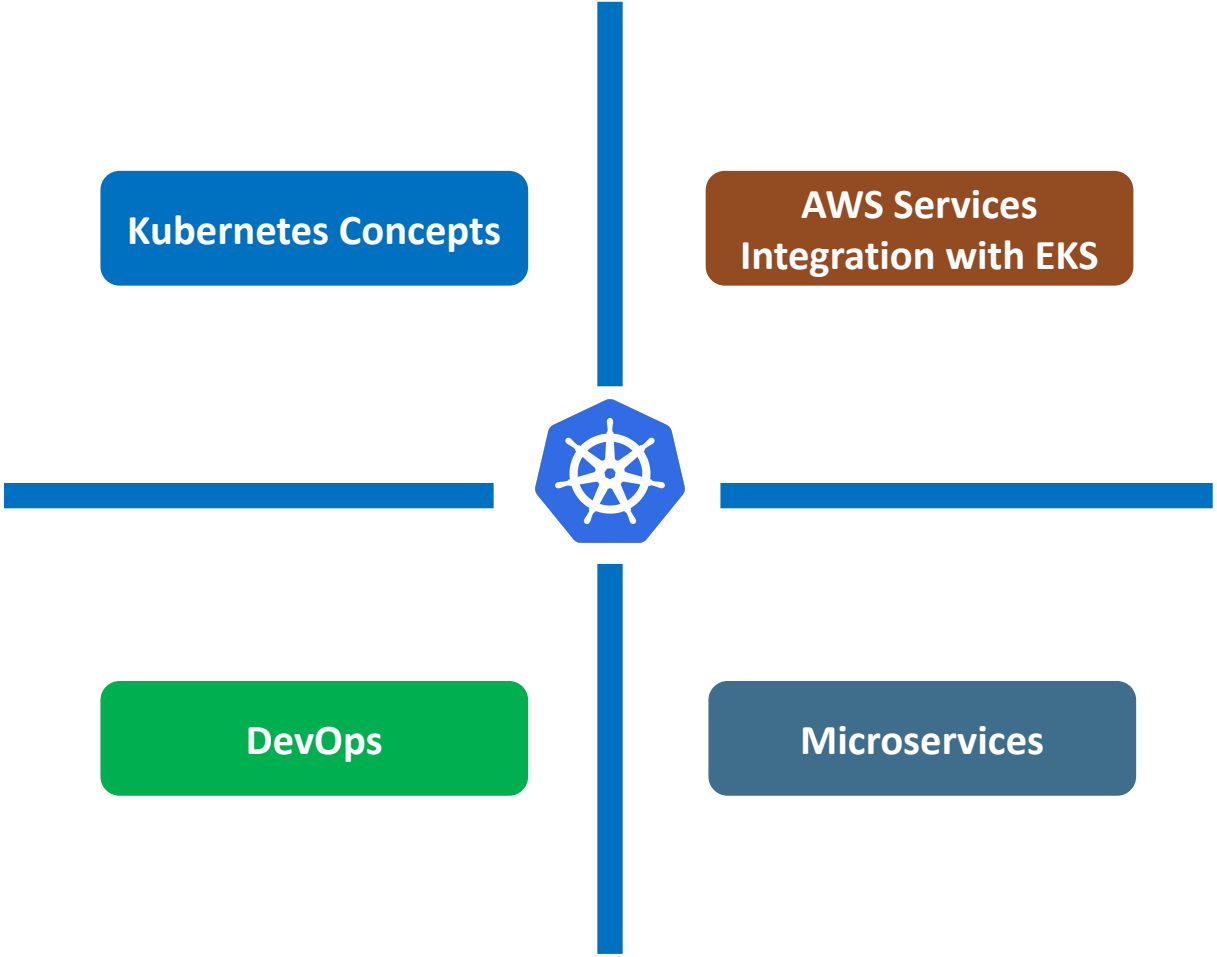
AWS EKS Kubernetes


Kubernetes Concepts
AWS Services Integration with EKS
DevOps
Microservices

Architecture
Pods
ReplicaSets
Deployments
Node Port Service
Cluster IP Service
External Name Service
Ingress Service
Ingress SSL
Ingress & External DNS

kubectl - Imperative
Declarative with YAML
Secrets
Init Containers
Probes
Requests & Limits
Namespaces
Limit Range
Resource Quota
Storage Classes

Persistent Volumes
PVC
Load Balancers
Annotations
Canary Deployments
HPA
VPA
DaemonSets
Fluentd for logs
ConfigMaps

KUBERNETES

AWS SERVICES

DevOps

AWS Developer Tools

AWS CodeCommit

AWS CodeBuild

AWS CodePipeline

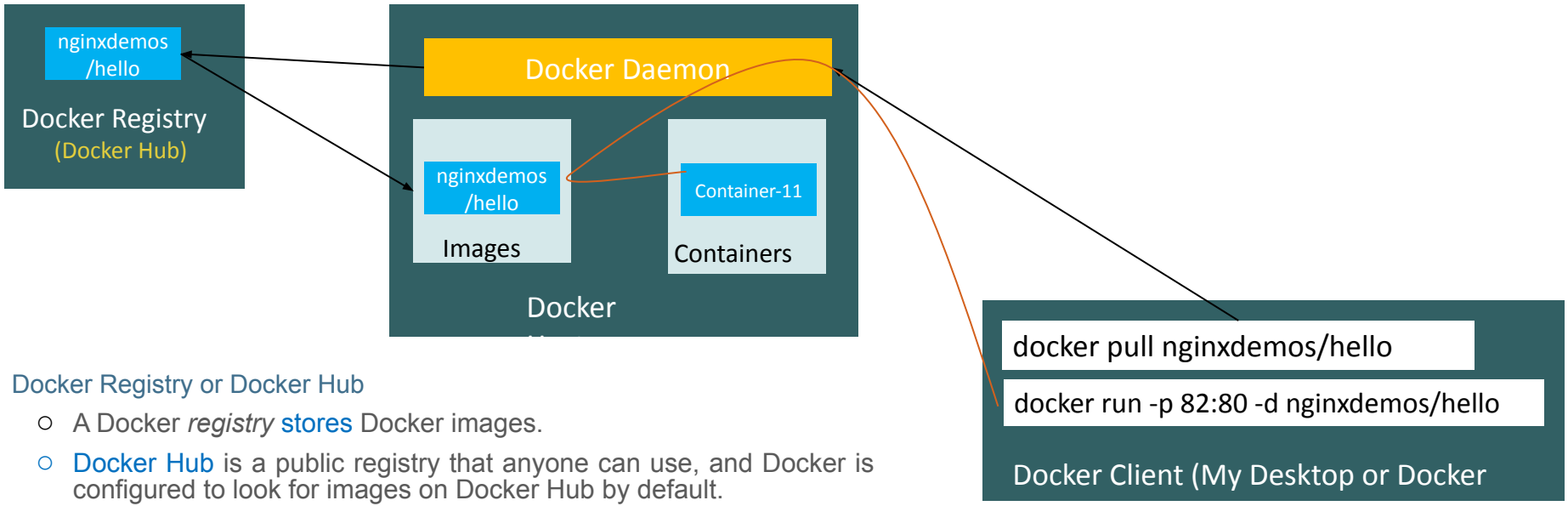
Microservices

Service Discovery

Distributed Tracing

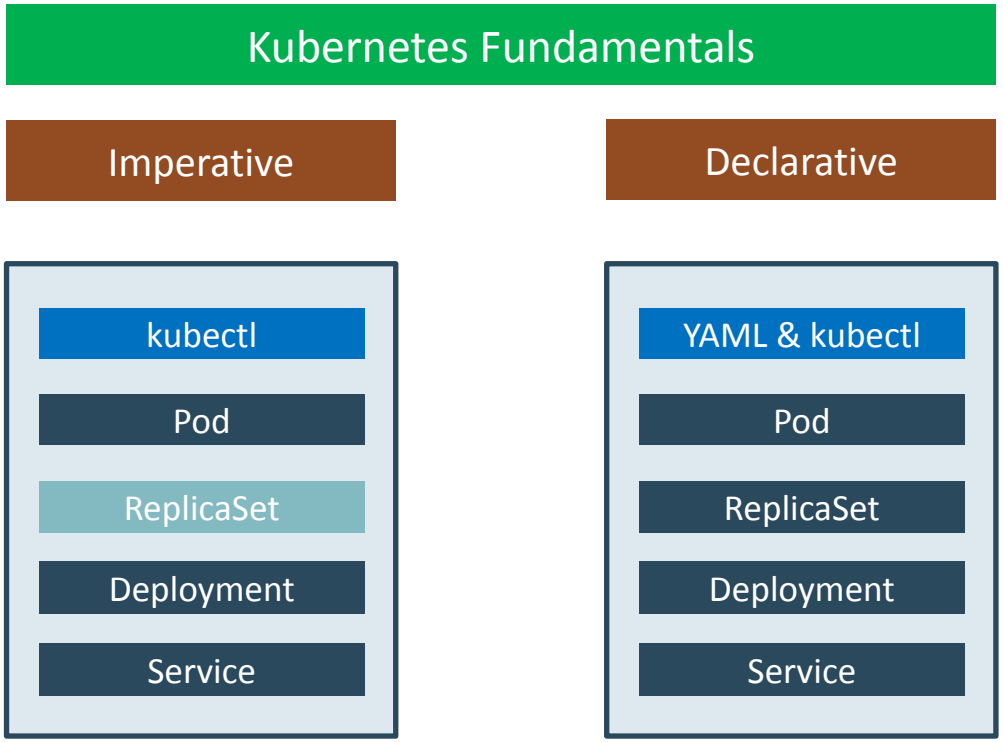
Canary Deployments

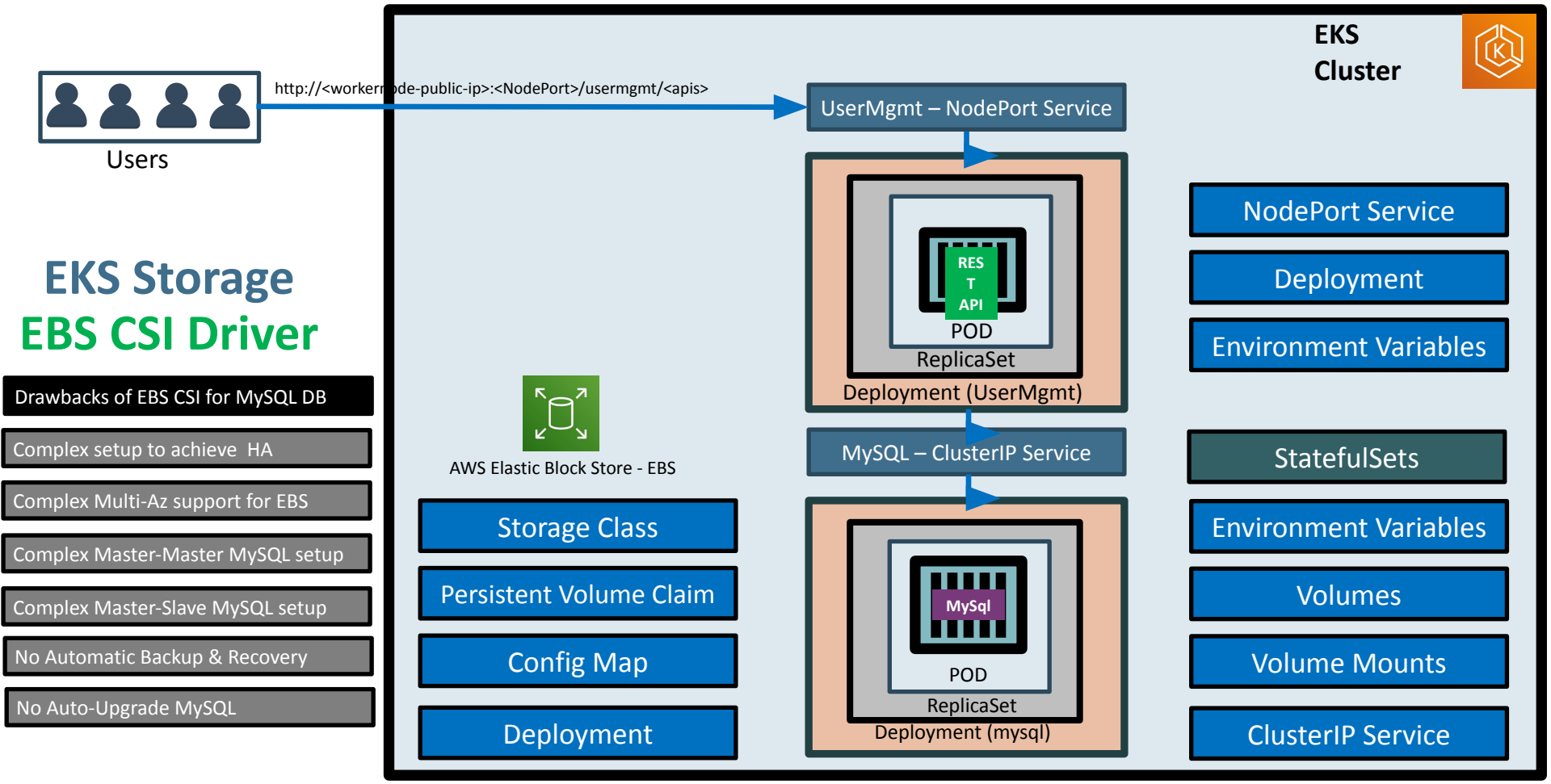
Docker - Fundamentals

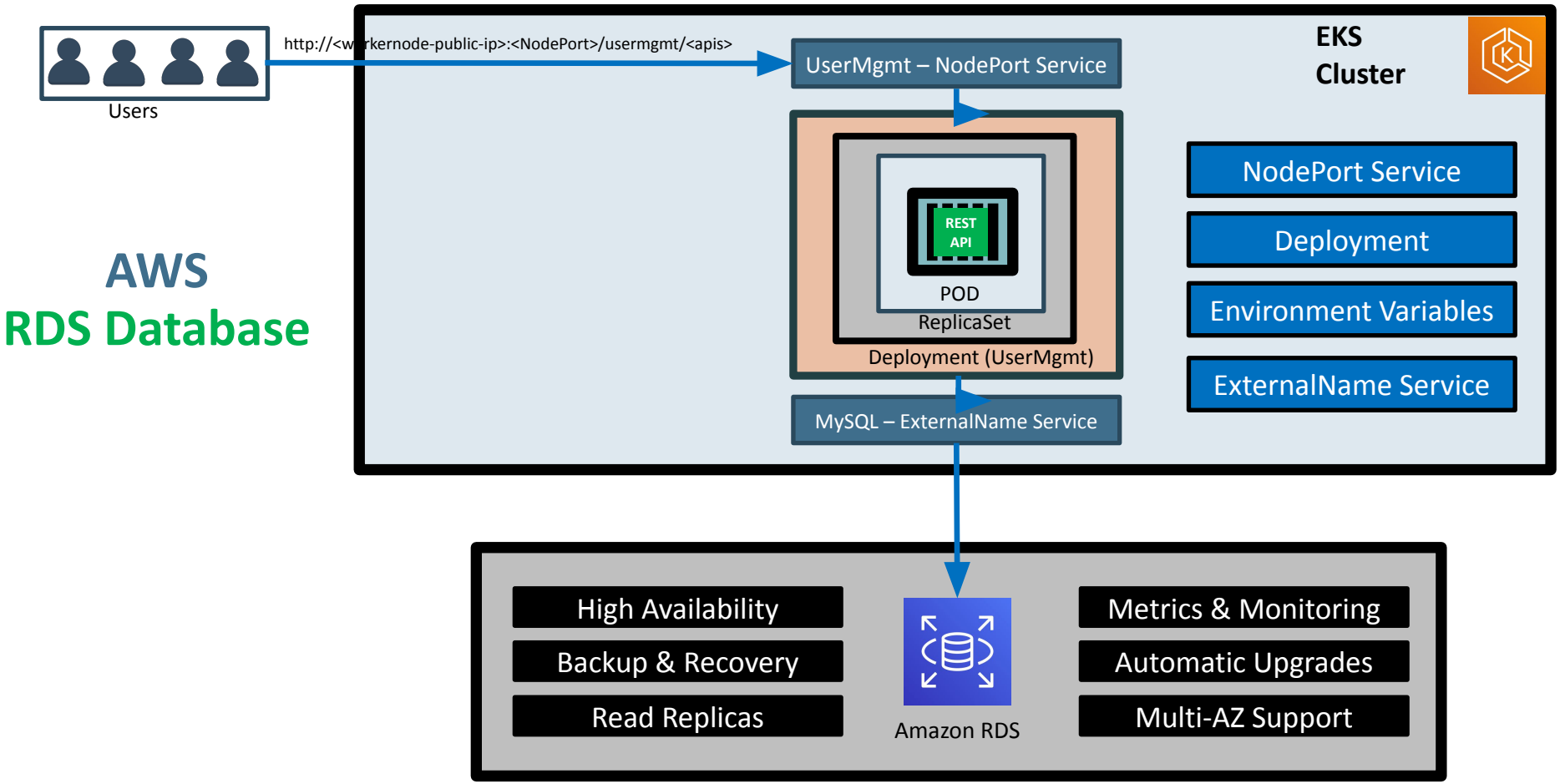


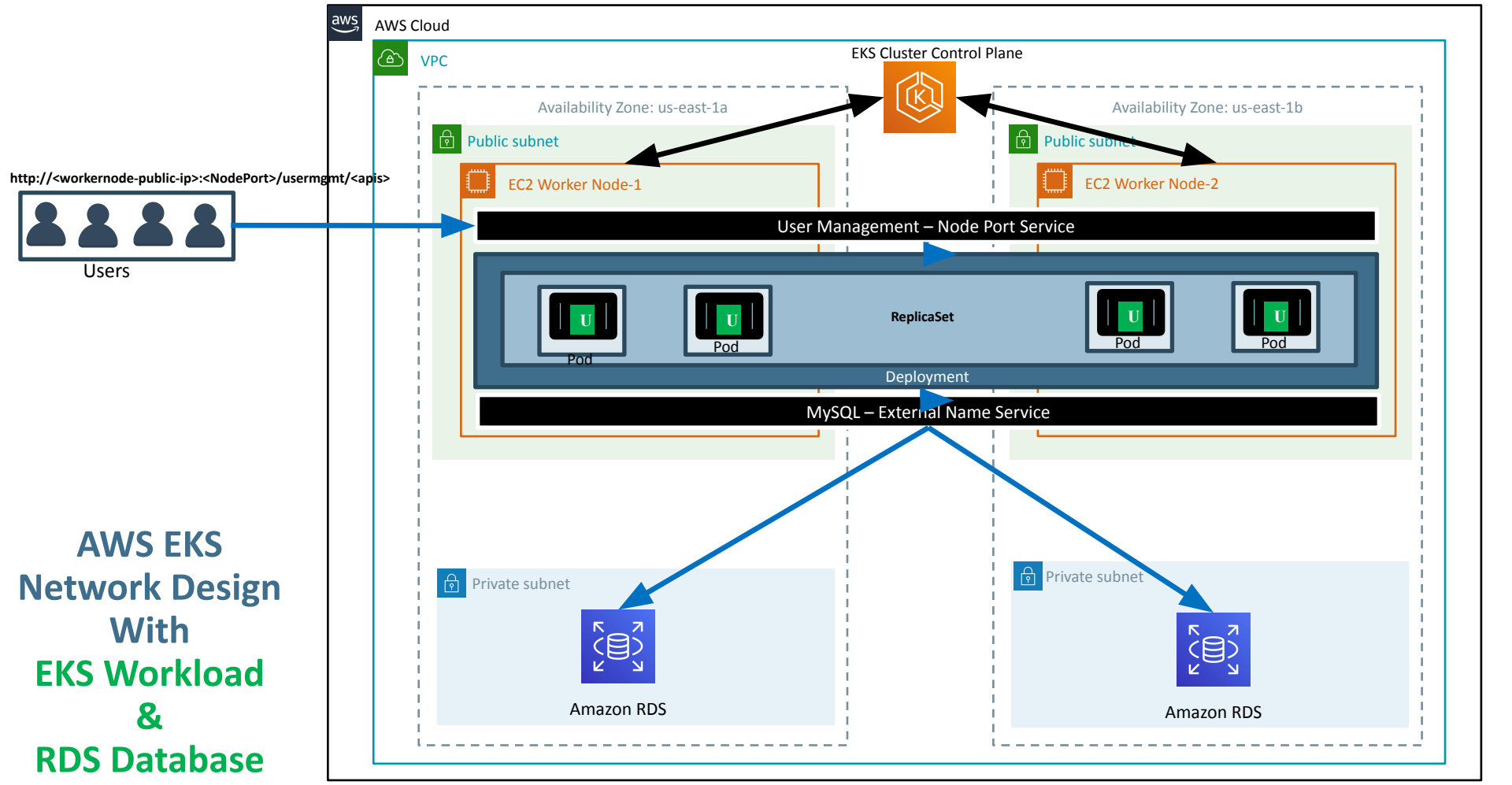
- Docker Registry or Docker Hub
  - A Docker *registry* stores Docker images.
  - Docker Hub is a public registry that anyone can use, and Docker is configured to look for images on Docker Hub by default.
  - We can even run our own private registry.
  - When we use the docker pull or docker run commands, the required images are pulled from our configured registry.
  - When we use the docker push command, our image is pushed to our configured registry.

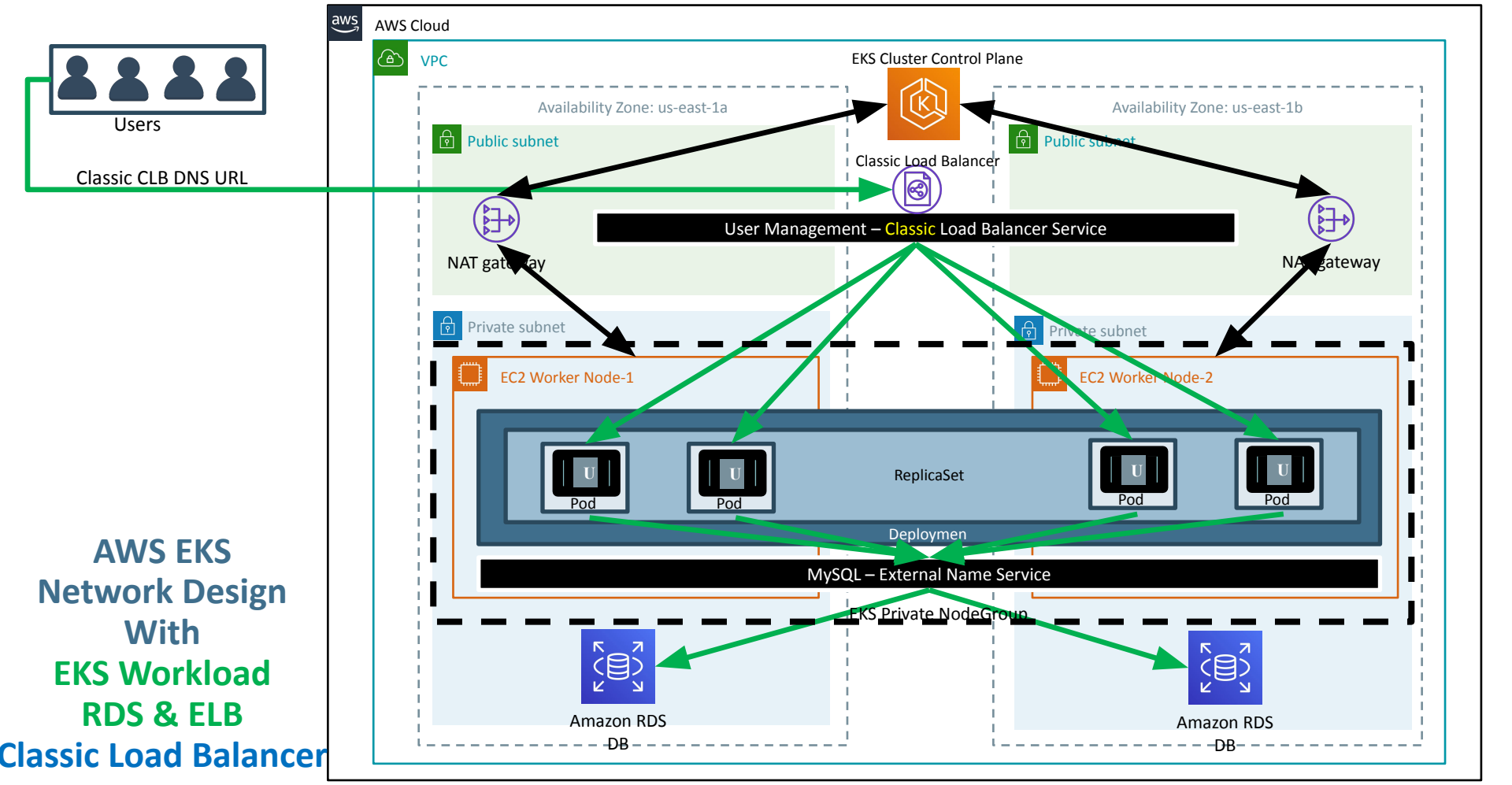
Kubernetes - Imperative & Declarative



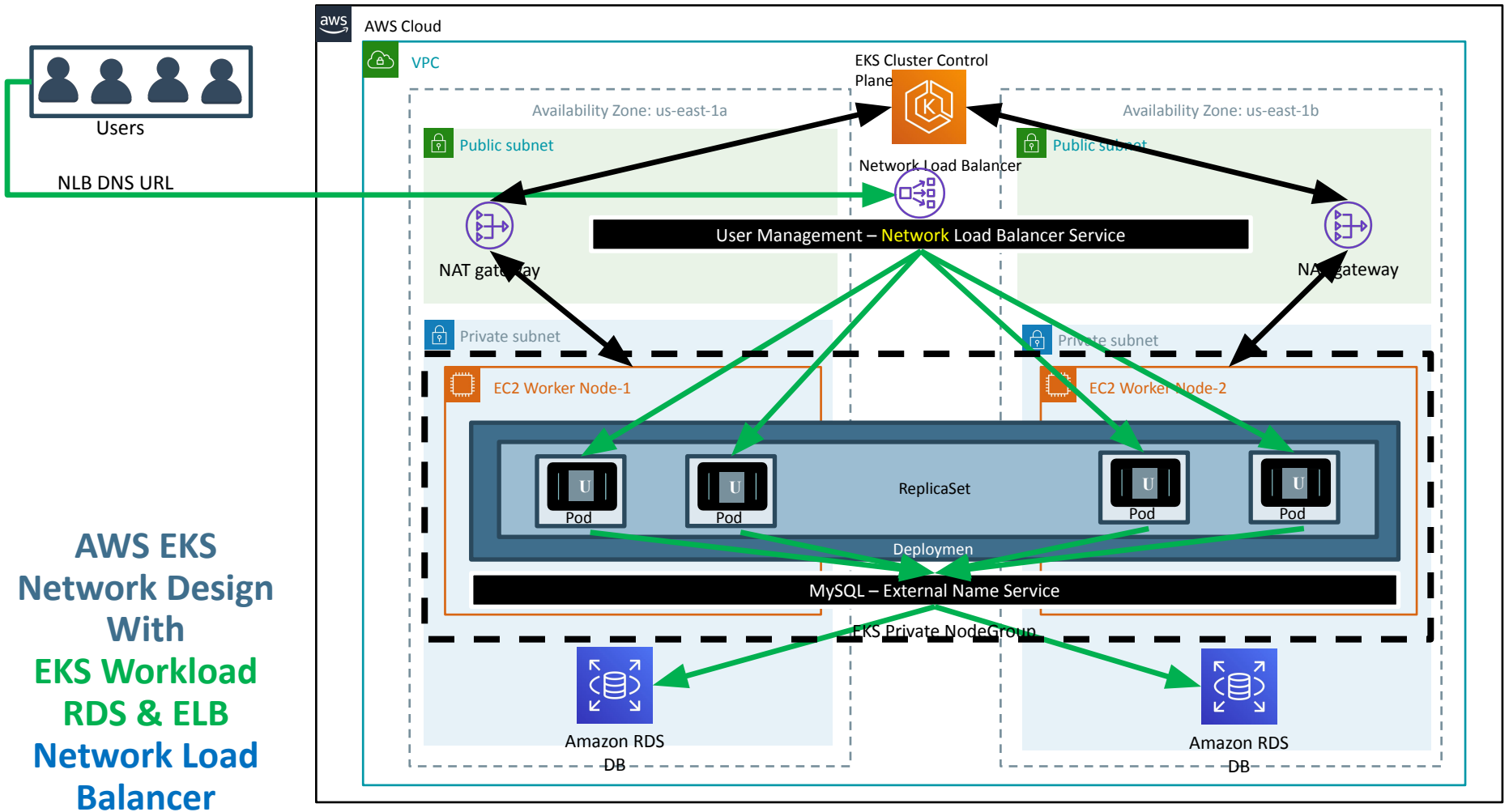

EKS Cluster
Users
http://<worker node-public-ip>:<NodePort>/usermgmt/<apis>
UserMgmt – NodePort Service
RES T API
POD
ReplicaSet
Deployment (UserMgmt)
NodePort Service
Deployment
Environment Variables
EKS Storage
EBS CSI Driver
Drawbacks of EBS CSI for MySQL DB
Complex setup to achieve HA
Complex Multi-Az support for EBS
Complex Master-Master MySQL setup
Complex Master-Slave MySQL setup
No Automatic Backup & Recovery
No Auto-Upgrade MySQL
AWS Elastic Block Store - EBS
Storage Class
Persistent Volume Claim
Config Map
Deployment
MySQL – ClusterIP Service
MySql
POD
ReplicaSet
Deployment (mysql)
StatefulSets
Environment Variables
Volumes
Volume Mounts
ClusterIP Service

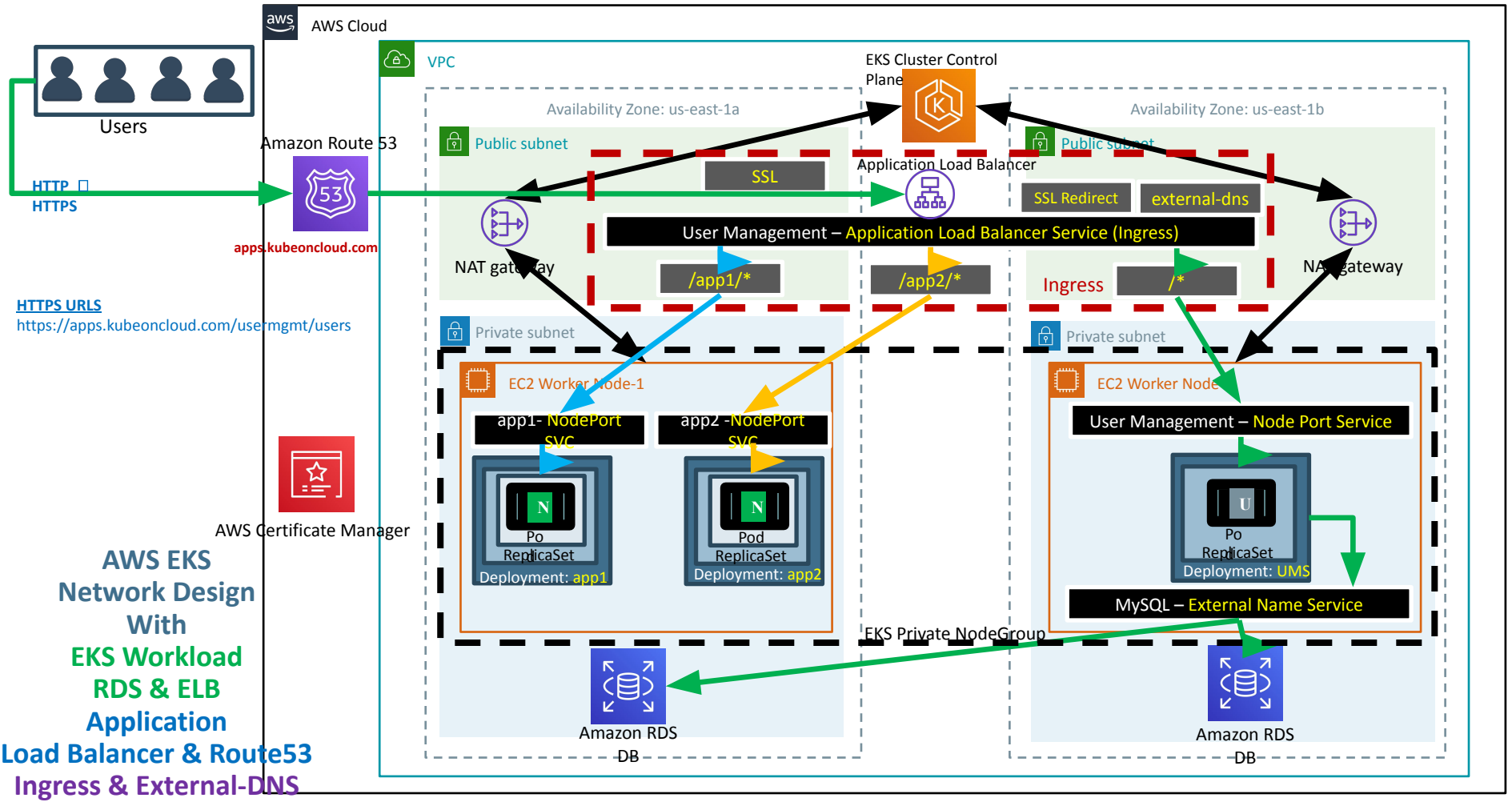

Users
http://<workernode-public-ip>:<NodePort>/usermgmt/<apis>
UserMgmt – NodePort Service
EKS Cluster
REST API
POD
ReplicaSet
Deployment (UserMgmt)
MySQL – ExternalName Service
NodePort Service
Deployment
Environment Variables
ExternalName Service
AWS
RDS Database
High Availability
Backup & Recovery
Read Replicas
Amazon RDS
Metrics & Monitoring
Automatic Upgrades
Multi-AZ Support


AWS Cloud
VPC
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
http://<workernode-public-ip>:<NodePort>/usermgmt/<apis>
Users
EC2 Worker Node-1
EC2 Worker Node-2
User Management – Node Port Service
ReplicaSet
Pod
Pod
Pod
Pod
Deployment
MySQL – External Name Service
Private subnet
Private subnet
Amazon RDS
Amazon RDS
AWS EKS
Network Design
With
EKS Workload
&
RDS Database

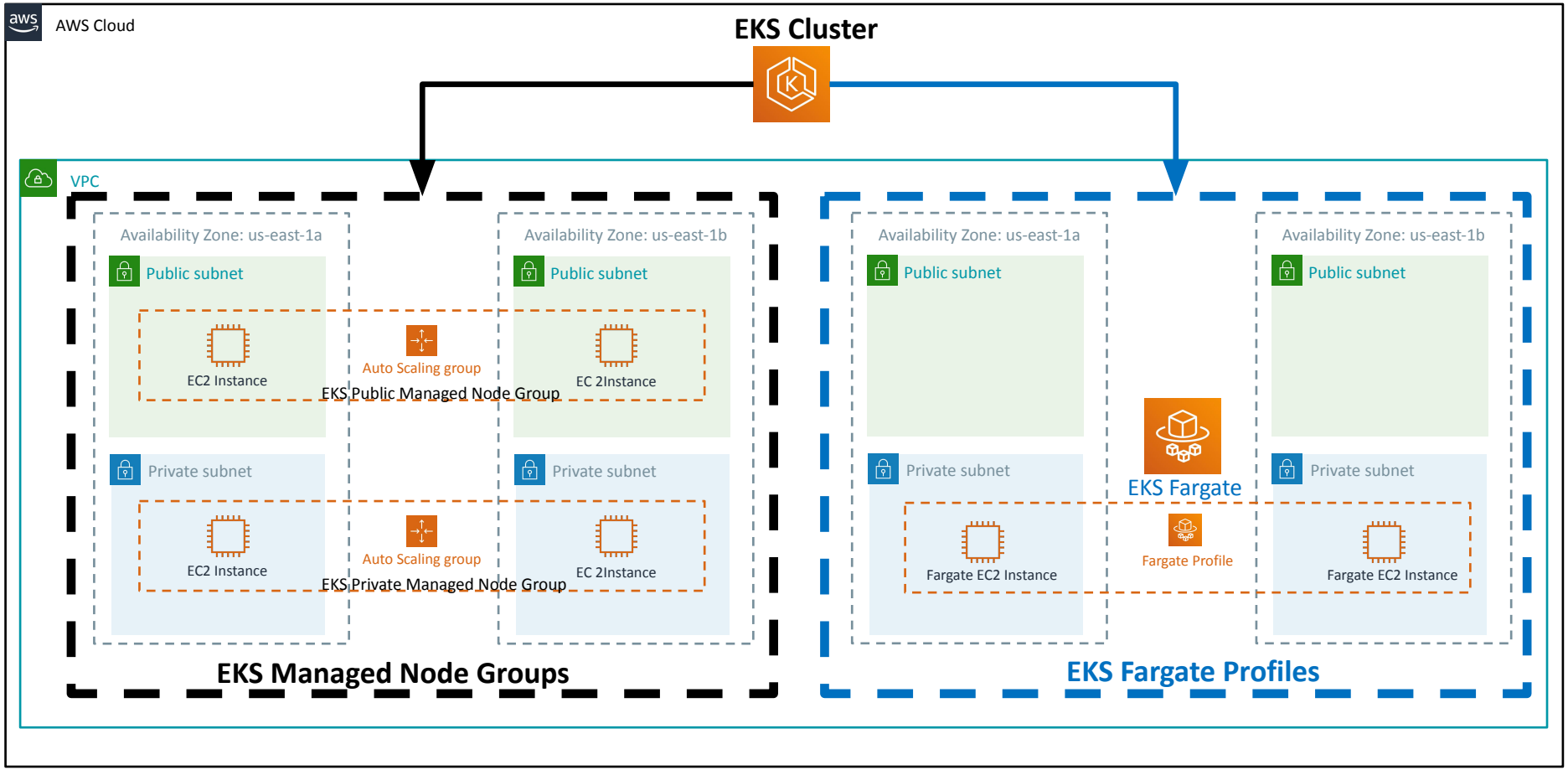

Users
Classic CLB DNS URL
AWS Cloud
VPC
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Classic Load Balancer
User Management – Classic Load Balancer Service
NAT gateway
NAT gateway
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
Pod
Pod
ReplicaSet
Pod
Pod
Deploymen
MySQL – External Name Service
EKS Private NodeGroup
Amazon RDS
DB
Amazon RDS
DB
AWS EKS
Network Design
With
EKS Workload
RDS & ELB
Classic Load Balancer

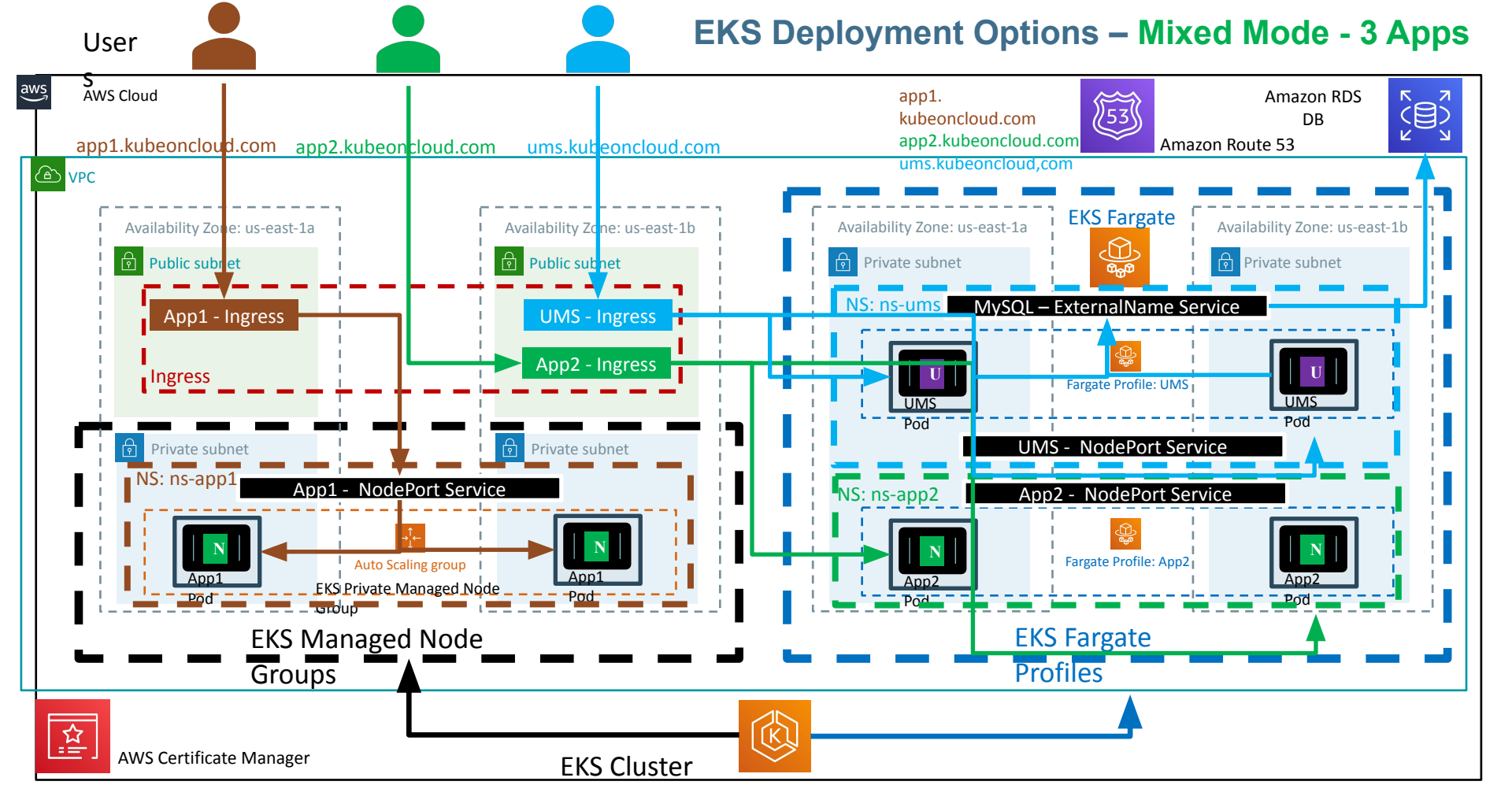
AWS EKS Network Design With EKS Workload RDS & ELB Network Load Balancer



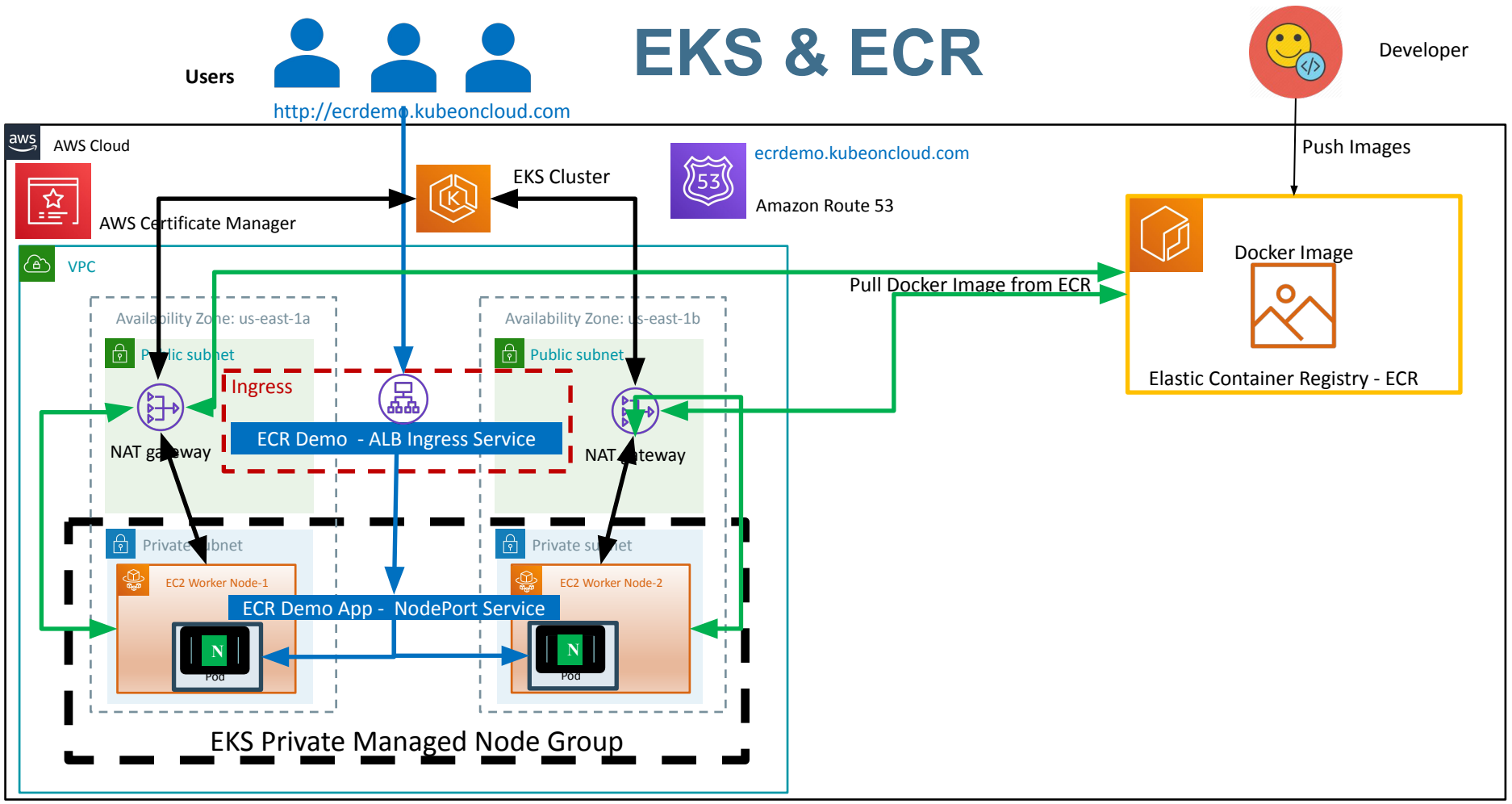

AWS Cloud
VPC
Users
Amazon Route 53
HTTP
HTTPS
apps.kubeoncloud.com
HTTPS URLS
https://apps.kubeoncloud.com/usermgmt/users
AWS Certificate Manager
EKS Cluster Control Plane
Application Load Balancer
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
SSL
SSL Redirect
external-dns
User Management – Application Load Balancer Service (Ingress)
NAT gateway
NAT gateway
/app1/*
/app2/*
Ingress
/*
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node
app1- NodePort SVC
app2 -NodePort SVC
User Management – Node Port Service
Pod
ReplicaSet
Deployment: app1
Pod
ReplicaSet
Deployment: app2
Pod
ReplicaSet
Deployment: UMS
MySQL – External Name Service
EKS Private NodeGroup
Amazon RDS DB
Amazon RDS DB
AWS EKS Network Design With EKS Workload RDS & ELB Application Load Balancer & Route53 Ingress & External-DNS

EKS Deployment Options - Mixed

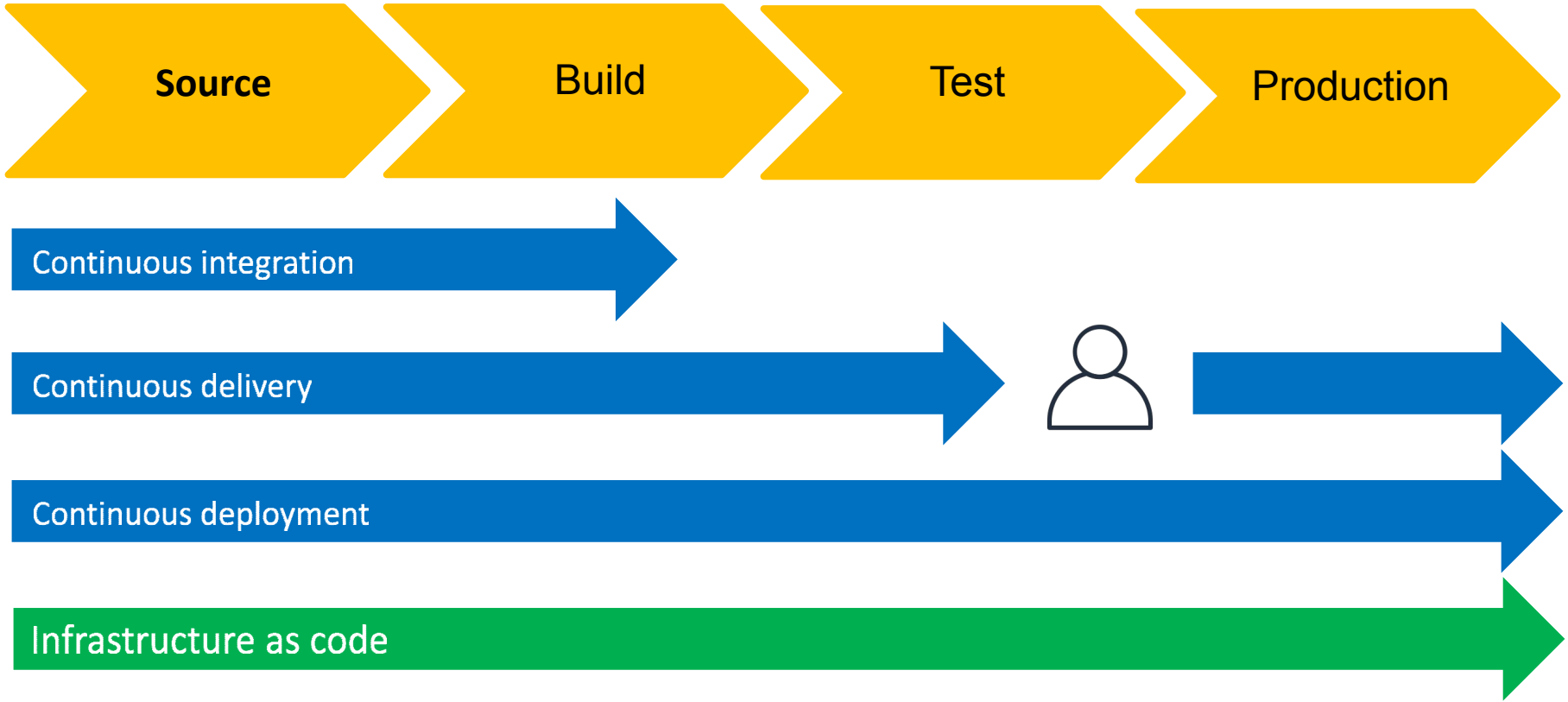



EKS Deployment Options – Mixed Mode - 3 Apps
User
s
AWS Cloud
app1.kubeoncloud.com
app2.kubeoncloud.com
ums.kubeoncloud.com
app1.
kubeoncloud.com
app2.kubeoncloud.com
ums.kubeoncloud,com
Amazon Route 53
Amazon RDS
DB
VPC
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Private subnet
EKS Fargate
App1 - Ingress
UMS - Ingress
App2 - Ingress
Ingress
NS: ns-ums
MySQL – ExternalName Service
Fargate Profile: UMS
UMS
Pod
UMS - NodePort Service
NS: ns-app1
App1 - NodePort Service
NS: ns-app2
App2 - NodePort Service
Fargate Profile: App2
App1
Pod
App2
Pod
Auto Scaling group
EKS Private Managed Node
Group
EKS Managed Node
Groups
EKS Fargate
Profiles
AWS Certificate Manager
EKS Cluster

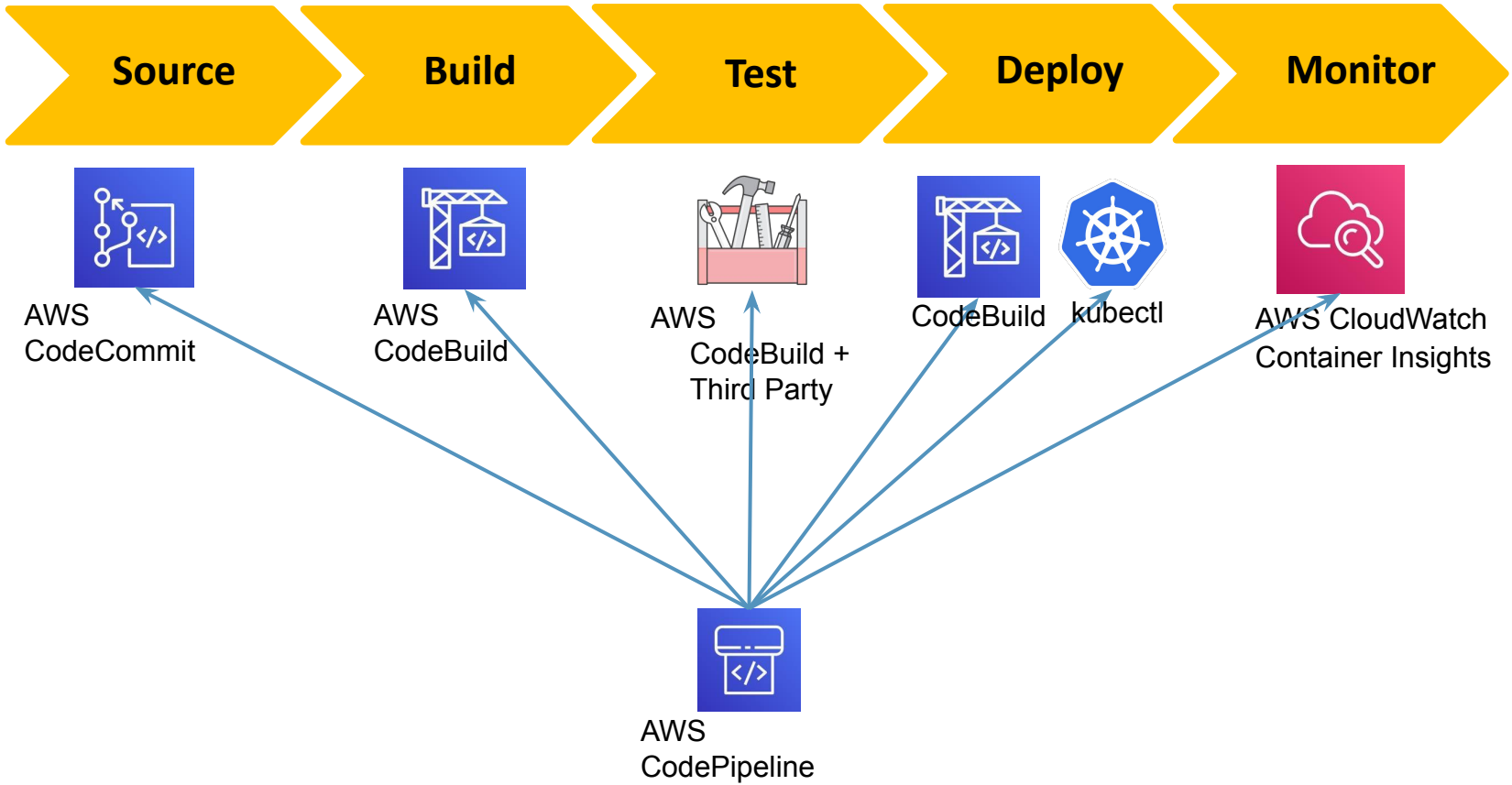
EKS & ECR


Users
http://ecrdemo.kubeoncloud.com
Developer
Push Images
AWS Cloud
AWS Certificate Manager
EKS Cluster
ecrdemo.kubeoncloud.com
Amazon Route 53
VPC
Pull Docker Image from ECR
Docker Image
Elastic Container Registry - ECR
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Ingress
ECR Demo - ALB Ingress Service
NAT gateway
NAT gateway
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
ECR Demo App - NodePort Service
Pod
Pod
EKS Private Managed Node Group

