STM32 WIRELESS update

STMicroelectronics and AVNET SILICA

Paolo Scanniffio

Technical Marketing Manager STM32

Iberia

- Wireless MCU
- Entry level MCU
- MPU
- Ultra Low Power MCU
- High- Performance MCU
- Analog rich MCU

SUB-Ghz portfolio

The best Sub-GHz portfolio on the market

PERFORMANCE

STM32WL5x

Application processor
Dual core Cortex-M4 / M0+ @ 48MHz

Build-in PA with 2x output power
Up to +15 dBm and up to +22 dBm
170 dB Link budget

Advanced Security, Rich Analog
Flash: up to 256KB / RAM: up to 64KB

Up to 72 GPIOs,
UFN48, BGA73

+ MODULE

STM32WLEx

Application processor
Cortex-M4 @ 48MHz

Build-in PA with 2x output power
Up to +15 dBm and up to +22 dBm
170 dB Link budget

Advanced Security, Rich Analog
Flash: up to 256KB / RAM: up to 64KB

Up to 72 GPIOs,
UFN48, BGA73

news

STM32WL3

Application processor
Cortex-M0+@ 64Mhz

Build-in PA with 2x output power
Up to +14 dBm and up to +20 dBm
152dB Link budget

LCD Driver
Low-Power analog sensing

FLASH up to 256KB /
RAM up to 32KB

Up to 32 GPIOs
QFN32/48

S2LP

Transceiver

Up to +16dBm output power
146 dB Link budget
QFN24

S2LP-TX

Transmitter (TX only)
QFN24

SPIRIT1

Transceiver

Up to +16dBm output power
136 dB Link budget
QFN20

STS1TX

Transmitter (TX only)
QFN20

ULTRA-LOW-POWER → **LOW-POWER**

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STM32 Sub-Ghz Product Families

Sub-GHz SoC Dual Core

Sub-GHz SoC Single Core

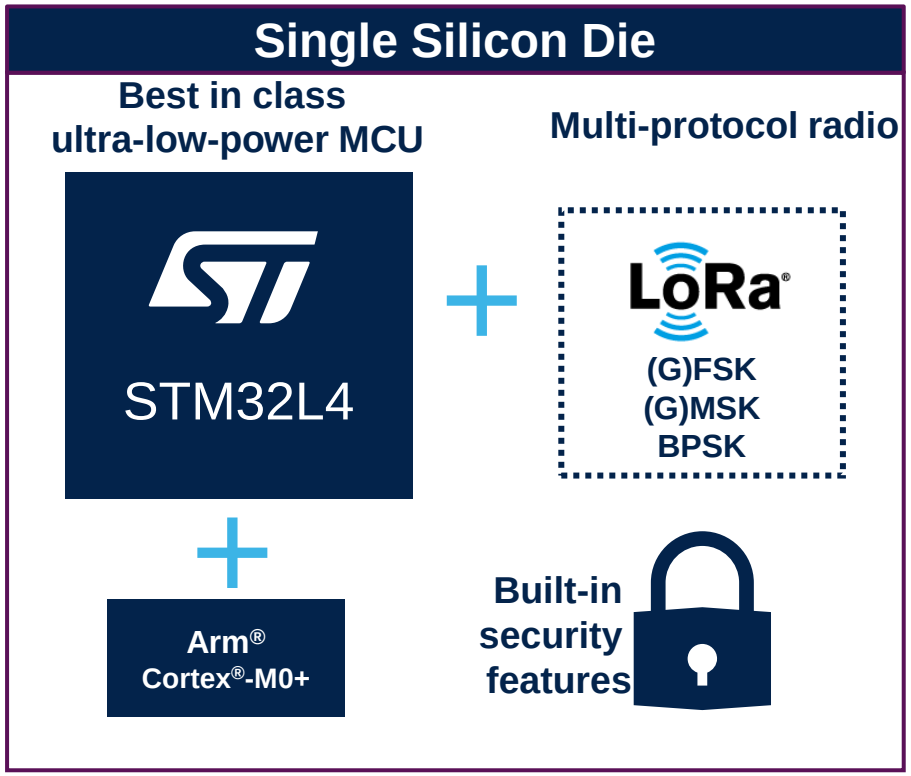
Sub-GHz Transceiver

	1st Generation SPIRIT1	2nd Generation S2-LP	STM32WL3x	STM32WL55 STM32WLE5
	General Purpose Sub-GHz radio	Ultra Low Power Sub-GHz radio		
SUPPORTED MODULATION	2 (G)FSK (G)MSK - OOK ASK -	2/4 (G)FSK (G)MSK BPSK (Sigfox) OOK ASK -	+ DSSS and IQ I/F on WL3	2 (G)FSK (G)MSK BPSK (Sigfox) - - LoRa (WLx5 P/N)
SUPPORTED PROTOCOLS	M-Bus wireless, 6LoWPAN	M-Bus wireless, 6LoWPAN, KNX, sigfox, Wi-SUN, mioty		M-Bus wireless, 6LoWPAN, KNX, sigfox, Wi-SUN, mioty, LoRaWAN

STM32WL

What is an STM32WL ?

