AKS Security Simplified for Developers

Wolfgang Ofner
Senior Cloud Architect

Agenda

- Authentication and Authorization
- Entra Workload ID
- Private AKS Cluster
- Azure Key Vault Provider for Secrets

Wolfgang Ofner

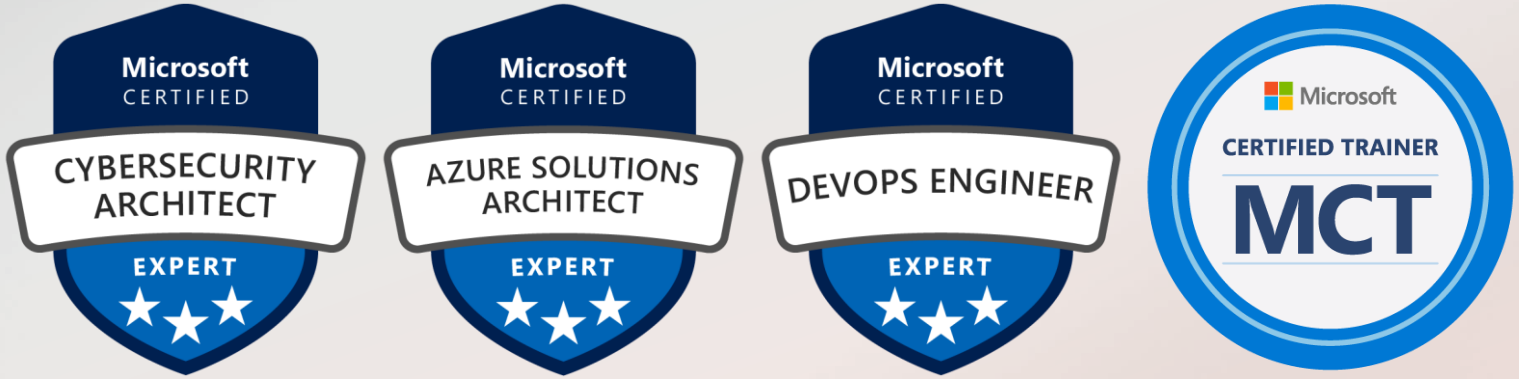
Freelance Cloud Architect, Toronto, Canada

Focus on Azure, Kubernetes, and DevOps

programmingwithwolfgang.com

wolfgangofner

YouTube @programmingwithwolfgang



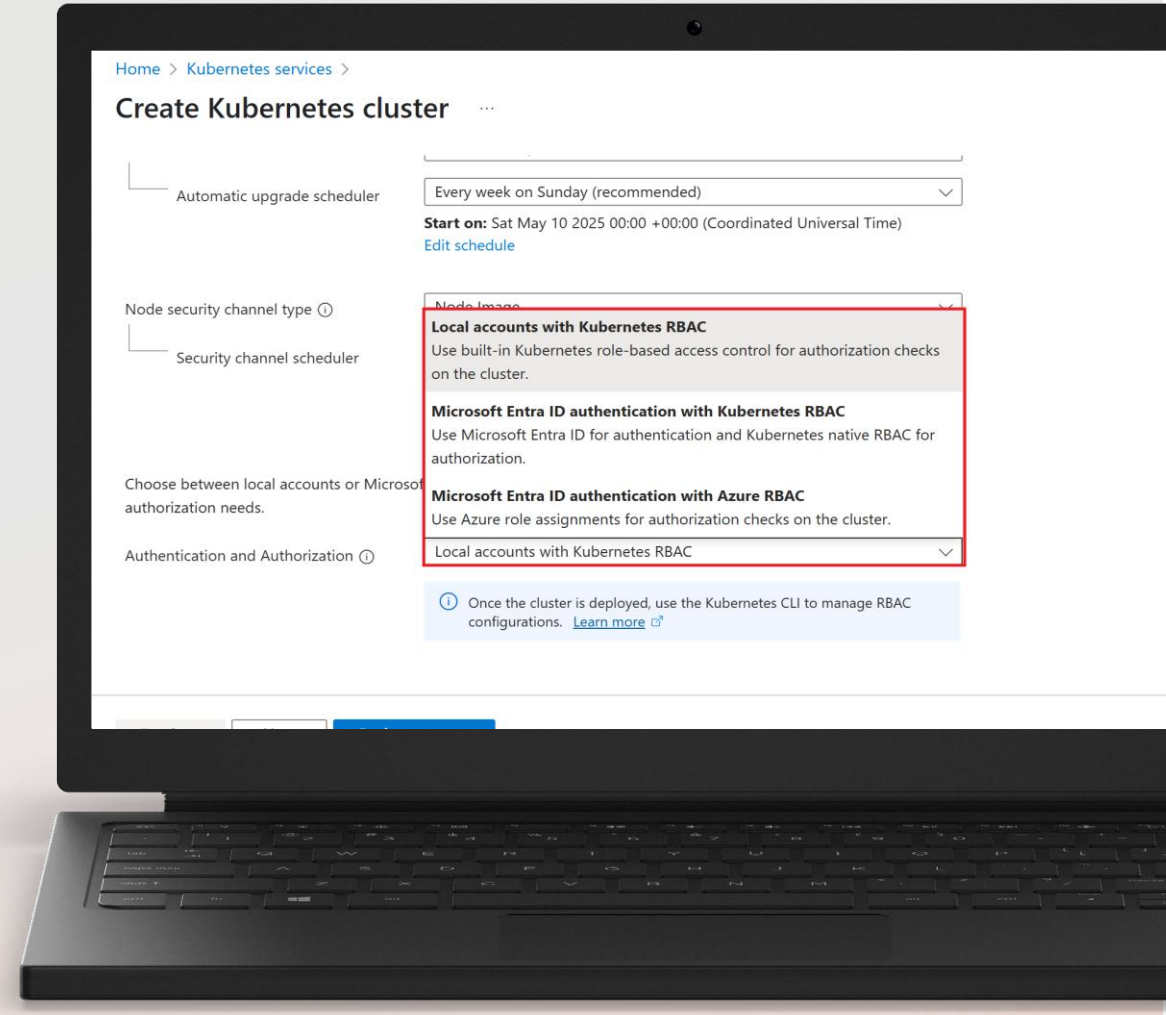
Authentication and Authorization

Authentication

Local Accounts with Kubernetes RBAC

Entra ID Authentication with Kubernetes RBAC

Entra ID Authentication with Azure RBAC



Create Kubernetes cluster

Automatic upgrade scheduler

Every week on Sunday (recommended)

Start on: Sat May 10 2025 00:00 +00:00 (Coordinated Universal Time)

Edit schedule

Node security channel type

Security channel scheduler

Local accounts with Kubernetes RBAC
Use built-in Kubernetes role-based access control for authorization checks on the cluster.

Microsoft Entra ID authentication with Kubernetes RBAC
Use Microsoft Entra ID for authentication and Kubernetes native RBAC for authorization.

Microsoft Entra ID authentication with Azure RBAC
Use Azure role assignments for authorization checks on the cluster.

Choose between local accounts or Microsof
authorization needs.

Authentication and Authorization

Local accounts with Kubernetes RBAC

Once the cluster is deployed, use the Kubernetes CLI to manage RBAC configurations. Learn more

Previous | Next | Review + create

Give feedback

Local Accounts with Kubernetes RBAC

Local Accounts K8s RBAC

Default authentication mode for AKS

No link between Microsoft Entra and AKS

Use K8s build-in authentication

Token is stored unencrypted in .kube config file

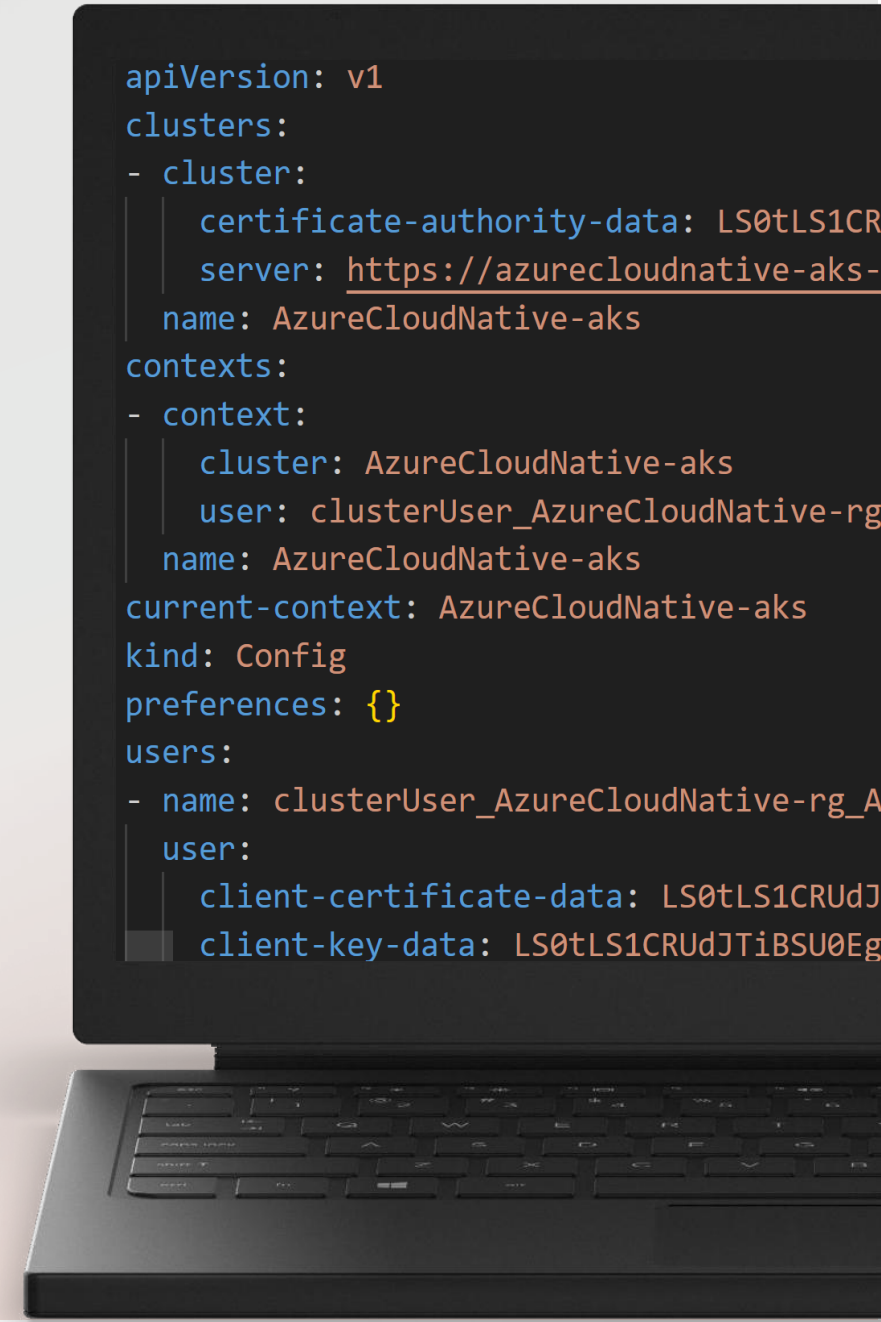
```
apiVersion: v1
clusters:
- cluster:
    certificate-authority-data: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSUU2RENDQXRDZ0
    server: https://azurecloudnative-aks-dns-537mjg6w.hcp.canadacentral.azmk8s.io:443
  name: AzureCloudNative-aks
contexts:
- context:
    cluster: AzureCloudNative-aks
    user: clusterUser_AzureCloudNative-rg_AzureCloudNative-aks
  name: AzureCloudNative-aks
current-context: AzureCloudNative-aks
kind: Config
preferences: {}
users:
- name: clusterUser_AzureCloudNative-rg_AzureCloudNative-aks
  user:
    client-certificate-data: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSUZIakNDQXdoZ0F3SU
    client-key-data: LS0tLS1CRUdJTiBSU0EgUFJJVkFURSBLRVktLS0tLQpNSUlKSndJQkFBS0NBZ0VBNT
```