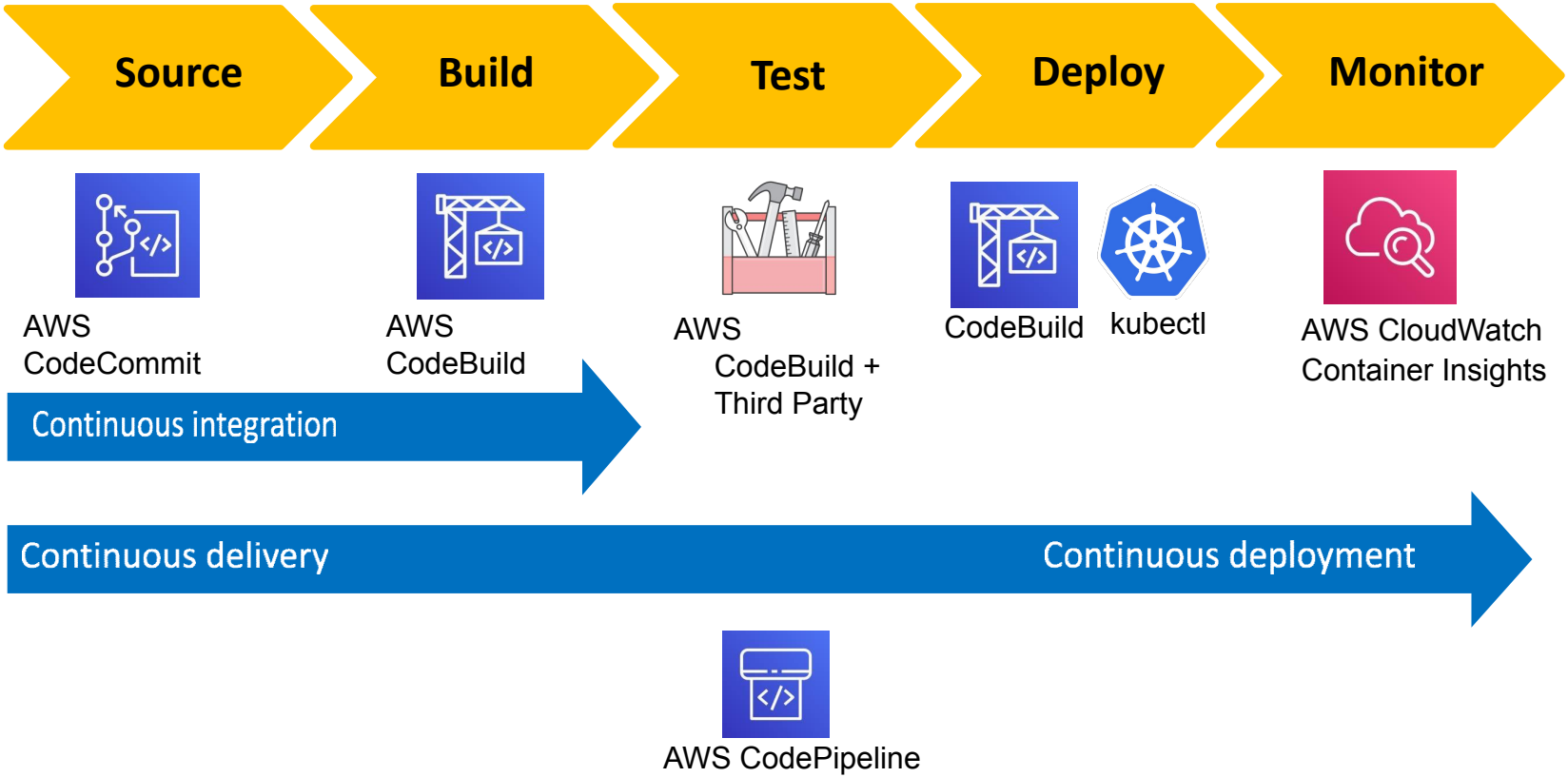
Stages in Release Process



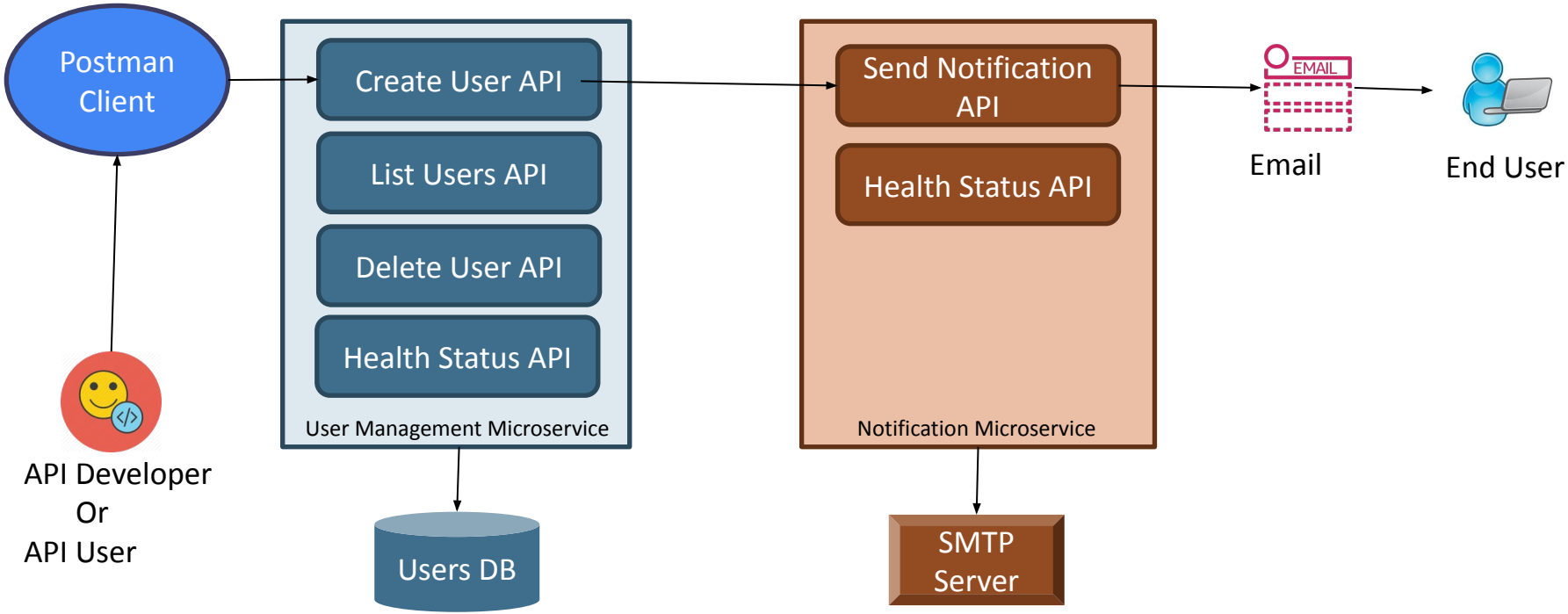
AWS Developer Tools or Code Services



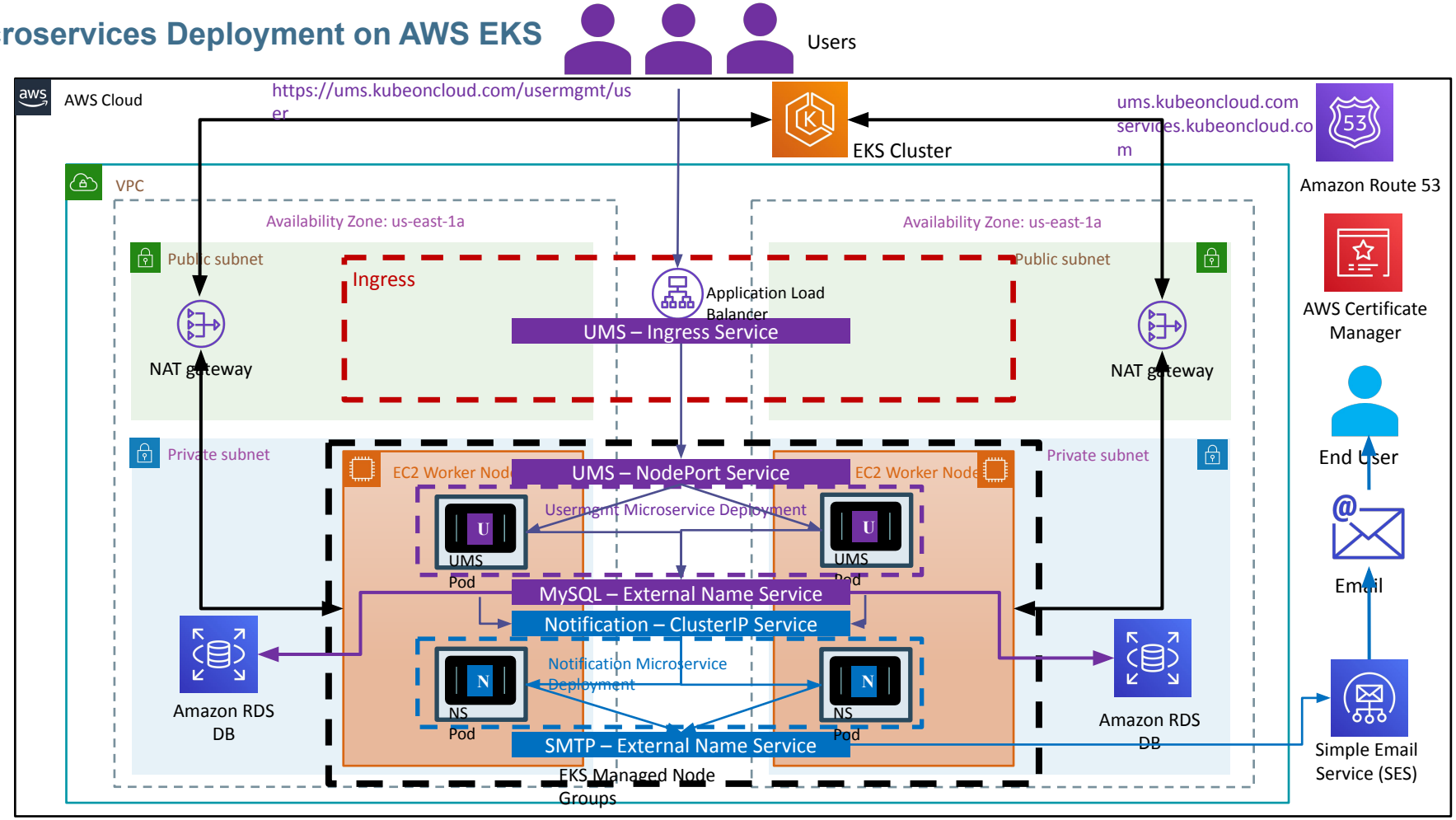
AWS Developer Tools or Code Services



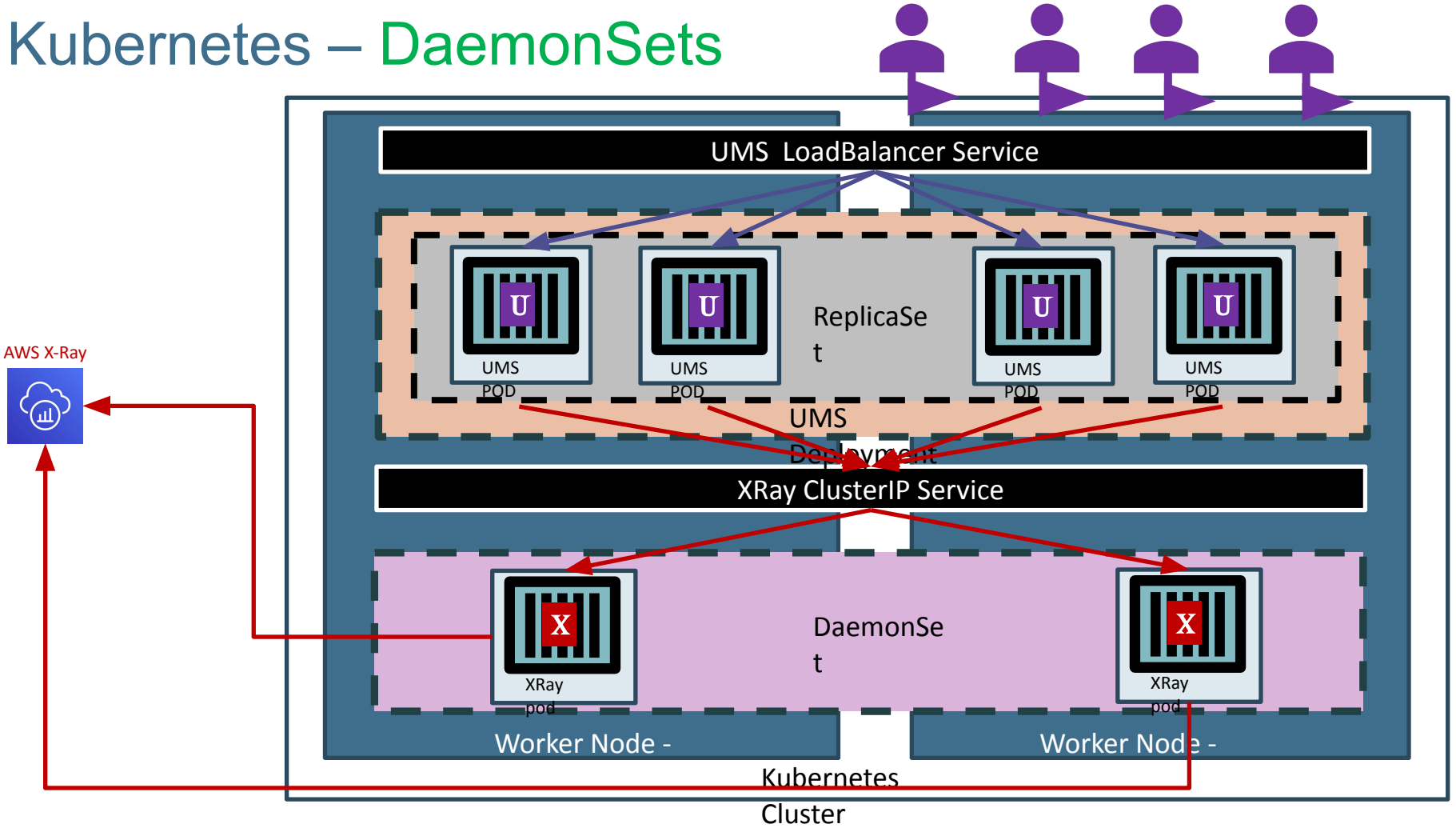
Microservices



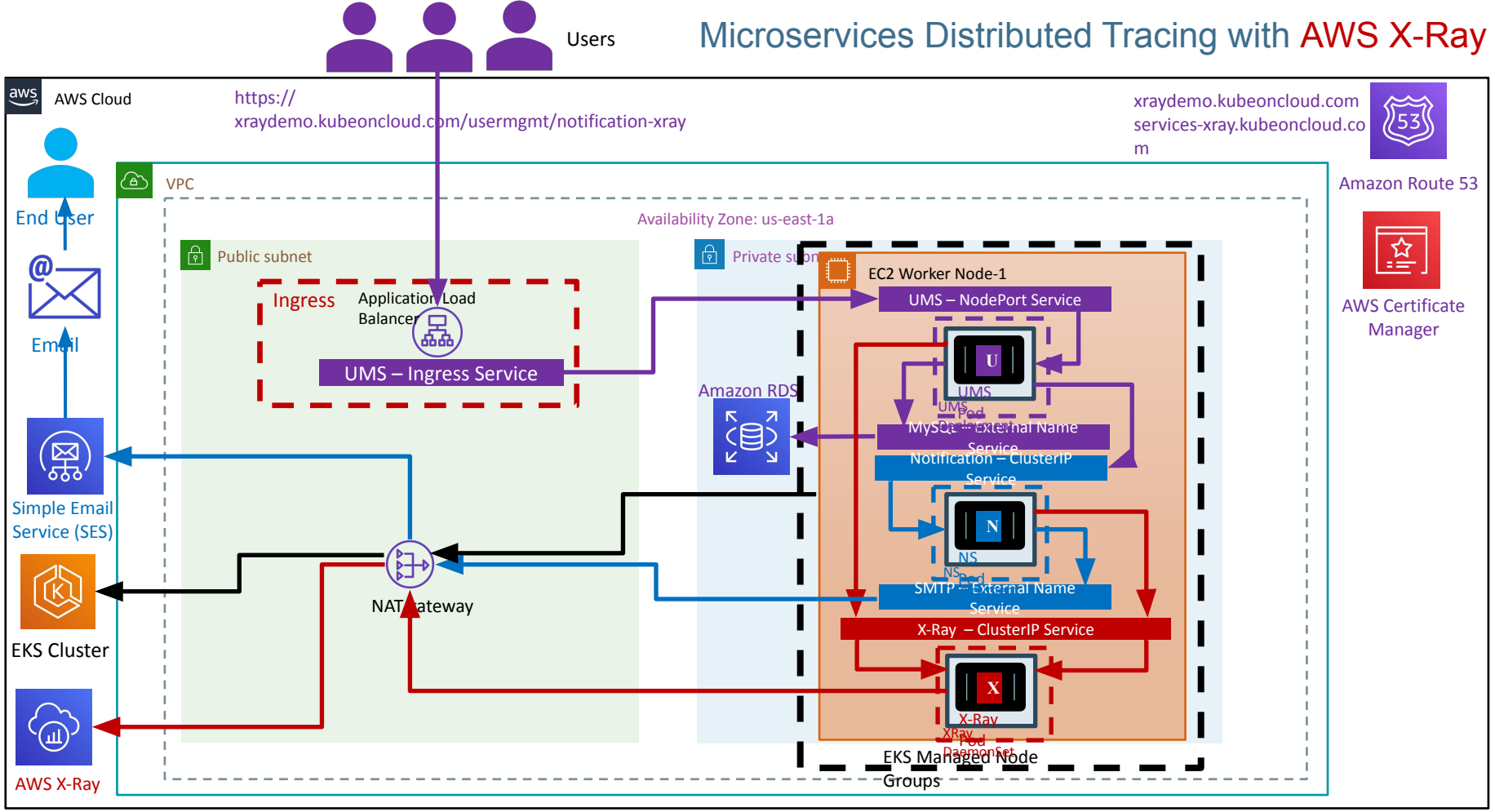
Microservices Deployment on AWS EKS



Kubernetes – DaemonSets

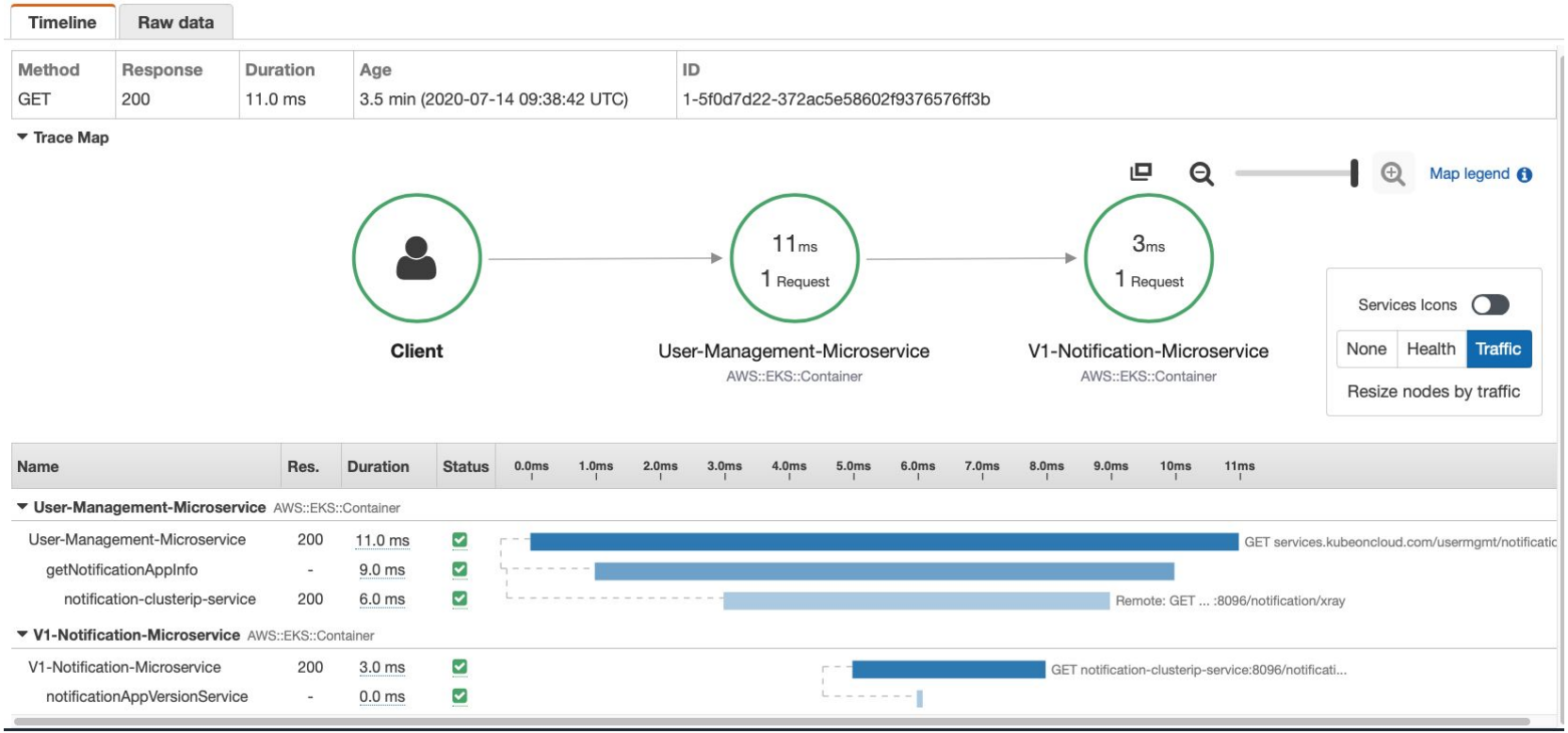


Microservices Distributed Tracing with AWS X-Ray

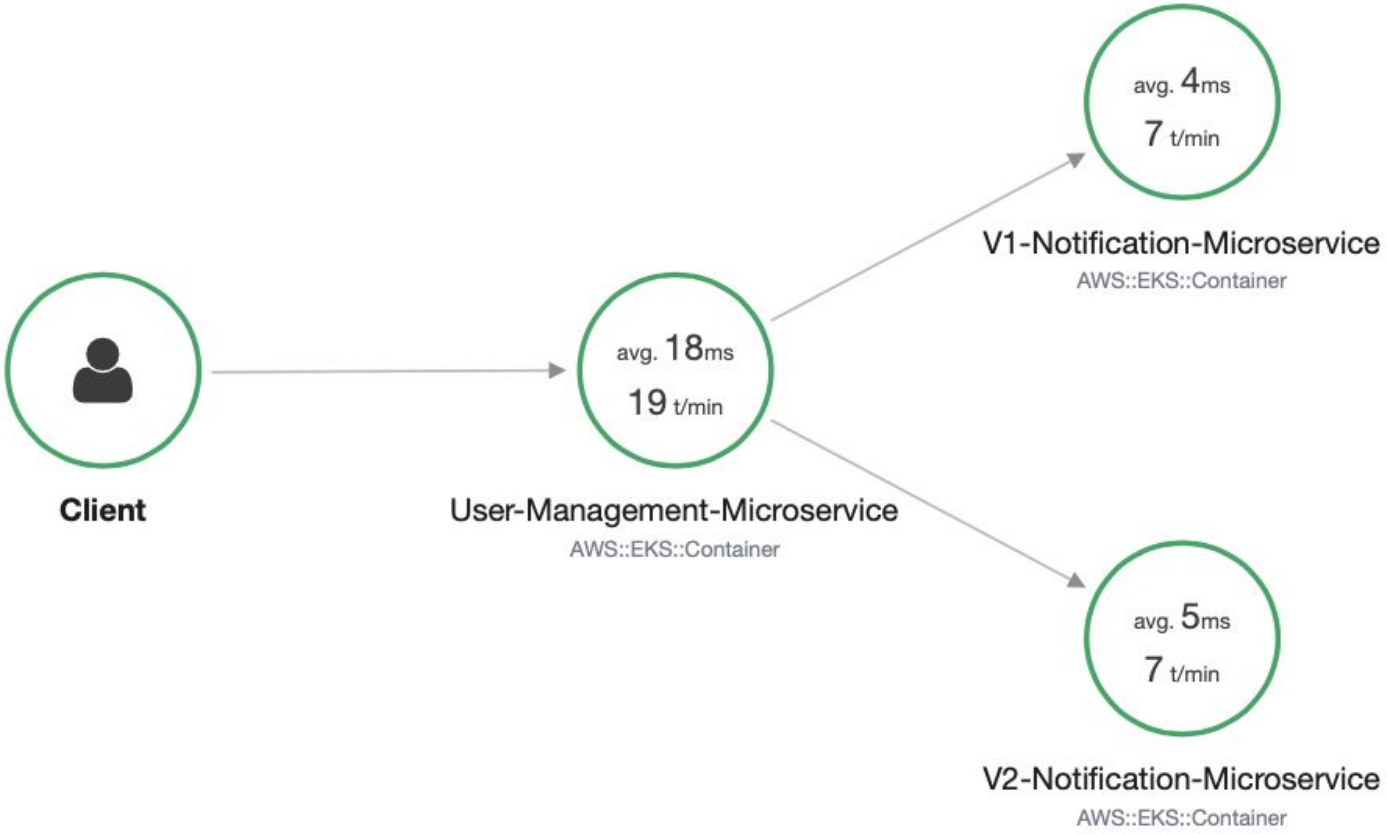


AWS X-Ray – Service Map

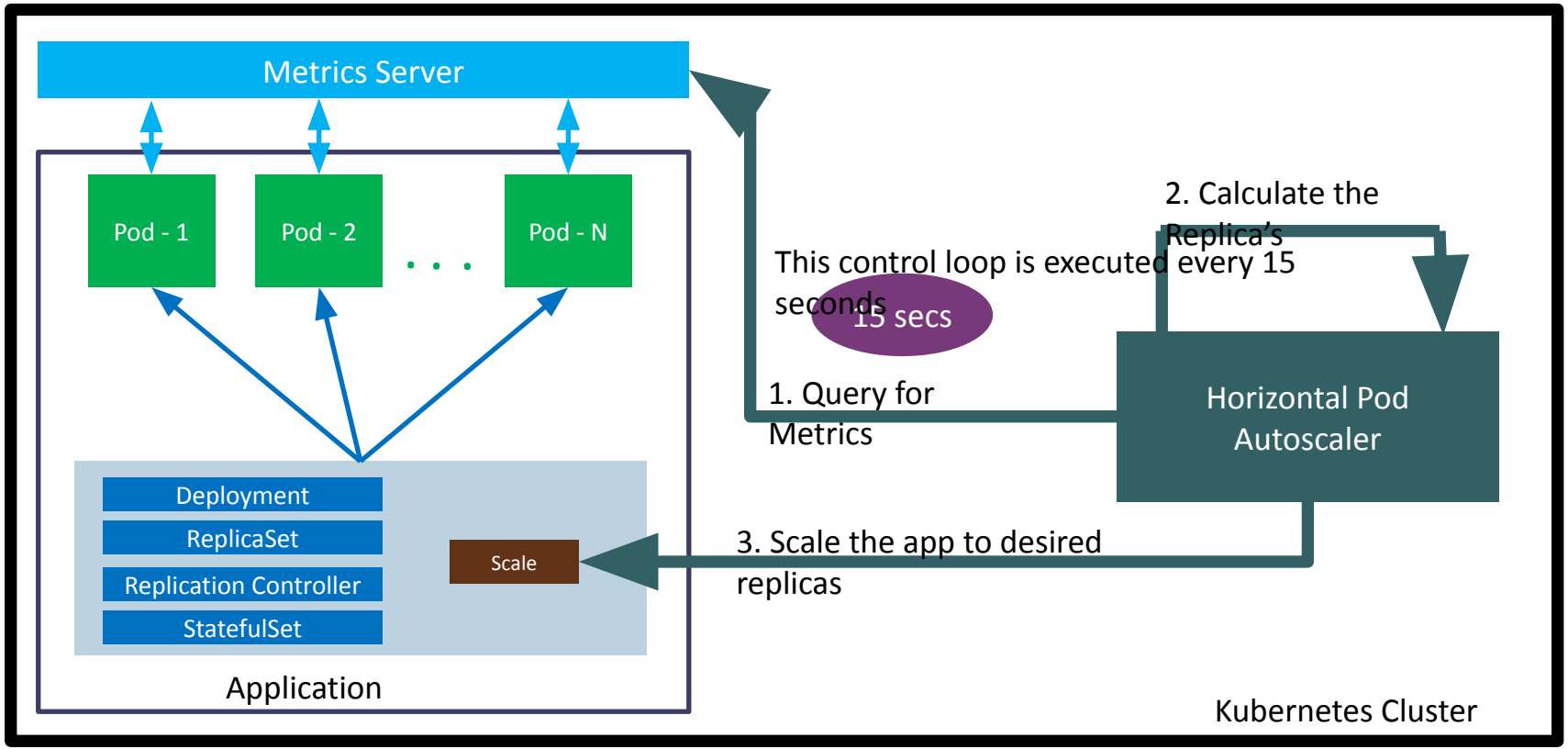
AWS X-Ray - Traces

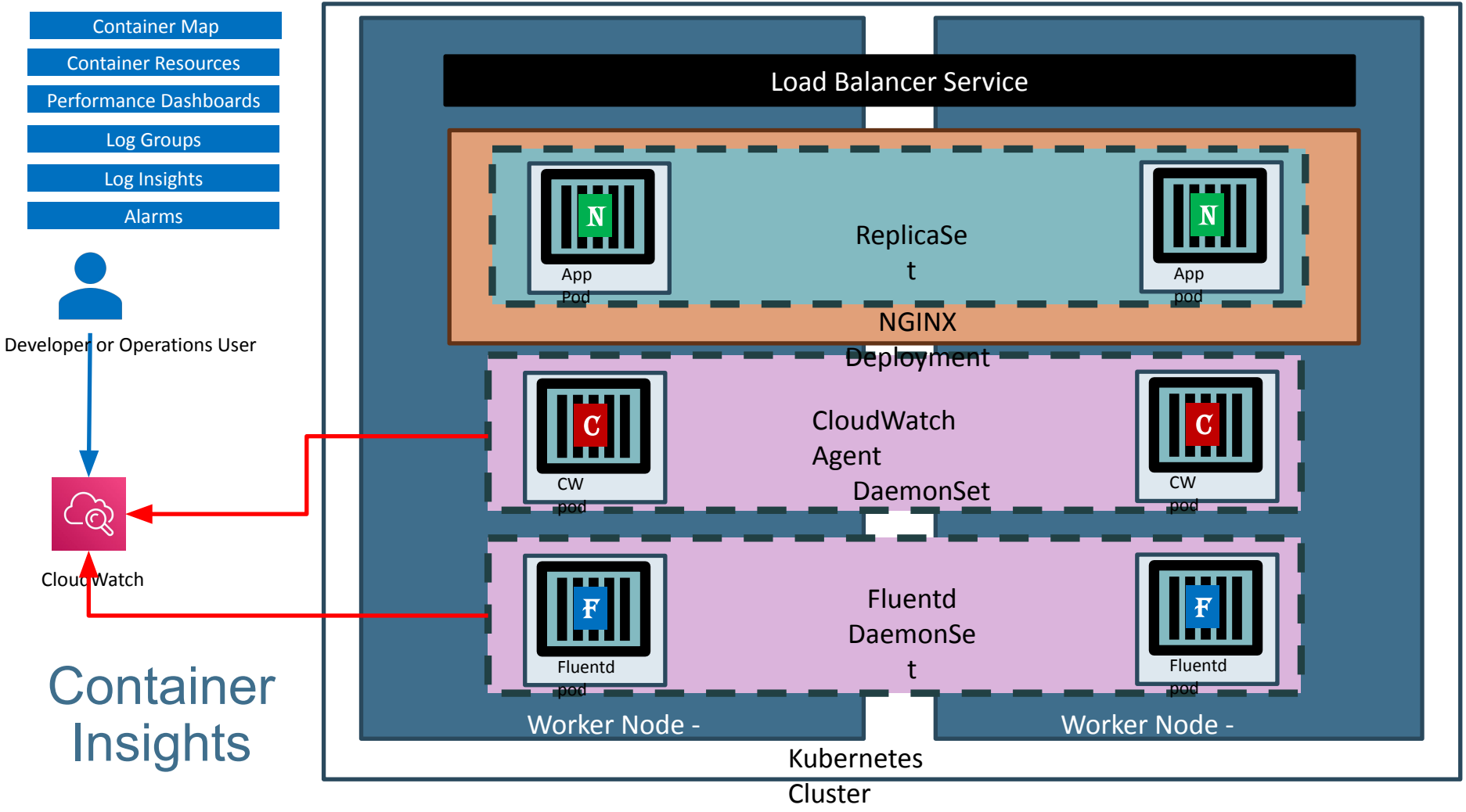


Microservices – Canary Deployments

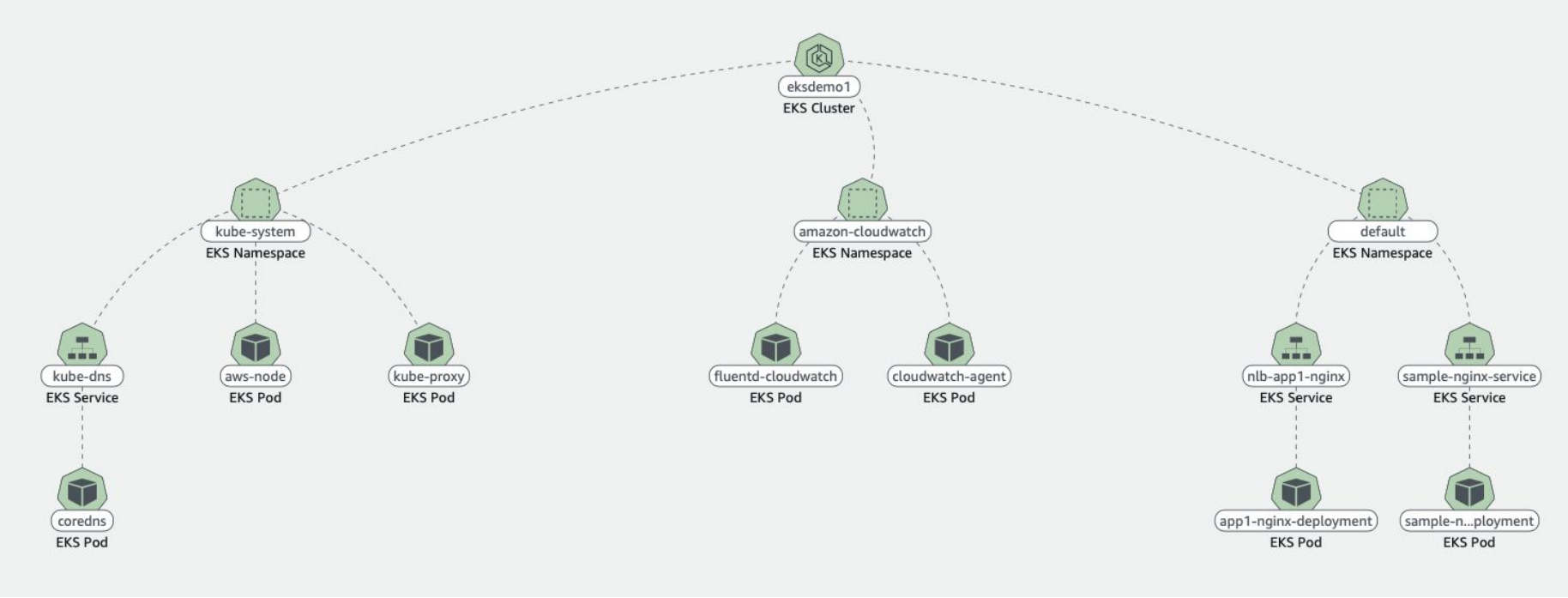


How HPA works?



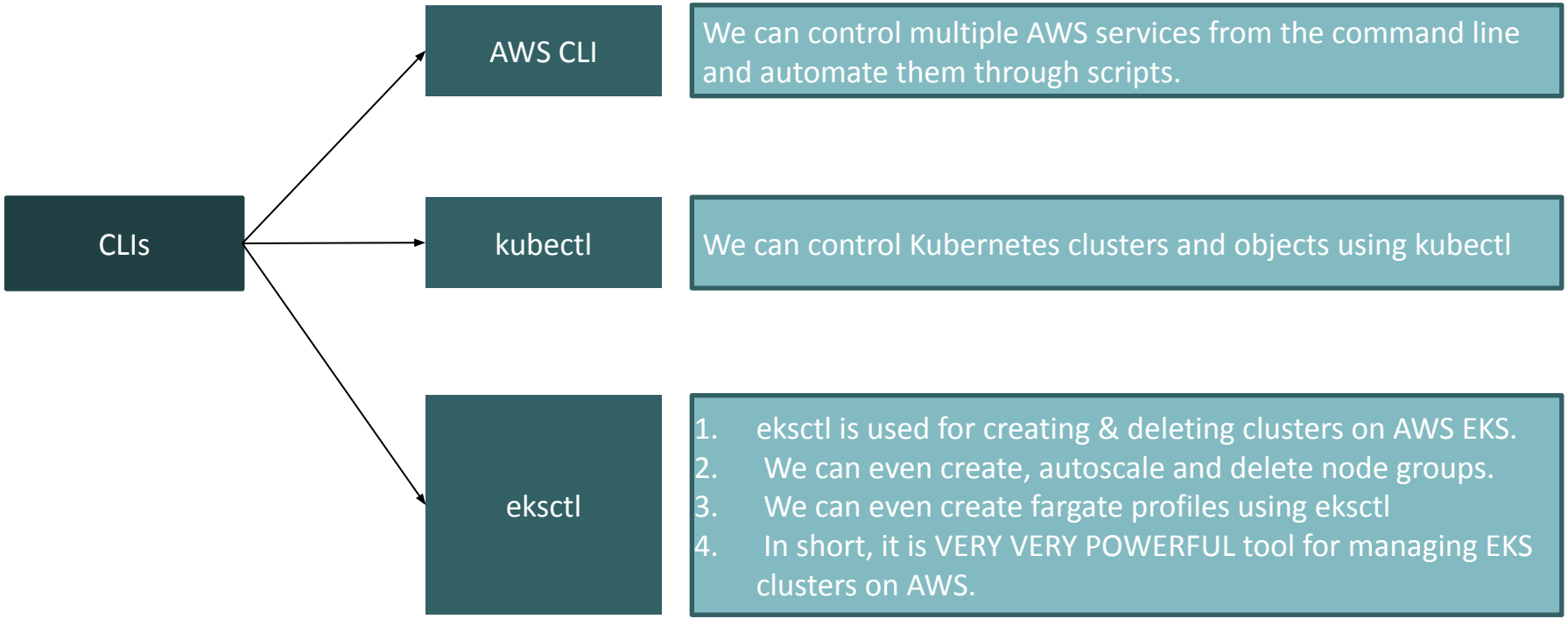

Container Map
Container Resources
Performance Dashboards
Log Groups
Log Insights
Alarms
Developer or Operations User
CloudWatch
Container Insights
Load Balancer Service
ReplicaSe
t
App
Pod
App
pod
NGINX
Deployment
CloudWatch
Agent
DaemonSet
CW
pod
CW
pod
Fluentd
DaemonSe
t
Fluentd
pod
Fluentd
pod
Worker Node -
Worker Node -
Kubernetes
Cluster

CloudWatch Container Insights Map



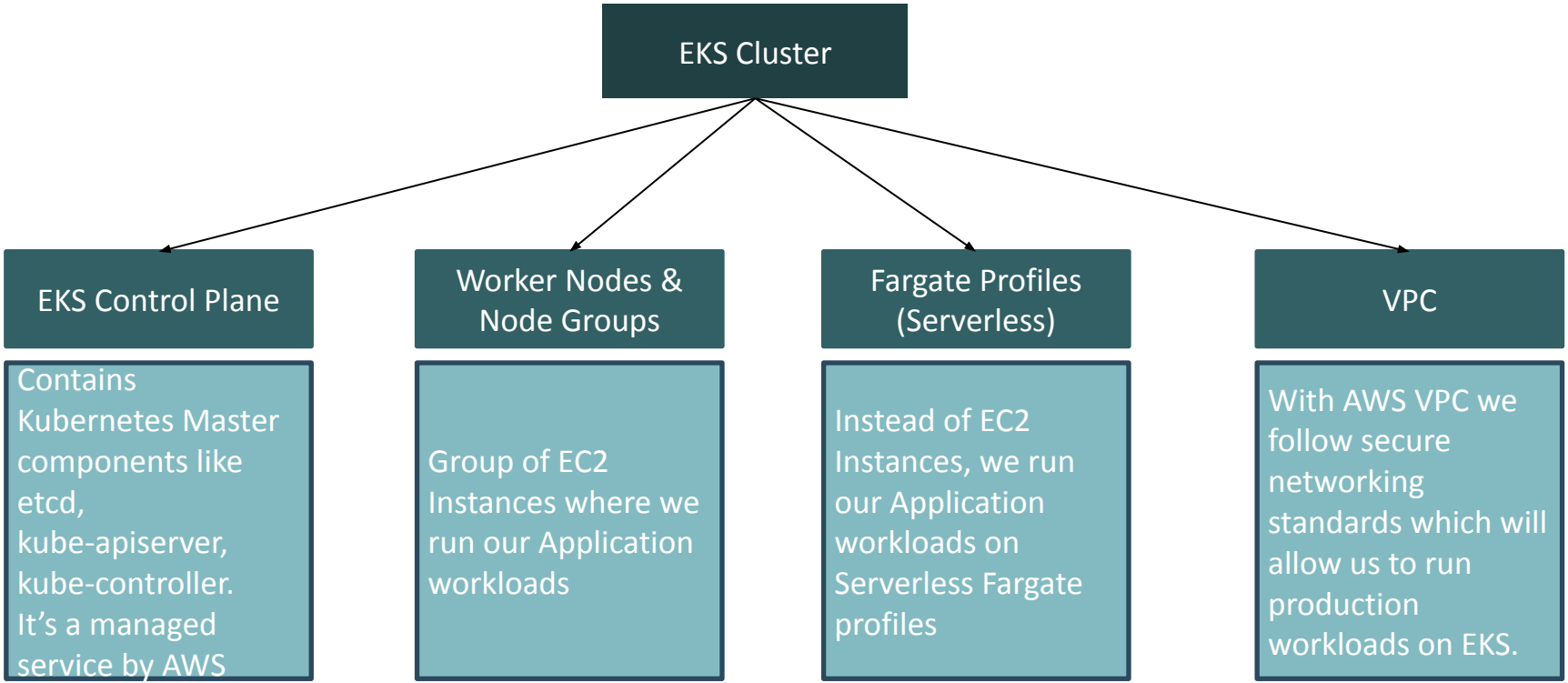
AWS EKS
CLIs

AWS EKS Cluster - CLIs

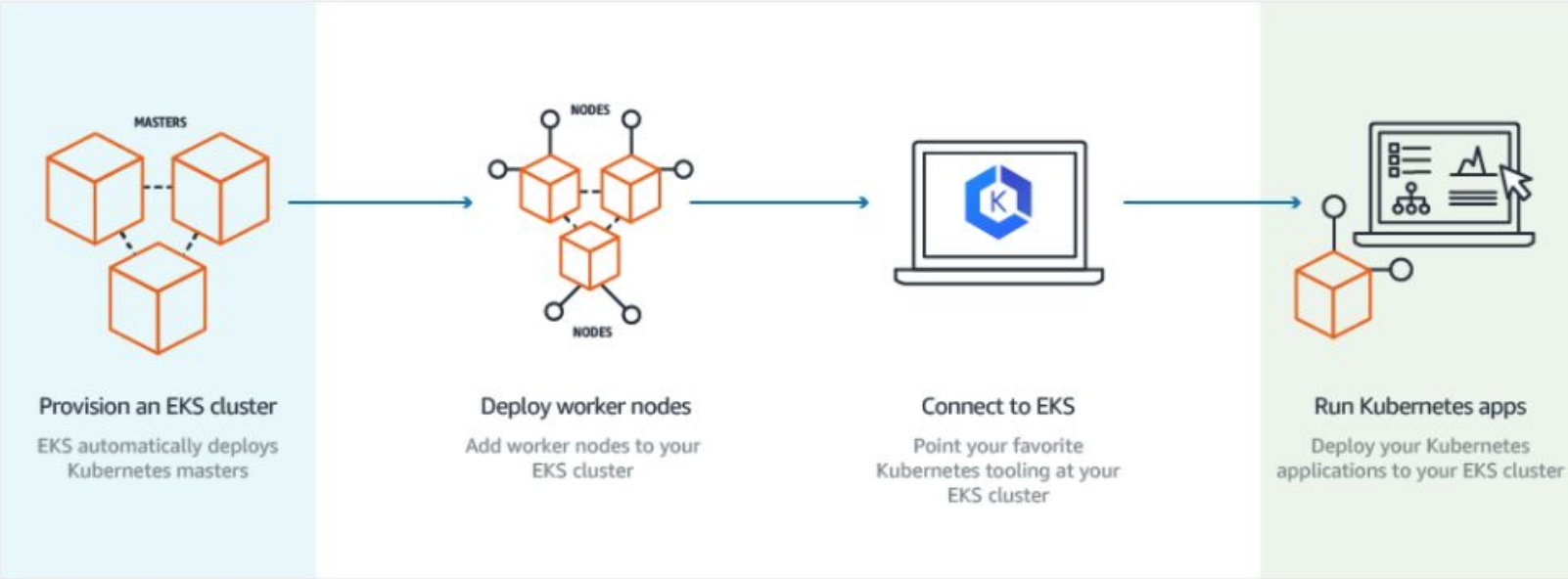


AWS EKS
Cluster

AWS EKS – Core Objects



How does EKS work?



EKS Cluster – Core Objects Detailed

EKS Control Plane

1. EKS runs a single tenant Kubernetes control plane for each cluster, and control plane infrastructure is not shared across clusters or AWS accounts.
2. This control plane consists of at least two API server nodes and three etcd nodes that run across three Availability Zones within a Region
3. EKS automatically detects and replaces unhealthy control plane instances, restarting them across the Availability Zones within the Region as needed.

Worker Nodes & Node Groups

1. Worker machines in Kubernetes are called nodes. These are EC2 Instances
2. EKS worker nodes run in our AWS account and connect to our cluster's control plane via the cluster API server endpoint.
3. A node group is one or more EC2 instances that are deployed in an EC2 Autoscaling group.
4. All instances in a node group must
    1. Be the same instance type
    2. Be running the same AMI
    3. Use the same EKS worker node IAM role

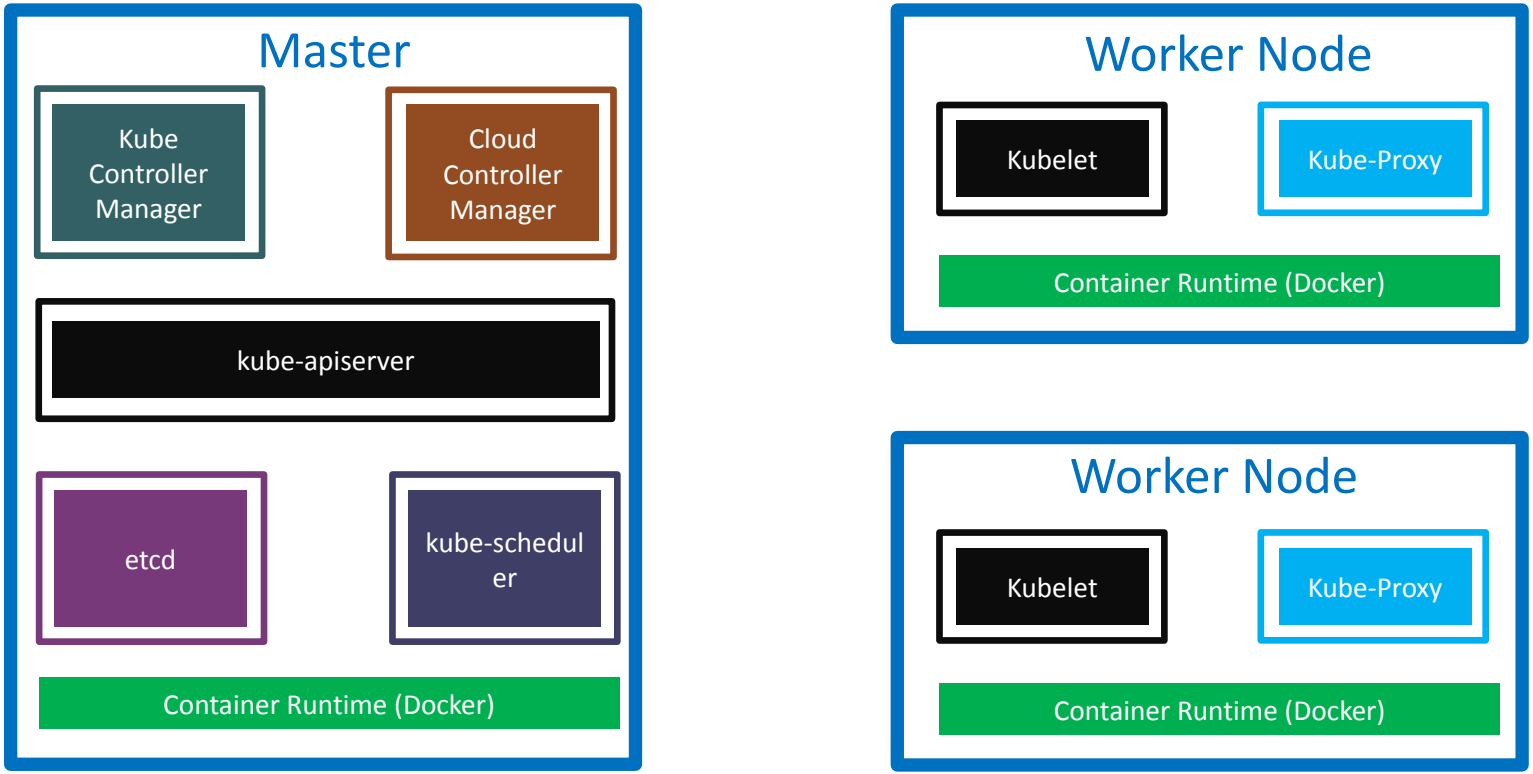
EKS Cluster – Core Objects Detailed

Fargate Profiles	1. AWS Fargate is a technology that provides on-demand, right-sized compute capacity for containers 2. With Fargate, we no longer have to provision, configure, or scale groups of virtual machines to run containers. 3. Each pod running on Fargate has its own isolation boundary and does not share the underlying kernel, CPU resources, memory resources, or elastic network interface with another pod. 4. AWS specially built Fargate controllers that recognizes the pods belonging to fargate and schedules them on Fargate profiles. 5. We will see more in our Fargate learning section.
VPC	1. EKS uses AWS VPC network policies to restrict traffic between control plane components to within a single cluster. 2. Control plane components for a EKS cluster cannot view or receive communication from other clusters or other AWS accounts, except as authorized with Kubernetes RBAC policies. 3. This secure and highly-available configuration makes EKS reliable and recommended for production workloads.

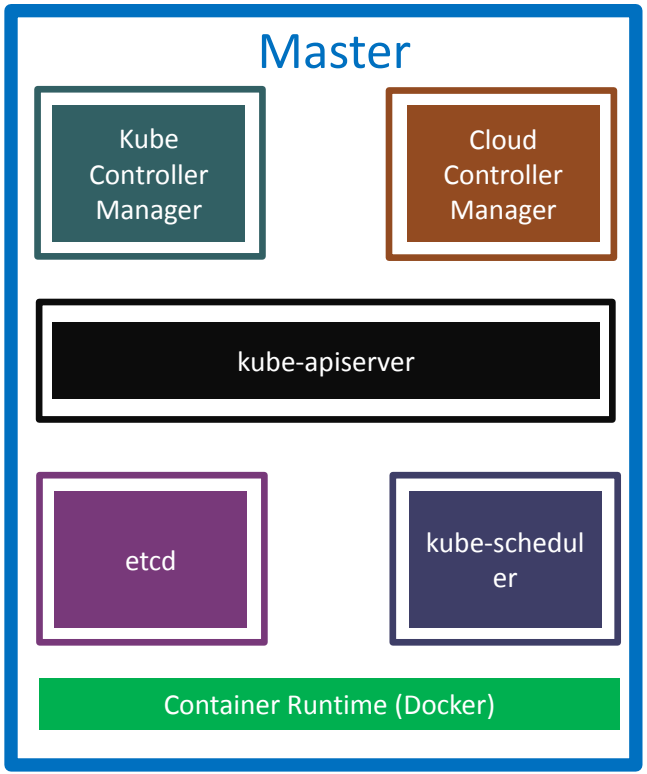
Kubernetes
Architecture

Kubernetes Architecture

Kubernetes - Architecture

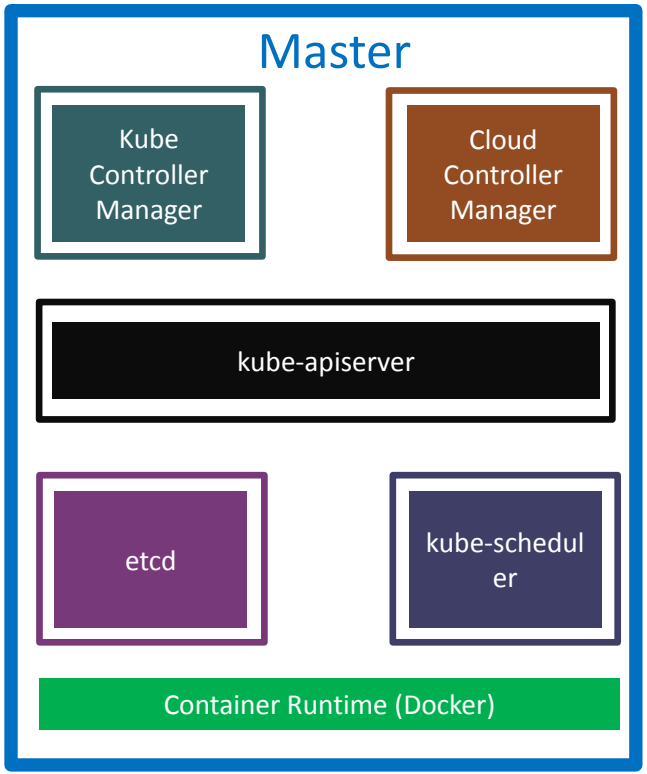


Kubernetes Architecture - Master



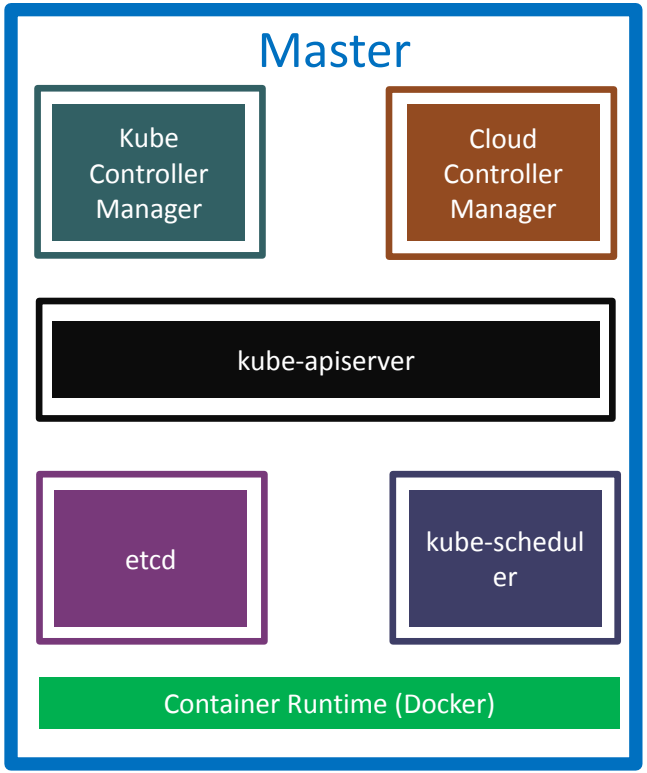
- kube-apiserver
  - It acts as front end for the Kubernetes control plane. It exposes the Kubernetes API
  - Command line tools (like kubectl), Users and even Master components (scheduler, controller manager, etcd) and Worker node components like (Kubelet) everything talk with API Server.
- etcd
  - Consistent and highly-available key value store used as Kubernetes' backing store for all cluster data.
  - It stores all the masters and worker node information.
- kube-scheduler
  - Scheduler is responsible for distributing containers across multiple nodes.
  - It watches for newly created Pods with no assigned node, and selects a node for them to run on.

Kubernetes Architecture - Master



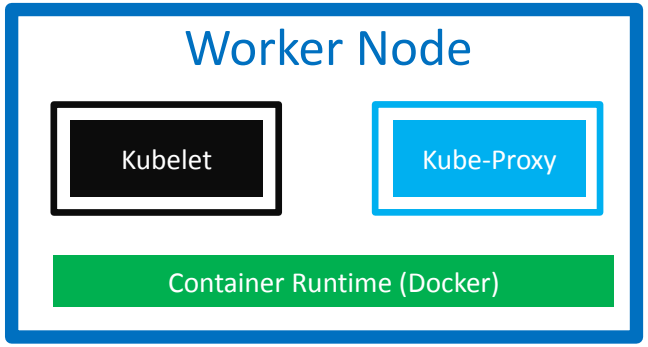
- **kube-controller-manager**
  - Controllers are responsible for noticing and responding when nodes, containers or endpoints go down. They make decisions to bring up new containers in such cases.
  - Node Controller: Responsible for noticing and responding when nodes go down.
  - Replication Controller: Responsible for maintaining the correct number of pods for every replication controller object in the system.
  - Endpoints Controller: Populates the Endpoints object (that is, joins Services & Pods)
  - Service Account & Token Controller: Creates default accounts and API Access for new namespaces.

Kubernetes Architecture - Master



- cloud-controller-manager
  - A Kubernetes control plane component that embeds cloud-specific control logic.
  - It only runs controllers that are specific to your cloud provider.
  - On-Premise Kubernetes clusters will not have this component.
  - Node controller: For checking the cloud provider to determine if a node has been deleted in the cloud after it stops responding
  - Route controller: For setting up routes in the underlying cloud infrastructure
  - Service controller: For creating, updating and deleting cloud provider load balancer

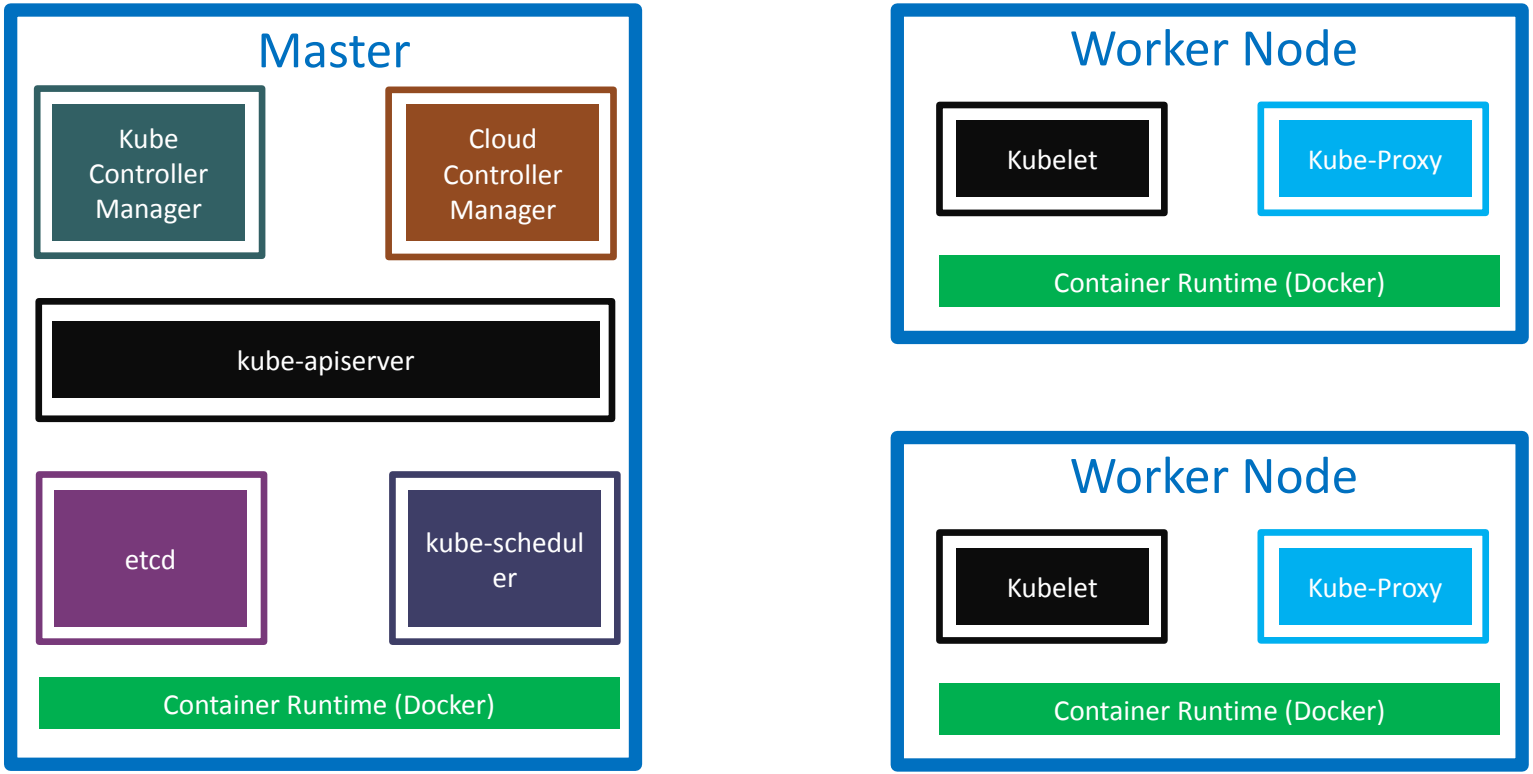
Kubernetes Architecture – Worker Nodes



- Container Runtime
  - Container Runtime is the underlying software where we run all these Kubernetes components.
  - We are using Docker, but we have other runtime options like rkt, container-d etc.

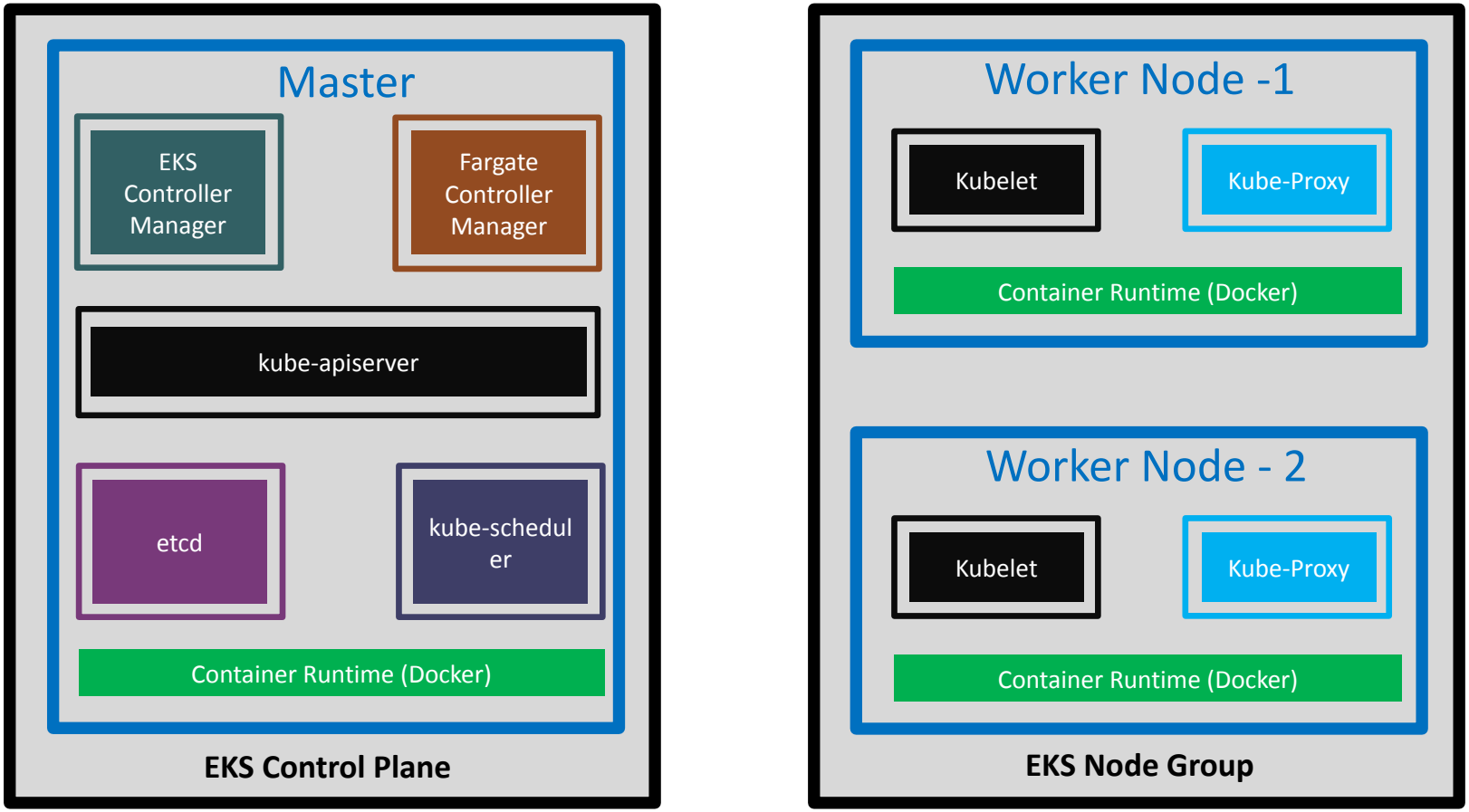
- Kubelet
  - Kubelet is the agent that runs on every node in the cluster
  - This agent is responsible for making sure that containers are running in a Pod on a node.
- Kube-Proxy
  - It is a network proxy that runs on each node in your cluster.
  - It maintains network rules on nodes
  - In short, these network rules allow network communication to your Pods from network sessions inside or outside of your cluster.

Kubernetes - Architecture



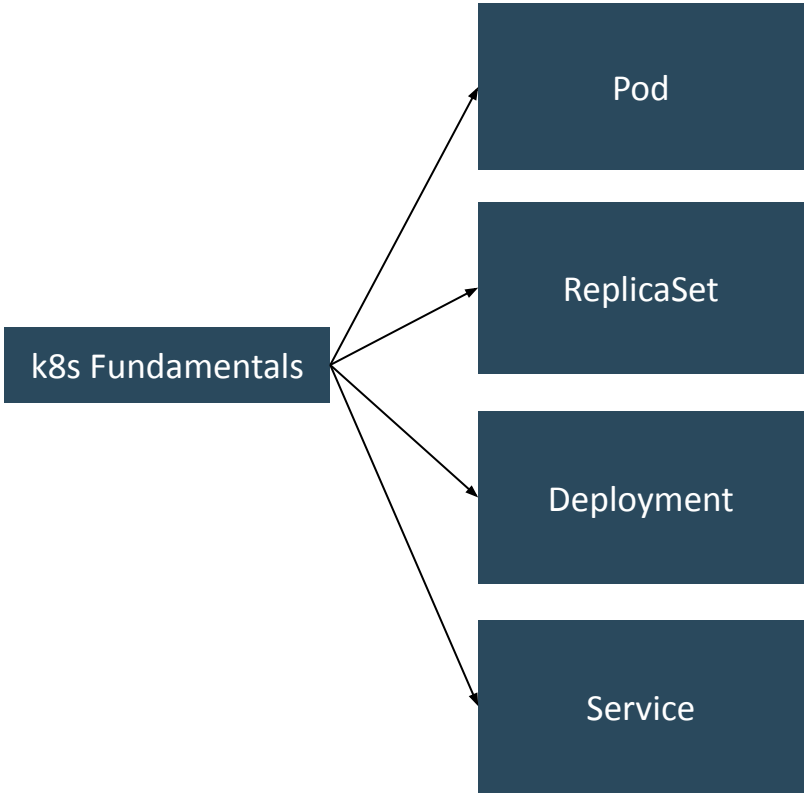
AWS EKS
Cluster

EKS Kubernetes - Architecture



Kubernetes
Fundamentals
Pod, ReplicaSet, Deployment & Service

Kubernetes - Fundamentals



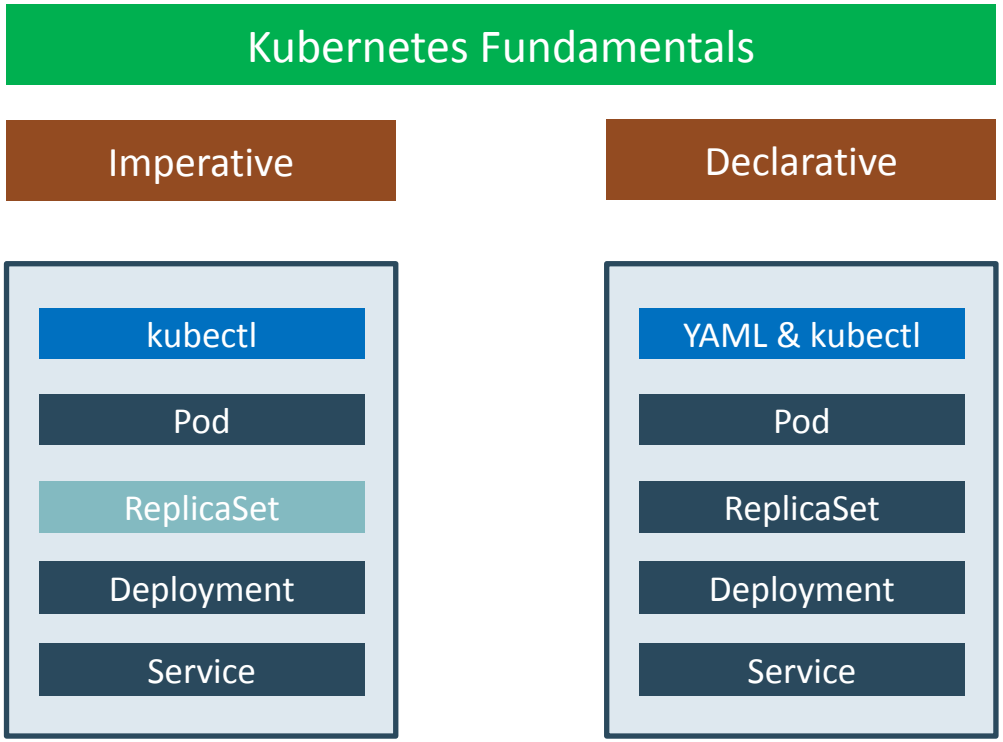
A POD is a single instance of an Application.
A POD is the smallest object, that you can create in Kubernetes.

A ReplicaSet will maintain a stable set of replica Pods running at any given time.
In short, it is often used to guarantee the availability of a specified number of identical Pods

A Deployment runs multiple replicas of your application and automatically replaces any instances that fail or become unresponsive. Rollout & rollback changes to applications. Deployments are well-suited for stateless applications.

A service is an abstraction for pods, providing a stable, so called virtual IP (VIP) address.
In simple terms, service sits In front of a POD and acts as a load balancer.

Kubernetes - Imperative & Declarative



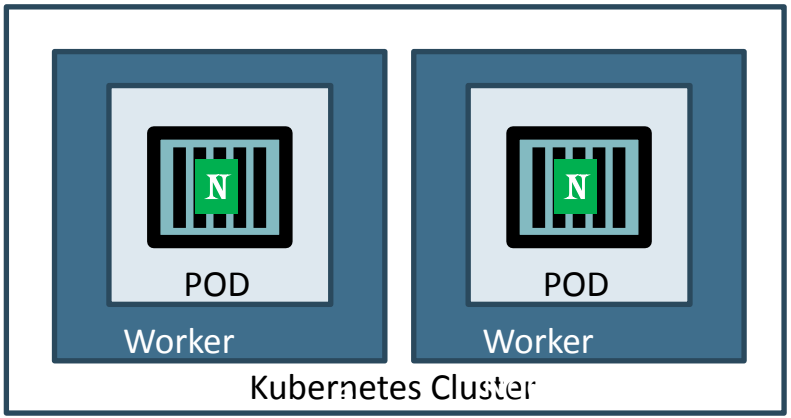
Kubernetes

POD

Kubernetes - POD

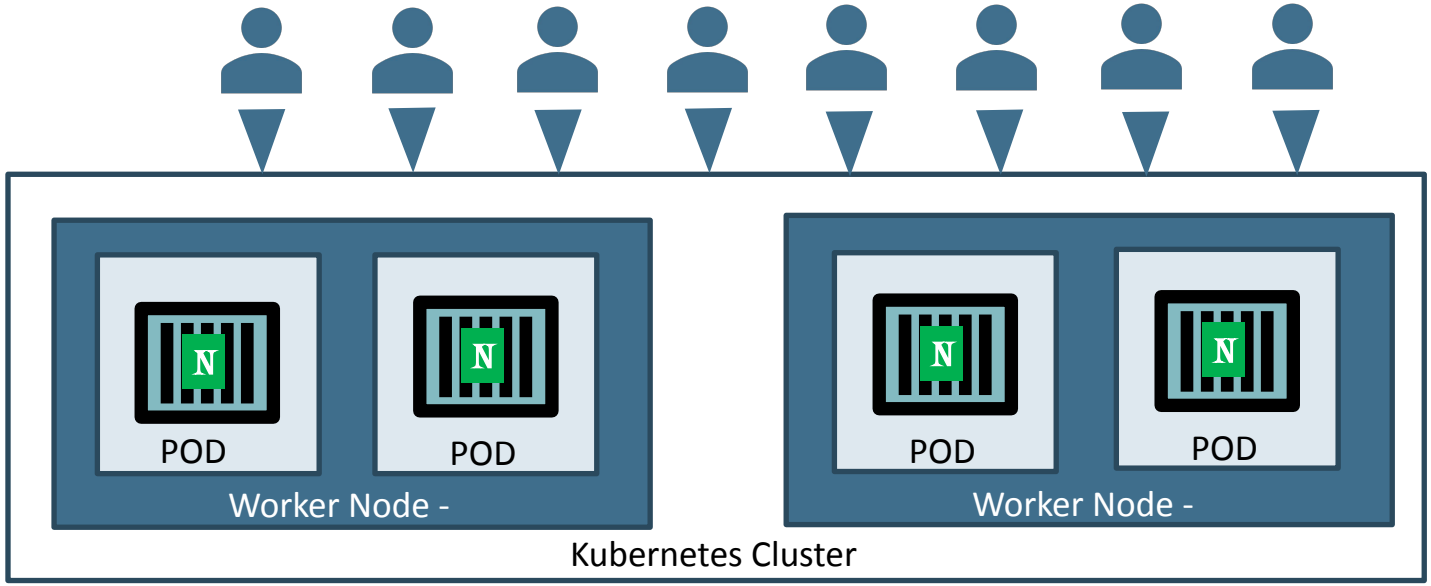
- With Kubernetes our core goal will be to deploy our applications in the form of containers on worker nodes in a k8s cluster.
- Kubernetes does not deploy containers directly on the worker nodes.
- Container is encapsulated in to a Kubernetes Object named POD.
- A POD is a single instance of an application.
- A POD is the smallest object that we can create in Kubernetes.

Nginx Container Image



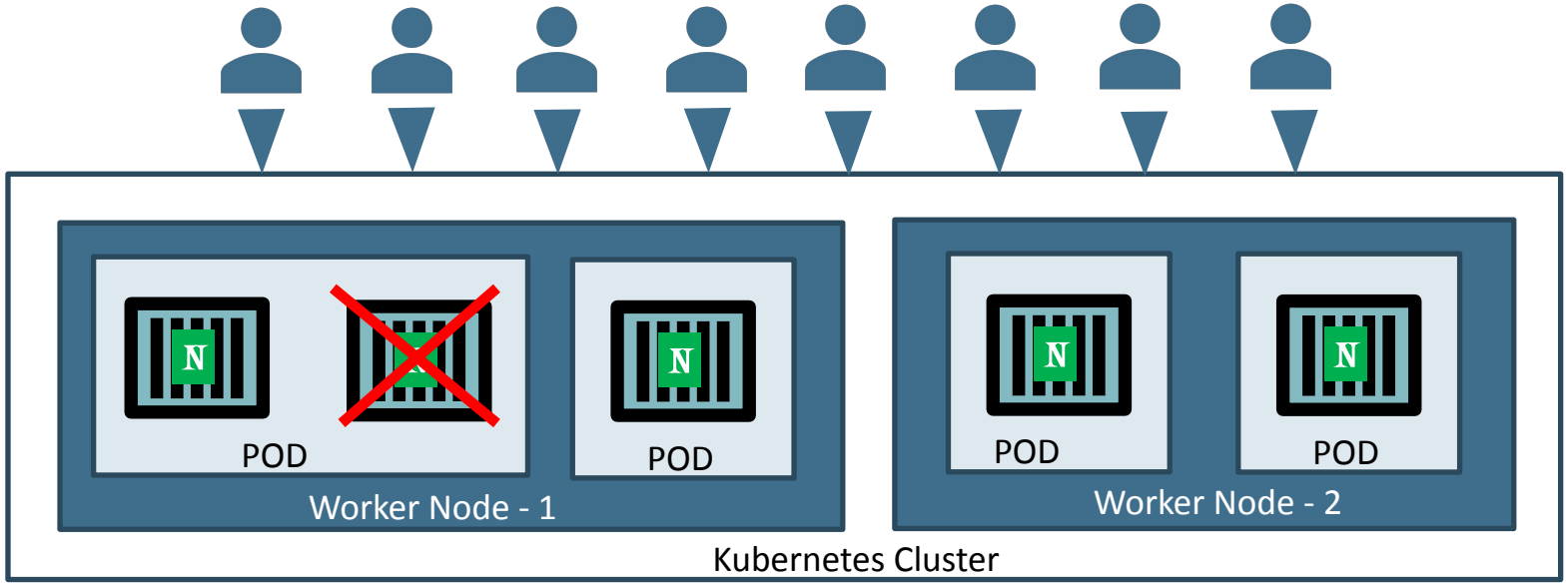
Kubernetes - POD

- PODs generally have one to one relationship with containers.
- To scale up we create new POD and to scale down we delete the POD.



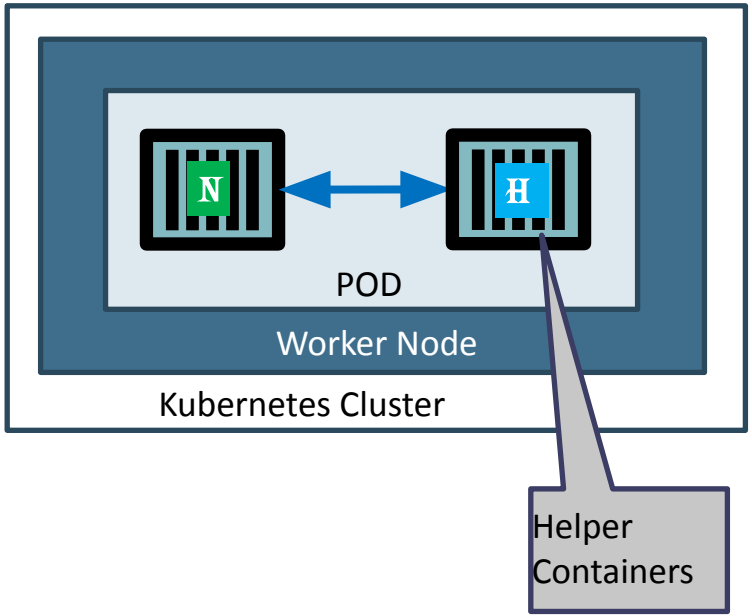
Kubernetes – PODs

- We cannot have multiple containers of same kind in a single POD.
- Example: Two NGINX containers in single POD serving same purpose is not recommended.



Kubernetes – Multi-Container Pods

- We can have multiple containers in a single POD, provided they are not of same kind.
- Helper Containers (Side-car)
  - Data Pullers: Pull data required by Main Container
  - Data pushers: Push data by collecting from main container (logs)
  - Proxies: Writes static data to html files using Helper container and Reads using Main Container.
- Communication
  - The two containers can easily communicate with each other easily as they share same network space.
  - They can also easily share same storage space.
- Multi-Container Pods is a rare use-case and we will try to focus on core fundamentals.



