



Next Generation BLE Beacons

JOE TILLISON | SR. MANAGER, REGIONAL PRODUCT MARKETING

EMBEDDED WORLD: FEBRUARY 26-28, 2019



What Is a Beacon? – A Brief Review

- Simplest of Bluetooth Low Energy devices
- Periodic broadcast of a pre-defined advertising packet
- One-way transmitter
- Enabler for “proximity aware” smartphone apps
- Small and typically battery powered
- Sometimes integrated with other services
 - e.g. temperature, open/close sensors, etc.
- Not defined by the Bluetooth SIG
 - All beacon formats are *pseudo*-standards
 - e.g. iBeacon and Eddystone

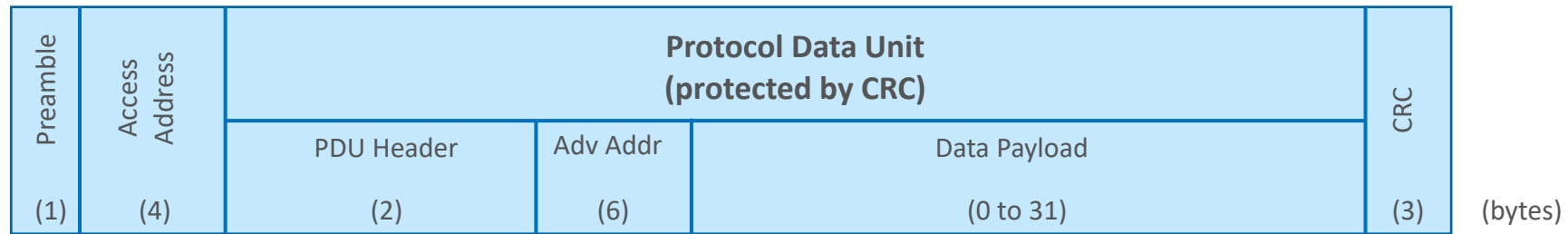


Proximity Aware Applications

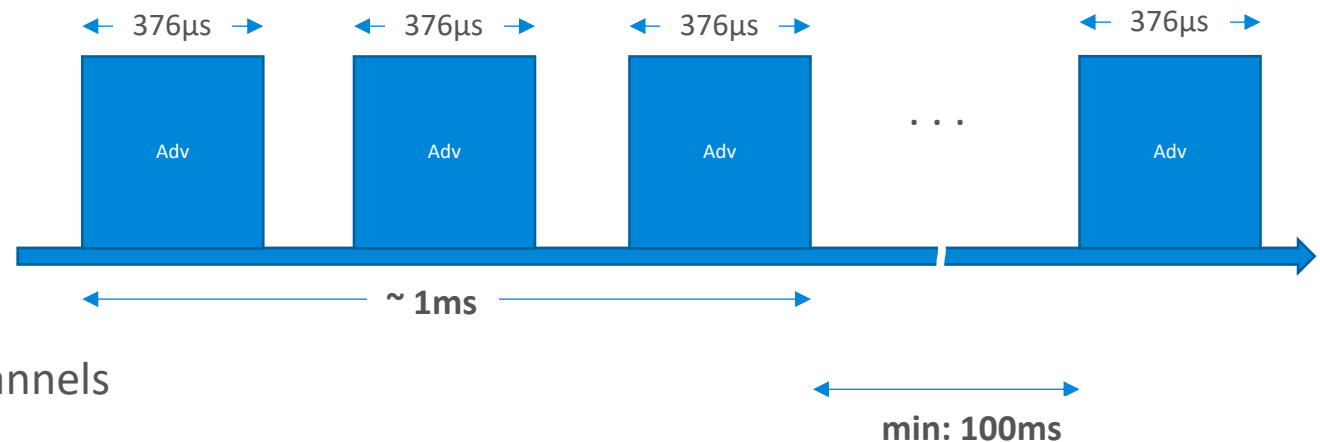
- Retail marketing push notifications
 - Personalized greetings
 - Loyalty programs – coupons, points
- Point-of-sale
 - Fast food pick up
 - Vending machine secure payments
- Indoor navigation and information
 - Hospitals, museums, airports, shopping centers
 - Could be integrated with Bluetooth mesh nodes e.g. commercial lighting
- Asset tracking
 - Location awareness of goods/containers within supply chain
 - Geo-fencing for inventory control and management



BLE 4.x Advertising Packet



- Up to 47 byte packet
 - Variable data payload up to 31 bytes
 - Organized as tuples – length, type, data
- 376 μ s for a full packet
- 3 packets per advertising event
 - One packet on each of three advertising channels



Challenges



- Limited 31-byte payload
 - iBeacon – UUID, major, minor
 - Eddystone – Four different beacon formats
- Interleaving multiple beacon formats
 - e.g. iBeacon @ 100 ms + Eddystone @ 1000 ms
- Crowded advertising channels
 - Especially with arrival of Bluetooth mesh
- Range

Bluetooth 5

Go Faster. Go Further.

