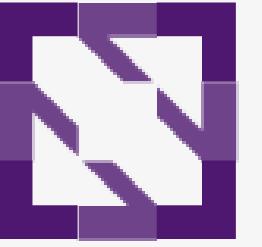


# Service via BGP with Calico and MetalLB



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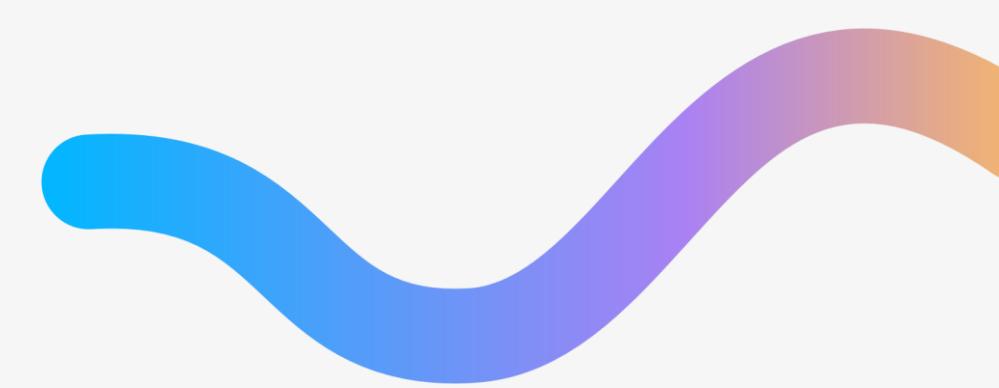


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# About Us

Service via BGP with  
Calico and MetalLB



**Francesco Grimaldi**  
*Team Leader & Trainer*



**Evangelista Tragni**  
*Manager AI Team &  
Authorized Instructor*





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- Service via BGP (Border Gateway Protocol)
- Deploy and Expose the Application



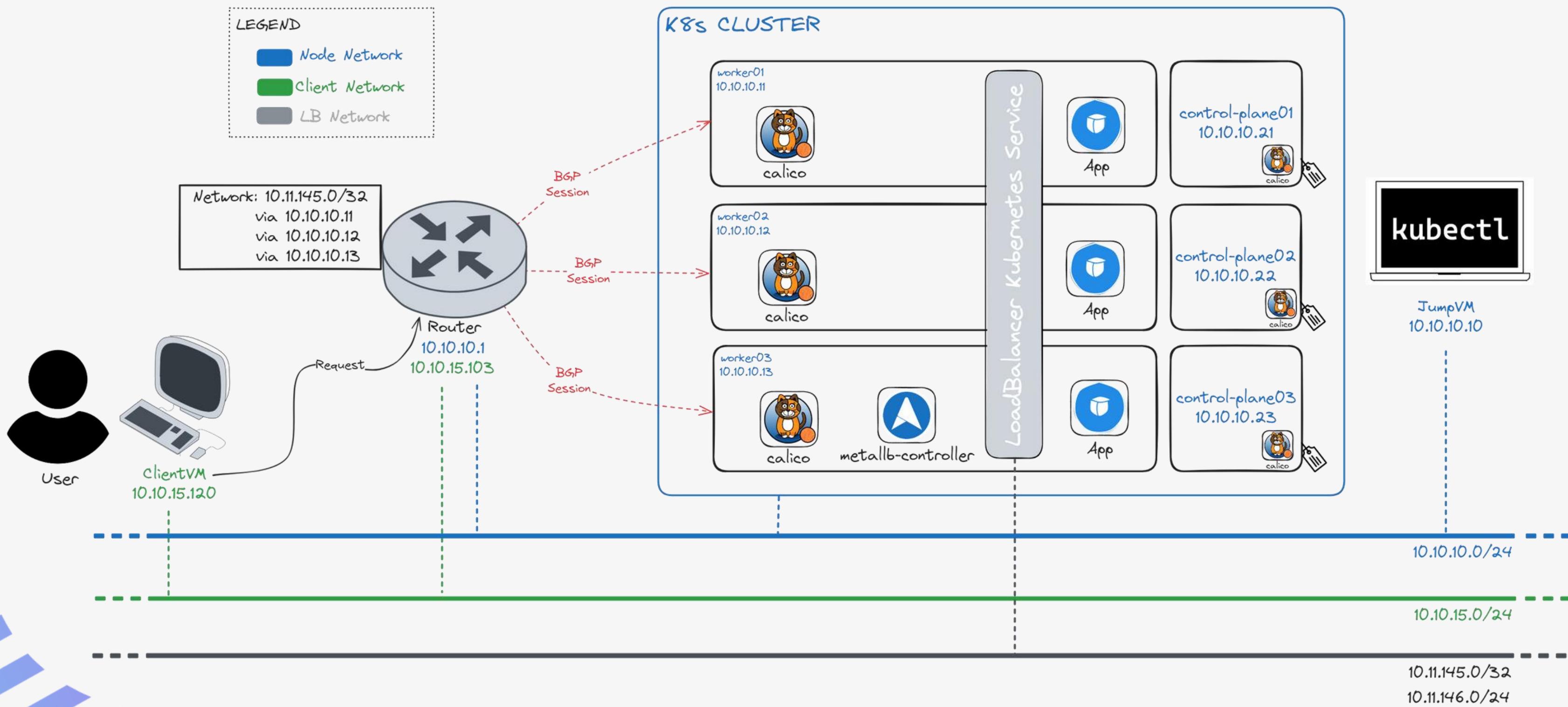
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# Final Architecture





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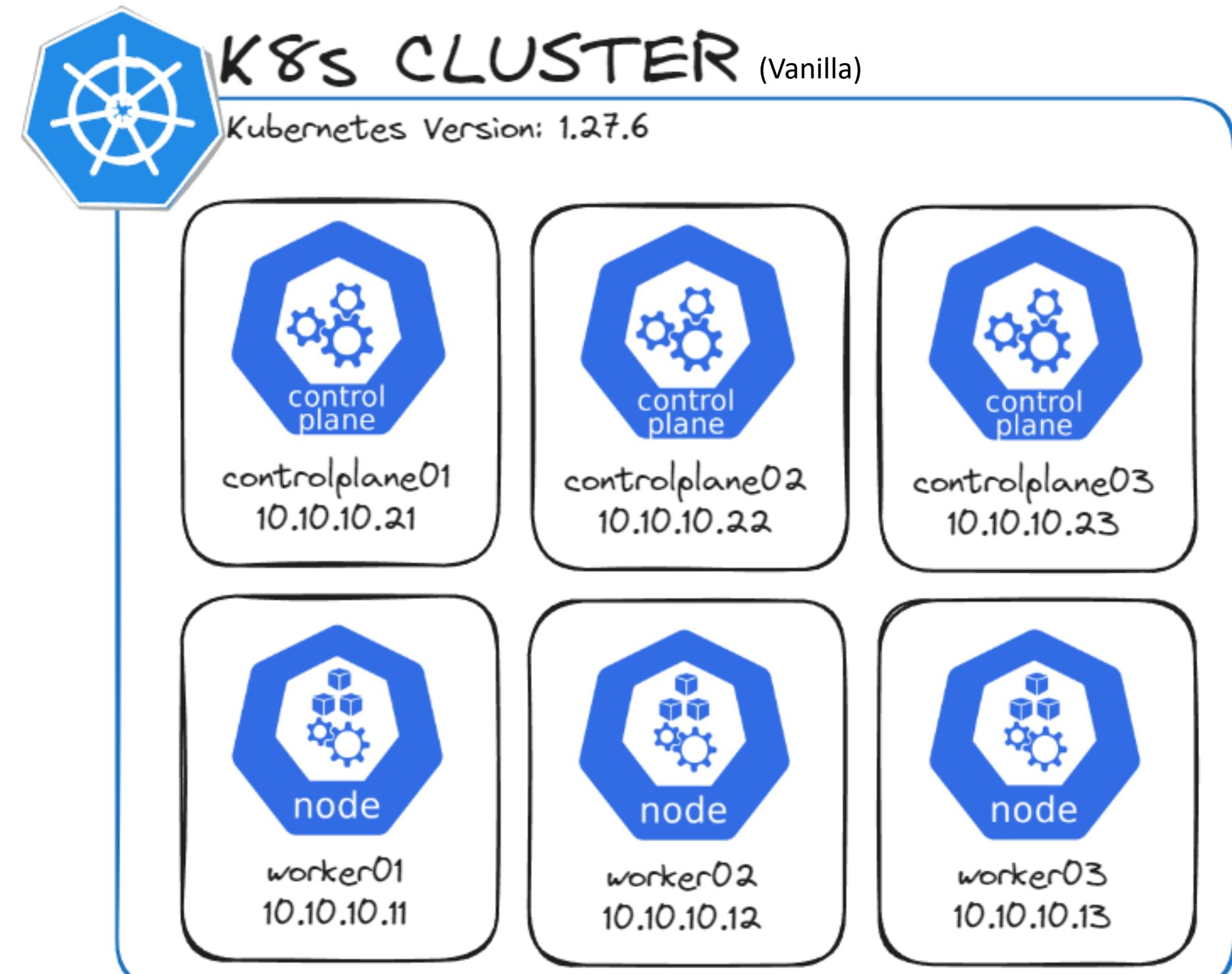
# Before Starting

A horizontal bar consisting of two overlapping rounded rectangles, one purple and one blue.

