IoT on the Edge and in the Cloud

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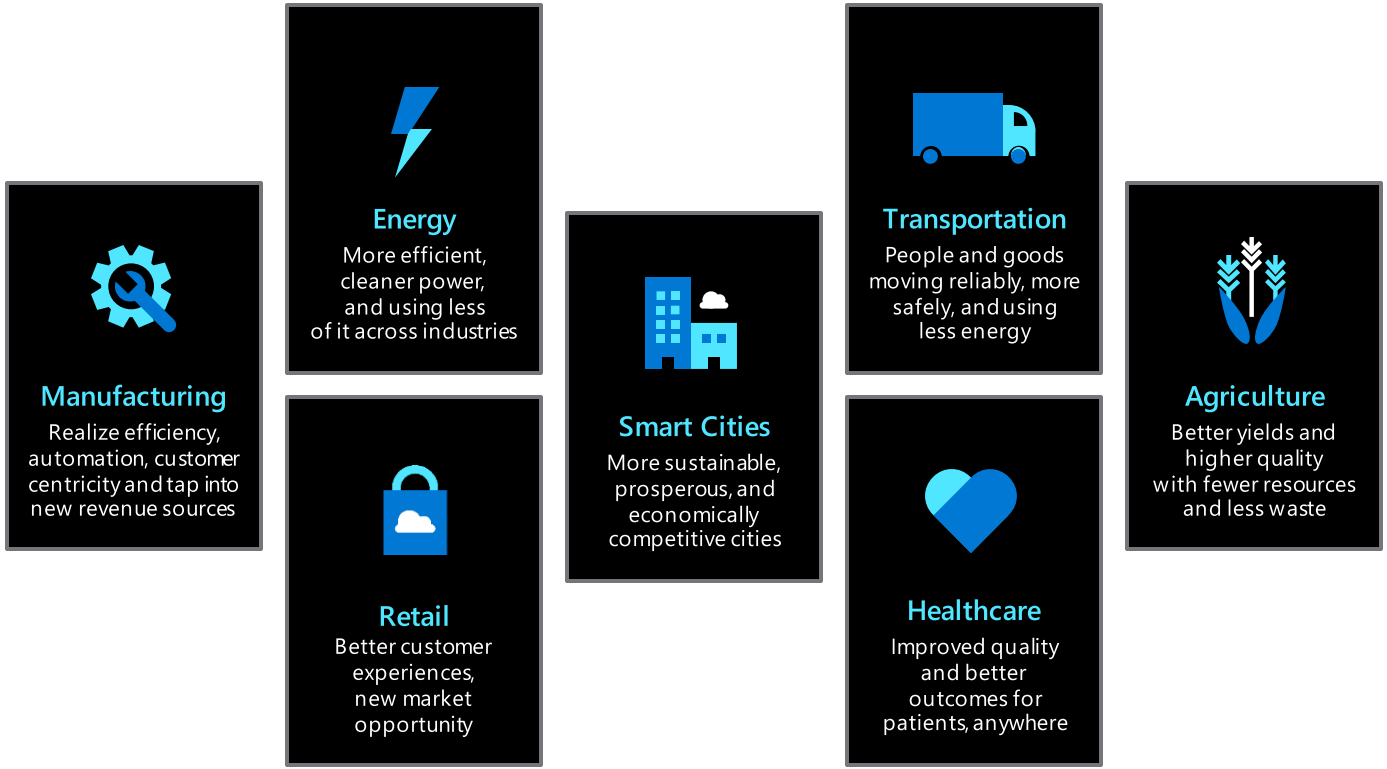
Microsoft Azure
+ AI Conference

CO-PRODUCED BY
Microsoft & DEVintersection

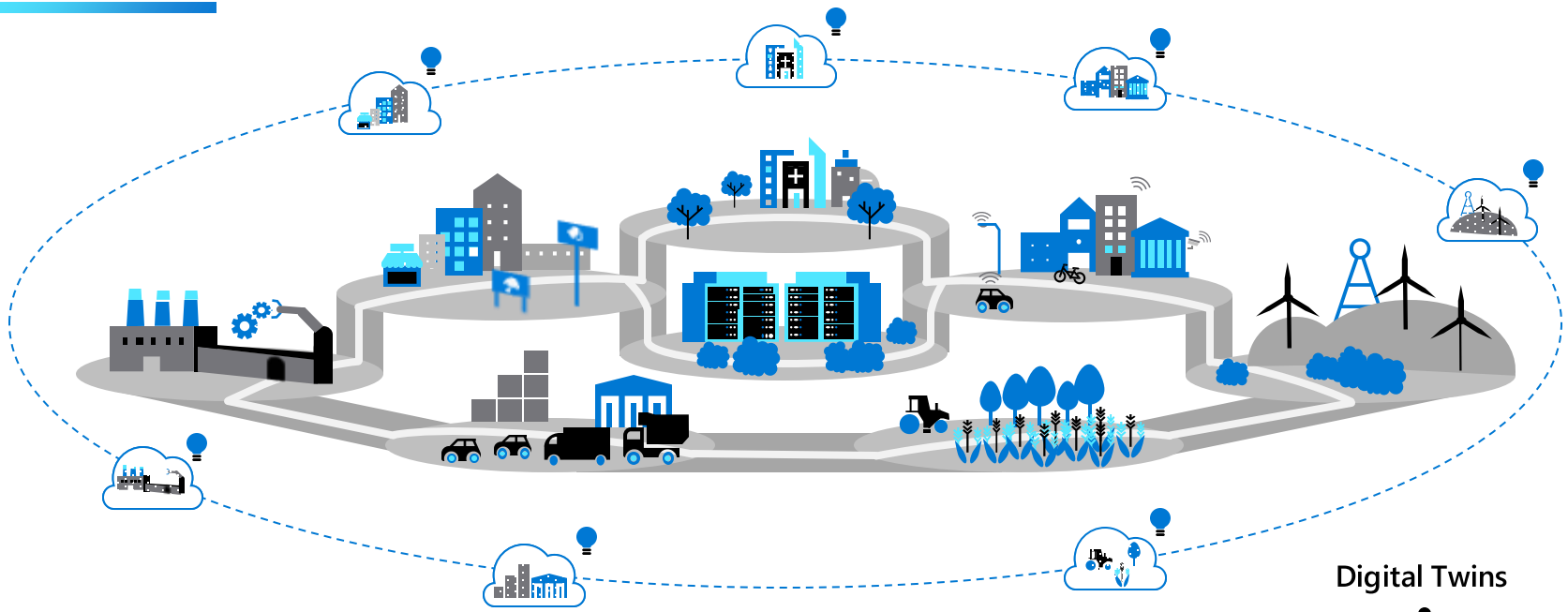
Build IoT Solutions with Azure IoT Edge

- **Azure IoT and Azure IoT Edge Overview**
- **Demo: Getting Started with Azure IoT Edge and Azure Functions**
- **Challenges around building with Azure IoT Edge**
- **Other Azure IoT Services**
  - Azure Time Series Insights
  - Azure IoT Central
  - Azure Sphere
  - Azure RTOS
  - Azure Security Center for IoT

We’re in a new era of digitization across industries



Catalytic innovations enabling new opportunities



Cloud
Globally available, unlimited compute resources

IoT
Harnessing signals from sensors and devices, managed centrally by the cloud

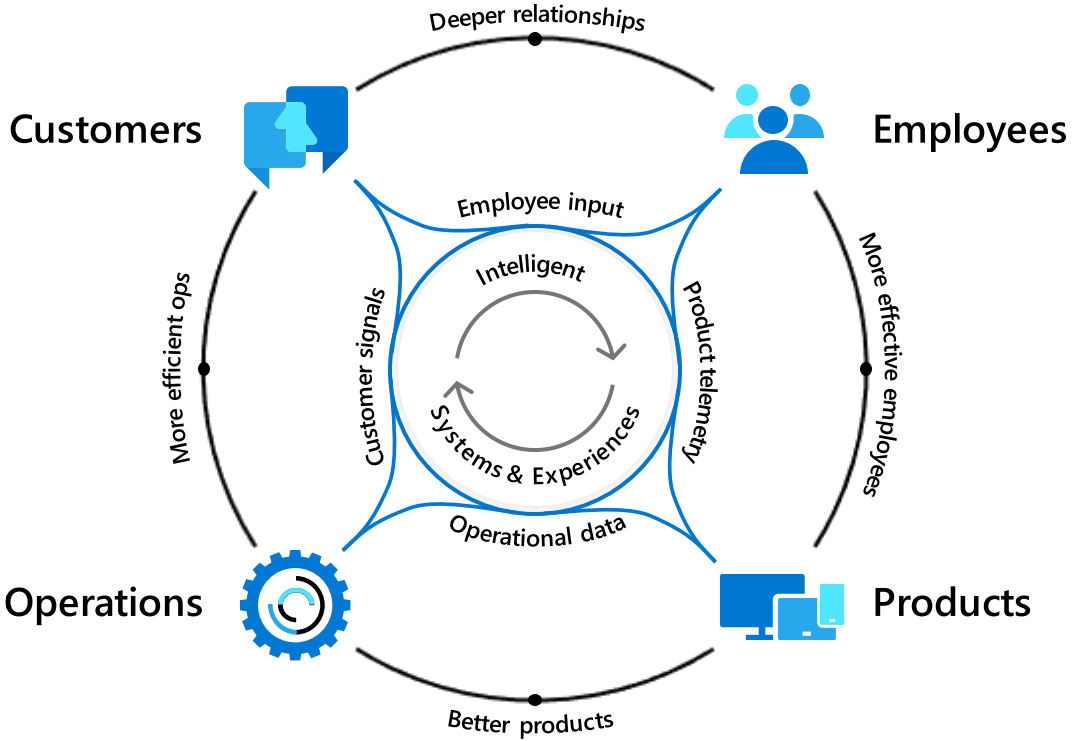
Edge
Intelligence offloaded from the cloud to IoT devices

AI
Breakthrough intelligence capabilities, in the cloud and on the edge

Digital Twins
Create living replicas of any physical environment, track the past and predict the future

