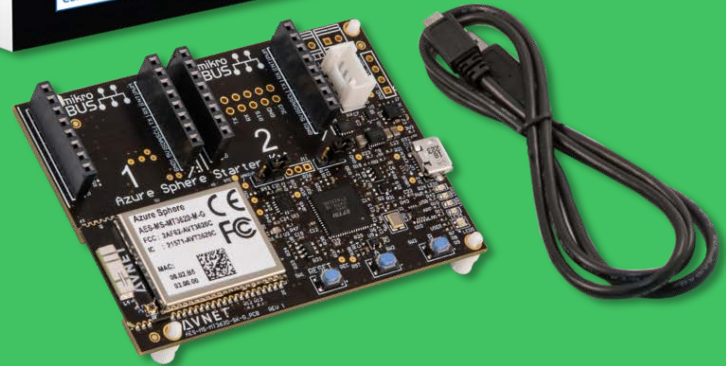
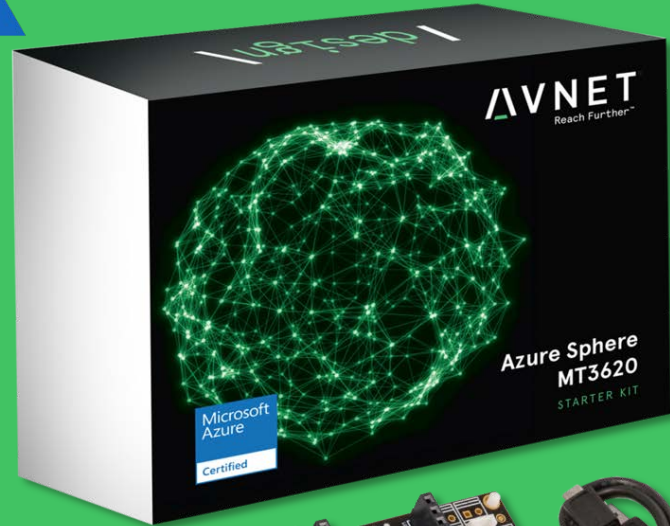


# Microsoft Azure Sphere

## Introduction to Avnet Starter Kit & Modules



# Azure Sphere Avnet Starter Kit

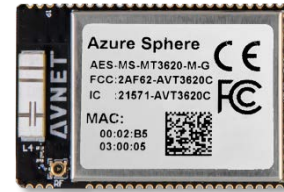
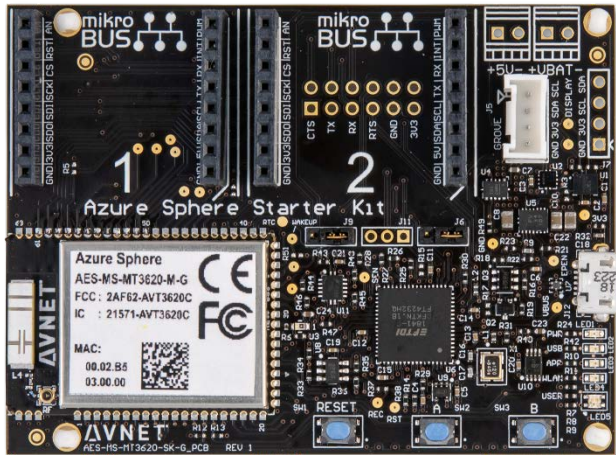


# Azure Sphere Enablement from Avnet



Avnet enablement for Azure Sphere includes:

- 2-day customer “Bootcamp” trainings
- Azure Sphere MT3620 modules (production-ready)
- Azure Sphere Starter Kit
- Expansion via Click boards and I2C Grove sensors
- Exclusive distributor for Mediatek MT3620 devices



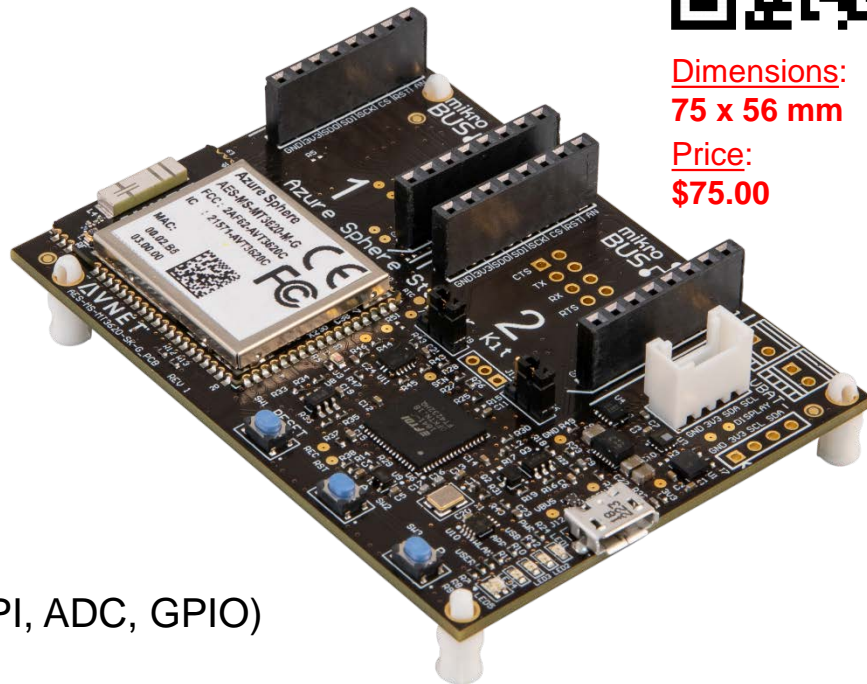
CE FC IC  
(\*pending)



<http://avnet.me/mt3620-kit>

# Avnet Sphere Starter Kit Features

- **Avnet MT3620 Azure Sphere Module**
  - Dual-band chip antenna
  - 32kHz XTAL for RTC and LP operation
- **4-Port USB-to-Serial Bridge (FT4232HQ)**
  - Service-, Debug- and Recovery UARTs
  - SWD, Reset and Recovery signals
- **Multiple Onboard Sensors**
  - Accelerometer, Gyro, Temperature
  - Barometric Pressure (Elevation)
  - Ambient light sensor
- **Multiple Expansion Ports**
  - 2x mikroBUS Click sockets (UART, I2C, SPI, ADC, GPIO)
  - 1x Grove connector (I2C)
  - 1x Optional OLED 128x64 display (I2C)
  - 1x Optional Pmod connector (UART, GPIO)



Dimensions:  
**75 x 56 mm**

Price:  
**\$75.00**

<http://avnet.me/mt3620-kit>

**AVNET**



# Avnet Sphere Starter Kit (cont.)

- **Push-Button Switches**

Reset Switch

User-A, User-B Switches

- **Multiple LEDs**

3V3 power - Green

USB activity - Amber

App. status - Amber

Wi-Fi status - Amber

User LED - RGB

- **DC/DC Regulator**

5V input via USB or mini screw-terminal

- **ADC Ref voltage, PMU controls and Wakeup input are accessible**

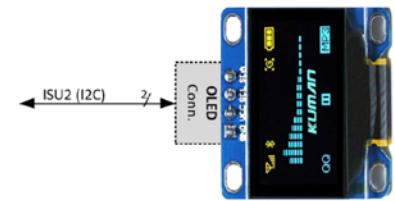
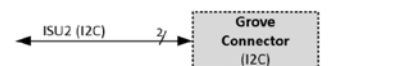
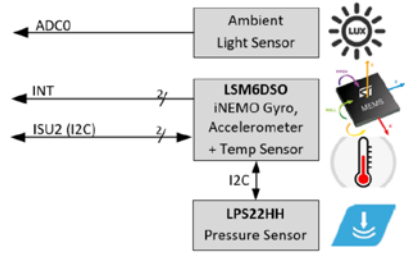
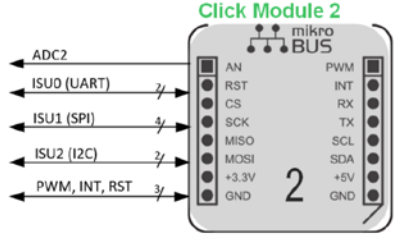
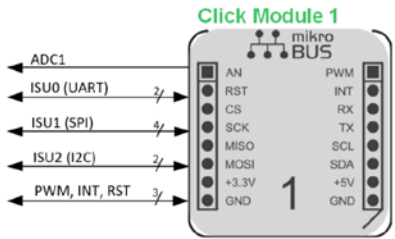
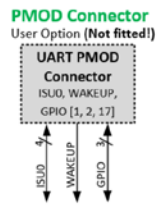
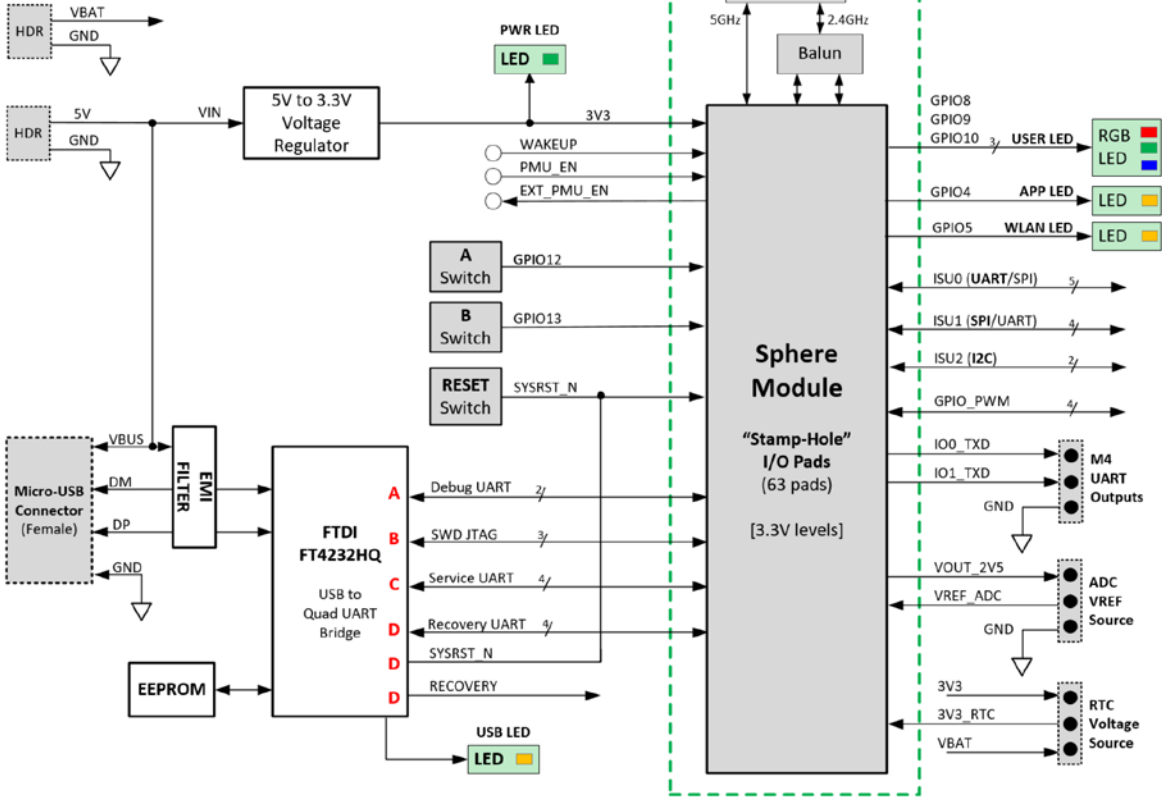
- **RTC and 5V DC terminal inputs (optional)**

Low-numbered MT3620 GPIOs are pinned-out from the Avnet Sphere module (for best function flexibility), eg.

