V. 02/24

Bluetooth®

SoC and Module Selector Guide for Industrial and Commercial IoT

Selecting the Right Bluetooth Device for your Smart Cities, Industrial, Commercial, and Clinical Medical Application

SILICON LABS | Bluetooth®

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Making Industrial IoT Products on the World's Largest and Fastest Growing Wireless Technology - Bluetooth®

Bluetooth® offers developers and manufacturers one of the world's fastest growing wireless connectivity technologies. In fact, 5.4 billion Bluetooth-enabled IoT devices are expected to be shipped by 2023. However, succeeding in this intensely competitive market isn't easy; it takes more than a myopic focus on chip footprint or hardware specs.

Today's IoT products need to place an emphasis on protecting users' privacy against constantly evolving security threats while delivering great user-experiences through superior RF performance, smooth connectivity, long battery life, and cutting-edge software functionalities. In addition to juggling these requirements, developers also need to launch products faster to the market via simplified development experience and maintain the installed-base securely, over-the-air, throughout the product lifecycle.

Powering hundreds of millions of Bluetooth-enabled IoT devices globally, Silicon Labs' Bluetooth® portfolio makes it possible to build energy-efficient IIoT devices and applications quickly and maintain the product lifecycle securely using over-the-air firmware updates.

The portfolio comprises five elements: hardware, software, security, development kits, and learning resources for Bluetooth Low Energy as well as Bluetooth mesh.

Hardware
SoCs and Modules

Software
SDKs, Stacks & Tools

Security
Hardware and Software

Development
Kits and Boards

Support
Knowledge Base & Community

This guide provides you with a quick overview of our Bluetooth® hardware so you can make an informed decision when selecting the SoCs and modules for your next project.

Four Bluetooth® Hardware Highlights

Learn more about our Bluetooth Development Kits here.

BG21

The BG21 has the industry's longest range and is the only SoC with +20 dBm TX power, ideal for line powered devices.

BG22

The BG22 is the most energy-efficient SoC enabling 10+ years lifetime with a coin cell battery

BG24

The ultra-low power BG24 features the largest Flash and RAM capacities in our portfolio and PSA Level 3 Secure Vault™ protection and AI/ML Acceleration. Available in WLCSP package for small form factor applications

BG27

The BG27 is our most Battery Versatile SoC, available with DCDC Boost in WLCSP packaging for small form factor applications, from medical devices to wearables and beyond.

Why Silicon Labs Bluetooth® SoCs and Modules are Ideal

Hardware

The broad range of Bluetooth® SoCs (System-on-Chip) and modules Silicon Labs offers means there's an optimal solution for every Industrial IoT use-case. Our hardware is renowned for superior RF performance, equipping your products with the best connectivity, reliability, and user-experience available.

ULTRA-LOW ENERGY CONSUMPTION

Our innovative transmitter performance provides your IoT devices with up to +10 years of life from a single coin cell battery.

LONGEST RANGE

For IoT applications requiring extreme range, Silicon Labs hardware delivers the world's highest transmit power up to +20 dBm.

