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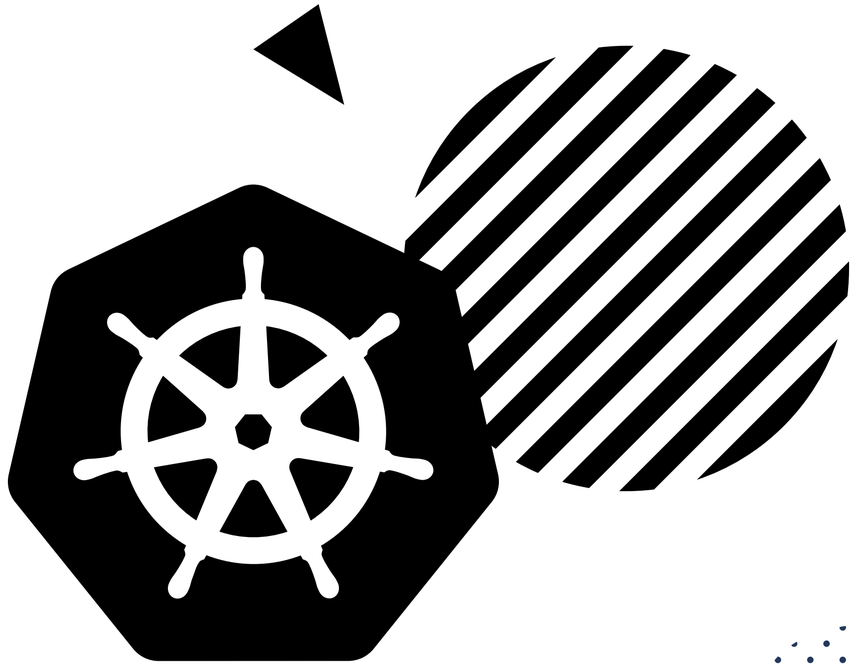
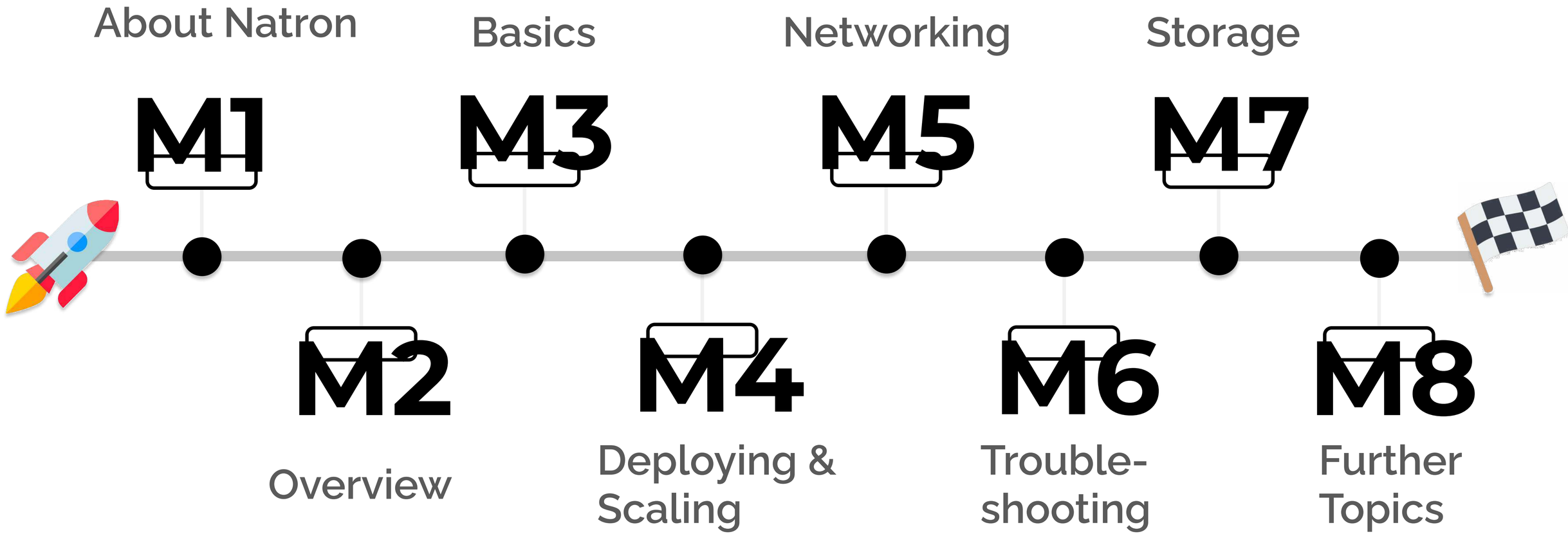
NATRON

K8sLab 2023

Roadmap to Kubernetes





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Introduction to Kubernetes

- Hands-On with Kubelab
- Core concepts
- CKAD preparation

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M1 About us

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M2 Kubernetes Basics

- What is Kubernetes?

Kubernetes is a powerful **open-source** system, initially developed by **Google**, for managing **containerized applications** in a **clustered** environment. It aims to provide better ways of managing related, distributed components and services across varied infrastructure.

Often seen: **K8S** (**K**uberneteS)

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M2-1 History

- Founded by Google
- Development and design are heavily influenced by Google's Borg system
- **Documentary**: https://www.youtube.com/watch?v=BE77h7dmoQU
- Original code name for Kubernetes within Google was Project Seven of Nine, the « **friendlier** » Borg
- Kubernetes **v1.0** was released on **July 21, 2015**. Google partnered with the Linux Foundation to form the Cloud Native Computing Foundation (**CNCF**)

Current Release: **1.27**

M2-2 Community Contributions

Kubernetes Companies statistics (Contributions, Range: Last decade), bots excluded

Rank	Company	Number
	All	3749886
1	Google LLC	1119419
2	Red Hat Inc.	451501
3	VMware Inc.	302668
4	Microsoft Corporation	153885
5	Independent	121132
6	International Business Machines Corporation	116782
7	Huawei Technologies Co. Ltd	49421
8	Intel Corporation	42156
9	The Scale Factory Limited	39996
10	Amazon	36350

https://k8s.devstats.cncf.io/d/9/companies-table?orgId=1

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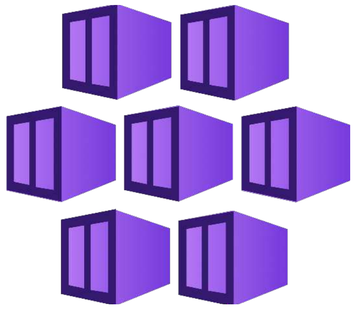
M2-3 Certified Kubernetes

- Consistency
  - when interacting with any installation of Kubernetes
- Confirmability
  - by running identical open source conformance applications
- Timely Updates
  - updates yearly or more frequently



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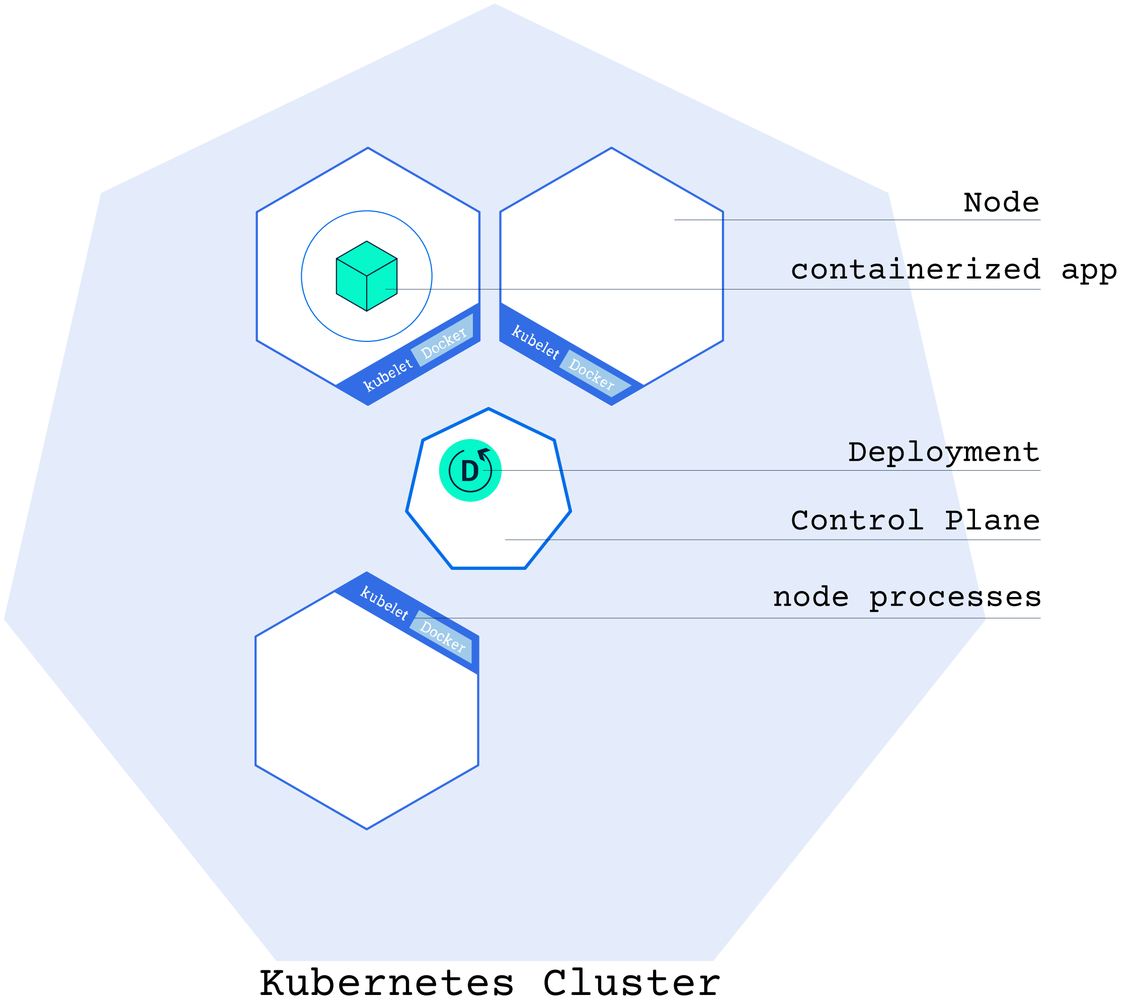
M2-4 What is it?

