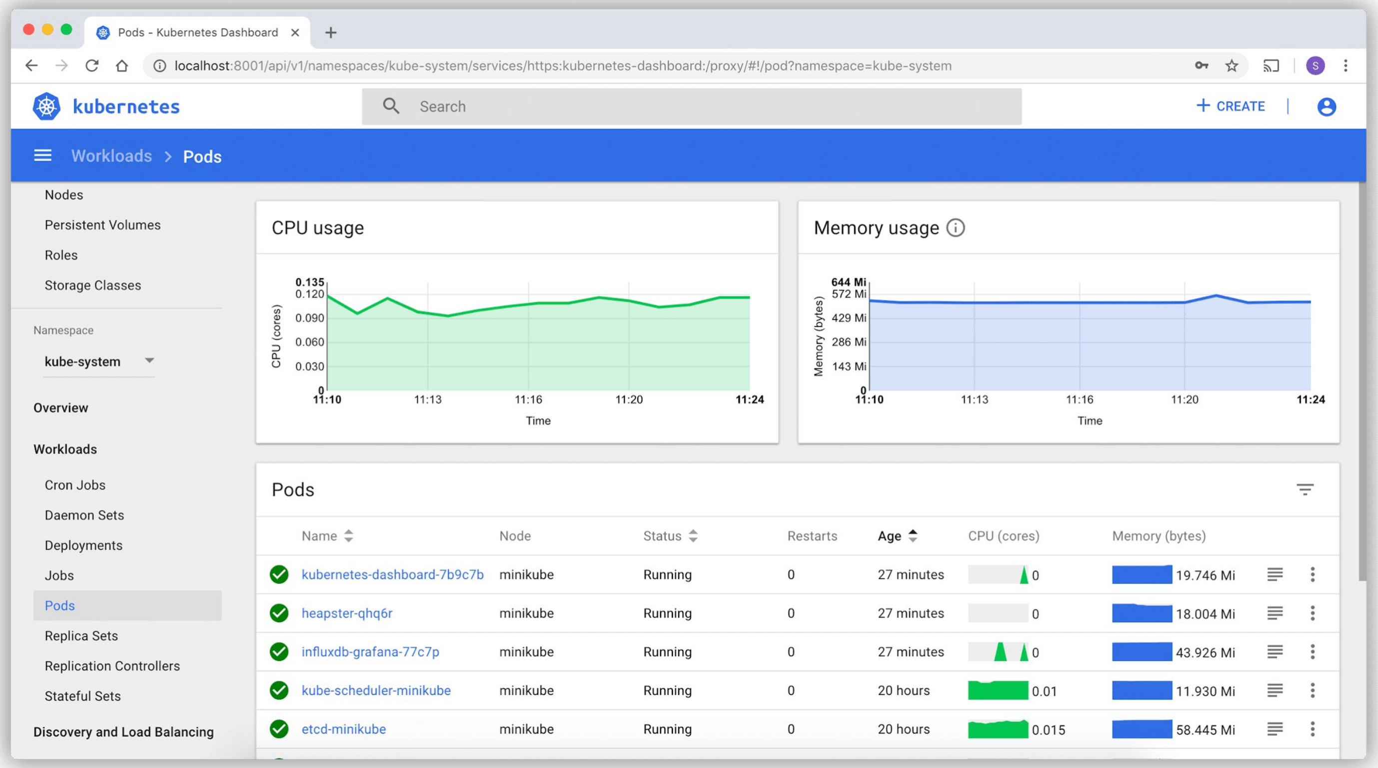
```
#~/bin/move-certificates.sh

#kubeadm join 192.168.4.20:6443 \
      --token ??? \
      --discovery-token-ca-cert-hash sha256:??? \
      --experimental-control-plane
```

# Components Setup: Fixing CoreDNS

```
kubectl get nodes

kubectl get deploy --all-namespaces -o wide

kubectl get deploy coredns -n kube-system -o yaml > coredns.yaml

==========
vi coredns.yaml

replicas: 3

nodeSelector:
  node-role.kubernetes.io/master: ""

==========

kubectl apply -f coredns.yaml -n kube-system

watch -n1 kubectl get pods -n kube-system

kubectl run --rm -it busybox --image=busybox --restart=Never -- bash -
```

# DEMO
# High Availability

# Components Setup: Kubernetes Dashboard



# Components Setup: Kubernetes Dashboard

```
kubectl create -f
https://raw.githubusercontent.com/kubernetes/dashboard/master/aio/deploy/recommended/kubernetes-dashboard.yaml

kubectl get deploy --all-namespaces -o wide

kubectl get deploy kubernetes-dashboard -n kube-system -o wide

kubectl get deploy kubernetes-dashboard -n kube-system -o yaml > kubernetes-dashboard.yaml

==========

vi kubernetes-dashboard.yaml

replicas: 3

nodeSelector:
  node-role.kubernetes.io/master: ""

==========

kubectl apply -f kubernetes-dashboard.yaml -n kube-system

watch -n1 kubectl get pods -n kube-system
```

# Components Setup: Kubernetes Dashboard

```
kubectl create serviceaccount cluster-admin-dashboard -n kube-system

kubectl create clusterrolebinding cluster-admin-dashboard \
      --clusterrole=cluster-admin \
      --serviceaccount=kube-system:cluster-admin-dashboard \
      --dry-run -o yaml -n kube-system

kubectl get secret -n kube-system

kubectl describe secret cluster-admin-dashboard-token-????? -n kube-system

kubectl proxy
```

# DEMO
# Dashboard

# DEMO
# Application

# MetalLB

# Components Setup: Kubernetes MetalLB

*“MetalLB is a load-balancer implementation for bare metal Kubernetes clusters, using standard routing protocols.”*

