



tech **talks** UPCOMING SESSIONS

FEB 23RD | ML in Predictive Maintenance and Safety Applications

MAR 23RD | Unboxing: What's New With Bluetooth

APR 20TH | What's New with Bluetooth Mesh 1.1

MAY 18TH | Bluetooth Portfolio: What's Right for Your Application

JUN 15TH | The Latest in HADM With Bluetooth LE



Bluetooth® Portfolio: What's Right For Your Application



Agenda

Why Bluetooth® 5.4?

What's new with Bluetooth® 5.4

Bluetooth® Portfolio

Bluetooth Selector Guide

Code Levels

Summary and Q&A

Bluetooth® 5.4

Petteri Paatsila

Why Bluetooth 5.4?



- **Need for standardized large scale star networks**
 - Capability to host thousands of nodes
 - Encrypted data traffic
 - Ultra-low power consumption
 - Driven by electronic shelf label (ESL) market
- **Enhancements**
 - Optimizing access to secure data
 - Better control for LE Coded PHY for extended advertising

Bluetooth 5.4 – Target Markets & Use Cases



SMART RETAIL

- Electronics Shelf Labels
- Shelf Sensors

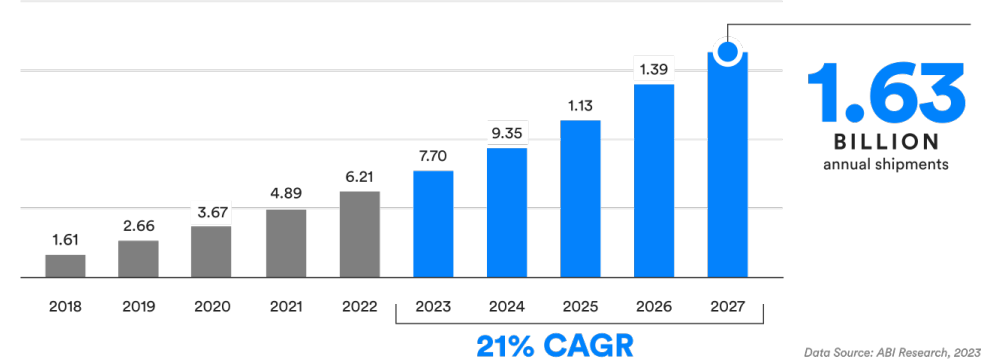


INDUSTRIAL

- Manufacturing & Logistics
- Digital Signage
- Asset monitoring

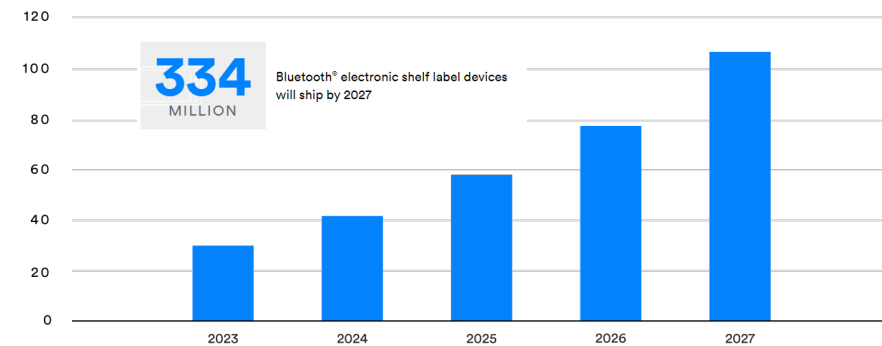
Annual Bluetooth® Device Networks Device Shipments

NUMBERS IN BILLIONS



Annual Bluetooth® ESL Shipments

NUMBERS IN MILLIONS



Source: <https://www.bluetooth.com/2023-market-update/>

Bluetooth 5.4 New Features



Periodic Advertising with Responses (PAWR)

Provides energy efficient, large-scale, and bi-directional one-to-many communication topology



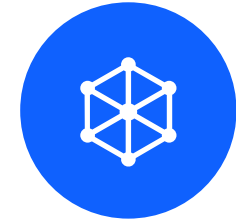
Encrypted Advertising Data (EAD)

Feature to the secure broadcasting of data in advertising packets



LE GATT Security Levels Characteristic

Devices can indicate the security mode and level required for all their GATT functionality to be available

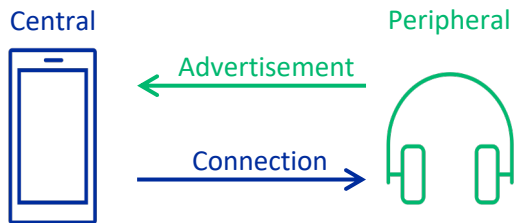


Advertising Coding Selection

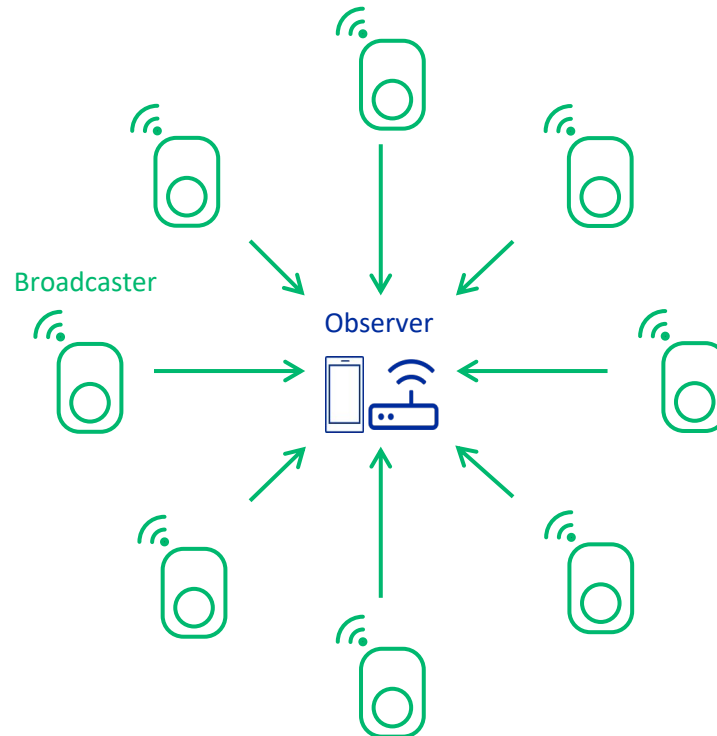
The Host can specify which of two supported long range coding options are used with LE extended advertising

