# Modern Software Architecture, Containerization, and Kubernetes

## INTRODUCTION TO KUBERNETES

**Frank Heilmann**
Platform Architect and Freelance Instructor

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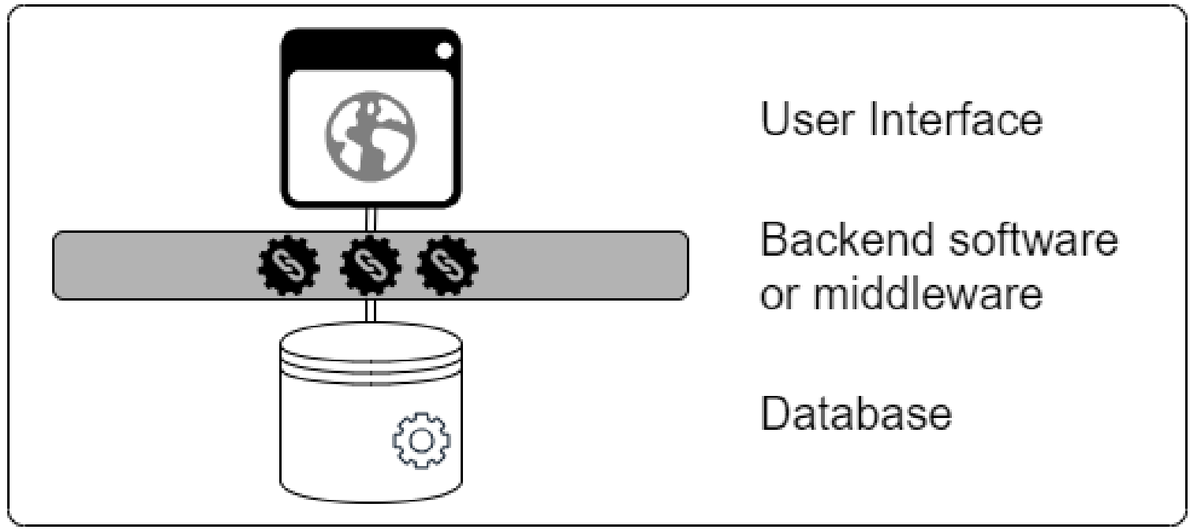
# About Me

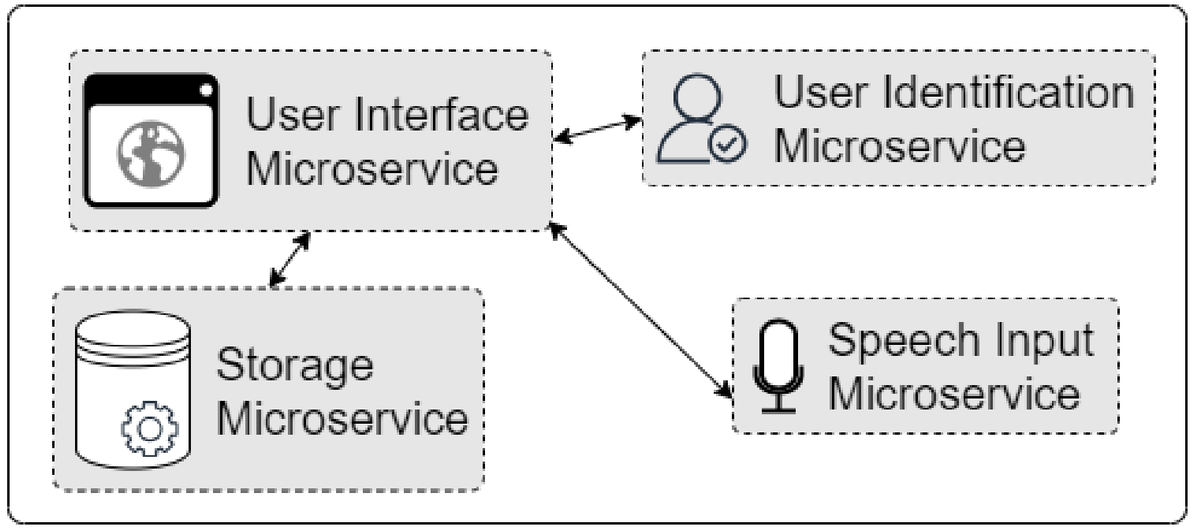
- Experienced Platform Architect, projects in different sectors
- Into Kubernetes since 2018 with focus on scalable data platforms on-prem and using major cloud providers
- Focus on resilience and high availability

