Secure, Smart, and Low-Power Wireless Solutions For IIoT

Anson Huang | Sr. FAE

November 2021

The Leader in IoT Wireless Connectivity

100%
Revenue Based on IoT

Bluetooth® Multiprotocol Proprietary
THREAD Wi Fi® Wi SUN zigbee
Z-WAVE amazon sidewalk matter
Breadth and Depth of Wireless IoT Protocols

#1
Share in Mesh

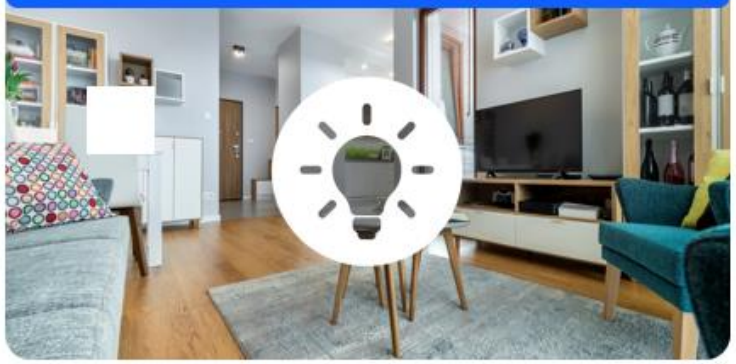
1st
To Market with Multiprotocol, BLE Mesh, BLE 5.1

Innovation
Performance, Power, CoEx, Modules, SecureVault™

ember	ENERGY micro	blue giga	telegesis	Micriμm®	ZENTRI	Z-WAVE	REDPINE SIGNALS
2012	2013	2015	2015	2016	2017	2018	2020
Software ZigBee SoC	Low-power 32-bit MCUs	BT Smart Modules	ZigBee/Thread Modules	Software RTOS	Cloud Connected Wi-Fi	Smart Home Protocol	Ultra Low Power Wi-Fi

