Azure AKS Kubernetes - Masterclass | Azure DevOps, Terraform

Kalyan Reddy Daida

STACKSIMPLIFY

Kubernetes On Cloud Roadmap

- Kubernetes for Beginners On Cloud
- AWS EKS Kubernetes - Masterclass | DevOps, Microservices
- Azure AKS Kubernetes - Masterclass | DevOps, Terraform
- Google GKE Kubernetes - Masterclass | DevOps, Microservices
- Docker & Kubernetes for Java Spring Boot Developers on AWS

Kubernetes Concepts

Azure Services Integration with AKS

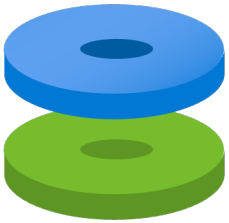
Azure DevOps

Terraform

Kubernetes Concepts

- Imperative way using kubectl
- Declarative way using YAML
- Init Containers
- Annotations
- Ingress SSL with LetsEncrypt
- Ingress Context Path based Routing
- Ingress Domain Name based Routing
- Ingress with External DNS
- Virtual Kubelet

Azure Services Integrated with AKS


Azure Disks


Azure Public IP


Azure AD


Azure Container Registry


Azure Kubernetes Service

Azure MySQL


Standard Load Balancer


AD Groups


Azure DevOps


AKS Linux & Windows Nodepools


Azure Files


Virtual Network


AD Users


Azure Build & Release Pipelines


Azure VM ScaleSets


Storage Account


Subnets

Azure DNS Zones


Azure Container Instances Virtual Nodes


Azure Managed Service Identity

Azure DevOps

- Build and Push Docker Image to ACR
- Deploy to Azure Kubernetes Clusters
- Starter Pipelines Write from scratch
- Release Pipelines to deploy across Environments (Dev,QA)

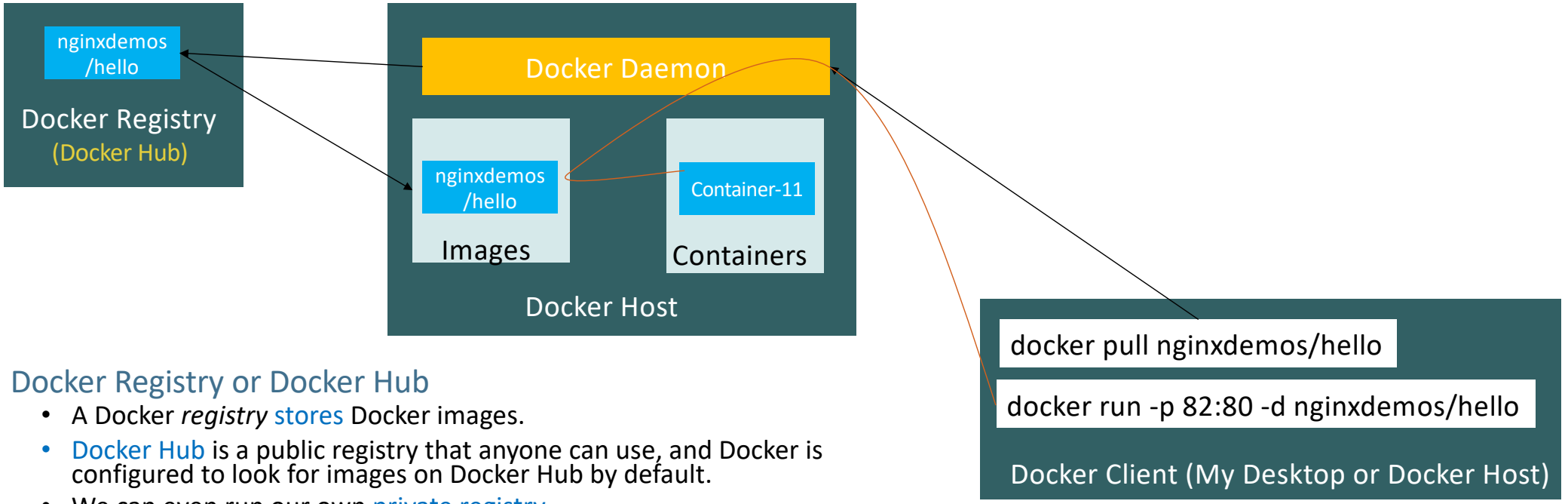
Terraform

- Terraform Command Basics
- Terraform Language Basics
- Provision production grade AKS Cluster using Terraform
- Provision AKS Cluster using Terraform & Azure DevOps

GitHub Repositories & Presentation

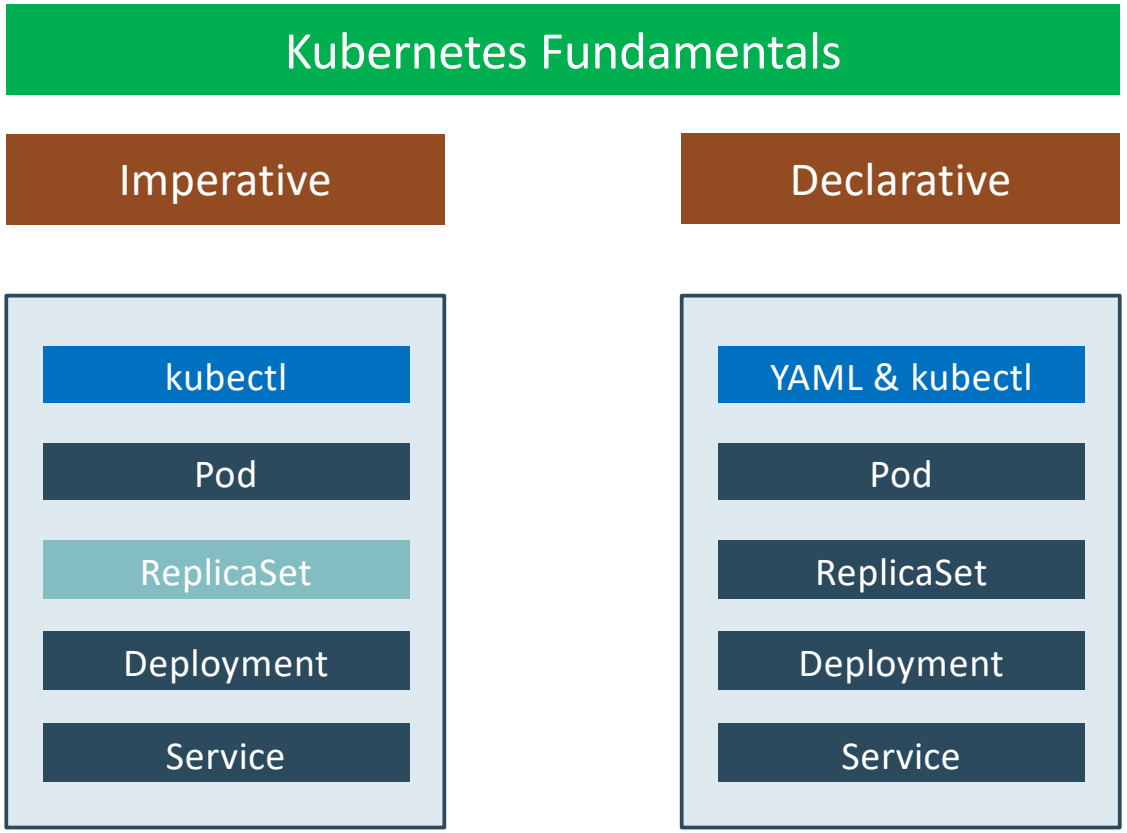
GitHub Repository Name	GitHub Repository Link
Azure AKS Kubernetes Master Class **Main Repo**	https://github.com/stacksimplify/azure-aks-kubernetes-masterclass
Azure DevOps for running Kubernetes workloads on Azure AKS Cluster	https://github.com/stacksimplify/azure-devops-github-acr-aks-app1
Provision Azure AKS Cluster using Azure DevOps and Terraform	https://github.com/stacksimplify/azure-devops-aks-kubernetes-terraform-pipeline
Docker Fundamentals	https://github.com/stacksimplify/docker-fundamentals
Course presentation with 250 slides outlining various architectures and designs	https://github.com/stacksimplify/azure-aks-kubernetes-masterclass/ppt-presentation

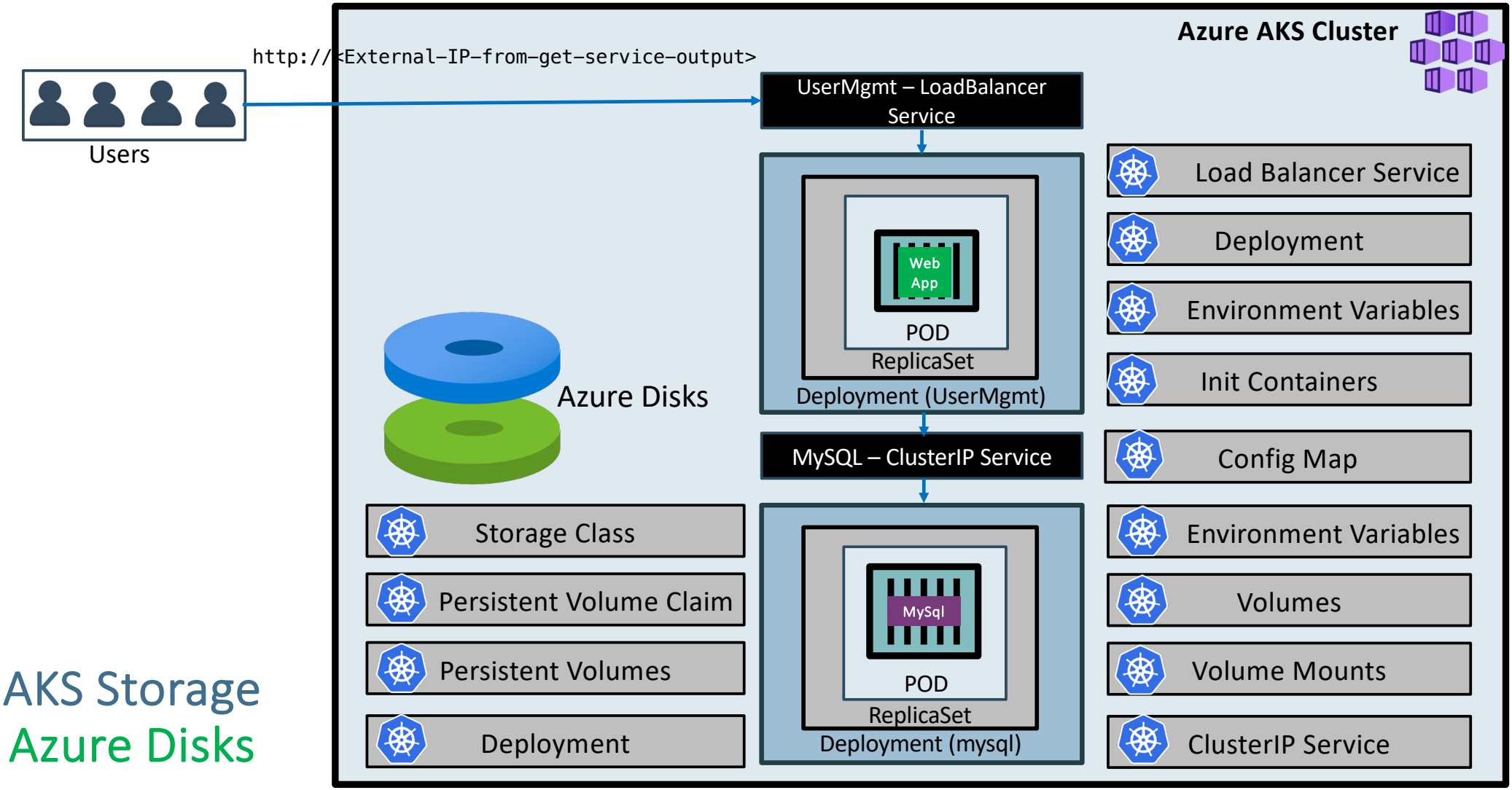
Docker - Fundamentals



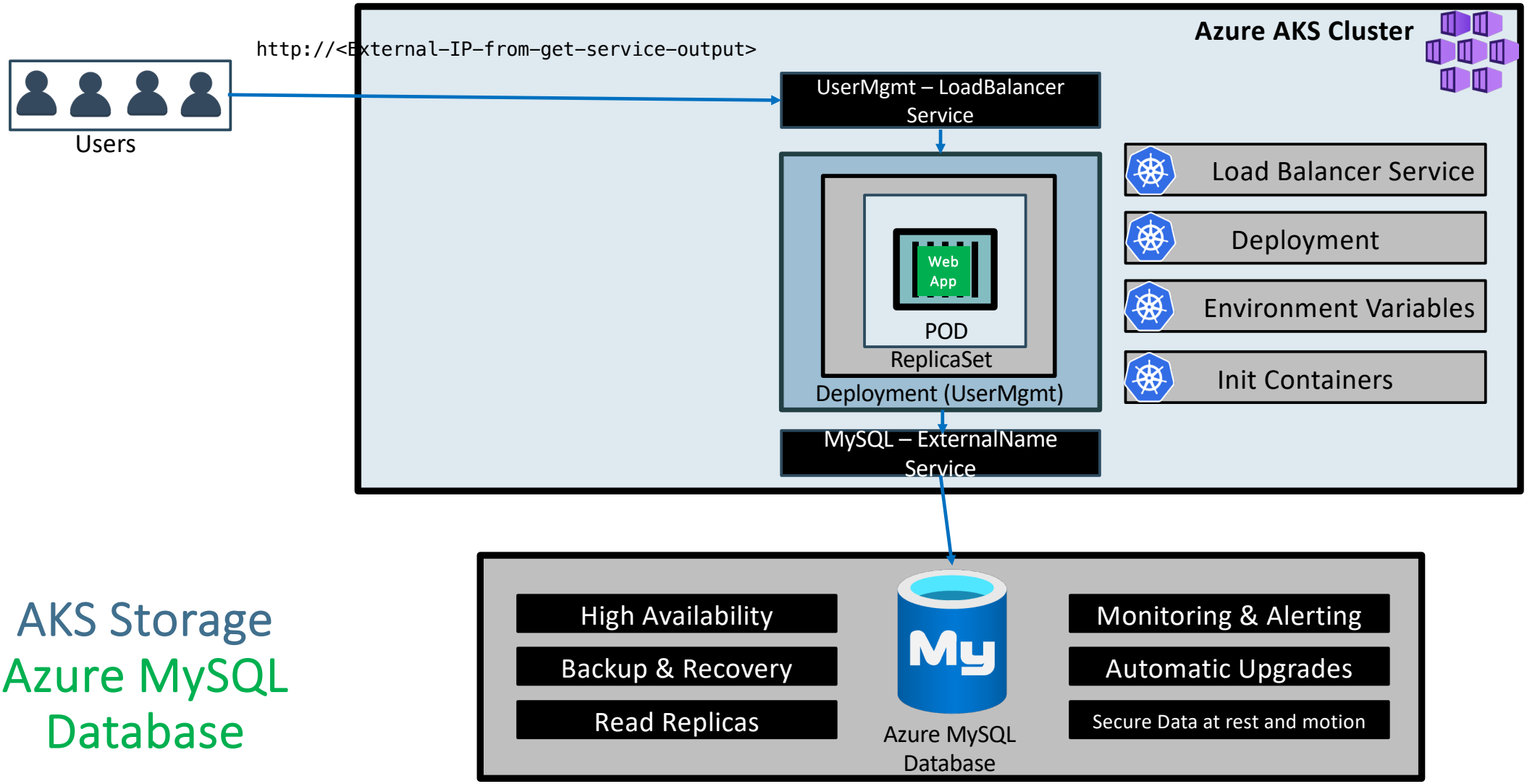
- Docker Registry or Docker Hub
  - A Docker *registry* stores Docker images.
  - Docker Hub is a public registry that anyone can use, and Docker is configured to look for images on Docker Hub by default.
  - We can even run our own private registry.
  - When we use the docker pull or docker run commands,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



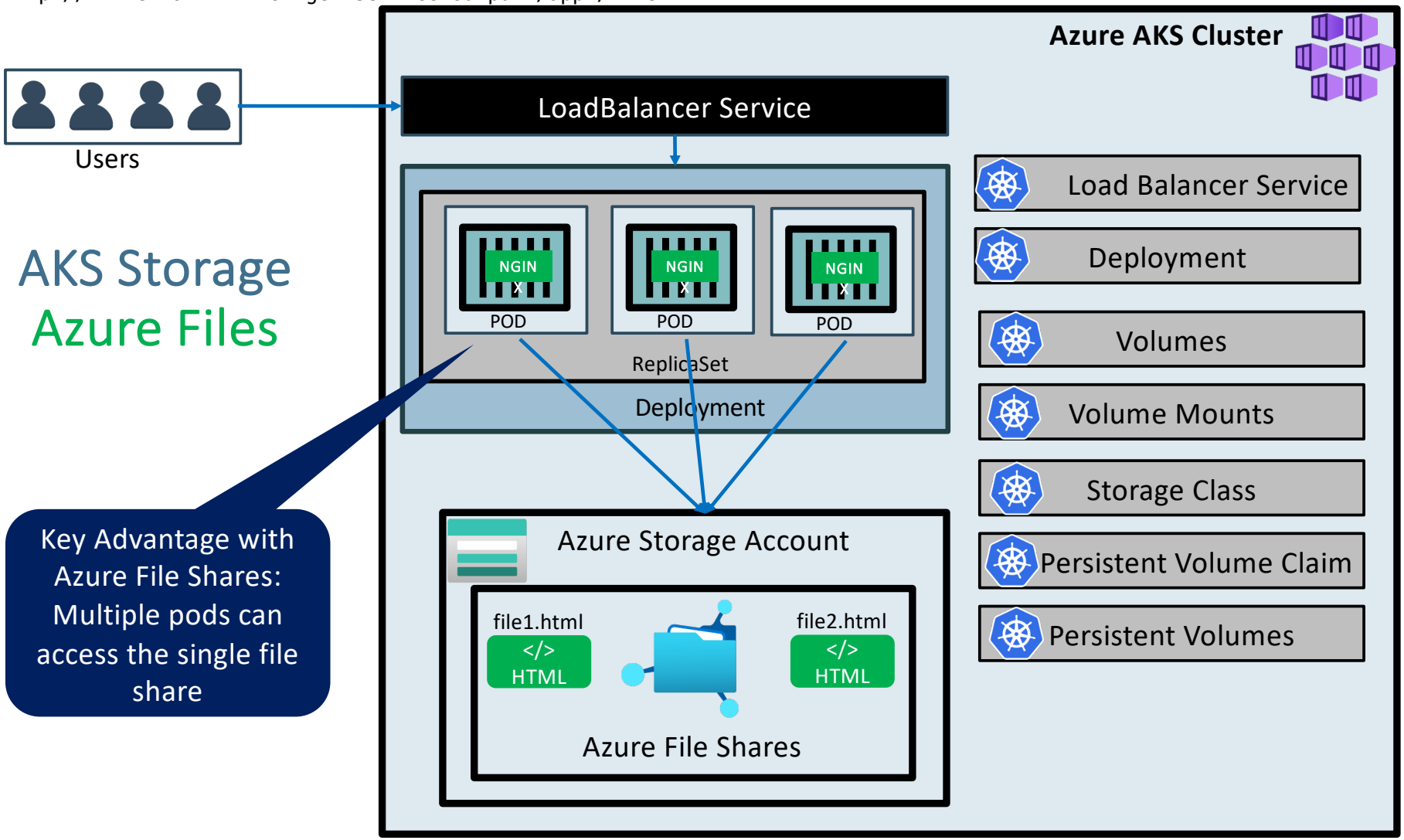


AKS Storage
Azure Disks



AKS Storage
Azure MySQL Database

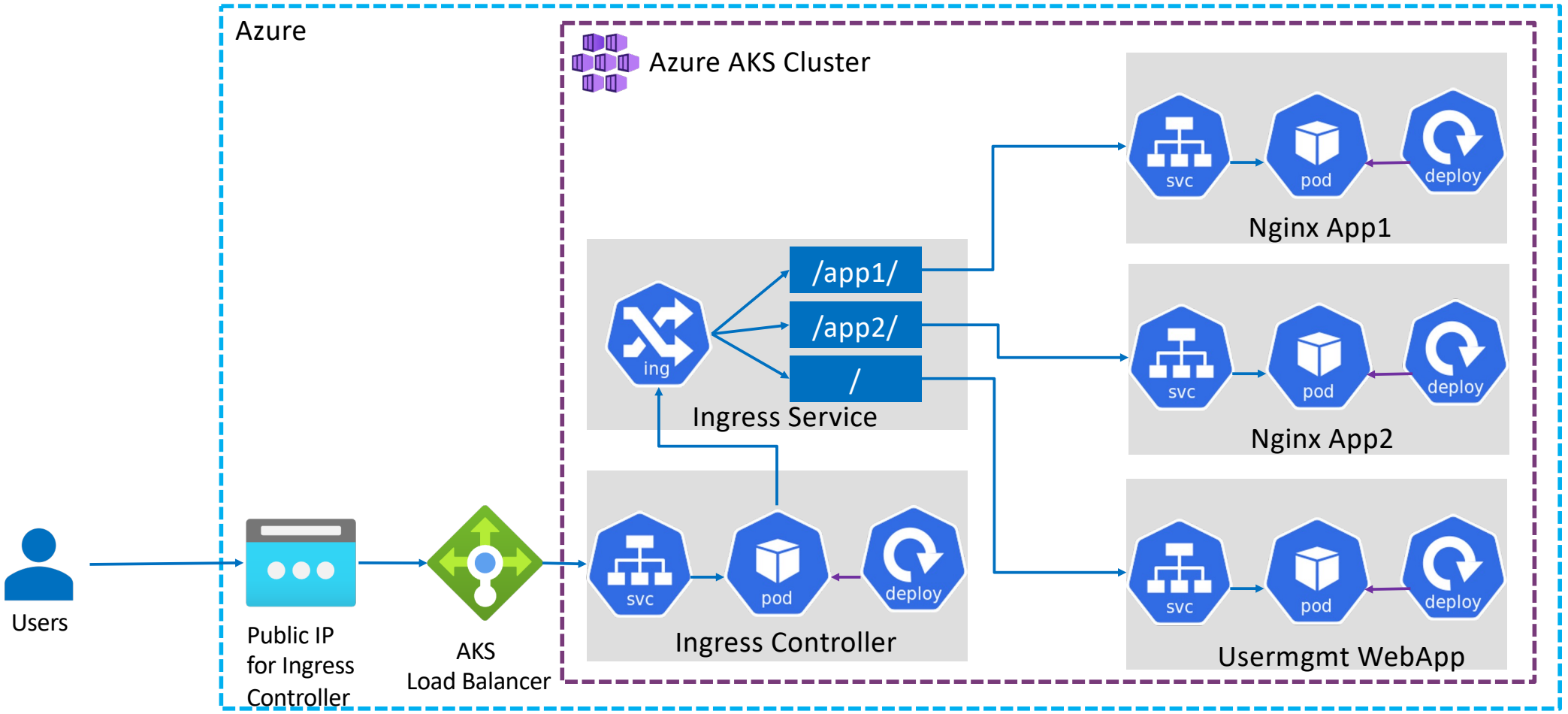
http://<External-IP-from-get-service-output>/app1/file1.html



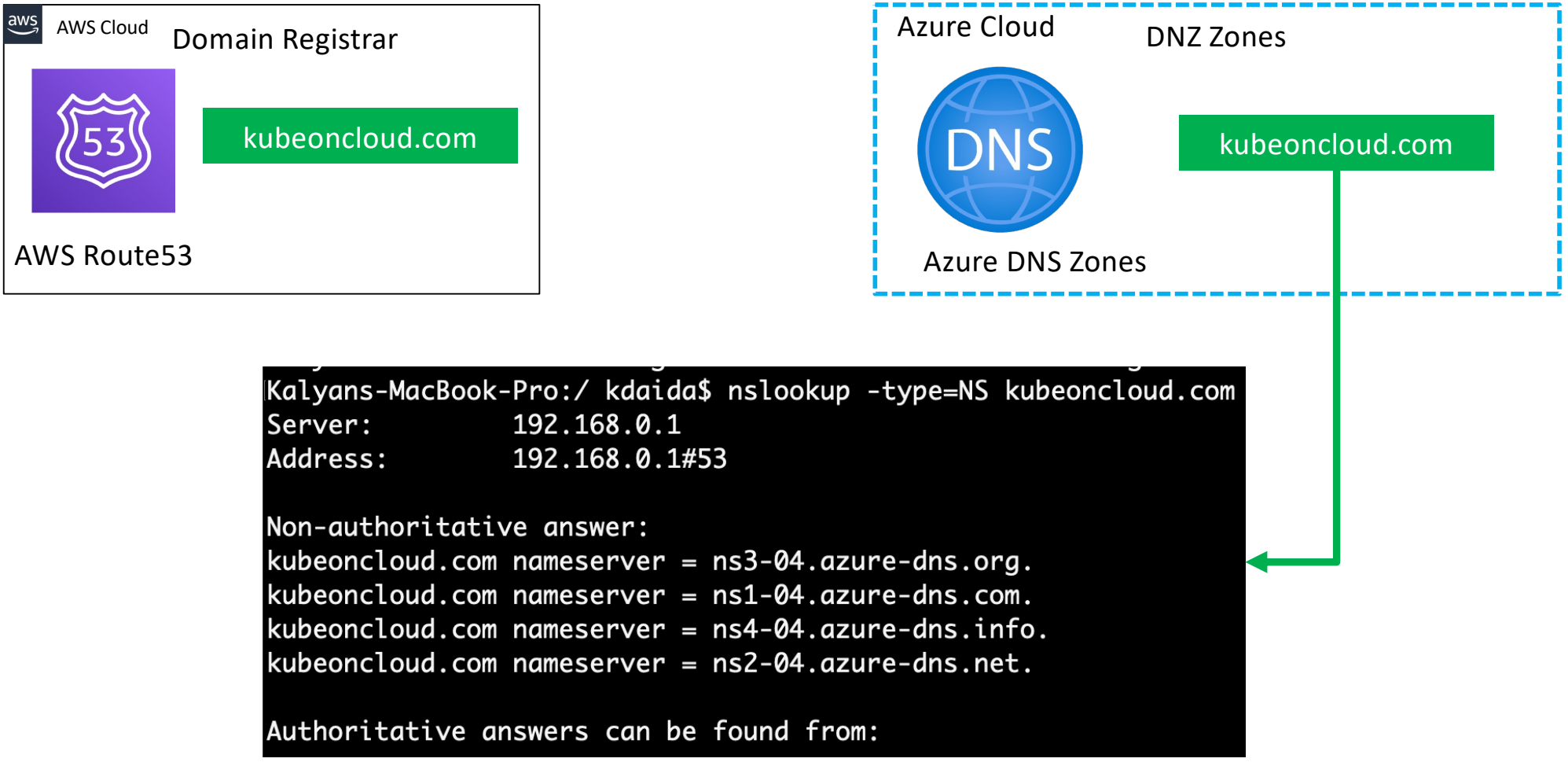
AKS Storage
Azure Files

Key Advantage with Azure File Shares: Multiple pods can access the single file share

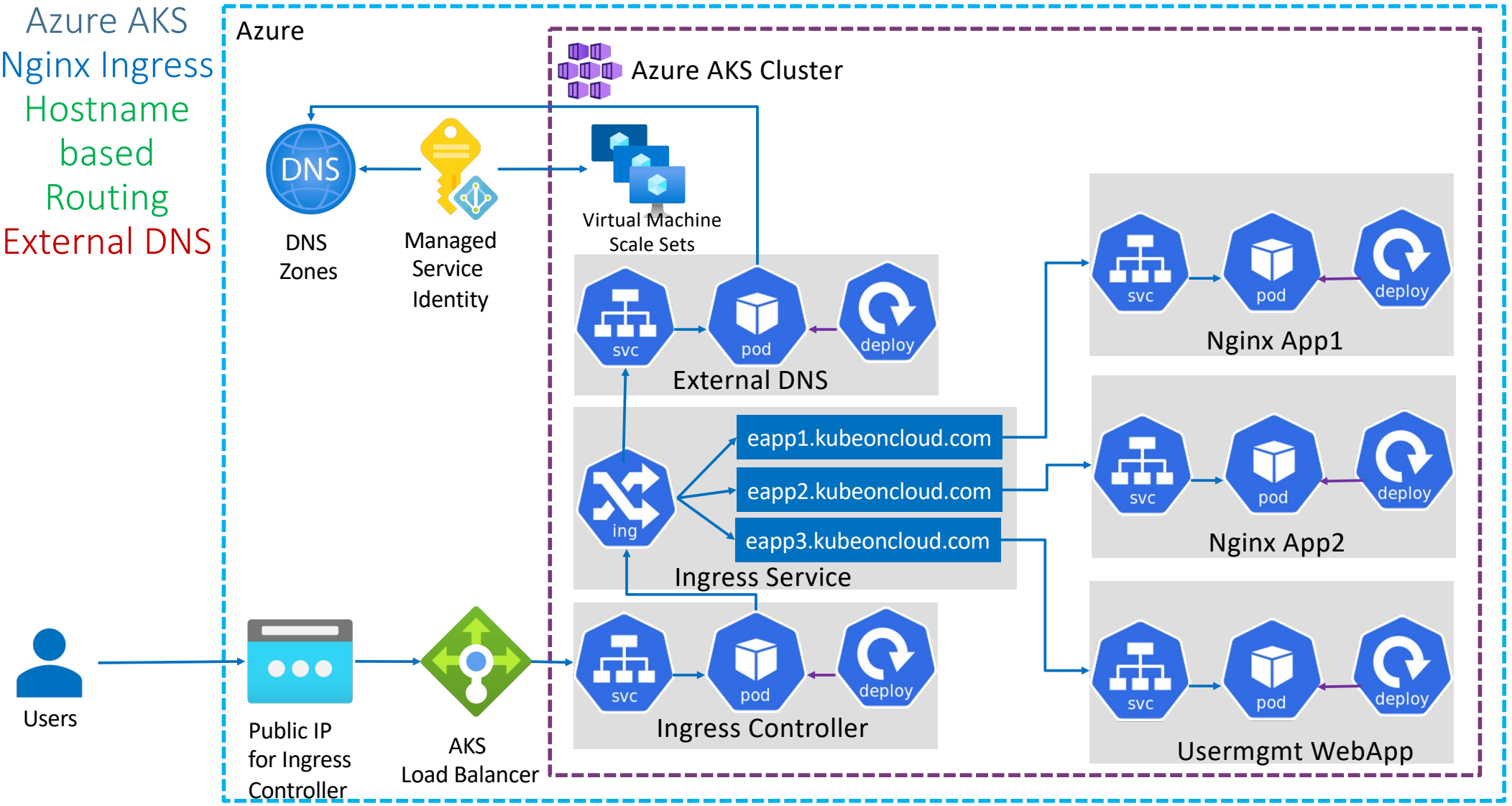
Azure AKS & Nginx Ingress – Context Path Based Routing

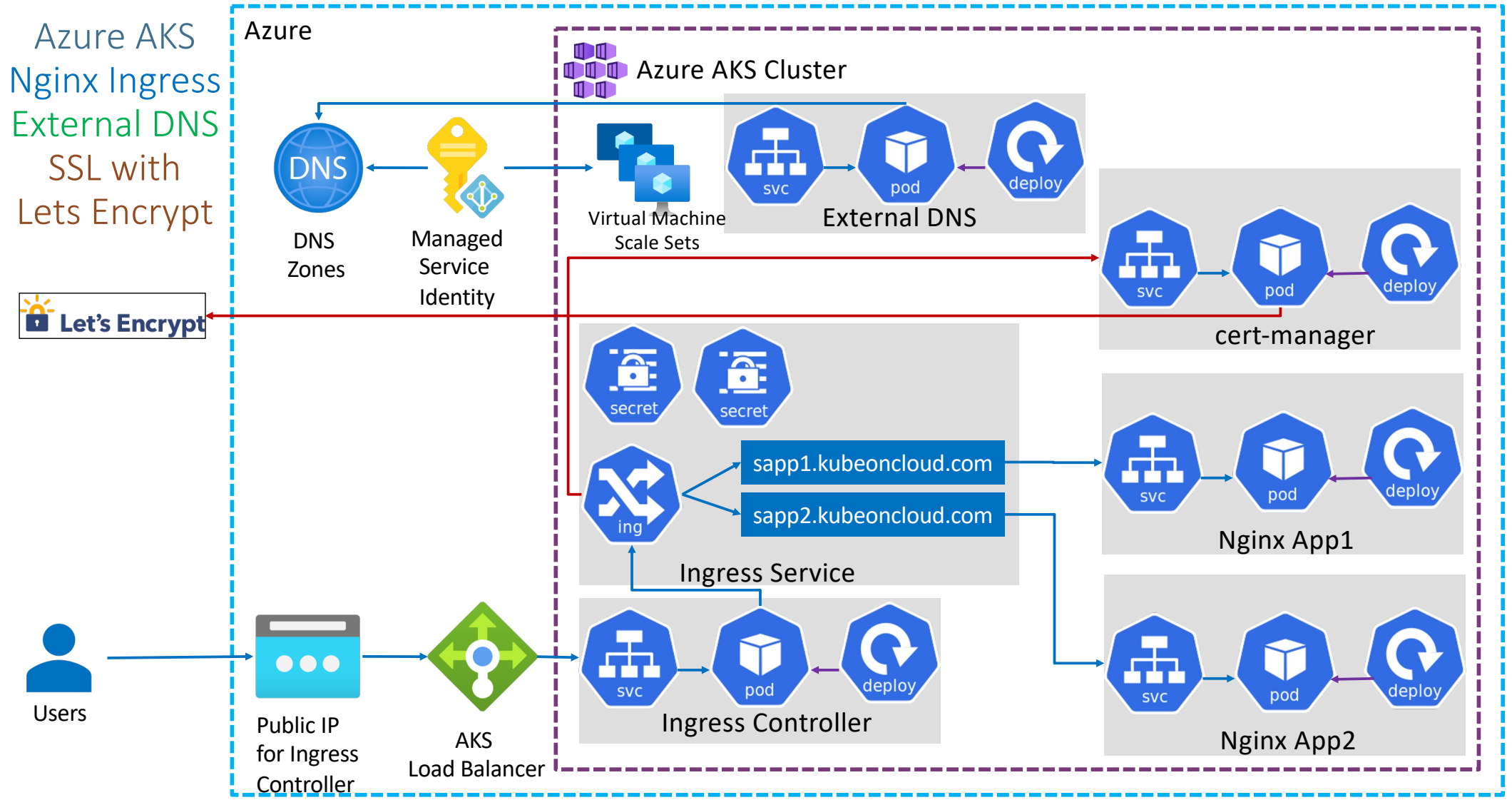


Delegate Domain to Azure DNS

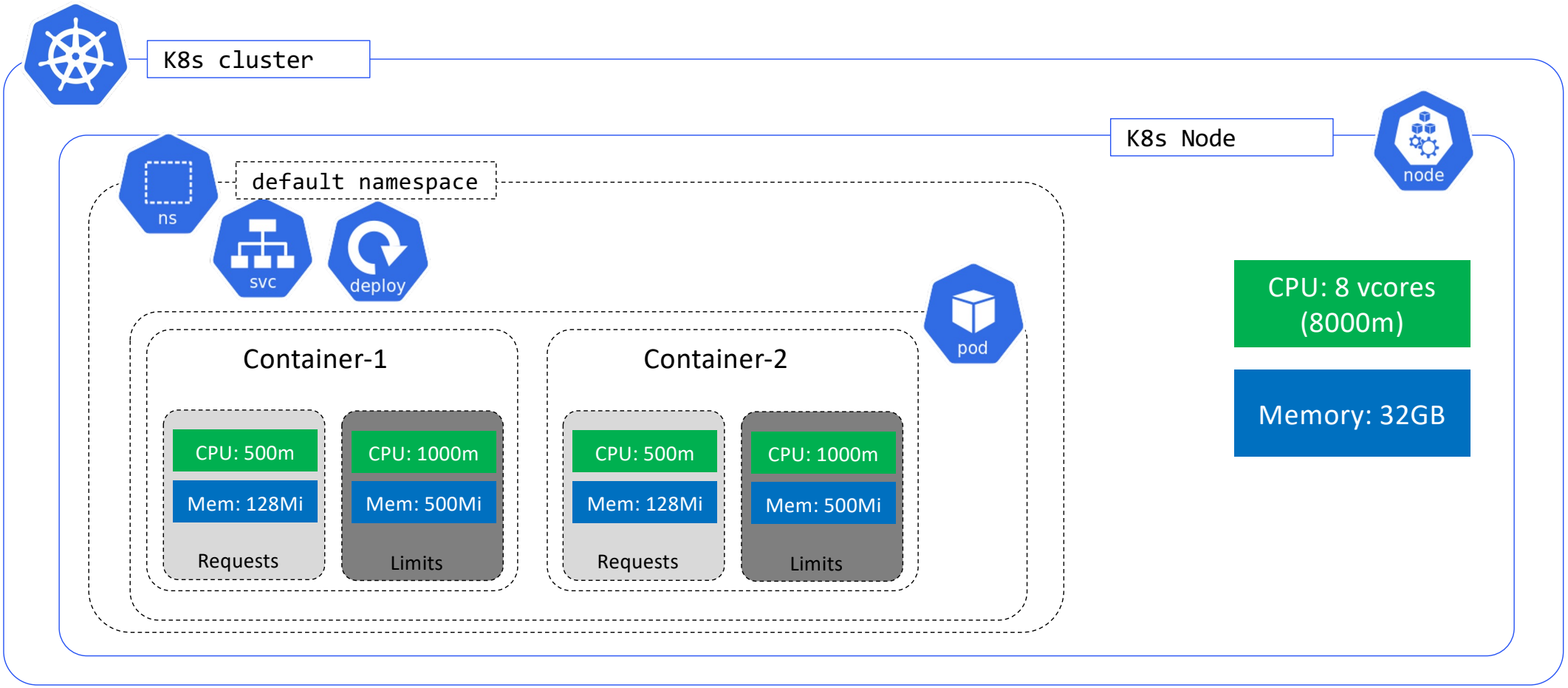


Azure AKS Nginx Ingress Hostname based Routing External DNS

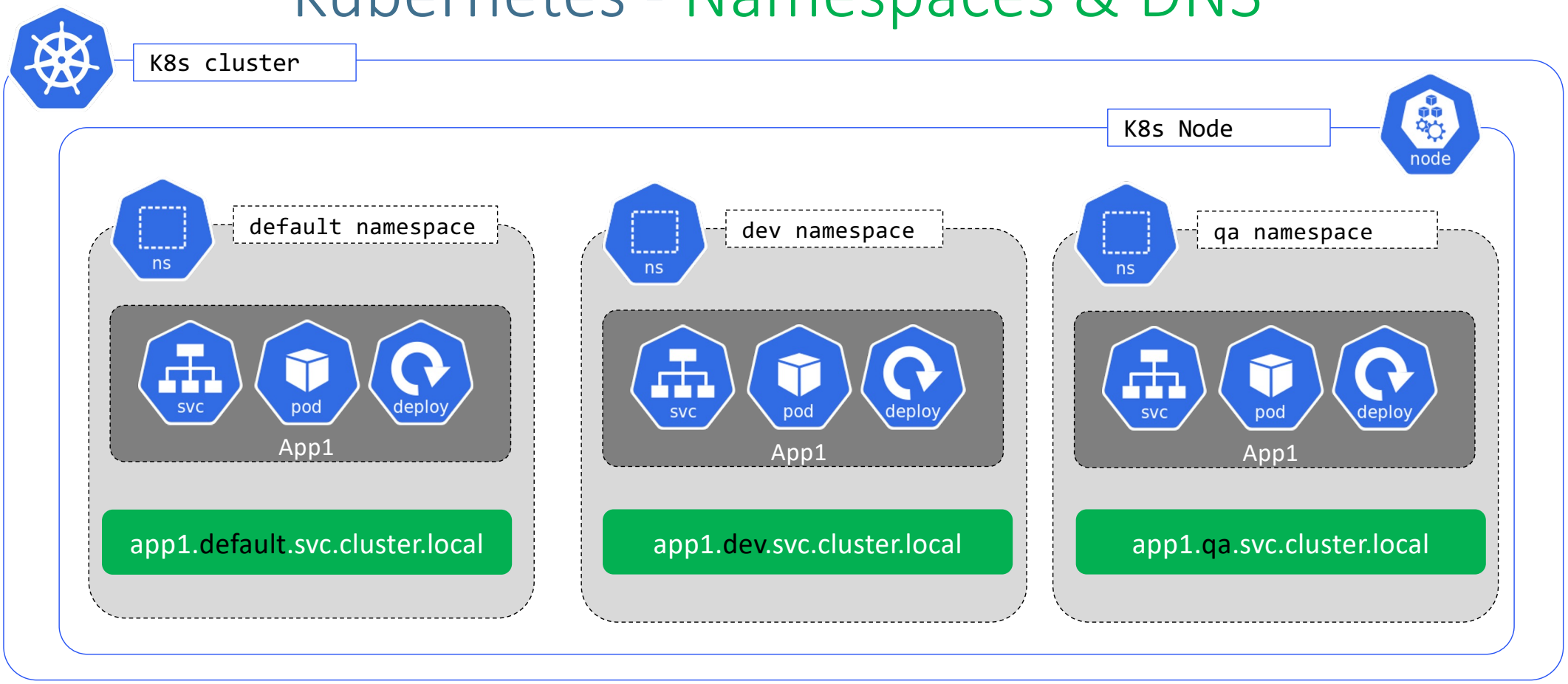




Kubernetes – Requests & Limits

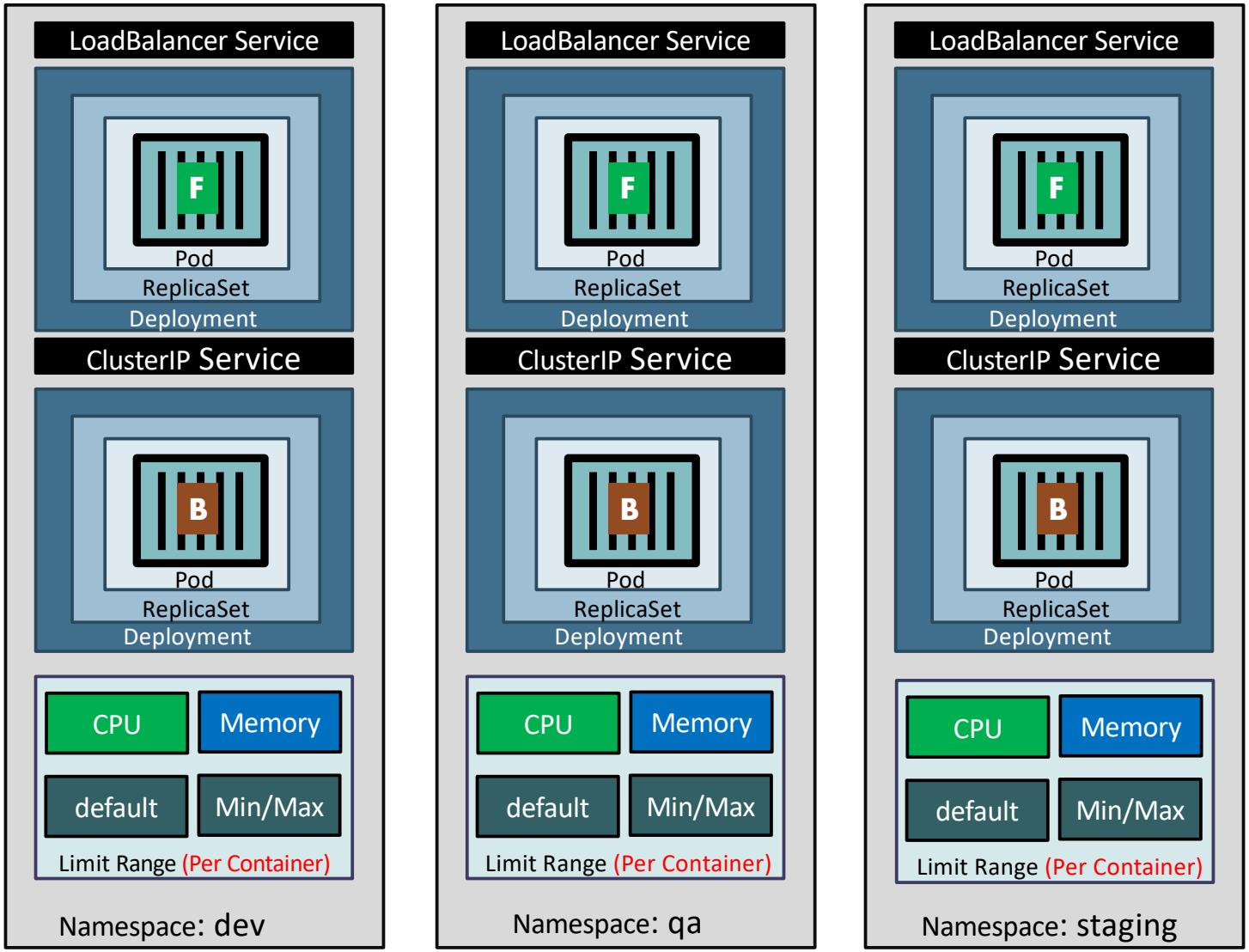


Kubernetes - Namespaces & DNS



<service-name>.<namespace-name>.svc.cluster.local

Limit Range



Limit Range Manifest

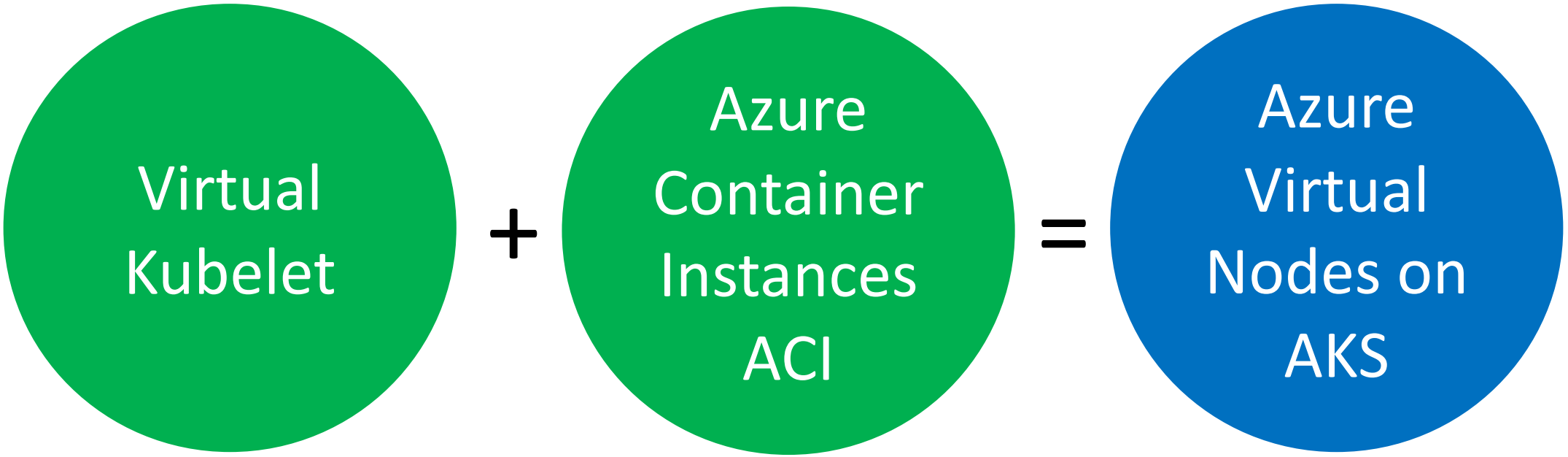
```yaml
apiVersion: v1
kind: LimitRange
metadata:
  name: default-cpu-mem-limit-range
  namespace: dev3
spec:
  limits:
    - default:
        memory: "512Mi"
        cpu: "500m"
      defaultRequest:
        memory: "256Mi"
        cpu: "300m"
      type: Container
```

Resource Quota

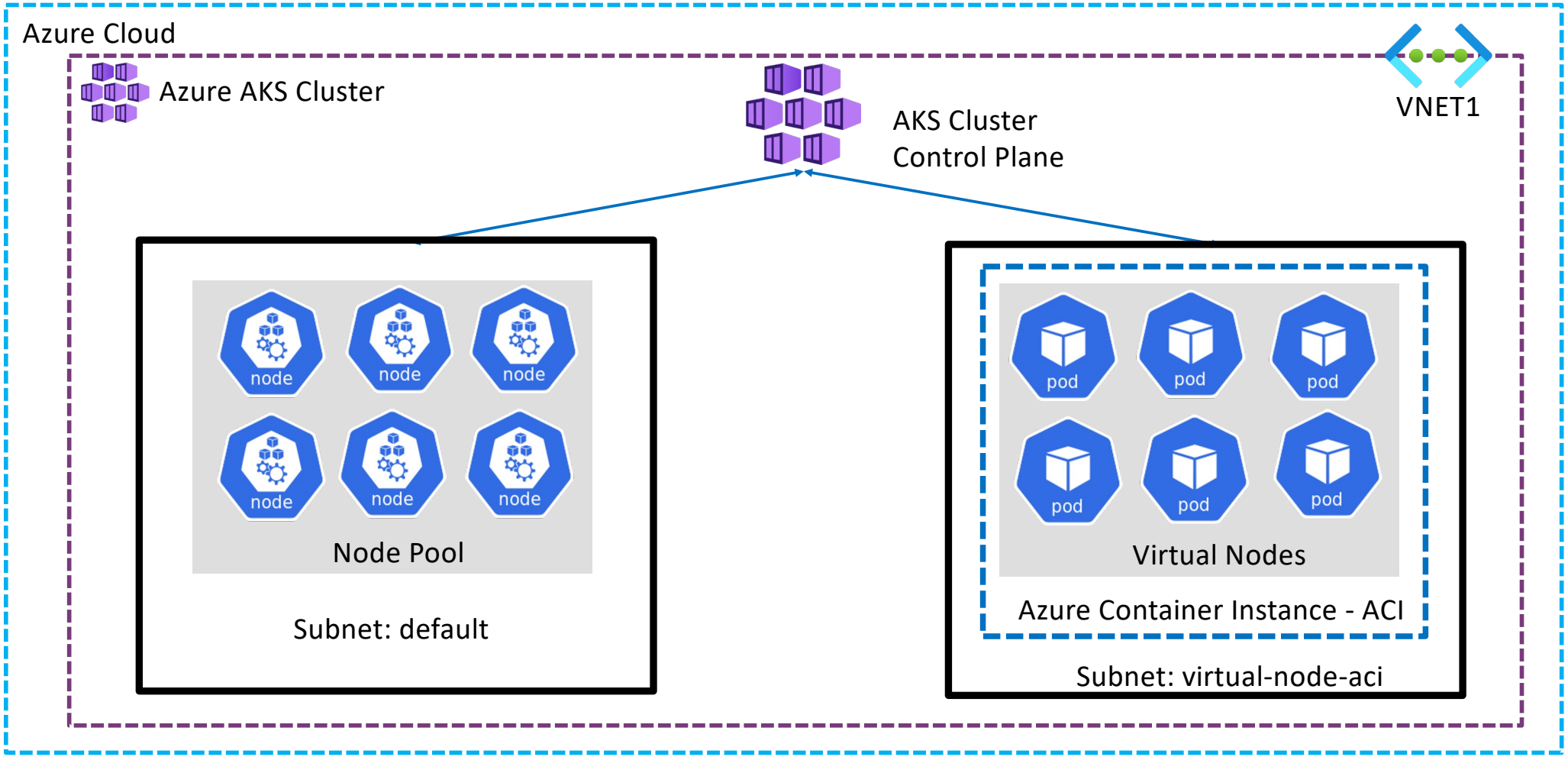
Resource Quota Manifest

```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"
```

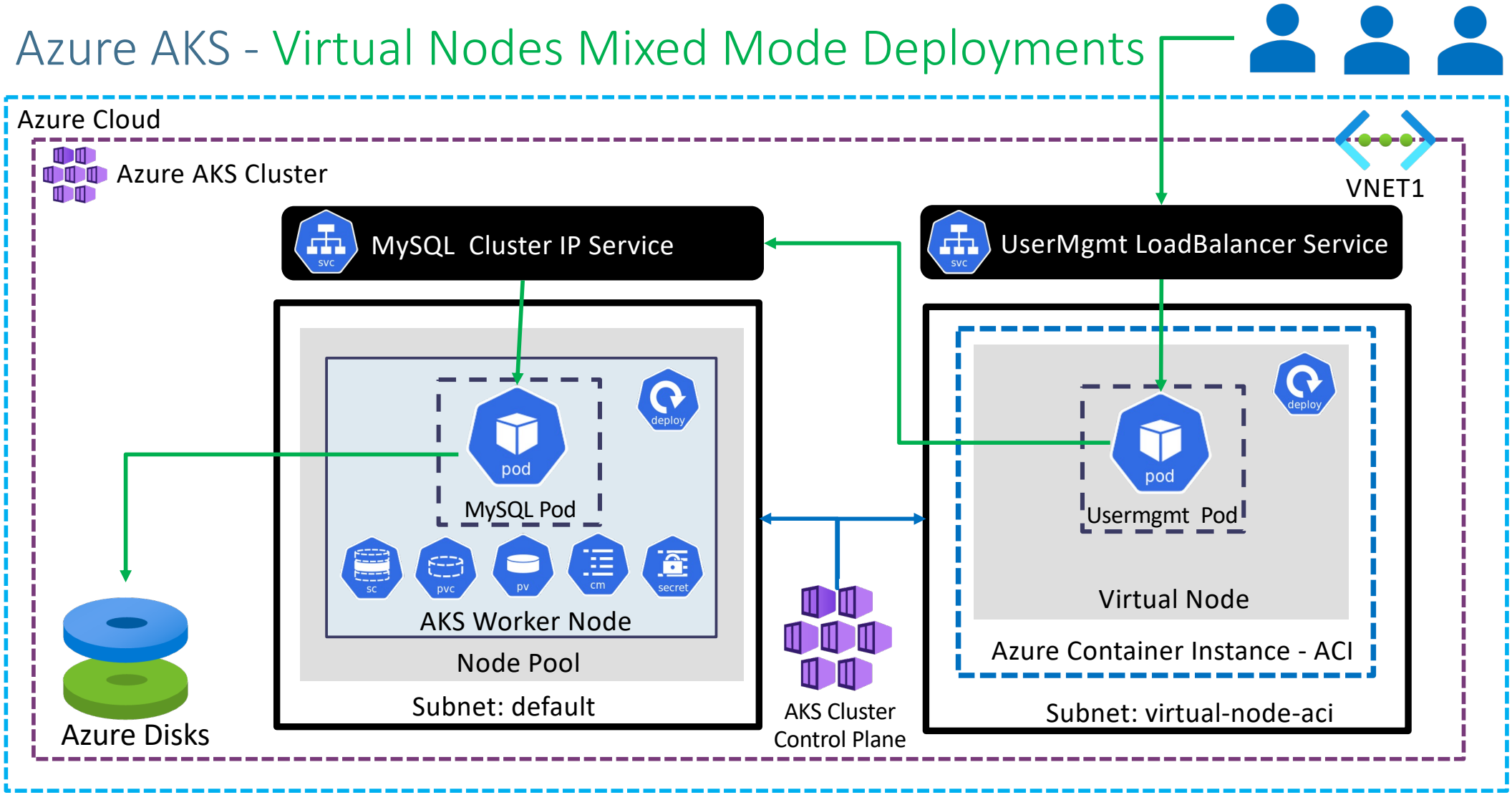
Azure AKS Virtual Nodes



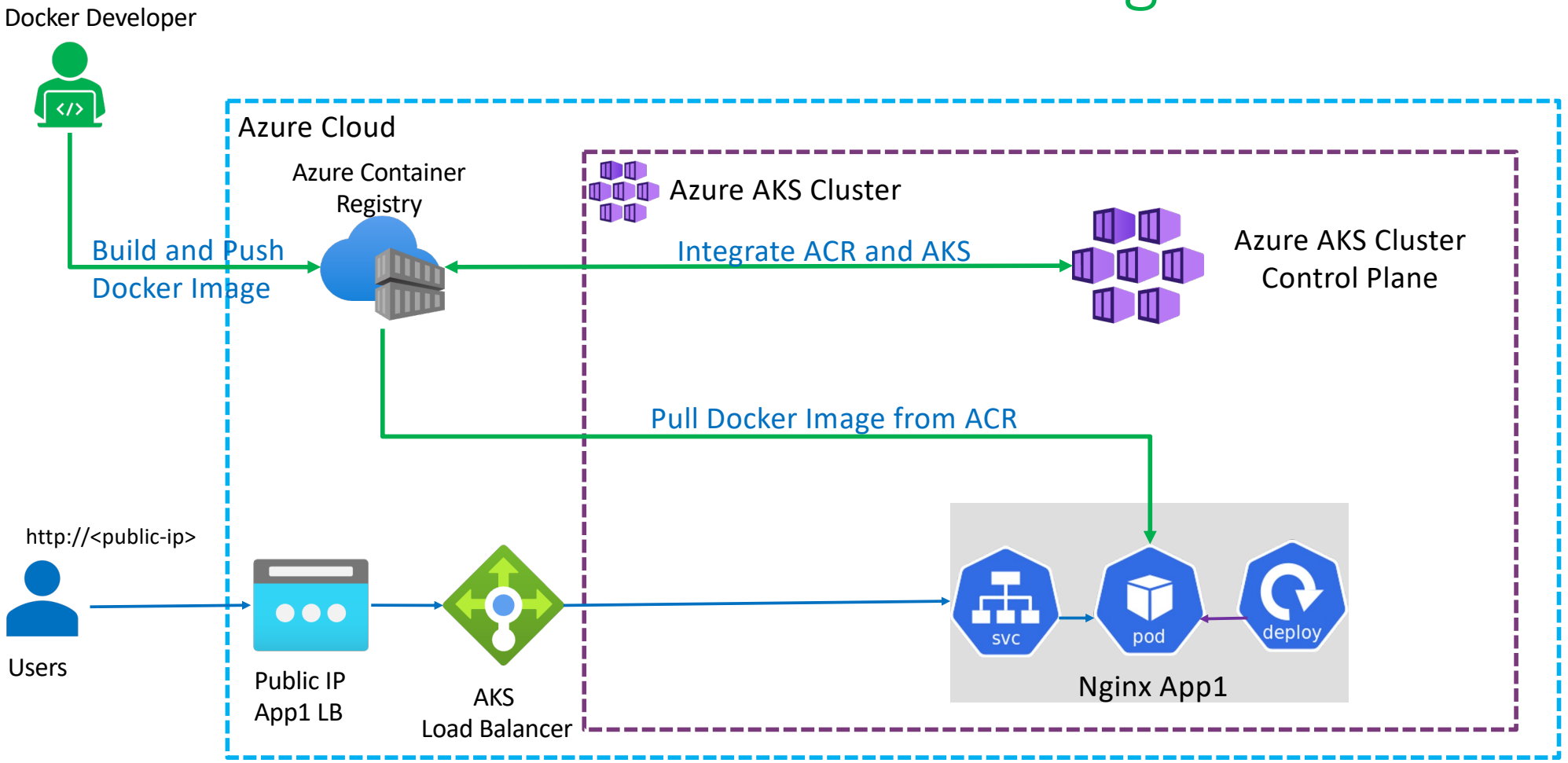
Azure AKS - Virtual Nodes



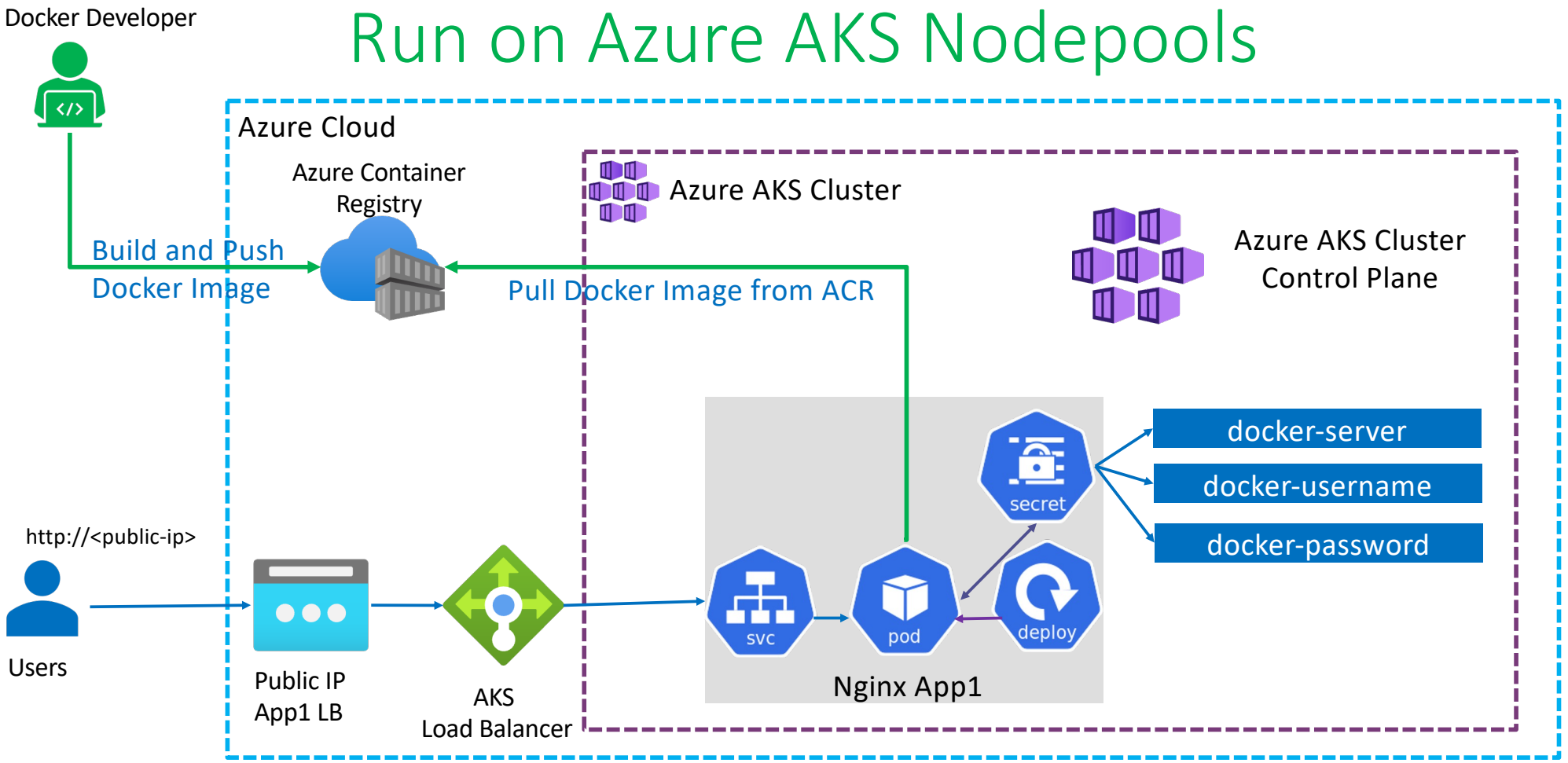
Azure AKS - Virtual Nodes Mixed Mode Deployments



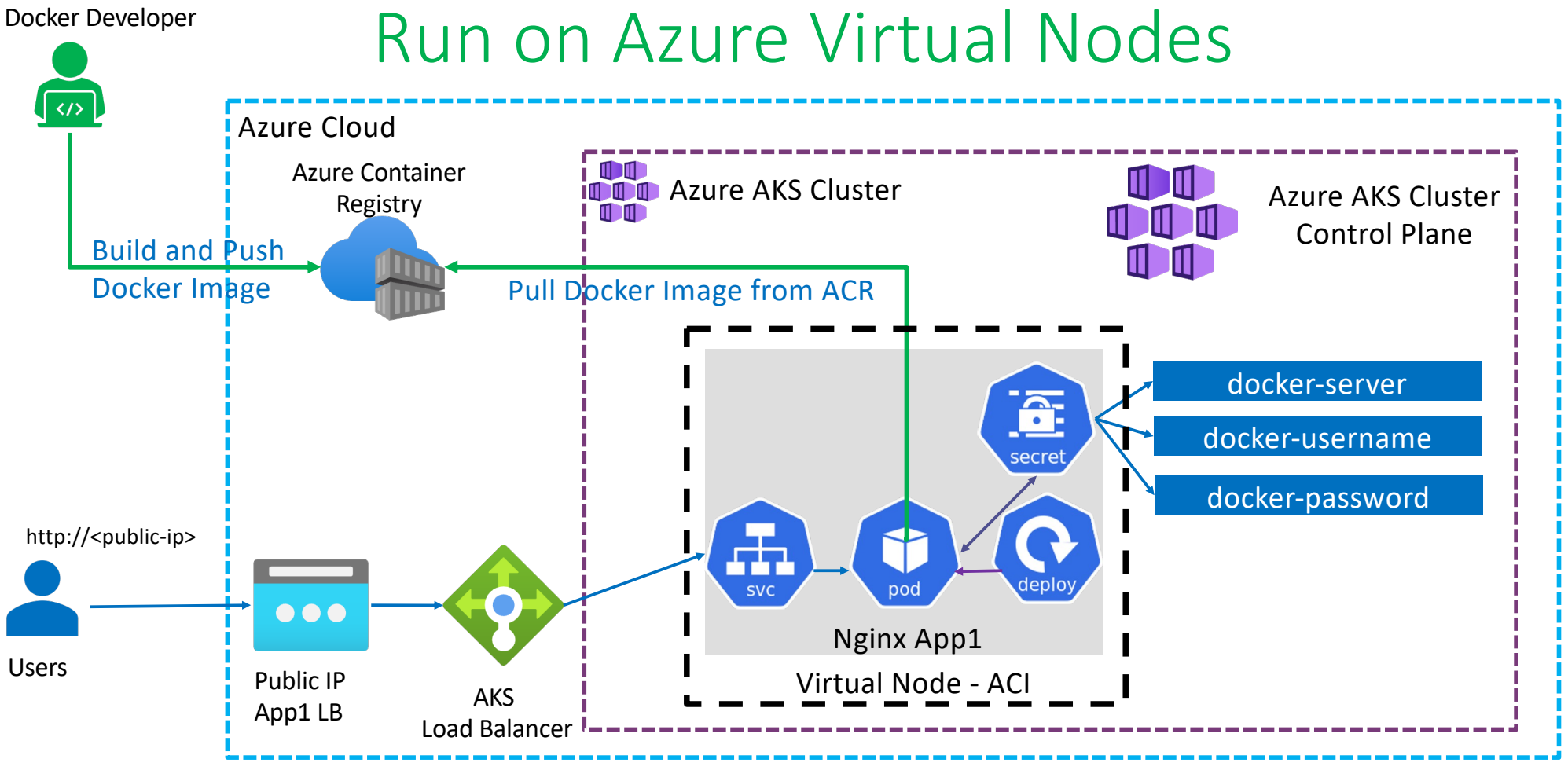
Azure ACR and AKS - Integration



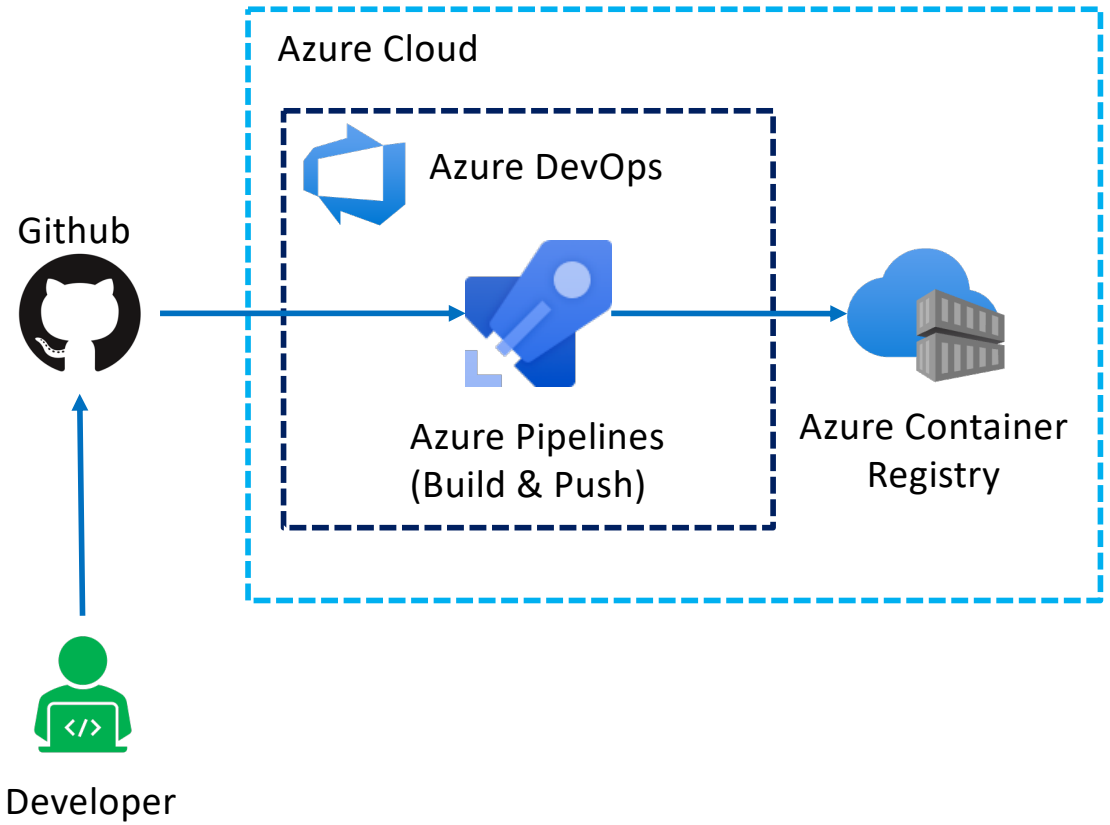
Pull Docker Images from ACR using Service Principal Run on Azure AKS Nodepools