Local Accounts K8s RBAC

Only recommended when non of the users are in Entra

User management can become very challenging

Local accounts should be disabled for better security

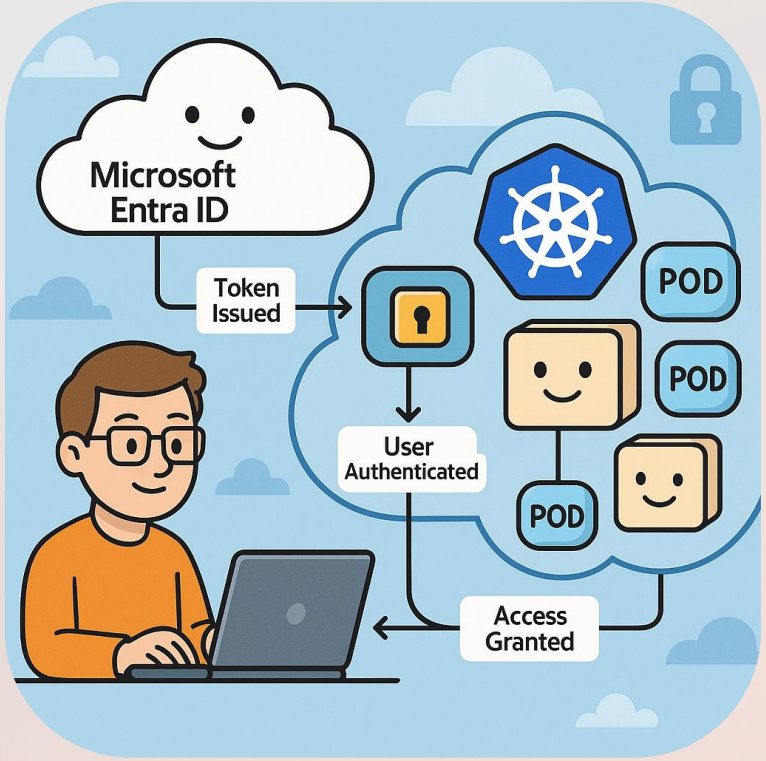


Entra ID Authentication with Kubernetes RBAC

Entra ID with K8s RBAC

Authentication via Microsoft Entra

Authorization via K8s RBAC



Entra ID with K8s RBAC

Admin creates role bindings between K8s role and Entra user or group

Entra user or group needs “Azure Kubernetes Cluster User Role” role to download credentials

```yaml
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: reader
  namespace: read
rules:
- apiGroups: [""]
  resources: ["pods", "services", "endpoints", "persistentvolumeclaims",
  verbs: ["get", "list", "watch"]
- apiGroups: ["apps"]
  resources: ["deployments", "daemonsets", "replicasets", "statefulsets"]
  verbs: ["get", "list", "watch"]
- apiGroups: ["batch"]
  resources: ["jobs", "cronjobs"]
  verbs: ["get", "list", "watch"]
- apiGroups: ["extensions"]
  resources: ["ingresses"]
```

```yaml
kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: reader-user-binding
  namespace: read
subjects:
  - kind: Group
    name: 24975d09-19e9-47a5-aa3b-e952c693c016 # Entra ID
    namespace: read
roleRef:
  kind: Role # or ClusterRole
  name: reader
  apiGroup: rbac.authorization.k8s.io
```

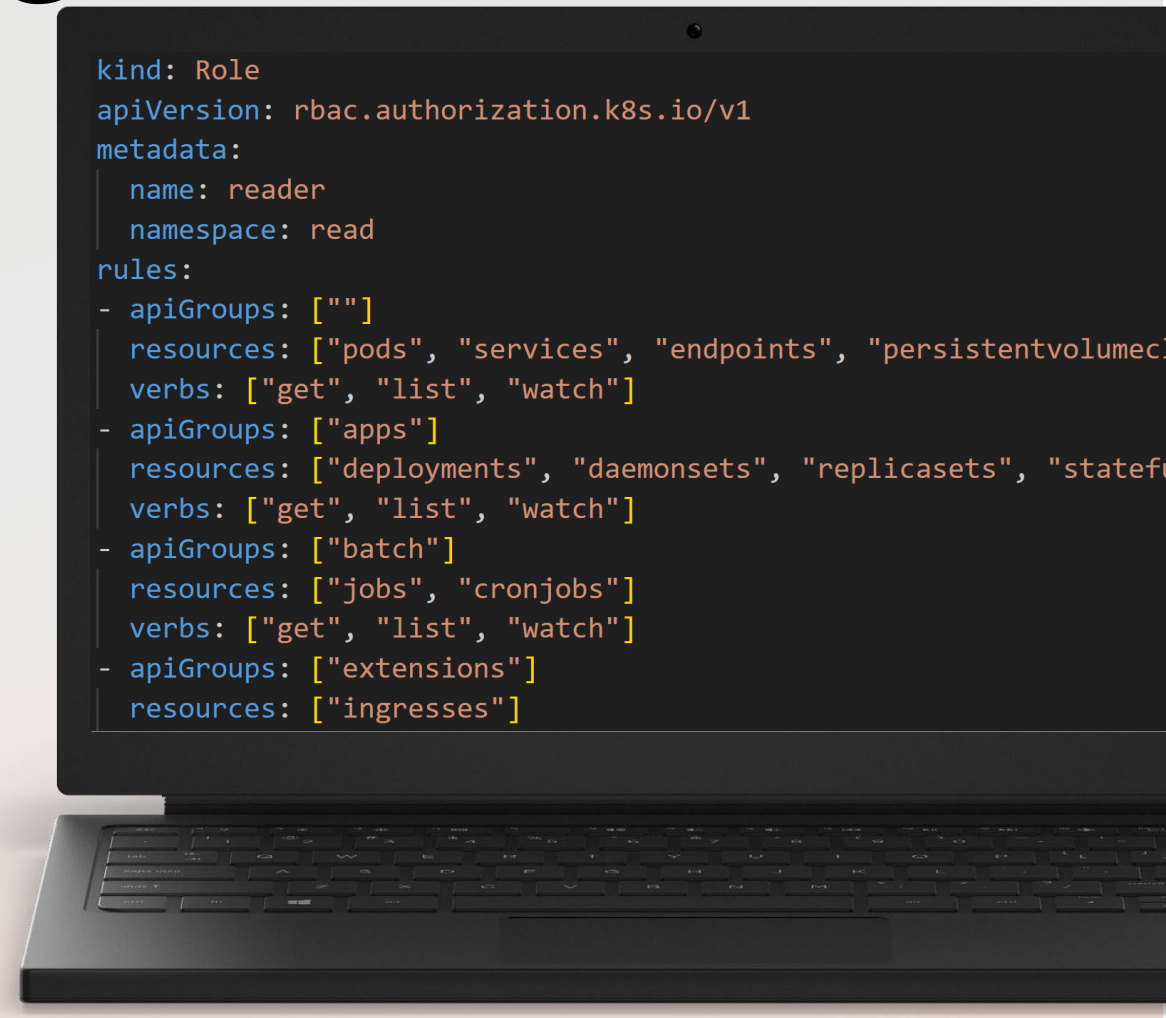
Entra ID with K8s RBAC

```
PS C:\Demo> kubectl get all -n read
NAME          READY   STATUS    RESTARTS   AGE
pod/nginx     1/1     Running   0          4m32s
Error from server (Forbidden): replicationcontrollers is forbidden
: User "demo.user@programmingwithwolfgang.com" cannot list resourc
e "replicationcontrollers" in API group "" in the namespace "read"
Error from server (Forbidden): horizontalpodautoscalers.autoscalin
g is forbidden: User "demo.user@programmingwithwolfgang.com" canno
t list resource "horizontalpodautoscalers" in API group "autoscali
ng" in the namespace "read"
```

