

# Bring DevOps to the Swiss Alps

Wolfgang Ofner

Organizatorem wydarzenia jest Fundacja Academic Partners

ACADEMIC PARTNERS

# Wolfgang Ofner

Freelance Cloud Architect, Toronto, Canada

Focus on Azure, Kubernetes, DevOps, and .NET

<https://programmingwithwolfgang.com>

<https://www.linkedin.com/in/wolfgangofner>

<https://www.youtube.com/>

[@programmingwithwolfgang](#)



# Agenda



Project “Autonomous Ropeway System”



Challenges in the project



Azure Arc integration



Further Azure Arc features





# Project “Autonomous Ropeway System”

Ropeway vehicle comes out of the garage automatically

Routing possible → ropeway vehicle can find its way

Saves costs due to better usage of resources and less wear and tear

Running 24/7 with minimum human interaction

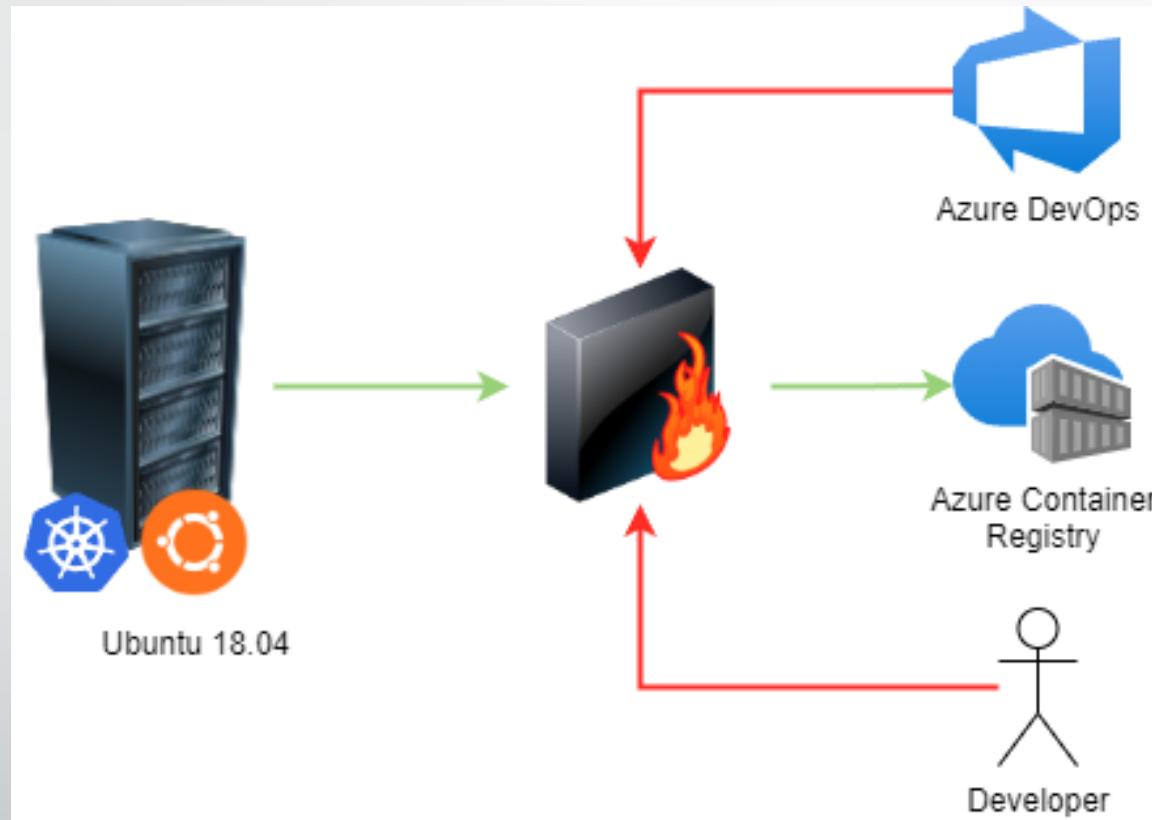
# Challenges

Use existing hardware

No inbound traffic allowed

- No connection from Azure DevOps
- How can developers access the Kubernetes cluster?
- How to collect logs from the cluster?
- No VPN or ExpressRoute allowed

# Network Overview









Azure Arc

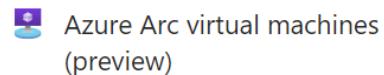
# Azure Arc Overview

Project infrastructure running outside of Azure into Azure

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

[Get started](#)[Infrastructure](#)[Services](#)[Learn more](#)

Machines

Azure Arc virtual machines  
(preview)

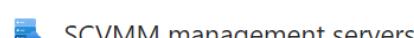
Azure Stack HCI



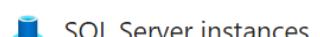
Kubernetes clusters



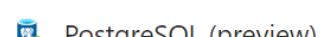
VMware vCenters



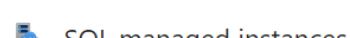
SCVMM management servers

**Data services**

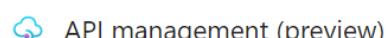
SQL Server instances



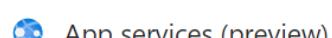
PostgreSQL (preview)



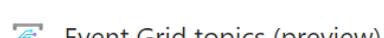
SQL managed instances

**Application Services**

API management (preview)



