

Smart Home Bluetooth® Low Energy Connectivity



STM32WB



BlueNRG-LP





Smart Home Bluetooth ® LE Connectivity with STM32WB

STM32WB Bluetooth LE + 802.15.4 SoC



STM32WB Protocol stacks



STM32WB Intercom Demo



Bluetooth LE companion solutions





Largest Bluetooth® LE + 802.15.4 portfolio

Ultra Low Power Solutions



Dual-Core



Single-Core

BlueNRG-2N

Bluetooth Low Energy
5.2 Network
processor

BlueNRG-MS

Bluetooth Low Energy
4.1 Network
processor

BlueNRG-2

Bluetooth Low Energy 5.2
Application processor
Cortex-M0 32MHz

BlueNRG-1

Bluetooth Low Energy 5.2
Application processor
Cortex-M0 32MHz

BlueNRG-LP

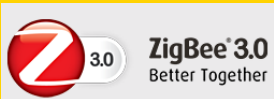
Bluetooth Low Energy 5.2
Application processor
Cortex-M0+ 64MHz,
**Industry leading
security features**

STM32WBx0

Bluetooth Low Energy 5.2
802.15.4, Zigbee 3.0, Thread
Application processor
Dual core Cortex-M4, 64MHz
/ M0+, 32MHz
Advanced Security

STM32WBx5

Bluetooth Low Energy 5.2
802.15.4, Zigbee 3.0 Thread
Application processor
Dual core Cortex-M4, 64MHz
/ M0+, 32MHz
Advanced Security



Bluetooth Low Energy CONNECTIVITY

ADVANCED CONNECTIVITY - MULTI-PROTOCOL



MORE INFO

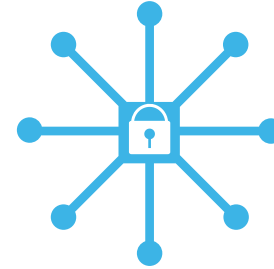
STM32WB series: the 7 keys points



Open 2.4 GHz radio
Multi-protocol



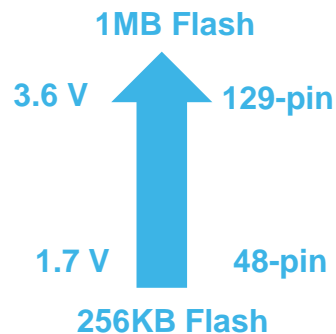
Dual-core / Full control
Ultra-low-power



IoT Protection ready



Massive integration
Cost saving



A large offer



STM32
CubeMonitor-RF

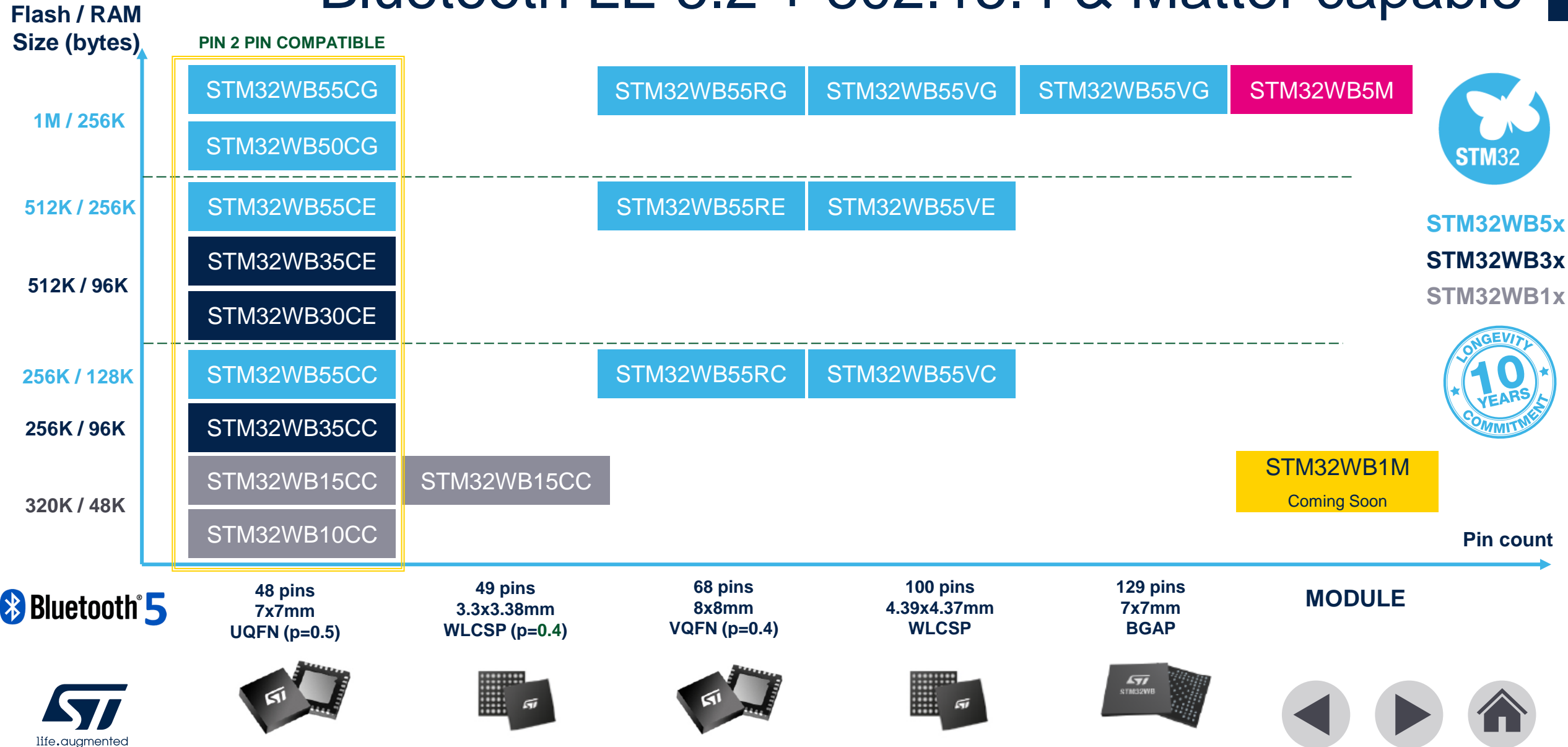
Advanced RF tool, Energy control
with C code generation



No matter what!

