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
- 3.6 V 129-pin
- 1.7 V 48-pin
- 256KB Flash
- A large offer
- Advanced RF tool, Energy control with C code generation
- No matter what!
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

Make it yours

Proprietary protocol

Bluetooth like

LLD BLE

LLD 802.15.4

Profiles

Bluetooth 5.2

zigbee PRO

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)

Antenna
Simplicity of development

2 independent cores for real-time execution

Mono-core

<table>
<thead>
<tr>
<th>CPU -x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Firmware + Peripherals + Radio stack</td>
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</tbody>
</table>

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

STM32WB

<table>
<thead>
<tr>
<th>Arm® Cortex®-M4</th>
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<tbody>
<tr>
<td>Application Firmware + Peripherals</td>
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<table>
<thead>
<tr>
<th>Arm® Cortex®-M0+</th>
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<tbody>
<tr>
<td>Radio Stack</td>
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</table>

• **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
KEY FEATURES

2 independent cores for real time execution

Ultra-low-power consumption
- 50 µA/MHz Active mode (at 3.0V)
- 2.1 µA Stop mode (Radio in standby + 256KB 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 3.6V voltage range (DC/DC, LDO)

-40°C to +105°C temperature range
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 built-in FUS
Bluetooth 5 and 802.15.4 protocols Mesh capable to extend network range

Lighting

Fleet maintenance

Industrial devices

Fitness/Healthcare

Beaconing

Home security and Audio

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

- 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

- -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

- Beacon profile available among a huge list
- External PA support to get ultra wide communication distance
- Down to 600 nA mode with RTC and 32KB of RAM
- Only 5us wakeup time over 16 wakeup lines
- PCROP, ECC, TRNG, PKA, for best design robustness
- Reduce BOM cost with built-in LCD booster

- Up to 105°C radio capable
- 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

- Reduce BOM cost with built-in LCD booster
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
   Authentication signature matches preprogrammed key
   Case not, the process is aborted and device resets
4. New FW package is decrypted with proprietary Key. Device upload on going.
### Attacks

<table>
<thead>
<tr>
<th>Non-Invasive Attacks</th>
<th>Attacks description</th>
<th>STM32WB Countermeasures</th>
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</thead>
<tbody>
<tr>
<td>• Environment modification</td>
<td></td>
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<tr>
<td>• Temperature</td>
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<tr>
<td>• Voltage</td>
<td></td>
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<tr>
<td>• Clock</td>
<td></td>
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<tr>
<td>• Fault injection (glitches....)</td>
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<tr>
<td>• Exploit debug features</td>
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<tr>
<td>• Side channel, power Analysis, …</td>
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<tr>
<td>• Temperature sensor</td>
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<tr>
<td>• Power supply integrity monitor</td>
<td></td>
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<tr>
<td>• Clock security system</td>
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<tr>
<td>• Tamper pads</td>
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<tr>
<td>• Memory ECC, Parity check</td>
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<tr>
<td>• RTC alarm, registers, SRAM mass erase</td>
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<td></td>
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<tr>
<td>• JTAG Read out protection</td>
<td></td>
<td></td>
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<tr>
<td>• BOOT from Flash only</td>
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<table>
<thead>
<tr>
<th>Software Attacks</th>
<th>Attacks description</th>
<th>STM32WB Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low Authentication / Encryption</td>
<td></td>
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<tr>
<td>• Extract keys</td>
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<td></td>
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<tr>
<td>• Exploitation of applicative test features</td>
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<tr>
<td>• Malware / Virus</td>
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<td></td>
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<tr>
<td>• Replay, privilege escalation</td>
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</tr>
<tr>
<td>• Customer Key Storage (CKS)</td>
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<td></td>
</tr>
<tr>
<td>• RNG, Crypto accelerator, CRC</td>
<td></td>
<td></td>
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<tr>
<td>• Write memory protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Read Out memory protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Memory Protection Unit (MPU)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Firmware Upgrade Service (FUS)</td>
<td></td>
<td></td>
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<tr>
<td>• Secure Firmware Update (SFU)</td>
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<td></td>
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<tr>
<td>• Proprietary Code Read-Out Protection (PCROP)</td>
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<tr>
<td>• 96-bit ID</td>
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</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 2.4GHz offer

STM32WB55
- Cortex-M4
- ADC 4.1 Msps
- 2 Comp
- SAI
- USB 2.0
- Quad-SPI
- LCD
- Concurrent
- Up to 1MB / 256kB
- QFN48
- QFN68
- WLCS100
- BGA129
- STM32WB5M

STM32WB50
- Cortex-M4
- ADC 2.1 Msps
- Up to 1MB / 128kB
- QFN48
- WLCSP100
- BGA129
- STM32WB5M

STM32WB35
- Cortex-M4
- ADC 4.1 Msps
- 2 Comp
- SAI
- USB 2.0
- Quad-SPI
- Up to 512KB / 96kB
- QFN48

