Network Service Mesh
Intro

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The Journey

- Some thoughts on Cloud Native Networking
  - Good Example: K8s Networking API
- Story Time: Marsha and the Multi-cloud Application
- How Network Service Mesh works at a High Level
- More Resources/Get Involved

Network Service Mesh

Some Thoughts on Cloud Native Networking

Cloud Native Definition

Cloud native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, **immutable infrastructure**, and declarative APIs exemplify this approach.

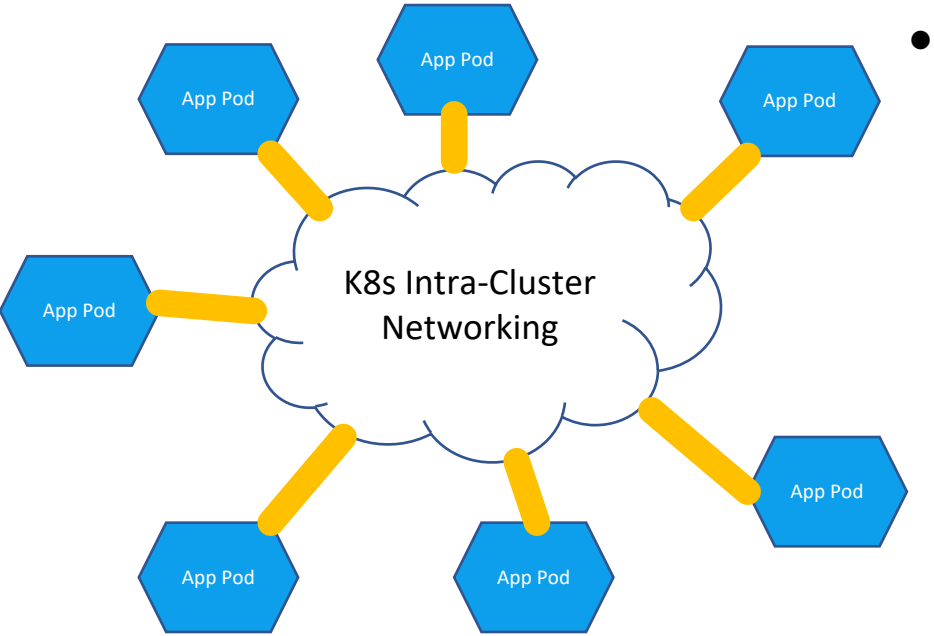
These techniques enable **loosely coupled** systems that are resilient, manageable, and observable. Combined with robust automation, they allow engineers to make high-impact changes frequently and predictably with **minimal toil**.

The Cloud Native Computing Foundation seeks to drive adoption of this paradigm by fostering and sustaining an ecosystem of open source, vendor-neutral projects. We democratize state-of-the-art patterns to make these innovations accessible for everyone.

Minimal Toil Networking

- Minimal Conceptual Toil
  - No Interfaces/Routes/Subnets as concepts
  - Conceptualize as ‘Network Services’
    - Intersection of Connectivity/Security/LoadBalancing/NAT/etc
- Minimal Consumption Toil
  - Ask for what you want by name:
    - secure-intranet-connectivity
    - manufacturing-partner-network
    - marshas-app-connectivity

Minimal Toil - Example

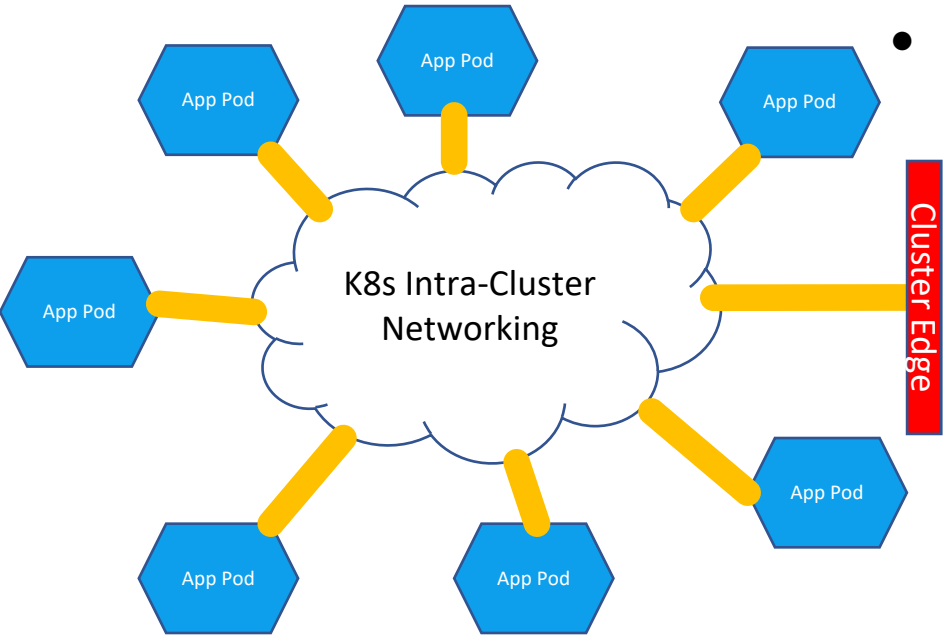


- Example: K8s Networking:
  - K8s Network Conceptually:
    - Connectivity - L3 between all Pods
    - Security - Network Policies
    - Load Balancing - Services/Endpoints
    - But mostly Intra-cluster
  - Consumption:
    - It's just there
    - Network Policies/Services are easy