App services (preview)



Event Grid topics (preview)



Functions (preview)



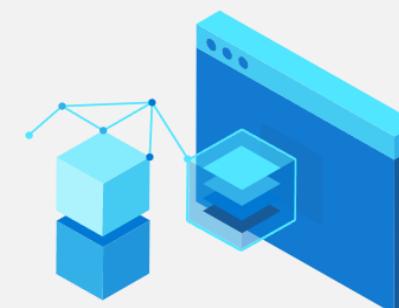
Azure IoT Operations (preview)



Logic apps (preview)

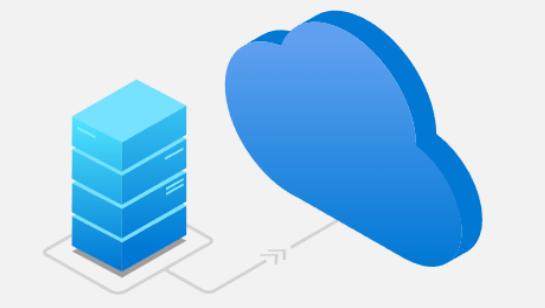
## See and manage all your on-prem infrastructure, anywhere. It's free to get started.

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 | Kubernetes clusters



Microsoft

Search



Add



Manage view



Refresh



Export to CSV



Open query



Assign tags

## Infrastructure

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)

Filter for any field...

Subscription equals **all**Type equals **all**Resource group equals **all**

X Add filter

Showing 1 to 2 of 2 records.

No grouping

<input type="checkbox"/> 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

# Azure Arc Overview

Project infrastructure running outside of Azure into Azure

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

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

# Proof of Concept

# Proof of Concept

K3s

Lightweight, open-source CNCF certified Kubernetes

Developed and maintained by Rancher

```
curl -sfL https://get.k3s.io | sh -
```

# Azure Arc Installation Prerequisites

Azure CLI

Azure CLI Arc extension

# Azure Arc Installation

Install with Azure CLI on Master node of k3s cluster

```
root@Office:/home/wolfgang# az connectedk8s connect --name k3s-arc --resource-group ArcDemo  
This operation might take a while...
```

# Azure Arc Installation

Install with Azure CLI on Master node of k3s cluster

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 | Kubernetes clusters



Microsoft

Search



Add



Manage view



Refresh



Export to CSV



Open query



Assign tags

## Infrastructure

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

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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

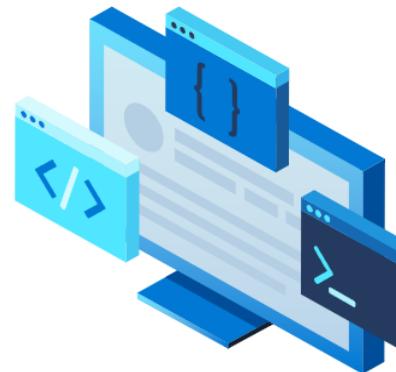
Open Service Mesh

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 \*

Search



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

## 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.

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Service account bearer token \* i

```
kiOdK/RA-w-xqoNuMDA2tWHMzB1KDt8W-
Z6D7M4k5yknroHRuMN7MLCr66on9pO6Xul19MlbZDo8KskUD4
GCWOriMTAnMbq5rfpr9Pv1g_tvHocHrmUwH-
m3K4Pes4M_DRQFCOYhURRULsdEeHsJz9KSv7MucEhWAV31L3S
cfxzNpmzvmGS0tana-
rTGWFIr3mC2KamA2gELhcWyoayKJdfr4TG264Wx1Ce50pyO-
t0xuQU1hoBYB0RoiqXWsEZidFgWvoWVue5qpUKpy5DRImcDCG
YpqvKK7qTCE6m_I9SGnxxNF9mVRIebuFumfTHmeVlf940TInJ5i6
BNq_yj1kprraL3zpa9MuT6F9Ccg7IInq9JdZEIbfJBbo-
vvh56sifkq2YOygiSjDBDcumDBOpYIQI9ZG96pdQK5bEMrGCs2E
e9b9zIBb0rTXrxil2piA9LpaVBMpsJjkKWTfi1l5Pfy92262alOwo
ZVJvreM5cU6hPedvSffHfq-TK4JCSaq3ZEzo8
```

Sign in

# DemoArc | Workloads

Kubernetes - Azure Arc

 Add
 Delete
 Refresh
 Show labels
 Give feedback

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Security (preview)

Kubernetes resources (preview)

Namespaces

Workloads

Services and ingresses

Storage

Configuration

Settings

Extensions

GitOps (preview)

Policies

Properties

Locks

Monitoring

Insights

Alerts

Metrics

Logs

Workbooks

Automation

Tasks (preview)

[Deployments](#)
[Pods](#)
[Replica sets](#)
[Stateful sets](#)
[Daemon sets](#)
[Jobs](#)
[Cron jobs](#)