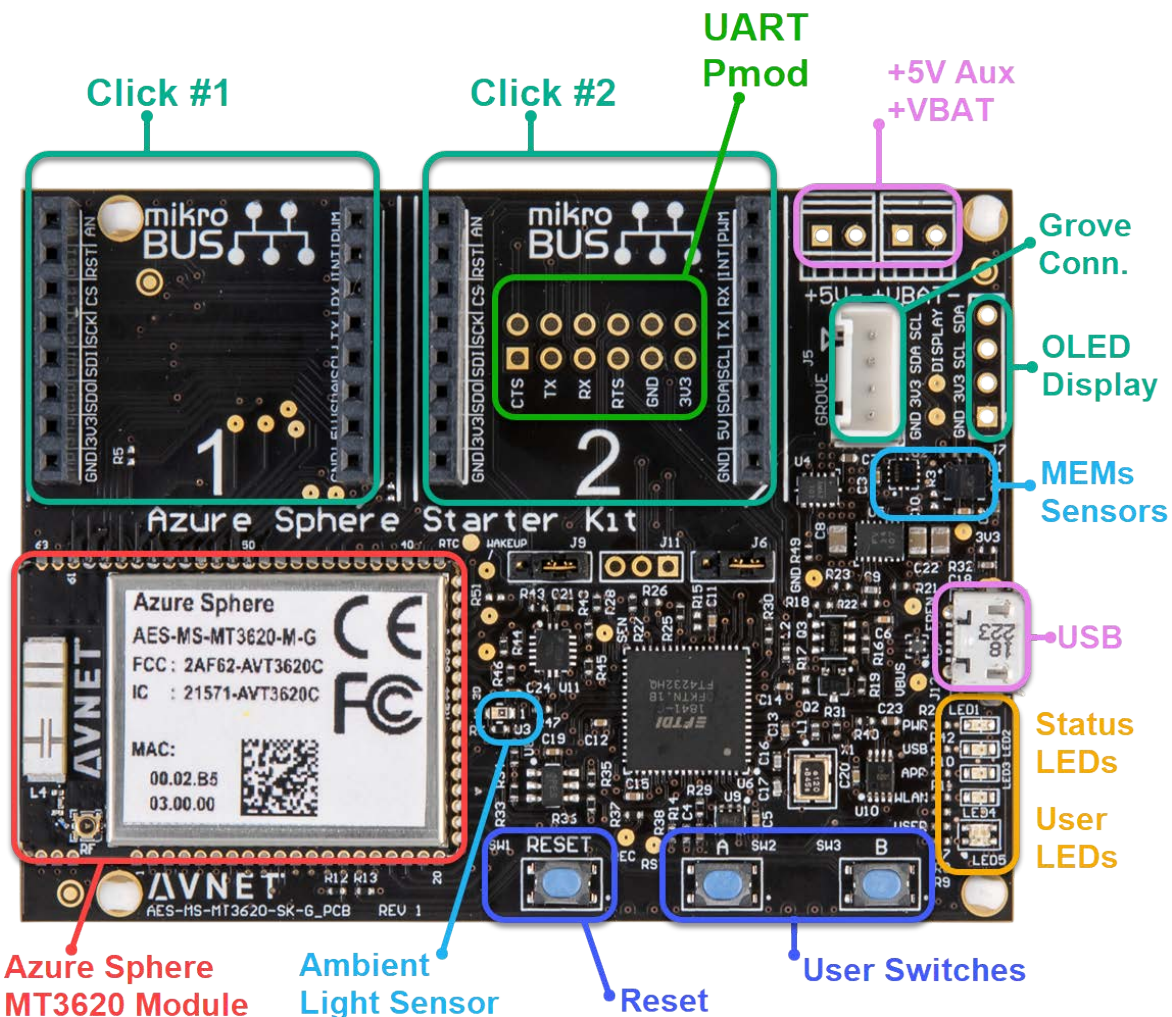
GPIO group	GPIO sub-group	Pin name	Function			
			Counter	GPIO	PWM	EINT
GPIO group 0	GPIO_0	GPIO0	Yes	Yes	Yes	Yes
	GPIO_1	GPIO1	Yes	Yes	Yes	Yes
	GPIO_2	GPIO2	Optional	Yes	Yes	Yes
	GPIO_3	GPIO3	No	Yes	Yes	Yes
GPIO group 1	GPIO_0	GPIO4	Yes	Yes	Yes	Yes
	GPIO_1	GPIO5	Yes	Yes	Yes	Yes
	GPIO_2	GPIO6	Optional	Yes	Yes	Yes
	GPIO_3	GPIO7	No	Yes	Yes	Yes
GPIO group 2	GPIO_0	GPIO8	Yes	Yes	Yes	Yes
	GPIO_1	GPIO9	Yes	Yes	Yes	Yes
	GPIO_2	GPIO10	Optional	Yes	Yes	Yes
	GPIO_3	GPIO11	No	Yes	Yes	Yes
GPIO group 3	GPIO_0	GPIO12	Yes	Yes	No	Yes
	GPIO_1	GPIO13	Yes	Yes	No	Yes
	GPIO_2	GPIO14	Optional	Yes	No	Yes
	GPIO_3	GPIO15	No	Yes	No	Yes
GPIO group 4	GPIO_0	GPIO16	Yes	Yes	No	Yes
	GPIO_1	GPIO17	Yes	Yes	No	Yes
	GPIO_2	GPIO18	Optional	Yes	No	Yes
	GPIO_3	GPIO19	No	Yes	No	Yes

# Avnet Sphere Starter Kit

## Avnet Sphere Module



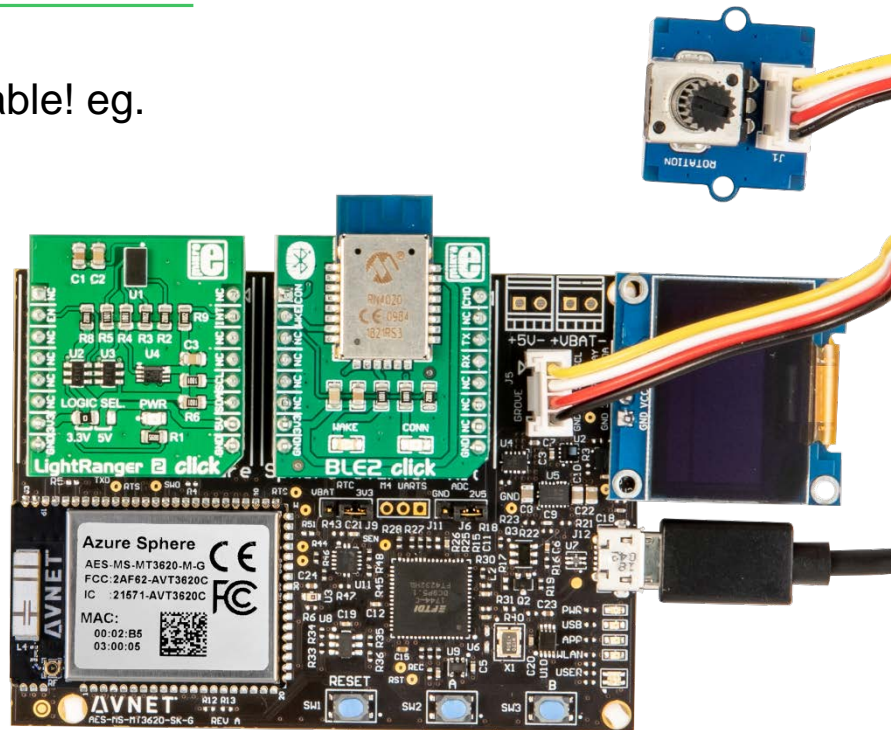
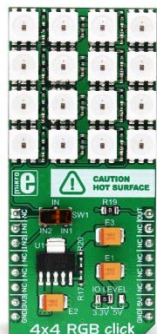
User Option (Not fitted!)



# Starter Kit Expandability

**mikroBUS Click boards** - <https://www.mikroe.com/click>

- Starter Kit has sockets for two Click boards
- Over 650+ different Click boards now available! eg.
  - Sensors (192)
  - Display (40)
  - Wireless (83)
  - Mixed Signal (39)
  - Interface (51)
  - Motor Control (30)





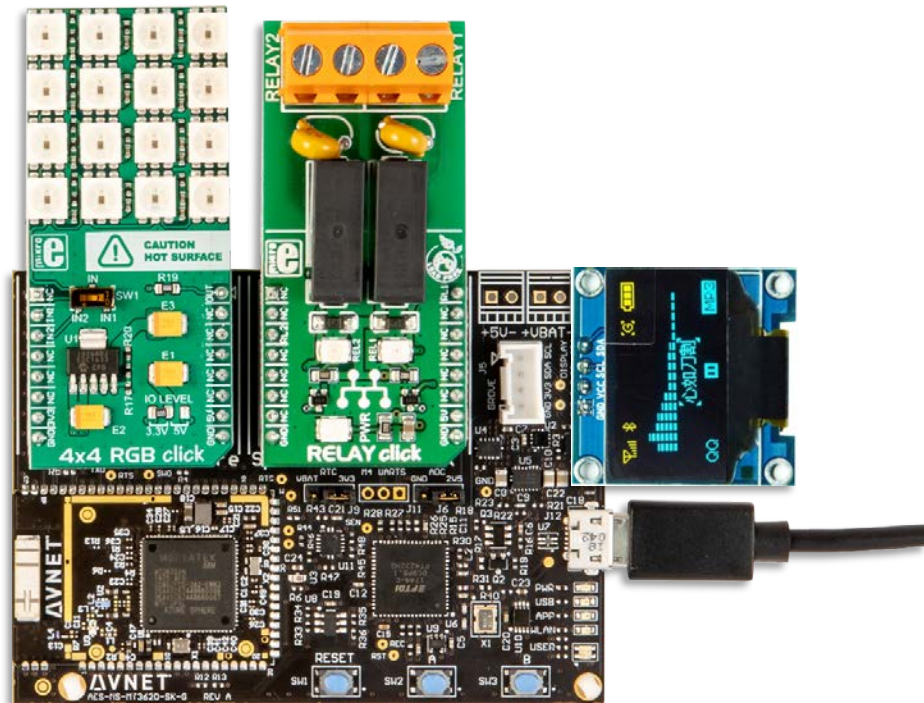
# Expandability (cont.)

## Grove Connector

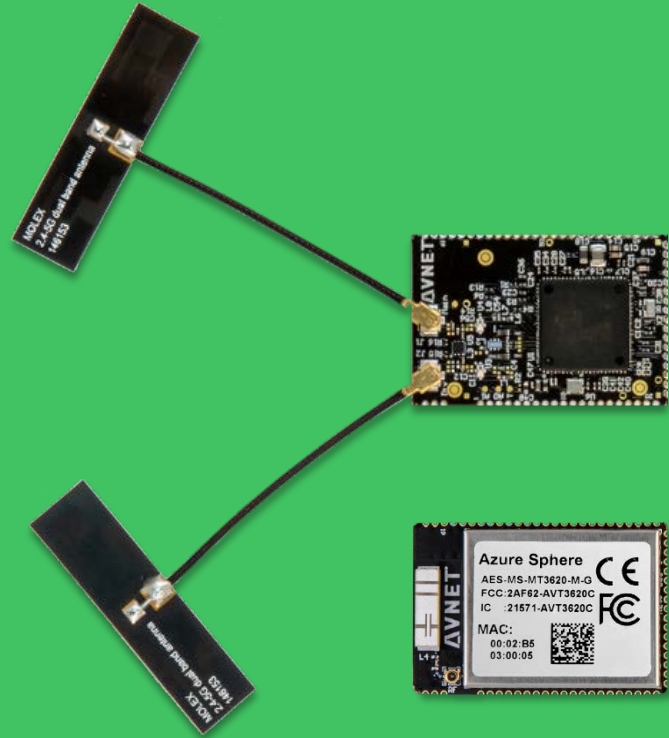
- Choose from around 100 different 3rd-party Grove boards - [link](#)
- Cable interface adds flexibility
- 4-pin connector with I2C interface

## OLED Display Interface

- Easy addition of optional graphic display
- Many sub-\$10 OLED 128x64 graphic display options available - [link](#)



# Azure Sphere MT3620 Module

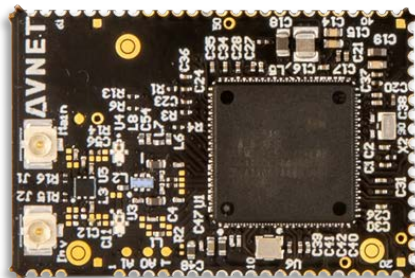
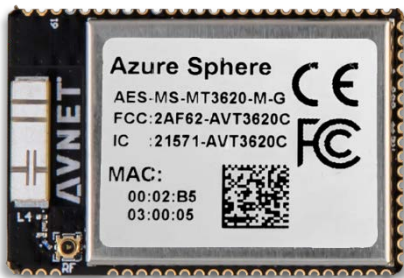


# Certified Azure Sphere Modules



Single on-board  
dual-band  
chip-antenna  
*(lowest cost)*

Dual off-board  
dual-band  
UFL antennas  
*(best performance)*

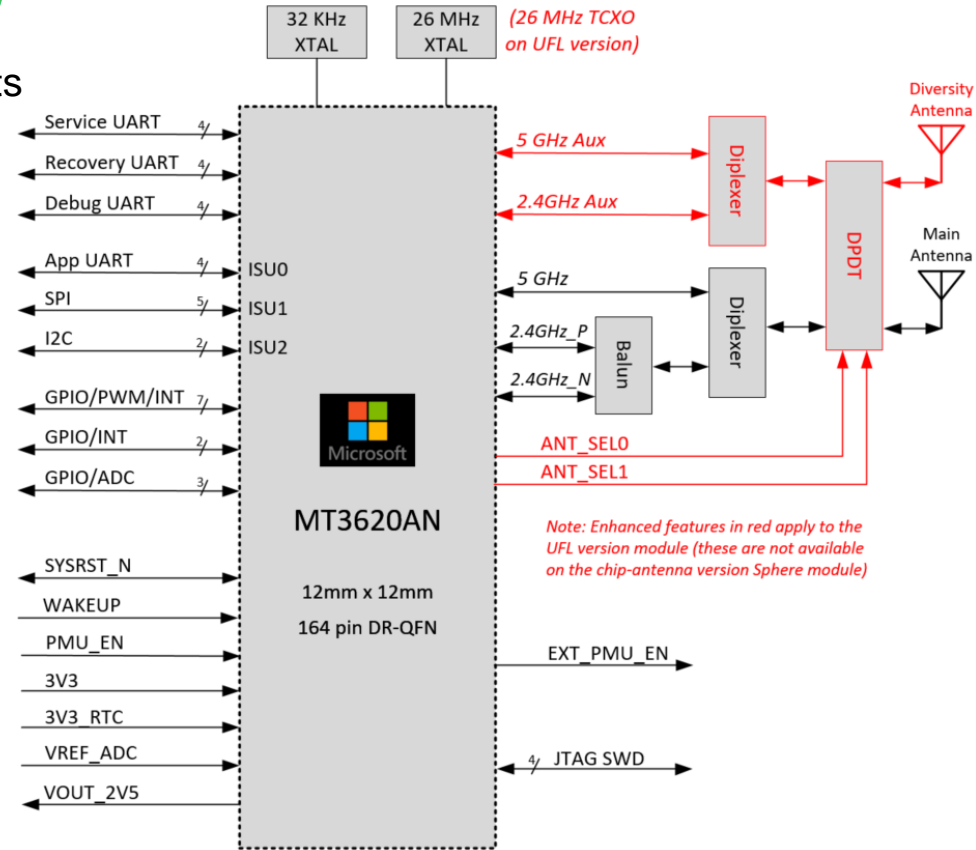


Footprint-compatible  
Azure Sphere Modules  
(Mediatek MT3620AN)