OPTIMIZED FOR LARGE-SCALE NODE NETWORKS

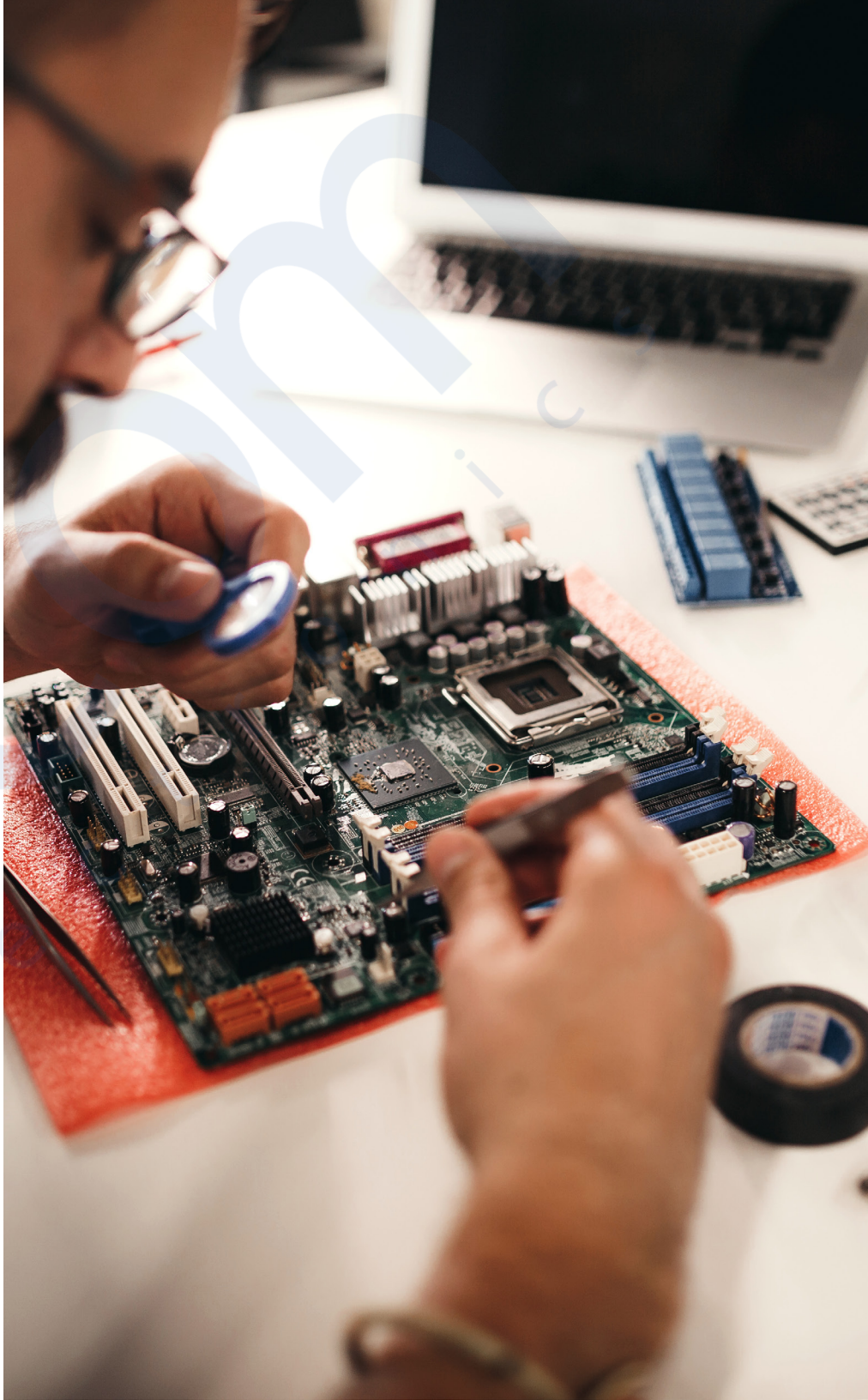
Silicon Labs' Bluetooth® Low Energy (LE) devices support mesh networking for many-to-many (m:m) communications.

SOFTWARE

Silicon Labs helps you keep your products ahead of the competition by continually developing our Bluetooth® software development kits (SDK) at the forefront of the industry – delivering the latest protocols and high-quality implementations of all the essential features on Bluetooth® Low Energy and Bluetooth® mesh.

The dynamic multiprotocol support, Wi-Fi coexistence, support for new Bluetooth 5.4 electronic shelf label (ESL) features, and direction finding are just a few highlights of our market-leading Bluetooth® feature parity.

Thanks to our hardware-agnostic stacks, you can reuse your Bluetooth® application software, APIs, and integrated development environment across our hardware portfolio, radically minimizing software and hardware migration efforts when you develop new Bluetooth-enabled products.



SECURITY

When you want your products to withstand the most sophisticated cyber-security attacks, you can trust our technology to safeguard your customers' privacy and your brand by implementing robust security at all levels:

Bluetooth® Stack

Our Bluetooth® stack implements the standard security features to protect your applications against the common wireless threats.

Software

The mbed TLS software execution layer allows your applications to use our advanced chip-level secure hardware capabilities.

Device-level

Our hardware implements robust security via secure boot with root of trust and secure loader, secure over-the-air update, crypto engine, true random number generator, and Silicon Labs' cutting-edge Secure Vault technology.

DEVELOPMENT

Silicon Labs SDKs work with C programming as well as GCC and IAR based compilers. For ultimate ease, you can download Simplicity Studio, our unified development environment for all Silicon Labs technologies. When installed, it automatically customizes your development environment and SDKs based on the target hardware into an intuitive, end-to-end development experience. Simplicity Studio offers the most powerful utility toolbox at no cost.

Silicon Labs Secure Vault technology enabled the world's first wireless SoCs to achieve PSA Certified Level 3 certification.

Based on the strength of Secure Vault, Silicon Labs' received the 2022 Leadership in Engineering Achievement Program (LEAP) for connectivity award.

RAIL

Silicon Labs RAIL (Radio Abstraction Interface Layer) provides an intuitive and easily-customizable radio interface that is designed to support proprietary or standards-based wireless protocols. RAIL allows customers to adopt the latest RF technology without sacrificing the previous development investment and future-proofs the code migration to future EFR32 ICs. The unified radio software API abstracts the significant number of hardware registers and complexity of the lower-level radio block, allowing customers to focus on their proprietary wireless application development instead of mastering device-specific details.

SUPPORT

There is a complete set of in-depth Bluetooth technical documents and development resources to get you ahead fast. Silicon Labs is renowned for its ambitious community support and quick turnaround time.

