Writing a CNI plugin from scratch

Eran Yanay

Twistlock™

Who am I

Eran Yanay

Twistlock

R&D Team Lead

eran@twistlock.com

```
kubectl apply -f
"https://cloud.weave.works/k8s/net?k8s-version
=$(kubectl version | base64 | tr -d '\n')"
```

Objectives

Writing a CNI (Container Network Interface) plugin from scratch, using only bash

- What is CNI?
- How do CNI plugins work?
- What a CNI plugin is made of?
- How a CNI plugin is being used in K8s?
- How a CNI plugin is executed?
- Anatomy of pod networking
- Live demo

What is CNI?

- CNI stands for Container Networking Interface
- An interface between container runtime and the network implementation
- Configures the network interfaces and routes
- Concerns itself only with network connectivity
- https://github.com/containernetworking/cni/blob/spec-v0.4.0/SPEC.md

How do CNI plugins work (in k8s)

- A CNI plugin

  Handles connectivity - configures the network interface of the pod

- A daemon

  Handles reachability - manages routings across the cluster

What a CNI plugin is made of?

```
# cat /etc/cni/net.d/10-my-cni-demo.conf
{
    "cniVersion": "0.3.1",
    "name": "my-cni-demo",
    "type": "my-cni-demo",
    "podcidr": "10.240.0.0/24",
}
```

```
# cat /opt/cni/bin/my-cni-demo
case $CNI_COMMAND in
ADD)
   # Configure networking for a new container
;;
DEL)
    # Cleanup when container is stopped
;;
GET)

;;
VERSION)
    # Get the plugin version
;;
esac
```

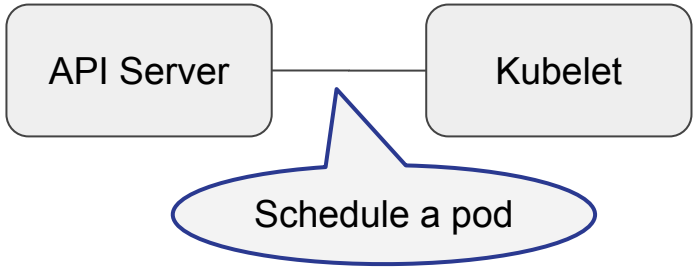
The weave example..

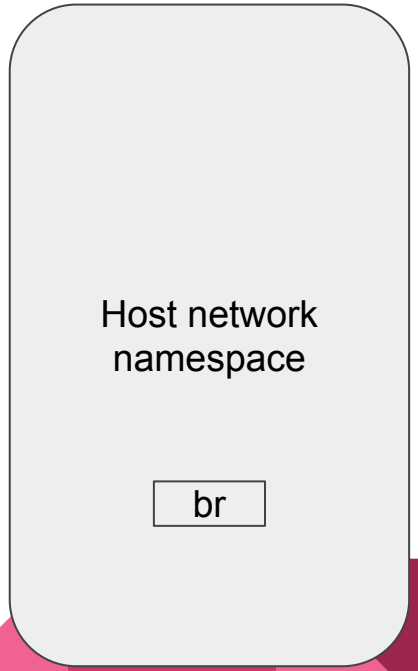
```
kind: DaemonSet
spec:
 containers:
   - name: weave
     command:
       - /home/weave/launch.sh
     image: 'docker.io/weaveworks/weave-kube:2.5.1'
     volumeMounts:
       - name: weavedb
         mountPath: /weavedb
       - name: cni-bin
         mountPath: /host/opt
       - name: cni-bin2
         mountPath: /host/home
       - name: cni-conf
         mountPath: /host/etc
 hostNetwork: true
```

The weave example..

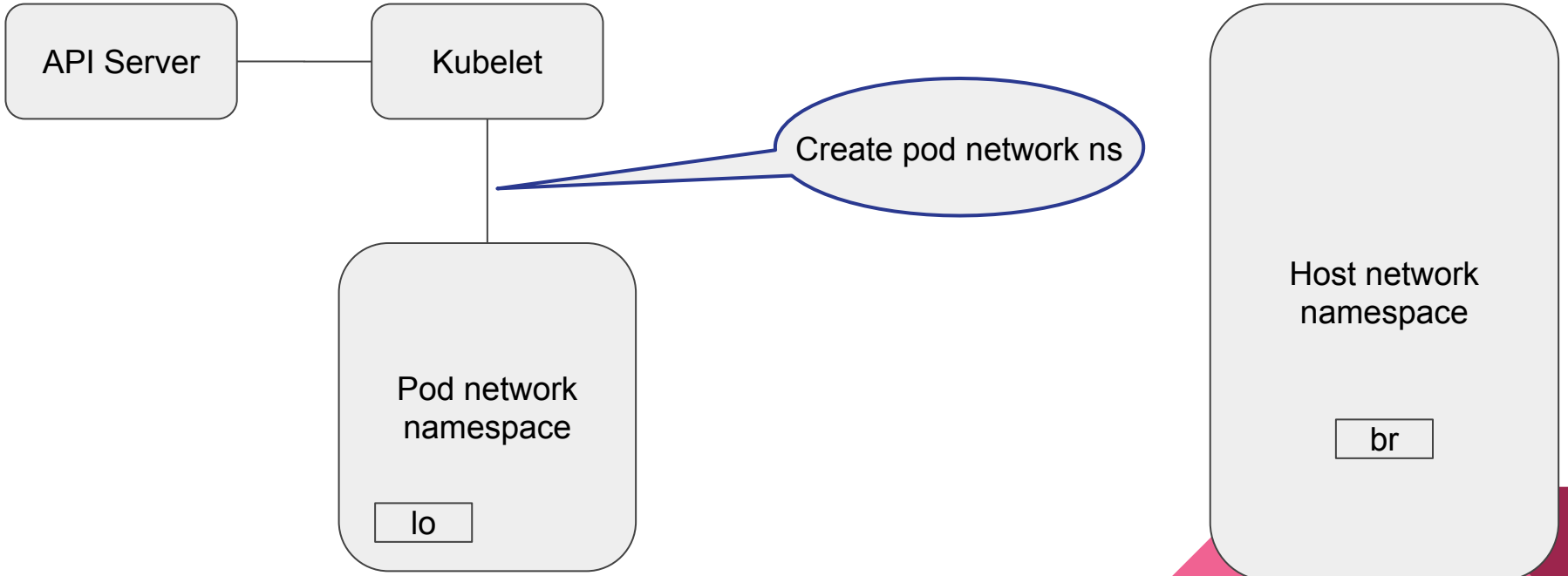
```
$ cat /home/weave/launch.sh
# ... previous non related code ...
# Install CNI plugin binary to typical CNI bin location
# with fall-back to CNI directory used by kube-up on GCI OS
if ! mkdir -p $HOST_ROOT/opt/cni/bin ; then
   if mkdir -p $HOST_ROOT/home/kubernetes/bin ; then
       export WEAVE_CNI_PLUGIN_DIR=$HOST_ROOT/home/kubernetes/bin
   else
       echo "Failed to install the Weave CNI plugin" >&2
       exit 1
   fi
fi
mkdir -p $HOST_ROOT/etc/cni/net.d
export HOST_ROOT
/home/weave/weave --local setup-cni
```