# K8S Cluster Review

## Cluster Specs

- Bootstrapped with kubeadm
- Nodes as virtual machine
- ContainerD as CR
- Calico as CNI





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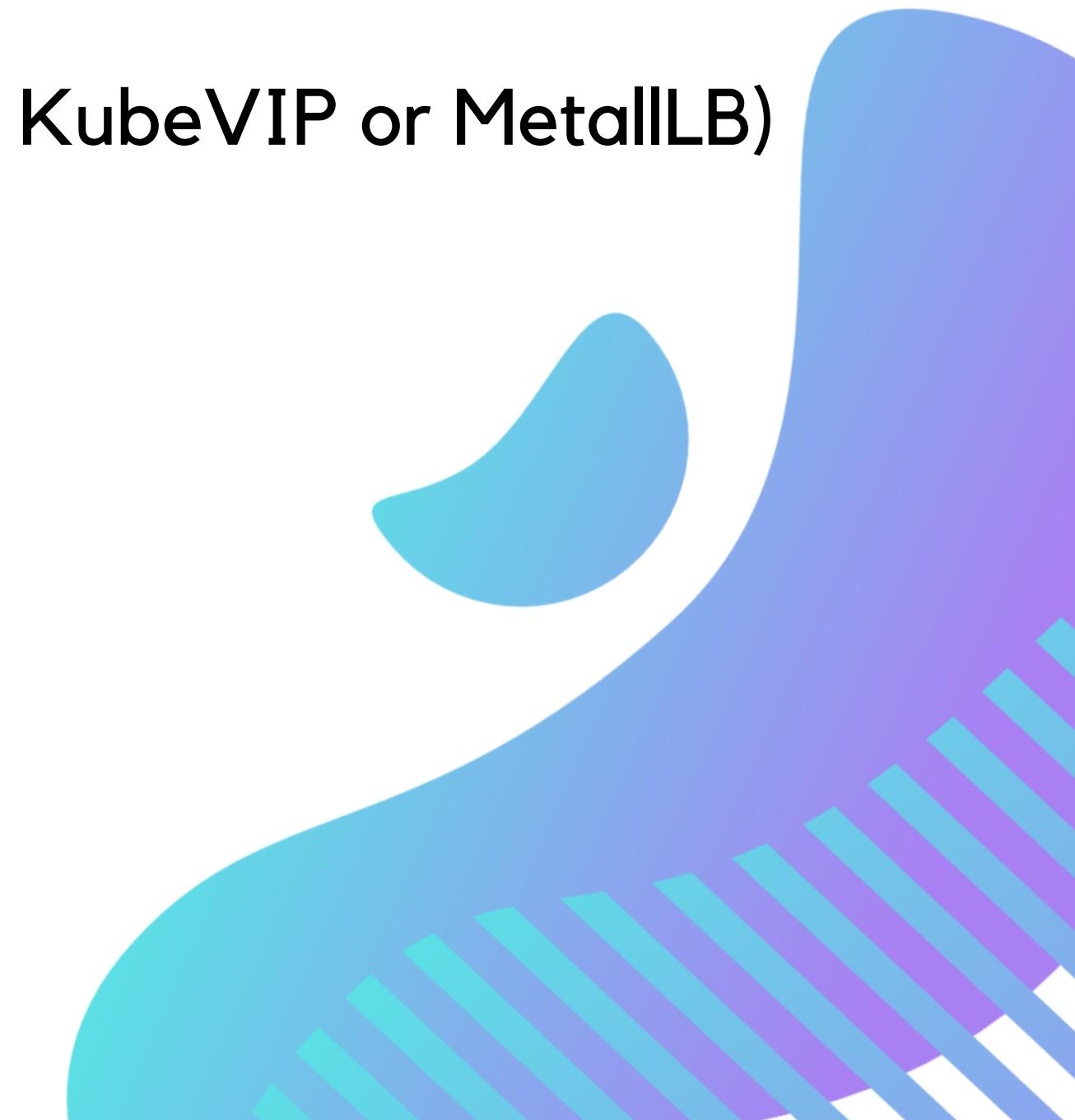


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# Service LB on K8S vanilla

- Not supported out of the box
- Needs extra component LoadBalancer solution (like: KubeVIP or MetallLB)
- Better than classic NodePort svc
- Can work in Layer2 mode or BGP





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# L2 Mode or BGP?

## Layer 2 mode

### Pros:

- Easy to install, no complex config
- Pretty Universal solution, no need of special network devices
- Fast to implement

### Cons:

- Some networks can be G-ARP hostile
- Not a real load balancing, node bottleneck
- Problems with updating arp cache of underlying network devices
- Can occurs problem during leader election, possible downtime





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# BGP is the right way?



## LET'S FIND OUT



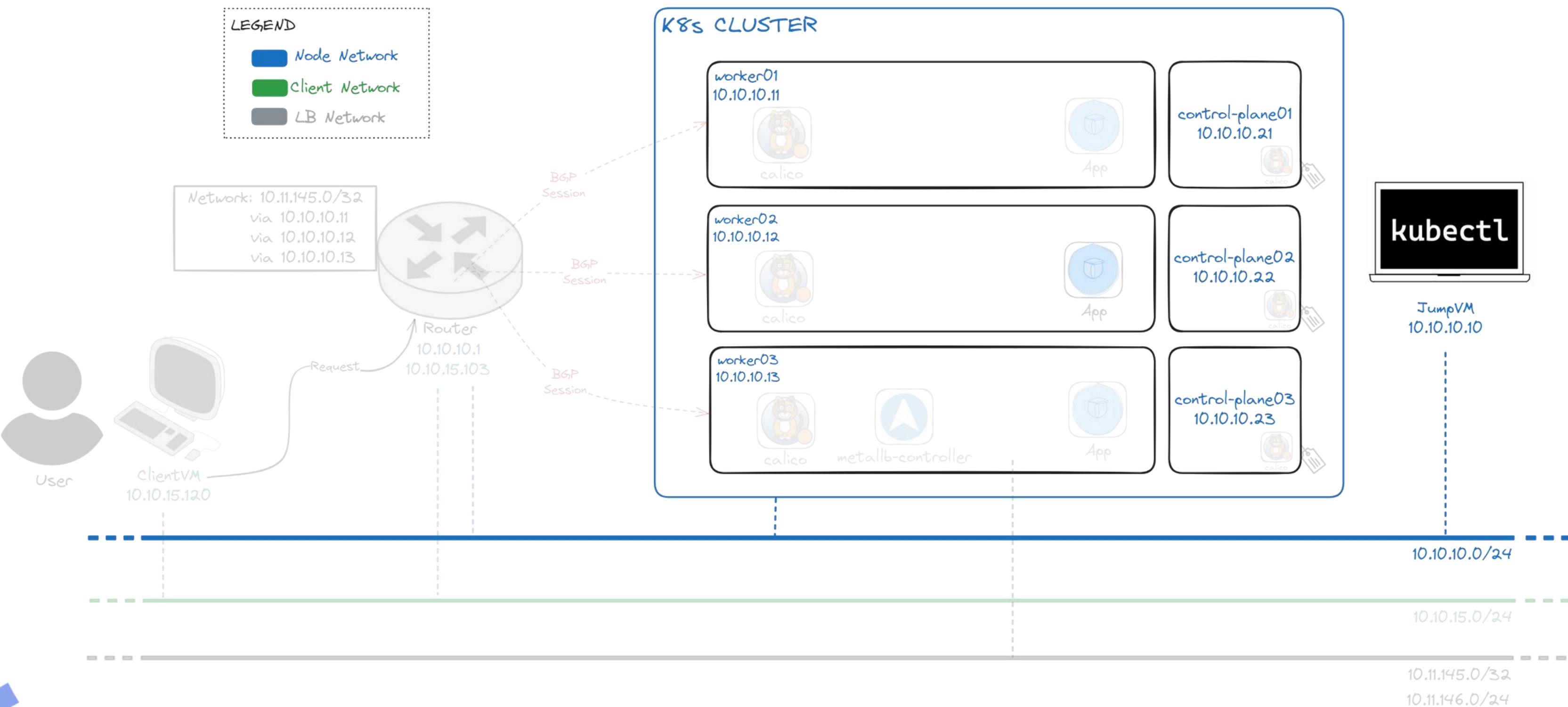
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# Quick Recap





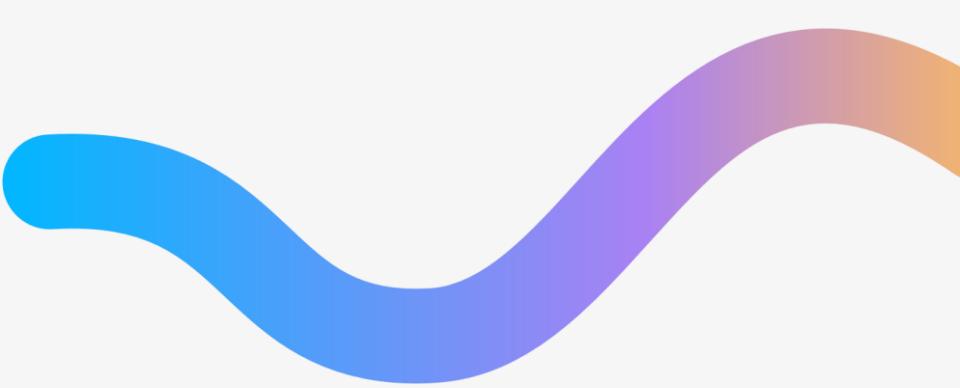
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# Calico as CNI (Container Network Interface)





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# Calico Project

Enables better utilization of node resources and a simple but powerful network stack for the infrastructure

It uses 3-layer based routing, route distribution via BGP, and implements policy-based network security via iptable rules



PROJECT  
**CALICO**



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# Calico Components

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Each orchestrator has its own plugin mechanism, but the overall architecture remains the same

- Plugin
- Global State
- Calicoctl CLI
- Calico Felix Agent

## Calico Routing Agent

---

responsible for managing  
the routing and forwarding  
of network traffic in a K8s  
cluster



