
KubeCon
CloudNativeCon
North America 2023


KubeCon | CloudNativeCon

North America 2023

Multi-Network, A New Level of Cluster Multi-Tenancy

Maciej Skrocki, Google
Doug Smith, Red Hat

Agenda

- What is K8s Native Multi-networking?
  - Use cases
- User Journey
- What happens with CNI and Container Runtimes?
- Get involved!

Introduction

 @mskrocki

Maciej Skrocki

- GKE/Anthos Networking team member @ Google

  @dougbtv

Doug Smith

- OpenShift Networking team member @ Red Hat
- Multus CNI maintainer
- Network Plumbing Working Group member
- Focus on analyzing gaps in containerized workloads for NFV, including container networking & orchestration (e.g. Kube & OpenShift)
- Blog: https://dougbtv.com


KubeCon | CloudNativeCon

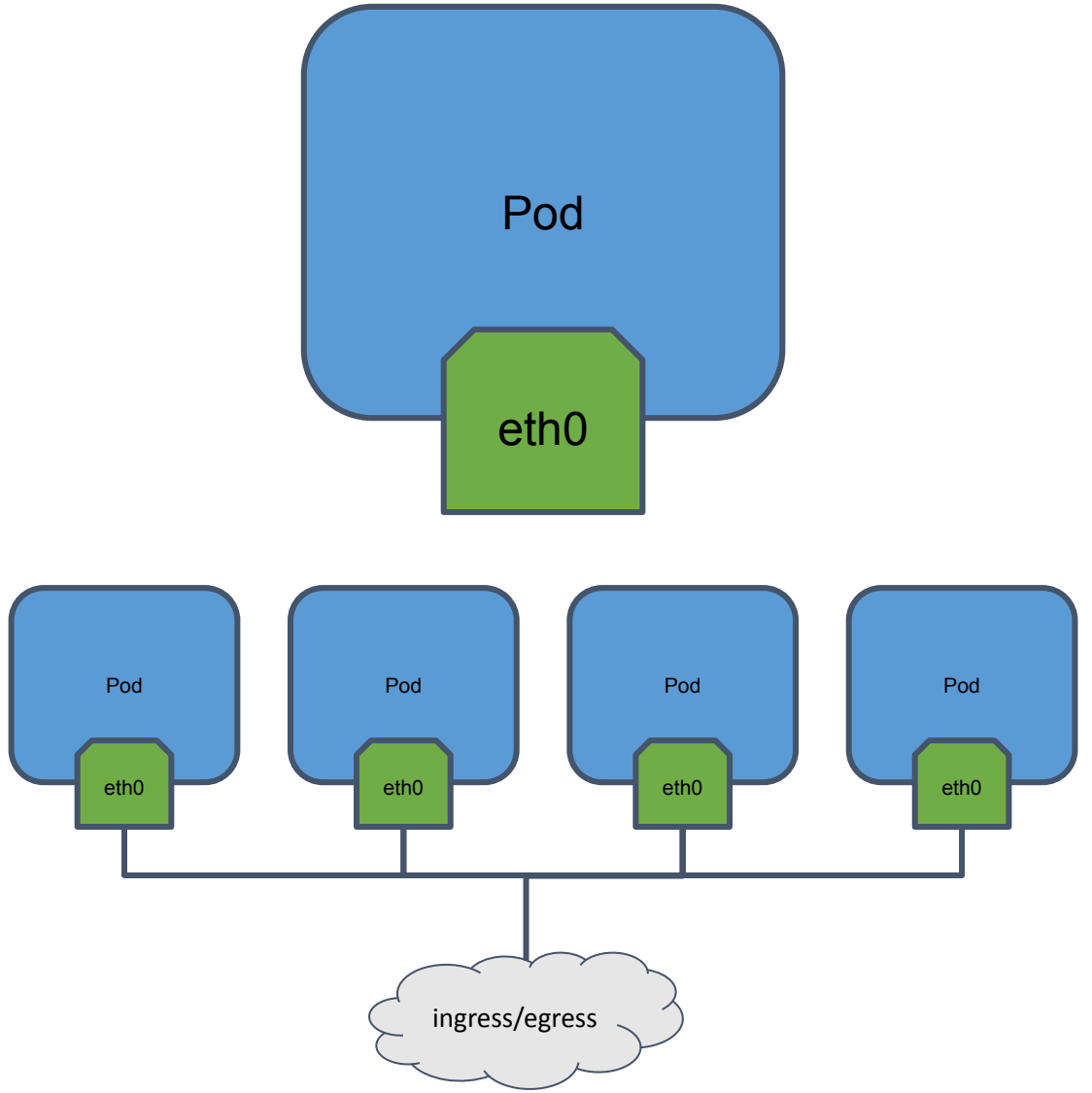
North America 2023

Multi-Network!

What is K8s Native Multi-Networking?

