

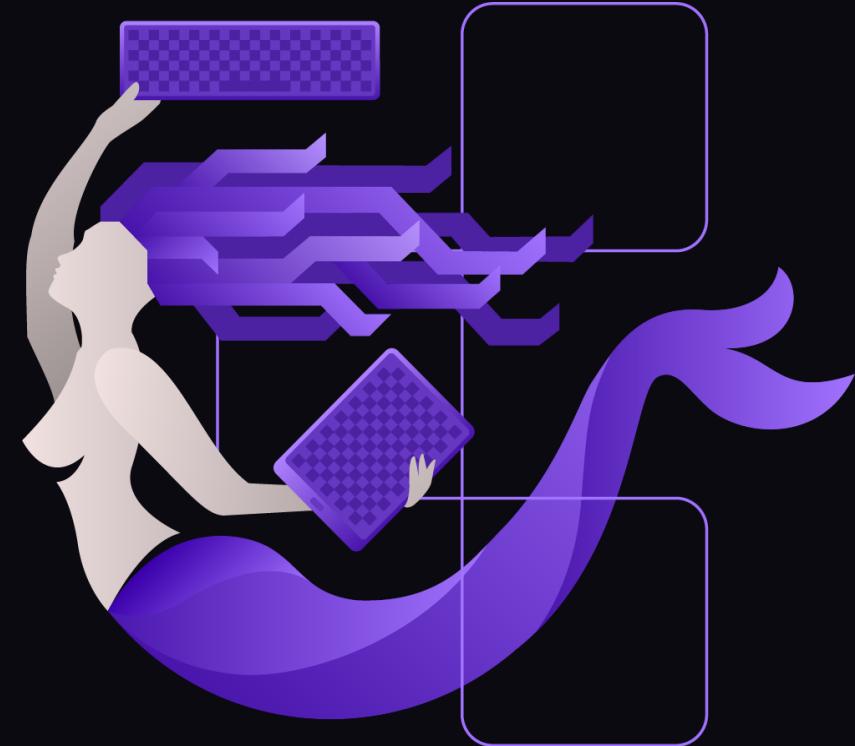


WARSAW
IT DAYS

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

Wolfgang Ofner

Freelance Cloud Architect, ProgrammingWithWolfgang



MAIN ORGANIZER: **AcademicPartners**
FUNDACJA

ORGANIZING COMMITTEE: dozens of organizations from the IT / data science sector (full list on the event website)



Wolfgang Ofner

Freelance Cloud Architect, Perth, Australia
Focus on Azure, Kubernetes, DevOps and .NET

<https://programmingwithwolfgang.com>

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https://twitter.com/wolfgang_ofner



Agenda



Introduction to Hybrid Cloud



Azure Arc and Kubernetes



Integrating On-Premises with Cloud



Real-World Examples



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

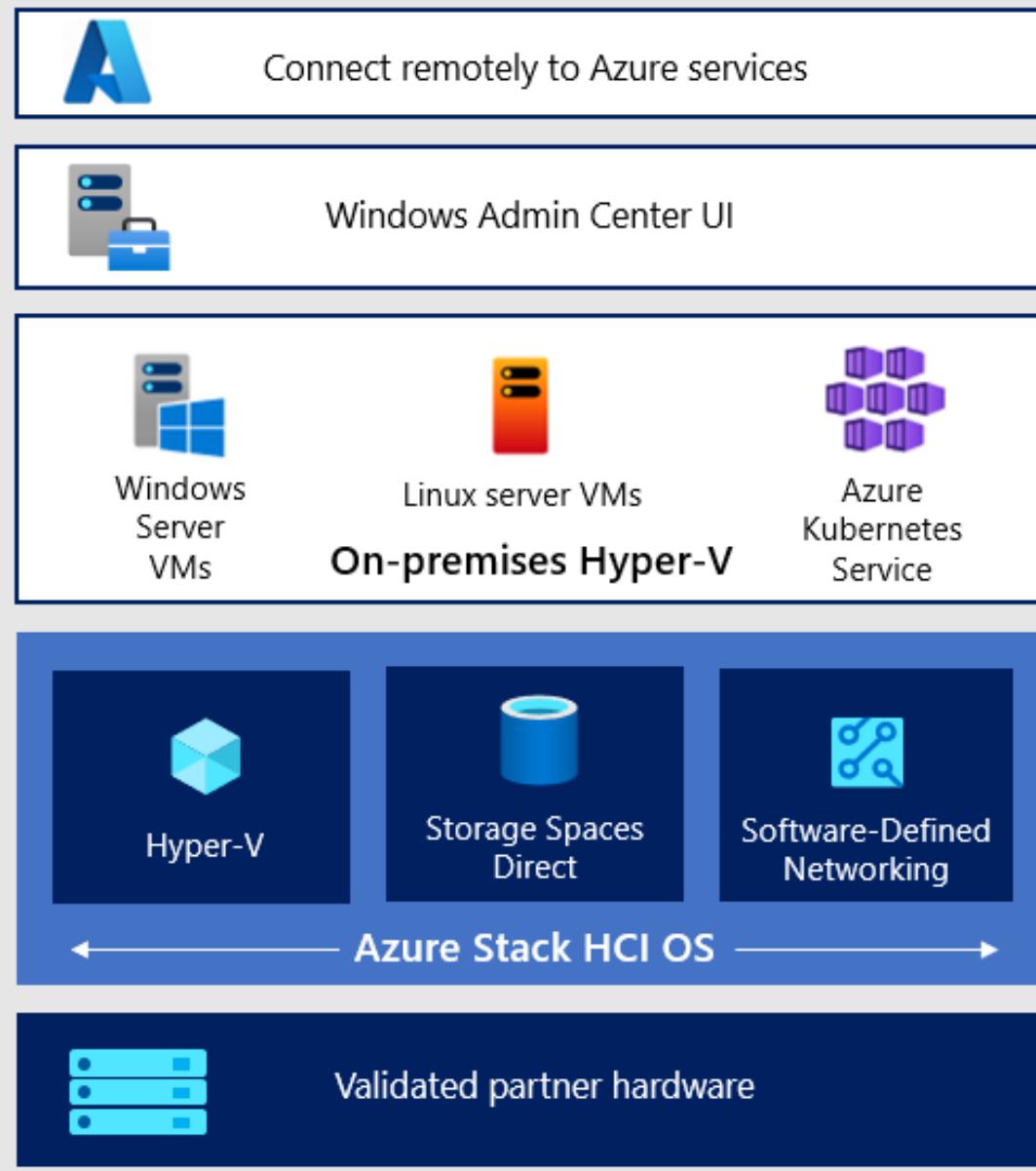
- Built on proven technologies such as Hyper-V, Storage Spaces Direct, and Azure-inspired SDN
- Each cluster consists of 1 to 16 physical servers