Advertising Modes in Bluetooth 5.4

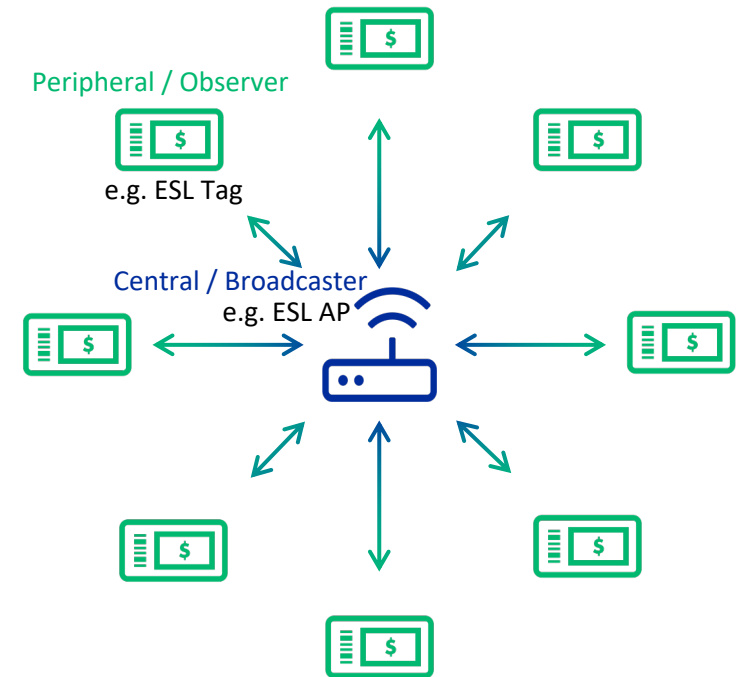
Advertising for Connection (irregular, unidirectional)



One-way "Beaconing" (regular, unidirectional)



Periodic Advertising with Responses (regular, bidirectional)



New mode enabling "Synchronized" mode network. Used by BT ESL.

Periodic Advertisement with Responses (PAwR) Explained

PAwR train setup

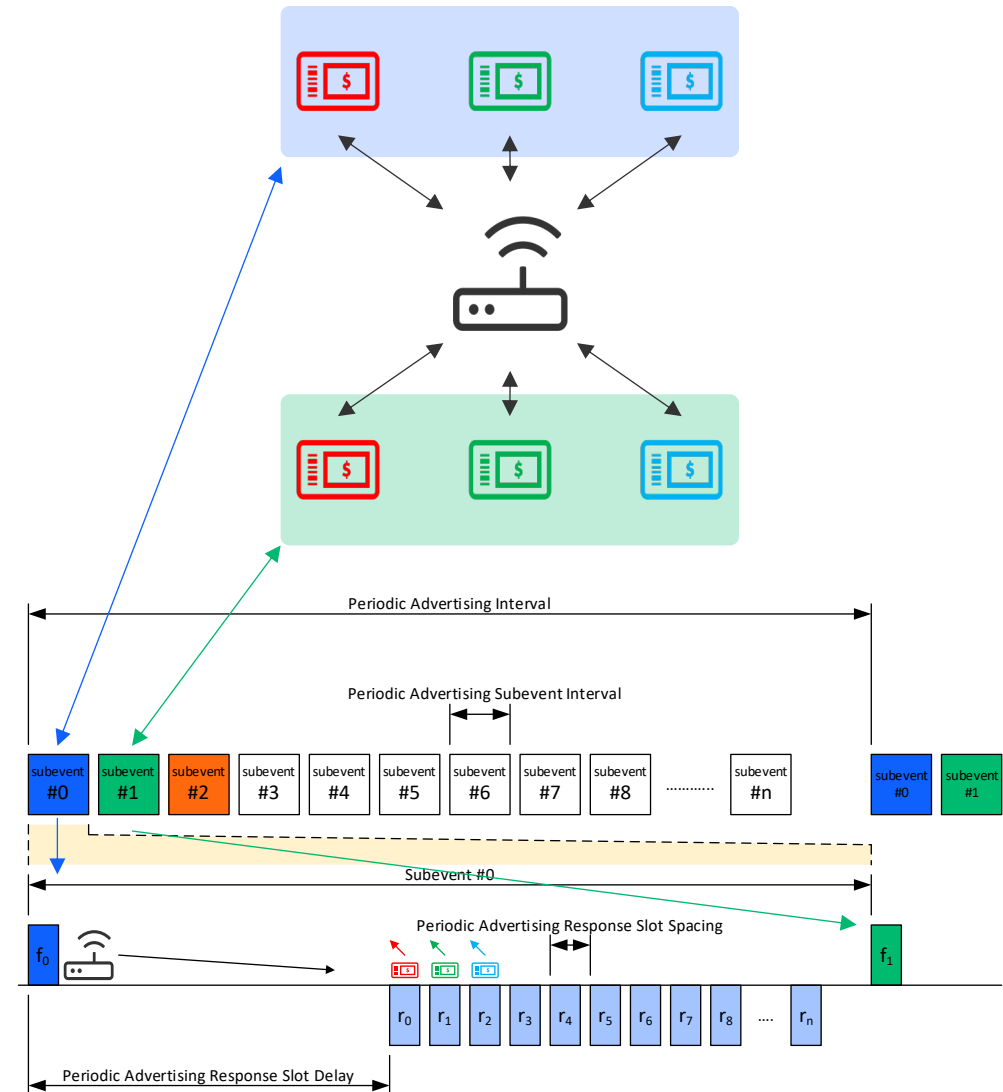
- Sets timing parameters
- Configure number of Subevents and Response Slots

Subevents

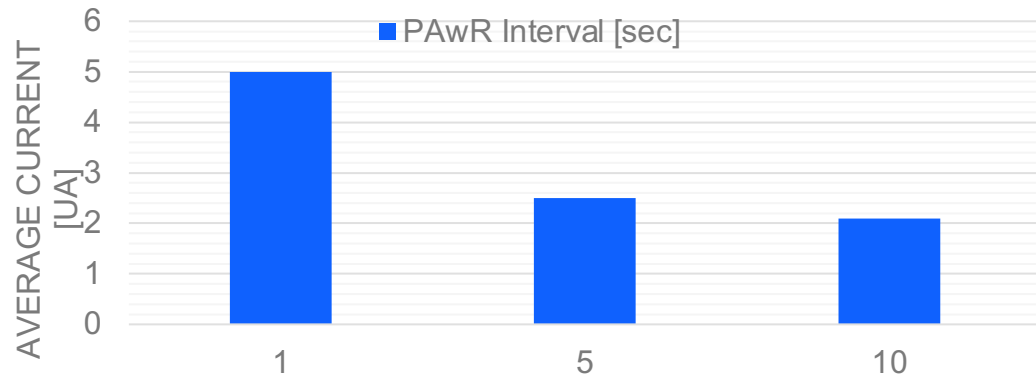
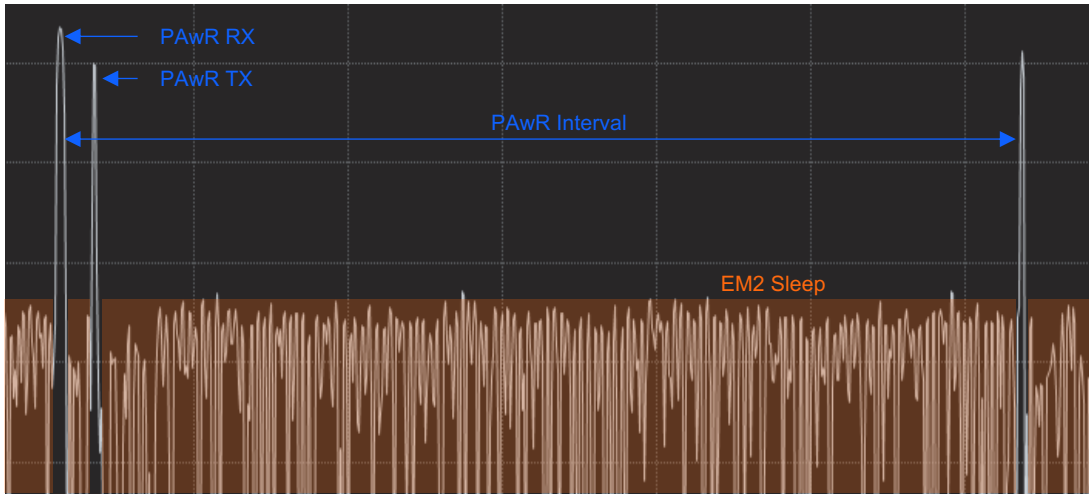
- Each Peripheral (ESL) belongs to one Subevent
- Maximum 128 Subevents (ESL Group)
- 255 unique ESLs in one ESL Group
- Total max 32,640 Peripherals in the network