One Lone Network Interface…

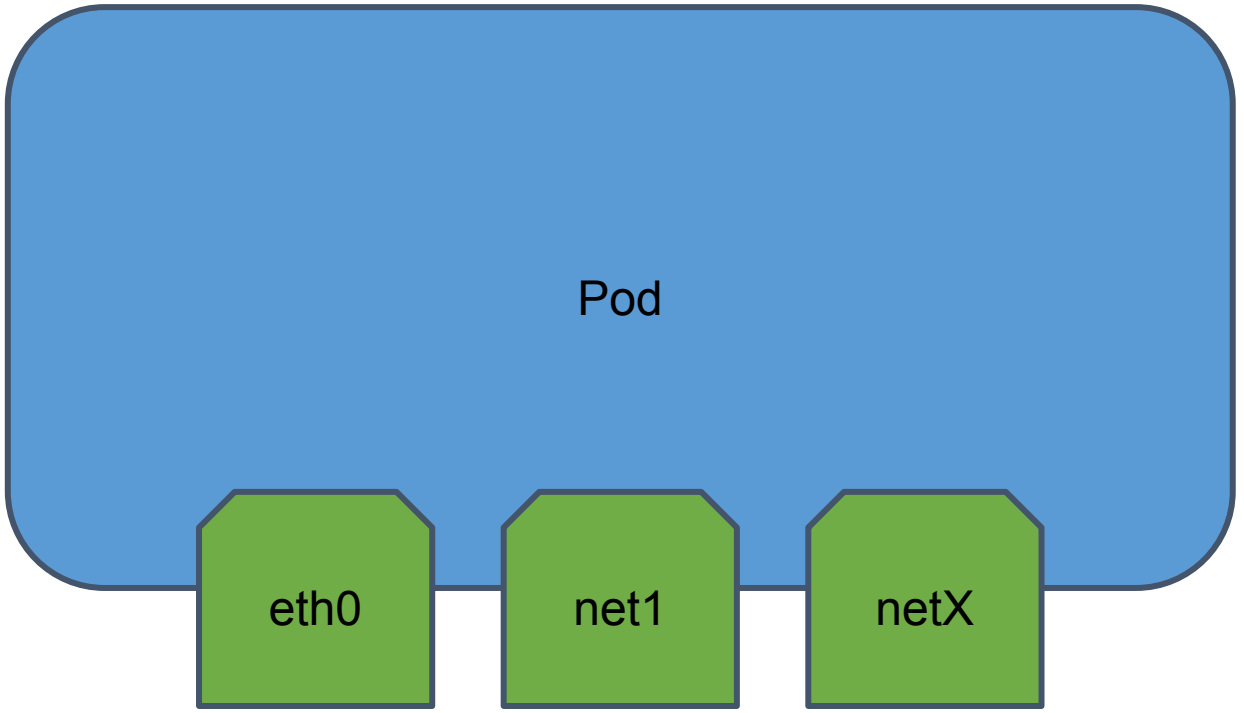
Today, by default, we have just one network interface on each pod, that pod is promised network connectivity among pods in the network…



What is K8s Native Multi-Networking?

ALL THE NETWORKS!

With K8s Native Multi-networking, we can provide advanced connectivity to complex network topologies, in order to isolate traffic, connect to existing networks, and more.



Why now?

It's about time

Kubernetes networking is pretty mature as a model, and has several stable implementations.
Kubernetes seems to have "crossed the chasm" and is being applied to more and more use-cases.
Because of that we (hopefully) are better able to absorb some complexity than we were 5 years ago, considering extra complexity is a tax paid by ALL, so we need to be careful.


KubeCon | CloudNativeCon

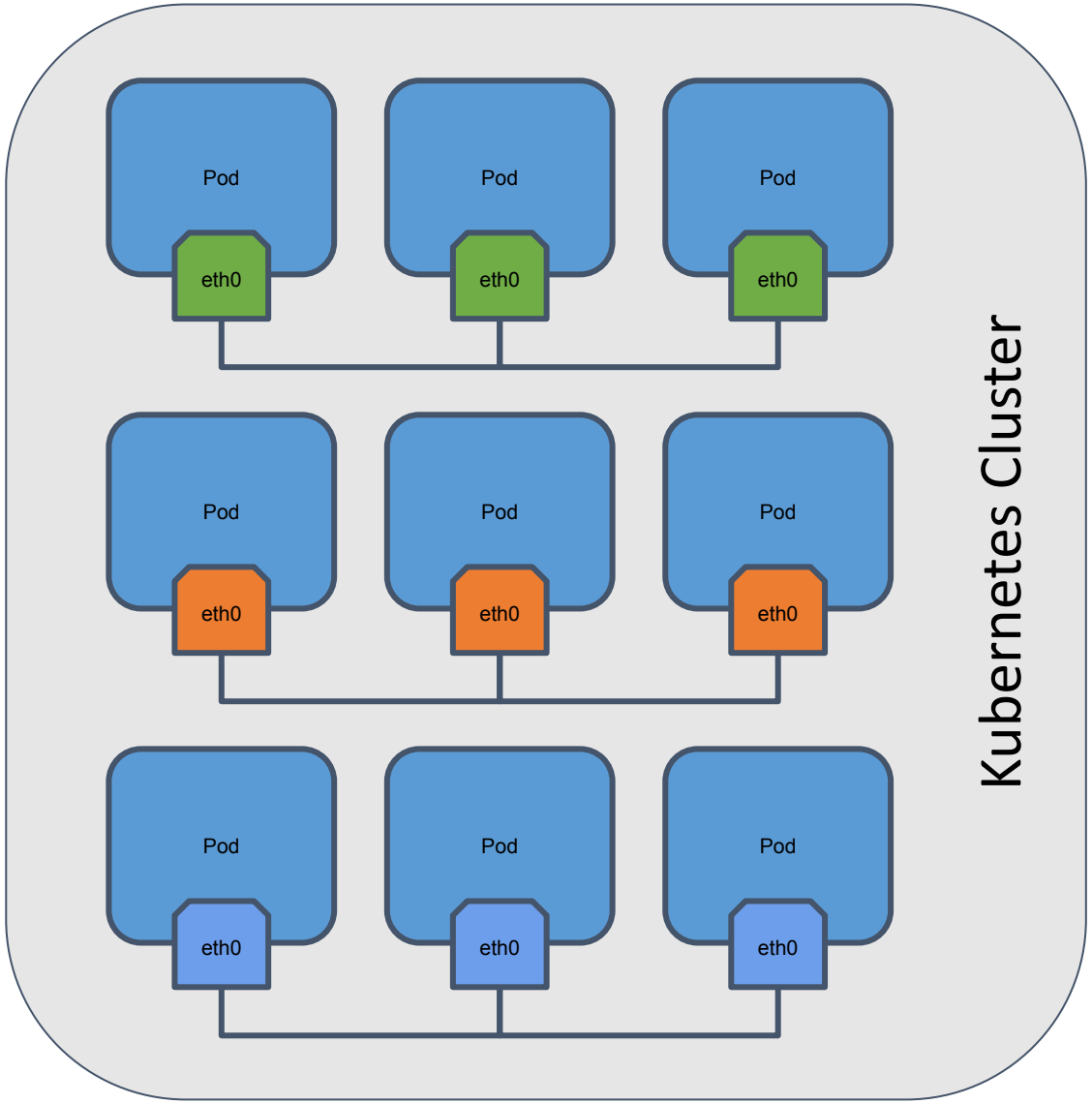
North America 2023

Use Cases

What is K8s Native Multi-Networking?

