How This Course is Structured

- Kubernetes Basics
- EKS Basics
- Logging And Monitoring
- EKS Advanced Concepts
- Securing EKS
- Fargate
- Deploying EKS with DevOps
- Real World EKS Projects

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What is Docker Container?

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In The Beginning

Environment: Dev

Code

Runtime Engine: Python 3.8

import requests
import kitchen-sink

Dependencies

DNS Service Name
Database connection

Configuration

Environment: Test

Code

Runtime Engine: Python 3.6

import requests
import kitchen-sink

Dependencies

DNS Service Name
Database connection

Configuration

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Environment: Prod

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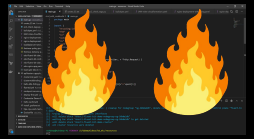
Environment: Prod



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Runtime Engine: Python 2.7

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DNS Service Name
Database connection

Configuration

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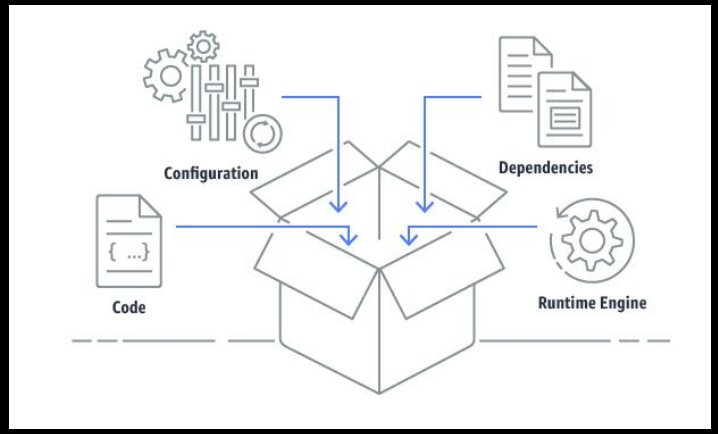
Container



A container is an atomic, self contained package of software that includes everything it needs to run (code, runtime, libraries, packages, etc.)

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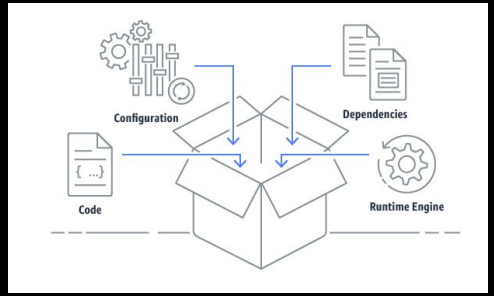
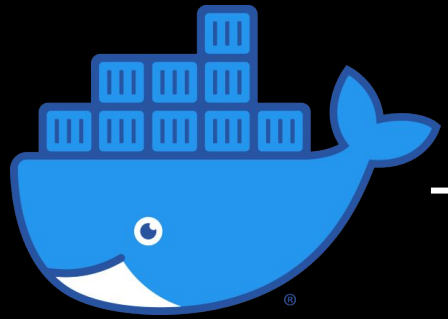
Docker Image Vs Container

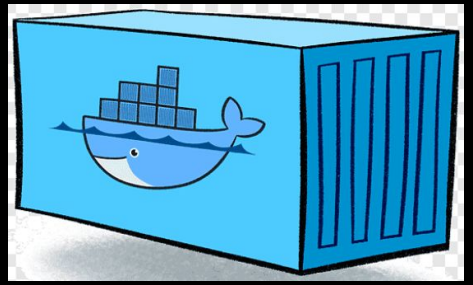


Build



Docker Image
Container Image

Run



Container

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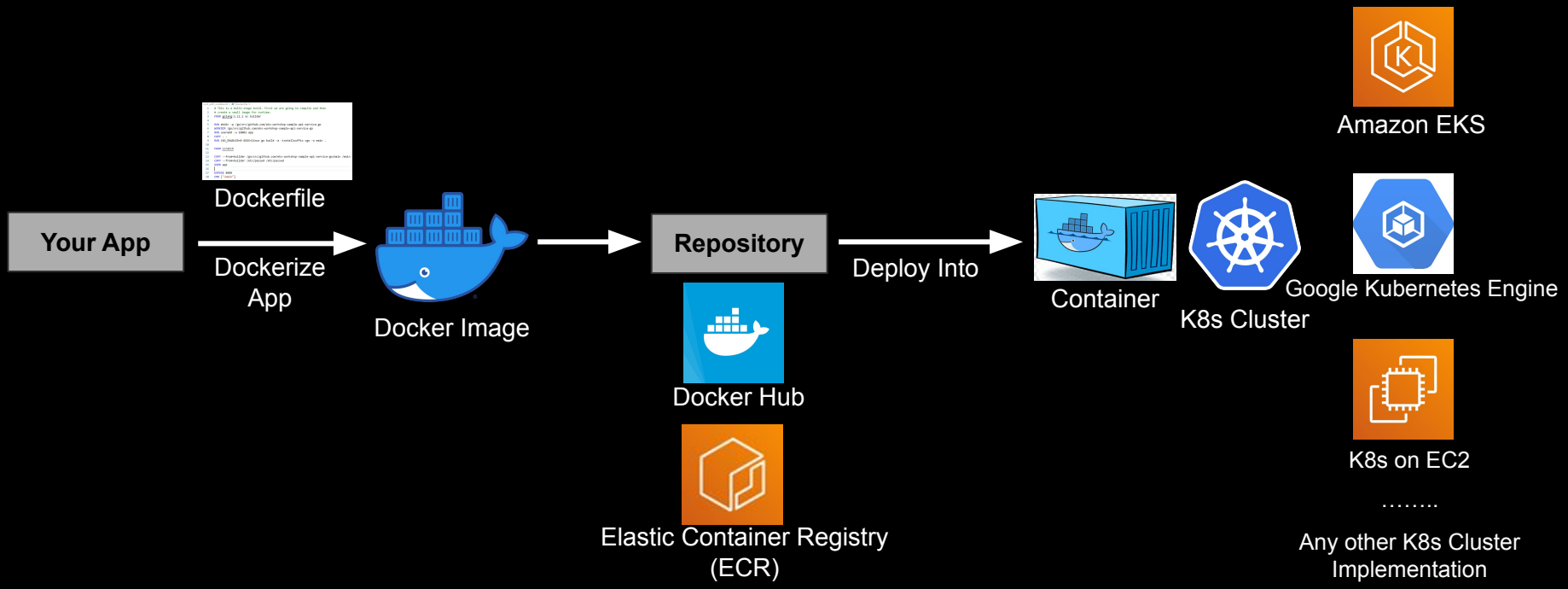
The Big Picture



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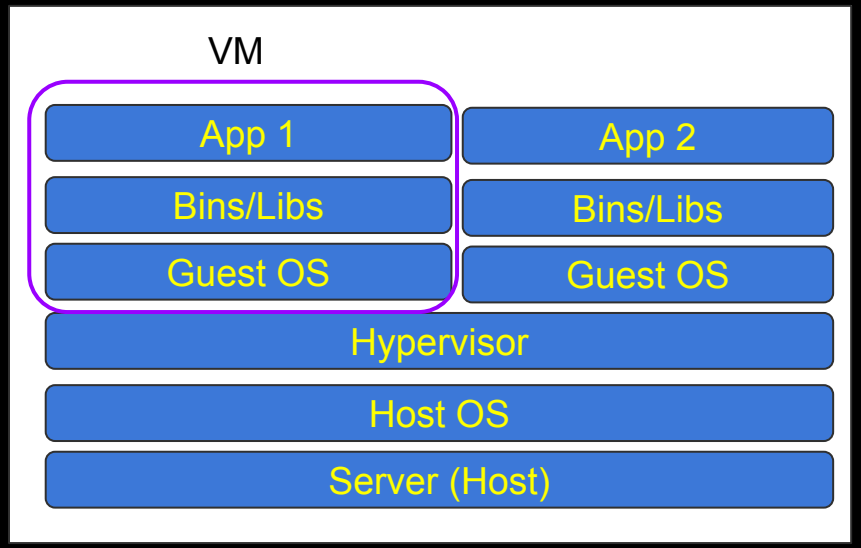
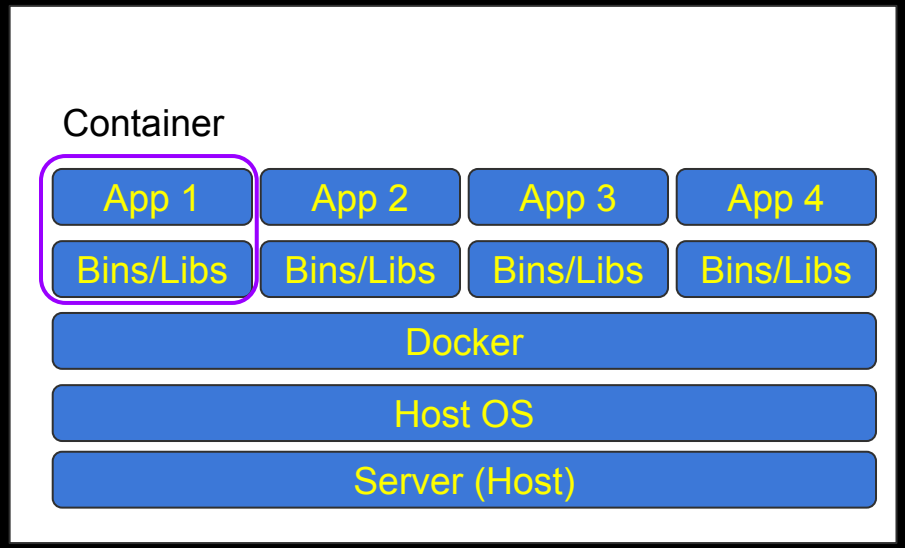
Virtual Machine Vs Container





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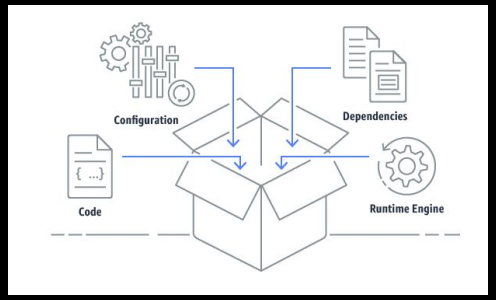
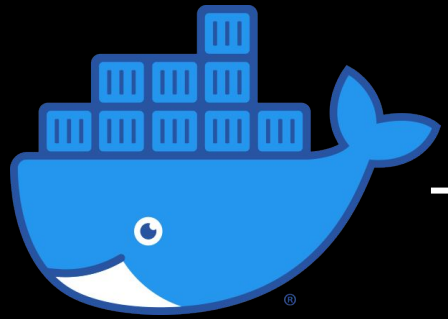
Advantages

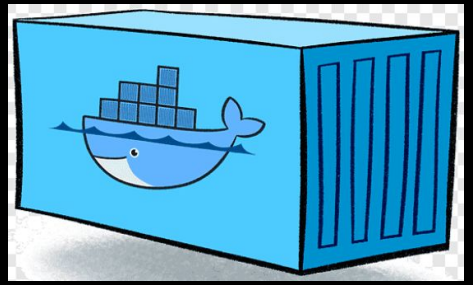


Build



Docker Image

Run



Container

Runs reliably in any environment

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Going Back to Our Sad Developer

Environment: Dev

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Runtime Engine: Python 3.8

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Going Back to Our Sad Developer

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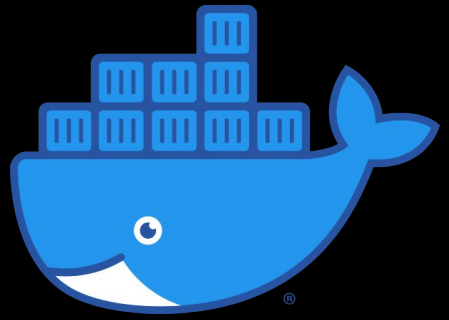

Docker Image

Runs seamlessly in Dev, Test, Prod

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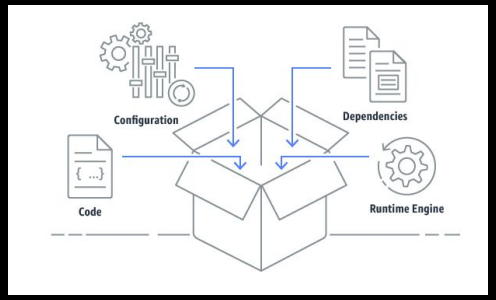
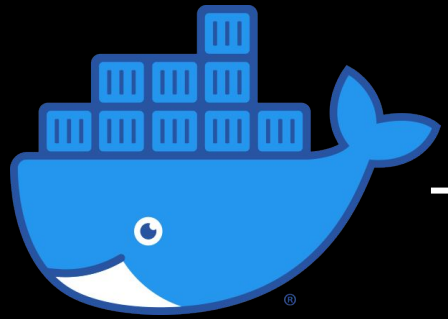
Advantages

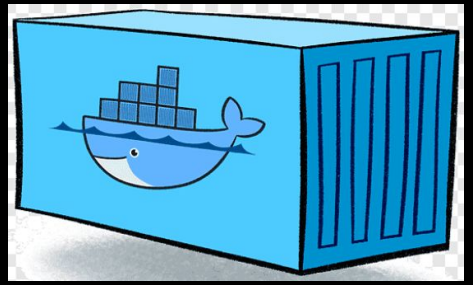


Build



Docker Image

Run



Container

Runs reliably in any environment

Better resource utilization

App isolation

Speed

Container Orchestration is SOLVED!

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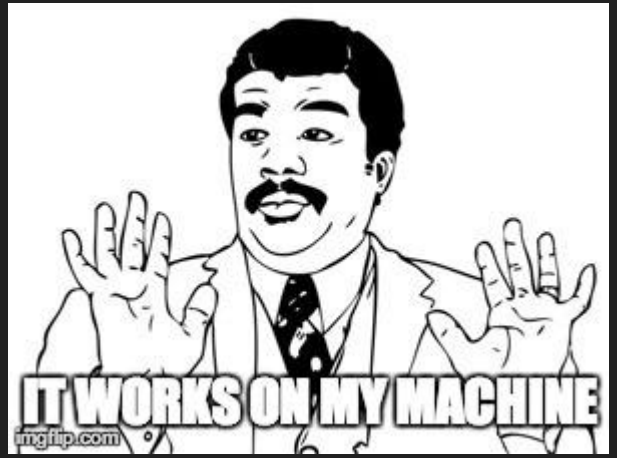
What is Container Orchestrator??!!

What is Docker/Container?

- Docker packages software into standardized units called containers that have everything your software needs to run including libraries, code and runtime

- Lets you quickly deploy and scale applications into any environment



What is Container Orchestrator?

How Does Docker Work?

Insert Video here

Draw a pentagon representations of 2 apps, color it different, then say it needs a host to run, so we spin up EC2s, move the pentagons inside EC2.

EC2s are like hyenas, if you see one, other ones are nearby.

To make it Highly Available, you need another in Az

Then comes scaling, put it in ASG, to route traffic you need Load Balancer.

If one task fails then u need to spin up

Tasks Associated with Containers

- Deployment of Containers
- Redundancy and availability of Containers
- Scaling up or down of Containers
- Load Balancing
- Health Monitoring of Containers and Hosts
- Service Discovery
- And More...

Container Orchestrator

Say Hello to Container Orchestrators

- Docker Swarm
- Apache Mesos
- Cattle, Nomad, Empire
- AWS ECS (Elastic Container Service)
- Kubernetes
  - EKS (Elastic Container Service for Kubernetes)
- AWS Fargate

What is

Kubernetes?

(The most popular Container Orchestrator)

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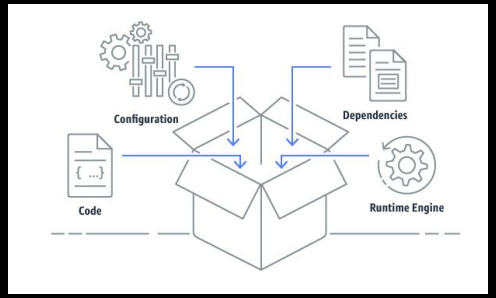
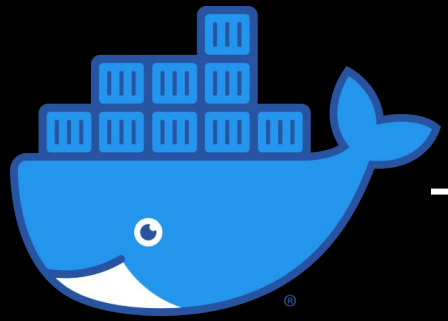
Working Backwards



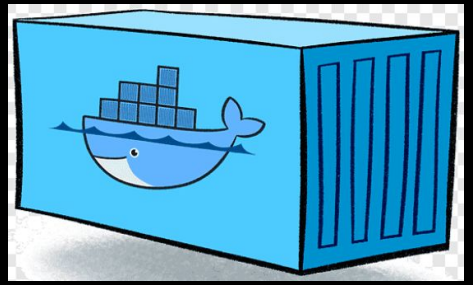
Your Application

Build



Docker Image
Container Image

Run



Container

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Kubernetes Architecture

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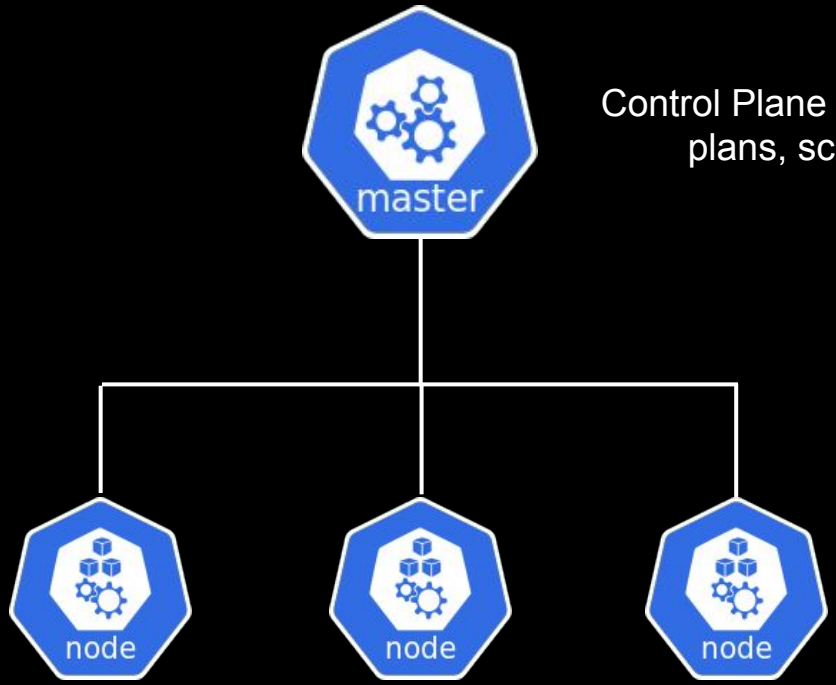
Who Manages Nodes?



Control Plane manages, monitors, plans, schedules nodes

Worker Nodes host Containers

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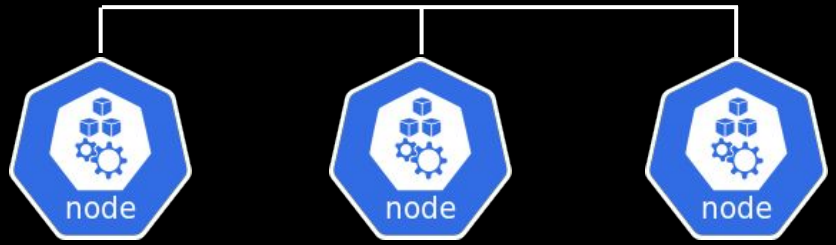
Control Plane Components

Control Plane manages, monitors, plans, schedules nodes

Key Value Store for critical cluster info

Ensures proper state of cluster components

Puts containers to proper nodes



Worker Nodes host Containers

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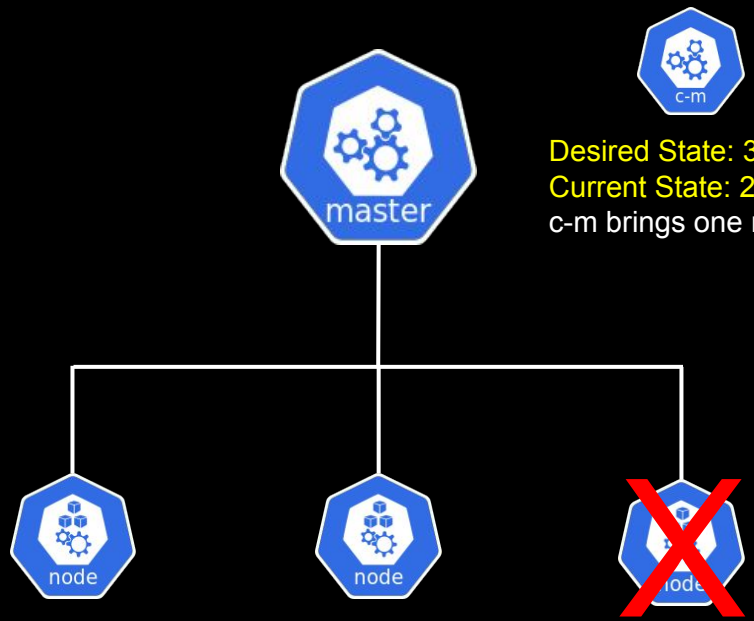
Kubernetes Cluster State



Desired State: 3 Nodes
Current State: 2 Nodes
c-m brings one node up so current state = desired state

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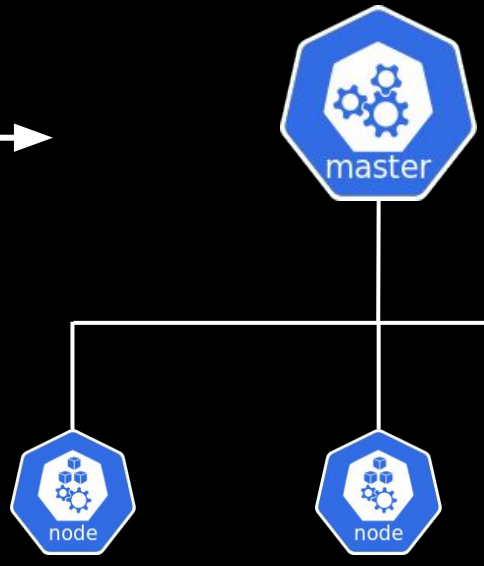
Who Specifies State?

YOU

Manifest File

Run 6 copies of an container image



Desired State: 6 Containers
Current State: 0 Containers

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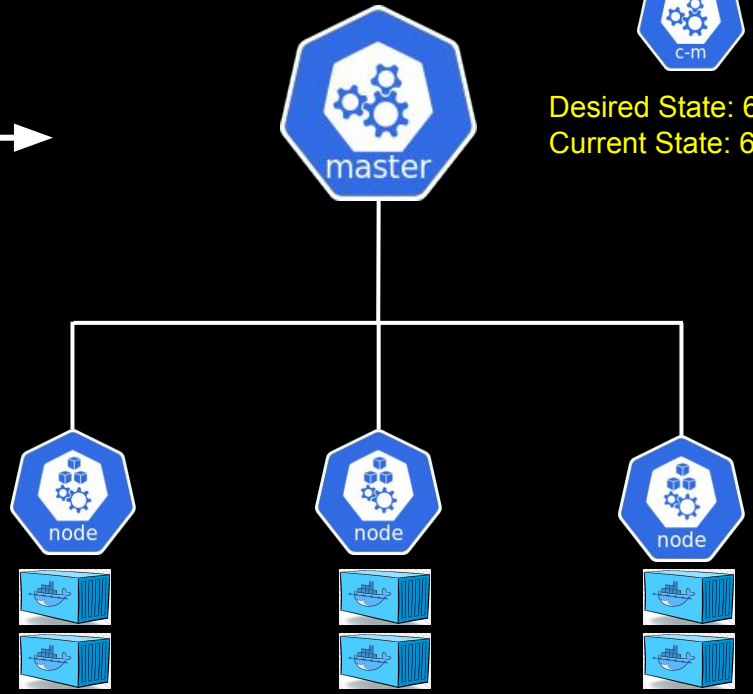
Who Specifies State?

YOU

Manifest File

Run 6 copies of an container image



Desired State: 6 Containers
Current State: 6 Containers

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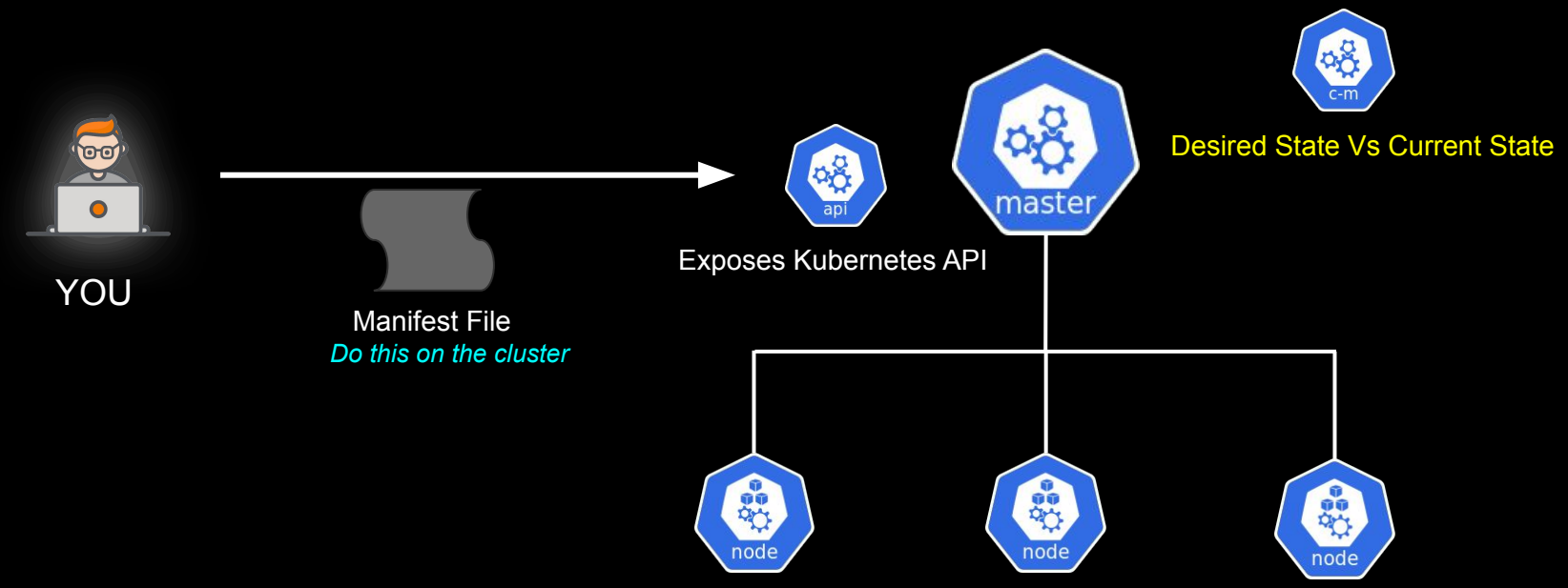
Gateway to Control Plane



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Kubernetes Architecture

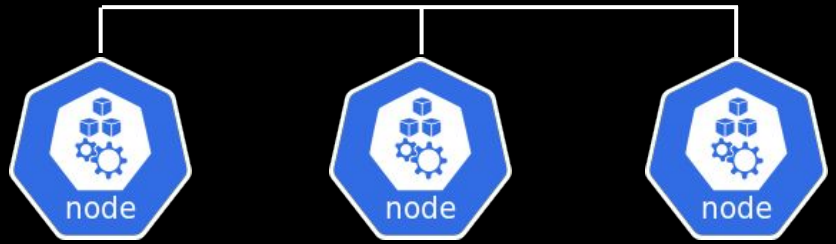
Control Plane manages, monitors, plans, schedules nodes

Key Value Store for critical cluster info

Ensures proper state of cluster components

Puts containers to proper nodes

Exposes Kubernetes API



Worker Nodes host Containers

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What’s In Node?

Container Runtime Engine
Docker, Containerd, CRI-O, frakti

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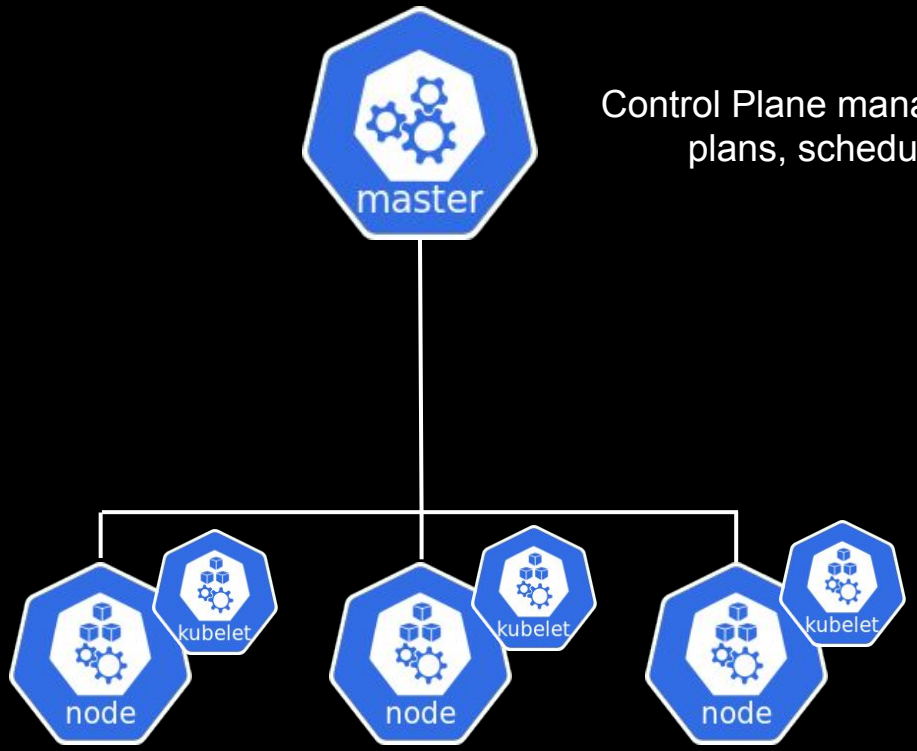
Control Plane - Node Communication



Control Plane manages, monitors, plans, schedules nodes

Status of the node and containers to Control Plane

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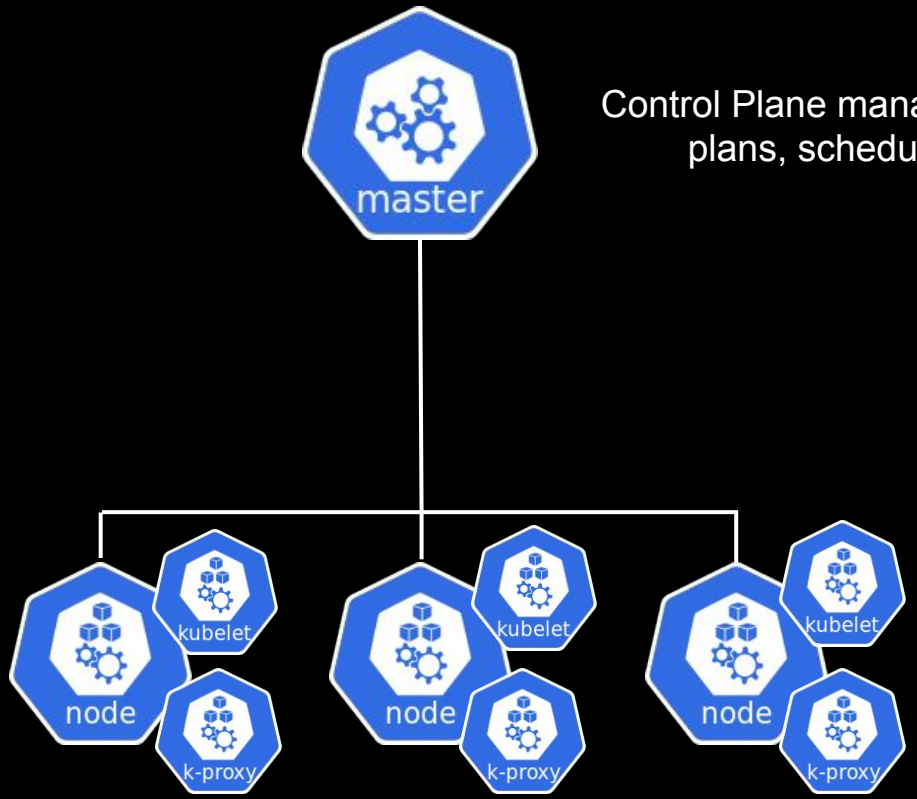
Container-Container Communication



Control Plane manages, monitors, plans, schedules nodes

Status of the node and containers to Control Plane

Allows network communications

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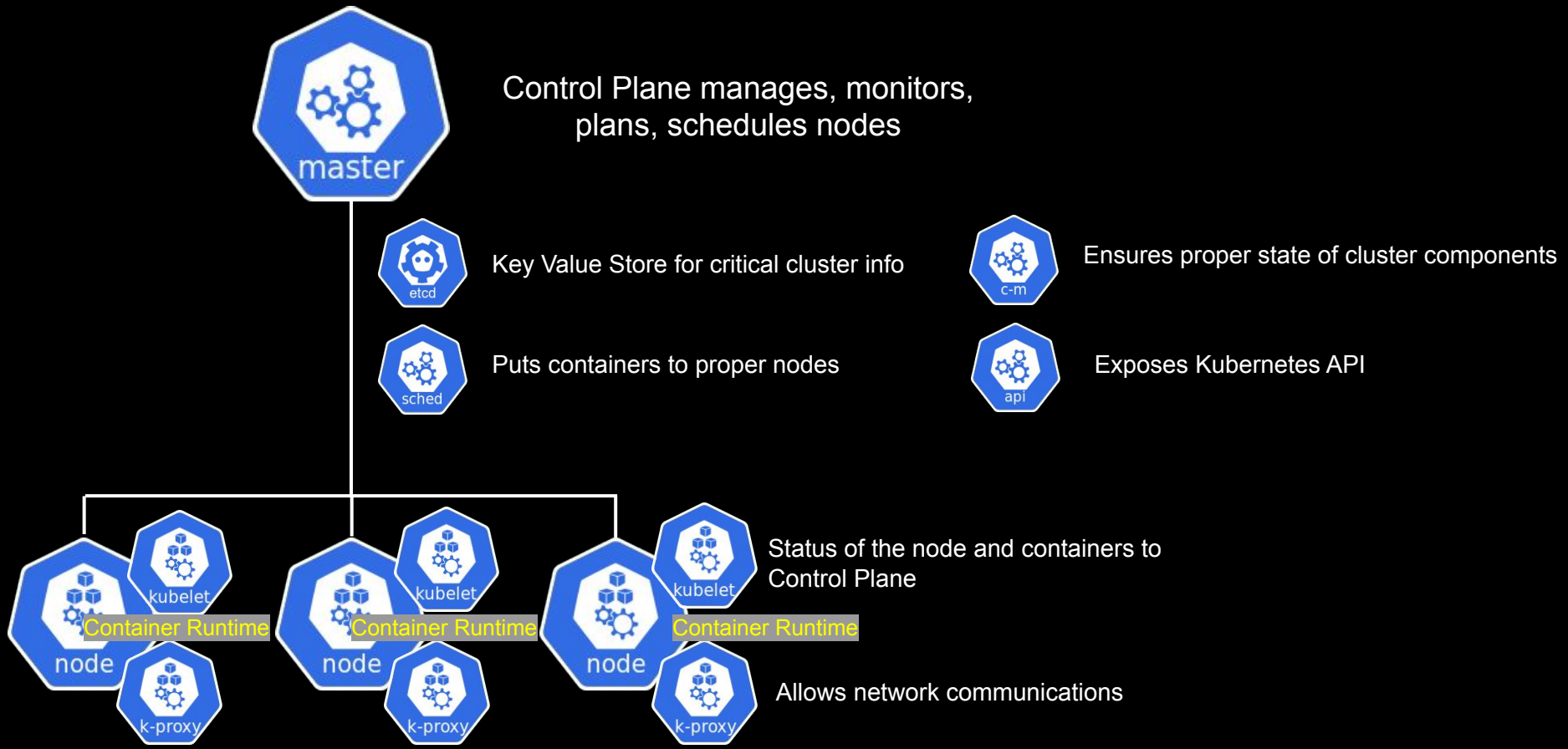
Putting it All Together



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K8s?!

Kubernetes

8 Letters

K8s

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Pods

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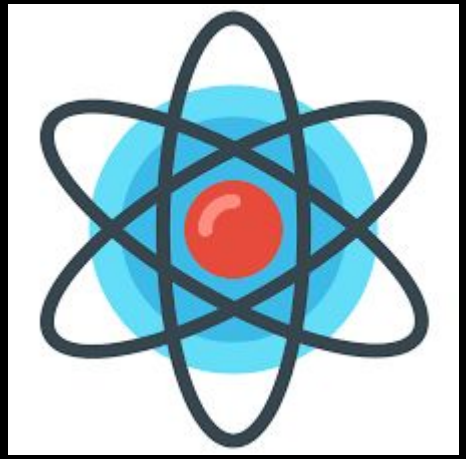
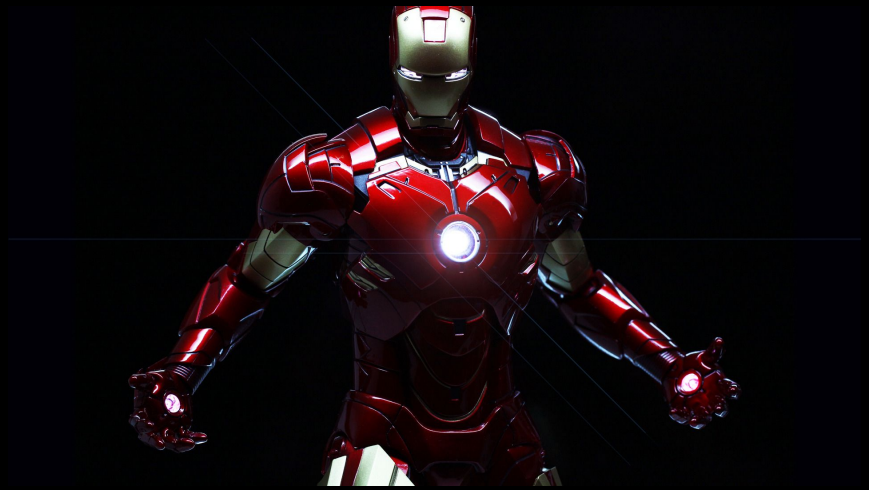
Pods





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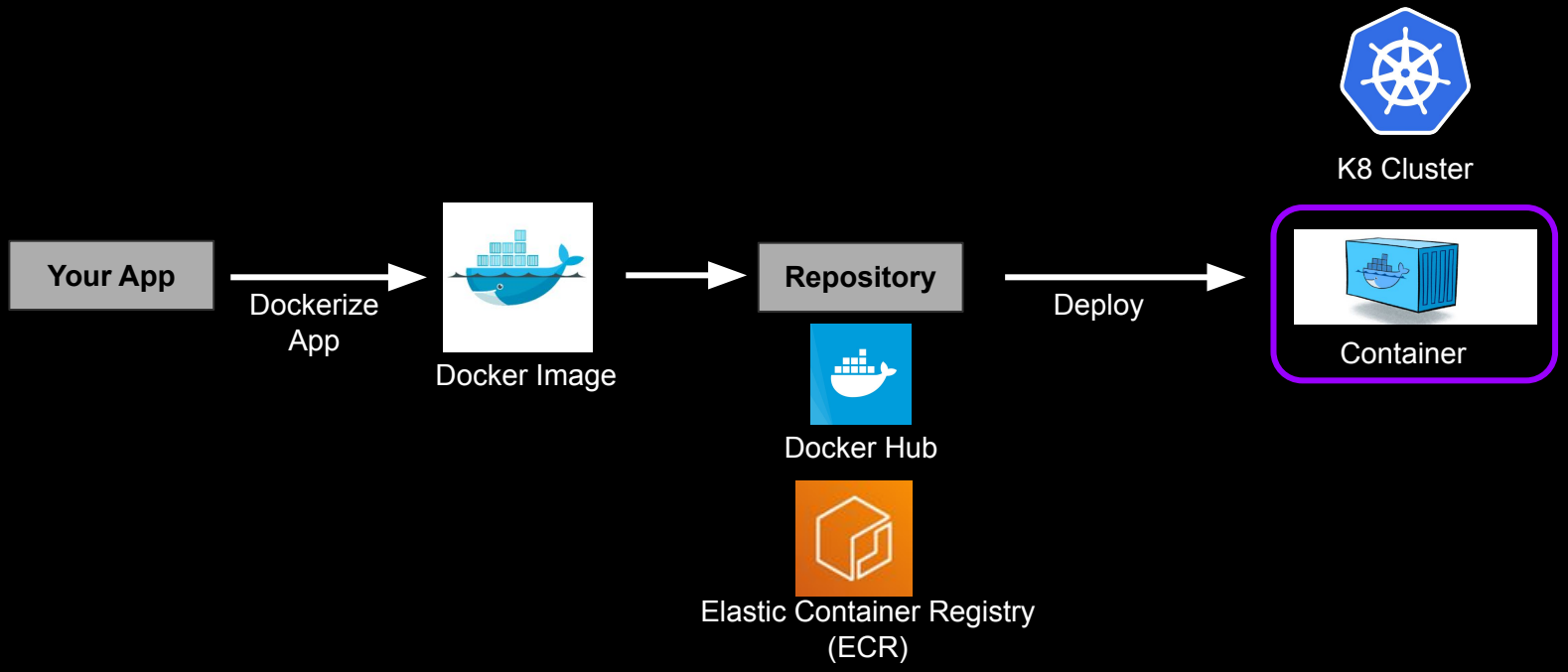
The Big Picture



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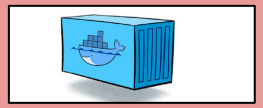
NPC

K8 Cluster

NODE

POD



Container

- Smallest object you can create in Kubernetes
- Remember NPC (Node > Pod > Container)

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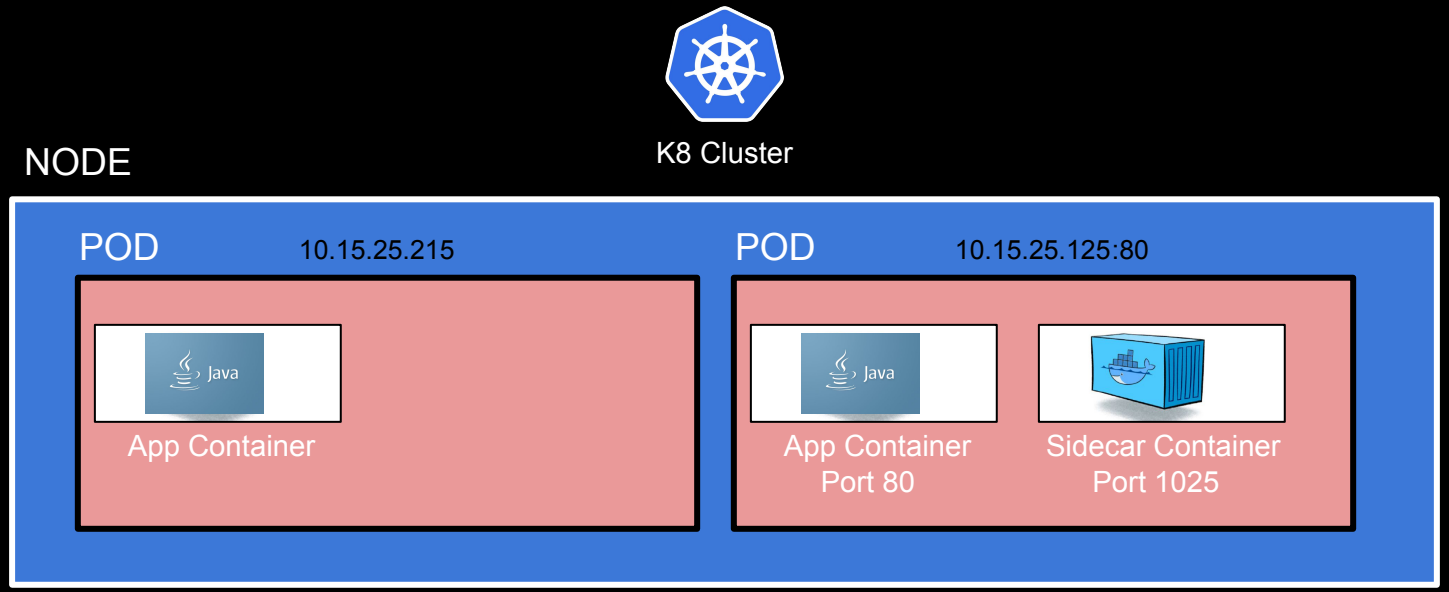
Life of a Pod



- One App Container per Pod
- Each POD has unique IP address

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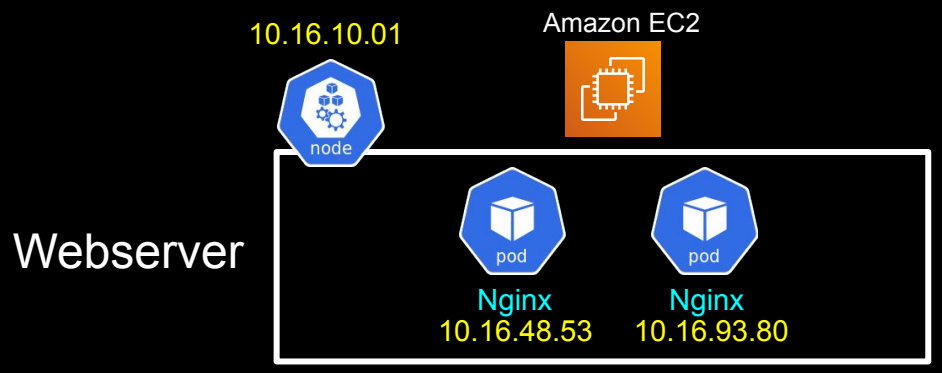
Sample Pods



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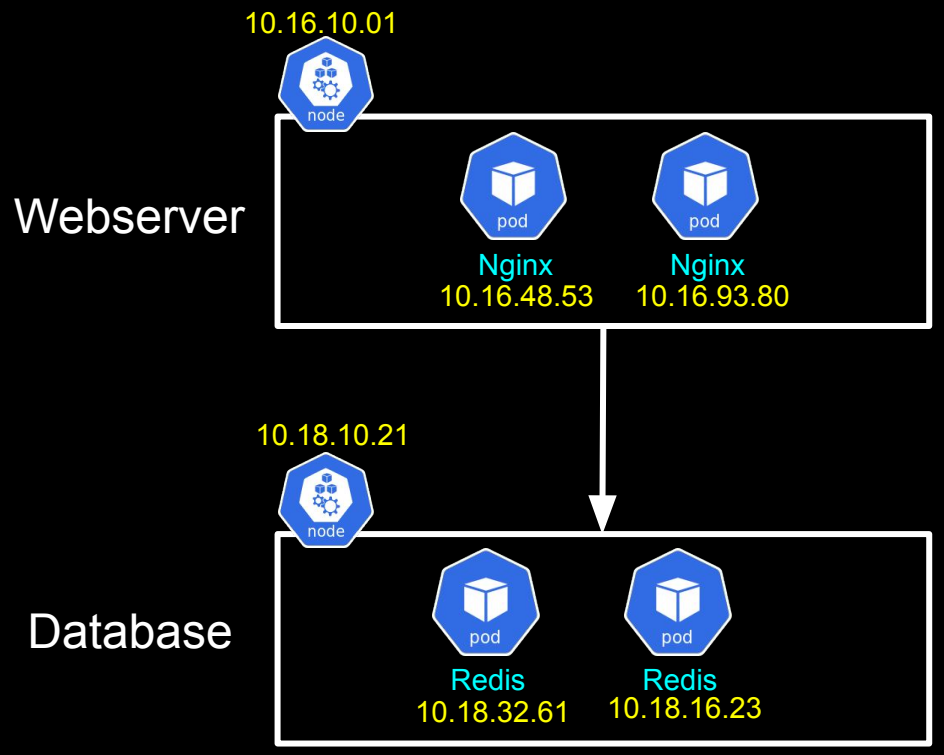
Life Of A Simple Pod



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Deployment

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Deployment
+
Rolling Update
+
Replicaset

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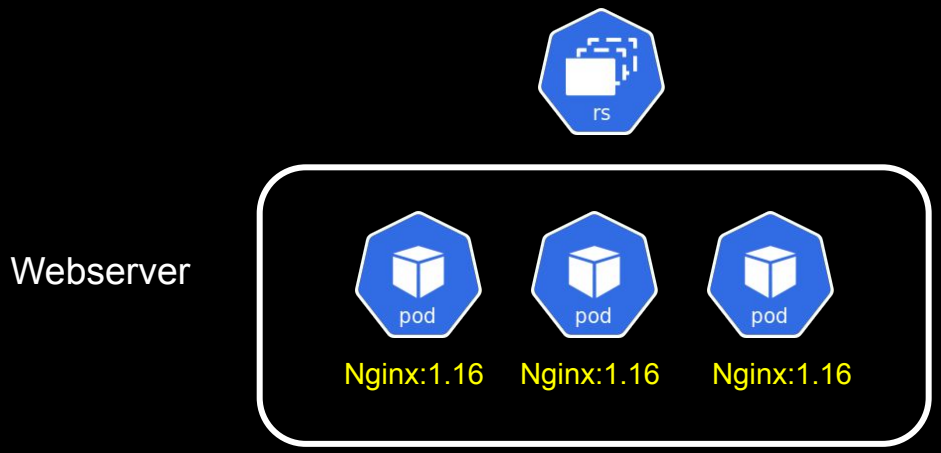
Pods In Real World



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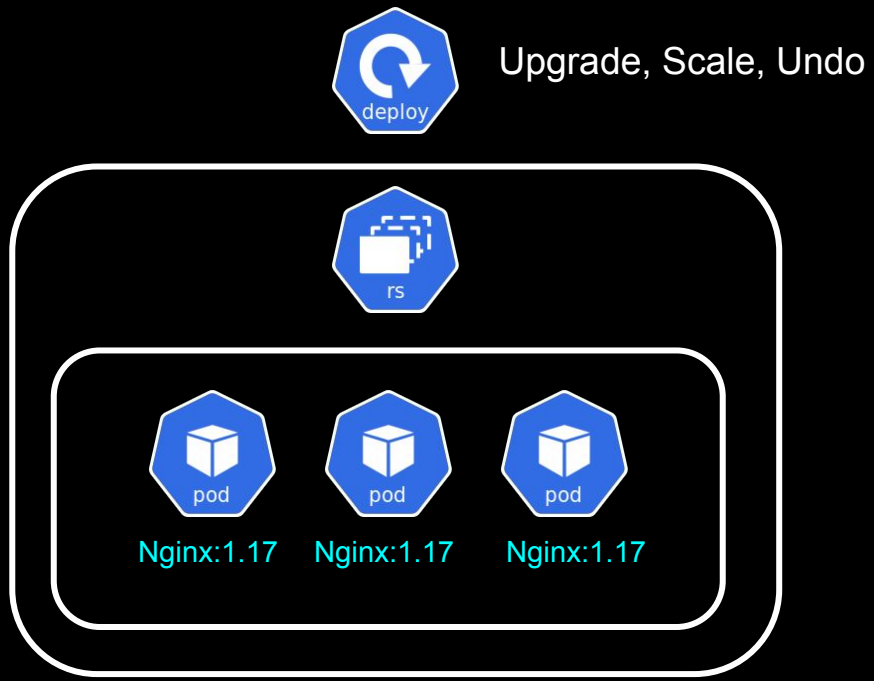
Deployment: Update of Container



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Deployment: Manifest File

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.16
        name: nginx
```

Manages pods with label *environment:test* and manages replicaset defined within

Manages pods with label *environment:test*

Nginx:1.16
environment:test

Nginx:1.16
environment:test

Nginx:1.16
environment:test

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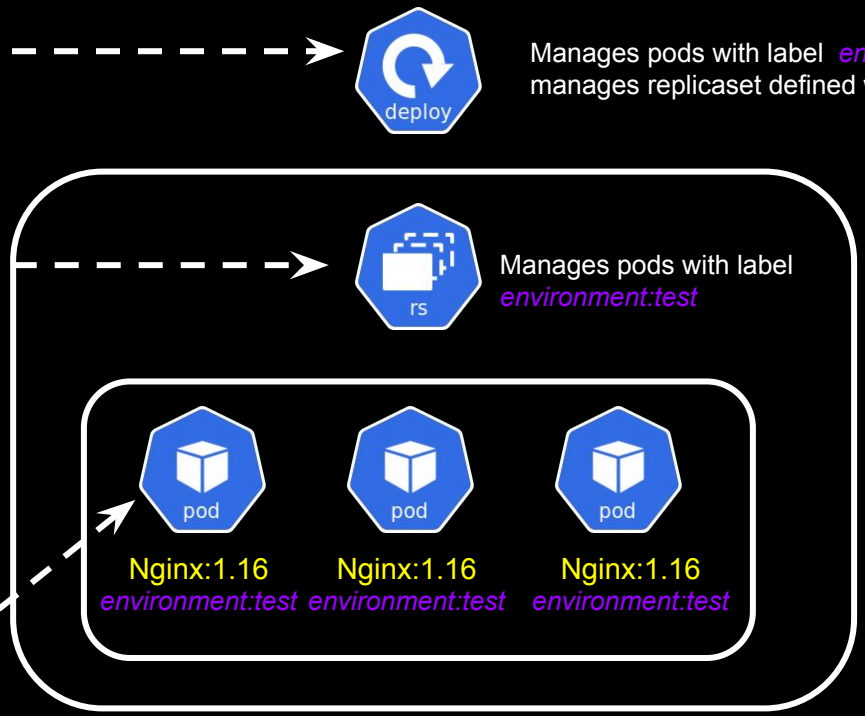
K8 Deployment YAML + DEMO

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.16
        name: nginx
```



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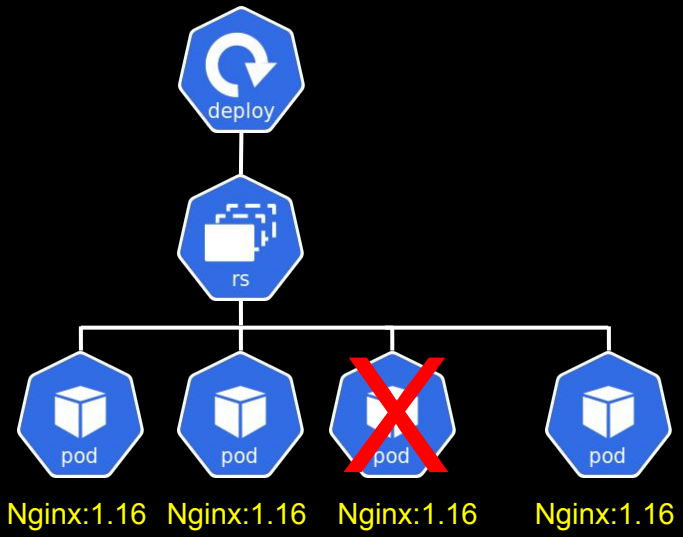
Replicaset Restores Pods

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.17
        name: nginx
```



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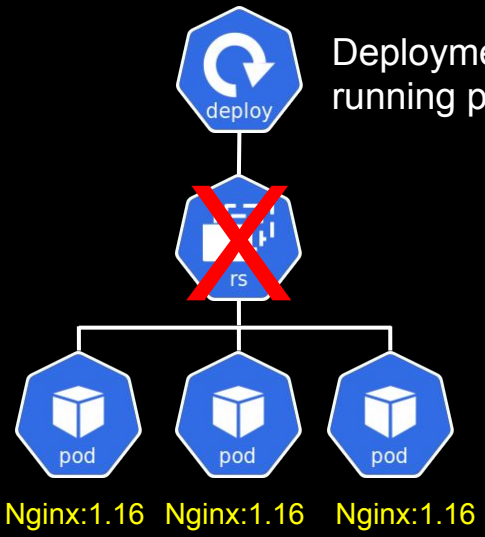
Deployment Restores Replicaset

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.17
        name: nginx
```



Deployment will restore replicaset with running pods - super fast!