Entra ID with K8s RBAC

Easier user management than local accounts

Use for Arc-enabled K8s clusters

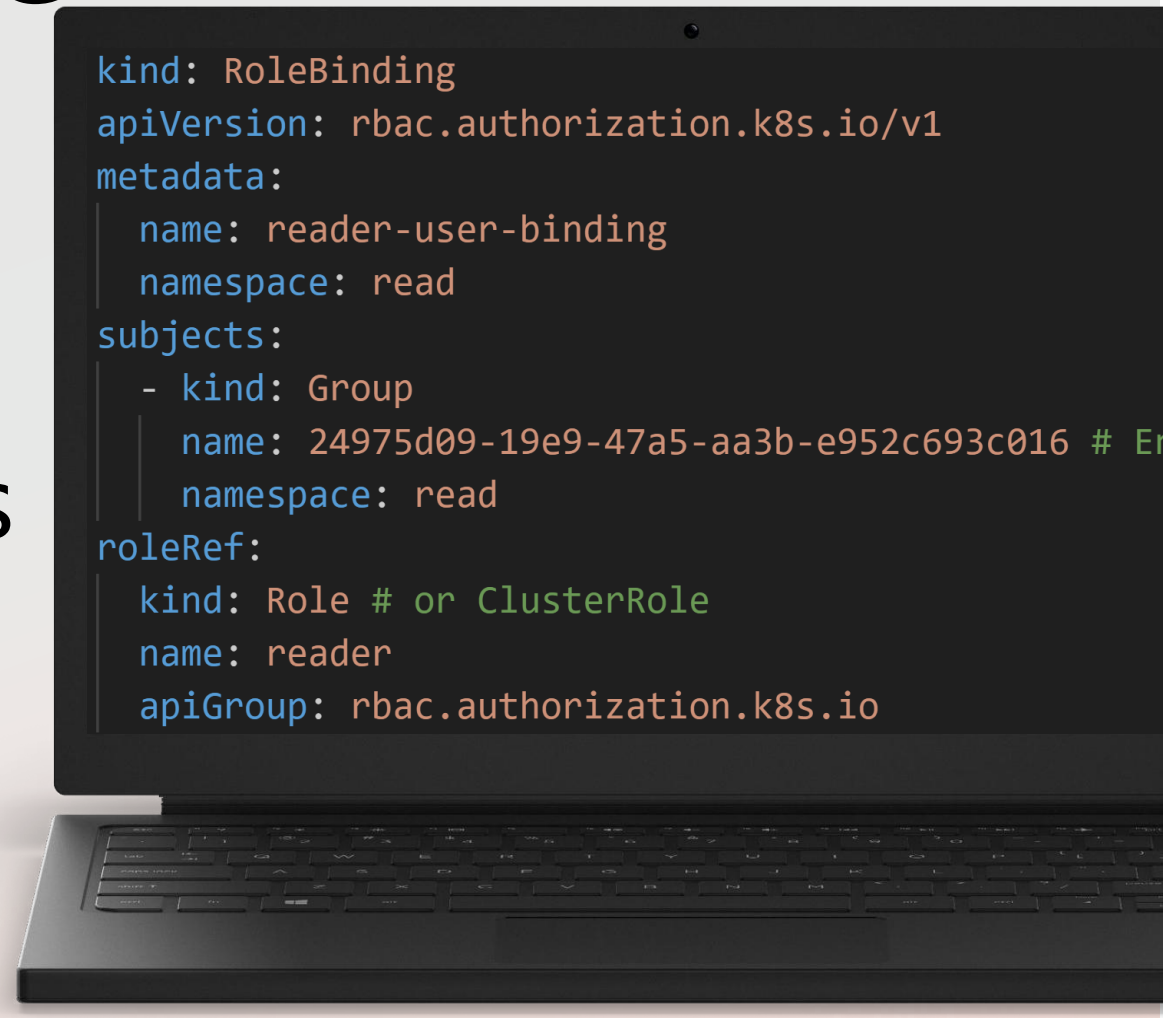


Entra ID with K8s RBAC

Auditing access to the cluster can be cumbersome

Management with Entra IDs

Access can be given to Entra users and groups



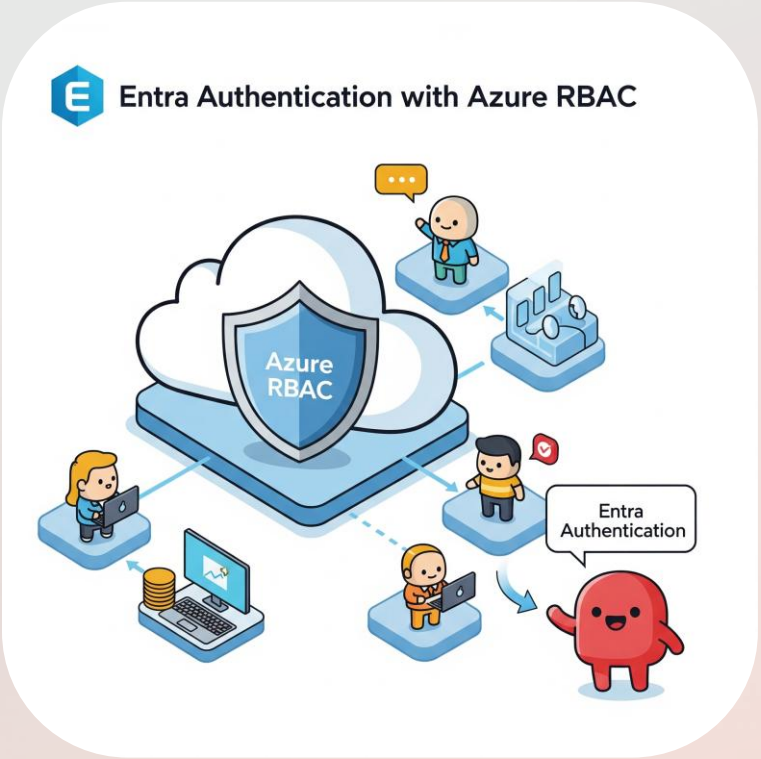
Entra ID Authentication with Azure RBAC

Entra Authentication with Azure RBAC

Manage access to the cluster with Azure only

Use Azure RBAC roles to manage permissions inside AKS

Recommended way to manage AKS cluster

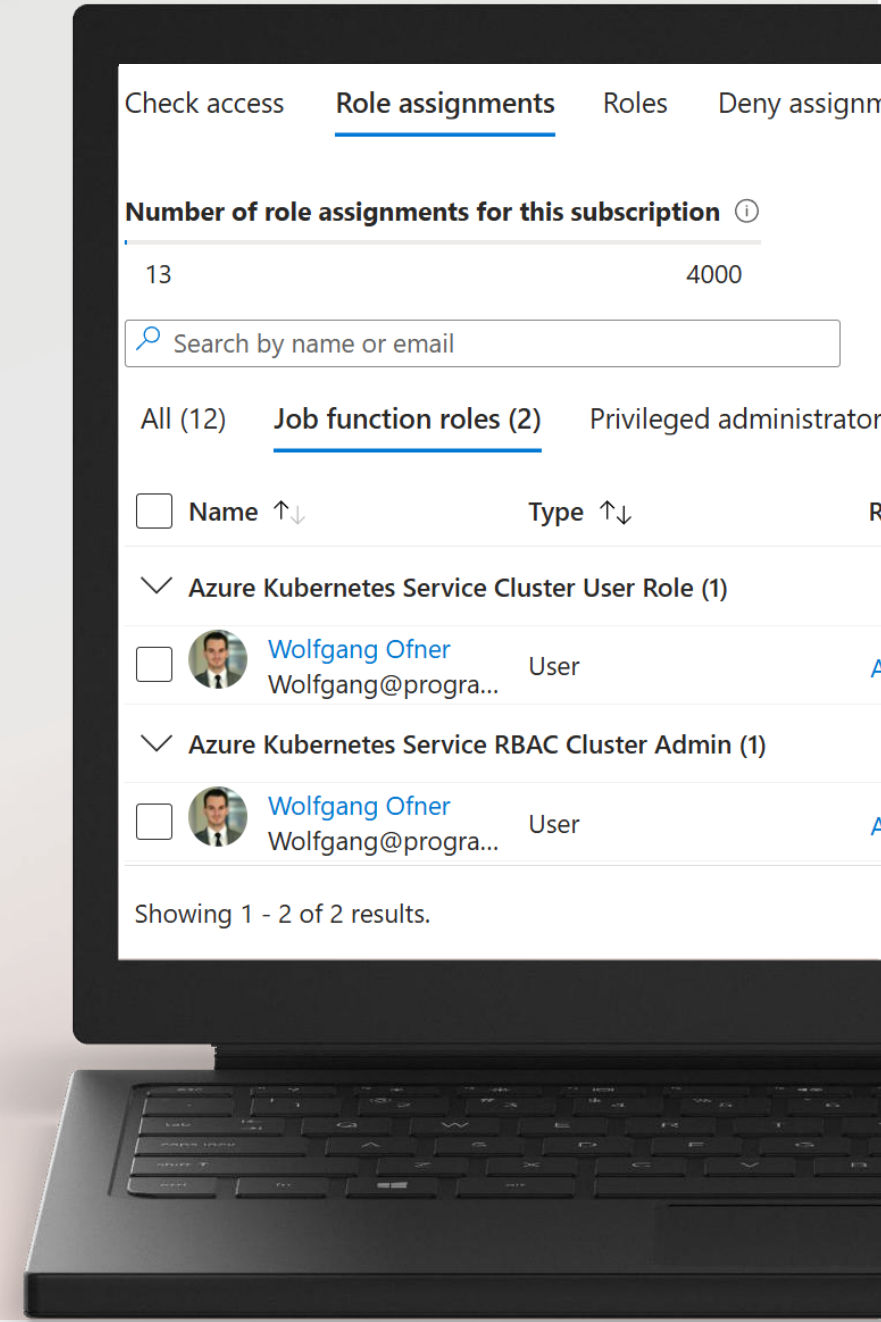


Entra Authentication with Azure RBAC

"Azure Kubernetes Service Cluster User Role" to download credentials

Assign built-in or custom roles

Namespace specific permissions via Azure CLI only



Entra
Workload Identity

Entra Workload Identity