How a CNI plugin is being used in K8s?

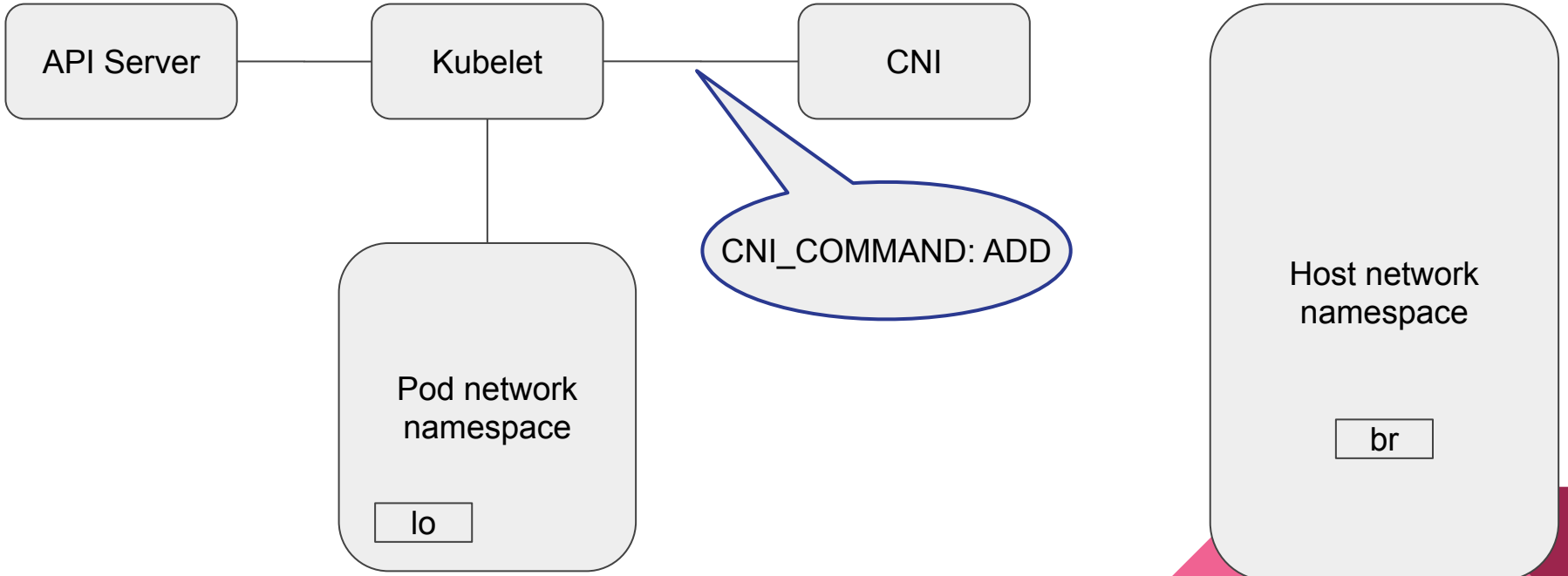




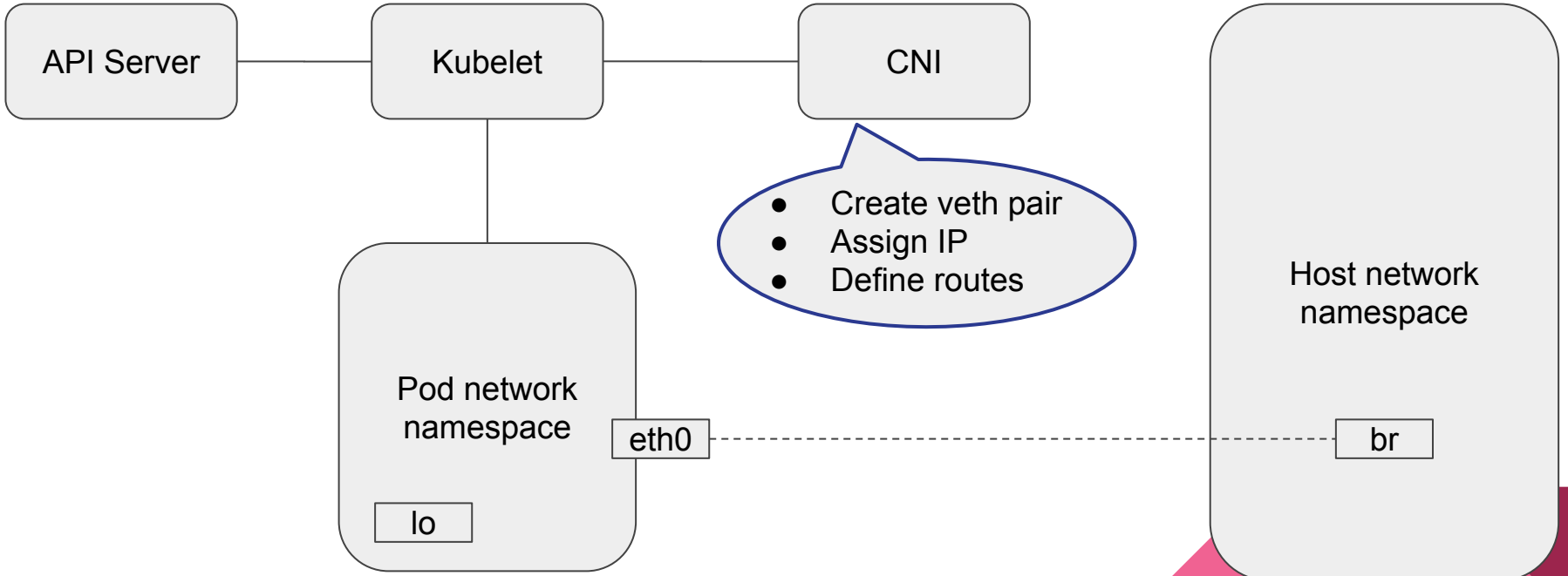
How a CNI plugin is being used in K8s?



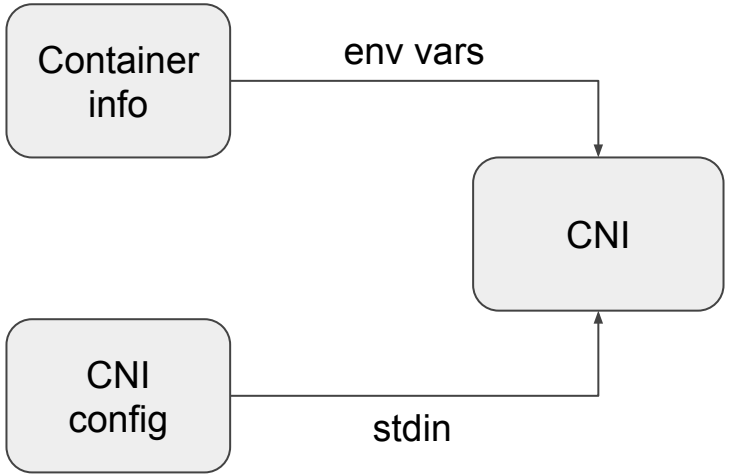
How a CNI plugin is being used in K8s?



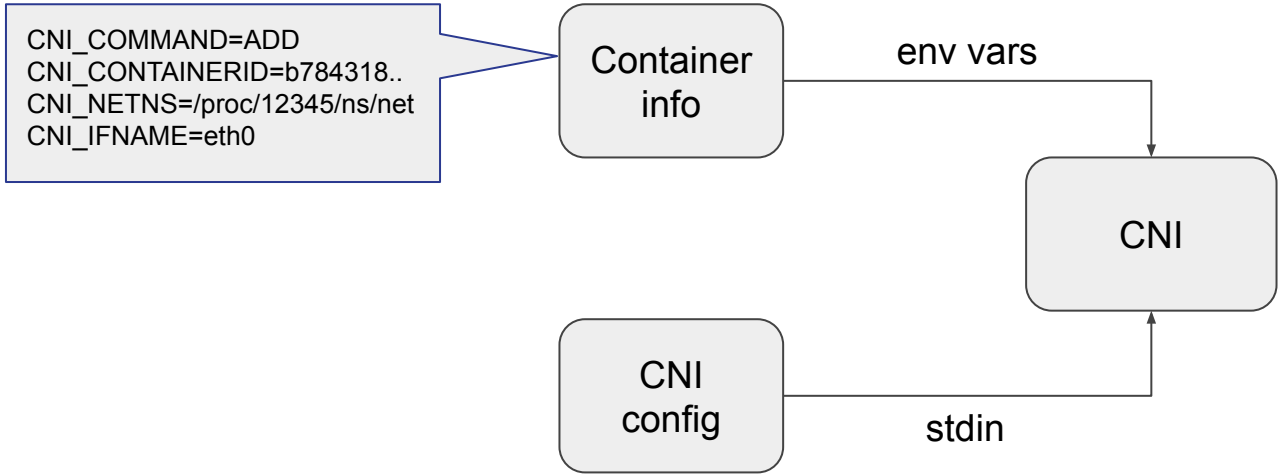
How a CNI plugin is being used in K8s?