## ***Why?***

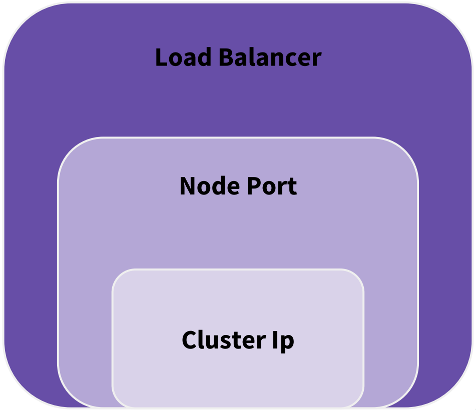
*Kubernetes does not offer an implementation of network load-balancers (Services of type LoadBalancer) for bare metal clusters. The implementations of Network LB that Kubernetes does ship with are all glue code that calls out to various IaaS platforms (GCP, AWS, Azure…). If you’re not running on a supported IaaS platform (GCP, AWS, Azure…), Load Balancers will remain in the “pending” state indefinitely when created.*

# Components Setup: Kubernetes Service

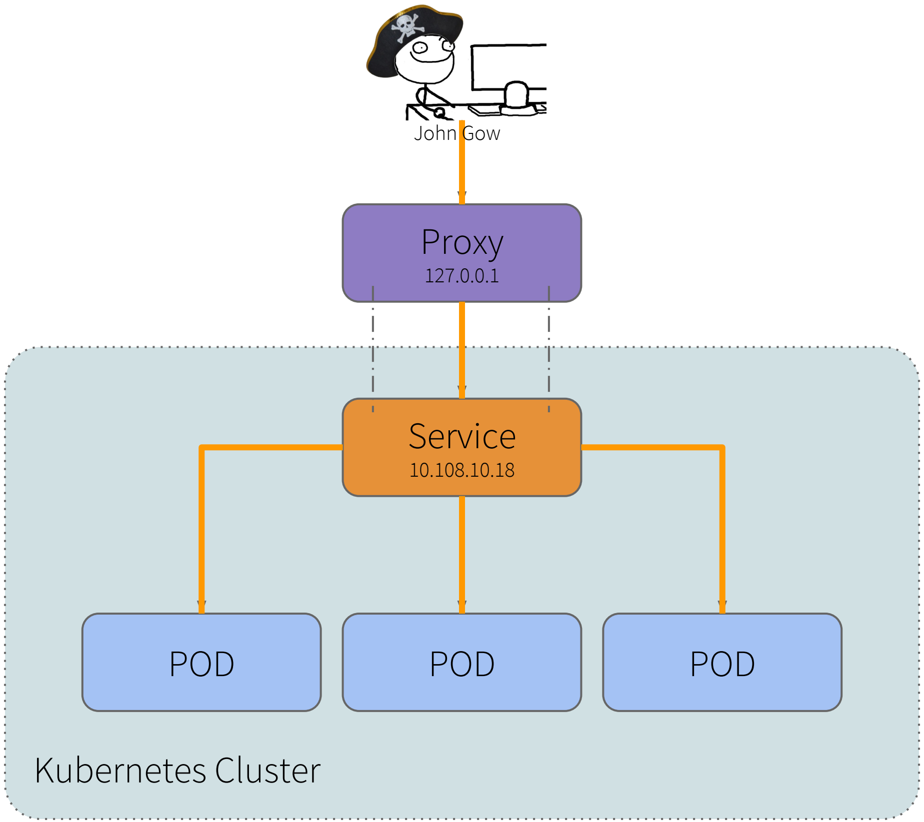
- **ClusterIP**: Exposes the service on a cluster-internal IP. Choosing this value makes the service only reachable from within the cluster. This is the default ServiceType.

- **NodePort**: Exposes the service on each Node’s IP at a static port (the NodePort). A ClusterIP service, to which the NodePort service will route, is automatically created. You’ll be able to contact the NodePort service, from outside the cluster, by requesting <NodeIP>:<NodePort>.

- **LoadBalancer**: Exposes the service externally using a cloud provider’s load balancer. NodePort and ClusterIP services, to which the external load balancer will route, are automatically created.

