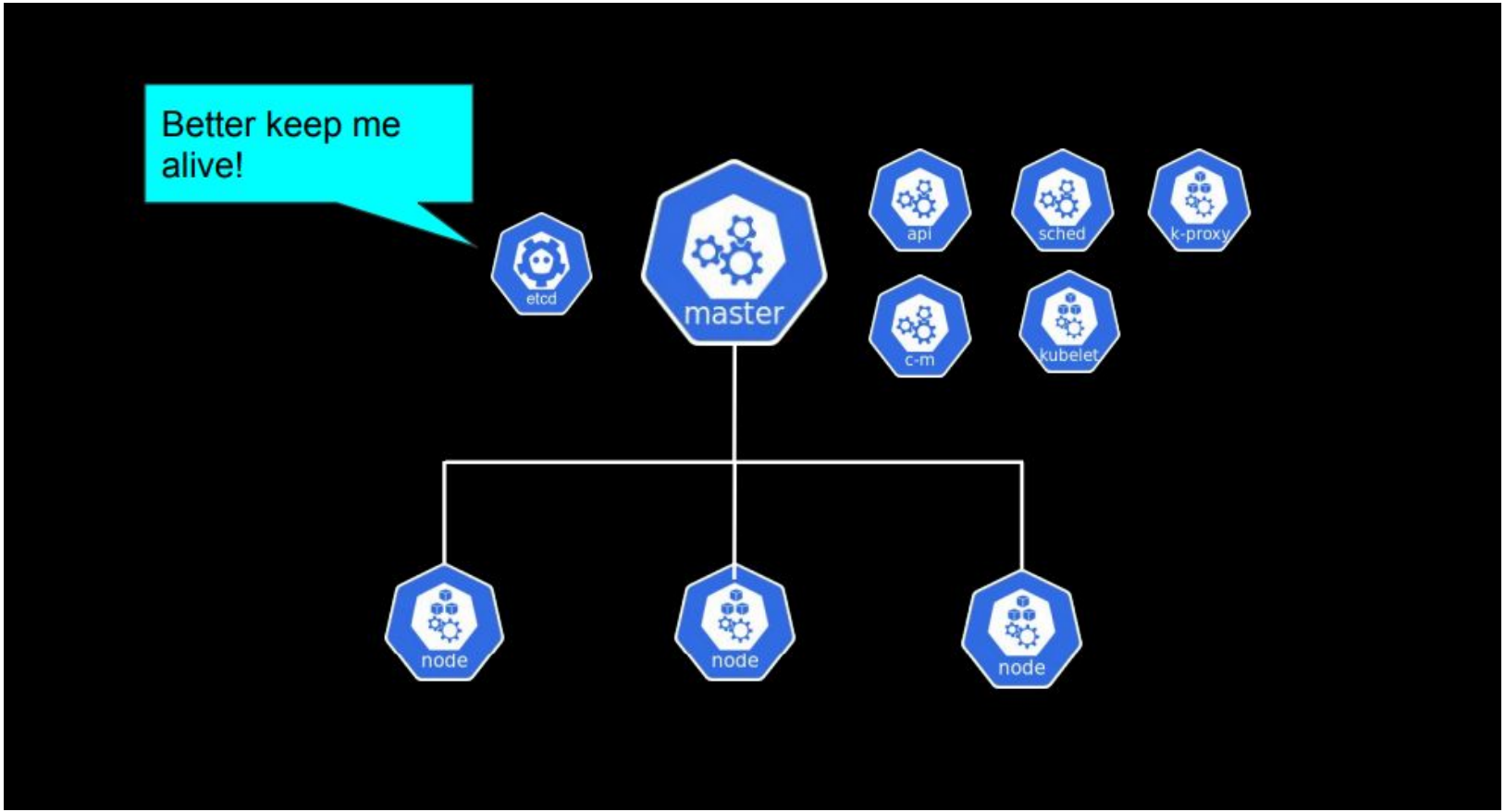
Introduction to Amazon EKS

Outline

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

What is EKS?

Kubernetes Architecture



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

Kubernetes Control Plane - AWS Managed

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

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

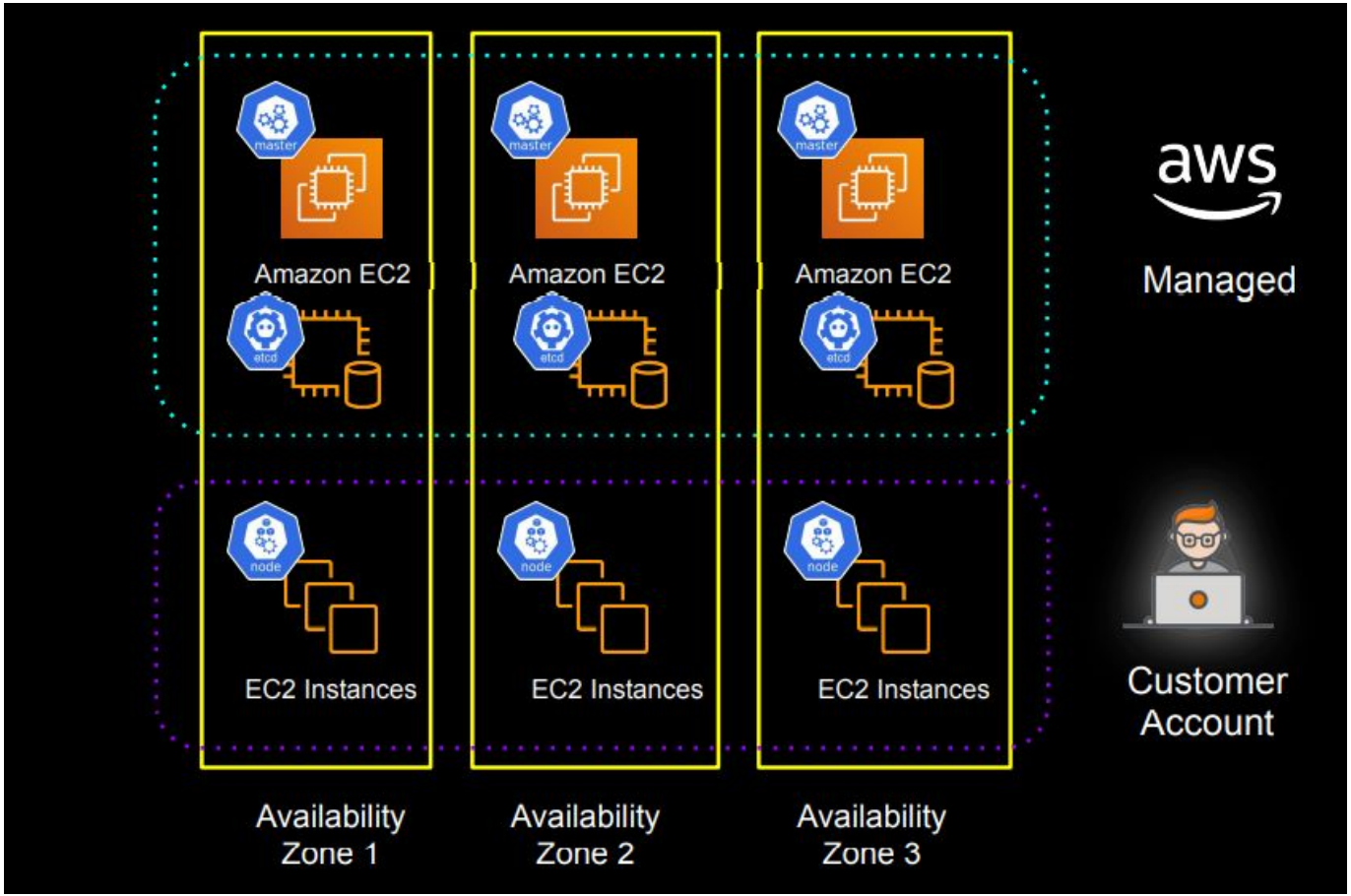
- AWS manages worker EC2s
- AWS provides AMI with security patches, version upgrade
- AWS manages pod disruption during upgrade
- Doesn't work with custom AMI

AWS Fargate

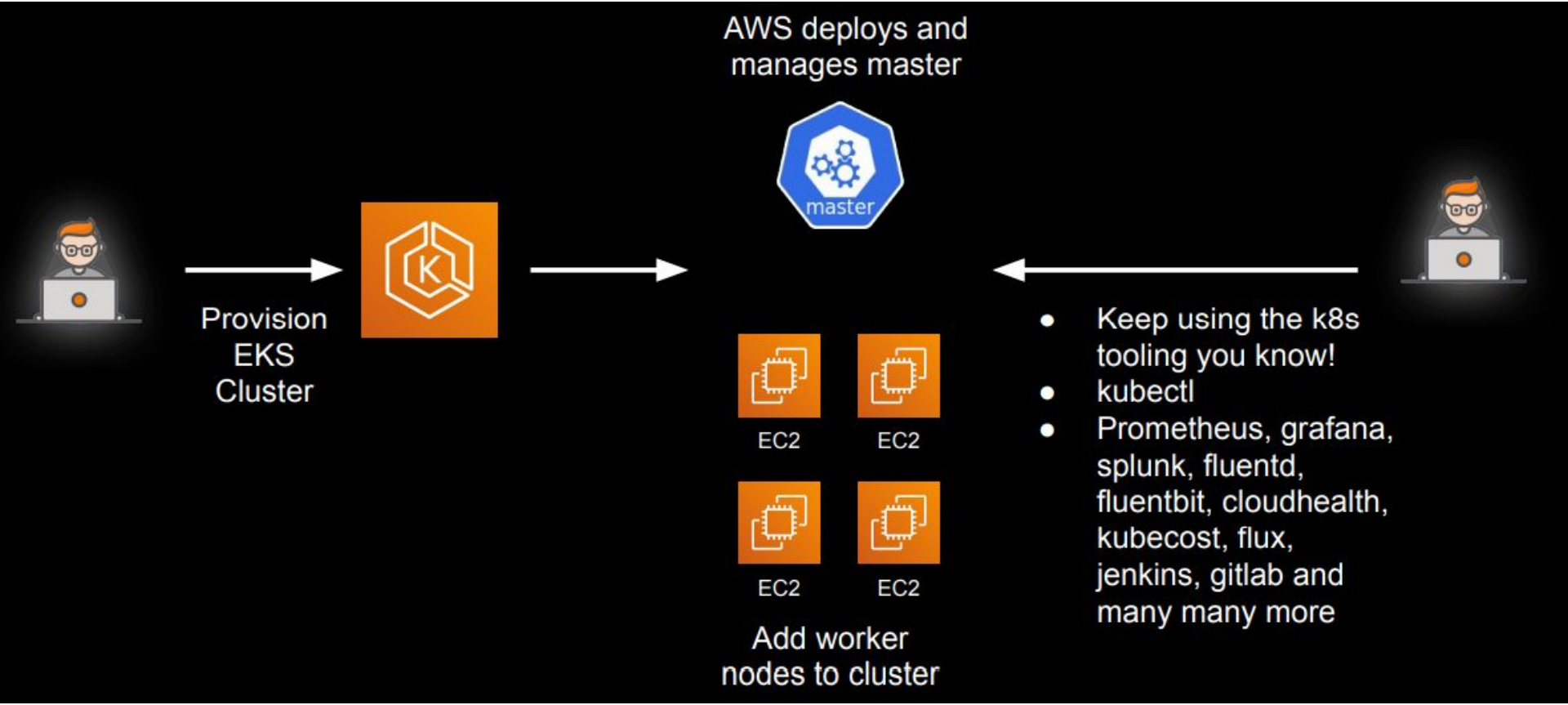
- No worker EC2 whatsoever!
- You define and deploy pods
- Container + Serverless!

EKS in AWS Ecosystem

EKS High Level Architecture



High Level Flow



Money Matters

Amazon Elastic Container Service for Kubernetes

Flat Charge 10 cents/Hour = $72/Month

EC2 EC2 EC2

Price based on EC2

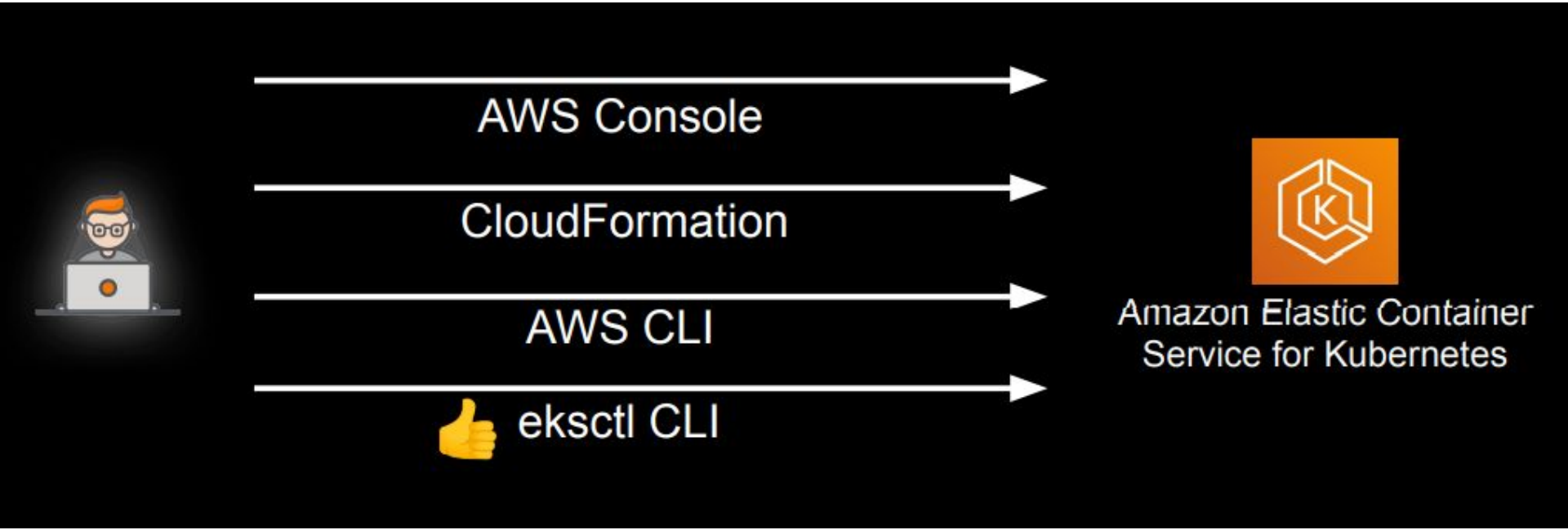
EKS with 3 m5.large in us-east-1 = EKS Control Plane + Worker Nodes (m5.large X 3)

= $72/mo + $219.24/mo

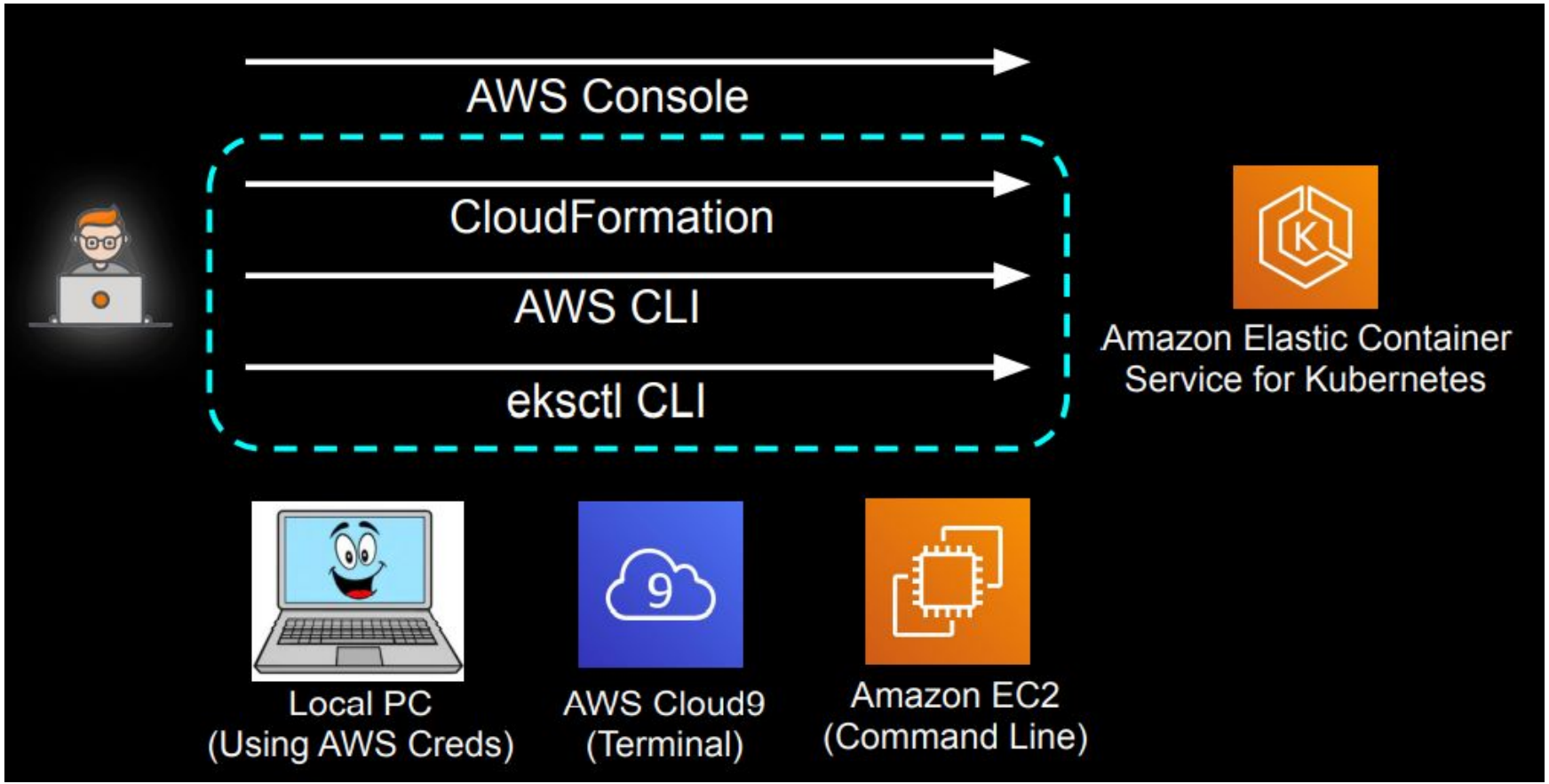
= $291.24/mo

eksctl & kubectl

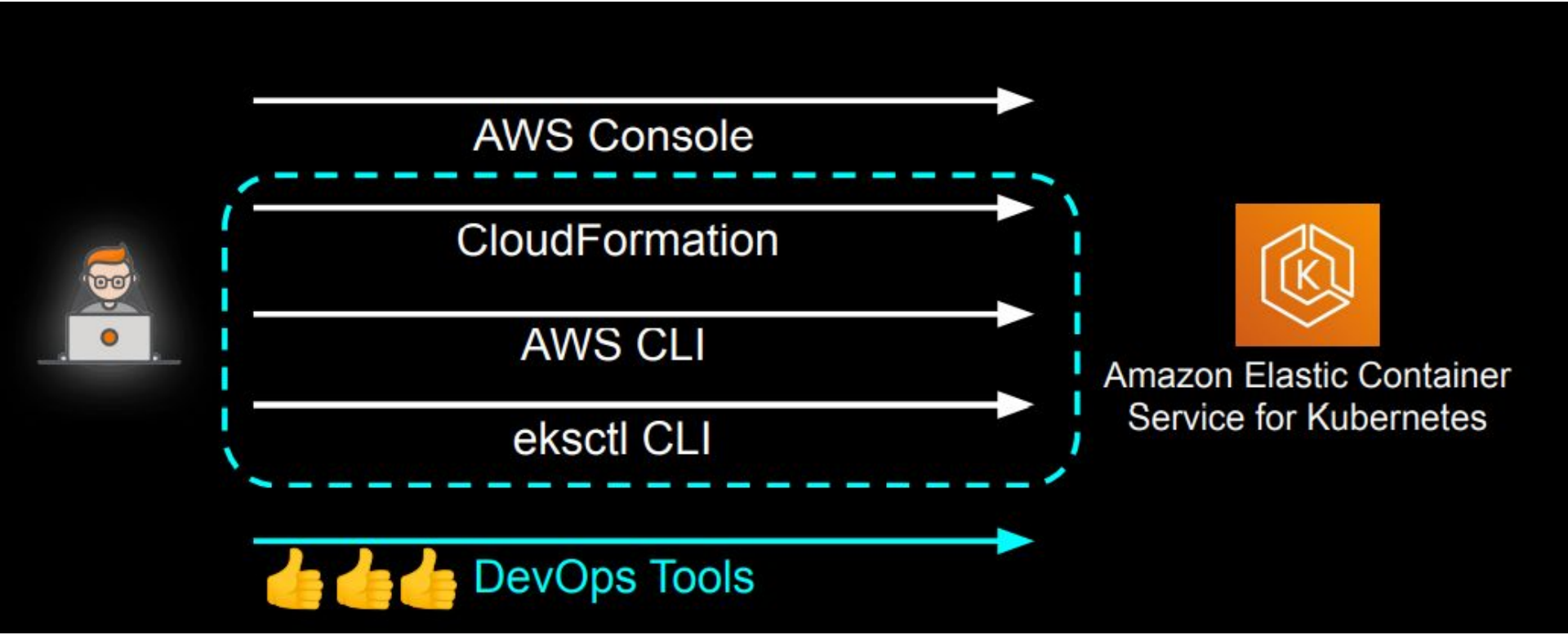
Ways To Spin Up EKS Cluster



Learning Medium



Automation


AWS Console
CloudFormation
AWS CLI
eksctl CLI
DevOps Tools
Amazon Elastic Container Service for Kubernetes

