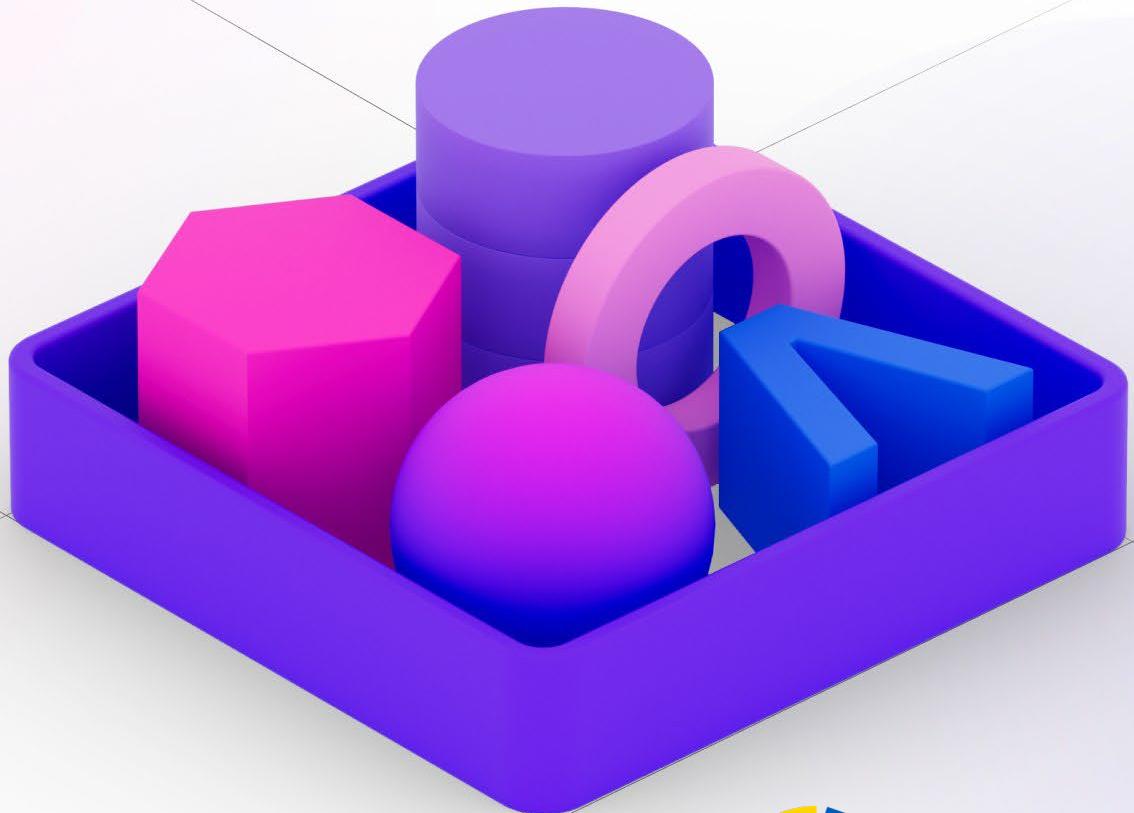
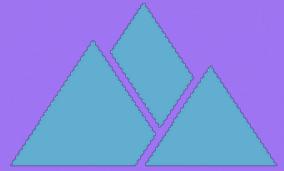