CUSTOM PART MANUFACTURING SERVICE

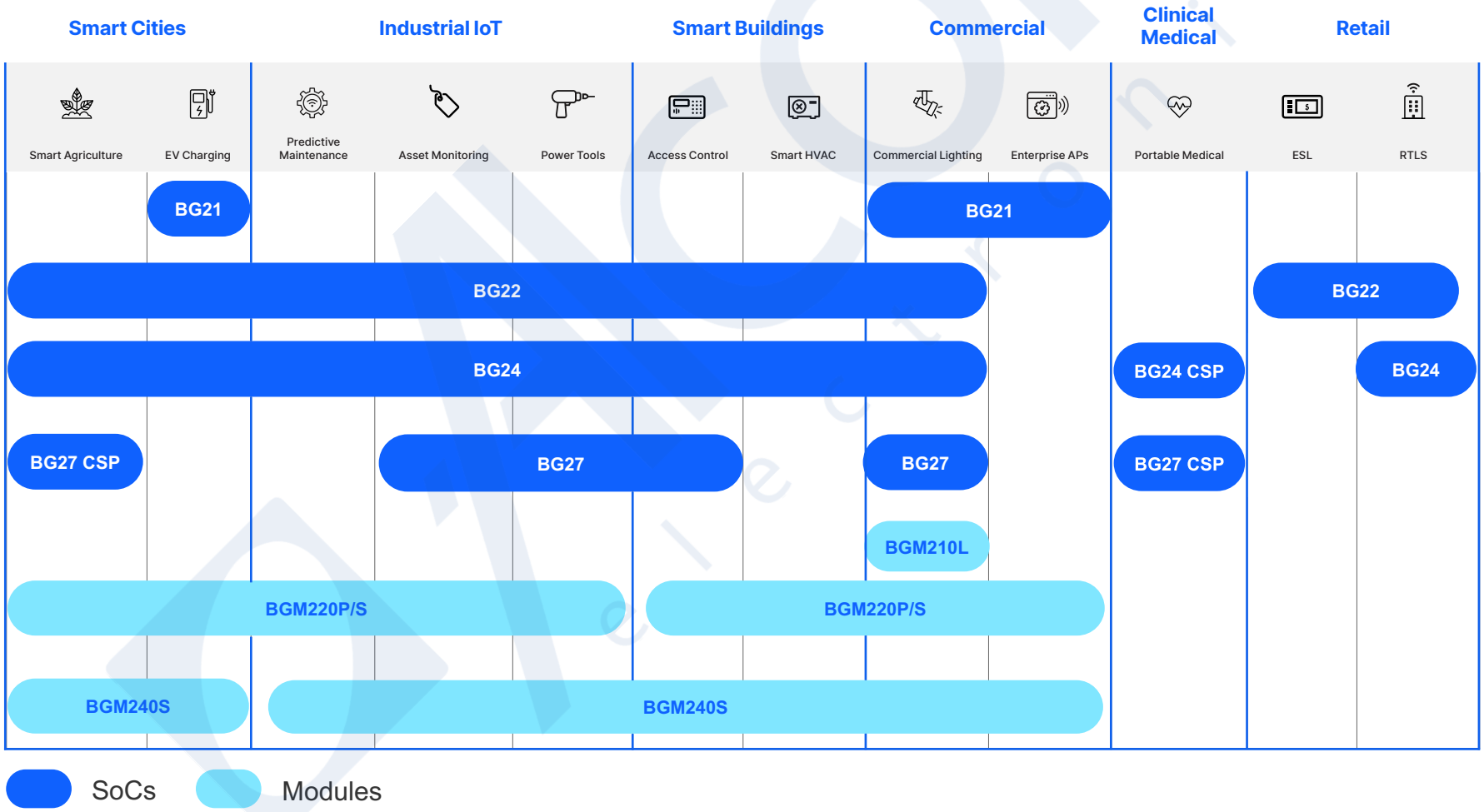
Security is critical for IoT devices, but developing secure products is complex. Our new Custom Part Manufacturing Service (CPMS) simplifies the process by making it possible for IoT device makers and application developers to configure and order customized wireless hardware and MCUs directly from Silicon Labs. In addition to flash programming, CPMS also provides more advanced security provisioning such as secret key injection, anti-tamper configuration, secure boot, and debug lock configuration.

Bluetooth® Technology Leader

As an Associate Member of Bluetooth SIG and a leading influencer in the standardization body, we drive the future of Bluetooth based on our world-class R&D and customer feedback. This in-depth knowledge of future use-cases and requirements allows us to develop better solutions, delivered to you in the industry forefront.

Silicon Labs Bluetooth®
Portfolio for Consumer IoT

Silicon Labs offers a broad range of Bluetooth® wireless SoCs and modules for every consumer IoT application and device category. To simplify your selection process, the table here gives you a quick overview to match our SoCs and modules to your application.



How to Choose the Right Bluetooth® SoC and Module

To narrow down your selection, the product summaries here highlight the key capabilities, features, and properties of each family. This will help you to choose the correct product family based on your design requirements such as range, security, form-factor, and power credentials. If you need to accelerate your time to market, most of our Bluetooth® SoCs offer RF pre-certified modules that will save you development time and costs.

