

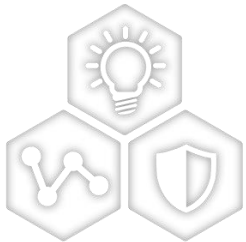
# Microchip Wireless Technology and Sustainability

Microchip Wireless 與地球生  
態共存的永續發展



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A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

**WSG**

May 8, 2023

# Agenda

- **Microchip Wireless and Sustainability**
- **Microchip Wireless Solution Successful Stories**
- **Smart Industrial Thermostat**
- **WSG product examples on MicrochipTech GitHub**
- **Q&A**

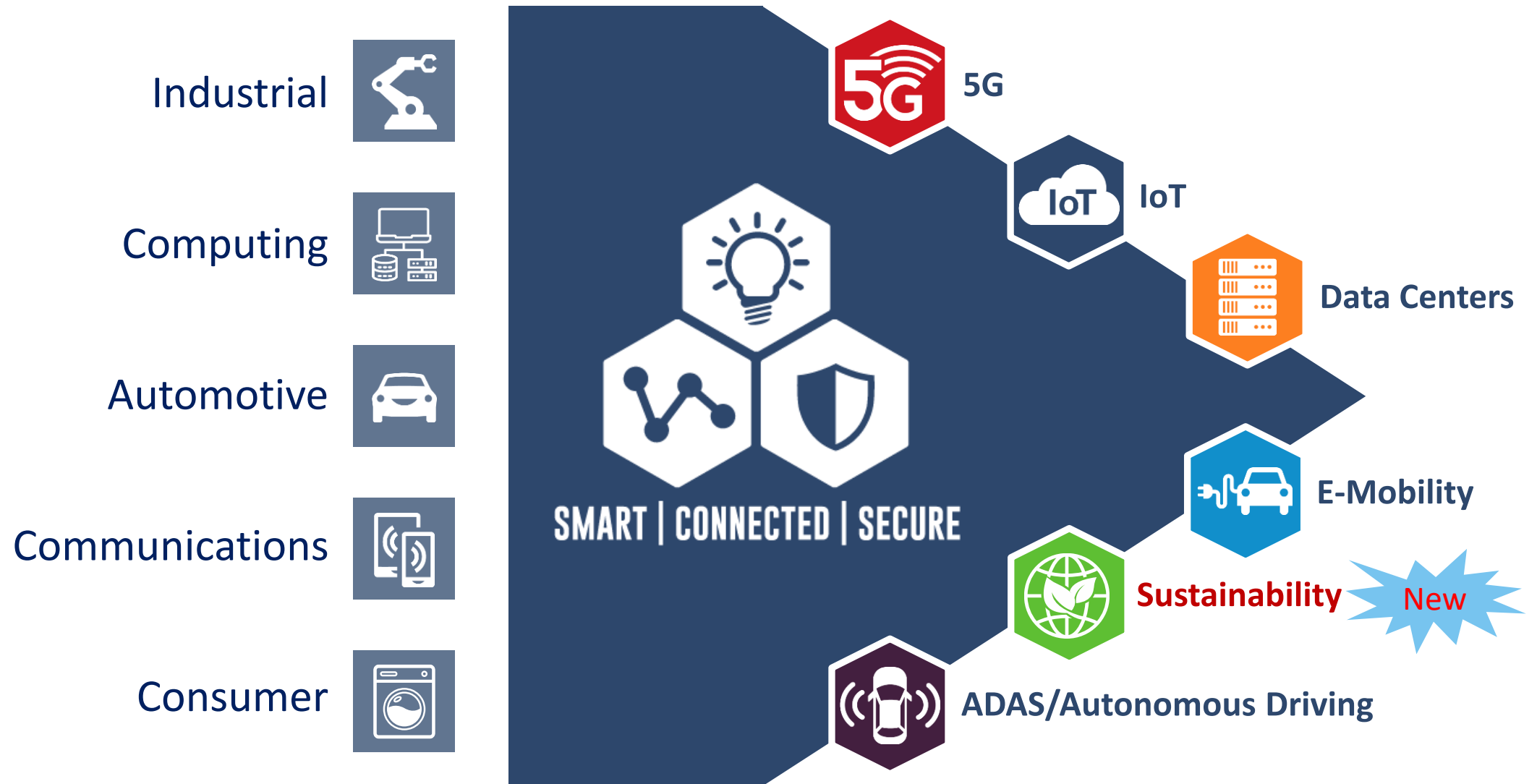


# Microchip Wireless and Sustainability

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How Microchip Wireless Solutions can help our customers for sustainability?

# Megatrend Growth: Sustainability



# Microchip Solutions in Sustainability



## Energy Generation, Storage and Distribution

- Solar Power Systems
- Wind Turbines
- Alternative Energy such as Biomass
- Hydrogen Fuel Cells
- Energy Storage Systems (Battery Charging, Battery Management Systems)
- Smart Grid Applications



## Efficient Energy and Water Use

- Smart Agriculture (targeted irrigation & fertilization)
- High Efficiency Power Supplies
- Solar Inverters
- Higher Efficiency Motor Control
- LED Lighting
- Smart Dimmers, Actuators and Valves
- Heating, Ventilation and Air Conditioning
- Energy Star Appliances



## Resource Monitoring and Optimization

- Smart Electric/Water/Gas Meters
- In-Home Energy Displays and Awareness Systems
- Motion Sensors
- Gas Leak Detection
- Building Management (Light, Energy use)



## Waste Reduction and Reuse

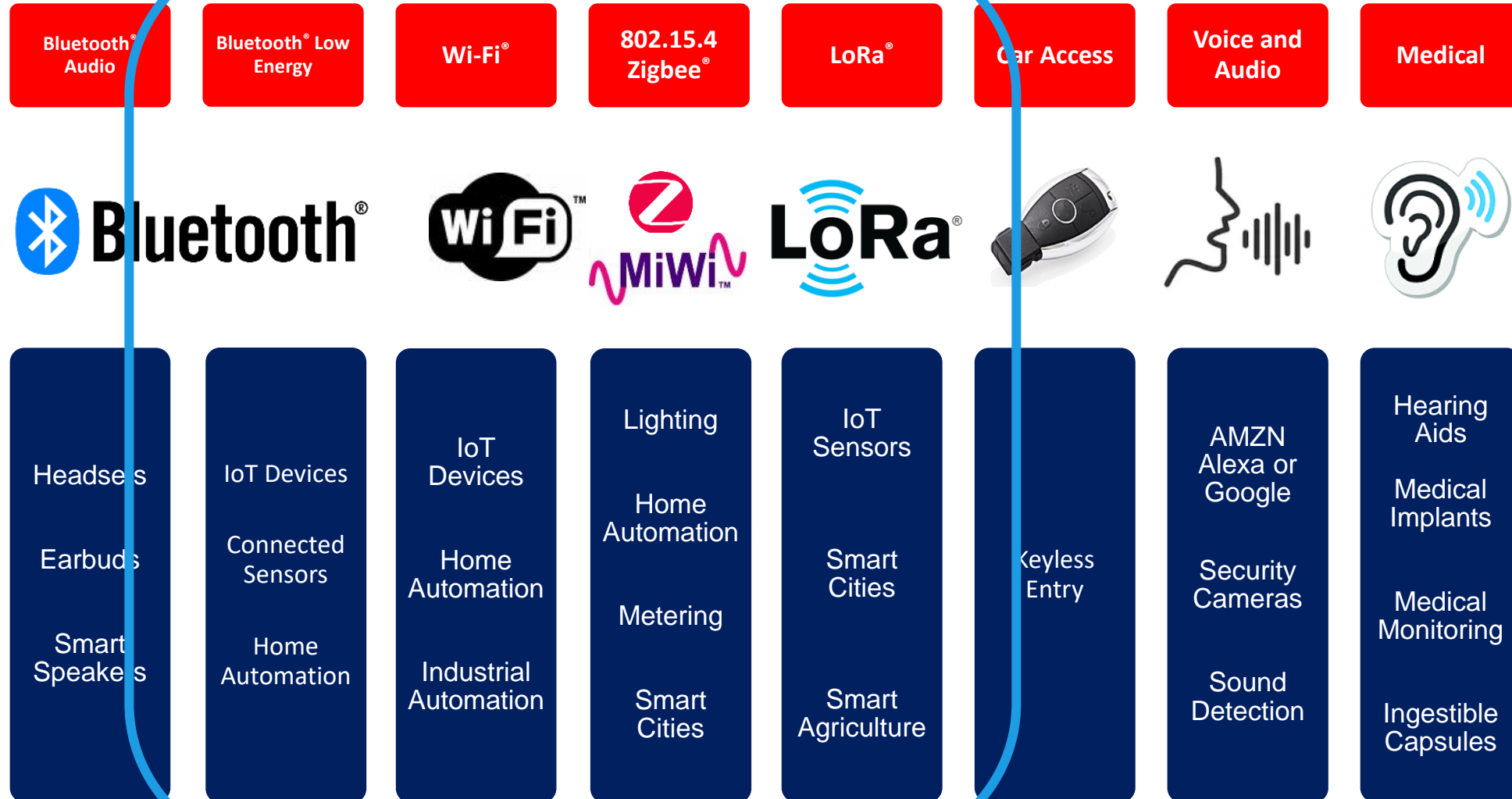
- Smart Waste Management
- Water Bottle Refilling Stations
- Smart Irrigation Systems
- Asset Tracking
- Public Restroom Dispensers (Soap, Paper, Water)
- Low Standby Power

# Wireless Technology and Sustainability

- 無線科技在地球永續發展中扮演著重要的角色。它可以幫助人們更有效地使用資源和能源，促進環境保護和減少污染。
  - 物聯網網絡：物聯網 (IoT) 是相互無線通信的互連設備網絡。物聯網網絡可用於更有效地監控和管理水和能源等資源，減少浪費並提高永續性。
  - 無線感測器：無線感測器可以監測不同的環境因素，例如空氣和水的質量，並將這些數據傳回中央數據庫進行分析。這有助於監測和保護環境，以及改進能源效率。
  - 可再生能源：無線技術可用於監測和控制太陽能和風能等可再生能源。這有助於優化發電並最大限度地減少浪費，使可再生能源更具經濟性和環境可持續性。
- 無線技術可以通過提高資源使用效率、支持可再生能源以幫助實現更環保與高效的能源和資源使用，促進地球永續發展。然而，重要的是要考慮無線技術對環境的潛在影響，並以負責任和永續的方式使用它。

# Microchip Wireless Solutions

## Wireless Data Products





# IoT Development Made Easy

- **Cloud support**

- Libraries and example software of Cloud connections
- Out-of-box application examples with AWS and Azure connection
- Voice control function enabled
- Certified Boards

- **MPLAB and Harmony**

- Rich system-level example applications
- Drivers for MCU peripherals and external Microchip add-on devices
- Fast prototyping, seamless integration

- **Software tools**

- Mobile apps with source codes provided





# Microchip Total System Solutions

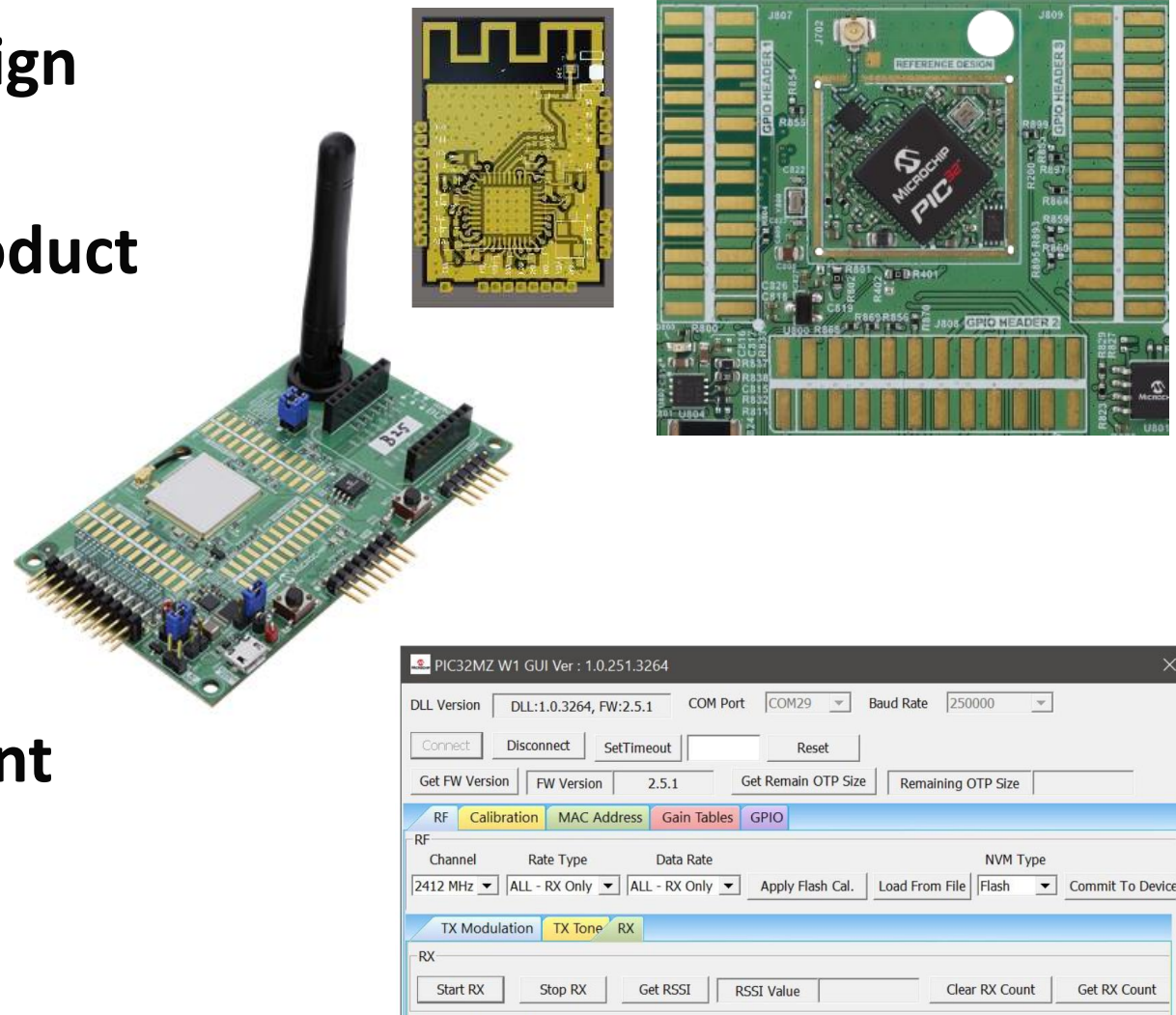
## Full Product Lifecycle Support



# Chip-down Reference Design Packages

## Develop professional RF product

- Pre-certified module reference design
- Easy-to-integrate PCB SNIP files
- Tools, Collateral for all stages in product life-cycle
  - Design
  - Validation
  - Certification
  - Production
- Strict layout guidelines for important sections
- Free Wireless Check Services





