

Lab 2: Advanced Kubernetes Networking with Multus and OVS-CNI

In this lab, you will learn how to enhance Kubernetes pod networking using Multus to add secondary network interfaces and Open Virtual Switch CNI (OVS-CNI) to manage virtual network connections.

This setup is used in our 5G core network architectures to support traffic isolation for different interfaces between pods.

About OVS

- **What is OVS?** A software-based switch enabling network connectivity in virtualized environments, such as VMs, containers, and physical devices.
- **Importance in 5G:** SDN controllers like ONOS can be used to orchestrate and manage network slices in real-time, enabling the creation of isolated paths with specific Quality of Service (QoS) requirements for each slice.
- **Container Networking with OVS-CNI:** OVS-CNI integrates OVS in Kubernetes, supporting multi-interface pods and advanced network setups.

Prerequisites

Change into the lab2 directory, where you can find all required files for this lab.

```
cd labs/lab2
```

Ensure that Multus and OVS-CNI are installed and configured in your Kubernetes cluster. Verify by running:

```
kubectl get pods -A | grep -E 'multus|ovs'
```

cluster-network-addons	ovs-cni-amd64-5gjpg	1/1	Running
kube-system	kube-multus-ds-pt78j	1/1	Running

You should see Multus and OVS pods and they should be in **Running** state.

Creating OVS Bridges

Let's create one OVS bridge to understand the fundamentals of adding secondary interfaces to pods using OVS-CNI.

Create an OVS bridge (`br0`) on your host.

```
sudo ovs-vsctl add-br br0
```

You can check if the bridge has been created using:

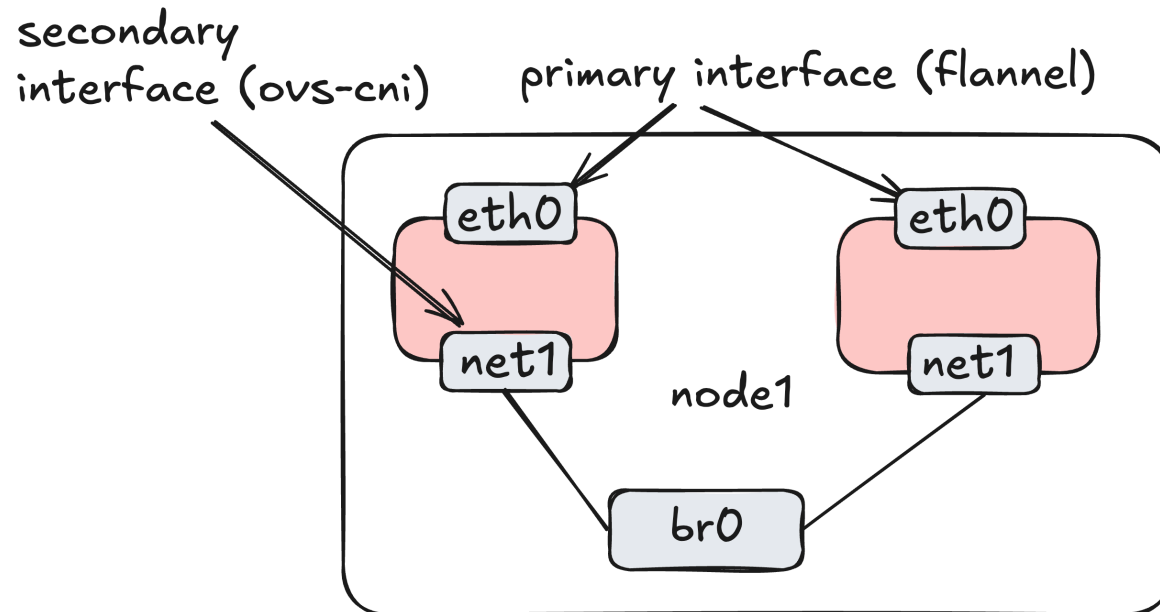
```
sudo ovs-vsctl show
```

Note: If you have used the testbed-automator script, you will also see three other bridges - `n2br` , `n3br` and `n4br` , which will be used later when we deploy our 5G core network.

Create NADs with Multus

Network Attachment Definitions (NADs) allow you to add secondary network interfaces to Kubernetes pods using Multus.

In this lab, we will define a NAD to add an additional network interface to an Ubuntu pod.