Azure resource can have identities

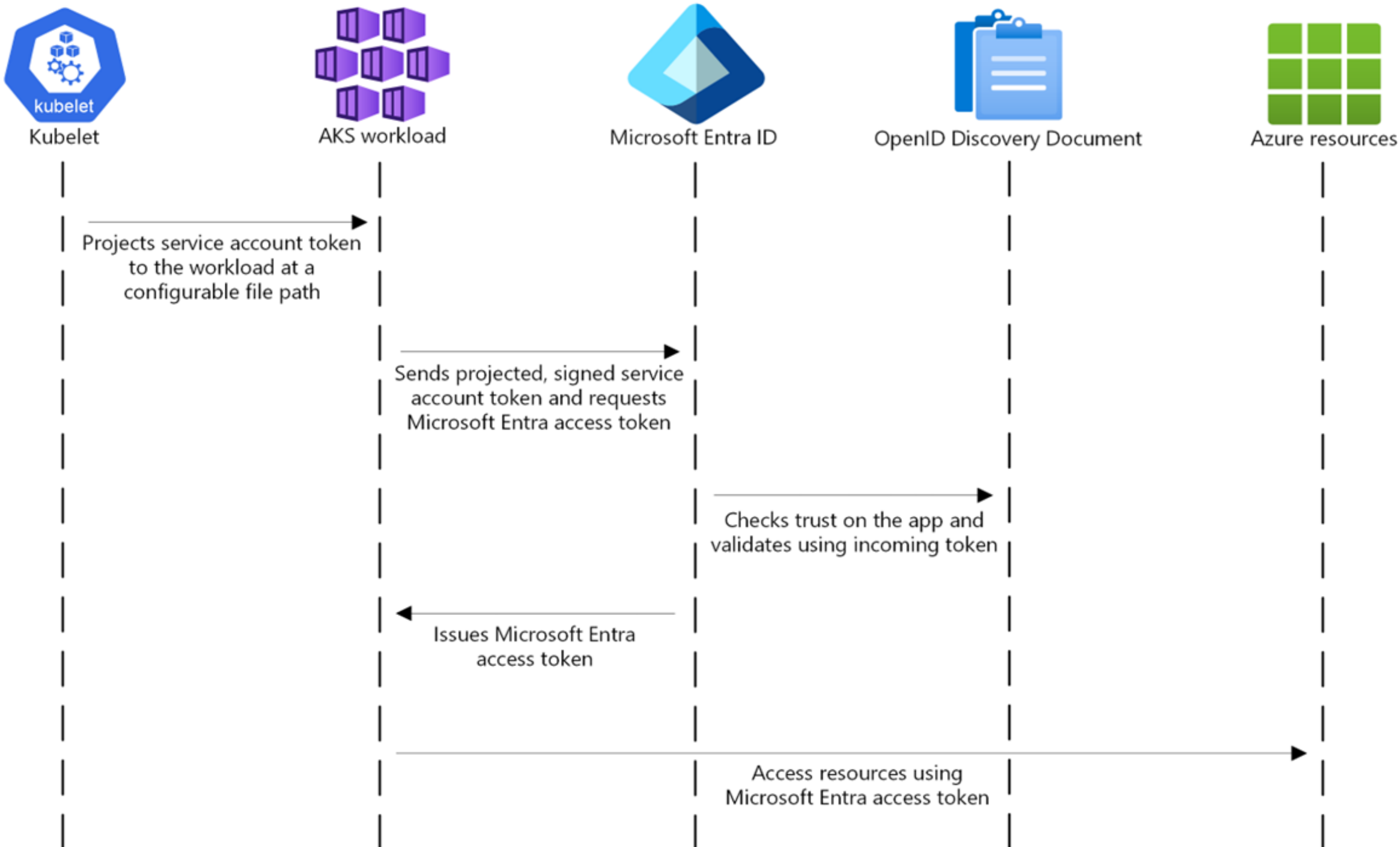
Always use identities over username and password

AKS identity is not assigned to the pods

Entra Workload Identity

Entra Workload Identity gives a pod an identity

- Pods can access Azure resources with this identity
- OIDC Issuer must be enabled for the AKS cluster
- Label pod and annotate service account

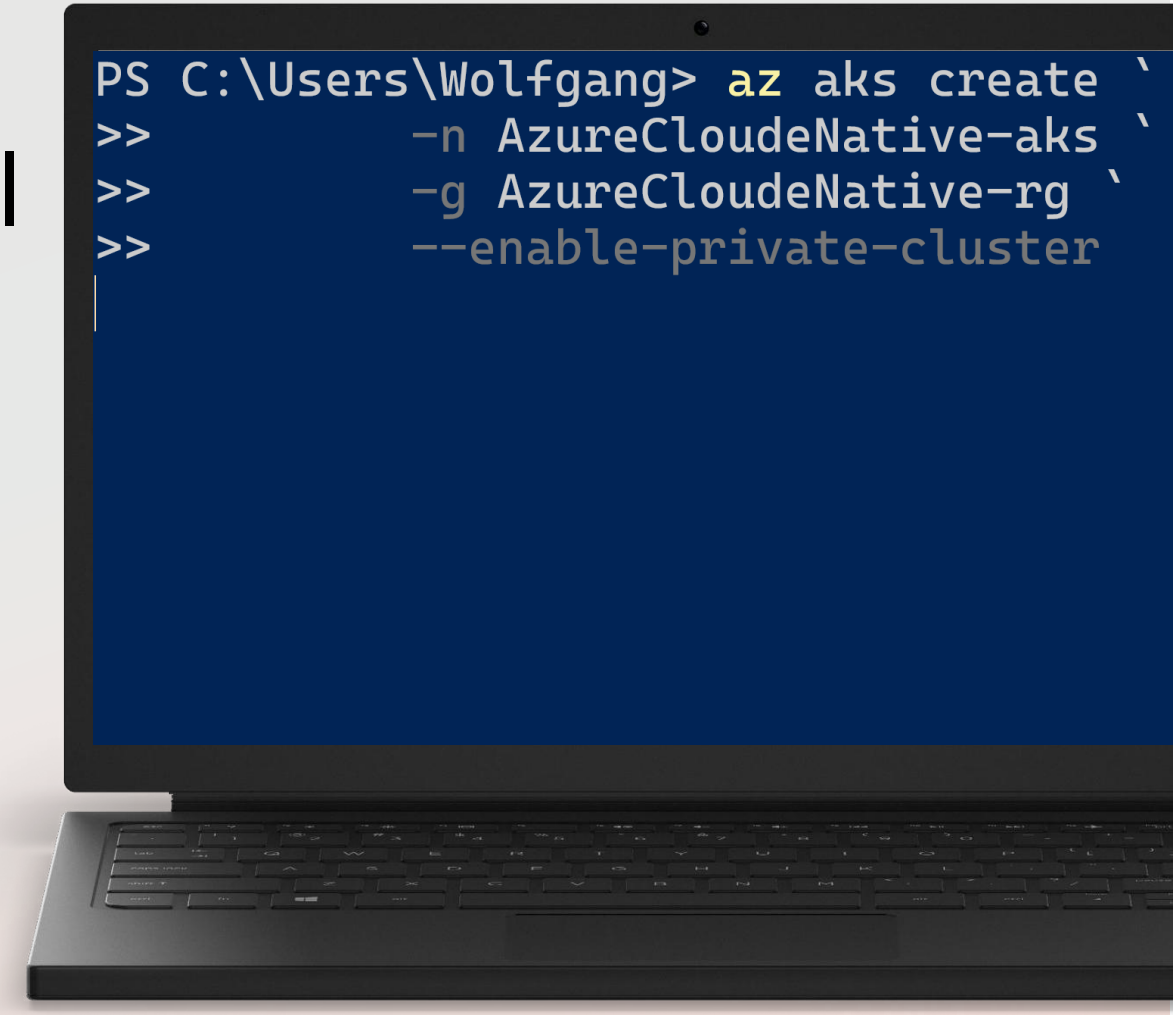

kubelet
Kubelet
AKS workload
Microsoft Entra ID
OpenID Discovery Document
Azure resources
Projects service account token to the workload at a configurable file path
Sends projected, signed service account token and requests Microsoft Entra access token
Checks trust on the app and validates using incoming token
Issues Microsoft Entra access token
Access resources using Microsoft Entra access token