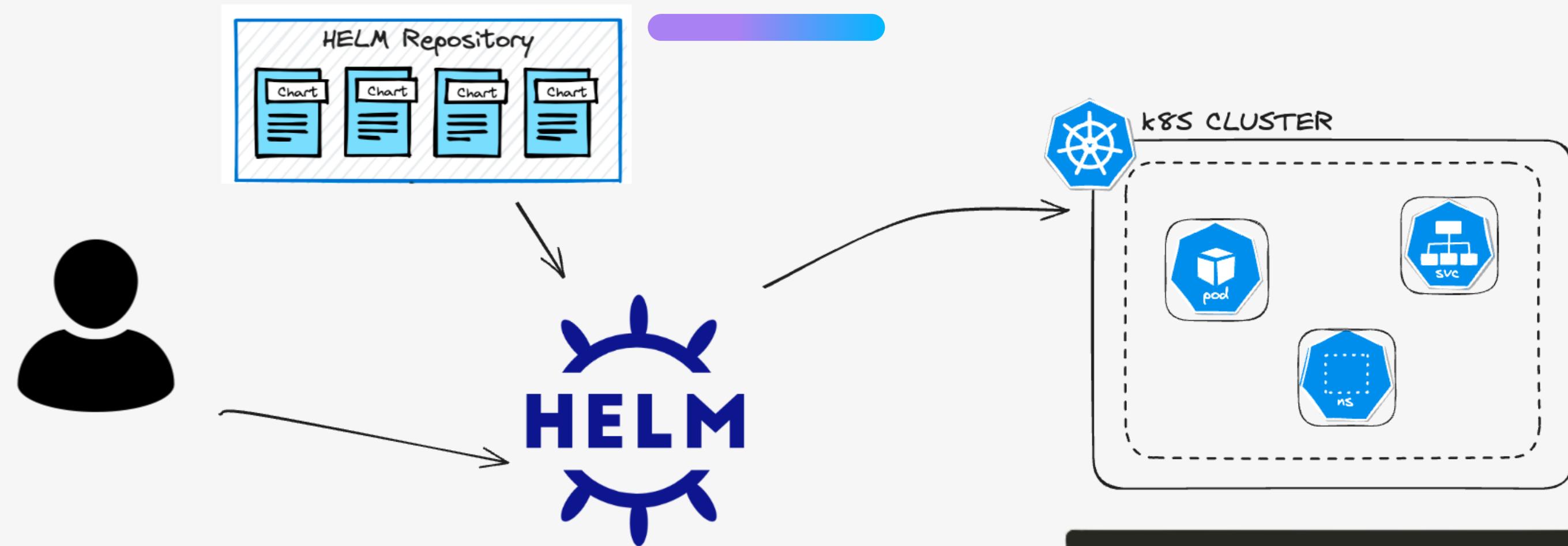
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# YAML



```
1 helm install calico projectcalico/tigera-operator -f calico-values.yaml
```

```
1 installation:
2   cni:
3     type: Calico
4   calicoNetwork:
5     bgp: Enabled
6     ipPools:
7       - cidr: "10.244.0.0/16"
8         encapsulation: VXLAN
```



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# Demo

```
student@jumpVM:~$ kubectl get nodes
NAME           STATUS    ROLES      AGE   VERSION
controlplane01  NotReady control-plane 27m   v1.27.6
controlplane02  NotReady control-plane 26m   v1.27.6
controlplane03  NotReady control-plane 26m   v1.27.6
worker01        NotReady <none>     25m   v1.27.6
worker02        NotReady <none>     25m   v1.27.6
worker03        NotReady <none>     25m   v1.27.6
student@jumpVM:~$ 
```



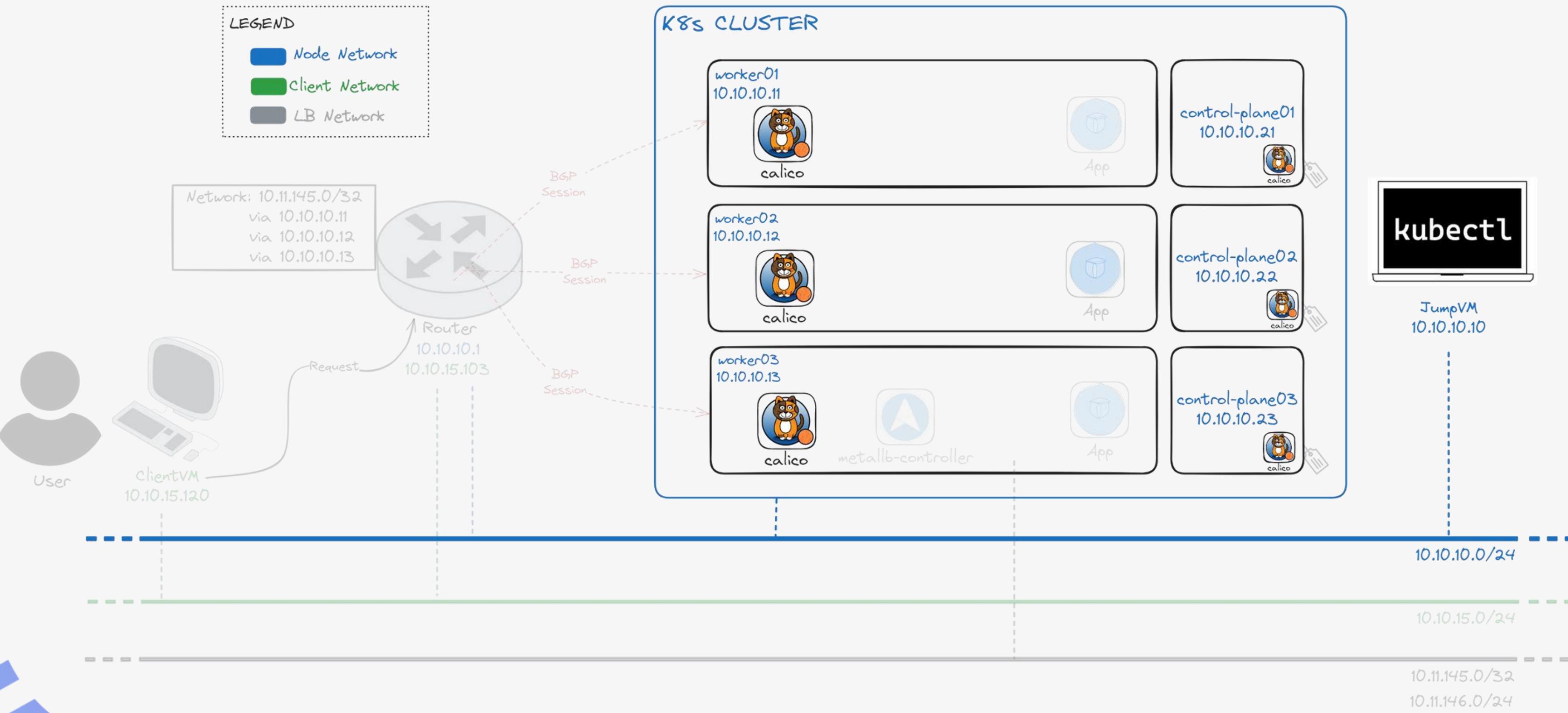
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# Quick Recap





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# LoadBalancer Service

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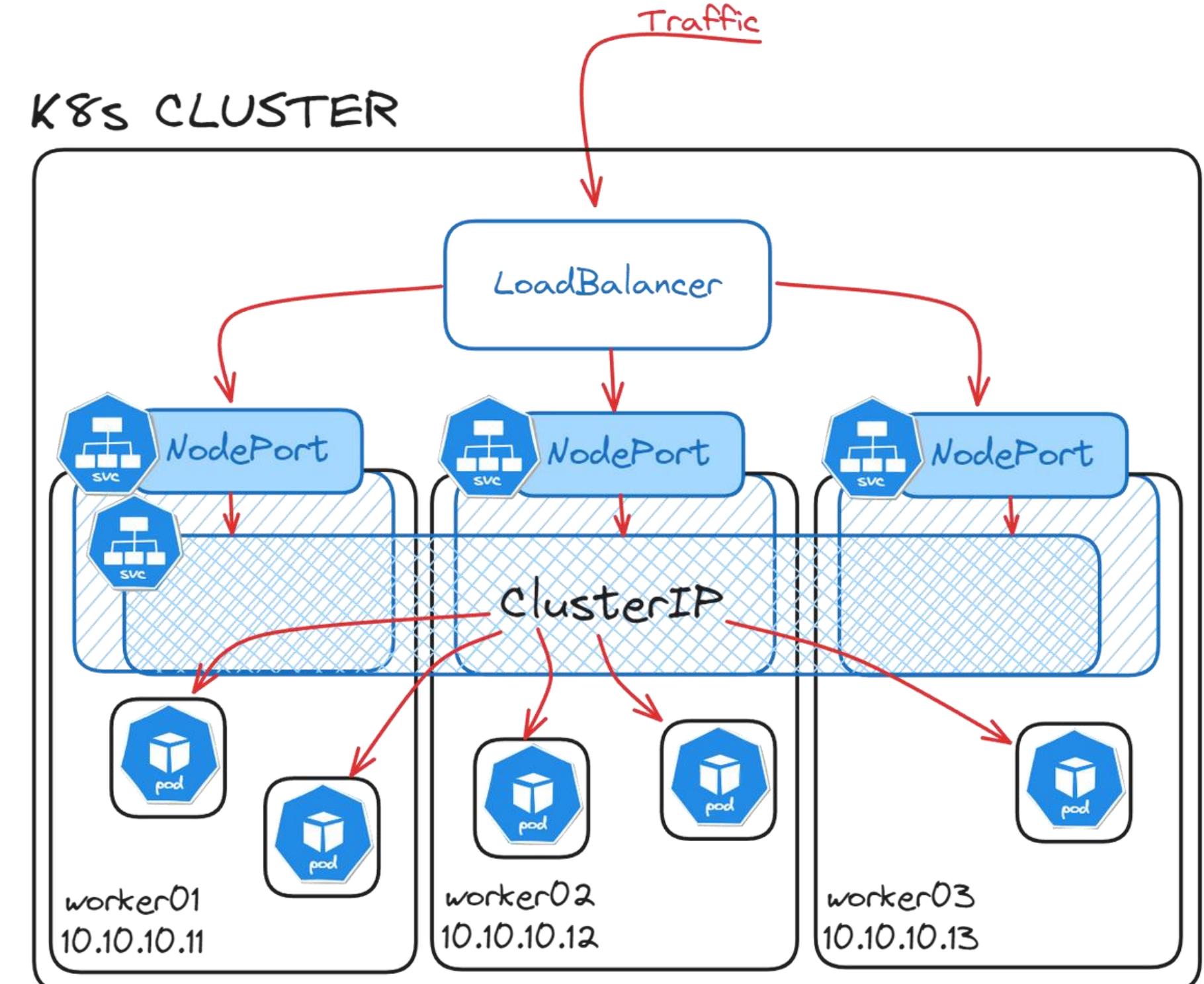


