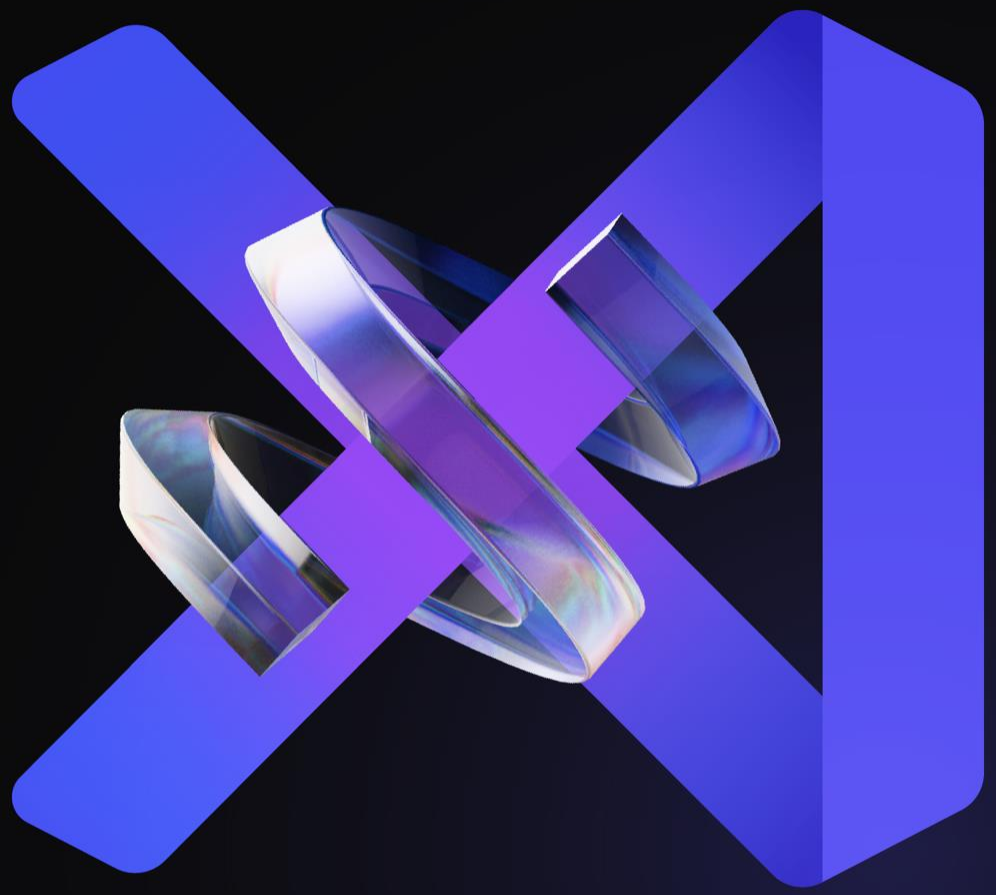
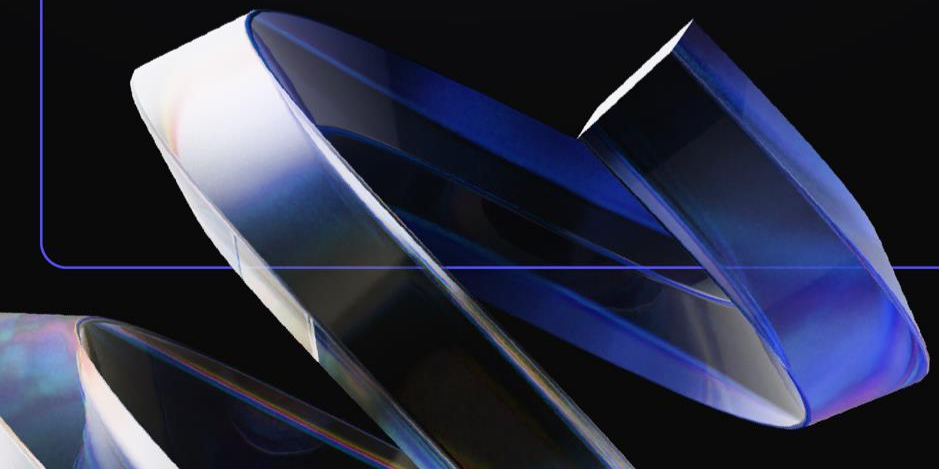
//MSTS/ MS TECH SUMMIT

Unleashing the Potential of Hybrid Cloud: Streamlining Multi-Cloud Management and On-Premises Integration

Wolfgang Ofner





Organizatorem wydarzenia jest Fundacja Academic Partners

ACADEMIC PARTNERS

Wolfgang Ofner

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Focus on Azure, Kubernetes, DevOps, and .NET

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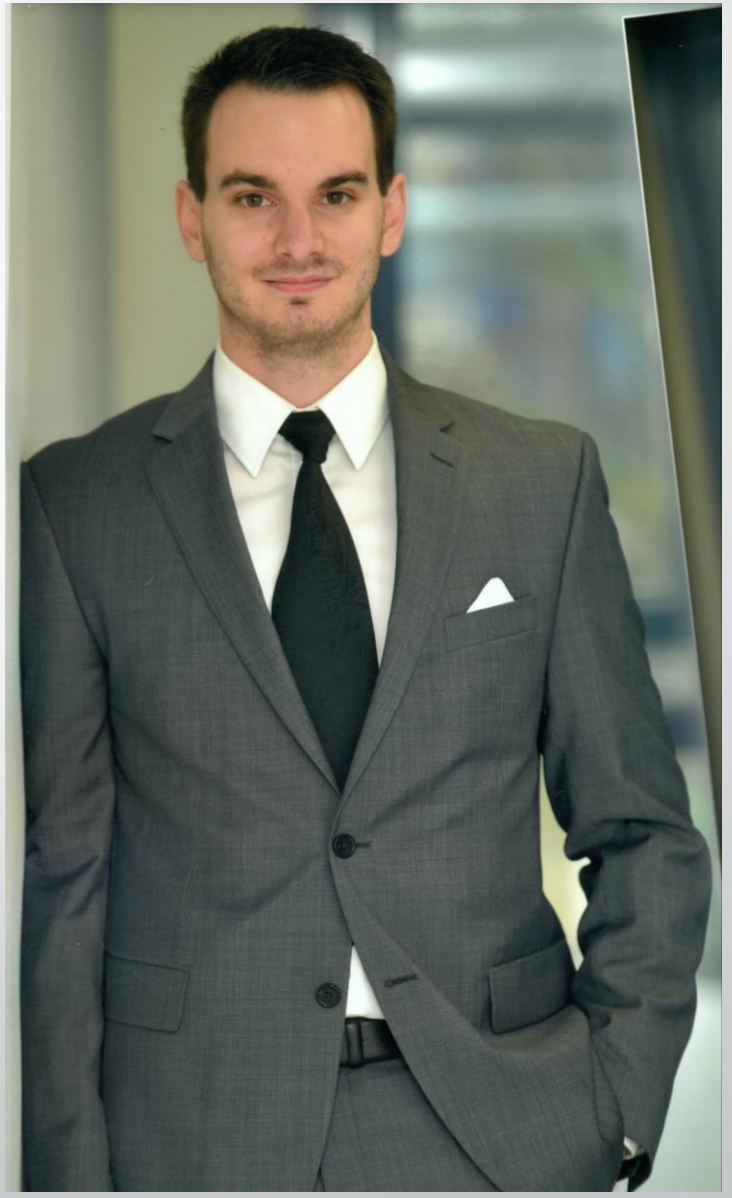


Agenda

- Introduction to Hybrid Cloud
- Azure Arc and Kubernetes
- Integrating On-Premises with Cloud
- Conclusion

Hybrid Cloud

Hybrid Cloud Definition

Hybrid Cloud is a combination of public and private cloud services, along with on-premises infrastructure, creating a unified computing environment that offers greater flexibility, scalability, and cost-effectiveness.

