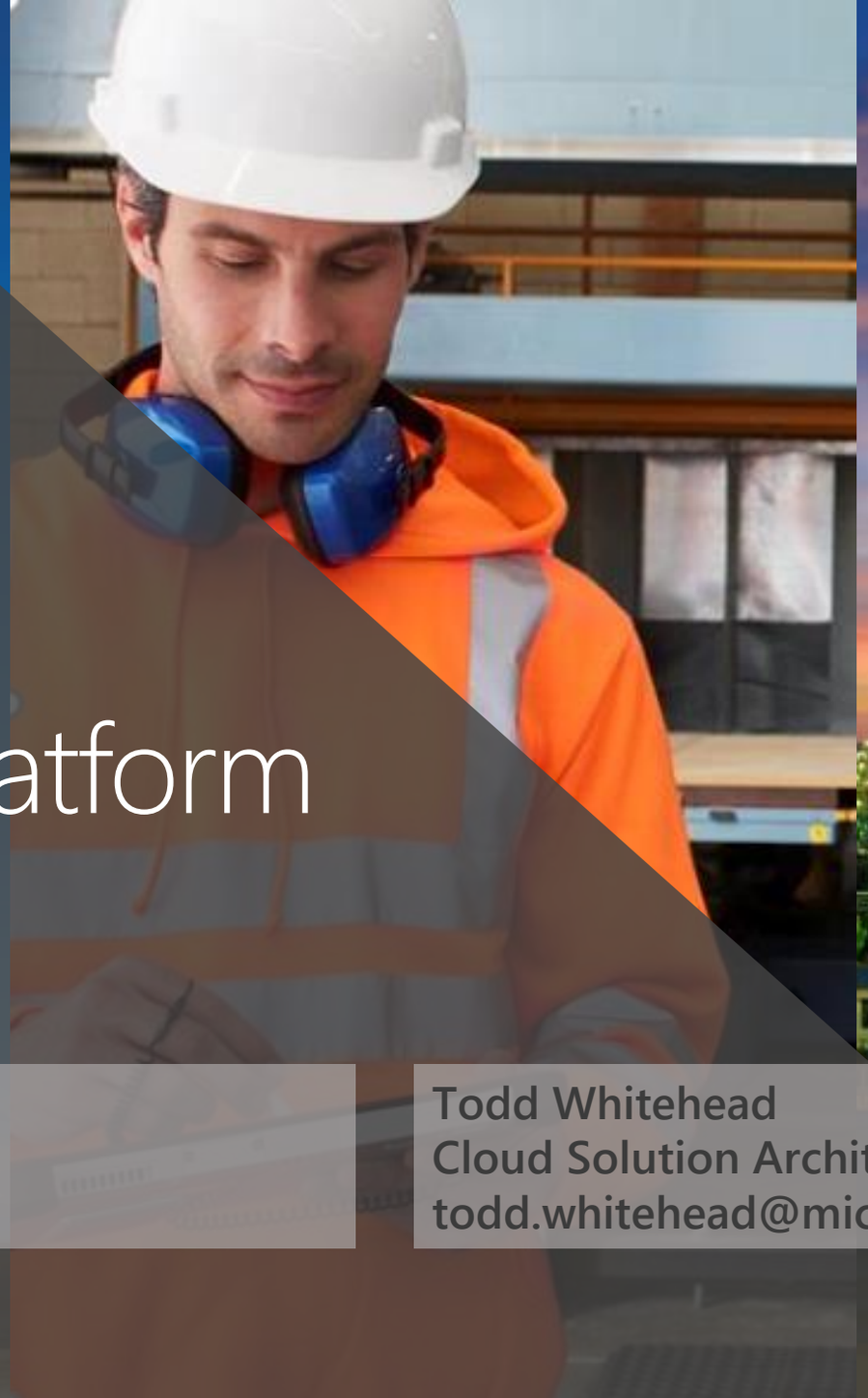


Microsoft IoT Platform

Technical Overview

Dave Toronto
Cloud Solution Architect
david.toronto@microsoft.com

Todd Whitehead
Cloud Solution Architect
todd.whitehead@microsoft.com

Microsoft

Before We Start

1. Do you have an Azure account?
   If not got to https://azure.microsoft.com/en-us/free/ and get a free account

2. Do you have the required software installed?
   1. Windows 10 Fall Creators Update (build 16299)
   2. Docker for Windows ** the "community edition" is fine. Make sure you install the STABLE version. A reboot
   3. Visual Studio Code
   4. .NET Core SDK
   5. Arduino IDE
   6. Open SSL
   7. git
   8. Python 2.7 for Windows -- make sure it's 2.7.x, NOT 3.x.x

   Setup Instructions at https://github.com/toddwhitehead/azure-iot-edge-hol

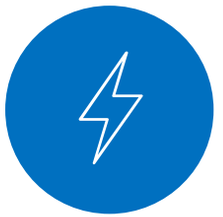
Agenda

1. Azure IoT Platform Overview
2. Workshop
3. Q&A

Defining IoT

Things

Insights



Action

IoT projects are still complex

Security
is a **challenge**

Time-consuming
to get started

Incompatible with
existing infrastructure

Challenging
to scale

The industry's most comprehensive portfolio

Solutions (PaaS)

Azure IoT Suite (PaaS)
Preconfigured solutions for common IoT scenarios

Solutions (SaaS)

Microsoft IoT Central
IoT SaaS

Microsoft Dynamics
Connected Field Service

Technologies (PaaS)

Device support

- Azure IoT Device SDK
- Azure IoT certified devices
- Security Program for Azure IoT
- Windows 10 IoT

IoT

- Azure IoT Hub
- IoT Hub Device Provisioning Service

Edge

- Azure IoT Edge

Data and Analytics

- Azure Stream Analytics
- Azure HD Insight
- Azure Time Series Insights
- Azure Data Lake Analytics
- Azure Machine Learning
- Azure Data Lake
- Cosmos DB

Visualization and Integration

- Microsoft Flow
- Azure Active Directory
- Azure Logic Apps
- Microsoft Power BI
- Notification Hubs
- Azure Monitor
- Azure Websites

Microsoft has a comprehensive set of offerings for IoT

IoT Solutions (SaaS)

- Azure IoT Central
  IoT SaaS
- Microsoft Connected Field Service
  Field Service SaaS

IoT Solution Accelerators (PaaS)

Azure IoT solution accelerators

- Remote Monitoring
- Predictive Maintenance
- Connected factory

Platform Services & Device Support

Device Support	Edge Support	IoT Services	Data & Analytics Services		Visualization & Integration Services	
Azure Sphere	Azure IoT Edge	Azure IoT Hub	Azure Stream Analytics	Azure HD Insight Spark, Storm, Kafka	Microsoft Flow	Microsoft Power BI
Windows 10 IoT Core and IoT Enterprise	AzureML	Azure IoT Hub Device Provisioning Service	Azure Time Series Insights	Azure Event Hubs	Azure Logic Apps	Azure Maps
Azure IoT Device SDK	Azure Stream Analytics	Azure Sphere Security Service	Azure Machine Learning	Azure Data Lake Analytics	Azure Event Grid	Azure Monitor
Azure Certified for IoT	Azure Cognitive Services	Windows IoT Update Control	Cosmos DB	Azure Data Lake	Azure Websites	Azure Function