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)

Available eksctl features (Only on EKS)

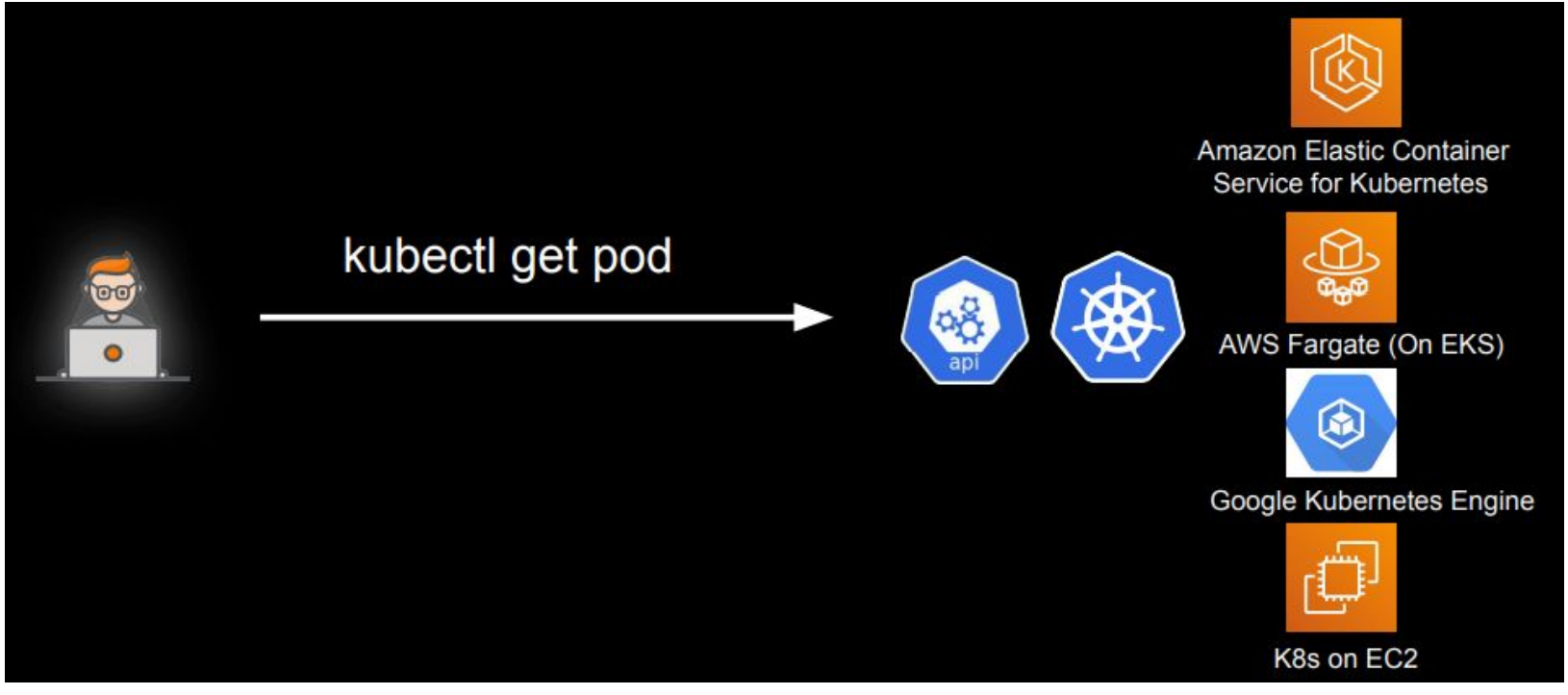
- Create, drain and delete nodegroups
- Scale a nodegroup
- Update a cluster
- Use custom AMIs
- Configure VPC Networking
- Configure access to API endpoints
- Support for GPU nodegroups
- IAM Management and Add-on Policies
- Spot instances and mixed instances
- List cluster Cloudformation stacks
- Install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

eksctl Commands

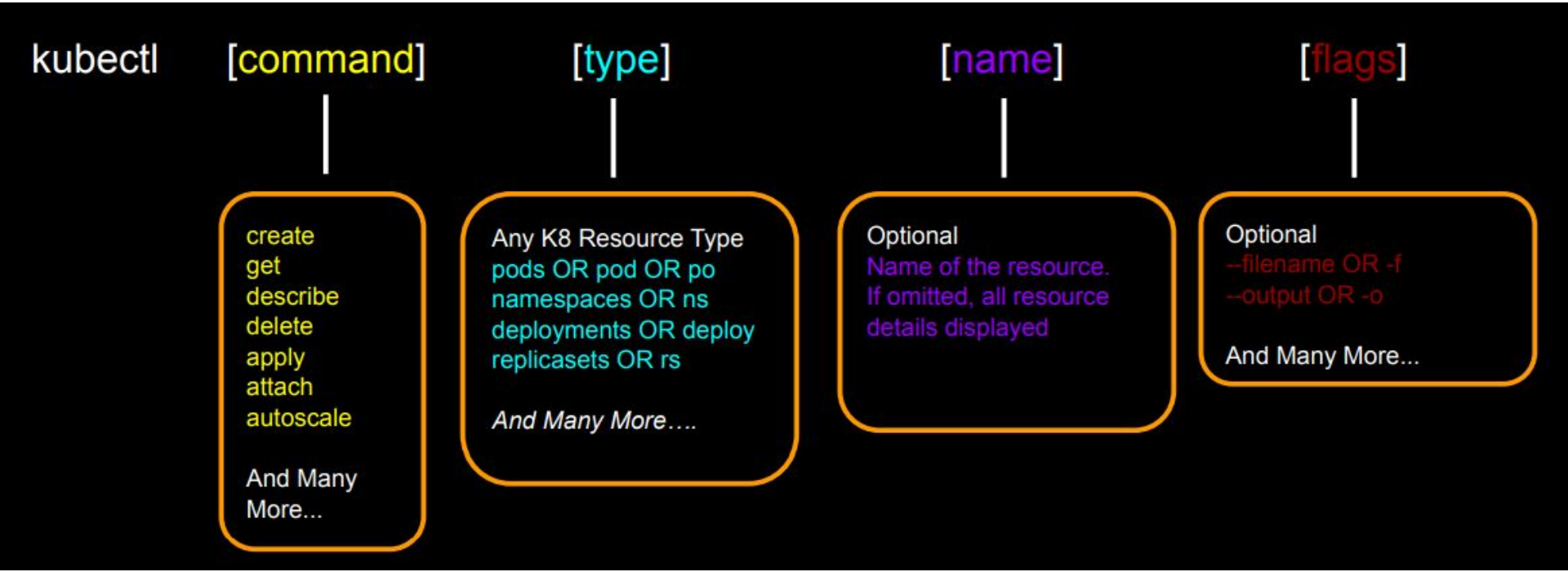
Command	Brief Description
`eksctl create cluster`	Create EKS Cluster with one nodegroup containing 2 m5.large
`eksctl create cluster --name <name> --version 1.15 --node-type t3.micro --nodes 2`	Create EKS Cluster with K8 version 1.15 with 2 t3.micro nodes
`eksctl create cluster --name <name> --version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

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 Command Syntax



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

kubectl Command Syntax

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

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

DEMO TIME!