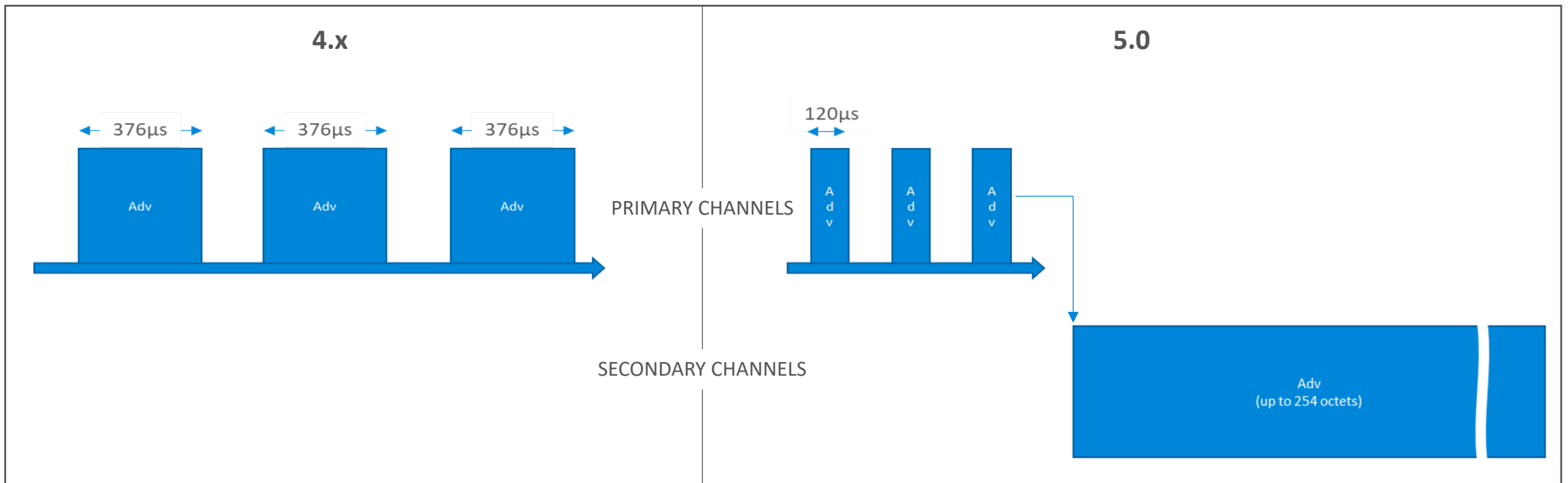
- Two new PHYs
 - LE 2M PHY - 2Mbps
 - LE Coded PHY (500kbps, 125kbps)
- New channel selection algorithm
 - Enables +20dBm in EU
- Advertising Extensions
 - Secondary advertising channels
 - Advertising Packet Chaining
 - Advertising Sets
 - Periodic Advertising
 - High Duty Cycle Advertising

Advertising PDU Types

Description	PDU Type	ADV PDU	4.x	5.0	Allowed LE PHY			Advertising channel
					1M	2M	Coded	
Connectable and scannable undirected advertising	ADV_IND	•	•	•	•			Primary
Connectable directed advertising	ADV_DIRECT_IND	•	•	•	•			Primary
Non-connectable and non-scannable undirected advertising	ADV_NONCONN_IND	•	•	•	•			Primary
discoverable undirected advertising event replaced by ADV_SCAN_IND	ADV_DISCOVER_IND	•	•					Primary
replaced by CONNECT_IND	CONNECT_REQ		•					Primary
Scan request	SCAN_REQ		•	•	•			Primary
Scan request	AUX_SCAN_REQ			•	•	•	•	Secondary
Scan response	SCAN_RSP		•	•	•			Primary
Connection request	CONNECT_IND			•	•			Primary
Connection request	AUX_CONNECT_REQ			•	•	•	•	Secondary
Scannable undirected advertising	ADV_SCAN_IND	•	•	•	•			Primary
All advertising events (except connectable and scannable undirected)	ADV_EXT_IND	•		•	•		•	Primary
All advertising events (except connectable and scannable undirected)	AUX_ADV_IND	•		•	•	•	•	Secondary
AUX scan response	AUX_SCAN_RSP			•	•	•	•	Secondary
Periodic advertising	AUX_SYNC_IND	•		•	•	•	•	Secondary
Additional advertising data	AUX_CHAIN_IND	•		•	•	•	•	Secondary
Connection response	AUX_CONNECT_RSP			•	•	•	•	Secondary