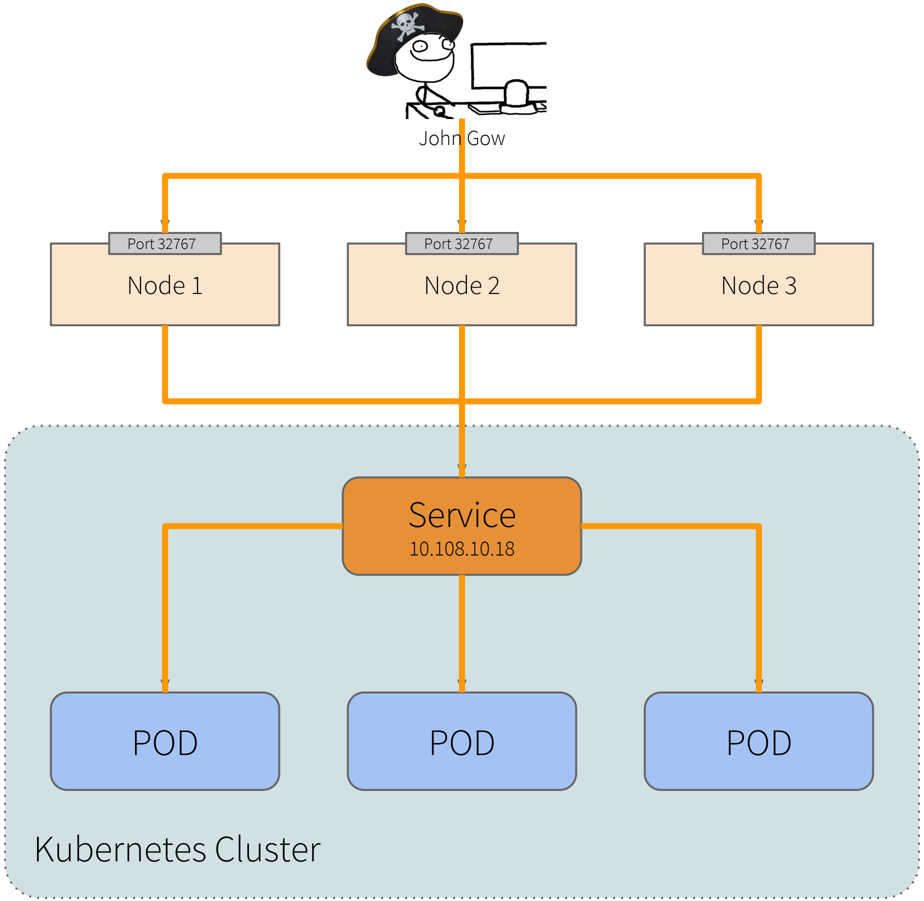


# Components Setup: Kubernetes Service ClusterIP



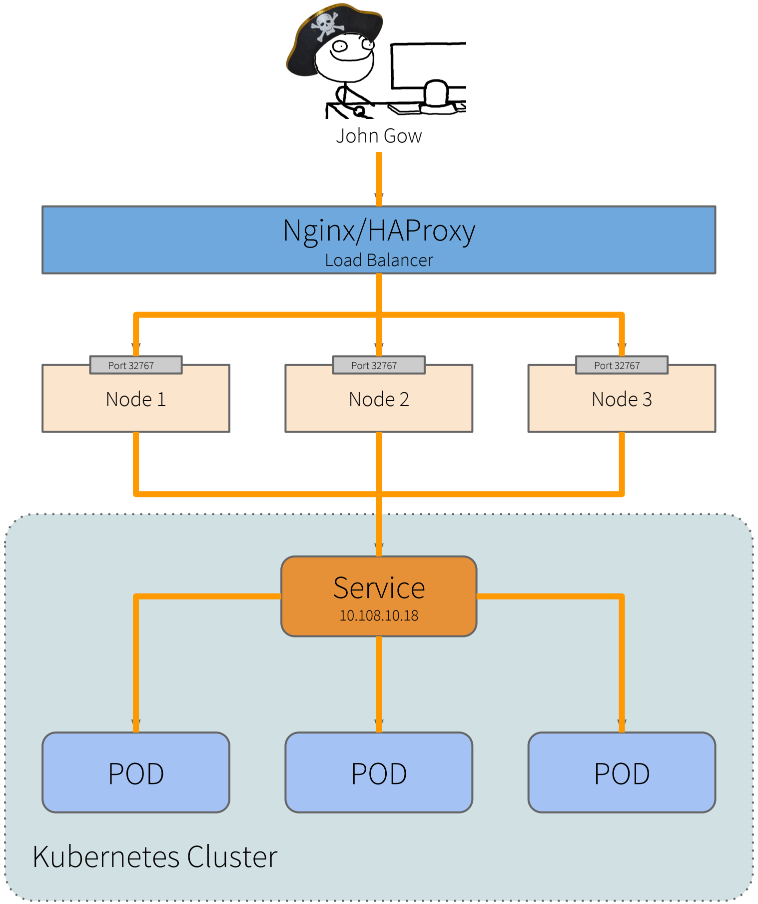

```yaml
apiVersion: v1
kind: Service
metadata:
  name: clusterip-service
spec:
  selector:
    app: my-super-app
  type: ClusterIP
  ports:
  - name: http
    port: 80
    targetPort: 80
    protocol: TCP
```

# Components Setup: Kubernetes Service NodePort



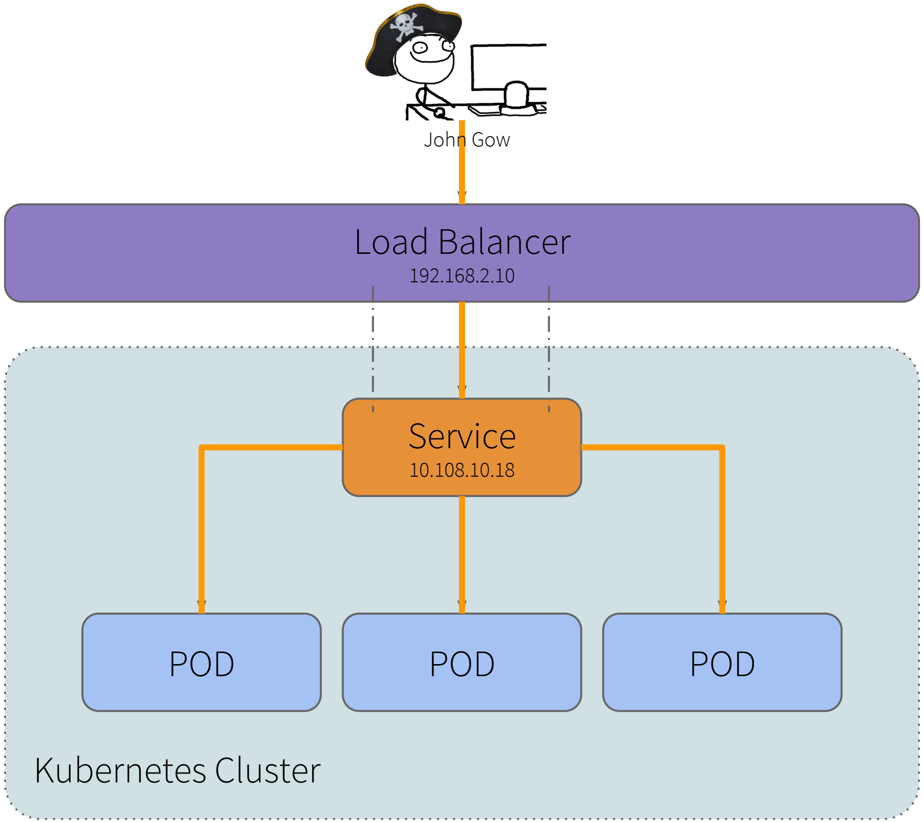

```yaml
apiVersion: v1
kind: Service
metadata:
  name: nodeport-service
spec:
  selector:
    app: my-super-app
  type: NodePort
  ports:
  - name: http
    port: 80
    targetPort: 80
    nodePort: 32767
    protocol: TCP
```

