Low power RF
Bluetooth® Low Energy
products family

life.augmented

BlueNRG

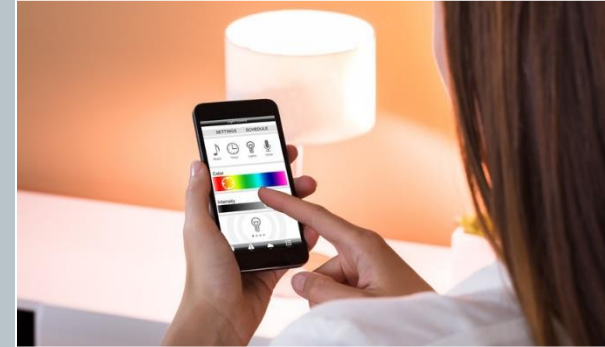# Bluetooth® Low Energy markets

Wearable

Healthcare

Beacon / Retail

Lighting

Remote Controller

Animal Tracking

Toys / Gaming

Home Appliance

BlueNRG family: Performance, Flexibility, Scalability

BlueNRG SoC simplifies IoT

Low-Power Bluetooth® Low Energy Application Processor (ARM Cortex-M0/-M0+ programmable core with up to 256 kB eFLASH)

- Simplified HMI
- Easy customization
- Remote reading
- Service and maintenance
- Firmware upgrade
- Added-value services

Bluetooth® 5
Certified

LONGEVITY **10** YEARS COMMITMENT

QFN48	QFN32	WLCSP49	WLCSP34
6 x 6 mm	5 x 5 mm	3.14 x 3.14 mm	2.66 x 2.56 mm

Scalable packages

BlueNRG SoC simplifies IoT

Just add sensors!
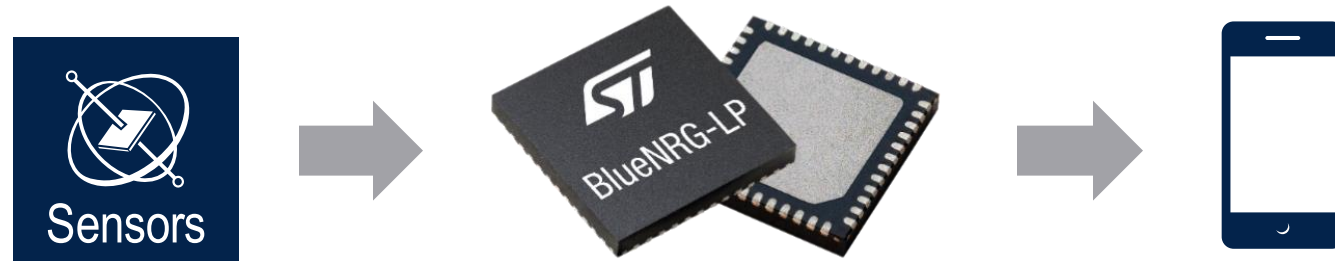
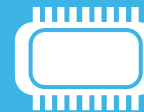| The lowest power consumption	Processing power on demand	Flexible memory architecture	Maximum security
>3 years lifetime on CR2032[(*)] 18 µA/MHz 0.6 µA deep stop	Low-power architecture Cortex-M0+ @ 64 MHz	256 kB eFLASH 64 kB ULL SRAM	ECC-256 / AES-128 Factory UID Secure bootloader

(*) Based on the average current consumption in connection mode (8.04 µA, connection interval 1000 ms, full SRAM retention, 8dBm Pout)

BlueNRG's design flexibility

NETWORK PROCESSOR

Application is running over a dedicated MCU along with **BLE middleware**

External HOST (MCU)

APPLICATION + Middleware + Radio Driver

GPIO
UART
I2C
SPI
PWM

SPI/UART

RADIO VENDOR: IC (+ FW) + MIDDLEWARE

RADIO stack
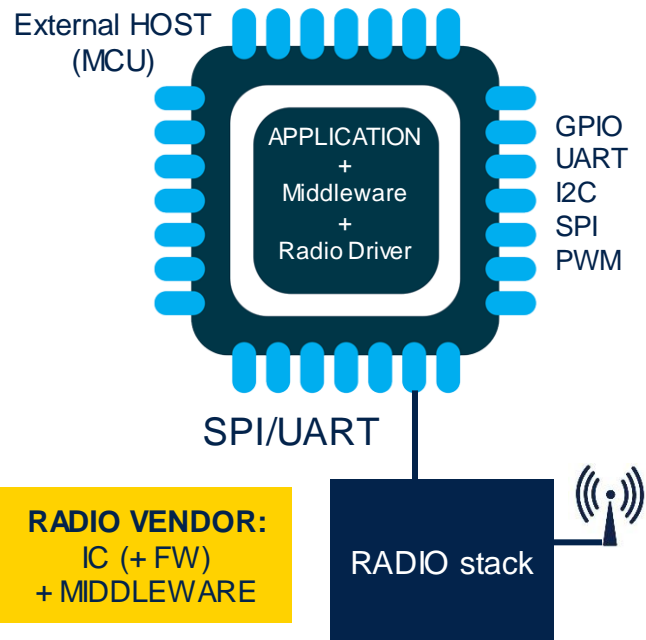
Specific integration of radio middleware/driver required

DATA-PUMP

Radio link added through a simple and standard **serial interface**

External HOST (MCU)

APPLICATION + SPI / UART

GPIO
UART
I2C
SPI
PWM

SPI/UART

RADIO VENDOR: IC + SDK

RADIO stack + SPP driver
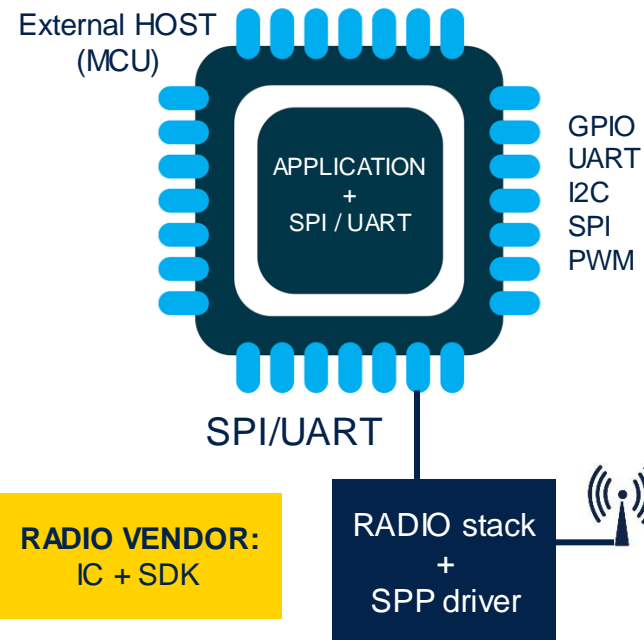
Radio as a simple plug-in on a standard serial interface

APPLICATION PROCESSOR

Data acquisition, **processing** and **radio connectivity** in a single-chip

EDGE Vs **CLOUD** computing

APPLICATION + RADIO stack

GPIO
UART
I2C
SPI
PWM

RADIO VENDOR: SoC + SDK + libraries
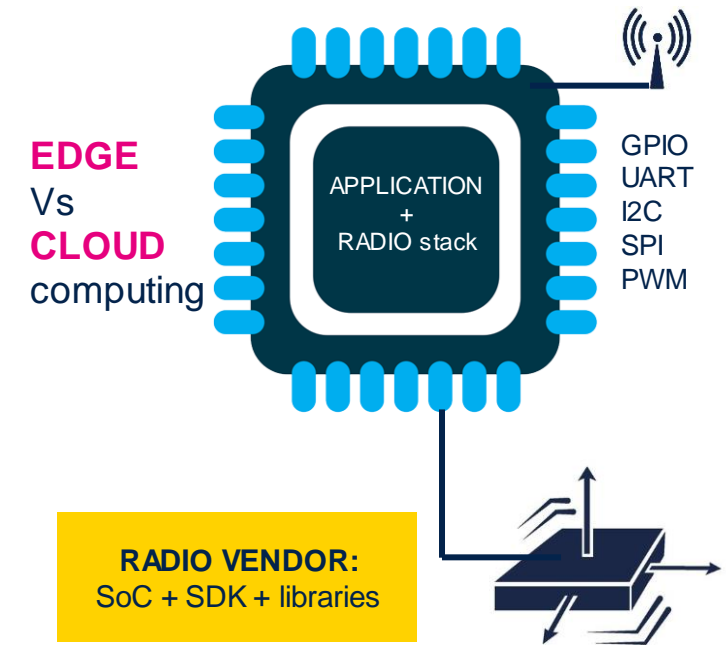
Full code ownership in all-in-one image (data, processing, radio)