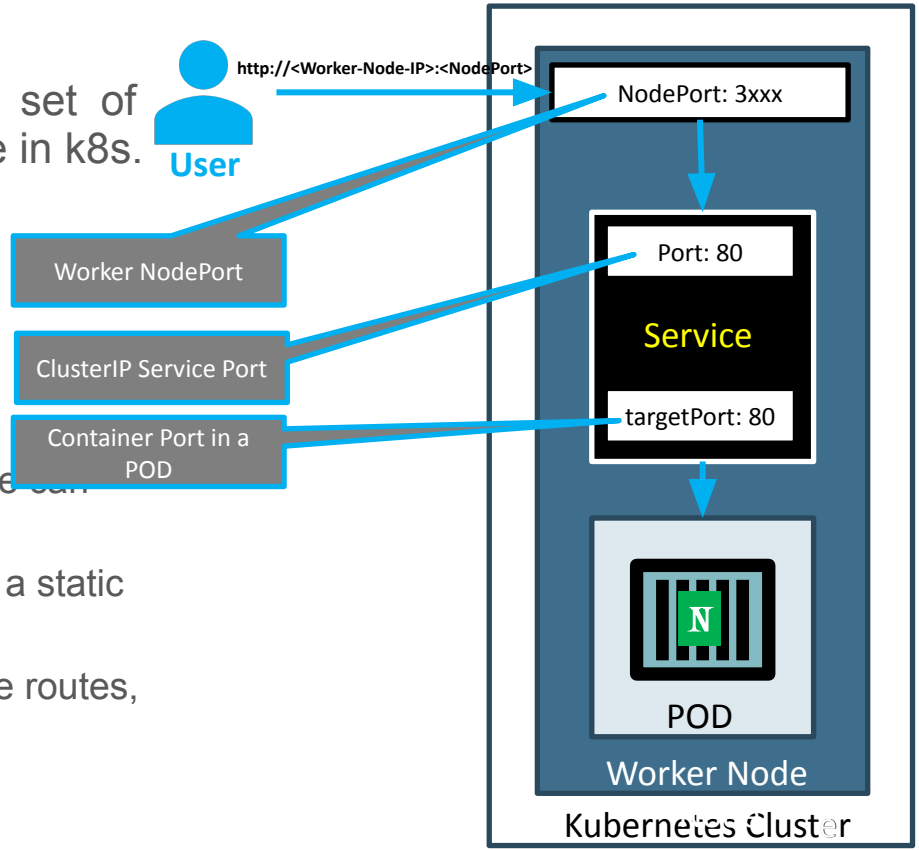
Kubernetes
PODs
Demo

Kubernetes

Services - NodePort

Kubernetes – Service - NodePort

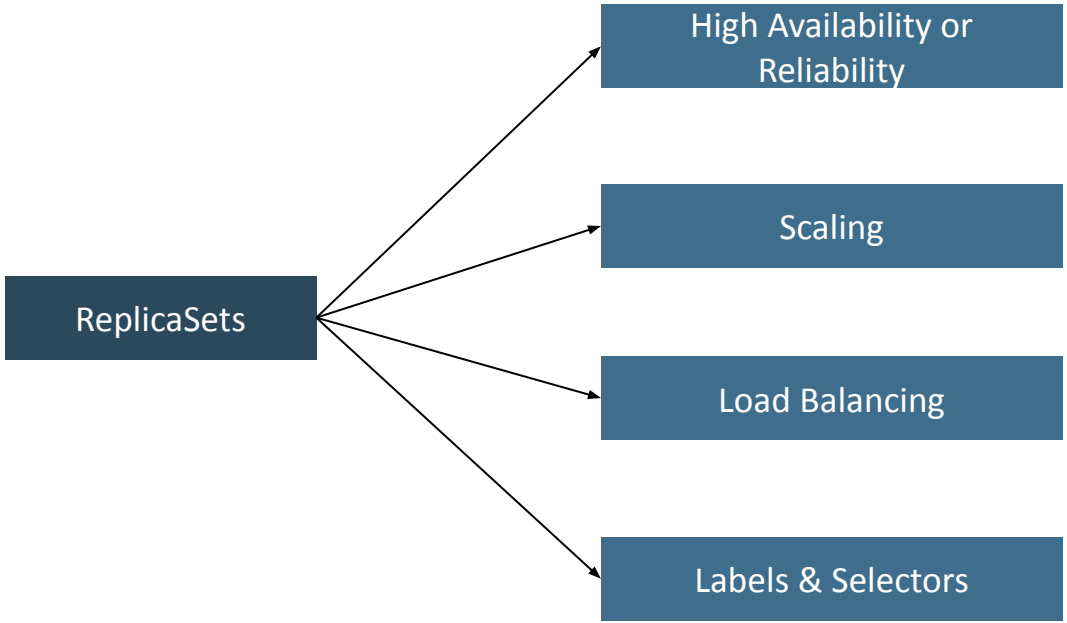
- We can expose an application running on a set of PODs using different types of Services available in k8s.
  - ClusterIP
  - NodePort
  - LoadBalancer
- NodePort Service
  - To access our application outside of k8s cluster, we can use NodePort service.
  - Exposes the Service on each Worker Node's IP at a static port (nothing but NodePort).
  - A ClusterIP Service, to which the NodePort Service routes, is automatically created.
  - Port Range 30000-32767



Kubernetes
POD & NodePort Service
Demo

Kubernetes
ReplicaSets

Kubernetes - ReplicaSets

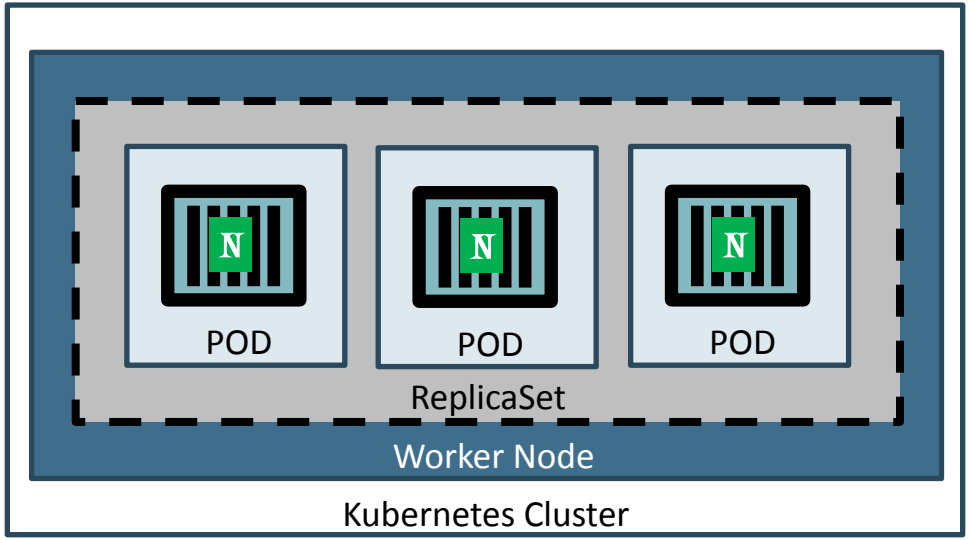


Kubernetes – ReplicaSet

- A ReplicaSet's purpose is to maintain a stable set of replica Pods running at any given time.

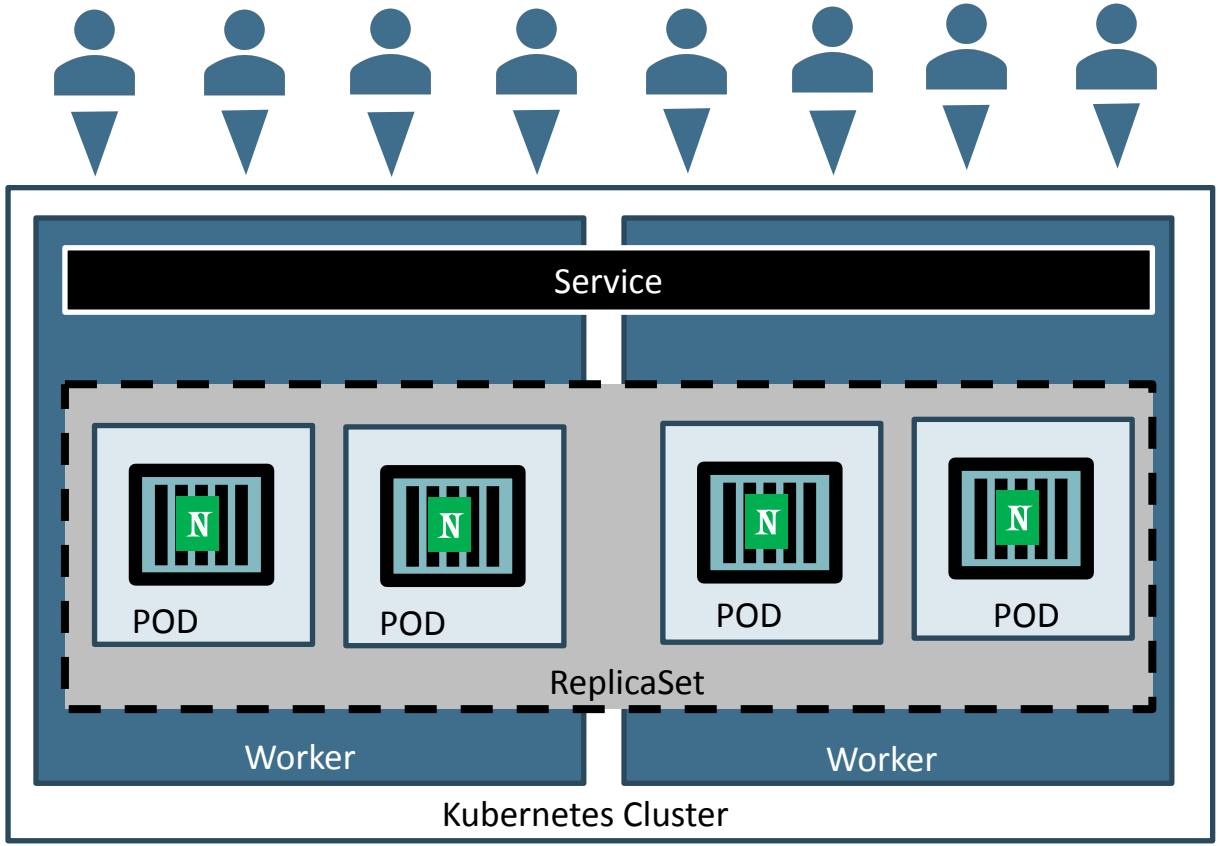
- If our application crashes (any pod dies), replicaset will recreate the pod immediately to ensure the configured number of pods running at any given time.

Reliability
Or
High Availability



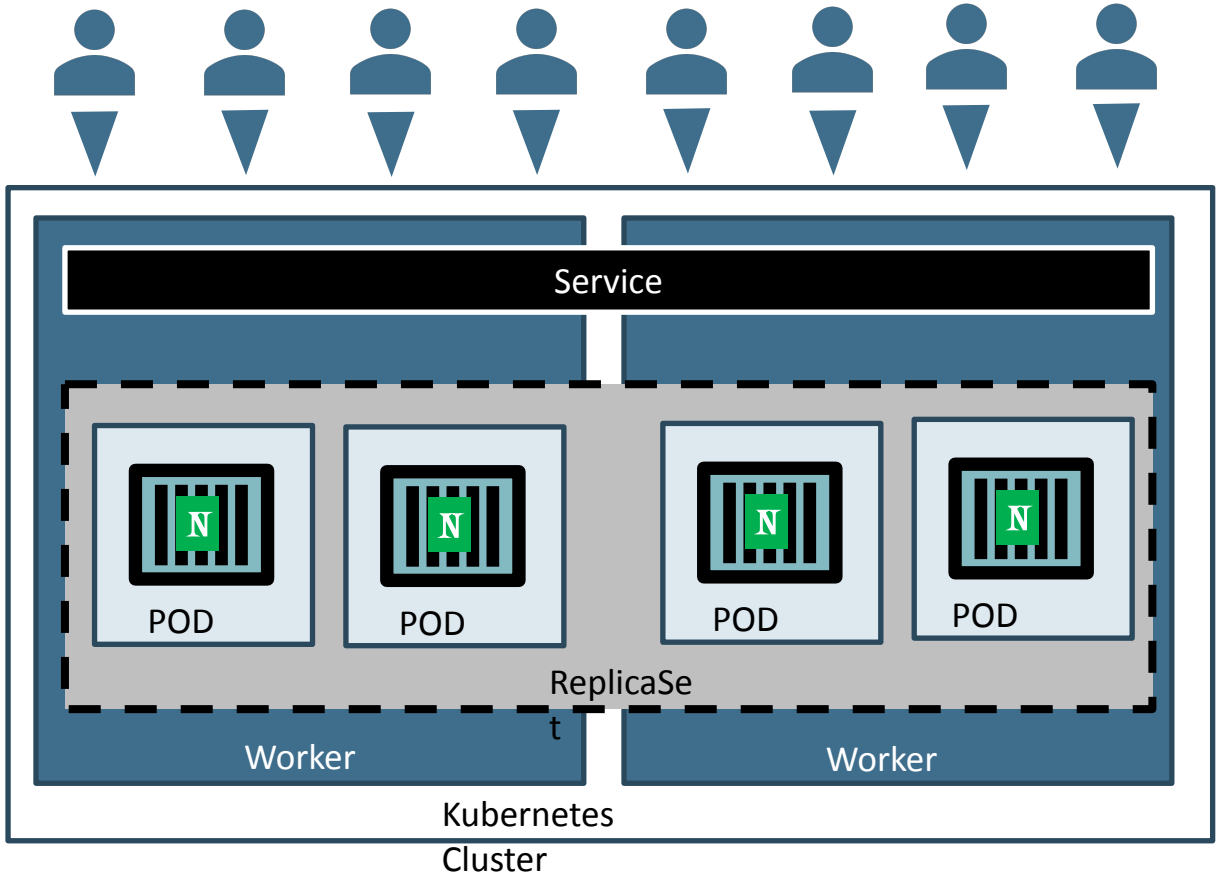
Kubernetes – ReplicaSet

- **Load Balancing**
- To avoid overloading of traffic to single pod we can use **load balancing**.
- Kubernetes provides pod load balancing **out of the box** using **Services** for the pods which are part of a ReplicaSet
- **Labels & Selectors** are the **key items** which **ties** all 3 together (Pod, ReplicaSet & Service), we will know in detail when we are writing YAML manifests for these objects



Kubernetes – ReplicaSet

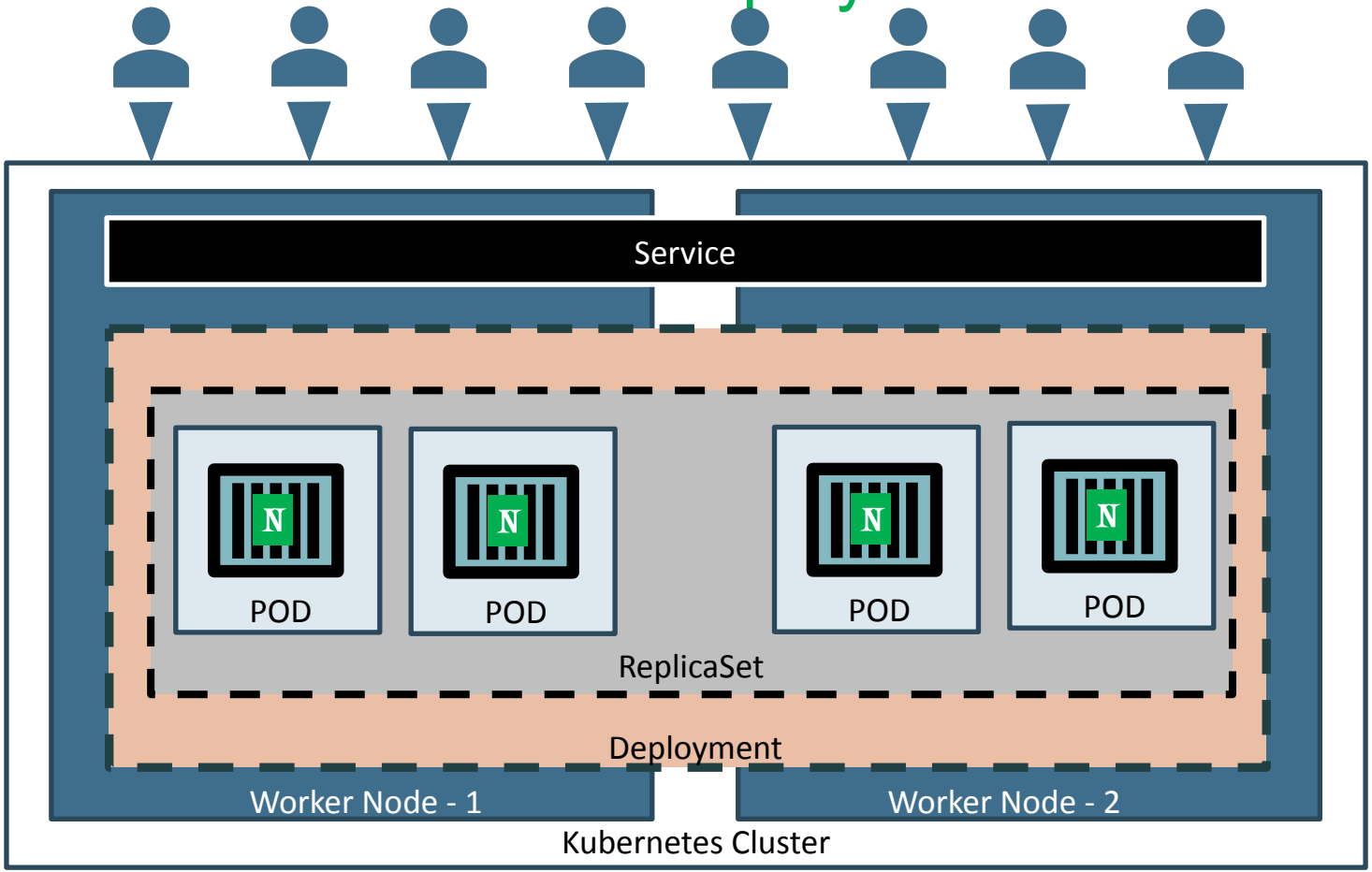
- Scaling
- When load become too much for the number of existing pods, Kubernetes enables us to easily scale up our application, adding additional pods as needed.
- This is going to be seamless and super quick.



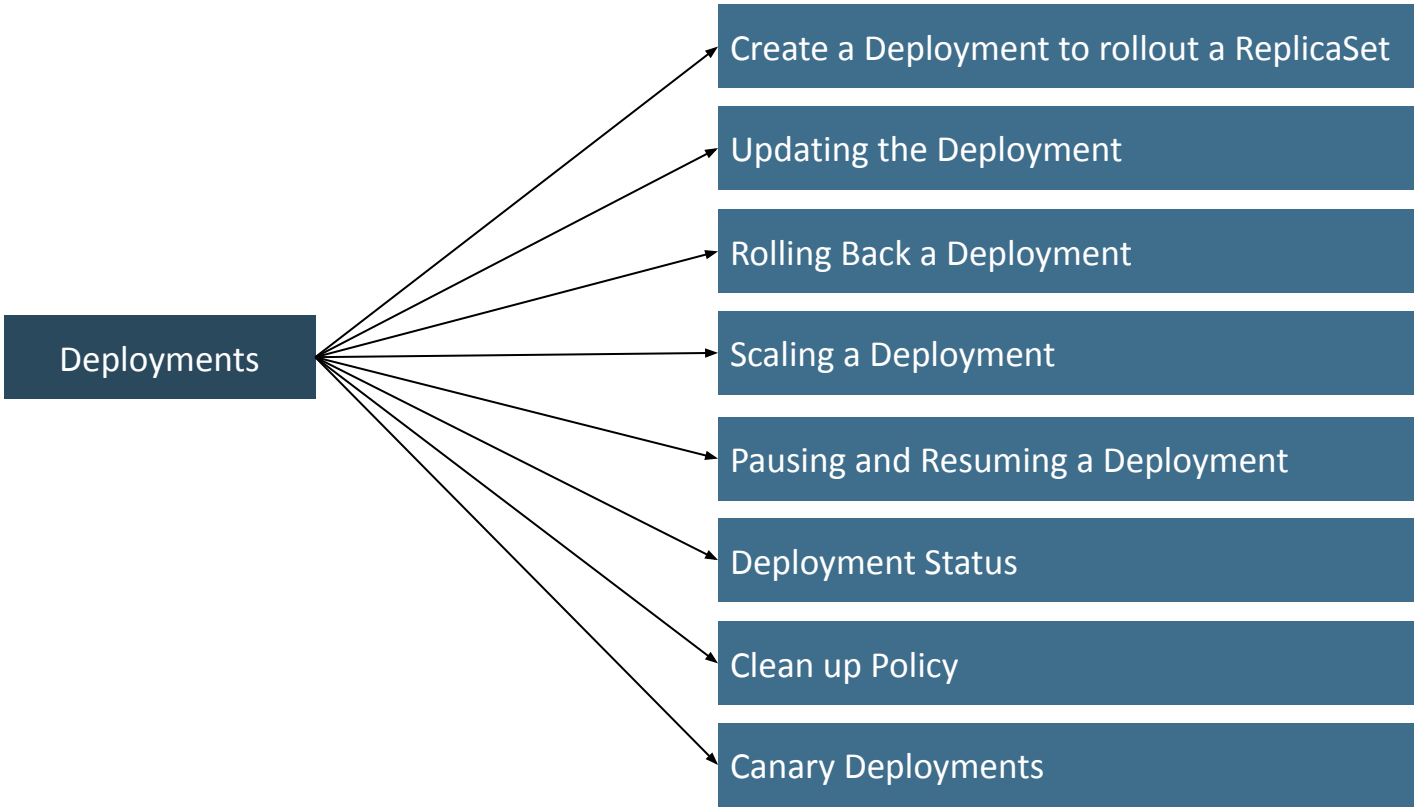
Kubernetes ReplicaSets Demo

Kubernetes
Deployments

Kubernetes – Deployments



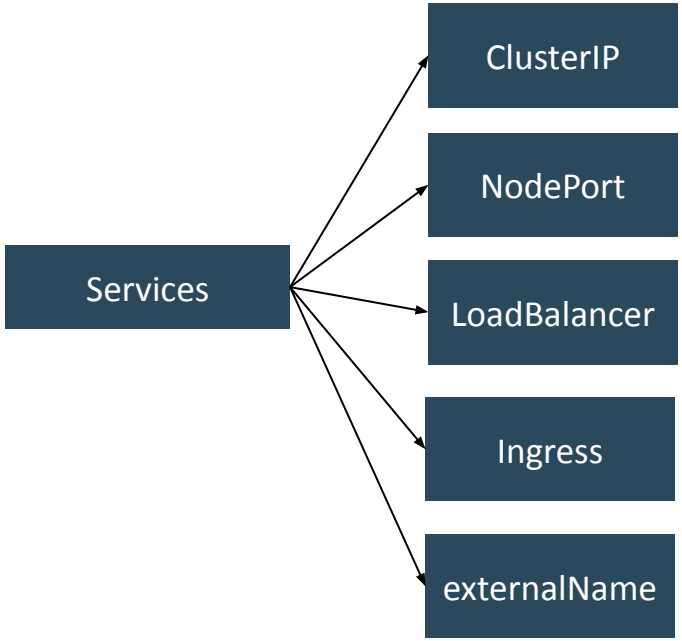
Kubernetes - Deployment



Kubernetes Deployments Demo

Kubernetes
Services

Kubernetes - Services



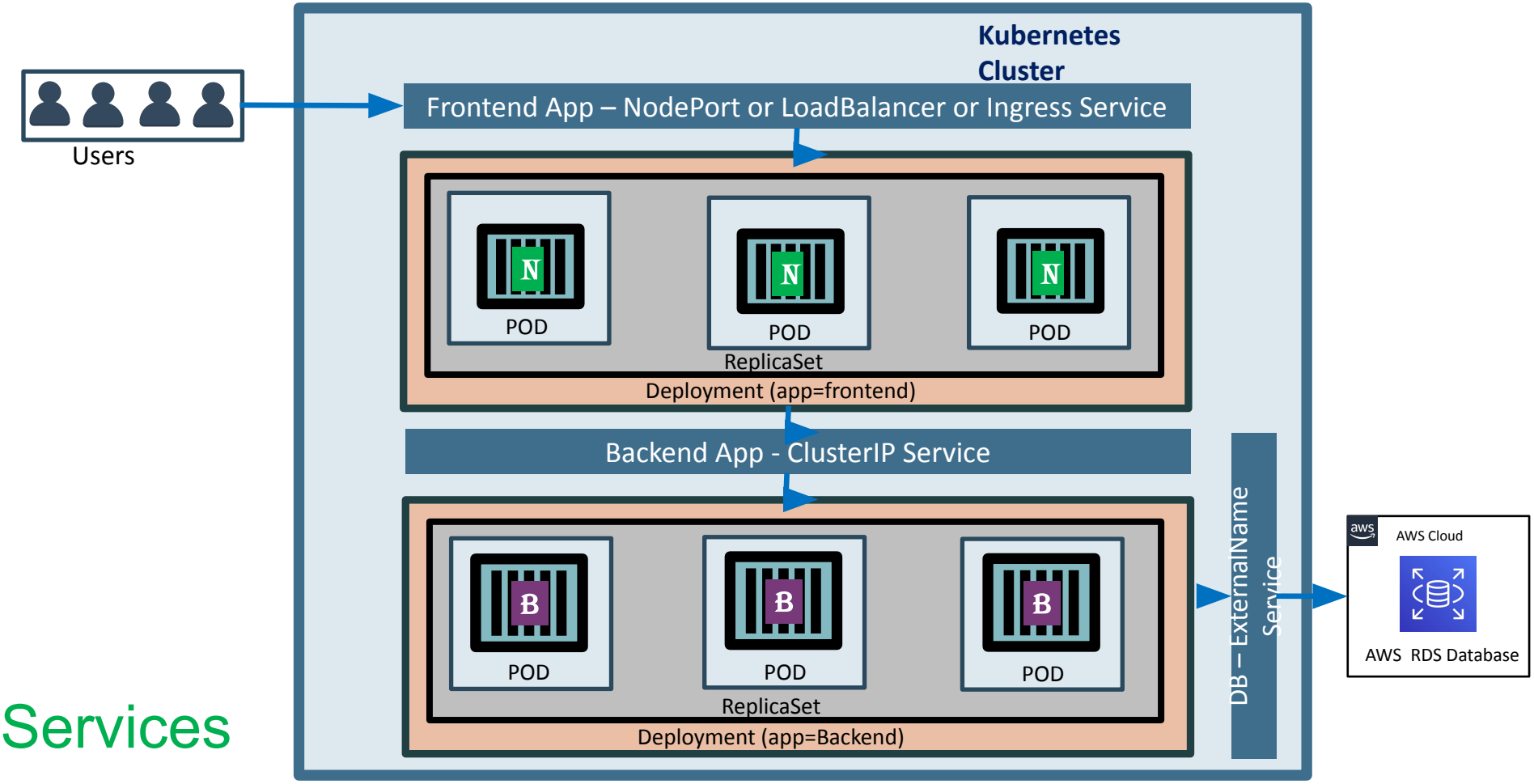
Used for communication between applications inside k8s cluster (Example: Frontend application accessing backend application)

Used for accessing applications outside of of k8s cluster using Worker Node Ports (Example: Accessing Frontend application on browser)

Primarily for Cloud Providers to integrate with their Load Balancer services (Example: AWS Elastic Load Balancer)

Ingress is an advanced load balancer which provides Context path based routing, SSL, SSL Redirect and many more (Example: AWS ALB)

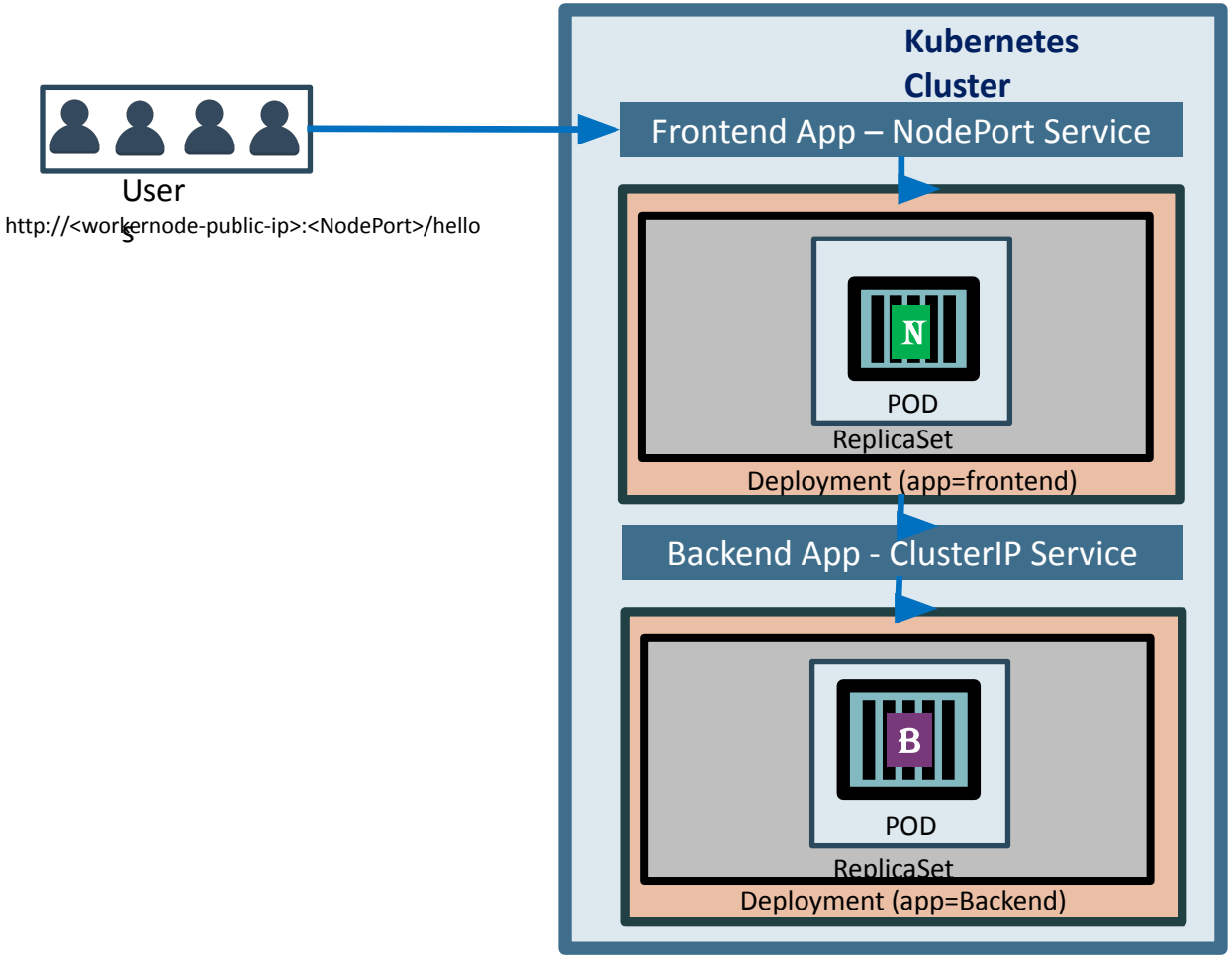
To access externally hosted apps in k8s cluster (Example: Access AWS RDS Database endpoint by application present inside k8s cluster)


Kubernetes Cluster
Users
Frontend App – NodePort or LoadBalancer or Ingress Service
POD
POD
POD
ReplicaSet
Deployment (app=frontend)
Backend App - ClusterIP Service
POD
POD
POD
ReplicaSet
Deployment (app=Backend)
DB – ExternalName Service
AWS Cloud
AWS RDS Database

Services

Kubernetes
Services
Demo

Services Demo



Kubernetes
YAML Basics

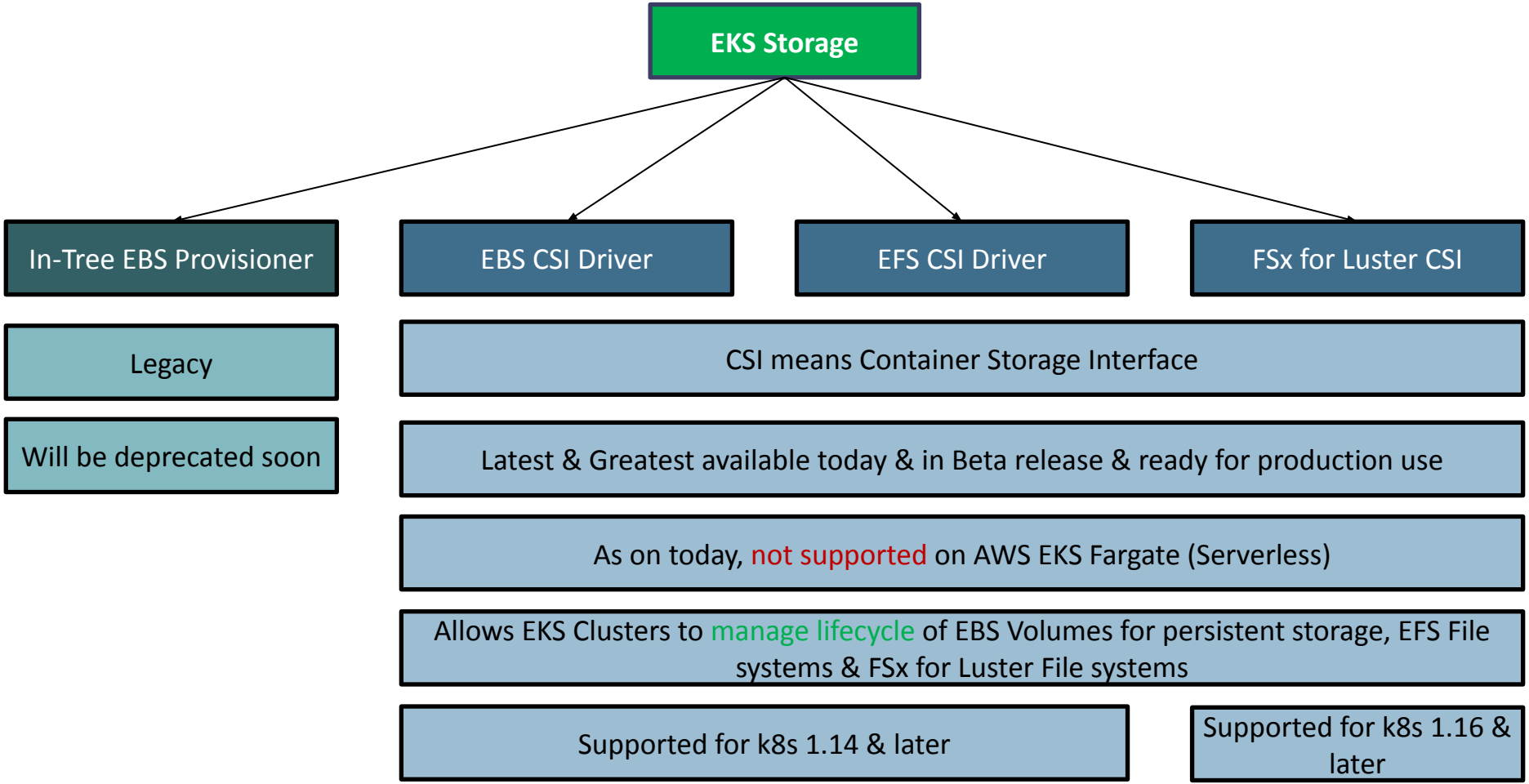
YAML Basics

- YAML is not a Markup Language
- YAML is used to store information about different things
- We can use YAML to define key, Value pairs like variables, lists and objects
- YAML is very similar to JSON (Javascript Object Notation)
- YAML primarily focuses on readability and user friendliness
- YAML is designed to be clean and easy to read
- We can define YAML files with two different extensions
    - abc.yml
    - abc.yaml

YAML Basics

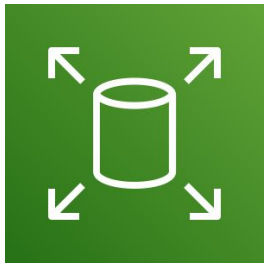
- YAML Comments
- YAML Key Value Pairs
- YAML Dictionary or Map
- YAML Array / Lists
- YAML Spaces
- YAML Document Separator

AWS EKS
Storage


EKS Storage
In-Tree EBS Provisioner
EBS CSI Driver
EFS CSI Driver
FSx for Luster CSI
Legacy
CSI means Container Storage Interface
Will be deprecated soon
Latest & Greatest available today & in Beta release & ready for production use
As on today, not supported on AWS EKS Fargate (Serverless)
Allows EKS Clusters to manage lifecycle of EBS Volumes for persistent storage, EFS File systems & FSx for Luster File systems
Supported for k8s 1.14 & later
Supported for k8s 1.16 & later

AWS EKS Storage

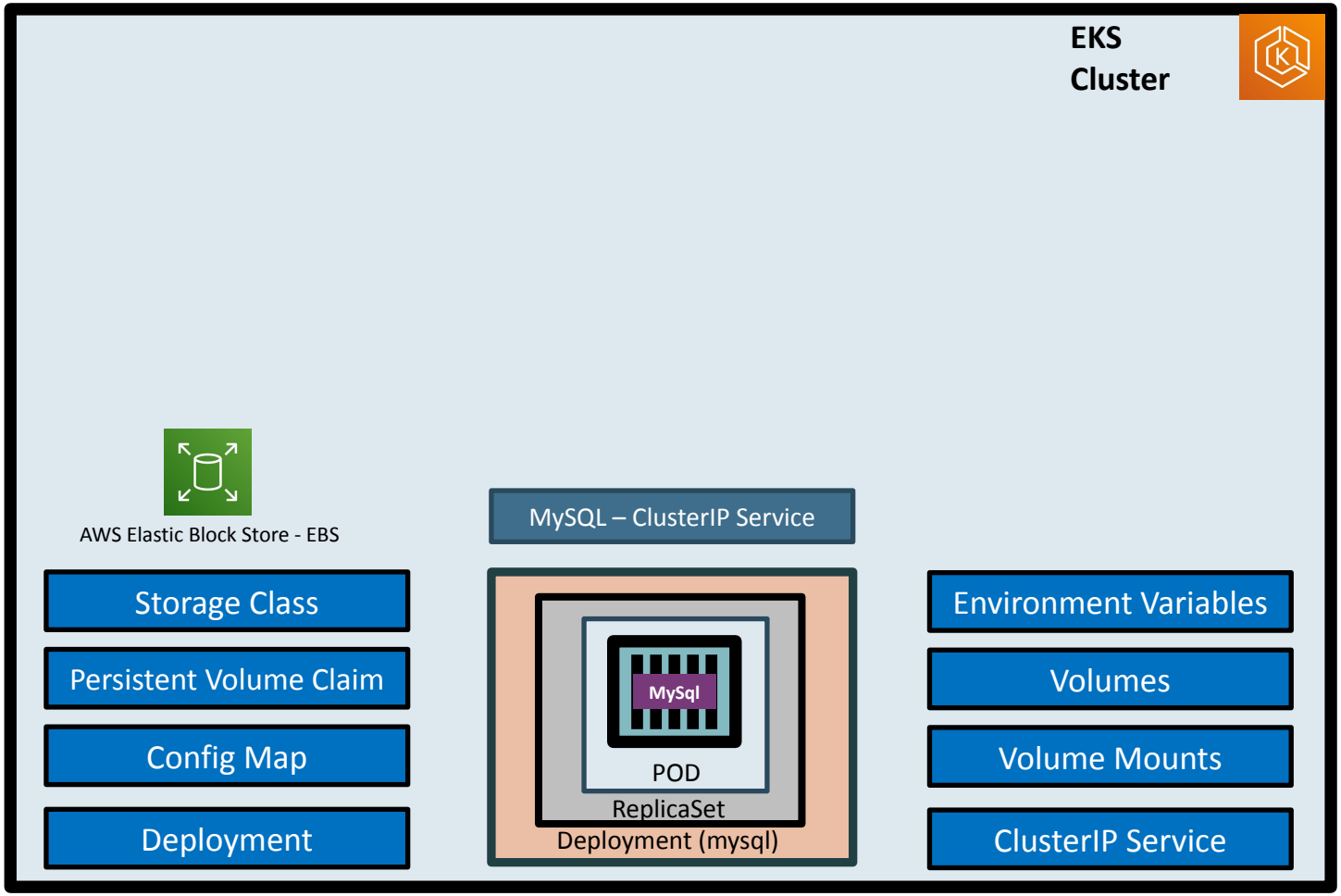
EBS CSI Driver

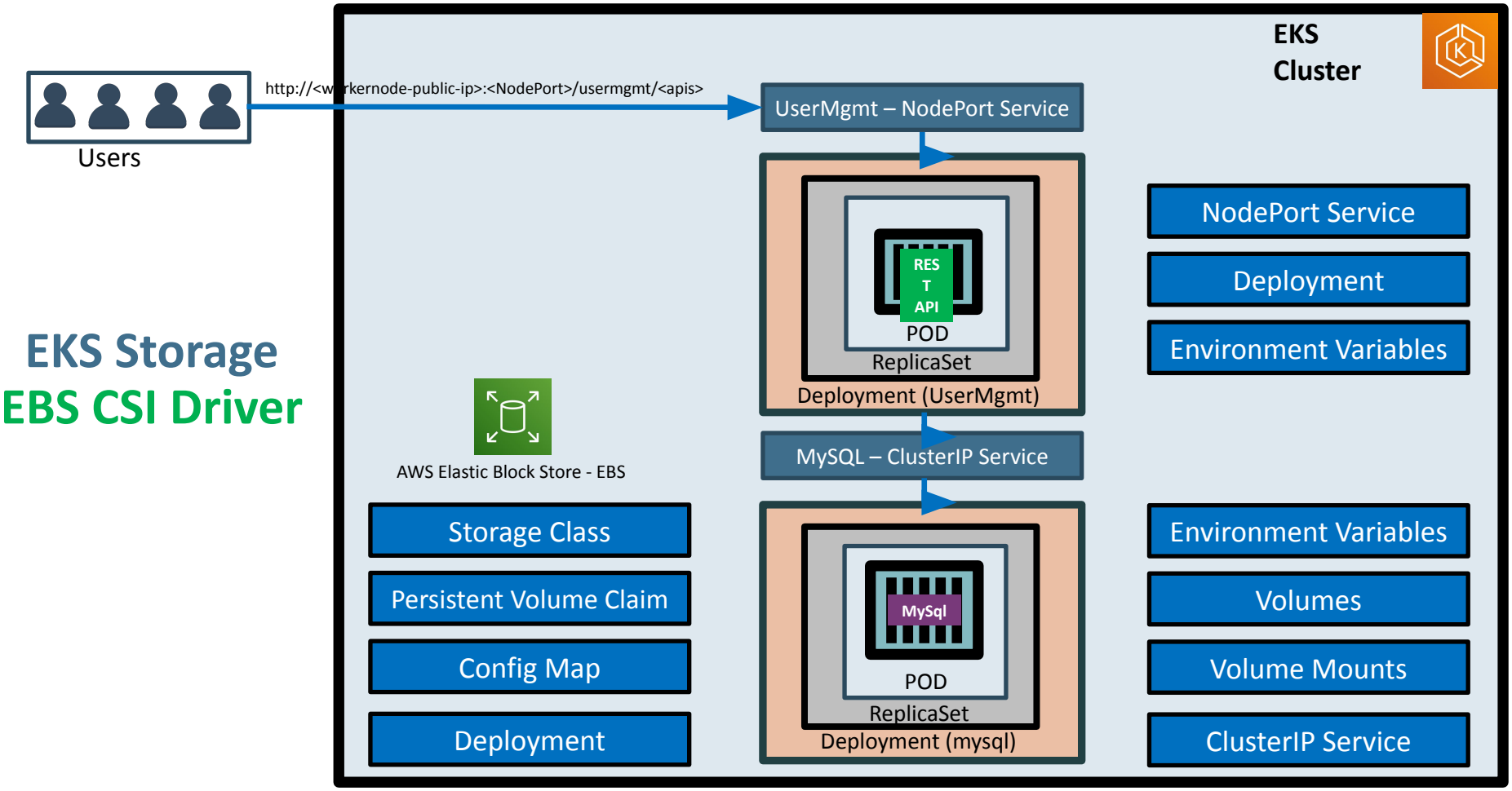


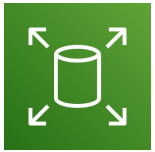
AWS Elastic Block Store - Introduction

- EBS provides block level storage volumes for use with EC2 & Container instances.
- We can mount these volumes as devices on our EC2 & Container instances.
- EBS volumes that are attached to an instance are exposed as storage volumes that persist independently from the life of the EC2 or Container instance.
- We can dynamically change the configuration of a volume attached to an instance.
- AWS recommends EBS for data that must be quickly accessible and requires long-term persistence.
- EBS is well suited to both database-style applications that rely on random reads and writes, and to throughput-intensive applications that perform long, continuous reads and writes.

EKS Storage EBS CSI Driver




EKS Storage
EBS CSI Driver
Users
http://<workernode-public-ip>:<NodePort>/usermgmt/<apis>
EKS Cluster
UserMgmt – NodePort Service
RES T API
POD
ReplicaSet
Deployment (UserMgmt)
NodePort Service
Deployment
Environment Variables
AWS Elastic Block Store - EBS
MySQL – ClusterIP Service
Storage Class
Persistent Volume Claim
Config Map
Deployment
MySql
POD
ReplicaSet
Deployment (mysql)
Environment Variables
Volumes
Volume Mounts
ClusterIP Service

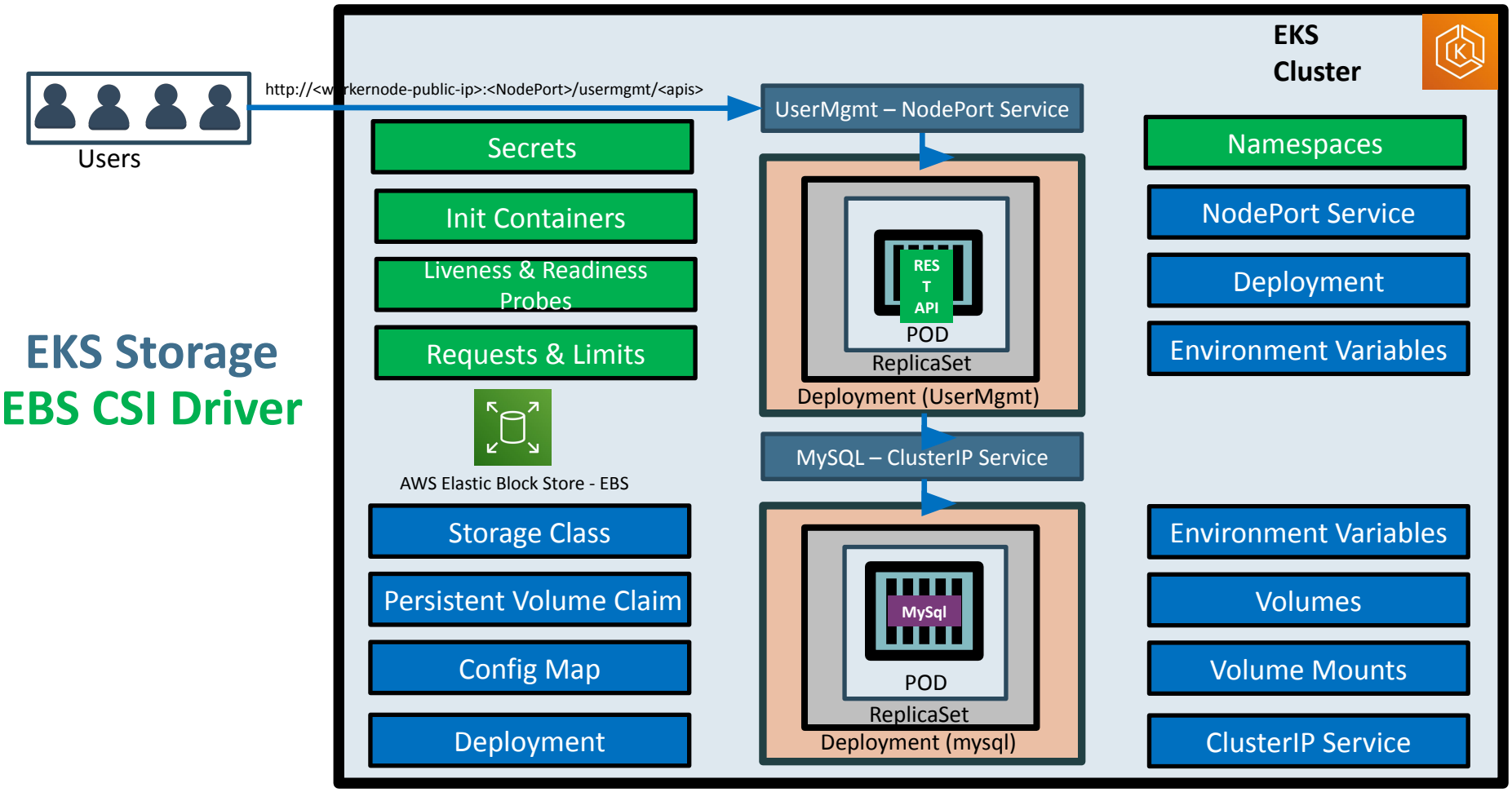


Elastic Block Store

AWS EKS Storage

EBS CSI Driver

Important k8s Concepts for Application Deployments


EKS Storage
EBS CSI Driver
Users
http://<workernode-public-ip>:<NodePort>/usermgmt/<apis>
EKS Cluster
UserMgmt – NodePort Service
Secrets
Init Containers
Liveness & Readiness Probes
Requests & Limits
RES T API
POD
ReplicaSet
Deployment (UserMgmt)
Namespaces
NodePort Service
Deployment
Environment Variables
AWS Elastic Block Store - EBS
MySQL – ClusterIP Service
Storage Class
Persistent Volume Claim
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Deployment
MySql
POD
ReplicaSet
Deployment (mysql)
Environment Variables
Volumes
Volume Mounts
ClusterIP Service

Probes

Liveness Probe

Kubelet uses liveness probes to know when to restart a container

Liveness probes could catch a deadlock, where an application is running, but unable to make progress and restarting container helps in such state

Readiness Probe

Kubelet uses readiness probes to know when a container is ready to accept traffic

When a Pod is not ready, it is removed from Service load balancers based on this readiness probe signal.

Startup Probe

Kubelet uses startup probes to know when a container application has started

Firstly this proble disables liveness & readiness checks until it succeeds ensuring those pods don't interfere with app startup.

This can be used to adopt liveness checks on slow starting containers, avoiding them getting killed by the kubelet before they are up and running.

Options to define Probes

Check using Commands	/bin/sh –c nc -z localhost 8095
Check using HTTP GET Request	httpget path:/health-status
Check using TCP	tcpSocket Port: 8095

Kubernetes
Namespaces

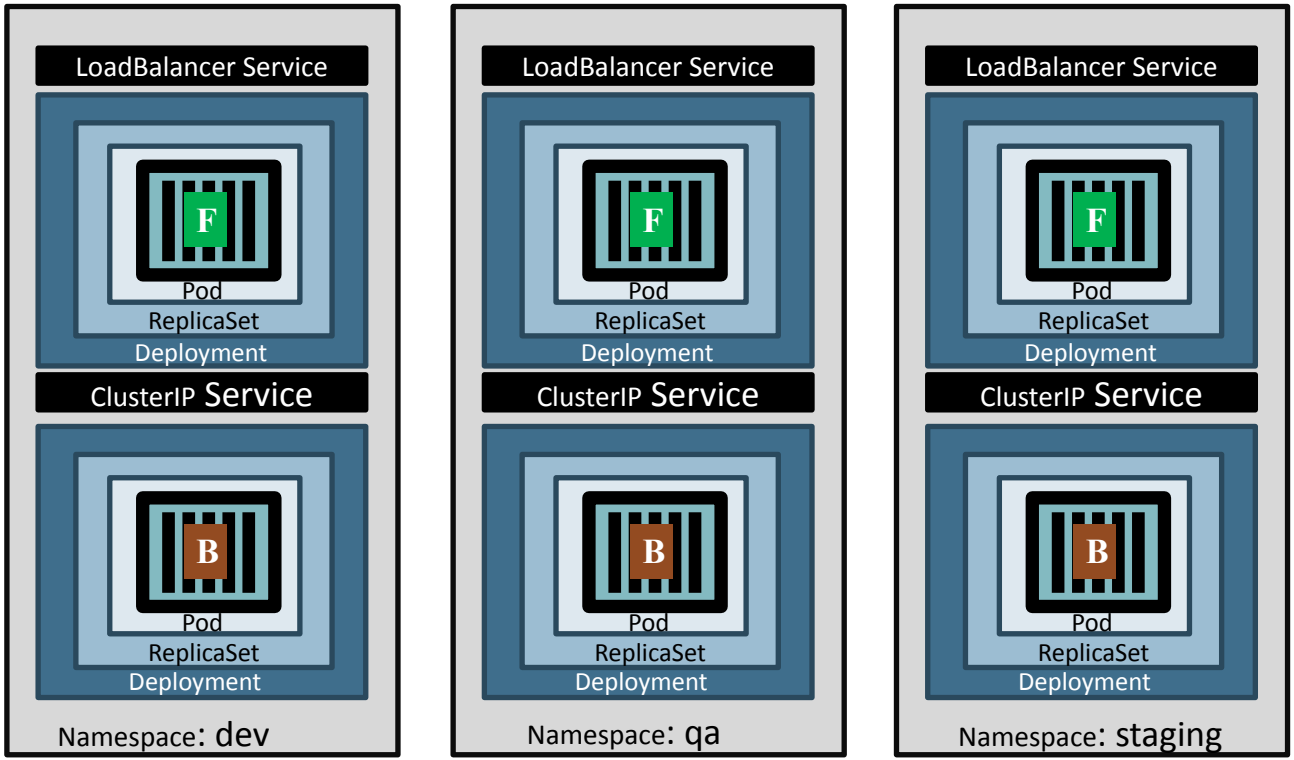
Namespaces - Introduction

- Namespaces are also called Virtual clusters in our physical k8s cluster
- We use this in environments where we have many users spread across multiple teams or projects
- Clusters with tens of users ideally don't need to use namespaces
- Benefits
  - Creates isolation boundary from other k8s objects
  - We can limit the resources like CPU, Memory on per namespace basis (Resource Quota).

```
kubectl get namespace
```

```
NAME              STATUS   AGE
default           Active   141m
kube-node-lease   Active   141m
kube-public       Active   141m
kube-system       Active   141m
```

Namespaces

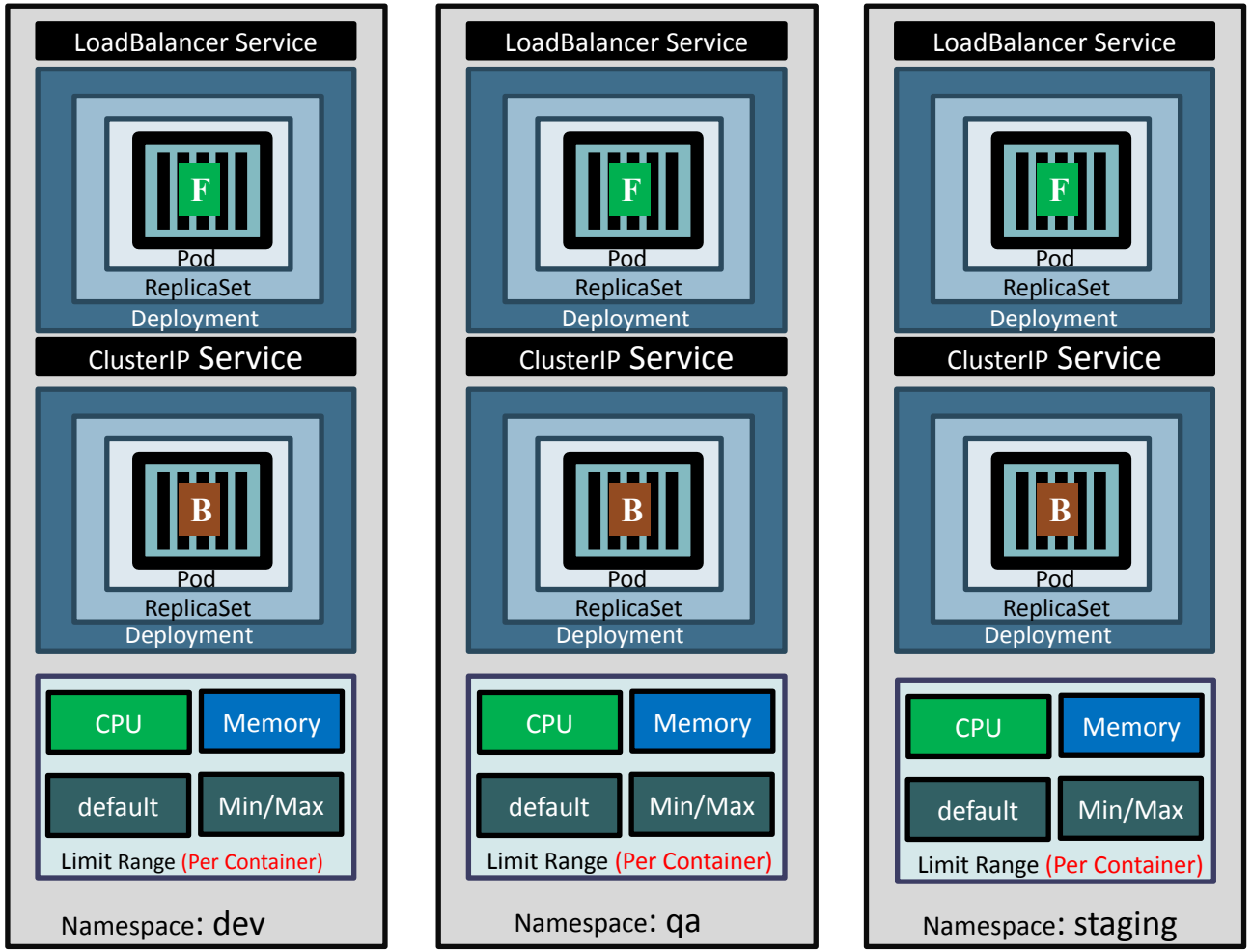


Namespace Manifest - Declarative

```yaml
apiVersion: v1
kind: Namespace
metadata:
  name: dev3
```

Namespace Manifest - Imperative

```
kubectl create namespace dev1
```



Limit Range

Limit Range Manifest

```yaml
apiVersion: v1
kind: LimitRange
metadata:
  name: default-cpu-mem-limit-range
  namespace: dev3
spec:
  limits:
    - default:
        memory: "512Mi"
        cpu: "500m"
      defaultRequest:
        memory: "256Mi"
        cpu: "300m"
      type: Container
```

Resource Quota

Resource Quota

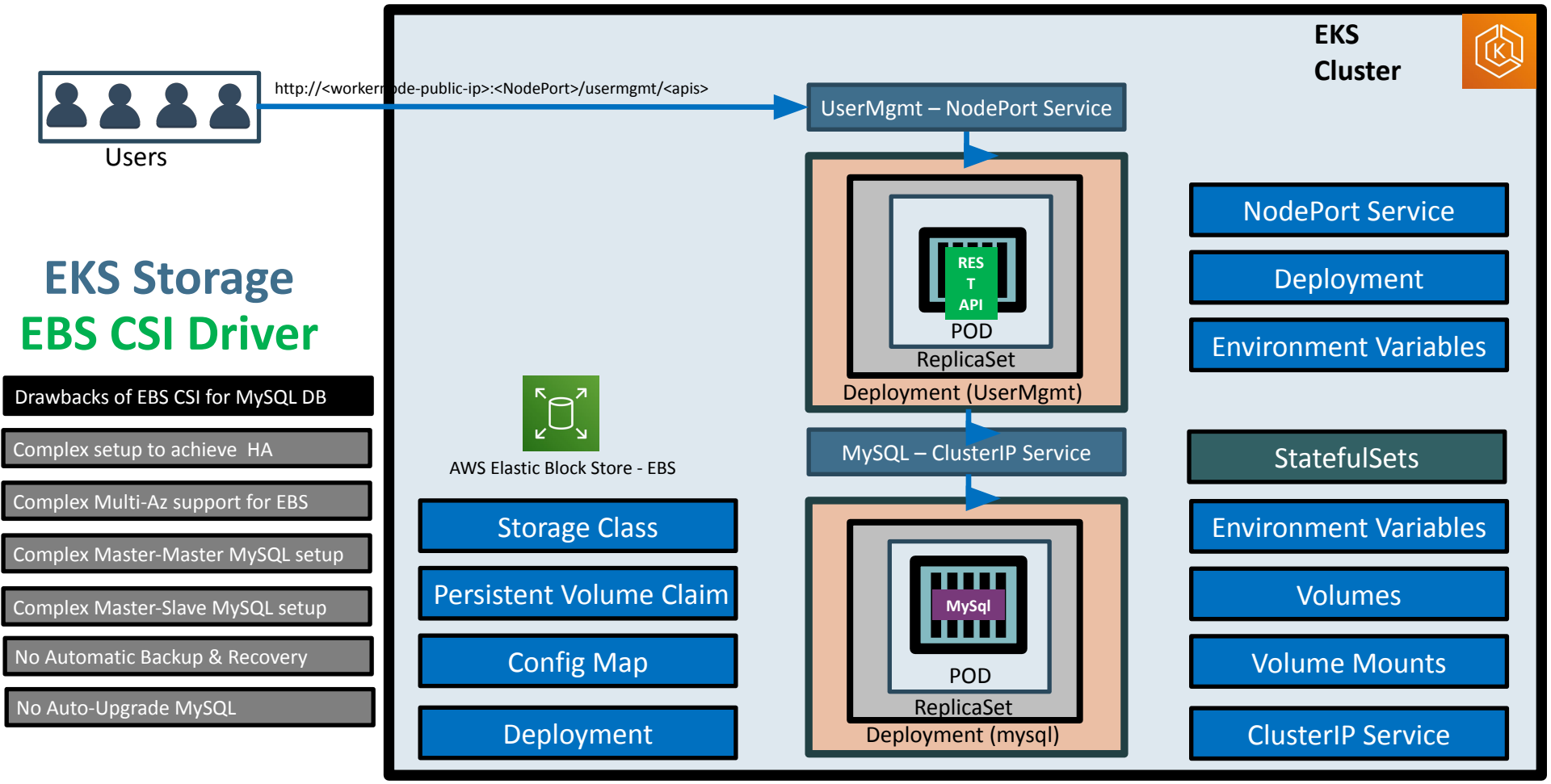
```yaml
apiVersion: v1
kind: ResourceQuota
metadata:
  name: ns-resource-quota
  namespace: dev3
spec:
  hard:
    requests.cpu: "1"
    requests.memory: 1Gi
    limits.cpu: "2"
    limits.memory: 2Gi
    pods: "5"
    configmaps: "5"
    persistentvolumeclaims: "5"
    secrets: "5"
    services: "5"
```

Amazon RDS

AWS EKS

&

RDS Database


EKS Cluster
Users
http://<worker node-public-ip>:<NodePort>/usermgmt/<apis>
UserMgmt – NodePort Service
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Deployment (UserMgmt)
NodePort Service
Deployment
Environment Variables
EKS Storage
EBS CSI Driver
Drawbacks of EBS CSI for MySQL DB
Complex setup to achieve HA
Complex Multi-Az support for EBS
Complex Master-Master MySQL setup
Complex Master-Slave MySQL setup
No Automatic Backup & Recovery
No Auto-Upgrade MySQL
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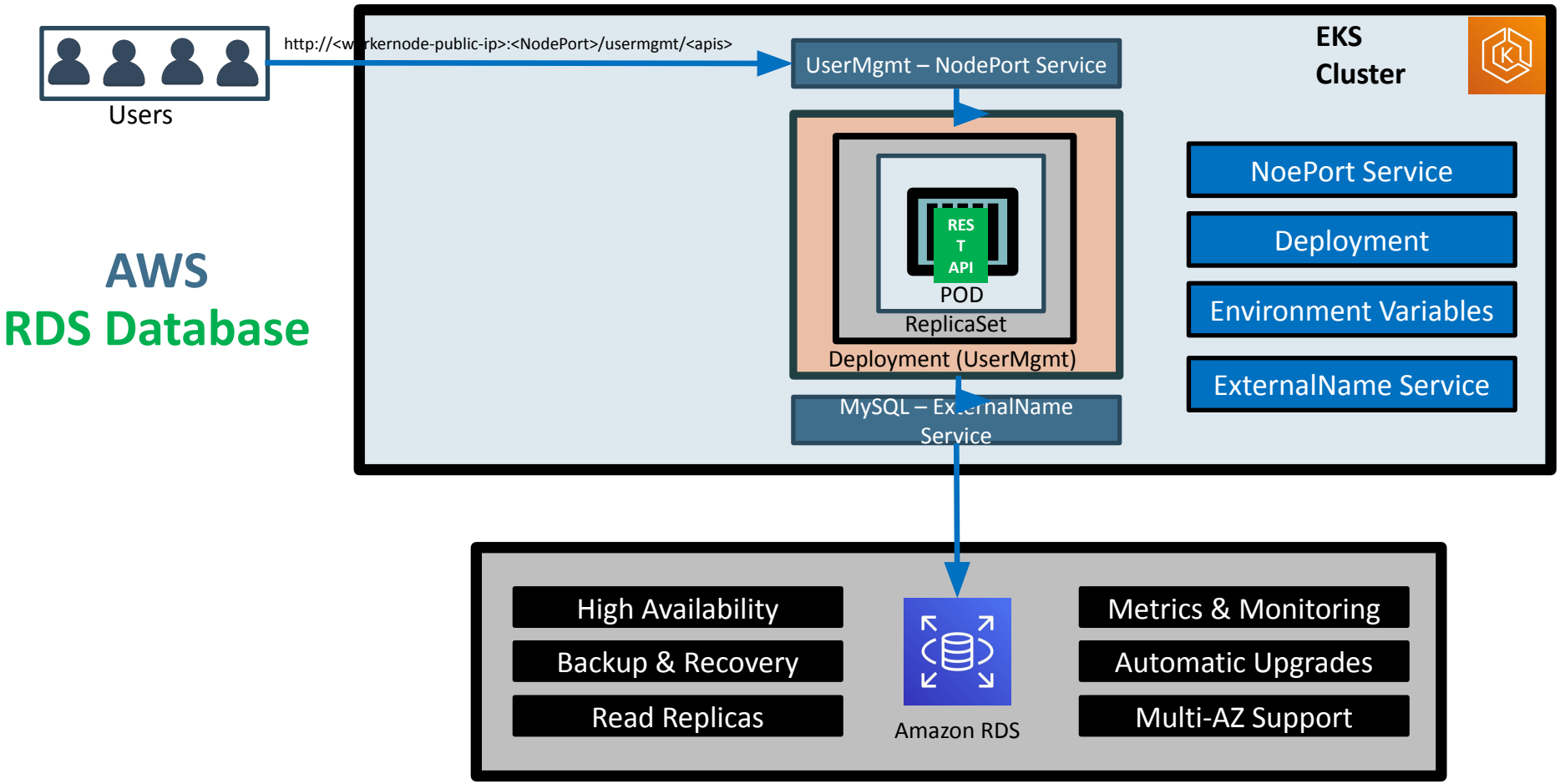
Users
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UserMgmt – NodePort Service
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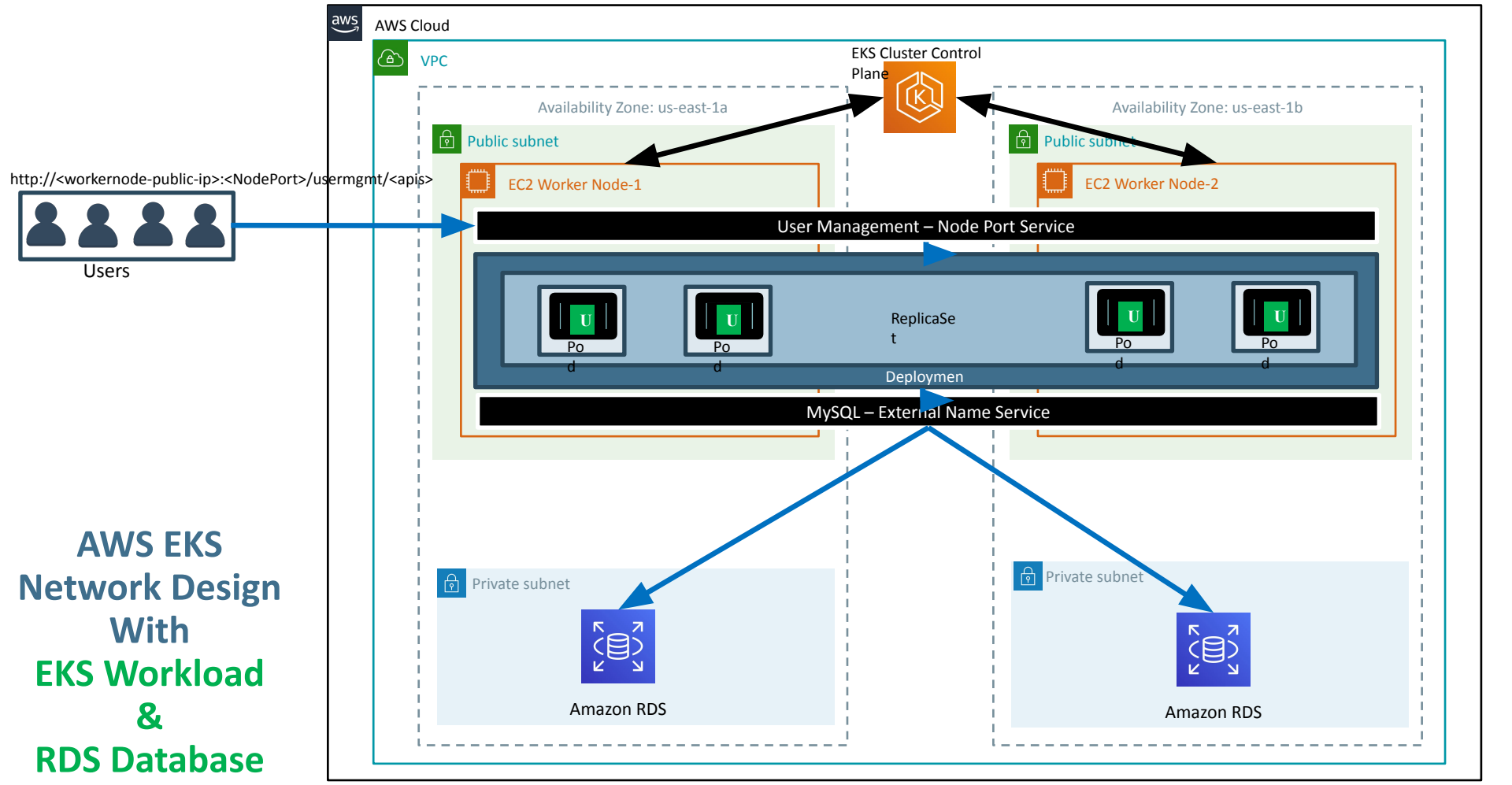
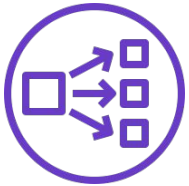
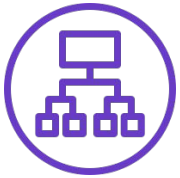
Deployment
Environment Variables
ExternalName Service
AWS
RDS Database
High Availability
Backup & Recovery
Read Replicas
Amazon RDS
Metrics & Monitoring
Automatic Upgrades
Multi-AZ Support