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# LoadBalancer

In k8s "LoadBalancer" is a type of service that allows external traffic to be load balanced across multiple pods in a cluster





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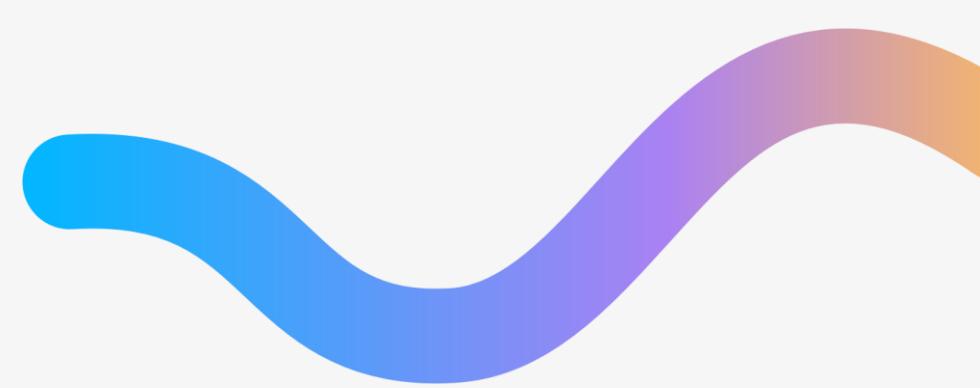
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# MetalLB Load Balancer for Bare Metal

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## MetalLB





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# MetallB



Offers a network load balancer implementation that integrates with standard network equipment so that external services on bare-metal clusters also "work"

It provides exceptional reliability, supports Layer 2 and BGP modes, and offers high scalability and customization to meet specific needs



## MetallB

MetalLB is a young project.  
You should treat it as a beta system.



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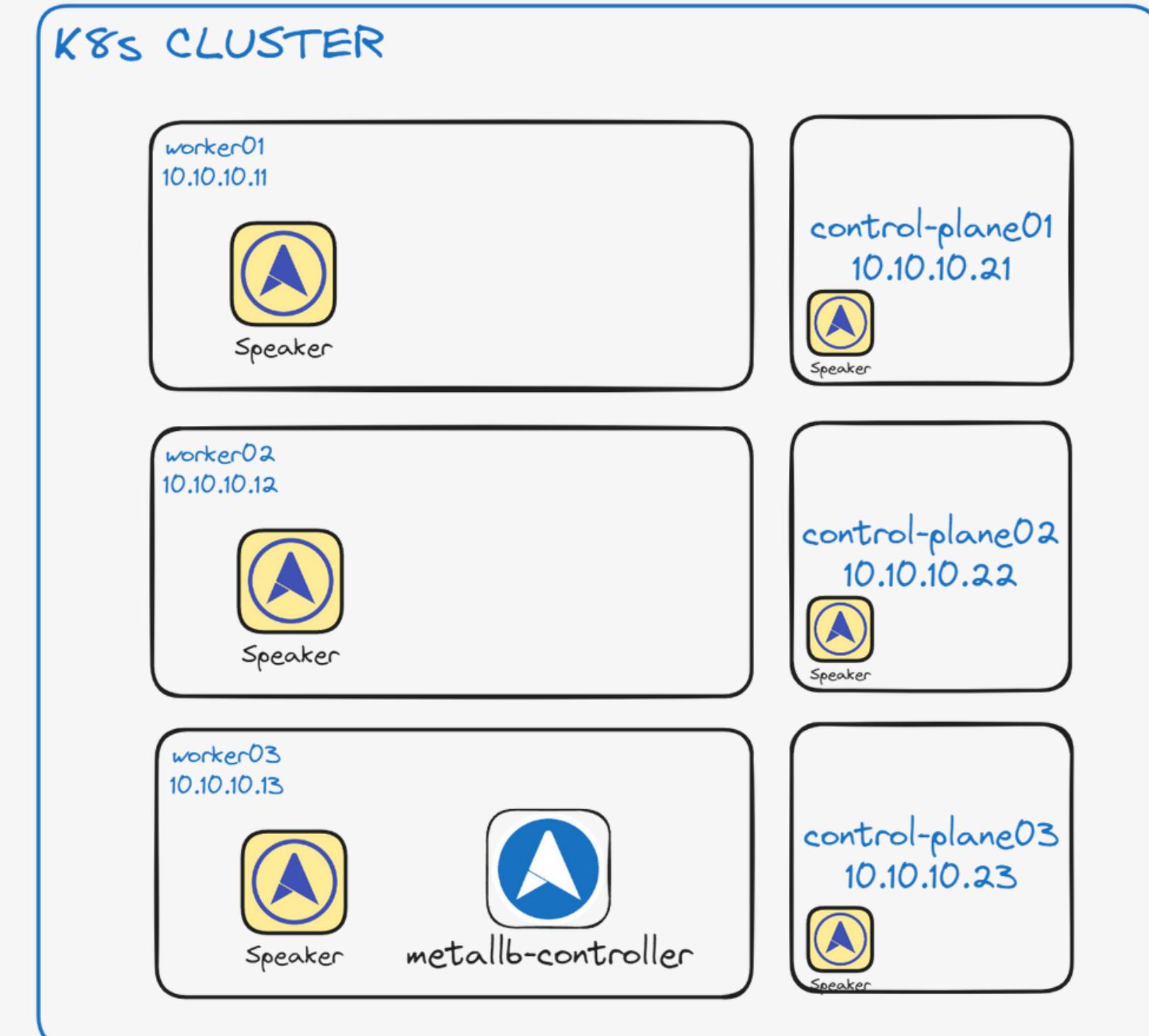


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# MetalLB Components

- Controller (Single Instance)
- Speaker (One per Node)





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# Our MetalLB Setup



```
1 kubectl delete deamonset -n metallb-system speaker
```



```
1 kubectl label node controlplane01 node.kubernetes.io/exclude-from-external-load-balancers=true
```

K8S CLUSTER

worker01  
10.10.10.11

controlplane01  
10.10.10.21

worker02  
10.10.10.12

controlplane02  
10.10.10.22

worker03  
10.10.10.13



metallb-controller

controlplane03  
10.10.10.23

x3



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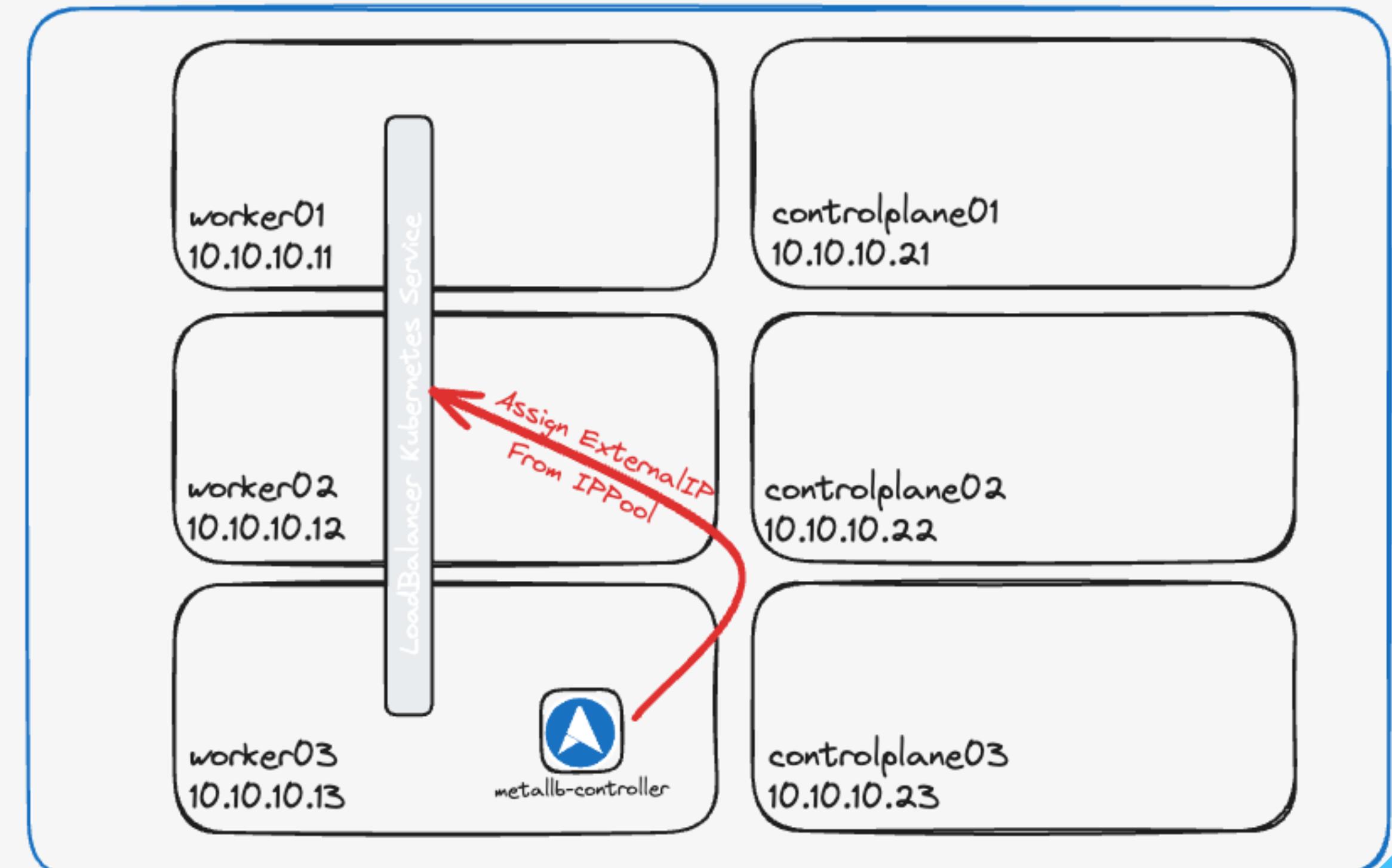
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# MetalLB Config