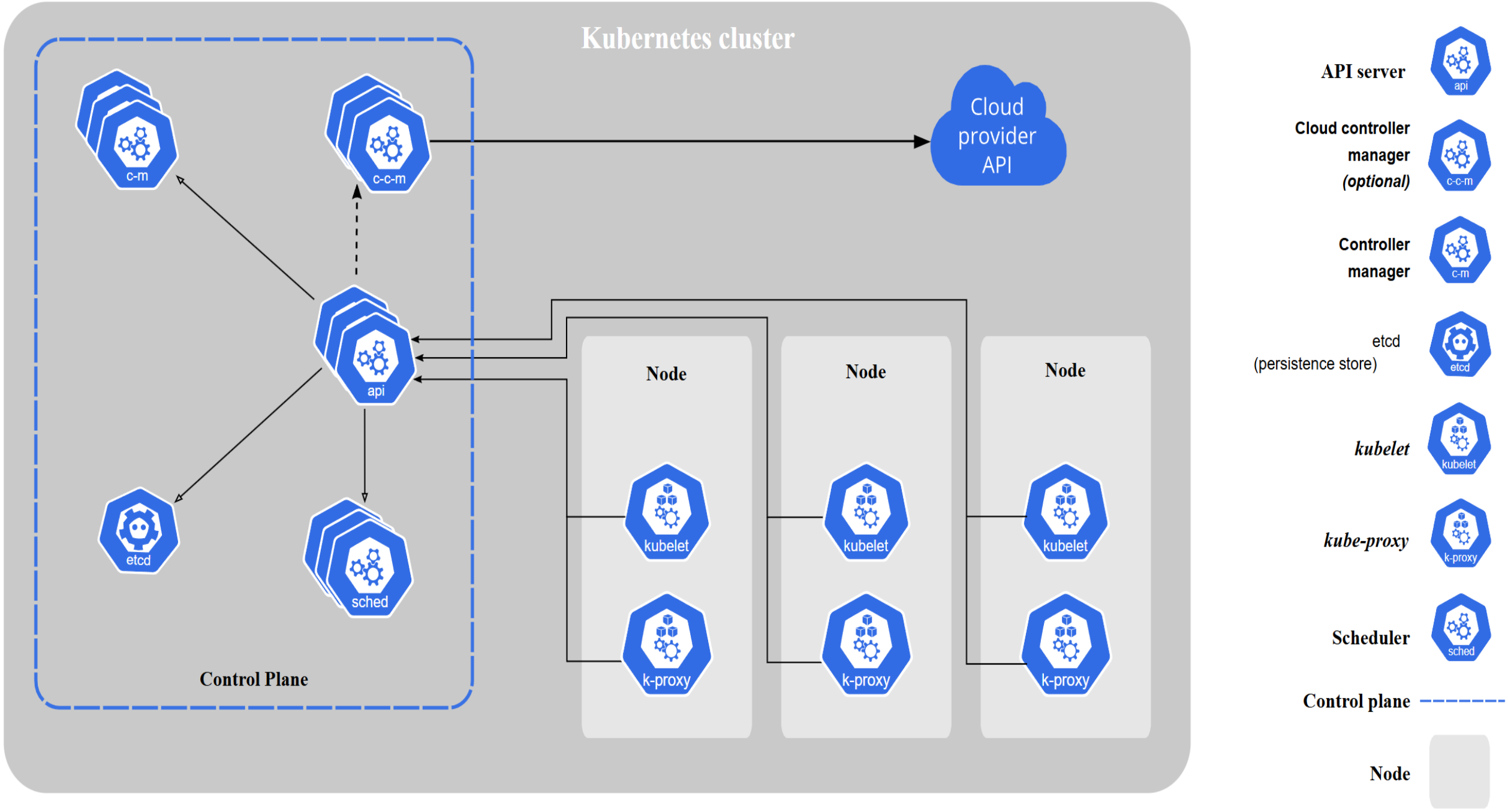
Private
AKS Cluster

Private AKS Cluster

Disable public access to API

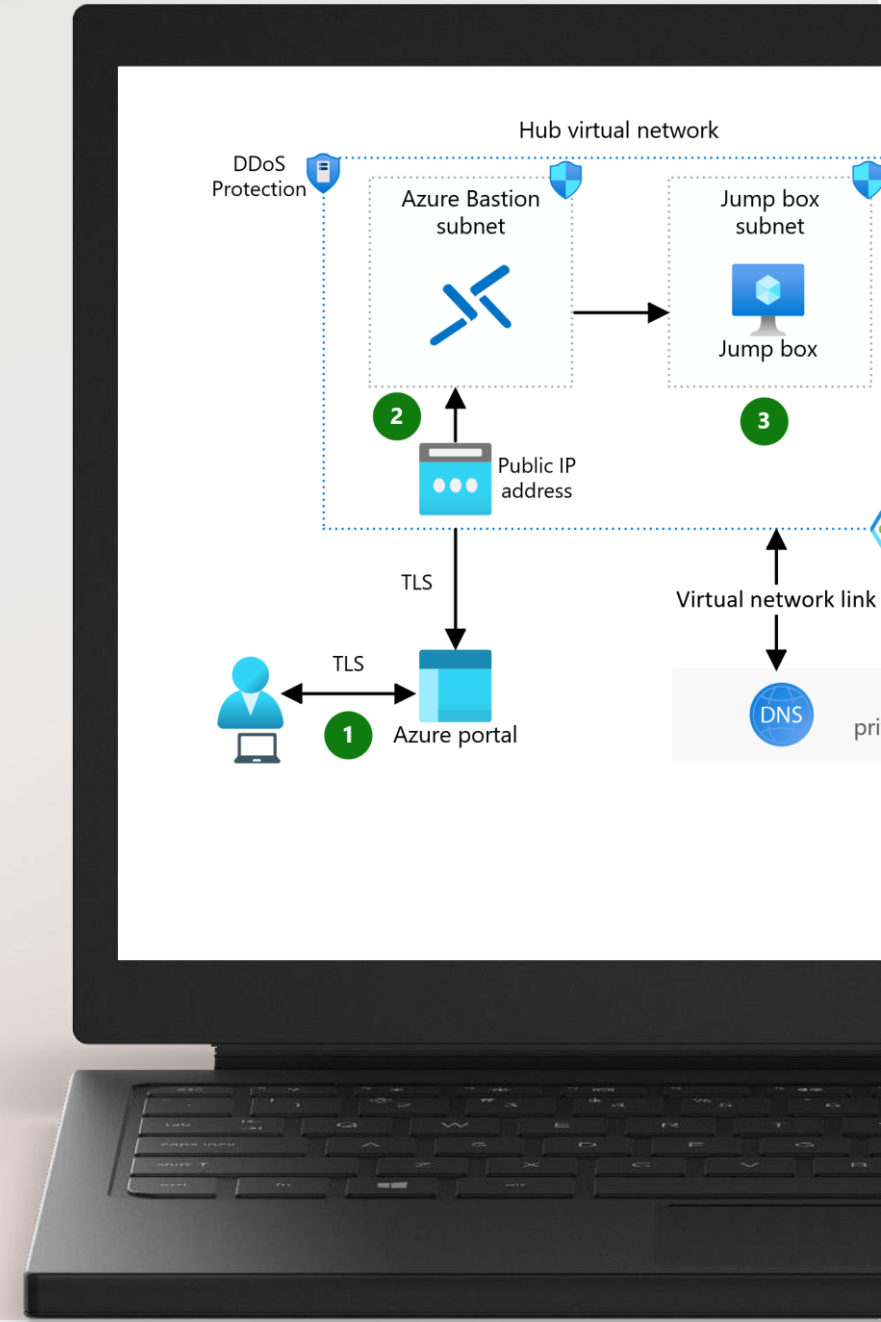
Communication between Worker and Master nodes over a private connection

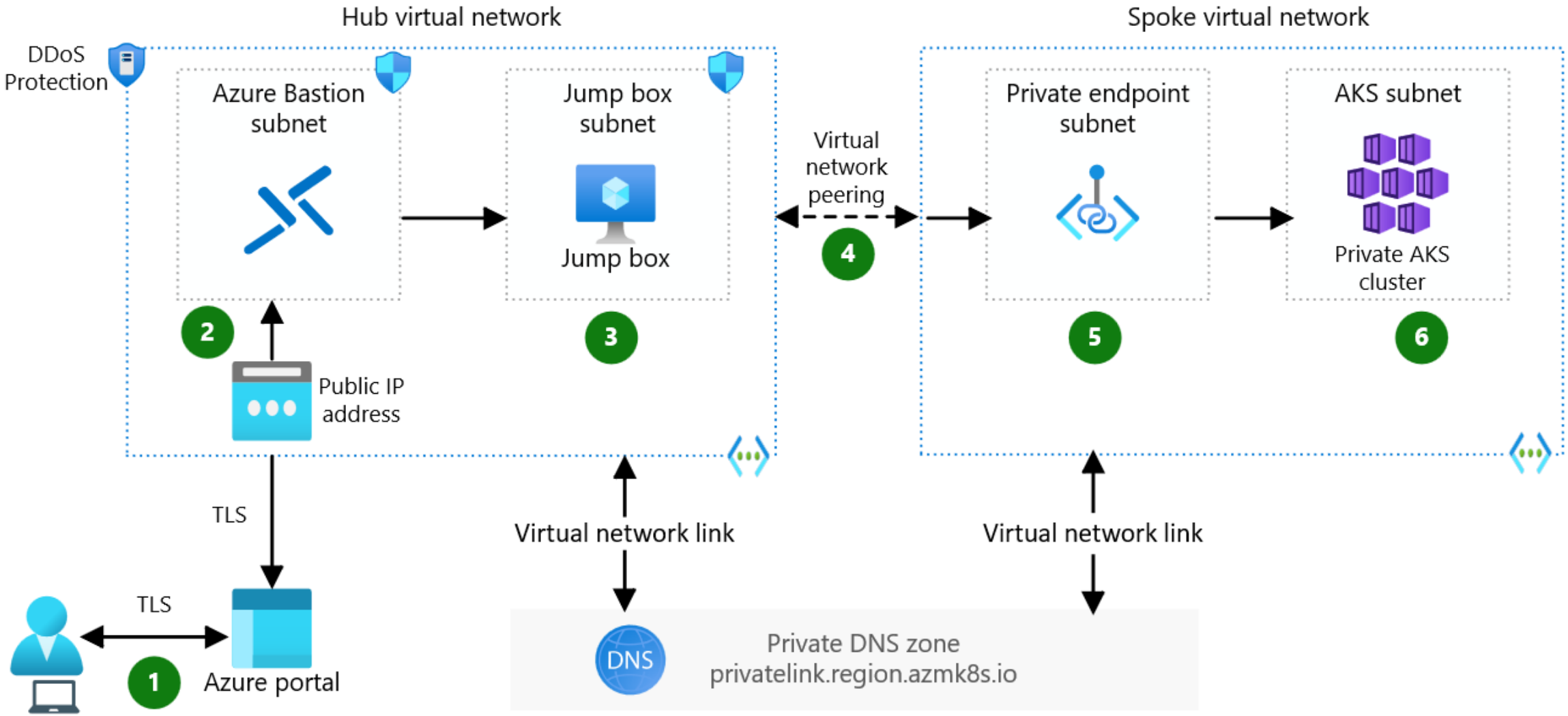



Kubernetes cluster
c-m
c-c-m
Cloud provider API
api
etcd
sched
Control Plane
Node
kubelet
k-proxy
Node
kubelet
k-proxy
Node
kubelet
k-proxy
API server
Cloud controller manager (optional)
Controller manager
etcd (persistence store)
kubelet
kube-proxy
Scheduler
Control plane
Node