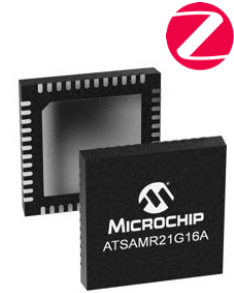
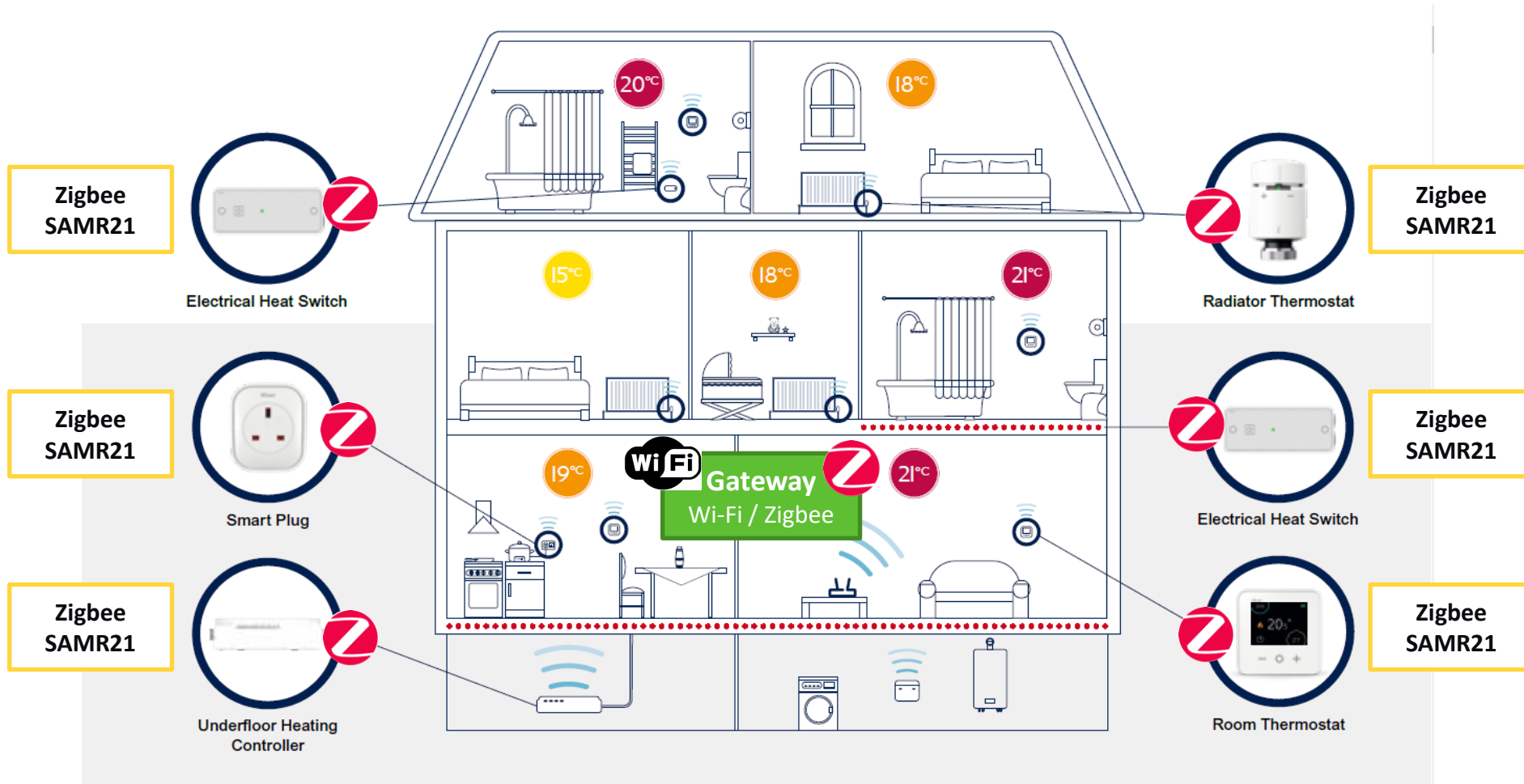
# Successful Stories

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Microchip Wireless Solutions used in product to  
achieve sustainability

# Thermostat / Energy Mgt

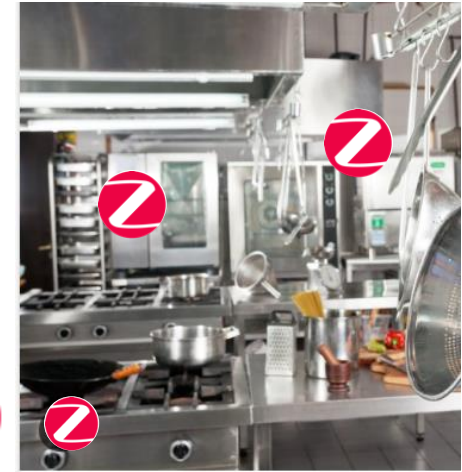
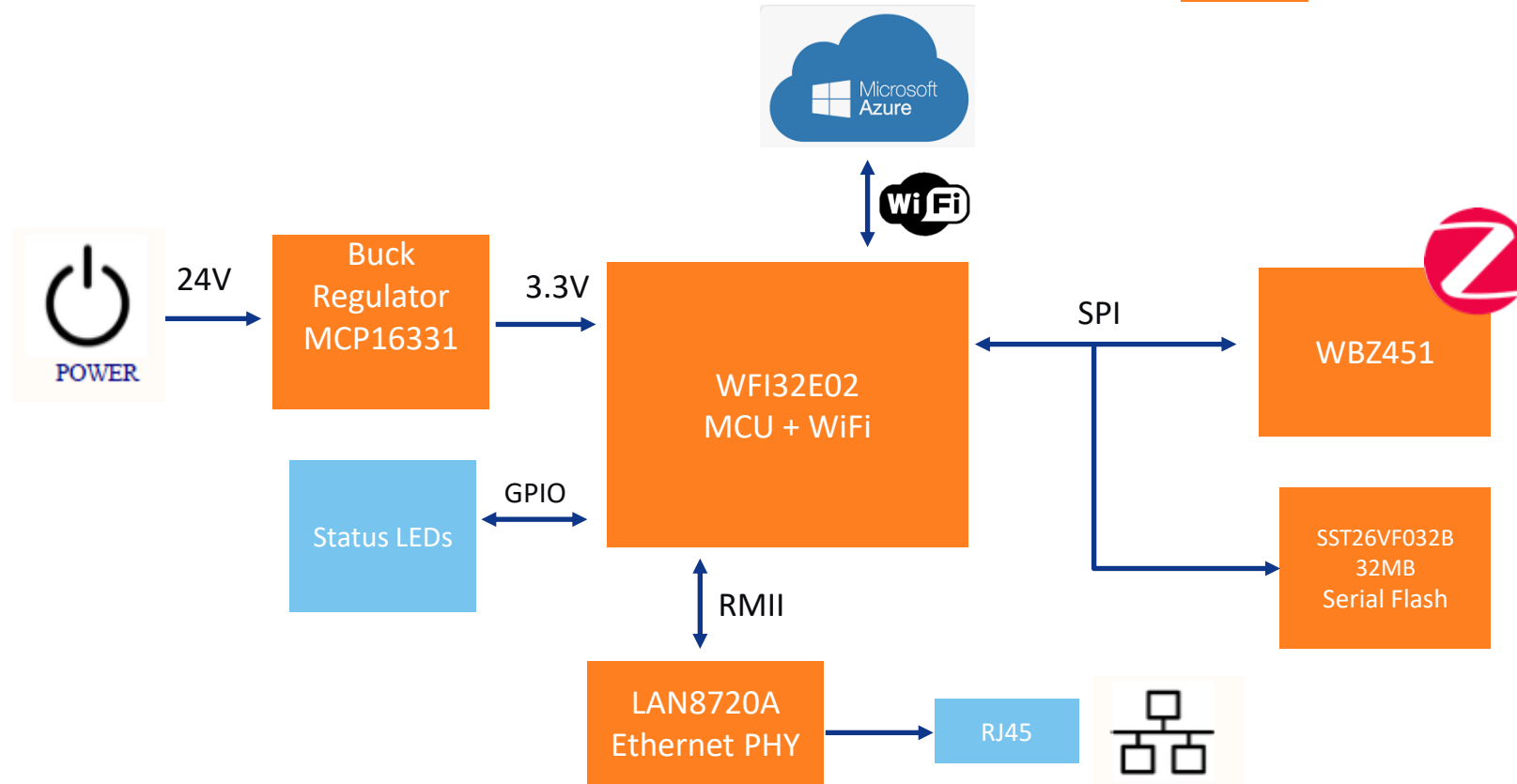
## Legrand



- Now 2.4Mu/y with SAMR21
- PIC32CX-BZ2 or BZ6 promoted for next Gen (Matter)



# Connected Industrial Kitchen

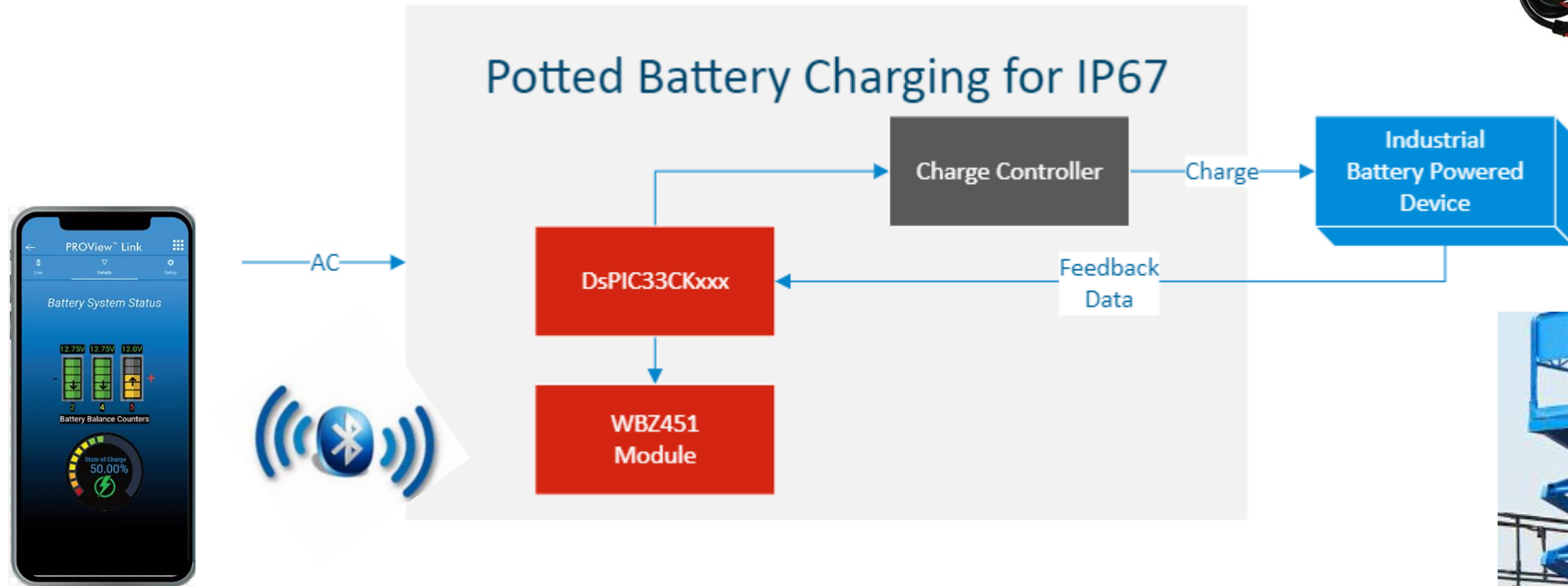


- WFI32 is host MCU with rich peripherals (Ethernet, SPI, GPIO, ADC, etc.)
- WBZ451 provides Zigbee mesh network to oven, refrigerator, lights, etc.
- MCHP power management, serial flash, and Ethernet PHY.