# Components Setup: Kubernetes Service NodePort (extra infra)




```yaml
apiVersion: v1
kind: Service
metadata:
  name: nodeport-service
spec:
  selector:
    app: my-super-app
  type: NodePort
  ports:
  - name: http
    port: 80
    targetPort: 80
    nodePort: 32767
    protocol: TCP
```

# Components Setup: Kubernetes Service LoadBalancer




```yaml
apiVersion: v1
kind: Service
metadata:
  name: load-balancer-service
spec:
  selector:
    app: my-super-app
  type: LoadBalancer
  ports:
  - name: http
    port: 80
    targetPort: 80
    protocol: TCP
```

# Components Setup: Kubernetes MetalLB

```
kubectl apply -f
https://raw.githubusercontent.com/google/metallb/v0.7.3/manifests/metallb.yaml

kubectl get deploy --all-namespaces -o wide

kubectl get deploy controller -n metallb-system -o wide

kubectl get deploy controller -n metallb-system -o yaml > controller.yaml

=================
vi ~/controller.yaml

replicas: 3

tolerations:
- effect: NoSchedule
  key: node-role.kubernetes.io/master
nodeSelector:
  node-role.kubernetes.io/master: ""
=================

kubectl apply -f ~/controller.yaml -n metallb-system
```

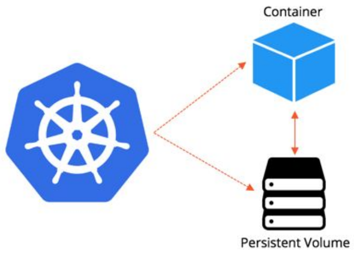
# Components Setup: Kubernetes MetalLB

```
vi metallb-configmap.yaml
---
apiVersion: v1
kind: ConfigMap
metadata:
  namespace: metallb-system
  name: config
data:
  config: |
    address-pools:
    - name: default
      protocol: layer2
      addresses:
      - 192.168.2.10-192.168.2.49
=================

kubectl apply -f metallb-configmap.yaml -n metallb-system

kubectl get configmap -n metallb-system -o wide

watch -n1 kubectl get pods -n metallb-system
```

# DEMO
# Load balancer

# Kubernetes Volumes

# Kubernetes Volumes




- **Filesystem**
  In Kubernetes, each container can read and write in its own **filesystem**. But the data written into this filesystem is destroyed when the container is restarted or removed.

- **Volume**
  Kubernetes has **volumes**. Volumes that are in a POD will exist as long as the POD exists. Volumes can be shared among the same POD containers. When a POD is restarted or removed the volume is destroyed.

- **Persistent Volume**
  The Kubernetes has **persistent volumes**. Persistent volumes are long-term stores within the Kubernetes cluster. Persistent volumes go beyond containers, PODs, and nodes, they exist as long as the Kubernetes cluster exists. A POD claims the use of a persistent volume for reading or writing or for reading and writing.

| Type | How long? |
| --- | --- |
| Filesystem | Container lifetime |
| Volume | Pod lifetime |
| Persistent Volume | Cluster lifetime |

# GlusterFS

# Components Setup: GlusterFS

Resource that will be responsible for the availability of the service of storage of dynamic volumes requested by **Kubernetes**.

# Components Setup: GlusterFS volume types

- **Distributed** - Distributed volumes distribute files across the bricks in the volume. You can use distributed volumes where the requirement is to scale storage and the redundancy is either not important or is provided by other hardware/software layers.

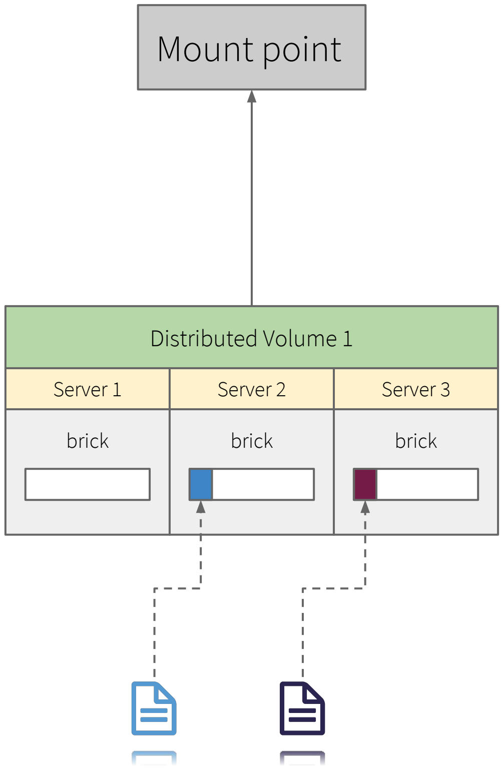
- **Replicated** - Replicated volumes replicate files across bricks in the volume. You can use replicated volumes in environments where high-availability and high-reliability are critical.