<http://avnet.me/mt3620-modules>

# Sphere Module Overview

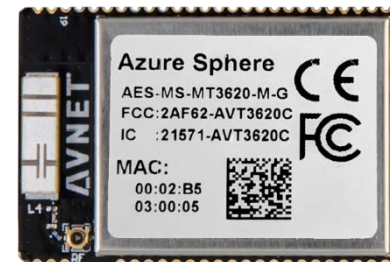
- 3 ISUs assigned as UART, SPI and I2C ports (or can be 11 additional GPIOs)
- 12 GPIO ports (multi-function)
- Debug UARTs and JTAG port
- Power Control
- Single 3.3V input
- Two antenna options
  - On-board
    - 2.4/5 GHz chip-antenna, or
  - U.FL connectors
    - 2.4/5 GHz with TX/RX diversity
- Region-specific wireless certifications
- Small size – 33 x 22 x 2 mm (1.2 mm pitch)
- 63-pin stamp-hole style module
- The modules are footprint-compatible



# Chip-Antenna Sphere Module

MT3620AN based module with the following features pinned-out:

- 1x 500MHz ARM Cortex A7, 4MB SRAM
- 2x 200MHz ARM Cortex M4F cores, 64KB SRAM
- Programming, Recovery and Debug interfaces
- 3x ISU interfaces, pre-configured for UART, SPI, I2C (max interface rates: UART=3Mbps, SPI=40MHz, I2C=1MHz)
- ADC/GPIO: 3x 12bit ADC inputs (or can be used as GPIOs)
- PWM/GPIO: 9x PWM outputs, or use as GPIOs (for total of up to 24 GPIOs)
- RTC : On-chip, requires VBAT supply
- Wi-Fi: Dual-band 2.4/5GHz 802.11 a/b/g/n
- Antenna: Single onboard dual-band 2.4/5GHz chip antenna (Pulse W3006)
- Operating Temperature: -30~85°C
- Dimensions: 33mm x 22mm x 3mm
- Certification: FCC, IC, CE, RoHS



# UFL Sphere Module

Features are as listed for  
Chip-Antenna version module  
plus...

the following enhancements:

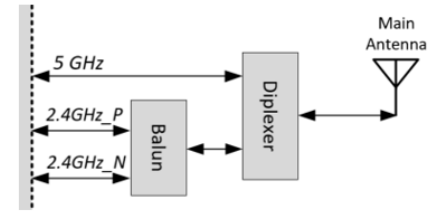
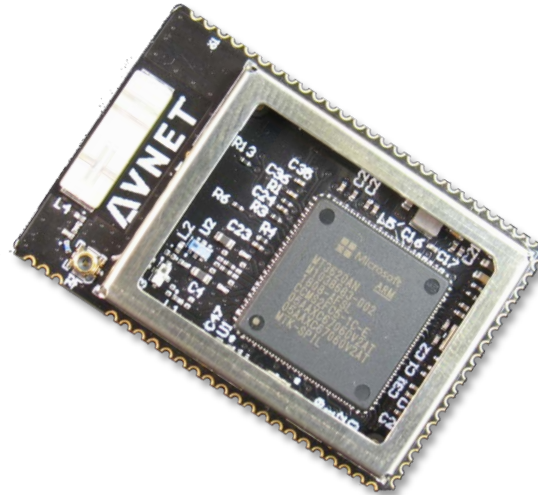
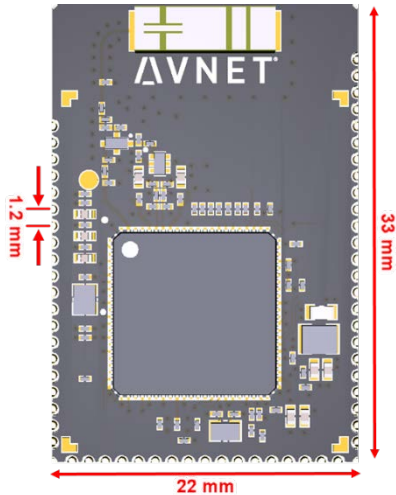
- RF front-end: Full TX and RX antenna diversity
- Antennas: Two U.FL connectors  
(for external 2.4/5GHz flex antennas)
- Operating Temperature:  
Full -40C~85°C industrial rating  
(has 26 MHz TCXO)



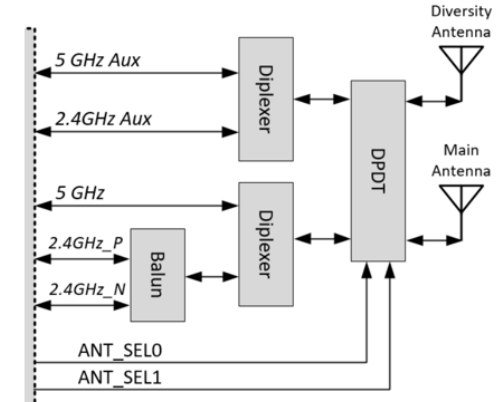
UFL version module is fitted  
with Molex p/n **1461530050**  
dual-band flex antennas  
(50mm feed cables)

# Module PCB Layout Considerations

- Module pin-out is 66 Stamp-hole pads with 1.2 mm pitch
- Additional components (Diplexer, DPDT RF switch, TCXO) on UFL version facilitate full RX and TX antenna diversity (dual UFL external antennas) and -40..+85C specification



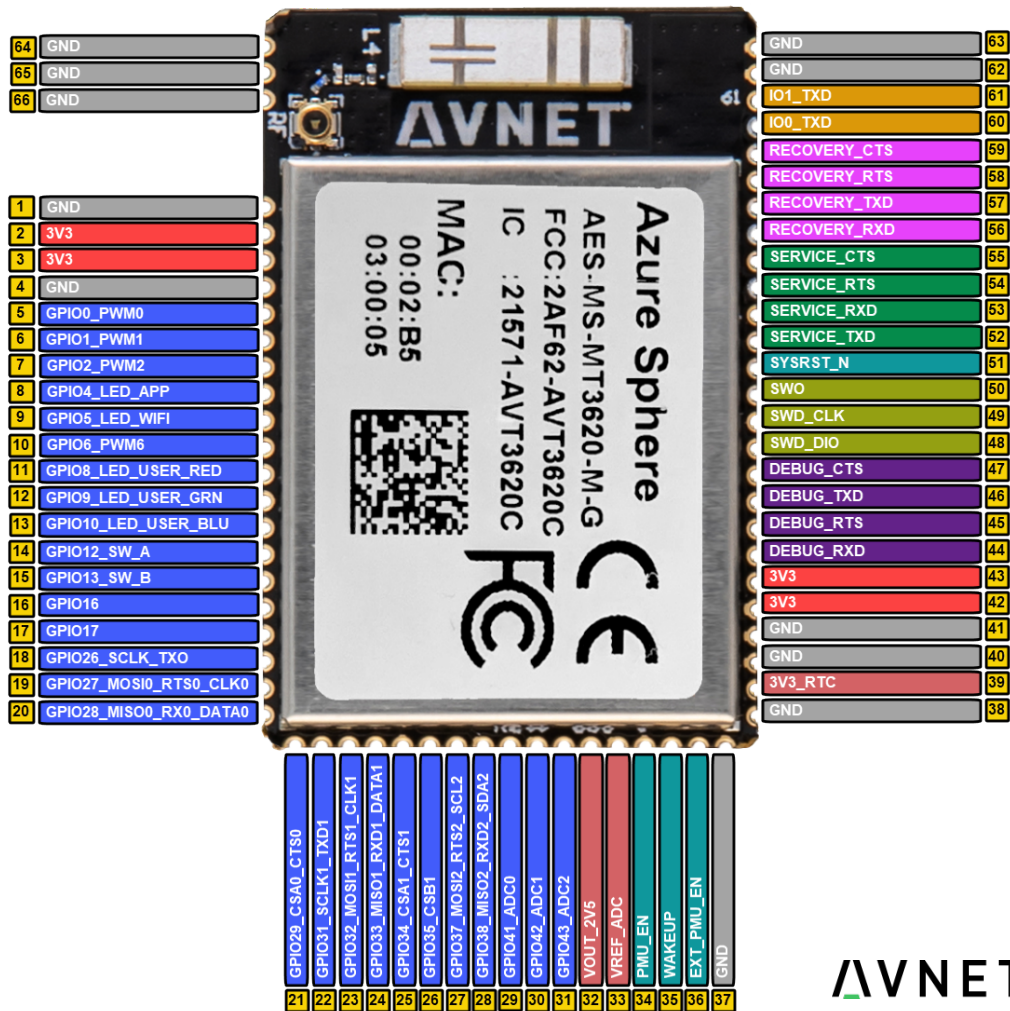
SKU A: Module has single dual-band chip antenna (simple, lowest cost, but no diversity)



SKU B: Module has two dual-band U.F.L. antennas (for transmit and receive diversity)

# Azure Sphere MT3620 Module Pinout

- Chip and UFL versions have identical footprint
- Single 3.3V supply







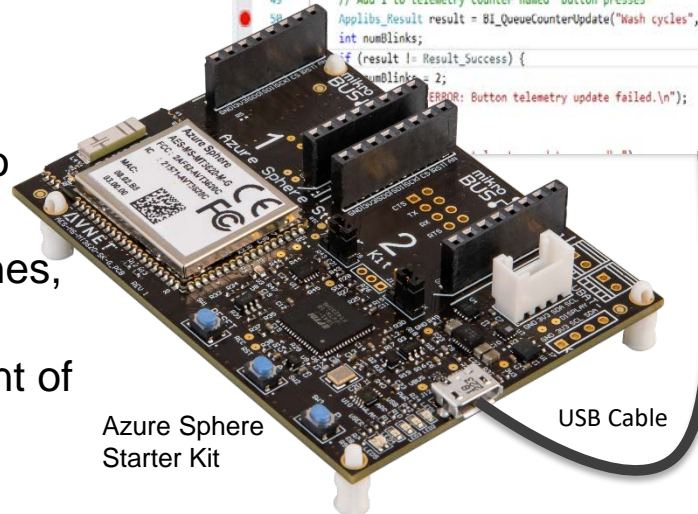
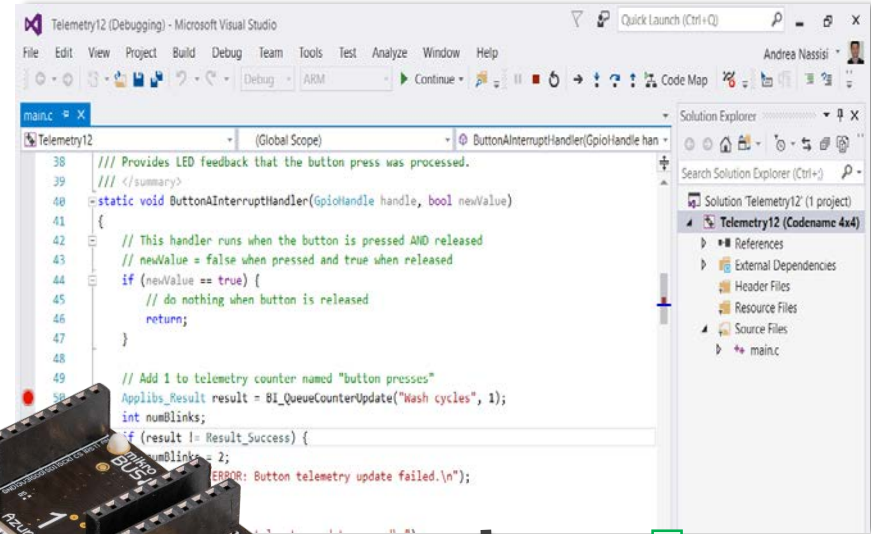
# Azure Sphere Developer Experience

## Applications Developed in Visual Studio 2017

- C programming language with IntelliSense
- Libraries: hardware drivers, concurrency, and Azure IoT connectivity
- Best in class debugging tools
- Easy to create project based on samples, templates and reference designs
- Comprehensive documentation

## Application Deployment

- Local deployment UI integrated into Microsoft Visual Studio
- Staged deployments to test machines, then products in the field.
- Online web apps allow management of devices world-wide



