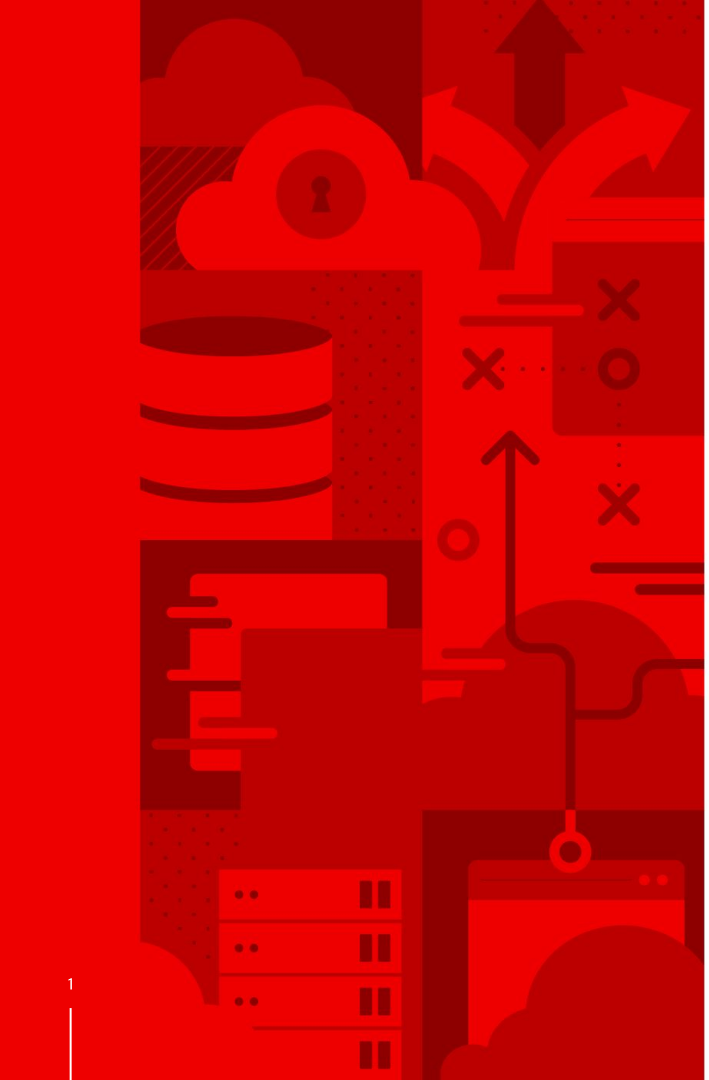

Free my Kubernetes network!

Breaking away from the Kubernetes networking model

FOSDEM 2025

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Hey there ! We are ...

@dougbtv

@maiqueb

Doug Smith

- Technical lead for OpenShift Network Plumbing Team in OpenShift Engineering
- Multus CNI maintainer
- Network Plumbing Working Group member
- Blog: https://dougbtv.com

Miguel Duarte

- OpenShift Virt network engineer
- Network Plumbing Working Group member
- Blog: https://maiqueb.github.io

What’s on the docket?

Agenda

Open Source Jungle.

OVNKUBERNETES

KubeVirt

CNI

MULTUS

OvS

Open vSwitch

K8S NETWORK PLUMBING WORKING GROUP

NPWG

Motivation

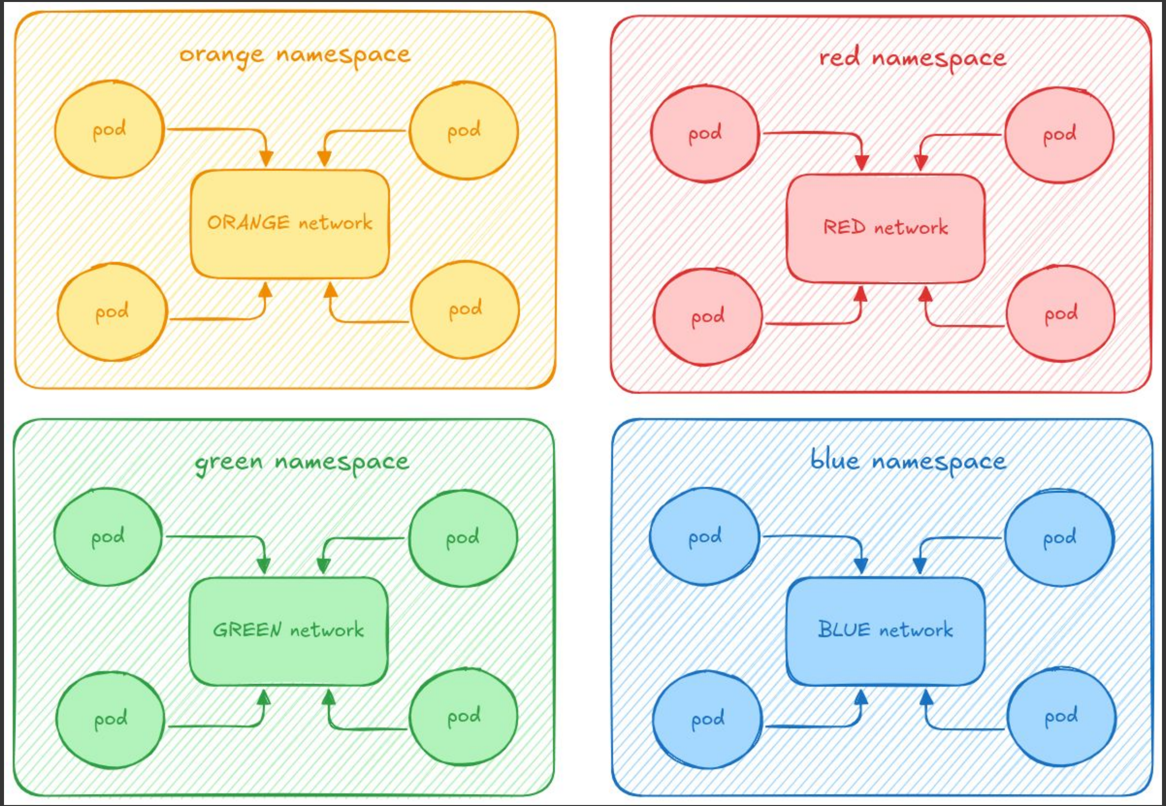
- Traditional virt user
  - L2 isolation
- Kubernetes savvy user
  - Managed experience
- Stable IP addresses

Problem: Kubernetes is opinionated!