Types of Hybrid Cloud

Split cloud and on-premise usage

Extend on-premise usage with simple cloud services

- Storage or database services
- VPN or ExpressRoute into the cloud

Unify on-premises and cloud environment

- Run cloud services in your datacenter

Benefits of Hybrid Cloud

Data Sovereignty

Security

Latency

Cost

Resiliency

Challenges of Hybrid Cloud

Complex infrastructure

Security and compliance

Data integration

Skill set

Run Azure Services On-Premises

Azure Stack Edge

Azure Stack Hub

Azure Stack HCI

Azure Arc

Azure Stack HCI

Azure Stack HCI OS is an operating system based on Windows Server

Built on proven technologies such as Hyper-V, Storage Spaces Direct, and Azure-inspired SDN

Each cluster consists of 1 to 16 physical servers

Often used in disconnected scenarios

Azure portal, ARM and bicep templates, Azure CLI and tools

Microsoft Entra ID

Azure Site Recovery

Azure Backup

Azure File Sync

Azure Update Manager

Additional Azure services integration via Arc

Azure Policy

Azure Monitor

Azure Key Vault

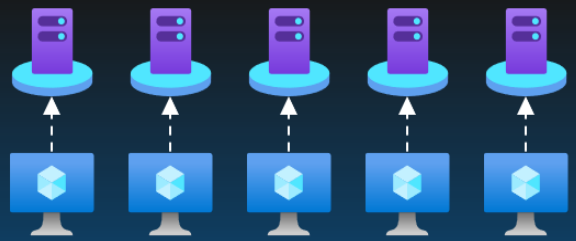
Microsoft Defender for Cloud

Azure Stack HCI solution

Traditional, non-containerized applications

Kubernetes-based applications

Arc-enabled services



Windows and Linux virtual machines as Arc-enabled servers

Azure Virtual Desktop

AKS enabled by Azure Arc

Hyper-V

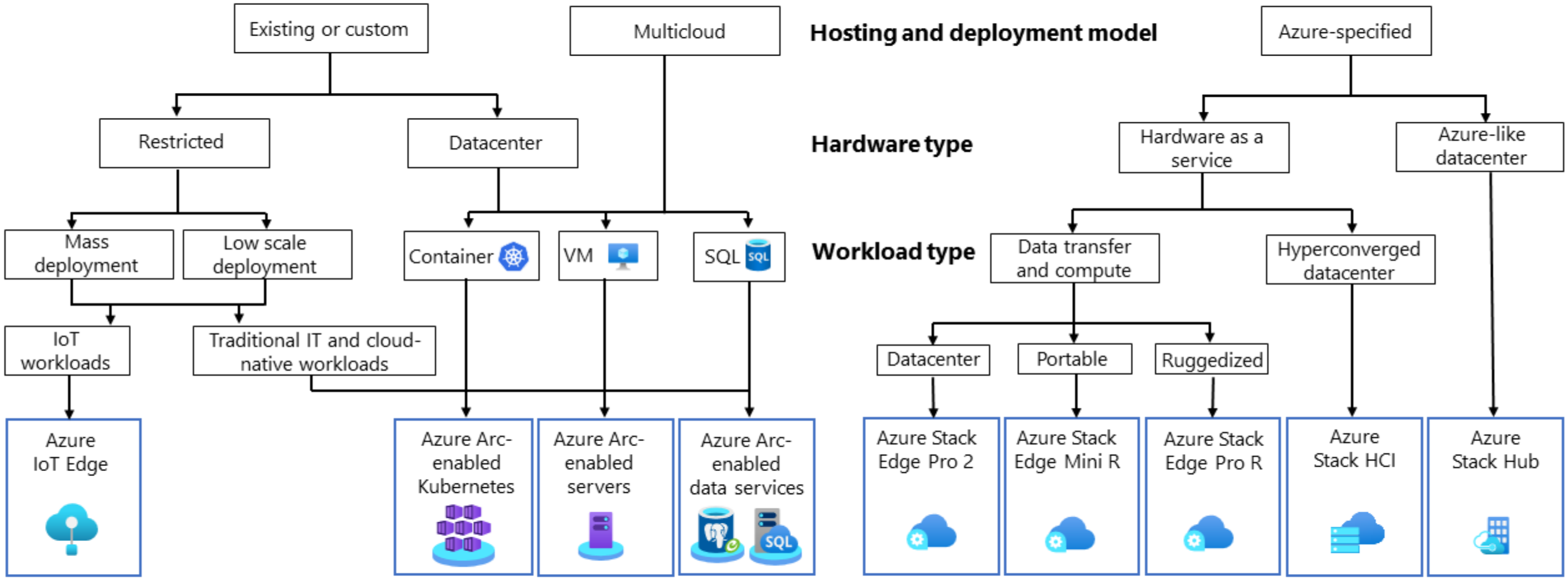
Storage Spaces Direct

Azure Stack HCI Operating System

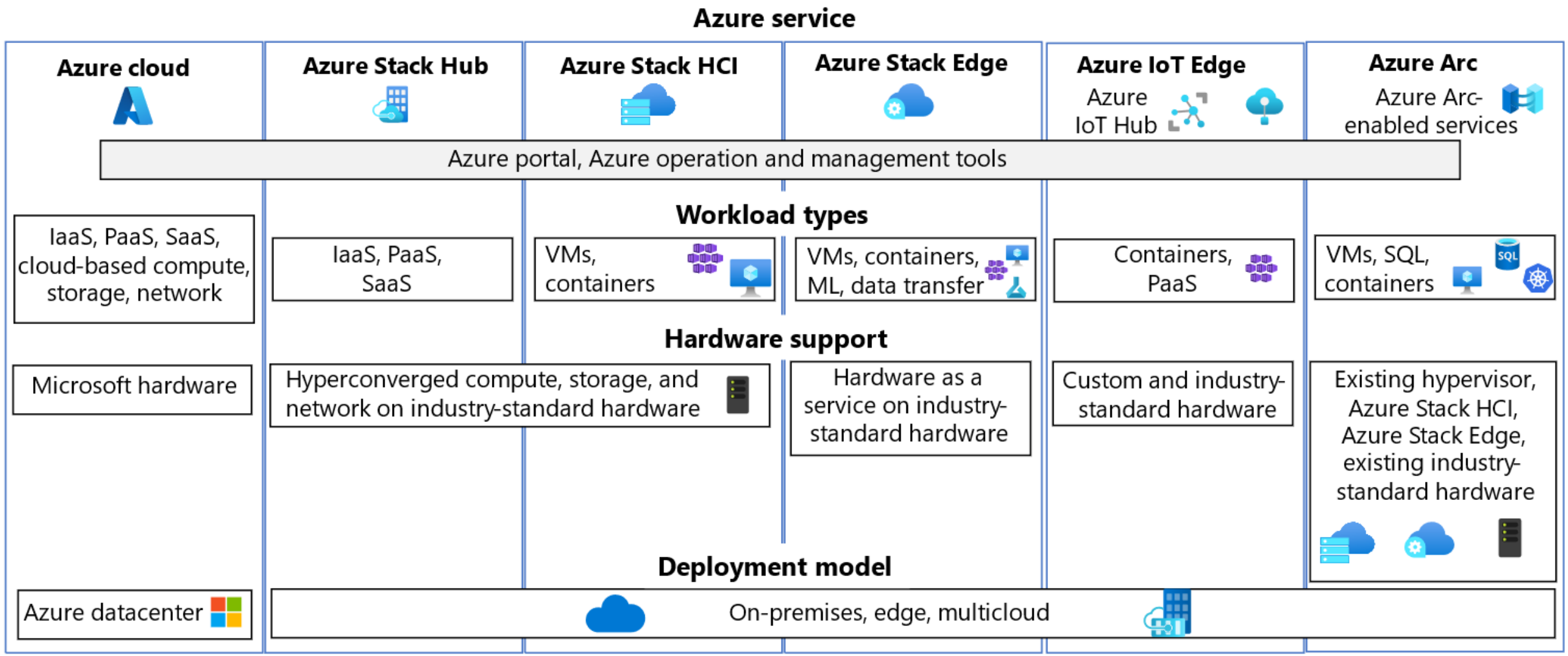
Premier solutions

Validated nodes

Integrated systems



Microsoft Azure



Microsoft Azure

Azure Arc

Azure Arc Overview

Project infrastructure running outside of Azure into Azure

- Linux and Windows VMs and bare metal servers
- Any CNCF certified Kubernetes distribution
- Microsoft SQL Server

Azure Arc

Microsoft

Search

Machines
Azure Arc virtual machines (preview)
Azure Stack HCI
Kubernetes clusters
VMware vCenters
SCVMM management servers

Data services

SQL Server instances
PostgreSQL (preview)
SQL managed instances

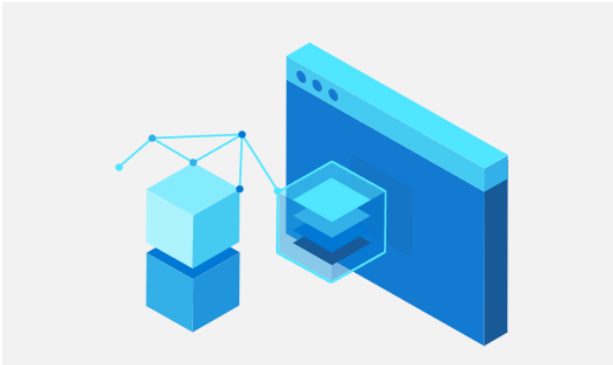
Application Services

API management (preview)
App services (preview)
Event Grid topics (preview)
Functions (preview)
Azure IoT Operations (preview)
Logic apps (preview)

Get started | Infrastructure | Services | Learn more

See and manage all your on-prem infrastructure, anywhere. It's free to get started.

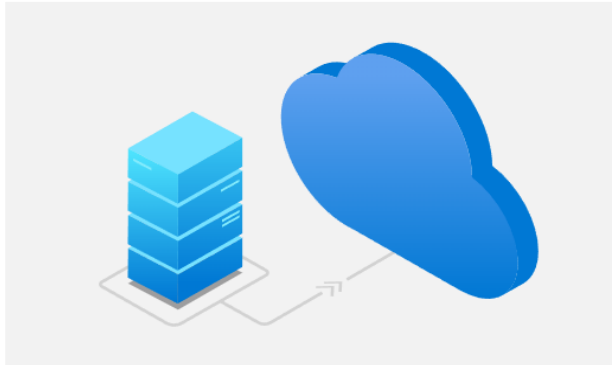
With Azure Arc, you can manage your infrastructure in all your environments, including on-premises, other public clouds, and edge devices. There's no charge to start, just add your infrastructure and enjoy the views. Learn more



Get hands-on with ArcBox