Loose Coupling

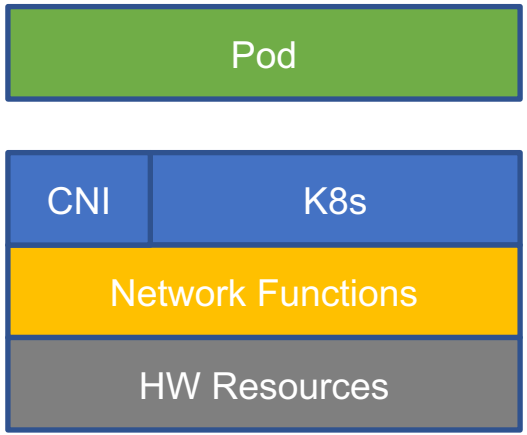
- App Microservices are loosely coupled to each other:
  - Allows lego block assembly of complex patterns from simple primitives
  - Flexibility
- Historically, Networking is **strongly coupled**
  - Networking is defined at the level of
    - Cluster
    - Datacenter
    - VPC
    - Etc
  - Coarse Granularity - many workloads get the same ‘Network Service’ based on where they **run**, not what they need.
    - You may have fine tuning, but only the same ones everyone in that domain gets

Loose Coupling



- Example: K8s Networking:
  - K8s API loosely coupled to implementation
    - Many CNI plugins
  - Strongly coupled to cluster
    - Usually one CNI per cluster
  - Single Edge for entire cluster
    - Or possibly multiple clusters
  - Coarse granularity
    - Realistically all workloads in cluster or none

Immutable Infrastructure



- Pods/Network Services use, rather than modify, infrastructure
- Unprivileged

Network Service Mesh

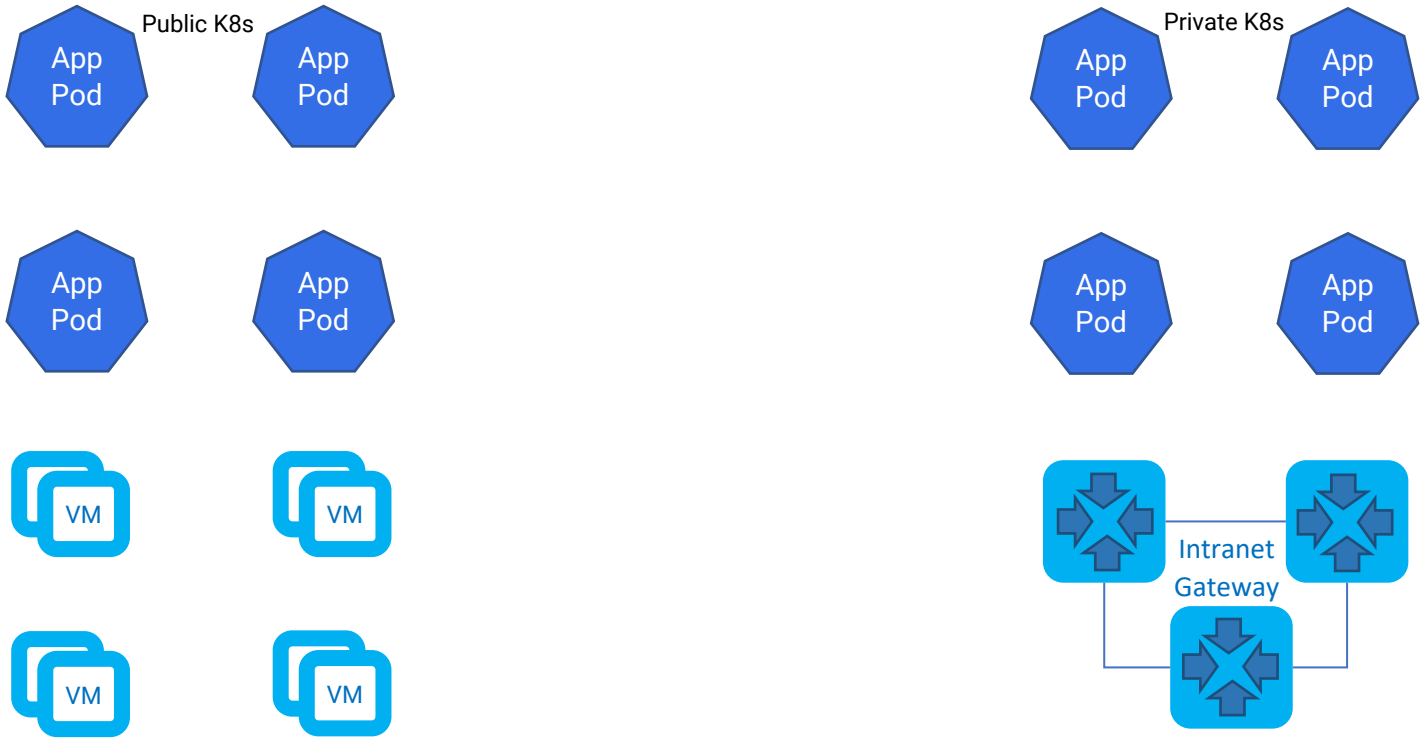
Story Time
Marsha and the multi-cloud application

Marsha

Meet Marsha. Marsha is building an app that has a lot of **multi-cloud** and **hybrid** cloud aspects.