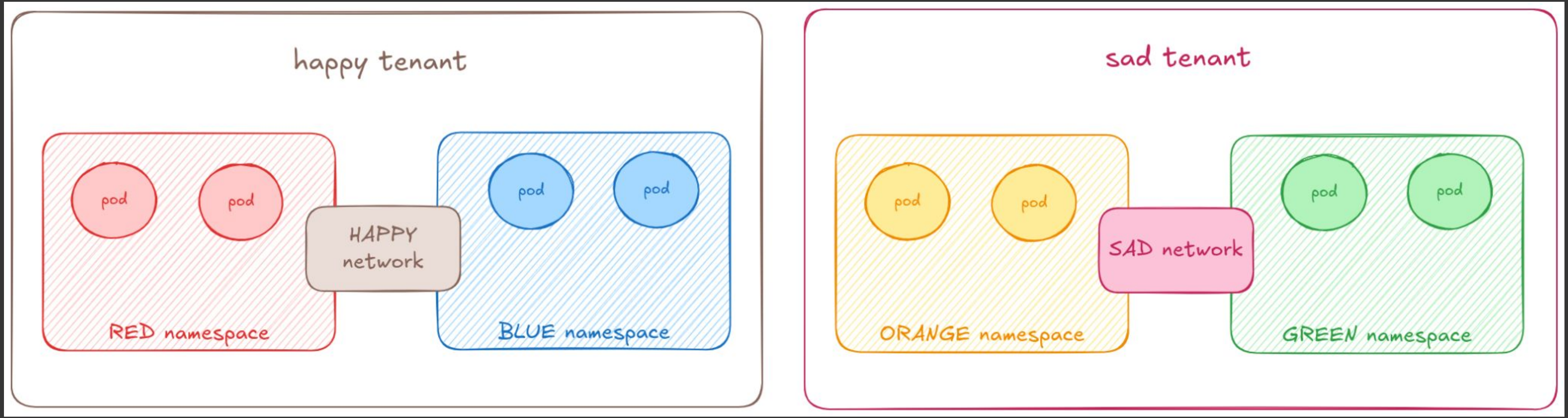
- Single network !!!
- Everything’s connected !!!
- Micro-segmentation via NetworkPolicy

Use Cases

Native Namespace Isolation



Native cluster-wide network isolation



Goals

Goals

Workload/Tenant Isolation

Ability to group different types of applications in different isolated networks that cannot talk to each other

Overlapping podIPs

Ability to create Multiple Networks in your cluster with same pod Subnet range thereby possible to have copies of setups!

Kubernetes APIs supported!

Primary UDNs will have full support for **services**, **network policies**, **admin network policies**

Goals

Stable IPAM configuration

Workloads require their IPs, GW, and DNS configuration to be stable during their lifecycle

Cloud platform support

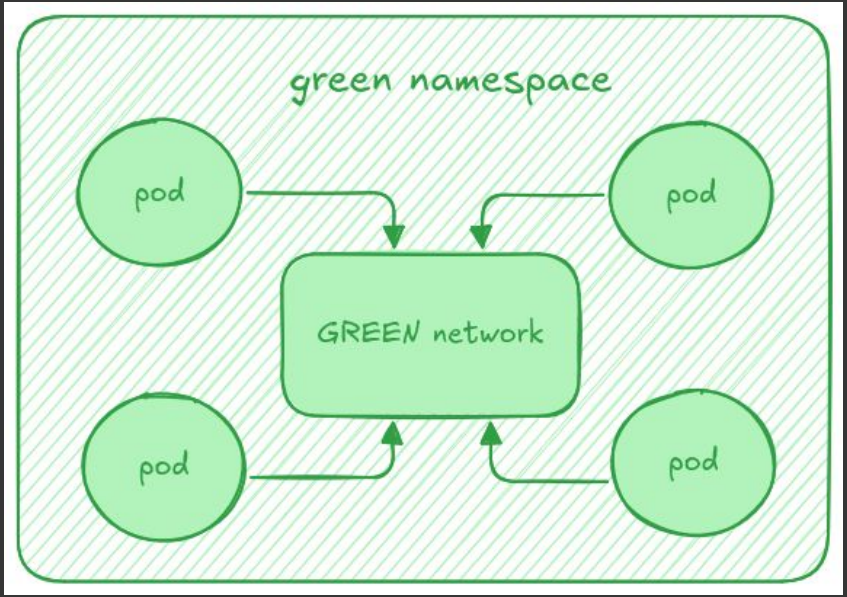
Packets must egress the cluster w/ the IP addresses of the *node* it runs on, to appease cloud providers

Access to *some* kube services

Workloads attached to primary UDNs will *still* have access to kube-dns *and* kube-api