AWS Cloud
VPC
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
EC2 Worker Node-1
EC2 Worker Node-2
http://<workernode-public-ip>:<NodePort>/usermgmt/<apis>
Users
User Management – Node Port Service
Pod
Pod
ReplicaSet
Pod
Pod
Deployment
MySQL – External Name Service
Private subnet
Private subnet
Amazon RDS
Amazon RDS
AWS EKS
Network Design
With
EKS Workload
&
RDS Database

Classic
Load
Balancer



Network
Load
Balancer

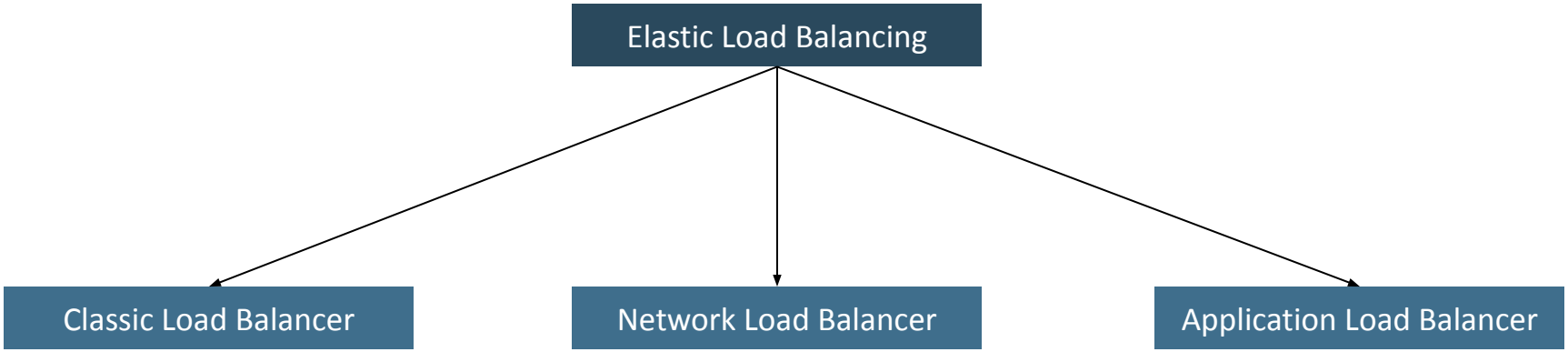


Application
Load
Balancer

AWS

Elastic Load Balancing

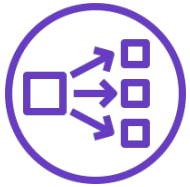
Overview



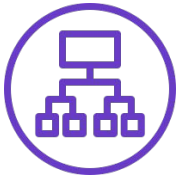
https://aws.amazon.com/elasticloadbalancing/features/#compare

Elastic Load Balancing

Classic Load Balancer



Network Load Balancer



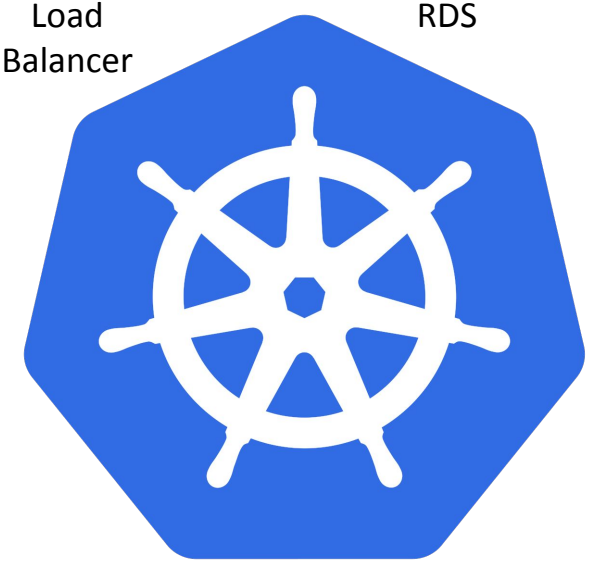
Application Load Balancer

Amazon RDS

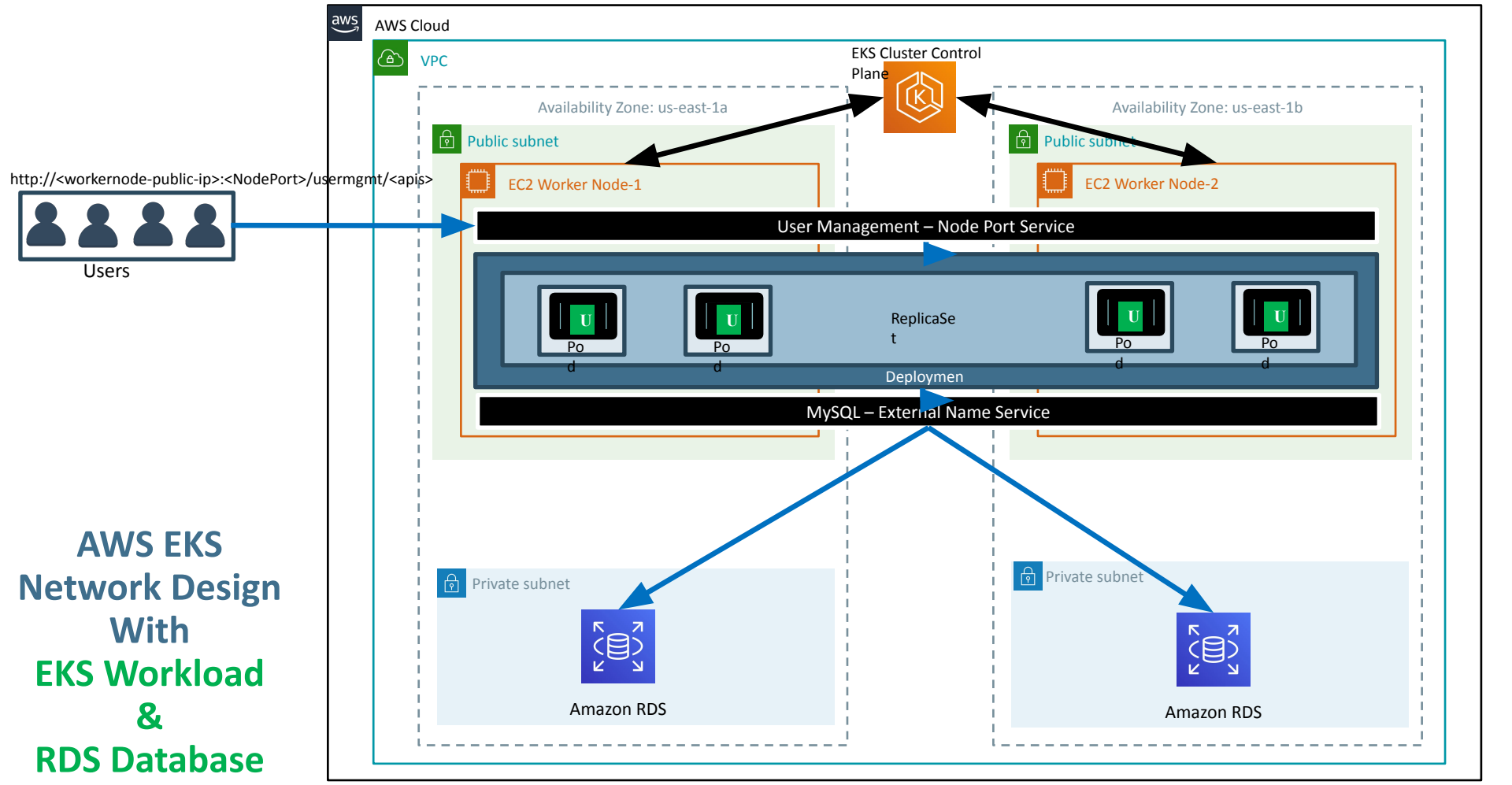
AWS EKS

&

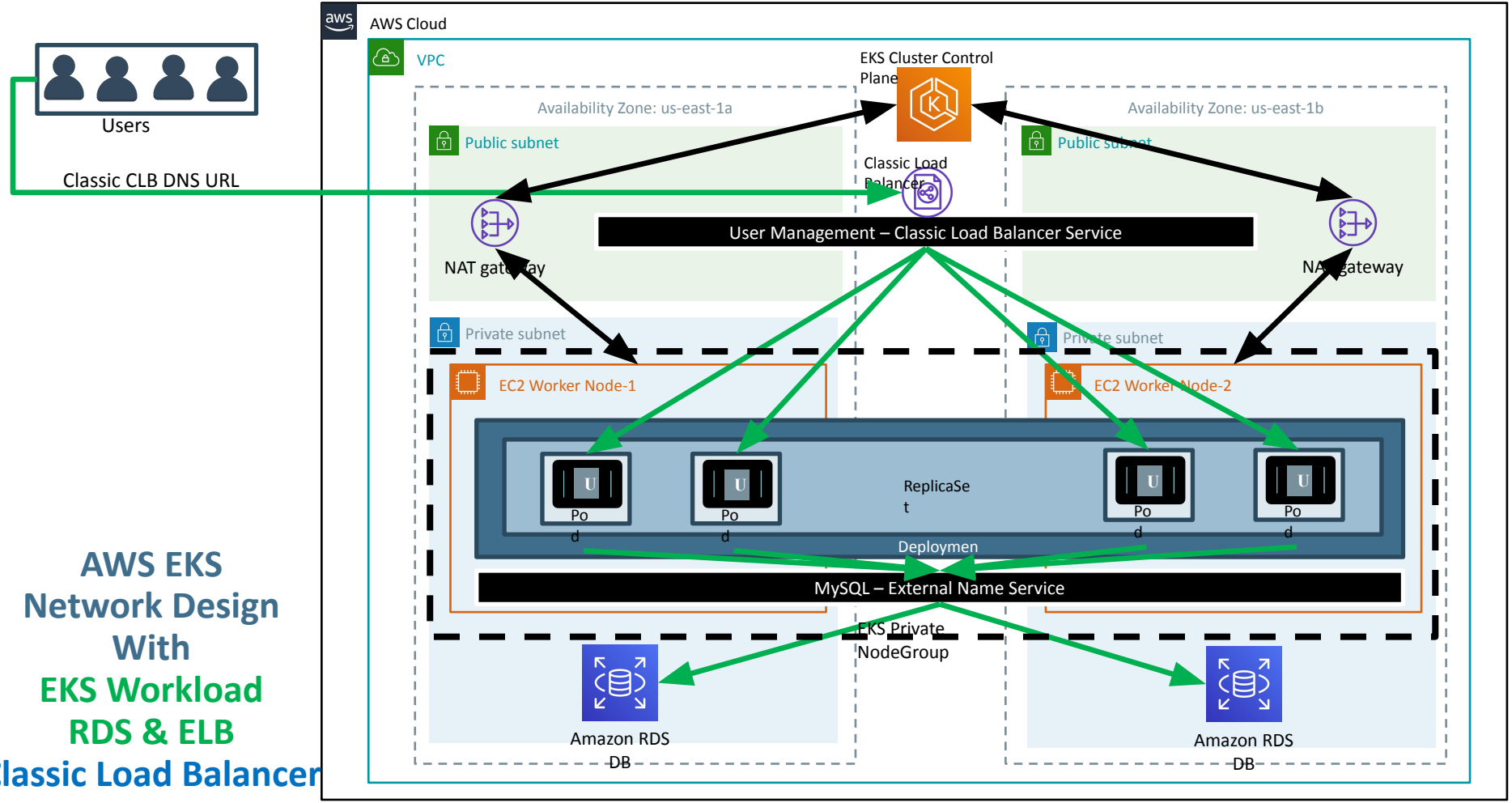
RDS & ELB



Classic Load Balancer

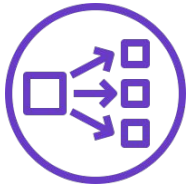

AWS Cloud
VPC
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
EC2 Worker Node-1
EC2 Worker Node-2
http://<workernode-public-ip>:<NodePort>/usermgmt/<apis>
Users
User Management – Node Port Service
Pod
Pod
ReplicaSet
Pod
Pod
Deployment
MySQL – External Name Service
Private subnet
Private subnet
Amazon RDS
Amazon RDS
AWS EKS
Network Design
With
EKS Workload
&
RDS Database

AWS EKS Network Design With EKS Workload RDS & ELB Classic Load Balancer

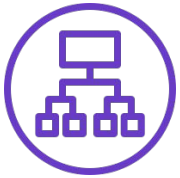


Elastic Load Balancing

Classic Load Balancer



Network Load Balancer



Application Load Balancer

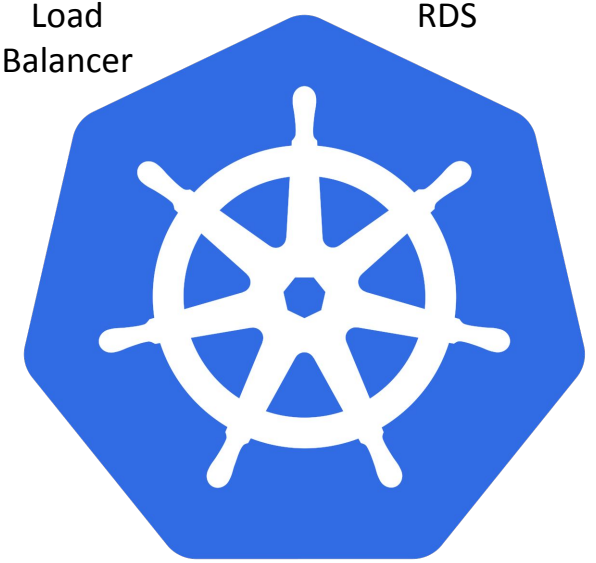
Amazon RDS

AWS EKS

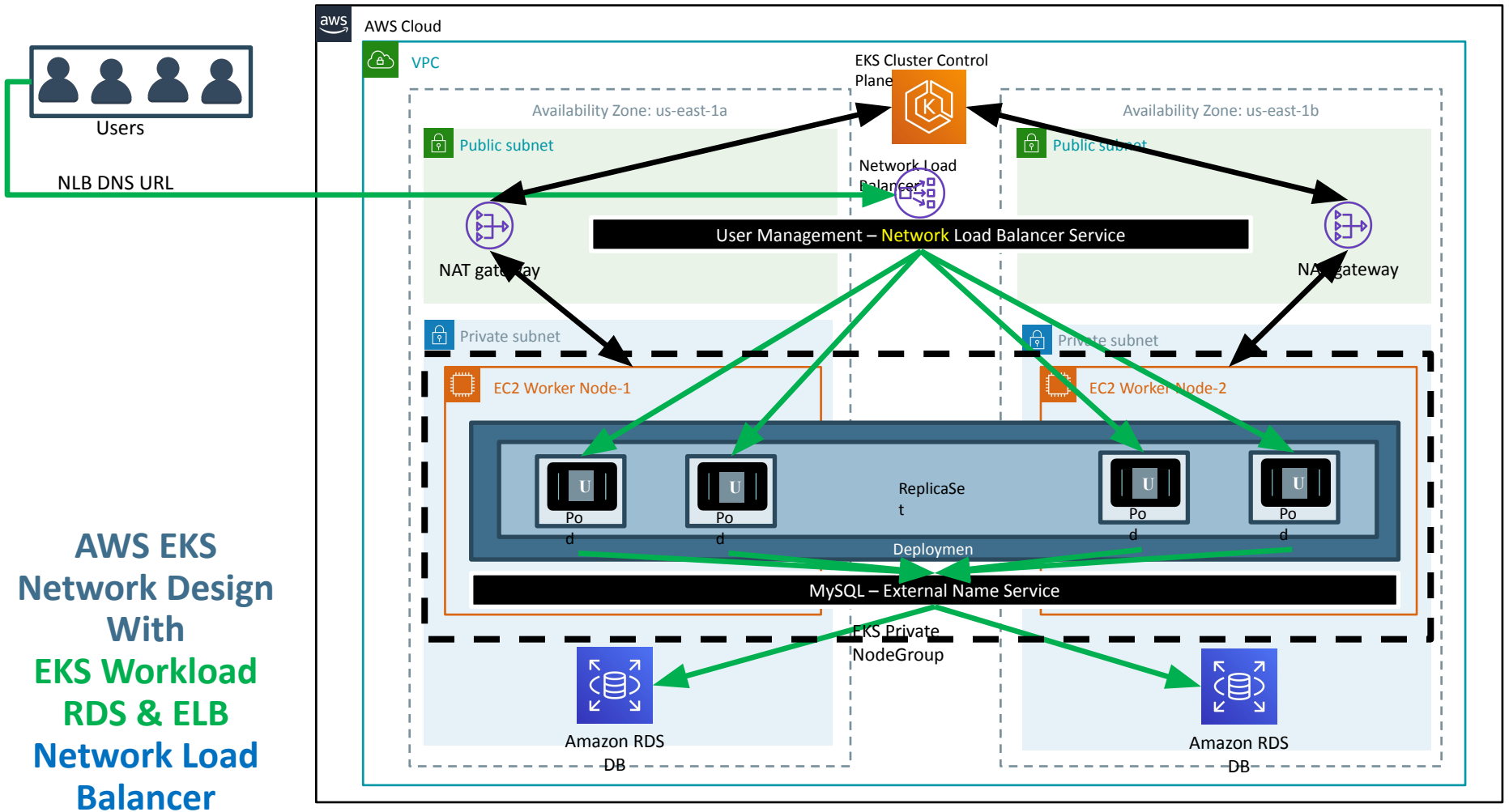
&

RDS & ELB

Network Load Balancer

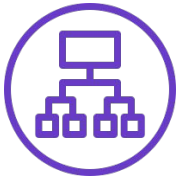


AWS EKS Network Design With EKS Workload RDS & ELB Network Load Balancer

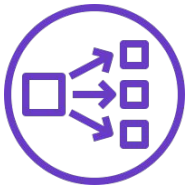


AWS Load Balancer Controller Updates - Start

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

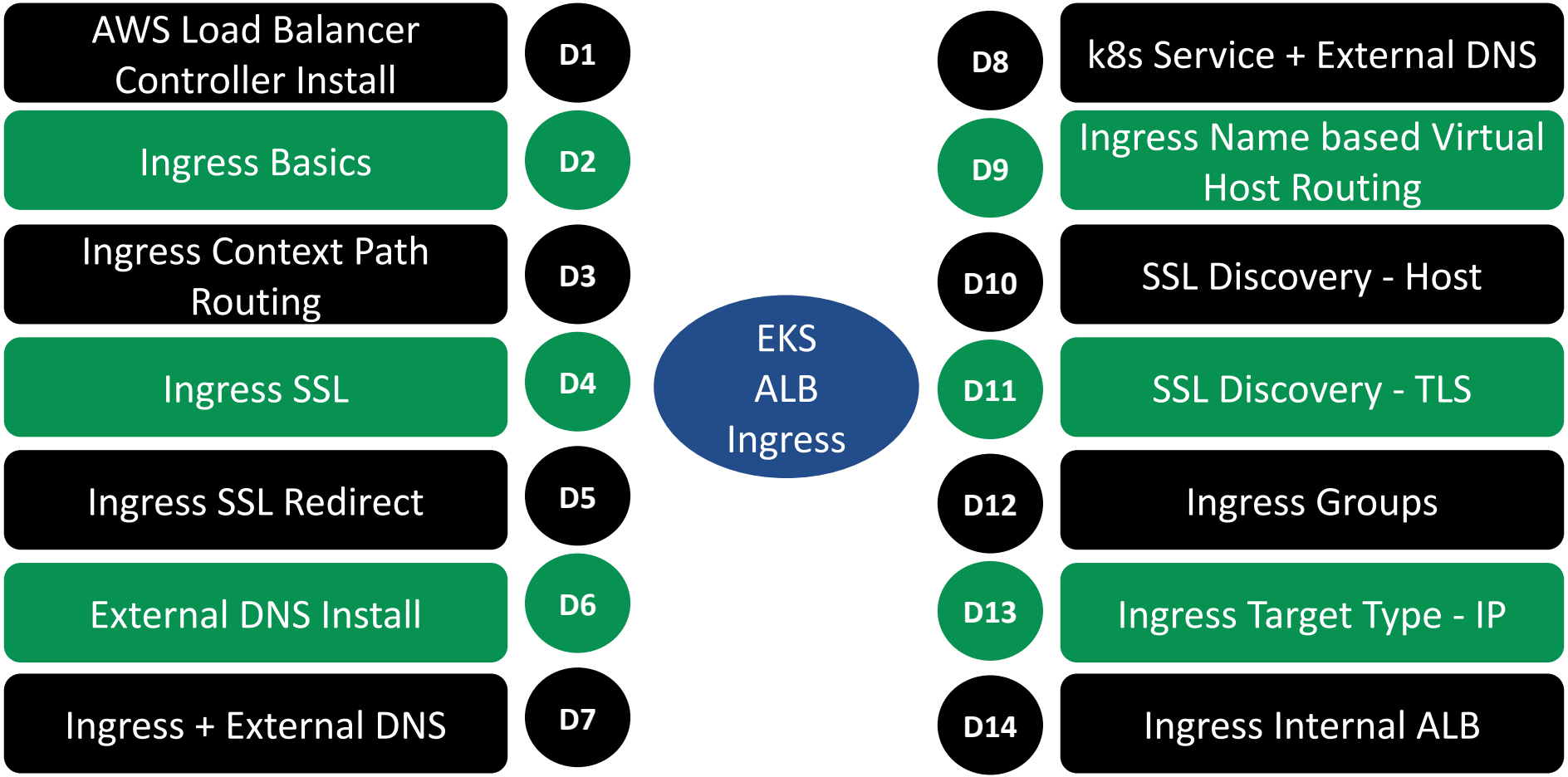
AWS EKS

Load Balancer Controller

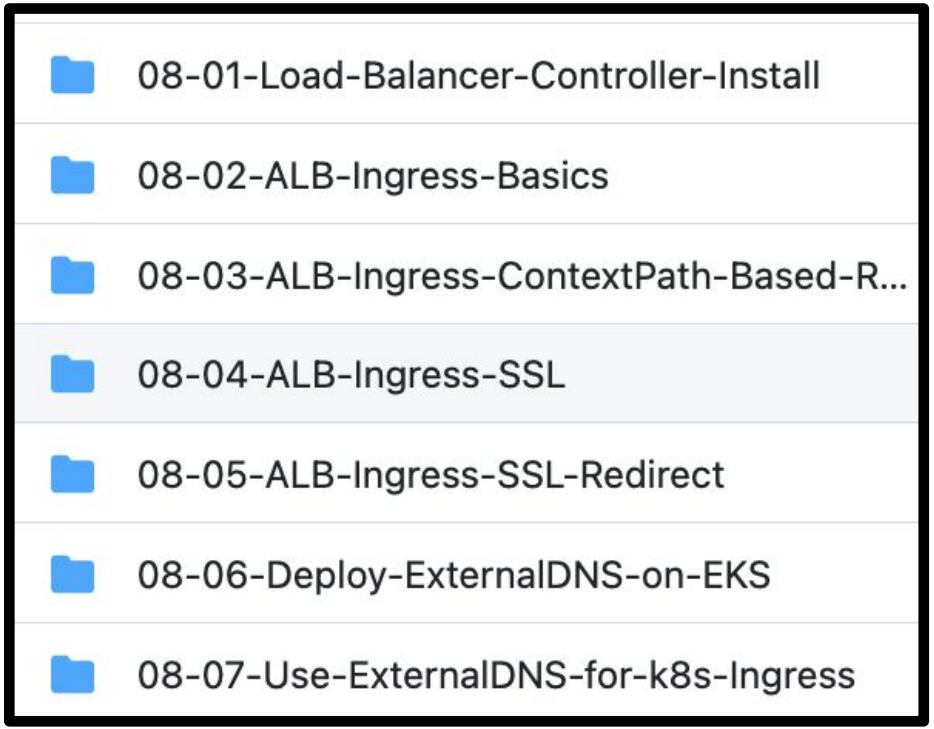
Kubernetes Ingress

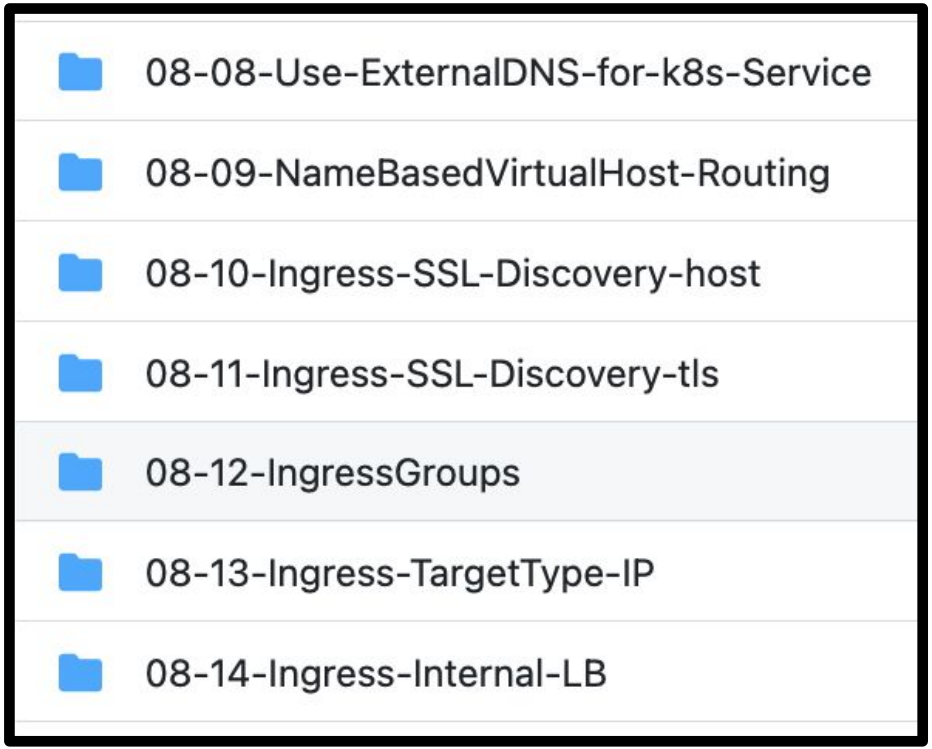
Application Load

14 Demos

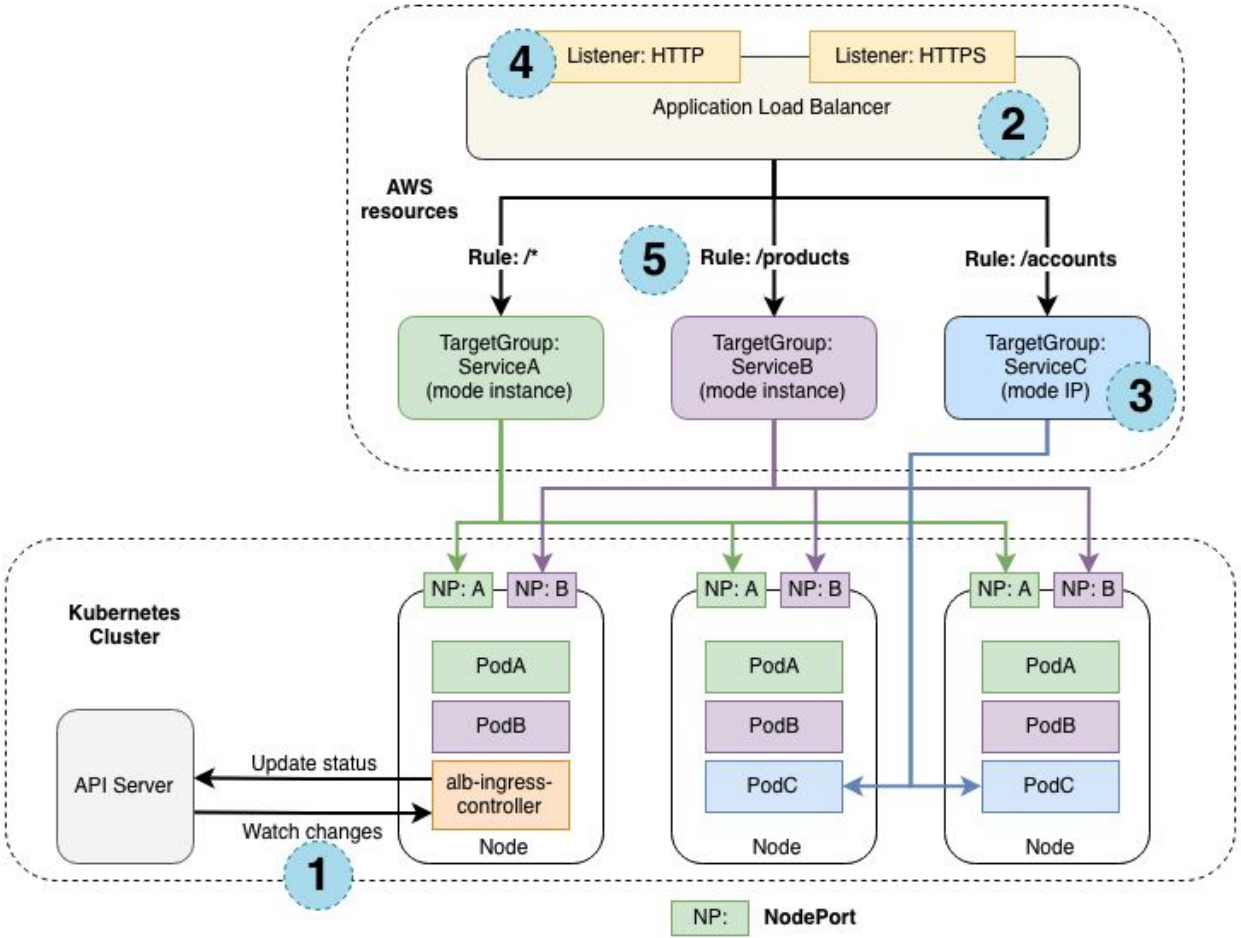

AWS Load Balancer Controller Install
D1
Ingress Basics
D2
Ingress Context Path Routing
D3
Ingress SSL
D4
Ingress SSL Redirect
D5
External DNS Install
D6
Ingress + External DNS
D7
EKS ALB Ingress
D8
k8s Service + External DNS
D9
Ingress Name based Virtual Host Routing
D10
SSL Discovery - Host
D11
SSL Discovery - TLS
D12
Ingress Groups
D13
Ingress Target Type - IP
D14
Ingress Internal ALB

Git Repo:
https://github.com/kascade-training/aws-eks-kubernetes-masterclass/tree/master/08-NEW-ELB-Application-LoadBalancers

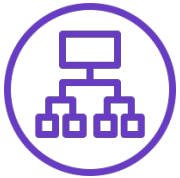




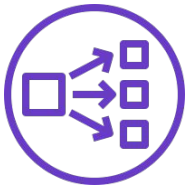
How Ingress Works?



Elastic Load Balancing



Application Load Balancer



Network Load Balancer

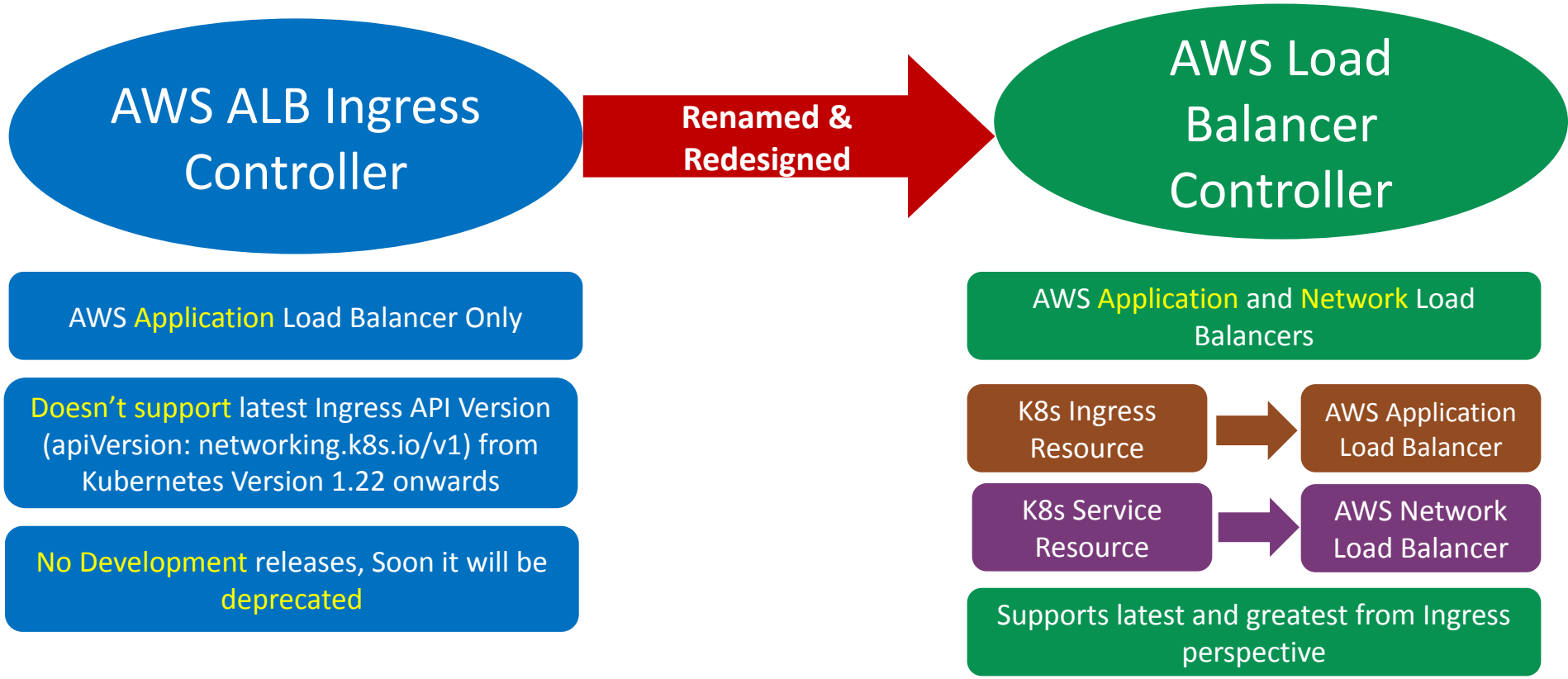
Kubernetes Ingress

AWS EKS

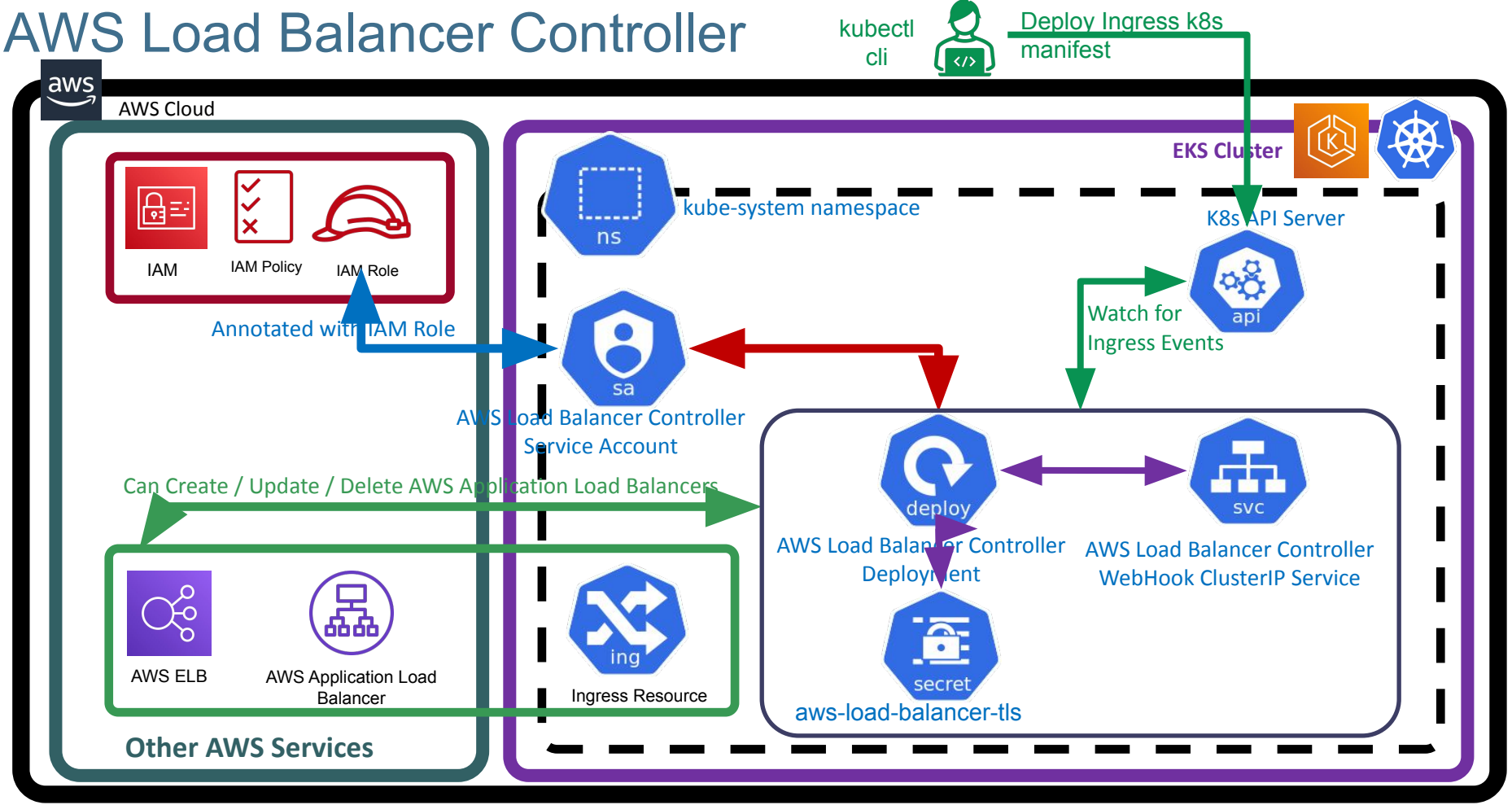
Load Balancer Controller

Install

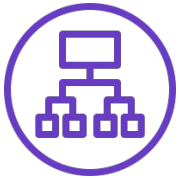
Kubernetes Ingress



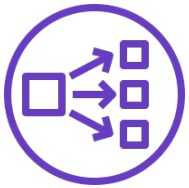
AWS Load Balancer Controller



Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

AWS EKS

Load Balancer Controller

Kubernetes Ingress Class

Kubernetes Ingress Class

AWS EKS ALB Ingress Controller

NGINX Ingress Controller

AKS Application Gateway Ingress Controller

If we have multiple Ingress Controllers running in our Kubernetes cluster, how to identify to which Ingress Controller our Ingress Resource/Service should be associated to ?

Kubernetes Object
Kind: IngressClass

More Ingress Controllers: https://kubernetes.io/docs/concepts/services-networking/ingress-controllers/

Kubernetes Ingress Class

```yaml
apiVersion: networking.k8s.io/v1
kind: IngressClass
metadata:
  name: my-aws-ingress-class
  annotations:
    ingressclass.kubernetes.io/is-default-class: "true"
spec:
  controller: ingress.k8s.aws/alb
```

Ingress Class

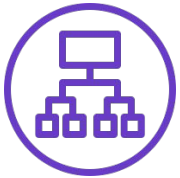
```yaml
apiVersion: networking.k8s.io/v1
kind: IngressClass
metadata:
  name: my-aws-ingress-class
  #annotations:
    #ingressclass.kubernetes.io/is-default-class: "true"
spec:
  controller: ingress.k8s.aws/alb
```

If IngressClass is not defined as is-default-class:true then in Ingress Resource we need to define the spec.ingressClassName in Ingress Resource

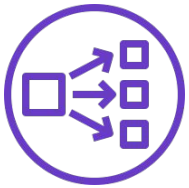
Ingress Resource

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: ingress-nginxapp1
  labels:
    app: app1-nginx
  annotations:
    alb.ingress.kubernetes.io/load-balancer-name: app1ingress
    alb.ingress.kubernetes.io/scheme: internet-facing
spec:
  ingressClassName: my-aws-ingress-class # Ingress Class
  defaultBackend:
    service:
      name: app1-nginx-nodeport-service
      port:
        number: 80
```

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

AWS EKS

Load Balancer Controller

Kubernetes Ingress Basics

Ingress Manifest – Key Items

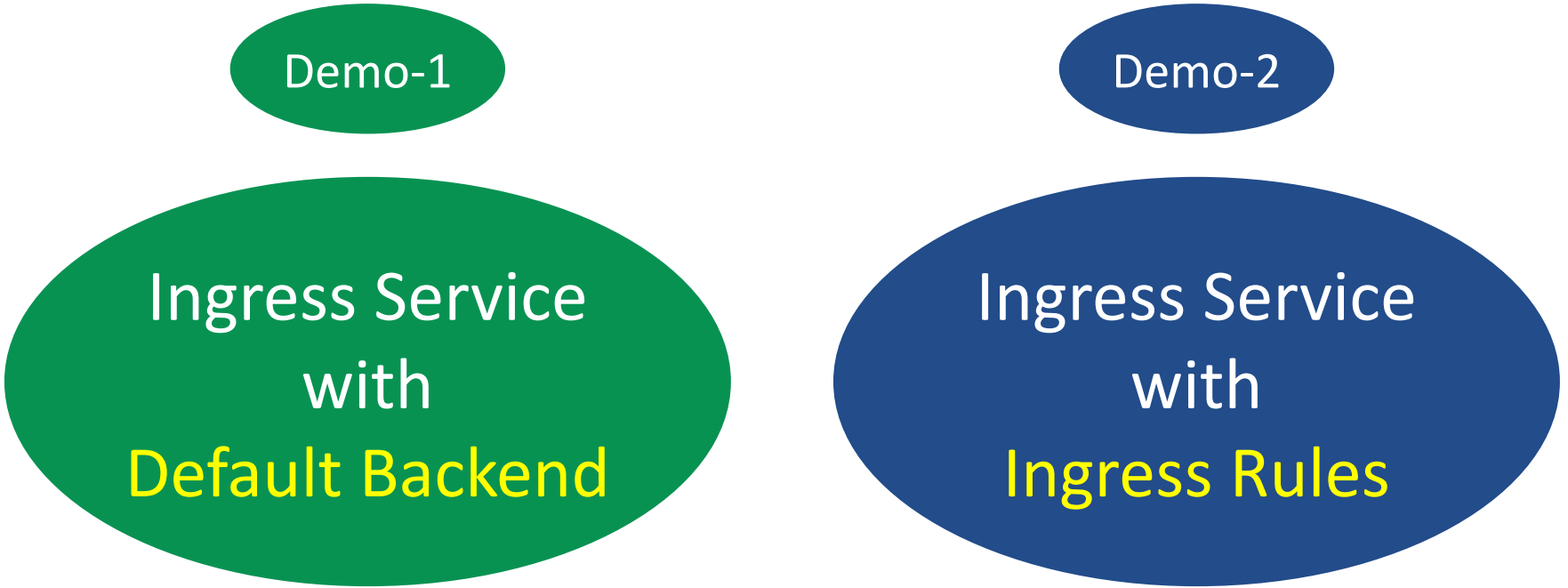
Ingress Annotations
(Load Balancer Settings)

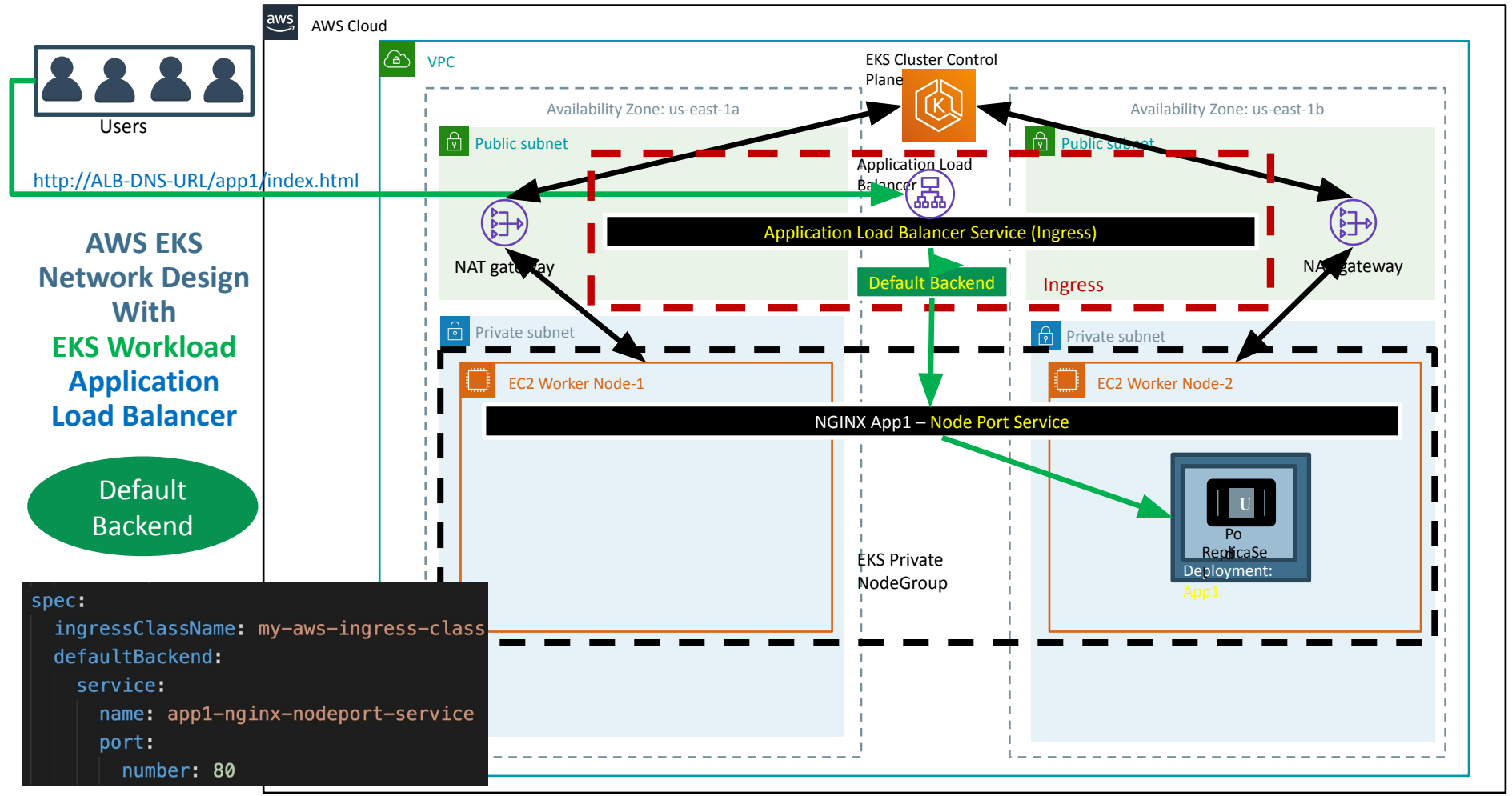
Ingress Spec
Ingress Class Name
(Which Ingress Controller to use)

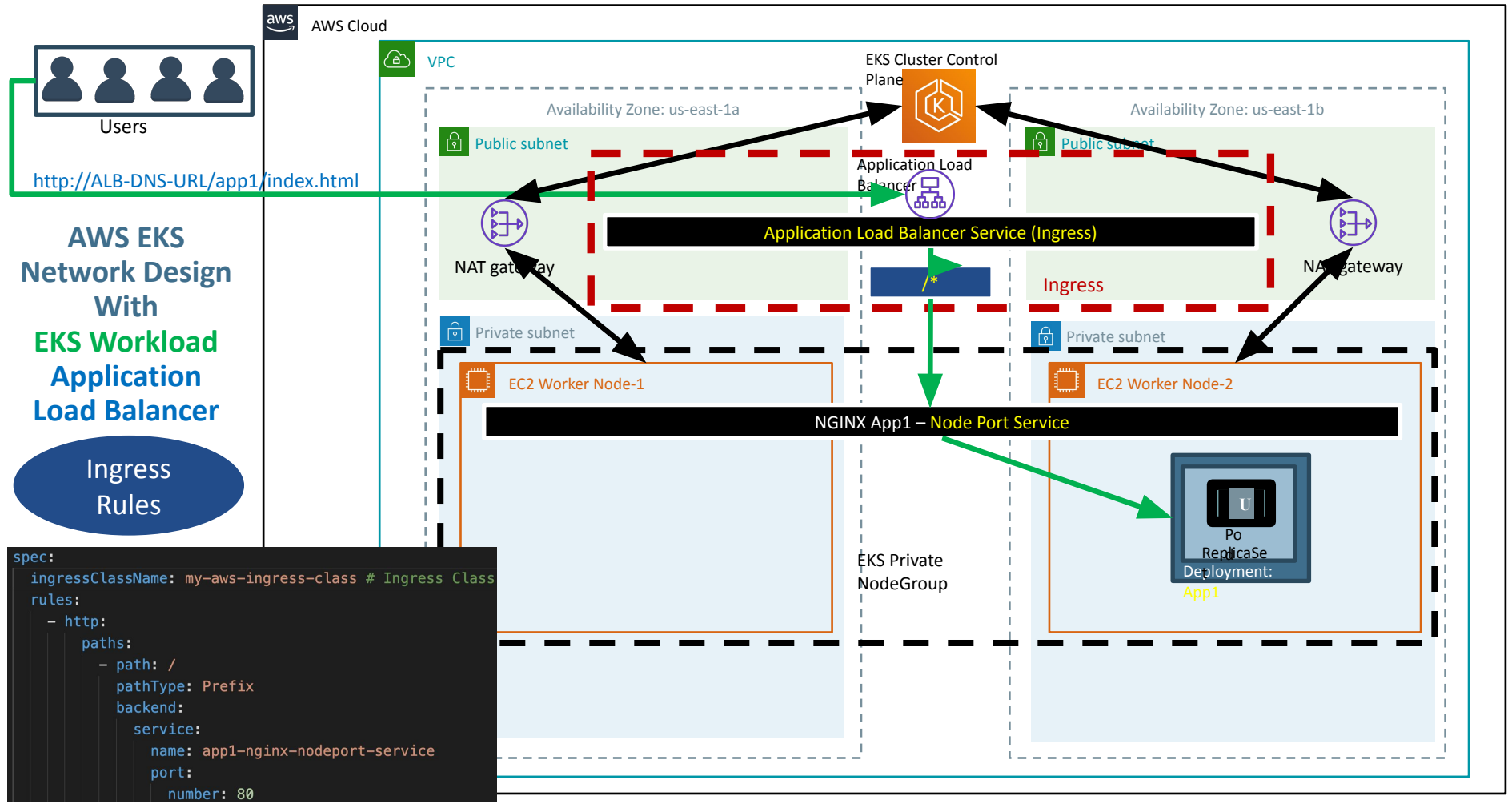
Ingress Spec
(Define Ingress Routing Rules, Default Backend)

Annotations Reference:
https://kubernetes-sigs.github.io/aws-load-balancer-controller/v2.3/guide/ingress/annotations/#annotations

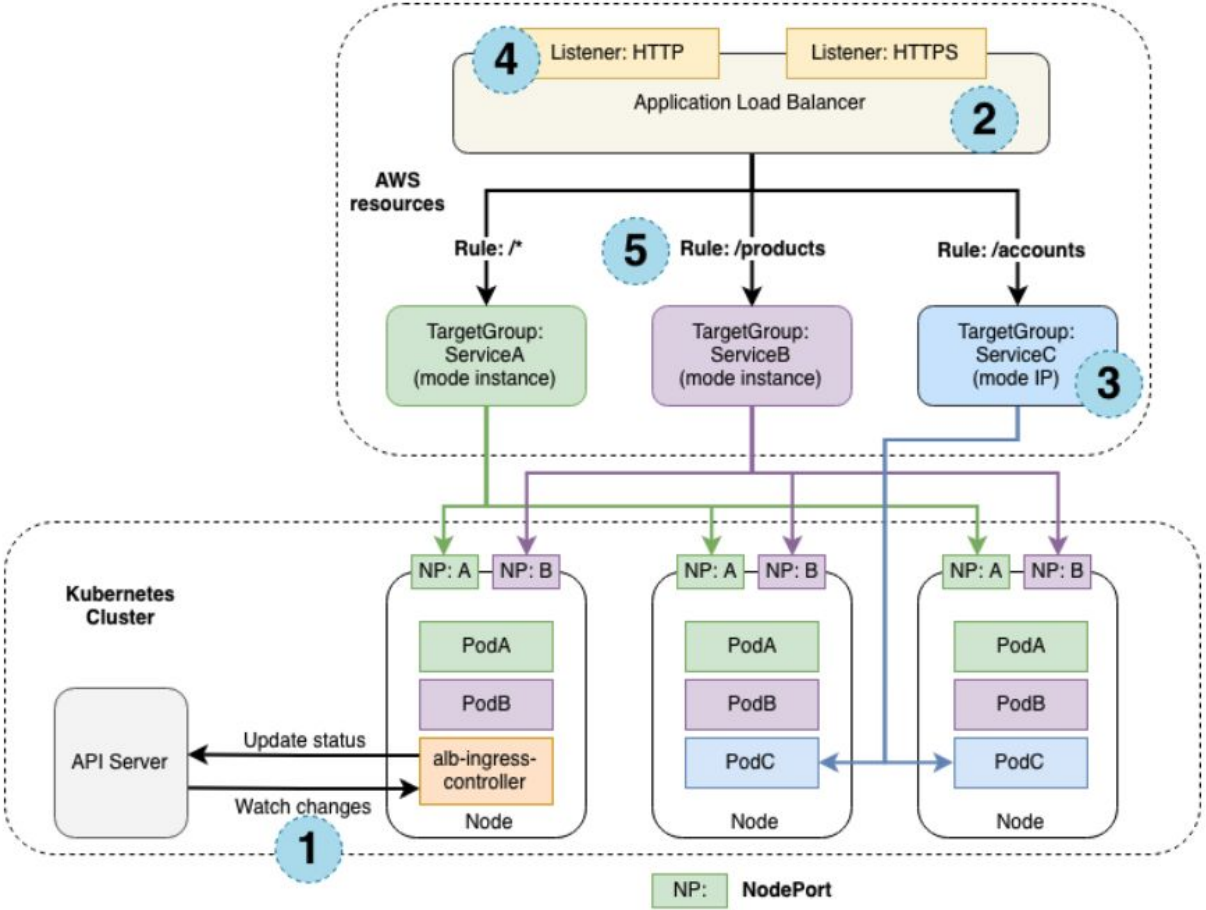
Two Ingress Basic Demos




AWS Cloud
VPC
Users
http://ALB-DNS-URL/app1/index.html
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Application Load Balancer
Application Load Balancer Service (Ingress)
NAT gateway
NAT gateway
Default Backend
Ingress
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
NGINX App1 – Node Port Service
EKS Private NodeGroup
Deployment:
App1
AWS EKS Network Design With EKS Workload Application Load Balancer
Default Backend
spec:
ingressClassName: my-aws-ingress-class
defaultBackend:
service:
name: app1-nginx-nodeport-service
port:
number: 80