# Battery Charging System

## PRO Charging Systems

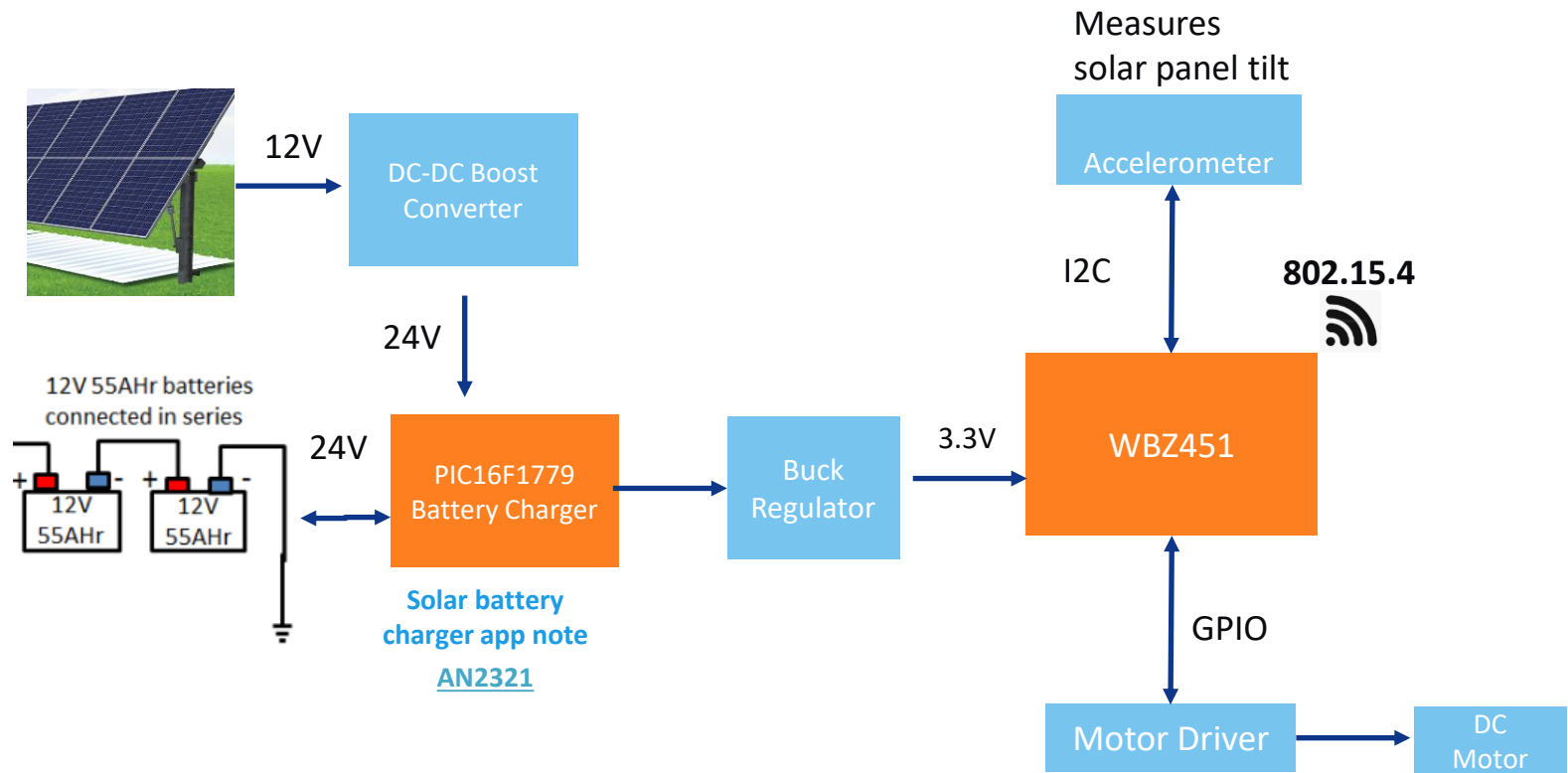
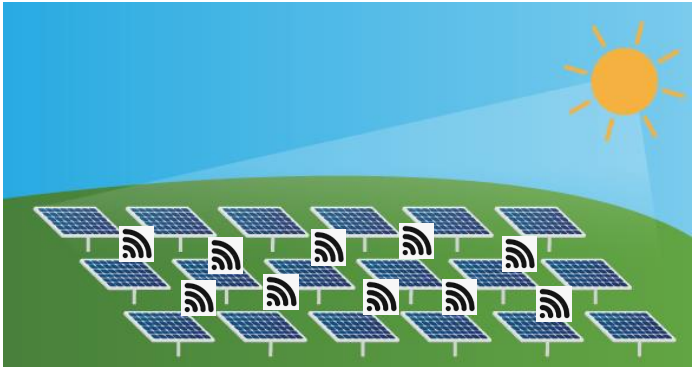


- WBZ451 provide BLE to connect with Phone App and HMI
- WBZ451 Allows OTA updates
- WBZ451 Settings and Status
- WBZ451 Send out long term battery status

# Solar panel node controller

## GameChange Solar

MCHP



### Power Budget

TABLE 1: SYSTEM POWER BUDGET

System	Power	Use
Solar panel	130W in full sun	Provide system with 1.3 kWh charge in 10 hours
Battery	Two 12V@55Ahr	Storage capacity for 1.3 kWh of charge

- WBZ451 provides 802.15.4 mesh network. Up to 250 nodes.
- WBZ451 is both host MCU and radio.
- WBZ451 uses BLE for mobile device connection





# Microchip Product Update on Wi-Fi & BLE

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Microchip Wireless Solutions used in product to  
achieve sustainability

**Wi-Fi®**

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# Wi-Fi Roadmap

Development

Production

## WINCS02 / RNWF02

Wi-Fi 4, 2.4GHz  
**Embedded MCU**  
Network Controller  
SPI/UART I/F  
48 QFN, Module

Turnkey

## WILCS02 / WIUBS02

Wi-Fi 4, 2.4GHz  
**Linux/RTOS**  
Link Controller  
SDIO, USB I/F  
48 QFN, Module

Turnkey

### MCU/MPU attach

- Best for Linux applications
- WINC/WILC migration path
- “RN style” simplicity
- Supporting Matter/Thread

Attach

## WFI32E02Ux

Wi-Fi 4, 2.4GHz  
**1MB Flash/320kB RAM**  
2xADC, ENET, USB, PWM  
AWS, Azure, Class B Support  
Module for 62 GPIO

## WFI32E01Px Ux/ PIC32MZ-W1xxx

Wi-Fi 4, 2.4GHz  
**1MB Flash/320kB RAM**  
2xADC, ENET, USB, PWM  
AWS, Azure, Class B Support  
132 DQFN, Module

Standalone MCU

## WFI32E03 / PIC32MZ-W1xxx

Wi-Fi 4, 2.4GHz  
**2MB Flash/512kB RAM**  
2xADC, ENET, USB, PWM  
AWS, Azure, **Matter**  
Class B Support  
132 DQFN, Module

### MCUs with integrated Wi-Fi

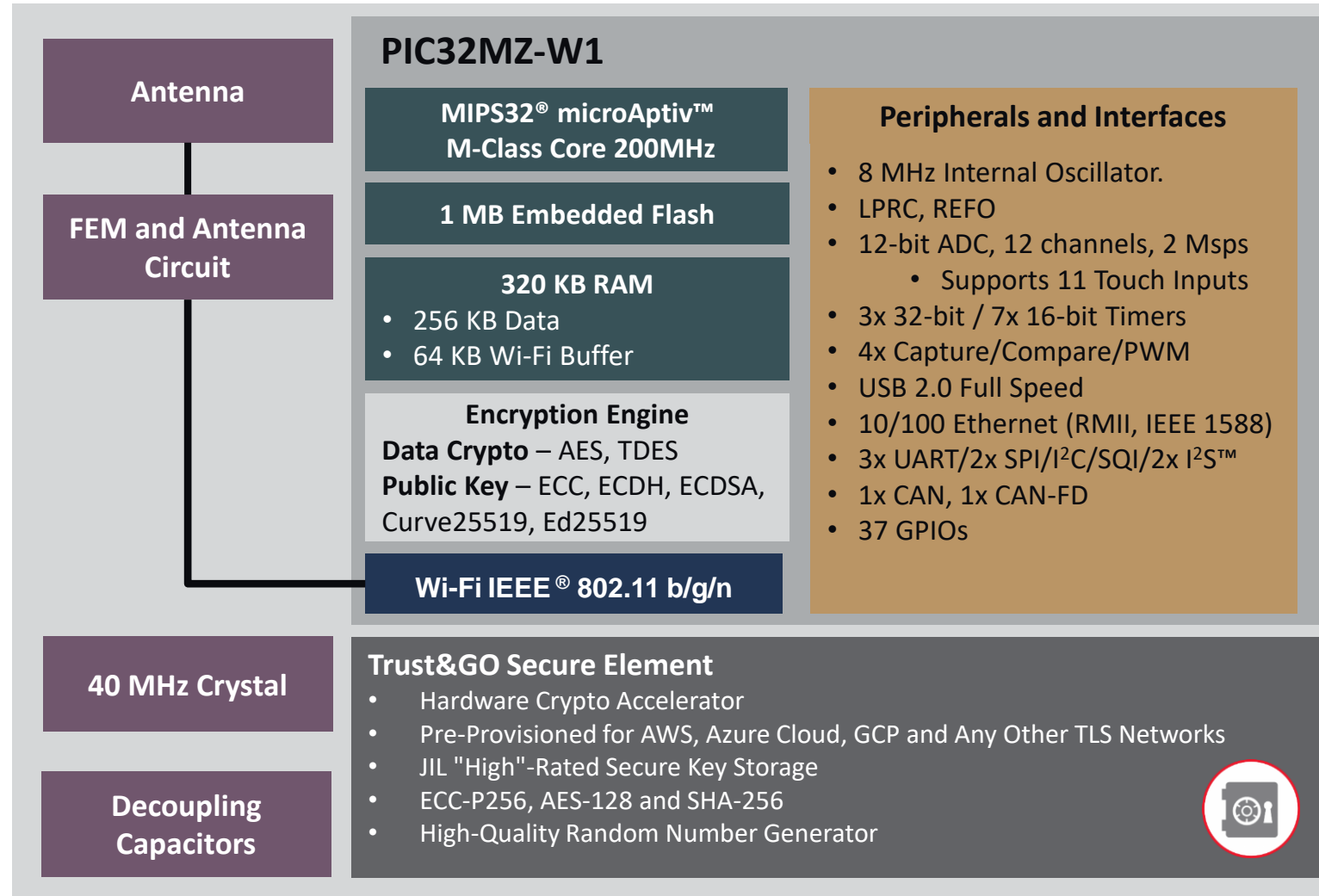
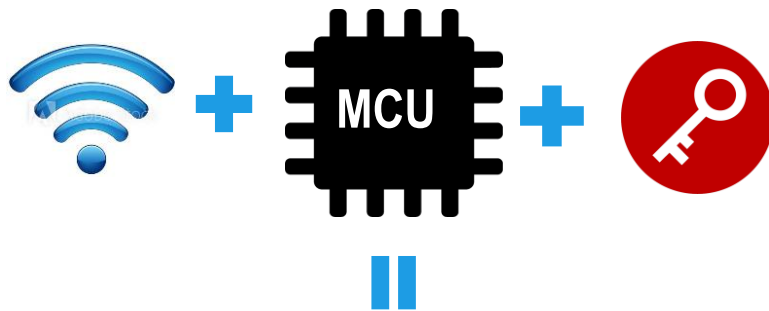
- MPLAB Harmony ecosystem
- General purpose use cases
- Generous peripherals
- Protocol Bridging

# WFI32E01PC

## 54-Pad Trust&GO Wi-Fi MCU Module



- High performance and low power 32-bit Wi-Fi MCU, PIC32MZ-W1
- Best-in-class peripheral set
- Trust&GO hardware security
- Powerful Wi-Fi radio
- All-in-one module

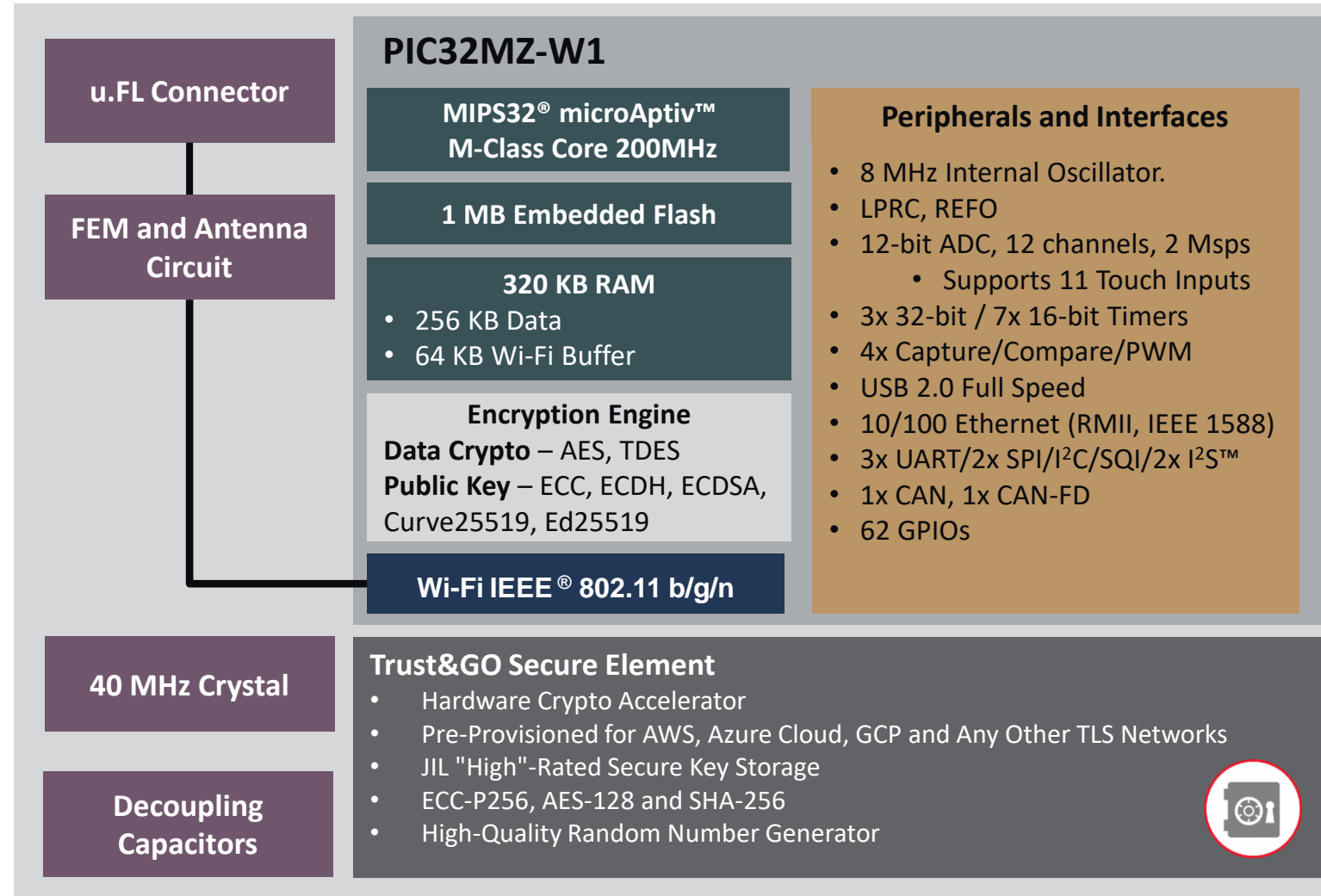
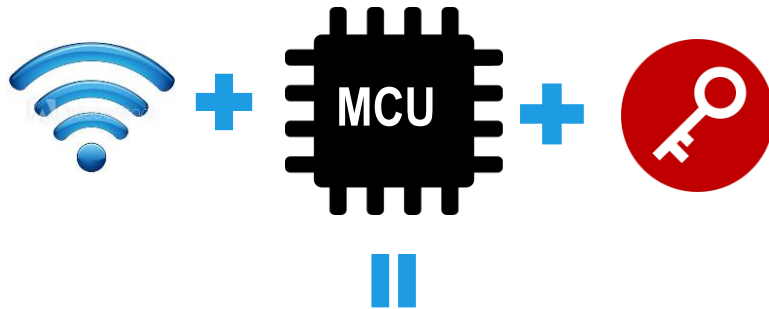