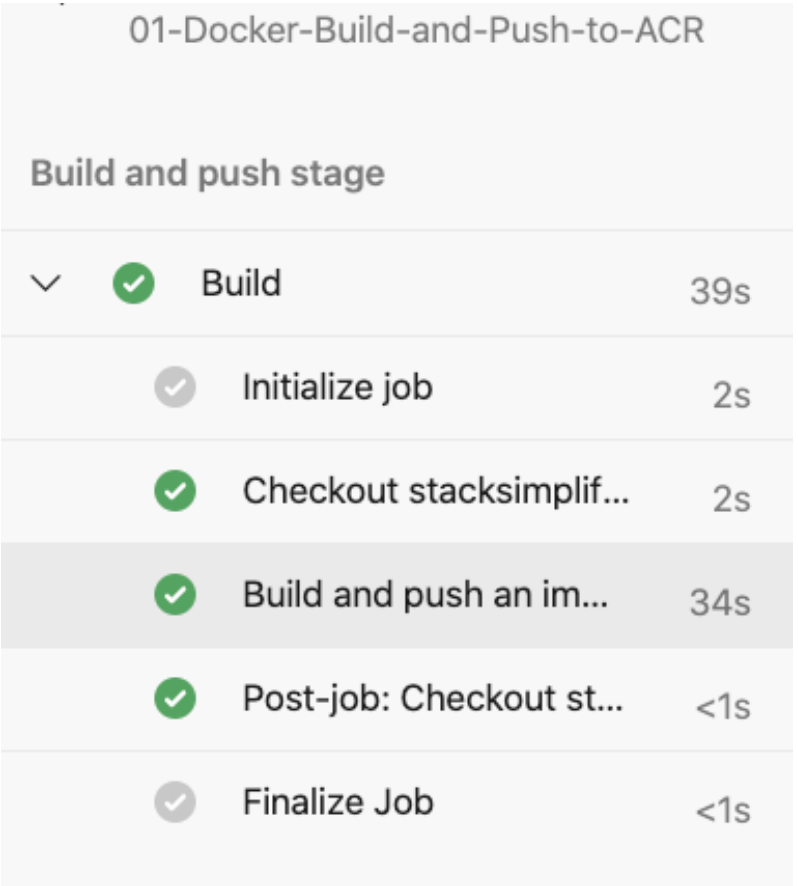


Pull Docker Images from ACR using Service Principal Run on Azure Virtual Nodes

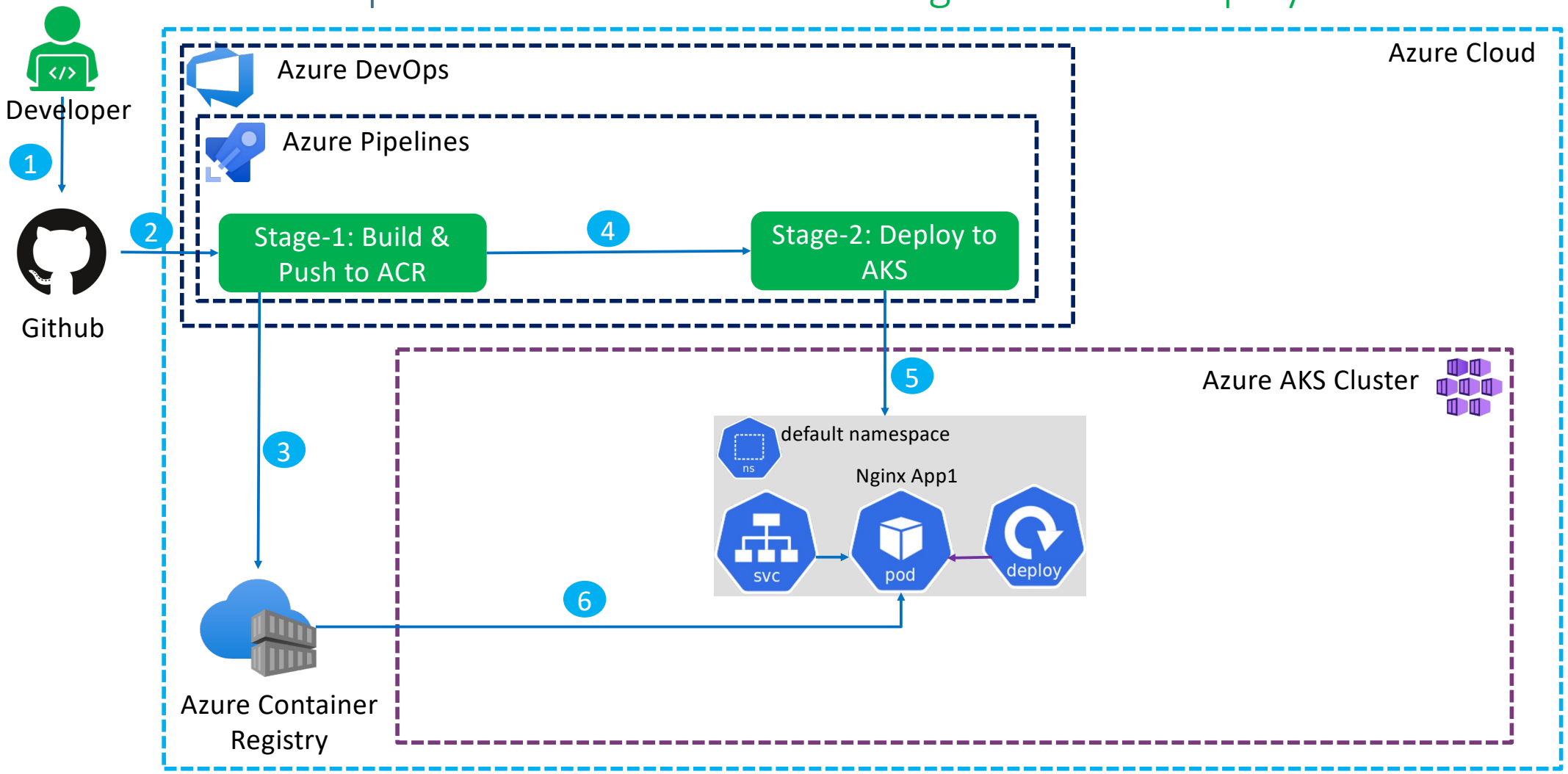


Azure DevOps Pipelines – Build & Push Docker Image to ACR

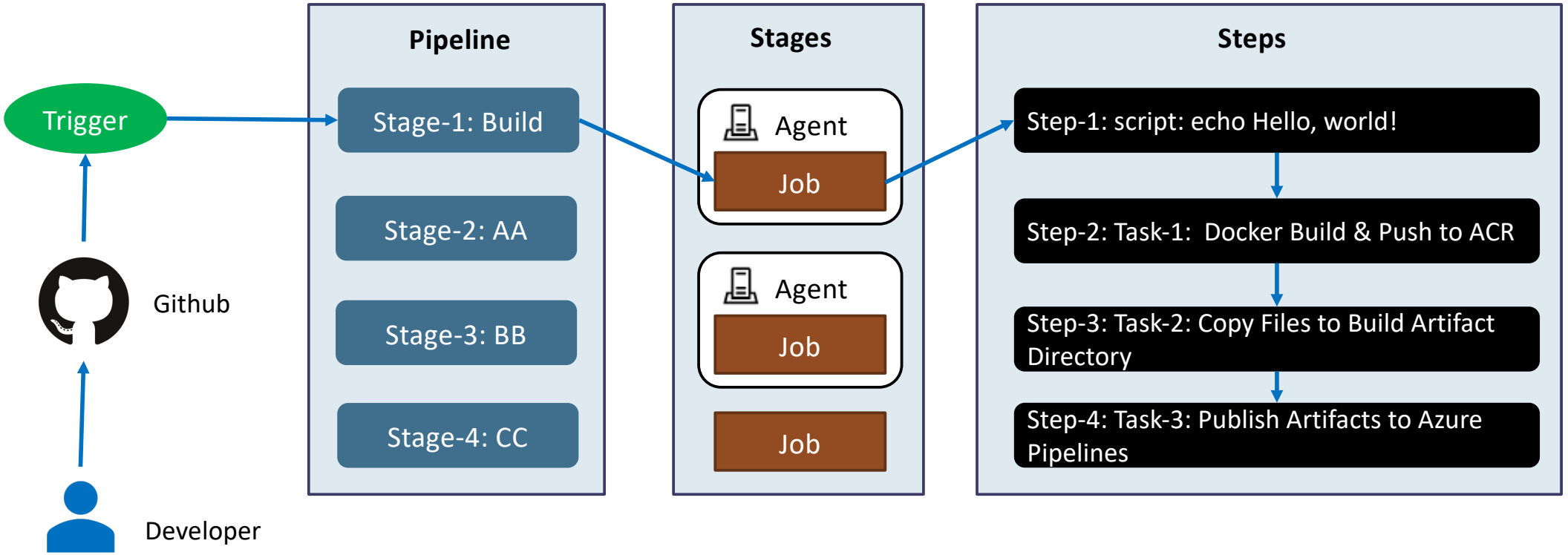




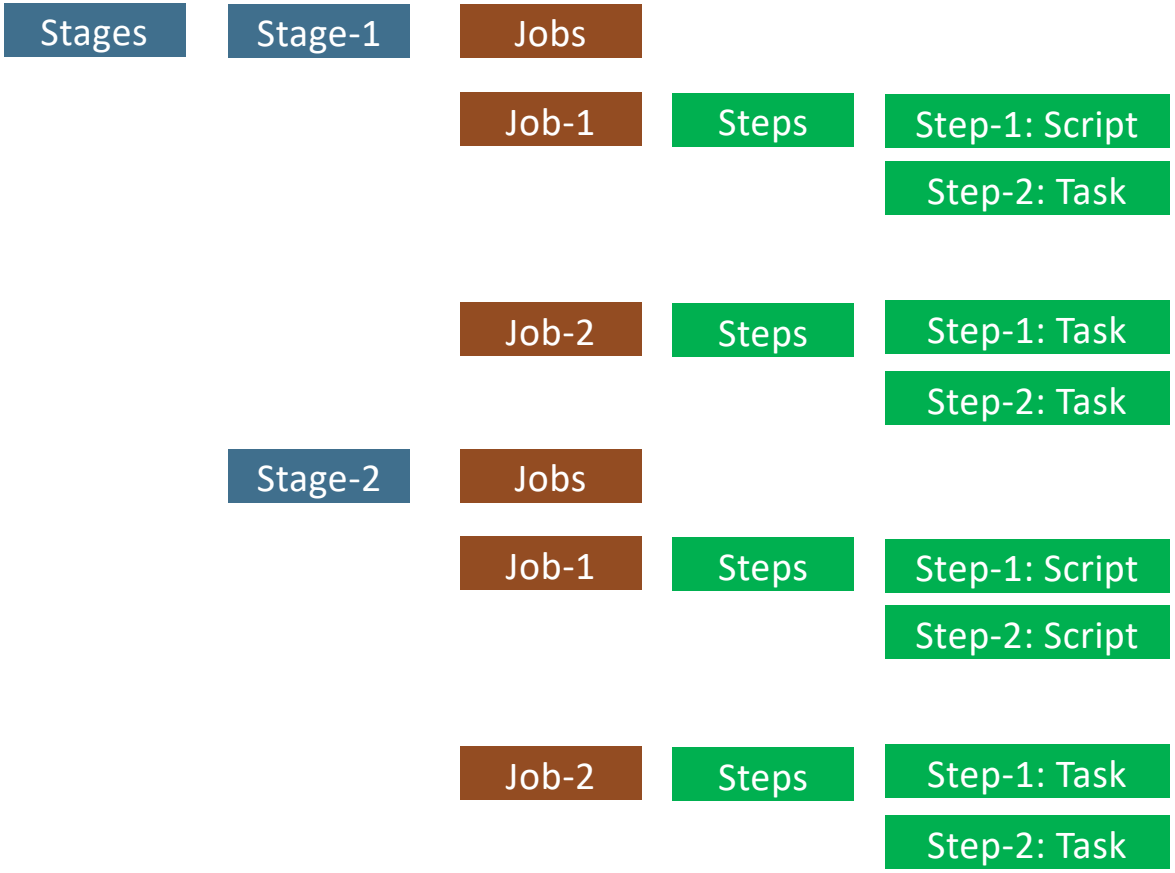
Azure DevOps – Build & Push Docker Image to ACR & Deploy to AKS



Azure Pipelines – Key Concepts



Azure Pipelines – Key Concepts




```yaml
stages:
- stage: Stage-1
  jobs:
  - job: Job-1
    steps:
    - script: echo Step-1
    - script: echo Step-2
  - job: Job-2
    steps:
    - task: some task step-1
    - task: some task step-2
- stage: Stage-2
  jobs:
  - job: Job-1
    steps:
    - task: some task step-1
    - task: some task step-2
  - job: Job-2
    steps:
    - script: echo Step-1
    - script: echo Step-2
```

Azure Pipelines – Starter Pipeline

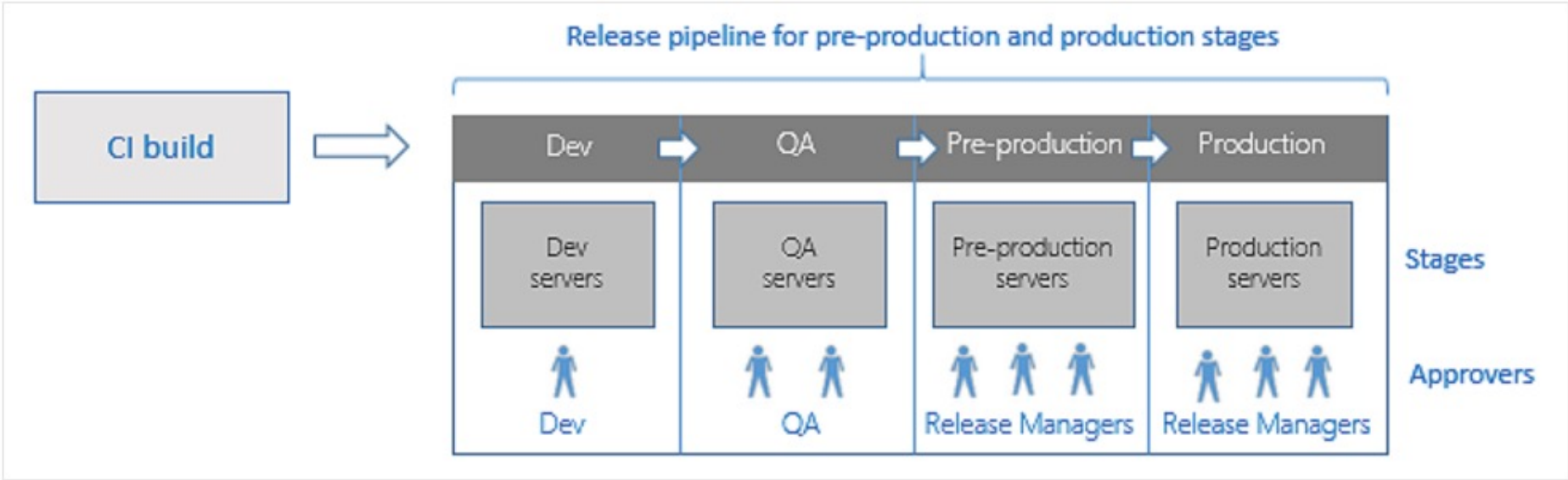
Goal	Create a Pipeline that will build docker images, push them to Azure Container Registry and Publish Kubernetes Manifests to Azure Pipelines

Part-1	Semi Customized
Task-1	Use pre-defined Docker Build & Push Pipeline
Task-2	Customize Pipeline to Use Copy Files Task
Task-3	Customize Pipeline to Use Publish Build Artifacts Task

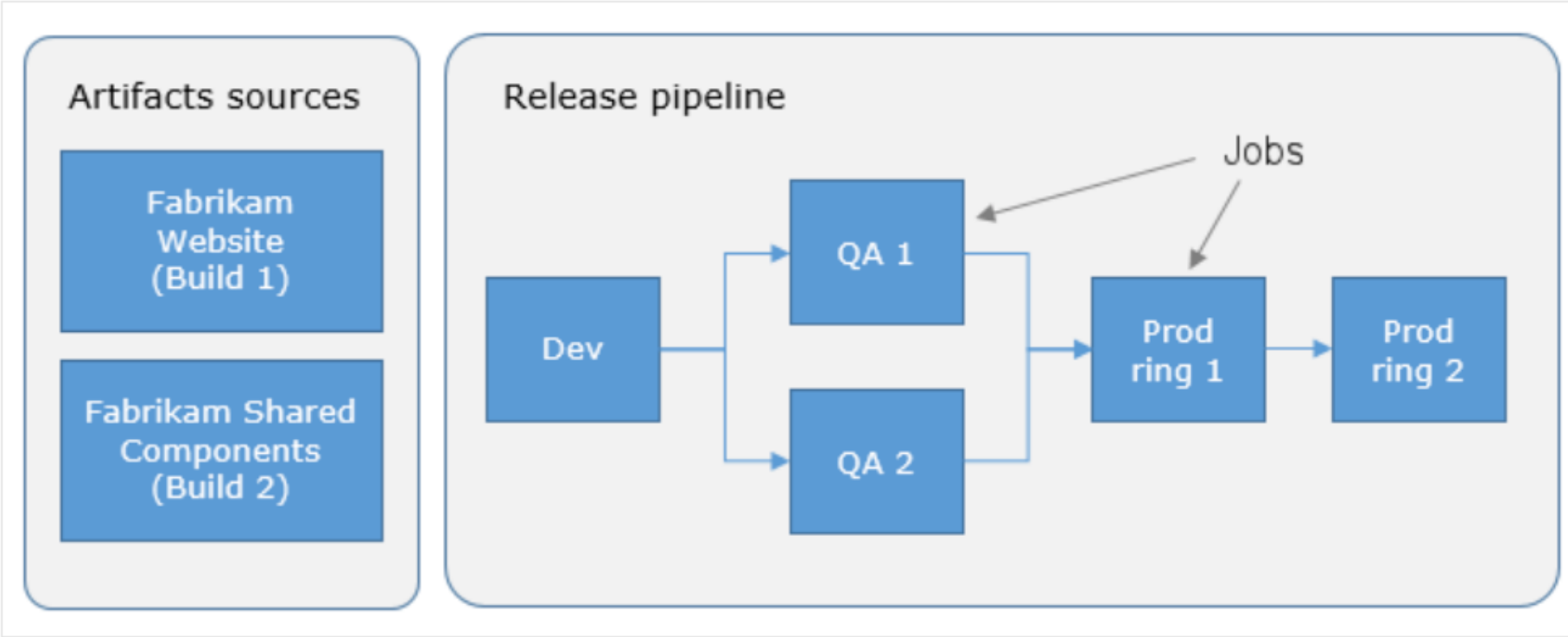
Part-2	Fully Customized using Starter Pipeline
Task-1	Start using Starter pipeline and use Docker Build or Push Docker Images Task
Task-2	Customize Pipeline to Use Copy Files Task
Task-3	Customize Pipeline to Use Publish Build Artifacts Task

Azure DevOps – Release Pipelines

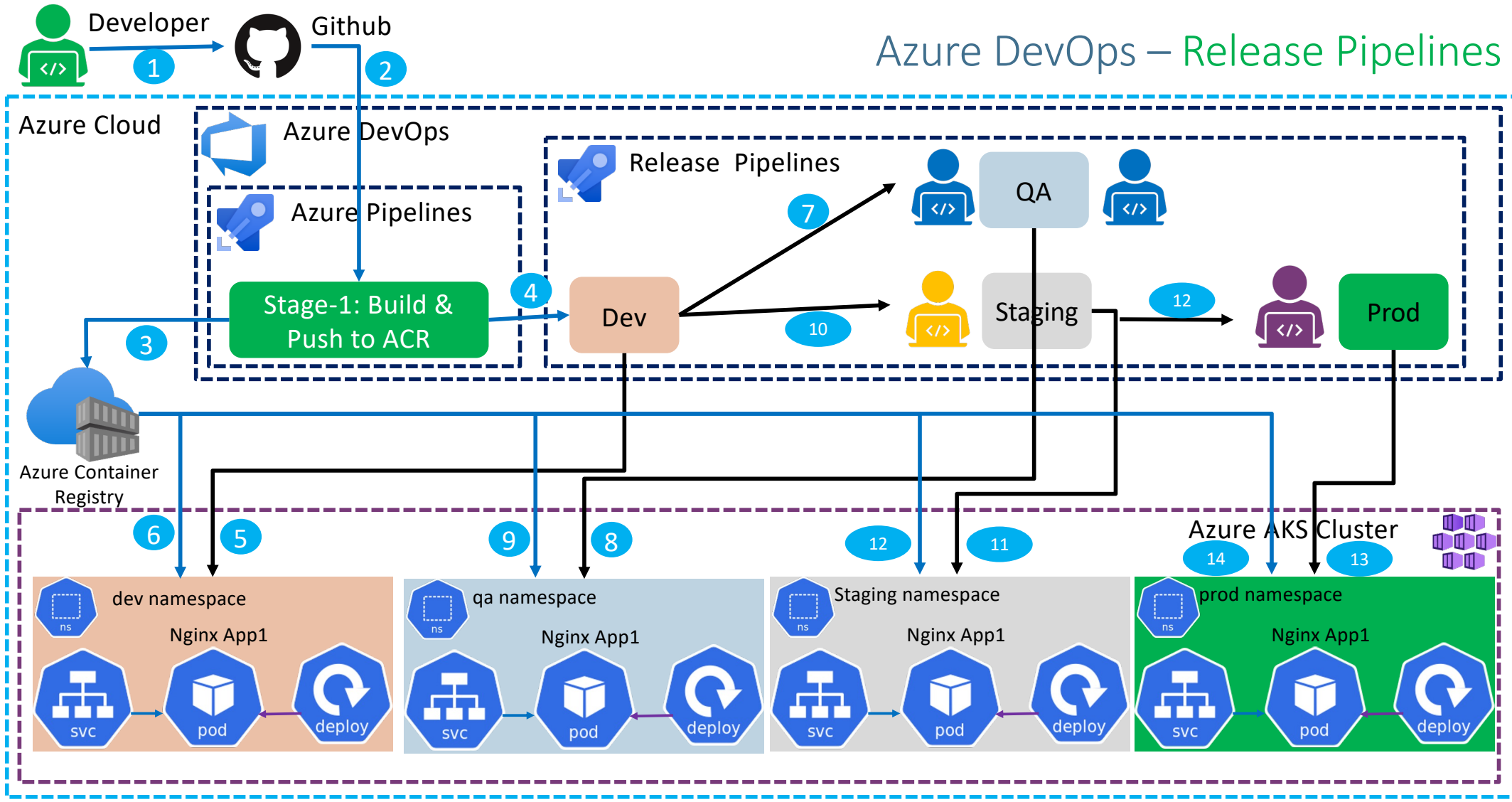
To achieve Continuous Delivery we use Release Pipelines



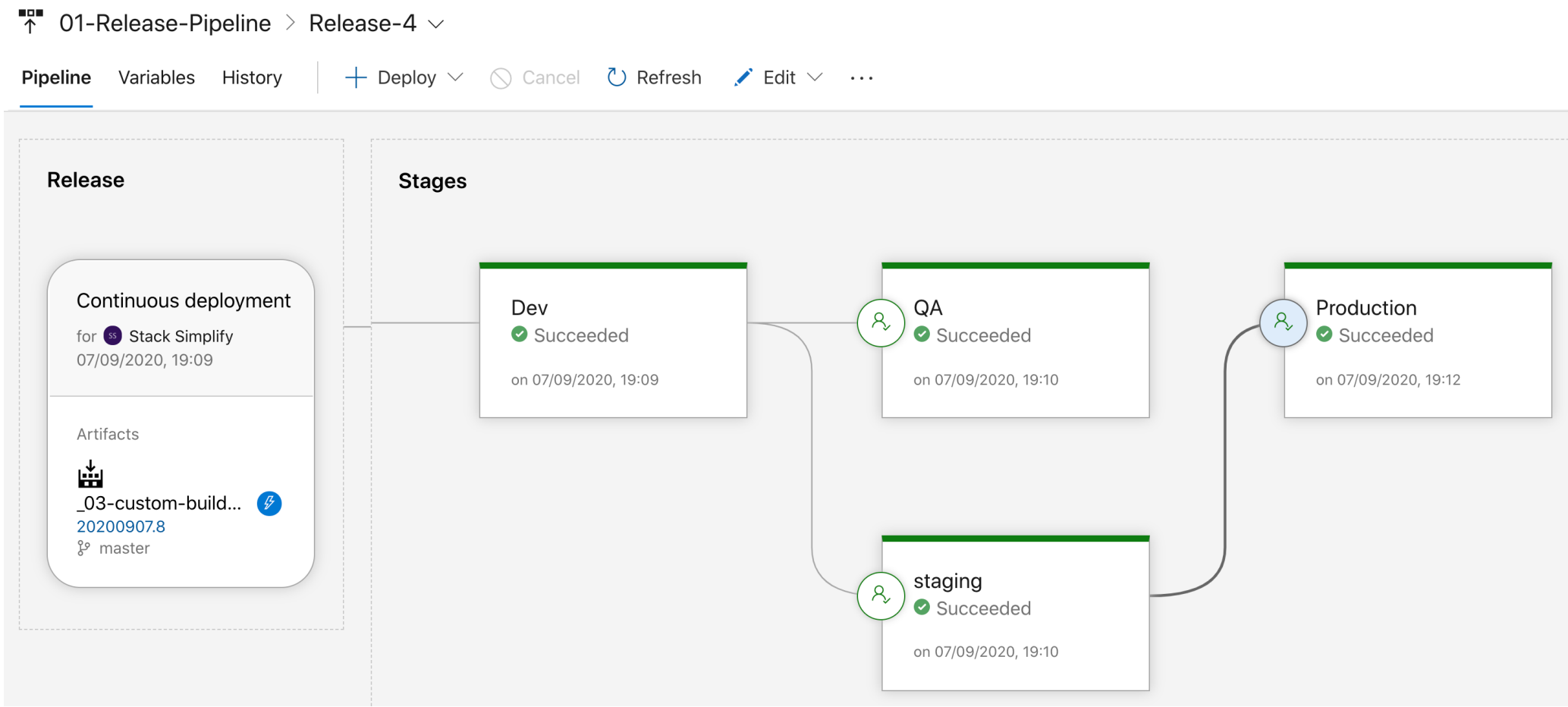
Azure DevOps – Release Pipelines



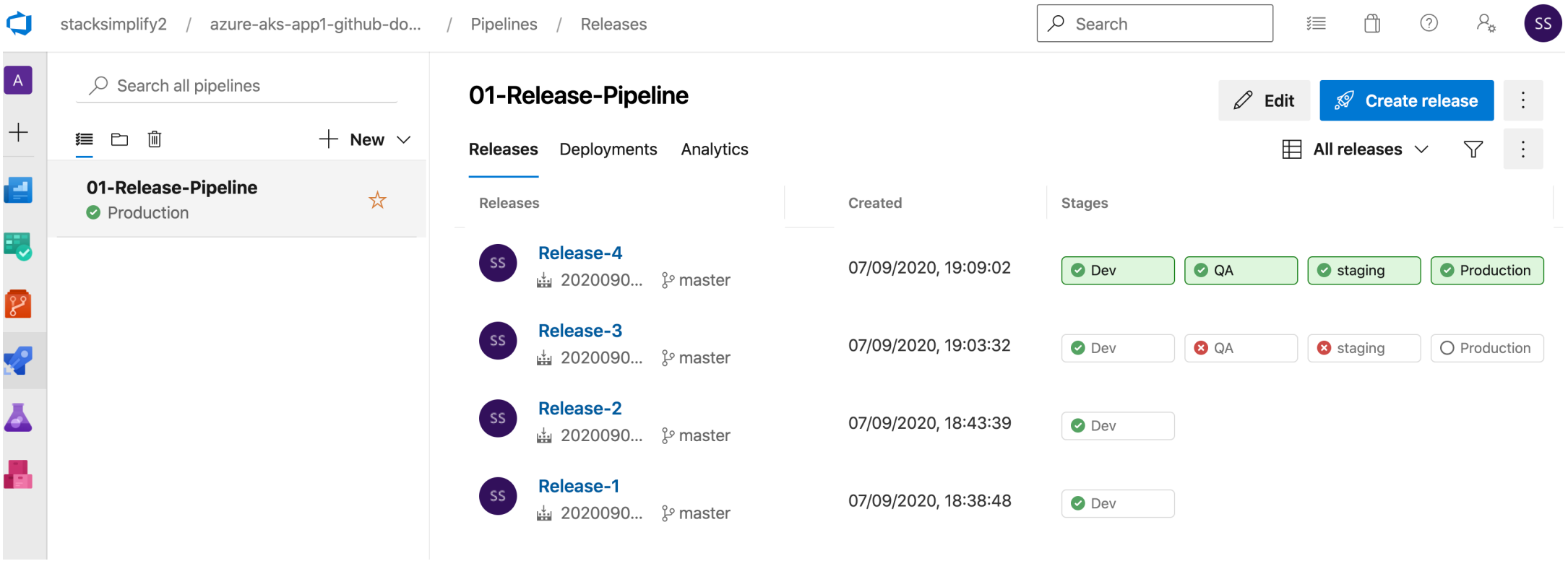
Azure DevOps – Release Pipelines



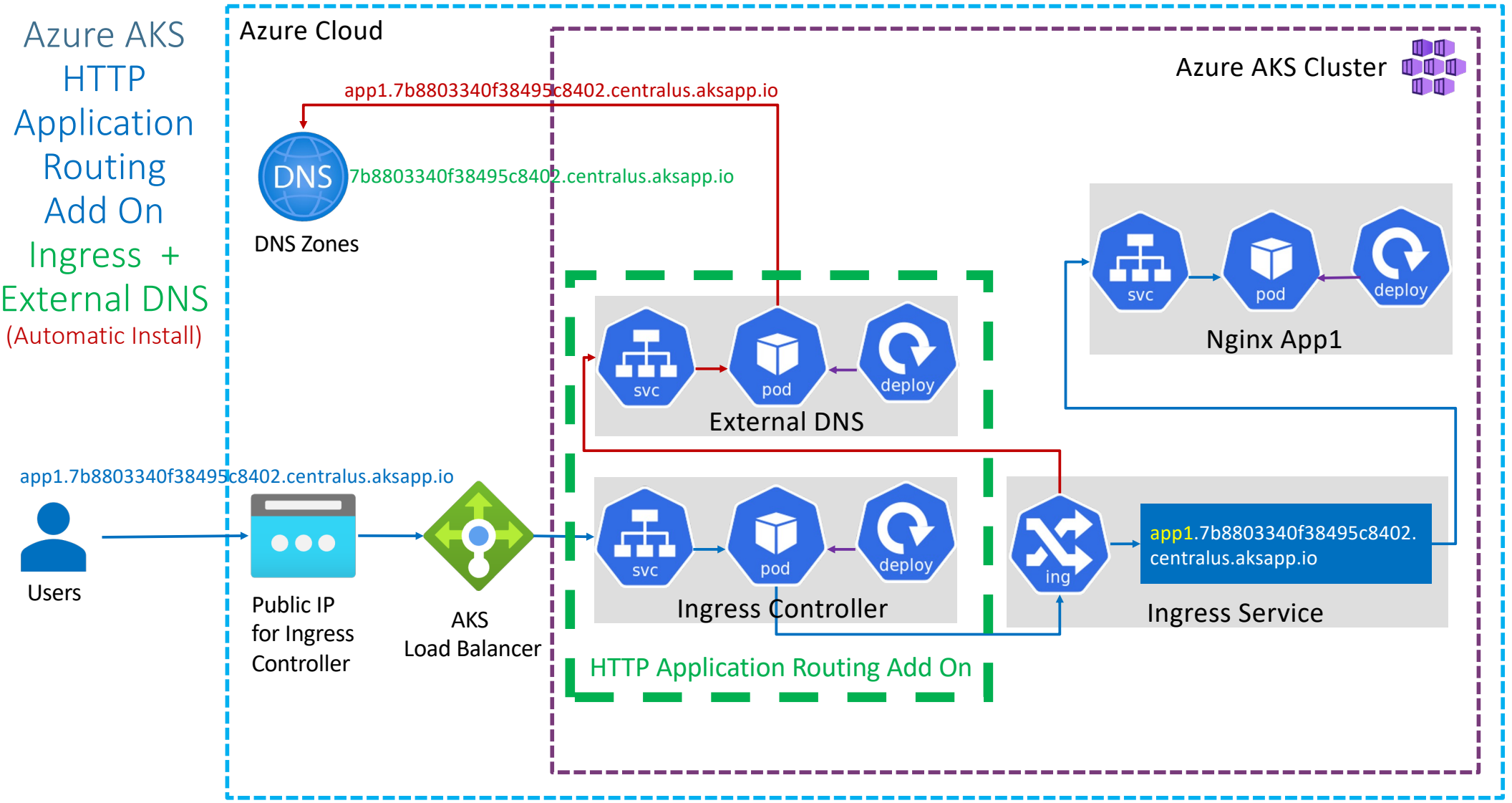
Azure Release Pipelines



Azure Release Pipelines - Releases



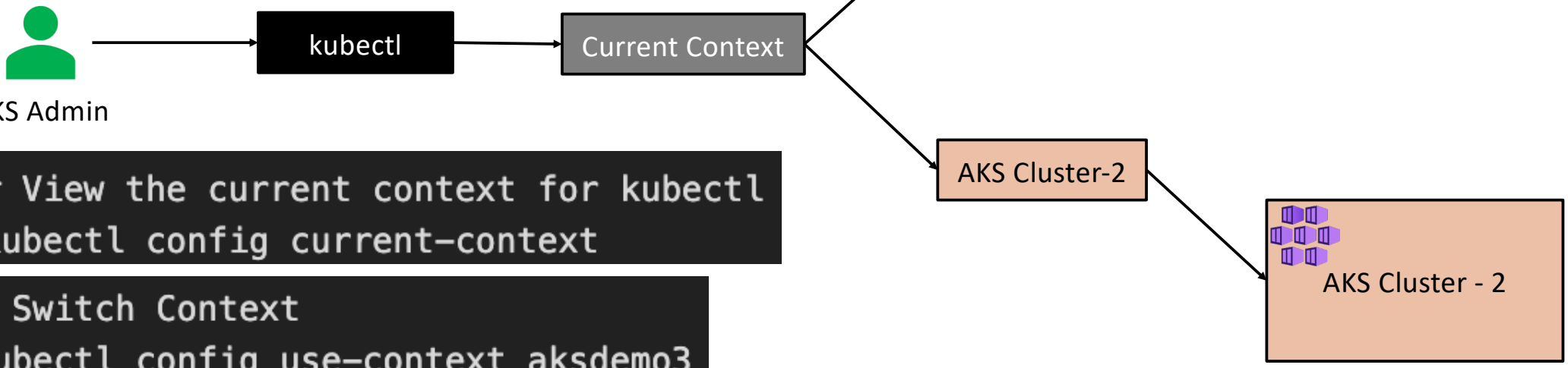
Azure AKS HTTP Application Routing Add On Ingress + External DNS (Automatic Install)



Azure AKS Cluster Access

```
# Configure AKSDEMO3 & 4 Cluster Access for kubectl
az aks get-credentials --resource-group aks-rg3 --name aksdemo3
az aks get-credentials --resource-group aks-rg4 --name aksdemo4
```

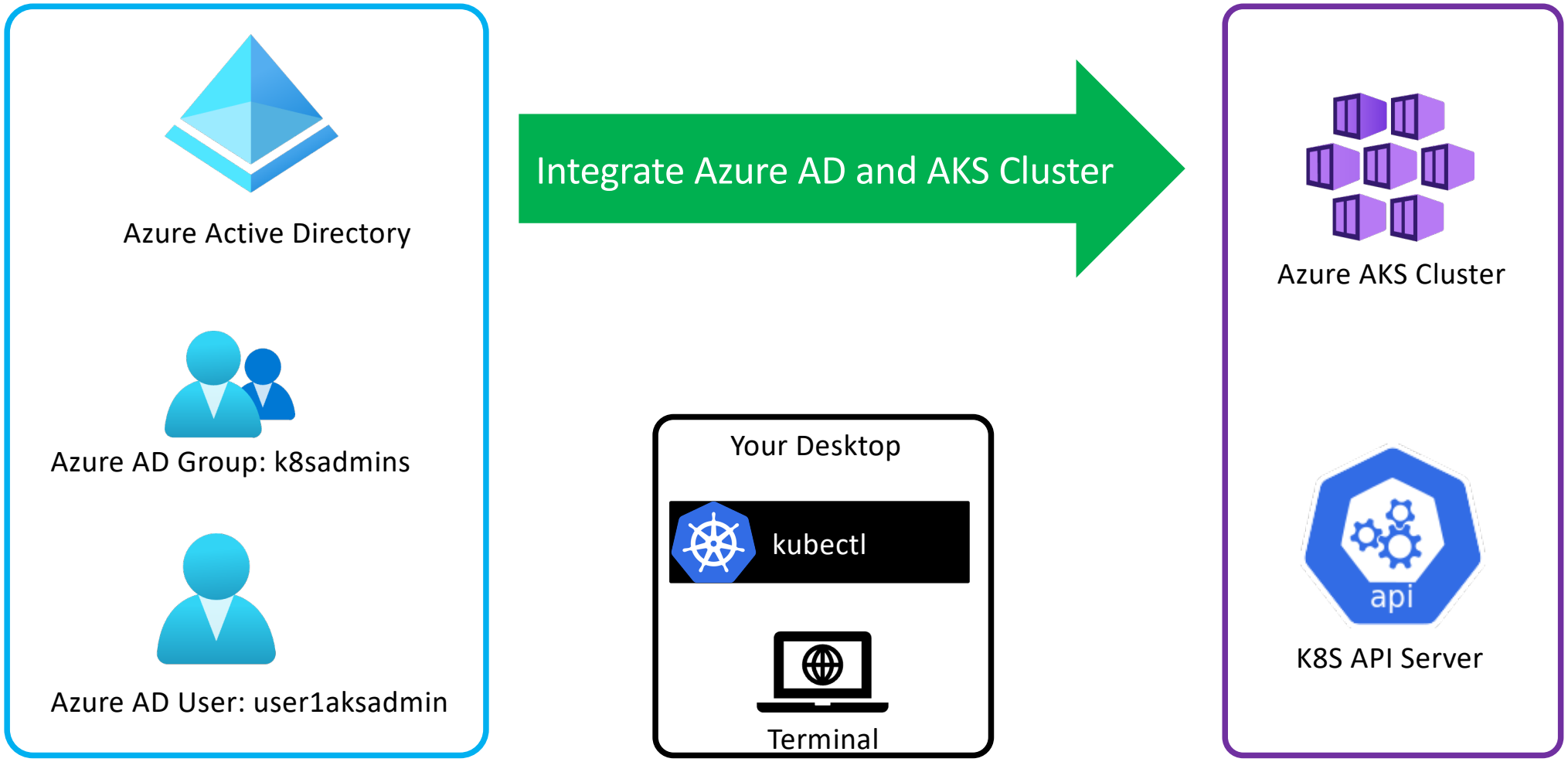
```
# View kubeconfig
kubectl config view
```



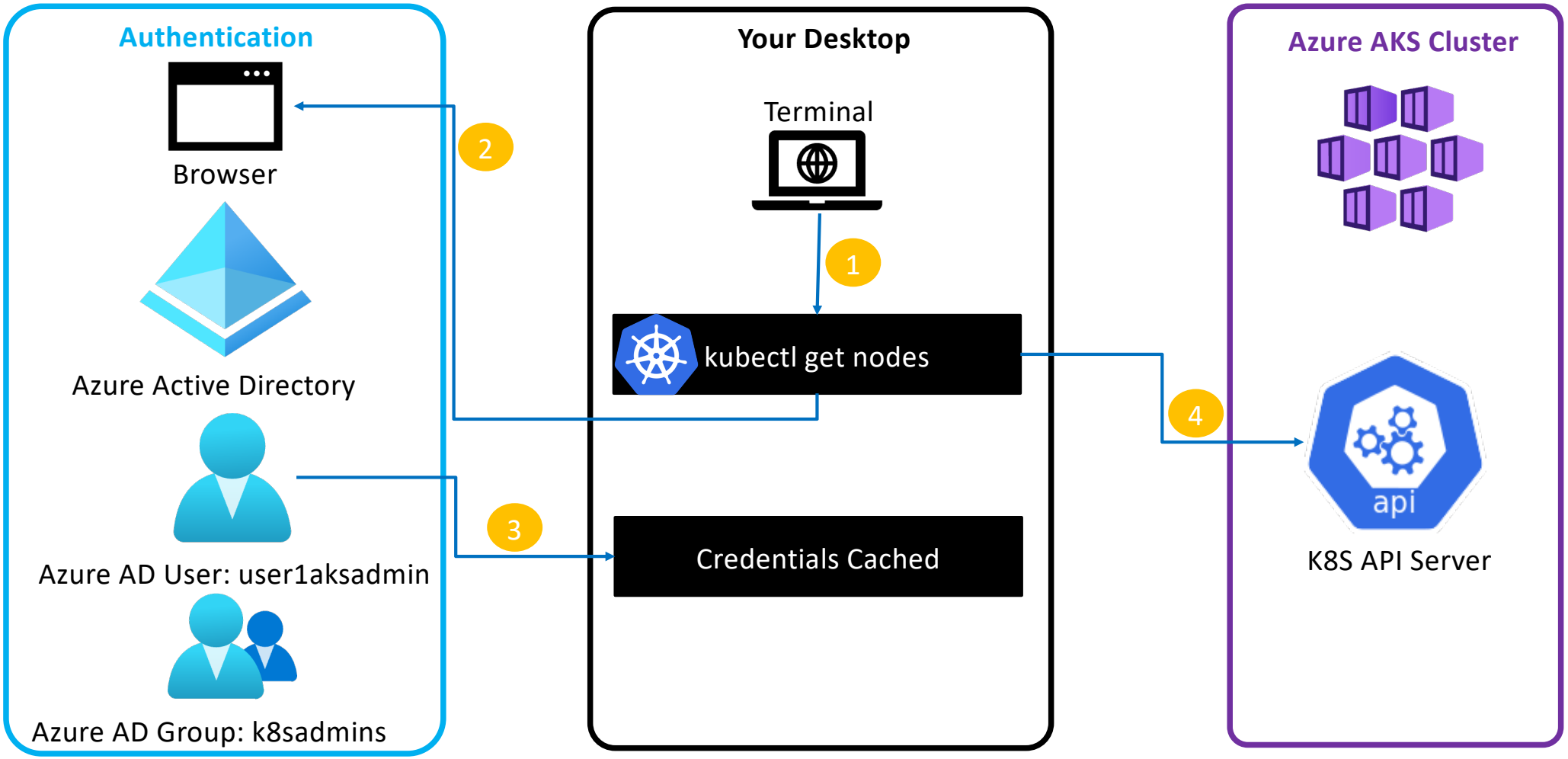

```
# View the current context for kubectl
kubectl config current-context
```

```
# Switch Context
kubectl config use-context aksdemo3
```

Azure Active Directory Authentication for AKS Admins



Azure Active Directory Authentication for AKS Admins



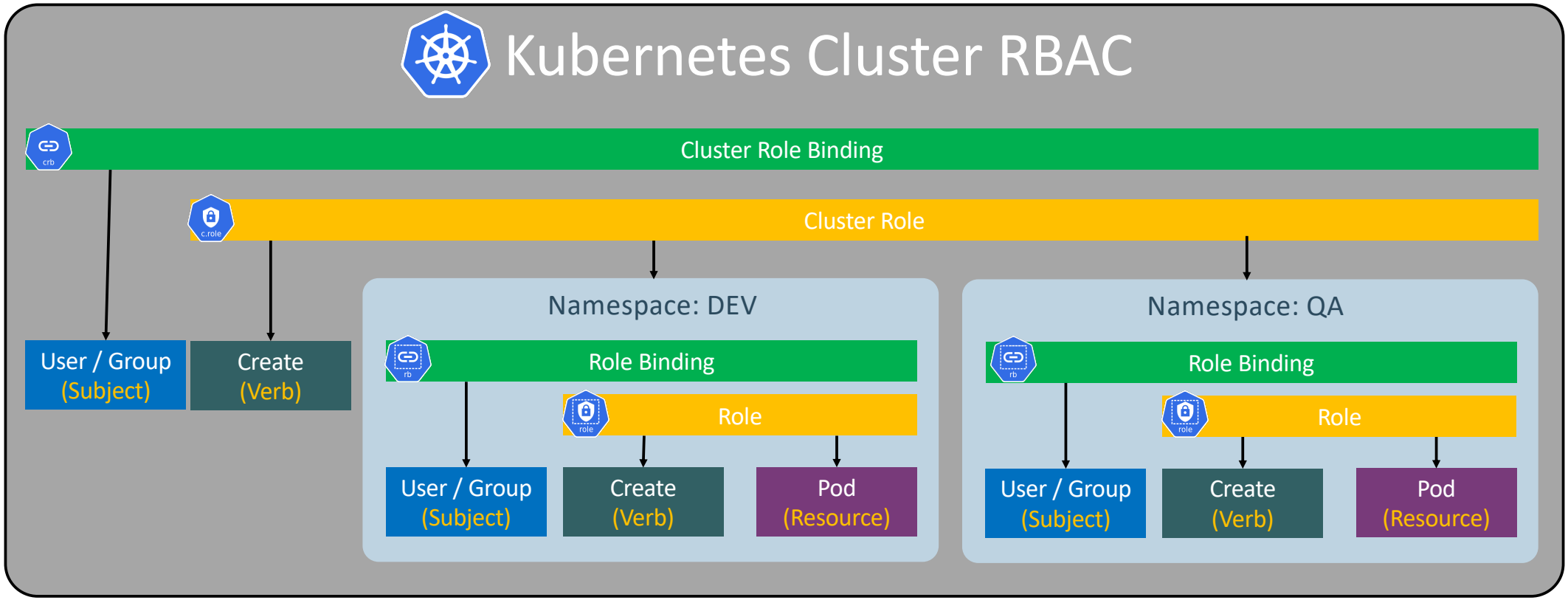
Kubernetes RBAC

Kubernetes RBAC - Fundamentals

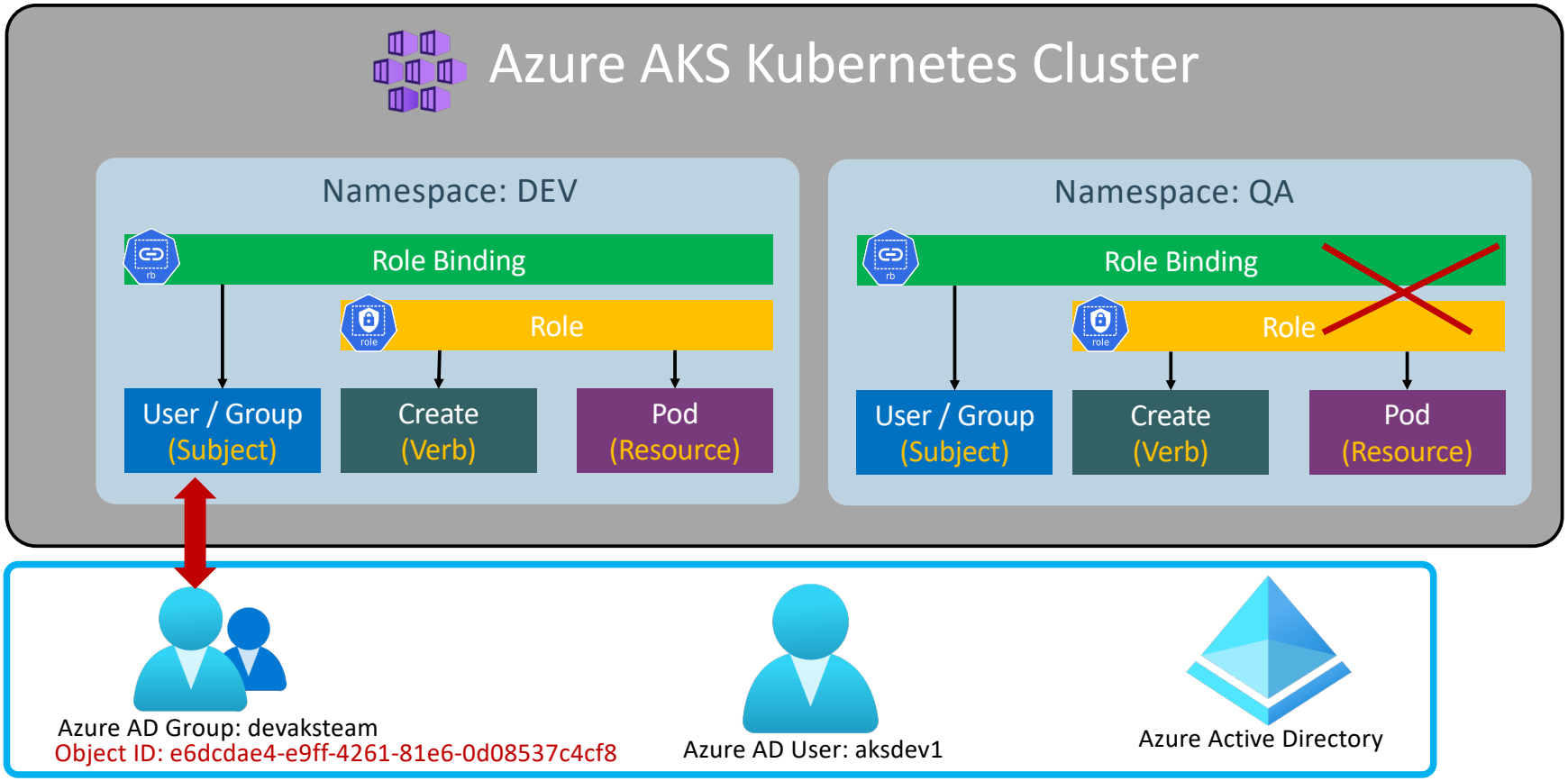
Subjects	API Groups	Resources	Verbs
Users or processes that need access to the Kubernetes API	The k8s API objects that we grant access to		List of actions that can be taken on a resource
Kind: Group, User	core	Pods	Create
Kind: Service Account	extensions	Deployments	List
	apps	Services	Watch
	batch	StatefulSets	Delete
			Patch
			get
			Replace
			Read

Reference: https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.19

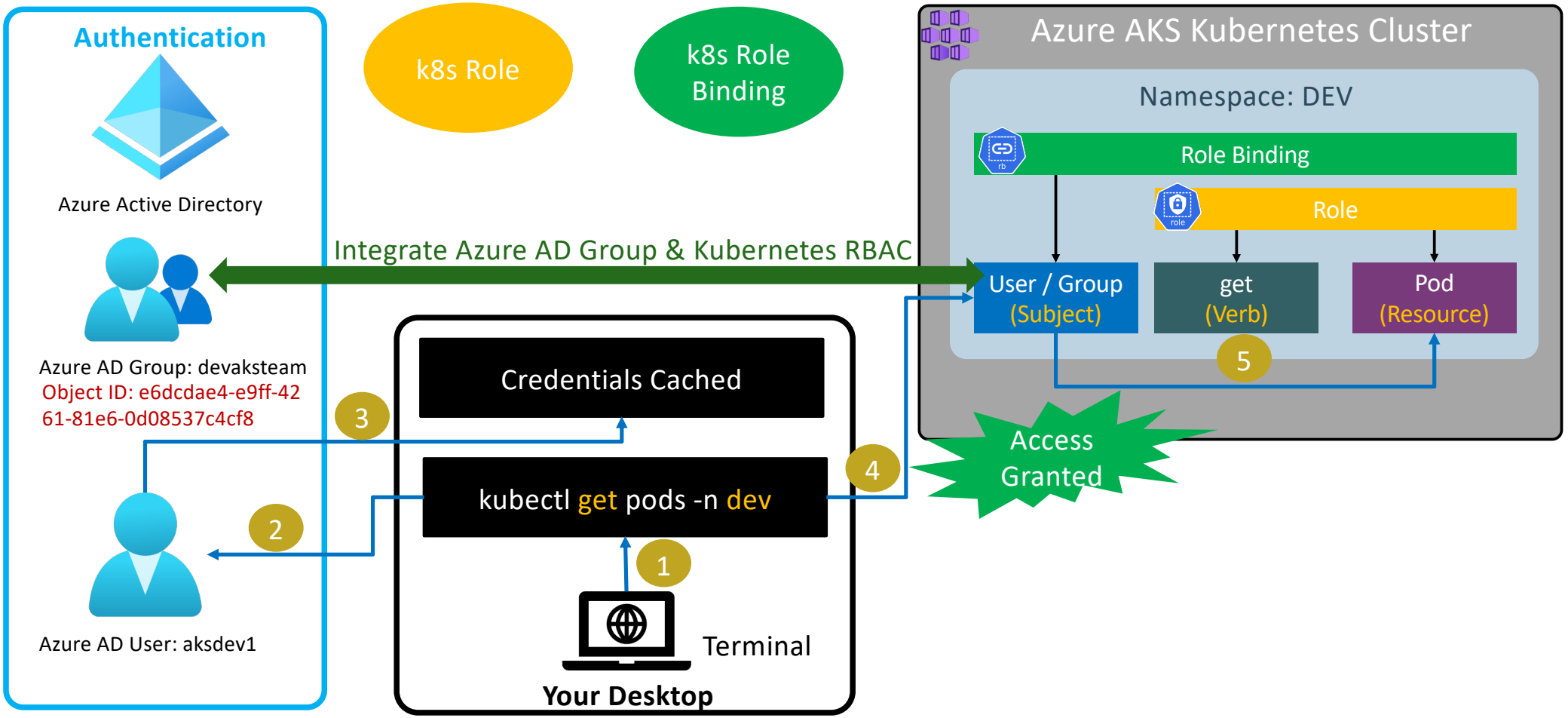
Kubernetes RBAC



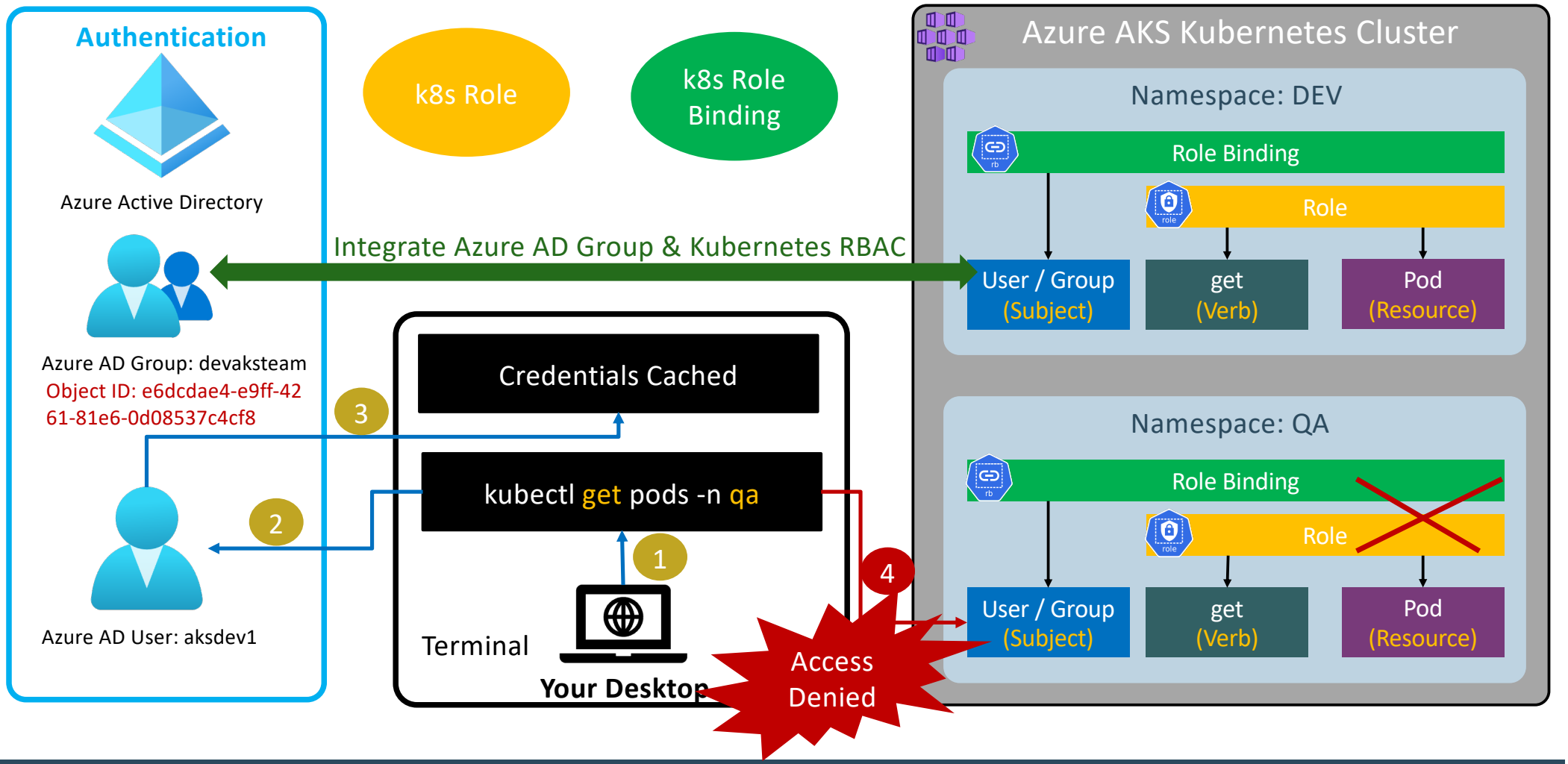
Azure Active Directory & Kubernetes RBAC



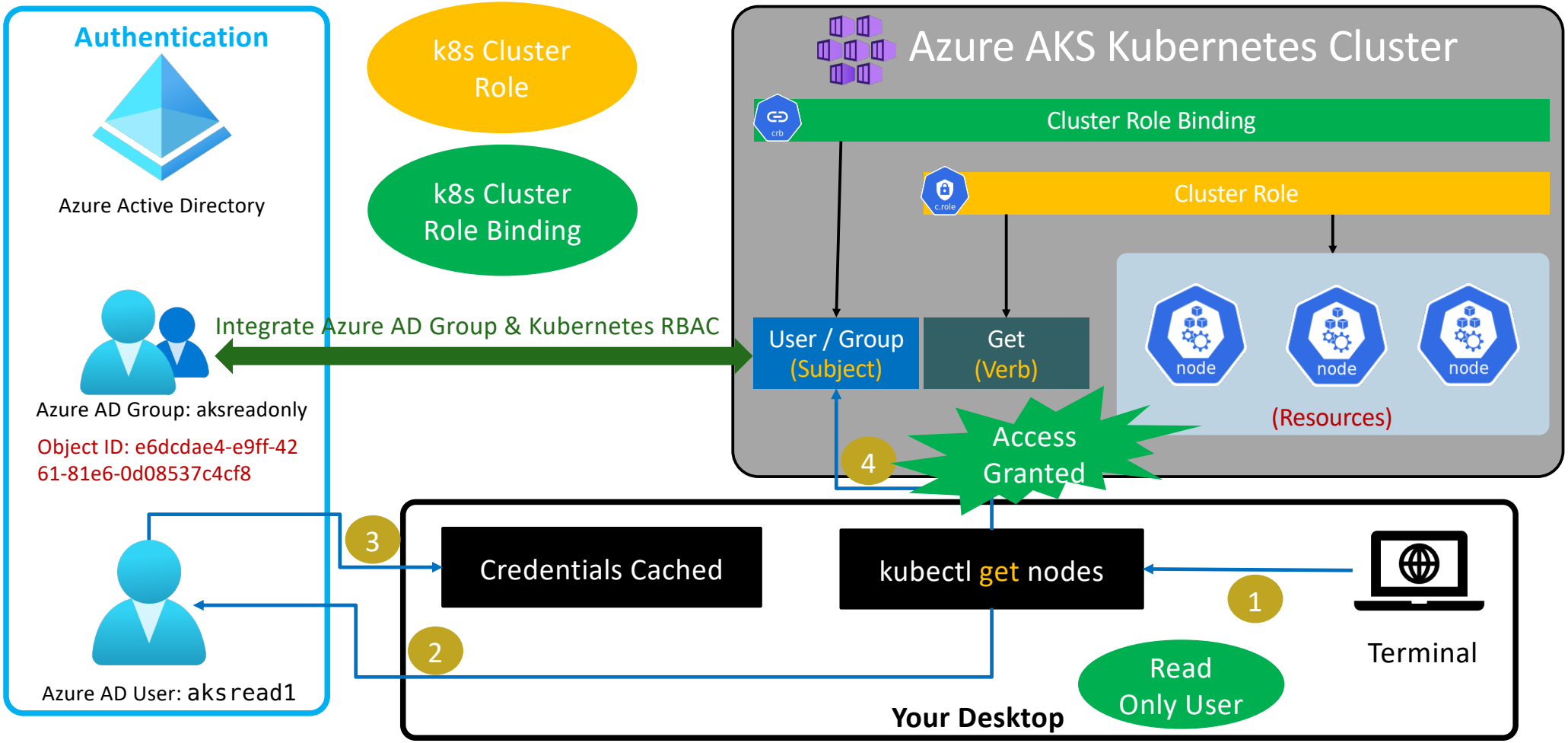
Azure Active Directory & Kubernetes RBAC



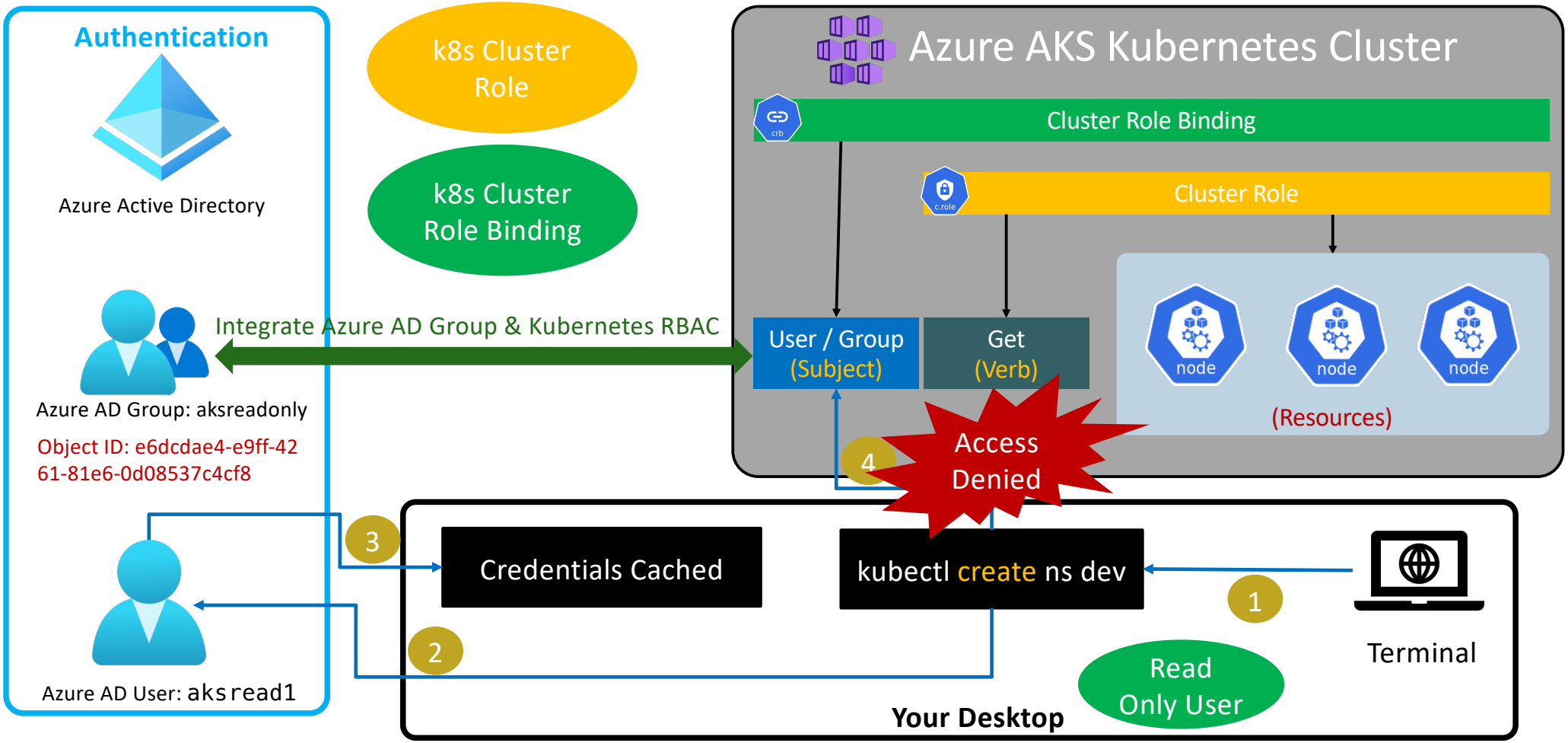
Azure Active Directory & Kubernetes RBAC



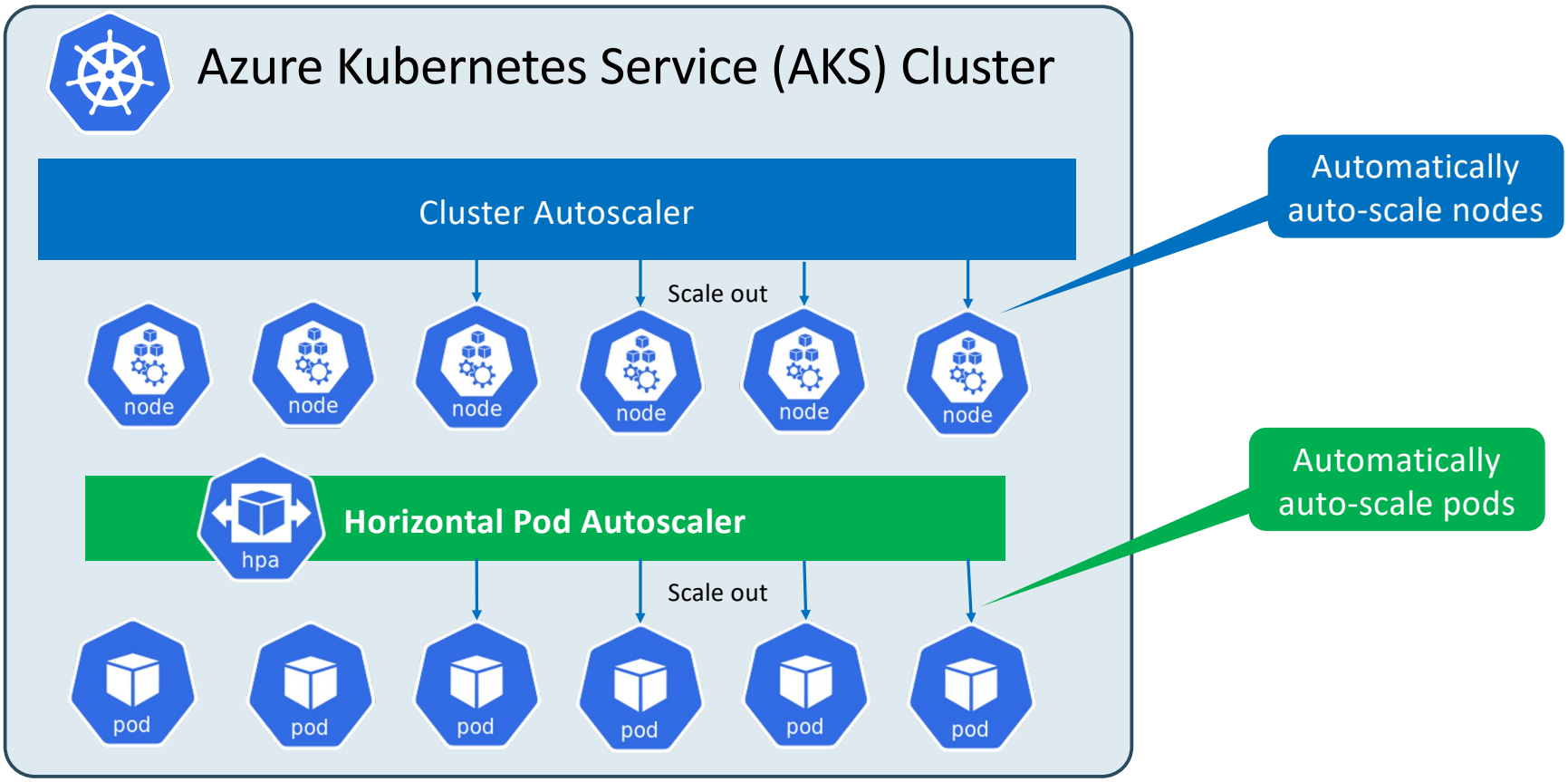
Azure Active Directory & Kubernetes RBAC