Multi-tenancy!

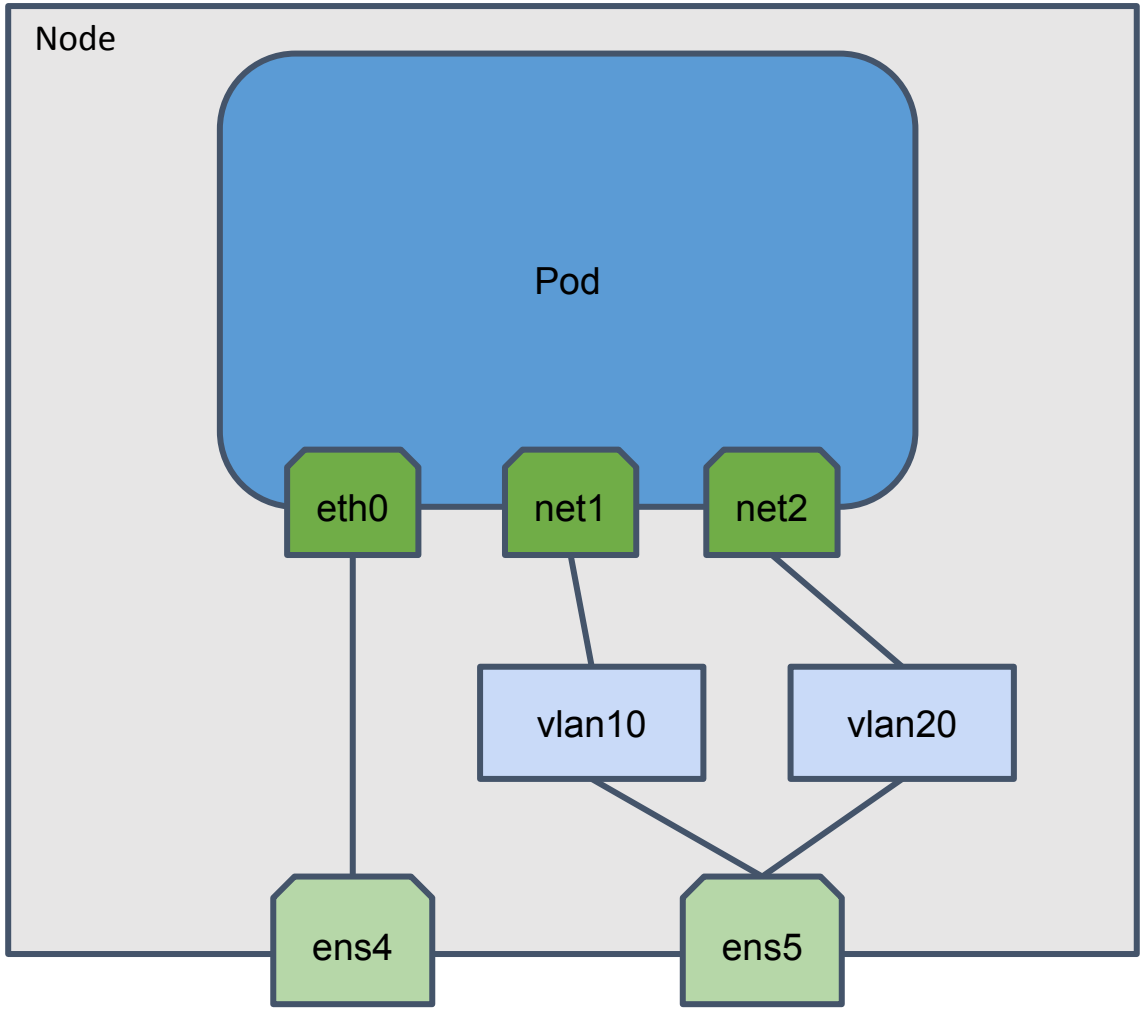
We can associate pods with specific networks and allow connectivity only within a client network, leveraging isolation for use as a multi-tenant environment in a single cluster