Inside a Subevent

- All Peripherals in one Subevent receive the Central Device transmission (downlink)
 - ▶ Keeps up the synchronization to the PAwR train
 - ▶ Transmits downlink payload data
- Each Peripheral has its own Response Slot to reply (uplink)



Example of PAwR Current Consumption



Peripheral device use case

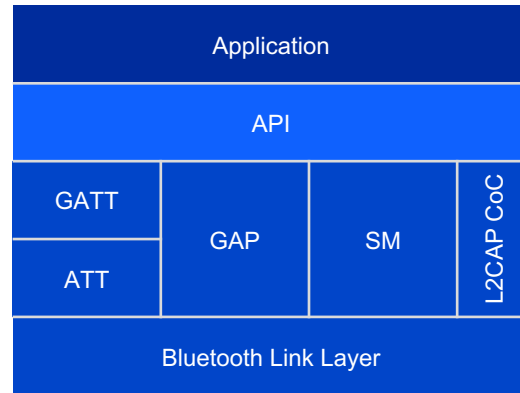
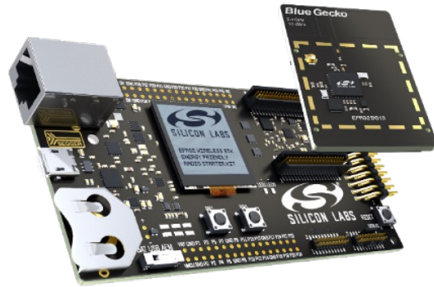
- Receives Central Device downlink transmission at given Subevent time slot
- Responses uplink at given Response Slot
- Remains in sleep mode rest of time

Measurement condition

- MG22 Radio Board
- Vinput 3.0V, DC/DC in use
- SoC Current only
- TX 0dBm
- LFXO accuracy 50ppm

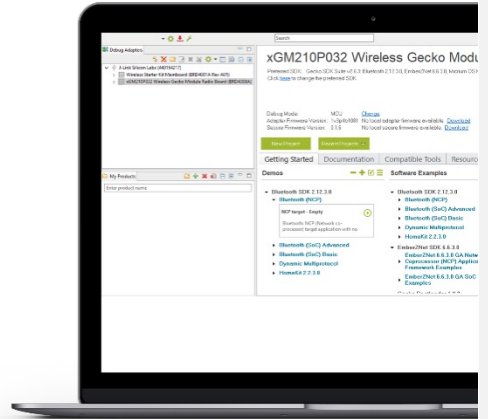
A Complete Solution for Bluetooth 5.4 Development

Early Access available on request. Public GSDK release taking place in June.



```

Python
2025-01-14 14:31:53.410: BLE - INFO - Write request, length: 2048
2025-01-14 14:31:53.437: BLE - INFO - Transfer finished, result: 0
2025-01-14 14:31:53.437: BLE - DEBUG - [Event] Image sent
2025-01-14 14:31:53.437: BLE - DEBUG - [Event] Connected
2025-01-14 14:31:53.474: AP - INFO - [Event] Image sent
2025-01-14 14:31:53.474: AP - INFO - Image sent to the device
Image_update: 1 Image/Device.png
2025-01-14 14:31:58.803: AP - DEBUG - Display type matches object type
2025-01-14 14:31:58.806: BLE - DEBUG - [Command] Write Image
2025-01-14 14:31:58.806: BLE - DEBUG - Starting image transfer using OTS
2025-01-14 14:31:59.087: BLE - INFO - Write request, length: 2048
2025-01-14 14:31:59.088: BLE - INFO - Transfer finished, result: 0
2025-01-14 14:31:59.088: BLE - DEBUG - [Event] Image sent
2025-01-14 14:31:59.088: BLE - DEBUG - [Event] Connected
2025-01-14 14:31:59.033: AP - INFO - [Event] Image sent
2025-01-14 14:31:59.034: AP - INFO - Image sent to the device
#Image2: 2
2025-01-14 14:37:29.134: BLE - INFO - [Command] Initiate PAST
2025-01-14 14:37:29.190: BLE - INFO - Connection prepared for sync transfer
2025-01-14 14:37:31.491: BLE - INFO - Connection closed
2025-01-14 14:37:31.491: BLE - DEBUG - [Event] Idle
2025-01-14 14:37:31.491: BLE - DEBUG - Connection closed, reason: 0x1813
2025-01-14 14:37:31.500: AP - INFO - [Event] Connection closed
2025-01-14 14:37:31.500: AP - INFO - [Event] Idle
[TAG] BLE Address: 8C:F6:81:08:42:26
[TAG] ESI Address: 2 (0x0002)
[TAG] ESI ID: 2
[TAG] Group ID: 0
[TAG] AP sync key: **** (set)
[TAG] Response key: **** (set)
[TAG] Absolute Time: Last time set to 78367
[TAG] Display: [D] Width: 128 Height: 128 type: 255
[TAG] Max Image Index: 1
[TAG] Sensors: [X] Present Input voltage [Y] Present device operating temperature [Z] Device firmware version [TS] Date of manufacture [C] Device operating temperature range specification [CS] Silicon revision counter [OS] Present ambient temperature [CT] Silabs button
[TAG] LED Info: [D] Colored, current color: RGB(333)
[TAG] PMP Info: Vendor: Silicon Labs Product ID: RWS5 Product version: 0x000
[TAG] Link status: Synchronized (0x000)
-----
link 0
There's no advertising tag.
link 0
There's no connected tag.
link 0
[TAG] BLE Address: 8C:F6:81:08:42:26 ESI Address: 1
[TAG] BLE Address: 8C:F6:81:08:42:26 ESI Address: 2
There are 2 synchronized tags.
#Image: 0 #
2025-01-14 14:37:51.812: AP - DEBUG - [Event] PMP subevent data request
2025-01-14 14:37:51.821: BLE - DEBUG - [Command] Get periodic advertisement data
2025-01-14 14:37:51.900: AP - DEBUG - [Event] PMP response
2025-01-14 14:37:51.900: AP - INFO - Response received in subevent 0 slot 0
2025-01-14 14:37:51.900: AP - INFO - Reply from ESI ID 2, in group 0
2025-01-14 14:37:51.931: AP - INFO - [Event] User response: 0x000, Index: 0 Image_Index: 0 (0x10000)
    
```