Microsoft is simplifying IoT

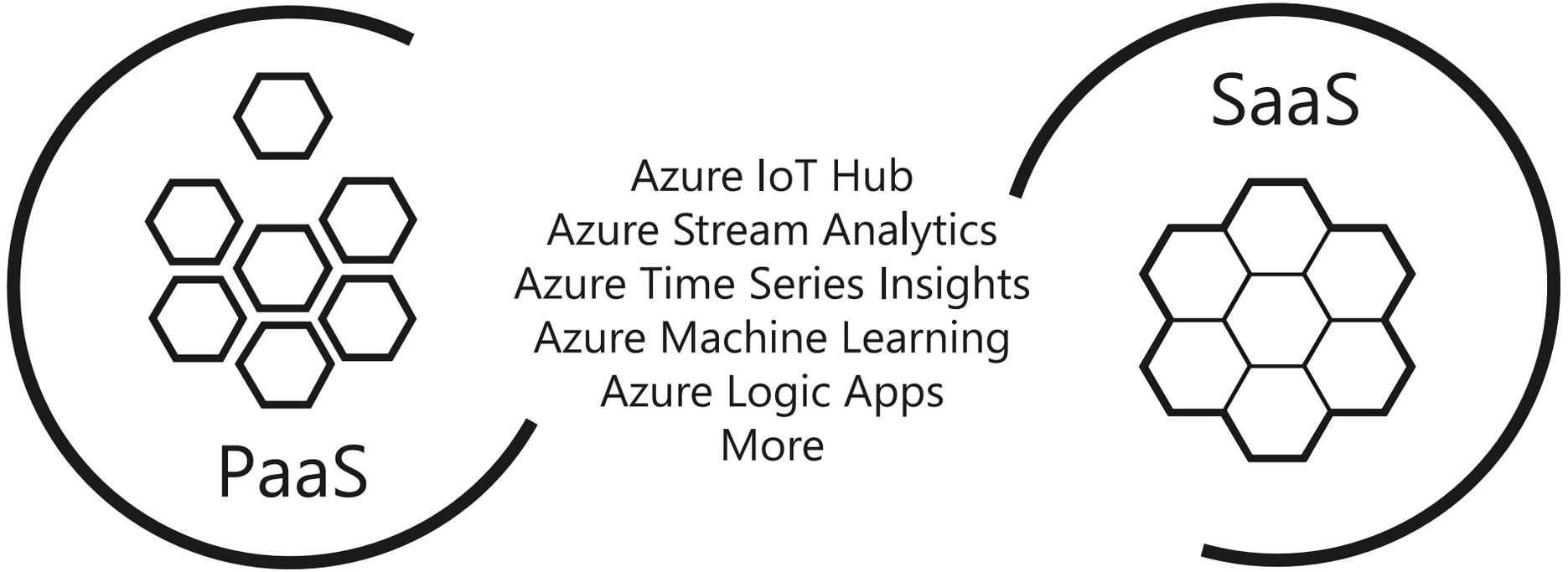
Azure IoT Solution Accelerators

Solution accelerators
for common IoT scenarios

Remote Monitoring | Predictive Maintenance | Connected Factory

Azure IoT Central

Fully managed IoT SaaS
No cloud solution expertise required



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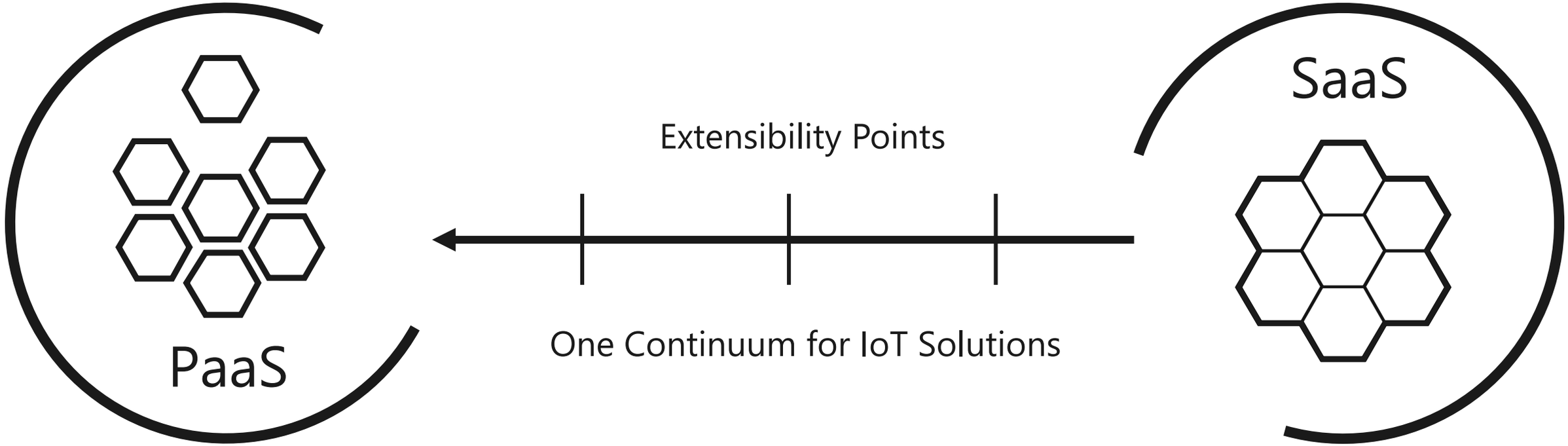
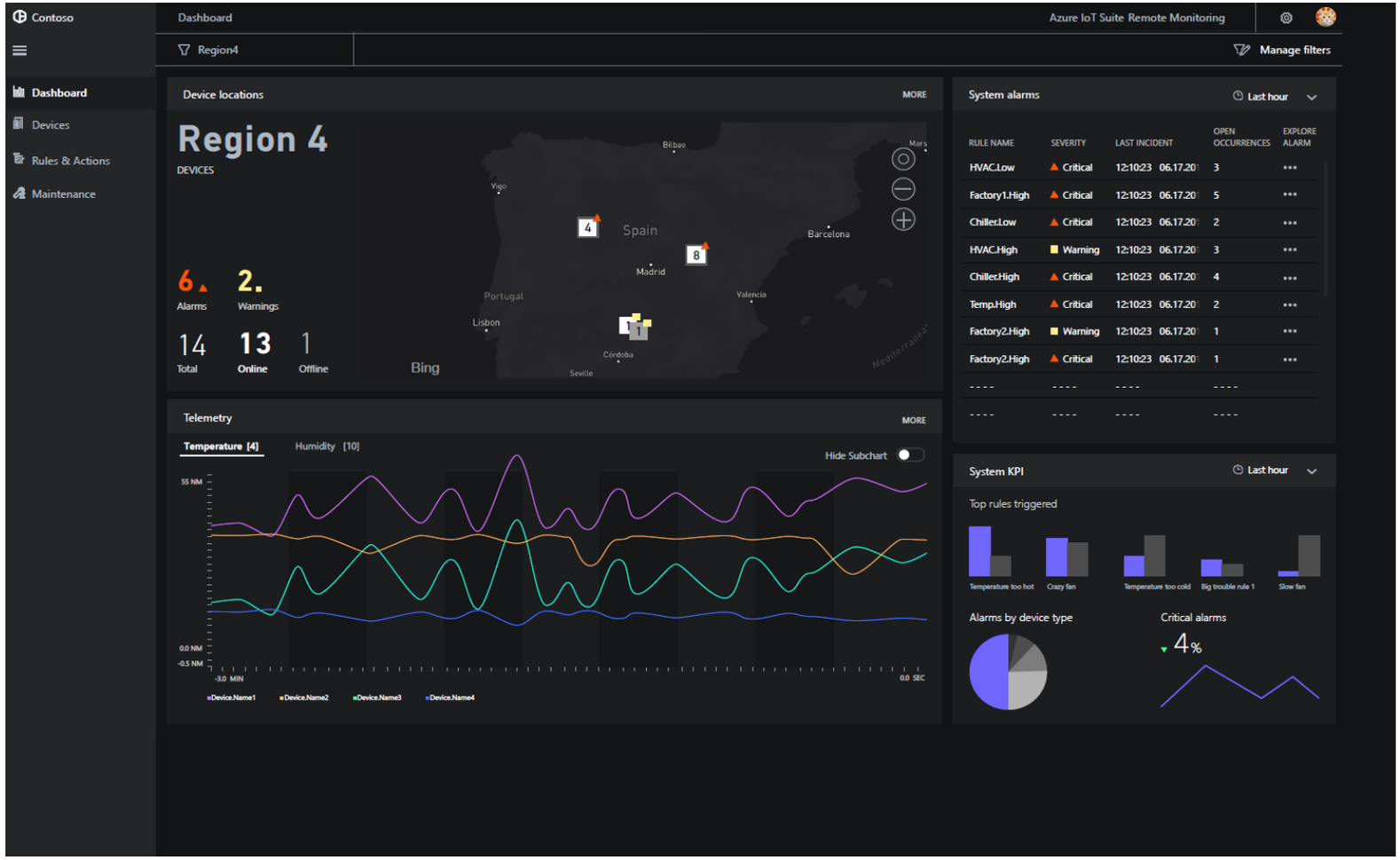


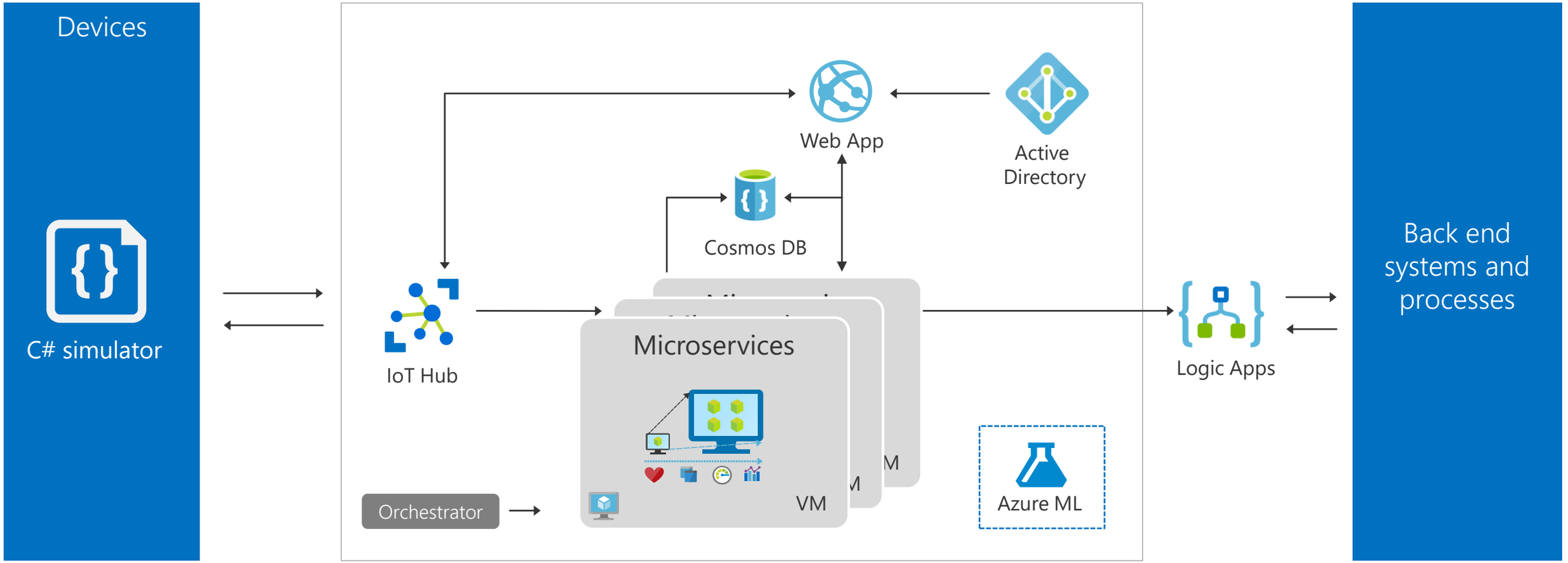
Azure IoT solution accelerators

- Device Connectivity & Management
- Data Ingestion and Command & Control
- Stream Processing & Predictive Analytics
- Workflow Automation and Integration
- Dashboards and Visualization
- Preconfigured Solutions
  - Remote monitoring
  - Predictive maintenance
  - Connected factory

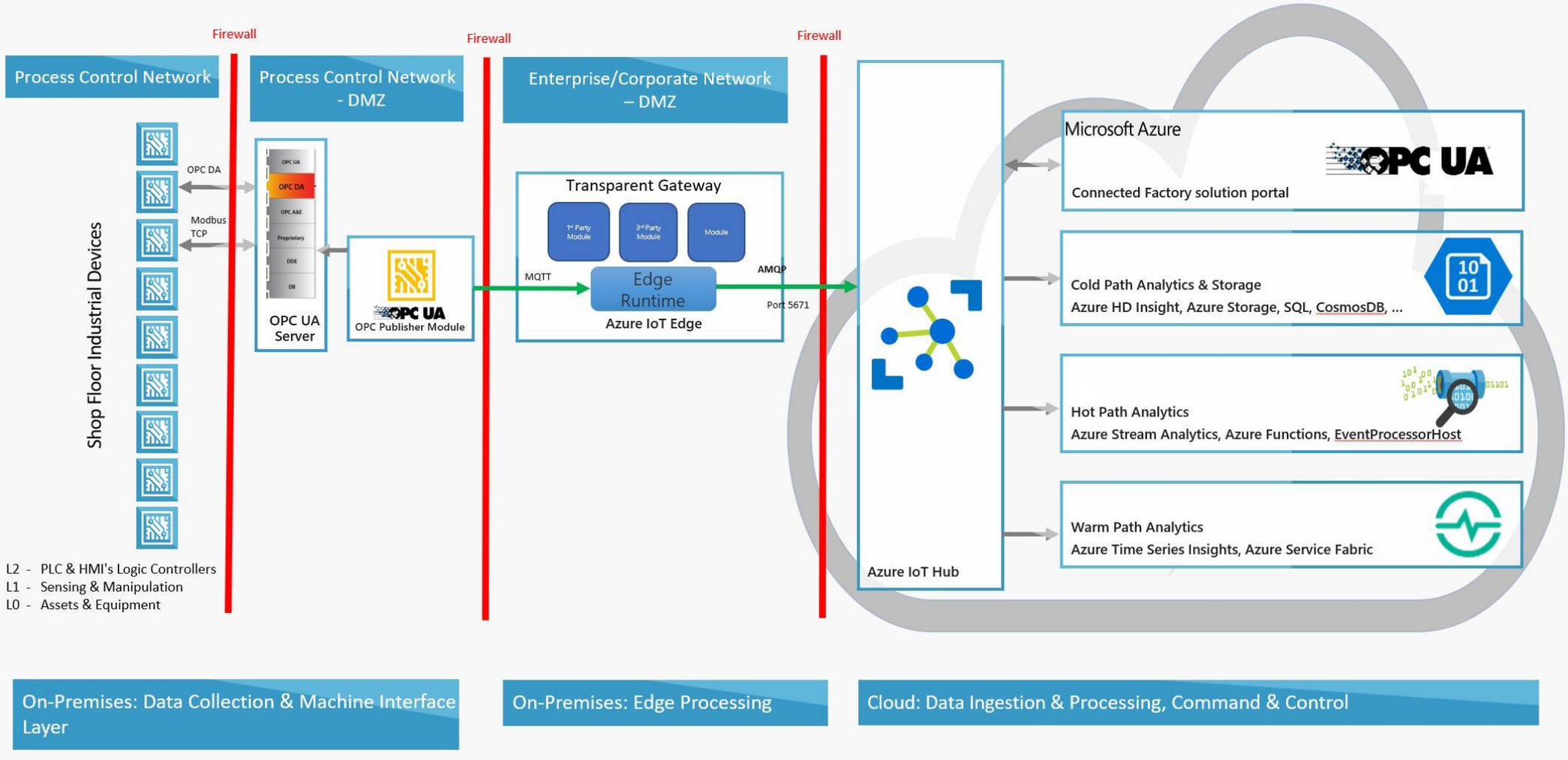


Components of a preconfigured solution

Remote monitoring | Predictive maintenance | Connected factory | Device Simulation



OPC UA Publishers with Azure IoT Edge Transparent Gateway

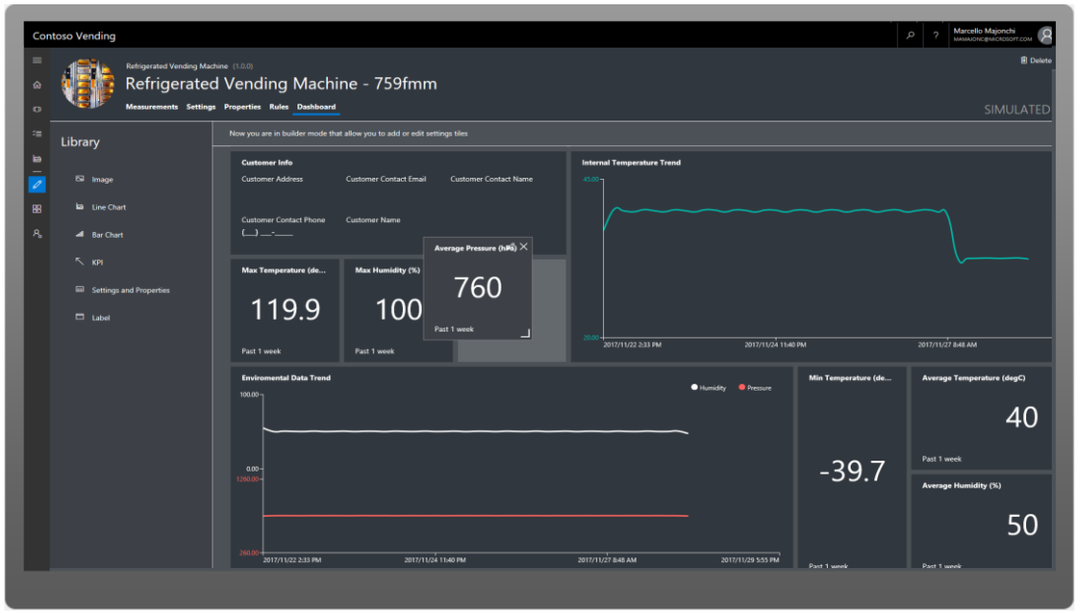


https://github.com/faister/connectedfactory

Microsoft **IoT Central**

- Fully hosted and managed by Microsoft
- No cloud development expertise required
- Device connectivity and management
- Monitoring rules and triggered actions
- User roles and permissions
- Analytics, dashboards and visualization
- Risk-free trial with simplified pricing

Builder

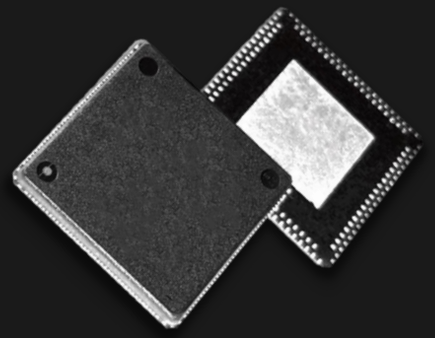


- Product Modeler
- Device settings
- Template Management
- Rules Workflows
- User and identity management

Operator

- Device management
- Analytics & dashboards
- Time-series Insights
- Alerts and actions

The microcontroller (MCU)
a low-cost, single chip computer



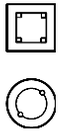
9 BILLION new MCU devices are deployed every year

Highly-secured connected devices require 7 properties

Hardware Root of Trust

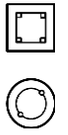
Is your device's identity and software integrity secured by hardware?