- **Distributed Replicated** - Distributed replicated volumes distribute files across replicated bricks in the volume. You can use distributed replicated volumes in environments where the requirement is to scale storage and high-reliability is critical. Distributed replicated volumes also offer improved read performance in most environments.

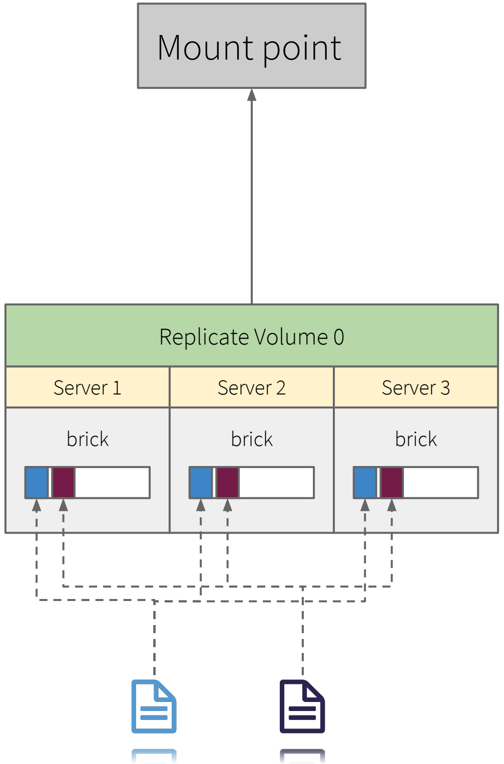
- **Dispersed** - Dispersed volumes are based on erasure codes, providing space-efficient protection against disk or server failures. It stores an encoded fragment of the original file to each brick in a way that only a subset of the fragments is needed to recover the original file. The number of bricks that can be missing without losing access to data is configured by the administrator on volume creation time.

- **Distributed Dispersed** - Distributed dispersed volumes distribute files across dispersed subvolumes. This has the same advantages of distribute replicate volumes, but using disperse to store the data into the bricks.