IoT Trends Driven by Silicon Labs

IOT LEADERSHIP



#1 provider of Smart Home IoT wireless software and silicon solutions

Unmatched breadth and depth of IoT wireless technologies

zigbee · Bluetooth · Z-WAVE · THREAD · Wi Fi · Proprietary

Industry Collaborations

Project Connected Home Over IP · Open Z-Wave · amazon sidewalk

WIRELESS PRODUCT SOLUTIONS

Our product portfolio allows deployments across any device type and application

1000's of Applications

10,000's of Customers

Security · Home Automation · Small Appliances

Lighting · Operator Services · Portable Medical

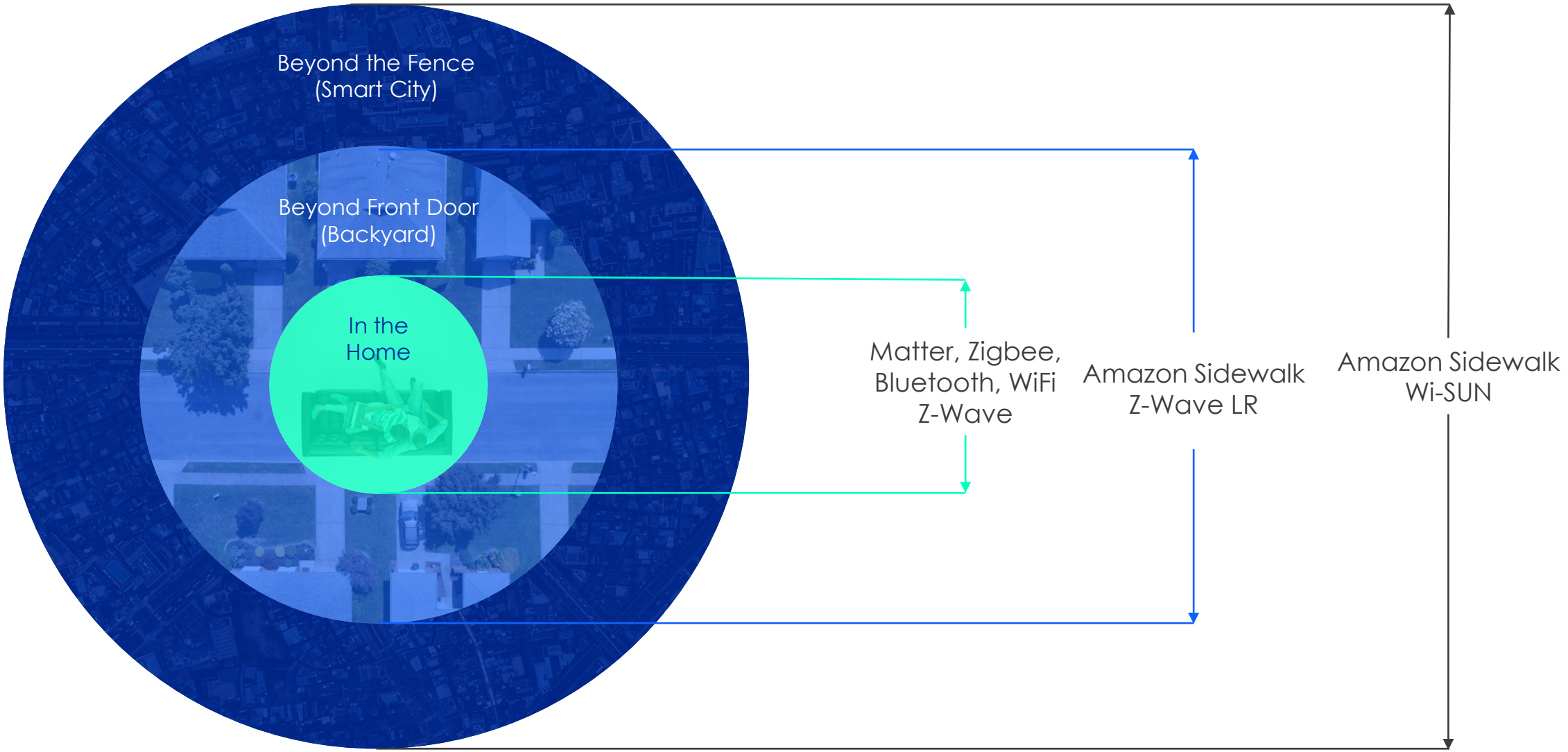
WORKS WITH ANY ECOSYSTEM

Silicon Labs wireless platform works with any smart home ecosystem

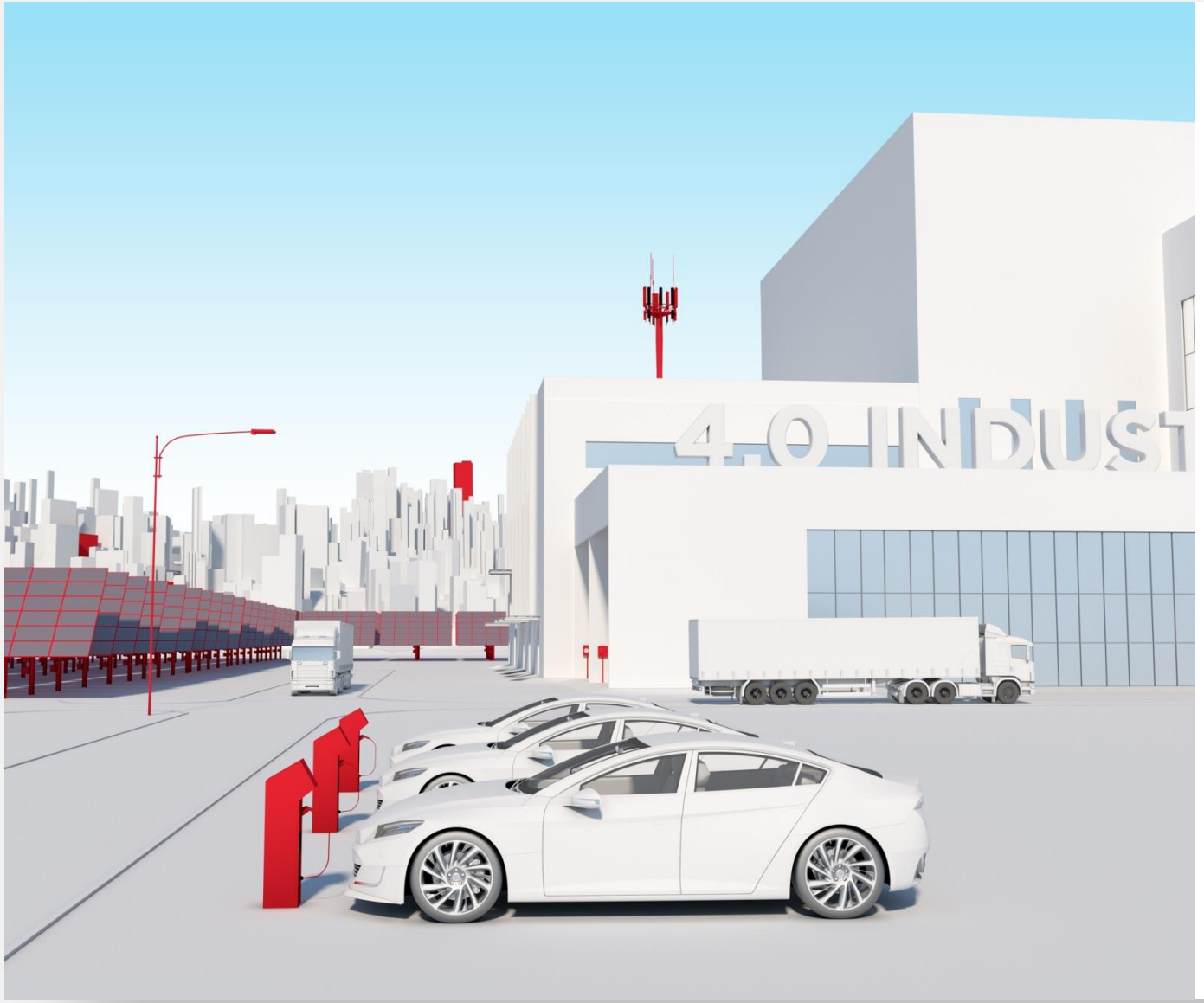
Actively engaged with all ecosystems helping end-device and gateway partners to market

amazon · Google · ring · SAMSUNG SmartThings · IKEA · ALARM.COM · COMCAST

Full Coverage Enabling Unlimited Opportunities



Industry 4.0 Presents Challenges



- **Machines operate as autonomous systems**
- **Manual set-up, maintenance & repair processes**
- **Technology fragmentation increases complexity**
- **Security concerns raise risk to unacceptable levels**

- **Wireless Connectivity add the value**
  - Add remote monitoring and control to machines
  - Replace cables with wireless communication links
  - Future proof equipment with OTA updates
  - Use advanced encryption to secure processes

Asset Tracking

- Protect your workforce, equipment and inventory across large areas with advanced, reliable wireless devices that power real-time location systems (RTLS)

How It Works

- Asset tags broadcast Bluetooth beacons in manufacturing facilities
- Bluetooth mesh or Sub-GHz nodes receive beacons and passes location data to a gateway
- Gateway sends relevant asset location information to a cloud application