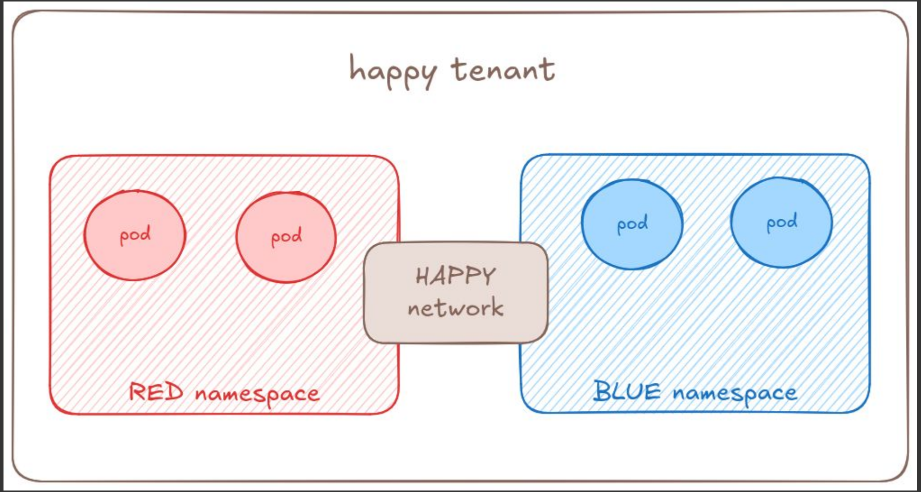
The API

UserDefinedNetwork



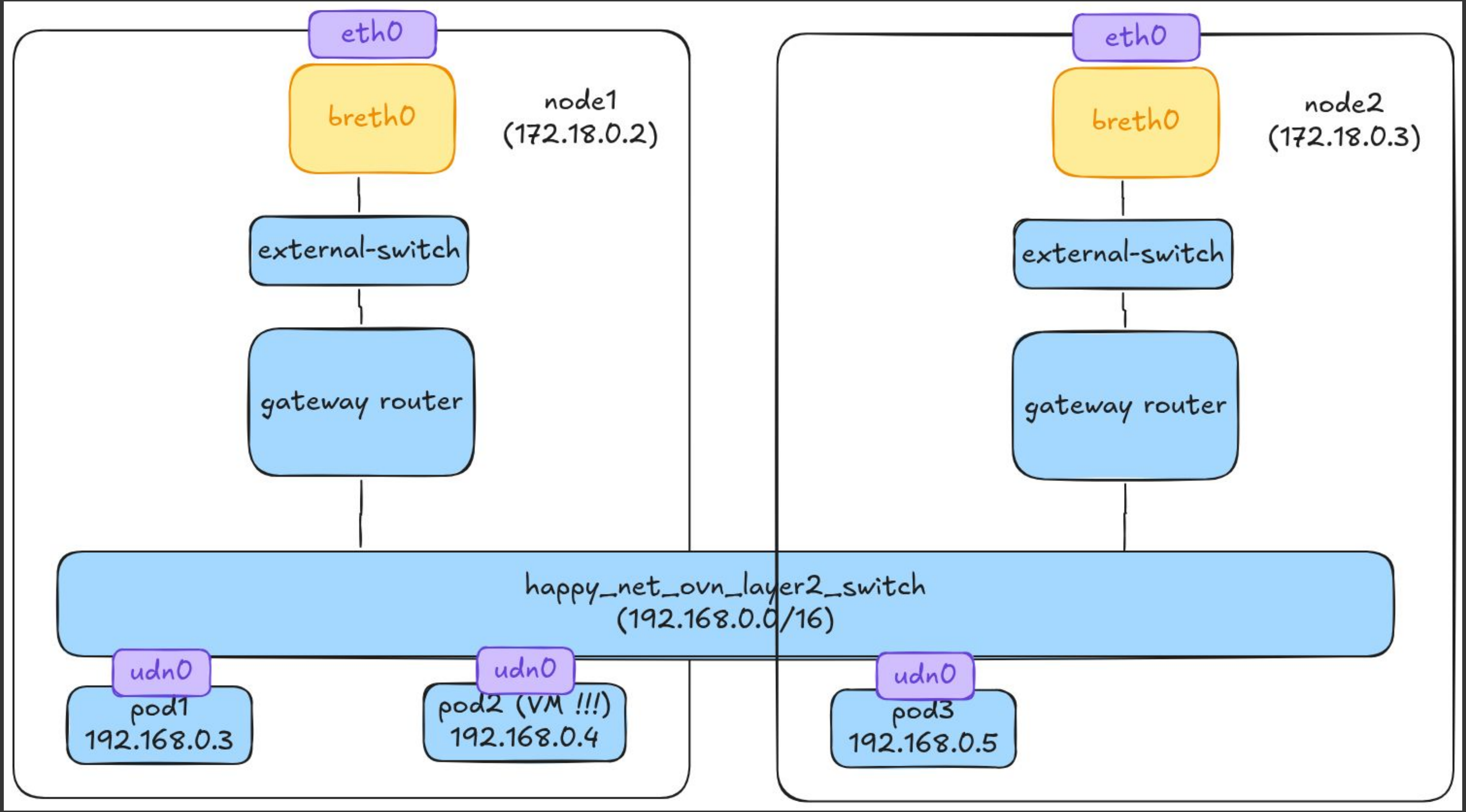
```yaml
apiVersion: k8s.ovn.org/v1
kind: UserDefinedNetwork
metadata:
  name: namespace-scoped
  namespace: green
spec:
  topology: Layer2
  layer2:
    role: Primary
    subnets:
      - 203.203.0.0/16
    ipam:
      lifecycle:  Persistent
```