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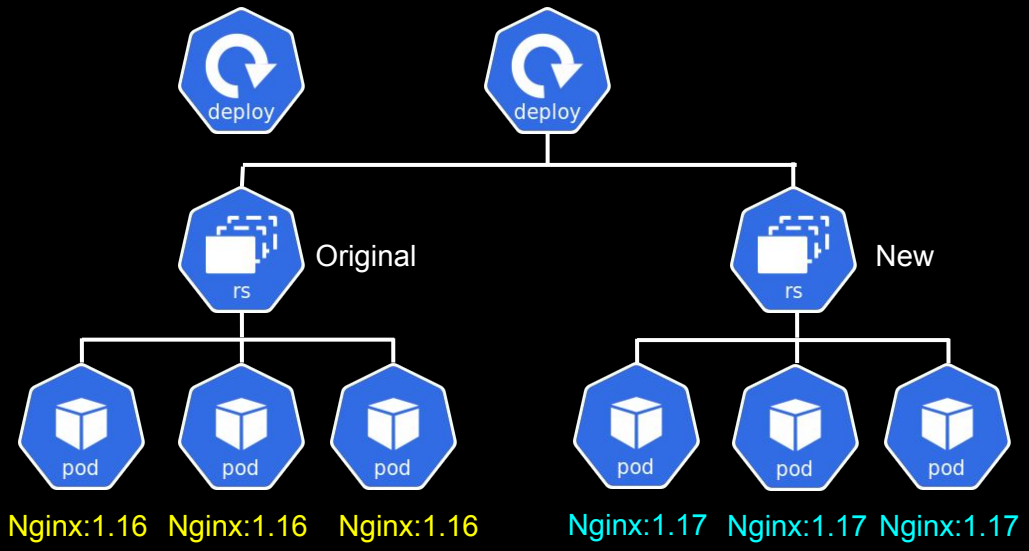
Deployment Rolling Update

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.17
        name: nginx
```



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Replicaset And Deployment Demo

- Implement Deployment
- Delete some stuff!
- Update Container Image via Deployment

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Service

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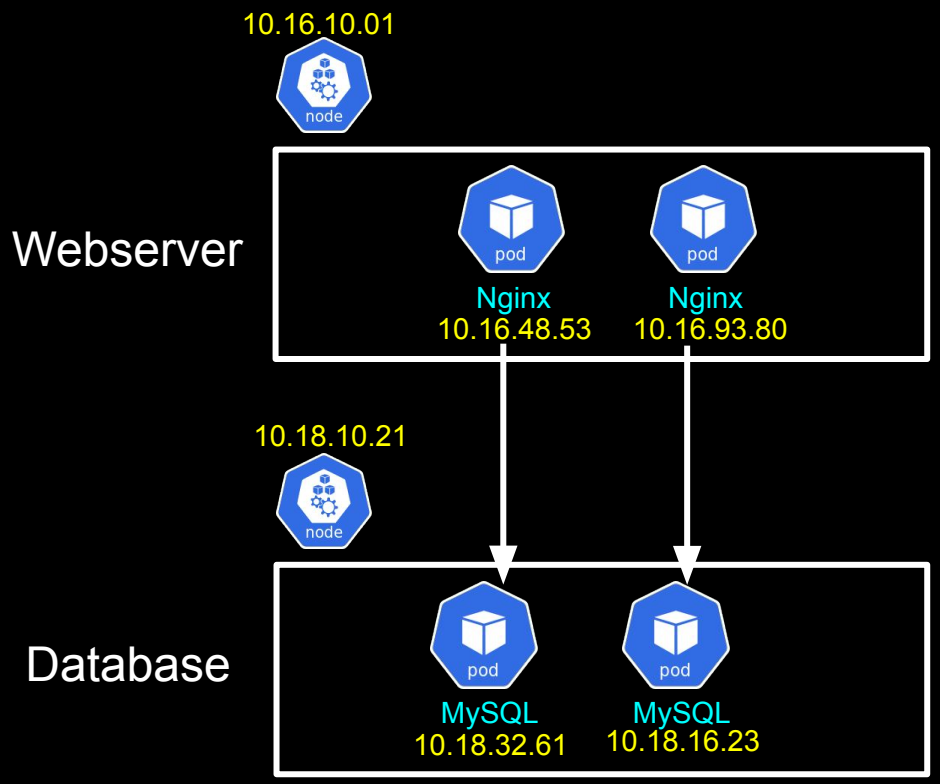
Life Of A Simple Pod



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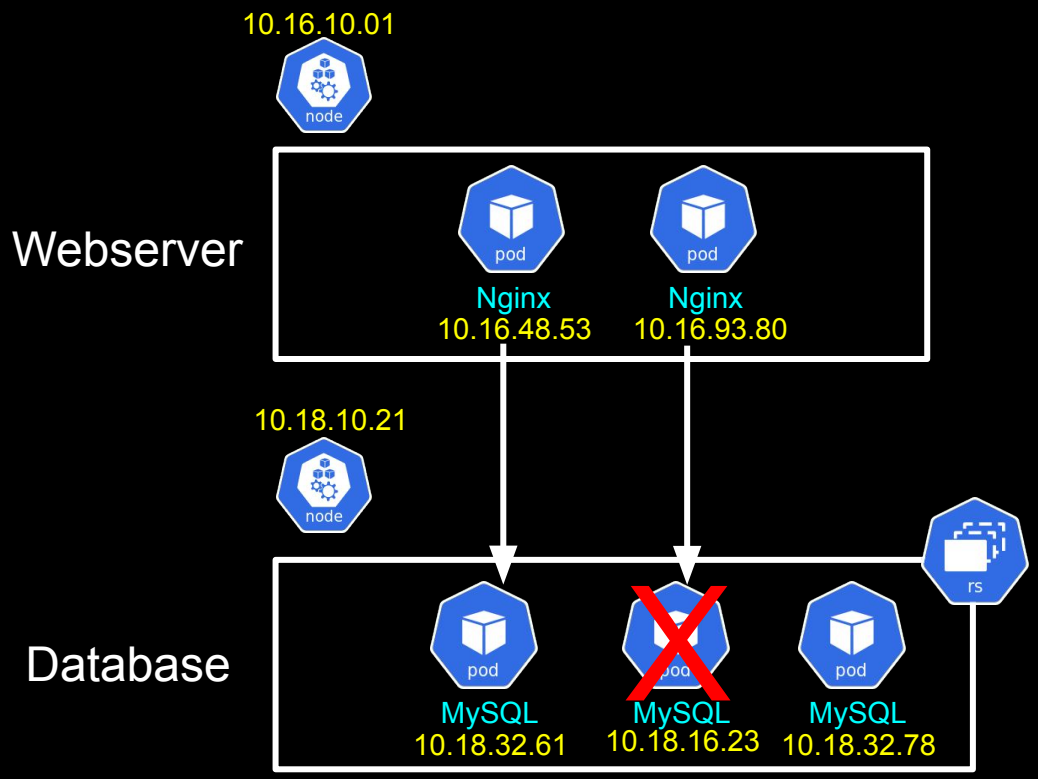
Life Of A Simple Pod



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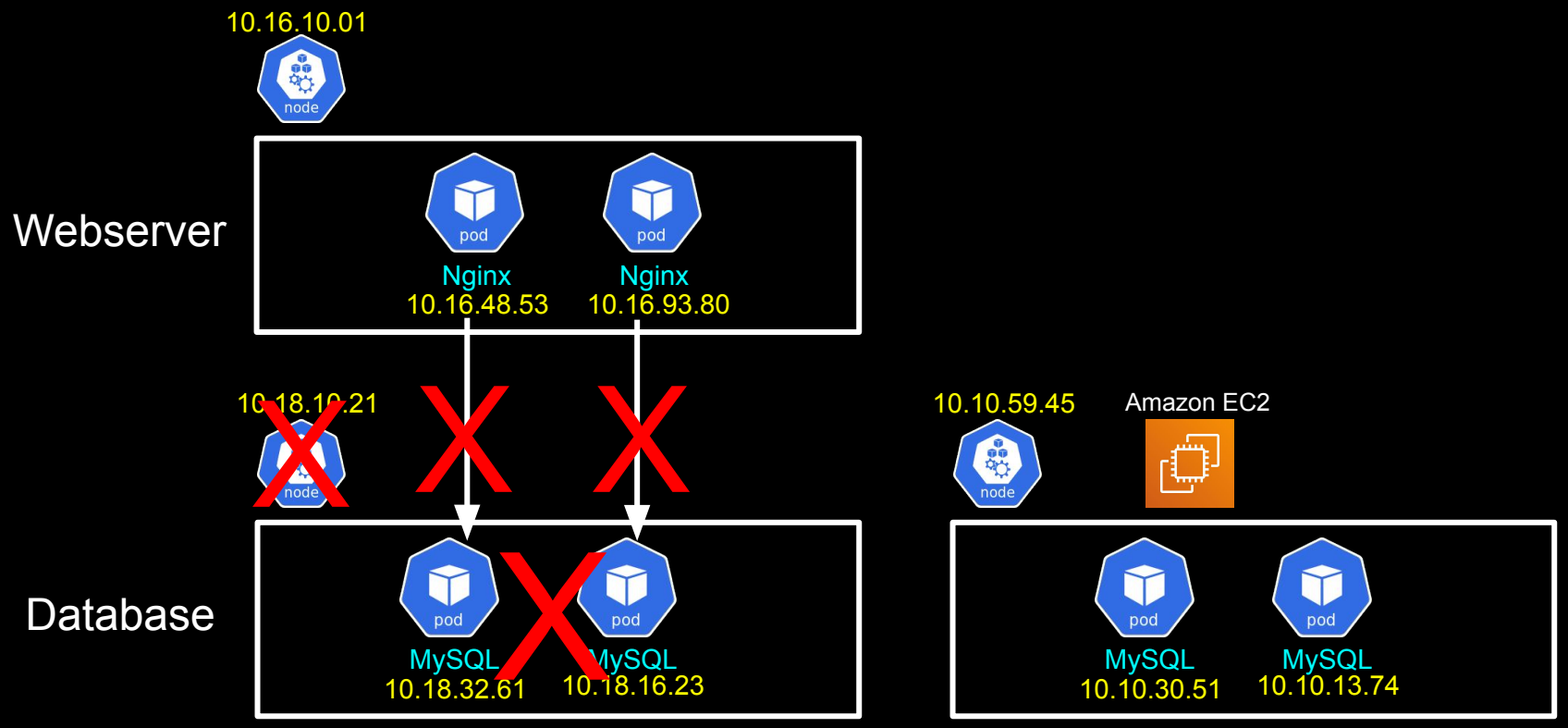
Life Of A Simple Pod



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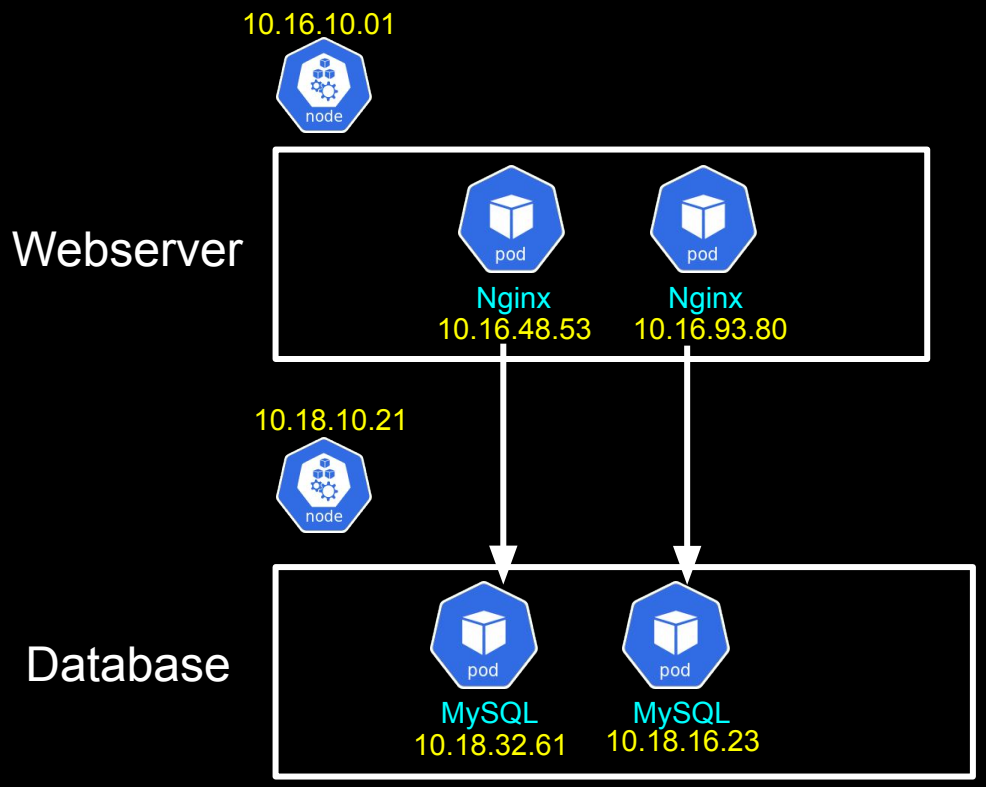
Life Of A Simple Pod



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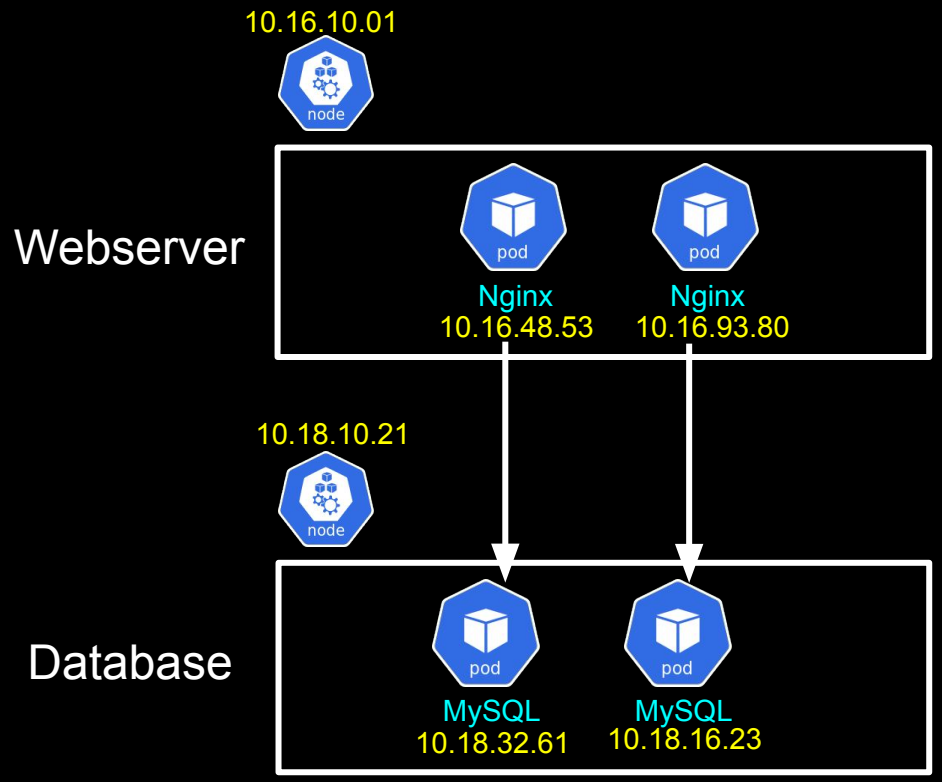
Say Hello To Service



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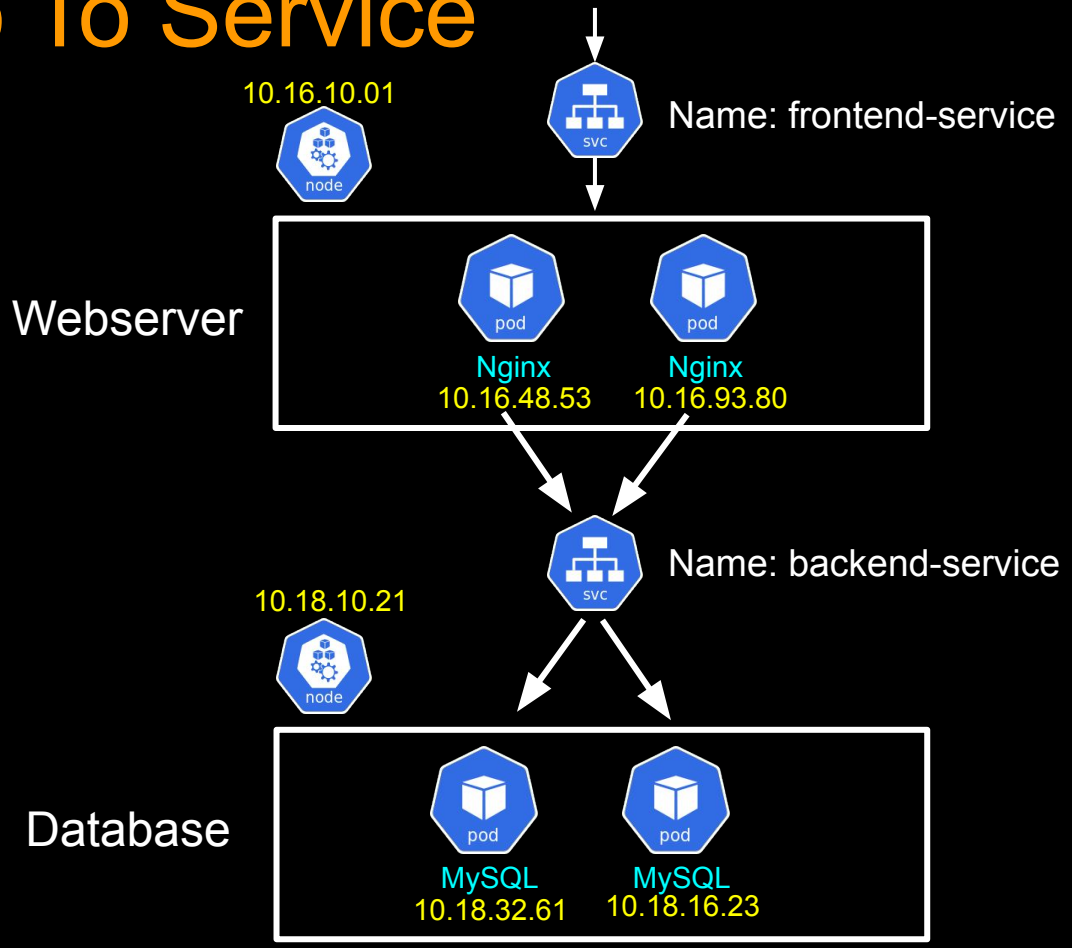
Say Hello To Service



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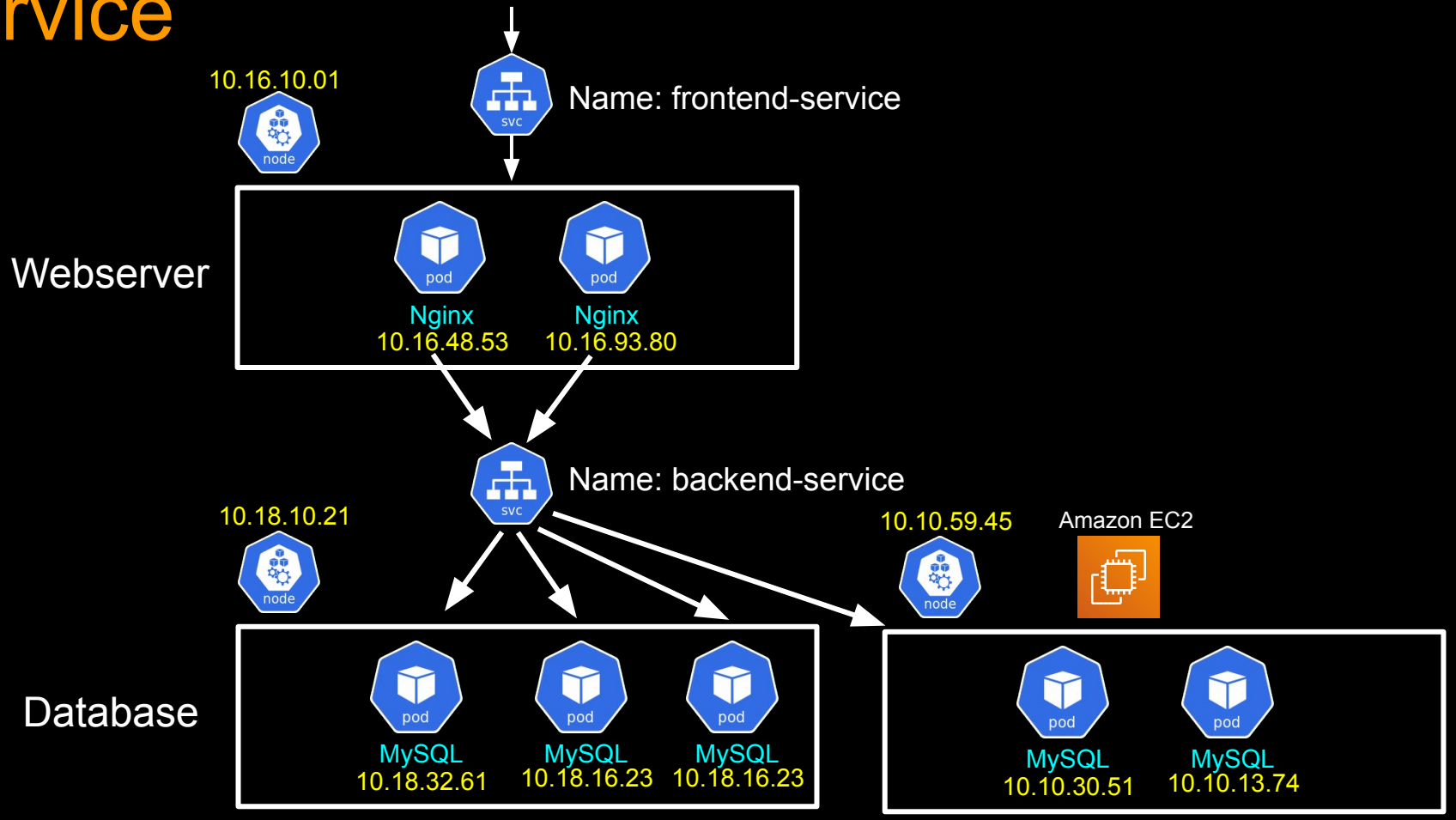
Service



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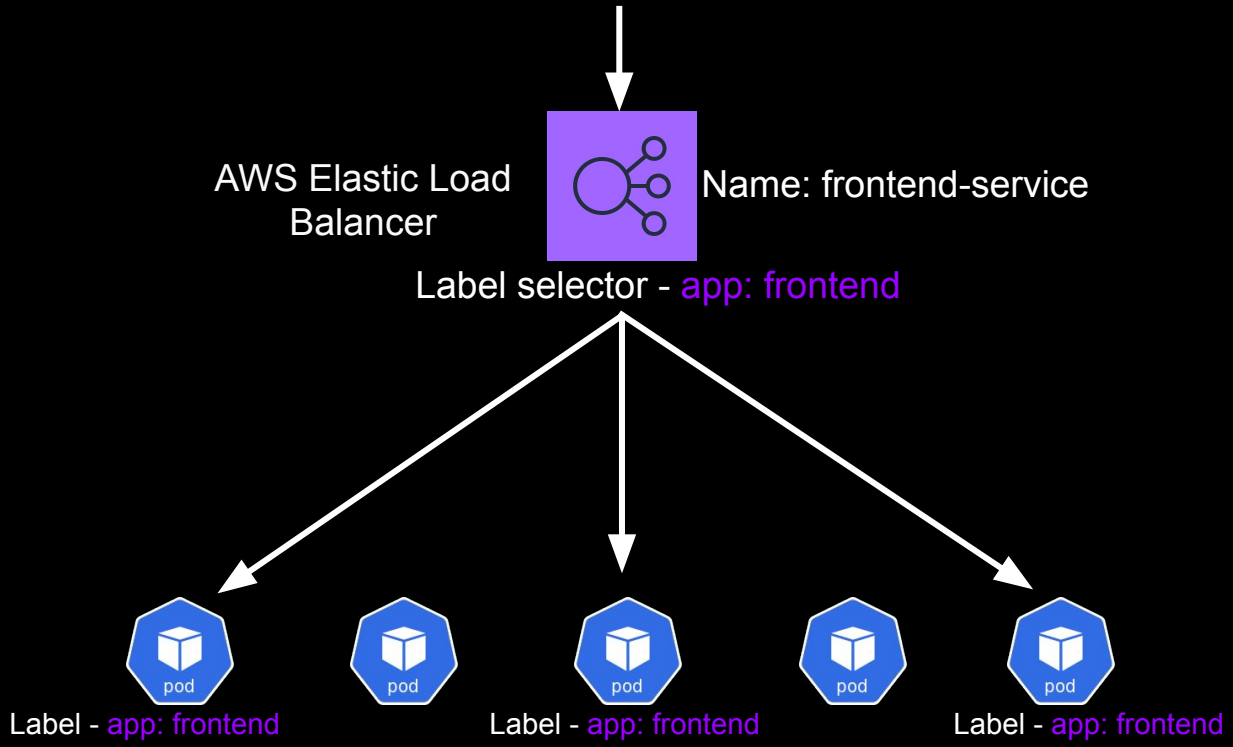
Service



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Different Types of Service

- LoadBalancer
- ClusterIP
- Nodeport

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Service Manifest

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: frontend-deployment
spec:
  replicas: 2
  selector:
    matchLabels:
      app: frontend
  minReadySeconds: 30
  strategy:
    type: RollingUpdate
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
  template:
    metadata:
      labels:
        app: frontend
    spec:
      containers:
      - name: frontend-container
        image: nginx
```

loadbalancer-service.yaml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: lb-service
  labels:
    app: lb-service
spec:
  type: LoadBalancer
  ports:
  - port: 80
  selector:
    app: frontend
```

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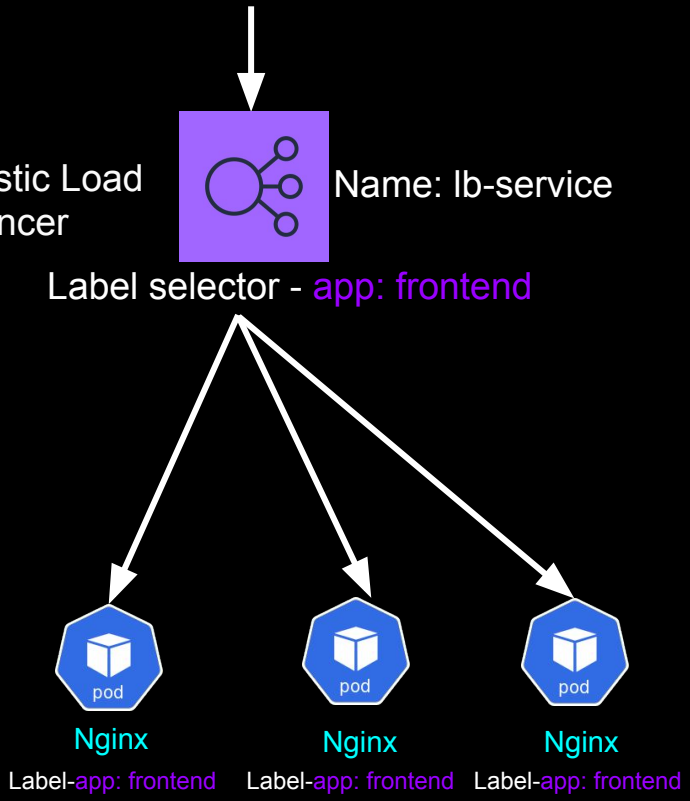
LoadBalancer Service Manifest

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: frontend-deployment
spec:
  replicas: 2
  selector:
    matchLabels:
      app: frontend
  minReadySeconds: 30
  strategy:
    type: RollingUpdate
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
  template:
    metadata:
      labels:
        app: frontend
    spec:
      containers:
      - name: frontend-container
        image: nginx
```

! loadbalancer-service.yaml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: lb-service
  labels:
    app: lb-service
spec:
  type: LoadBalancer
  ports:
  - port: 80
  selector:
    app: frontend
```



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Different Types of Service

- ClusterIP
- Nodeport
- LoadBalancer

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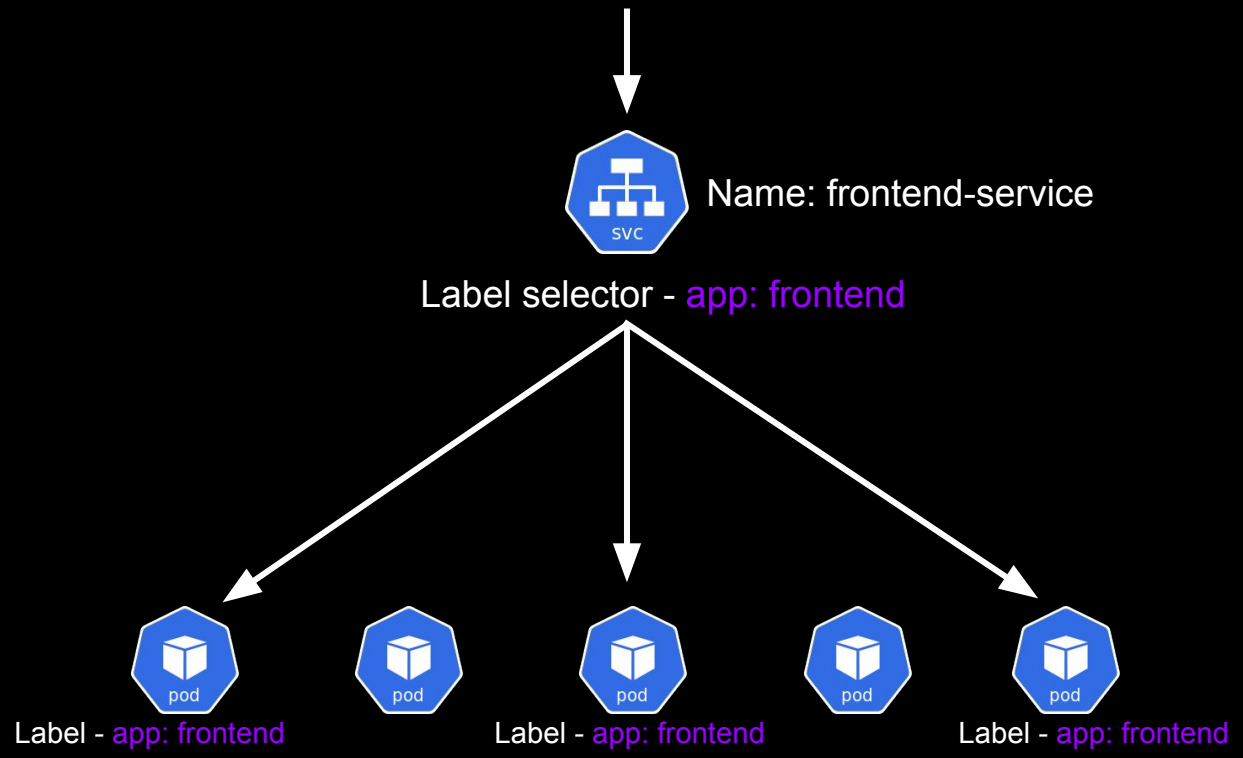
Motto of all Service



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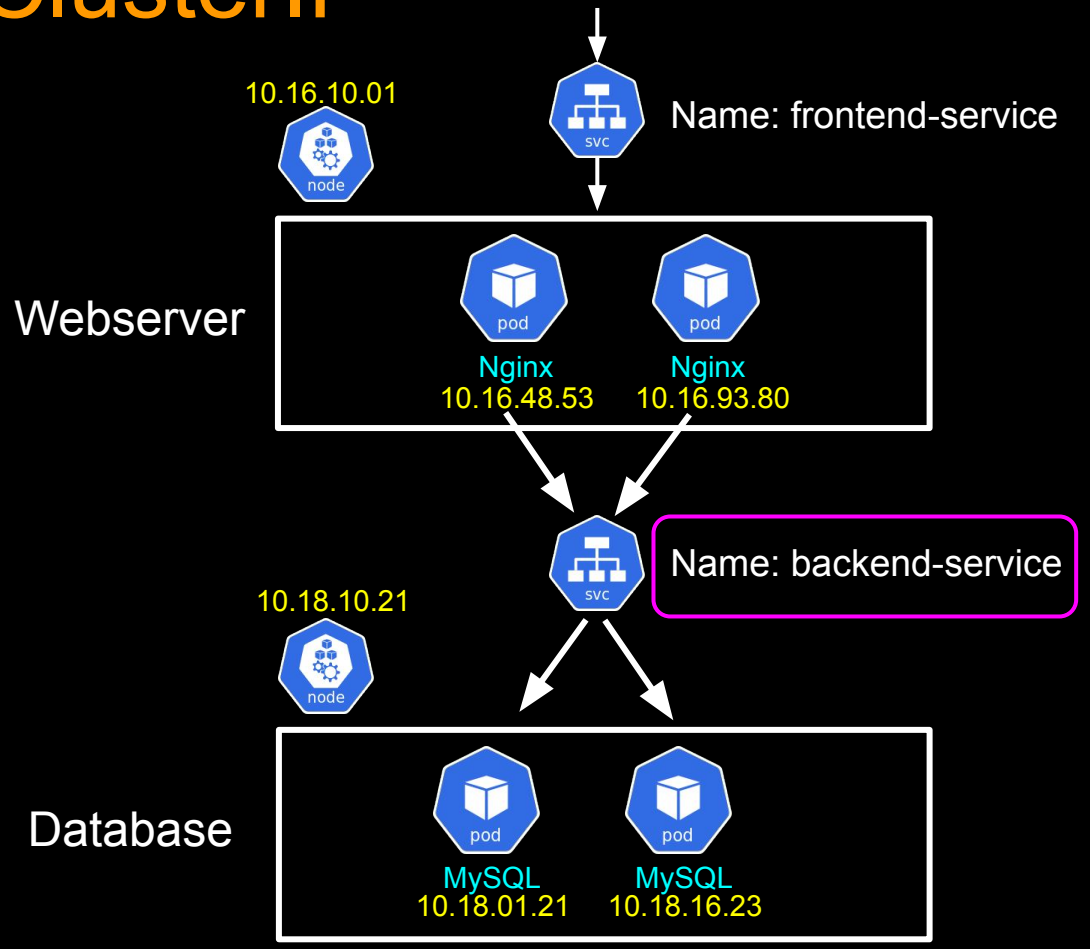
ClusterIP



- Default kind of Service
- Only accessible from within cluster

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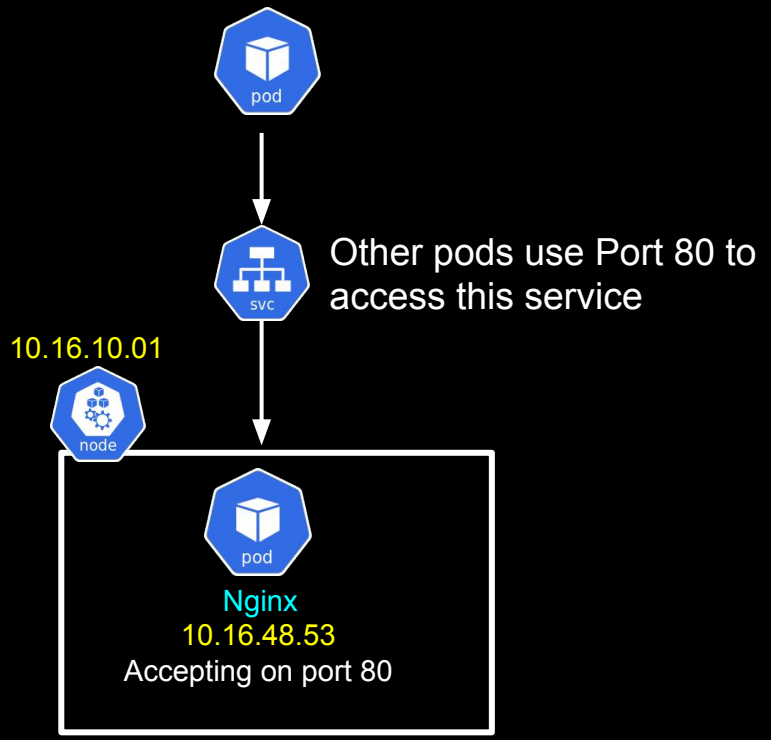
ClusterIP Manifest File

clusterip-service.yaml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: app-service
spec:
  ports:
    - port: 80
      protocol: TCP
  selector:
    app: app-server

```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: app-server
  labels:
    app: app-server
spec:
  selector:
    matchLabels:
      app: app-server
  template:
    metadata:
      labels:
        app: app-server
    spec:
      containers:
      - name: web-server
        image: nginx
        ports:
        - containerPort: 80
```



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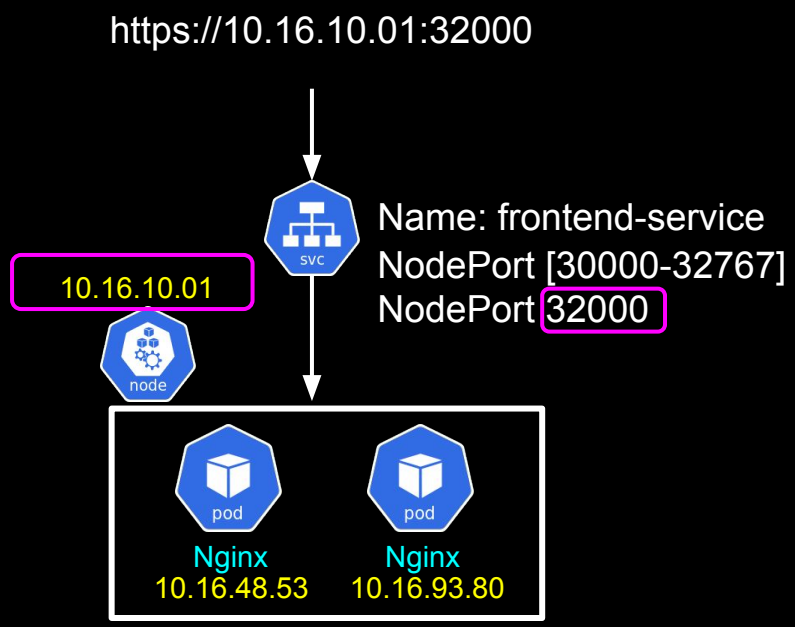
Nodeport



- Accessible from outside cluster
- Creates cluster wide port

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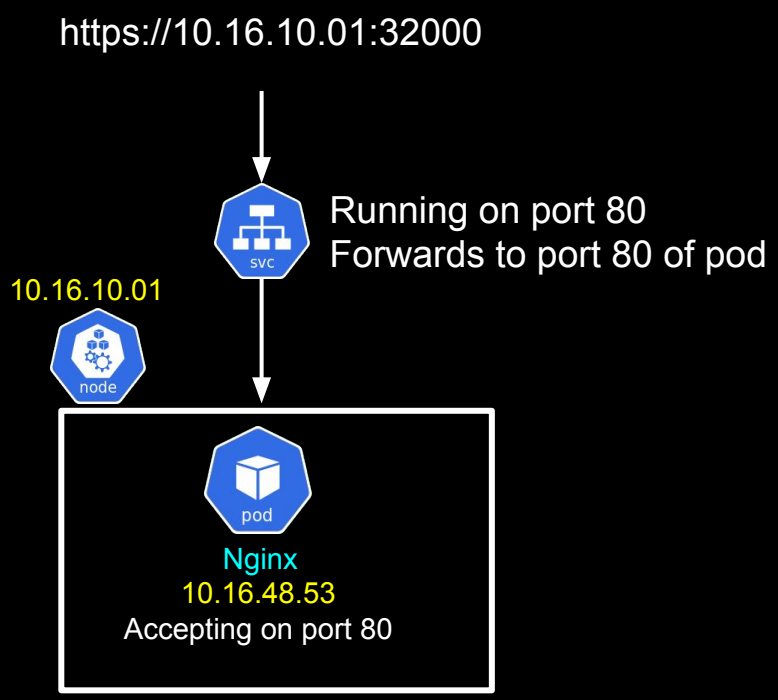
Nodeport Manifest File

nodeport-service.yaml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: app-service
spec:
  type: NodePort
  ports:
    - nodePort: 32000
      port: 80
      targetPort: 80
  selector:
    app: app-server
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: app-server
  labels:
    app: app-server
spec:
  selector:
    matchLabels:
      app: app-server
  template:
    metadata:
      labels:
        app: app-server
    spec:
      containers:
      - name: web-server
        image: nginx
        ports:
        - containerPort: 80
```



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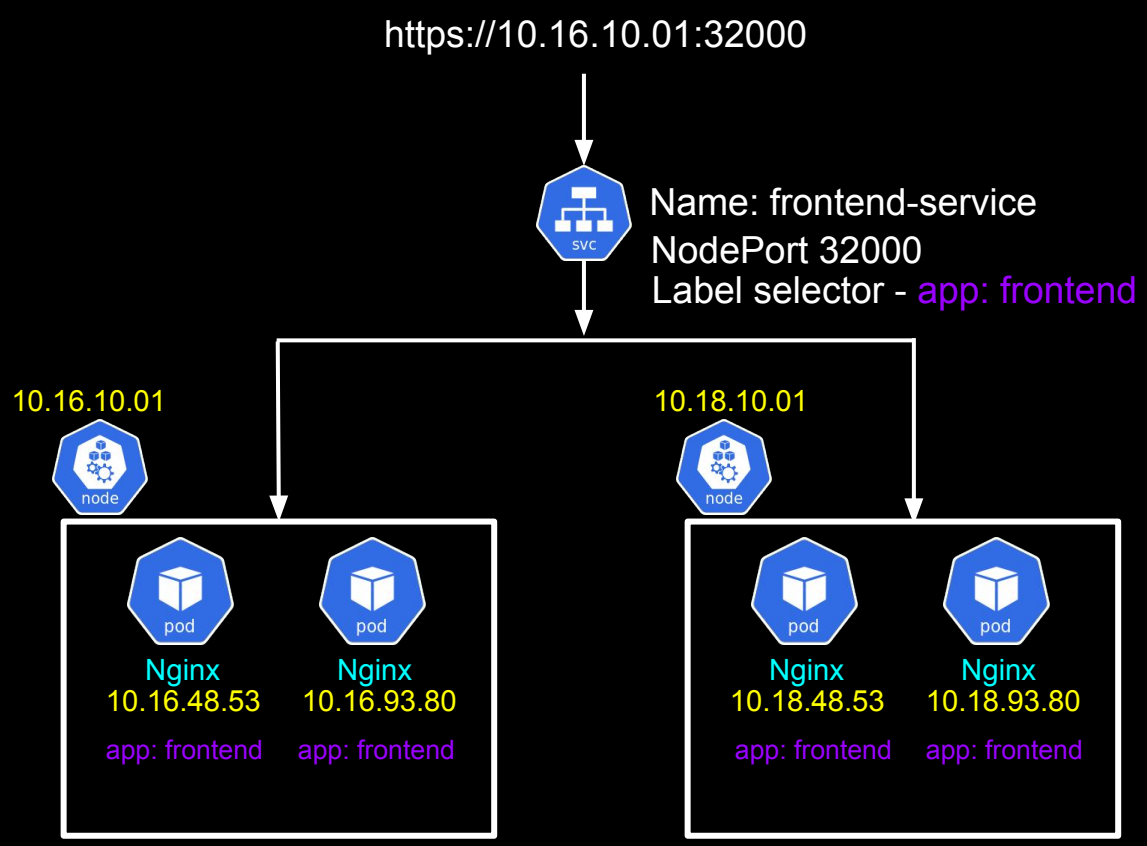
Nodeport



- Nodeport exposed to all nodes in cluster

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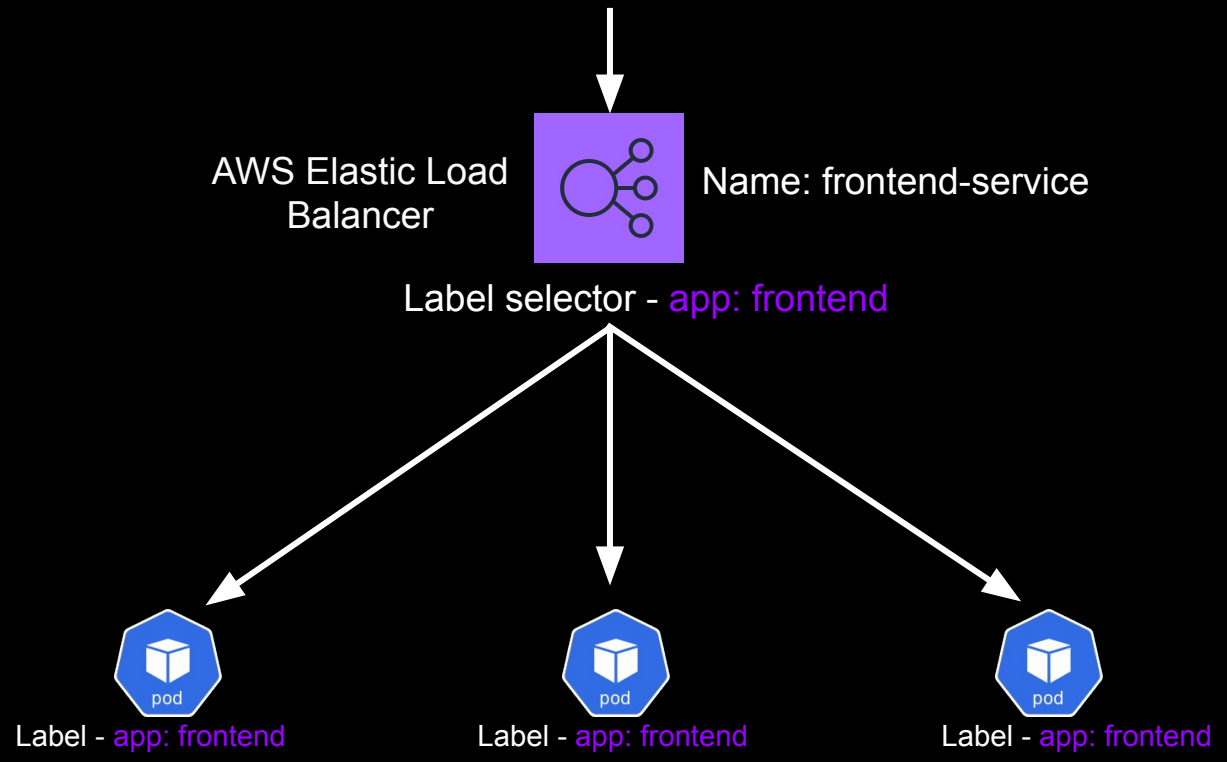
LoadBalancer



- Cloud Specific Implementation
- Accessible from outside cluster
- Has DNS name
- SSL Termination, WAF Integration, Access Logs, Health Check etc.

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What is EKS?

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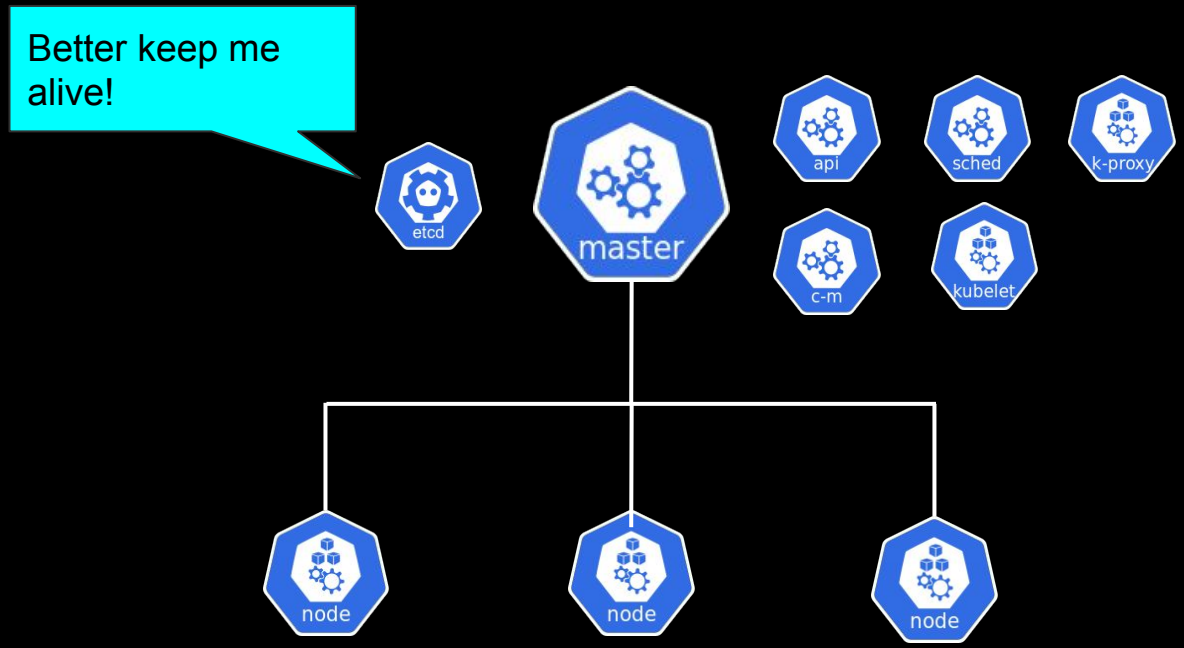
Kubernetes Architecture



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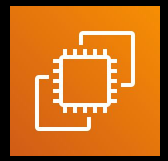
Kubernetes Control Plane - Self Managed



Amazon EC2

- Need to make Control Plane Highly Available
  - Maintain multiple EC2 in multiple AZ
- Scale Control Plane if needed
- Keep etcd up and running
- Overhead of managing EC2s
  - AMI Rehydration
  - Security Patching
  - Replace failed EC2s
  - Orchestration for Kubernetes Version Upgrade

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Kubernetes Control Plane - AWS Managed

Amazon EKS
Kubernetes Service

AWS Manages Kubernetes Control Plane

- AWS maintains High Availability - Multiple EC2s in Multiple AZs
- AWS Detects and Replaces Unhealthy Control Plane Instances
- AWS Scales Control Plane
- AWS Maintain etcd
- Provides Automated Version Upgrade and Patching
- Supports Native and Upstream Kubernetes
- Integrated with AWS Ecosystem

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EKS Data Plane

Amazon EC2

Self Managed Node Groups

- You maintain worker EC2s
- You orchestrate version upgrade, security patching, AMI Rehydration, keeping pods up during upgrade
- Can use custom AMI

Amazon EC2

Managed Node Groups

- AWS manages worker EC2s
- AWS provides AMI with security patches, version upgrade
- AWS manages pod disruption during upgrade
- Doesn’t work with custom AMI

AWS Fargate

- No worker EC2 whatsoever!
- You define and deploy pods
- Container + Serverless!

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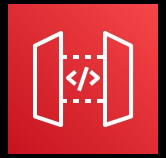
EKS in AWS Ecosystem

AWS Secrets Manager



Amazon API Gateway

Elastic Load Balancing

Amazon EKS

AWS Identity and Access Management (IAM)

Amazon CloudWatch

AWS CodePipeline

And More….

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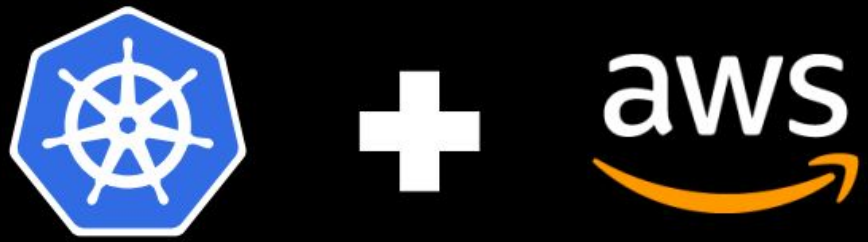
Kubernetes on AWS



51%

of Kubernetes workloads run on AWS today

- CNCF

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Amazon EKS Customers

And Many More..