# WFI32E02Ux



## 70-Pad Trust&GO Wi-Fi MCU Module with 62 GPIOs

- High performance and low power 32-bit Wi-Fi MCU, PIC32MZ-W1
- Offer 62 GPIOs on the module, 25 more than WFI32E01 module
- Optional Trust&GO security
- u.FL Connector only

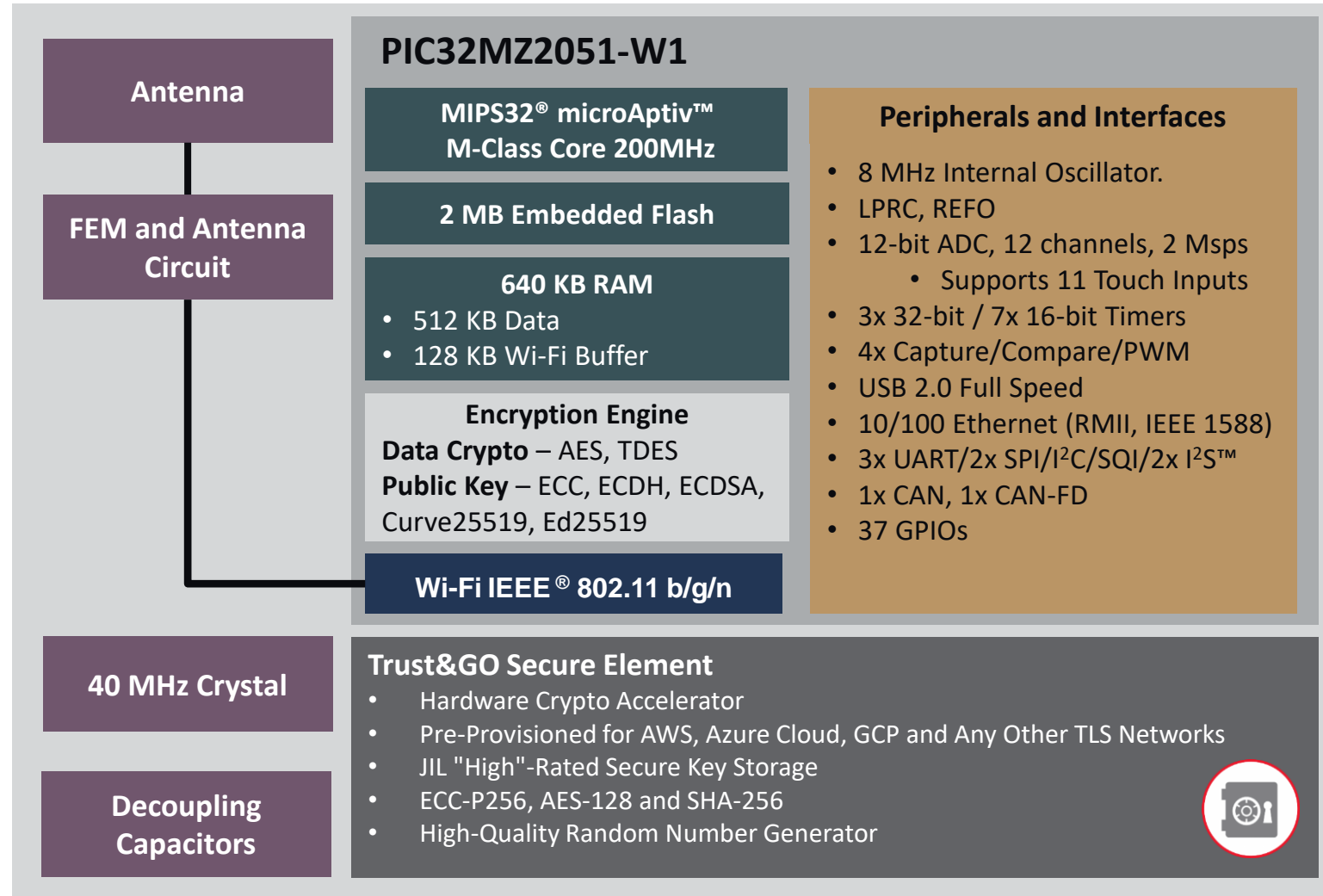
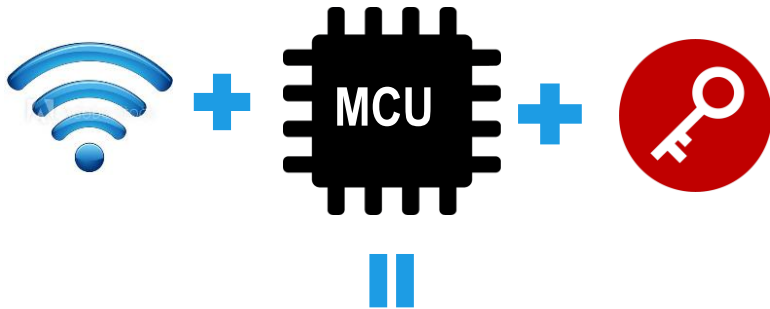


# WF132E03PC



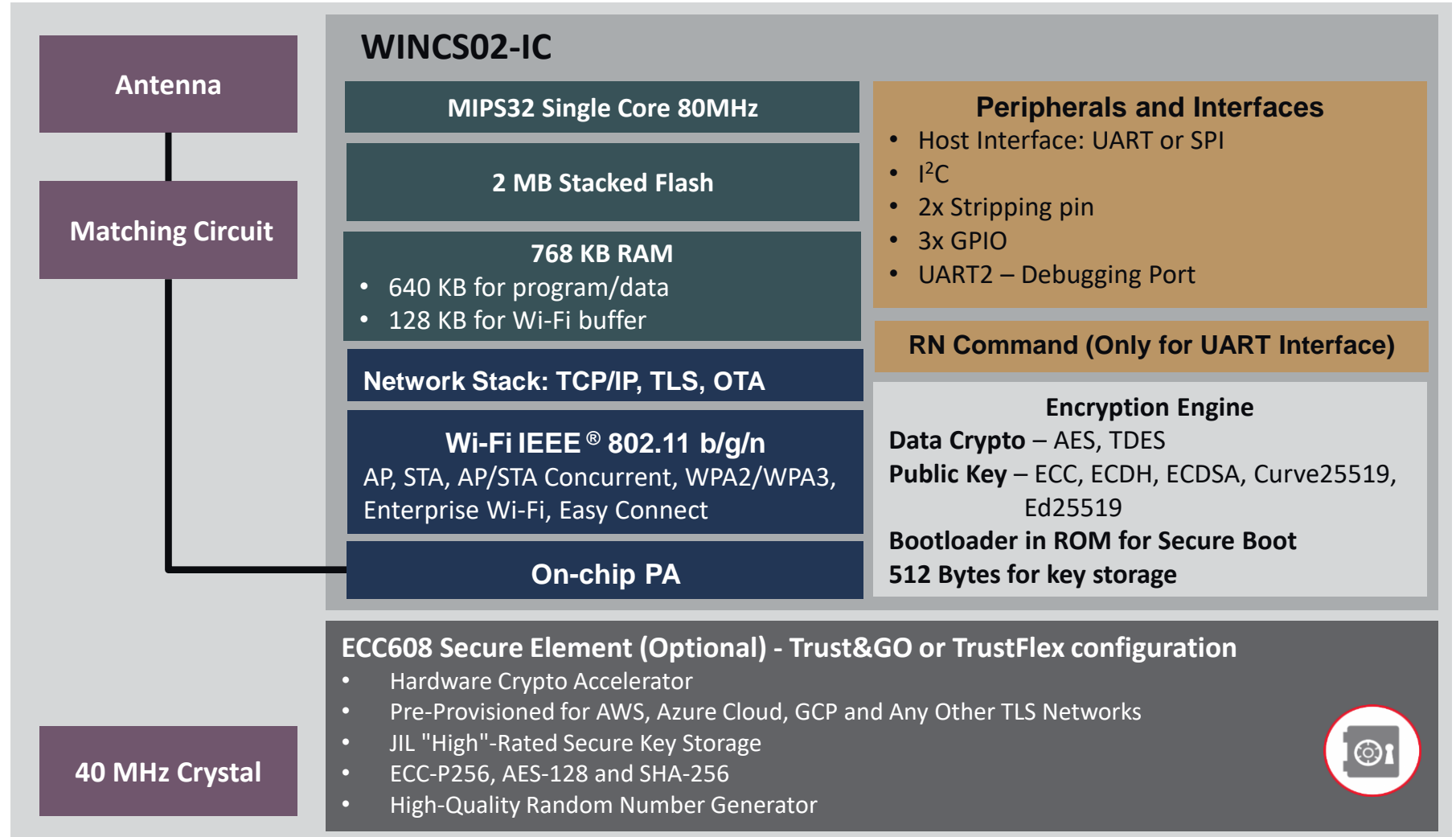
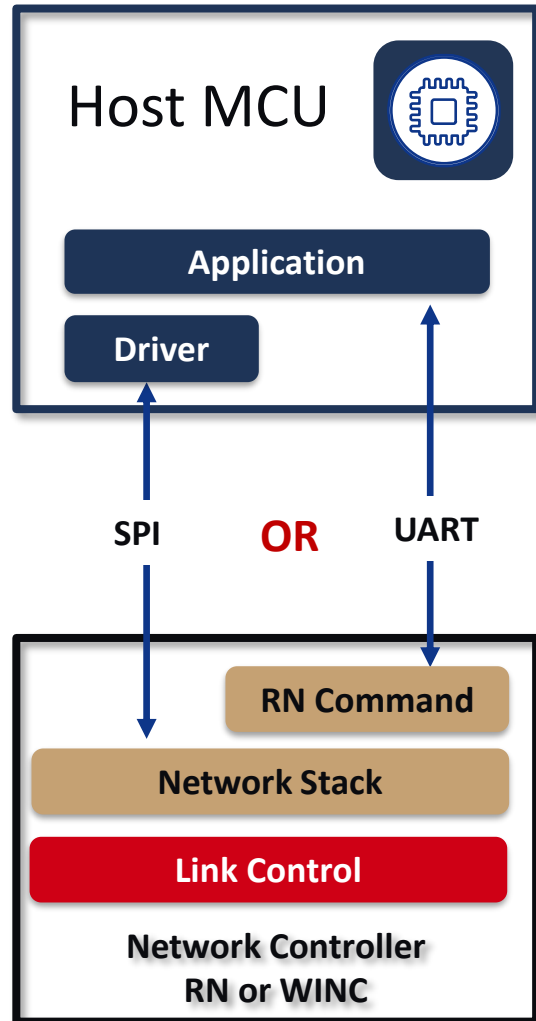
## 54-Pad Trust&GO Wi-Fi MCU Module with 2MB Flash and 640kB RAM

- High performance 32-bit Wi-Fi MCU, PIC32MZ-W1
- Best-in-class peripheral set
- Trust&GO hardware security
- Powerful Wi-Fi radio
- All-in-one module



# WINCS02 (SPI) / RNWF02 (UART)

## Wi-Fi Network Controller Companion Module to MCU





# WINCS02 (SPI) / RNWF02 (UART)

## Feature set

- **Next generation network controller module – replacement of WINC15x0**

- Support IPv6
- AT-Command through UART
  - Host sends serial commands to control the module
  - Smaller driver size at host
- New advanced features planned
  - Secure Boot
  - WPA3 (Latest Wi-Fi security standard)
- Optional Trust&GO or TrustFlex on the module