STM32WB portfolio

Bluetooth LE 5.2 + 802.15.4 & Matter capable





arm
MBED

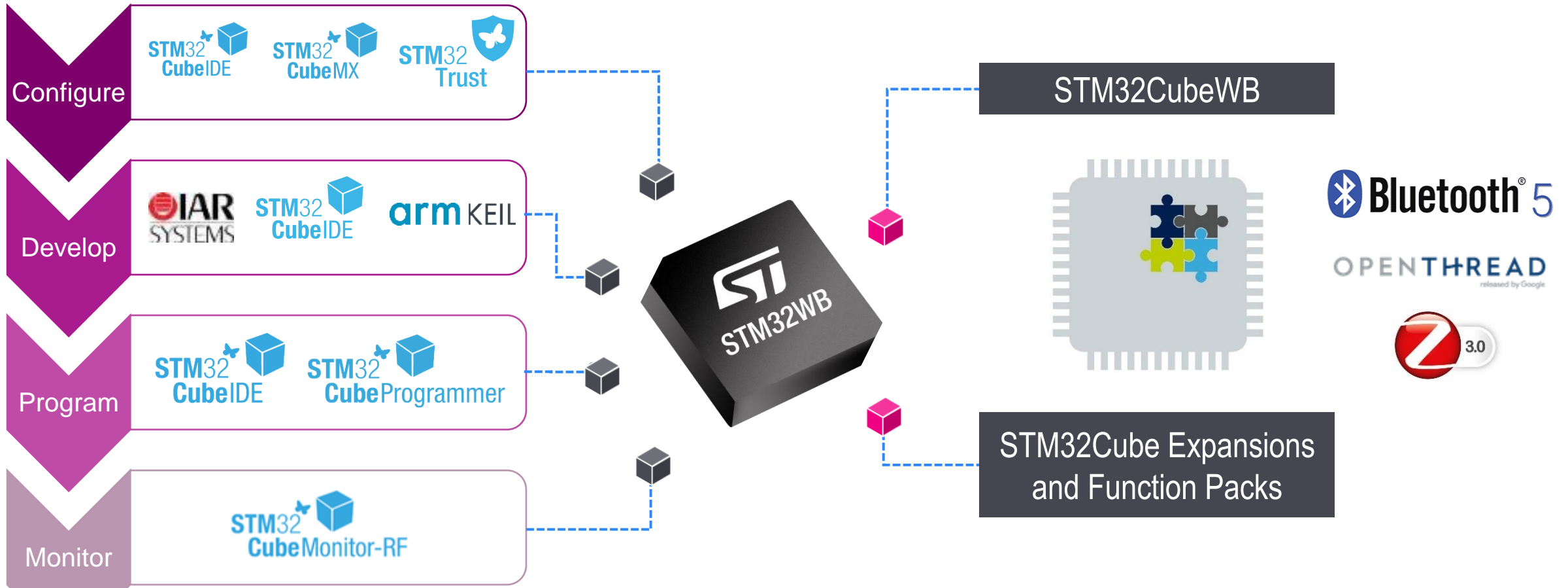


STM32WB Ecosystem recap



Software Tools

Embedded Software





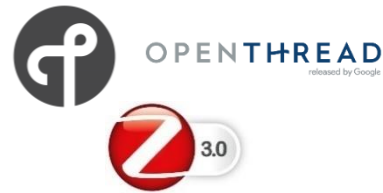
MORE INFO

Multiprotocol and open radio



 **Bluetooth® 5**

- Fully certified Bluetooth LE™ 5.2 radio
- 2x faster speed with 2Mbps capable mode



