STM32WB series MCU with built-in Bluetooth 5.0 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
- 256KB Flash
- 48-pin
- 129-pin
- 3.6 V
- 1.7 V
- Massive integration Cost saving
- A large offer
- Advanced RF tool, Energy control with C code generation
- No matter what!
Multiprotocol and open radio

- Fully certified Bluetooth® 5.0 radio
- 2x faster speed with 2Mbps capable mode
- Extend network coverage with BLE Mesh

- Last IEEE 802.15.4 standard ready
- OpenThread, ZigBee 3.0
- Bluetooth 5.0 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
Profiles

IEEE 802.15.4 MAC

LLD 802.15.4

ZigBee® 3.0

6LoWPAN (RPL)

Bluetooth 5

2.4 GHz Radio
+6 dBm output / -100 dBm sensitivity (802.15.4)
-96 dBm sensitivity (BLE 1 Mbps)

Make it yours
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</td>
</tr>
<tr>
<td>Peripherals</td>
</tr>
<tr>
<td>Radio stack</td>
</tr>
</tbody>
</table>

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

**STM32WB**

- **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

Arm® Cortex®-M4

Application Firmware + Peripherals

Arm® Cortex®-M0+

Radio Stack
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**

- Retrofit legacy product to **Bluetooth 5.0** and concurrency mode
- Remotely upgrade device with **OTA capability**
- Brand protection with Authenticated FW upgrade system

- **Retrofit legacy product to Bluetooth 5.0 and concurrency mode**
- **Remotely upgrade device with OTA capability**
- **Brand protection with Authenticated FW upgrade system**

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**Lighting**
- **Up to 105°C radio capability**
- **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**

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**Fleet maintenance**
- **Multipoint BLE 5 connections**
- **Small form factor design with CSP100 pins**
- **Battery life time 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**

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**Industrial devices**
- **Beacon profile available among a huge list**
- **Embedded balun to minimize design cost**
- **Only 5.2mA Radio TX current to extend beacon life time**
- **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**

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**Fitness/Healthcare**
- **-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**

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**Beaconing**
- **Robust RF link -100dBm sensitivity with IEEE 802.15.4 and +6 dBm output power**
- **Upgrade legacy 802.15.4 device to Bluetooth 5.0 Update** securely Radio and stack firmware with build-in FUS Bluetooth 5 and 802.15.4 protocols Mesh capable to extend network range

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**Home security and Audio**
- **-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**
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.
## STM32WB Countermeasures against Attacks

### Non-Invasive Attacks

<table>
<thead>
<tr>
<th>Attacks</th>
<th>Attacks description</th>
<th>STM32WB Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>环境修改</td>
<td>• Environment modification</td>
<td></td>
</tr>
<tr>
<td>温度</td>
<td>• Temperature</td>
<td></td>
</tr>
<tr>
<td>电压</td>
<td>• Voltage</td>
<td></td>
</tr>
<tr>
<td>时钟</td>
<td>• Clock</td>
<td></td>
</tr>
<tr>
<td>故障注入 (glitches)</td>
<td>• Fault injection (glitches....)</td>
<td></td>
</tr>
<tr>
<td>exploit debug features</td>
<td>• Exploit debug features</td>
<td></td>
</tr>
<tr>
<td>side channel, power Analysis</td>
<td>• Side channel, power Analysis,</td>
<td></td>
</tr>
<tr>
<td>温度传感器</td>
<td>• Temperature sensor</td>
<td></td>
</tr>
<tr>
<td>电源完整性监控</td>
<td>• Power supply integrity monitor</td>
<td></td>
</tr>
<tr>
<td>时钟安全系统</td>
<td>• Clock security system</td>
<td></td>
</tr>
<tr>
<td>防篡改垫</td>
<td>• Tamper pads</td>
<td></td>
</tr>
<tr>
<td>内存 ECC, Parity check</td>
<td>• Memory ECC, Parity check</td>
<td></td>
</tr>
<tr>
<td>RTC alarm, registers, SRAM mass erase</td>
<td>• RTC alarm, registers, SRAM mass erase</td>
<td></td>
</tr>
<tr>
<td>JTAG Read out protection</td>
<td>• JTAG Read out protection</td>
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<tr>
<td>BOOT from Flash only</td>
<td>• BOOT from Flash only</td>
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</tr>
</tbody>
</table>

### Software Attacks

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<tr>
<th>Attacks</th>
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<th>STM32WB Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>低认证/加密</td>
<td>• Low Authentication / Encryption</td>
<td></td>
</tr>
<tr>
<td>解密</td>
<td>• Extract keys</td>
<td></td>
</tr>
<tr>
<td>应用测试特性的利用</td>
<td>• Exploitation of applicative test features</td>
<td></td>
</tr>
<tr>
<td>恶意/病毒</td>
<td>• Malware / Virus</td>
<td></td>
</tr>
<tr>
<td>重放,权限提升</td>
<td>• Replay, privilege escalation</td>
<td></td>
</tr>
<tr>
<td>客户密钥存储 (CKS)</td>
<td>• Customer Key Storage (CKS)</td>
<td></td>
</tr>
<tr>
<td>RNG, Crypto accelerator, CRC</td>
<td>• RNG, Crypto accelerator, CRC</td>
<td></td>
</tr>
<tr>
<td>写入内存保护</td>
<td>• Write memory protection</td>
<td></td>
</tr>
<tr>
<td>读取内存保护</td>
<td>• Read Out memory protection</td>
<td></td>
</tr>
<tr>
<td>内存保护单元 (MPU)</td>
<td>• Memory Protection Unit (MPU)</td>
<td></td>
</tr>
<tr>
<td>固件升级服务 (FUS)</td>
<td>• Firmware Upgrade Service (FUS)</td>
<td></td>
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<tr>
<td>安全固件更新 (SFU)</td>
<td>• Secure Firmware Update (SFU)</td>
<td></td>
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<tr>
<td>私有代码读取-出保护 (PCROP)</td>
<td>• Proprietary Code Read-Out Protection (PCROP)</td>
<td></td>
</tr>
<tr>
<td>96-bit ID</td>
<td>• 96-bit ID</td>
<td></td>
</tr>
</tbody>
</table>
Massive cost saving