ClusterUserDefinedNetwork



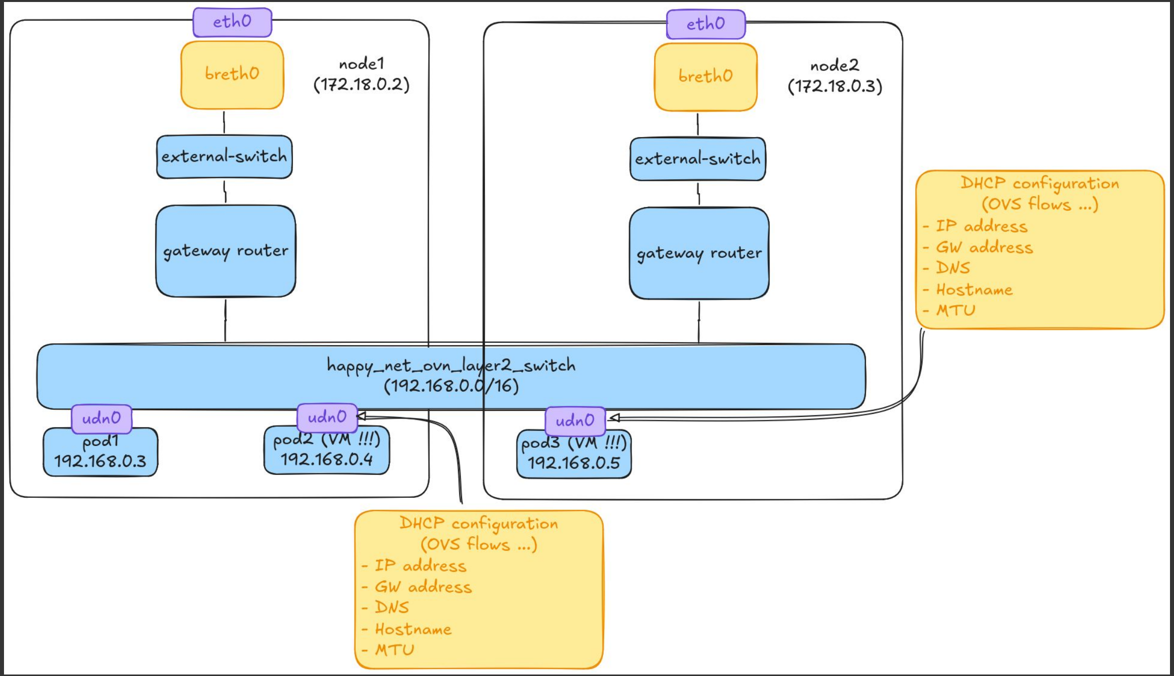
```yaml
apiVersion: k8s.ovn.org/v1
kind: ClusterUserDefinedNetwork
metadata:
  name: happy-tenant
spec:
  namespaceSelector:
    matchExpressions:
      - key: kubernetes.io/metadata.name
        operator: In
        values:
          - red-namespace
          - blue-namespace
  network:
    topology: Layer2
    layer2:
      role: Primary
      ipam:
        lifecycle: Persistent
      subnets:
        - 192.168.0.0/16
```

Topology


eth0
breth0
node1
(172.18.0.2)
external-switch
gateway router
eth0
breth0
node2
(172.18.0.3)
external-switch
gateway router
happy_net_ovn_layer2_switch
(192.168.0.0/16)
udn0
pod1
192.168.0.3
udn0
pod2 (VM !!!)
192.168.0.4
udn0
pod3
192.168.0.5