Source: https://aws.amazon.com/eks/customers/

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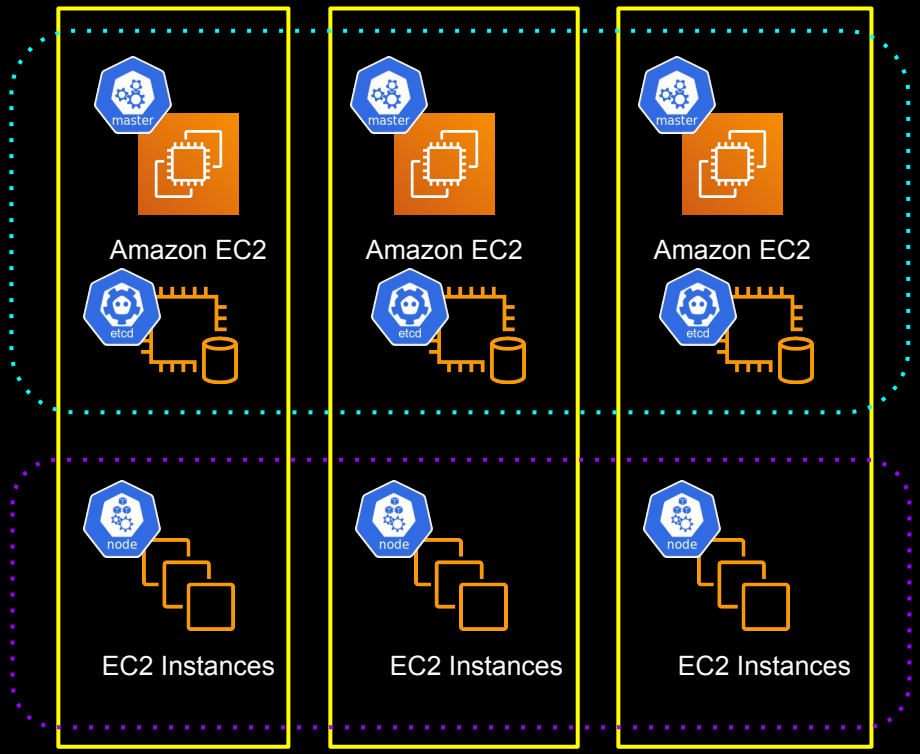
EKS High Level Architecture



Availability Zone 1

Availability Zone 2

Availability Zone 3

aws

Managed

Customer Account

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High Level Flow

Provision EKS Cluster

AWS deploys and manages master

EC2 EC2

EC2 EC2

Add worker nodes to cluster

- Keep using the k8s tooling you know!
- kubectl
- Prometheus, grafana, splunk, fluentd, fluentbit, cloudhealth, kubecost, flux, jenkins, gitlab and many many more

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Cost Of EKS

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Money Matters

Amazon Elastic Container Service for Kubernetes

Flat Charge 10 cents/Hour = $72/Month

EC2 EC2 EC2

Price based on EC2

EKS with 3 m5.large in us-east-1 = EKS Control Plane + Worker Nodes (m5.large X 3)

= $72/mo + $219.24/mo

= $291.24/mo

EC2 Price calculation: https://calculator.aws/#/

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eksctl

&

kubectl

Ways To Spin Up EKS Cluster

AWS Console

CloudFormation

AWS CLI

👍 eksctl CLI

Amazon Elastic Container Service for Kubernetes

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Learning Medium

AWS Console

CloudFormation

AWS CLI

eksctl CLI

Amazon Elastic Container Service for Kubernetes

Local PC
(Using AWS Creds)

AWS Cloud9
(Terminal)

Amazon EC2
(Command Line)

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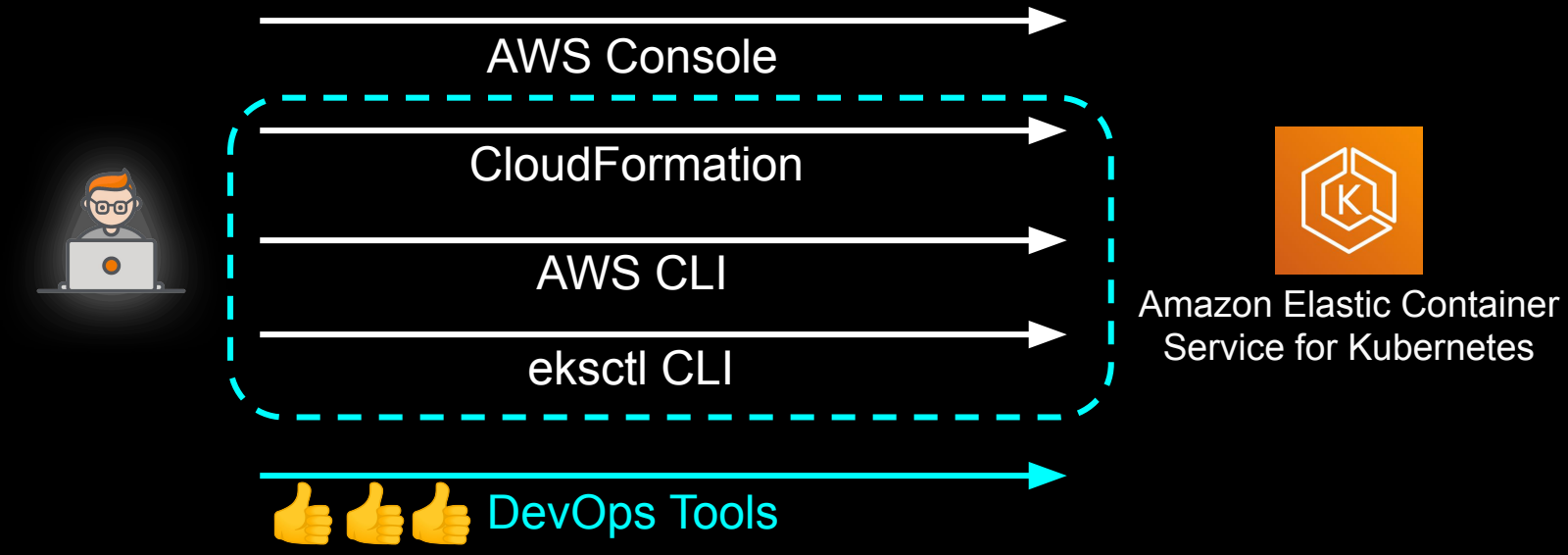
Automation



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What is eksctl?

- CLI tool for creating clusters on EKS
- Easier than console, for real!
- Abstracts lots of stuff - VPC, Subnet, Sec. Group etc. using CloudFormation

eksctl create cluster

Amazon Elastic Container Service for Kubernetes

AWS Fargate (On EKS)

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Available eksctl features (Only on EKS)

- Create, get, list and delete clusters
- Create, drain and delete nodegroups
- Scale a nodegroup
- Update a cluster
- Use custom AMIs
- Configure VPC Networking
- Configure access to API endpoints
- Support for GPU nodegroups
- Spot instances and mixed instances
- IAM Management and Add-on Policies
- List cluster Cloudformation stacks
- Install coredns
- Write kubeconfig file for a cluster

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eksctl Commands

Command	Brief Description
eksctl create cluster	Create EKS Cluster with one nodegroup containing 2 m5.large nodes
eksctl create cluster --name <name> --version 1.15 --node-type t3.micro --nodes 2	Create EKS Cluster with K8 version 1.15 with 2 t3.micro nodes
eksctl create cluster --name <name> --version 1.15 --nodegroup-name <nodegrpname> --node-type t3.micro --nodes 2 --managed	Create EKS cluster with managed node group
eksctl create cluster --name <name> --fargate	EKS Cluster with Fargate Profile

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What is kubectl?

- CLI for running commands against a cluster on K8s resources
- Communicate via cluster API Server
- Works for any K8s cluster - EKS, K8s on EC2, GKE etc.

kubectl get pod

Amazon Elastic Container Service for Kubernetes

AWS Fargate (On EKS)

Google Kubernetes Engine

K8s on EC2

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kubectl Command Syntax

kubectl [command] [type] [name] [flags]

[command]

create
get
describe
delete
apply
attach
autoscale

And Many More...

[type]

Any K8 Resource Type
pods OR pod OR po
namespaces OR ns
deployments OR deploy
replicasets OR rs

And Many More….

[name]

Optional
Name of the resource.
If omitted, all resource details displayed

[flags]

Optional
--filename OR -f
--output OR -o

And Many More...

All available command and resource type : https://kubernetes.io/docs/reference/kubectl/overview/

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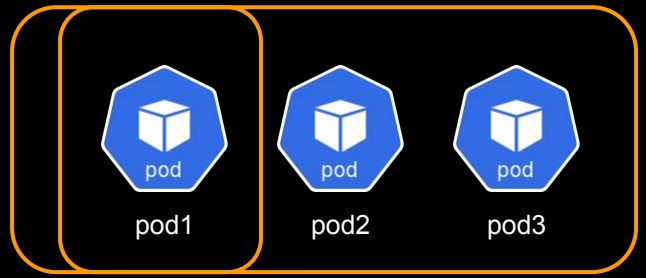
kubectl Command Syntax

kubectl	[command]	[TYPE]	[NAME]	[flags]
kubectl	get	pod	pod1	
kubectl	get	pod		
kubectl get po				
kubectl	get	pod	pod2	-o yaml



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Most Used kubectl Commands

Command	Brief Description
kubectl apply -f ./manifest-file.yaml	Create resources based on manifest. Declarative Way! Best Way!
kubectl get nodes	List all node info
kubectl get services	List all services
kubectl get pods -o wide	List pods with more details
kubectl get pod my-pod -o yaml	Get a pod's YAML
kubectl get deployment my-dep	List a particular deployment
kubectl exec -it *podname* -- /bin/bash	Get a shell to the running Container

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DEMO TIME!

- Spin up EKS Cluster using eksctl
- Use kubectl
  - Deploy nginx using manifest file
  - Get resources info

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EC2 Instance Type And Pod Limit

- Max number of allowed pods depends on EC2 Instance Type
- Bigger the instance type, more pods

Note - For some demos, m5.large is used

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EKS Managed Nodegroups

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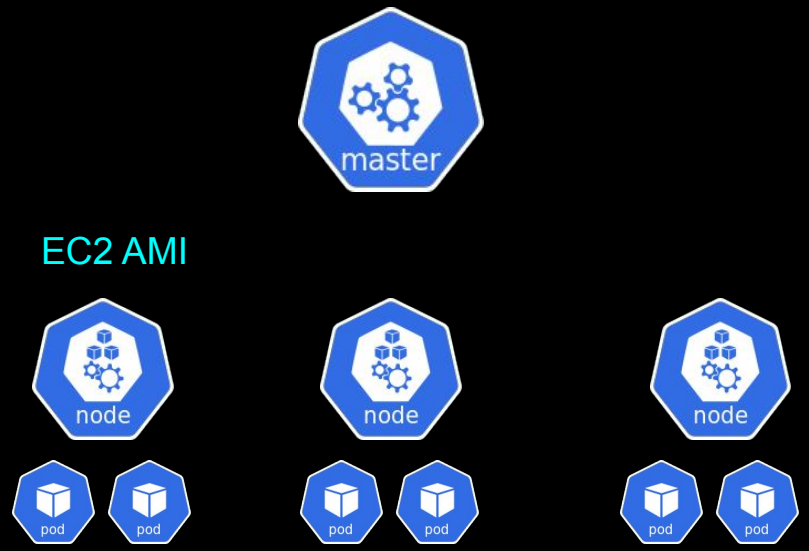
EKS Regular Nodes and Pods

- K8 Version needs to be updated
- Deploy Security Patches
- EC2 AMI Need to Be Updated



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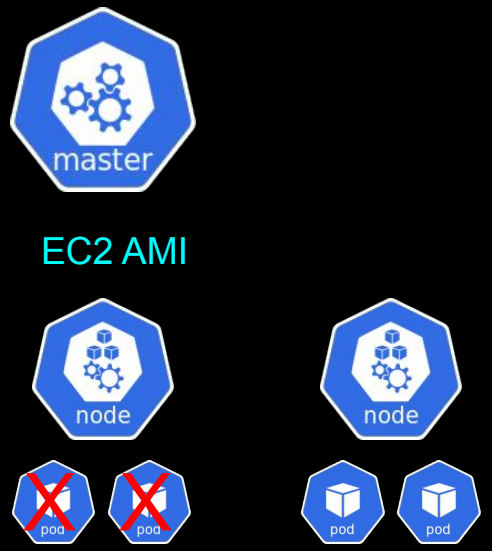
EKS Nodes Regular Update

- K8 Version needs to be updated
- Deploy Security Patches
- EC2 AMI Need to Be Updated
  - You need to create AMIs



- Application will be DOWN!!
- Or You have to orchestrate HA

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EKS Managed Nodegroups

- Create and Manage EC2 Workers for you
- Amazon releases AMIs with bug fix, security patches for EKS Worker Nodes
  - Custom AMIs not supported (As of April, 2020)
- Automated deployment of updated AMIs with security patches, CVEs
  - No app downtime
  - No overhead of user managed orchestration
  - Auto scaling group is used behind the scenes

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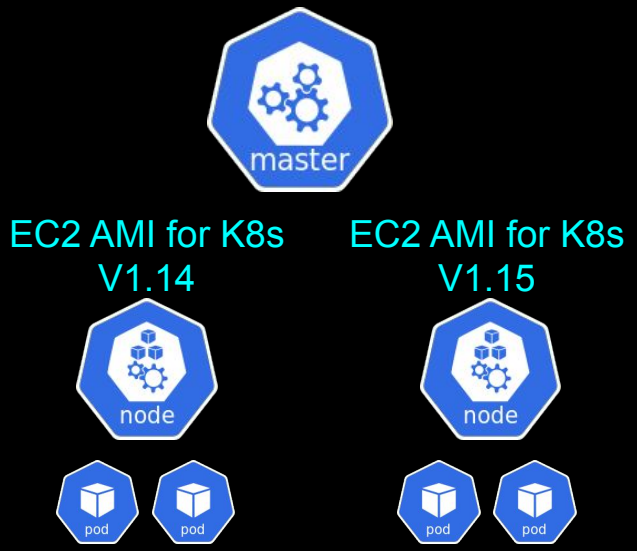
EKS Nodes: Managed Nodegroup Update

- Worker Node K8s Version updated with one click/API call
- AWS Provides AMI with security updates
  - No patching/Rehydrate effort for you



- Application will be up and running
- AWS orchestrate HA through Auto Scaling Group
- Respects Pod Disruption Budget

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EKS Managed Nodegroups

DEMO

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Helm And Charts

Chart

From Wikipedia, the free encyclopedia

For other uses, see Chart (disambiguation), Graph (disambiguation), and Diagram.
For information about charts in Wikipedia, see Wikipedia:Graphs and charts.

This article has multiple issues. Please help **improve it** or discuss these issues on the **talk page**. *(Learn how and when to remove these template messages)* [show]

A **chart** is a graphical representation of data, in which "the data is represented by symbols, such as bars in a bar chart, lines in a line chart, or slices in a pie chart".[1] A chart can represent tabular numeric data, functions or some kinds of qualitative structure and provides different info.

The term "chart" as a graphical representation of data has multiple meanings:

- A data chart is a type of diagram or graph, that organizes and represents a set of numerical or qualitative data.
- Maps that are adorned with extra information (map surround) for a specific purpose are often known as charts, such as a nautical chart or aeronautical chart, typically spread over several map sheets.
- Other domain specific constructs are sometimes called charts, such as the chord chart in music notation or a record chart for album popularity.

Helm Charts have nothing to do with graphical charts or dashboards!

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Helm And Charts - What Does it Solve?

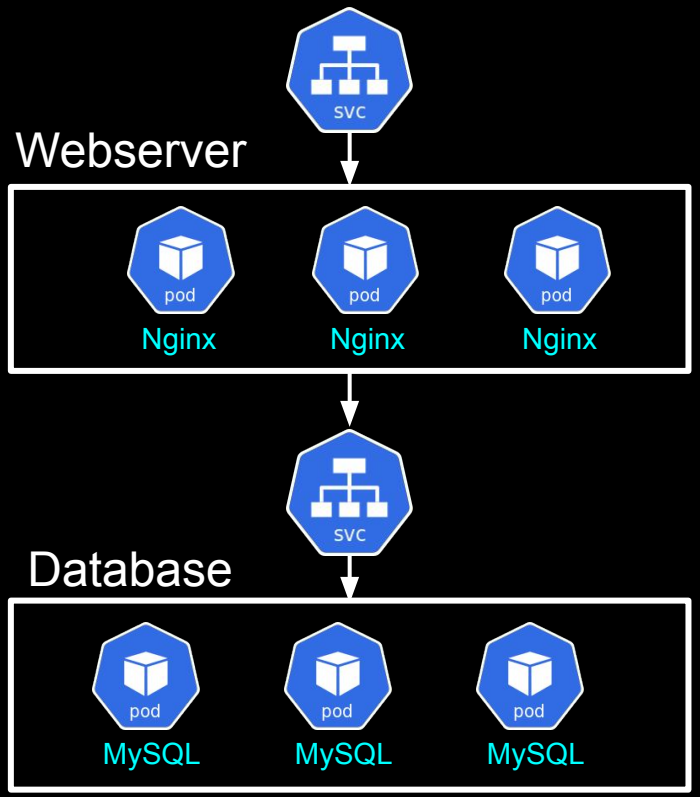
Deploying Wordpress

kubectl apply -f frontservice.yml

kubectl apply -f websrvr.yml

kubectl apply -f backservice.yml

kubectl apply -f database.yml



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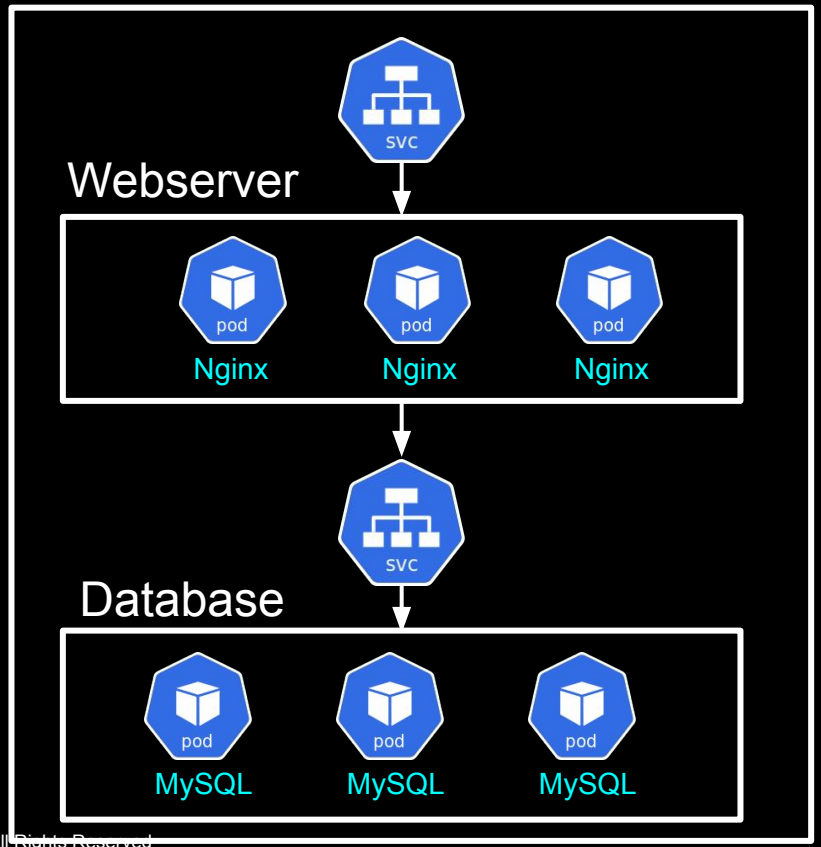
Helm And Charts - What Does it Solve?

Deploying Wordpress

helm install x stable/wordpress



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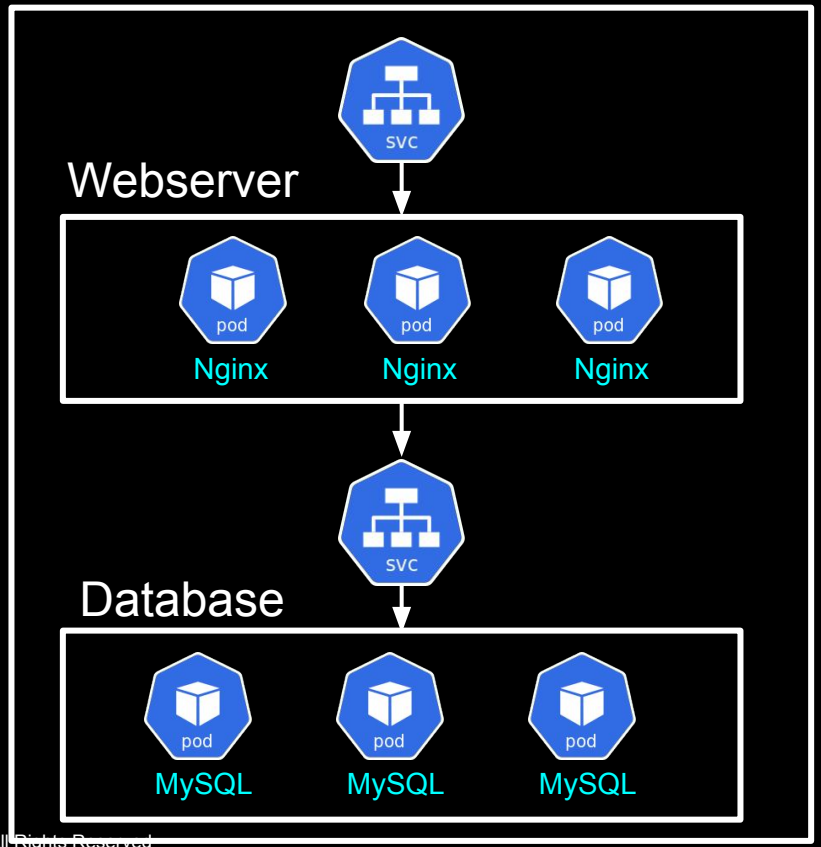
HELM CHARTS

helm install x
stable/wordpress



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Helm And Charts

- Helm is package manager for Kubernetes
- Helm packages are called Charts
- Helm Charts help define, install, and upgrade complex Kubernetes application
- Helm Charts can be versioned, shared, and published
- Helm Charts can accept input parameter
  - kubectl need template engine to do this (Kustomize, jinja etc.)
- Popular packages already available

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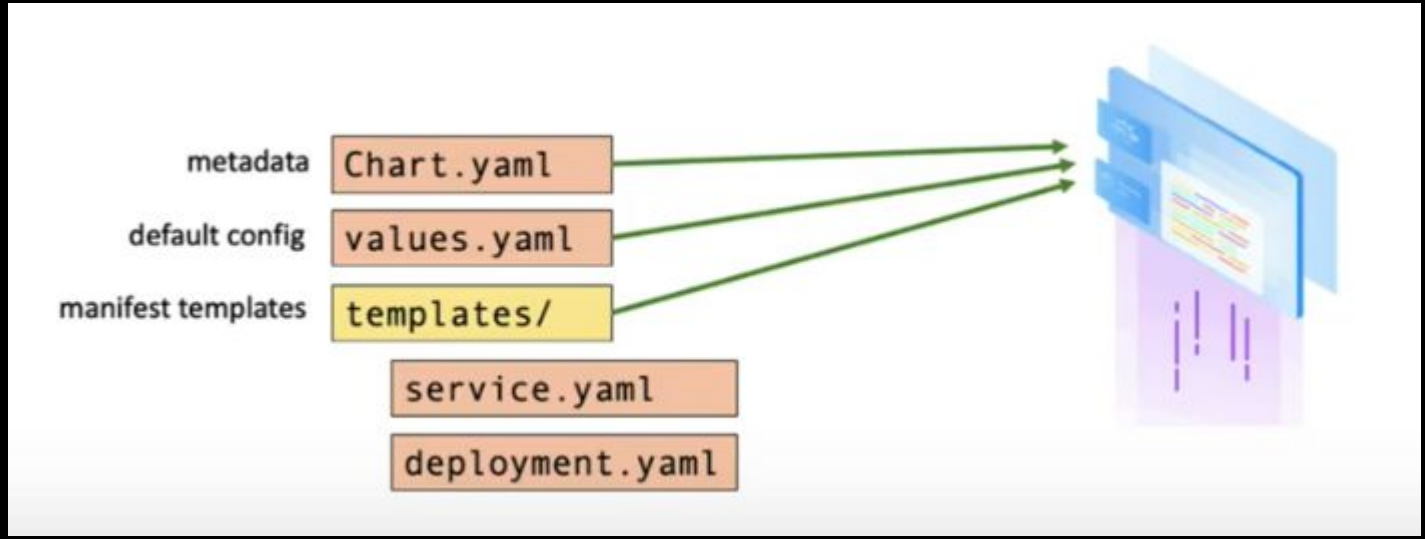
Charts Files



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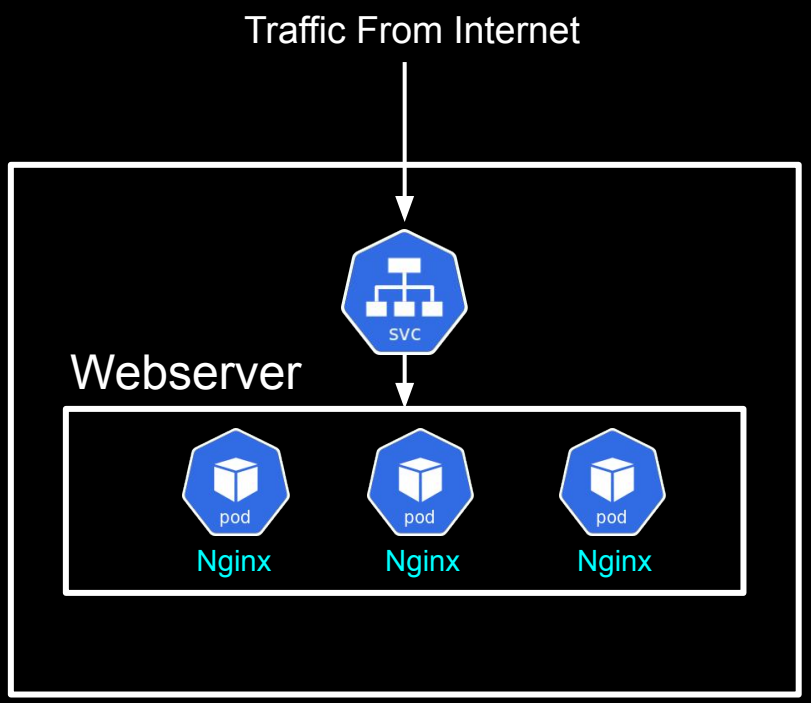
Helm On EKS Demo



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EKS Logging

& Monitoring

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EKS Logging

- EKS Control Plane Logging
- EKS Worker Nodes Logging

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EKS Logging

- EKS Control Plane Logging
  - K8 api
  - audit
  - authenticator
  - controllerManager
  - scheduler
- EKS Worker Nodes Logging

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EKS Logging

- EKS Control Plane Logging
  - K8 api
  - audit
  - authenticator
  - controllerManager
  - scheduler
- EKS Worker Nodes Logging
  - System logs from kubelet, kube-proxy, or dockerd
  - Application logs from application containers

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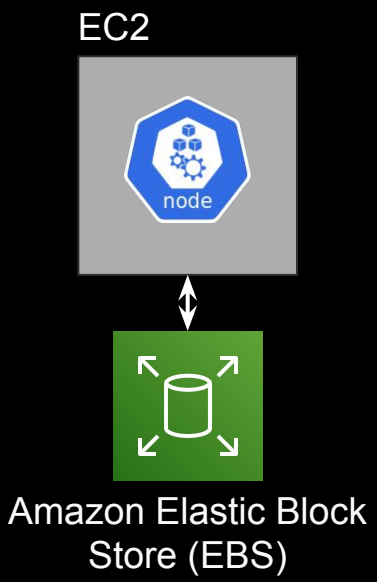
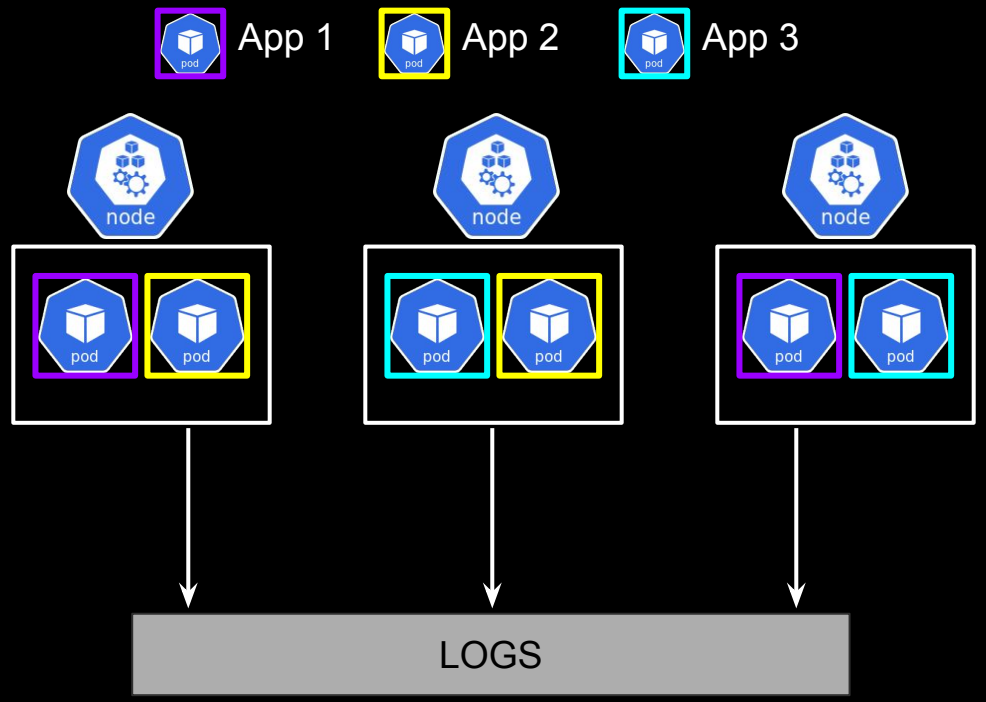
Logging Caveat





- If instance terminated, logs are gone

- Logs need to be aggregated in a meaningful way

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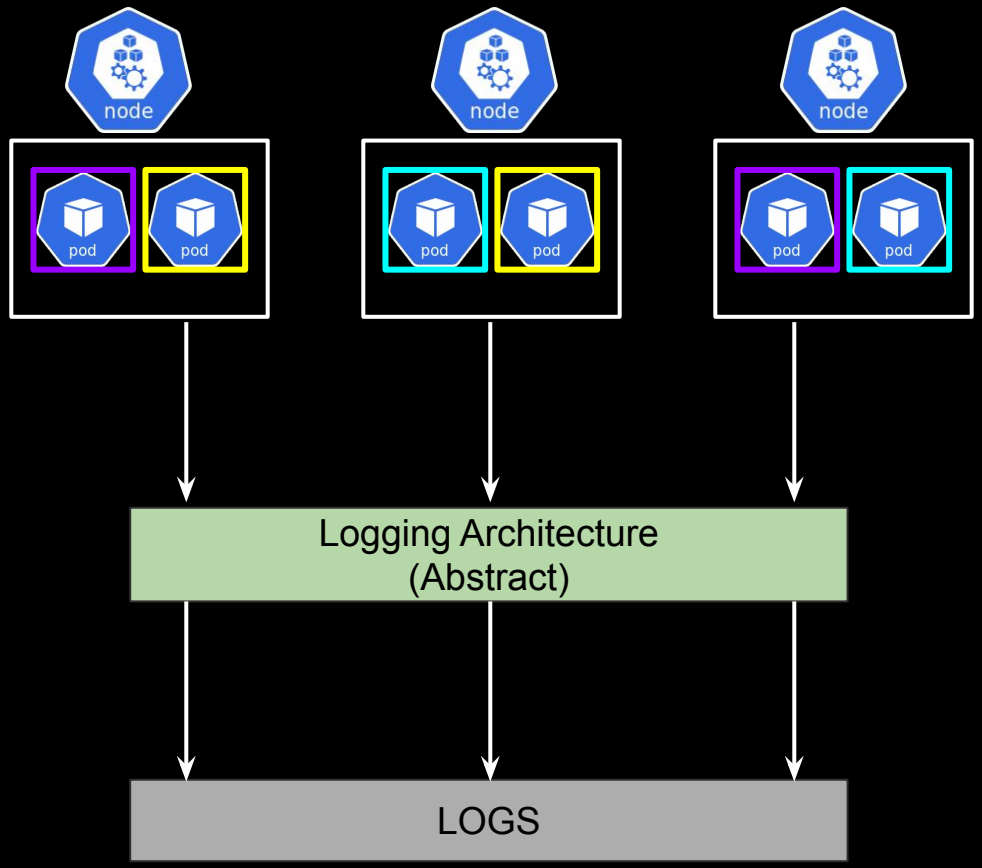
Logging Caveat



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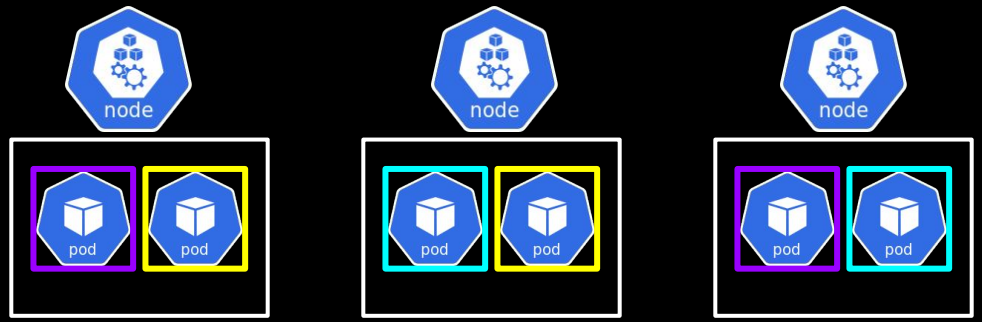
Kubernetes Worker Nodes



- Containerized application writes to
  - stdout and stderr
- System logs go to
  - systemd
- Container redirect logs to /var/log/containers/*.log files
- Now we know where to extract logs from!

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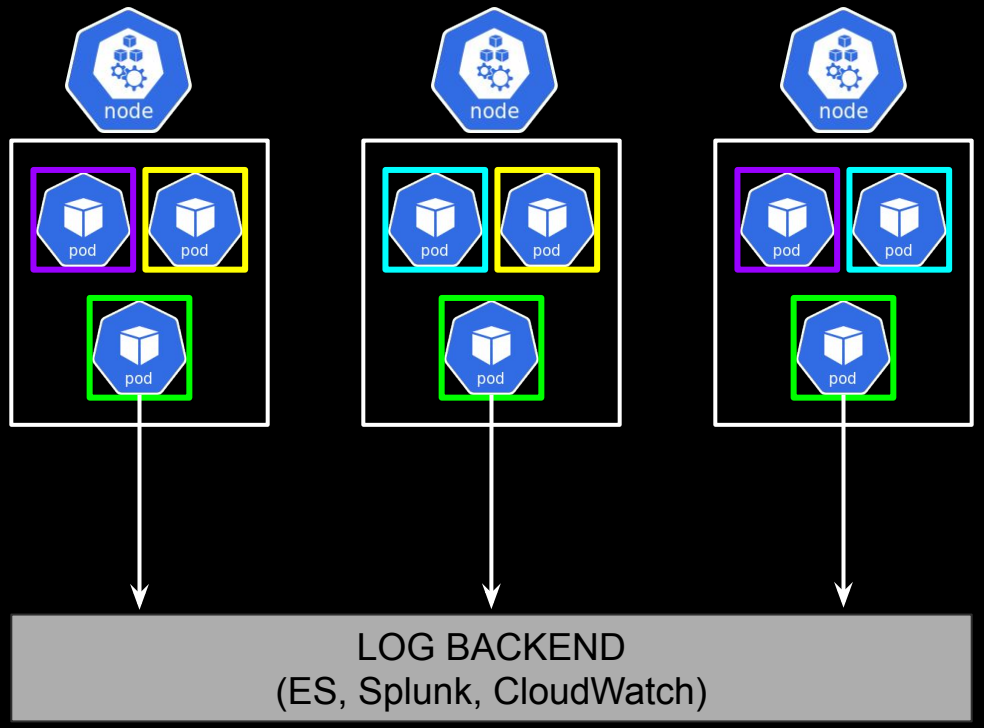
Implementation



= Logging agent running as daemon, reading logs from /var/log and sending to logging backend

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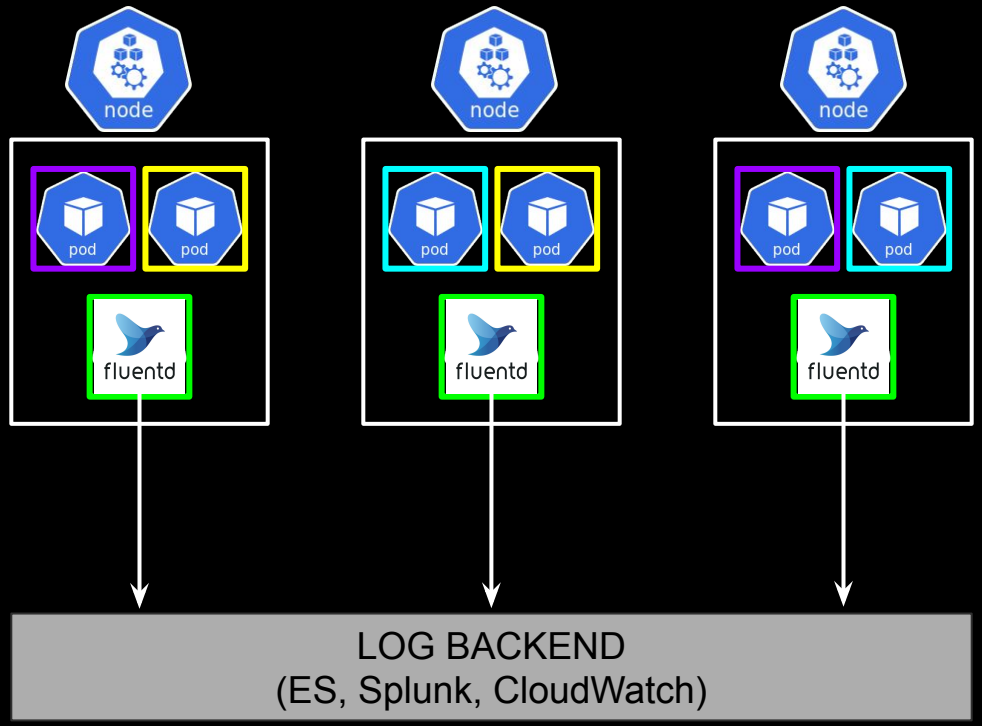
Implementation



= Logging agent running as daemon, reading logs from /var/log and sending to logging backend

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Different Options

Agent

Logging Backend

Amazon Elasticsearch Service

etc.

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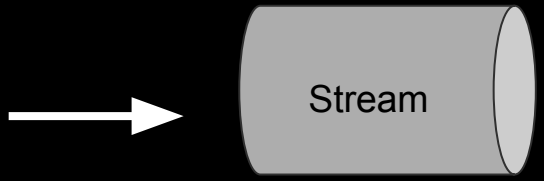
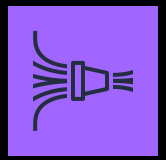
For Streaming to Multiple Log Backends

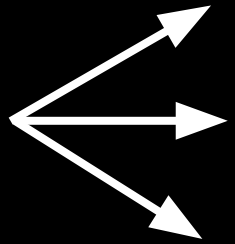
Logging Backend

Agent





Amazon Kinesis
Data Firehose



Amazon Elasticsearch
Service

etc.

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EFK Stack

Amazon Elasticsearch Service

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Under Pressure!

- fluentd has 100+ plugins, fluentbit has around 20 (April 2020)
- However as traffic goes up, fluentd can’t keep up
  - fluentd based on Ruby and memory intensive
  - Slow propagation of logs
  - Loss of logs
  - fluentd buffer can be increased to solve this, but not dynamic

Contd on next slide..

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Under Pressure!

- fluentbit is lightweight and keeps up with higher traffic
- Ways to solve the high traffic problem
  - fluentd to Kinesis Data Firehose to Logging Backend
  - fluentbit to Logging Backend
  - Hard to replace fluentd coz of plugin support if already existing in enterprise

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Logging Demo - 1

Amazon CloudWatch

Amazon Elasticsearch Service

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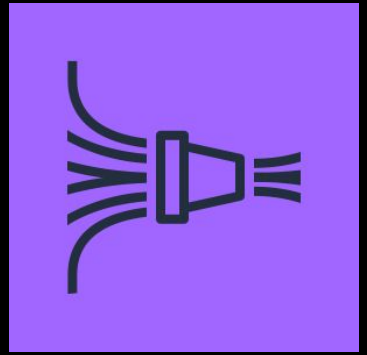
Logging Demo - 2



Amazon Kinesis Data Firehose

Amazon S3

https://aws.amazon.com/blogs/opensource/centralized-container-logging-fluent-bit/

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EKS Control Plane Logging

- EKS Control Plane Logging
  - K8s api
  - audit
  - authenticator
  - controllerManager
  - scheduler

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EKS Control Plane Logging

- EKS Control Plane Logging
  - K8s api
  - audit
  - authenticator
  - controllerManager
  - scheduler

Amazon CloudWatch

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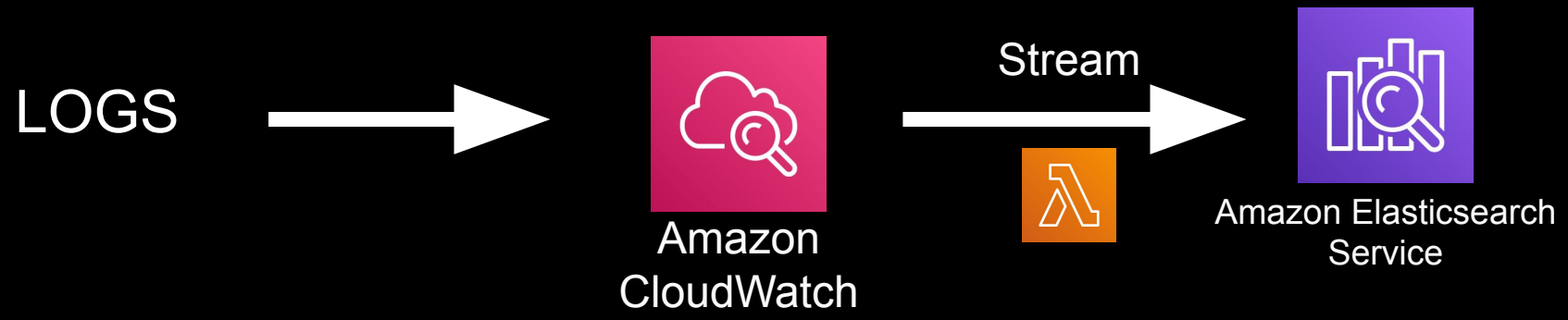
EKS Control Plane Logging



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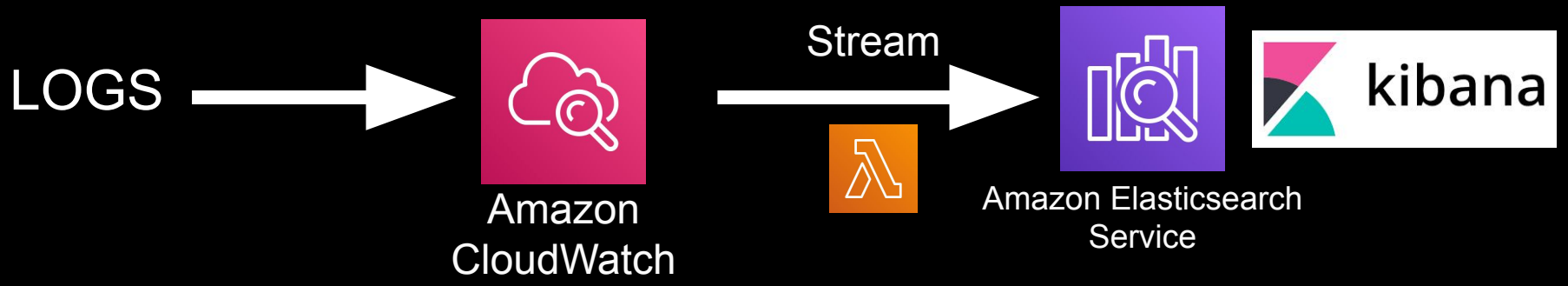
EKS Control Plane Logging Demo



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Kubernetes Dashboard

- Web-based Kubernetes user interface
- Overview of applications and resources running on cluster
- Create and modify resources!
  - Pod
  - Deployments
  - Jobs
  - etc

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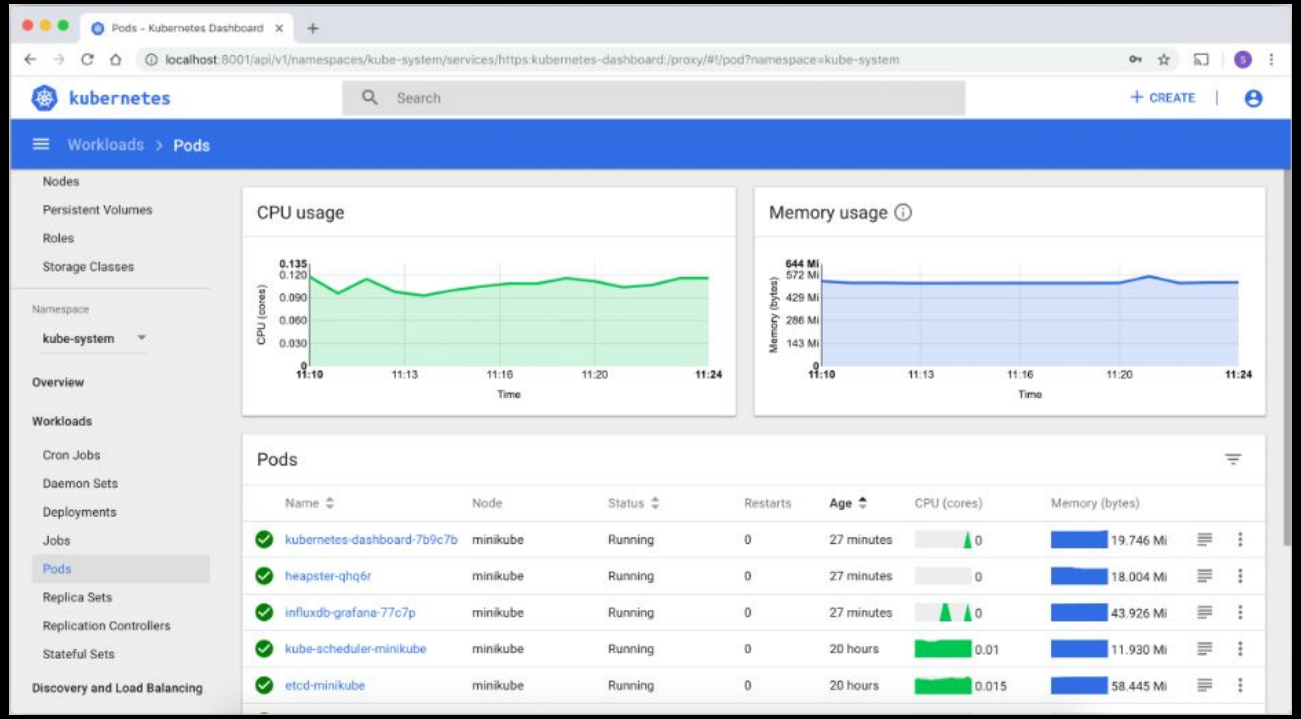
Kubernetes Dashboard Demo



https://kubernetes.io/docs/tasks/access-application-cluster/web-ui-dashboard/

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Monitoring using Prometheus

- Monitor Kubernetes cluster
- Query time series data to generate graphs, tables
- Create alerts
- Open source

Prometheus

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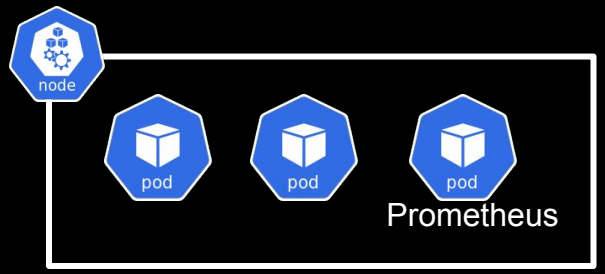
Where Does Prometheus Live?

```
kubectl get all -n prometheus
```

```
NAME                                                    READY
pod/prometheus-alertmanager-77cfdf85db-s9p48            2/2
pod/prometheus-kube-state-metrics-74d5c694c7-vqtjd      1/1
pod/prometheus-node-exporter-6dhpw                      1/1
pod/prometheus-node-exporter-nrfkn                      1/1
pod/prometheus-node-exporter-rtrm8                      1/1
pod/prometheus-pushgateway-d5fdc4f5b-dbmrg              1/1
pod/prometheus-server-6d665b876-dsmh9                   2/2
```



Prometheus

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Prometheus Deep Dive

Prometheus

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Prometheus Demo

Prometheus

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Graphs using Grafana

- Visualize metrics
- Works out of the box with Prometheus
- Create alerts
- Open source

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Grafana Demo

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EKS ADVANCED CONCEPTS

Prometheus

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Quiz: What Resources Created?