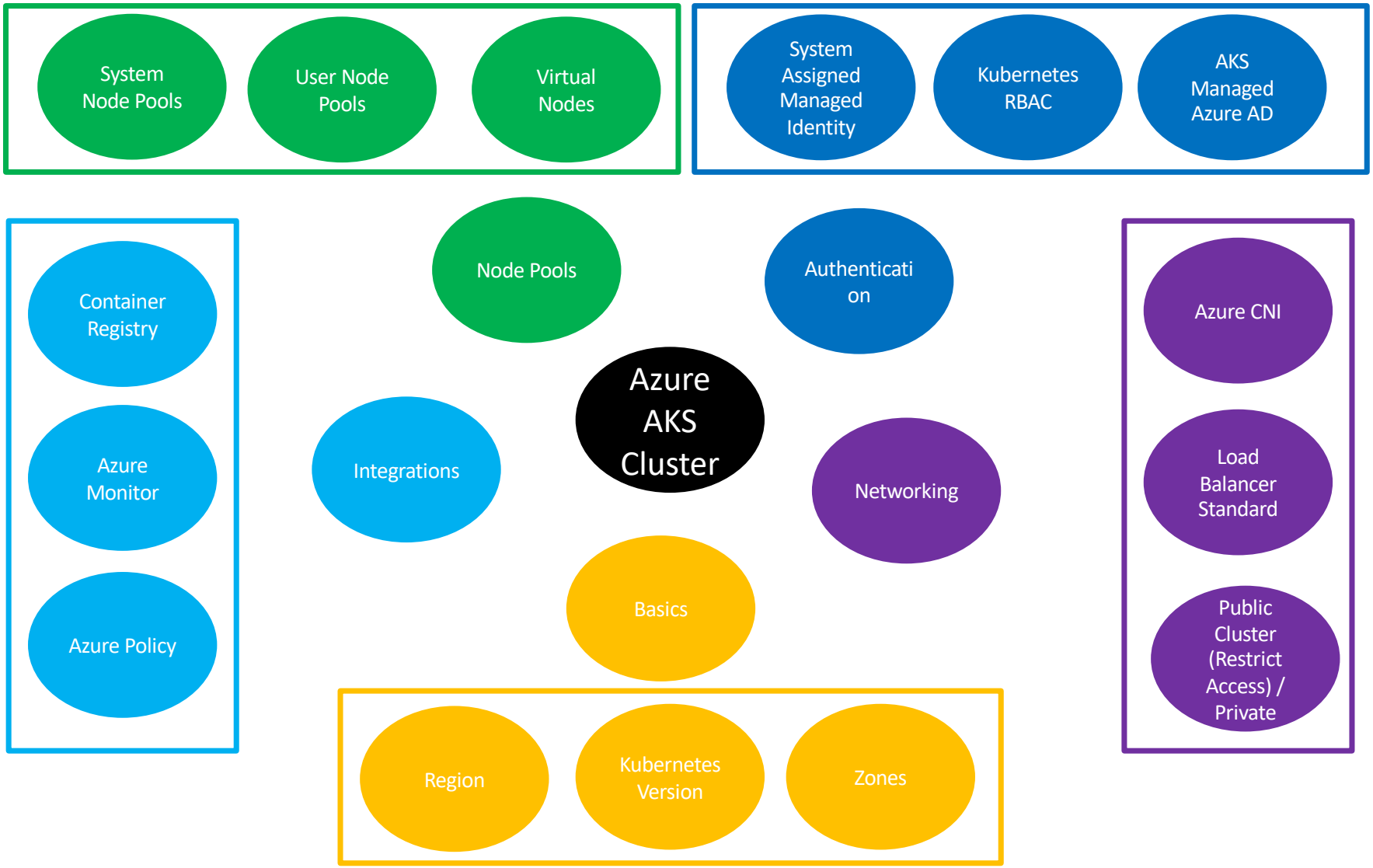


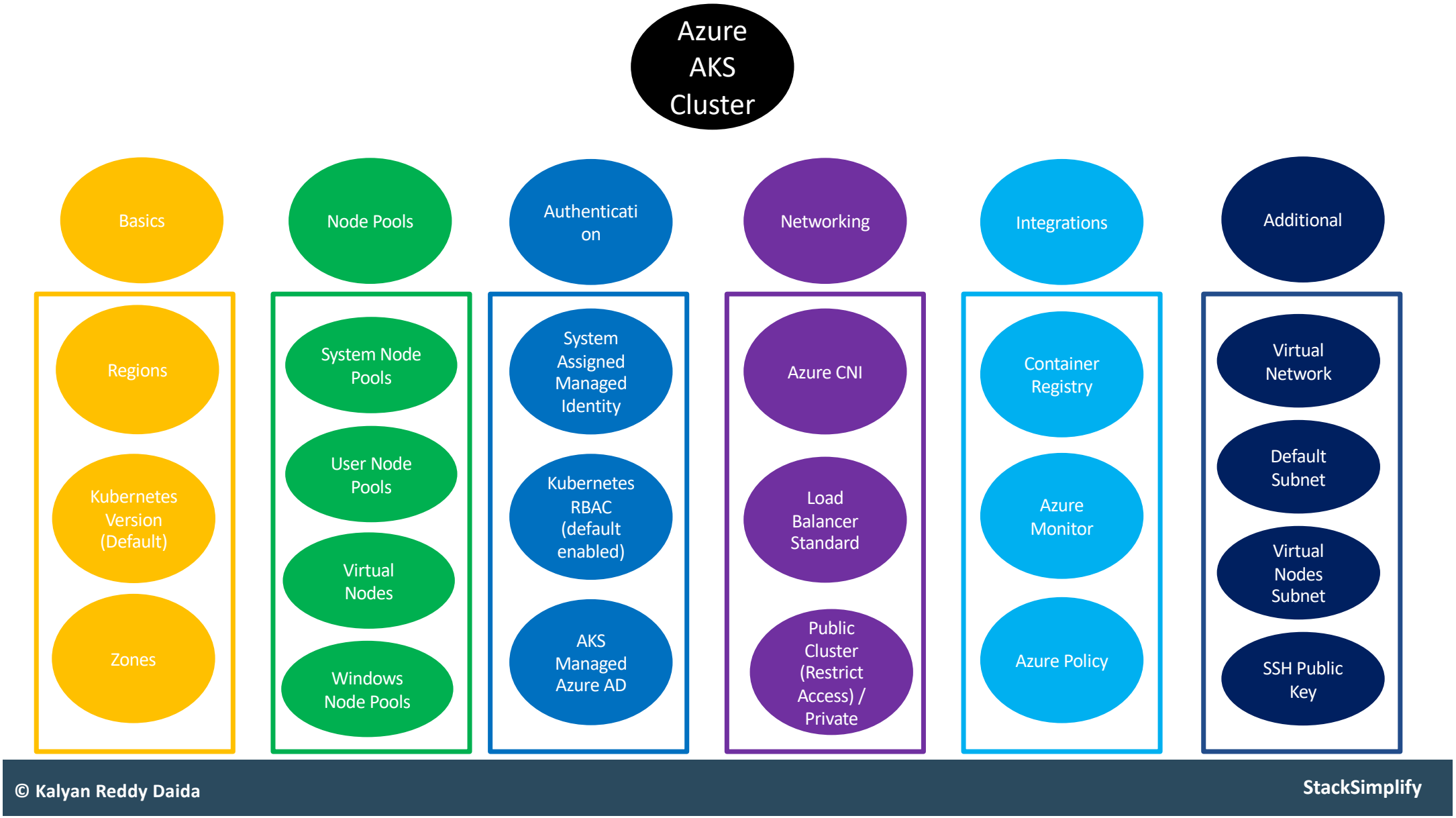
Azure Active Directory & Kubernetes RBAC



Azure AKS – Autoscaling Nodes & Pods





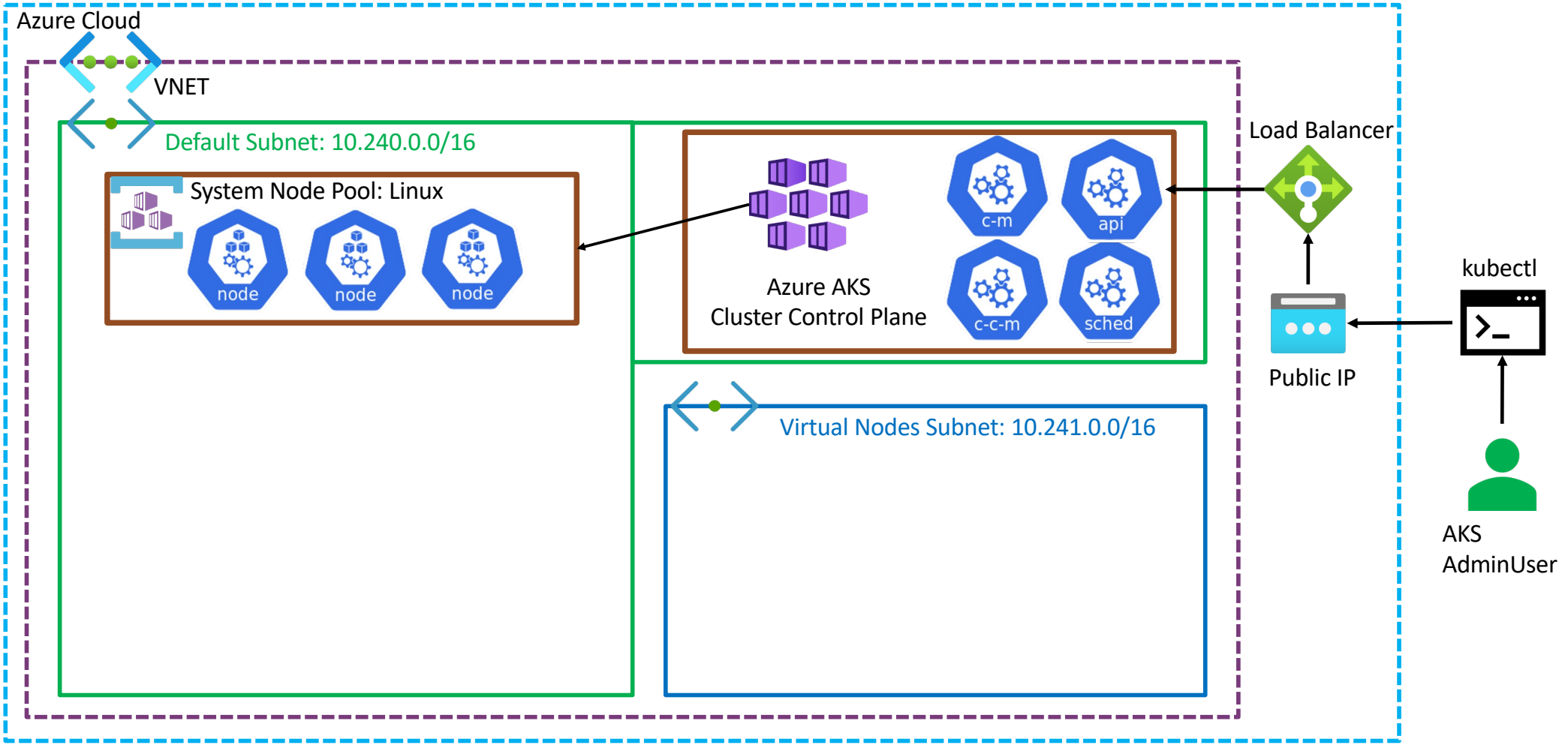


Section-1
Create AKS Cluster

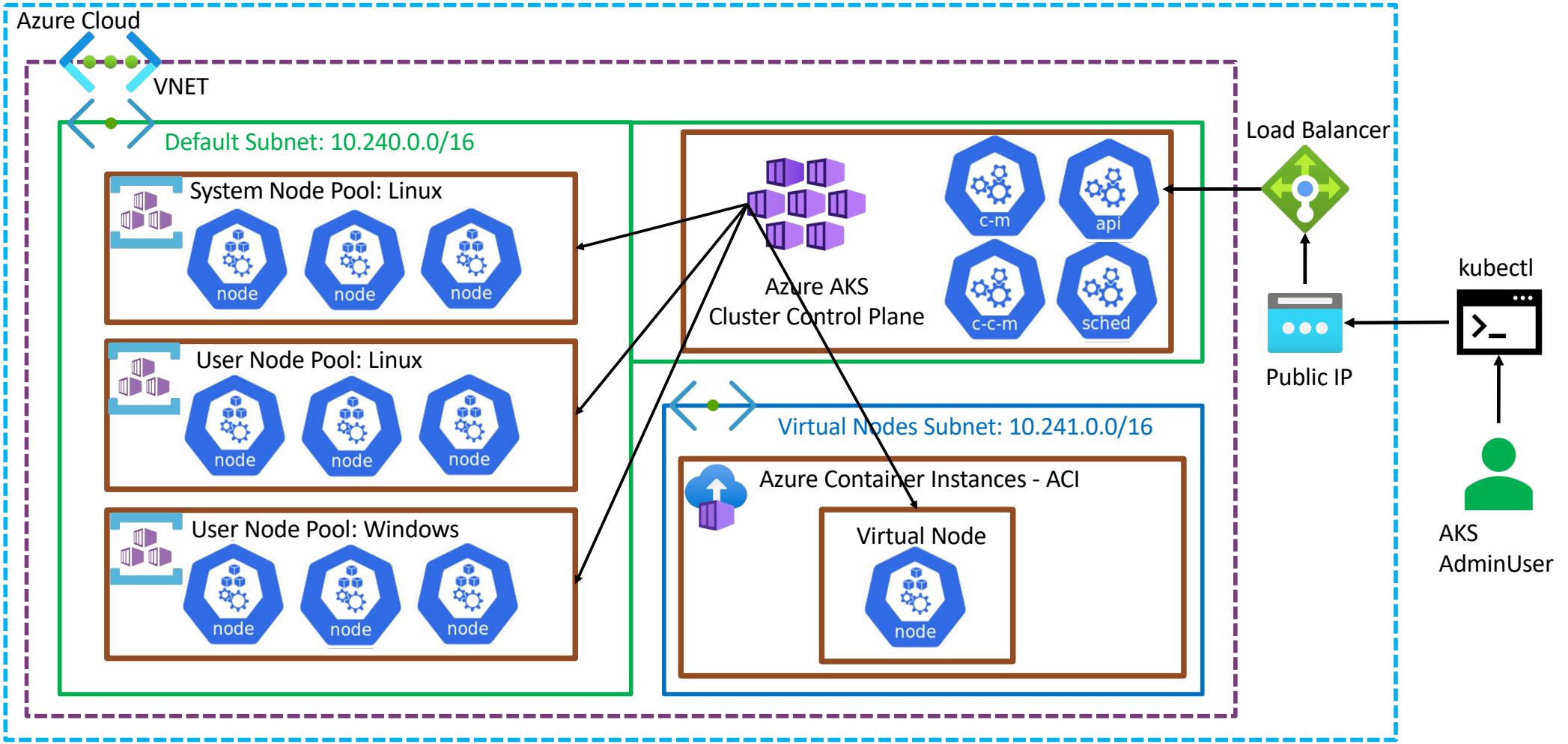
Section-2
Create Windows, Linux User Node Pools and Virtual Nodes

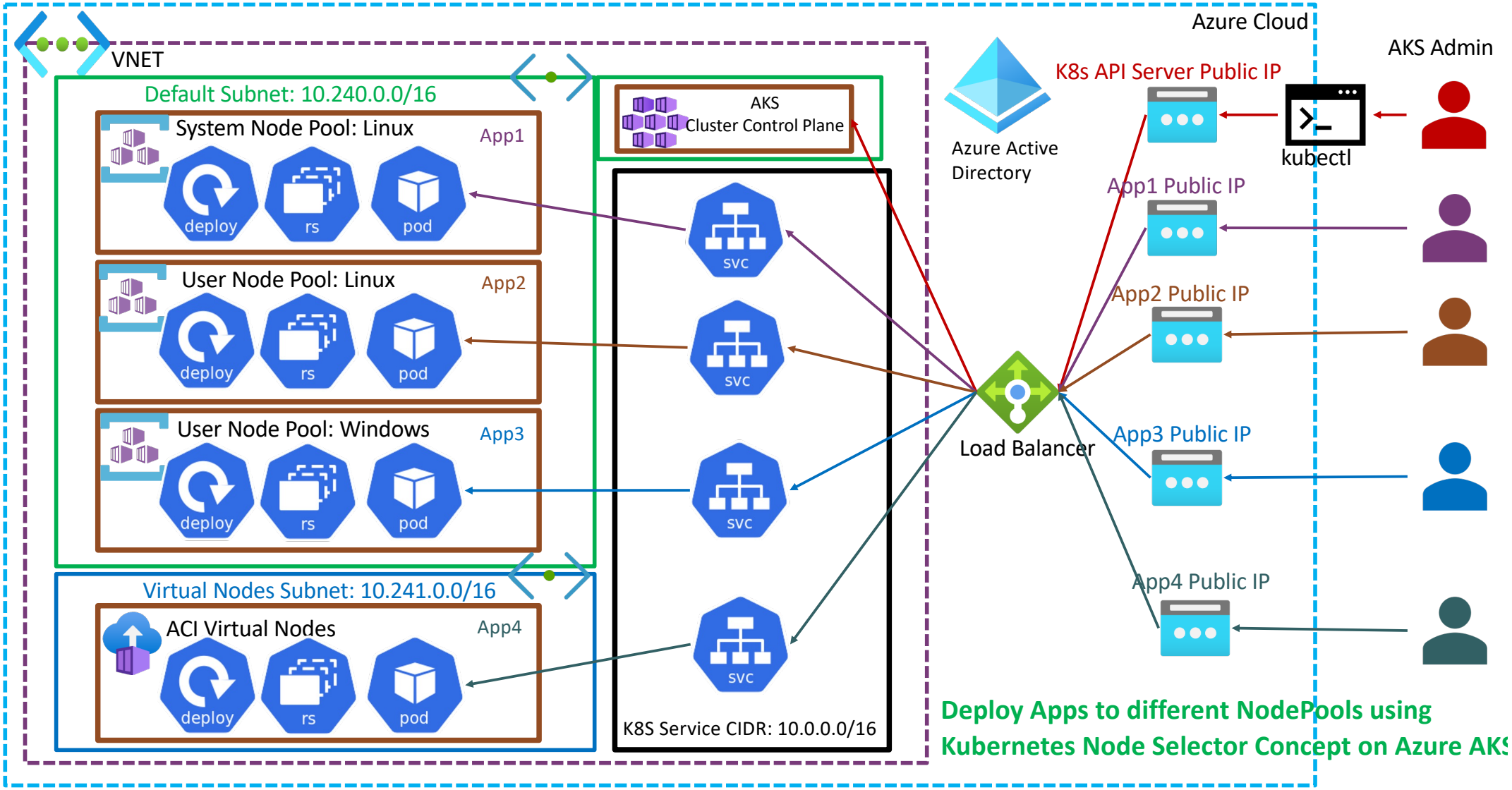
Section-3
Deploy Apps to all 4 node pools using Kubernetes Node Selector concept

Azure AKS Cluster – Create AKS Cluster using CLI

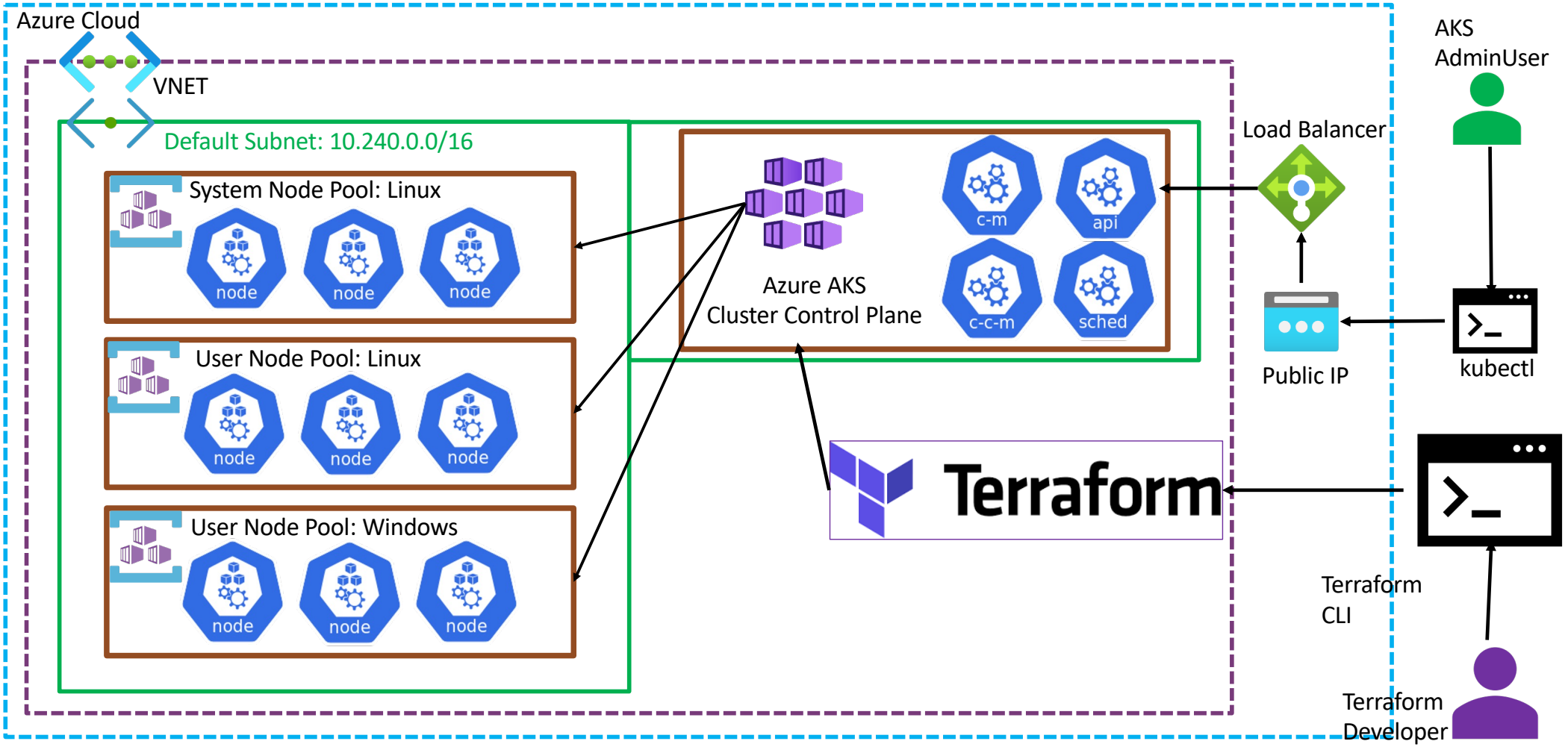


Azure AKS Cluster – Node Pools (Linux, Windows, Virtual)

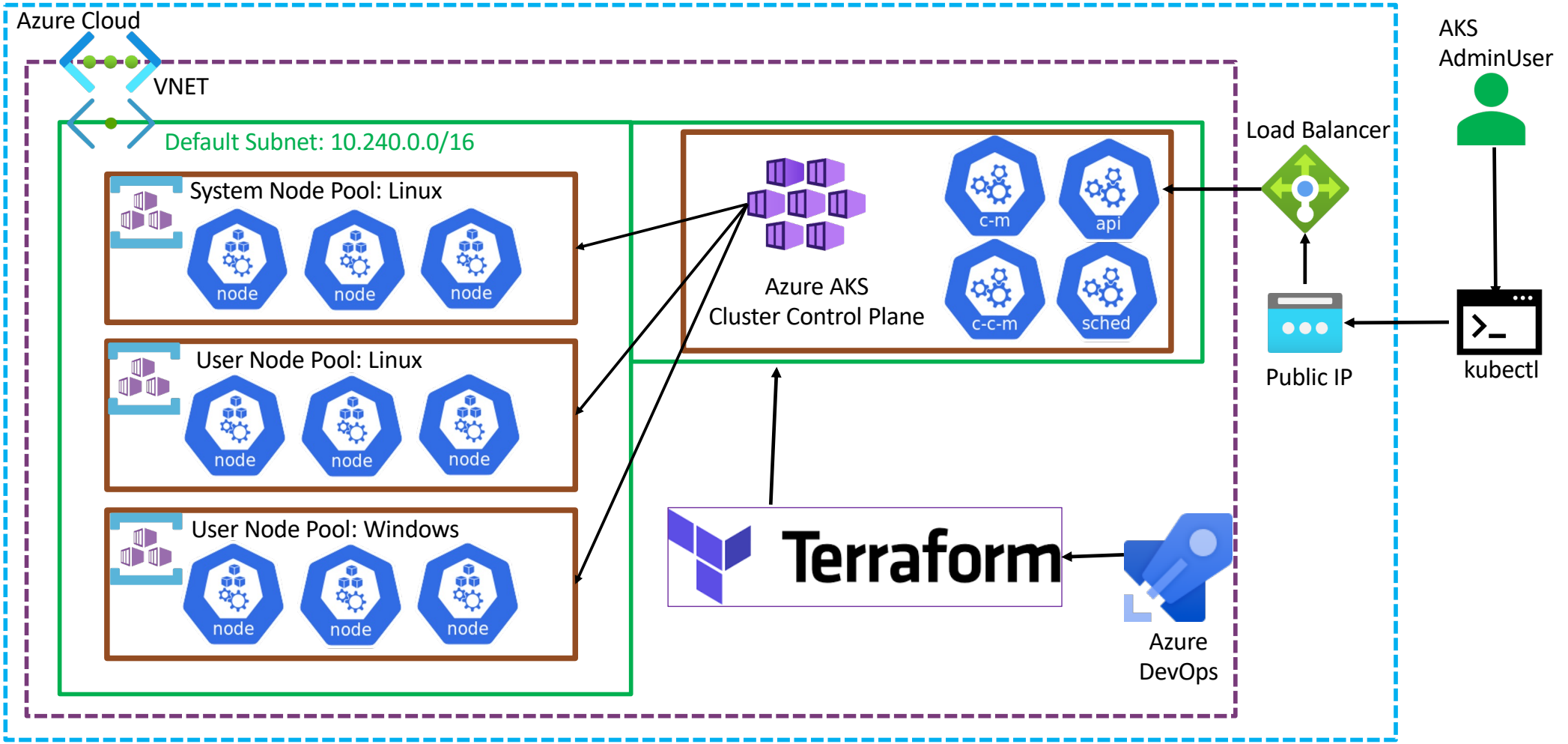


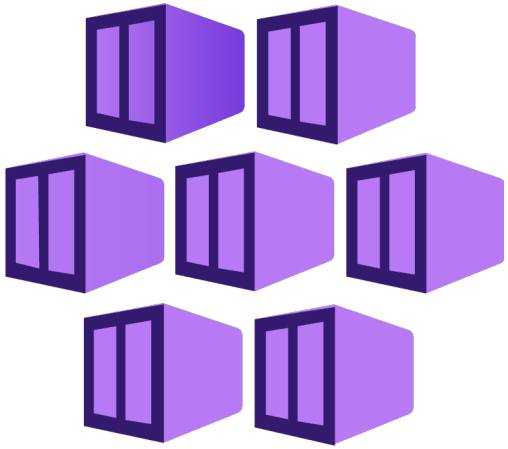


Azure AKS Cluster – Node Pools (Linux, Windows)



Azure AKS Cluster – Node Pools (Linux, Windows)



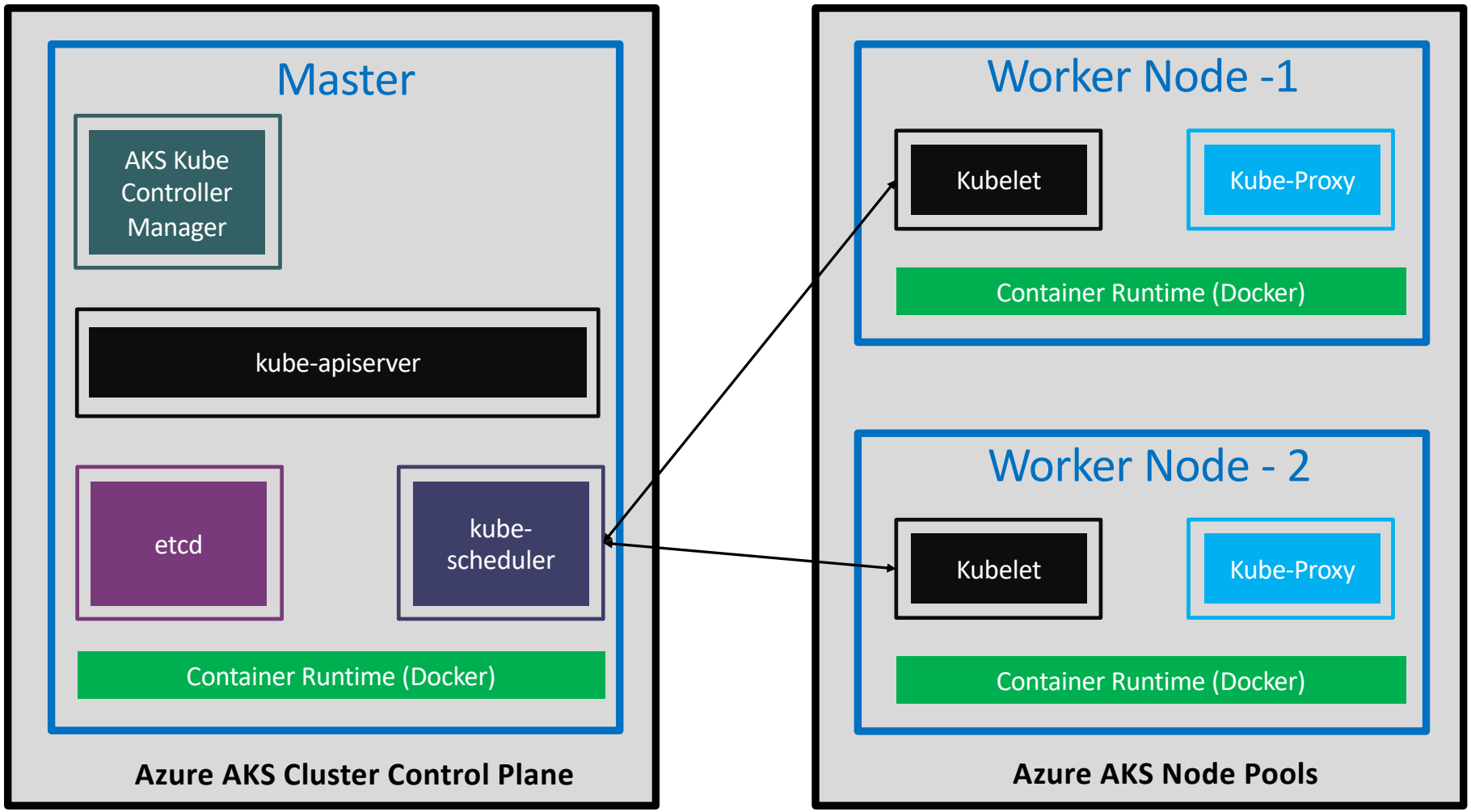


Azure AKS
Create Cluster
Introduction

AKS - Introduction

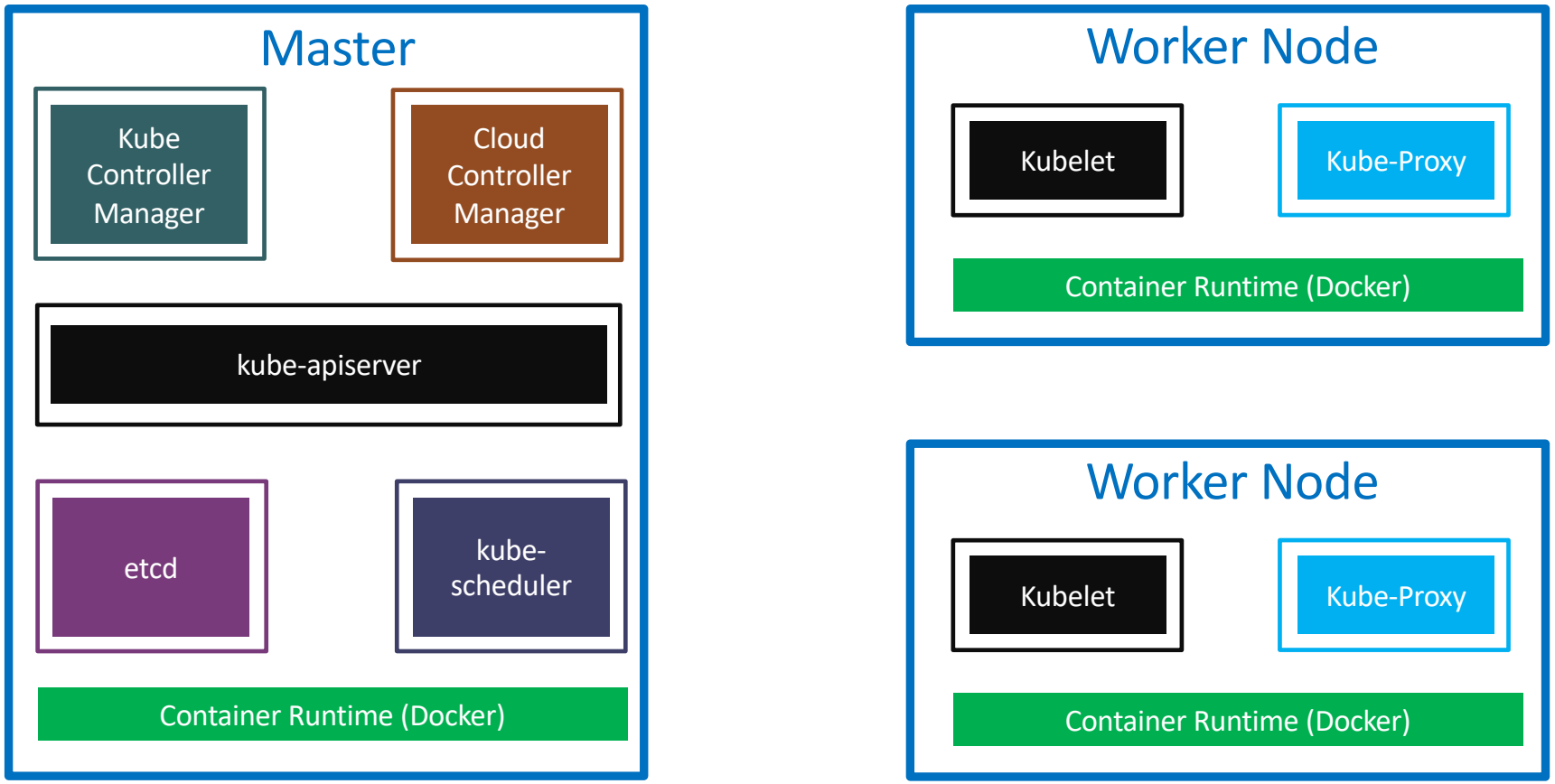
- AKS – Azure Kubernetes Service
- AKS is highly available, secure and fully managed Kubernetes Service
- As on today available in 36 regions and growing.
- When compared to other cloud providers, AKS is the one which is available in highest number of regions
- Will be able to run any type of workloads
  - Windows based applications like .Net Apps
  - Linux supported applications like Java
  - IOT device deployment and management on demand
  - Machine Learning Model training with AKS

AKS Kubernetes - Architecture

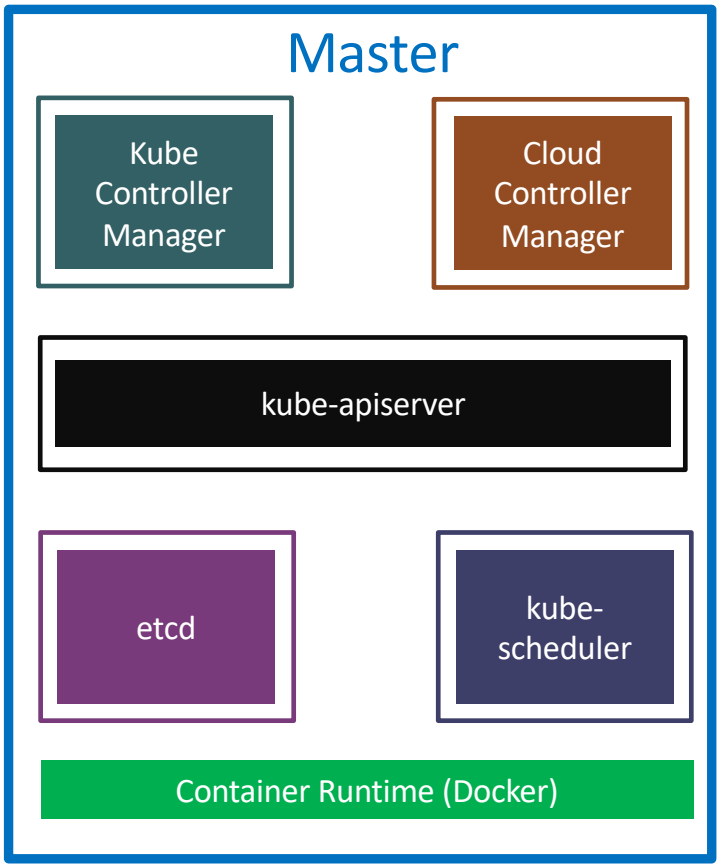


Kubernetes
Architecture

Kubernetes - Architecture

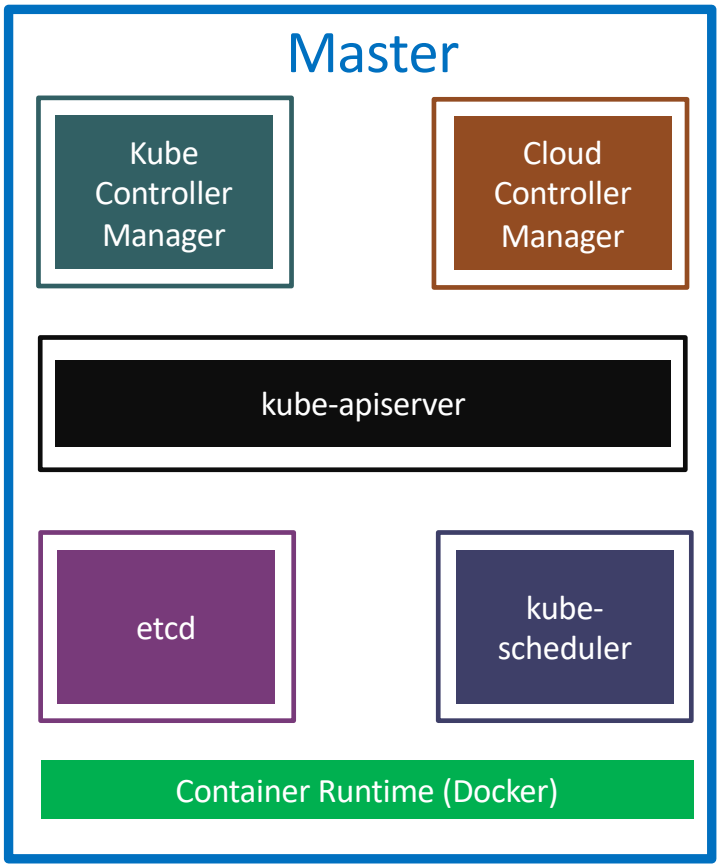


Kubernetes Architecture - Master



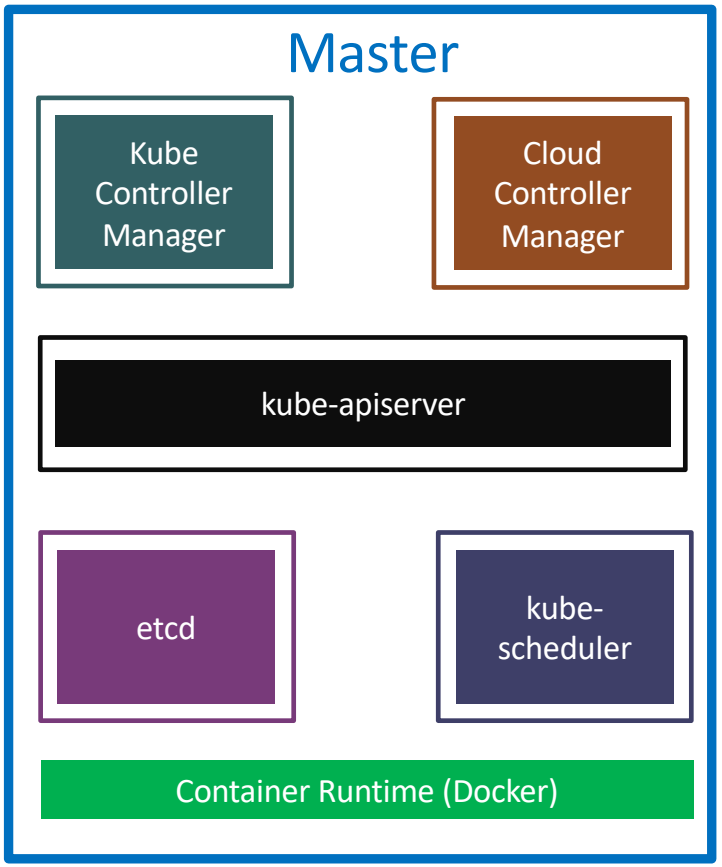
- kube-apiserver
  - It acts as front end for the Kubernetes control plane. It exposes the Kubernetes API
  - Command line tools (like kubectl), Users and even Master components (scheduler, controller manager, etcd) and Worker node components like (Kubelet) everything talk with API Server.
- etcd
  - 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



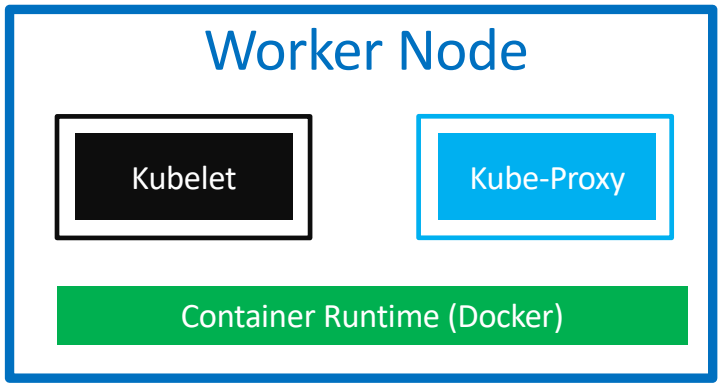
- kube-controller-manager
  - Controllers are responsible for noticing and responding when nodes, containers or endpoints go down. They make decisions to bring up new containers in such cases.
  - Node Controller: Responsible for noticing and responding when nodes go down.
  - Replication Controller: 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

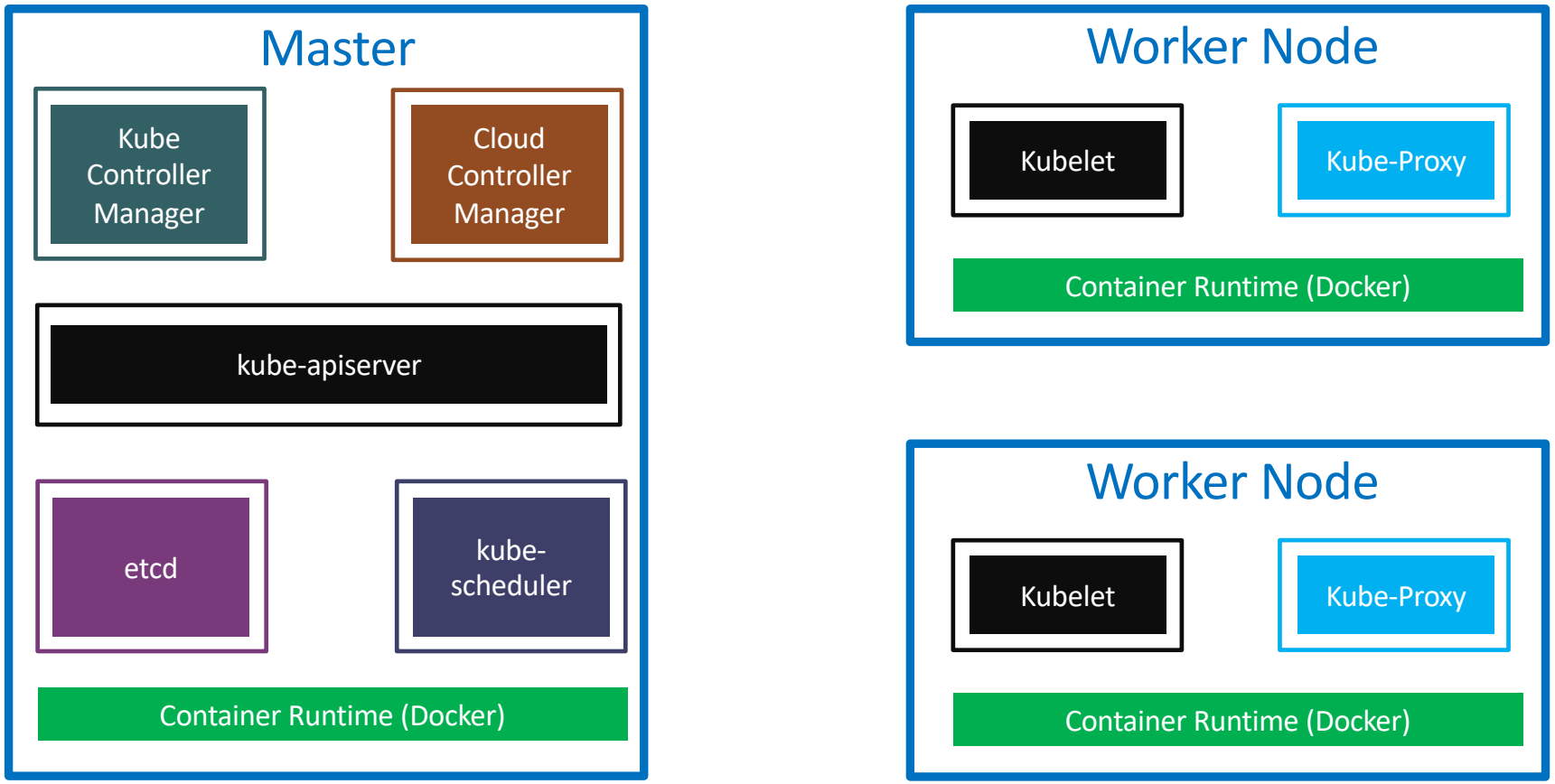
Kubernetes Architecture – Worker Nodes



- 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.

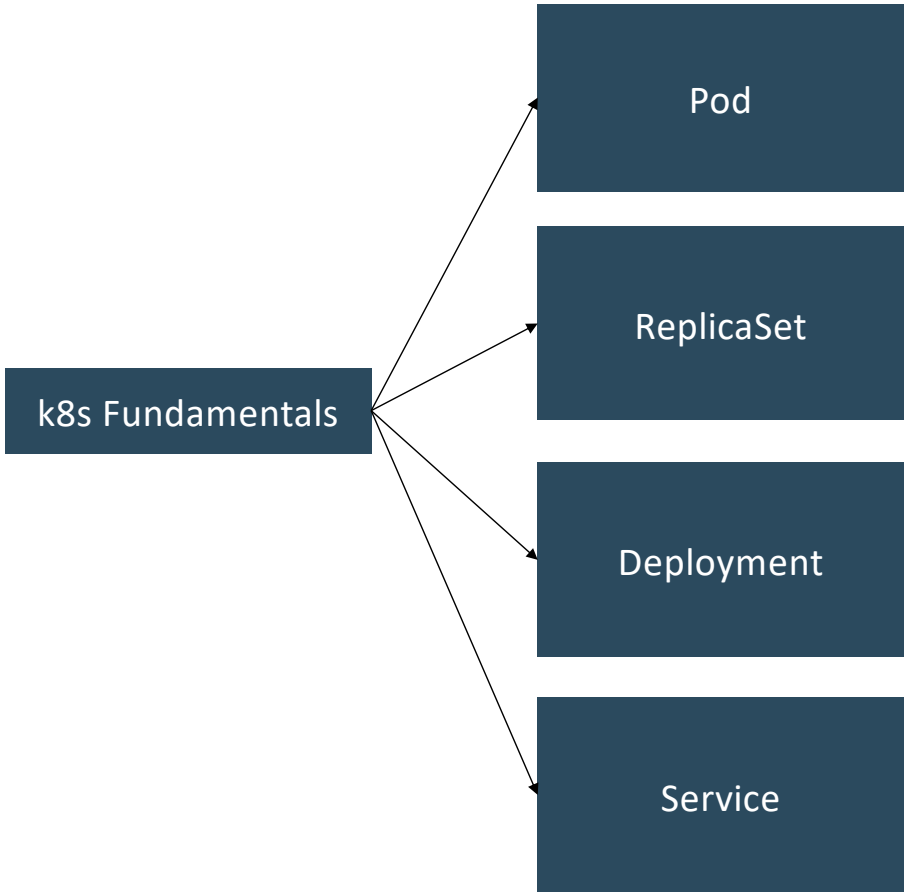
- Kubelet
  - Kubelet is the agent that runs on every node in the cluster
  - This agent is responsible for making sure that containers are running in a Pod on a node.
- Kube-Proxy
  - It is a network proxy that runs on each node in your cluster.
  - It maintains network rules on nodes
  - In short,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

Kubernetes - Architecture



Kubernetes
Fundamentals
Pod, ReplicaSet, Deployment & Service

Kubernetes - Fundamentals



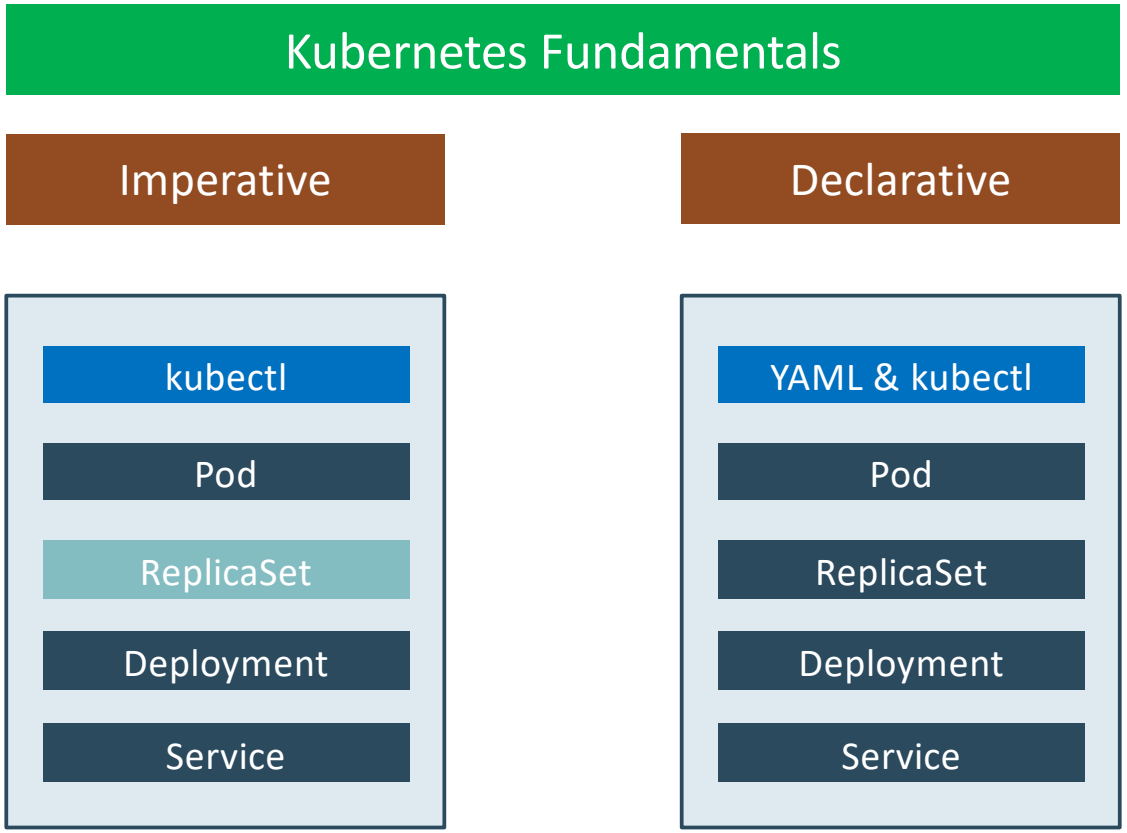
A POD is a single instance of an Application.
A POD is the smallest object, that you can create in Kubernetes.

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 Infront of a POD and acts as a load balancer.

Kubernetes - Imperative & Declarative



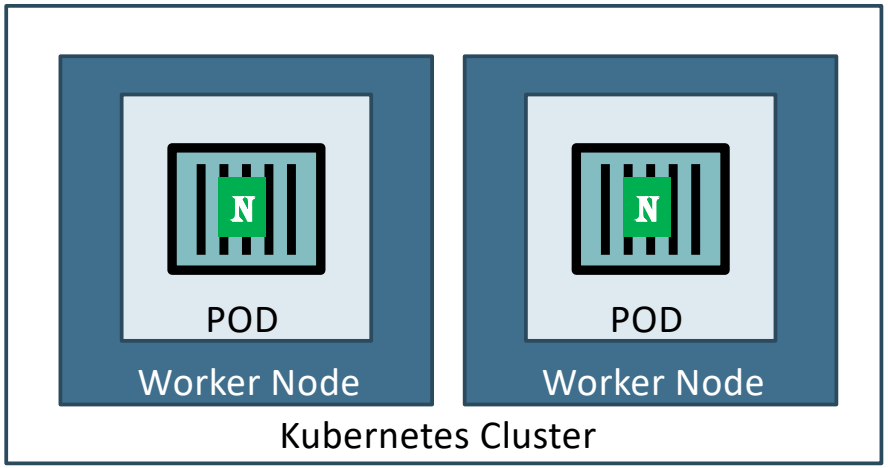
Kubernetes

POD

Kubernetes - POD

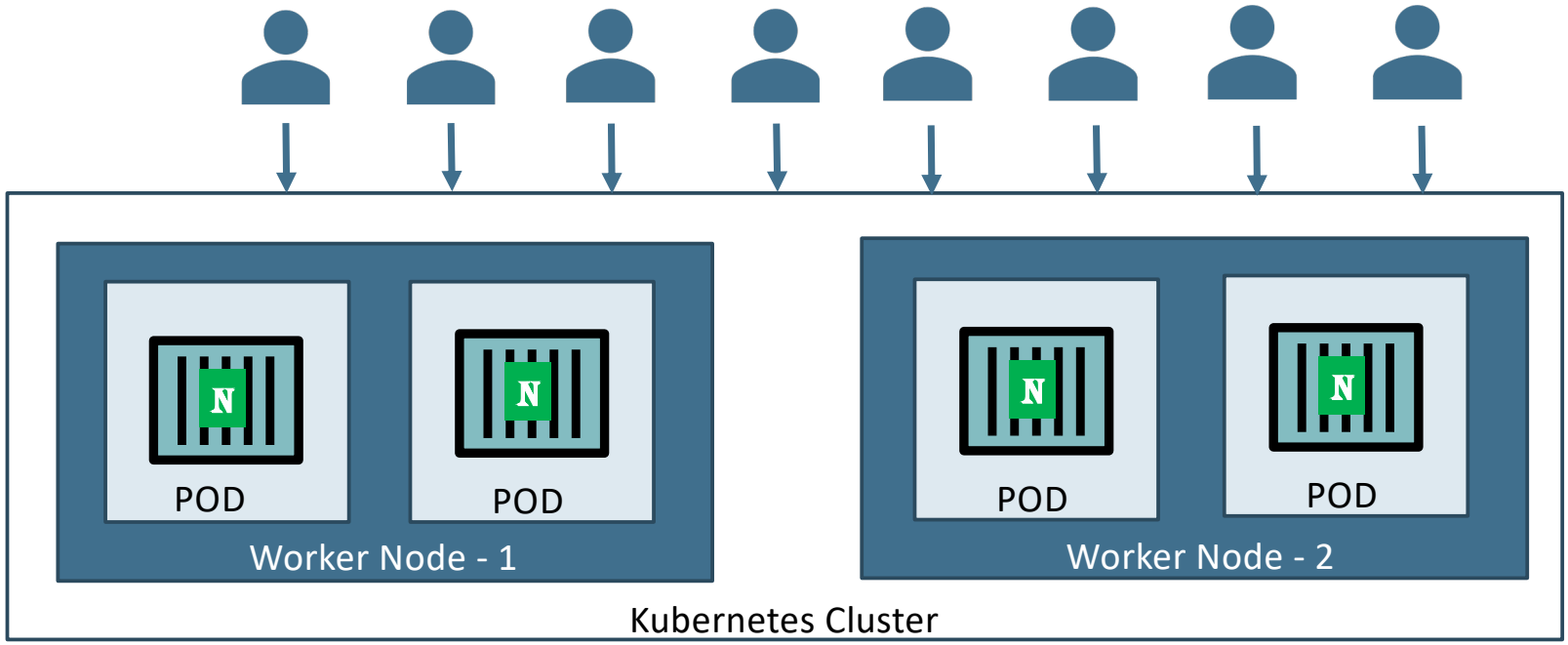
- With Kubernetes our core goal will be to deploy our applications in the form of containers on worker nodes in a k8s cluster.
- Kubernetes does not deploy containers directly on the worker nodes.
- Container is encapsulated in to a Kubernetes Object named POD.
- A POD is a single instance of an application.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

Nginx Container Image



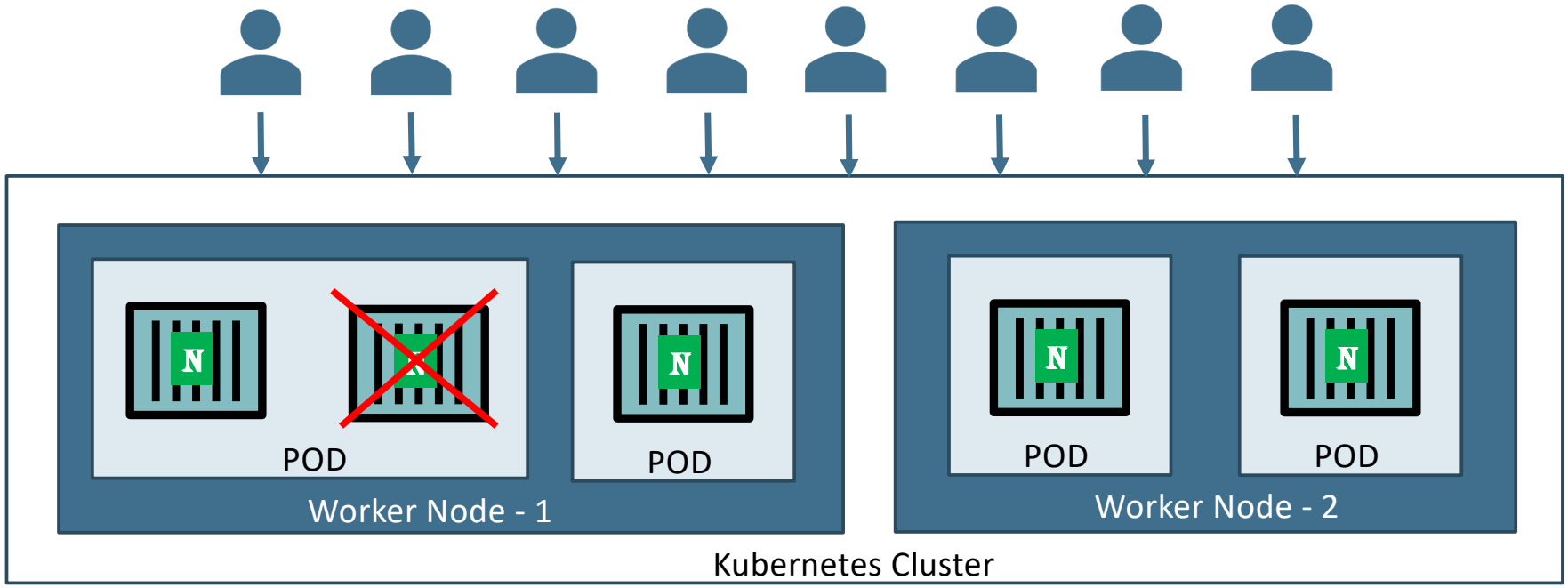
Kubernetes - POD

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



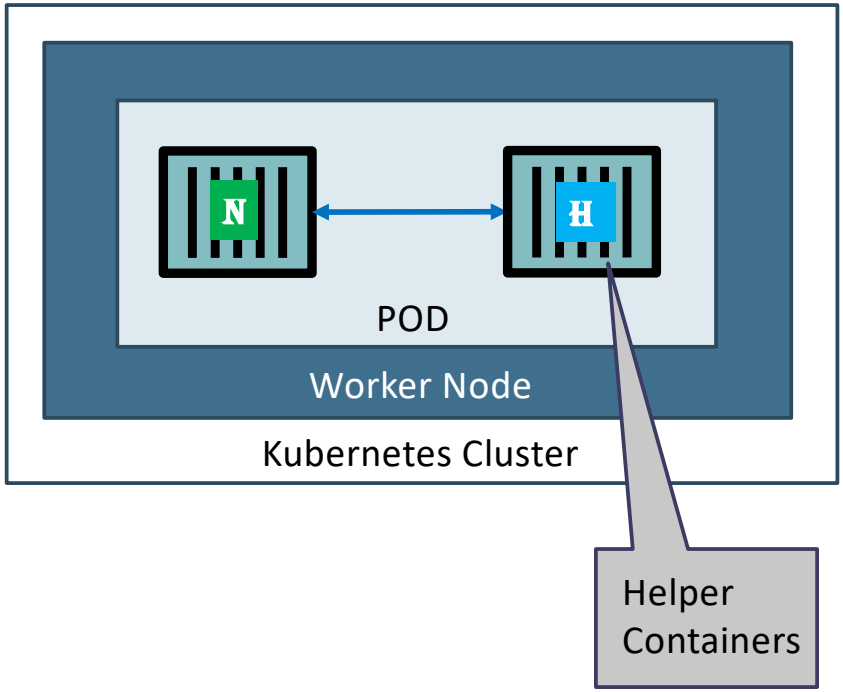
Kubernetes – PODs

- 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

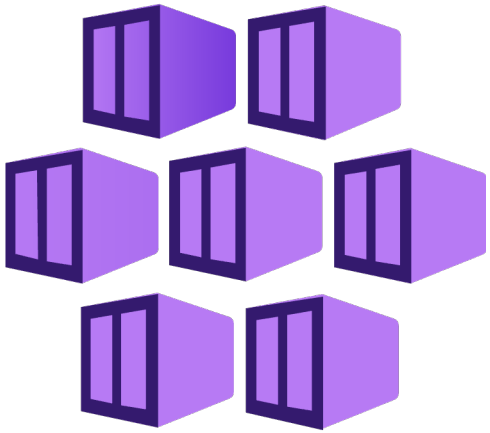
- We can have multiple containers in a single POD, provided they are not of same kind.
- Helper Containers (Side-car)
  - Data Pullers: Pull data required by Main Container
  - Data pushers: Push data by collecting from main container (logs)
  - Proxies: Writes static data to html files using Helper 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

Azure Public
IP Address

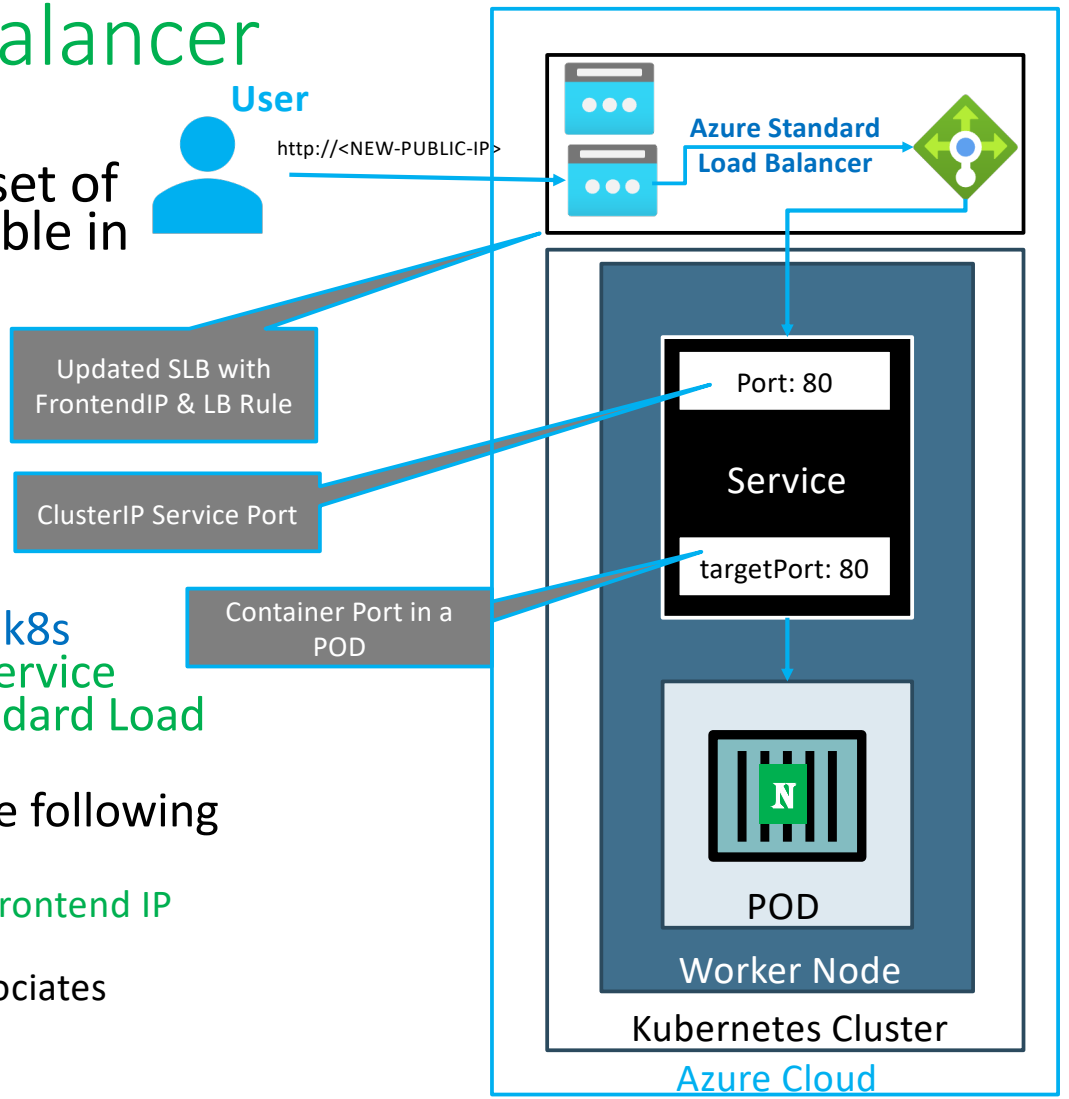
Azure Standard
Load Balancer



Kubernetes
Services
Load Balancer

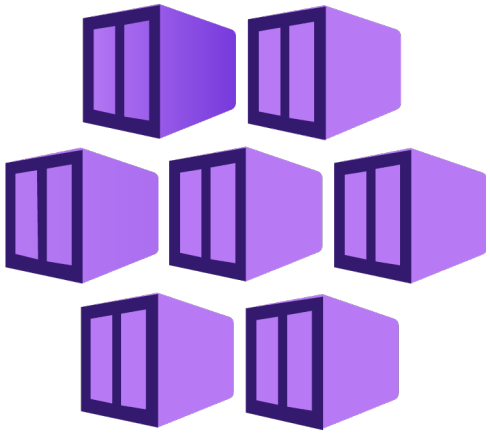
Kubernetes – Service - LoadBalancer

- We can expose an application running on a set of PODs using different types of Services available in k8s.
  - ClusterIP Service(Internal to k8s cluster)
  - NodePort Service (To internet)
  - LoadBalancer Service (To internet)
  - Ingress Service (To internet)
- LoadBalancer Service
  - To access our application outside of Azure AKS k8s cluster, we can use Kubernetes LoadBalancer service which will be eventually mapped to Azure Standard Load Balancer.
  - When we deploy k8s load balancer service, the following will happen in Azure Standard Load Balancer
    - A new Public IP gets created and associates that to Frontend IP Configuration
    - A new Load Balancing rule will be created which associates frontend ip and backend pool