Azure Stack HCI

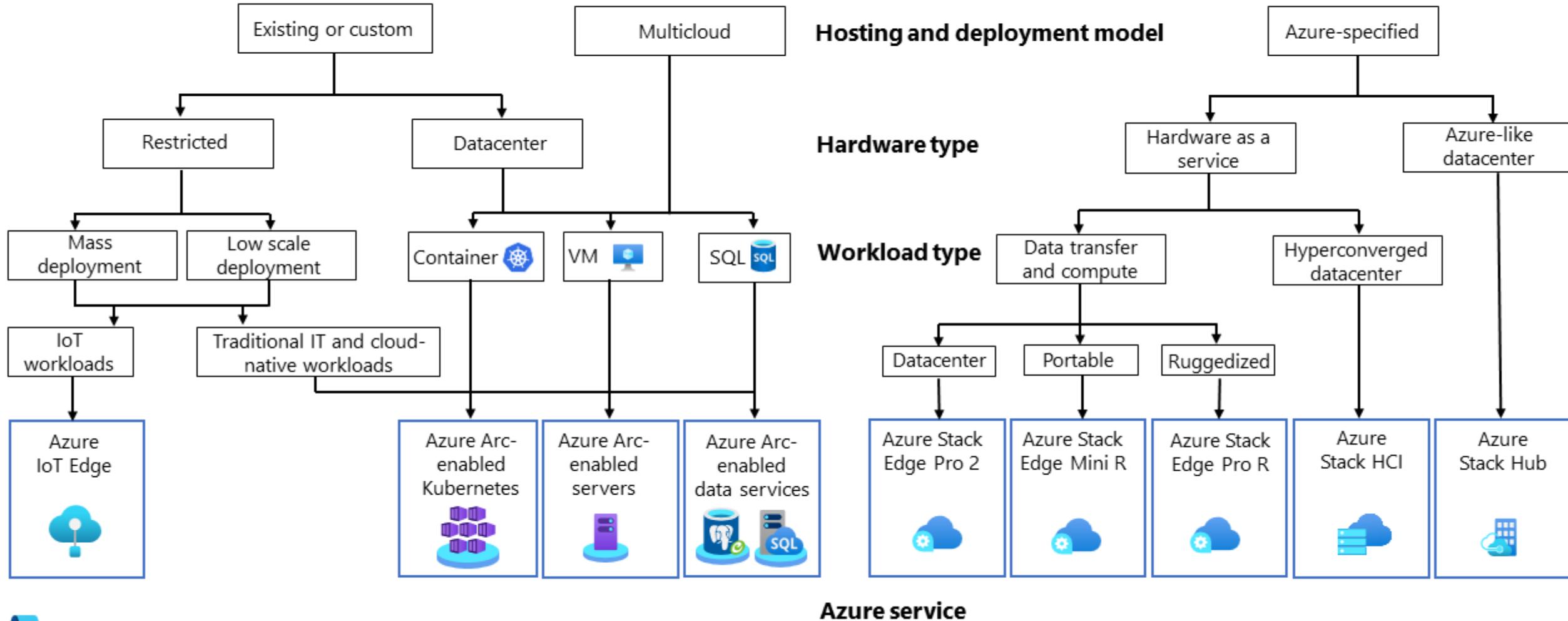
- Delivered as an Azure service and billed to an Azure subscription, with access to cloud-based monitoring, Site Recovery, VM backups, and central view of Azure Stack HCI deployments
- Often used in disconnected scenarios



Azure Stack HCI solution



Azure cloud





Azure Arc

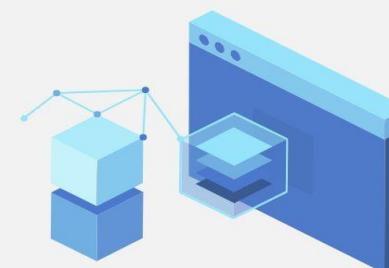
Azure Arc Overview

- Project infrastructure running outside of Azure into Azure
 - Linux and Windows VMs and bare metal servers
 - Any CNCF certified Kubernetes distribution
 - SQL Server

Search[Get started](#)[Infrastructure](#)[Services](#)[Learn more](#)[All Azure Arc resources](#)**Management**[Custom locations](#)[Data controllers](#)[Resource bridges \(preview\)](#)[Service principals](#)[Private link scopes](#)**Infrastructure**[Azure Arc virtual machines \(preview\)](#)[Azure Stack HCI](#)[Kubernetes clusters](#)[Servers](#)[SQL Servers](#)[VMware vCenters \(preview\)](#)[SCVMM management servers \(preview\)](#)**Data services**[PostgreSQL Hyperscale \(preview\)](#)[SQL managed instances](#)[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 (preview)

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

- 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

Azure Arc Installation Prerequisites

- Azure CLI
- Azure CLI Arc extension

```
curl -sL https://aka.ms/InstallAzureCLIDeb | sudo bash
```

```
az extension add --name connectedk8s
```

Azure Arc Installation Prerequisites

- Azure CLI
- Azure CLI Arc extension
- Register Azure Provider

```
root@Office:/home/wolfgang ~ + ^  
root@Office:/home/wolfgang# az provider register --namespace Microsoft.Kubernetes  
root@Office:/home/wolfgang# az provider register --namespace Microsoft.KubernetesConfiguration  
root@Office:/home/wolfgang# az provider register --namespace Microsoft.ExtendedLocation
```