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

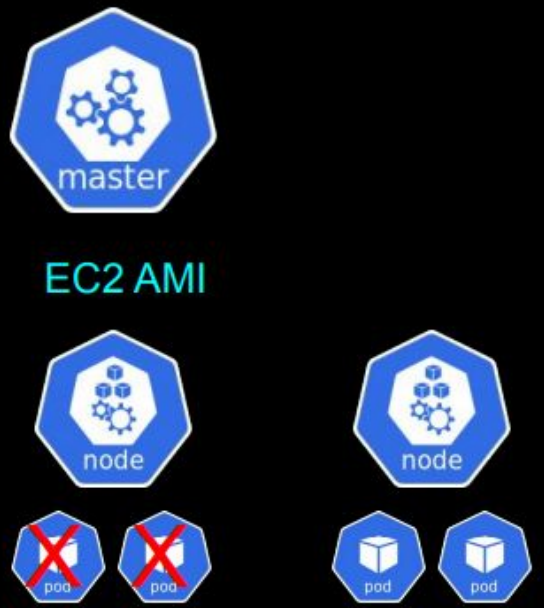
EKS Managed Nodegroups

EKS Regular Nodes and Pods

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

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

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

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

EKS Logging & Monitoring

EKS Logging

EKS Control Plane Logging

EKS Worker Nodes Logging

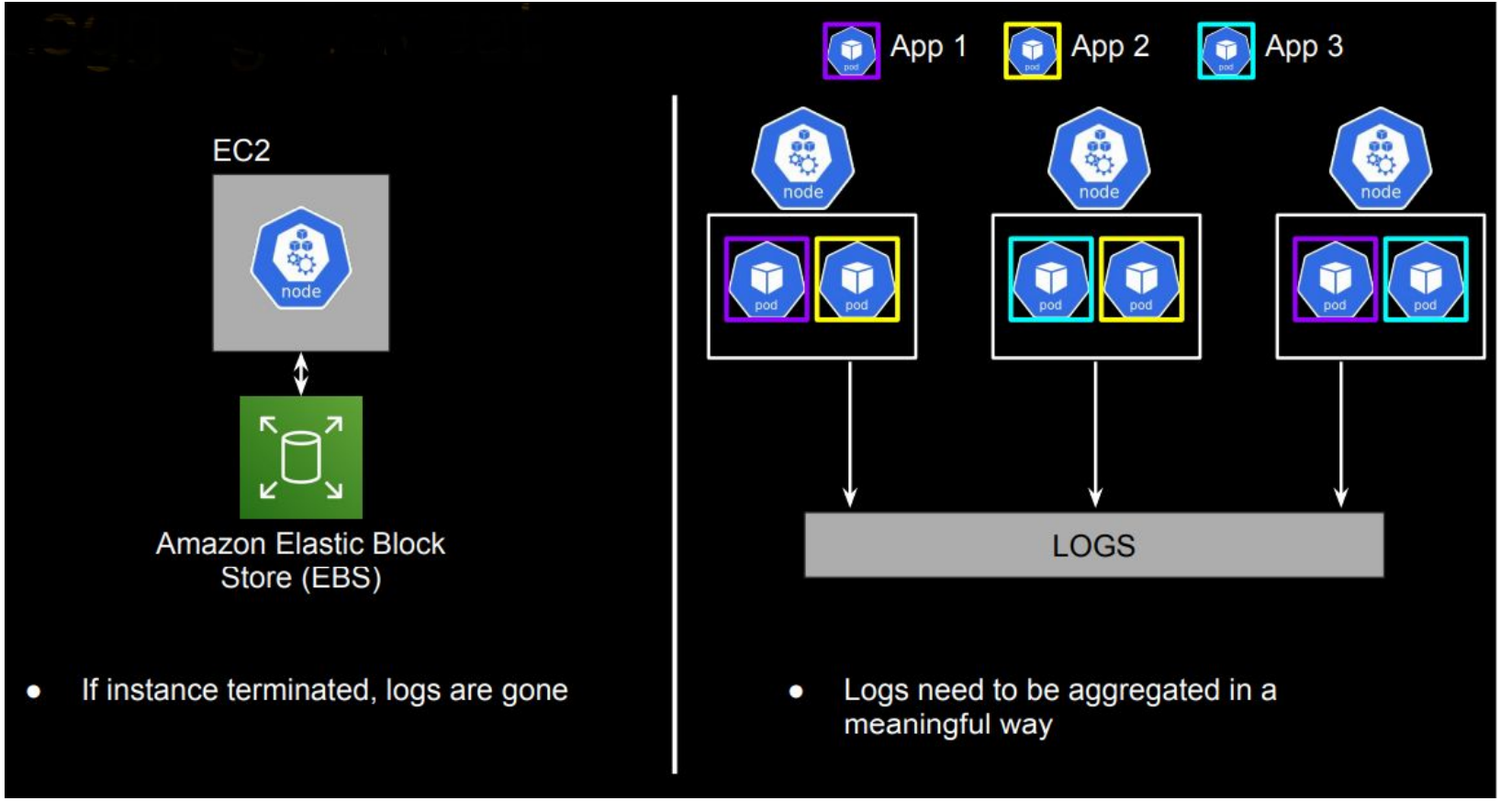
EKS Logging

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

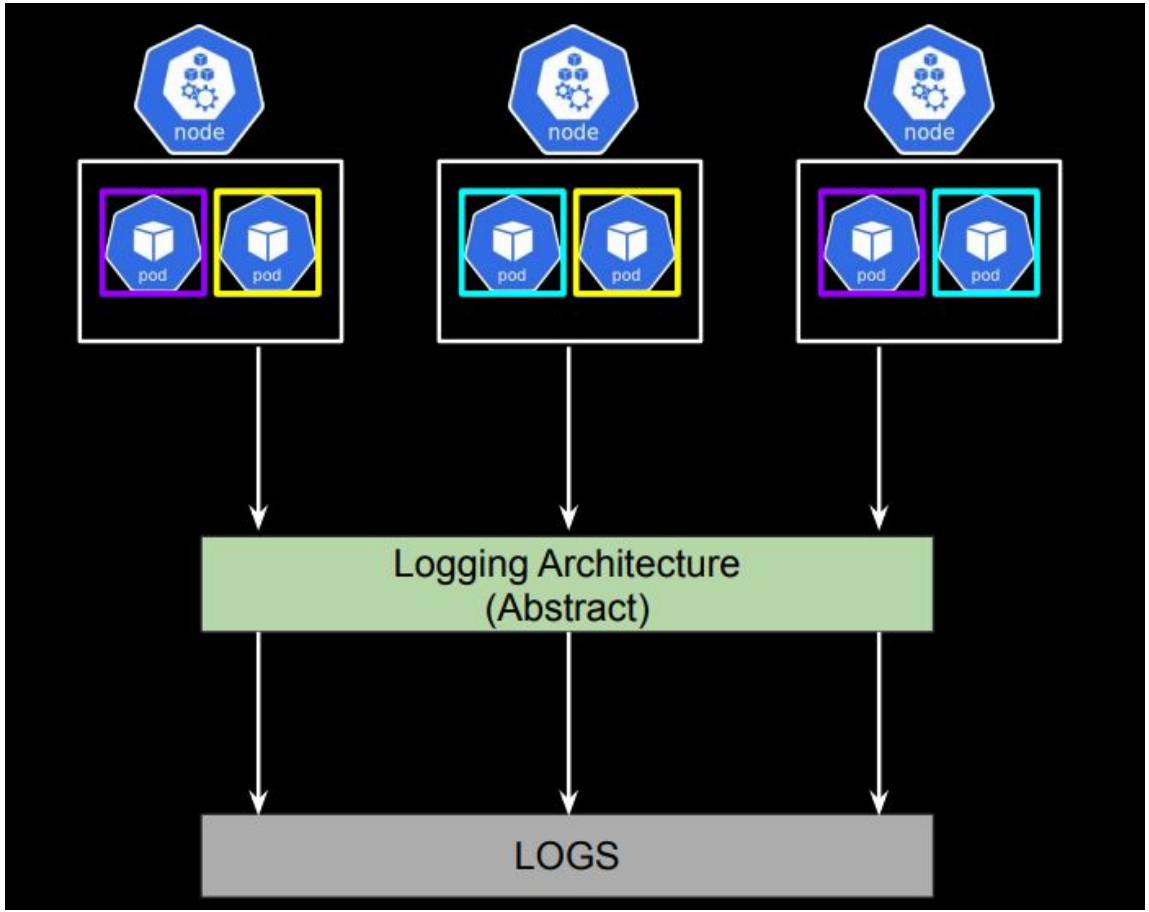
EKS Logging

- 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

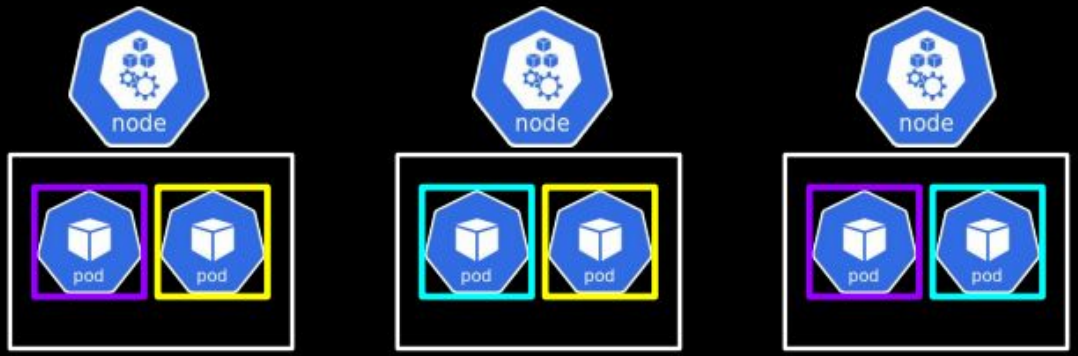
Logging Caveat



Logging Caveat

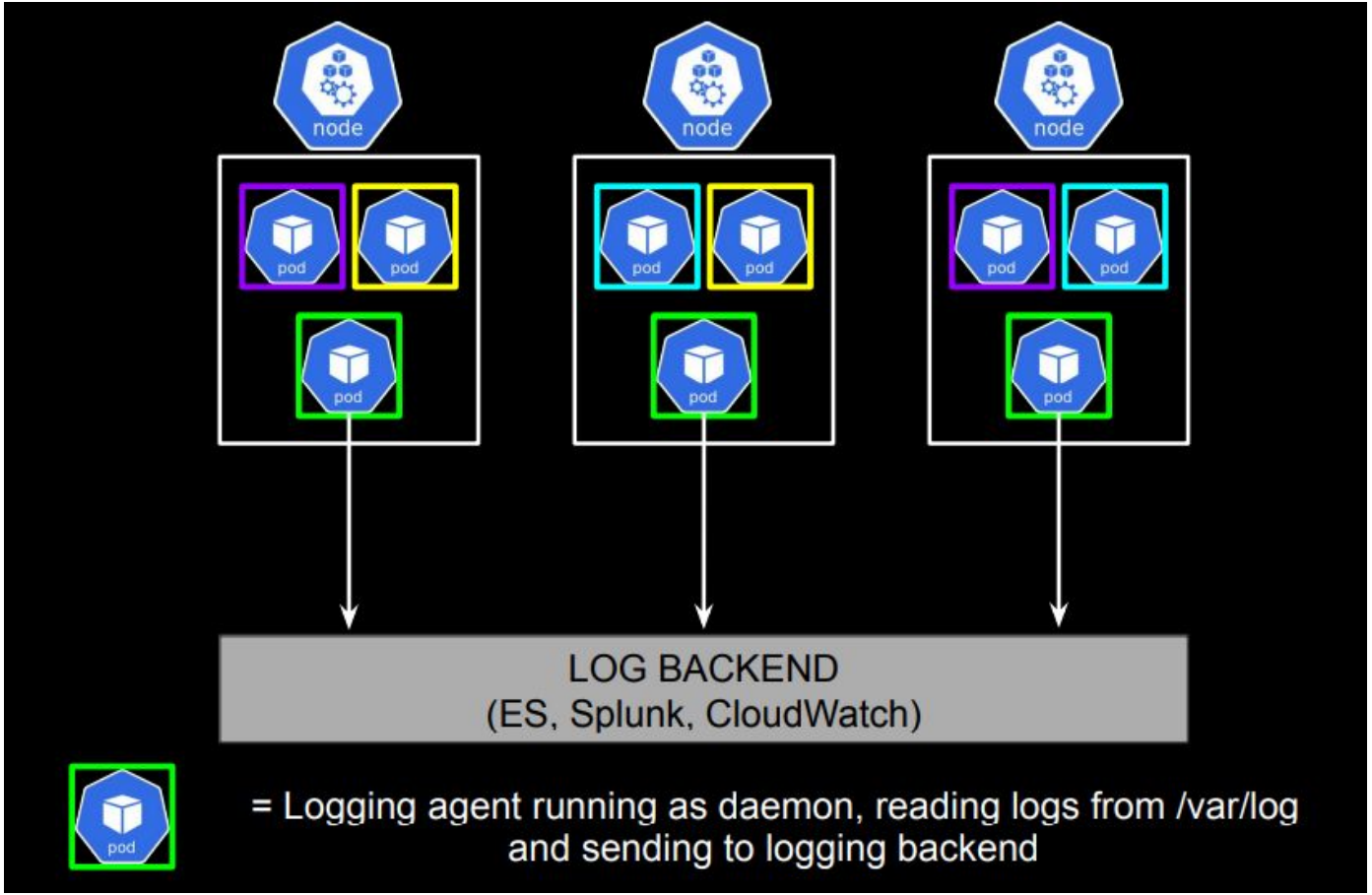


Kubernetes Worker Nodes

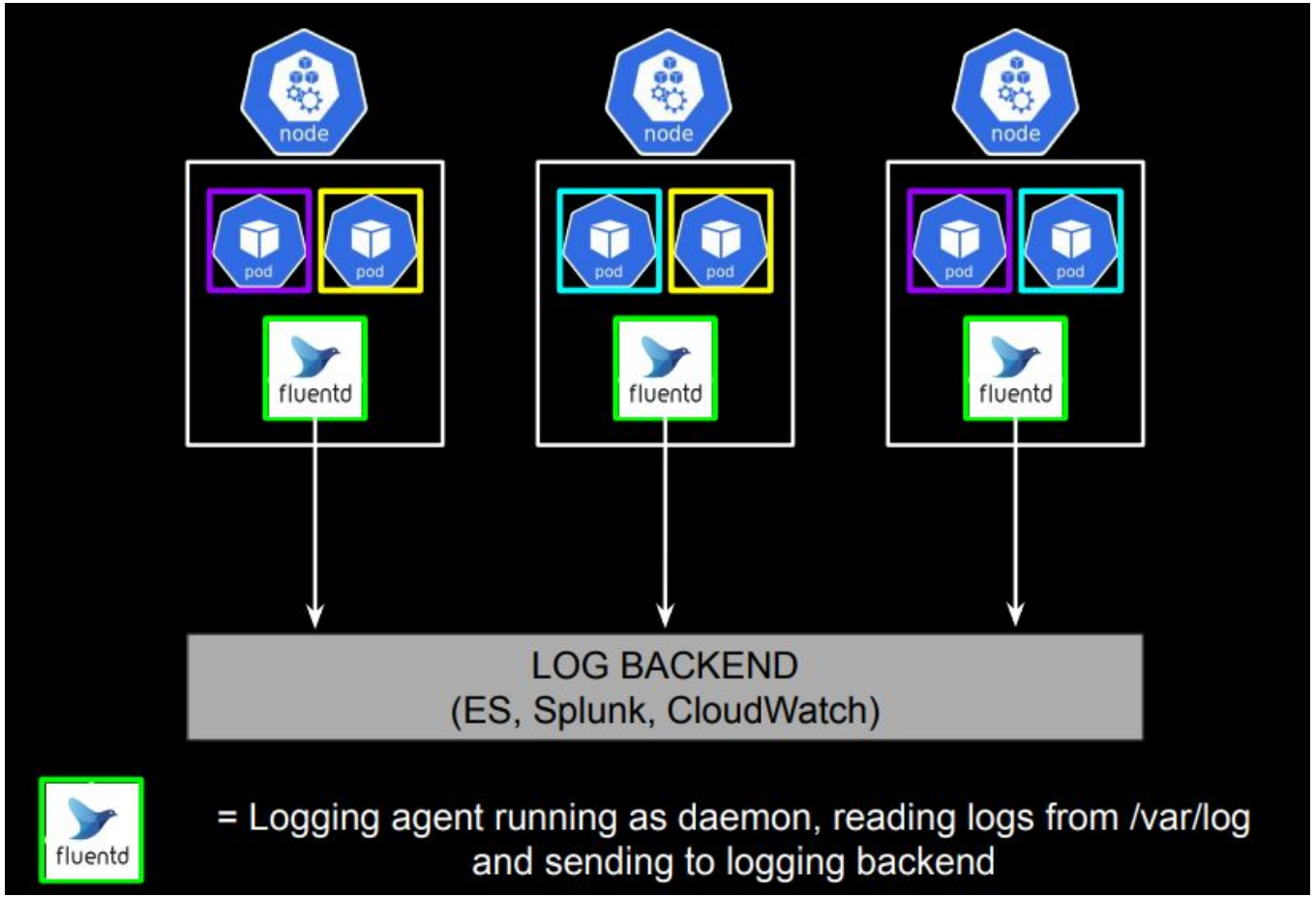


- Containerized application writes to
  - stdout and stderr
- System logs go to
  - systemd
- Container redirect logs to /var/log/containers/*.log files
- Now we know where to extract logs from!

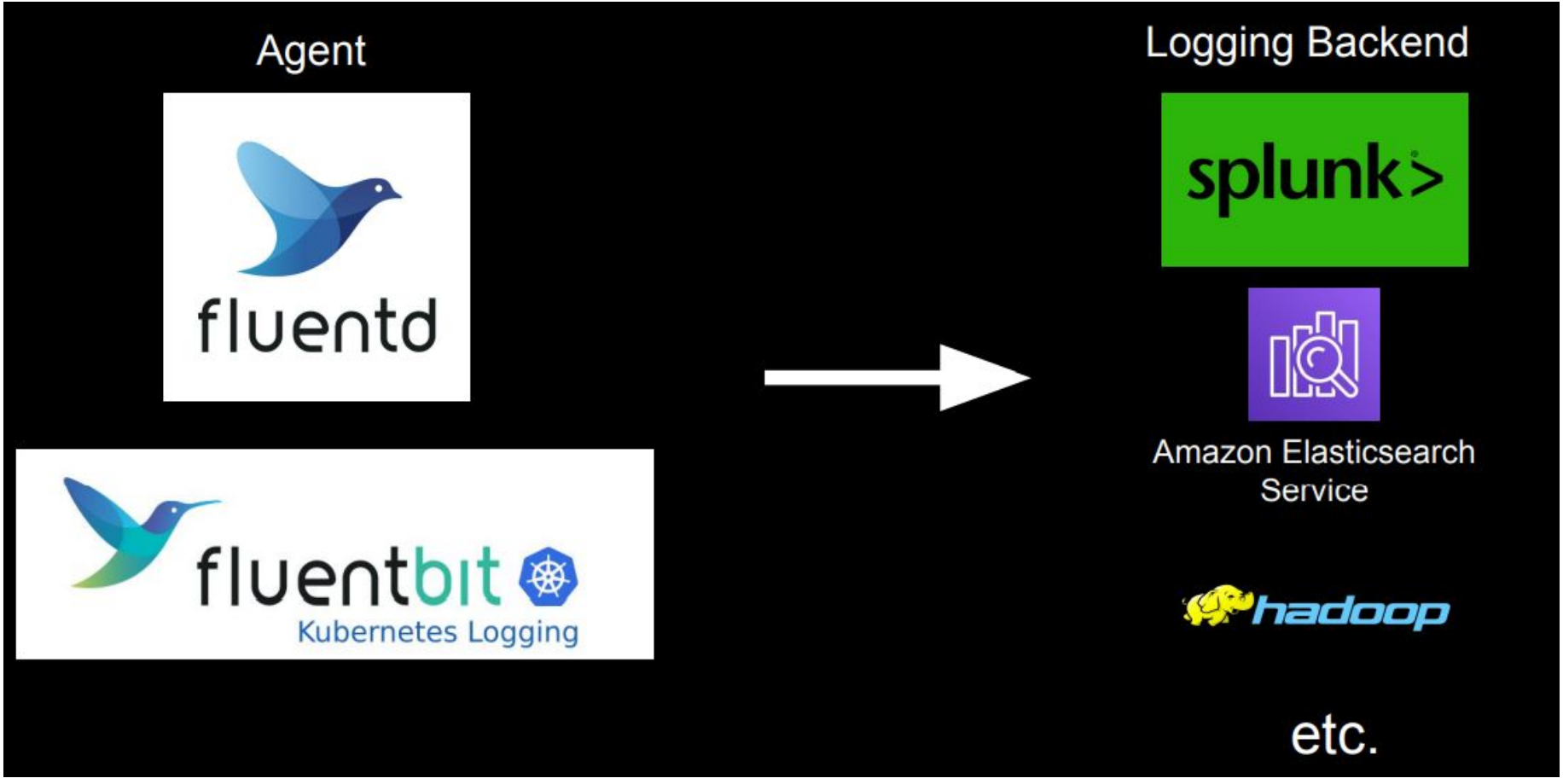
Implementation



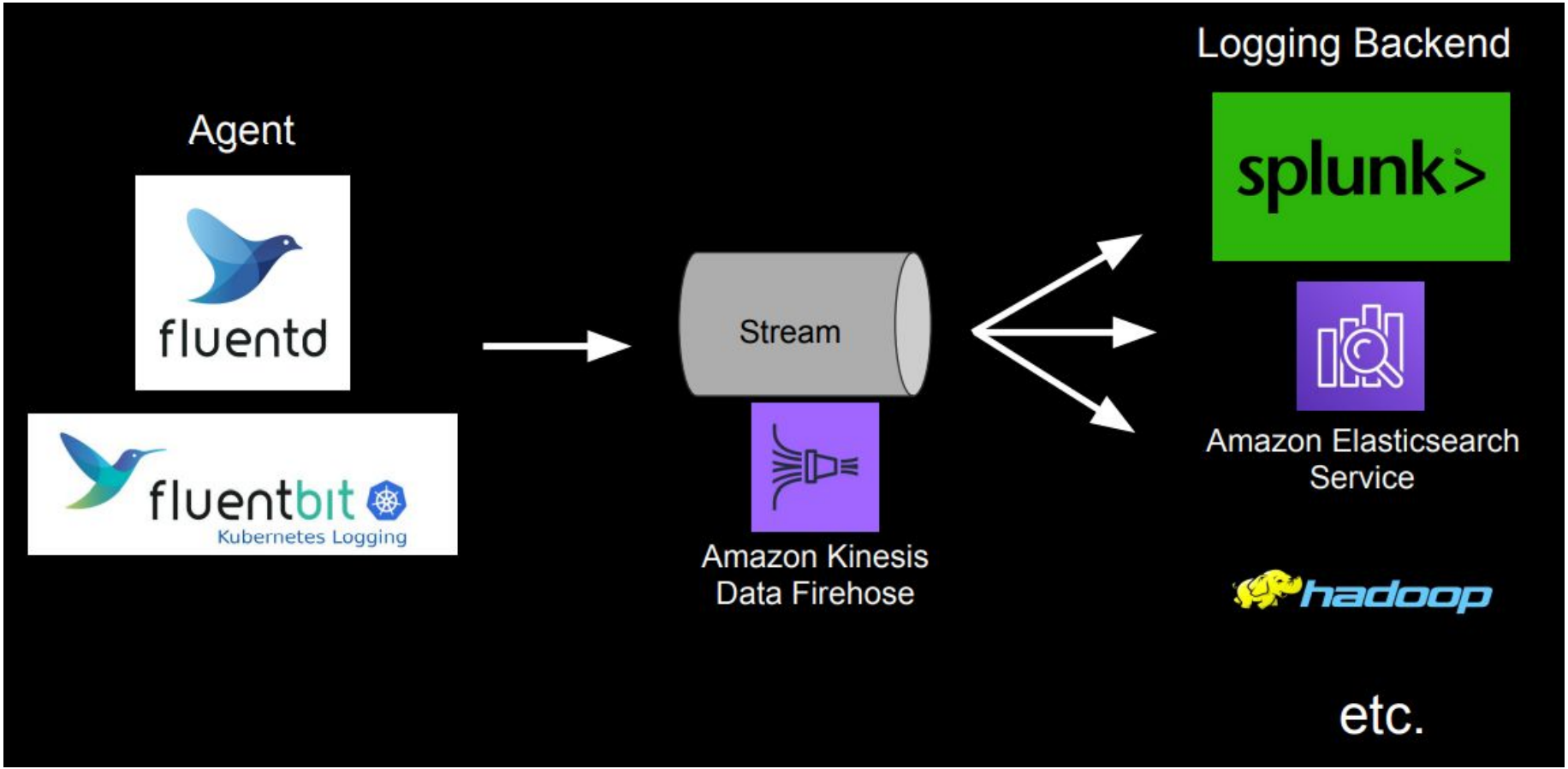
Implementation



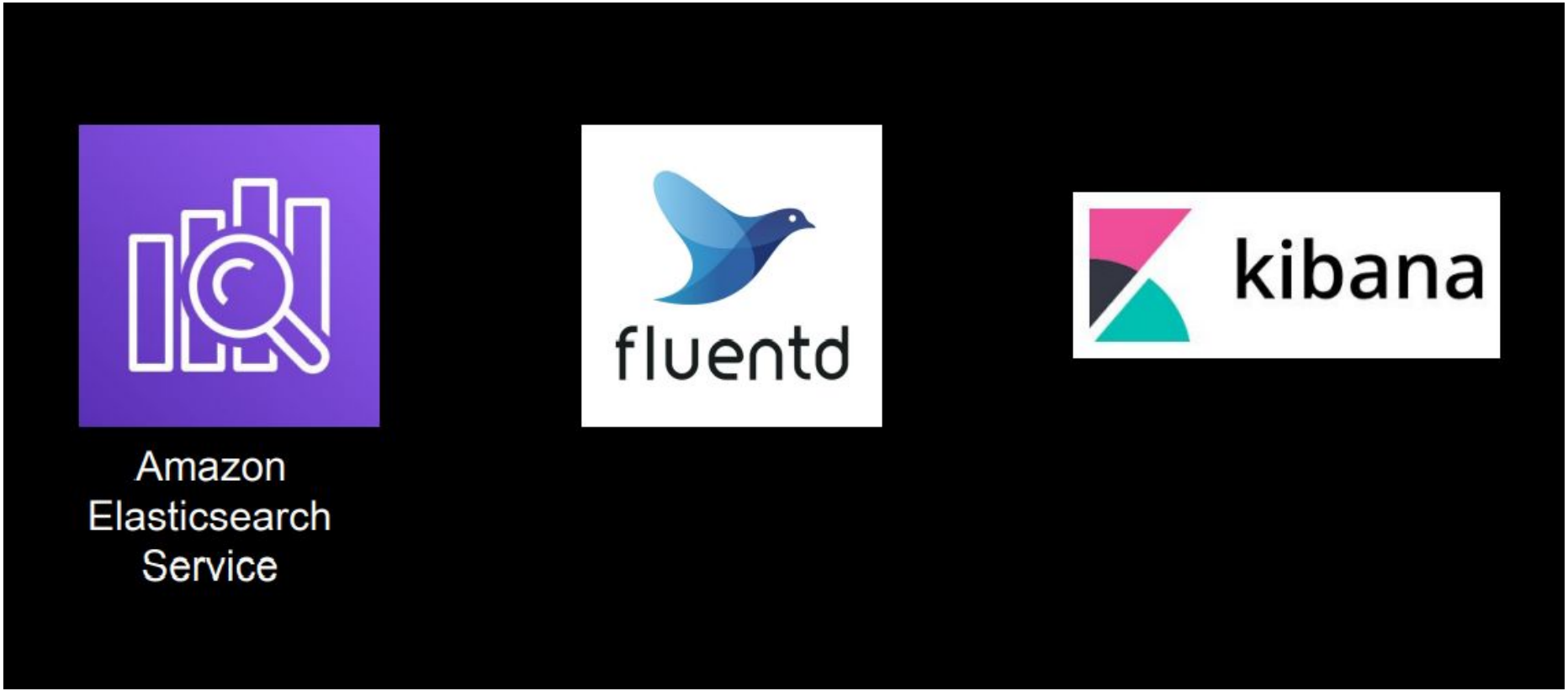
Different Options



For Streaming to Multiple Log Backends



EFK Stack



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..

Under Pressure!

Implementation

EKS Control Plane Logging

EKS Control Plane Logging

- K8s api
- audit
- authenticator
- controllerManager
- scheduler

EKS Control Plane Logging

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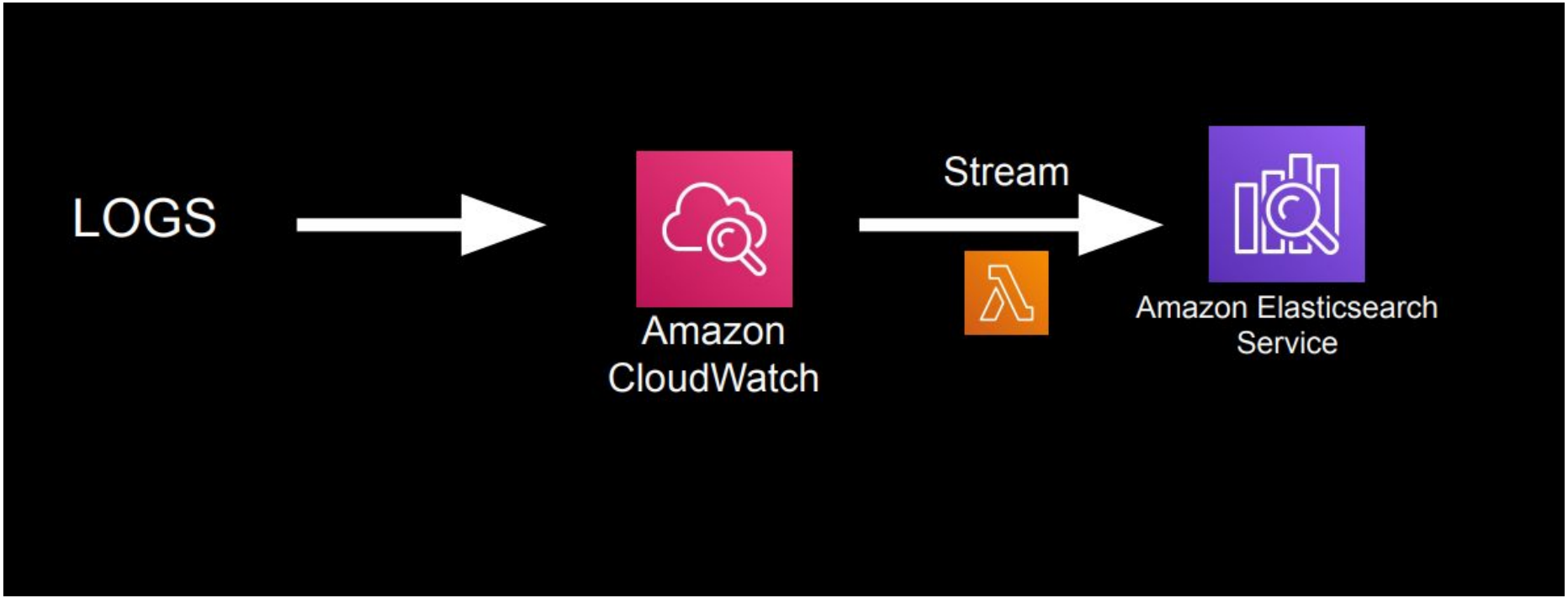
  - scheduler

Amazon
CloudWatch

EKS Control Plane Logging



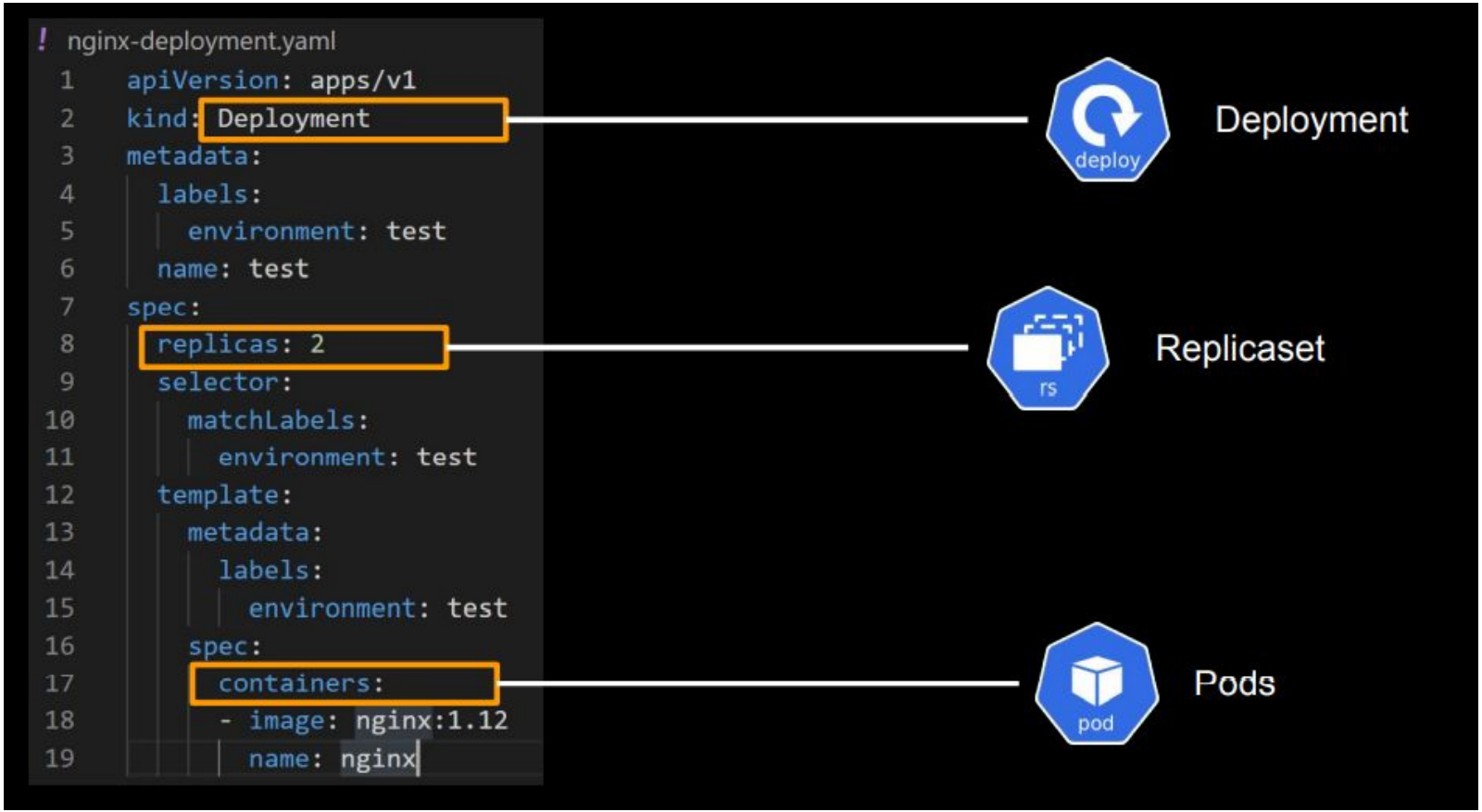
Kubernetes Dashboard

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

Kubernetes Dashboard

EKS ADVANCED CONCEPTS

Quiz: What Resources Created?