## K8s CLUSTER

```
● ● ●  
1 apiVersion: metallb.io/v1beta1  
2 kind: IPAddressPool  
3 metadata:  
4   name: default  
5   namespace: metallb-system  
6 spec:  
7   addresses:  
8     - 10.11.146.0/24
```

```
● ● ●  
1 apiVersion: metallb.io/v1beta1  
2 kind: IPAddressPool  
3 metadata:  
4   name: single-ip  
5   namespace: metallb-system  
6 spec:  
7   addresses:  
8     - 10.11.145.0/32
```





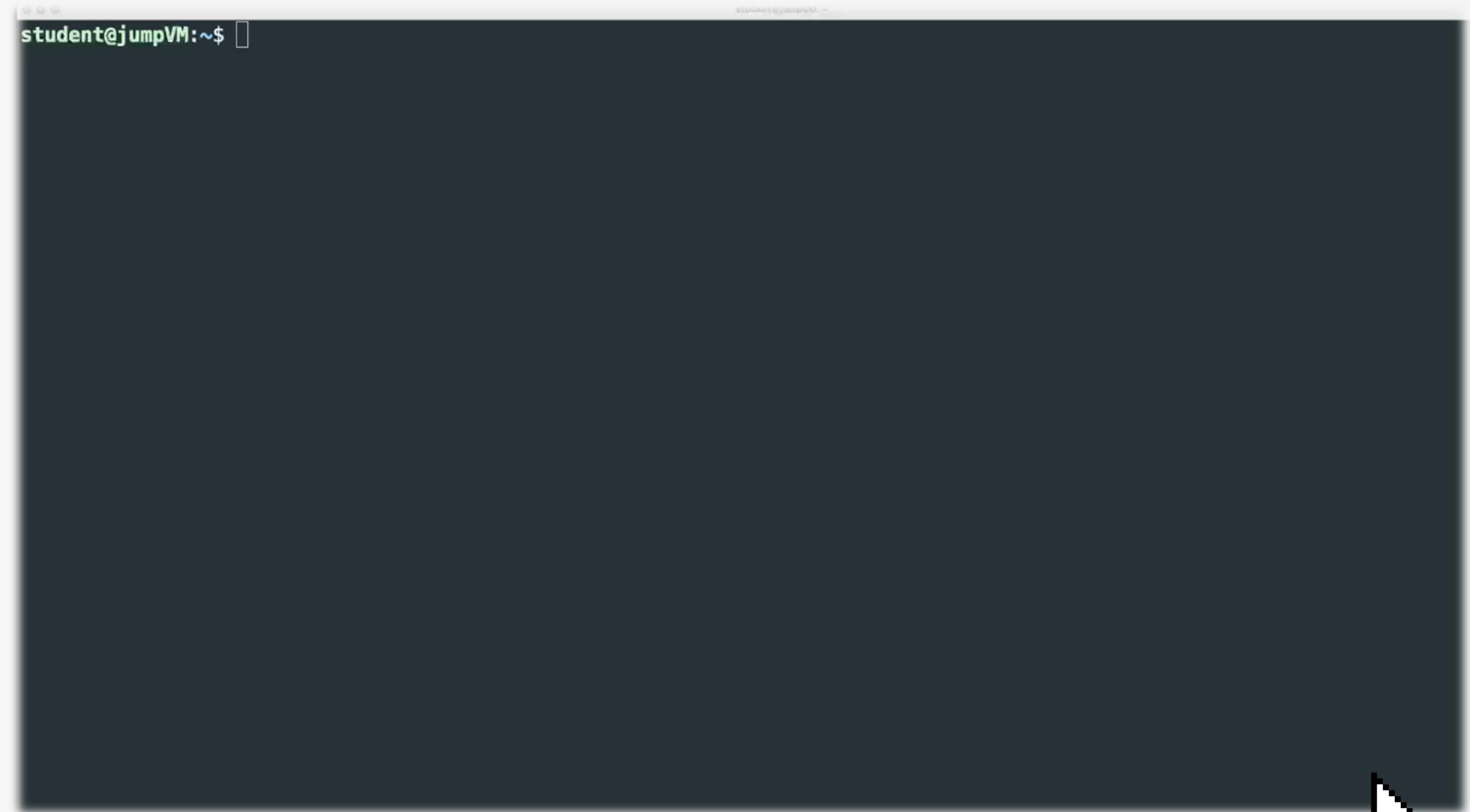
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# Demo



```
student@jumpVM:~$
```



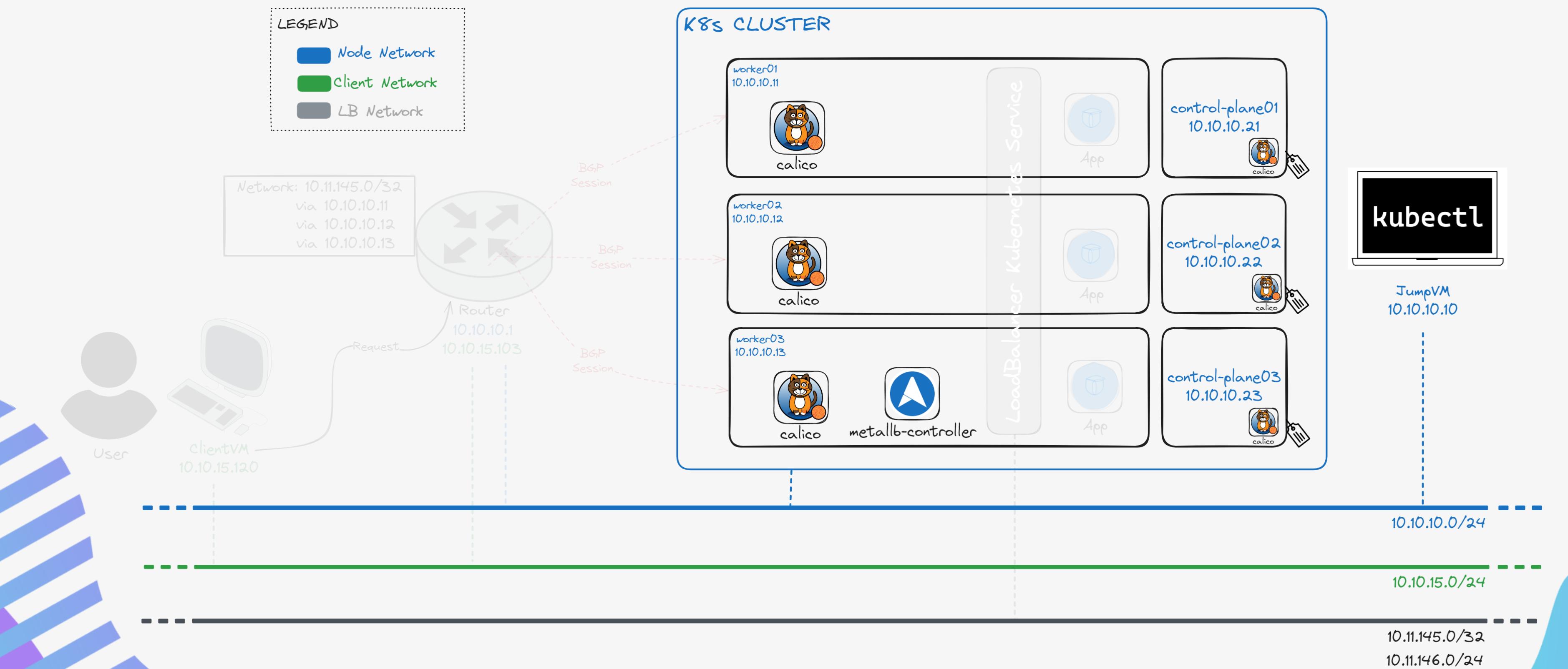
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# Quick Recap