A Sub-1GHz wireless MCU supporting long range Wireless protocols



STM32WL

LoRaWAN
sigfox
mioty
M-Bus wireless
ZETA

Proprietary

The world first LoRa SoC

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STM32**WL**

STM32WL – All In One Sub-GHz SoC

- Worldwide compatibility

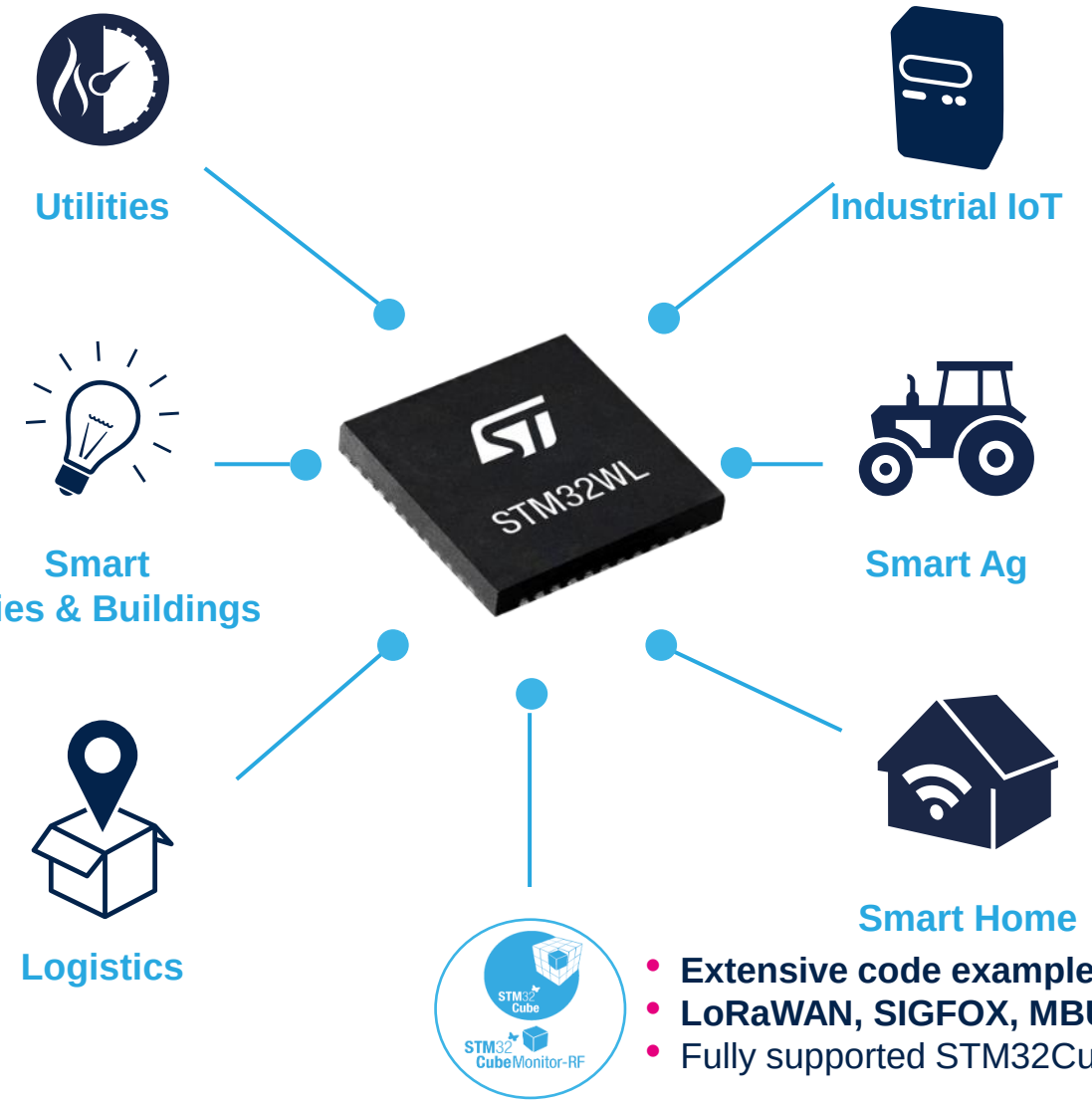
150 MHz to 960 MHz Linear Range

- Multi-protocol capable
- ST Longevity commitment:

10 years life time

- Up to **+22 dBm** output power for wide coverage
- **-148 dBm** sensitivity with LoRa: **Robust RF Link**
- **Reduced BOM cost**

- **Unique-IDs** for enhanced traceability
- Down to 390 nA mode with RTC and 32KB of RAM for extended Battery lifetime
- Small form factor with **UFBGA 5x5 package & module 10x10**



- Up to **105 °C** temperature rating
- **Only 5 µs wakeup time**
- Only 4.82 mA as LoRa RX consumption to extend battery life

- Link Budget > **160 dB** = Very long ranges
- Excellent battery lifetime: Only 15 mA for LoRa TX consumption @ 10 dBm
- **PCROP**, **ECC**, TRNG, **PKA**, for IoT security

- Down to 71 µA/MHz in Run mode reducing battery consumption
- < 1 µA Stop mode with full RAM for **battery life** optimization
- 12-bit ADC & DAC for mixed signal applications

- **Extensive code examples in the STM32CubeWL**
- **LoRaWAN, SIGFOX, MBUS stacks available**
- Fully supported STM32CubeMX (late 2020)

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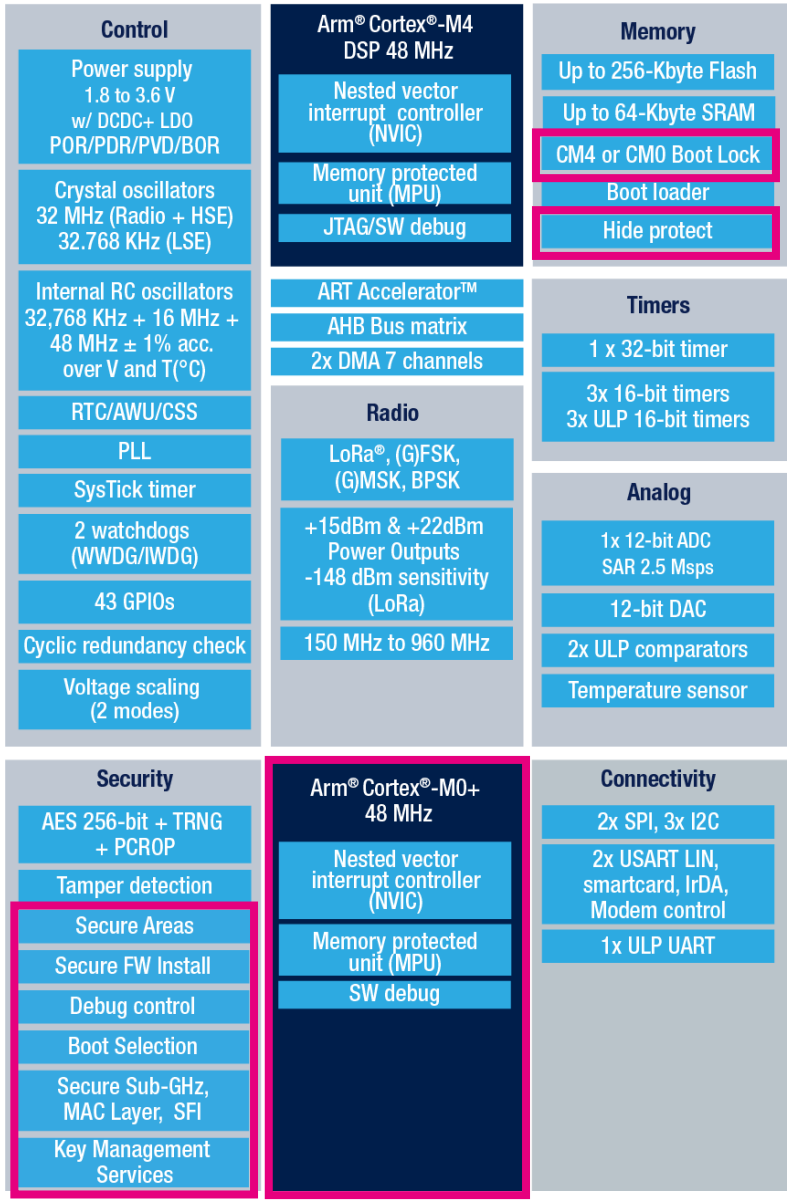
STM32WL5x Line - a rich feature set
Dual-core and enhanced security



