



Microsoft's IoT Vision and Roadmap

Sam George
Director, Azure IoT



IoT Enables a Digital Feedback Loop

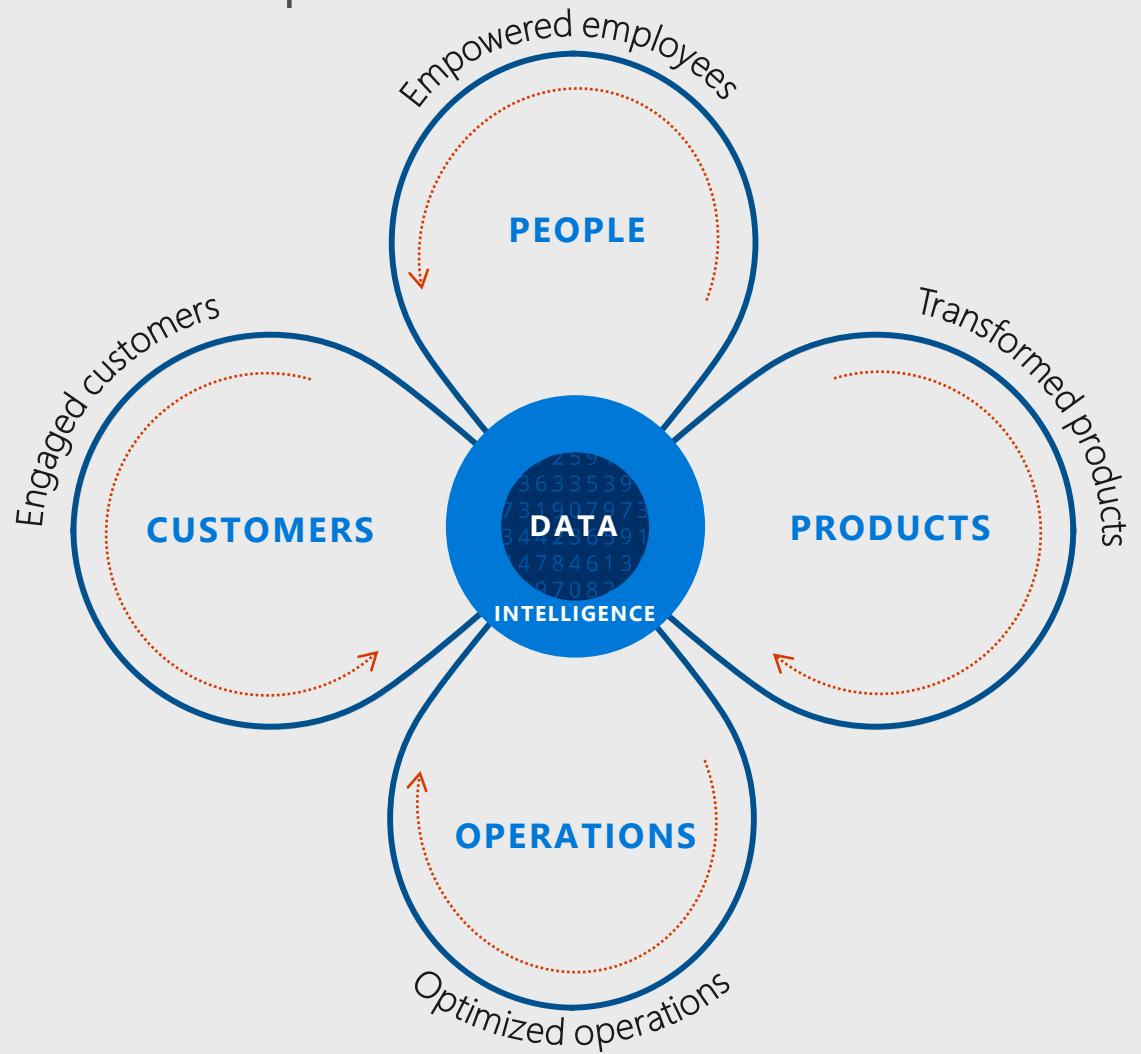
IoT Enables a Digital Feedback Loop

The benefits are profound

IoT enables a “digital feedback loop”
that connects

- Customers
- Operations
- Products/Assets
- Employees

Our vision is to help businesses take
advantage of the digital feedback loop

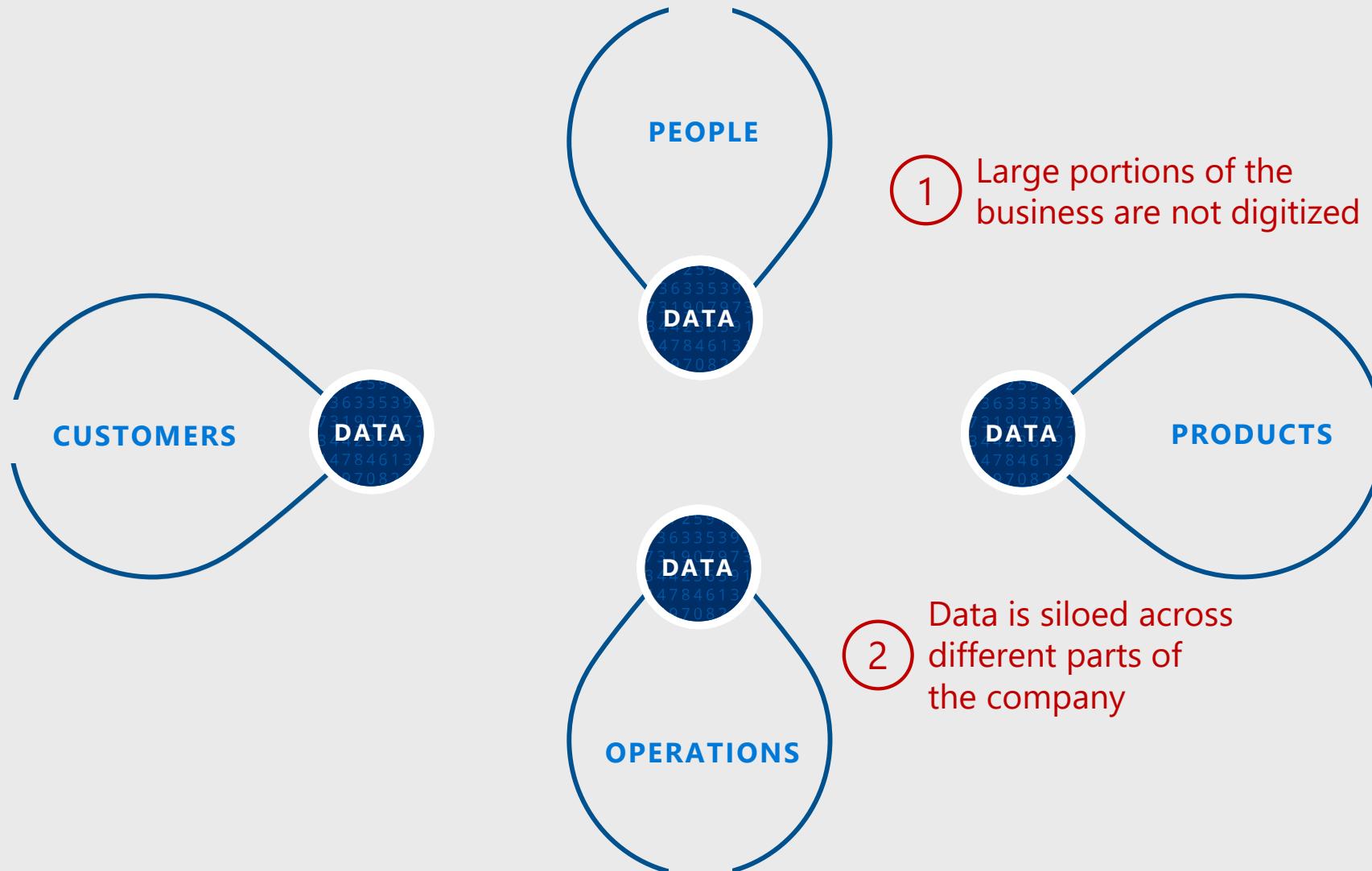


Digital Feedback Loop

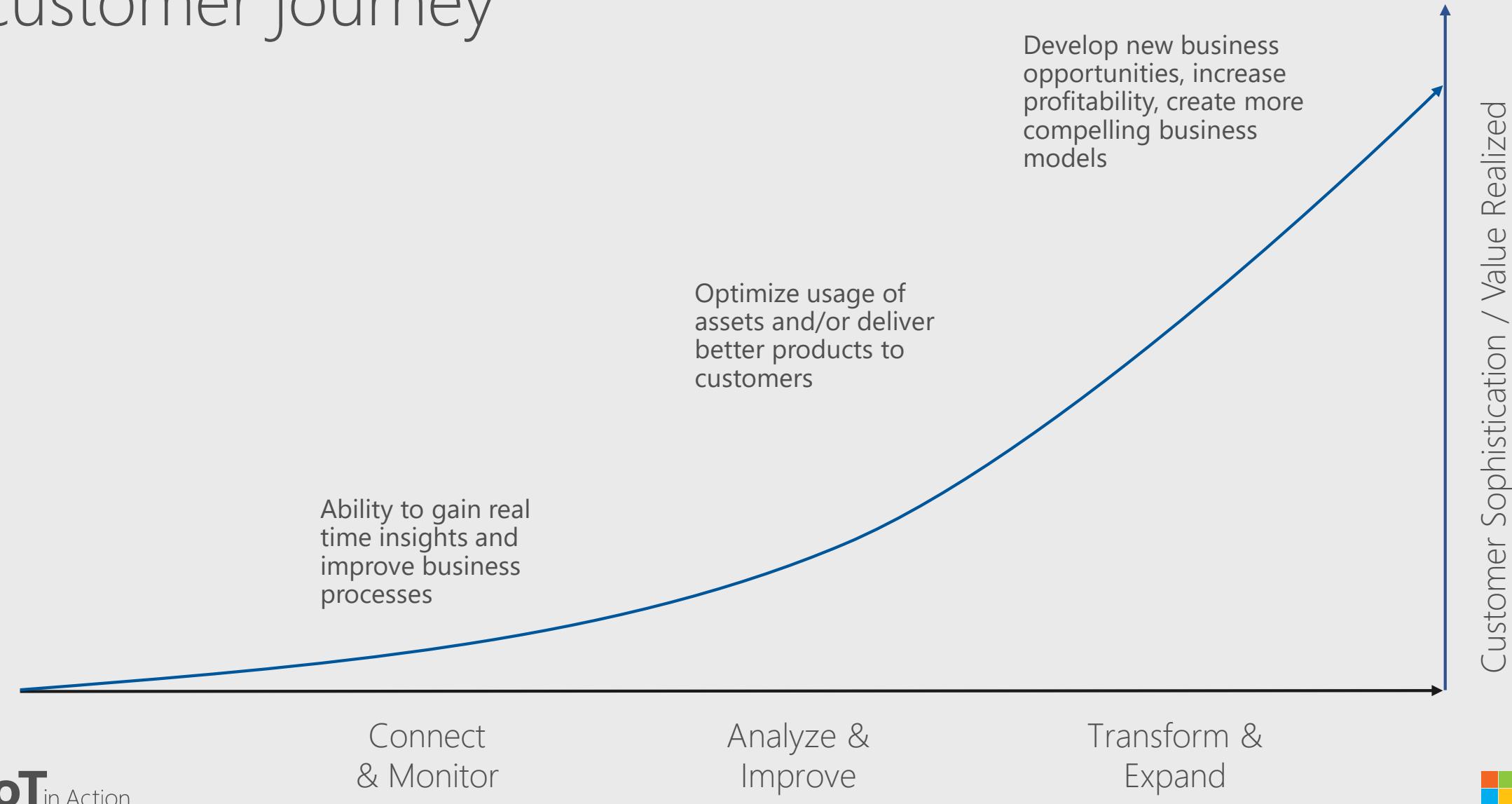
A realtime connection enables new breakthrough levels of insights that in turn drive informed actions



Today companies have major gaps that prevent a digital feedback loop



We've observed three primary stages in the IoT customer journey



Microsoft is a trusted partner that helps customers & partners benefit from IoT

Microsoft is investing 5 billion dollars in IoT over the next 4 years

Azure IoT Market Leadership & Momentum

CBRE



energisme

**Johnson
Controls**

 **essity**

yanzi

KOHLER



CRESTRON



Steelcase

PCL

BUHLER

Microsoft Azure is the *only* hyperscale cloud provider in the leaders category of the 2018 Industrial IoT Software Platforms Wave



'Microsoft has ambitions to play a bigger role in the industrial IoT space in its own right. It offers a comprehensive set of development tools as well as a rich set of advanced analytics capabilities.' Forrester Wave, Industrial IIoT, Q3 2018

Microsoft is simplifying IoT

Microsoft is simplifying IoT

- Easier to build secure, scalable solutions from device to cloud
- Easier to provision devices at scale
- Easier to secure devices at scale
- Easier to manage devices at scale
- Easier to find insights from your IoT devices
- Easier to run cloud services on devices
- Easier to benefit from IoT