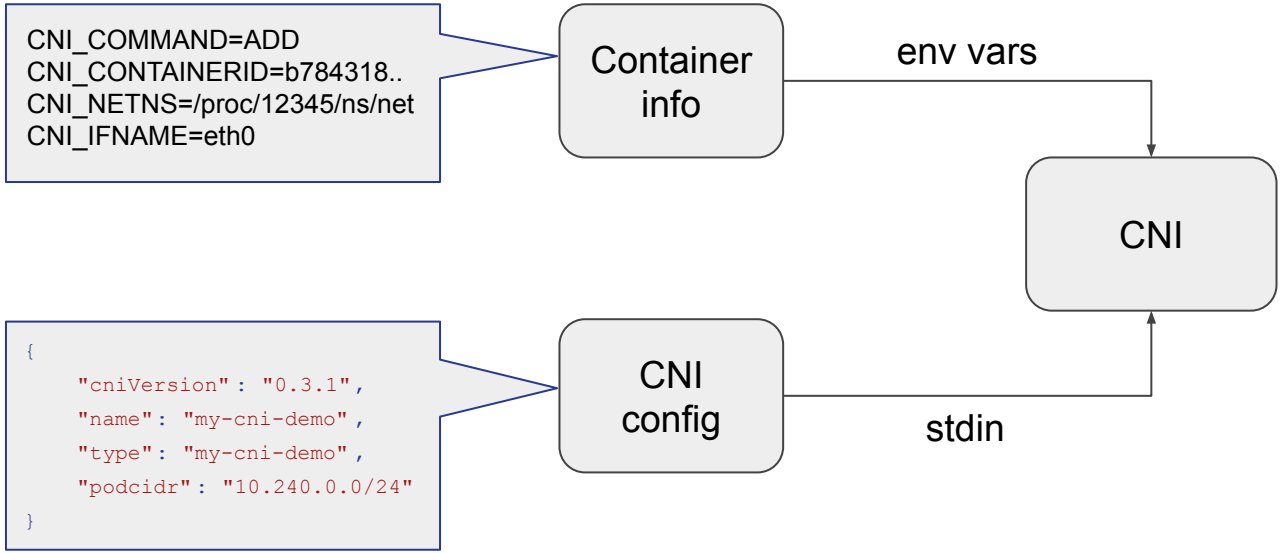
How a CNI plugin is executed?



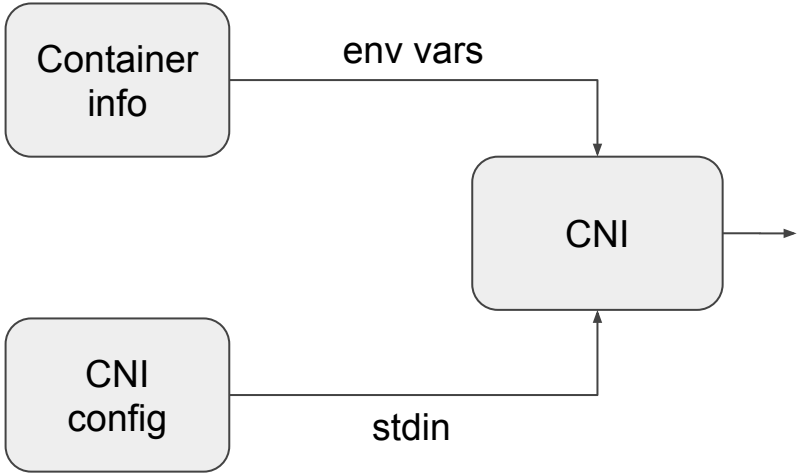
How a CNI plugin is executed?



How a CNI plugin is executed?

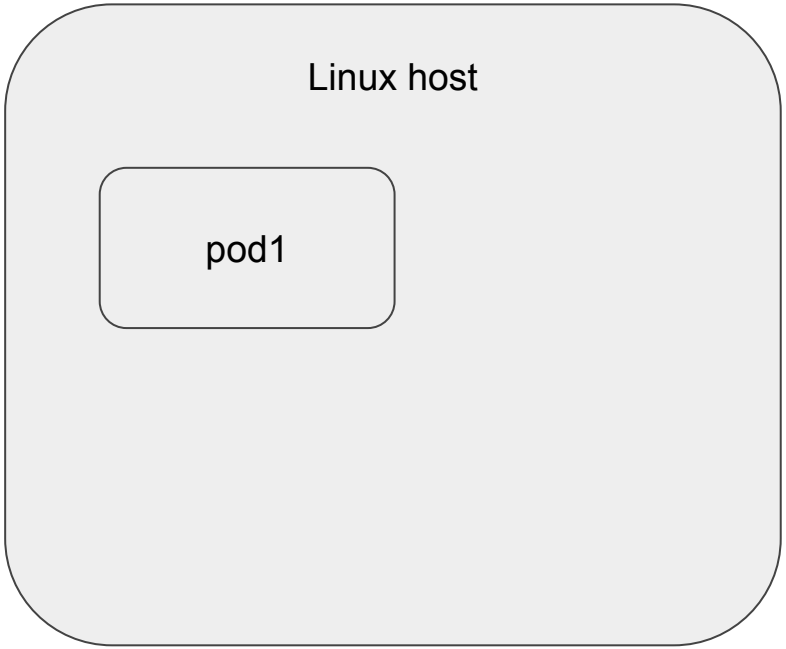


How a CNI plugin is executed?