Use Cases: Network Isolation

Network Isolation

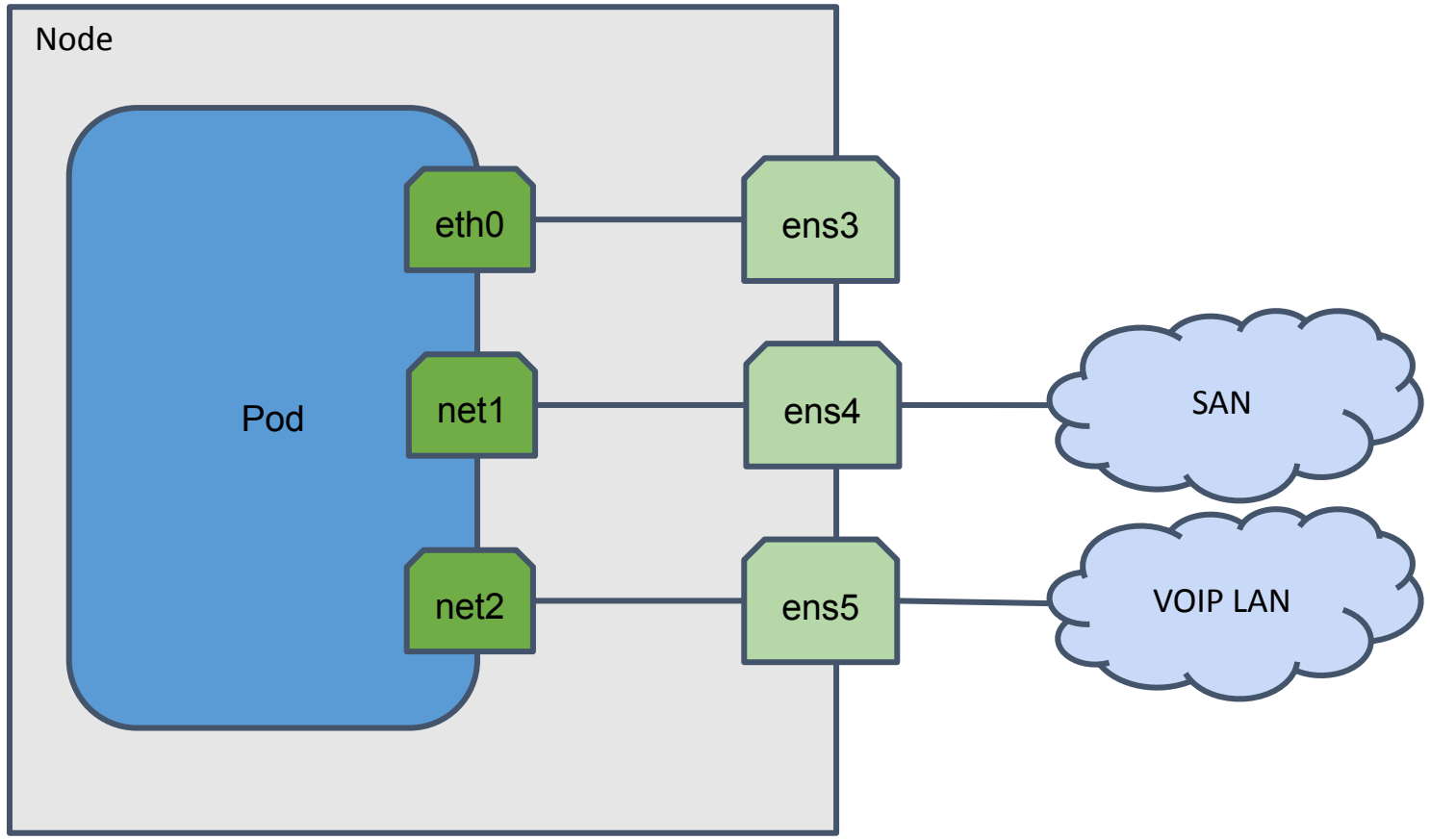
As a Cloud Native Network Function (CNF) vendor I require an additional interface to be provisioned into the Kubernetes Pod. Each of these interfaces has to be in an isolated network for regulatory compliance. The isolation has to be done on a Layer-2.



Use Cases: On-prem connectivity

On-premise connectivity

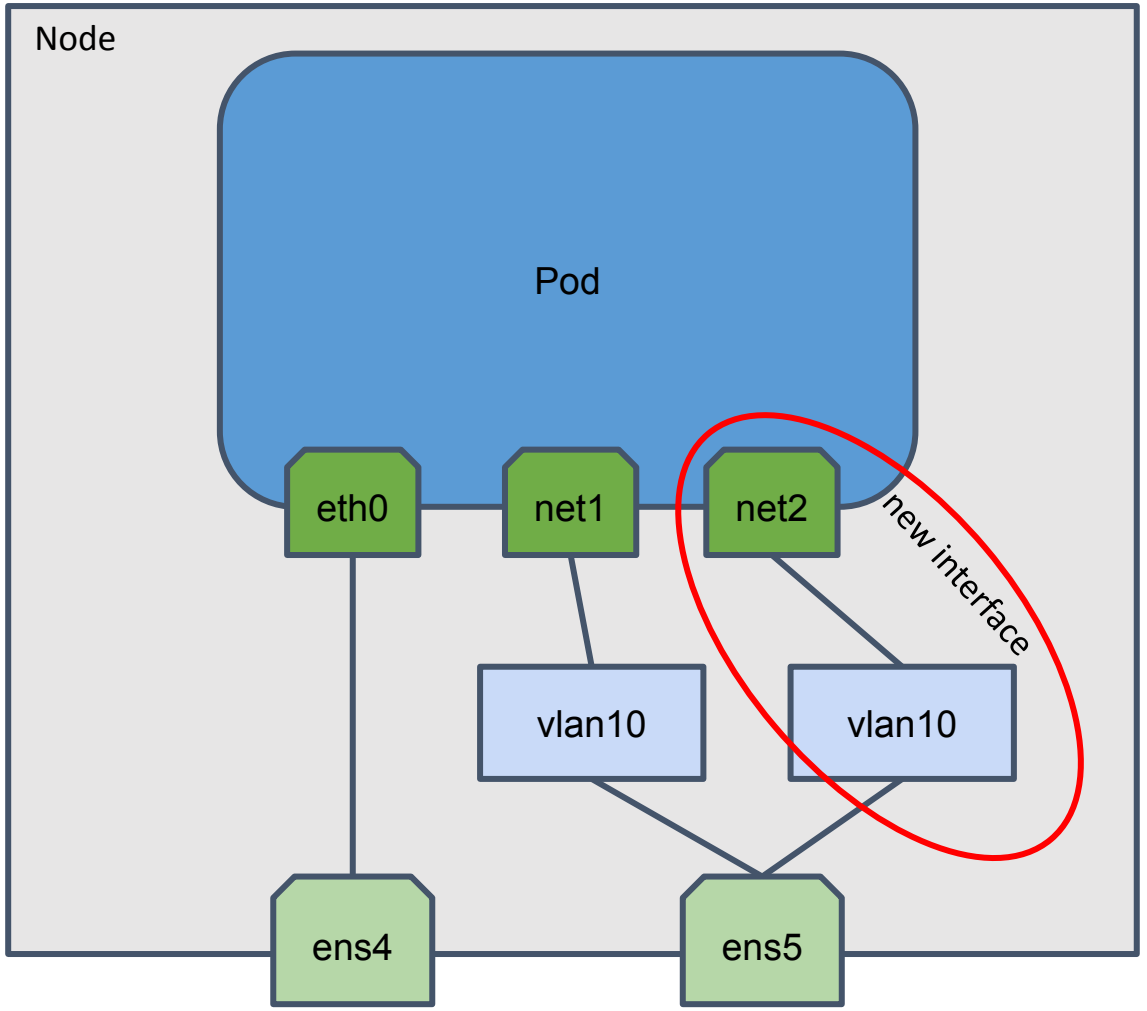
In bare metal and hybrid cloud architectures, networks may exist before Kubernetes is implemented, and some workloads may need access to these existing networks.