Generally Available

Azure IoT Central

Fully managed SaaS solution

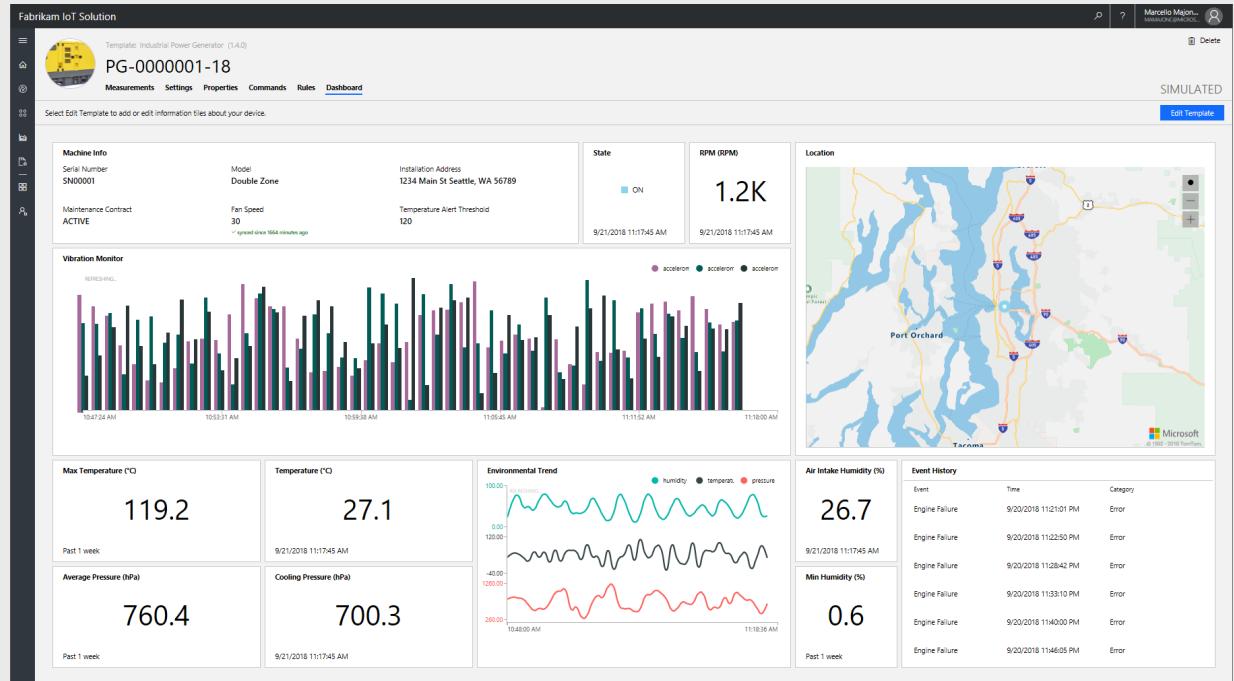
No cloud expertise required

Built in security best practices

New extensibility features

Transparent and predictable per device pricing

Try today: <http://azureiotcentral.com>



Azure IoT Central empowers you to



Get results fast

Build production-grade applications in hours

Remove the management burden, operational cost, and overhead

Easily understand TCO with transparent and predictable per device pricing

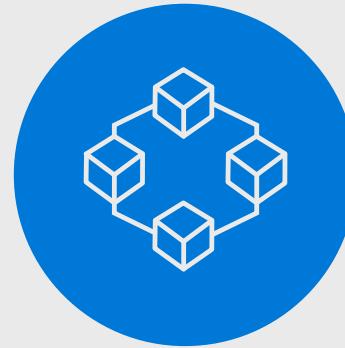


Grow and scale with ease, securely

Enable IoT projects from small to large

Integrate with your existing business systems to execute workflows, such as field service support, alerts etc.

Leverage industry leading security standards and data protection features to help keep you in control of your data



Enterprise grade solution

Built on the hyperscale and enterprise-grade services provided by Azure and IoT

Leverage the latest advances when you need them

Bring your connected product strategy to life by keeping your most critical data secure



Azure IoT Central



Fully hosted and managed by Microsoft



No cloud development expertise required



Device connectivity and management



Monitoring rules and triggered actions



Extensibilities (Flow, Dynamics, Webhooks, etc.)



Analytics, dashboards and visualization



Risk-free trial with simplified pricing

Demo

Microsoft IoT

Intelligent Cloud

Azure IoT Central

Azure IoT Solution Accelerators

Azure IoT Platform Services

Intelligent Edge

Azure IoT Edge

Windows IoT

Azure Sphere

Microsoft IoT

Intelligent Cloud

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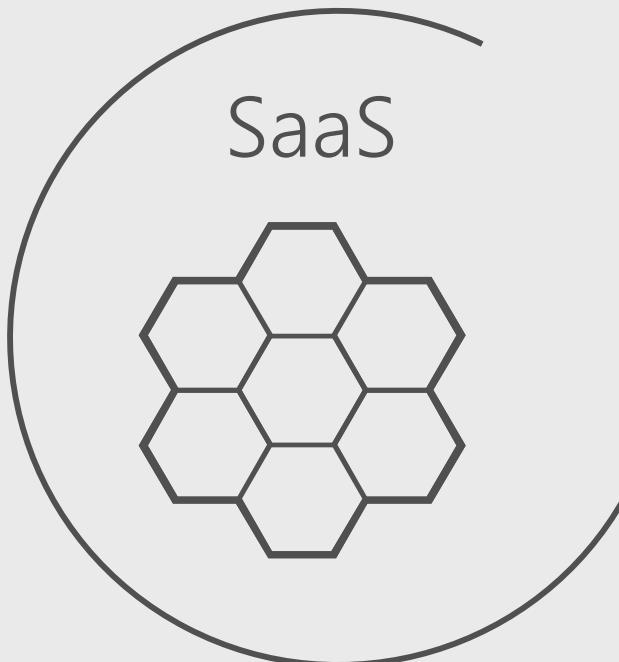
Windows IoT

Azure Sphere

Azure IoT Central

Fully managed IoT SaaS

No cloud solution expertise required



Azure IoT Solution Accelerators

Solution accelerators for customers with cloud solution expertise and the need to fully customize



Built on the same Azure IoT Platform Services

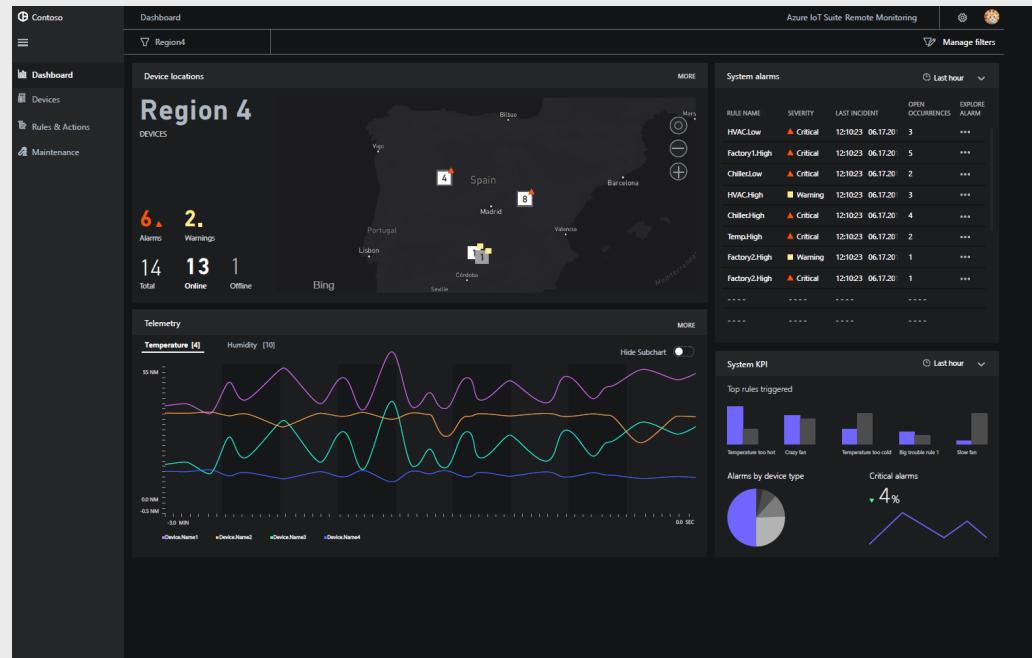
Rich extensibility points in IoT Central
Continuum of support for IoT solution needs

Azure IoT Solution Accelerators & Reference Architecture

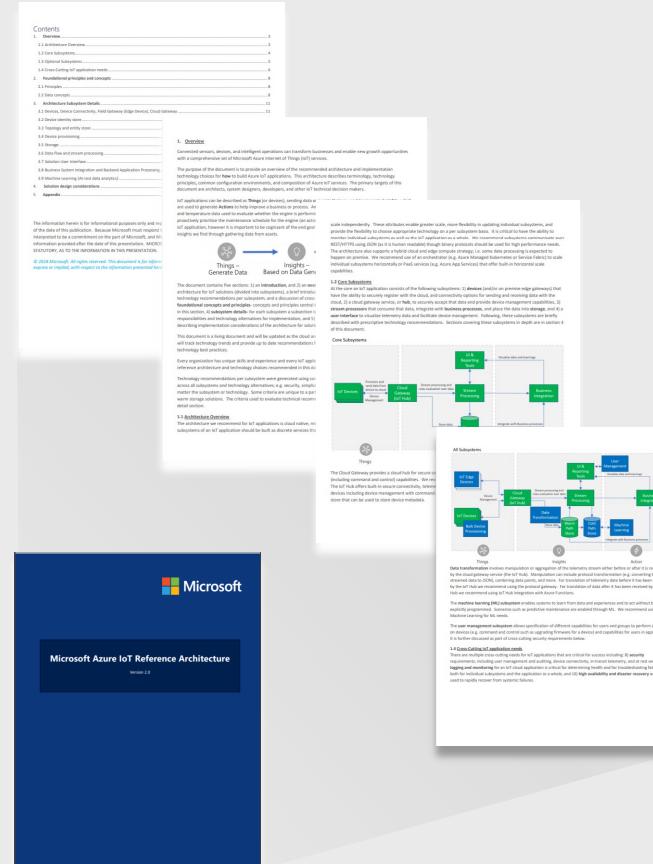
Accelerates custom solutions

Open source & fully customizable

Built on the Azure IoT Reference Architecture



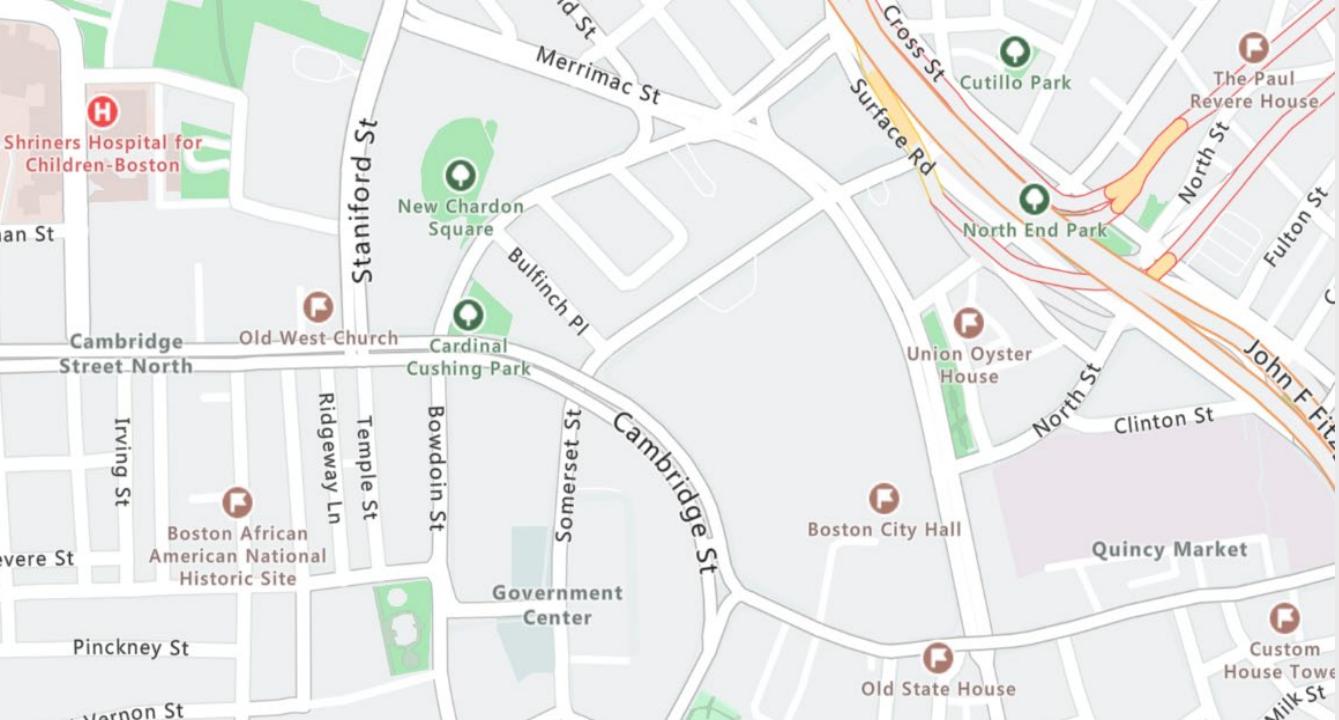
<https://azureioticsolutions.com>



<https://aka.ms/iotrefarchitecture>

Azure Maps

Azure IoT Central & Azure IoT Solution Accelerators



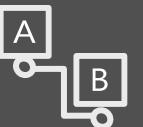
Maps

The ability to fetch a visual rendition of map data



Map Control

A web control mechanism for developers to more easily integrate mapping capabilities into their applications



Routing

The ability to calculate a route from point A to B or n points, and receive step by step directions



Search and Geocoding

The ability to find places, addresses, businesses, POIs etc.