SOC, MODULES, DEV KITS

Multiple physical interfaces to support advanced development and debugging

- UART, Ethernet, USB
- LCD, LED, buttons

STACK SOFTWARE

In-house developed stack

Bluetooth 5.4

Support for PAwR, EAD, PAST, CoC, BT ESL Service and Profile

All security features supported

ESL ACCESS POINT DEMO

Python based ESL AP

ESL Library (GATT, OTS & NCP Events)

EFR32 radio with NCP

DEVELOPMENT TOOLS

Simplicity Studio

BT 5.4 NCP and SoC

BT ESL Example

Energy Profiler

Bluetooth® Portfolio

Aashish Chaddha

The Portfolio of SoCs and Modules

Increasing Features



Industry-leading energy efficient SoC

- Lowest power Bluetooth LE
- Direction Finding
- Bluetooth mesh LPNs
- SoC, PCB Module and SiP
- Balance of features, size, power, cost
- Support in SoC mode BT 5.4 stack and ESL application

Q2 2023



BG27 SoC

Most Battery Versatile SoC for Connected Health, Smart Home, Portable Products

- Supports button cells
- DCDC Buck and Boost
- Coulomb counting
- Small form factor WLCSP
- Wake-up pin (BOOST_EN)
- Support in SoC mode BT 5.4 stack and ESL application
- Bluetooth mesh Relay, Proxy, LPNs



BG21 SoC



BGM210L & PCB Module

Optimized for LED lighting, Gateway/Hub, and Bluetooth mesh applications

- Highest output power in Industry
- Line-powered devices
- Secure Vault High, PSA L3
- Bluetooth mesh
- Bluetooth 5.4 gateway devices



BG24 SoC



BGM240S SiP & PCB Modules

Feature rich device with Highest integration

- Largest Flash/RAM
- High I/O pin count
- AI/ML hardware accelerator
- High sensing ADC
- Secure Vault High, PSA L3
- Bluetooth mesh
- Bluetooth 5.4 gateway devices
- SoC mode for micro gateways

Increasing Flash/RAM

BG22 and BGM220: Lowest Power for Battery Powered End Devices

SoCs and Modules



BG22 SoC



BGM220S SiP Module



BGM220P PCB Module

SoC Device Specifications

High Sensitivity 2.4 GHz Radio

- -98.9 dBm RX @ BLE 1 Mbps

Efficient ARM® Cortex®-M33

- Up to 76.8 MHz
- 512kB Flash, 32kB RAM

Low Power

- 27 μ A/MHz
- 4.1 mA TX @ 0 dBm
- 3.6 mA RX (BLE 1 Mbps)
- 1.4 μ A EM2
- 0.17 μ A EM4

Multiple protocol support

- Bluetooth (1M/2M/LR)
- Bluetooth mesh LPN
- Direction Finding
- Proprietary 2.4 GHz

SoCs and Modules

- 5x5 QFN40
- 4x4 QFN32
- 4x4 TQFN32
- 6x6 SiP Module
- 12.9x15.0 PCB Module

Differentiated Features

- **Lowest Power RF**
 - Increases battery life
- **RFSense with OOK mode**
 - Ultra low power receive mode
- **PLFRCO**
 - Eliminates need for 32 KHz xtal
- **16-bit ADC**
 - Up to 14-bit ENOB for better analog sensing

Segments and Applications

Smart Cities

- Livestock Management

Industrial

- Access Control
- Human Machine Interface
- Predictive Maintenance
- Asset Tracking

Commercial / Building

- Electronic Shelf Labels
- Clinical Medical
- Point of Sale
- Loss Prevention
- Indoor Real Time Location Services

Smart Home

- Appliances
- Locks
- Switches
- Sensors
- HVAC

Connected Health

- Portable Medical
- Smart Hospitals
- Smart Wearables

BG27: Most Battery Versatile Series-2 SoC

SoCs and Modules



BG27 SoC

SoC Device Specifications

High Performance 2.4 GHz Radio

- Up to +8 dBm TX
- -98.9 dBm RX @ BLE 1 Mbps
- -106.7 dBm RX @ BLE 125 kbps

MCU Core

- ARM Cortex®-M33 (76.8 MHz with FPU & DSP)

Memory

- Up to 64kB RAM
- Up to 768kB Flash

Ultra Low Power

- 4.1 mA TX @ 0 dBm
- 3.6 mA RX (BLE 1 Mbps)
- 1.6 μ A EM2
- 0.18 μ A EM4

Multiple protocol support

- Bluetooth (1M/2M/LR)
- Bluetooth mesh
- Proprietary 2.4 GHz

Package

- 2.3x2.6 WLCSP (19 GPIO) +85°C
- 5x5 QFN40 (26 GPIO) +125°C
- 4x4 QFN32 (18 GPIO) +125°C

Differentiated Features

Extremely small form-factor

- 2.3 x 2.6 WLCSP package

Flexible battery support

- DCDC Buck/Boost
- Supports 0.8 to 1.7 volts
- Supports 1.8 to 3.8 volts

Enhanced security

- Secure Vault™ Mid
- Tamper detect
- Secure Key Management w/PUF

Battery management

- Coulomb counter

Wake-up pin (BOOST_EN)

- allows the device to be off (<20 nA) for long-term storage
- Up to 10 years of shelf storage

RFsense with OOK mode

- Ultra low power receive mode

Segments and Applications

Smart Home

- Appliances
- Door Locks
- Sensors
- Switches
- HVAC
- LED Lighting

Medical and Health and Fitness

- Portable Medical
- Clinical Medical
- Wearables

Industrial & Commercial

- Access Control
- HMI
- HVAC
- Smart Buildings
- Asset Tracking
- Indoor RTLS
- Point of Sale
- Commercial Lighting
- Predictive Maintenance

