WALCHAND COLLEGE OF ENGINEERING, SANGLI

WALCHAND LINUX USERS' GROUP

WLUG
Community | Knowledge | Share

METAMORPHOSIS

Navigating the DevOps Wave

LIMITED SEATS

EXCITING PRIZES

15 & 16 FEB

Let's Dock It!
SESSION 1

DockerVerse
SESSION 2

REGISTER AT

Sailing to K8s
SESSION 3

Pod Power
SESSION 4

WARGAMES

POWERED BY
IT'S FOSS

CONTACT WITH US

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Main & Mini CCF

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President WLUG	HoD Computer Science and Engineering	HoD Information Technology	Staff Advisor WLUG	Staff Advisor WLUG	Associate Dean WCE	I/C Director WCE

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CONTENTS

- Distributed systems
- Microservices & REST APIs
- What is Kubernetes?
- Architecture of K8S
- Docker vs Kubernetes
- Kubernetes Installation

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Docker


PEOPLE
KUBERNETES
....
STORAGE
NETWORKING
DOCKER
YAML
LINUX

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DISTRIBUTED SYSTEMS

Collection of independent computers which appear to be working as single coherent system

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CHARACTERISTICS

- Resource sharing
- Scalability
- Parallelism
- Fault tolerance

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DISTRIBUTED SYSTEMS

Blade Servers

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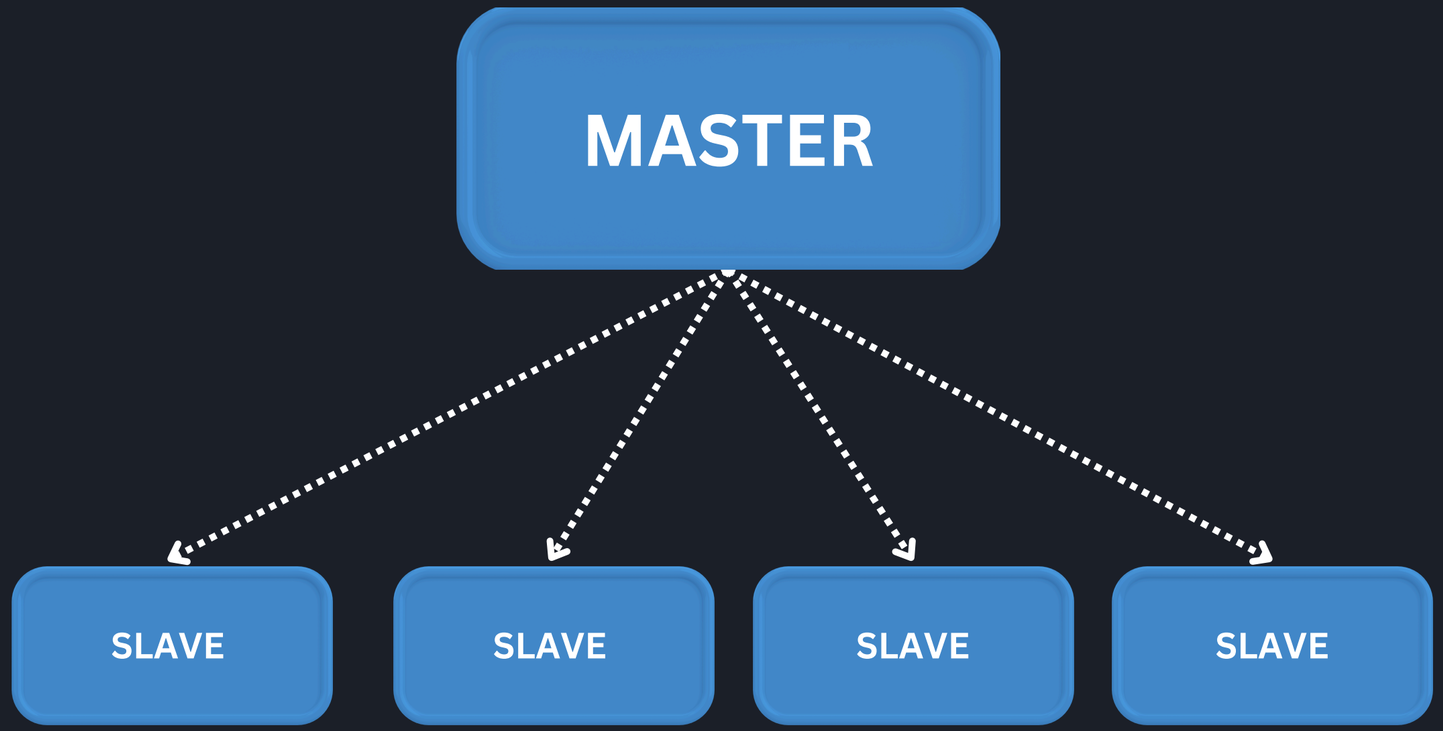
DISTRIBUTED ALGORITHMS



Master Slave Architecture

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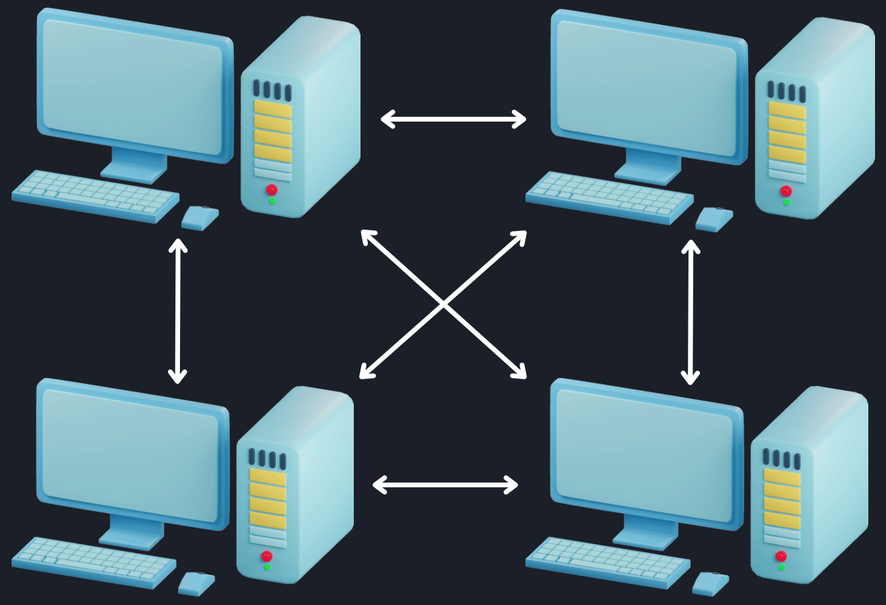
DISTRIBUTED ALGORITHMS



Peer-to-Peer Architecture

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MICROSERVICES

- Implementation of distributed systems
- An application built up of different parts
- Use API for communication
- Broken into microservices
- Decentralized managemnet
- Example: Various Restaurant services

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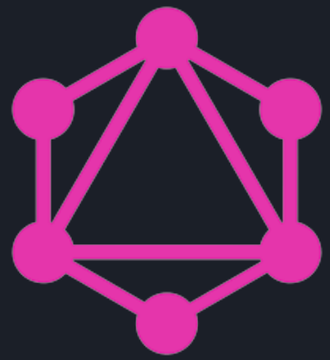
WEB API

A standard protocol for communication between two devices over a network

REST



GraphQL

Sockets

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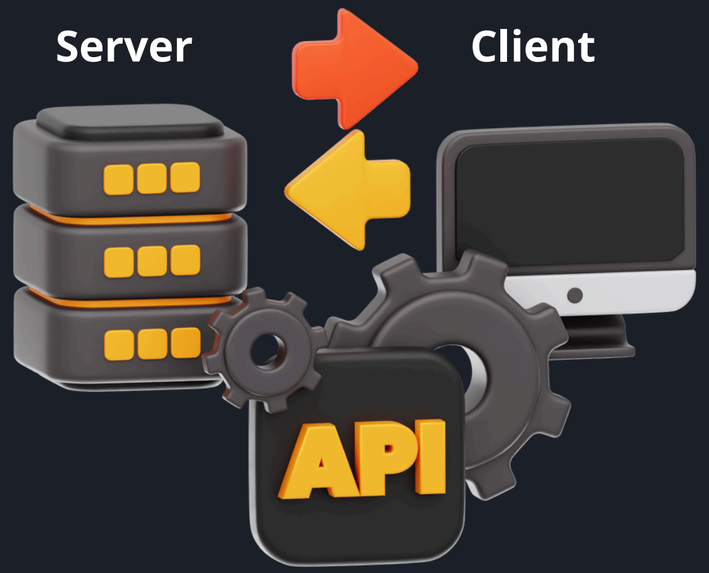
CLIENT-SERVER ARCHITECTURE

- The party requesting specific service is client
- The party serving the request and making a response is server
- Back and forth communication



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CLIENT-SERVER ARCHITECTURE

Database Server

Login Server

User

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BENEFITS OF MICROSERVICES

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SCALING

Easily scale up and allocate available resources across any service

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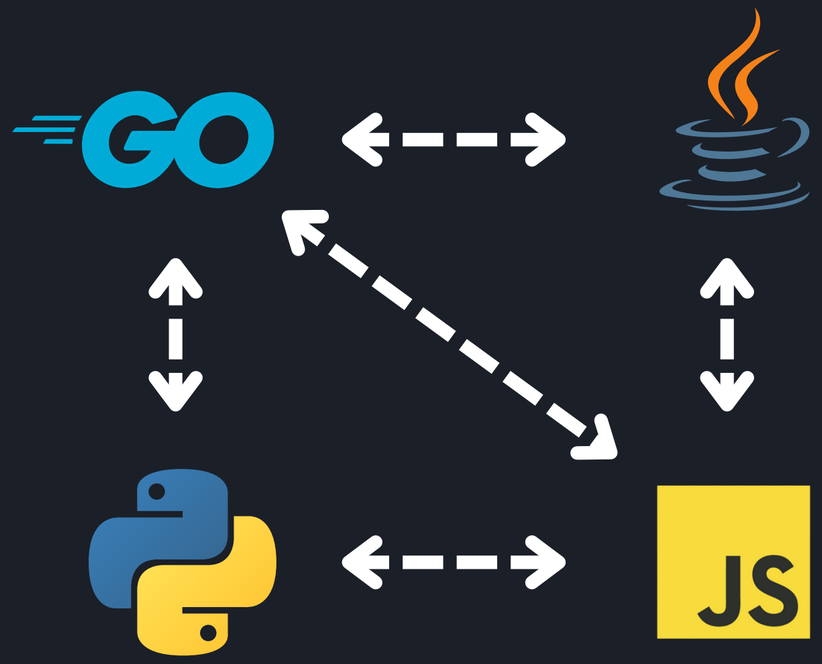
FLEXIBILITY