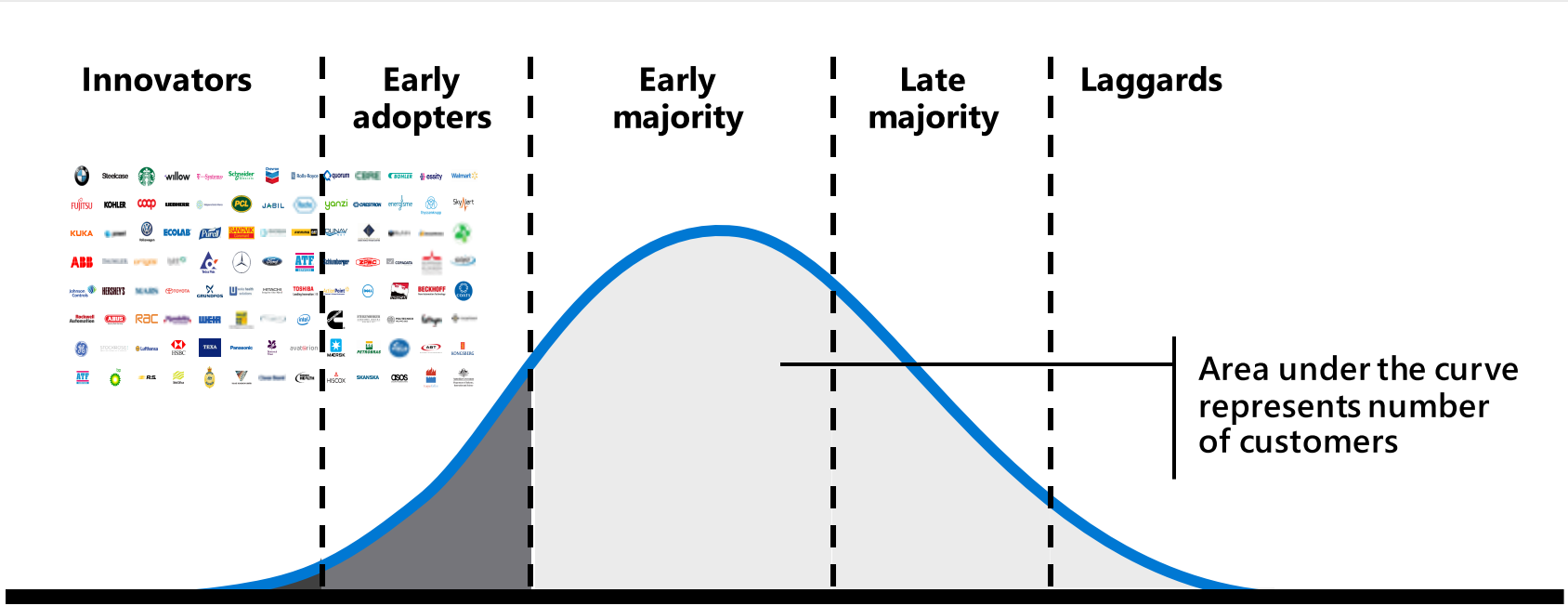
Enabling a digital feedback loop

1. Data: Capture digital signal across business
2. Insight: Connect and synthesize data
3. Action: Improve business outcomes



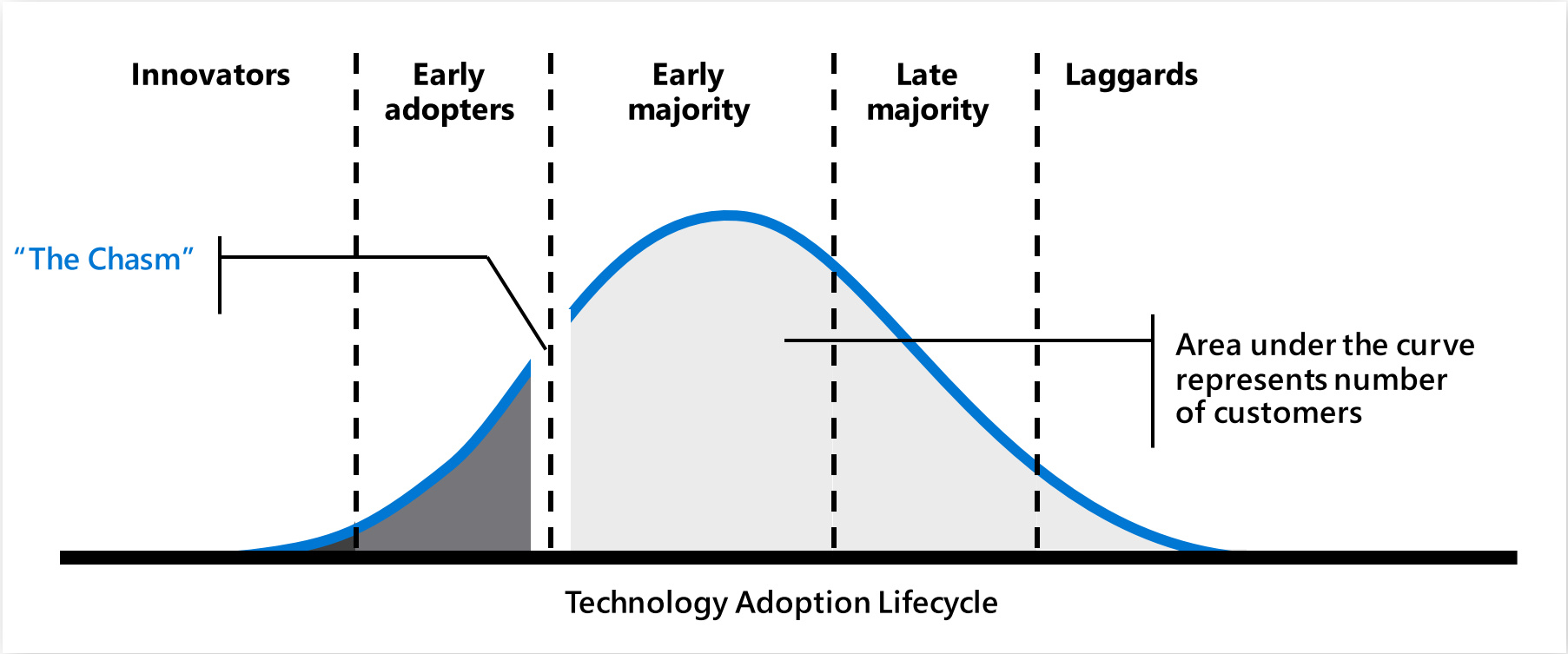
Thousands of Azure IoT customers

Technology adoption lifecycle



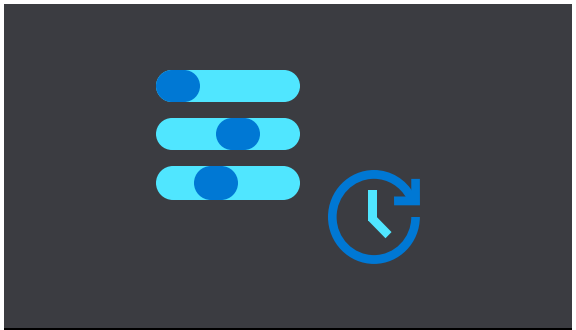
Technology Adoption Lifecycle

IoT is crossing the chasm and going mainstream

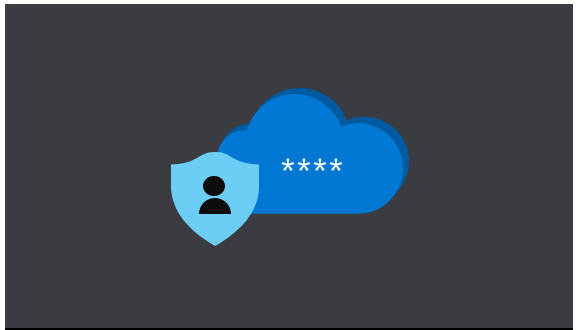


What we learned from customers in our IoT Signals survey

88% See IoT as critical to business success



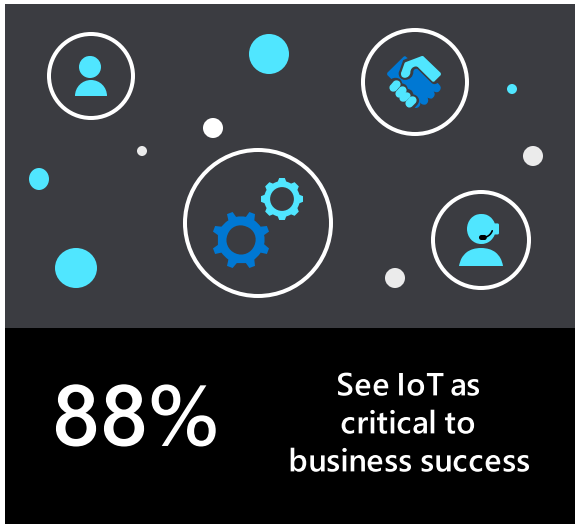
48% Cite lack of skilled workers for IoT solutions



97% Security is top of mind

Source: IoT Signals
https://azure.microsoft.com/en-us/iot/signals/

The need for comprehensive IoT services



Microsoft's comprehensive IoT product portfolio

Azure Security Center for IoT

Azure IoT Priority Verticals

Manufacturing | Retail | Agriculture | Energy | Smart Cities | Healthcare | Transportation

Azure IoT Solutions

- Azure IoT Central (SaaS)
- Azure IoT Reference Architecture & Accelerators (PaaS)
- Dynamics Connected Field Service (SaaS)

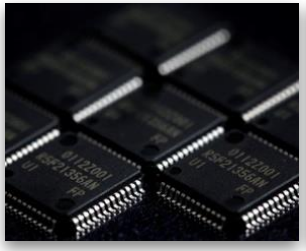
Azure Services for IoT

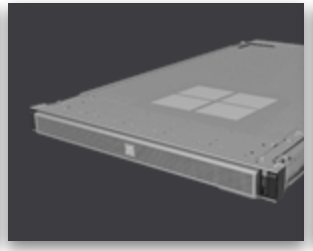
- Azure IoT Hub
- Azure IoT Hub Device Provisioning Service
- Azure Digital Twins
- Azure Time Series Insights
- Azure Maps
- Azure Stream Analytics
- Azure Cosmos DB
- Azure AI
- Azure Cognitive Services
- Azure ML
- Azure Logic Apps
- Azure Active Directory
- Azure Monitor
- Azure DevOps
- Power BI
- Azure Data Share
- Azure Spatial Anchors

IoT & Edge Device Support

- Azure RTOS
- Azure Sphere
- Azure IoT Device SDK
- Azure IoT Edge
- Data Box Edge
- Windows IoT
- Azure Certified for IoT—Device Catalog
- Azure Stream Analytics
- Azure Storage
- Azure ML
- Azure SQL
- Azure Functions
- Azure Cognitive Services