SILICON LABS

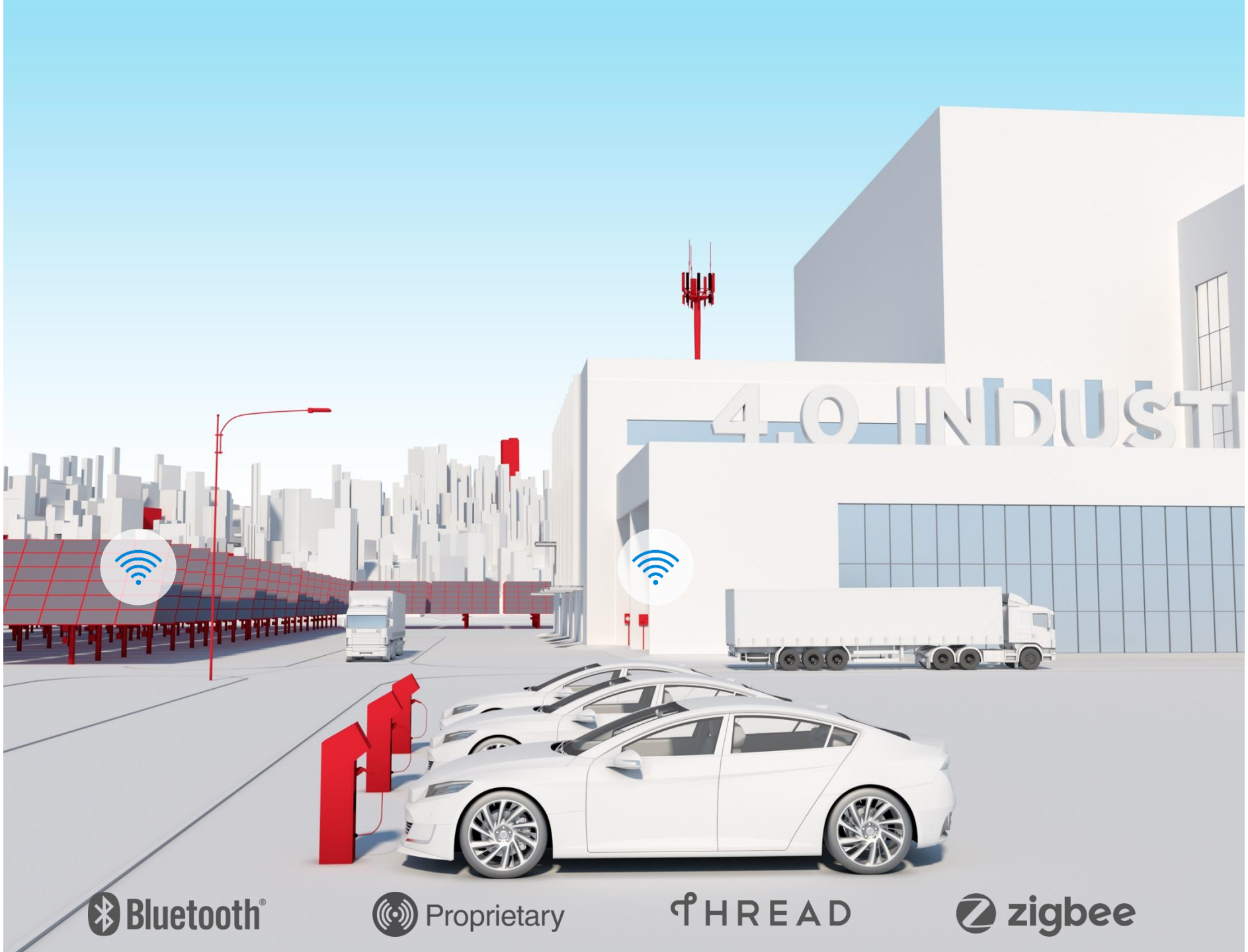
Connected Lighting

Reduce energy consumption, customize settings by work area, and control lighting from remote locations

How It Works

- Large scale mesh network connects lights, luminaires, controls and switches
- Bluetooth mesh, Sub-GHz, Thread or Zigbee technologies are ideal for mesh networking
- Multiprotocol connectivity enables a multi-function IoT wireless backbone

SILICON LABS



Smart Energy Management

Generate electricity and heat water with a wireless smart energy system that provides factory operators the ability to reduce costs and better manage energy usage

How It Works

- Industrial-grade LPWAN provides connectivity to solar panels, smart meters, thermostats, HVAC and environmental sensors throughout the facility
- Multiprotocol Sub-GHz and Bluetooth IoT wireless network provides simultaneous long-range device-to-device communications and direct smartphone connectivity
- Direct smartphone control simplifies device set-up, monitoring, and maintenance

SILICON LABS

Process Automation

Connect machines, devices, sensors and people to a system that automates factory tasks including production, maintenance, quality control, and reporting

How It Works

- LPWAN or mesh networks provide the wireless reach to factory automation sensors located throughout the premises
- Bluetooth mesh, Sub-GHz, Thread or Zigbee all meet the needs of low-power sensor applications
- IoT gateways provide cloud connectivity and enable remote management

SILICON LABS

Technical solutions to the key careabouts

EXTENDED BATTERY LIFE

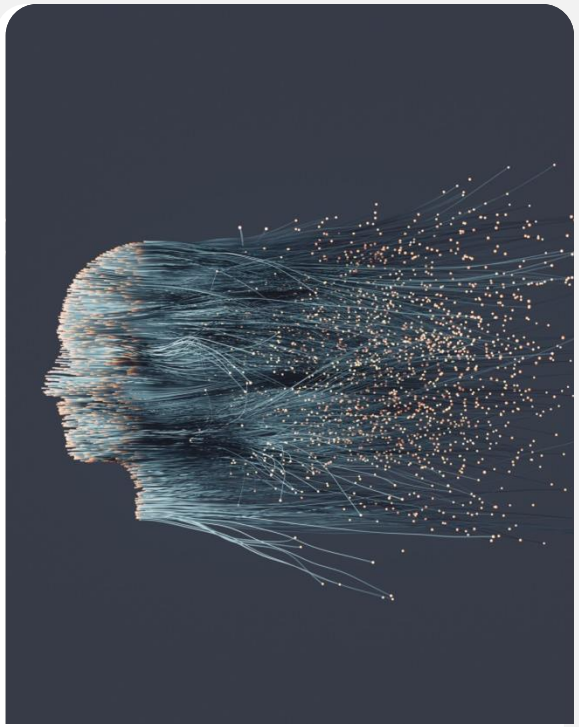
Ultra low-power chips & power-efficient communication stacks

Utilization of energy harvesting technologies

RELIABLE CONNECTIVITY

Using stacks with high forward error correction rate

Leveraging frequency hopping and dual-band technologies



EMBEDDED INTELLIGENCE

Reducing power consumption by pre-processing the data locally

Using embedded AI/ML to mitigate network congestion

BUILT-IN SECURITY

Designing in parts that prevent rogue FW execution, detect tampering, meet the latest IoT security standards and have upgradable security features

Industrial automation segmentation

MONITORING

INTERFACING

NETWORKING

BT Mesh

Proprietary

BLE

802.15.4 Mesh

Proprietary

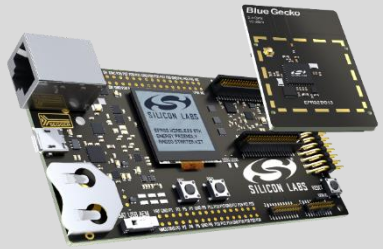
Wi-Fi

802.15.4 Mesh

Secure Vault

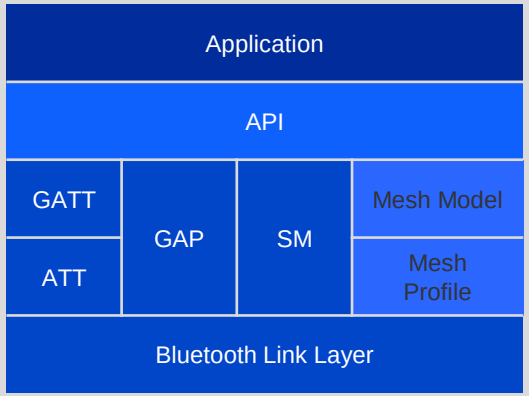
A Complete Solution for Enabling Bluetooth Products