nginx-deployment.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: test
spec:
  replicas: 2
  selector:
    matchLabels:
      environment: test
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.12
        name: nginx
```

Deployment

Replicaset

Pods

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Container Scaling

- Quick Look into EC2 Scaling
- Container Scaling
- Understand Pod Limits and Requests
- Horizontal Pod Autoscaler
- Understand Manifest File
- HPA Demo

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Horizontal Pod Autoscaler

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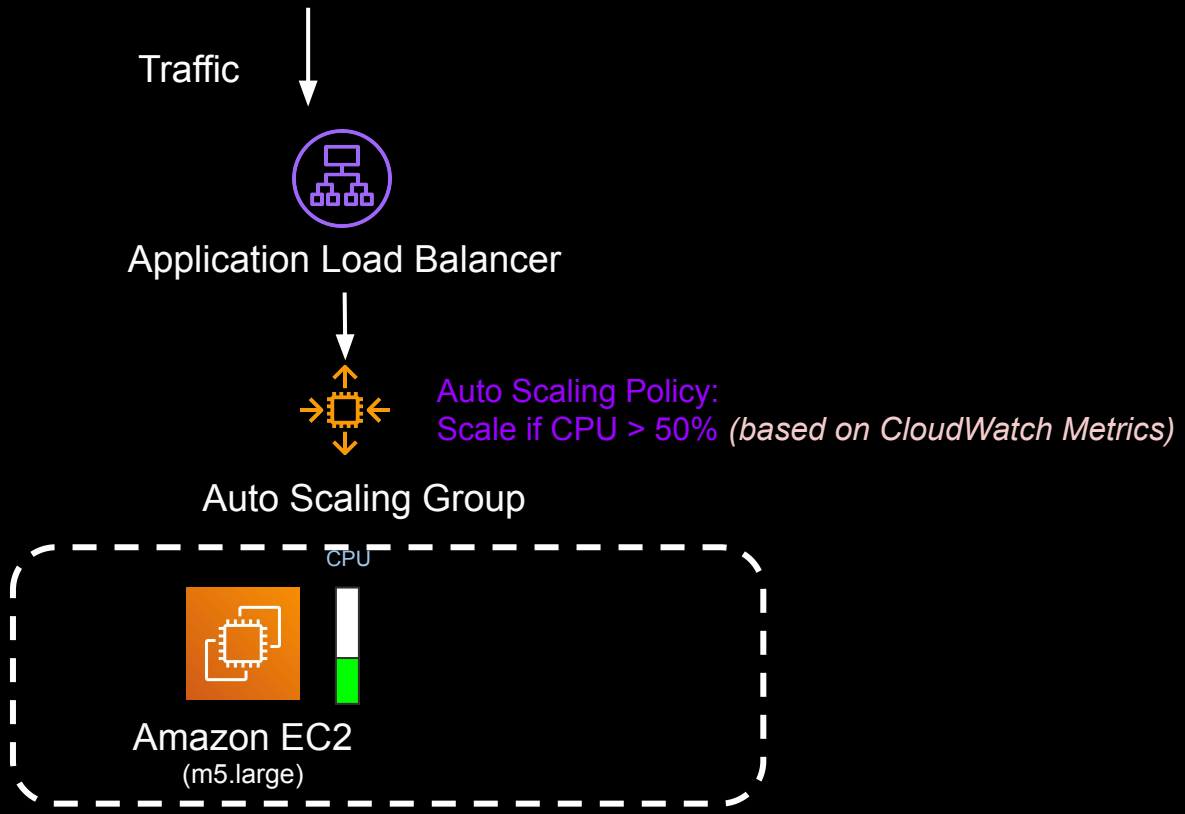
Going Back to EC2 Scaling



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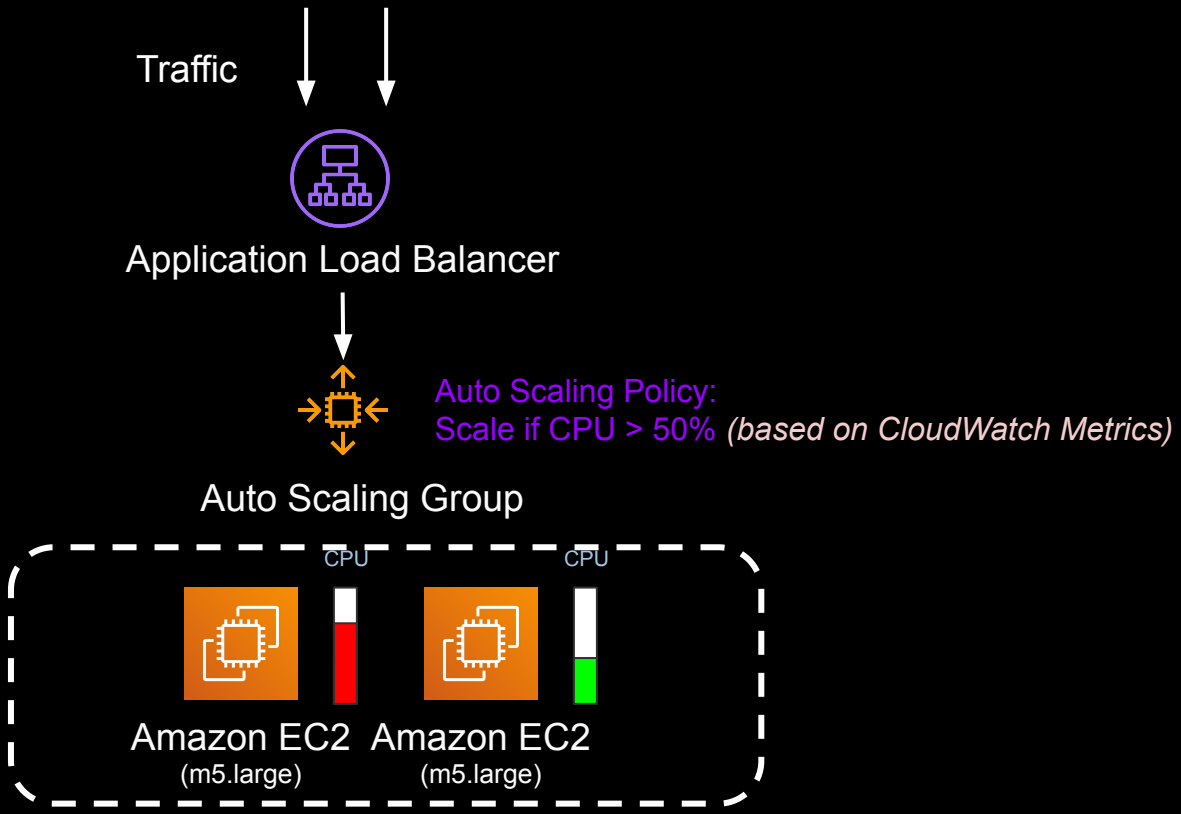
Going Back to EC2 Scaling



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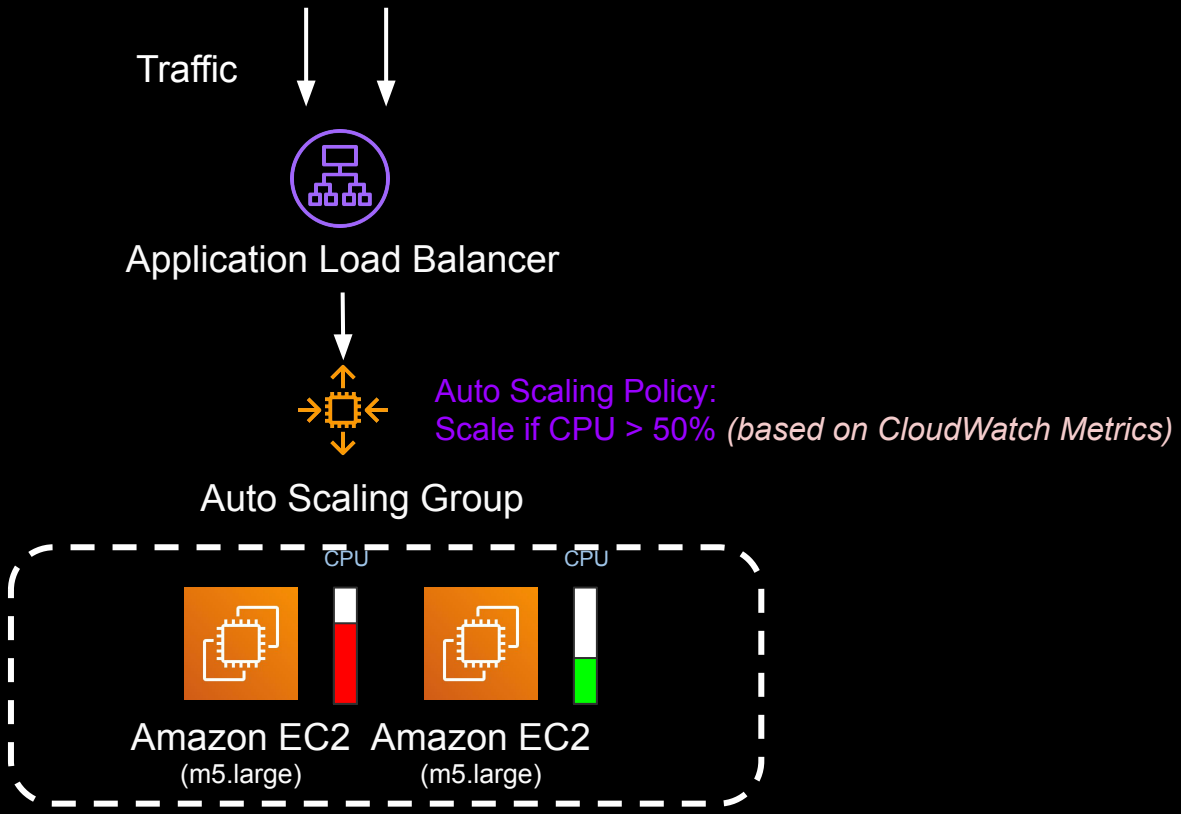
Going Back to EC2 Scaling



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EKS Container Scaling

Amazon EC2
(m5.large)

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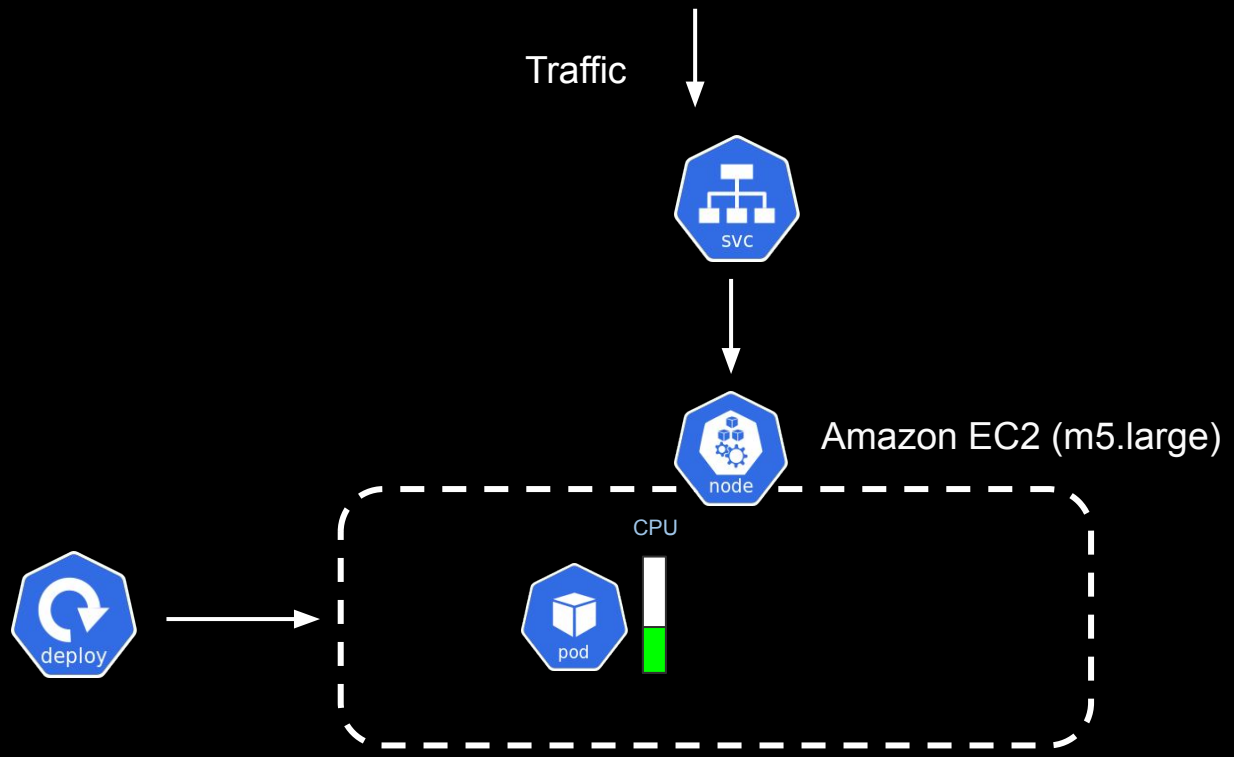
Horizontal Pod Autoscaler (HPA)



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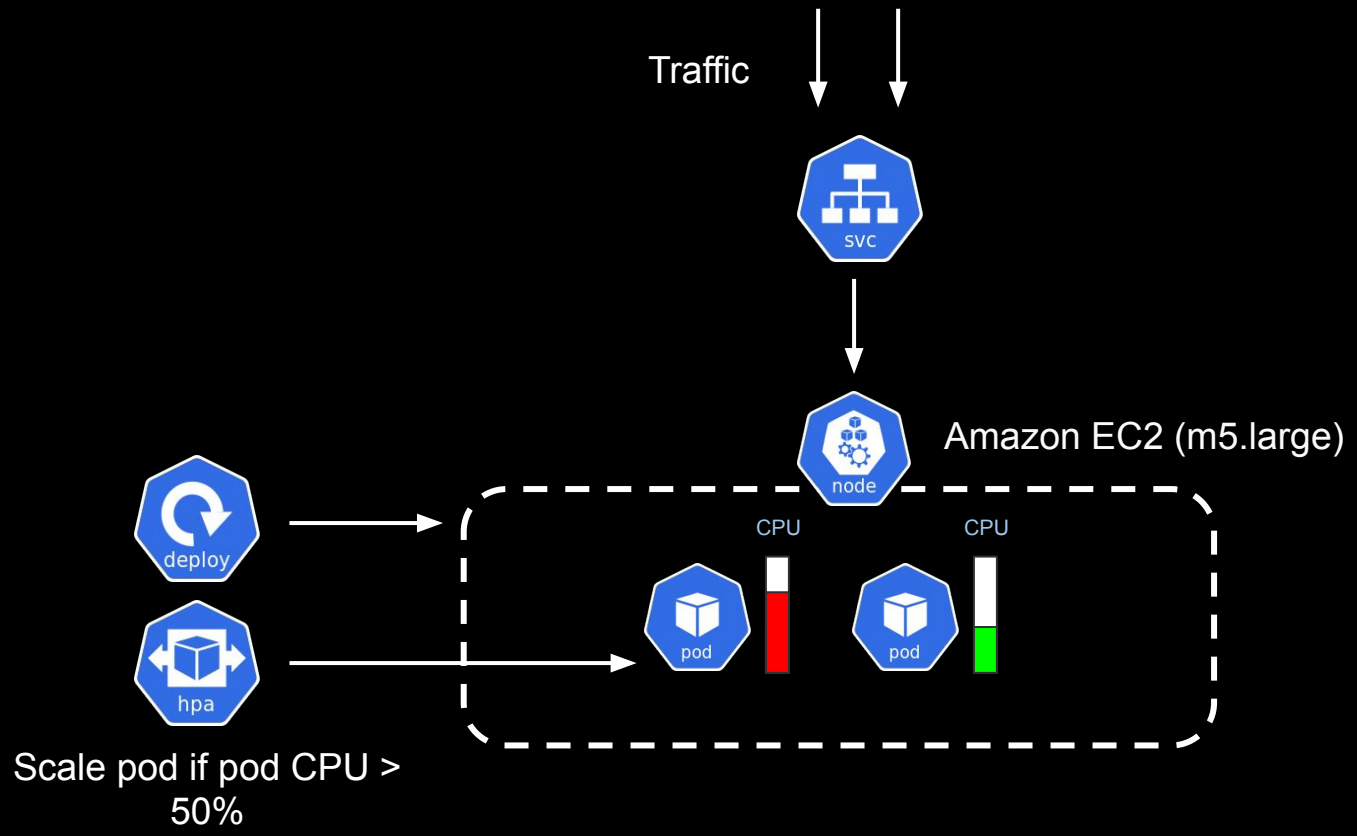
Horizontal Pod Autoscaler (HPA)



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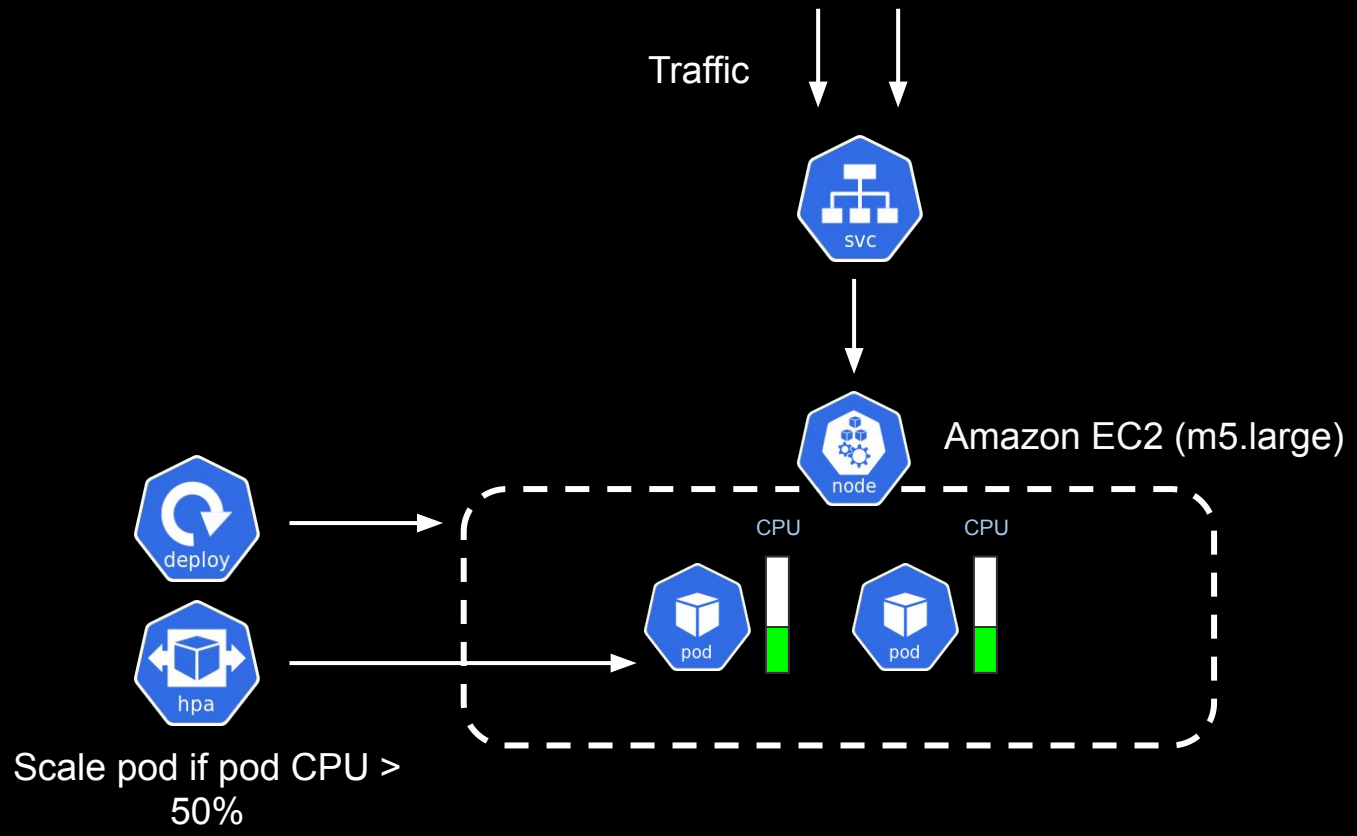
Horizontal Pod Autoscaler (HPA)



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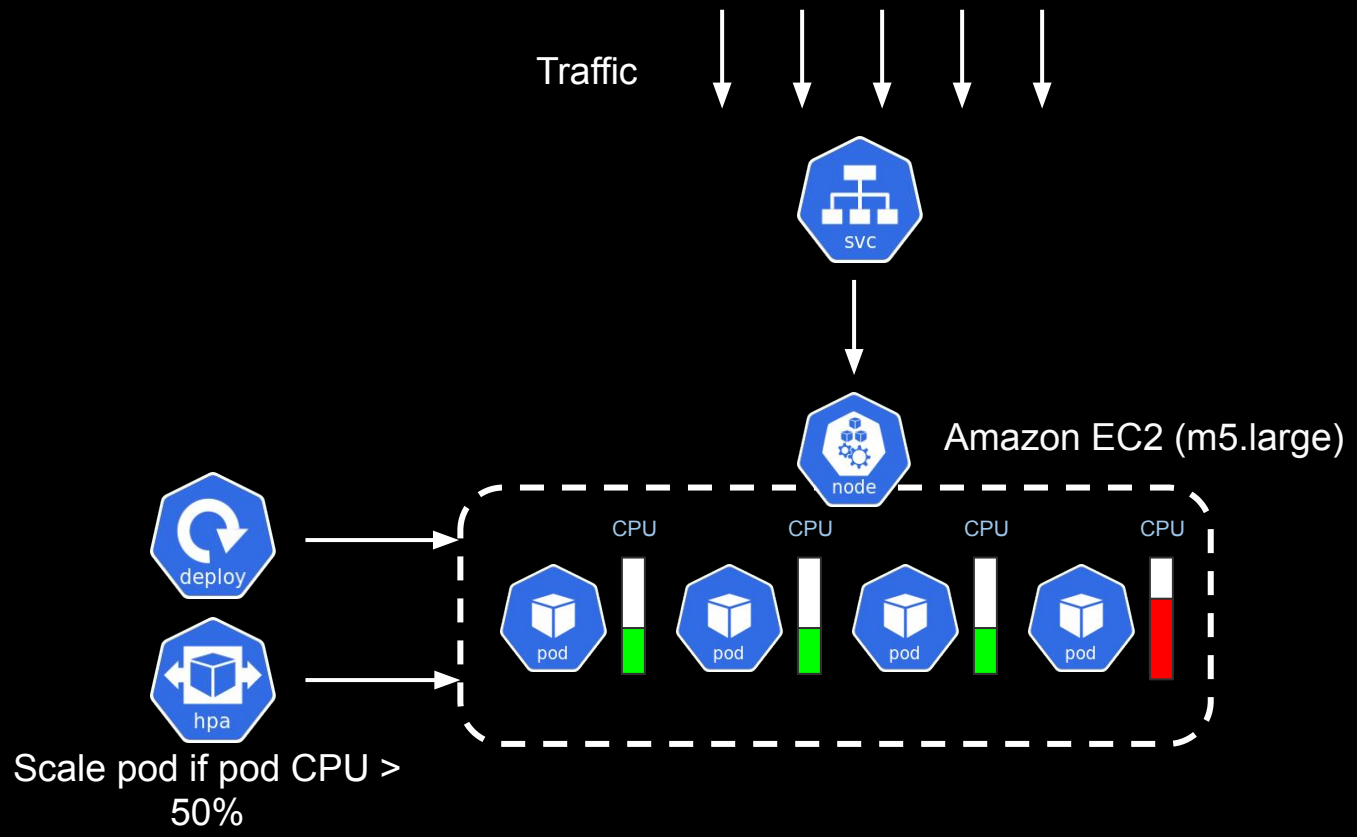
Horizontal Pod Autoscaler (HPA)



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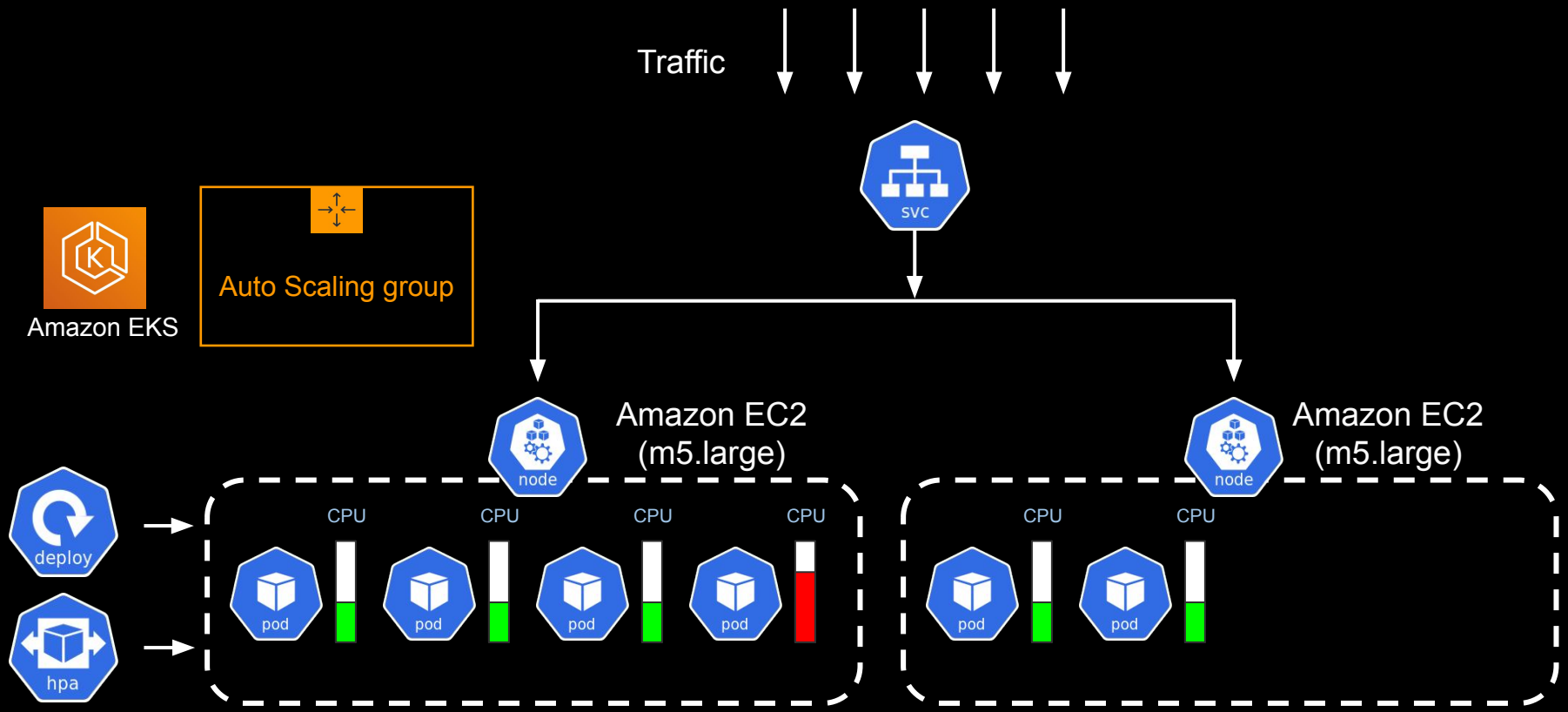
EKS Cluster Autoscaler



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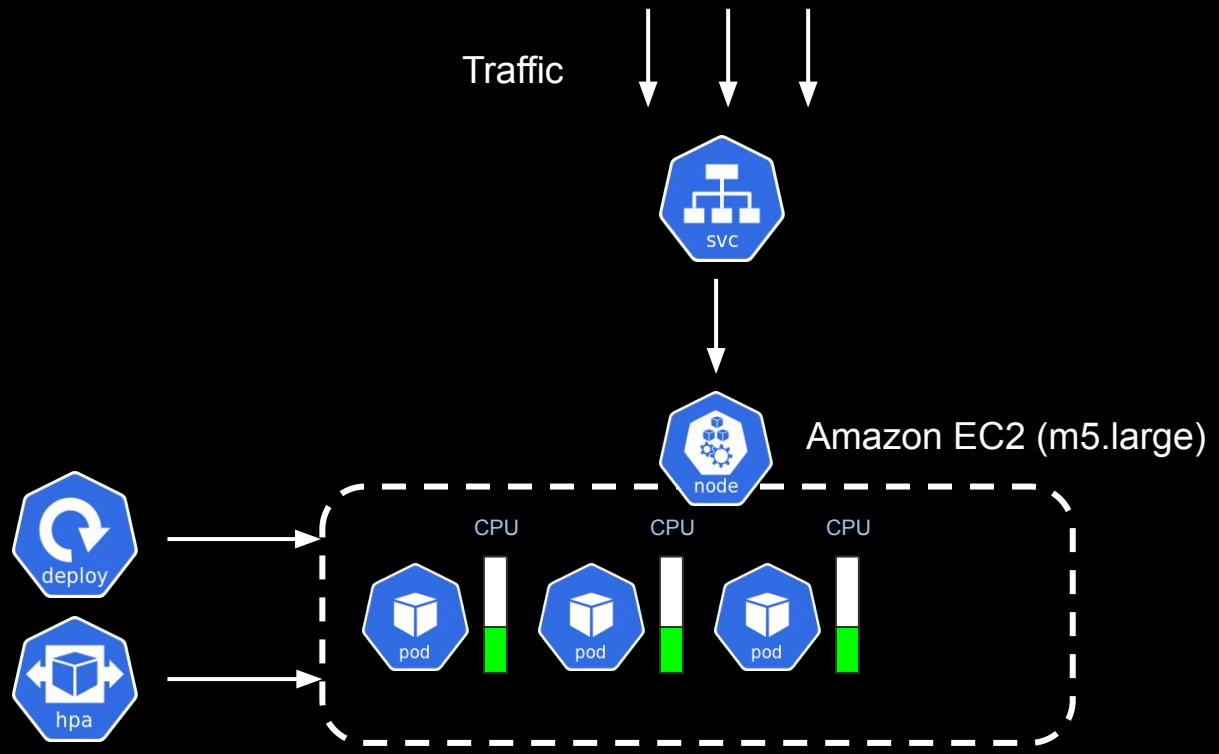
Horizontal Pod Autoscaler (HPA)



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Pod Request And Limit

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```

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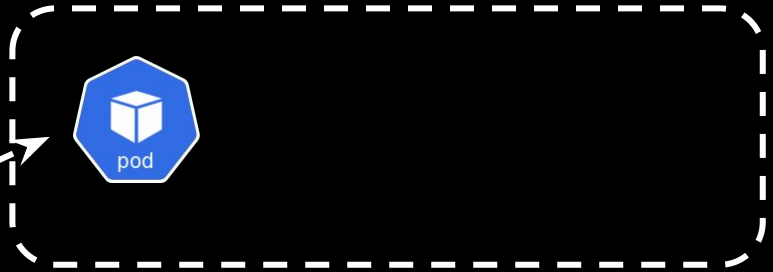
Pod Request And Limit

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```

Amazon EC2
(m5.large)



Instance Size	vCPU	Memory (GiB)
m5.large	2	8

1 vCPU = 1000m (milicore)

One pod requesting CPU of 500m (Half of 1 vCPU)

One pod CPU limit 1000m (1 vCPU)

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Pod Request And Limit

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```

=

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 0.5
          limits:
            cpu: 1
```

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Pod Request And Limit

hpa-cpu-and-memory-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
            memory: 256Mi
          limits:
            cpu: 1000m
            memory: 512Mi
```

Amazon EC2
(m5.large)

Instance Size	vCPU	Memory (GiB)
m5.large	2	8

1 vCPU = 1000m (milicore)

One pod requesting CPU of 500m (Half of 1 vCPU) and 256 MiB of Memory

One pod CPU limit 1000m (1 vCPU) and 512 MiB of Memory

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Pod Request And Limit + HPA

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```

Create Replica of Pod
If pod CPU > 50% of request CPU
(If pod CPU exceeds 250m)

```yaml
apiVersion: autoscaling/v1
kind: HorizontalPodAutoscaler
metadata:
  name: php-apache
  namespace: default
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: php-apache
  minReplicas: 1
  maxReplicas: 10
  targetCPUUtilizationPercentage: 50
```

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K8s HPA YAML + DEMO

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 1
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```

```yaml
apiVersion: autoscaling/v1
kind: HorizontalPodAutoscaler
metadata:
  name: php-apache
  namespace: default
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: php-apache
  minReplicas: 1
  maxReplicas: 10
  targetCPUUtilizationPercentage: 50
```

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Pod Request And Limit + HPA

hpa-php-apache.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 10
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```

Create Replica of Pod
If pod CPU > 50% of request CPU
(If pod CPU exceeds 250m)

```yaml
apiVersion: autoscaling/v1
kind: HorizontalPodAutoscaler
metadata:
  name: php-apache
  namespace: default
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: php-apache
  minReplicas: 1
  maxReplicas: 10
  targetCPUUtilizationPercentage: 50
```

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HPA Demo on EKS

- Install Metrics Server
- Deploy Deployment, Service, HPA
- Increase Load
- Pod scale!

  Note - Need node larger than t3.micro

https://kubernetes.io/docs/tasks/run-application/horizontal-pod-autoscale-walkthrough/

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Cluster Autoscaler

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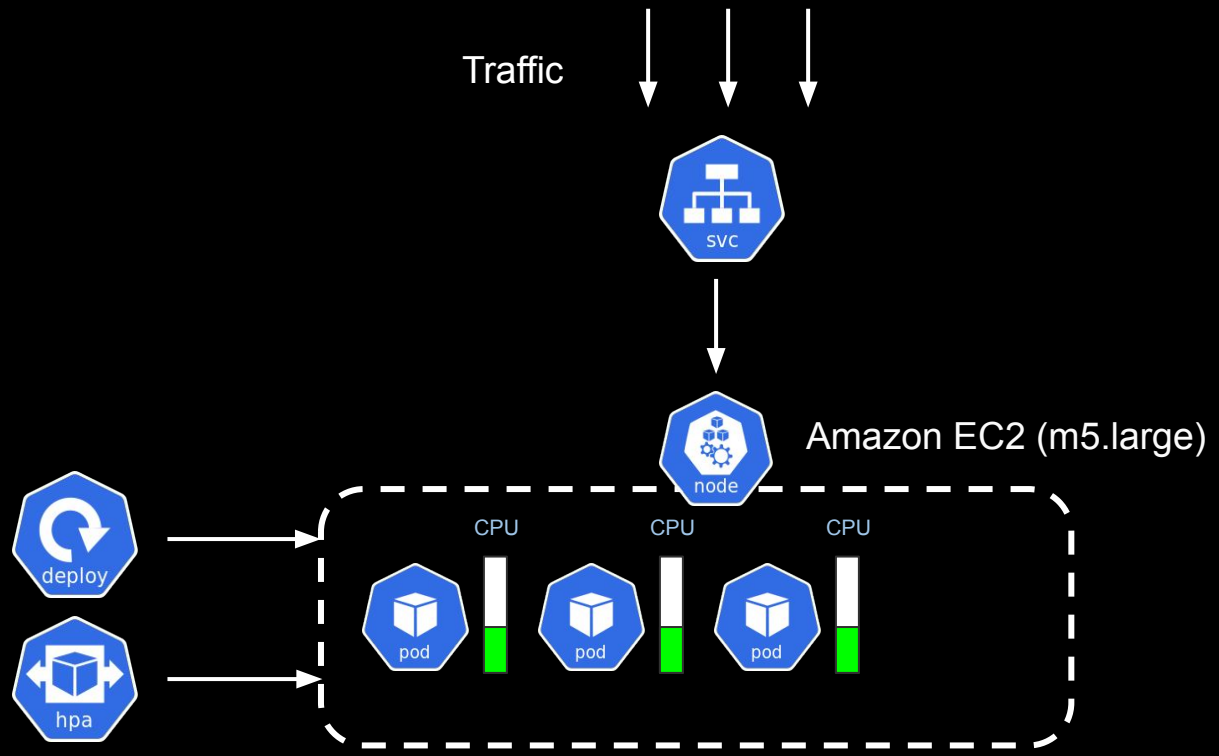
Horizontal Pod Autoscaler (HPA)



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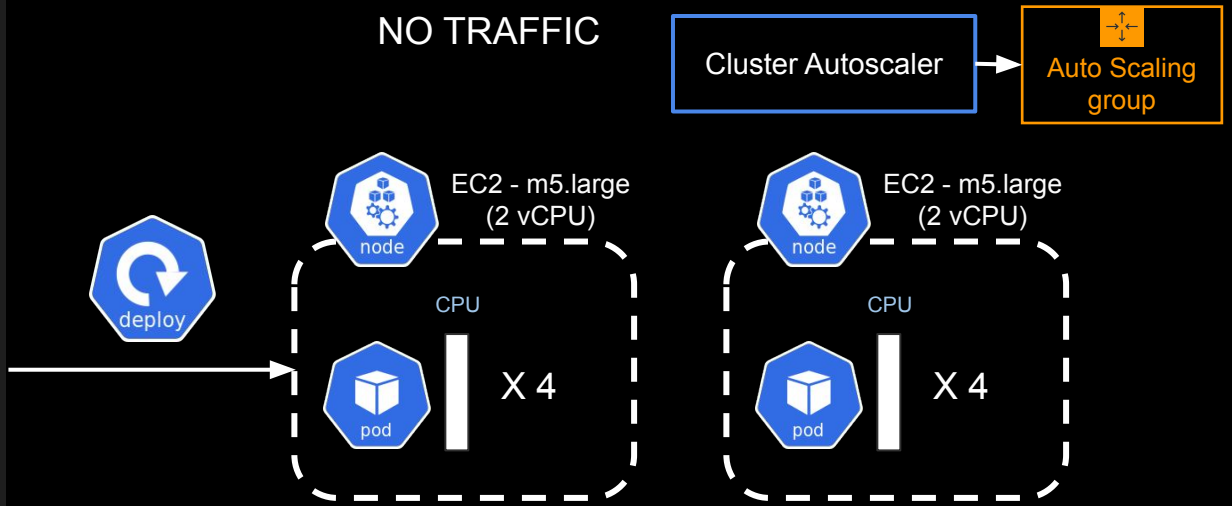
Cluster Autoscaler

cluster-autoscaler-deployment-1.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 20
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```



Requesting:
500m X 20 Replicas
~ 10,000m
~(10,000/1,000) vCPU
=10 vCPU

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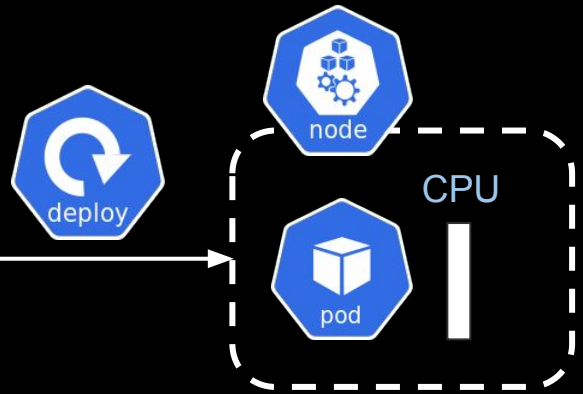
CLUSTER AUTOSCALER

cluster-autoscaler-deployment-1.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 20
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example
        ports:
        - containerPort: 80
        resources:
          requests:
            cpu: 500m
          limits:
            cpu: 1000m
```



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EKS Cluster Autoscaler Demo

- Cluster Autoscaler has two components
  - Open Source Cluster Autoscaler
  - EKS Implementation (ASG, IAM etc.)
- Deploy App
- Nodes scale!

https://docs.aws.amazon.com/eks/latest/userguide/cluster-autoscaler.html

+

Extra Steps Required

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Vertical Pod Autoscaler

Do NOT use this in Production!

- Restarts PODs

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Vertical Pod Autoscaler

- Vertical Vs Horizontal Scaling
  - Vertical - Going up in Size
  - Horizontal - Create more of same size
- Pods will go up or down in size (after restart!)
- Used in dev to determine optimal CPU and memory for the Pod
  - VPA recommends pod request, limit
  - Use the numbers for request, limits, HPA
  - VPA should not be used with HPA
- Accept VPA recommendation with grain of salt!

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Vertical Pod Autoscaler Demo

- Practical and Useful Application of VPA

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Vertical Pod Autoscaler Demo

- Run VPA standalone
- Why do we need a tool?
- Demo Goldilocks

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Namespaces

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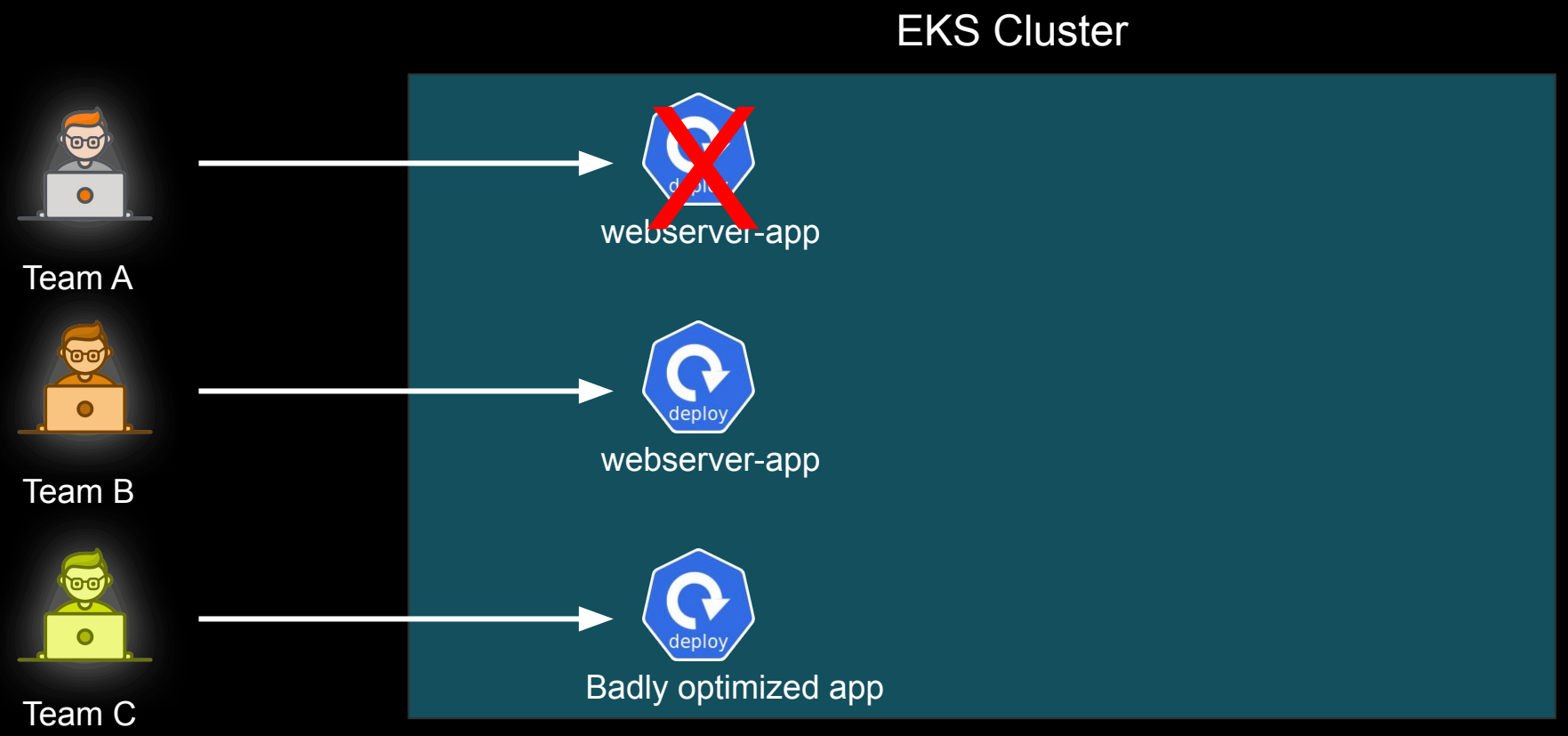
Namespaces



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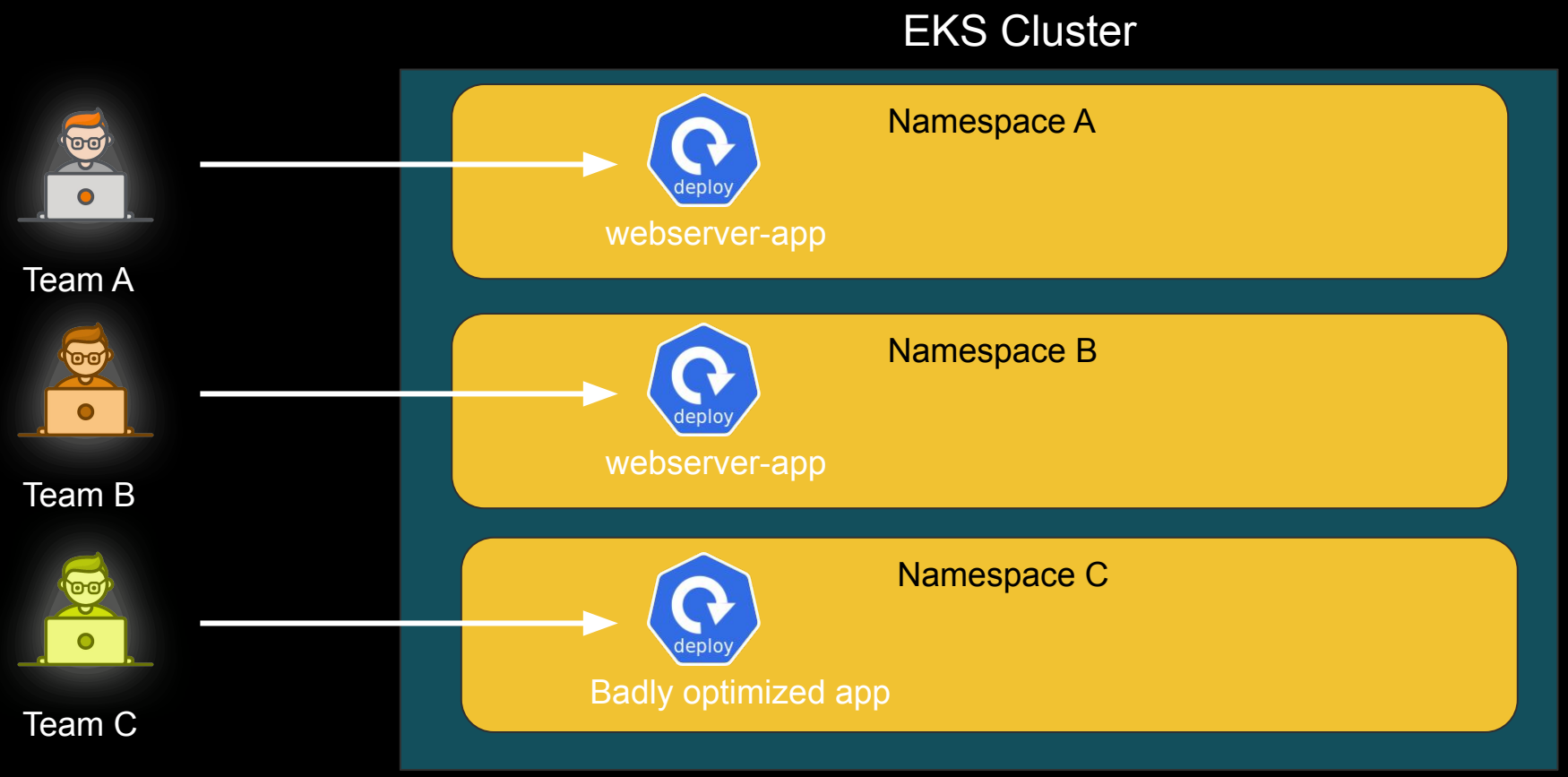
Namespaces



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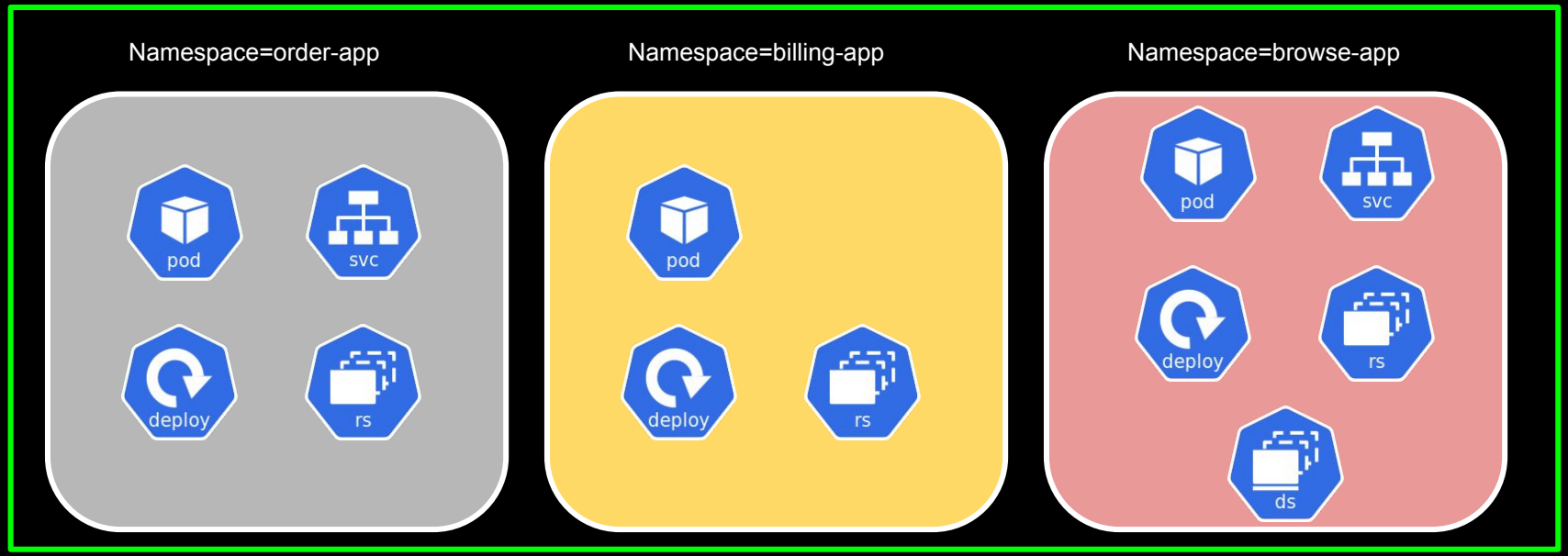
EKS Cluster
Worker Nodes



- Each namespace is a virtual cluster within cluster
- Used for segregate different applications within same cluster
- Can apply separate quota, policies to each namespace
- Namespaces are NOT segregated by nodes

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Namespaces

- Each K8s cluster comes with three namespaces
  - kube-public
  - kube-system
  - default (used when no namespace parameter given)
- Let’s see this in action!

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Namespaces

- Multiple virtual cluster boundary within one physical cluster
- Provides scope for naming
- Divide cluster resources to namespaces
- Useful for namespace specific accesses

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EKS Ingress

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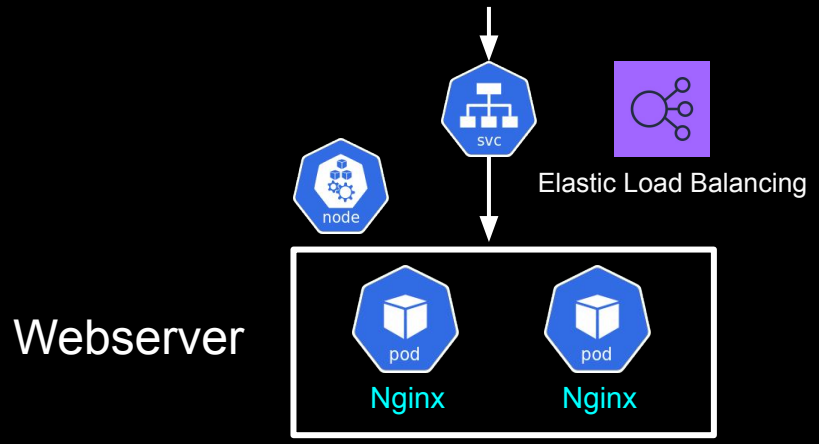
Ingress - What and Why?



loadbalancer-service.yaml

```yaml
apiVersion: v1
kind: Service
metadata:
  name: lb-service
  labels:
    app: lb-service
spec:
  type: LoadBalancer
  ports:
  - port: 80
  selector:
    app: frontend
```

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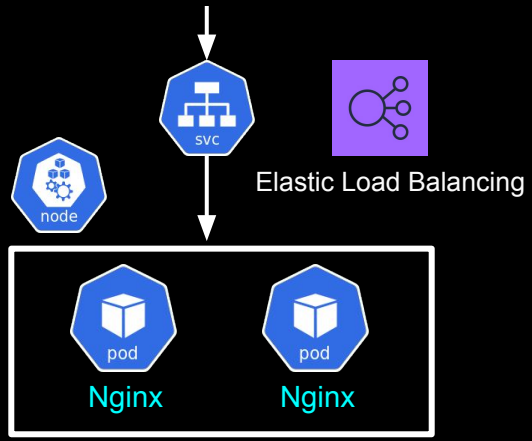
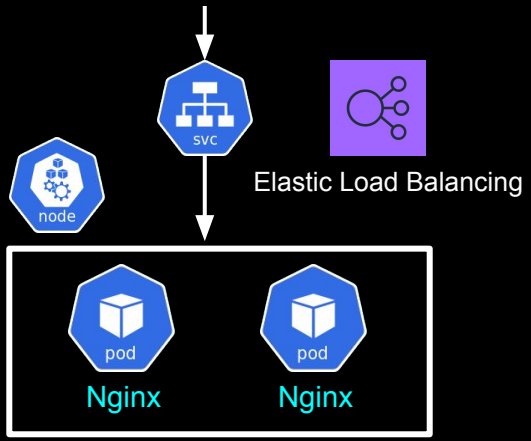
Ingress - What and Why?

I want to run Bat Cave Systems using Kubernetes

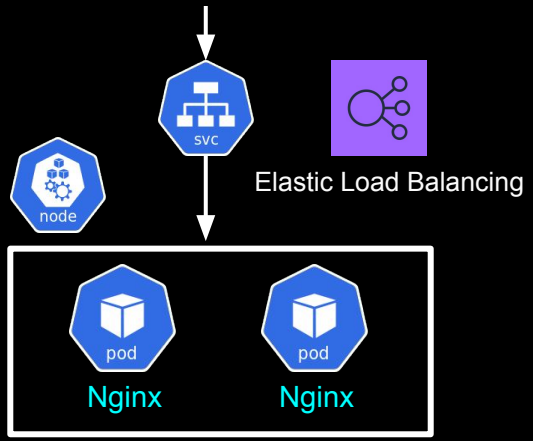
http://track-joker.com



http://monitor-batcave.com



http://order-new-batsuit.com



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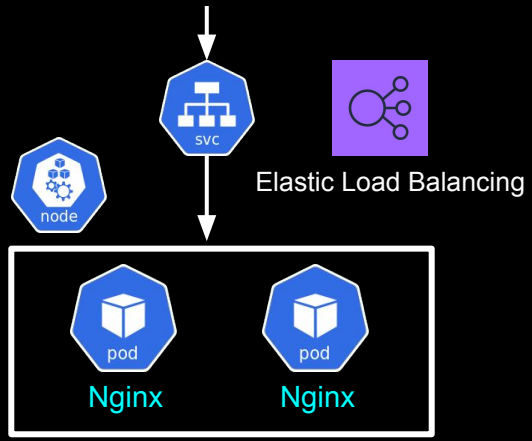
Ingress - What and Why?

- Costly to maintain one Load Balancer for each service
- No URL based routing
- Maintenance overhead of managing all separate services

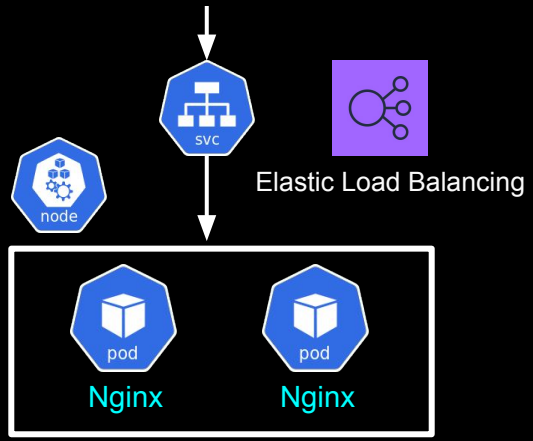
"Alfred HELP ME"

https://batcave.com/track-joker
https://batcave.com/monitor-batcave
https://batcave.com/order-new-batsuit

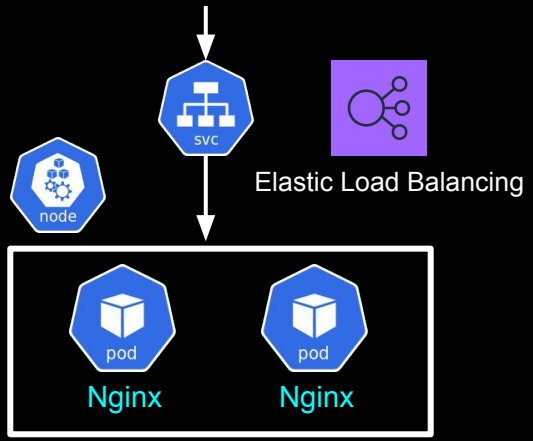
http://track-joker.com



http://monitor-batcave.com



http://order-new-batsuit.com



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Ingress - What and Why?