Microsoft's comprehensive IoT & Edge offerings



Sensors + Control | **Sensors to Interactive** | **Integrated Platform** | **Global scale processing**

Microcontroller
Azure RTOS & Azure Sphere

Integrated Circuit designed to govern a specific operation in an embedded system

Highly-secured, connected MCU

Azure Sphere Linux OS for modern MCUs

Included Azure IoT Device SDK

IoT Devices
Azure IoT Device SDK

Endpoint devices such as appliances, vehicles, or factory machines that connect, interact and exchange data

1300+ devices, 300+ partners - all certified to work great with Azure IoT Services

Cross-platform and open source: Windows IoT, Linux, Android, iOS, RTOSs and more

Edge Devices
Azure IoT Edge

Devices that aggregate, process & provide gateway capabilities for IoT endpoints

Deploy and manage Azure Services in containers on any IoT device

AI, AzureML, Azure Stream Analytics and more

Cross-platform and open source: Windows IoT, Linux

Edge Appliances
Azure Stack Edge

Integrated appliances that provide a subset of cloud edge roles, such as ML-inferencing

Azure Stack Edge: AI-Enabled, Storage and compute Azure Edge appliance

Edge Stack
Azure Stack Hub

Scalable solutions that provide a full cloud stack, including IaaS and PaaS capabilities

Edge and Disconnected Scenarios

Regulatory Requirements

Cloud app model on-premises

Hyperscale Cloud
Edge Regions

First-party cloud regions

Full Range Hyperscale Cloud Services

Tiered Service availability: Heroes > Hubs > Satellites

Open Source Based Services & Tools

Most specialization — Full Spectrum of Cloud + Edge Form Factors — Fewest form factors

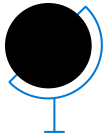
Fewest services — Intentional & Appropriate Azure Service Availability — Most services

IoT Hub

Platform as a Service (PaaS)

Establish bi-directional communication with billions of IoT devices

Enhance security with per device authentication



Provision devices at scale with IoT Hub Device Provisioning Service

Manage devices at scale with device management

Multi-language and open source SDKs

Connect, Manage and Monitor millions of devices at scale

Rockwell Automation

Rolls-Royce

ECOLAB

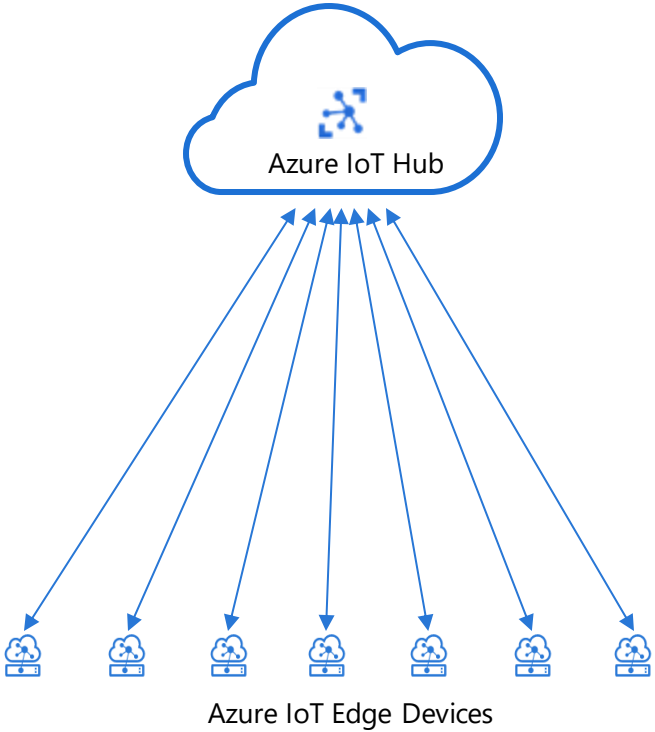
Schneider Electric

Azure IoT Edge

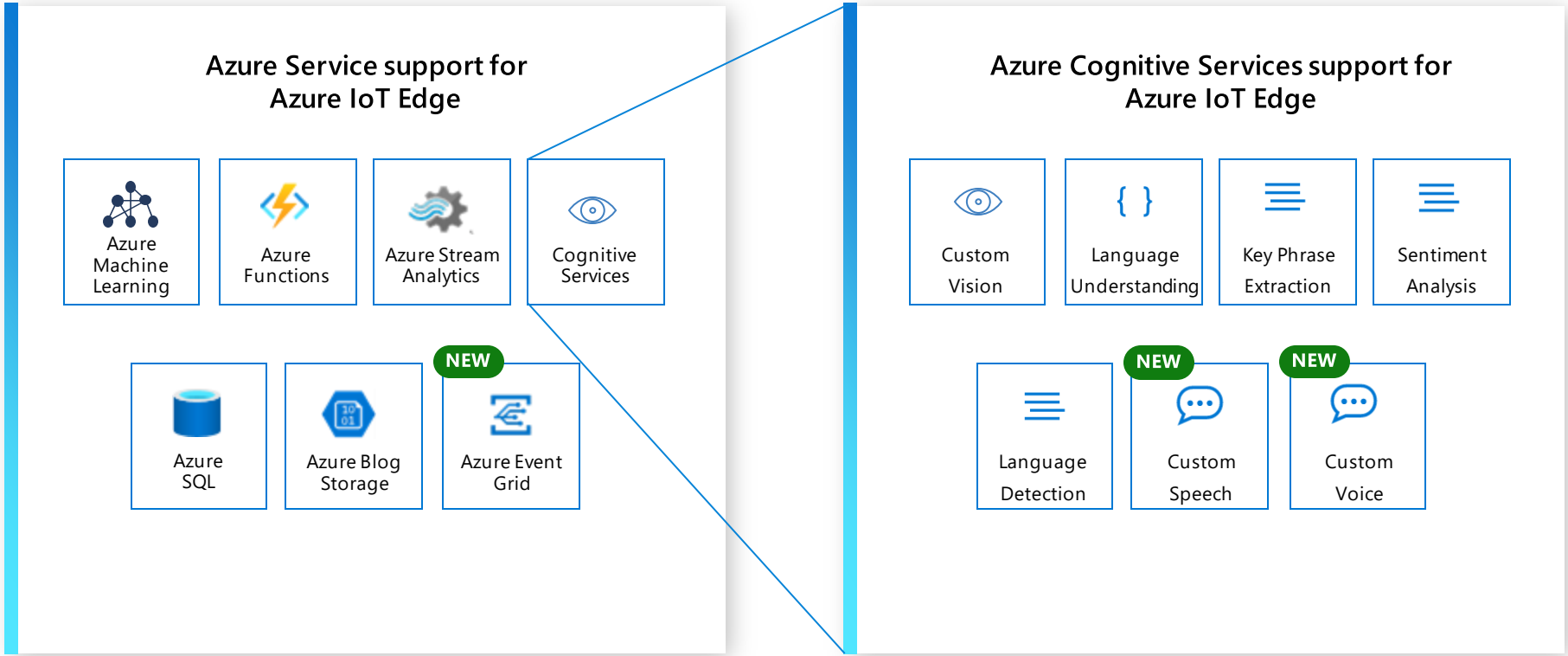
Run Azure AI, Azure Services & Custom Services directly on IoT devices

Azure IoT Edge

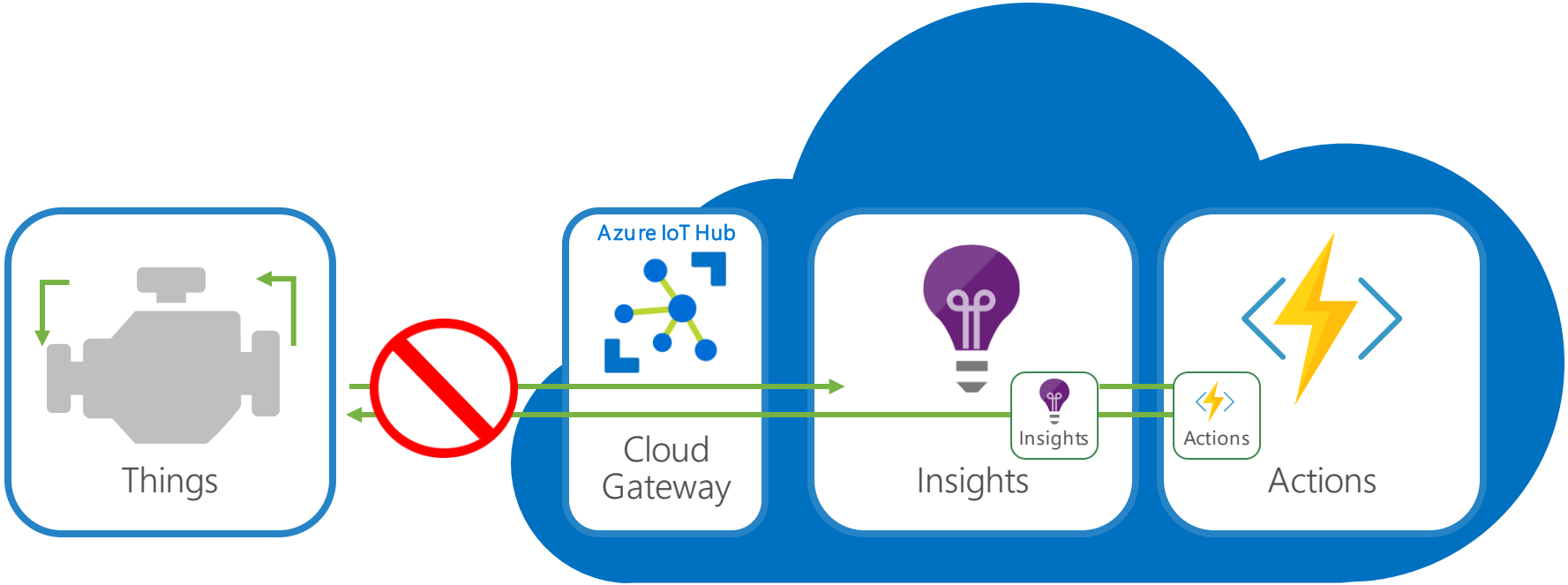
- Open source, cross platform, container-based edge runtime
- Run Azure services & your own code on IoT class and larger devices – fully extensible
- Manage the devices and IoT Edge workloads centrally
- Supports offline operation
- Fully Visual Studio + Visual Studio Code developer support
- Azure DevOps + Jenkins CI/CD support
- NEW **Over 80 Azure Certified for IoT, 3rd party IoT Edge devices**