Azure Arc Installation Prerequisites

- Register Azure Provider

```
root@Office:/home/wolfgang# az provider show -n Microsoft.Kubernetes -o table
+-----+-----+-----+
| Namespace | RegistrationPolicy | RegistrationState |
+-----+-----+-----+
| Microsoft.Kubernetes | RegistrationRequired | Registered |
root@Office:/home/wolfgang# az provider show -n Microsoft.KubernetesConfiguration -o table
+-----+-----+-----+
| Namespace | RegistrationPolicy | RegistrationState |
+-----+-----+-----+
| Microsoft.KubernetesConfiguration | RegistrationRequired | Registered |
root@Office:/home/wolfgang# az provider show -n Microsoft.ExtendedLocation -o table
+-----+-----+-----+
| Namespace | RegistrationPolicy | RegistrationState |
+-----+-----+-----+
| Microsoft.ExtendedLocation | RegistrationRequired | Registered |
```

Azure Arc Installation

- Install with Azure CLI

```
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
- Applications are installed in the azure-arc namespace

Azure Arc Applications

NAME	READY	STATUS	RESTARTS	AGE
clusterconnect-agent-897468586-zgxj9	3/3	Running	0	44m
flux-logs-agent-86cf4f7b7d-55fld	1/1	Running	0	44m
config-agent-69dcdb554d-7swhm	2/2	Running	0	44m
controller-manager-5494575977-rfc6g	2/2	Running	0	44m
extension-manager-7dc84fb6d7-sfnzl	2/2	Running	0	44m
resource-sync-agent-56f777f6b6-7zj9n	2/2	Running	0	44m
clusteridentityoperator-77f6bf4f89-trs59	2/2	Running	0	44m
metrics-agent-84ccd8598f-6h885	2/2	Running	0	44m
cluster-metadata-operator-9945b897c-nxcwr	2/2	Running	0	44m
kube-aad-proxy-8564d4dd5d-qqccbq	2/2	Running	0	44m

Azure Arc in the Azure Portal

- “Single pane of glass”
- Manage outside infrastructure within Azure

(1 result)[Get started](#)[Infrastructure](#)[Services](#)[Learn more](#)[All Azure Arc resources](#)

Management

[Custom locations](#)[Data controllers](#)[Resource bridges \(preview\)](#)[Service principals](#)[Private link scopes](#)

Infrastructure

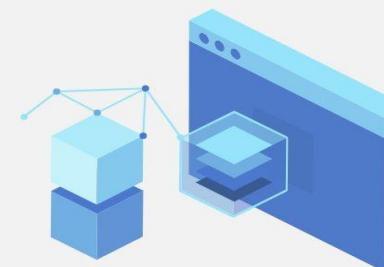
[Azure Arc virtual machines \(preview\)](#)[Azure Stack HCI](#)[Kubernetes clusters](#)[Servers](#)[SQL Servers](#)[VMware vCenters \(preview\)](#)[SCVMM management servers \(preview\)](#)

Data services

[PostgreSQL Hyperscale \(preview\)](#)[SQL managed instances](#)[Get started](#)[Infrastructure](#)[Services](#)[Learn more](#)

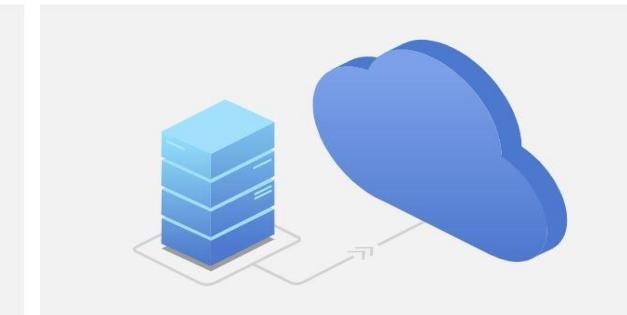
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[Add](#)

Deploy Azure services

Use Azure Arc to deploy Azure services on your infrastructure. [Learn more](#)

[Deploy](#)

Azure Arc | Kubernetes clusters

...



Azure Arc | Kubernetes clusters

Microsoft

Search

<<

+ Add a Kubernetes cluster with Azure Arc

Manage view

Refresh

Export to CSV

Open query

Infrastructure

Azure Arc virtual machines (preview)

Azure Stack HCI

Kubernetes clusters

Servers

SQL Servers

VMware vCenters (preview)

SCVMM management servers (preview)

Data services

PostgreSQL Hyperscale (preview)

SQL managed instances

Filter for any field...

Subscription equals all

Resource group equals all

Add filter

More

No grouping

List view

<input type="checkbox"/> Name ↑↓	Type ↑↓	Resource group ↑↓	Kubernetes... ↑↓	Location ↑↓
<input type="checkbox"/> AzureServices-Arc	Kubernetes - Azure Arc	ArcDemo	1.23.12	West Europe
<input type="checkbox"/> k3s-arc	Kubernetes - Azure Arc	ArcDemo	1.23.12	West Europe

k3s-arc | Namespaces

Kubernetes - Azure Arc

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.

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



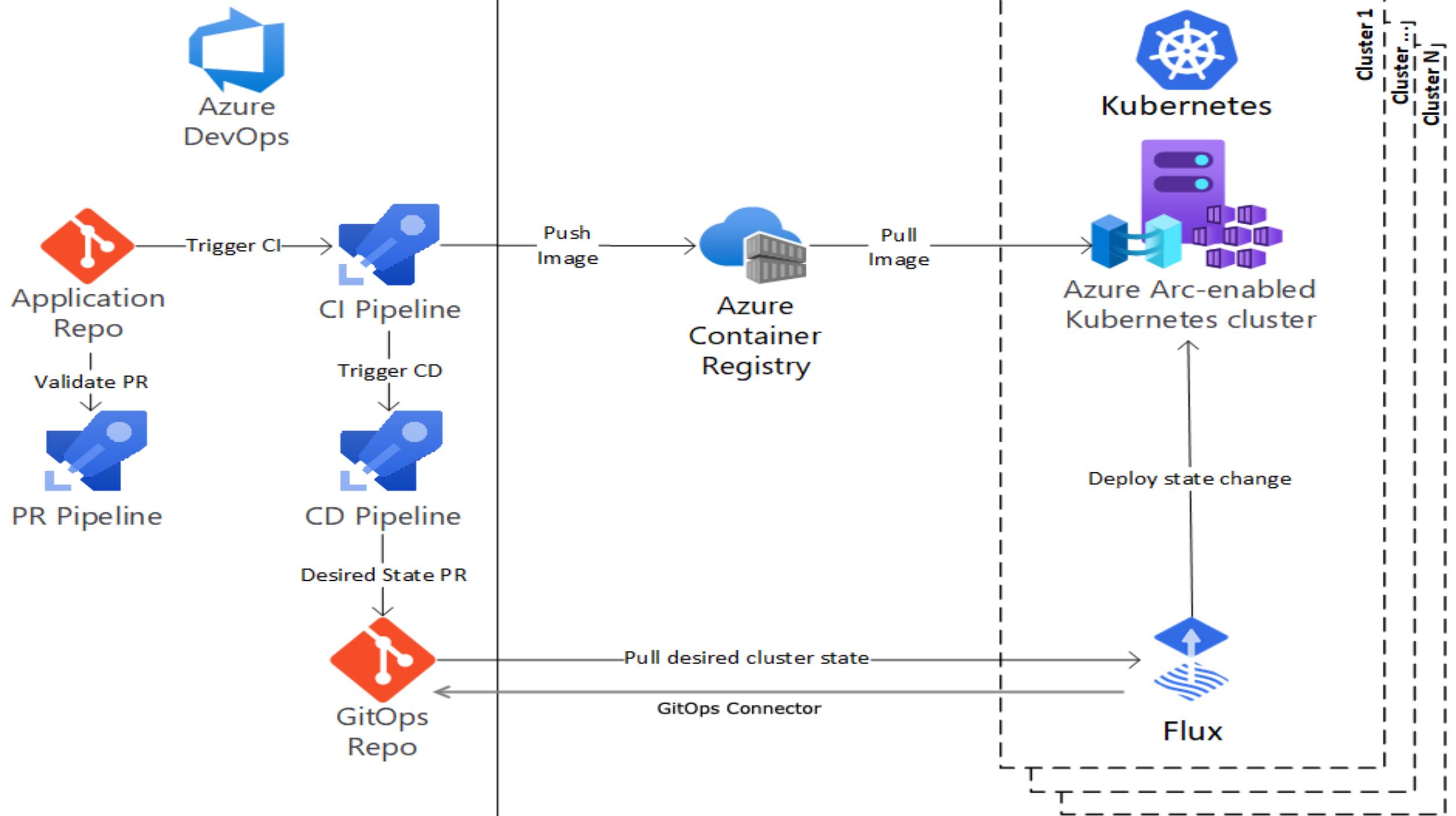
Azure Arc Extensions

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



Git Ops Extension Installation

- Single Azure CLI command to configure and install GitOps operator

Git Ops Extension Installation