Kubernetes, at its basic level, is a system for **running and coordinating** containerized applications across a cluster of machines. It is a platform designed to completely manage the life cycle of containerized applications and services using methods that provide **predictability**, **scalability**, and **high availability**.



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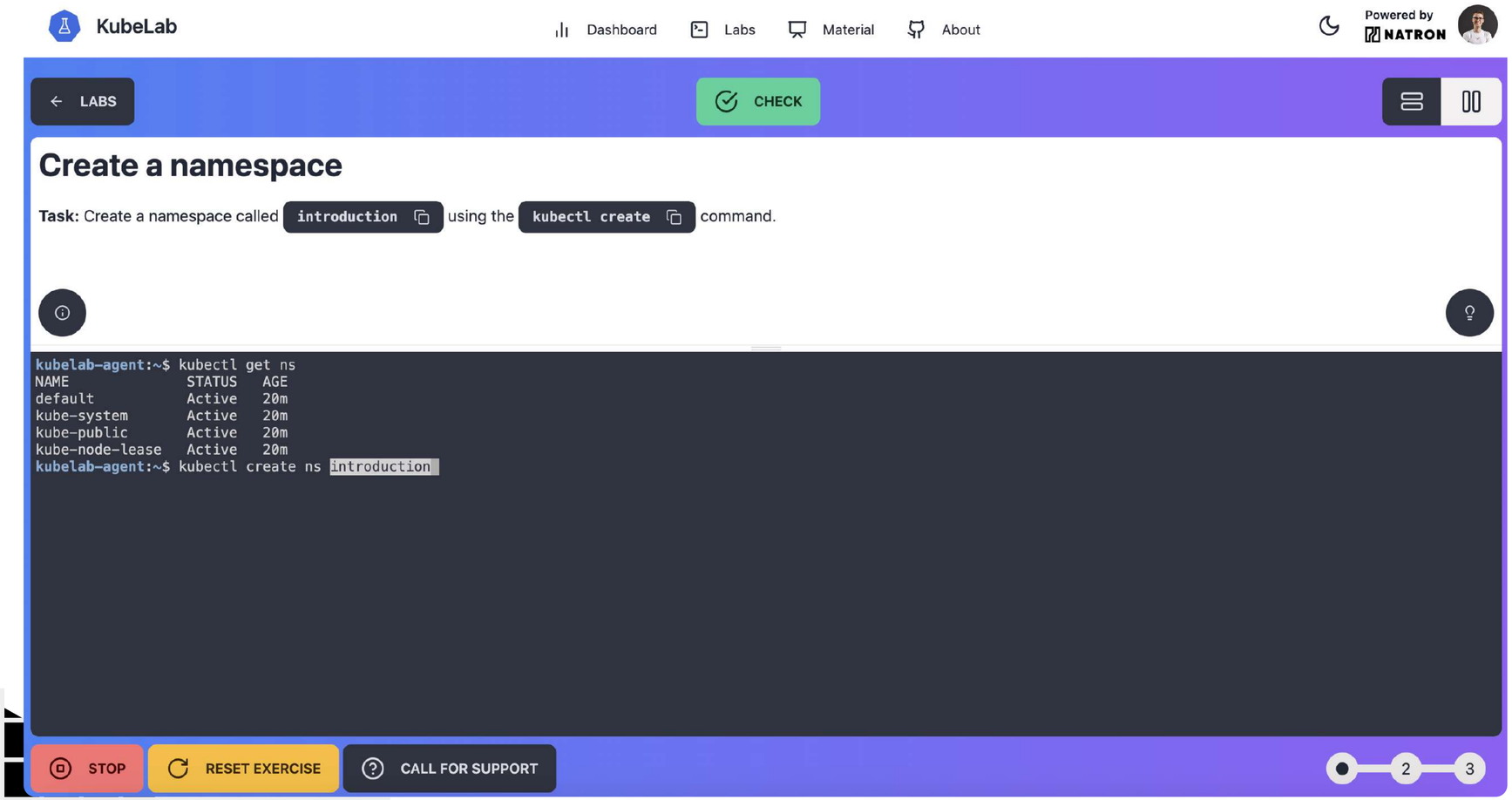
M2-5 KubeLab https://kubelab.ch



- Practical Hands-On exercises
- Seamless in-browser terminal experience
- Each learning session is isolated with its own Kubernetes cluster

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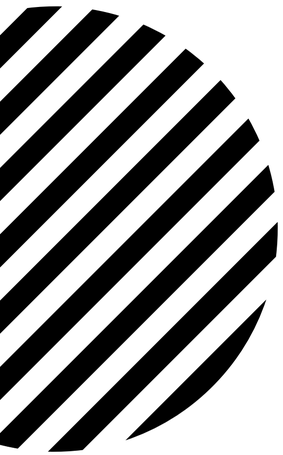
M2-6 Tools

- **kubectl** (https://kubernetes.io/de/docs/tasks/tools/install-kubectl)
- Creating resources **imperative:**

```
kubectl create deployment nginx --image=nginx
```

- Creating resources **declarative:**

```
kubectl apply -f deployment.yaml
```



Cheat-Sheet: https://kubernetes.io/docs/reference/kubectl/cheatsheet/

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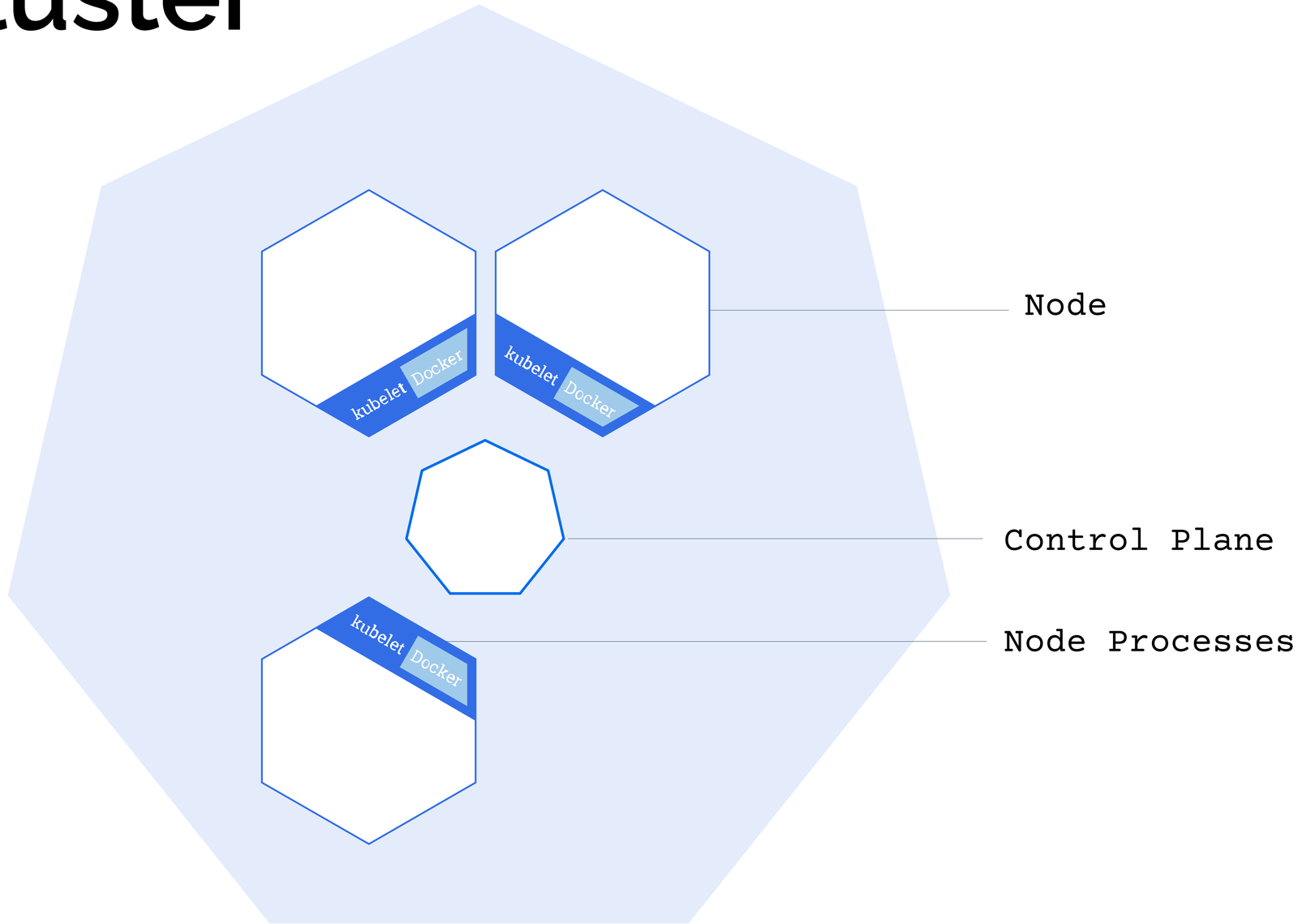
LAB 1