```yaml
spec:
  ingressClassName: my-aws-ingress-class # Ingress Class
  rules:
    - http:
        paths:
          - path: /
            pathType: Prefix
            backend:
              service:
                name: app1-nginx-nodeport-service
                port:
                  number: 80
```

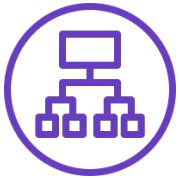


How AWS Load Balancer controller works?

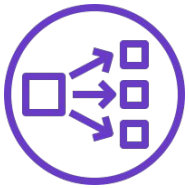
- Three Apps: A, B, C
- 3 Worker Nodes, 3 Pods per App
- ALB Context Path Routing
- Node Port Service
- Traffic Mode: Instance, IP
- ALB Ingress Controller watch for Events from k8s API Server

Reference: https://kubernetes-sigs.github.io/aws-load-balancer-controller/v2.3/how-it-works/

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

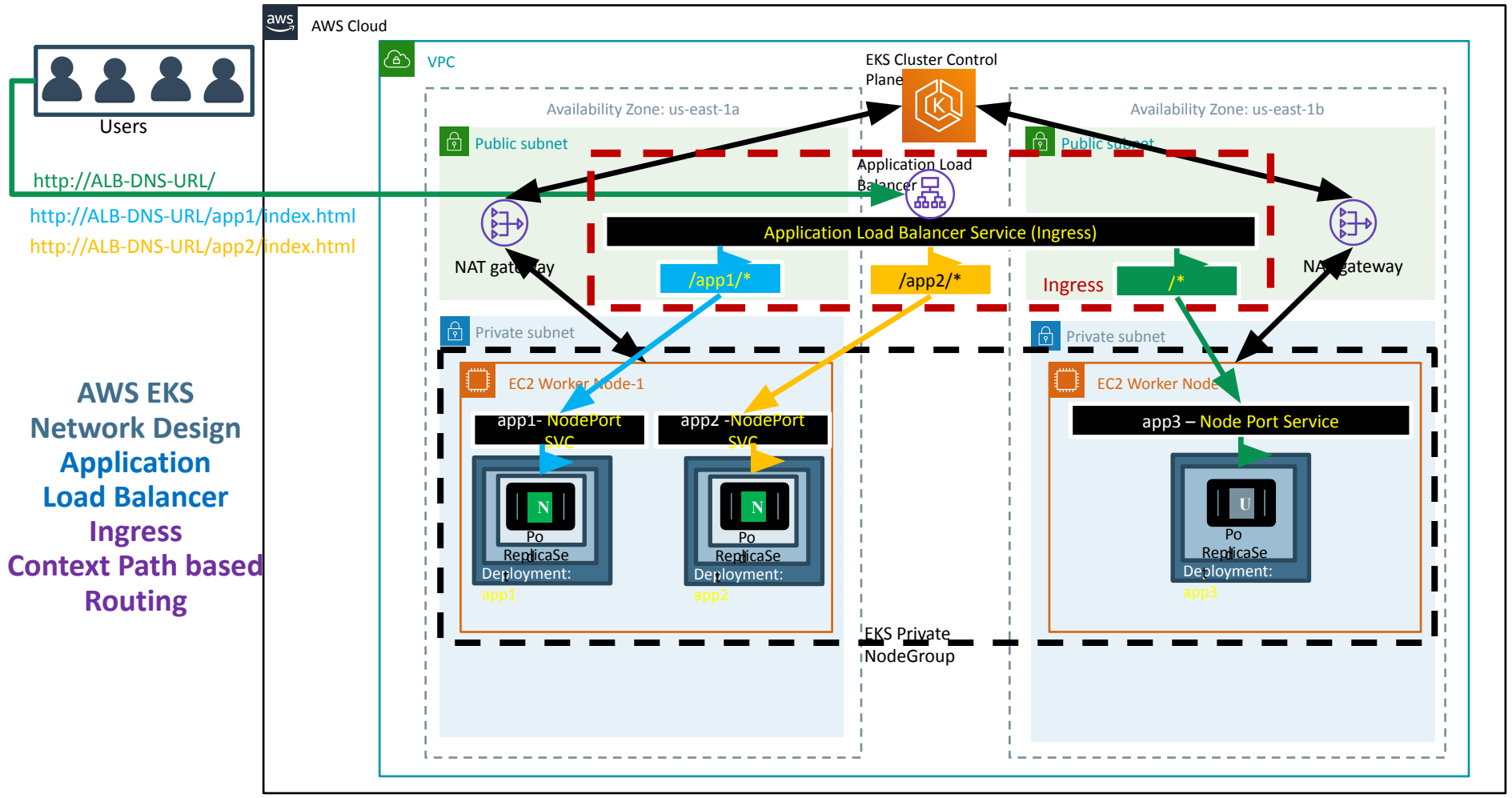
Kubernetes Ingress

AWS EKS

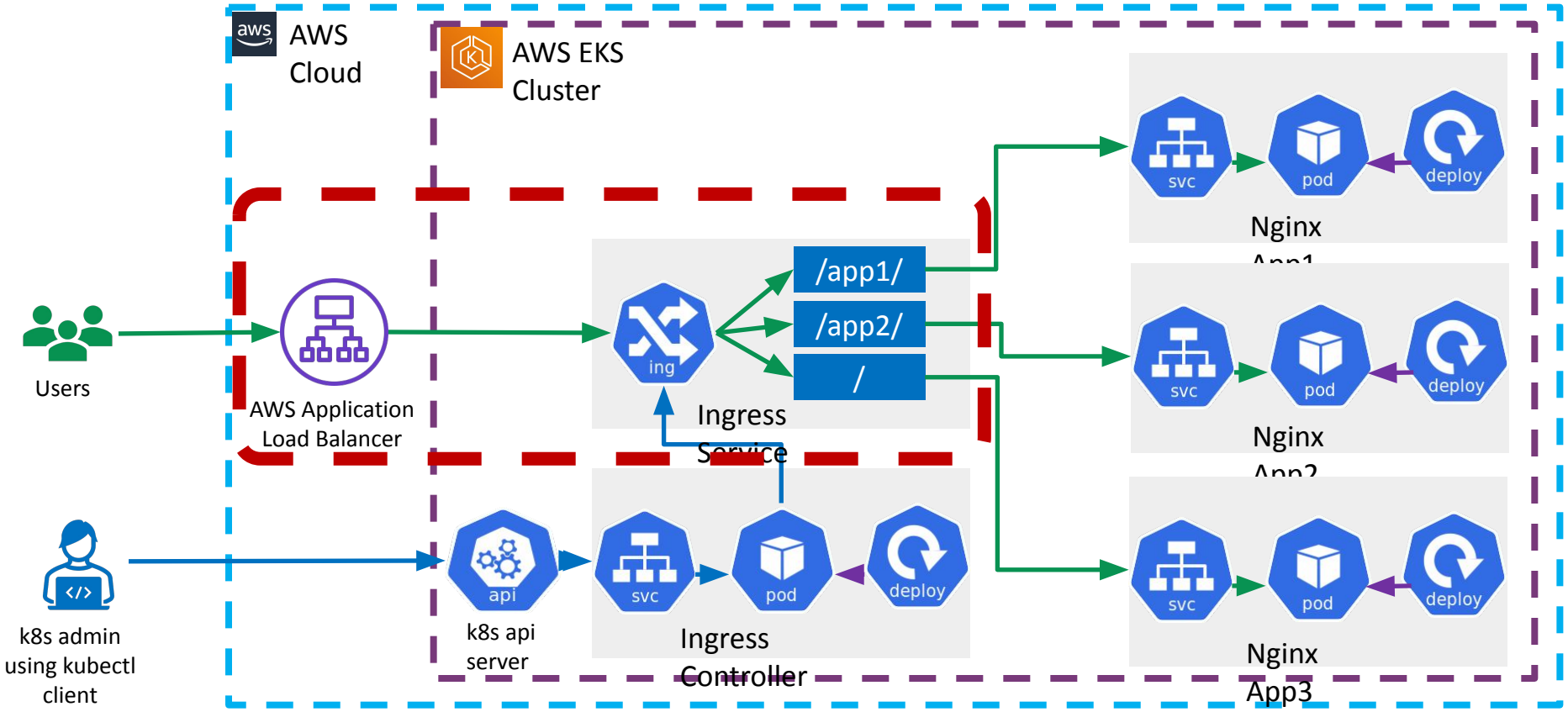
Load Balancer Controller

Kubernetes Ingress

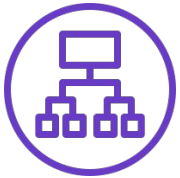
Context Path based Routing


AWS Cloud
VPC
Users
http://ALB-DNS-URL/
http://ALB-DNS-URL/app1/index.html
http://ALB-DNS-URL/app2/index.html
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Application Load Balancer
Application Load Balancer Service (Ingress)
NAT gateway
/app1/*
/app2/*
Ingress
/*
Private subnet
EC2 Worker Node-1
app1- NodePort SVC
app2 -NodePort SVC
app3 – Node Port Service
Deployment:
app1
app2
app3
EKS Private NodeGroup
AWS EKS
Network Design
Application
Load Balancer
Ingress
Context Path based
Routing

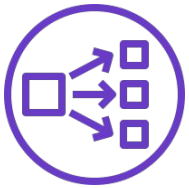
AWS EKS ALB Ingress – Context Path Based Routing



Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

AWS EKS

Load Balancer Controller

Kubernetes Ingress

SSL

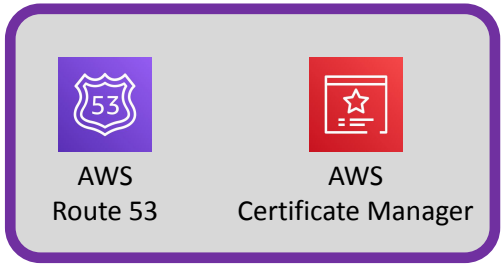
ALB Ingress SSL

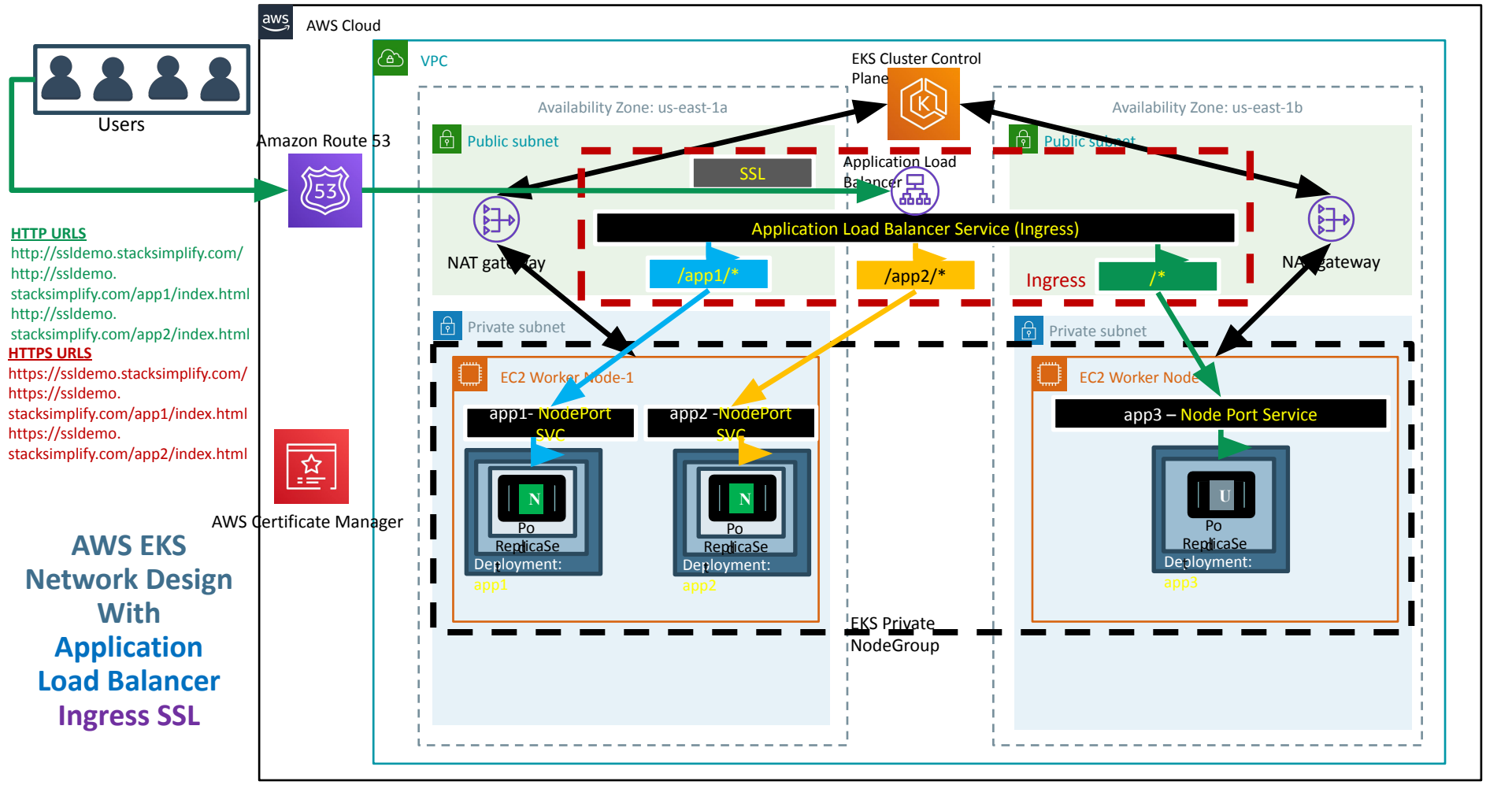
Task-1: Register AWS Route53 DNS Domain

Task-2: Create SSL Certificate in AWS Certificate Manager

Task-3: Update SSL Annotations in Ingress Service

Task-4: Deploy k8s manifests and Test




AWS Cloud
VPC
Users
Amazon Route 53
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
SSL
Application Load Balancer
Application Load Balancer Service (Ingress)
NAT gateway
NAT gateway
/app1/*
/app2/*
Ingress
/*
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node
app1- NodePort SVC
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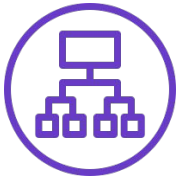
app3 – Node Port Service
Deployment:
app1
Deployment:
app2
Deployment:
app3
EKS Private NodeGroup
HTTP URLS
http://ssldemo.stacksimplify.com/
http://ssldemo.stacksimplify.com/app1/index.html
http://ssldemo.stacksimplify.com/app2/index.html
HTTPS URLS
https://ssldemo.stacksimplify.com/
https://ssldemo.stacksimplify.com/app1/index.html
https://ssldemo.stacksimplify.com/app2/index.html
AWS Certificate Manager
AWS EKS Network Design With Application Load Balancer Ingress SSL

Register a Domain using AWS Route53

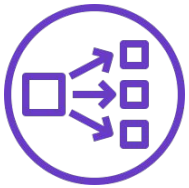
stacksimplify.com is already a registered domain used for our websites

We are going to use Domain named kubeoncloud.com to register a new domain using AWS Route53

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

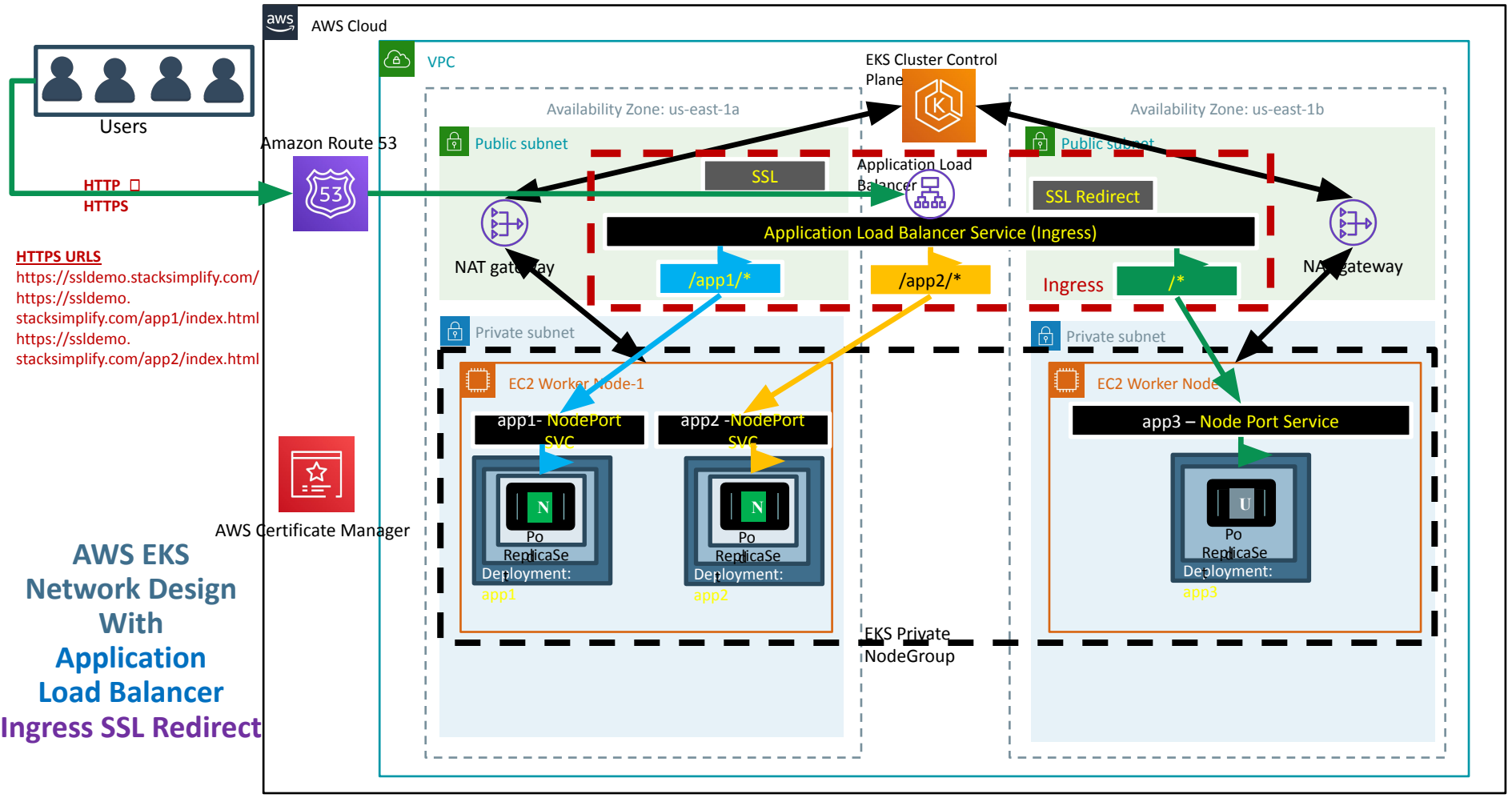
Kubernetes Ingress

AWS EKS

Load Balancer Controller

Kubernetes Ingress

SSL Redirect


AWS Cloud
VPC
Users
HTTP
HTTPS
Amazon Route 53
EKS Cluster Control Plane
Availability Zone: us-east-1a
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Public subnet
Public subnet
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Application Load Balancer
SSL Redirect
Application Load Balancer Service (Ingress)
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/*
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EC2 Worker Node-1
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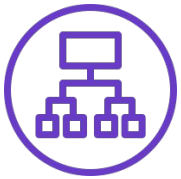
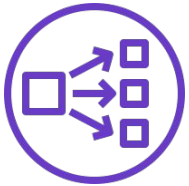
Deployment:
app1
Deployment:
app2
Deployment:
app3
EKS Private NodeGroup
AWS Certificate Manager
HTTPS URLS
https://ssldemo.stacksimplify.com/
https://ssldemo.stacksimplify.com/app1/index.html
https://ssldemo.stacksimplify.com/app2/index.html
AWS EKS Network Design With Application Load Balancer Ingress SSL Redirect

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

External DNS

AWS EKS

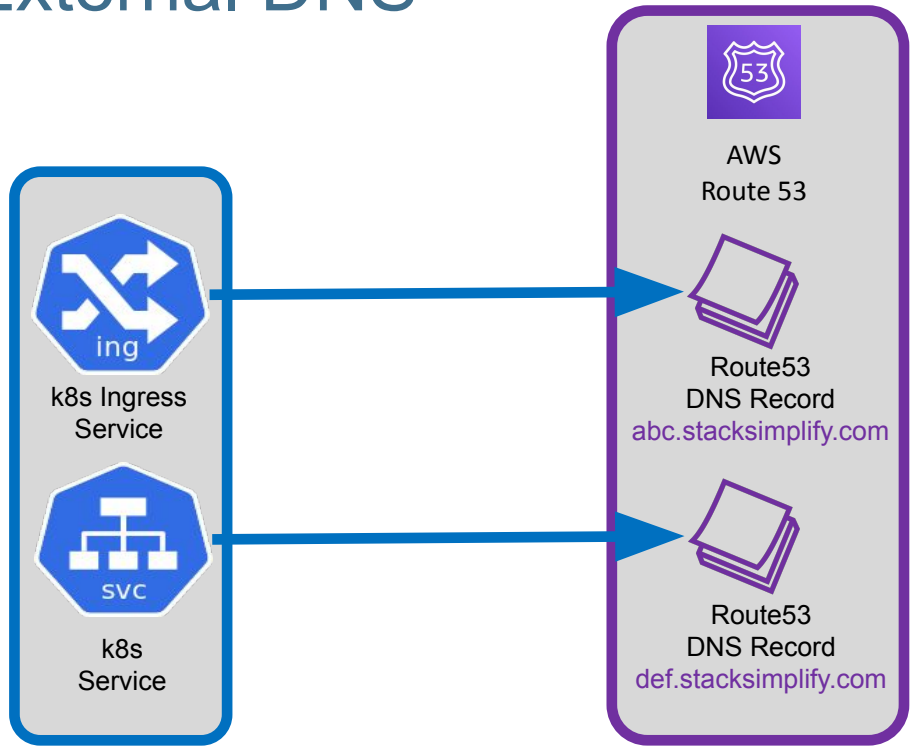
Load Balancer Controller

External DNS Install

Kubernetes External DNS

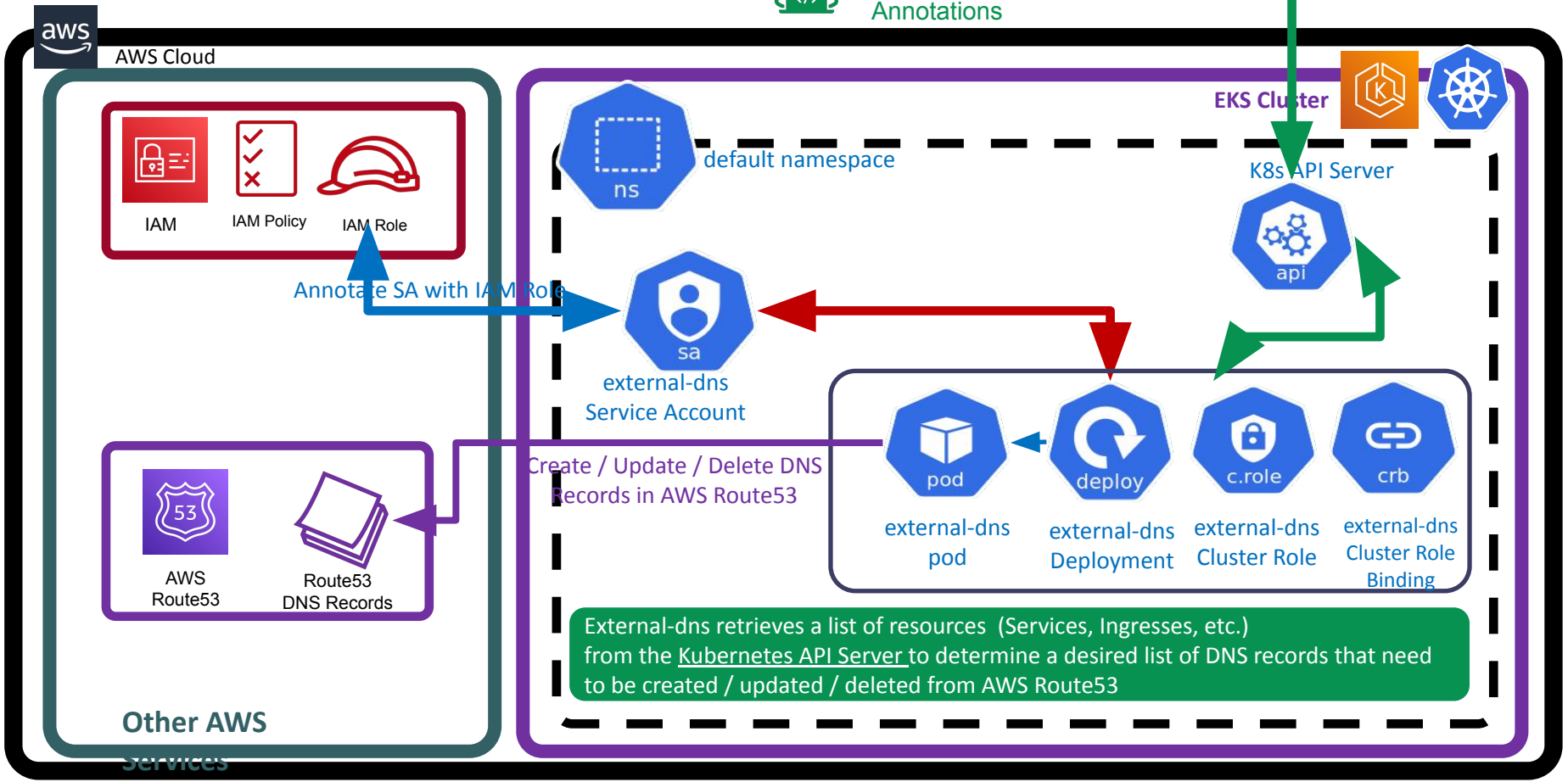
In previous SSL Demos, we added AWS Route53 DNS Record manually (ssldemo101.stacksimplify.com)

With External DNS we can automatically add it for a Kubernetes Ingress Service or Kubernetes Service by defining it as Annotation

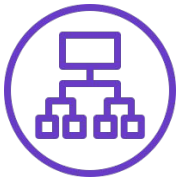



```
# External DNS - For creating a Record Set in Route53
external-dns.alpha.kubernetes.io/hostname: dnstest901.stacksimplify.com
```

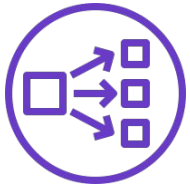
AWS EKS + External DNS



Elastic Load Balancing



Application Load Balancer



Network Load Balancer

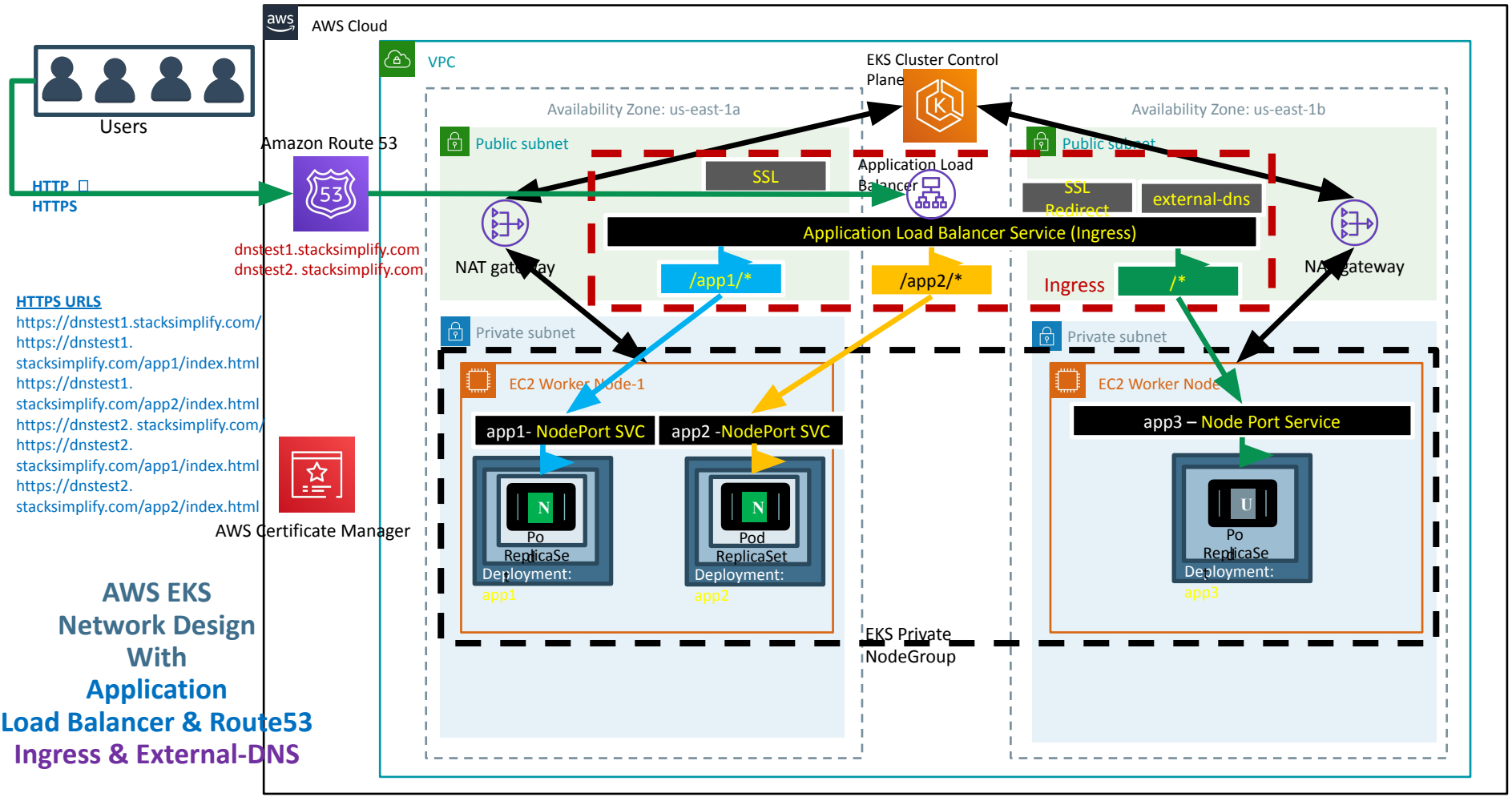
Kubernetes Ingress

External DNS

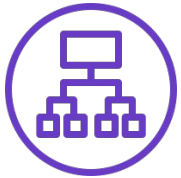
AWS EKS

Load Balancer Controller

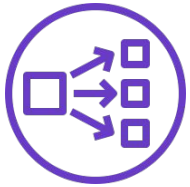
Kubernetes Ingress & External DNS


AWS Cloud
VPC
Users
HTTP
HTTPS
Amazon Route 53
dnstest1.stacksimplify.com
dnstest2. stacksimplify.com
HTTPS URLS
https://dnstest1.stacksimplify.com/
https://dnstest1.
stacksimplify.com/app1/index.html
https://dnstest1.
stacksimplify.com/app2/index.html
https://dnstest2. stacksimplify.com/
https://dnstest2.
stacksimplify.com/app1/index.html
https://dnstest2.
stacksimplify.com/app2/index.html
AWS Certificate Manager
EKS Cluster Control Plane
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
SSL
Application Load Balancer
SSL Redirect
external-dns
Application Load Balancer Service (Ingress)
NAT gateway
NAT gateway
/app1/*
/app2/*
Ingress
/*
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node
app1- NodePort SVC
app2 -NodePort SVC
app3 – Node Port Service
Pod
ReplicaSet
Deployment:
app1
Pod
ReplicaSet
Deployment:
app2
Pod
ReplicaSet
Deployment:
app3
EKS Private NodeGroup
AWS EKS Network Design With Application Load Balancer & Route53 Ingress & External-DNS

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

External DNS

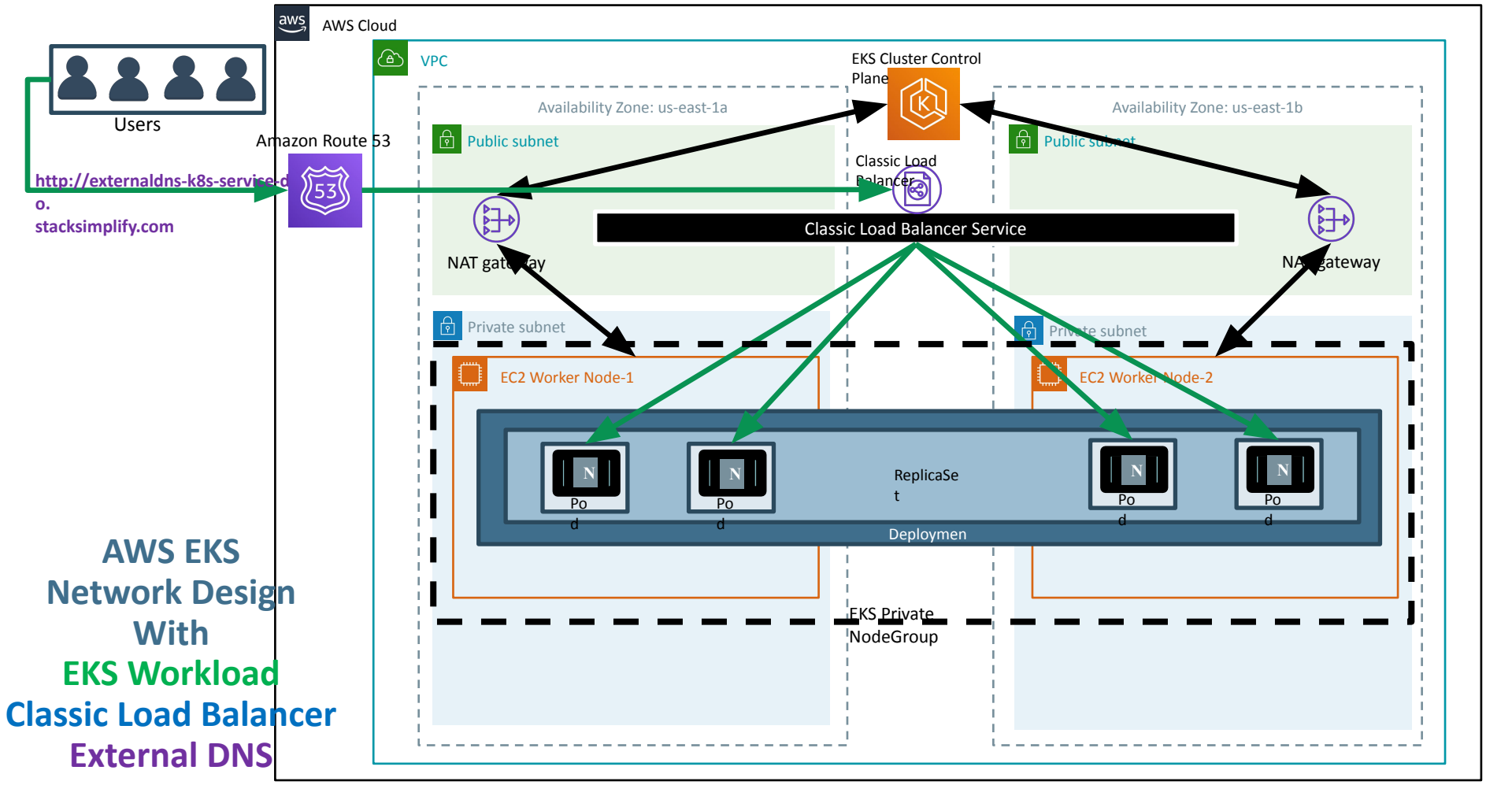
AWS EKS

Load Balancer Controller

Kubernetes Service & External DNS

Kubernetes Service with External DNS

```yaml
apiVersion: v1
kind: Service
metadata:
  name: app1-nginx-loadbalancer-service
  labels:
    app: app1-nginx
  annotations:
    external-dns.alpha.kubernetes.io/hostname: externaldns-k8s-service-demo.stacksimplify.
spec:
  type: LoadBalancer
  selector:
    app: app1-nginx
  ports:
    - port: 80
      targetPort: 80
```


AWS Cloud
VPC
EKS Cluster Control Plane
Users
Amazon Route 53
http://externaldns-k8s-service-d
o.
stacksimplify.com
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Classic Load Balancer
Classic Load Balancer Service
NAT gateway
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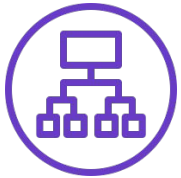
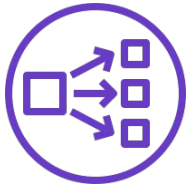
EKS Private NodeGroup
AWS EKS
Network Design
With
EKS Workload
Classic Load Balancer
External DNS

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

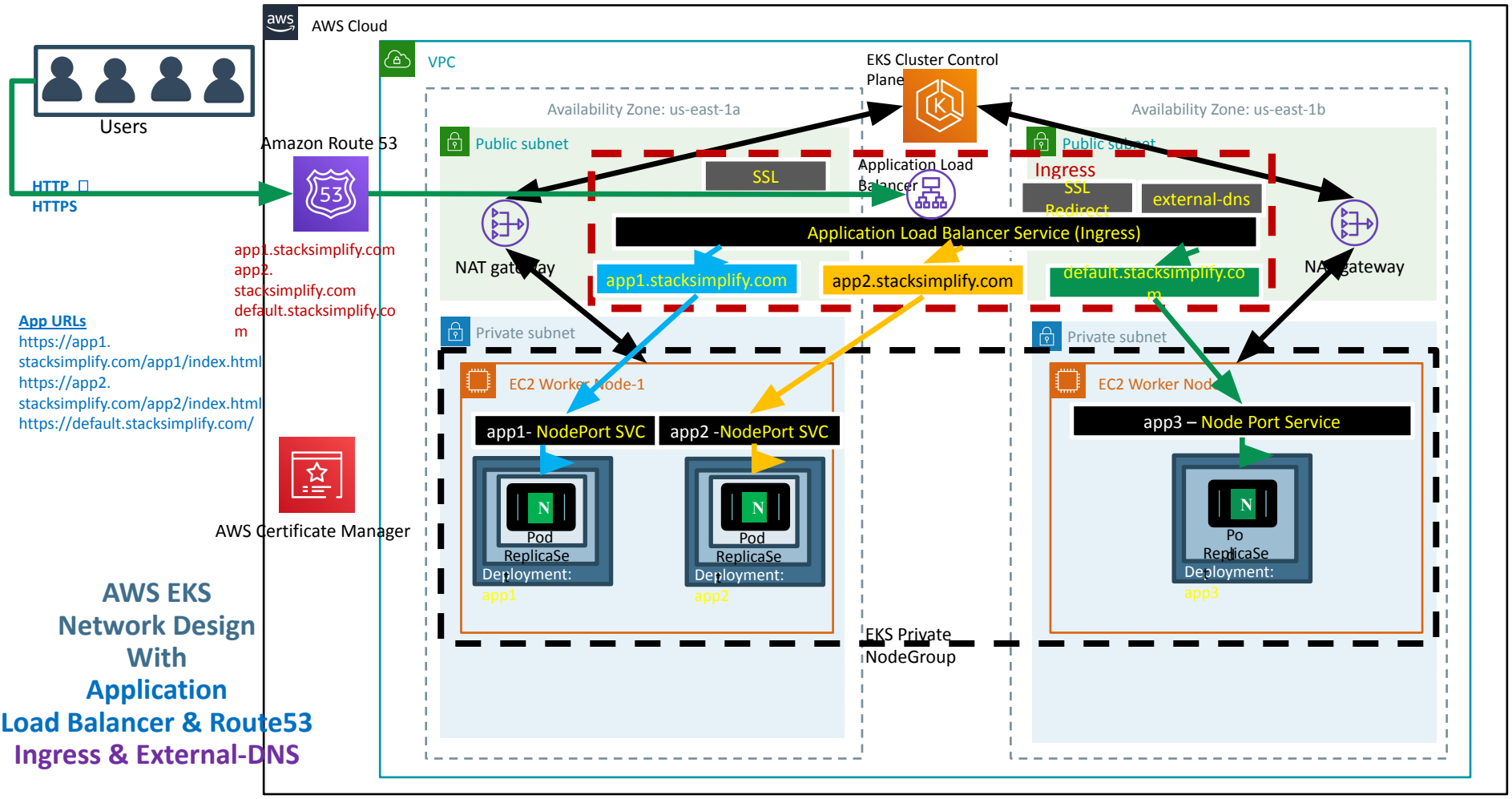
External DNS

AWS EKS

Load Balancer Controller

Kubernetes Ingress

Name based Virtual Host / Host Header Routing


AWS Cloud
VPC
Users
HTTP
HTTPS
Amazon Route 53
app1.stacksimplify.com
app2.
stacksimplify.com
default.stacksimplify.com
App URLs
https://app1.
stacksimplify.com/app1/index.html
https://app2.
stacksimplify.com/app2/index.html
https://default.stacksimplify.com/
AWS Certificate Manager
EKS Cluster Control Plane
Availability Zone: us-east-1a
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Pod
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app1
Pod
ReplicaSe
Deployment:
app2
Po
Replicase
Deployment:
app3
EKS Private NodeGroup
AWS EKS
Network Design
With
Application
Load Balancer & Route53
Ingress & External-DNS

Name based Virtual Host Routing

```
rules:
  - host: app101.stacksimplify.com
    http:
      paths:
        - path: /
          pathType: Prefix
          backend:
            service:
              name: app1-nginx-nodeport-service
              port:
                number: 80
  - host: app201.stacksimplify.com
    http:
      paths:
        - path: /
          pathType: Prefix
          backend:
            service:
              name: app2-nginx-nodeport-service
              port:
                number: 80
```

Requests with app101.stacksimplify.com will go to App1 Node Port Service

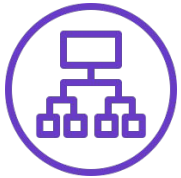
Requests with app201.stacksimplify.com will go to App2 Node Port Service

Named based Virtual Host Routing

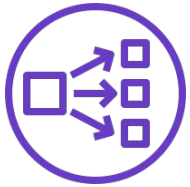
```
    # External DNS - For creating a Record Set in Route53
    external-dns.alpha.kubernetes.io/hostname: default101.stacksimplify.com
spec:
  ingressClassName: my-aws-ingress-class   # Ingress Class
  defaultBackend:
    service:
      name: app3-nginx-nodeport-service
      port:
        number: 80
```

Requests with default101.stacksimplify.com will go to App3 Node Port Service (Default Backend)

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

External DNS

AWS EKS

Load Balancer Controller

Kubernetes Ingress

SSL Discovery – Host & TLS

Ingress SSL Certificate Discovery using Host

```yaml
rules:
  - host: app101.stacksimplify.com
    http:
      paths:
        - path: /
          pathType: Prefix
          backend:
            service:
              name: app1-nginx-nodeport-service
              port:
                number: 80
  - host: app201.stacksimplify.com
    http:
      paths:
        - path: /
          pathType: Prefix
          backend:
            service:
              name: app2-nginx-nodeport-service
              port:
                number: 80
```

Demo-1: SSL Discovery – Host

TLS certificates for ALB Listeners can be automatically discovered with hostnames from Ingress resources if the alb.ingress.kubernetes.io/certificate-arn annotation is not specified.

The controller will attempt to discover TLS certificates from the tls field in Ingress and host field in Ingress rules.

Important Note: You need to explicitly specify to use HTTPS listener with listen-ports annotation.
alb.ingress.kubernetes.io/listen-ports: '[{"HTTPS":443}]'

Ingress SSL Certificate Discovery using tls

```
    # External DNS - For creating a Record Set in Route53
    external-dns.alpha.kubernetes.io/hostname: certdiscovery-tls-901.stacksimplify.com
spec:
  ingressClassName: my-aws-ingress-class   # Ingress Class
  defaultBackend:
    service:
      name: app3-nginx-nodeport-service
      port:
        number: 80
  tls:
  - hosts:
    - "*.stacksimplify.com"
  rules:
    - http:
        paths:
          - path: /app1
            pathType: Prefix
            backend:
              service:
                name: app1-nginx-nodeport-service
```

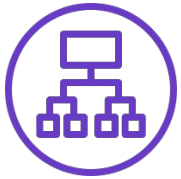
Demo-2: SSL Discovery – tls

Comment certificate-arn Annotation

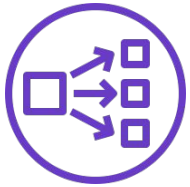
Comment alb.ingress.kubernetes.io/certificate-arn Annotation when using host / tls options

```
## SSL Settings
alb.ingress.kubernetes.io/listen-ports: '[{"HTTPS":443}, {"HTTP":80}]'
#alb.ingress.kubernetes.io/certificate-arn: arn:aws:acm:us-east-1:180789647333:certificate/632a3ff6-3f6d-464c-9121-b9d97481a76b
#alb.ingress.kubernetes.io/ssl-policy: ELBSecurityPolicy-TLS-1-1-2017-01 #Optional (Picks default if not used)
# SSL Redirect Setting
alb.ingress.kubernetes.io/ssl-redirect: '443'
```

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

External DNS

AWS EKS

Load Balancer Controller

Kubernetes Ingress

Ingress Groups

Without Ingress Groups

Single Ingress Resource for all three Apps

Any changes to App3 we need to update the "my-apps" ingress resource

Example: If we have 50 apps which needs different rules in them and all should be part of single ALB, maintaining such huge k8s manifest file with configs becomes tedious and confusing.

Ingress Resource: my-apps

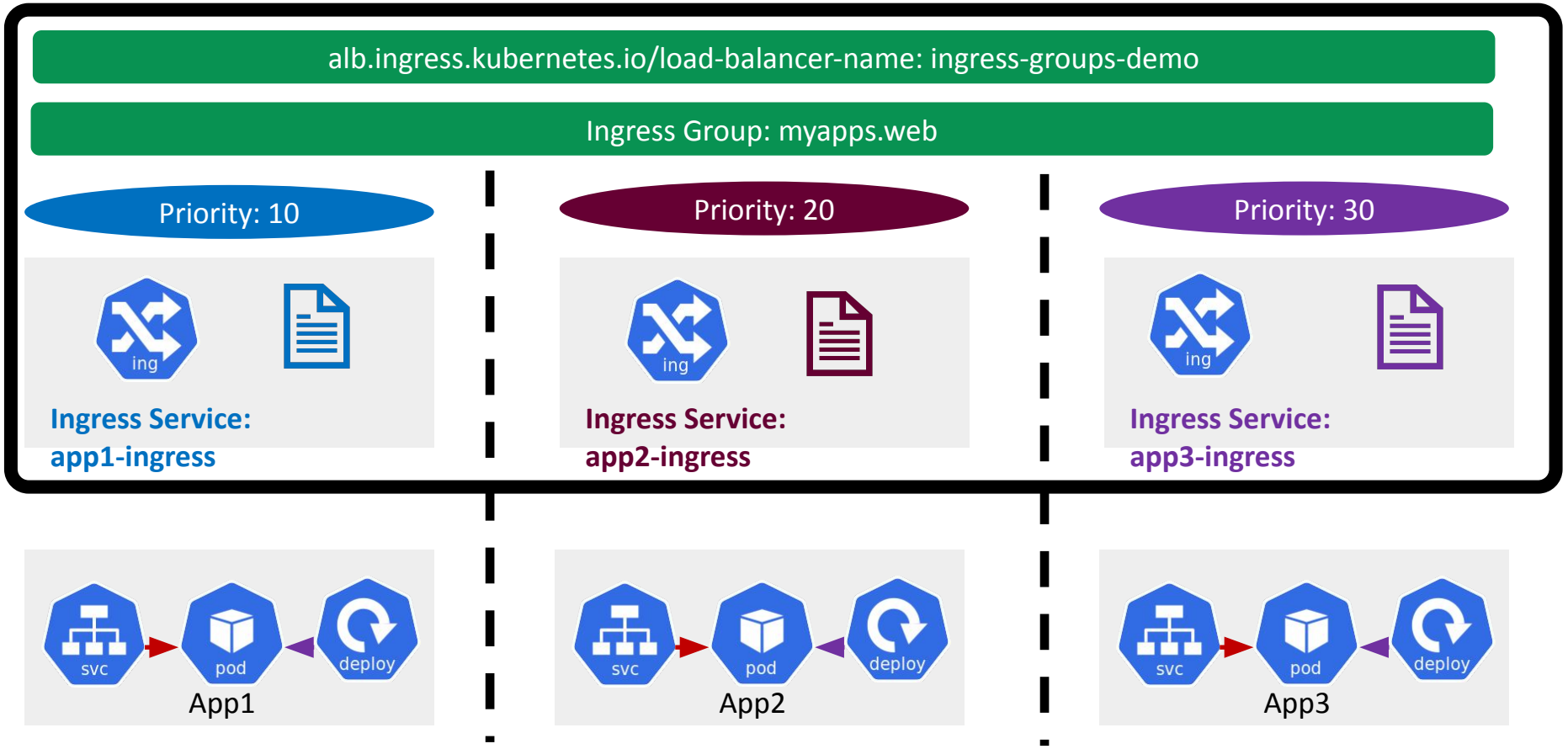
With Ingress Groups we can simplify our Kubernetes Ingress Manifest when dealing with multiple apps requiring single ALB

App1

App2

App3

With Ingress Groups



Ingress Groups

1

IngressGroup feature enables you to group multiple Ingress resources together.

2

The controller will automatically merge Ingress rules for all Ingresses within IngressGroup and support them with a single ALB.

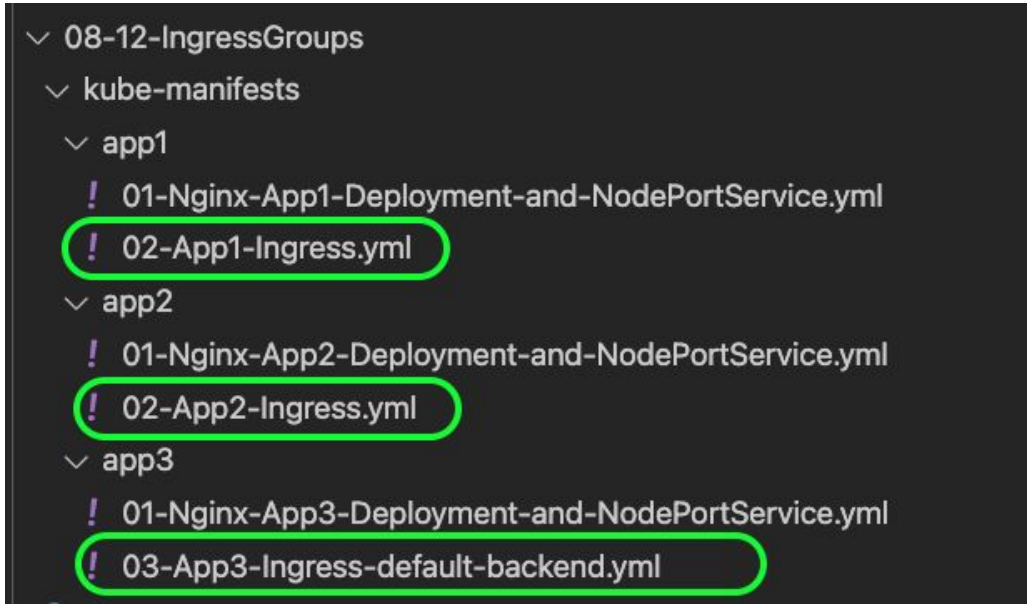
3

VERY VERY IMPORTANT NOTE: In addition, most annotations defined on an Ingress only applies to the paths defined by that Ingress.

Sample

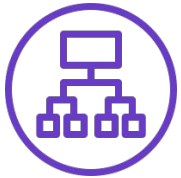
```
# Ingress Groups
alb.ingress.kubernetes.io/group.name: myapps.web
alb.ingress.kubernetes.io/group.order: '10'
```

Ingress Groups

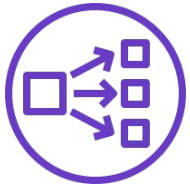


3 Ingress Kubernetes Manifests creates 3 Ingress Resources and merge to create a Single AWS ALB.

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

External DNS

AWS EKS

Load Balancer Controller

Kubernetes Ingress

Target Type: IP

ALB Ingress Target Types

What is alb.ingress.kubernetes.io/target-type Annotation ?

target-type specifies how to route traffic to pods.

ALB Ingress Target Types

Instance

instance mode will route traffic to all ec2 instances within cluster on NodePort opened for your service.

service must be of type "NodePort" or "LoadBalancer" to use instance mode

Default Target Type is Instance Mode which means no need to define this annotation in Ingress, by default it takes Instance Mode

```
# Target Type: Instance
alb.ingress.kubernetes.io/target-type: instance
```

IP

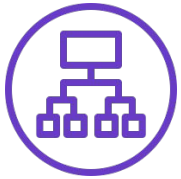
ip mode will route traffic directly to the pod IP.

ip mode is required for sticky sessions to work with Application Load Balancers.

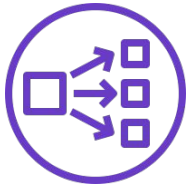
Need to define the annotation explicitly as target-type: ip

```
# Target Type: IP
alb.ingress.kubernetes.io/target-type: ip
```

Elastic Load Balancing



Application Load Balancer



Network Load Balancer

Kubernetes Ingress

External DNS

AWS EKS

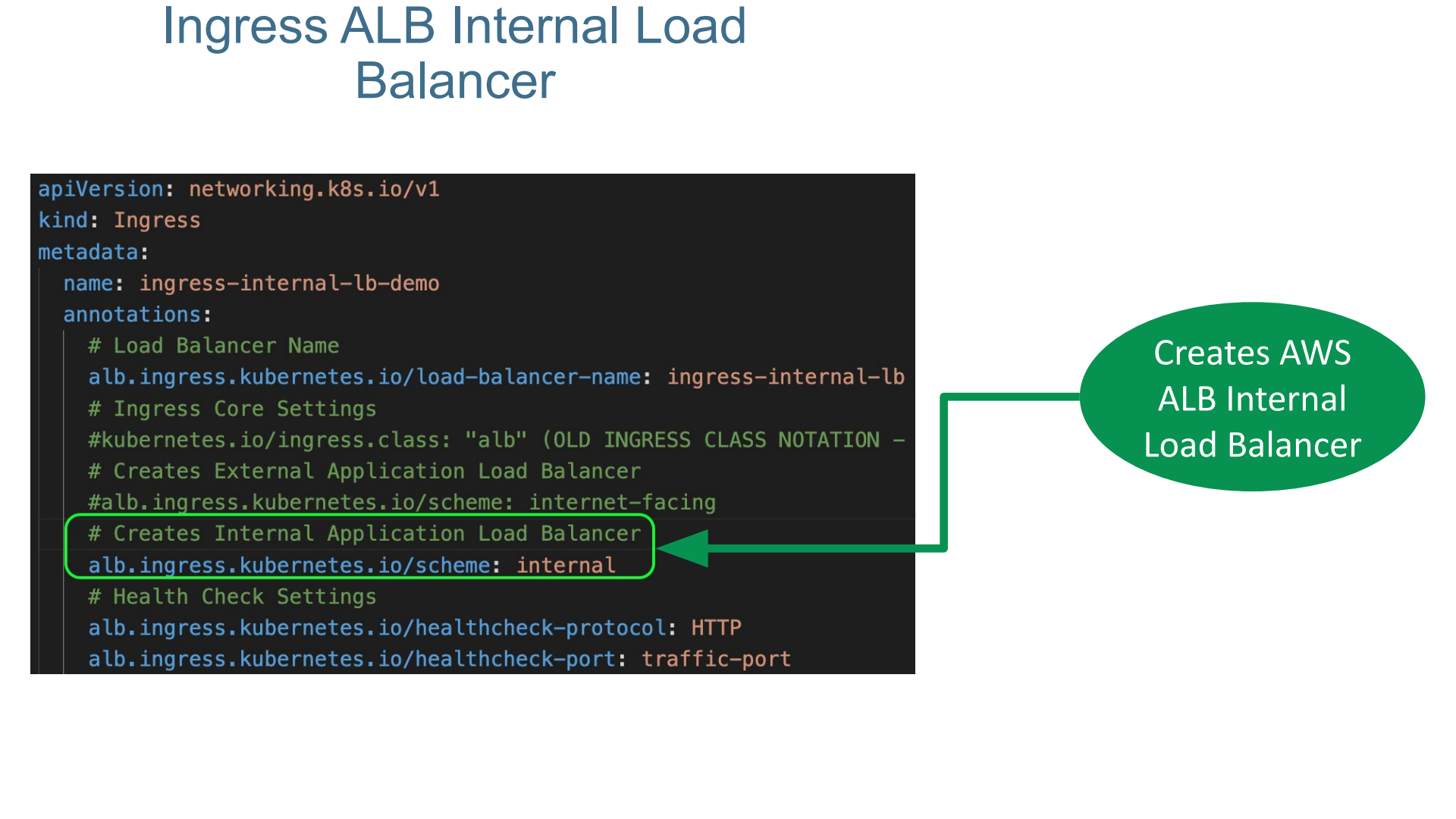
Load Balancer Controller

Kubernetes Ingress

Internal Application Load Balancer

Ingress ALB Internal Load Balancer

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: ingress-internal-lb-demo
  annotations:
    # Load Balancer Name
    alb.ingress.kubernetes.io/load-balancer-name: ingress-internal-lb
    # Ingress Core Settings
    #kubernetes.io/ingress.class: "alb" (OLD INGRESS CLASS NOTATION -
    # Creates External Application Load Balancer
    #alb.ingress.kubernetes.io/scheme: internet-facing
    # Creates Internal Application Load Balancer
    alb.ingress.kubernetes.io/scheme: internal
    # Health Check Settings
    alb.ingress.kubernetes.io/healthcheck-protocol: HTTP
    alb.ingress.kubernetes.io/healthcheck-port: traffic-port
```



Curl Pod

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: curl-pod
spec:
  containers:
  - name: curl
    image: curlimages/curl
    command: [ "sleep", "600" ]
```

We cannot connect to Internal LB directly from internet to test it.

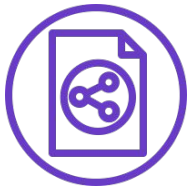
We will deploy a curl pod in EKS Cluster so we can connect to curl pod in EKS Cluster and test the Internal LB Endpoint using curl command.

Command to Test Ingress AWS Internal ALB using curl pod

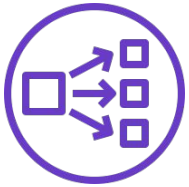
```
# Deploy curl-pod
kubectl apply -f kube-manifests-curl