Filter by deployment name

Enter the full deployment name

Filter by label selector ⓘ

foo=bar,key!=value

Filter by namespace

All namespaces

<input type="checkbox"/>	Name	Namespace	Ready	Up-to-date	Available	Age ↓
<input type="checkbox"/>	coredns	kube-system	1/1	1	1	54 minutes
<input type="checkbox"/>	local-path-provisioner	kube-system	1/1	1	1	54 minutes
<input type="checkbox"/>	metrics-server	kube-system	1/1	1	1	54 minutes
<input type="checkbox"/>	traefik	kube-system	1/1	1	1	54 minutes
<input type="checkbox"/>	clusterconnect-agent	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	flux-logs-agent	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	config-agent	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	controller-manager	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	extension-manager	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	resource-sync-agent	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	clusteridentityoperator	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	metrics-agent	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	cluster-metadata-operator	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	kube-aad-proxy	azure-arc	1/1	1	1	46 minutes
<input type="checkbox"/>	omsagent-rs	kube-system	1/1	1	1	20 minutes
<input type="checkbox"/>	mqtt	myapps	1/1	1	1	15 minutes
<input type="checkbox"/>	kedademoapi	myapps	1/1	1	1	12 minutes
<input type="checkbox"/>	customerapi	myapps	1/1	1	1	12 minutes
<input type="checkbox"/>	orderapi	myapps	1/1	1	1	12 minutes
<input type="checkbox"/>	kubernetesdeploymentdemo	myapps	1/1	1	1	10 minutes

# Azure Arc extensions

Bring Azure Services to your Kubernetes cluster

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

# Azure Arc-enabled Kubernetes GitOps

Flux GitOps Agent runs inside the cluster

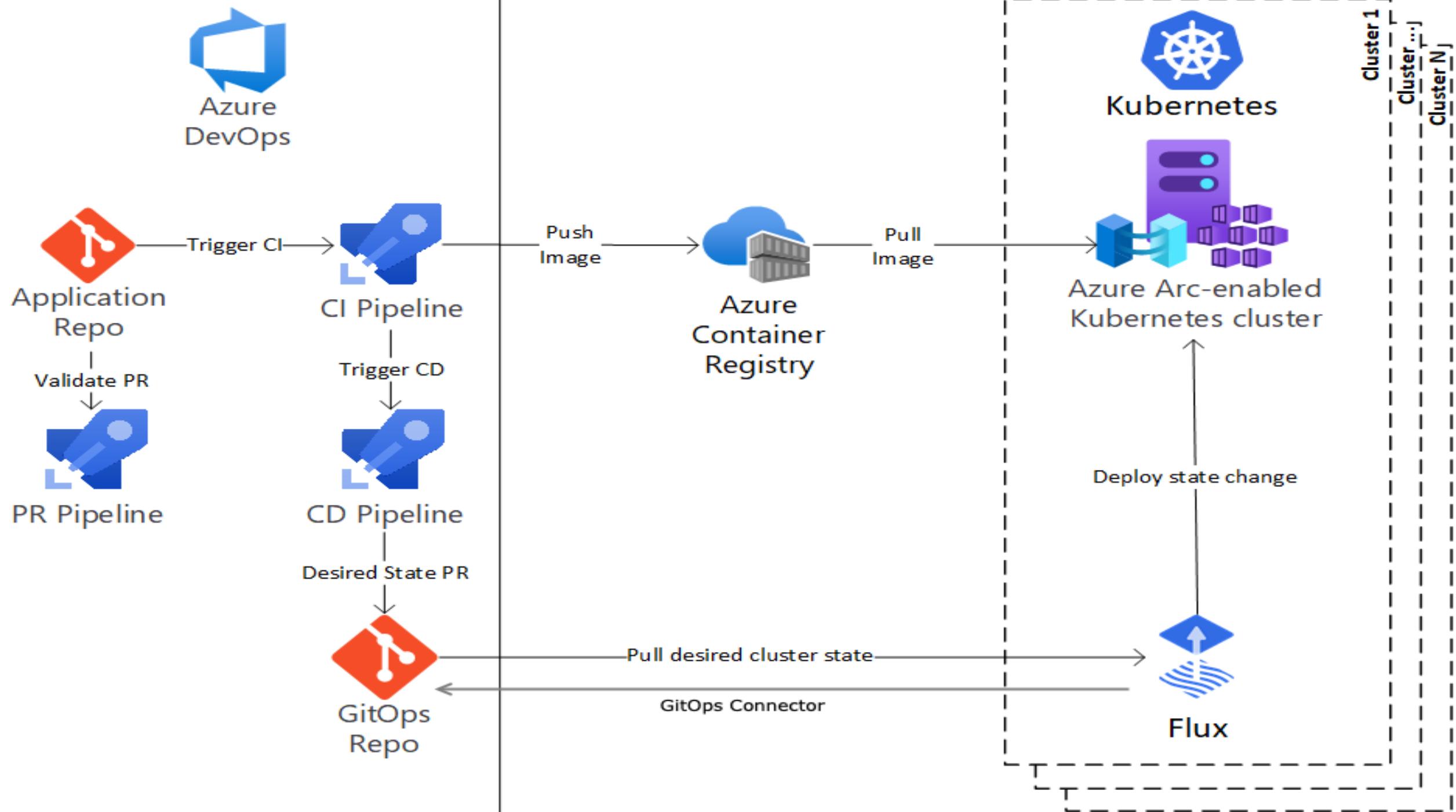
Can be installed via Azure CLI or Azure Portal