Introduction

M3 Cluster



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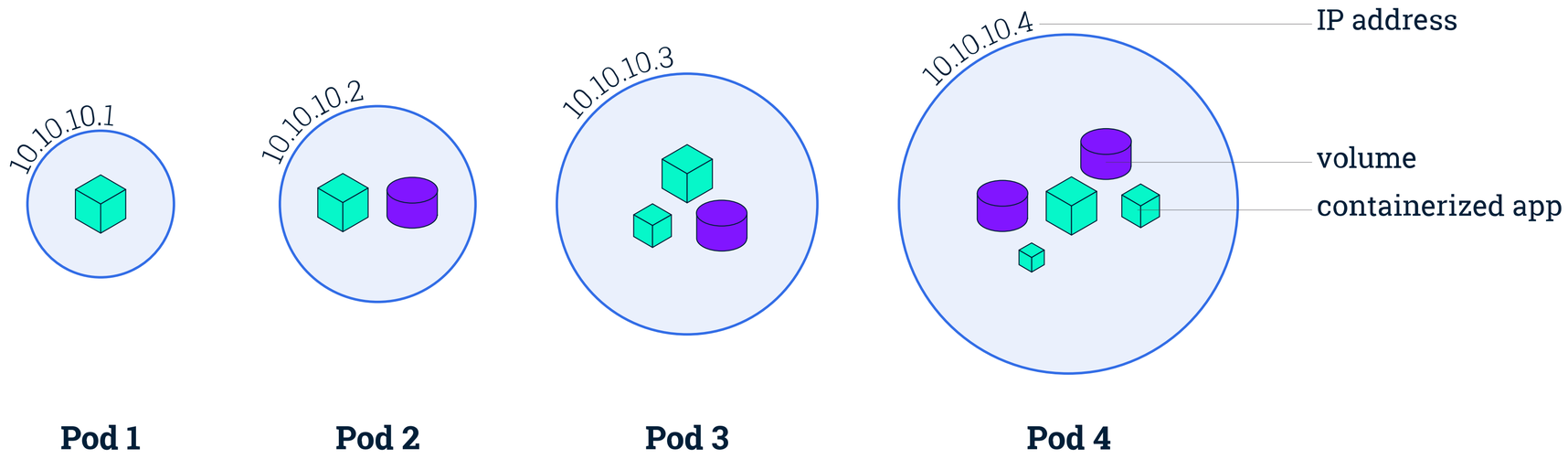
M3-1 Kubernetes Objects

- **Pod** is the smallest deployable unit on a Node. It's a group of containers which must run together. Quite often, but not necessarily, a Pod usually contains one container.
- **Volume** is essentially a directory accessible to all containers running in a Pod.



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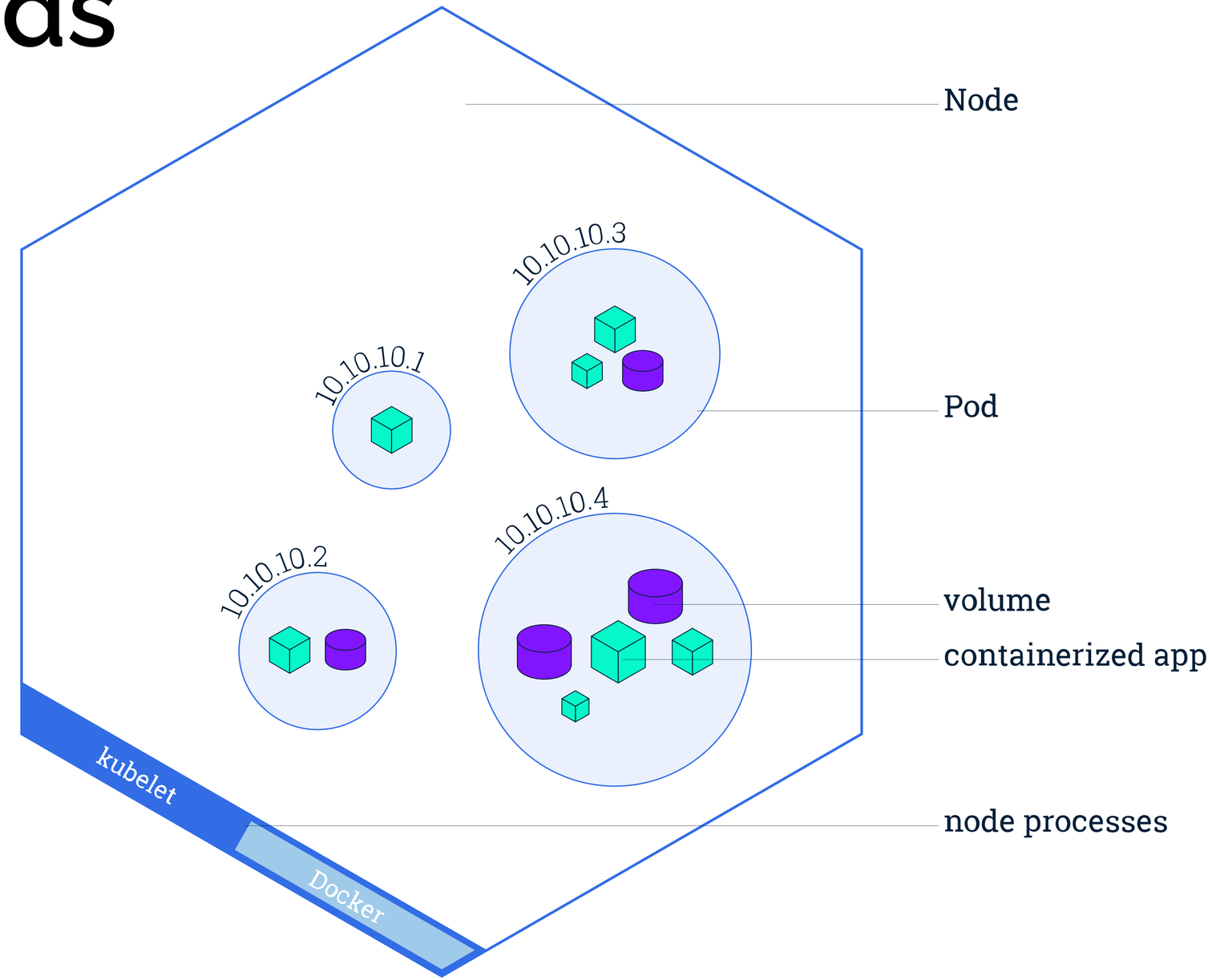
M3-2 Pods