Independent development, testing and deployment of individual services



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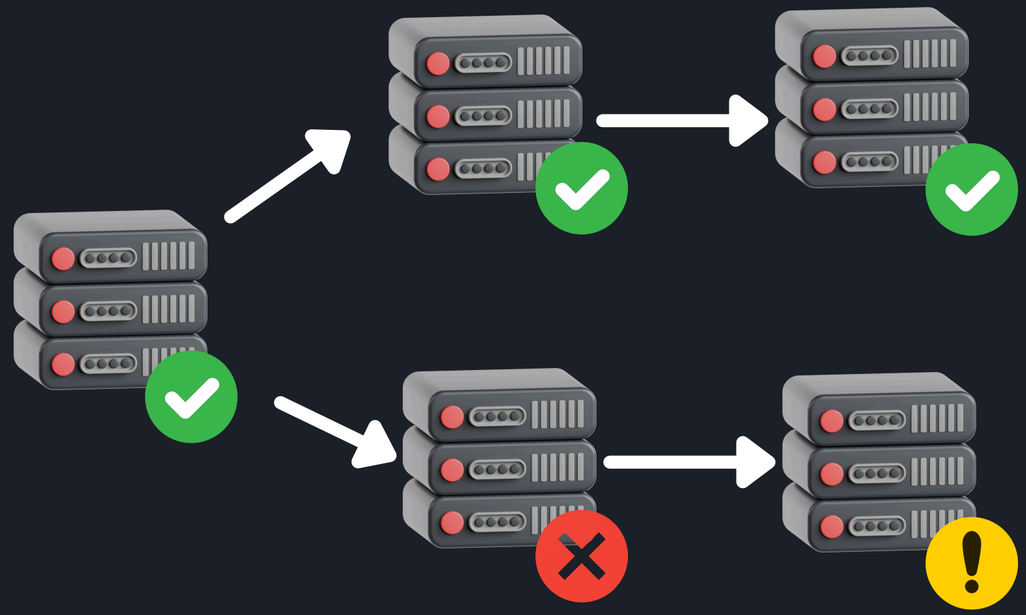
FAULT ISOLATION

Service failure only affects dependent services, while others remain unaffected



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FASTER DEVELOPMENT AND DEPLOYMENT

Services can be developed, tested and deployed parallel

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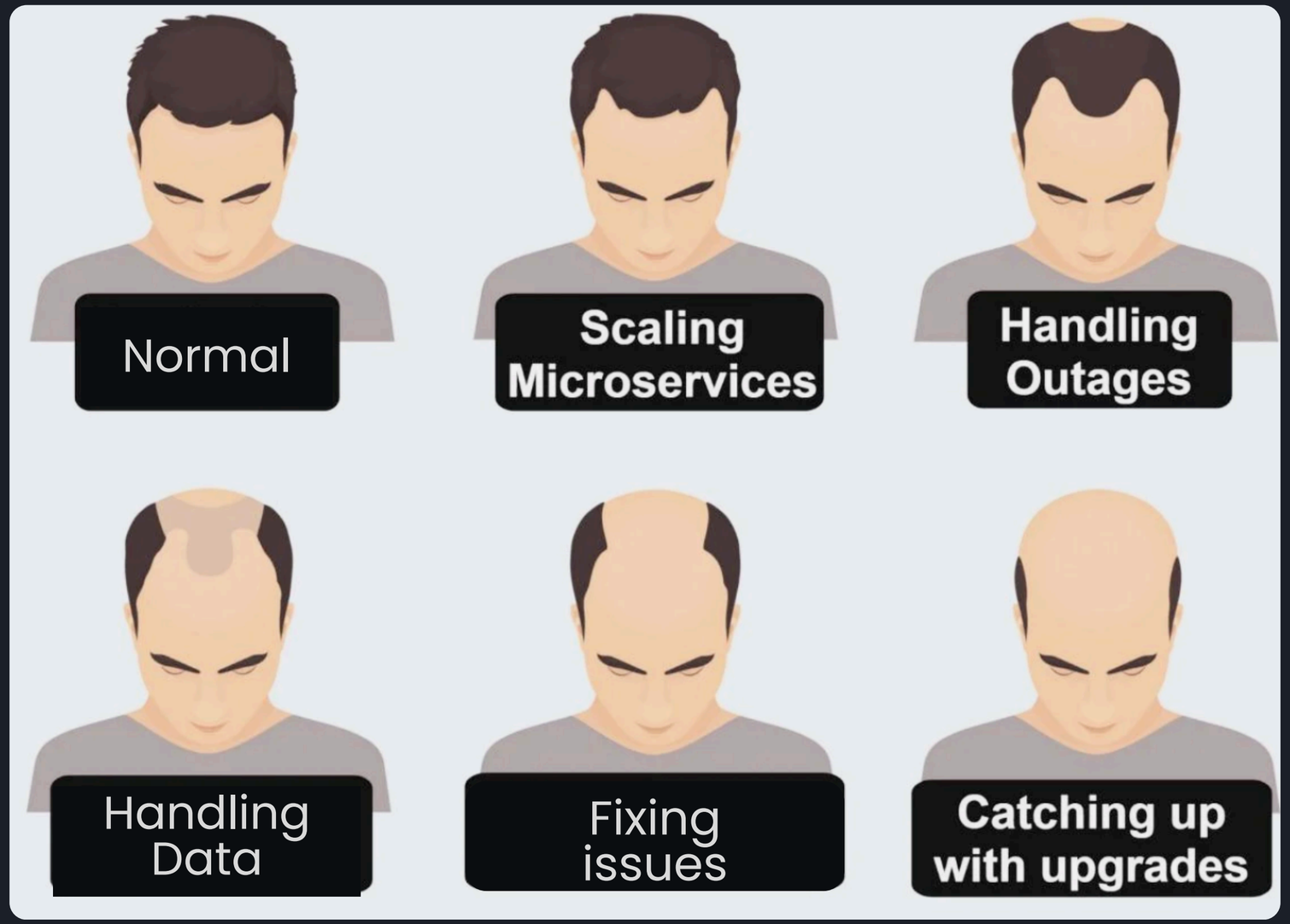
CHALLENGES

- Distributing work between same service is difficult
- Implementing fault tolerance and manually tracking services is time consuming
- Updating and deploying new service to integrate with current can be tricky


Normal
Scaling Microservices
Handling Outages
Handling Data
Fixing issues
Catching up with upgrades

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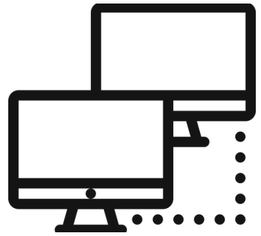
NEED OF A MANAGER

Kubernetes acts as a comprehensive management tool
It ensures the following:

Automated Operations



Load Balancing

Resource Optimization

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KUBERNETES

- Open Source container orchestration software
- Originally developed by Google in 2014
- Now maintained by the Cloud Native Computing Foundation (CNCF)
- Written in the GO programming language

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PODS

- Smallest, most basic deployable unit in Kubernetes
- Represents a single instance of a running process in your application
- Can contain one or more tightly coupled containers
- Containers within a pod share the same network namespace and storage volumes

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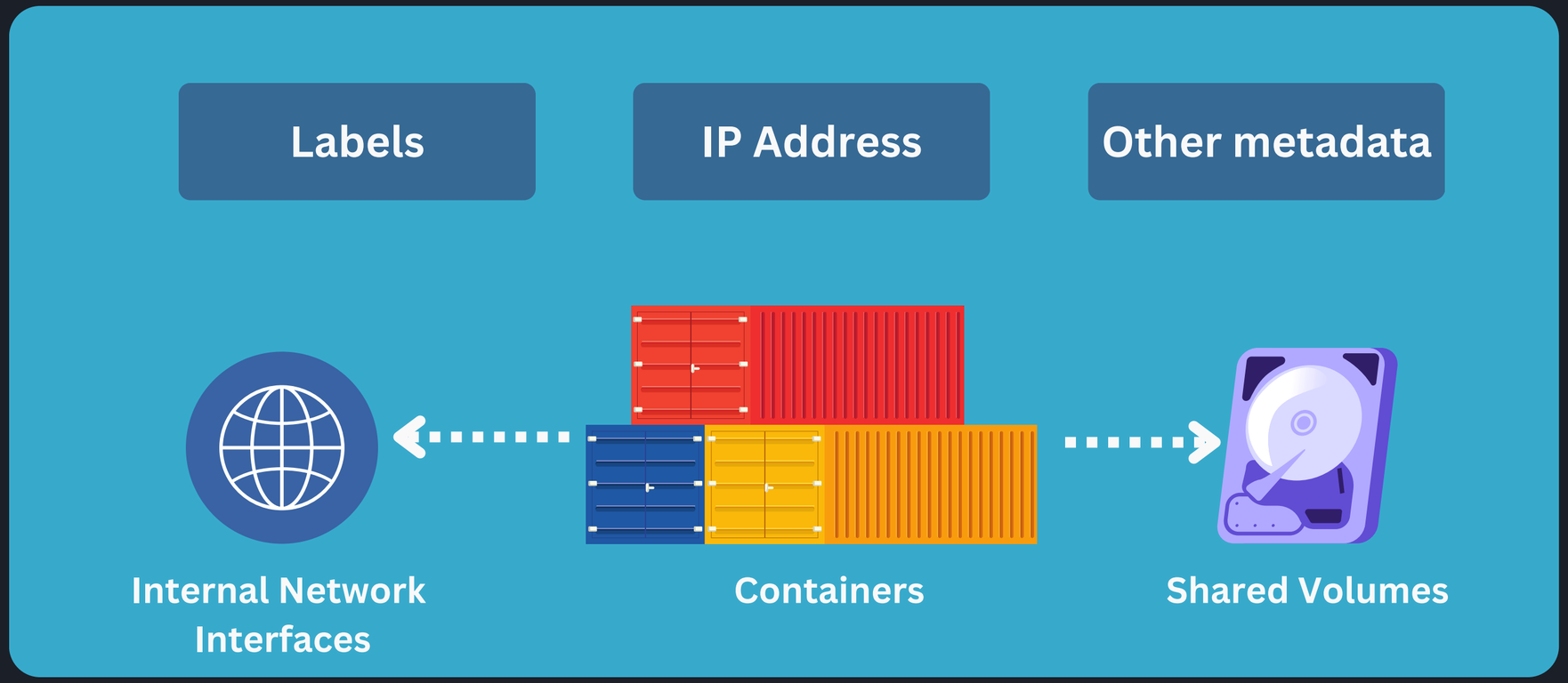
PODS