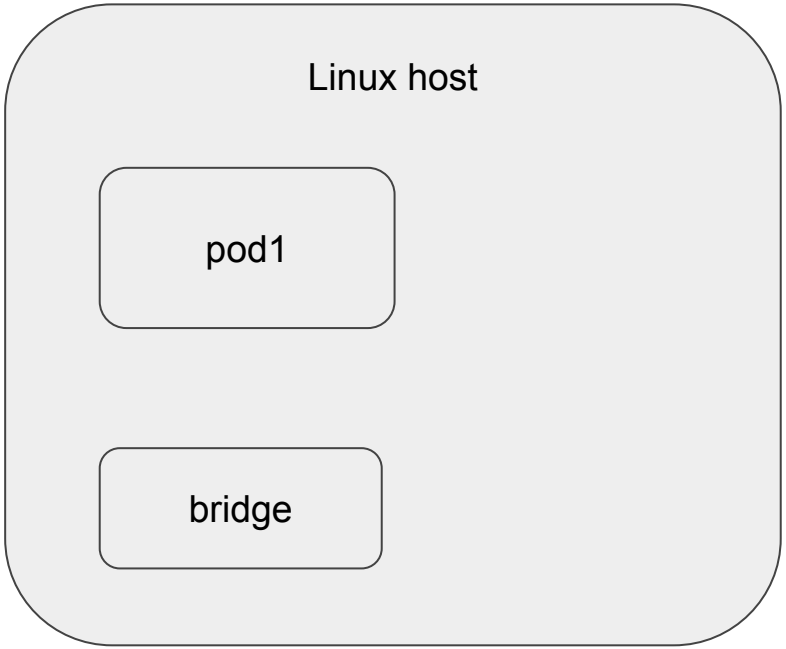



```
{
 "cniVersion": "0.3.1",
 "interfaces": [
     {
         "name": "eth0",
         "mac": "ce:60:4c:b9:3a:06",
         "sandbox": "/proc/15116/ns/net"
     }
 ],
 "ips": [
     {
         "version": "4",
         "address": "10.240.0.6/24",
         "gateway": "10.240.0.1",
         "interface": 0
     }
 ]
}
```

