STM32WB series MCU built-in Bluetooth® LE 5.2 and IEEE 802.15.4
Make the choice of STM32WB series
the 7 keys points to make the difference

- Open 2.4 GHz radio Multi-protocol
- Dual-core / Full control Ultra-low-power
- IoT Protection ready
- Massive integration Cost saving
- 1MB Flash
- 1.7 V 48-pin
- 3.6 V 129-pin
- 256KB Flash
- A large offer
- Advanced RF tool, Energy control with C code generation
- No matter what!

Features set depending on STM32WB reference
Multiprotocol and open radio

- Fully certified Bluetooth® LE 5.2 radio
- 2x faster speed with 2 Mbps capable mode
- Extend network coverage with Bluetooth Mesh

- Last IEEE 802.15.4 standard ready
- OpenThread, Zigbee 3.0
- Bluetooth 5.2 and 802.15.4 protocols in Static and Dynamic concurrent mode

- Proprietary protocol capable (Bluetooth Low Energy like or 802.15.4)
- Best-in-class RF with up to +6dBm output power and 102 dB link budget
- Energy sensitive application with only 4.5mA in RX and 5.2mA in TX (@ 0dBm)
- BOM cost reduction thanks to Integrated balun
**ZCL 3.0**

**IEEE 802.15.4 MAC**

**2.4 GHz Radio**
- +6 dBm output
- -100 dBm sensitivity (802.15.4)
- -96 dBm sensitivity (Bluetooth LE @ 1 Mbps)

**Profiles**
- **Proprietary protocol**
- **Bluetooth like**
- **LLD BLE**
- **HCI**
- **PRO**
- **PRO**
- **LLD 802.15.4**

**Make it yours**

**Proprietary**

**Bluetooth**
- **5.2**
- **zigbee PRO**

**Antenna**
Simplicity of development

2 independent cores for real-time execution

**Mono-core**

- CPU - x
- Application Firmware + Peripherals + Radio stack

**Drawbacks**
- Time sharing
- Longer processing time – Greedy current consumption
- Need companion MCU (increased cost)

**STM32WB**

- Arm® Cortex®-M4
  - Application Firmware + Peripherals
- Arm® Cortex®-M0+
  - Radio Stack

**Benefits**
- SOC solution (1 single die)
- Full flexibility - Easy development – User experience
- Increase battery life
- All-in-1 solution - cost saving
- Speed up time to market
- Easy certification process
Rich feature set for STM32WB55

KEY FEATURES

2 independent cores for real time execution

Ultra-low-power consumption
- 50 µA/MHz Active mode (at 3.0 V)
- 2.1 µA Stop mode (Radio in standby + 256 KB RAM)
- < 50 nA Shutdown mode

Peripherals
- 2xI²C, 1xUSART, 1xLP-UART, 2xSPI, 1x USB 2.0 FS device supporting Battery Charging Detection, 1xSAI, Quad-SPI (XIP), 6x 16-bit timer (including LPWM and low-power one)

1.7 to 3.6 V voltage range (DC/DC, LDO)

-40°C to +105°C temperature range
<table>
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<tr>
<th>Featured product</th>
<th>Connectivity</th>
<th>Memory</th>
<th>Output power range (dBm)</th>
<th>Main peripherals</th>
<th>MCU Arm® Core</th>
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<td>-20 to +4 USB 2.0 FS ADC 16bits</td>
<td>Cortex®-M4/M0+</td>
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<td>STM32WB30</td>
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<td>Cortex®-M4/M0+</td>
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<td>STM32WB10</td>
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<td>Cortex®-M4/M0+</td>
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<tr>
<td>STM32WB55</td>
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<td>Cortex®-M4/M0+</td>
<td>37, 30</td>
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<td>STM32WB50M</td>
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<td>128</td>
<td>-20 to +4 USB 2.0 FS ADC 16bits</td>
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<tr>
<td>STM32WB30M</td>
<td>1 Mbps</td>
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<td>-20 to +4 ADC 16bits</td>
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<td>30</td>
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<tr>
<td>STM32WB10M</td>
<td>1 Mbps</td>
<td></td>
<td>48</td>
<td>-20 to +4 Touch sensing ADC 12bits Comparator</td>
<td>Cortex®-M4/M0+</td>
<td>30</td>
<td>UQFN48</td>
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<td>STM32WB5M</td>
<td>2 Mbps</td>
<td>Zipbee 3.0</td>
<td>1024</td>
<td>-20 to +6 Touch sensing USB 2.0 FS LCD driver</td>
<td>Cortex®-M4/M0+</td>
<td>68</td>
<td>LGA86</td>
</tr>
</tbody>
</table>