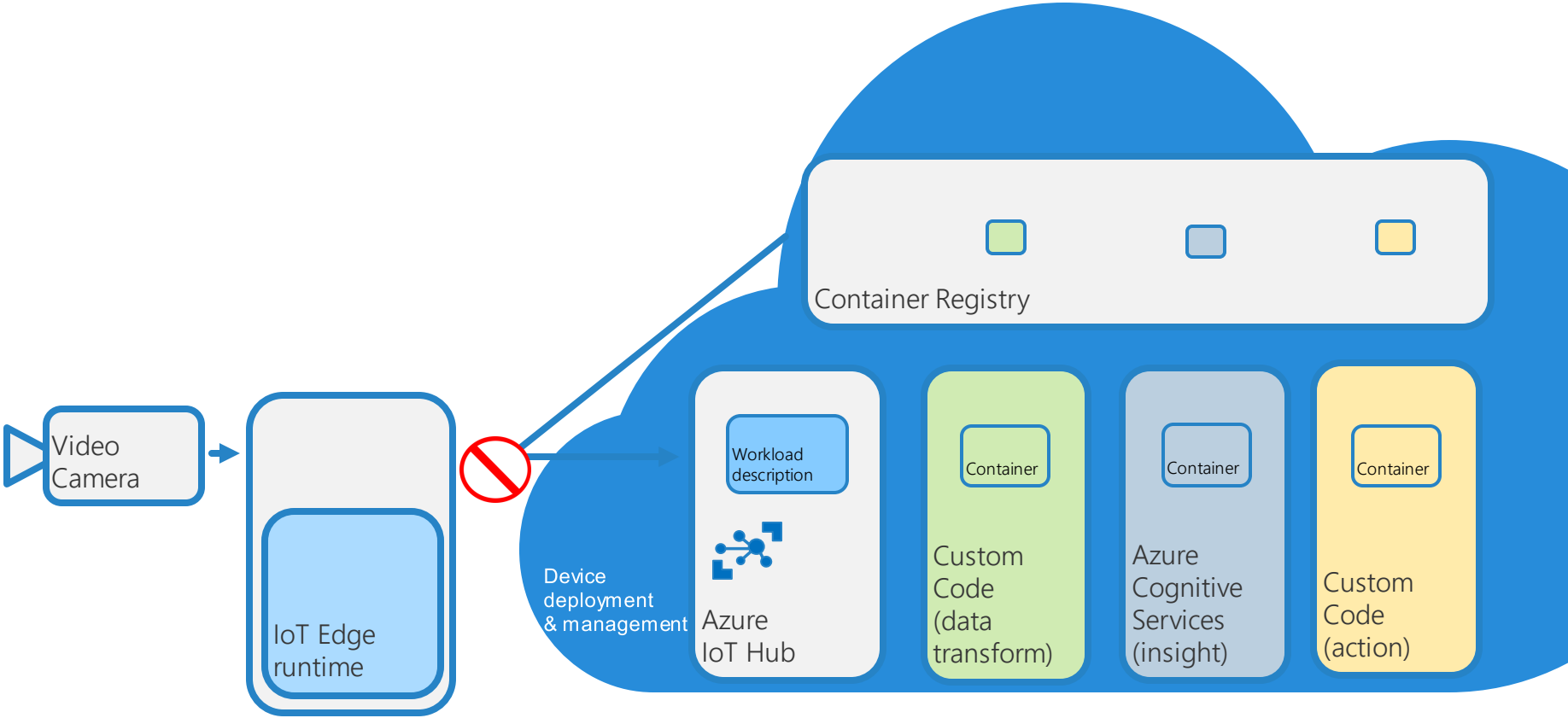
Azure Service Support for Azure IoT Edge



IoT application pattern + edge intelligence



Edge intelligence enabled with Azure IoT Edge



Basic Azure IoT Edge functionality

Create workloads which can include high value AI

Target workloads at the correct type of device

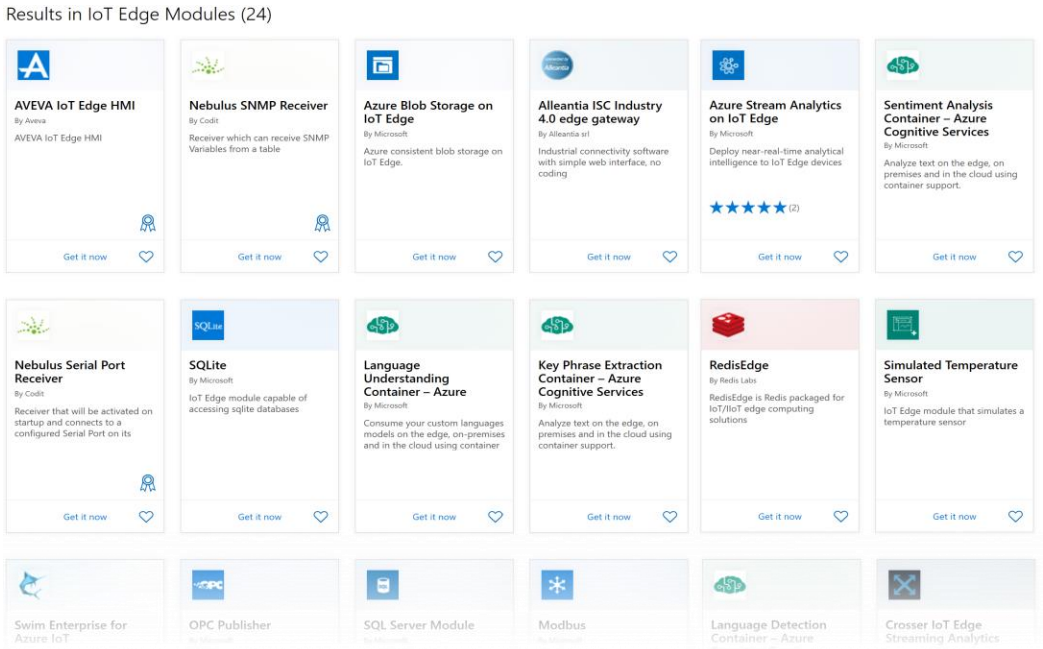
Run those workloads locally, in a disconnected manner

Monitor the health of the workloads

Module Marketplace

Solution builder - Leverage an ecosystem

ISV - Highlight your tech
(https://aka.ms/iot-edge-marketplace-doc)