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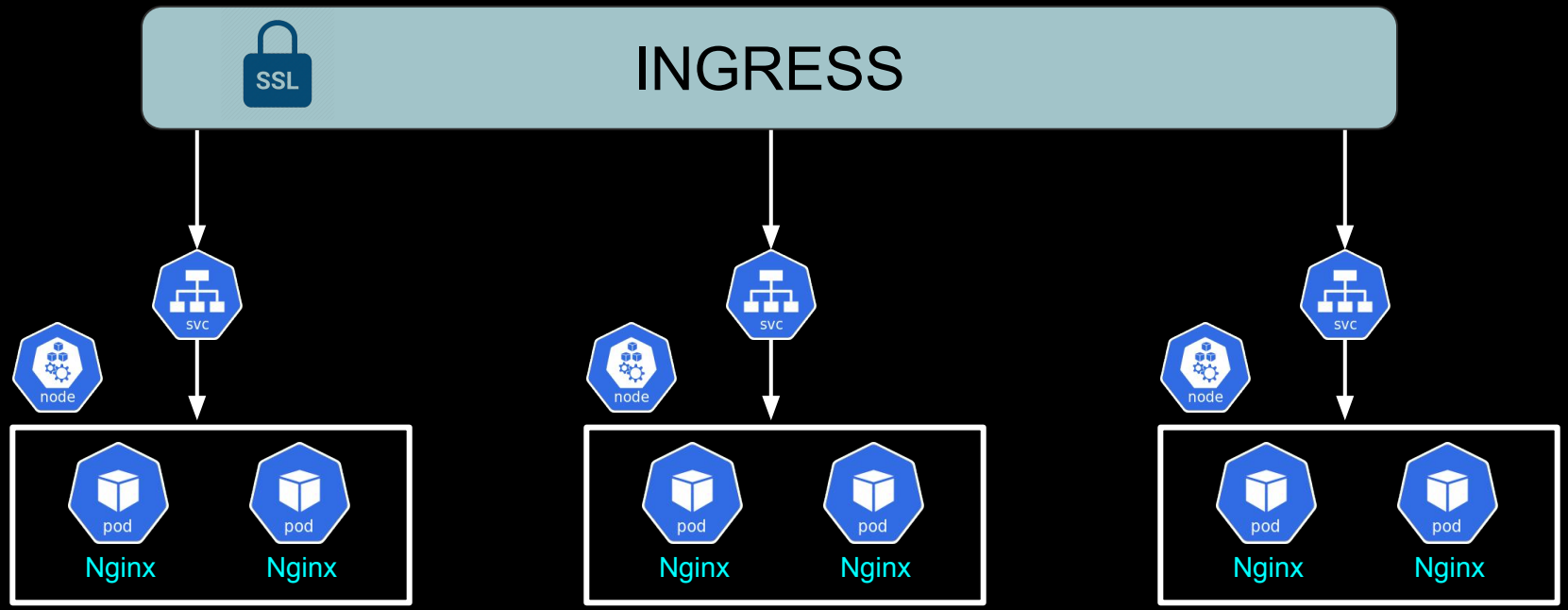
Ingress - What and Why?

https://batcave.com/track-joker
https://batcave.com/monitor-batcave
https://batcave.com/order-new-batsuit



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Ingress Controllers

alb-ingress-controller
+
AWS ALB

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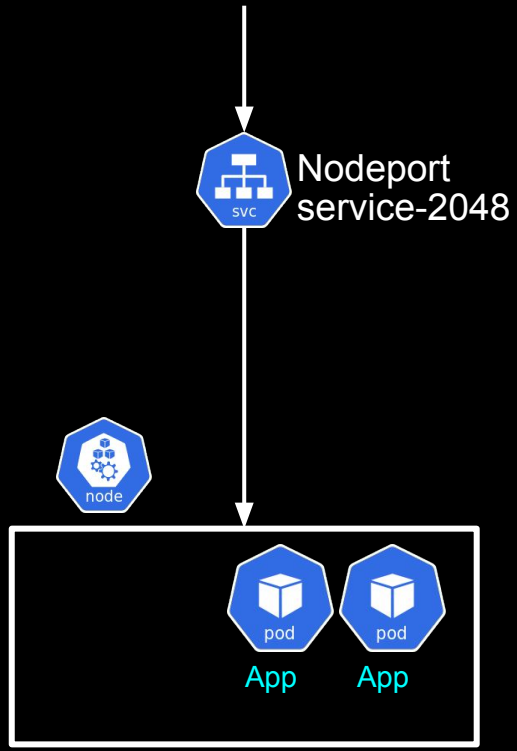
ALB Ingress




```yaml
apiVersion: v1
kind: Service
metadata:
  name: "service-2048"
  namespace: "2048-game"
spec:
  ports:
    - port: 80
      targetPort: 80
      protocol: TCP
  type: NodePort
  selector:
    app: "2048"
```

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: "2048-deployment"
  namespace: "2048-game"
spec:
  selector:
    matchLabels:
      app: "2048"
  replicas: 5
  template:
    metadata:
      labels:
        app: "2048"
    spec:
      containers:
      - image: alexwhen/docker-2048
        imagePullPolicy: Always
        name: "2048"
        ports:
        - containerPort: 80
```

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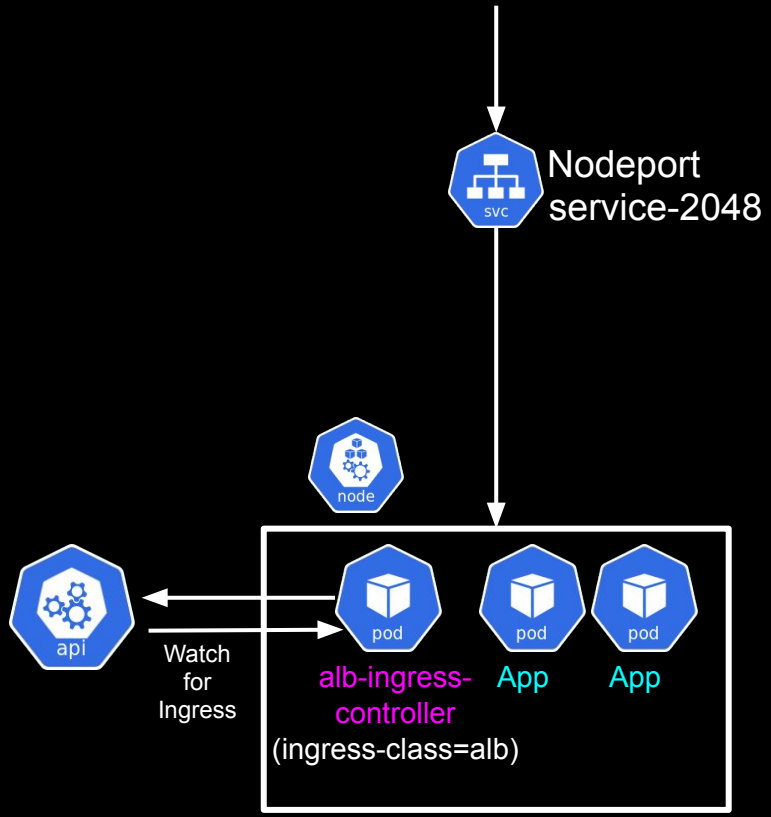
ALB Ingress Controller




```yaml
# Application Load Balancer (ALB) Ingress Controller Deployment Manifest.
# This manifest details sensible defaults for deploying an ALB Ingress Controller.
# GitHub: https://github.com/kubernetes-sigs/aws-alb-ingress-controller
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
  # Namespace the ALB Ingress Controller should run in. Does not impact which
  # namespaces it's able to resolve ingress resource for. For limiting ingress
  # namespace scope, see --watch-namespace.
  namespace: kube-system
spec:
  selector:
    matchLabels:
      app.kubernetes.io/name: alb-ingress-controller
  template:
    metadata:
      labels:
        app.kubernetes.io/name: alb-ingress-controller
    spec:
      containers:
        - name: alb-ingress-controller
          args:
            # Limit the namespace where this ALB Ingress Controller deployment will
            # resolve ingress resources. If left commented, all namespaces are used.
            # - --watch-namespace=your-k8s-namespace

            # Setting the ingress-class flag below ensures that only ingress resources with the
            # annotation kubernetes.io/ingress.class: "alb" are respected by the controller. You may
            # choose any class you'd like for this controller to respect.
            - --ingress-class=alb
```

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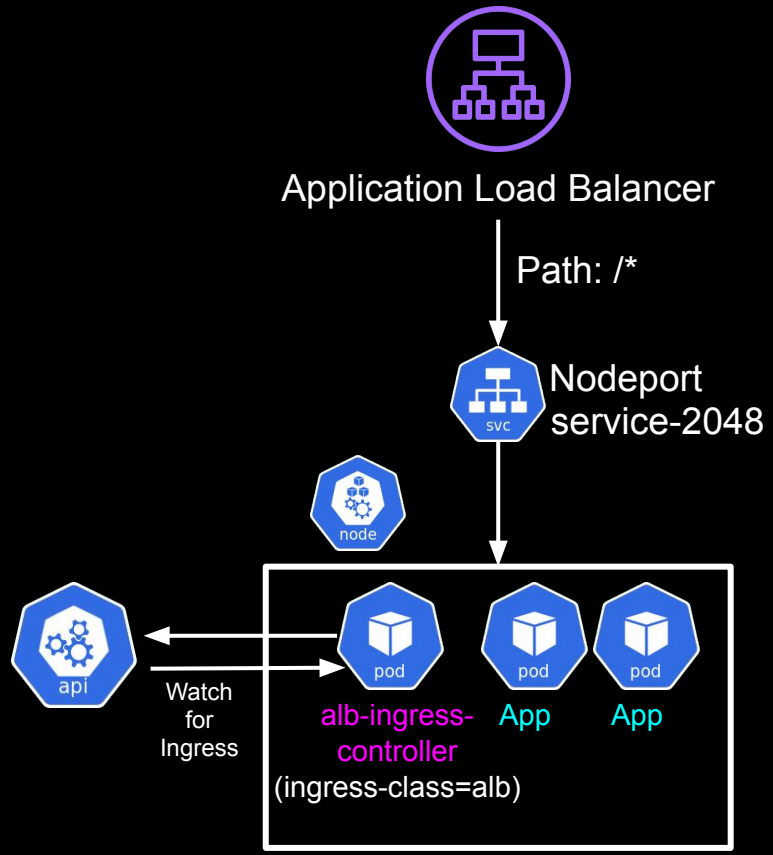
Ingress resource