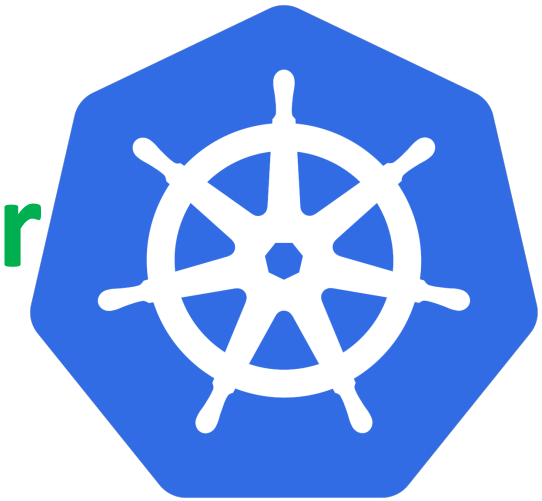


Azure Public
IP Address

Azure Standard
Load Balancer

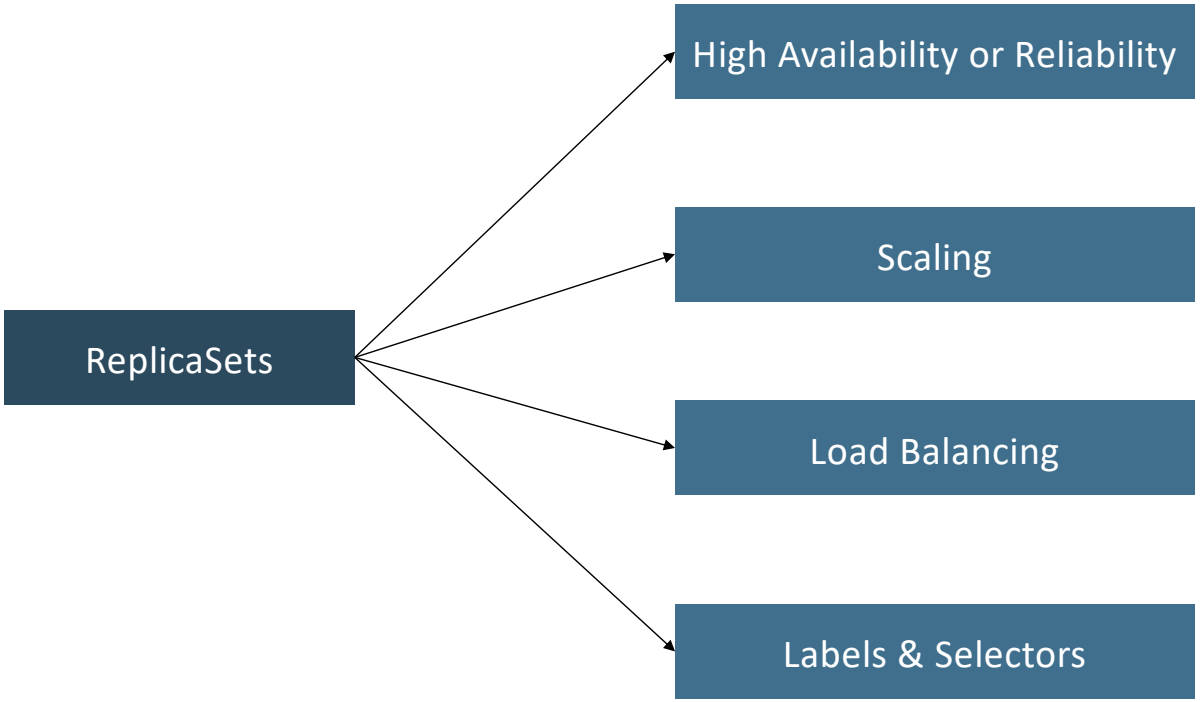


Kubernetes
POD & Load Balancer Service
Demo



Kubernetes
ReplicaSets

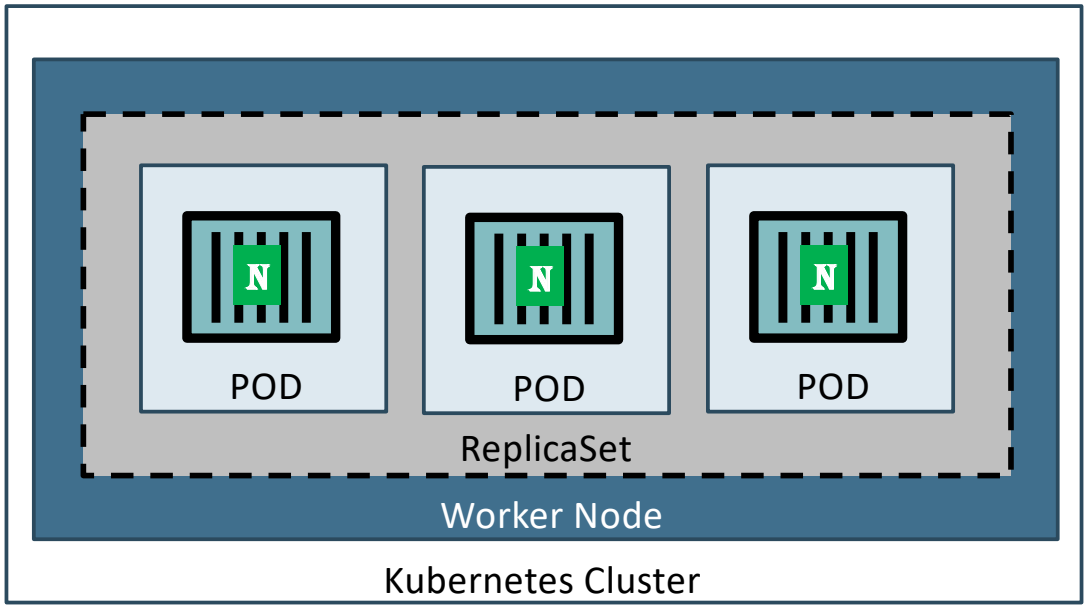
Kubernetes - ReplicaSets



Kubernetes – ReplicaSet

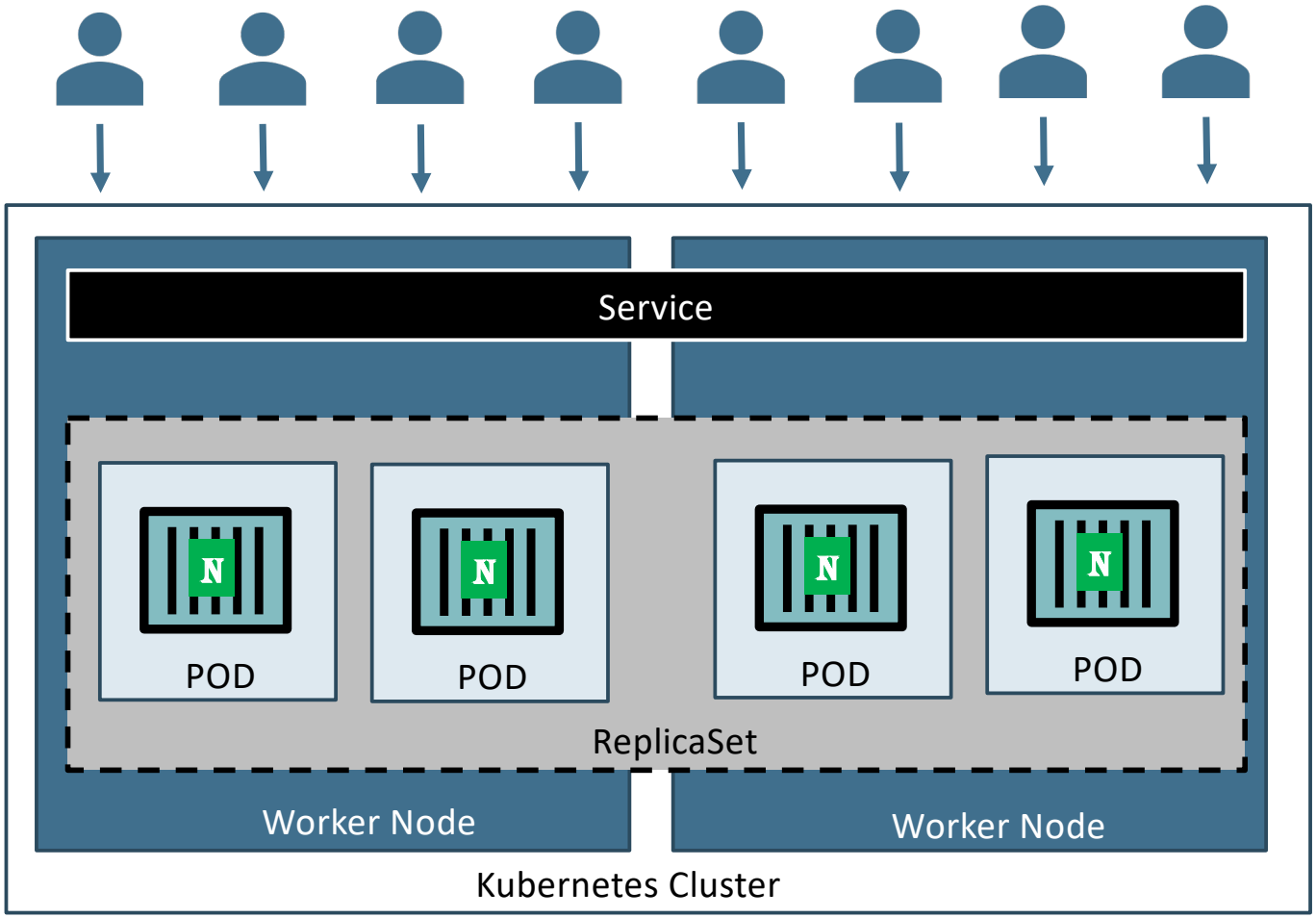
- A ReplicaSet's purpose is to maintain a stable set of replica Pods running at any given time.
- If our application crashes (any pod dies), replicaset will recreate the pod immediately to ensure the configured number of pods running at any given time.

Reliability
Or
High Availability



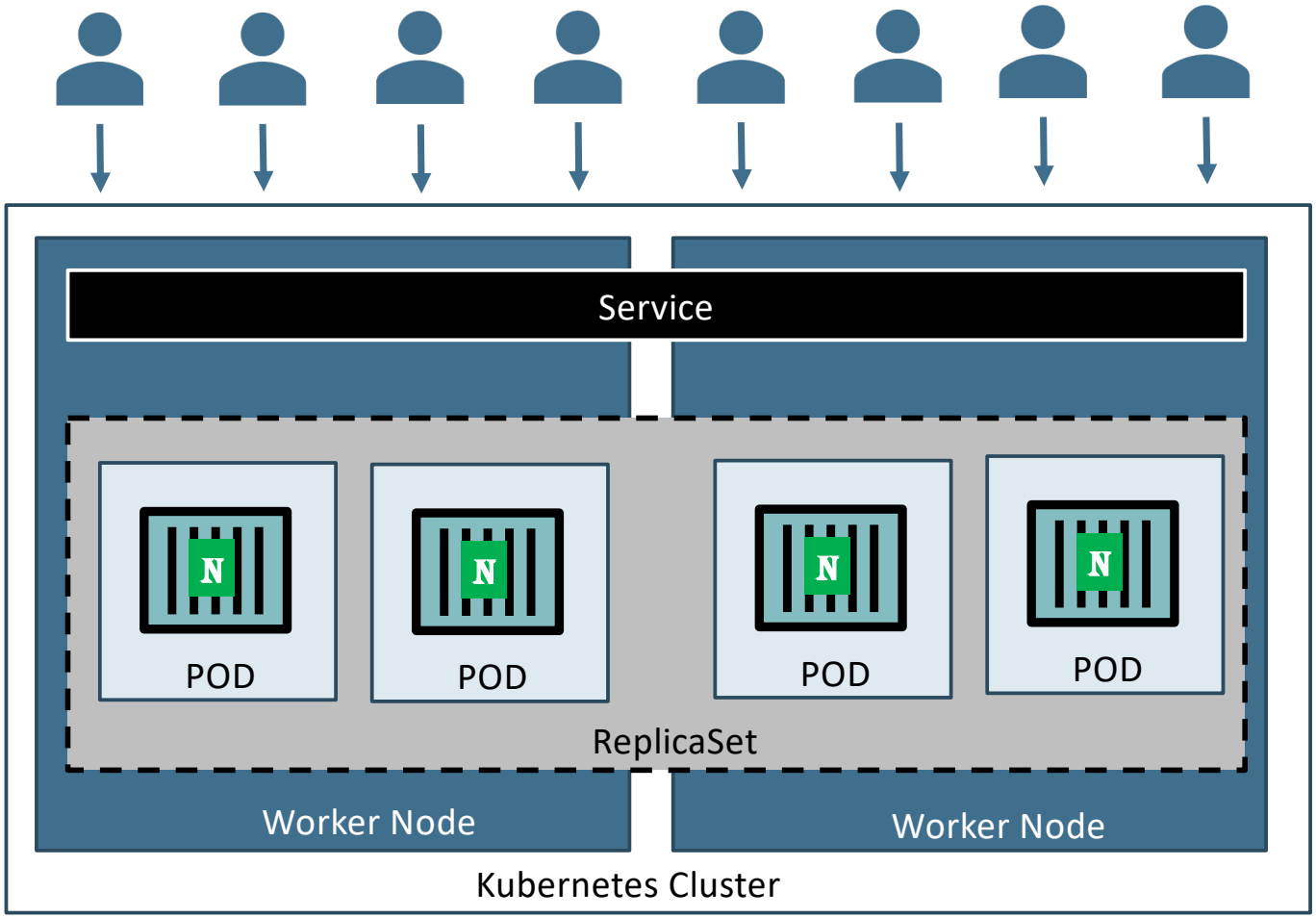
Kubernetes – ReplicaSet

- 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

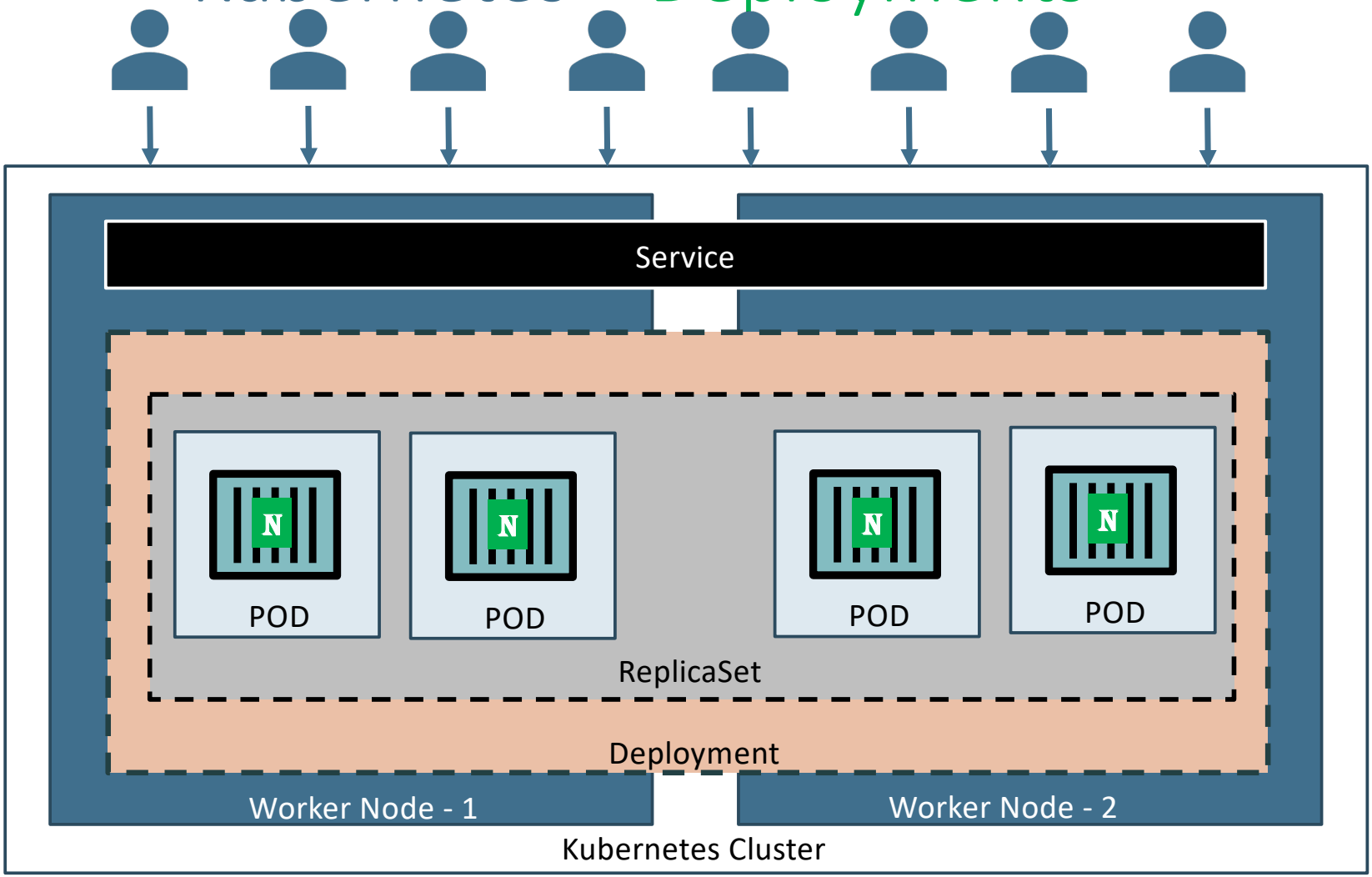
- Scaling
- When load become too much for the number of existing pods, Kubernetes enables us to easily scale up our application, adding additional pods as needed.
- This is going to be seamless and super quick.



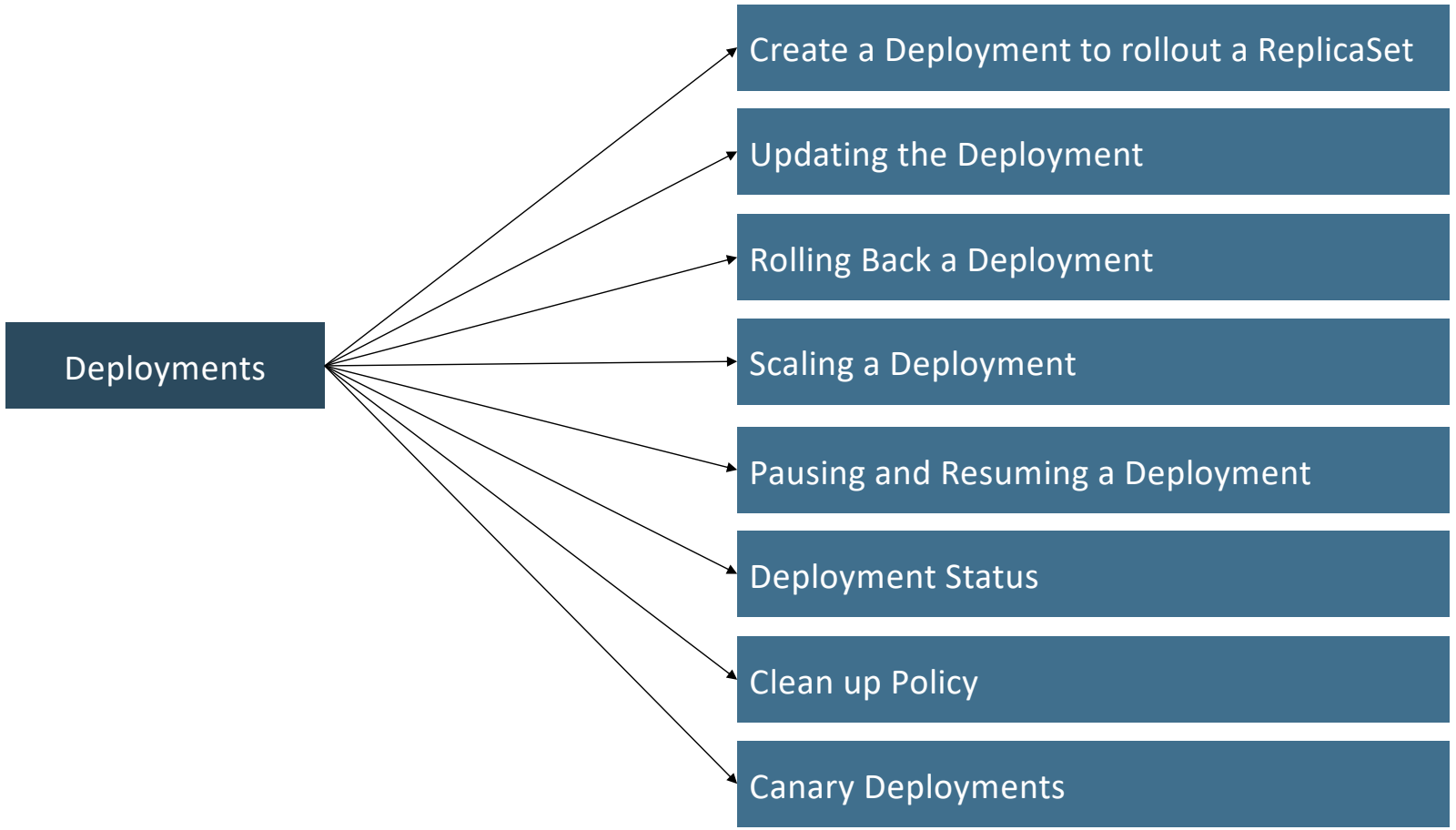
Kubernetes ReplicaSets Demo

Kubernetes
Deployments

Kubernetes – Deployments



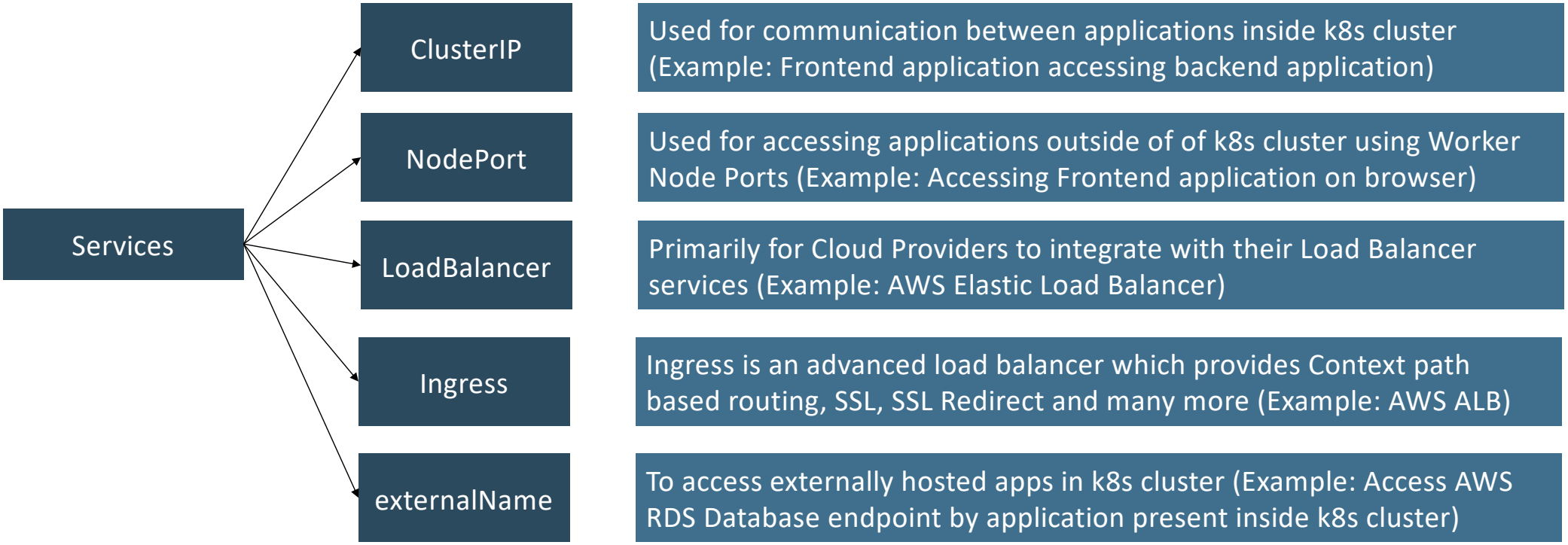
Kubernetes - Deployment



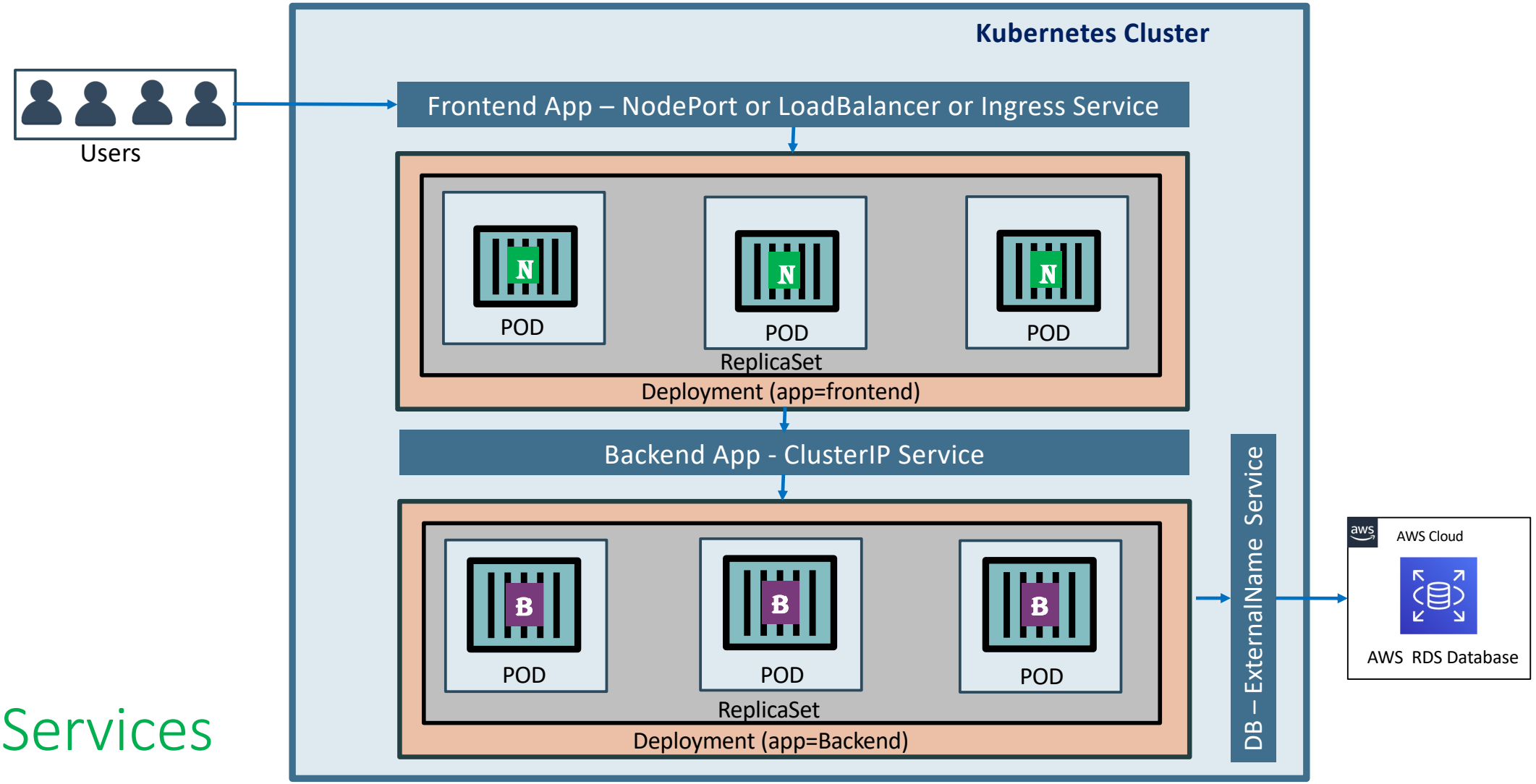
Kubernetes Deployments Demo

Kubernetes
Services

Kubernetes - Services

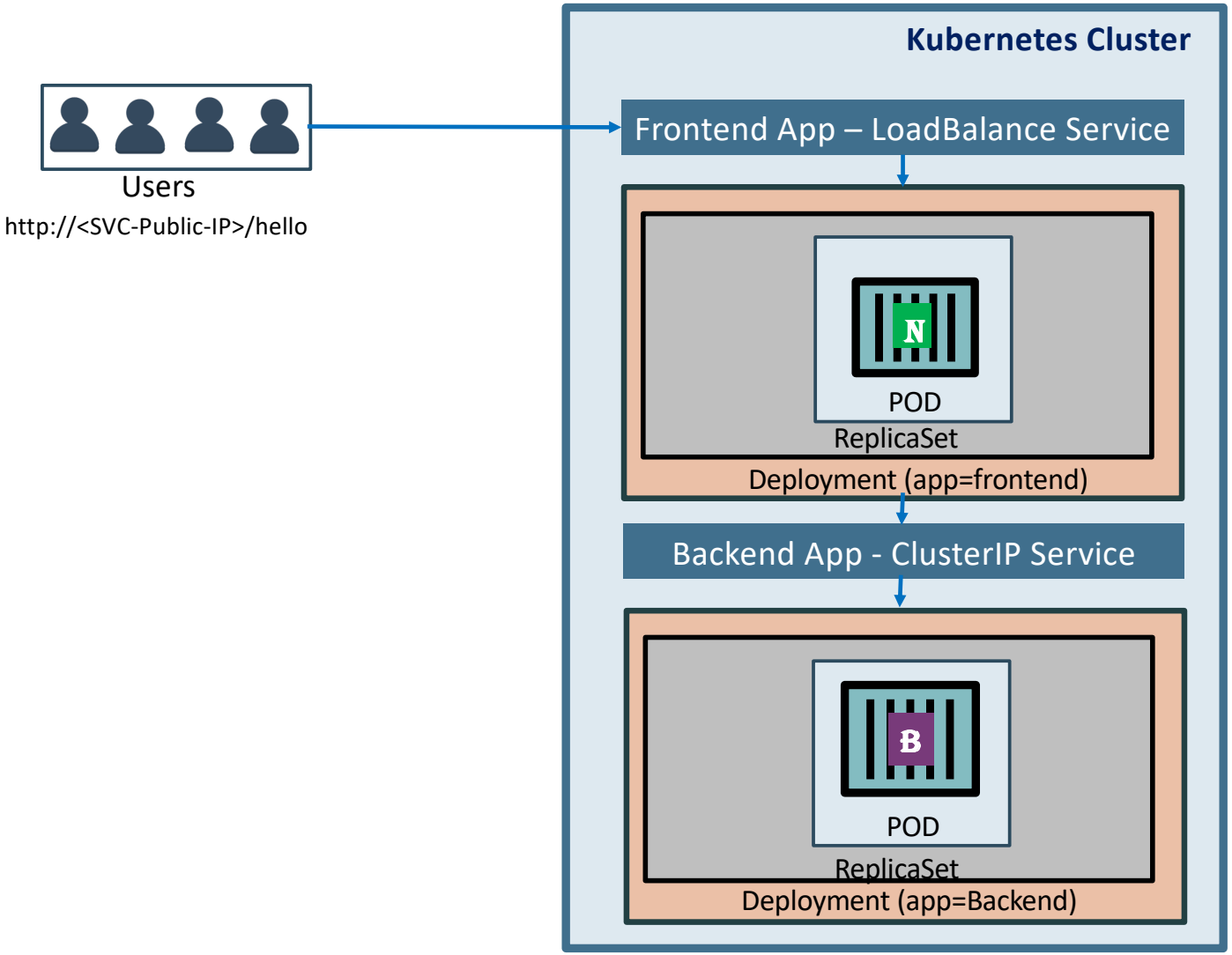


Services


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

Kubernetes
Services
Demo

Services Demo



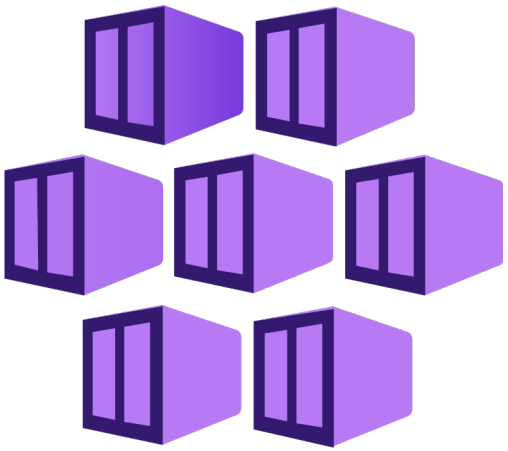
Kubernetes
YAML Basics

YAML Basics

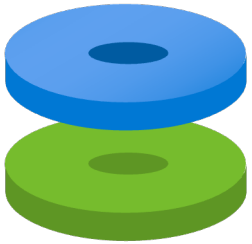
- YAML is not a Markup Language
- YAML is used to store information about different things
- We can use YAML to define key, Value pairs like variables, lists and objects
- YAML is very similar to JSON (Javascript Object Notation)
- YAML primarily focuses on readability and user friendliness
- YAML is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

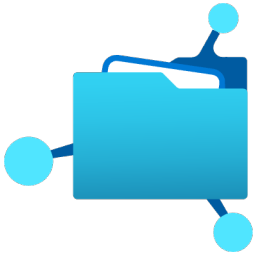
YAML Basics

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

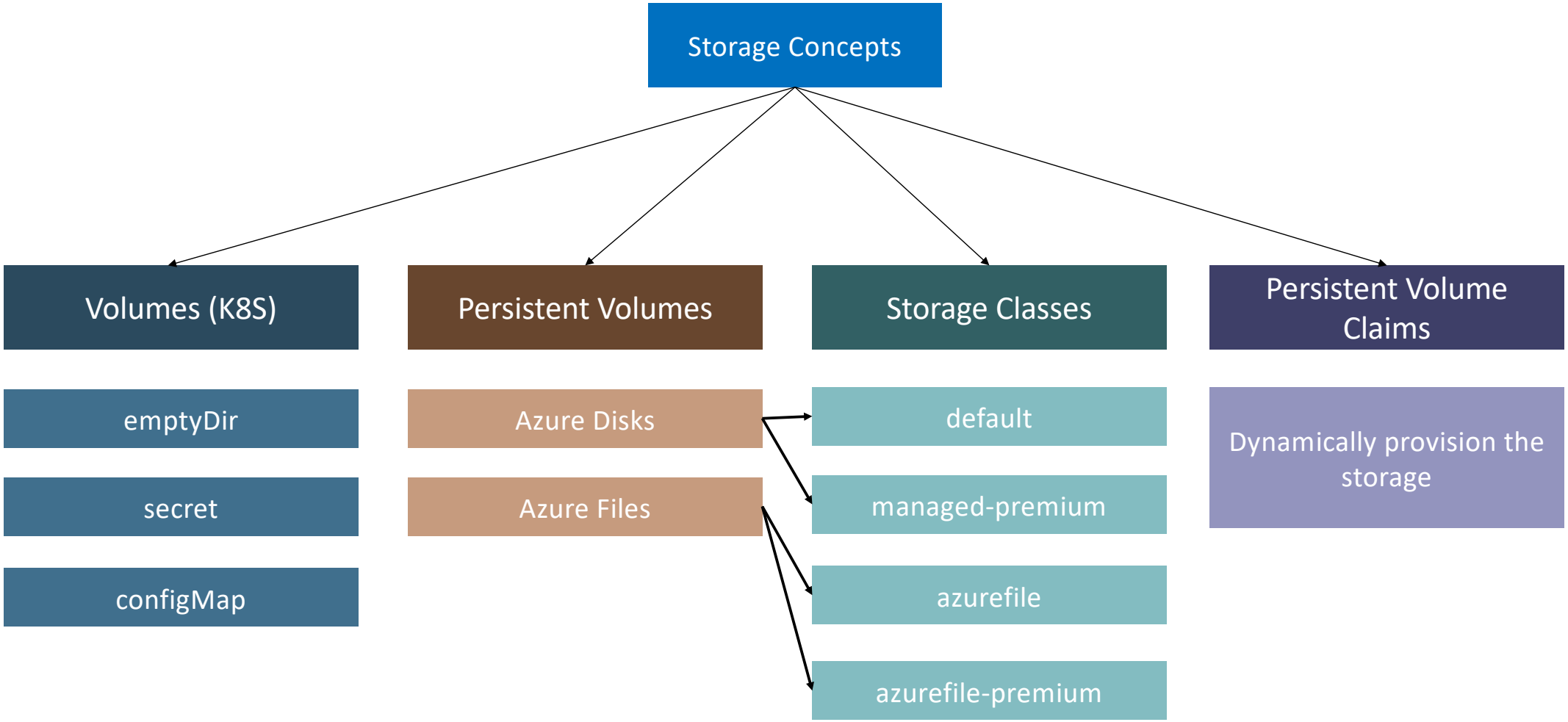


Azure AKS Storage with Azure Disks & Files



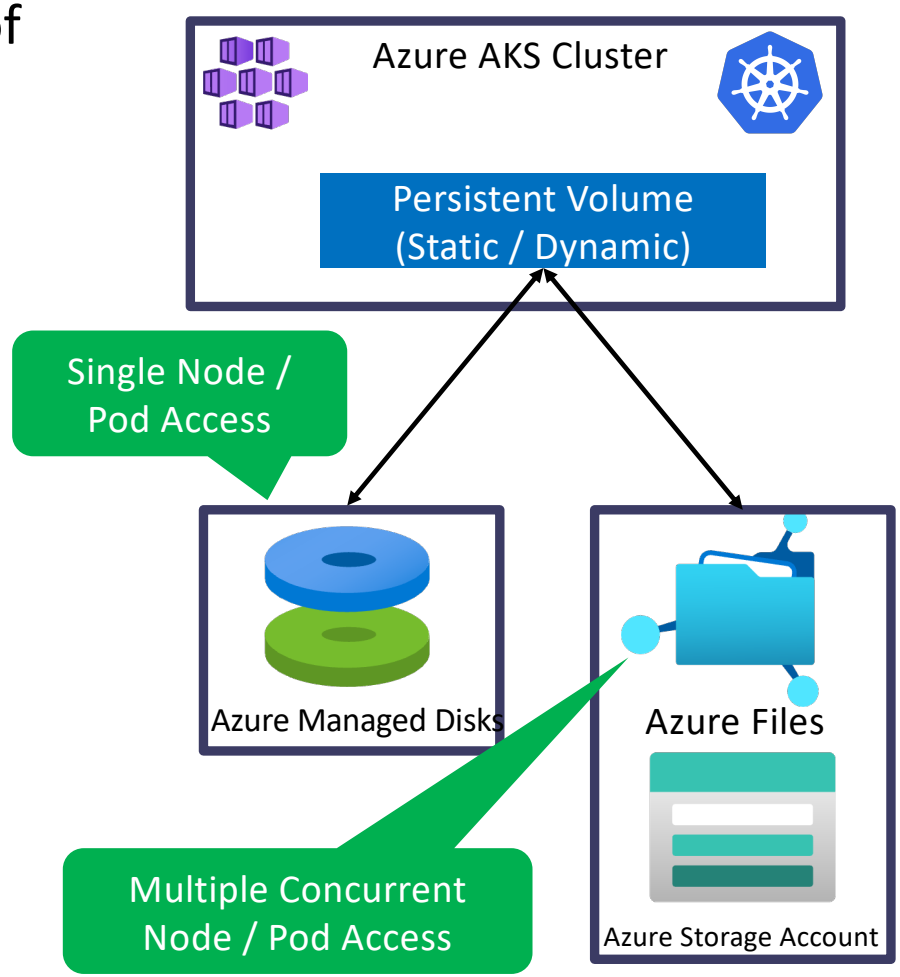


AKS Storage Concepts



Why do we need Persistent Storage in Kubernetes?

- Volumes that are defined and created as part of the pod lifecycle only exist until the pod is deleted.
- Pods often expect their storage to remain if a pod is rescheduled on a different host during a maintenance event, especially in StatefulSets.
- A *persistent volume* (PV) is a storage resource created and managed by the Kubernetes API that can exist beyond the lifetime of an individual pod.
- For AKS, Azure Disks or Azure Files are used to provide the PersistentVolume.



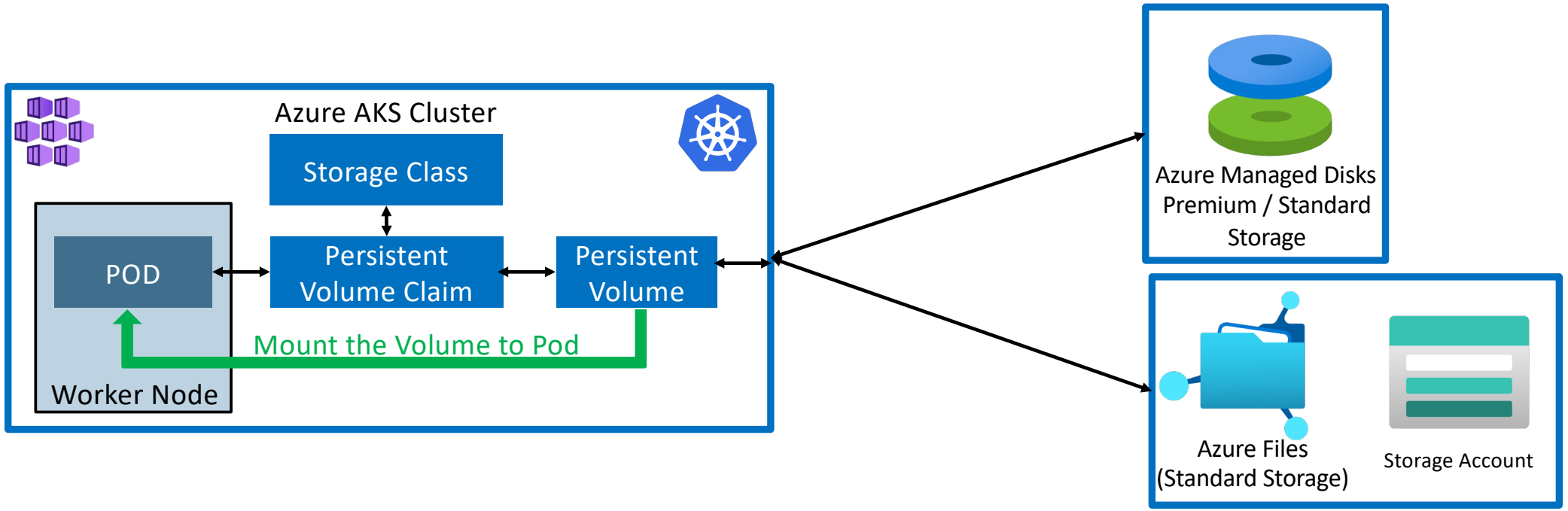
Persistent Volume Claims – How it works?

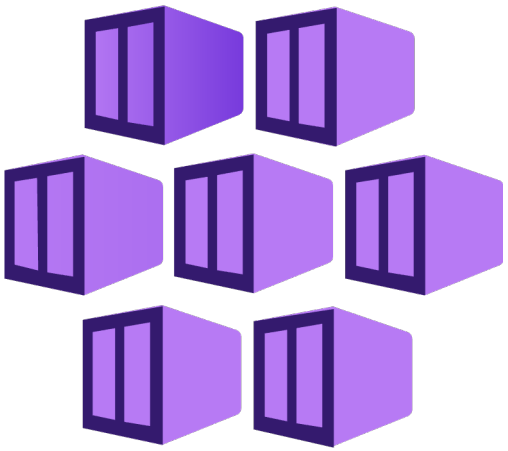
create a pod

PVC will request storage based on specifics from Storage class (Disk or File)

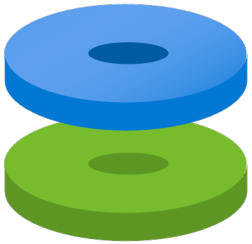
Kube API Server will dynamically provision the Persistent Volume PV requested

Once the PV is available it will get mounted to Pod for usage.





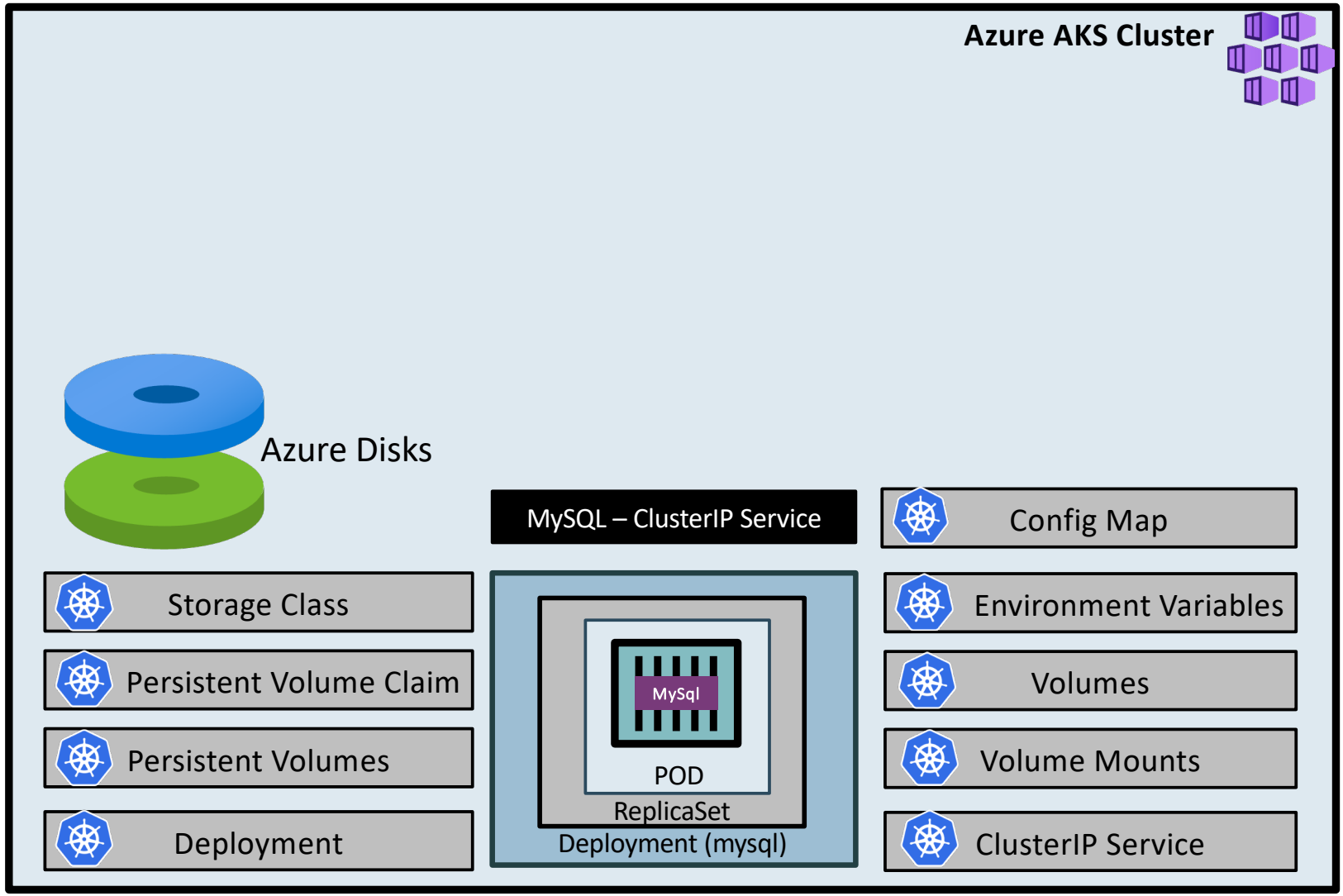
Azure AKS Storage with Azure Disks

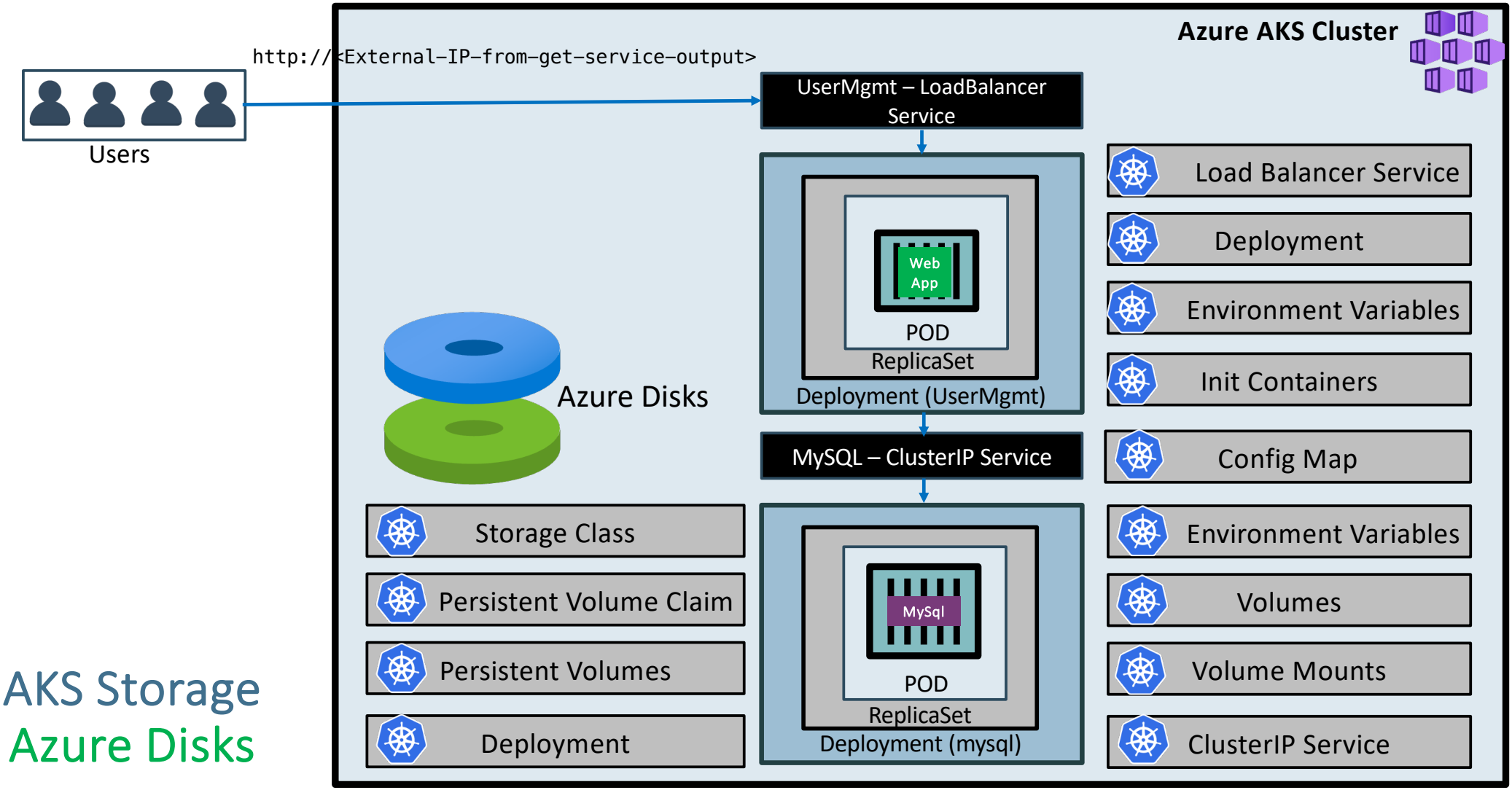


Azure Disks - Introduction

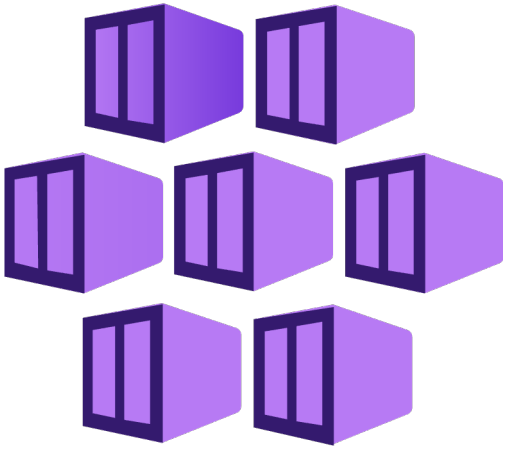
- Azure Disk Storage offers high-performance, highly durable block storage for our mission- and business-critical workloads
- We can mount these volumes as devices on our Virtual Machines & Container instances.
- **Cost-effective storage**
  - Built-in bursting capabilities to handle unexpected traffic and process batch jobs cost-effectively
- **Unmatched resiliency**
  - 0 percent annual failure rate for consistent enterprise-grade durability
- **Seamless scalability**
  - Dynamic scaling of disk performance on Ultra Disk Storage without disruption
- **Built-in security**
  - Automatic encryption to help protect your data using Microsoft-managed keys or your own

AKS Storage
Azure Disks

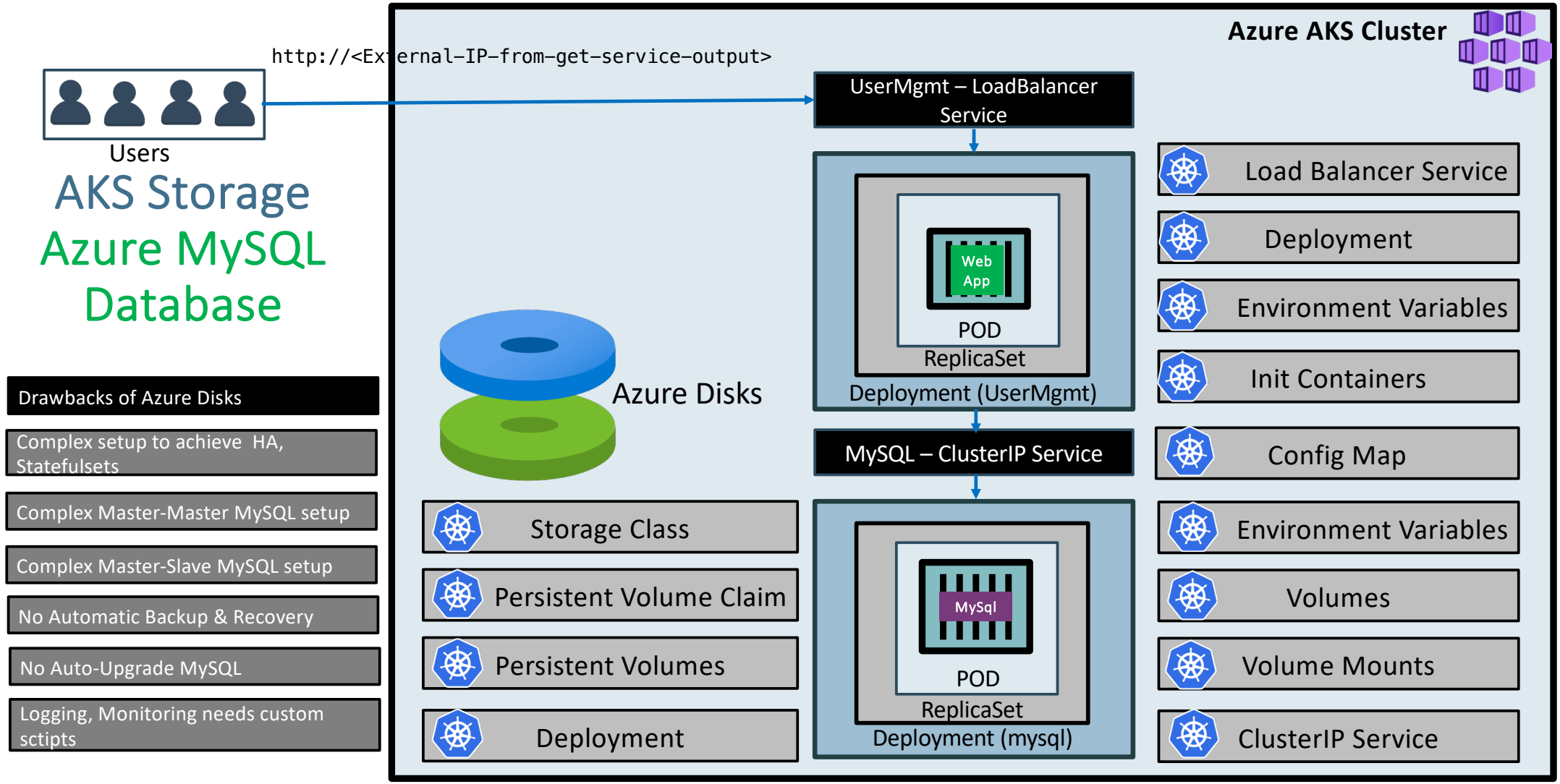




AKS Storage
Azure Disks



Azure AKS Storage with Azure MySQL Database



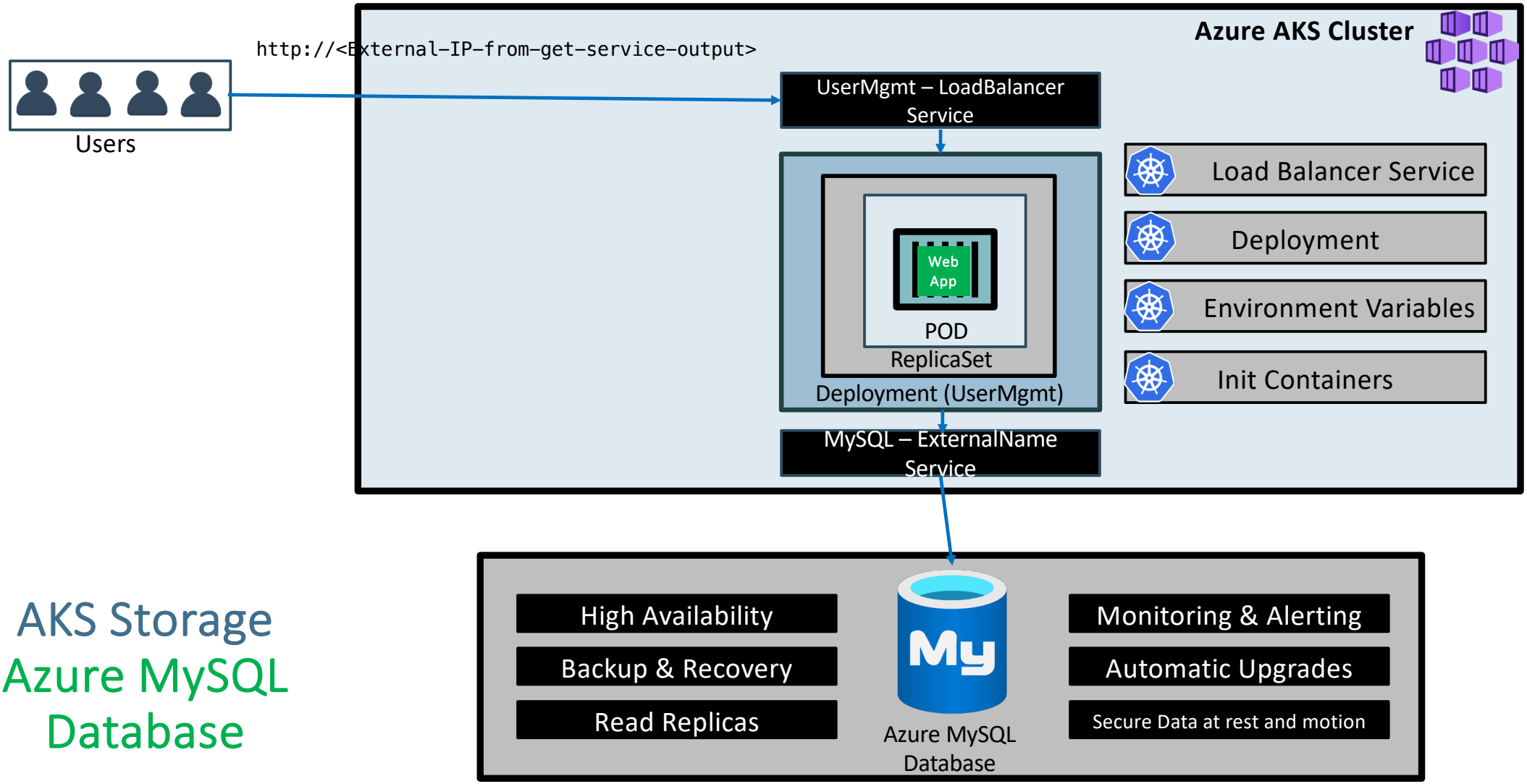
AKS Storage
Azure MySQL Database

Drawbacks of Azure Disks

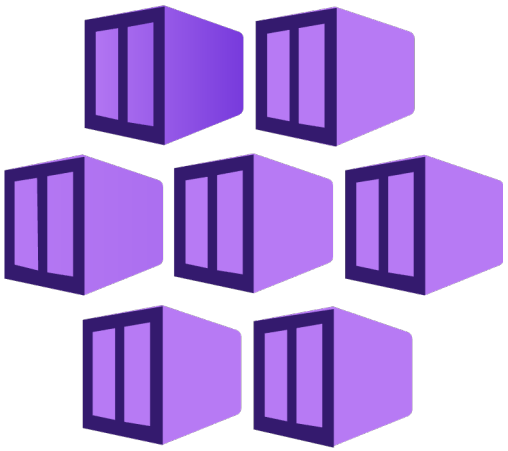
- Complex setup to achieve HA, Statefulsets
- Complex Master-Master MySQL setup
- Complex Master-Slave MySQL setup
- No Automatic Backup & Recovery
- No Auto-Upgrade MySQL
- Logging, Monitoring needs custom sctipts

Azure MySQL Database

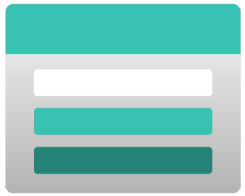
- **Features**
- Built-in high availability with no additional cost.
- Predictable performance, using inclusive pay-as-you-go pricing.
- Scale as needed within seconds.
- Secured to protect sensitive data at-rest and in-motion.
- Automatic backups and point-in-time-restore for up to 35 days.
- Enterprise-grade security and compliance.