Traffic

The ability to show dynamic traffic and incident information



Time Zones

The ability to query for a time zone

Note: Additional services will be added to the offering in the future

Microsoft IoT

Intelligent Cloud

Azure IoT Central

Azure IoT Solution Accelerators

Azure IoT Platform Services

Intelligent Edge

Azure IoT Edge

Windows IoT

Azure Sphere

Azure IoT Hub



Bi-directional communication

Millions of Devices
Multi-language, open source SDKs
HTTPS/AMQPS/MQTT
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 Policies
Firmware/Software Updates
Azure Security Center Support

Azure IoT Hub Device Provisioning Service



IoT-scale automated provisioning

Zero-touch provisioning
Centralize your provisioning workflow
Load balance across multiple IoT Hubs
Re-provisioning support
Supports TPM + X.509

New Capabilities

Azure IoT Hub

Automatic Device Management

IoT Hub will automatically goal seek management operations as devices match standing queries

Advanced Message Routing

Automatically route inbound device messages based on Device Twin properties

New Azure portal configuration experience with unified navigation between message routes and custom endpoints

Android and Android Things Support

In development and coming soon

Azure IoT Hub Device Provisioning Service

Increased limits

25 CA certificates (up from 10)

500,000 enrollments, with more available if you contact support (up from 10,000)

High availability

Automatic failover to Azure geo-paired region in case of regional-wide disaster

Symmetric key attestation (Preview)

Support for symmetric keys in both individual and group enrollments

Automatic re-provisioning (Preview)

For device factory reset and migration scenarios

Enrollment-level device allocation policies (Preview)

Assign distinct allocation policies to each enrollment; link multiple IoT Hubs to each policy

Custom provisioning logic (Preview)

Trigger an Azure function to determine IoT Hub destination and initial configuration

Microsoft IoT

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Azure IoT Solution Accelerators

Azure IoT Platform Services

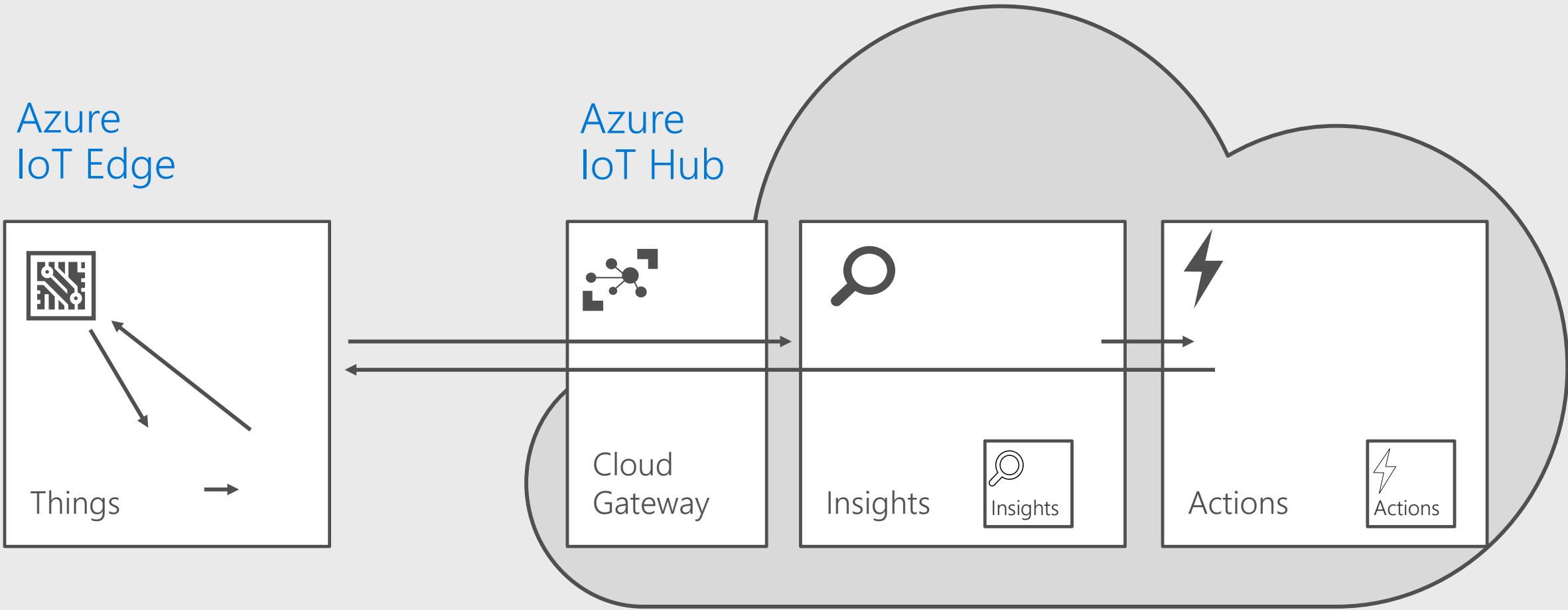
Intelligent Edge

Azure IoT Edge

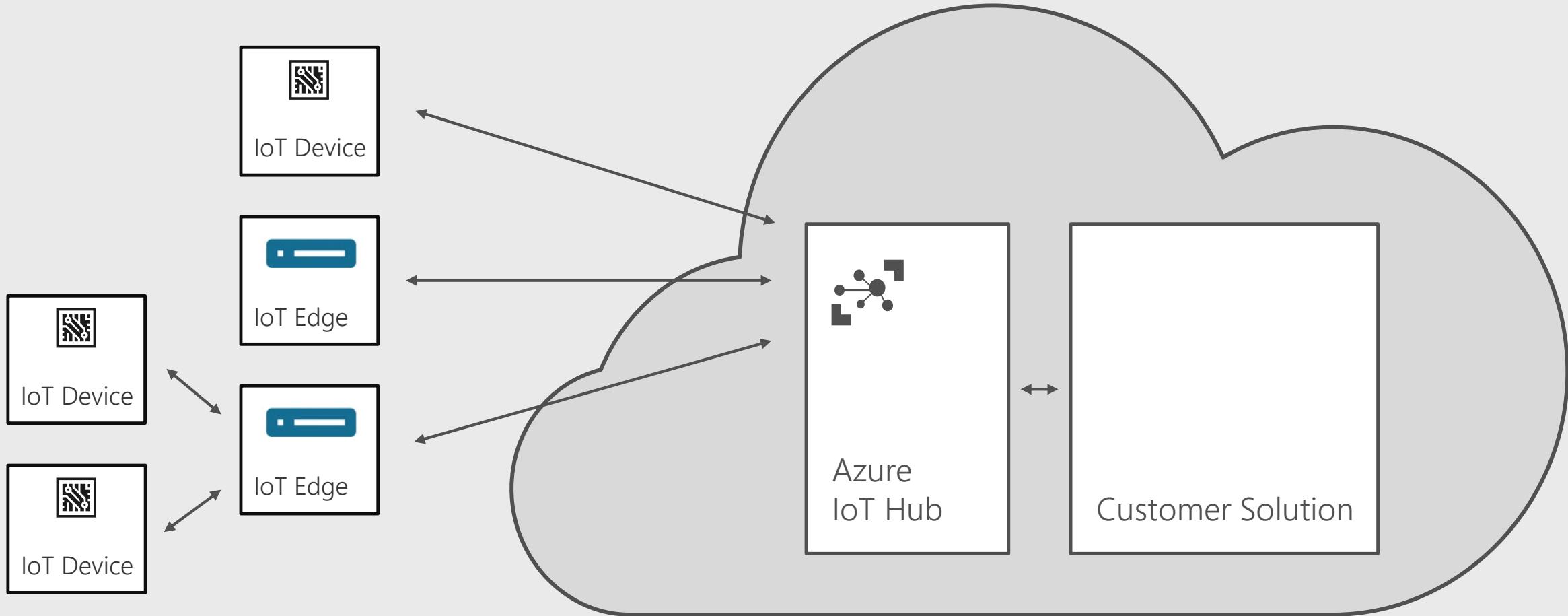
Windows IoT

Azure Sphere

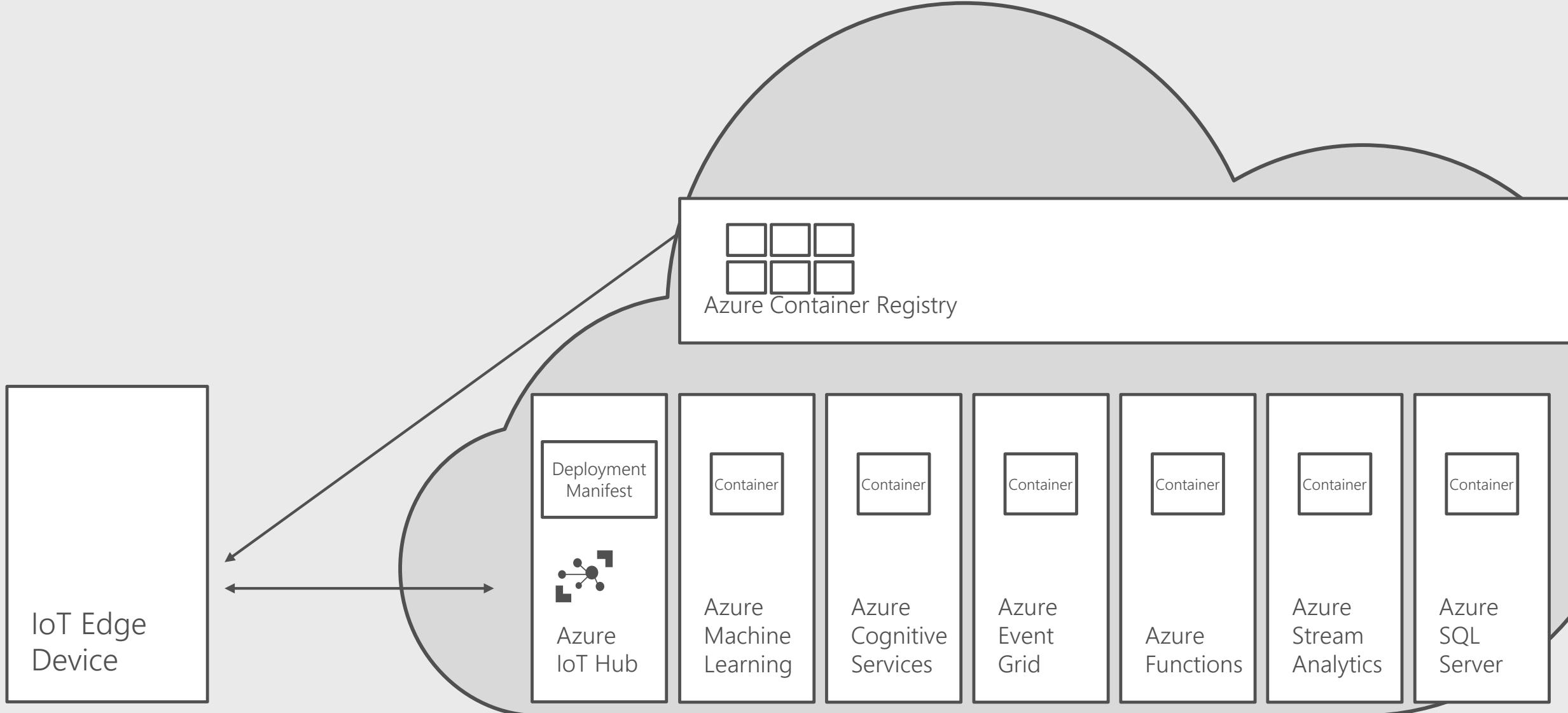
IoT Pattern + Edge



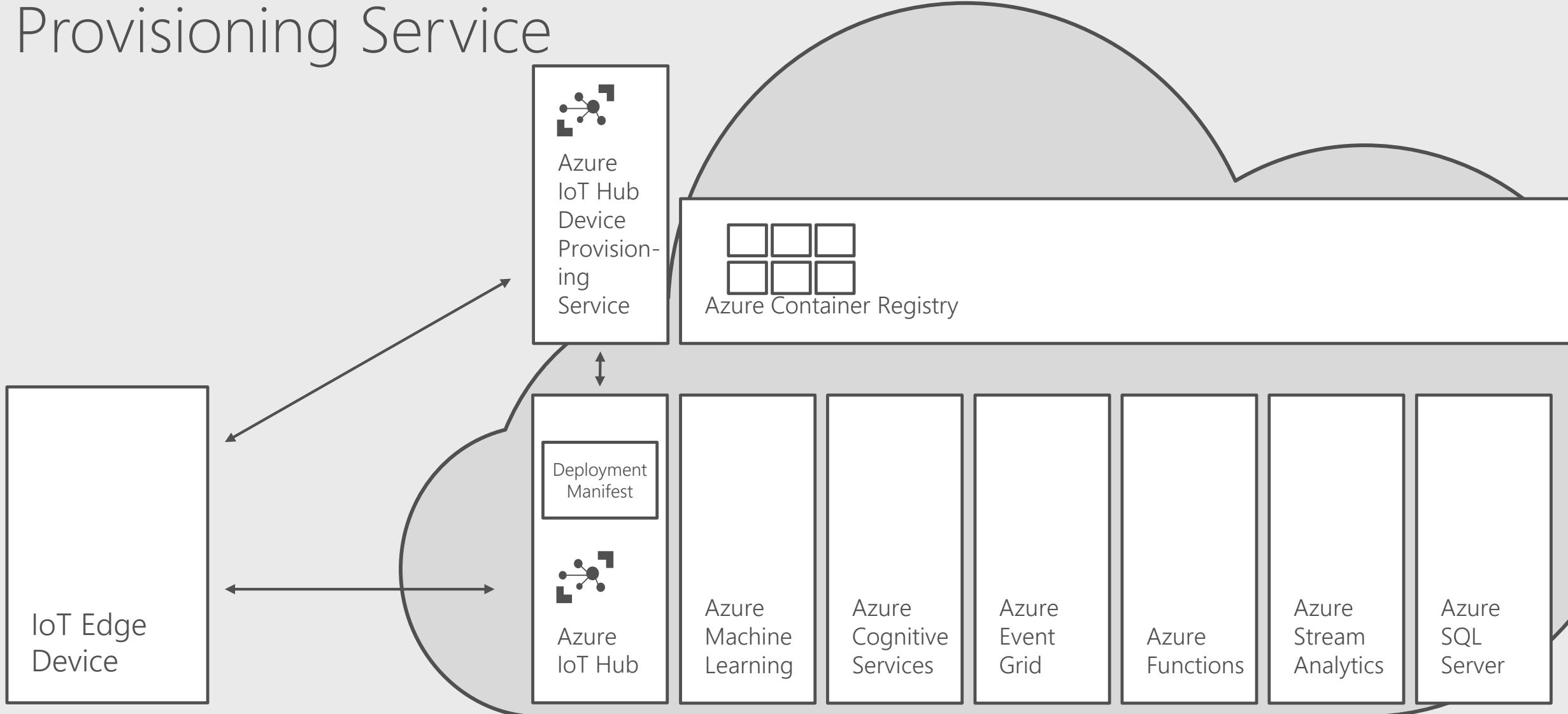
High Level Topology



Azure IoT Edge Deployment



Azure IoT Edge Deployment + Azure IoT Hub Device Provisioning Service



Available Now

Azure IoT Edge Vision AI Developer Kit

Qualcomm

Order now: <https://visionaidevkit.com/>



Azure IoT Edge: New Capabilities

Offline Support!