BlueNRG product family

LONGEVITY 10 YEARS COMMITMENT

Scalability ↑

BlueNRG-MS

BT4.2 Certification
Basic features

BlueNRG-2N

BT5.0 Certification
LE Privacy 1.2
LE Secure Conn
LE Data Len ext

BlueNRG-1

BT5.0 Certification
LE Privacy 1.2
LE Secure Conn

Cortex-M0, 32MHz
MEMORY: 160KB/24KB

BlueNRG-2

BT5.0 Certification
LE Privacy 1.2
LE Secure Conn
LE Data Len ext

Cortex-M0, 32MHz
MEMORY: 256KB/24KB

BlueNRG-LP

BT5.2 Certification
Advertisement ext
High speed (2 Mbps)
Long range
GATT Caching

Cortex-M0+, 64MHz
MEMORY: 256KB/64KB

	BlueNRG-MS	BlueNRG-2N	BlueNRG-1	BlueNRG-2	BlueNRG-LP
QFN48				BlueNRG-248	BlueNRG-355MT[(*)]
QFN32	BlueNRG-MSQTR	BlueNRG-232N	BlueNRG-132	BlueNRG-232	BlueNRG-355AT[(*)]
WLCSP	BlueNRG-MSCSP	BlueNRG-234N	BlueNRG-134	BlueNRG-234	BlueNRG-355VT[(*)]

Value →

(*) Dual option available for both RAM size (32 kB and 64 kB) and temperature range (up to +85 ºC and up to +105 ºC)

Bluetooth® LE SoC vs network processor

| Dual-chip architecture	Single-chip architecture
Network Processor	Application Processor
Radio with external host	**Single-chip solution**
• Monolithic radio link	• Space optimized
• Software de-coupling	• Anticipated requirements
• Flexible architecture	• Limited model variations
• Design scalability	• Predictable deign complexity
• Device model diversity	• Cost effectiveness
BLUENRG-MS **BLUENRG-2N**	**BLUENRG-1** **BLUENRG-2** **BLUENRG-LP**

BlueNRG PC tools ecosystem

BlueNRG Navigator: out-of-the-box

Graphical user interface (GUI) that provides simple and user-friendly interface to browse, flash, and run application examples included in the SDK package. It also allows to explore STEVAL KIT in each and all of its features.
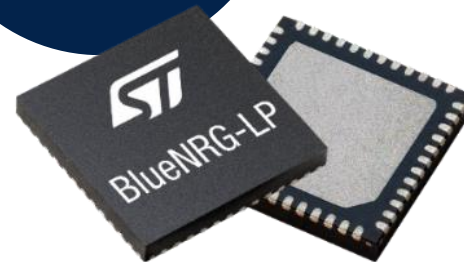

BlueNRG Dev tools: hands-on

Radio Init Wizard

ST-Link Utility

Power Consumption

Flasher utility

Graphical User I/f
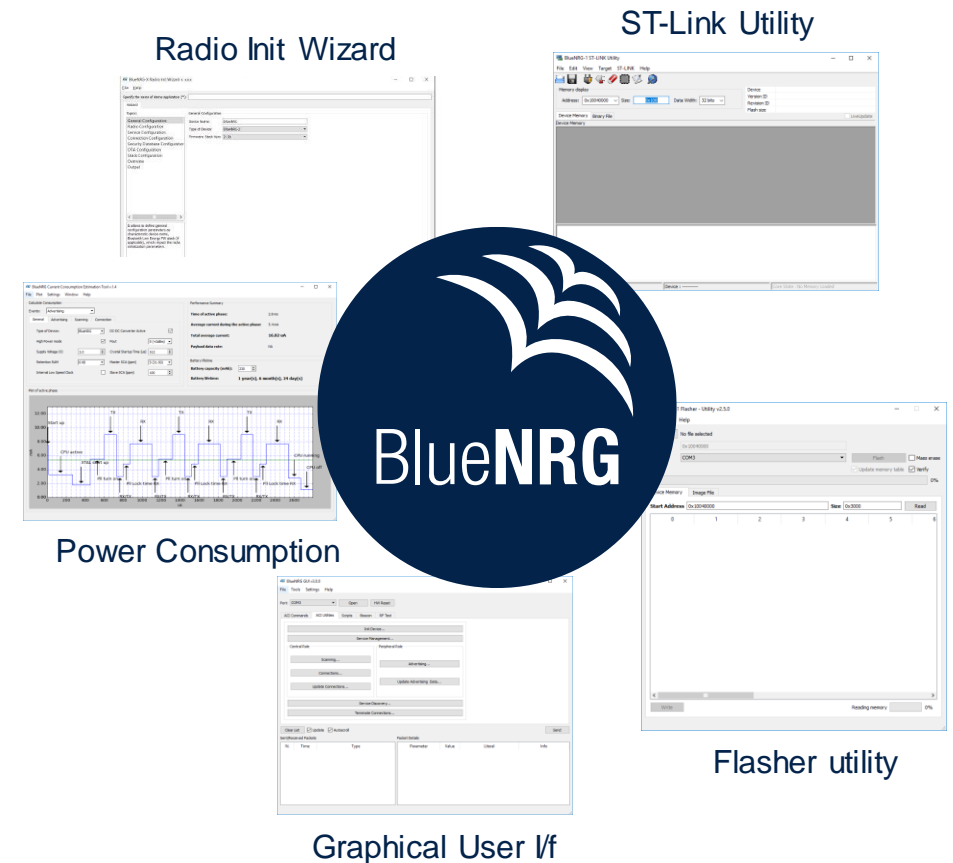
Legacy and future proof mobile interoperability

Tested with more than:

20+

Worldwide top brands

200+

Most popular mobile devices

Uncompromised user experience

Bluetooth® Low Energy 5.0 Network Processor

Ultra low current consumption

- Sleep current consumption down to 900 nA
- TX current consumption 6.8 mA (@ -2 dBm)
- RX current consumption 6.2 mA (@ sensitivity level)

Optimized BLE protocol stack

- Bluetooth® Low Energy 5.0 certified
- Fully compliant with Bluetooth® v4.2 standard
  - LE Data Length Extension (up to 700 kbps @ appl. level)
  - LE Privacy 1.2
  - LE Secure Connections
- Multi master to multi slave communication guaranteed
  - 2 Masters to 6 slaves simultaneously
  - Up to 8 simultaneous connections handled
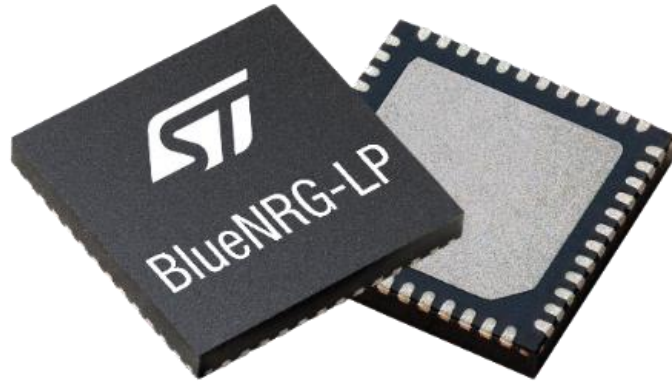- FOTA supported (256 kB embedded Flash), 2.5 times faster

Flexibility

- BlueNRG-232N QFN32 / BlueNRG-234N WLCSP
- Selectable SPI or UART interface (via 1 GPIO)

The device comes with a pre-programmed and production-ready certified stack image.

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BlueNRG-LP has come!