[1] https://de.linkedin.com/in/frank-heilmann-19556590

# Modern Software Architecture

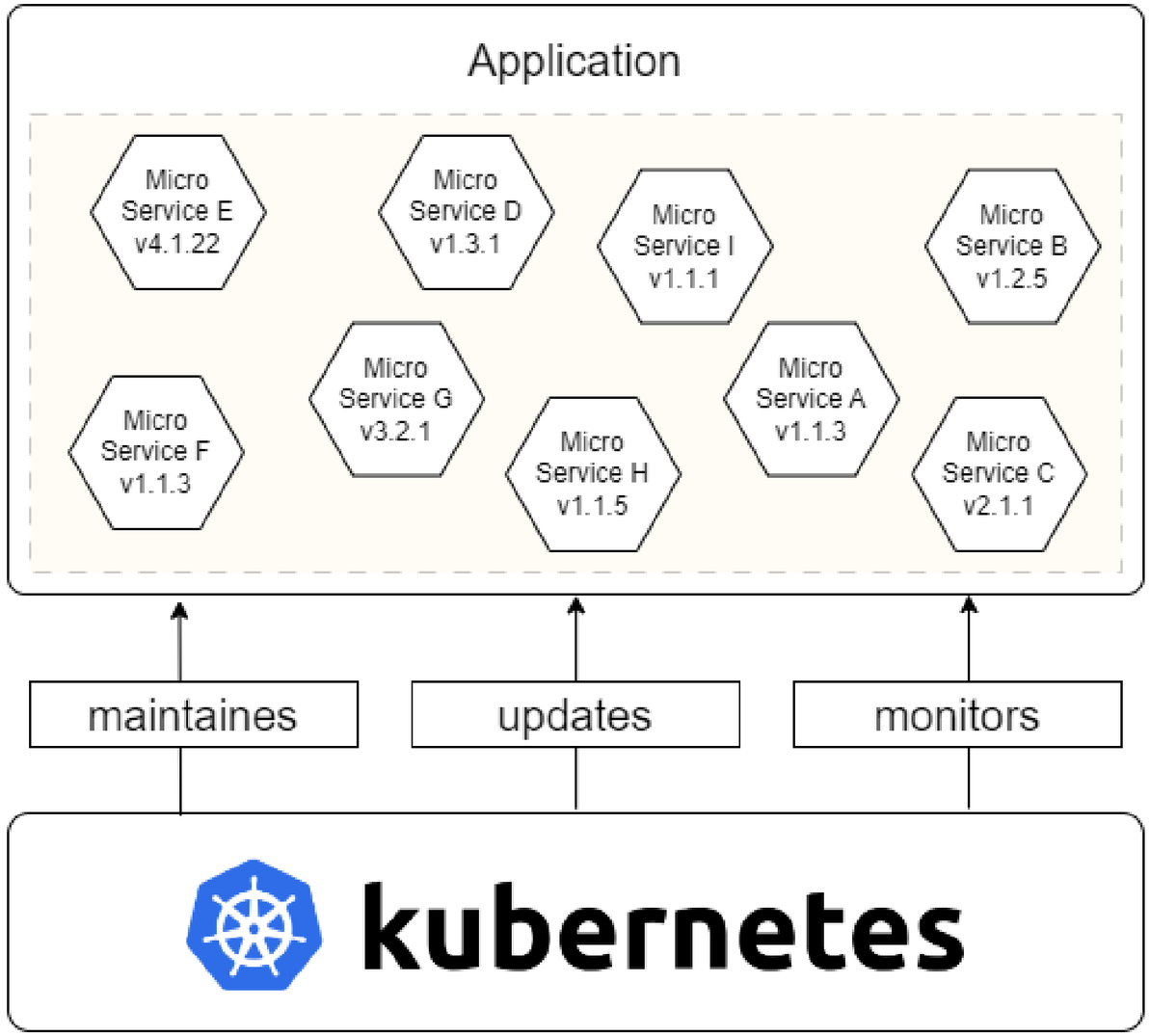



- Traditional architecture: **monoliths**
- Single applications, typically run independent from other applications
  - Hard to maintain and to update