Key Properties of our Bluetooth SoC Families

- For Line Powered Devices
- Long Range +20dBm Tx
- High Temp +125°C
- CA Title 20
- Secure Vault High (Sesip L3 / PSA L3)
- BGM210L Module with flexible mount-ability (Vertical or Horizontal) integrated antenna and RF certifications for faster time to market

- For Battery Powered Devices
- High Temp +125°C
- CA Title 20
- Ultra-Low Power
- Secure Vault Mid
- BGM220P/S modules with integrated antenna and RF certifications for faster time to market

- Fpr Battery Powered Devices
- Long Range – Low Power
- Large Memory
- AI/ML accelerator for tiny edge processing
- Secure Vault High (Sesip L3 / PSA L3)
- BGM240P/S modules with integrated antenna and RF certifications for faster time to market
- Small 3.1x3.0mm CSP form-factor

- For Small Form Factor Battery Operation
- Ultra small form-factor 2.3×2.6mm
- Exceptional Receiver Sensitivity
- Ultra-low Transmit Power
- Battery Life Tracking (Coulomb Counter)
- DC-DC Converter
- Wakeup Pin
- Secure Vault Mid
- Standards IEEE 2621 & IEC62304 complia

Bluetooth® SoC Lineup

	BG21	BG22	BG24	BG27
Bluetooth features	5.4 and mesh 1.1 (1M, 2M, LE Coded PHYs and AE)	5.4 and Bluetooth mesh LPN (1M, 2M, LE Coded PHYs, AE and Bluetooth direction finding)	5.4 and Bluetooth mesh 1.1 (1M, 2M, LE Coded PHYs, AE and Bluetooth direction finding hardware accelerator)	5.4 and Bluetooth mesh 1.1 (1M, 2M, LE Coded PHYs, and AE)
Proprietary 2.4G	2(G)FSK, (G)MSK, OQPSK DSSS	2(G)FSK, (G)MSK, OQPSK DSSS	2(G)FSK, (G)MSK, OQPSK DSSS	2(G)FSK, (G)MSK, OQPSK DSSS
TX / RX (1M,GFSK)	+20 dBm / -97.5 dBm	+6 dBm / -98.9 dBm	+19.5 dBm/-97.6 dBm	+8 dBm/-99.2 dBm
TX Current (MCU + radio value)	9.3 mA (0 dBm) 33.8 mA (10 dBm)	4.1 mA (0dBm) 8.2 mA (6 dBm)	5mA (0 dBm) 19.1mA (10 dBm)	4.1 mA (0 dBm) 11.3 mA (8 dBm)
RX Current (1M, GFSK)	8.8 mA	3.6 mA	4.4 mA	3.6 mA
CPU / CLock Speed	Cortex M33 (80 MHz) Cortex M0+ (Security)	Cortex M33 (up to 76.8 MHz) Cortex M0+ for radio	Cortex-M33 (up to 78 MHz) Cortex M0+ for radio	Cortex M33 (up to 76.8 MHz) Cortex MO+ for radio Cortex M0+ (Security)
Flash (kB)	Up to 1024kB	Up to 512kB	Up to 1536kB	768kB
RAM (kB)	Up to 96kB	32kB	Up to 256kB	64kB
Sleep Current (EM2)	4.5 µA (16 kB RAM)	1.2 µA (8 kB RAM)	1.3 µA (16 kB RAM)	1.6 µA (64 kB RAM)
Active Current (EM0)	50.9 µA / MHz	27 µA / MHz	33.4 µA/MHz	29 µA/MHz
Security	Secure Vault - Mid Secure Vault - High	Secure Vault - Mid	Secure Vault - Mid Secure Vault - High	Secure Vault - Mid
Operating Voltage	1.71V - 3.8V	1.71V - 3.8V	1.71V - 3.8V	0.8V - 1.7V 1.8V - 3.8V
Packages (mm)	4×4 QFN32	4×4 QFN32 4×4 TQFN32 5×5 QFN40	5×5 QFN40 6×6 QFN48 3.1×3.0 WLCSP	5×5 QFN40 4×4 QFN32 2.3x.2.6 CSP

Bluetooth®
Module Lineup

	BGM210P	BGM210L	BGM220P	BGM220S	BGM240P	BGM240S
Protocols	5.4 and mesh 1.1 (1M, 2M, Coded PHY and AE)	5.4 and mesh 1.1 (1M, 2M, Coded PHY and AE)	5.4 and mesh 1.1 LPN (1M, 2M, Coded PHY, AE and Bluetooth direction finding)	5.4 and mesh 1.1 LPN (1M, 2M, Coded PHY, AE and Bluetooth direction finding)	5.4 and Bluetooth mesh (1M, 2M, LE Coded PHYs, AE and Bluetooth direction finding)	5.4 and Bluetooth mesh (1M, 2M, LE Coded PHYs, AE and Bluetooth direction finding)
EFR32 SoC	BG21	BG21	BG22	BG22	BG24	BG24
Antenna	Built-in or RF pin	Built-in	Built-in	Built-in or RF pin	Built-in or RF pin	Built-in or RF pin
Max TX power	+10 / +20 dBm	+12.5 dBm	+8 dBm	+6 dBm	+10/ +20 dBm	+10 dBm
Sensitivity (1M)	-97 dBm	-97 dBm	-98 dBm	-98 dBm	-98.5 dBm	-97.0 dBm
Flash (kB)	1024	1024	512	512	1536	1536
RAM (kB)	96	96	32	32	256	256
GPIO	20	12	24, 25	25	26	32
Operating Voltage	1.8V - to 3.8V	1.8V – 3.8V	1.8V - to 3.8V	1.8V - to 3.8V	1.8V - to 3.8V	1.8V - to 3.8V
Operating Temp.	–40 to +125°	–40 to +125°	–40 to +105°	–40 to +105°	–40 to +105°	–40 to +105°
Dimensions W x L x H (mm)	12.9 x 15.0 x 2.2	15.5 x 22.5 x 2.2	12.9 x 15.0 x 2.2	6 x 6 x 1.3	12.9 mm x 15.0 mm	7 mm x 7 mm x 1.18mm
Certifications	BT, CE, FCC, ISED, Japan & S-Korea	BT, CE, FCC, ISED, Japan & S-Korea	BT, CE, FCC, ISED, Japan & S-Korea	BT, CE, FCC, ISED, Japan & S-Korea	CE, UKCA, FCC, ISED, MIC, KC	FCC, ISED, CE, UKCA, MIC, KC