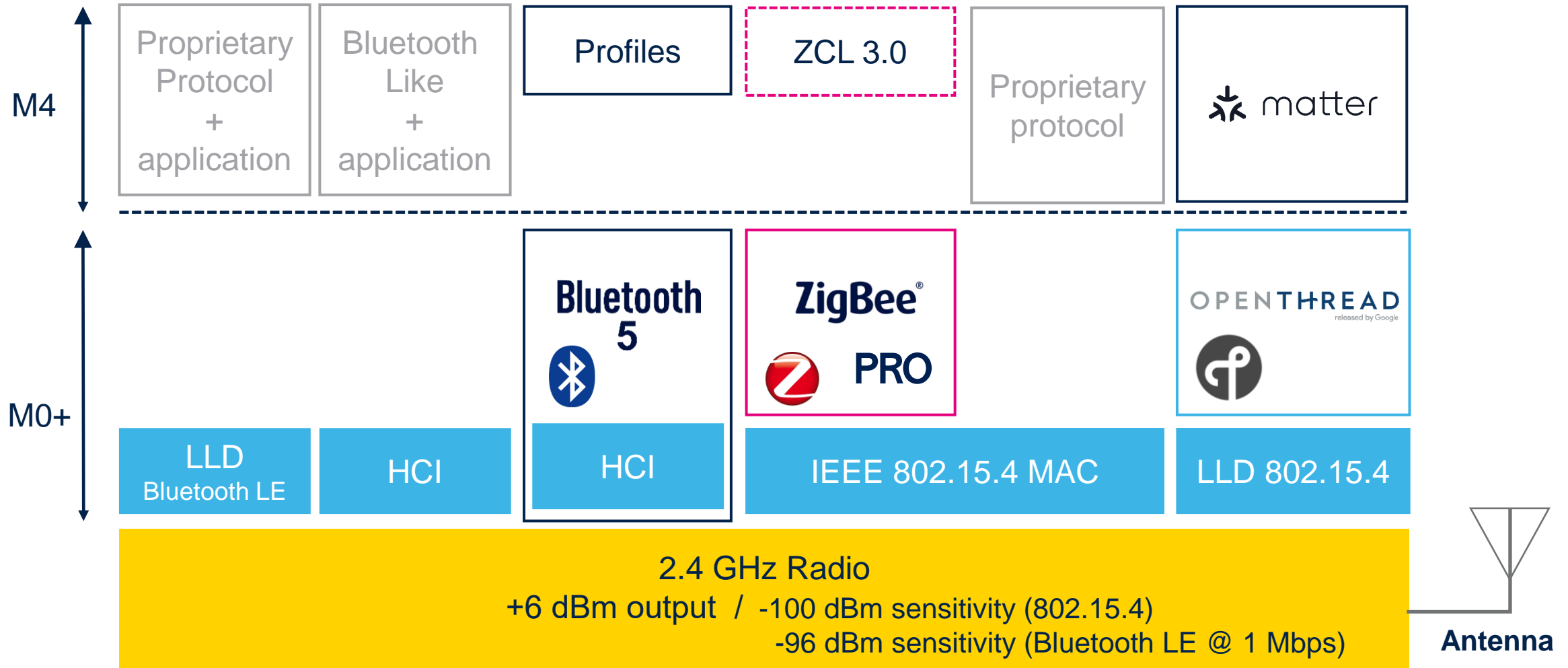
- OpenThread, Zigbee PRO & Zigbee 3.0
- Bluetooth LE™ 5.2 and 802.15.4 protocols in Static and Dynamic concurrent mode

2.4 GHz
Open

- Proprietary protocol capable (Bluetooth LE™ like or 802.15.4)



Your choice for certified stack offerings



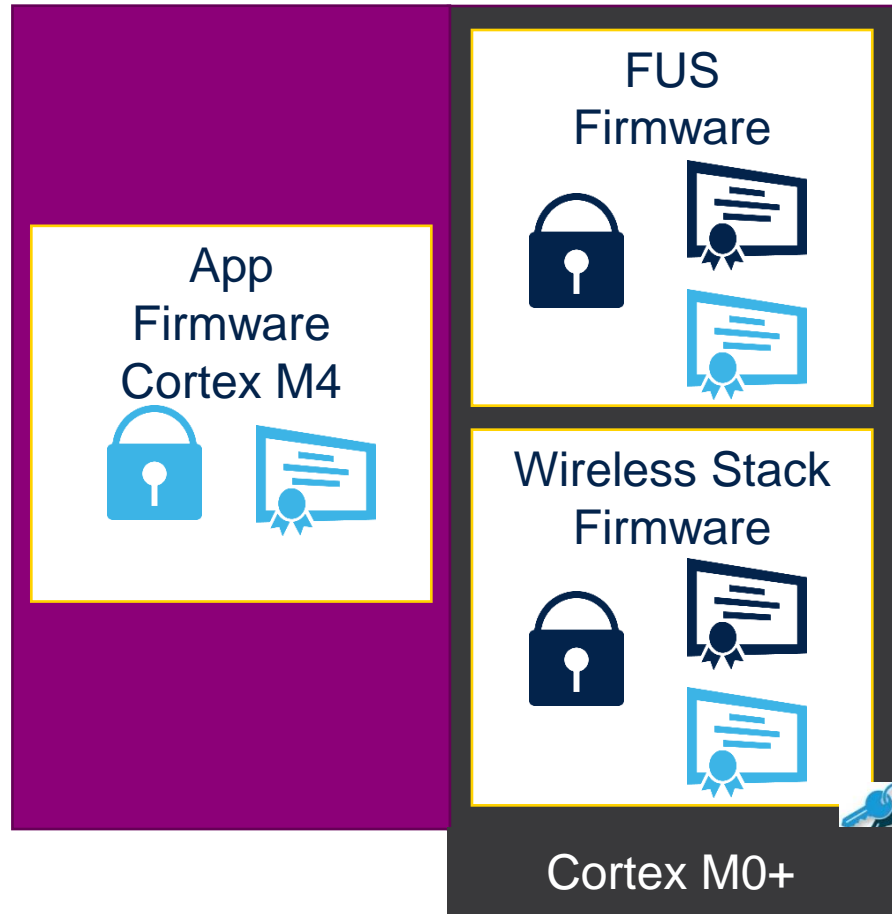


MORE INFO

Stacks and application remain secure

App Firmware

- ✓ Typically Encrypted and Signed by customer with SBSFU



FUS Firmware & Wireless Stack Firmware

- ✓ Encrypted and signed by ST
- ✓ Optional to have it signed again by customer chosen keys