Use Cases: Hot Pluggable Interfaces

KubeVirt with hot pluggable interfaces

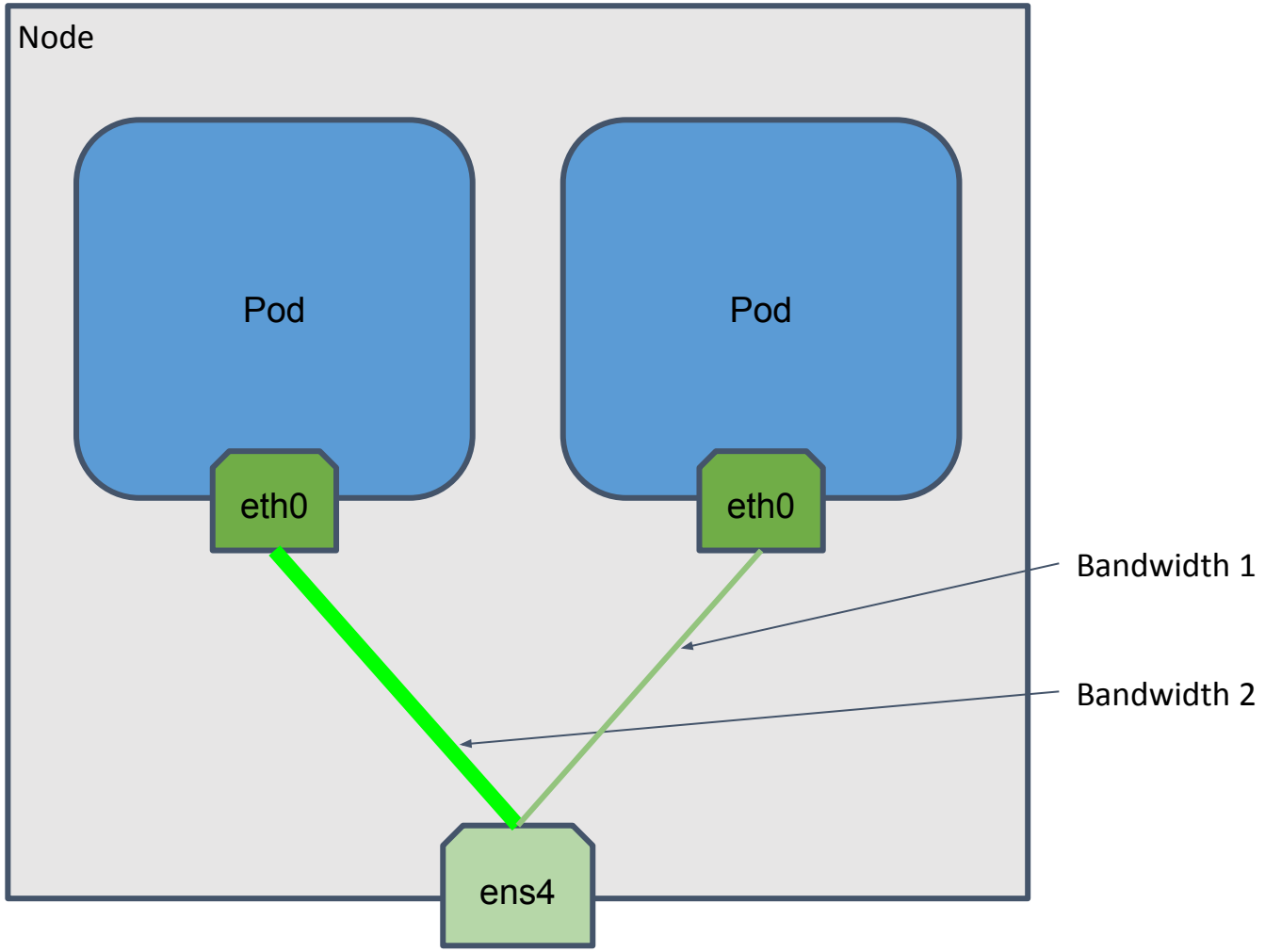
On traditional VM platforms, hot plugging an interface is a baseline assumption. In an organization's journey to cloud native, bringing feature parity for legacy VM workloads is crucial.