Agent pulls changes from a configured repository and applies them

- YAML files
- Helm charts

Securely access private Git repositories

No inbound connection needed



# 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 7ubfok7viuepij24pymxbsekhyjcdjxbsqgcczyplsuo6sv3x5a `>> --url https://dev.azure.com/ProgrammingWithWolfgang/AzureArcDemo/_git/AzureArcDemoGitOps `>> --branch master `>> --kustomization name=app path=./AzureArcDemo prune=trueD:\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

Home > k3s-Arc

## k3s-Arc | GitOps

Kubernetes - Azure Arc

Search  Create Delete Refresh

Flux configurations can now be monitored across clusters, subscriptions, resource groups, etc. [Learn more](#)

	Configuration	Compliance	Namespace	Scope	State	Source last updated
<input type="checkbox"/>	arcdemo-gitops	Compliant	azurearcdemo	cluster	Succeeded	Wed Jan 17 2024 03:25:58 GMT-0500 (Eastern Standard Time)

Settings

- Extensions
- Open Service Mesh
- GitOps
- Policies
- Properties

# Git Ops Extension Installation

Home > k3s-Arc | GitOps >

 **k3s-Arc/arcdemo-gitops** ⚡ ⭐ ... X

GitOps configuration

Delete Refresh Give feedback

Overview Configuration objects Source Kustomizations

Status		Source	
Compliance state	<span style="color: green;">✓ Compliant</span>	Source kind	GitRepository
Configuration objects	<a href="#">3 objects</a>	Repository URL	<a href="https://dev.azure.com/ProgrammingWithWolfgang/Az...">https://dev.azure.com/ProgrammingWithWolfgang/Az...</a>
Installation status	Succeeded	Repository reference type	Branch
Source last sync commit	master@sha1:4ad385bd016dc352ecc0839505f22794c2...	Branch	master
Source last updated	2024-01-17, 3:25:58 a.m.	Repository public key	---
Status last updated	2024-01-17, 3:47:01 a.m.	Sync interval	1 mins
		Sync timeout	1 mins
Properties			
Namespace	azurearcdemo	Type	Flux v2
Scope	cluster	Kustomizations	<a href="#">1 Kustomizations</a>

# GitOps Deployment

```
PS C:\Users\Wolfgang> kubectl get pods -n azurearcdemo
NAME                      READY   STATUS    RESTARTS   AGE
azurearcdemo-64fb7fcfc-4v6qr   1/1     Running   0          28m
```