- **Processor:**

- MIPS32® Single-Core, 80MHz

- **Memory:**

- 2MB stacked flash, 768KB RAM, 128KB ROM
- 512B eFuse, Immutable Boot

- **Interface:**

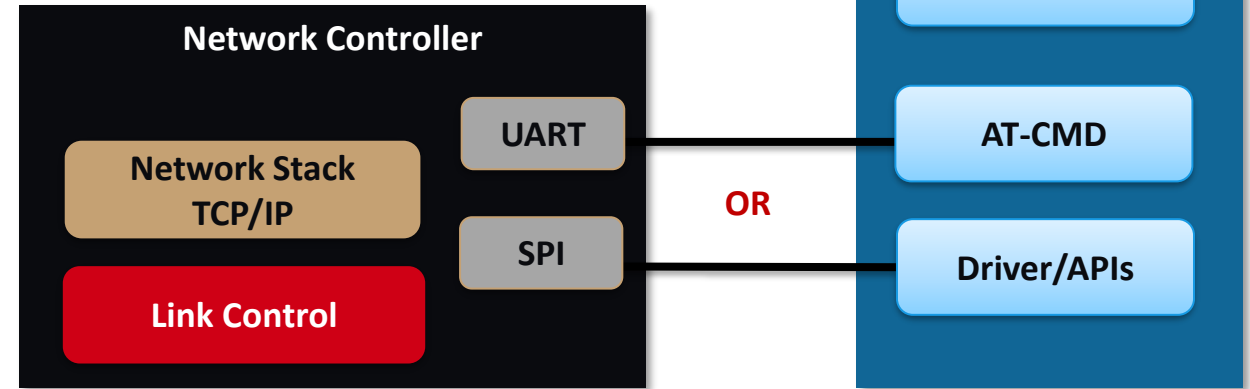
- UART/SPI
- Module Pin-pin compatible to WINC15x0 module

- **Planned schedule:**

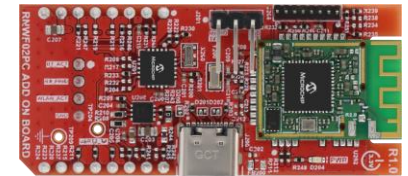
- RTP: Nov 2023 (RN); Jan 2024 (NC)
- Early Access program: Jun 23 (RN); Dec 23 (NC);

- **Development Board**

- RN (UART) or NC (SPI) Add-on board (Click interface)
- IOT board (optional/future)



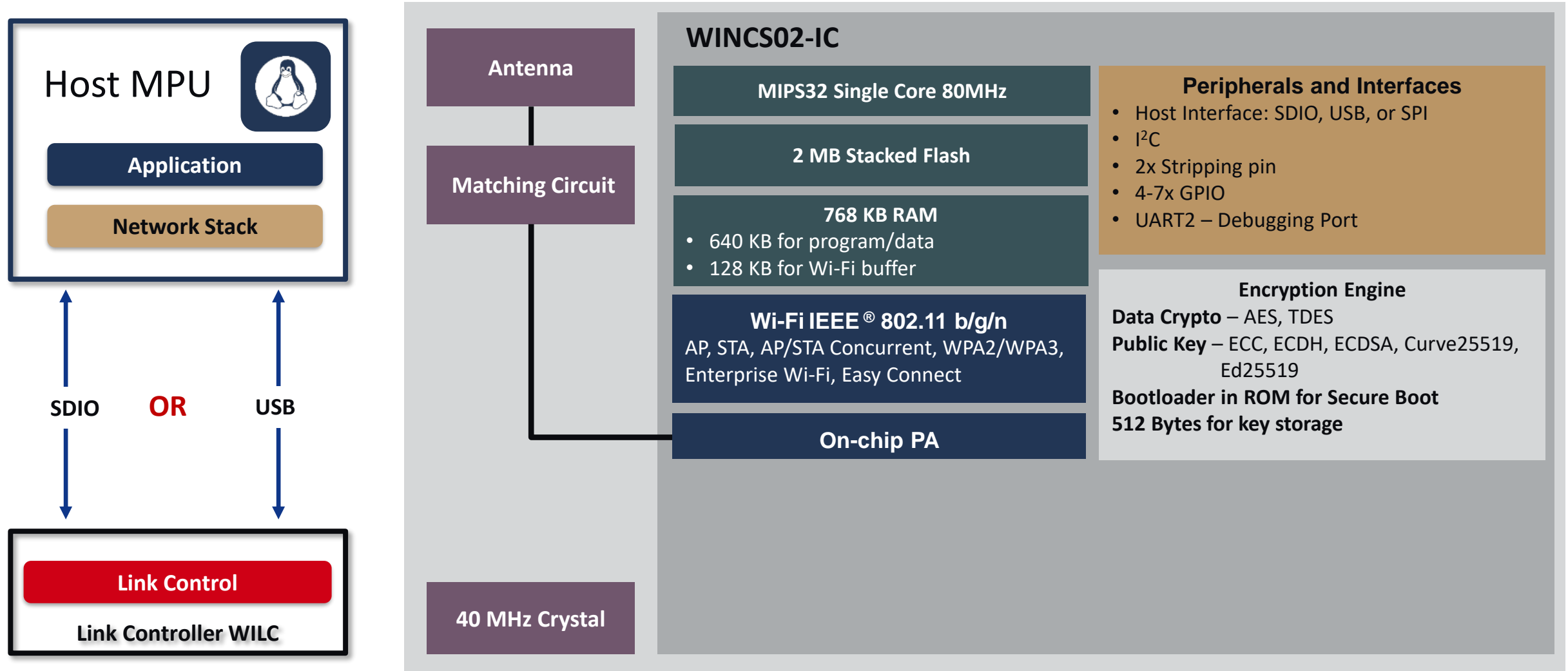
Option 1 - SPI	Option 2- UART	
Function	Function	Comments
SPI (4)	UART1 (4)	Host interface
UART2 (2)	UART2 (2)	Debug
I2C (2)	I2C (2)	ECC608
PTA/GPIO (3)	PTA/GPIO (3)	Co-ext
WAKE (1)	WAKE (1)	Wakeup
RTC/GPIO (4)	RTC/GPIO (4)	RTC input /GPIO
INT (1)	INT (1)	Interrupt to MCU
Strapping Pin (1)	Strapping Pin (1)	Select SPI/UART



# WILCS02 (SDIO) / WIUBS02 (USB)



## Wi-Fi Link Controller Companion Module to MPU Linux



# EA Schedule – 18/04/23

- **WFI32E02UC (Standalone Wi-Fi MCU module with 1MB Flash and 62 GPIOs)**
  - EAC Jun'23
  - Production Oct'23
- **WFI32E03PC (Standalone Wi-Fi MCU module with 2MB Flash)**
  - EAC Sept'23
  - Production Dec'23
- **RNWF02 (UART) – RN Style with MCU**
  - EAC June'23
  - Production Nov'23
- **WILCS02 (SDIO) – Link Controller with MPU Linux**
  - EAC Sept'23
  - Production Dec'23
- **WINCS02 (SPI) – Network Controller with MCU**
  - EAC Dec'23
  - Production Jan'24
- **WIUBS02 (USB) – Link Controller with MPU Linux**
  - EAC CQ1' 24
  - Production CQ2' 24

# Bluetooth® Low Energy

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# Bluetooth® Low Energy Portfolio Roadmap

## Standalone

### PIC32CX-BZ2/WBZ45x

M4F, 64MHz  
1MB/128k  
**BLE 5.2 + ZB 3.x**  
**OTA**  
32/48 QFN (SoC/Module)

### PIC32CX-BZ3/WBZ35x

M4F, 64MHz  
512k/96k  
**BLE 5.2 / ZB 3.x / Thread**  
**Secure Boot, OTA,**  
**CVD Touch, Low Power RF**  
32/48 QFN (SoC/Module)

### PIC32CX-BZ6/WBZ65x

M4F, 128MHz, **2MB/512k**  
**BLE 5.2 + ZB 3.x / Thread**  
**Secure Boot, OTA, CVD**  
**Touch, USB, CAN-FD, QDEC,**  
**10/100,**  
**Low Power RF**  
48-/64-QFN/132-DQFN,  
(SoC/Module)

## Network Co-Processor Attach

### BM70/71

BLE 5  
Binary UART  
Full DLE

### RN4870/71

BLE 5  
**ASCII Interface**

### BM78

BLE 5 + BT Classic  
Binary UART  
DLE or SPP

### RN4678

BLE 5 + BT Classic  
**ASCII Interface**

### RNBD451

**BLE 5.2**  
ASCII Interface  
**OTA (Embedded)**  
39-pin SMD Module

### RNBD350

**BLE 5.2**  
ASCII Interface  
Secure Boot  
30-pin SMD  
Module

Released

In Development

# Bluetooth® Comparison Chart

## Quick Reference Guide

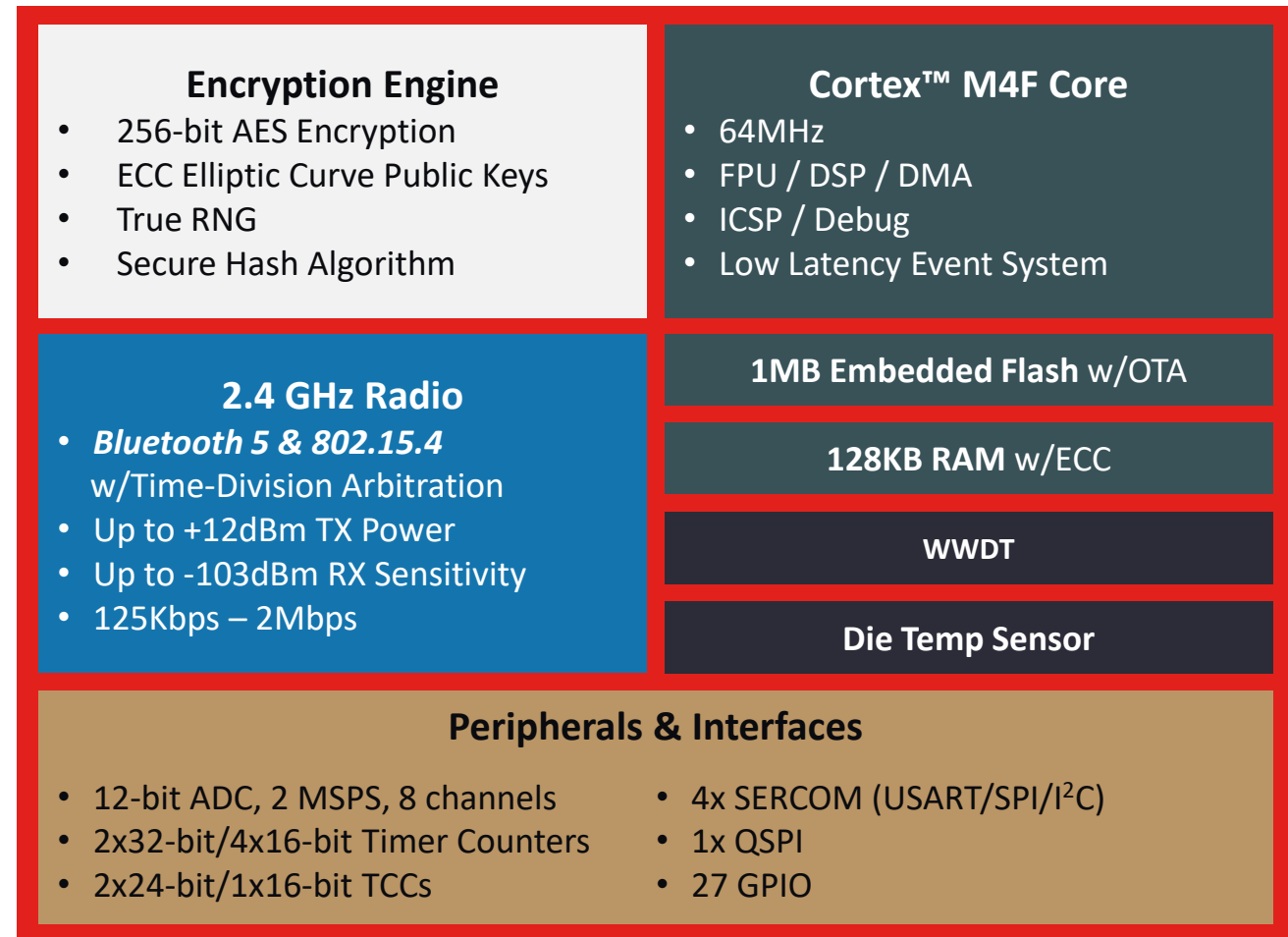
	Host UART Commands	Bluetooth® Core Spec	Bluetooth Low Energy Features Supported			Bluetooth Classic Features Supported			Development Environment Frameworks				Module Features	Idle Mode Current Consumption*	Antenna	Size (mm)	Regulatory Certifications
			LE Secure Connections	Data Length Extensions	Multi-Link/Multi-Role	Security	SPP	IAP2	MCC	ASF3	ASF4	Harmony 2	Deep-Sleep Current				
RNBD451	ASCII	5.2	Y	255 bytes	Y	AES Engine, TRNG, SHA1, SHA224, SHA256	x	x	x	x	x	x	1.2 µA	810 µA	PCB Antenna	15.5 × 20.7	US, Canada, EU, Japan, Korea, Taiwan
WBZ451	NA	5.2	Y	255 bytes	Y	AES Engine, TRNG, SHA1, SHA224, SHA256	x	x	x	x	x	x	1.2 µA	810 µA	PCB and u.FL Antenna	15.5 × 20.7	US, Canada, EU, Japan, Korea, Taiwan
RN4871	ASCII	5.0	Y	155 bytes	N	–	–	–					2.9 µA	80 µA	Chip Antenna Class 3	9 × 11.5	US, Canada, EU, Japan, Korea, Taiwan, China
BM71	Binary/Host SDK	5.0	Y	255 bytes	Y	–	–	–		x		x	2.9 µA	80 µA	Chip Antenna Class 3	9 × 11.5	US, Canada, EU, Japan, Korea, Taiwan, China
RN4870	ASCII	5.0	Y	155 bytes	N	–	–	–					2.9 µA	80 µA	Chip Antenna Class 2	12 × 22	US, Canada, EU, Japan, Korea, Taiwan, China
BM70	Binary/Host SDK	5.0	Y	255 bytes	Y	–	–	–		x		x	2.9 µA	80 µA	Chip Antenna Class 2	12 × 22	US, Canada, EU, Japan, Korea, Taiwan, China
RN4678	ASCII	"5.0 + Classic"	N	No	Y	Legacy Pairing	Y	Y					130 µA	390 µA	Chip Antenna Class 2	12 × 22	US, Canada, EU, Japan, Korea, Taiwan, China, India
BM78	Binary	"5.0 + Classic"	Y	No	Y	Legacy Pairing	Y	Y					130 µA	390 µA	Chip Antenna Class 2	12 × 22	US, Canada, EU, Japan, Korea, Taiwan, China, India

\*Idle mode is the minimum power consumption in which the radio will maintain a Bluetooth connection.