BG21 and BGM210: Optimized for LED lighting and Gateway/Hub Devices

SoCs and Modules



BG21 SoC



BGM210P PCB Module

SoC Device Specifications

High Performance 2.4 GHz Radio

- Up to +20 dBm TX
- -97.5 dBm RX @ BLE 1 Mbps
- -104.5 dBm RX @ 802.15.4

Efficient ARM® Cortex®-M33

- Up to 80 MHz
- 1024kB Flash, 96kB RAM

Low Power

- 50.9 μ A/MHz
- 9.3 mA TX @ 0 dBm
- 8.8 mA RX (BLE 1 Mbps)
- 4.5 μ A EM2 sleep

Multiple protocol support

- Bluetooth (1M/2M/LR)
- Bluetooth mesh
- Proprietary 2.4 GHz

SoCs and Modules

- 4x4 QFN32
- 12.9 x 15.0 PCB Module
- 15.5 x 22.5 Lighting Module

Differentiated Features

+20 dBm output power

- Eliminates the need for an external power amplifier

Secure Vault High

- Protects data, IP and device
- PSA L3 Certified

Co-existence

- Improves RF performance in crowded 2.4 GHz environments

Low BOM count

- Reduces cost and complexity

Segments and Applications

Smart Home

- Appliances
- Locks
- LED Lighting
- Switches
- Gateways, Hubs and Panel
- HVAC

Industrial

- Circuit Breakers
- HVAC

Commercial

- Commercial Lighting
- Access Points

BG24 and BGM240: Ideal for Battery Powered IoT Mesh Devices

SoCs and Modules



BG24 SoC



BGM240S SiP Module



BGM240P PCB Module

SoC Device Specifications

High Performance Radio

- Up to +19.5 dBm TX
- -97.6 dBm RX @ BLE 1 Mbps

Efficient ARM® Cortex®-M33

- 78 MHz
- 1536kB Flash, 256kB RAM

Low Power

- 33.4 μ A/MHz
- 5.0 mA TX @ 0 dBm
- 4.4 mA RX (BLE 1 Mbps)
- 1.3 μ A EM2 sleep

Multiple protocol support

- Bluetooth (1M/2M/LR)
- Bluetooth mesh
- Proprietary 2.4 GHz

SoCs and Modules

- 5x5 QFN40
- 6x6 QFN48
- 7x7 SiP Module
- 12.9x15.0 PCB Module

Differentiated Features

Upto +19.5 dBm output power

- Eliminates need for external power amplify

AI/ML accelerator

- Accelerates inferencing while reducing power consumption

Secure Vault High

- Protects data, IP and device
- PSA L3 Certified

20-bit ADC

- 16-bit ENOB for advance sensing

Improved Coexistence

- Ideal for gateways and hubs

PLFRCO

- Eliminates need for 32 KHz xtal

Segments and Applications

Smart Home

- HVAC
- Locks
- LED Lighting
- Switches
- Sensors
- Gateways, Hubs and Panels

Connected Health

- Portable Medical

Industrial and Smart Buildings

- Access Control
- HVAC
- Predictive Maintenance
- Asset Tracking

Smart Cities

- EV Charging

Commercial

- Lighting
- Access Points
- Clinical Medical
- Indoor Real Time Location Services

Bluetooth Development Hardware Options

	Explorer Kit	Dev Kit	Pro Kit
Debug Speed	1.6MHz	1.6MHz	8MHz
Debug USB	Full Speed	Full Speed	High Speed
Packet Trace Interface (PTI)	✓	✓	✓ 2x
Breakout Pads	✓	✓	✓
Pushbuttons & User LEDs	✓	✓	✓
Virtual COM	✓	✓	✓
Coin cell battery holder	-	✓	✓
On-board Sensors	-	✓	✓
Battery Pack Connector	-	✓	✓
Radio Board Connectors	-	-	✓
EXP Connector	-	-	✓
Display	-	-	✓
Debug OUT	-	-	EFM8/32, EFR32, EZR32
Debug Ethernet	-	-	100 Mbit/s
Energy Monitor (AEM)	-	-	✓
3 rd Party Hardware addons	✓	-	-

✓ Supported

✓ Optional or not mounted

- Not Supported



Explorer Kit

- Lowest price point
- On-board debugger and signal breakouts
- Minimal on-board features
- 3rd part hardware support

Dev Kit

- Single device development board
- On-board debugger and signal breakouts
- On-board sensors
- Impressive out-of-the-box demos

Pro Kit



















- Modular development platform
- Advanced development use cases
- Energy profiling and external device debug
- Ethernet for large network test
- Designed to maximize reuse of EFR32 devices

Home & Life - Bluetooth Selector Guide













Home Automation								Home Security			Appliances			Entertainment		Medical & Wearables	
LED Lighting	Gateways	Outdoor Living	Switches	Sensors	Locks	HVAC	Shades Blinds	Cameras	Sensors	Control Panels	Whitegoods	Countertop	Robot Vacuums	AR/VR	Toys	Portable Medical	Wearables
BG21			BG21			BG21											
			BG22										BG22				
BG24																	
BG27								BG27			BG27			BG27		BG27 CSP	
BGM 210L				BGM220P/S				BGM220S			BGM220P		BGM220P/S				
BGM240P/S										BGM240P		BGM240S					

SoCs
 Modules

Home & Life - Bluetooth Positioning








Home Automation								Home Security			Appliances			Entertainment		Medical & Wearables		
																		
LED Lighting	Gateways	Outdoor Living	Switches	Sensors	Locks	HVAC	Shades Blinds	Cameras	Sensors	Control Panels	Whitegoods	Countertop	Robot Vacuums	AR/VR	Toys	Portable Medical	Wearables	
BG21		BG22						BG22			BG24			BG22				
<ul style="list-style-type: none"> Line Powered Long Range +20dBm Tx High Temp +125°C CA Title 20 Secure Vault High (Sesip L3 / PSA L3) 		<ul style="list-style-type: none"> Battery Powered High Temp +125°C CA Title 20 Ultra-Low Power Secure Vault Mid 						<ul style="list-style-type: none"> Battery Powered High Temp +125°C CA Title 20 Ultra-Low Power Secure Vault Mid 			<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator 			<ul style="list-style-type: none"> 4.1mA Tx current @0dBm Secure Vault Mid -98.9dBm Rx Sensitivity 4x4 mm 				
BG24		BG27						BG24			BG27			BG24				
<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator 		<ul style="list-style-type: none"> Battery Powered Battery Life tracking (Coulomb Counter) DC-DC Converter Ultra-Low Power Secure Vault Mid 						<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator for tiny edge processing 			<ul style="list-style-type: none"> Battery Powered Devices Battery Life tracking (Coulomb Counter) DC-DC Converter Ultra-Low Power Secure Vault Mid 			<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator for tiny edge processing -97.6dBm Rx Sensitivity 5x5 mm 				
BGM210L		BGM240P/S						BG27 CSP			BGM220P/S							
<ul style="list-style-type: none"> Line Powered High Temp +125°C CA Title 20 Long Range +12.5dBm Tx Antenna and RF Certifications Flexible mountability (vertical / horizontal) 		<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 7x7mm SIP, 12.9x15mm PCB 						<ul style="list-style-type: none"> Ultra small form-factor 2.3x2.6mm -98.9dBm Rx Sensitivity 4.1mA Tx current @0dBm Battery Life Tracking (Coulomb Counter) DC-DC Converter Wakeup Pin Secure Vault Mid 			<ul style="list-style-type: none"> Battery Powered Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 							
BGM220P/S		BGM220S						BGM220P			BGM240S							
<ul style="list-style-type: none"> Battery Powered Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 		<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 						<ul style="list-style-type: none"> Battery Powered Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 			<ul style="list-style-type: none"> Energy Efficient Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 							
BGM240P/S		BGM240P						BGM240P/S			BGM240S							
<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 		<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 						<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 			<ul style="list-style-type: none"> Battery Powered Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 7x7mm SIP 							