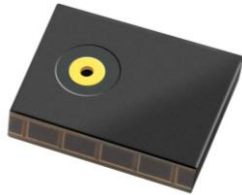


Encrypted Firmware
Signed Firmware





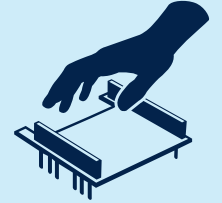
MORE INFO



STM32WB intercom demo

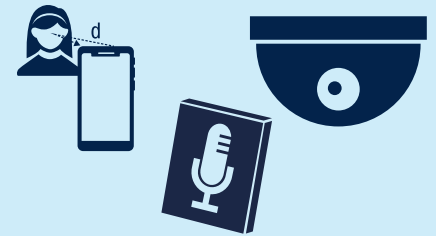
Nucleo Boards

- X-NUCLEO-6180XA1
- X-NUCLEO-CCA02M2
- NUCLEO-WB55RG



Motion, MEMs, Imaging sensors

- VL6180X Time of Flight motion detection
- MP34DT06J MEMs microphone
- OMNIVISION Camera Module



Processing

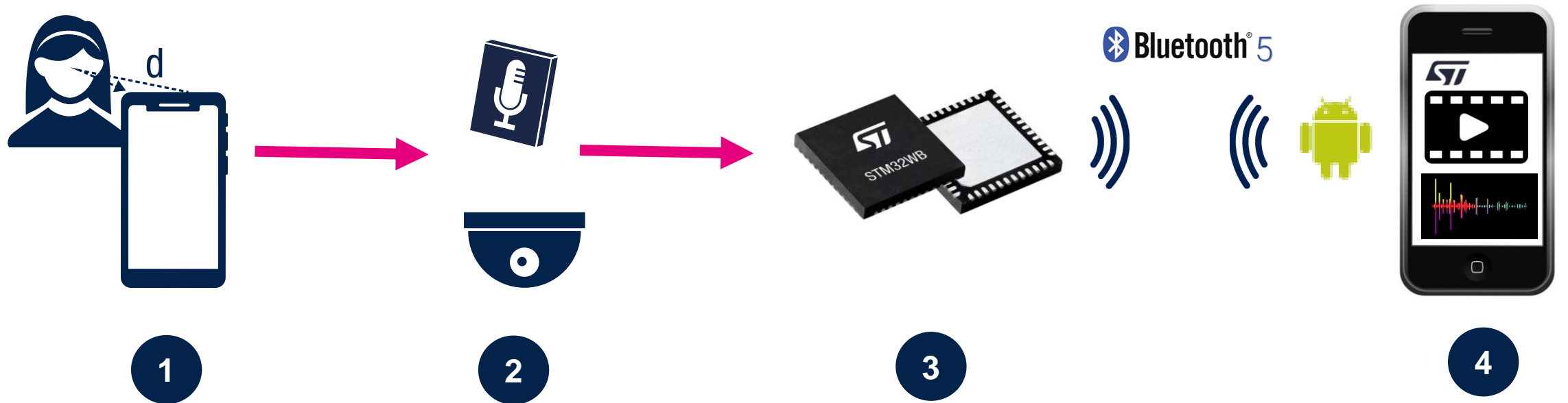
- STM32WB55RGV6 Bluetooth LE + 802.15.4 SoC
- Smart Phone Android smartphone





MORE INFO

STM32WB intercom demo flow



- Four steps are taken inside the demo to view the video and hear the audio on the smartphone



MORE INFO

STM32WB intercom demo explanation

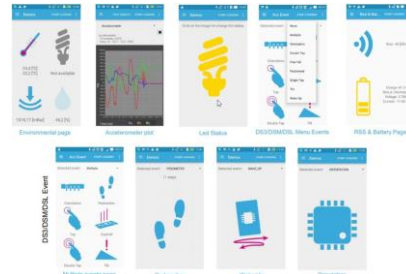
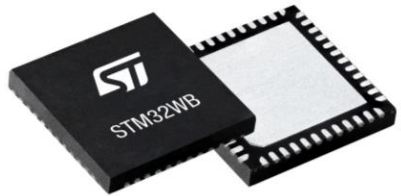
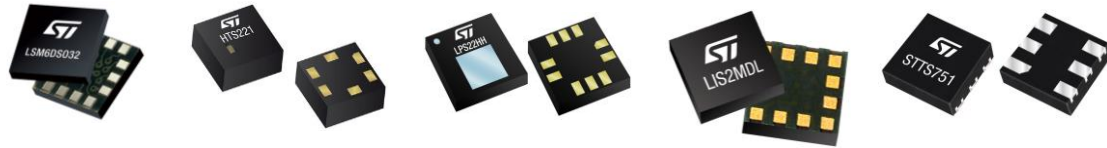
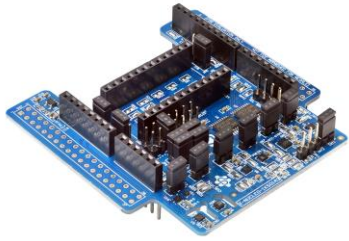
- Presence detection is done through the VL6180X, STM32WB
- Audio and Video are captured
- STM32WB processes both audio and video
 - Audio PDM is acquired through the SAI port and decimated to PCM at 16kHz sampling rate (F_s)
 - Video is captured through SPI port, camera commands are through I2C port
 - Audio is compressed with OPUS audio compression standard
 - Audio and video is sent through the proprietary Bluetooth LE profile at 167Kbyte/s
- Android application receives the data through the proprietary Bluetooth LE profile where Audio and Video are recovered