# .NET Conf 2023





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Powered by Innovation

# Azure IoT Services

## Episode IV

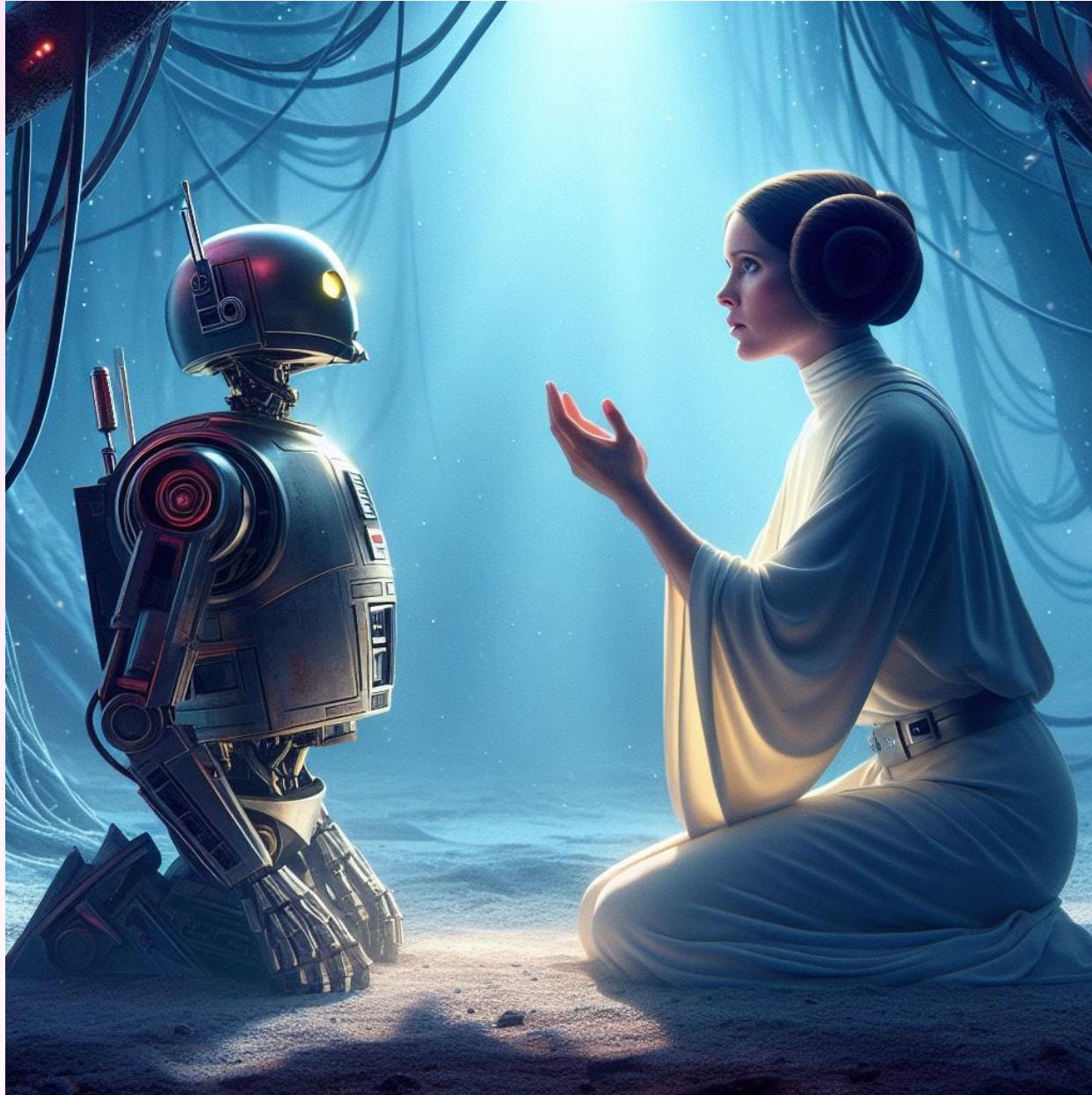
### Una nuova speranza

Marco Dal Pino





# NanoFramework, you are my only Hope...



# Azure Arc-Enabled Infrastructure

Run modern containerized workloads on infrastructure that offers robust high-availability, elastic compute

## Azure Arc-enabled

### Windows IoT

Operating system optimized for running on embedded devices ranging from robots, kiosks, HMIs to edge gateways.

Works with AKS Edge Essentials to create light-weight platform for running containerized applications on edge devices.

### Azure Stack HCI

Server-class infrastructure that provides an out-of-the-box Arc-enabled platform for running and managing Azure edge solutions.

Works with AKS on Azure Stack HCI to run containerized applications on server class devices.

**Microsoft supported software stack from kernel to cloud, Windows to Azure covering your solution from top to bottom**

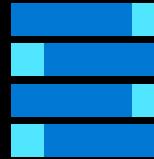
# Azure cloud-to-edge infrastructure

Connect, manage and operate on any infrastructure with consistent and familiar tools



## Azure Arc





### Reach

Windows and Linux  
VM and bare metal  
At scale searchable inventory



### Configure

Consistent VM extensions  
Centralized agent management – Monitoring, Security, Update Management



### Govern

Built-in Azure policies  
Compliance across environments  
Audit and enforce OS settings



### Secure

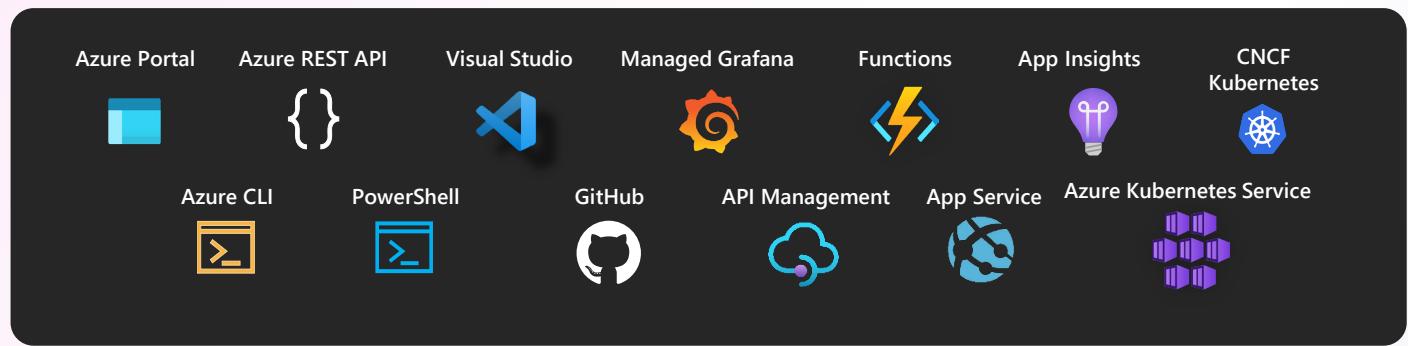
Azure Active Directory  
Managed Identity  
Server security baselines  
Role-Based Access control

# Azure's cloud-to-edge application platform

Connect, manage and operate applications and Kubernetes clusters running anywhere