KEY FEATURES

- Arm® Cortex®-M4 & DSP up to 48 MHz
- Up to 256 KB Flash and 64 KB SRAM
- Arm® Cortex®-M0+ up to 48 MHz

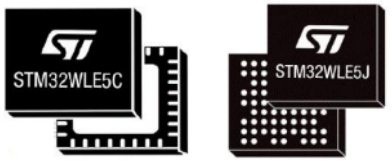
- **Sub-GHz Radio**
  - Multi-modulation: LoRa, (G)FSK, (G)MSK, BPSK
  - 2 embedded power amplifiers:
    - 1 output up to +15 dBm
    - 1 output up to +22 dBm
  - LoRa RX sensitivity: -148 dBm (SF12, BW=10.4kHz)
  - RX: 4.82mA and TX: 15mA (at 10dBm) / 87mA (at 20dBm) [3.3V]

- **Ultra-Low Power consumption**
  - < 71µA/MHz Active mode (3V - RF OFF)
  - 1 µA Stop2 mode with RAM retention
  - 390 nA Standby mode with RTC
  - 31 nA Shutdown mode

- **Peripherals**
  - 3xI²C, 2xUSART, 1xLP-UART, 2xSPI
  - 7x timers + 2x ULP Comparators

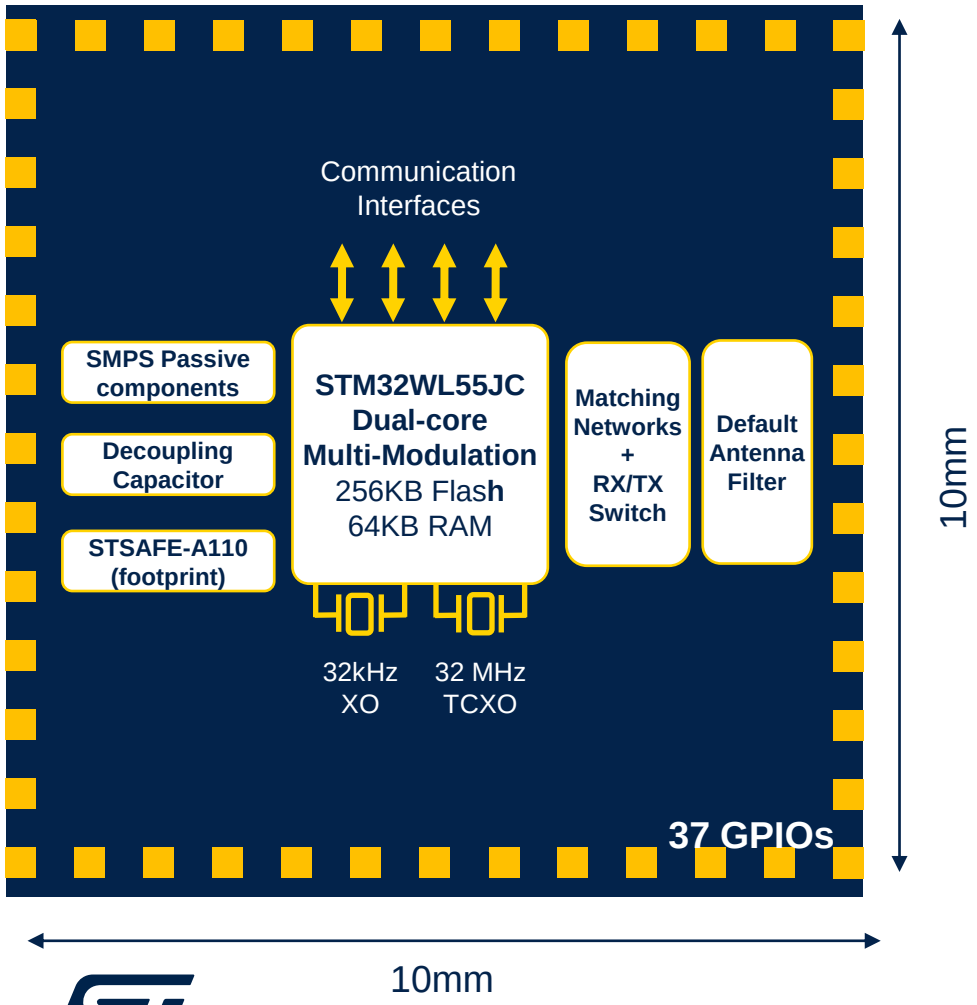
- **Advanced security features**

- 1.8 to 3.6V voltage range (DC/DC, LDO)
- -40 to up to +105°C temperature range



-> Packages: QFN48, BGA73

STM32WL5M: Key takeaways



- **Open Module** (AT commands firmware available)
- **HF bands:** 864 to 928MHz
- **Selectable PA** : low power (up 15 dBm) / high power (up 22 dBm)
- **External Antenna**
- **Full BOM integrated**: Crystals, Decoupling, Matching, Filters
- **Allows 2 layers PCB**
- **Tiny form factor: 10x10mm** with 0.5mm pitch
- Operating range: -40°C to -85°C / 1.8V to 3.6V
- STSAFE internal footprint