Azure Sphere Starter Kit

USB Cable

Publish/Deploy



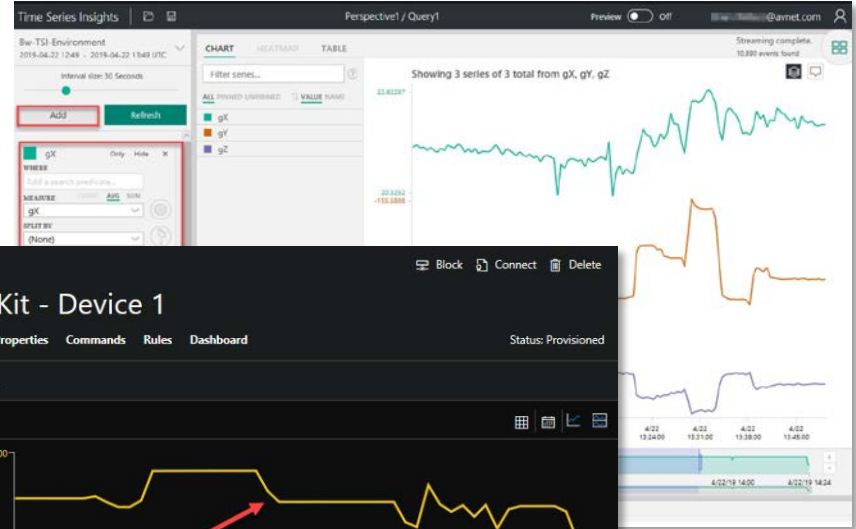
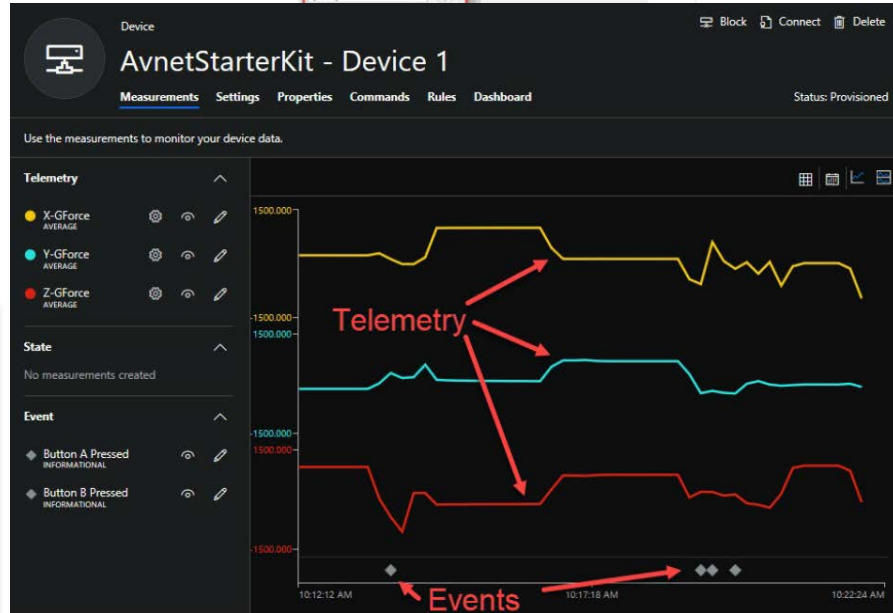
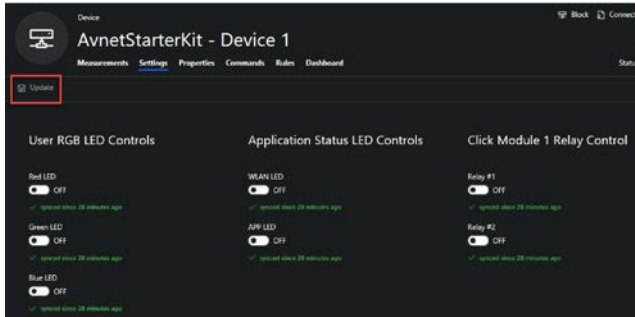
# Azure Sphere Starter Kit Reference Designs

## Comprehensive out-of-box Example

Part 1 Intro to Avnet MT3620 Starter Kit  
(Samples on-board sensors and reports locally)

Part 2 Azure IoT Hub, Device Twin  
and Azure Time Series Insights...

Part 3 Azure IoT Central for  
Sensor Display and Remote  
Control of Device Outputs



# Ordering Information

Module Part Number	Description
AES-MS-MT3620-M-G	Azure Sphere MT3620 Module (Chip-Antenna) <a href="http://avnet.me/mt3620-modules">http://avnet.me/mt3620-modules</a>
AES-MS-MT3620-UFL-M-G	Azure Sphere MT3620 Module (UFL-Antennas) <a href="http://avnet.me/mt3620-modules">http://avnet.me/mt3620-modules</a>

Part Number	Description
AES-MS-MT3620-SK	Azure Sphere MT3620 Starter Kit <a href="http://avnet.me/mt3620-kit">http://avnet.me/mt3620-kit</a>
MikroE Click boards	<a href="https://www.mikroe.com/click">https://www.mikroe.com/click</a>

# Key Take -away

**Avnet Guardian Module.** Unlocks brownfield IoT by bringing Azure Sphere's security to equipment previously deemed too critical to be connected. **Available soon**

**Avnet MT3620 Starter Kit.** Azure Sphere prototyping and development platform. Connectors allow easy expandability options with a range of MikroE Click and Grove modules. Your system- POC. **Pre-Order**

**Avnet Wi-Fi Module.** Azure Sphere-based module designed for easy final product assembly. Simplifies quality assurance with stamp hole (castellated) pin design. Regional certifications available. **Available Soon**



# Azure Sphere

IoT Device Experience team  
Consumer & Device Sales



# Our opportunity



Billions of connected multi-sense devices on the intelligent edge



Seamless access to interactive data powered by the intelligent cloud

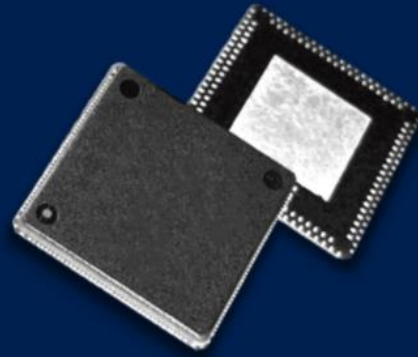


Compute power at the edge with silicon + software + Cloud



Intelligent Edge

Microcontrollers (MCUs)  
low-cost, single chip computers



**9 BILLION** new MCU devices  
built and deployed every year

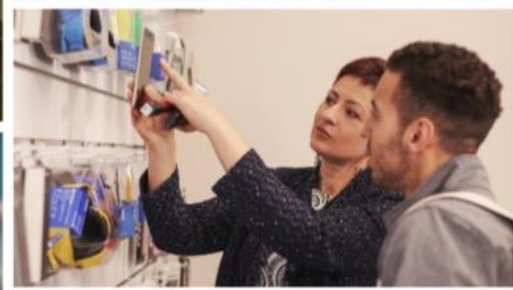


**Data and analytics**

**Operational efficiency**

**New business models**

**Customer experiences**





The image features a complex network of glowing orange and white nodes connected by thin lines, set against a dark background with a curved horizon line. The nodes are arranged in a pattern that suggests a global or interconnected network. The text "Opportunity | Risk" is centered in the middle of the image.

Opportunity | Risk

The image features a dark background with a glowing network of nodes and connections. The nodes are small, bright white dots, and the connections are thin, golden-yellow lines. The network is dense and complex, with many nodes interconnected. In the upper portion of the image, a curved, glowing horizon line, likely representing the Earth, is visible. The overall aesthetic is futuristic and digital.

What happens when you connect  
a device to the internet?

**“Ransomware attacks will target more IoT devices in 2018”**

**“Huge IoT botnet may be used for Ukraine attack”**

**“When smart gadgets spy on you: Your home life is less private than you think”**

**“Industrial IoT to equip new era of corporate intruders coming in through devices”**

**“Security experts warn of dangers of connected home devices”**

**“Hacking these IoT baby monitors is child’s play, researchers reveal”**

**“Hackers infect 500,000 consumer routers all over the world with malware”**

**“Your smart fridge may kill you: The dark side of IoT”**

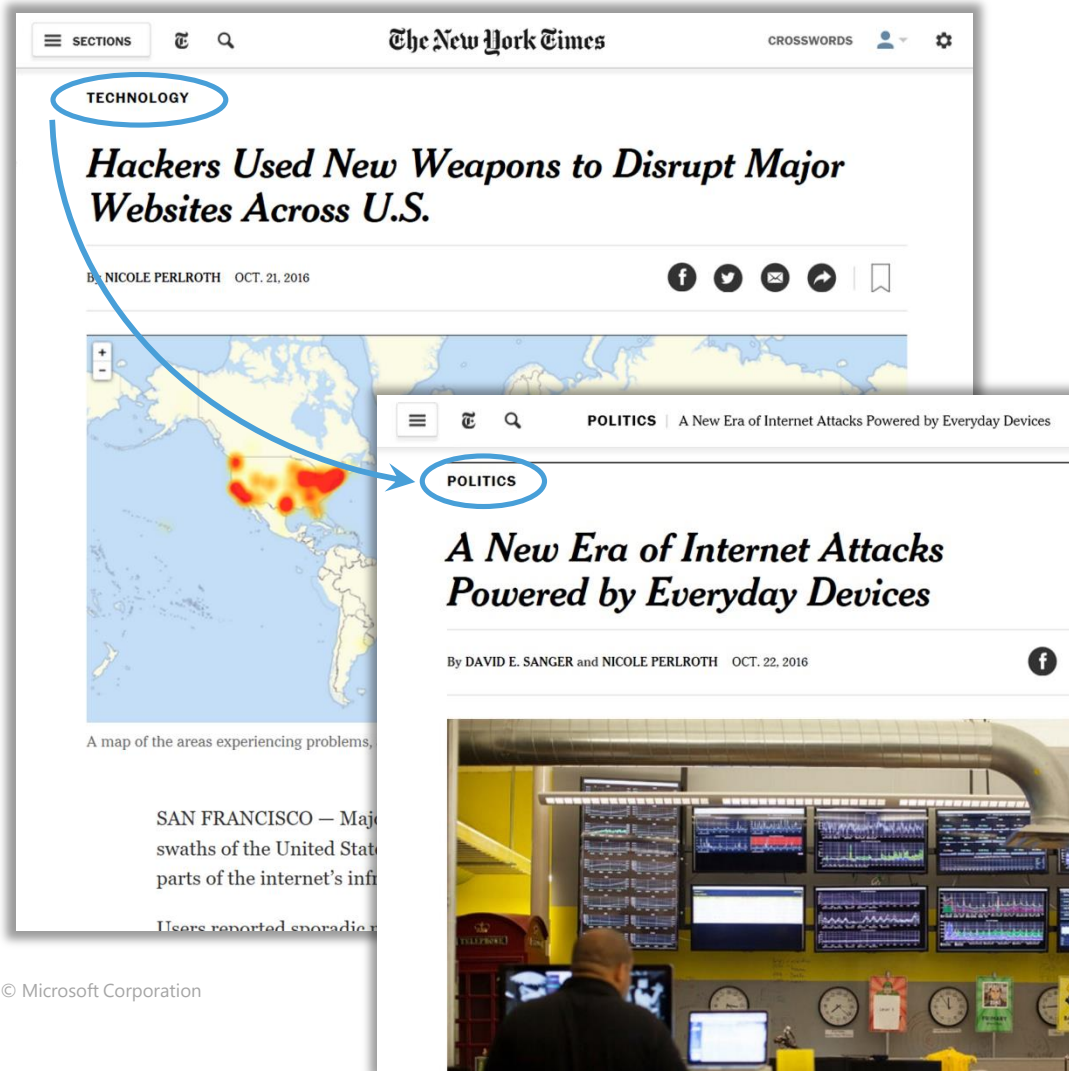
**“The Lurking Danger of Medical Device Hackers”**

**“Why the KRACK Wi-Fi mess will take decades to clean up”**

**“Hacking critical infrastructure via a vending machine? The IOT reality”**

**“Protecting Your Family: The Internet of Things Gives Hackers Creepy New Options”**

# October 21, 2016 New York Times DDoS Attack: Device Security hits the public conscience



## Observations:



Device Security is a socioeconomic concern.

**Day 1** the attack is **Technology** headline in NY Times.  
**Day 2** the attack is **Politics** headline.



Future attacks could be much larger.

This attack was small; just 100K devices.  
Imagine a 100M-device attack.



Future attacks could create liability exposure.

Risk of exploit etc.. Actuating devices could cause property damage or loss of life.



The IOT industry response to date is inadequate.

For example, vendors offer to turn off network ports.



The attack exploited well-known weaknesses.

Weak common passwords, no early detection, no remote update, etc.

# 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



# 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

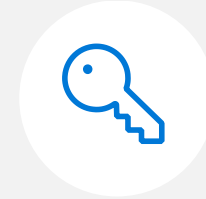


Renewable  
Security

# Some properties depend only on hardware support



© Microsoft Corporation



Hardware  
Root of Trust

---

## Hardware Root of Trust

Unforgeable cryptographic keys  
generated and protected by hardware

- Hardware to protect Device Identity
- Hardware to Secure Boot
- Hardware to attest System Integrity

# Some properties depend on hardware and software



Defense in  
Depth



Dynamic  
Compartments



Small Trusted  
Computing Base

---

## Dynamic Compartments

Internal barriers limit the reach of any single failure

- Hardware to **Create Barriers**
- Software to **Create Compartments**



# Some properties depend on hardware, software and cloud



Certificate-Based  
Authentication



Failure  
Reporting



Renewable  
Security

---

## Renewable Security

Device security renewed to overcome  
evolving threats

- Cloud to **Provide Updates**
- Software to **Apply Updates**
- Hardware to **Prevent Rollbacks**

# Meeting the 7 properties is difficult and costly

Design and build a holistic solution



Recognize and mitigate emerging threats



Distribute and apply updates on a global scale



**!** You're only as secure as your weakest link.

You must have the technical expertise to stitch disparate security components into an gap-free, end-to-end solution.

**!** Threats evolve over time.

You must have the ongoing security expertise to identify and create the updates needed to mitigate new threats as they emerge.

**!** Update efficiency is critical.

You must have the infrastructure, logistics and operational excellence to deliver and deploy updates globally to your entire fleet of devices in hours.

# Azure Sphere empowers manufacturers to create highly-secured, connected MCU devices

## SECURITY

---

### Peace of mind

Every device built with Azure Sphere is secured by Microsoft. For its 13-year lifetime.

## PRODUCTIVITY

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### Faster time to market

The Azure Sphere developer experience shortens OEM time to market.