STM32WB30
- Cortex-M4
- ADC 2.1 Msps
- 512KB / 96kB
- QFN48

STM32WB15
- Cortex-M4
- ADC 2.5 Msps
- 1 Comp
- 320KB / 48kB
- QFN48

STM32WB10
- Cortex-M4
- ADC 2.1 Msps
- 320KB / 48kB
- QFN48

* Peripherals list non-exhaustive, for cross series comparison purpose
STM32WB value lines

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

- Dual Core
- Full speed 64 MHz
- 7x7mm
- +4 dBm to -96 dBm
- -10° to +85°C
- WB30: 512KB Flash, 96KB RAM
- WB50: 1MB Flash, 128KB RAM
- WB10: 320KB Flash, 48KB RAM

Protocol flavors:
- Zigbee
* Zigbee and Thread not available on STM32WB10
STM32WB50 / STM32WB30 / STM32WB10 positioning

- **Sensitivity (dBm)**
- **Max Output Power (dBm)**
- **Flash memory (bytes)**
- **RAM memory (bytes)**
- **Bluetooth data rate (bps)**
- **Security**
- **Supply mode**
- **Radio standard**
- **Temperature range (°C)**
- **Min Power supply (V)**

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

* Run with Bluetooth LE only
## STM32WB5M Module

<table>
<thead>
<tr>
<th>Control</th>
<th>Memory</th>
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<tbody>
<tr>
<td>Power supply 1.8 to 3.6 V w/ DC/DC + POR/PDR/PVD/BOR</td>
<td>1-Mbyte Flash memory</td>
</tr>
<tr>
<td>Xtal oscillators 32 MHz (RF) 32,769 kHz (LSE)</td>
<td>256-Kbyte SRAM</td>
</tr>
<tr>
<td>Internal RC oscillators 32 kHz+ 4 ~ 48 MHz +16 MHz (HSI) +48 MHz ±1% acc. over V and T(°C)</td>
<td>Boot ROM</td>
</tr>
<tr>
<td>PLL/FLL</td>
<td>Secure boot loader</td>
</tr>
<tr>
<td>SysTick timer</td>
<td>Connectivity</td>
</tr>
<tr>
<td>2 watchdogs (WWDG/WDG)</td>
<td>2 x SPI, 2 x I2C</td>
</tr>
<tr>
<td>Up to 68 GPIOs</td>
<td>1 x UART, LIN, Smartcard, IrDA, Modem control</td>
</tr>
<tr>
<td>Cyclic redundancy check</td>
<td>1 x ULP UART</td>
</tr>
<tr>
<td>Voltage scaling (2 modes)</td>
<td>USB 2.0 FS - Xtal less</td>
</tr>
<tr>
<td>Analog</td>
<td>Quad-SPI (XIP)</td>
</tr>
<tr>
<td>2 x ULP comparators</td>
<td>SAI (full duplex)</td>
</tr>
<tr>
<td>1 x 12-bit ADC SAR 4.25 Mspis</td>
<td>Timers</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>4 x 16-bit 32-bit timers</td>
</tr>
<tr>
<td></td>
<td>2 x ULP 16-bit timers</td>
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<tr>
<td></td>
<td>Sensing</td>
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<td>16-key capacitive touch</td>
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<td></td>
<td>Encryption/security</td>
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<td></td>
<td>256-bit AES/PKA</td>
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<td></td>
<td>TRNG/PCROP</td>
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<td></td>
<td>FUS/CKS</td>
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<tr>
<td></td>
<td>Display</td>
</tr>
<tr>
<td></td>
<td>8 x 40 LCD driver</td>
</tr>
</tbody>
</table>

### Flash memory / RAM size (bytes)

- 1 M / 256 K

### Pin count

- 86-pin LGA
- (0.435 mm pitch)
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
zigbee
OPEN THREAD
+ 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

Hardware
Evaluation Pack, Nucleo-64 board, Discovery Kit

*Available in H1/2021

STM32CubeMX/STM32CubeWB/STM32CubeProg & STM32CubeMonitor
Code generation
Power calculation

STM32WB

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

STM32Cube

A complete flow, from configuration up to monitoring

Software development tools

STM32CubeMX, GUI Builders
Configure & Generate Code

ST and Partner IDEs
Compile and Debug

STM32CubeProg/Monitor
Monitor, Program & Utilities

More to come after mass market launch
IPD - MLPF-WB-0xE3
harmonic filter with integrated impedance matching

Integrated Balun

STM32WB
Arm Cortex-M4
Application firmware + Peripherals
Arm Cortex-M0+
Radio Stack

MLPF-WB-0xE3
Integrated STM32WB impedance matching
Deep rejection harmonic filter
• Exercise wireless features of STM32WB
  • Bluetooth Low Energy commands
  • Bluetooth LE RF tests
  • send OpenThread commands
  • perform 802.15.4 RF tests

STM32CubeMonRF

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

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

STM32WB Nucleo development board +
Digital MEMS microphones 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
- **STM32H7**
  - Up to 3224 CoreMark
  - Up to 550 MHz Cortex-M7
  - 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-M4
- **STM32G4**
  - 550 CoreMark
  - 170 MHz Cortex-M4

### 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
- **STM32L5+**
  - 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

---

STM32

Life augmented

LONGEVITY COMMITMENT

10 YEARS
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
Thank you