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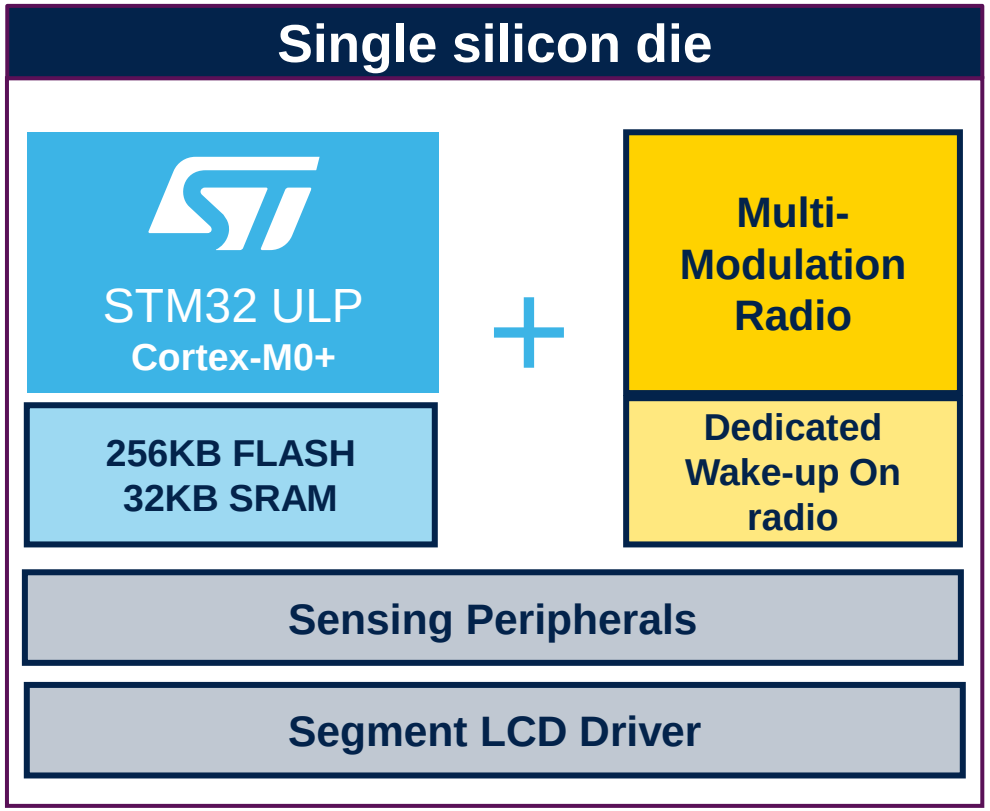
STM32WL3 New Sub-1GHz SoC

Unique wireless SoC combining multi-protocol Sub-GHz radio and application features

PACKAGE
QFN48 6x6mm
QFN32 5x5mm



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STM32WL

STM32WL3 key features

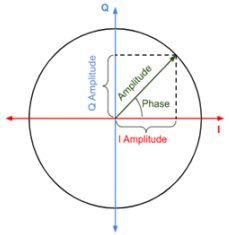
Wide Sub-1 Ghz protocols support

STM32WL3 RF System-On-Chip

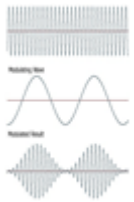
ARM
Cortex M0+
64 MHz

Direct radio access

IQ sample interface



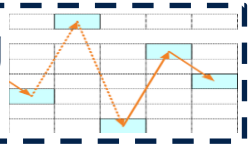
OOK
ASK
2-(G)FSK
4-(G)FSK
DBPSK
DSSS



Ultra flexible packet handler

+20dBm Tx output power

Frequency hopping



sigfox

M-Bus wireless

mioty

LoWPAN

KNX RF

802.15.4g

Wi SUN

Proprietary protocols :
- Alarms
- Smart Home
- Building automation
- Industrial monitoring

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Extended battery life: Ultra low power Radio

Best Efficiency Sub-GHz Radio

Two radios One single chip

Dedicated ultra-low-power Wideband wake-up radio

Main radio
RX current (LPM): 5.6 mA*
TX current (10dBm): 9 mA*

With autonomous sequencer
sniff-mode, frequency hopping,
low duty-cycle mode,
listen before talk (LBT).

Zzzz

CPU

autonomous radio management

4.2µA **always on** receiver
(100MHz – 2.4GHz)
RX OOK @ -50dBm

Fully autonomous radio
for proximity detection tracking
Pass through factory application
Drive by metering application

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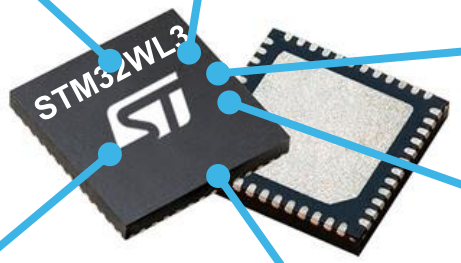
* Including SoC core consumption (in WFI mode)

STM32WL

STM32WL3 key features

Reliable and efficient system architecture



Cortex-M0+ and Radio

Single Core architecture.
Efficient architecture with CM0+ driving both application and Sub-1 Ghz protocols

Up to 256kB flash

Scalable flash memory size

1kB OTP

Store ID, Keys and calibration data

DMA

DMA controller with 8 channels

Internal buses (AHB & APB)

Peripherals - including Sub-1 Ghz Radio IPs - interfaced with internal buses to enable **concurrent** accesses

2 x 16kB SRAM banks

Up to 32kB – selectable retention to optimize low-power figures

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STM32WL

STM32WL3 key features

STM32WL3 Peripheral and timers

Timers

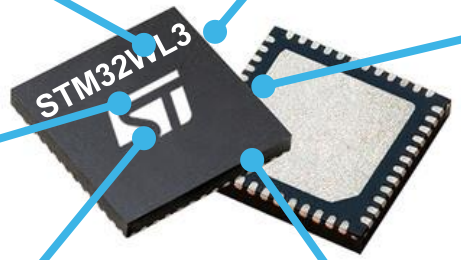
- 2 general purpose timers (16-bit)
  - 4+1 PWMs
- Watchdog timer
- RTC
- 3 specific Sub-1 Ghz IP timers (LP timer)

Standard peripherals

- 2 x SPI
- 2 x I2C
- I2S
- (LP)UART

Analog comparator and DAC

- Analog comparator
- 6-bit DAC (threshold)



security

- AES-128 HW block
- Secure bootloader

Analog LC sensor

- Dedicated for flow metering
- Water and Heat Meters

12-bit ADC

- 1Msps frequency
- Single-ended (8Ch) & differential (4Ch)
- Temperature and battery level

Up to 20-pin LCD driver

- Up to 16 Segments / up to 8 COM
  - 16 Seg x 4 COM or 12 Seg x 8 COM maximum
- Static, ½, ¼, 1/8 duty
- Static, ½, ¼ bias
- Double buffer memory

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STM32WL3x resources

Single Cortex-M0+ Core

Ultra flexible and low-power radio

- ✓ 7mA Tx @ +10dBm / 4mA Rx
- ✓ +20dBm max output power
- ✓ Proximity detection radio (4µA)

Memory

- ✓ Up to 256kB flash + 1kB OTP
- ✓ 16/32kB RAM

peripherals

- ✓ SPIs, I2Cs, I2S, USART, LPUART
- ✓ 20-pin LCD driver
- ✓ LC-sensor IP, Analog comparator

Control

Power supply from 1.7 to 3.6v with DCDC

Crystal oscillators
48MHz (Radio + HSE)
32.768 kHz (LSE)
Internal 32kHz RCO

Crystal oscillators
48MHz (Radio + HSE)
32.768 kHz (LSE)
Internal 32kHz RCO

Internal buses

AHB Bus Matrix
Direct radio register access

DMA 8 channels

Timers

2 16-bit GP timers + 16-bit prescalers, SysTick, RTC, PWMs

Watchdog

Arm® Cortex®-M0+ Up to 64MHz

Nested vector interrupt controller (NVIC)