# PIC32CX-BZ2 MCU

## What's inside?

- **Highly Integrated PIC32 Microcontroller**
  - 1 MB flash grants ample code space for the application or OTA updates.
  - Rich peripheral set, Premium Analog and Up to 27 GPIOs.
- **Multi-protocol wireless**
  - Long range Bluetooth combining high transmit power (up to +12 dBm) and 125 Kbps coded PHY.
  - Simultaneous multi-protocol Bluetooth 5.2 and ZigBee 3.0 operation through hardware & software arbitration.
- **Security**
  - Advanced on-board security engine for security from remote attacks.

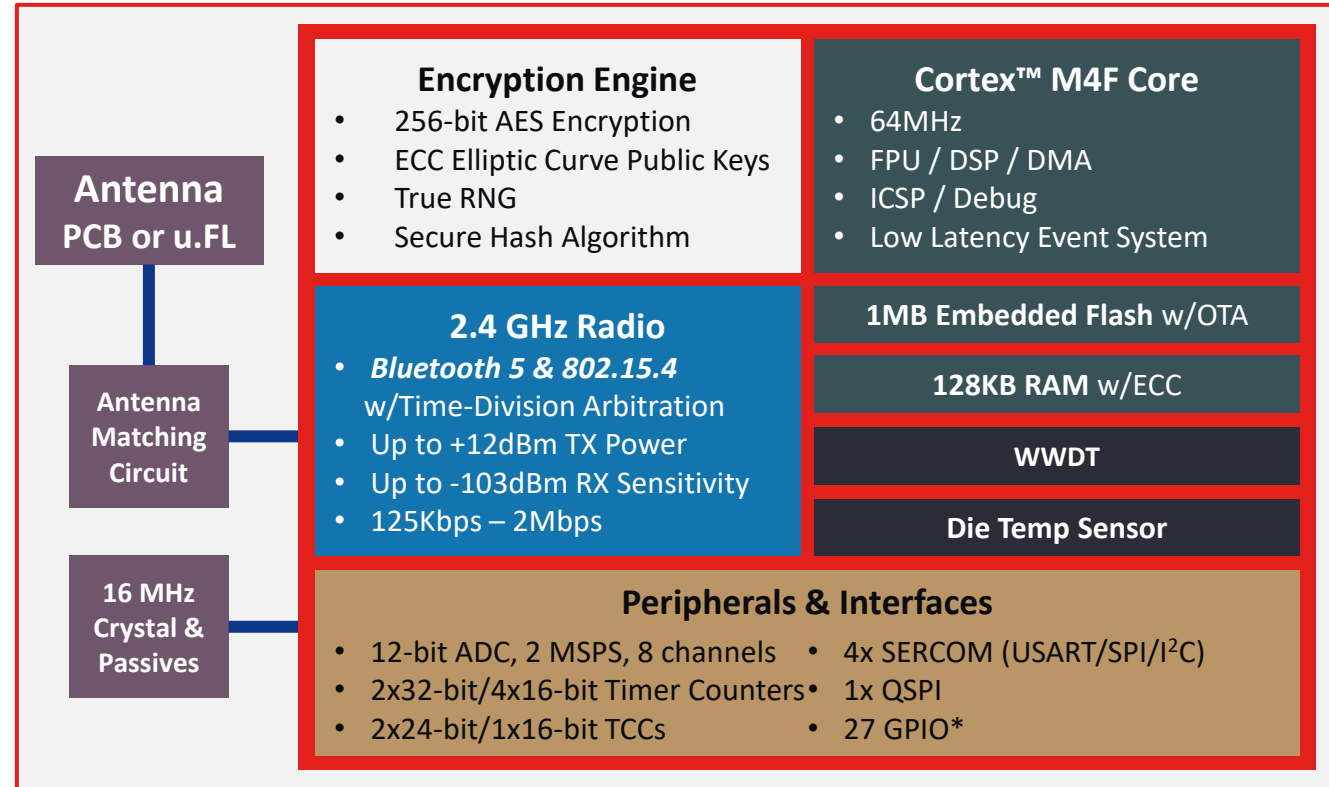




# WBZ451 Module

## Block Diagram for 39-Pad Module

- **Highly integrated, regulatory (FCC, ISED, CE) certified**, multi-protocol wireless module, powered by the PIC32CX-BZ2 MCU.
- **Long range** Bluetooth combining high transmit power (**up to +12 dBm**) and 125 Kbps coded PHY.
- **On-board PCB Antenna** or **u.FL connector** for external antenna.
- **Compact size**: 15.5 x 20.7 x 2.8 mm.

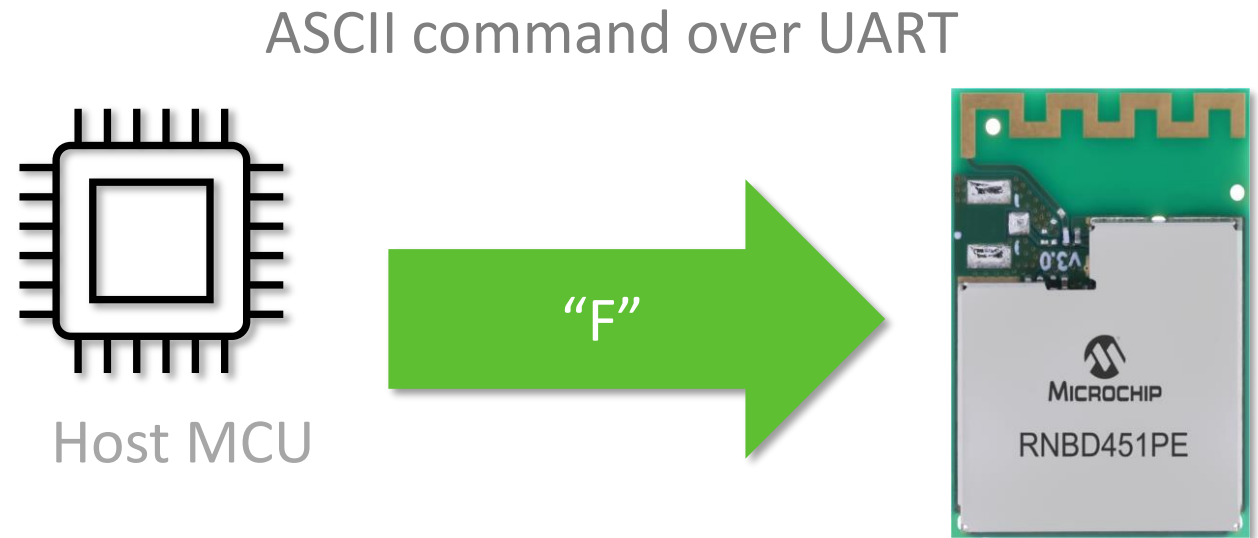


\*All GPIO are brought out to pads on the module

# RNBD451

## Simplicity without sacrificing advanced features

- **True plug-and-play**
  - Bluetooth available to pair as soon as you power module on
- **ASCII command interface**
  - Control connection setup/teardown
  - Access General Attribute Profile (GATT) characteristics
  - Change configuration settings
- **Serial data transfer over Transparent UART**
- **Remote Command Console**
- **Highly integrated and certified**
  - US, Canada, CE, UKCA, China, Taiwan, Korea, and Japan
  - 39-pin SMD Package with Shield CAN (15.5 mm x 20.7 mm x 2.8 mm)



Example: Start Bluetooth Low Energy (LE) Scanning by sending the character "F". As simple as that.

# Product Family



IC

PIC32CX1012BZ25048

Bluetooth® and 802.15.4 IC with Long Range Radio (up to +12dBm)

48-pin  
7x7mm  
QFN



## Modules (pre-certified\*)

WBZ451

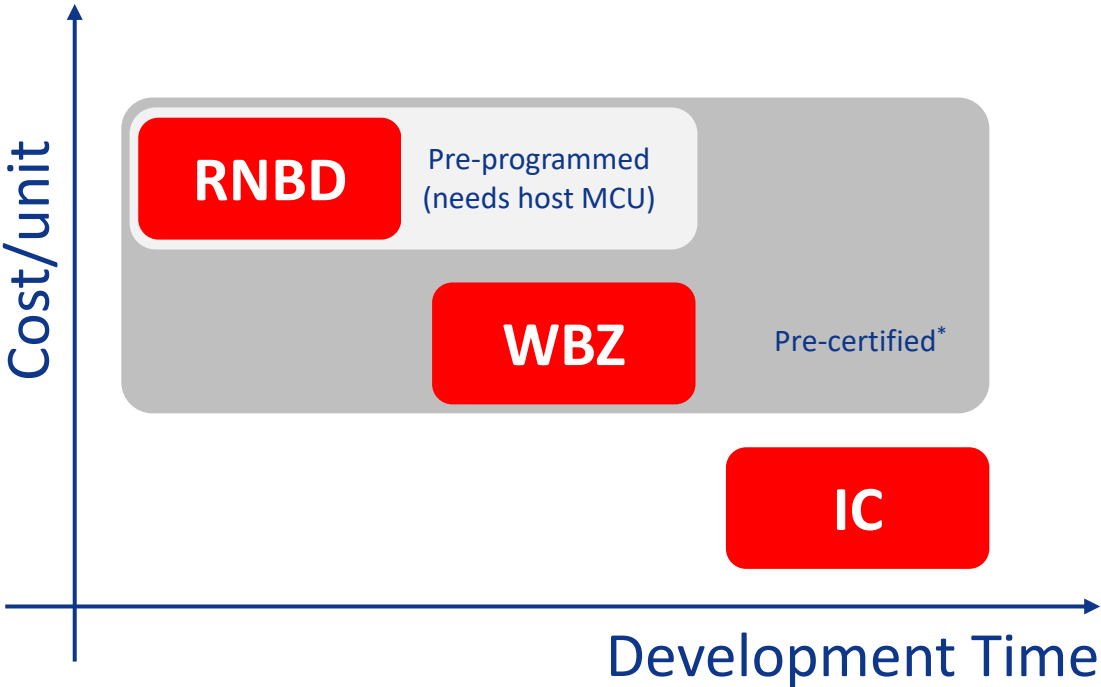
Bluetooth and 802.15.4 module with PCB or u.FL antenna, long range, and shield.

39-pad  
21x16mm  
LGA

RNBD451PE

Bluetooth network processor (pre-programmed) with PCB antenna, long range, and shield. ASCII command interface.

39-pad  
21x16mm  
LGA



\*Pre-certified in U.S., Canada, EU.

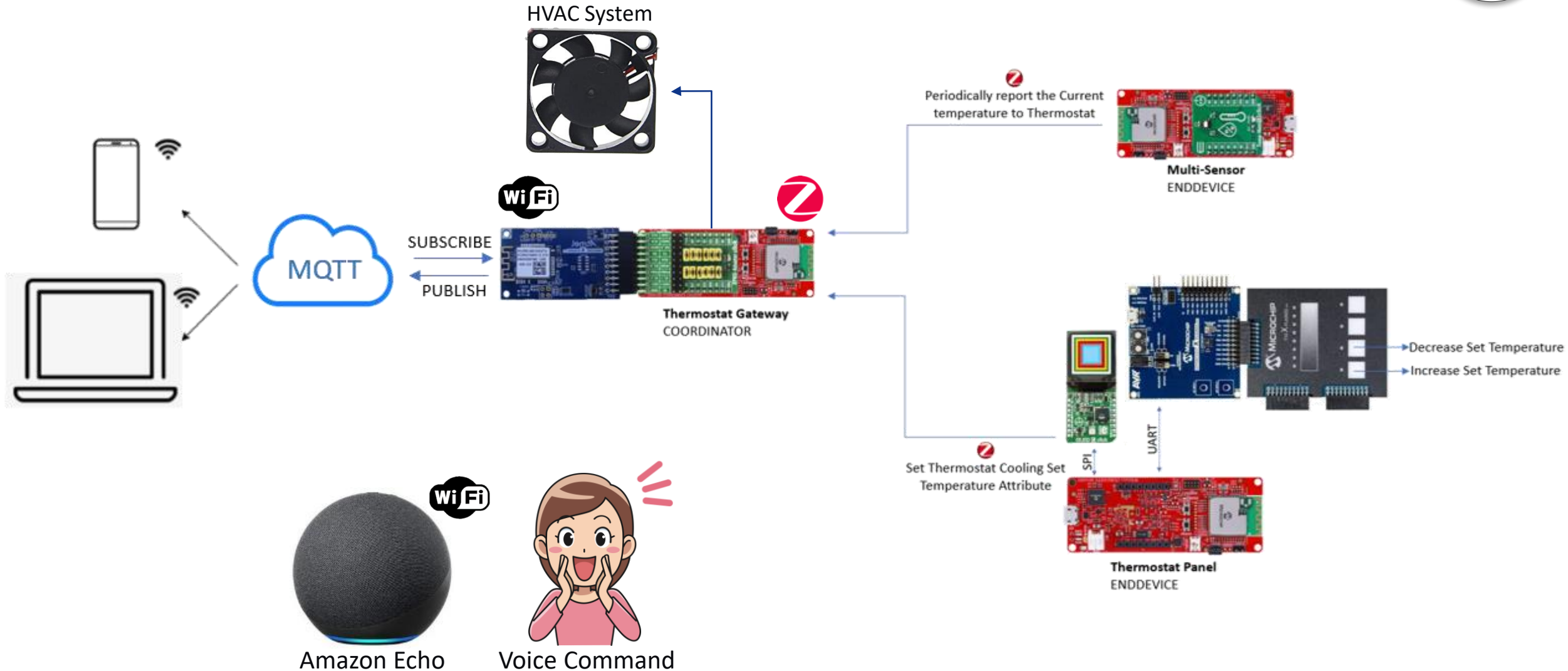


# Smart Industrial Thermostat

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A good IoT Mode Easy example