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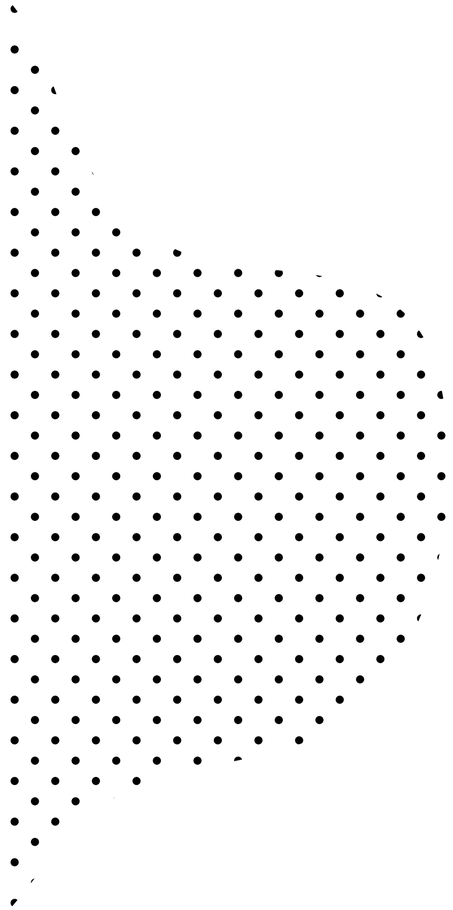
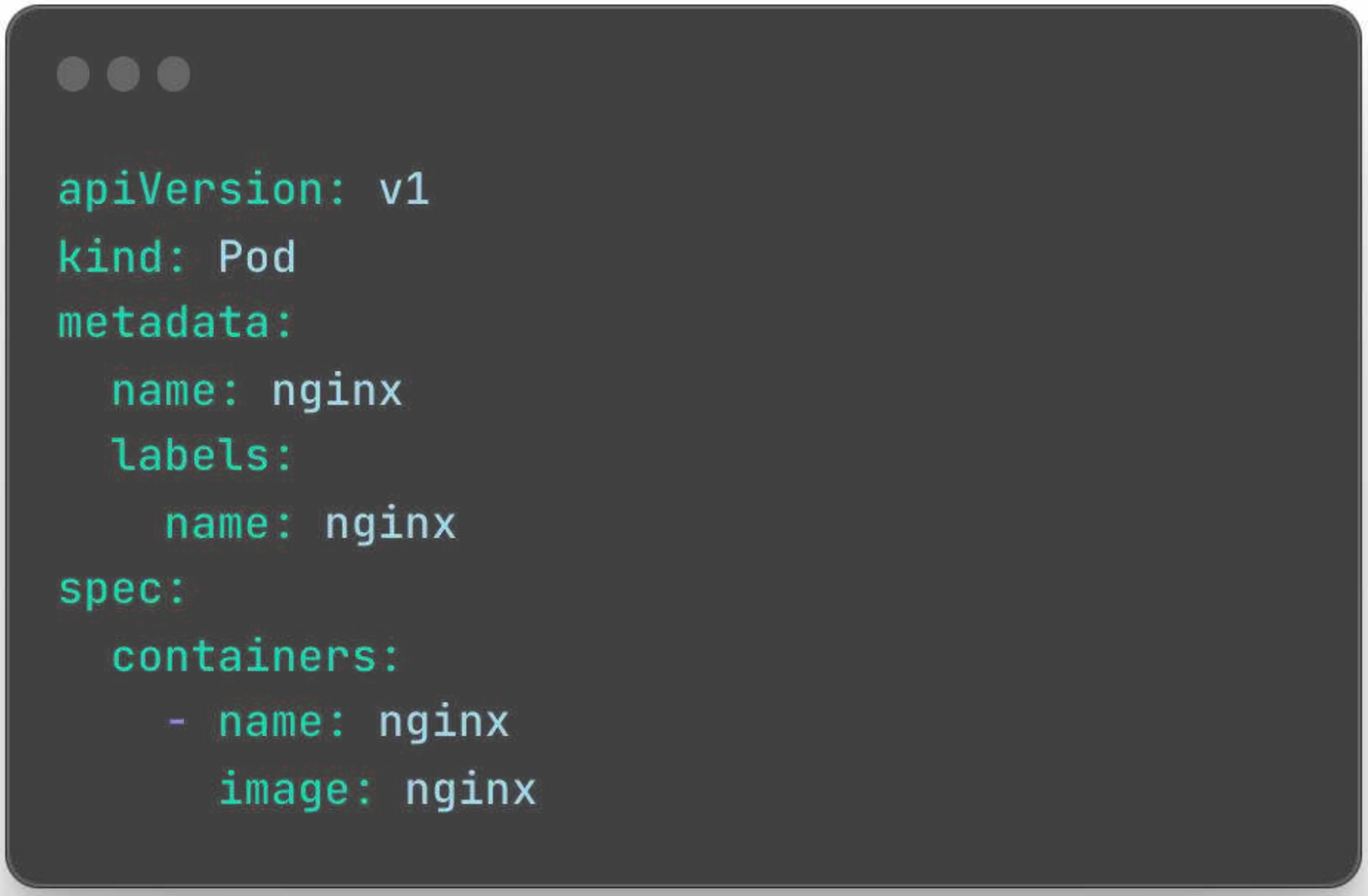
M3-3 Pods - YAML





```yaml
apiVersion: v1
kind: Pod
metadata:
  name: nginx
  labels:
    name: nginx
spec:
  containers:
    - name: nginx
      image: nginx
```

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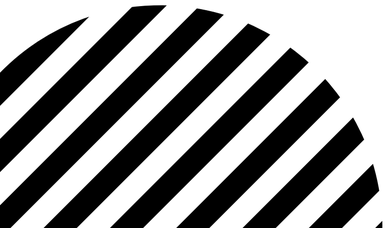
M3-4 Namespaces

Namespaces provides a mechanism for **isolating groups** of resources within a single cluster.

- Namespaces are intended for use in environments with many users spread across multiple teams, or projects.
- Namespaces provide a scope for names. Names of resources need to be **unique within** a namespace, but **not across namespaces**. Namespaces **can not be nested** inside one another and each Kubernetes resource can only be **in one namespace**.
- Namespaces are a way to divide cluster resources between multiple users (via **resource quota**).



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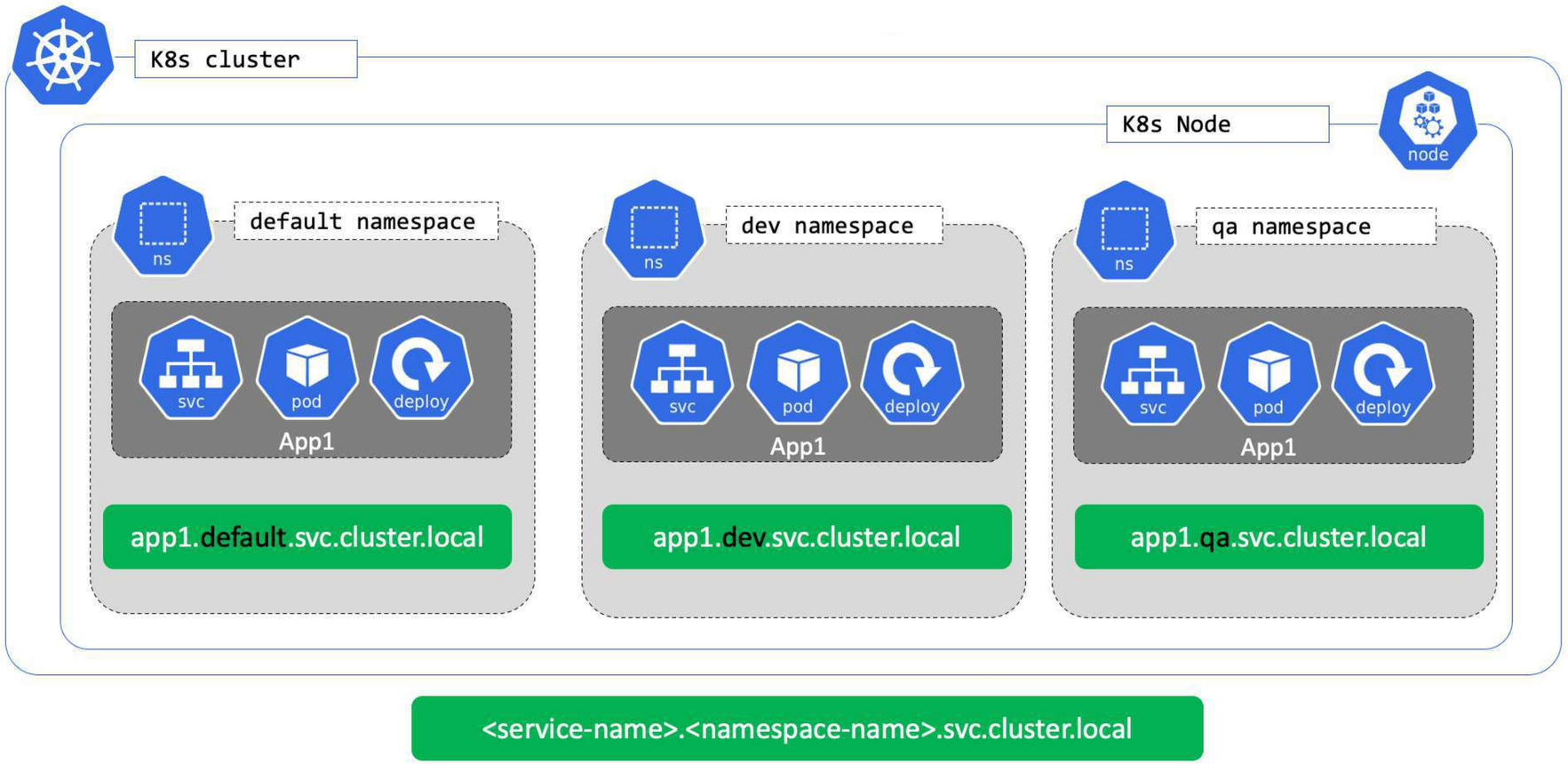
M3-5 Namespaces



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LAB 2

First Steps

M4 Replication Sets

- A **ReplicaSet's** purpose is to maintain a stable set of **replica** Pods running at any given time. As such, it is often used to **guarantee** the availability of a specified **number** of **identical** Pods.
- defines **pod template**
- control parameters to **scale replicas**
- scaling **horizontally**

replicaset.yaml

```yaml
apiVersion: apps/v1
kind: ReplicaSet
metadata:
  name: frontend
  labels:
    app: guestbook
    tier: frontend
spec:
  replicas: 3
  selector:
    matchLabels:
      tier: frontend
  template:
    metadata:
      labels:
        tier: frontend
    spec:
      containers:
      - name: nginx
        image: nginx
```

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M4-1 Deployments

- A **Deployment** provides declarative updates for **Pods** and **ReplicaSets**.
- Deployments use replication sets as a **building block**, adding **flexible** life cycle management functionality to the mix.