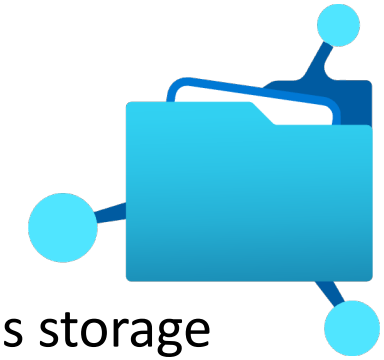
AKS Storage
Azure MySQL Database



Azure AKS Storage with Azure Files

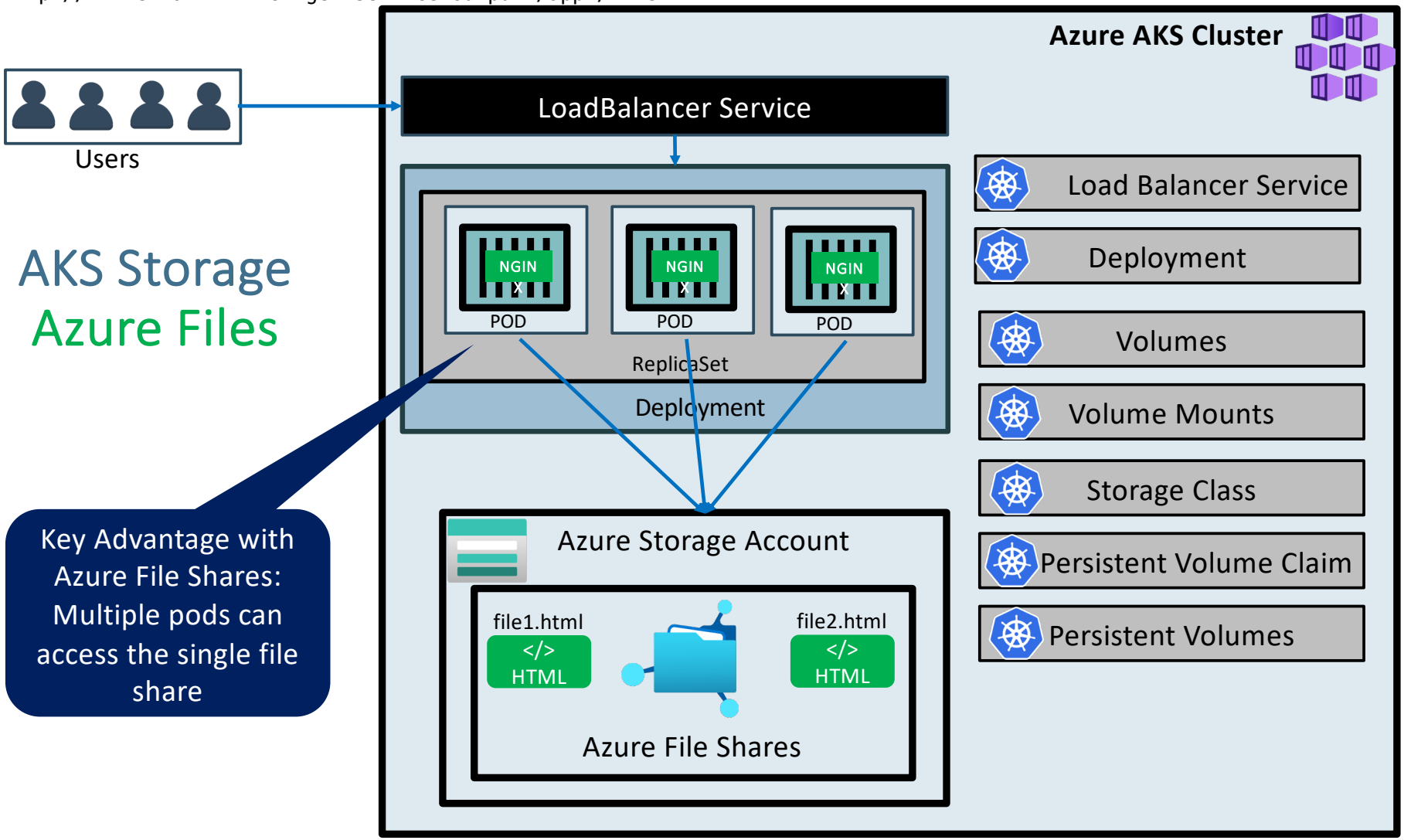


Azure Files



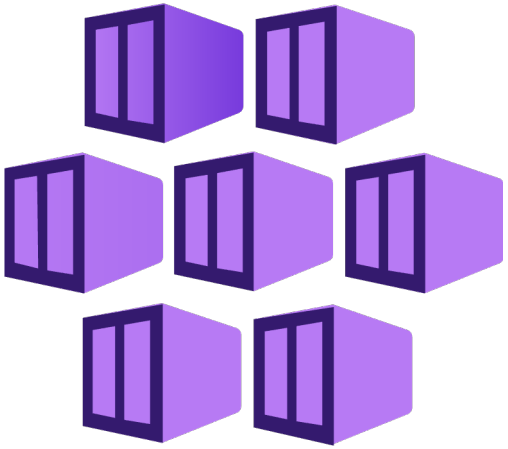
- These are simple, secure and fully managed cloud file shares
- We can secure data at rest and in-transit using SMB 3.0 and HTTPS
- We can create high-performance file shares using the Premium Files storage tier
- We can replace or supplement on-premises file servers
- Scripting and tooling: PowerShell cmdlets and Azure CLI can be used to create, mount, and manage Azure file shares as part of the administration of Azure applications.
- We can create and manage Azure file shares using Azure portal and Azure Storage Explorer.
- For Application workloads we can use for use cases like Static Content storage, shared configuration access to multiple JVMs etc.

http://<External-IP-from-get-service-output>/app1/file1.html



AKS Storage
Azure Files

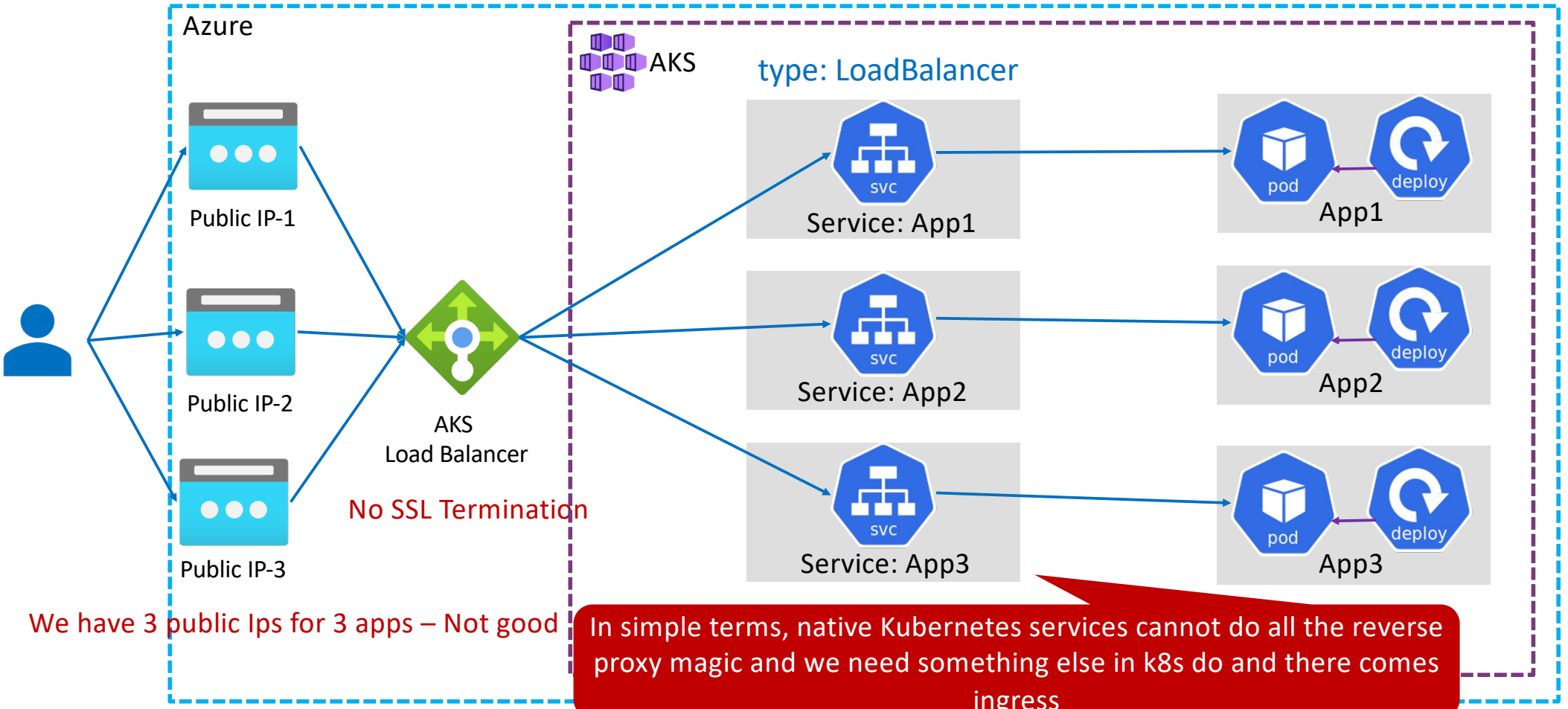
Key Advantage with Azure File Shares: Multiple pods can access the single file share



Azure AKS

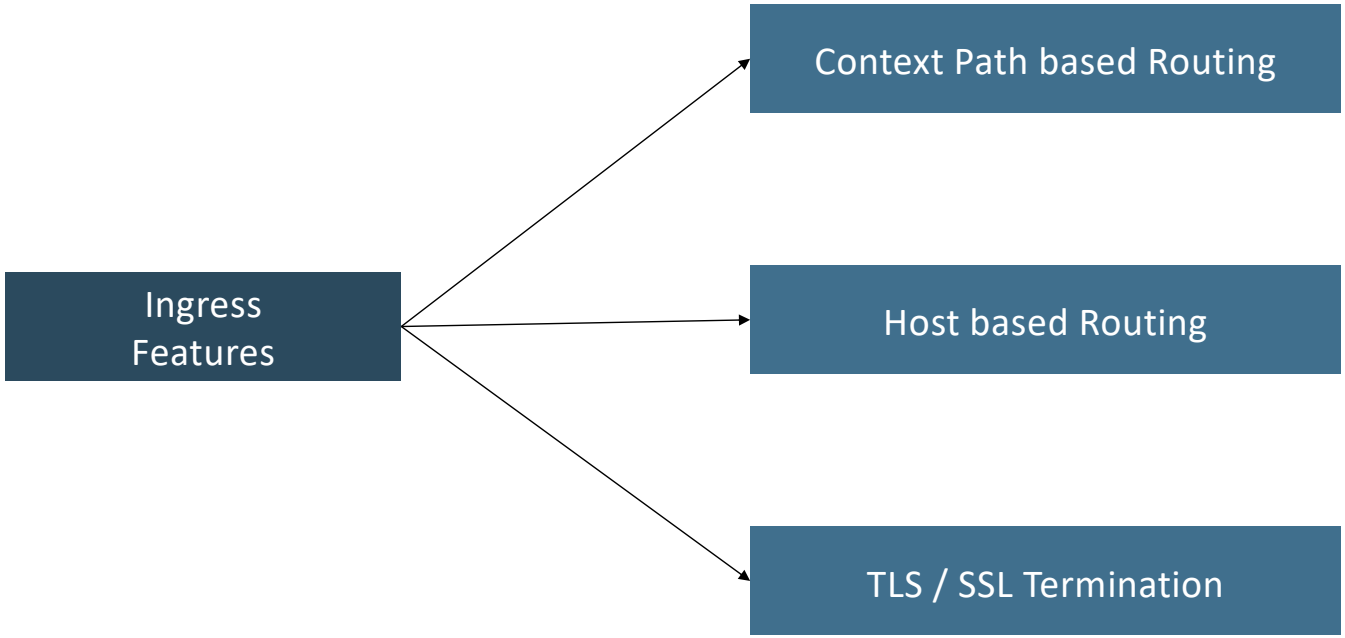
Ingress

Why do we need Ingress?



What is Ingress?

Ingress is a Kubernetes resource that lets us configure an HTTP load balancer for applications running on Kubernetes, with advanced capabilities at HTTP layer.



Ingress - Terminology

Ingress Controller

Ingress controller is an application that runs in a cluster and configures an HTTP load balancer according to Ingress resources.

The load balancer can be a software load balancer running in the cluster or a hardware or cloud load balancer running externally.

In the case of NGINX, the Ingress controller is deployed in a pod along with the load balancer.

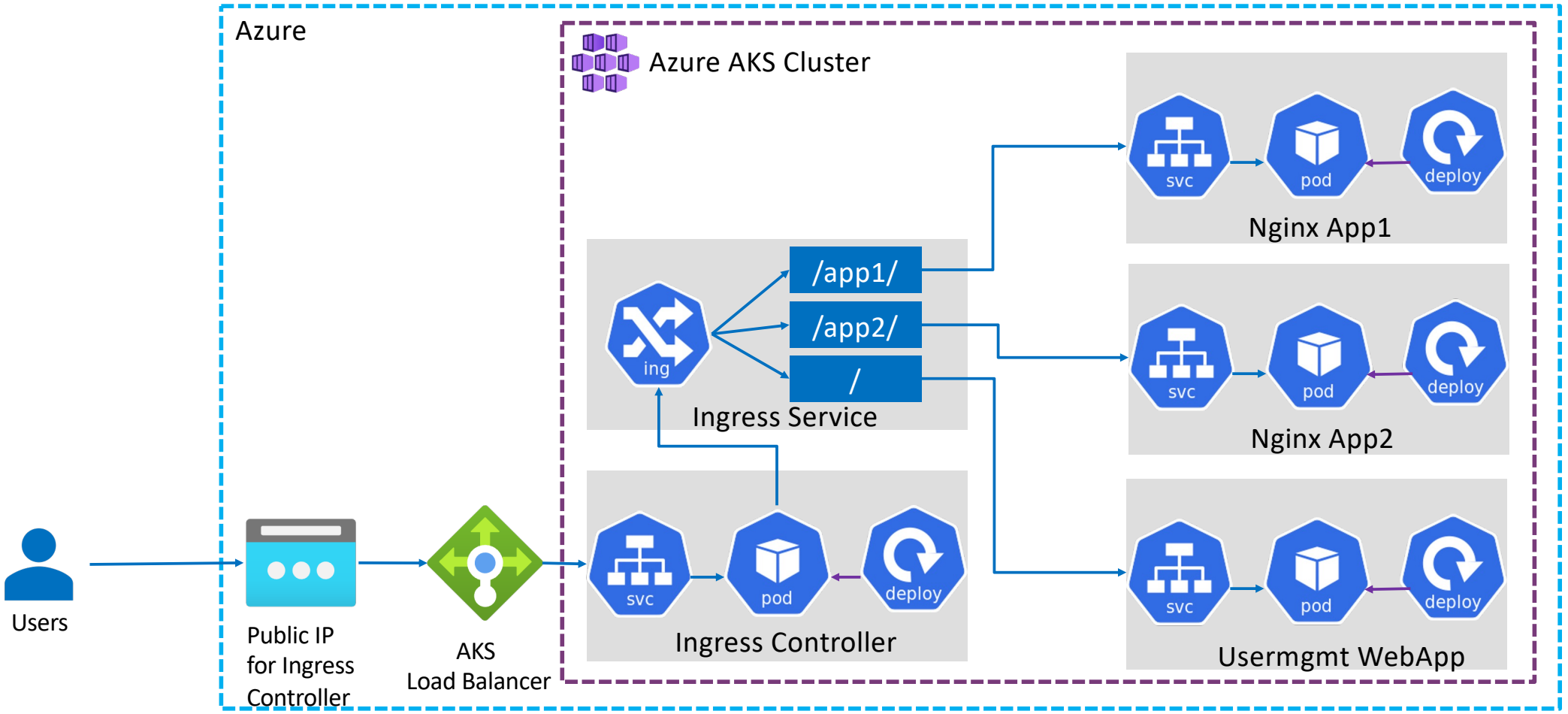
Ingress Resource or Service

Equivalent to Kubernetes Services but with lot of additional features

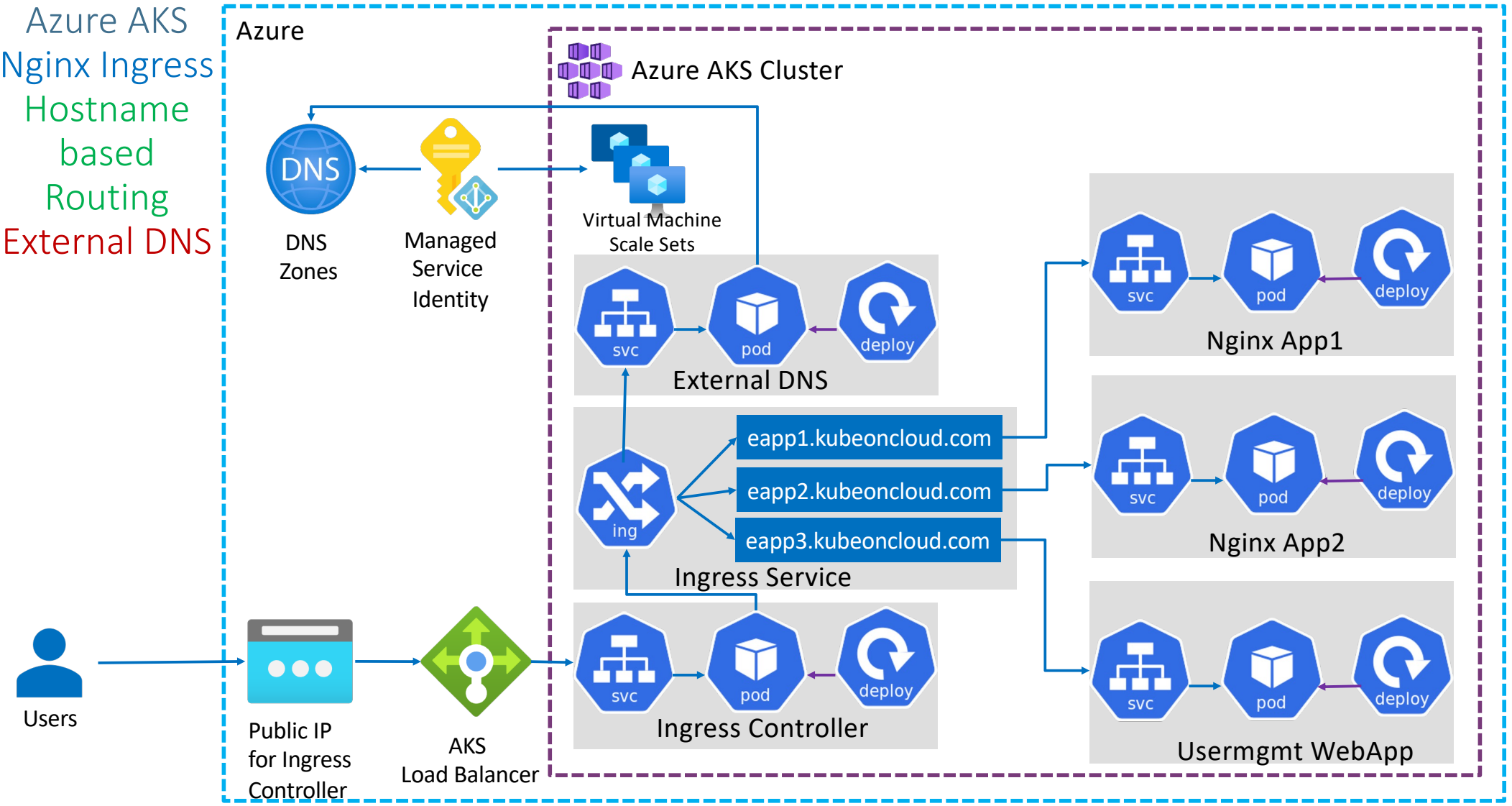
We can define routing rules based on URI or Hostname in Ingress Resource Manifest

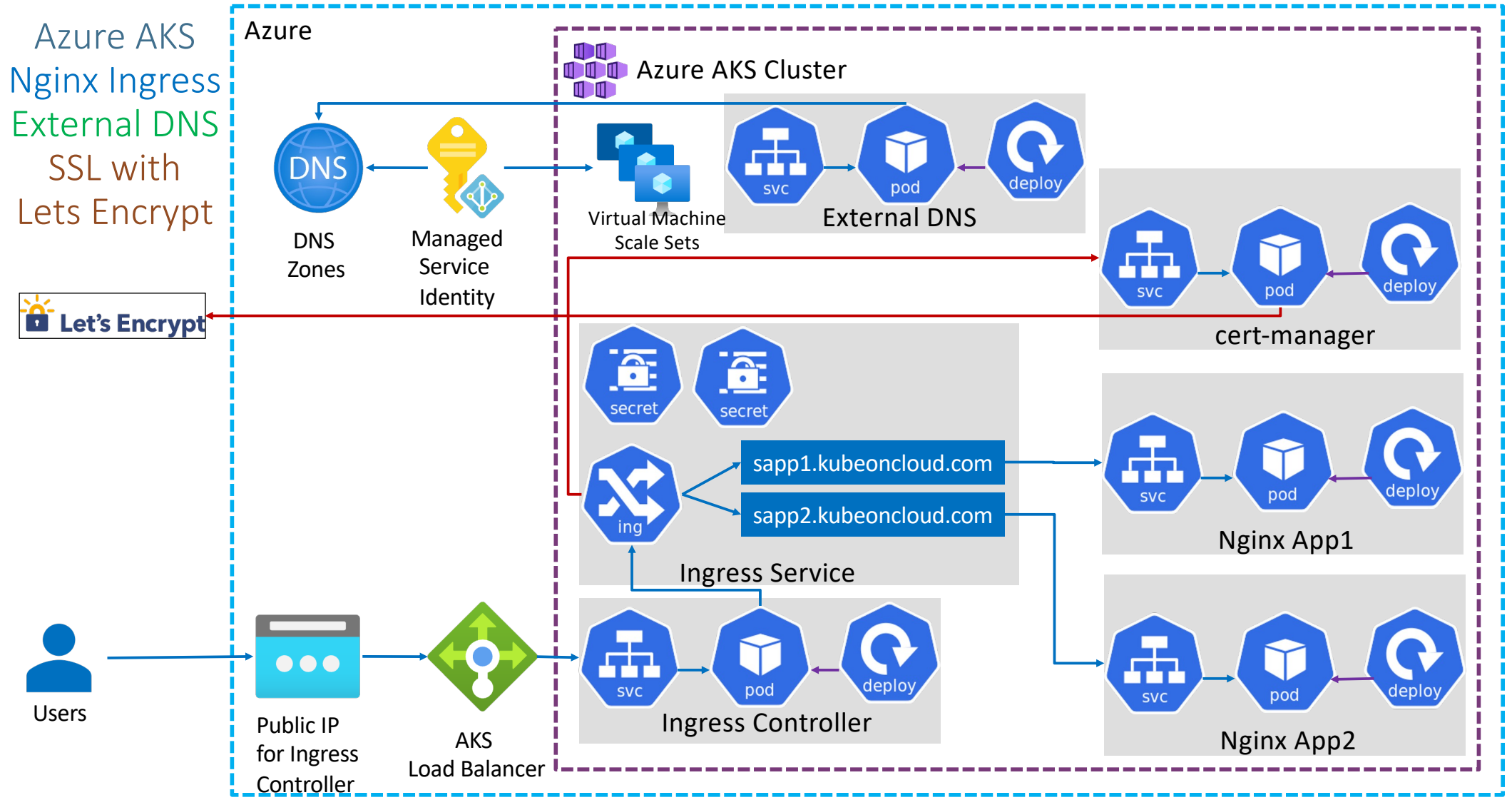
We can even define SSL / TLS related information in Ingress Resource Manifest

Azure AKS & Nginx Ingress – Context Path Based Routing



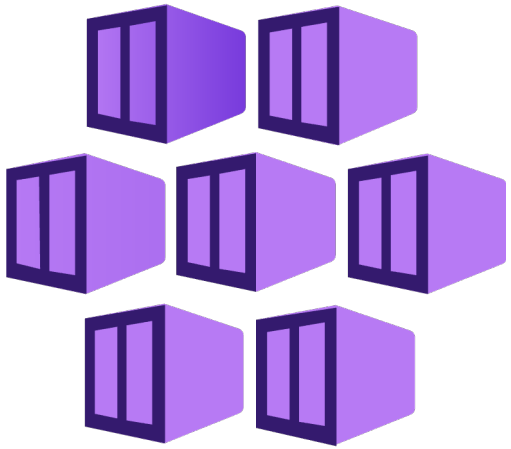
Azure AKS Nginx Ingress Hostname based Routing External DNS





Nginx Ingress Controller - References

- List of Ingress Controllers
  - https://kubernetes.io/docs/concepts/services-networking/ingress-controllers/
- Azure AGIC (Application Gateway Ingress Controller)
  - https://github.com/Azure/application-gateway-kubernetes-ingress
  - https://azure.microsoft.com/en-in/pricing/details/application-gateway/

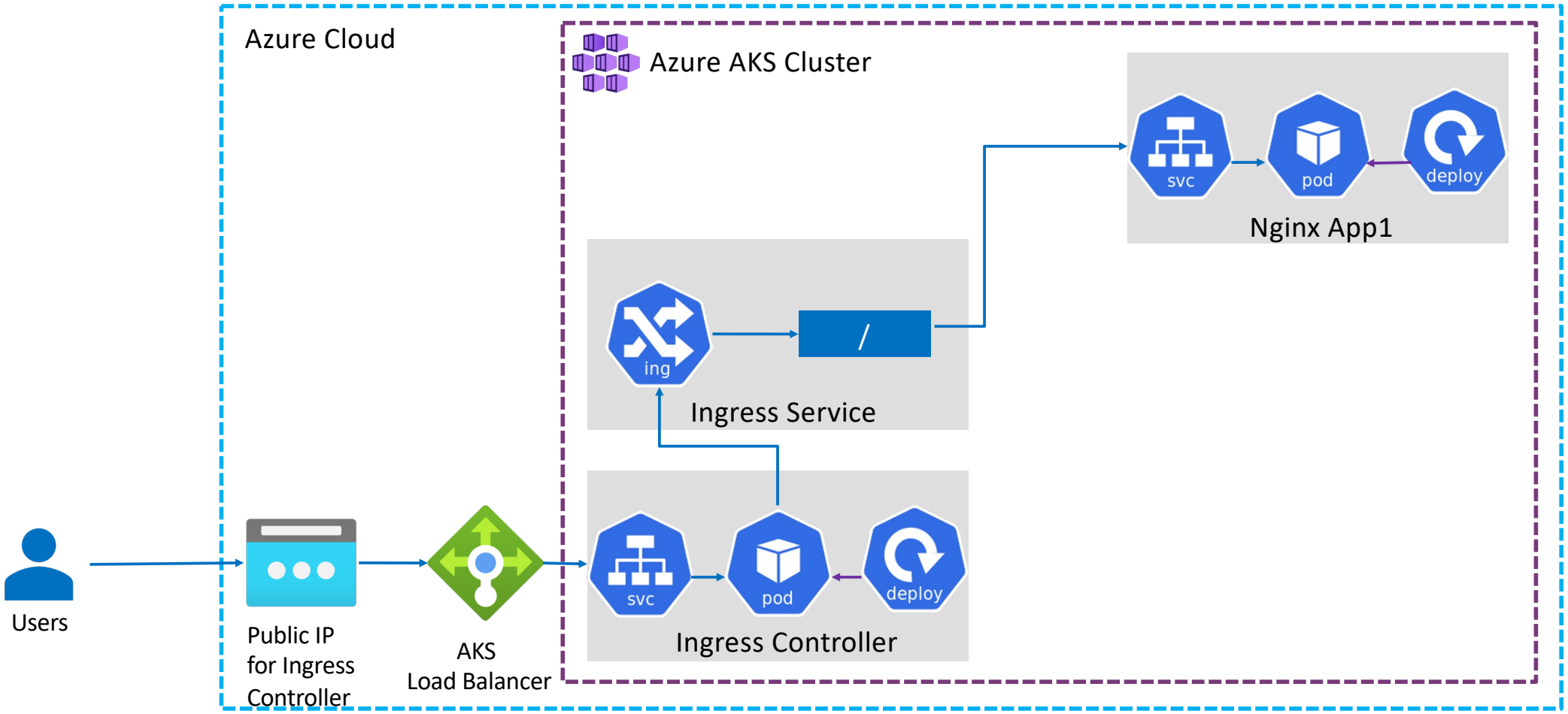


Azure AKS

Nginx Ingress Service

Install & Implement

Azure AKS & Nginx Ingress – Basic Architecture



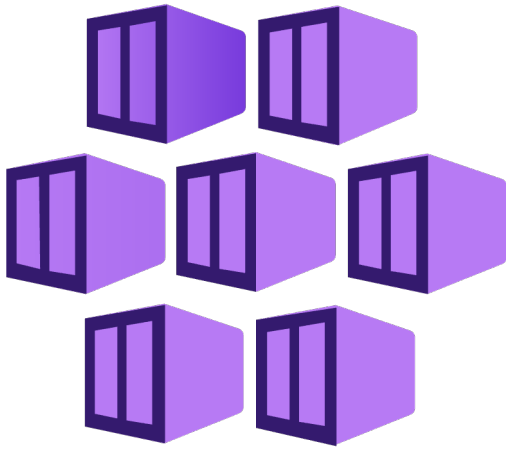
Basic Ingress Manifest

! 03-Ingress-Basic.yml ×

azure-aks-kubernetes-masterclass > 09-Ingress-Basic > kube-manifests > ! 03-Ingress-Basic.yml > apiVersion

```yaml
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
  name: nginxapp1-ingress-service
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  rules:
  - http:
      paths:
      - path: /
        backend:
          serviceName: app1-nginx-clusterip-service
          servicePort: 80

```

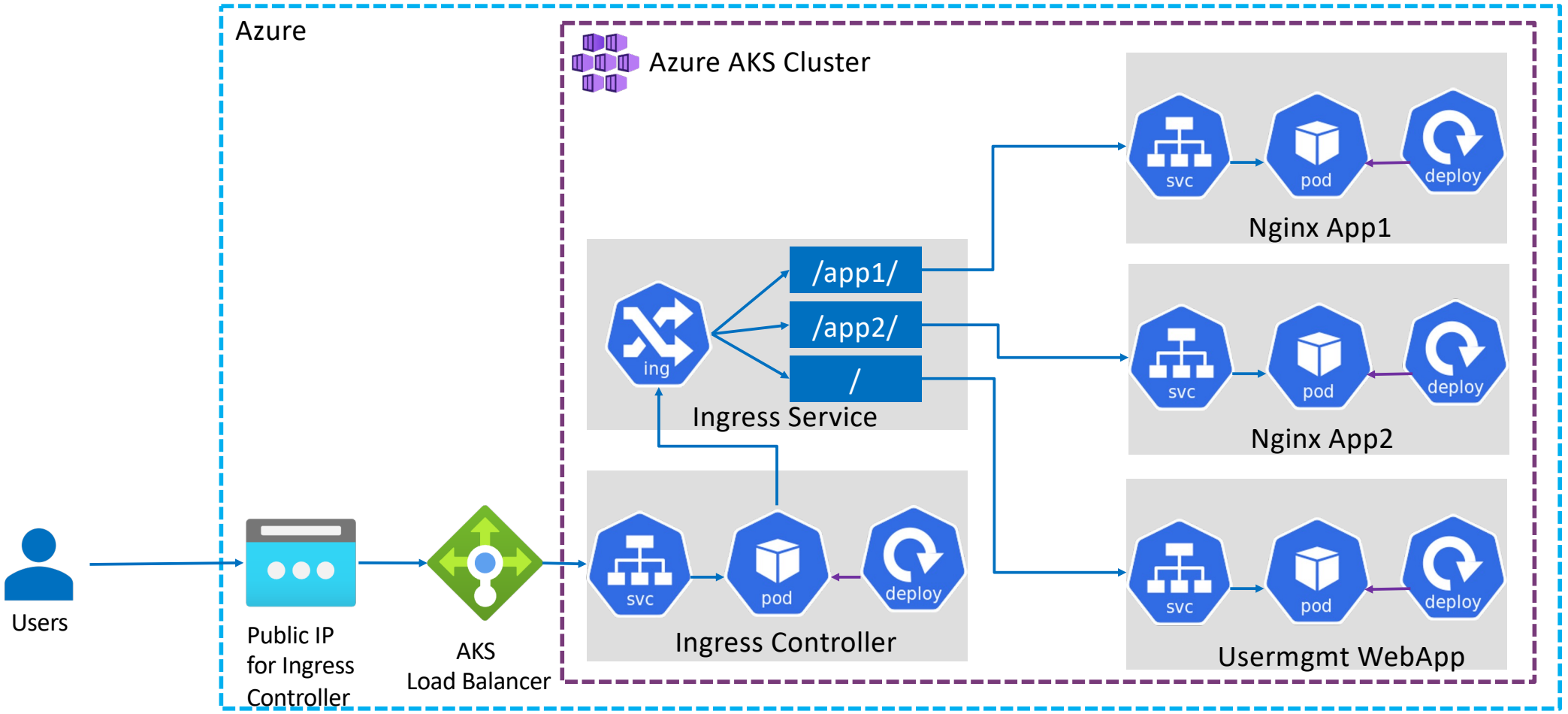


Azure AKS

Nginx Ingress Service

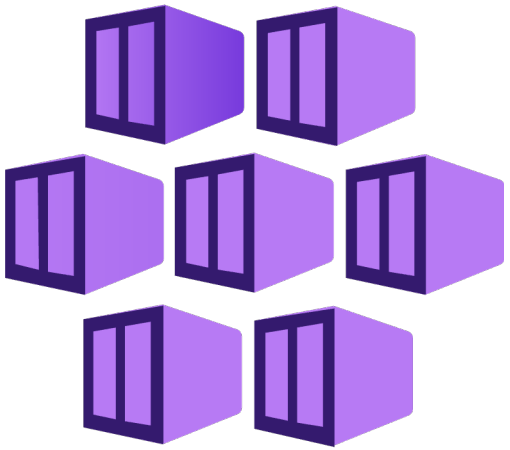
Context Path based Routing

Azure AKS & Nginx Ingress – Context Path Based Routing



Ingress CPR Manifest

```yaml
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
  name: ingress-cpr
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  rules:
  - http:
      paths:
      - path: /app1/
        backend:
          serviceName: app1-nginx-clusterip-service
          servicePort: 80
      - path: /app2/
        backend:
          serviceName: app2-nginx-clusterip-service
          servicePort: 80
      - path: /
        backend:
          serviceName: usermgmt-webapp-clusterip-service
          servicePort: 80
```



Azure AKS
&
Azure DNS Zones

Domain Registrar

- A domain registrar is a company who can provide Internet domain names.
  - Example: GoDaddy, Wix, Namcheap, AWS Route53
- They verify if the Internet domain you want to use is available and allow you to purchase it.
- Once the domain name is registered, you are the legal owner for the domain name.
- If you already have an Internet domain, you will use the current domain registrar to delegate to Azure DNS.

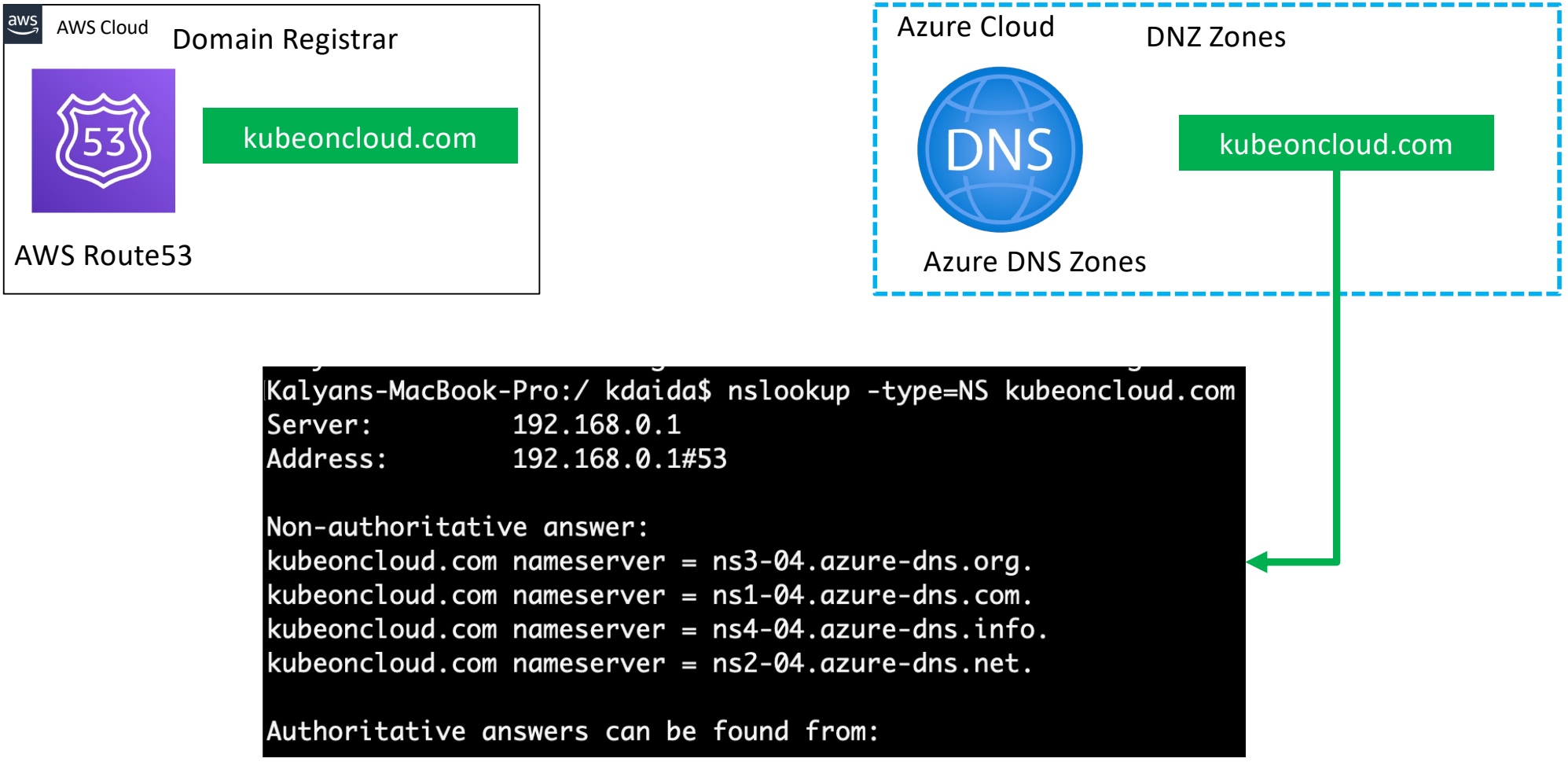
DNS Zone

- A domain is a unique name in the Domain Name System, for example stacksimplify.com.
- A DNS zone is used to host the DNS records for a particular domain.
- For example, the domain stacksimplify.com may contain several DNS records such as
  - mail.stacksimplify.com (for a mail server)
  - www.stacksimplify.com (for a website).
  - courses.stacksimplify.com (Sub domains to host other applications)

Azure DNS Zones

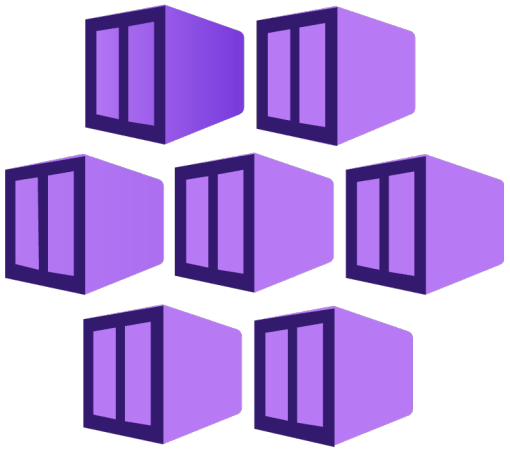
- Azure DNS is not the domain registrar.
- Azure DNS allows you to host a DNS zone and manage the DNS records for a domain in Azure.
- For DNS queries for a domain to reach Azure DNS, the domain must be delegated to Azure DNS from the parent domain

Delegate Domain to Azure DNS



DNS Zones

Managed Service Identity



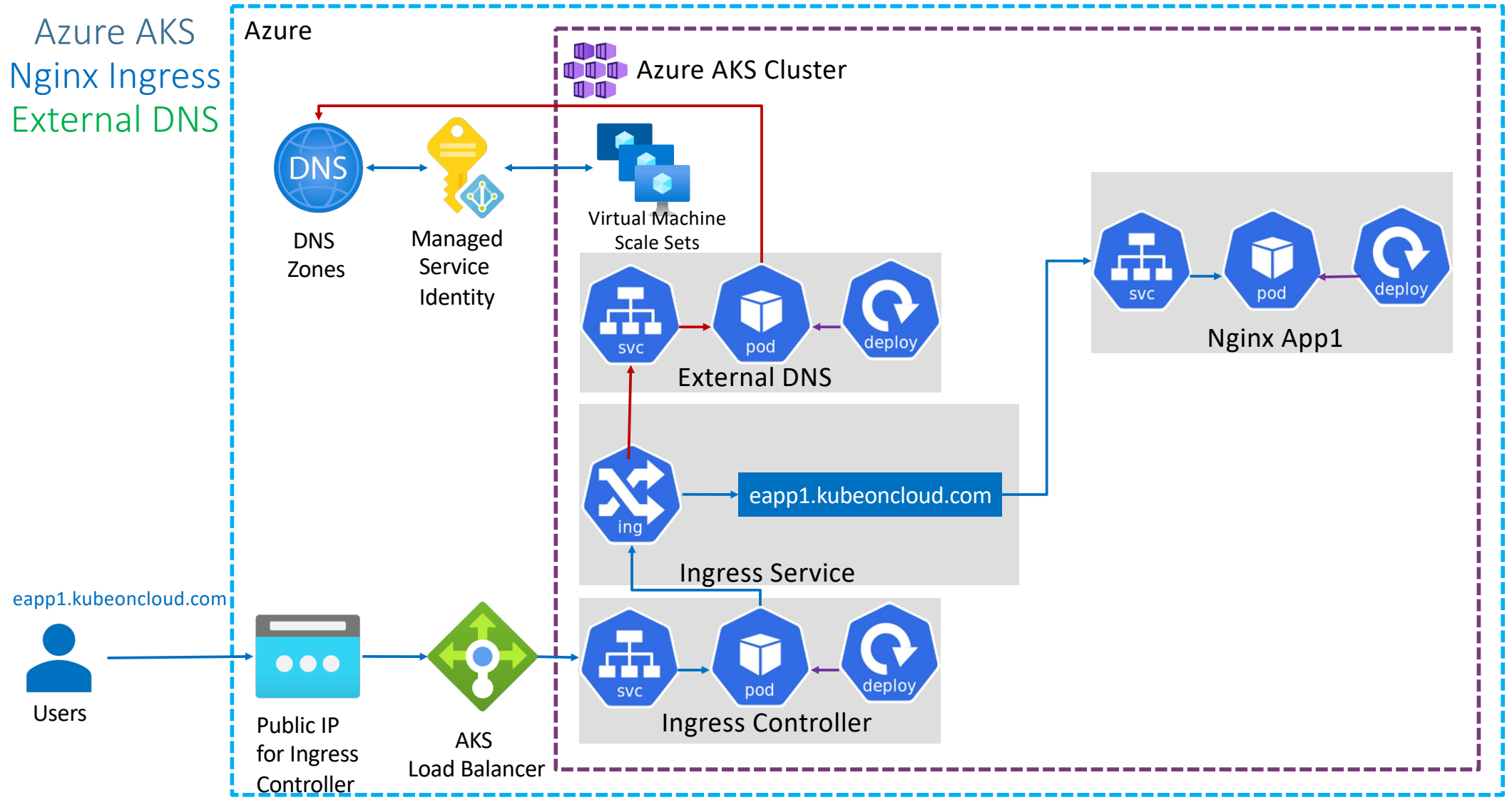
Azure AKS

Nginx Ingress Service

External DNS

Kubernetes External DNS

- ExternalDNS synchronizes exposed Kubernetes Services and Ingresses with DNS providers.
- In simple terms, ExternalDNS allows you to control DNS records dynamically via Kubernetes resources in a DNS provider-agnostic way.
- Reference: https://github.com/kubernetes-sigs/external-dns



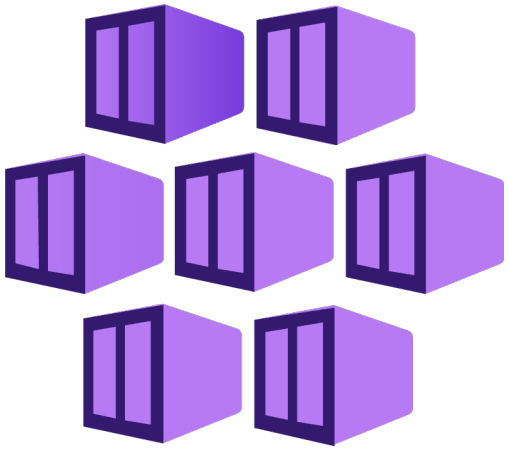
Ingress with External DNS

```yaml
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
  name: nginxapp1-ingress-service
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  rules:
  - host: eapp1.kubeoncloud.com
    http:
      paths:
      - path: /
        backend:
          serviceName: app1-nginx-clusterip-service
          servicePort: 80
```

This will help us to add DNS Record Set in Azure DNS Zones using k8s External DNS

DNS Zones

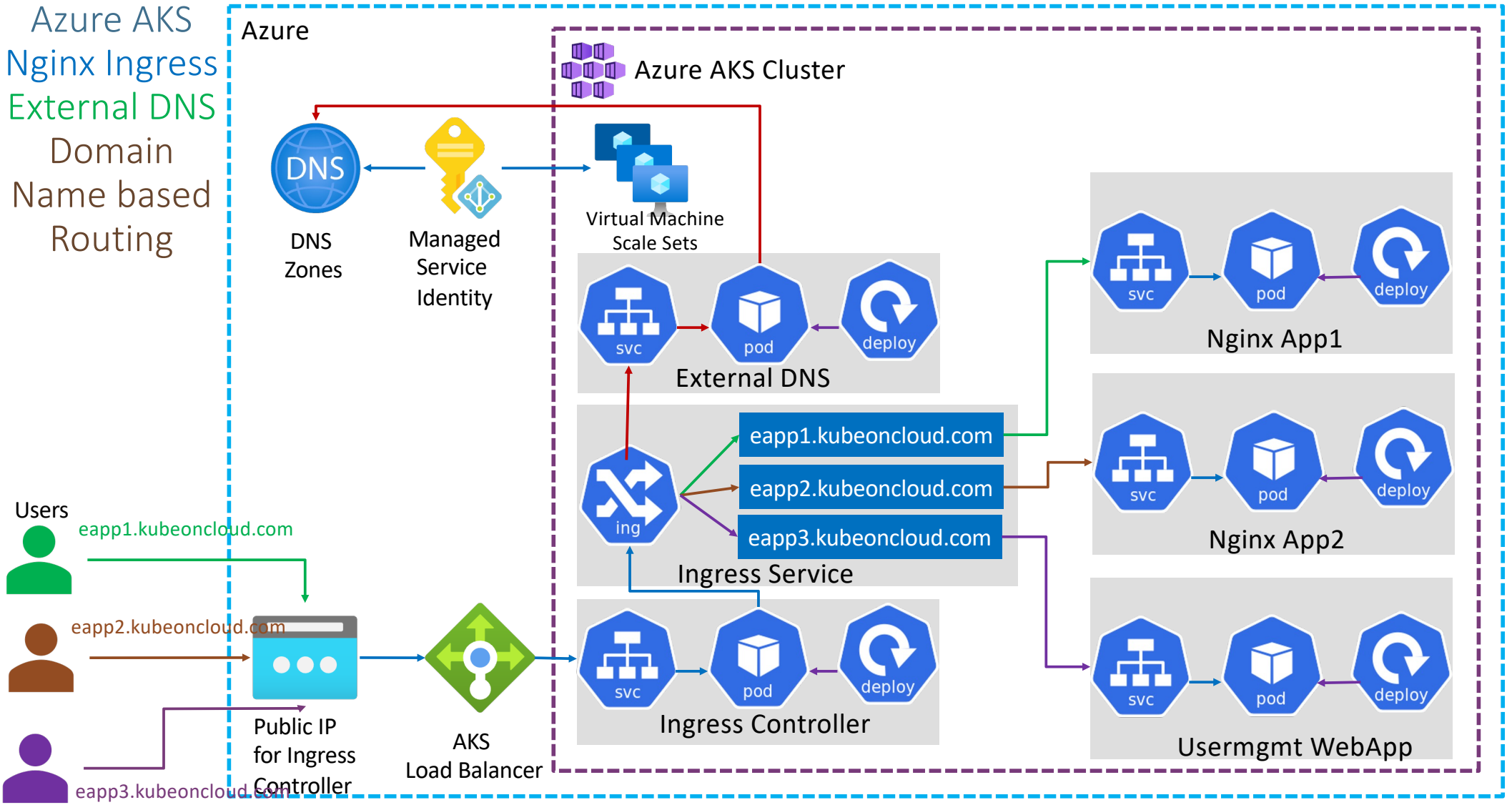
Managed Service Identity



Azure AKS

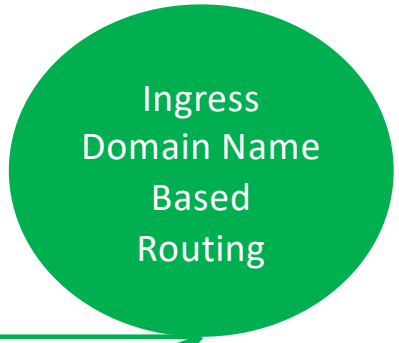
Nginx Ingress Service

Domain Name based Routing



Ingress with External DNS and Domain Name based Routing

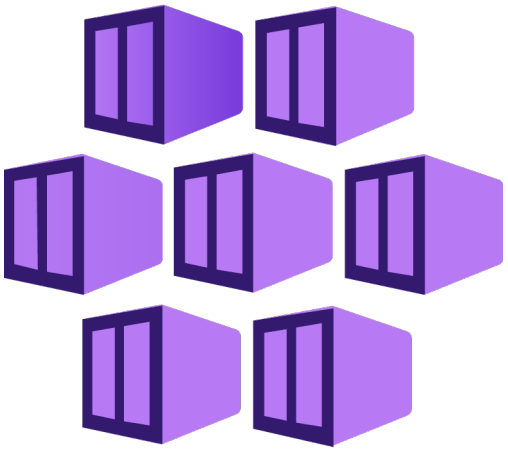
```yaml
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
  name: ingress-app1-app2-app3
  annotations:
    kubernetes.io/ingress.class: "nginx"
spec:
  rules:
  - host: eapp1.kubeoncloud.com
    http:
      paths:
      - path: /
        backend:
          serviceName: app1-nginx-clusterip-service
          servicePort: 80
  - host: eapp2.kubeoncloud.com
    http:
      paths:
      - path: /
        backend:
          serviceName: app2-nginx-clusterip-service
          servicePort: 80
```




```yaml
  - host: eapp3.kubeoncloud.com
    http:
      paths:
      - path: /
        backend:
          serviceName: usermgmt-webapp-clusterip-service
          servicePort: 80
```

DNS Zones

Managed Service Identity



Azure AKS

Nginx Ingress Service

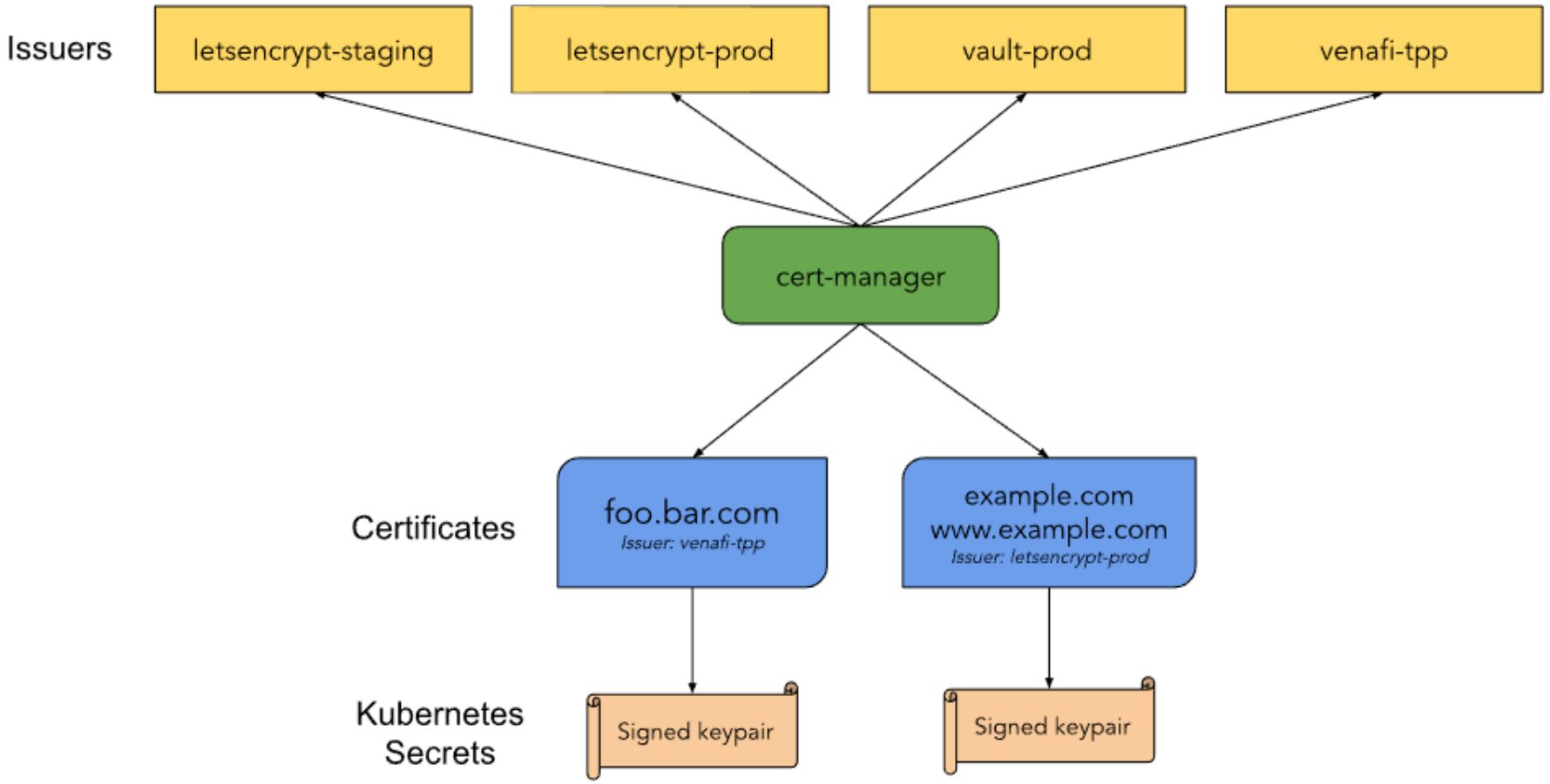
Ingress SSL

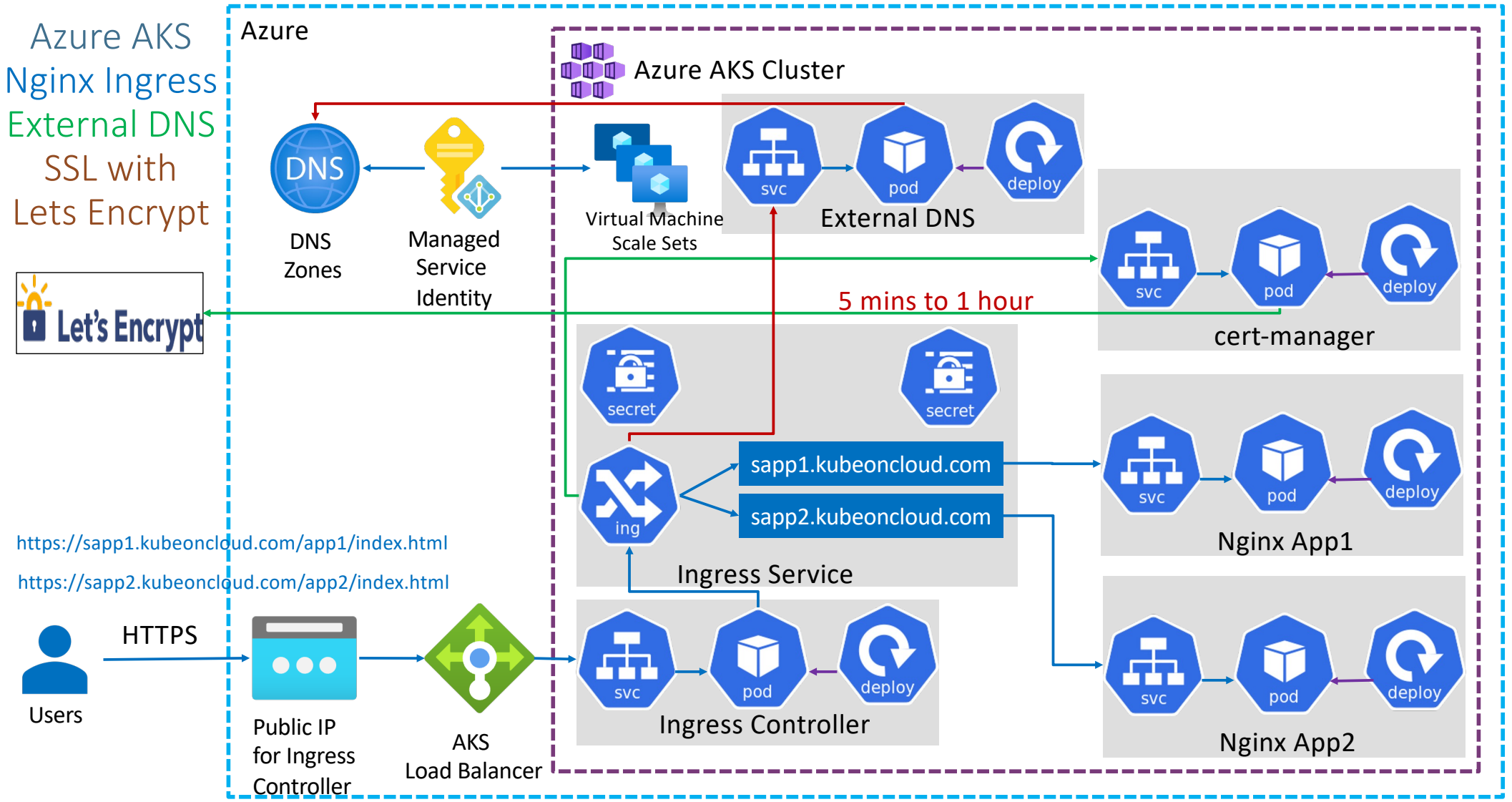
Automatically generate and renew ssl certificates

Kubernetes Cert Manager

- cert-manager is a native Kubernetes certificate management controller.
- It can help with issuing certificates from a variety of sources, such as Let's Encrypt, HashiCorp Vault, Venafi, a simple signing key pair, or self signed.
- It will ensure certificates are valid and up to date, and attempt to renew certificates at a configured time before expiry.
- Reference: https://cert-manager.io/docs/

Kubernetes cert-manager





Ingress with External DNS, DNR and SSL

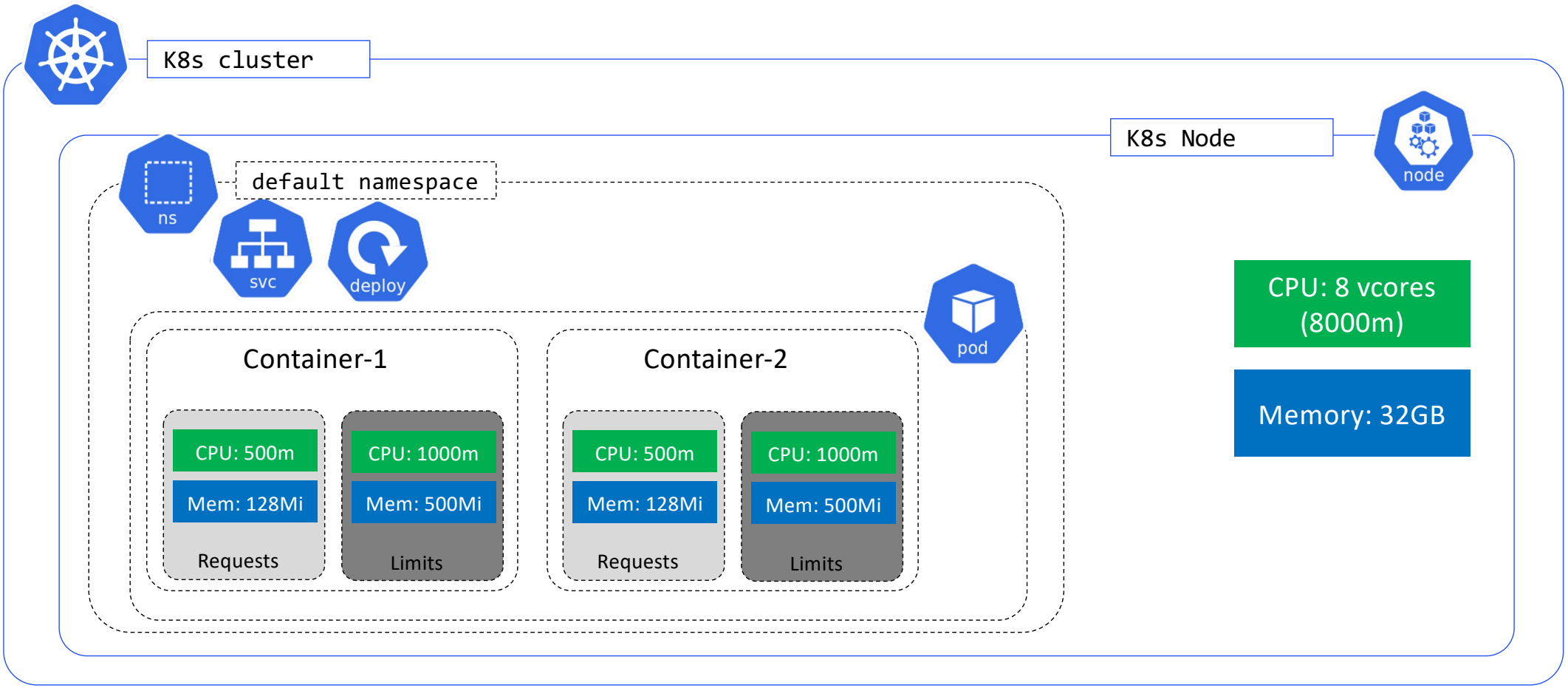
```yaml
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
  name: ingress-ssl
  annotations:
    kubernetes.io/ingress.class: "nginx"
    cert-manager.io/cluster-issuer: letsencrypt
spec:
  rules:
  - host: sapp1.kubeoncloud.com
    http:
      paths:
      - path: /
        backend:
          serviceName: app1-nginx-clusterip-service
          servicePort: 80
  - host: sapp2.kubeoncloud.com
    http:
      paths:
      - path: /
        backend:
          serviceName: app2-nginx-clusterip-service
          servicePort: 80
  tls:
  - hosts:
    - sapp1.kubeoncloud.com
    secretName: sapp1-kubeoncloud-secret
  - hosts:
    - sapp2.kubeoncloud.com
    secretName: sapp2-kubeoncloud-secret
```

Kubernetes
Resources
Requests & Limits

Kubernetes - Resources Requests & Limits

- We can specify how much each container in a pod needs the resources like CPU & Memory.
- When we provide this information in our pod definition for a specific container, the scheduler uses this information to decide which node to place the Pod on based on availability of k8s worker Node CPU and Memory Resources.
- When you specify a resource limit for a Container, the kubelet enforces those `limits` so that the running container is not allowed to use more of that resource than the limit you set.
- The kubelet also reserves at least the request amount of that system resource specifically for that container to use.

Kubernetes – Requests & Limits



Kubernetes
Requests & Limits

We have defined Requests & Limits for a specific container in a Deployment Manifest.

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: app1-nginx-deployment
  labels:
    app: app1-nginx
spec:
  replicas: 1
  selector:
    matchLabels:
      app: app1-nginx
  template:
    metadata:
      labels:
        app: app1-nginx
    spec:
      containers:
        - name: app1-nginx
          image: stacksimplify/kube-nginxapp1:1.0.0
          imagePullPolicy: Always
          ports:
            - containerPort: 80
          # Requests & Limits for usermgmt-webapp Container
          resources:
            requests:
              cpu: "100m"
              memory: "128Mi"
            limits:
              cpu: "200m"
              memory: "256Mi"
```

Kubernetes
Namespaces

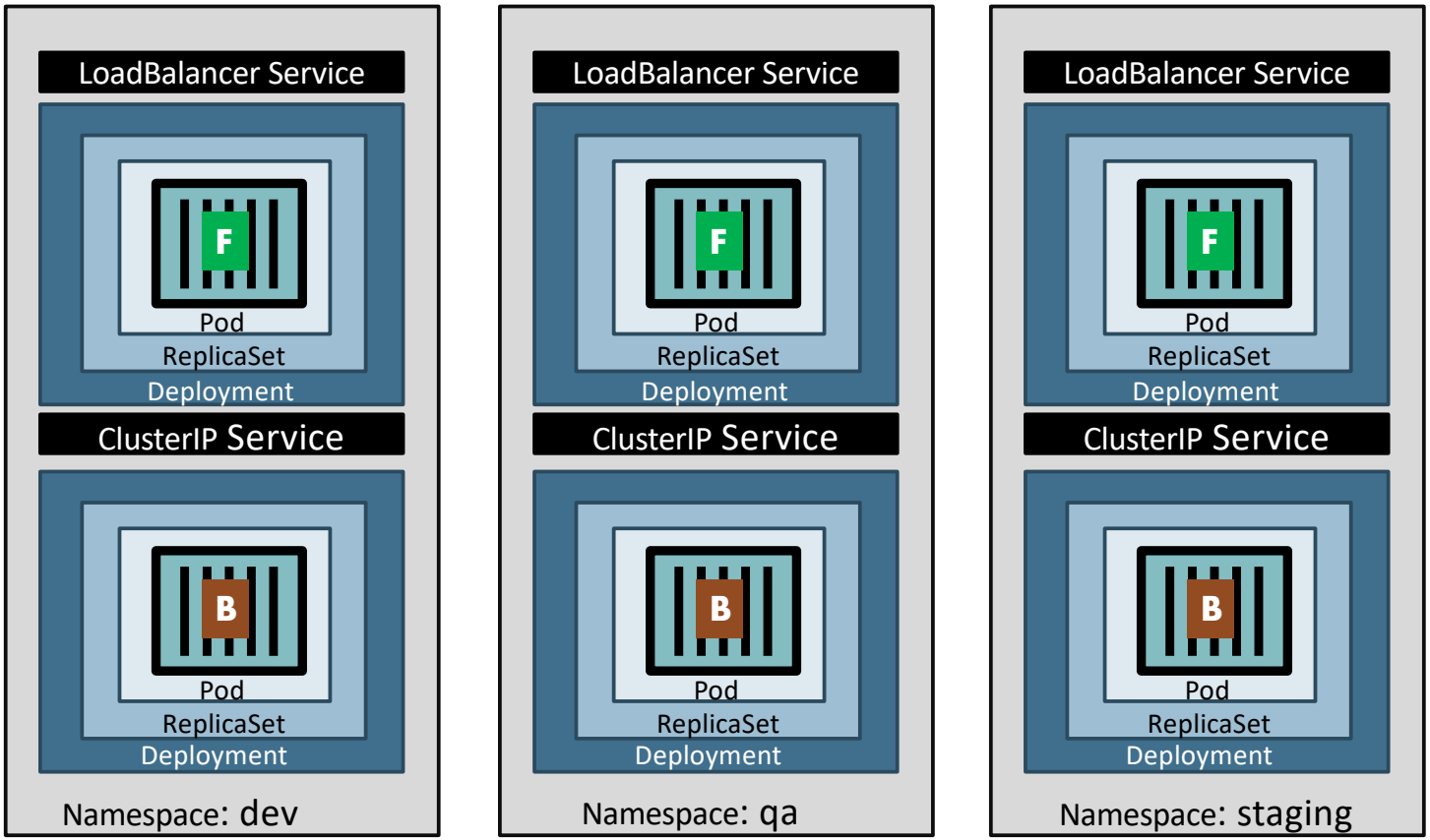
Kubernetes - Namespaces

- 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
```

Kubernetes - Namespaces



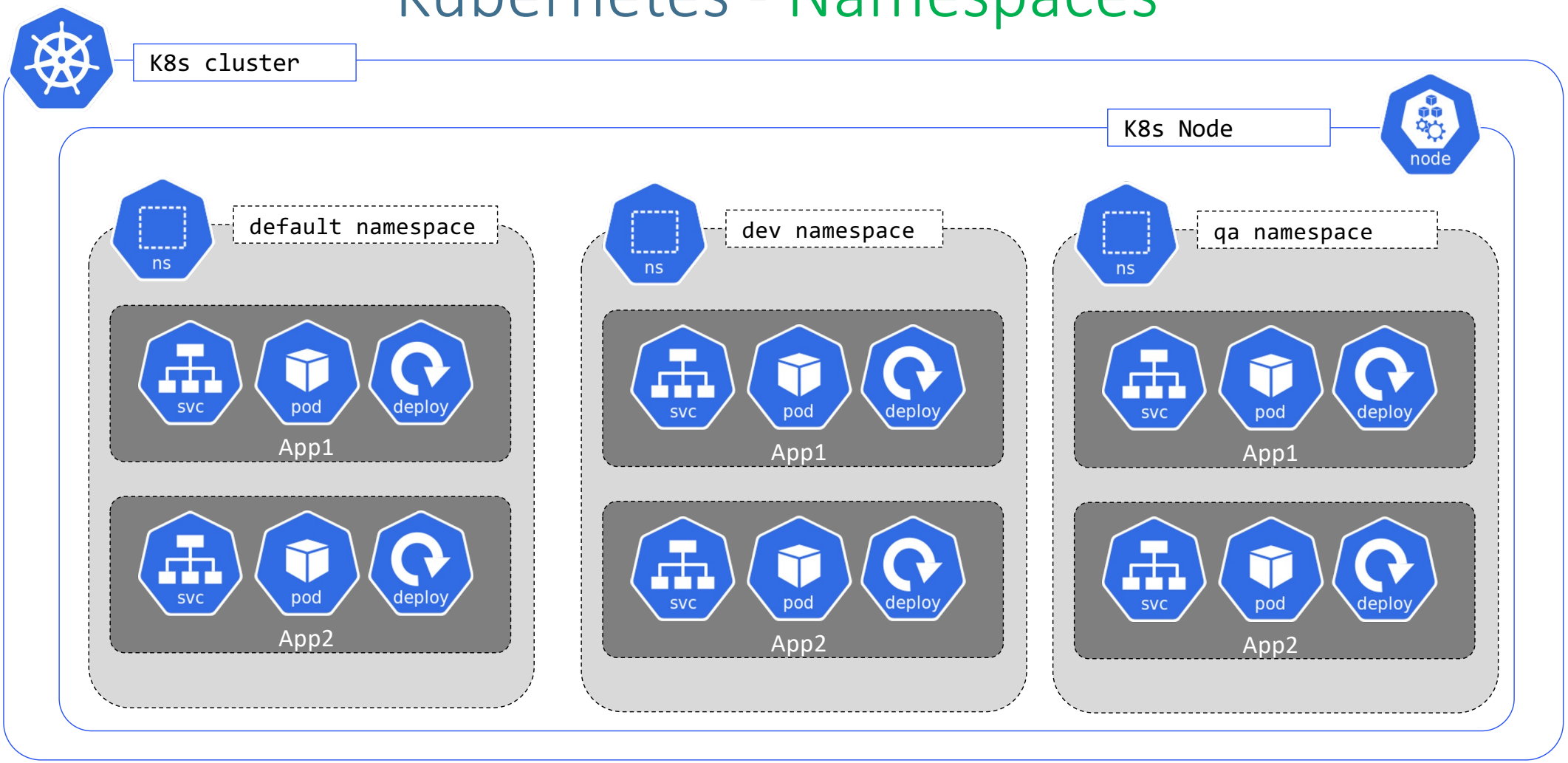
Namespace Manifest - Declarative

```
1  apiVersion: v1
2  kind: Namespace
3  metadata:
4    name: dev3
```

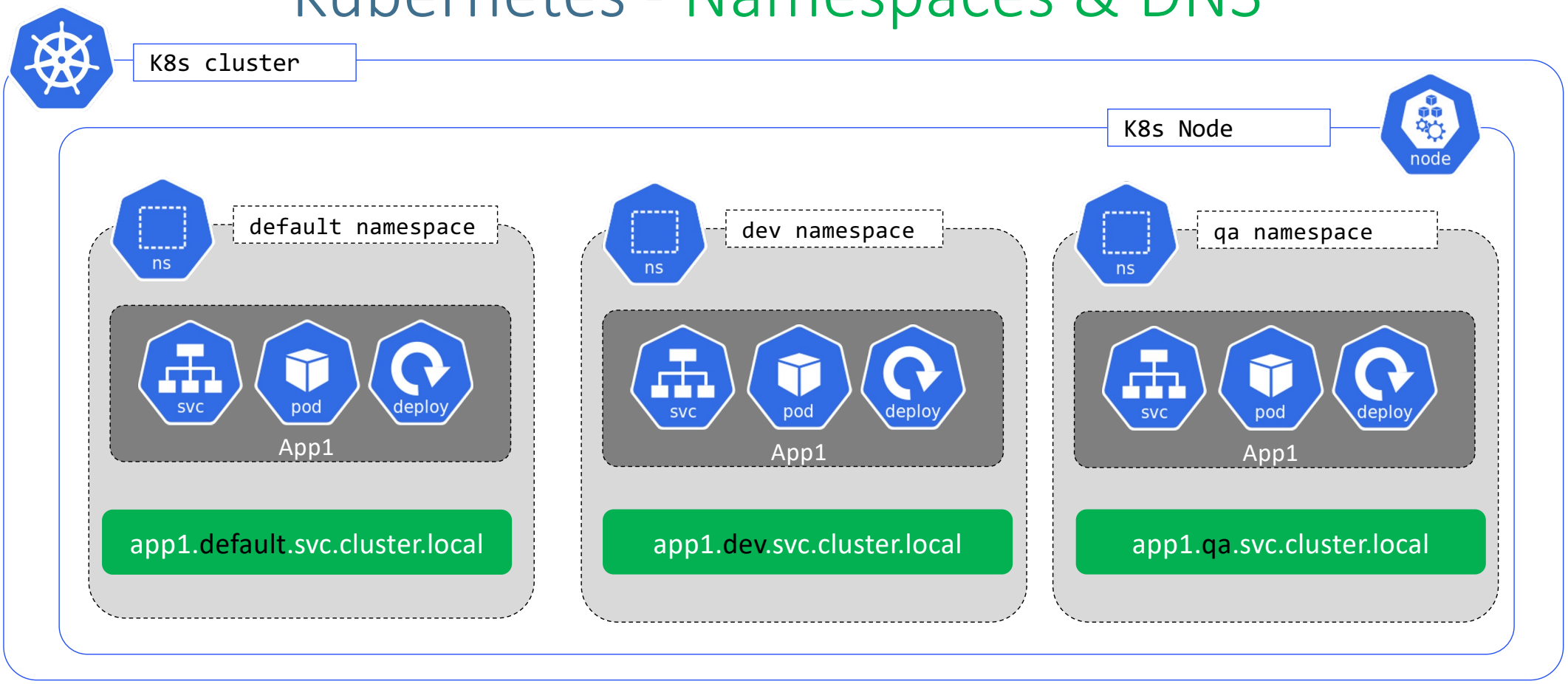
Namespace Manifest - Imperative

```
kubectl create namespace dev1
```

Kubernetes - Namespaces



Kubernetes - Namespaces & DNS



<service-name>.<namespace-name>.svc.cluster.local

Kubernetes
Namespaces
Limit Range

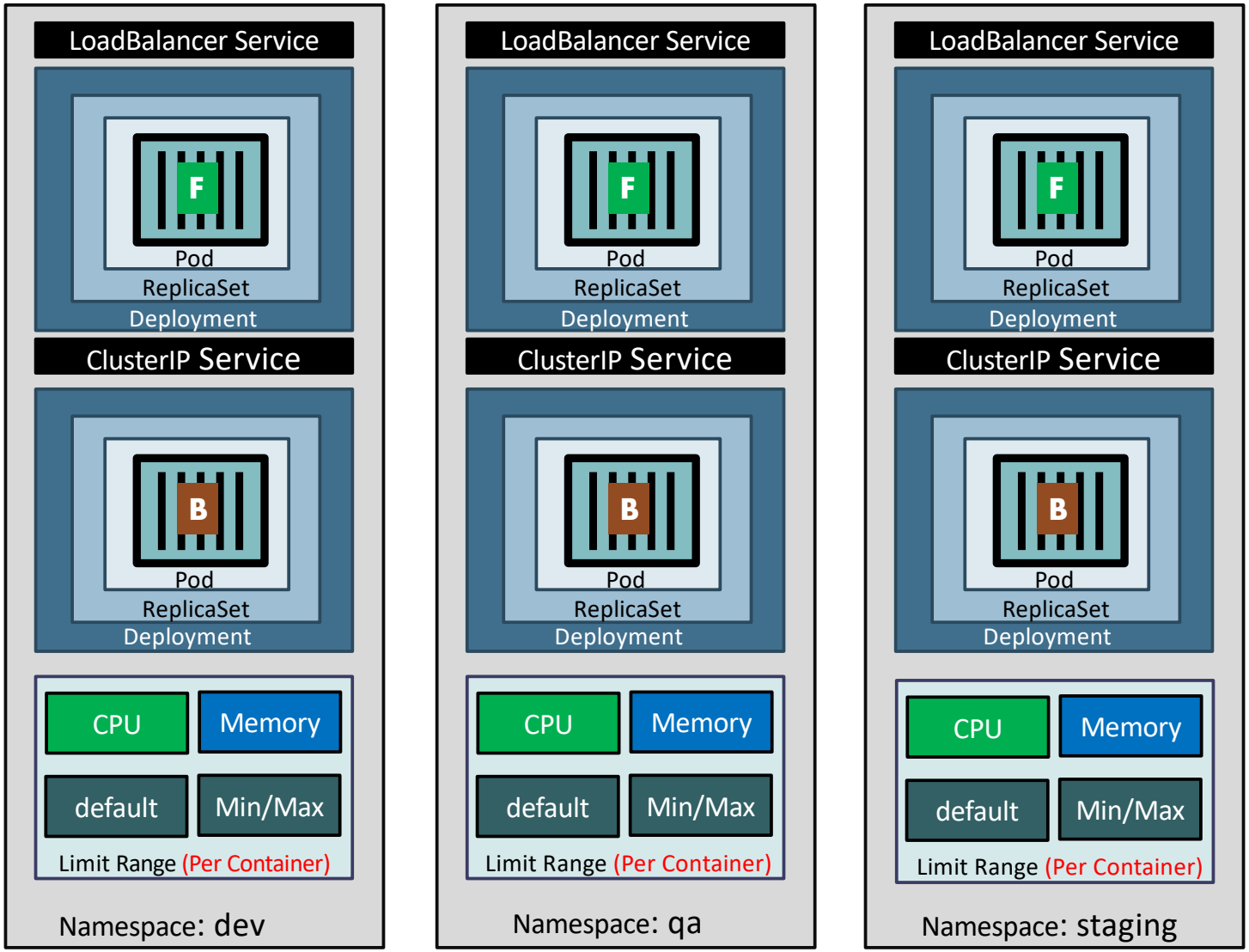
Namespaces – Limit Range

- By default, containers run with unbounded compute resources on a Kubernetes cluster.
- With resource quotas, cluster administrators can restrict resource consumption and creation on a namespace basis.
- Within a namespace, a Pod or Container can consume as much CPU and memory as defined by the namespace's resource quota.
- There is a concern that one Pod or Container could monopolize all available resources.
- A LimitRange is a policy to constrain resource allocations (to Pods or Containers) in a namespace.