SoCS AND MODULES



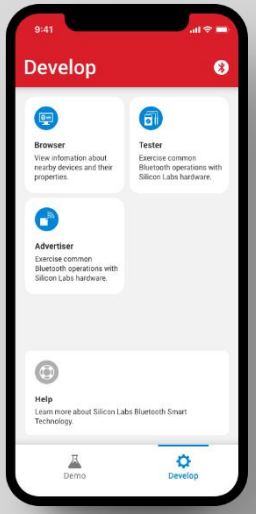
Industry leading Bluetooth 5.1 and 5.2 SoCs and pre-certified modules

STACK SOFTWARE



In-house developed stacks with latest Bluetooth 5.2 and mesh features

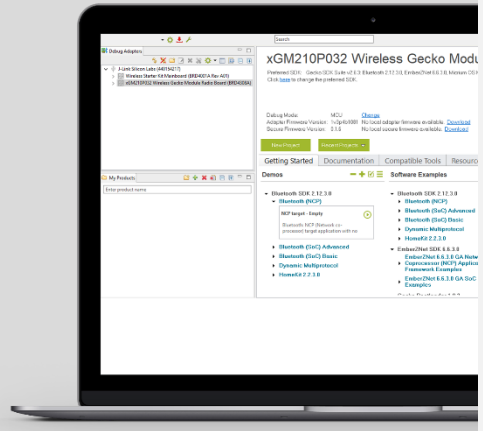
MOBILE APPLICATIONS



Reference applications and source code for iOS and Android

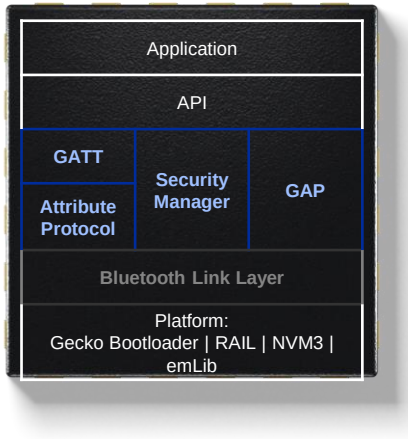
Phone interoperability test program

DEVELOPMENT TOOLS



Free-of-charge development and protocol analysis tools to boost productivity

Bluetooth LE and Mesh Software



A Bluetooth 5.2 compliant Bluetooth stack, with:

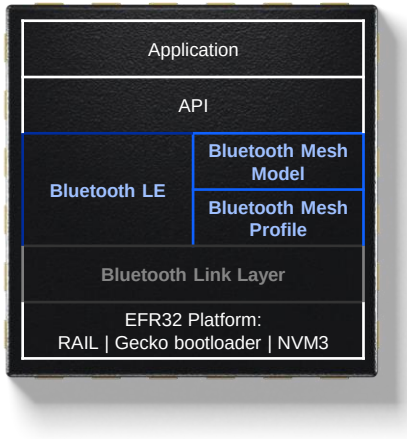
- Bluetooth 5.2 Dynamix TX power control
- Bluetooth 5.1 Direction Finding
- Bluetooth 5.0 standard features
- Bluetooth 4.x features

Packed with advanced functionality

- Multiple connections and advertisers
- Concurrent advertising, scanning and LE connections
- Optimized throughput and power consumption

Built on top of the common EFR32 software platform

- Gecko bootloader
- emLib for MCU peripherals and drivers
- NVM3 key/value pair data storage with wear leveling
- RAIL radio driver



A complete Bluetooth mesh profile, supporting:

- Proxy, relaying and friend nodes
- Bluetooth mesh low power nodes (LPN)
- Low latency communications down to 10ms per hop
- Large network support up to 4096 nodes

A comprehensive Mesh Model application layer, with:

- Lighting models for On/Off, Dimming & color temperature
- Occupancy based lighting for commercial applications
- Scene, Sensor, Generic and Vendor models

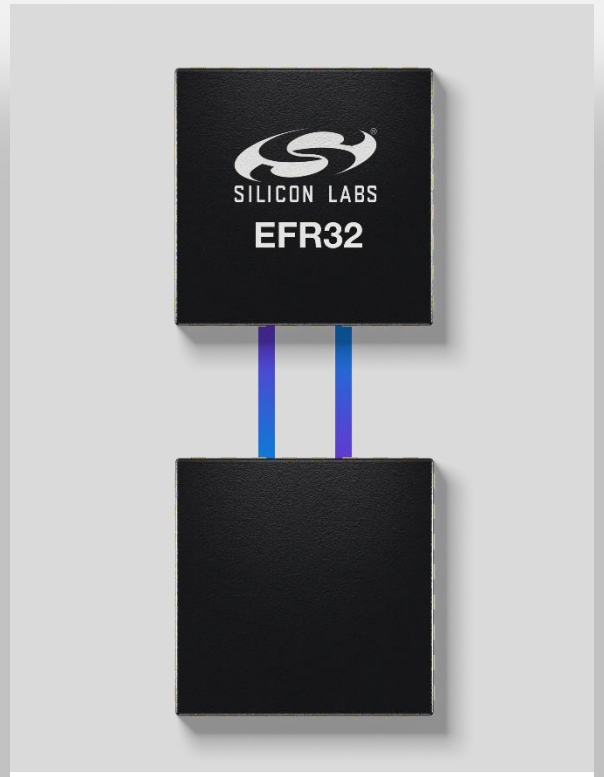
Bluetooth LE support includes

- Beaconing for indoor positioning systems
- Scanning for asset tracking
- Phone connectivity

It’s More Than Just a Bluetooth Stack…

Secure Over-the-Air Updates

Helps you to easily implement secure
in-field software updates



Network Co-Processor Mode

Run applications on a separate MCU and use EFR32 as a Bluetooth co-processor

Direction Finding

Direction Finding library converts raw IQ data to reliable azimuth and elevation data

Wi-Fi Co-Existence

Wi-Fi co-ex scheme significantly improves performance
in co-located radio designs

BG22: Optimized Battery Powered Bluetooth LE

Optimized

Secure Bluetooth 5.2 SoCs for High-Volume Products

Radio
Bluetooth 5.2
+6 dBm TX
-106.7 dBm RX (125Kbps)
AoA & AoD

Ultra-Low Power
3.5 mA TX (radio)
2.6 mA RX (radio)
1.4 µA EM2 with 32 kB RAM
0.5 µA w/ RTC in EM4