Key benefits and enhancements

QFN48	BlueNRG-345Mx	BlueNRG-355Mx
QFN32	BlueNRG-345Ax	BlueNRG-355Ax
WLCSP49	BlueNRG-345Vx	BlueNRG-355Vx
	32KB RAM	64KB RAM

Dual option available for Temperature operating range
(up to +85 ºC and up to +105 ºC)

1 BLE 5.2 core certified

2 Faster data transfer (2Mbps)

3 Long range communication

4 Multiple concurrent connections

5 Robust BLE protocol stack

6 Ultra-low-power architecture

7 Cryptographic security

LONGEVITY
10 YEARS
COMMITMENT

BlueNRG-LP wireless processor technology highlights

Faster data transfer	The **2 Mbps** feature has now doubled the bandwidth, allowing lower latency and OTA upgrade in less than 5 seconds
Long range communication	The higher **maximum output power (+8 dBm)**, together with **Long Range** feature, will enable to cover greater distance and to communicate effectively
Multiple concurrent connections	World's first Bluetooth® LE 5.2-certified SoC supporting **up to 128 concurrent connections**
Robust BLE protocol stack	**Highly optimized, upgradable and robust-proven Bluetooth® Low Energy stack** developed and maintained by ST expertise team
Ultra-low-power architecture	Optimized power consumption thanks to the **ultra-low-leakage memories** and **sophisticated power-management architecture (< 1µA in deep stop mode)**
Cryptographic security	Built-in **image authentication technology** enhances cyber-security by always checking the stack before starting to allow only signed firmware images to run

BlueNRG-LP applications

Asset tracking and beacons

- Ultra-low power consumption
- Market leading BLE range
- SigFox LPWAN with S2-LP
- Cost optimized (2-layer PCB, integrated Balun & xtal caps, device variants)

Smart tools and appliances

- Future proof with BTH5.2 certification
- 10 years longevity
- Flexible architecture (SoC or add on)
- Device security

Industrial connectivity

- Remote UI, remote control units
- Enhanced processing & peripherals
- Audio IF (PDM, Analog, I2S)
- 10 years longevity
- Device security

Lighting and building automation

- Lighting, ventilation, heating, HVAC, smart locks
- BLE MESH, +105ºC compliancy (T version)
- Adv. ext. (AE), Long Range (LR), CSA #2
- Application security

Personal electronics

- Toothbrush, shaver, e-cigarette, massage tools, gaming, etc.
- Enhanced processing & peripherals
- MEMS sensor libraries
- BLE stack flexibility, RF driver
- 2Mbps PHY and secure OTA
- Device package and memory variants

Connected toys, robots

- Toys, robot vacuum, lawn mover, pool robot. etc.
- Flexible architecture (SoC or add on)
- Cost optimized (2-layer PCB, integrated Balun & xtal caps, device variants)

Healthcare, wearable

- Auto injectors, dispensers, inhalers, sports sensors
- 10 years longevity, security

People and animal tracking

- Social distancing and tracing, worker tracking, pet & livestock tracking, prisoner tags
- Ultra-low power, application security
- Cost effective in application

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BlueNRG-LP
Go faster, go further!

Up to 1.3 Km communication range…

STANDARD mode: **960 m**
LE1M PHY

LONG RANGE: **1.3 km**
Coded PHY LE S=8

Range measurement report
available on demand

… and up to 128 concurrent connections

BlueNRG-LP
Bluetooth® Low Energy 5.2 certified SoC

Key highlights

Bluetooth® LE 5.2 certified

Radio performance
- RX Sensitivity level
- **-97dBm** @ 1Mbps
- **-104 dBm** @ 125bps
- Up to **+8 dBm** output power level
- **4.3 mA** TX current
- **3.4 mA** RX current

Reduced BOM cost
- **Integrated Balun**
- **Capacitor-less** 32MHz crystal.
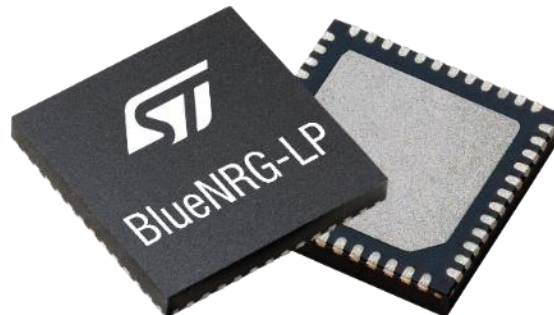
Advanced security set
- **Flash read/write protection.**
- **Secure bootloader**
- **SWD access can be disabled**

Block Diagram

BLE 5.2 radio
- 2Mbps data-rate
- Long Range
- Advertising Extension
- Advertising Data Set
- Direction Finding (AoA/AoD)
- Periodic Advertising Sync Transfer
- Gatt Caching

Balun

2.4 GHz Radio Driver

BlueNRG Core Coprocessor

BLE Link Layer

Packet Input / Output

Program Memory FLASH 256 kB

Data Memory RAM 64kB

ARM Cortex M0+ up to 64MHz

8 Ch. DMA Engine

Security & HW accelerators

Timing & Control

Power Management Unit

Regulators

DC-DC converter

Analog Front End 8 Ch. ADC

Battery Monitoring

Analog watchdog

Analog Mic I/F with PGA

1xLPUART

1xUSART

2xI²C

2xSPI/I²S

1xSystick

1xPDM Mic I/F

6xPWM

RTC

Watchdog timer

32xGPIOs
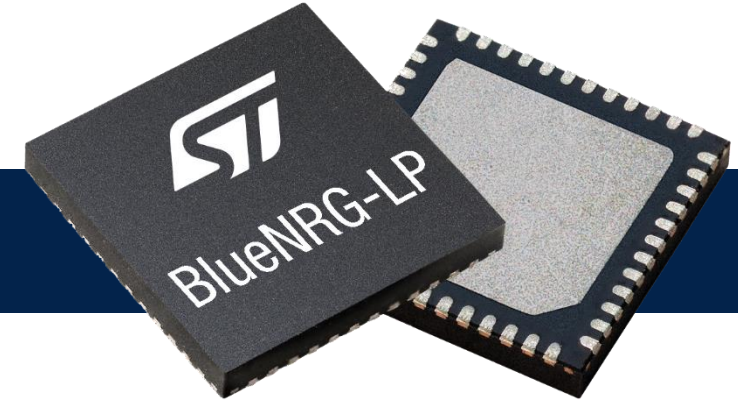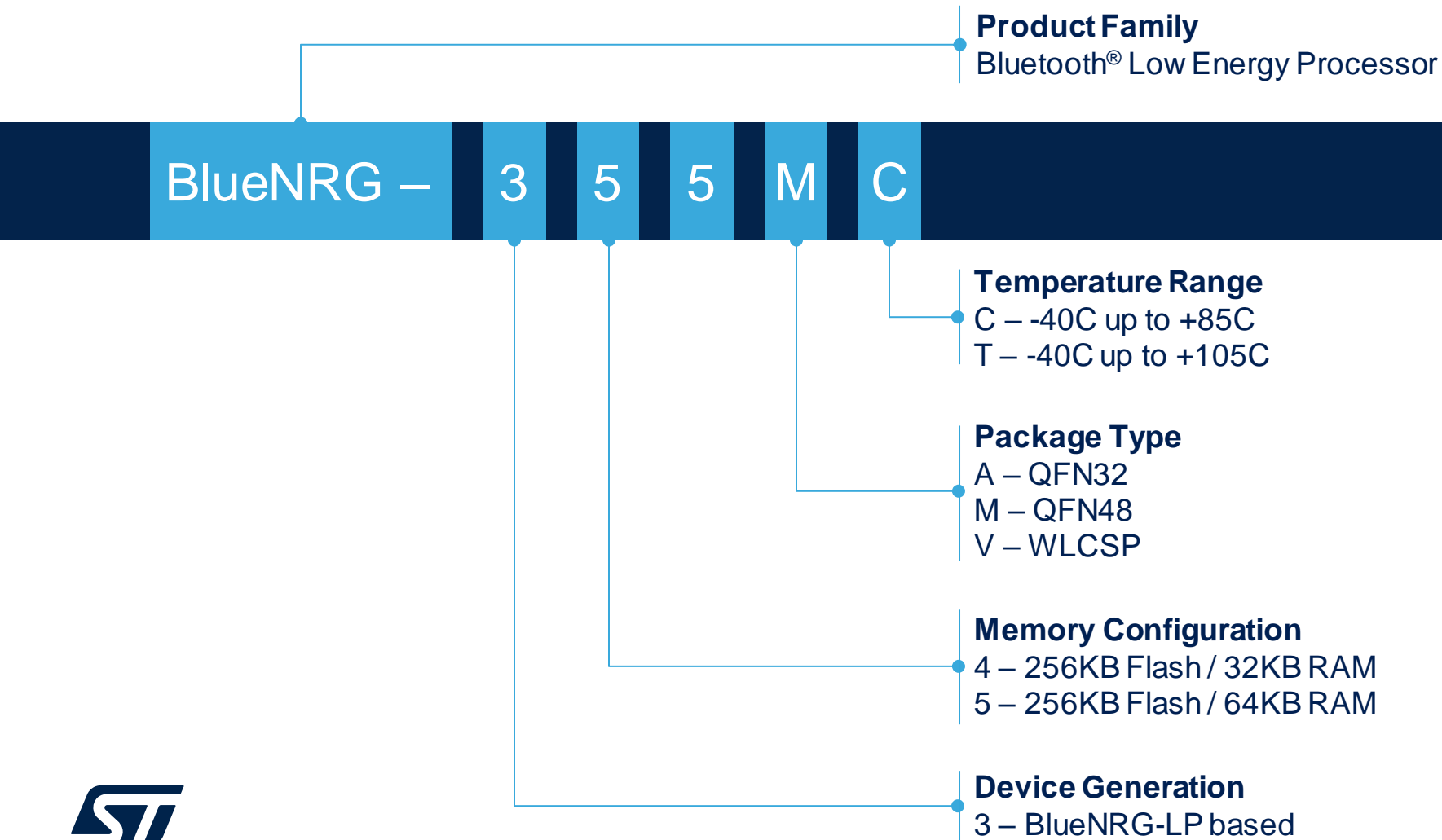
LONGEVITY 10 YEARS COMMITMENT