```
root@Office:/home/wolfgang# az k8s-configuration create \
>   --name gitops-arcdemo \
>   --cluster-name k3s-Arc \
>   --resource-group ArcDemo \
>   --operator-instance-name gitops-arcdemo \
>   --operator-namespace gitops-arcdemo \
>   --repository-url git@ssh.dev.azure.com:v3/programmingwithwolfgang/AzureArcDemo/AzureArcDemoGitOps \
>   --scope Cluster \
>   --cluster-type connectedClusters \
>   --operator-params "--git-poll-interval 1m --git-branch=master --git-path=./AzureArcDemo" \
>   --enable-helm-operator \
>   --helm-operator-params "--set helm.versions=v3"
This command has been deprecated and will be removed in a future release. Use 'k8s-configuration flux create' instead.
{
  "complianceStatus": {
    "complianceState": "Pending",
    "lastConfigApplied": "0001-01-01T00:00:00+00:00",
    "message": "{\"OperatorMessage\":null,\"ClusterState\":null}",
    "messageLevel": "Information"
  }
}
```

Git Ops Extension Installation

Dashboard > Azure Arc | Kubernetes clusters > k3s-arc

k3s-arc | GitOps

Kubernetes - Azure Arc

Search

Storage Configuration Settings Extensions Open Service Mesh GitOps Policies

Create Delete Refresh

	Name	Operator instance	Operator namespace	Operator scope	Operator state
<input type="checkbox"/>	gitops-arcdemo	gitops-arcdemo	gitops-arcdemo	namespace	✓ Succeeded

gitops-arcdemo

Kubernetes cluster configuration



+ Create Delete Refresh

<input checked="" type="checkbox"/>	Name	Operator instance	Operator name
<input checked="" type="checkbox"/>	gitops-arcdemo	gitops-arcdemo	gitops-arcdemo

Operator details

Operator state

Succeeded

Instance name

gitops-arcdemo

Message

{ "OperatorMessage": "ts=2022-10-07T08..."

[View full message](#)

Operator last updated

10/7/2022, 04:25 PM GMT+8

Namespace

gitops-arcdemo

Operator scope

cluster

Operator type

Flux

Operator parameters

--git-readonly --git-poll-interval 1m --git-branch...

Enable helm



Helm operator parameters

--set helm.versions=v3

Repository details

Repository URL

git@ssh.dev.azure.com:v3/programmingwithwolf...

Repository public key

ssh-rsa

AAAAAB3NzaC1yc2EAAAQABAAABgQDQ