Namespaces – Limit Range

- A *LimitRange* provides constraints that can:
- Enforce minimum and maximum compute resources usage per Pod or Container in a namespace.
- Enforce minimum and maximum storage request per PersistentVolumeClaim in a namespace.
- Enforce a ratio between request and limit for a resource in a namespace.
- Set default request/limit for compute resources in a namespace and automatically inject them to Containers at runtime.

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
```

Kubernetes
Namespaces
Resource Quota

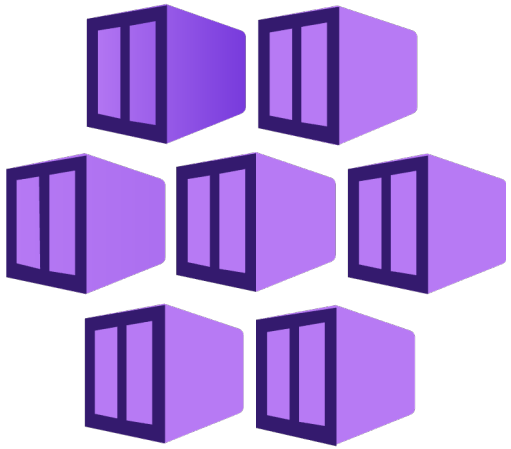
Namespaces - Resource Quota

- When several users or teams share a cluster with a fixed number of nodes, there is a concern that one team could use more than its fair share of resources.
- Resource quotas are a tool for administrators to address this concern.
- A resource quota, defined by a ResourceQuota object, provides constraints that limit aggregate resource consumption per namespace.
- It can limit the quantity of objects that can be created in a namespace by type, as well as the total amount of compute resources that may be consumed by resources in that project.

Resource Quota

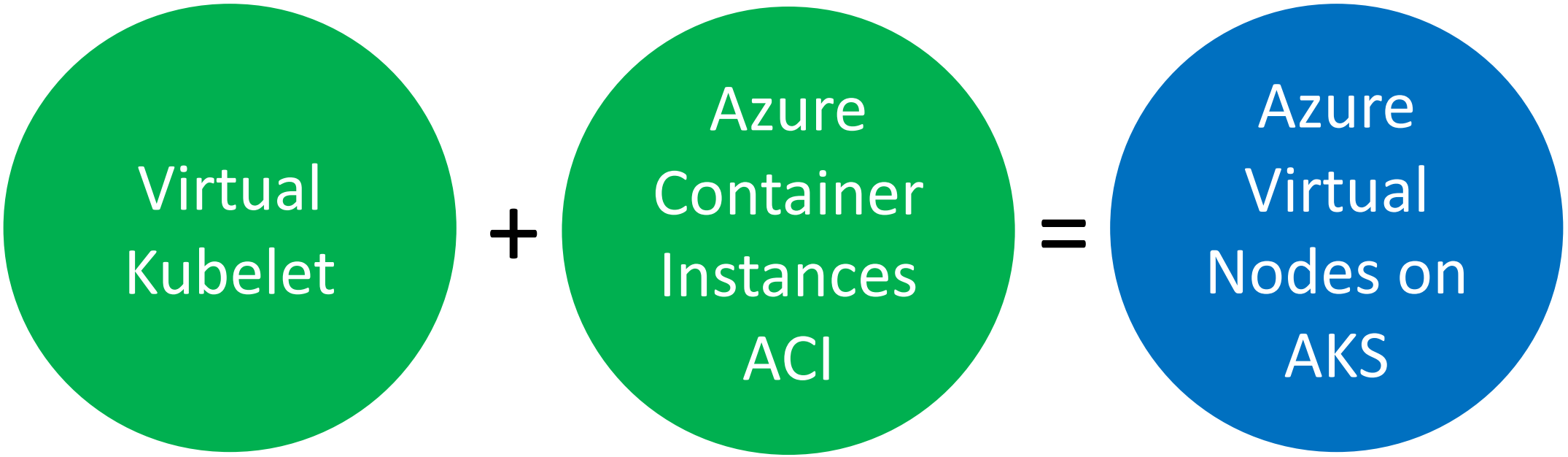
Resource Quota Manifest

```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"
```

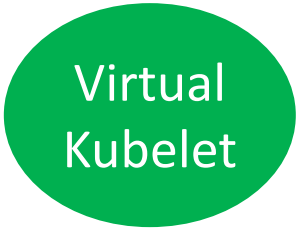


Azure AKS
Virtual Nodes
(Serverless)

Azure AKS Virtual Nodes



What is Virtual Kubelet?

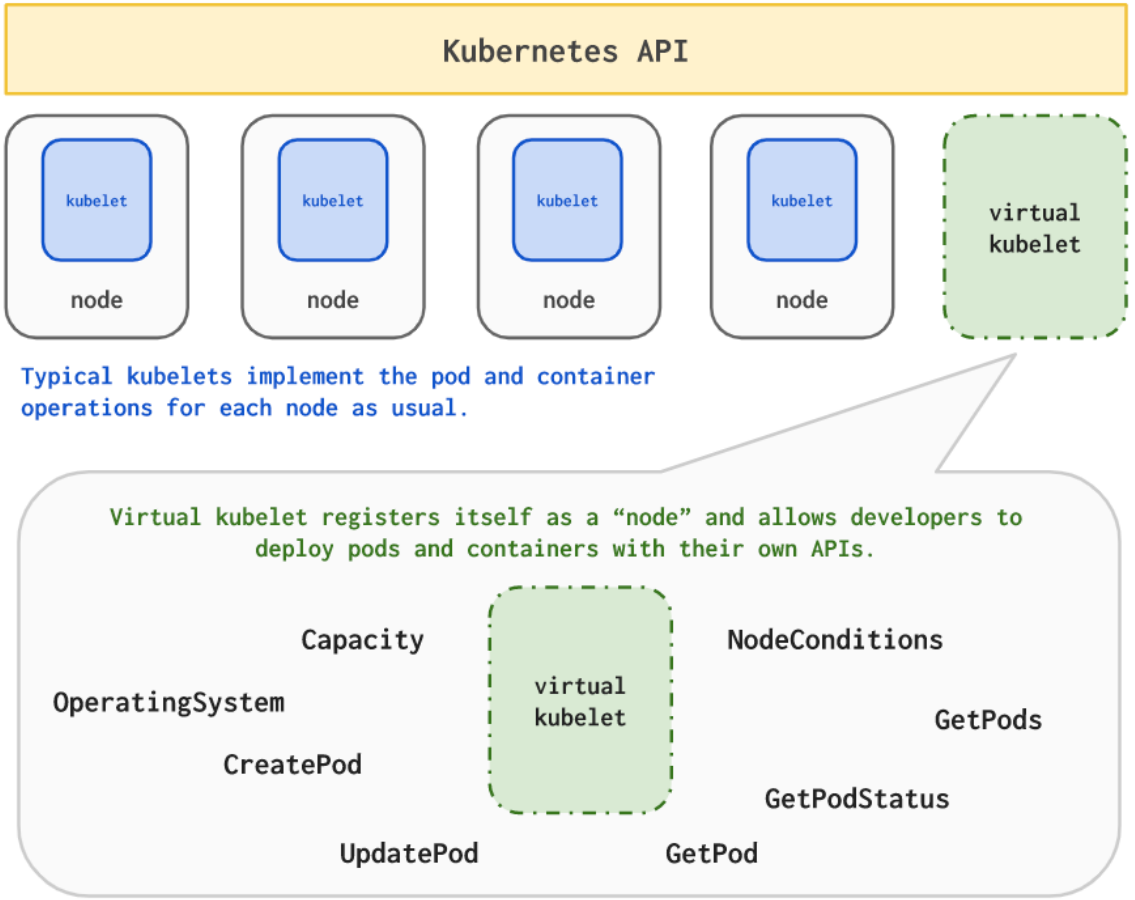


- Virtual Kubelet is an open source Kubernetes kubelet implementation that acts as a kubelet for the purposes of connecting Kubernetes to other APIs.
- This allows the k8s worker nodes to be backed by other services like Azure ACI and AWS Fargate
- The primary scenario for VK is enabling the extension of the Kubernetes API into serverless container platforms like Azure ACI and AWS Fargate

How Virtual-Kubelet works?

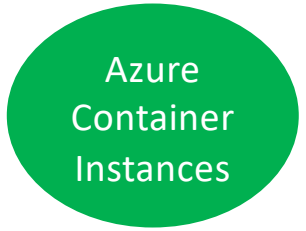
Virtual Kubelet

- **Current Features**
- create, delete and update pods
- container logs, exec, and metrics
- get pod, pods and pod status
- capacity
- node addresses, node capacity, node daemon endpoints
- operating system
- bring your own virtual network



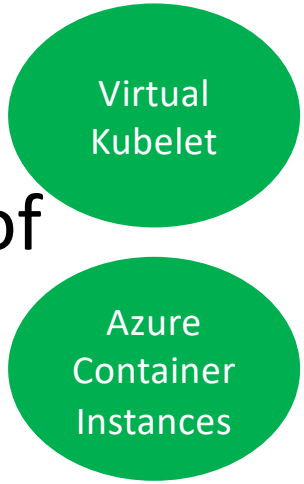
What is ACI (Azure Container Instances)?

- Azure Container Instances (ACI) provide a hosted environment for running containers in Azure.
- When using ACI, there is no need to manage the underlying compute infrastructure, Azure handles this management for you.
- When running containers in ACI, you are charged by the second for each running container



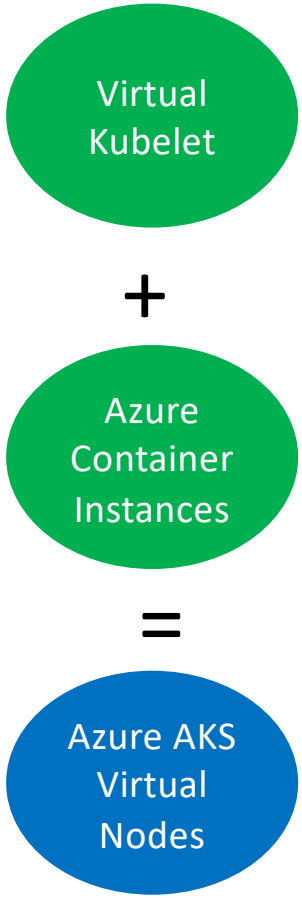
Kubernetes Virtual Kubelet with Azure ACI

- The Azure Container Instances (ACI) provider for the Virtual Kubelet configures an ACI instance as a node in any Kubernetes cluster.
- When using the Virtual Kubelet ACI provider, pods can be scheduled on an ACI instance as if the ACI instance is a standard Kubernetes node.
- This configuration allows you to take advantage of both the capabilities of Kubernetes and the management value and cost benefit of ACI.

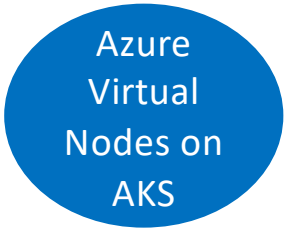


Virtual Kubelet's ACI provider - Features

- Volumes: empty dir, github repo, Azure Files
- Secure env variables, config maps
- Bring your own virtual network (VNet)
- Network security group support
- Basic Azure Networking support within AKS virtual node
- Exec support for container instances
- Azure Monitor integration or formally known as OMS

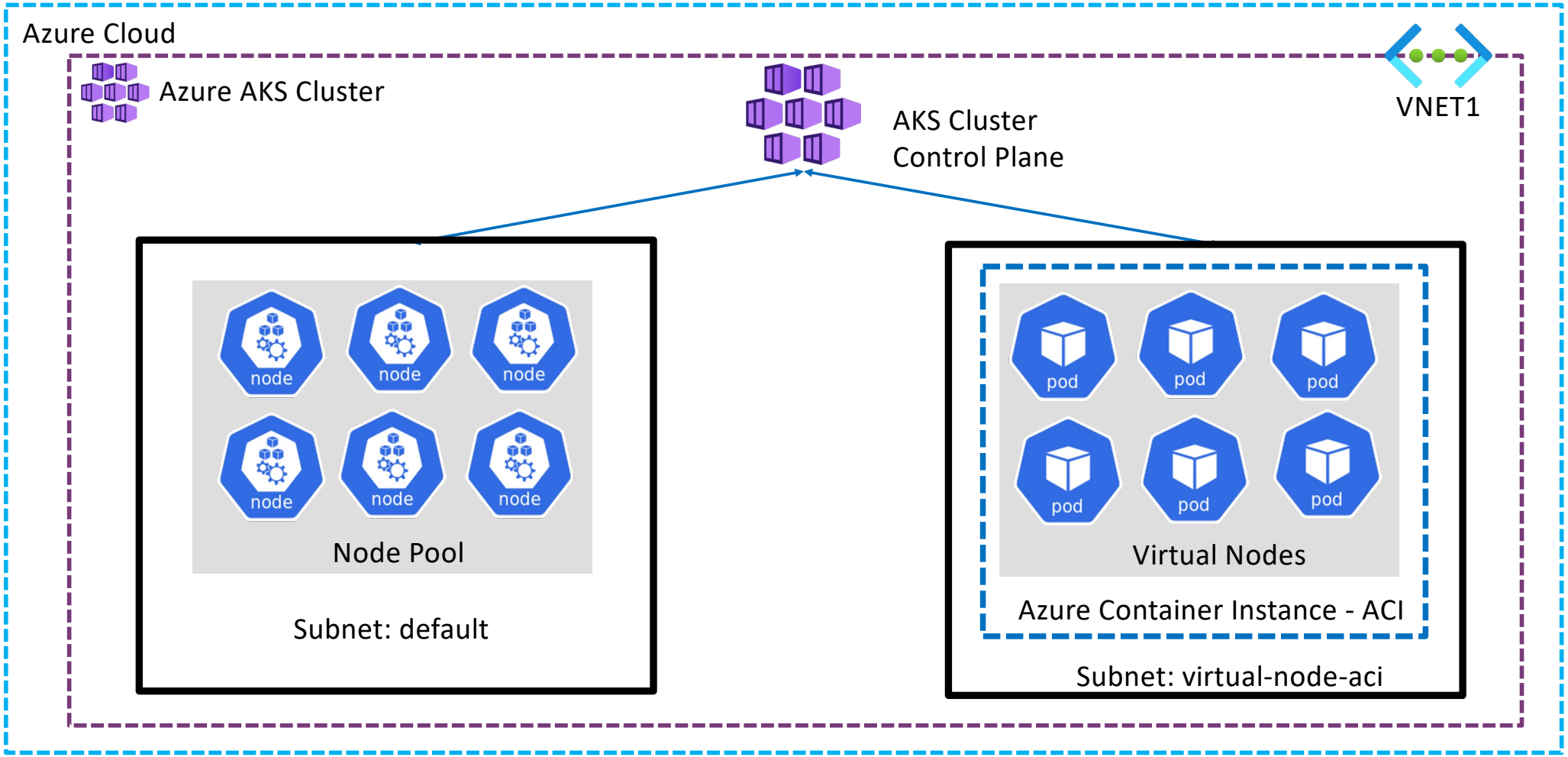


Azure AKS – Virtual Nodes (Serverless)



- We can run our Kubernetes workloads on Serverless Infrastructure of Azure which is called Virtual Nodes
- Advantages
  - Scale our applications rapidly without any limitations
  - Quick Provisioning of pods using Virtual Nodes when compared to cluster autoscaler.
  - Cluster Autoscaler need to provision the Nodes in a managed node pool first then only Kubernetes can schedule pods on those newly provisioned nodes.
- Limitations (Huge and Many)
  - https://docs.microsoft.com/en-us/azure/aks/virtual-nodes-cli#known-limitations

Azure AKS - Virtual Nodes



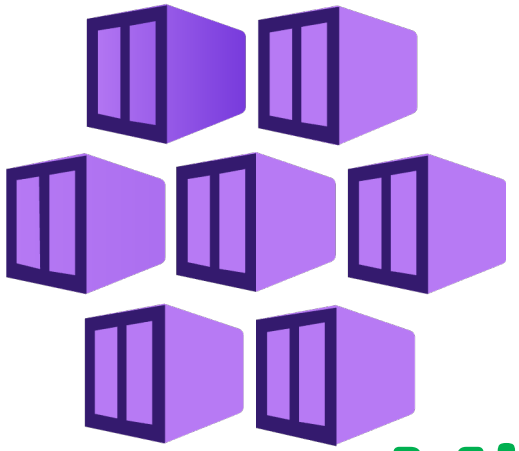
AKS Virtual Nodes
NodeSelector

```
    spec:
      containers:
        - name: app1-nginx
          image: stacksimplify/kube-nginxapp1:1.0.0
          ports:
            - containerPort: 80
# To schedule pods on Azure Virtual Nodes
      nodeSelector:
        kubernetes.io/role: agent
        beta.kubernetes.io/os: linux
        type: virtual-kubelet
      tolerations:
      - key: virtual-kubelet.io/provider
        operator: Exists
      - key: azure.com/aci
        effect: NoSchedule
```

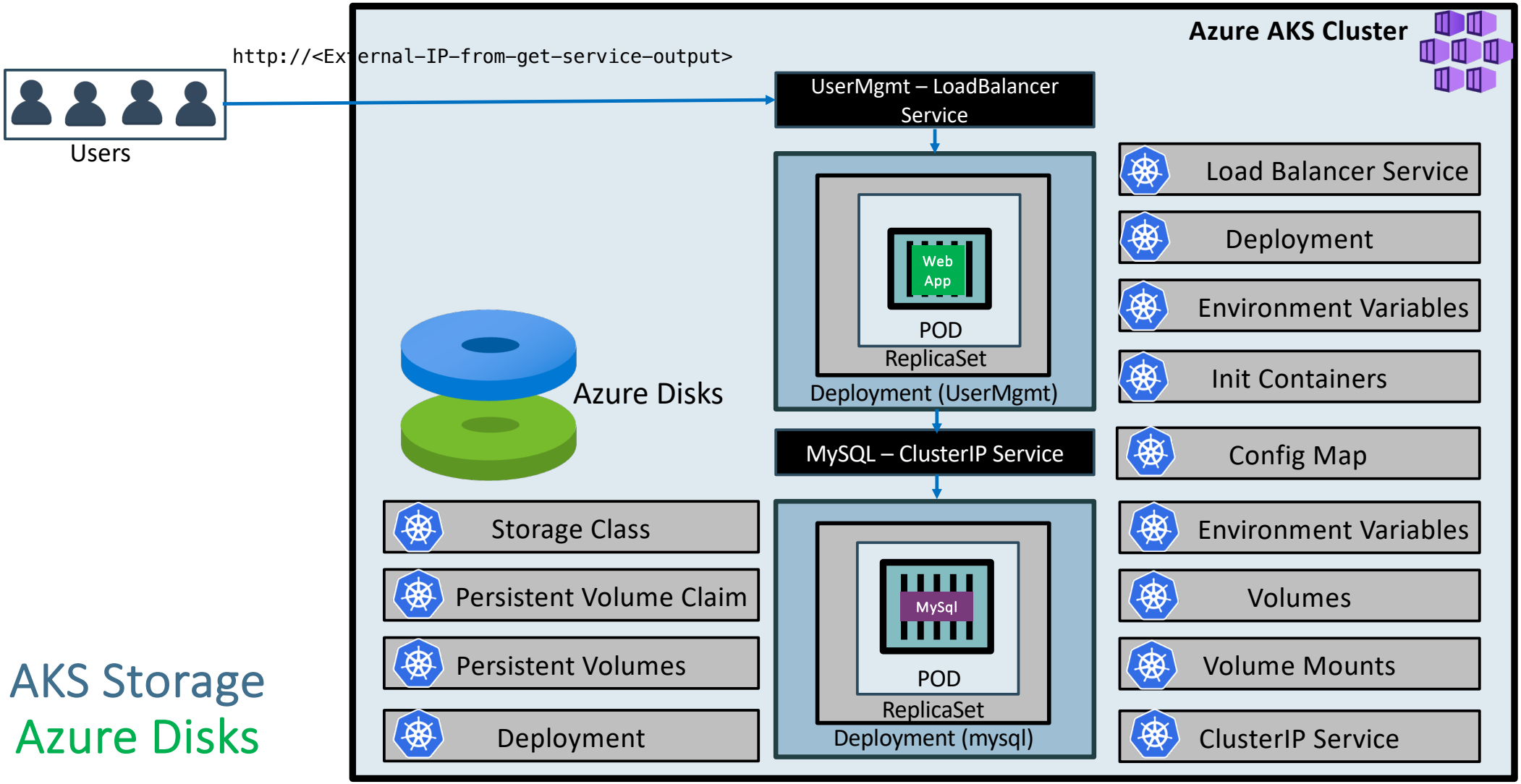
01-NginxApp1-Deployment.yml

githubcontent > azure-aks-kubernetes-masterclass > 17-Azure-Virtual-Nodes-for-AKS > kube-manifests > ! 01-NginxAp

```
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    name: app1-nginx-deployment
5    labels:
6      app: app1-nginx
7  spec:
8    replicas: 2
9    selector:
10     matchLabels:
11       app: app1-nginx
12   template:
13     metadata:
14       labels:
15         app: app1-nginx
16     spec:
17       containers:
18         - name: app1-nginx
19           image: stacksimplify/kube-nginxapp1:1.0.0
20           ports:
21             - containerPort: 80
22 # To schedule pods on Azure Virtual Nodes
23       nodeSelector:
24         kubernetes.io/role: agent
25         beta.kubernetes.io/os: linux
26         type: virtual-kubelet
27       tolerations:
28       - key: virtual-kubelet.io/provider
29         operator: Exists
30       - key: azure.com/aci
31         effect: NoSchedule
```

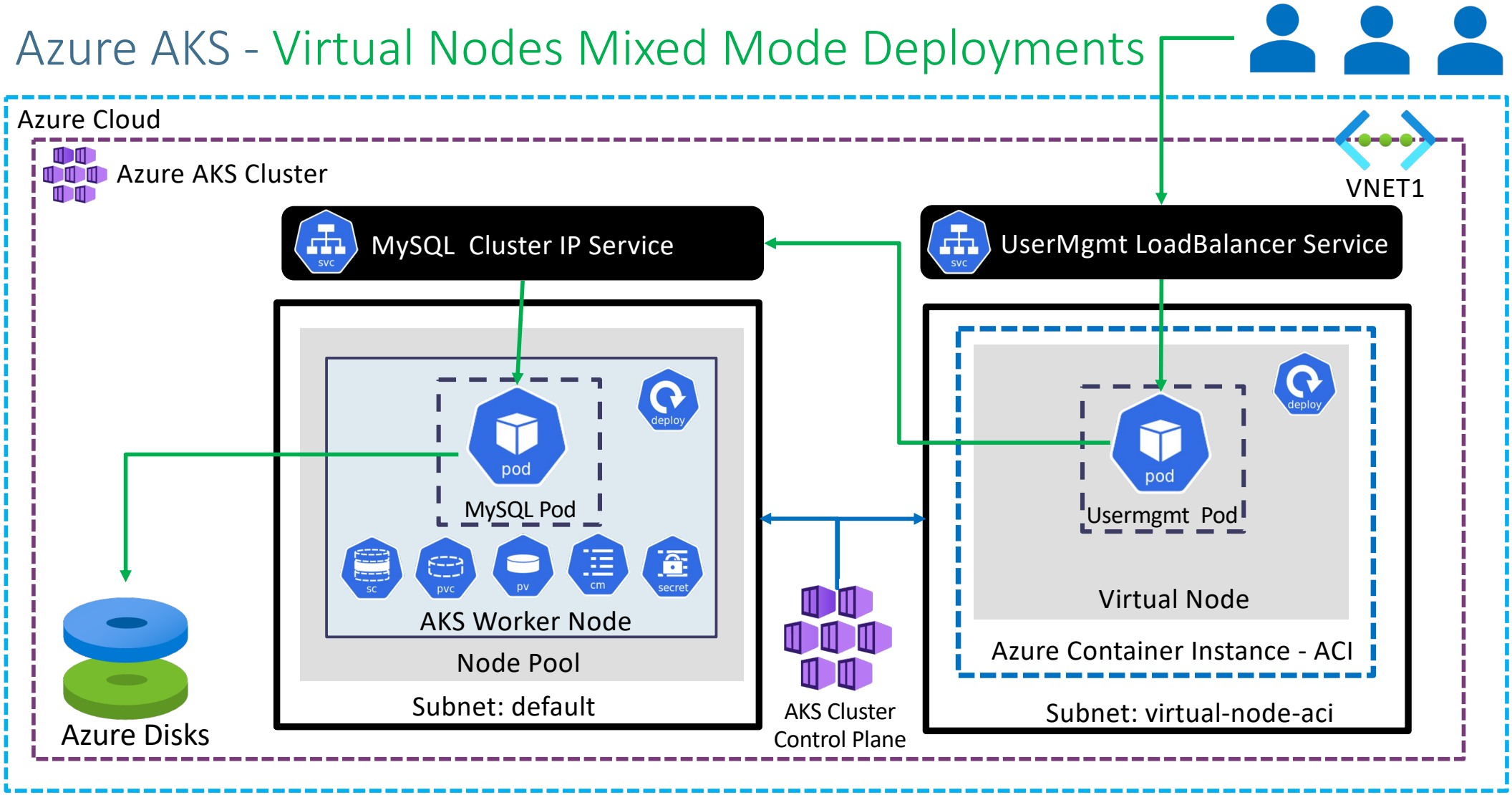


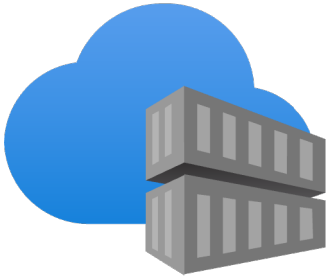
Azure AKS
Virtual Nodes
(Serverless)
Mixed Mode Deployments

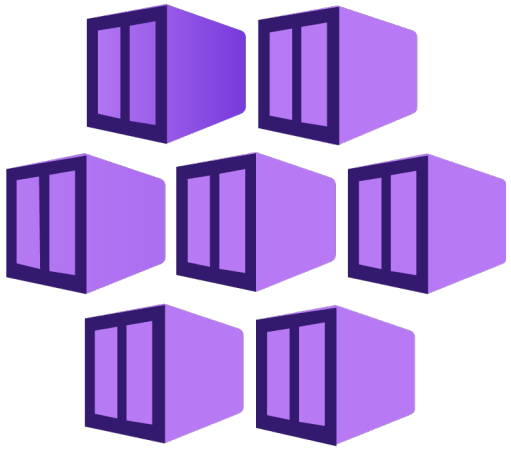


AKS Storage
Azure Disks

Azure AKS - Virtual Nodes Mixed Mode Deployments







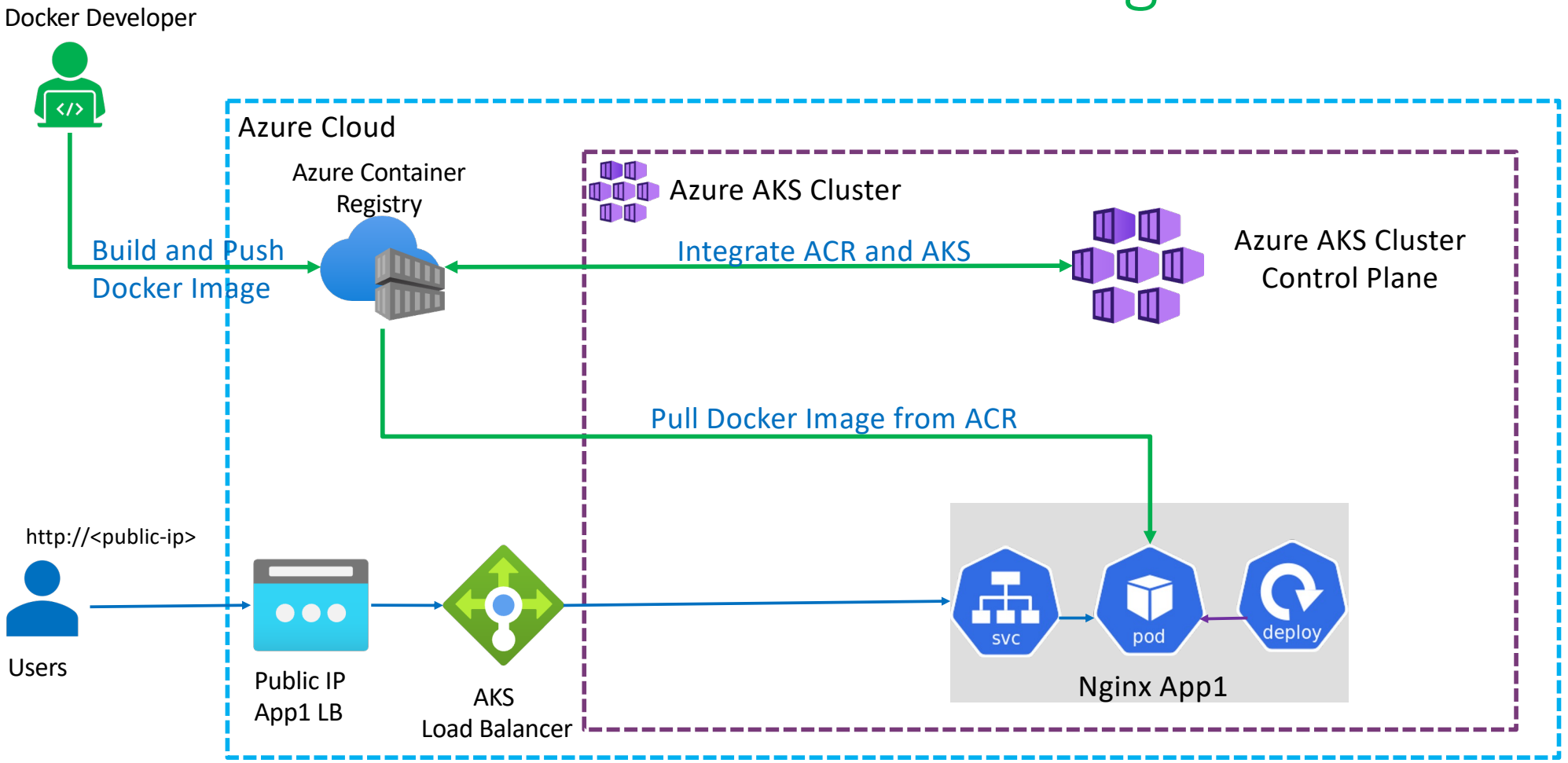
Azure AKS

Azure Container Registry (ACR)

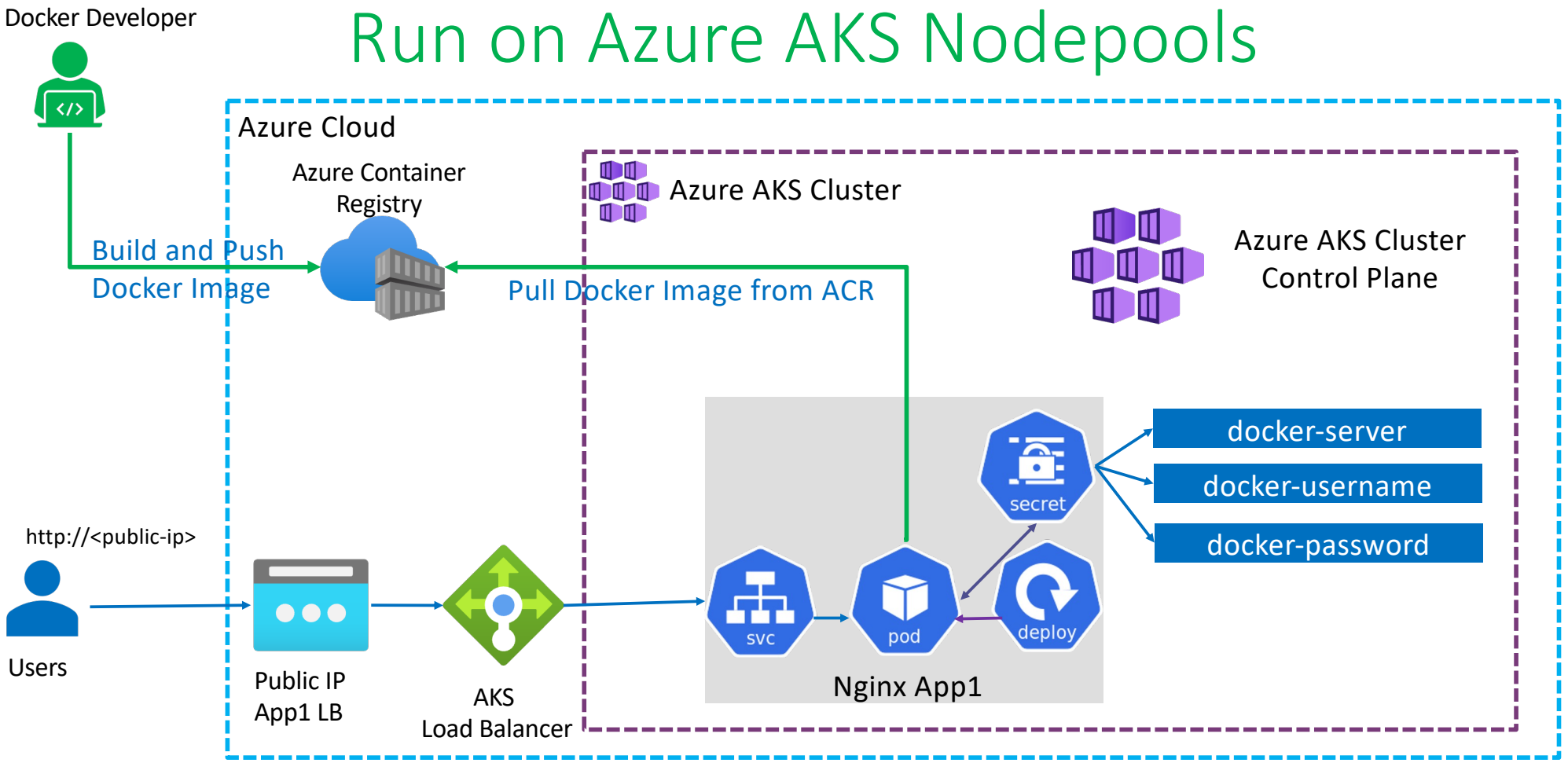
Azure Container Registry - Introduction

- Azure Container Registry is a managed, private Docker registry service
- We can create and maintain Azure container registries to store and manage our private Docker container images.
- With ACR, we can simplify our container lifecycle management.
- Geo-replication to efficiently manage a single registry across multiple regions
- Automated container building and patching including base image updates and task scheduling
- Integrated security with Azure Active Directory (Azure AD) authentication, role-based access control, Docker Content Trust and virtual network integration

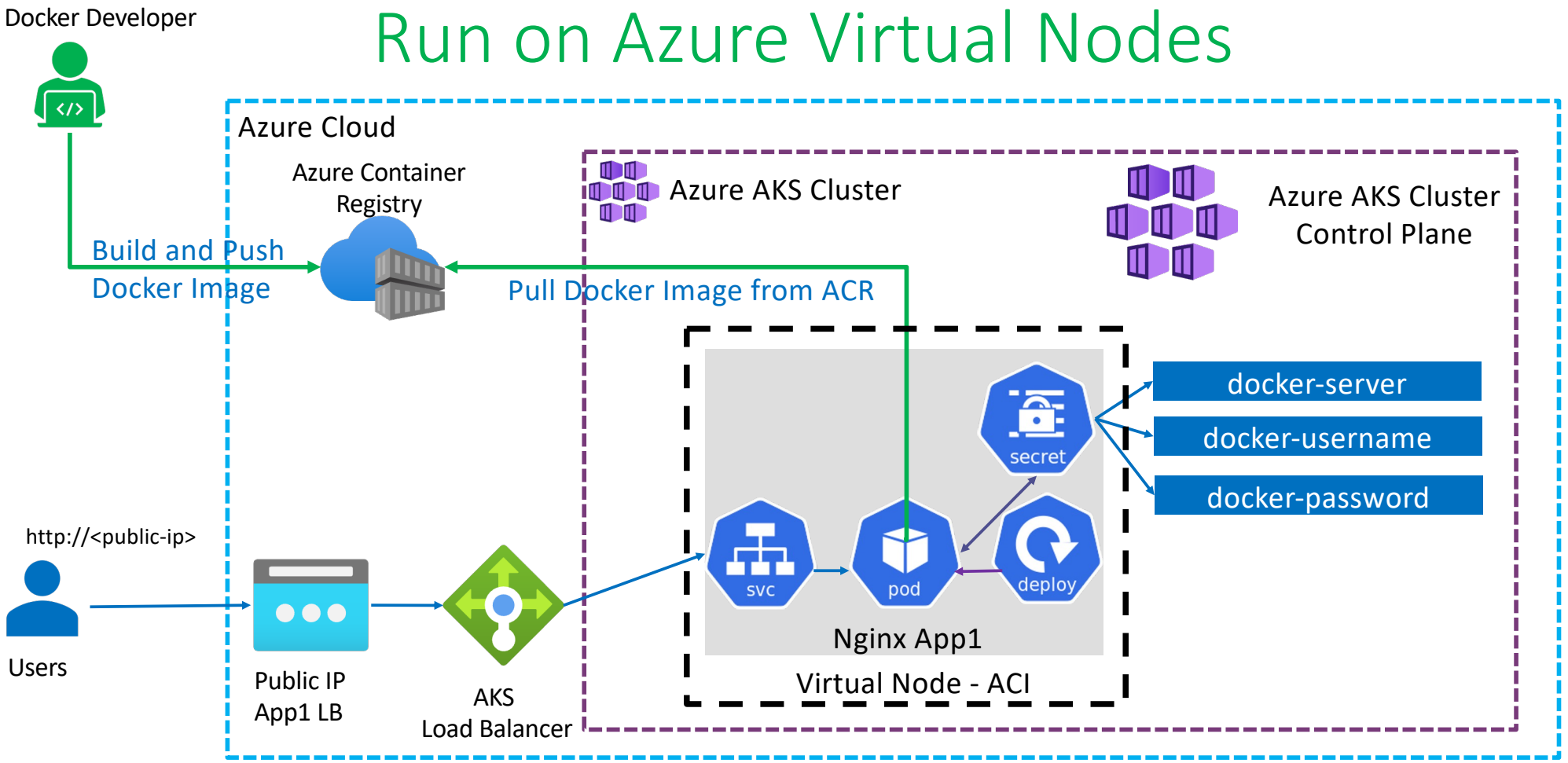
Azure ACR and AKS - Integration



Pull Docker Images from ACR using Service Principal Run on Azure AKS Nodepools



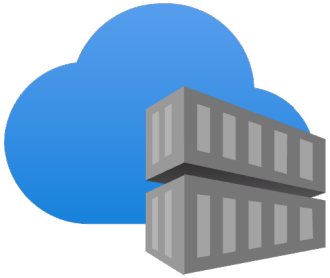
Pull Docker Images from ACR using Service Principal Run on Azure Virtual Nodes

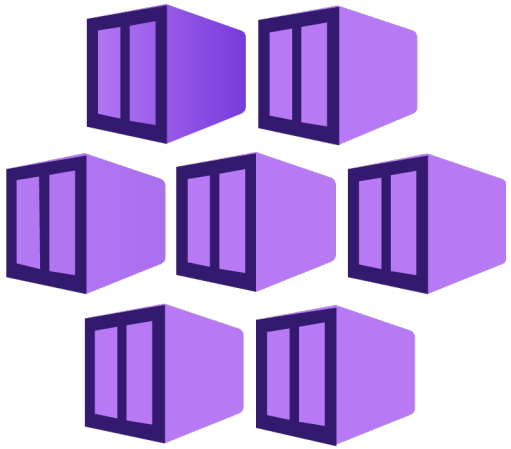


Azure Container Registry – Pricing Tiers

Basic	Standard	Premium
Enabled as Public Endpoint (Public Docker Registry)	Enabled as Public Endpoint (Public Docker Registry)	Enabled as Public & Private Endpoint (Private Docker Registry)
No Customer Managed Key for Encryption	No Customer Managed Key for Encryption	Can use Customer Managed Key for Encryption
Storage: 10GB (Max Up to 20TB)	Storage: 100GB (Max Up to 20TB)	Storage: 500GB (Max Up to 20TB)
No Geo Replication & Content Trust	No Geo Replication & Content Trust	Supports Geo Replication & Content Trust
Download Speed: 30MBps Upload Speed: 10MBps	Download Speed: 60MBps Upload Speed: 20MBps	Download Speed: 100MBps Upload Speed: 50MBps
$0.167 per day + Other Charges	$0.667 per day + Other Charges	$1.667 per day + Other Charges

Reference: https://docs.microsoft.com/en-us/azure/container-registry/container-registry-skus#service-tier-features-and-limits



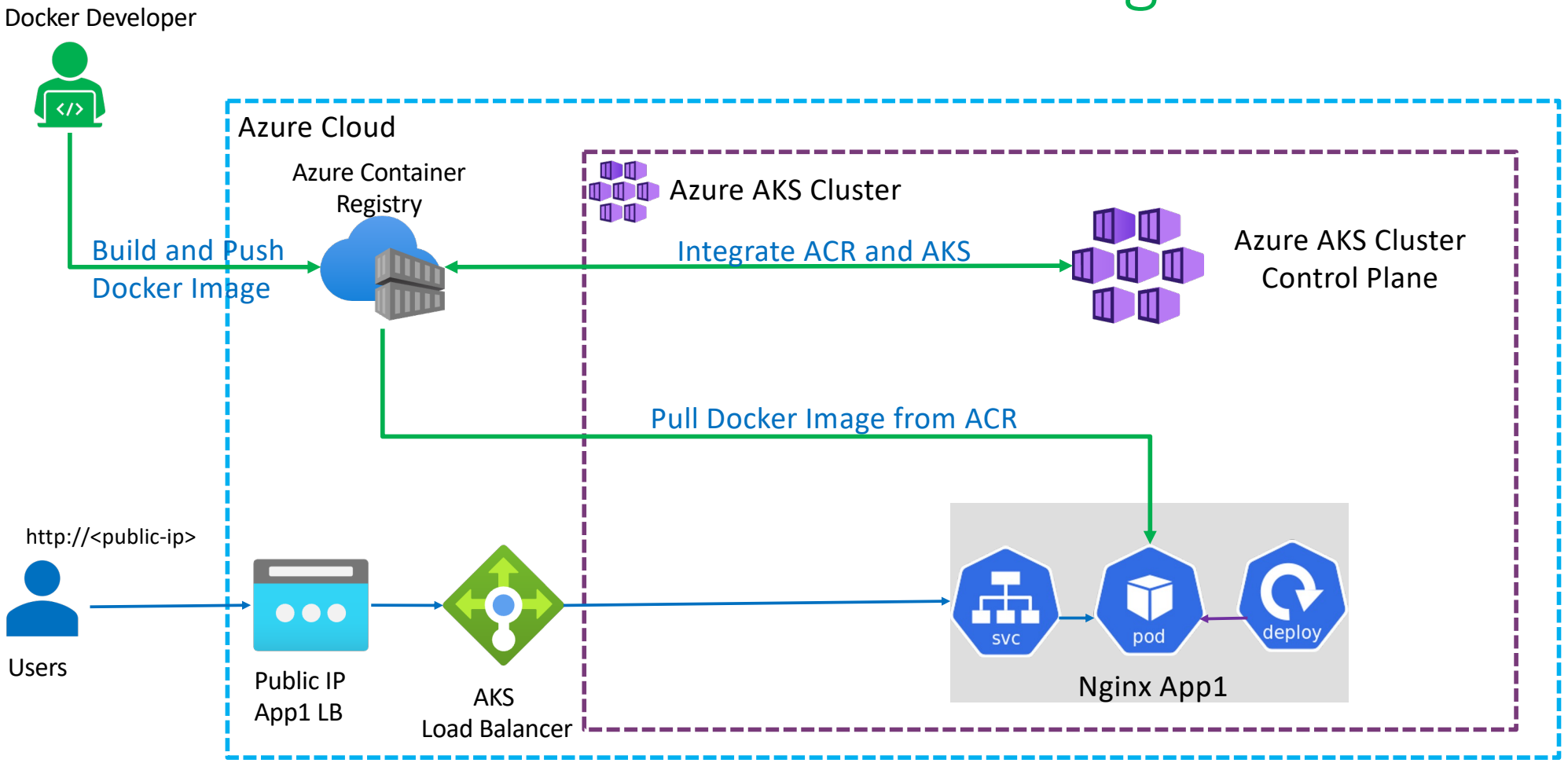


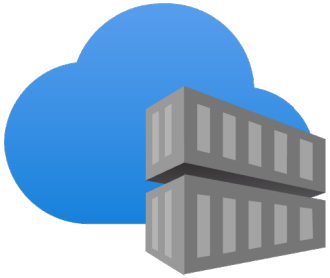
Azure AKS

Azure Container Registry (ACR)

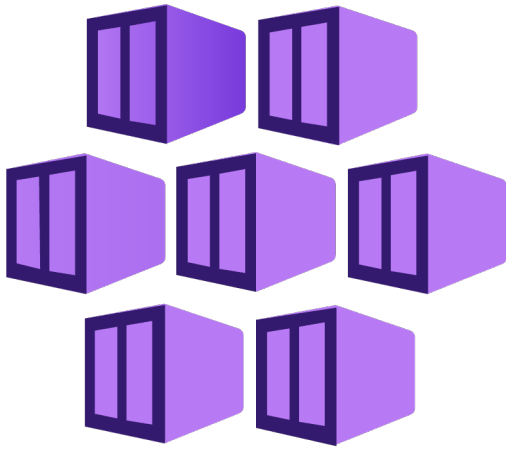
Integrate ACR & AKS

Azure ACR and AKS - Integration





Run
AKS Node
Pools

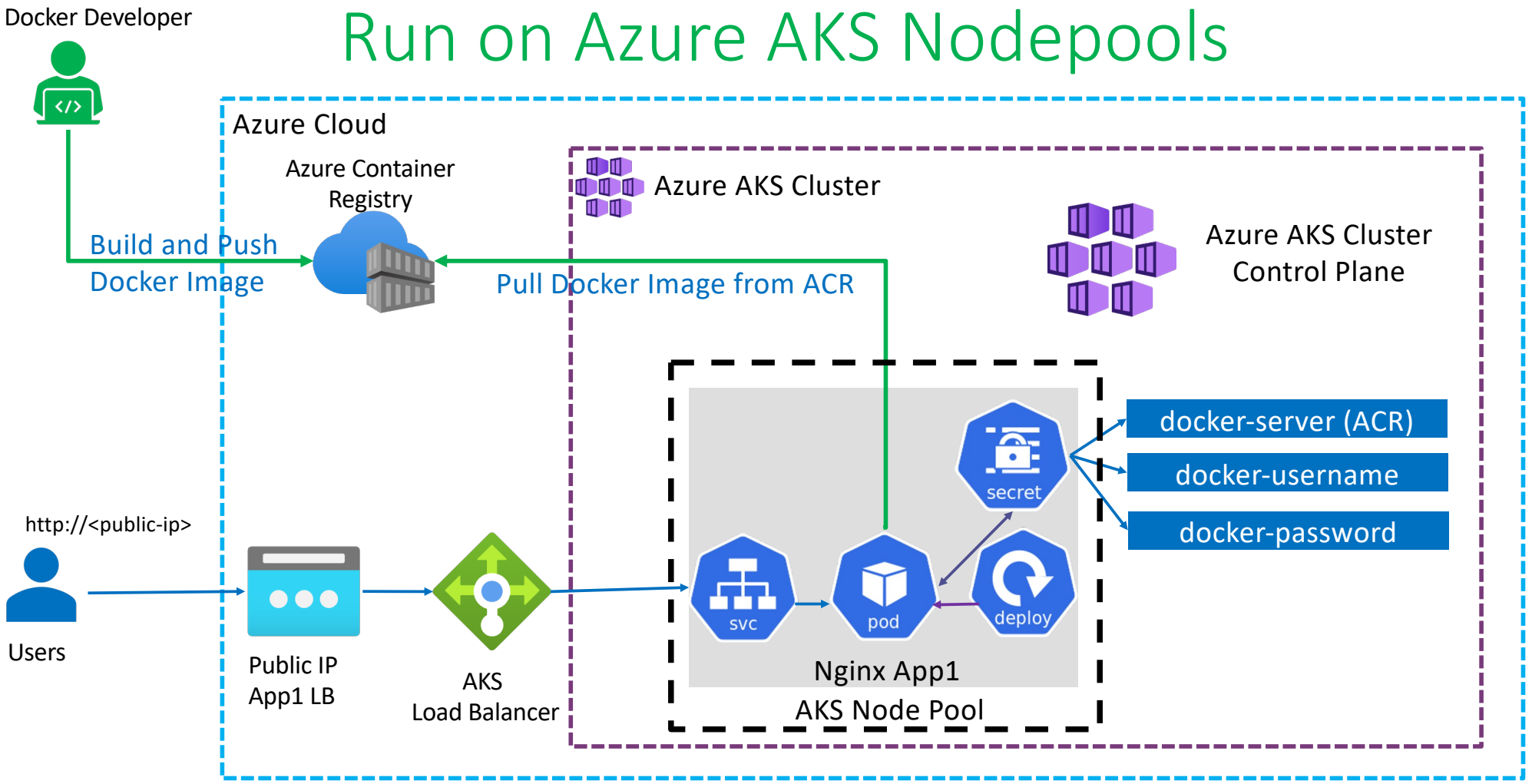


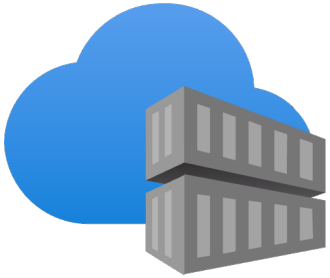
Azure AKS

Azure Container Registry (ACR)

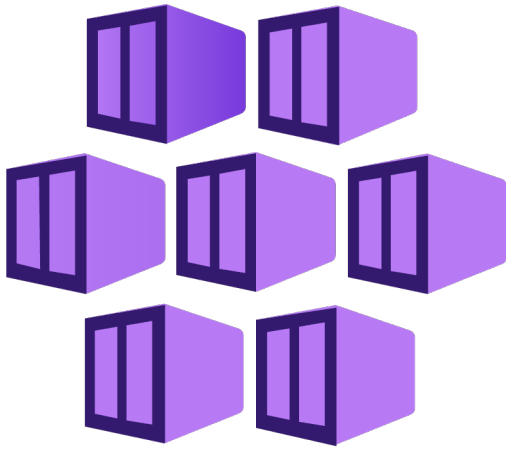
Pull Images from ACR using Service Principal

Pull Docker Images from ACR using Service Principal Run on Azure AKS Nodepools





Schedule on AKS Virtual Nodes

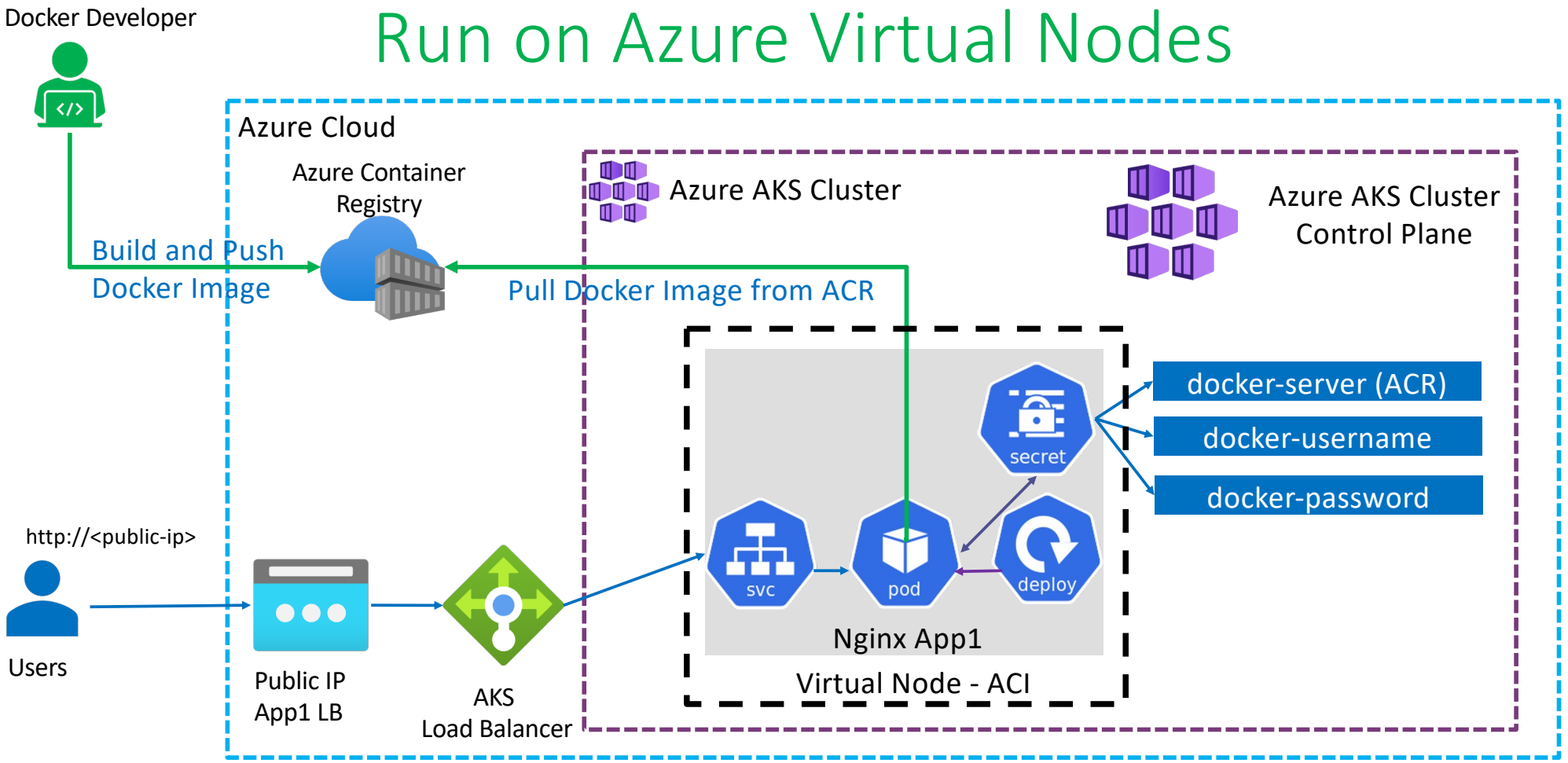


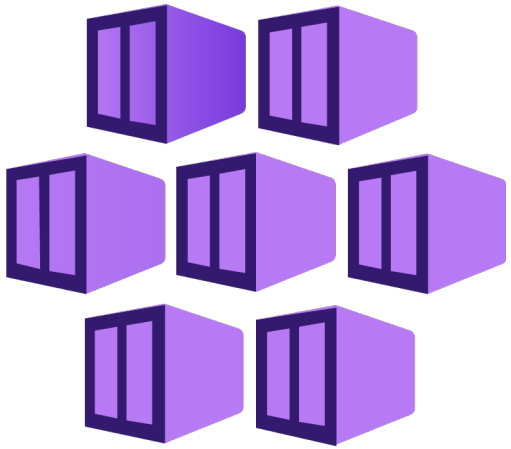
Azure AKS

Azure Container Registry (ACR)

Pull Images from ACR using Service Principal

Pull Docker Images from ACR using Service Principal Run on Azure Virtual Nodes





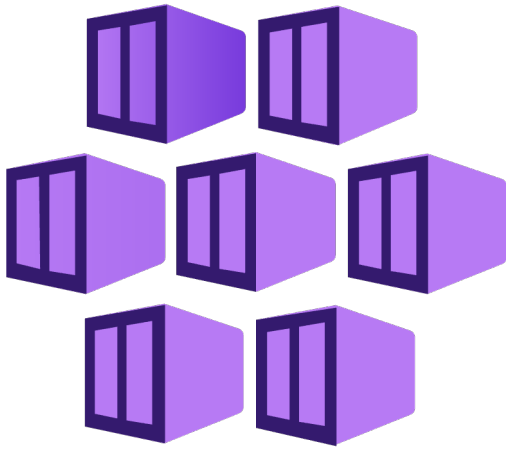
Azure AKS
Azure DevOps
Introduction

Github

Azure
DevOps

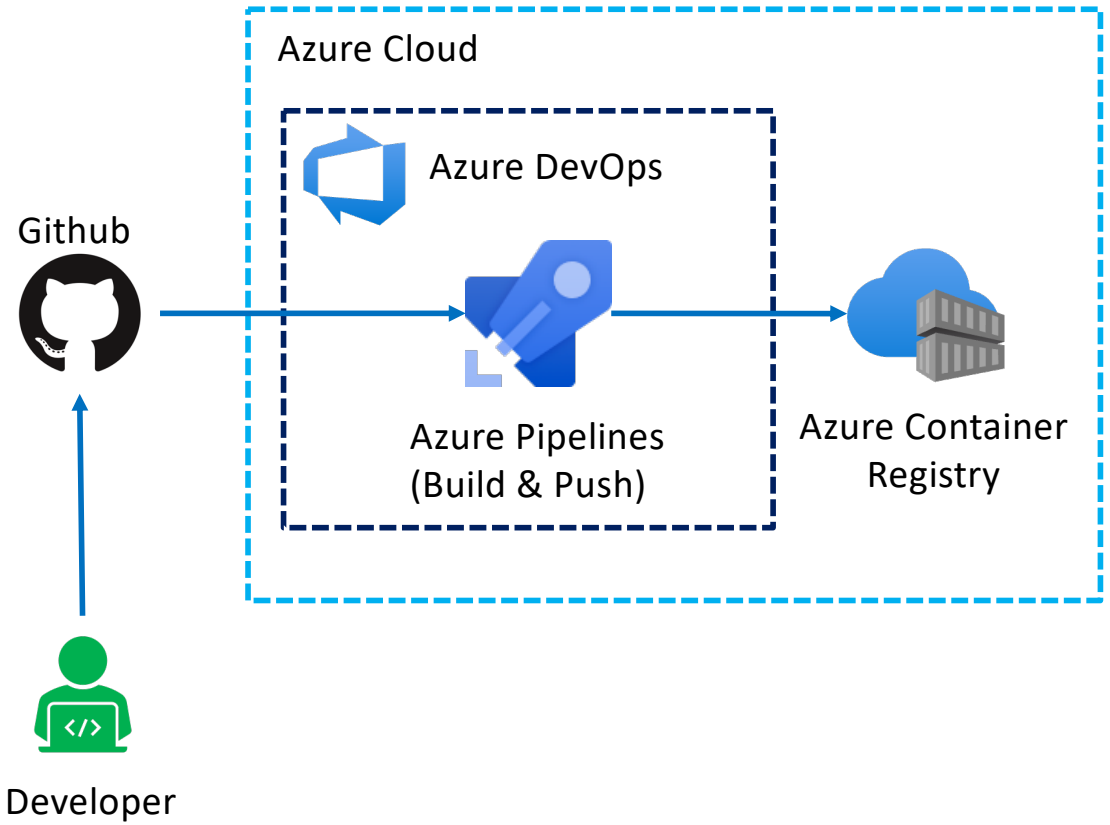
Azure
Pipelines

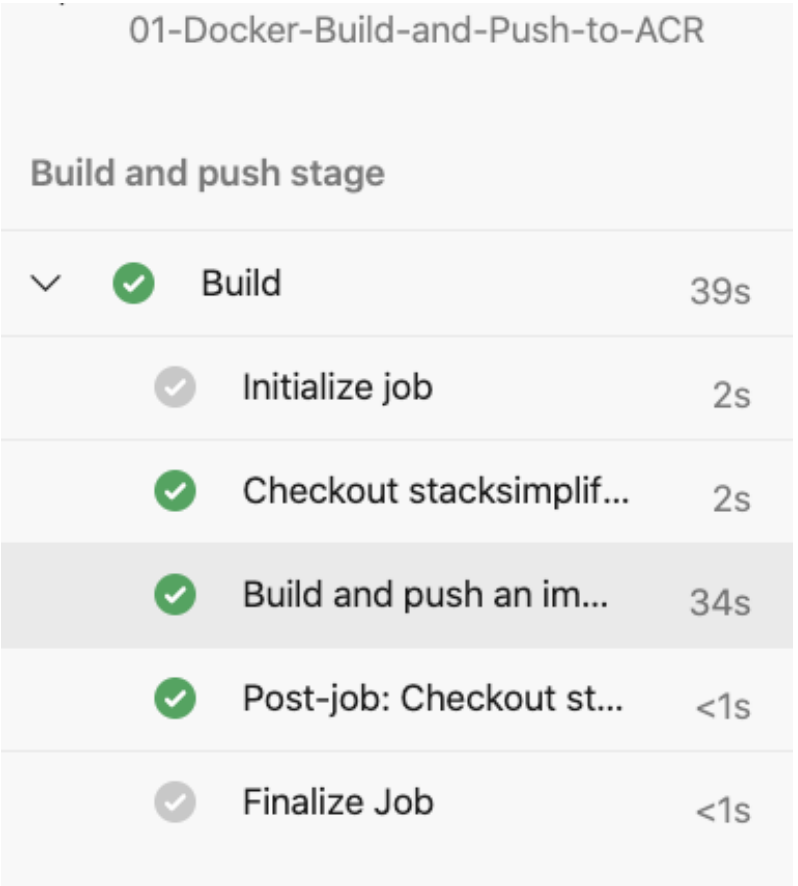
Azure
Container Registry



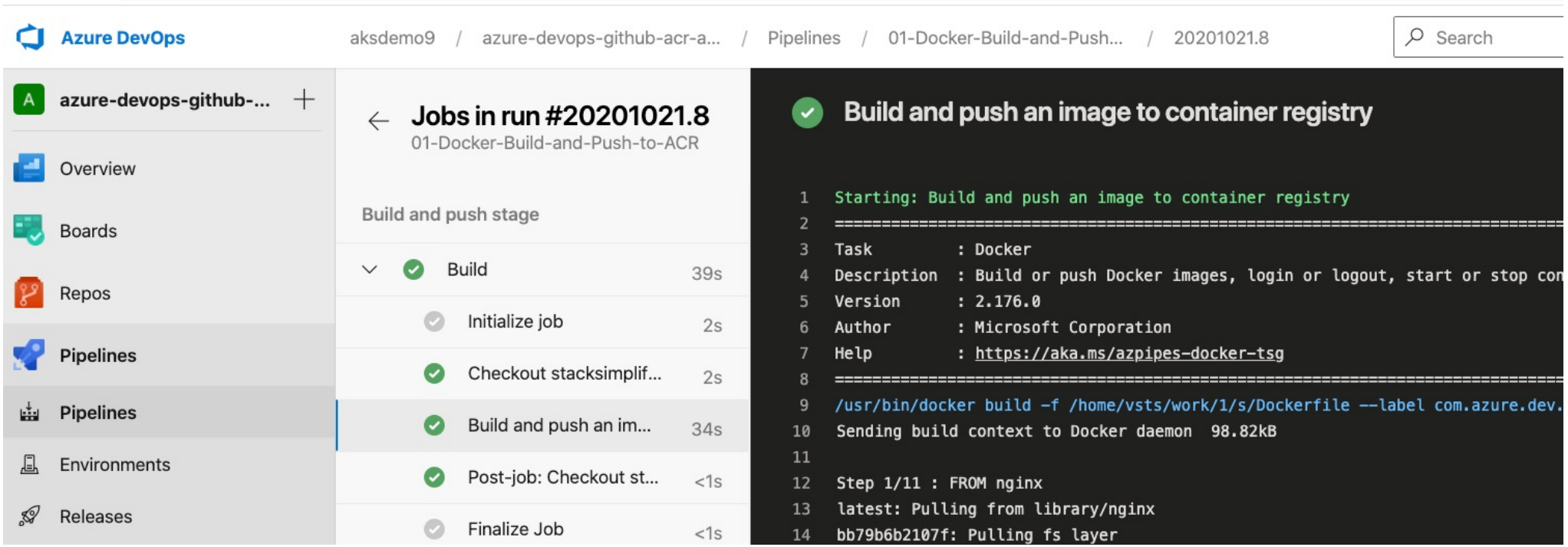
Azure AKS
Azure DevOps
Build & Push
Docker Image to ACR

Azure DevOps Pipelines – Build & Push Docker Image to ACR





Azure DevOps Pipelines – Build & Push Docker Image to ACR

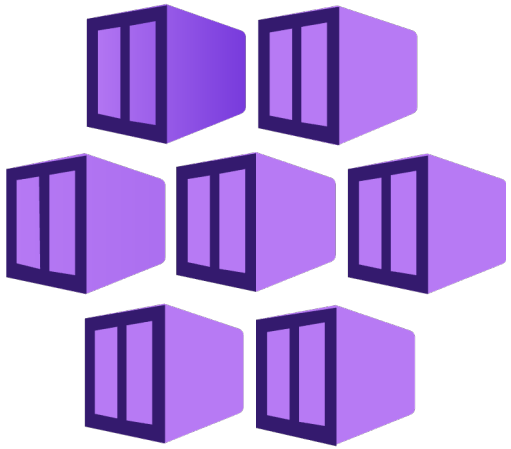


Github

Azure
DevOps

Azure
Pipelines

Azure
Container Registry



Azure AKS

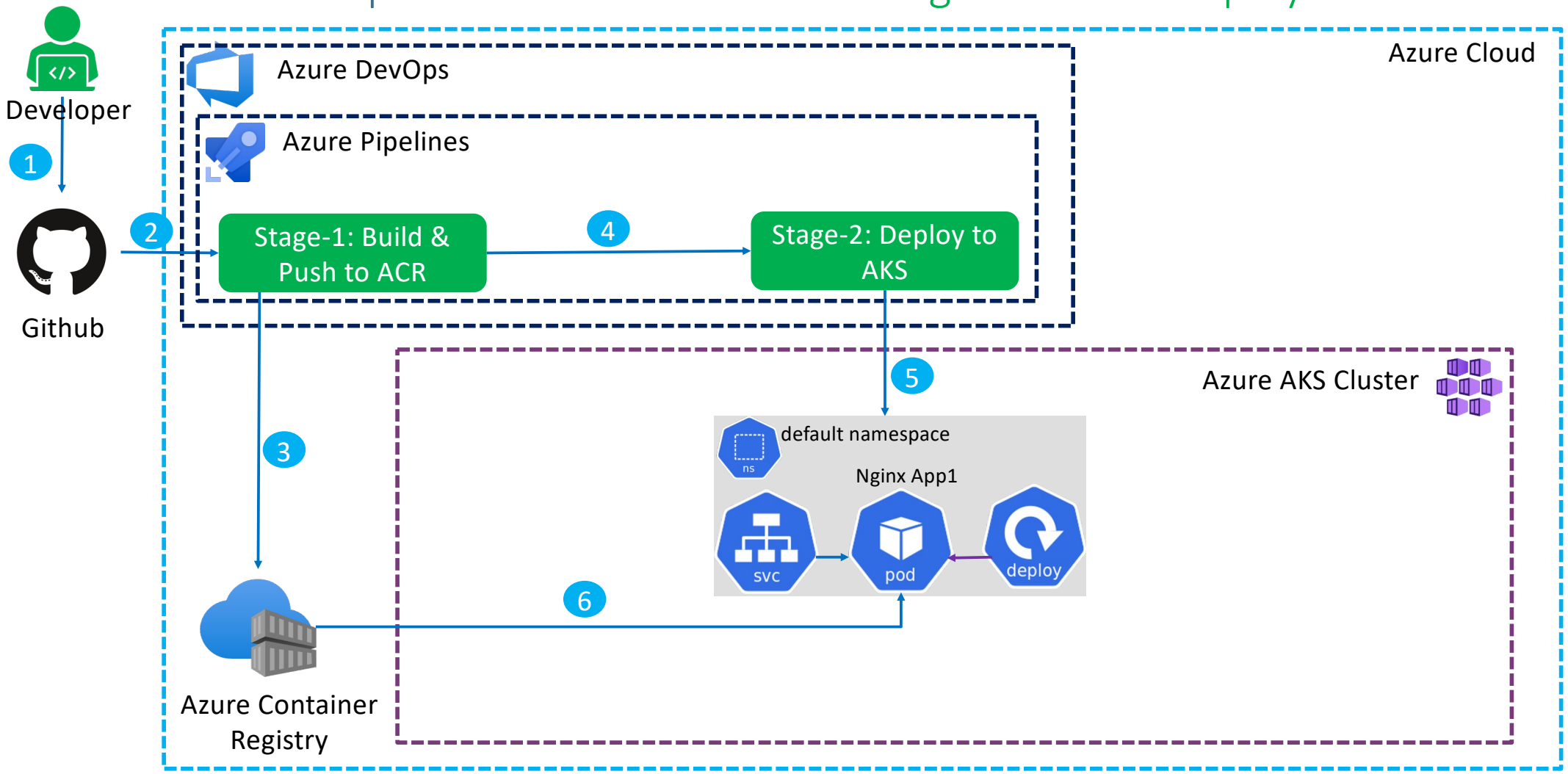
Azure DevOps

Build & Push

Docker Image to ACR

Deploy to AKS

Azure DevOps – Build & Push Docker Image to ACR & Deploy to AKS

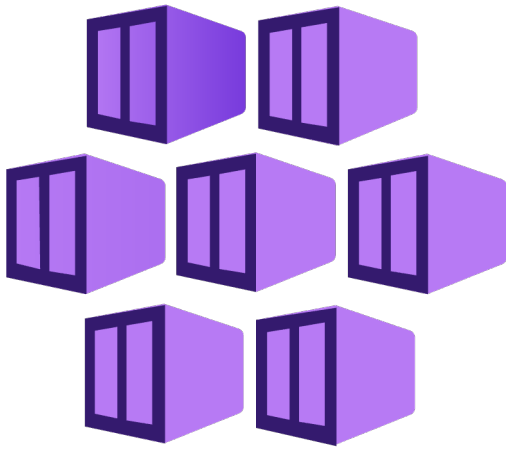


Github

Azure
DevOps

Azure
Pipelines

Azure
Container Registry



Azure AKS

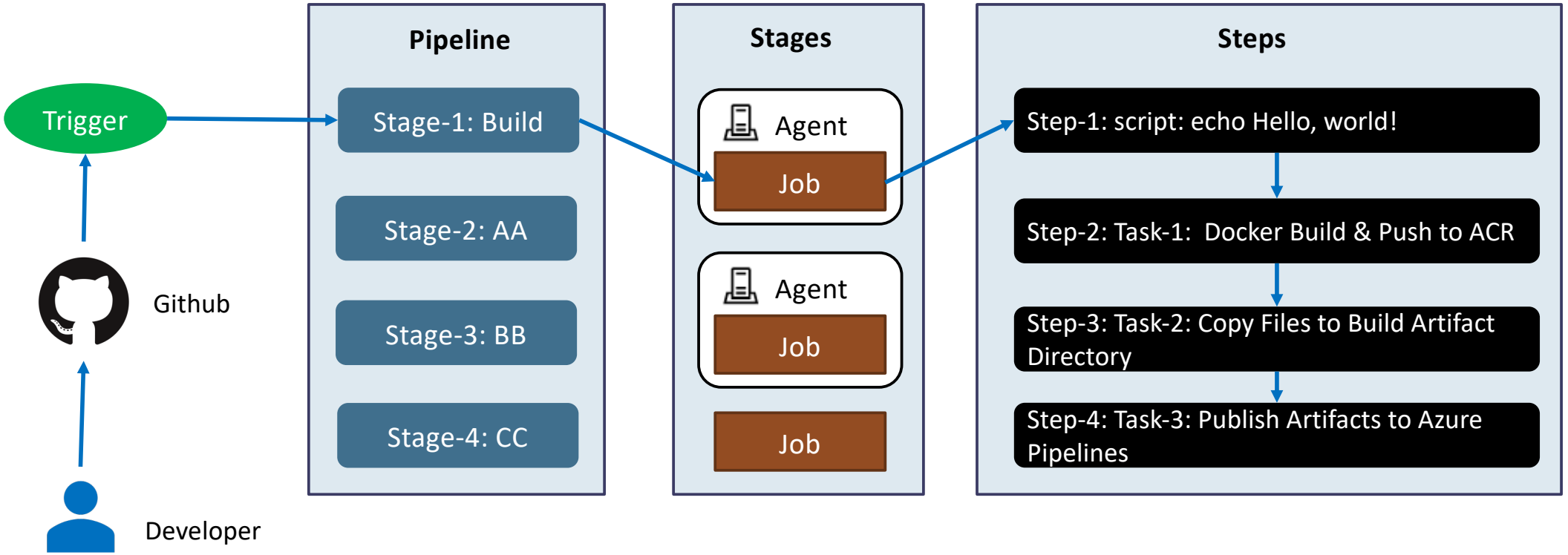
Azure DevOps

Build & Push

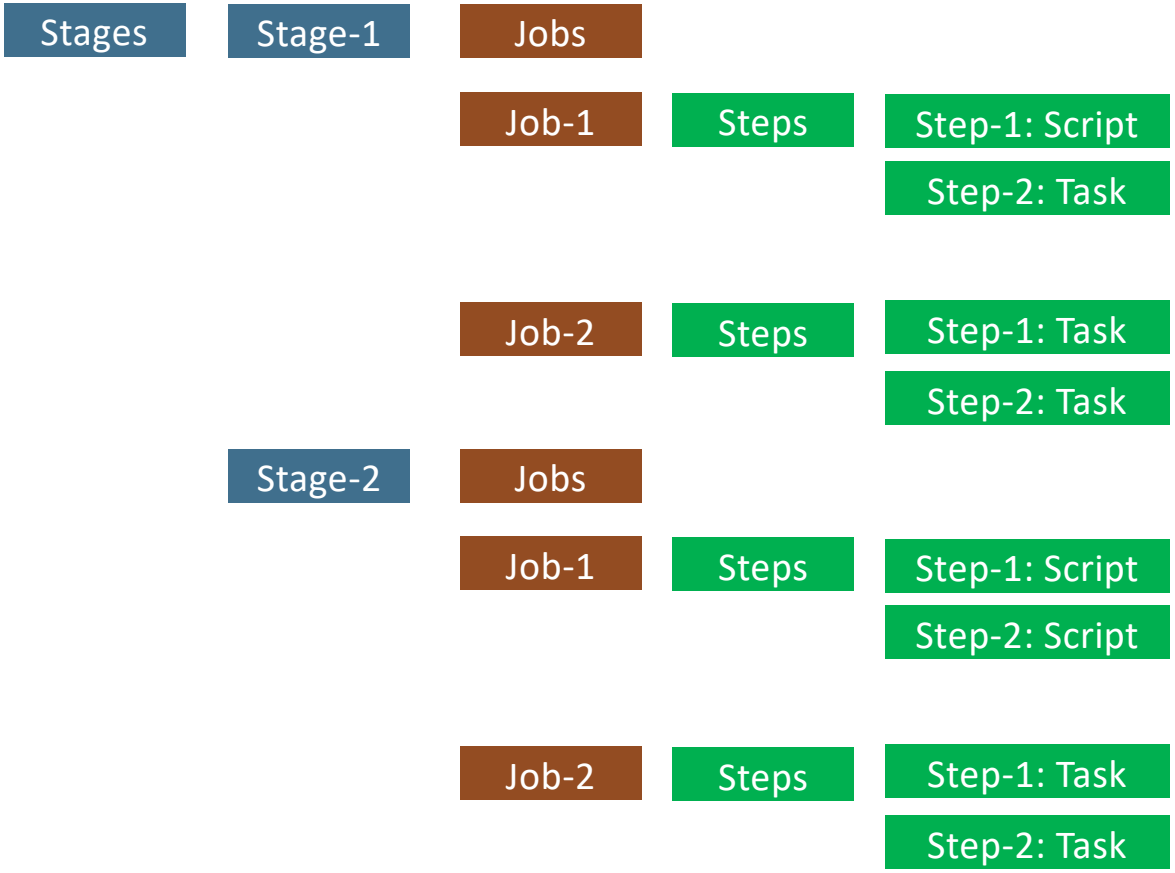
Docker Image to ACR, Publish Artifacts

STARTER PIPELINE

Azure Pipelines – Key Concepts



Azure Pipelines – Key Concepts