Memory protection unit (MPU)

SWD interface

Low-power Radio

7mA @ +10dBm Tx
4mA Rx

2-(G)FSK, (G)MSK, 4-(G)MSK, OOK, ASK, DSSS, DBPSK

Up to +20dBm Tx power
-111dBm Rx sensitivity @ 38,4kbps

413-479MHz, 826-958MHz
169MHz*

16-bit IQ access

2nd Radio for proximity detection

Memory

64/128/256kB flash

16/32kB RAM

1kB OTP

ROM secure bootloader

Peripherals

2 x SPI, 2 x I2C, I2S, USART, LPUART

20-pin LCD driver

Up to 32 GPIOs

Analog

12-bit ADC SAR 1Msps

Analog comparator + DAC

3 LC-sensor channels

Temperature sensor

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2.4Ghz portfolio

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2.4GHz Bluetooth LE & Multiprotocol portfolio

STM32WB

Dual core Arm® Cortex® M4 / M0+ & security
- Bluetooth® Low Energy 5.4 (2Mbps), Zigbee, Thread, Proprietary
- Multiprotocol, Matter

STM32WB55 / STM32WB50
- Up to 1Mbytes flash
- Up to 256Kbytes RAM
- USB, LCD Driver, Quad-SPI

STM32WB35 / STM32WB30
- 512KB flash
- 96kB RAM
- USB, LCD Driver, Quad-SPI

STM32WB15 / STM32WB10
- 320 Kbytes flash
- 48Kbytes RAM

excluding 802.15.4

STM32WBA

Arm® Cortex® M33 w/ TrustZone® @100MHz
- Bluetooth® Low Energy 5.4 (long-range, 2Mbps, adverting extension), Zigbee, Thread, Proprietary
- Multiprotocol, Matter (gateway)

- Up to 1Mbytes flash
- Up to 128Kbytes RAM
- Up to +10dBm output power
- **Enhanced security**
- SMPS/ LDO

BlueNRG

Single core Arm® Cortex® M0 @32MHz or M0+ @64MHz
- Bluetooth® Low Energy

BlueNRG-1*
- 160Kbytes flash
- 24Kbytes RAM
- Bluetooth® Low Energy 5.2

BlueNRG-2*
- 256Kbytes flash
- 24Kbytes RAM
- Bluetooth® Low Energy 5.2

BlueNRG-LP
- 256Kbytes flash
- 64Kbytes RAM
- Bluetooth® Low Energy 5.3, (long-range, 2Mbps, adv. ext.)

BlueNRG-LPS
- 192Kbytes flash
- 24Kbytes RAM
- Bluetooth® Low Energy 5.3 (long-range, 2Mbps, adv. ext., AoA/AoD)

STM32WB09
- 512Kbytes flash
- 64Kbytes RAM
- Bluetooth® Low Energy 5.3 (long-range, 2Mbps, adv. ext., AoA/AoD, Isochronous Ch.)
- up to 8dBm out put power

*: Arm® Cortex® M0

Module available

New Product in 2023

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Product positioning

High processing
Enhanced security
High RF Power

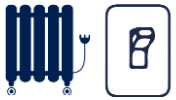
Multi-protocol
Dual core
Reach feature set

Dual core
Simple application

Single core

Tiny app

Network processor



PERFORMANCE

$

STM32WBA52
QFN48

STM32WB55/35
UFBGA129, WLCSP100, VQFN68, UQFN48, Module

STM32WB50/30
UQFN48

STM32WB15
UQFN48, WLCSP49, Module

STM32WB10
UQFN48

STM32WB09
QFN32, WLCSP36

BlueNRG-LP
QFN48/32, WLCSP49

BlueNRG-LPS
QFN32, WLCSP36

BlueNRG-2
QFN32, QFN48, WLCSP34

BlueNRG-1
QFN32, WLCSP34

BlueNRG-2N
QFN32, WLCSP34

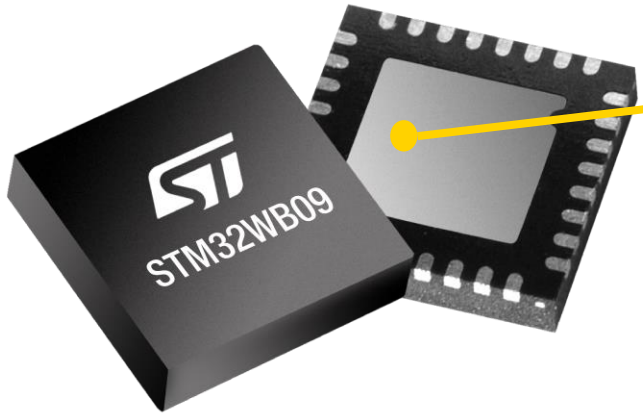
High-end applications — **Entry level applications**

New Product in 2023

What the STM32WB0 MCU series offers

Wireless performance
in a compact, energy-efficient design

5.3



High wireless performance

- System performance: Arm® Cortex® -M0+ core at 64 MHz
- Best-in-class radio enabling robust and stable connectivity

Certified for Bluetooth® Low Energy 5.3

- Upgradable, highly modular and robust Bluetooth® Low Energy stack, developed and maintained by ST

Longer battery life for IoT devices

- State-of-the-art radio efficiency (3.9 mA TX peak current / 3.2 mA RX peak current)
- Power control options, 15.5 µA/MHz for the Cortex® -M0+ core

Lower costs

- Affordable price point
- High integration in tiny packages (balun, capacitor-less 32 MHz crystal) and enables 2-layer PCBs for reduced BOM and simplified circuitry

Streamlined development

- Extensive wireless design ecosystem with hardware (RF reference designs, IPD chip for easy impedance matching), Bluetooth® Low Energy and Mesh stacks, tools, and resources

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STM32WB09 – key highlights

Bluetooth® Low Energy 5.3 certified

Radio performance

- RX Sensitivity level
  - **-97 dBm at** 1 Mbps
  - **-104 dBm at** 125 Kbps
- Up to **+8 dBm** output power level
- **3.9 mA** TX peak current
- **3.2 mA** RX peak current
- Fast data transfer: **2 Mbps** data rate
- Distance Robustness: long-range 125 kbps or 500 kbps
- **Advertisement Extension**: 255 bytes advertising data, advertising data set and periodic advertising sync transfer
- **AoA/AoD direction finding**
- **Isochronous channels**

Reduced BOM cost

- Integrated balun
- Integrated capacitor-less 32 MHz crystal
- High accuracy low speed internal oscillator
- Enables 2-layer PCB designs