replicaset.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: frontend
  labels:
    app: guestbook
    tier: frontend
spec:
  replicas: 3
  strategy:
    type: RollingUpdate
  selector:
    matchLabels:
      tier: frontend
  template:
    metadata:
      labels:
        tier: frontend
    spec:
      containers:
      - name: nginx
        image: nginx
```

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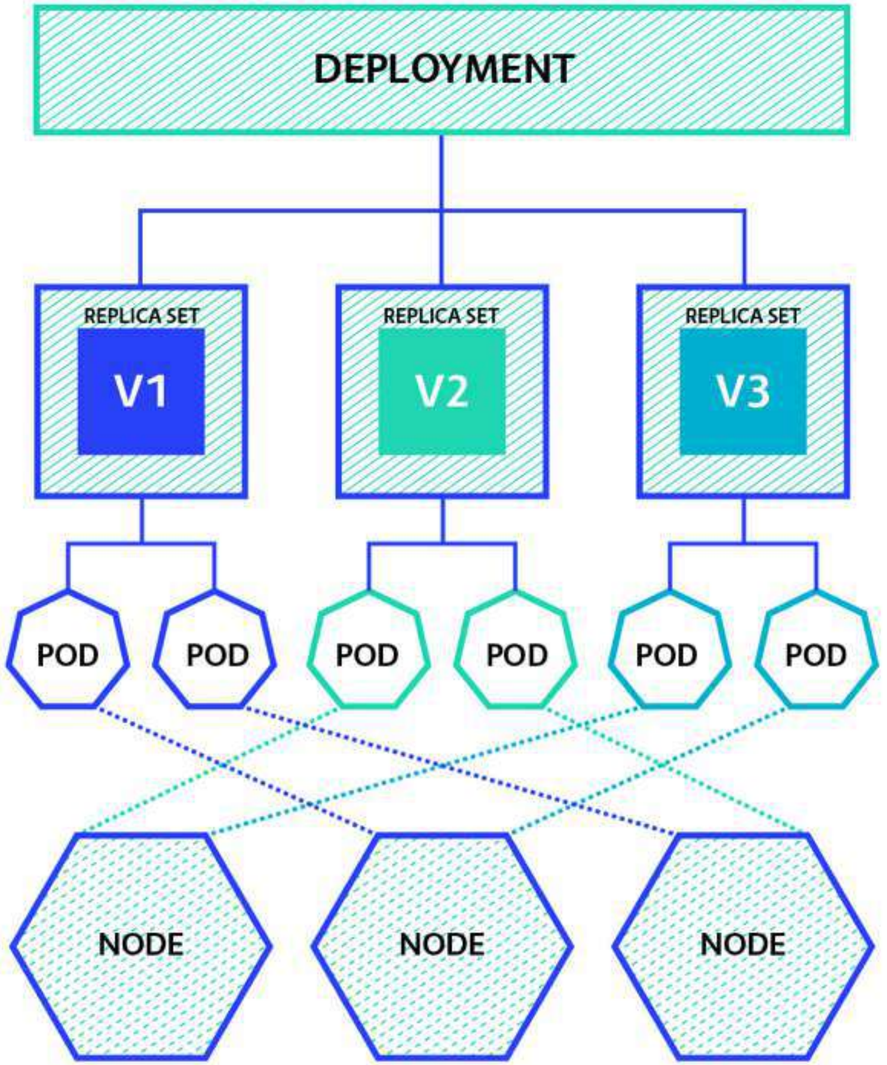
M4-2 Deployments & Replicasets



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M4-3 Services

- An abstract way to **expose** an application running on a set of **Pods** as a network service.
- Kubernetes gives Pods their own **IP addresses** and a single **DNS name** for a set of Pods, and can **load-balance** across them.

replicaset.yaml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: guestbook-service
  labels:
    app: guestbook
spec:
  selector:
    tier: frontend
  ports:
  - protocol: TCP
    port: 3000
    targetPort: 3000
```

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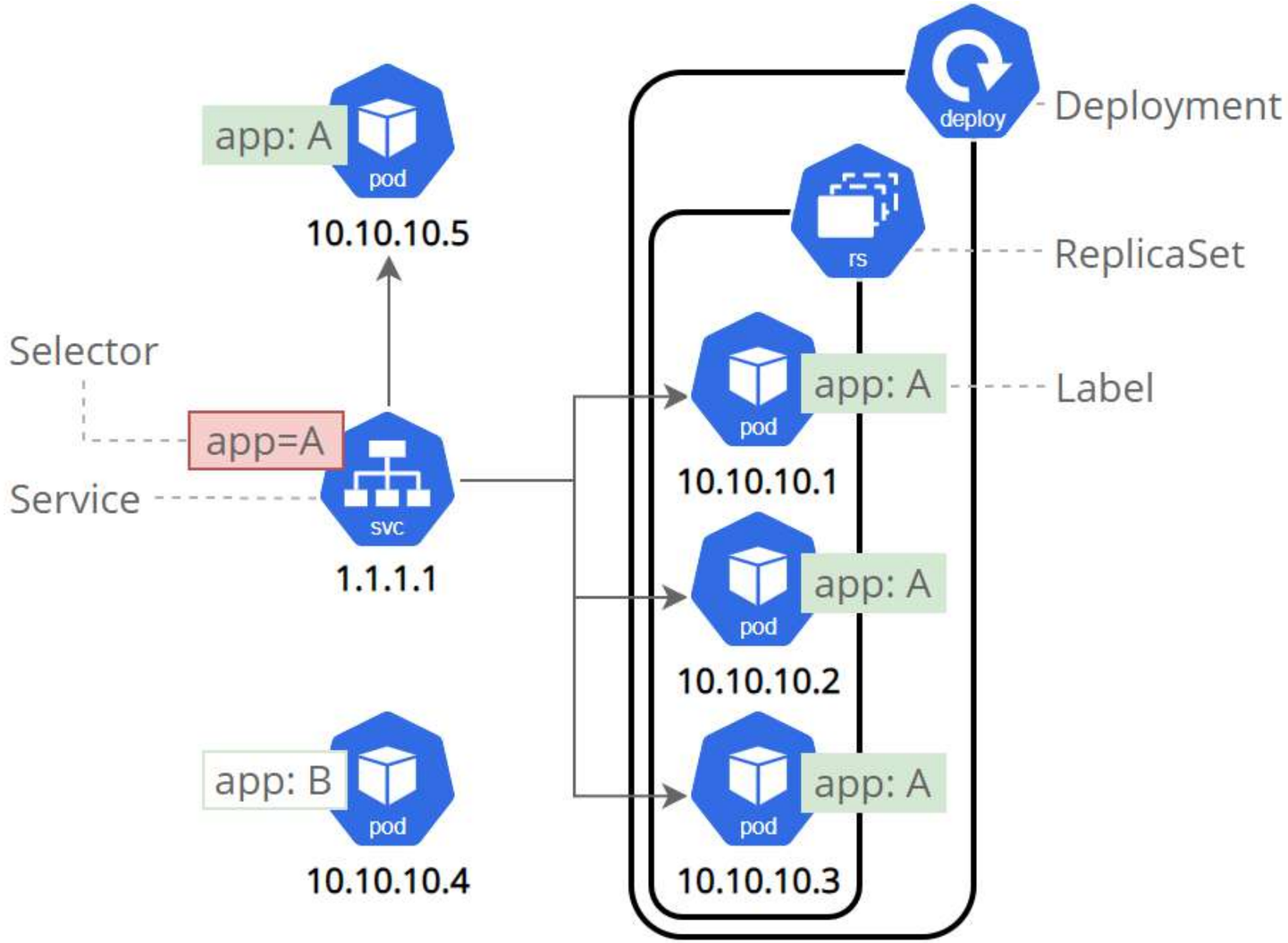
M4-4 Services Diagram