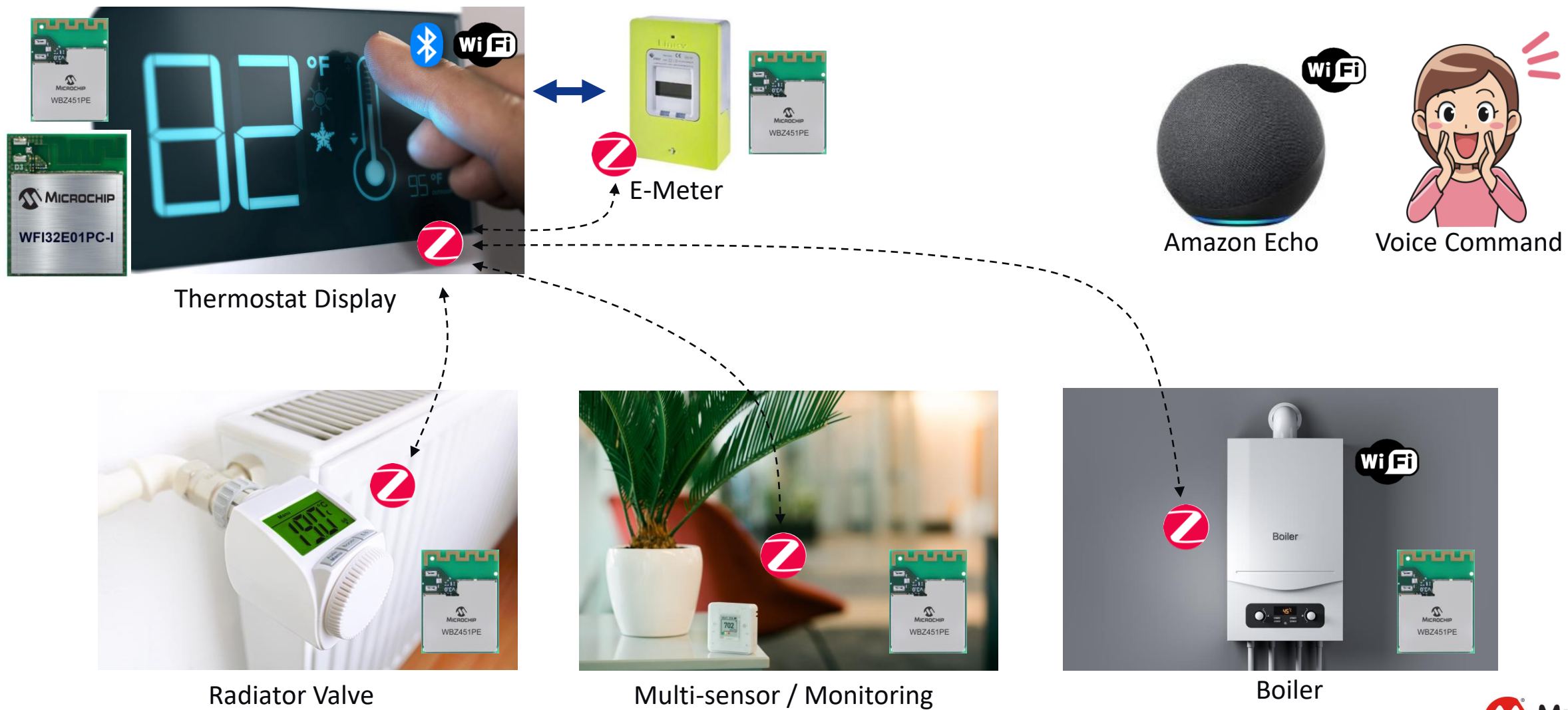
# Smart Industrial Thermostat



# Smart Thermostat / Energy Management

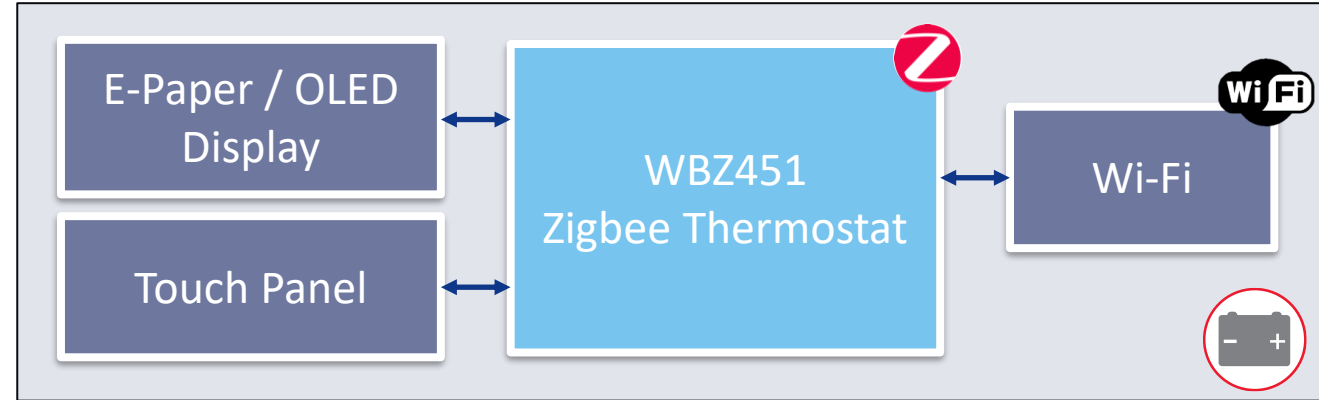


IoT Made Easy - 1



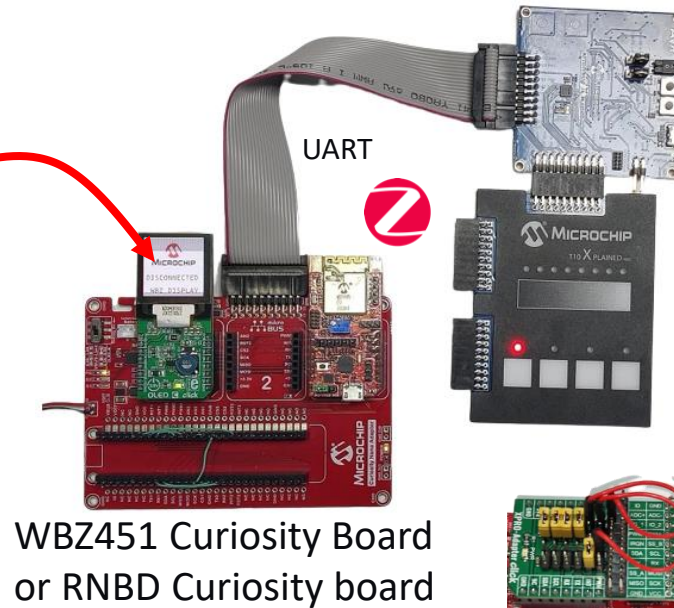
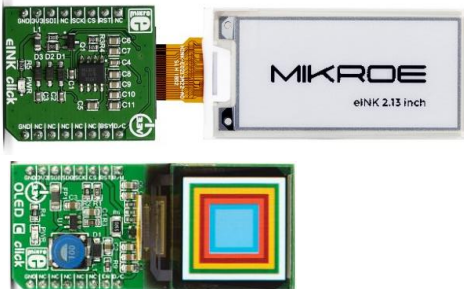


# Block #1 : Thermostat Display



E-Paper Bundle 2 or OLED C Click

[www.mikroe.com/e-paper-bundle-2](http://www.mikroe.com/e-paper-bundle-2)  
<https://www.mikroe.com/oled-c-click>



WBZ451 Curiosity Board  
or RNBD Curiosity board

ATTiny3217 Xplained Pro kit

Ref ATTINY3217-XPRO

[www.microchip.com/ATTINY3217-XPRO](http://www.microchip.com/ATTINY3217-XPRO)

T10 Xplained Pro extension board

Ref AC47H23A

[www.microchip.com/AC47H23A](http://www.microchip.com/AC47H23A)



ATWINC1500-XPRO Board

[www.microchip.com/ATWINC1500-XPRO](http://www.microchip.com/ATWINC1500-XPRO)

XPRO-ADAPTER Click

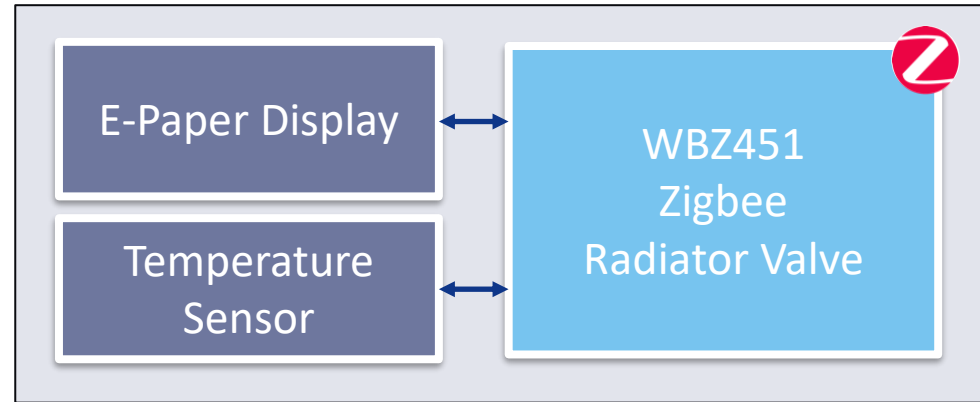
[www.mikroe.com/xpro-adapter-click](http://www.mikroe.com/xpro-adapter-click)



# Block #2 : Radiator Valve



Radiator Valve



E-Paper Bundle 2

[www.mikroe.com/e-paper-bundle-2](http://www.mikroe.com/e-paper-bundle-2)

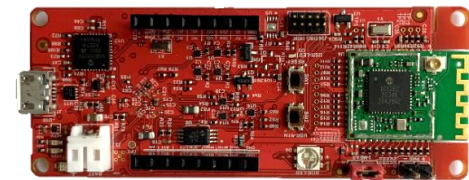


Temperature & Humidity Click

[www.mikroe.com/temp-hum-click](http://www.mikroe.com/temp-hum-click)



I2C



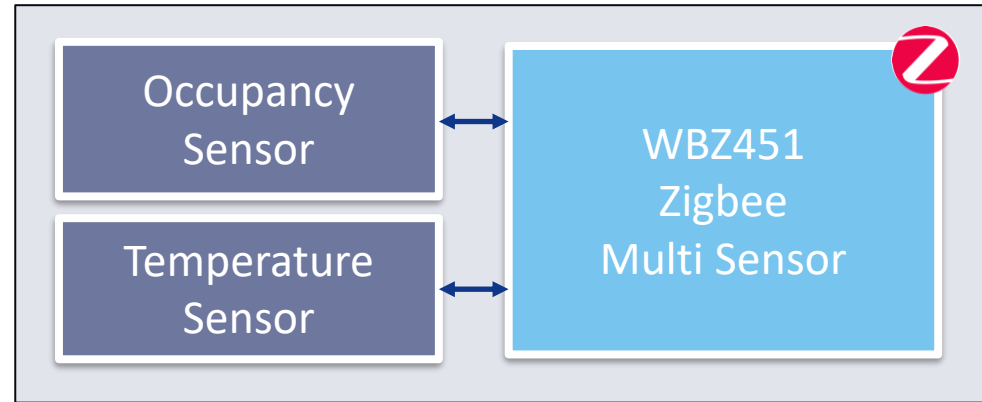
WBZ451 Curiosity Board



# Block #3 : Multi Sensor



Multi-sensor / Monitoring



Motion 4 Click

[www.mikroe.com/motion-4-click](http://www.mikroe.com/motion-4-click)



Temperature & Humidity Click

[www.mikroe.com/temp-hum-click](http://www.mikroe.com/temp-hum-click)