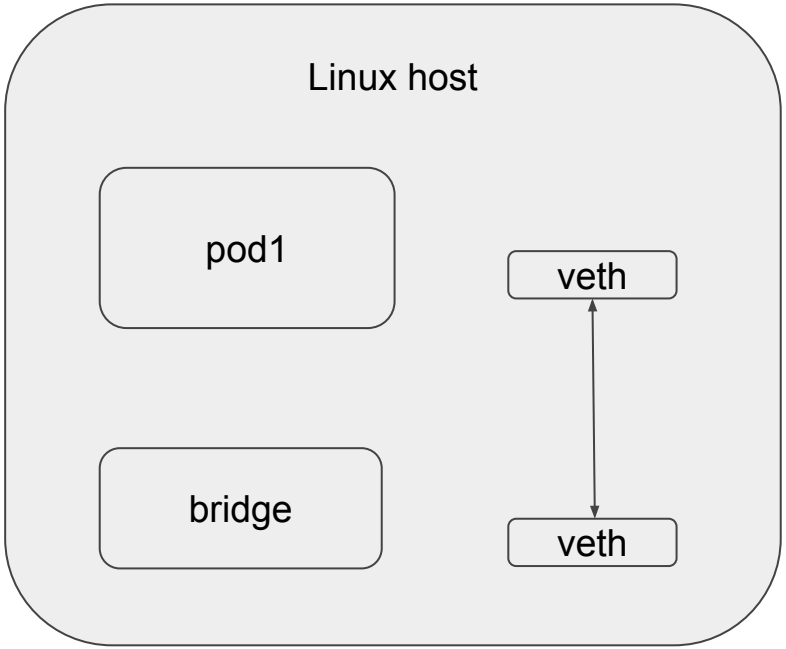
Anatomy of pod networking



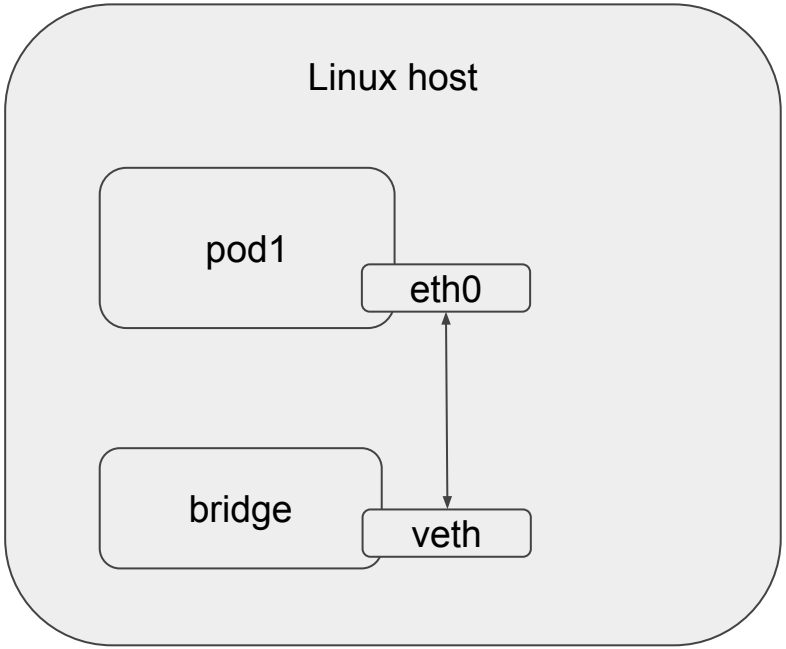
Anatomy of pod networking



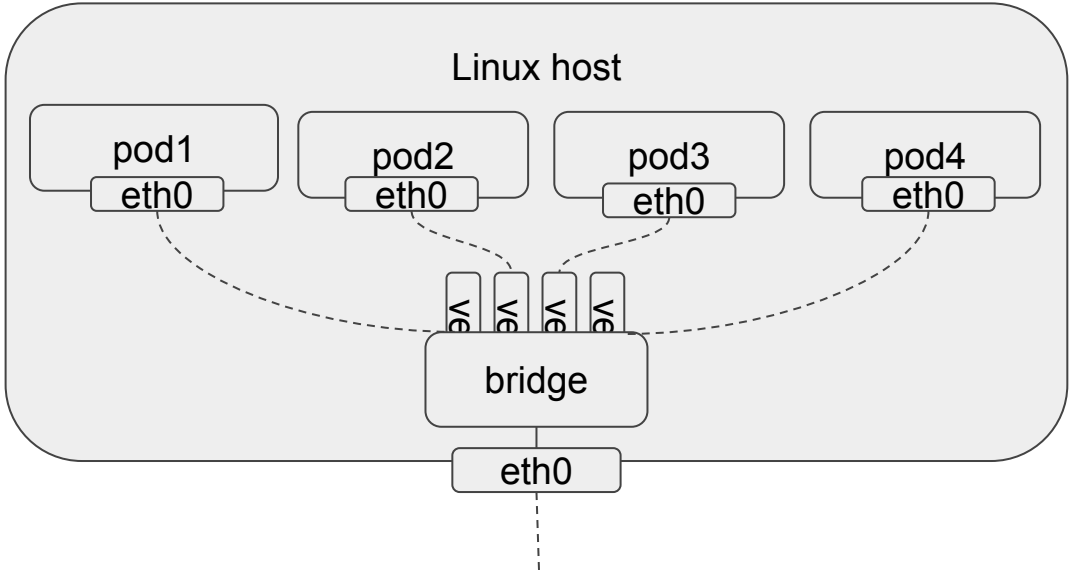
Anatomy of pod networking



Anatomy of pod networking

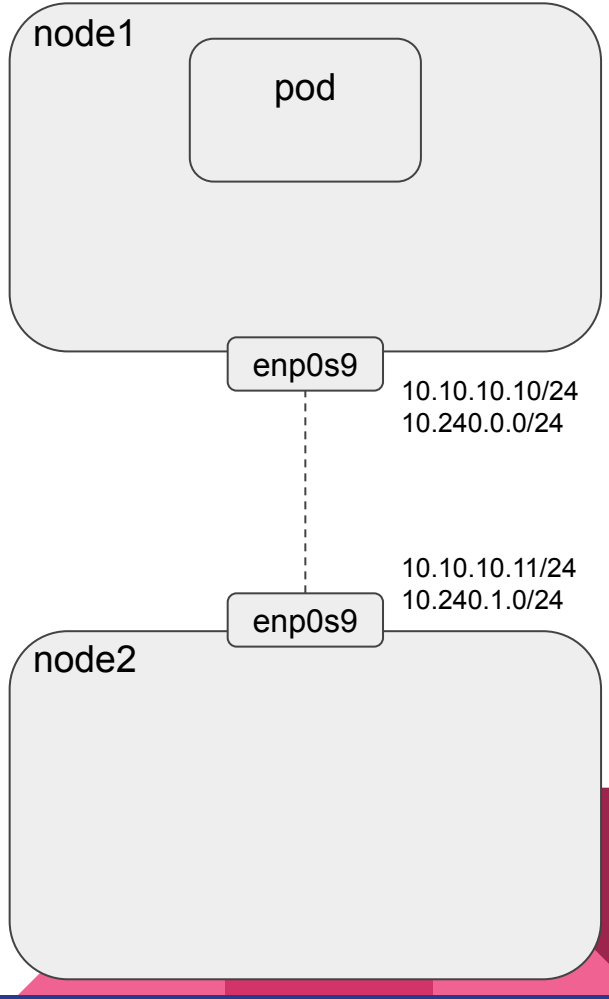


Anatomy of pod networking

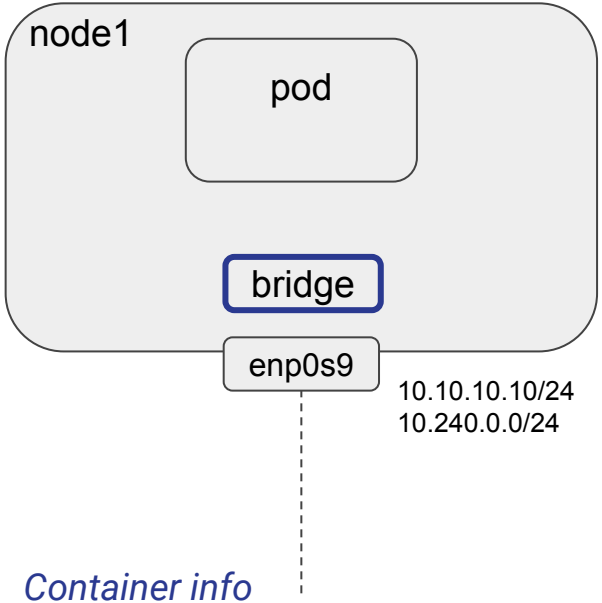


```
# cat /etc/cni/net.d/10-my-cni-demo.conf
{
    "cniVersion": "0.3.1",
    "name": "my-cni-demo",
