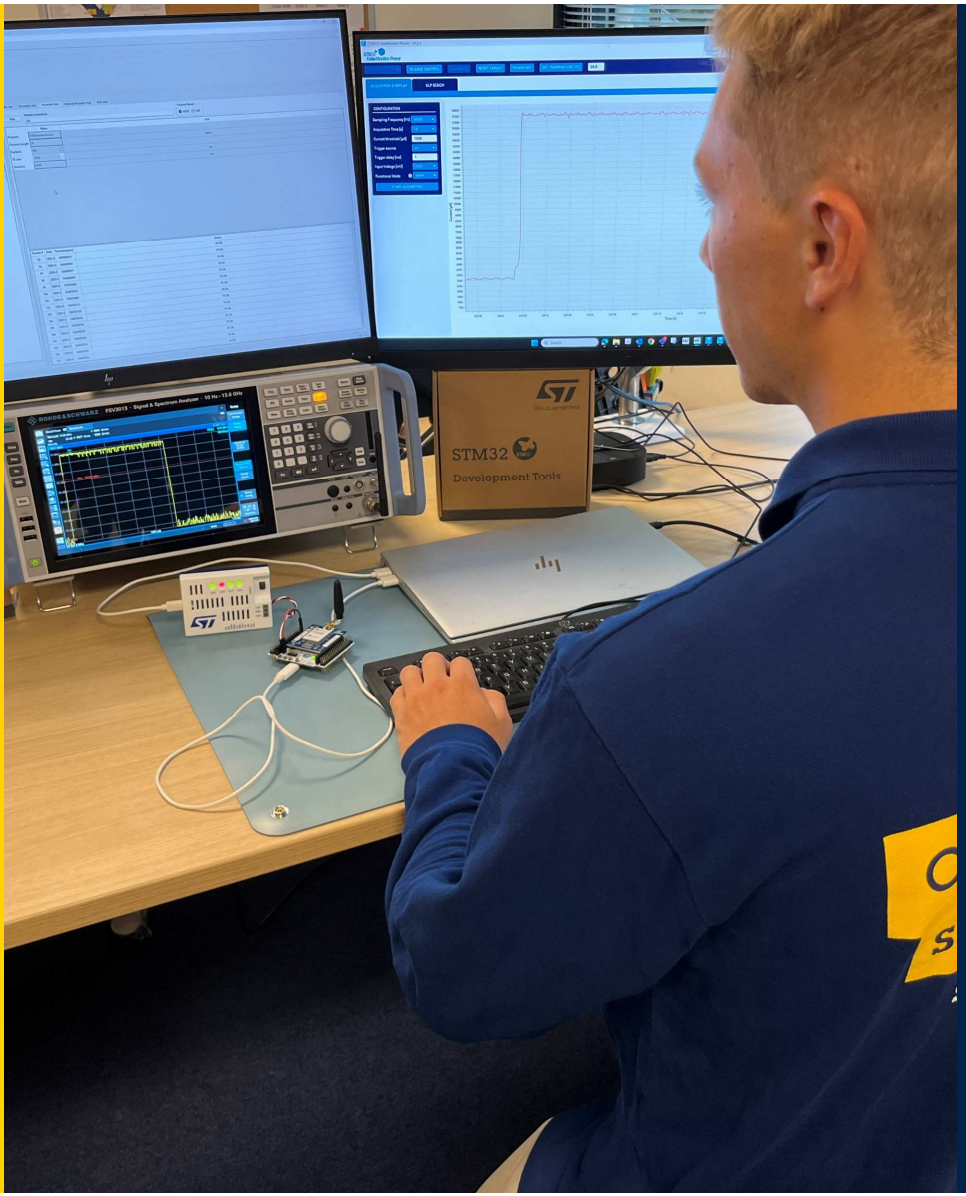


Welcome to
STM32WL3 series workshop

Introduction and agenda
Start at 9 am CET

Workshop team

Purpose of the workshop

- Highlights **STM32WL3 portfolio** and its **flexible ecosystem** to address any Sub-GHz wireless applications.
- Show case STM32WL3 in real world with **live demos** to demonstrate multiple use cases starting from unboxing Nucleo boards up to advanced demos
- **Video tour of our RF Lab** showing ST RF support and services
- Demonstrate ease of use, how to evaluate and prototype an application using **STM32 wireless ecosystem**

Demo
hands-on

Agenda (9:00 – 12:00)

1 — 5 min — Introduction

2 — 25 min — Introduction to STM32WL3 series

3 — 20 min — Unboxing STM32WL3 Nucleo, demonstrate STM32 ecosystem

4 — 30 min — Demonstrate STM32WL3 radio flexibility (packet handler, modulation, interoperability)

5 — 10 min — Break

6 — 30 min — Demonstrate “state of the art” current consumption of STM32WL3

7 — 20 min — wM-bus solutions for STM32WL3

8 — 15 min — Mioty solutions for STM32WL3

9 — 20 min — ST RF Lab services and capabilities

10 — 5 min — Takeaways, Q&A

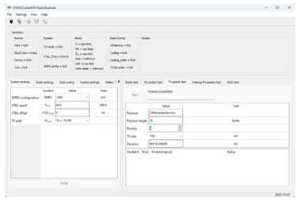
Tools

Demo1 : Unboxing NUCLEO-WL33

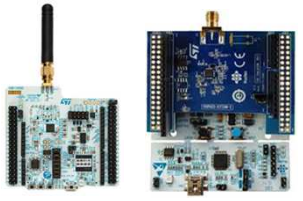
Demo2 : STM32WL3 radio flexibility

x2

NUCLEO-WL33CCx



STM32CubeWiSE-RadioExplorer tool



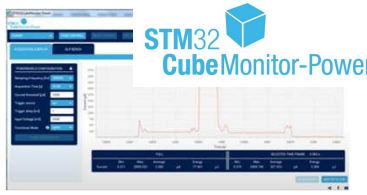
Any other RF board (WL55, S2-LP, ..)