World Class Software
Bluetooth 5.2
Bluetooth mesh LPN
Direction Finding
Apple HomeKit

Compact Size
5x5 QFN40 (26 GPIO)
4x4 QFN32 (18 GPIO)
4x4 TQFN32 (18 GPIO)

ARM Cortex-M33 with TrustZone
76.8 MHz
FPU and DSP
352/512 kB of flash
32kB RAM

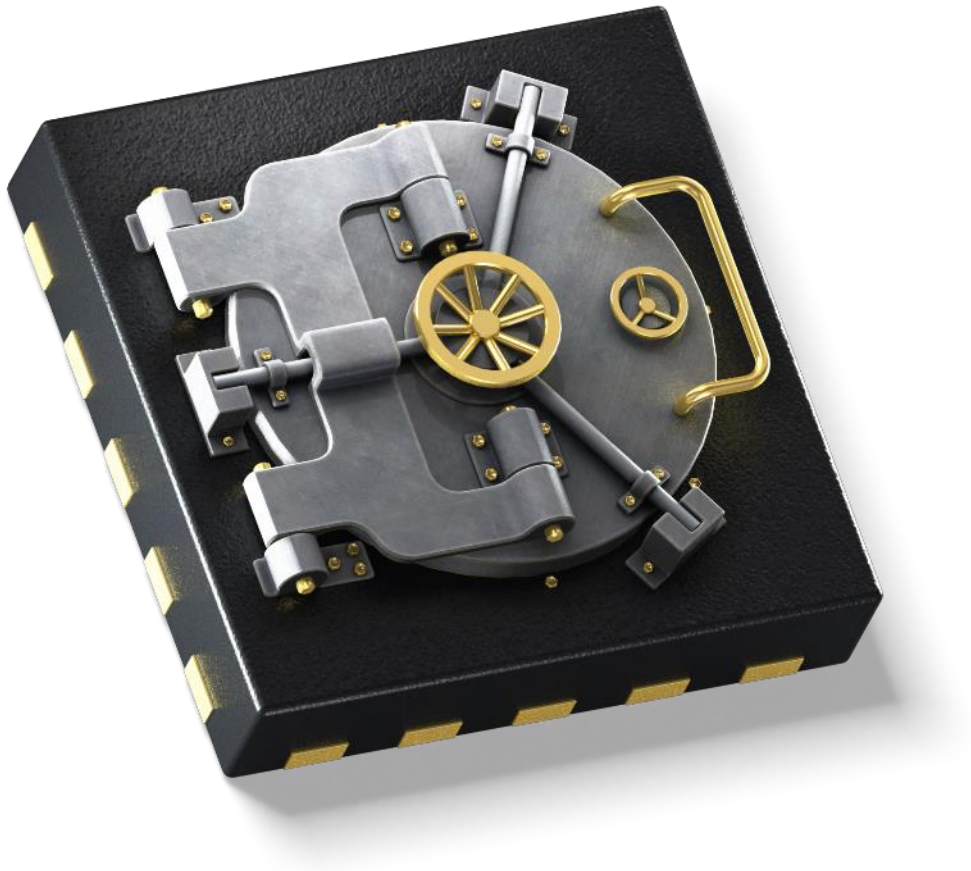
Peripherals Fit for Purpose
2x USART, 2x I2C, 2x PDM and GPIO
12-bit ADC (16 channels)
Built-in temperature sensor with +/- 1.5 °C
32 kHz, 500ppm PLFRCO eliminates crystal

Security
AES128/256,SHA-1, SHA-2 (256-bit)
ECC (up to 256-bit), ECDSA and ECDH
True Random Number Generator (TRNG)
Secure boot with RTSL
Secure debug with lock/unlock

Extending Battery Life in Bluetooth Applications

Data Transfer	Location Services
Connected to a phone at 2000ms interval	Advertising 10 bytes every 1000ms
Using 2M PHY and transmitting 10 Byte / packet	TX at 0dBm and using 1 channel
Average current: 4.2µA	Average current: 3.7µA
5+ years on CR2032 10+ years on a CR2354	

Securing Bluetooth Products with BG22



- **Hardware Accelerated Crypto**
  - Faster, more energy efficient and secure than software
- **True Random Number Generator (TRNG)**
  - Compliant with NIST SP800-90 and AIS-31
- **Secure Boot with Root of Trust and Secure Loader (RTSL)**
  - Prevents malware injection and rollback
  - Ensures authentic firmware execution and OTA updates
- **Secure Debug with Lock/Unlock**
  - Allows authenticated access for enhanced Failure Analysis (FA)
- **ARM Cortex M33 Core with TrustZone**
  - Provides cost effective hardware isolation

www.silabs.com/security

SecureVault™

Base	Mid	High	Feature
✓	✓	✓	True Random Number Generator
✓	✓	✓	Crypto Engine
✓	✓	✓	Secure Application Boot
—	VSE/HSE	HSE	Secure Engine
—	✓	✓	Secure Boot with RTSL
—	✓	✓	Secure Debug with Lock/Unlock
—	Optional	✓	DPA Countermeasures
—	—	✓	Anti-Tamper
—	—	✓	Secure Attestation
—	—	✓	Secure Key Management
—	—	✓	Advanced Crypto

Selecting a BG22 Device

	BG22C112	BG22C222	BG22C224
Use cases	High-volume, consumer	Better RF, more GPIO	Advanced features, higher temp rating
Bluetooth features	1M and 2M PHYs AoA TX	1M and 2M PHYs AoA TX	1M and 2M PHYs 125k and 500k LE Coded PHYs Bluetooth mesh LPN IQ sampling for AoA
Max TX power	0 dBm	6 dBm	6 dBm
RAM	32 kB	32 kB	32 kB
Flash	352 kB	352 kB	512 kB
Max Temperature	-40 to +85°C	-40 to +85°C	-40 to +85°C (GN OPNs) -40 to +125°C (IM OPNs)
Max GPIO	18	26	26
Package options	4x4 QFN32	4x4 QFN32 4x4 TQFN32 5x5 QFN40	4x4 QFN32 4x4 TQFN32 5x5 QFN40

See BG22 Data Sheet for complete list of Orderable Part Numbers (OPNs

BGM220 Bluetooth Modules

BGM220S - SiP

- 6 x 6 mm
- Up to +6 dBm TX
- Up to 25x GPIO
- Built-in antenna and RF Pin
- With or without RF shield