```
root@Wolfgang-PC:/home/wolfgang# kubectl get pods -n demo
NAME                      READY   STATUS    RESTARTS   AGE
azurearcdemo-bb66f7b4f-zh2kz   1/1     Running   0          5m48s
root@Wolfgang-PC:/home/wolfgang# kubectl get service -n demo
NAME            TYPE      CLUSTER-IP      EXTERNAL-IP      PORT(S)        AGE
azurearcdemo   LoadBalancer   10.0.192.106   51.105.204.160   80:32544/TCP   5m53s
```

Swagger UI

x +

Not secure | 51.105.204.160/swagger/index.html

☆ ABP T ⚙️ Incognito (2)

Swagger. Supported by SMARTBEAR

Select a definition AzureArcDemo v1

AzureArcDemo 1.0 OAS3

<http://51.105.204.160/swagger/v1/swagger.json>

Hello

GET /Hello

Try it out

Parameters

No parameters

Responses

Code	Description	Links
200	Success	No links

Media type

text/plain



Controls Accept header.

[Example Value](#) | [Schema](#)

string

GitOps Repository

- YAML file containing information about the Helm chart
 - Git repository
 - Branch
 - Path to Helm chart

GitOps Repository

- YAML file containing information about the Helm chart

```
apiVersion: helm.fluxcd.io/v1
kind: HelmRelease
metadata:
  name: azurearcdemo
  namespace: demo
spec:
  releaseName: azurearcdemo
  chart:
    git: git@ssh.dev.azure.com:v3/programmingwithwolfgang/AzureArcDemo/AzureArcDemoGitOps
    ref: master
    path: AzureArcDemo/AzureArcDemo
```

GitOps Repository

- YAML file containing information about the Helm chart