July ‘18
1st party modules only

October ‘18
Open to 3rd party modules
Deeper tooling integration

Feb ‘19
1st party monetization

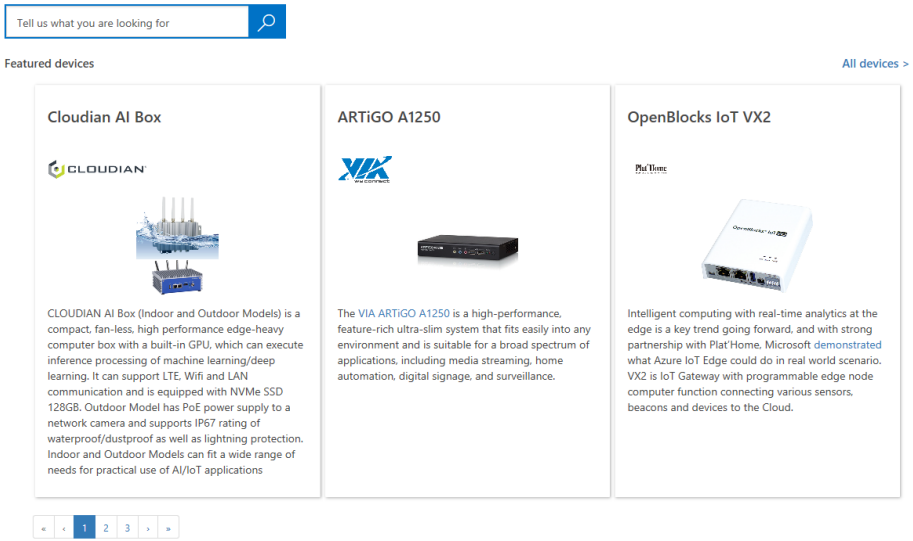
2020
3rd party monetization

Azure IoT Edge certified devices

Simplifies IoT solution development

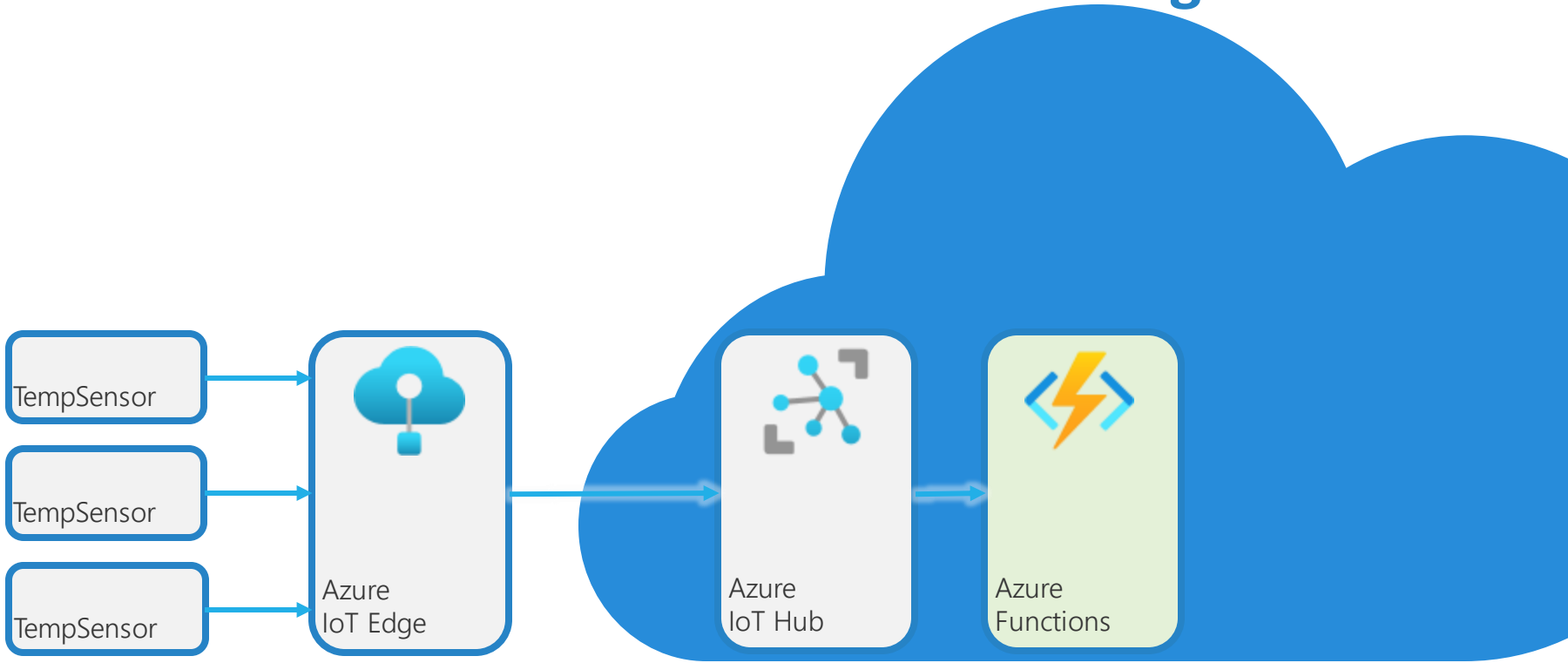
Streamlined certification process

All certified devices are featured



Visit http://aka.ms/certfaq to learn more about program requirements

Demo: Functions on Cloud and Edge



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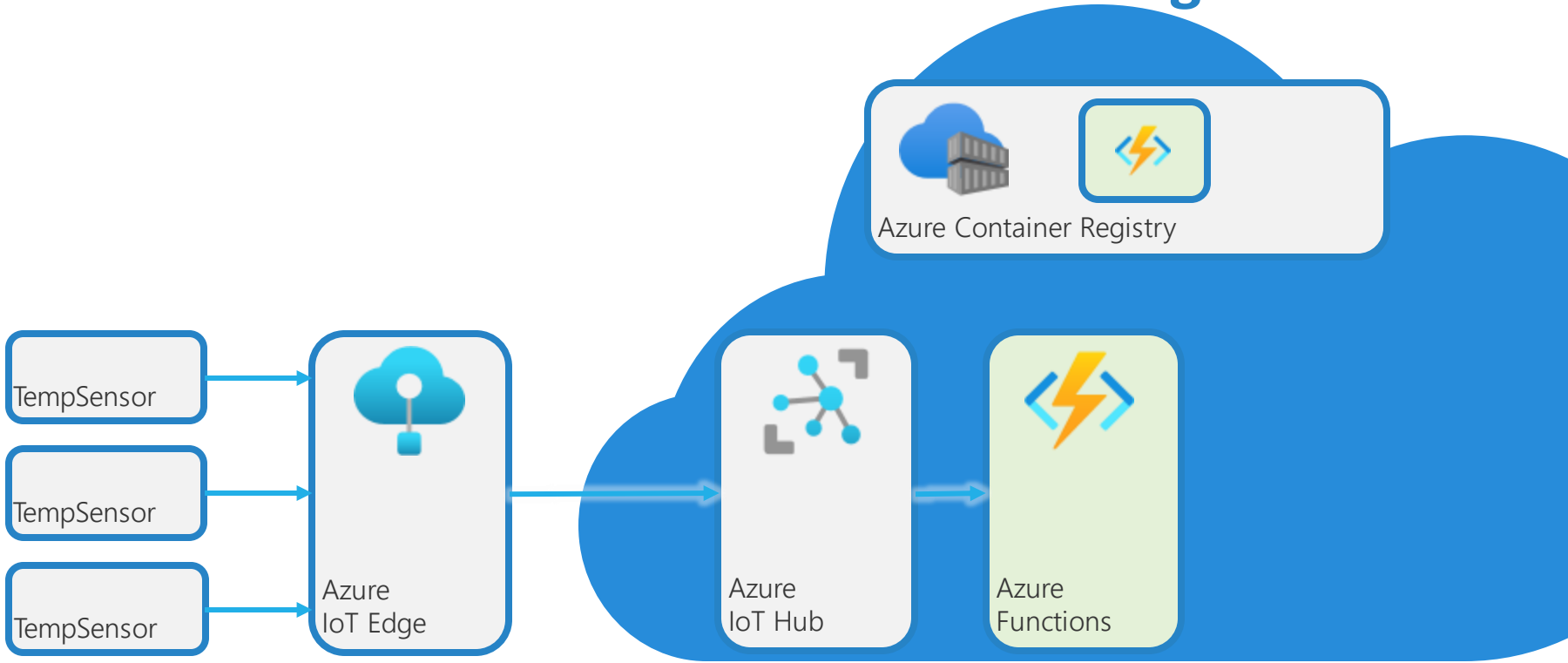

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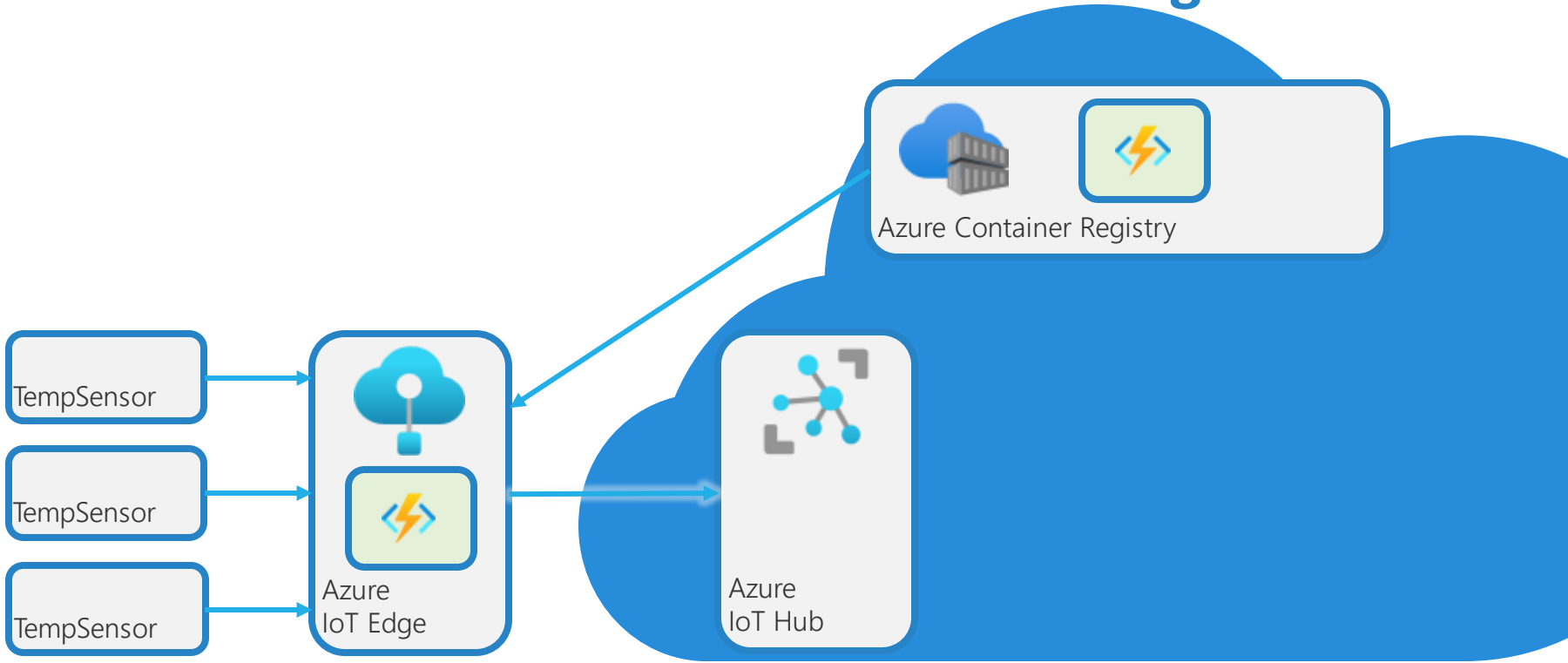


Demo: Functions on Cloud and Edge

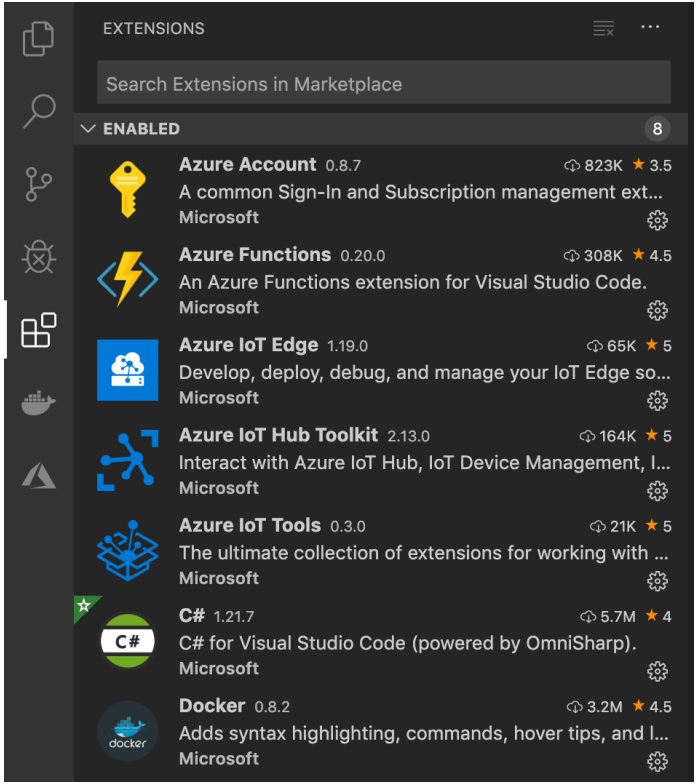
What we will do:

1. **Create an IoT Hub**
2. **Deploy a simulated Sensor Device**
3. **Deploy a simulated IoT Edge Device**
4. **Build and deploy an Azure Function that processes sensor data in the Cloud**
5. **(re)Deploy our Azure Function to IoT Edge**
6. **View the processing happening on the Edge Device**