BlueNRG-LP

Device information

- High Throughput: **2 Mbps** Data Rate
- Distance Robustness: **Long-range** 125kbps or 500kbps
- **Advertisement Extension**: 255 bytes Advertising data, Advertising Data Set and Periodic Advertising Sync Transfer
- Frequency Hopping Robustness: Channel Selection Algor. #2
- GATT caching
- **ARM Cortex-M0+, 64 MHz**
- **256-Kbyte** Flash, **64-Kbyte** (32-KByte) SRAM , MPU
- Extensive peripheral set: 2 x SPI / I2S, 1x SPI, 2 x I²C, 1 x USART, 1 x UART, 6 x PWM, 1 x PDM, 1 x 12-bit ADC SAR
- Analog microphone i/f with PGA
- True Random Number Generator (RNG)
- Hardware encryption AES 128-bit security co-processor
- HW public key accelerator (PKA)
- CRC calculation unit
- 48-bit unique ID
- Operating supply voltage: **from 1.7 V to 3.6 V**
- Operating temperature: from -40 up to 85 ℃ / **-40 up to 105 ℃**
- Package available: **QFN32** (20 GPIOs), **QFN48** (32 GPIOs), **WLCSP49** (26 GPIOs)

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BlueNRG-LP
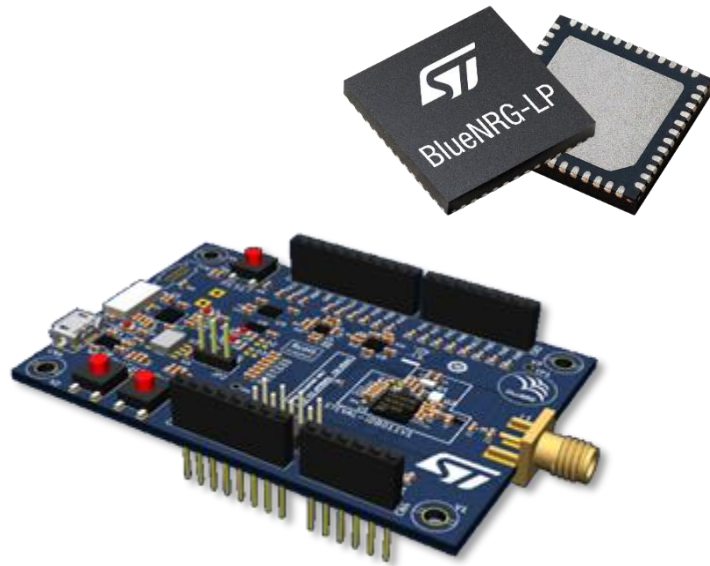# Ordering Information

Product Family
Bluetooth® Low Energy Processor

BlueNRG – 3 5 5 M C

Temperature Range
C – -40C up to +85C
T – -40C up to +105C

Package Type
A – QFN32
M – QFN48
V – WLCSP

Memory Configuration
4 – 256KB Flash / 32KB RAM
5 – 256KB Flash / 64KB RAM

Device Generation
3 – BlueNRG-LP based

HW Evaluation Kit	SW Development Kit	Tackle your market!

BLE

STSW-BNRGLP-DK

2.4Ghz proprietary protocol

1 Byte	4 Bytes	1 Byte	1 Byte	0 to 31 Bytes	3 Byte
Preamble	NetworkID	Header	Length	Data	CRC

STSW-BNRGLP-MESH
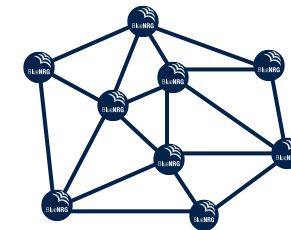
BLE- Mesh

STEVAL-IDB010V1 (WLCSP)
STEVAL-IDB011V1 (QFN48)

Free of charge certified stack: BLE and Mesh

Easily connecting appliances to iOS/Android, out-of-the-box

- Bluetooth® **Mesh 1.0.1 certified Profile Library, Server and Client Model,** and **Bluetooth® LE stack**
- **Two-layer security** (128-bit AES-CCM and 256-bit ECDH protocol)
- **Low-power** and **Friendship** supported
- Provisioned node **database transfer** among smartphones via Email and Cloud application
- **Embedded** and **Mobile SDK** to build both your Android and iOS Apps
- Reduces development costs and accelerates time-to-market