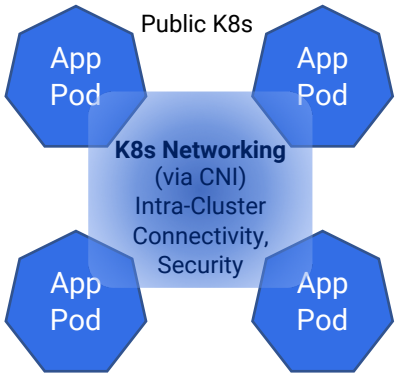
Marsha

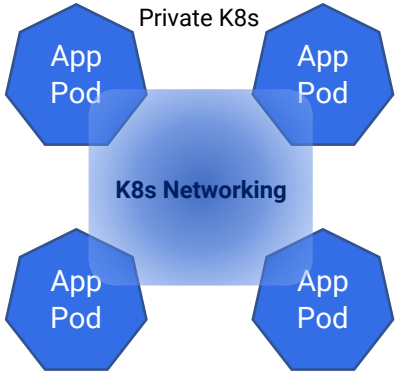
Marsha's app has workloads running in public K8s clusters, private K8s clusters, legacy VMs, and bare metal on prem servers.

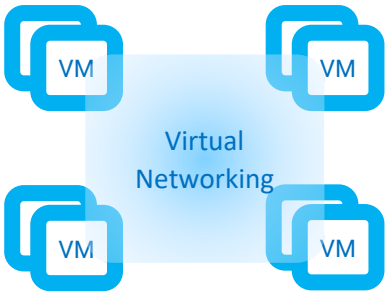


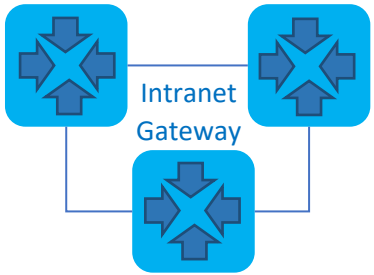
Marsha

Each of those domains has its own intra-networking.