- Indefinite offline operation after one-time sync with IoT Hub!
- Downstream IoT devices can connect to offline Edge device and queue messages for deferred cloud delivery - no code changes, just works!
- Edge + downstream devices can restart and reauthenticate when offline.
- Local Inter-device communication facilitated by Edge Runtime.

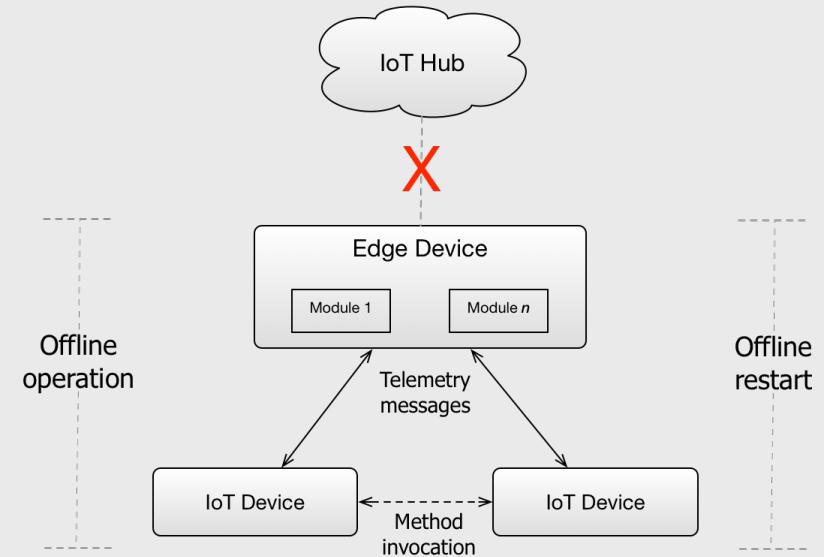
Azure Marketplace support for 3rd party Edge functionality (modules)

Azure Blob Storage module

Visual Studio + Visual Studio Code Tooling

Azure DevOps & Jenkins CI/CD support

High Availability / Multi-Device Support in Development



Microsoft IoT

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Intelligent Edge

Azure IoT Edge

Windows IoT

Azure Sphere

Introducing Windows 10 IoT Core Services

Commercialize your project with enterprise-grade security and support



Updates

Take control of Windows updates with cloud-based **IoT Core Device Update Center (DUC)**

Manage updates for OS, apps, settings, and OEM-specific files from the cloud

Distributed over same global CDN used by Windows Update



Security

Help ensure the safety of your network and devices with cloud-based **Device Health Attestation (DHA)**

Backed by the **same security research team and validation process** used by 500M Windows 10 devices

Leverage hardware and cloud services to provide tamper proofing and remote attestation of device health



Support

Count on stable systems with **10 years of LTSC (Long Term Servicing Channel) support** with security updates only (no new features)

Access to monthly published Windows IoT Core packages
Official Microsoft Lifecycle Support statement - links to software license agreement

Access to monthly published Windows IoT Core packages for **building fully patched images** with OEM tools

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Azure Sphere

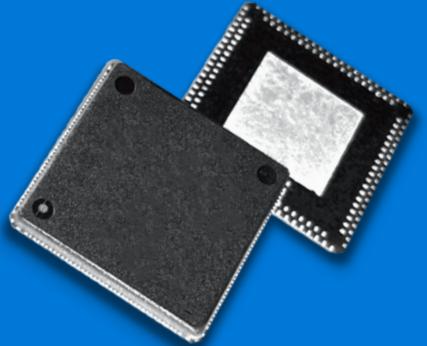


Azure Sphere

Galen Hunt | Distinguished Engineer and
Managing Director, Azure Sphere



Microcontrollers (MCUs) low-cost, single chip computers



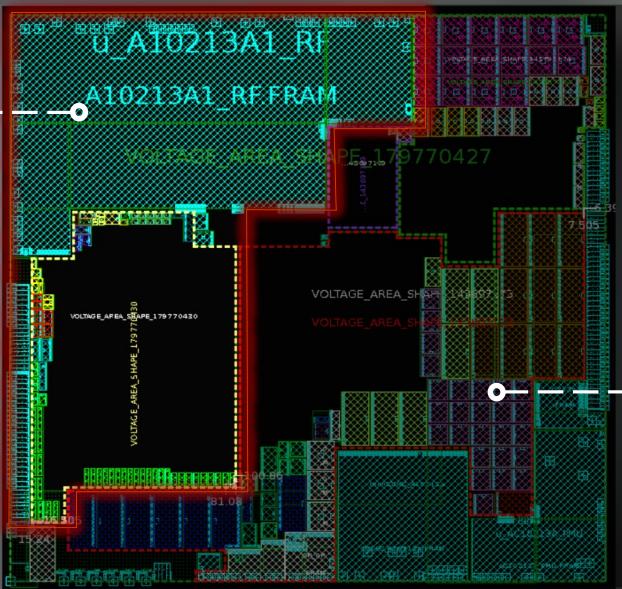
9 BILLION new MCU devices built and deployed every year



Fewer than 1% of MCUs are connected today.

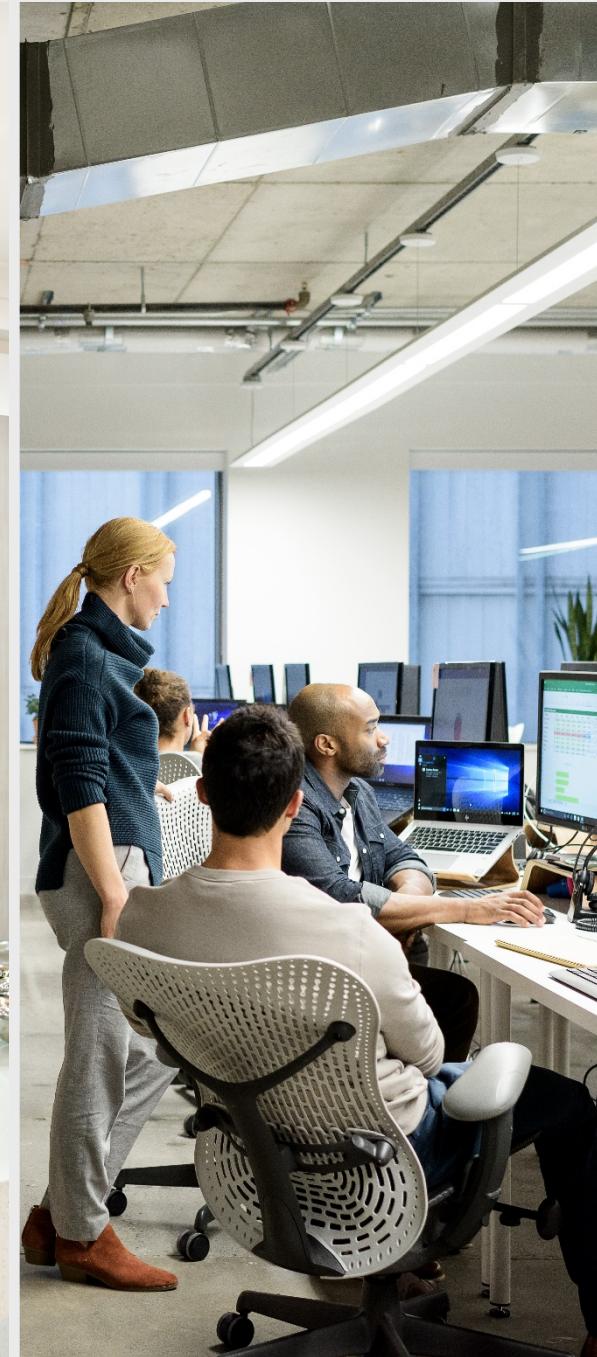
Radio

2.4GHz WiFi



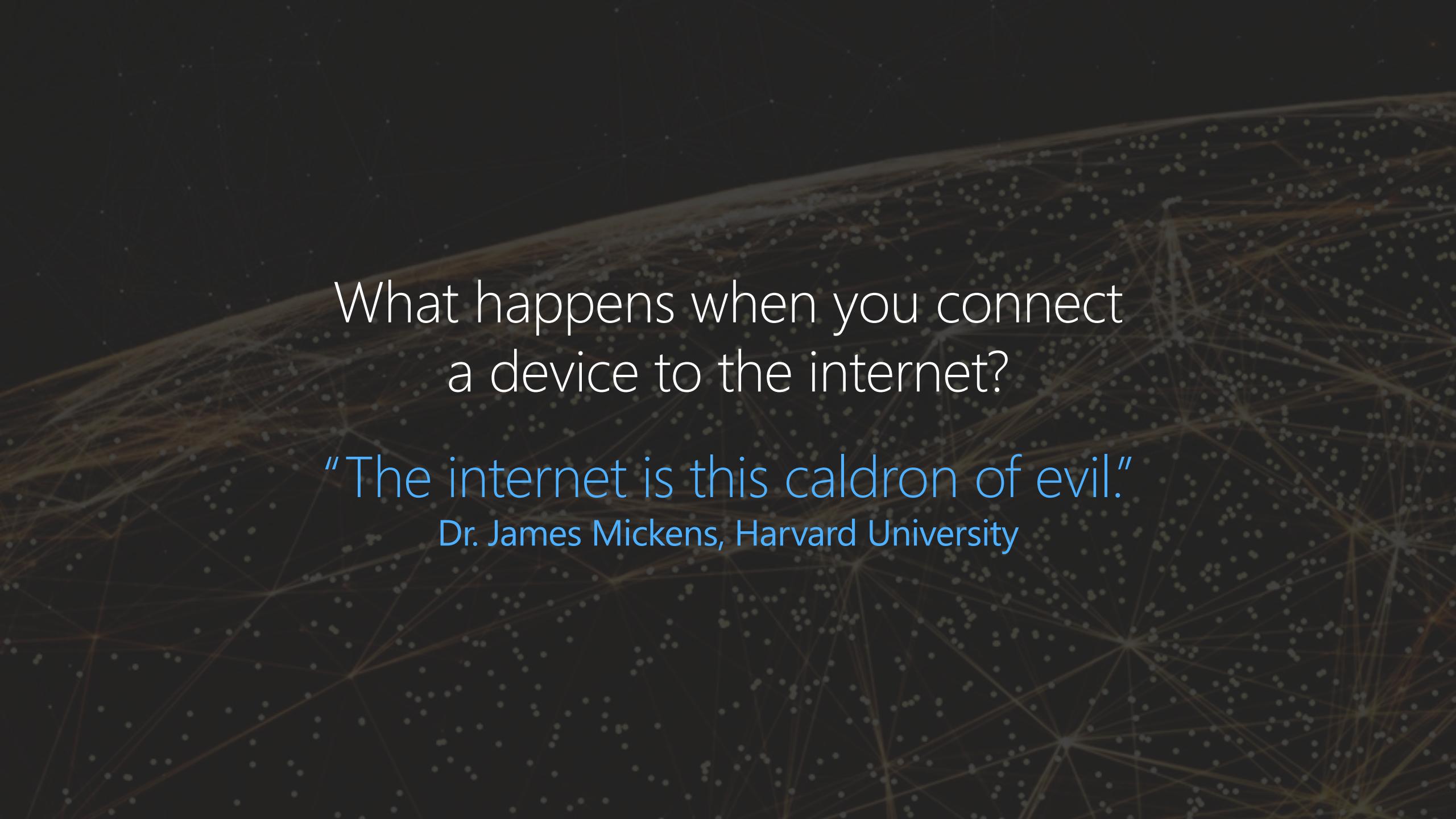
MCU

192Mhz Cortex-M4
256KB SRAM
1MB NOR FLASH
GPIO, I2C, I2S, etc.
RTOS (no kernel)





Opportunity | Risk



What happens when you connect
a device to the internet?