```yaml
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: "2048-ingress"
  namespace: "2048-game"
  annotations:
    kubernetes.io/ingress.class: alb
    alb.ingress.kubernetes.io/scheme: internet-facing
  labels:
    app: 2048-ingress
spec:
  rules:
    - http:
        paths:
          - path: /*
            backend:
              serviceName: "service-2048"
              servicePort: 80
```

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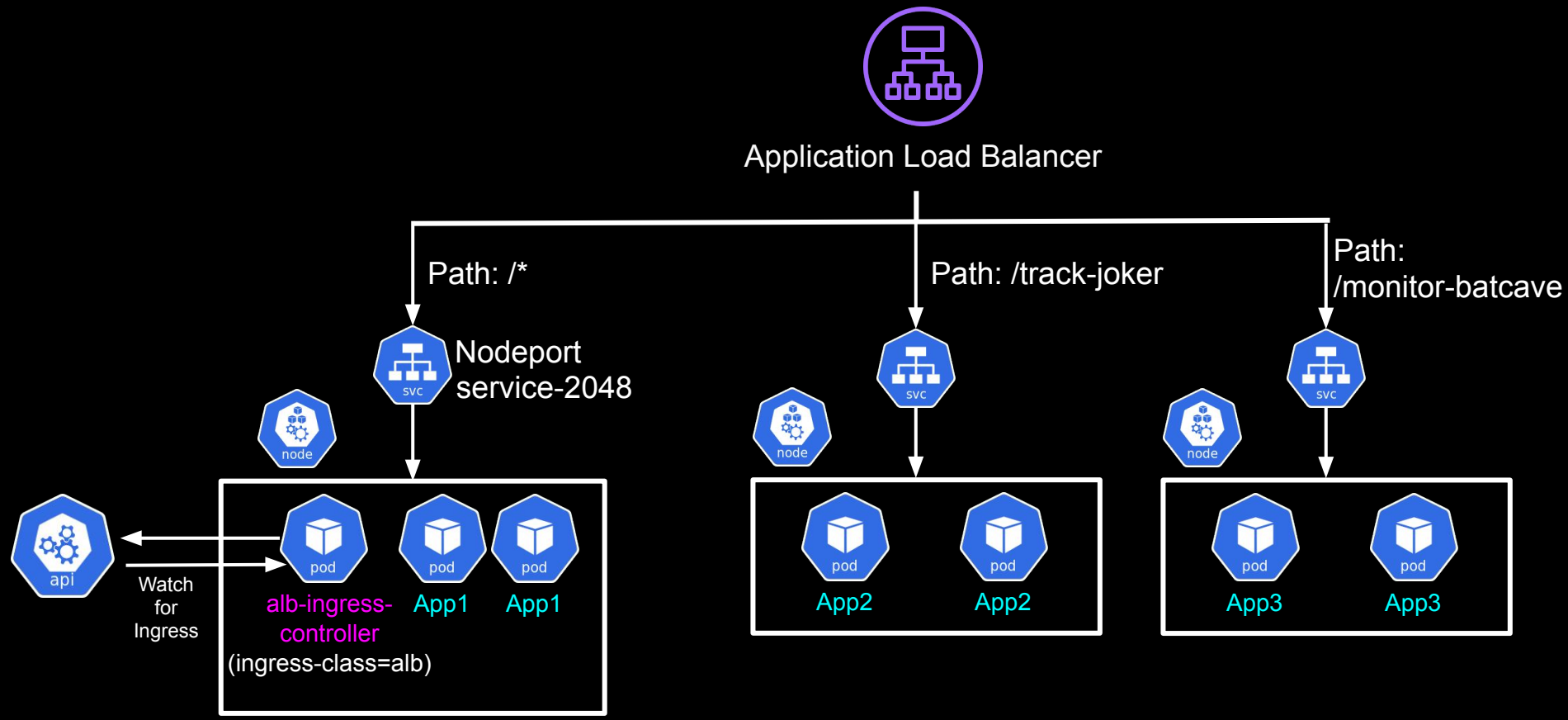
ALB Ingress



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Ingress - What and Why?

INGRESS CONTROLLER

- Monitors Ingress resources
- Creates necessary AWS resources for Ingress
  - Such as ALB for ALB Ingress Controller
- One Cluster can have more than one Ingress Controller!
  - Ingress Resource defines which Ingress Controller to use

INGRESS RESOURCE

- Selects which Ingress Controller to use
- Defines the URL Path and corresponding backend Service

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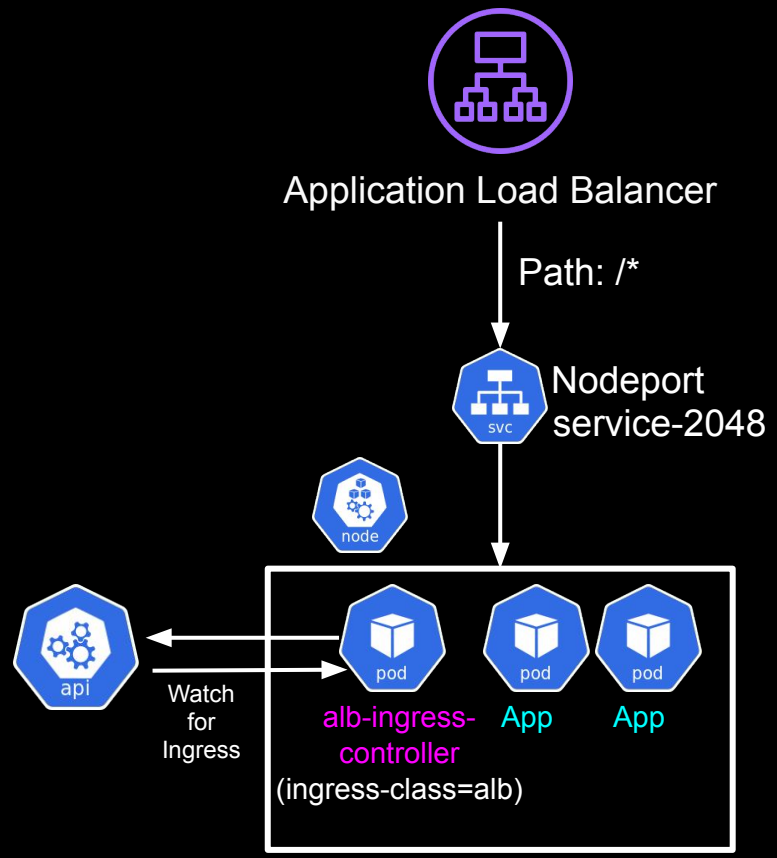
ALB Ingress



INGRESS CONTROLLER

- Creates ALB and AWS Resources
  - Directed by Ingress Resource
- Require proper IAM Policy
- Require Service Account and IAM Role for the alb-ingress-controller pod

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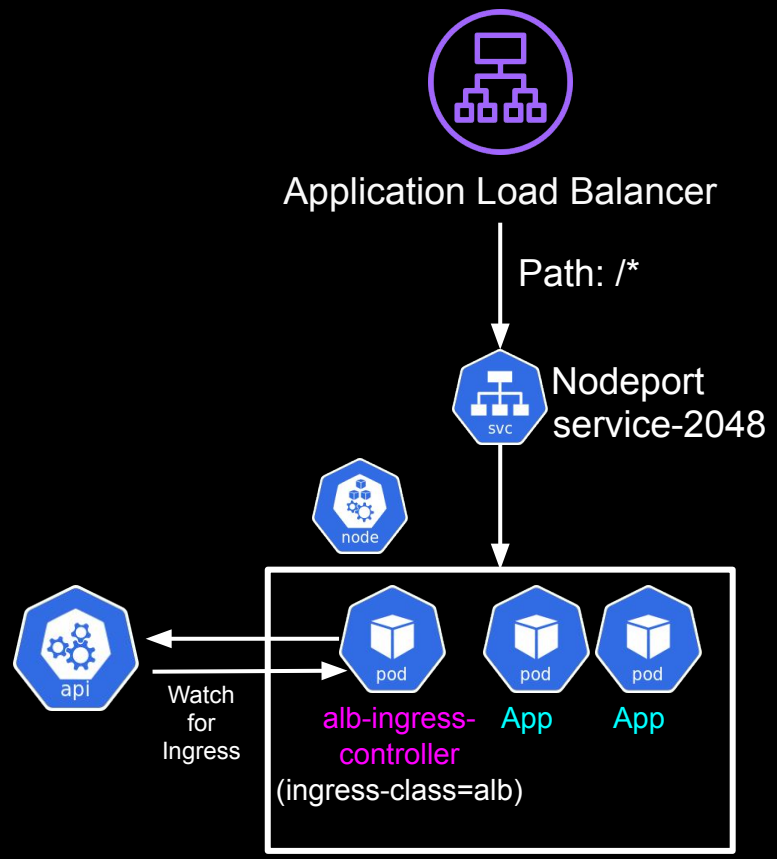
ALB Ingress



INGRESS TRAFFIC

- instance mode
  - ALB to Nodeport to pods
- ip mode
  - ALB to pods directly
  - Require secondary IP address on ENI as pode IP for networking plugin (AWS CNI plugin for kubernetes)
  - Saves one hop
  - alb-ingress-controller specific feature

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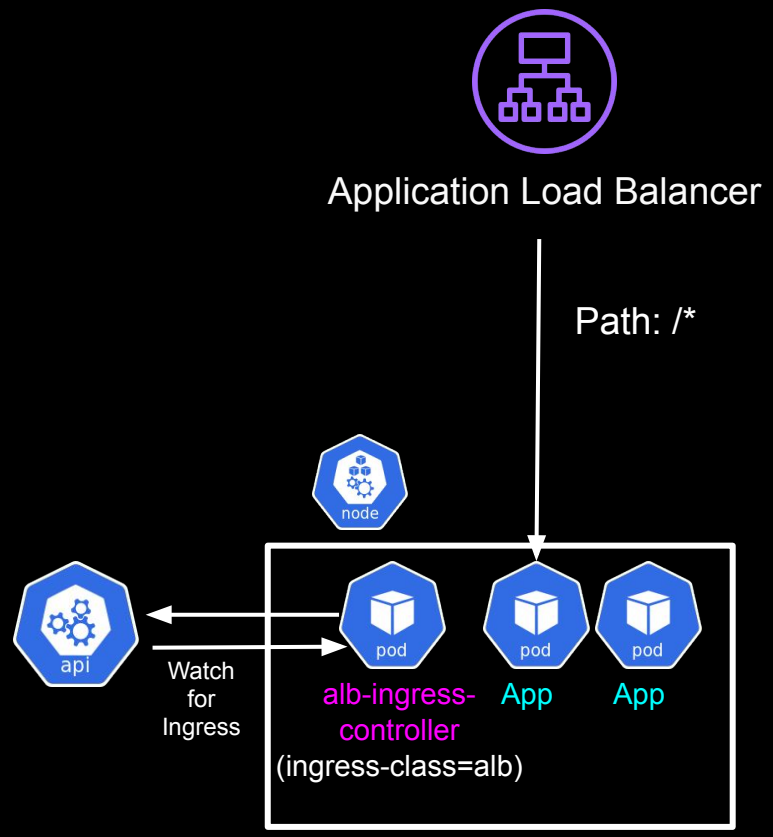
ALB Ingress



INGRESS TRAFFIC

- instance mode
  - ALB to Nodeport to pods
- ip mode
  - ALB to pods directly
  - Require secondary IP address on ENI as pode IP for networking plugin (AWS CNI plugin for kubernetes)
  - Saves one hop
  - alb-ingress-controller specific feature

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ALB Ingress Demo

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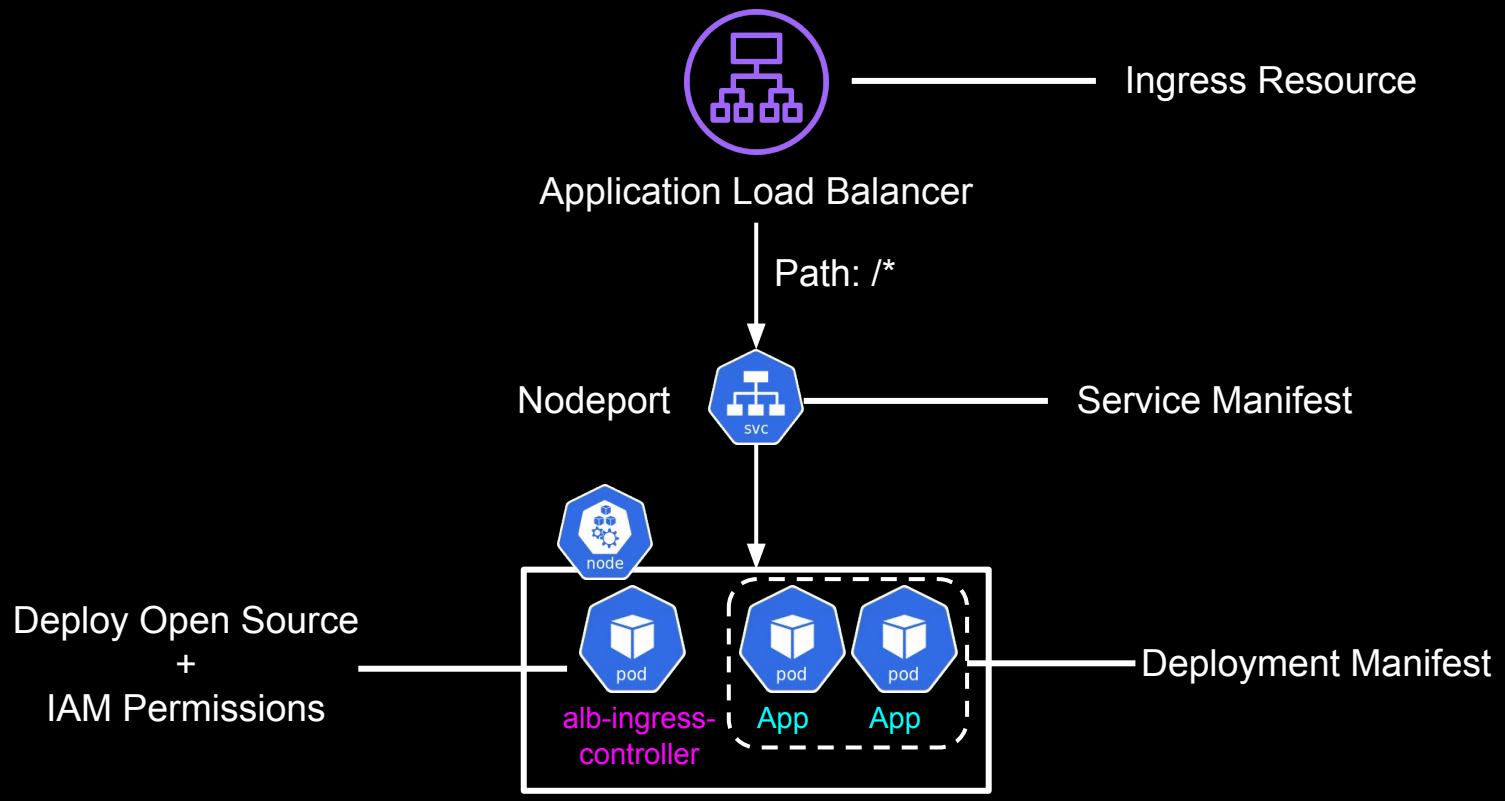
ALB Ingress Demo-1



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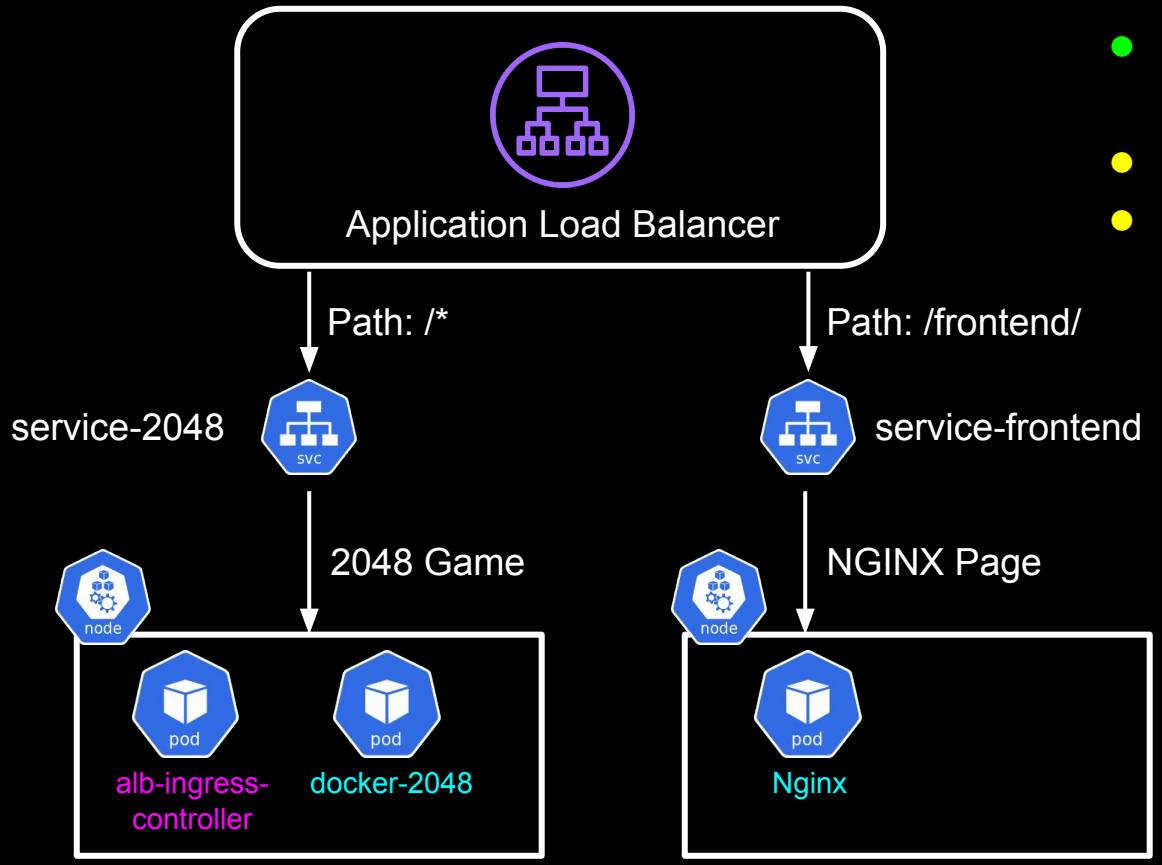
ALB Ingress Demo-2



- NOTE - Ingress path ordering matters
- Tweaking in Container!
- IP Mode - bypass one hop!

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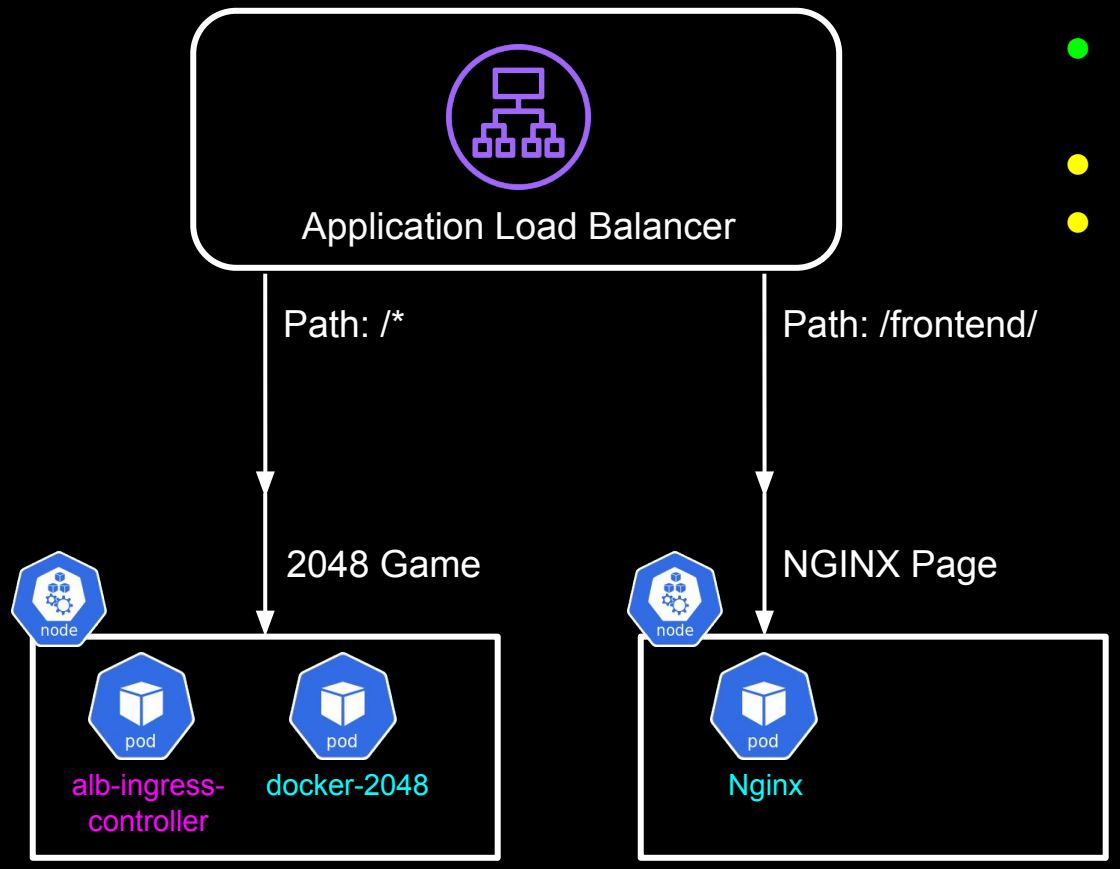
ALB Ingress Demo-2



- NOTE - Ingress path ordering matters
- Tweaking in Container!
- IP Mode - bypass one hop!

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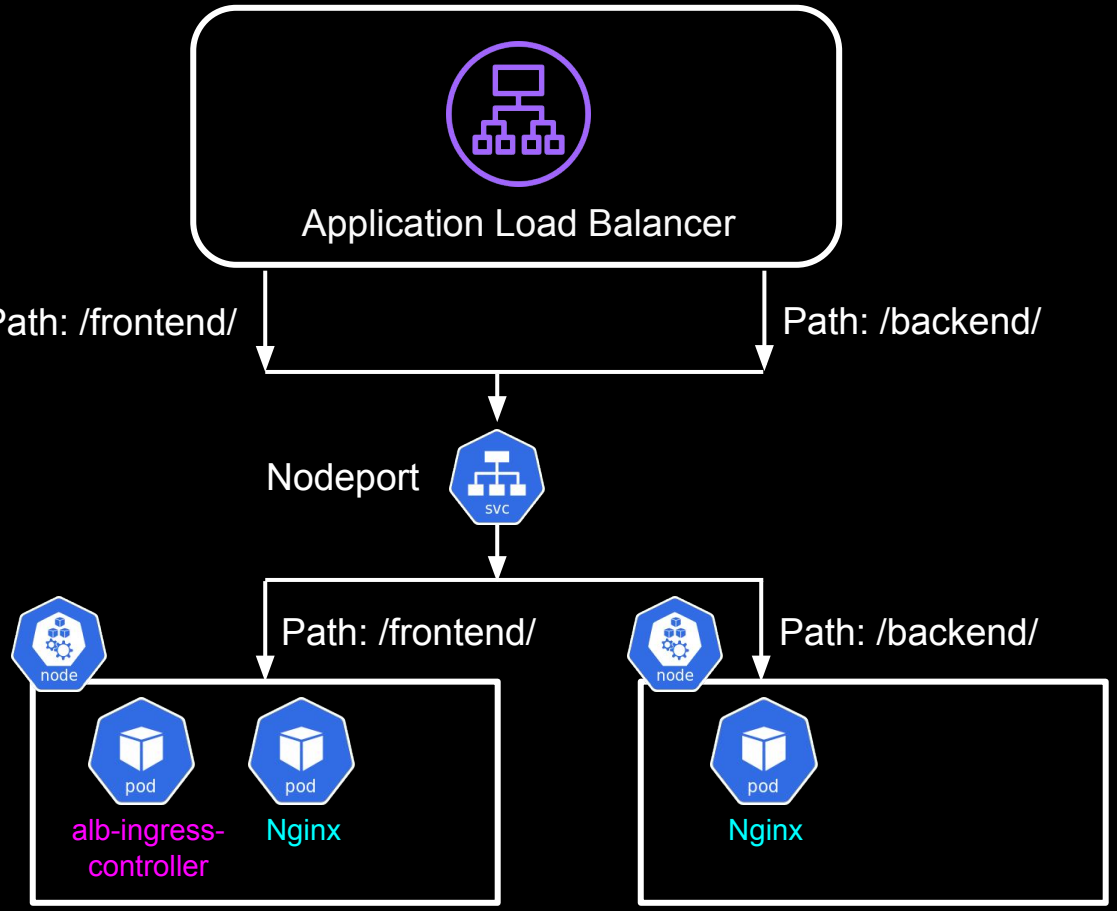
ALB Ingress Demo-3



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Basic HTML

www.example.com
www.example.com/ → /var/www/html/index.html

www.example.com/frontend → /var/www/html/frontend/index.html

www.example.com/backend → /var/www/html/backend/index.html

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Service Mesh

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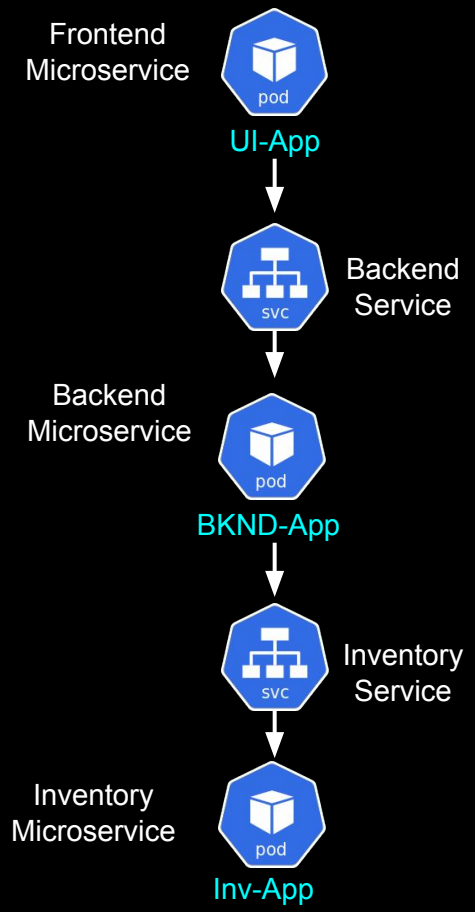
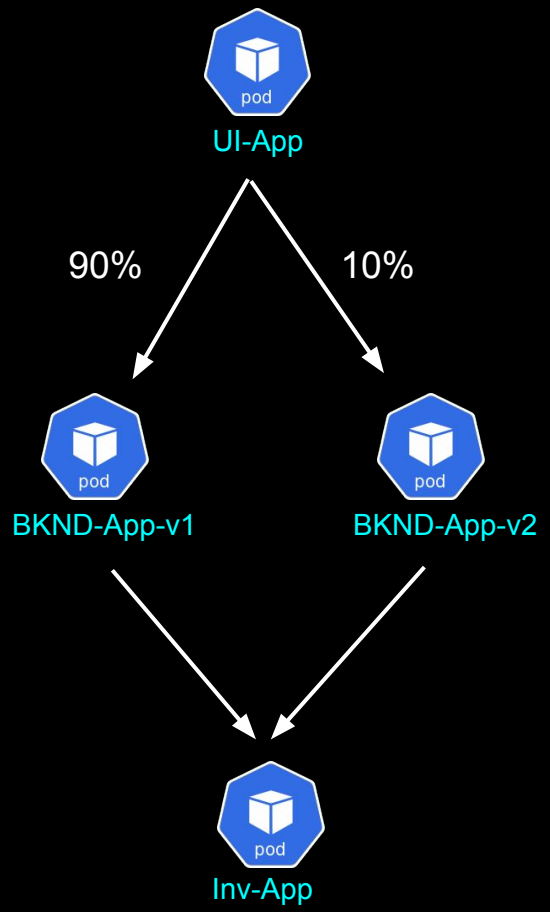
Regular K8s Application





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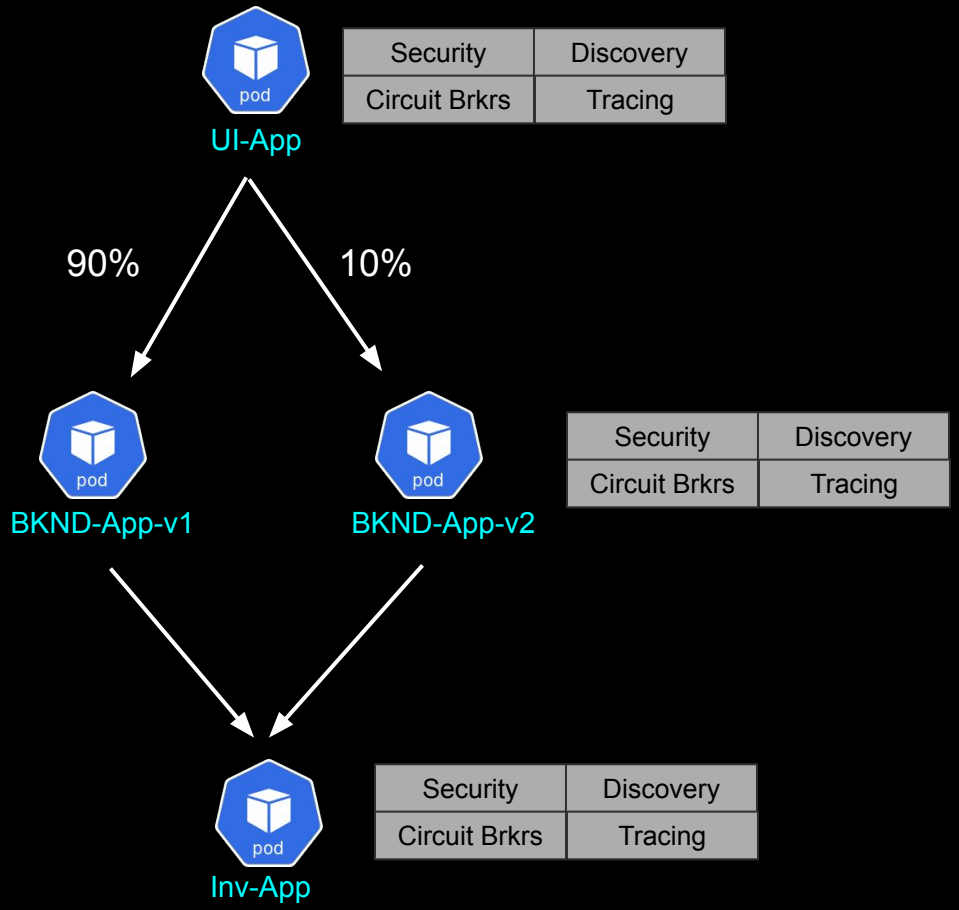
Regular K8s Application

Security	Discovery
Circuit Brkrs	Tracing



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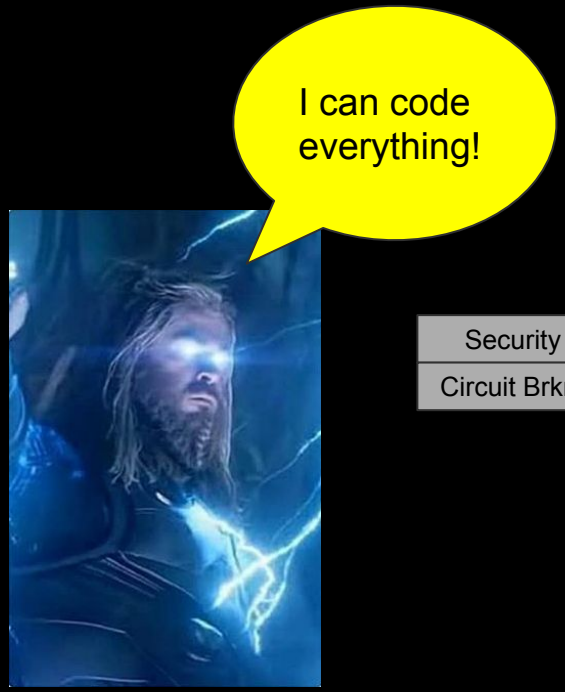
Regular K8s Application



Security	Discovery
Circuit Brkrs	Tracing

UI-App

Security	Discovery
Circuit Brkrs	Tracing

90%

10%

BKND-App-v1

BKND-App-v2

Security	Discovery
Circuit Brkrs	Tracing

Inv-App

Security	Discovery
Circuit Brkrs	Tracing

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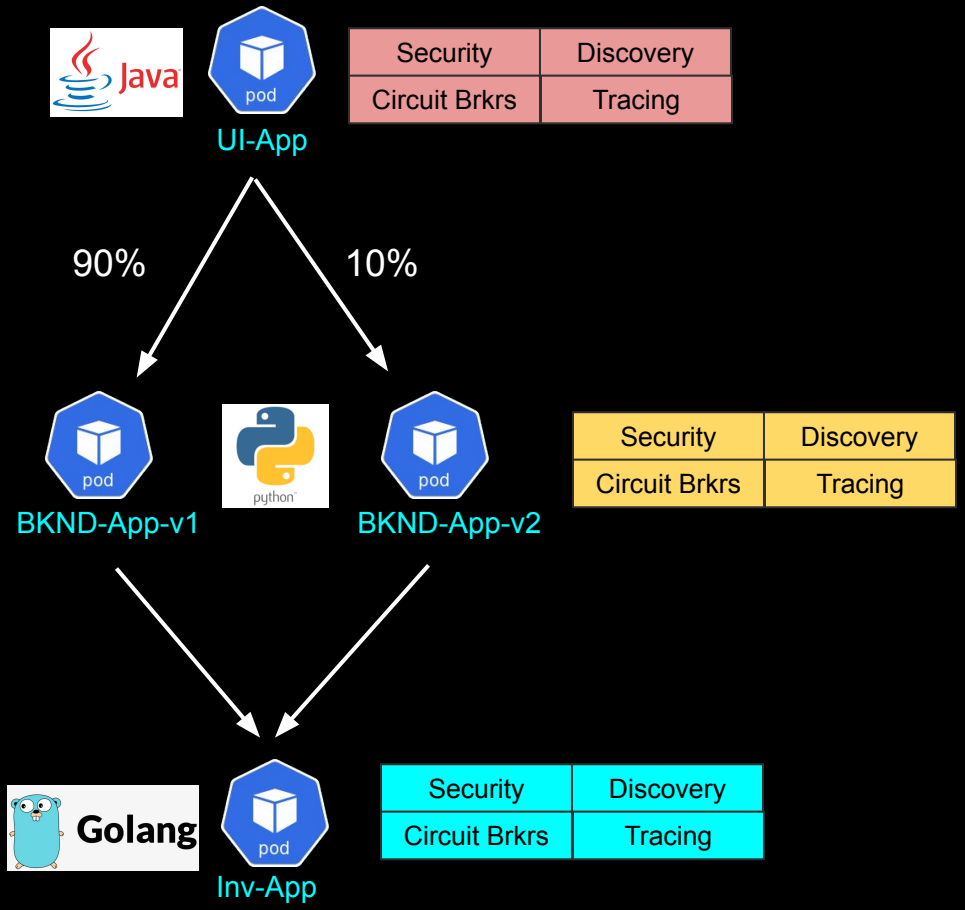
Polyglot

Security	Discovery
Circuit Brkrs	Tracing



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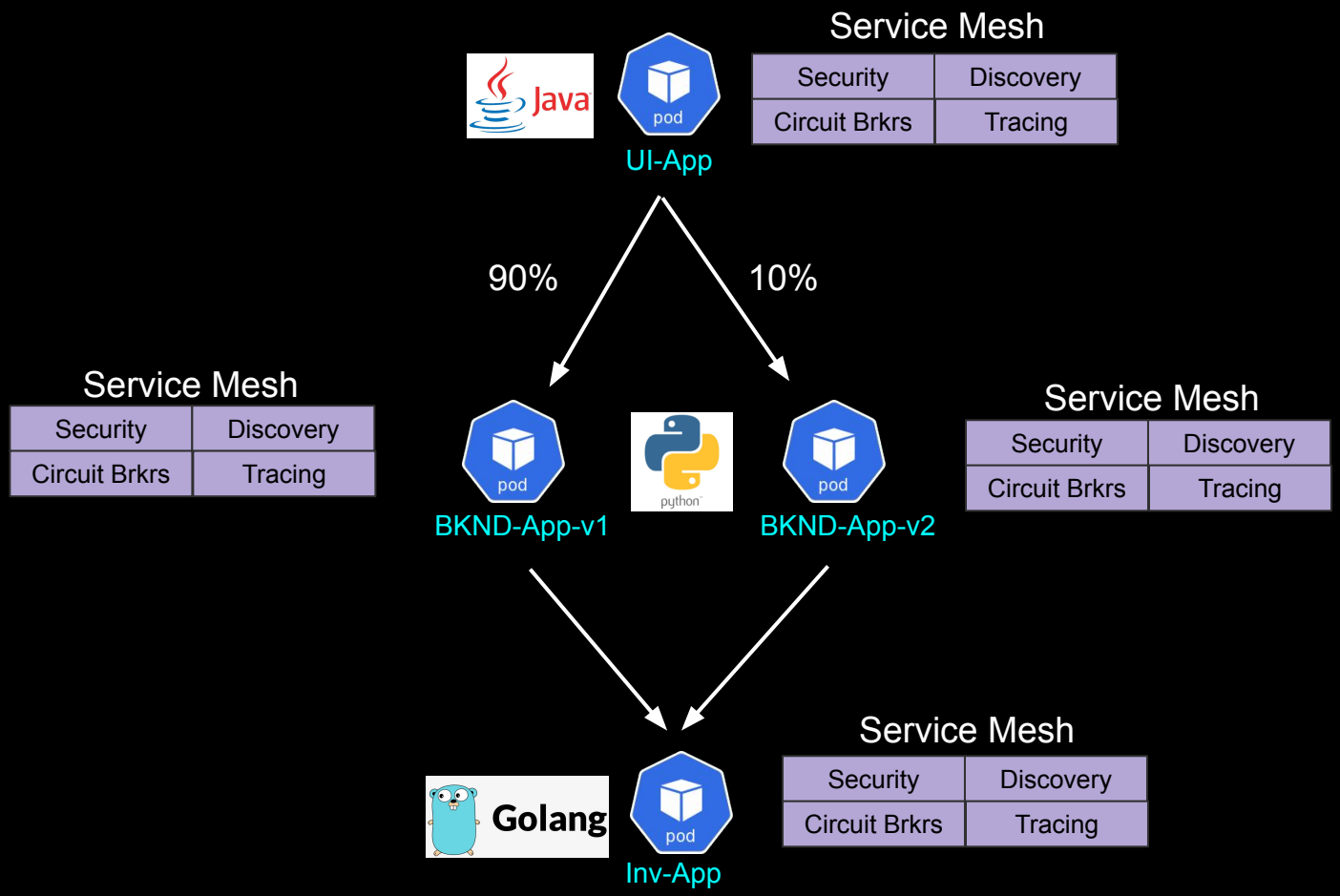
Say Hello to Service Mesh!



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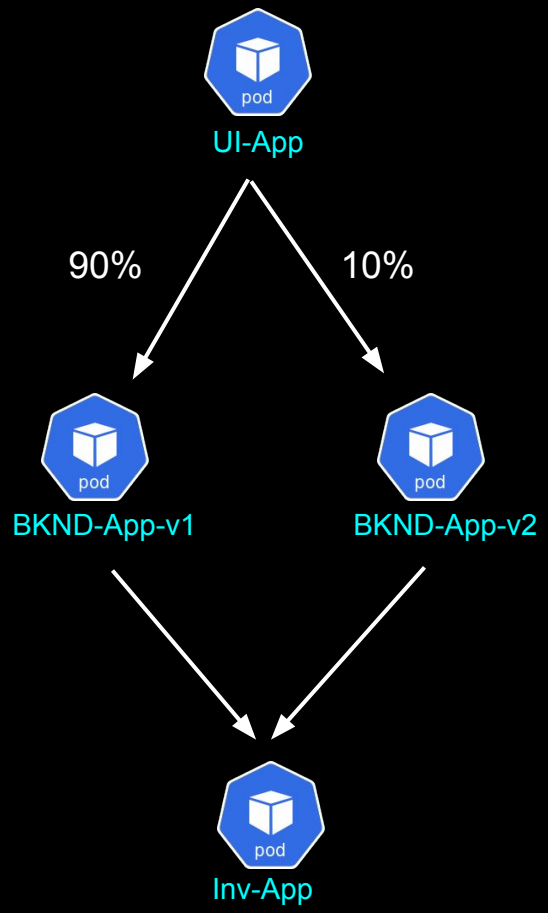
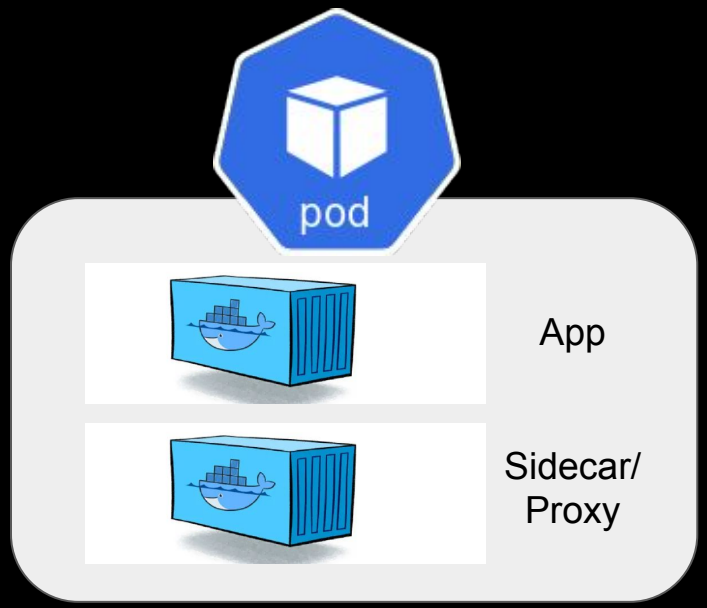
Anatomy of a Pod





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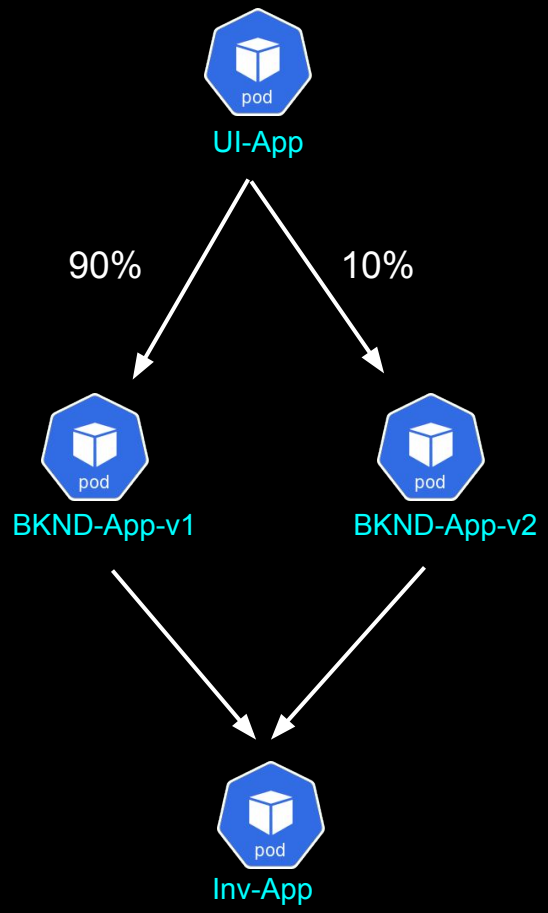
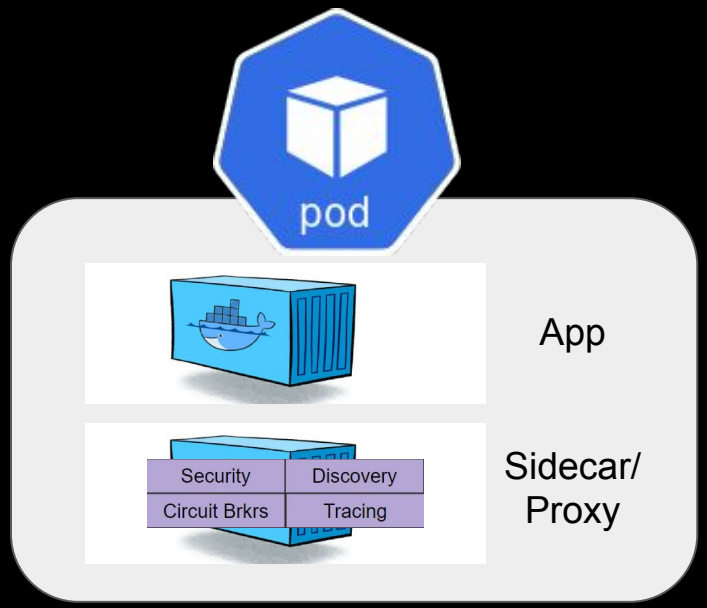
Anatomy of a Pod





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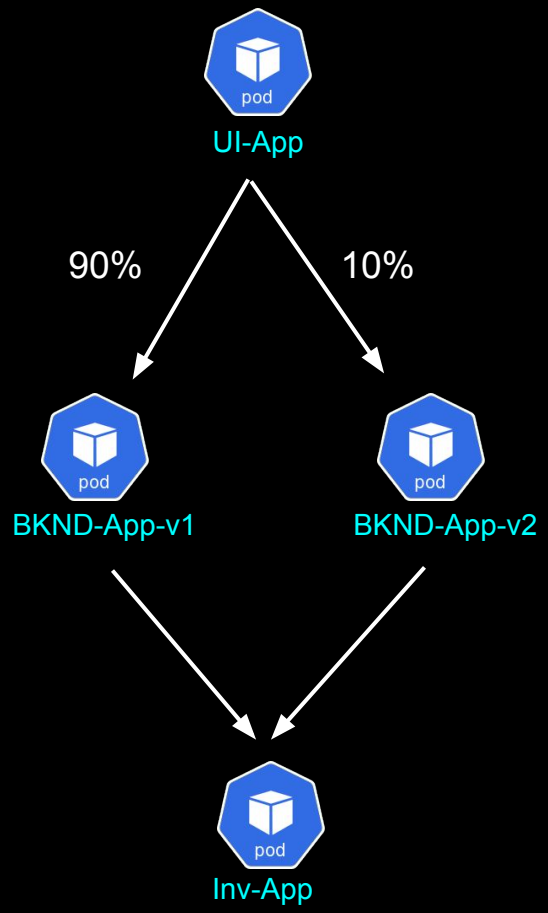
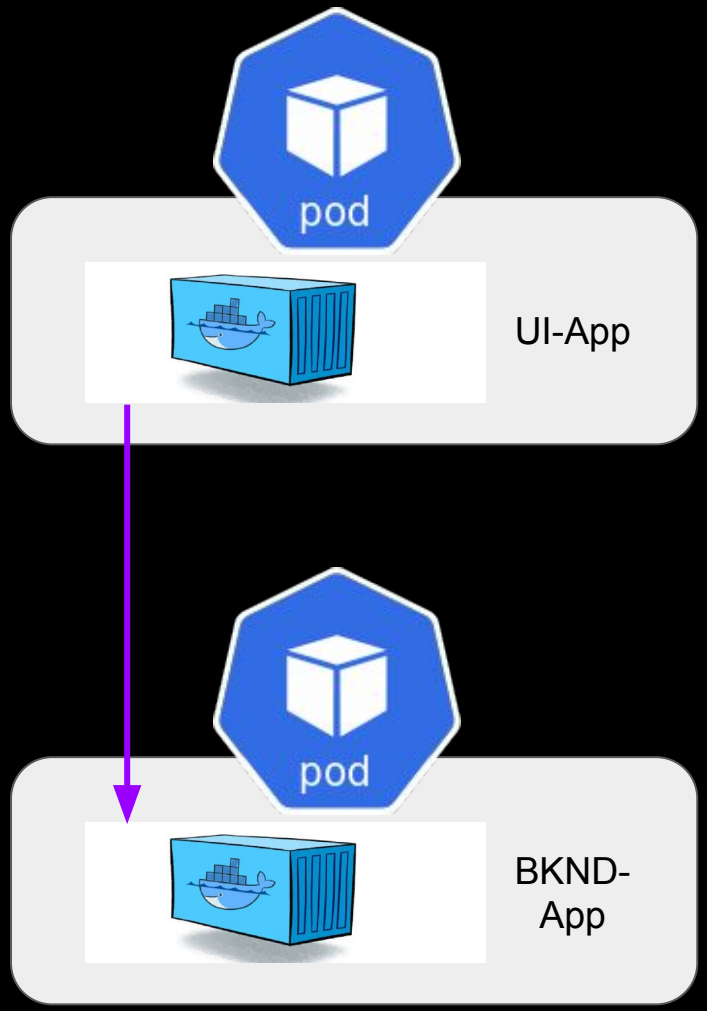
Without Service Mesh





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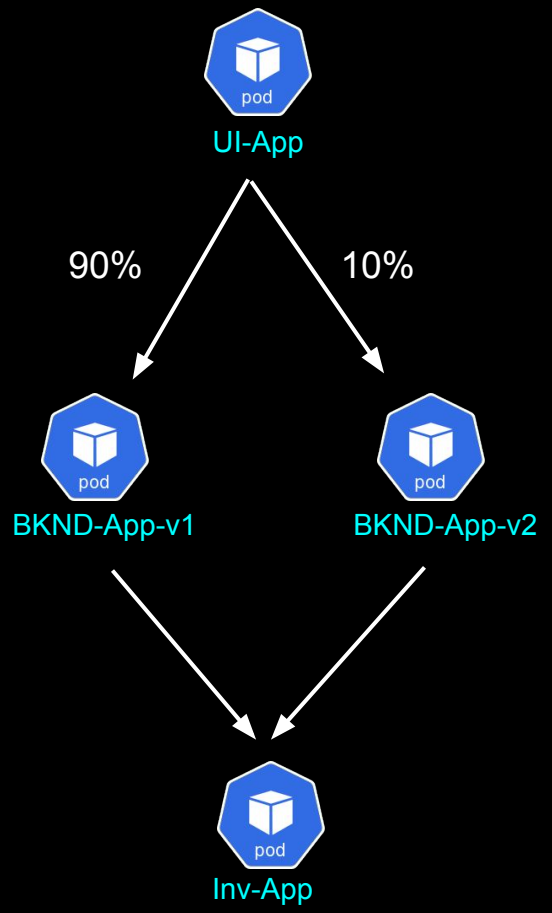
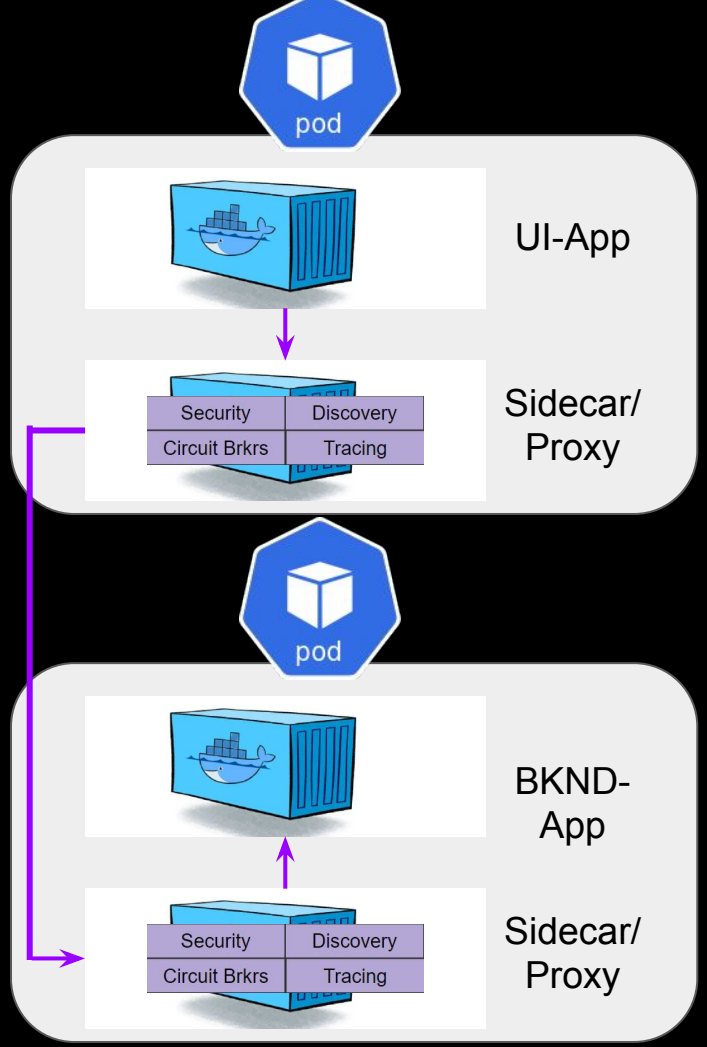
With Service Mesh





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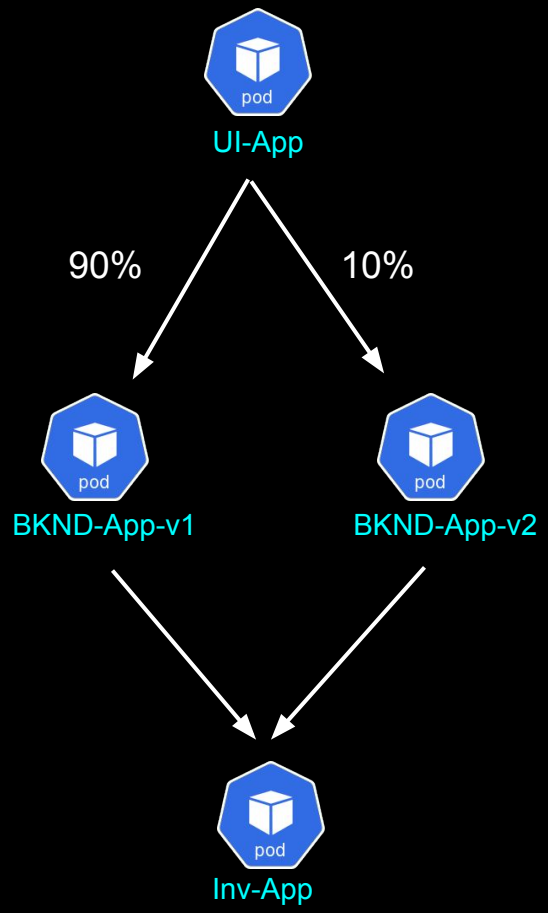
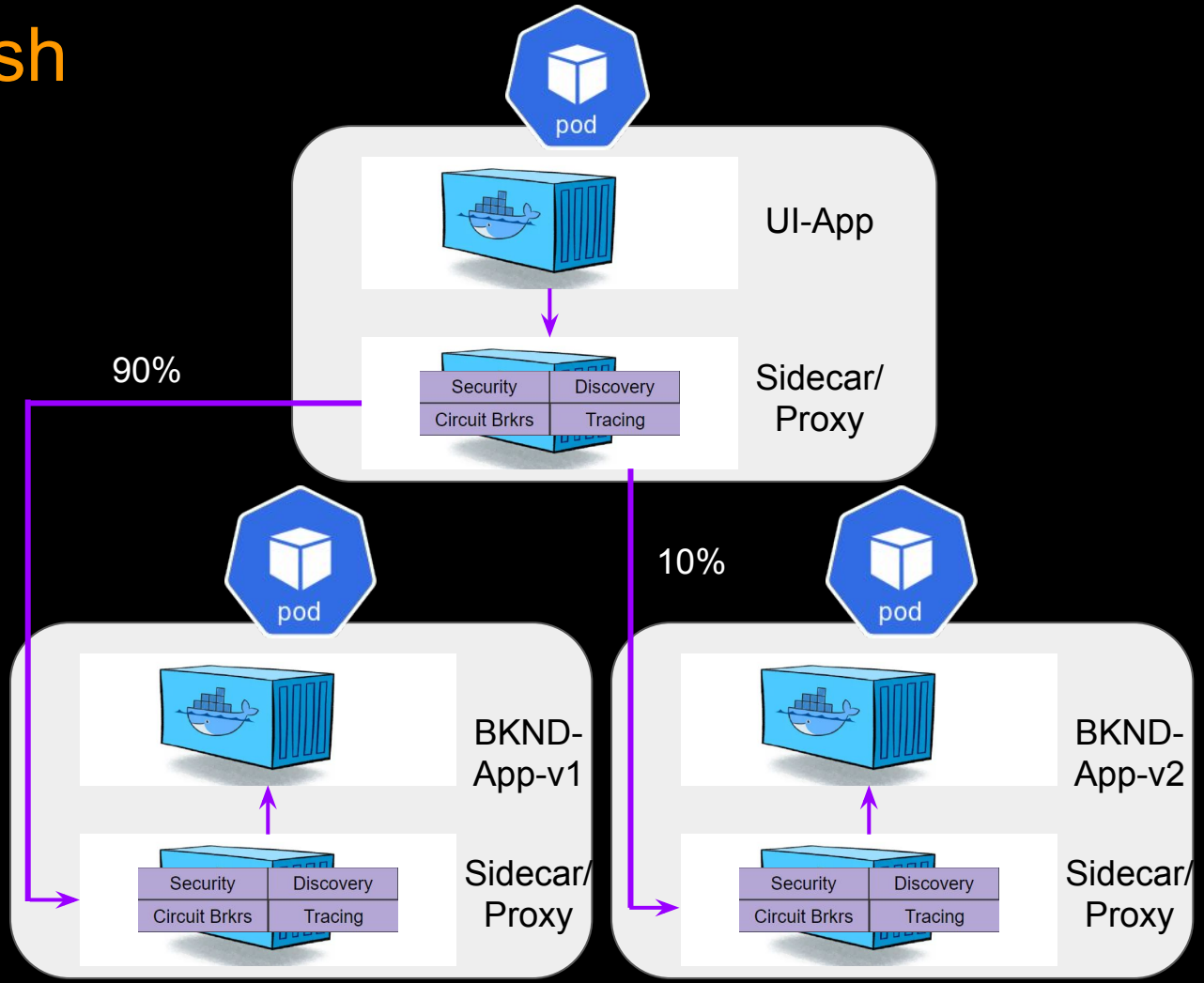
With Service Mesh





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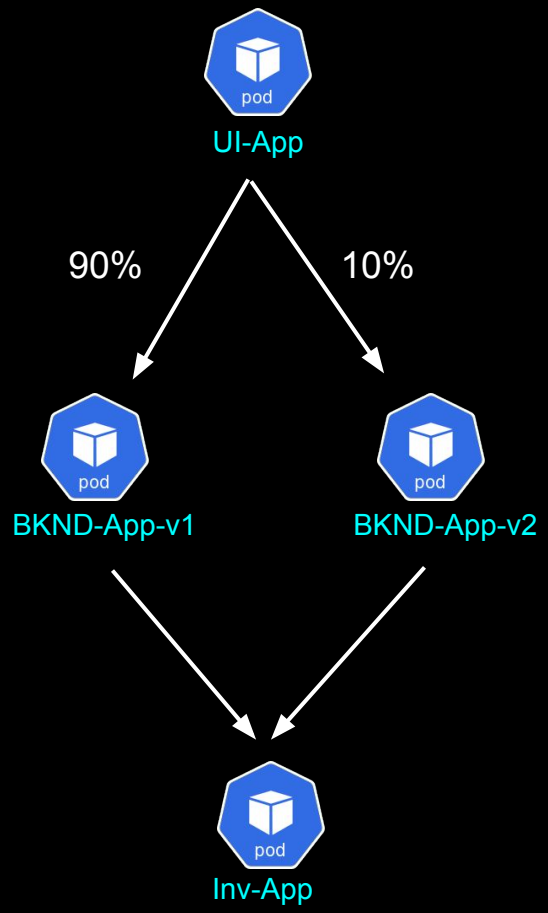
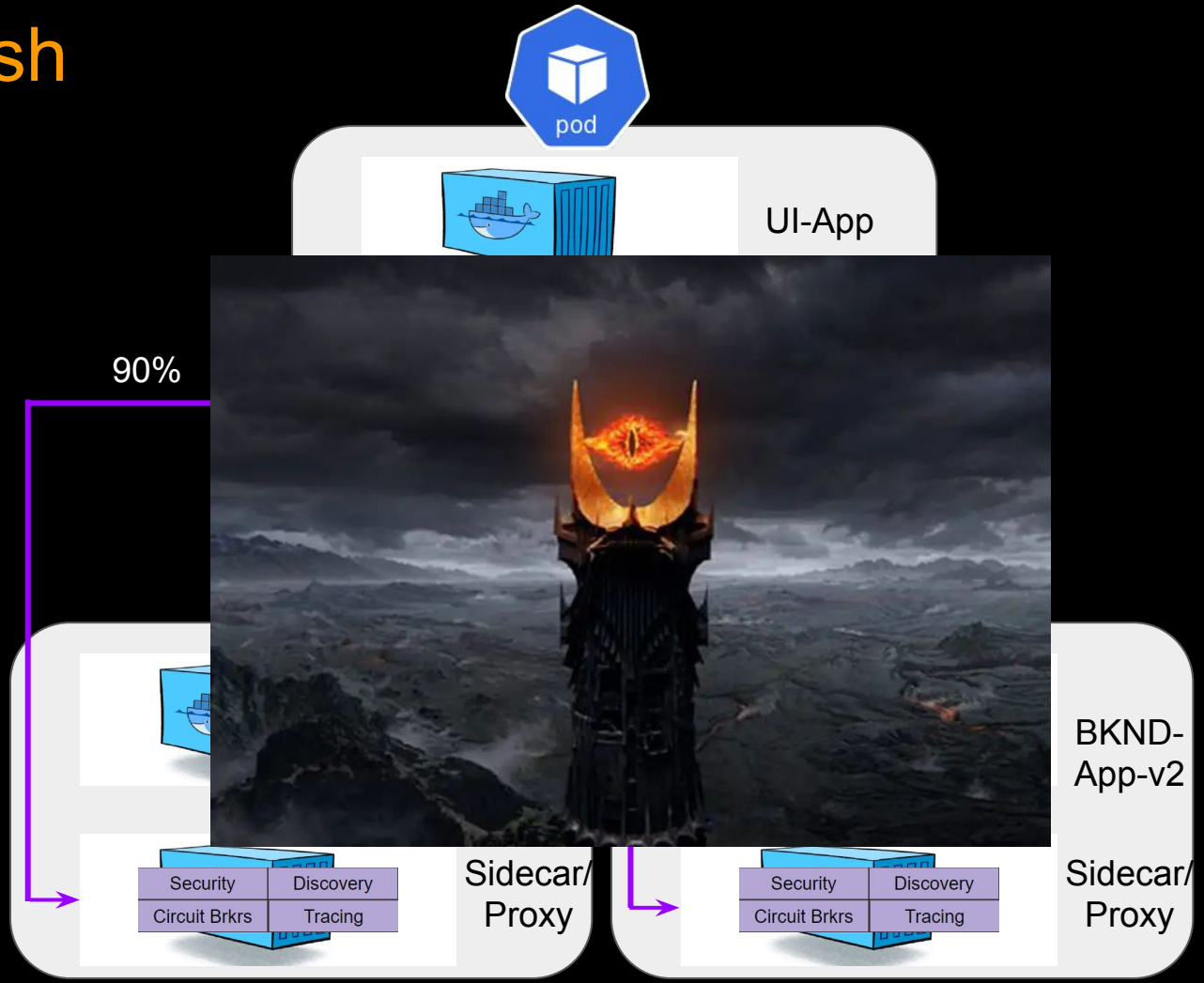
With Service Mesh





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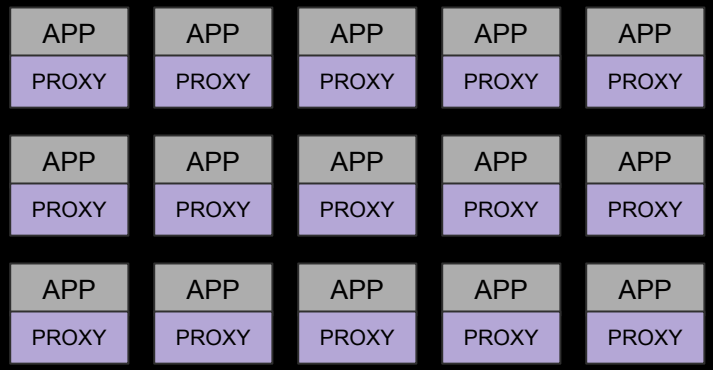
Control Plane - Data Plane



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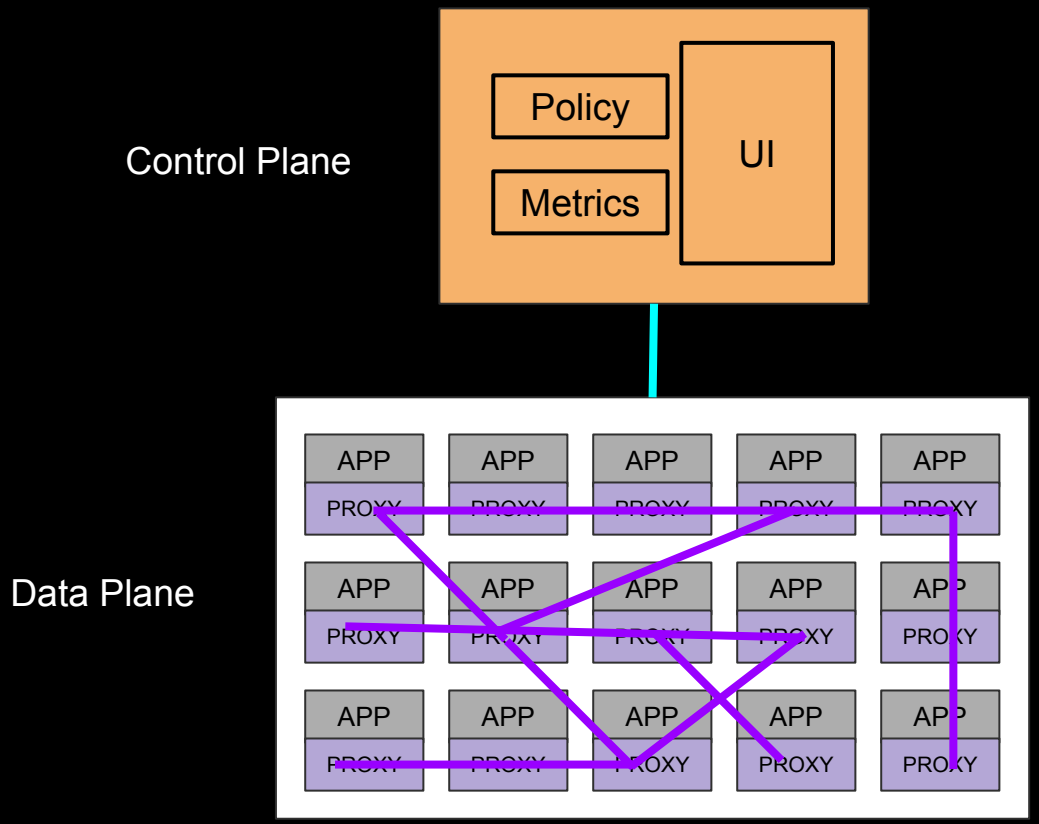
Control Plane - Data Plane



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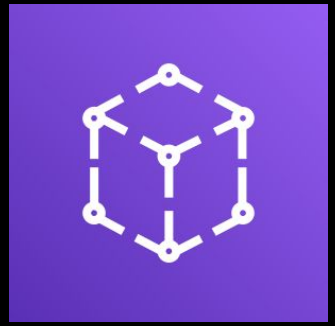
Popular Service Meshes



AWS App Mesh

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CNI (Container Network Interface) (Moderate to Advanced)

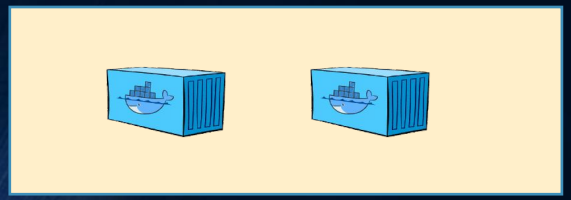
Agenda

- What is CNI ?
- Kubernetes Networking – Pod and Host Networking
  - Amazon VPC CNI
- What do you do with CNI?
  - Kubernetes Networking Policy
- CNI Evolution - Pod Security Group
- Kubernetes Networking Policy vs Service Mesh

Big Picture

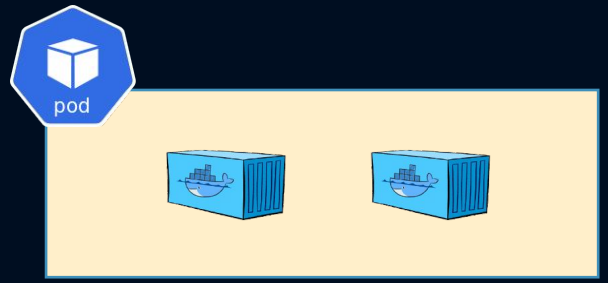
CRI (Container Runtime Interface)

- Pulls images and runs container
- Docker, RKT, CRI-O etc.



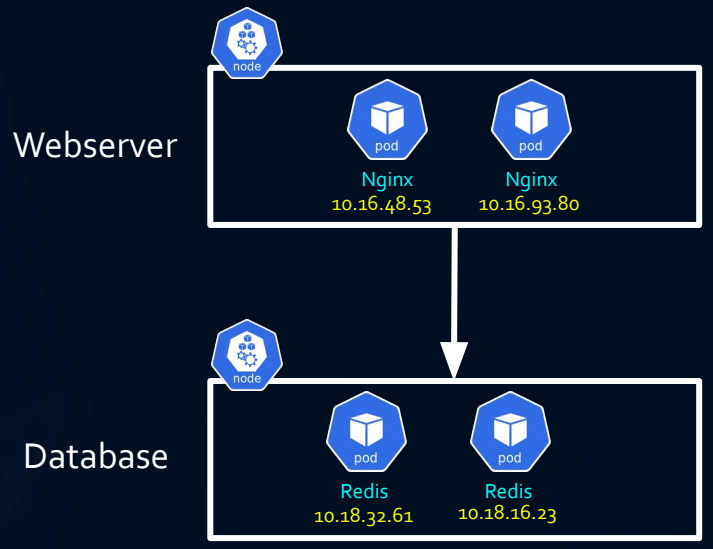
Task

Amazon Elastic Container Service



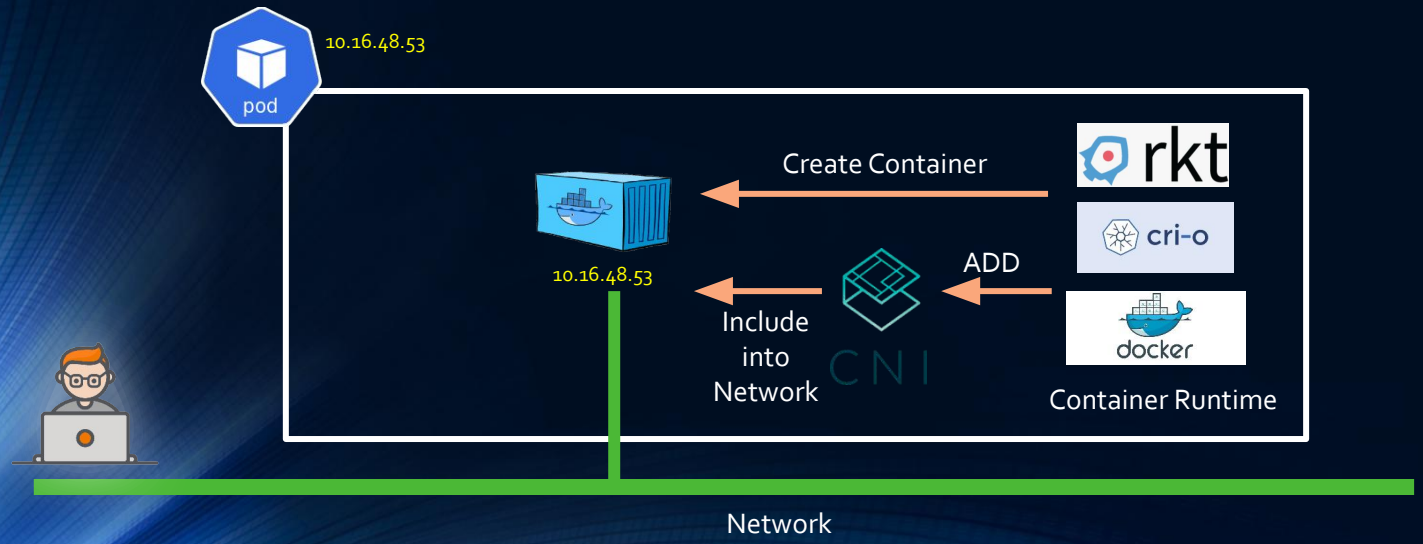
Pod

How do you access Pod?

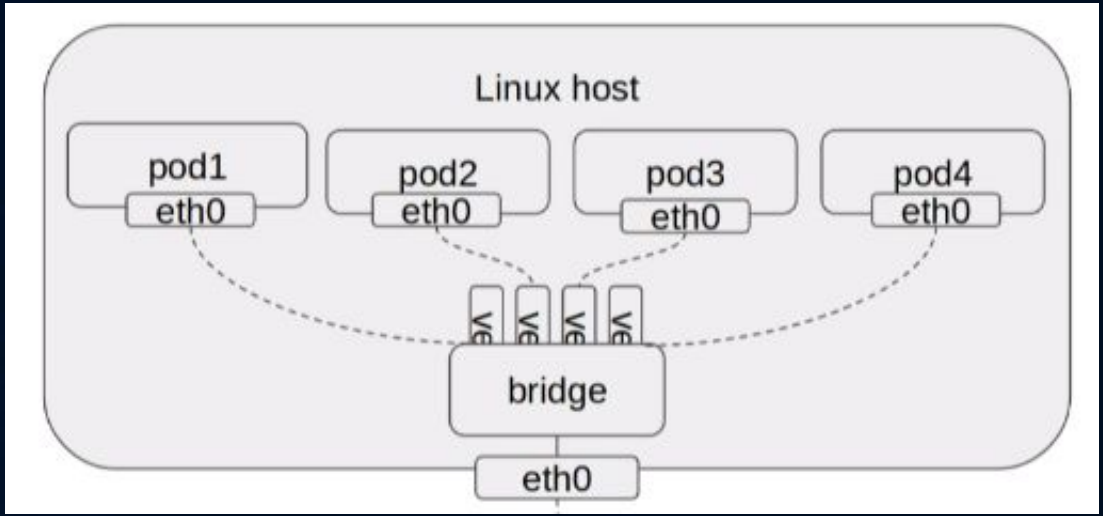


CNI (Container Network Interface)

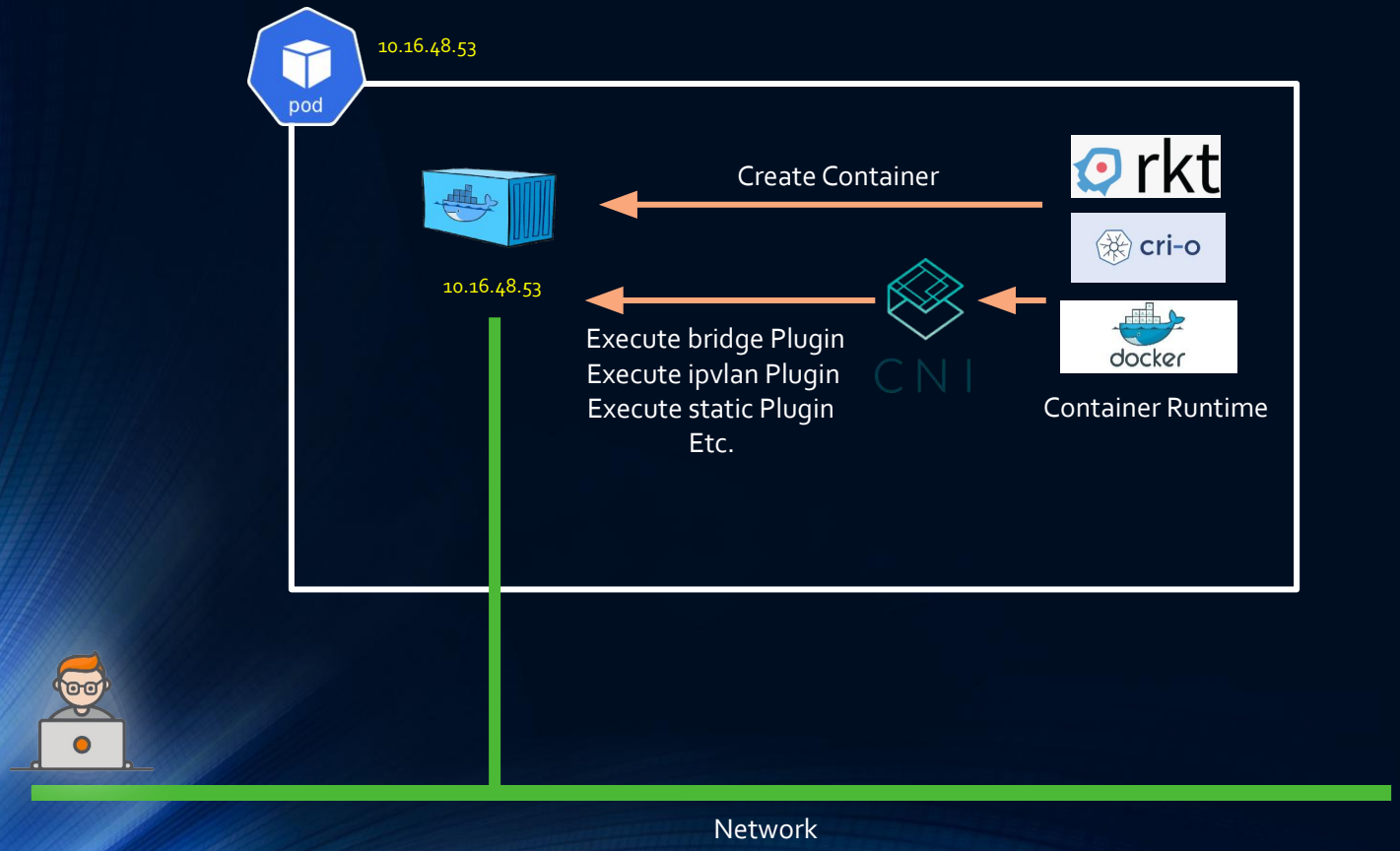
- Interface between container runtime interface and network
- Configures the network routes



Kubernetes Network



CNI Plugin


pod
10.16.48.53
Create Container
rkt
cri-o
10.16.48.53
Execute bridge Plugin
Execute ipvlan Plugin
Execute static Plugin
Etc.
CNI
docker
Container Runtime
Network

Plugins supplied:

Main: interface-creating

- `bridge` : Creates a bridge, adds the host and the container to it.
- `ipvlan` : Adds an ipvlan interface in the container.
- `loopback` : Set the state of loopback interface to up.
- `macvlan` : Creates a new MAC address, forwards all traffic to that to the container.
- `ptp` : Creates a veth pair.
- `vlan` : Allocates a vlan device.
- `host-device` : Move an already-existing device into a container.

Windows: windows specific

- `win-bridge` : Creates a bridge, adds the host and the container to it.
- `win-overlay` : Creates an overlay interface to the container.

IPAM: IP address allocation

- `dhcp` : Runs a daemon on the host to make DHCP requests on behalf of the container
- `host-local` : Maintains a local database of allocated IPs
- `static` : Allocate a static IPv4/IPv6 addresses to container and it's useful in debugging purpose.

Meta: other plugins

- `flannel` : Generates an interface corresponding to a flannel config file
- `tuning` : Tweaks sysctl parameters of an existing interface
- `portmap` : An iptables-based portmapping plugin. Maps ports from the host's address space to the container.
- `bandwidth` : Allows bandwidth-limiting through use of traffic control tbf (ingress/egress).
- `sbr` : A plugin that configures source based routing for an interface (from which it is chained).
- `firewall` : A firewall plugin which uses iptables or firewalld to add rules to allow traffic to/from the container.

https://github.com/containernetworking/plugins

CNI is NOT just for Kubernetes

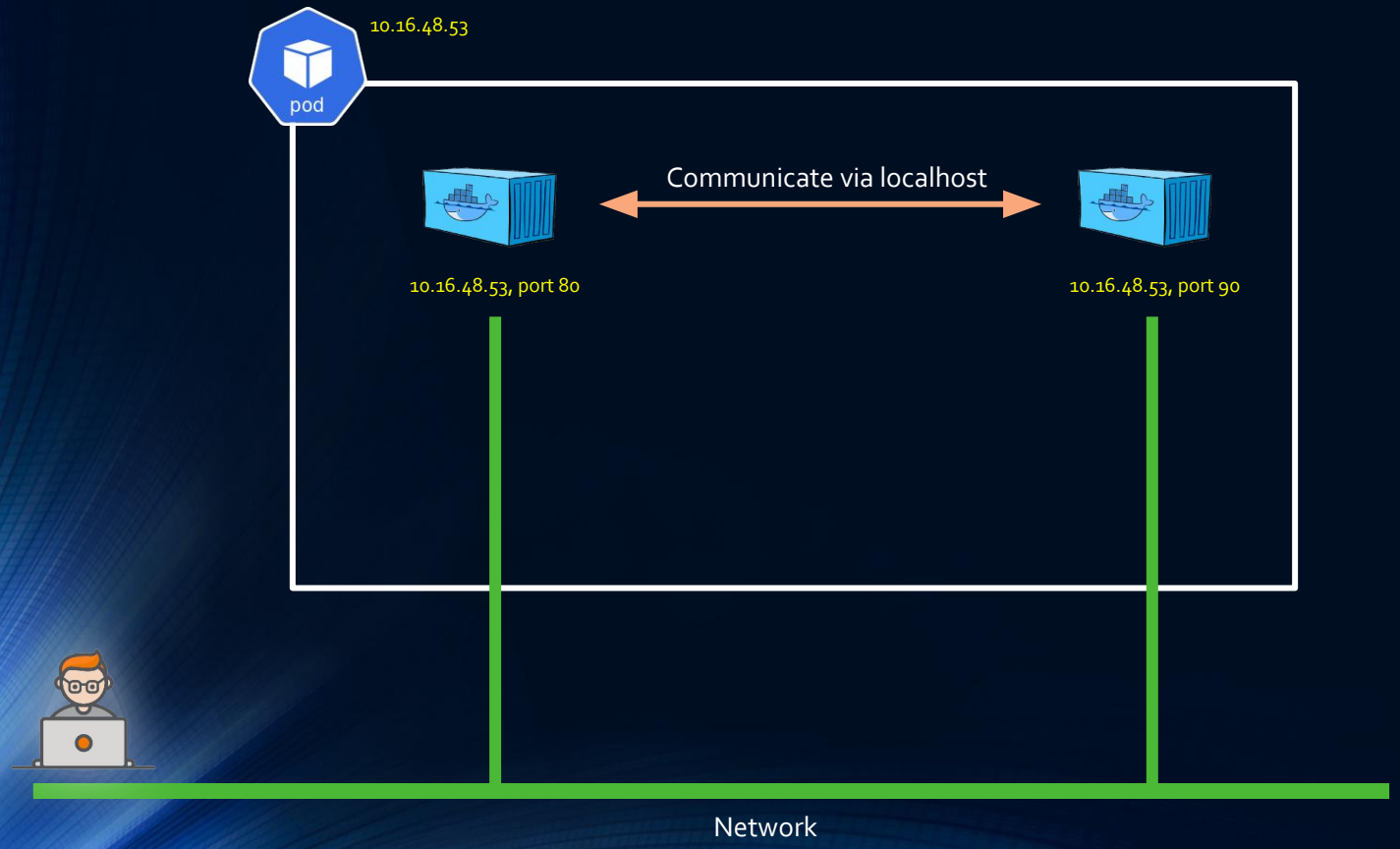
- Any CRI (Container Runtime Interface) can call CNI Plugins
- CNI Plugins need to follow certain specifications
  - Specific parameters
  - Need to support specific operations (ADD, DEL, CHECK, VERSION)

https://github.com/containernetworking/cni/blob/master/SPEC.md

Kubernetes Networking Requirements

- Each pod gets it's own IP
  - Containers within a pod share network namespaces
- All pods can communicate with all other pods without NAT (Network Address Translation)
- All nodes can communicate with all pods without NAT
- The IP of the pod is same throughout the cluster

Containers in same Pod



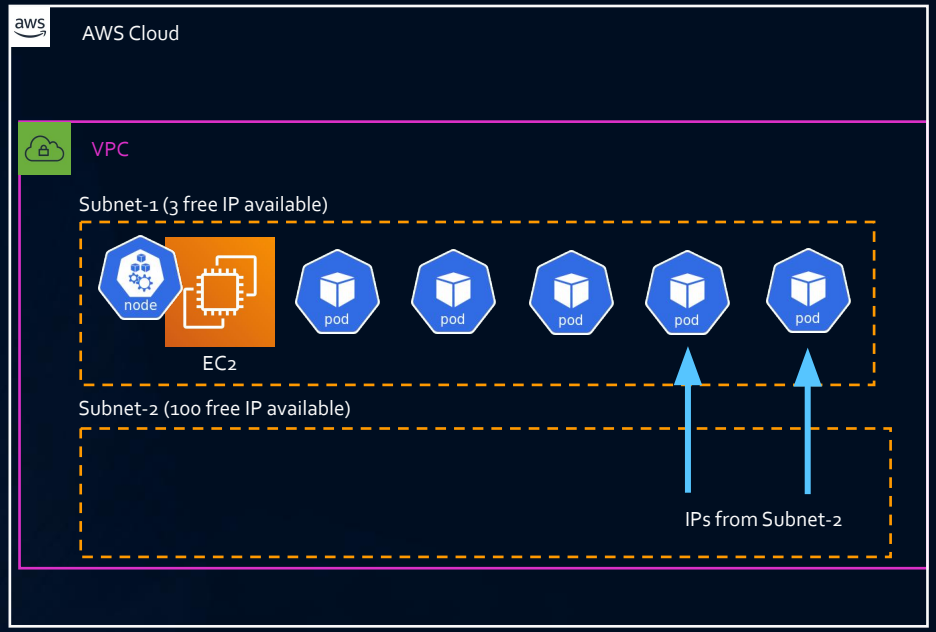
Available CNIs

Amazon
VPC
CNI Plugin

Amazon VPC CNI Plugin

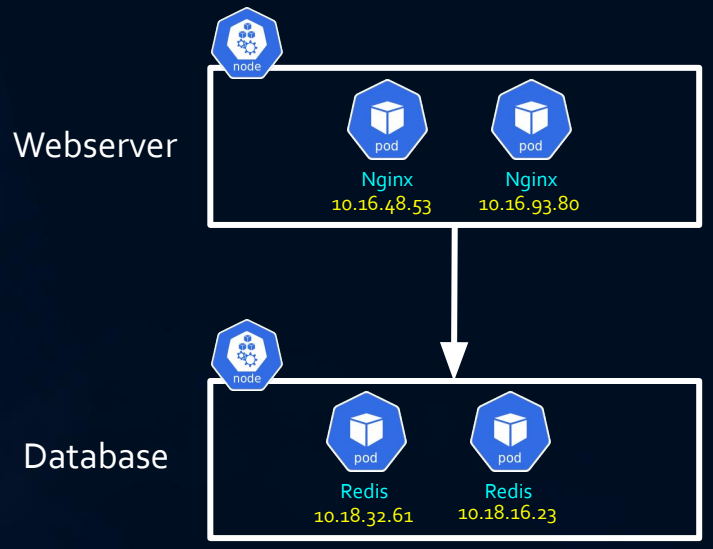
- Pod IP is same throughout the VPC
- Native VPC networking fast performance, scalable
- VPC features – flow logs, direct connect etc.
- Support pod security group (more on this later!)
- Open source, supported by AWS

Amazon VPC CNI Custom Networking for Pod

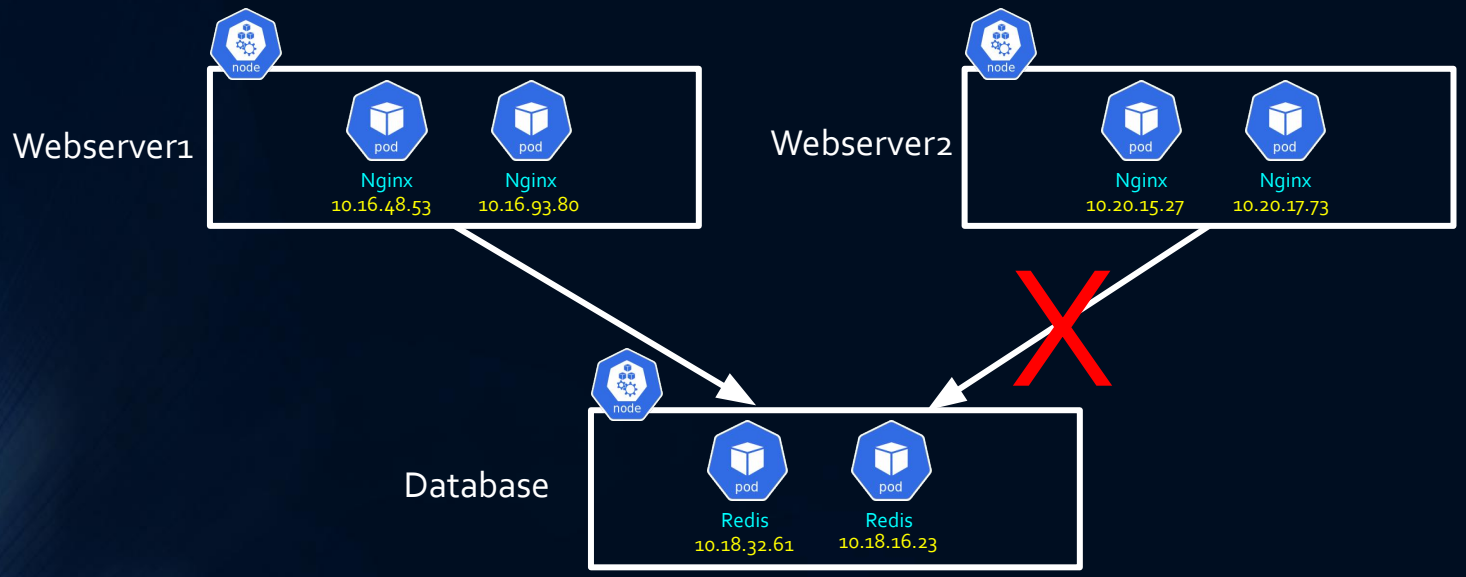


- Using secondary network interface attached to EC2
- Expand EKS cluster by adding additional CIDR to VPC

What can you do with ALL this?



Kubernetes Network Policies

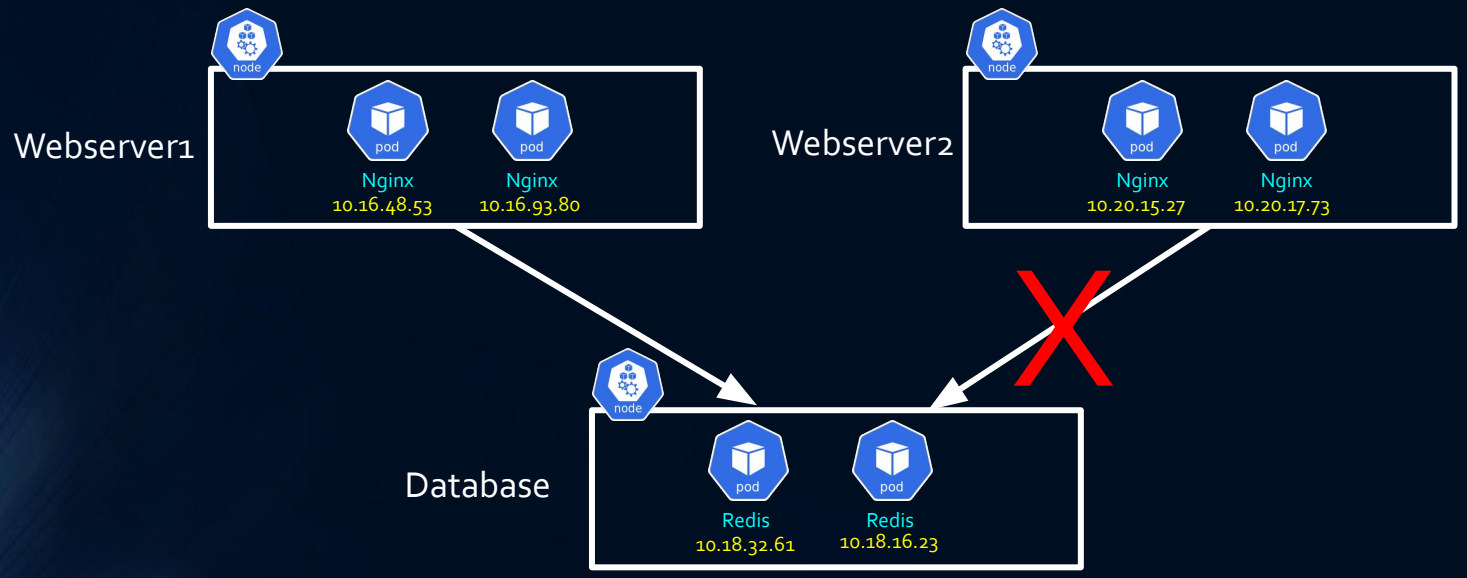


- Great for multi-tenant cluster

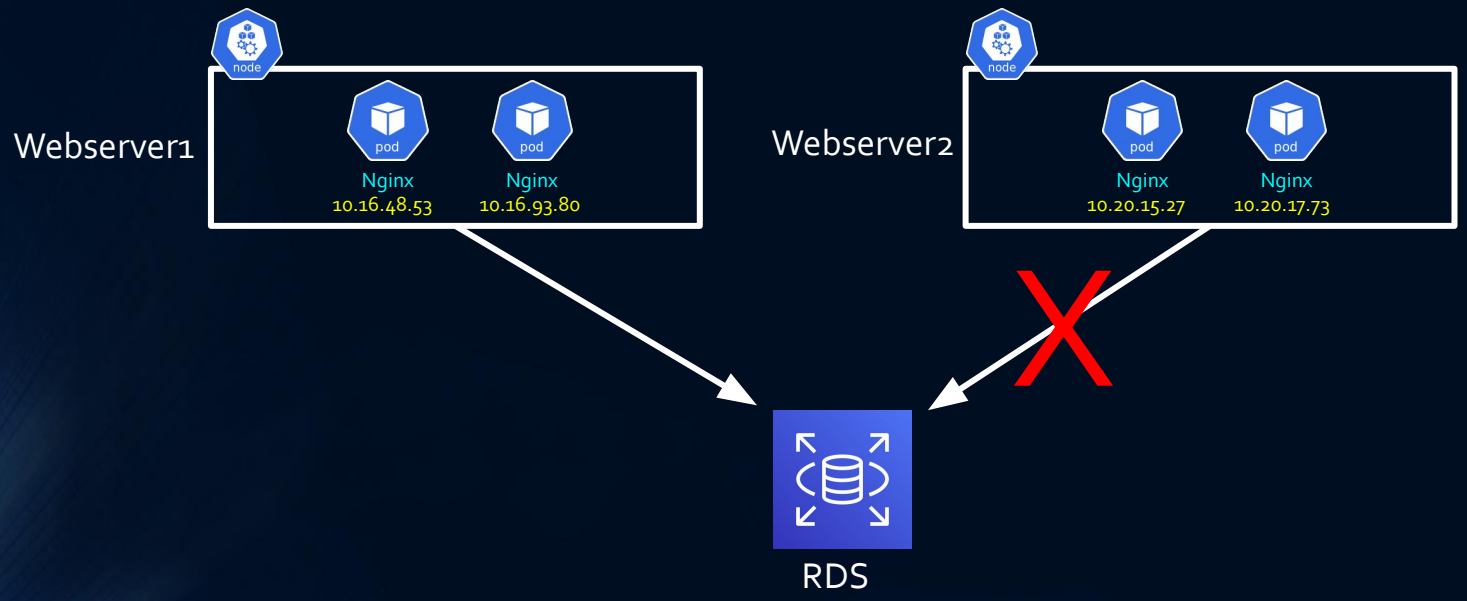
Kubernetes Network Policies