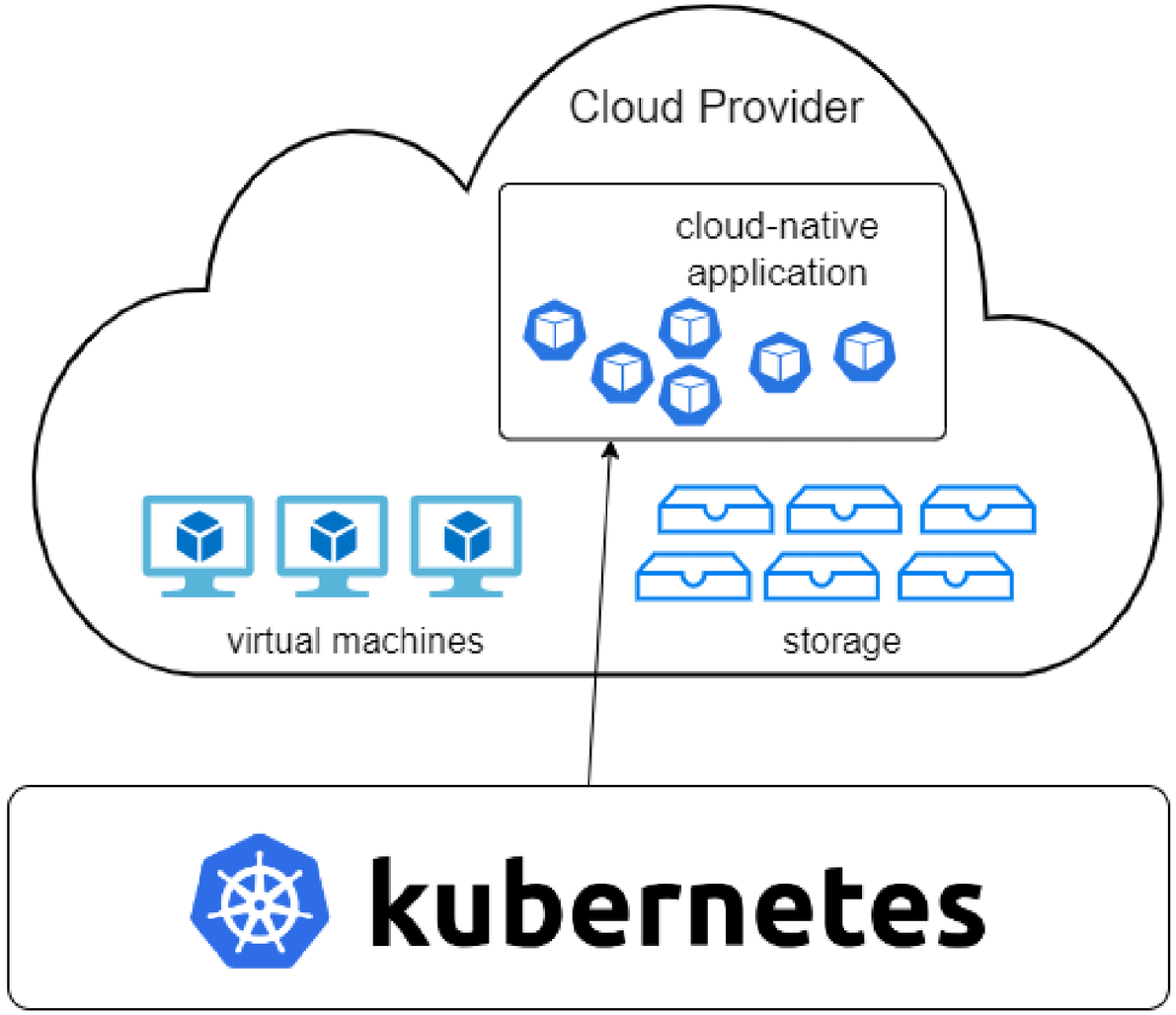

- Modern architecture: constructed from independent building blocks: **microservices**
  - Can be independently maintained and updated
- Ideally suited for cloud computing

# Containerization and Kubernetes




- Modern applications consist of potentially thousands building blocks
- Deployed via **containers**!
  - Each building block is *delivered* in an individual container
- **Kubernetes** keeps track of all containers

# Cloud Nativeness and Kubernetes




- *Cloud-native*: a way to build & deploy applications in the cloud
- **Cloud-native applications** are designed to be scalable
- **Kubernetes** is cloud-native:
  - simplifies deploying and managing containers
  - enables easy scaling of applications

# Kubernetes Distributions and Cloud Offerings

- Kubernetes is an open-source project by Google
- Everyone can download, install, and use it
- We can also use Kubernetes with all cloud providers as a managed service
- "Kubernetes" --> "K *ubernete* s" --> "K8s"