“The internet is this caldron of evil.”
Dr. James Mickens, Harvard University

"Ransomware attacks will target more IoT devices in 2018"

"When smart gadgets spy on you: Your home life is less private than you think"

"Hackers infect 500,000 consumer routers all over the world with malware"

"Hacking critical infrastructure via a vending machine? The IOT reality"

"Security experts warn of dangers of connected home devices"

"The Lurking Danger of Medical Device Hackers"

"Industrial IoT to equip new era of corporate intruders coming in through devices"

"Huge IoT botnet may be used for Ukraine attack"

"Hacking these IoT baby monitors is child's play, researchers reveal"

"Your smart fridge may kill you: The dark side of IoT"

"Protecting Your Family: The Internet of Things Gives Hackers Creepy New Options"

"Why the KRACK Wi-Fi mess will take decades to clean up"



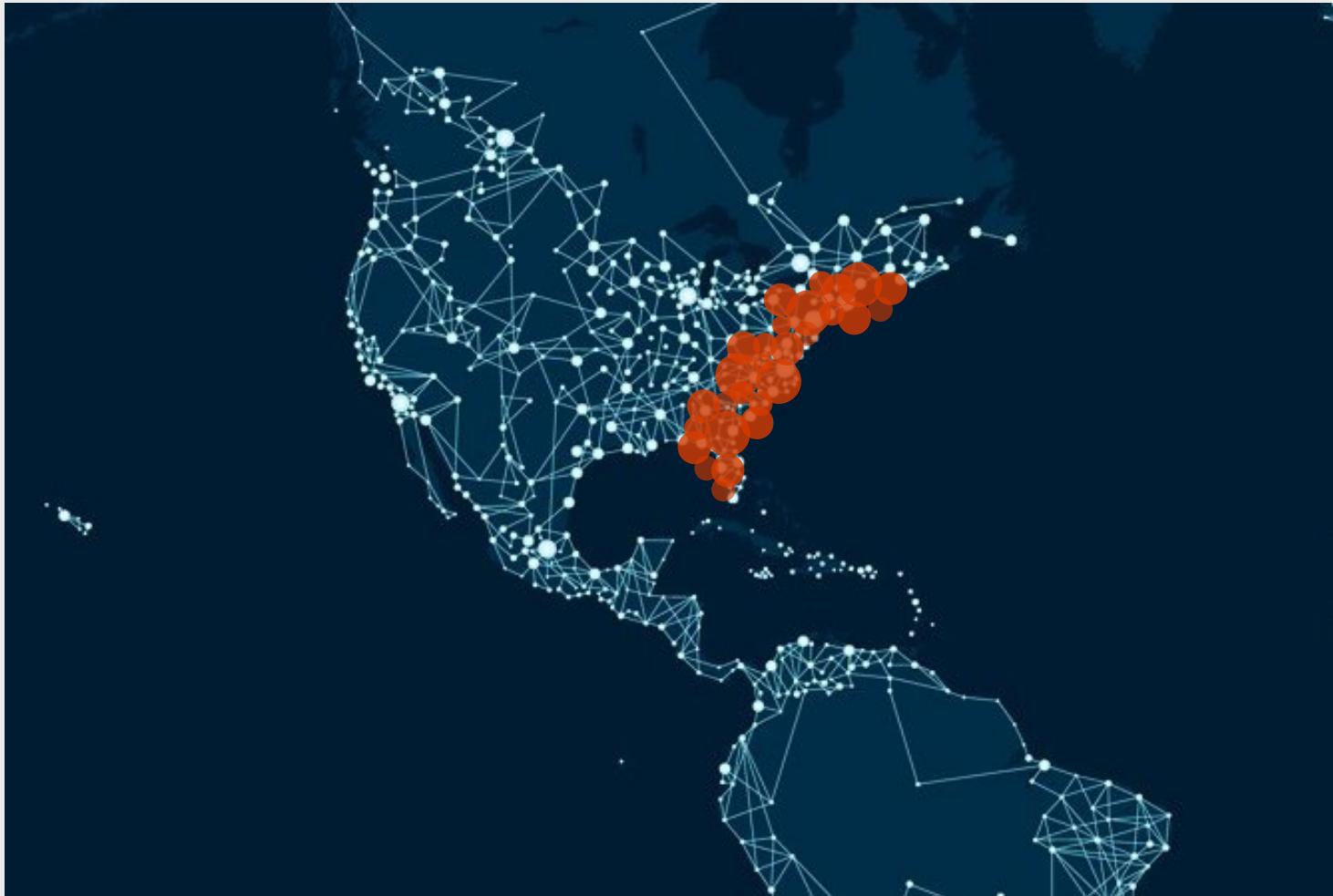
Mirai Botnet attack

Everyday devices are used to launch an attack that takes down the internet for a day

100k devices

Exploited a well known weakness

No early detection, no remote update



Hackers attack casino

Attackers gain access to casino database through fish tank

Entry point was a connected thermometer

Once in, other vulnerabilities were exploited

Gained access to high-roller database



No manufacturer wants to make insecure devices

From: Hackers
To: Consumer
Subject: Your Fridge

We control your fridge.
Send us \$5 in bitcoin or else...



Terrorists Ignite Thousands of House Fires with Hacked Stoves



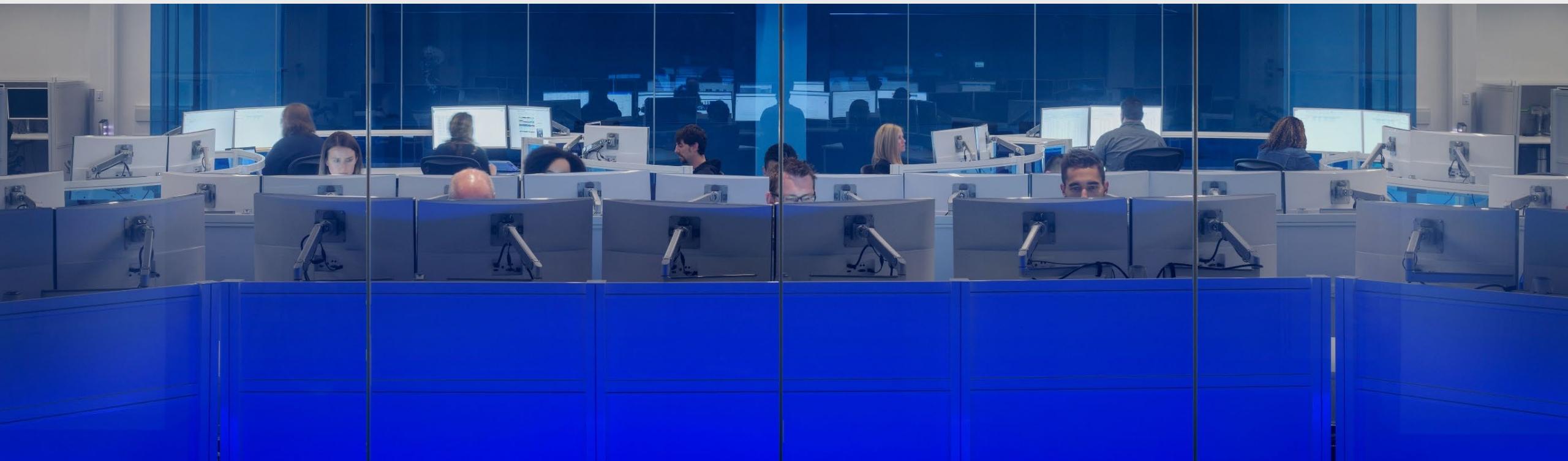


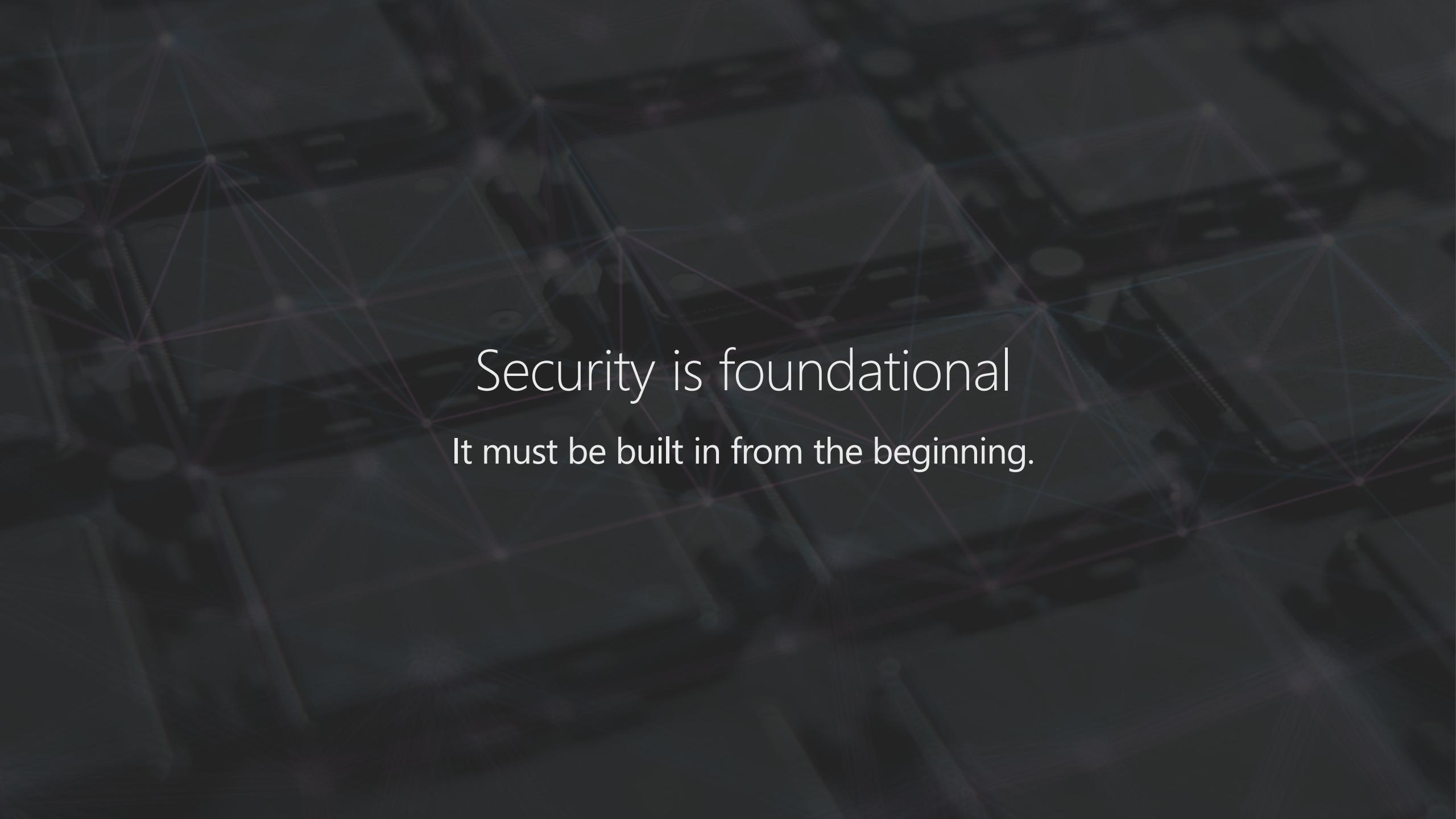
You'll try to keep the hackers out of your device.
But, what will you do if they get in?

The internet security battle.

We've been fighting it for *decades*.

We have experience to share.





Security is foundational
It must be built in from the beginning.