## Azure Arc



**Azure Arc-enabled Kubernetes**  
Multiple 3P Kubernetes flavors supported

**Azure Arc-enabled services**  
Deploy and run Azure services outside of Azure while still operating it from Azure

**Azure Arc-enabled developer services**  
Deploy apps and configurations at-scale with GitOps

# Azure's cloud-to-edge data platform

The data platform for the era of AI



Azure Arc + Azure IoT Operations

## Locally Aware

Ingest and process  
data

Open Standards  
(MQTT, OPCUA)  
Connected to Azure

## Lake centric and open

OneLake

One Copy

Open at every tier

## Complete Analytics Platform

Familiar and intuitive

Built into Microsoft 365

Insight to action

## AI Powered

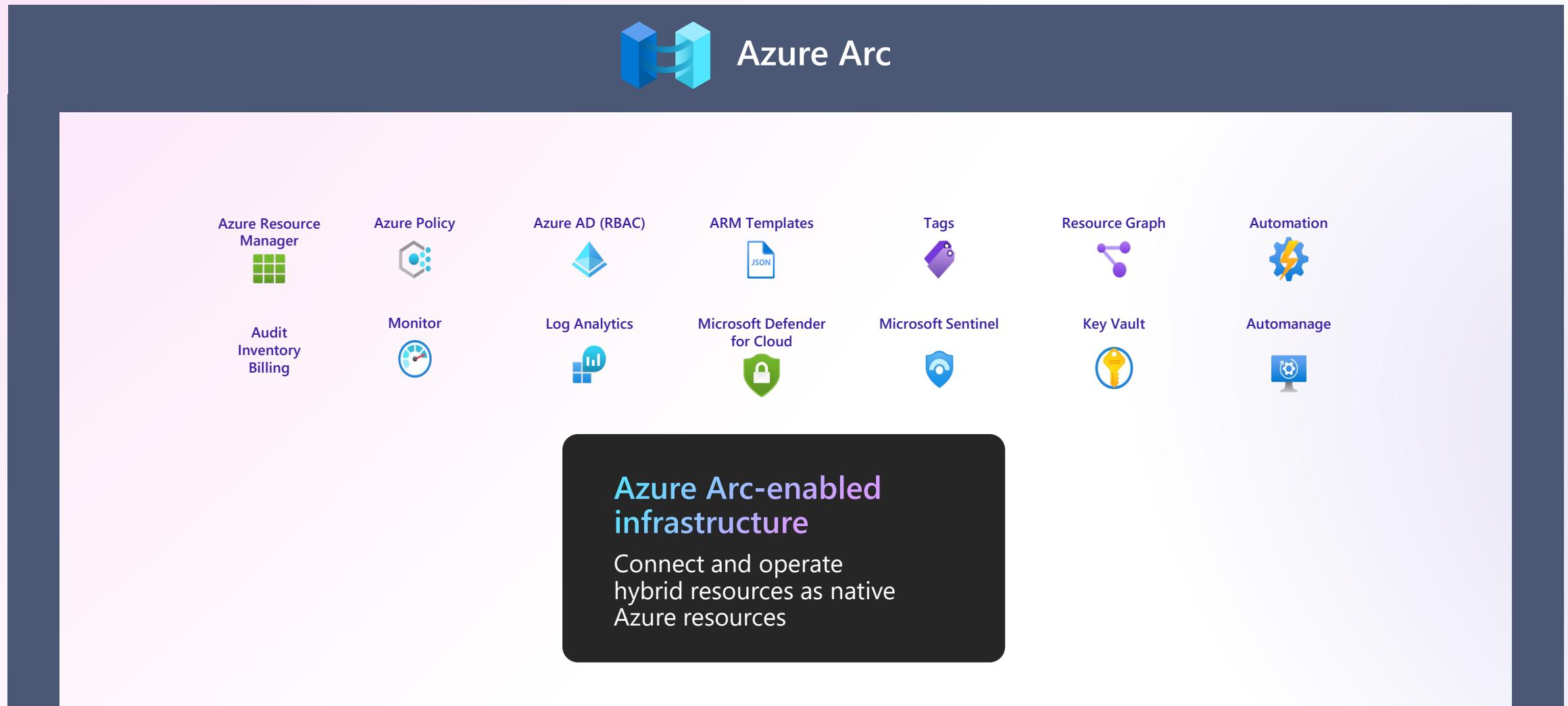
Copilot accelerated

ChatGPT on your data

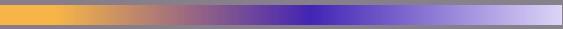
AI driven insights

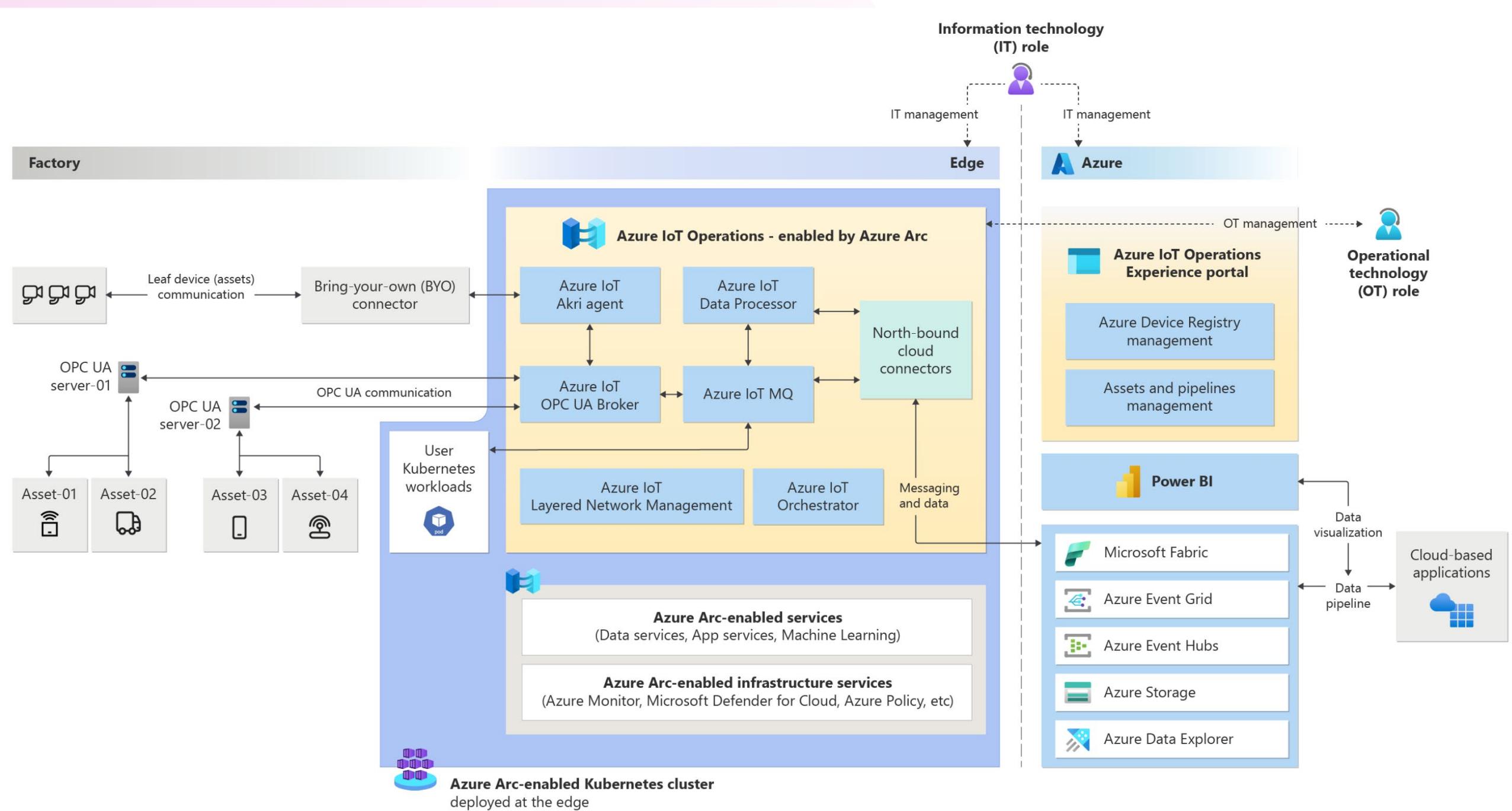
# Azure's cloud-to-edge management platform