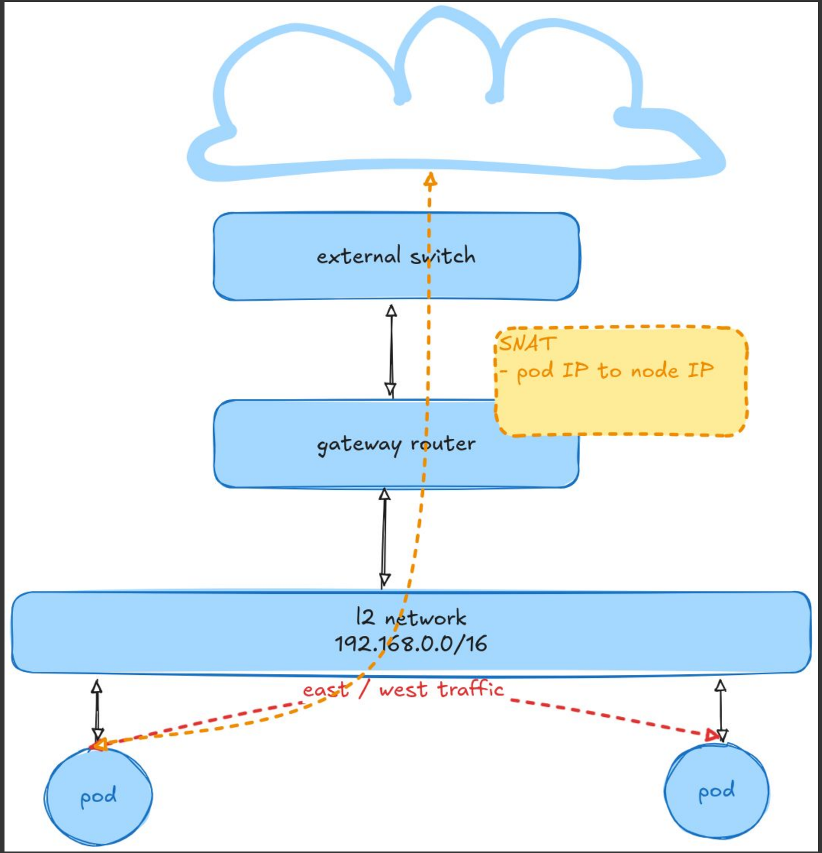
VM Guest IPAM config

Per port DHCP configuration in OVN

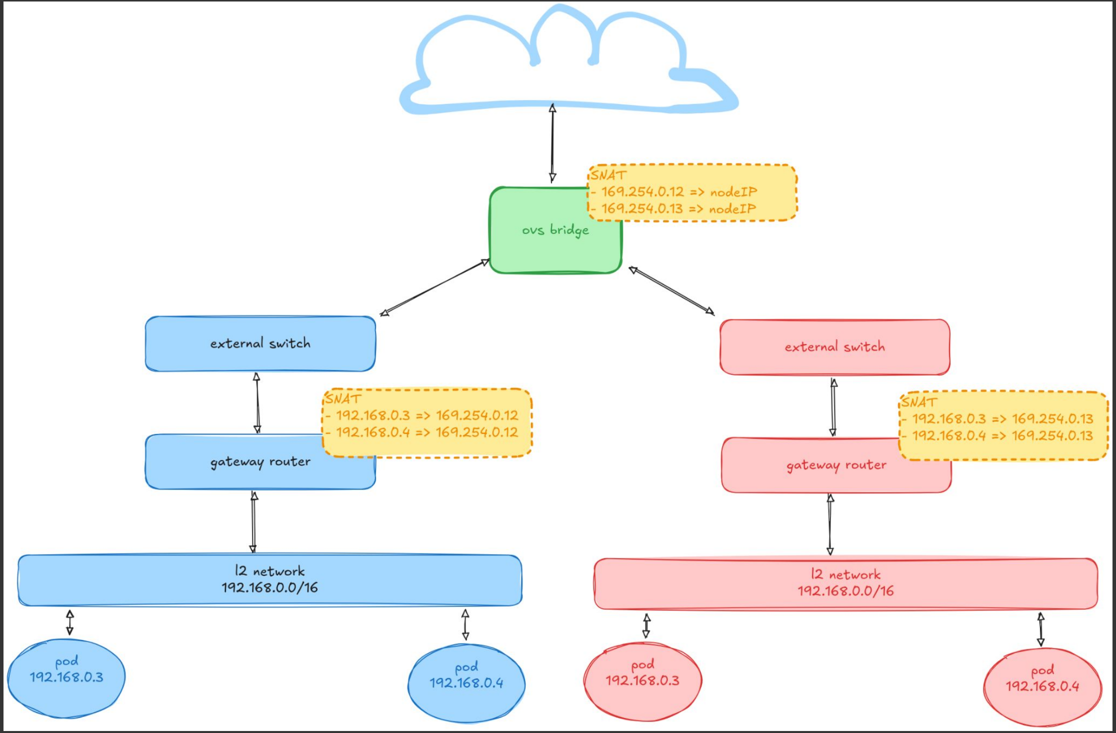


Enabling UDN for cloud platforms

NAT'ed egress

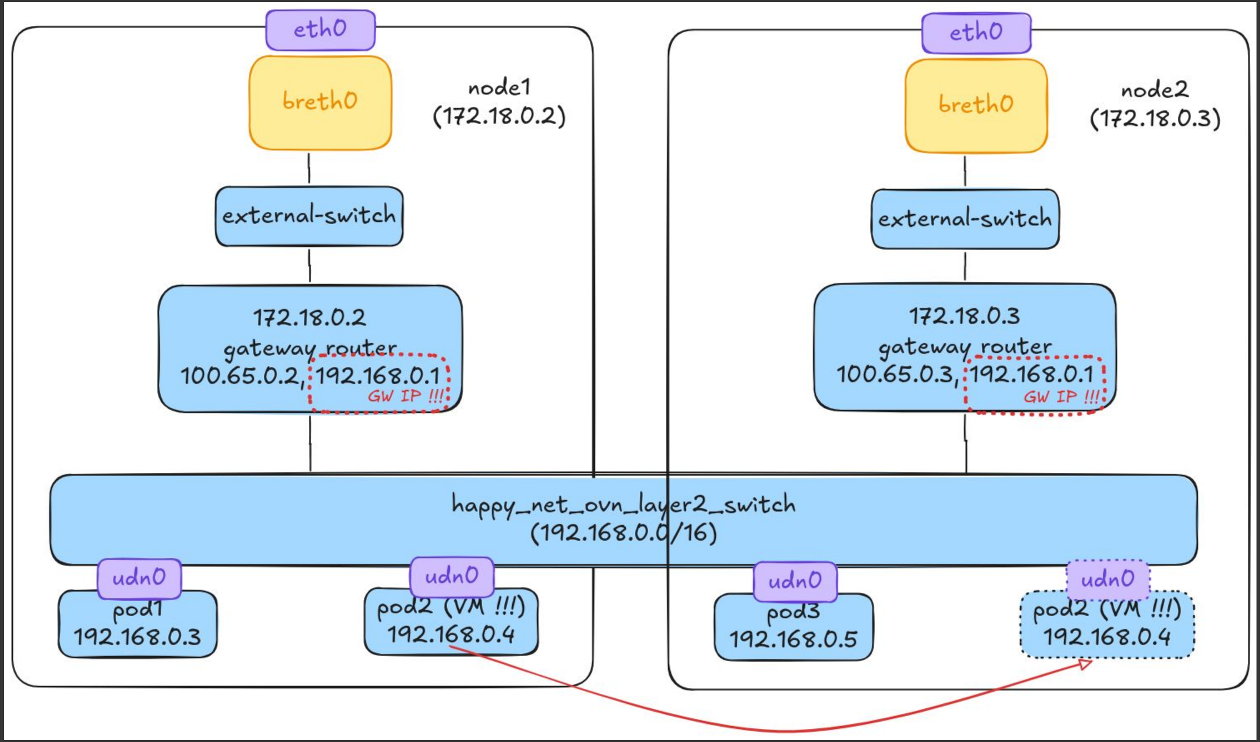


Overlapping subnets

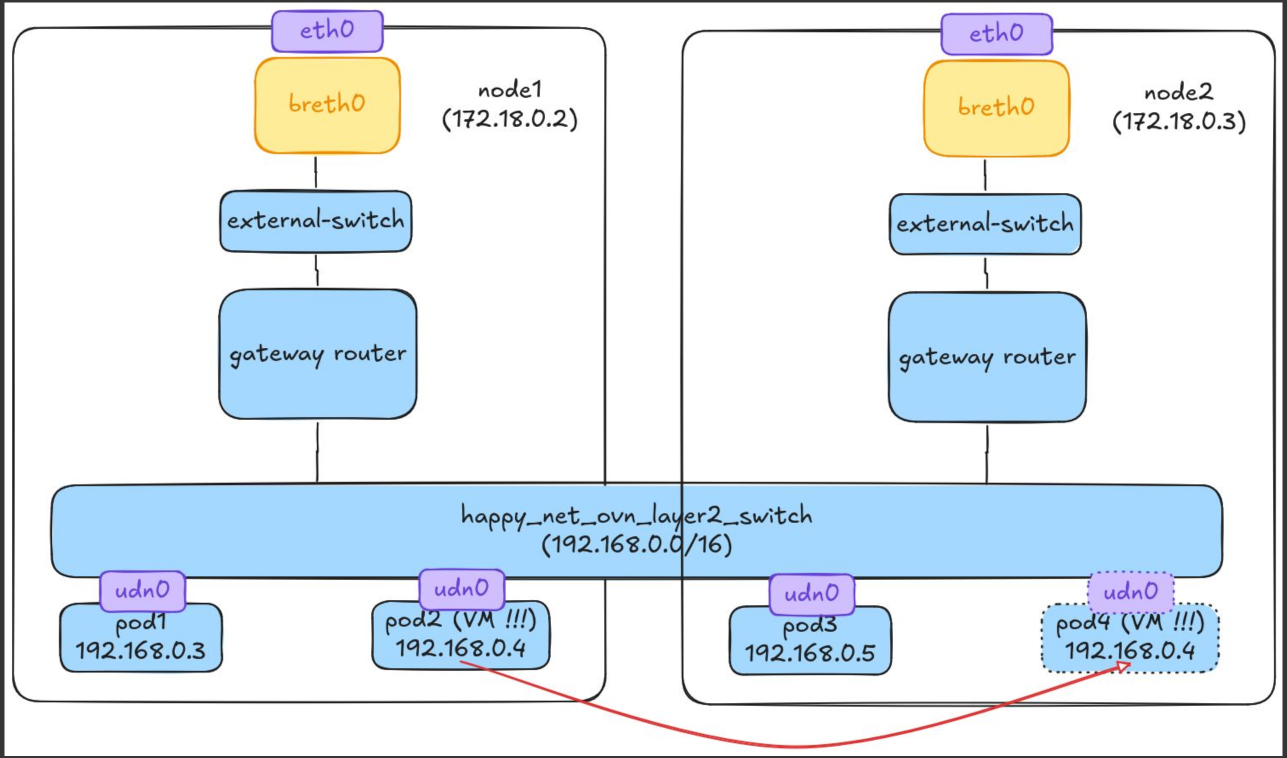


Stable IPAM

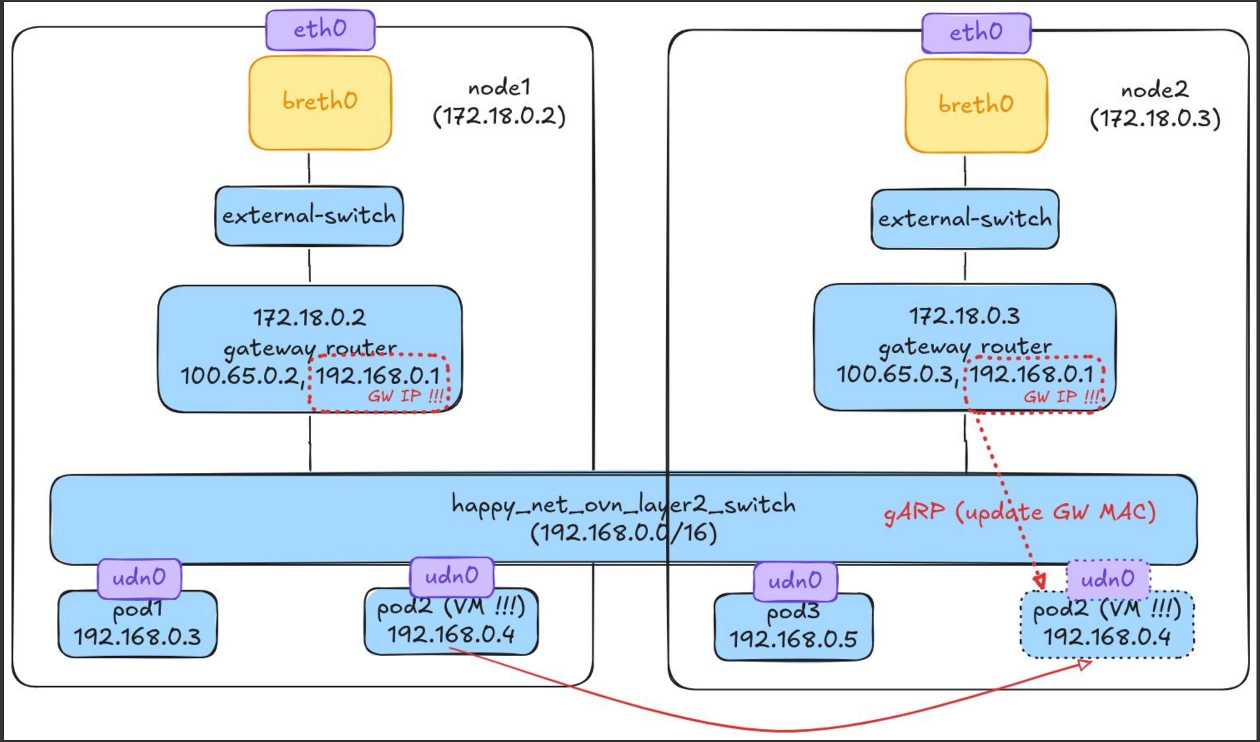