    "type": "my-cni-demo",
    "podcidr": "10.240.0.0/24",
}

# cat /opt/cni/bin/my-cni-demo
case $CNI_COMMAND in
ADD)
   ;; # Configure networking
DEL)
    ;; # Cleanup
GET)
    ;;
VERSION)
    ;; # Print plugin version
esac
```



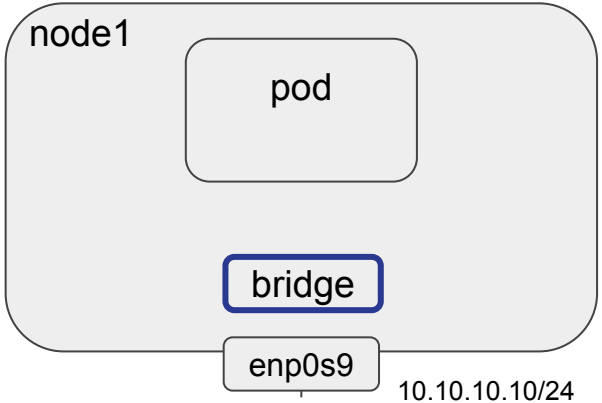
```
case $CNI_COMMAND in
ADD)
  podcidr=$(cat /dev/stdin | jq -r ".podcidr") # 10.240.0.0/24
  podcidr_gw=$(echo $podcidr | sed "s:0/24:1:g") # 10.240.0.1
;;
```