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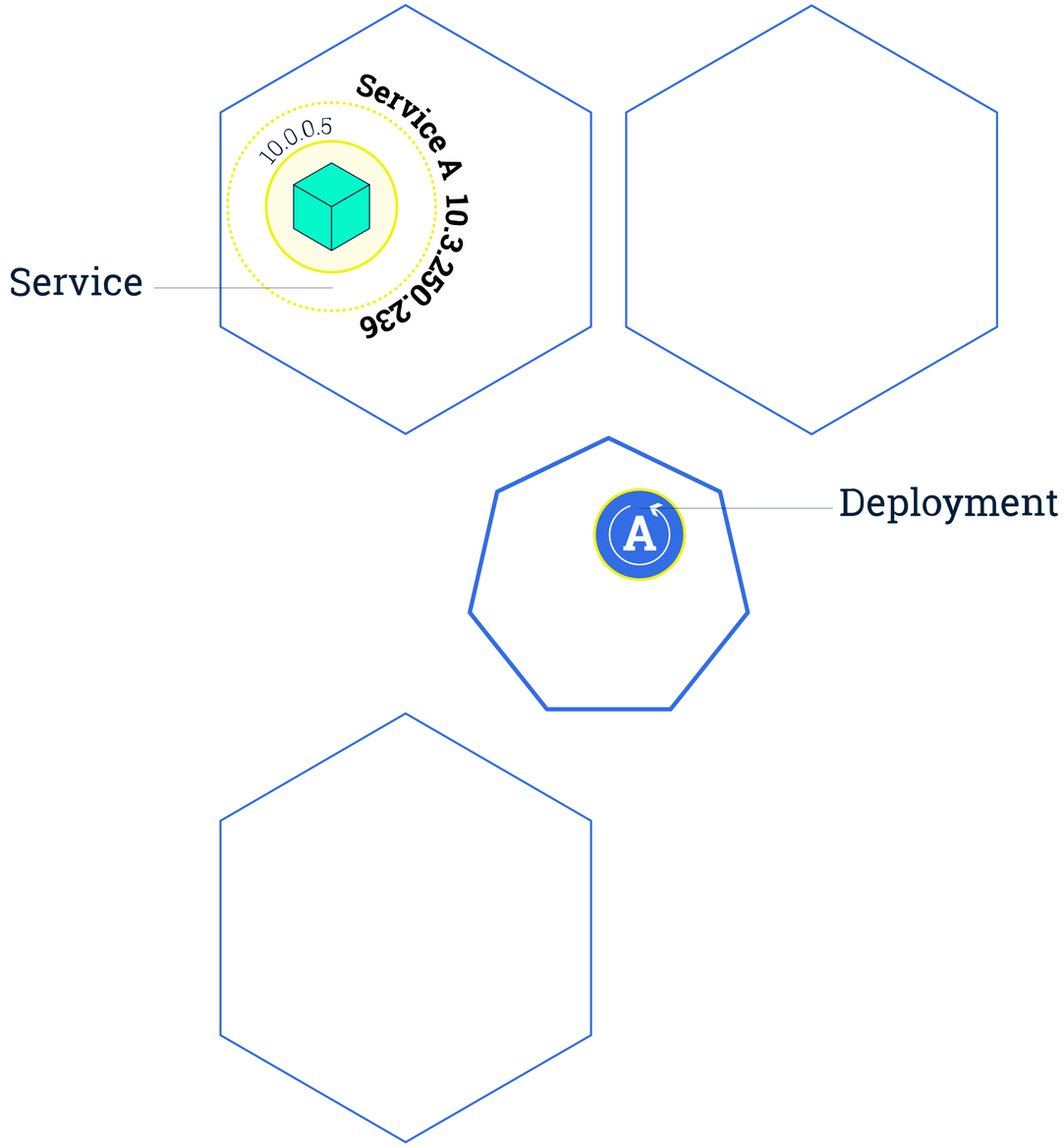
M4-5 Scaling



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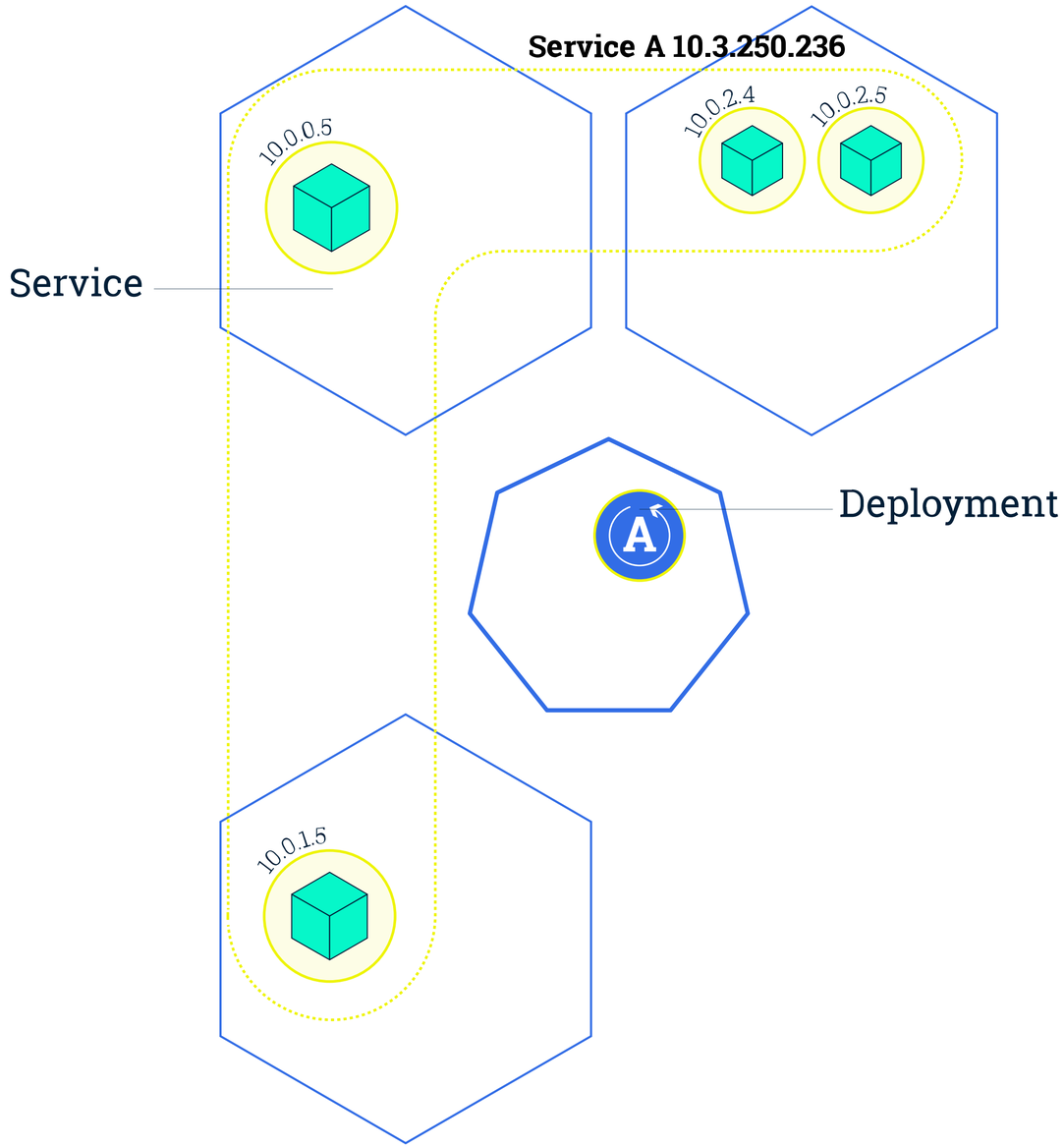
M4-6 Scaling



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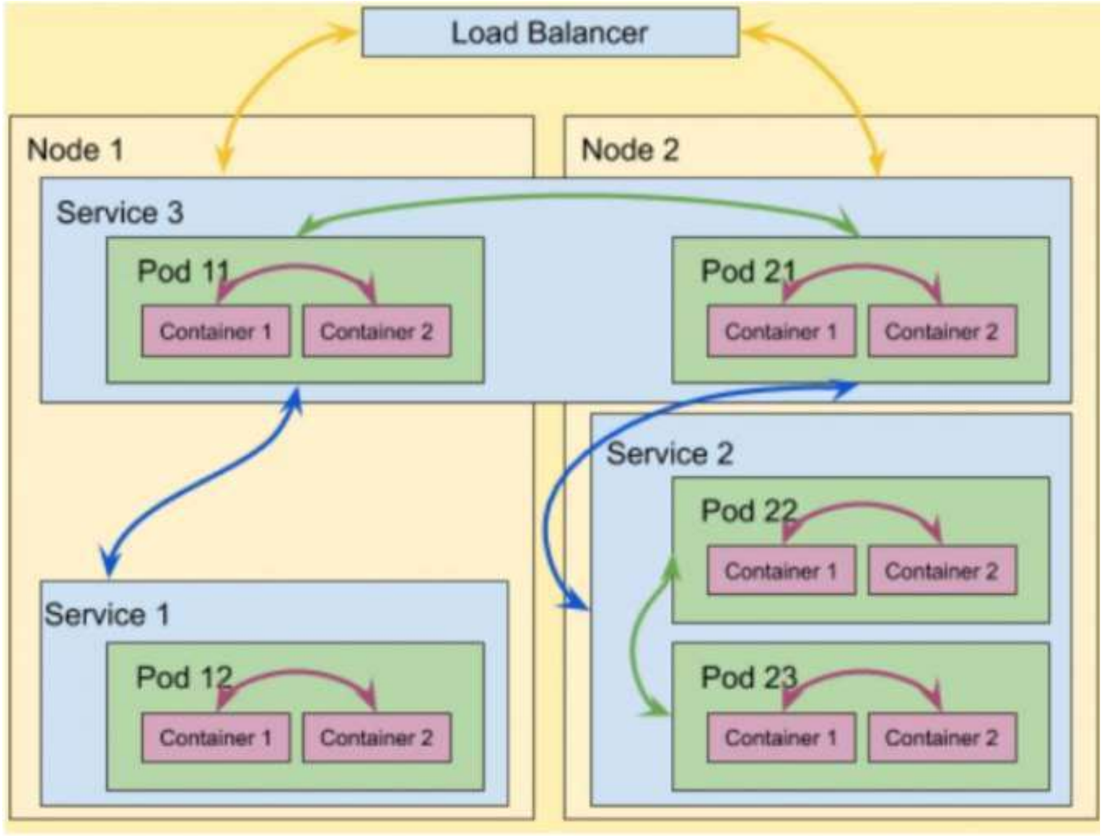
LAB 3

Deploy and Scale

M5 Communication

- **Container** to **Container** communication
- **Pod** to **Pod** communication
- **Pod** to **Service** communication
- **External** to **Service** communication