```yaml
stages:
- stage: Stage-1
  jobs:
  - job: Job-1
    steps:
    - script: echo Step-1
    - script: echo Step-2
  - job: Job-2
    steps:
    - task: some task step-1
    - task: some task step-2
- stage: Stage-2
  jobs:
  - job: Job-1
    steps:
    - task: some task step-1
    - task: some task step-2
  - job: Job-2
    steps:
    - script: echo Step-1
    - script: echo Step-2
```

Azure Pipelines – Starter Pipeline

Goal	Create a Pipeline that will build docker images, push them to Azure Container Registry and Publish Kubernetes Manifests to Azure Pipelines

Part-1	Semi Customized
Task-1	Use pre-defined Docker Build & Push Pipeline
Task-2	Customize Pipeline to Use Copy Files Task
Task-3	Customize Pipeline to Use Publish Build Artifacts Task

Part-2	Fully Customized using Starter Pipeline
Task-1	Start using Starter pipeline and use Docker Build or Push Docker Images Task
Task-2	Customize Pipeline to Use Copy Files Task
Task-3	Customize Pipeline to Use Publish Build Artifacts Task

Azure DevOps – Build Pipeline

Task-1	Docker Image Build and Push to Azure Container Registry
Task-2	Copy files (kube-manifests folder) from System default working Directory to Build Artifact Directory
Task-3	Publish Build Artifacts to Azure Pipelines, so that we can use them in Release Pipelines

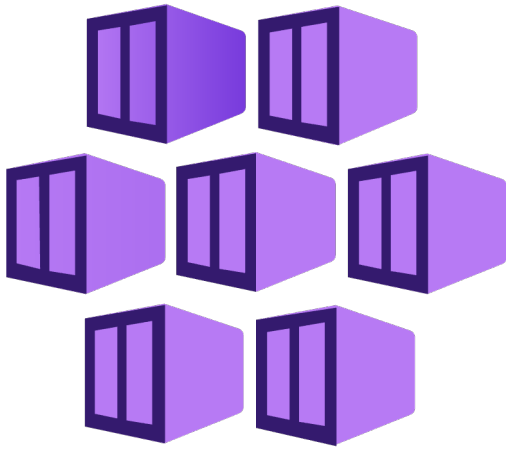
Github

Azure
DevOps

Azure
Pipelines

Azure
Container Registry

Azure
Release Pipelines



Azure AKS

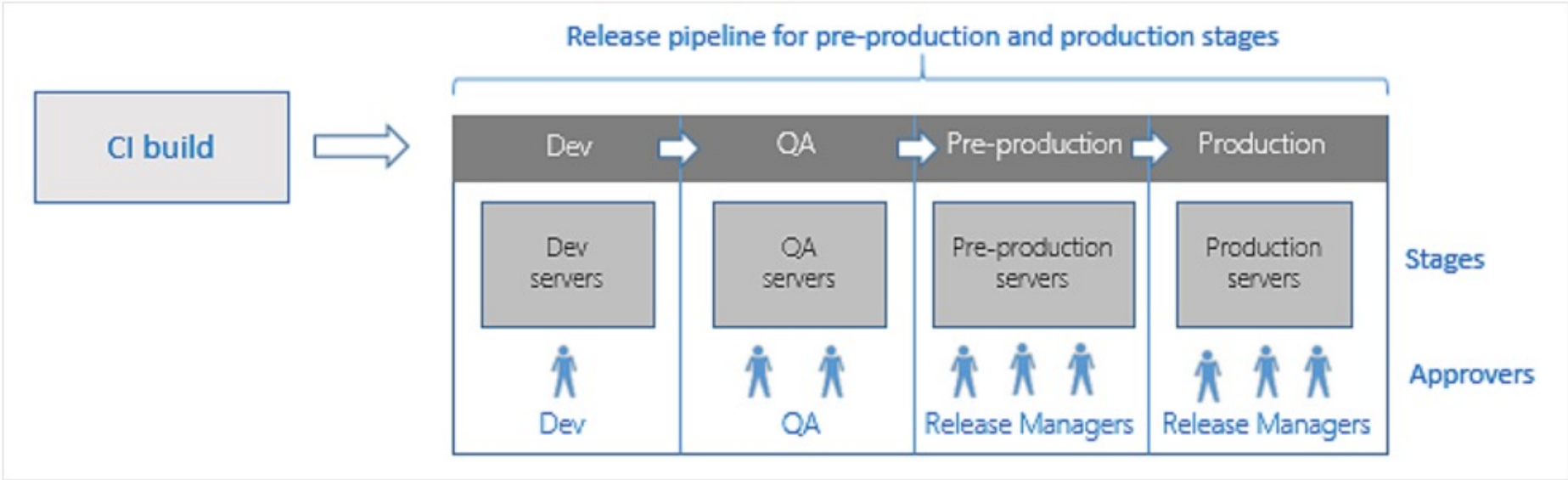
Azure DevOps

Release Pipelines

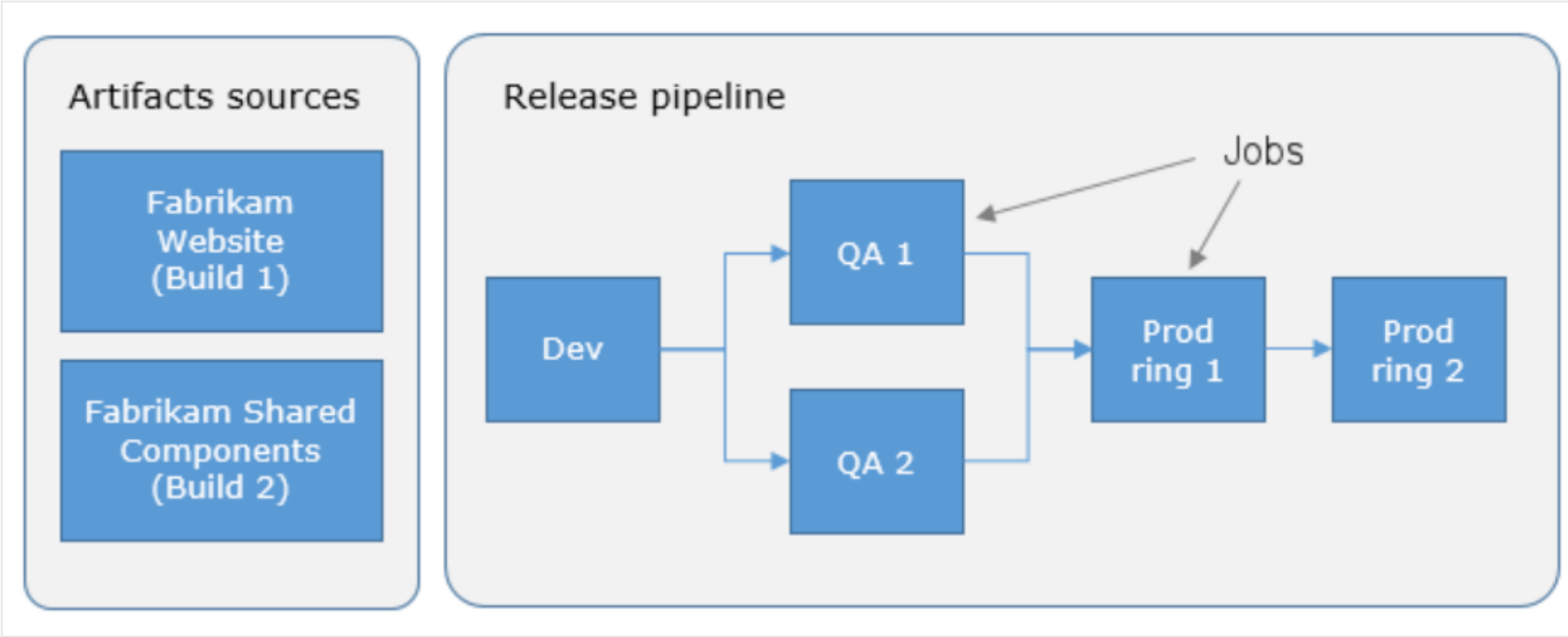
Continuous Delivery

Azure DevOps – Release Pipelines

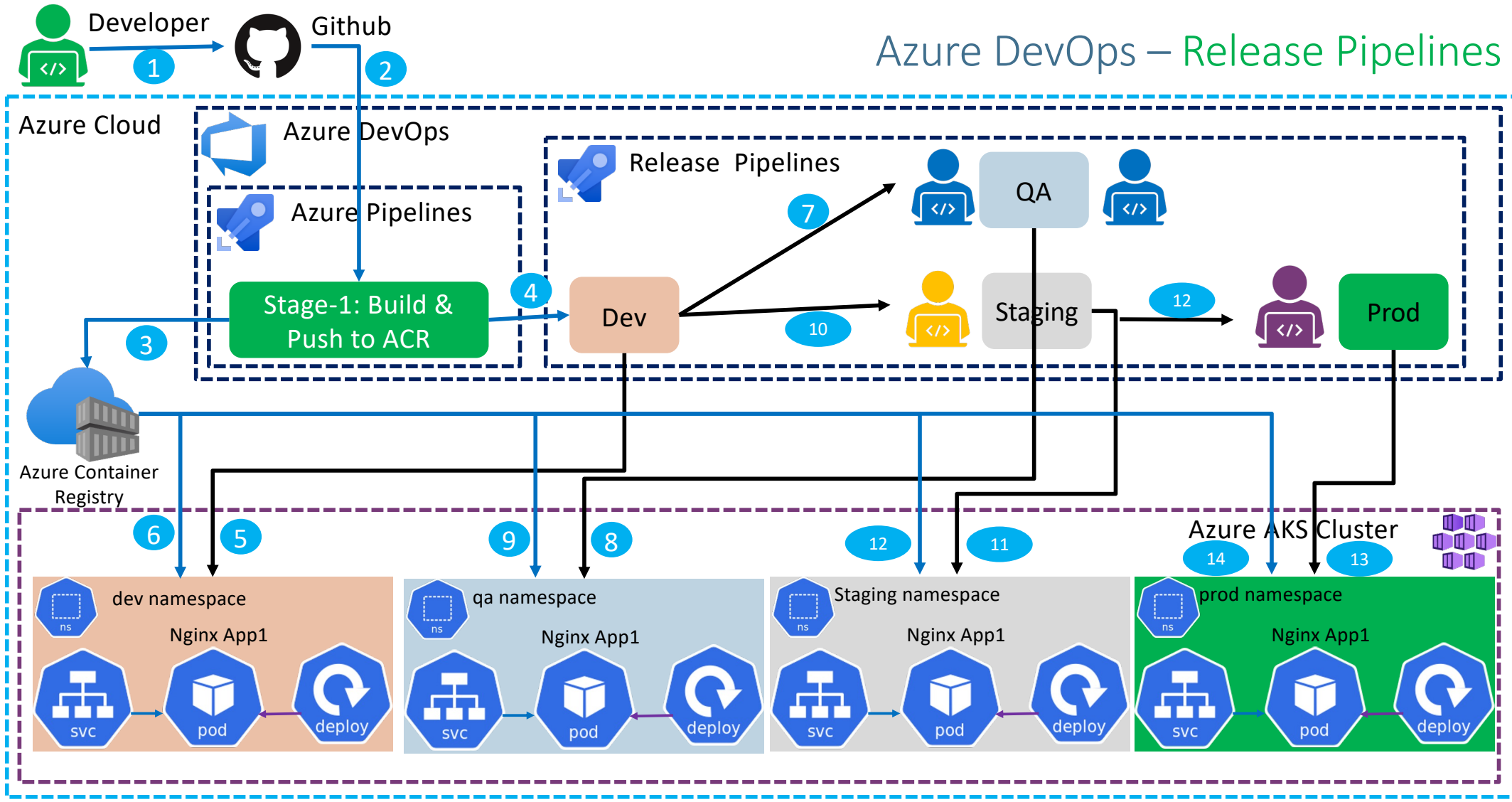
To achieve Continuous Delivery we use Release Pipelines



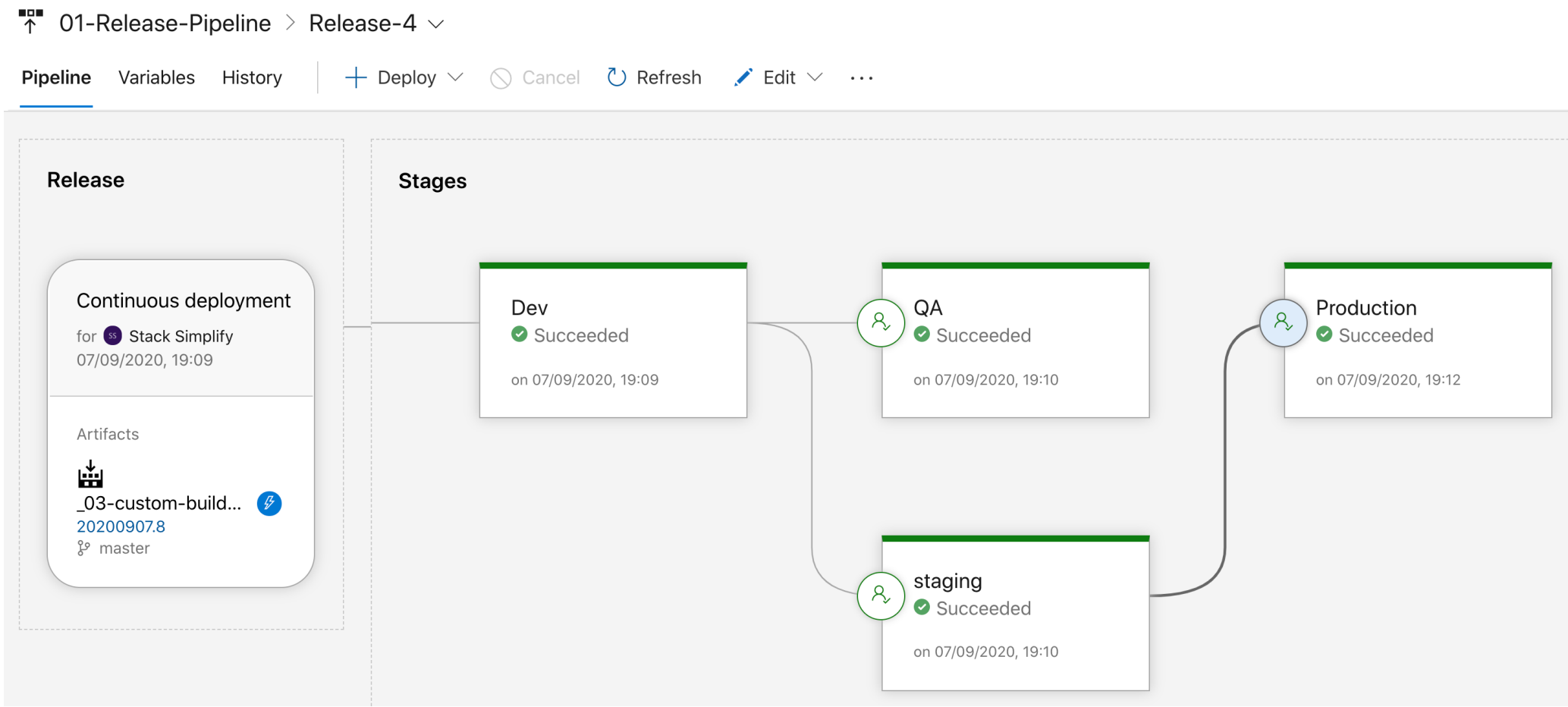
Azure DevOps – Release Pipelines



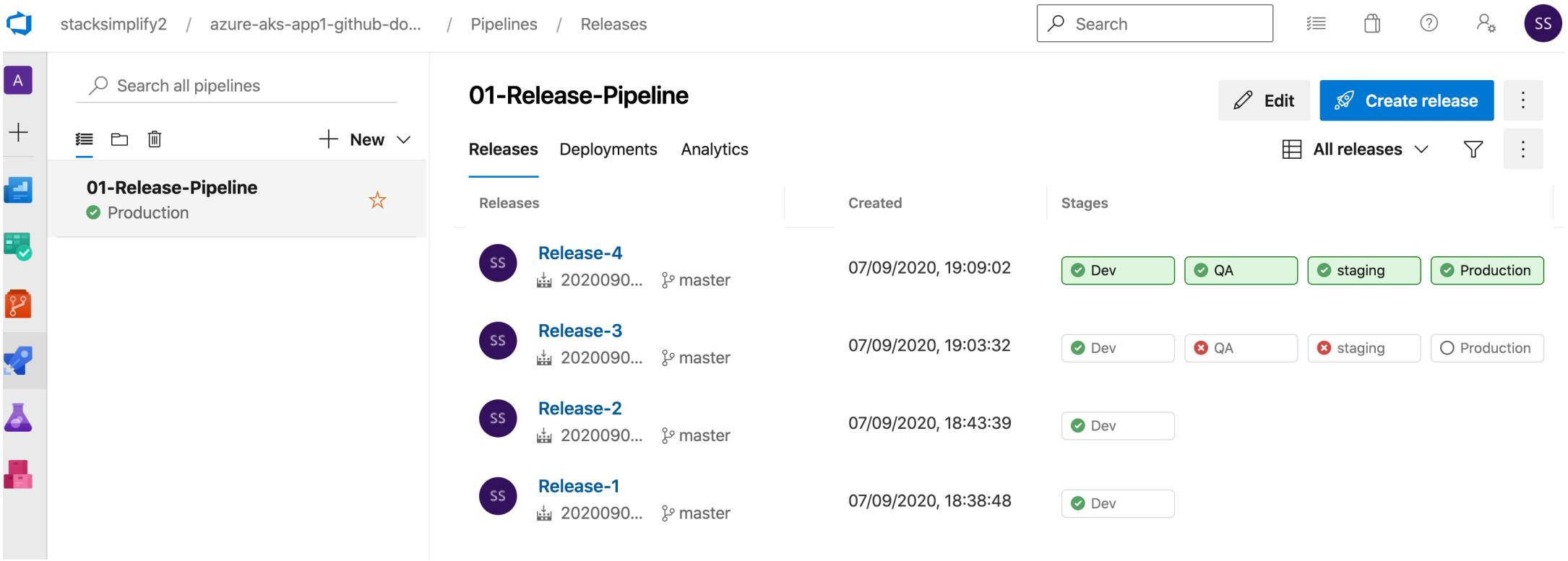
Azure DevOps – Release Pipelines



Azure Release Pipelines



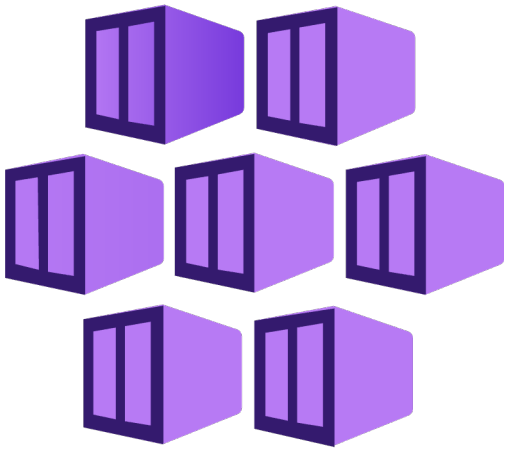
Azure Release Pipelines - Releases



DNS Zones

Managed Service Identity

AKS Addon

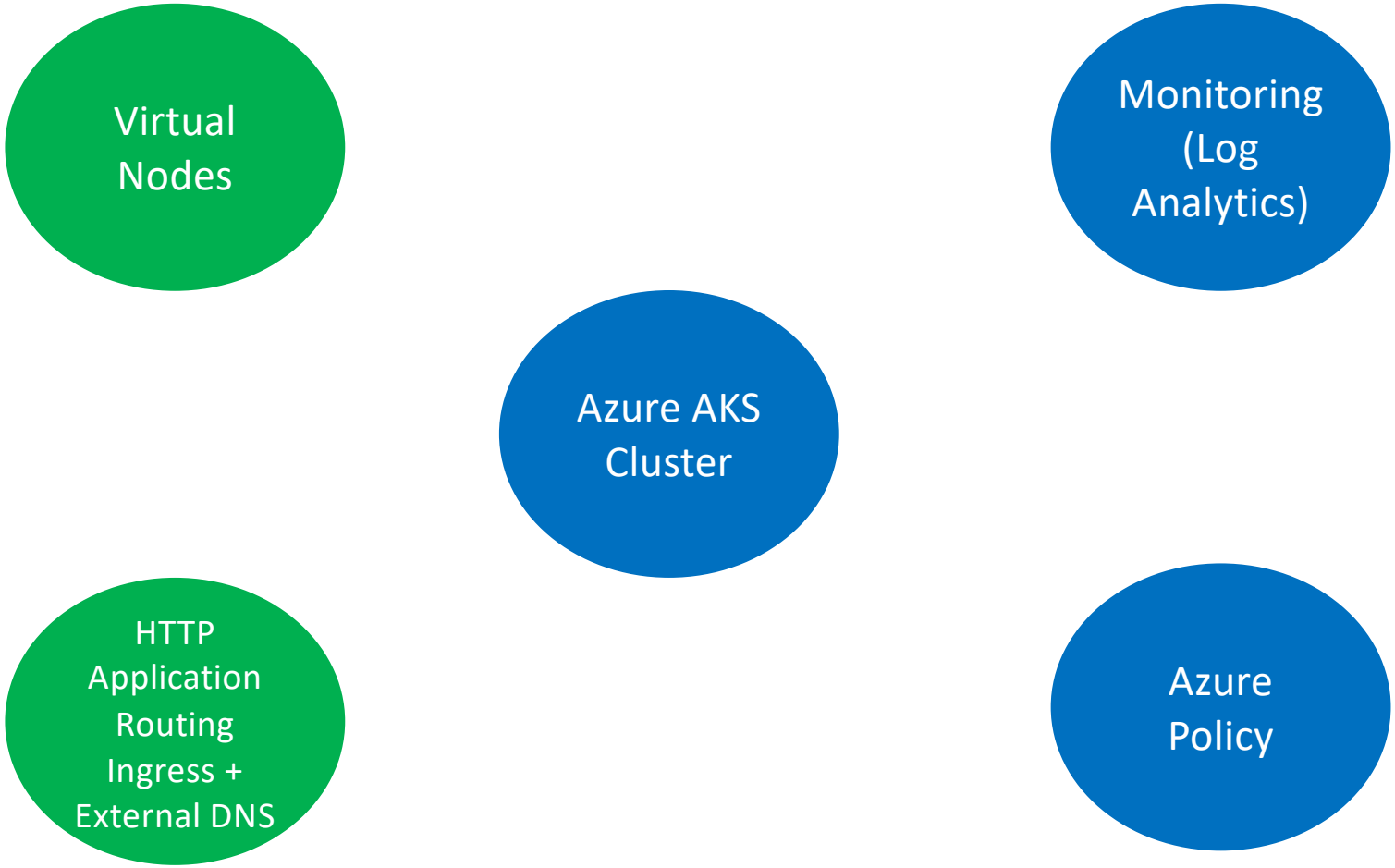


Azure AKS

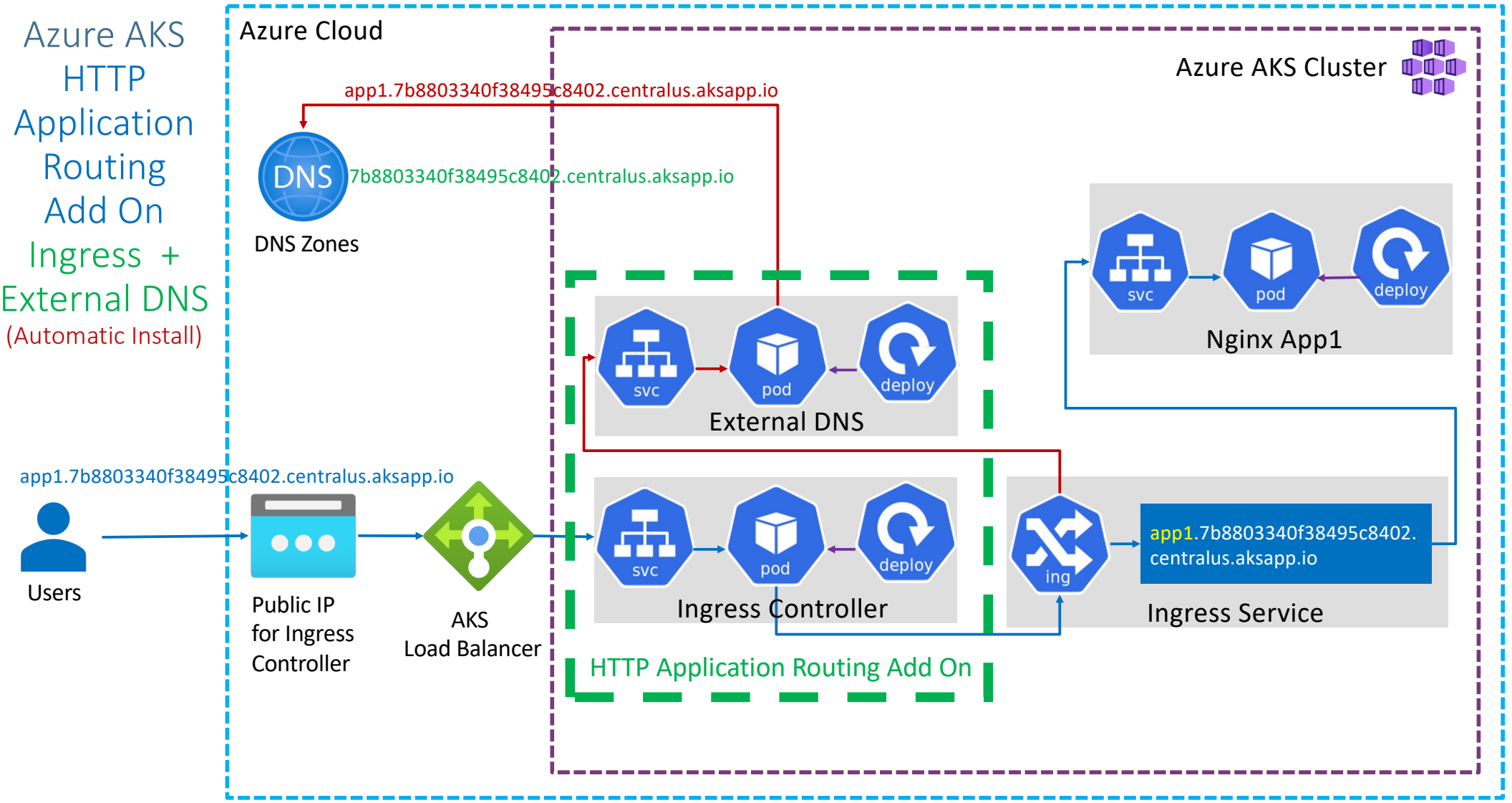
HTTP Application Routing Add On

Ingress Controller + External DNS

Azure AKS - Addons



Azure AKS HTTP Application Routing Add On Ingress + External DNS (Automatic Install)

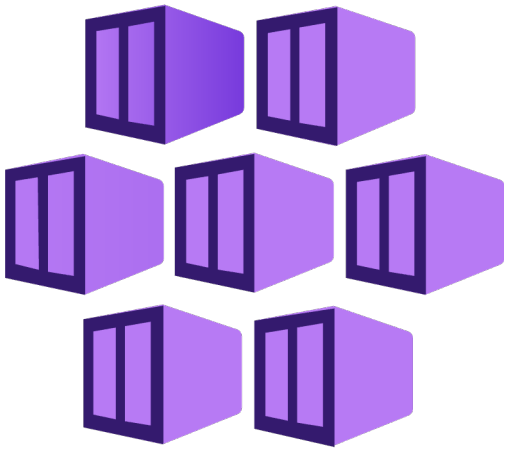


Ingress with External DNS

This annotation will ensure the ingress service we are creating will be part Ingress Controller created using HTTP Application Routing Add On

This will help us to add DNS Record Set in Azure DNS Zones using k8s External DNS

```yaml
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
  name: ingress-demo
  annotations:
    kubernetes.io/ingress.class: addon-http-application-routing
spec:
  rules:
  - host: app1.7b8803340f38495c8402.centralus.aksapp.io
    http:
      paths:
      - path: /
        backend:
          serviceName: app1-nginx-clusterip-service
          servicePort: 80
```

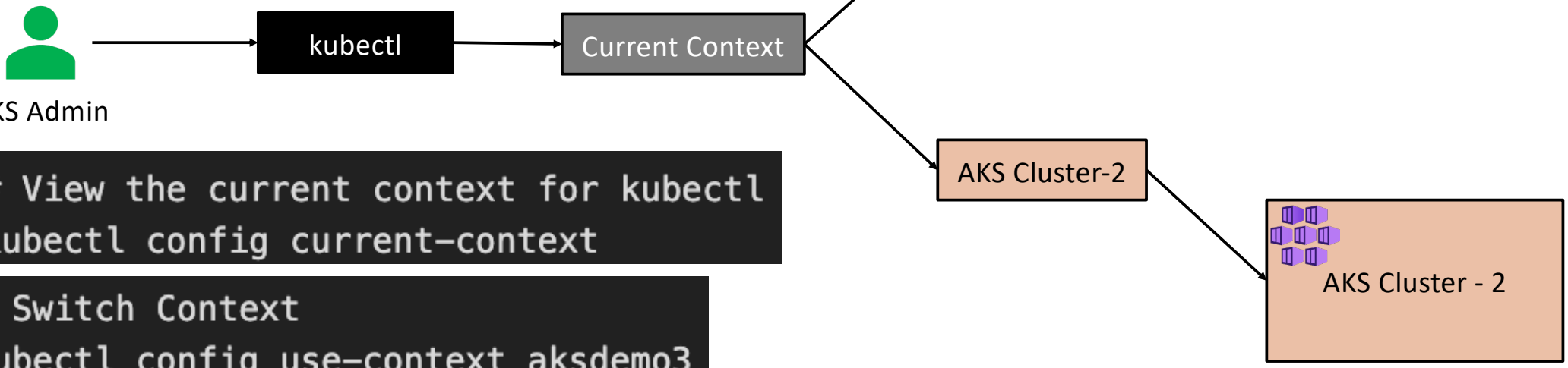


Azure AKS
Configure Access
To
Multiple AKS Clusters

Azure AKS Cluster Access

```
# Configure AKSDEMO3 & 4 Cluster Access for kubectl
az aks get-credentials --resource-group aks-rg3 --name aksdemo3
az aks get-credentials --resource-group aks-rg4 --name aksdemo4
```

```
# View kubeconfig
kubectl config view
```



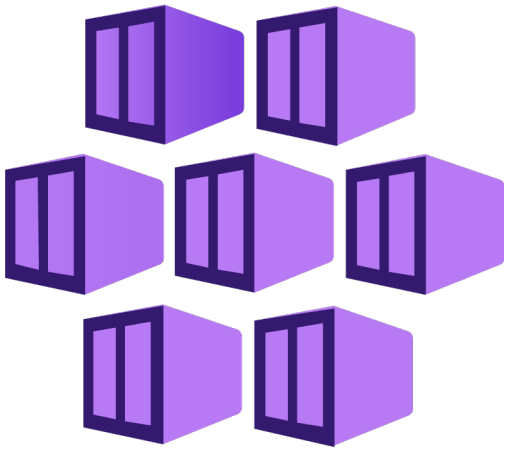

```
# View the current context for kubectl
kubectl config current-context
```

```
# Switch Context
kubectl config use-context aksdemo3
```

Azure Active Directory

Azure AD Groups

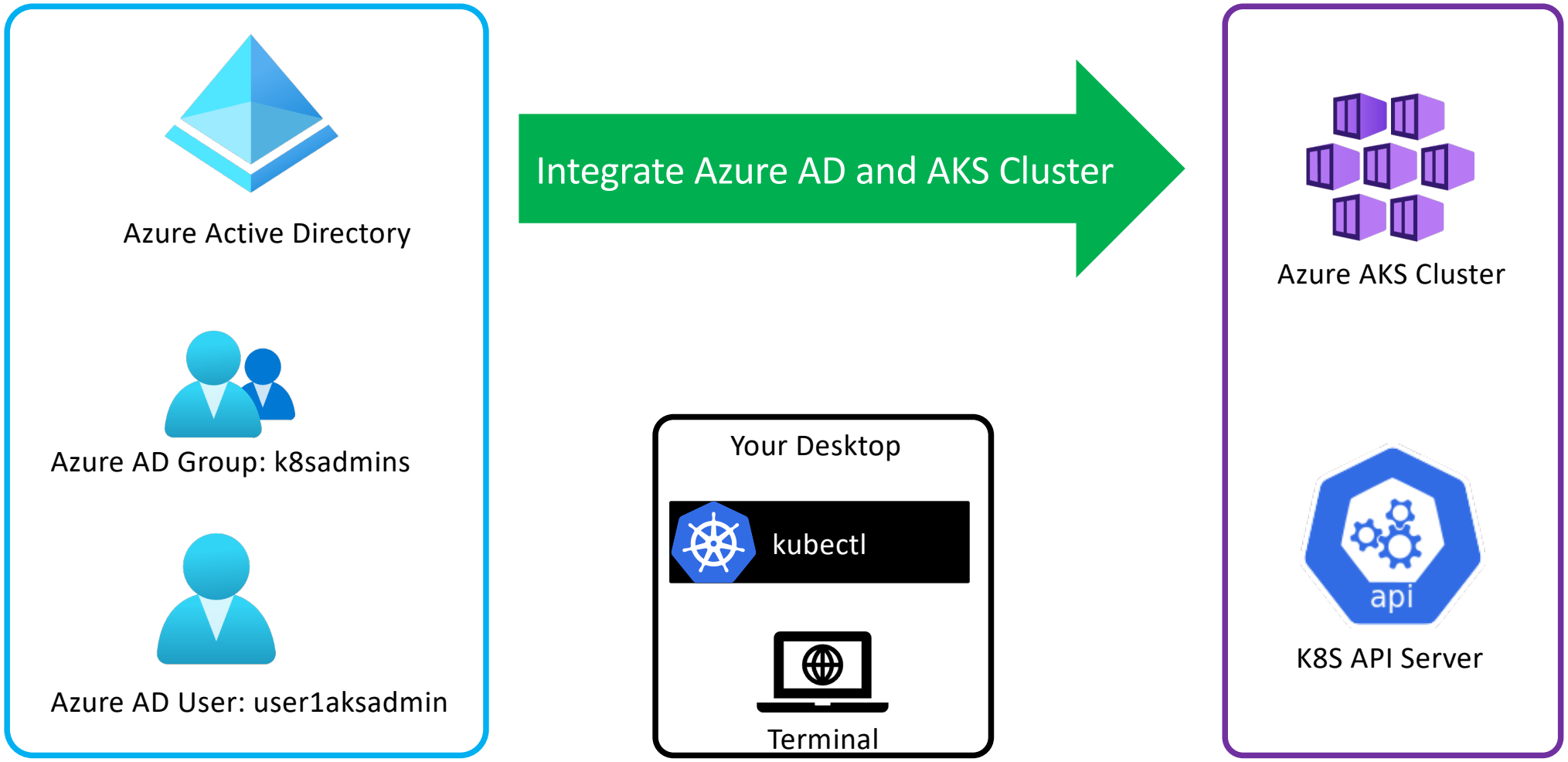
Azure AD Users



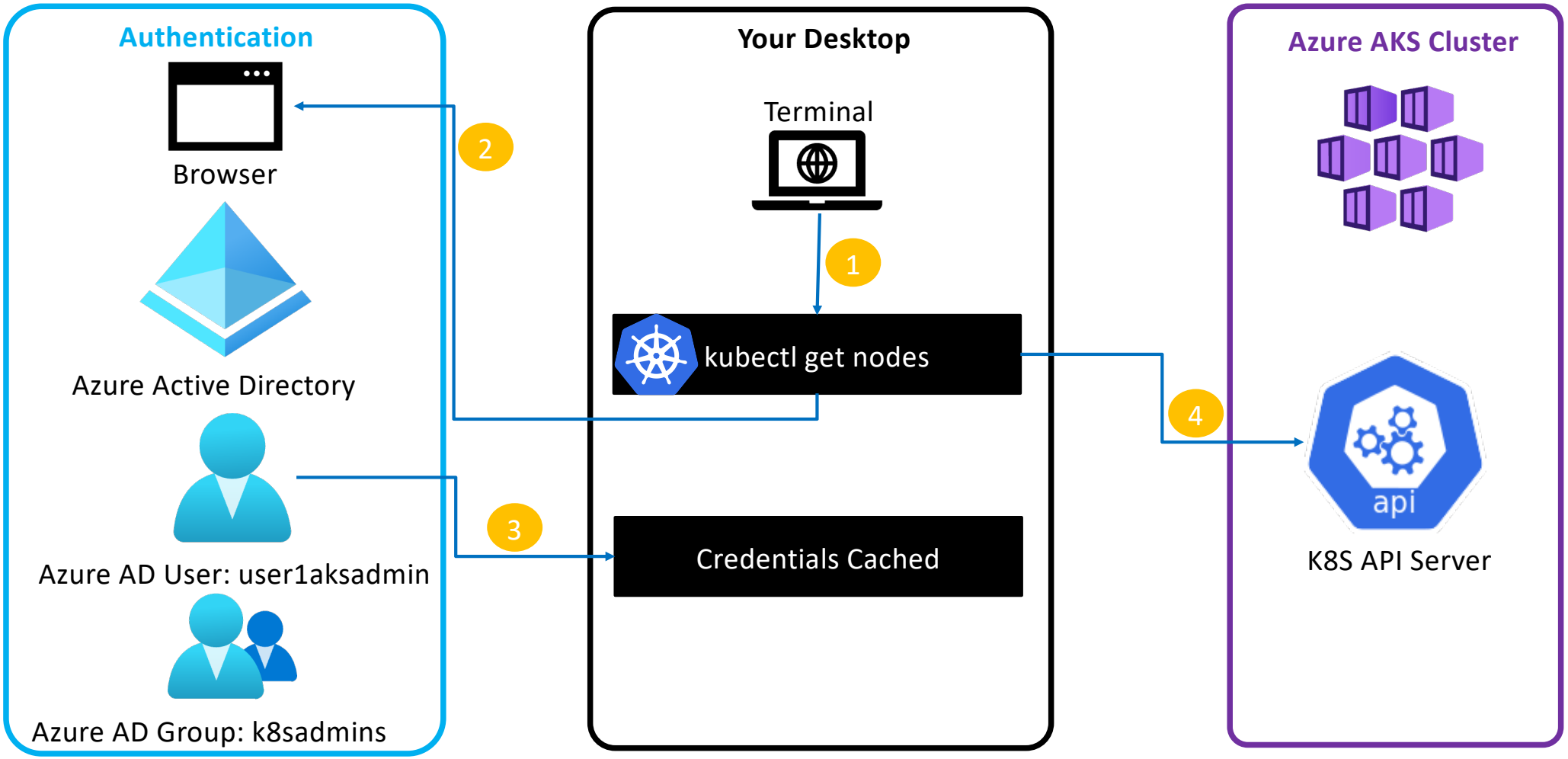
Azure AKS

Azure AD Authentication for AKS Admins

Azure Active Directory Authentication for AKS Admins



Azure Active Directory Authentication for AKS Admins

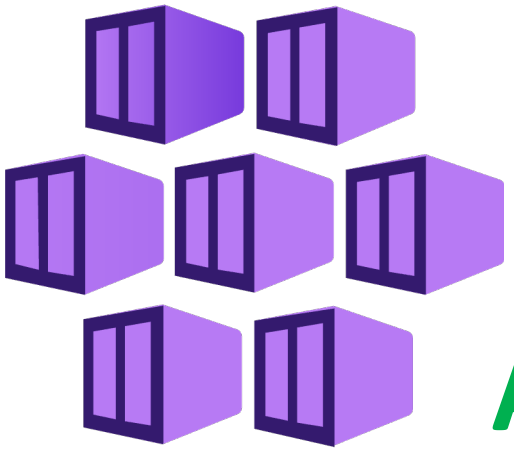


Role

Role Binding

Cluster Role

Cluster Role Binding



Azure AKS

Kubernetes RBAC

Azure Active Directory

Active Directory

AD Groups

AD Users

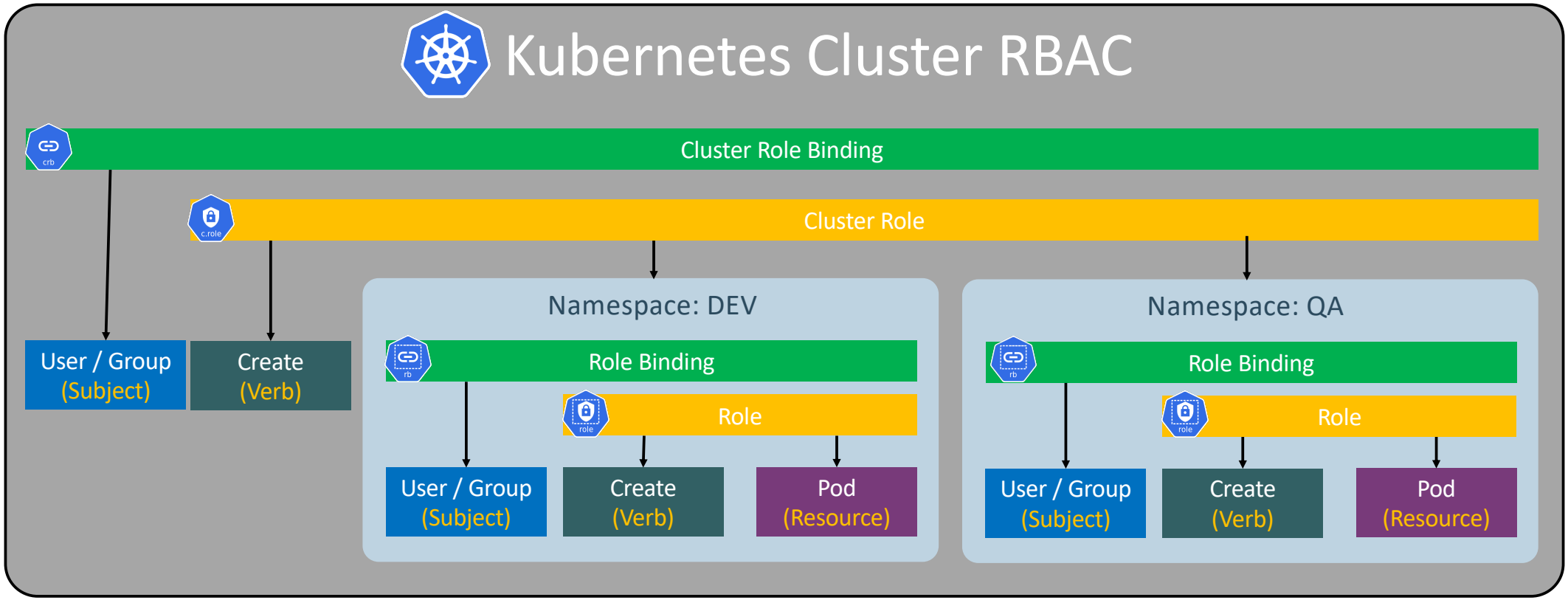
Kubernetes RBAC

Kubernetes RBAC - Fundamentals

Subjects	API Groups	Resources	Verbs
Users or processes that need access to the Kubernetes API	The k8s API objects that we grant access to		List of actions that can be taken on a resource
Kind: Group, User	core	Pods	Create
Kind: Service Account	extensions	Deployments	List
	apps	Services	Watch
	batch	StatefulSets	Delete
			Patch
			get
			Replace
			Read

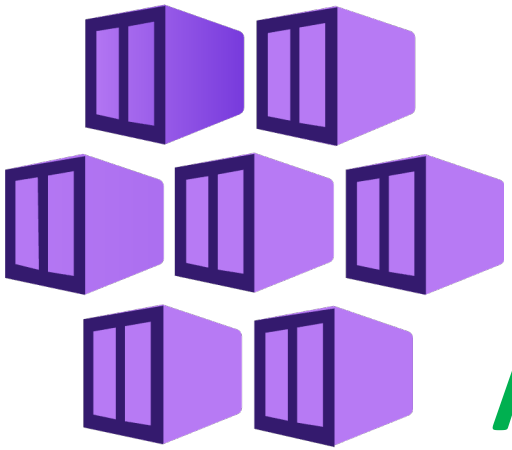
Reference: https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.19

Kubernetes RBAC



Role

Role Binding



Azure AKS

Kubernetes RBAC

Azure Active Directory

Active Directory

AD Groups

AD Users

Kubernetes RBAC Role

A Role can only be used to grant access to resources within a single namespace.