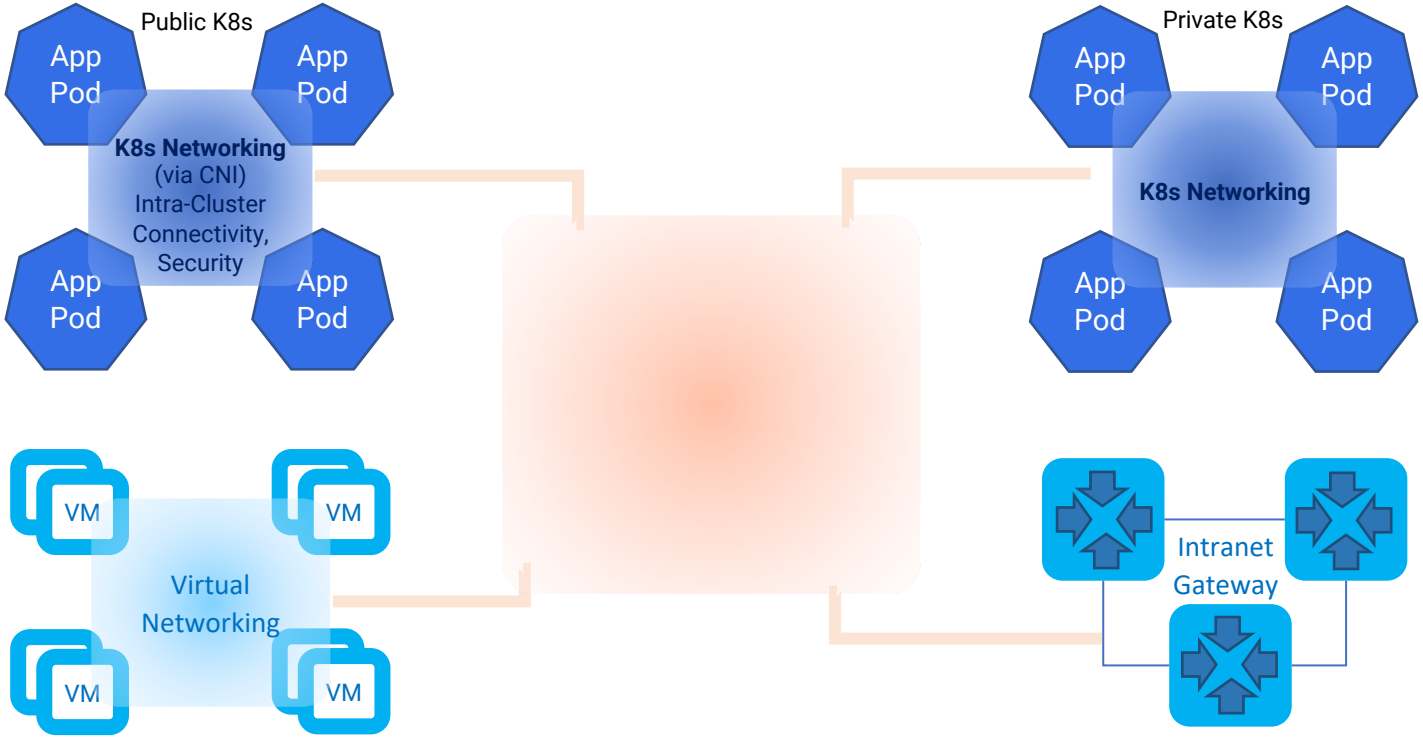






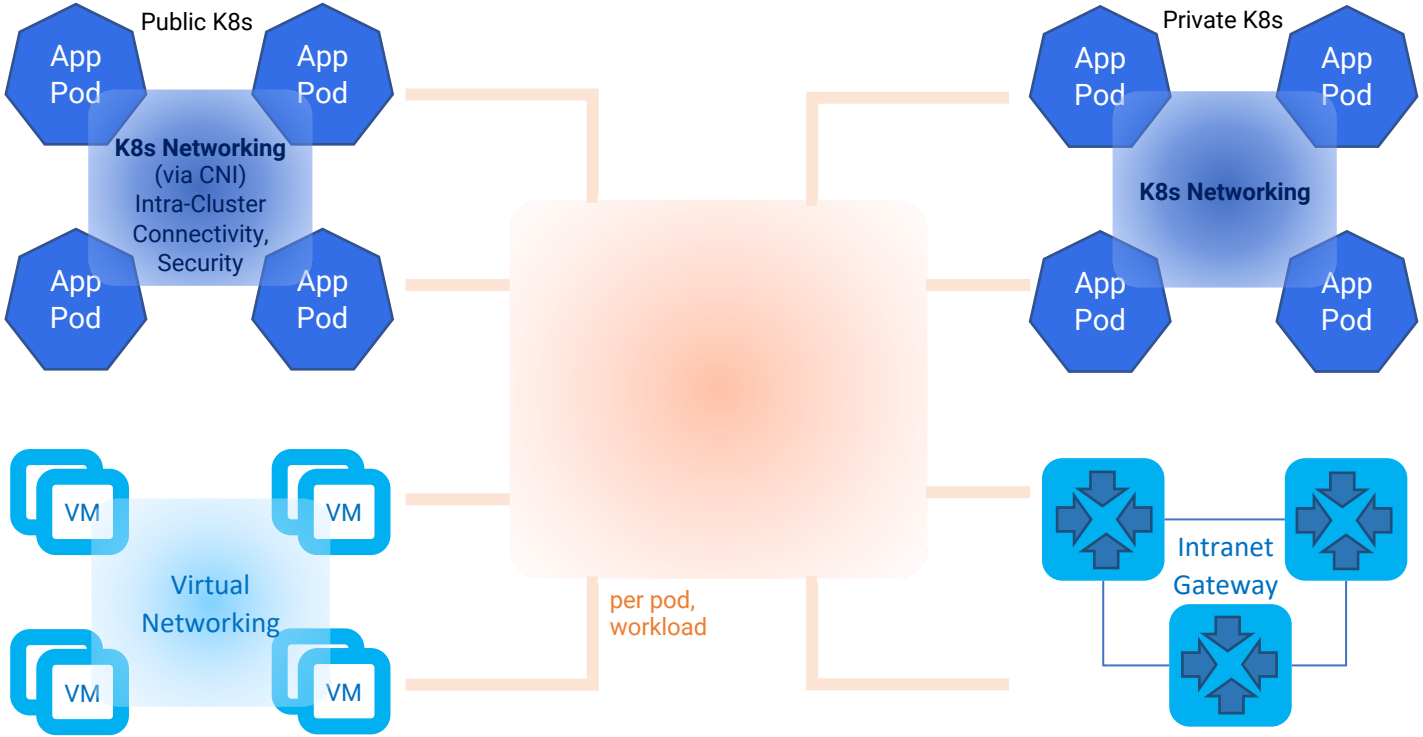
Marsha

Marsha doesn't want to connect the clusters/VIMs/DC networks. That's too course a granularity.