BGM220P - PCB

- 13 x 15mm
- Up to +8 dBm TX
- Up to 25x GPIO
- Built-in antenna
- With or without built-in LFXO

Module Features

- **Built-in high performance antennas simplify RF design**
- **Compact SIP modules for minaturized IoT design**
- **Integrated DC-DC, XTALs and passives**
- **Extended temperature rating up to 105°C**
- **Regulatory certifications for major global markets**
  - CE, FCC, IC,MIC and KCC
- **Bluetooth 5.2 certified**
  - Dynamic power control operational performance

SILICON LABS

Series 2
FG23 SoCs

FG23: Industry Leading Sub-GHz Wireless Connectivity

Smart Metering

Industrial Automation

Smart Lighting

Building Automation

Hubs & Gateways

High-Performance

- + 20 dBm output power & -125.6 dBm RX
- Arm Cortex-M33 processor core

Low Power

- 10+ years coin cell battery operation
- Preamble Sense Mode, LESENSE

Secure

- Secure Vault™
- Arm PSA certified

Optimized

- Highly integrated MCU, PMU, RF & peripherals
- Flexible GPIO mapping

Advanced Wireless

- Amazon Sidewalk, Wireless M-Bus, mioty & Proprietary

High-Performance Sub-GHz Wireless SoCs

Low Power.
Long Range.
Secure.

Sub-GHz SoCs Optimized for Metering & Home/Industrial Automation Applications

High Performance Radio
- Up to +20 dBm TX
- -110dBm RX @ 920MHz, 50kbps GFSK*
- -126dBm RX @ 915MHz, 4.8kbps O-QPSK*
- RX Antenna Diversity*

Low Power
- 25 mA TX @ +14 dBm, 925 MHz*
- 85.5 mA TX @ +20 dBm, 915 MHz*
- 4.2 mA RX @ 920 MHz, 400 kbps 4-FSK*
- 26 µA/MHz*
- 1.2 µA EM2 with 16 kB RAM
- Preamble Sense

Wireless Technologies
- Amazon Sidewalk
- mioty
- Wireless M-BUS
- Proprietary

ARM® Cortex®-M33 with TrustZone®
- 78 MHz (FPU and DSP)*
- 512kB of flash
- 64kB of RAM

Security
- Secure Vault Mid
- Secure Vault High (select OPNs)

Low-power Peripherals
- EUSART, USART, I^2C
- 16-bit ADC, 12-bit VDAC, ACMP
- 20 x 4 LCD Controller
- LESENSE, Pulse Counter
- Temperature sensor +/- 1.5°C

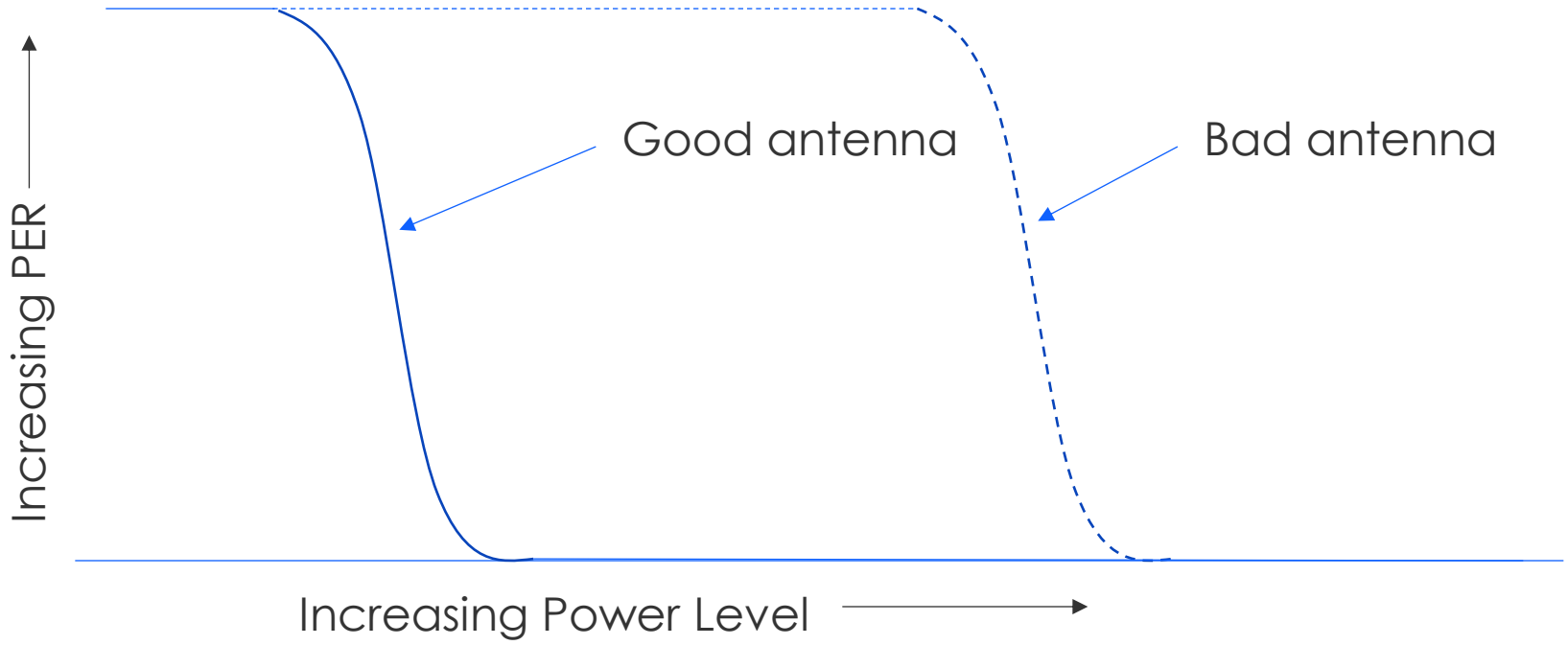
Compact Size
- 5x5 QFN40 (22/23 GPIO)
- 6x6 QFN48 (31 GPIO)