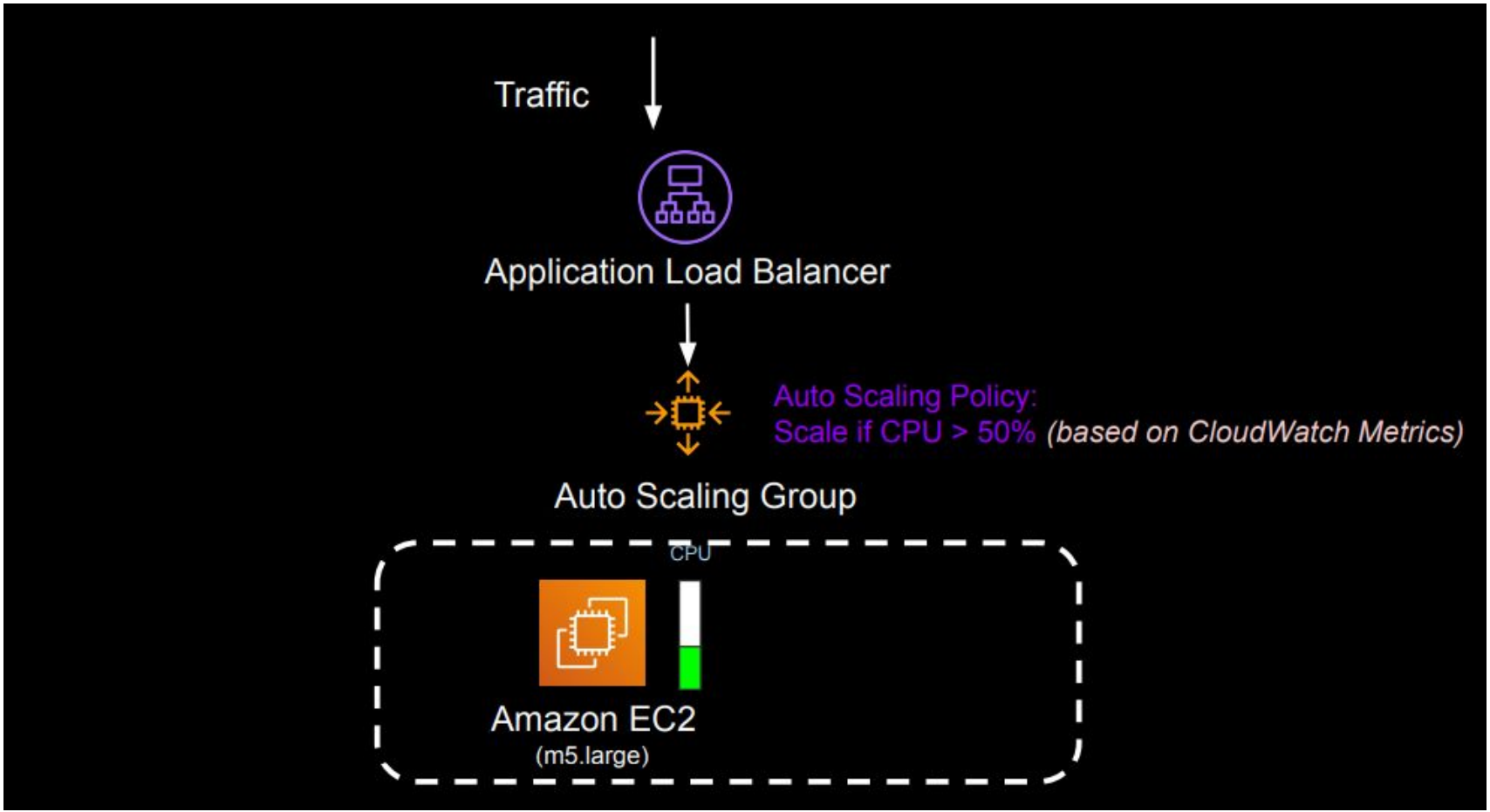


Container Scaling

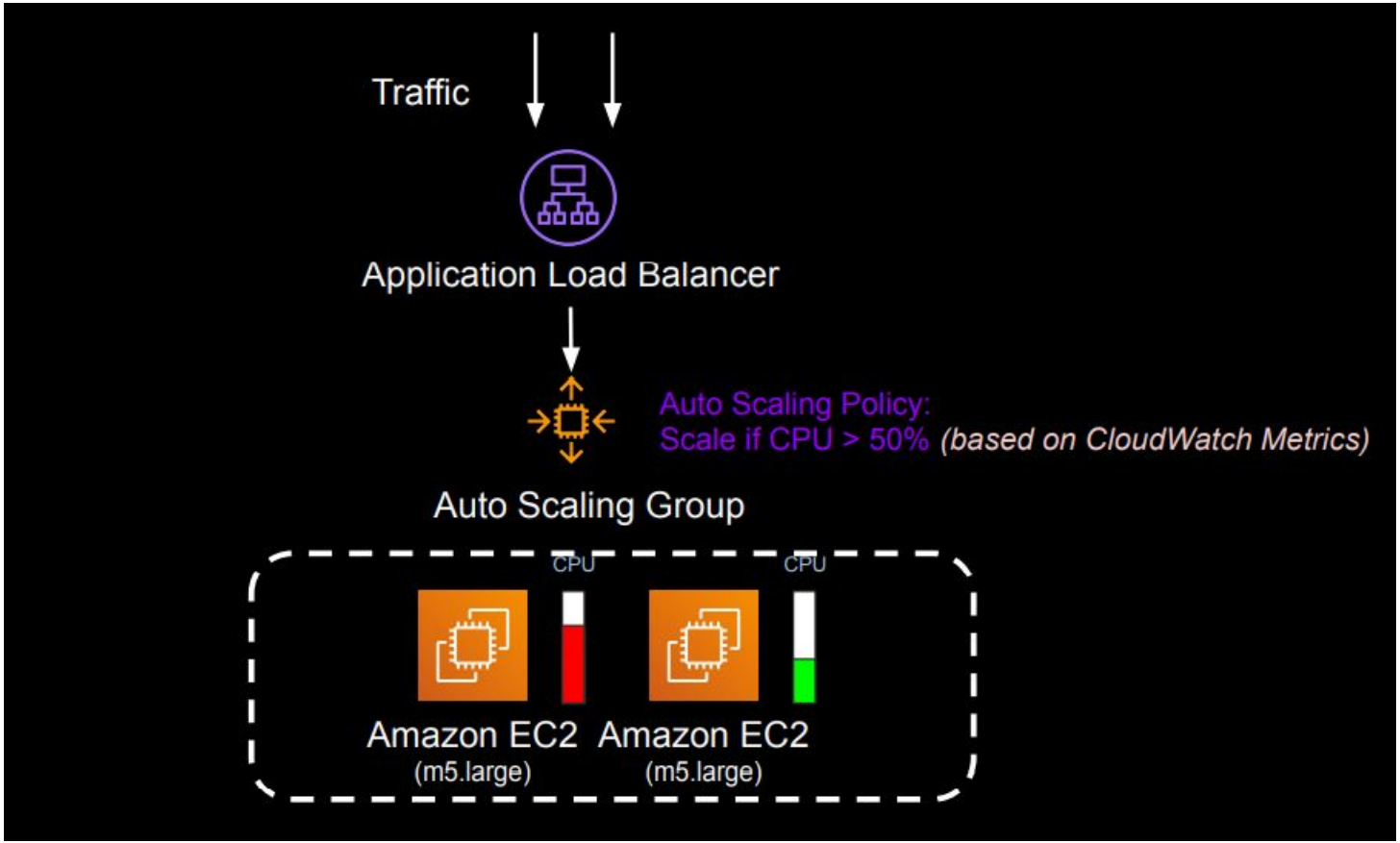
- Quick Look into EC2 Scaling
- Container Scaling
- Understand Pod Limits and Requests
- Horizontal Pod Autoscaler
- Understand Manifest File
- HPA Demo

Horizontal Pod Autoscaler

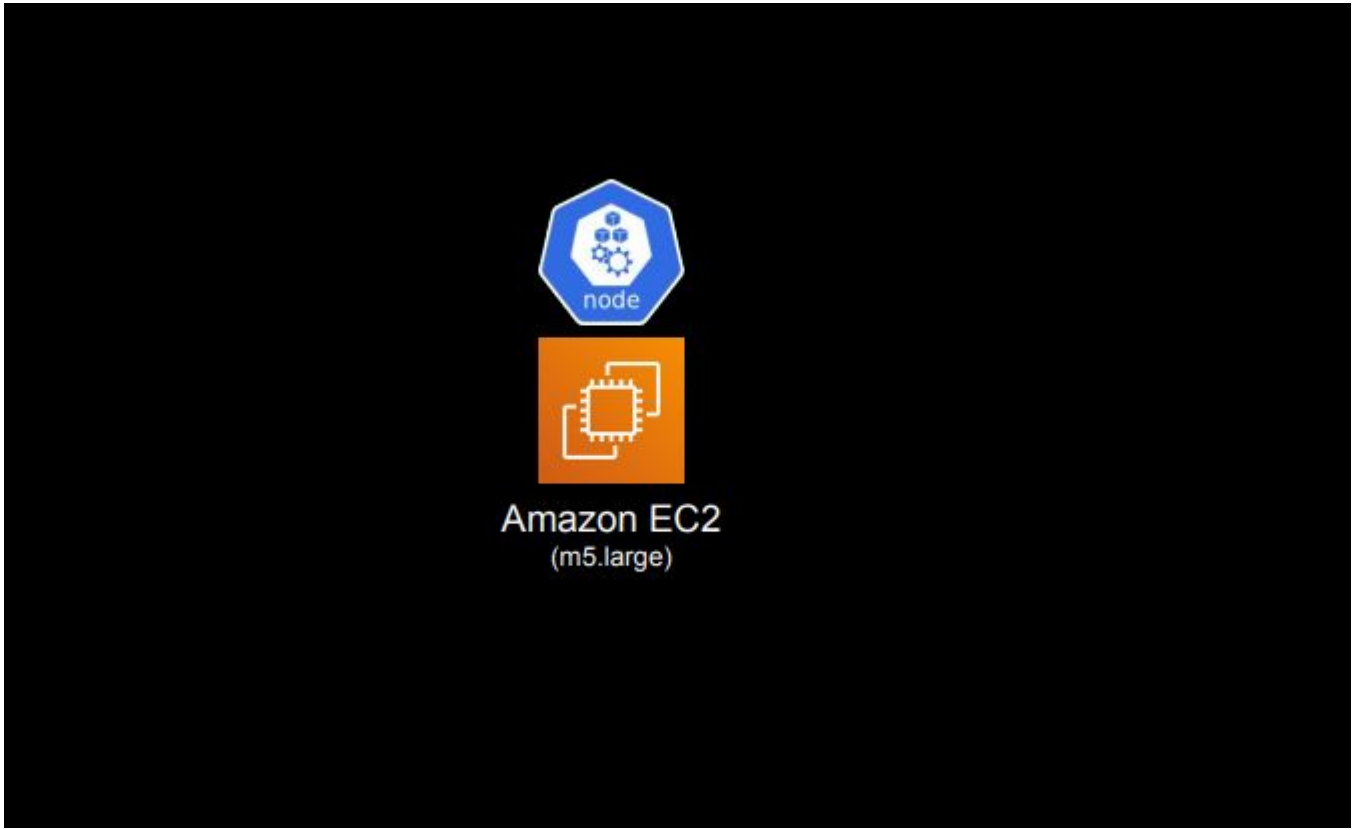
Going Back to EC2 Scaling



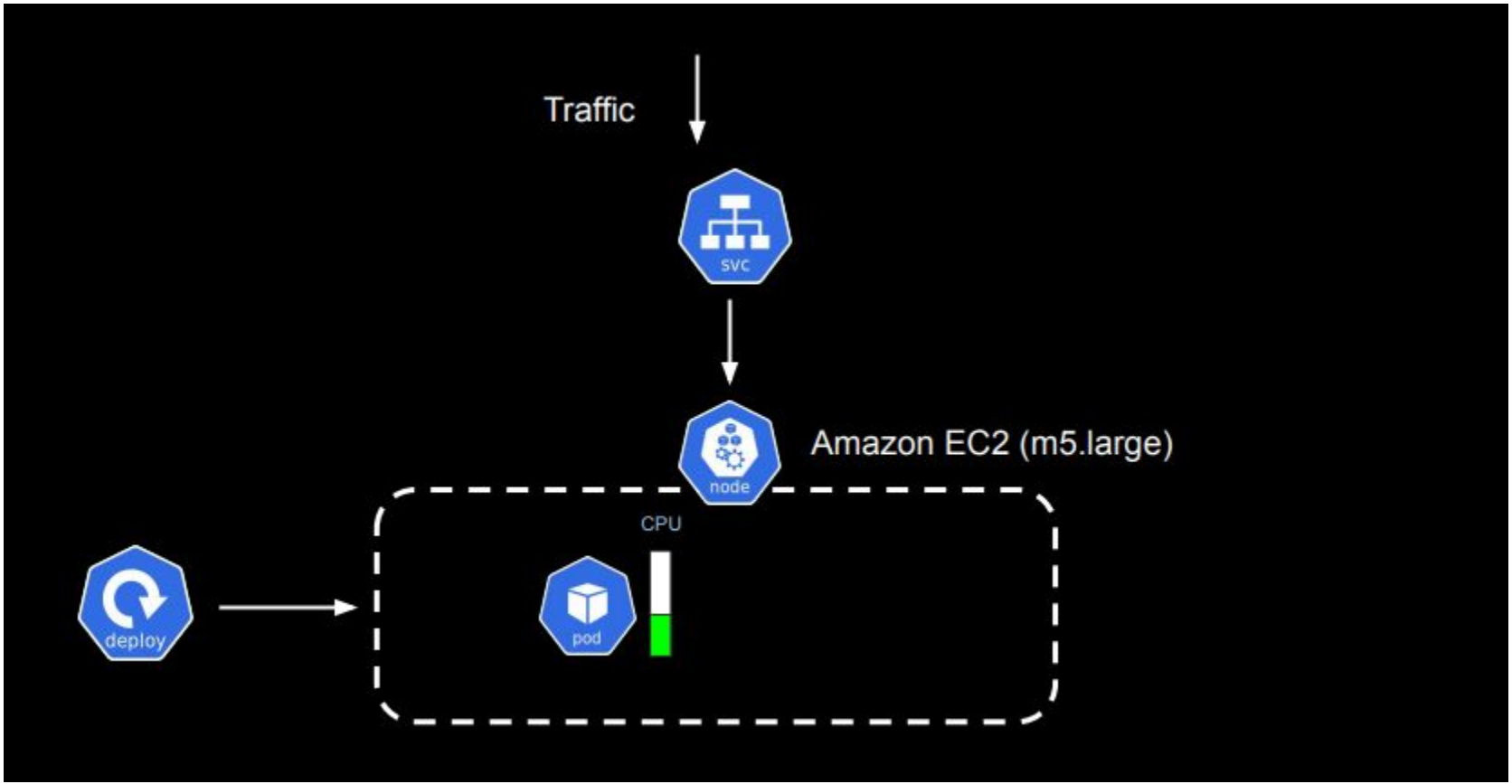
Going Back to EC2 Scaling



EKS Container Scaling



Horizontal Pod Autoscaler (HPA)



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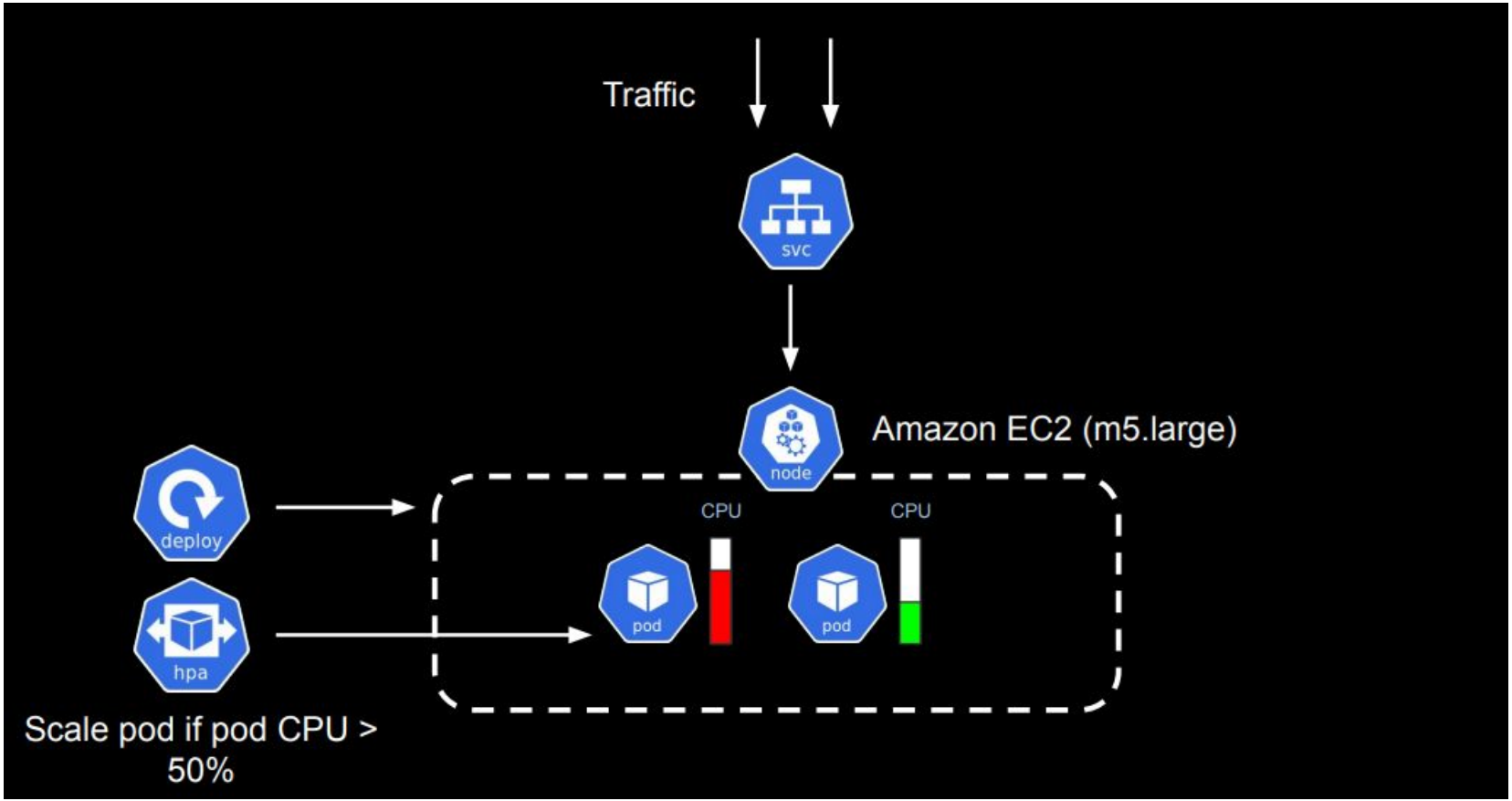