Advanced security set

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

Power management

High efficiency embedded SMPS step-down converter with intelligent bypass mode

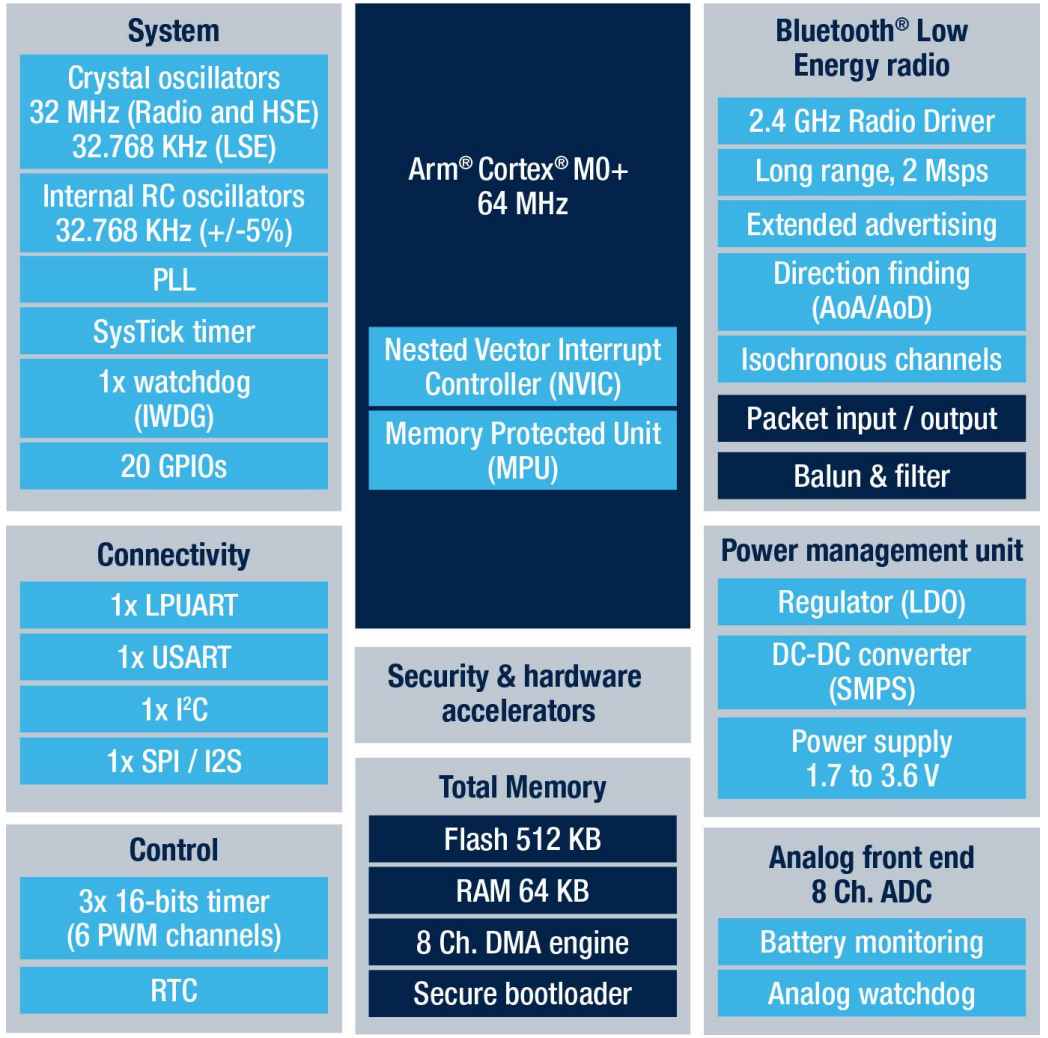
Operating temperature:

From -40 up to 85 °C / **-40 up to 105 °C**

Packages available:

QFN32 (20 GPIOs)

Available soon: WLCSP36* (20 GPIOs)



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2.4GHz Module Offering

BlueNRG-M0L
BlueNRG-M0A

Based on **BlueNRG-MS**
- BLE4.2 certification
- 64KB Flash / 12KB RAM
- DCDC
- +8dBm
- 2 layers PCB
- Size: 11.5 x 13.5mm
- CE, FCC, IC , TYPE, BQE, WPC

STM32WB5M

matter

Based on **STM32WB55VGY**
- **World 1st STM32 2.4 GHz SIP**
- Dual-Core
- All-in-one BLE 5.4, Zigbee 3.0, OpenThread 1.3
- MATTER Ready
- 1MB Flash / 256KB SRAM
- 2 layers PCB, crystal included
- Size: 11x7.3mm
- FCC, CE, NCC, JRF, KC, SRRC, ISED, GOST

BlueNRG-M2SA
BlueNRG-M2SP

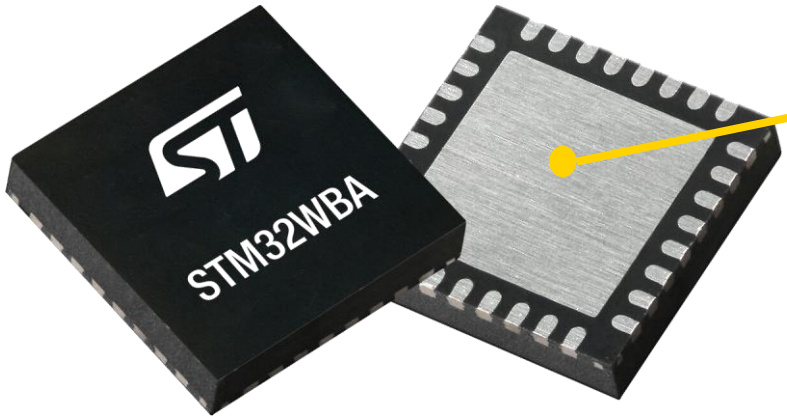
Based on **BlueNRG-2**
- BLE5.2 certification
- 256KB Flash / 24KB RAM
- DCDC
- +8dBm
- Up to 14 GPIOs
- CE, FCC,IC ,TYPE, BQE, WPC, SRRC, KCC

STM32WB1M

Based on **STM32WB15CCY**
- Tiny SIP form factor - Cost affordable
- Dual-Core
- BLE 5.4, Built-in FUS
- 320KB Flash, 48KB SRAM
- 2 layers PCB, crystal included
- Size: 10x6.5mm
- Possibility to connect to external antenna
- FCC, CE, NCC, JRF, KC, SRRC, ISED, GOST

STM32WBA5x an ultralow power Bluetooth® Low Energy 5.4 platform

Bluetooth Low Energy 5.4



Built using **40nm process technology**

Integrated 2.4GHz radio

Bluetooth® Low Energy 5.4 (long range, 2Msps, advertising extension)
+10 dBm output power