* Available in Q3 2021
Benefit of dual cores processing

1. Independent Radio activity
   - Uploading data to mesh network or smartphone
   - OTA of Radio protocol stack or application FW
   - Running on Arm Cortex-M0+

2. Energy saving mode
   - RAM + RTC running @ 2.1μA
   - Fast wake up @ 5μs

3. Main application activity
   - Computing data (sensor fusion …)
   - Flexible Arm Cortex-M4 CPU speed up to 64 MHz
   - Batch Acquisition Mode (BAM) with CPU & Flash turned off

4. Dual CPU activity
   - 50μA/MHz only!
   - Both Radio and Application running independently

5. Super saving mode
   - Shutdown < 50 nA
   - Battery energy saving
All in one MCU full flexibility control

Robust RF link -100dBm sensitivity with IEEE 802.15.4 and +6 dBm output power
Upgrade legacy 802.15.4 device to Bluetooth LE 5.2
Update securely Radio and stack firmware with build-in FUS
Bluetooth 5 and 802.15.4 protocols Mesh capable to extend network range

• Retrofit legacy product to Bluetooth LE 5.2 and concurrency mode
• Remotely upgrade device with OTA capability
• Brand protection with Authenticated FW upgrade system

Up to 105°C radio capable
External PA support to get ultra wide communication distance
Down to 600 nA mode with RTC and 32KB of RAM
Only 5µs wakeup time over 16 wakeup lines
PCROP, ECC, TRNG, PKA, for best design robustness
Reduce BOM cost with built-in LCD booster

• Multipoint Bluetooth LE 5.2 connections
• Small form factor design with CSP100 pins
• Battery lifetime care with < 50 nA Shutdown mode
• Dynamic Efficient 50 µA/MHz
• Extend memory storage with Quad-SPI
• Handle advanced algorithm with 1 Mbyte of Flash
• Cost optimized product with USB 2.0 crystal-less device

Beacon profile available among a huge list
Embedded balun to minimize design cost
Only 5.2mA Radio TX current to extend beacon lifetime
Up to +6 dBm output power to get best beacon range
< 2.1 µA Stop mode with full RAM for battery life optimization
Down to 1.71 full feature capable

• -100 dBm sensitivity to increase area coverage
• Customer Key Storage (CKS) for trustable Application update
• Manage full duplex audio with embedded SAI
• USB FS 2.0 with Battery Charging Detection for remote device

Lighting
Fleet maintenance
Industrial devices
Fitness/Healthcare
Beaconing
Home security and Audio
IoT protection ready (1/2)
radio stack and/or application FW update

1. New FW package received
2. New FW detected
   Update is launched
3. App Processor send New FW package signature and encryption key for authentication
4. Authentication signature matches preprogrammed key
   Case not, the process is aborted and device resets
5. New FW package is decrypted with proprietary Key. Device upload on going.
### IoT protection ready (2/2)