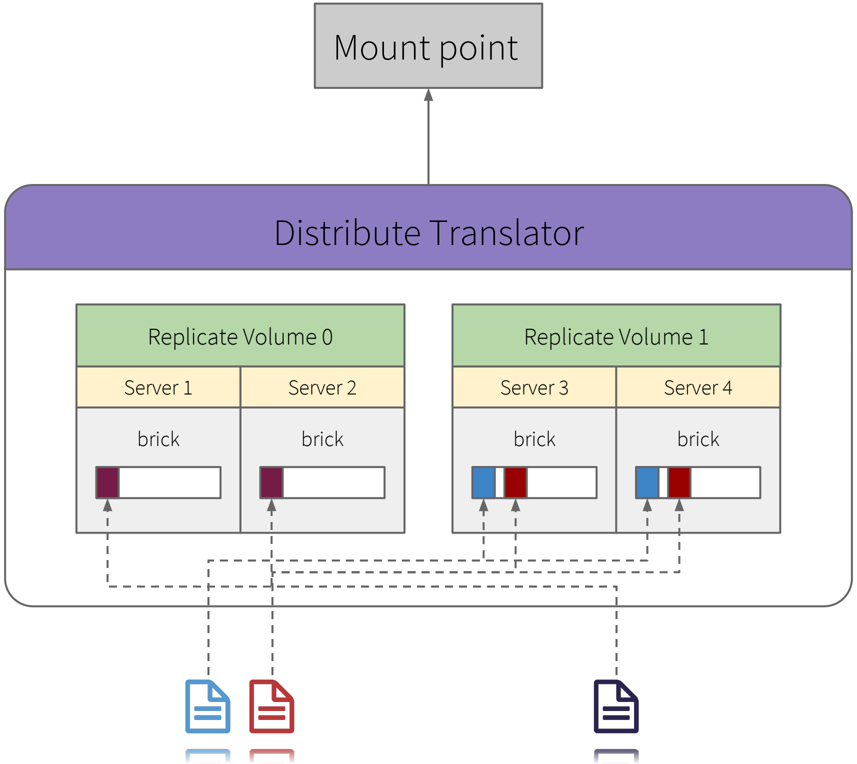
# Components Setup: Distributed Volume



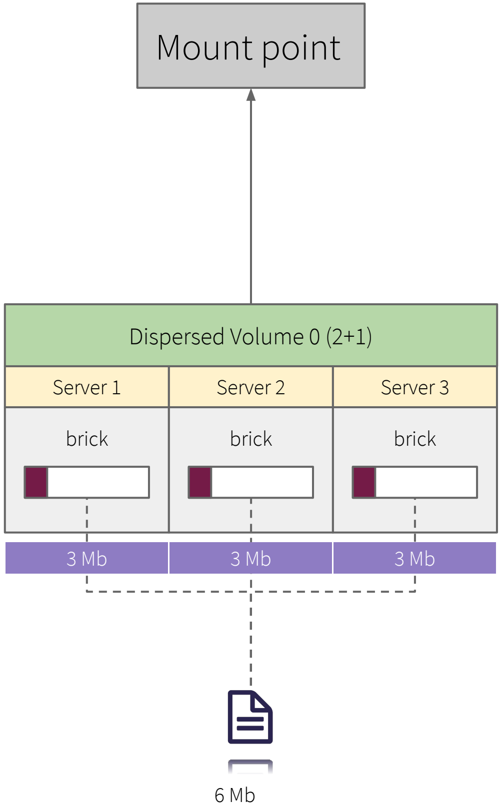
# Components Setup: Replicated Volume



# Components Setup: Distributed Replicated Volume



# Components Setup: Dispersed Volume

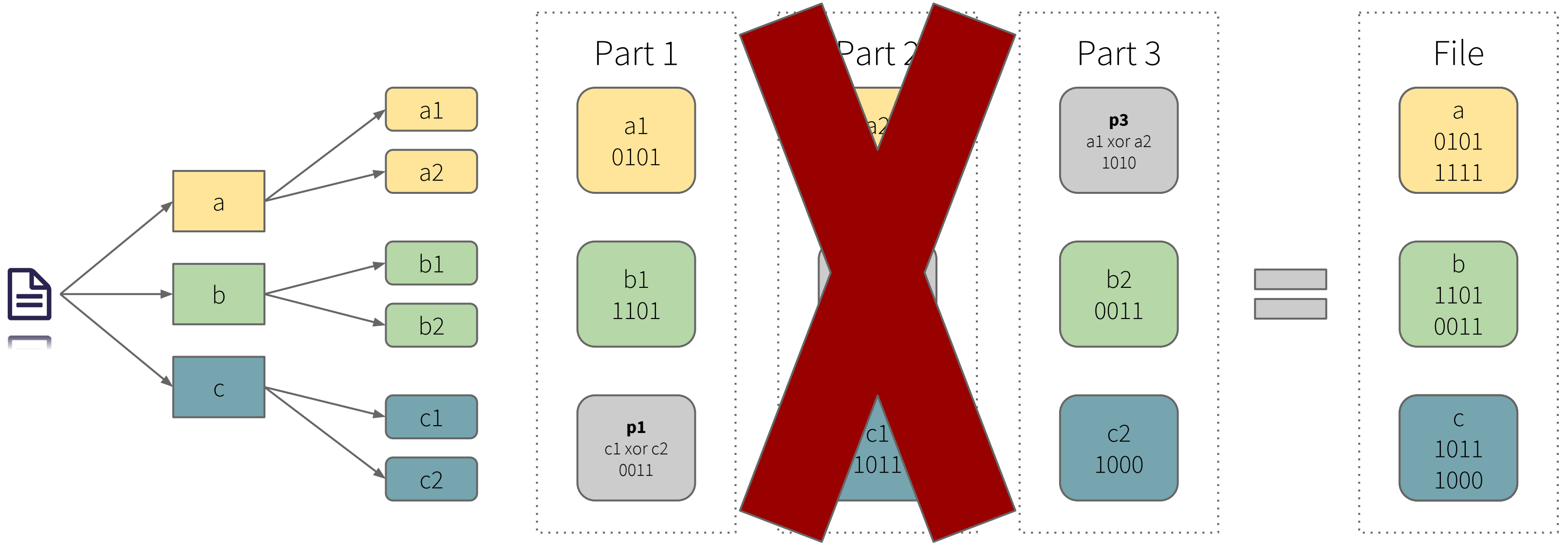



**Erasure coding (EC)** is a data protection and storage process through which a data object is separated into smaller components/fragments and each of those fragments is encoded with redundant data padding. EC transforms data object fragments into larger fragments and uses the primary data object identifier to recover each fragment.

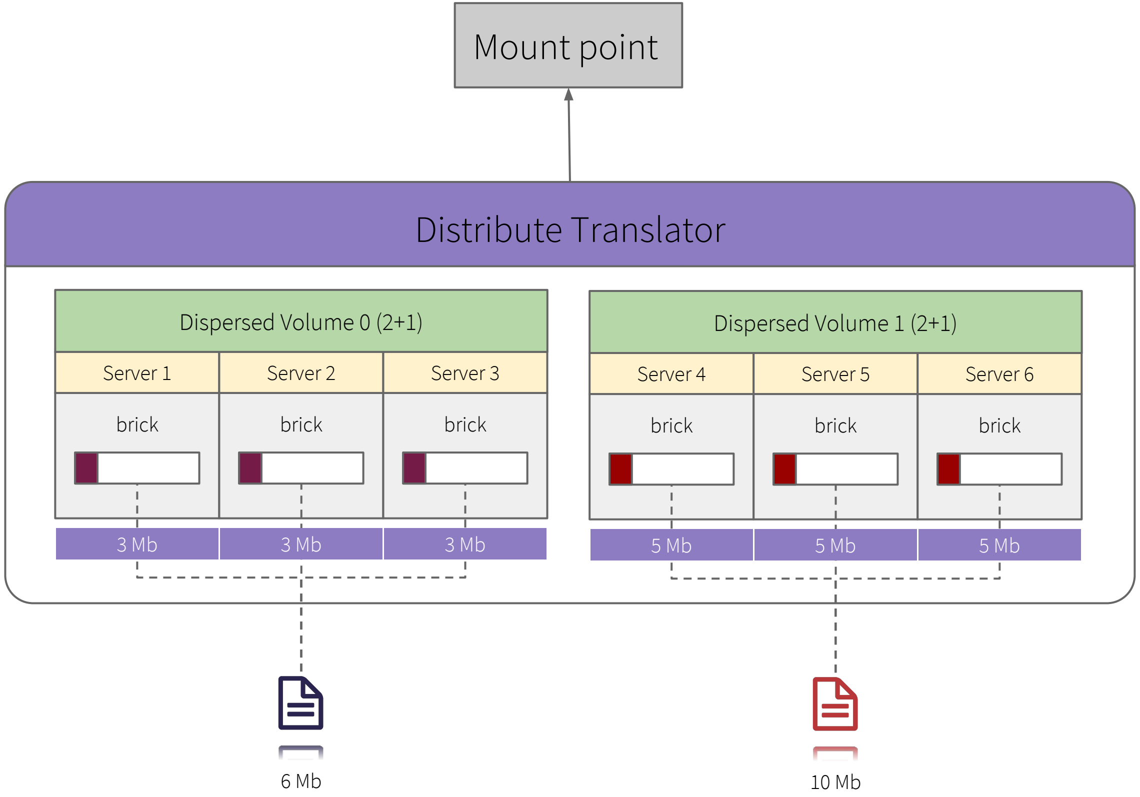
Erasure coding is also known as **forward error correction (FEC)**.