A Pod

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NODES

- Actual computer that run applications which are the pods
- Each node contains the necessary components to manage pods
- A node can be a virtual or physical machine
- Includes a container runtime (like Docker), kubelet and kube-proxy

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NODES

Container Runtime

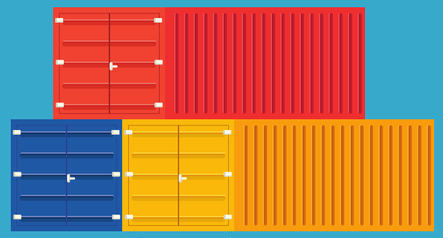
Kubelet

Kube Proxy

POD

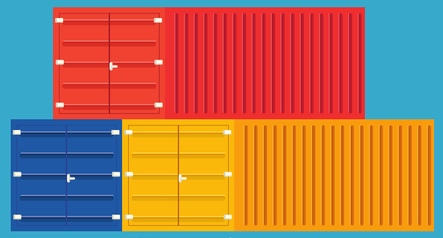
Containers

POD



Containers

POD



Containers

A Kubernetes Node

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CLUSTER

- Set of Nodes managed as a single entity by Kubernetes
- Consists of a control plane that manages worker nodes
- Allows seamless orchestration of applications
- High availability and fault tolerance

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CLUSTER

CONTROL PLANE NODE

WORKER NODE

Components

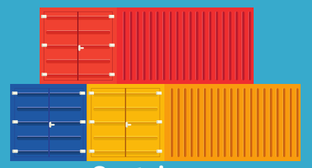
POD

Containers

WORKER NODE

Components

POD



Containers

WORKER NODE

Components

POD

Containers

WORKER NODE

Components

POD

Containers

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USE CASES

- Cloud-Native Apps
- Multi-Cloud Environments
- Continuous Updates
- Scalable Services

When the person with Kubernetes experience is brought into a room...

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WHY KUBES?

Kubernetes is like a smart manager, automating tasks to keep everything running smoothly

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PROPERTIES

- Self-Healing
- Automated Updates
- Load Balancing
- Efficient Use of Resources

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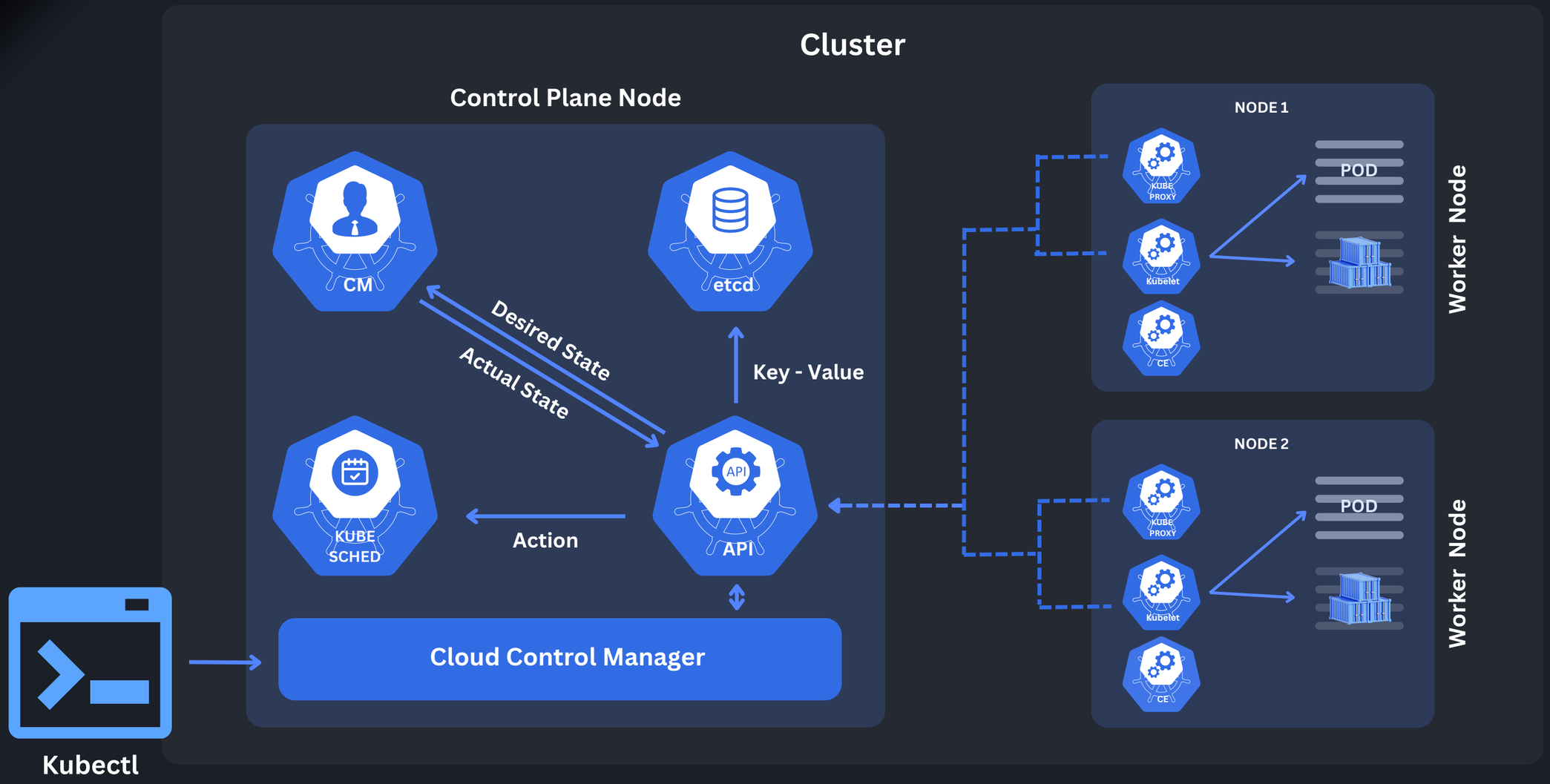
K8S