Use ArcBox to deploy an Azure Arc sandbox in less than an hour. Learn more

Try ArcBox



Add your infrastructure for free

See all your infrastructure in Azure. There's no charge to add and view your existing resources. Learn more

Add

Deploy Azure services

Use Azure Arc to deploy Azure services on your infrastructure. Learn more

Deploy

Azure Arc Overview

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Manage infrastructure as it was running in Azure

- Update Management
- Configuration Management
- Microsoft Cloud Defender

Azure Arc-enabled Kubernetes

Install Azure Arc extensions to manage the cluster

- Azure Monitor
- GitOps with Flux
- Azure Policy
- Azure Key Vault Secrets Provider

Securely access cluster without opening inbound ports

Azure Arc Installation

Install with Azure CLI

Azure Arc Installation

Install with Azure CLI

Applications are installed in the azure-arc namespace

Azure Arc Applications

```
PS C:\Users\Wolfgang> kubectl get pods -n azure-arc
NAME                                READY   STATUS    RESTARTS   AGE
cluster-metadata-operator-5dcbb5d97b-k2pwb   2/2     Running   0          14m
clusterconnect-agent-5776f946d9-jchl4        3/3     Running   0          14m
clusteridentityoperator-bf596c845-h8s7s      2/2     Running   0          14m
config-agent-6cd59d5896-d4tvx                2/2     Running   0          14m
controller-manager-59bcd87698-m8jj9          2/2     Running   0          14m
extension-events-collector-55c95b8c4d-m8l5d  2/2     Running   0          14m
extension-manager-75d47f499f-62twm           3/3     Running   0          14m
flux-logs-agent-7d7dc6754f-l24tq             1/1     Running   0          14m
kube-aad-proxy-775476dd6d-bpdld              2/2     Running   0          14m
metrics-agent-595bcfdc9-4jpkg                2/2     Running   0          14m
resource-sync-agent-c9559b855-bggcp          2/2     Running   0          14m
```

Azure Arc in the Azure Portal

"Single pane of glass"

Manage outside infrastructure within Azure

Azure Arc

Microsoft

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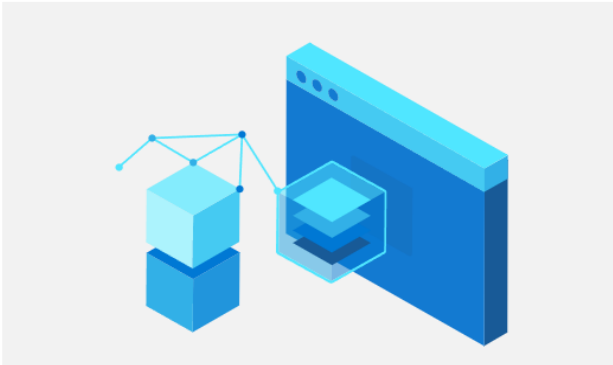

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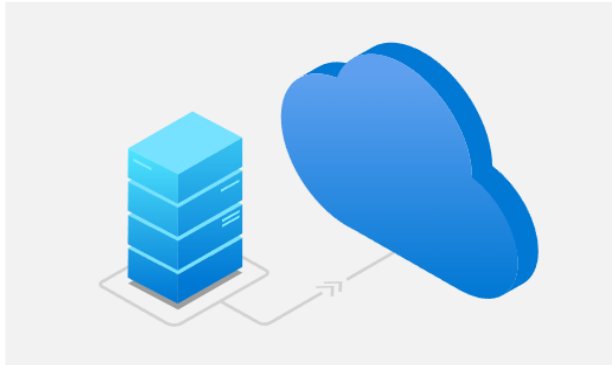

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Add

Deploy Azure services

Use Azure Arc to deploy Azure services on your infrastructure. Learn more

Deploy

Azure Arc | Kubernetes clusters

Microsoft

Search

Add | Manage view | Refresh | Export to CSV | Open query | Assign tags

Filter for any field... | Subscription equals **all** | Type equals **all** | Resource group equals **all** | Add filter

Showing 1 to 2 of 2 records.