Bluetooth Support for Electronic Shelf Label (ESL) Applications

The latest version of Bluetooth – Bluetooth 5.4 – was released early in 2023 and one of the main improvements in Bluetooth 5.4 is the bi-directional communication with thousands of end nodes from a single access point. The rapidly growing ESL market will highly benefit from this feature by allowing the use of the current standard-based Bluetooth wireless communication.

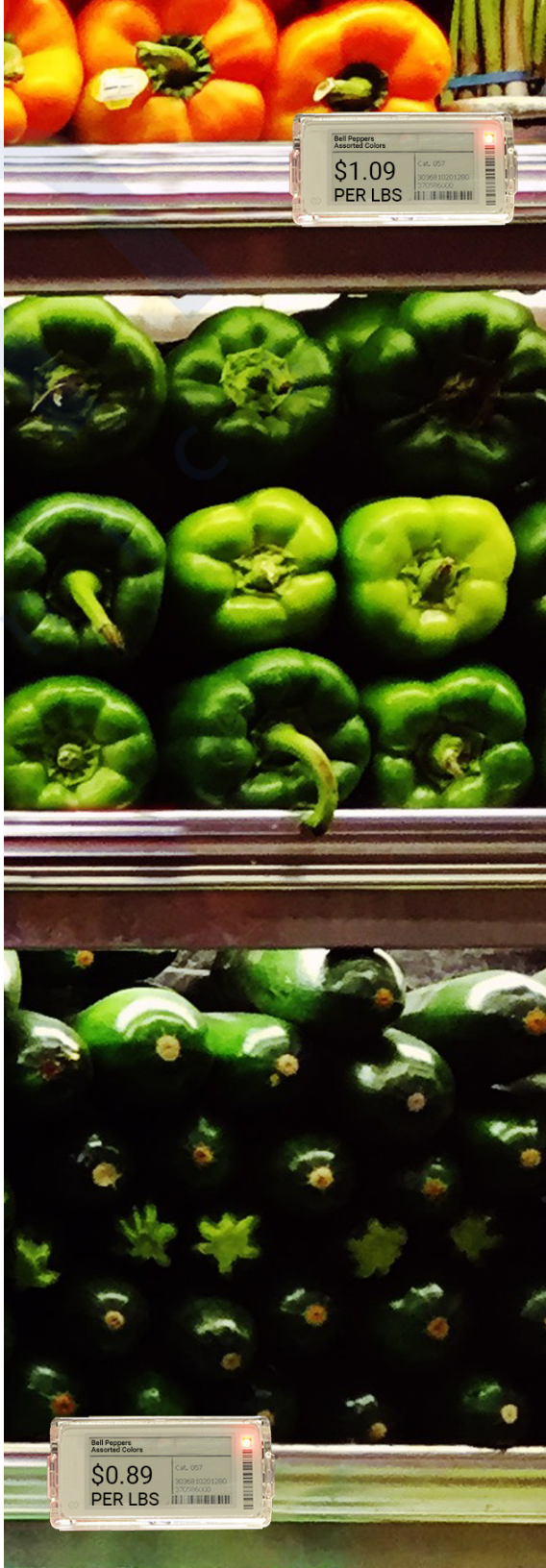
With ESLs, retailers can increase pricing efficiency and accuracy, optimize click and collect, and simplify replenishment. Store operators can quickly react to market prices and easily synchronize pricing to keep up with the online competition. ESLs allow customers to immediately see the correct price and get personalized, in-depth product information creating a seamless in-store and online shopping experience with price transparency.