The 7 properties of highly secured devices



Hardware
Root of Trust



Defense
in Depth



Small Trusted
Computing Base



Dynamic
Compartments



Certificate-Based
Authentication



Failure
Reporting



Renewable
Security

Meeting these seven properties is difficult and costly

Design and build
a holistic solution



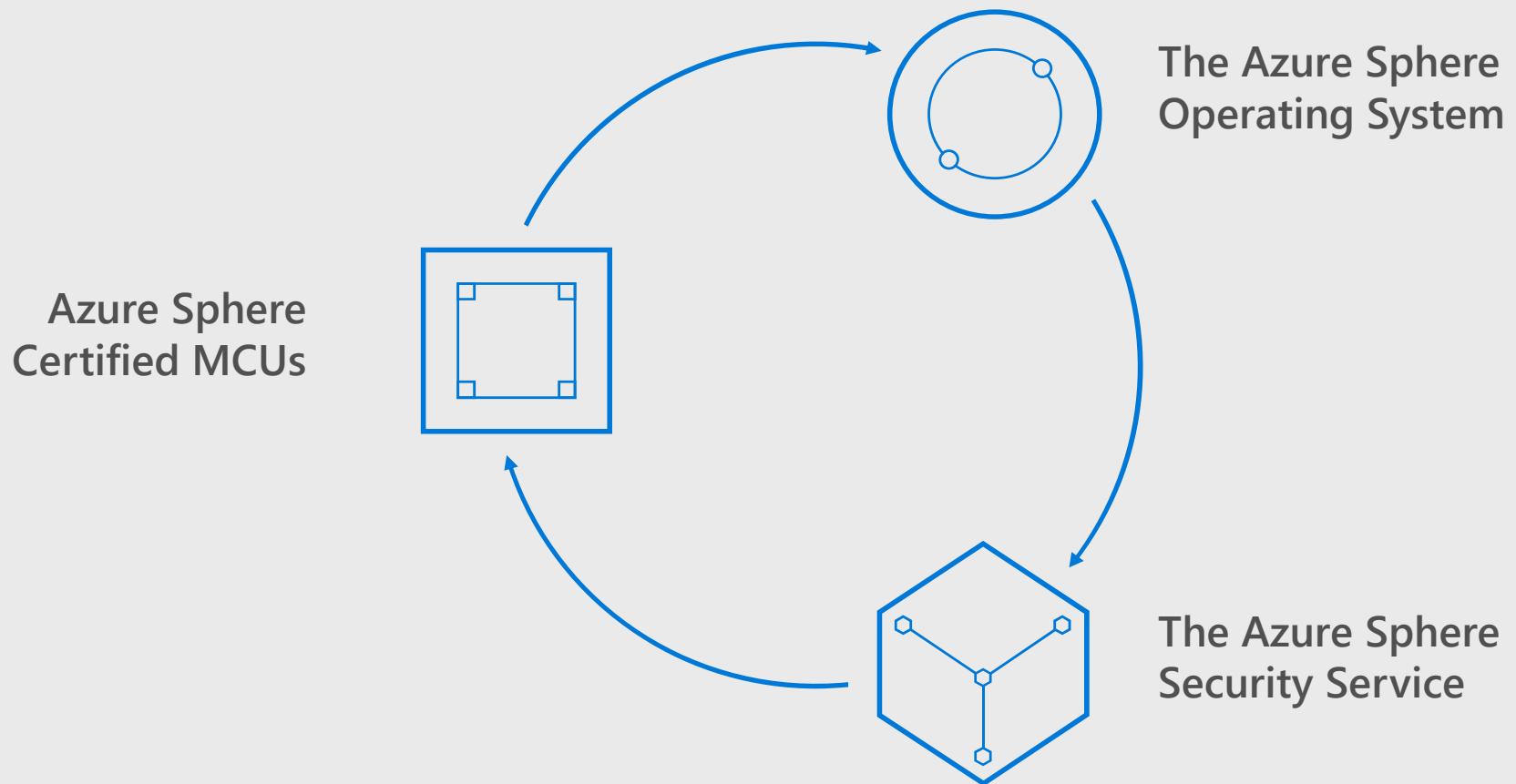
Recognize and mitigate
emerging threats



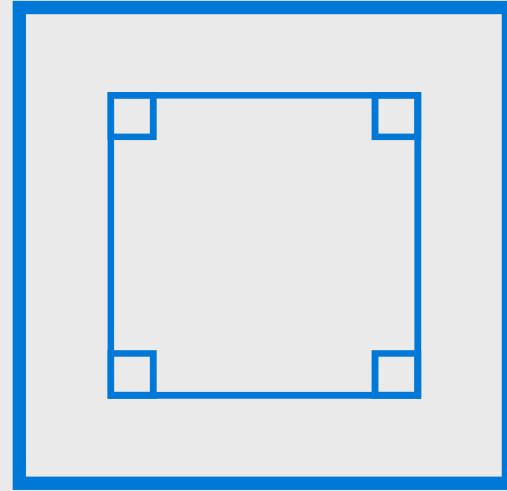
Distribute and apply
updates on a global scale

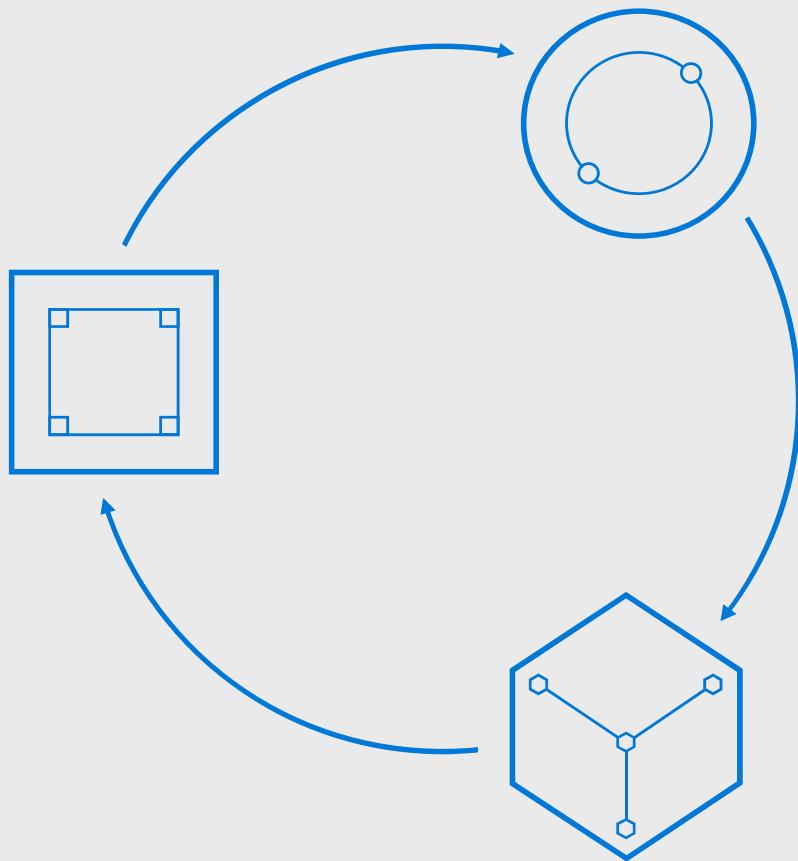


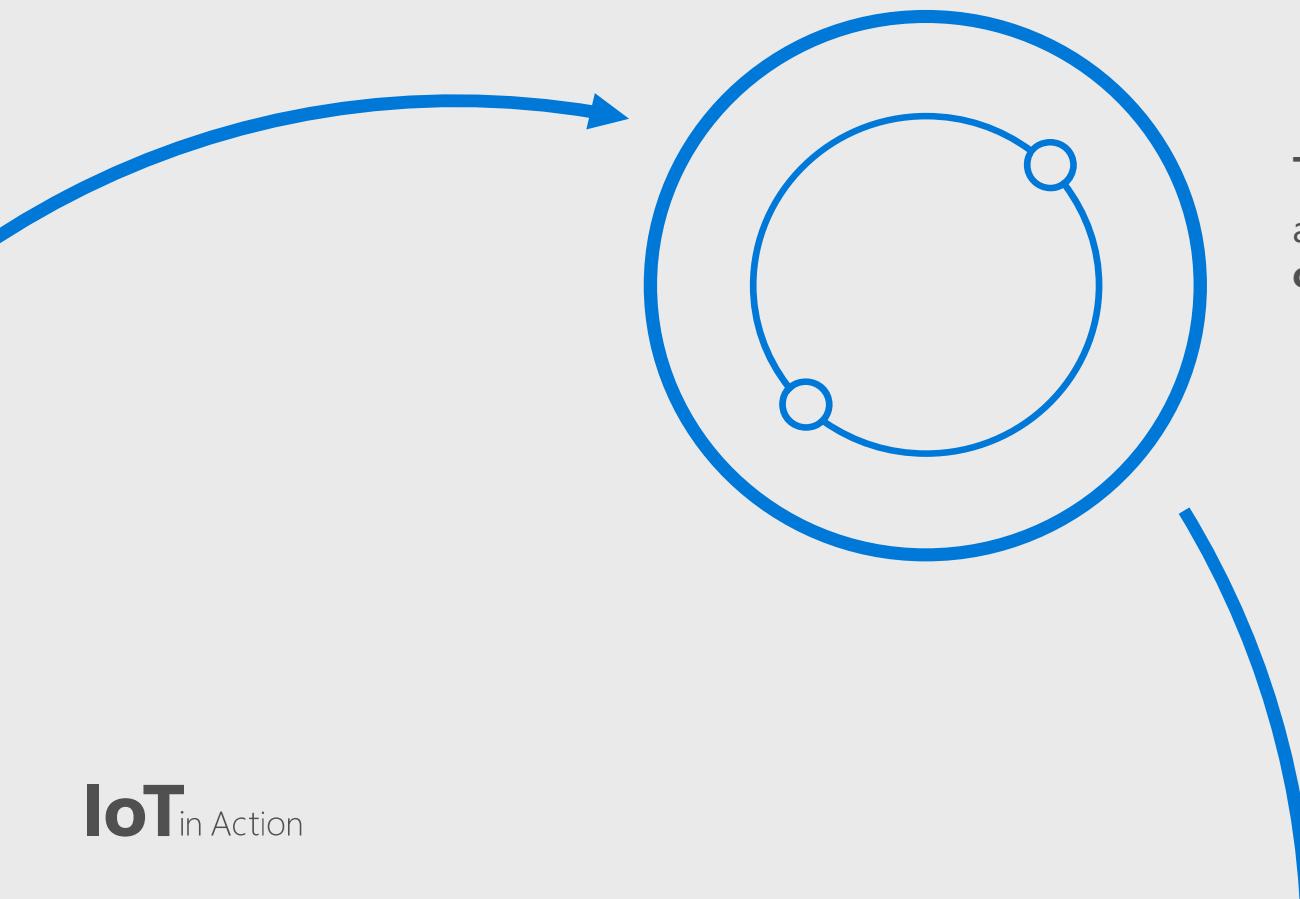
Azure Sphere is an end-to-end solution for securing MCU powered devices



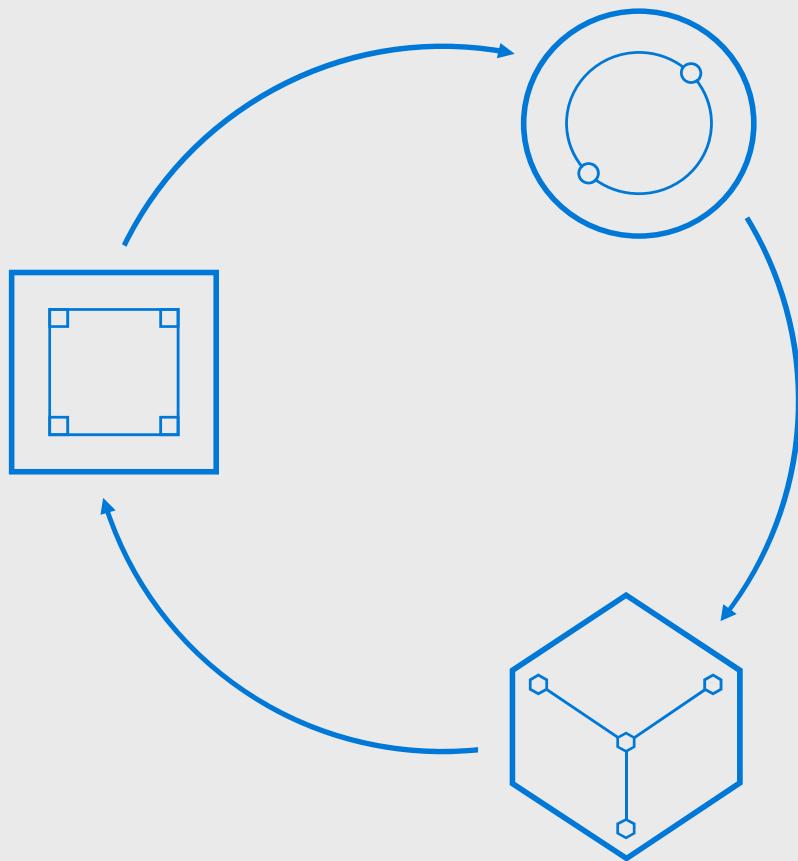
Azure Sphere Certified MCUs
from silicon partners, with built-in Microsoft
security technology provide connectivity and
a dependable **hardware root of trust**.

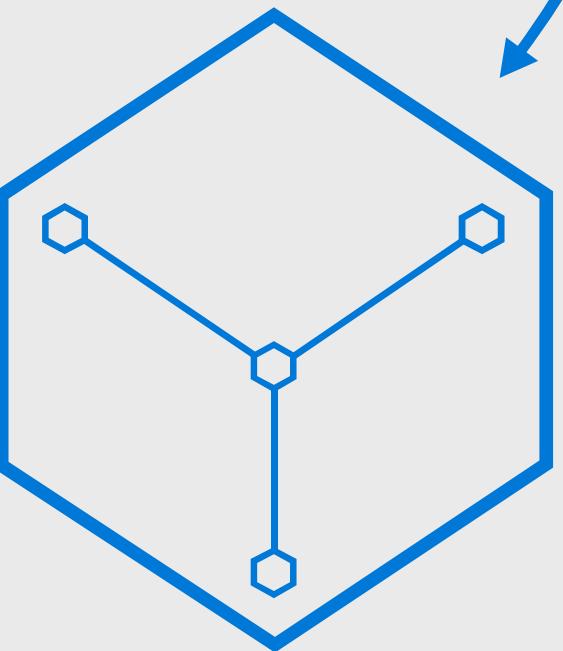






The Azure Sphere Operating System
a four-layer defense in depth OS with ongoing updates
creates a secured platform for IoT experiences.





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**.