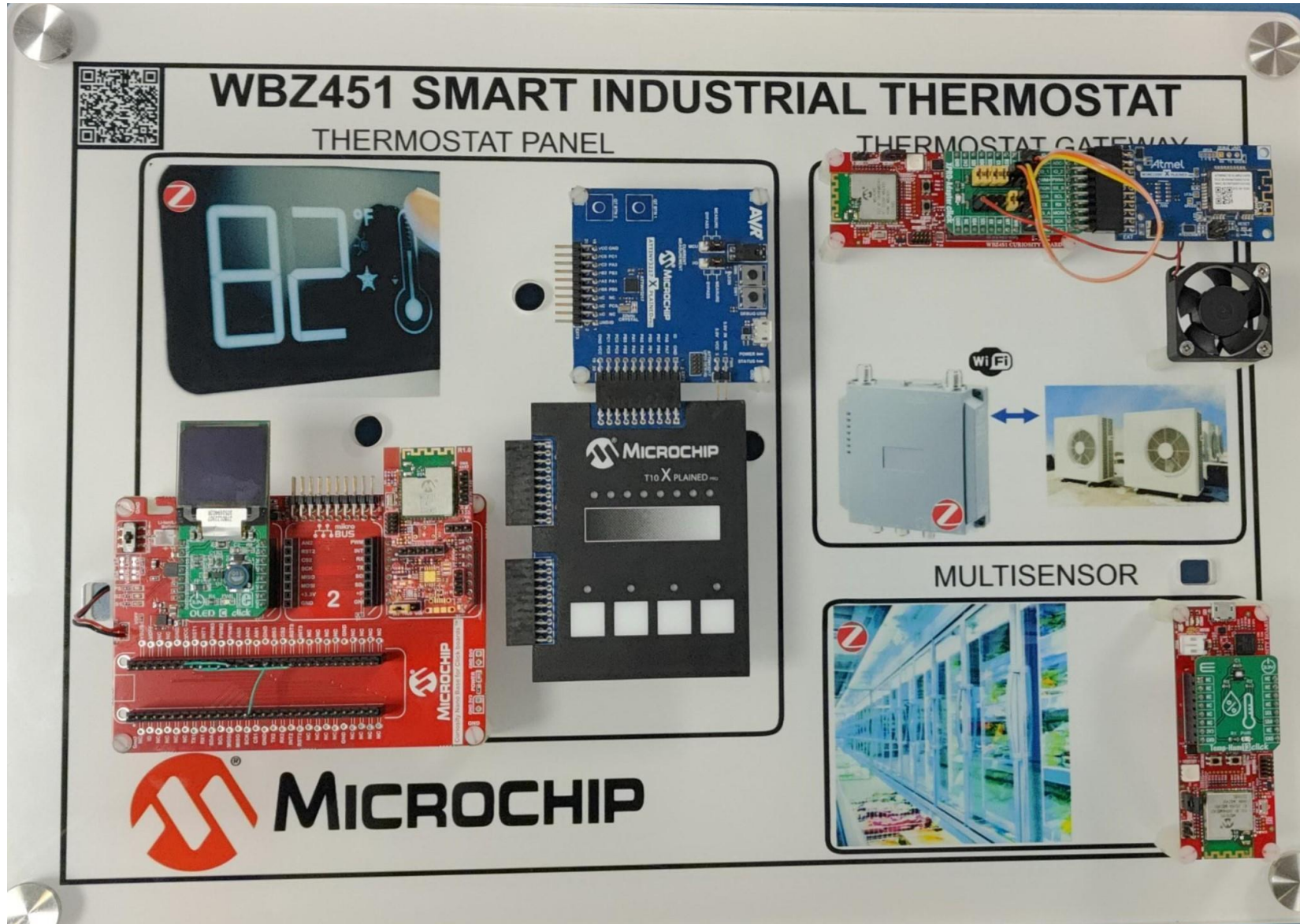
I2C



WBZ451 Curiosity Board

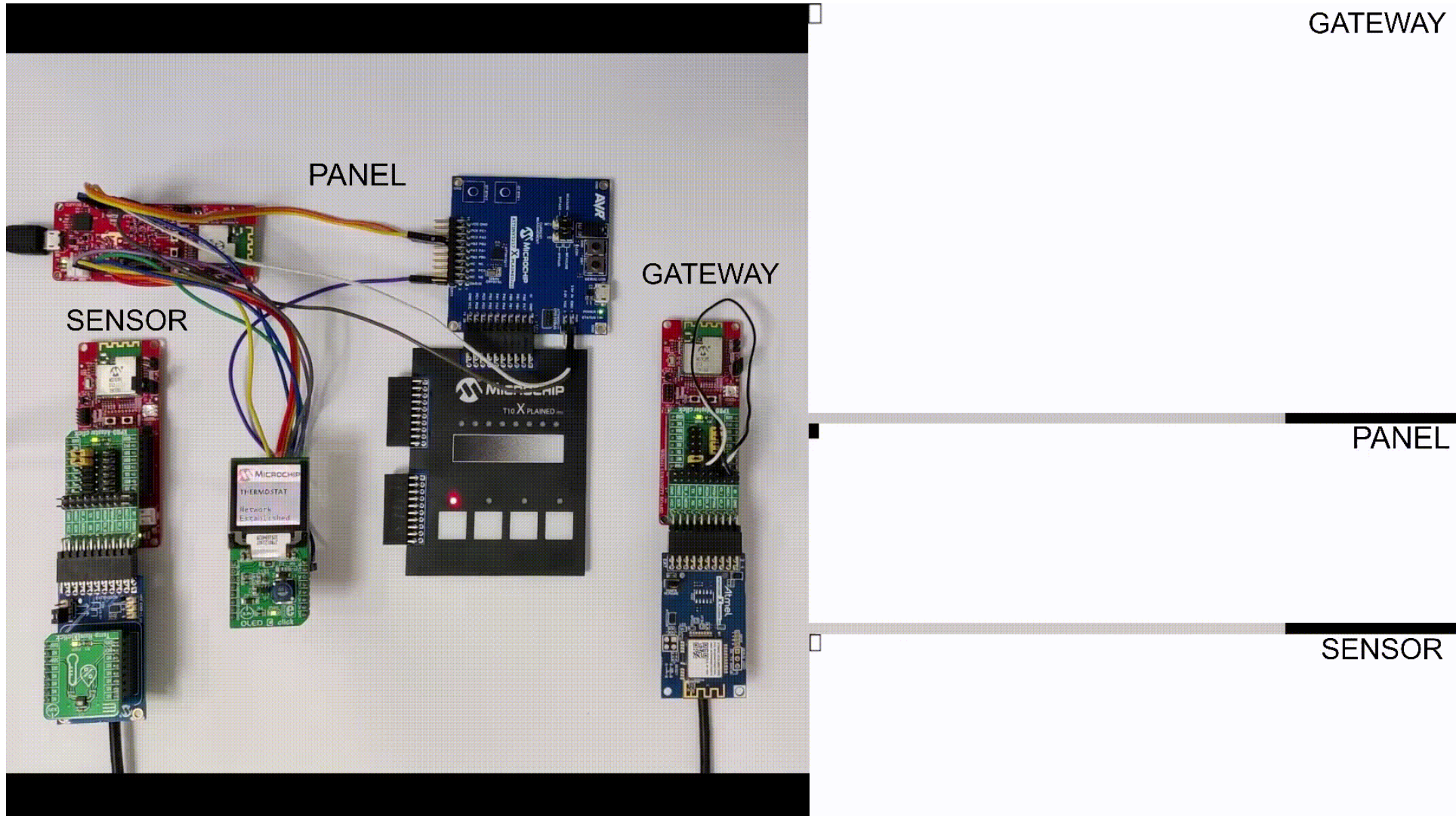


# Industrial Thermostat Demo





# Demo Video, Smart Thermostat

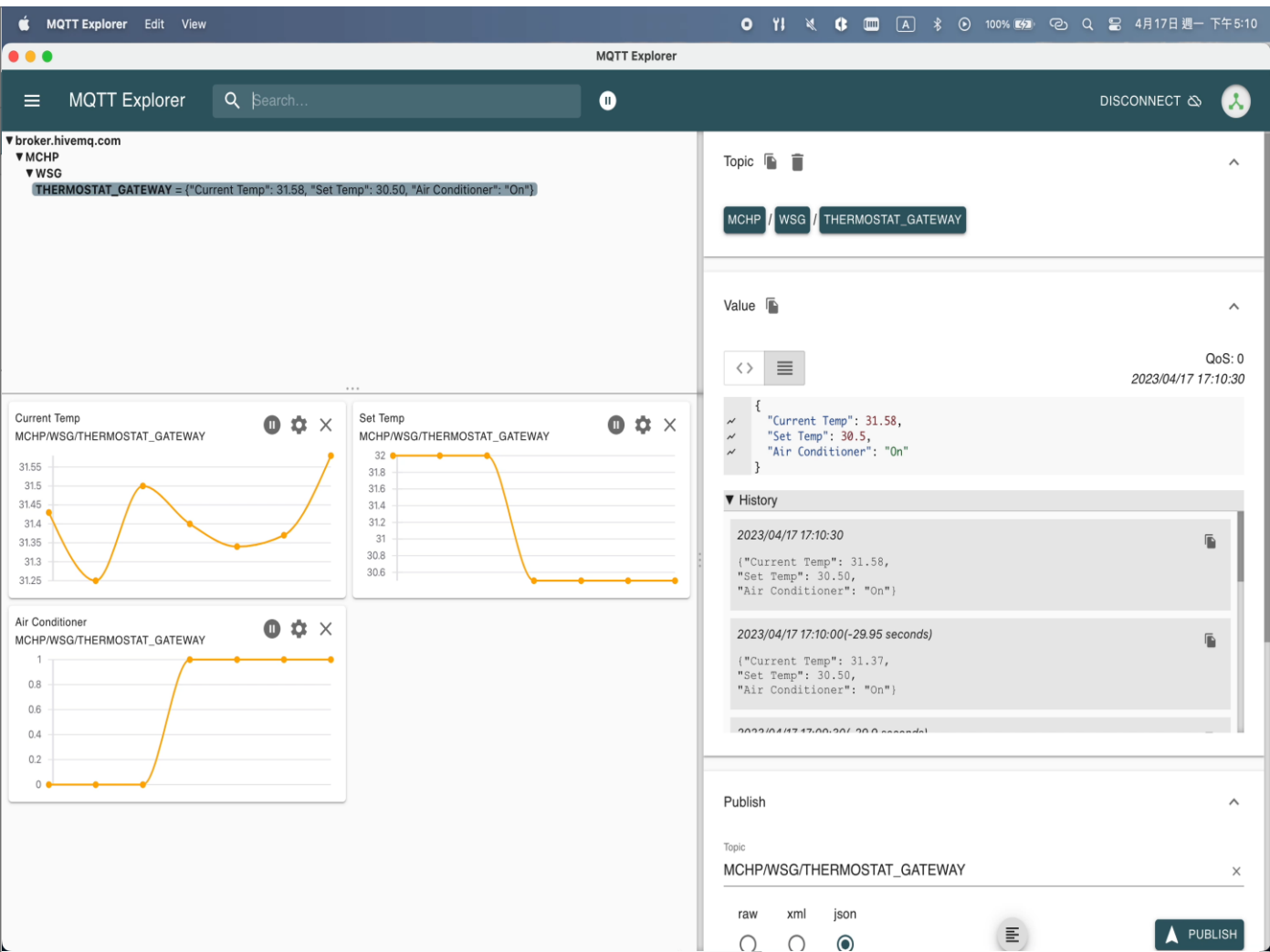
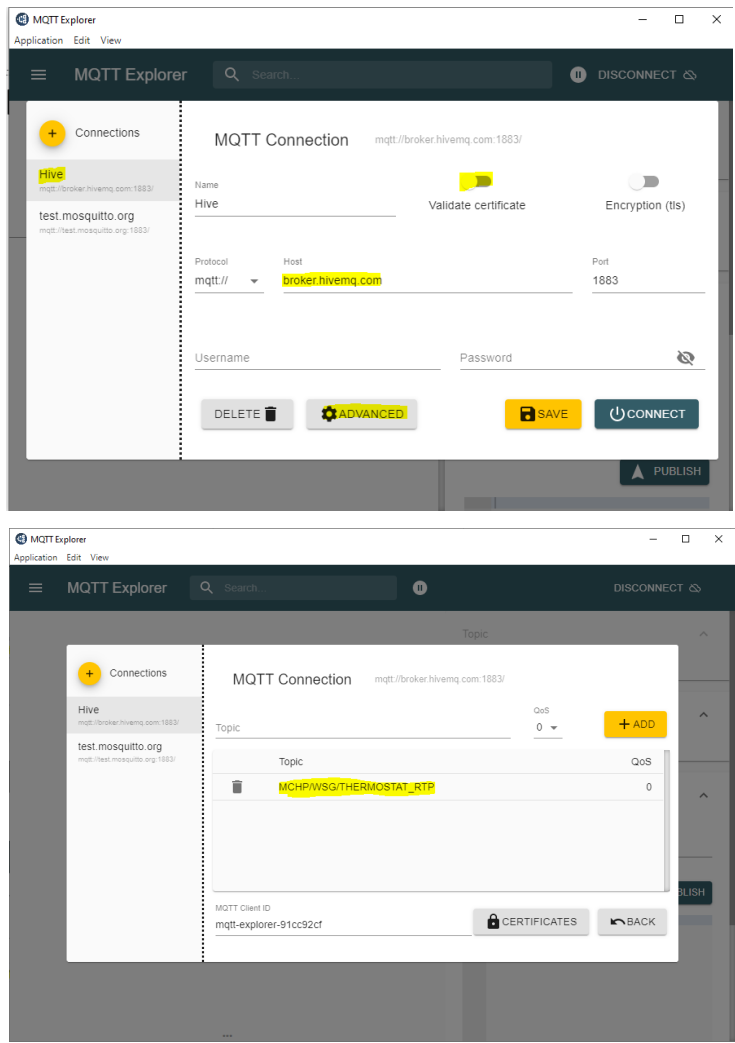


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# Demo Video, Smart Thermostat, Gateway

## MQTT Explorer Setting, Subscribe & Published



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# MicrochipTech WSG GitHub Solutions

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Variety of Microchip Wireless demos  
for End product ideas!

# MVP from MicrochipTech GitHub

## Out of 70 repositories



Bluetooth	Zigbee	Wi-Fi	Thread	Matter
<a href="#">WBZ451 BLE Sensor Multi-role</a>	<a href="#">WBZ451 Home Thermostat</a>	<a href="#">WFI32 AnyCloud</a>	<a href="#">SAMR21 FTD CLI App</a>	<a href="#">WFI32 Light Accessory</a>
<a href="#">WBZ451 BLE TRSP UART &amp; OLED display</a>	<a href="#">WBZ451 Smart Thermostat</a>			
<a href="#">WBZ451 BLE TRSP UART &amp; ePaper display</a>	<a href="#">WBZ451 Combined Interface with OLED display</a>	<a href="#">WFI32 Amazon Frustration Free Setup</a>		
<a href="#">WBZ451 BLE to CAN Bridge</a>	<a href="#">WBZ451 Multi-sensor</a>	<a href="#">WFI32 IoT OoB to AWS Cloud</a>		
<a href="#">WBZ451 BLE with capacitive touch</a>	<a href="#">WBZ451 Access Control with FPGA Face recognition</a>	<a href="#">Add cloud over Wi-Fi to WBZ451 using WINC1500</a>		
<a href="#">WBZ451 BLE Transparent Credit Base Profile</a>	<a href="#">WBZ451 OoB Zigbee light and BLE commissioning</a>	<a href="#">WFI32 Ethernet to Wi-Fi Bridge with PHY</a>		
<a href="#">WBZ451 from sensor to phone App</a>		<a href="#">WFI32 IFTTT Action example</a>		



# More information...



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MicrochipTech  
GitHub



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Microchip  
Wi-Fi Solutions



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Zigbee Solutions



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Bluetooth Solutions



# Any Questions?



# Thank you!

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