No grouping

Name	Type	Resource group	Kubernetes version	Location
dev-cluster-arc	Kubernetes - Azure Arc	ArcDemo	1.27.7	West Europe
k3s-Arc	Kubernetes - Azure Arc	ArcDemo	1.27.7	West Europe

k3s-Arc | Namespaces

Kubernetes - Azure Arc

Search

Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems

Kubernetes resources (preview)

Namespaces
Workloads
Services and ingresses
Storage
Configuration

Settings

Extensions
Open Service Mesh
GitOps
Policies
Properties
Locks

Sign in to view your Kubernetes resources.

A service account bearer token is required to view the Kubernetes resources on this cluster. This can be created using kubectl while connected to your cluster via CLI. Learn how to create a service account bearer token

Service account bearer token *

Sign in

Azure Arc Extensions

Azure Arc extensions

Bring Azure Services to your Kubernetes cluster

- GitOps for deployments
- Azure Monitor
- Azure Key Vault Secrets Provider

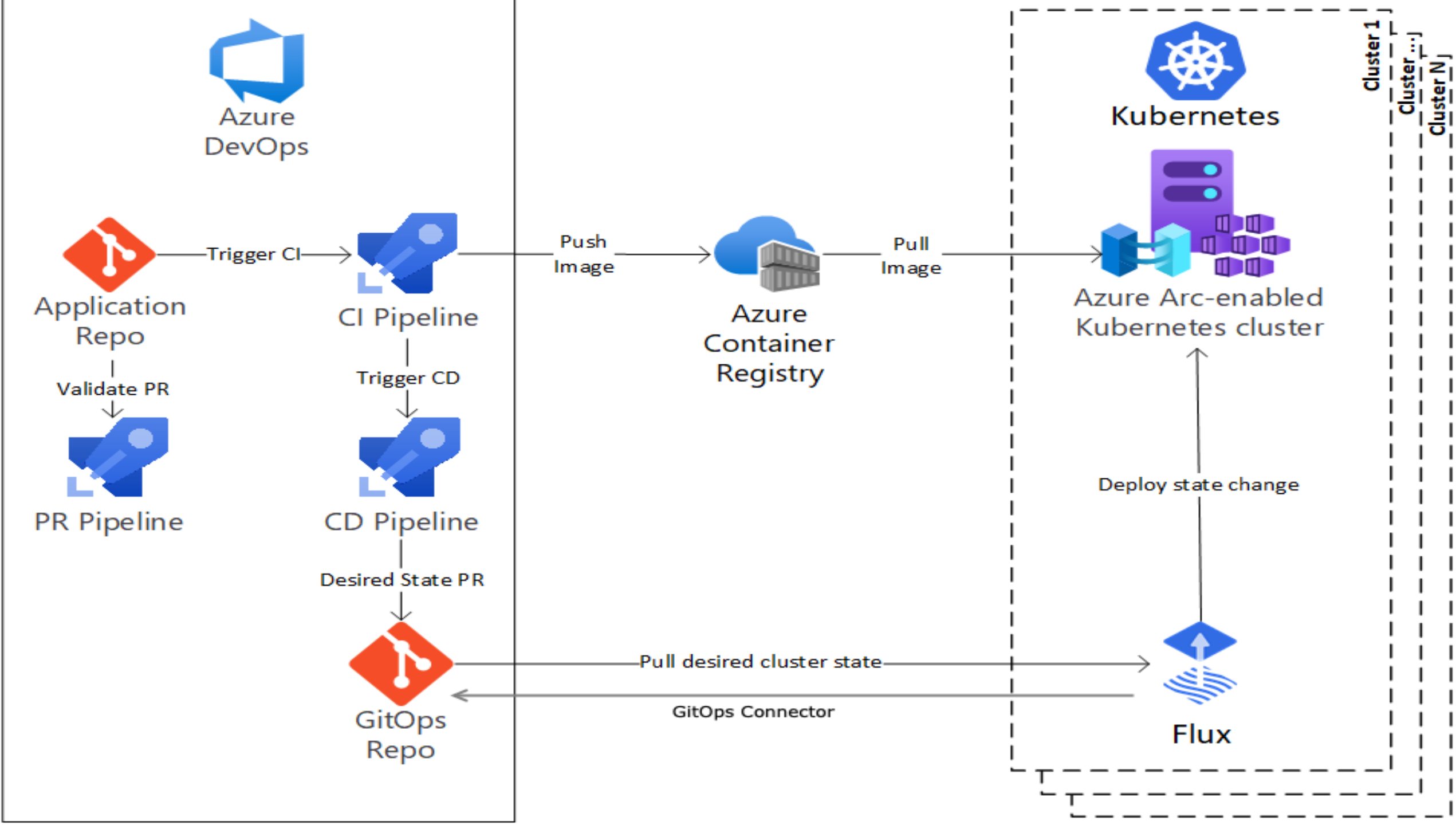
Git Ops Extension

Uses Flux as GitOps agent

Can be installed via Azure CLI or Azure Portal

2 repositories

- Application repository
- Configuration repository


Azure DevOps
Application Repo
Trigger CI
CI Pipeline
Push Image
Azure Container Registry
Pull Image
Kubernetes
Cluster 1
Cluster ...
Cluster N
Azure Arc-enabled Kubernetes cluster
Validate PR
PR Pipeline
Trigger CD
CD Pipeline
Deploy state change
Desired State PR
GitOps Repo
Pull desired cluster state
GitOps Connector
Flux