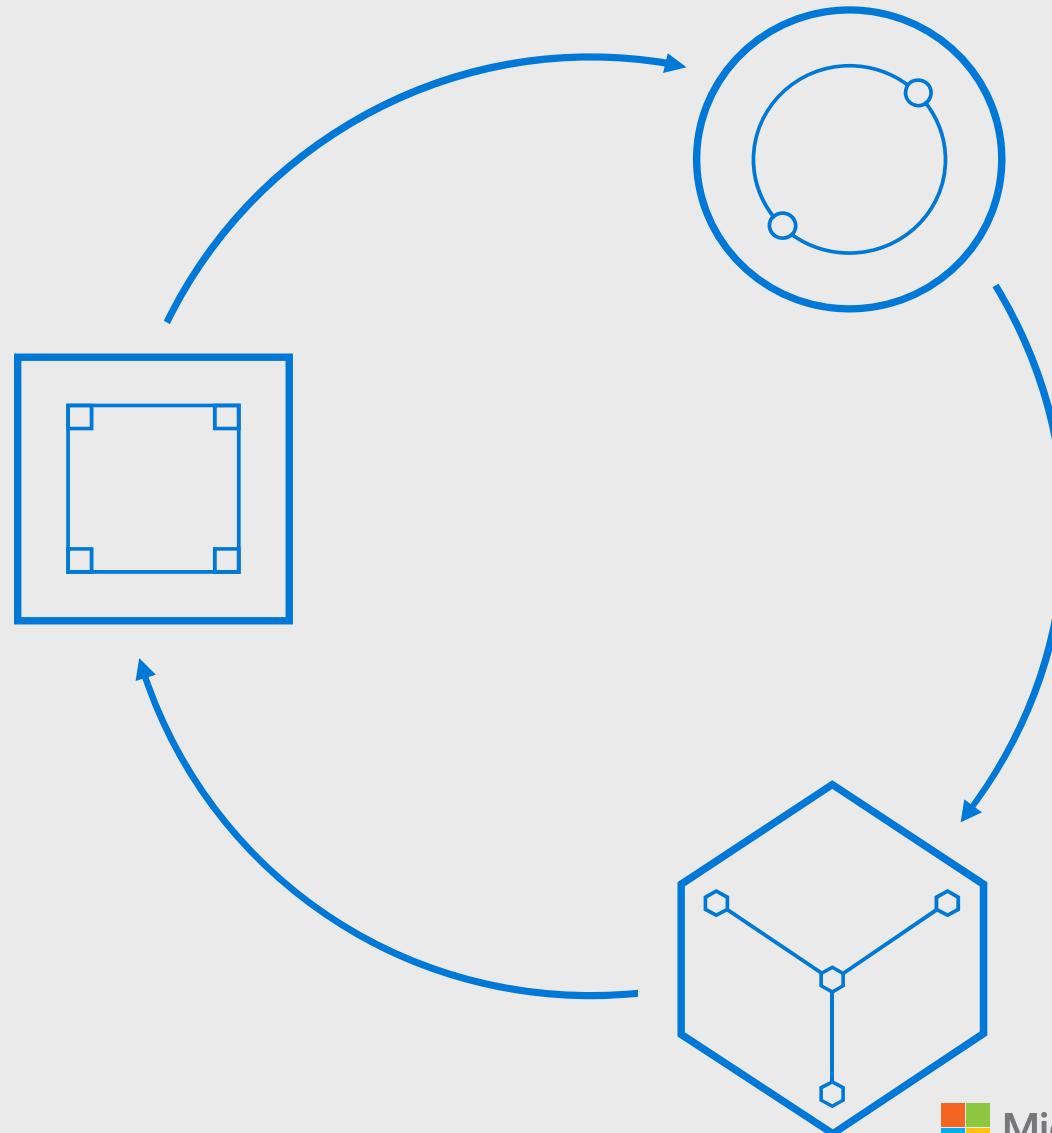
Azure Sphere is Open.

Three components.
One low price.
No subscription fees.

An Azure Sphere certified MCU

The Azure Sphere OS
with ongoing on-device OS updates

The Azure Sphere Security Service
with ongoing on-device security updates



Microsoft has modernized MCU development with Azure Sphere, Visual Studio, and Azure DevOps

Simplify development

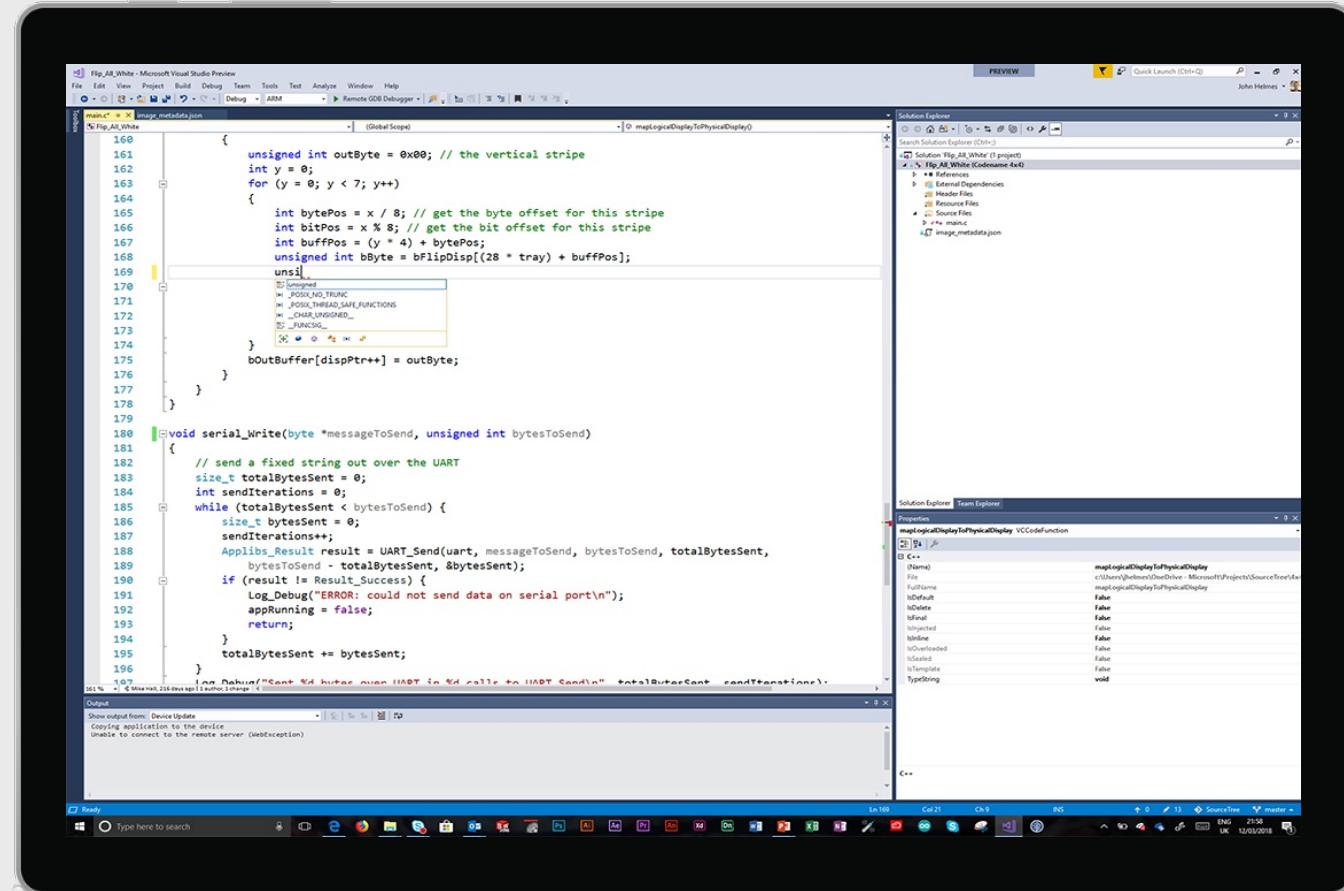
Focus your device development effort on the value you want to create

Streamline debugging

Experience interactive, context-aware debugging across device and cloud

Collaborate across your team

Apply tool-assisted collaboration across your entire development organization



SECURITY

Peace of mind

PRODUCTIVITY

Faster time to market

OPPORTUNITY

The future is now



Alex Cirlan
Head of Home Energy
Management & Software,
E.ON Group

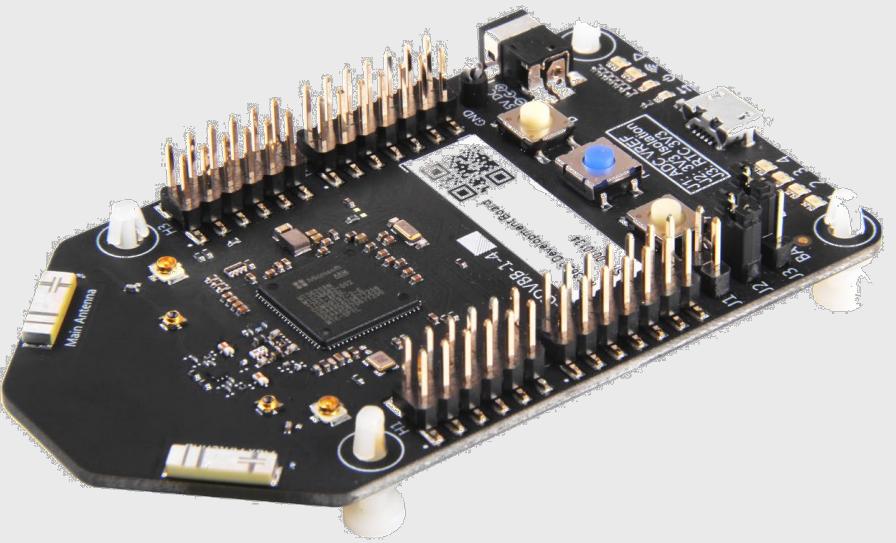
Get Started with Azure Sphere Today!

Now available

- Azure Sphere development kits from Seeed studios

Public preview availability

- Azure Sphere OS
- Azure Sphere Security Service
- Visual Studio tools for Azure Sphere



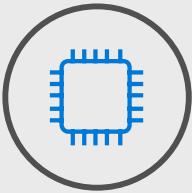
Try today: <http://www.azure-sphere.com>



Opportunity | Risk | Responsibility

New IoT Offerings

Integrating IoT into your IT security is challenging



Diverse devices

Numerous devices with diverse OSes make management difficult



New threats

IoT threats and defenses against them are evolving



Cloud and Device

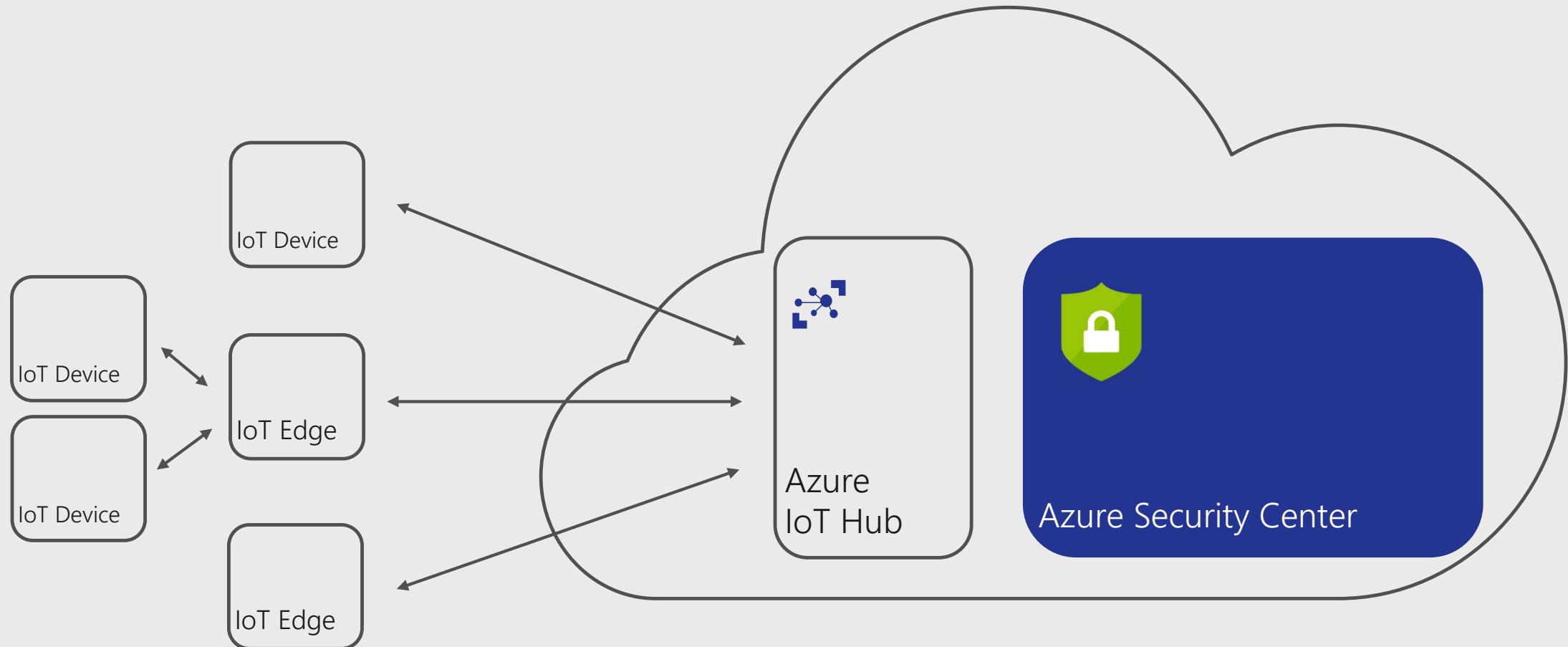
IoT security requires monitoring thousands of devices on one side and cloud services on the other