Defense in Depth



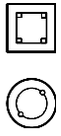
Does your device remain protected if a security mechanism is defeated?

Small Trusted Computing Base



Is your device's TCB protected from bugs in other code?

Dynamic Compartments



Can your device's security protections improve after deployment?

Certificate-Based Authentication

Does your device use certificates instead of passwords for authentication?

Failure Reporting

Does your device report back about failures and anomalies?

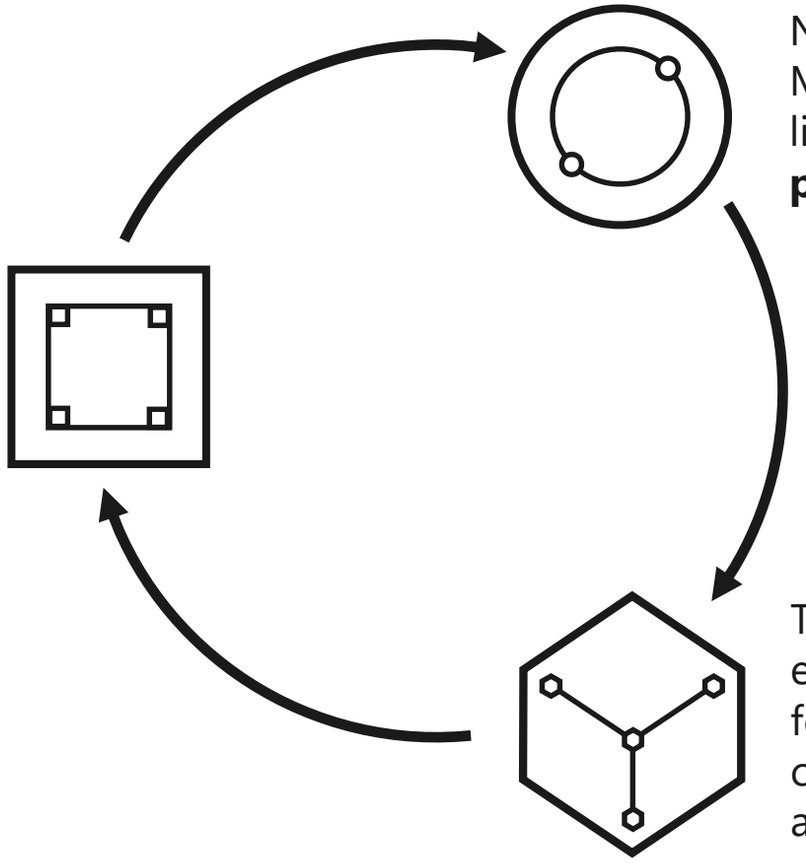
Renewable Security

Does your device's software update automatically?

 = Silicon support required  = OS support required  = Cloud Service support required

Azure Sphere is an end-to-end solution for securing MCU powered devices

New **Azure Sphere certified MCUs,** from silicon partners, with built-in Microsoft security technology provide connectivity and a dependable **hardware root of trust**.



New **Azure Sphere OS** secured by Microsoft for the devices 10-year lifetime to create **a trustworthy platform** for new IoT experiences

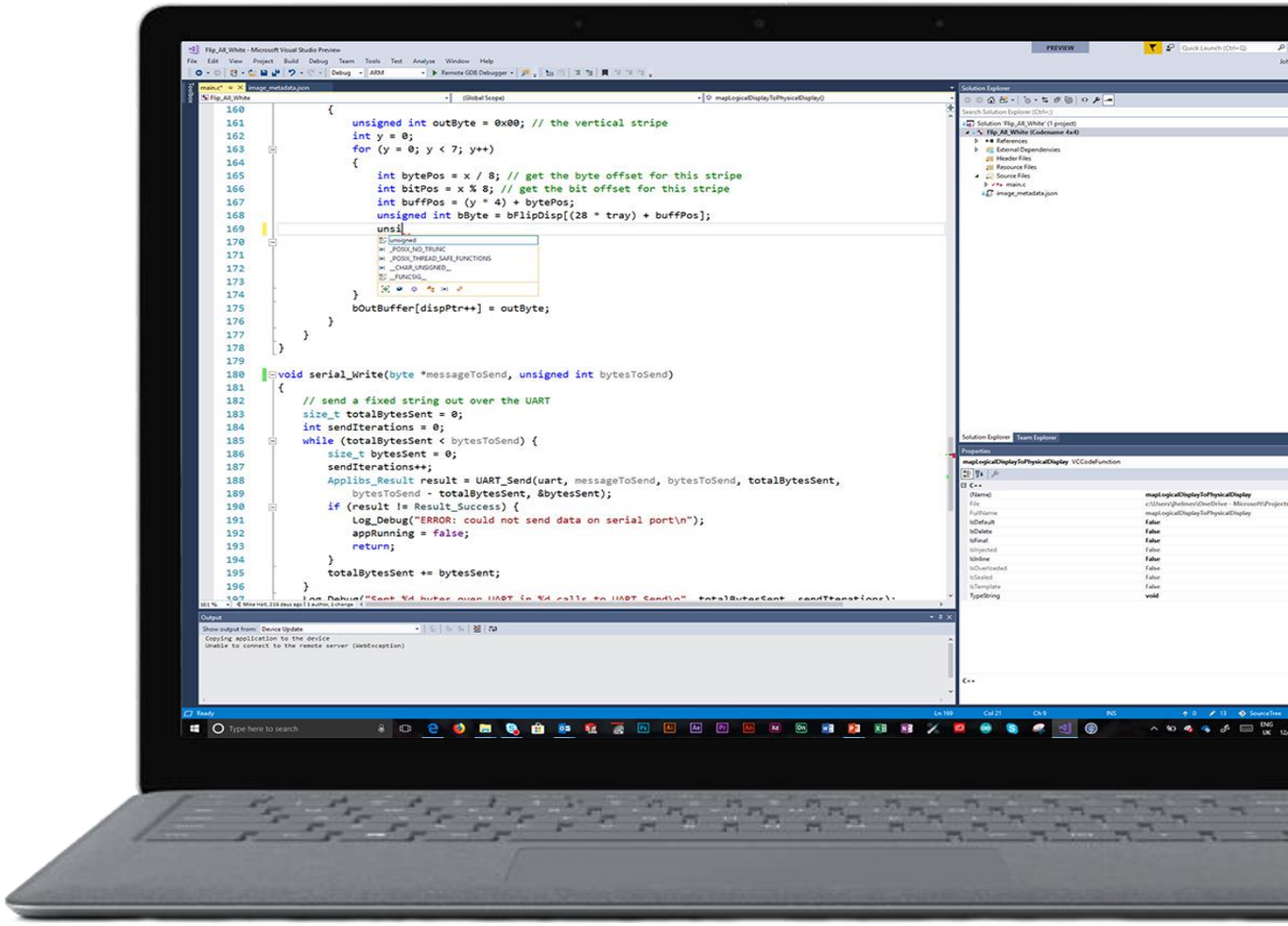
The **Azure Sphere Security Service** guards every Azure Sphere device; it **brokers trust** for device-to-device and device-to-cloud communication, **detects emerging threats**, and **renews device security**.

Modernize MCU development with Azure Sphere and Visual Studio

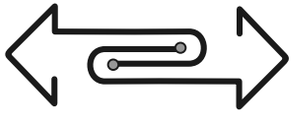
Simplify development
Focus your device development effort on the value you want to create

Streamline debugging
Experience interactive, context-aware debugging across device and cloud

Simplify Azure connect
Connect your Azure Sphere devices quickly and easily to Azure IoT



Azure IoT Hub



Bi-directional communication

Millions of Devices

Multi-language, open source SDKs

HTTPS/AMQPS/MQTTS

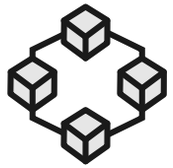
Send Telemetry

Receive Commands

Device Management

Device Twins

Queries & Jobs



Enterprise scale & integration

Billions of messages

Scale up and down

Declarative Message Routes

File Upload

WebSockets & Multiplexing

Azure Monitor

Azure Resource Health

Configuration Management

End-to-end security

Per Device Certificates

Per Device Enable/Disable

TLS Security

X.509 Support

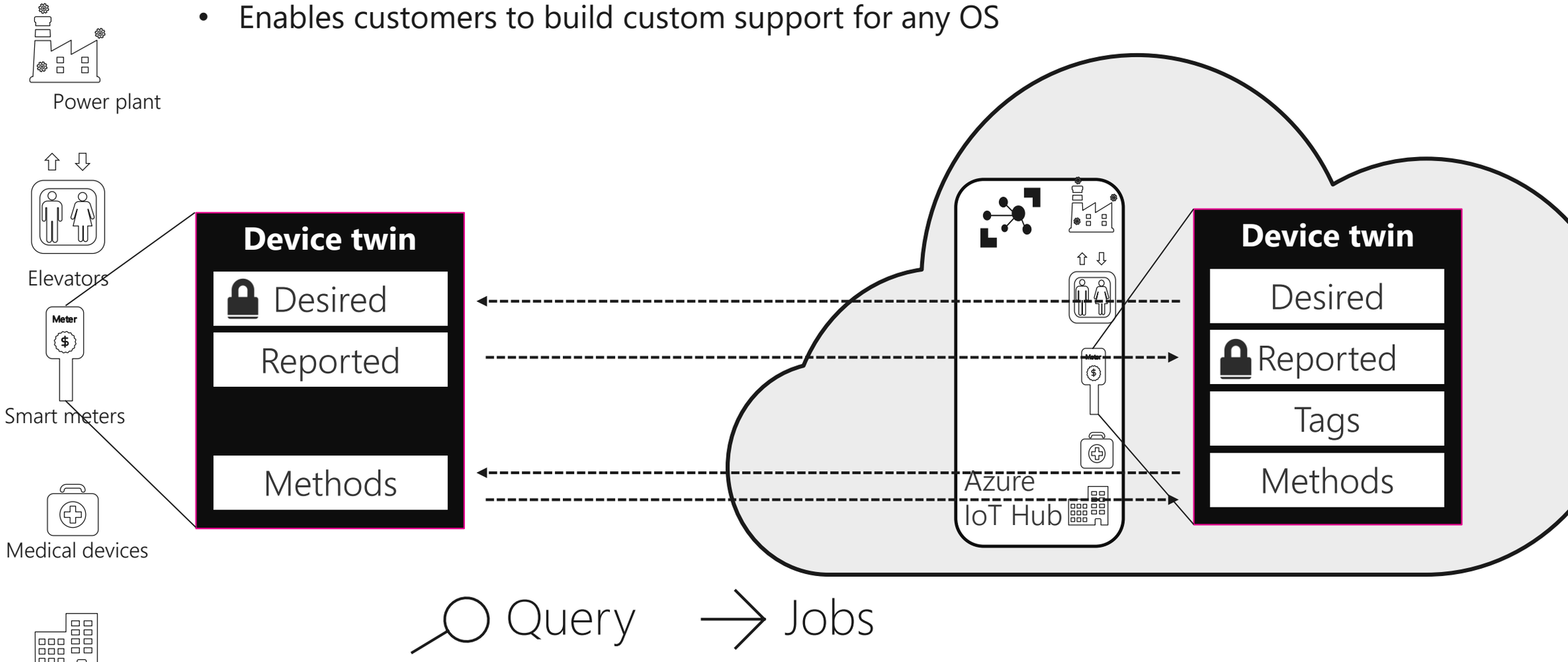
IP Whitelisting/Blacklisting

Shared Access Polices

Firmware/Software Updates

Azure IoT Hub – Device Management

- Used to orchestrate software/firmware/configuration changes
- Enables customers to build custom support for any OS