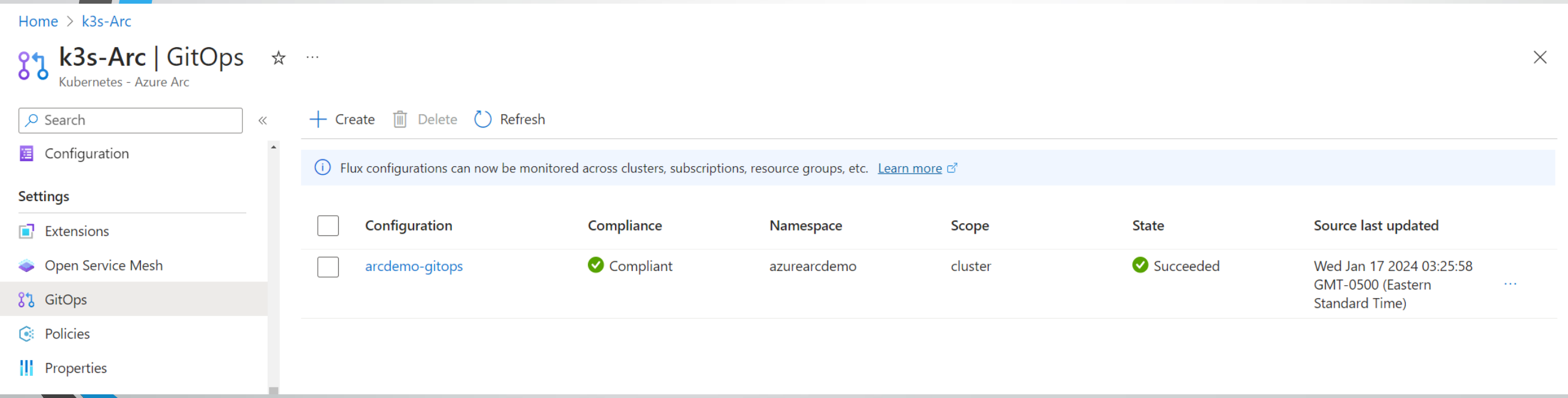
Git Ops Extension Installation

Single Azure CLI command to configure and install GitOps operator

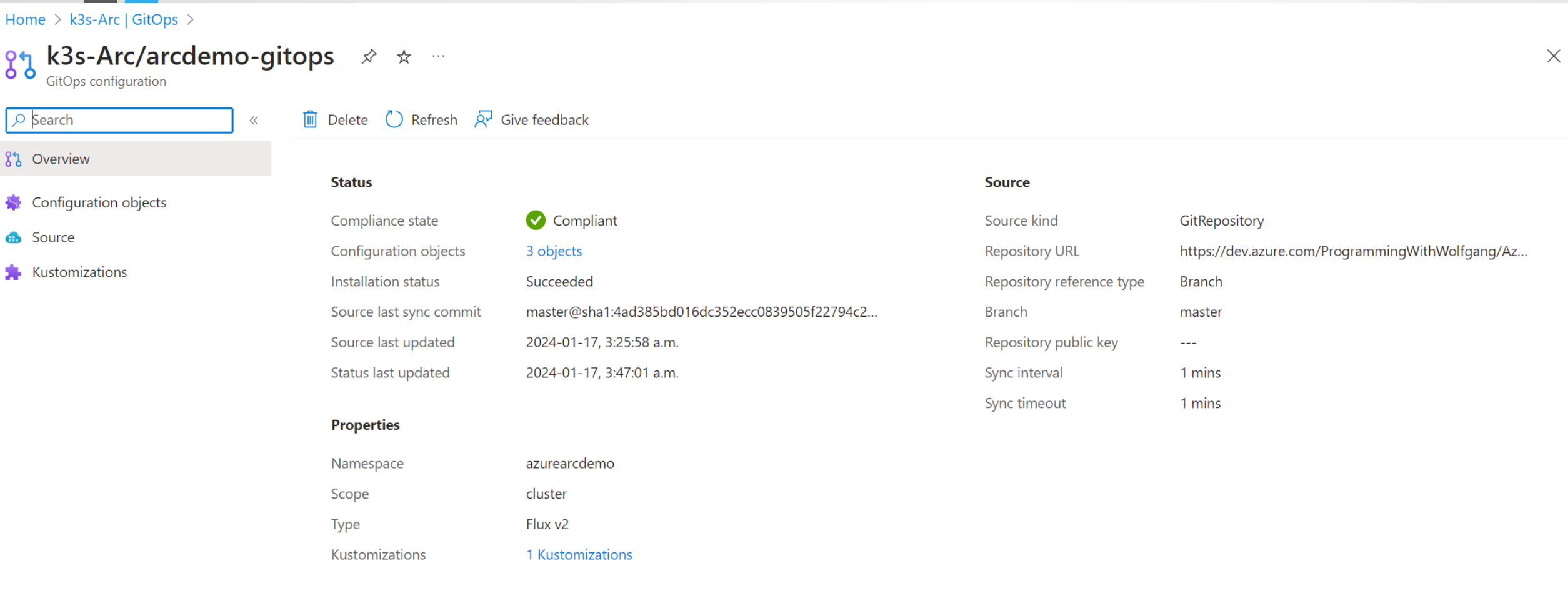
Git Ops Extension Installation

```
PS C:\Users\Wolfgang> az k8s-configuration flux create `
>> --cluster-name k3s-Arc `
>> --resource-group ArcDemo `
>> --name arcdemo-gitops `
>> --namespace azurearcdemo `
>> --cluster-type connectedClusters `
>> --scope cluster `
>> --https-user wolfgang@programmingwithwolfgang.com `
>> --https-key 7ubfok7viuepij24pymxblsekhyjcdjxbsqgcczyplsuo6sv3x5a `
>> --url https://dev.azure.com/ProgrammingWithWolfgang/AzureArcDemo/_git/AzureArcDemoGitOps `
>> --branch master `
>> --kustomization name=app path=./AzureArcDemo prune=true
D:\a\_work\1\s\build_scripts\windows\artifacts\cli\Lib\site-packages\cryptography/hazmat/backends/openssl
/backend.py:27: UserWarning: You are using cryptography on a 32-bit Python on a 64-bit Windows Operating
System. Cryptography will be significantly faster if you switch to using a 64-bit Python.
'Microsoft.Flux' extension not found on the cluster, installing it now. This may take a few minutes...
```

Git Ops Extension Installation



Git Ops Extension Installation



GitOps Deployment

```
PS C:\Users\Wolfgang> kubectl get pods -n azurearcdemo
NAME                                READY   STATUS    RESTARTS   AGE
azurearcdemo-64fbd7fcfc-4v6qr   1/1     Running   0          28m
```

GitOps Repository

Kustomize file referencing all release files

GitOps Repository

```yaml
apiVersion: kustomize.config.k8s.io/v1
kind: Kustomization
resources:
- HelmRelease.yaml
```

GitOps Repository

Kustomize file referencing all release files

HelmRelease YAML file containing information about the Helm chart

```yaml
apiVersion: helm.toolkit.fluxcd.io/v2beta1
kind: HelmRelease
metadata:
  name: azurearcdemo
  namespace: azurearcdemo
  annotations:
    clusterconfig.azure.com/use-managed-source: "true"
spec:
  interval: 1m
  releaseName: azurearcdemo
  chart:
    spec:
      chart: ./AzureArcDemo/charts/azurearcdemo
```