Industrial & Commercial - Bluetooth Selector Guide

Smart Cities		Industrial IoT			Smart Buildings		Commercial		Clinical Medical	Retail	
 Smart Agriculture	 EV Charging	 Predictive Maintenance	 Asset Monitoring	 Power Tools	 Access Control	 Smart HVAC	 Commercial Lighting	 Enterprise APs	 Portable Medical	 ESL	 RTLS
	BG21						BG21				
BG22										BG22	
BG24											BG24
BG27 CSP			BG27				BG27		BG27 CSP		
							BGM210L				
BGM220P/S					BGM220P/S						
BGM240S		BGM240S									

 SoCs  Modules

Industrial & Commercial - Bluetooth Selector Guide

Smart Cities		Industrial IoT			Smart Buildings		Commercial		Clinical Medical	Retail	
 Smart Agriculture	 EV Charging	 Predictive Maintenance	 Asset Monitoring	 Power Tools	 Access Control	 Smart HVAC	 Commercial Lighting	 Enterprise APs	 Portable Medical	 ESL	 RTLS
BG27 CSP	BG24	BG22			BG22		BG22	BG21	BG27 CSP	BG22	
<ul style="list-style-type: none"> Ultra small form-factor 2.3x2.6mm -98.9dBm Rx Sensitivity 4.1mA Tx current @0dBm Battery Life Tracking (Coulomb Counter) DC-DC Converter Wakeup Pin Secure Vault Mid 	<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator -97.6dBm Rx Sensitivity 5x5 mm 	<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid 			<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid 		<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid 	<ul style="list-style-type: none"> Line Powered Devices Long Range +20dBm Tx Secure Vault High (Sesip L3 / PSA L3) 	<ul style="list-style-type: none"> Ultra small form-factor 2.3x2.6mm -98.9dBm Rx Sensitivity 4.1mA Tx current @0dBm Battery Life Tracking (Coulomb Counter) DC-DC Converter Wakeup Pin Secure Vault Mid 	<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid 	
BG22	BG22	BG24			BG24		BG24			BG24	
<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid 	<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid 	<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator -97.6dBm Rx Sensitivity 5x5 mm 			<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator -97.6dBm Rx Sensitivity 5x5 mm 		<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator -97.6dBm Rx Sensitivity 5x5 mm 			<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator -97.6dBm Rx Sensitivity 5x5 mm 	
BG24	BG21	BG27			BG27		BG27	BG21		BG24	
<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High -97.6dBm Rx Sensitivity 5x5 mm 	<ul style="list-style-type: none"> Line Powered Long Range +20dBm Tx High Temp +125°C CA Title 20 Secure Vault High (Sesip L3 / PSA L3) 	<ul style="list-style-type: none"> Battery Powered Devices Battery Life tracking (Coulomb Counter) DC-DC Converter Ultra-Low Power Secure Vault Mid 			<ul style="list-style-type: none"> Battery Powered Devices Battery Life tracking (Coulomb Counter) DC-DC Converter Ultra-Low Power Secure Vault Mid 		<ul style="list-style-type: none"> Battery Powered Devices Battery Life tracking (Coulomb Counter) DC-DC Converter Ultra-Low Power Secure Vault Mid 	<ul style="list-style-type: none"> Line Powered Long Range +20dBm Tx High Temp +125°C CA Title 20 Secure Vault High (Sesip L3 / PSA L3) 		<ul style="list-style-type: none"> 5.0mA Tx current @0dBm Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory AI/ML accelerator -97.6dBm Rx Sensitivity 5x5 mm 	
BGM240S		BGM240S			BGM220 P/S		BGM220 P/S	BGM210L		BG24	
<ul style="list-style-type: none"> Battery Powered Devices Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 		<ul style="list-style-type: none"> Battery Powered Devices Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 			<ul style="list-style-type: none"> Battery Powered Devices Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 		<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 	<ul style="list-style-type: none"> Line Powered High Temp +125°C CA Title 20 Long Range +12.5dBm Tx Antenna and RF Certifications Flexible mountability (vertical / horizontal) 		<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 	
BGM220 P/S		BGM220 P/S			BGM240S		BGM240S			BG24	
<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 		<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 			<ul style="list-style-type: none"> Battery Powered Devices Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 		<ul style="list-style-type: none"> Battery Powered Devices Long Range – Low Power Secure Vault High (Sesip L3 / PSA L3) Large Memory Antenna and RF Certifications 			<ul style="list-style-type: none"> Battery Powered Devices Ultra-Low Power Secure Vault Mid Antenna and RF Certifications 	

Bluetooth Selector Guide



Bluetooth® SoC and Module Selector Guide

Silicon Labs offers a range of Bluetooth® wireless SoCs and modules to suit virtually every design requirement. To narrow down your selection, take a look at the product summaries below. Consider the design requirements you have in terms of range, security, dual-band capability, and low power credentials.

Another consideration is whether you wish to undertake your own wireless type approvals or benefit from one of our pre-certified Bluetooth® modules.

	Low Power	Range	Sensitivity	Security	Solution Type	Target Applications
 BG21	●○○○○	●●●●●	●●●●○	●●●●●	SoC	Industrial automation, general purpose
 BGM210P	●○○○○	●●●●●	●●●●○	●●●●●	Module w/ antenna and certifications	Mains powered, lighting, long range, switches, dimmers
 BG22	●●●●●	●●●●○	●●●●●	●●●●○	SoC	Battery powered devices, consumer, medical
 BGM220P	●●●●●	●●●●○	●●●●●	●●●●○	Module w/ antenna and certifications	Battery powered devices, consumer, medical
 BGM220S	●●●●●	●●●○	●●●●●	●●●●○	Module w/ antenna and certifications	Battery powered devices, consumer, medical
 BG24	●●●●○	●●●●●	●●●●○	●●●●●	SoC	Battery Powered devices, consumer and medical

Bluetooth® SoC Lineup



BGM21 (Series 2)



BGM22 (Series 2)



BGM24 (Series 2)

Bluetooth features	5.1 and mesh 1.0 (1M, 2M, LE Coded PHYs and AE)	5.2 and Bluetooth mesh LPN (1M, 2M, LE Coded PHYs, AE and Bluetooth direction finding)	Bluetooth Low Energy, Bluetooth mesh
Proprietary 2.4G	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 / -97.5 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)	5.1 mA (0 dBm) 20 mA (10 dBm)
RX Current (1M, GFSK)	8.8 mA	3.6 mA	4.4 mA
CPU / Clock Speed	Cortex M33 (80 MHz)	Cortex M33 (up to 76.8 MHz) Cortex M0+ for radio	Cortex-M33 (up to 78 MHz)
Flash (kB)	Up to 1024	Up to 512	Up to 1536
RAM (kB)	Up to 96	32	Up to 256
Sleep Current (EM2)	4.5 µA (16 kB RAM)	1.2 µA (8 kB RAM) - 1.4 µA (32 kB RAM)	1.3 µA EM2 DeepSleep current (16 kB RAM)
Active Current (EM0)	50.9 µA / MHz	27 µA / MHz	32.2 µA / MHz
Security	Secure Vault - Mid Secure Vault - High	Secure Vault - Mid	Secure Vault - Mid Secure Vault - High
Operating Voltage	1.71V to 3.8V	1.71V to 3.8V	1.71 V to 3.8 V
Packages (mm)	4x4 QFN32	4x4 QFN32 4x4 TQFN32 5x5 QFN40	5x5 QFN40 6x6 QFN48