Orderable Part Number
- EFR32FG23A/B

* Feature enhancements compared to EFR32xG13

Antenna Diversity Introduction

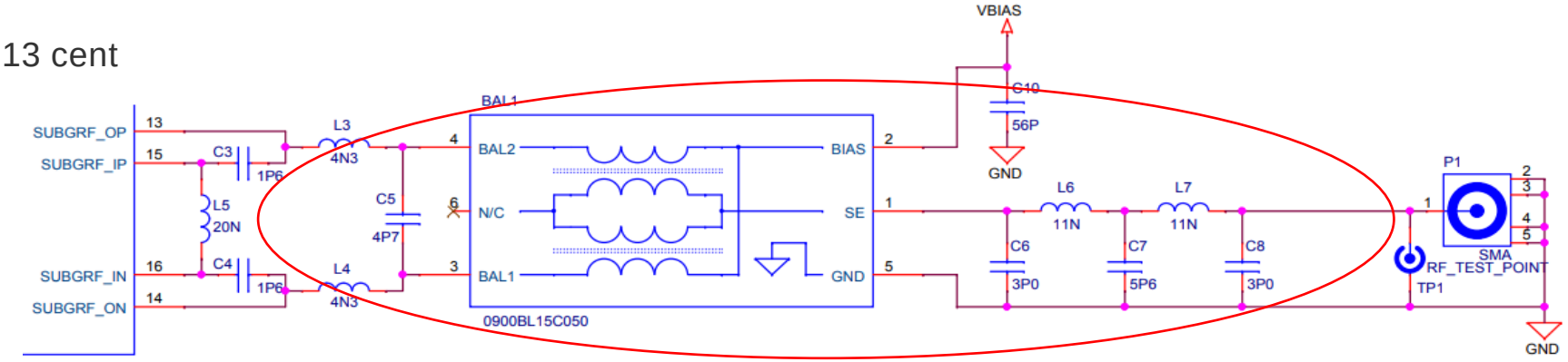
- Uses two antenna at least a ¼ wave apart and typically 90 degrees orientation for polarization
- During multipath and/or blocking, one antenna will have better SNR and/or desired signal RSSI
- During the preamble, RX antenna diversity monitors both antennas and selects better antenna
- Improves the performance in multipath environments by about 6-8 dB



Simplified Single Ended Match – Optimized BOM

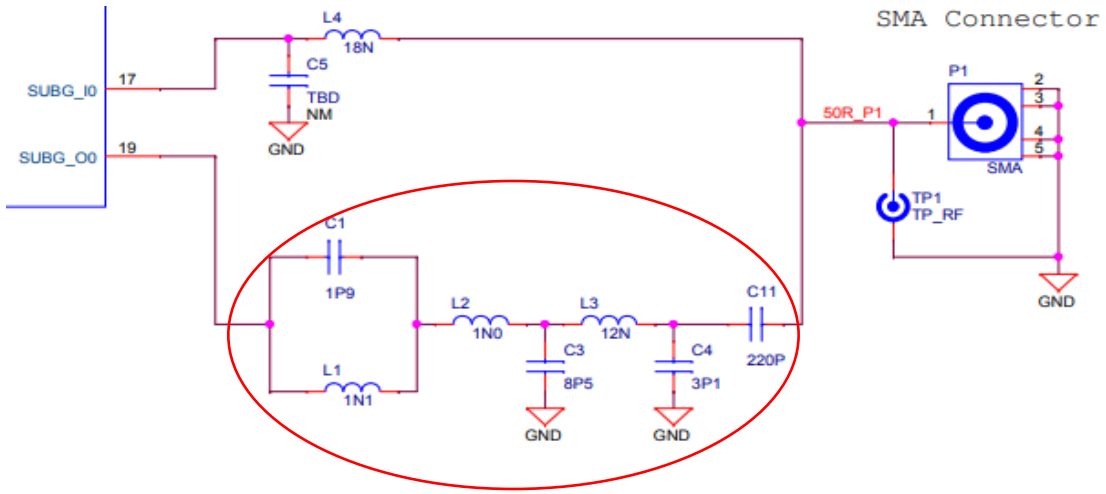
Series 1 match:

BOM price example: 13 cent



xG23 match:

BOM price example: 4 cent



Gateways in the IoT

- **Gateways are a requirement for the IoT and are complex devices**
  - Gateways must connect, manage a multitude of end device types with complex profiles
- **Complex system Infrastructure is a barrier for IoT adoption**
  - More gateways, routers, and bridges are needed
  - Crucial for IoT platforms, clouds and networks
  - Difficult to develop, install and maintain
- **Only few software platform providers are at IoT gateway layer**
- **Abstracts wireless IoT protocol evolution for IoT services**
- **Enterprise gateways and access points are adding IoT radios for indoor location services**
- **Edge computing and Edge-to-Cloud IoT service enablement**
  - Allows customers to connect to cloud services
  - Enables local on-premises computing

Let's Solve the "IoT Gateway Problem"

Unify SDK Solves the IoT Gateway Challenge

What is it?

