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
- 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
IEEE 802.15.4 MAC

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

2 independent cores for real-time execution

**Mono-core**

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

**STM32WB**

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

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

**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 @ 2.1 µA
   - 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
- 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
- -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

- 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
- 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
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- Cost optimized product with USB 2.0 crystal-less device
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- USB FS 2.0 with Battery Charging Detection for remote device

- 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 5us wakeup time over 16 wakeup lines
- PCROP, ECC, TRNG, PKA, for best design robustness
- Reduce BOM cost with built-in LCD booster

- 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

- Lighting
- Fleet maintenance
- Industrial devices
- Fitness/Healthcare
- Beaconsing
- 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
   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.
## Non Invasive Attacks

- Environment modification
  - Temperature
  - Voltage
  - Clock ….
- Fault injection (glitches….)
- Exploit debug features
- Side channel, power Analysis, …

## Software Attacks

- Low Authentication / Encryption
- Extract keys
- Exploitation of applicative test features
- Malware / Virus
- Replay, privilege escalation

## STM32WB Countermeasures

- Temperature sensor
- Power supply integrity monitor
- Clock security system
- Tamper pads
- Memory ECC, Parity check
- RTC alarm, registers, SRAM mass erase
- JTAG Read out protection
- BOOT from Flash only

- Customer Key Storage (CKS)
- RNG, Crypto accelerator, CRC
- Write memory protection
- Read Out memory protection
- Memory Protection Unit (MPU)
- Firmware Upgrade Service (FUS)
- Secure Firmware Update (SFU)
- Proprietary Code Read-Out Protection (PCROP)
- 96-bit ID
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

Ecosystem cost

- Bluetooth 5.0 stack: Free of charge
- ZigBee 3.0 stack: Free of charge
- OpenThread stack: Free of charge
- Generic 802.15.4 MAC: Free of charge
- Generic HCI drivers: Free of charge
- STM32CubeMX: Free of charge
- STM32CubeMonitor-RF: Free of charge
- IDEs (AC6: SW4STM32; ST: STM32CubeIDE): Free of charge
- BLE and 802.15.4 concurrency avoids to use a second radio MCU
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
- 10; +85°C
STM32WB - a Large Offer

Bluetooth 5.0, OpenThread, ZigBee 3.0 and proprietary protocol capable

Flash memory / RAM size (bytes)

- 1 M / 256 K: STM32WB55CG, STM32WB55RG, STM32WB55VG
- 1 M / 128 K: STM32WB50CG
- 256 K / 128 K: STM32WB55CC, STM32WB55RC, STM32WB55VC

Pin count:
- 48-pin UQFN (0.5 mm pitch)
- 68-pin VQFN (0.4 mm pitch)
- 100-pin WLCSP (0.4 mm pitch)
- 129-pin UFBGA (0.5 mm pitch)

Legend:
- STM32WBx5 line
- STM32WBx0 Value line pin-to-pin compatible with STM32WBx5

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

Hardware Evaluation Pack

STM32CubeMX
STM32CubeWB
Code generation
Power calculation
STM32CubeMonRF
Harmonic Filter with Integrated Impedance Matching
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

FREE IDE’s

STM32 Cube

Windows

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More to come after mass market launch
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Cortex®-M0
Cortex®-M0+
Cortex®-M3
Cortex®-M4
Cortex®-M33
Cortex®-M7

Dual Cortex®-M7 & Cortex®-M4

Note: Cortex-M0+ Radio Co-processor