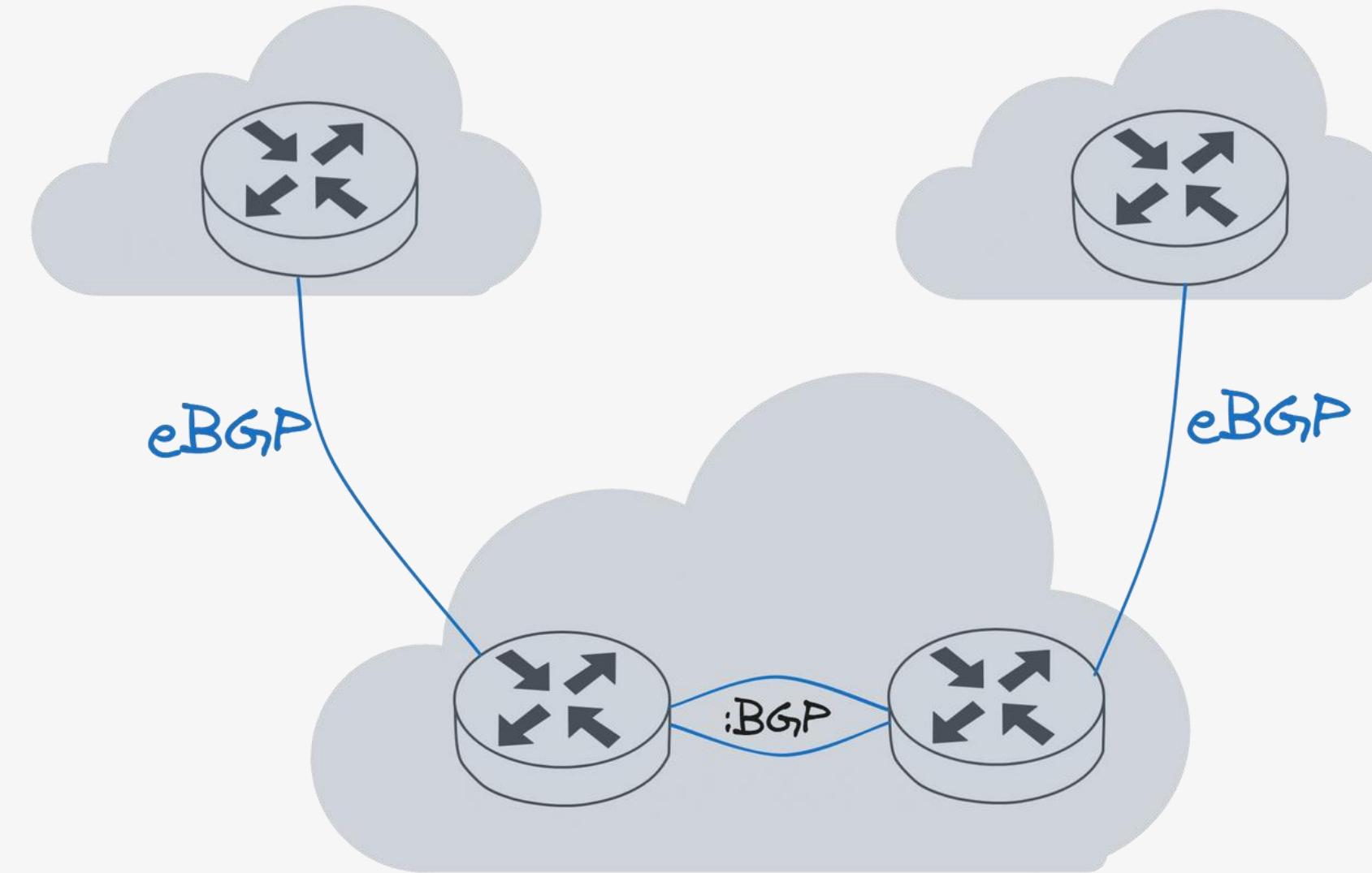
# **Service via BGP**

## **(Border Gateway Protocol)**



# BGP

BGP (Border Gateway Protocol) is a routing protocol used to exchange routing information between different networks on the Internet



*It enables the interconnection of autonomous system (ASes) and helps route data between them*



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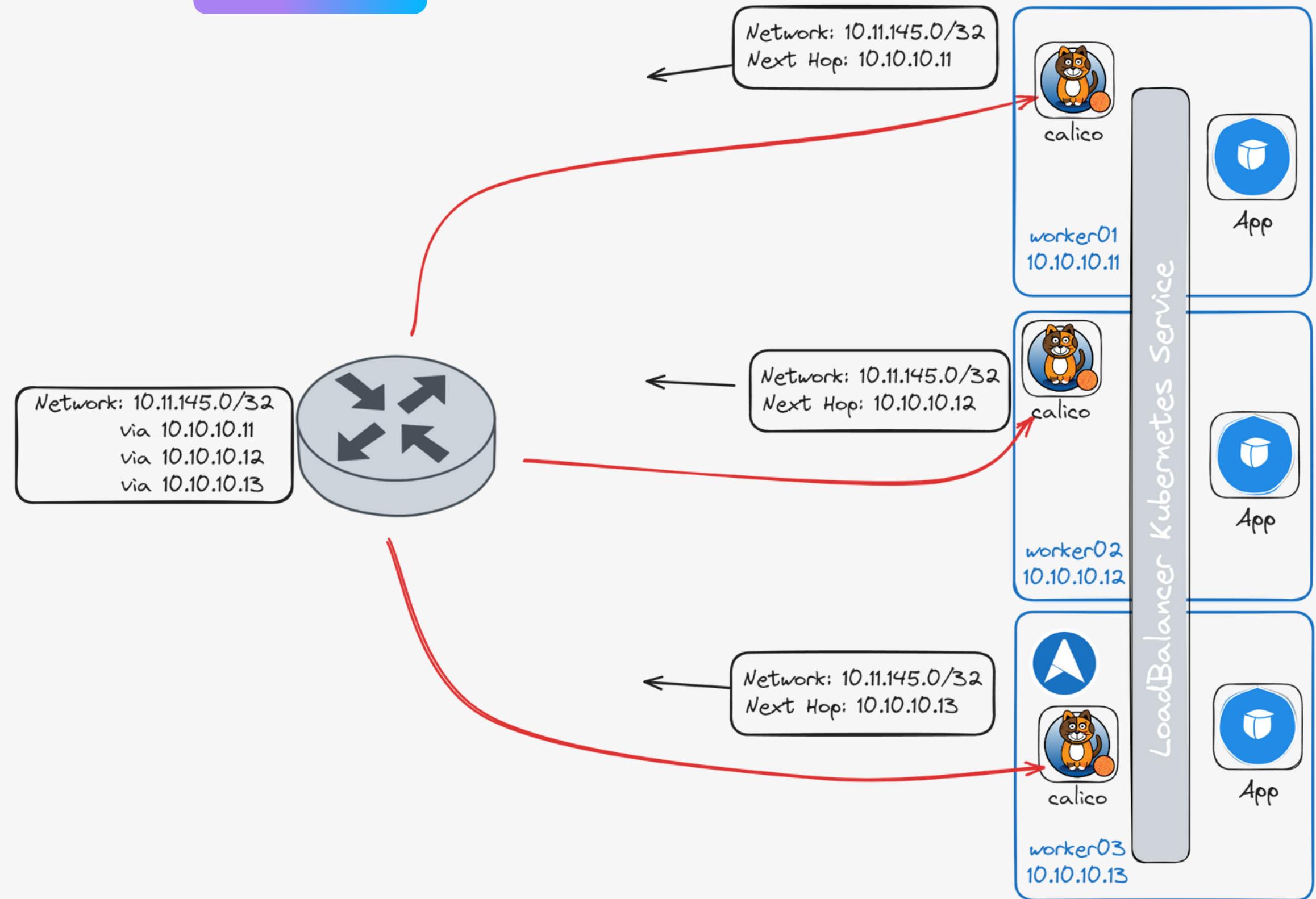


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# BGP Mode

```
● ● ●  
1 Service:  
2  
3   type: LoadBalancer  
4   status:  
5     loadBalancer:  
6       ingress:  
7         - ip: 10.11.145.0
```





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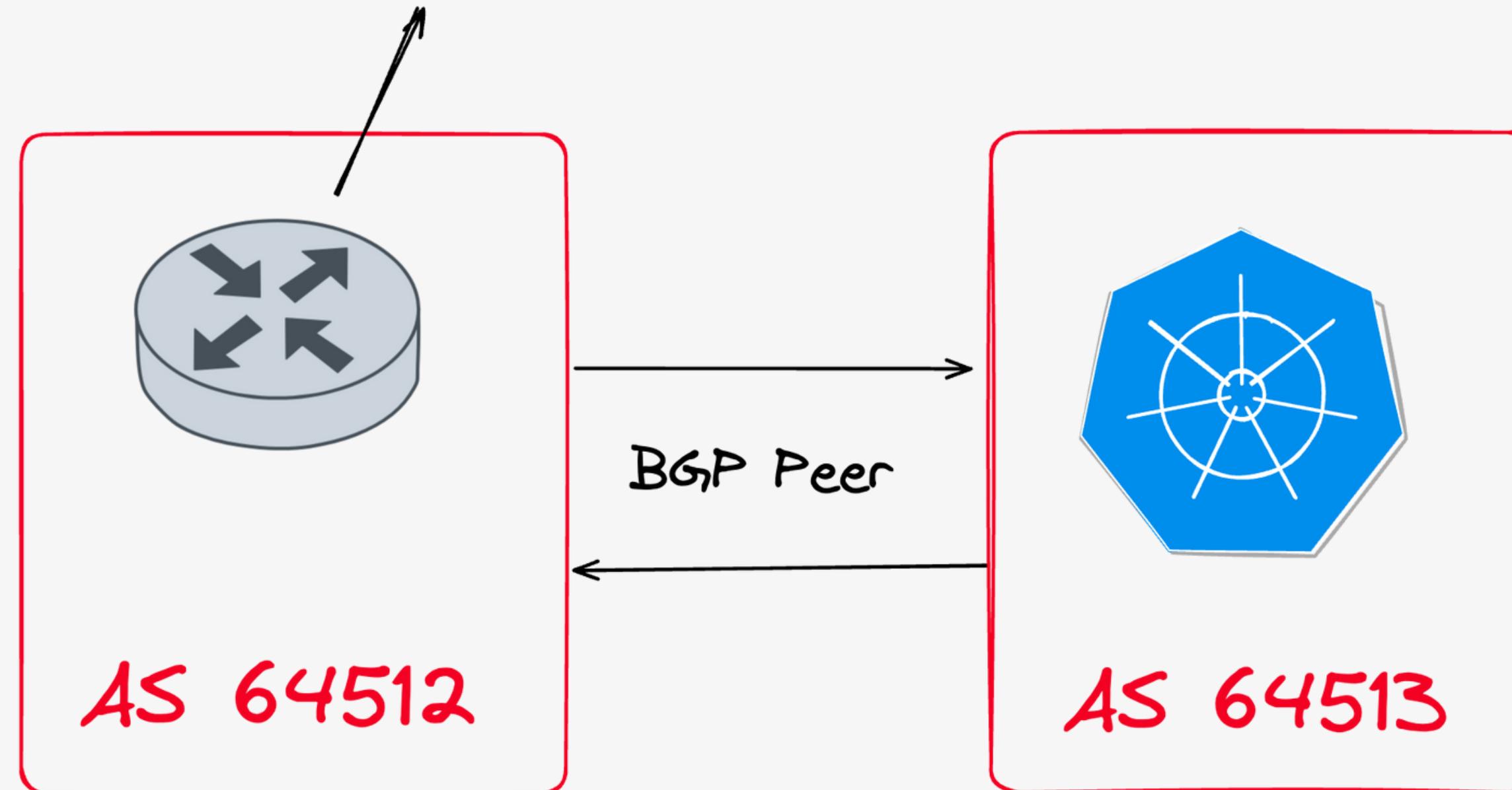


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# BGP Configuration 1/2

```
● ● ●  
1 set protocols bgp 64512 neighbor 10.10.10.11 remote-as 64513  
2 set protocols bgp 64512 neighbor 10.10.10.12 remote-as 64513  
3 set protocols bgp 64512 neighbor 10.10.10.13 remote-as 64513
```