Setup your Development Environment

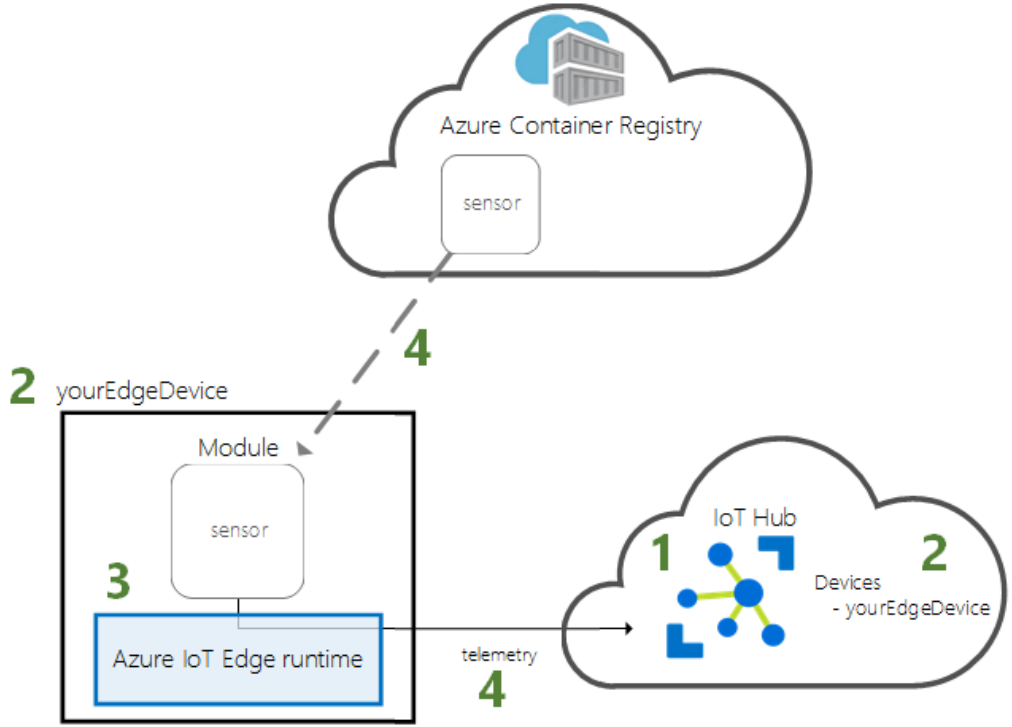
What you need:

- Free Azure Account
- Visual Studio Code with
  - Azure IoT Tools Extension
  - Azure Functions Extension
  - Docker Extension
  - Language support (C#, Java, C, Node.js, Python)
- az cli with Azure IoT Extension



Getting Started: Create an IoT Hub and Connect IoT Edge

1. **Create an IoT Hub**
2. **Register an IoT Edge device to your IoT hub**
3. **Install and start the IoT Edge runtime on your virtual device**
4. **Remotely deploy a module to an IoT Edge device**



Follow along with Azure Cloud Shell

Go To https://shell.azure.com

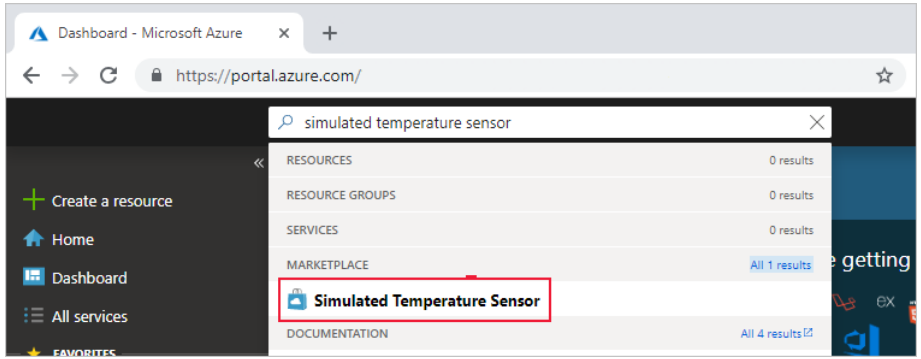
Demo - Creating and Connecting the Edge Device

```
# Create a Resource Group
az group create --name IoTEdgeResources --location westus2

# Start a Virtual Machine to host our IoT Edge
az vm image accept-terms –urn microsoft_iot_edge:iot_edge_vm_ubuntu:ubuntu_1604_edgeruntimeonly:latest
az vm create --resource-group IoTEdgeResources --name EdgeVM \
–image microsoft_iot_edge:iot_edge_vm_ubuntu:ubuntu_1604_edgeruntimeonly:latest \
--admin-username azureuser --generate-ssh-keys

# Create an IoT Hub
az iot hub create --resource-group IoTEdgeResources --name myHubDevInterSection2019 --sku F1

# Create an Edge Device and Get its Connection String
az iot hub device-identity create --hub-name myHubDevInterSection2019 --device-id myEdgeDevice --edge-enabled
az iot hub device-identity show-connection-string --device-id myEdgeDevice --hub-name myHubDevInterSection2019
```

Demo - Creating and Connecting the Edge Device

```
# Connect the Edge Device
az iot hub show-connection-string
az vm run-command invoke -g IoTEdgeResources -n EdgeVM --command-id RunShellScript \
--script "/etc/iotedge/configedge.sh '{device_connection_string}'"
```

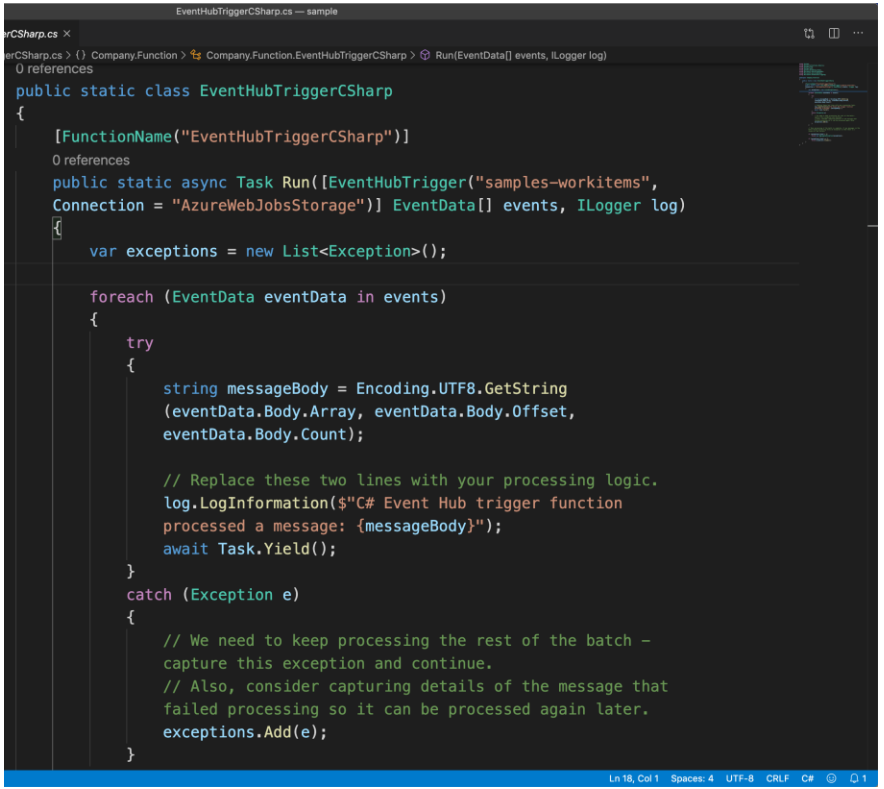
- **Connect Edge to Hub w/Connection string**
- **Deploy Sensor Container from Marketplace to Edge**
- **Route all/all -> View on Cloud**



Demo: Creating an Azure Function for IoT

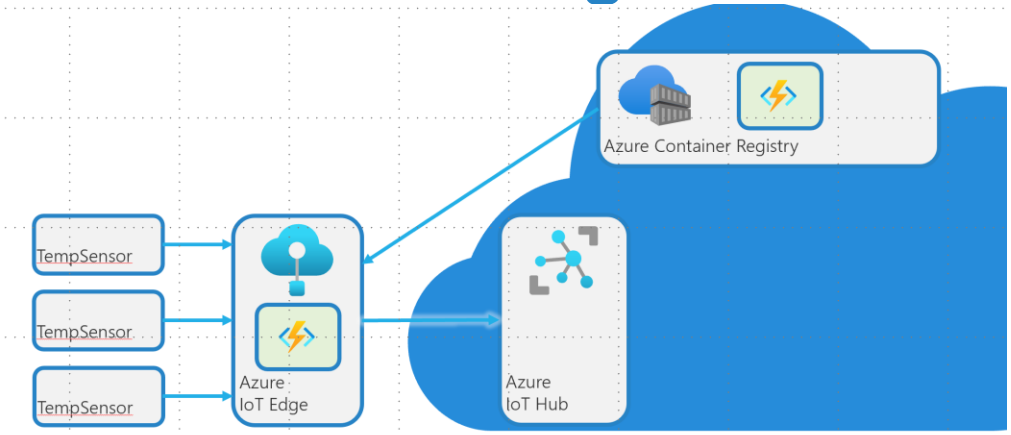
1. **In VS Code, Create a new Azure Function**
   1. (use command palette)
2. **Add Code for your IoT Hub (EventHub) Trigger**
3. **Get Connection String for IoT Hub EventHub**

   > az iot hub show-connection-string
4. **Local Debugging (F5)!**
5. **Deploy Function to Azure Functions App**
   1. (use command palette)
6. **View Messages in Azure Portal**



Demo: Package and Run Function at the Edge

1. **Add Code for your IoT Edge Hub Trigger (no connection string!)**
    1. (can also start new function w/edge trigger)
2. **Set routes to Edge Function in deployment manifest**
3. **Build container and push to ACR**
4. **Deploy to IoT Edge from VS Code**
5. **View Docker logs of Edge Function**
6. **View Messages in Cloud with VS Code**




```
83    "$edgeHub": {
84      "properties.desired": {
85        "schemaVersion": "1.0",
86        "routes": {
87          "TemperatureFilterToIoTHub": "FROM /messages/modules/
            TemperatureFilter/outputs/* INTO $upstream",
88          "sensorToTemperatureFilter": "FROM /messages/modules/
            SimulatedTemperatureSensor/outputs/temperatureOutput INTO
            BrokeredEndpoint(\"/modules/TemperatureFilter/inputs/input1\")"
89        },
90        "storeAndForwardConfiguration": {
91          "timeToLiveSecs": 7200
92        }
93      }
94    }
95  }
```

Azure IoT Edge: Powerful Messaging and Control

What we saw:

- **IoT Edge can act as a transparent gateway (proxy sensor data to cloud)**
- **The code you use on the cloud can be pushed to the Edge for local processing -> take action on the edge!**
- **When Edge connects to the cloud, after being offline, your messages can also still be routed to the cloud**