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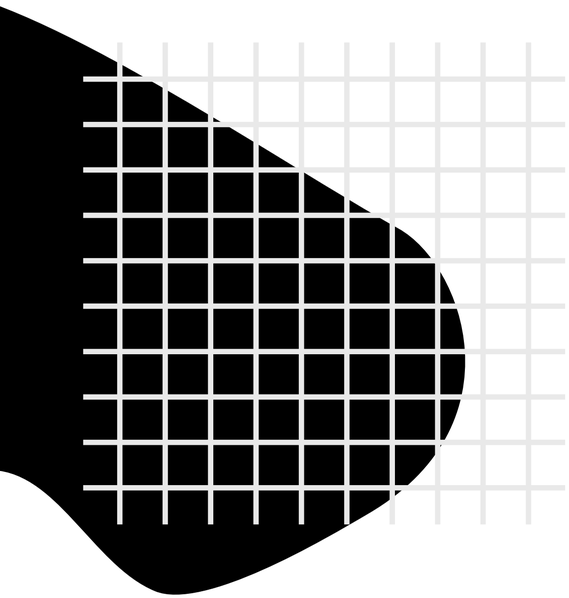
M5-1 Network Model

- All **containers** can communicate with each other **without NAT**
- All **nodes** can communicate with containers **without NAT**
- The IP address a **container** sees for itself is the **same address** everyone else sees

M5-2 Container Network Interface (CNI)



- Kubernetes enables networking through **2** different network plugins:
  - **Kubenet**
  - **CNI**
- **CNI** is only responsible for network connectivity of **containers** and **removing** allocated resources when the container is deleted.
- Initially the **container/pod** has **no network interface**. To connect containers Kubernetes calls the CNI plugin with commands like **ADD**, **DEL**, **CHECK**, **VERSION**.

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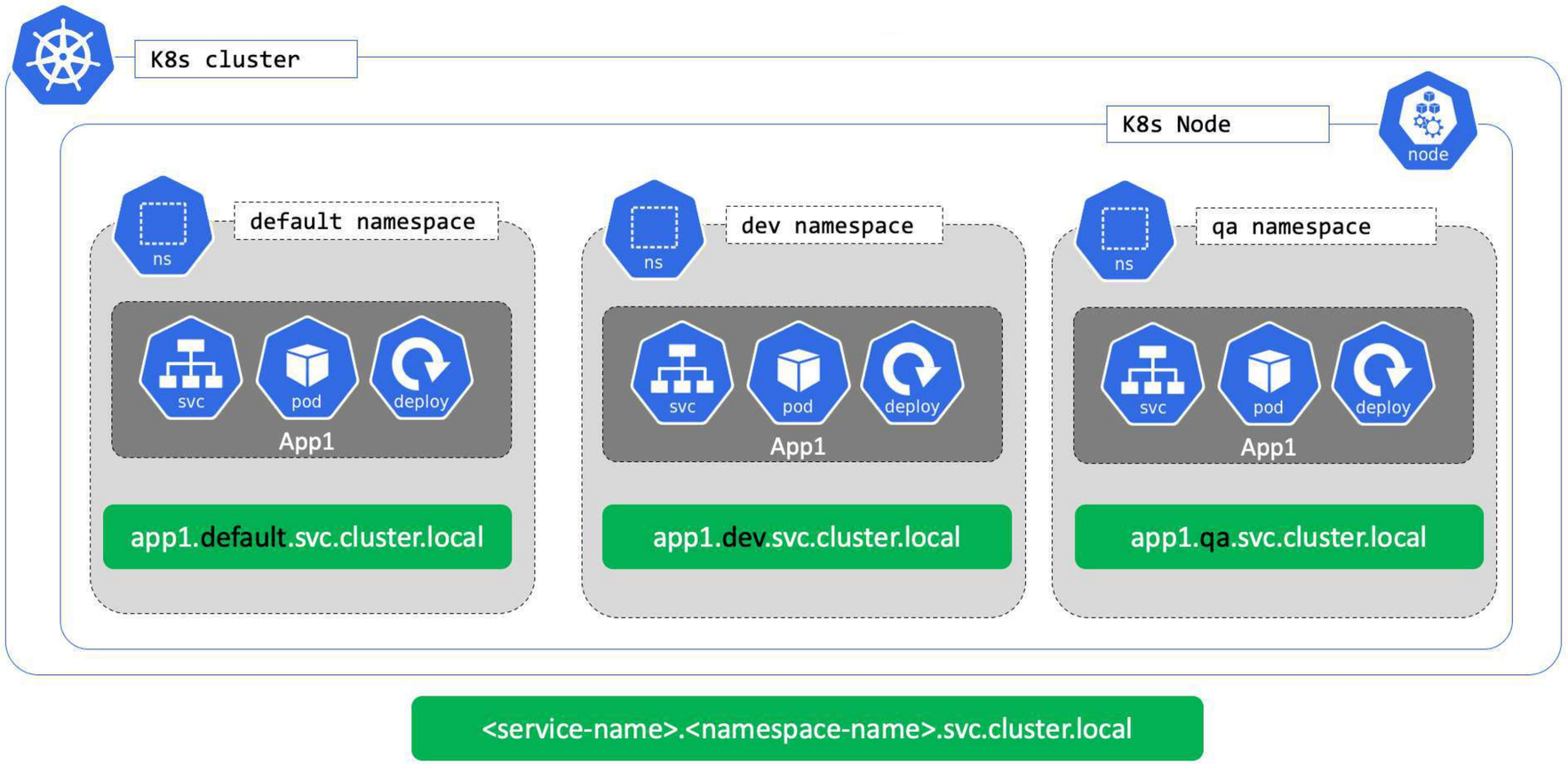
M5-3 DNS



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M5-4 DNS

- **“Normal” (not headless) Services are assigned a DNS A or AAAA record**
  - my-svc.my-namespace.svc.cluster.local
- **Pods are assigned a DNS A or AAA record**
  - pod-ip-address.my-namespace.pod.cluster.local
- **Pods exposed by a Service have the following DNS resolution:**
  - pod-ip-address.service-name.my-namespace.svc.cluster.local

M5-5 Ingress

- An API object that manages **external access** to the services in a cluster, typically **HTTP**.
- **Ingress** may provide load balancing, SSL termination and name-based **virtual hosting**.

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: guestbook-ingress
spec:
  ingressClassName: public-ingress
  rules:
  - host: example.com
    http:
      paths:
      - path: /
        pathType: Prefix
        backend:
          service:
            name: guestbook-service
            port:
              number: 3000
  tls:
  - hosts:
    - example.com
    secretName: example-tls
```

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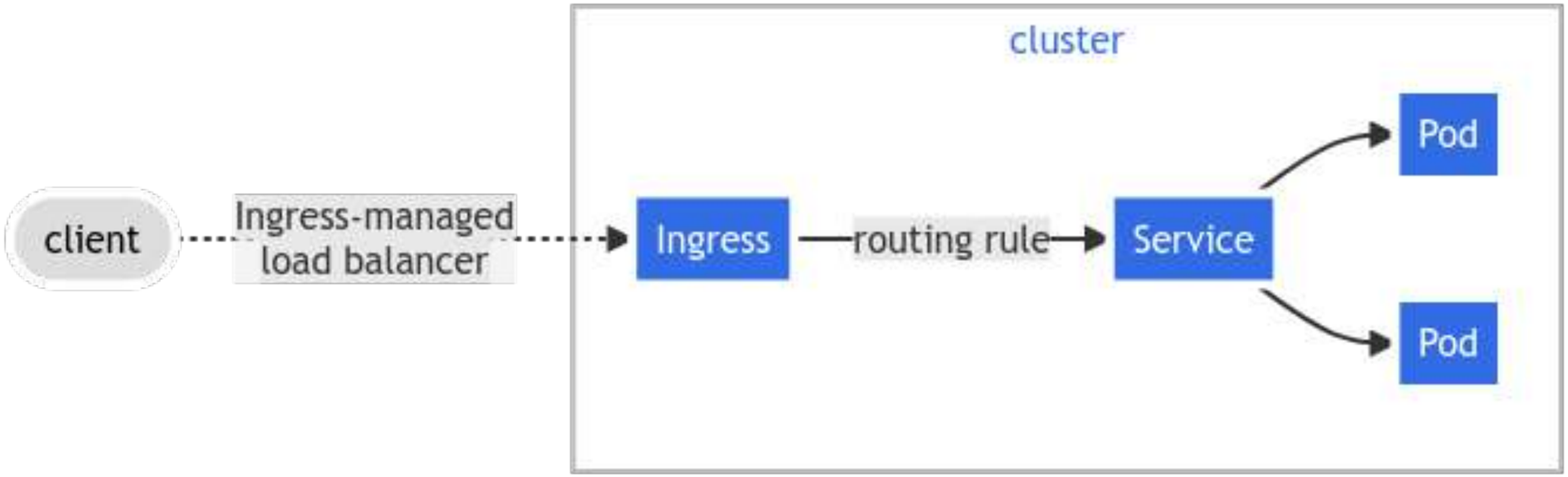
M5-6 Ingress



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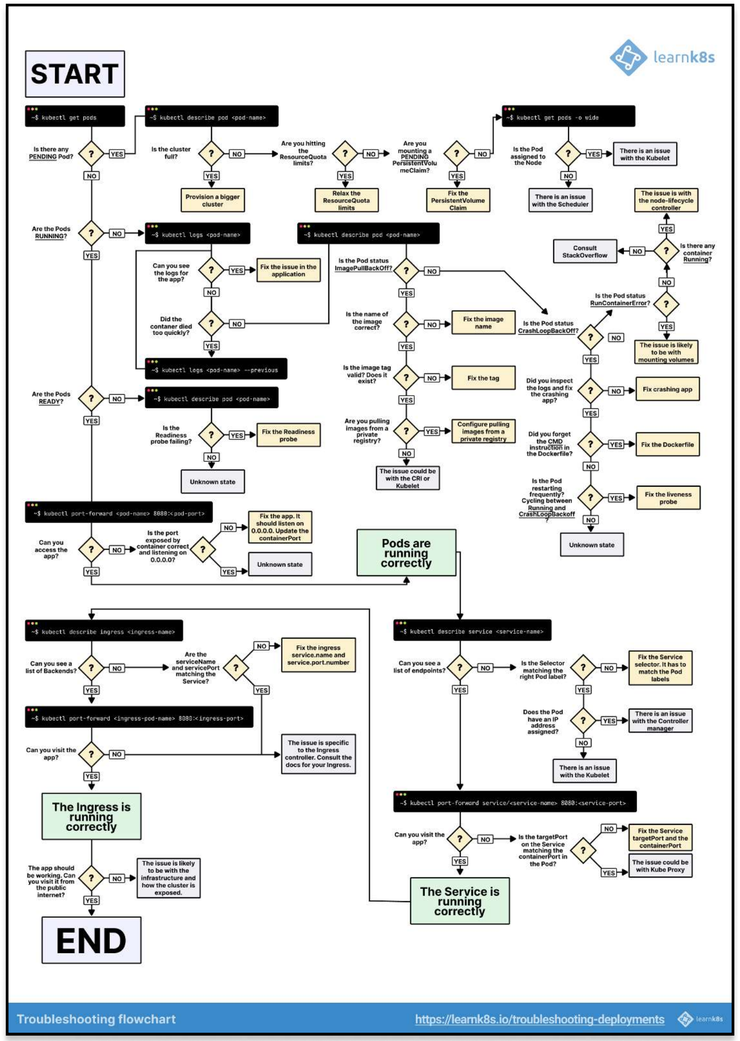
LAB 4

Networking

M6 Troubleshooting

- Be aware of the architecture
- Troubleshoot step by step



https://learnk8s.io/troubleshooting-deployments

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M6-1 Troubleshooting

Troubleshooting Steps

1. **Pod**
    a. is Pod running?
    b. is Pod ready?
2. **Service**
    a. has Service Endpoints?
3. **Ingress**
    a. is backend correct?