MORE INFO

Motion Sensors and activity sensing



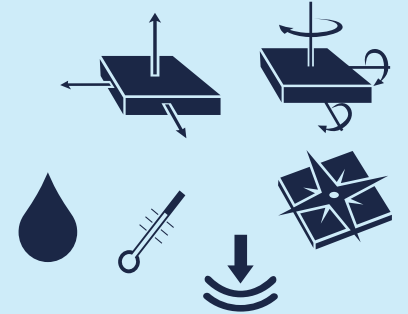
Nucleo Boards

- X-NUCLEO-IKS01A3
- NUCLEO-WB55RG



MEMs motion and environmental

- LSM6DSO 3 Axis XL, 3 Axis Gyro
- LIS2MDL 3 Axis Magnetometer
- HTS221 Temperature and Humidity
- LPS22HH Ambient Pressure
- STTS751 Temperature



Processing

- STM32WB55RGV6 Bluetooth LE + 802.15.4 SoC
- Smart Phone iOS or Android



Software Package

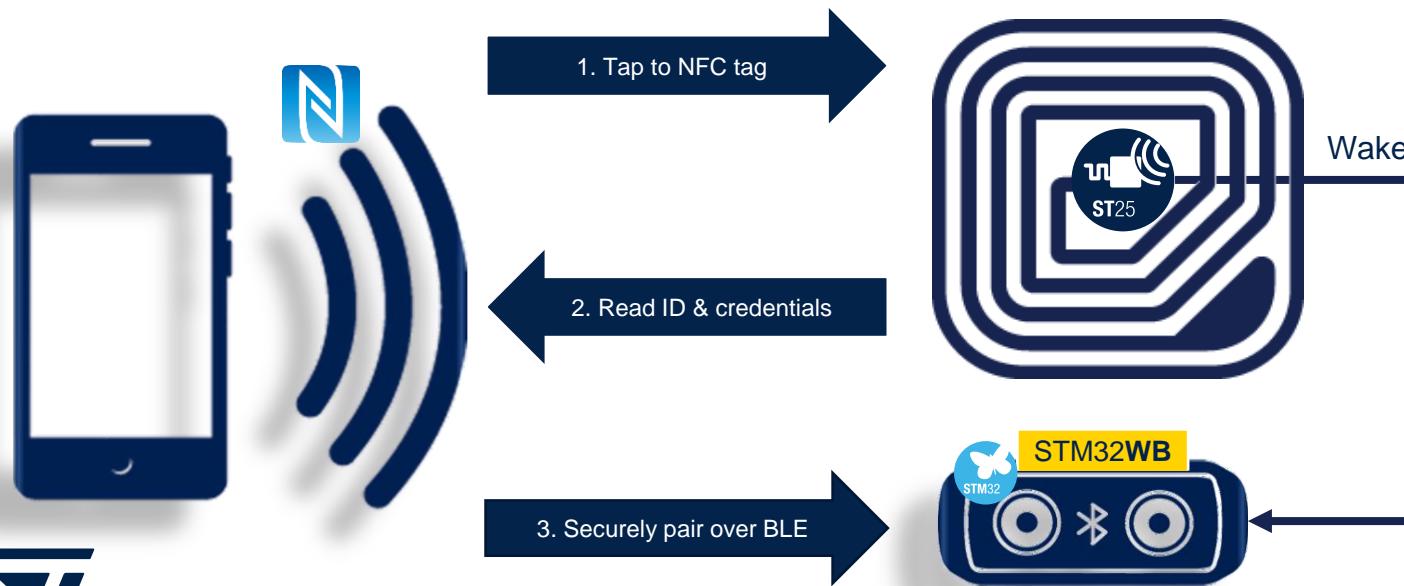
- FP-SNS-MOTENVWB1



ST25 NFC - pairing Bluetooth LE devices

Pair with a **SIMPLE TAP**

- NFC only... no other input is needed!





Smart Home Bluetooth LE Connectivity with BlueNRG-LP



BlueNRG-LP: Best in Class Bluetooth LE SoC

BlueNRG-LP Protocol stacks

BlueNRG-LP Concurrent Connection

BlueNRG-LP Driving Smart Home applications





Largest Bluetooth® LE + 802.15.4 portfolio

Ultra Low Power Solutions



Dual-Core



Single-Core

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5.2 Network
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BlueNRG-LP

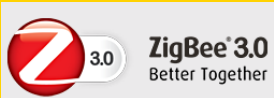
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Application processor
Dual core Cortex-M4, 64MHz
/ M0+, 32MHz
Advanced Security