 - Git repository
 - Branch
 - Path to Helm chart
- Helm chart

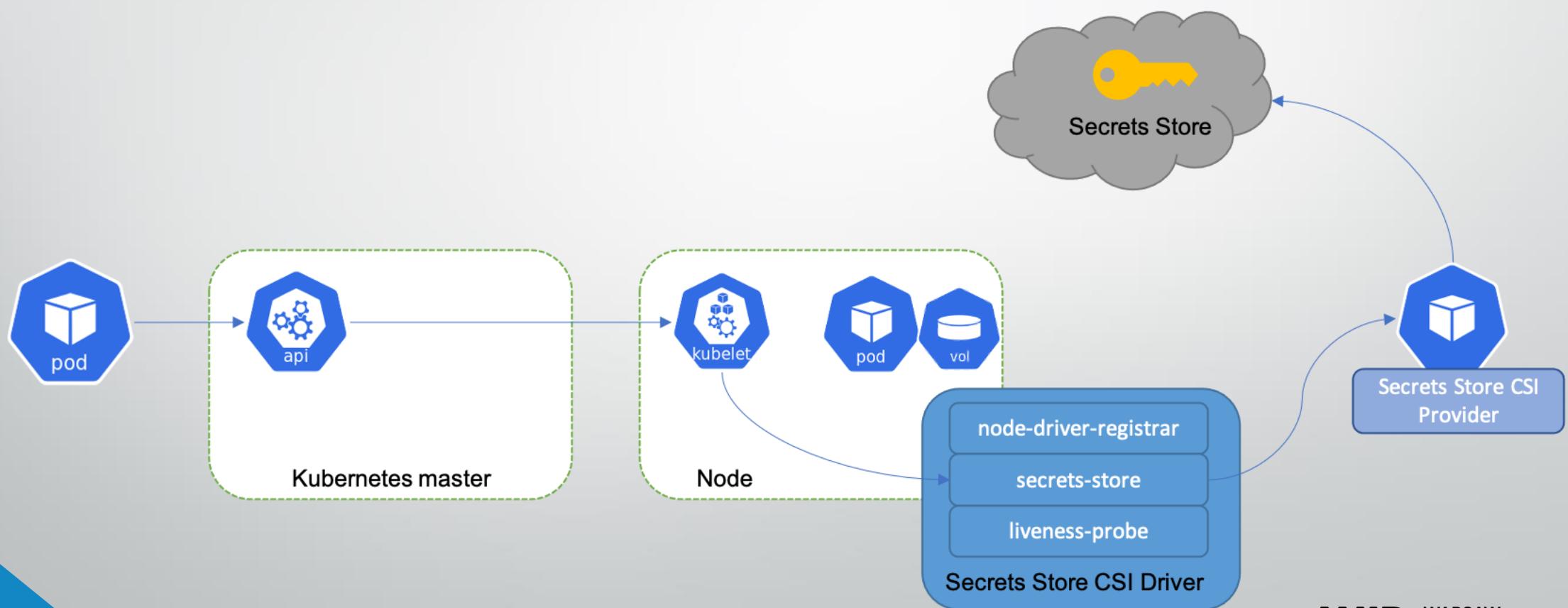
GitOps Pipeline

- 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
- Tag can be set manually when starting the pipeline

Key Vault Extension

- Mount secrets from Azure Key Vault into Kubernetes
- Secrets are retrieved using gRPC
- Get all advantages from Azure Key Vault
- Use pipeline to write/rotate secrets in Key Vault

Key Vault Extension



Azure Monitor Extension

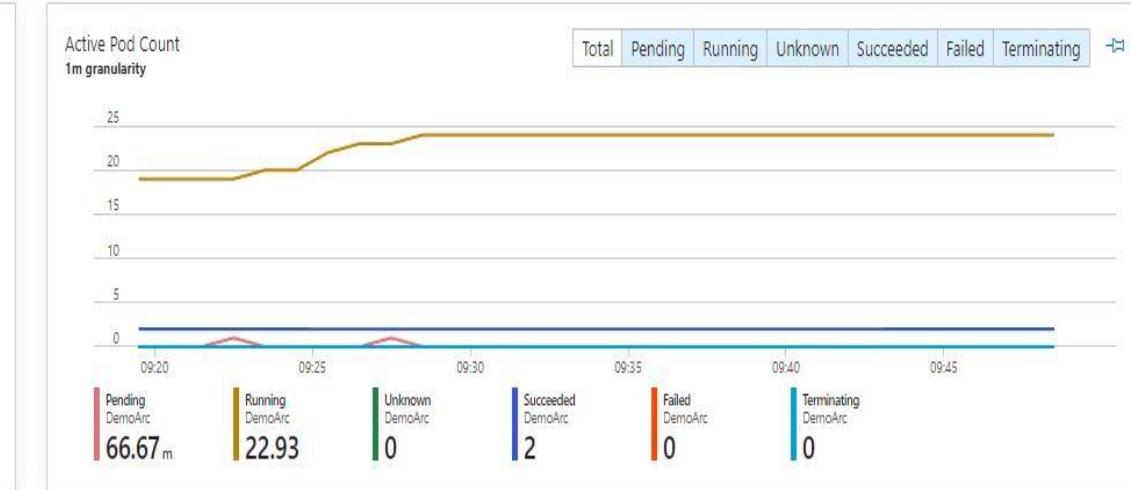
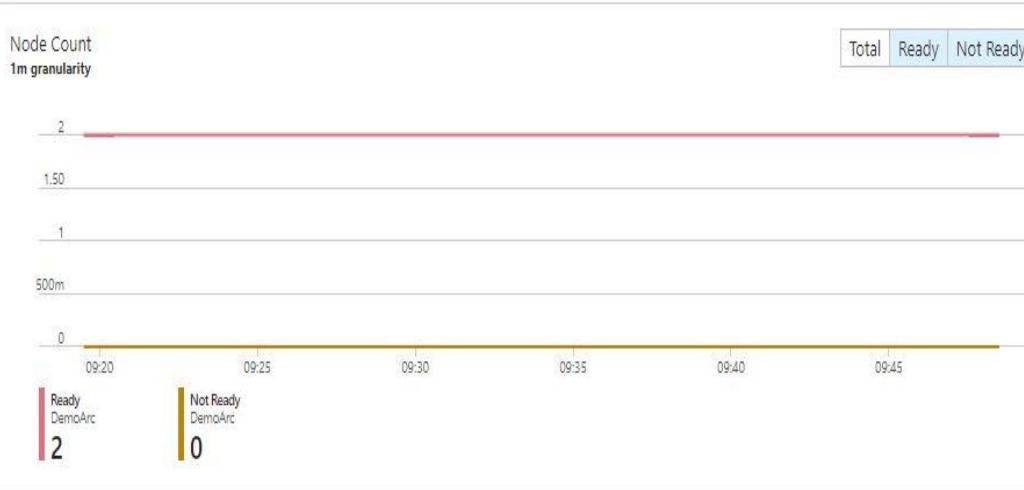
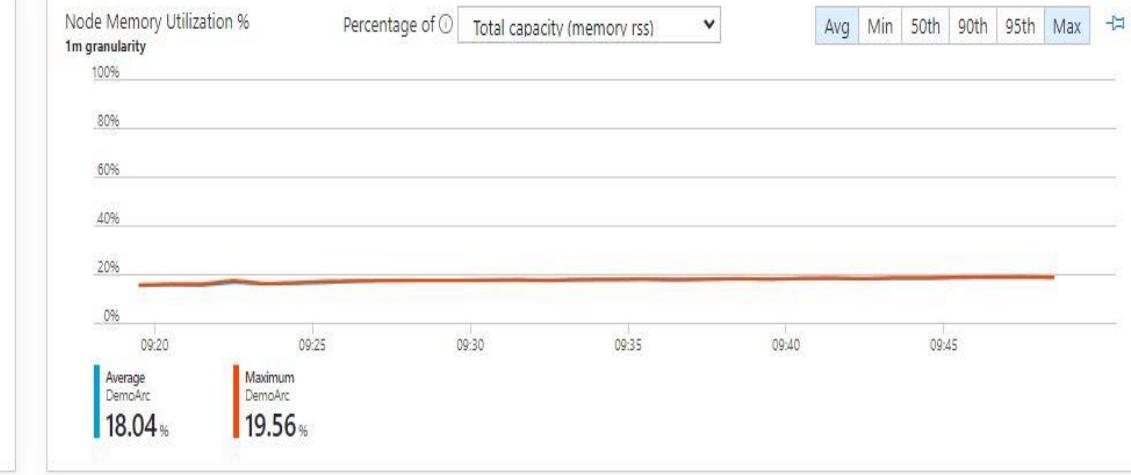
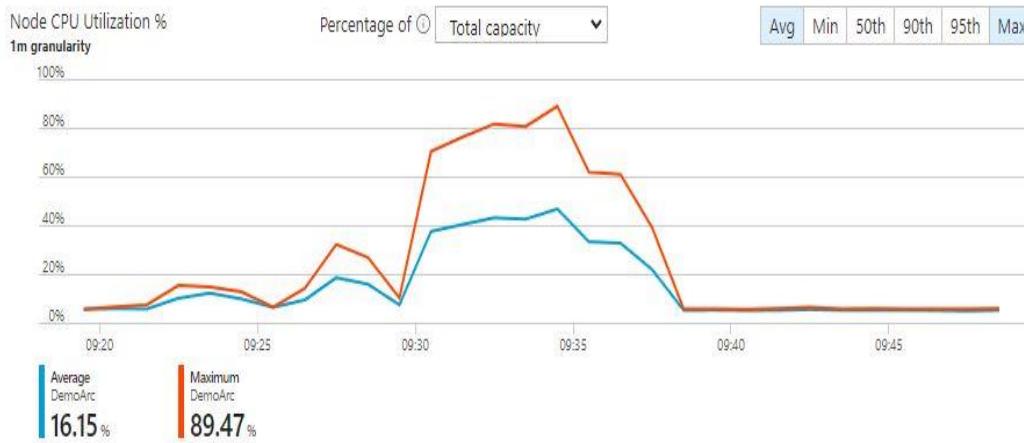
- Azure Monitor agent is installed in its own namespace
- Agent sends information to Log Analytics Workspace
- Azure Monitor:
 - Dashboards
 - Alerting
 - Container Insights

DemoArc | Insights

Kubernetes - Azure Arc

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

Time range = Last 30 minutes

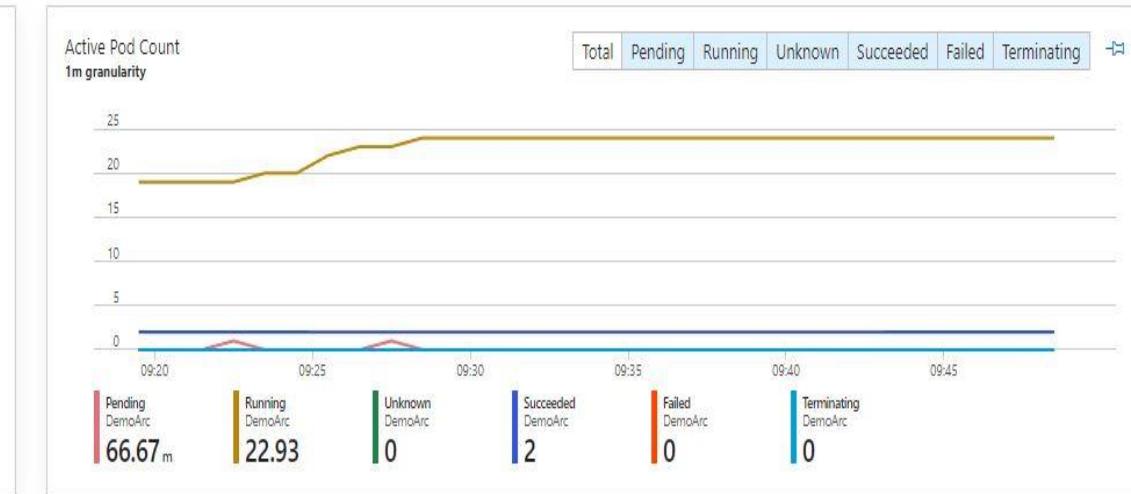
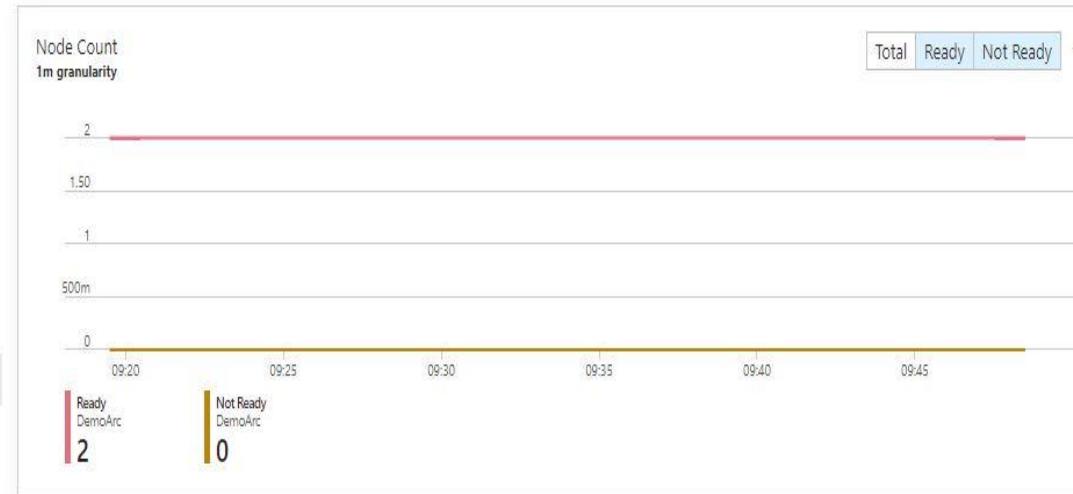
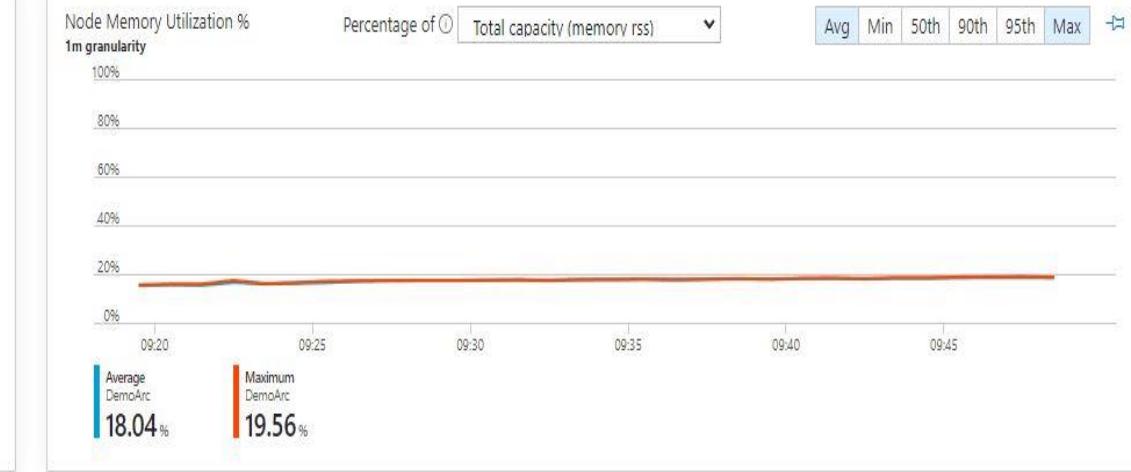
Add Filter
[What's new](#)
[Cluster](#)
[Reports](#)
[Nodes](#)
[Controllers](#)
[Containers](#)
SettingsExtensionsGitOps (preview)PoliciesPropertiesLocksMonitoringInsightsAlertsMetricsLogs

DemoArc | Insights

Kubernetes - Azure Arc

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DemoArc | Insights

Kubernetes - Azure Arc