- Query across millions of device twins, schedule jobs to update them

Preview: Azure IoT Hub *Automatic* Device Management

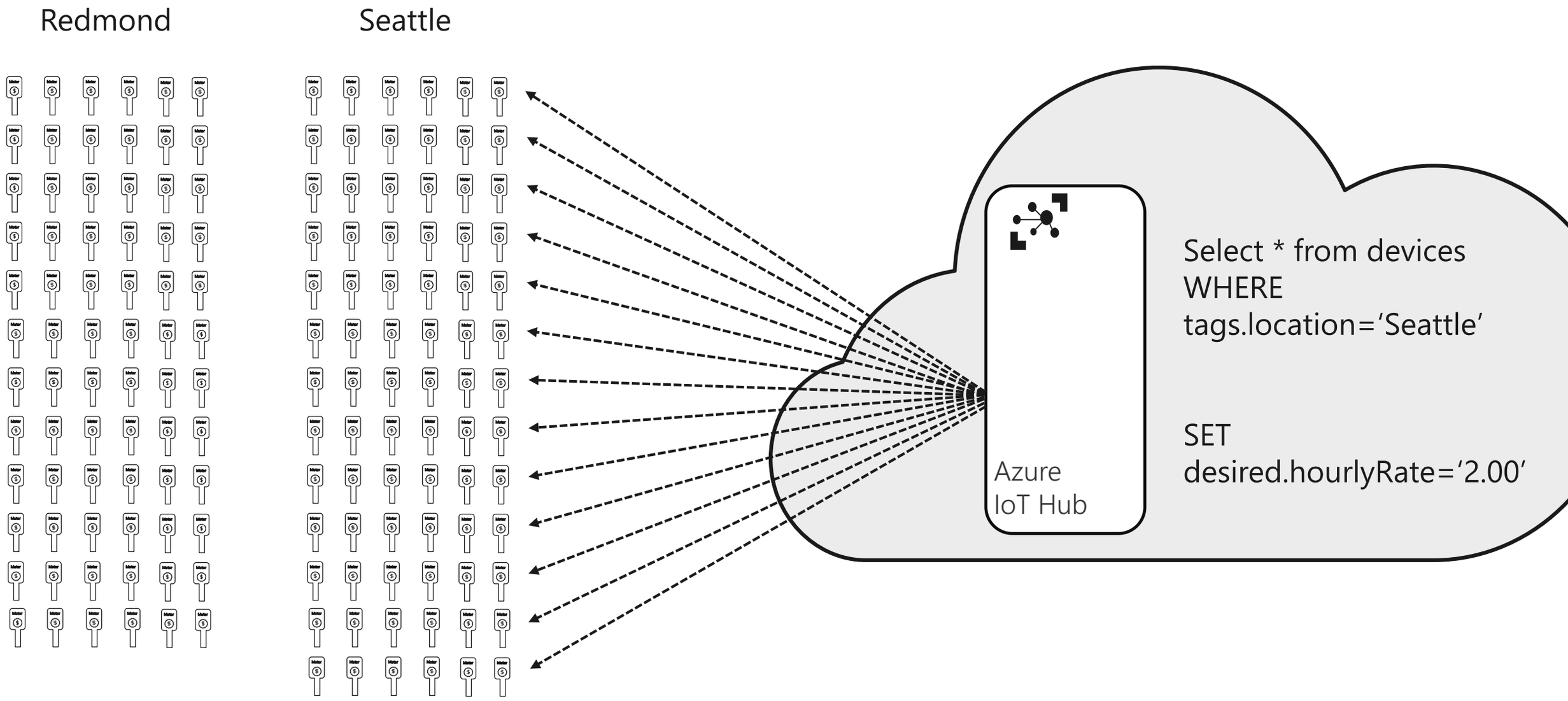
Now in preview!

1. Set up standing queries against device twin properties
2. When a query matches a device and the device is connected, device management operations are *automatically* applied

Initially available:

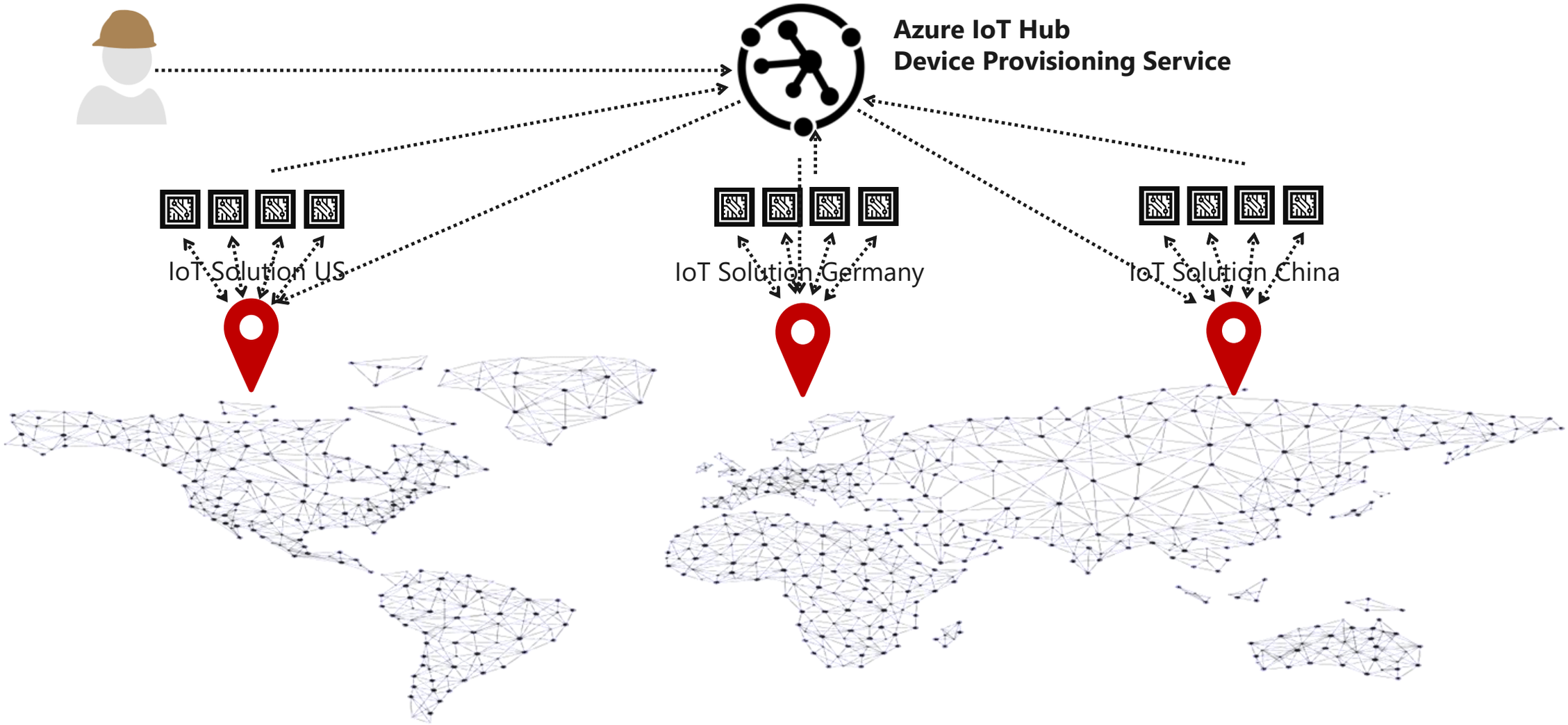
- Automatic IoT Device configurations
- Automatic IoT Edge deployments

Preview: Azure IoT Hub Automatic Device Management



Azure IoT Hub Device Provisioning Service

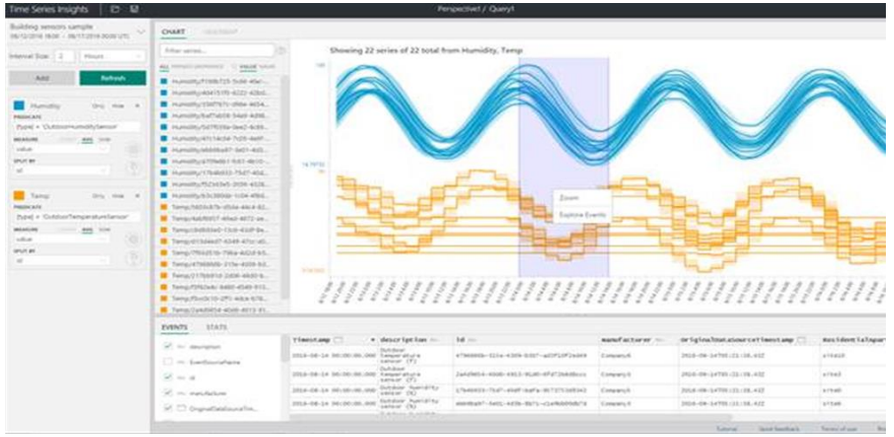
Generally Available

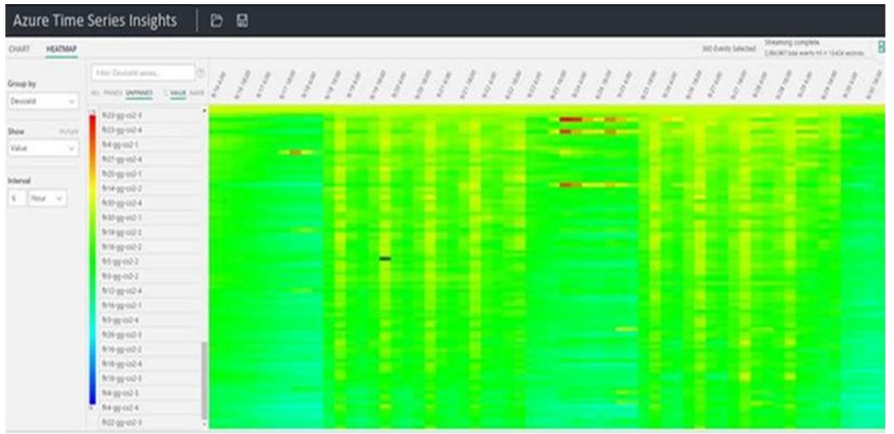


Azure Time Series Insights

IoT scale time-series data store

- Schema-less store, just send data, we determine the shape and track drift
- Easy IoT Hub connection, seconds to configure
- Store, query and visualize billions of events **in seconds**
- Simple and fast navigation with built in UX
- Can be used alone as a time-series data store