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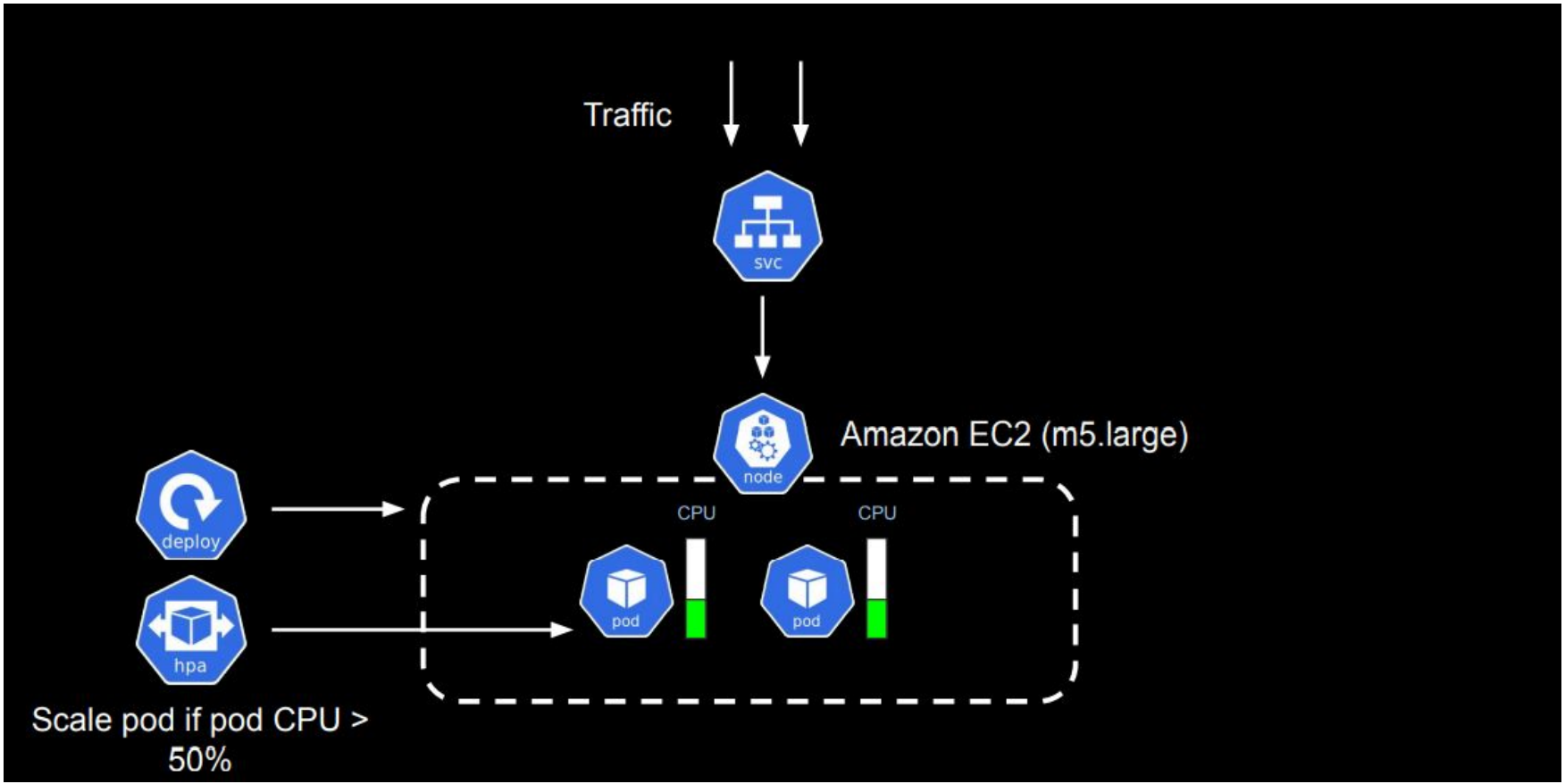

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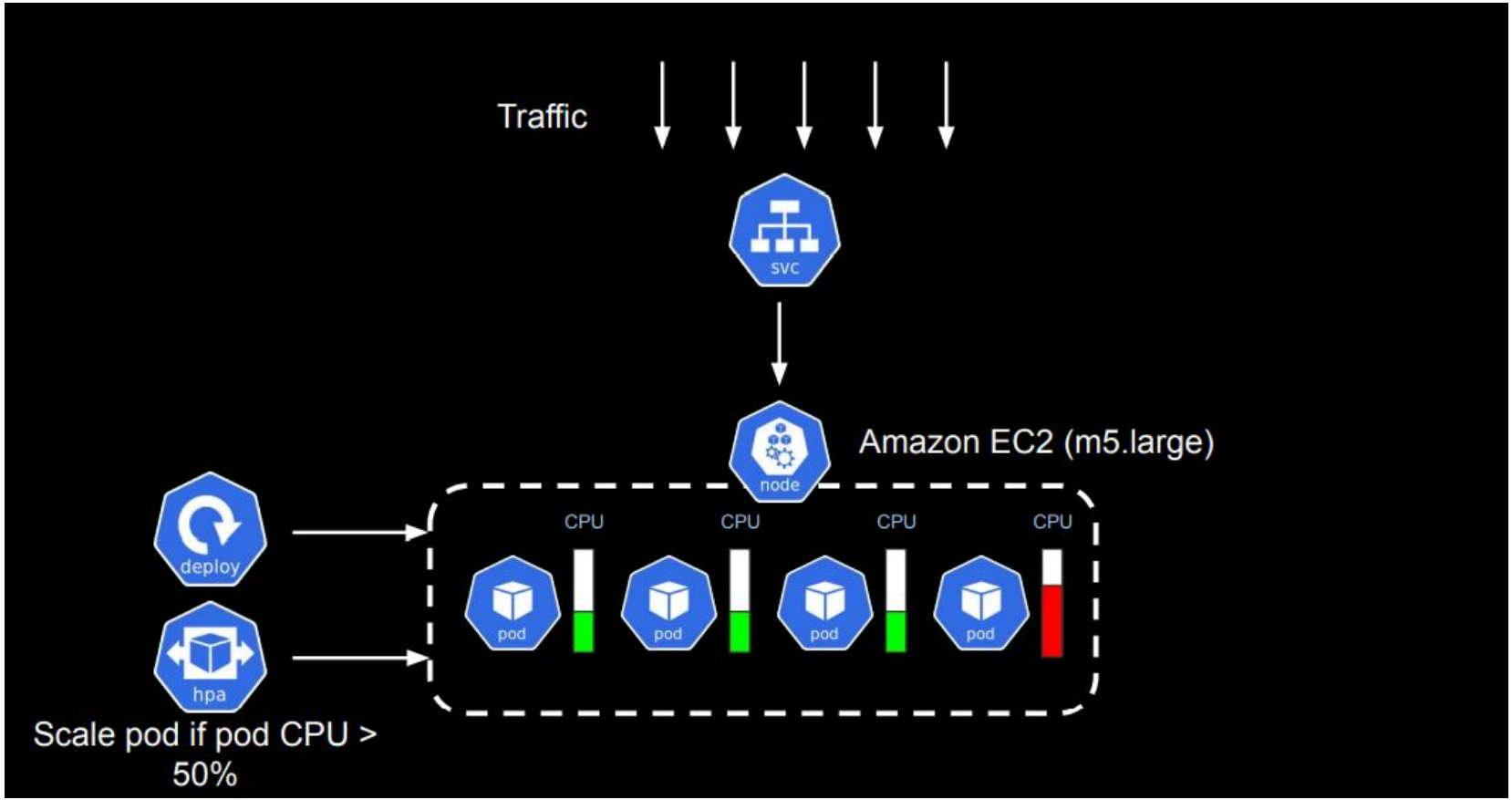
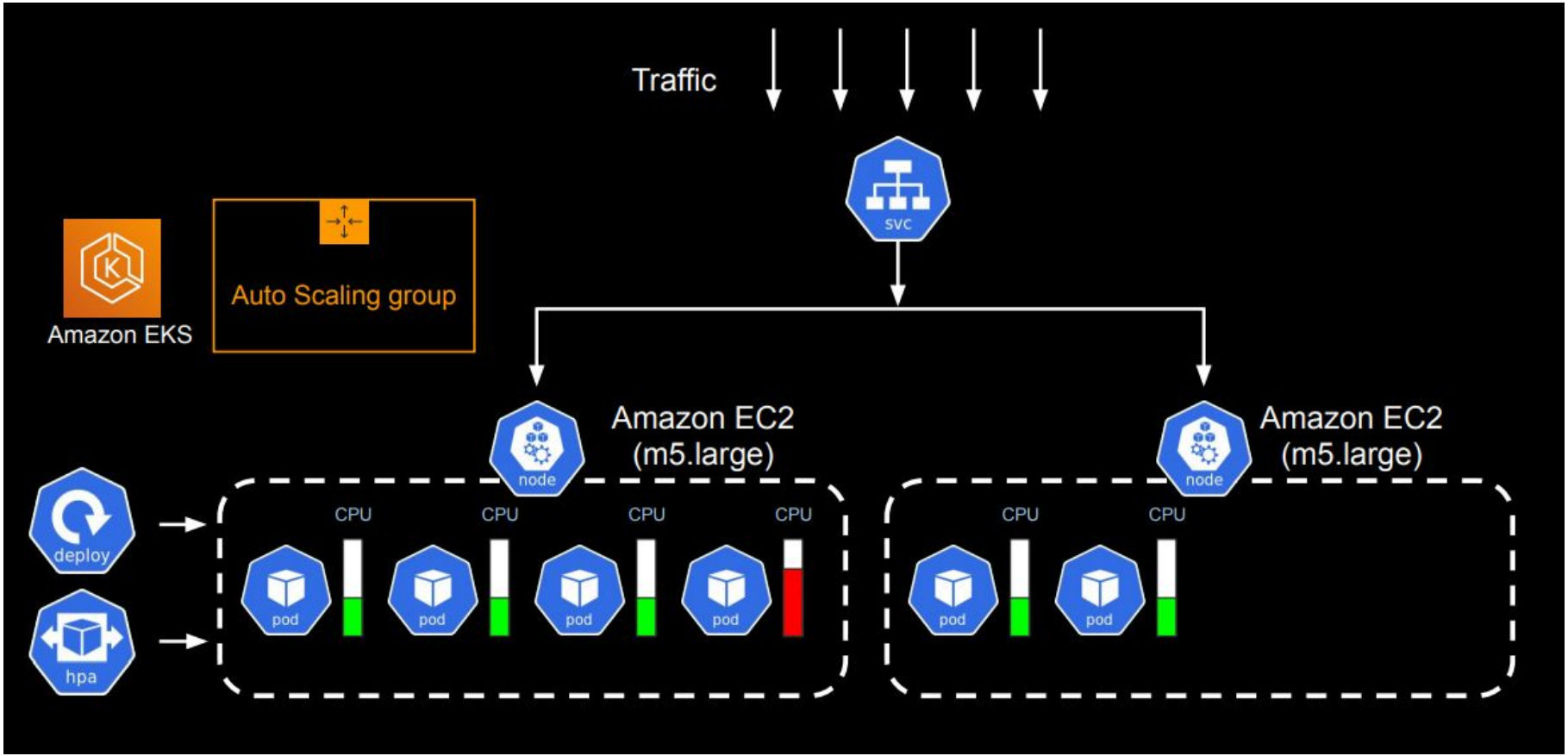
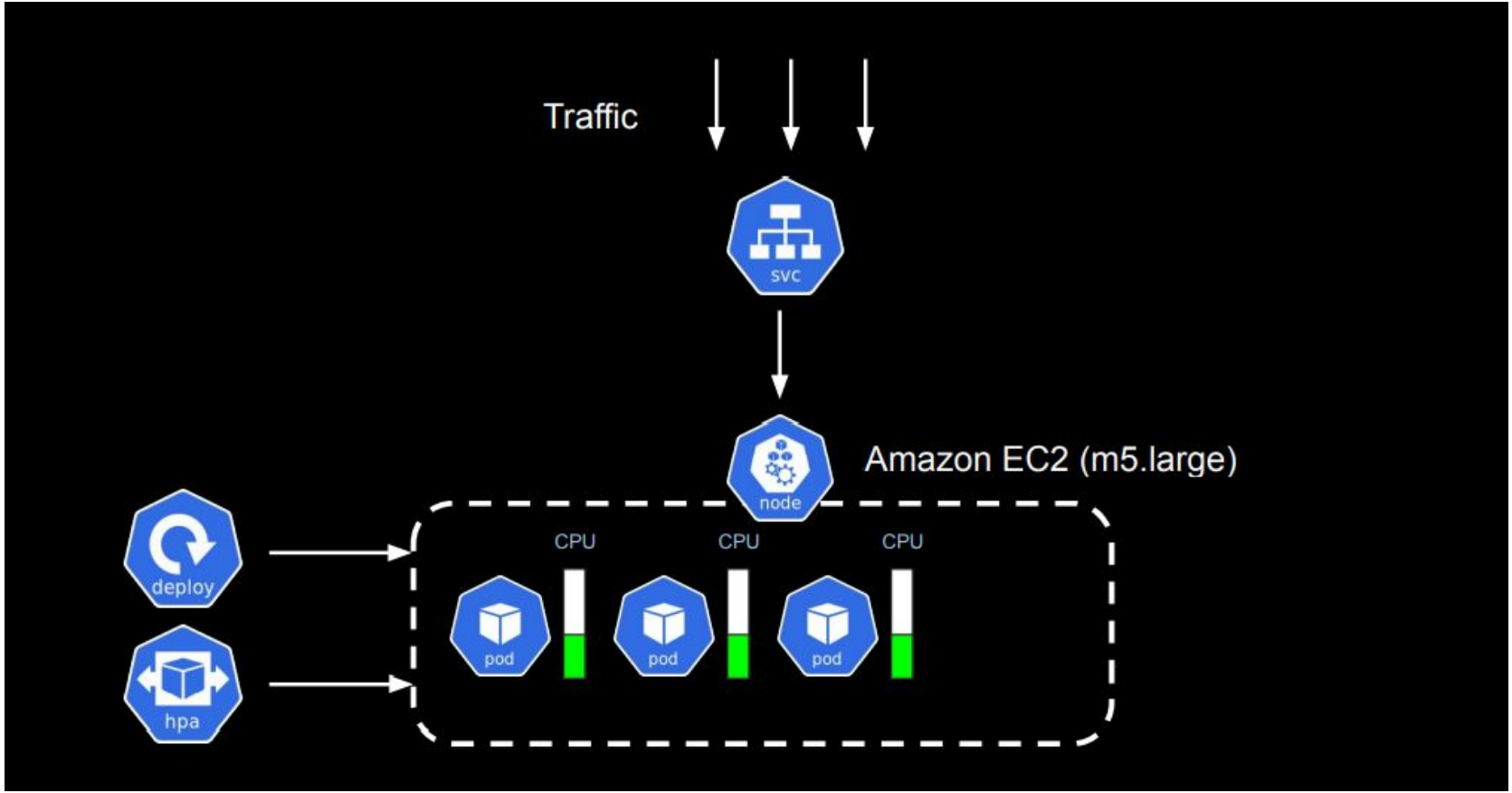


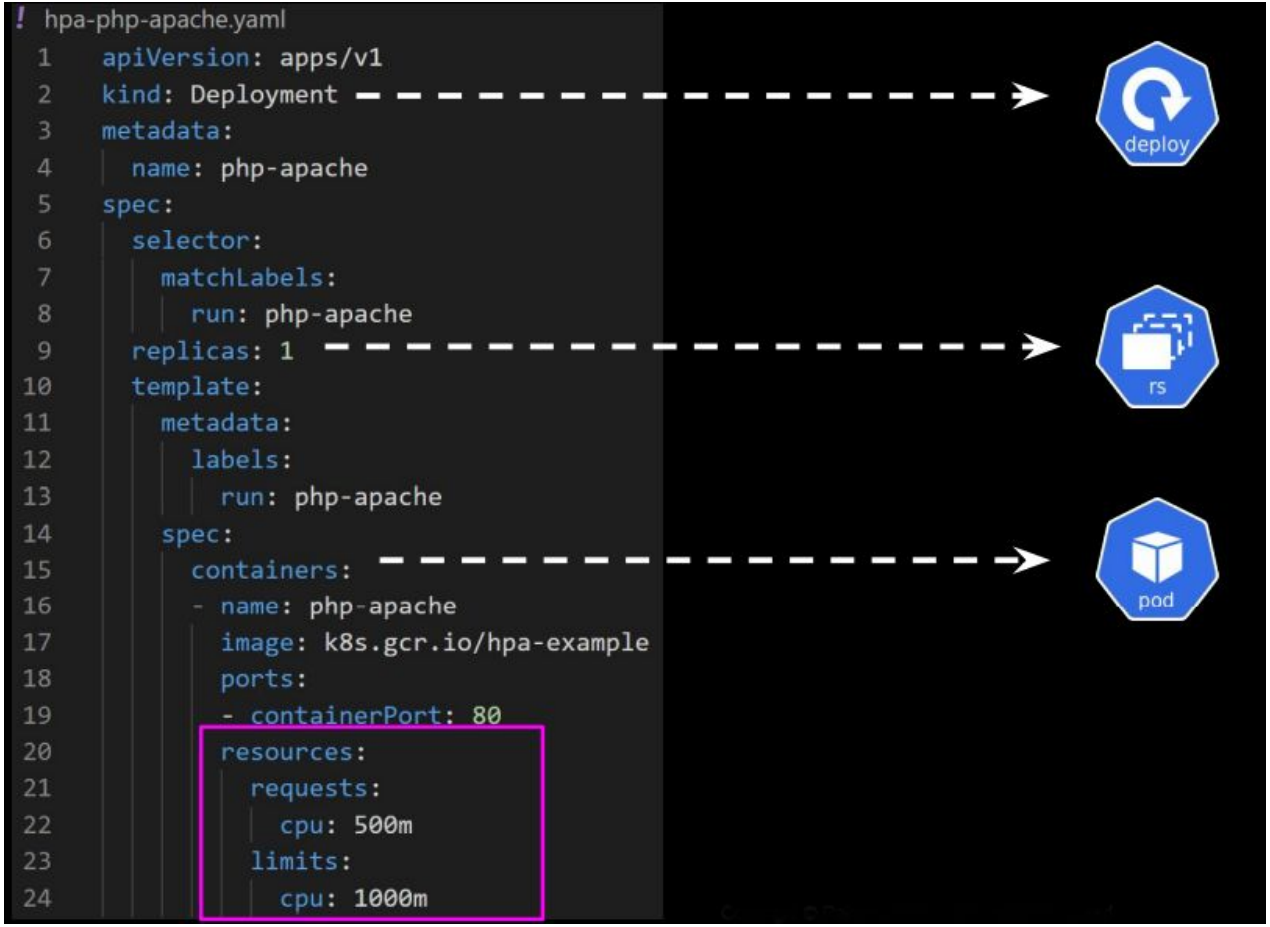
EKS Cluster Autoscaler



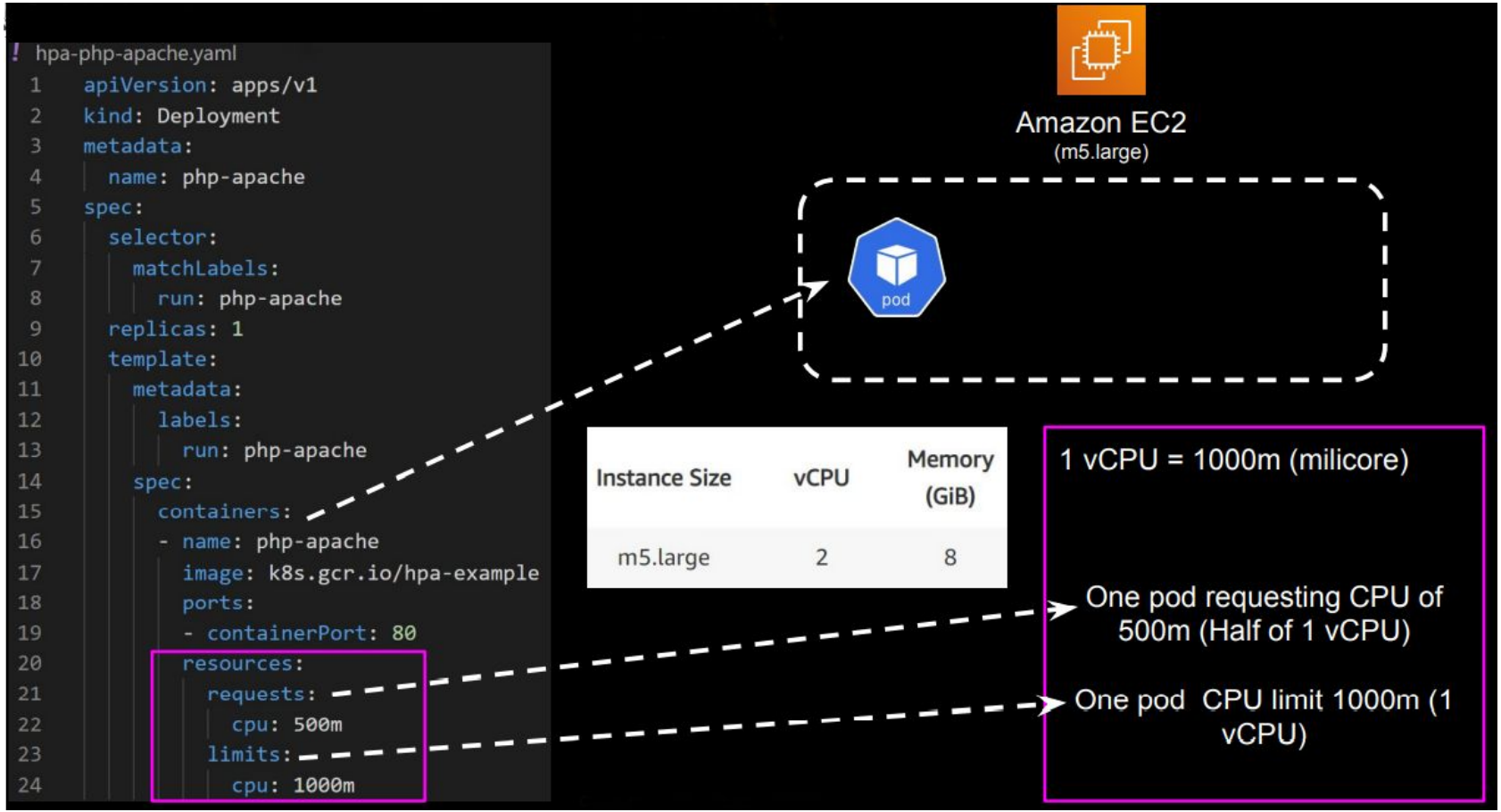
Horizontal Pod Autoscaler (HPA)