```yaml
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: test-network-policy
  namespace: default
spec:
  podSelector:
    matchLabels:
      role: db
  policyTypes:
  - Ingress
  - Egress
  ingress:
  - from:
    - ipBlock:
        cidr: 172.17.0.0/16
        except:
        - 172.17.1.0/24
    - namespaceSelector:
        matchLabels:
          project: myproject
    - podSelector:
        matchLabels:
          role: frontend
    ports:
    - protocol: TCP
      port: 6379
  egress:
  - to:
    - ipBlock:
        cidr: 10.0.0.0/24
    ports:
    - protocol: TCP
      port: 5978
```

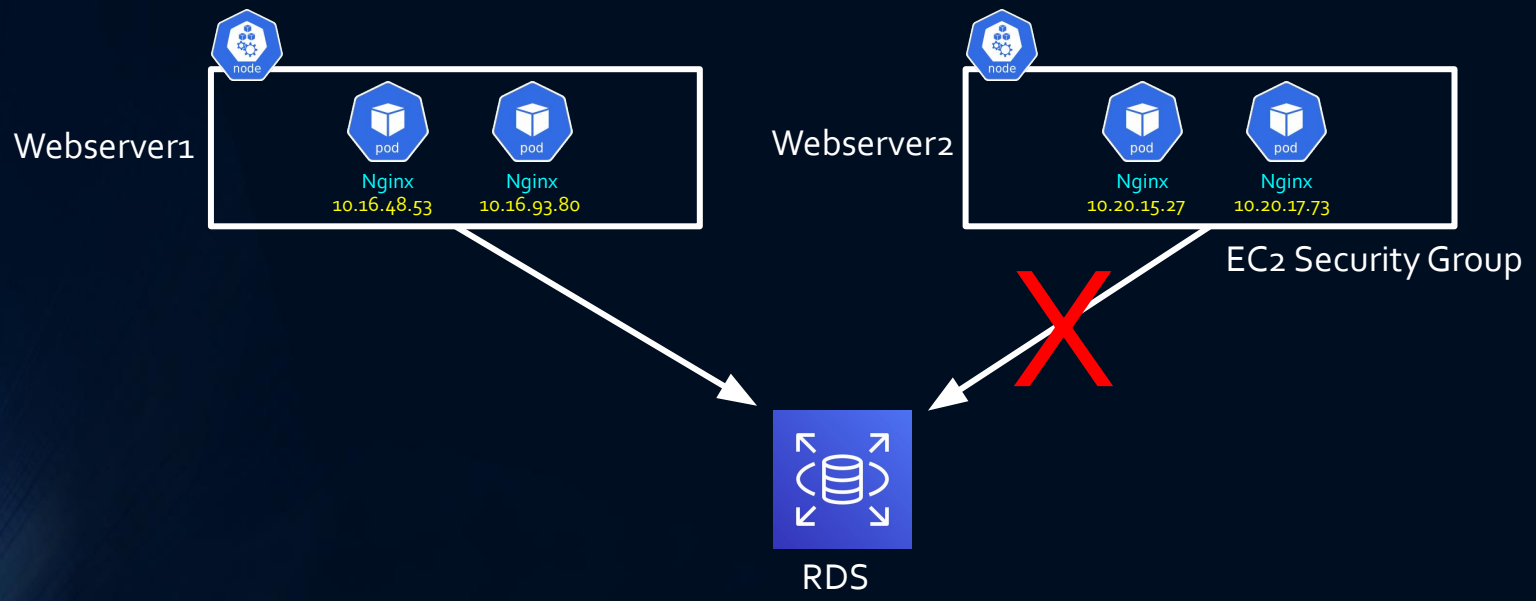
What if a resource doesn't expose IP?



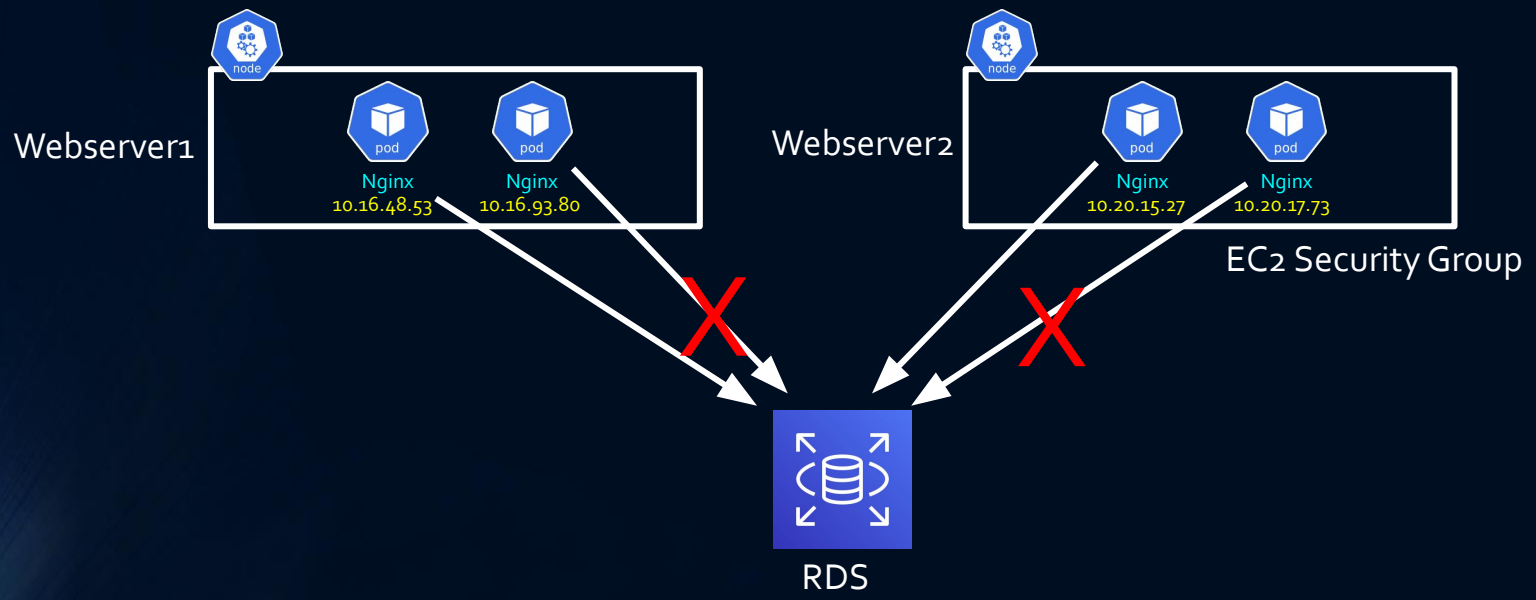
What if a resource doesn't expose IP?



Issue with EC2 Security Group

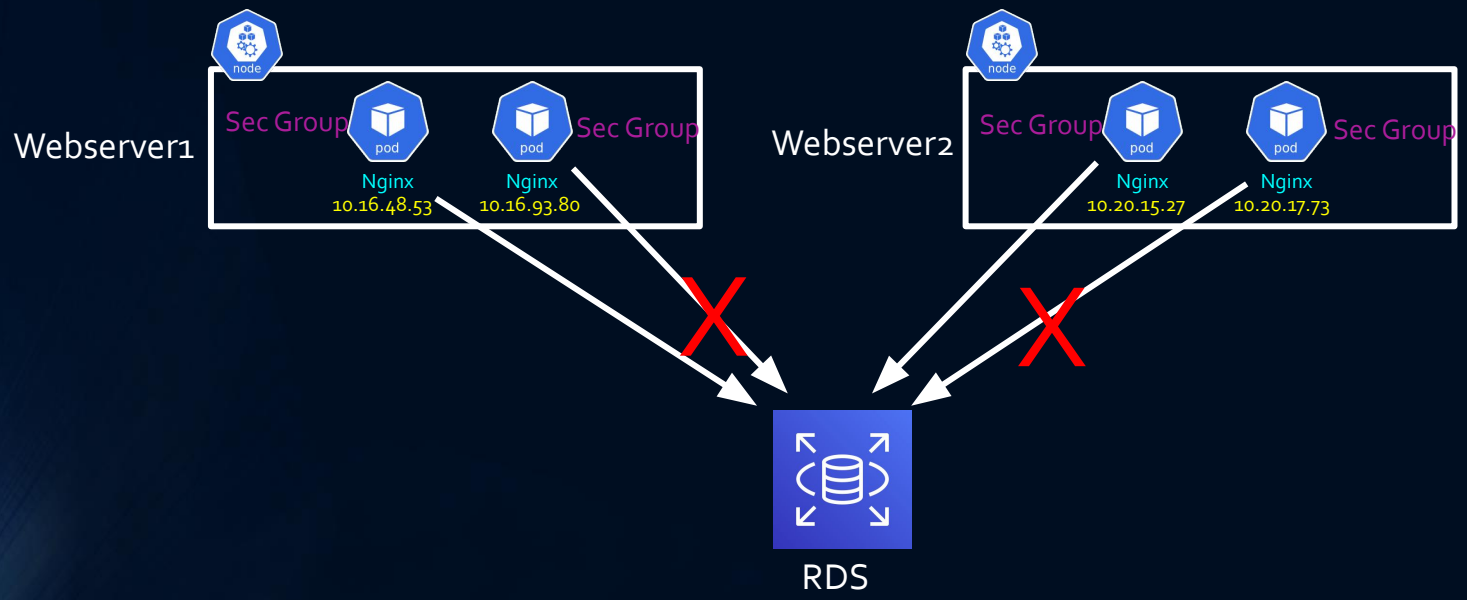


Issue with EC2 Security Group



- Requires using taint to schedule specific pods to specific nodes
- Gets complex as cluster scales

Pod Security Group EKS



- Security control in multi tenant cluster
- Control network access from pods to outside cluster AWS services
- Easier to migrate from EC2 to EKS

Service Mesh
vs.
Network Policy Enforcer

EKS Cost Optimization

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4 Commandments of Cost Optimization

Right Sizing

- Utilize pod requests, limits, resource quotas
- Use open source, third-party tools to tune pod requests, limits (More on this later)

Auto Scaling

- Once pods are optimized, enable auto scaling
- Utilize HPA, Cluster Autoscaling, Proportional Autoscaling

Down Scaling

- Terminate pods unnecessary during nights, weekends
- Utilize DevOps

EC2 Purchase Options

- Use RI, Spot, Savings Plan

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Right Sizing Tools

Open Source

right size guide

Kubernetes Resource Report

And More...

Third Party

And More...

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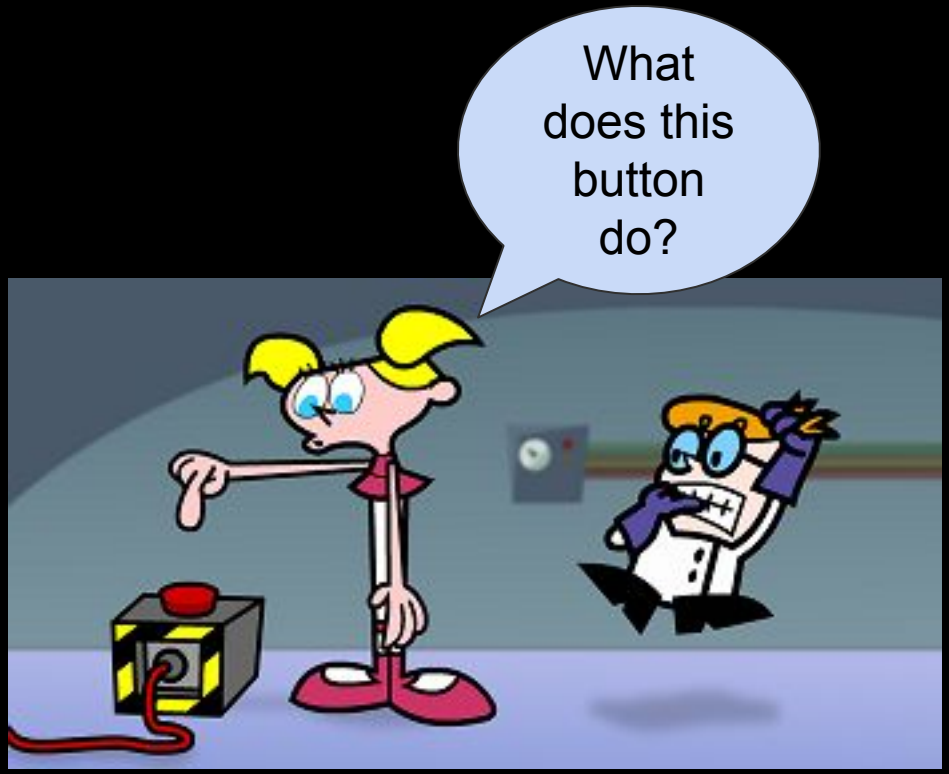
EKS Tools Ecosystem



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EKS Tools Ecosystem

DevOps

Security

Ingress

ALB Ingress Controller

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EKS Tools Ecosystem

Logging

Monitoring

Cost Optimization

Kubernetes Resource Report

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EKS Roadmap

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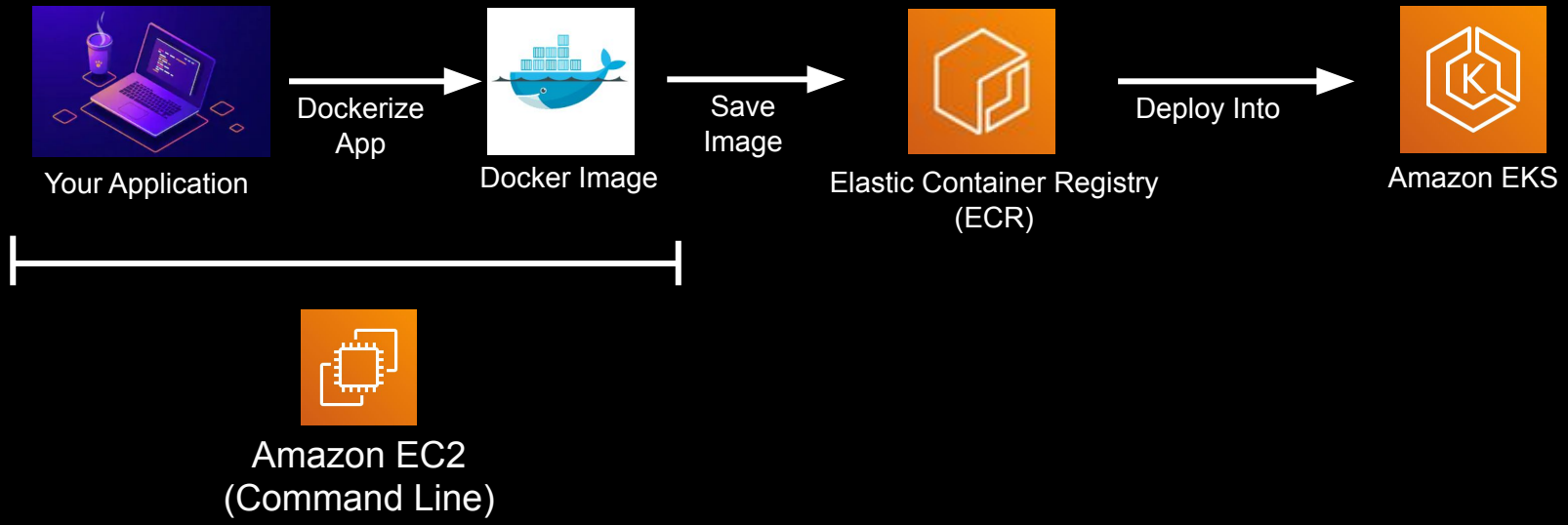
ECR Demo Setup



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EKS Security

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Kubernetes Security

RBAC

IRSA

RoleBinding

ClusterRole

ClusterRoleBinding

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Kubernetes Security

- Your Application
- You! (As in human users)

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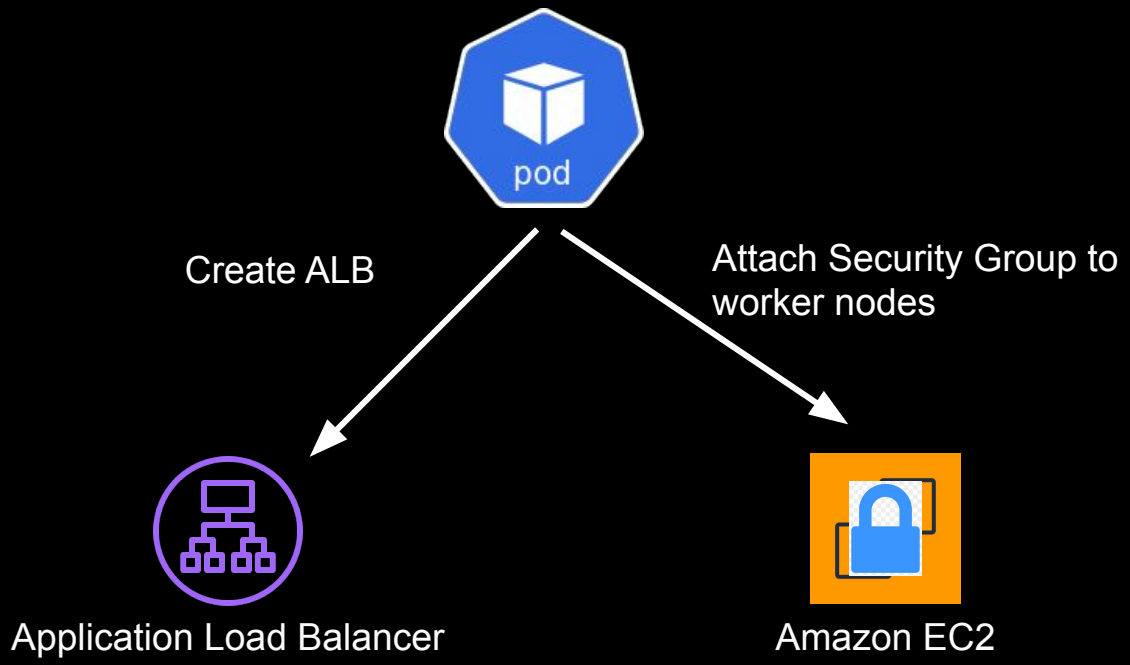
Working Backwards



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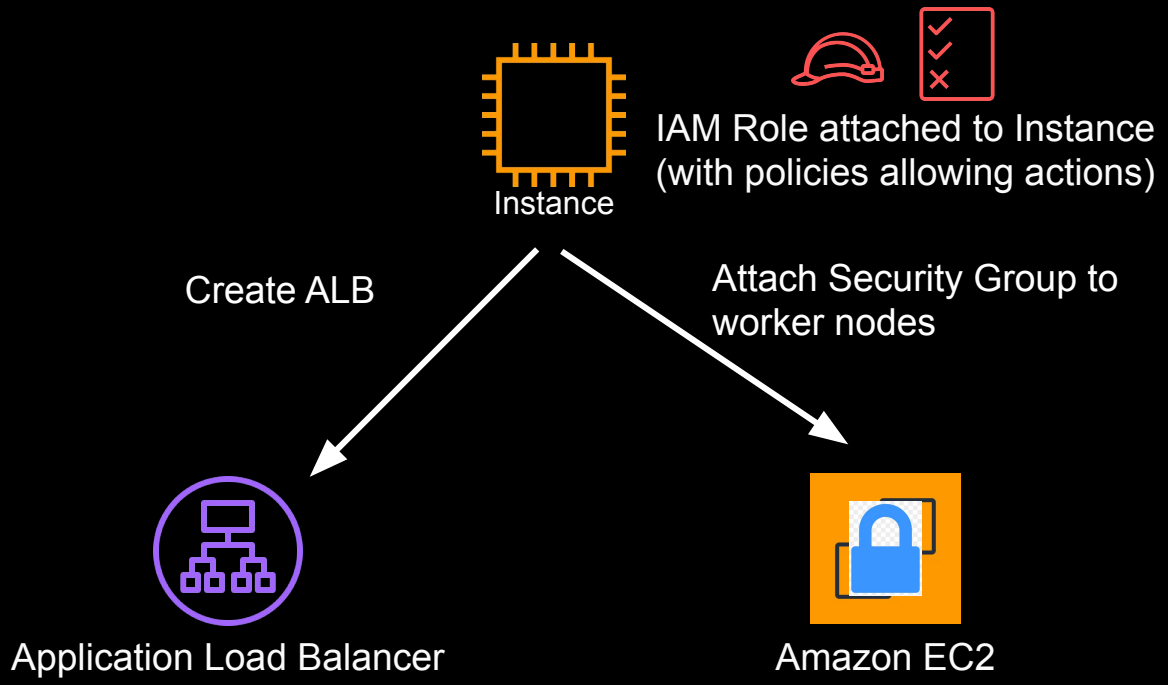
Back to EC2 Days



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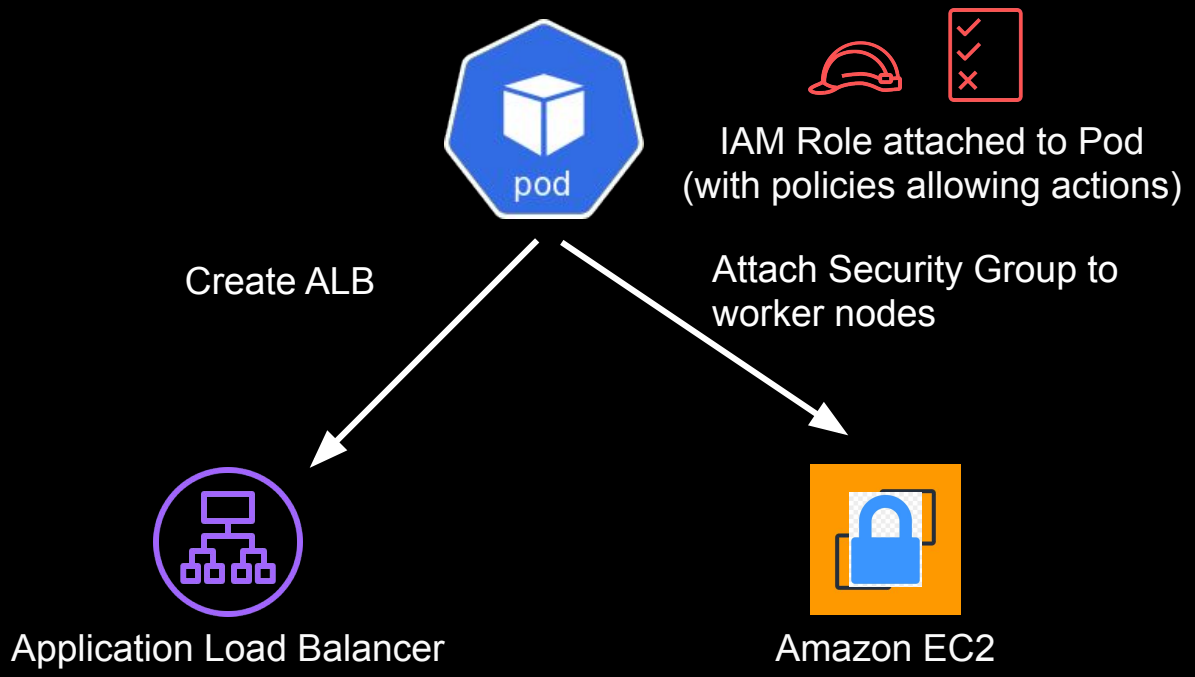
Back to Pod



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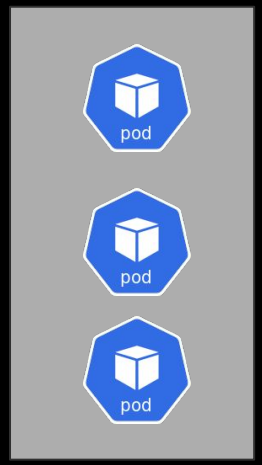
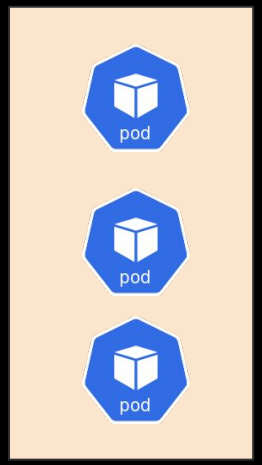
Not so simple life of pod

IAM Role attached to Pod
(with policies allowing actions)

Namespace1



Namespace2



Need To Be Implemented in
Deployment Manifest

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Deployment Manifest

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.16
        name: nginx
```

- Deployment is a Kubernetes construct
- Need to abstract cloud specific construct in K8s construct
  - Enables K8s to run in multiple platform
- Say hello to Service Account

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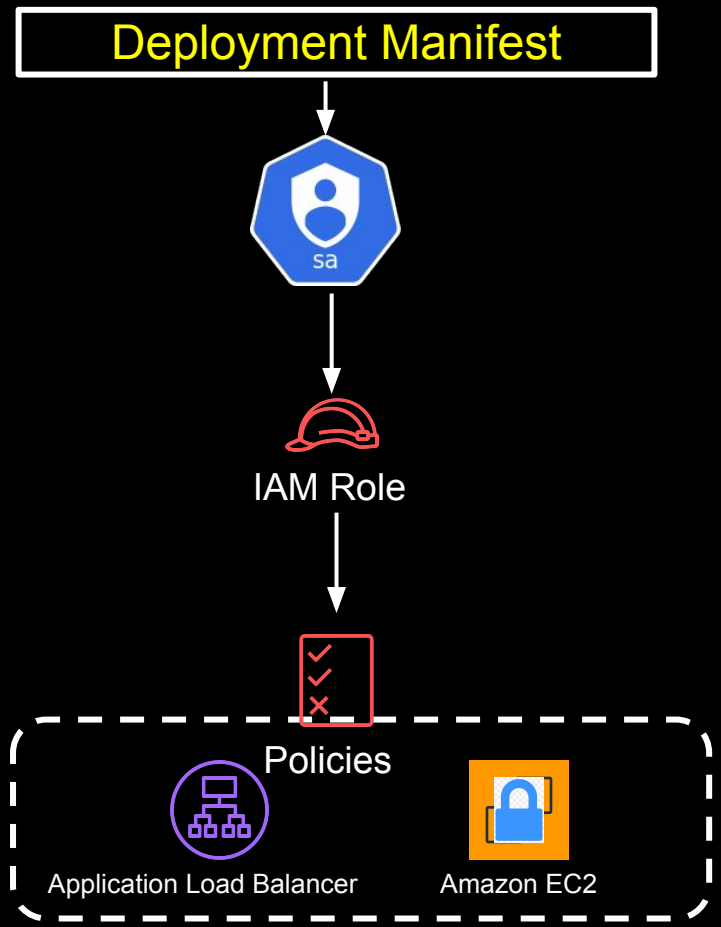
Service Account



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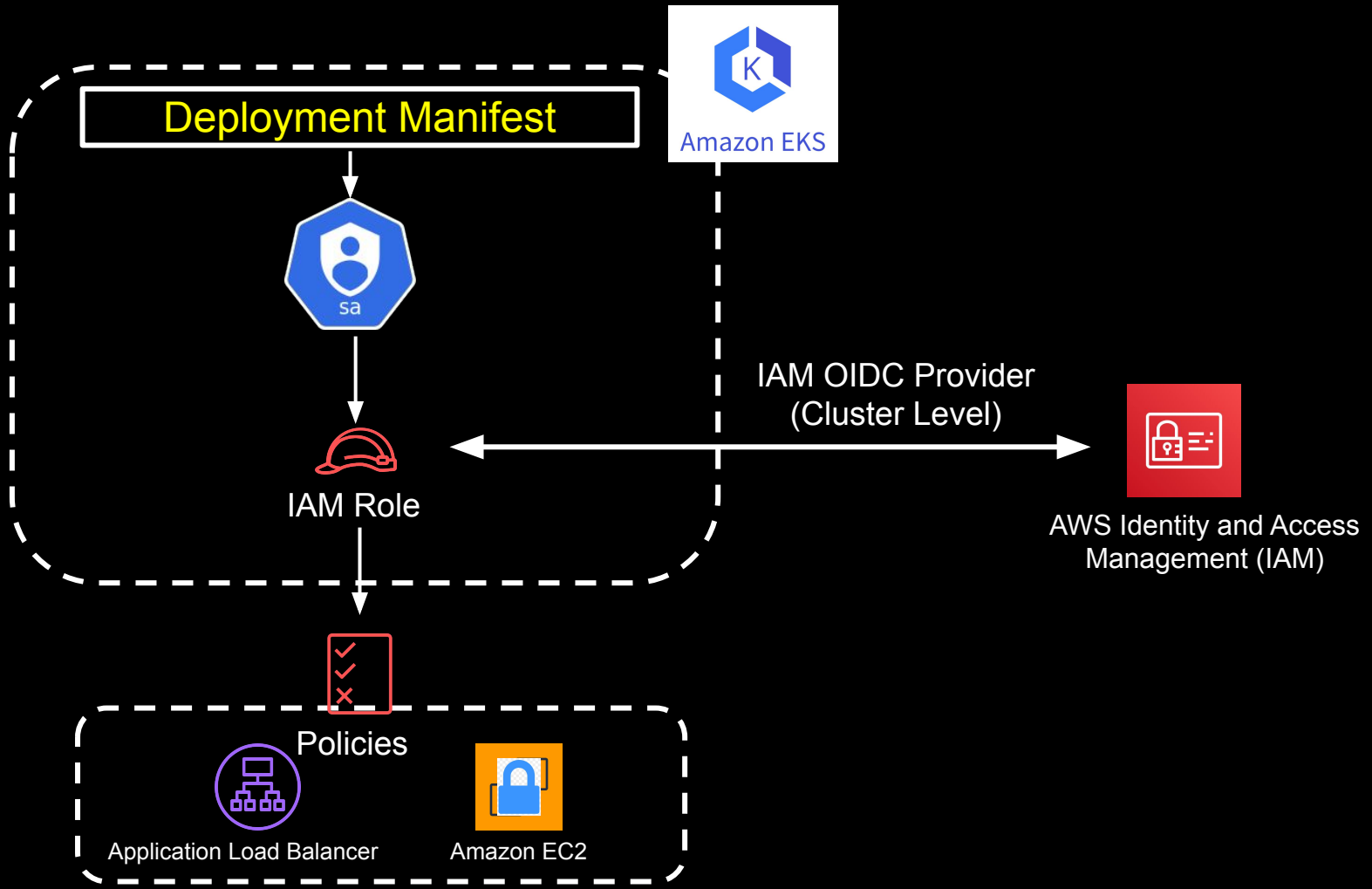
OIDC



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Deployment Manifest

nginx-deployment-withrolling.yaml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    environment: test
  name: testdeploy
spec:
  replicas: 3
  selector:
    matchLabels:
      environment: test
  minReadySeconds: 10
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        environment: test
    spec:
      containers:
      - image: nginx:1.16
        name: nginx
```

- When Service Account is not specified, default is used

```
AdminRole:~/environment $ kubectl get sa
NAME       SECRETS   AGE
default    1         17h
```

```
AdminRole:~/environment $ kubectl get sa -A
NAMESPACE          NAME                                  SECRETS   AGE
2048-game          alb-ingress-controller                1         15h
2048-game          default                               1         15h
default            default                               1         17h
kube-node-lease    default                               1         17h
kube-public        default                               1         17h
kube-system        alb-ingress-controller                1         16h
kube-system        attachdetach-controller               1         17h
kube-system        aws-cloud-provider                    1         17h
kube-system        aws-node                              1         17h
kube-system        certificate-controller                1         17h
kube-system        clusterrole-aggregation-controller    1         17h
kube-system        coredns                               1         17h
kube-system        cronjob-controller                    1         17h
kube-system        daemon-set-controller                 1         17h
kube-system        default                               1         17h
kube-system        deployment-controller                 1         17h
kube-system        disruption-controller                 1         17h
kube-system        endpoint-controller                   1         17h
kube-system        expand-controller                     1         17h
kube-system        generic-garbage-collector             1         17h
kube-system        horizontal-pod-autoscaler             1         17h
kube-system        job-controller                        1         17h
kube-system        kube-proxy                            1         17h
kube-system        namespace-controller                  1         17h
kube-system        node-controller                       1         17h
kube-system        persistent-volume-binder              1         17h
kube-system        pod-garbage-collector                 1         17h
```

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Deployment Manifest

```yaml
pods/pod-projected-svc-token.yaml

apiVersion: v1
kind: Pod
metadata:
  name: nginx
spec:
  containers:
  - image: nginx
    name: nginx
    volumeMounts:
    - mountPath: /var/run/secrets/tokens
      name: vault-token
  serviceAccountName: build-robot
```

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Deployment Manifest

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
  namespace: kube-system
spec:
  selector:
    matchLabels:
      app.kubernetes.io/name: alb-ingress-controller
  template:
    metadata:
      labels:
        app.kubernetes.io/name: alb-ingress-controller
    spec:
      containers:
        - name: alb-ingress-controller
          args:
          image: docker.io/amazon/aws-alb-ingress-controller:v1.1.4
      serviceAccountName: alb-ingress-controller
```

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Service Account IAM Mapping

```
AdminRole:~/environment $ kubectl describe sa alb-ingress-controller -n 2048-game
Name:                alb-ingress-controller
Namespace:           2048-game
Labels:              <none>
Annotations:         eks.amazonaws.com/role-arn: arn:aws:iam::708523690135:role/eksctl-fargate-cluster-addon-iamserviceac
cou-Role1-KYVDLO1VZSIM
Image pull secrets:  <none>
Mountable secrets:   alb-ingress-controller-token-v4x29
Tokens:              alb-ingress-controller-token-v4x29
Events:              <none>
```

IAM Role

Visual editor | JSON | Import managed policy

```
1  {
2      "Version": "2012-10-17",
3      "Statement": [
4          {
5              "Effect": "Allow",
6              "Action": [
7                  "acm:DescribeCertificate",
8                  "acm:ListCertificates",
9                  "acm:GetCertificate"
10             ],
11             "Resource": "*"
12         },
13         {
14             "Effect": "Allow",
15             "Action": [
16                 "ec2:AuthorizeSecurityGroupIngress",
17                 "ec2:CreateSecurityGroup",
18                 "ec2:CreateTags",
19                 "ec2:DeleteTags",
20                 "ec2:DeleteSecurityGroup",
```

Policies attached to the Role

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Service Account and Cluster

- IAM Role is all about specific implementation (AWS in this case)
- Pods need Kubernetes Cluster access as well
- ClusterRoles grant access to cluster-specific resources
  - Create/Delete/List/etc. Nodes
  - Create/Delete/List/etc. Pods
  - Create/Delete/List/etc. Namespaces
  - etc.

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Service Account and Cluster

```
AdminRole:~/environment $ kubectl get clusterrole
NAME                                                                   AGE
admin                                                                  17h
alb-ingress-controller                                                 16h
aws-node                                                               17h
cluster-admin                                                          17h
edit                                                                   17h
eks:fargate-manager                                                    17h
eks:node-bootstrapper                                                  17h
eks:node-manager                                                       17h
eks:podsecuritypolicy:privileged                                       17h
system:aggregate-to-admin                                              17h
system:aggregate-to-edit                                               17h
system:aggregate-to-view                                               17h
system:auth-delegator                                                  17h
system:basic-user                                                      17h
system:certificates.k8s.io:certificatesigningrequests:nodeclient       17h
system:certificates.k8s.io:certificatesigningrequests:selfnodeclient   17h
system:controller:attachdetach-controller                              17h
system:controller:certificate-controller                               17h
system:controller:clusterrole-aggregation-controller                   17h
system:controller:cronjob-controller                                   17h
system:controller:daemon-set-controller                                17h
system:controller:deployment-controller                                17h
system:controller:disruption-controller                                17h
system:controller:endpoint-controller                                  17h
system:controller:expand-controller                                    17h
system:controller:generic-garbage-collector                            17h
system:controller:horizontal-pod-autoscaler                            17h
```

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ClusterRole admin

```
AdminRole:~/environment $ kubectl describe clusterrole admin
Name:         admin
Labels:       kubernetes.io/bootstrapping=rbac-defaults
Annotations:  rbac.authorization.kubernetes.io/autoupdate: true
PolicyRule:
  Resources                                       Non-Resource URLs  Resource Names  Verbs
  ---------                                       -----------------  --------------  -----
  rolebindings.rbac.authorization.k8s.io          []                 []              [create delete deletecollection get list patch update watch]
  roles.rbac.authorization.k8s.io                 []                 []              [create delete deletecollection get list patch update watch]
  configmaps                                      []                 []              [create delete deletecollection patch update get list watch]
  endpoints                                       []                 []              [create delete deletecollection patch update get list watch]
  persistentvolumeclaims                          []                 []              [create delete deletecollection patch update get list watch]
  pods                                            []                 []              [create delete deletecollection patch update get list watch]
  replicationcontrollers/scale                    []                 []              [create delete deletecollection patch update get list watch]
  replicationcontrollers                          []                 []              [create delete deletecollection patch update get list watch]
  services                                        []                 []              [create delete deletecollection patch update get list watch]
  daemonsets.apps                                 []                 []              [create delete deletecollection patch update get list watch]
  deployments.apps/scale                          []                 []              [create delete deletecollection patch update get list watch]
  deployments.apps                                []                 []              [create delete deletecollection patch update get list watch]
  replicasets.apps/scale                          []                 []              [create delete deletecollection patch update get list watch]
  replicasets.apps                                []                 []              [create delete deletecollection patch update get list watch]
  statefulsets.apps/scale                         []                 []              [create delete deletecollection patch update get list watch]
  statefulsets.apps                               []                 []              [create delete deletecollection patch update get list watch]
  horizontalpodautoscalers.autoscaling            []                 []              [create delete deletecollection patch update get list watch]
  cronjobs.batch                                  []                 []              [create delete deletecollection patch update get list watch]
  jobs.batch                                      []                 []              [create delete deletecollection patch update get list watch]
  daemonsets.extensions                           []                 []              [create delete deletecollection patch update get list watch]
  deployments.extensions/scale                    []                 []              [create delete deletecollection patch update get list watch]
  deployments.extensions                          []                 []              [create delete deletecollection patch update get list watch]
```

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ClusterRole admin contd..

```
daemonsets.extensions                                  []                  []                  [create delete deletecollection patch update get list watch]
deployments.extensions/scale                           []                  []                  [create delete deletecollection patch update get list watch]
deployments.extensions                                 []                  []                  [create delete deletecollection patch update get list watch]
ingresses.extensions                                   []                  []                  [create delete deletecollection patch update get list watch]
networkpolicies.extensions                             []                  []                  [create delete deletecollection patch update get list watch]
replicasets.extensions/scale                           []                  []                  [create delete deletecollection patch update get list watch]
replicasets.extensions                                 []                  []                  [create delete deletecollection patch update get list watch]
replicationcontrollers.extensions/scale                []                  []                  [create delete deletecollection patch update get list watch]
ingresses.networking.k8s.io                            []                  []                  [create delete deletecollection patch update get list watch]
networkpolicies.networking.k8s.io                      []                  []                  [create delete deletecollection patch update get list watch]
poddisruptionbudgets.policy                            []                  []                  [create delete deletecollection patch update get list watch]
deployments.apps/rollback                              []                  []                  [create delete deletecollection patch update]
deployments.extensions/rollback                        []                  []                  [create delete deletecollection patch update]
localsubjectaccessreviews.authorization.k8s.io         []                  []                  [create]
pods/attach                                            []                  []                  [get list watch create delete deletecollection patch update]
pods/exec                                              []                  []                  [get list watch create delete deletecollection patch update]
pods/portforward                                       []                  []                  [get list watch create delete deletecollection patch update]
pods/proxy                                             []                  []                  [get list watch create delete deletecollection patch update]
secrets                                                []                  []                  [get list watch create delete deletecollection patch update]
services/proxy                                         []                  []                  [get list watch create delete deletecollection patch update]
bindings                                               []                  []                  [get list watch]
events                                                 []                  []                  [get list watch]
limitranges                                            []                  []                  [get list watch]
namespaces/status                                      []                  []                  [get list watch]
namespaces                                             []                  []                  [get list watch]
pods/log                                               []                  []                  [get list watch]
pods/status                                            []                  []                  [get list watch]
replicationcontrollers/status                          []                  []                  [get list watch]
resourcequotas/status                                  []                  []                  [get list watch]
resourcequotas                                         []                  []                  [get list watch]
```

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User Defined ClusterRole

```
AdminRole:~/environment $ kubectl get clusterrole
NAME                                                                   AGE
admin                                                                  17h
alb-ingress-controller                                                 16h
aws-node                                                               17h
cluster-admin                                                          17h
edit                                                                   17h
eks:fargate-manager                                                    17h
eks:node-bootstrapper                                                  17h
eks:node-manager                                                       17h
eks:podsecuritypolicy:privileged                                       17h
system:aggregate-to-admin                                              17h
system:aggregate-to-edit                                               17h
system:aggregate-to-view                                               17h
system:auth-delegator                                                  17h
system:basic-user                                                      17h
system:certificates.k8s.io:certificatesigningrequests:nodeclient       17h
system:certificates.k8s.io:certificatesigningrequests:selfnodeclient   17h
system:controller:attachdetach-controller                              17h
system:controller:certificate-controller                               17h
system:controller:clusterrole-aggregation-controller                   17h
system:controller:cronjob-controller                                   17h
system:controller:daemon-set-controller                                17h
system:controller:deployment-controller                                17h
system:controller:disruption-controller                                17h
system:controller:endpoint-controller                                  17h
system:controller:expand-controller                                    17h
system:controller:generic-garbage-collector                            17h
system:controller:horizontal-pod-autoscaler                            17h
```

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User Defined ClusterRole

```
AdminRole:~/environment $ kubectl describe clusterrole alb-ingress-controller
Name:         alb-ingress-controller
Labels:       app.kubernetes.io/name=alb-ingress-controller
Annotations:  kubectl.kubernetes.io/last-applied-configuration:
                {"apiVersion":"rbac.authorization.k8s.io/v1","kind":"ClusterRole","metadata":{"annotations":{},"labels":{"app.kubernetes.io/name":"a
lb-ing...
PolicyRule:
  Resources                     Non-Resource URLs  Resource Names  Verbs
  ---------                     -----------------  --------------  -----
  services                      []                 []              [create get list update watch patch get list watch]
  services.extensions           []                 []              [create get list update watch patch get list watch]
  configmaps                    []                 []              [create get list update watch patch]
  endpoints                     []                 []              [create get list update watch patch]
  events                        []                 []              [create get list update watch patch]
  ingresses/status              []                 []              [create get list update watch patch]
  ingresses                     []                 []              [create get list update watch patch]
  configmaps.extensions         []                 []              [create get list update watch patch]
  endpoints.extensions          []                 []              [create get list update watch patch]
  events.extensions             []                 []              [create get list update watch patch]
  ingresses.extensions/status   []                 []              [create get list update watch patch]
  ingresses.extensions          []                 []              [create get list update watch patch]
  namespaces                    []                 []              [get list watch]
  nodes                         []                 []              [get list watch]
  pods                          []                 []              [get list watch]
  secrets                       []                 []              [get list watch]
  namespaces.extensions         []                 []              [get list watch]
  nodes.extensions              []                 []              [get list watch]
  pods.extensions               []                 []              [get list watch]
  secrets.extensions            []                 []              [get list watch]
```

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ClusterRole Manifest & ClusterRoleBinding

```yaml
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
rules:
  - apiGroups:
      - ""
      - extensions
    resources:
      - configmaps
      - endpoints
      - events
      - ingresses
      - ingresses/status
      - services
    verbs:
      - create
      - get
      - list
      - update
      - watch
      - patch
  - apiGroups:
      - ""
      - extensions
    resources:
      - nodes
      - pods
      - secrets
      - services
      - namespaces
    verbs:
      - get
      - list
      - watch
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: alb-ingress-controller
subjects:
  - kind: ServiceAccount
    name: alb-ingress-controller
    namespace: kube-system
---
apiVersion: v1
kind: ServiceAccount
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
  namespace: kube-system
...
```

Create ClusterRole

Tie ClusterRole And Service Account ClusterRoleBinding

Create Service Account

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Bringing Them All Together!

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
rules:
  - apiGroups:
      - ""
      - extensions
    resources:
      - configmaps
      - endpoints
      - events
      - ingresses
      - ingresses/status
      - services
    verbs:
      - create
      - get
      - list
      - update
      - watch
      - patch
  - apiGroups:
      - ""
      - extensions
    resources:
      - nodes
      - pods
      - secrets
      - services
      - namespaces
    verbs:
      - get
      - list
      - watch
---
```

Create ClusterRole

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: alb-ingress-controller
subjects:
  - kind: ServiceAccount
    name: alb-ingress-controller
    namespace: 2048-game
---
```

Tie ClusterRole And Service Account
ClusterRoleBinding

```yaml
apiVersion: v1
kind: ServiceAccount
metadata:
  labels:
    app.kubernetes.io/name: alb-ingress-controller
  name: alb-ingress-controller
  namespace: 2048-game
```

Create Service Account

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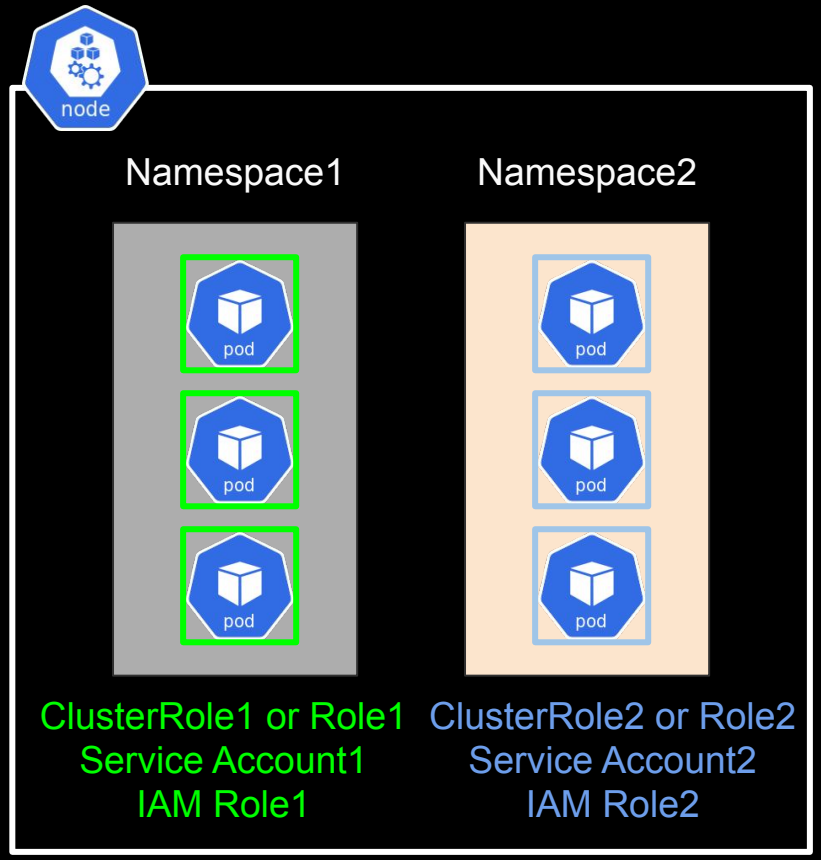
What does this buy us?



- Each application can have different access
- Node IAM Role doesn't have to have ALL access
- Secure and Granular Design
- Also known as IRSA (IAM Roles for Service Accounts) - replaces kube2iam

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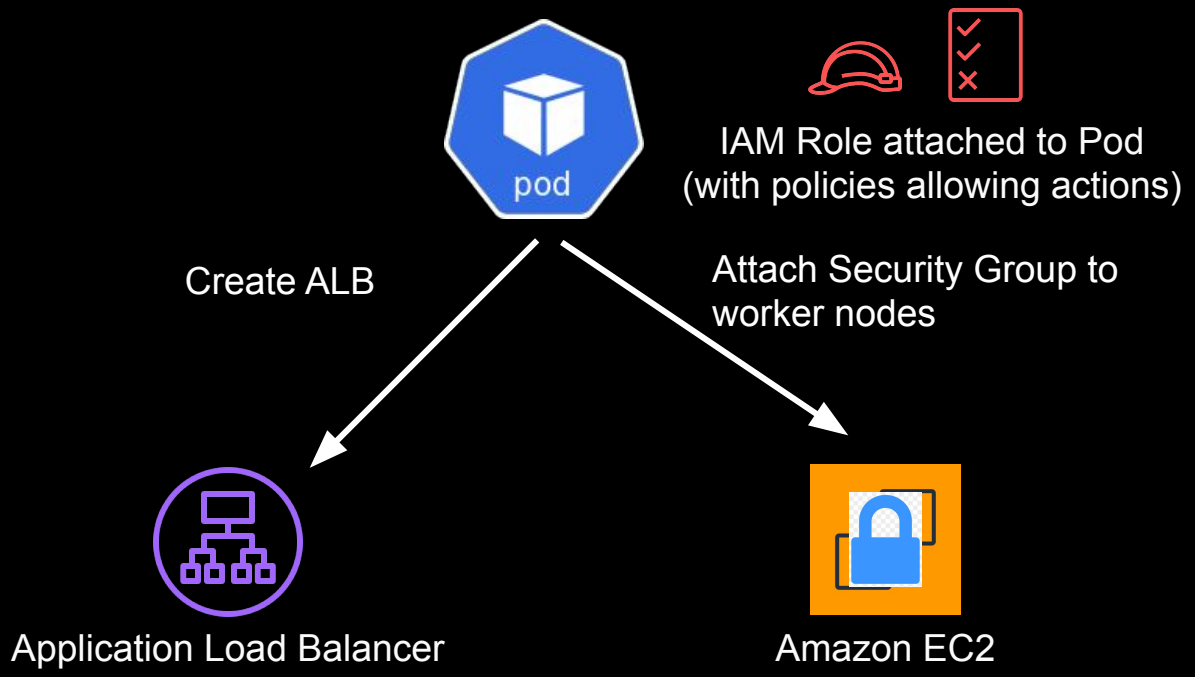
Your App Running in Pod



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What About YOU?

You!

Admin of course!

DevOps Person

Granular Permission
[create, get, list, update, delete, watch, patch] On [deployments, replicasets, pods]

Amazon Elastic Kubernetes Service

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What About YOU?

You!

Admin of course!

Amazon Elastic Kubernetes Service

- K8s has a predefined Role/Group for Admin (system:masters)
- Map AWS IAM username to K8s username and Group (Configmap)

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ConfigMap/aws-auth

- Grant other AWS users permission to your cluster
- Grant AWS roles access to your cluster
- Works with RBAC
- Easier to understand with Demo!

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What About YOU?

You!

```yaml
apiVersion: v1
data:
  mapUsers: |
    - userarn: arn:aws:iam::719217631821:user/developertina
      username: developertina
      groups:
        - system:masters
kind: ConfigMap
```

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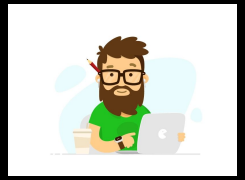
What About DevOps Person?



DevOps Person

Granular Permission in Namespace
[create, get, list, update, delete, watch, patch] On [deployments, replicasets, pods]

- Create K8s Role defining access to resources in namespace (Role)
- Map K8s username to Role (RoleBinding)
- Map AWS IAM username to K8s username and Group (Configmap/aws-auth)

Amazon Elastic Kubernetes Service

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Role Vs ClusterRole

- Both Role and ClusterRole represent set of permissions
- A Role sets permission within a particular namespace - have to specify namespace
- ClusterRole is non-namespaced

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What About DevOps Person?