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[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)
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-4pfjt	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-sfnzl	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 Arc Services

- Azure Arc-enabled 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



Azure resources



Azure Arc-enabled infrastructure resources
(Servers, SQL servers, Kubernetes)



Azure Arc-enabled services resources
(Data services, App services, Machine Learning services)



Azure Resource Manager

Azure Arc

Azure Arc-enabled
infrastructure onboarding

Azure Arc-enabled
services deployment

Azure Arc-enabled
infrastructure onboarding

On-premises IT
infrastructure resources



On-premises Arc-enabled services
(Data services, App services, Machine Learning services)



Multicloud Arc-enabled services
(Data services, App services, Machine Learning services)



Multicloud IT
infrastructure resources



Azure Stack HCI

VMware®

Amazon Web Services

Google Cloud Platform

Real-World Examples

- Project “Autonomous Ropeway System”
- Project Smart Machine Factory



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
 - No possibility to use cloud services like Azure Monitor
 - How to collect logs from the Kubernetes cluster?
 - No VPN or ExpressRoute allowed



Smart Machine Factory

- Run Azure Stack HCI AKS in factories around the globe
- Use Azure Arc to manage AKS cluster
 - Azure Monitor for monitoring and alerting
 - GitOps for deployments without access to the factory
- Run additional service in AKS such as managed PostgreSQL

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
- Deep technical knowledge necessary
- Too many applications to talk about them in just one hour

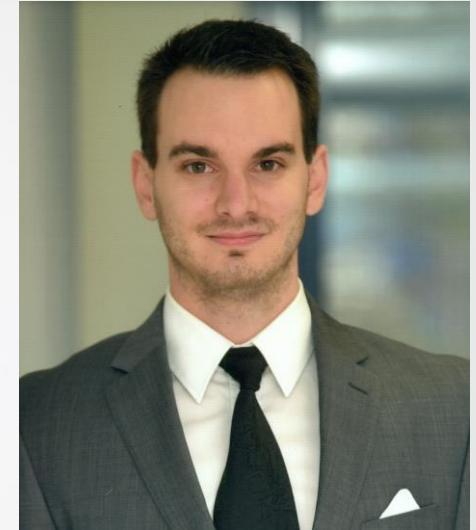
Azure Arc Conclusion

- Possibly the most powerful Azure service
- Major focus from Microsoft
- Deep technical knowledge required
- Can be buggy
- Documentation needs improvement

Resources

- [Slides](#)
- [Azure Arc Series](#)
- [Azure Arc Youtube Playlist](#)
- [Azure Arc Documentation](#)
- [Azure Stack HCI](#)
- [Flux CD](#)





Contact

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Wolfgang Ofner

<https://programmingwithwolfgang.com>

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

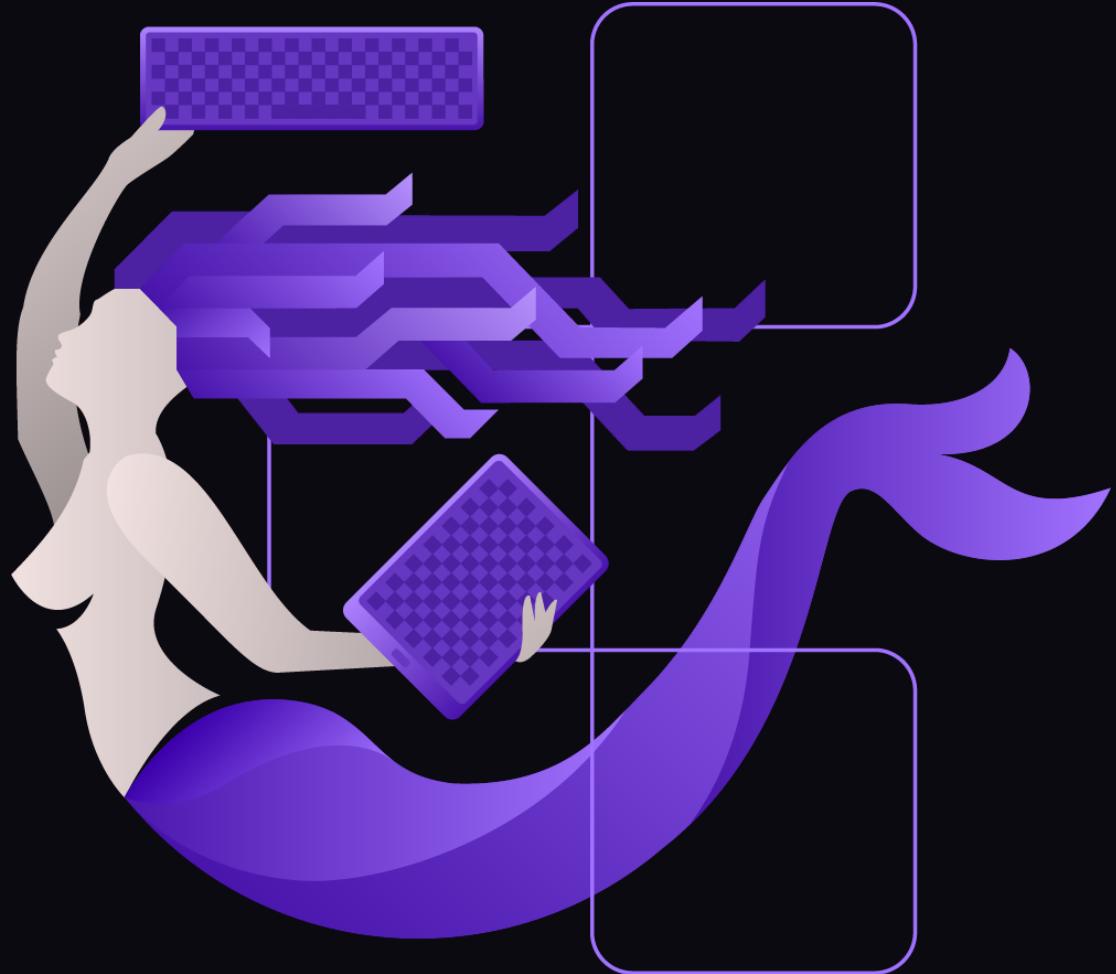
https://twitter.com/wolfgang_ofner



WARSAW
IT DAYS

Thank you for watching!

Remember to rate the presentation and leave your questions in the section below.



www.WarszawskieDniInformatyki.pl



31 March - 1 April 2023



Politechnika Warszawska + online

MAIN ORGANIZER: AcademicPartners
FUNDACJA

ORGANIZING COMMITTEE: dozens of organizations from the IT / data science sector (full list on the event website)