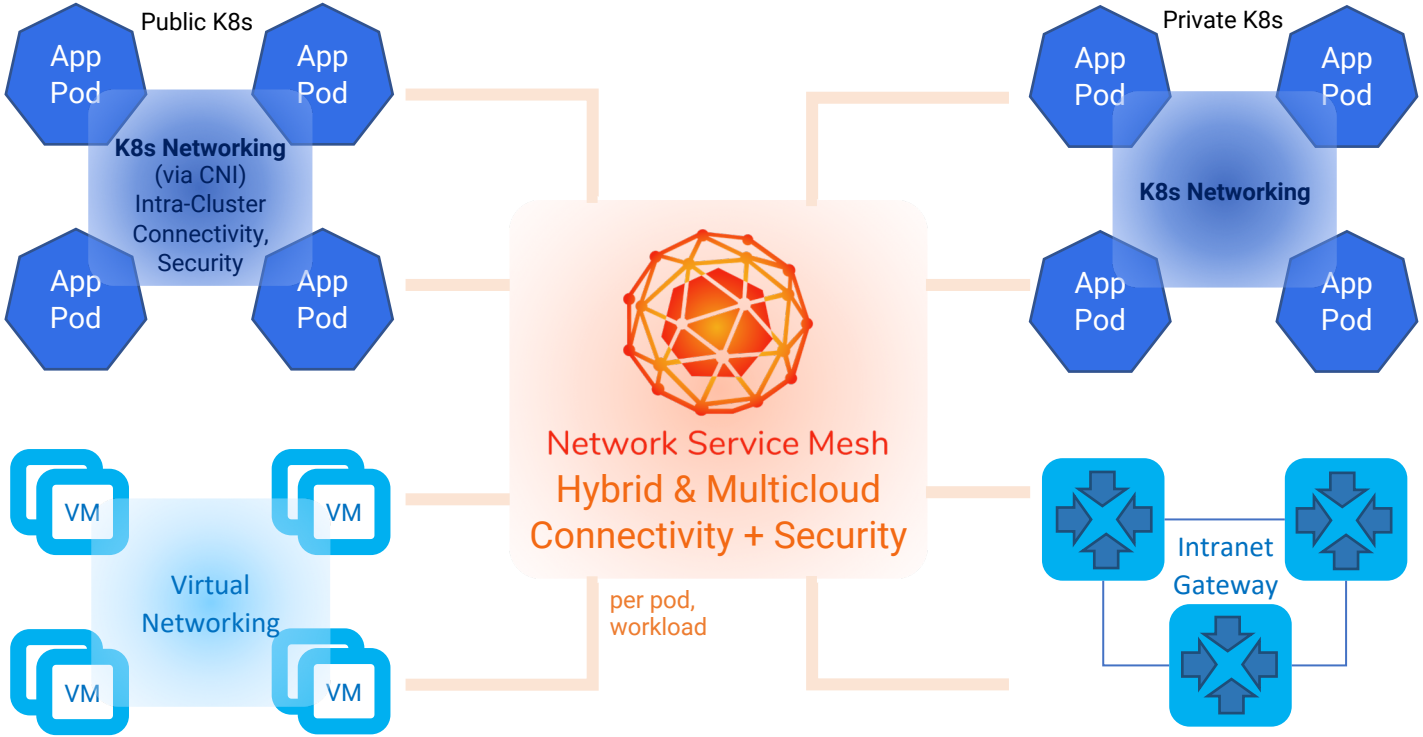
Marsha

What Marsha really needs is Connectivity between the workloads in her app, wherever they are.