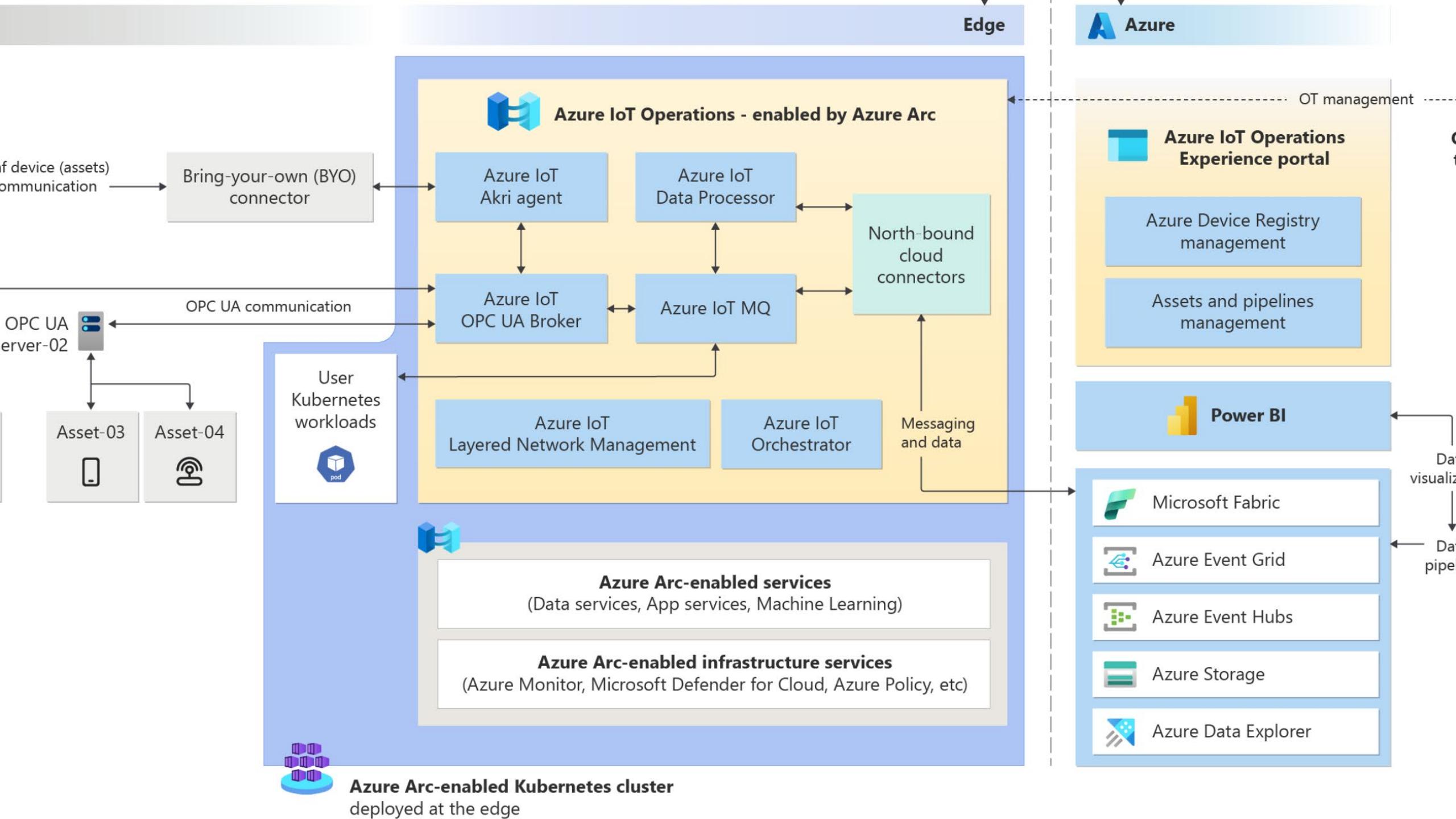
Single control plane to simplify operations, management, and security



# Introducing: Azure IoT Operations, enabled by Azure Arc



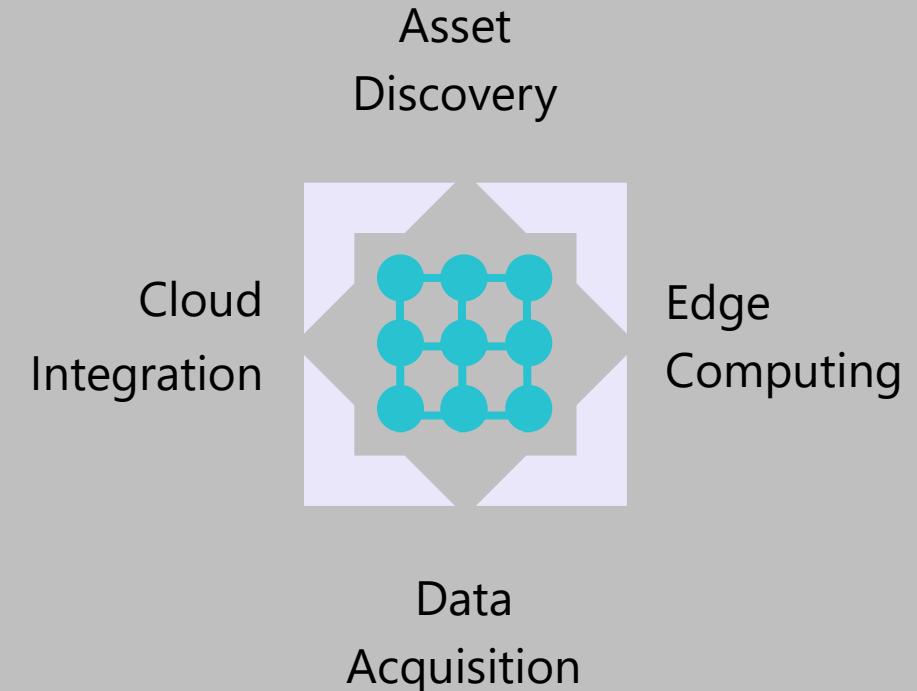




# Azure IoT Operations

An Arc-enabled suite of composable and modular services that help organizations discover assets, capture insights, and take actions to optimize their operations:

- Out of box compatibility with existing Arc-connected infrastructure: Windows IoT, AKS Edge Essentials, AKS on Azure Stack HCI, and more
- Designed for high availability, resiliency, scalability, and security
- An edge-native data plane built on industry standards (MQTT, OPC UA, OTel)
- Bring cloud-native development to the edge through Kubernetes
- Simplifies management of all edge services from cloud using Azure Arc



# Azure IoT Operations

The Arc-enabled suite of services for Digital Transformation

- 1 Discover and onboard assets easily
- 2 Edge-native data plane with built in bi-directional cloud-to-edge communication
- 3 Efficiently process data at the edge
- 4 Control devices in isolated network layers
- 5 Rely on ready-to-use cloud connectors
- 6 Push and pull the right data to and from the cloud
- 7 Single control plane for management and security
- 8 Scalable approach to application development and deployment
- 9 Use orchestration to simplify the deployment, configuration, and updates
- 10 Troubleshooting & monitoring via industry-standard tools

# Azure IoT Operations Use Cases



## Industrial

Predictive Maintenance  
Asset Health  
Factory Automation



## Retail

Contactless Checkout  
Inventory Management  
Edge Vision AI



## Healthcare

Patient Monitoring  
Real-time Diagnosis  
Intelligent Devices



## Financial Services

Fraud Detection  
Real-time Analytics  
Compliance Monitoring

Common needs for holistic  
integration, security and cost  
optimization

# Azure IoT Operations Services

Modular, composable services for diverse needs

Azure IoT Akri

Azure IoT OPC UA Broker

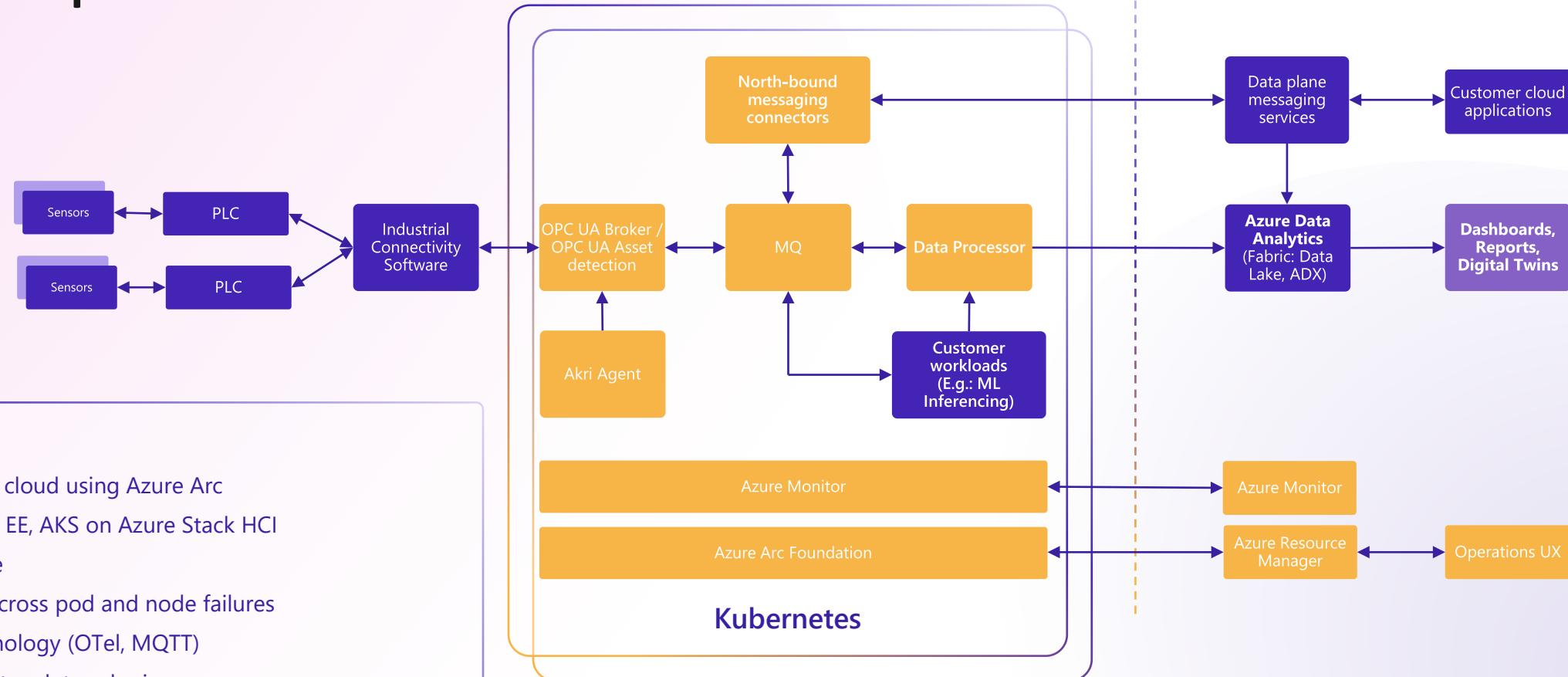
Azure IoT MQ

Azure IoT Data Processor

Azure IoT Layered Network Management

Azure IoT Orchestrator

# Azure IoT Operations Architecture

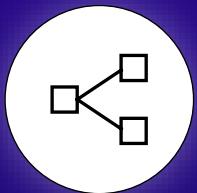


## Key Attributes:

- Manage all edge services from cloud using Azure Arc
- Out of the box works with AKS EE, AKS on Azure Stack HCI
- Extensible, scalable, and secure
- High availability and resilient across pod and node failures
- Built on standards-based technology (OTel, MQTT)
- Built-in support for isolated network topologies
- Customer workloads integrated into the platform as a unified solution
- Supports GitOps configuration as code flows for deployment and updates
- Natively integrates with Azure Data Analytics (Data Lake, ADX) in the cloud
- Common operational model (deploy, configure and update)
- Common support model using support bundles for expedited CSS troubleshooting



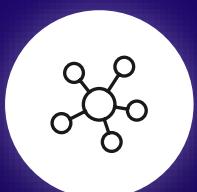
# Azure IoT Akri overview



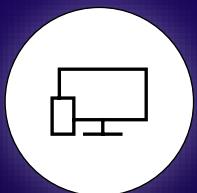
Enables connections to devices via their protocols (OPC UA, ONVIF, udev, etc.) thus extending our reach to both off-cluster and non-K8s devices