Available across full BlueNRG portfolio – iOS and Android SDK

Bluetooth® LE 5.2 certified SoC solution

Sensors
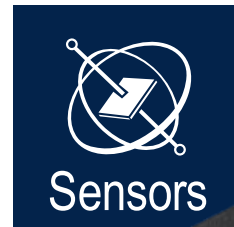
STSW-BNRGLP-DK

BlueNRG-LP has been designed to support up to **128** concurrent connection

STSW-BNRGLP-MESH

Bluetooth® SIG-certified Mesh stack: up to **126** hops and **32,000** nodes
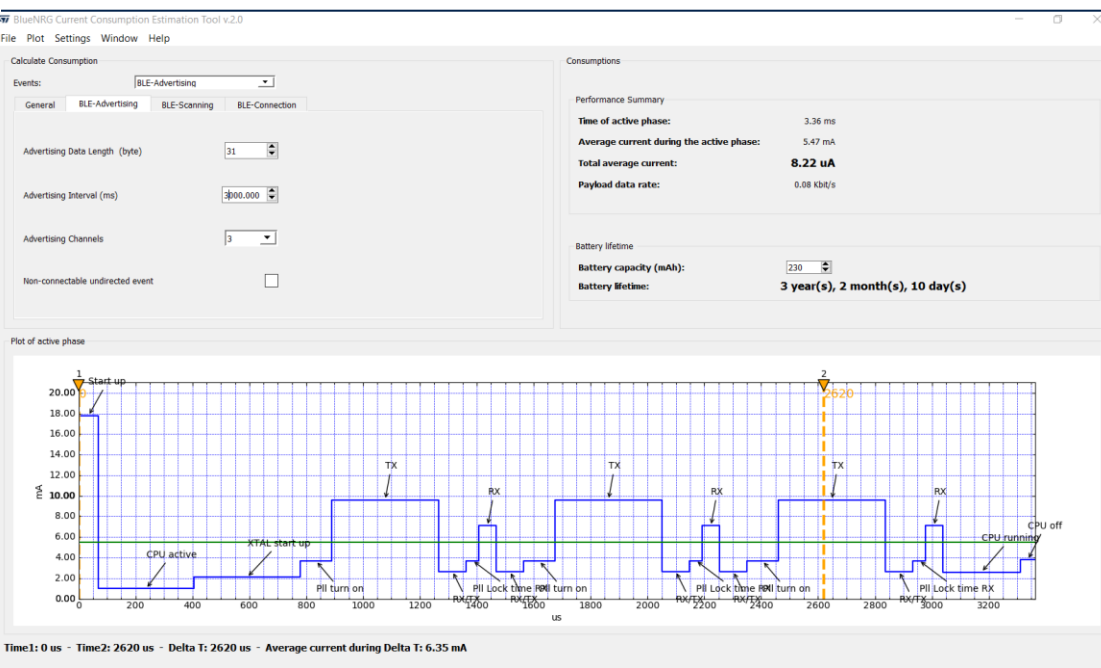
Extended temperature range -40°C to +105°C
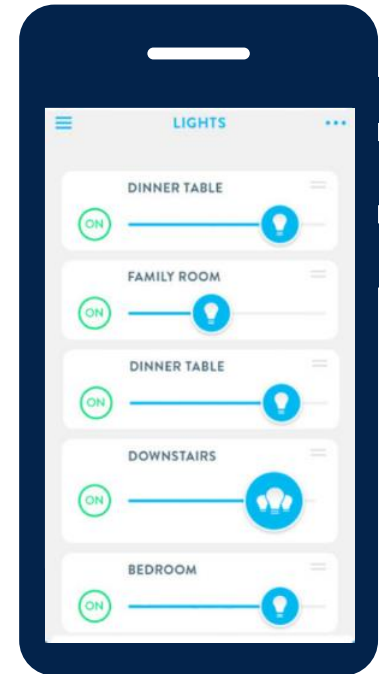
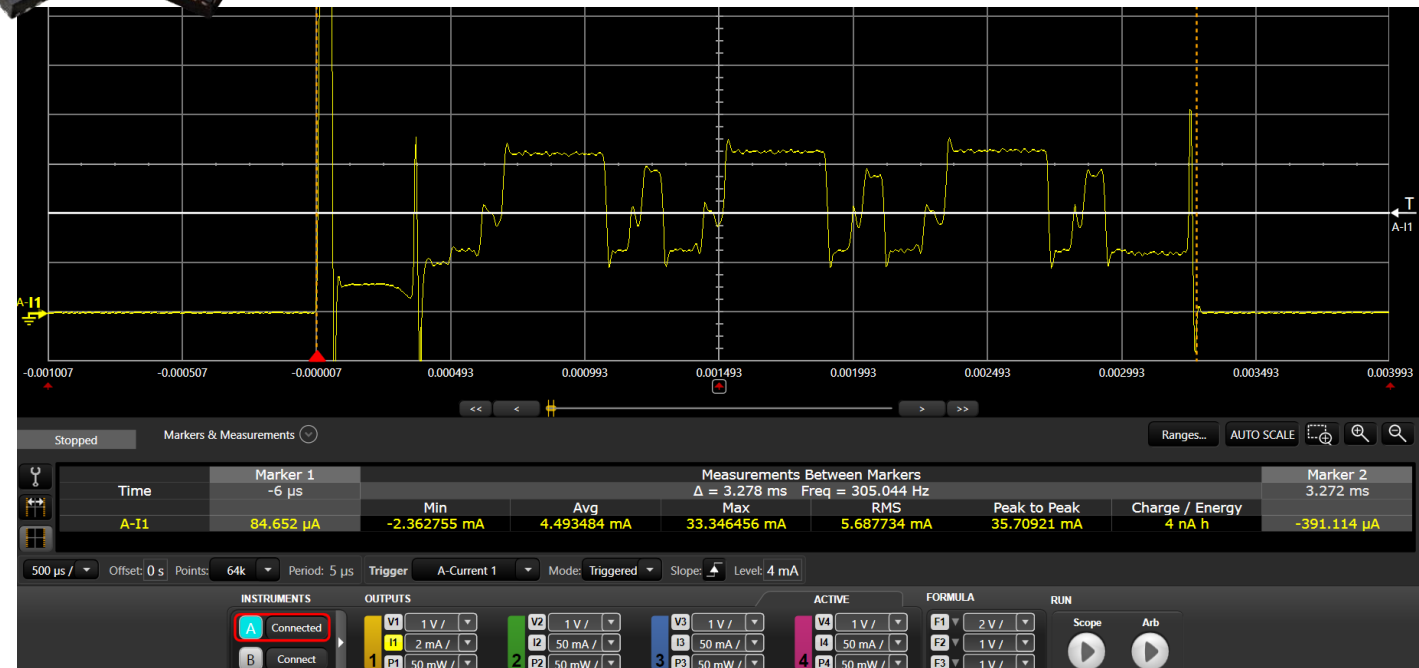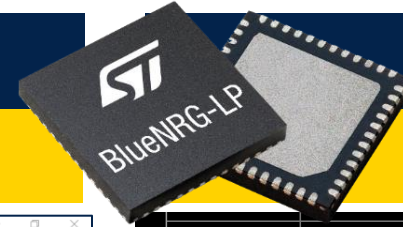# Accurate BlueNRG-LP battery lifetime simulator

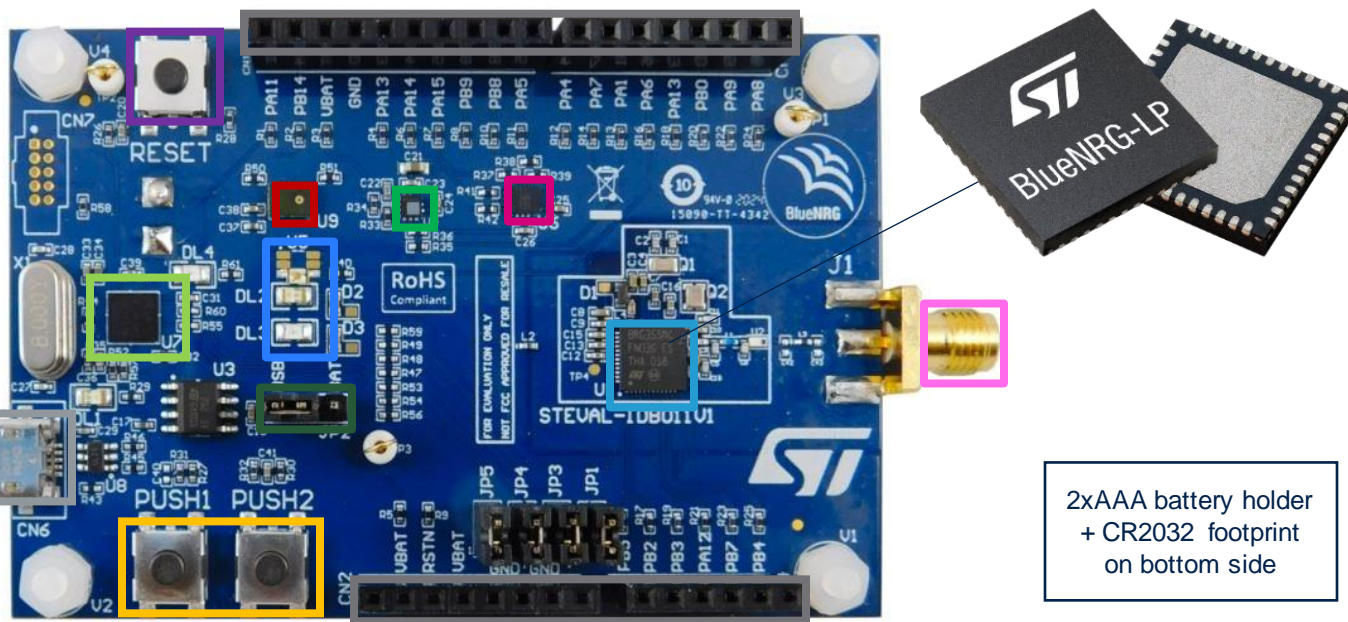| Estimate	Measure
Accurate prediction of **battery lifetime** using **PC GUI**	Actual measurement of predicted power waveform

STSW-BNRG001 – power consumption tool

BlueNRG-LP is offering the best power efficient solution

STEVAL-IDB011V1 and STSW-BNRGLP-DK

BlueNRG-LP evaluation HW and SW development kit

2xAAA battery holder + CR2032 footprint on bottom side

Legend:
- BlueNRG-355MC
- MP34DT05-A
- LPS22HB
- LSM6DSOX
- User LED (2 + 1 RGB)
- User button (2)
- Reset button
- USB/Battery power selection
- USB connector
- Arduino UNO R3 connector
- SMA connector
- CMSIS-DAP debugger/programmer

File list:
- BLE_ANCS
- BLE_Beacon
- BLE_Beacon_FlashManagement
- BLE_Beacon_FreeRTOS
- BLE_HID_Peripheral
- BLE_MultipleConnections
- BLE_OTA_ResetManager
- BLE_OTA_ServiceManager
- BLE_Power_Consumption
- BLE_Privacy
- BLE_RC_LongRange
- BLE_RemoteControl
- BLE_Security
- BLE_SensorDemo
- BLE_SensorDemo_BlueMSap
- BLE_SensorDemo_Central
- BLE_SensorDemo_StaticStack
- BLE_SerialPort
- BLE_SerialPort_Master_Slave
- BLE_StaticStack
- BLE_Throughput
- DTM
- DTM_basic
- DTM_Updater