ARCHITECTURE

- Master-Slave Architecture
- Control Plane Components
- Worker Node Components



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HEADQUARTERS

Branch Office 1

Branch Office 2

Branch Office 3

OWNER

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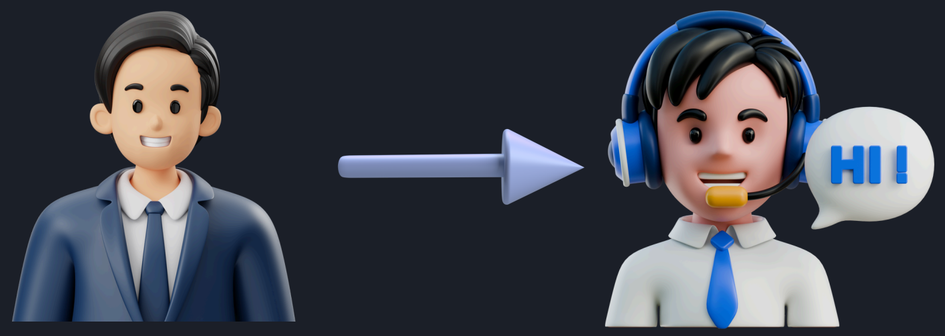
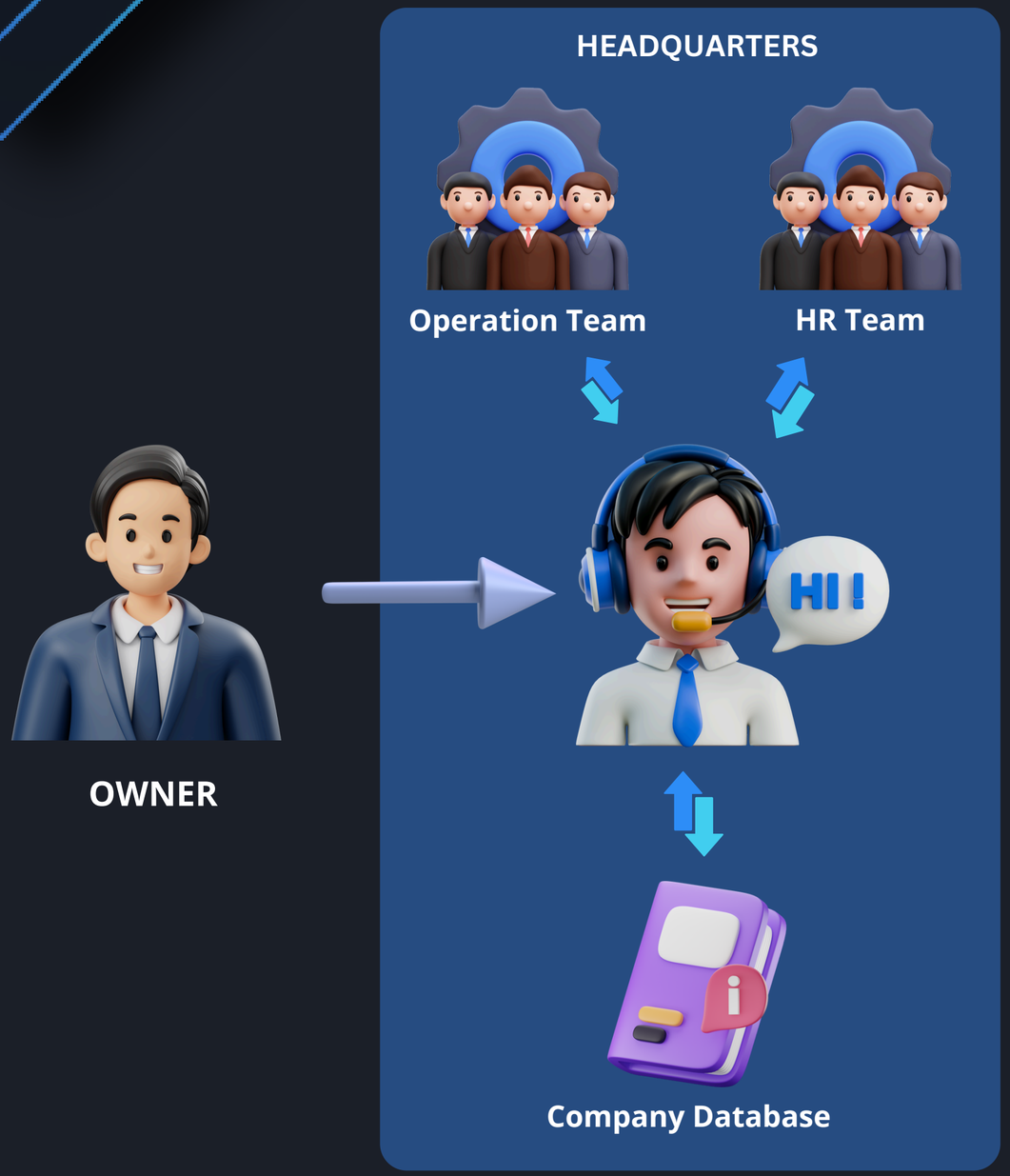
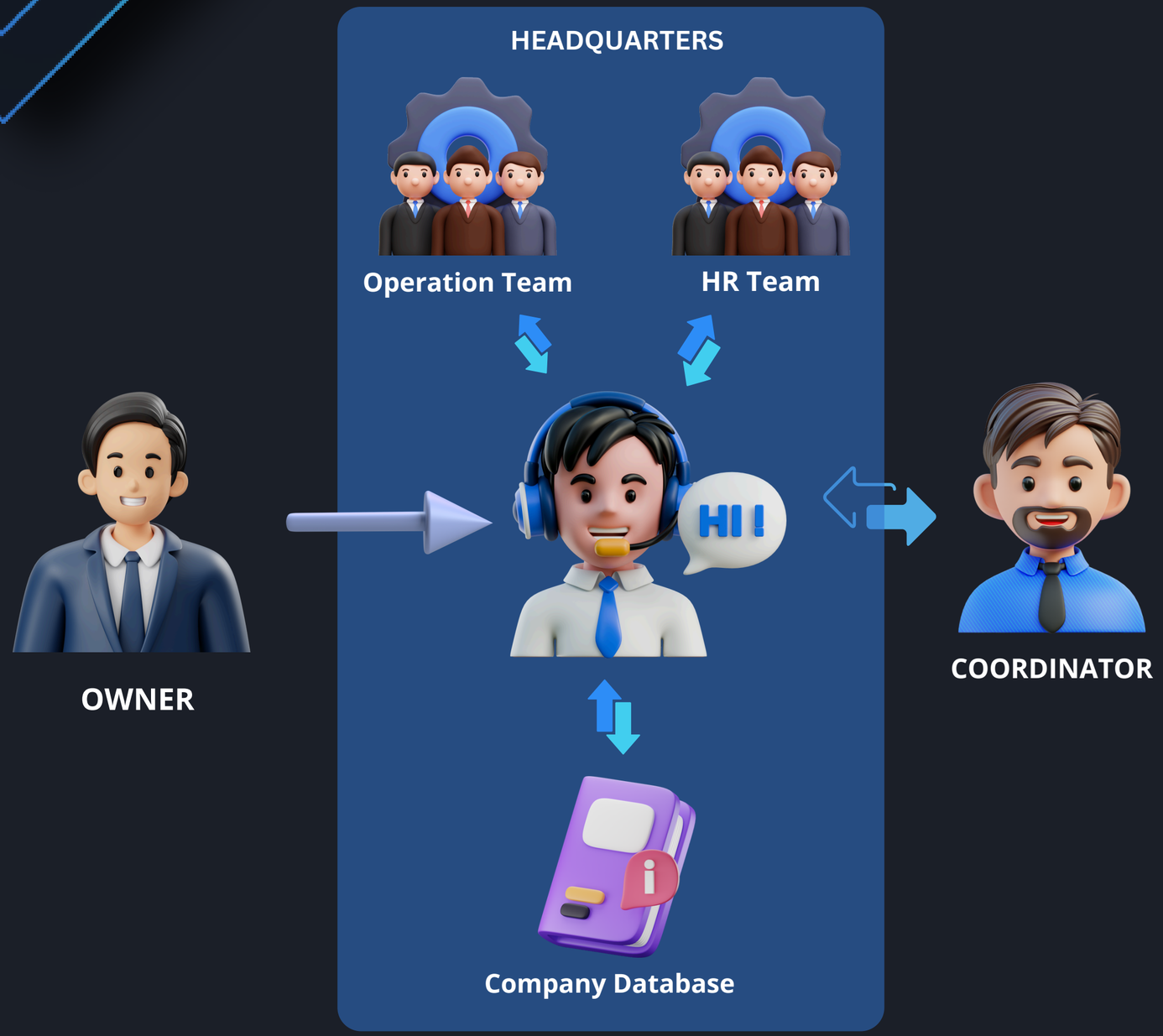


OWNER


HEADQUARTERS
Operation Team
HR Team
HI !
OWNER
Company Database


HEADQUARTERS
Operation Team
HR Team
HI !
OWNER
COORDINATOR
Company Database

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HEADQUARTERS

Operation Team

HR Team

OWNER

Company Database

COORDINATOR

Branch Office 1

Manager

Branch Office 2

Manager

Branch Office 3

Manager

CONTROL PLANE NODE

- Brain of a Kubernetes clusters
- Manages the overall cluster and worker nodes
- Api Server, ETCD, Controller Manager, Kube Scheduler
- Manages scheduling, scaling and maintaining the application's health

WORKER NODES

- Executes containerized application and manages Pods
- Handles tasks assigned by the Control Plane Node
- Kubelet, KubeProxy, Container Engine
- User workloads run on Worker Nodes

Manages

Control Plane Node

Worker Nodes

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Cluster

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Cluster

?

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Cluster

Control Plane Node

CONTROL PLANE
NODE

API SERVER

Entry Point to K8S cluster

- Handles communication between the user and the control plane
- Entry/Access point to K8S cluster
- Authenticates, validates and routes requests within the cluster

CONTROL PLANE
NODE

CONTROLLER MANAGER

Keeps track of actual and desired state

- Runs a control loop to monitor the current state of the cluster
- Compares the current state with the desired state and makes changes to align the two
- Maintains cluster's health and performance

CONTROL PLANE
NODE

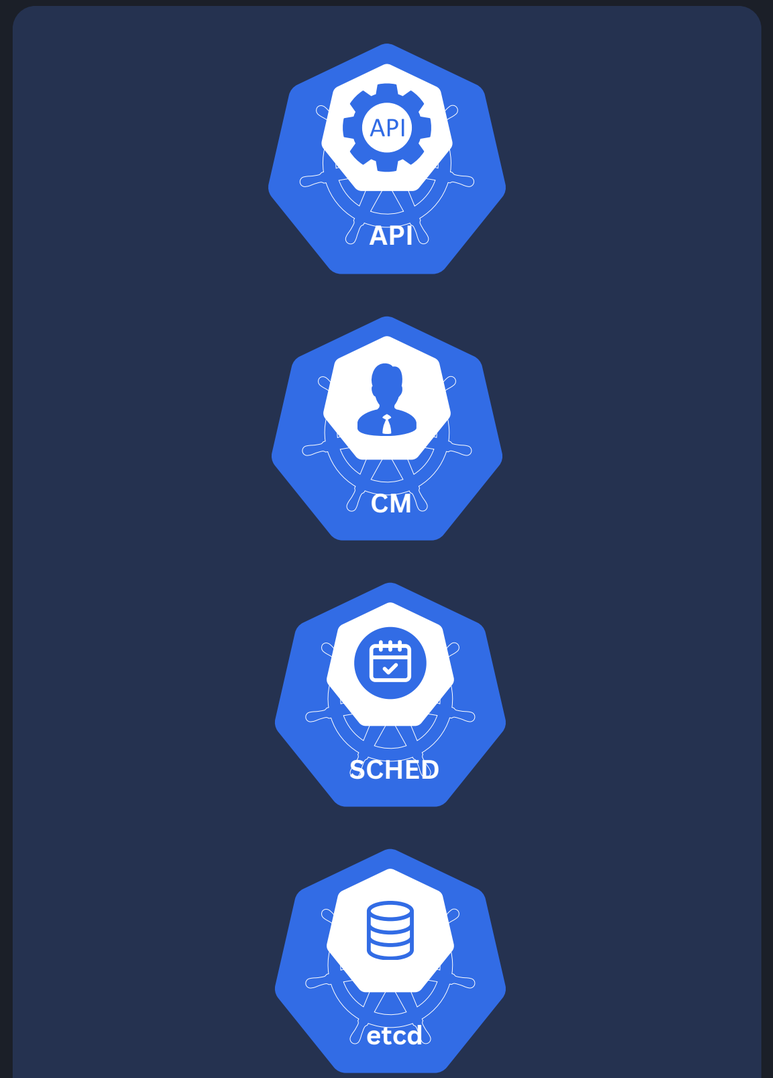
KUBE SCHEDULER
performs action based on request

- Finds the "best" machine (node) to deploy the pod
- Prefers machines where the already-running pods are consuming the least resources
- Ensures pods are spread out across nodes, avoiding resource hotspots and improving cluster balance