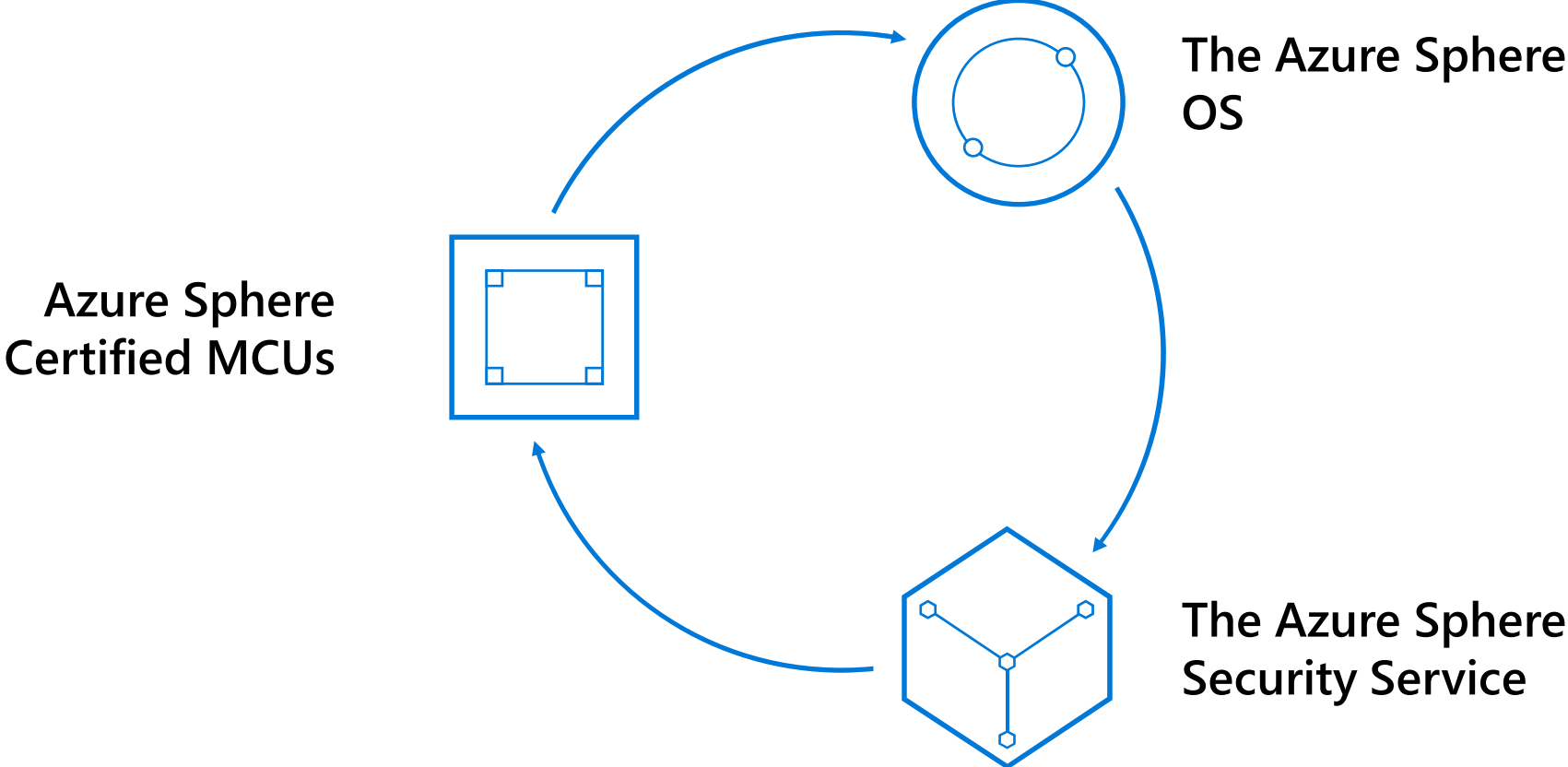
## OPPORTUNITY

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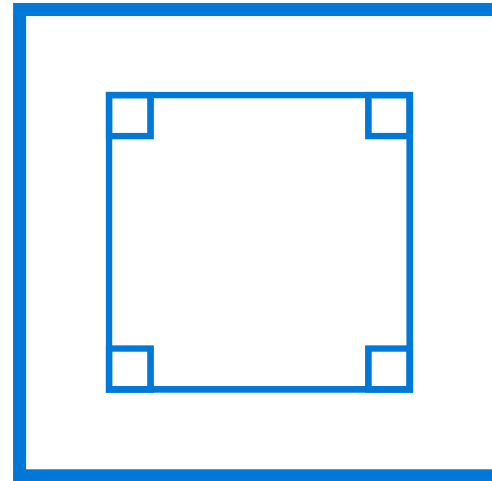
### The future is now

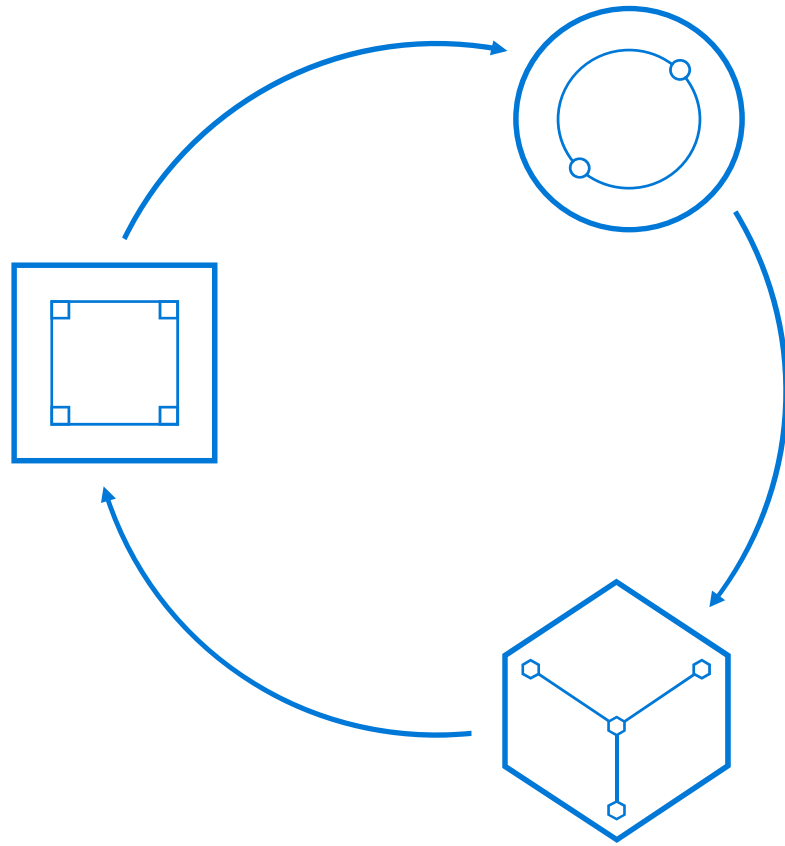
Azure Sphere empowers OEMs to create new customer experiences and business models.

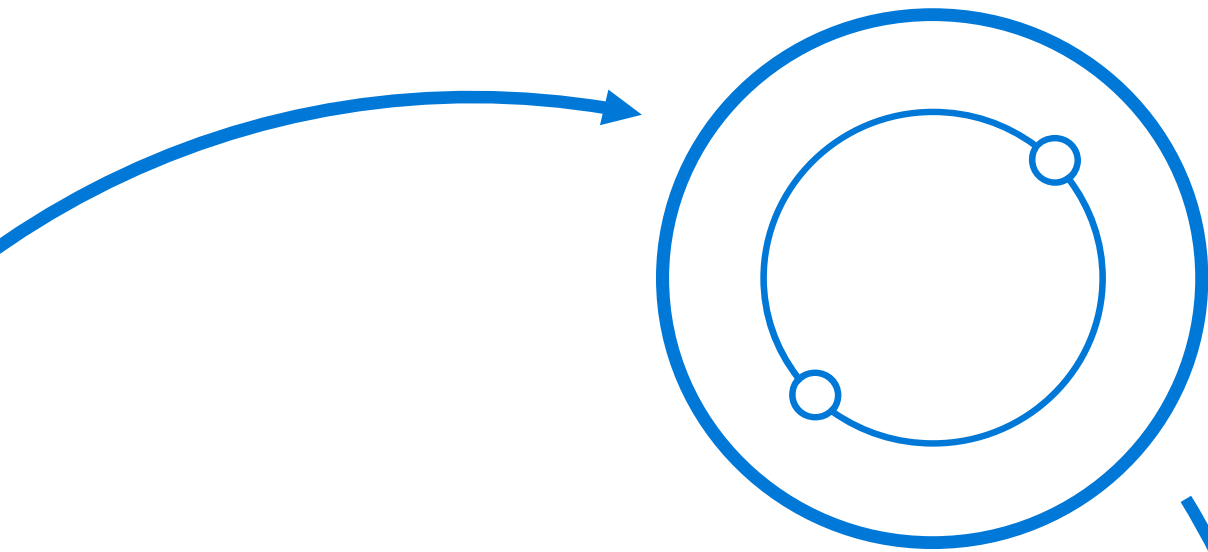
# Azure Sphere is an end-to-end solution for securing MCU powered devices



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

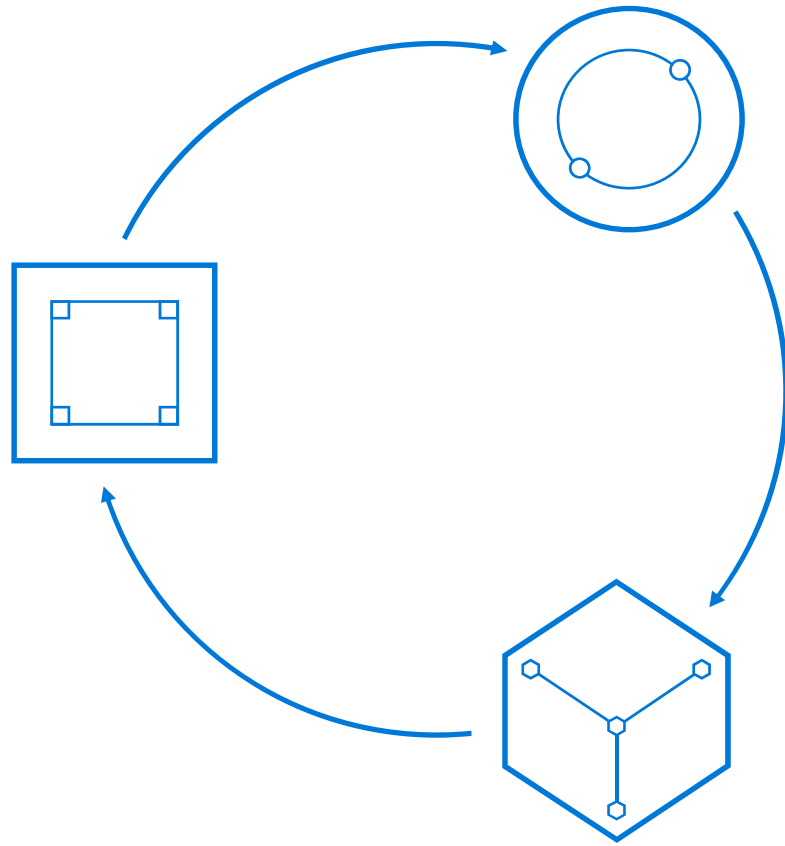




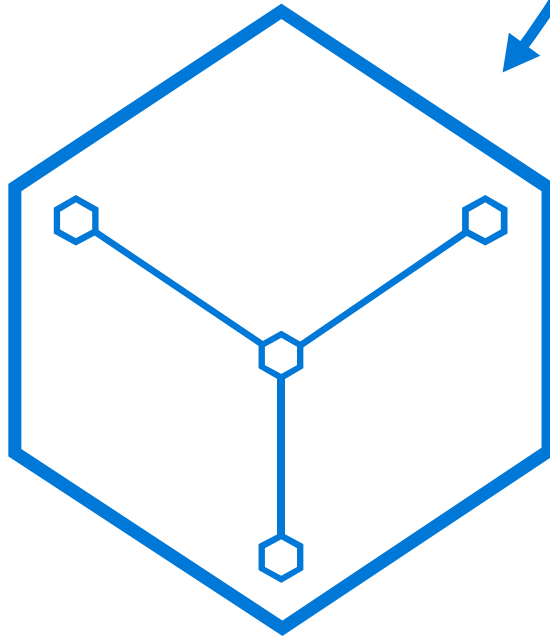


## The Azure Sphere OS

secured by Microsoft for the devices 13-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**.