Use Cases: Pod-level link differentiation

Pod-level link differentiation

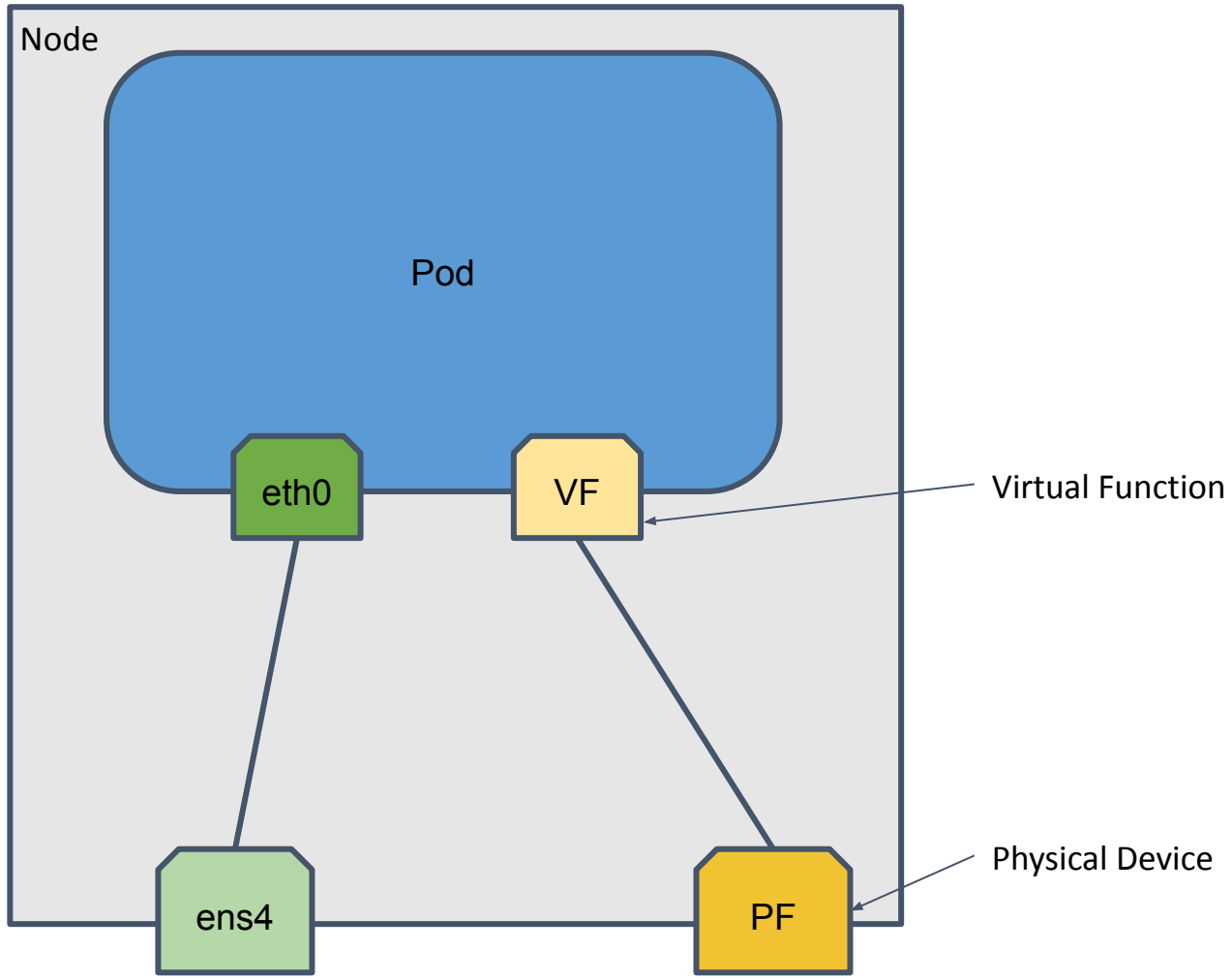
As Cluster operator I wish to introduce QoS tiers via bandwidth management. I wish to control this on a per pod basis, and at the same time preserve all other Pod networking configuration and, have a single reference for that network.



Use Cases: Performance Hardware

Performance Hardware

For performance networking use-cases, features of physical devices need to be utilized, as well as user-space networking (like DPDK), such as SR-IOV. Often times, Device Plugins need to add scheduler awareness about the hardware and resource availability on nodes.



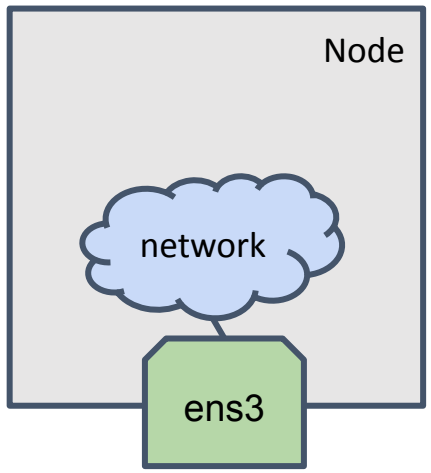

KubeCon | CloudNativeCon

North America 2023

User Journey

Define network with PodNetwork

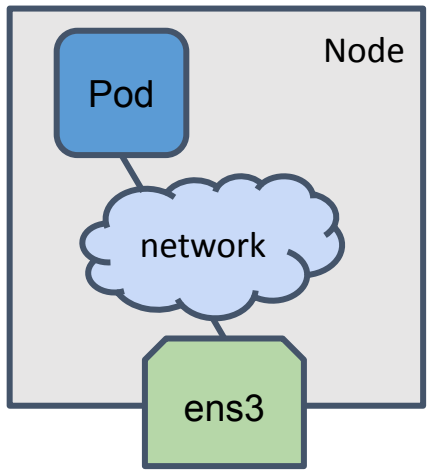
- simple and generic handle
- reference to custom resource
- no IPAM definition - handled externally




```yaml
---
apiVersion: v1
kind: PodNetwork
metadata:
  name: dataplane
spec:
  provider: "k8s.cni.cncf.io/multus"
  parametersRefs:
  - group: k8s.cni.cncf.io
    kind: network-attachment-definitions
    name: dp-network
    namespace: default
```

Reference PodNetwork in Pod

- expand Pod spec to list PodNetworks to attach
- additional, per-attachment configurability
- fully optional, using “default” PodNetwork




```
---
kind: Pod
metadata:
  name: pod1
spec:
  networks:
  - podNetworkName: default
    interfaceName: eth0
  - podNetworkName: dataplane
    interfaceName: net1
  [...]
```

Get the status

- expand existing status

```
---
kind: Pod
metadata:
  name: pod1
spec:
  [...]
status:
  podIP: 192.168.5.54
  podIPs:
  - ip: 192.168.5.54
    podNetwork: default
    interfaceName: eth0
  - ip: 10.0.0.20
    podNetwork: dataplane
    interfaceName: net1
  [...]
```

Get PodNetwork the status

- using standard kubernetes conditions
- add control to implementations

```
---
apiVersion: v1
kind: PodNetwork
metadata:
  name: dataplane
spec:
  [...]
status:
  conditions:
  - lastProbeTime: null
    lastTransitionTime: "2022-11-17T18:38:01Z"
    status: "True"
    type: Ready
  - lastProbeTime: null
    lastTransitionTime: "2022-11-17T18:38:01Z"
    status: "True"
    type: ParamsReady
```


KubeCon | CloudNativeCon

North America 2023

CNI & Runtime Considerations

net-attach-def vs. k8s native multi-net

Network Plumbing Working Group / Multus CNI

CNI JSON inside YAML and "out-of-tree"

```
---
kind: Pod
metadata:
  name: pod1
  annotations:
    k8s.cni.cncf.io/networks: '{"name":
"media-net", "interface": "net1"}'
spec:
  [...]
```

```
---
kind: NetworkAttachmentDefinition
[...]
spec:
  conf: '{
  "type": "bridge",
  "name": "media-net",
  "ipam": {"type": "static"}
}'
```

K8s Native Multi-networking / PodNetwork

All YAML and all "in tree"

```
---
kind: Pod
metadata:
  name: pod1
spec:
  networks:
  - podNetworkName: media-net
    interfaceName: net1
  [...]
```

```
---
apiVersion: v1
kind: PodNetwork
metadata:
  name: media-net
spec:
  provider: "myprovider.io/application"
```

What happens to CNI & Multus?