GitOps Pipeline

CD Pipeline reads newest tag from Azure Container Registry

Replace tag in values.yaml file

Commit changes to master branch

GitOps Agent sees changes and applies them to the K8s cluster

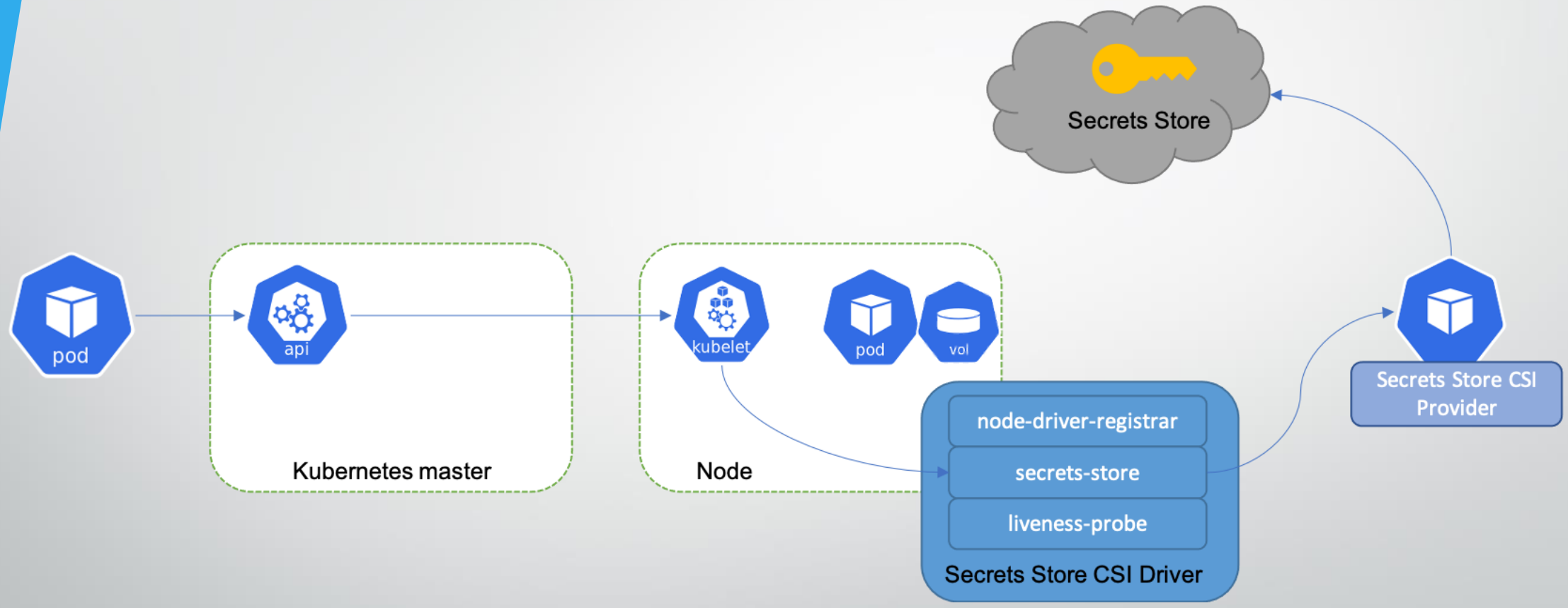
Azure Key Vault Secrets Provider Extension

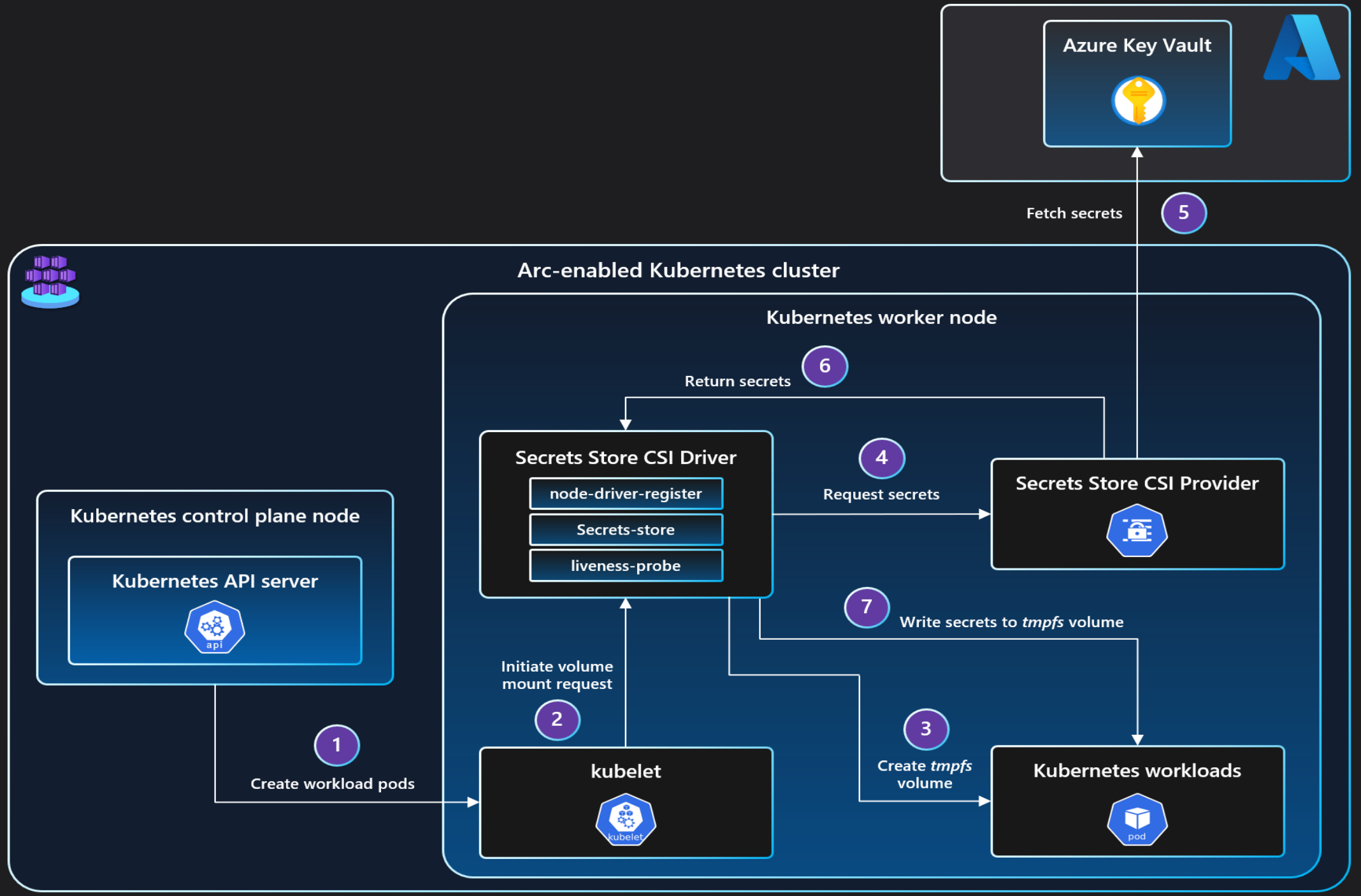
Mount secrets from Azure Key Vault into Kubernetes

Secrets are retrieved using gRPC

Get all advantages from Azure Key Vault

Azure Key Vault Secrets Provider Extension




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

Azure Monitor Extension

Azure Monitor agent is installed in its own namespace

Agent sends information to Log Analytics Workspace

Azure Monitor:

- Dashboards
- Alerting
- Container Insights

DemoArc | Insights

Kubernetes - Azure Arc

Search (Ctrl+/) « Refresh View All Clusters Recommended alerts (Preview) View Workbooks Help Feedback

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems
- Security (preview)

Kubernetes resources (preview)

- Namespaces
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- Properties
- Locks