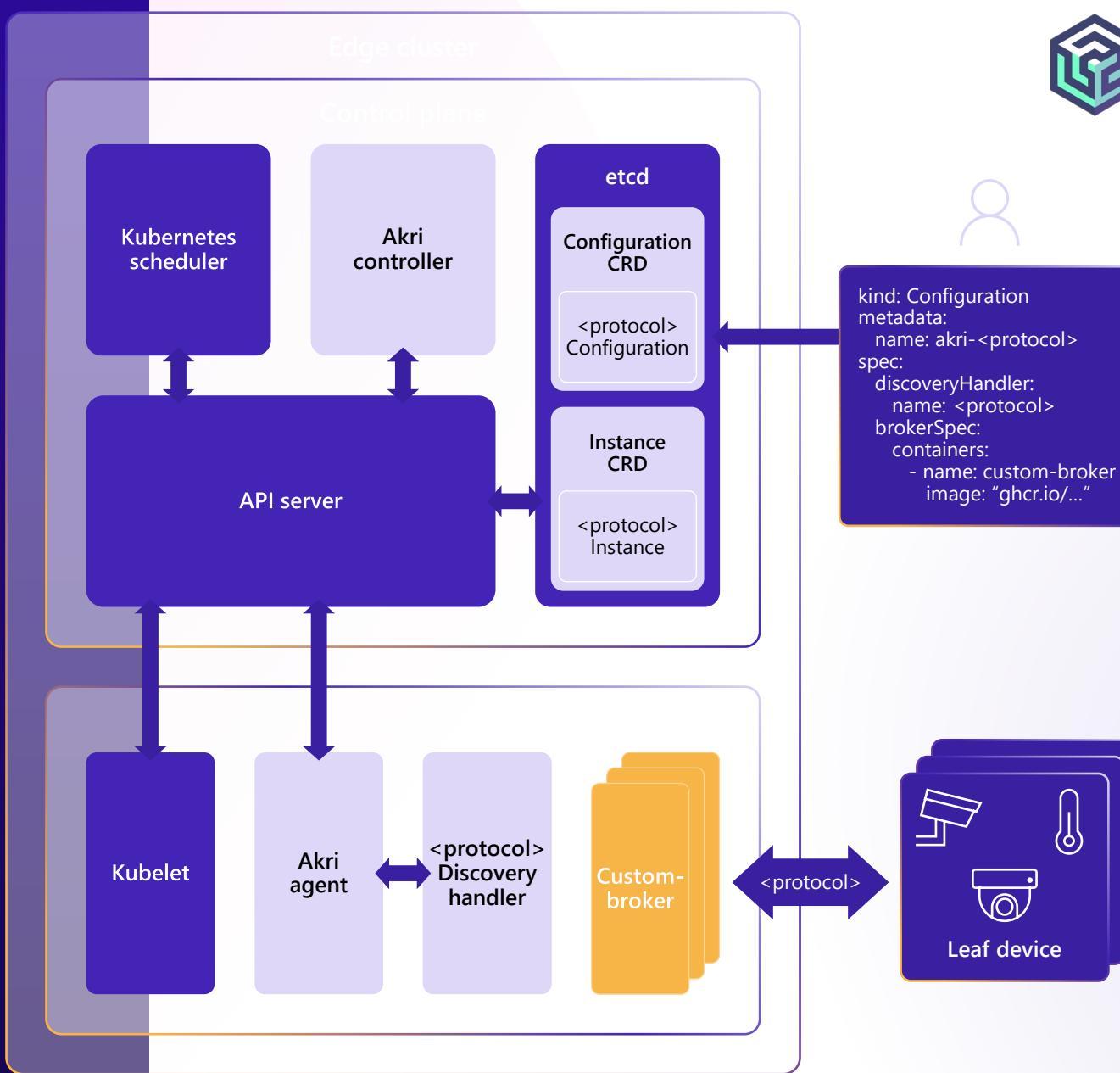
Detects new devices automatically or on-demand, making scaling up or down very easy



Registers devices as Kubernetes resources, just like memory or CPUs



Assign workloads to specific devices or group of devices, even if attached to other nodes



# Azure IoT OPC UA Broker overview

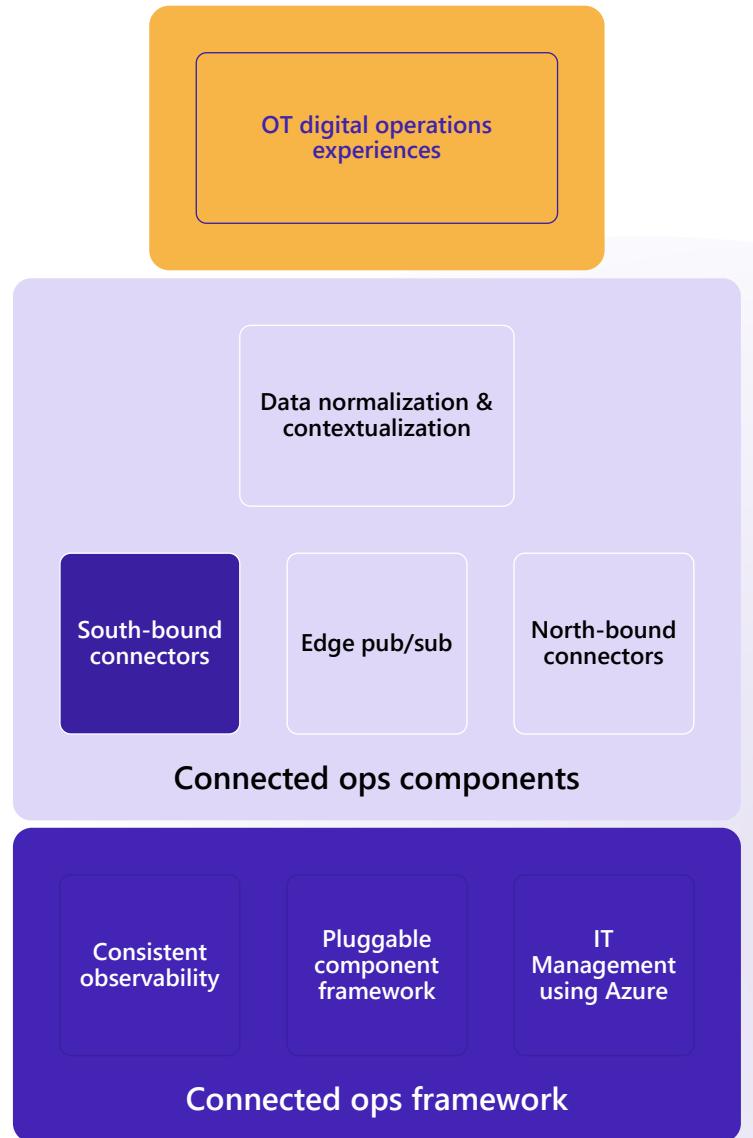
- OPC UA Broker is enriching and simplifying the experience OT experts and developers have when integrating the necessary functions required to connect to local OPC UA.