- Network abstraction framework for IoT cloud and platform providers

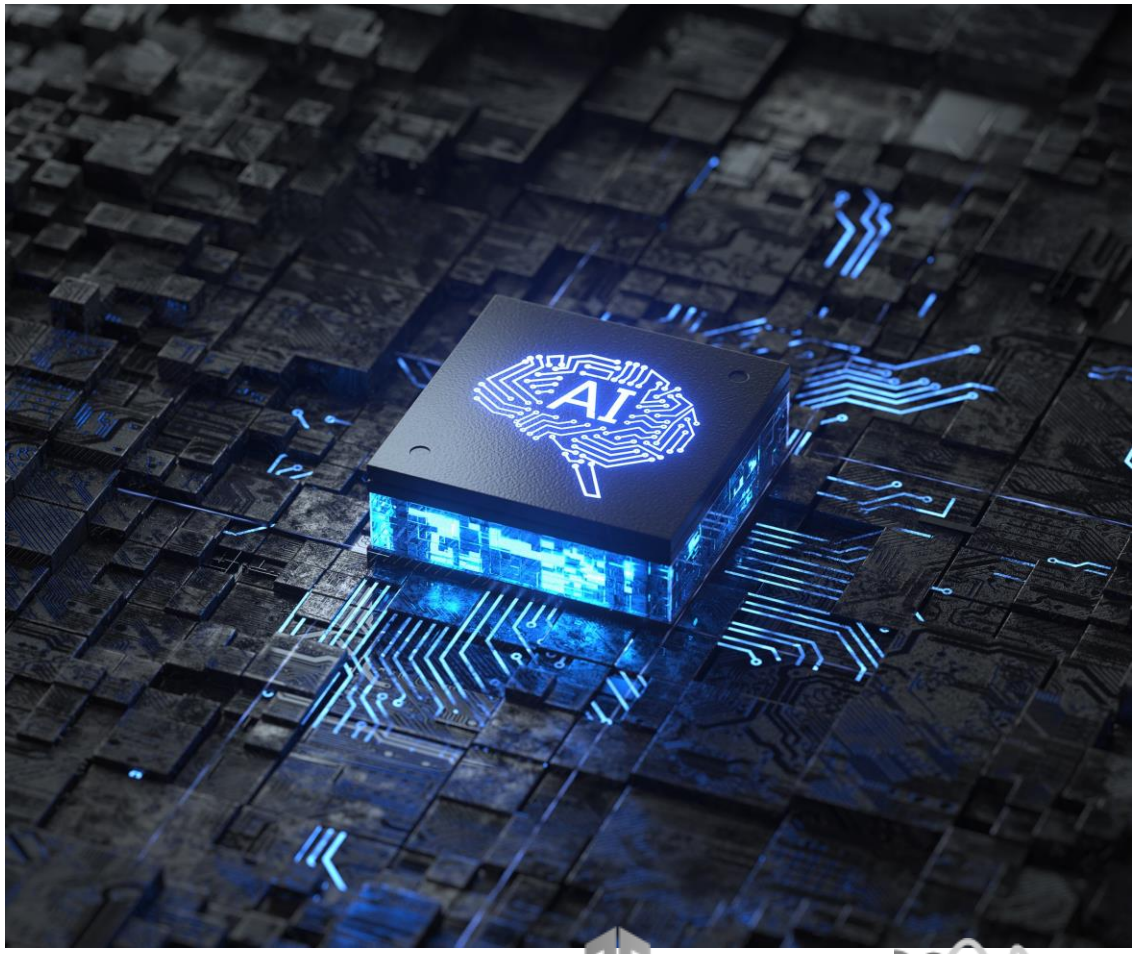
What can you do with it?

- Develop a single gateway software base
- Let Unify SDK handle the protocol-specific translations
- Maintain just one code base for your cloud and platform, regardless of the devices and wireless protocols
- Z-Wave and Zigbee initially, more protocols to follow – Bluetooth, Thread, and Matter

How does it work?

- A common, well-defined data model, API, and status definitions for IoT services such as adding, updating, and removing a device
- Protocol drivers translate the common IoT services into protocol-specific formats

Embedded AI on Cortex-M devices for Smarter IoT



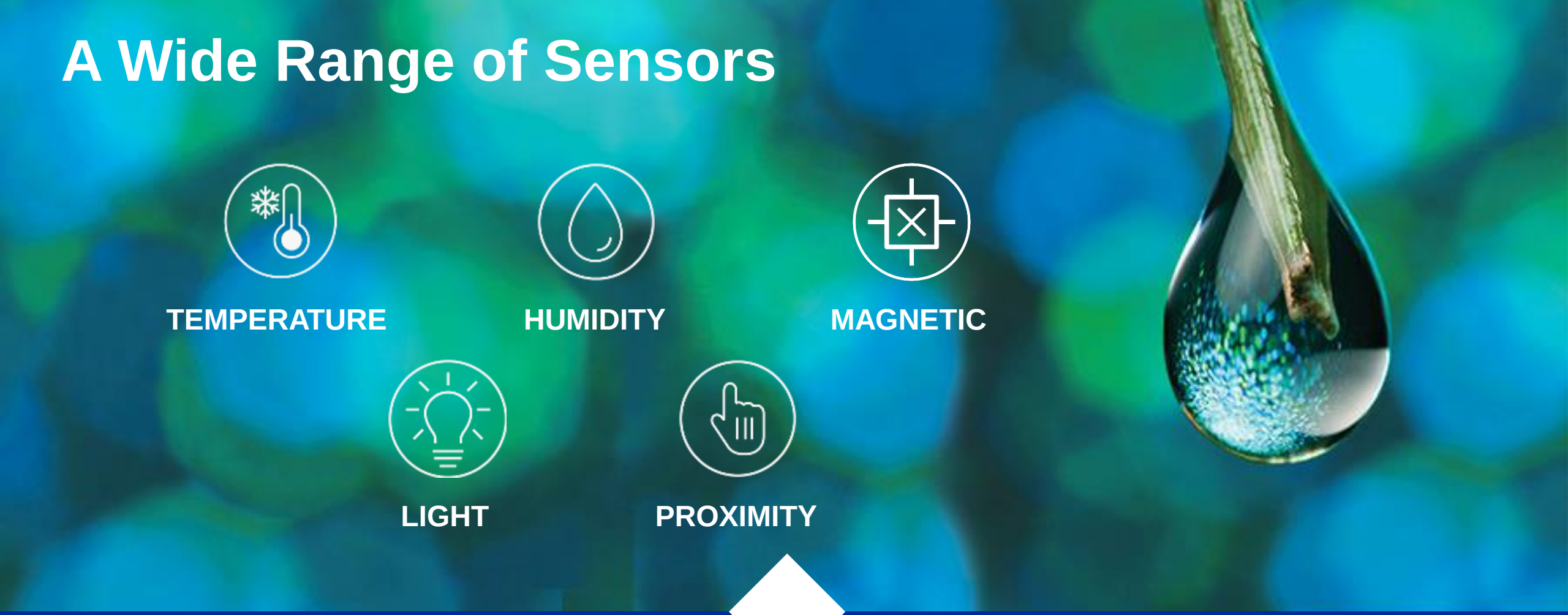
EDGE IMPULSE

TensorFlow Lite

SensiML™

- **Applications in**
  - Predictive maintenance
  - Asset management
  - Occupancy sensing with environmental sensors
  - Other – Sound profiling, anti tamper, fault detection
- **Benefits of Edge AI/ML**
  - Longer battery life
  - Reduced need for bandwidth
  - Lower latency Better UX
  - Privacy & Security
  - Lower cost (Cloud, Multipurposing)

A Wide Range of Sensors



TEMPERATURE

HUMIDITY

MAGNETIC

LIGHT

PROXIMITY

Enabling existing and emerging application areas

完整議程隨選重播

藍牙應用課程

工業物聯網應用課程

SILICON LABS | EDOM TECHNOLOGY CO., LTD.

Thank you!

欲瞭解更多資訊，請聯繫益登科技

TEL ：886-2-2657-8811

Mail : sales@edomtech.com

Silicon Labs 官方網站	Silicon Labs 臉書粉絲專頁	Silicon Labs 線上社群