Monitoring

- Insights
- Alerts
- Metrics
- Logs

Time range = **Last 30 minutes** Add Filter

What's new | Cluster | Reports | Nodes | Controllers | Containers

Node CPU Utilization %

1m granularity

Percentage of Total capacity

Avg | Min | 50th | 90th | 95th | Max

Average DemoArc **16.15** %

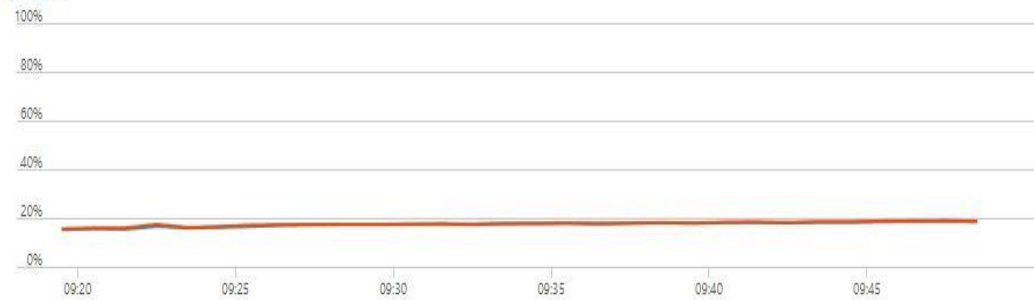
Maximum DemoArc **89.47** %

Node Memory Utilization %

1m granularity

Percentage of Total capacity (memory rss)

Avg | Min | 50th | 90th | 95th | Max



Average DemoArc **18.04** %

Maximum DemoArc **19.56** %

Node Count

1m granularity

Total | Ready | Not Ready

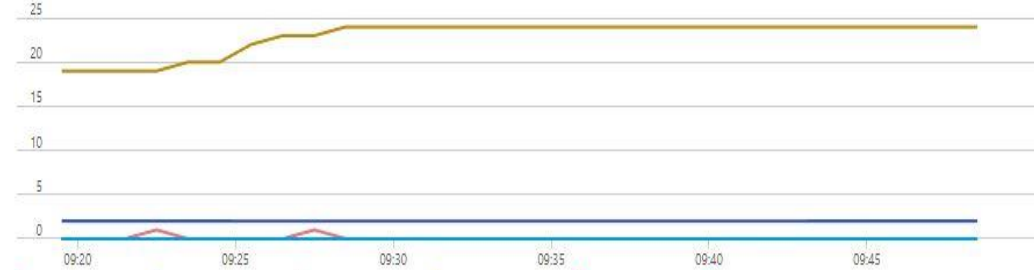
Ready DemoArc **2**

Not Ready DemoArc **0**

Active Pod Count

1m granularity

Total | Pending | Running | Unknown | Succeeded | Failed | Terminating



Pending DemoArc **66.67** m

Running DemoArc **22.93**

Unknown DemoArc **0**

Succeeded DemoArc **2**

Failed DemoArc **0**

Terminating DemoArc **0**

DemoArc | Insights

Kubernetes - Azure Arc

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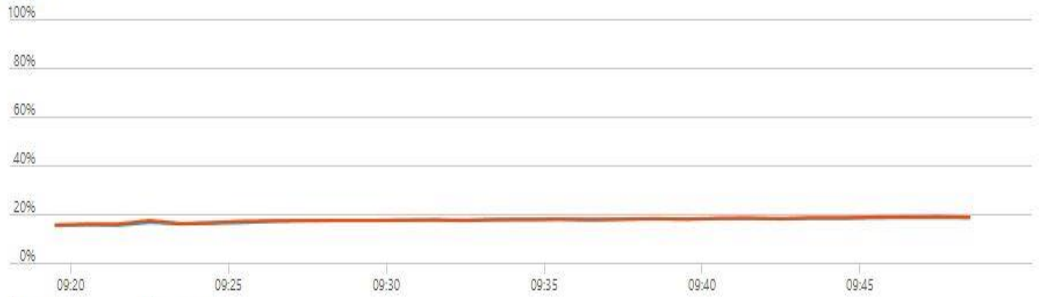
Node CPU Utilization %
1m granularity
Percentage of Total capacity
Avg Min 50th 90th 95th Max

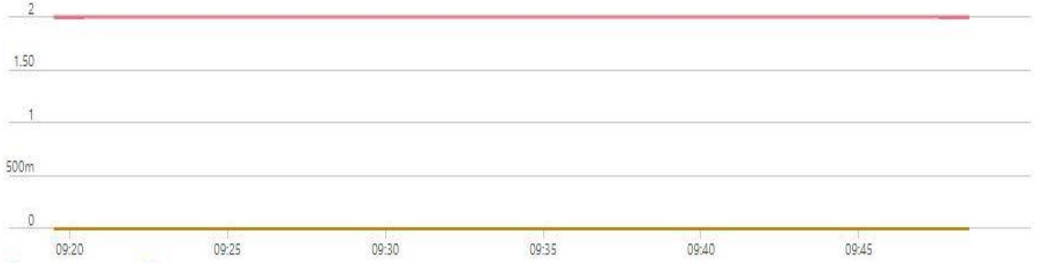
Average DemoArc 16.15 %
Maximum DemoArc 89.47 %

Node Memory Utilization %
1m granularity
Percentage of Total capacity (memory rss)
Avg Min 50th 90th 95th Max



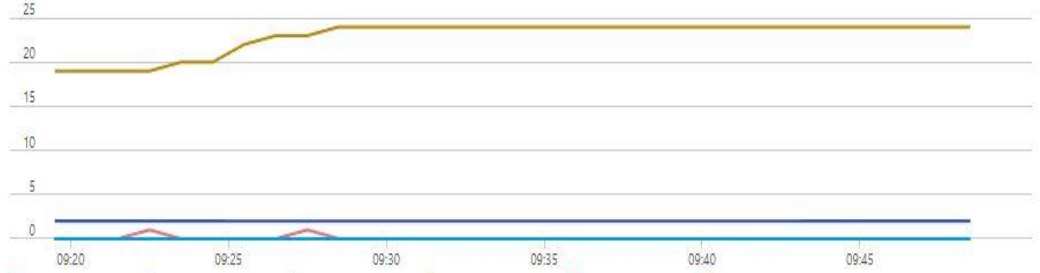
Average DemoArc 18.04 %
Maximum DemoArc 19.56 %

Node Count
1m granularity
Total Ready Not Ready



Ready DemoArc 2
Not Ready DemoArc 0

Active Pod Count
1m granularity
Total Pending Running Unknown Succeeded Failed Terminating



Pending DemoArc 66.67 m
Running DemoArc 22.93
Unknown DemoArc 0
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Terminating DemoArc 0

DemoArc | Insights

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What's new | Cluster | Reports | Nodes | Controllers | **Containers**

Search by name... Metric: CPU Usage (millicores) | Min | Avg | 50th | 90th | 95th | Max