# GitOps Repository

Kustomize file referencing all release files

# GitOps Repository

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

# GitOps Repository

Kustomize file referencing all release files

YAML file containing information about the Helm chart

```
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 k3s cluster

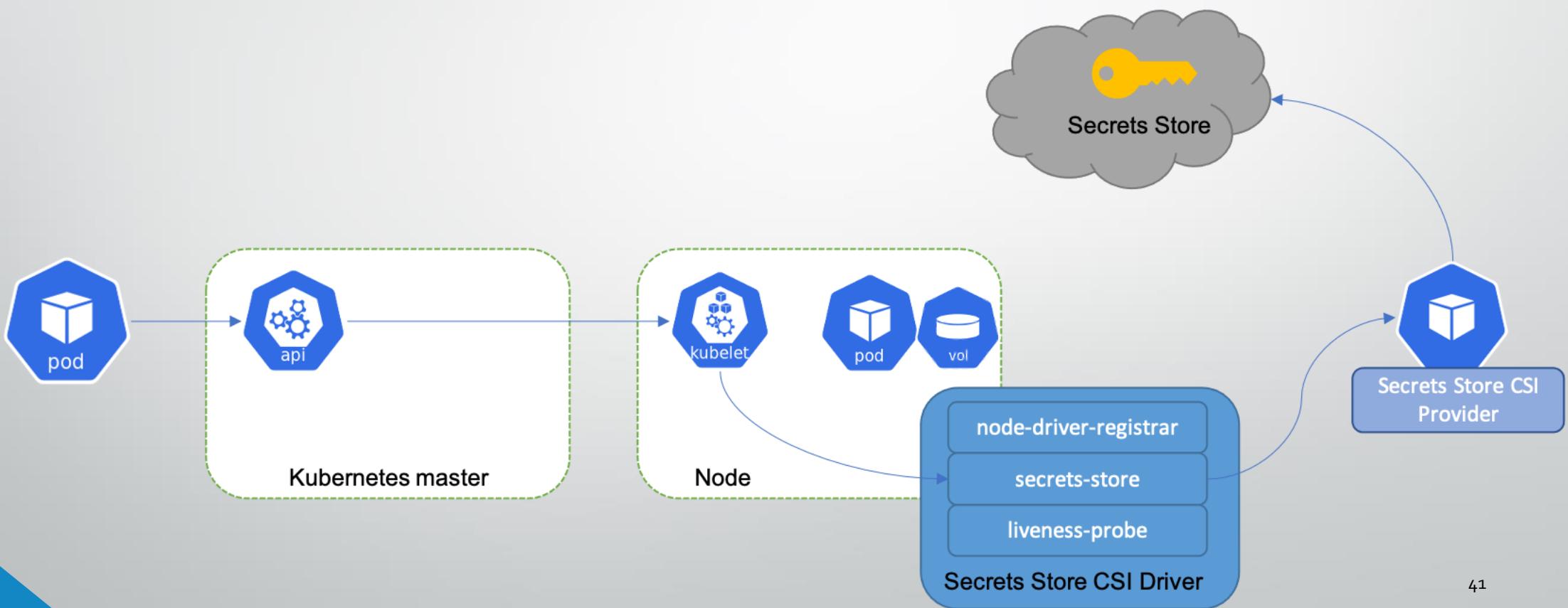
# Key Vault Extension

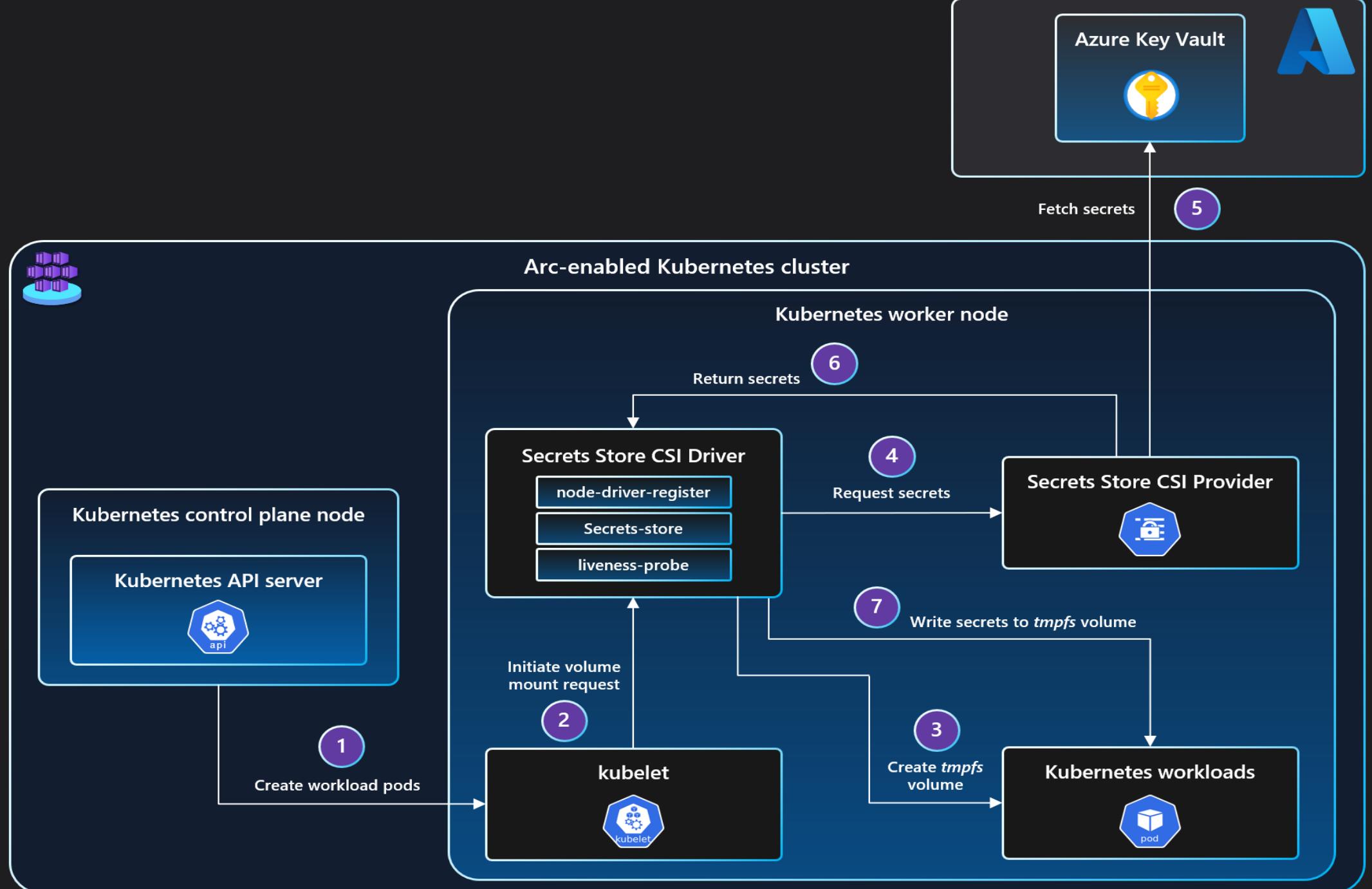
Mount secrets from Azure Key Vault into Kubernetes

Secrets are retrieved using gRPC

Get all advantages from Azure Key Vault

# Key Vault Extension





# Azure Monitor Extension

Azure Monitor agent is installed in its own namespace

Agent sends information to Log Analytics Workspace

Azure Monitor:

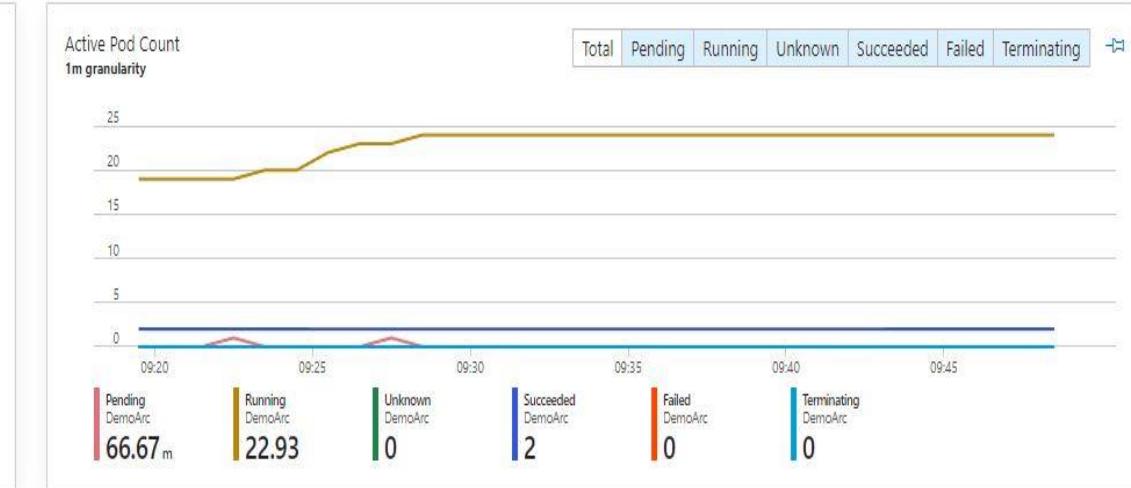
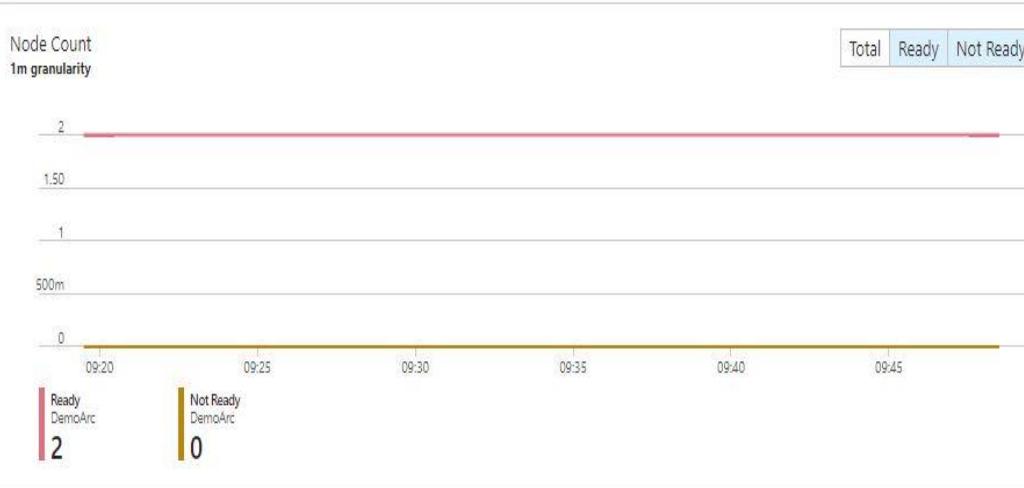
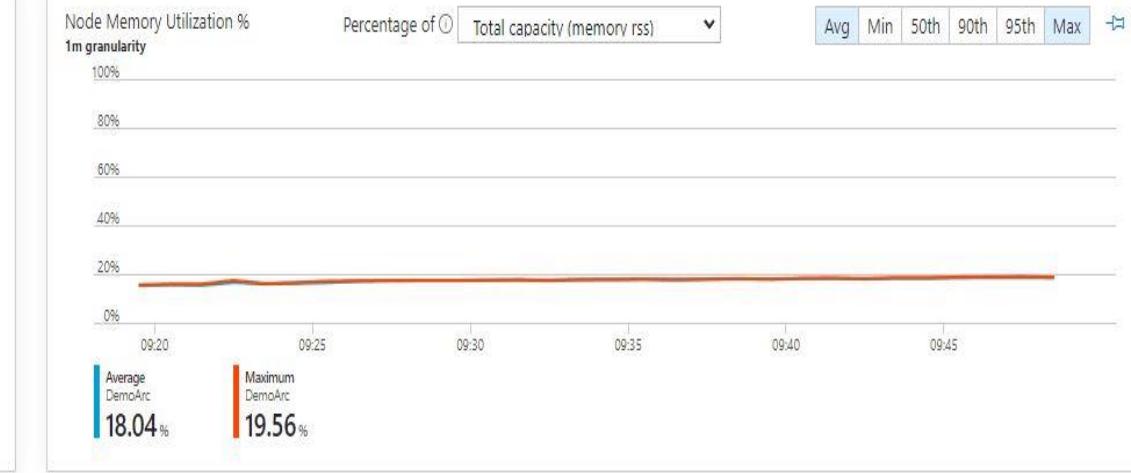