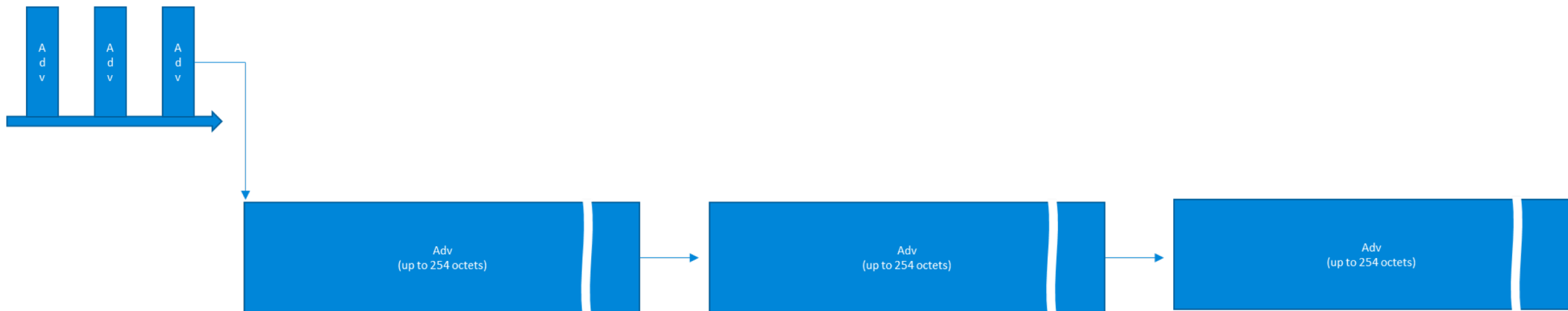
Secondary Advertising Channels

- Channels 37, 38, 39: **primary advertising channels**
- Channels 0 – 36: data and **secondary advertising channels**
- New packet type for Primary Channels ADV_EXT_IND
 - Only contains header with Aux pointer to secondary advertising channel



Secondary Advertising Channels

- Can use any PHY: 1M, 2M or LE Coded PHY
- Up to 254 byte payload
- Can include Aux pointer to another packet - ***Advertising Packet Chaining***
 - Multiple packets can be chained for payloads larger than 254 bytes
- Offloads traffic from primary advertising channels
 - Especially important with Bluetooth mesh



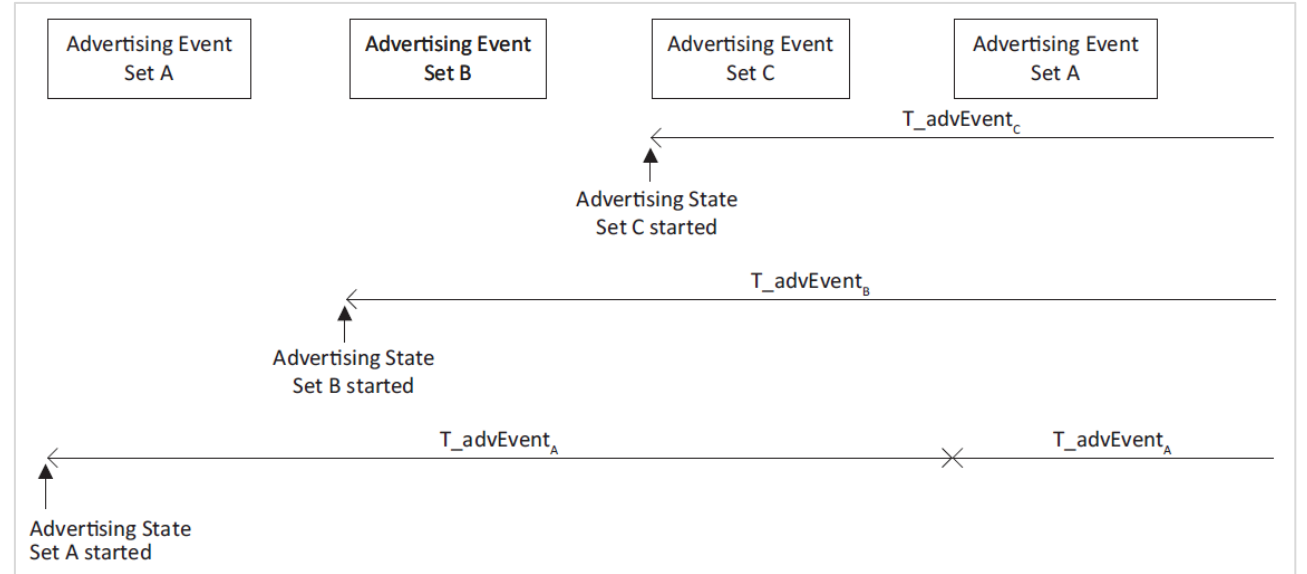
Advertising Data Sets and Scan Event Reporting