High performance

- Arm® Cortex®-M33 at 100MHz
- 407 CoreMark score
- 100 K cycles for 256 Kbytes of Flash

Enhanced security

- TrustZone® technology, **target SESIP Level 3**

Leveraging STM32U5 ultra-low-power platform

- Low-power direct memory access (LP-DMA)
- Flexible power-saving states with fast wake-up times
- Same digital and analog peripherals

STM32WBA52x
Product ID card & block diagram

Flash memory size / RAM size (bytes)

1 M / 128 K — STM32WBA52CG

512 K / 96 K — STM32WBA52CE

Pin count

UFQFPN 48
7 x 7 mm
p: 0.5mm

LONGEVITY 10 YEARS COMMITMENT

Control
- Power supply 1.71V to 3.6V (LDO) POR/PDR/PVD/BOR
- Crystal oscillators 32MHz (radio and HSE) 32,768KHz (LSE)
- RTC / AWU / CSS
- PLL / FLL
- SysTick timer
- 2 watchdogs (WWDG / IWDG)
- 35 GPIOs
- Cyclic redundancy check
- Voltage scaling (2 modes)

Security
- HUK, AES 256-bit, HASH, PKA, TRNG, SHA-1/2, SBSFU, SKS

Arm® Cortex® -M33 FPU/DSP 100 MHz + TrustZone®
- Nested vector interrupt controller (NVIC)
- Memory protected unit (MPU)
- JTAG / SW debug

- ART Accelerator™
- AHB bus matrix
- 1x GPDMA

Radio protocol
- **Bluetooth® Low Energy 5.4**
- Long Range / Ext Adv / 2Msps
- Flexible Master/Slave setting

- 48 pins (UFQFPN)

Total memory
- **Up to 1 Mbyte flash**
- **Up to 128 Kbytes SRAM**
- Secure bootloader

Connectivity
- 2x SPI, 2x I²C
- 2x USART

Control
- 1x 32-bit timer
- 4x 16-bit timer (1xMotor control)
- 2x 16-bit timer (ULP)

Analog
- 1x 12-bit ADC SAR 2Msps

Sensing
- Capacitive touch

Side attack resistant
Active antitamper

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Stronger security

Extensive functionality to protect your assets

Memory protections
against illegal access control

OTP, **HDP,** WRP, MPU
Secure Debug
Active Tamper, 4 pairs & V/T

Cryptography
for hardware robustness

Side channel AES, PKA
Additional AES, SHA, TRNG,
HUK (Hardware Unique key)

Platform protection
during product lifecycle

RDP: 4 protection level states
Password based regression

Code isolation
for runtime protection

4 isolation stages
Arm® TrustZone® technology

Security services

STM32Trust **TEE TF-M**

Secure boot & secure updates

Secure firmware install

NIST - CAVP certified CryptoLib

State-of-the-art security assurance level

target certifications

SESIP™3

psacertified™ level three

Note: New features for STM32**WBA** are highlighted in **bold**

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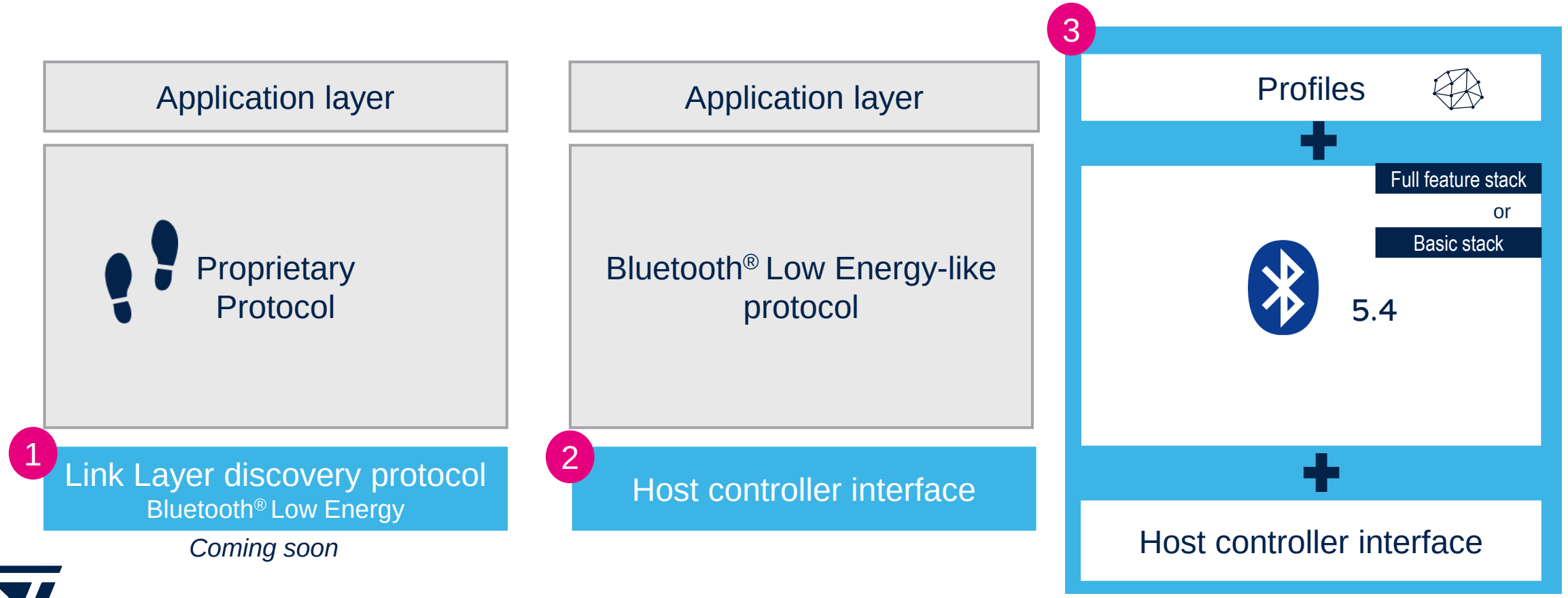
STM32WBA5x a versatile product