## Benefits

- Simplified, plug and play experience for OPC UA enabled equipment
- Scalability and high availability
- Support for publishing, control loops, alarms and events
- Targeting “zero-data-loss”
- Seamless integration with Azure (e.g., Azure Arc-enable)

## Features

- Native Kubernetes workload connected to E4K
- HA and 0-data-loss with active/standby model on E4K data plane
- Asset detection based on OPC UA Companion Specifications
- GitOps –ready
- OPC UA Events, Browsing, and Read/Write/Call



# Azure IoT MQ

Kubernetes-native, Azure Arc-enabled MQTT data plane platform for the edge

Custom workloads w/ DAPR integration

North-bound messaging connectors

Distributed edge MQTT Broker

## Edge-native

- Efficient, tunable resource usage
- Built-in self-healing capabilities
- Operationally simple with minimal dependencies and rich self-help tooling
- Message persistence built-in for network outage resilience

## Spec-compliant MQTT ++

- High performance, highly available and scalable MQTT Broker – MQTT v3.1.1 and v5 spec compliant
- Kubernetes-native configuration and management – CRDs + operator
- Built-in HA key value store facility
- Rich, modern observability instrumentation

## Gateway to the cloud

- Flexible bi-directional cloud/edge connectivity via first-party north-bound connectors:
  - MQTT Bridge to Event Grid MQTT Broker
  - Kafka / Event Hub
  - IoT Hub
- Nested ISA-95 network topology support

## Integrate workloads your way

- Works seamlessly with standard MQTT client libraries
- Implements Dapr pub/sub and state store building blocks
- MQTT Sparkplug B friendly
- Enables use of low-code platforms like Node-RED

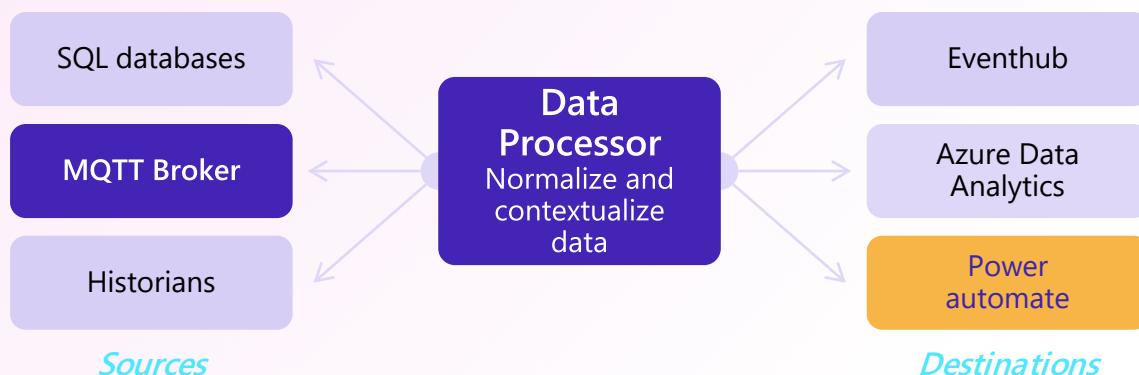
# Azure IoT Data Processor

## Why

Customers are trying to get value from their data easily and quickly, however IoT data is difficult to work with.

IoT data challenges:

- Assets generate data in different formats
  - JSON, Protobuf, CBOR, MessagePack
- Assets use various protocols for communication
- Data stored in multiple data silos
  - Historian, MES, OPCUA server
- Structure of data is not conducive for easy query

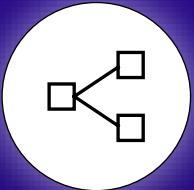


## What

Data Processor is an Azure ARC-enabled service that runs on the edge.

- Integrates with E4K on the edge
- Provides flexible data normalization and foundational contextualization in near real-time
- **Normalization**
  - Format conversion (Protobuf, binary etc.)
  - Homogenize units of measures
  - Metric extraction, computed metrics
  - Un batching, down sampling, aggregations
- **Contextualization**
  - Forward fill with Last Known Value
  - Enrich messages with contextual data about assets from on-prem data sources (SQL, InfluxDB, HTTP)
- Built-in Azure Data Analytics integration to easily analyze "clean data" coming out of Bluefin
- Provides clean data for partners to build higher value solutions on

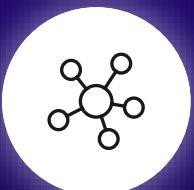
# Azure IoT Layered Network Management (LNM)



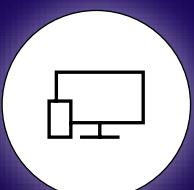
**Cloud connect devices in isolated network layers**  
(without direct line of sight to the Internet)