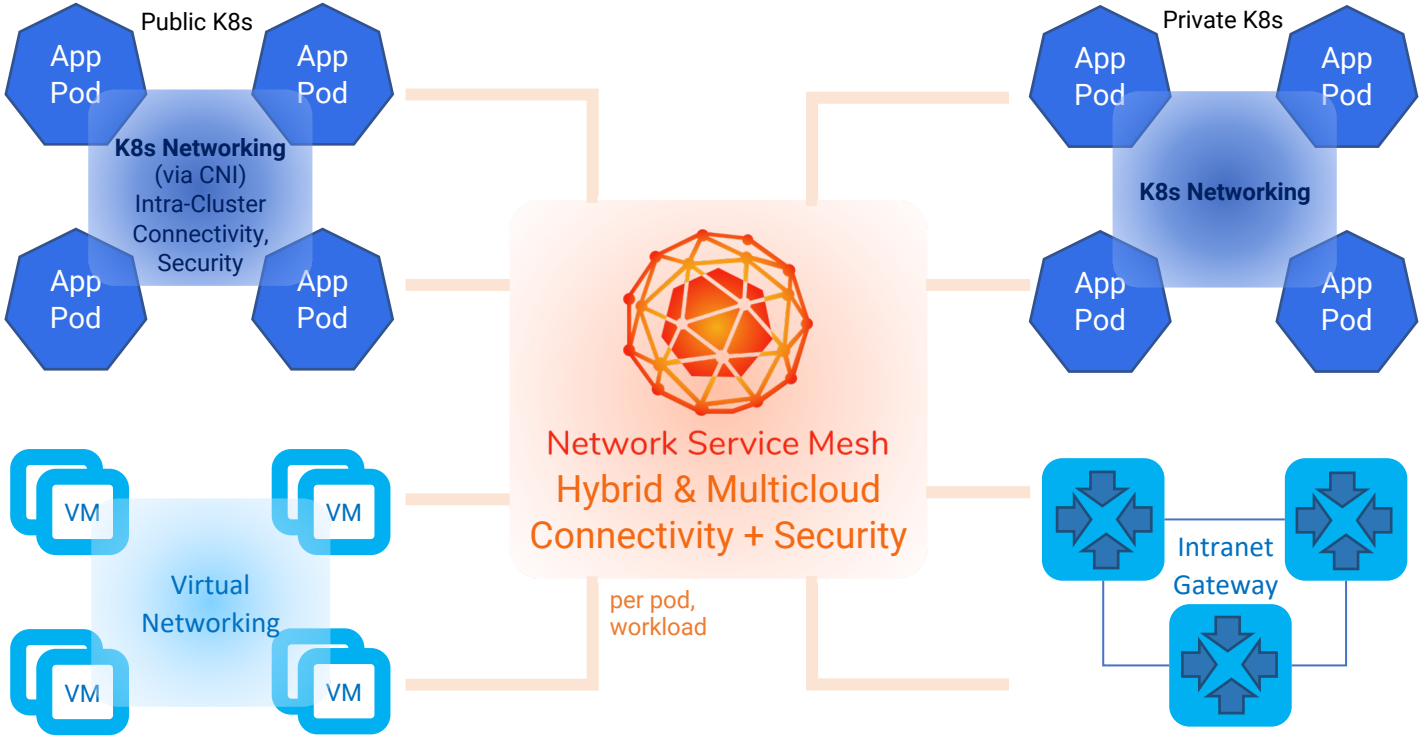
Marsha

Enter Network Service Mesh. Network Service Mesh uses ‘vWires’ to connect individual Pods/Workloads to a Network Service that provides her desired Connectivity/Security.



Marsha

The ‘marshas-app-connectivity’ provides the correct Connectivity/Security/other services for **her** app.



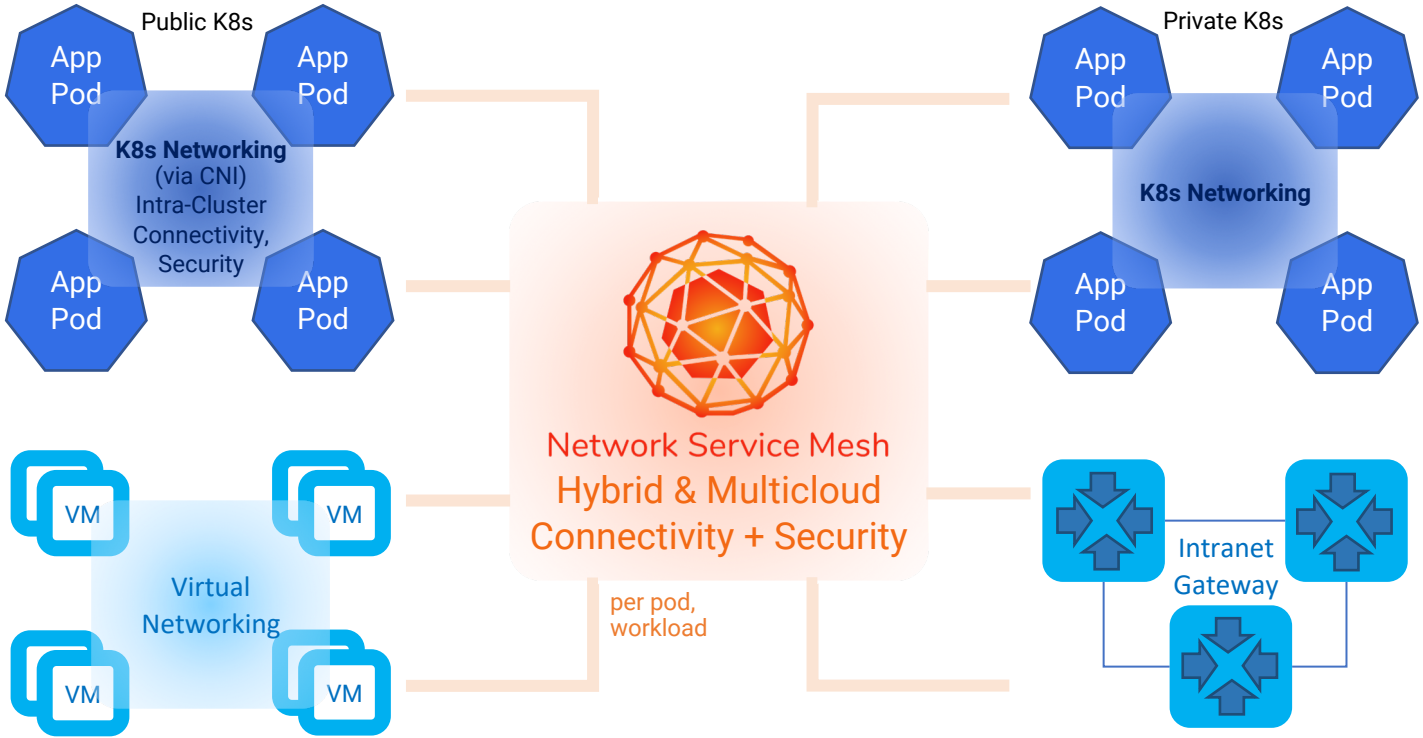
Minimal Toil

- Marsha directs her Pods to consume Network Service:

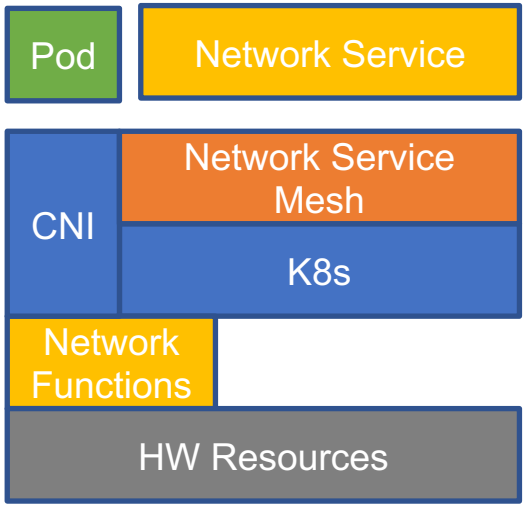
```
apiVersion: v1
kind: Pod
metadata:
 name: marshas-pod-1
 annotations:
   ns.networkservicemesh.io: marshas-app-connectivity
```

Loose Coupling

Breaks strong coupling of networking to cluster/VIM/DC network.

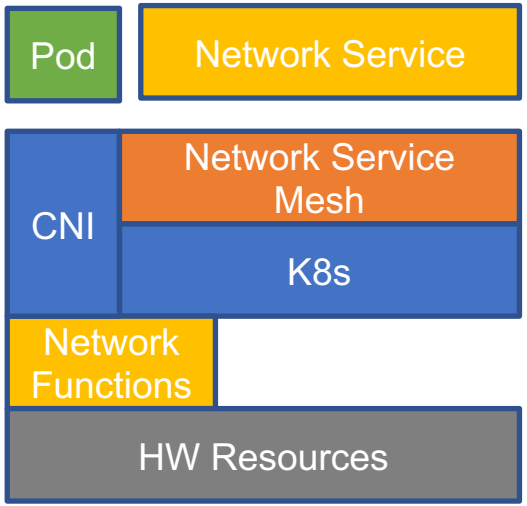


Immutable Infrastructure



- Day 0 - K8s admin enables Network Service Mesh on cluster
  - **helm install nsm**
- Day 1 - Network Service Deployed to K8s cluster
  - **helm install marshas-app-connectivity**
- No change to underlying K8s
- Works with any CNI

Immutable Infrastructure



- **Currently working in our CI/CD on:**
  - GKE
  - AKS
  - EKS
  - Vanilla K8s on VMs/bare metal
  - Kind