CONTROL PLANE
NODE

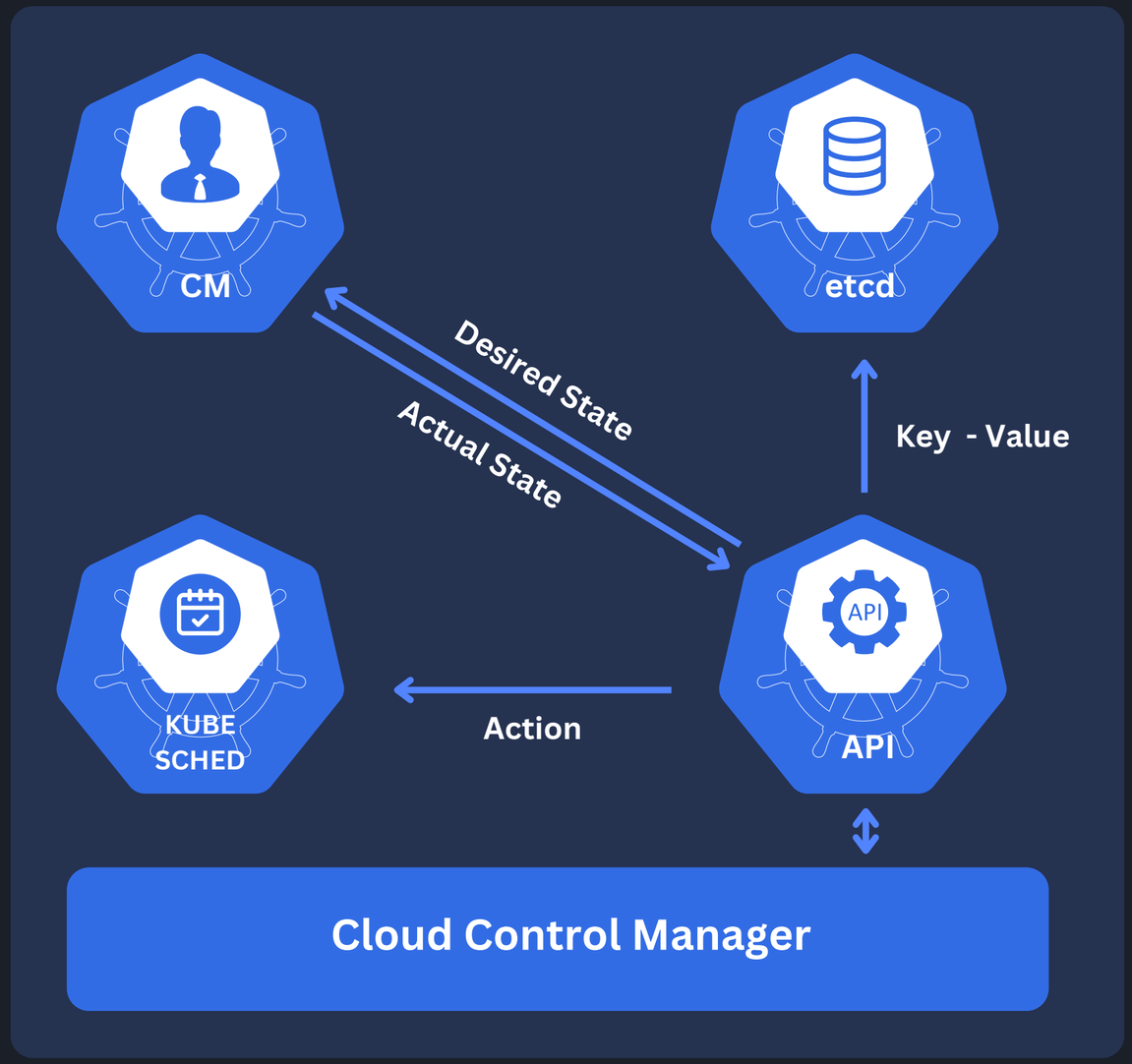
etcd
Kubernetes storage

- Distributed key-value store
- Stores metadata, status of cluster and configuration data
- Consistent and highly-available in nature