Challenges with IoT Edge Development

- **Not all Azure Services look the same on the Edge as in the cloud**
  - IoT Hub Message Routing Differences (eg Azure Functions trigger)
  - Deployment differences
- **Figuring out how to size your IoT Edge device hw**
  - Highly dependent on your workload
  - Subject to change with data size/rate
- **Setting up round-trip CI/CD**
  - Deployment manifest for modules can become complex quickly
  - Configuration can vary between test and production (virtual vs real devices, etc)

References

- **Docs links**
  - IoT Edge
  - QuickStart
  - VS Code IoT Edge Functions
  - VS Code Cloud Functions

- **Repos for the demo**
  - https://github.com/Azure-Samples/azure-functions-edge-and-cloud

You can get started today:

- **Build/Practice your skills in Azure using simulated devices**
- **When you are ready, you can get certified devices and deploy ready-to-run modules from Azure Marketplace**
- **You can also build modules for the Marketplace (3rd party monetization coming 2020)**

Other Azure IoT Services

Azure Time Series Insights (TSI)

A Serverless, Fully Managed Platform as a Service (PaaS) Solution Built for IoT

Ingest, process, store, and query highly contextualized, time-series-optimized, IoT-scale data

Built in rich User Experience for ad-hoc queries and exploration

Rich analytics APIs for ad-hoc exploration and operational intelligence

JavaScript control library for building custom analytics apps on the TSI platform

Turn data into decisions with actionable real-time IoT insights

ABB

ExxonMobil
Energy lives here

Fonterra
Dairy for life

Chevron

ENGIE

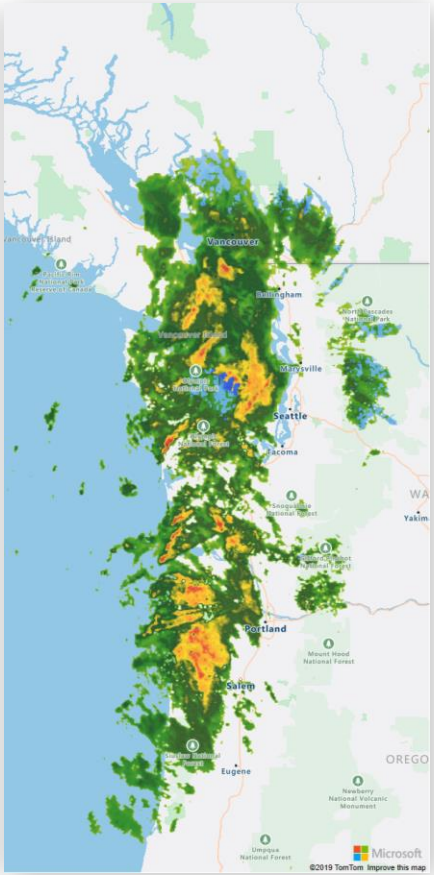
bp

Azure Maps

Recent updates

Microsoft's recommended mapping service for Azure solutions

- ✓ IoT spatial analytics using Azure Map (also Azure Notebooks integration)
- ✓ Real-Time Public Transit data in partnership with Moovit
- ✓ Best Accessibility rating in the market
- ✓ Azure Maps Spatial Operations (General Availability)
- ✓ New Cartography and styling updates
- ✓ Geopolitical view to see map boundaries based local



Windows IoT

Smart, Secure, Fast

NEW

✓ Availability of NXP SOC

- General Availability of NXP i.MX SOC
- Increased silicon choice for device and solution builders
- Industrial grade silicon

NEW

✓ Windows ML Container

- Public Preview of new Windows ML Container
- Fast and agile platform to build enterprise-grade IoT solutions
- Hardware acceleration can take advantage of any DirectX 12 compliant GPU

NEW

✓ SQL Server IoT 2019

- Addresses latency and connectivity requirements
- Maintains data on-premises
- Securely stores and analyzes large amounts of data

Azure RTOS

ANNOUNCING

Azure RTOS ThreadX

Over 6.2 billion deployments, making it one of the most deployed RTOS in the world.

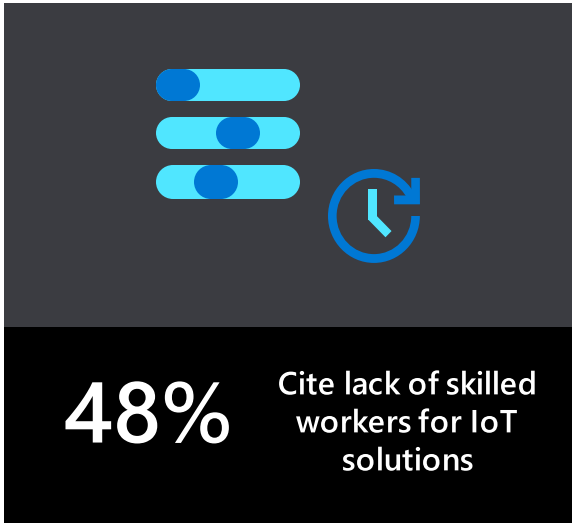
NEW

✓ Partnership announcement

- Microsoft & Renesas combine forces to simplify the Device-to-Cloud experience
- Integration of Azure RTOS ThreadX with the Renesas Flexible Software Package
- Seamless and easy out-of-box support for Azure RTOS

Express Logic acquisition

The need for solutions that enable rapid application development without cloud development skills



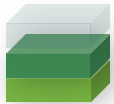
IoT Central

A fully managed IoT app platform

- ✓ Highly secure
- ✓ Enterprise-grade
- ✓ Predictable pricing
- ✓ Industry-focused

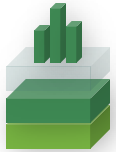
Get connected

Connect IoT devices to the cloud faster than any other platform.



Stay connected

Reconfigure and update devices with centralized device management.



Transform

Bridge the gap with connectors and extensibility APIs.

Existing solution builders

MESHSYSTEMS™ cradlepoint Connect Beyond sagegreenlife flex C.H. ROBINSON imec

FOOTMARKS Kroger jda. BOSCH QUEST BORN TO ENGINEER

IoT Central

NEW **Preview Capabilities**


App templates for Industry Verticals


White labeling your SaaS – your brand


Azure IoT Edge support


Multitenancy Support


API Support


IoT Plug and Play Support


New 2-tiered pricing model announced, based on message volume

App templates are tools to help partners & solution builders kickstart IoT solution development

Use or sell to customers directly or through AppSource

Your brand, your SaaS

App templates consist of:

- Sample operator dashboards
- Sample device templates
- Simulated devices
- Pre-configured rules and jobs
- Rich documentation including tutorials
- Brand templates using white labeling features

IoT Central

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Retail

- Digital distribution center
- In-store analytics
- Checkout, Condition monitoring
- Connected logistics
- Smart inventory management

Healthcare

- Continuous patient monitoring

Energy

- Smart meter analytics
- Solar power monitoring

Government

- Water quality monitoring
- Water consumption monitoring
- Connected waste management

IoT Central

NEW Capabilities

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- White labeling your SaaS – your brand
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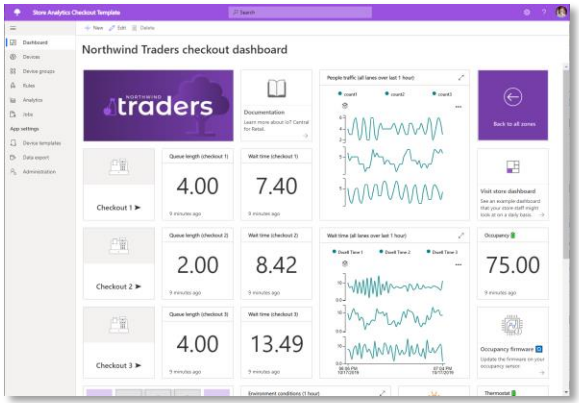