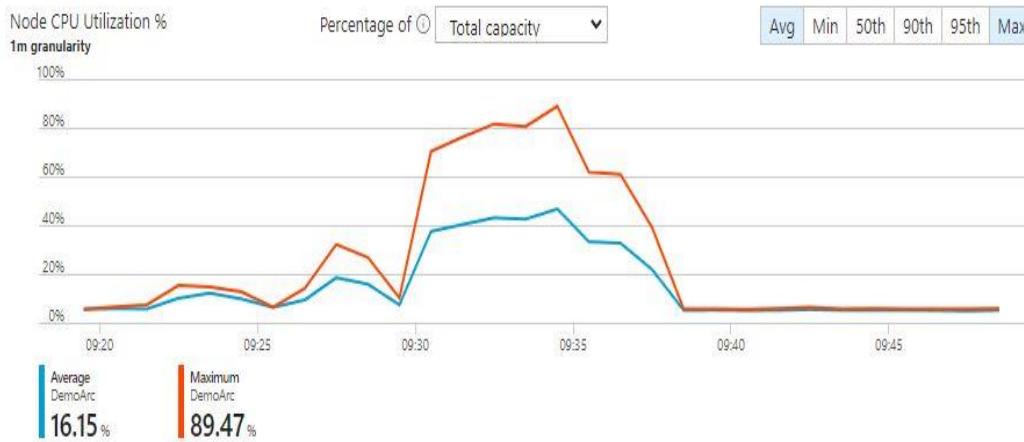
- Dashboards
- Alerting
- Container Insights

# DemoArc | Insights

Kubernetes - Azure Arc

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

Time range = Last 30 minutes

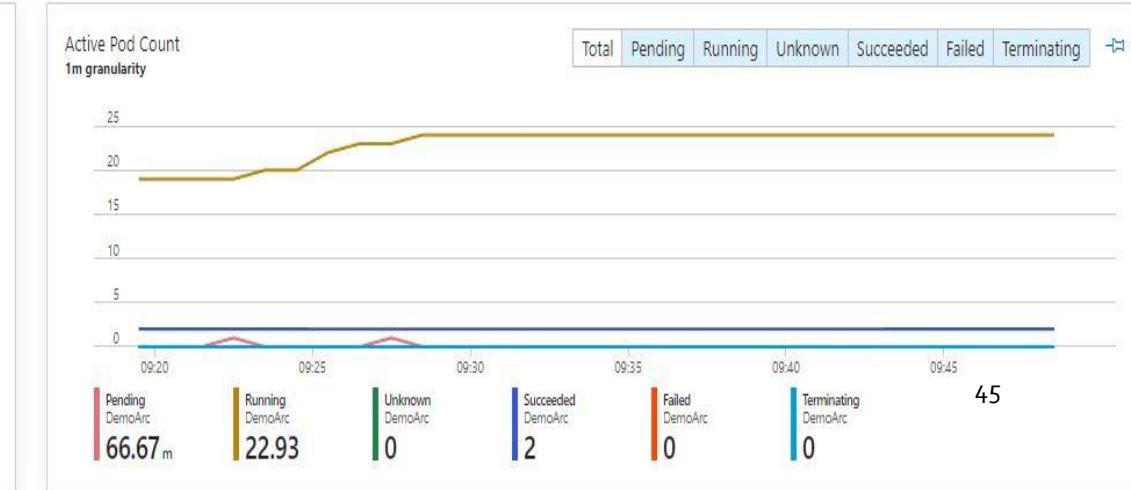
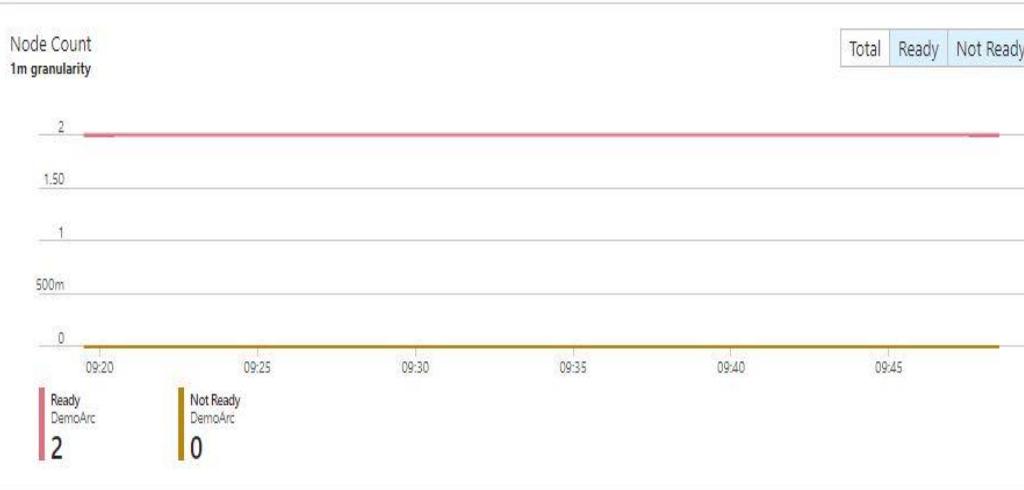
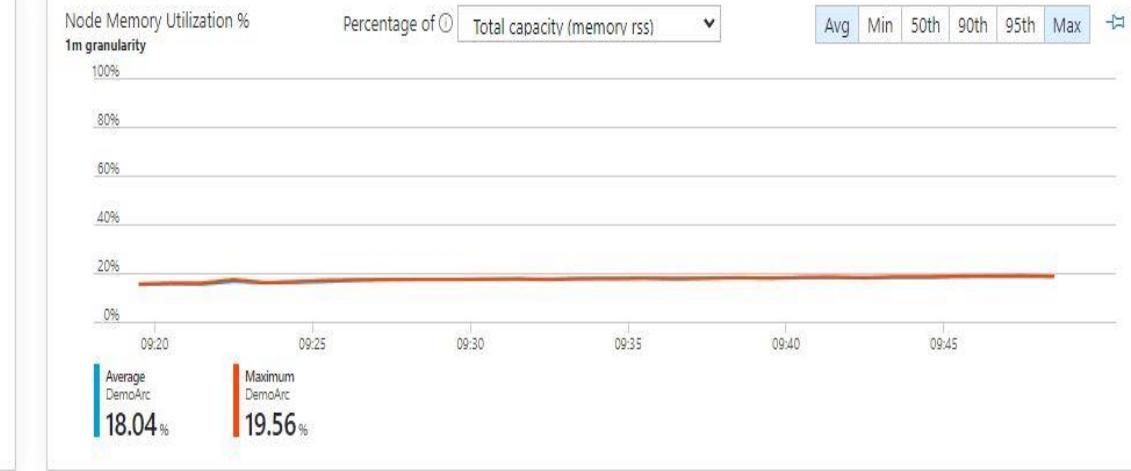
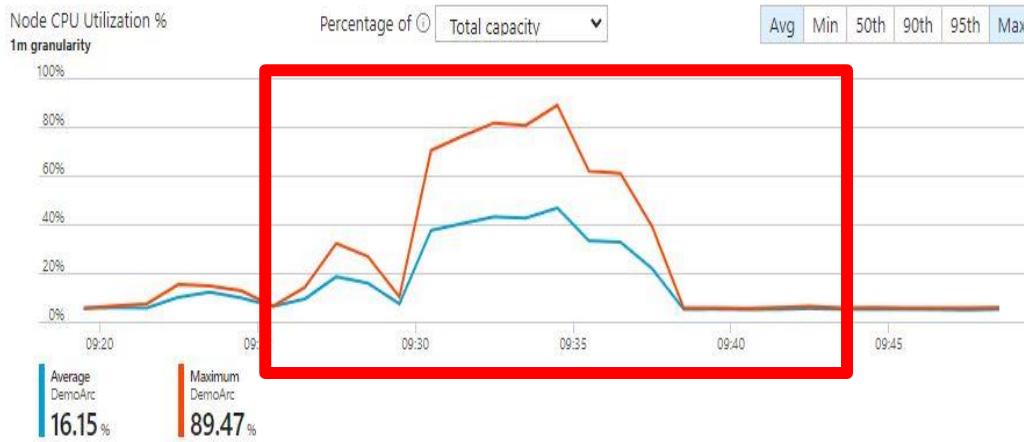
Add Filter
[What's new](#)
[Cluster](#)
[Reports](#)
[Nodes](#)
[Controllers](#)
[Containers](#)
SettingsExtensionsGitOps (preview)PoliciesPropertiesLocksMonitoringInsightsAlertsMetricsLogs

# DemoArc | Insights

Kubernetes - Azure Arc

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Logs

# DemoArc | Insights

Kubernetes - Azure Arc

Search (Ctrl+ /)

« Refresh

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? Help

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Add Filter