VM Live Migration



VM Live Migration



VM Live Migration



Demos

https://github.com/maiqueb/fosdem2025-p-udn

Namespace isolation

https://asciinema.org/a/699323

Cluster-wide network / cluster ingress

https://asciinema.org/a/699643

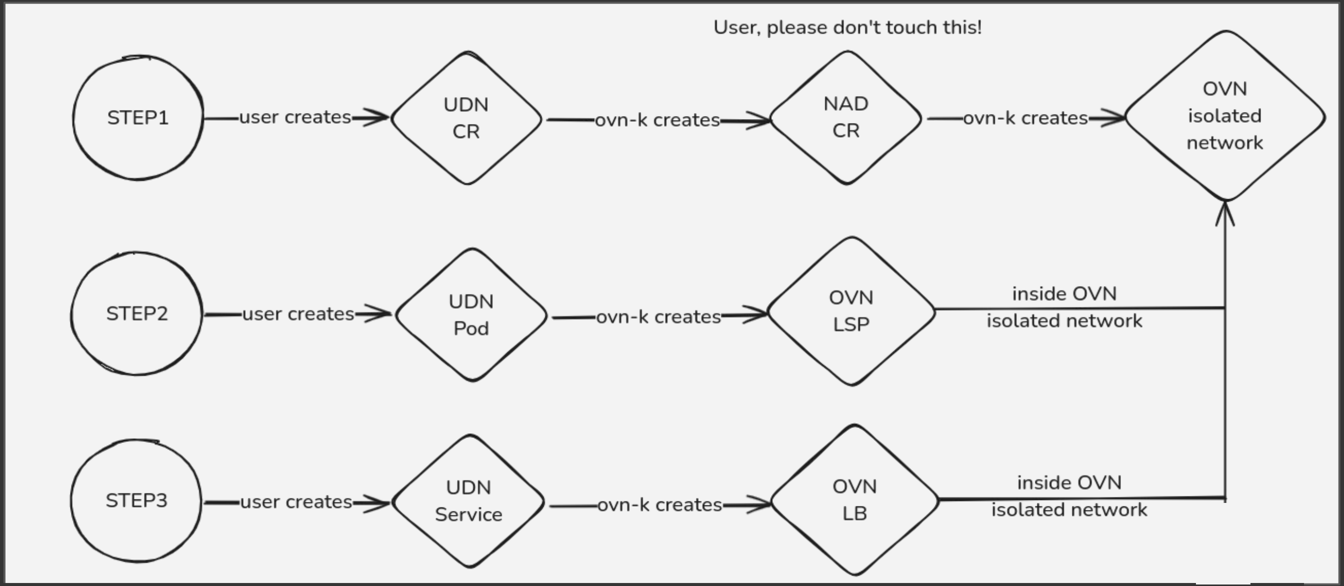
Conclusions

Conclusions

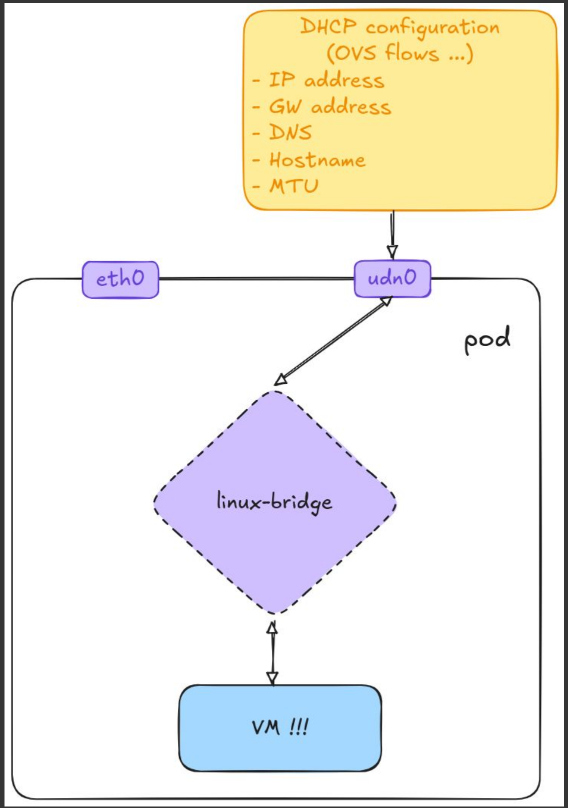
- Primary UDN provides
  - OpenStack neutron like(ish) type of networks in Kubernetes
  - Managed experience
- VM network requirements >> pod network requirements
- Integrated w/ Kubernetes API - net pol / services / ...
- Overlapping IPs in primary UDNs
- Cloud platforms are picky ! (as they should ...)

the end ...