# Azure Sphere is open

Open to any MCU manufacturer  
We are licensing our Pluton security subsystem royalty **free for use** in any chip\*

Open to any cloud  
Azure Sphere devices are free to connect to Azure or any other cloud, proprietary or public for application data

Open to any innovation  
MCU manufacturers are free to innovate with our GPL'd OSS Linux kernel code base

# Our silicon partners



MediaTek



ARM



STMicroelectronics



NXP



Silicon Labs



Nordic



Nuvoton



Hilscher



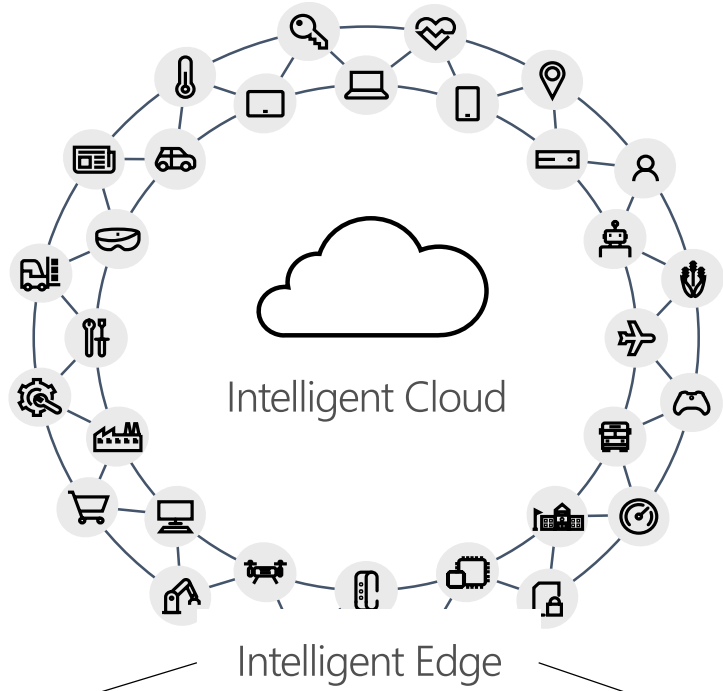
Toshiba



VeriSilicon



Qualcomm

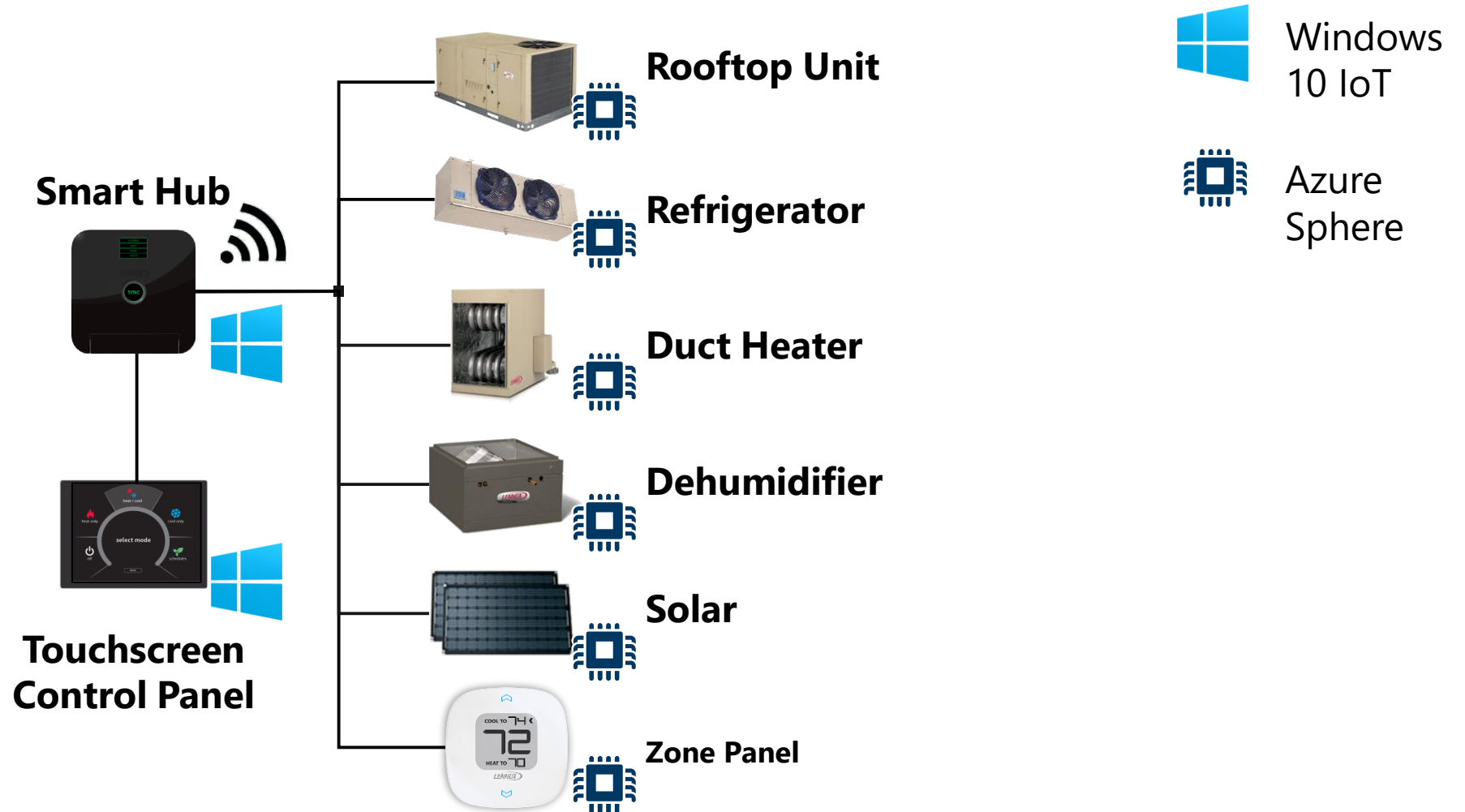


**Azure Sphere**  
Basic & Tiny Things  
MCU  
4mb/16mb

**Windows 10 IoT Core**  
Smart Things  
MPU  
512MB / 2 GB

**Windows 10 IoT Enterprise**  
PC-Like Device  
MPU  
1GB / 16 GB

# Commercial HVAC (Heating Ventilation & Air Conditioning) Example

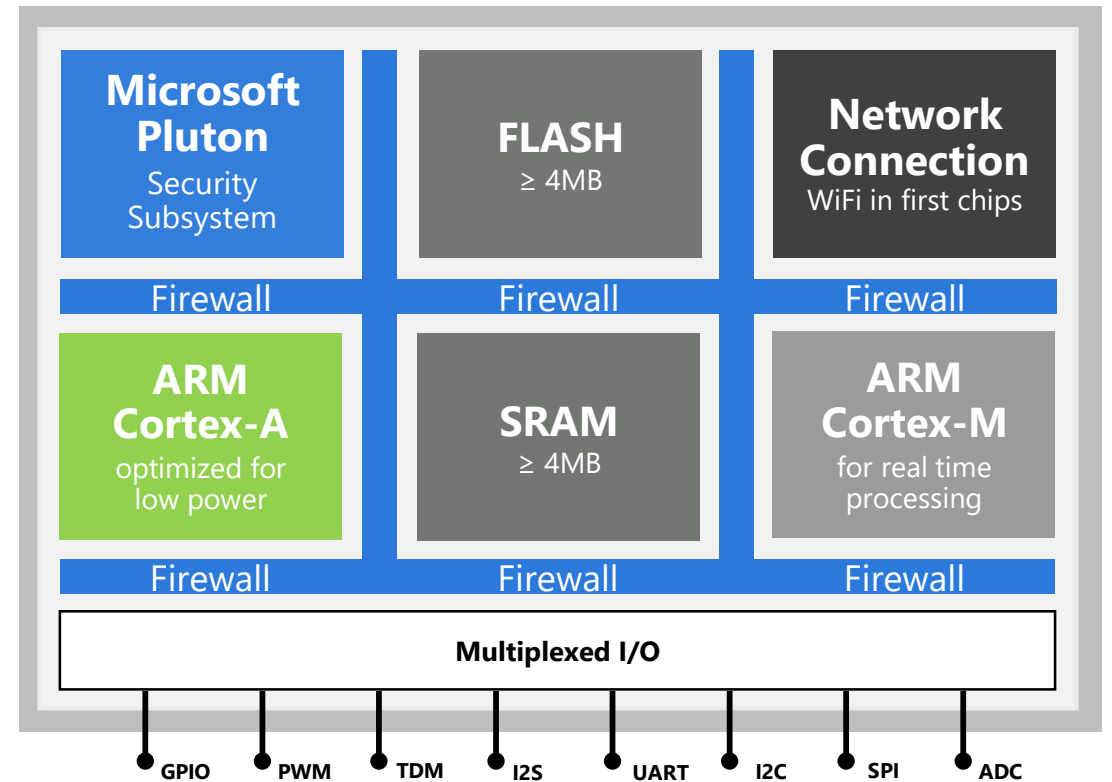


# Azure Sphere certified MCUs create a secured root of trust for connected, intelligence edge devices

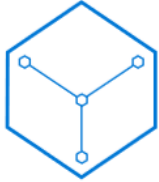
**CONNECTED** with built-in networking

**SECURED** with built-in Microsoft silicon security technology including the Pluton Security Subsystem

**CROSSOVER** Cortex-A processing power brought to MCUs for the first time



# A Socket to Azure and Azure IoT ...not Windows Replacement



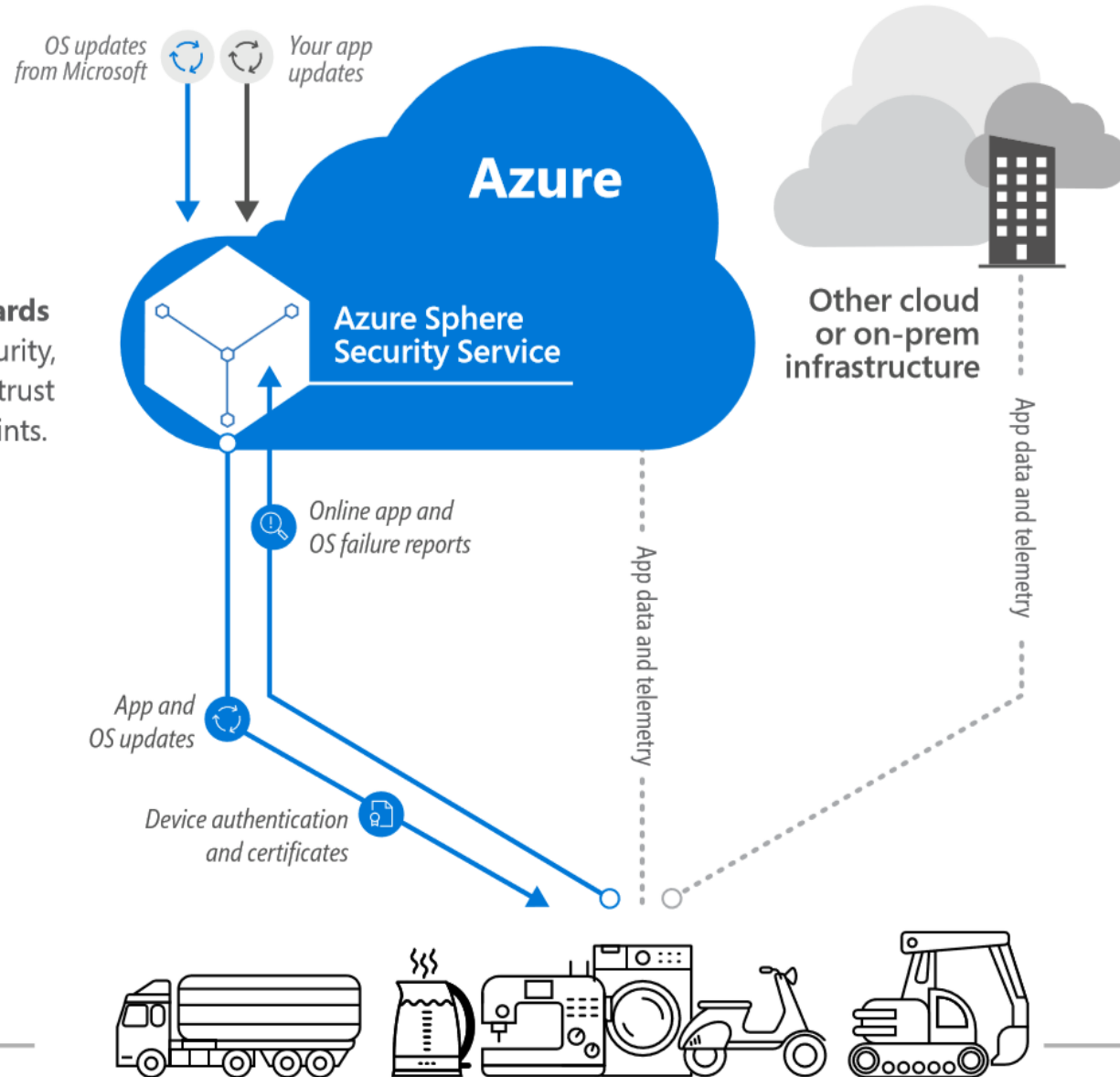
**The Azure Sphere Security Service guards** every Azure Sphere device. It renews security, identifies emerging threats, and brokers trust between device, cloud, and other endpoints.

Protecting devices with certificate-based authentication

Guaranteeing device authenticity and running only your genuine software

Getting insight into device and application failure and visibility into emerging threats

Deploys app updates to your Azure Sphere powered devices



**Azure Sphere gives you choice.** You can connect data from any cloud, proprietary or public, or even to your on-prem infrastructure to the Azure Sphere Security Service.