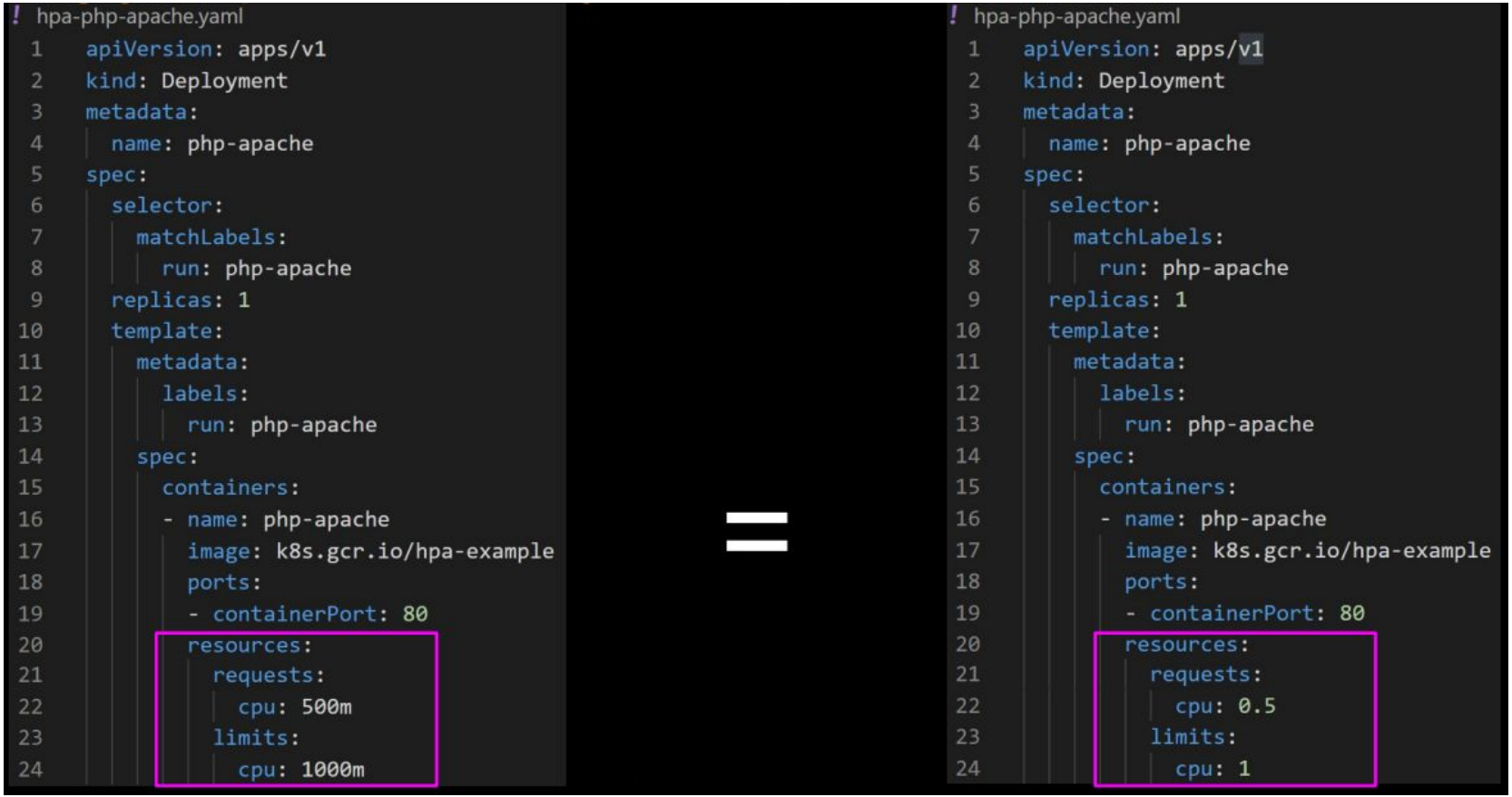
Pod Request And Limit



Pod Request And Limit



Pod Request And Limit



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

Pod Request And Limit + HPA

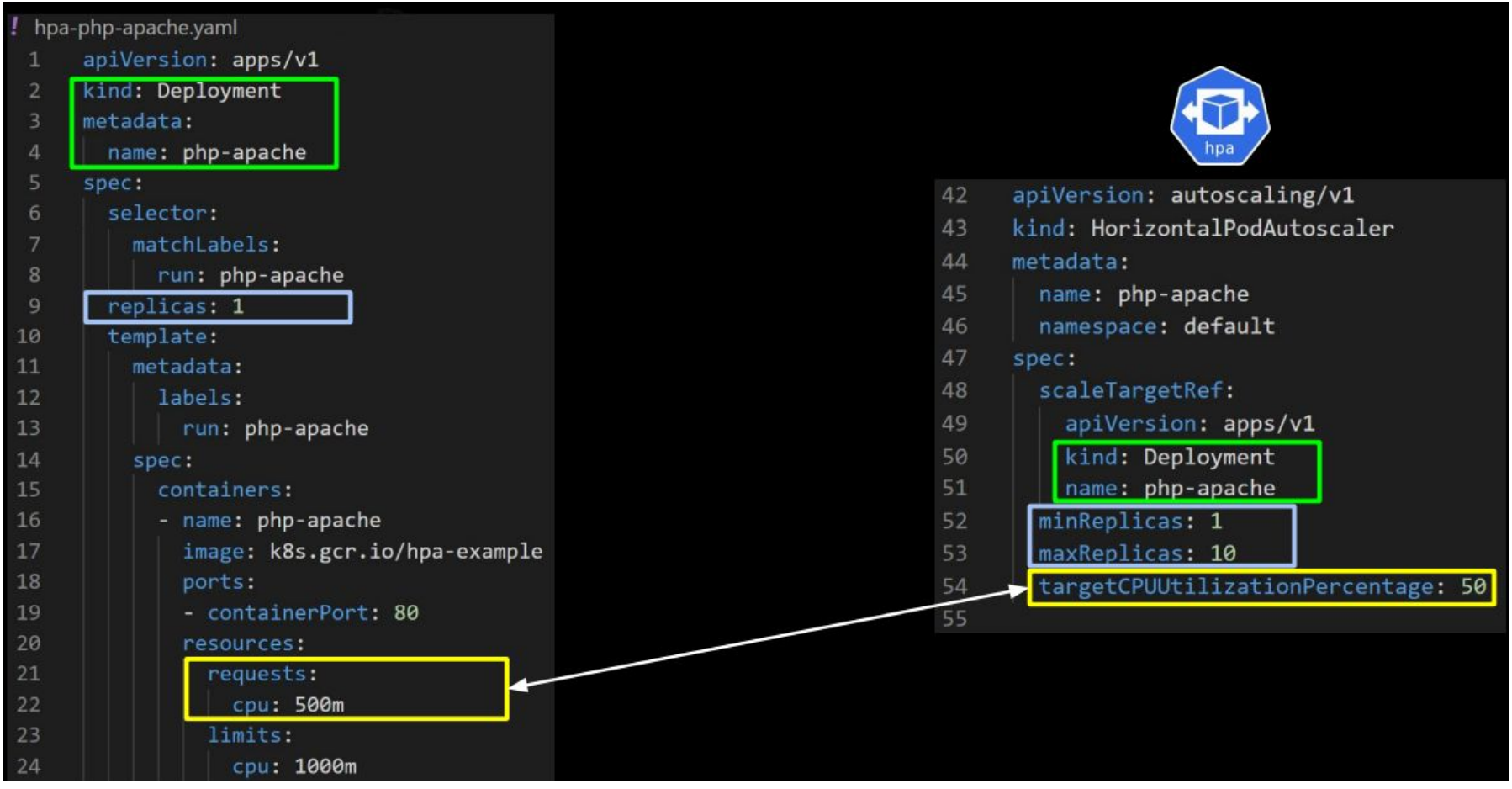
hpa-php-apache.yaml

```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
```

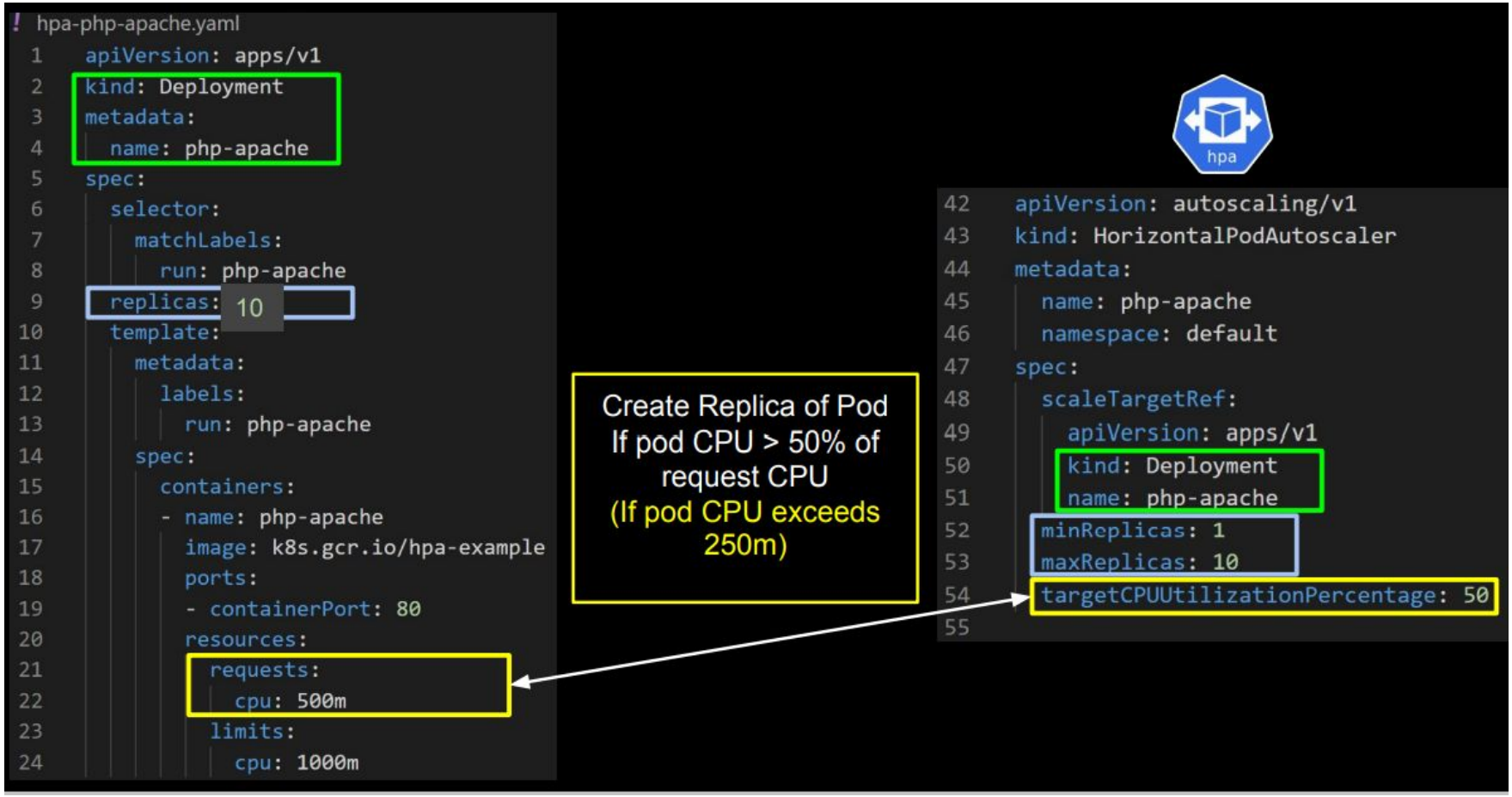
Create Replica of Pod
If pod CPU > 50% of request CPU
(If pod CPU exceeds 250m)


```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
```

K8s HPA YAML


hpa-php-apache.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
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

Pod Request And Limit



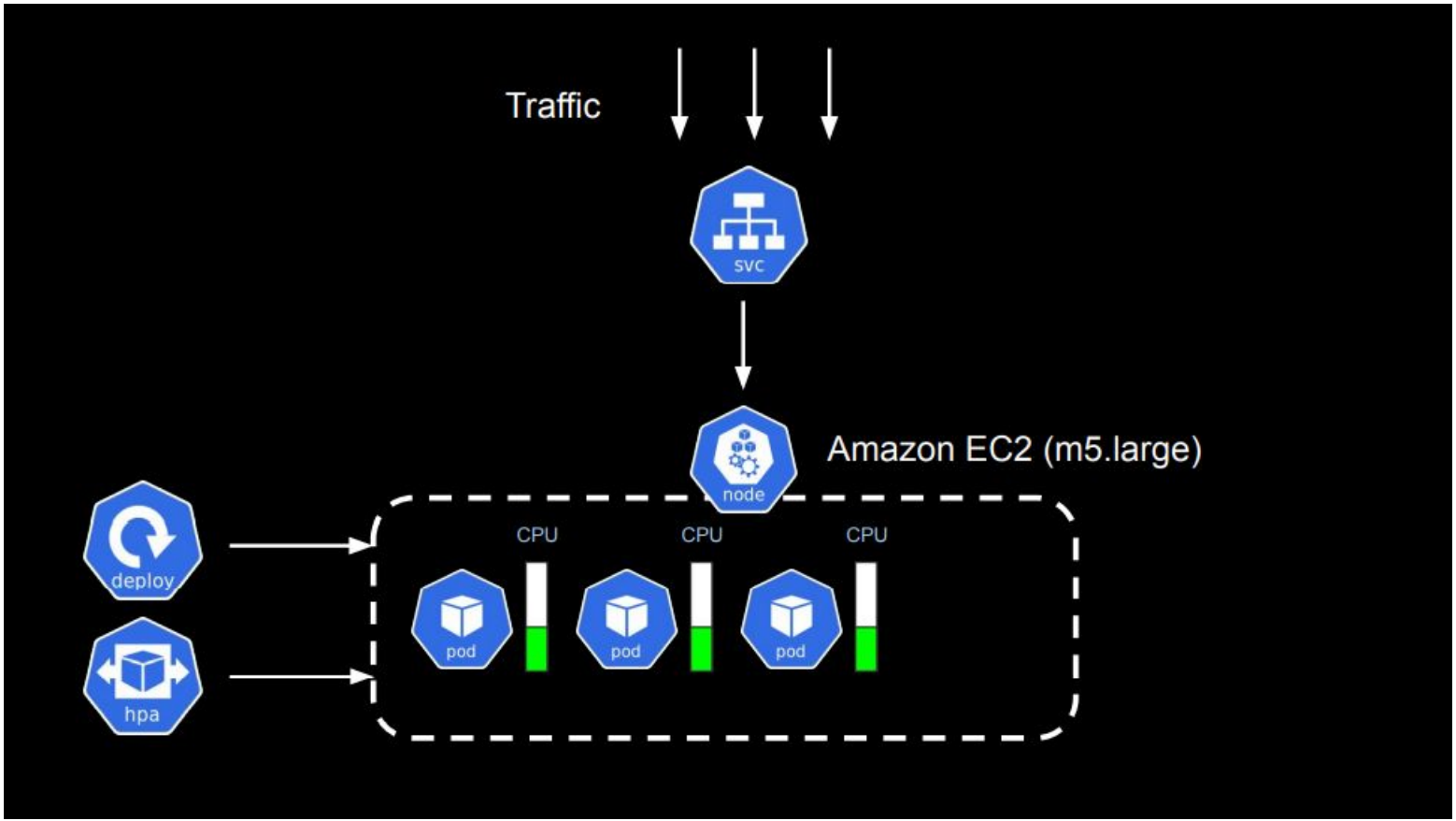
HPA Demo on EKS

- 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

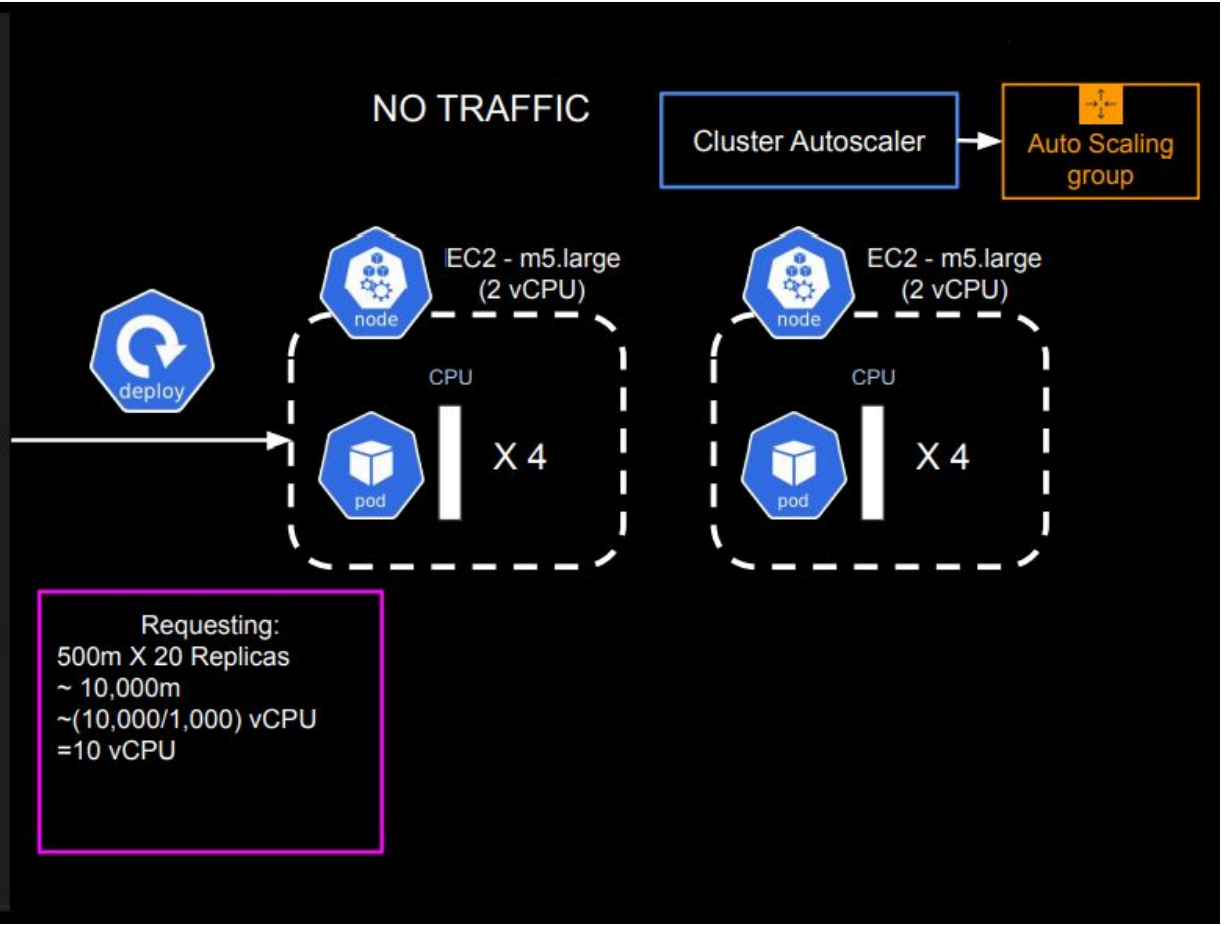
Horizontal Pod Autoscaler (HPA)



Cluster Autoscaler

cluster-autoscaler-deployment-1.yaml

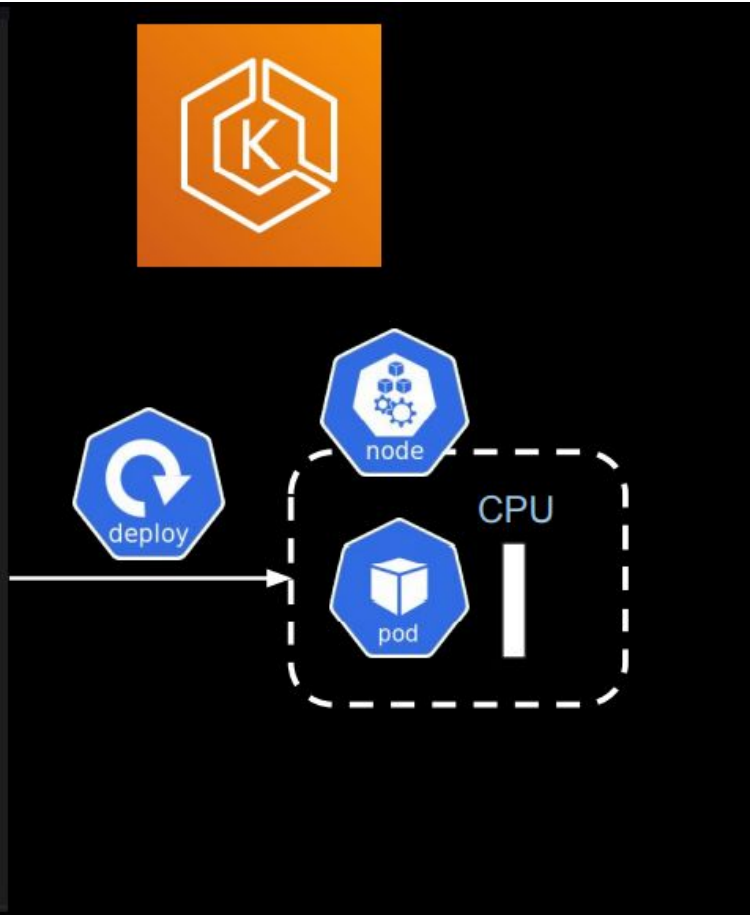
```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: php-apache
spec:
  selector:
    matchLabels:
      run: php-apache
  replicas: 20
  template:
    metadata:
      labels:
        run: php-apache
    spec:
      containers:
      - name: php-apache
        image: k8s.gcr.io/hpa-example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



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
```



Vertical Pod Autoscaler

Do NOT use this in Production!