BLE_Beacon
Enabling Advertsing Extension, and getting 8x Broadcast (BLE5.0 feature)

BLE_MultipleConnections
Allow a MasterSlave device to connect to a configurable number of peers (up to 128)

BLE_RC_LongRange
Enabling Long Range, and getting 1.5x Range (BLE5.0 feature)

BLE_SensorDemo_BlueMSapp
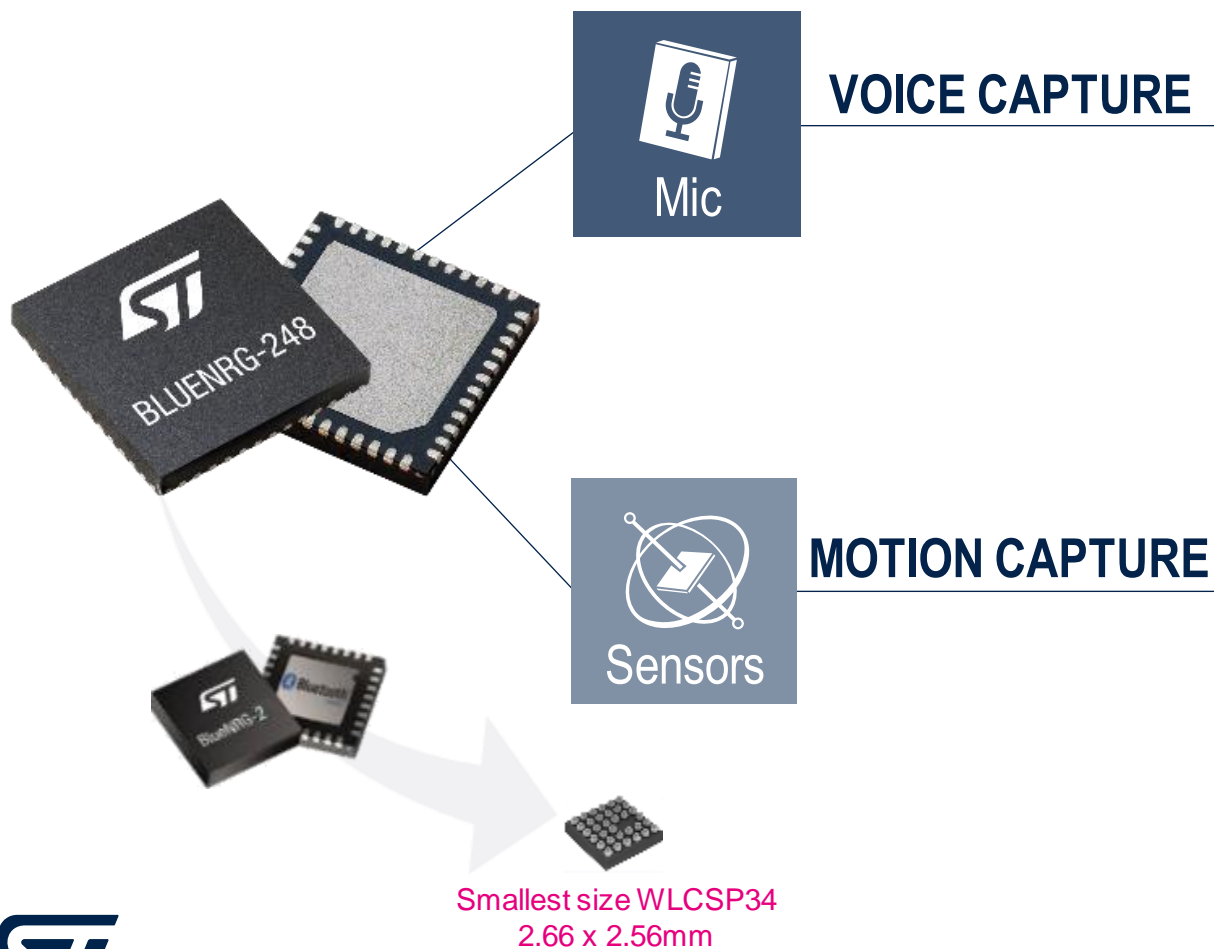Connect and share data sensor with ST BLE Sensor App

BLE_Thoughput
Enabling 2Mbps, and getting 2x Speed (BLE5.0 feature)

BlueNRG-2 and MEMS sensors
Ready-to-go software libraries for voice and motion

VOICE CAPTURE

Voice over BLE

High quality voice capturing and compression (ADPCM)
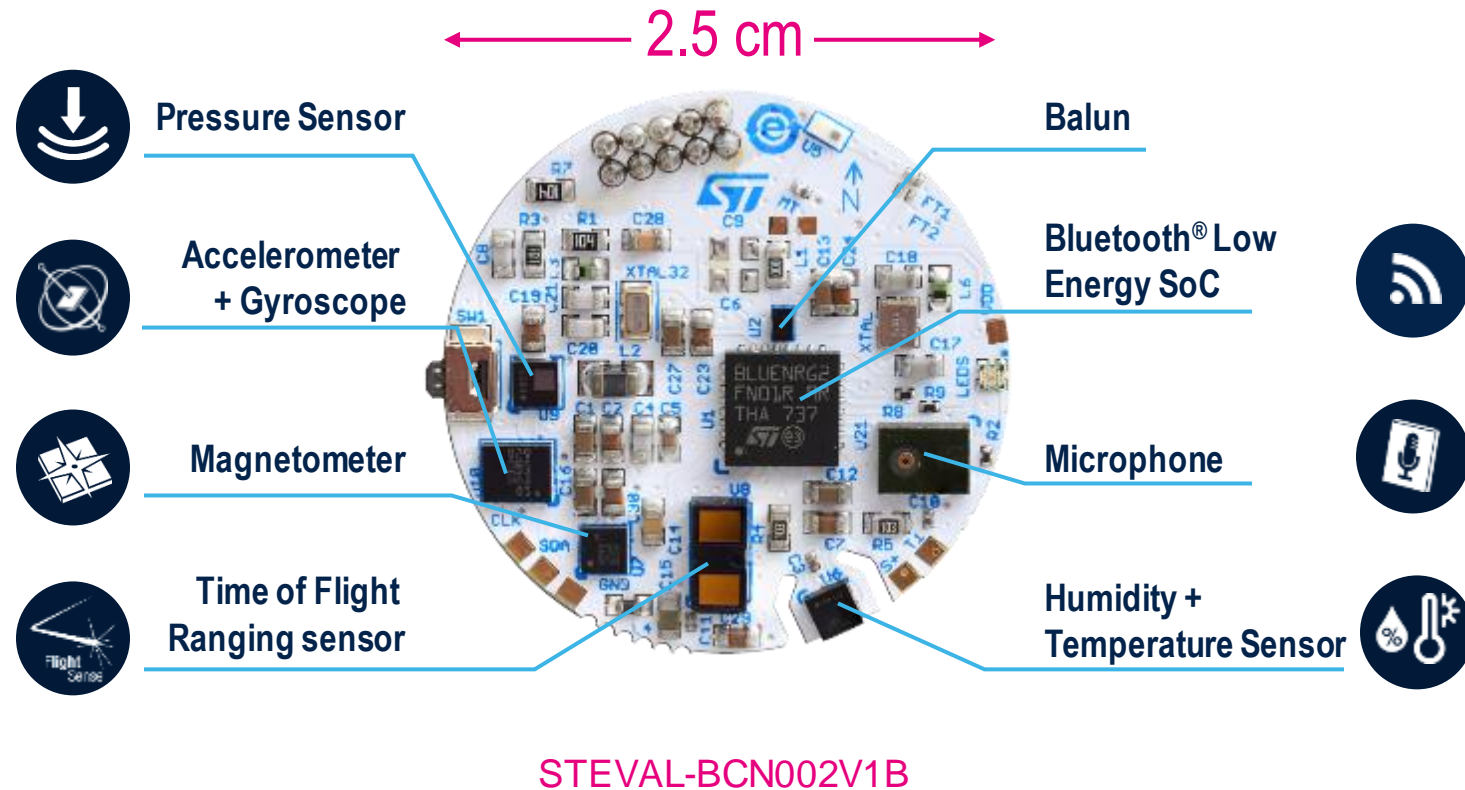More codec supported through external host
(Speex, Opus, …)