Erasure coding is primarily used in applications that have a low tolerance for data errors. This includes most data backup services and technologies including disk arrays, object-based cloud storage, archival storage and distributed data applications.

# Components Setup: EC (2+1) redundancy level 1

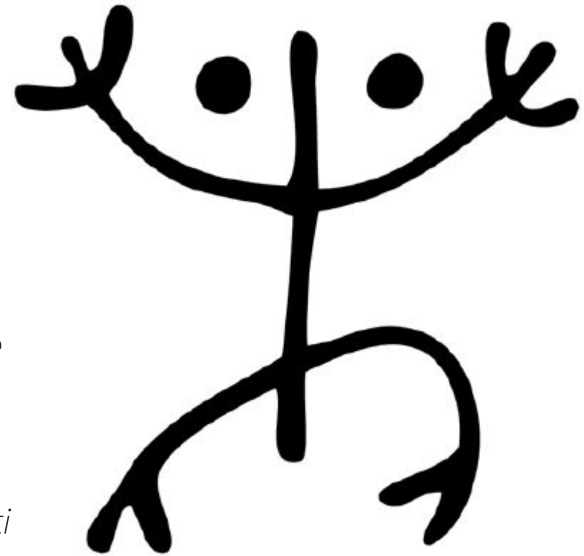


# Components Setup: Distributed Dispersed Volume



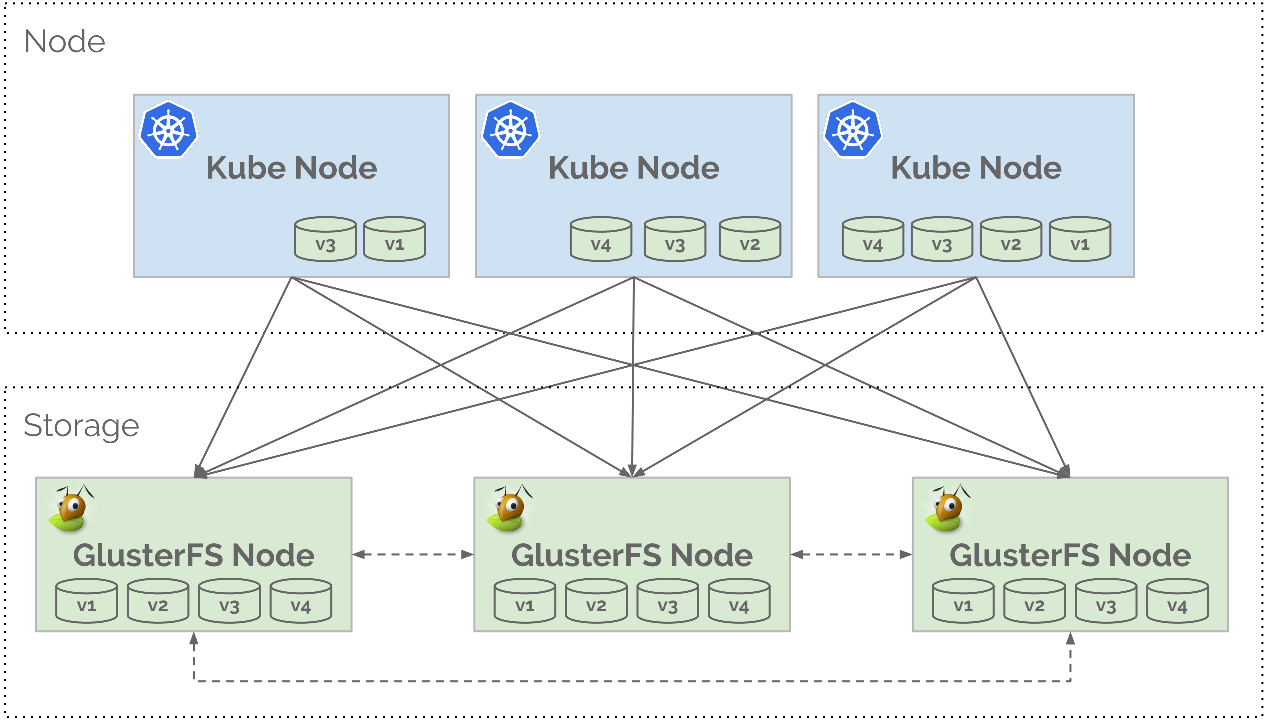
# Heketi

# Components Setup: Heketi

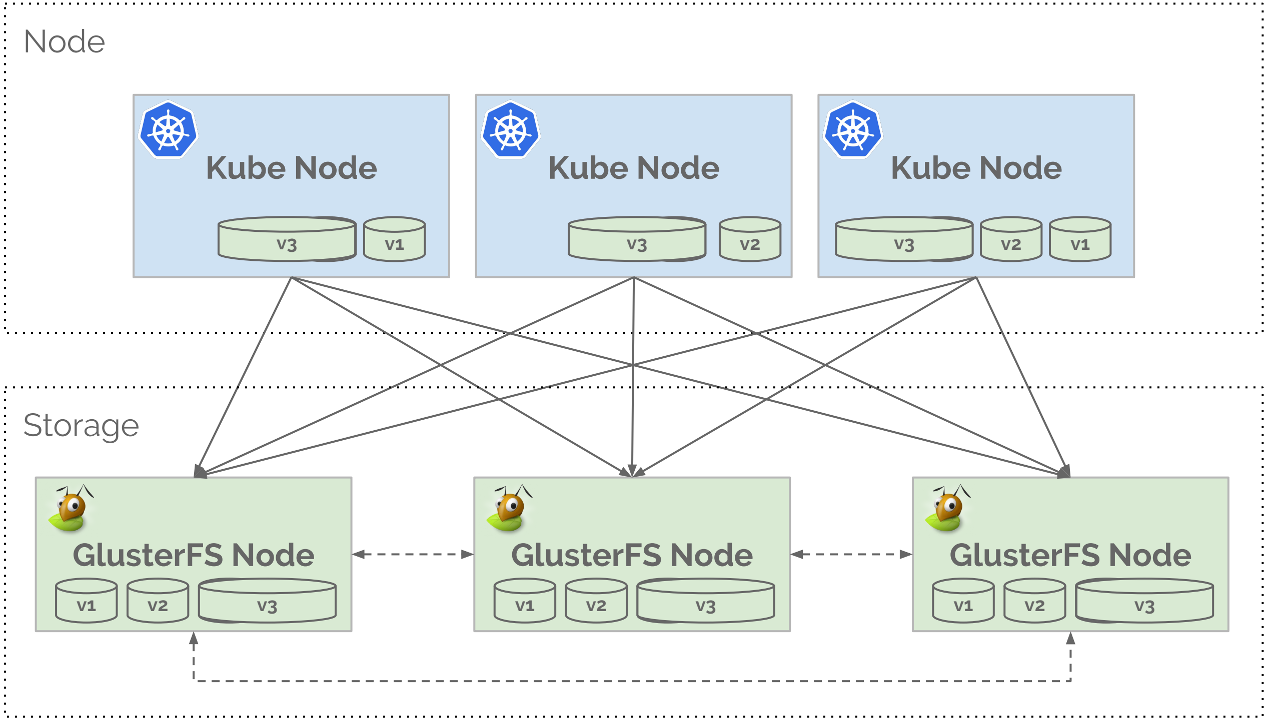


*"Heketi provides a RESTful management interface which can be used to manage the life cycle of GlusterFS volumes. With Heketi, cloud services like OpenStack Manila, Kubernetes, and OpenShift can dynamically provision GlusterFS volumes with any of the supported durability types. Heketi will automatically determine the location for bricks across the cluster, making sure to place bricks and its replicas across different failure domains. Heketi also supports any number of GlusterFS clusters, allowing cloud services to provide network file storage without being limited to a single GlusterFS cluster."*

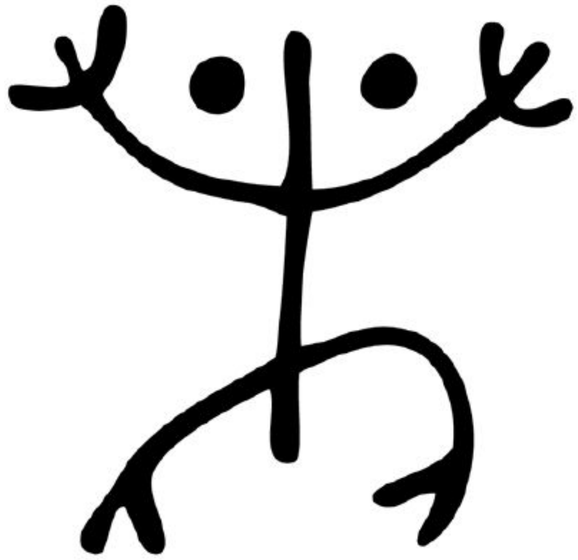
# Components Setup: Create Volume



# Components Setup: Expand Volume



# Components Setup: Heketi



```
git clone git@github.com:gluster/gluster-kubernetes.git

cd deploy

vi topology

kubectl create namespace glusterfs

./gk-deploy --ssh-keyfile ~/.ssh/id_rsa --ssh-user root --cli kubectl \
        --templates_dir ./kube-templates --namespace glusterfs \
        topology.json

==================