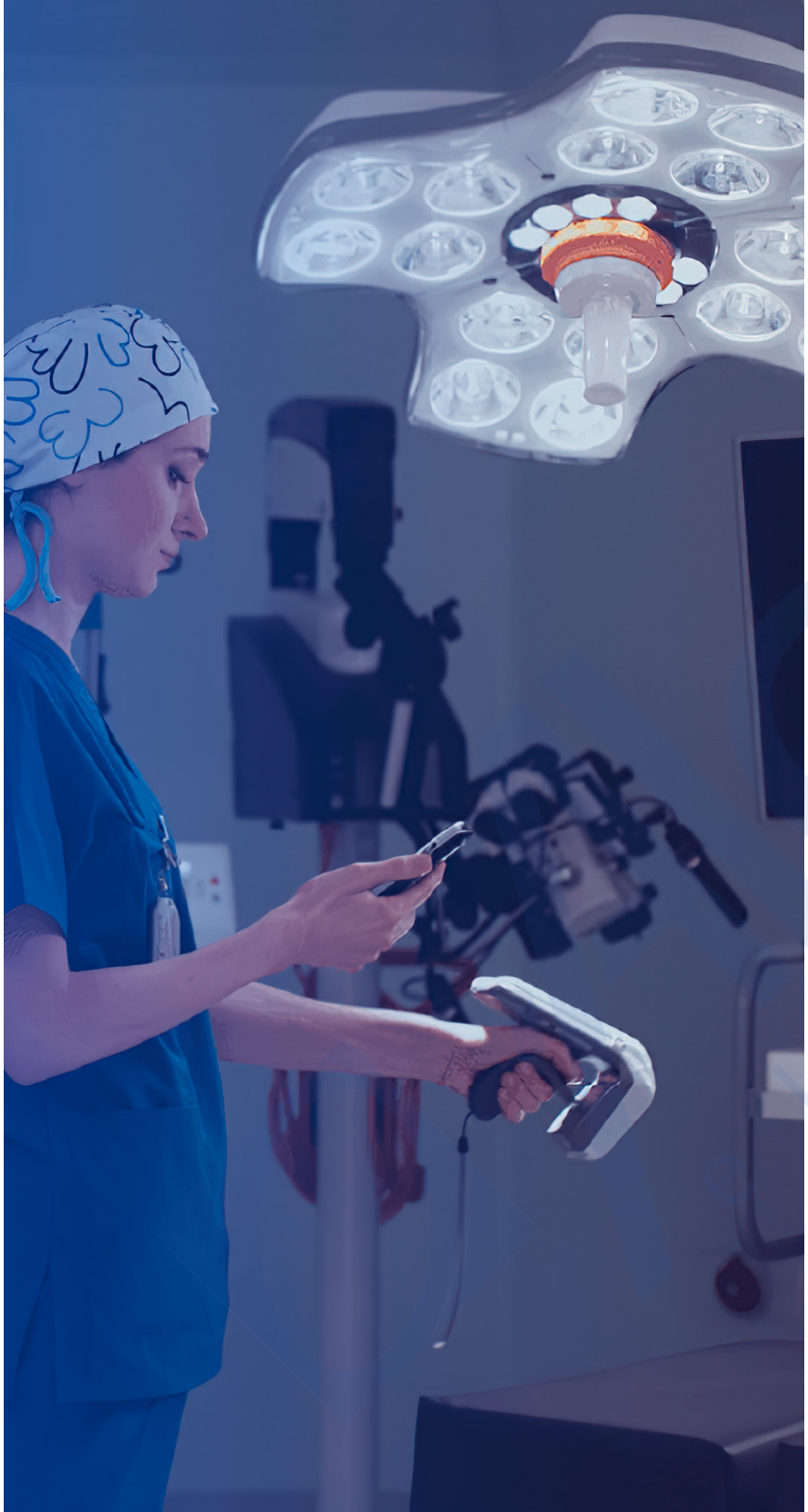
Two key features for ESL applications now available include:

- **Periodic Advertising with Responses (PAwR)**
  PAwR will allow the implementation of a time-synchronized star network with bi-directional communication using an enhanced Periodic Advertisement with a Response feature. This feature adds the capability for devices that receive data from a periodic advertiser to respond to the transmitter of the periodic advertiser. Additionally, devices can be allocated to groups, allowing them to listen only to their group's transmissions. The key benefit of this feature is the capability to support massive-sized star network implementations powerfully and efficiently.

- **Encrypted Advertising Data (EAD)**
  EAD adds the ability to encrypt advertising data. Encrypted advertisement data can be received by any device but can only be decrypted and authenticated by devices that have previously shared the session key. The significant benefit of this feature is that it allows for the encryption of data shared over periodic advertisement with responses.

Bluetooth SIG is also developing a standardized Profile and Service that will regulate communication with the Electronic Shelf Label (ESL) devices utilizing the new features of Bluetooth 5.4. For more information on these specifications in development, visit the publicly shared Bluetooth SIG on ESL/PAwR.





Bluetooth® Industrial and Commercial Application Examples

Borda Technology

borda
IoT for Healthcare

For nearly two decades, Borda Technology has used connectivity to improve efficiency in healthcare settings.

Borda offers tamper-proof tracking tags and locators, based on Silicon Labs' BG22 Bluetooth® SoCs, that take advantage of the high-precision accuracy offered by current Bluetooth® specifications, including angle-of-arrival (AoA). These tags offer the ability to track the utilization of devices as well as the interactions with the asset by patients and hospital staff. In a real-world setting, assets are moved around all the time without being used, so Borda provides a much clearer picture of utilization.