Create a simple NAD

We will use `secondary-network.yaml` to create our NAD which will associate our secondary interface with the OVS bridge we just created.

```
kind: NetworkAttachmentDefinition
spec:
  config: '{
    "cniVersion": "0.3.1",
    "type": "ovs",
    "bridge": "br0",
    ...
  }'
```

```
kubectl apply -f secondary-network.yaml
```

You can verify whether they have been deployed using:

```
kubectl get network-attachment-definitions -n workshop
```

Deploy Pod with a Secondary Interface

Let's look at `ubuntu-multus-pod.yaml` :

```
apiVersion: v1
kind: Pod
metadata:
  name: ubuntu-multus
  annotations:
    k8s.v1.cni.cncf.io/networks: '[
      { "name": "secondary-network", "ips": [ "10.10.1.11/24" ] } ]'
  ...
```

Deploy the pod as follows:

```
kubectl apply -f ubuntu-multus-pod.yaml
```

Verify that the pod is deployed and running as follows:

```
kubectl get pods -n workshop
```

Verify the Secondary Interface

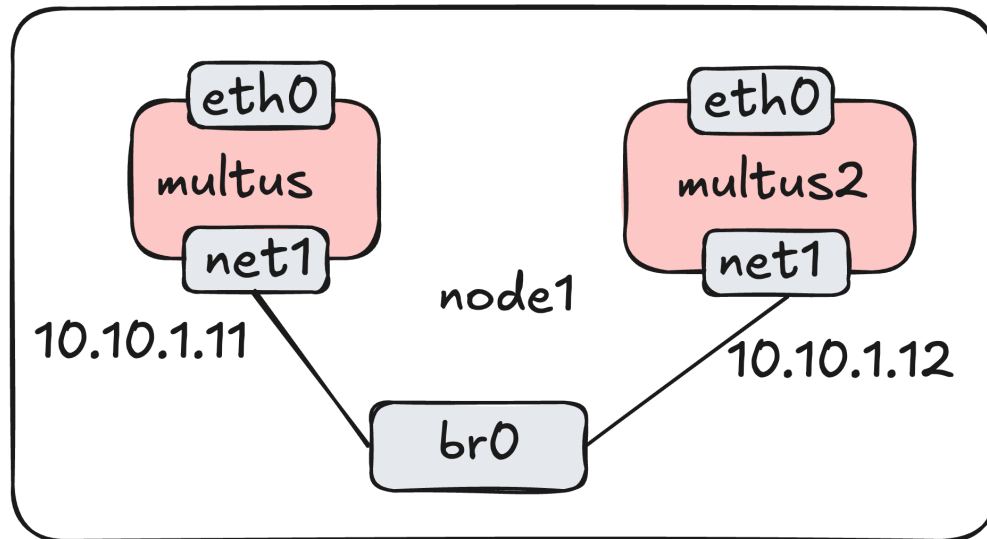
Once the pod is running, verify the secondary interface, by executing

```
kubectl exec -it -n workshop ubuntu-multus -- ip addr
```

You should see an additional interface `net1` besides the default `eth0`, with an IP address `10.10.1.11` as specified in `secondary-network.yaml`.

Testing Connectivity between Pods

To test if our secondary interface is working, we can deploy a topology as follows using OVS-CNI. The secondary interface `net1` will connect both `ubuntu-multus` and `ubuntu-multus2` pods.



Deploy a second Ubuntu Pod

Let's create another pod with a similar configuration, but different IP addresses. Look at the the `ubuntu-multus-pod2.yaml` file. Here the `metadata -> annotations -> k8s.v1.cni.cncf.io/networks -> ips` has been changed to `10.10.1.12`:

```
apiVersion: v1
kind: Pod
metadata:
  name: ubuntu-multus2
  annotations:
    k8s.v1.cni.cncf.io/networks: '[
      { "name": "secondary-network", "ips": ["10.10.1.12/24"]
      } ]'
  ...
```

Apply the configuration

```
kubectl apply -f ubuntu-multus-pod2.yaml
```

Verify connectivity

Once the second pod is running, ping the IP of `ubuntu-multus2`'s secondary interface from the first multus pod:

```
kubectl exec -it ubuntu-multus -n workshop -- ping 10.10.1.12 -c 4
```

You should see the pings going through.

Congratulations! You have successfully configured multi-interface networking in Kubernetes using OVS-CNI. Now you are ready to deploy the 5G network! Continue to deploying the 5G network with [open5gs-k8s](#).