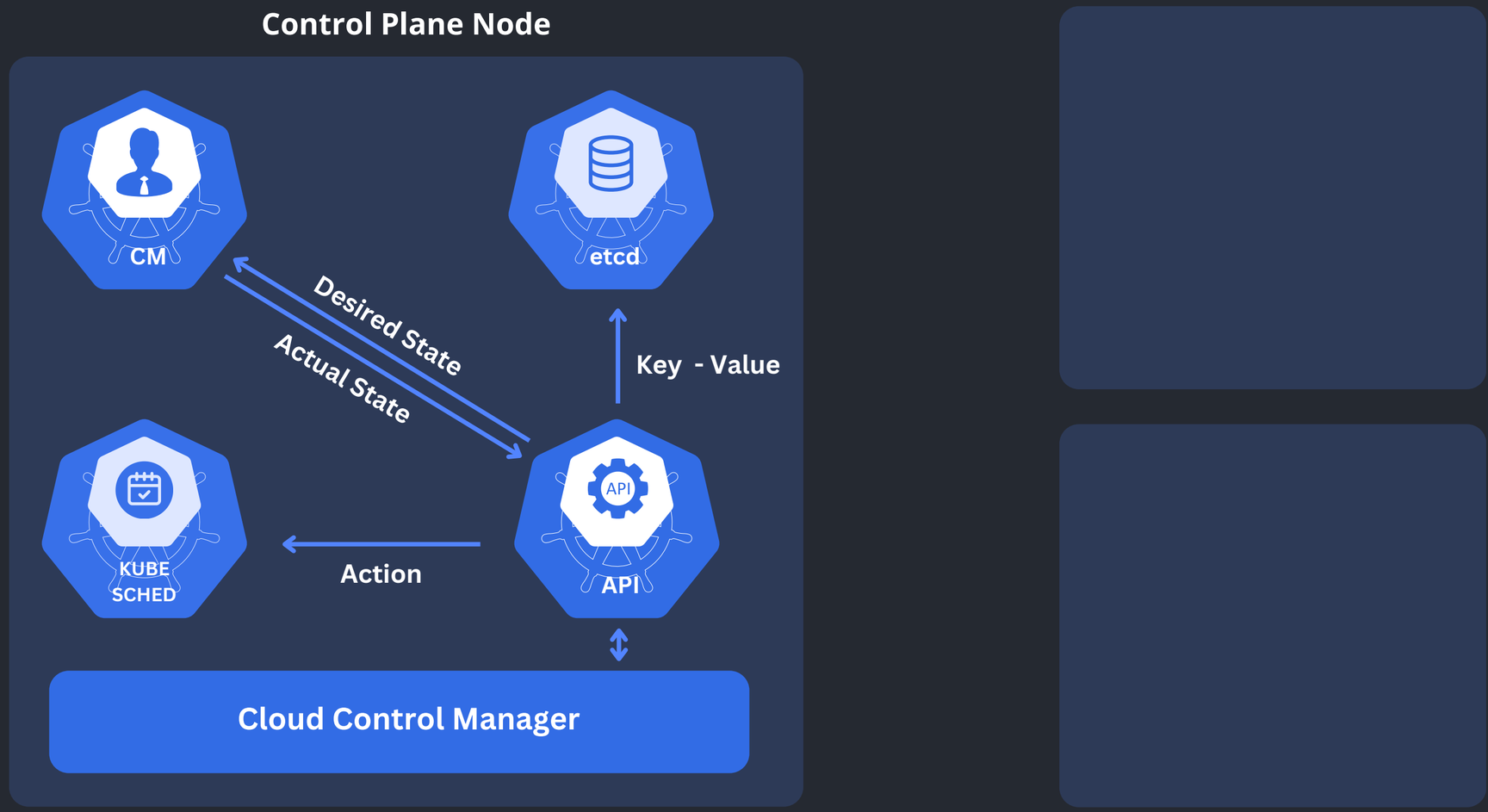


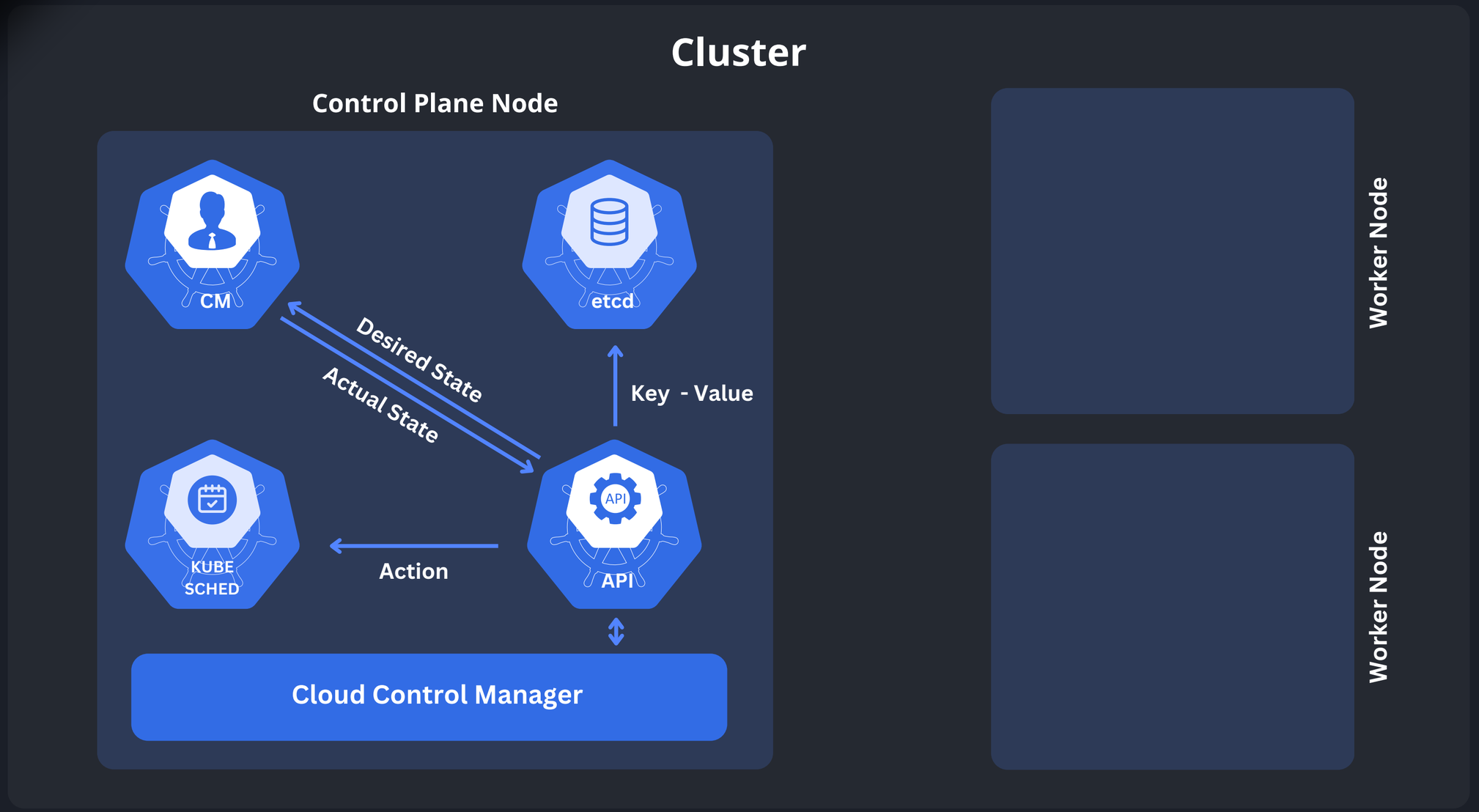
CONTROL PLANE
NODE

Control Plane Node



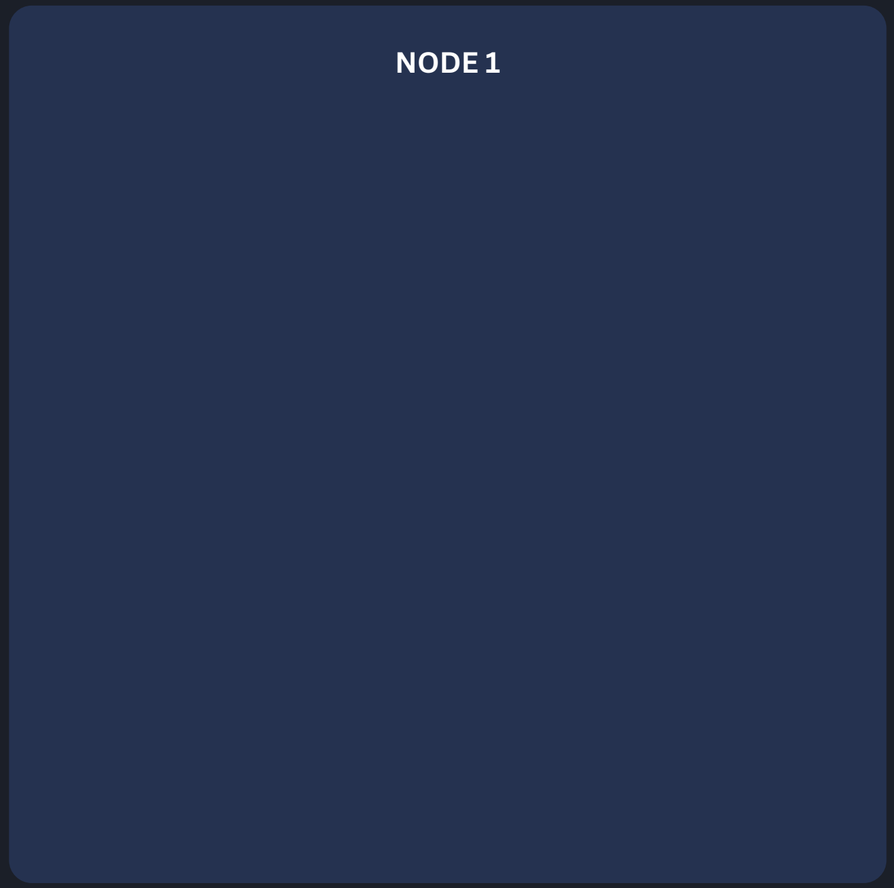
Cluster


Control Plane Node
CM
etcd
Desired State
Actual State
Key - Value
KUBE
SCHED
Action
API
API
Cloud Control Manager
2
2


Cluster
Control Plane Node
CM
etcd
Desired State
Actual State
Key - Value
KUBE
SCHED
Action
API
API
Cloud Control Manager
Worker Node
Worker Node

NODE

- Single machine
  (Virtual / Physical)
- Runs in K8S cluster and hosts POD
- Provides CPU, memory and storage to Pods
- Flexible in nature



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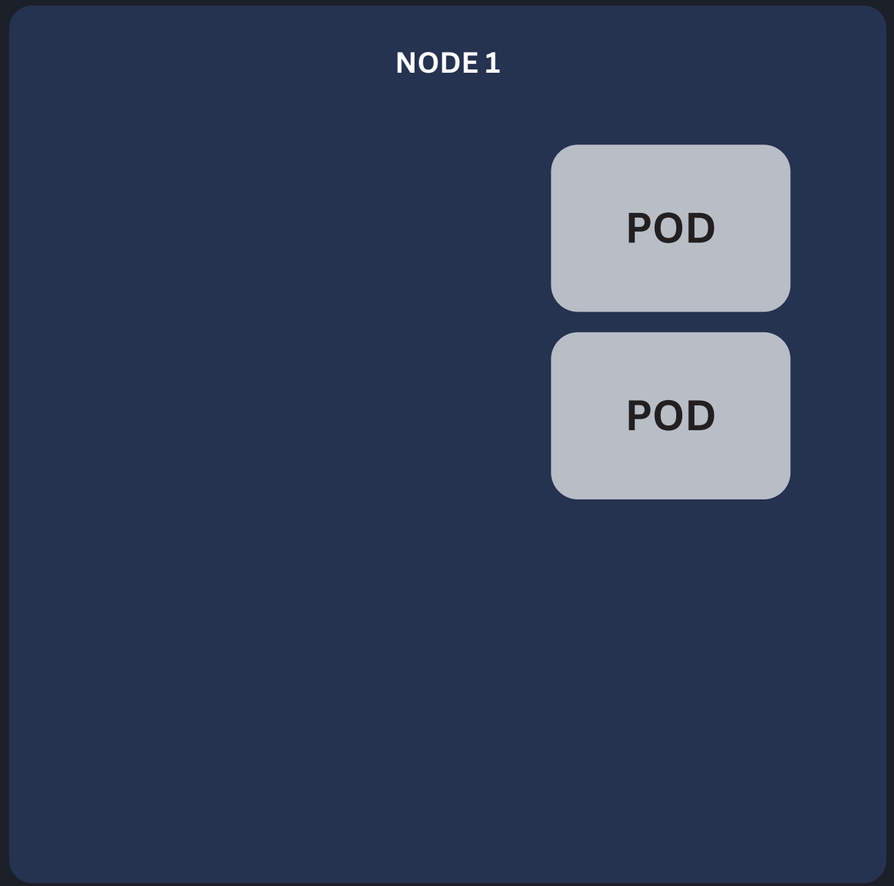
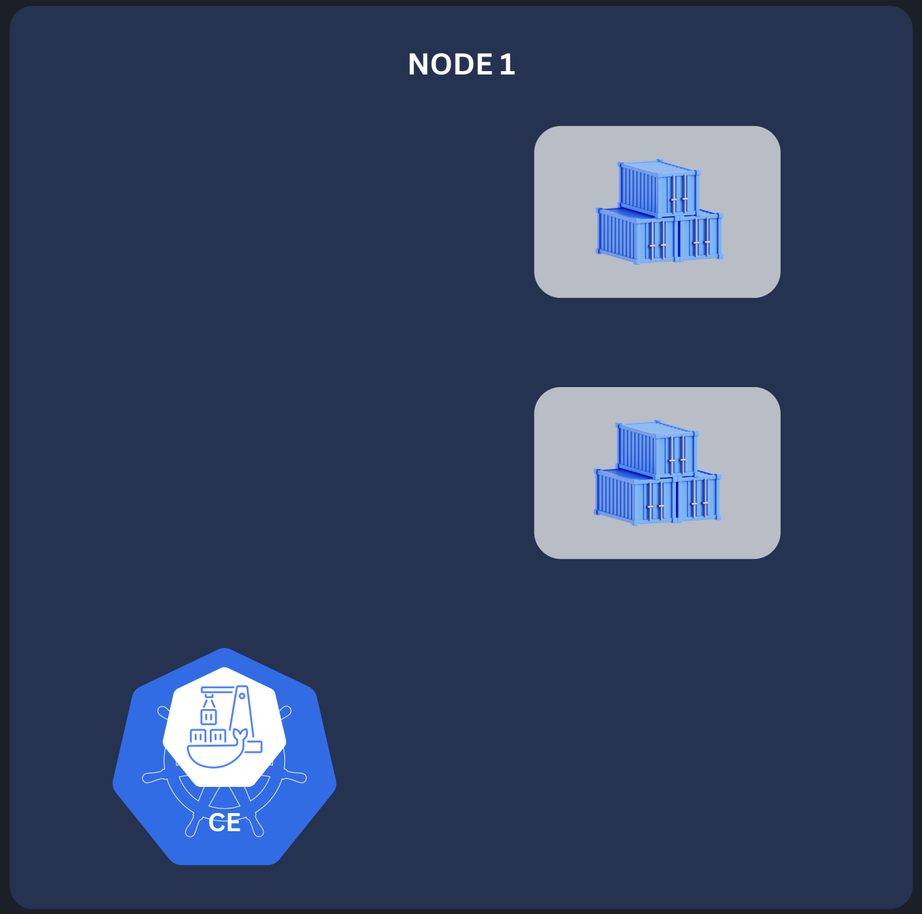
PODS

- Smallest and deployable unit
- Abstraction over container
- Single instance of a running process
- Each Pod gets its own IP address
- Pods are ephemeral



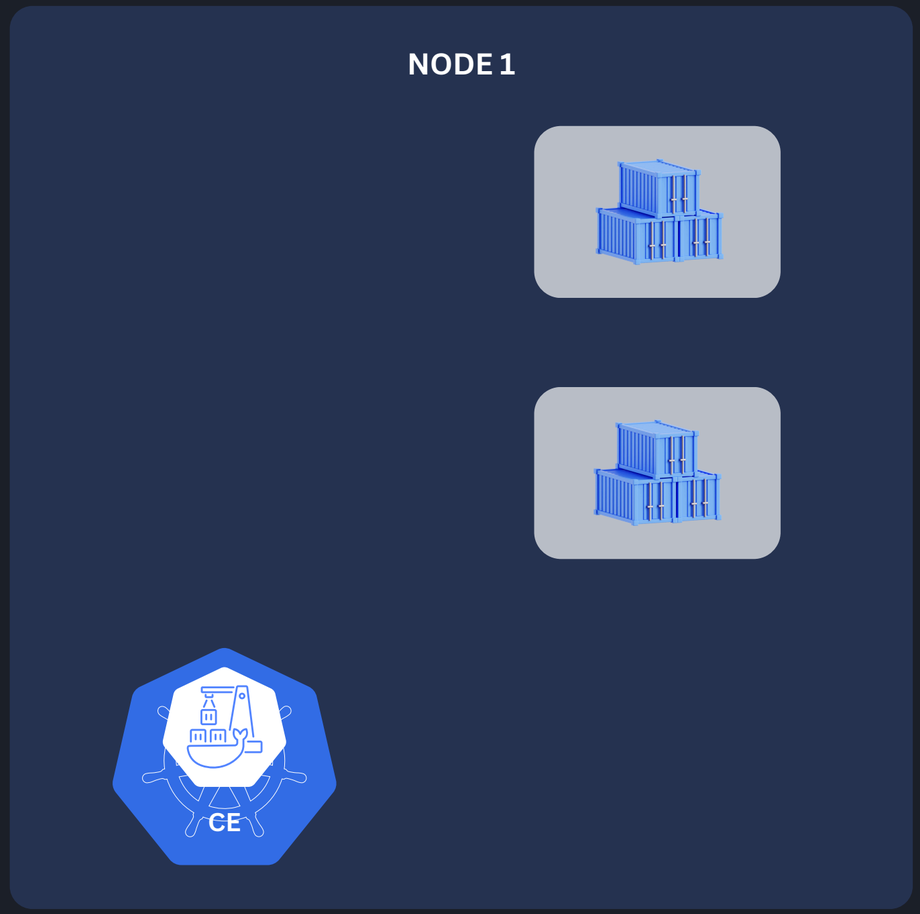
CONTAINER

- Pod usually runs 1 application
- It may contain multiple containers
- Each container has a specific role (e.g., app code, logging, monitoring).
- Containers share the Pod’s resources
- They communicate via localhost