DevOps Person

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: deployment-role
  namespace: frontend
rules:
  - apiGroups:
      - ""
      - extensions
      - apps
    resources:
      - deployments
      - replicasets
      - pods
    verbs:
      - create
      - get
      - list
      - update
      - delete
      - watch
      - patch
```

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: deployment-rolebinding
  namespace: frontend
roleRef:
  apiGroup: ""
  kind: Role
  name: deployment-role
subjects:
  - kind: User
    name: developerbob
    apiGroup: ""
```

```yaml
  mapUsers: |
    - userarn: arn:aws:iam::719217631821:user/developerbob
      username: developerbob
      groups:
        - deployment-role
kind: ConfigMap
```

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Kubernetes Security

RBAC

IRSA

RoleBinding

ClusterRole

ClusterRoleBinding

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Kubernetes Security

RBAC

IRSA

RoleBinding

ClusterRole

ClusterRoleBinding

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Cluster Authentication

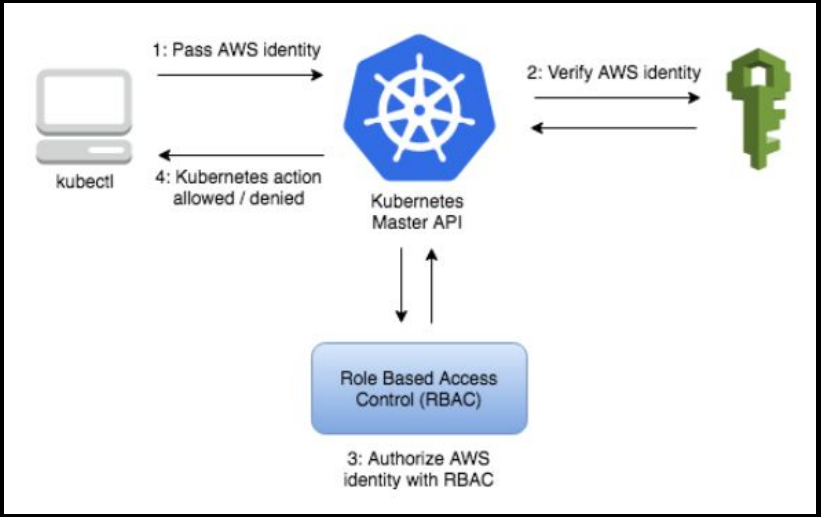

Image: https://docs.aws.amazon.com/eks/latest/userguide/managing-auth.html

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In The Early Days

- If Private Key is intercepted, cluster is vulnerable
- For each user, need to generate and maintain cert
- Management overhead

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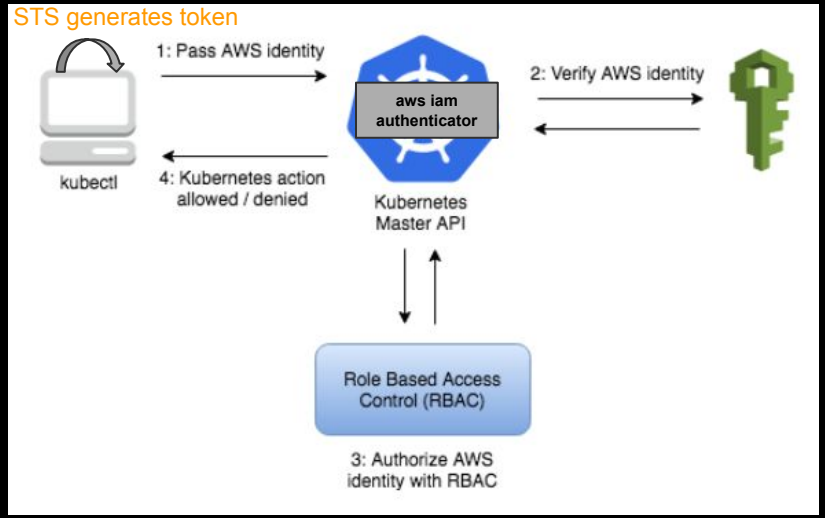
AWS IAM Authenticator



- Works with AWS IAM to authenticate to K8s cluster
- No separate credential provider required
- Removes overhead of creating certs for new users
- Works well with IAM Roles and RBAC

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AWS IAM Authenticator - Kubeconfig

```
[▶]  creating EKS cluster "exciting-mongoose-1587093191" in "us-west-2" region with un-managed nodes
[▶]  will create 2 separate CloudFormation stacks for cluster itself and the initial nodegroup
[▶]  if you encounter any issues, check CloudFormation console or try 'eksctl utils describe-stacks --region=us-west-2 --cluster=exciting-mon
goose-1587093191'
[▶]  CloudWatch logging will not be enabled for cluster "exciting-mongoose-1587093191" in "us-west-2"
[▶]  you can enable it with 'eksctl utils update-cluster-logging --region=us-west-2 --cluster=exciting-mongoose-1587093191'
[▶]  Kubernetes API endpoint access will use default of {publicAccess=true, privateAccess=false} for cluster "exciting-mongoose-1587093191" i
n "us-west-2"
[▶]  2 sequential tasks: { create cluster control plane "exciting-mongoose-1587093191", create nodegroup "ng-ed09bddb" }
[▶]  building cluster stack "eksctl-exciting-mongoose-1587093191-cluster"
[▶]  deploying stack "eksctl-exciting-mongoose-1587093191-cluster"
[▶]  building nodegroup stack "eksctl-exciting-mongoose-1587093191-nodegroup-ng-ed09bddb"
[▶]  --nodes-min=2 was set automatically for nodegroup ng-ed09bddb
[▶]  --nodes-max=2 was set automatically for nodegroup ng-ed09bddb
[▶]  deploying stack "eksctl-exciting-mongoose-1587093191-nodegroup-ng-ed09bddb"
[▶]  all EKS cluster resources for "exciting-mongoose-1587093191" have been created
[▶]  saved kubeconfig as "C:\\Users\\Ashdeep/.kube/config"
[▶]  adding identity "arn:aws:iam::719217631821:role/eksctl-exciting-mongoose-15870931-NodeInstanceRole-A9PRSS2R2HWG" to auth ConfigMap
[▶]  nodegroup "ng-ed09bddb" has 0 node(s)
[▶]  waiting for at least 2 node(s) to become ready in "ng-ed09bddb"
[▶]  nodegroup "ng-ed09bddb" has 2 node(s)
[▶]  node "ip-192-168-38-172.us-west-2.compute.internal" is ready
[▶]  node "ip-192-168-92-221.us-west-2.compute.internal" is ready
[▶]  kubectl command should work with "C:\\Users\\Ashdeep/.kube/config", try 'kubectl get nodes'
[▶]  EKS cluster "exciting-mongoose-1587093191" in "us-west-2" region is ready
```

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Giving Access To Your EKS Cluster

- Give Admin Access to Other IAM Users for Your Cluster
- Give Role Based Granular Access to Other IAM Users for Your Cluster

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Giving Admin Access

```
kubectl edit -n kube-system configmap/aws-auth
```

```
# Please edit the object below. Lines beginning with a '#' will be ignored,
# and an empty file will abort the edit. If an error occurs while saving this file will be
# reopened with the relevant failures.
#
apiVersion: v1
data:
  mapRoles: |
    - groups:
      - system:bootstrappers
      - system:nodes
      rolearn: arn:aws:iam::719217631821:role/eksctl-eks-access-test-nodegroup-NodeInstanceRole-1U4X1KCH9BEMJ
      username: system:node:{{EC2PrivateDNSName}}
  mapUsers: |
    []
kind: ConfigMap
metadata:
  creationTimestamp: "2020-06-01T18:56:49Z"
  name: aws-auth
  namespace: kube-system
  resourceVersion: "753"
  selfLink: /api/v1/namespaces/kube-system/configmaps/aws-auth
  uid: 9b0d3aef-efe6-4325-bb59-5c64ea5bff24
```

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Giving Access To Your EKS Cluster

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PREREQUISITE - WATCH K8S SECURITY FIRST

RBAC

IRSA

ClusterRole

ClusterRoleBinding

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KubeConfig

```
PS C:\UdemyVideos\k8_eks\resources> kubectl get pods
NAME                      READY   STATUS    RESTARTS   AGE
test-845595fffc-9cztc     1/1     Running   0          94s
test-845595fffc-jslmw     1/1     Running   0          94s
test-845595fffc-k8cml     1/1     Running   0          94s
PS C:\UdemyVideos\k8_eks\resources>
```

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KubeConfig

```
PS C:\UdemyVideos\k8_eks\resources\security> eksctl create cluster --name=udemy-ekscourse
[i]  eksctl version 0.20.0
[i]  using region us-west-2
[i]  setting availability zones to [us-west-2b us-west-2a us-west-2c]
```

```
[i]  deploying stack "eksctl-udemy-ekscourse-nodegroup-ng-81e0059a"
[i]  waiting for the control plane availability...
[✓]  saved kubeconfig as "C:\\Users\\Ashdeep/.kube/config"
[i]  no tasks
[✓]  all EKS cluster resources for "udemy-ekscourse" have been created
```

$HOME/.kube/config

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Life Without KubeConfig

```
kubectl get pods
        --server  my-eks-cluster:6443
        --client-key  admin.key
        --client-certificate admin.crt
        --certificate-authority-data <base64 encoded long string>
```

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KubeConfig File

Clusters	Contexts	Users
dev-ekscluster	MegaAdmin@dev-ekscluster	MegaAdmin
stage-ekscluster	MegaAdmin@prod-ekscluster	DevopsGuy
prod-ekscluster	DeveloperGal@stage-ekscluster	DeveloperGal
	DevopsGuy@dev-ekscluster	

current-context: MegaAdmin@dev-ekscluster

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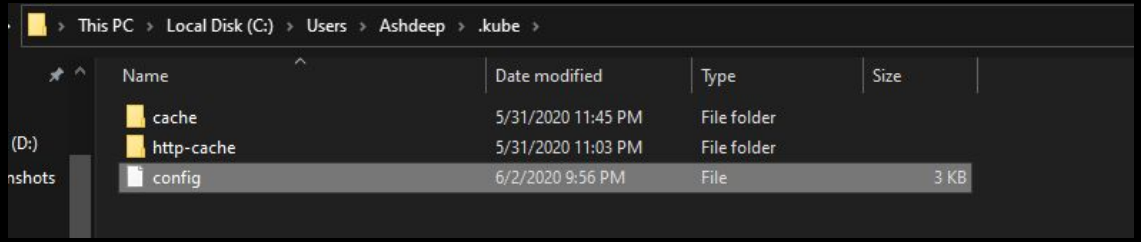
A Real KubeConfig File



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A Real KubeConfig File

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AWS Shared Responsibility Model

Security of the cloud - Responsibility of AWS

- Kubernetes Control Plane
  - Control Plane Nodes
  - etcd Database

Security in the cloud - Responsibility of You

- Security configuration of Data Plane
  - Security groups for traffic between EKS control plane and VPC
- Configuration of worker nodes and containers
- Worker node operating system (updates, security patches)
- Network controls - firewall rules
- Platform level identity and access
- Data in worker nodes

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IAM for EKS

Security of the cloud - Responsibility of AWS

- Kubernetes Control Plane
  - Control Plane Nodes
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- Platform level identity and access
- Data in worker nodes

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EKS Fargate

Amazon Elastic Container Service for Kubernetes

AWS Fargate

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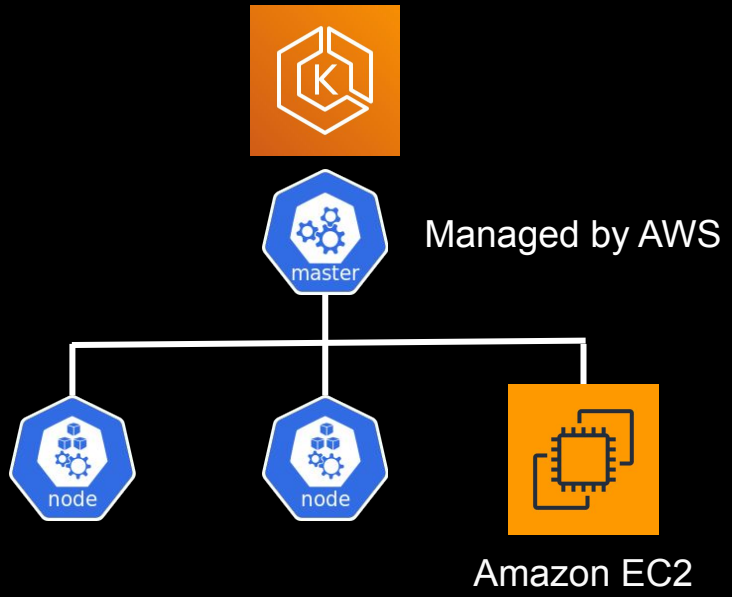
Why?



- At the end of the day, still have overhead of EC2
  - AMI Rehydration
  - Patching, Scaling, Securing
  - Focus on cost optimization

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EKS FARGATE

DEMO

VS

EKS

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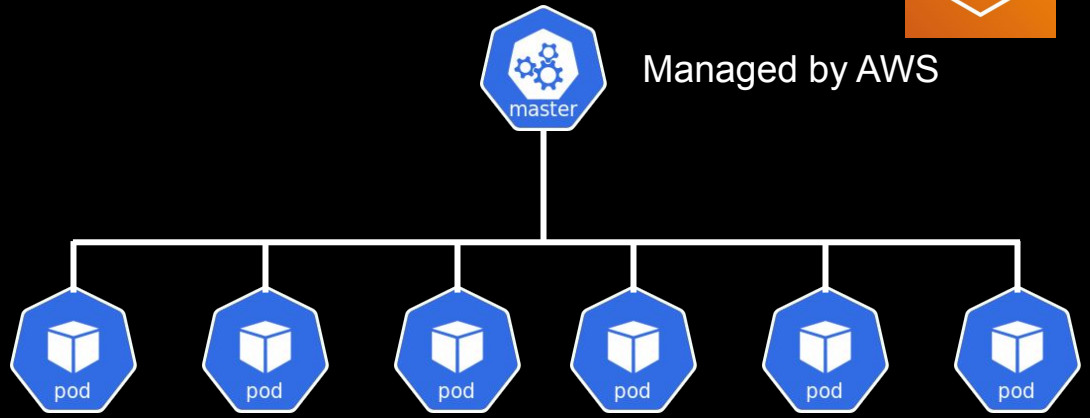
What is fargate



- Fargate
  - NO Worker Nodes to manage (Still require Control Plane)
  - Define and deploy your pods on Fargate
  - Possible to mix Fargate and regular EC2 based EKS cluster
  - HPA possible
  - Pay Control Plane Cost + (Pay per pod based on vCPU, Memory, Time)

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May 2020

EKS Worker

Control Plane runs on EKS

Worker Nodes runs on EC2, user need to manage Nodes

Pods can be exposed using Services (Load Balancer) And Ingress

Daemonsets are supported and used heavily

Able to run stateful apps (using EFS)

Wide range of workload dependant EC2 selection, e.g GPU

Can work in public and private subnet

EKS Fargate

Control Plane runs on EKS

No Worker Nodes required. Much less management overhead

Classic and NLBs not supported. Pods can be exposed using Ingress

Daemonsets are not supported. Need to run as Sidecar

Stateful apps not recommended

Can’t select workload specific underlying hardware, no GPU. Max Pod size 4 vCPU and 30 Gb memory per pod

Only works in private subnet

Contd..

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May 2020

EKS Worker

HostPort or HostNetwork supported for Pods

CNI Custom Networking possible

Cost?

Control Plane + Worker EC2 Cost
(Possibility to have more idle cost)

EKS Cluster with 2 m5.large EC2
= Control Plane Cost + Worker Nodes Cost
Control Plane Cost
= $0.10/hour X 24 Hours X 30 Days
= $72/Month
Worker Nodes Cost
= ($0.096/hour X 24 Hours X 30 Days) X 2
= $138.24/Month
Total Cost/Month
= $72 + $138.24 = **$210.24/Month**

EKS Fargate

HostPort or HostNetwork not supported for Pods

CNI Custom Networking not possible

Cost?

Control Plane + Cost to run Pods
(Leaning towards pay per use model)

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May 2020

EKS Fargate

Pod cost per vCPU per hour = $0.04048
Pod cost per GB memory per hour = $0.004445

CPU	Memory Values
0.25 vCPU	0.5GB, 1GB, and 2GB
0.5 vCPU	Min. 1GB and Max. 4GB, in 1GB increments
1 vCPU	Min. 2GB and Max. 8GB, in 1GB increments
2 vCPU	Min. 4GB and Max. 16GB, in 1GB increments
4 vCPU	Min. 8GB and Max. 30GB, in 1GB increments

Pricing is per second with 1 minute minimum

Pricing Case 1

20 Pods, using 1vCPU, 2GB memory each, ran for 10 minutes, every day of month

= Control Plane Cost + Fargate Pods Cost

Control Plane Cost

= $0.10/hour X 24 Hours X 30 Days

= $72/Month

Fargate Pod vCPU Cost

= # of pods X # vCPUs X price per CPU-second X CPU duration per day in seconds X # of days

= 20 pods X (1 vCPU X ($0.04048/(60 X 60) seconds) X 600 seconds X 30 days

= $4.04/Month

Fargate Pod memory Cost

= # of pods X # memory in GB X price per GB-second X memory duration per day in seconds X # of days

=20 X 2 X ($0.004445/(60X60)) X 600 X 30 days

= $0.889

Total Cost/Month = $72 + $4.04 + $0.889

= **$76.92/Month**

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May 2020

EKS Fargate

Pod cost per vCPU per hour = $0.04048
Pod cost per GB memory per hour = $0.004445

CPU	Memory Values
0.25 vCPU	0.5GB, 1GB, and 2GB
0.5 vCPU	Min. 1GB and Max. 4GB, in 1GB increments
1 vCPU	Min. 2GB and Max. 8GB, in 1GB increments
2 vCPU	Min. 4GB and Max. 16GB, in 1GB increments
4 vCPU	Min. 8GB and Max. 30GB, in 1GB increments

Pricing is per second with 1 minute minimum

Pricing Case 2

20 Pods, using 1vCPU, 2GB memory each, ran for 12 hours, every day of month

= Control Plane Cost + Fargate Pods Cost

Control Plane Cost

= $0.10/hour X 24 Hours X 30 Days

= $72/Month

Fargate Pod vCPU Cost

= # of pods X # vCPUs X price per CPU-second X CPU duration per day in seconds X # of days

= 20 pods X (1 vCPU X ($0.04048/(60 X 60) seconds) X 43200 seconds X 30 days

= $291.45/Month

Fargate Pod memory Cost

= # of pods X # memory in GB X price per GB-second X memory duration per day in seconds X # of days

=20 X 2 X ($0.004445/(60X60)) X 43200 X 30 days

= $64.00

Total Cost/Month = $72 + $291.45 + $64.00

= **$427.45/Month**

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“We don’t believe in one tool to rule the world. We want you to use the right tool for the right job.”—Andy Jassy, CEO of AWS

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EKS DevOps

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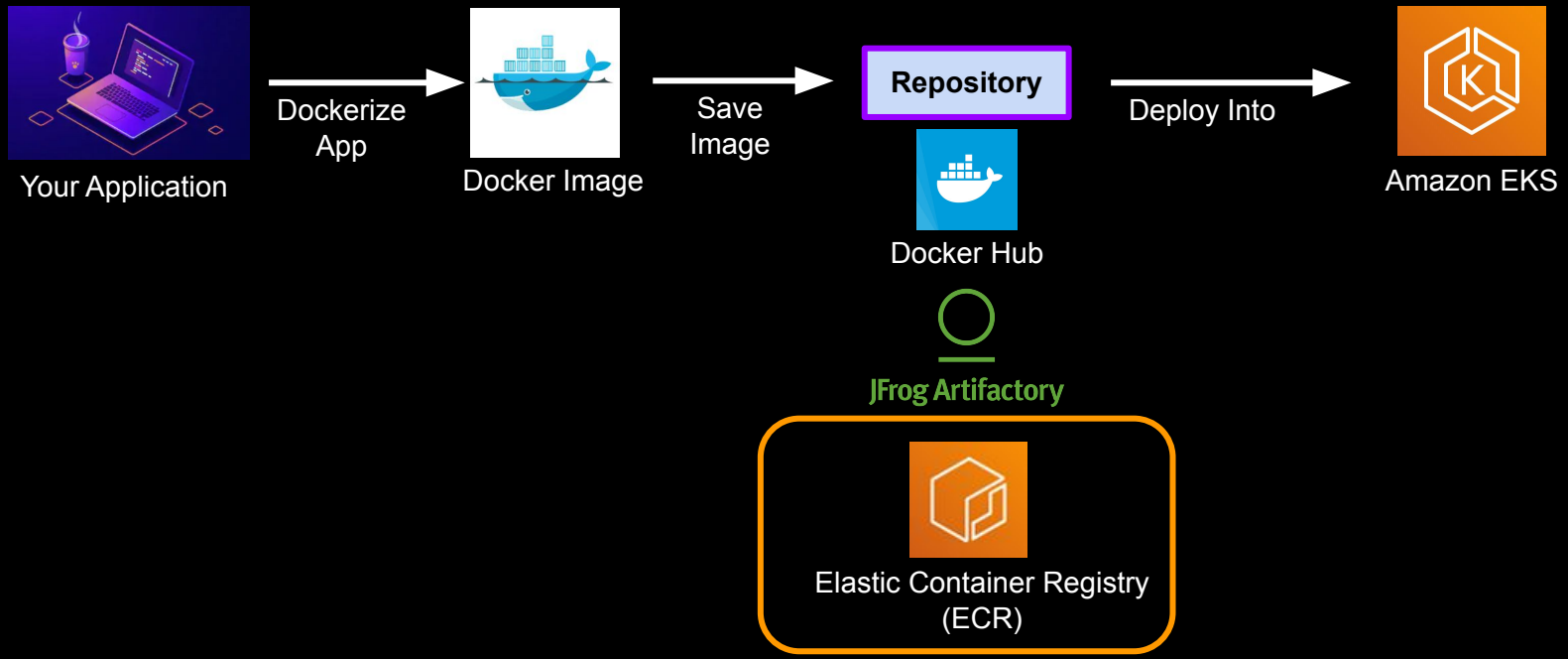
ECR - In Big Picture



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ECR - What And Why

- Docker Container Registry to store, manage, and deploy container images
- Fully Managed And Scalable
- Secure
- Highly Available
- Simplified Workflow
- No Upfront Fee Or Commitments

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How ECR Works

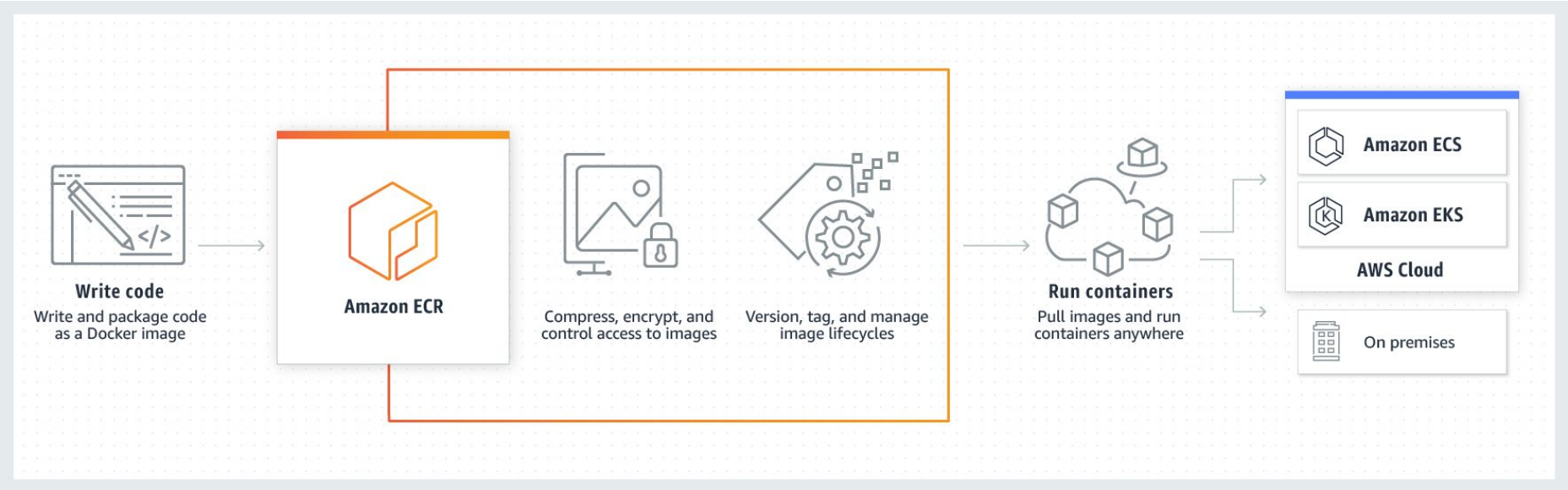

Image: https://aws.amazon.com/ecr/

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DEMO TIME!

- Dockerize Sample App
- Save image in ECR
- Deploy in EKS

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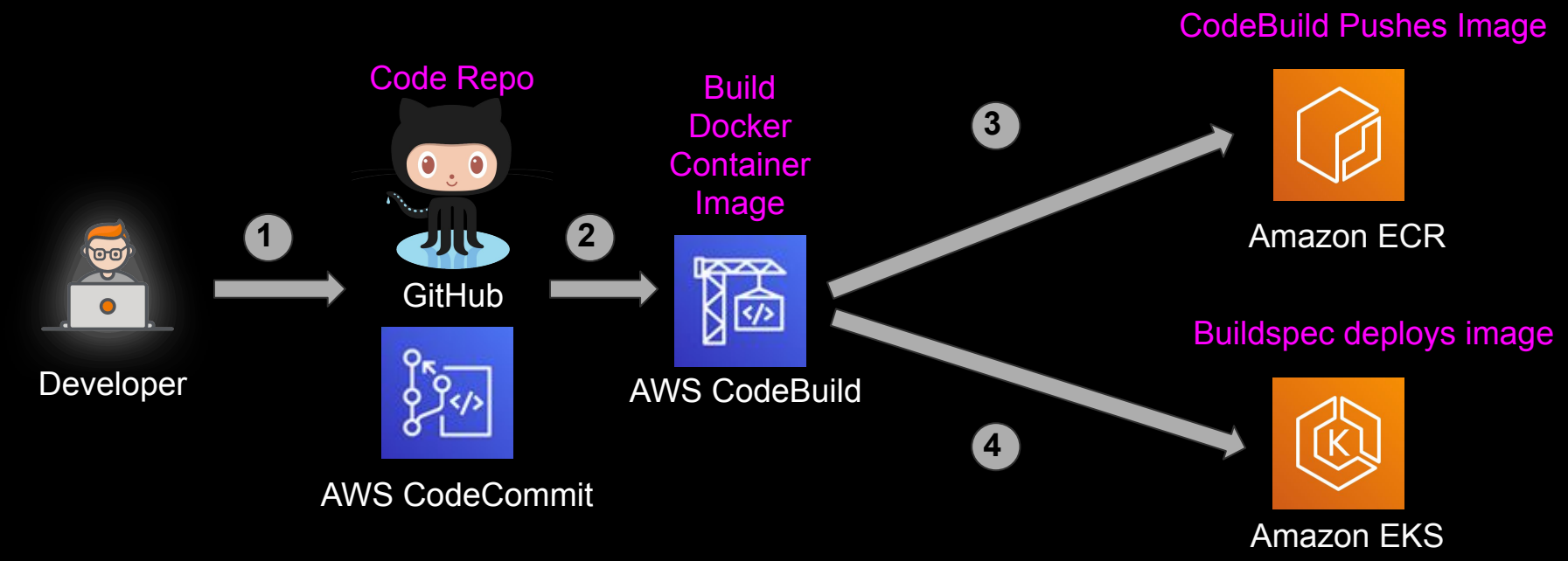
CI/CD Flow-1 for EKS



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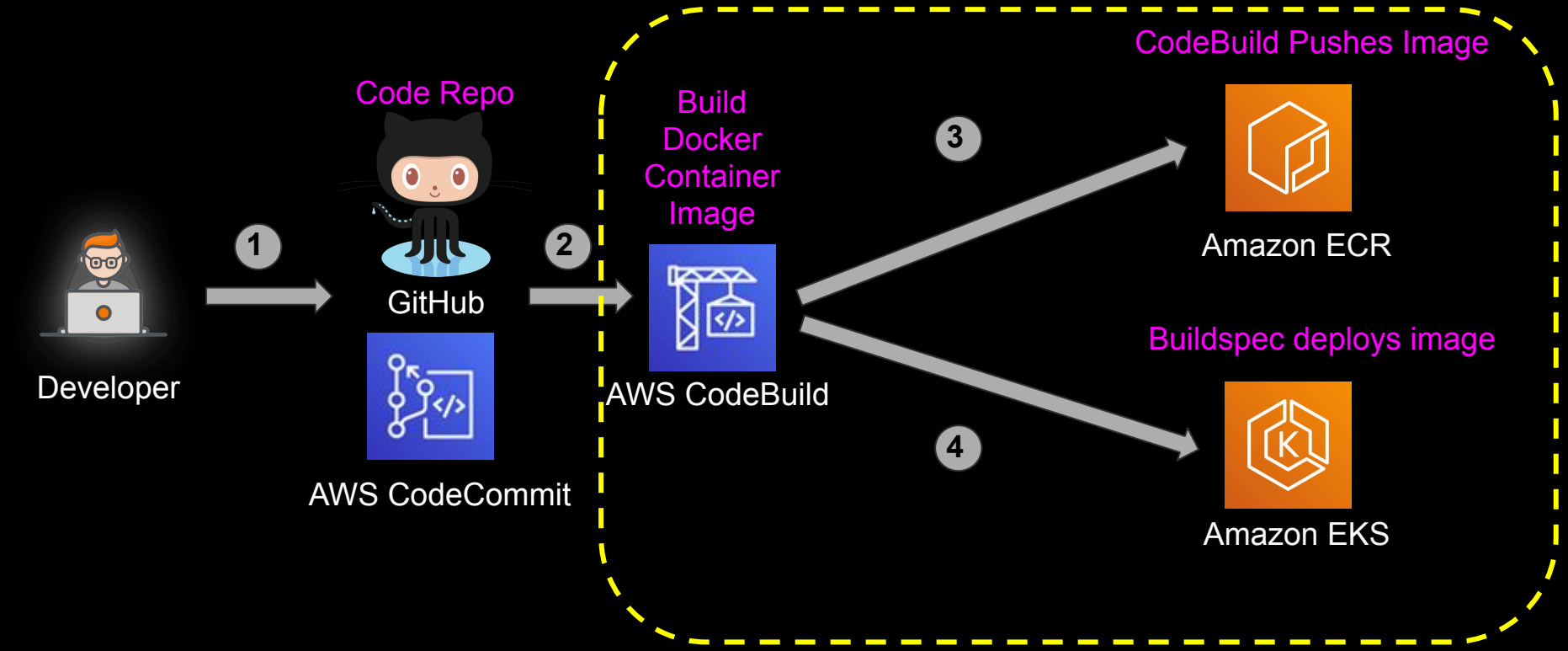
CI/CD Flow-1 for EKS



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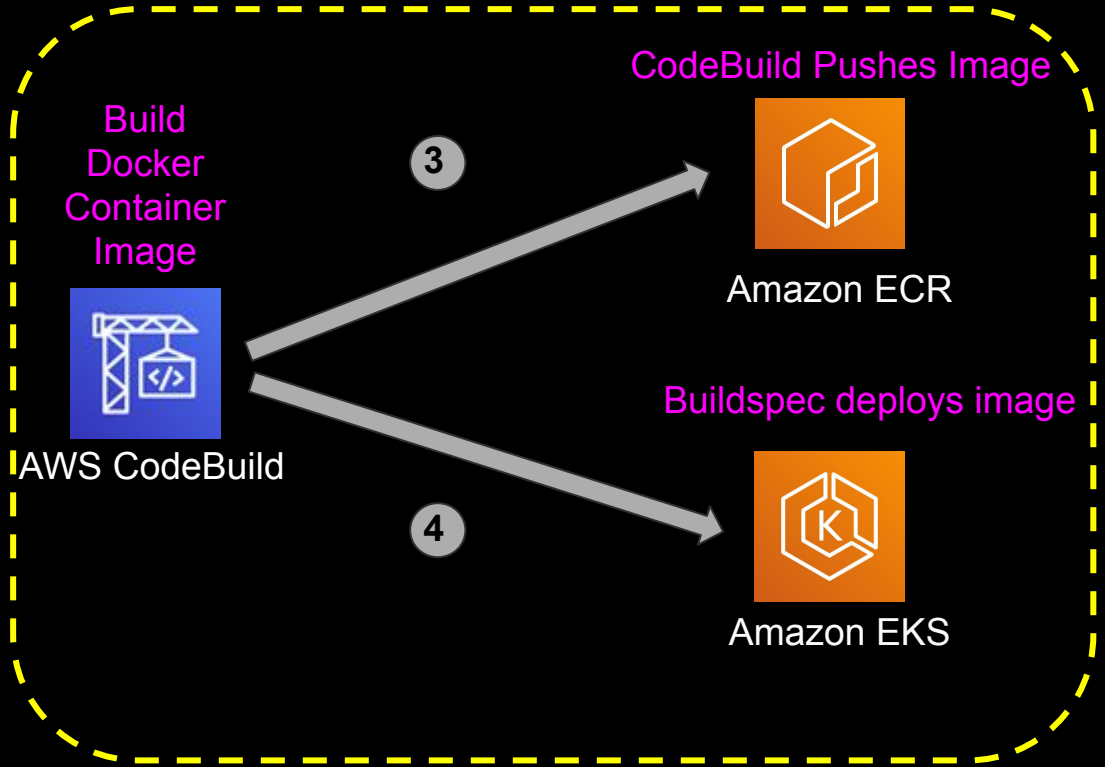
Understanding Buildspec



buildspec.yml
(run any bash command!)

```
build:
  commands:
    - docker build --tag $REPOSITORY_URI:$TAG .
```

```
- docker push $REPOSITORY_URI:$TAG
```

Application container image in Amazon ECR

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Understanding Buildspec Flow

hello-k8s.yml

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: hello-k8s
spec:
  replicas: 3
  strategy:
    type: RollingUpdate
    rollingUpdate:
      maxUnavailable: 2
      maxSurge: 2
  selector:
    matchLabels:
      app: hello-k8s
  template:
    metadata:
      labels:
        app: hello-k8s
    spec:
      containers:
        - name: hello-k8s
          image: CONTAINER_IMAGE
          securityContext:
            privileged: false
            readOnlyRootFilesystem: true
            allowPrivilegeEscalation: false
          ports:
            - containerPort: 8080
```

buildspec.yml
(run any bash command!)

```yaml
build:
  commands:
    - docker build --tag $REPOSITORY_URI:$TAG .
```

```
- docker push $REPOSITORY_URI:$TAG
```

Application container image in Amazon ECR

```
- sed -i 's@CONTAINER_IMAGE@'"$REPOSITORY_URI:$TAG"'@' hello-k8s.yml
```

(replace CONTAINER_IMAGE with actual image with tags)

```
- kubectl apply -f hello-k8s.yml
```

New Image deployed into EKS

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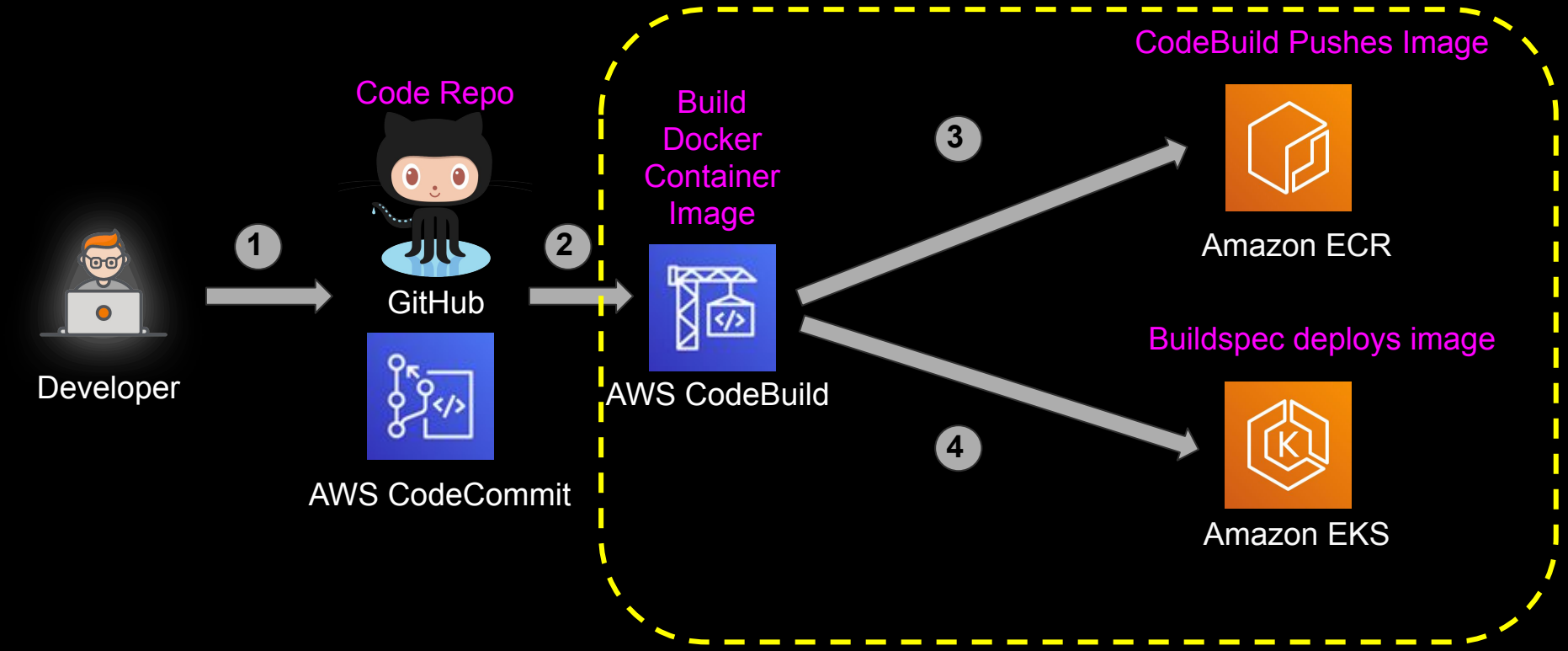
CI/CD Flow-1 for EKS



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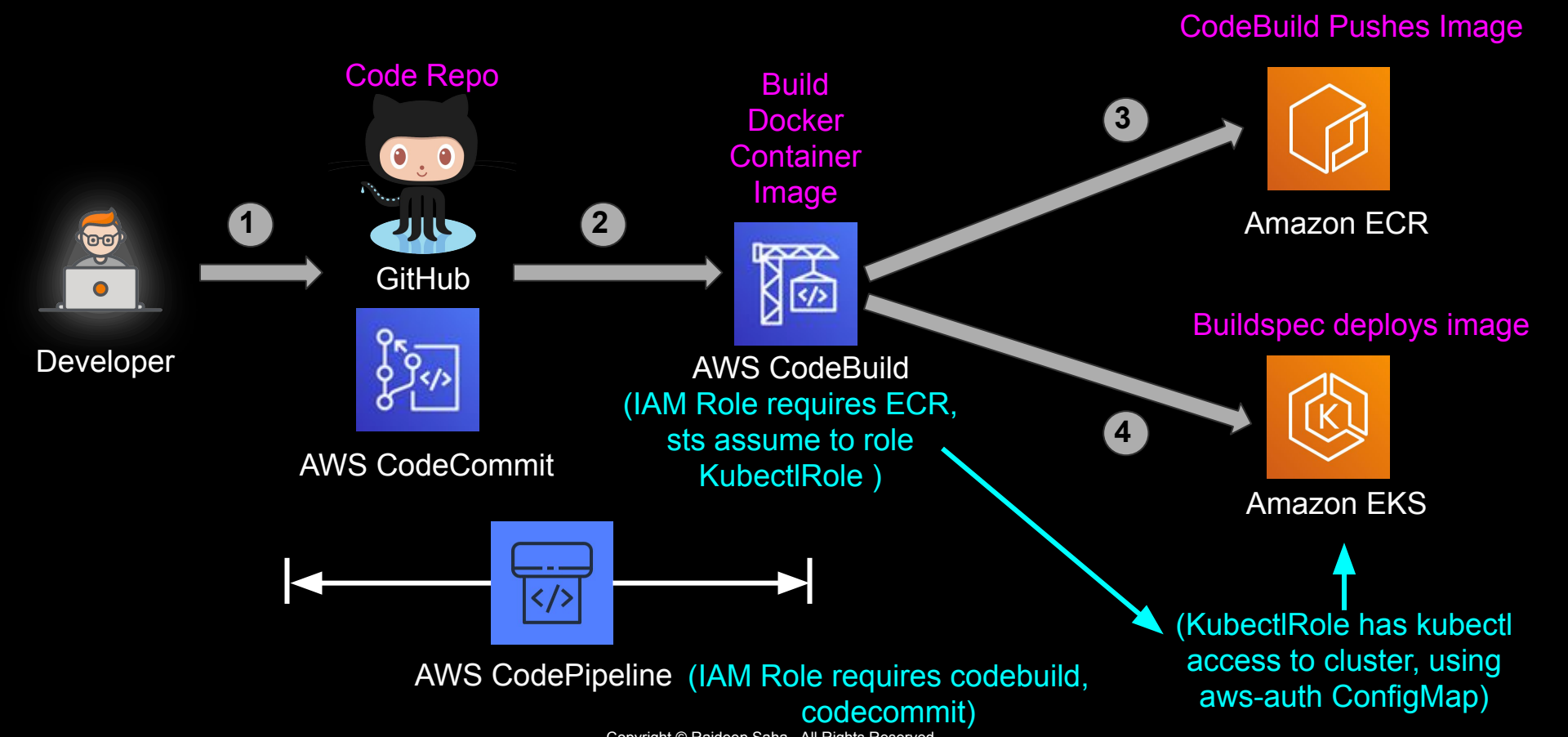
The Mundane (Admin) Part!



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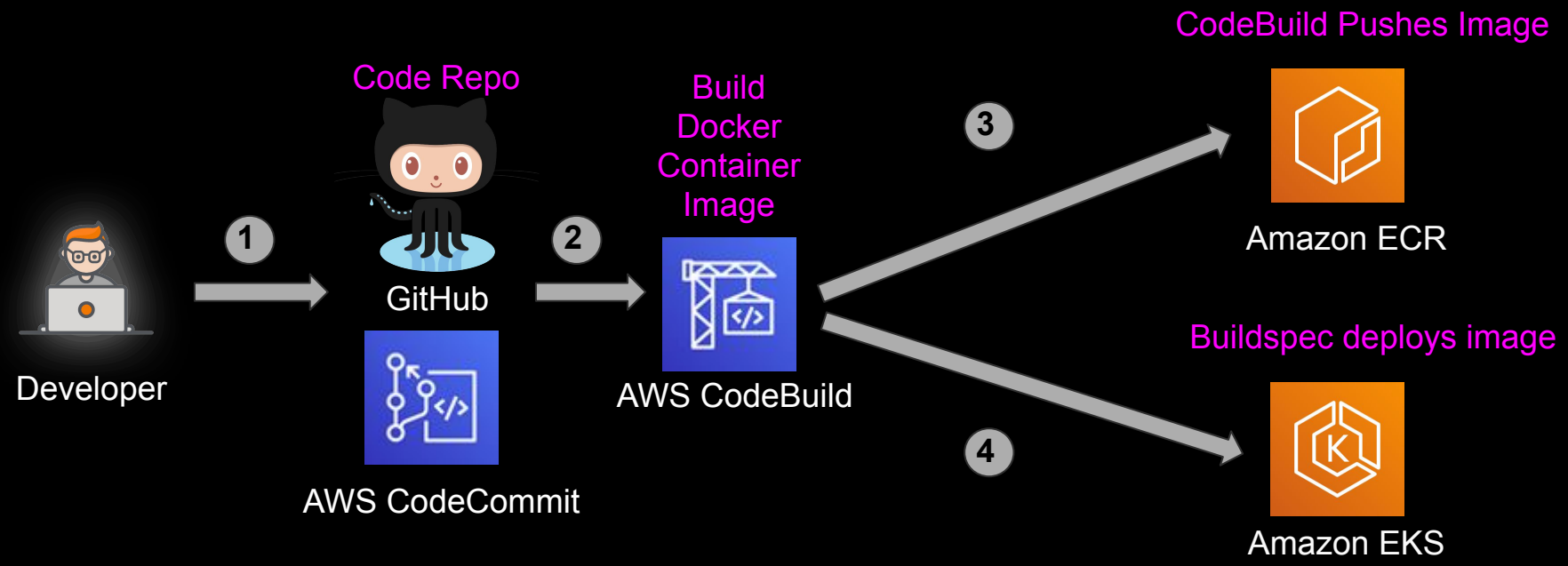
CI/CD Flow-1 for EKS DEMO



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CI/CD Flow-1 for EKS DEMO

Part 1 - IAM and Setup

- Create IAM Roles for
  - CodePipeline
  - CodeBuild
  - Kubectl role
- Edit configmap to give access to Kubectl role

Part 2 - Pipeline

- Create CodePipeline pipeline
- Discuss relevant files
  - Dockerfile
  - Buildspec
- Run the pipeline

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CI/CD Flow-1 for EKS DEMO

Part 1 - IAM and Setup

- Create IAM Roles for
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CI/CD Flow-1 for EKS DEMO

Part 1 - IAM and Setup

- Create IAM Roles for
  - CodePipeline
  - CodeBuild
  - Kubectl role
- Edit configmap to give access to Kubectl role

Part 2 - Pipeline

- Create CodePipeline pipeline
- Discuss relevant files
  - Dockerfile
  - Buildspec
- Run the pipeline

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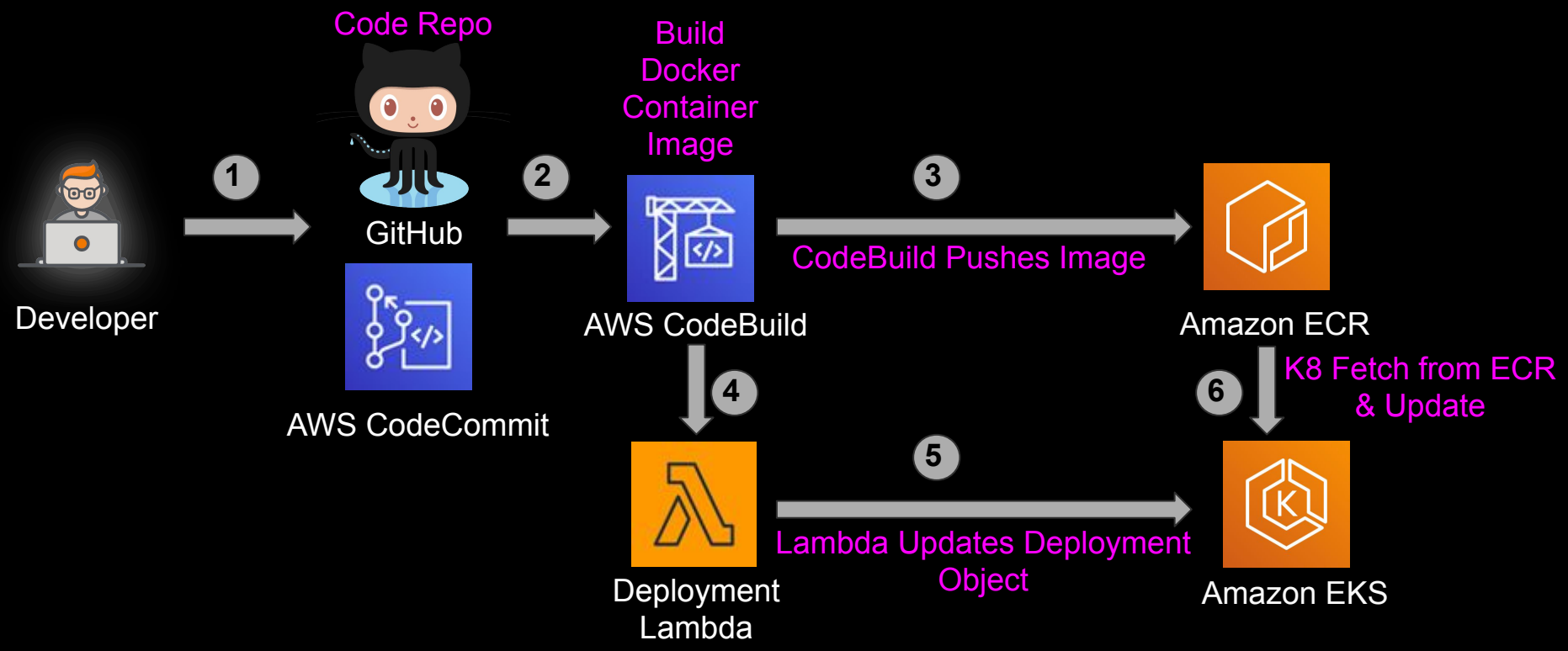
CI/CD Flow-2 for EKS



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Real World

Stateless App

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Guest Book Application

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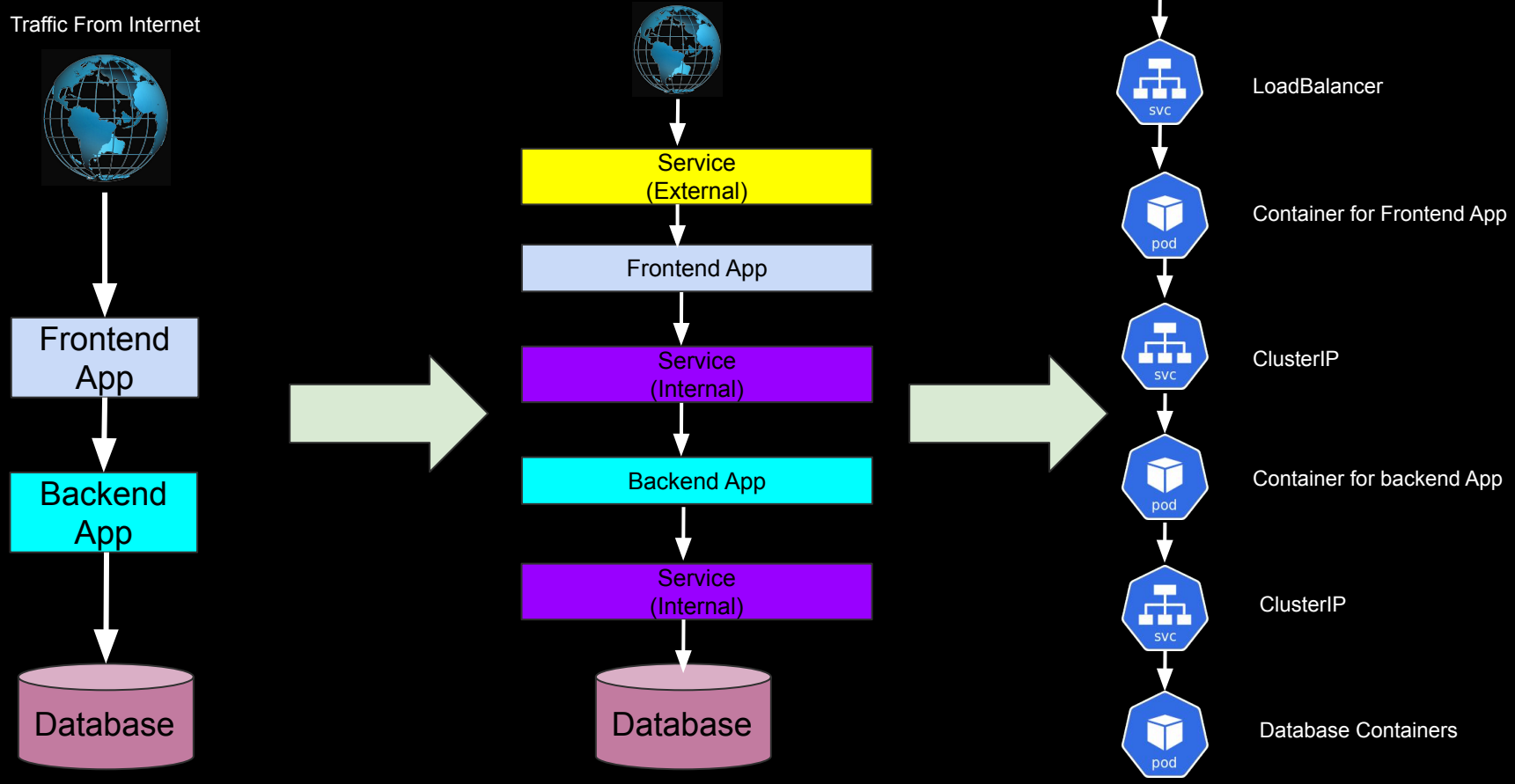
The Big Picture

Think about the concepts and not a specific solution!



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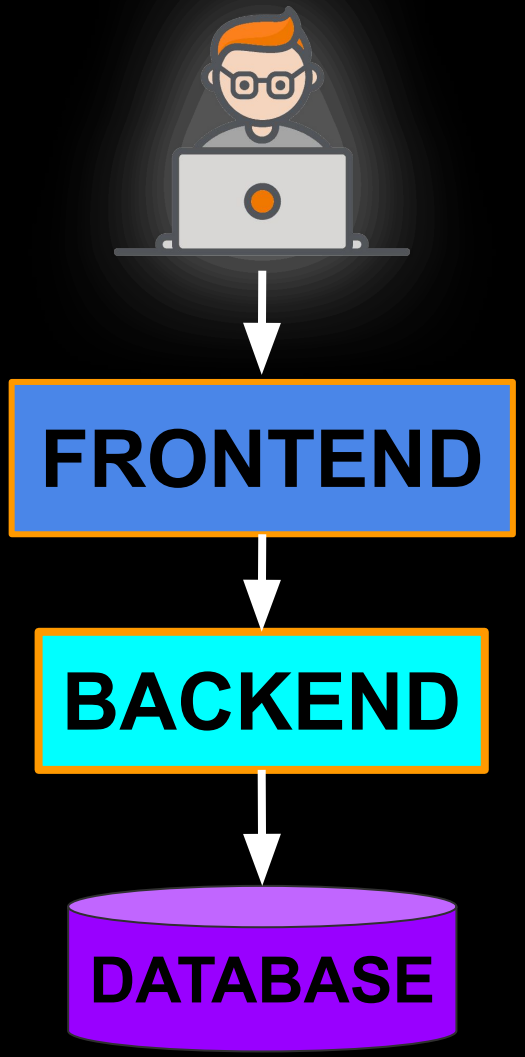

HOW ??!!

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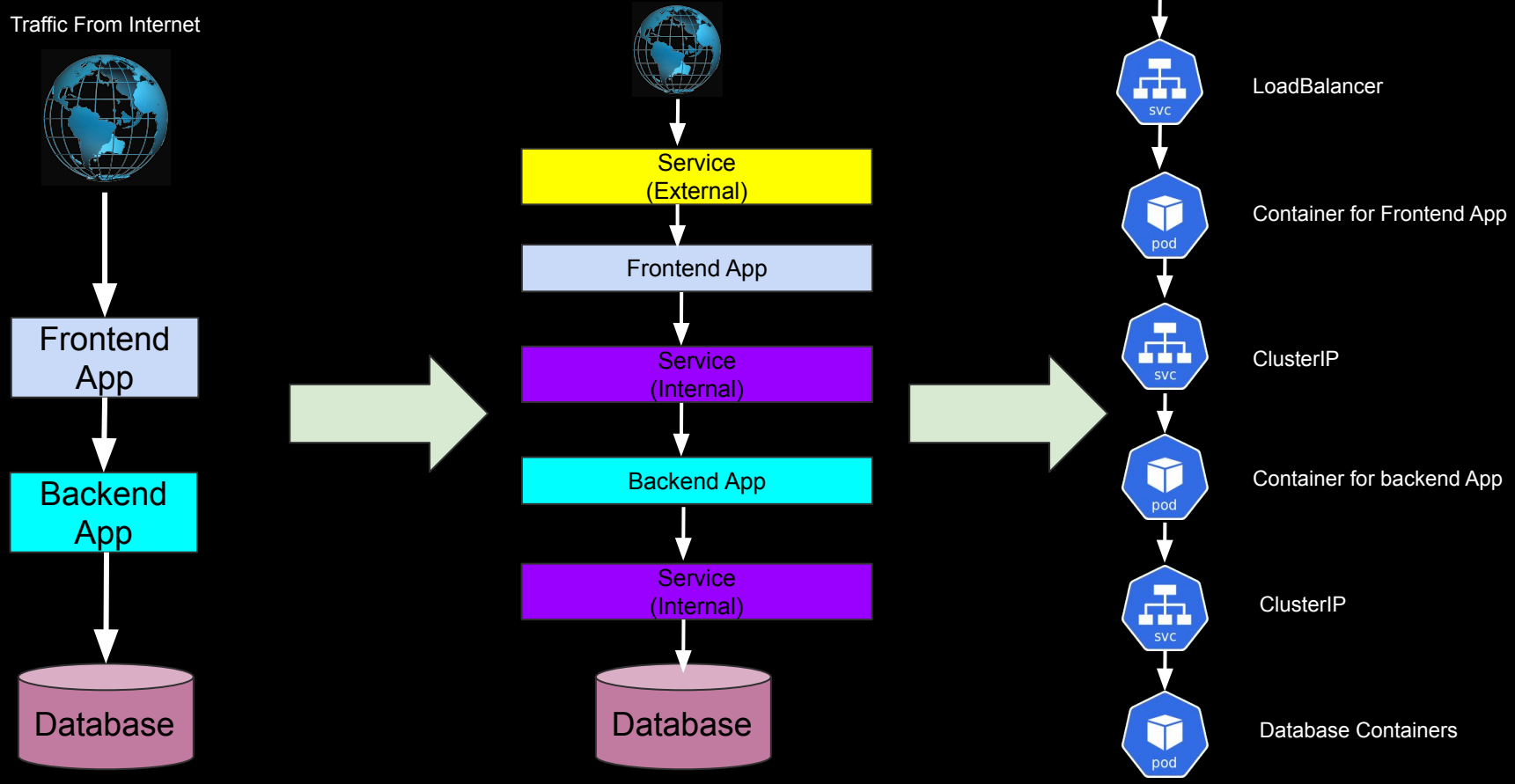
The Big Picture

Think about the concepts and not a specific solution!



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