vi glusterfs-storageclass.yaml

---
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: glusterfs-storage
  namespace: glusterfs
provisioner: kubernetes.io/glusterfs
allowVolumeExpansion: true
reclaimPolicy: Retain
parameters:
  resturl: "http://10.244.xxx.xxx:8080"
  restuser: "admin"
  restuserkey: "none"
  volumetype: "replicate:3"
==================

kubectl create -f glusterfs-storageclass.yaml
```

# DEMO

# Volumes

# Questions?

*“Any fool can write code that a computer can understand. Good programmers write code that humans can understand.”*

***Martin Fowler***

# References


- **NAT** - https://en.wikipedia.org/wiki/Network_address_translation
- **DNS** - https://en.wikipedia.org/wiki/Domain_Name_System
- **DHCP** - https://en.wikipedia.org/wiki/Dynamic_Host_Configuration_Protocol
- **cloud-init** - https://cloudinit.readthedocs.io/en/latest/
- **dnsmasq** - http://www.thekelleys.org.uk/dnsmasq/doc.html
- **corosync** - http://corosync.github.io/corosync/
- **pacemaker** - https://clusterlabs.org/
- **HAProxy** - http://www.haproxy.org/
- **Docker** - https://docs.docker.com/
- **GlusterFS** - https://docs.gluster.org/en/latest/
- **XFS** - http://xfs.org/index.php/Main_Page
- **LVM** - http://www.sourceware.org/lvm2/
- **VirtualBox** - https://www.virtualbox.org/
- **Debian** - https://www.debian.org/
- **Kubernetes** - https://kubernetes.io/
- **Flannel** - https://github.com/coreos/flannel
- **CoreDNS** - https://github.com/coredns/coredns
- **MetalLB** - https://metallb.universe.tf/
- **Heketi** - https://github.com/heketi/heketi

# Thank you!