# Will open up a terminal session into the container
kubectl exec -it curl-pod -- sh

# We can now curl external addresses or internal services:
curl http://google.com/
curl <INTERNAL-INGRESS-LB-DNS>

# Default Backend Curl Test
curl internal-ingress-internal-lb-1839544354.us-east-1.elb.amazonaws.com

# App1 Curl Test
curl internal-ingress-internal-lb-1839544354.us-east-1.elb.amazonaws.com/app1/index.html

# App2 Curl Test
curl internal-ingress-internal-lb-1839544354.us-east-1.elb.amazonaws.com/app2/index.html
```

AWS Load Balancer Controller Updates - End

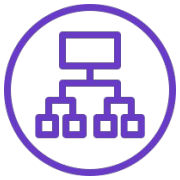
Elastic Load Balancing



Classic Load Balancer



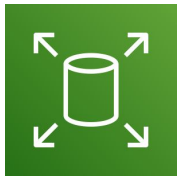
Network Load Balancer



Application Load Balancer

Certificate Manager

Route53



Elastic Block Store

Amazon RDS

AWS EKS

Fargate Profiles

Serverless

Fargate Profiles

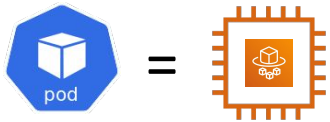
What is Fargate?

- Fargate is a Serverless compute platform for containers on AWS
- Fargate provides on-demand, right-sized compute capacity for containers
- EKS integrates Kubernetes with Fargate by using controllers that are built by AWS using the upstream, extensible model provided by Kubernetes.
- These controllers run as part of the EKS managed Kubernetes control plane and are responsible for scheduling native Kubernetes pods onto Fargate.
- The Fargate controllers include a new scheduler that runs alongside the default Kubernetes scheduler in addition to several mutating and validating admission controllers.
- When we start a pod that meets the criteria for running on Fargate, the Fargate controllers running in the cluster recognize, update, and schedule the pod onto Fargate.

AWS EKS on Fargate

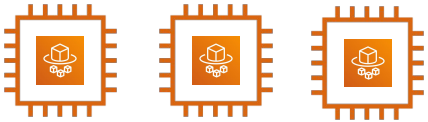
Bring existing pods

- We don't need to change our existing pods
- Fargate works with existing workflows and services that run on kubernetes



Production Ready

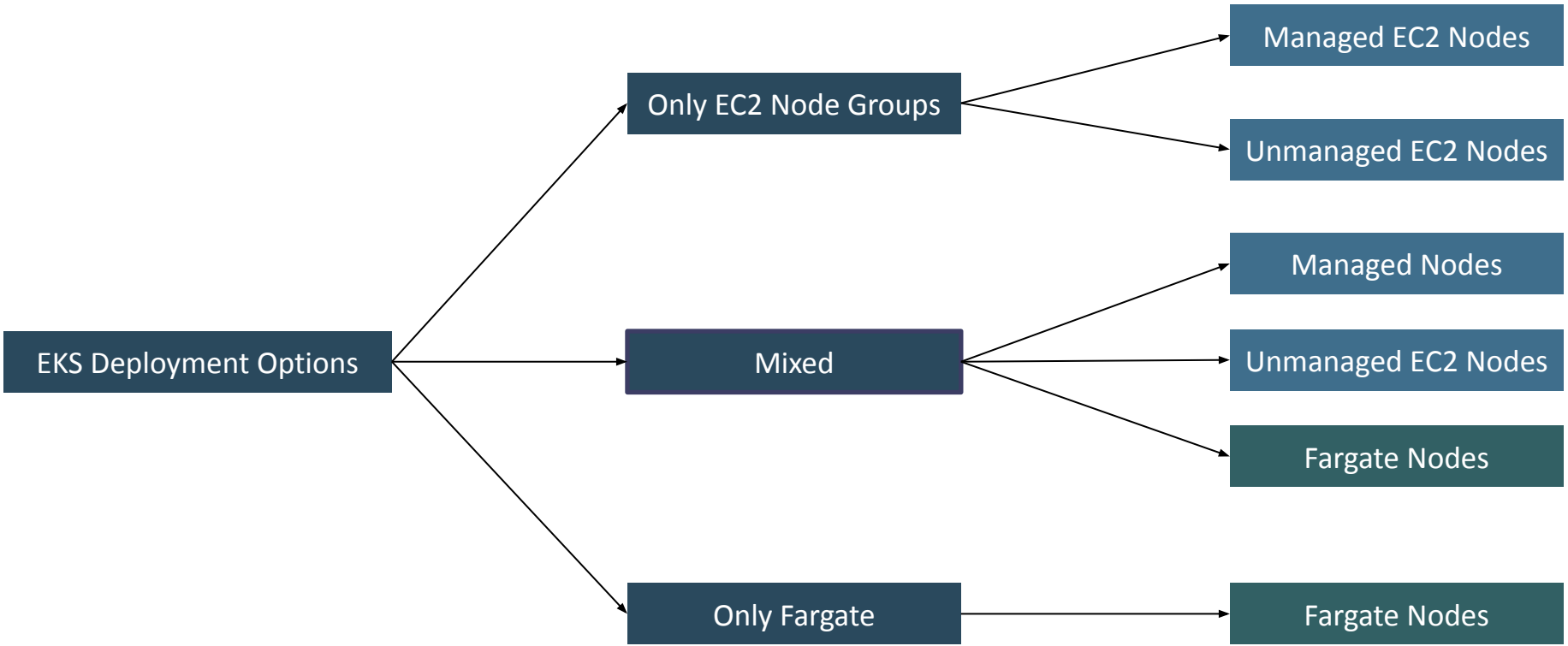
- Launch pods easily.
- Easily run pods across Azs for HA
- Each pod runs in an isolated compute environment



Rightsized and Integrated

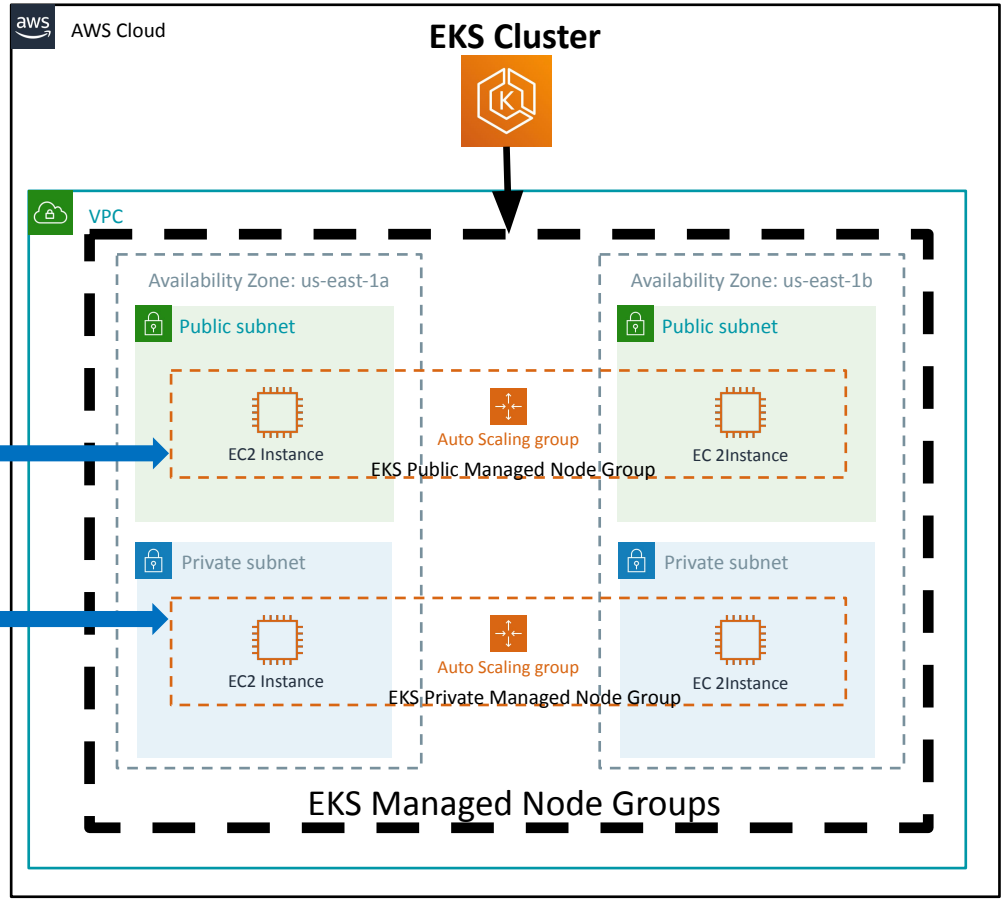
- Only pay for resources you need to run your pods
- Includes native AWS integrations for networking and security

EKS Deployment Options

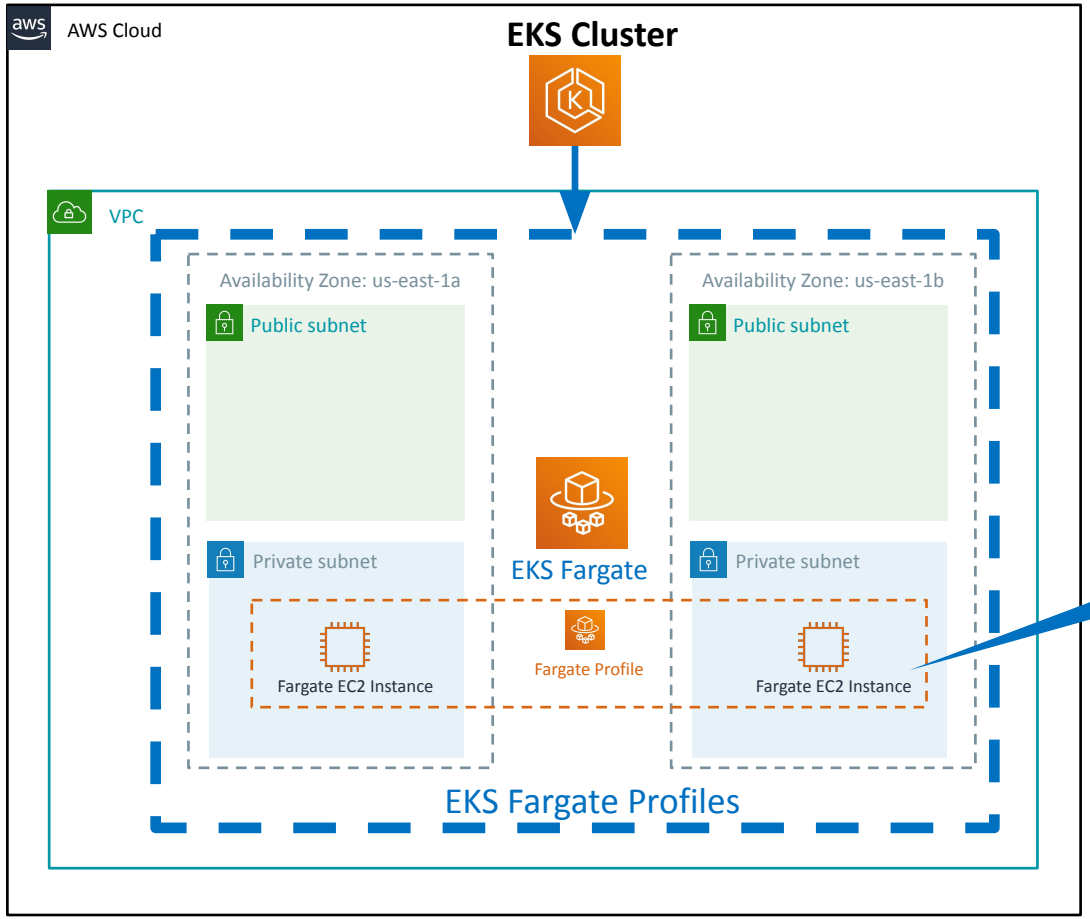


EKS Deployment Options – EC2 Node Groups

We can deploy EC2 Managed Node Groups in both public and private subnets of a VPC

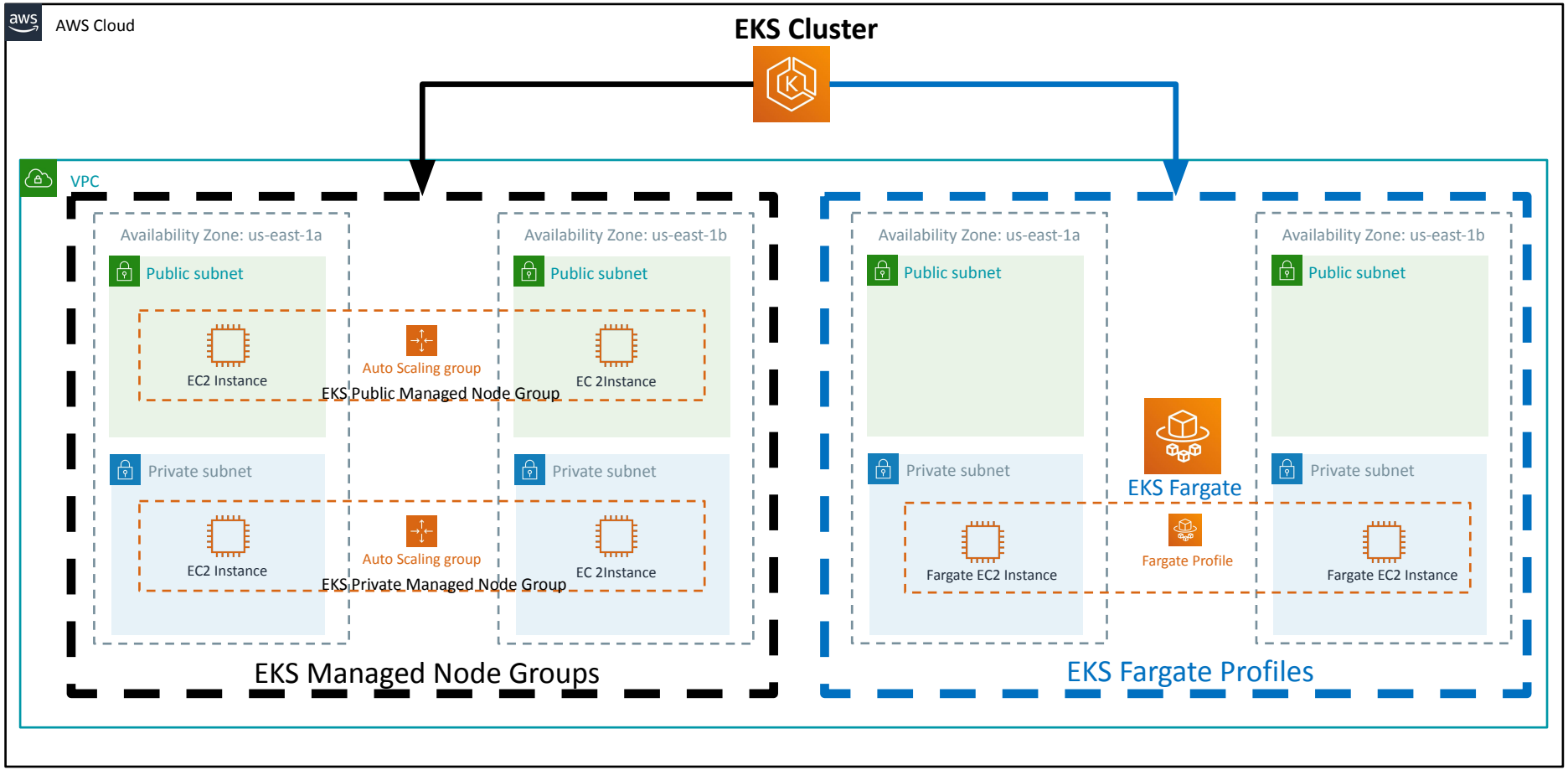


EKS Deployment Options – Only Fargate



Pods running on Fargate are only supported on private subnets

EKS Deployment Options - Mixed



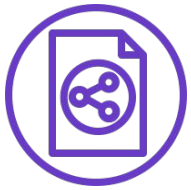
EKS Fargate vs Managed vs Unmanaged Nodes

	Fargate	Managed nodes	Unmanaged nodes
Units of work	Pod	Pod and EC2	Pod and EC2
Unit of charge	Pod	EC2	EC2
Host lifecycle	There is no visible host	AWS (SSH is allowed)	Customer
Host AMI	There is no visible host	AWS vetted AMIs	Customer BYO
Host : Pods	1 : 1	1 : many	1 : many

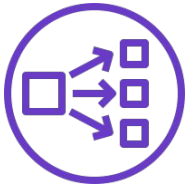
EKS Fargate Considerations

- There are many considerations we need to be aware of before we decide our Kubernetes workloads to run on Fargate.
- Documentation Link
- https://docs.aws.amazon.com/eks/latest/userguide/fargate.html

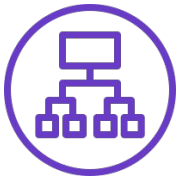
Elastic Load Balancing



Classic Load Balancer



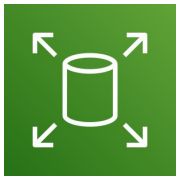
Network Load Balancer



Application Load Balancer

Certificate Manager

Route53



Elastic Block Store

Amazon RDS

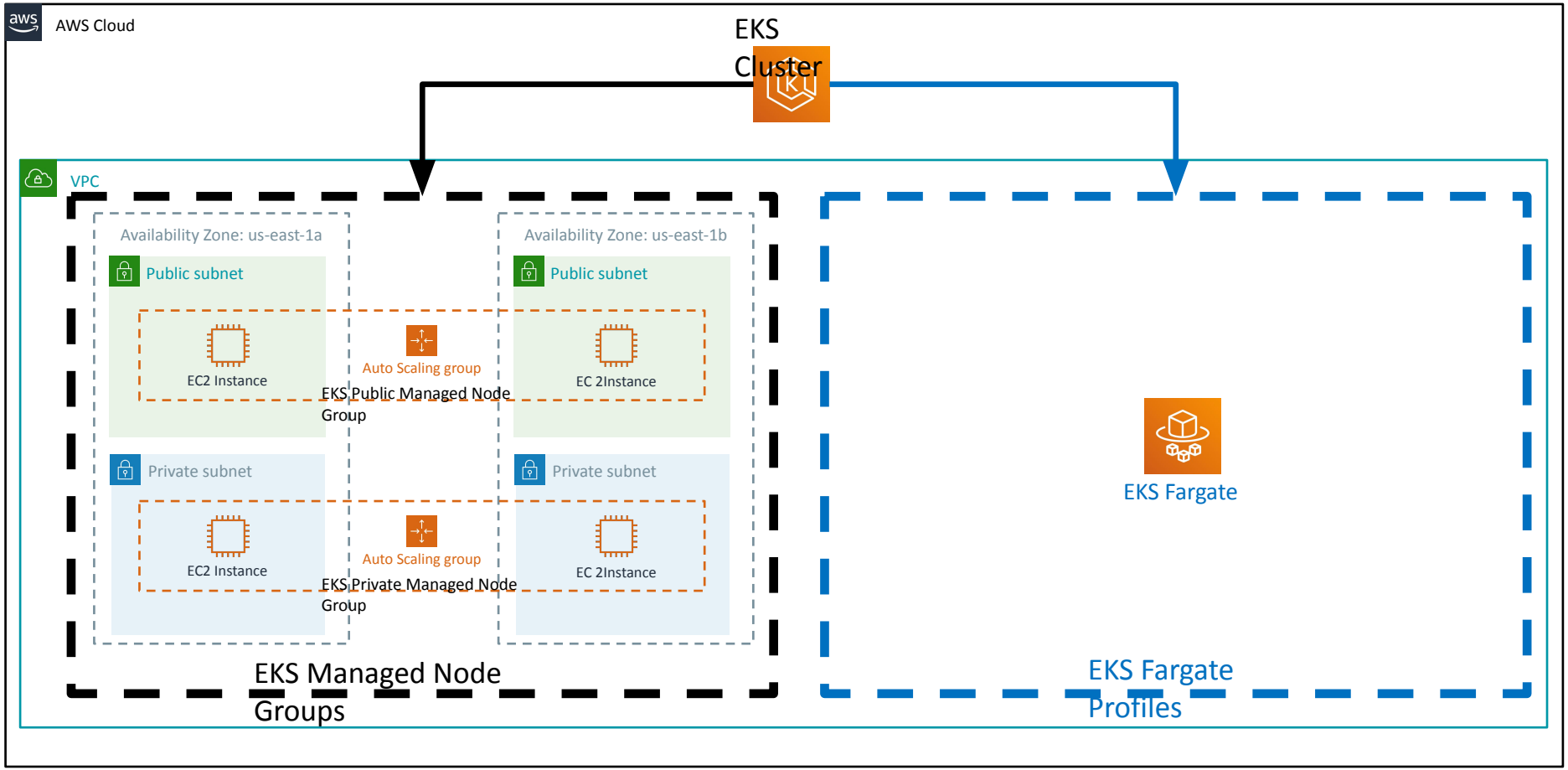
AWS EKS

Fargate Profiles

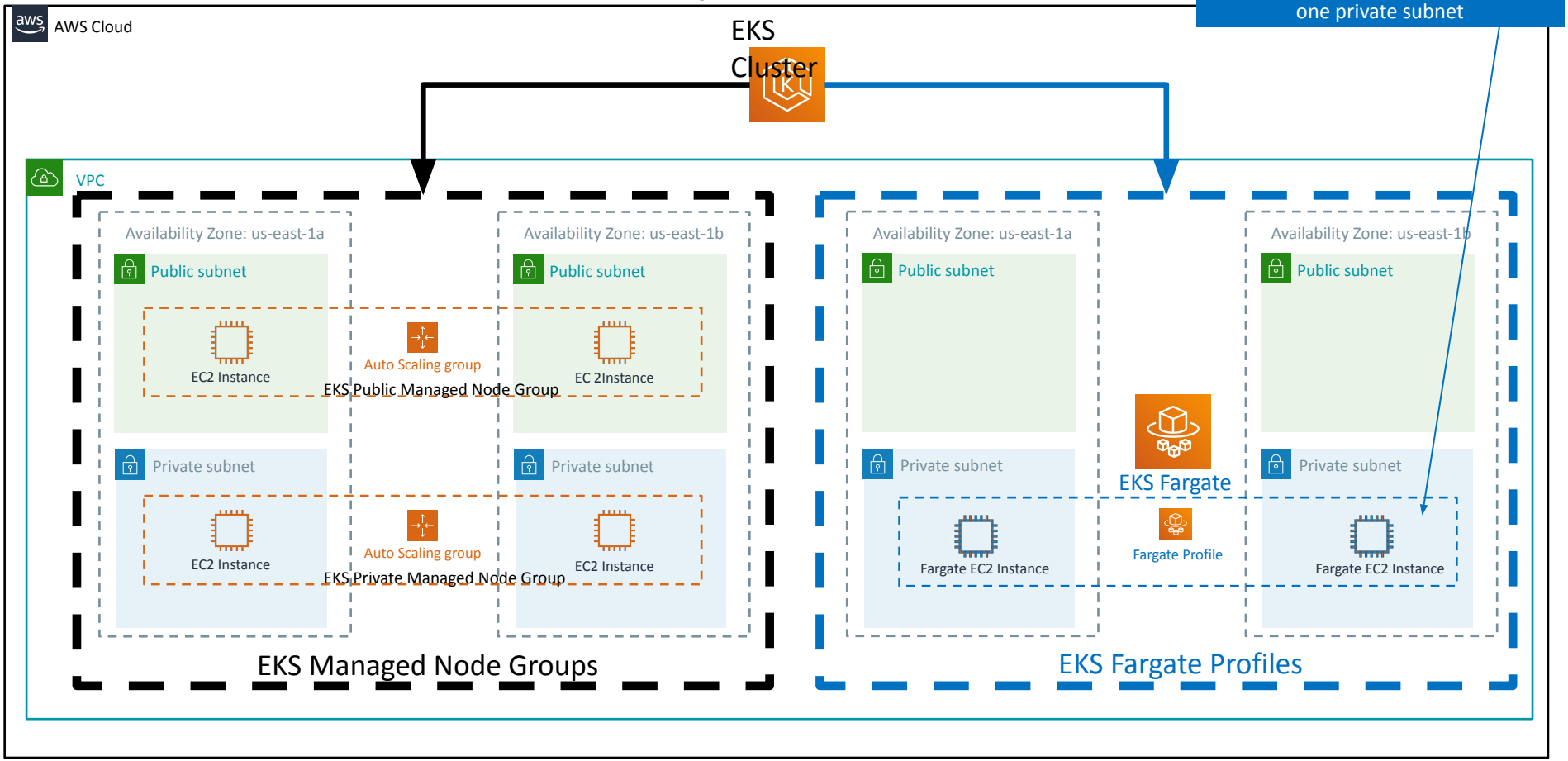
Basics

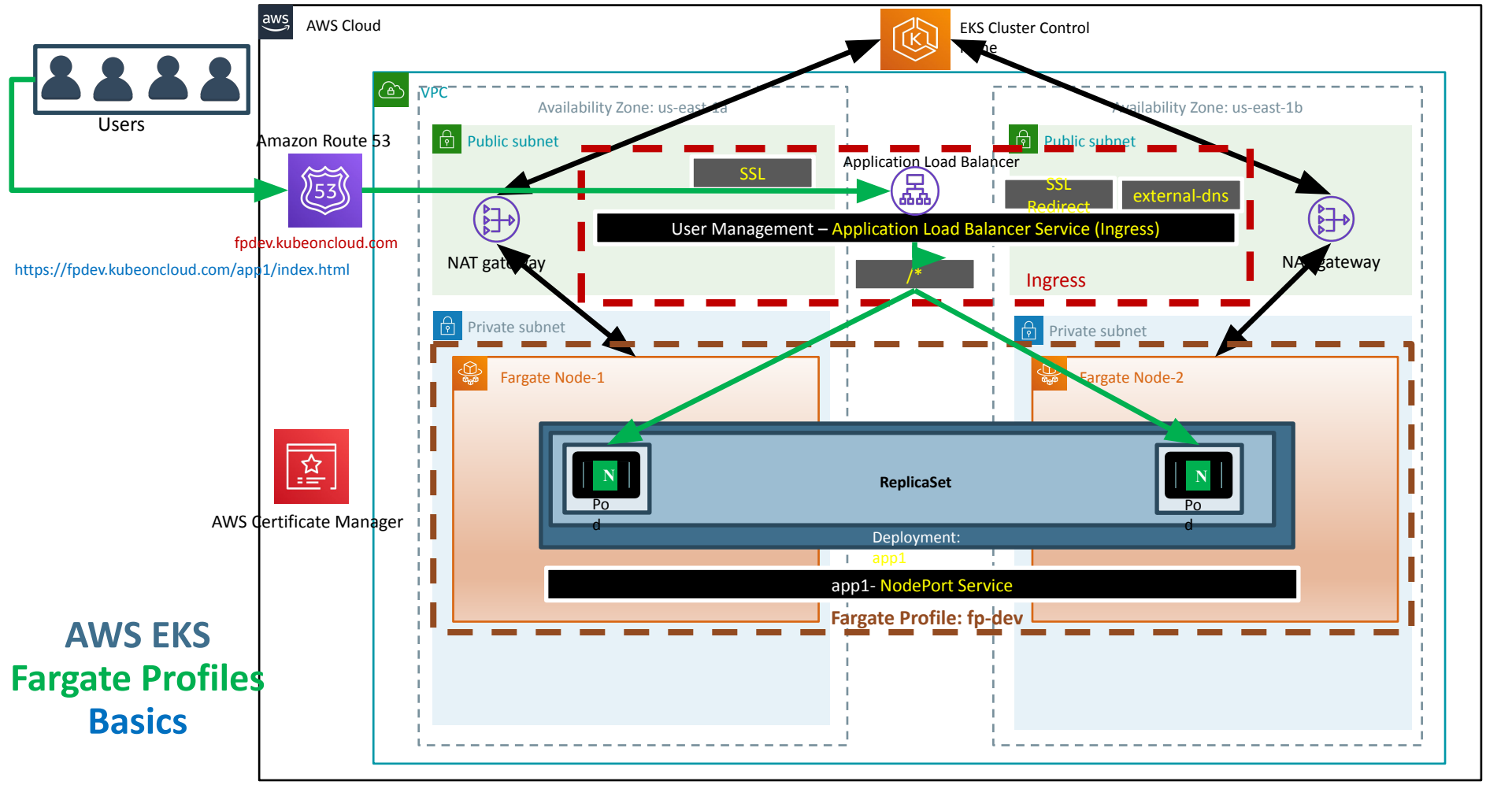
Fargate Profiles

EKS Deployment Options - Mixed

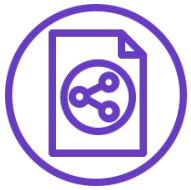


EKS Deployment Options - Mixed

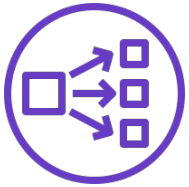



AWS Cloud
EKS Cluster Control
Users
Amazon Route 53
VPC
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
SSL
Application Load Balancer
SSL Redirect
external-dns
fpdev.kubeoncloud.com
https://fpdev.kubeoncloud.com/app1/index.html
User Management – Application Load Balancer Service (Ingress)
NAT gateway
/*
Ingress
Private subnet
Private subnet
Fargate Node-1
Fargate Node-2
ReplicaSet
Pod
Pod
Deployment:
app1
app1- NodePort Service
Fargate Profile: fp-dev
AWS Certificate Manager
AWS EKS
Fargate Profiles
Basics

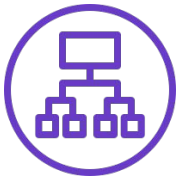
Elastic Load Balancing



Classic Load Balancer



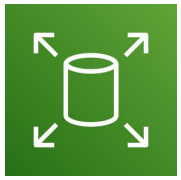
Network Load Balancer



Application Load Balancer

Certificate Manager

Route53



Elastic Block Store

Amazon RDS

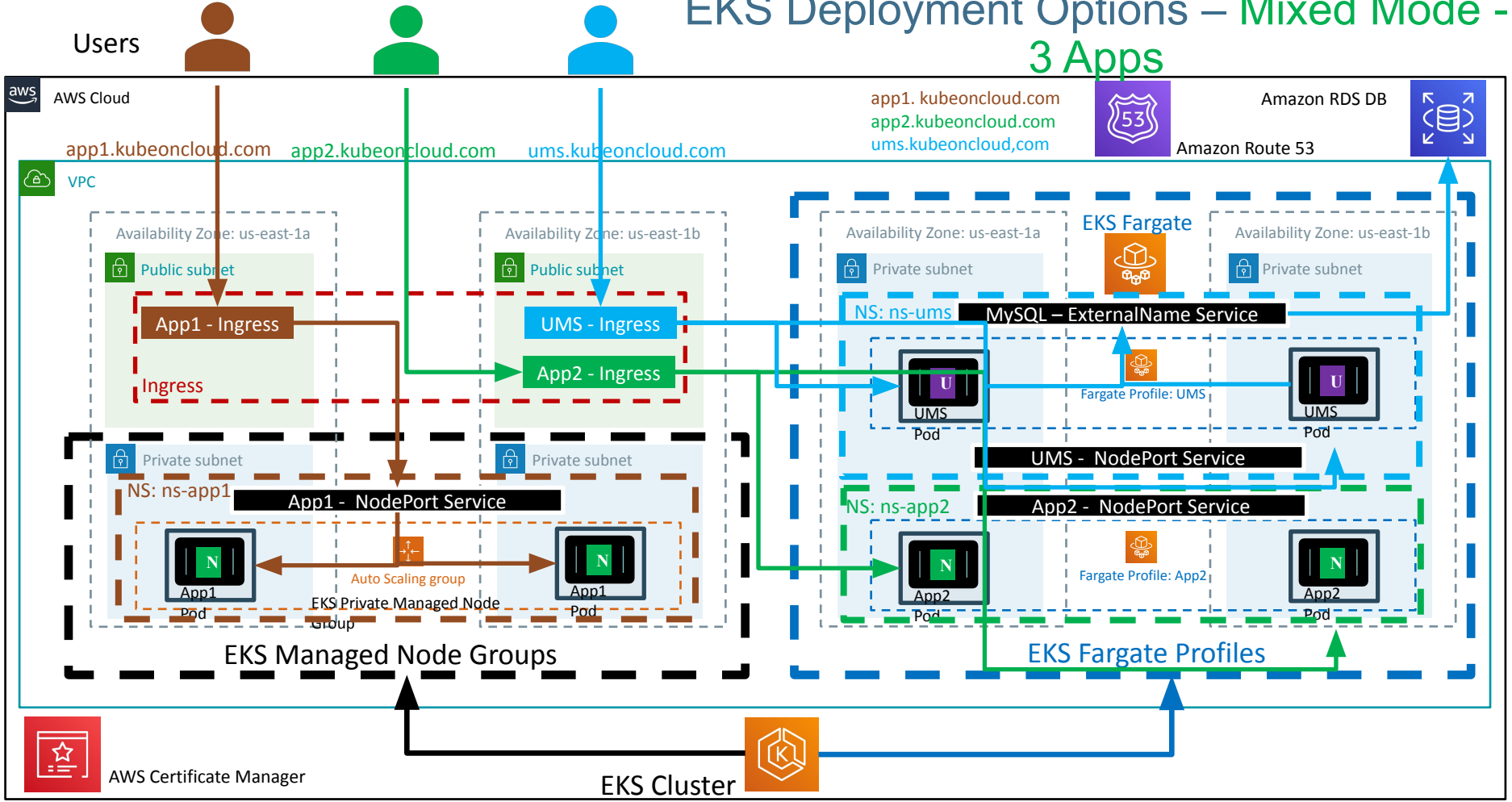
AWS EKS

Fargate Profiles

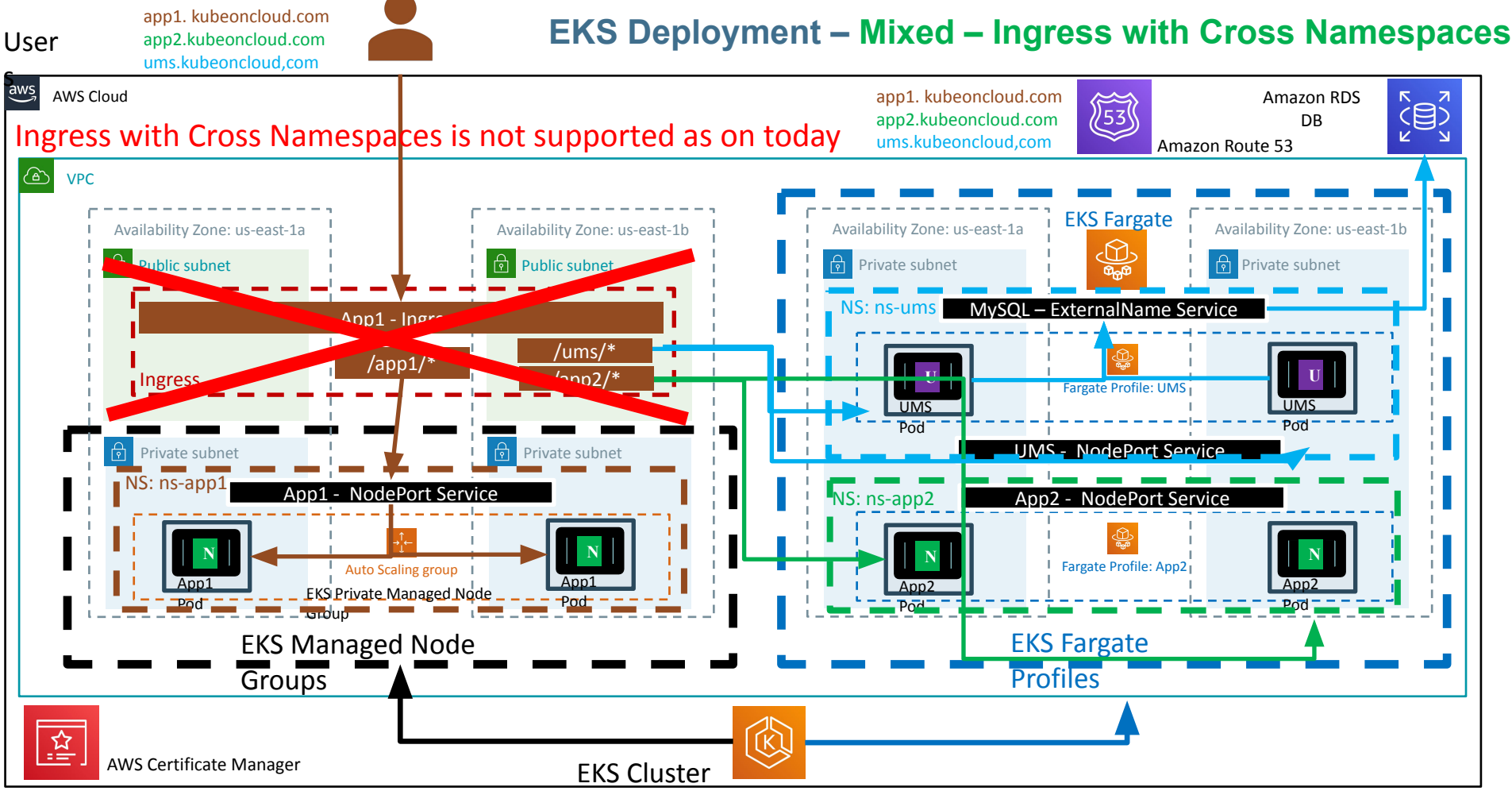
Advanced with YAML

Fargate Profiles

EKS Deployment Options – Mixed Mode - 3 Apps

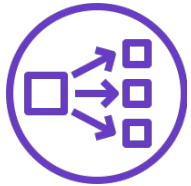


EKS Deployment – Mixed – Ingress with Cross Namespaces



AWS Load Balancer Controller & AWS Network Load Balancer – NEW TOPIC ADDITION - START

Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

AWS EKS

Load Balancer Controller

Kubernetes Service

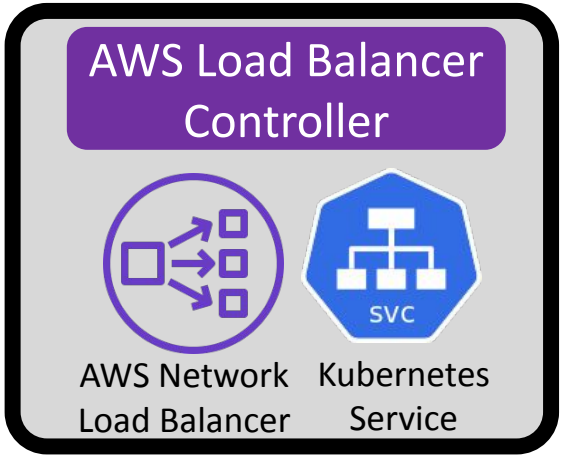
Network Load Balancer

6 Demos

Demo-1: NLB Basics

Demo-2: NLB TLS SSL

Demo-3: NLB & External DNS

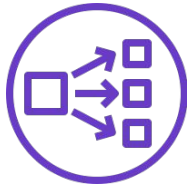


Demo-4: NLB & Elastic IP

Demo-5: Internal NLB

Demo-6: NLB & Fargate

Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

AWS EKS

Load Balancer Controller

Kubernetes Service

Network Load Balancer - Basics

Network Load Balancer

What is Network Load Balancer ?

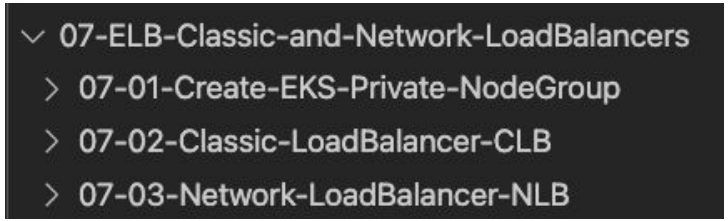
Network traffic is load balanced at L4 of the OSI model.
Supports TCP, UDP and TLS Protocols

ELB Features Comparison for Additional Understanding:
https://aws.amazon.com/elasticloadbalancing/features/

Options for creating Network Load Balancer using Kubernetes on EKS Cluster

AWS cloud provider load balancer controller

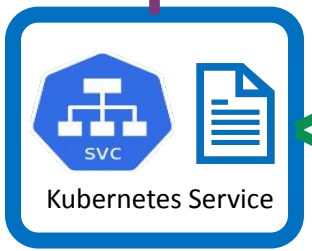
- Legacy Controller which can create AWS Classic LB and Network LB
- Creates very basic Network Load Balancer
- This controller will receive only critical bug fixes and in long run it will be deprecated
- This controller will not have any new features added to it



AWS Load Balancer Controller

- Latest and greatest which can create AWS ALB and NLB
- Supports Protocols TCP, UDP & TLS (SSL) and for Health Check it supports TCP, HTTP & HTTPS
- Supports Instance and IP Mode(For Fargate)
- Supports Internal, External NLB and Custom Subnet Discovery
- Supports Static Elastic IP and Access Control
- Supports 25+ new Annotations https://kubernetes-sigs.github.io/aws-load-balancer-controller/v2.4/guide/service/annotations/

How to ensure our Network LB created using Kubernetes Service will be associated with only latest AWS Load Balancer Controller ?



service.beta.kubernetes.io/aws-load-balancer-type: nlb

AWS Cloud Provider Load Balancer Controller (Legacy)

service.beta.kubernetes.io/aws-load-balancer-type: nlb-ip (Deprecated - Used just for backward compatability)

service.beta.kubernetes.io/aws-load-balancer-type: external

AWS Load Balancer Controller (Latest)

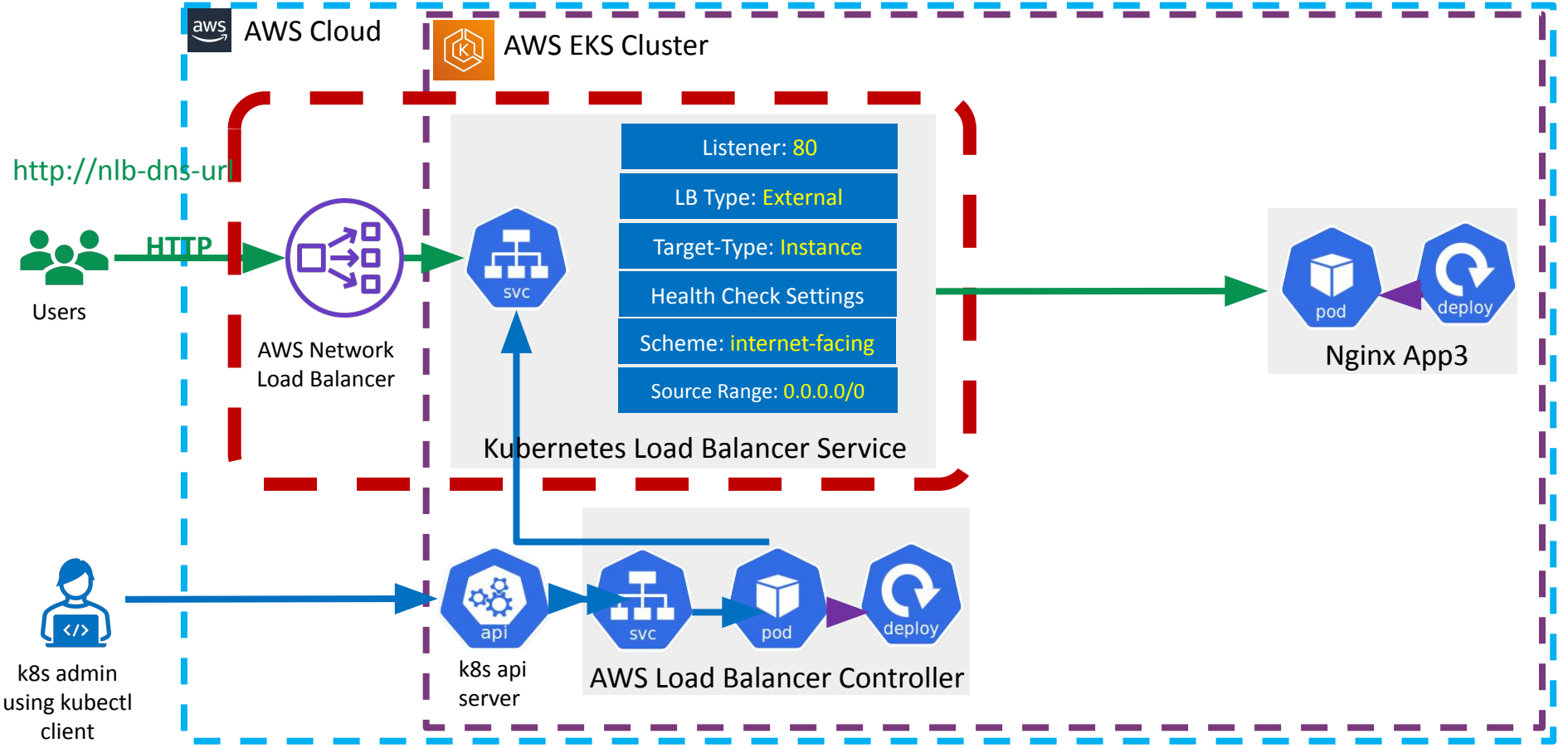
Additional Note-1: If the values of aws-load-balancer-type annotation is nlb-ip or external legacy controller ignores that k8s service so that AWS Load Balancer Controller can take over.

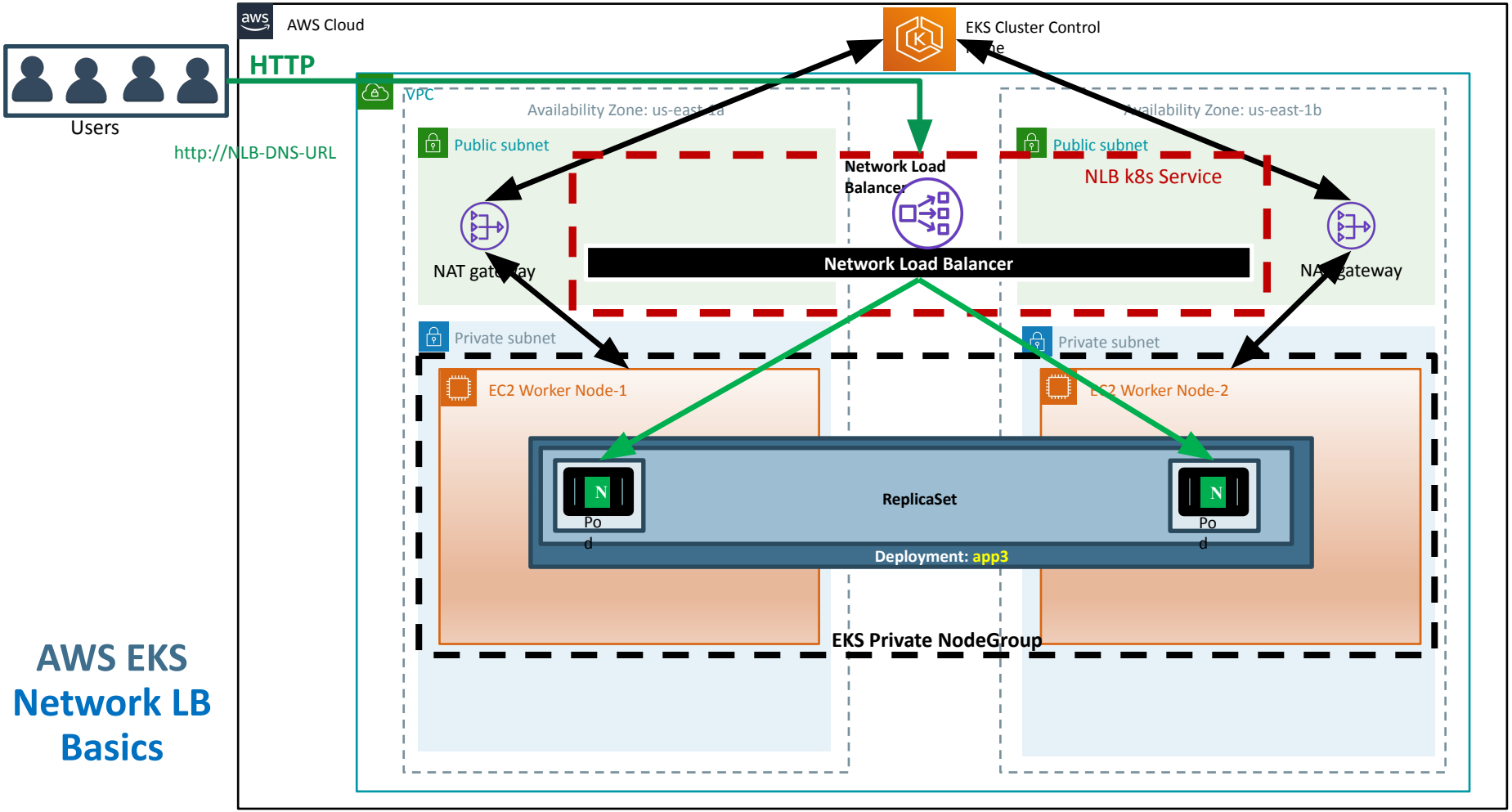
Additional Note-2: EKS Cluster Versions v1.18.18+, v1.19.10+ and v1.20 and higher are supported

```yaml
apiVersion: v1
kind: Service
metadata:
  name: lbc-network-lb-demo
  annotations:
    # Traffic Routing
    service.beta.kubernetes.io/aws-load-balancer-name: lbc-network-lb-demo
    service.beta.kubernetes.io/aws-load-balancer-type: external
    service.beta.kubernetes.io/aws-load-balancer-nlb-target-type: instance
    #service.beta.kubernetes.io/aws-load-balancer-subnets: subnet-xxxx, mySubnet ## Subnets are auto-d

    # Health Check Settings
    service.beta.kubernetes.io/aws-load-balancer-healthcheck-protocol: http
    service.beta.kubernetes.io/aws-load-balancer-healthcheck-port: traffic-port
    service.beta.kubernetes.io/aws-load-balancer-healthcheck-path: /index.html
    service.beta.kubernetes.io/aws-load-balancer-healthcheck-healthy-threshold: "3"
    service.beta.kubernetes.io/aws-load-balancer-healthcheck-unhealthy-threshold: "3"
    service.beta.kubernetes.io/aws-load-balancer-healthcheck-interval: "10" # The controller currently

    # Access Control
    service.beta.kubernetes.io/load-balancer-source-ranges: 0.0.0.0/0
    service.beta.kubernetes.io/aws-load-balancer-scheme: "internet-facing"

    # AWS Resource Tags
    service.beta.kubernetes.io/aws-load-balancer-additional-resource-tags: Environment=dev,Team=test
spec:
  type: LoadBalancer
  selector:
    app: app3-nginx
  ports:
    - port: 80
      targetPort: 80
```

This Kubernetes Service creates Network Load Balancer which will be associated to latest AWS Load Balancer Controller

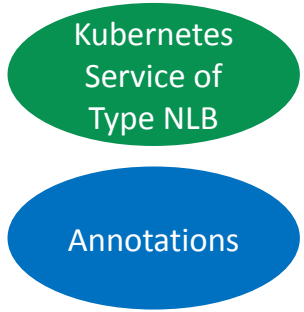
AWS EKS NLB – Basics



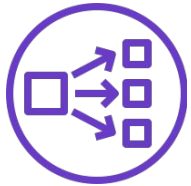


AWS EKS Network LB Basics

```yaml
annotations:
  # Traffic Routing
  service.beta.kubernetes.io/aws-load-balancer-name: lbc-network-lb-demo
  service.beta.kubernetes.io/aws-load-balancer-type: external
  service.beta.kubernetes.io/aws-load-balancer-nlb-target-type: instance
  #service.beta.kubernetes.io/aws-load-balancer-subnets: subnet-xxxx, mySubnet ## Subnets

  # Health Check Settings
  service.beta.kubernetes.io/aws-load-balancer-healthcheck-protocol: http
  service.beta.kubernetes.io/aws-load-balancer-healthcheck-port: traffic-port
  service.beta.kubernetes.io/aws-load-balancer-healthcheck-path: /index.html
  service.beta.kubernetes.io/aws-load-balancer-healthcheck-healthy-threshold: "3"
  service.beta.kubernetes.io/aws-load-balancer-healthcheck-unhealthy-threshold: "3"
  service.beta.kubernetes.io/aws-load-balancer-healthcheck-interval: "10" # The controlle

  # Access Control
  service.beta.kubernetes.io/load-balancer-source-ranges: 0.0.0.0/0
  service.beta.kubernetes.io/aws-load-balancer-scheme: "internet-facing"

  # AWS Resource Tags
  service.beta.kubernetes.io/aws-load-balancer-additional-resource-tags: Environment=dev,
```



Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

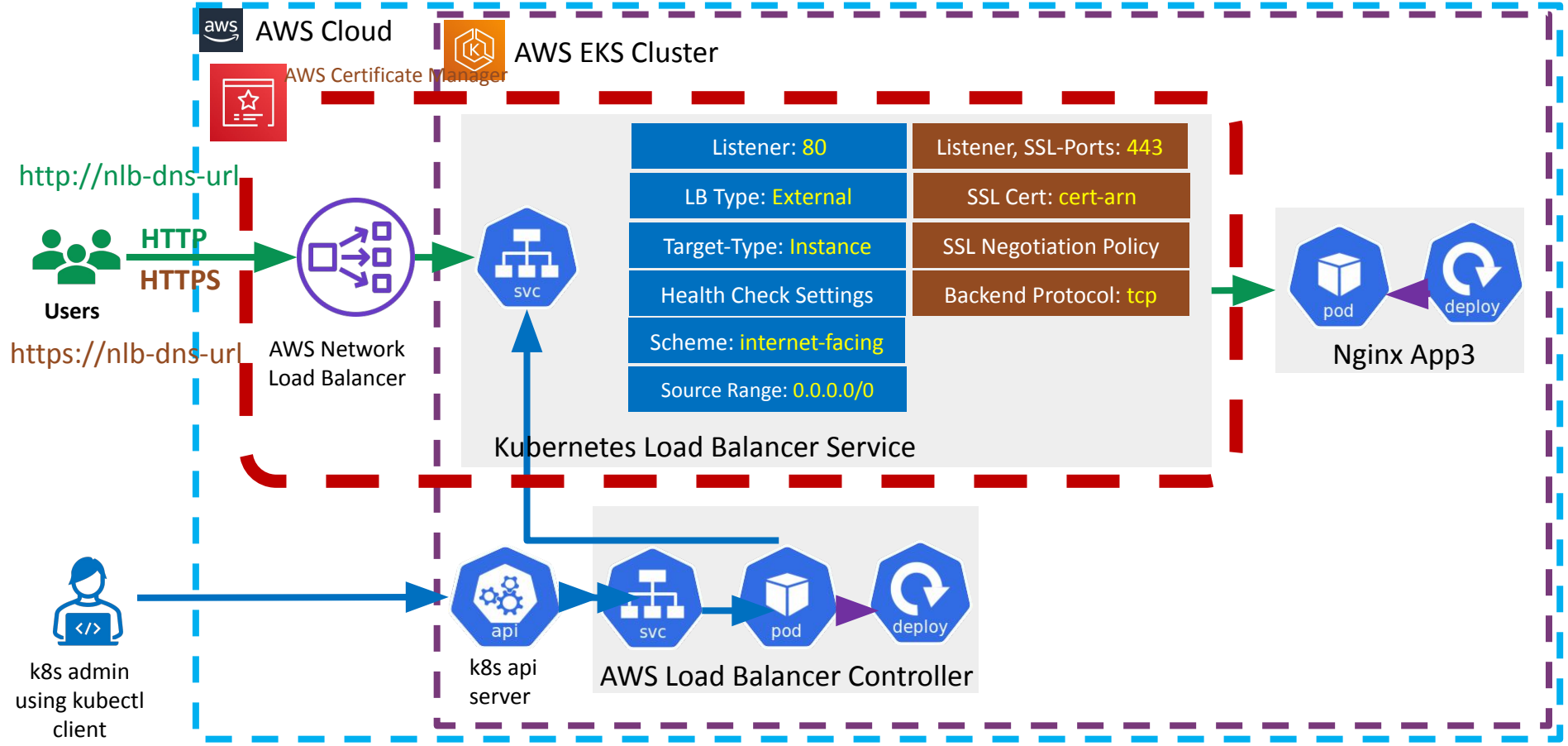
AWS EKS

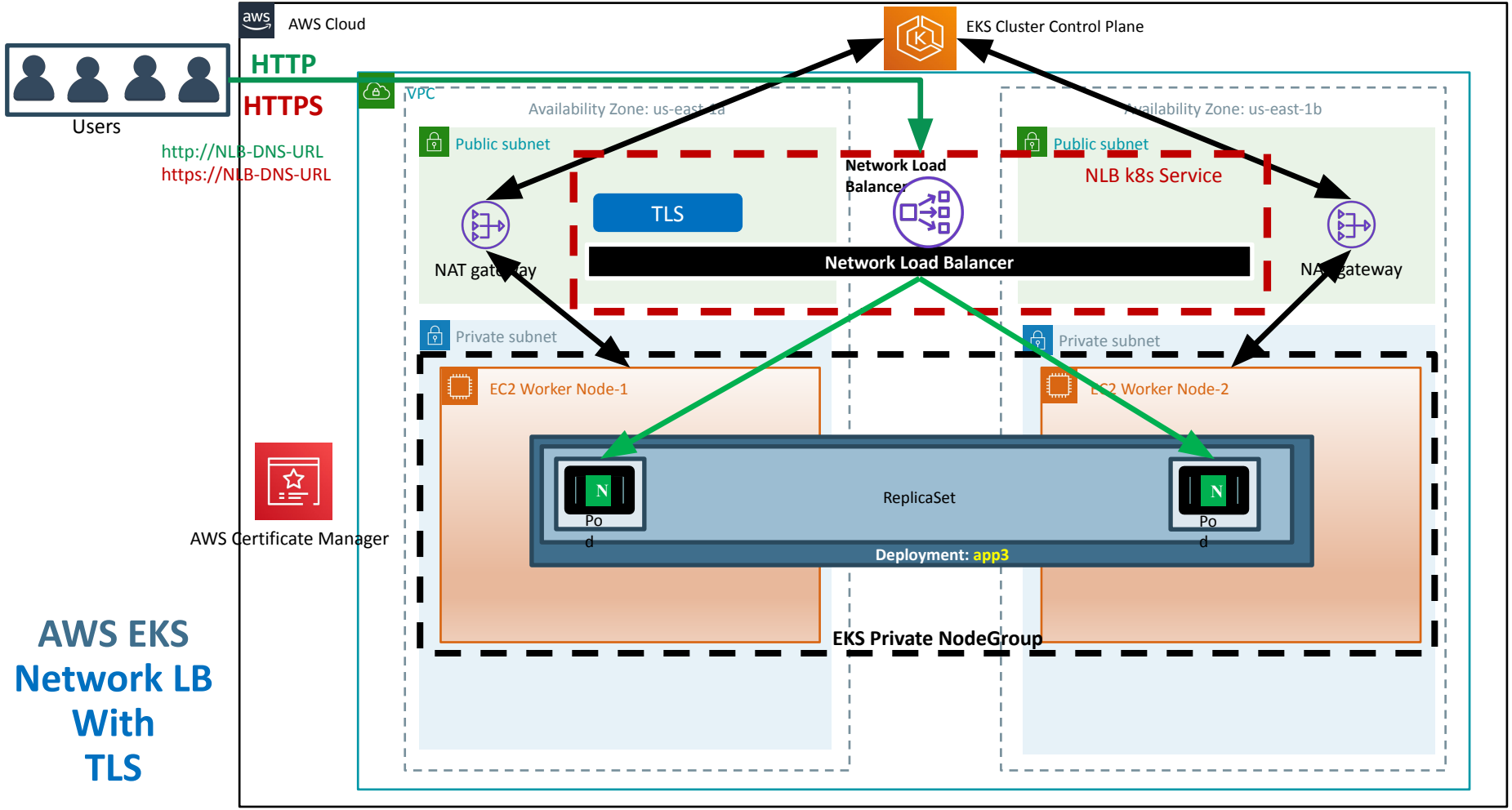
Load Balancer Controller

Kubernetes Service

Network Load Balancer - TLS

AWS EKS NLB – TLS (HTTP + HTTPS)




AWS Cloud
EKS Cluster Control Plane
HTTP
HTTPS
Users
http://NLB-DNS-URL
https://NLB-DNS-URL
VPC
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Network Load Balancer
NLB k8s Service
TLS
Network Load Balancer
NAT gateway
NAT gateway
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
ReplicaSet
Pod
Pod
Deployment: app3
EKS Private NodeGroup
AWS Certificate Manager
AWS EKS
Network LB
With
TLS

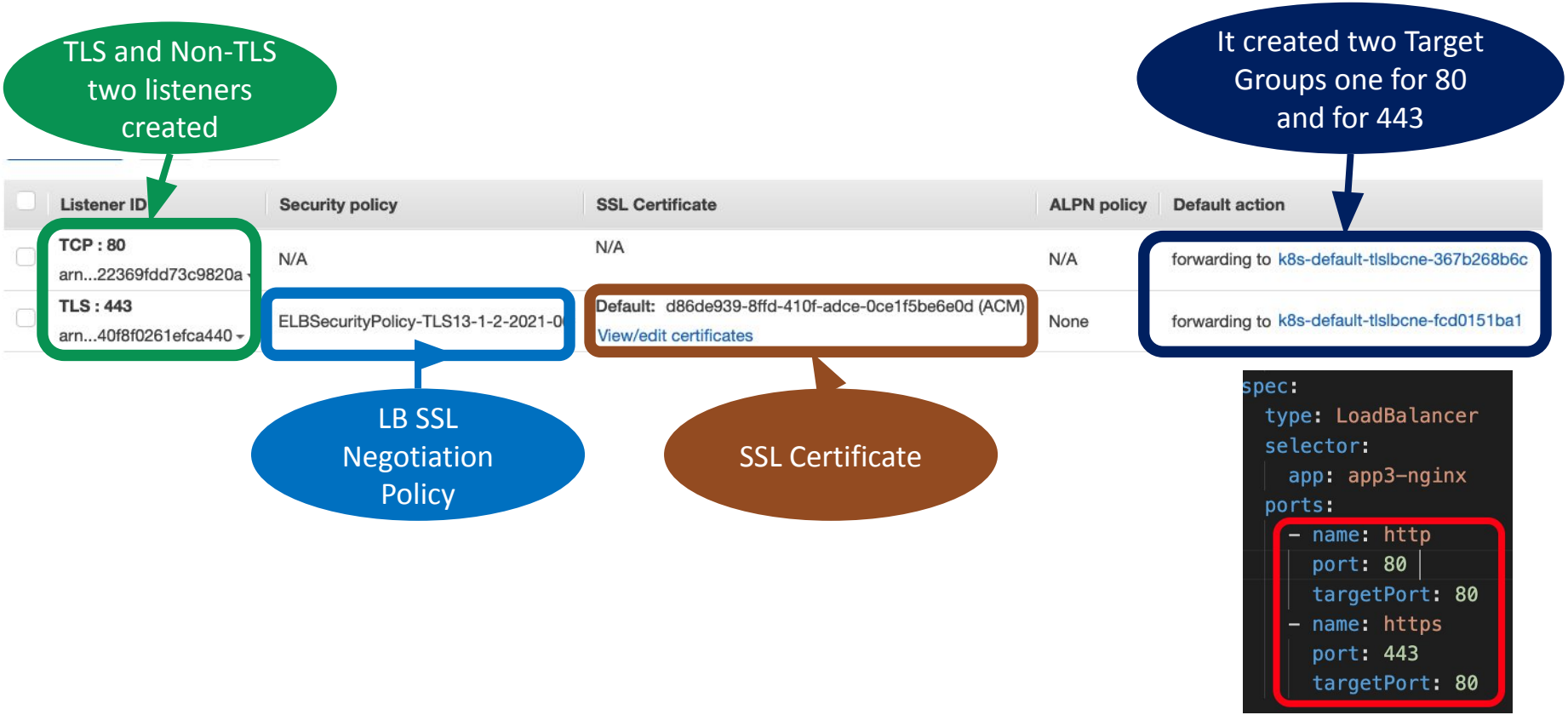
AWS EKS NLB - Annotations

```yaml
    # TLS
    service.beta.kubernetes.io/aws-load-balancer-ssl-cert: arn:aws:acm:us-east-1:180789647333:certificate/d8
    service.beta.kubernetes.io/aws-load-balancer-ssl-ports: 443, # Specify this annotation if you need both
    service.beta.kubernetes.io/aws-load-balancer-ssl-negotiation-policy: ELBSecurityPolicy-TLS13-1-2-2021-06
    service.beta.kubernetes.io/aws-load-balancer-backend-protocol: tcp # specifies whether to use TLS or TCP
spec:
  type: LoadBalancer
  selector:
    app: app3-nginx
  ports:
    - name: http
      port: 80
      targetPort: 80
    - name: https
      port: 443
      targetPort: 80
```

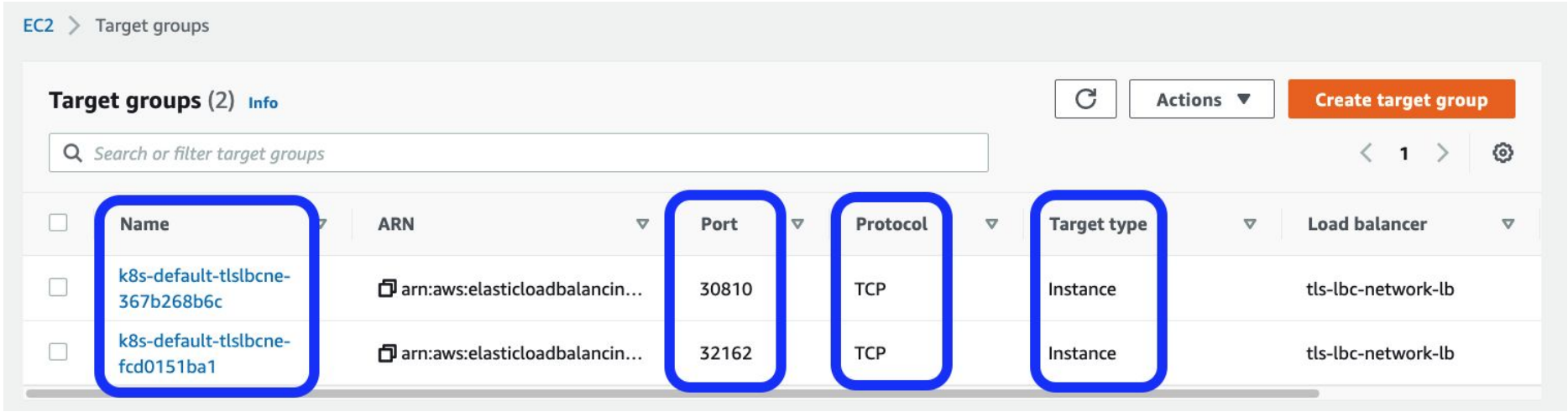
AWS EKS NLB - Annotations

```
    # TLS
    service.beta.kubernetes.io/aws-load-balancer-ssl-cert: arn:aws:acm:us-east
    service.beta.kubernetes.io/aws-load-balancer-ssl-ports: 443, # Specify thi
    service.beta.kubernetes.io/aws-load-balancer-ssl-negotiation-policy: ELBSe
    service.beta.kubernetes.io/aws-load-balancer-backend-protocol: tcp # speci
spec:
  type: LoadBalancer
  selector:
    app: app3-nginx
  ports:
    - name: http
      port: 80        # Creates NLB Port 80 Listener
      targetPort: 80  # Creates NLB Port 80 Target Group-1
    - name: https
      port: 443       # Creates NLB Port 443 Listener
      targetPort: 80  # Creates NLB Port 80 Target Group-2
    - name: http81
      port: 81        # Creates NLB Port 81 Listener
      targetPort: 80  # Creates NLB Port 80 Target Group-3
    - name: http82
      port: 82        # Creates NLB Port 82 Listener
      targetPort: 80  # Creates NLB Port 80 Target Group-4
```

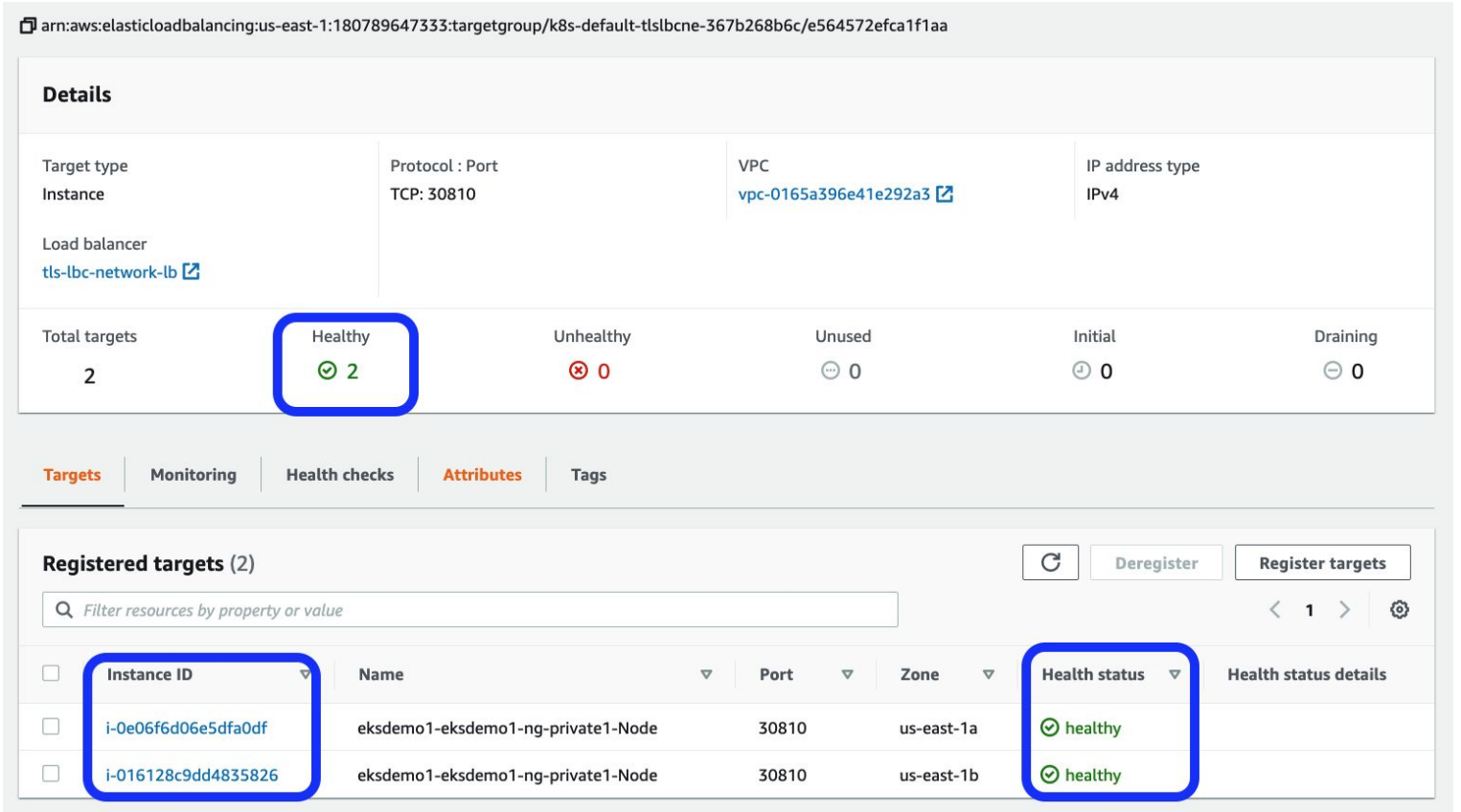
AWS EKS NLB –Load Balancer



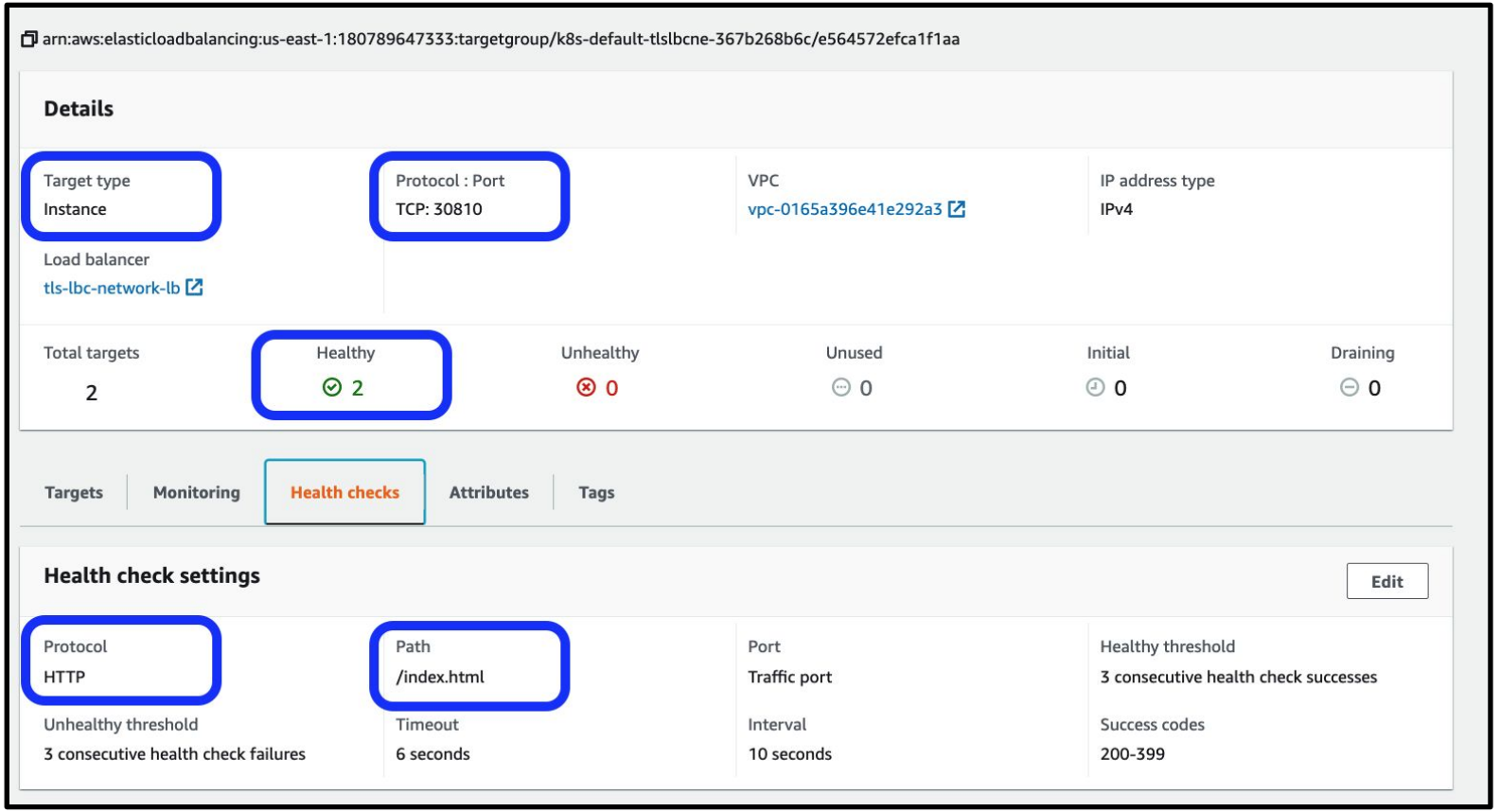
AWS EKS NLB - Target Groups



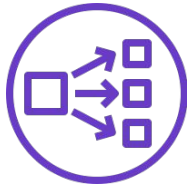
AWS EKS NLB - Target Groups



AWS EKS NLB - Target Groups



Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

AWS EKS

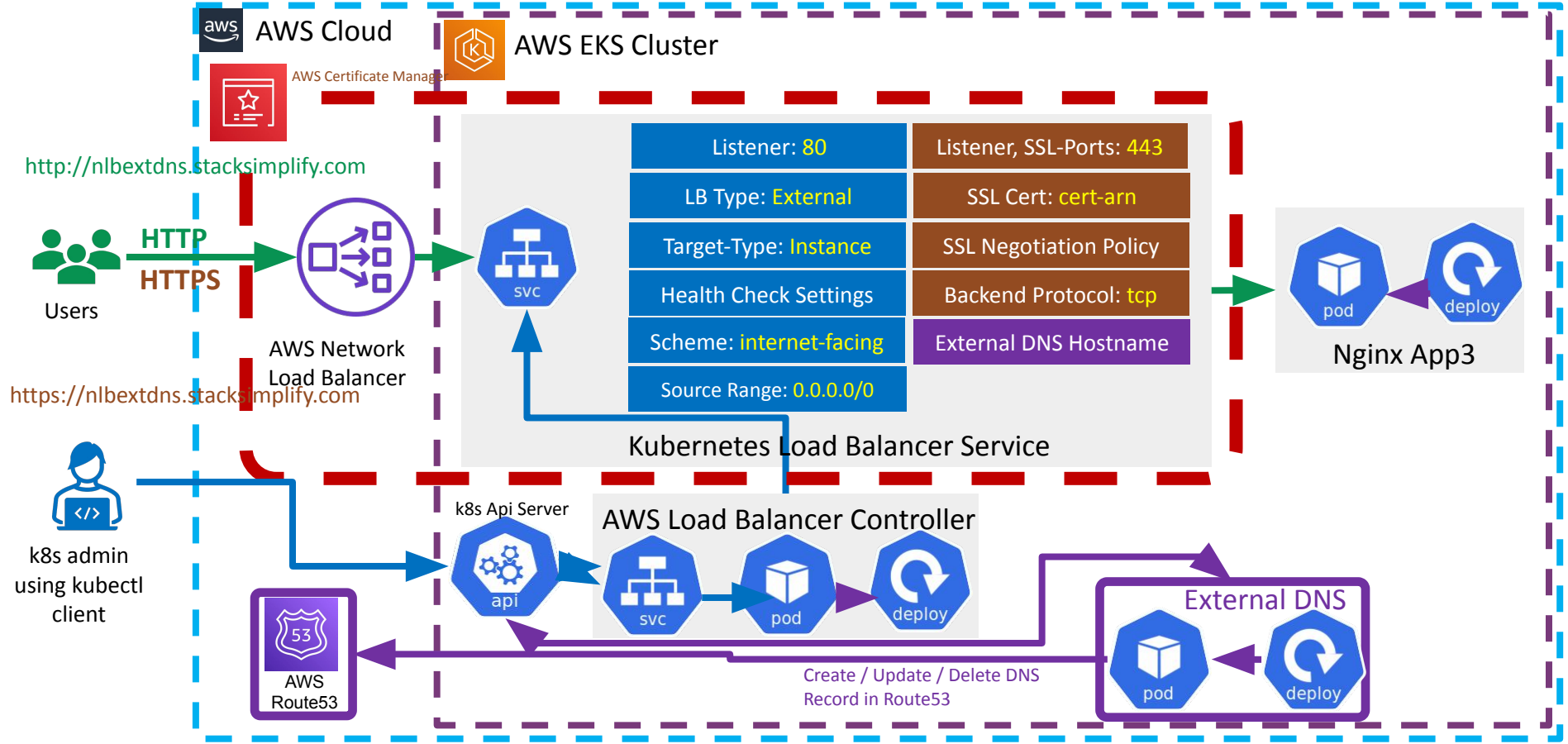
Load Balancer Controller

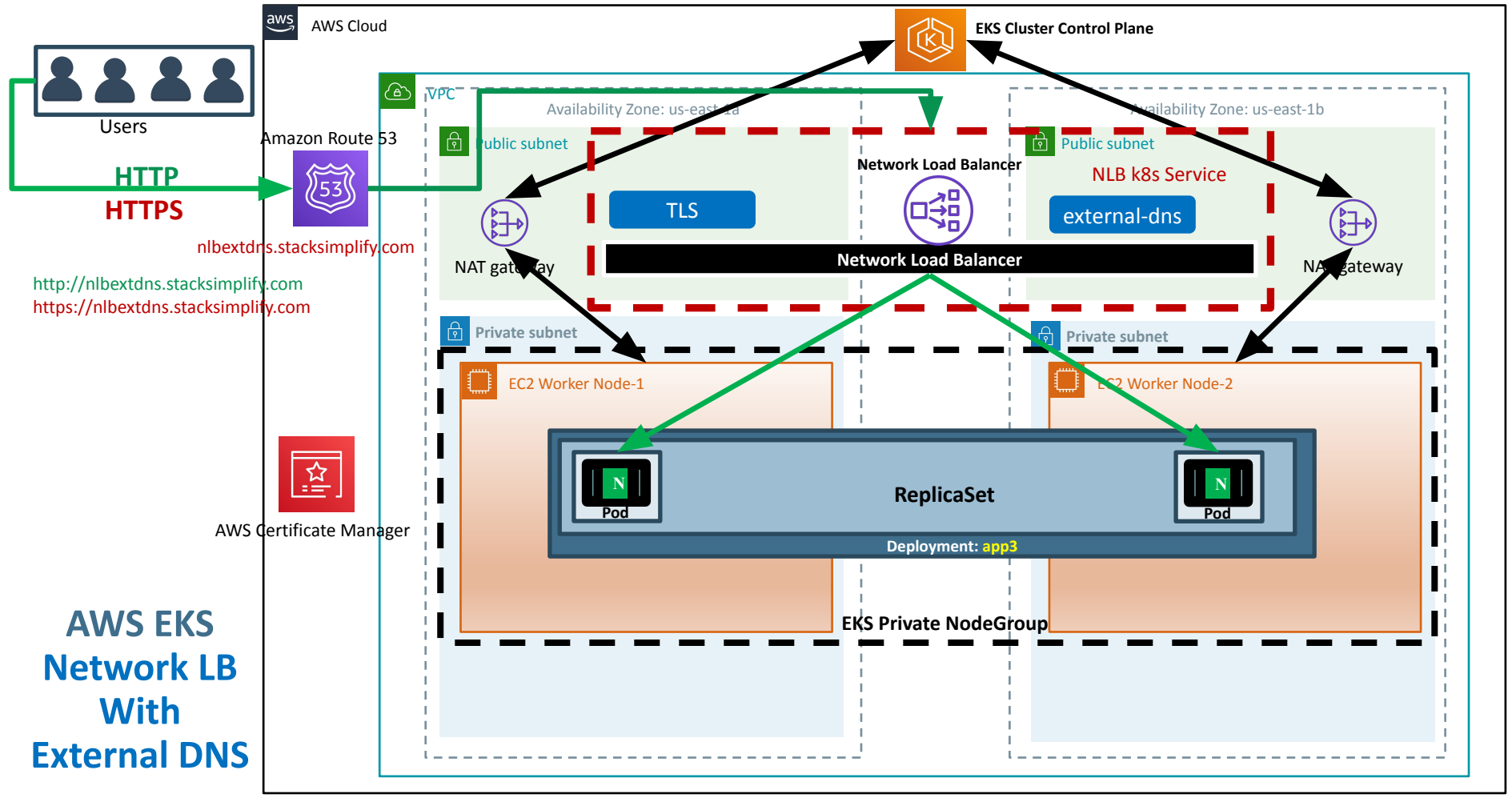
Kubernetes Service

Network Load Balancer

External DNS

AWS EKS NLB – External DNS

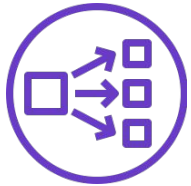



AWS Cloud
EKS Cluster Control Plane
Users
HTTP
HTTPS
Amazon Route 53
nlbextdns.stacksimplify.com
http://nlbextdns.stacksimplify.com
https://nlbextdns.stacksimplify.com
VPC
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Network Load Balancer
NLB k8s Service
TLS
external-dns
NAT gateway
Network Load Balancer
NAT gateway
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
Pod
ReplicaSet
Pod
Deployment: app3
EKS Private NodeGroup
AWS Certificate Manager
AWS EKS
Network LB
With
External DNS

AWS EKS NLB - External DNS Annotation