Bluetooth Low Energy CONNECTIVITY

ADVANCED CONNECTIVITY - MULTI-PROTOCOL



life.augmented





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

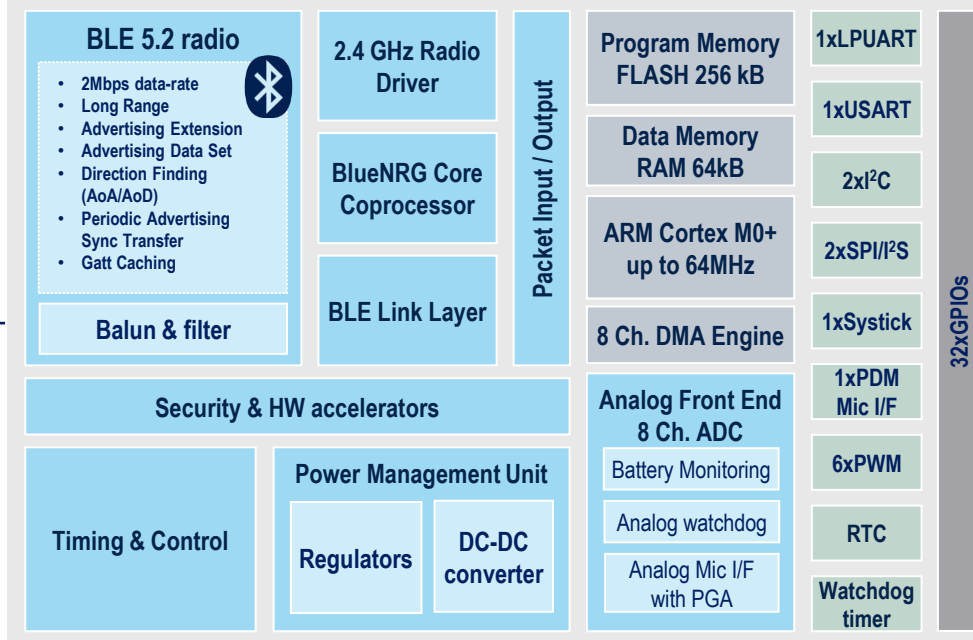
Reduced BOM cost

- **Integrated Balun**
- **Capacitor-less** 32MHz crystal.

Advanced security set

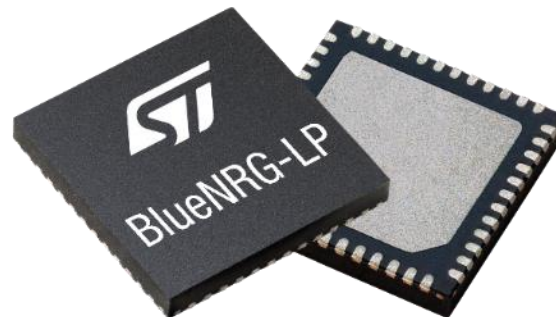
- **Flash read/write protection.**
- **Secure bootloader**
- **SWD access can be disabled**

Block Diagram



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
- **Up to 128 Concurrent connections**
- 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 °C / **-40 up to 105 °C**
- Package available: **QFN32** (20 GPIOs), **QFN48** (32 GPIOs), **WLCSP49** (26 GPIOs)





Featured BlueNRG-LP SoC

FULL BLUETOOTH 5.0 RADIO

- Full Featured **Bluetooth LE 5.0**
 - **Long-range 125Kbps and 500Kbps**
 - **Channel Selection Algorithm #2**
 - **Advertisement Extension**
 - Advertising Data Set
 - 2Mbps Data Rate
 - GATT caching
- Bluetooth LE 5.1 Errata

SOFTWARE and SDK

- Linkable BLE 5.0 stack library
- 2.4GHz proprietary driver
- **L2CAP channel-oriented connections driver**
- BLE Mesh featured SDK

DIGITAL and ANALOG PERIPHERAL SET

- Up to 32 GPIOs
- 1xSPI, 2xSPI/I2S, 2xI2C, 1xUSART, 1xLPUART
- 1xRTC, 1xSysTick, 1x16-bit Timer/PWM
- 12-bit ADC up to 200KHz Fs
 - ENOB: 11.5 bit in DIFF, 11.1 bit in SE
 - STHD: 80.5dB in DIFF, 78dB in SE

BEST IN CLASS RADIO PERFORMANCES

- **-104dBm RX Sensitivity @ 125Kbps**
- **-97dBm RX Sensitivity @ 1Mbps**
- **+8dBm Power Output (1dBm steps)**

BEST IN CLASS ULTRA LOW-POWER

- **3.8mA (*) Rx Current @ Sensitivity Level**
- **4.3mA Tx Current @ 0dBm**
- **50nA in SHUTDOWN mode**
- **900 nA in DEEPSTOP mode (w/ LSE osc)**

AUDIO PERIPHERALS

- Digital microphone input (PDM)
- Analog microphone with bias and PGA
- I2S digital I/O interface up to 96KHz

DESIGN FLEXIBILITY

- **Designed for 2-layer PCB**
- Integrated DC/DC and LDO step-down converter
- Integrated RF BALUN with 50Ω single-ended output

PROCESSING UNIT

- ARM Cortex-M0+, 64 MHz, 256 KB Flash, 64 KB SRAM
- Dynamic power consumption: 40uA/MHz

SECURITY FEATURES

- PKA, AES (256-bit), ECC (256-bit), TRNG, CRC
- 48-bit unique ID
- Secure boot and firmware update

PACKAGE

- WLCSP49 3.14 x 3.14 mm, pitch 0.4mm, 30 I/Os
- QFN32 5x5 mm, pitch 0.5mm, 20 I/Os
- QFN48 6x6 mm, pitch 0.4mm, 32 I/Os

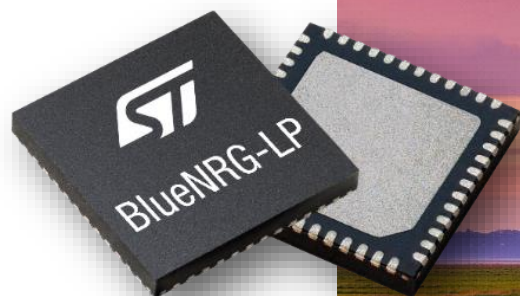




BLUENRG-LP



MORE INFO



Up to 1.3 Km communication range...