Name	Status	95th % ↓	95th	Pod	Node	Restarts	UpTime	Trend 95th % (1 bar = 1m)
customerapi	Ok	91%	1810 mc	customerapi-5d5f8d96c5-v8nt7	master	0	25 mins	
mqtt	Ok	64%	322 mc	mqtt-58b75468c-zcnzx	master	0	27 mins	
kube-aad-proxy	Ok	17%	17 mc	kube-aad-proxy-8564d4dd5d-qqcbq	worker1	0	54 mins	
omsagent	Ok	7%	10 mc	omsagent-727fd	worker1	0	31 mins	
omsagent	Ok	4%	6 mc	omsagent-4pftj	master	0	32 mins	
fluent-bit	Ok	4%	0.8 mc	config-agent-69dcdb554d-7swhm	worker1	0	57 mins	
fluent-bit	Ok	4%	0.8 mc	cluster-metadata-operator-9945b897c-nxcwr	worker1	0	57 mins	
cluster-metadata-operator	Ok	4%	2 mc	cluster-metadata-operator-9945b897c-nxcwr	worker1	0	58 mins	
fluent-bit	Ok	3%	0.7 mc	controller-manager-5494575977-rfc6g	worker1	0	57 mins	
flux-logs-agent	Ok	3%	1 mc	flux-logs-agent-86cf4f7b7d-55fld	worker1	0	58 mins	
fluent-bit	Ok	3%	0.6 mc	extension-manager-7dc84fb6d7-sfznl	worker1	0	57 mins	
resource-sync-agent	Ok	3%	1 mc	resource-sync-agent-56f777f6b6-7zj9n	worker1	0	58 mins	

Azure Arc Services

Azure Arc Services

Azure Arc-enabled infrastructure

- Azure Arc-enabled servers
- Azure Arc-enabled Kubernetes
- Azure Stack HCI

Azure Arc Services

Azure Arc-enabled services

- Azure App Service
- Azure Logic Apps
- Azure Event Grid
- Azure Functions
- Azure API Management
- Azure Container Apps

Azure Arc Services

Azure Arc-enabled data services

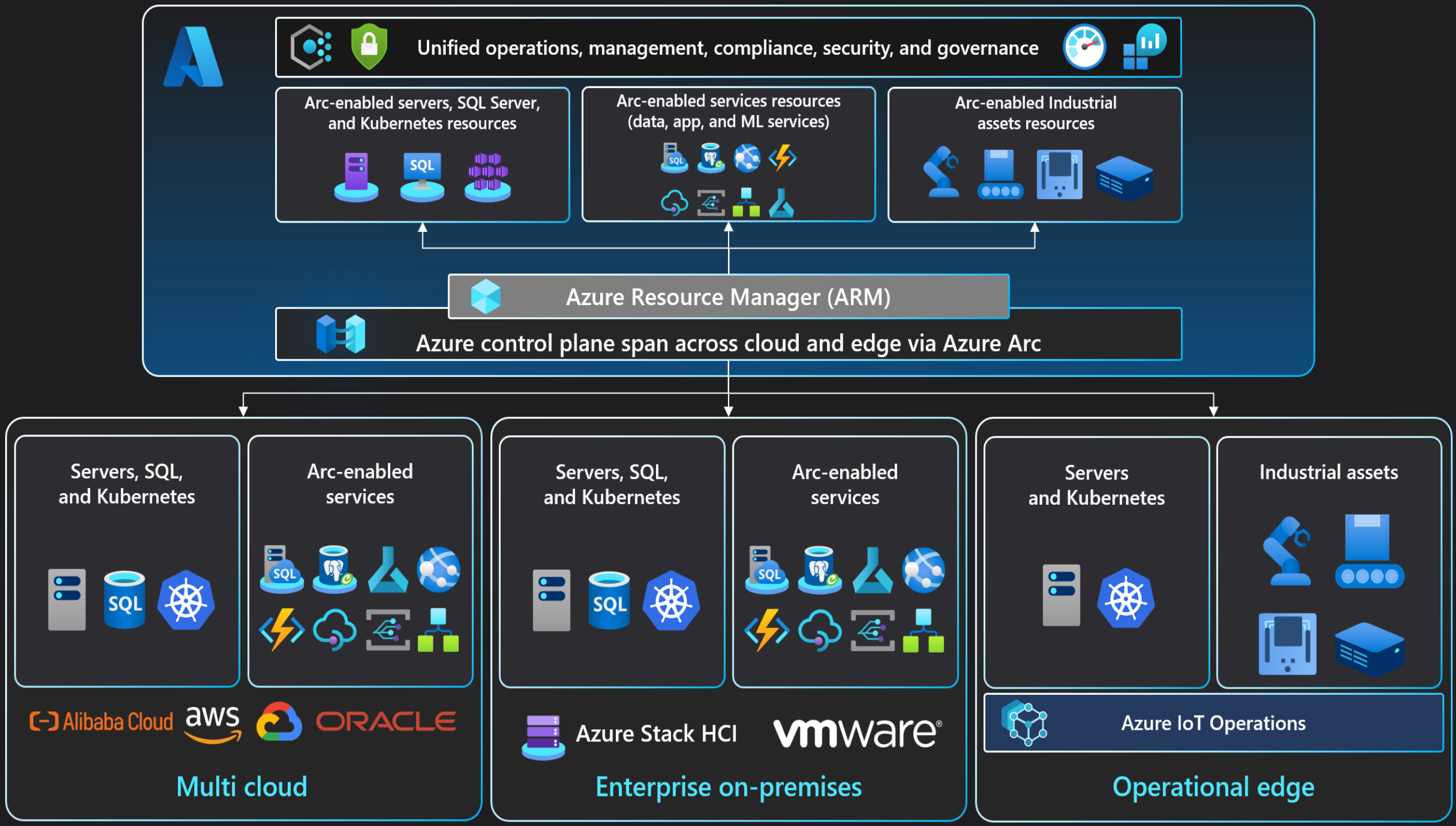
- Azure SQL Managed Instance
- PostgreSQL Hyperscale
- Azure Machine Learning

Azure Arc Services

Azure Arc-enabled services run inside a Kubernetes cluster

Bring Azure services to your on-prem datacenter

Developers can continue using their tools


Unified operations, management, compliance, security, and governance
Arc-enabled servers, SQL Server, and Kubernetes resources
SQL
Arc-enabled services resources (data, app, and ML services)
Arc-enabled Industrial assets resources
Azure Resource Manager (ARM)
Azure control plane span across cloud and edge via Azure Arc
Servers, SQL, and Kubernetes
SQL
Arc-enabled services
SQL
Alibaba Cloud
aws
ORACLE
Multi cloud
Servers, SQL, and Kubernetes
SQL
Arc-enabled services
SQL
Azure Stack HCI
vmware
Enterprise on-premises
Servers and Kubernetes
Industrial assets
Azure IoT Operations
Operational edge

Hybrid Cloud Conclusion

Hybrid Cloud Conclusion

Powerful tool to combine on-premises requirements with cloud services

Manage on-premises infrastructure from the cloud

- Data never leaves your datacenter
- Combine cloud services with low latency

Broad technical knowledge necessary

Too many applications to talk about them in just one hour

Azure Arc Conclusion

Proof of concept was successful

Powerful service

Major focus from Microsoft

Broad IT-knowledge needed

Services can be a bit buggy

Documentation sometimes complicated

Resources

Azure Arc Series – Blog Posts

Azure Arc - Youtube Playlist

Azure Arc Documentation

Azure Stack HCI

Flux CD

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Unleashing the Potential of Hybrid Cloud: Streamlining Multi-Cloud Management and On-Premises Integration

Wolfgang Ofner