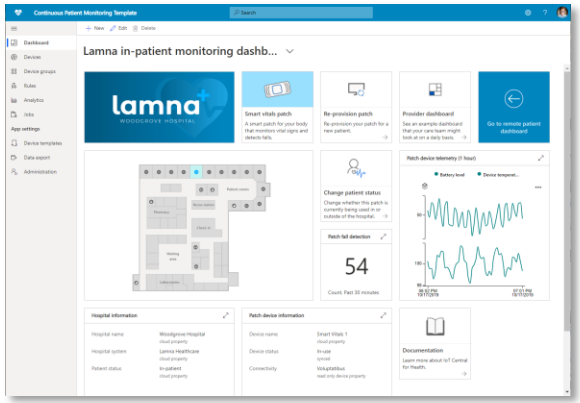

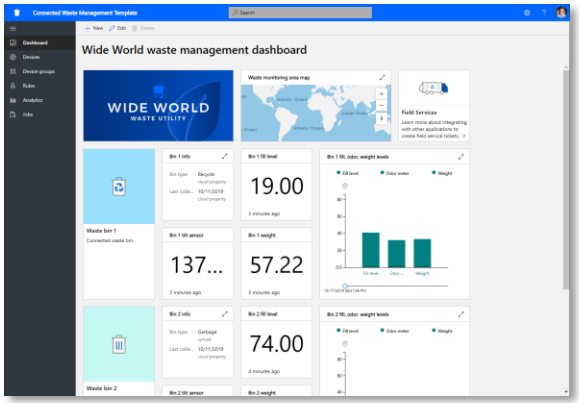

IoT Central

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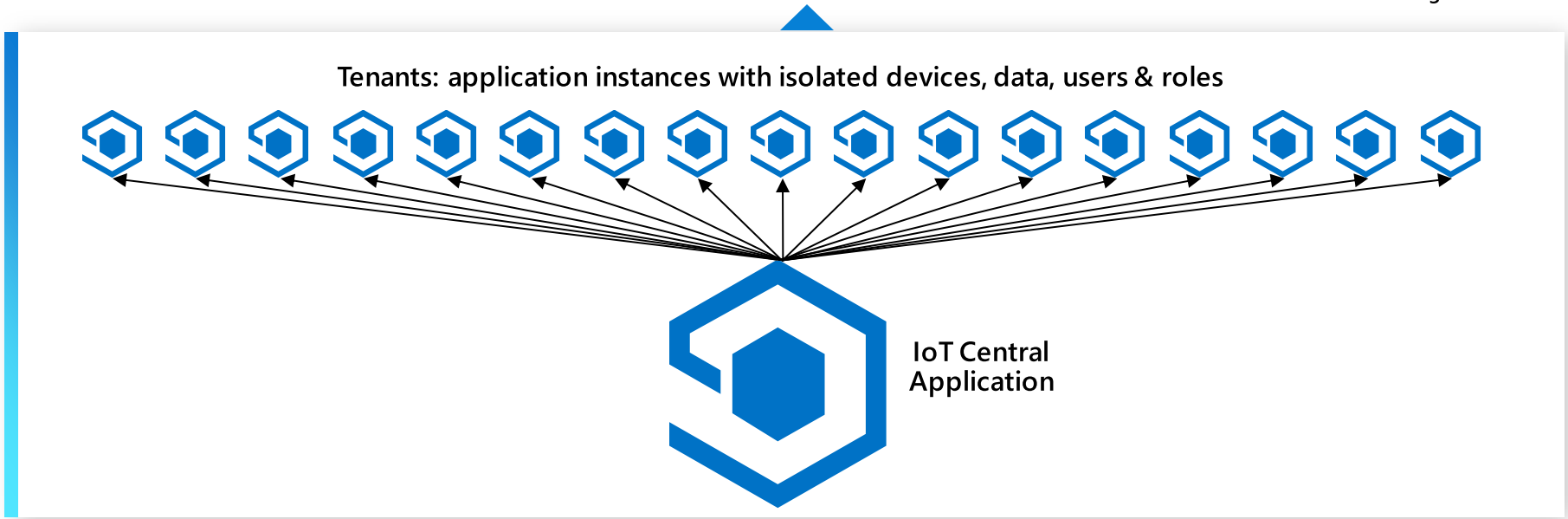
- API Support
- IoT Plug and Play Support
- New 2-tiered pricing model announced, based on message volume

IoT Central

NEW Preview Capabilities

- App templates for Industry Verticals
- White labeling your SaaS – your brand
- Azure IoT Edge support
- Multitenancy Support
- API Support
- IoT Plug and Play Support
- New 2-tiered pricing model announced, based on message volume



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Power BI

PowerApps

Web and Mobile

App Management APIs	Device Modelling APIs	Device Onboarding APIs	Device Management APIs	Data & Insights APIs

IoT Central Application

IoT Central

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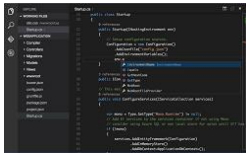
Device Capability Model

Device Capability Model

JSON-LD Schema

VS Code



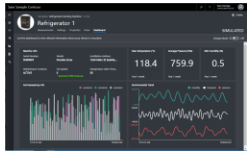
IoT Plug and Play Device Software

Generated Device Agent

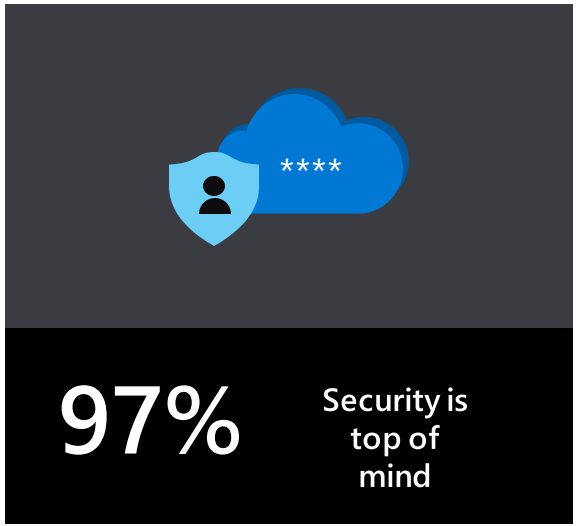
Azure IoT Device SDK

Azure IoT Device Catalog IoT Plug & Play Certified

Azure IoT Central & Partner Solutions



The need for turnkey IoT security solutions



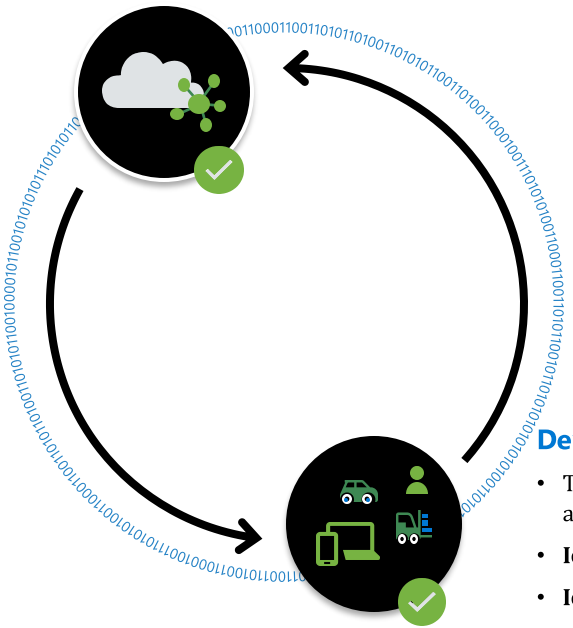
Protect all your IoT assets from threats

Azure Security Center for IoT:

Security posture and monitoring, alerts, and response

IoT Services

- Security by design in **IoT Hub** and **IoT Central**
- Scalable, policy-based access control
- Standards-based mutual authentication
- Industry-leading reliability and resilience

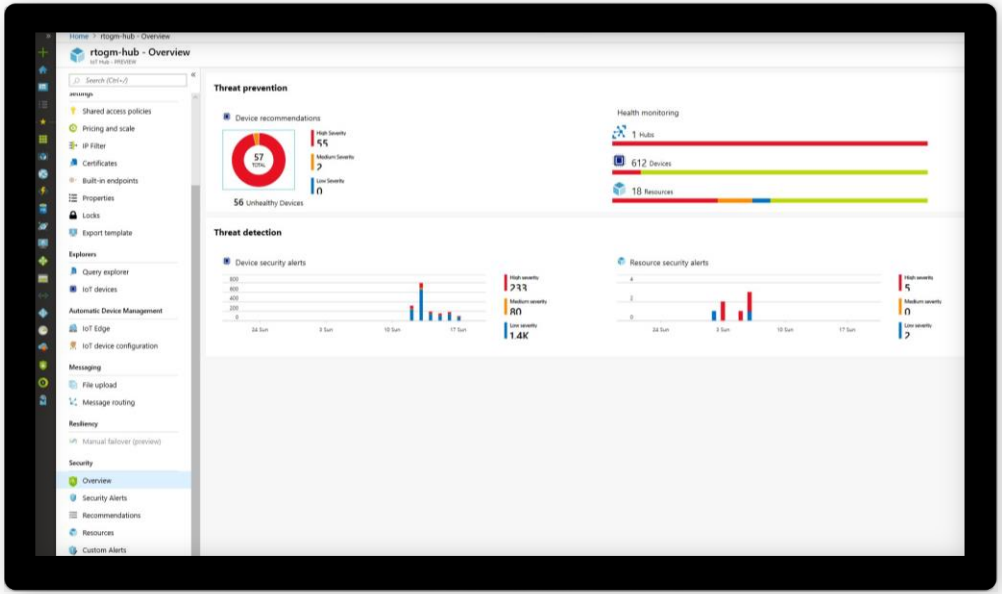


Devices

- Threat monitoring and mitigation across devices
- **IoT Devices**
- **IoT Edge devices and workloads**
- **Azure Sphere**

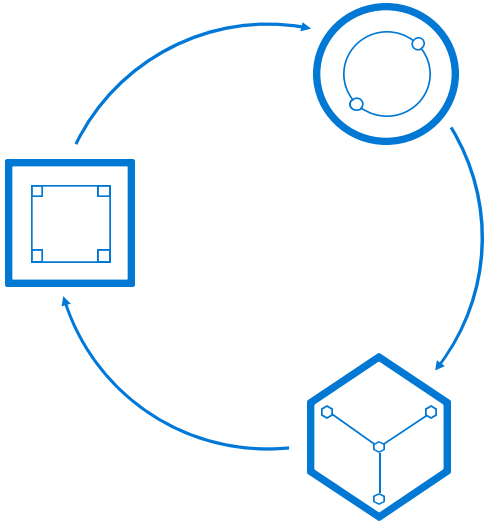
Azure Security Center for IoT

- ✓ Visibility into security posture and state of your IoT Solution
- ✓ Single pane of glass to manage IoT and hybrid cloud security infrastructure
- ✓ Actionable, prioritized alerts to respond to any potential compromises of your IoT solution
- ✓ Integrate with Azure Sentinel or other SIEMs to streamline threat mitigation
- ✓ Define custom alerts based on advanced queries



Azure Sphere

An end-to-end solution for securing IoT devices. Integrated hardware, software, and cloud services work seamlessly together and deliver active security by default.



Azure Sphere certified chips, from our silicon partners, with built-in Microsoft **hardware root of trust**

The **Azure Sphere OS** multi-layer, defense-in-depth operating system with **robust application isolation**

The **Azure Sphere Security Service** guards every Azure Sphere device. It **brokers trust**, **detects emerging threats,** and **renews device security**

Ongoing servicing with over 10 years of security and OS updates delivered directly to each device by Microsoft

Customers

Giving Starbucks the confidence to connect their mission-critical equipment to streamline operations and to deliver quality customer experiences.

Ensuring Gojo's data integrity while monitoring hygiene compliance in hospitals.

Helping Leoni secure their intelligent cable systems that manage energy and data

Azure Sphere

Silicon partners

MEDIATEK
Secured, WiFi-enabled MCU, available in volume today

NXP
Secured crossover application processor; samples available Q4 2020

NEW
QUALCOMM®
First cellular-enabled Azure Sphere chip, samples available Q4 2020

Ecosystem partners

AVNET Reach Further™
Wi-Fi Module
MT3620 Starter Kit
Guardian Module

USI®
Dual Band Wi-Fi + Bluetooth Module

AI-Link
Wi-Fi module
Guardian device

seeed studio The IoT Hardware Enabler
MT3630 Dev Board
MT3630 Mini Dev Board

ADVANTECH
Wireless I/O Module

Innovation that delivers durable value

- Growing silicon choice to support customers in the diversity of their use cases
- Enable unlocking value from existing/legacy equipment with guardian modules
- Rich hardware ecosystem with development kits & modules to streamline prototyping and implementation
- Developer tools and integration with Visual Studio to accelerate time to market

Please use EventsXD to fill out a session evaluation.

Thank you!

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+ AI Conference
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