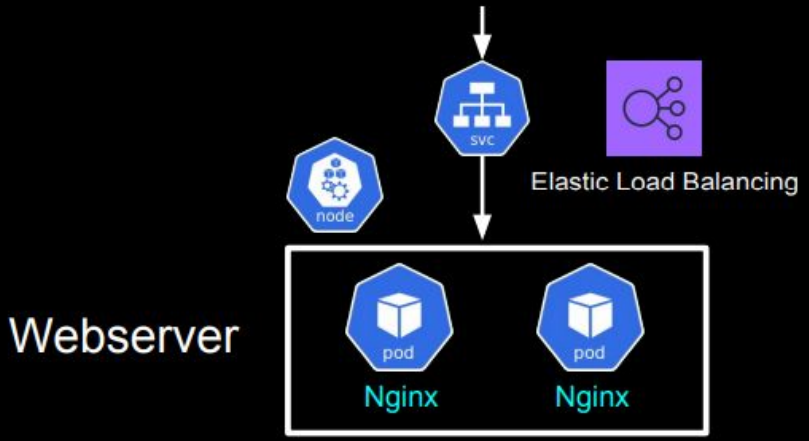
- Restarts PODs

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!

EKS Ingress

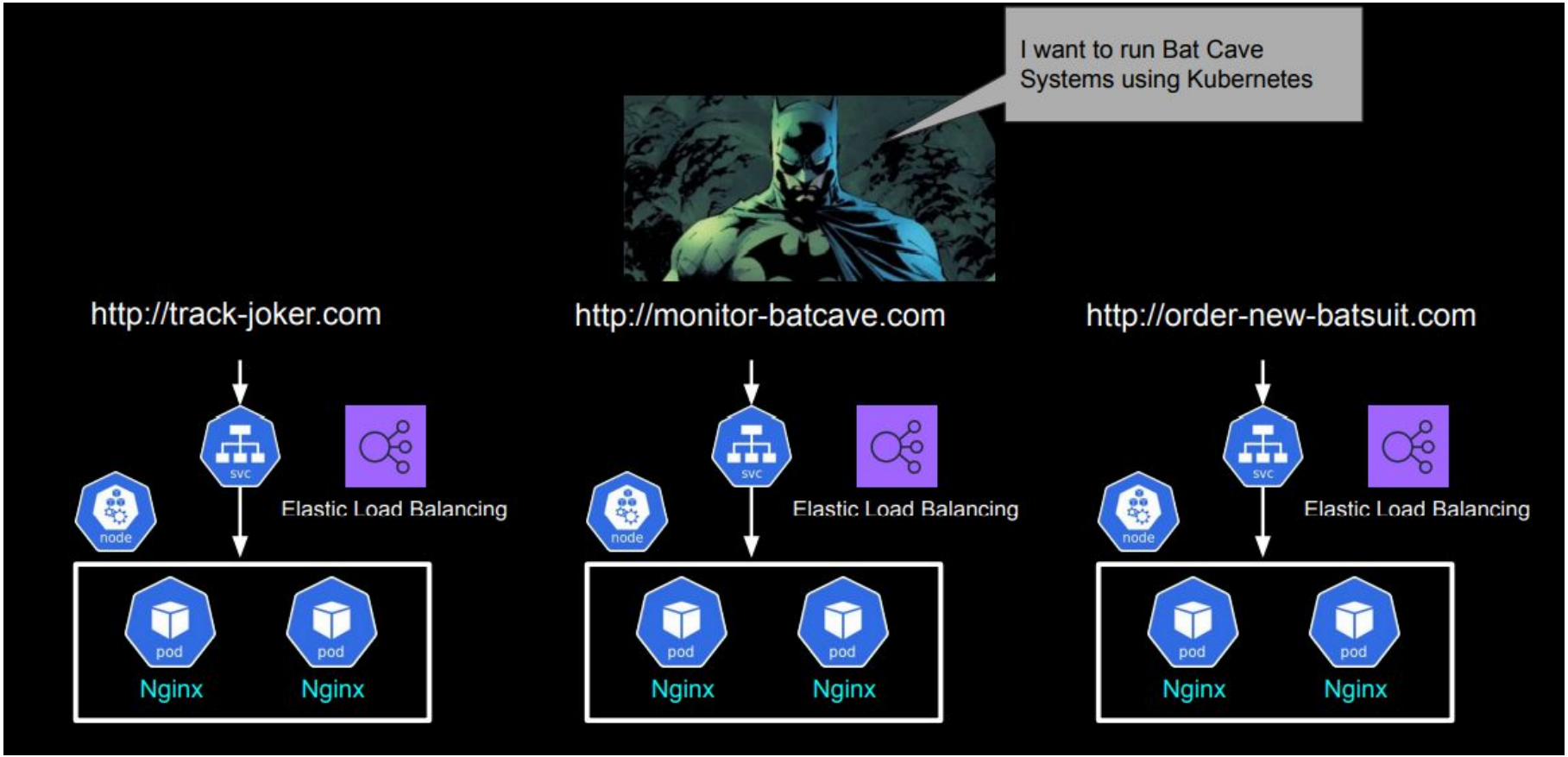
Ingress - What and Why?



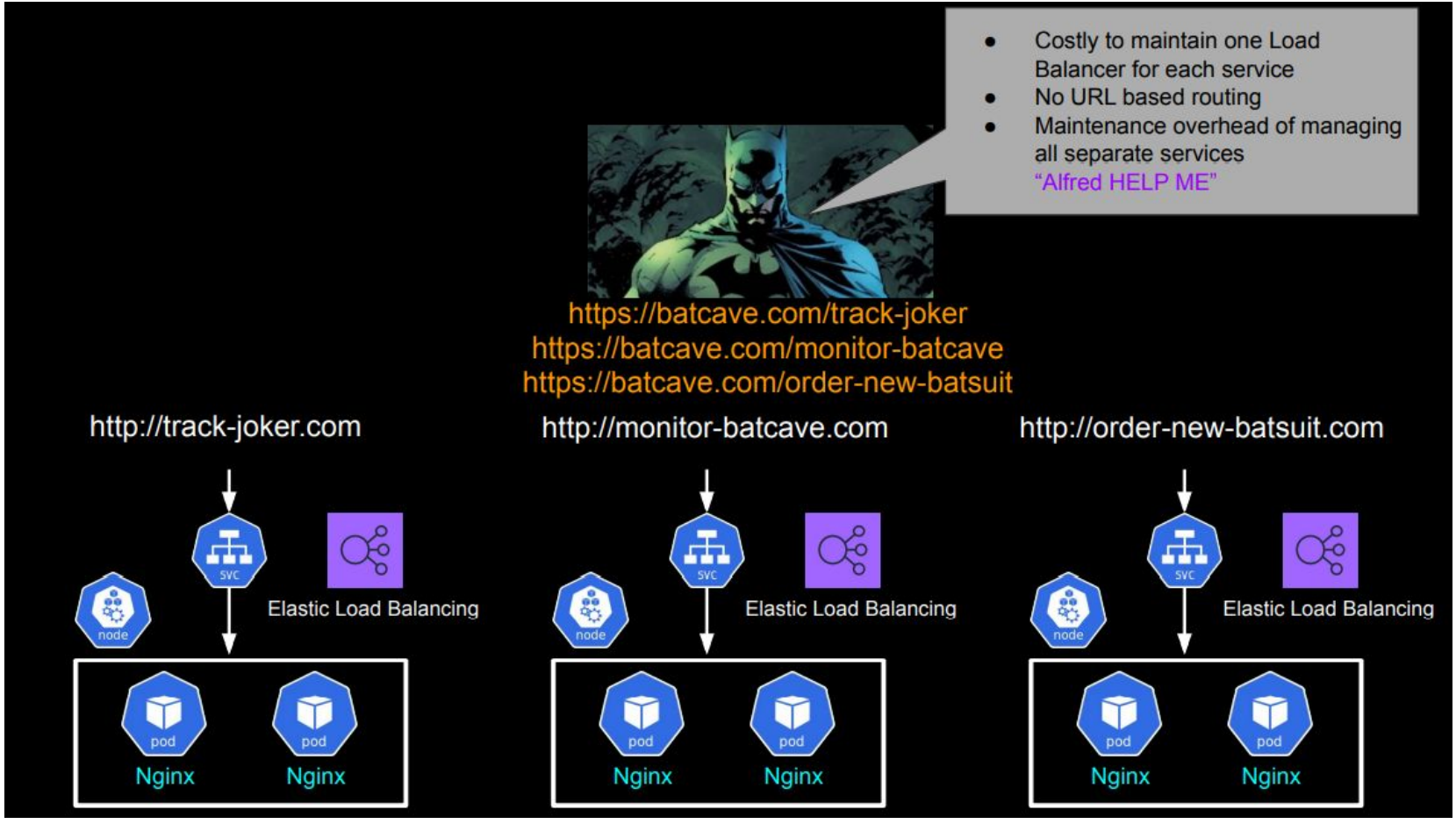
loadbalancer-service.yaml

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

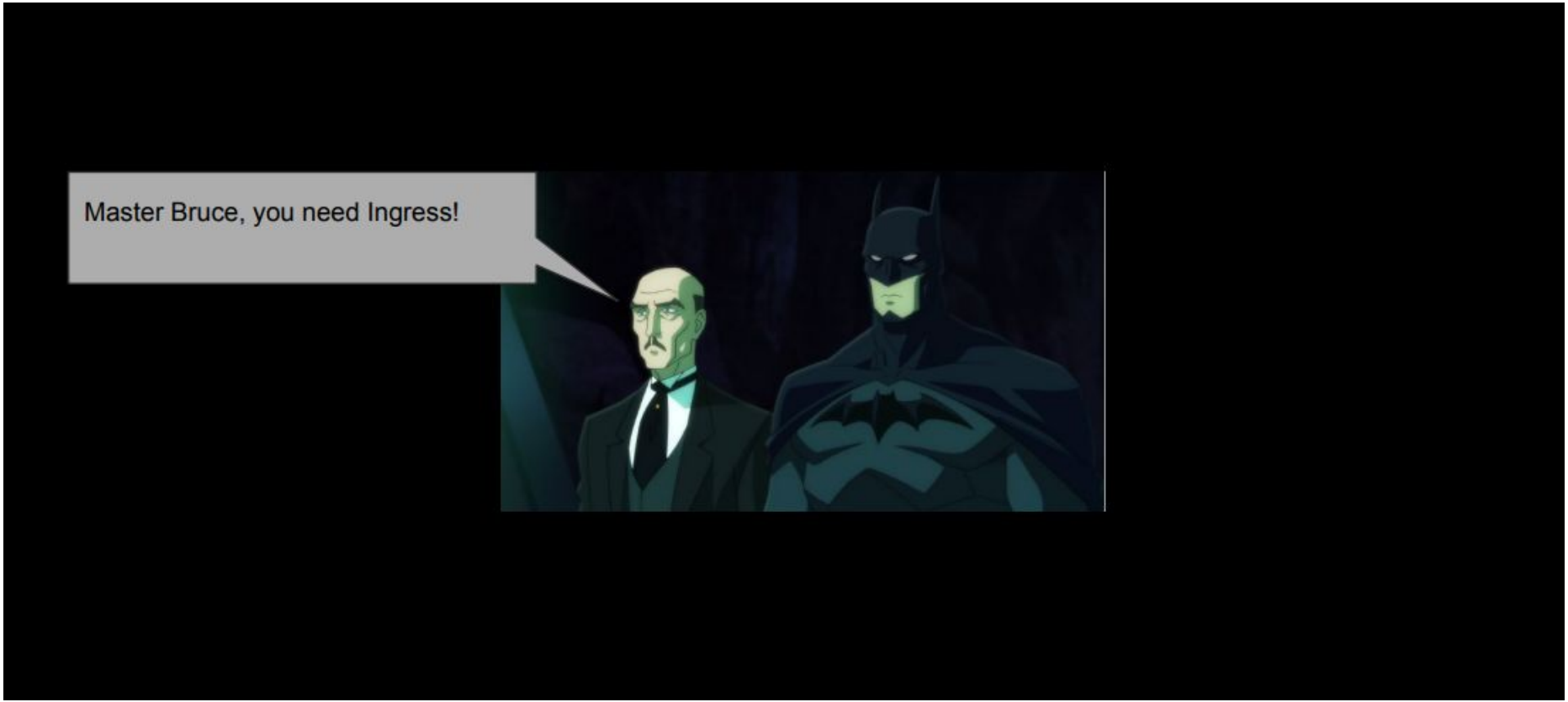
Ingress - What and Why?



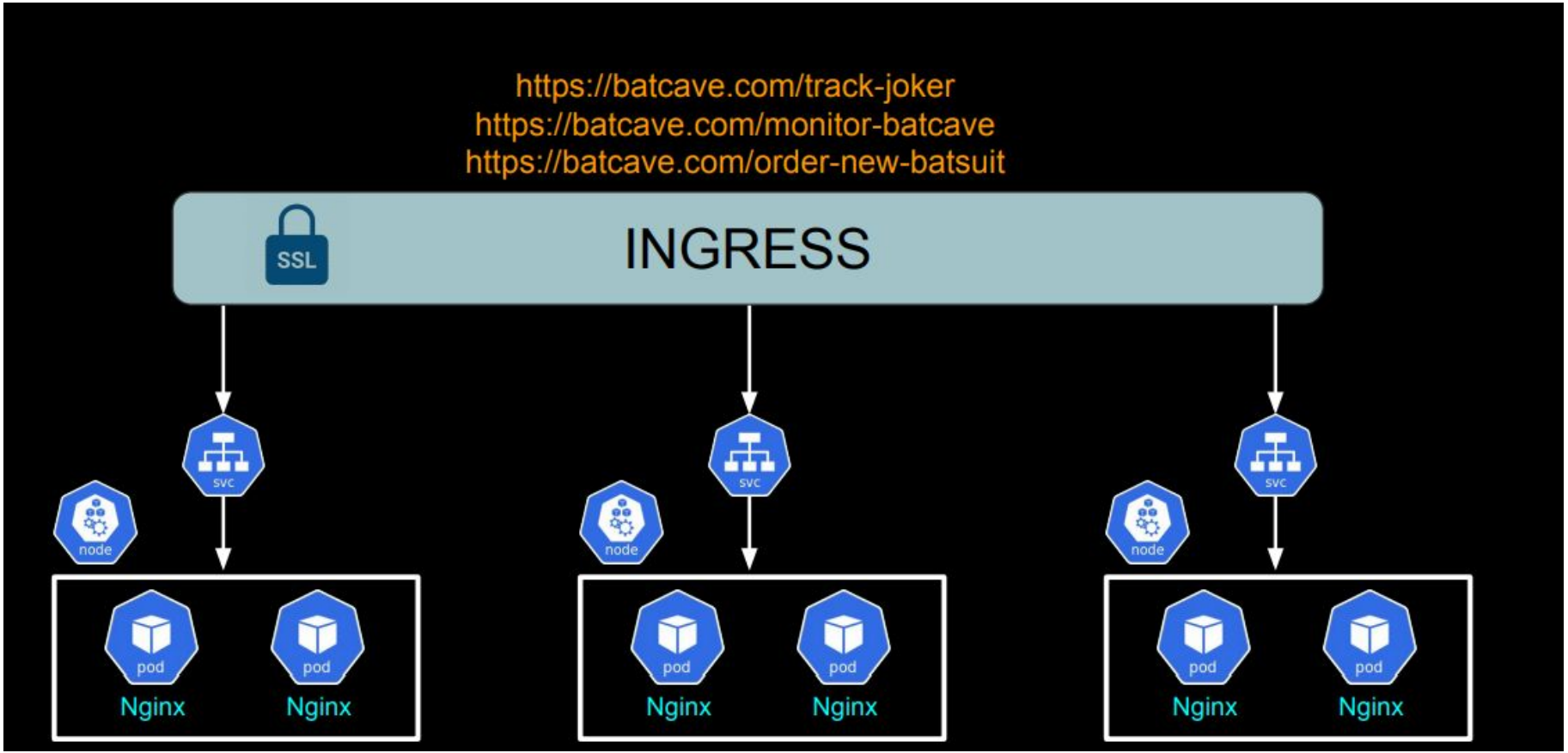
Ingress - What and Why?



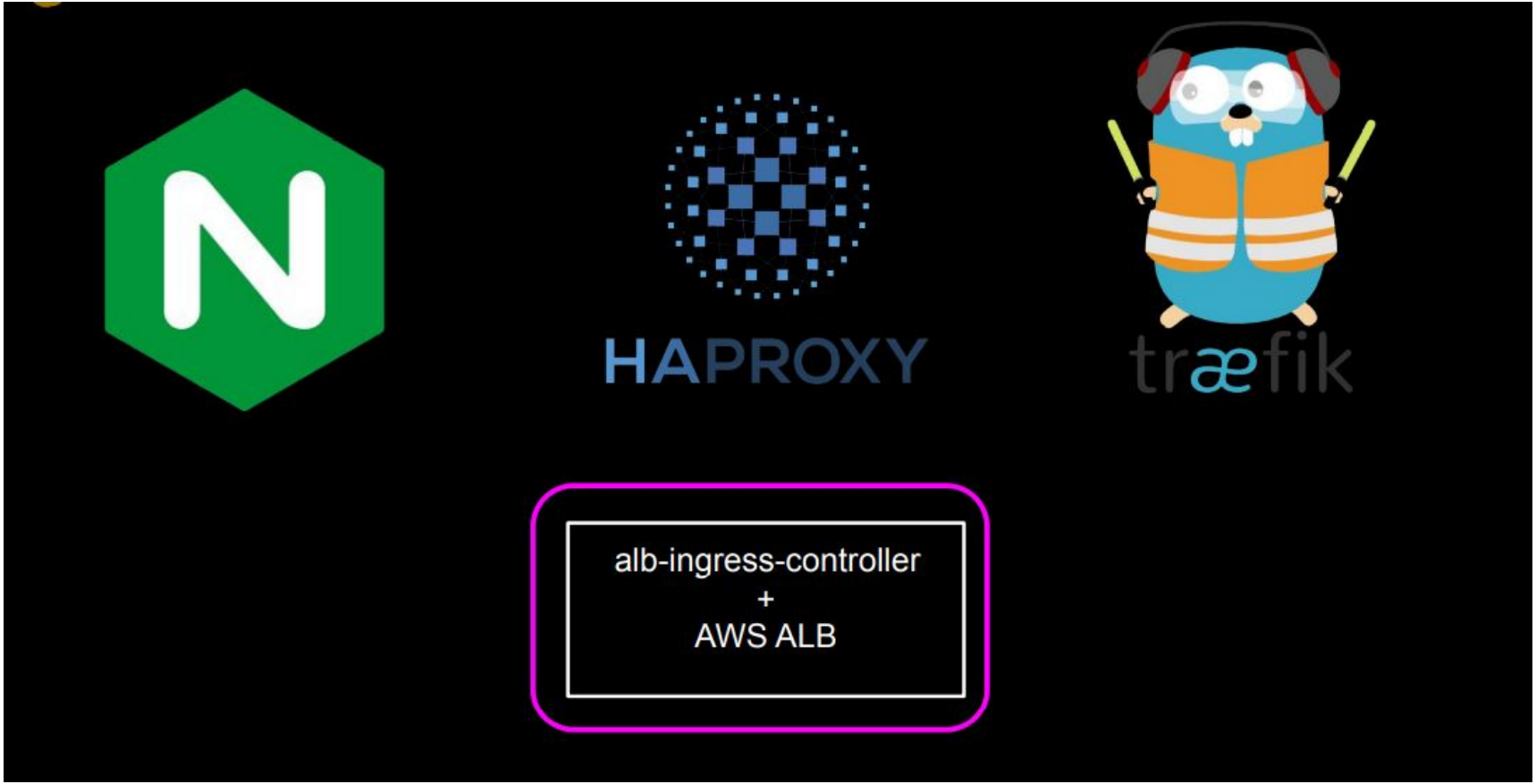
Ingress - What and Why?