Activity log

What's new Cluster Reports Nodes Controllers Containers

Access control (IAM)

Tags

Diagnose and solve problems

Security (preview)

Kubernetes resources (preview)

Namespaces

Workloads

Services and ingresses

Storage

Configuration

Settings

Extensions

GitOps (preview)

Policies

Properties

Locks

Monitoring

Insights

Alerts

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)
Kubernetes resources (preview)	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-qqcqb	worker1	0	54 mins	
	omsagent	Ok	7%	10 mc	omsagent-727fd	worker1	0	31 mins	
	omsagent	Ok	4%	6 mc	omsagent-4ptfj	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-sfzn1	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

# A



Unified operations, management, compliance, security, and governance



Arc-enabled servers, SQL Server, and Kubernetes resources



Arc-enabled services resources (data, app, and ML services)



Arc-enabled Industrial assets resources



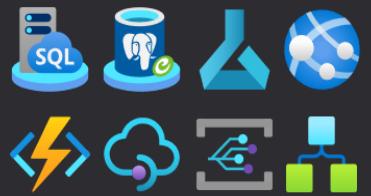
Azure Resource Manager (ARM)

Azure control plane span across cloud and edge via Azure Arc

Servers, SQL, and Kubernetes



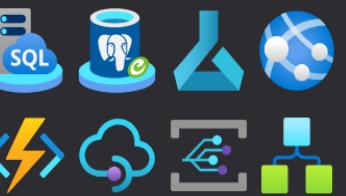
Arc-enabled services



Servers, SQL, and Kubernetes



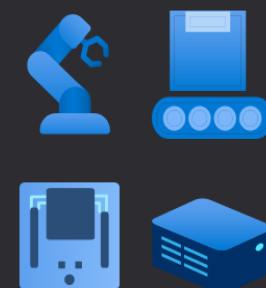
Arc-enabled services



Servers and Kubernetes



Industrial assets



Alibaba Cloud AWS

ORACLE

Multi cloud



Azure Stack HCI

vmware®

Enterprise on-premises



Azure IoT Operations

Operational edge



# Azure Arc Conclusion

# 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](#)

[Azure Arc Youtube Playlist](#)

[Azure Arc Documentation](#)

[k3s](#)

[Flux](#)



Bring DevOps to the Swiss Alps

Wolfgang Ofner