Informing your app with data

Storing telemetry and insights

Providing customer information

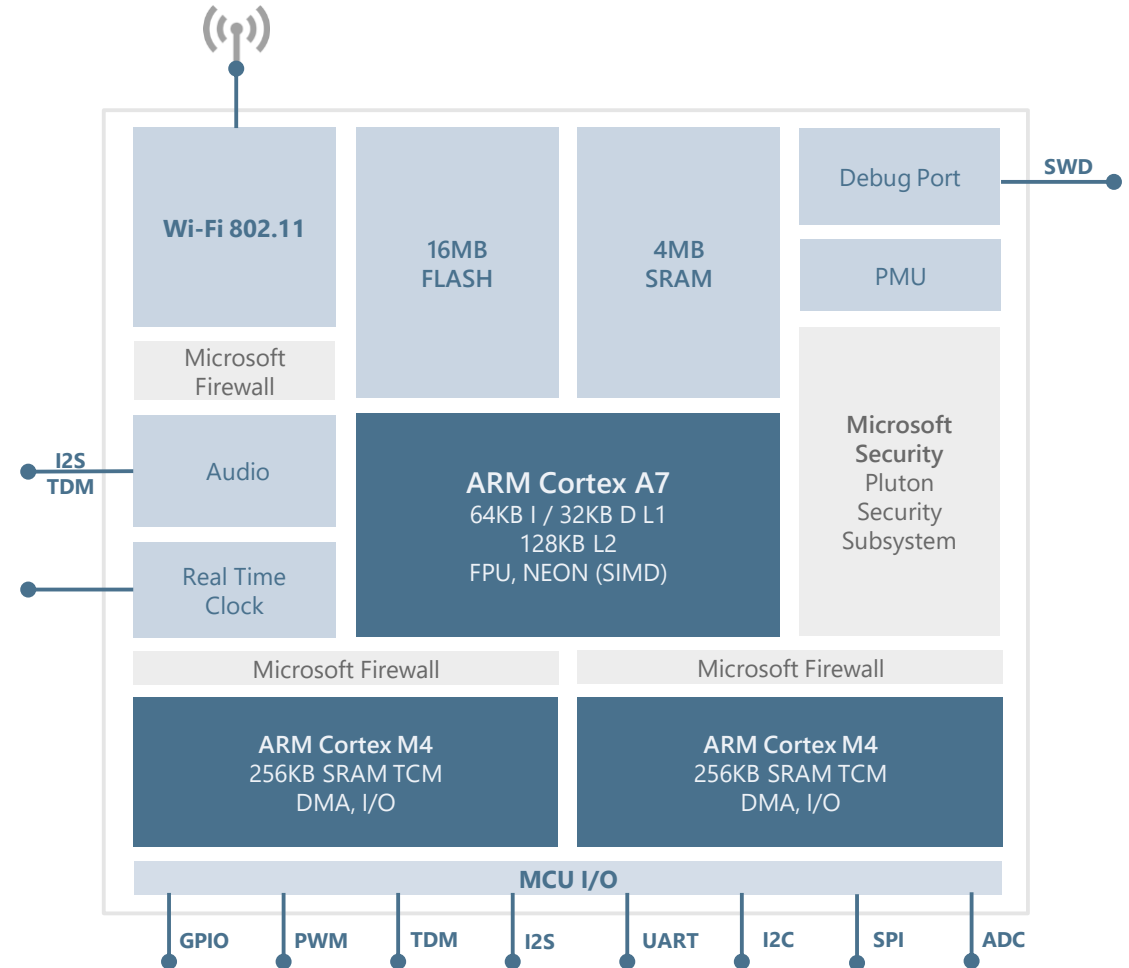
Housing commerce and other transactions



# Mt Blanca: volume production Azure Sphere MCU

Price competitive multicore MCU for device control and connectivity

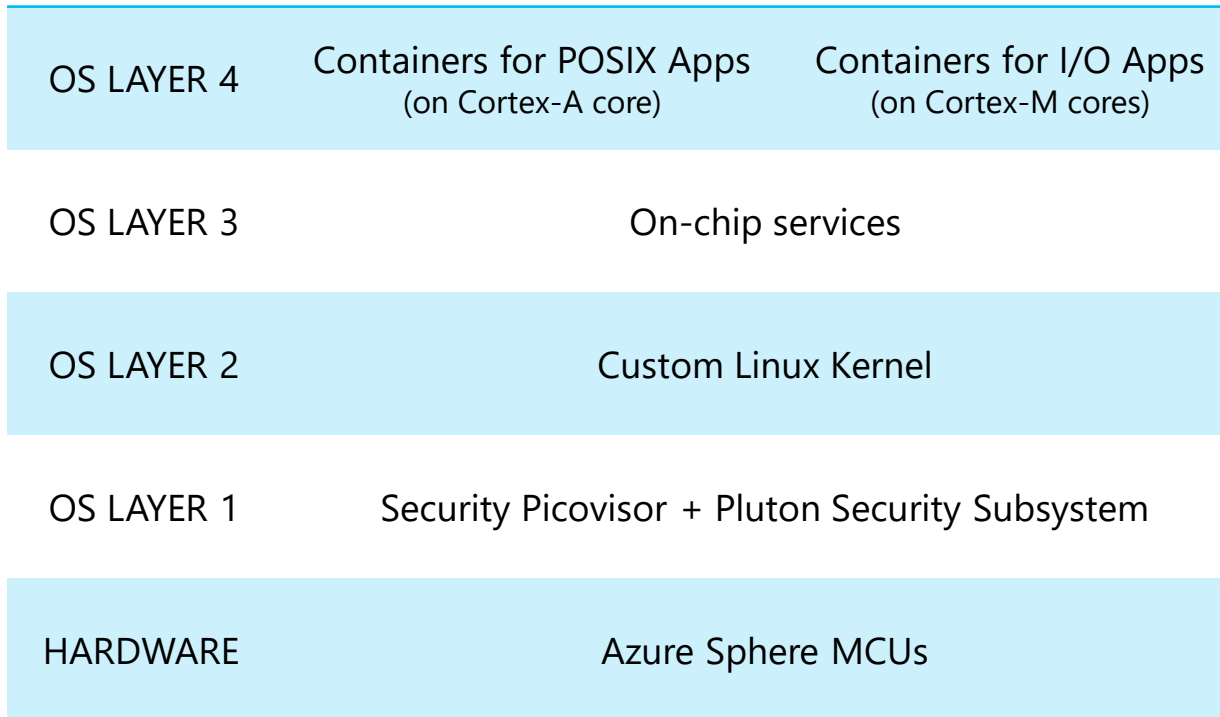
<b>CPUs</b>	<b>ARM Cortex A7 (500MHz) + 2 x Cortex M4 (192MHz)</b>	
<b>RAM</b>	4MB	
<b>Flash</b>	16MB (8MB Runtime Firmware + 8MB Backup Firmware)	
<b>Connectivity</b>	WiFi 802.11 b/g/n, dual band: 2.4GHz, 5GHz	
<b>Microsoft Security</b>	Firewalls, Crypto Accelerator: AES-256, SHA-2, ECC, RSA2K, e-Fused private and public keys, attestation, ...	
<b>I/O</b>	GPIO	24, 4 configurable as PWM
	SPI	6 configurable
	I2C	
	UART	
	ADC	8 Channels, 12bit SAR, 2M sample/sec
<b>I2S/TDM</b>	I2S (2 interfaces) or TDM (4 channels)	
<b>Package</b>	DR-QFN 164	
<b>Barcode Scanner Partner</b>	Honeywell	
<b>Target Price</b>	MCU + OS + 13 Year Azure Sphere Services < \$10	





# Azure Sphere OS: Architectural Layers

- Layered architecture supports *defense in depth*, *compartmentalization*, and small *trusted computing base*.
- Layers are *independently updatable*.



## **Secured application containers**

compartmentalize code for agility, robustness and security.

## **On-chip services**

provide update, authentication, and connectivity.

## **Custom Linux Kernel**

empowers agile silicon evolution and reuse of code.

## **Security Picovisor + Pluton Security Subsystem**

guard integrity and access to critical resources.

# The Azure Sphere Security Service renews device security

## Secure Over-The-Air (OTA) updates infrastructure

- Cloud infrastructure can **deliver updates to Azure Sphere devices around the world.**

## Robust application deployment and updates

- **Customer-written applications are signed, deployed and updated by the customer** using the Azure Sphere cloud.
- Attestation authorizes **only genuine software** to execute on device.

## Reliable System software updates

- Microsoft **automatically manages updating device software** to help ensure secure device operation.
- Updates are **delivered privately to device creators first to test updates.**

# Azure Sphere Developer Experience

## Create ARM Cortex-A applications in Visual Studio 2017

- C programming language with IntelliSense.
- Libraries: hardware drivers, concurrency, and Azure IoT connectivity.
- Best in class debugging tools.
- Easy to create project based on samples and templates.
- Comprehensive documentation.

## Create ARM Cortex-M applications

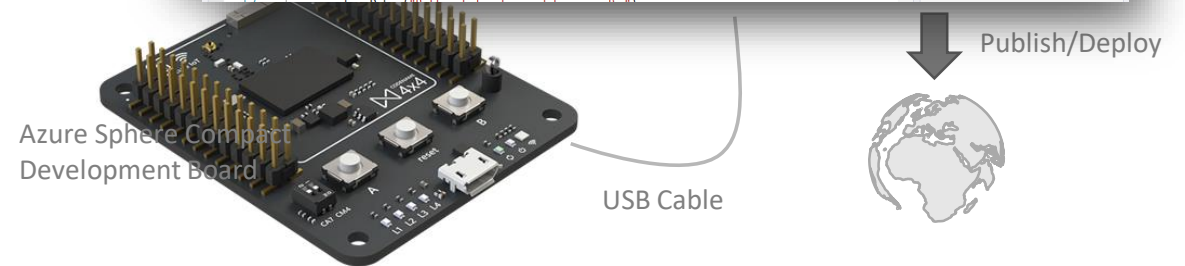
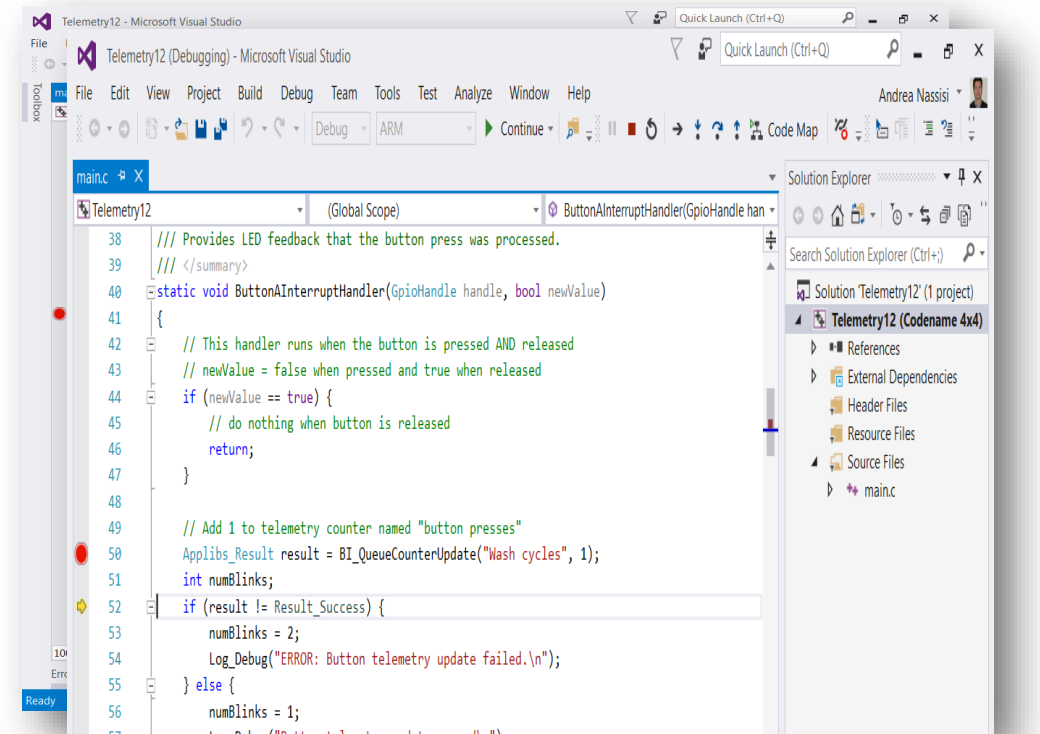
- Deterministic execution for I/O (GPIO, ADC, UART, SPI ...).
- The I/O processor comes with a reference RTOS.
- RTOS libraries and Visual Studio support for customers that want it.

## Azure Sphere Compact Development Board (cDVB)

- Provides prototype hardware to run and debug your applications.
- The headers pins: GPIO, ADCs, UART, SPI, I2C and I2S.
- On the board programmable: buttons, LEDs, temperature and motion sensor.

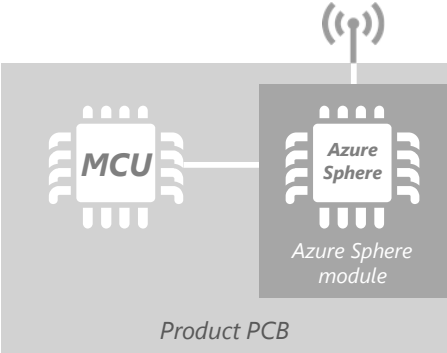
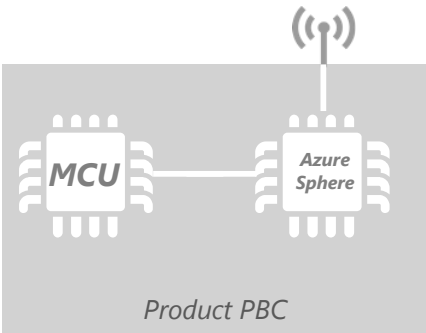
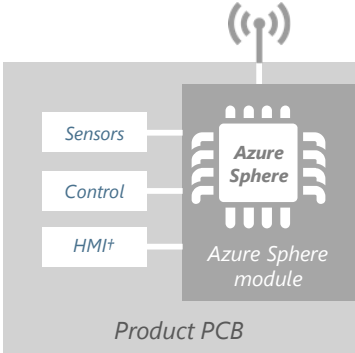
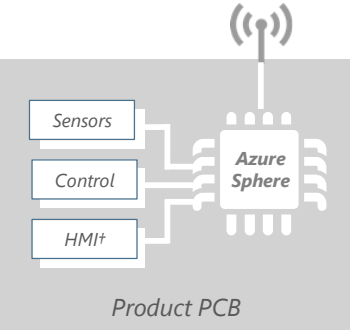
## Deploy your application

- Local deployment UI integrated to Visual Studio.
- Staged deployments to test machines then products in the field.
- Online web apps allow you to manage devices world-wide.