Private AKS Cluster

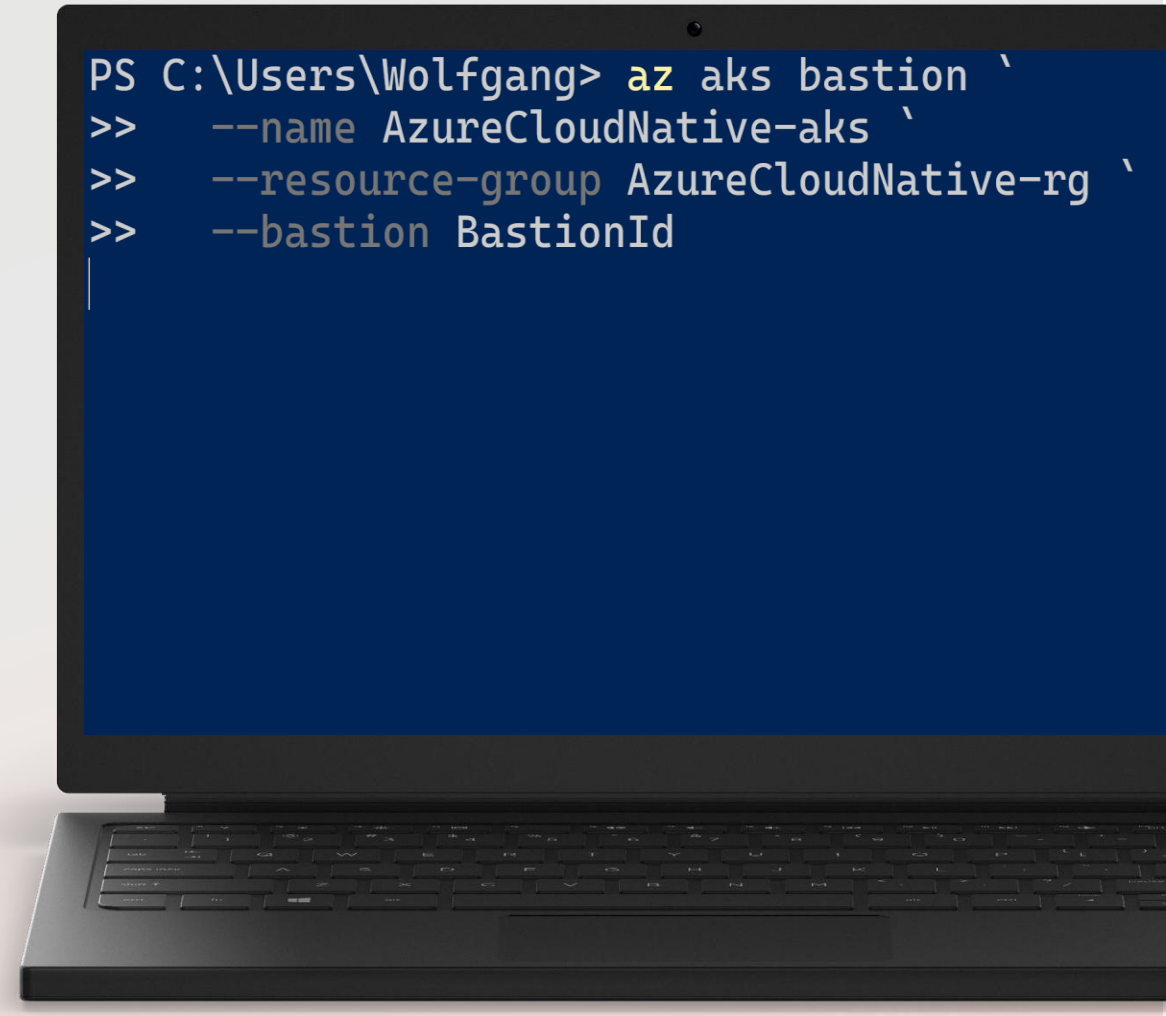
Use Azure Bastion and a Jump box

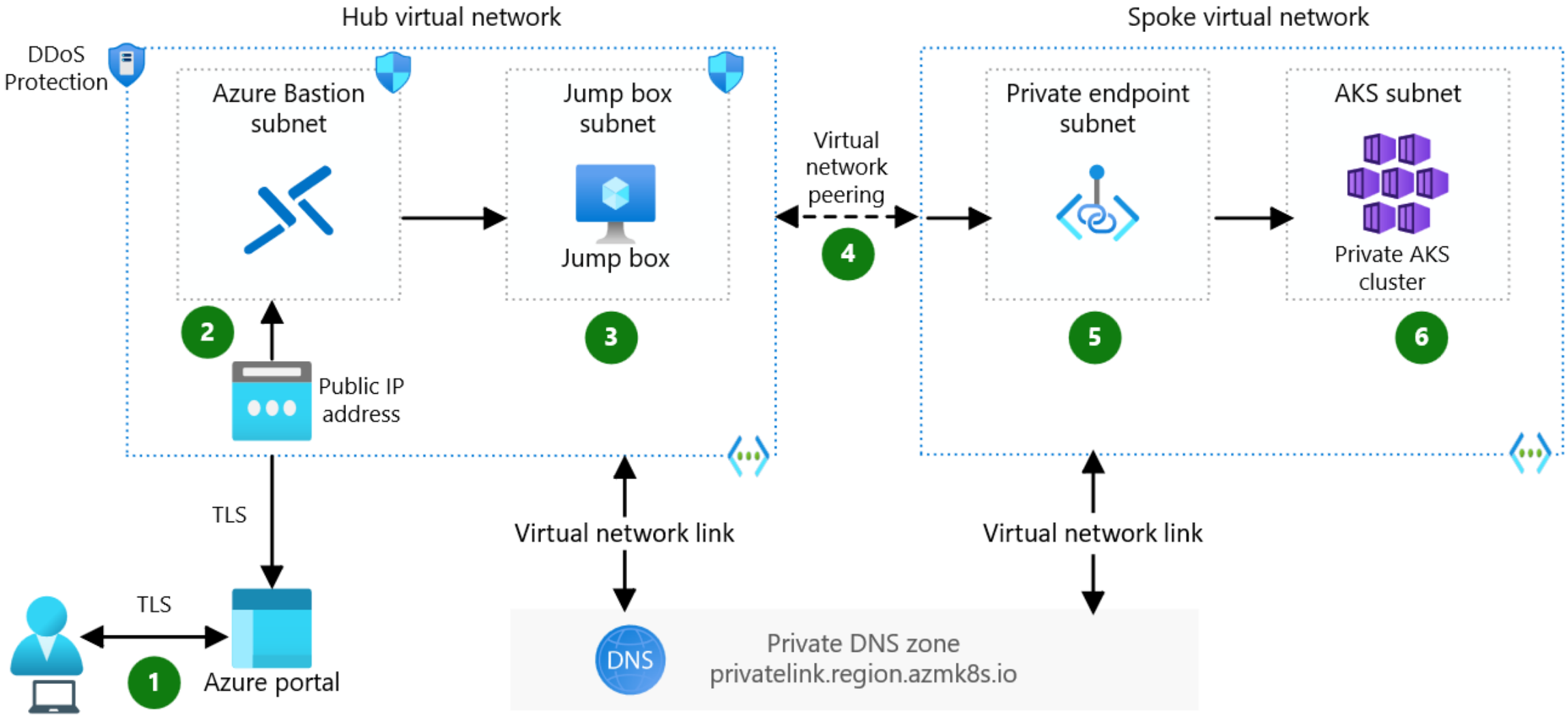



Hub virtual network
Spoke virtual network
DDoS Protection
Azure Bastion subnet
Jump box subnet
Jump box
Virtual network peering
Private endpoint subnet
AKS subnet
Private AKS cluster
2
3
4
5
6
Public IP address
TLS
TLS
Virtual network link
Virtual network link
DNS
Private DNS zone
privatelink.region.azmk8s.io
1
Azure portal

Private AKS Cluster

New feature to access AKS through Azure Bastion




Hub virtual network
Spoke virtual network
DDoS Protection
Azure Bastion subnet
Jump box subnet
Jump box
Virtual network peering
Private endpoint subnet
AKS subnet
Private AKS cluster
2
3
4
5
6
Public IP address
TLS
TLS
Virtual network link
Virtual network link
DNS
Private DNS zone
privatelink.region.azmk8s.io
1
Azure portal