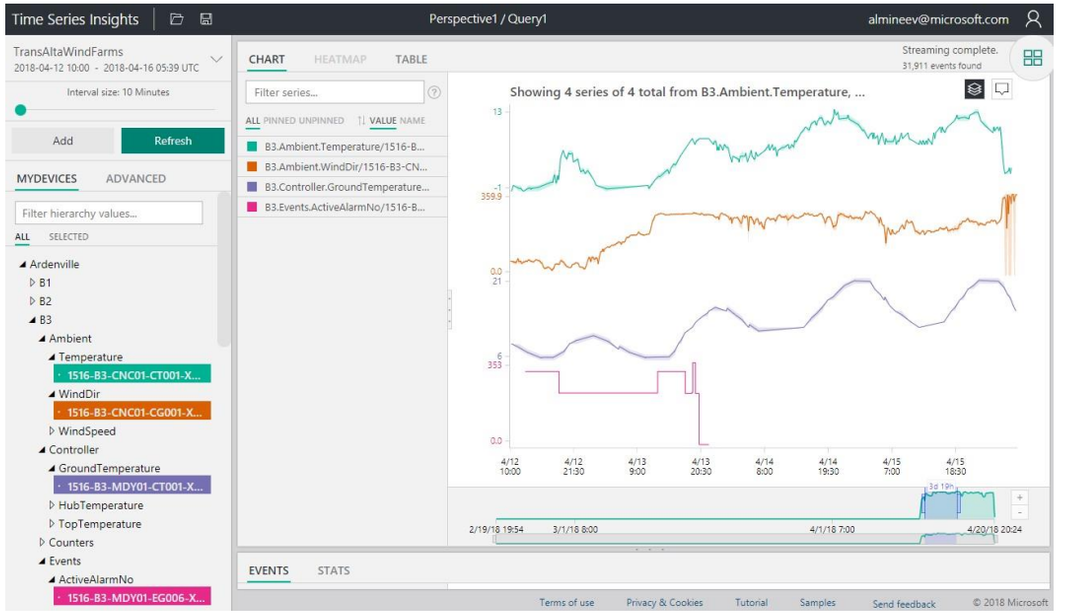


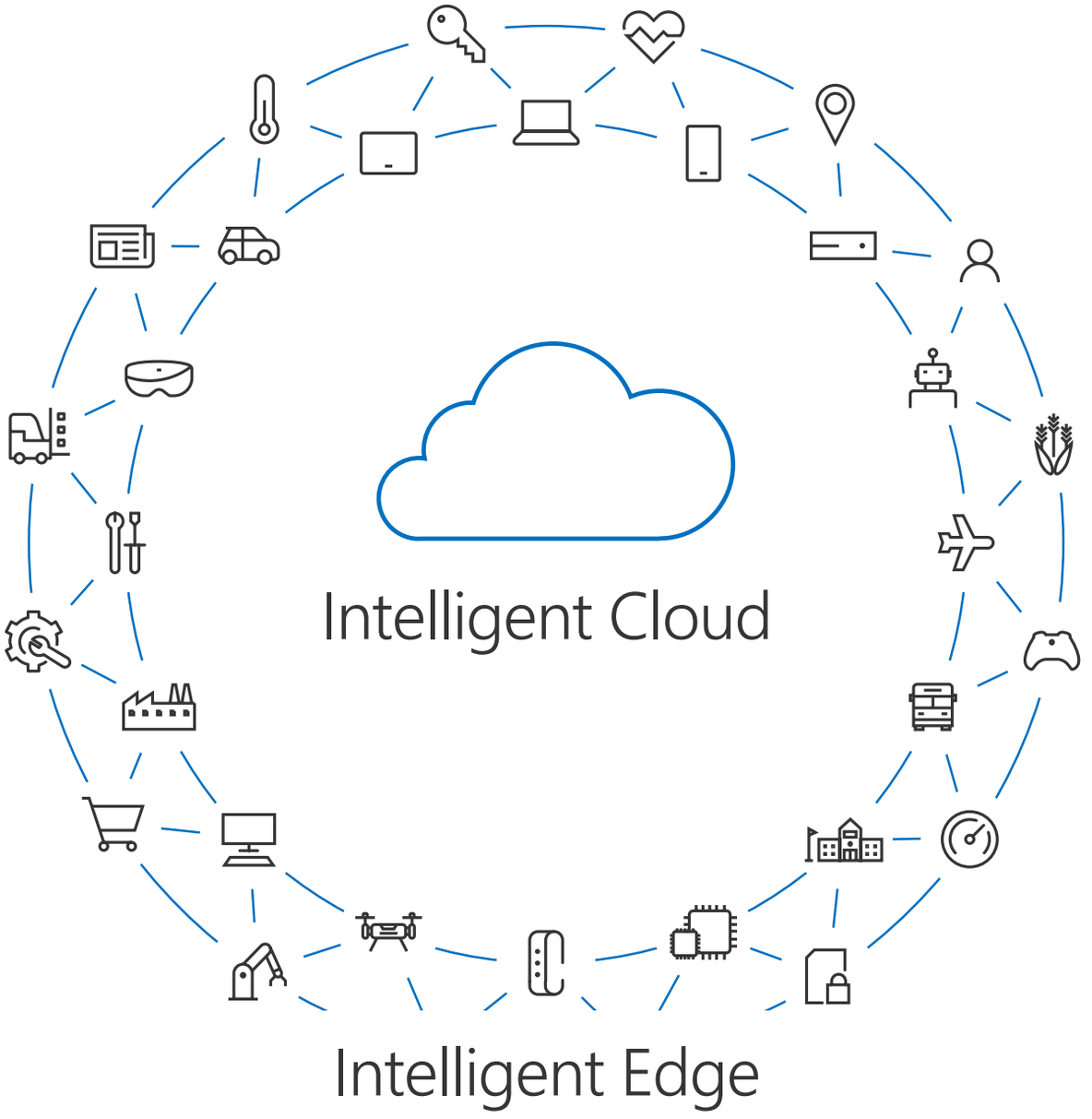


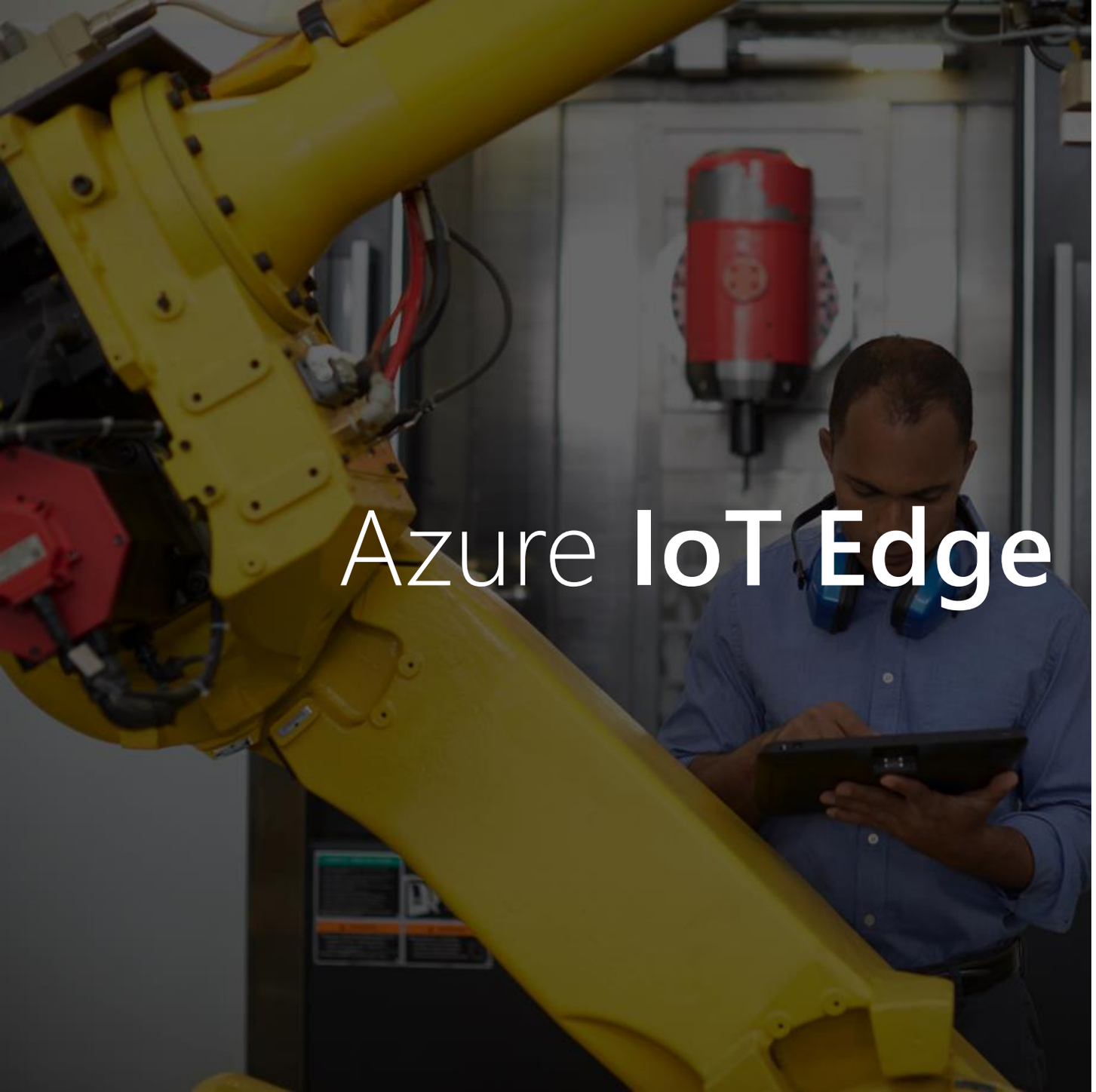
Azure Time Series Insights

New features coming!

- "Tag-based" user experience that makes it easy to group time series data into logical "things" and hierarchies of "things"
- Business reports with PowerBI integration
- Predictive analytics with Azure Machine Learning integration
- Data analysis with Jupyter and Apache Zeppelin notebook integration
- Advanced analytics with Azure Databricks, Apache Hadoop and Apache Spark integration



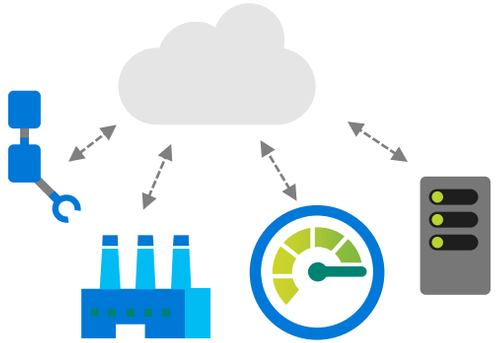

Intelligent Cloud
Intelligent Edge



Azure **IoT Edge**

- Move cloud and custom workloads to the edge, securely
- Seamless deployment of AI and advanced analytics
- Configure, update and monitor from the cloud
- Compatible with popular operating systems
- Code symmetry between cloud and edge for easy development and testing
- Secure solution from chipset to cloud

IoT in the Cloud and on the Edge

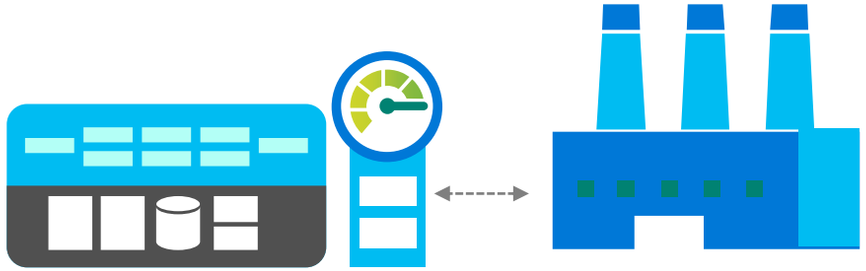


IoT in the Cloud

Remote monitoring and management

Merging remote data from multiple IoT devices

Infinite compute and storage to train machine learning and other advanced AI tools