Mic

MOTION CAPTURE

Motion Algorithms

Lightweight 6 or 9 axis sensor fusion (up to 50Hz ODR)
and gesture recognition algorithms

Sensors

BLUENRG-248

BlueNRG-2

Smallest size WLCSP34
2.66 x 2.56mm

STEVAL-BCN002V1B - BlueNRG-Tile
Wireless sensing, processing and streaming

2.5 cm

Pressure Sensor

Accelerometer + Gyroscope

Magnetometer

Time of Flight Ranging sensor

Balun

Bluetooth® Low Energy SoC

Microphone

Humidity + Temperature Sensor

STEVAL-BCN002V1B

2 LAYER PCB

BATTERY OPERATED

FCC/CE certified

Ultra-low-power software libraries & ready-to-use SW development kits for

Motion Algorithms
Gesture and Activity recognition
[STSW-BLUETILE-DK development kit]

Voice over BLE
High quality voice capturing and compression
[STSW-BLUETILE-DK development kit]

BLE Mesh
Range-extending networks with duplex communication
[STSW-BNRG-MESH development kit]

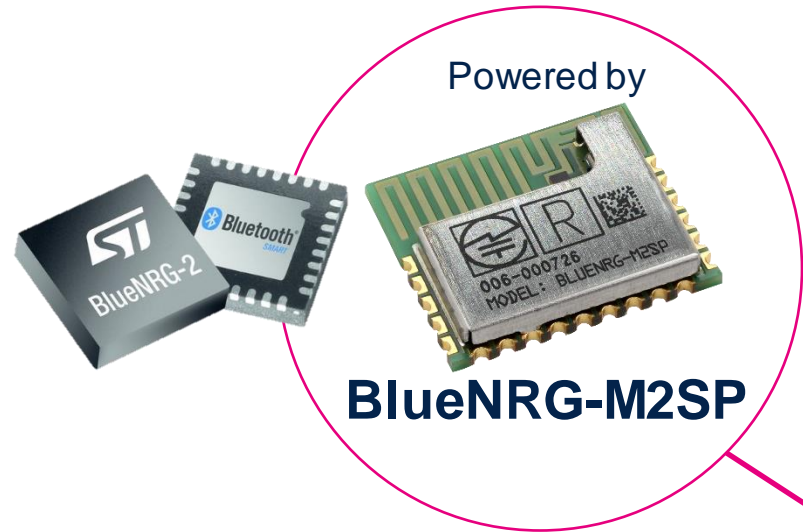**Seamless BlueNRG-Tile integration now available!**

Available features:

- Environmental data
  Temperature, humidity, pressure

- Motion Data
  Acceleration, angular velocity, magnetic field

- Acceleration events

- Compass outputs

- Sensor Fusion library outputs

- Battery status

- Data logging to CSV, TSV file
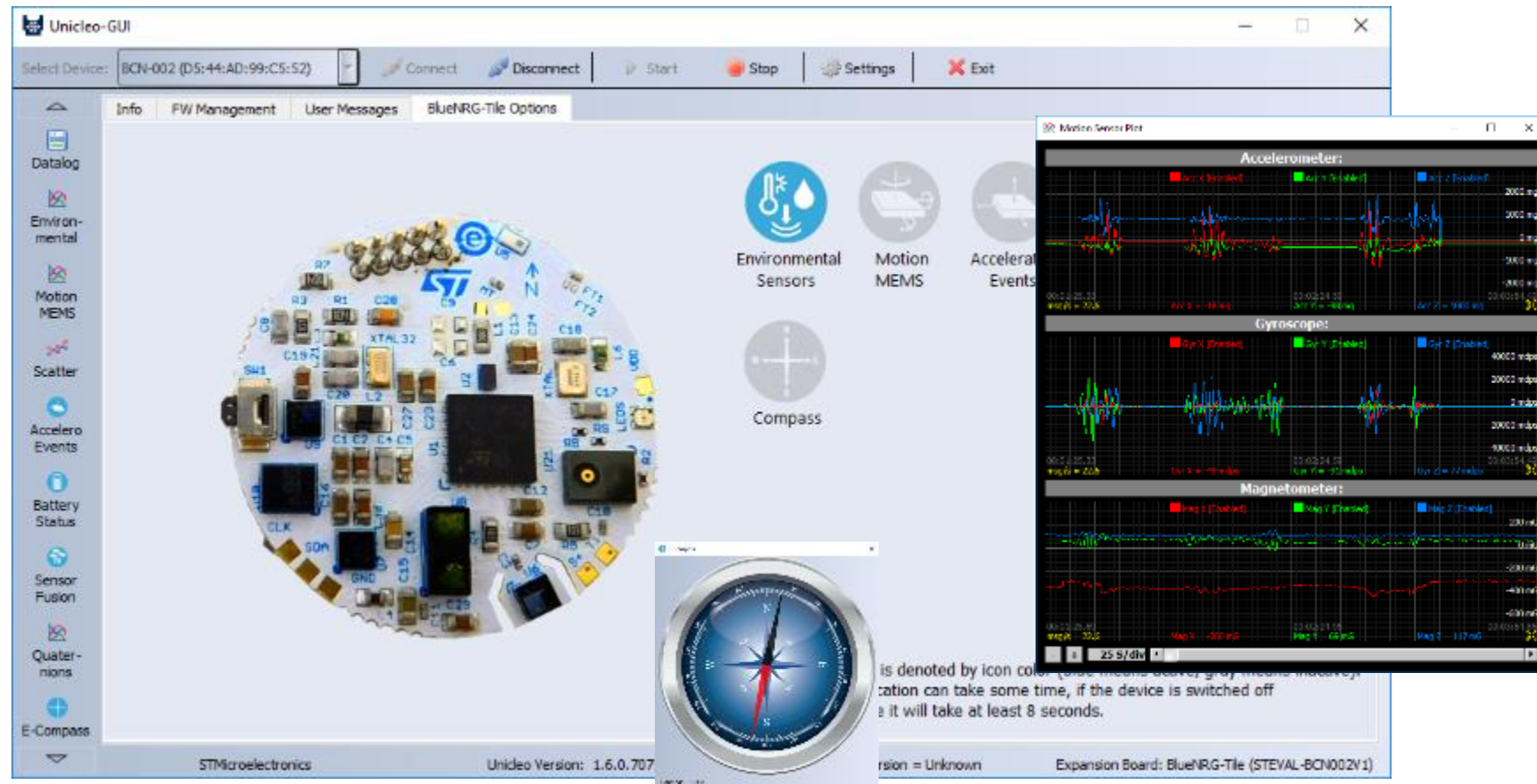
X-NUCLEO-BNRG2A1
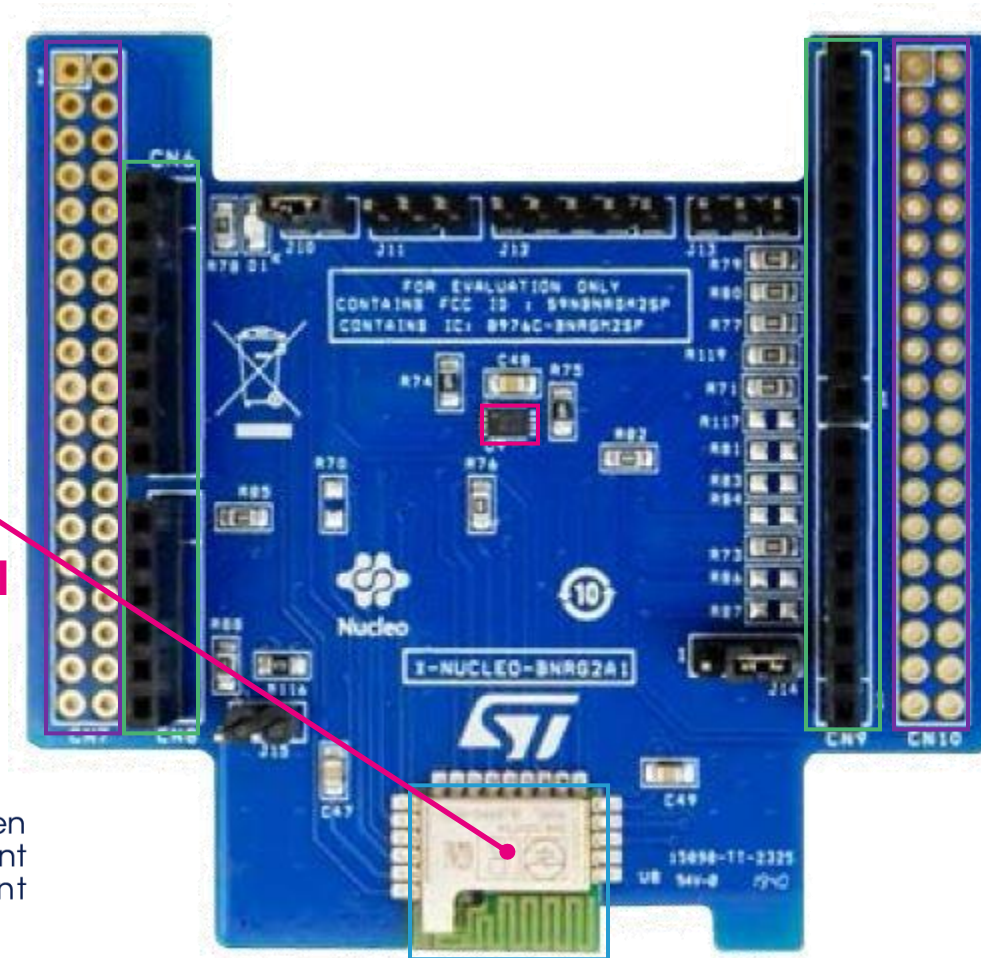# BLE5.0 Network Processor solution