**STM32WB counter measure against attacks**

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<th>Attacks</th>
<th>Attack's description</th>
<th>STM32WB Countermeasures</th>
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<td><strong>Non-Invasive</strong></td>
<td>• Environment modification</td>
<td>• Temperature sensor</td>
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<tr>
<td><strong>Attacks</strong></td>
<td>• Temperature</td>
<td>• Power supply integrity monitor</td>
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<tr>
<td></td>
<td>• Voltage</td>
<td>• Clock security system</td>
</tr>
<tr>
<td></td>
<td>• Clock ….</td>
<td>• Tamper pads</td>
</tr>
<tr>
<td>MCU</td>
<td>• Fault injection (glitches…)</td>
<td>• Memory ECC, Parity check</td>
</tr>
<tr>
<td></td>
<td>• Exploit debug features</td>
<td>• RTC alarm, registers, SRAM mass erase</td>
</tr>
<tr>
<td></td>
<td>• Side channel, power Analysis, …</td>
<td>• JTAG Read out protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• BOOT from Flash only</td>
</tr>
<tr>
<td><strong>Software</strong></td>
<td>• Low Authentication / Encryption</td>
<td>• Customer Key Storage (CKS)</td>
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<tr>
<td><strong>Attacks</strong></td>
<td>• Extract keys</td>
<td>• RNG, Crypto accelerator, CRC</td>
</tr>
<tr>
<td></td>
<td>• Exploitation of applicative test features</td>
<td>• Write memory protection</td>
</tr>
<tr>
<td></td>
<td>• Malware / Virus</td>
<td>• Read Out memory protection</td>
</tr>
<tr>
<td></td>
<td>• Replay, privilege escalation</td>
<td>• Memory Protection Unit (MPU)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Firmware Upgrade Service (FUS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Secure Firmware Update (SFU)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Proprietary Code Read-Out Protection (PCROP)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 96-bit ID</td>
</tr>
</tbody>
</table>
Massive cost saving

The more feature integration, the more the BOM drops down!

Silicon cost
- RF balun cost: Embedded
- External components: 7
- 32 kHz Master clock output available
- Crystal for USB 2.0 FS operation: embedded
- LCD display booster: embedded (only single glass)
- Capacitive touch controller: embedded
- PCB cost: 2 layers PCB only

Free of charge Ecosystem
- Bluetooth LE™ 5.2 stack
- Zigbee 3.0 stack
- OpenThread stack
- Generic 802.15.4 MAC
- Generic HCI drivers
- STM32CubeMX
- STM32CubeMonRF
- IDEs (AC6: SW4STM32; ST: STM32CubeIDE)
- Bluetooth LE and 802.15.4 concurrency avoids to use a second radio MCU
STM32WB - a large offer

Bluetooth LE 5.2, OpenThread, Zigbee 3.0 and proprietary protocol capable
STM32WB value lines

Essentials features product targeting entry-level Bluetooth® LE 5.2 and Mesh applications

- Protocol flavors*
  - Zigbee
  - Bluetooth

- Dual Core

- Full speed
  - 64 MHz

- 7x7mm

- +4 dBm
-96 dBm

- -10; +85°C

- 1MB Flash 128KB RAM
  - WB50

- 512KB Flash 96KB RAM
  - WB30

- 320KB Flash 48KB RAM
  - WB10

* Zigbee and Thread not available on STM32WB10
STM32WB50 / STM32WB30 / STM32WB10 positioning

Radio standard
- Bluetooth LE, 802.15.4
  - Concurrent

RAM memory (bytes)
- From 48 to 256K
- From 48 to 128K
- From 256K to 1M

Flash memory (bytes)
- From 256K to 1M
- -40;+105

Temperature range (°C)