```yaml
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: dev-user-full-access-role
  namespace: dev
rules:
- apiGroups: ["", "extensions", "apps"]
  resources: ["*"]
  verbs: ["*"]
- apiGroups: ["batch"]
  resources:
  - jobs
  - cronjobs
  verbs: ["*"]
```

Namespace: Creating this role in dev namespace

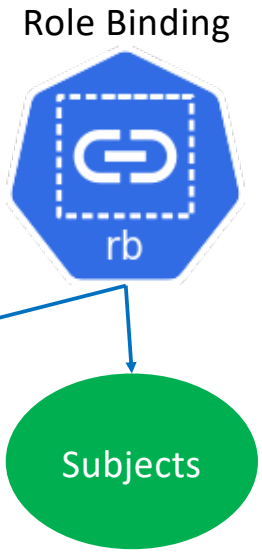
API Groups: core, extensions, apps

Resources: pods, deployments, services

Verbs: Create, List, Delete, Patch

Kubernetes RBAC Role Binding

A Role Binding is used to tie the Role and Subject together



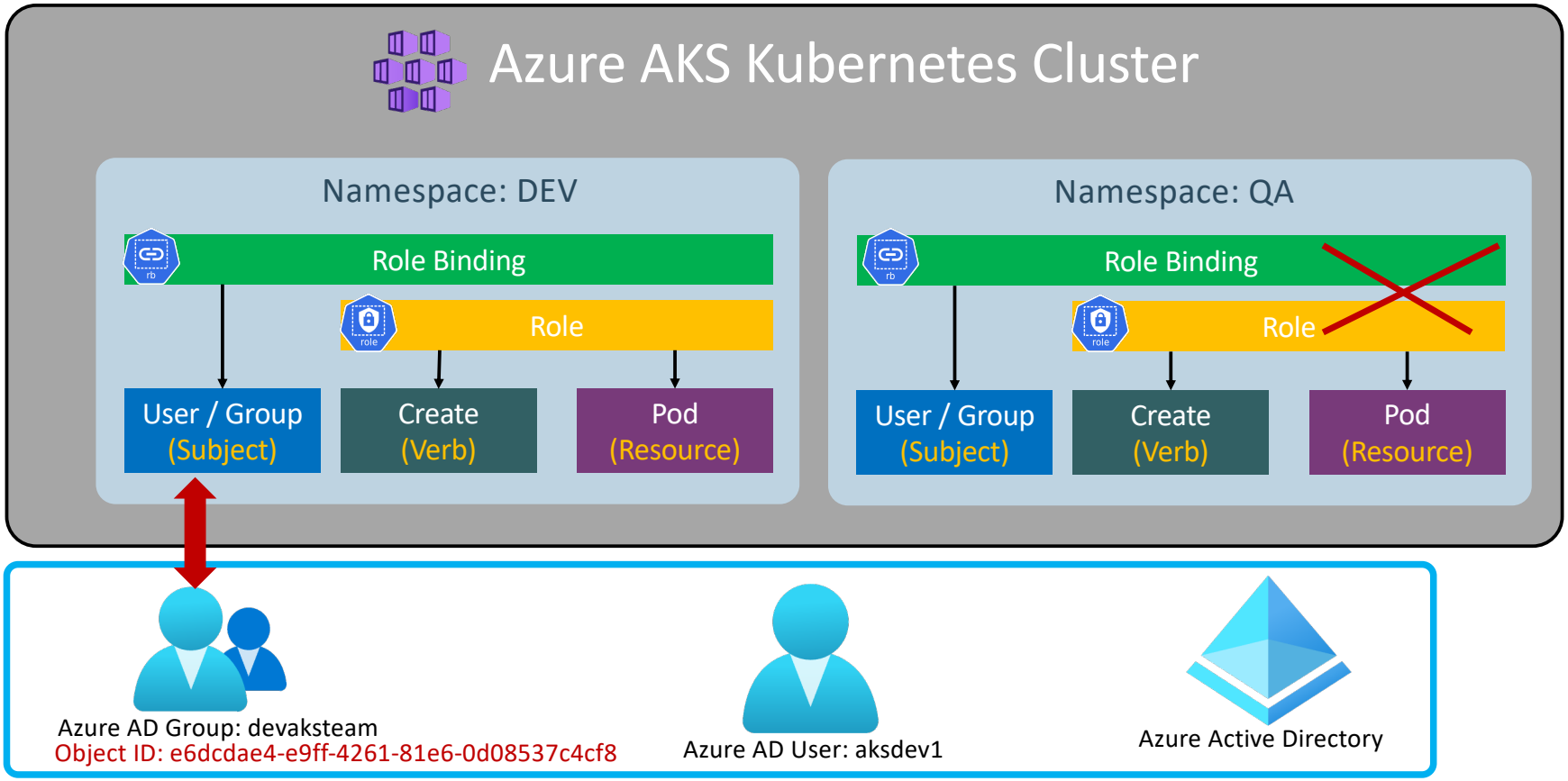

```yaml
kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: dev-user-access-rolebinding
  namespace: dev
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: Role
  name: dev-user-full-access-role
subjects:
- kind: Group
  namespace: dev
  name: "e6dcdae4-e9ff-4261-81e6-0d08537c4cf8"
```

Namespace: Creating this role binding in dev namespace

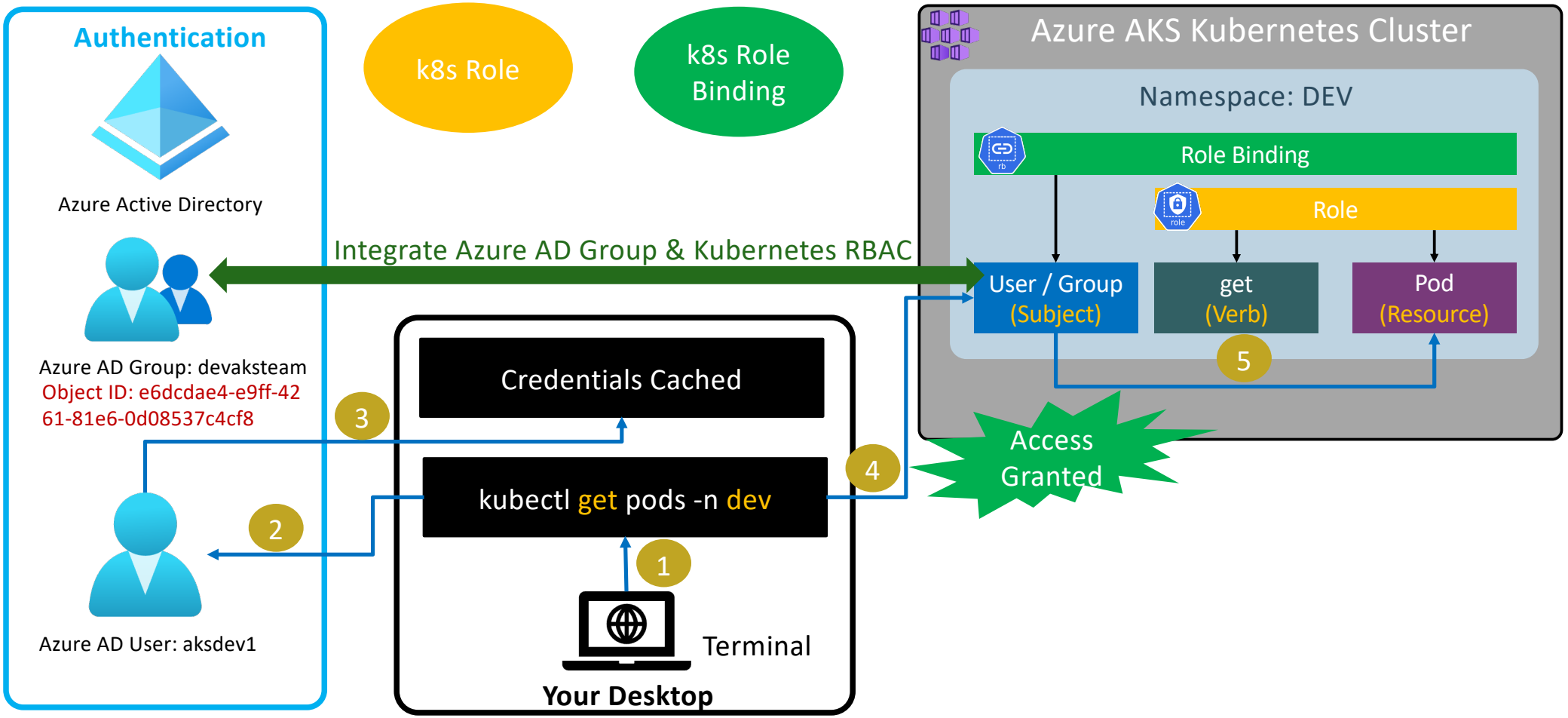
Role: Mapped role here

Subjects: Group: Azure AD Group with Object ID xxx has full access to namespace dev in AKS Cluster

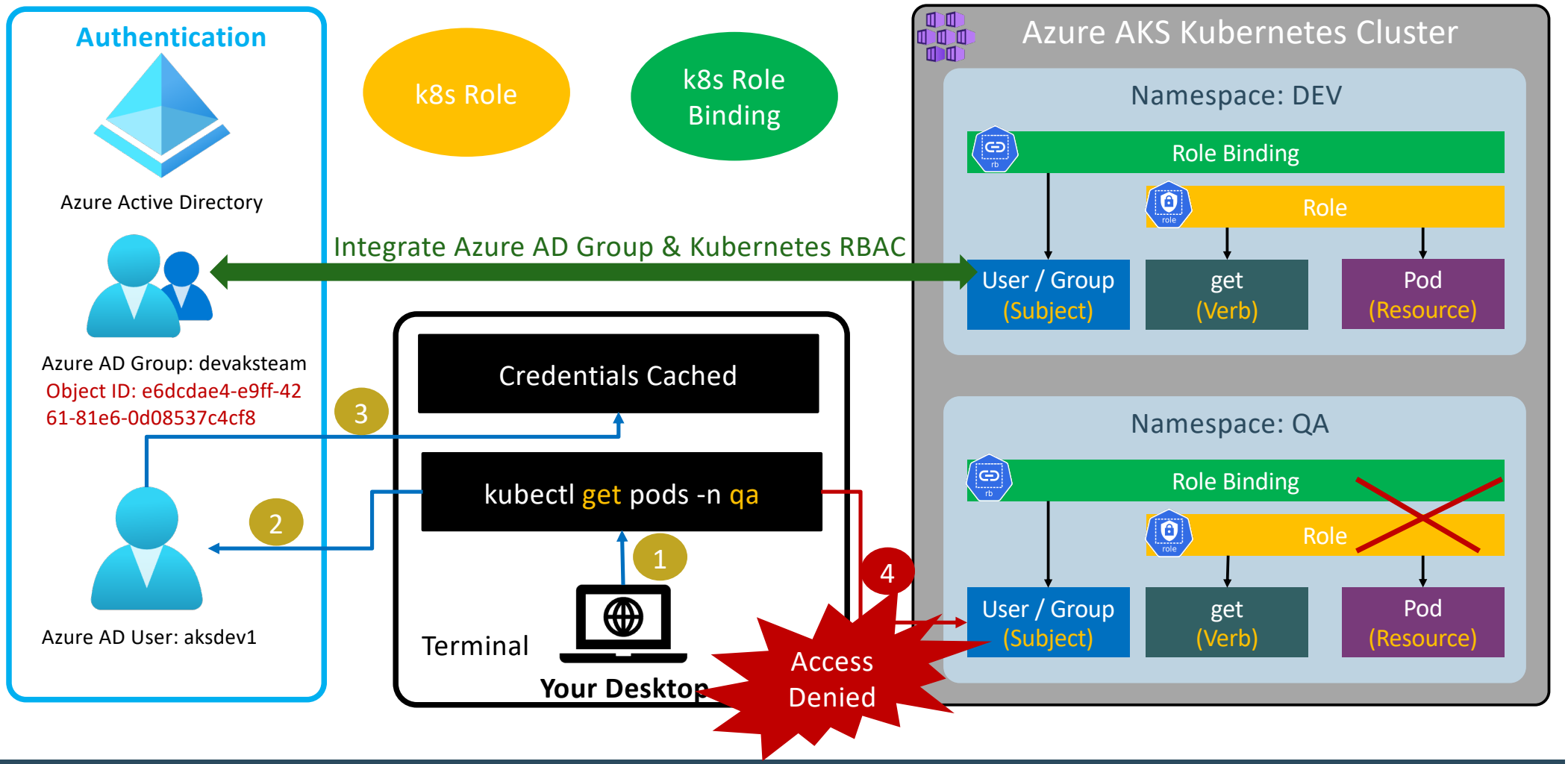
Azure Active Directory & Kubernetes RBAC



Azure Active Directory & Kubernetes RBAC

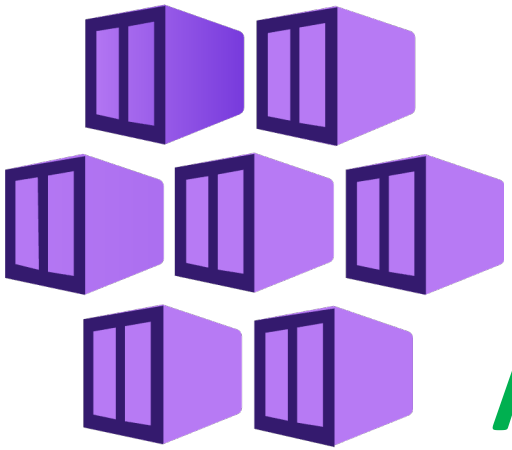


Azure Active Directory & Kubernetes RBAC



Cluster Role

Cluster Role Binding



Azure AKS

Kubernetes RBAC

Azure Active Directory

Active Directory

AD Groups

AD Users

Kubernetes RBAC Cluster Role

Cluster Role

A ClusterRole can be used to grant the same permissions as a Role, but because they are cluster-scoped, access will be granted across cluster

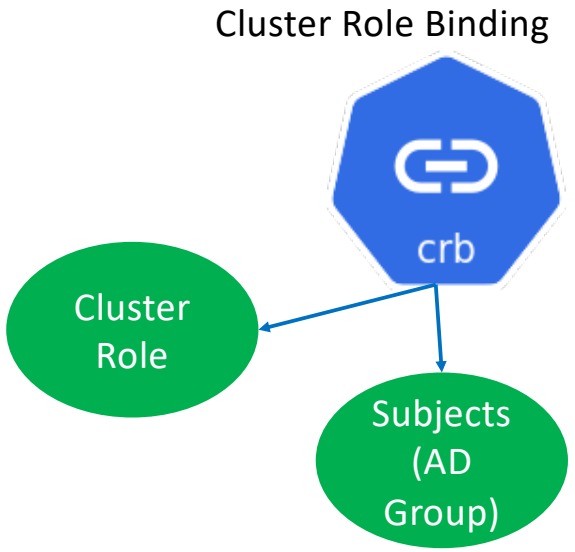
```yaml
kind: ClusterRole
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: aks-cluster-readonly-role
rules:
- apiGroups: ["", "extensions", "apps"]
  resources: ["*"]
  verbs: ["get", "list", "watch"]
- apiGroups: ["batch"]
  resources:
  - jobs
  - cronjobs
  verbs: ["get", "list", "watch"]
```

Read Only access to AKS Cluster

Read Only access to AKS Cluster

Kubernetes RBAC Cluster Role Binding

A Cluster Role Binding is used to tie the Cluster Role and Subject together

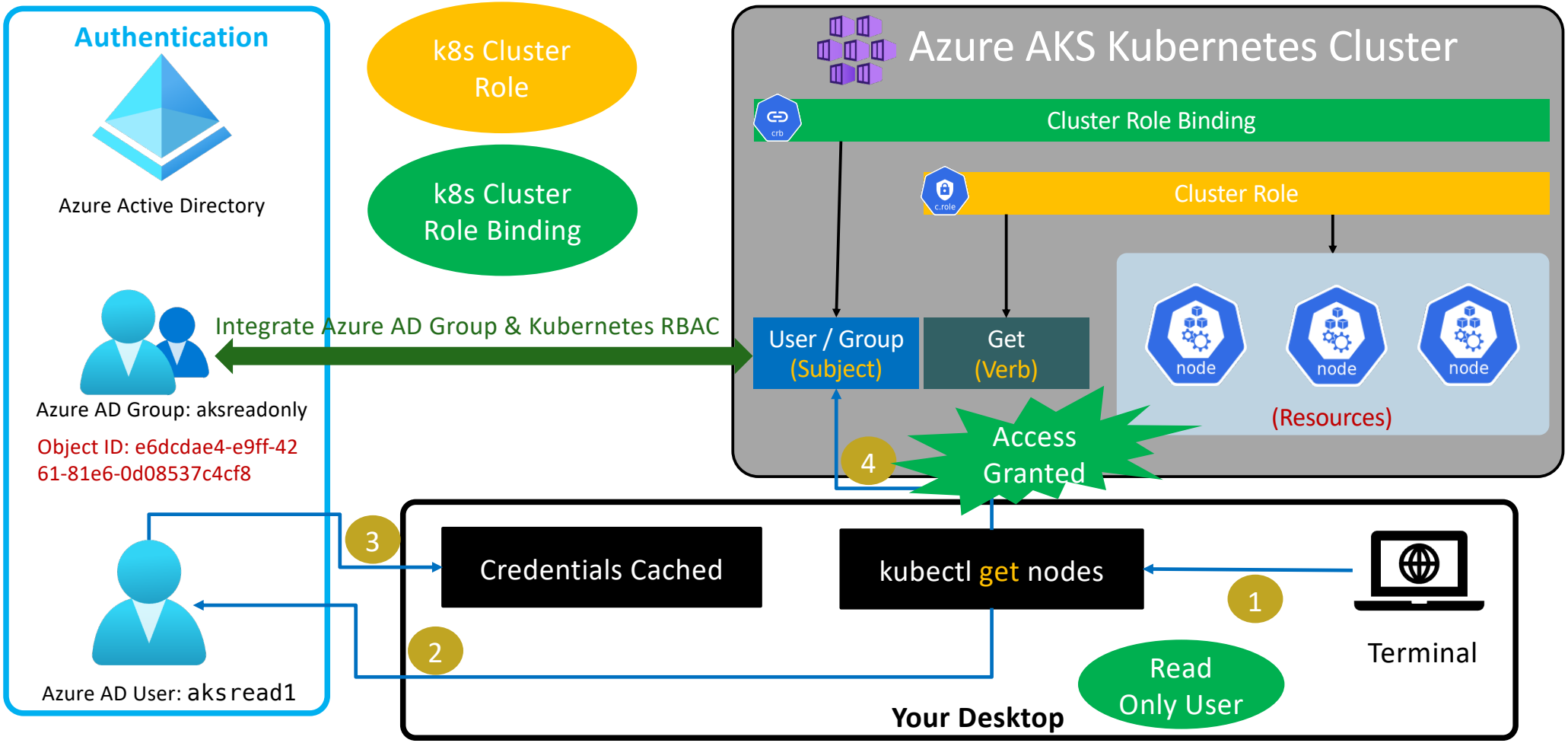



```yaml
kind: ClusterRoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: aks-cluster-readonly-rolebinding
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: aks-cluster-readonly-role
subjects:
- kind: Group
  name: "e808215d-d159-49ba-8bb6-9661ba478842"
```

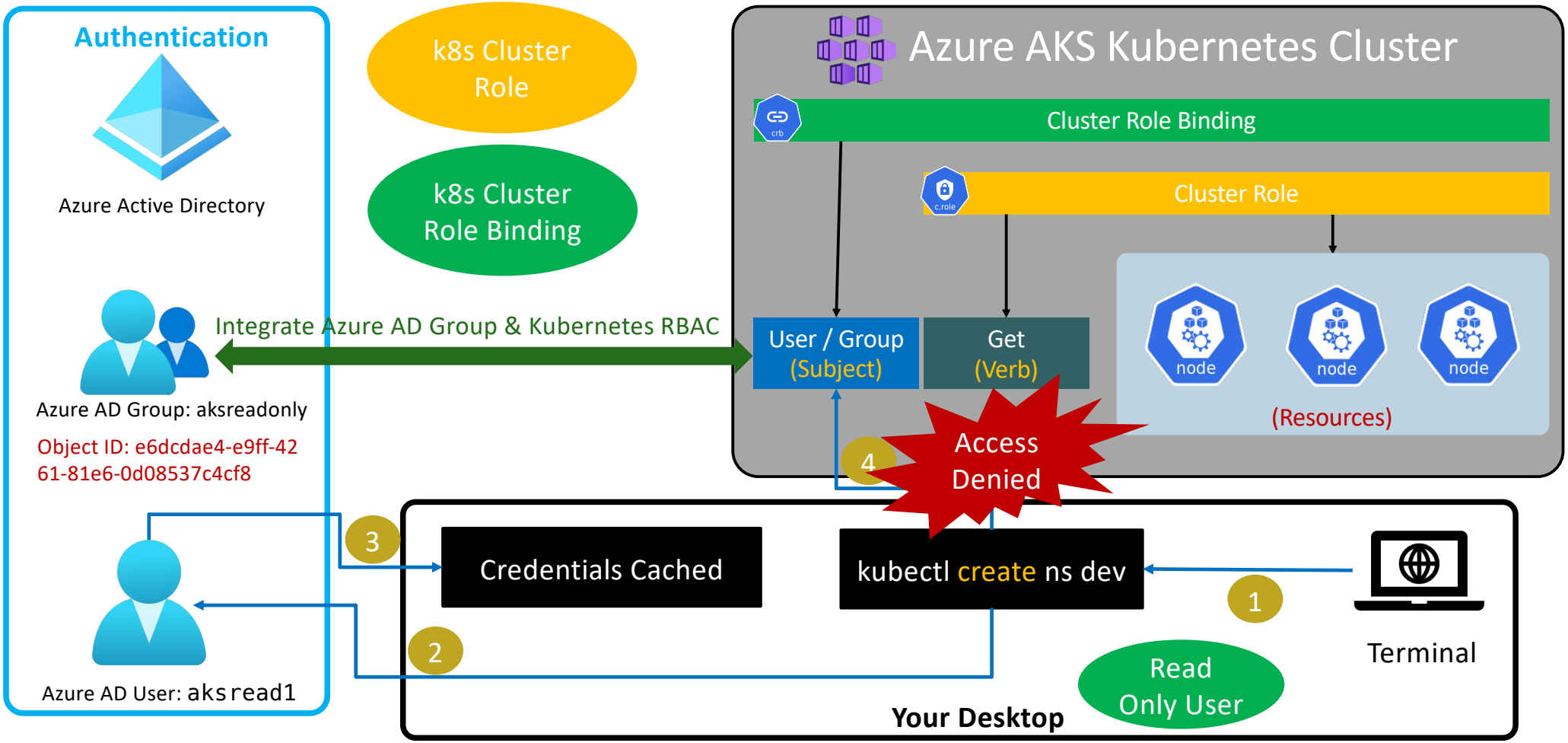
Role: Mapped role here

Subjects: Group: Azure AD Group with Object ID xxx has read only access to AKS Cluster

Azure Active Directory & Kubernetes RBAC

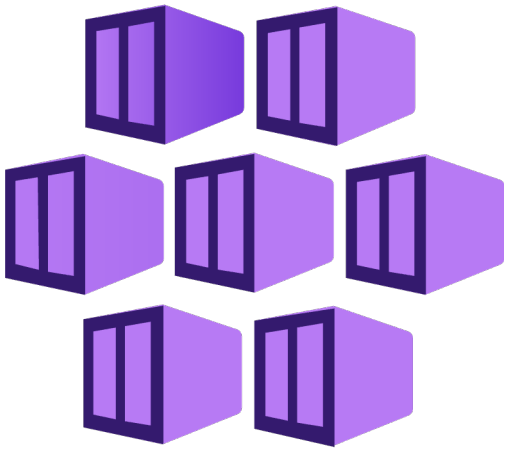


Azure Active Directory & Kubernetes RBAC



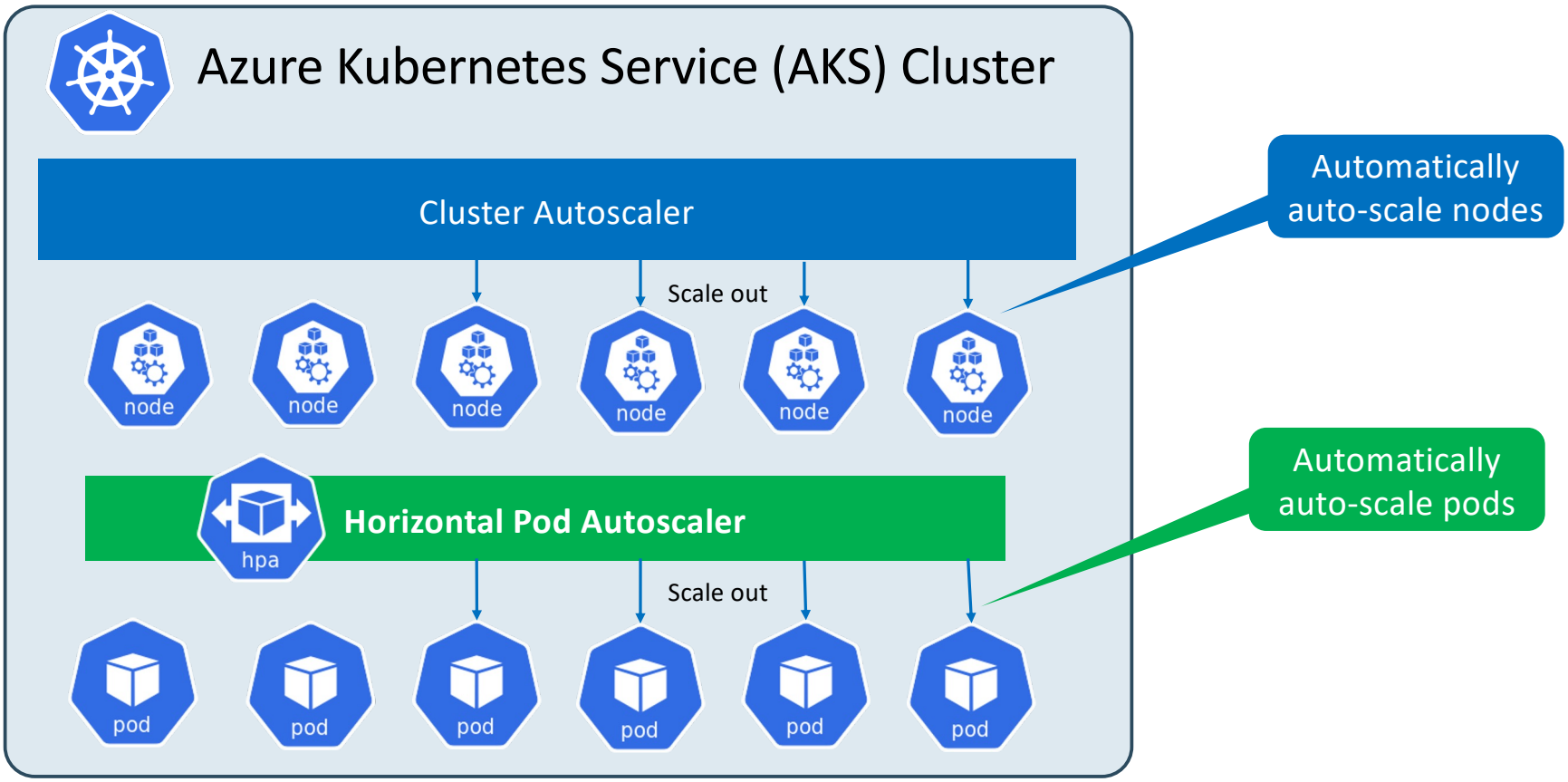
Cluster Autoscaler

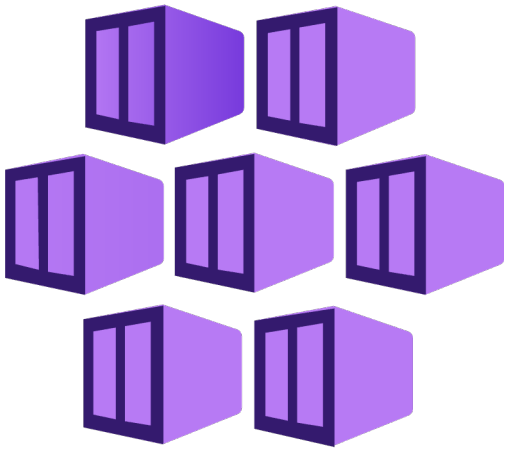
Horizontal Pod Autoscaler



Azure AKS Autoscaling Nodes & Pods

Azure AKS – Autoscaling Nodes & Pods

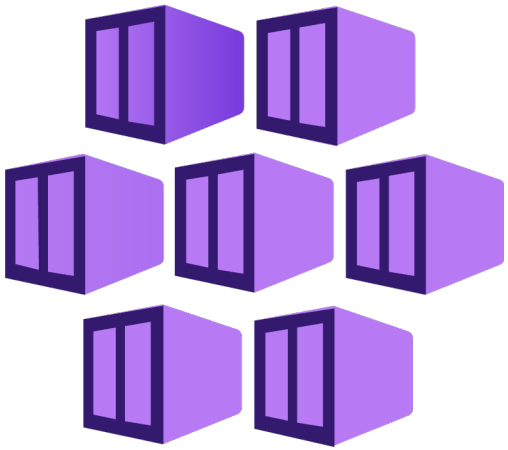




Azure AKS
Autoscaling
Cluster Autoscaler

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 nodepools so that they scale out when we need more resources and scale in when we have underutilized resources.



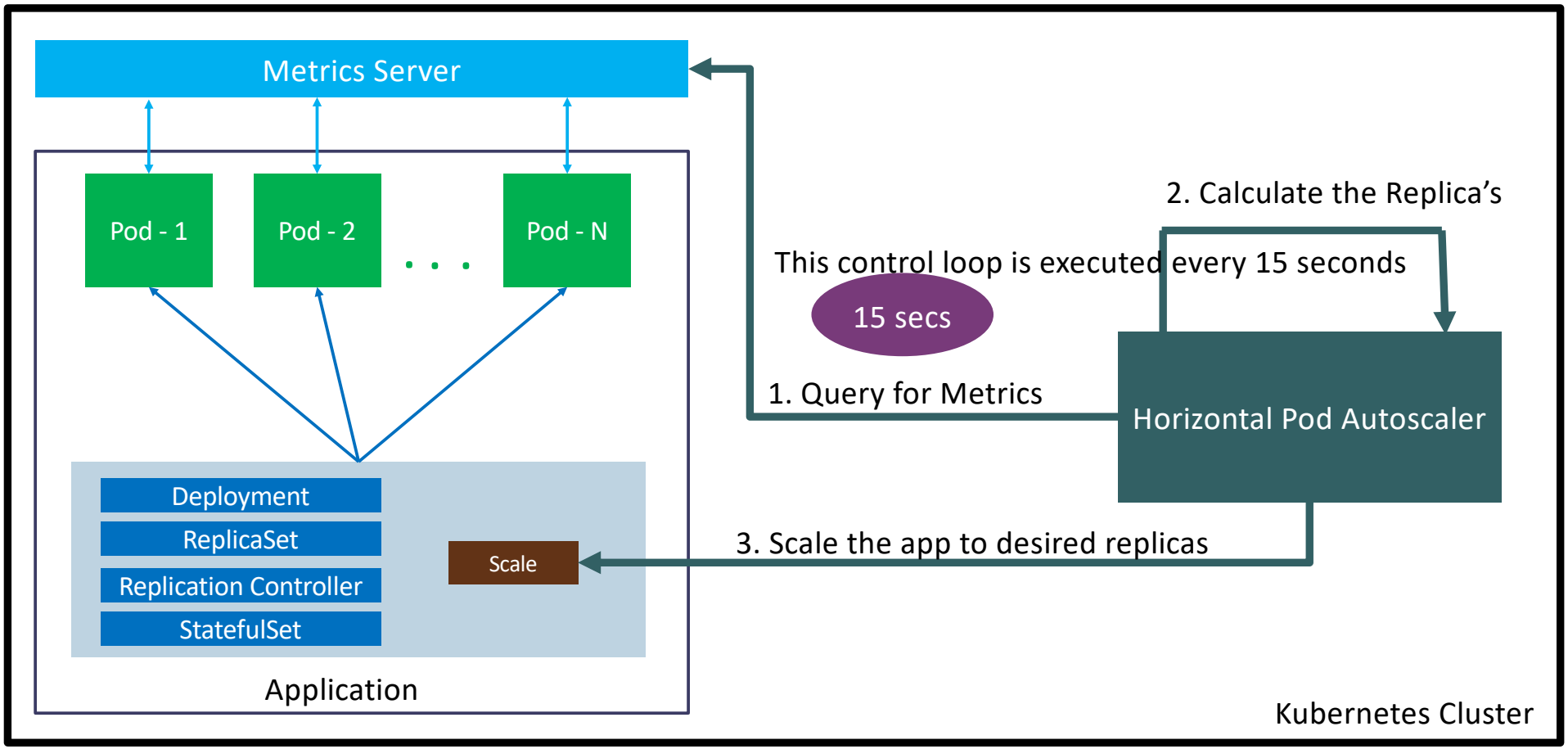
Azure AKS Autoscaling

Horizontal Pod Autoscaling

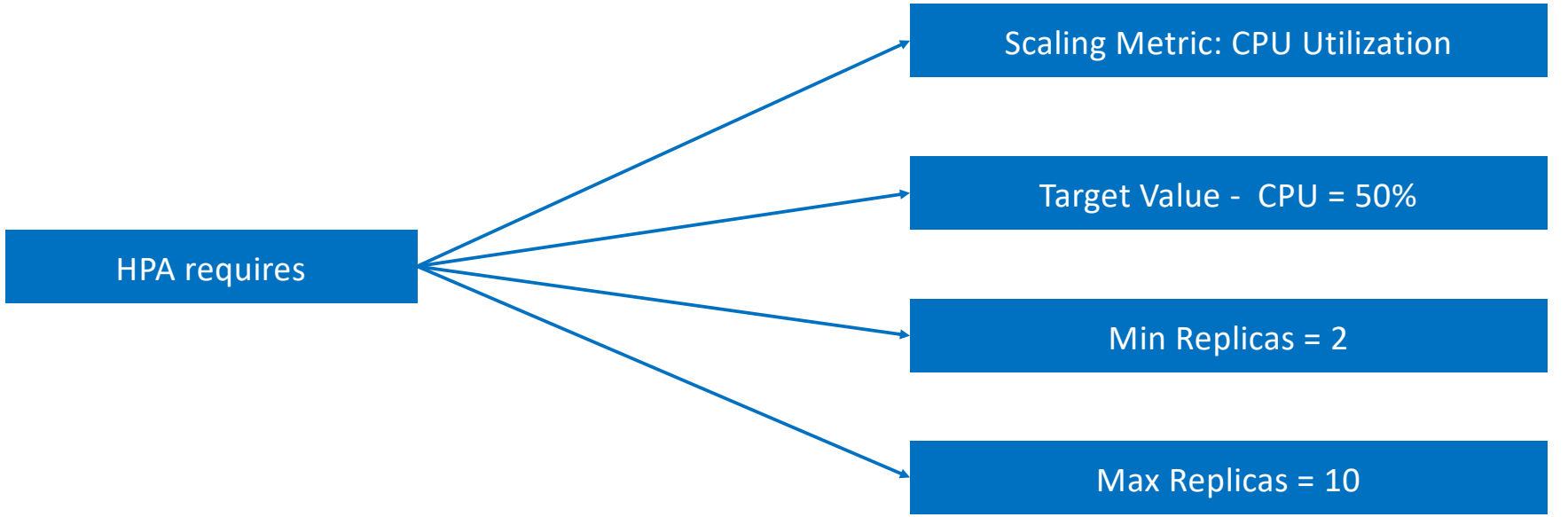
Horizontal Pod Autoscaler – HPA - Intoduction

- 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?

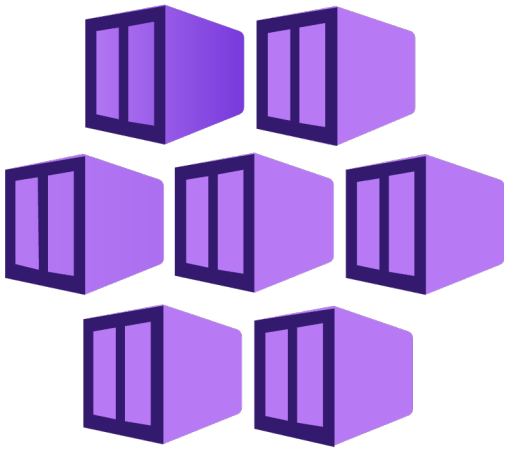



```
kubectl autoscale deployment demo-deployment  --cpu-percent=50 --min=1 --max=10
```

AKS Linux NodePools

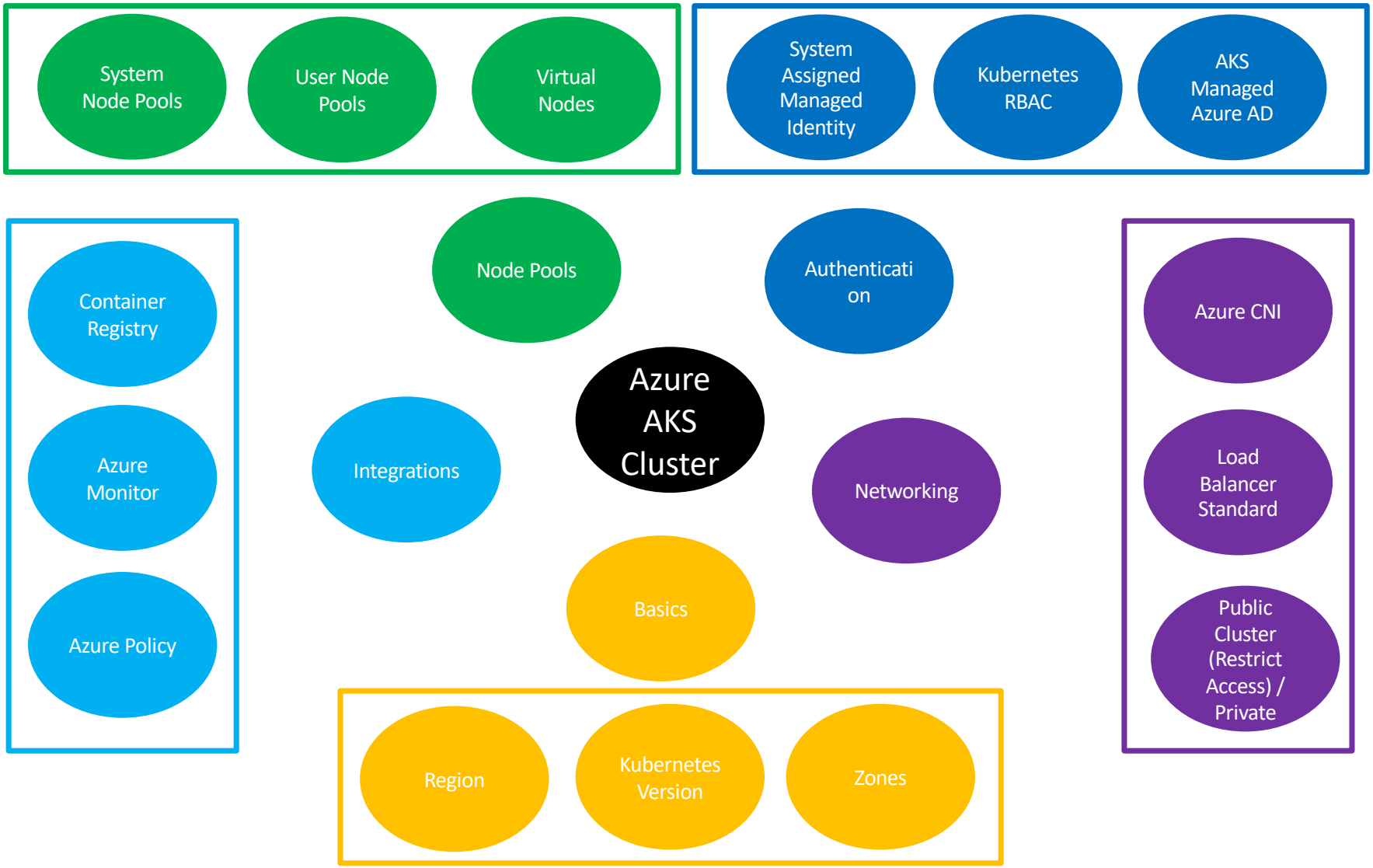
AKS Windows NodePools

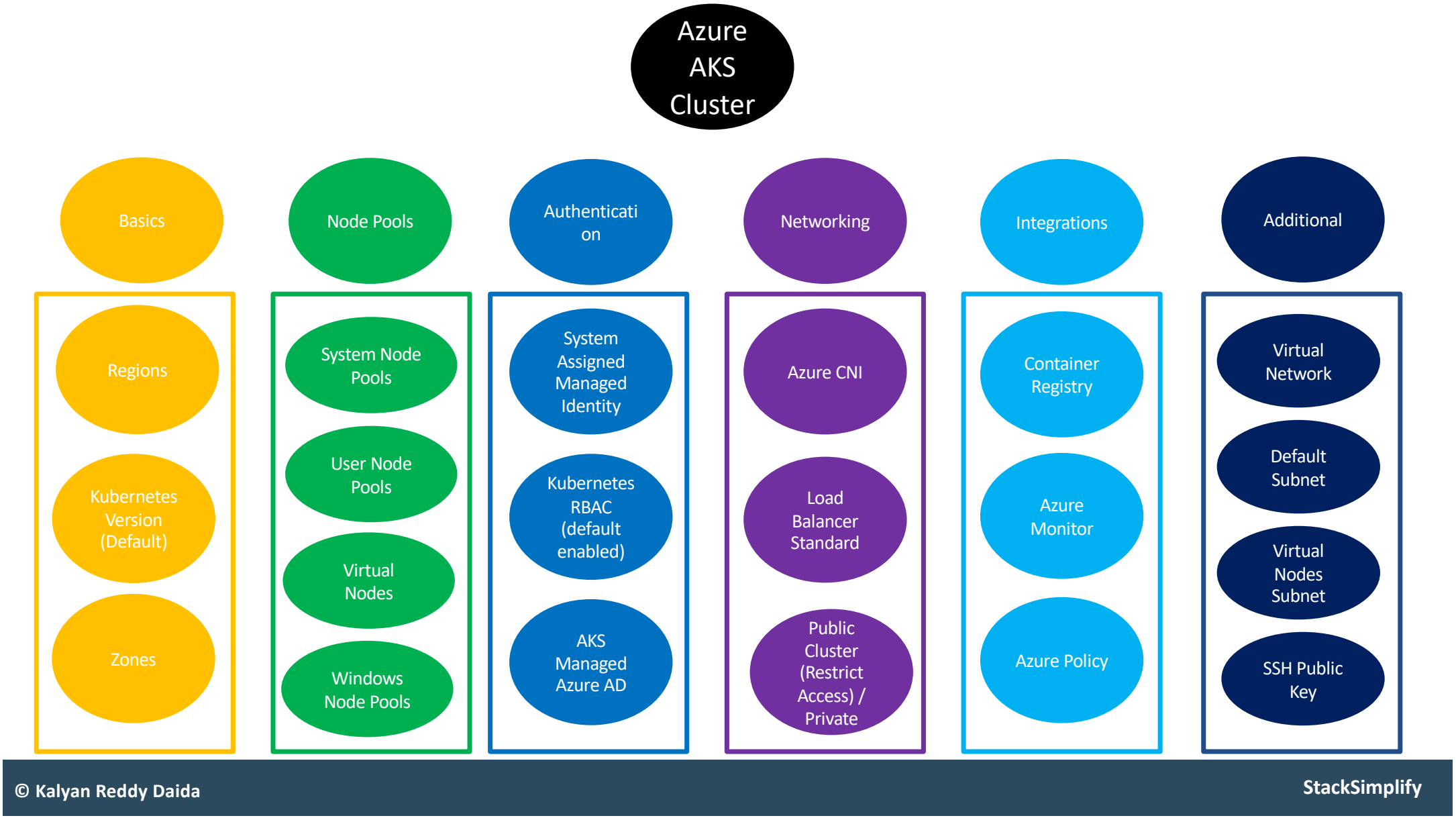
AKS Virtual Nodes



Azure AKS Design Production Grade AKS Cluster

az aks cli



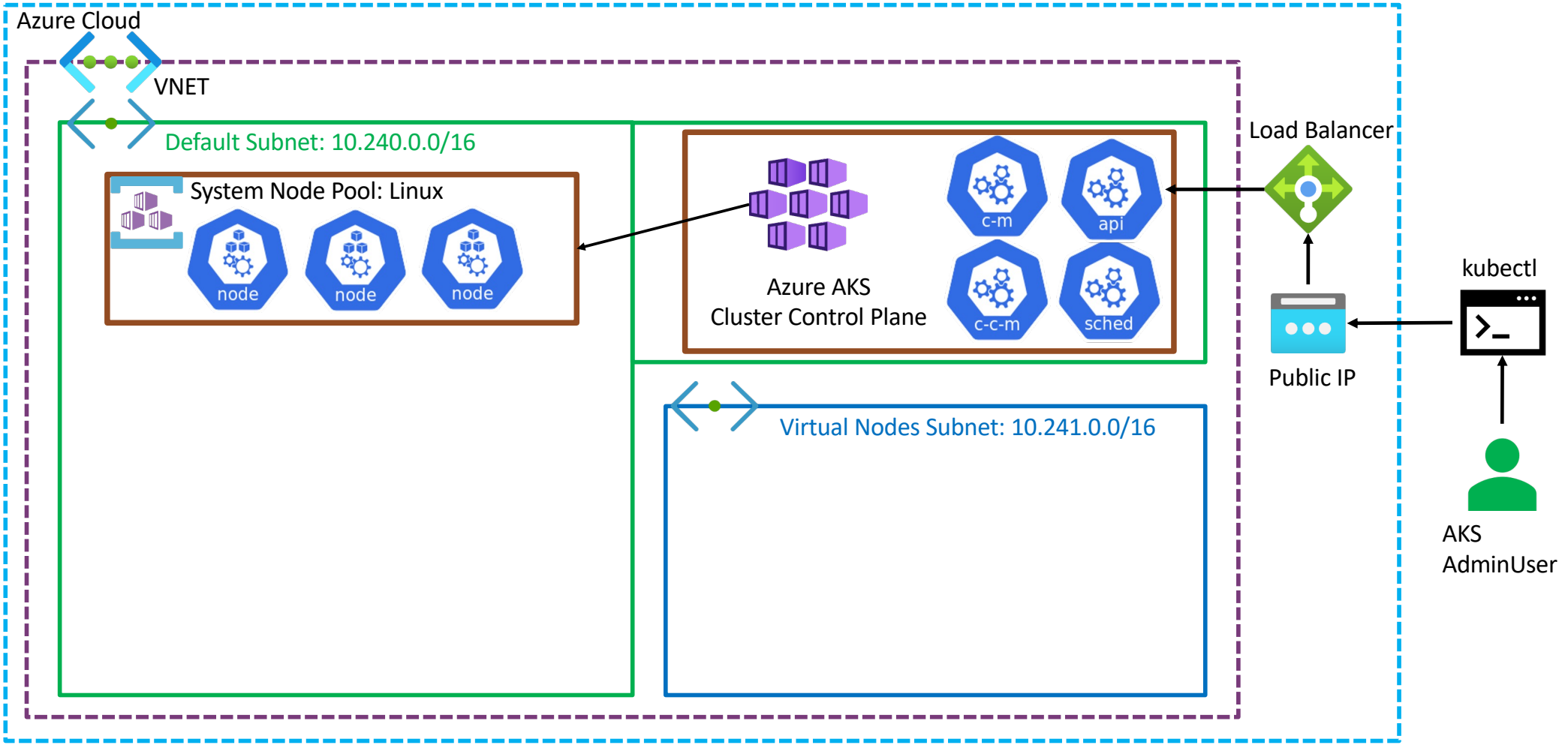


Section-1
Create AKS Cluster

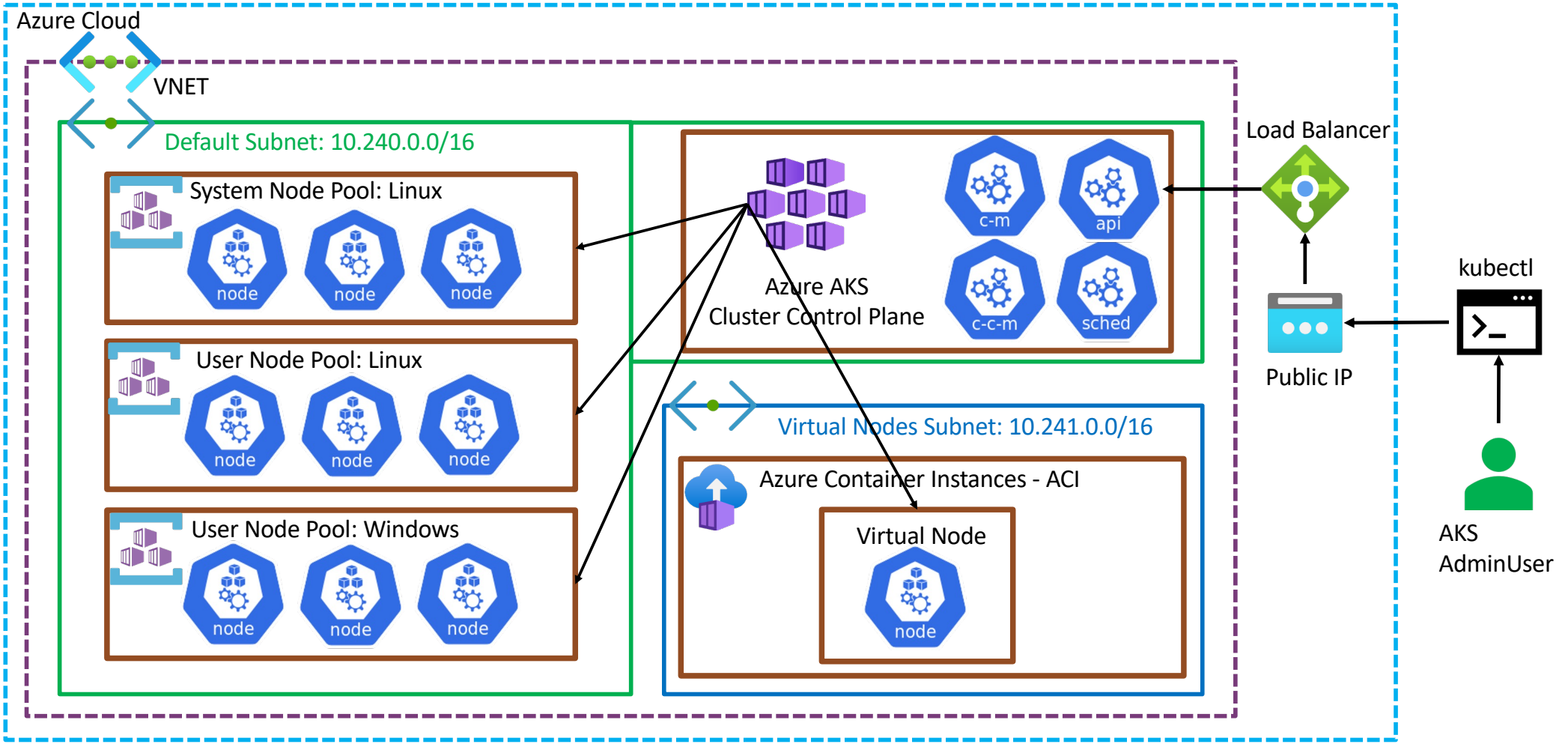
Section-2
Create Windows, Linux User Node Pools and Virtual Nodes

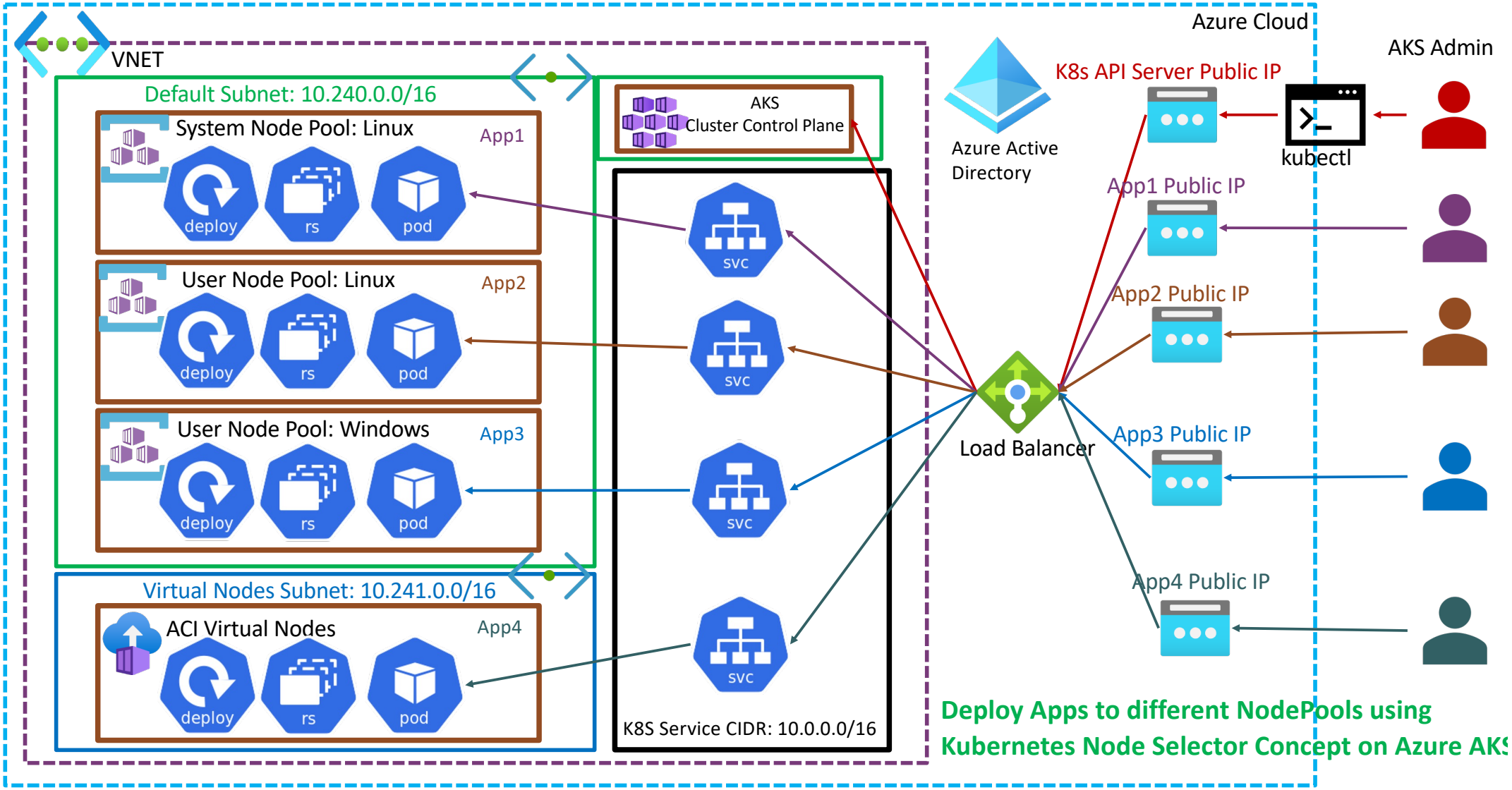
Section-3
Deploy Apps to all 4 node pools using Kubernetes Node Selector concept

Azure AKS Cluster – Create AKS Cluster using CLI



Azure AKS Cluster – Node Pools (Linux, Windows, Virtual)

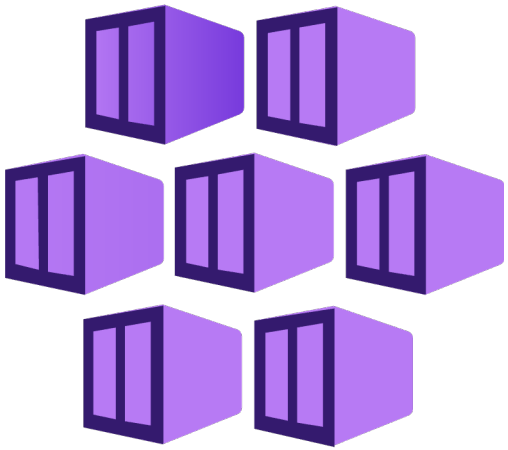




AKS Linux NodePools

AKS Windows NodePools

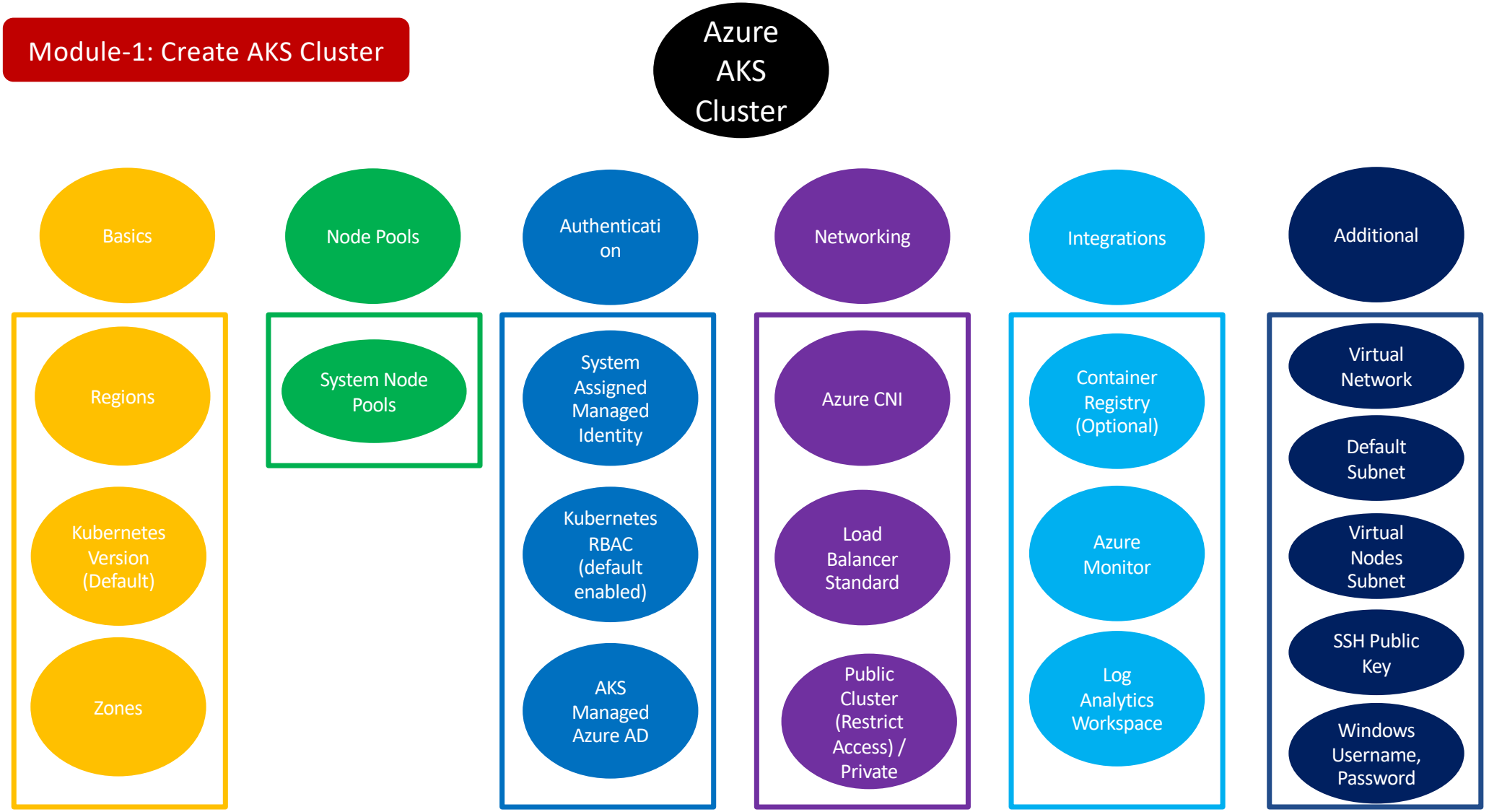
AKS Virtual Nodes



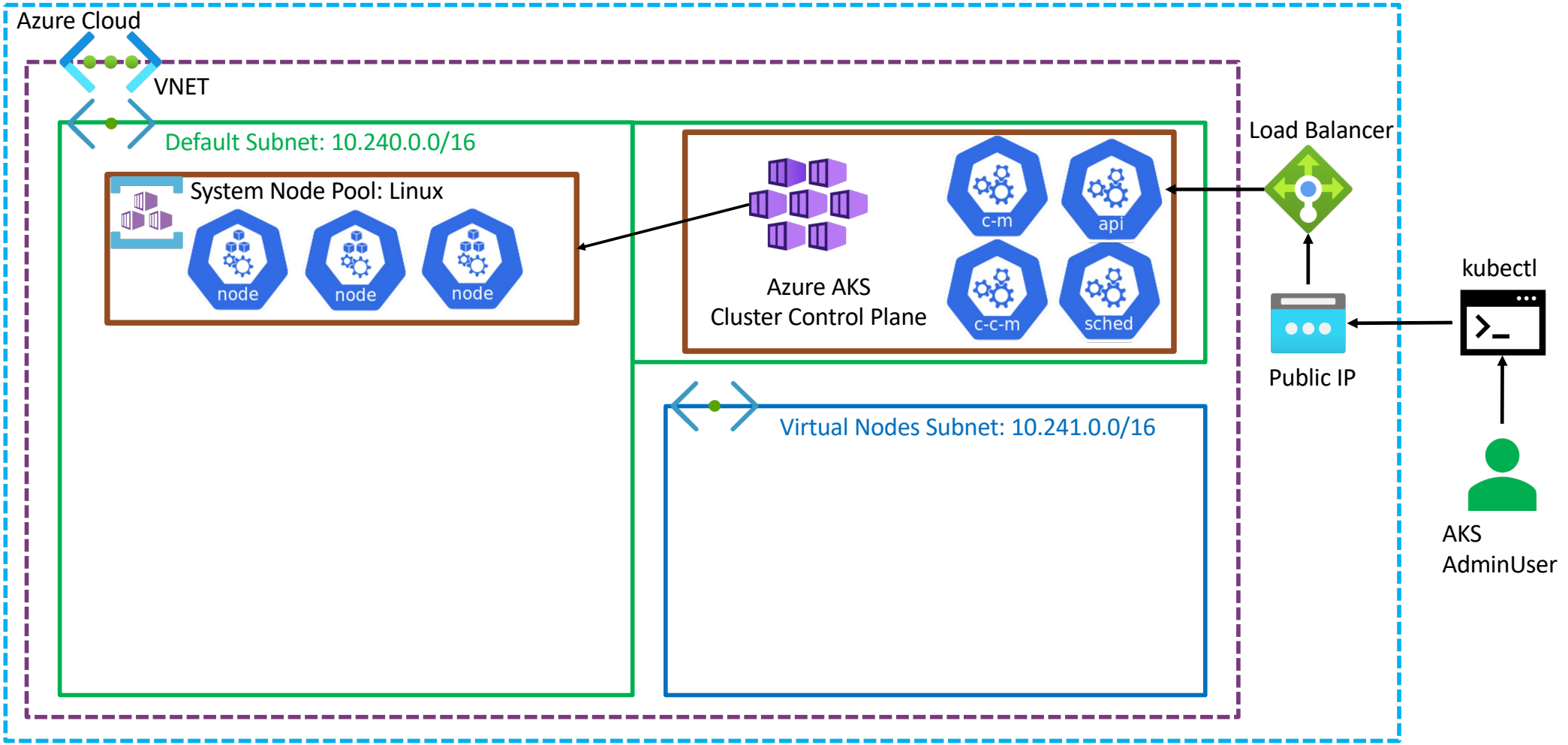
Azure AKS

Create AKS Cluster using az aks cli

Module-1: Create AKS Cluster



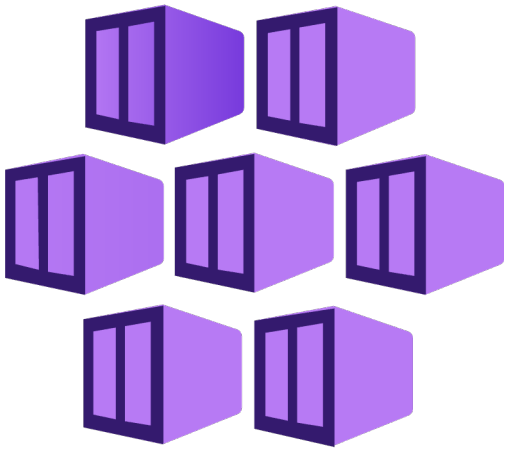
Azure AKS Cluster – Create AKS Cluster using CLI



AKS Linux NodePools

AKS Windows NodePools

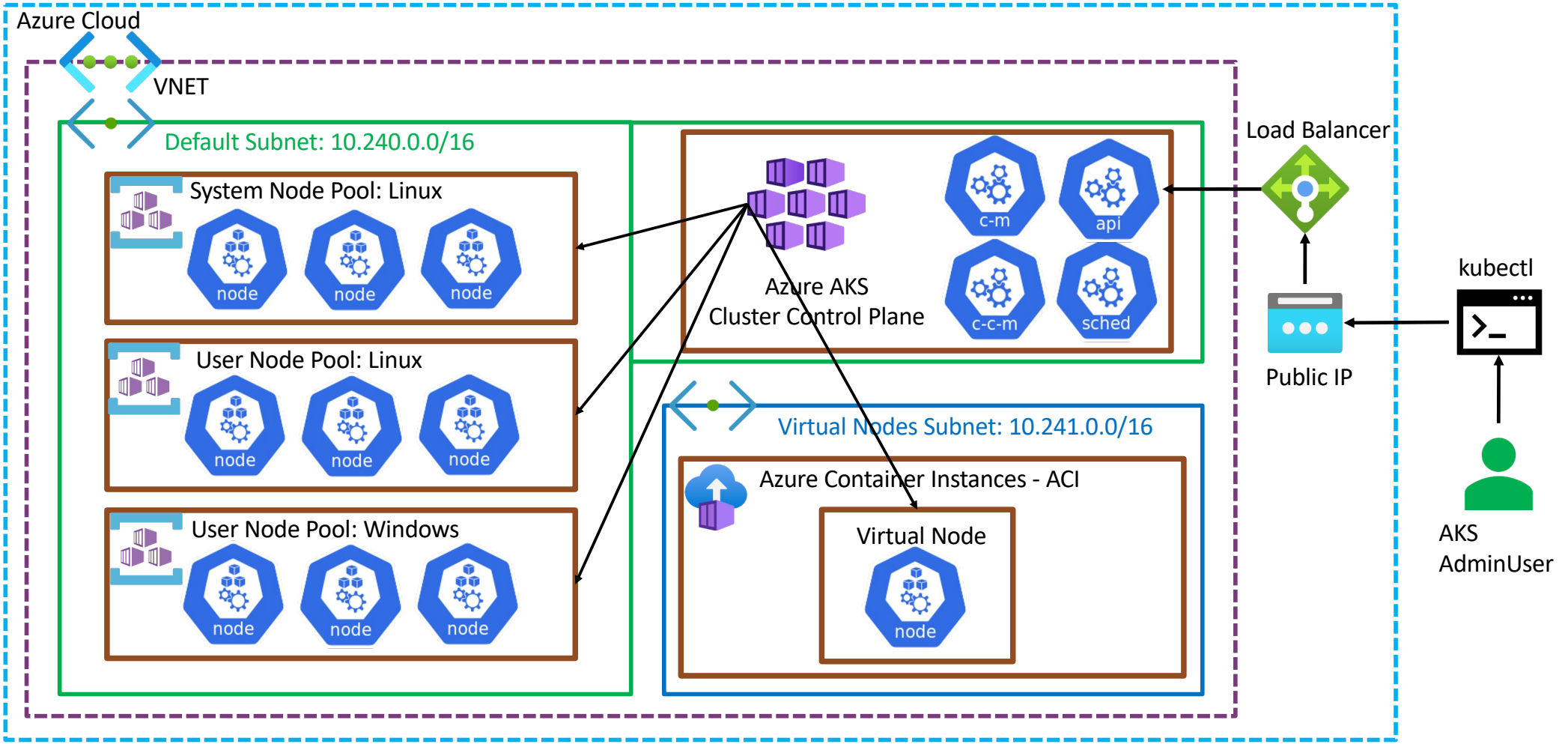
AKS Virtual Nodes



Azure AKS

Create Node Pools Windows, Linux and Virtual Nodes using az aks cli

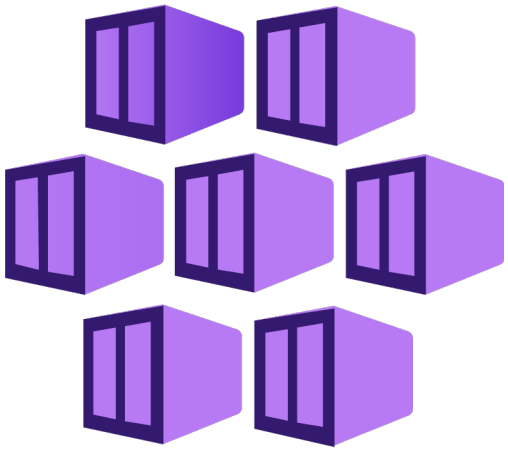
Azure AKS Cluster – Node Pools (Linux, Windows, Virtual)



AKS Linux NodePools

AKS Windows NodePools

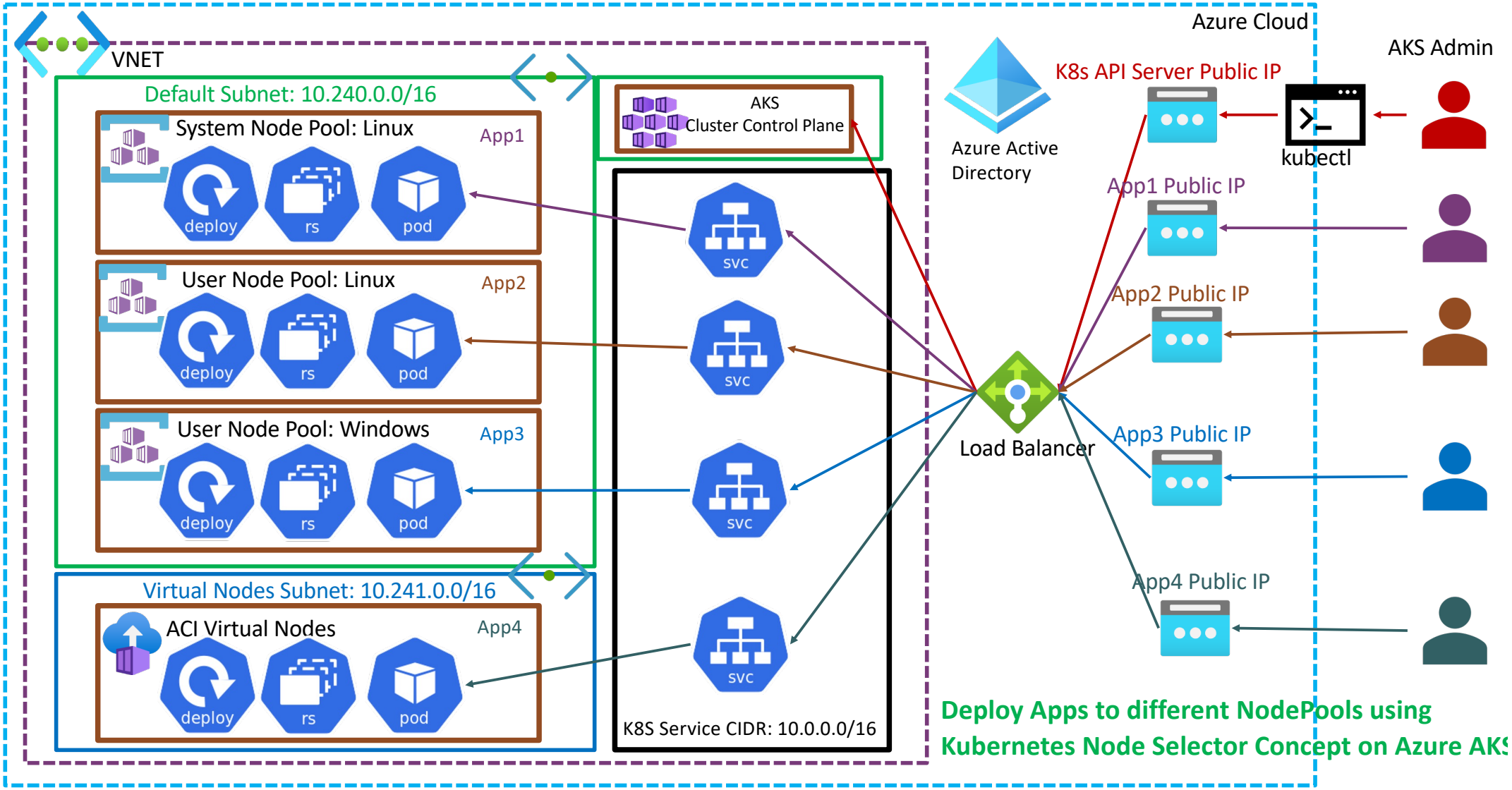
AKS Virtual Nodes

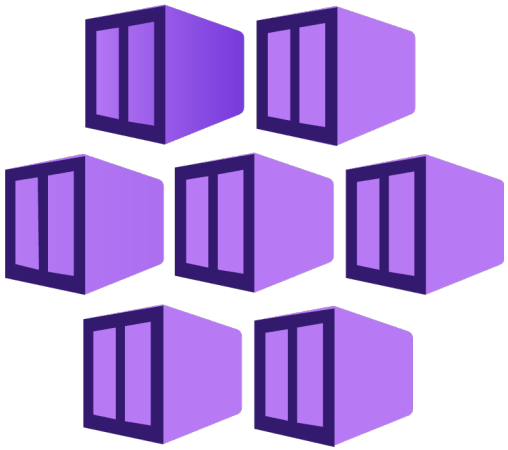


Azure AKS

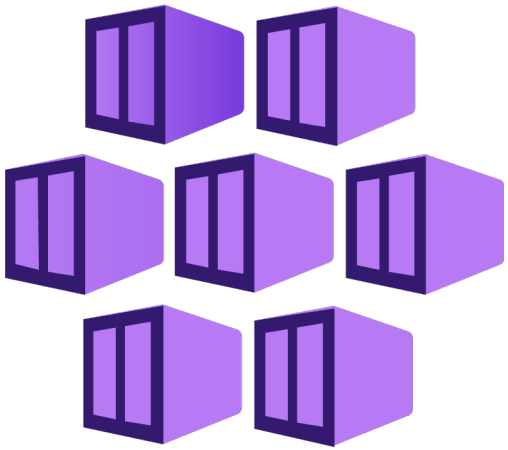
Deploy Apps to different NodePools using Node Selectors

az aks cli



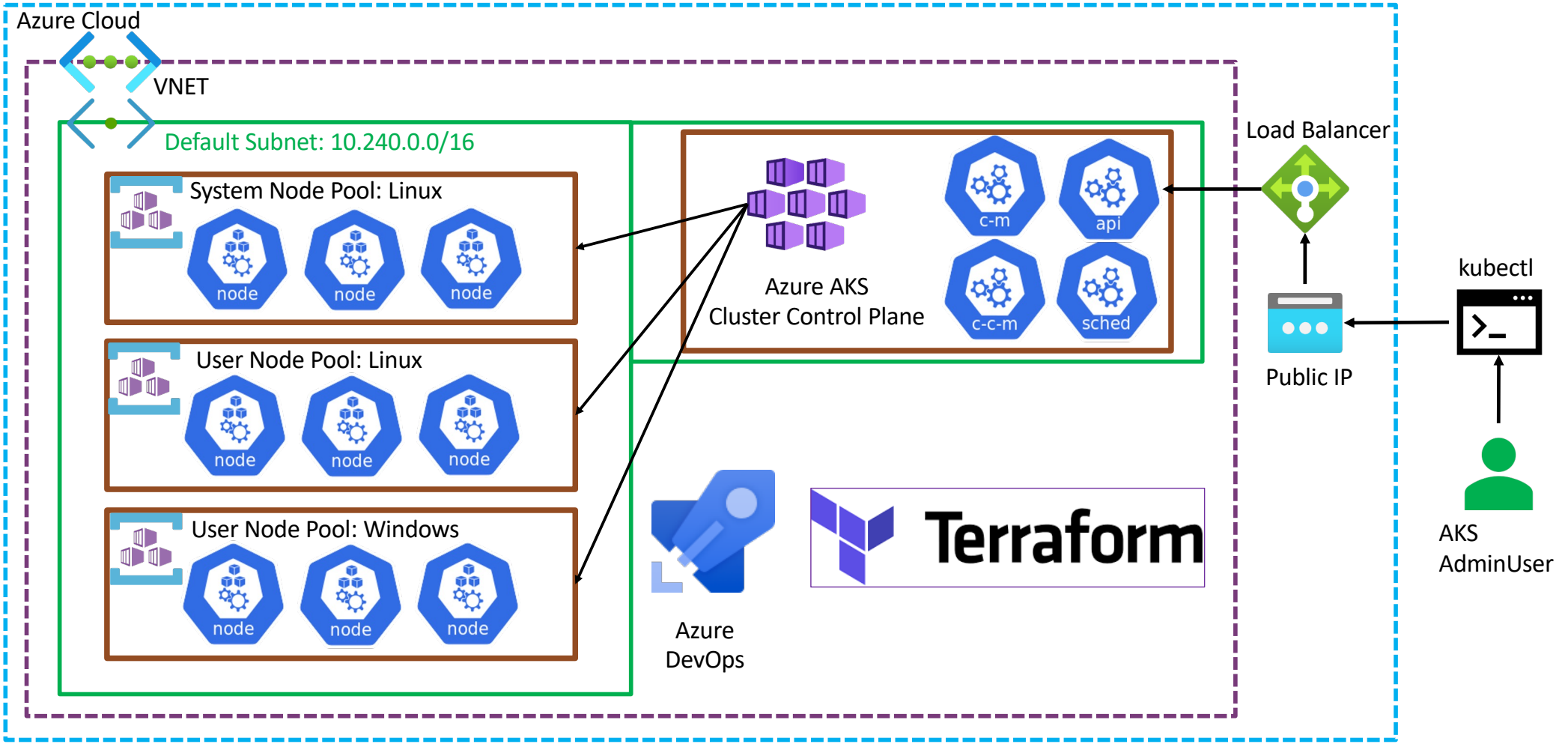


Azure AKS
Terraform Basics



Azure AKS
Azure DevOps
Terraform

Azure AKS Cluster – Node Pools (Linux, Windows



Thank You