Container info

```
CNI_CONTAINERID=b552f9…
CNI_IFNAME=eth0
CNI_COMMAND=ADD
CNI_NETNS=/proc/6137/ns/net
```

```
case $CNI_COMMAND in
ADD)
  podcidr=$(cat /dev/stdin | jq -r ".podcidr") # 10.240.0.0/24
  podcidr_gw=$(echo $podcidr | sed "s:0/24:1:g") # 10.240.0.1
  brctl addbr cni0 # create a new bridge (if doesnt exist), cni0
  ip link set cni0 up
  ip addr add "${podcidr_gw}/24" dev cni0 # assign 10.240.0.1/24 to cni0
;;
```

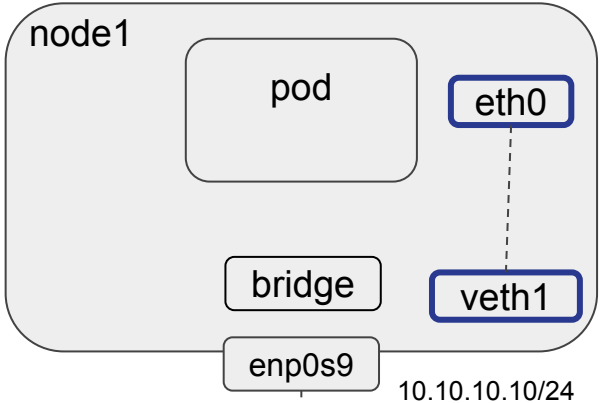


Container info

```
CNI_CONTAINERID=b552f9…
CNI_IFNAME=eth0
CNI_COMMAND=ADD
CNI_NETNS=/proc/6137/ns/net
```

```
case $CNI_COMMAND in
ADD)
  podcidr=$(cat /dev/stdin | jq -r ".podcidr") # 10.240.0.0/24
  podcidr_gw=$(echo $podcidr | sed "s:0/24:1:g") # 10.240.0.1
  brctl addbr cni0 # create a new bridge (if doesnt exist), cni0
  ip link set cni0 up
  ip addr add "${podcidr_gw}/24" dev cni0 # assign 10.240.0.1/24 to cni0

  host_ifname="veth$n" # n=1,2,3...
  ip link add $CNI_IFNAME type veth peer name $host_ifname
  ip link set $host_ifname up
;;
```



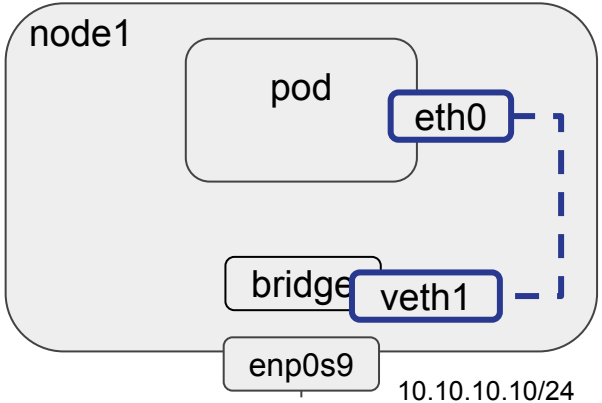
Container info

```
CNI_CONTAINERID=b552f9…
CNI_IFNAME=eth0
CNI_COMMAND=ADD
CNI_NETNS=/proc/6137/ns/net
```

```
case $CNI_COMMAND in
ADD)
  podcidr=$(cat /dev/stdin | jq -r ".podcidr") # 10.240.0.0/24
  podcidr_gw=$(echo $podcidr | sed "s:0/24:1:g") # 10.240.0.1
  brctl addbr cni0 # create a new bridge (if doesnt exist), cni0
  ip link set cni0 up
  ip addr add "${podcidr_gw}/24" dev cni0 # assign 10.240.0.1/24 to cni0

  host_ifname="veth$n" # n=1,2,3...
  ip link add $CNI_IFNAME type veth peer name $host_ifname
  ip link set $host_ifname up

  ip link set $host_ifname master cni0 # connect veth1 to bridge
  ln -sfT $CNI_NETNS /var/run/netns/$CNI_CONTAINERID
  ip link set $CNI_IFNAME netns $CNI_CONTAINERID # move eth0 to pod ns
;;
```