```
kubectl port-forward ...
```

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LAB 5

Troubleshoot

M7

Storage

A **PersistentVolume** (**PV**) is a piece of storage in the cluster that has been provisioned by an administrator or dynamically provisioned using **Storage Classes**. It is a resource in the cluster just like a node is a cluster resource. PVs are **volume plugins** like **Volumes**, but have a lifecycle independent of any individual pod that uses the PV. This API object captures the details of the implementation of the storage, be that **NFS**, iSCSI, or a **cloud-provider-specific storage system**.

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M7-1 PVC

A **PersistentVolumeClaim** (**PVC**) is a request for storage by a user. It is **similar** to a **pod**. Pods **consume node resources** and **PVCs** consume **PV** resources. **Pods** can request specific levels of resources (**CPU** and **Memory**). **Claims** can request specific **size** and **access modes** (e.g. can be mounted once **read/write** or **many times read-only**).

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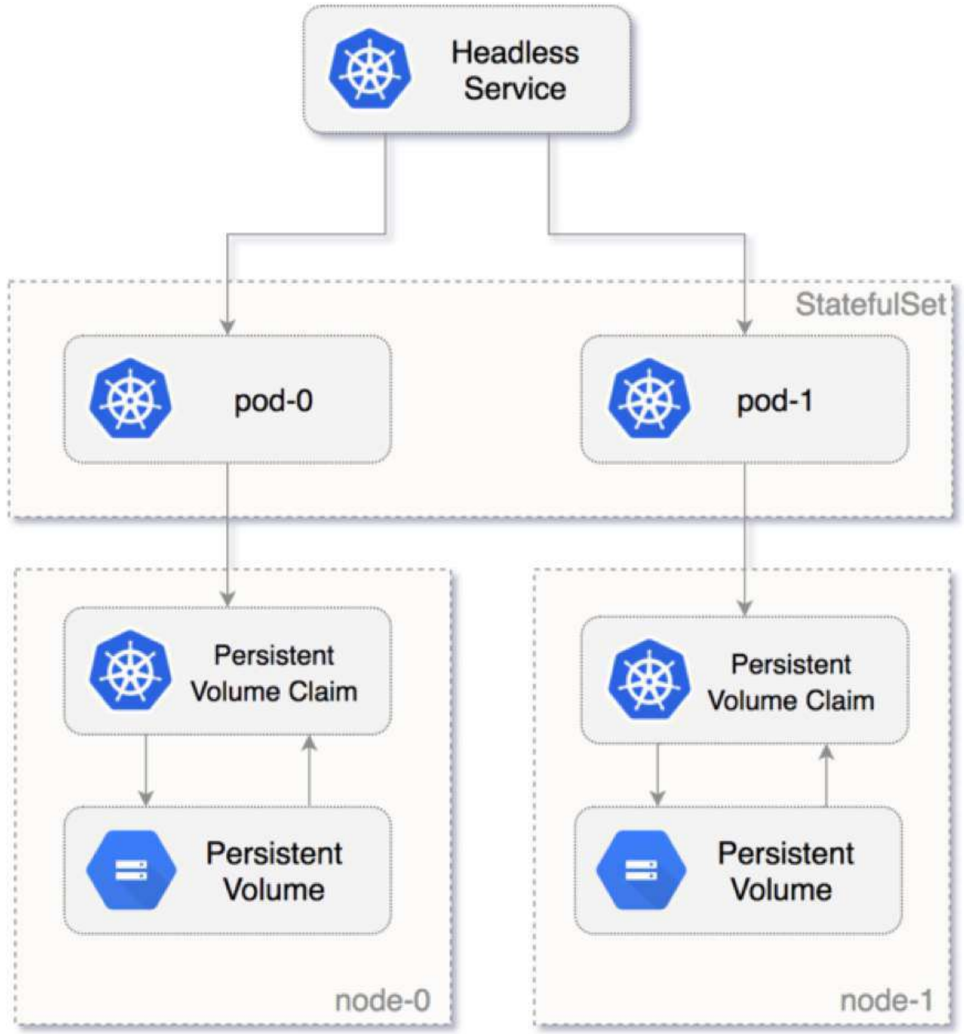
M7-2 Overview



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LAB 6

Storage

M8 Further Topics

- **Monitoring**
  - Kubernetes Dashboard
  - Kube Prometheus Stack
- **Gitops**
  - Gitlab CI/CD
  - Flux
  - ArgoCD

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M8-1 Useful Links

- **Official Kubernetes Docs**
  - https://kubernetes.io/docs/home/
- **CNCF Landscape**
  - https://landscape.cncf.io
- **Kubernetes API Reference**
  - https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.27/

M8-2 Get certified

- **Certified Kubernetes Application Developer (CKAD)**
  - https://www.cncf.io/certification/ckad/
- **Certified Kubernetes Administrator (CKA)**
  - https://www.cncf.io/certification/cka/
- **Certified Kubernetes Security Specialist (CKS)**
  - https://www.cncf.io/certification/cks/

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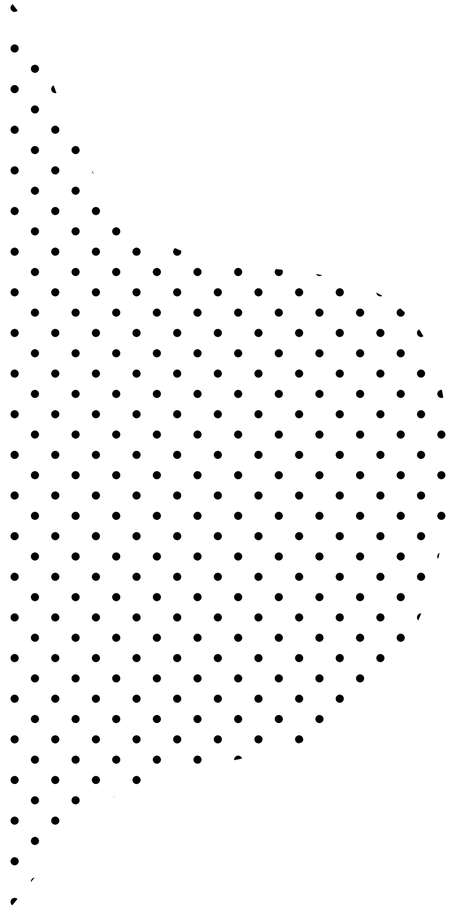
M8-3 Image Material



- https://www.weave.works/blog/kubernetes-faq-configure-storage-for-bare-metal-cluster
- https://stacksimplify.com/azure-aks/azure-kubernetes-service-namespaces-imperative/
- https://kubernetes.io/docs/home/
- https://ray.so
- https://undraw.co

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