Powered by

BlueNRG-M2SP

Suitable for BlueNRG-2N evaluation as well

EXPANSION FW PACKAGES
- X-CUBE-BLE2
- X-CUBE-BLEMESH1
- FP-SNS-BLEMESH1

STM32 **O**pen **D**evelopment **E**nvironment

BlueNRG Module Family
Suitable for

2.4GHz Proprietary

Bluetooth 5

Bluetooth SIG Mesh

	BlueNRG-232, BALF-NRG-02D2, 32MHz Oscillator		Arduino UNO R3 connector
	M95640		ST Morpho connector (opt)

BlueNRG Module Family
Suitable for

2.4GHz Proprietary

Bluetooth 5

Bluetooth SIG Mesh

Powered by
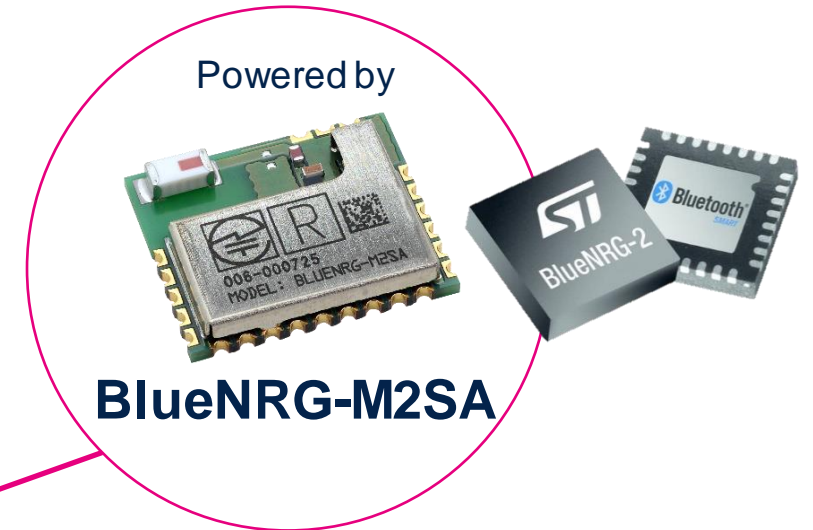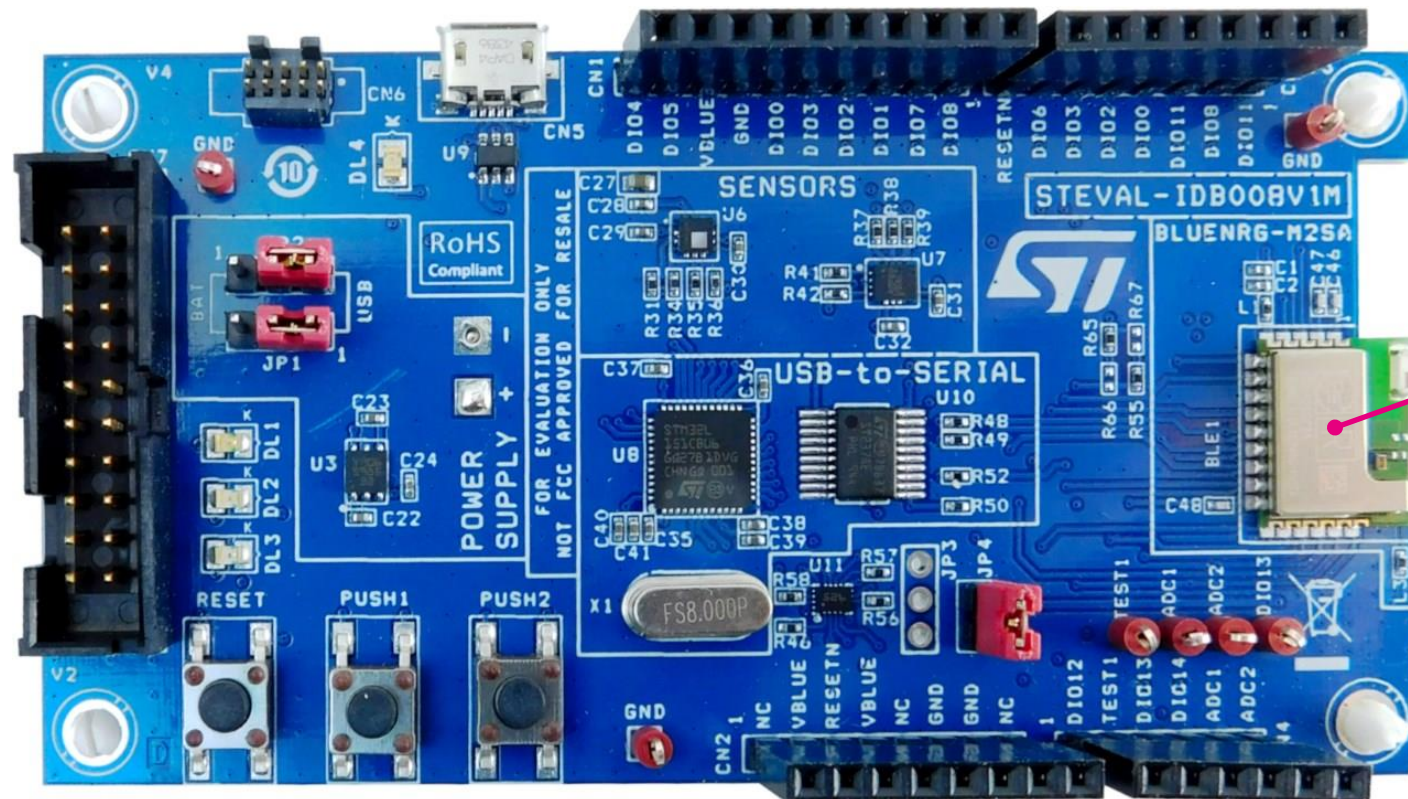
BlueNRG-M2SA

BlueNRG-M2 **Wireless SoC FW Package**
STSW-BLUENRG1-DK
including interactive, simple and user-friendly PC Graphical User Interfaces (GUIs)
- **BlueNRG Navigator**
- **BlueNRG Radio Initialization Wizard**

BlueNRG Takeaways

BlueNRG product family:
Your best choice for Bluetooth®-enabled devices

The highest radio efficiency in the market	Designed for ultra-low power applications, BlueNRG processors drastically extended battery lifetime
Free of charge certified BLE and Mesh stacks	Highly optimized, upgradable and robust-proven BLE stack, developed and maintained by ST expert team
Scalable SoC and network processing portfolio	Bluetooth® features, wide chip package and module flavors, and performances for every need
Advanced security set	State-of-the-art BLE security and privacy features, together with secure Bootloader and Flash protection
Ready-to-go software, libraries, and hardware development kits	User friendly development tools that will help you to cut the wires: from evaluation to final product

Thank you

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