Sensitivity (dBm)
- -10;+85
- 1.7
- 2

Max Output Power (dBm)
- +6

Supply mode
- DCDC + LDO
- LDO

Security
- AES 128/256

Bluetooth data rate (bps)
- 2M
- 1M

Legend
- STM32WB50 / STM32WB30 / STM32WB10*
- STM32WB55 / STM32WB35 / STM32WB15*

* Run with Bluetooth LE only
### STM32WB5M Module

#### Control
- Power supply: 1.8 to 3.6 V w/ DC/DC + POR/PDR/PVD/BOR
- Xtal oscillators: 32 MHz (RF) 32.769 kHz (LSE)
- Internal RC oscillators: 32 kHz + 48 MHz 16 MHz (HSI) + 48 MHz ± 1% acc. over V and T(°C)
- RTC/AWU/CSS
- PLL/FLL
- SysTick timer
- 2 watchdogs (WWDG/WDG)
- Up to 68 GP1O
- Cyclic redundancy check
- Voltage scaling (2 modes)

### Analog
- 2 x ULP comparators
- 1 x 12-bit ADC
- SAR 4.25 Msps
- Temperature sensor

### Arm® Cortex®-M4
- ARM® Cortex®-M4 FPU/DSP 64 MHz
- Nested vector interrupt controller (NVIC)
- Memory protected unit (MPU)
- JTAG/SW debug

### ART Accelerator™
- AHB Bus matrix
- 2 x DMA 7 channels

### Multi-protocol RF stack
- Bluetooth™ 5
- IEEE 802.15.4
- AES

### Arm® Cortex®-M0+
- 32 MHz
- Nested vector interrupt controller (NVIC)

### Memory
- 1-Mbyte Flash memory
- 256-Kbyte SRAM
- Boot ROM
- Secure boot loader

### Connectivity
- 2 x SPI, 2 x I2C
- 1 x USART, LIN, Smartcard, I2DA
- Modem control
- 1 x ULP UART
- USB 2.0 FS - Xtal less
- Quad-SPI (XIP)
- SAI (full duplex)

### Timers
- 4 x 16-bit 32-bit timers
- 2 x ULP 16-bit timers

### Sensing
- 16-key capacitive touch

### Encryption/security
- 256-bit AES/PKA
- TRNG/PCROP
- FUSE/CSK

### Display
- 8 x 40 LCD driver

---

**STM32WB5MMG**

**Flash memory / RAM size (bytes)**
- 1 M / 256 K

**Pin count**
- 86-pin LGA (0.435 mm pitch)

---

16
STM32WB5M multi-protocol module

Small form factor
- 7.3x11 mm
- Full ref design up to antenna, crystals

Reduce the cost
- Down to 2 PCB layers
- Everything inside (single cap outside)
- Free of charge radio stack
- Certified FCC, CE, NCC, JRF, KC, SRRC, ISED, GOST

Multi-protocols
- Bluetooth
- OpenThread
- zigbee
- + Concurrent modes & Proprietary 2.4GHz

Strong feature set
- Dual-core based
- 1MB Flash/256KB RAM
- LCD, USB FS, ADC, COMP
- Security
- OTA (application, radio)

Discovery kit

STM32 ecosystem

RPN: STM32WB5MMGH6TR
Prototyping made as easy as 1,2,3

**STM32WB**

- STM32CubeMX/STM32CubeWB/
- STM32CubeProg & STM32CubeMonitor
  - Code generation
  - Power calculation

**Hardware**
- Evaluation Pack, Nucleo-64 board,
- Discovery Kit

- P-NUCLEO-WB55
- NUCLEO-WB55RG
- NUCLEO-WB15CC
- STM32WB5MM-DK

STM32CubeMX/STM32CubeWB/
STM32CubeProg & STM32CubeMonitor
- Code generation
- Power calculation
Software development tools