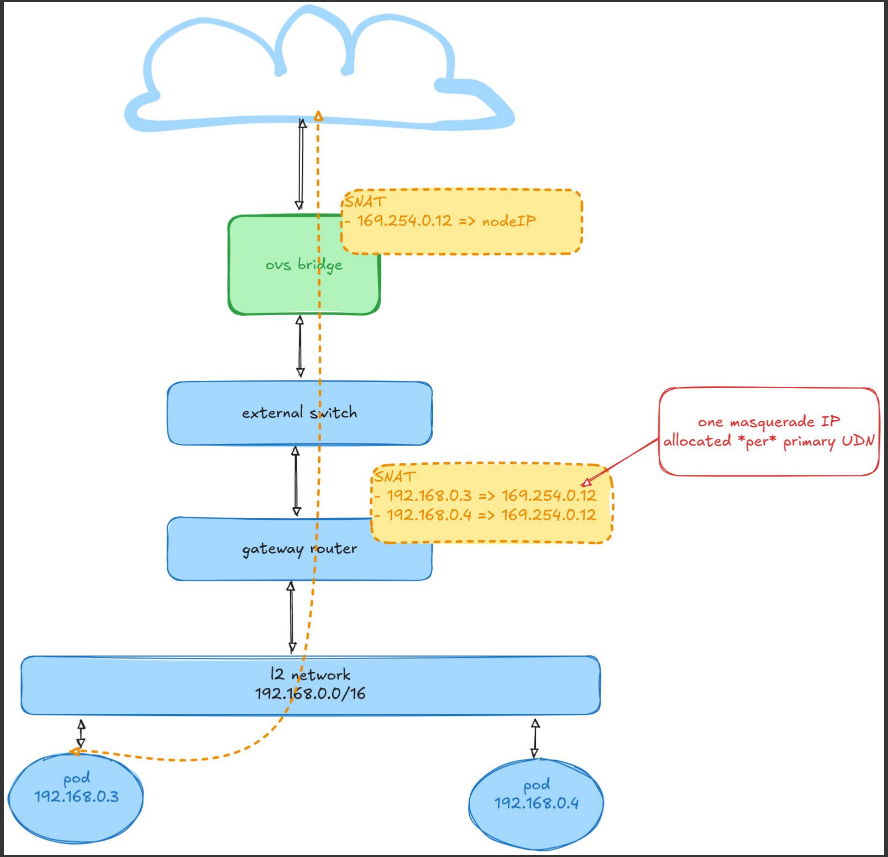
UDN configuration steps



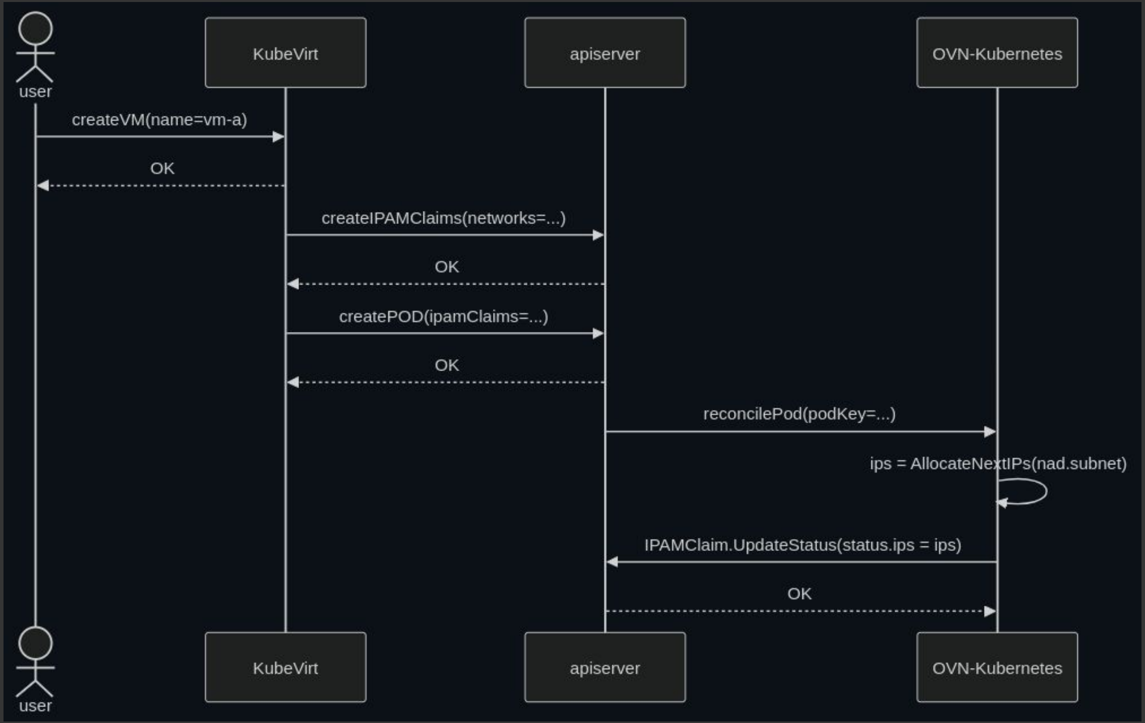
KubeVirt network binding



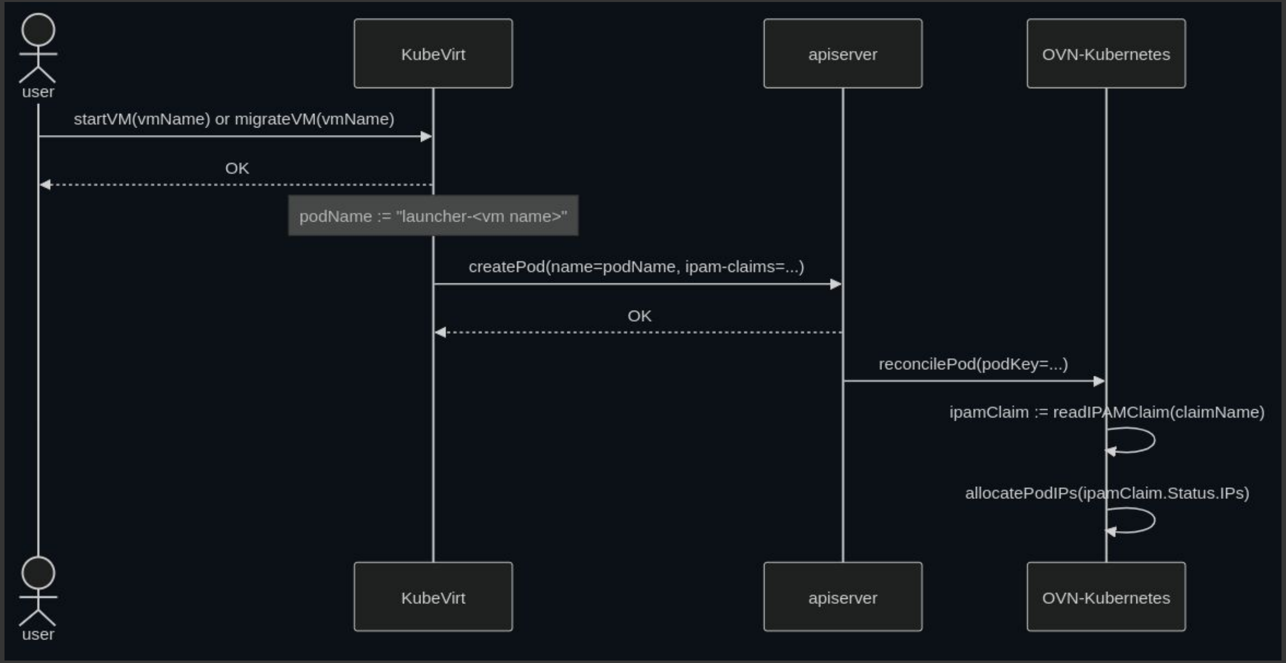
Overlapping subnets



Persisting IP addresses: IP allocation


user
KubeVirt
apiserver
OVN-Kubernetes
createVM(name=vm-a)
OK
createIPAMClaims(networks=...)
OK
createPOD(ipamClaims=...)
OK
reconcilePod(podKey=...)
ips = AllocateNextIPs(nad.subnet)
IPAMClaim.UpdateStatus(status.ips = ips)
OK
user
KubeVirt
apiserver
OVN-Kubernetes

Persisting IP addresses: IP recovery


user
KubeVirt
apiserver
OVN-Kubernetes
startVM(vmName) or migrateVM(vmName)
OK
podName := "launcher-<vm name>"
createPod(name=podName, ipam-claims=...)
OK
reconcilePod(podKey=...)
ipamClaim := readIPAMClaim(claimName)
allocatePodIPs(ipamClaim.Status.IPs)
user
KubeVirt
apiserver
OVN-Kubernetes