IoT on the Edge

Low latency tight control loops require near real-time response

Protocol translation & data normalization

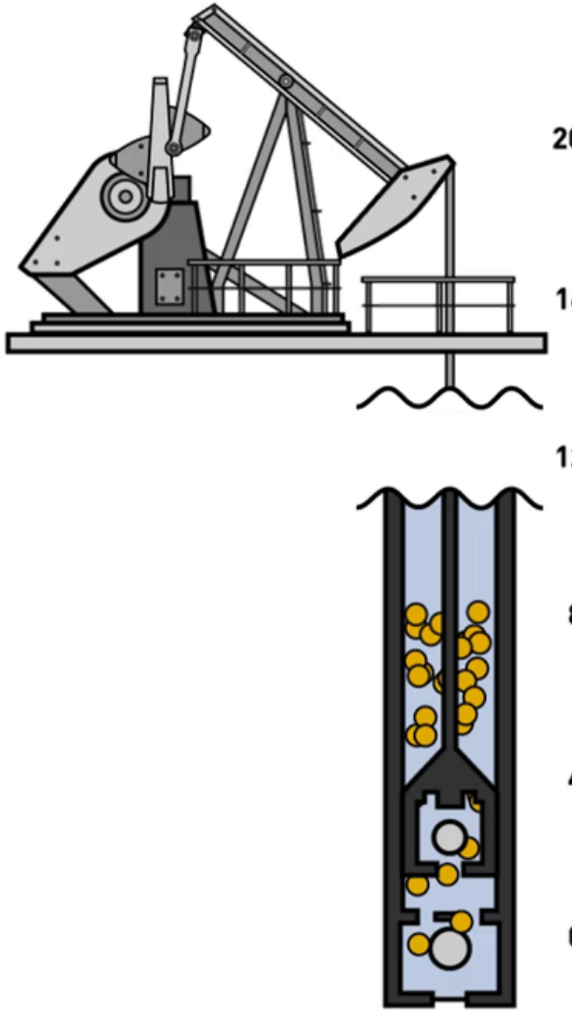
Privacy of data and protection of IP

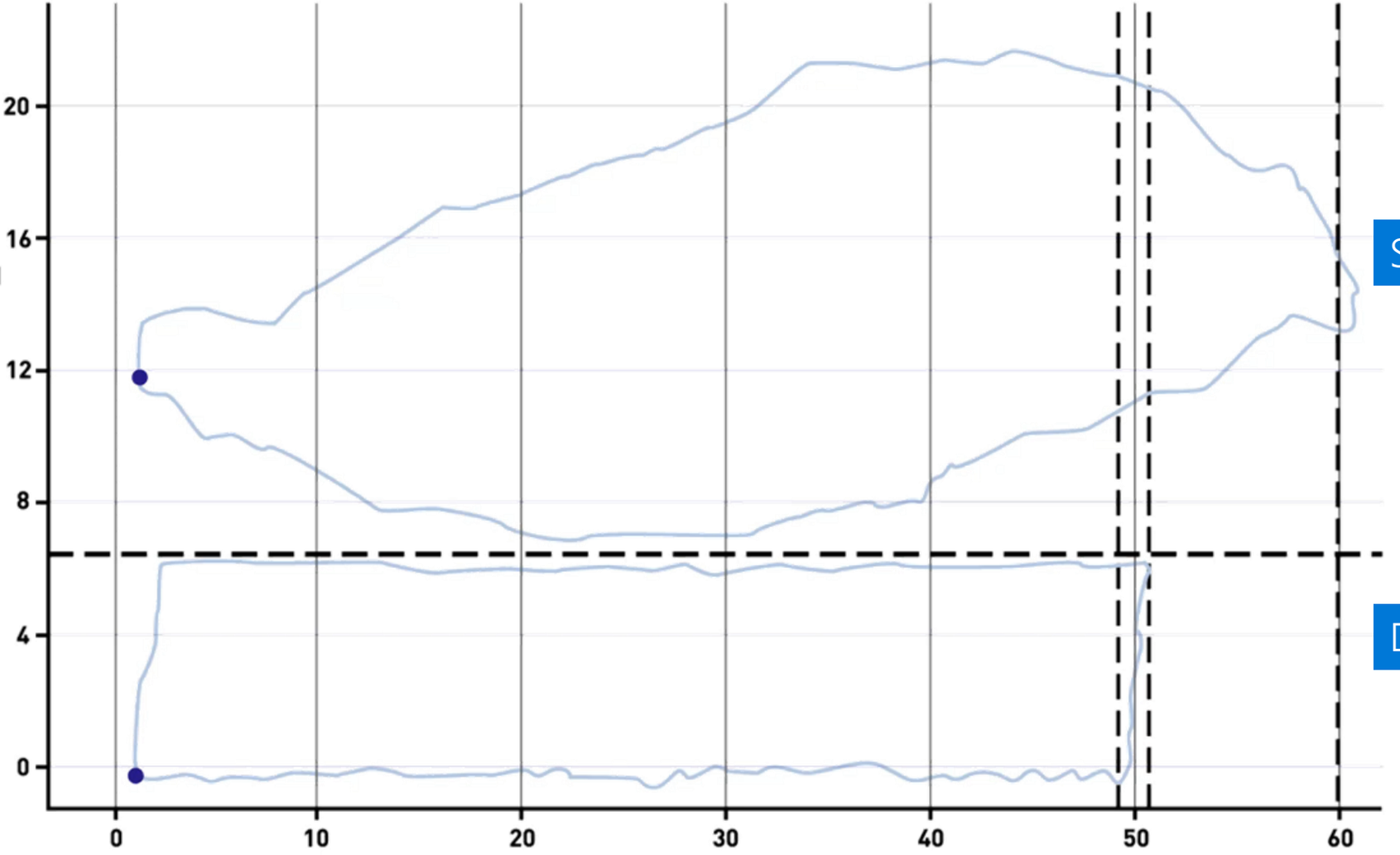
Symmetry

Operational patterns for Azure IoT Edge

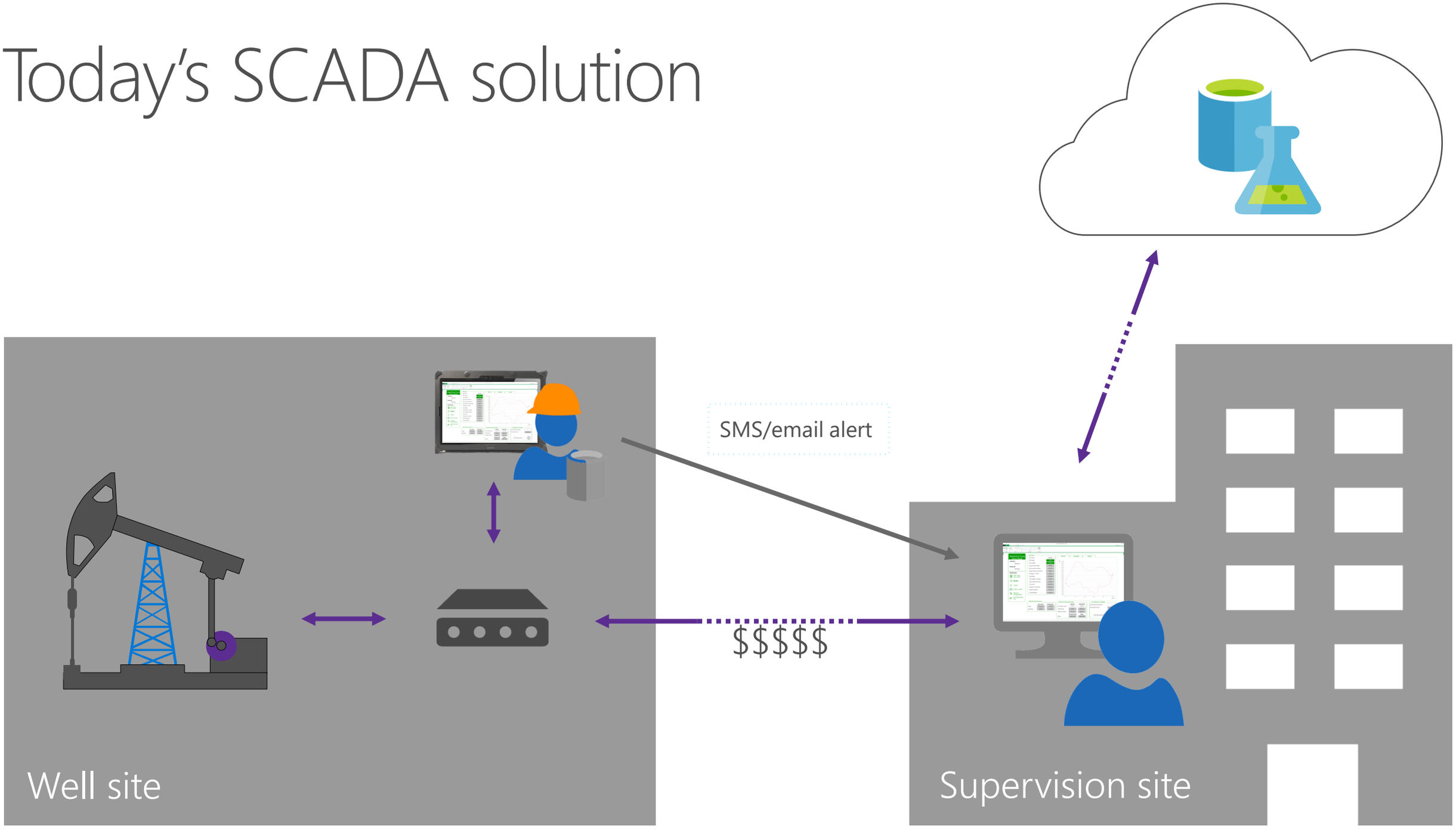
- **Protocol translation** – Collect data using any protocol and translate to IoT friendly protocols (e.g. Modbus -> MQTT)
- **On-prem data aggregation and analysis** – Aggregate and save on bandwidth, cost, privacy, IP
- **Offline** – Short or long term
- **Deploy intelligence at the edge** – Azure Machine Learning and AI, Azure Stream Analytics, Functions, your own code

Fluid load

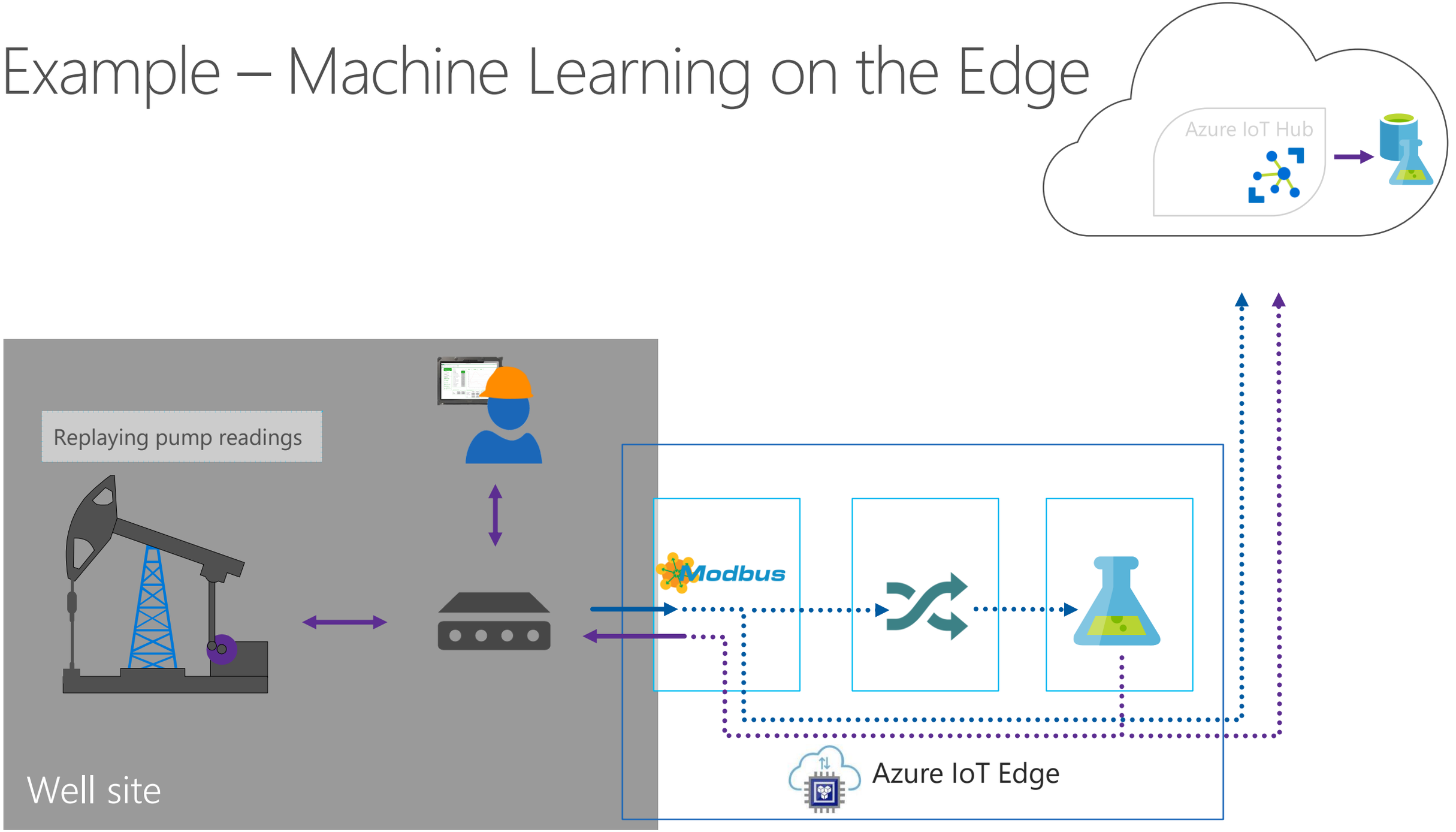




Today's SCADA solution



Example – Machine Learning on the Edge



Design

Design principles

Secure

Provides a secure connection to the Azure IoT Edge, update software/firmware/configuration remotely, collect state and telemetry and monitor security of the device

Cloud managed

Enables rich management of Azure IoT Edge from Azure provide a complete solution instead of just an SDK

Cross-platform

Enables Azure IoT Edge to target the most popular edge operating systems, such as Windows and Linux

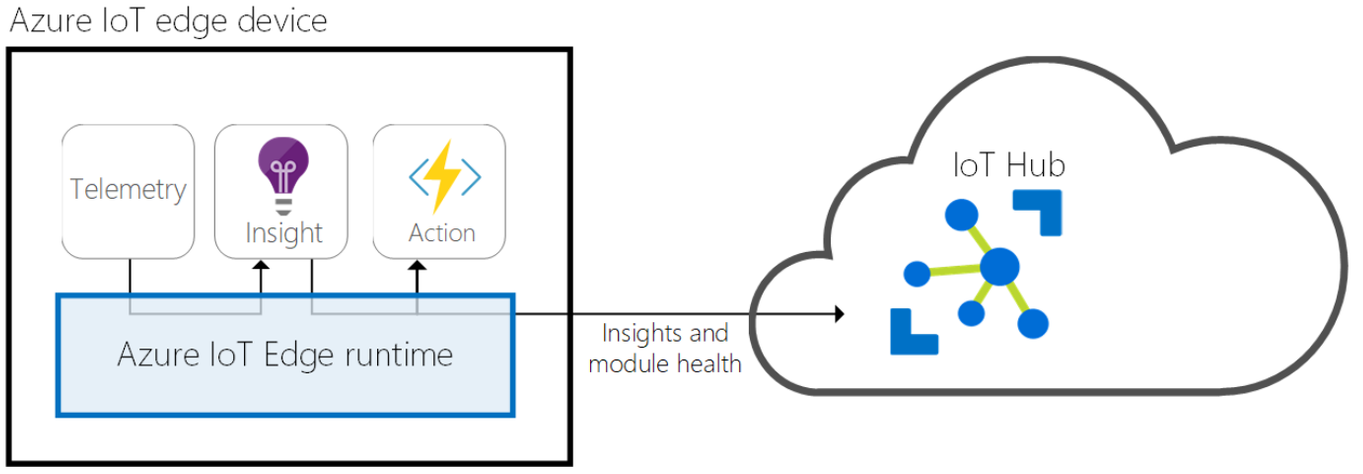
Portable

Enables Dev/Test of edge workloads in the cloud with later deployment to the edge as part of a continuous integration / continuous deployment pipeline