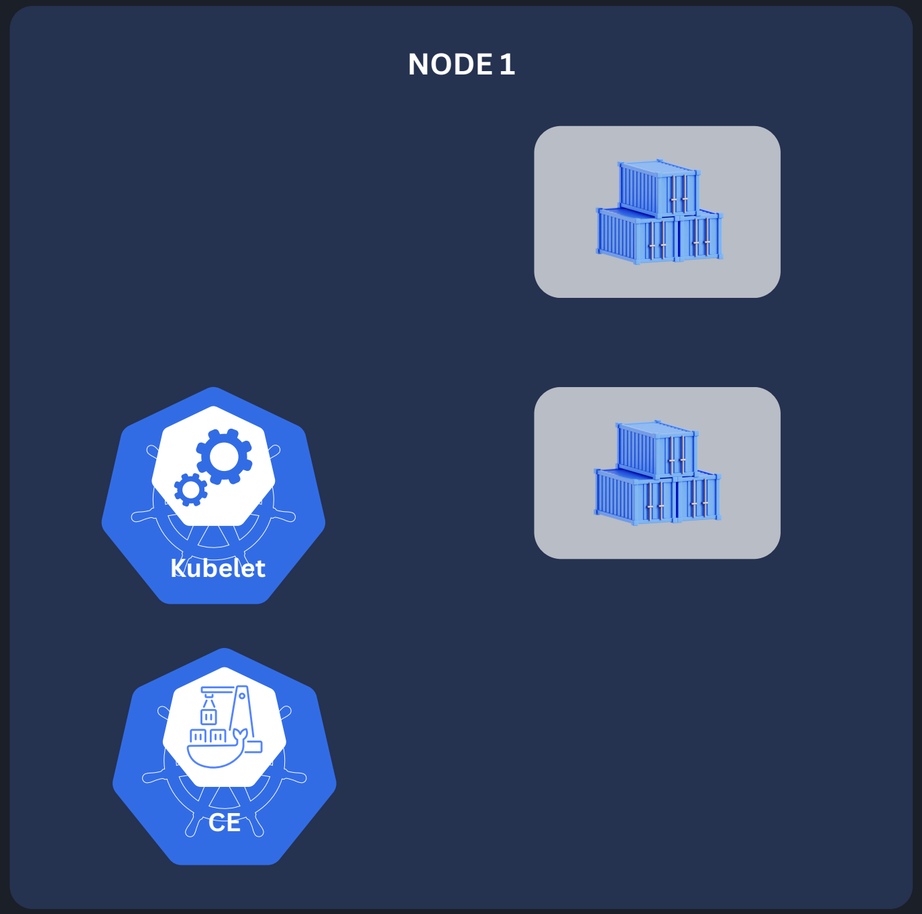
CONTAINER ENGINE

- Software responsible for running the container on each node
- Pull images from registry
- Stop - Start container
- Docker, containerd, CRI-O (common runtimes in Kubernetes)



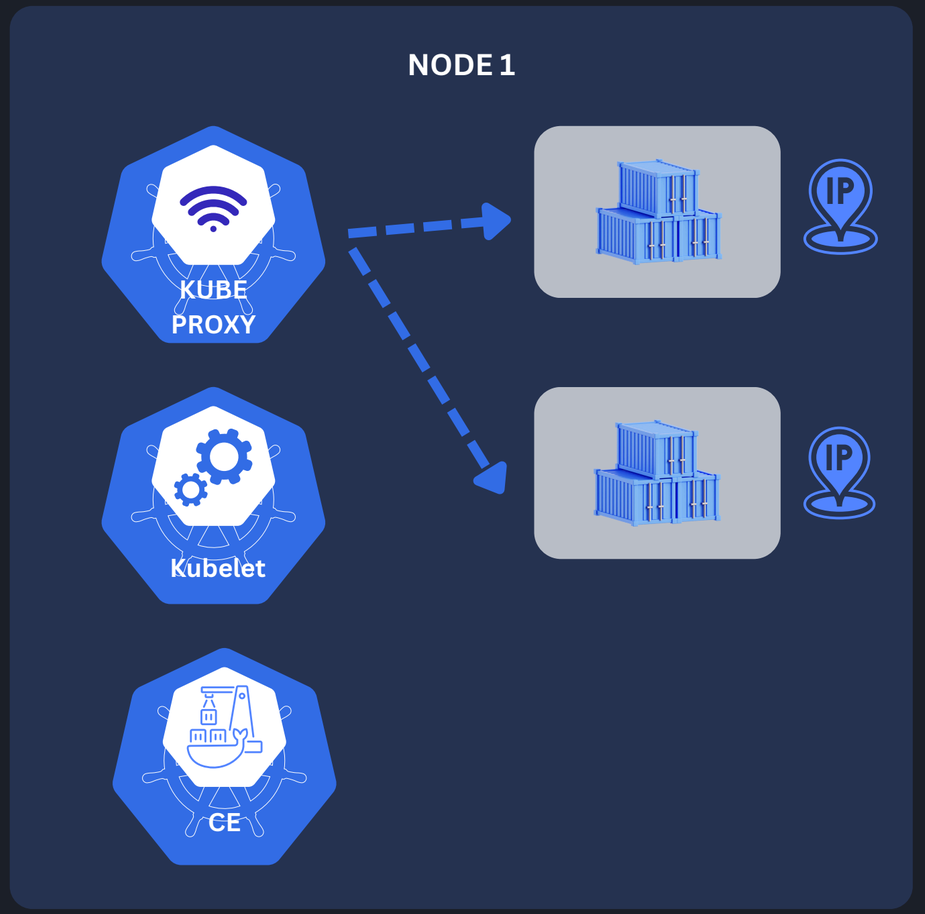
KUBELET

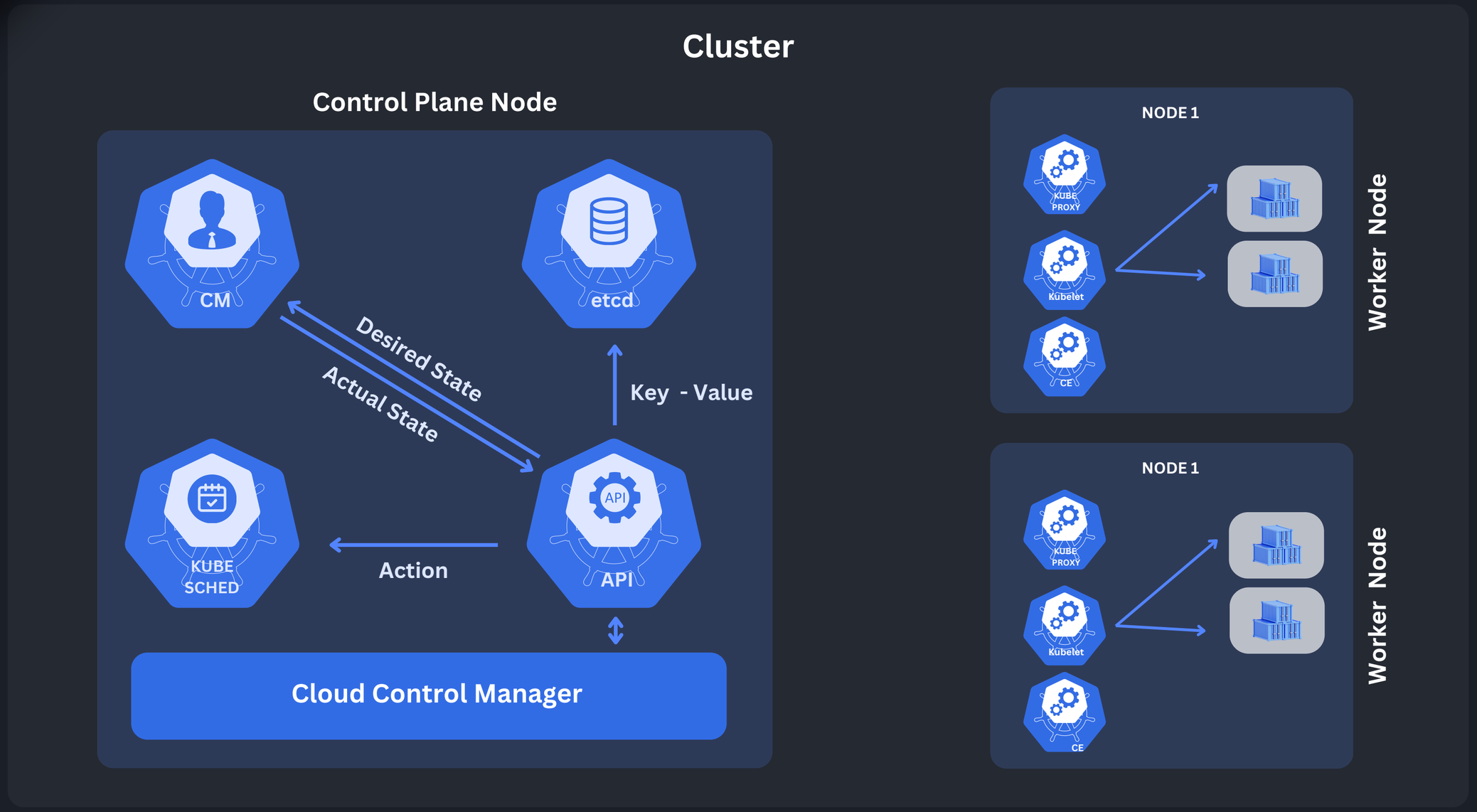
- Node agent running on node
- Communicates with API server
- Listen to commands from API server
- Sends success / fail report to API server