Multus CNI

Will still continue to operate as it does today.

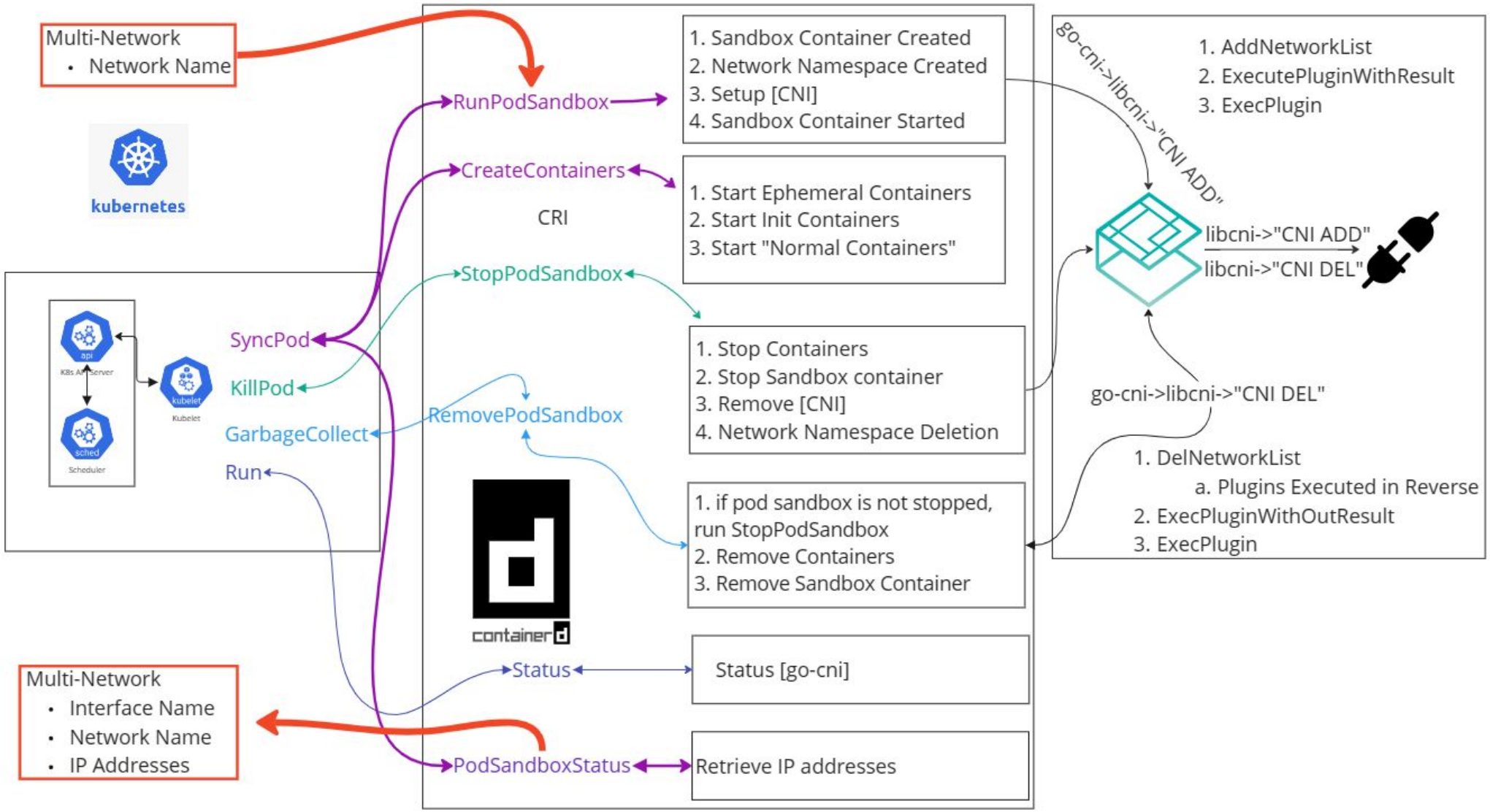
Network Plumbing Working Group

Is looking to define its North Star and next steps

Container Runtimes

We need to see what happens next

Container Runtime



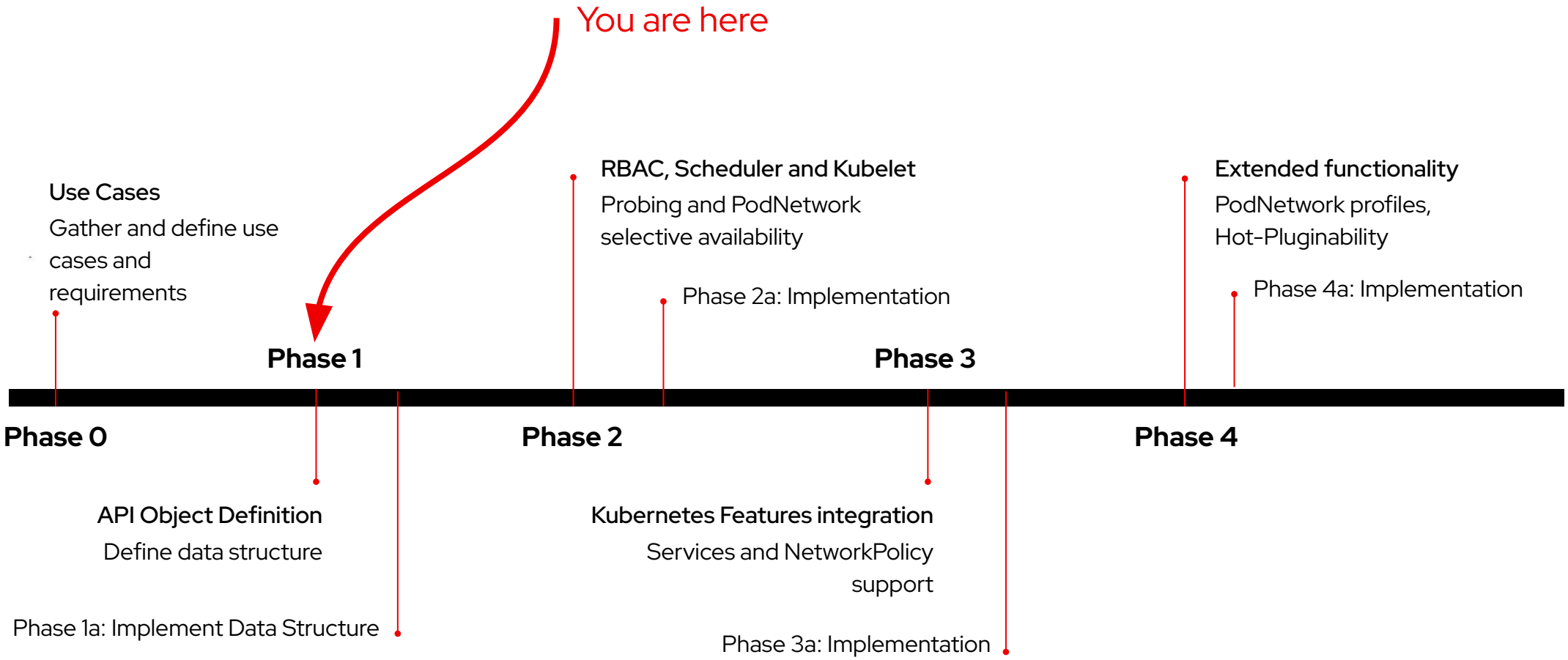

KubeCon | CloudNativeCon

North America 2023

Get Involved!

Where we're at today