■ Advertising Data Sets

- One device acts as a multiple beacons
- Separate instances of the advertising state
- Each uses different advertising parameters
 - PHY, power level, interval, packet format, etc.
- Interleaving is managed by link layer
 - No host CPU involvement necessary
 - More power efficient

■ Scan Event Reporting

- Scan requests notified to the host processor
- Positive indication that advertisement was successfully heard
- Host can take action e.g. stop successive advertisements



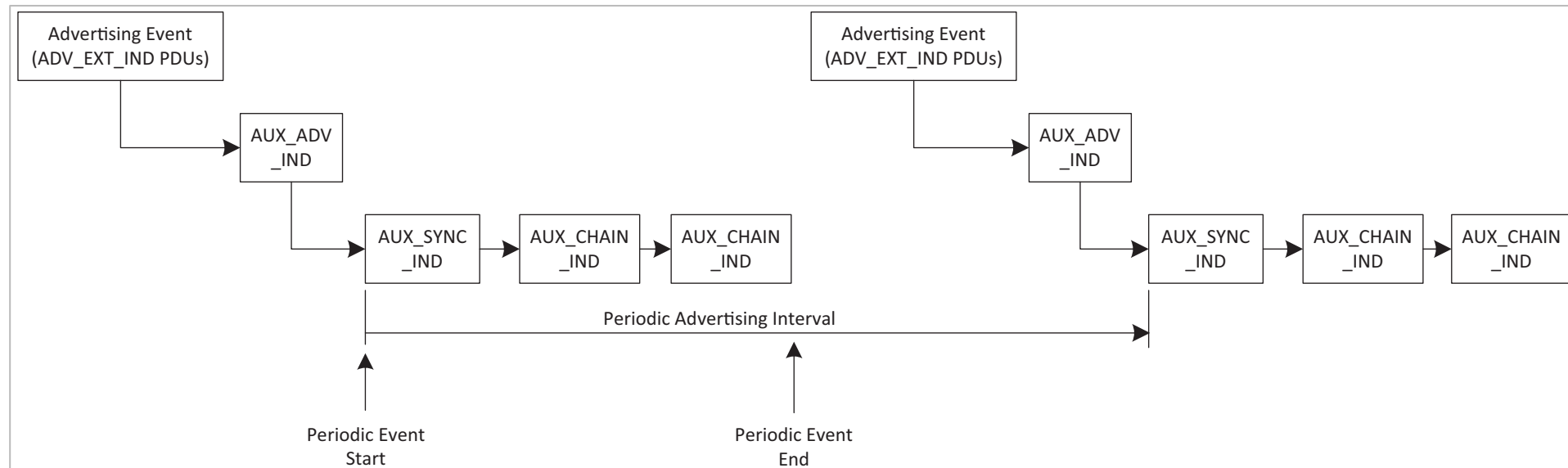
Other Advertising Enhancements

- Periodic Advertising

- Deterministic timing between advertising events
- Used to stream data over secondary channels
- Multiple receivers sync to advertising stream