```
# External DNS - For creating a Record Set in Route53
external-dns.alpha.kubernetes.io/hostname: nlbdns101.stacksimplify.com
```

Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

AWS EKS

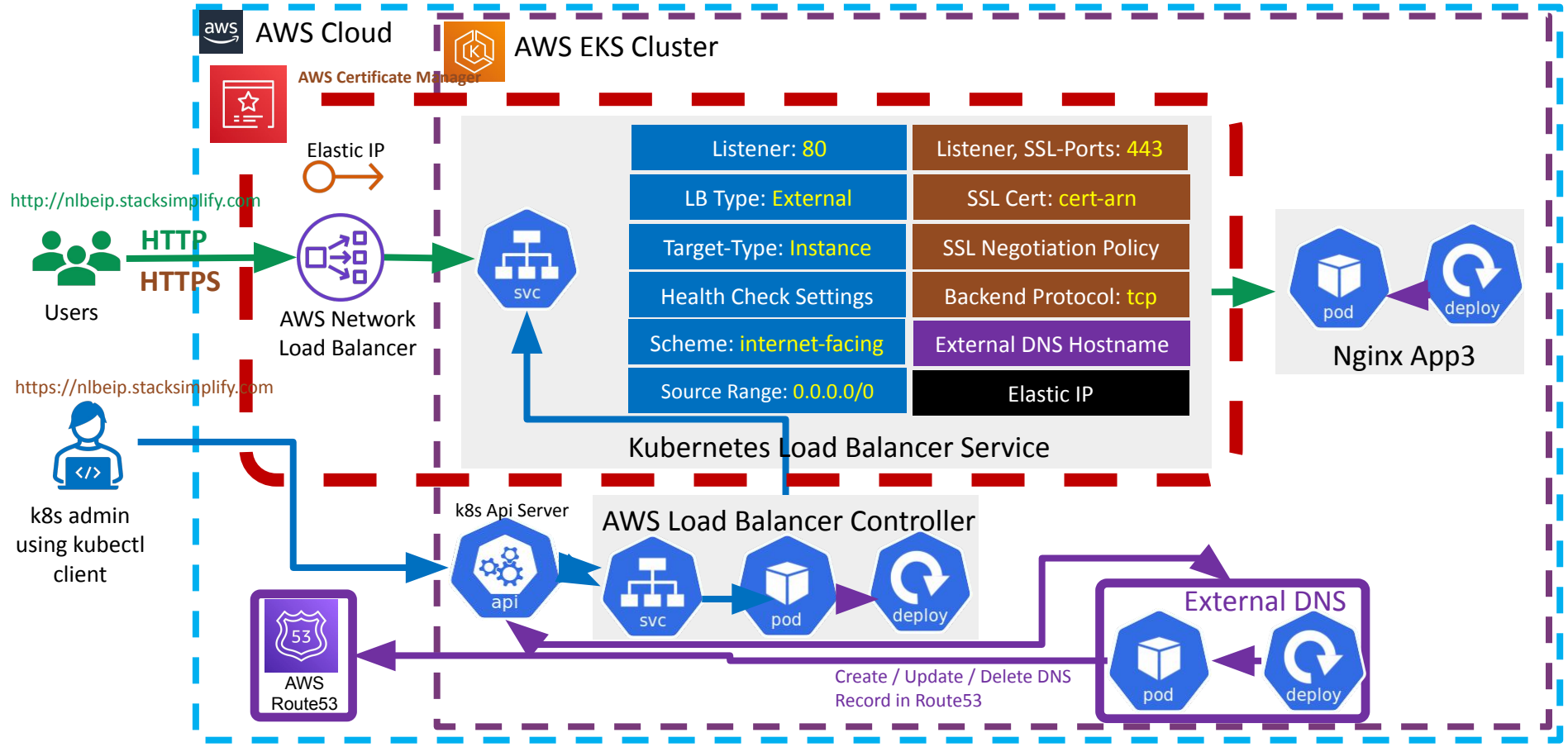
Load Balancer Controller

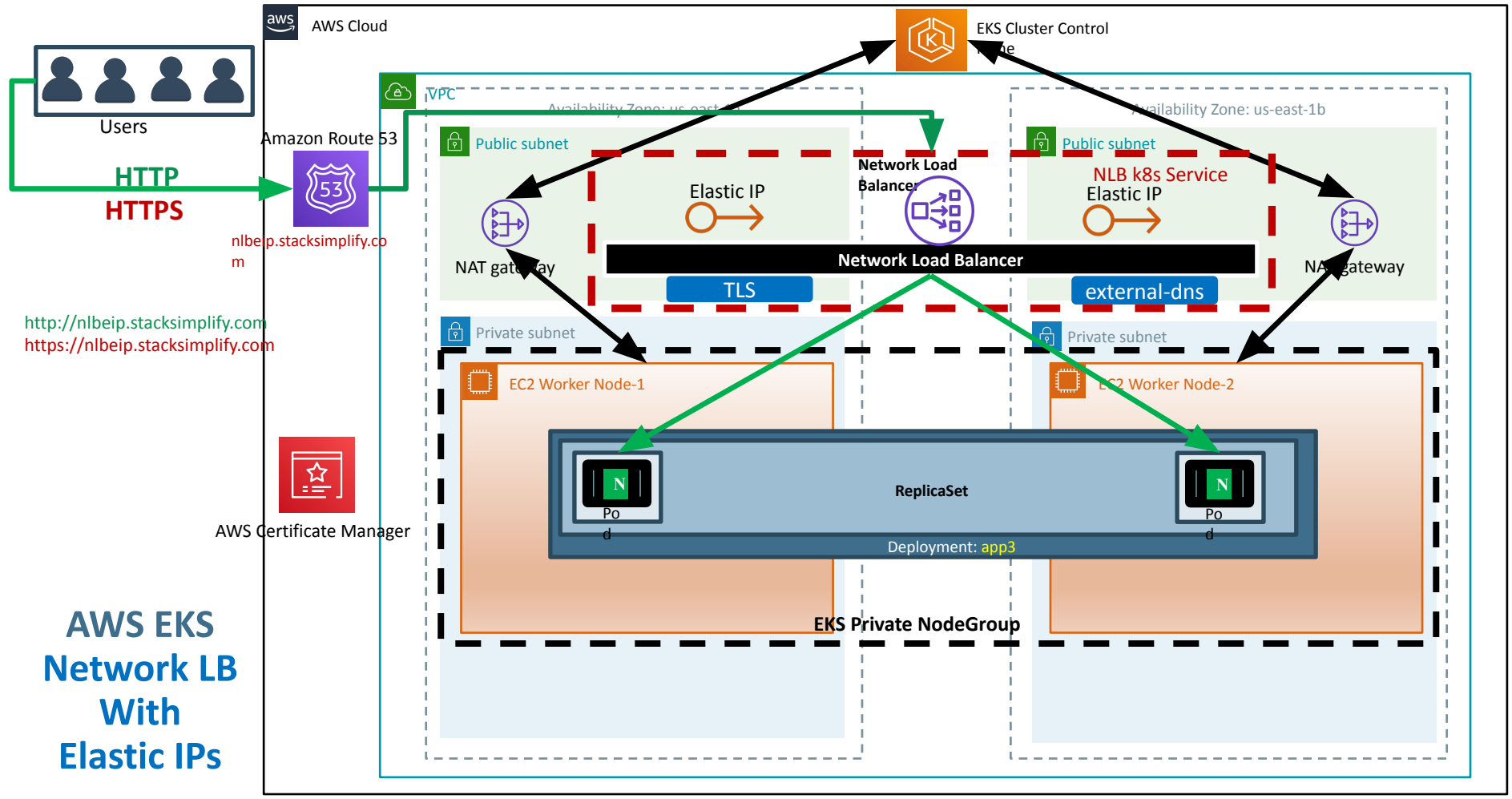
Kubernetes Service

Network Load Balancer

Elastic IP

AWS EKS NLB – External DNS




AWS Cloud
EKS Cluster Control
Users
VPC
Amazon Route 53
HTTP
HTTPS
nlbeip.stacksimplify.com
Availability Zone: us-east-1b
Public subnet
Public subnet
Network Load Balancer
Elastic IP
NLB k8s Service
Elastic IP
NAT gateway
Network Load Balancer
TLS
external-dns
http://nlbeip.stacksimplify.com
https://nlbeip.stacksimplify.com
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
ReplicaSet
Pod
Pod
Deployment: app3
AWS Certificate Manager
EKS Private NodeGroup
AWS EKS
Network LB
With
Elastic IPs

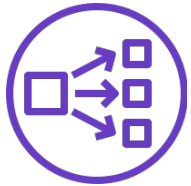
AWS EKS NLB - Elastic IP Annotation

```
# Elastic IPs
service.beta.kubernetes.io/aws-load-balancer-eip-allocations: eipalloc-07daf60991cfd21f0,
```

Important Note-1:
You must specify the same number of eip allocations as load balancer subnets annotation

Important Note-2:
NLB must be internet-facing

Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

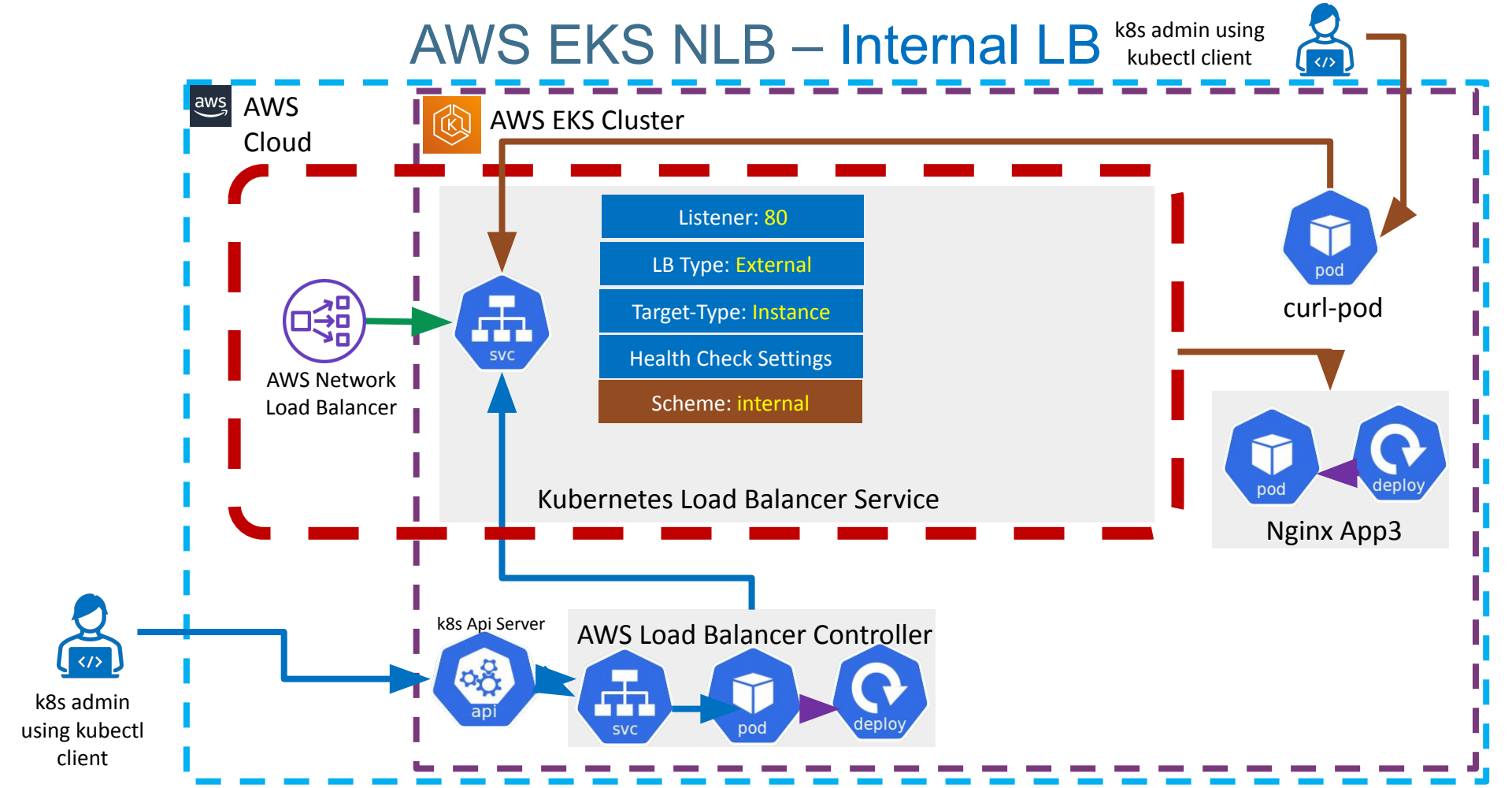
AWS EKS

Load Balancer Controller

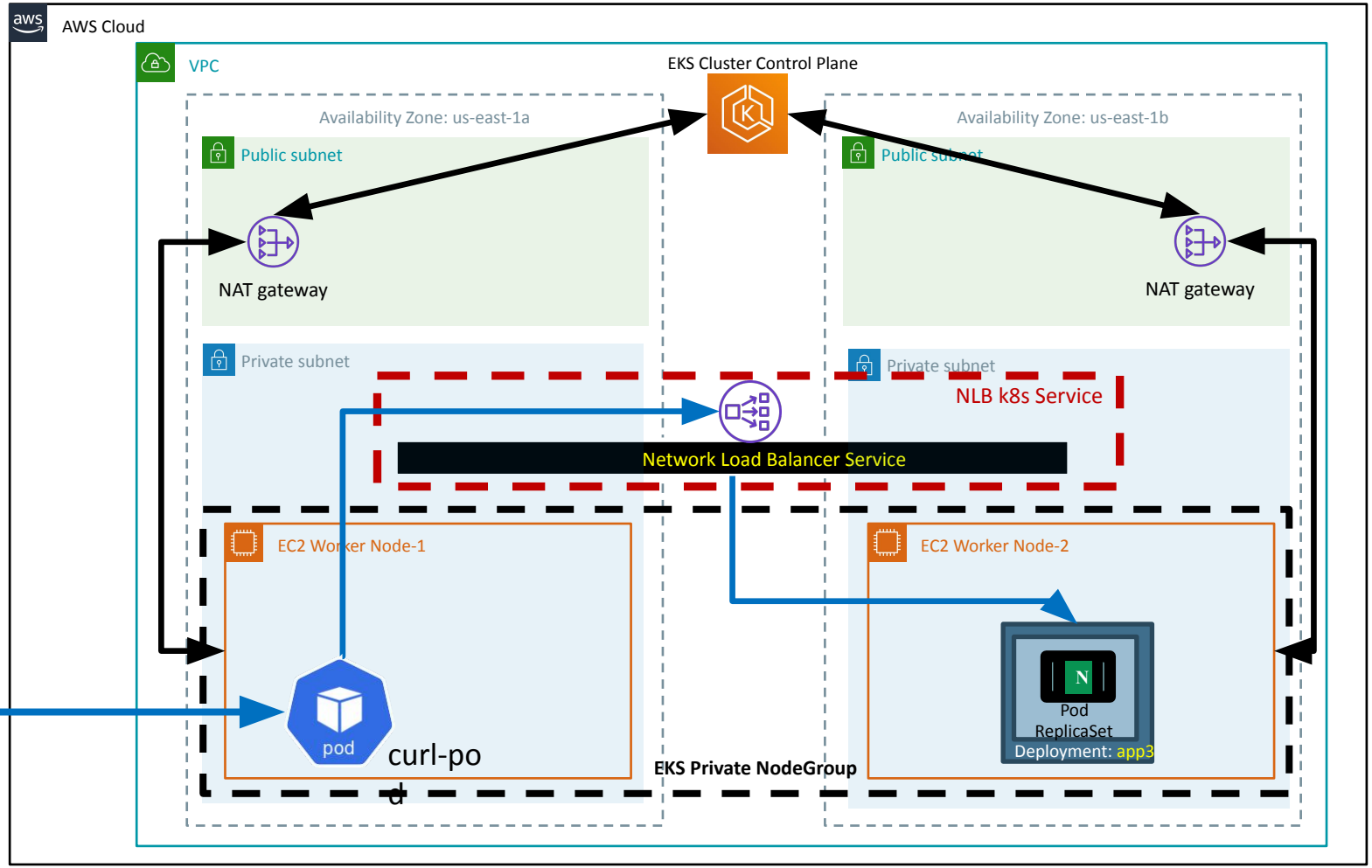
Kubernetes Service

Network Load Balancer

Internal LB


AWS EKS NLB – Internal LB
k8s admin using kubectl client
AWS Cloud
AWS EKS Cluster
Listener: 80
LB Type: External
Target-Type: Instance
Health Check Settings
Scheme: internal
AWS Network Load Balancer
svc
pod
curl-pod
Kubernetes Load Balancer Service
pod
deploy
Nginx App3
k8s Api Server
api
AWS Load Balancer Controller
svc
pod
deploy
k8s admin using kubectl client

AWS EKS Network Design With Network Load Balancer Internal



AWS EKS NLB - Internal

```
# Access Control
service.beta.kubernetes.io/aws-load-balancer-scheme: "internal"
```

Curl Pod

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: curl-pod
spec:
  containers:
  - name: curl
    image: curlimages/curl
    command: [ "sleep", "600" ]
```

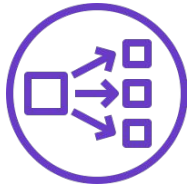
We cannot connect to Internal LB directly from internet to test it.

We will deploy a curl pod in EKS Cluster so we can connect to curl pod in EKS Cluster and test the Internal LB Endpoint using curl command.

Command to Test AWS Internal NLB using curl pod

```
# Deploy curl-pod
kubectl apply -f kube-manifests-curl

# Will open up a terminal session into the container
kubectl exec -it curl-pod -- sh

# We can now curl external addresses or internal services:
curl http://google.com/
curl <INTERNAL-NETWORK-LB-DNS>

# Internal Network LB Curl Test
curl lbc-network-lb-internal-demo-7031ade4ca457080.elb.us-east-1.amazonaws.com
```

Elastic Load Balancing



Network Load Balancer

Kubernetes Service

External DNS

AWS EKS

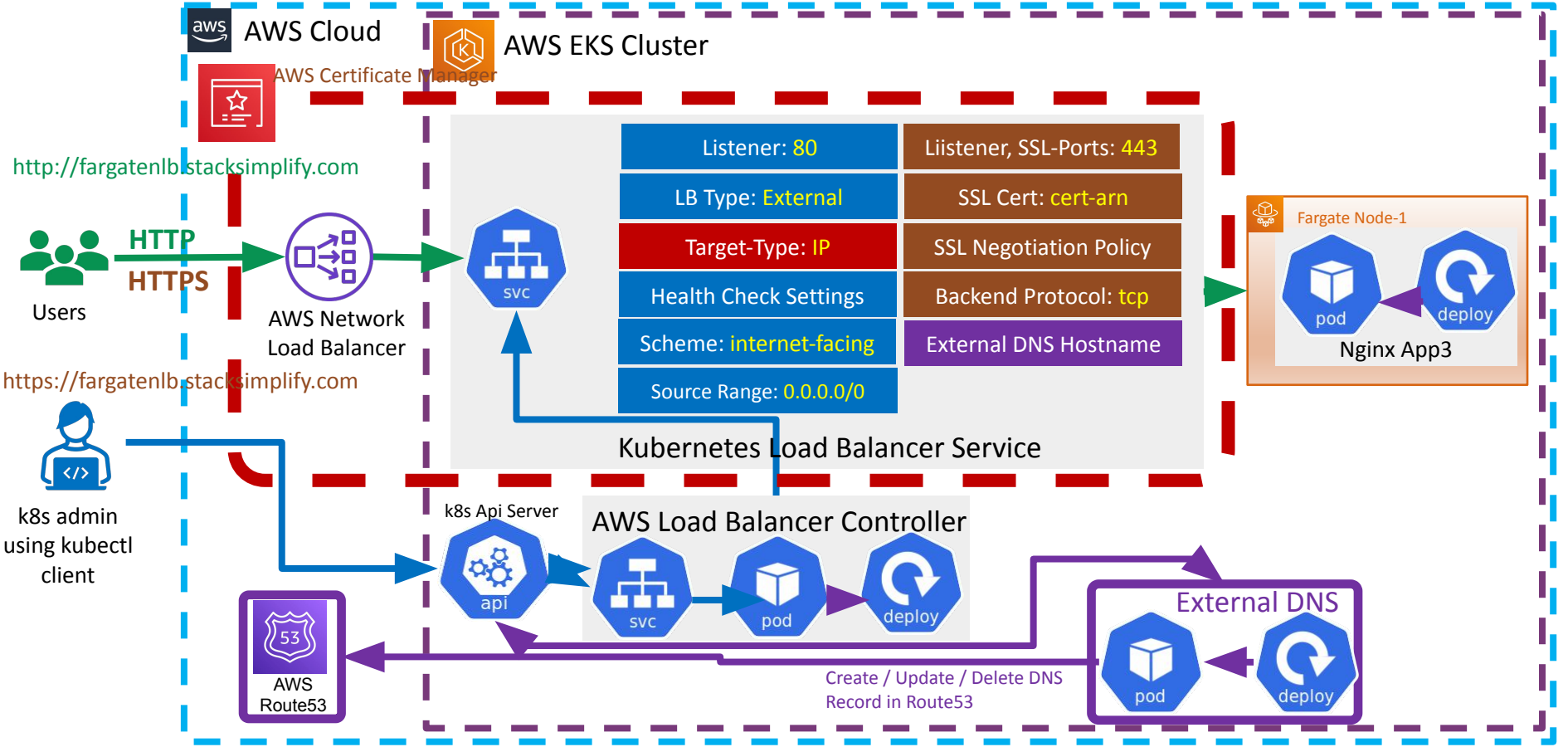
Load Balancer Controller

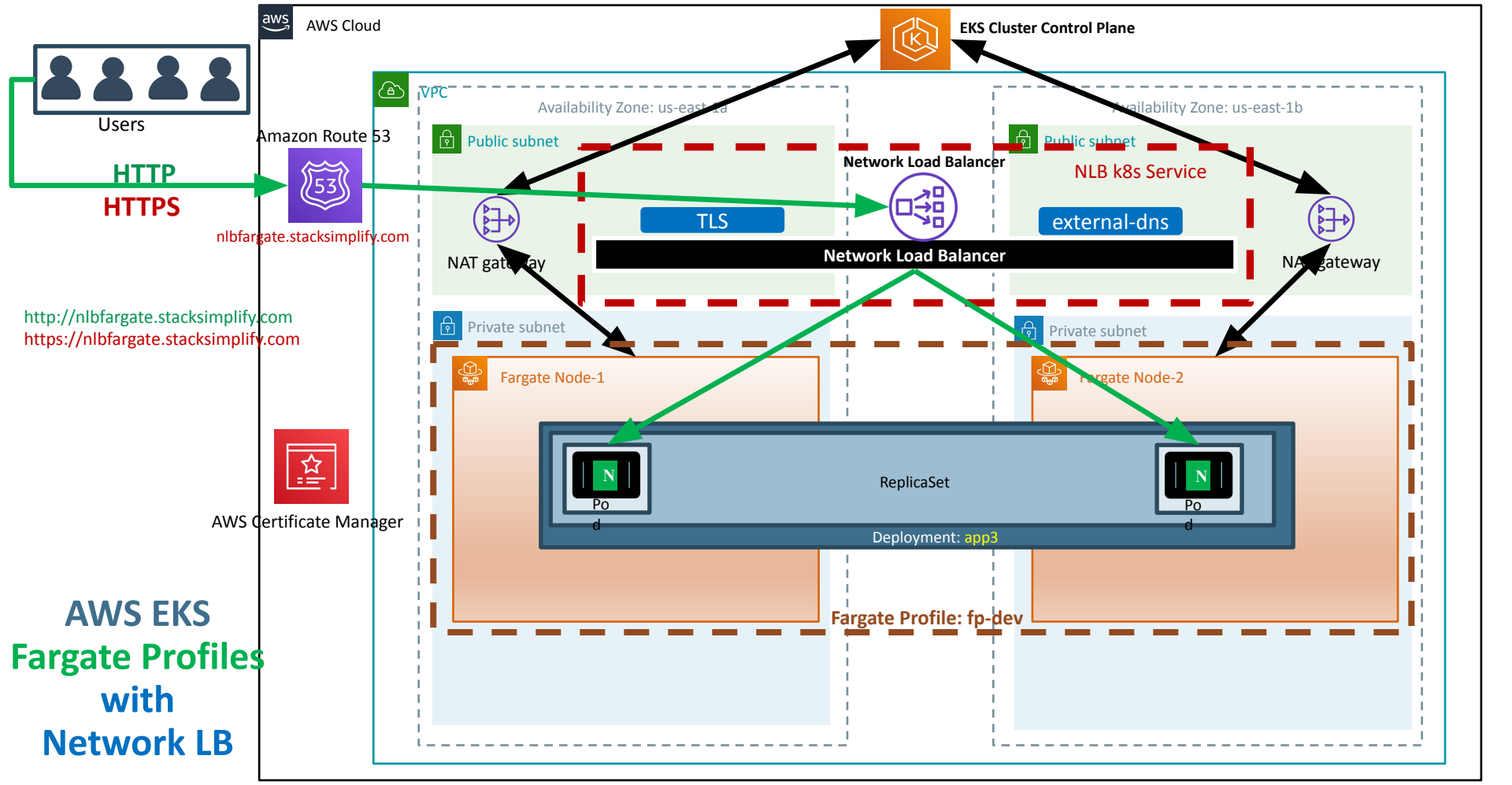
Kubernetes Service

Network Load Balancer

with Workload running on Fargate

AWS EKS NLB – Fargate Workloads




AWS Cloud
EKS Cluster Control Plane
Users
HTTP
HTTPS
Amazon Route 53
nlbfargate.stacksimplify.com
VPC
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Network Load Balancer
NLB k8s Service
TLS
external-dns
NAT gateway
Network Load Balancer
NAT gateway
http://nlbfargate.stacksimplify.com
https://nlbfargate.stacksimplify.com
Private subnet
Private subnet
Fargate Node-1
Fargate Node-2
ReplicaSet
Pod
Pod
Deployment: app3
AWS Certificate Manager
Fargate Profile: fp-dev
AWS EKS
Fargate Profiles
with
Network LB

AWS EKS NLB – Fargate Workloads

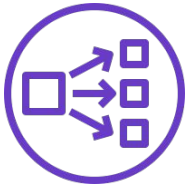
```
service.beta.kubernetes.io/aws-load-balancer-nlb-target-type: ip
```

Pod IP Address will be directly registered as targets in NLB Load Balancer Target Groups when we use Target Type as IP Mode

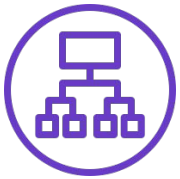
AWS Load Balancer Controller & AWS Network Load Balancer – NEW TOPIC ADDITION - END

Elastic Load Balancing

Classic Load Balancer



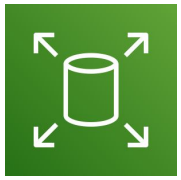
Network Load Balancer



Application Load Balancer

Certificate Manager

Route53



Elastic Block Store

Amazon RDS

AWS EKS

ECR

Elastic Container Registry

Fargate Profiles

Elastic Container Registry

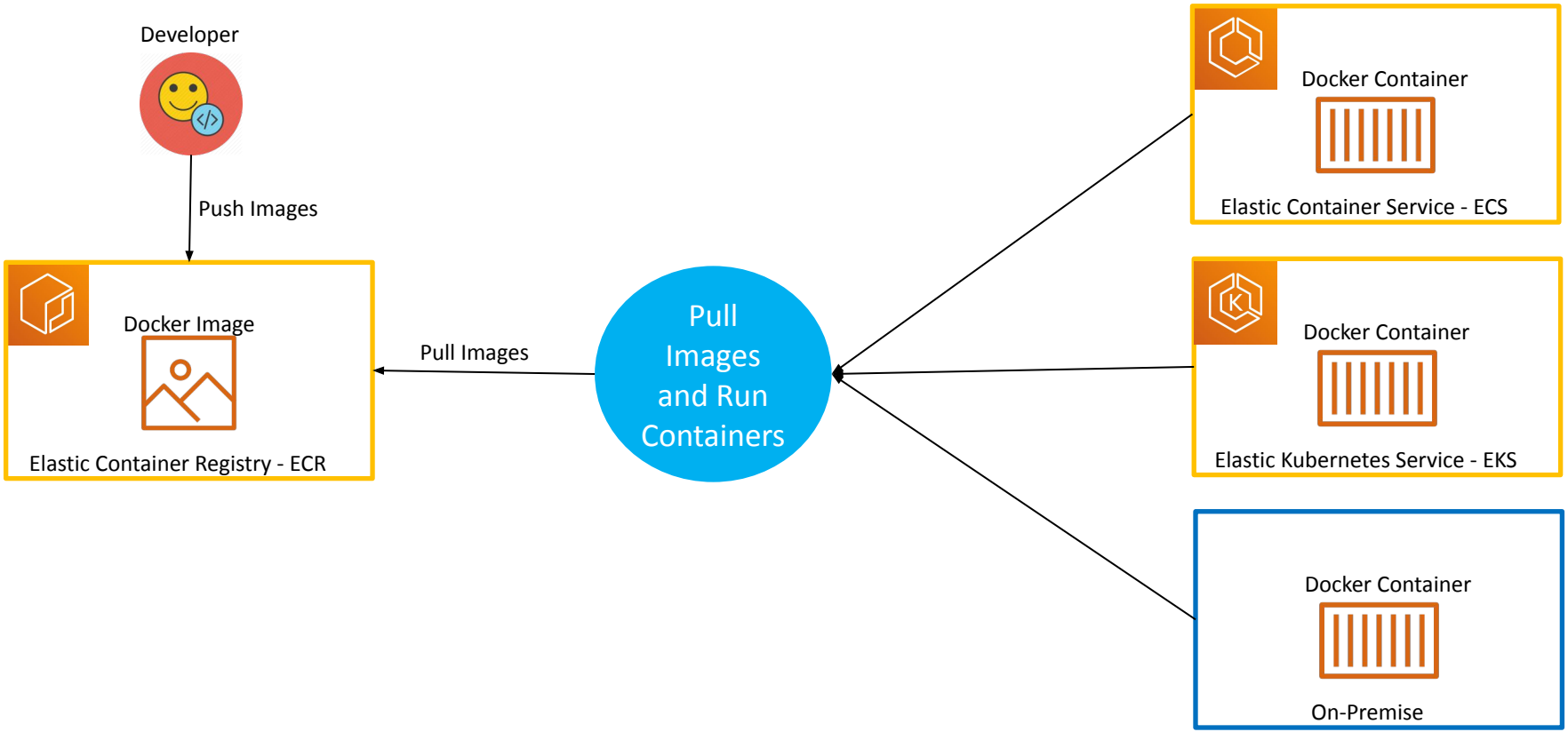
Elastic Container Registry - ECR

- Elastic Container Registry (ECR) is a fully-managed Docker container registry that makes it easy for developers to store, manage, and deploy Docker container images.
- ECR is integrated with Elastic Kubernetes Service (EKS), simplifying our development to production workflow.
- ECR eliminates the need to operate our own container repositories or worry about scaling the underlying infrastructure.
- ECR hosts our images in a highly available and scalable architecture, allowing us to reliably deploy containers for our applications.
- Integration with AWS Identity and Access Management (IAM) provides resource-level control of each repository.
- With Amazon ECR, there are no upfront fees or commitments. We pay only for the amount of data you store in your repositories and data transferred to the Internet.

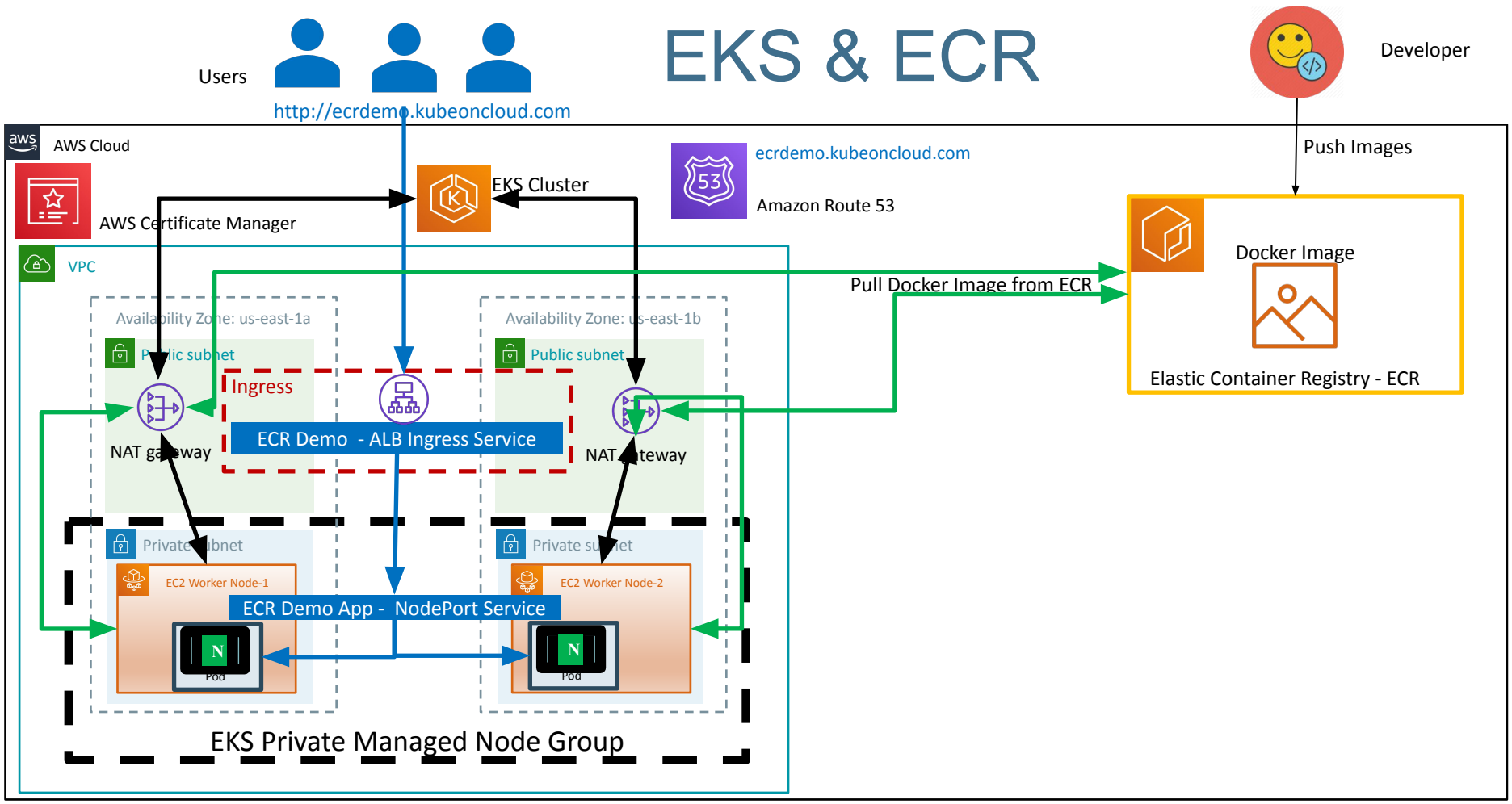
Elastic Container Registry - ECR

- Benefits
  - Full managed
  - Secure
  - Highly Available
  - Simplified Workflow

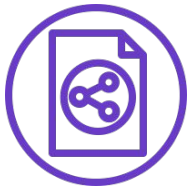
How ECR Works?



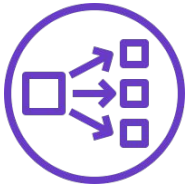
EKS & ECR


Users
http://ecrdemo.kubeoncloud.com
Developer
Push Images
AWS Cloud
AWS Certificate Manager
EKS Cluster
ecrdemo.kubeoncloud.com
Amazon Route 53
VPC
Pull Docker Image from ECR
Docker Image
Elastic Container Registry - ECR
Availability Zone: us-east-1a
Availability Zone: us-east-1b
Public subnet
Public subnet
Ingress
ECR Demo - ALB Ingress Service
NAT gateway
NAT gateway
Private subnet
Private subnet
EC2 Worker Node-1
EC2 Worker Node-2
ECR Demo App - NodePort Service
Pod
Pod
EKS Private Managed Node Group

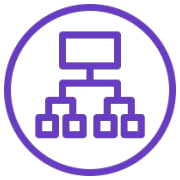
Elastic Load Balancing



Classic Load Balancer



Network Load Balancer



Application Load Balancer

Certificate Manager

Route53

Elastic Block Store

Amazon RDS

AWS EKS

&

AWS Developer Tools

Fargate Profiles

Elastic Container Registry

Code Commit

Code Build

Code Pipeline

Stages in Release Process

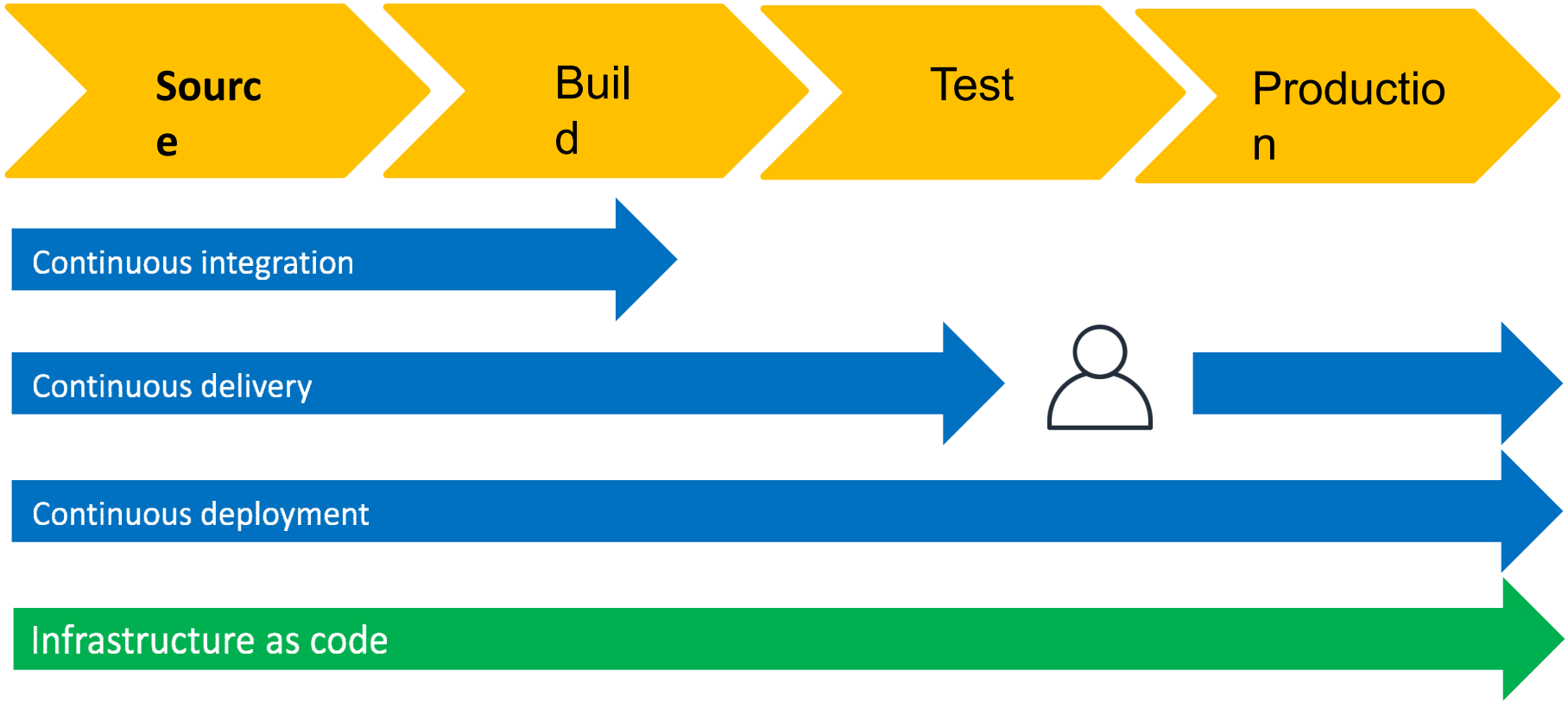
- Check-in source code
- Peer review new code
- Pull Request process

- Compile Code & build artifacts (war ,jar, container images, Kubernetes manifest files)
- Unit Tests

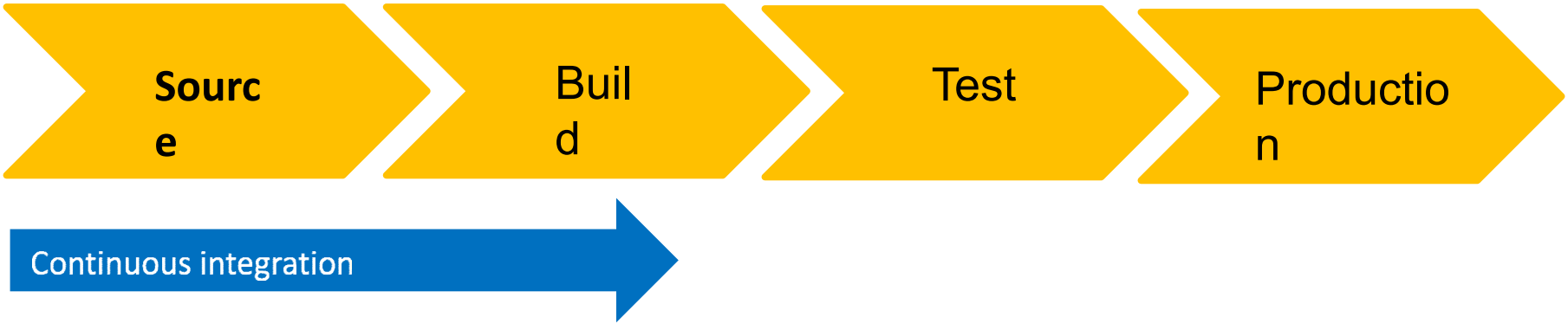
- Integration tests with other systems.
- Load Testing
- UI Tests
- Security Tests
- Test Environments (Dev, QA and Staging)

- Deployment to production environments
- Monitor code in production to quickly detect errors

Stages in Release Process



Continuous Integration

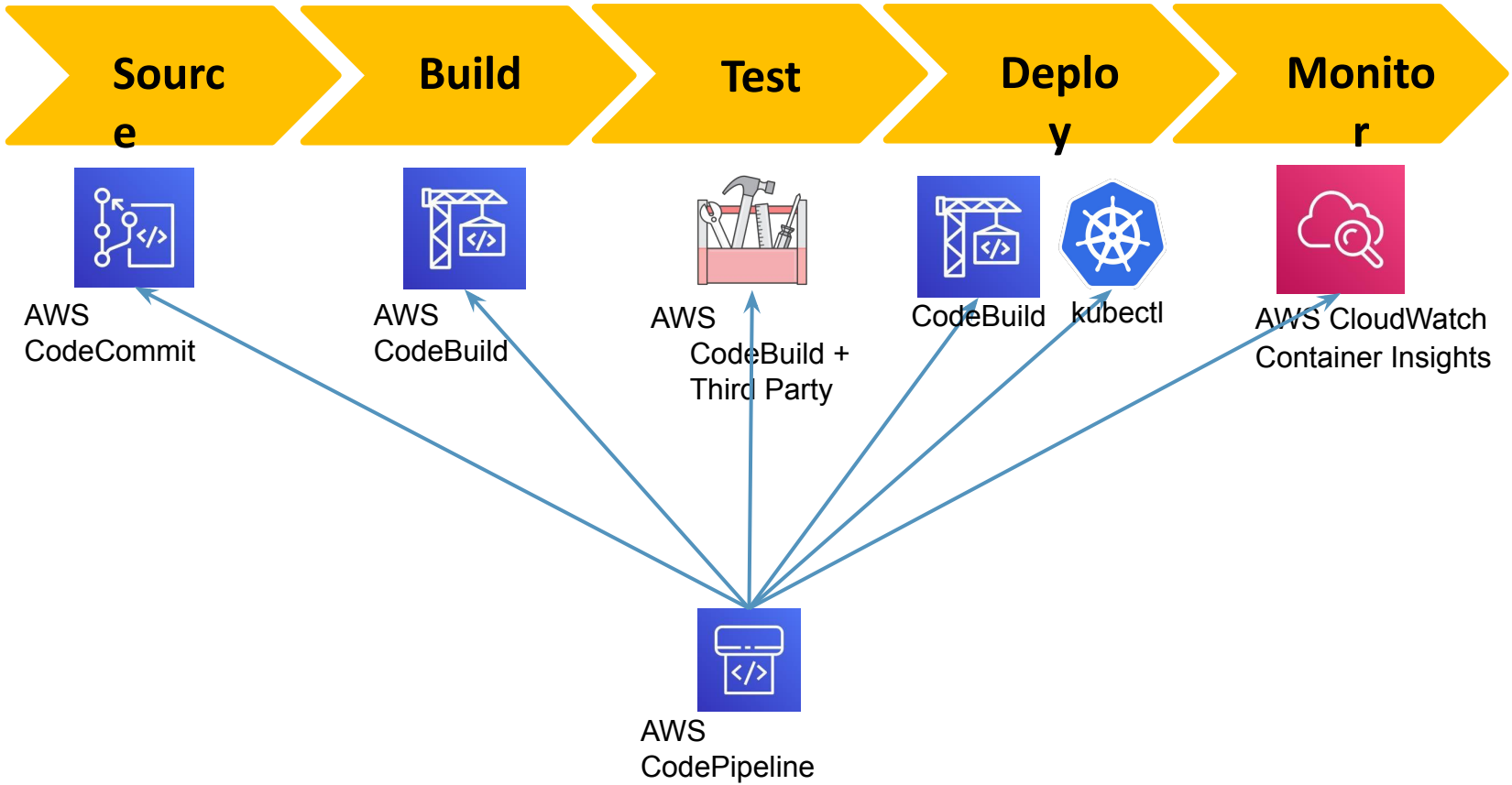


- Automatically kick off a new release when new code is checked- in
- Build and test code in a consistent, repeatable environment
- Continually have an artifact ready for deployment

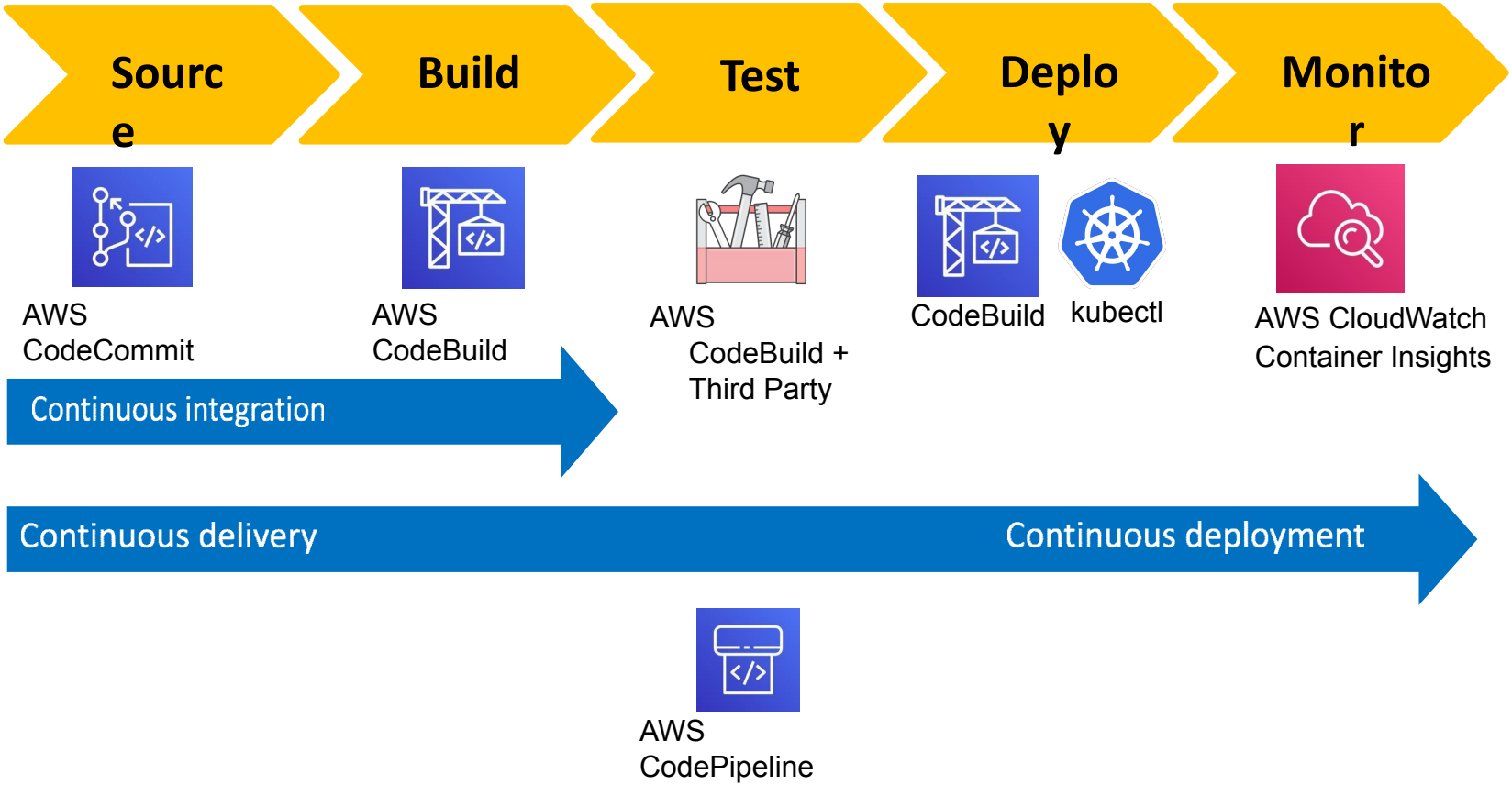
Continuous Delivery

- Automatically deploy new changes to staging environments for testing
- Deploy to production safely without affecting customers
- Deliver to customers faster
- Increase deployment frequency, and reduce change lead time and change failure rate

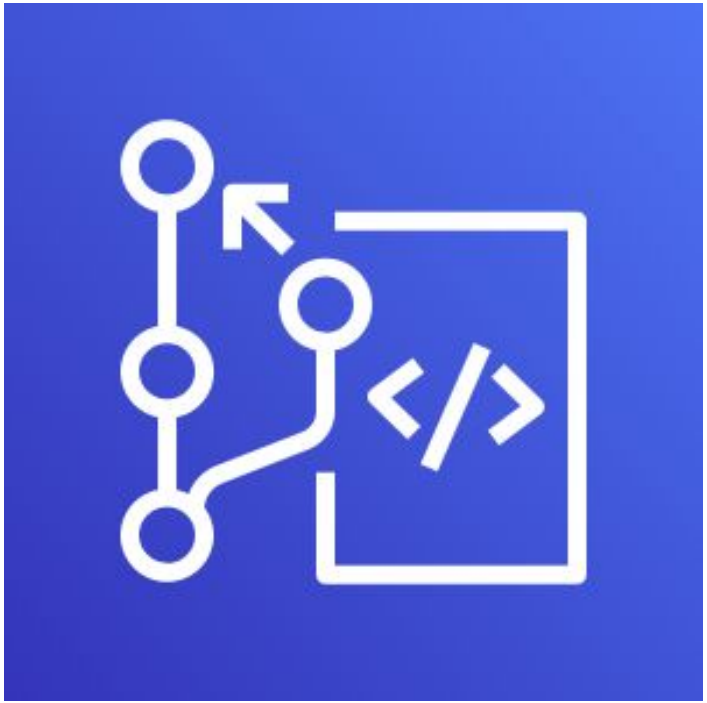
AWS Developer Tools or Code Services



AWS Developer Tools or Code Services



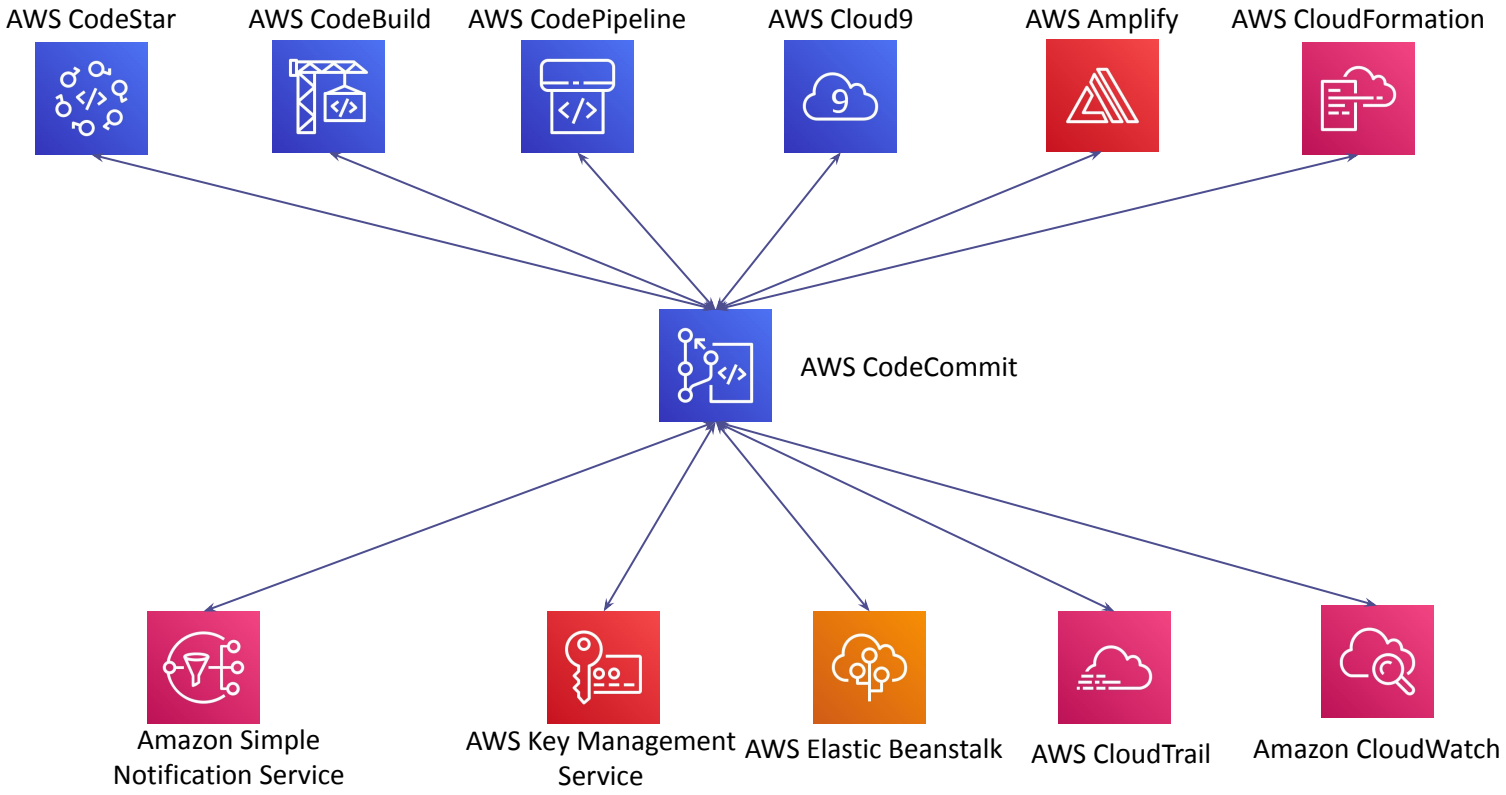
AWS CodeCommit



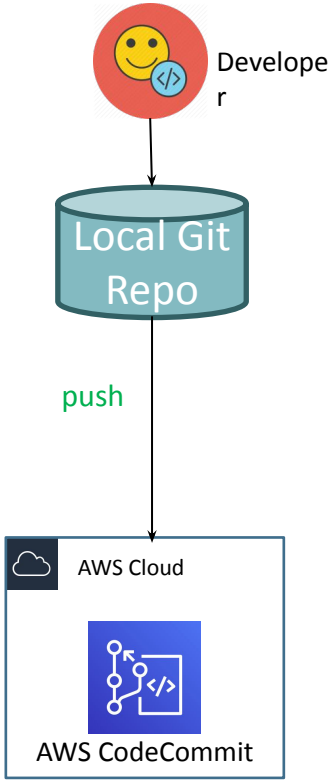
AWS CodeCommit - Introduction

- Version Control Service hosted by AWS
- We can privately store and manage documents, source code, and binary files
- Secure & highly scalable
- Supports standard functionality of Git (CodeCommit supports Git versions 1.7.9 and later.)
- Uses a static user name and password in addition to standard SSH..

CodeCommit – Integration with AWS Services



CodeCommit - Steps

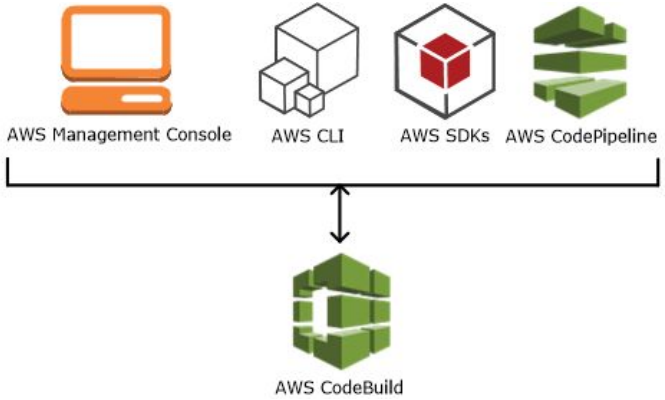


AWS CodeBuild

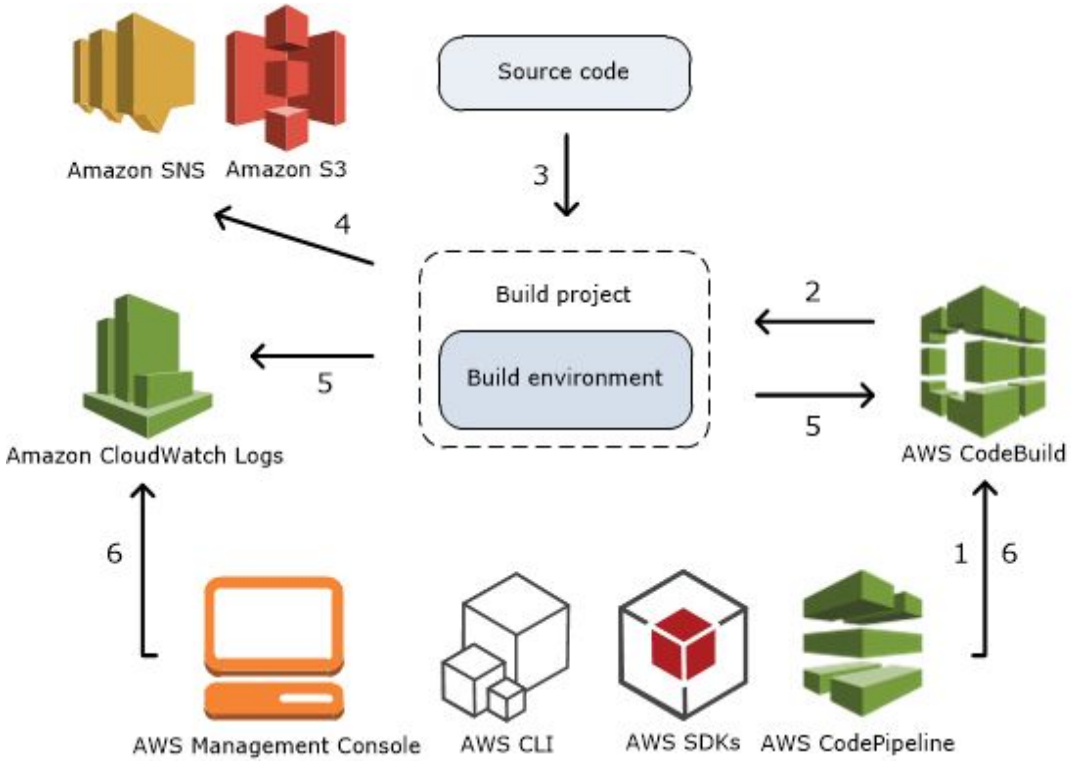
CodeBuild - Introduction

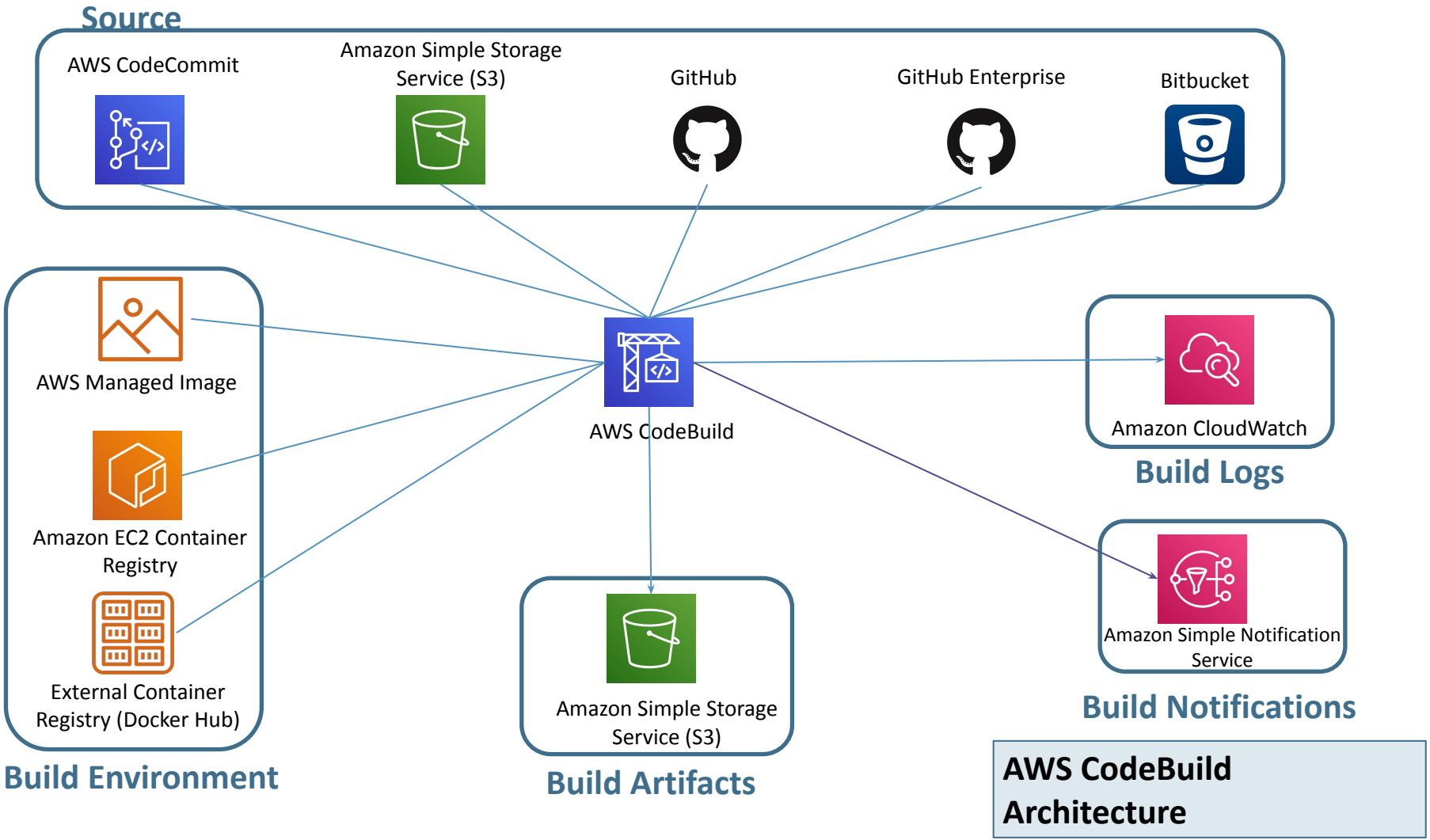
- CodeBuild is a fully managed build service in the cloud.
- Compiles our source code, runs unit tests, and produces artifacts that are ready to deploy.
- Eliminates the need to provision, manage, and scale our own build servers.
- It provides prepackaged build environments for the most popular programming languages and build tools such as Apache Maven, Gradle, and many more.
- We can also customize build environments in CodeBuild to use our own build tools.
- Scales automatically to meet peak build requests.

How to run CodeBuild?

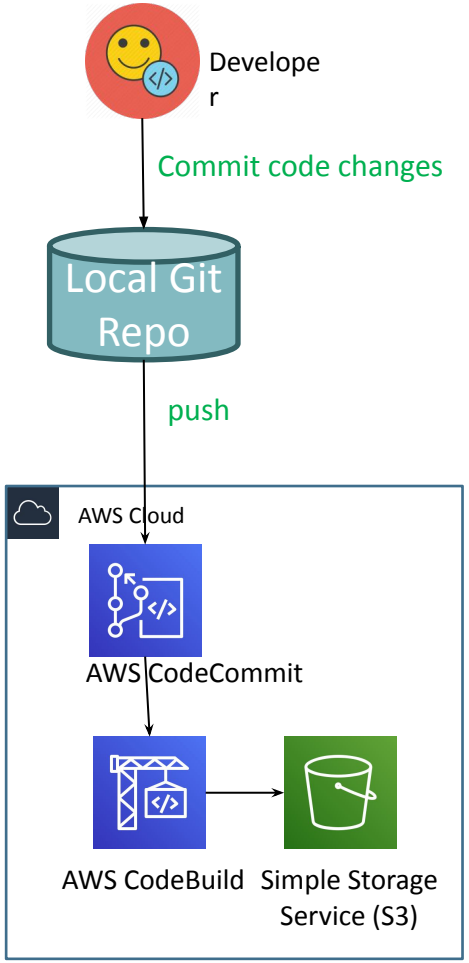


How CodeBuild works?




Source
AWS CodeCommit
Amazon Simple Storage Service (S3)
GitHub
GitHub Enterprise
Bitbucket
AWS Managed Image
Amazon EC2 Container Registry
External Container Registry (Docker Hub)
Build Environment
AWS CodeBuild
Amazon CloudWatch
Build Logs
Amazon Simple Notification Service
Build Notifications
Amazon Simple Storage Service (S3)
Build Artifacts
AWS CodeBuild Architecture

CodeBuild - Steps



AWS CodePipeline

CodePipeline - Introduction

- AWS CodePipeline is a continuous delivery service to model, visualize, and automate the steps required to release your software.
- Benefits
  - We can automate our release processes.
  - We can establish a consistent release process.
  - We can speed up delivery while improving quality.
  - Supports external tools integration for source, build and deploy.
  - View progress at a glance
  - View pipeline history details.

AWS CodePipeline Architecture

AWS CodePipeline

AWS CodeCommit

Amazon EC2 Container Registry

Simple Storage Service (S3)

GitHub

Source

AWS CodeBuild

Jenkins

Build

AWS CloudFormation

AWS CodeDeploy

AWS Elastic Beanstalk

AWS Service Catalog

Amazon Elastic Container Service

Amazon Elastic Container Service (Blue/Green)

Simple Storage Service (S3)

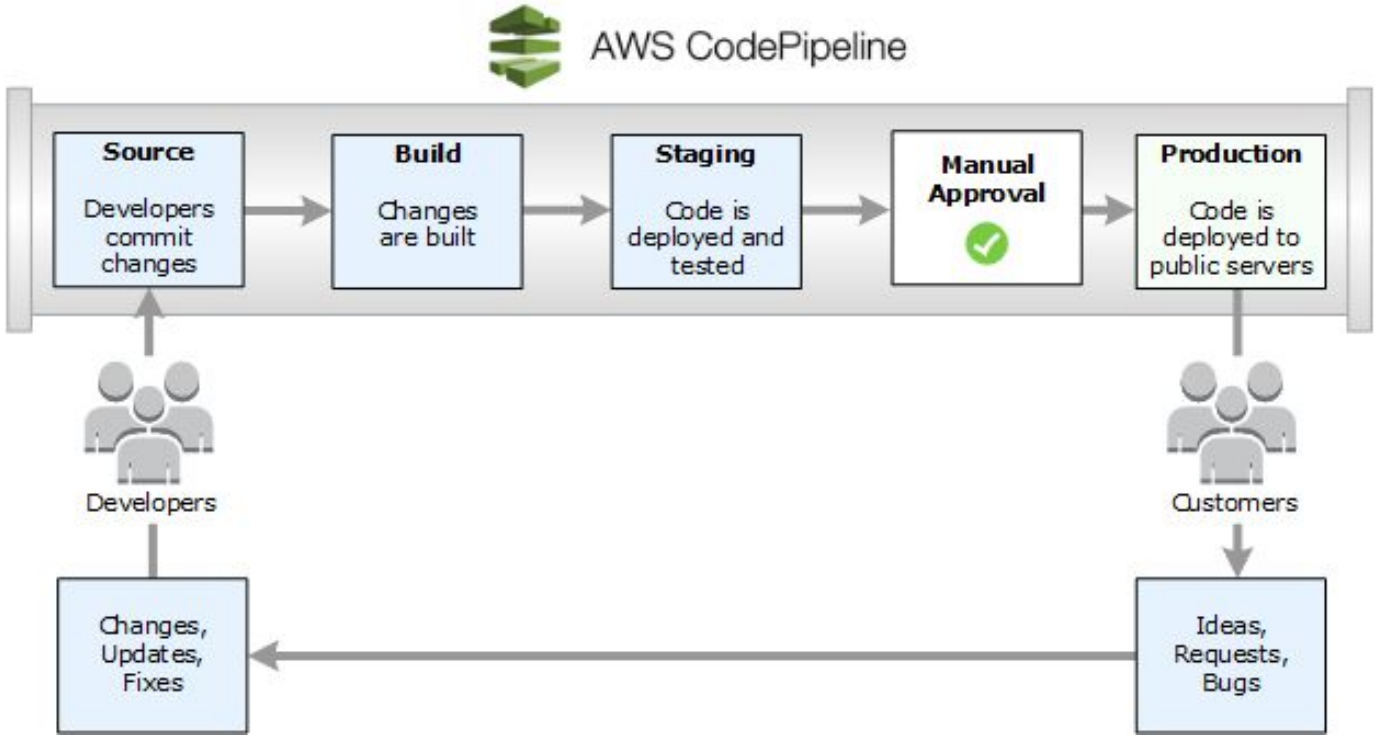
Deploy

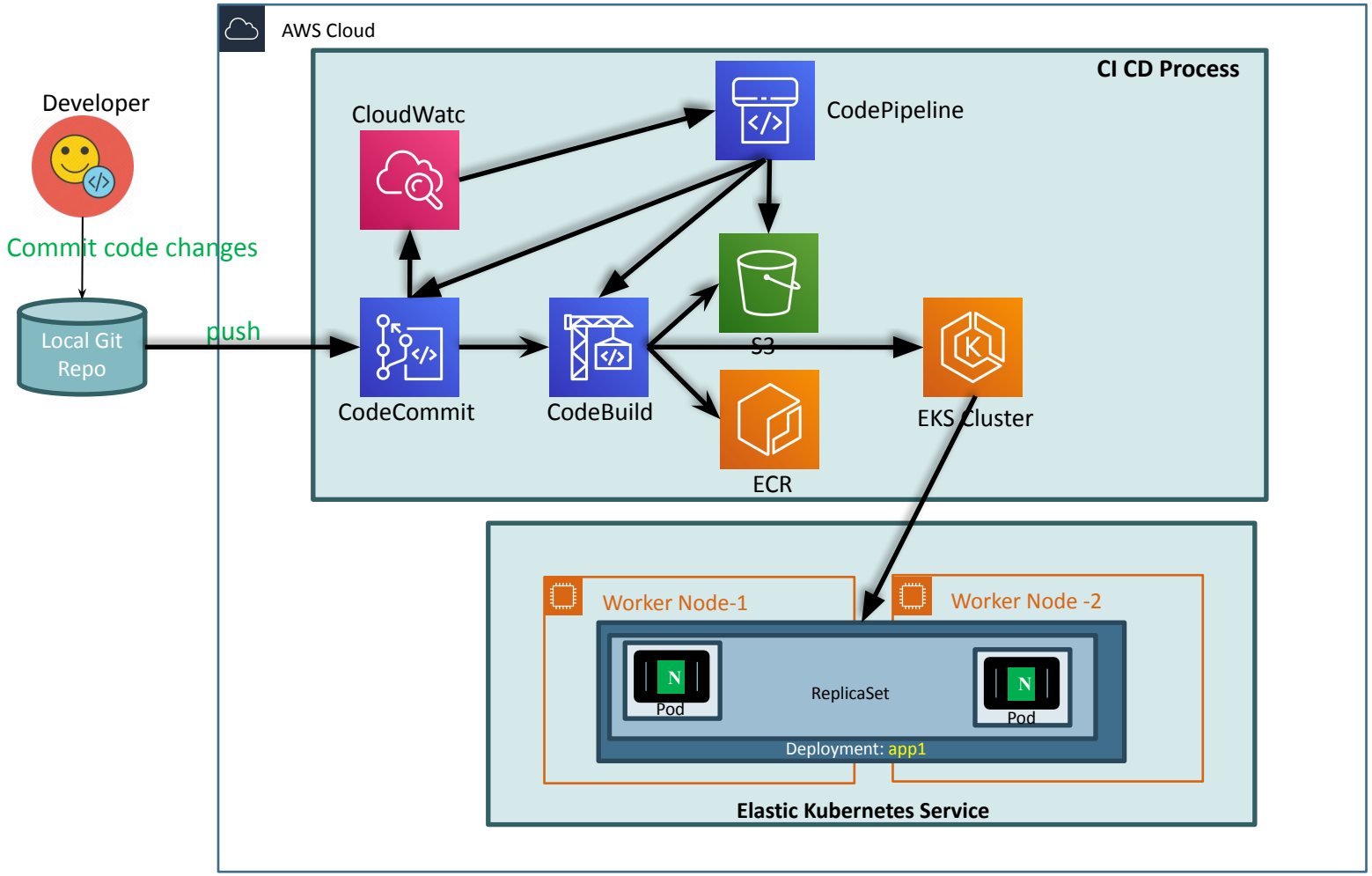
Amazon CloudWatch

GitHub Webhooks

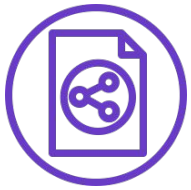
Monitor Source Changes

Continuous Delivery

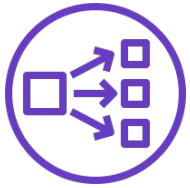



AWS Cloud
CI CD Process
Developer
Commit code changes
Local Git Repo
push
CloudWatc
CodePipeline
S3
CodeCommit
CodeBuild
ECR
EKS Cluster
Worker Node-1
Worker Node -2
Pod
ReplicaSet
Pod
Deployment: app1
Elastic Kubernetes Service

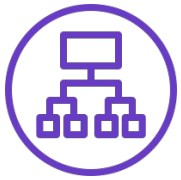
Elastic Load Balancing



Classic Load Balancer



Network Load Balancer



Application Load Balancer

Certificate Manager

Route53

Elastic Block Store

Amazon RDS

AWS EKS

What are Microservices?