The BG22 was developed with high-volume, cost-sensitive applications in mind, and Borda's asset tagging solution is a great example of why Bluetooth® is well-suited for real-time location services (RTLS) applications. In addition to Bluetooth's low-power operation, it's also virtually ubiquitous in the devices we use and familiar to most users.

Read the Case Study

Bluetooth® Industrial and Commercial Application Examples

BeeHero

BeeHero

BeeHero, an Israeli-based AgTech startup, is using Bluetooth-enabled sensor technology to make it possible for beekeepers to remotely monitor their hives.

BeeHero uses IoT sensors to monitor the temperature, humidity, activity, and acoustics of beehives, and shares that data to a cloud-based platform for analysis. From there, data scientists analyze patterns in hive activity using AI/ML. Especially in large-scale commercial beekeeping, accurate sensor data means there's hope for preventing hive collapse with early interventions. Data from IoT sensors enables targeted quality control, which saves time and money and increases yield.

BeeHero leverages Silicon Labs technology for sensors, gateway wireless modules, and sensor-integrated circuitry. Their system features Silicon Labs' EFR32BG24 Series 2 Bluetooth® Wireless System-on-Chip along with the BGM210P and BGM240P wireless Bluetooth® modules for high performance and low energy consumption.

Read the Case Study

Bluetooth® Industrial and Commercial Application Examples

CoreTigo

CoreTigo

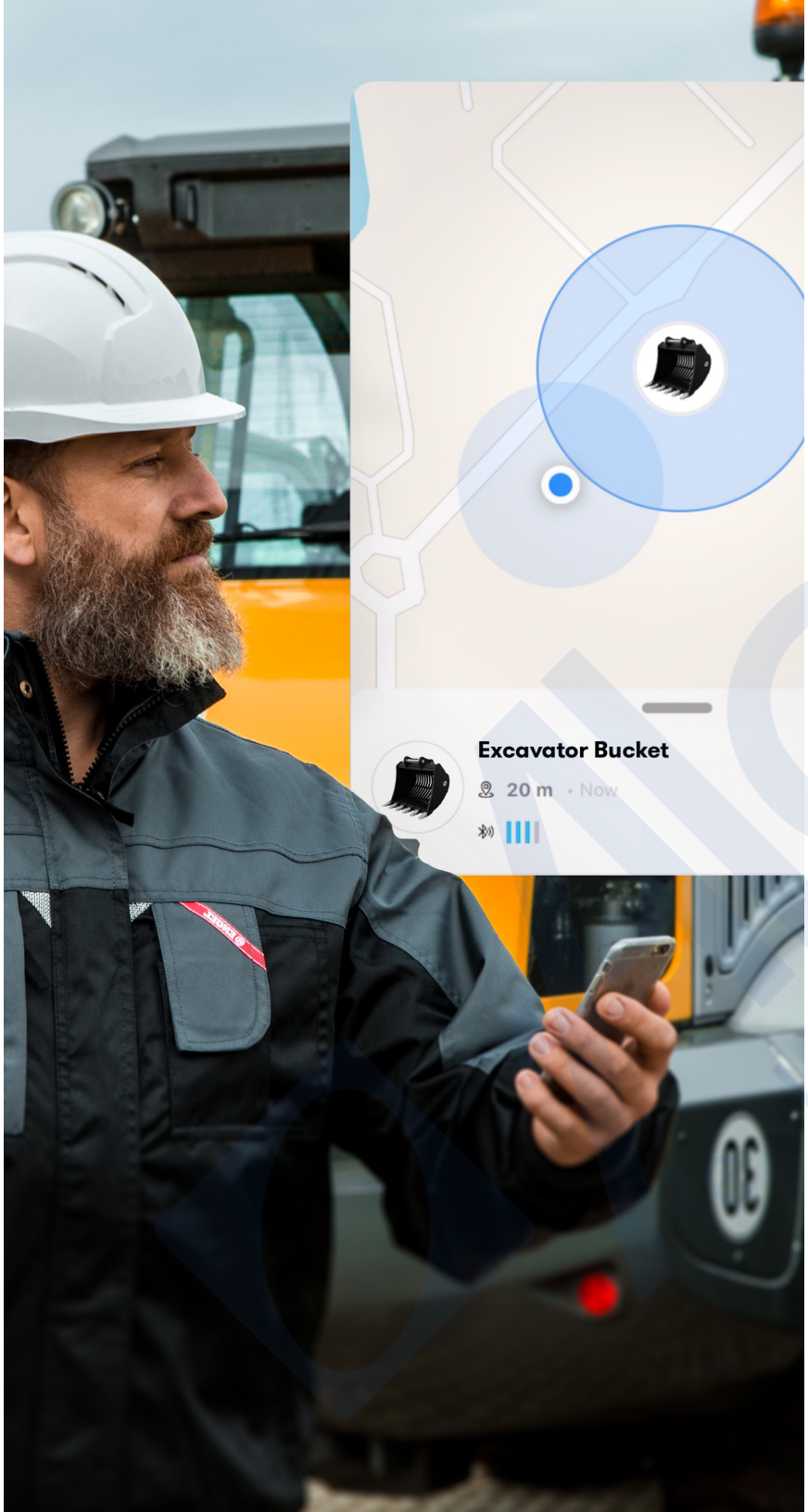
With a focus on harsh industrial environments, CoreTigo is a pioneer in wireless connectivity for factory automation.