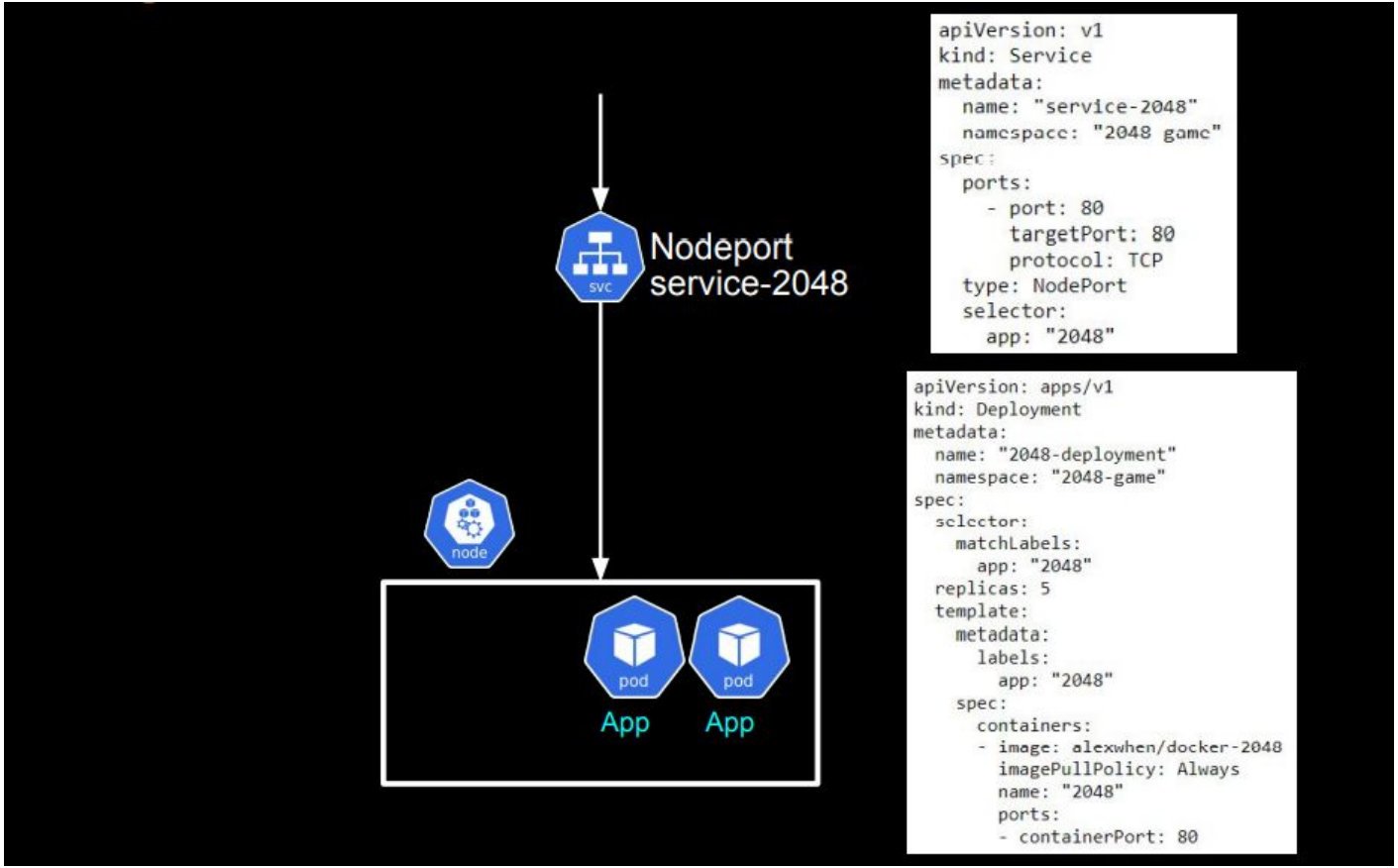
Ingress - What and Why?



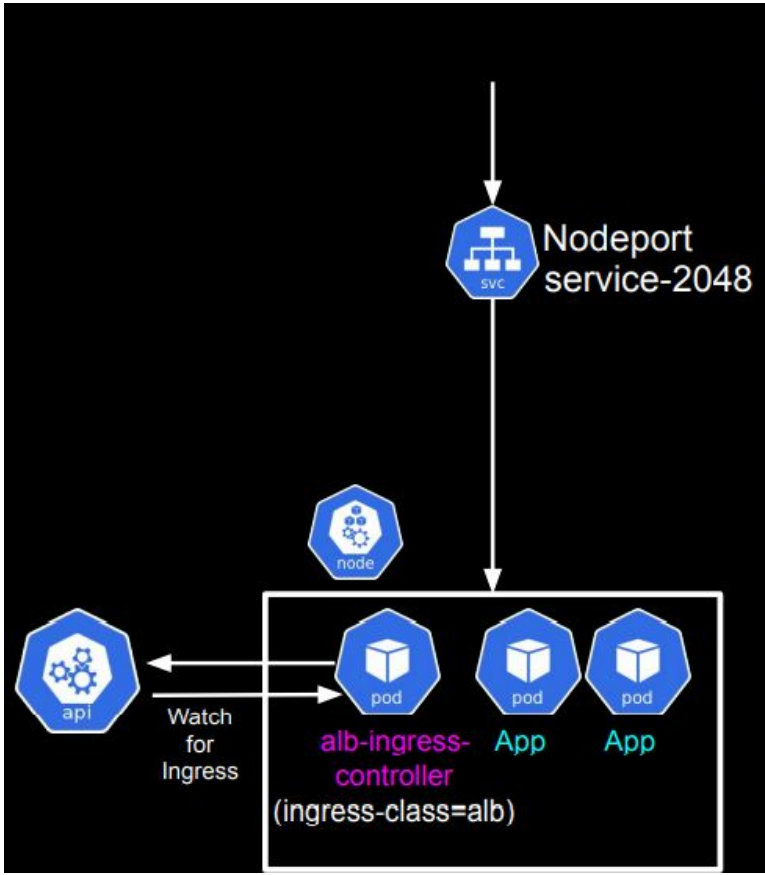
Ingress Controllers



ALB Ingress

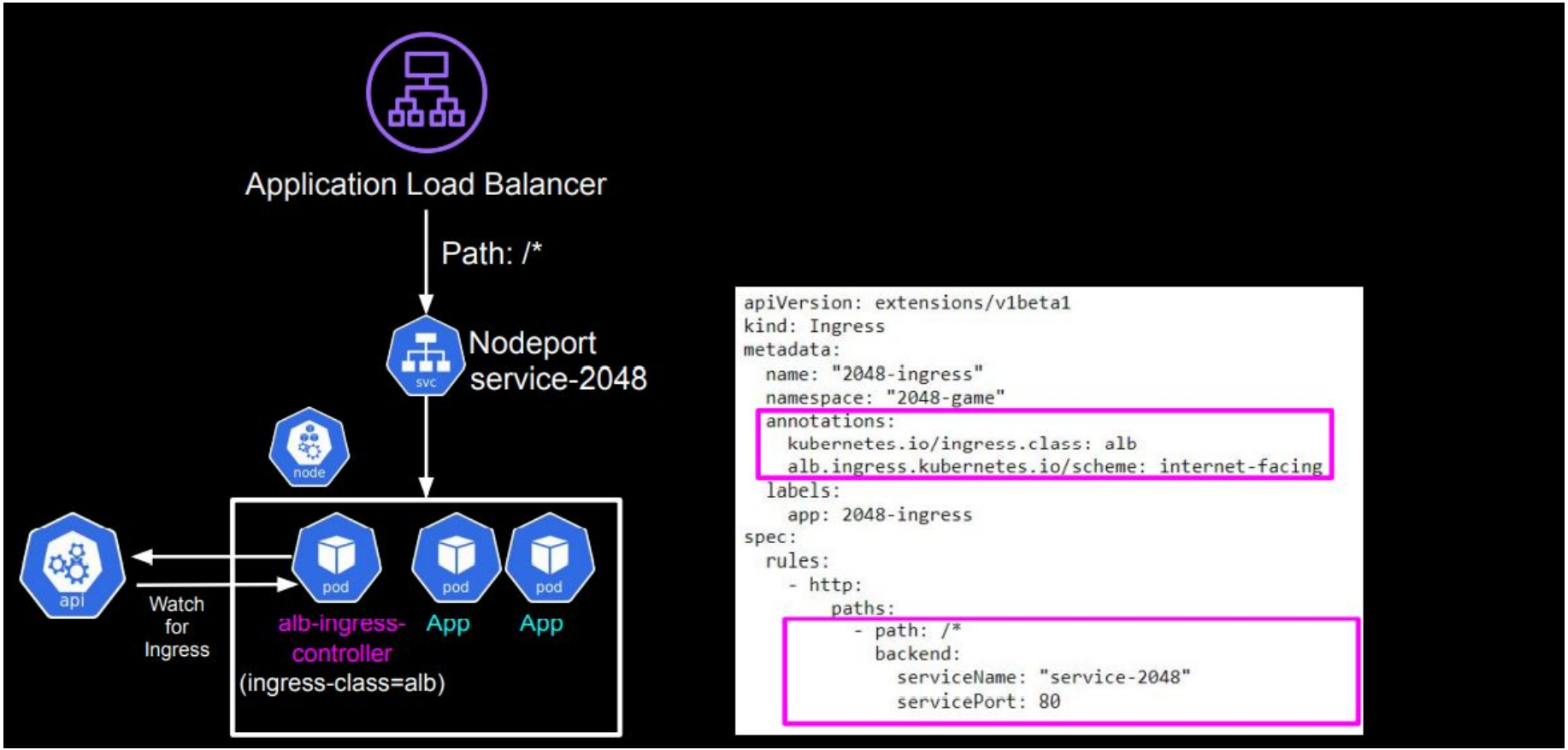

svc
Nodeport
service-2048
node
pod
pod
App
App
apiVersion: v1
kind: Service
metadata:
name: "service-2048"
namespace: "2048 game"
spec:
ports:
- port: 80
targetPort: 80
protocol: TCP
type: NodePort
selector:
app: "2048"
apiVersion: apps/v1
kind: Deployment
metadata:
name: "2048-deployment"
namespace: "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

ALB Ingress Controller



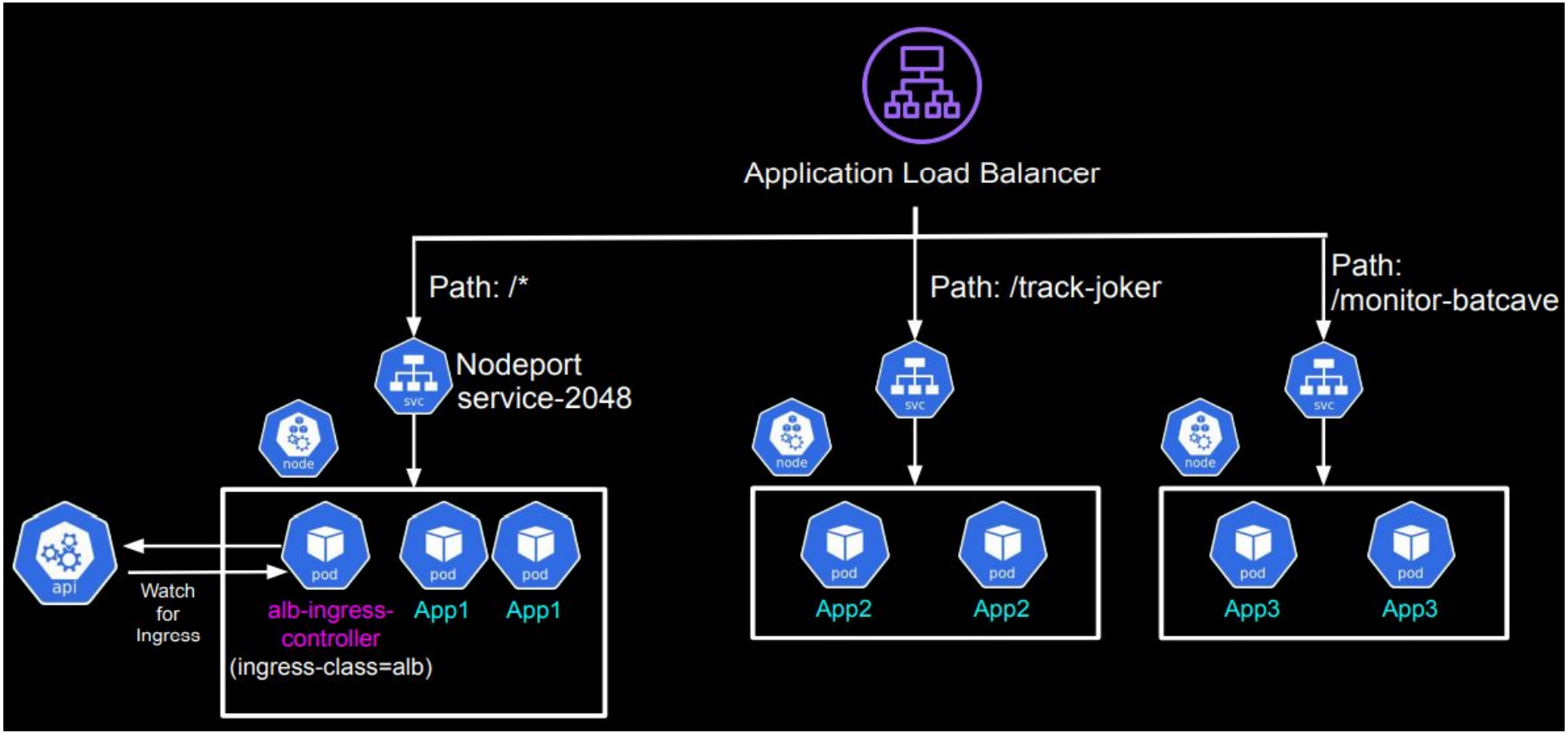

```
# Application Load Balancer (ALB) Ingress Controller Deployment Manifest.
# This manifest details sensible defaults for deploying an ALB Ingress Controller.
# GitHub: https://github.com/kubernetes-sigs/aws-alb-ingress-controller
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app.kubernetes.io/name: 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
```

Ingress resource




```
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
```

ALB Ingress


Application Load Balancer
Path: /*
Path: /track-joker
Path: /monitor-batcave
Nodeport service-2048
svc
node
pod
api
Watch for Ingress
alb-ingress-controller
(ingress-class=alb)
App1
App2
App3

Ingress - What and Why?

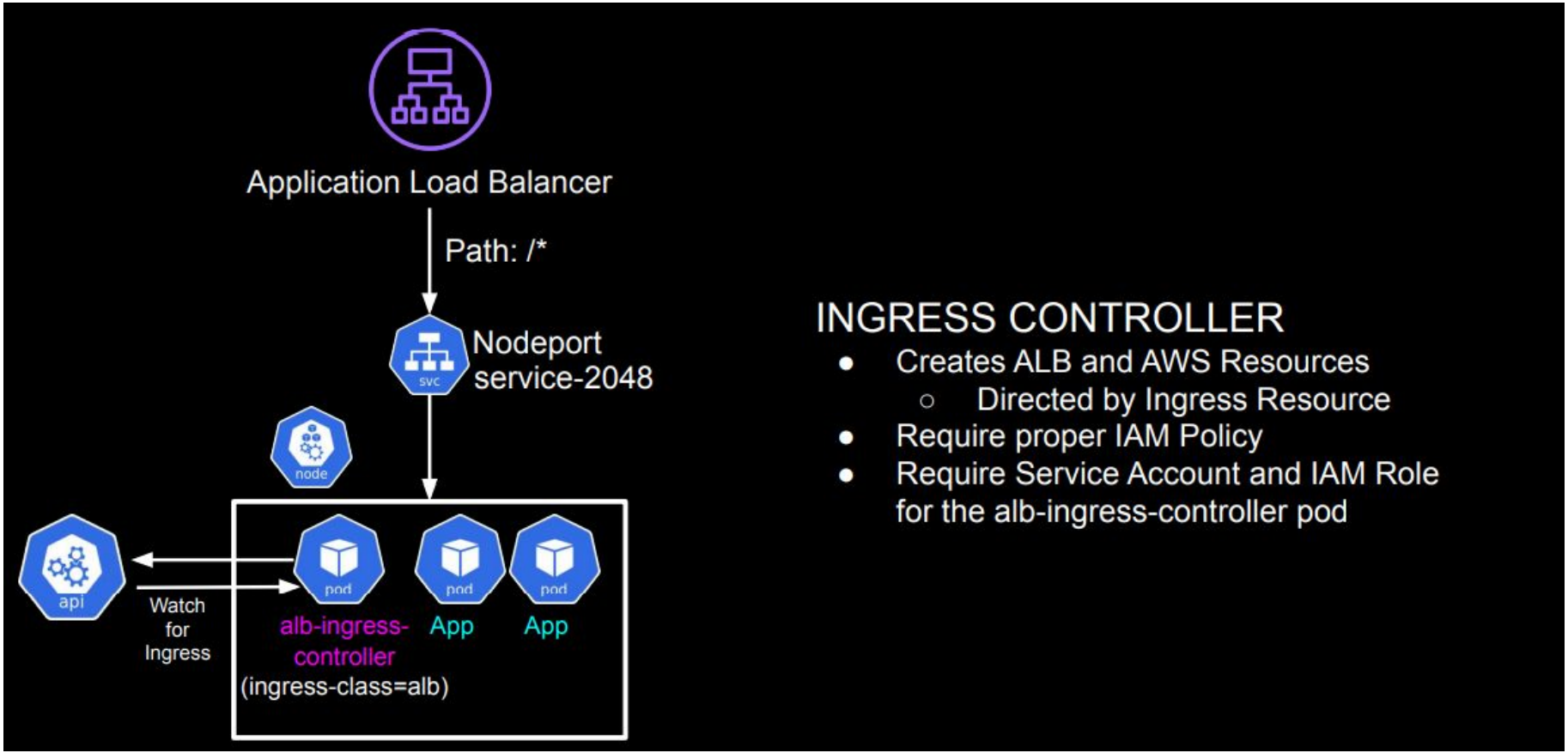
INGRESS CONTROLLER

- 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

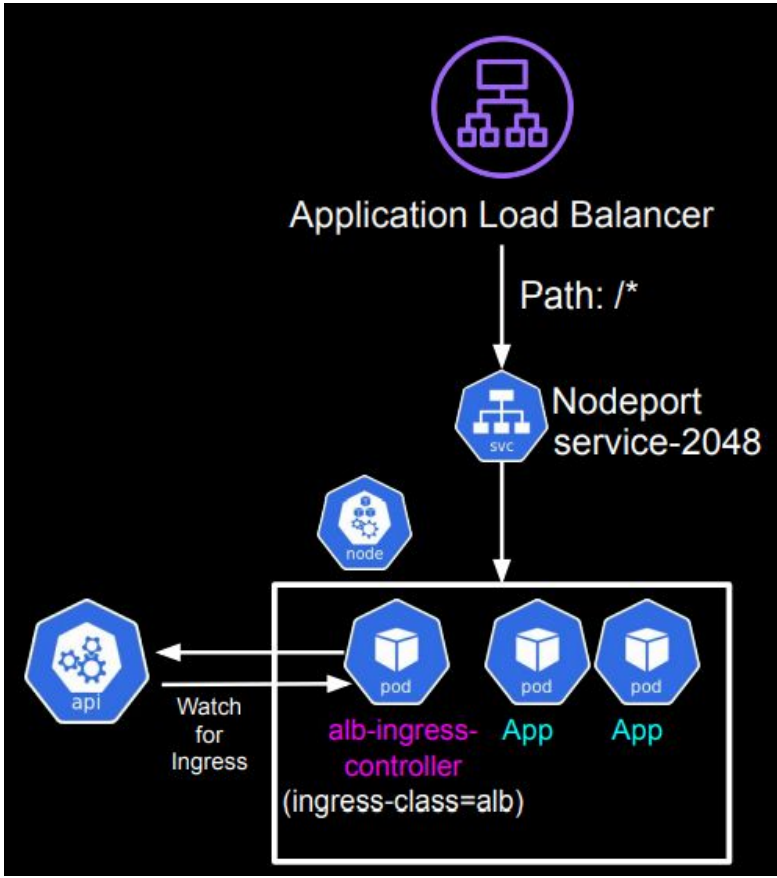
ALB Ingress



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

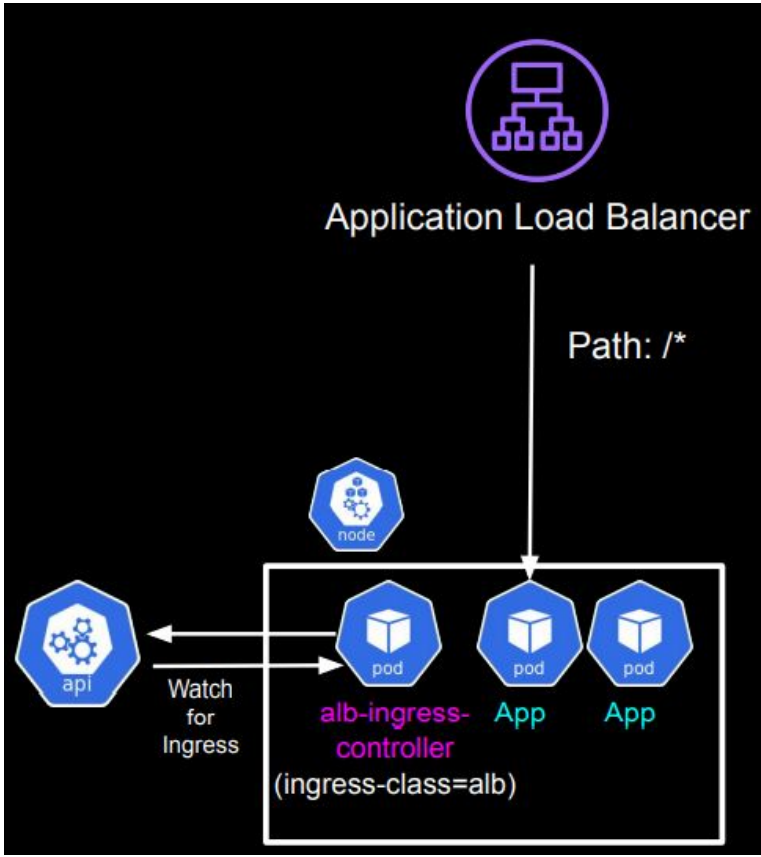
ALB Ingress



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

ALB Ingress



INGRESS TRAFFIC

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Thank You