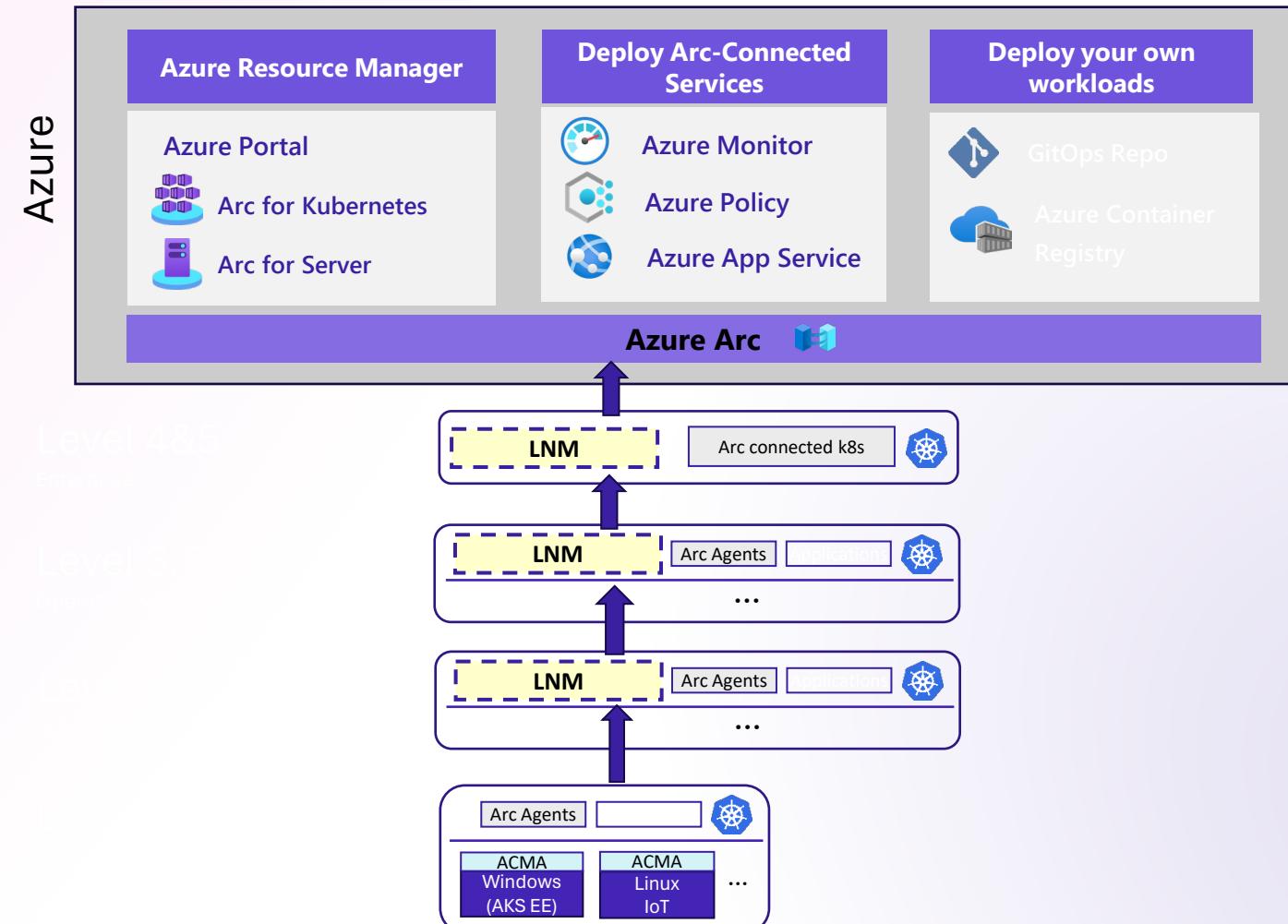
**Data flows compliant to security standards such as ISA-95**



**Manage and configure all hybrid workloads remotely from single Arc control plane**



**Configure endpoints to whitelist at each network level**



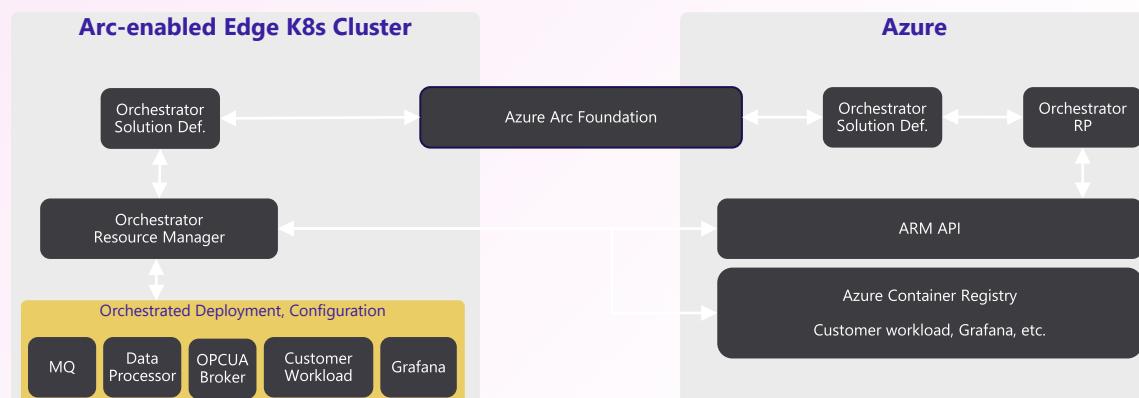
# Azure IoT Orchestrator

## Why

Customers are trying to deploy, manage and configure their workloads uniformly. However, platforms are heavily fragmented.

Customer challenges:

- Heterogeneous hardware that is fragmented heavily
  - One of our customers has 13 OS variants; E.g.: AUTOSR, Linux, Android, QNX
- Want to adopt Kubernetes, but still have lot of legacy apps
- Solutions typically contain combination of native Windows/Linux apps, Kubernetes services, and cloud services
- Application workloads are built and deployed using varying tech
  - Containers (Helm), Windows applications (MSI), Linux apps (Snap/RPM/), Android APKs, etc.



## What

Orchestrator is a highly extensible orchestration engine that can manage infrastructure, policies, and applications across a wide range of platforms.

- Customer can describe the solution using three simple concepts
  - Solution Template: list of all components in a solution
  - Target: a deployment target for a solution
  - Instance: bind a solution to a target
- Executes state seeking via an extensible provider model
  - Out of the box support for Helm, Kubectl, Arc, etc.
- Dependency chaining between components within a cluster
- Configure each service and their interdependencies such as secrets for cross service communication
- Parameterization of configuration, plus component overrides
- Approval gates at multiple levels
- GitOps can be easily overlayed on top of Symphony RP

# Single column of content

# Two columns of content

# Demo

# Code sample

Code sample

# Resources

- Download .NET 8  
[aka.ms/get-dotnet-8](https://aka.ms/get-dotnet-8)
- Lorem ipsum  
hyperlink
- Lorem ipsum  
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**Marco Dal Pino**  
**Technical Consultant**  
Microsoft

- 30+ years in IT (Developer, Architect, Consultant, PM, Trainer)
- Speaker, Community addicted
- IoT Influencer



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