Built on the IO-Link Wireless global standard, CoreTigo supports real-time control and monitoring for millions of sensors, actuators, and devices at sites worldwide. This level of control over operational technology improves adaptivity and modularity. IO-Link Wireless enables data capture to optimize maintenance, conserve energy, and improve throughput.

When designing their wireless solutions, CoreTigo needed a future-proof wireless SoC that could support IO-Link Wireless, which is known for high performance. To achieve cable-grade, reliable connectivity in the 2.4 GHz frequency band, IOLW combines frequency- and time-division multiple access schemes (F/TDMA) and uses frequency hopping to minimize the effects of channel-selective fading, shadowing, and interference.

The Silicon Labs EFR32MG13, EFR32MG21, and EFR32MG24 were natural choices for fast RF channel and radio state switching times, excellent radio sensitivity, and ultra-low power modes.

Read the Case Study



Bluetooth® Industrial and Commercial Application Examples

Trackunit

Trackunit®

Construction is the third-largest industry in the world, and typically slow to adopt new technology. But with the help of the Silicon Labs EFR32BG22, Trackunit developed an easy-to-deploy, small, and robust self-powered tag that bridges the gap between large machines and smaller accessories by enabling the entirety of a site inventory to be tracked through a phone app. Silicon Labs' Bluetooth 5.2 SoCs were instrumental in Trackunit's Kin, a tag that helps connect the entire construction fleet through one simple platform. Kin helps eliminate downtime by finding items exponentially faster. The amount of time that Trackunit's customers spend searching for small assets in large construction sites usually translates to extreme delay in schedules and overblown budget.

Trackunit Kin is simple to install and connect, and interfaces with Trackunit's secure, open, cloud-based productivity platform Iris. Not only does it provide clear identification by locating assets via visible LED pulses, but it also offers unparalleled data that allow each of these consumers to glean valuable insights.

Read the Case Study

Bluetooth® Industrial and Commercial Application Examples

Zliide

Zliide used our BGM220 Bluetooth module to bring its Zliide Security Tag to life, which operates like a typical garment security tag but also allows shoppers in the store to scan one of the tags using a smartphone app and access product information, photos, and branded videos. They can also pay for the item through the app so they can check out from anywhere in the store. Users can also shop a virtual version of the stores through the app any time of day from anywhere in the world. Because every item is tagged, you know exactly what is available and what isn't because you can interact with anything in the store.

This level of freedom, convenience, and accessibility has never been available in a retail setting. RF/AM tags have long been used for security applications just like this, but Zliide's Intelligent Tag can communicate with the customer's mobile device, opening up new levels of functionality and convenience.

Read the Case Study

Bluetooth® Development Kits

Our Bluetooth development kits are designed to help you get up and running as quickly as possible and are divided into three categories based on your development need. Silicon Labs offers kits for experimenting, prototyping, or developing your product.

- ✓ Supported
- — Not Supported
- ✓ Optional or not mounted

	Explorer Kit Our entry-level kit offers five powerful development features, including an onboard debugger, traffic analyzer, virtual COM port, mobile tester app, and connectors for MikroE and Qwiic peripheral boards. It's also is fully supported by Simplicity Studio, the unified development environment for all Silicon Labs technology.	**Development Kit** To simplify prototyping or field trials, our development kits support both a coin cell and a connector for external batteries or power supplies. The Arm Cortex-M series-based development kits also provide a 2.4 GHz chip antenna, a board controller, J-Link debugger, packet tracing, virtual COM, and various on-board sensors.	**Pro Kit** Developing production products require additional development features such as an energy profiler and a network analyzer to optimize your code and RF design. This kit also includes an LCD display, Ethernet port, 8-channel logic, and a standardized interface for all Silicon Labs radio board products.
Debug Speed	1.6MHz	1.6MHz	8MHz
Debug USB	Full Speed	Full Speed	High Speed
Packet Trace Interface (PTI)	✓	✓	✓ 2x
Breakout Pads	✓	✓	✓
Pushbutton s & User LEDs	✓	✓	✓
Virtual COM	✓	✓	✓
Coin cell battery holder	—	✓	✓
On-board Sensors	—	✓	✓
Battery Pack Connector	—	✓	✓
Radio Board Connectors	—	—	✓
EXP Connectors	—	—	✓
Display	—	—	✓
Debuge OUT	—	—	EFM8/32, EFR32, EZR32
Debuge Ethernet	—	—	100 Mbit/s
Energy Monitor (AEM)	—	—	✓
3rd Party Hardware addons	✓	—	—

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