*"The development tools are first class. Easy to build for, easy to debug on. Visual Studio stands head and shoulders above any Linux development environment we have used." "The board connectivity is excellent, plenty of GPIO, UART, Wifi. Azure Sphere Well documented, clear and concise." (Quotes from an early adopter)*

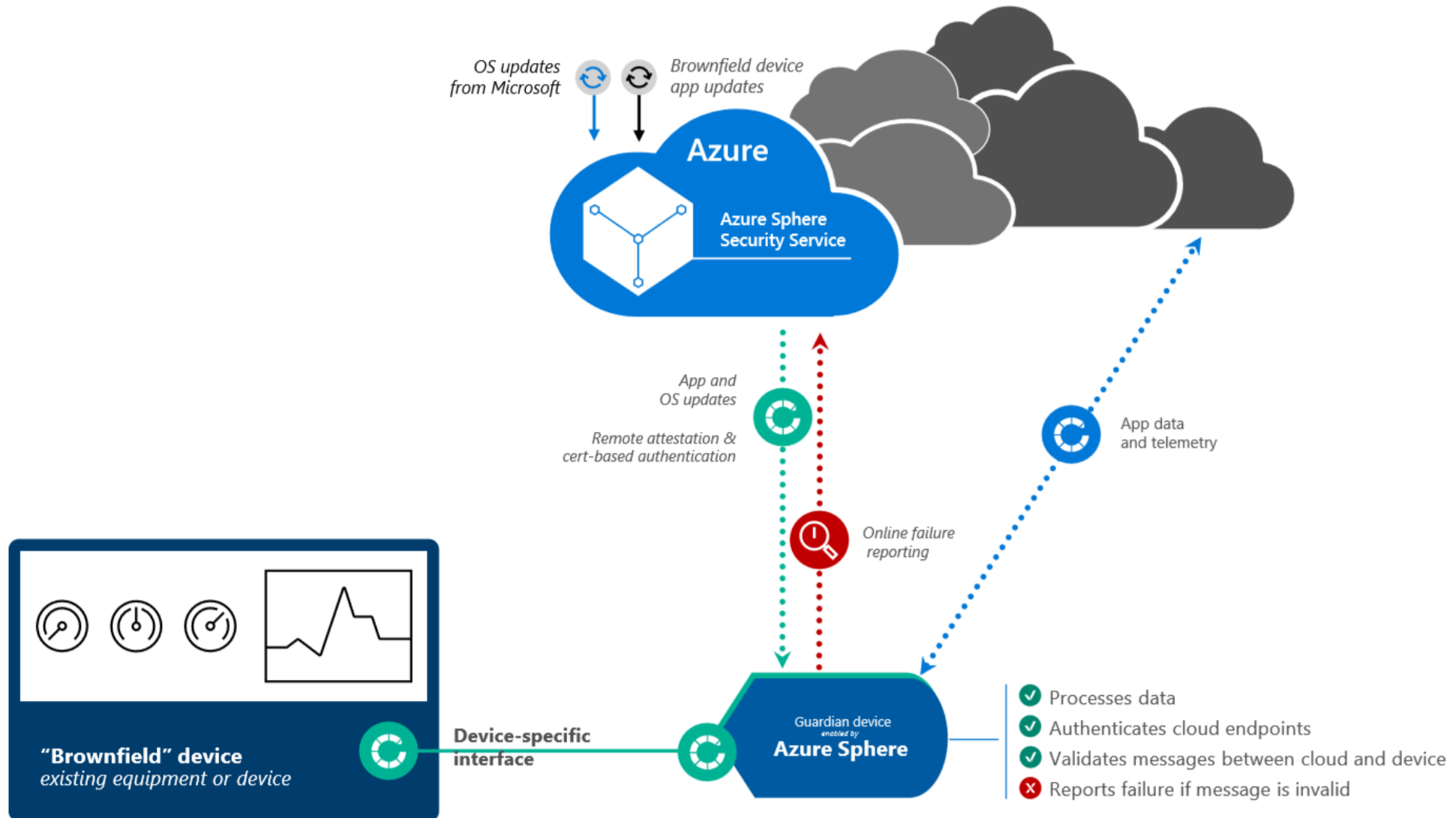
# Azure Sphere MCU and module application scenarios\*

		module	implementation	chip
architecture	complement existing MCU	 <p>Upgrade existing devices by adding a Azure Sphere module to existing MCU, connected by serial, SPI etc.</p>		 <p>Use a Azure Sphere MCU to provide connectivity in conjunction with an application-specific MCU.</p>
	replace existing MCU	 <p>Add connectivity to existing or new devices by wiring simple sensing, control and HMI to a Azure Sphere module.</p>		 <p>Use a Azure Sphere MCU to implement all the on-device logic and provide connectivity.</p>

















# Two types of implementations



# Guardian Module devices with Azure Sphere



# Brownfield opportunity in key verticals

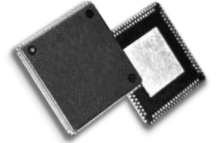
Retail	Infrastructure	Mining and Manufacturing	Logistics and Transportation
 Grocery	 Hotels	 Food and Beverage Manufacturing	 Fleet Transport
 Quick Service Restaurants	 Smart Cities	 Mining	 Insurance
 Department and Fashion Stores	 Electric and Gas Utilities	 Automotive Manufacturing	 Airport
 Retail Banking			 Railway
 Gas Stations			
 Consumer Goods			

# Our growing ecosystem of HW partners



## Azure Sphere certified MCUs

Our silicon foundation delivered through a growing ecosystem of chip manufacturers



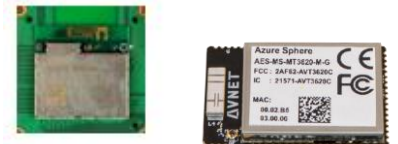
## Development kits

Help organizations prototype quickly



## Modules

Speed up time to market for device makers



## Guardian Modules

Enable secure brownfield IoT





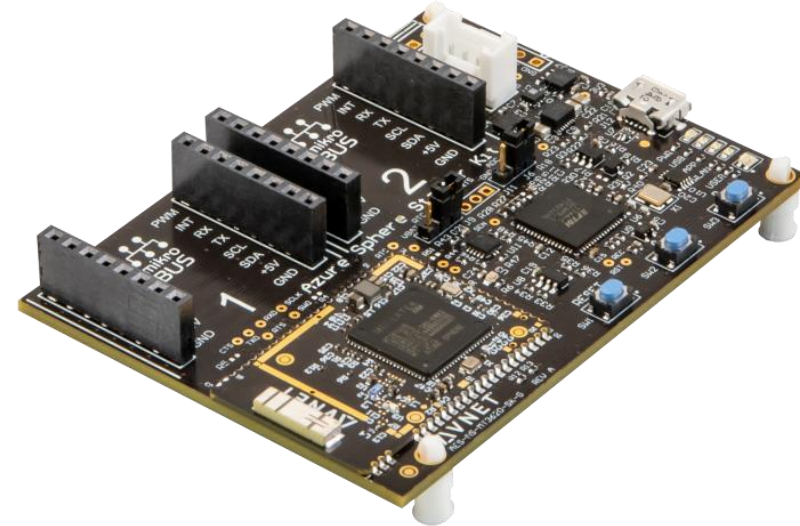
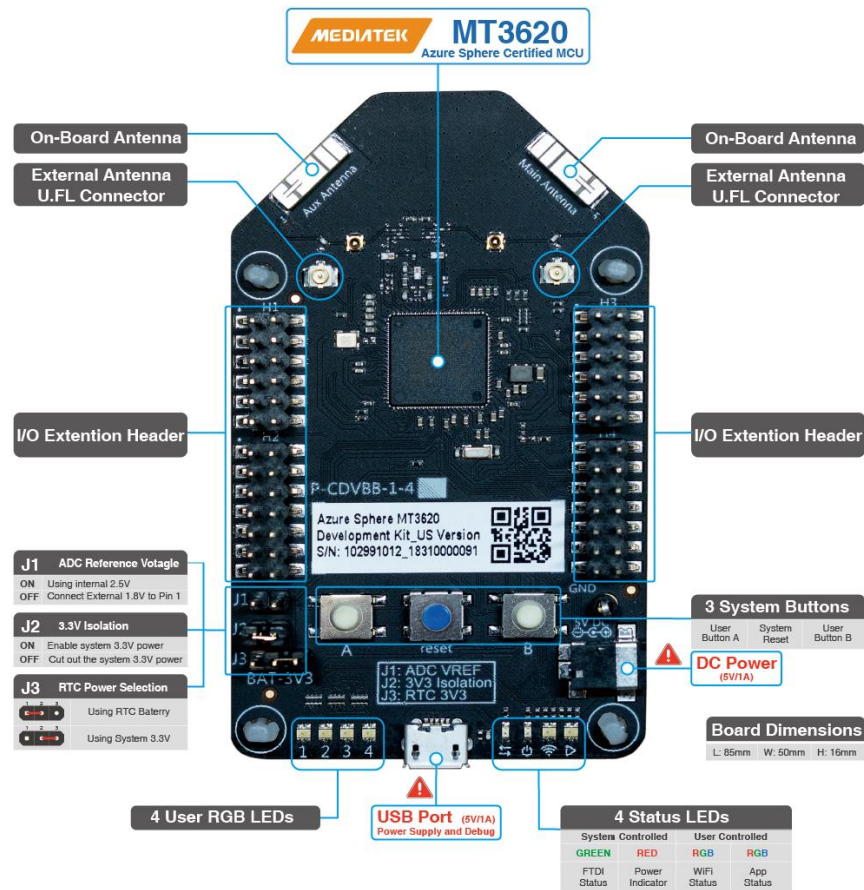
# The Partners Azure Sphere MT3620 Dev Kits

## Seed Azure Sphere MT3620 Starter Kit

## Avnet Azure Sphere MT3620 Starter Kit



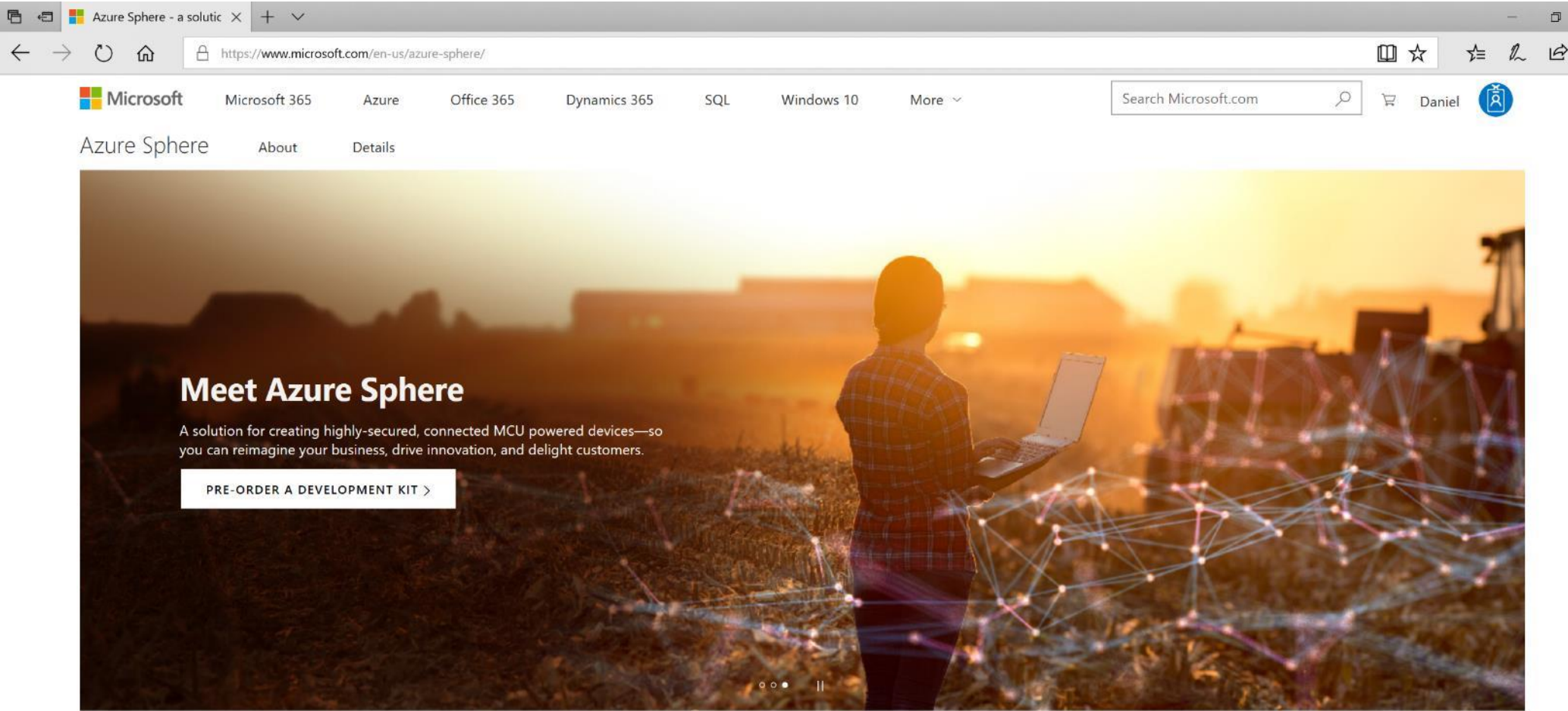
### MT3620 Development Board Diagram



### Carrier Board

- Two MikroE Click board expansion sockets
- Grove expansion connector (I2C)
- On-board sensors
  - 3-Axis accelerometer
  - 3-Axis gyro
  - Temperature
  - Pressure/Barometric
  - Ambient Light
- Interface for optional OLED 128x64 display
- USB Interface
  - Supports debug, service & recovery UARTs, and JTAG
- User pushbutton switches and LEDs
- 5V to 3.3V Power regulation
- DC Supply Input:
  - USB 5V from host computer
  - Terminal footprints for external 5V DC and VBAT supplies

# Visit Azure Sphere Page for Resources



**Transform and protect your products from the silicon up**