...up to 128 concurrent connections



BLE Software Development Kit

STSW-BNRGLP-DK : rich set of BLE examples

How to benefit and use **BLE 5.0** features

- 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_BlueMSapp
- BLE_SensorDemo_Central
- BLE_SensorDemo_StaticStack
- BLE_SerialPort
- BLE_SerialPort_Master_Slave
- BLE_StaticStack
- BLE_Throughput
- DTM
- DTM_basic
- DTM_Updater

BLE_Beacon

Enable a Beacon Application, enable **Advertising Extension**

BLE_RemoteControl

Play with CODED PHY and enable a **Long Range** communication

BLE_Throughput

How to increase your application data rate by enabling some BLE keys tips (connection interval, MTU) and the **2Mbps** over the air



8 X
Increase
broadcast

2 X Speed

4 X Range



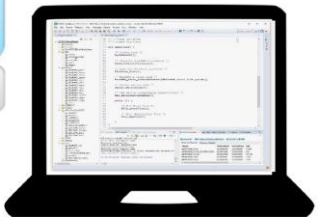
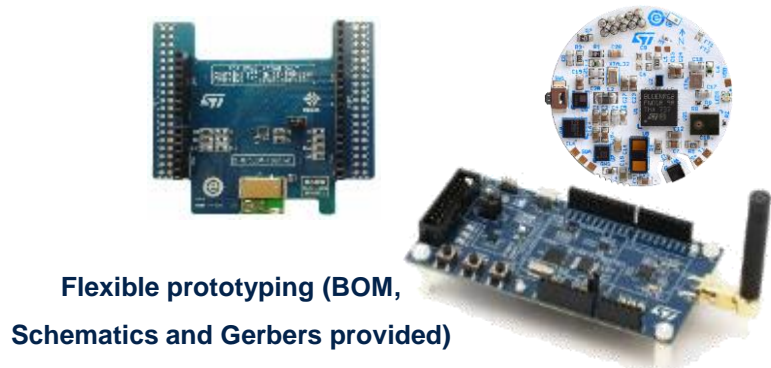


BlueNRG ecosystem

Complete Bluetooth Low Energy flexible ecosystem



Please contact your nearest ST Sales Office for more information



Starter Kits and Ref. Designs

PC and Mobile GUIs

SDKs and Libraries

*NP

SoC

X-NUCLEO-IDB05A2
X-NUCLEO-BNMG2A1
SensorTile.box

STEVAL-IDB008V2
BlueNRG-Tile
STEVAL-IDB008V1M
BlueNRG-Plug

Chip-down
Modules

STM32CubeIDE
STM32CubeMx
ST BLE Sensor App
ST BLE Mesh App

BlueNRG Navigator
BlueNRG Power Estimator
BlueNRG Init. Wizard

X-CUBE-BLE1/2
X-CUBE-BLEMESH1
FP-ATR-BLE1
FP-SNS-BLEMESH1

BlueNRG DK
BlueNRG Profiles
BlueNRG-Mesh



STM32 Open
Development
Environment



*Network Coprocessor





BlueNRG-LP BLE 5.x stack flexibility

BlueNRG-LP stack modular approach: Optimize your application footprint

full mode
client & slave roles 2Mbps, Advertising Extension Long Range (CODED PHY)
~100KB

basic mode
slave 1Mbps only
~62KB

2M & Long Range mode
slave 2Mbps, Advertising Extension Long Range (CODED PHY)
~70KB

Refer to stack release note part of
STSW-BNRGLP-DK



The following BlueNRG-BLE Stack Library modular configurations options are currently supported:

- BLE_STACK_FULL_CONF** -> preprocessor option to be added on Bluetooth LE user application IDE toolchain, for configuring the Bluetooth LE stack with all supported modular features:
 - Controller Privacy is enabled
 - LE Secure Connection is enabled
 - Master role is enabled
 - Data length extension is enabled
 - LE 2M PHY, LE CODED PHY are enabled
 - Extended Advertising is enabled
 - LE L2CAP Connection-Oriented Channels is enabled
- BLE_STACK_BASIC_CONF** -> preprocessor option to be added on Bluetooth LE user application IDE toolchain for configuring the Bluetooth LE stack with the basic configuration options:
 - Controller Privacy is disabled
 - LE Secure Connection is disabled
 - Master role is disabled (only Peripheral/Slave role is supported)
 - Data length extension is disabled
 - LE 2M PHY, LE CODED PHY are disabled
 - Extended Advertising is disabled
 - LE L2CAP Connection-Oriented Channels is disabled
- BLE_STACK_SLAVE_DLE_CONF** -> preprocessor option to be added on Bluetooth LE user application IDE toolchain for selecting the OTA Service support with Data length extension:
 - Controller Privacy is disabled
 - LE Secure Connections is disabled
 - Master role is disabled (only Peripheral/Slave role is supported)
 - Data length extension is enabled
 - LE 2M PHY and LE CODED PHY are disabled
 - Extended Advertising is disabled
 - LE L2CAP Connection-Oriented Channels is disabled

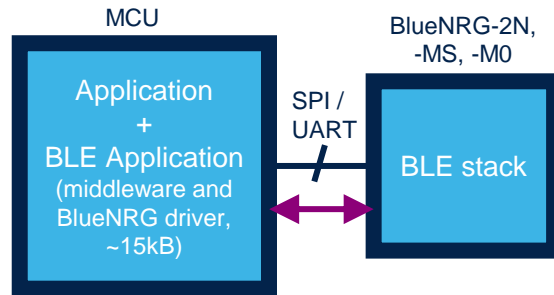




BlueNRG topologies

NP

Network Processor

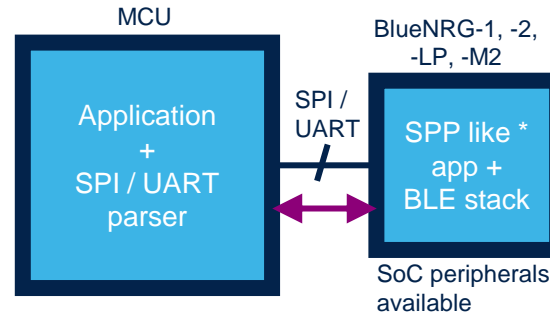


“Application is running over a dedicated MCU, and I need to **add BLE**”