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

<table>
<thead>
<tr>
<th>Silicon cost</th>
<th>Ecosystem cost</th>
</tr>
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<tbody>
<tr>
<td>• RF balun cost: Embedded</td>
<td>• Bluetooth 5.0 stack: Free of charge</td>
</tr>
<tr>
<td>• External components: 7</td>
<td>• ZigBee 3.0 stack: Free of charge</td>
</tr>
<tr>
<td>• 32 kHz Master clock output available</td>
<td>• OpenThread stack: Free of charge</td>
</tr>
<tr>
<td>• Crystal for USB 2.0 FS operation: embedded</td>
<td>• Generic 802.15.4 MAC: Free of charge</td>
</tr>
<tr>
<td>• LCD display booster: embedded (only single glass)</td>
<td>• Generic HCI drivers: Free of charge</td>
</tr>
<tr>
<td>• Capacitive touch controller: embedded</td>
<td>• STM32CubeMX: Free of charge</td>
</tr>
<tr>
<td>• PCB cost: 2 layers PCB only</td>
<td>• STM32CubeMonitor-RF: Free of charge</td>
</tr>
<tr>
<td></td>
<td>• IDEs (AC6: SW4STM32; ST: STM32CubeIDE): Free of charge</td>
</tr>
<tr>
<td></td>
<td>• BLE and 802.15.4 concurrency avoids to use a second radio MCU</td>
</tr>
</tbody>
</table>
STM32WB50 value line

Essentials features product targeting entry-level Bluetooth 5.0 and Mesh application

- Protocol flavors
- Dual Core
- Full speed 64MHz
- 7x7mm
- 1MB Flash 128KB RAM
- +4 dBm - 96 dBm
- -10; +85°C
STM32WB - a large offer

Bluetooth 5.0, OpenThread, ZigBee 3.0 and proprietary protocol capable

from 1.7 V to 3.6 V
from -40°C to +105°C
Advanced functionalities

Audio - Voice & streaming
Full-duplex audio streaming over Bluetooth 5.0 using Opus codec
STM32Cube function pack for STM32WB MCU: FP-AUD-BVLINKWB1

Sensor fusion & activity recognition
BLE 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
Prototyping made as easy as 1, 2, 3

STM32CubeMX
STM32CubeWB
Code generation
Power calculation
STM32CubeMonRF

Hardware Evaluation Pack
IPD - MLPF-WB55-01E3
harmonic filter with integrated impedance matching

Integrated STM32WB impedance matching
Deep rejection harmonic filter
- Exercise wireless features of STM32WB55
  - Bluetooth Low Energy (BLE) commands
  - BLE RF tests
  - send OpenThread commands
  - perform 802.15.4 RF tests

- DUT - Nucleo, USB dongle or customer boards.
- USB or UART to Virtual Com Port
Software development tools

A complete flow, from configuration up to monitoring

STM32CubeMX
Configure & Generate Code

Partners IDEs
Compile and Debug

STM32CubeMonRF
STM32CubeProg

Windows
macOS®

More to come after mass market launch
Find easily the MCU that suits YOU
tables/phones/computers ST MCU finder

- Browse STM32 & STM8 families wide portfolio and select the product that best fit their needs
- Access to technical information
- Also works offline!

www.st.com/STMCUFinder
# STM32 MCU “Wireless” series

## High Perf MCUs
- **STM32F2**: 398 CoreMark, 120 MHz
- **STM32F4**: 608 CoreMark, 180 MHz
- **STM32H7**: 3224 CoreMark, 240 MHz Cortex-M4, 480 MHz Cortex-M7
- **STM32F7**: 1082 CoreMark, 216 MHz

## Mainstream MCUs
- **STM32F0**: 106 CoreMark, 48 MHz
- **STM32G0**: 142 CoreMark, 64 MHz
- **STM32F1**: 177 CoreMark, 72 MHz
- **STM32F3**: 245 CoreMark, 72 MHz
- **STM32G4**: 550 CoreMark, 170 MHz

## Ultra-low Power MCUs
- **STM32L0**: 75 CoreMark, 32 MHz
- **STM32L1**: 93 CoreMark, 32 MHz
- **STM32L5**: 424 CoreMark, 110 MHz
- **STM32L4**: 273 CoreMark, 80 MHz
- **STM32L4+**: 409 CoreMark, 120 MHz

## Wireless MCUs
- **STM32WL**: 161 CoreMark, 48 MHz
- **STM32WB**: 216 CoreMark, 64 MHz

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- **Arm® Cortex® core**
  - M0
  - M0+
  - M3
  - M33
  - M4
  - M7

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

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www.st.com/STM32WB
Thank you