Extensible

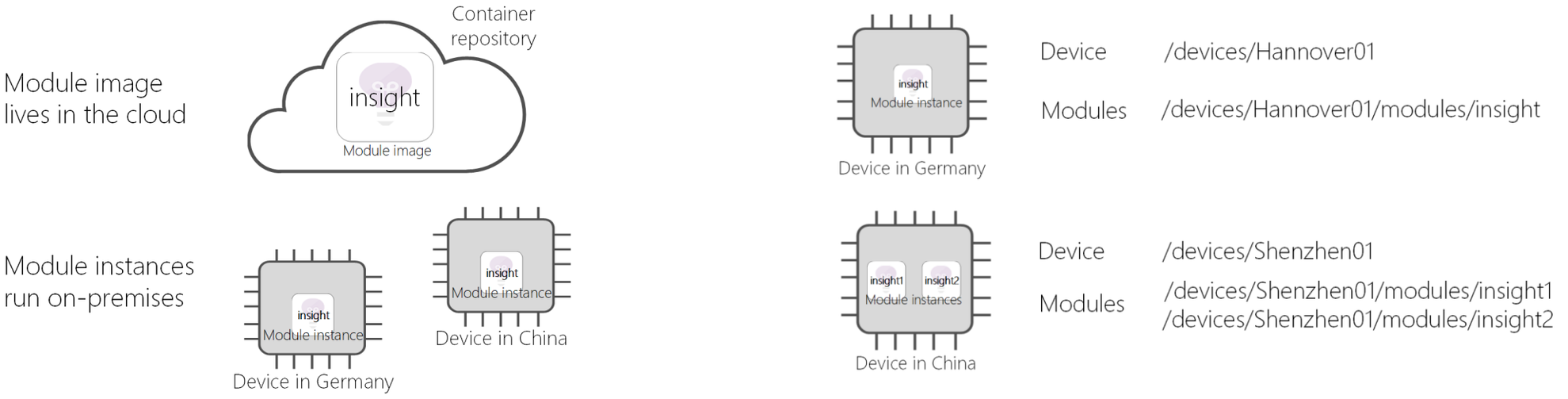
Enables seamless deployment of advanced capabilities such as AI from Microsoft, and any third party, today and tomorrow

Concept – Azure IoT Edge Runtime



- Installs and updates workloads on the device.
- Maintains Azure IoT Edge security standards on the device.
- Ensures that IoT Edge modules are always running.
- Reports module health to the cloud for remote monitoring.
- Facilitates communication between downstream leaf devices and the IoT Edge device.
- Facilitates communication between modules on the IoT Edge device.
- Facilitates communication between the IoT Edge device and the cloud

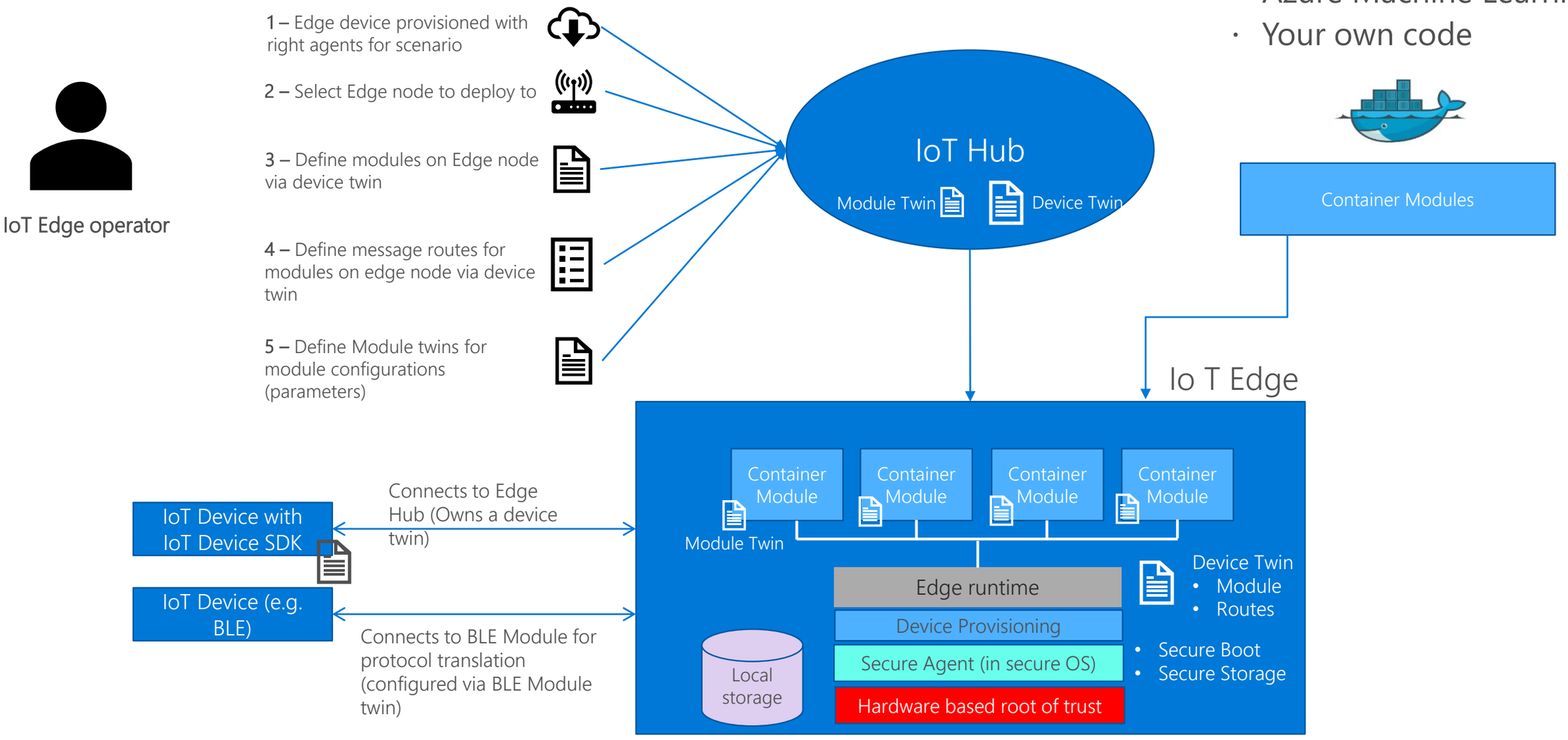
Concept – Module



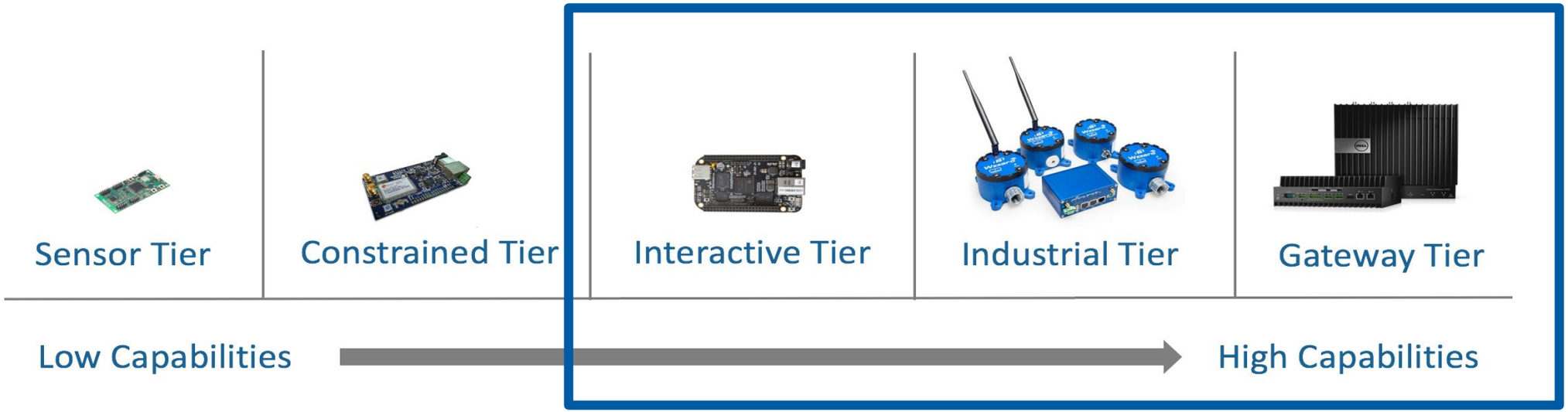
- A **module image** is a package containing the software that defines a module.
- A **module instance** is the specific unit of computation running the module image on an IoT Edge device. The module instance is started by the IoT Edge runtime.
- A **module identity** is a piece of information (including security credentials) stored in IoT Hub, that is associated to each module instance.
- A **module twin** is a JSON document stored in IoT Hub, that contains state information for a module instance, including metadata, configurations, and conditions.

IoT Edge in action

- Container based workloads
- Azure Functions
- Azure Stream Analytics
- Azure Machine Learning
- Your own code



Hardware for Azure IoT Edge



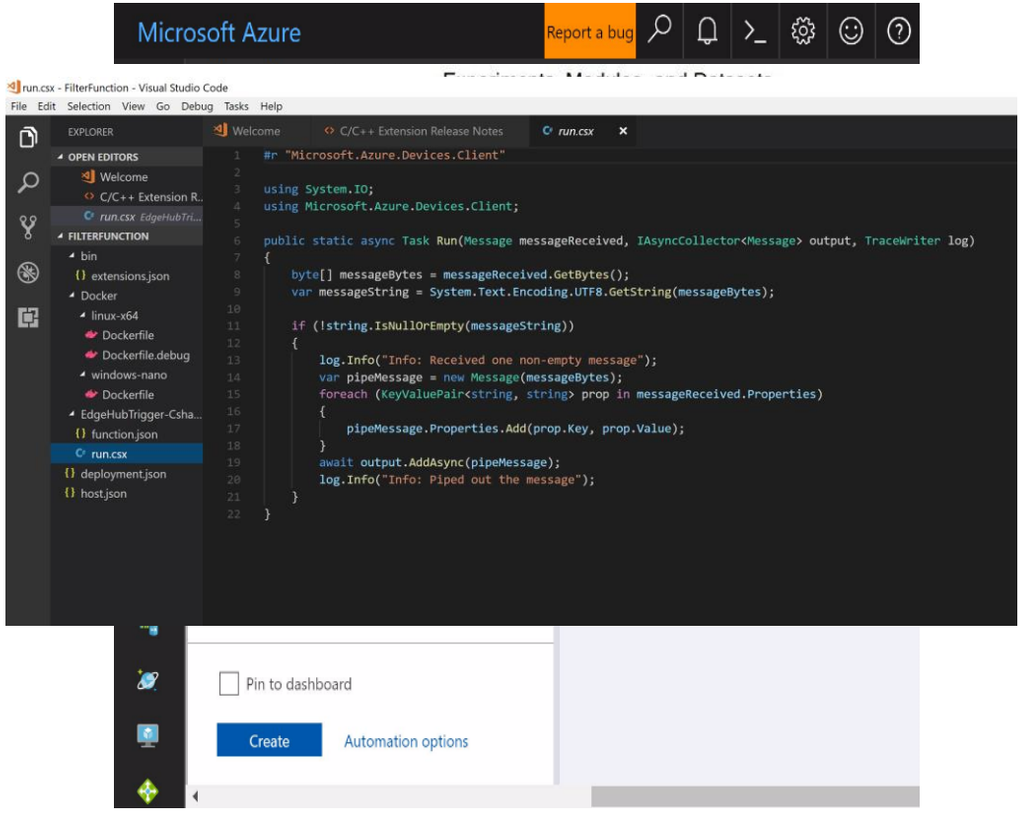
Linux and Windows supported on x64 and ARM (support for containers required)

Hardware sizing dependent on workloads

Internal tests on devices as small as Raspberry Pi 3 with four containers (on Linux)