Announcing

Azure Security Center IoT Support

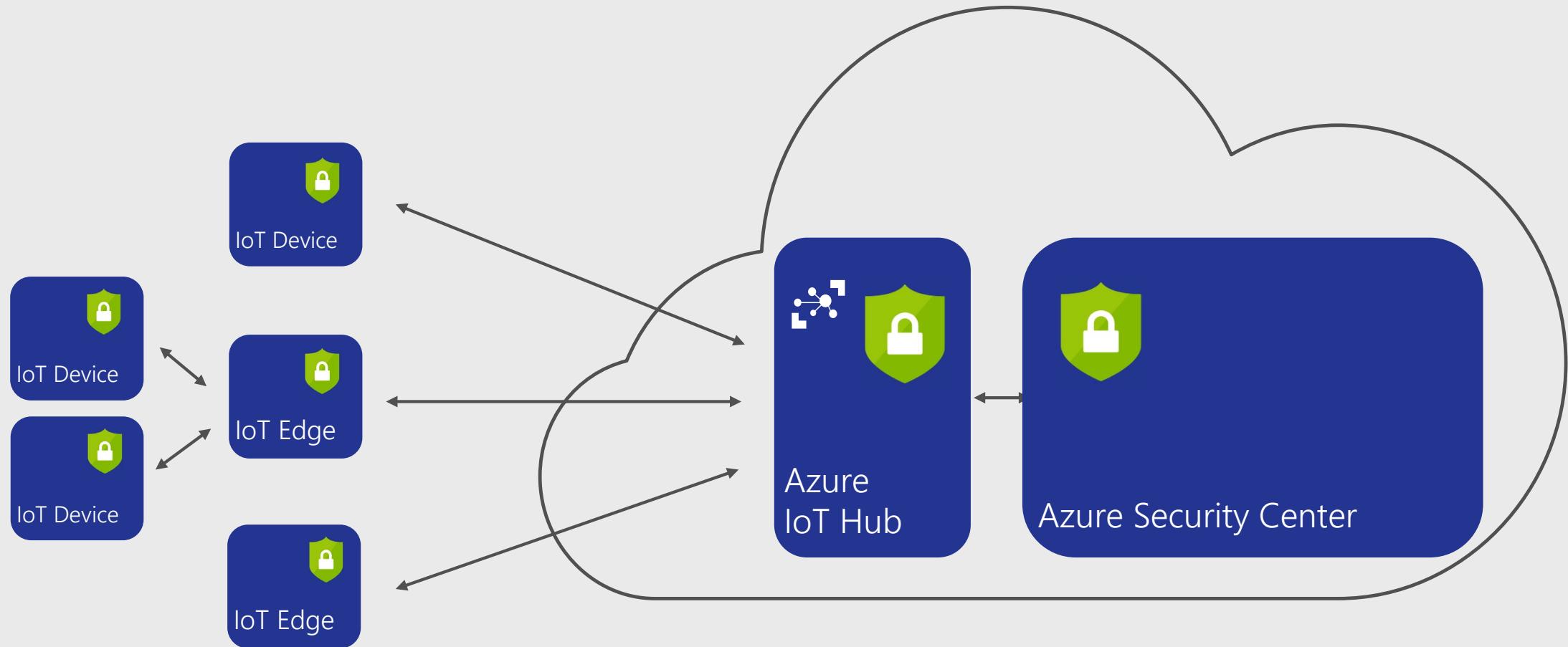
Announcing

Azure Security Center Extending Azure Security to IoT



Announcing

Azure Security Center Extending Azure Security to IoT

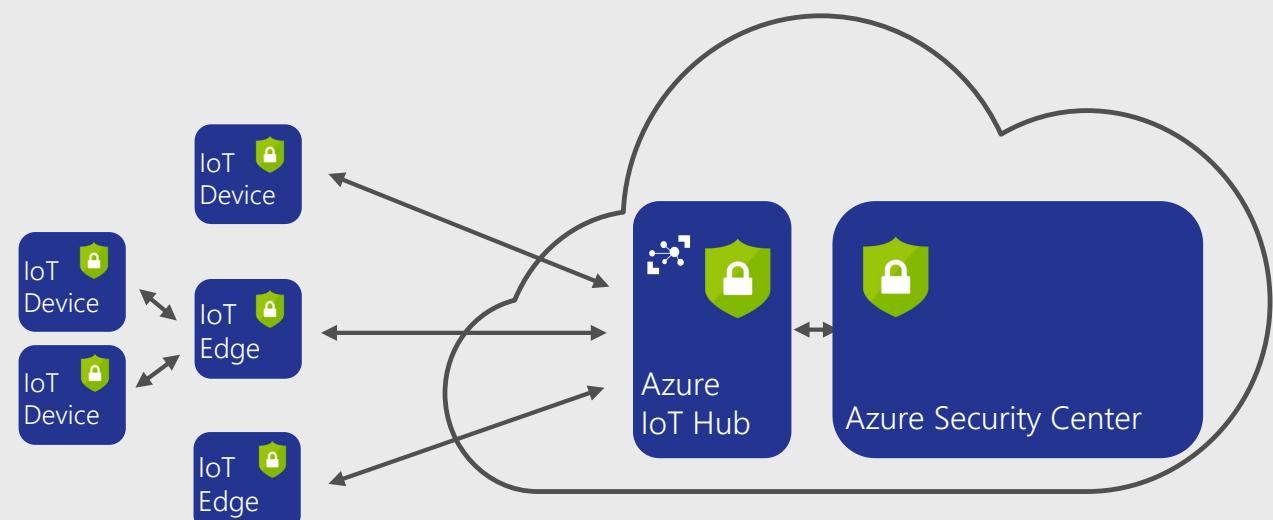


Azure Security Center Extending Azure Security to IoT

Comprehensive visibility into security posture and state of your **Azure IoT Solution – from Devices to Applications**

End-to-end analysis of the security posture. Actionable **Recommendations to reduce attack surface**

Real-time monitoring and analysis of security relevant events. Actionable **Alerts to timely respond to any potential compromises**



The Evolution of IoT

The Evolution of IoT

Early IoT solutions were based on lists of devices connected to Azure and monitoring them or predicting their maintenance needs

We are seeing the beginning of a new trend in IoT solutions

Customers want to model a physical environment first, and then keep the model up to date with IoT data

We're finding this is a more natural approach for building IoT solutions



Digital Twins

A History of Digital Twins

R&D & ENGINEERING

MANUFACTURING OPERATIONS, SERVICES

NEW SERVICES DRIVEN BUSINESS MODELS

Information mirroring* model

- Powerful modeling and analysis
- R&D and engineering focus

Simulation and 3D printing

- Digital design, virtual assembly, and simulation
- 3D printing mainstream

Connected IoT assets

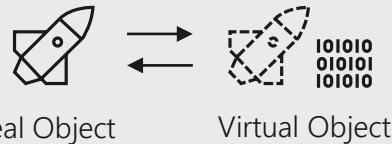
- Unified physical and virtual data
- Rapid feedback across design, manufacturing, and operations

Model any physical environment

- Humans and device collaboration
- Spatial awareness and intelligence
- Mixed Reality experience

1985–2002
(18 years)

Digital Twin evolution



2003–2014
(12 years)



2015–2017
(3 years)

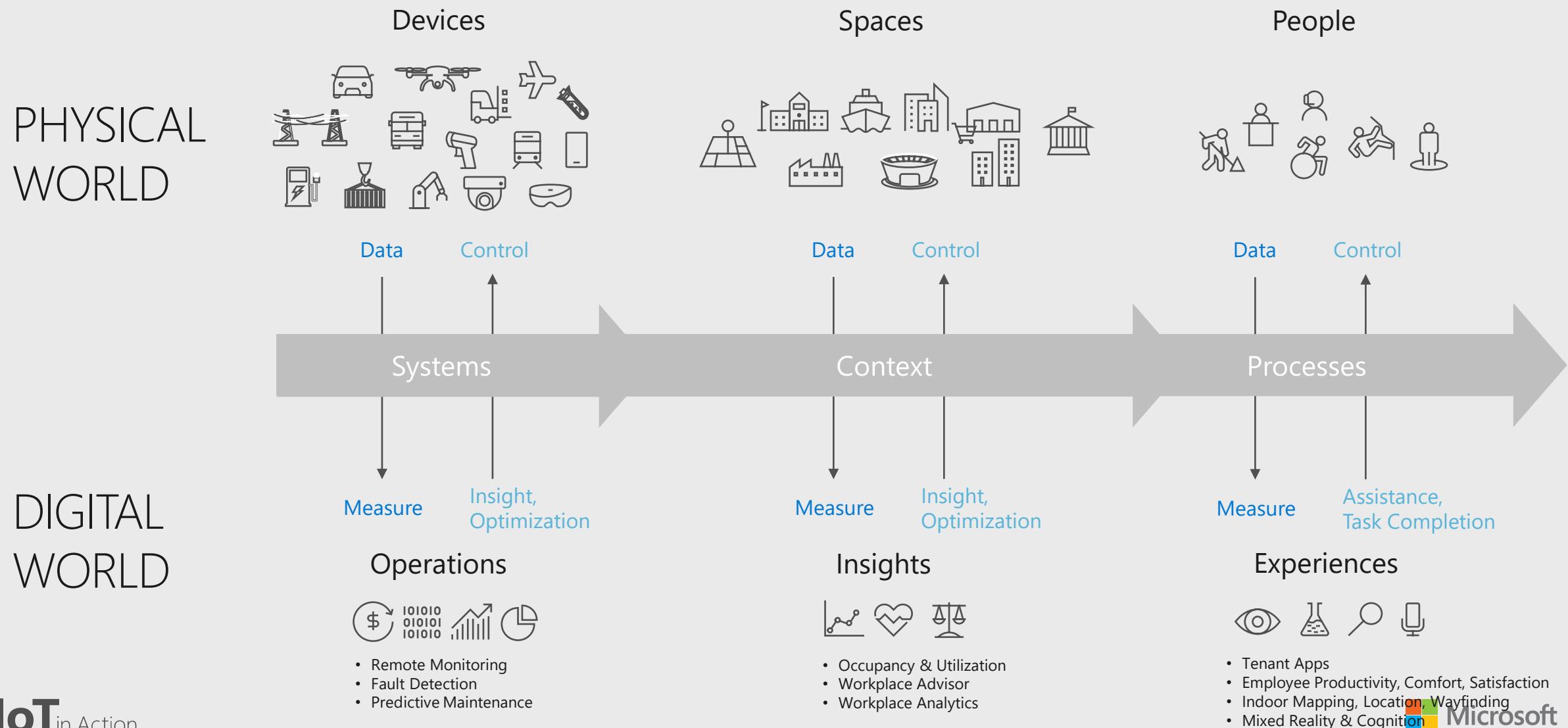


2018 - ...
(the future is now)



*Dr. Michael Grieves and John Vickers – University of Michigan

Digital Twins: Fusing physical and digital



Azure Digital Twins



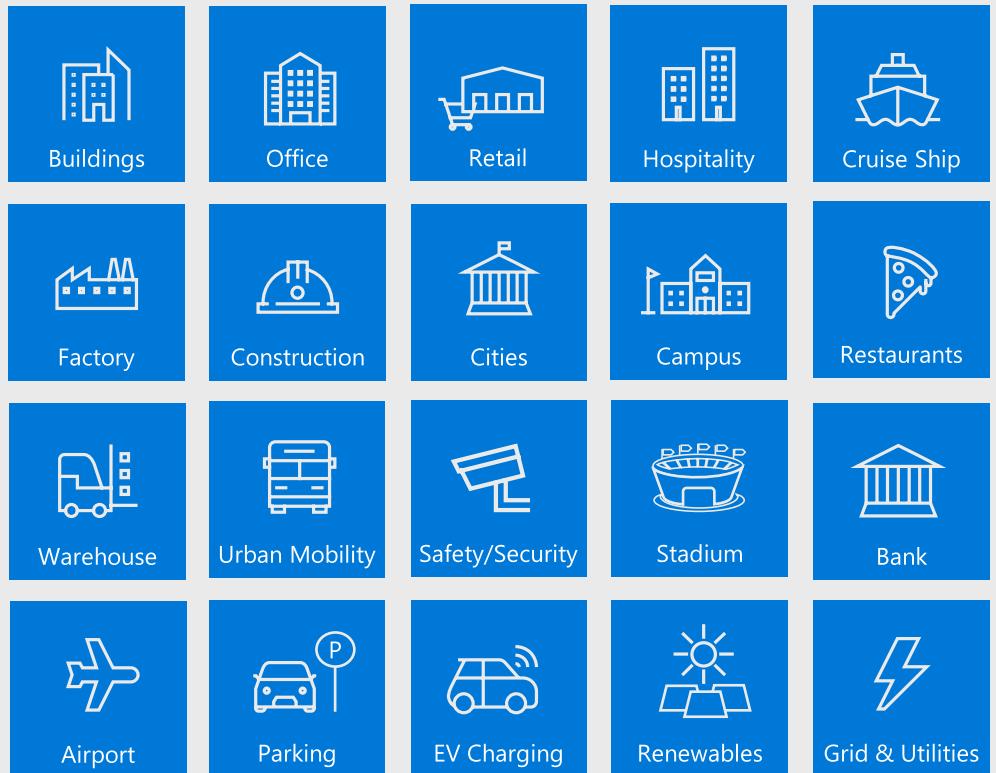
Build next generation IoT solutions with Azure Digital Twins

Virtually represent the physical world with a digital twin that **models the relationships between people, places and devices.**

Leverage predefined and **extensible Twin Object Models** to build contextually-aware solutions uniquely attuned to your industry domain.

Automate actions in a space with custom functions that send events and /or notifications to endpoints based on incoming telemetry.

Securely replicate solutions across multiple tenants through **built-in multi- and nested-tenancy.**



Azure Digital Twins in Action

Thank you!



IoT in Action