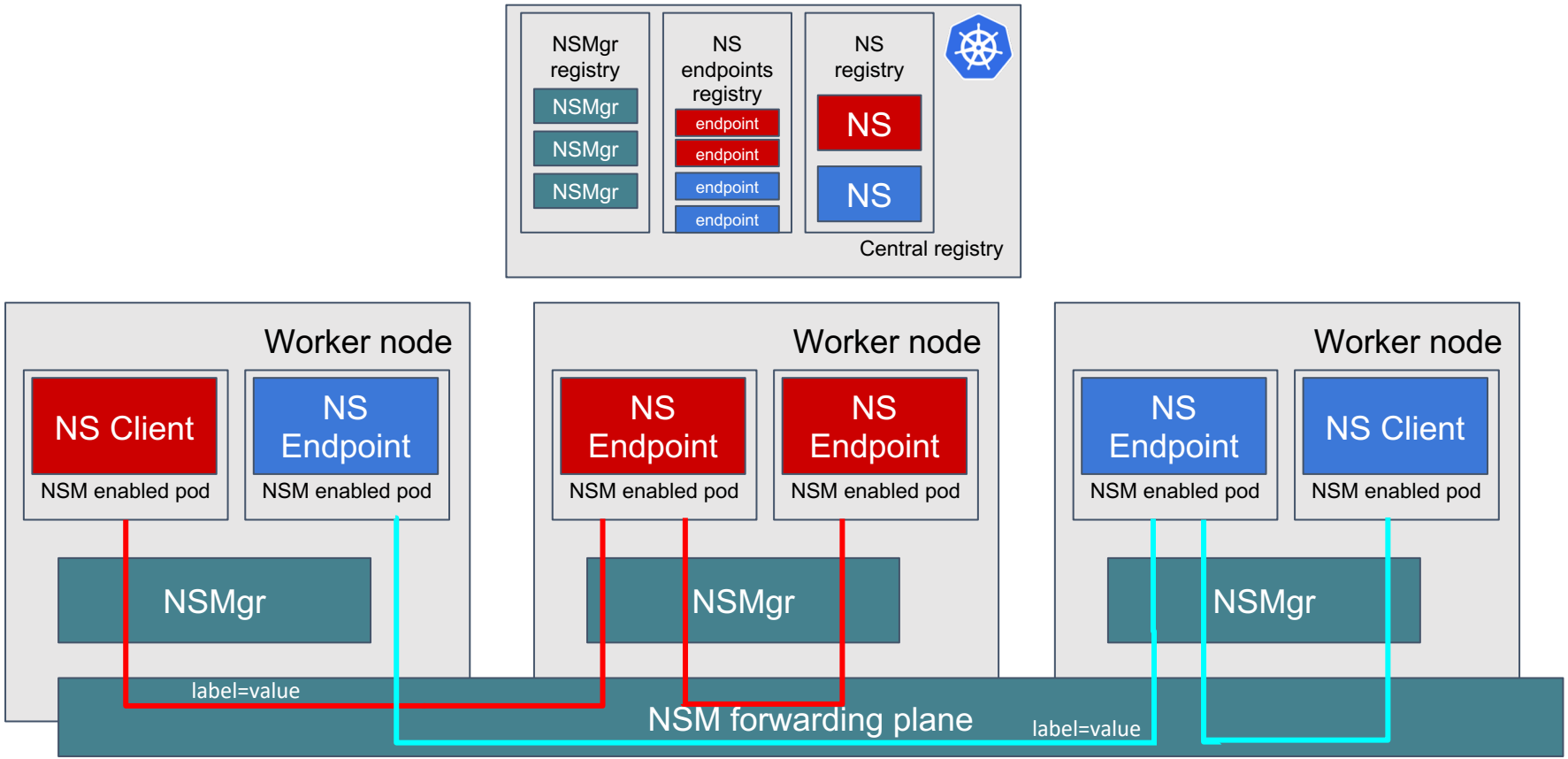
Network Service Mesh

How the Magic Works

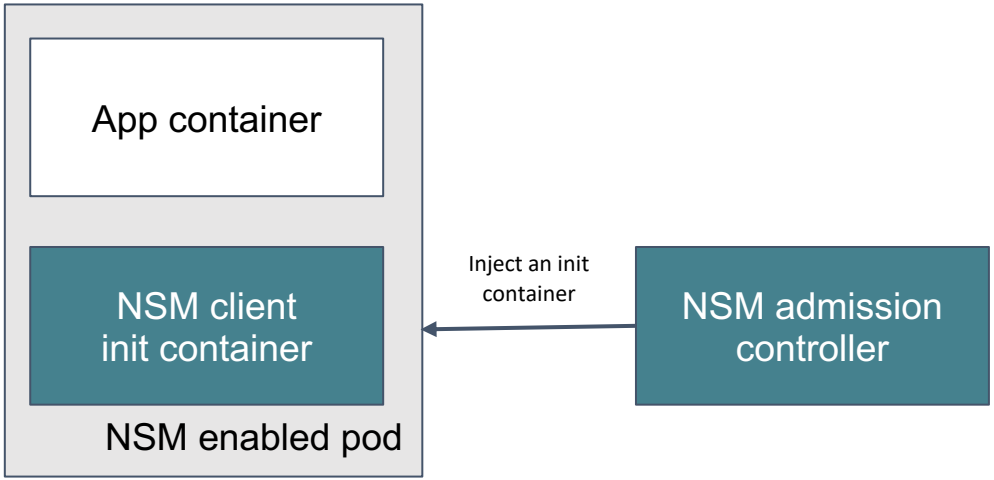
What is NSM

- A Network Service definition
- A gRPC API to describe, publish and consume Network Service(s)
- A distributed control plane with minimum shared state
- A concrete Kubernetes based implementation
  - Runtime interface injection/removal for Pods. Orthogonal to CNI
  - Leverage etcd as a central shared storage through CRDs
  - Use Kubernetes `DaemonSet` to provision local node agents
  - VPP as a base forwarding component

How NSM works



NS Service Consumption




```yaml
apiVersion: apps/v1
kind: Deployment
spec:
 template:
   spec:
     containers:
       - name: alpine-img
         image: alpine:latest
         command: ['tail', '-f', '/dev/null']
metadata:
 name: my-app
 annotations:
   ns.networkservicemesh.io: service?label=value
```

Network Service Manifest

```
apiVersion: networkservicemesh.io/v1
kind: NetworkService
metadata:
 name: secure-intranet-connectivity
spec:
 payload: IP
 matches:
   - match:
     sourceSelector:
       app: firewall
     route:
       - destination:
         destinationSelector:
           app: vpn-gateway
   - match:
     route:
       - destination:
         destinationSelector:
           app: firewall
```

Describe the type `NetworkService`

The name of the service is `secure-intranet-connectivity`

Match the service request labels for `app=firewall`

Find an endpoint that implements `secure-intranet-connectivity` and is labeled `app=vpn-gateway`

Wildcard `sourceSelector`

Network Service Mesh

Resources/Get Involved

Resources

www.networkservicemesh.io

github.com/networkservicemesh/networkservicemesh

networkservicemesh.io/community/

NSM at KubeCon China

- Tuesday, June 25th 14:00-16:00 VMware booth G8
- Wednesday, June 26th 11:30 CNCF Answer bar

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