# Let's practice!

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# Docker and Kubernetes

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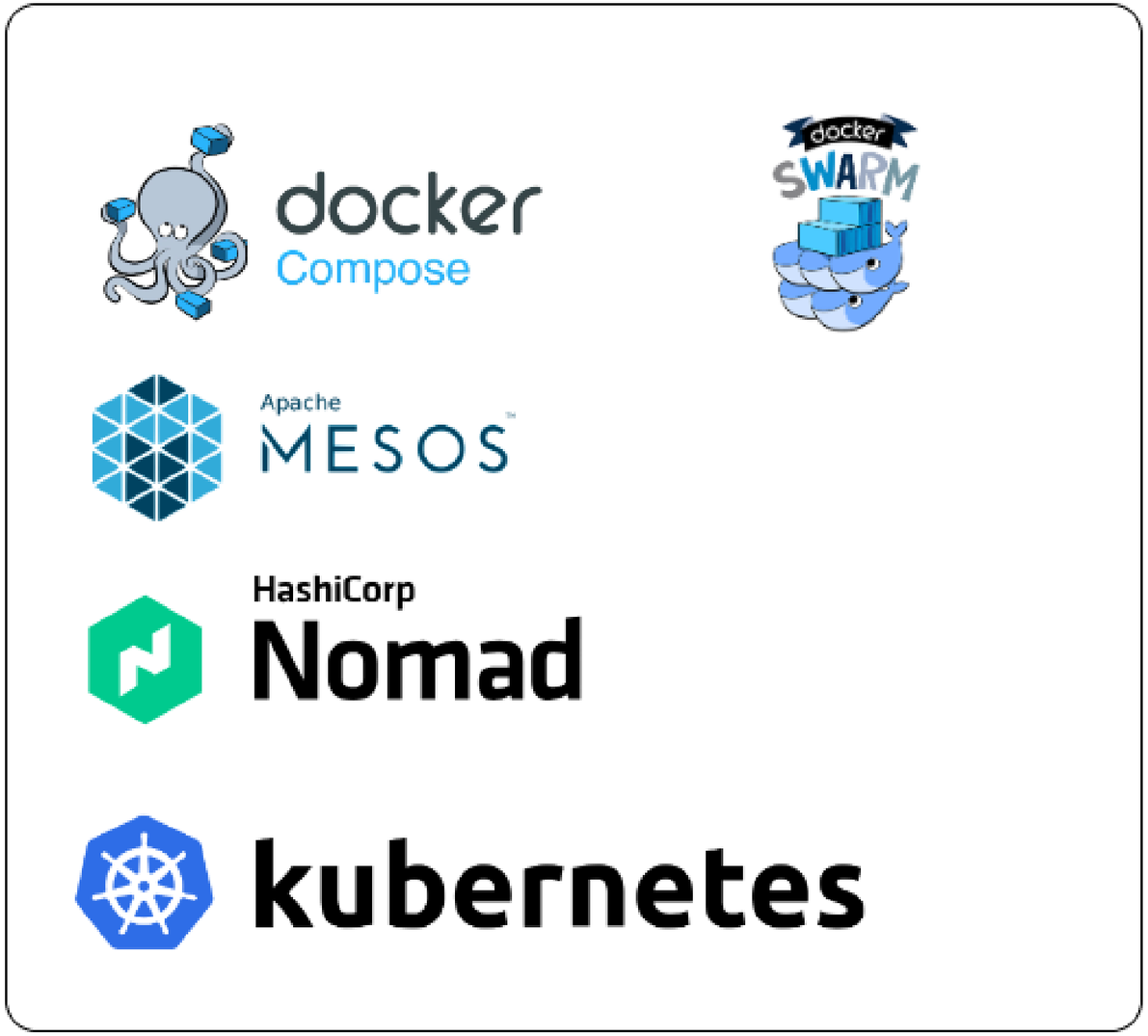
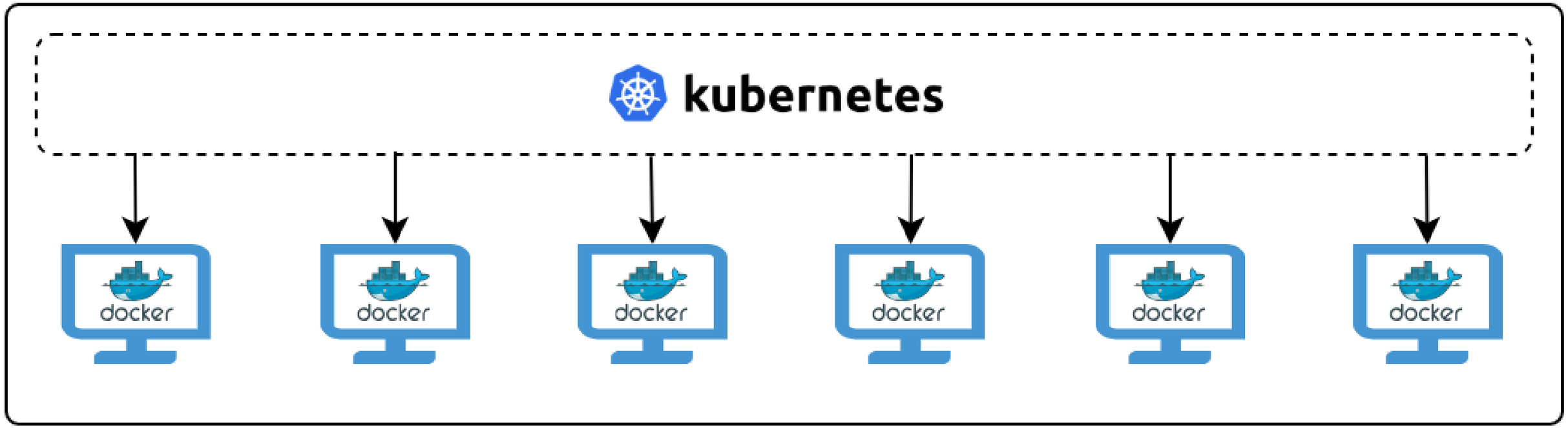
# Container Orchestration Tools




- Modern software stacks typically consist of potentially thousands of individual containers
- Managing all these containers is known as **Container Orchestration**, several **container orchestration tools** exist
- Kubernetes has an estimated market share well above 95%

# Kubernetes for Orchestration

- Kubernetes solves the typical challenges of container orchestration, e.g.,
  - scheduling and networking (where to deploy a container and how to connect them)
  - how to attach storage to a container
- To do that, Kubernetes interacts with **Container Engines**.