A complete flow, from configuration up to monitoring

STM32CubeMX, GUI Builders
Configure & Generate Code

STM32CubeProg/Monitor
Monitor, Program & Utilities

More to come after mass market launch

ST and Partner IDEs
Compile and Debug
IPD - MLPF-WB-0xE3

Harmonic filter with integrated impedance matching

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<td><strong>STM32WB</strong></td>
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<tr>
<td>Arm Cortex-M4</td>
</tr>
<tr>
<td>Application firmware + Peripherals</td>
</tr>
<tr>
<td>Arm Cortex-M0+</td>
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<td>Radio Stack</td>
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<table>
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<tr>
<th><strong>MLPF-WB-0xE3</strong></th>
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<tr>
<td>Integrated STM32WB <strong>impedance matching</strong></td>
</tr>
<tr>
<td>Deep rejection <strong>harmonic filter</strong></td>
</tr>
</tbody>
</table>
• Exercise wireless features of STM32WB
  • Bluetooth Low Energy commands
  • Bluetooth LE RF tests
  • send OpenThread commands
  • perform 802.15.4 RF tests, sniff RF activity

• DUT - Nucleo, USB dongle or customer boards.
• USB or UART to Virtual Com Port

STM32CubeMonRF

www.st.com/stm32CubeMonRF
Advanced functionalities

Audio - Voice & streaming
Full-duplex audio streaming over Bluetooth LE 5.2 using Opus codec
STM32Cube function pack for STM32WB MCU: FP-AUD-BVLINKWB1

Sensor fusion & activity recognition
Bluetooth LE connectivity with environmental and motion sensors
STM32Cube function pack for STM32WB MCU: FP-SNS-MOTENVWB1

STM32WB Nucleo-64 development board + Motion MEMS and Environmental Sensor Expansion board

Both packages are compatible with STBLESensor app for iOS and Android
## STM32 MCU “Wireless” series

### MPU
- **STM32MP1**
  - 4158 CoreMark
  - 650 MHz Cortex-M7
  - 209 MHz Cortex-M4

### High Perf MCUs
- **STM32F2**
  - Up to 398 CoreMark
  - 120 MHz Cortex-M3
- **STM32F4**
  - Up to 608 CoreMark
  - 180 MHz Cortex-M4
- **STM32F7**
  - 1082 CoreMark
  - 216 MHz Cortex-M7
  - Up to 3224 CoreMark
  - Up to 550 MHz Cortex-M7
- **STM32H7**
  - Up to 3224 CoreMark
  - 240 MHz Cortex-M4

### Mainstream MCUs
- **STM32F0**
  - 106 CoreMark
  - 48 MHz Cortex-M0
- **STM32G0**
  - 142 CoreMark
  - 64 MHz Cortex-M0+
- **STM32F1**
  - 177 CoreMark
  - 72 MHz Cortex-M3
- **STM32F3**
  - 245 CoreMark
  - 72 MHz Cortex-M3
- **STM32F4**
  - Up to 608 CoreMark
  - 180 MHz Cortex-M4
- **STM32F7**
  - 1082 CoreMark
  - 216 MHz Cortex-M7

### Ultra-low Power MCUs
- **STM32L0**
  - 75 CoreMark
  - 32 MHz Cortex-M0+
- **STM32L1**
  - 93 CoreMark
  - 32 MHz Cortex-M3
- **STM32L4**
  - 273 CoreMark
  - 80 MHz Cortex-M4
- **STM32L4+**
  - 409 CoreMark
  - 120 MHz Cortex-M4
- **STM32L5**
  - 443 CoreMark
  - 110 MHz Cortex-M33
- **STM32U5**
  - 651 CoreMark
  - 160 MHz Cortex-M33

### Wireless MCUs
- **STM32WL**
  - 162 CoreMark
  - 48 MHz Cortex-M4
  - 48 MHz Cortex-M0+
- **STM32WB**
  - 216 CoreMark
  - 64 MHz Cortex-M4
  - 32 MHz Cortex-M0+

---

- Optimized for mixed-signal applications
- Cortex-M0+ Radio co-processor

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*Image credit: STMicroelectronics*
Releasing your creativity

/STM32
@ST_World
community.st.com
www.st.com/STM32WB
wiki.st.com/stm32mcu
github.com/STMicroelectronics
STM32WB online training
STM32WB blog article
MOOC – STM32WB workshop
Our technology starts with You

Find out more at www.st.com/stm32