Bluetooth® Module Lineup



BGM210P



BGM210L



BGM220P



BGM220S



BGM240P

Protocols	5.3 and mesh 1.0 (1M, 2M, Coded PHY and AE)	5.3 and mesh 1.0 (1M, 2M, Coded PHY and AE)	5.3 and mesh 1.0 LPN (1M, 2M, Coded PHY, AE and Bluetooth direction finding)	5.3 and mesh 1.0 LPN (1M, 2M, Coded PHY, AE and Bluetooth direction finding)	5.3 and Bluetooth mesh (1M, 2M, LE Coded PHYs, AE and Bluetooth direction finding)
EFR32 SoC	BGM21	BGM21	BGM22	BGM22	BGM24
Antenna	Built-in or RF pin	Built-in	Built-in	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
Sensitivity (1M)	-97 dBm	-97 dBm	-98 dBm	-98 dBm	-98.5 dBm
Flash (kB)	1024	1024	512	512	1536
RAM (kB)	96	96	32	32	256
GPIO	20	12	24, 25	25	26
Operating Voltage	1.8V - to 3.8V	1.8V - 3.8V	1.8V - to 3.8V	1.8V - to 3.8V	1.8 to 3.8 V
Operating Temp.	-40 to +125°	-40 to +125°	-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
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

Code Levels

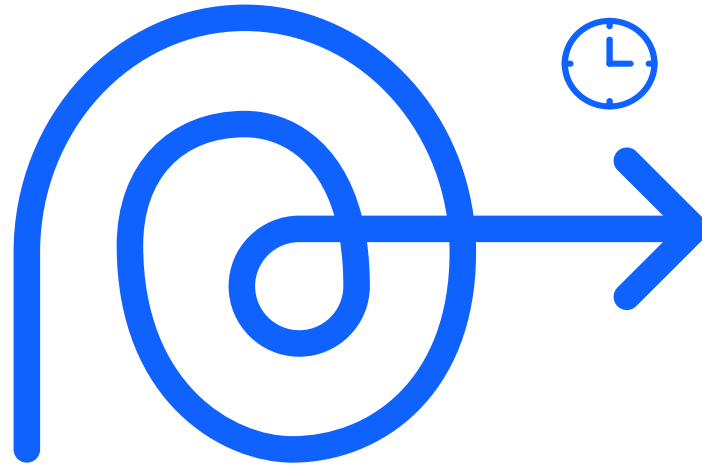
Máté Perjési

The Challenge of IoT Product Creation

IoT HW & SW Offering



The Challenge



The Desired IoT Product

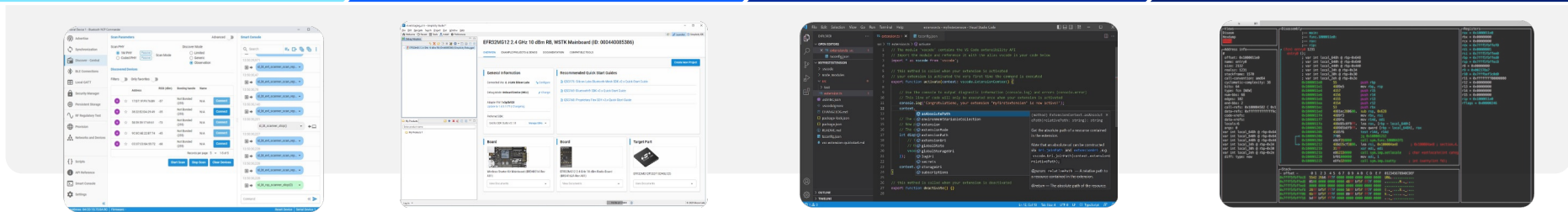


Silicon Labs Code Levels

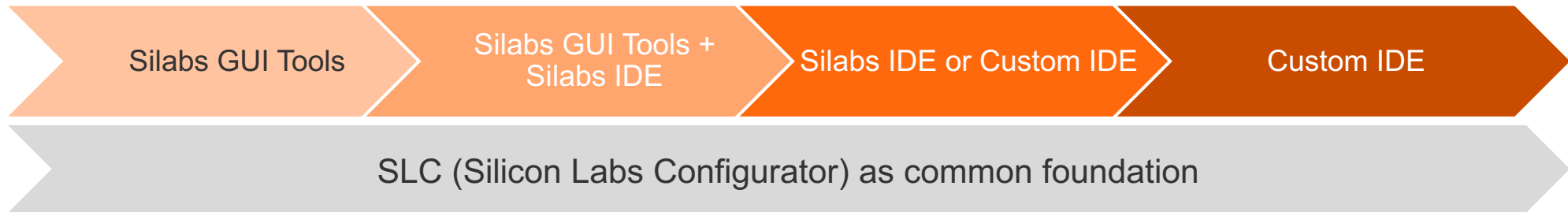
Large variety of customer expertise levels:



Matching developer flows, the Silicon Labs Code Levels:



Typical developer environment and tools:



No-code DX

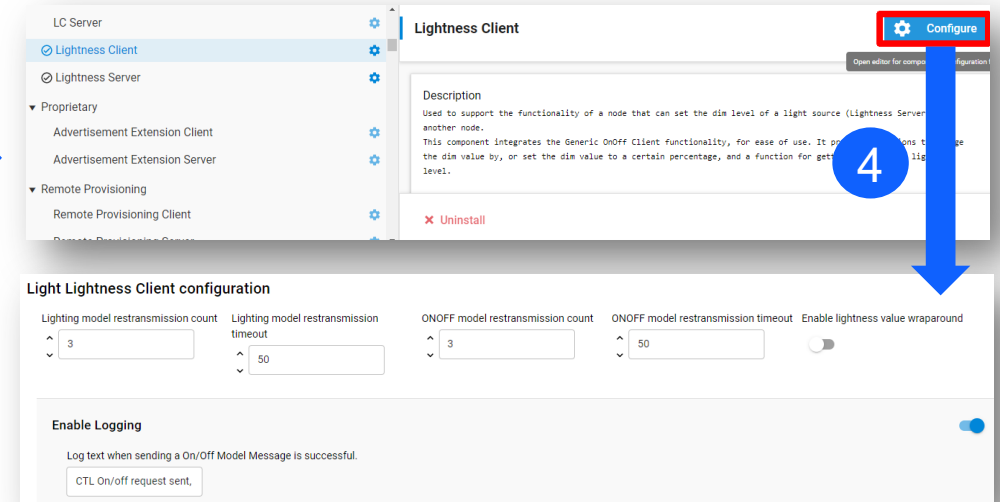
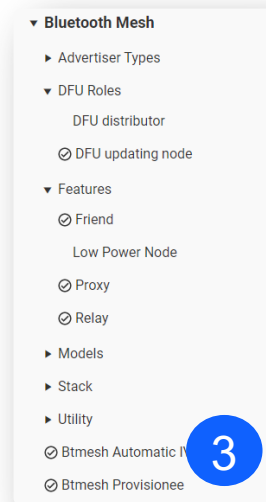
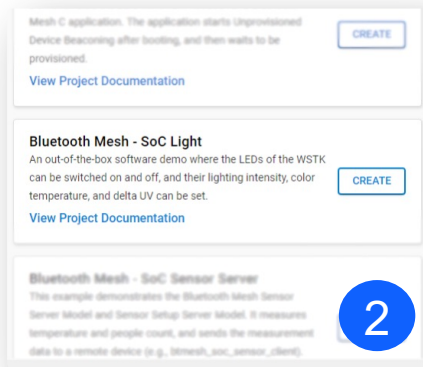
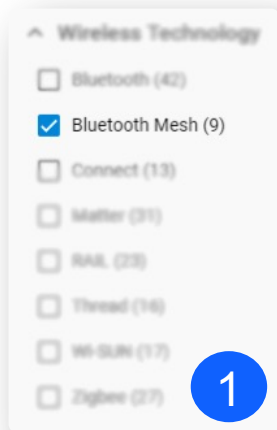
No-code

Low-code

Custom-code

Pro-code

- Targeted for **Beginner customers**
- Product creation with **no coding at all**
- For **well-defined use cases**
- Based on **Simplicity Studio**
- Builds on top of **SLC UI** in Simplicity Studio



Low-code DX

No-code

Low-code

Custom-code

Pro-code

- Targeted for **Intermediate customers**
- Product creation with **minimal coding**
- For **well-defined use cases**
- Based on **Simplicity Studio**
- Builds on top of **SLC UI + UI Tools**



5

```
/* Bluetooth Mesh stack event handler.
 * This overrides the dummy weak implementation.
 *
 * @param[in] evt Pointer to incoming event from the Bluetooth Mesh stack.
 */
void sl_btmesh_on_event(sl_btmesh_msg_t *evt)
{
    switch (SL_BT_MSG_ID(evt->header)) {
        default:
            break;
    }
}
```



125-pin BGA, 7x7 - (top view)

Custom-code DX



- Targeted for **Advanced customers**
- Product creation with **Simplicity Studio**
- **Customized** protocol solutions
- Based on **Simplicity Studio**
- Builds on top of **SLC UI + UI Tools**

1

Bluetooth - SoC Empty
A minimal project structure, that serves as a starting point for custom Bluetooth applications. The application starts advertising after boot and restarts advertising after a connection is closed.

[View Project Documentation](#)

[CREATE](#)



Implement app

```
/* Application Init.
*****
SL_WEAK void app_init(void)
{
    // Put your additional application initialization code here.
    // This is called once during start-up.
    // *****

    * Application Process Action.
    *****
SL_WEAK void app_process_action(void)
{
    // Put your additional application code here.
    // This is called infinitely.
    // Do not call blocking functions from here.
    // *****
}
```

Configure

Handle events

```
case sl_bt_evt_gatt_server_characteristic_status_id:
    if (gattdb_temperature_measurement ==
        evt->data.evt_gatt_server_characteristic_status.characteristic) {
        // client characteristic configuration changed by remote GATT client
        if (sl_bt_gatt_server_client_config ==
            (sl_bt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)
            // received from remove GATT client
            // information ==
            (sl_bt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)
            sl_bt_ht_temperature_measurement_indication_confirmed_cb(
                (sl_bt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t)
                (sl_bt_gatt_server_characteristic_status_flag_t)evt->data.evt_gatt_server_characteristic_status_flag_t);
    }
}
```

- Targeted for **IoT experts**
- Product creation with **customer's preferred IDE**
- **Customized** protocol solutions
- Builds on top of **SLC-CLI + UI Tools**
- Flexibility through **Makefile** and **VS Code** project generation
- **Control** over the development environment and flow



GNU Make



```
slc_cli git:(rel) slc
Welcome to SLC CLI...

```

```
gatt_configuration.btconf M X
bt_soc_training > config > btconf > gatt_configuration.btconf
1  <?xml version="1.0" encoding="UTF-8" standalone="no"?>
2  <!--Custom BLE GATT-->
3  <gatt gatt_caching="true" generic_attribute_service="true" header="gatt_db.h"
4
5  <!--Generic Access-->
6  <service advertise="false" name="Generic Access" requirement="mandatory" so
7  <!--informativeText-->Abstract: The generic_access service contains generic in
8
9  <!--Device Name-->
10 <characteristic const="false" id="device_name" name="Device Name" sourceI
11 <value length="13" type="utf-8" variable_length="false">Empty Example</
12 <properties>
13 <read authenticated="false" bonded="false" encrypted="false"/>
14 <write authenticated="false" bonded="false" encrypted="false"/>
15 </properties>
16 </characteristic>
17
```

```
54 // <<< sl:start_pin_tool >>>
55 |
56 // <gpio> SL_BOARD_ENABLE_VCOM
57 // ${GPIO_SL_BOARD_ENABLE_VCOM}
58 #define SL_BOARD_ENABLE_VCOM_PORT ..... gpioPortA
59 #define SL_BOARD_ENABLE_VCOM_PIN ..... 5
60 // [GPIO_SL_BOARD_ENABLE_VCOM]$
61
62 // <gpio> SL_BOARD_ENABLE_DISPLAY
63 // ${GPIO_SL_BOARD_ENABLE_DISPLAY}
64 #define SL_BOARD_ENABLE_DISPLAY_PORT ..... gpioPortD
65 #define SL_BOARD_ENABLE_DISPLAY_PIN ..... 15
66 // [GPIO_SL_BOARD_ENABLE_DISPLAY]$
67
68 // <gpio> SL_BOARD_ENABLE_SENSOR_RHT
69 // ${GPIO_SL_BOARD_ENABLE_SENSOR_RHT}
70 #define SL_BOARD_ENABLE_SENSOR_RHT_PORT ..... gpioPortB
71 #define SL_BOARD_ENABLE_SENSOR_RHT_PIN ..... 10
72 // [GPIO_SL_BOARD_ENABLE_SENSOR_RHT]$
73
```



BLUETOOTH SERIES

tech **talks** UPCOMING SESSIONS

FEB 23RD | ML in Predictive Maintenance and Safety Applications

MAR 23RD | Unboxing: What's New With Bluetooth

APR 20TH | What's New with Bluetooth Mesh 1.1

MAY 18TH | Bluetooth Portfolio: What's Right for Your Application

JUN 15TH | The Latest in HADM With Bluetooth LE



Thank You



Watch  ON DEMAND