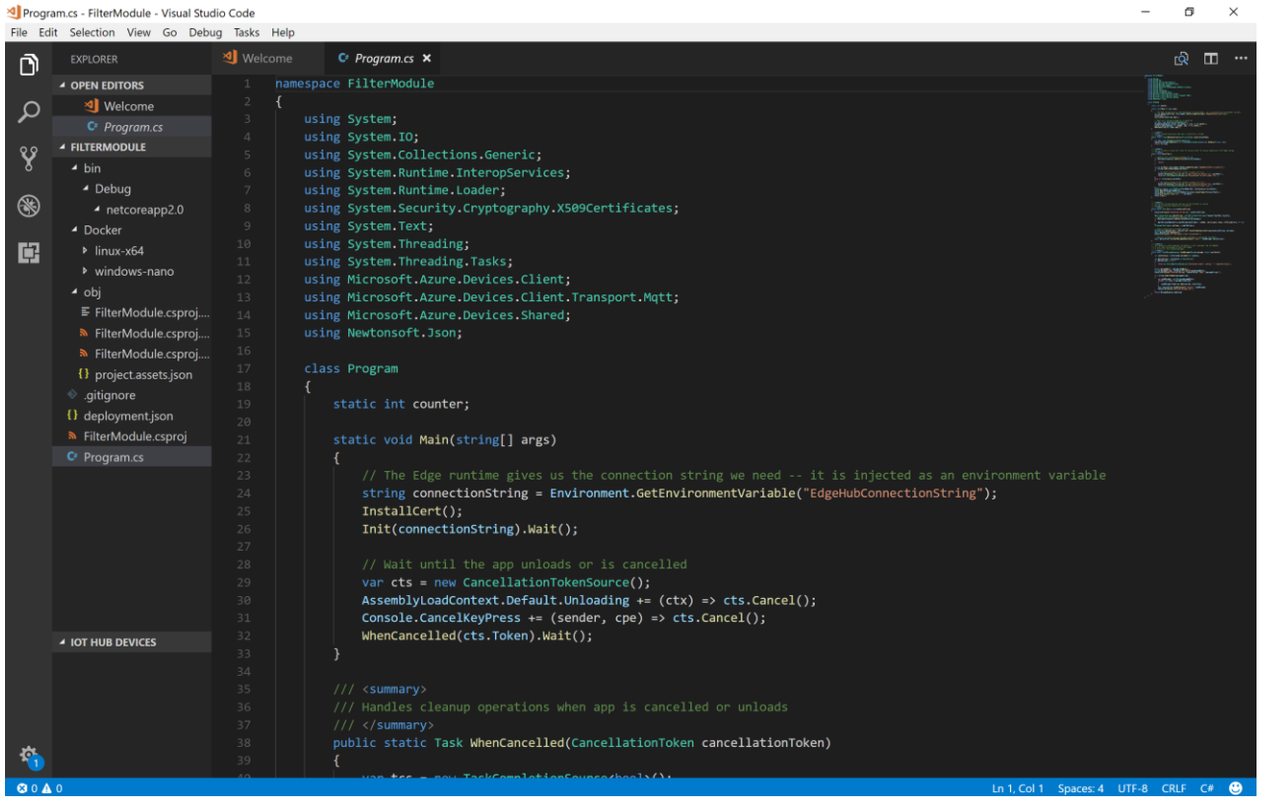
Azure IoT Edge – Package services in containers

- **Azure Stream Analytics –** In line experience in the ASA web portal
- **Azure Functions –** Use VSCode to develop Function for your scenario and package as a container
- **AI and Azure Machine Learning –** Package AI and ML model as a module in a container after training using ML Studio. Deploy packaged ML modules to the IoT Edge



Azure IoT Edge – Developer experience

- Azure IoT SDK for developing modules, which provide:
  - Protocol and messaging support
  - Security for module (identification and authentication)
  - Module twin support
- Develop and debug in your favorite language (C# released, C, Python, Java and Node.JS coming soon)
- Build container with your code and host in a container repo (e.g. Docker Hub or Azure Container Registry)



Azure IoT Edge

Announcing
AI Developer Kit

QUALCOMM

Azure IoT Edge

Announcing Windows SDK and Commercial Drone Solutions

with Azure IoT Edge and AI

Azure IoT Edge - Announcements

Support for Cognitive Services – Custom Vision

Support for Event Grid

Support for Kubernetes

IoT Hub Automatic Device Management for IoT Edge Deployments

VS/VS Code support

VSTS support for CI/CD

Azure IoT Edge will be open sourced

Azure IoT Edge container marketplace

Azure IoT Edge – Kubernetes Support

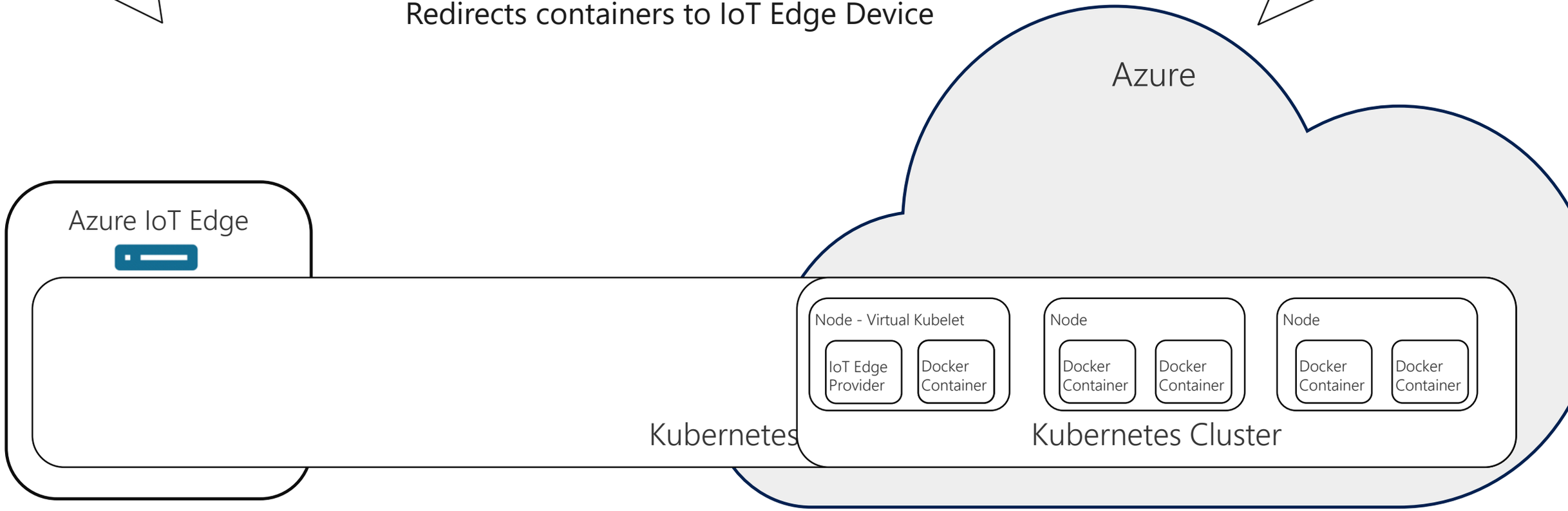
Compress
Encrypt
Send to Cloud

Uses Kubernetes Virtual Kubelet Support

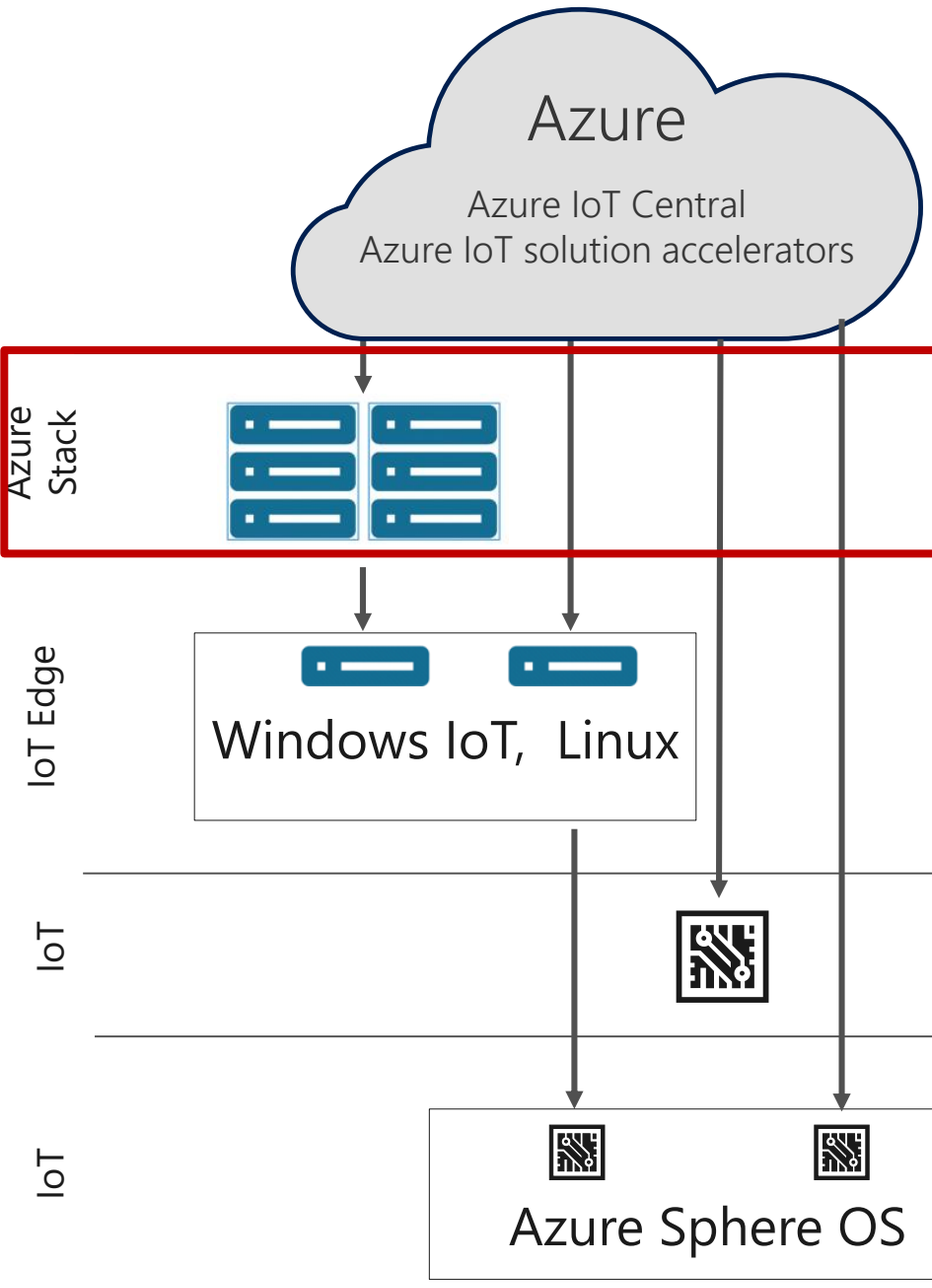
Open Source “IoT Edge Provider” Virtual Kubelet

Redirects containers to IoT Edge Device

Decrypt
Uncompress
Send to Storage



Azure, Azure Stack, IoT Edge and IoT



Azure	•	Available in Azure Regions Full functionality
Azure Stack	•	Azure Services & Management on-prem Managed by Azure or Locally
Azure IoT Edge	•	Deploy and manage cloud services Managed by Azure or Azure Stack
Windows IoT, Linux	•	Azure IoT Edge runs on Windows and Linux
Azure IoT Device SDK	•	Multi-device, multi-language, multi-OS iOS, Android, Windows, Linux
Azure Sphere	•	Peerless security for MCU devices Connect directly to Azure or via Azure IoT Edge
Azure Sphere OS	•	Linux Kernel that modernizes MCU devices

Next steps

- Get IoT Cloud Workshop Canada https://github.com/toddwhitehead/azure-iot-edge-hol

- Get started with Azure IoT at:
  - Azure IoT Hub
  - Azure IoT Suite
  - Microsoft IoT Central

Learning Resources

- Azure IoT Hub
- https://www.azureiotsolutions.com/Accelerators
- Microsoft IoT Central
- http://aka.ms/iotrefarchitecture
- Azure IoT School http://aka.ms/iotschool
- Azure IoT Learning Path
- https://github.com/faister/connectedfactory

- Workshops and Hackathons
  - https://microsoft.github.io/azure-iot-developer-kit/
  - https://github.com/Azure-Samples/azureiotlabs
  - https://github.com/faister/msiotcloudworkshopau

Learning Resources

- Build 2018 IoT Videos
  - Microsoft IoT Overview, Vision and Roadmap : Build 2018
    https://www.youtube.com/watch?v=ZfjDL3g0KO0
  - Windows IoT: Accelerate the Intelligent Edge with the Windows AI Platform
    https://www.youtube.com/watch?v=7bFAg6w4J00
  - Windows AI Platform and the Intelligent Edge
    https://www.youtube.com/watch?v=UJ8xaSXBlJQ
  - Vision Keynote: Intelligent Cloud and Intelligent Edge
    https://www.youtube.com/watch?v=rDLkKN8e8rA

- https://aka.ms/IoTShow