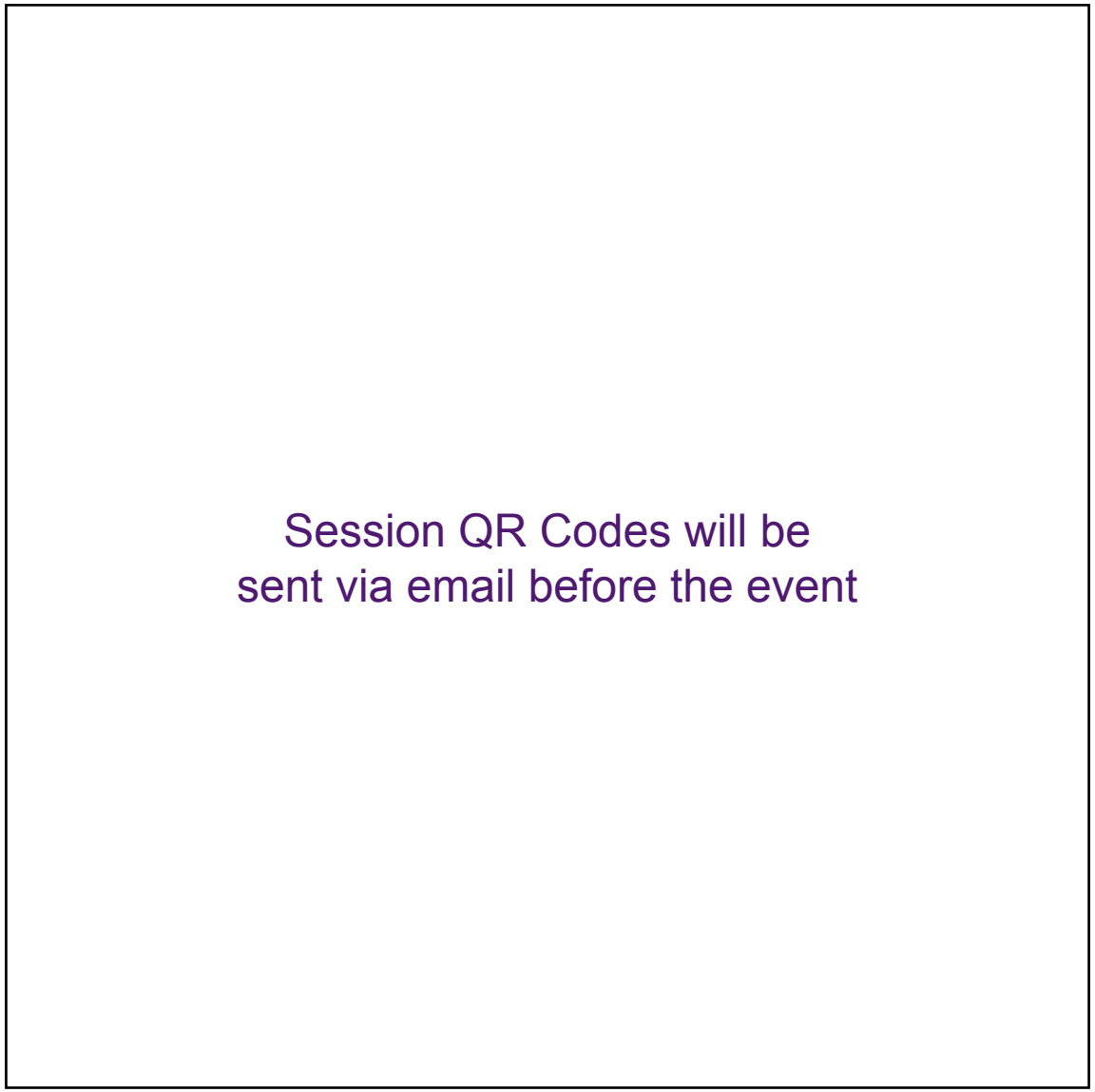
Current status and plan



All the links!

Join us:

- kubernetes slack channel **#sig-network-multi-network**
- weekly community sync **Wednesdays 8am PST**
- meeting doc - **https://tinyurl.com/k8s-mn-sync**
- KEP PR - https://github.com/kubernetes/enhancements/pull/3700



**Please scan the QR Code above
to leave feedback on this session**

PromCon
North America 2021