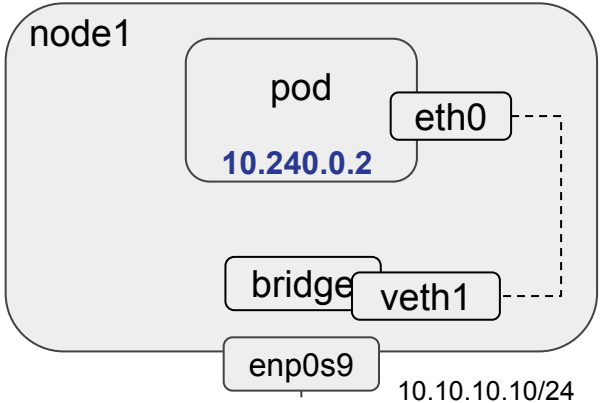
Container info

```
CNI_CONTAINERID=b552f9…
CNI_IFNAME=eth0
CNI_COMMAND=ADD
CNI_NETNS=/proc/6137/ns/net
```

```
case $CNI_COMMAND in
ADD)
  podcidr=$(cat /dev/stdin | jq -r ".podcidr") # 10.240.0.0/24
  podcidr_gw=$(echo $podcidr | sed "s:0/24:1:g") # 10.240.0.1
  brctl addbr cni0 # create a new bridge (if doesnt exist), cni0
  ip link set cni0 up
  ip addr add "${podcidr_gw}/24" dev cni0 # assign 10.240.0.1/24 to cni0

  host_ifname="veth$n" # n=1,2,3...
  ip link add $CNI_IFNAME type veth peer name $host_ifname
  ip link set $host_ifname up

  ip link set $host_ifname master cni0 # connect veth1 to bridge
  ln -sfT $CNI_NETNS /var/run/netns/$CNI_CONTAINERID
  ip link set $CNI_IFNAME netns $CNI_CONTAINERID # move eth0 to pod ns
  # calculate $ip
  ip netns exec $CNI_CONTAINERID ip link set $CNI_IFNAME up
  ip netns exec $CNI_CONTAINERID ip addr add $ip/24 dev $CNI_IFNAME
  ip netns exec $CNI_CONTAINERID ip route add default via $podcidr_gw
dev $CNI_IFNAME
```



Container info

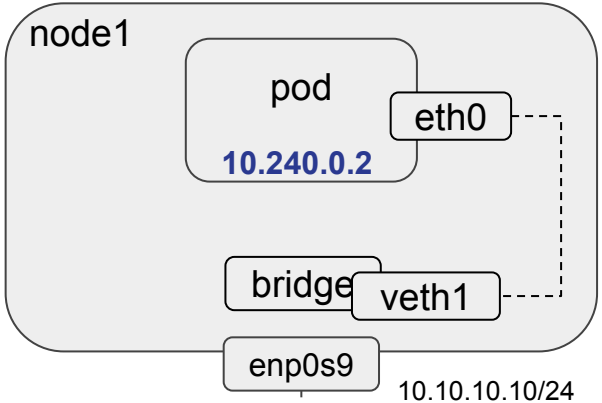
```
CNI_CONTAINERID=b552f9…
CNI_IFNAME=eth0
CNI_COMMAND=ADD
CNI_NETNS=/proc/6137/ns/net
```

```
case $CNI_COMMAND in
ADD)
  podcidr=$(cat /dev/stdin | jq -r ".podcidr") # 10.240.0.0/24
  podcidr_gw=$(echo $podcidr | sed "s:0/24:1:g") # 10.240.0.1
  brctl addbr                                                    i0
  ip link set
  ip addr add                                                    /24 to cni0

  host_ifname
  ip link add
  ip link set

  ip link set $host_        master cni0 # connect veth1 to bridge
  ln -sfT $CNI_NETNS        r/run/netns/$CNI_CONTAINERID
  ip link set $CNI_         NAME netns $CNI_CONTAINERID # move eth0 to pod ns
  # calculate $ip
  ip netns exec $CNI_CONTAINERID ip link set $CNI_IFNAME up
  ip netns exec $CNI_CONTAINERID ip addr add $ip/24 dev $CNI_IFNAME
  ip netns exec $CNI_CONTAINERID ip route add default via $podcidr_gw
dev $CNI_IFNAME
```

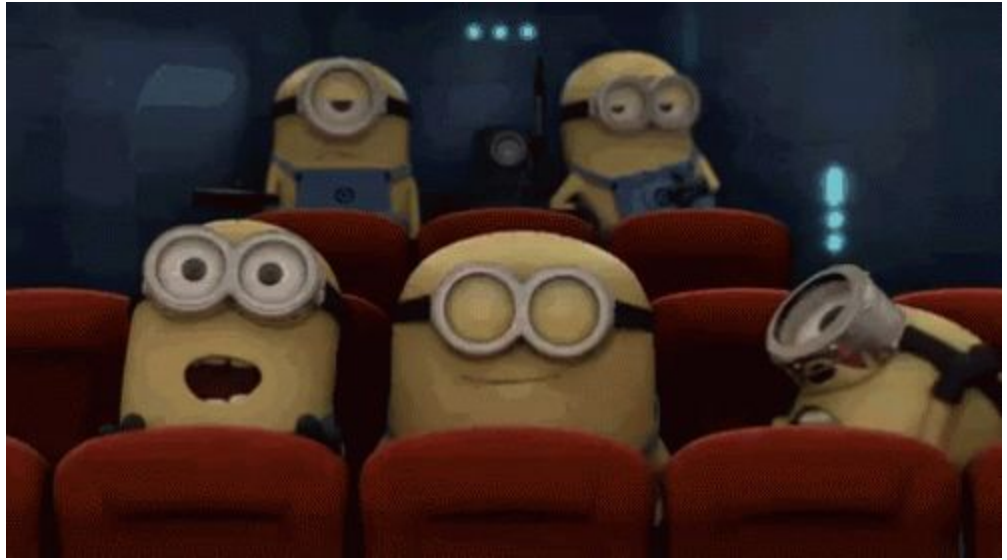
```
if [ -f /tmp/last_allocated_ip ];then
   n=`cat /tmp/last_allocated_ip`
else
   n=1
fi
ip=$(echo $podcidr | sed "s:0/24:$(($n+1)):g")
echo $(($n+1)) > /tmp/last_allocated_ip
```



Container info

```
CNI_CONTAINERID=b552f9…
CNI_IFNAME=eth0
CNI_COMMAND=ADD
CNI_NETNS=/proc/6137/ns/net
```

Lets see a demo!



Thank you!