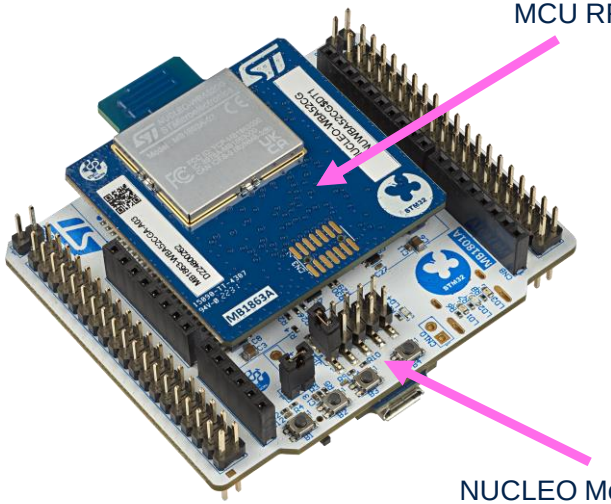
Make it yours

Different levels of integration so you can customize your solution



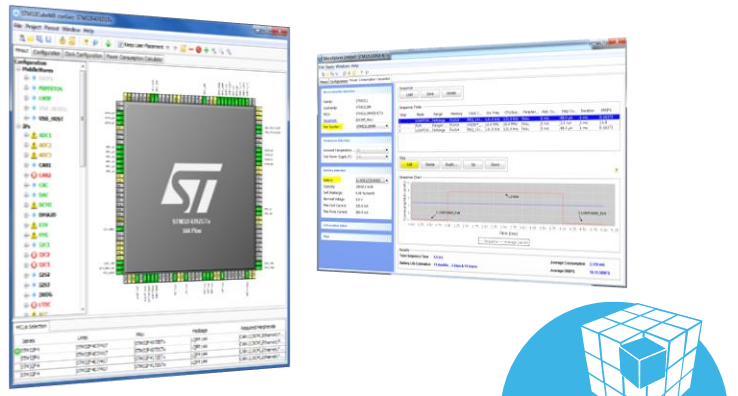
Available in STM32CubeWBA

STM32WBA ecosystem simplifies the design journey



Hardware
STM32 Nucleo board

STM32**WBA**



STM32CubeWBA
(connectivity + examples + peripherals)
STM32CubeMX / STM32CubeIDE
(code generation + power calculation)
STM32CubeMonRF
STM32CubeProg

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Free of Charge

Your wireless journey and how **We** can help

Support you to make the right choice

Make sure your choice was the right one

- Training
- Benchmark
- Datasheet review

- Eval kit bring-up
- Performance review

- Schematic review
- Layout review
- Software porting
- 1st PCB bring-up
- 1st RF test report
- Debugging

- Regional RF test report
- Protocol RF tests
- Corner case debugging
- Certification process guidance

- RF Production tooling
- Ramp-up support

Don’t wait too long to ask for any support.
The sooner the better!!

Please contact: ST MCU Marketing or FAE to get in touch with our RF lab services

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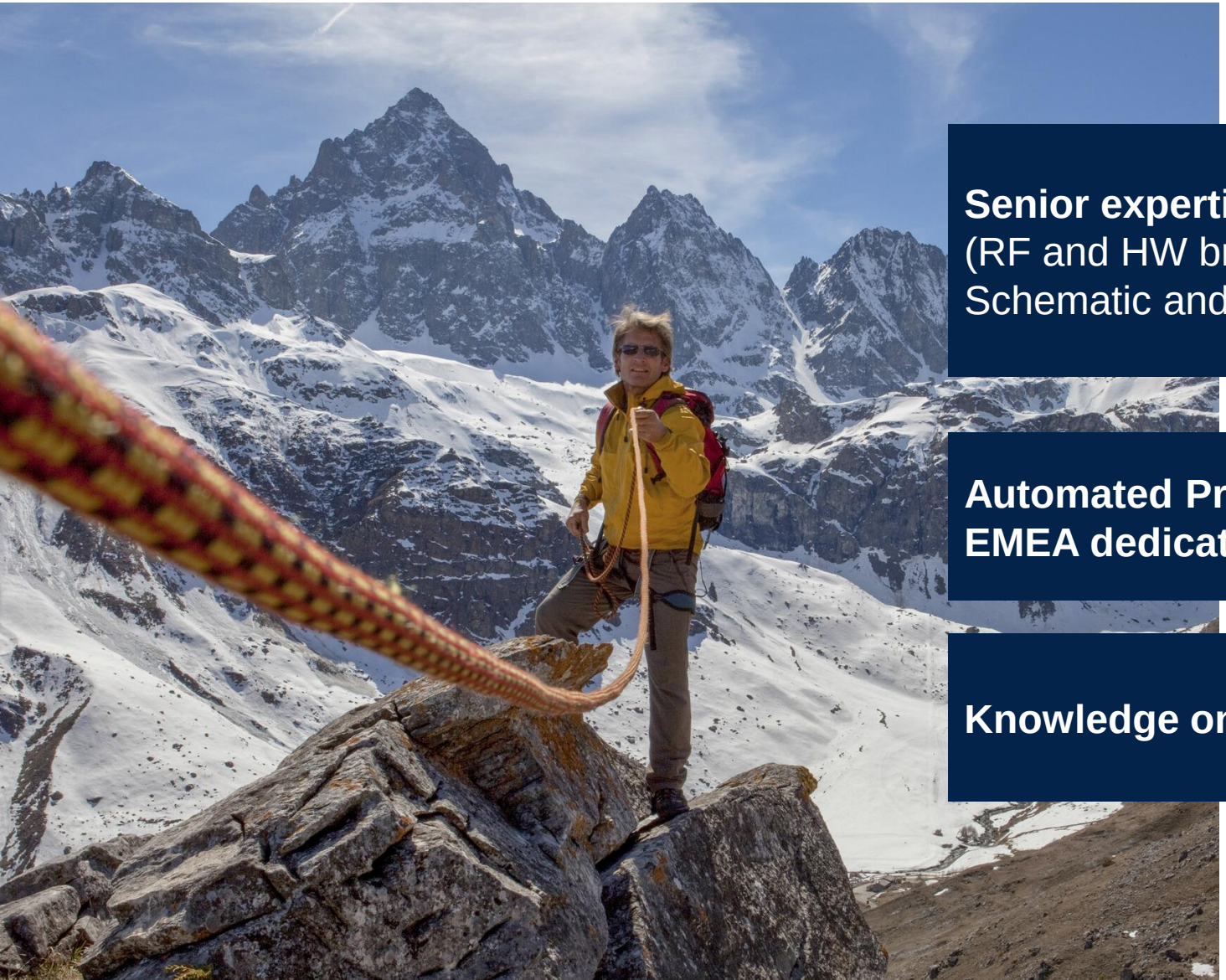
What you can expect from our wireless support team



Senior expertise in wireless communication
(RF and HW bring-up services, SW and HW debugging, Schematic and layout review)

Automated Pre-certification capabilities
EMEA dedicated application labs

Knowledge on your application

... in a fast and agile way

STM32WBA deep dive - WORK SHOP HERE on JAN 23th

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Let’s HANDS ON now !

Manuel Marcias FAE

Our technology starts with You

Find out more at www.st.com

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