# The Relationship between Docker and Kubernetes

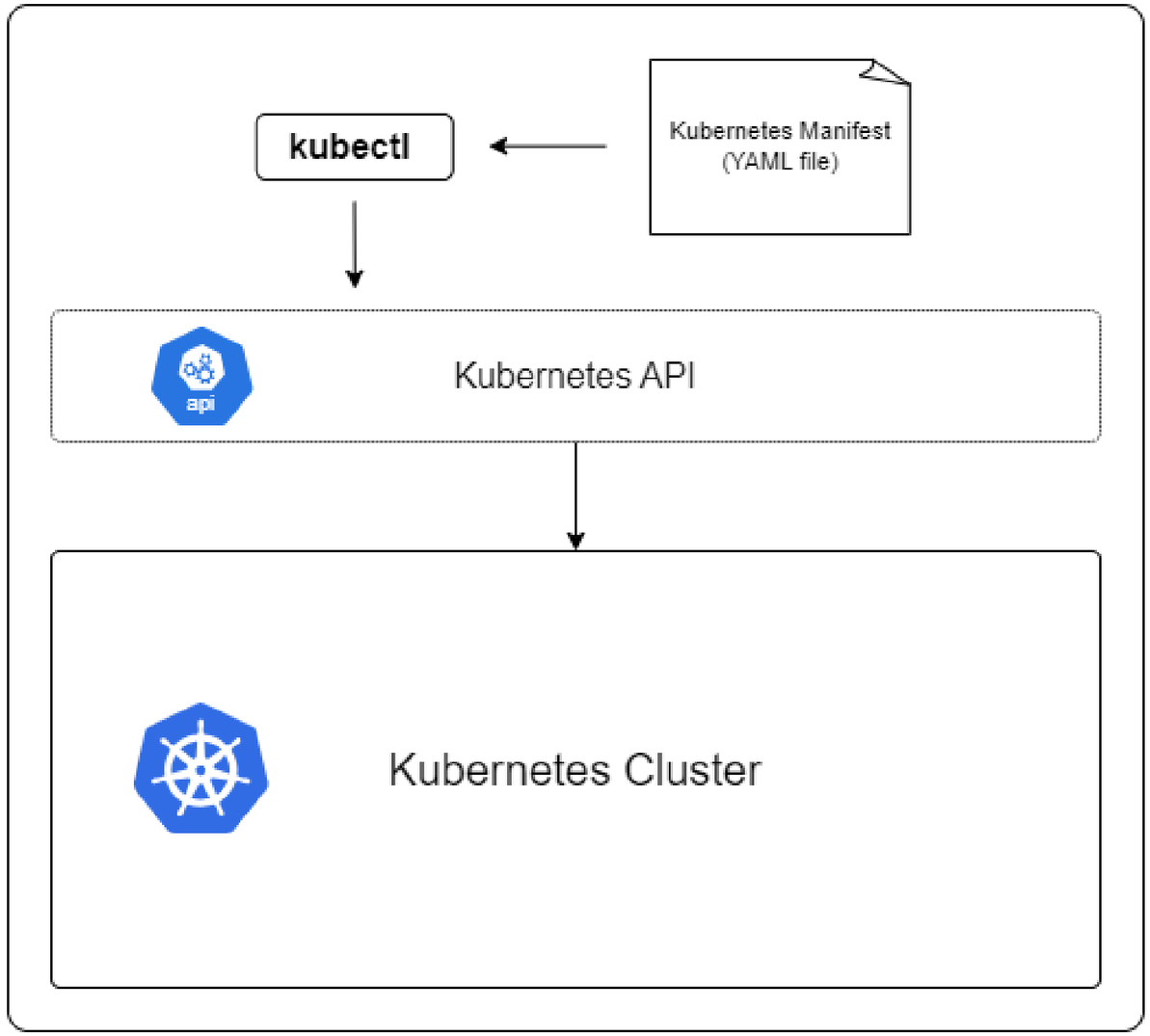
- Often, **Docker** is your container engine of choice
- Kubernetes interacts with Docker as a container engine to schedule and maintain containers
- Docker is typically used for two tasks:
  - creating and updating Docker images
  - starting containers from such images
- Kubernetes never creates Docker images, you use Docker for this