Fargate Profiles

Elastic Container Registry

Code Commit

Code Build

Code Pipeline

Simple Email Service

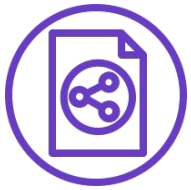
What are Microservices?

- Microservices - also known as the microservice architecture - is an architectural style that structures an application as a collection of services that are
  - Highly maintainable and testable
  - Loosely coupled
  - Independently deployable
  - Organized around business capabilities
  - Owned by a small team

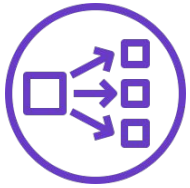
Microservices - Benefits

- **Developer independence**: Small teams work in parallel and can iterate faster than large teams.
- **Isolation and resilience**: If a component dies, you spin up another while and the rest of the application continues to function.
- **Scalability**: Smaller components take up fewer resources and can be scaled to meet increasing demand of that component only.
- **Lifecycle automation**: Individual components are easier to fit into continuous delivery pipelines and complex deployment scenarios not possible with monoliths.
- **Relationship to the business**: Microservice architectures are split along business domain boundaries, increasing independence and understanding across the organization.

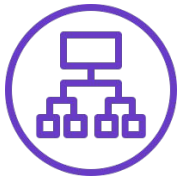
Elastic Load Balancing



Classic Load Balancer



Network Load Balancer



Application Load Balancer

Certificate Manager

Route53

Elastic Block Store

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Microservices Deployment

Fargate Profiles

Elastic Container Registry

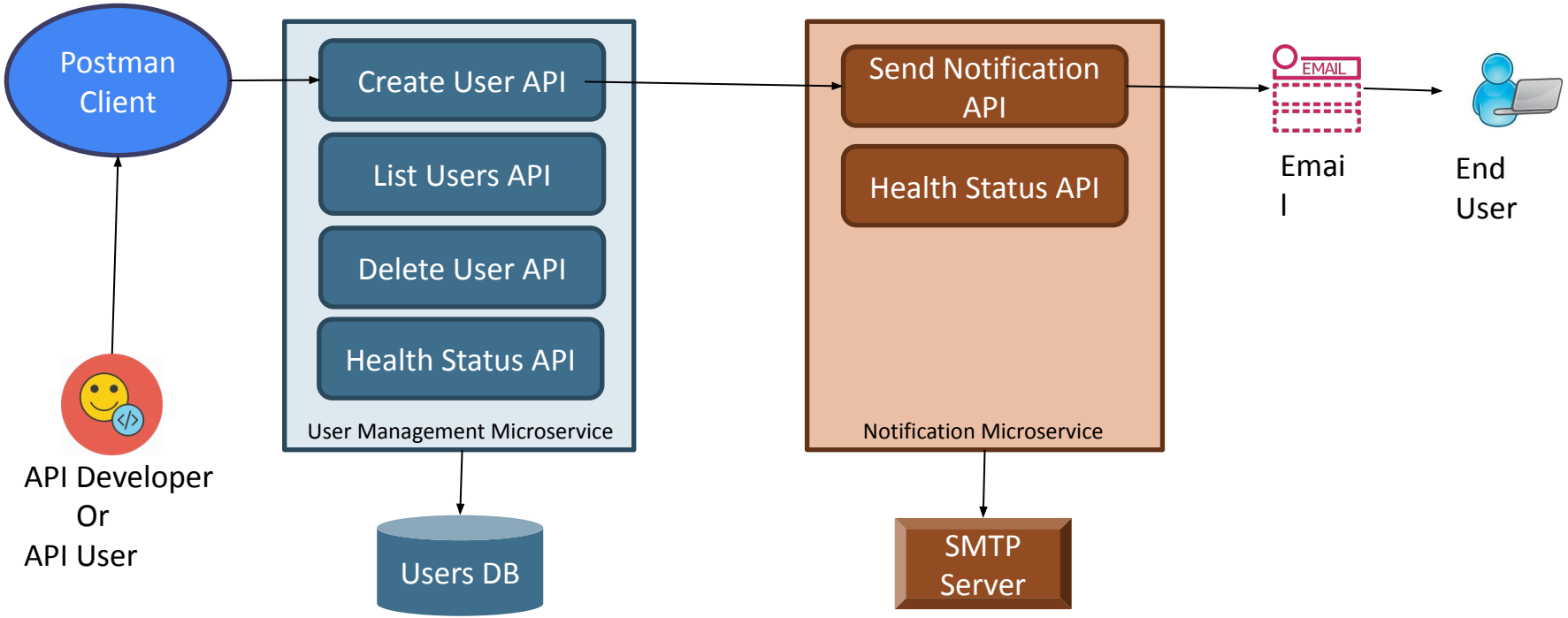
Code Commit

Code Build

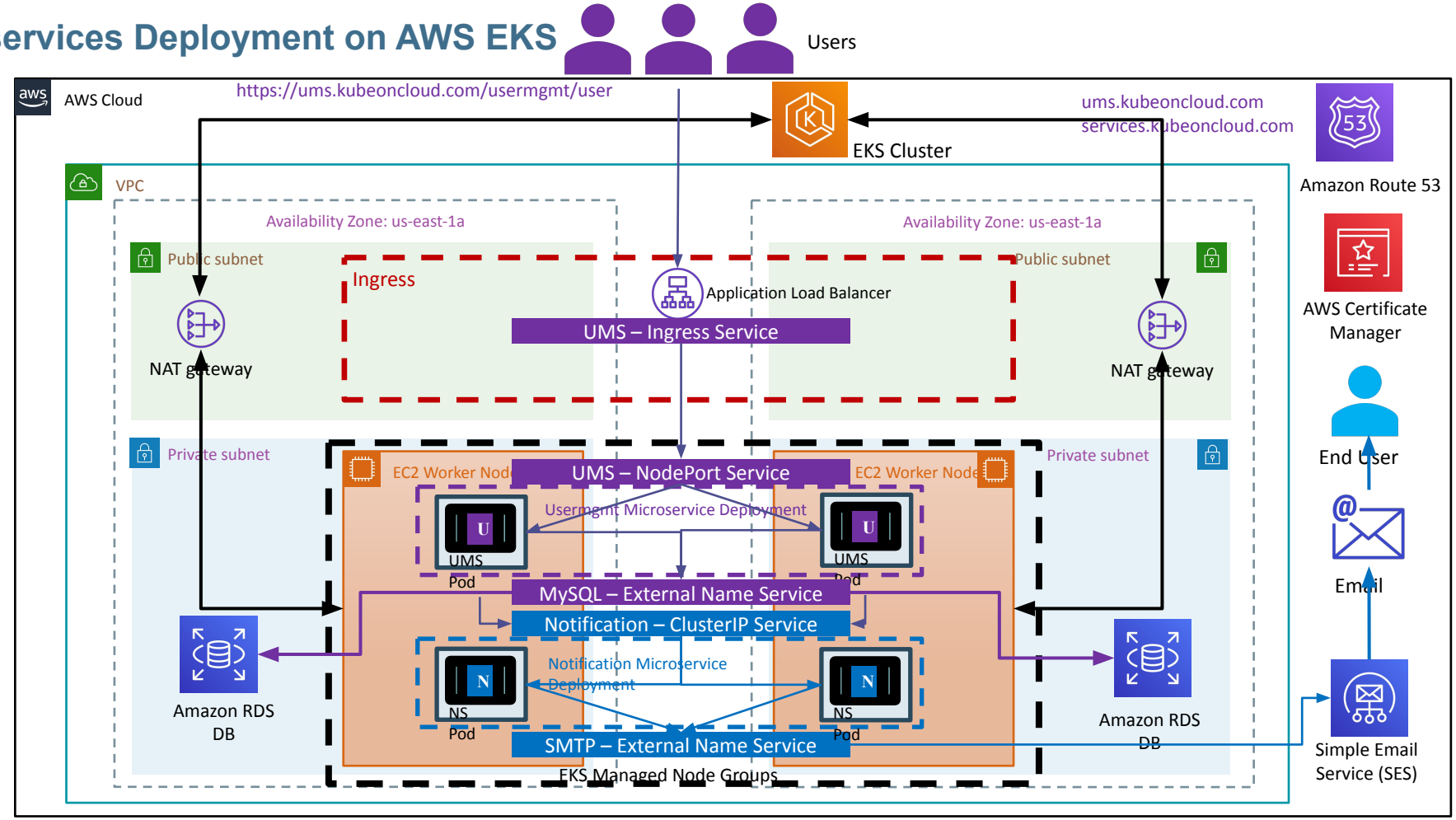
Code Pipeline

Simple Email Service

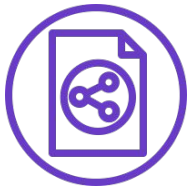
Microservices



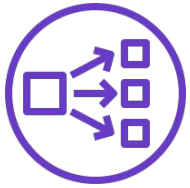
Microservices Deployment on AWS EKS



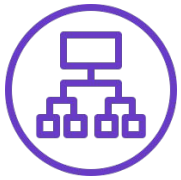
Elastic Load Balancing



Classic Load Balancer



Network Load Balancer



Application Load Balancer

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Microservices Distributed Tracing

AWS X-Ray

Fargate Profiles

Elastic Container Registry

Code Commit

Code Build

Code Pipeline

Simple Email Service

X-Ray

AWS X-Ray Introduction

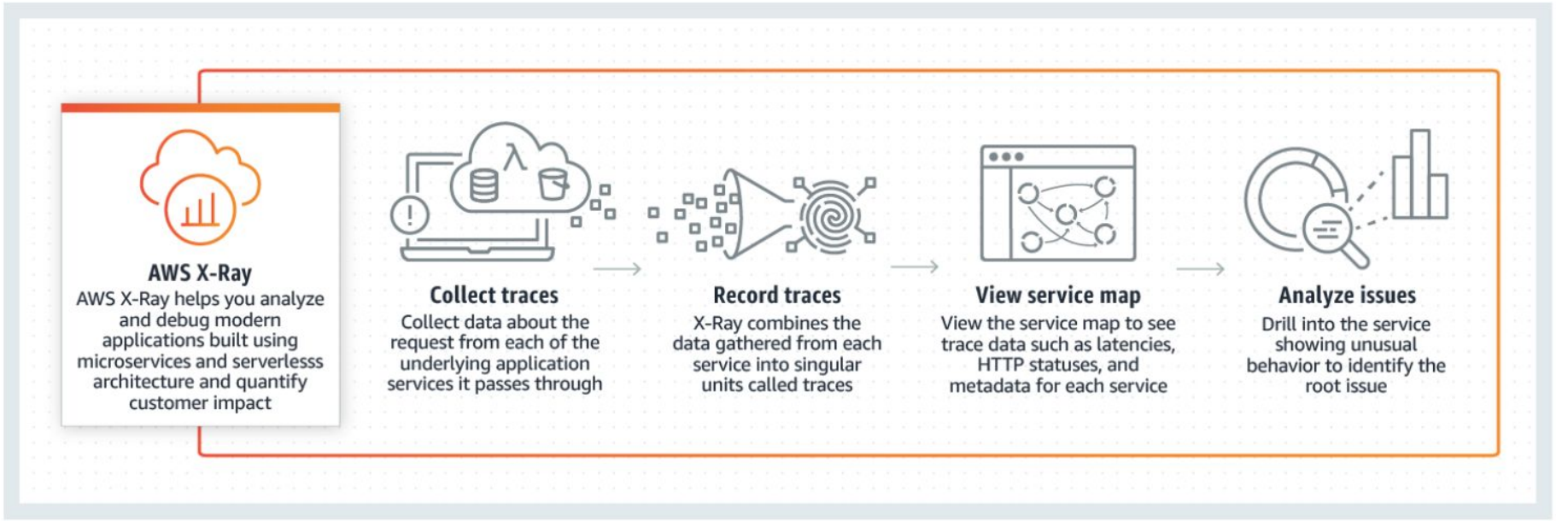
- AWS X-Ray helps analyse and debug distributed applications built using microservices architecture.
- With X-Ray, we can understand how our application and its underlying services are performing to identify and troubleshoot the root cause of performance issues and errors.
- X-Ray provides an end-to-end view of requests as they travel through our application and shows a map of our application's underlying components.
- We can also use X-Ray to analyse applications in development and in production, from simple three-tier applications to complex microservices applications consisting of thousands of services.

AWS X-Ray - Benefits

- Review request behavior
- Discover application issues
- Improve application performance
- Ready to use with AWS
- Designed for a variety of applications

AWS X-Ray – How it works?

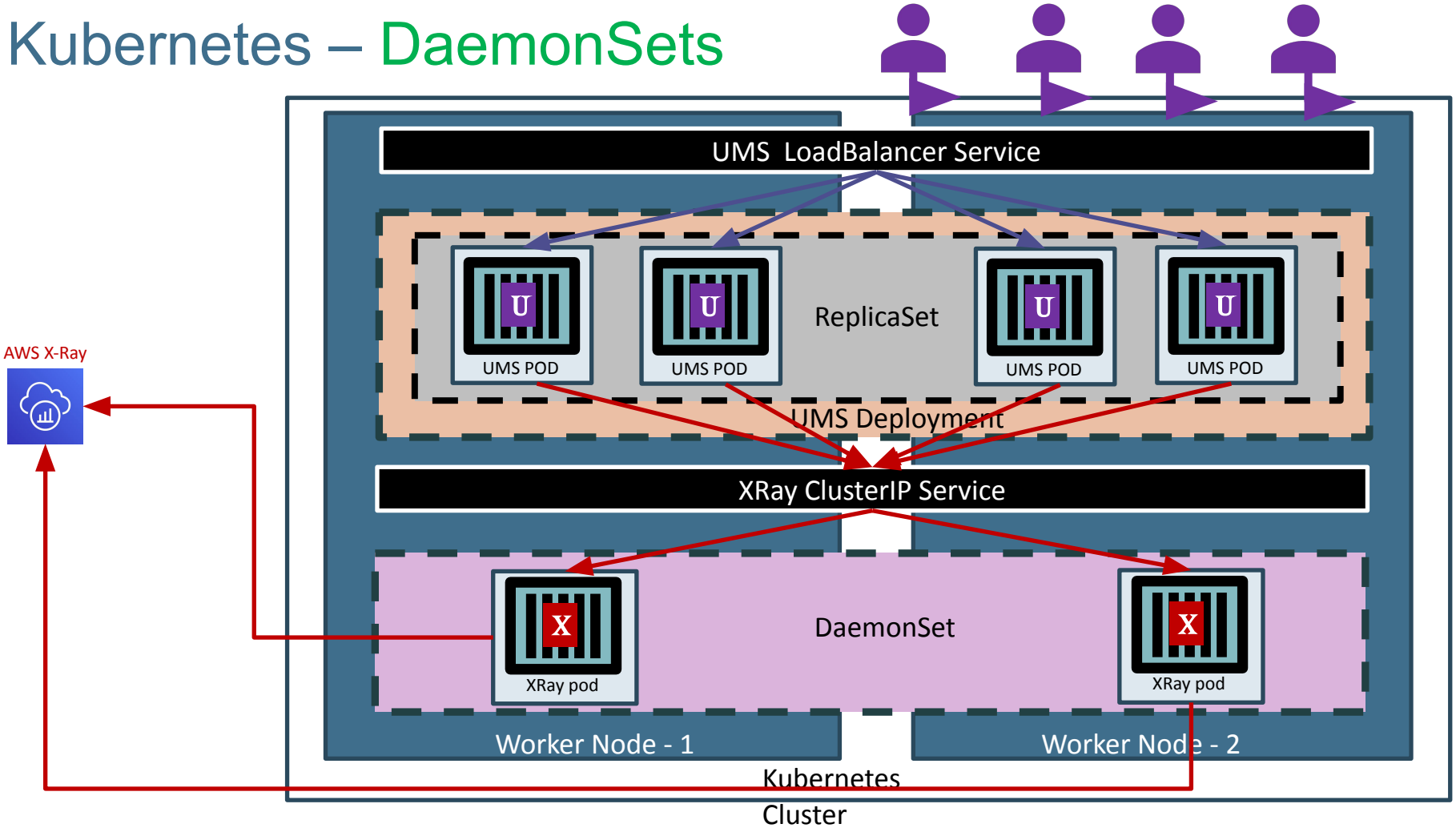
How it works



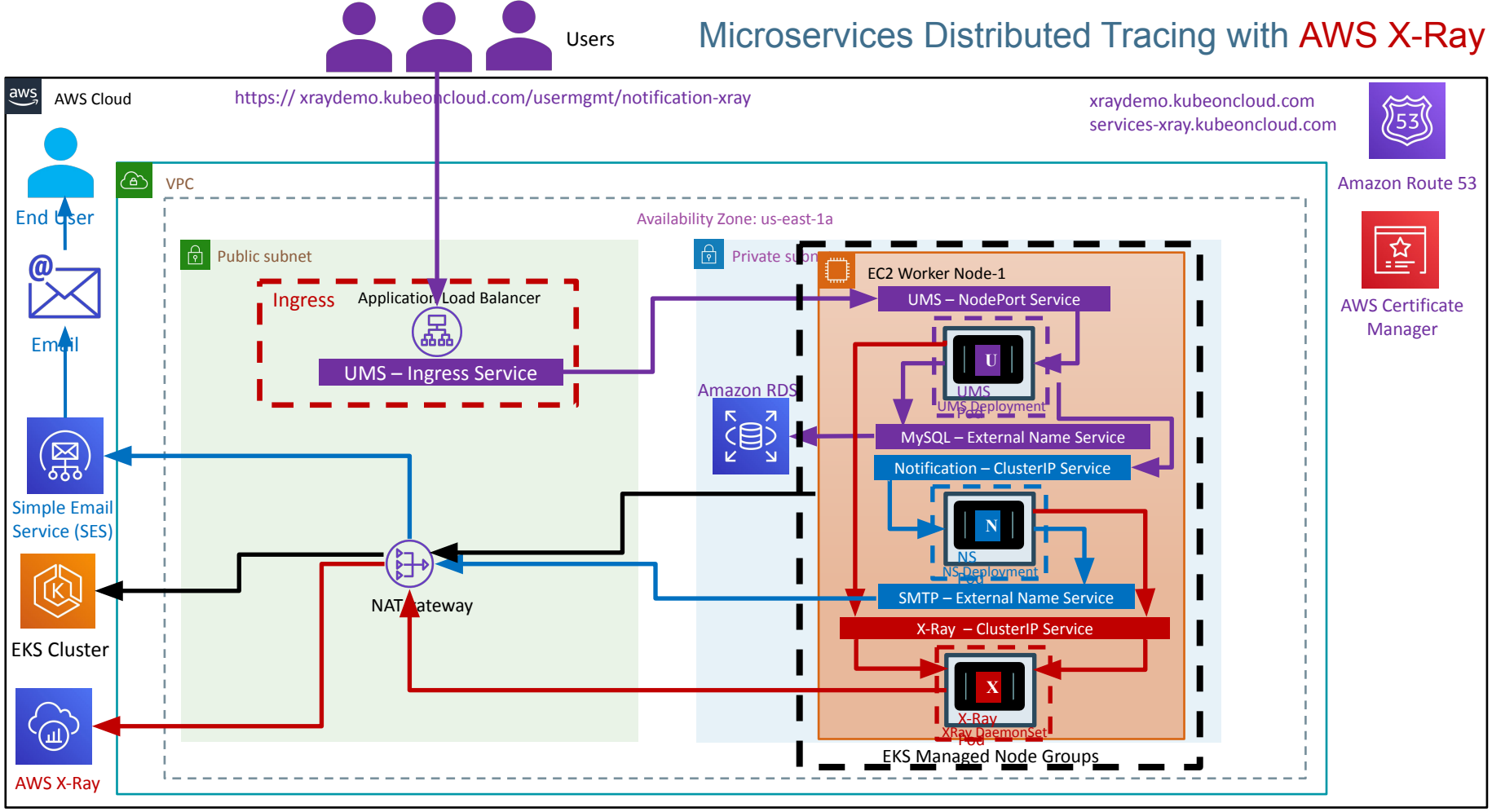
Kubernetes DaemonSets - Introduction

- A *DaemonSet* ensures that all (or some) Nodes run a copy of a Pod.
  - As nodes are added to the cluster, Pods are added to them.
  - As nodes are removed from the cluster, those Pods are garbage collected.
  - Deleting a DaemonSet will clean up the Pods it created.
- Some typical uses of a DaemonSet are:
  - running a logs collection daemon on every node (Example: fluentd)
  - running a node monitoring daemon on every node (Example: cloudwatchagent)
  - running an application trace collection daemon on every node (Example: AWS X-Ray)
- In a simple case, one DaemonSet, covering all nodes, would be used for each type of daemon.
- A more complex setup might use multiple DaemonSets for a single type of daemon, but with different flags and/or different memory and cpu requests for different hardware types

Kubernetes – DaemonSets

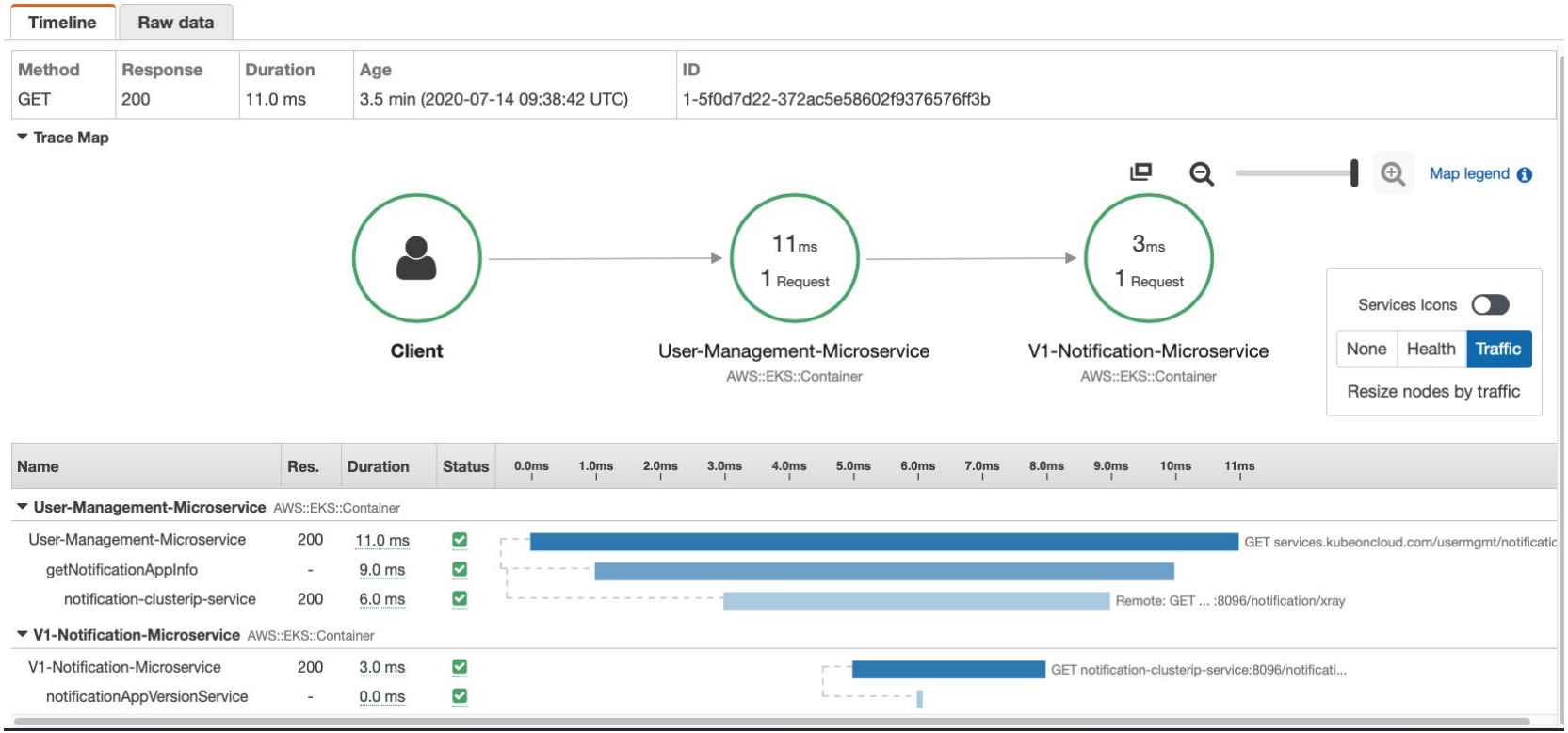


Microservices Distributed Tracing with AWS X-Ray



AWS X-Ray – Service Map

AWS X-Ray - Traces



AWS X-Ray - Traces

Segment - User-Management-Microservice

Overview | Resources | Annotations | Metadata | Exceptions

Segment ID	722d02f36eb066c4
Parent ID	
Name	User-Management-Microservice
Origin	AWS::EKS::Container

Time

Start time	2020-07-14 09:38:42.647 (UTC)
End time	2020-07-14 09:38:42.658 (UTC)
Duration	11.0 ms
In progress	false

Errors & Faults

Error	false
Fault	false

Request & Response

Request url	http://services.kubeoncloud.com/usermgmt/notification-xray
Request method	GET
Request user_agent	PostmanRuntime/7.25.0
Request client_ip	49.206.222.64
Request x_forwarded_for	true

Segment - User-Management-Microservice

Overview | Resources | Annotations | Metadata | Exceptions

CloudWatch Logs

```
[
  {
    "log_group": "/aws/containerinsights//application"
  }
]
```

EC2

Availability zone	us-east-1b
Instance ID	i-0247e0ae1264716b3
Instance size	t3.medium
Ami ID	ami-01b33458af4b31b8f

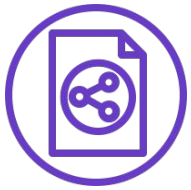
X-Ray

SDK version	2.6.1
SDK	X-Ray for Java

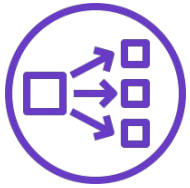
Eks

Pod	usermgmt-microservice-7598cb7fcf-txwck
Containerid	1aeabf8732ab8303eb24a138b31f963566d5d113dd571ea965f5b7ad2dd9e34a

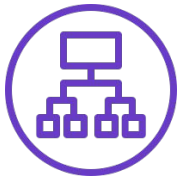
Elastic Load Balancing



Classic Load Balancer



Network Load Balancer



Application Load Balancer

Certificate Manager

Route53

Elastic Block Store

Amazon RDS

AWS EKS

Microservices

Canary Deployments

Fargate Profiles

Elastic Container Registry

Code Commit

Code Build

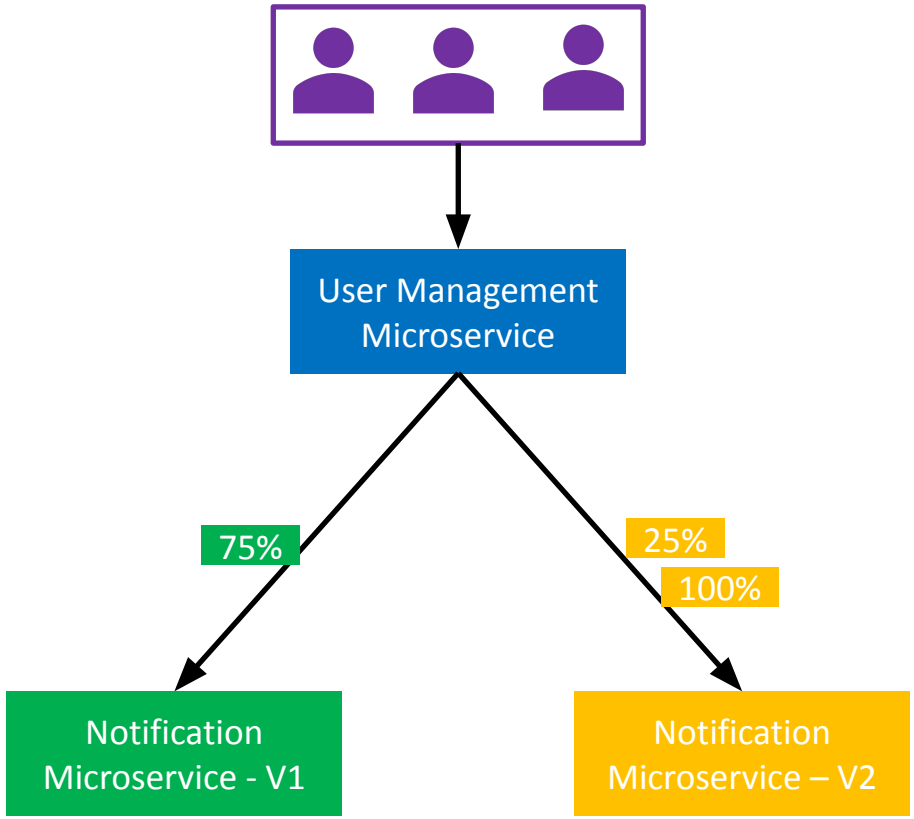
Code Pipeline

Simple Email Service

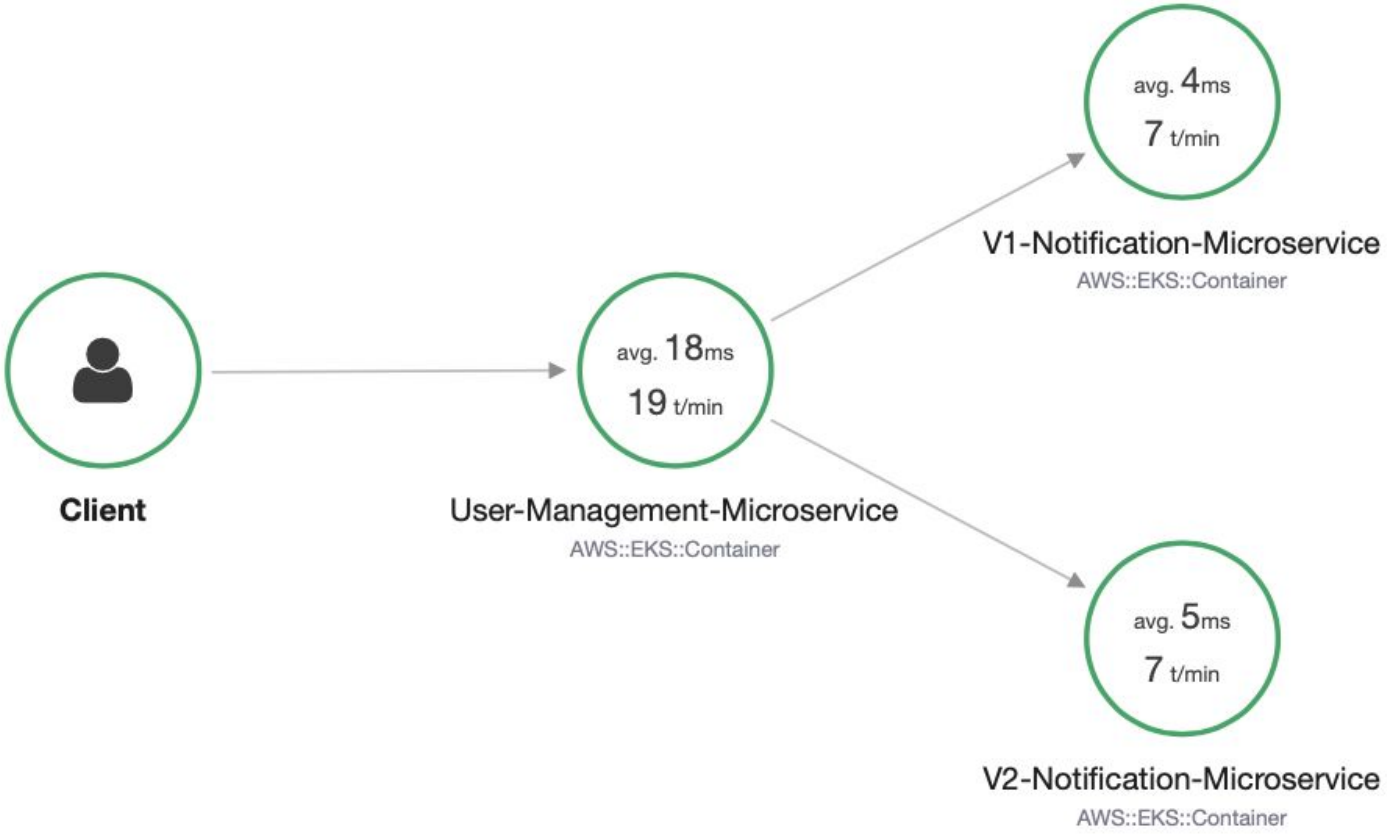
X-Ray

What are Canary Deployments?

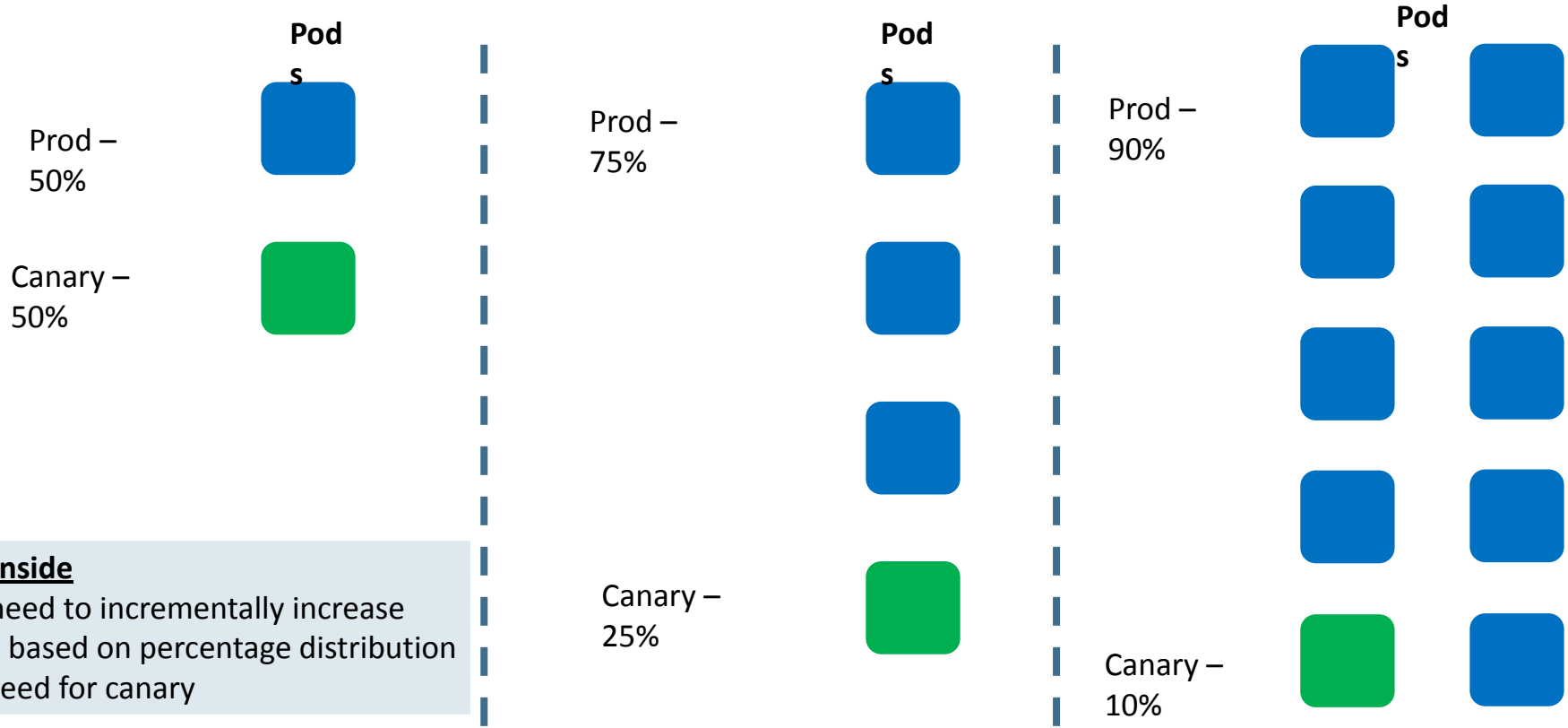
- Canaries means incremental rollouts
- With canaries, the new version of the application is slowly deployed to the Kubernetes cluster while getting a very small amount of live traffic
- In short, a subset of live users are connecting to the new version while the rest are still using the previous version
- Using canaries, we can detect deployment issues very early while they effect only a small subset of users
- If we encounter any issues with a canary, the production version is still present, and all traffic can simply be reverted to it.



Microservices – Canary Deployments



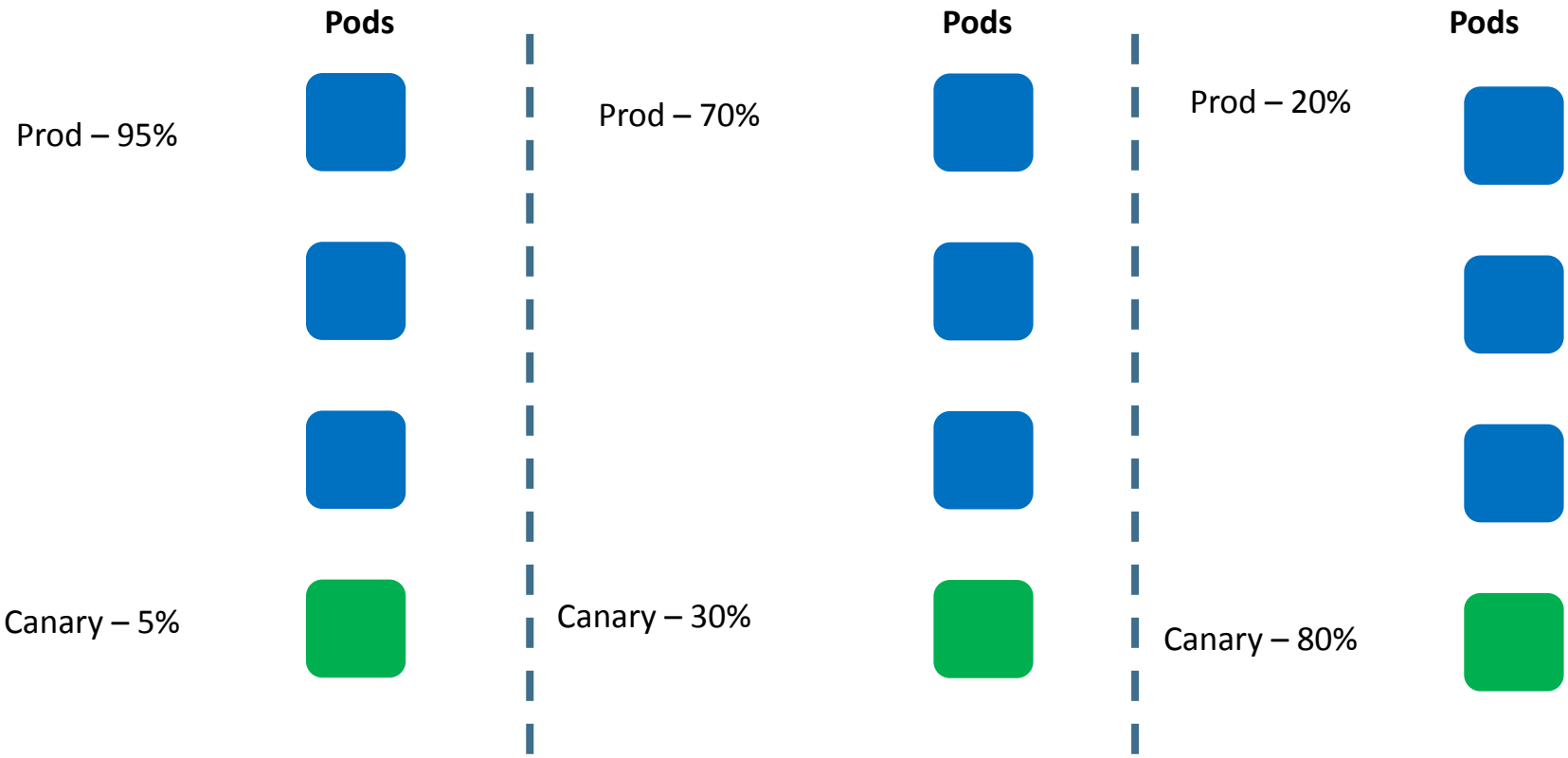
Canary Deployments out of box on Kubernetes



Downside

We need to incrementally increase pods based on percentage distribution we need for canary

Canary Deployments on Kubernetes with AWS App Mesh

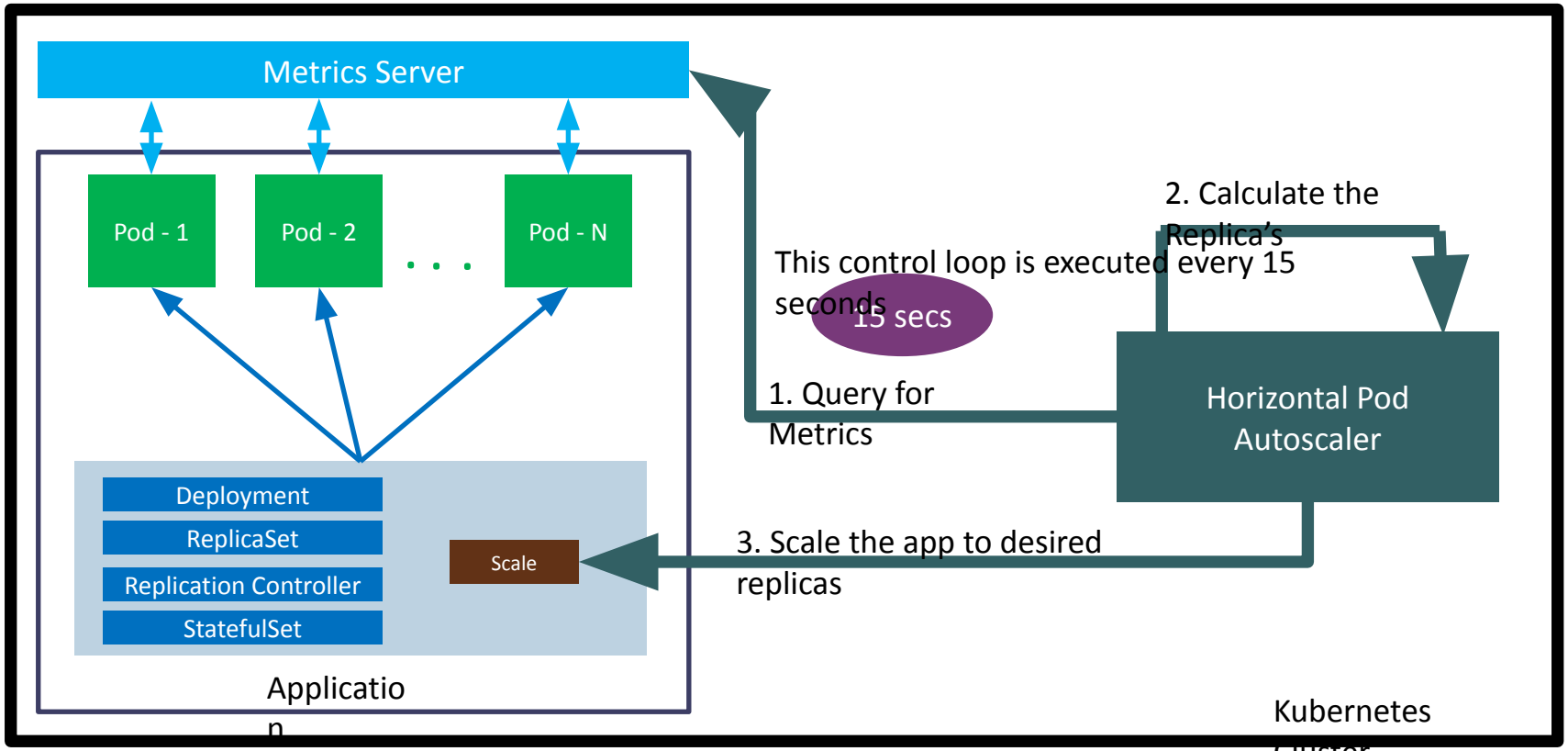


AWS EKS
Autoscaling
Horizontal Pod Autoscaler

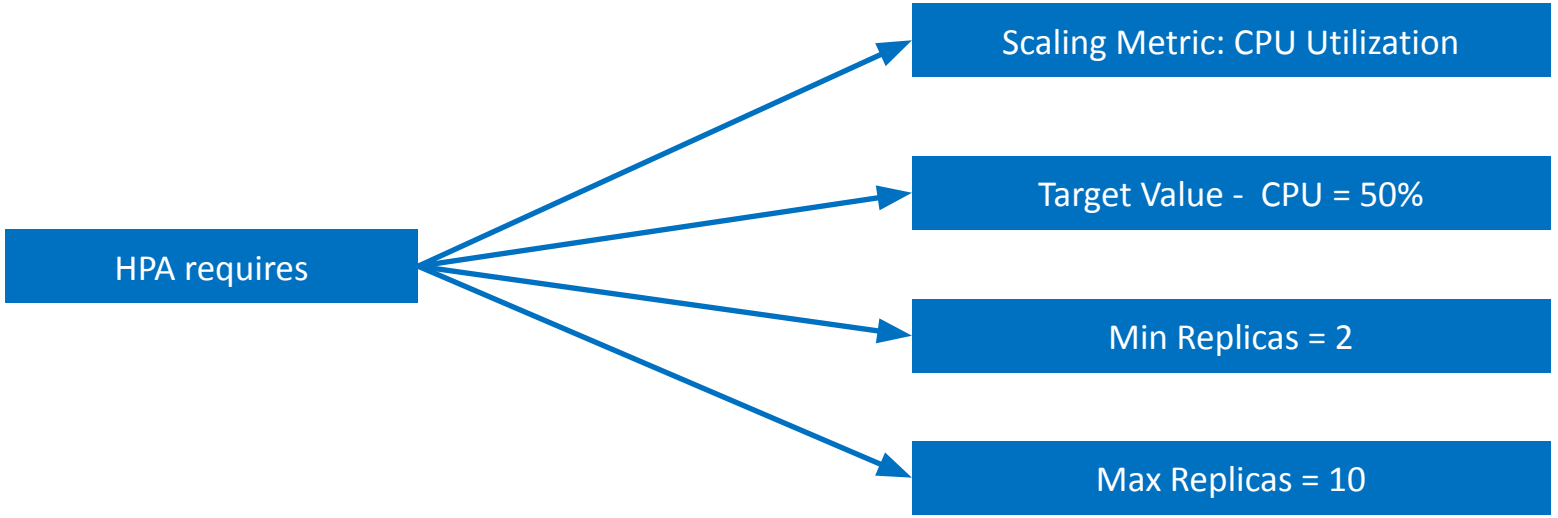
Horizontal Pod Autoscaler – HPA - Intoduction

- In a very simple note Horizontal Scaling means increasing and decreasing the number of Replicas (Pods)
- HPA automatically scales the number of pods in a deployment, replication controller, or replica set, stateful set based on that resource's CPU utilization.
- This can help our applications scale out to meet increased demand or scale in when resources are not needed, thus freeing up your worker nodes for other applications.
- When we set a target CPU utilization percentage, the HPA scales our application in or out to try to meet that target.
- HPA needs Kubernetes metrics server to verify CPU metrics of a pod.
- We do not need to deploy or install the HPA on our cluster to begin scaling our applications, its out of the box available as a default Kubernetes API resource.

How HPA works?



How is HPA configured?

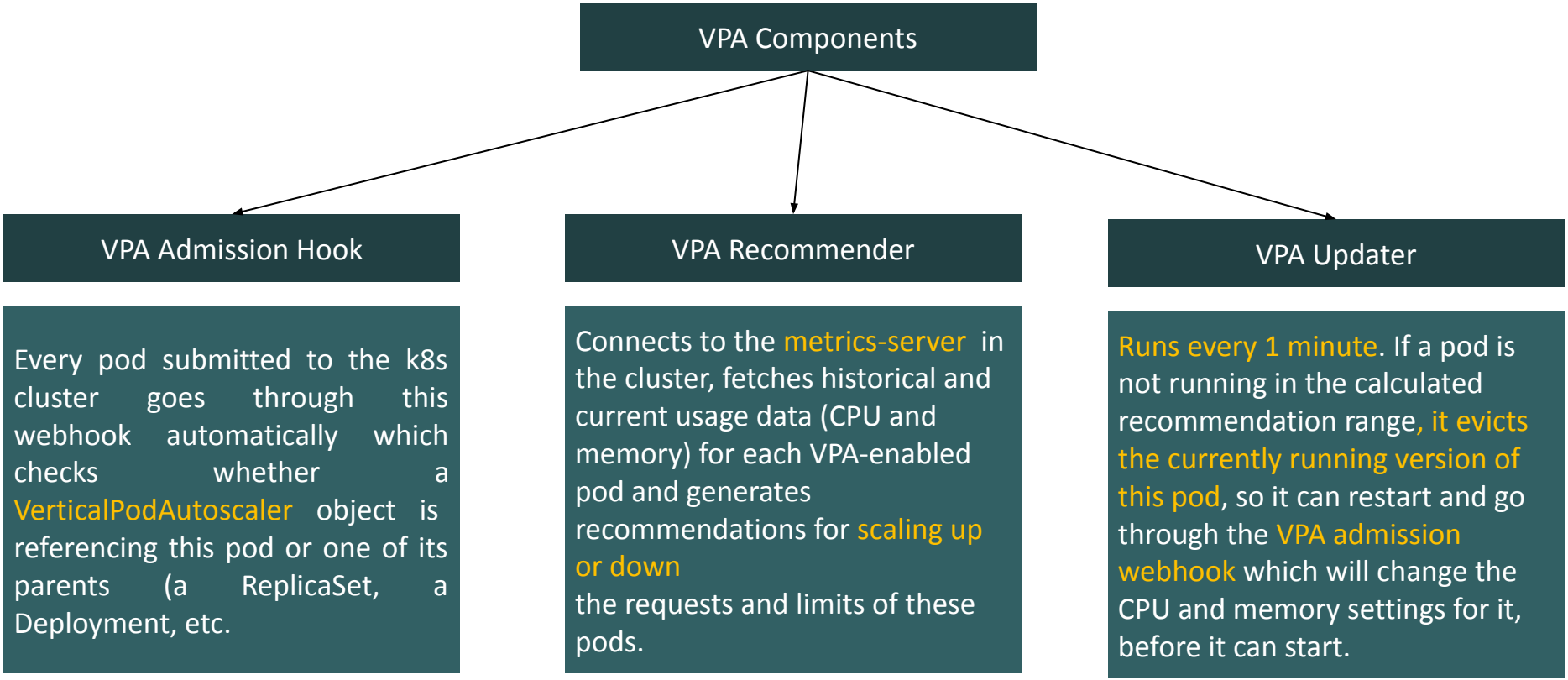



```
kubectl autoscale deployment demo-deployment  --cpu-percent=50 --min=1 --max=10
```

AWS EKS
Autoscaling
Vertical Pod Autoscaler

Vertical Pod Autoscaler – VPA - Introduction

- VPA automatically adjusts the CPU and memory reservations for our pods to help "right size" our applications.
- This adjustment can improve cluster resource utilization and free up CPU and memory for other pods.
- Benefits
  - Cluster nodes are used efficiently, because Pods use exactly what they need.
  - Pods are scheduled onto nodes that have the appropriate resources available.
  - We don't have to run time-consuming benchmarking tasks to determine the correct values for CPU and memory requests.
  - Maintenance time is reduced, because the autoscaler can adjust CPU and memory requests over time without any action on your part.

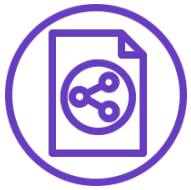

VPA Components
VPA Admission Hook
Every pod submitted to the k8s cluster goes through this webhook automatically which checks whether a VerticalPodAutoscaler object is referencing this pod or one of its parents (a ReplicaSet, a Deployment, etc.
VPA Recommender
Connects to the metrics-server in the cluster, fetches historical and current usage data (CPU and memory) for each VPA-enabled pod and generates recommendations for scaling up or down
the requests and limits of these pods.
VPA Updater
Runs every 1 minute. If a pod is not running in the calculated recommendation range, it evicts the currently running version of this pod, so it can restart and go through the VPA admission webhook which will change the CPU and memory settings for it, before it can start.

AWS EKS
Autoscaling
Cluster Autoscaler

Cluster Autoscaler - Introduction

- Cluster Autoscaler is a tool that automatically adjusts the size of a Kubernetes cluster when one of the following conditions is true:
- There are pods that failed to run in the cluster due to insufficient resources.
- There are nodes in the cluster that have been underutilized for an extended period of time and their pods can be placed on other existing nodes.
- The Cluster Autoscaler modifies our worker node groups so that they scale out when we need more resources and scale in when we have underutilized resources.

Elastic Load Balancing



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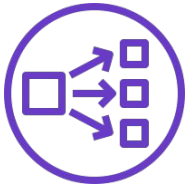
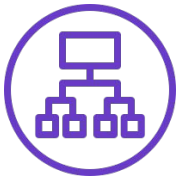


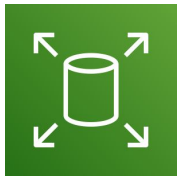
Network Load Balancer



Application Load Balancer

Certificate Manager

Route53



Elastic Block Store

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CloudWatch

Container Insights

Fargate Profiles

Elastic Container Registry

Code Commit

Code Build

Code Pipeline

Simple Email Service

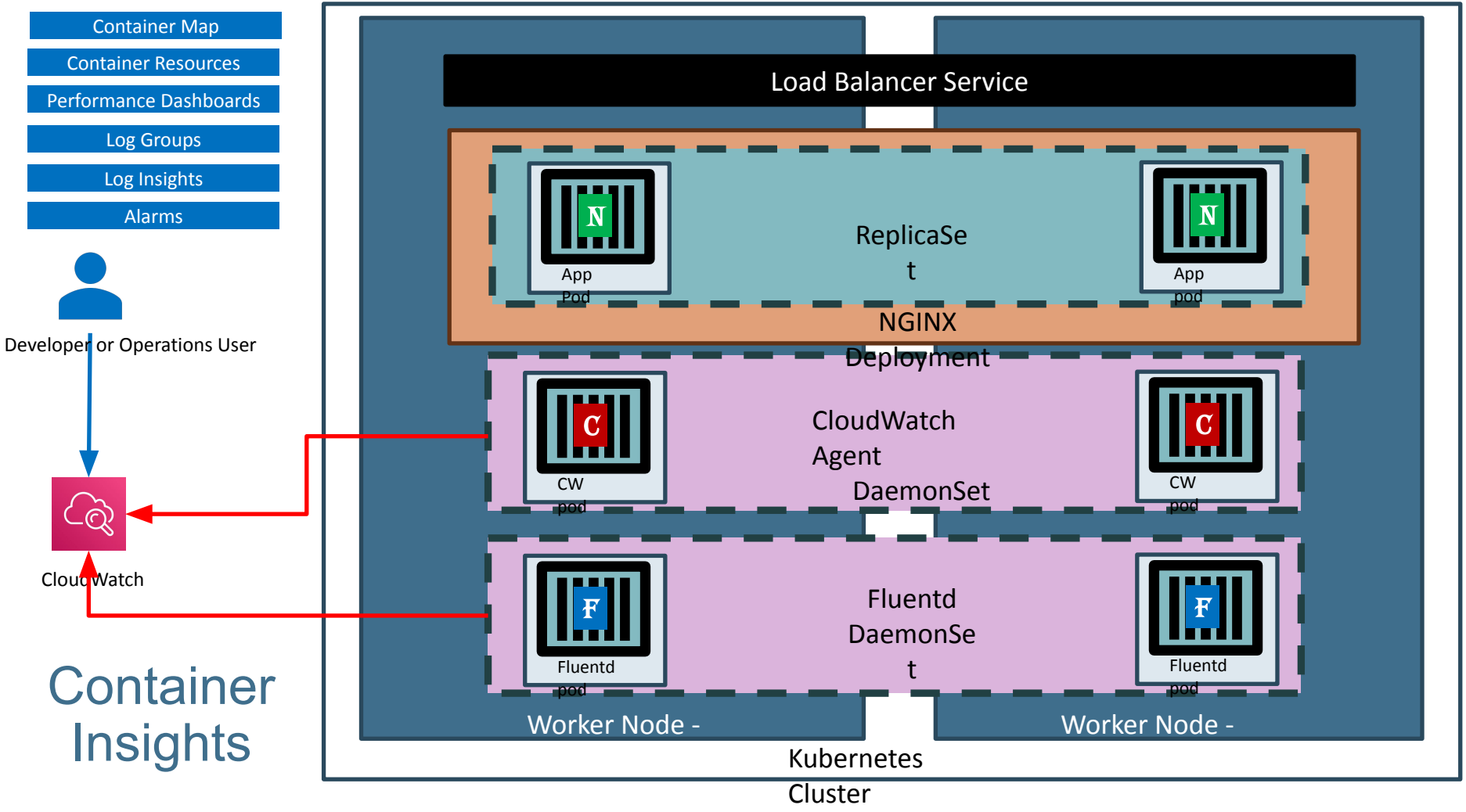
X-Ray

CloudWatch

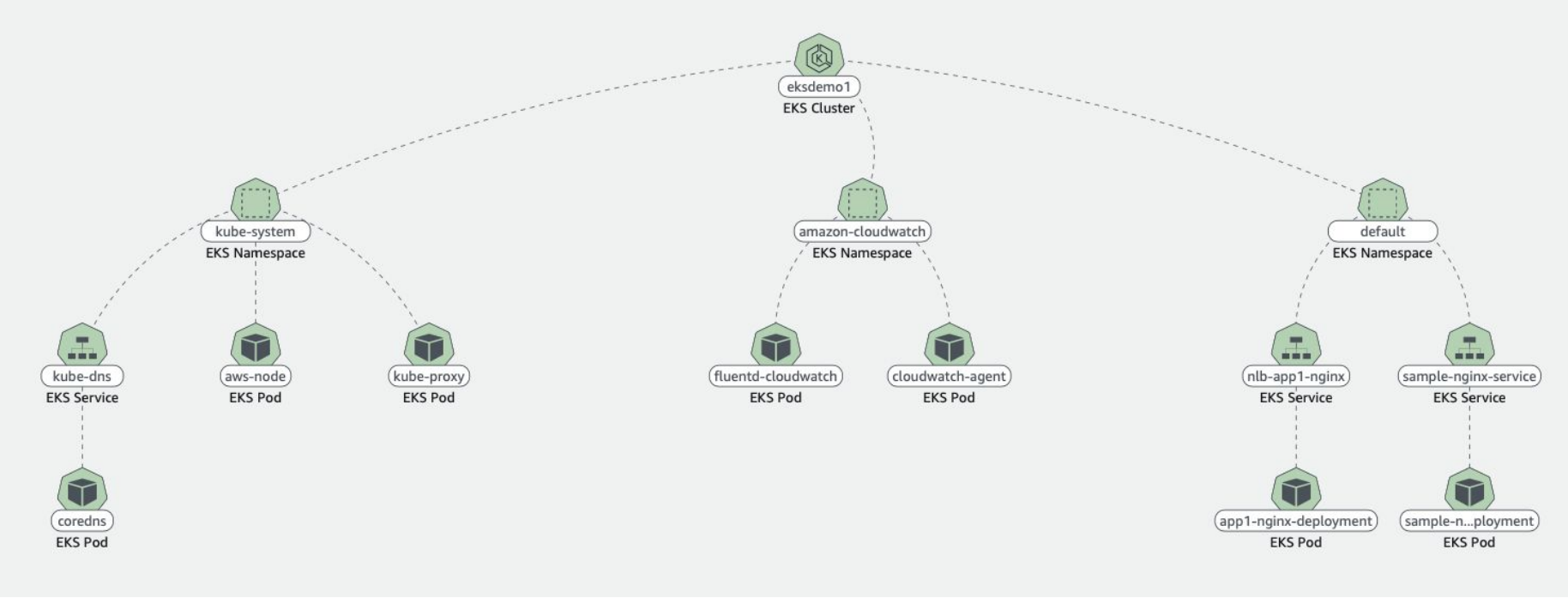
Simple Notification Service

Container Insights

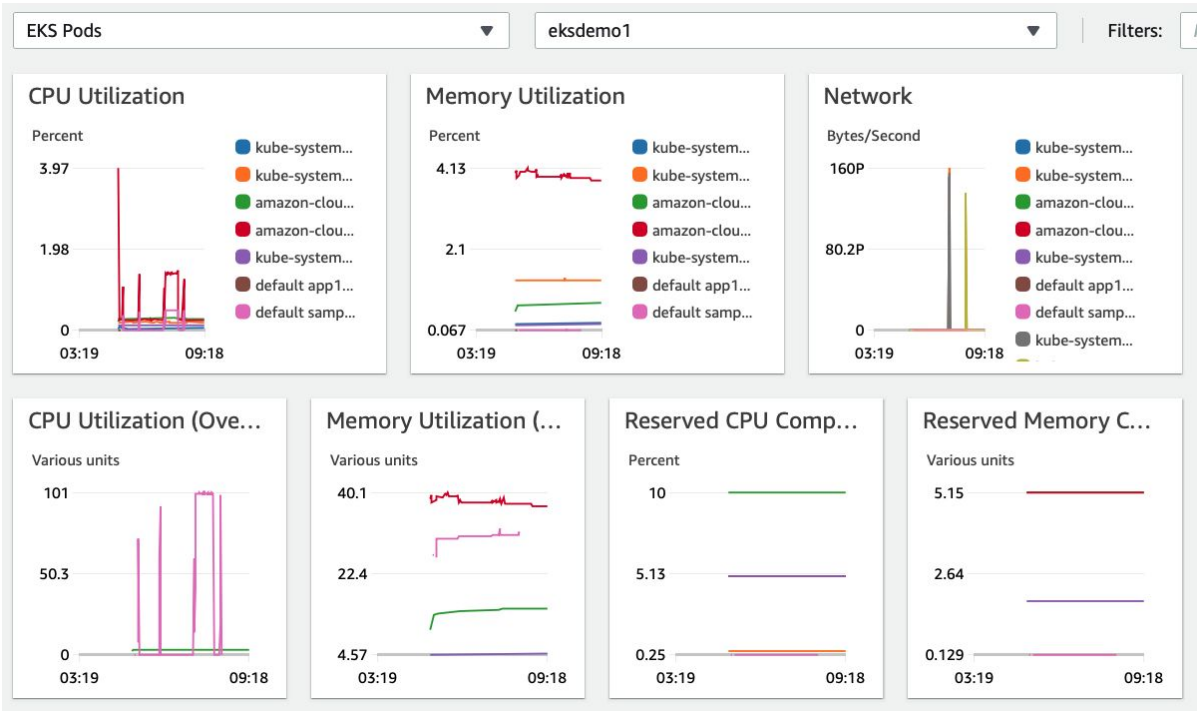
- A fully managed observability service for monitoring, troubleshooting and alarming on our containerized applications.
- Container Insights to collect, aggregate, and summarize metrics and logs from our containerized applications and microservices.
- The metrics include utilization for resources such as CPU, memory, disk, and network.
- It also provides diagnostic information, such as container restart failures, to help us isolate issues and resolve them quickly.
- We can also set CloudWatch alarms on metrics that Container Insights collects.
- The metrics that Container Insights collects are available in CloudWatch automatic dashboards.
- We can analyze and troubleshoot container performance and logs data with CloudWatch Logs Insights.

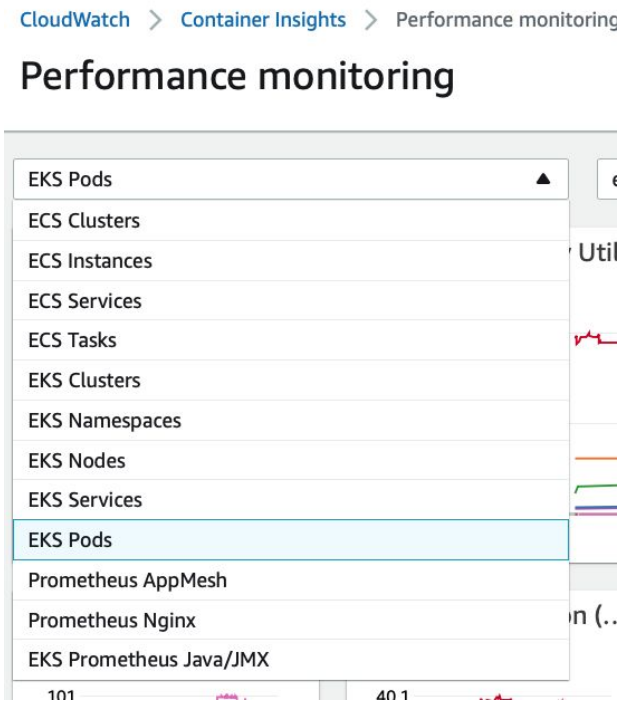

Container Map
Container Resources
Performance Dashboards
Log Groups
Log Insights
Alarms
Developer or Operations User
CloudWatch
Container Insights
Load Balancer Service
ReplicaSe
t
App
Pod
App
pod
NGINX
Deployment
CloudWatch
Agent
DaemonSet
CW
pod
CW
pod
Fluentd
DaemonSe
t
Fluentd
pod
Fluentd
pod
Worker Node -
Worker Node -
Kubernetes
Cluster

CloudWatch Container Insights Map



Automatic Performance Dashboard





THANK YOU