- + Device delivered with stack image pre-programmed
- Host side driver & middleware needed

DP

Data Pump

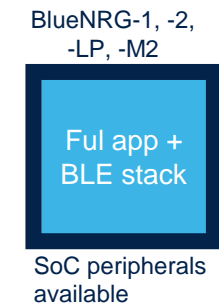


“Application is running over a dedicated MCU, and I need to **add BLE with flexibility & simplicity**”

- + Easy UART/SPI BLE comms addition while offloading host processor
- BLE image build and loading needed

AP

Application Processor



“Application and BLE running on same SoC for most **optimized solution**”

- + BlueNRG core handling BLE stack and application
- + Easy and simple implementation with to DK tool & examples





Up to 128 concurrent connections

Key Features

- First with 128 concurrent connections
- Ultra low power consumption
- Ultra low latency
- Slave nodes can act as master or other device



Central Unit



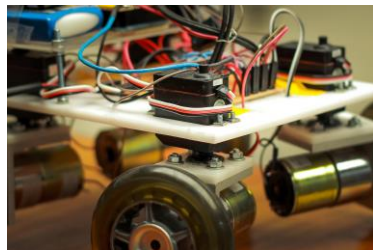
Peripheral Units





BlueNRG-LP star connection

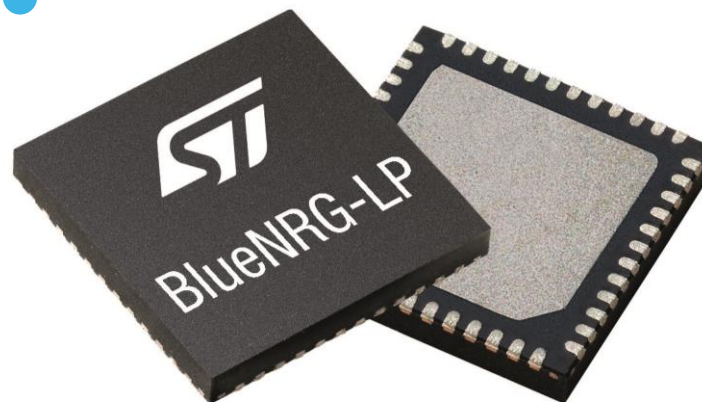
Low latency & LR enable new scenario



TOYS



ELECTRONIC SHELF LABEL



HEALTHCARE



HOME SECURITY / LIGHTING



FITNESS



DRONES





BlueNRG-LP Driving Smart Home applications

Key Features

- Best in class Radio performance
- Ultra low power consumption
- Robust communication link
- Long Range – up to 4x
- High Speed – up to 2x
- Extended Advertisement – 8x more data
- 128 Concurrent Low Latency Connections.
- Highly efficient stack
- Rich peripheral set





BlueNRG and MEMS Sensors

Ready-to-go software libraries for Voice and Motion

BEST IN CLASS RADIO PERFORMANCE

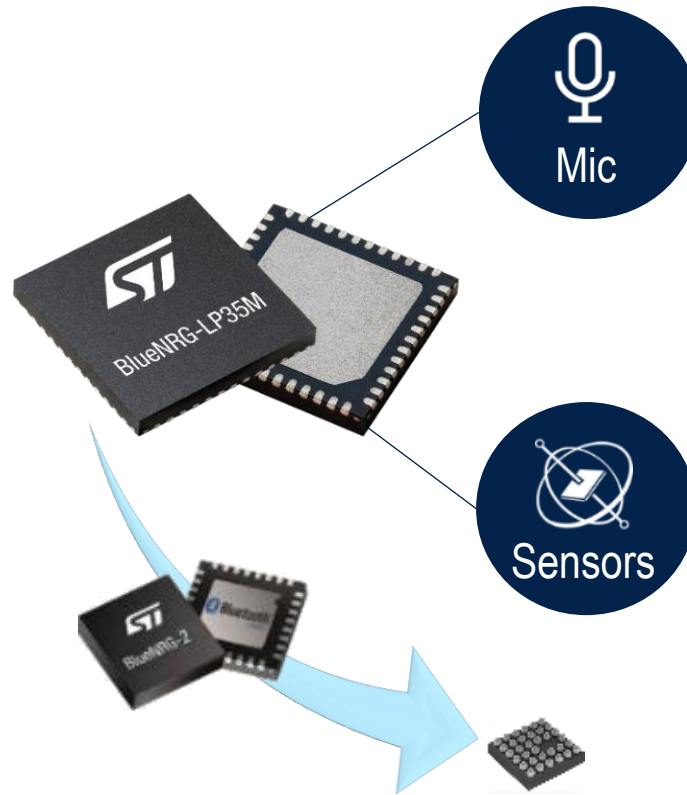
FAST DATA TRANSFER – UP TO 2X

LONG RANGE – UP TO 4X

EXTENDED ADVERTISEMENT

LOWEST POWER CONSUMPTION

128 CONCURRENT CONNECTIONS



VOICE CAPTURE

Voice over BLE

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

MOTION CAPTURE

Motion Algorithms

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