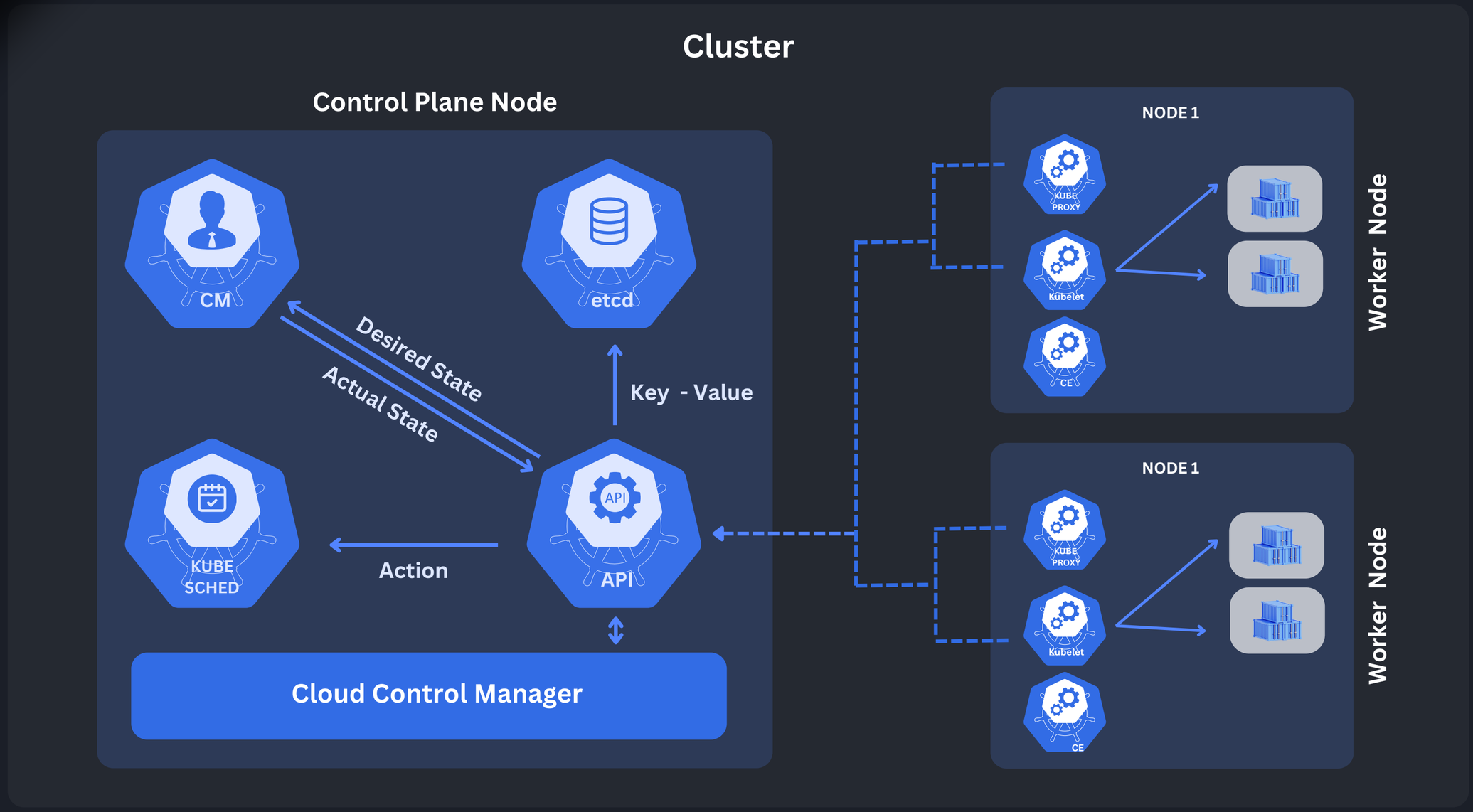


KUBE-PROXY

- Manages networking and communication for the pods
- Responsible for managing network rules
- Routing and load balancing traffic between services and pods



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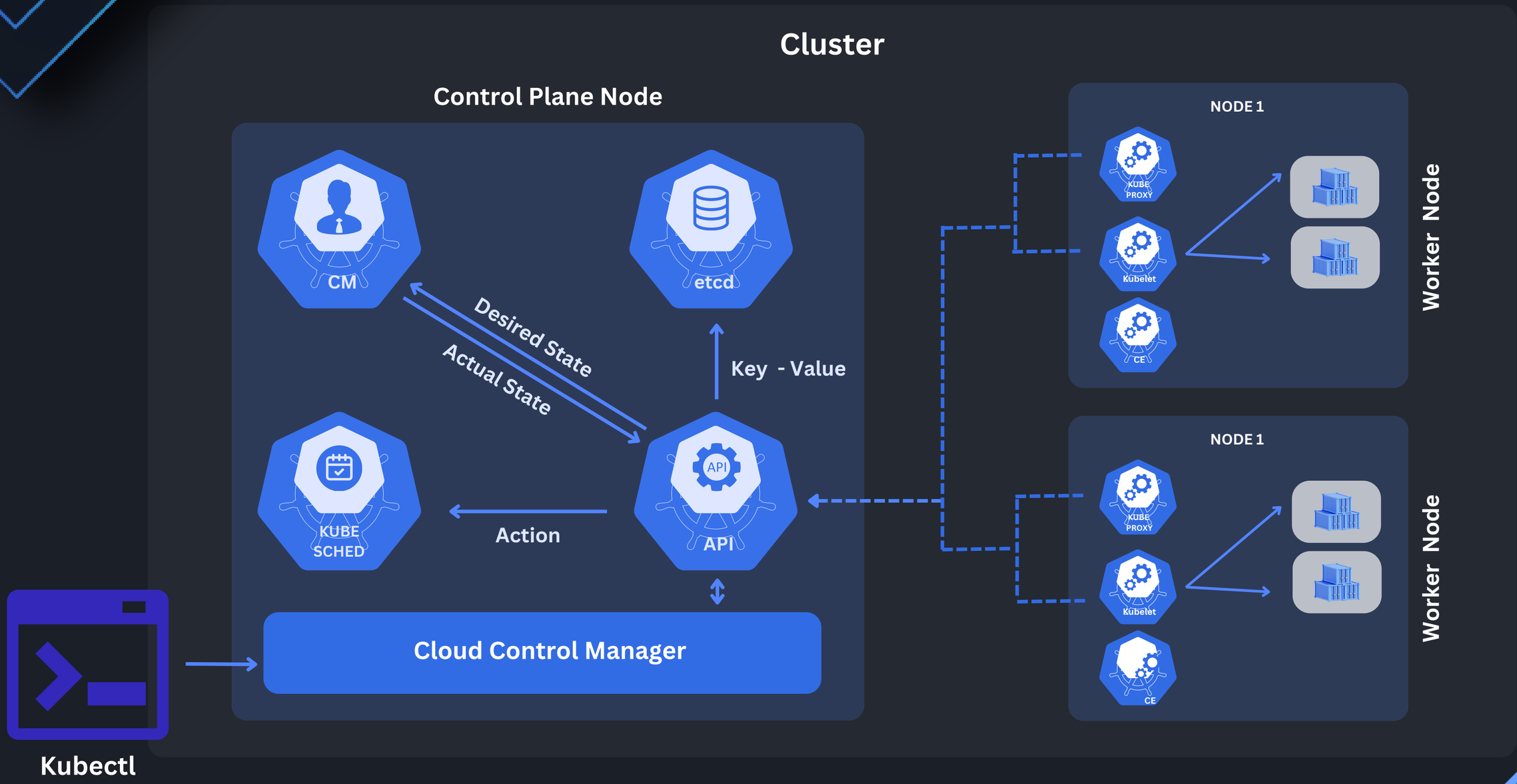
NODE 1
KUBE PROXY
Kubelet
CE
Worker Node
NODE 1
KUBE PROXY
Kubelet
CE
Worker Node



K8S FEATURES

- Automated rollouts and rollbacks
- Service discovery and load balancing
- Storage orchestration
- Self-healing

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K8S FEATURES

- Secret and configuration management
- IPv4/IPv6 dual-stack
- Batch execution
- Horizontal scaling

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DOCKER VS K8S

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DOCKER

- Tool to deploy, create and run application

KUBERNETES

- Container Orchestration tool

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DOCKER

- Provides a consistant environment for application using container

KUBERNETES

- Manages, Scales and Operates containers across multiple hosts

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DOCKER

- Docker does not support auto-scaling

KUBERNETES

- Supports auto-scaling of pods in a cluster

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DOCKER

- Manual setup or third-party tools for service discovery

KUBERNETES

- Built-in DNS-based service discovery (KubeProxy)

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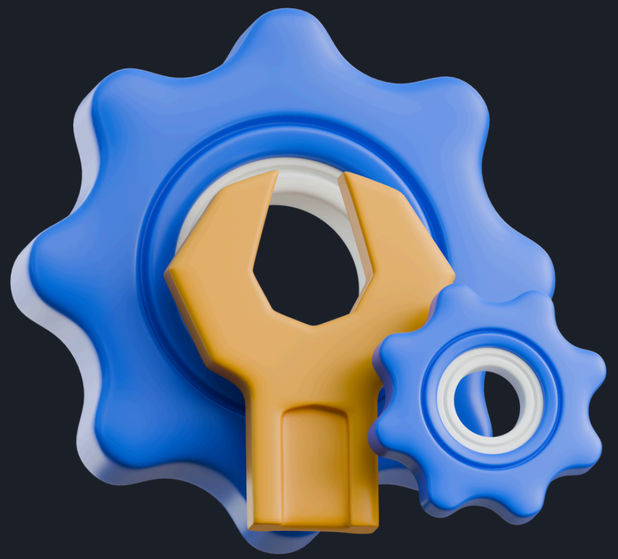
K8S TOOLS



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MINIKUBE

- Sets up a local Kubernetes cluster
- Lightweight, single-node cluster
- Creates a virtual machine for Kubernetes
- Supports the latest kubernetes release
- Used to learn and development

NEED OF MINIKUBE

- To Practice & Learn Kubernetes without needing cloud resources
- Local Development and Testing
- Zero Cost
- Easy to set up

KUBECTL

- Command-line tool
- Used to control, inspect and manage Kubernetes clusters
- Creates communication bridge between K8S cluster’s control plane using K8S API

KUBECTL

FEATURES:

- Declarative control: Define what you want and kubectl makes it happen
- Portability: Same commands work on any cluster (GKE, EKS, Minikube)

WORKING:

- Communicates with the Kubernetes API server to execute commands
- Uses YAML/JSON config files to define resources

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INSTALLATION

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MINIKUBE

```
sudo apt update
```

```
minikube version
```

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KUBECTL

```
sudo apt update
```

```
kubectl version --client
```

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COMMUNITY | KNOWLEDGE | SHARE

COMMAND THE FLEET

```
minikube start
```

```
minikube status
```

```
kubectl get nodes
```