# Kubernetes Manifests

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment
  labels:
    app: nginx
spec:
  replicas: 5
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx:1.25.4
        ports:
        - containerPort: 80
```

- Kubernetes objects (e.g., containers) are described in so-called **Kubernetes Manifests**
- Manifests are **YAML files** that describe which objects you want, how they should be configured, where they should be scheduled, and a lot more
- Manifest are **declarative**, i.e., you describe **what** you want, or which **state** to achieve
- They are **not imperative**, you do **not describe how to achieve it**

# kubectl




- `kubectl` is a command line tool to interact with Kubernetes
- `kubectl` comes with many commands and options
- `kubectl` reads your Manifest, sends them to Kubernetes via its API, and Kubernetes will compute what to do to achieve the state you want
- Pronounced *cube cuddle* ;-)

# Let's practice!

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# Kubernetes Architecture

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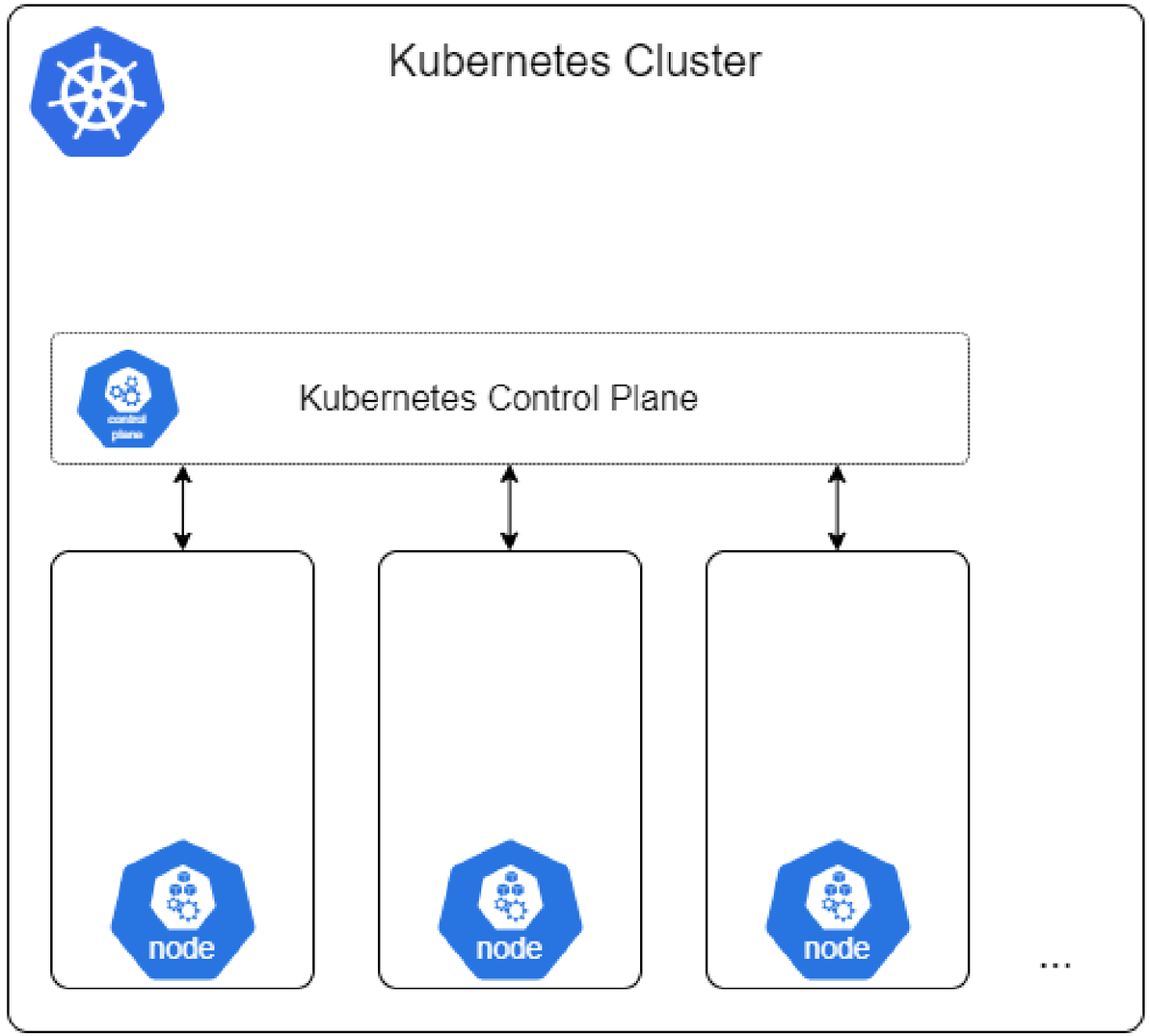
# Kubernetes Overview

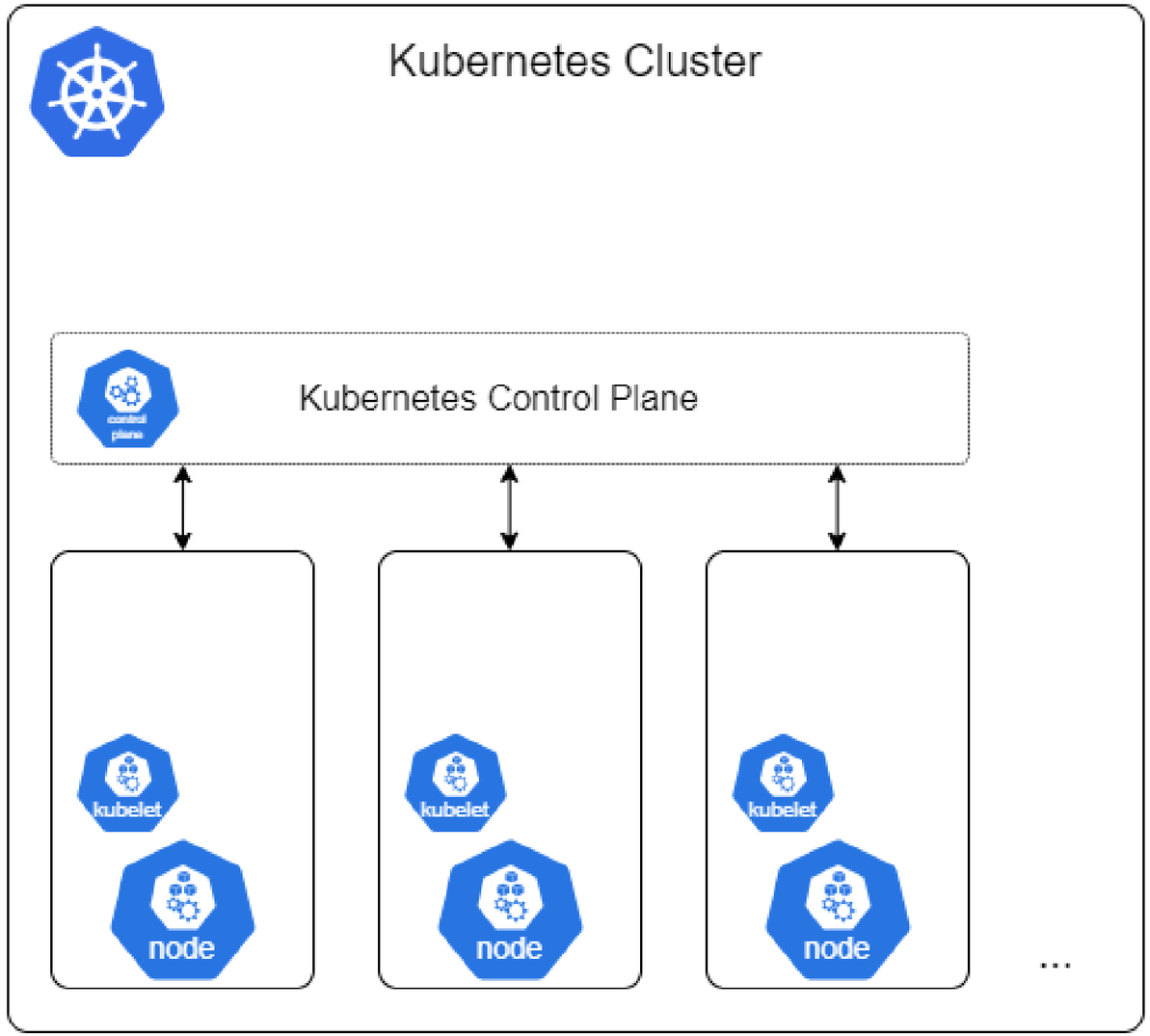
- Kubernetes is built from many elements:
- Most important ones, from larger to smaller:
  - **Clusters** and **Control Planes**
  - **Nodes**
  - **Pods**
- Network connectivity through **Services**

# Kubernetes Cluster and the Control Plane



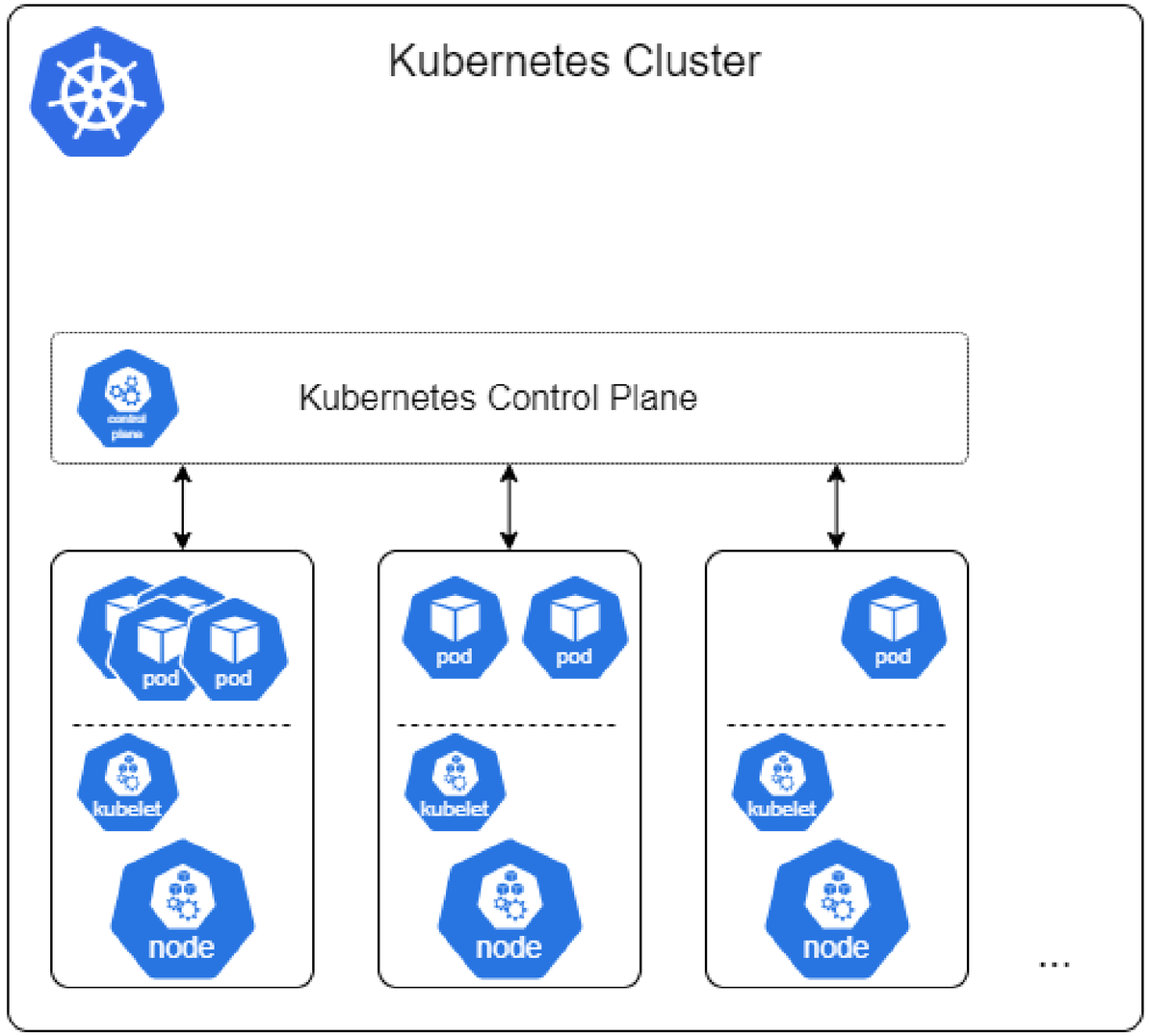

- A Kubernetes Cluster is a set of connected computers (or **Nodes**)
- Servers in a datacenter, virtual machines in the cloud
- The Kubernetes **Control Plane** manages these nodes
  - consists of many components, that can run on any node in the cluster

# Kubernetes Nodes



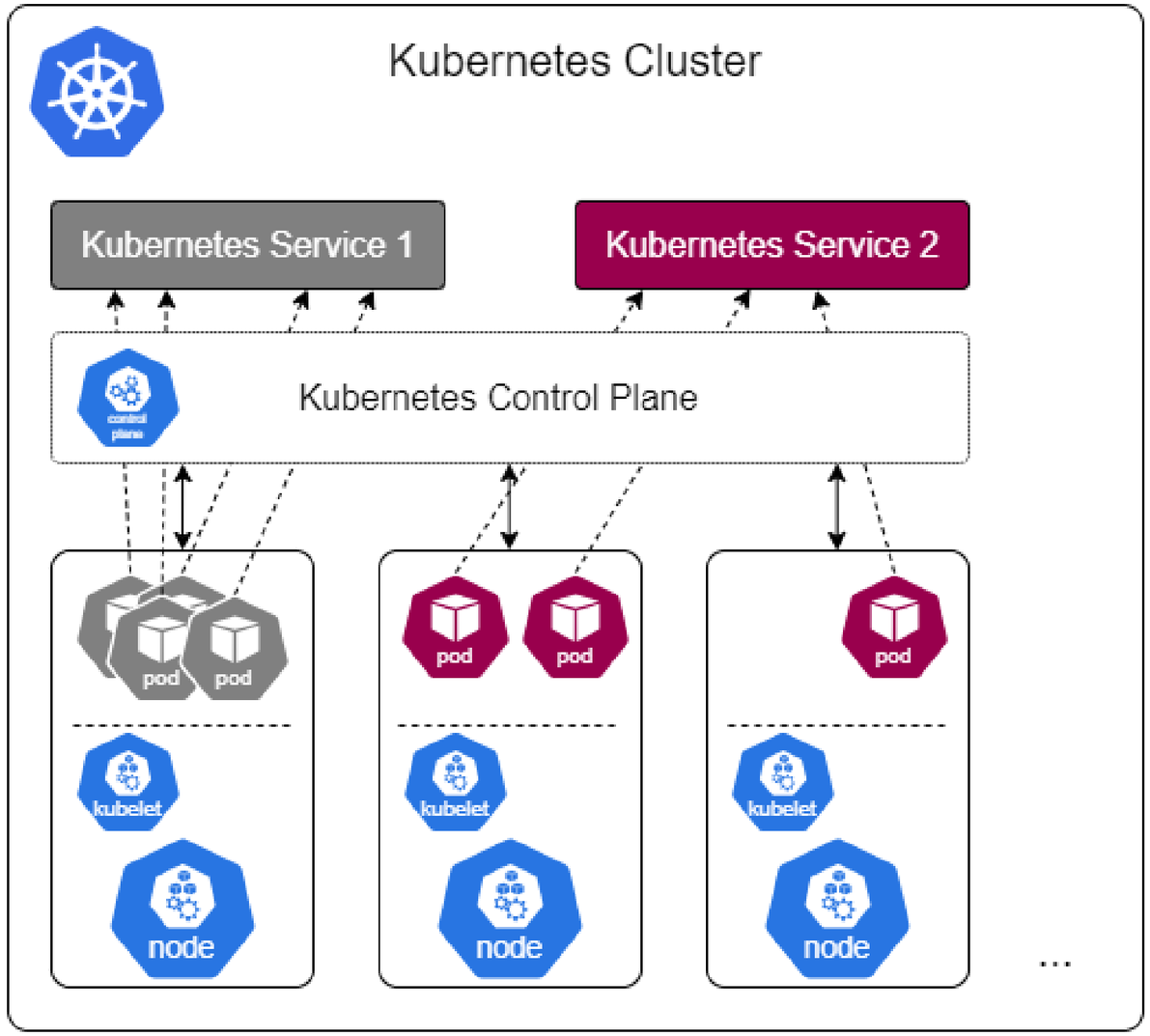

- A Kubernetes Node typically runs Linux + container engine (Docker)
- Nodes are also called **worker machines**
- Nodes run **Kubernetes Kubelet**
  - ensures containers run in so-called *Pods*

# Kubernetes Pods




- Kubernetes **Pod**
  - Smallest unit that you can deploy
  - A Pod is a set of one or more containers
- The containers in a Pod belong together logically, share storage and network
- Pods are *ephemeral*:
  - Pods can be stopped and recreated and any point in time.
  - Pods can moved to other nodes at any point in time.

# Kubernetes Services




- **Kubernetes Service:** resource for exposing network connectivity
- Required to connect to Pod from outside, or to communicate between Pods
- Reason: Pods may get re-deployed any time, and will
  - Receive a new IP address
- Services are not ***ephemeral***, they offer stable network connectivity

# Kubernetes Cheat Sheet

- Kubernetes **Cluster:** set of connected computers (Nodes) configured to run Kubernetes
- Kubernetes **Control Plane:** manages the Nodes in a Cluster
- Kubernetes **Nodes**: also called "worker machines", running Linux and a container engine
- Kubernetes **Pods**: a set of one or more containers, the smallest deployable unit
- Kubernetes **Services:** a resource for exposing network connectivity, required to connect to Pods from outside, and for communication between Pods

# Let's practice!

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