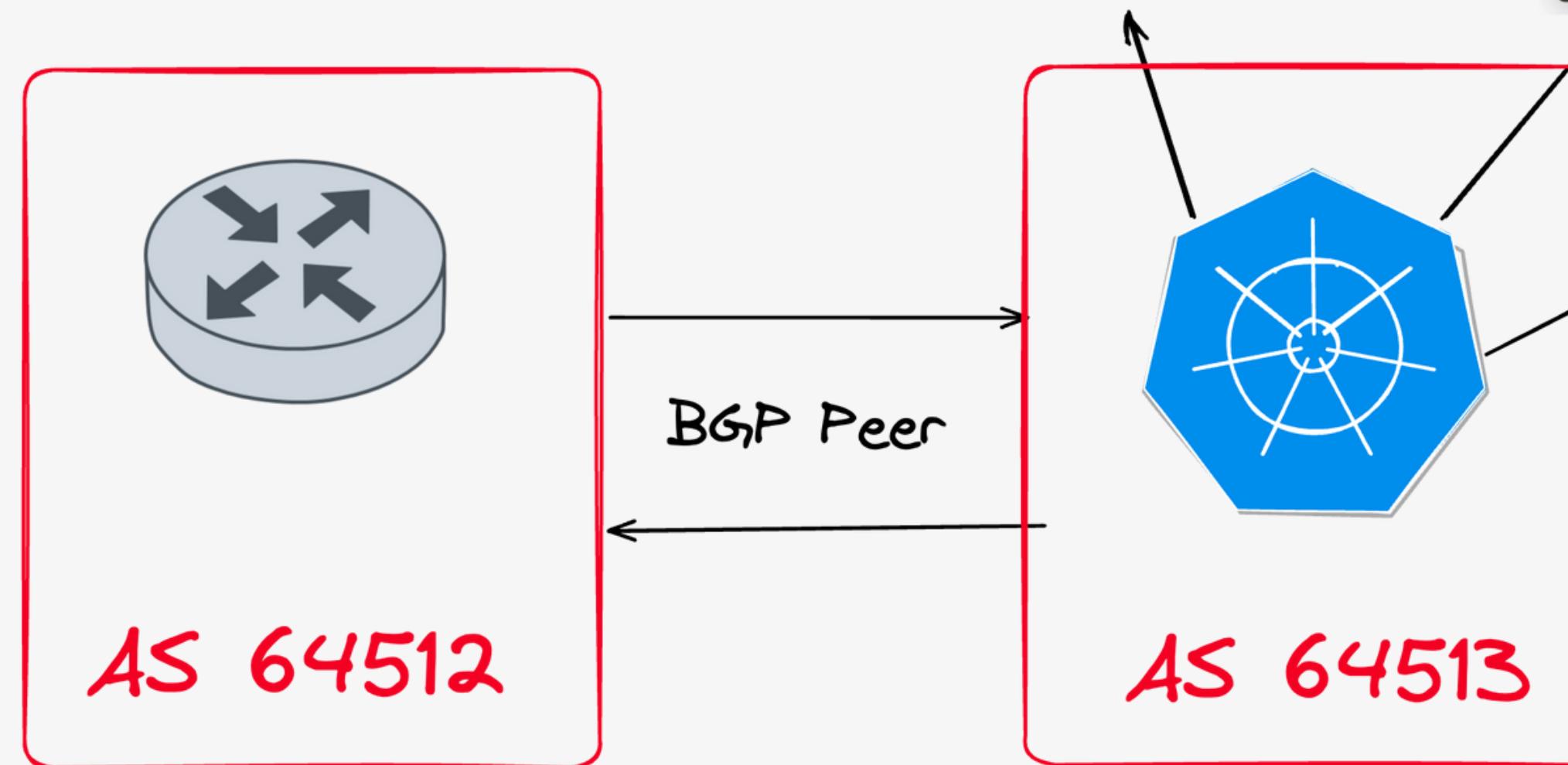
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# BGP Configuration 2/2



```
1 apiVersion: projectcalico.org/v3
2 kind: BGPConfiguration
3 metadata:
4   name: default
5 spec:
6   asNumber: 64513 #-->K8s Cluster
7   serviceExternalIPs:
8     - cidr: 10.11.145.0/32
9   serviceLoadBalancerIPs:
10    - cidr: 10.11.146.0/24
```

```
1 apiVersion: projectcalico.org/v3
2 kind: BGPPeer
3 metadata:
4   name: bgppeer-global
5 spec:
6   peerIP: 10.10.10.1
7   asNumber: 64512 #-->vyos
8   filters:
9     - deny-pod
```

```
1 apiVersion: projectcalico.org/v3
2 kind: BGPFILTER
3 metadata:
4   name: deny-pod
5 spec:
6   exportV4:
7     - action: Reject
8     matchOperator: In
9     cidr: 10.244.0.0/16
```



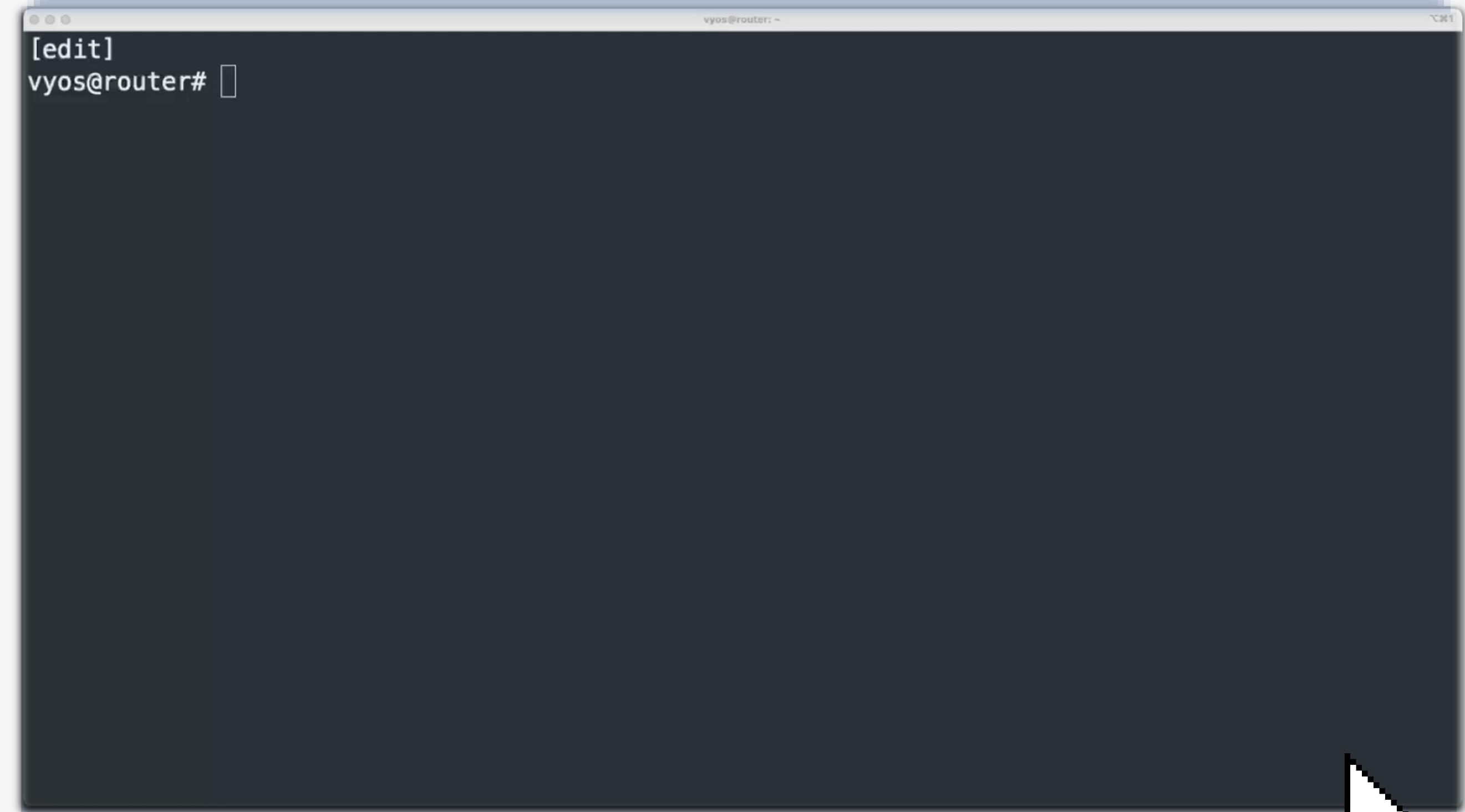
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# Demo



```
[edit]
vyos@router#
```



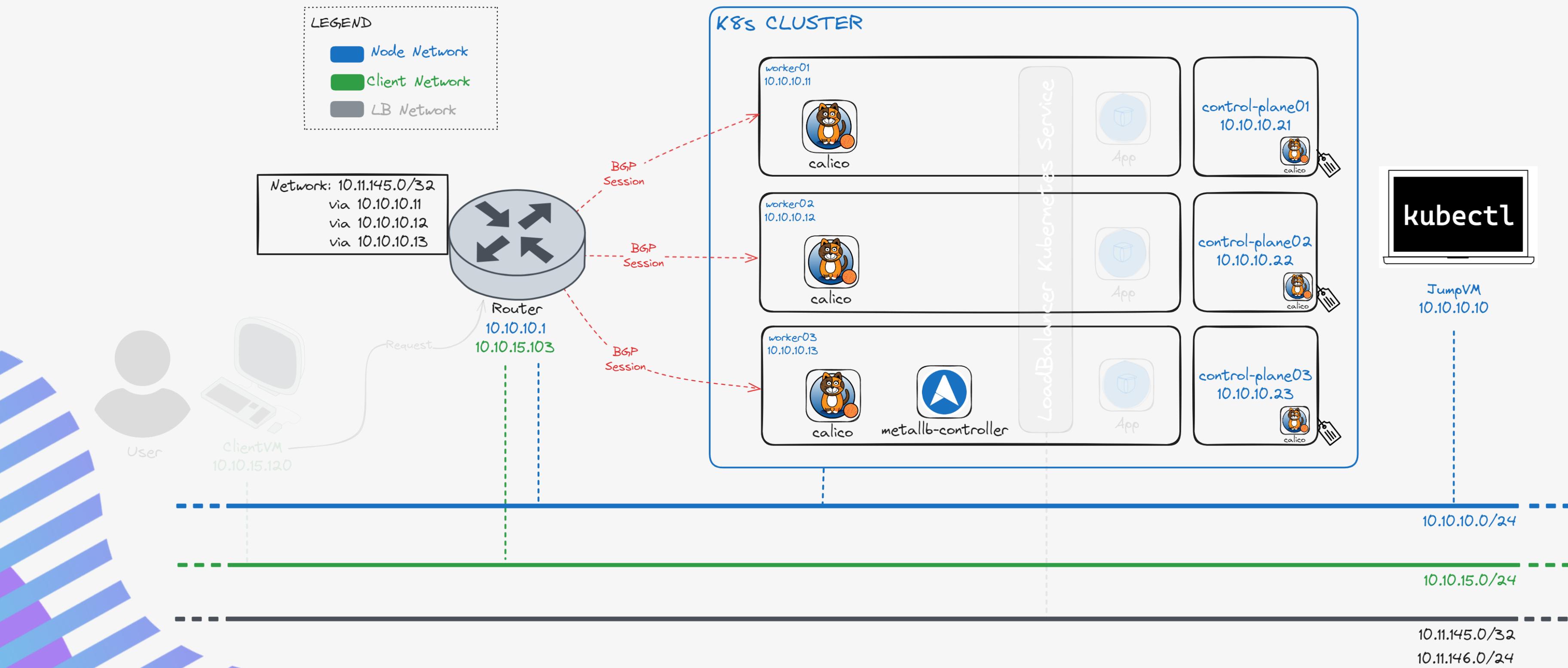
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# Quick Recap