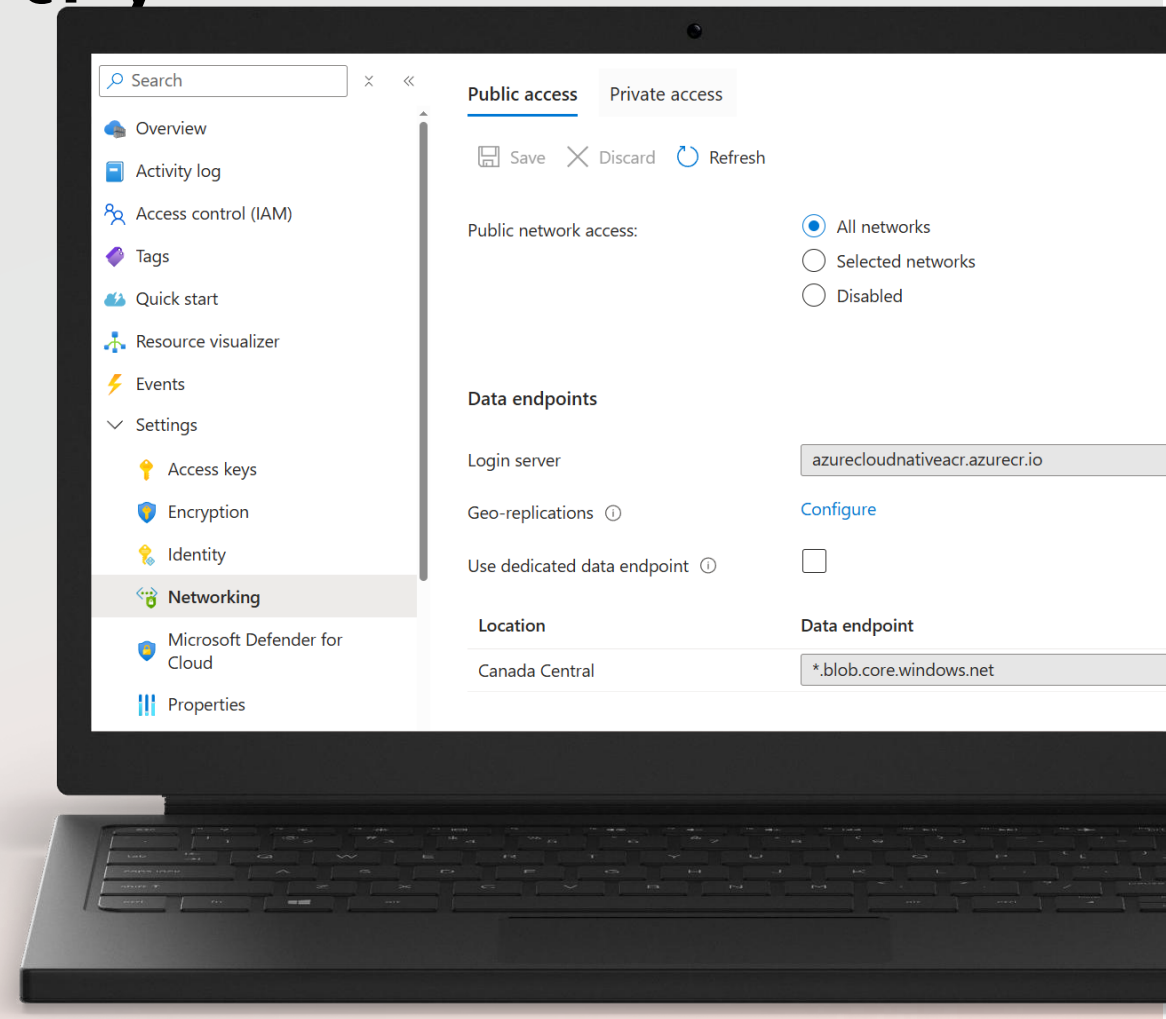
Private
Azure Container Registry

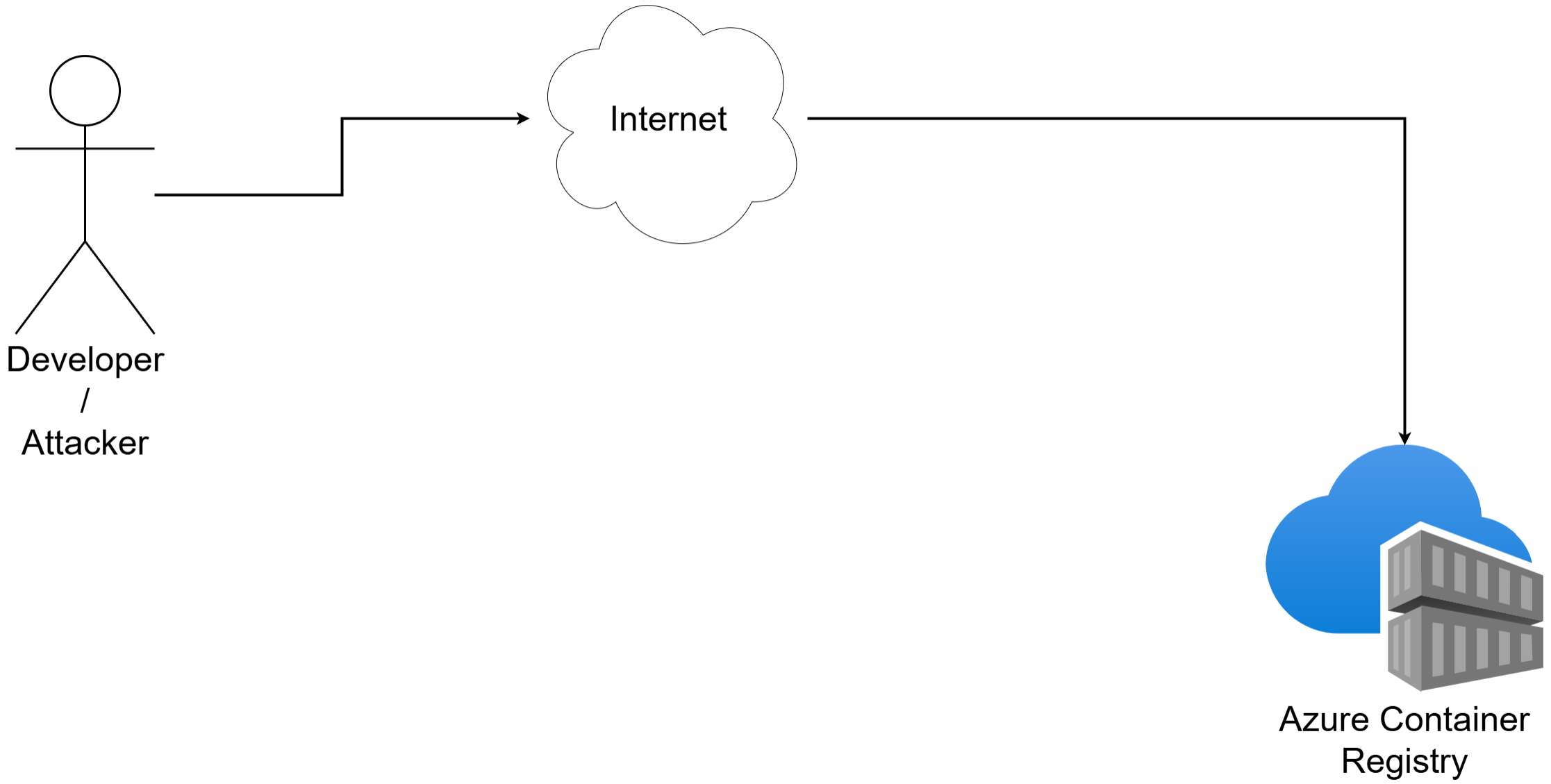
Azure Container Registry

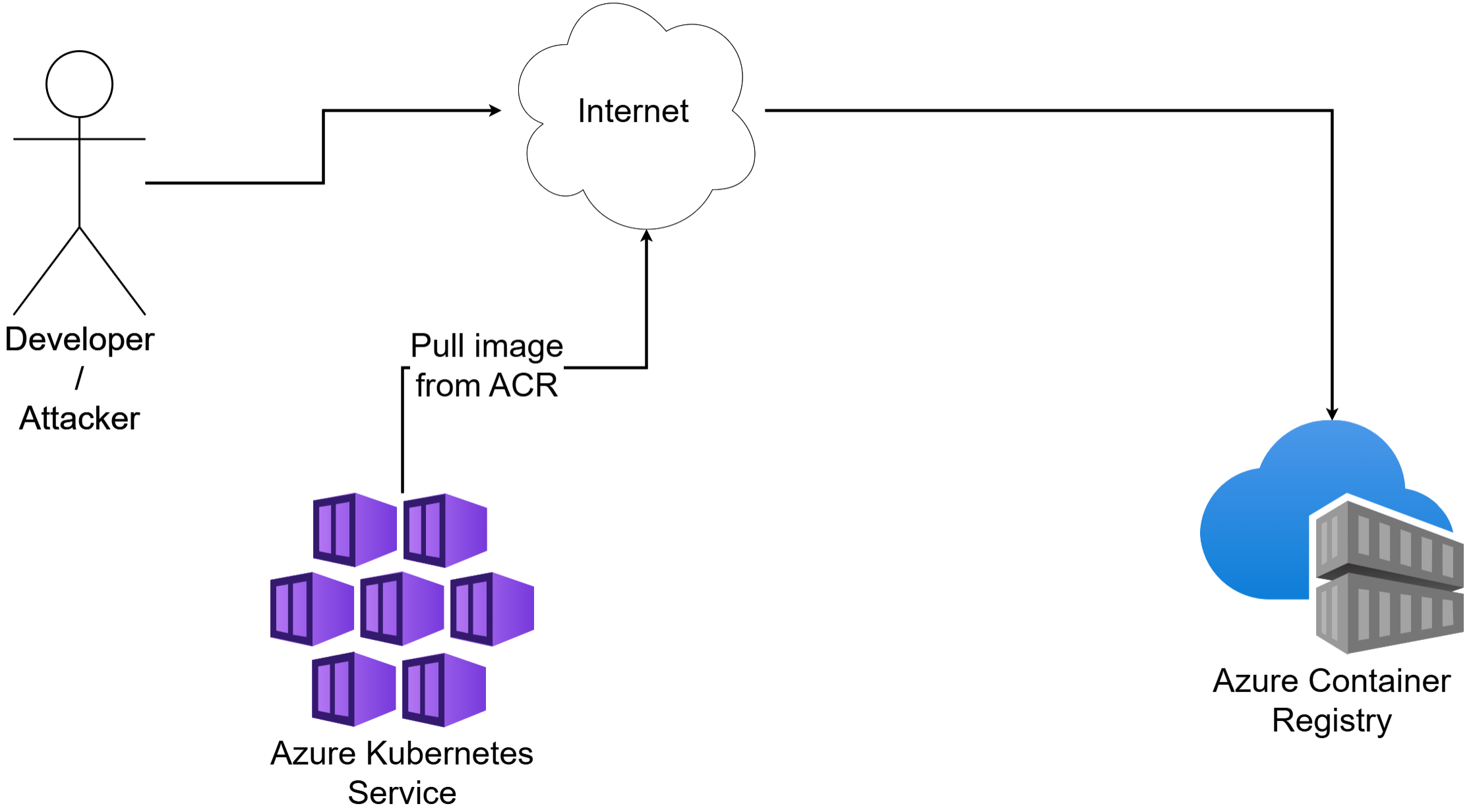
Store images in private registry

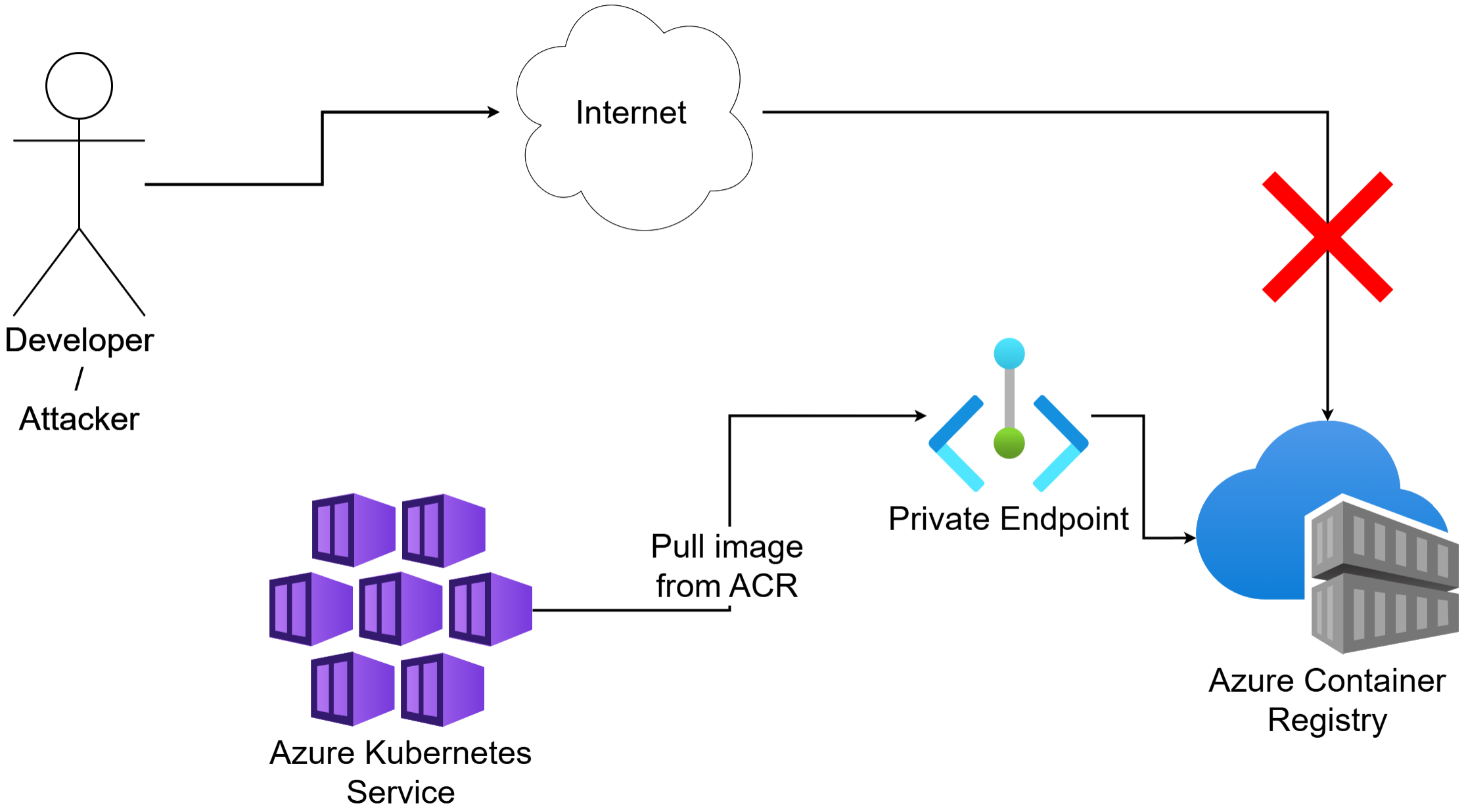
Keep everything private

AKS should download images over private connection




Internet
Developer
/
Attacker
Azure Container
Registry


Internet
Developer
/
Attacker
Pull image
from ACR
Azure Kubernetes
Service
Azure Container
Registry


Internet
Developer
/
Attacker
Private Endpoint
Pull image
from ACR
Azure Kubernetes
Service
Azure Container
Registry

Azure Container Registry

No changes for pull operation necessary

Private DNS-Zone resolves public FQDN

Build agent needs to push images over private endpoint

Azure Key Vault Provider for Secrets Store CSI Driver

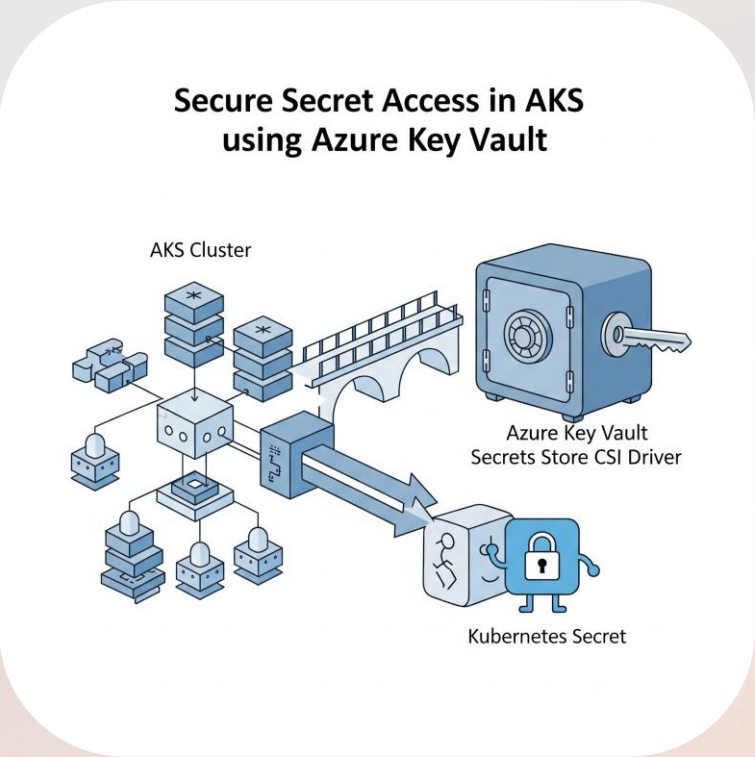
Key Vault Provider for Secrets Store

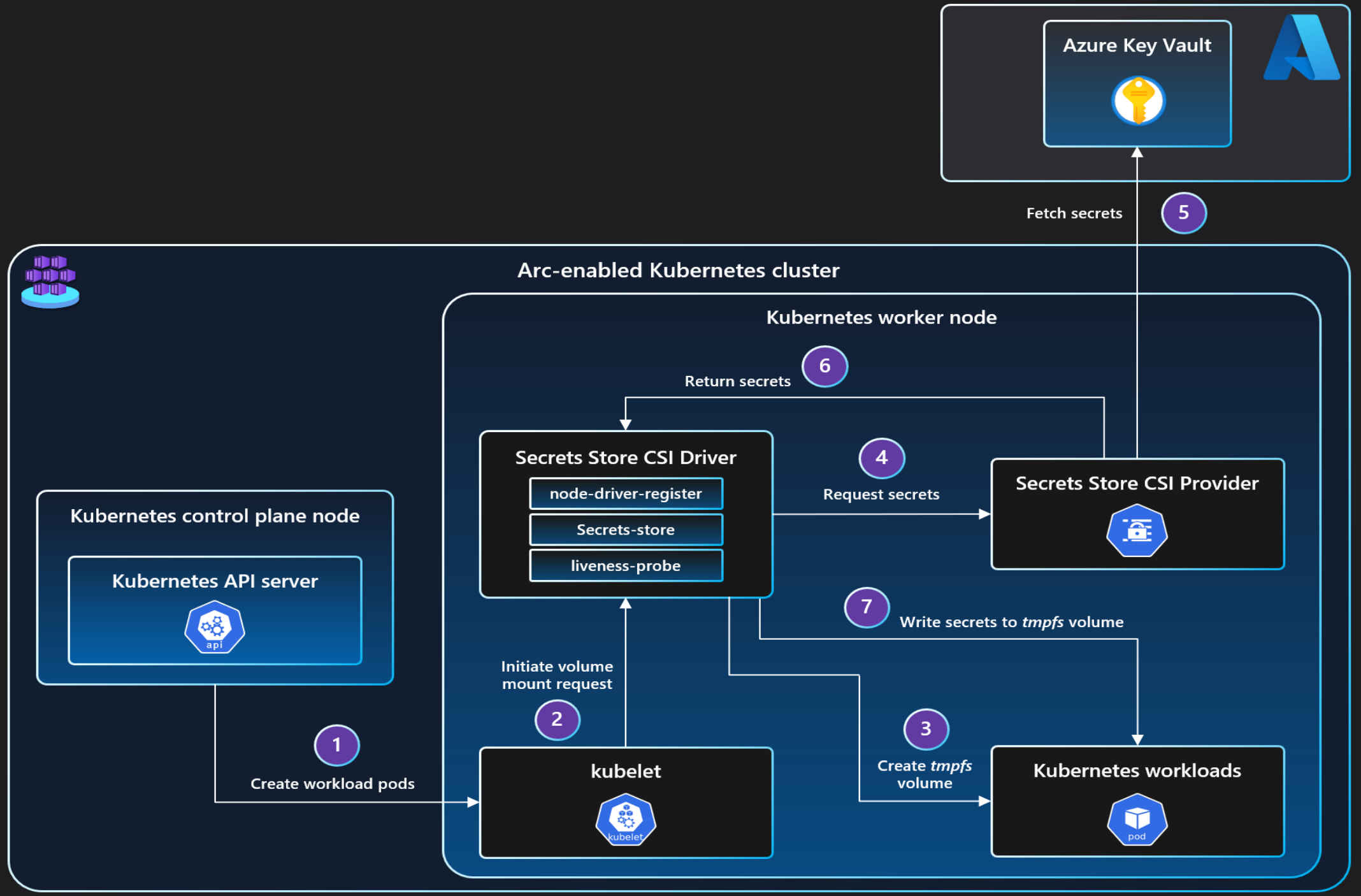
Mount secrets, keys, and certificates to pods

Auto-rotate secrets

Sync Azure Key Vault with Kubernetes secrets

Separation of concerns




Azure Key Vault
Fetch secrets
5
Arc-enabled Kubernetes cluster
Kubernetes worker node
6
Return secrets
Secrets Store CSI Driver
node-driver-register
Secrets-store
liveness-probe
4
Request secrets
Secrets Store CSI Provider
Kubernetes control plane node
Kubernetes API server
api
7
Write secrets to tmpfs volume
Initiate volume mount request
2
1
Create workload pods
kubelet
kubelet
3
Create tmpfs volume
Kubernetes workloads
pod

Further Security Topics

Further Security Topics

Use Azure Linux as your node OS

Disable SSH access

Disable local accounts

Install the Azure Policy addon

Microsoft Defender for Containers

Setup your cluster using AKS Automatic

Further Security Topics

Only run signed images

Validate image integrity

Limit the pod privileges

Set the security context

Reduce the pod capabilities

Configure seccom (secure computing)

AKS Security Simplified for Developers

Wolfgang Ofner
Senior Cloud Architect