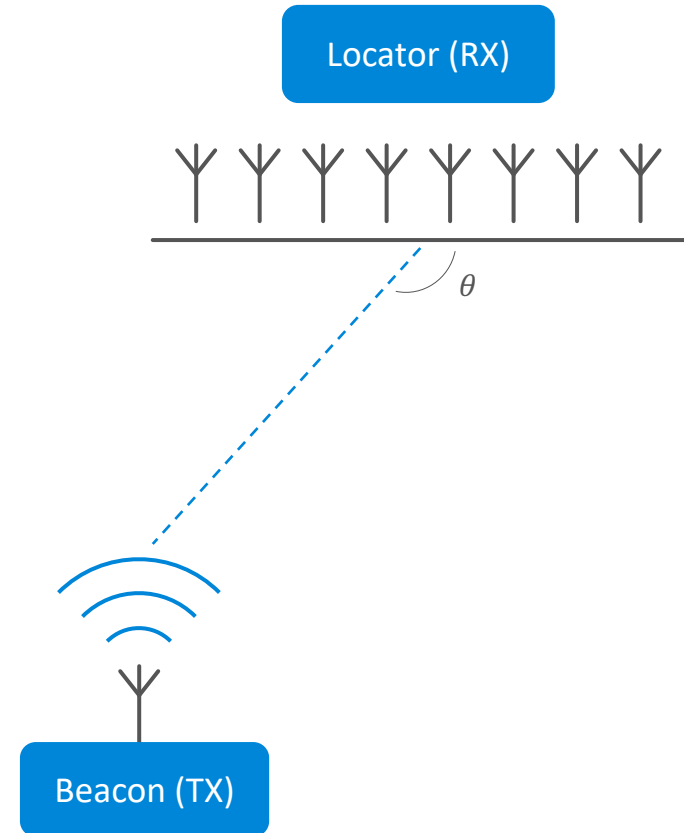
- High Duty Cycle Non-Connectable Advertising

- Minimum interval reduced from 100 ms to 20 ms
- Better location accuracy for moving objects



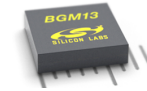
Advanced Beacons

- Virtually limitless content (large packets or chained packets)
 - All-inclusive beacons
 - e.g. Eddystone UID + URL + TLM
 - No more compressed URLs
 - Better network security
- Polymorphic beacon formats (advertising data sets)
 - e.g. iBeacon + Eddystone-UID + proprietary
- Long-range beacons (+20 dBm, Coded PHY, CSA#2)
- Offloaded traffic from Primary Advertising Channels
- Enabled with firmware update (AE)
- Backward compatible
- The future: Precision location with Angle-of-Arrival
 - Check schedule for the next presentation



Silicon Labs Devices for Bluetooth 5 Beacons

SoC	EFR32BG12	EFR32BG13
Bluetooth version	5.0 and mesh (2M and Bluetooth 5 Æ)	5.1 and mesh (2M, LE LR and Bluetooth 5 Æ)
Proprietary	2.4G and sub-GHz	2.4G and sub-GHz
Max TX power	+19 dBm	+19 dBm
CPU (Clock Speed)	Cortex M4 (38.4 MHz)	Cortex M4 (38.4 MHz)
Flash size (kB)	1024	512
RAM (kB)	256	64
Sleep Current (EM2)	1.5µA (16kB RAM, LFXO)	1.3µA (16kB RAM, LFXO)
Active Current (EM0)	70 µA/MHz	70µA/MHz
Max GPIO	65	31
Crypto Acceleration	2x AES-128/256, ECC, SHA-1/224/256, TRNG	2x AES-128/256, ECC, SHA-1/224/256, TRNG
Operating Voltage	1.8V – 3.6V	1.8V – 3.6V
Max Operating Temp (T _A / T _J)	-40 - +85C / -40 - +125C	-40 - +85C / -40 - +125C
Packages (mm)	7x7 QFN48, 7x7 BGA125	5x5 QFN32, 7x7 QFN48



Modules	BGM13P	BGM13S
Bluetooth version	5.1 and mesh (2M, LE LR and Bluetooth 5 Æ)	5.1 and mesh (2M, LE LR and Bluetooth 5 Æ)
SoC	EFR32BG13	EFR32BG13
Antenna	Chip or U.FL	Chip or RF pin
Max TX power	+8 / +19 dBm	+8 / +18 dBm
Flash size (kB)	512	512
RAM (kB)	64	64
Max GPIO	25	30
Operating Voltage	1.8V – 3.6V	1.8V – 3.6V
Max Operating Temp	-40 to +85C	-40 to +85C
Package dimensions (WxLxH) (mm)	13.0 x 15.0 x 2.2 LGA	6.5 x 6.5 x 1.4 LGA
Certifications	BT, CE, FCC, ISED, Japan, S-Korea and Taiwan	BT, CE, FCC, ISED, Japan & S-Korea



Thank You