# **Deploy and Expose the Application**

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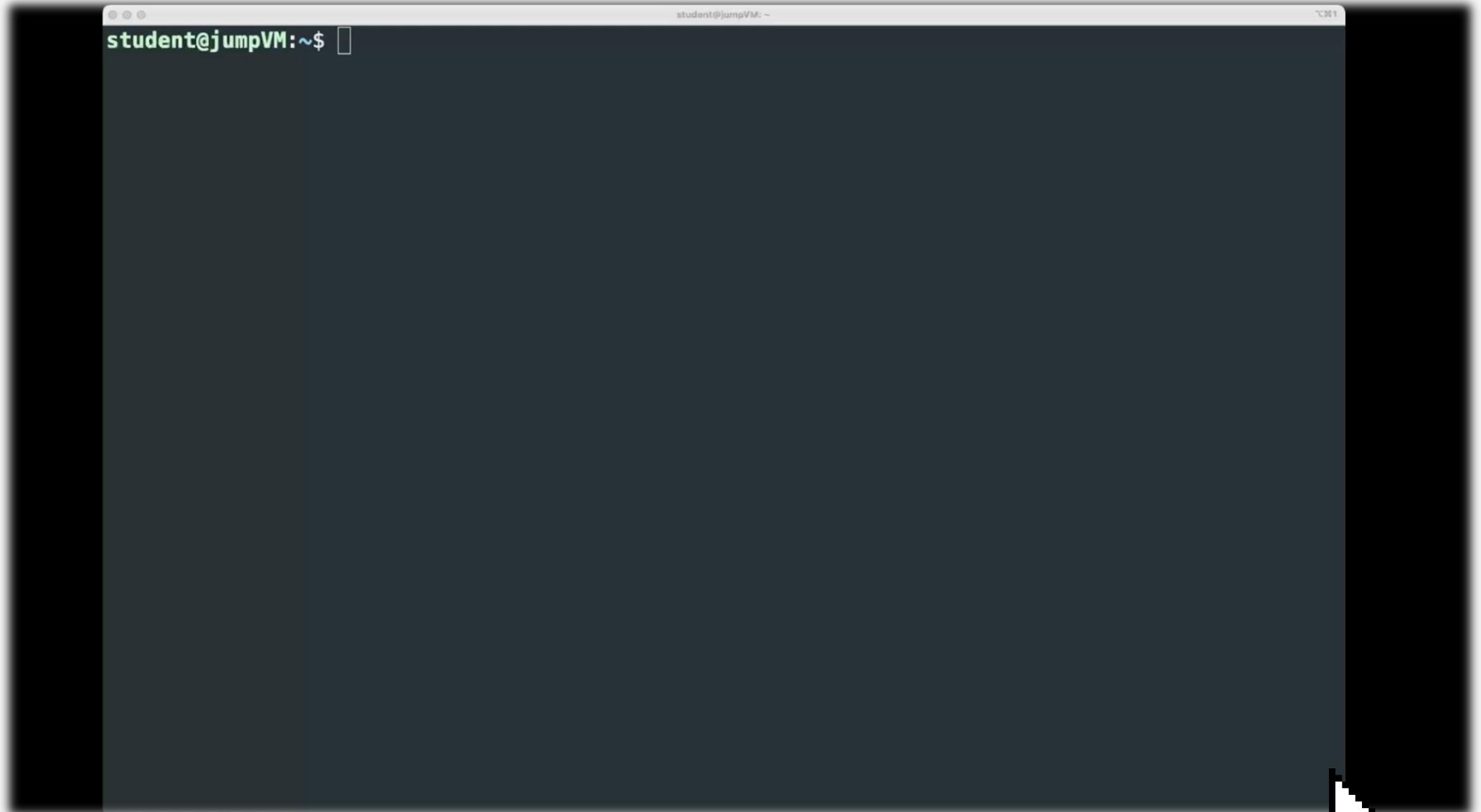
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# Demo



```
student@jumpVM:~$
```



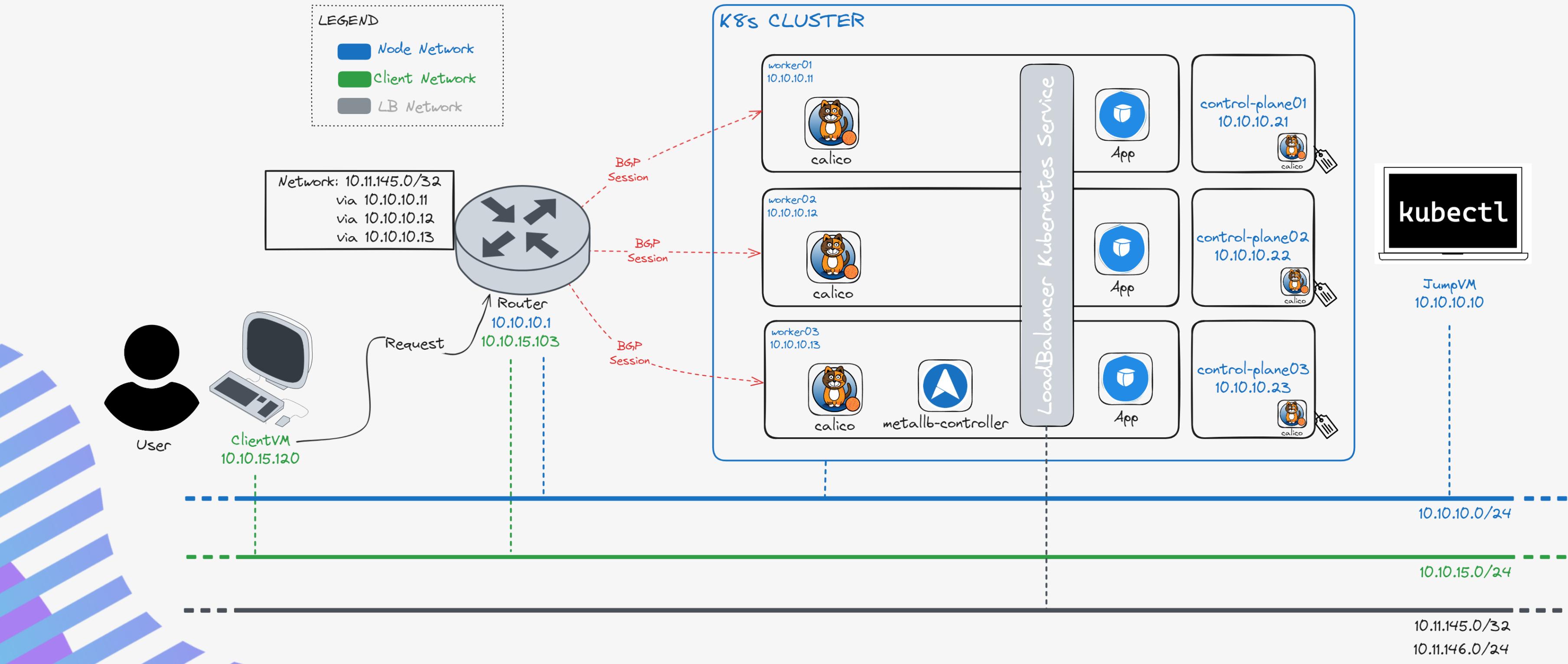
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# Final Architecture



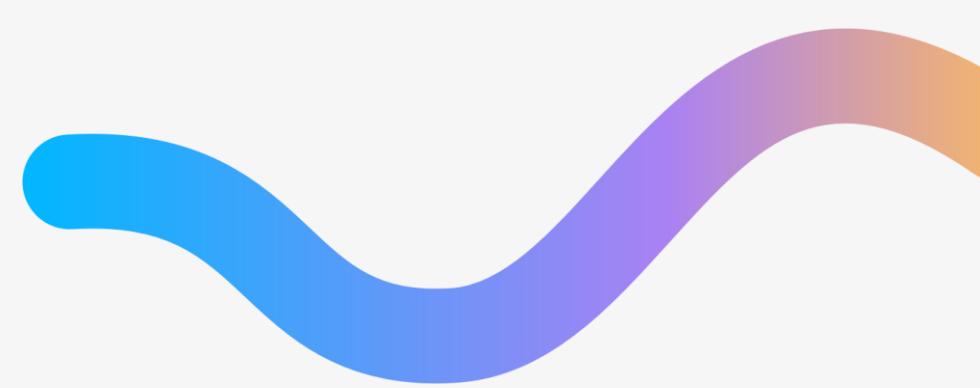


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# Conclusion





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# Thank You!

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