Demo3 : Power consumption

Demo4 : wM-Bus & mioty solutions

NUCLEO-WL33CCx

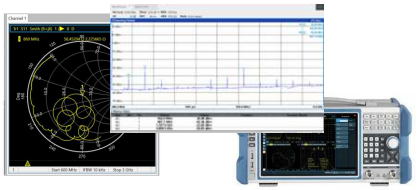
STLINK-V3PWR (or any ammeter)



STM32CubeMonitor-Power

Demo5 : Test your RF design

NUCLEO-WL33CCx



RF lab equipment

Workshop Package

- STM32CubeIDE
  https://www.st.com/en/development-tools/stm32cubeide.html
- STM32CubeWL3 Cube
  https://www.st.com/en/embedded-software/stm32cubewl3.html
- STM32CubeMonPwr
  https://www.st.com/en/development-tools/stm32cubemonpwr.html
- WiSE studio
  https://www.st.com/en/development-tools/stm32cubewisere.html
- Stdes , reference design for STM32WL3
  stdes stm32wl3 - Tools & Software - Search STMicrocontrollers

Payoff of the workshop

- Have better understanding of **STM32WL3 ecosystem from ST but also from our partner**, starting with STM32 nucleo unboxing
- See STM32WL3 in real use cases with live demos
- Get all information and code example to start **evaluation with STM32WL3 series**
- Get answer(s) to any other question(s) talking directly with STM32 wireless experts
- All workshop material and demos are accessible from following ST GitHub

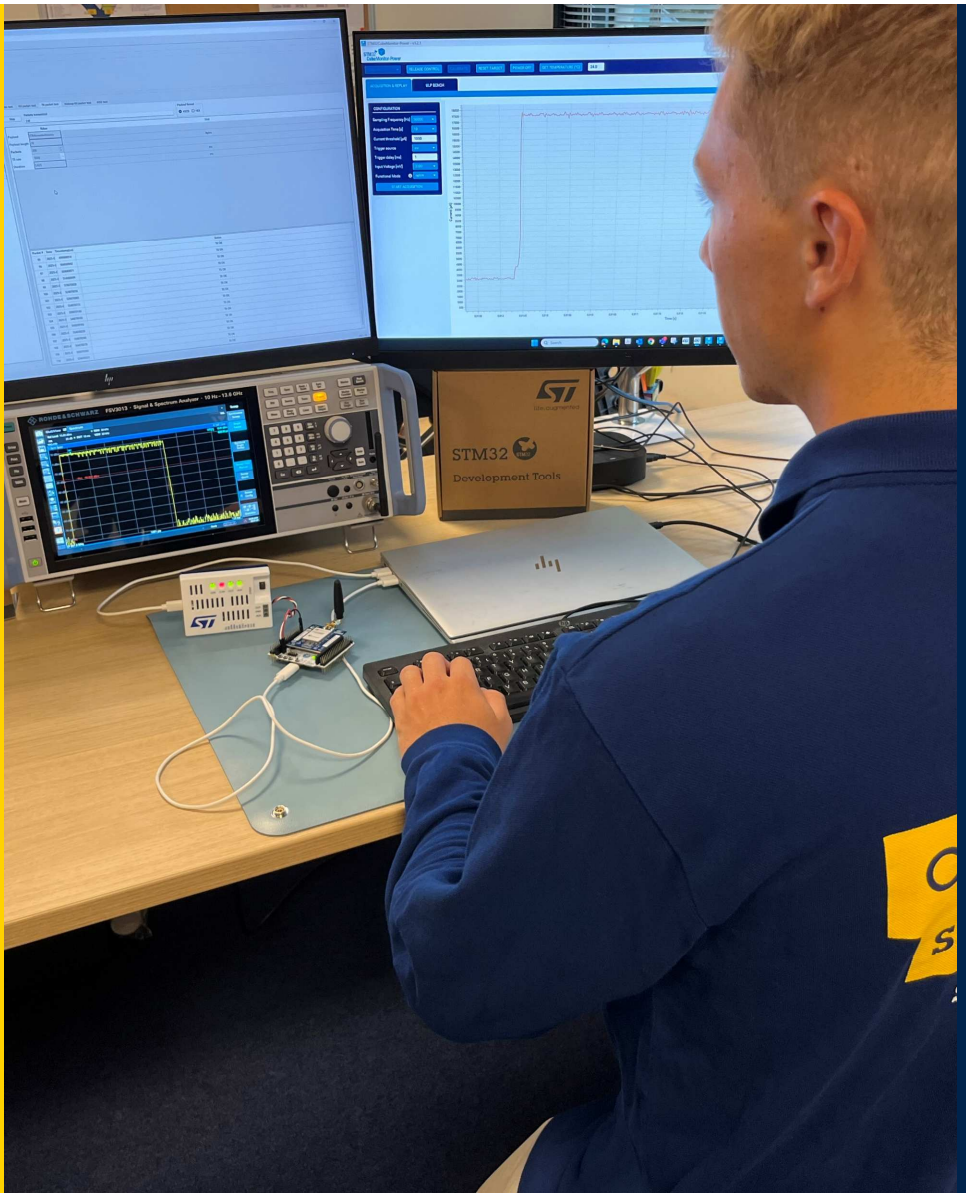
Remote flow and rules

Remote workshop **Rules**

- If not speaking **please make sure to be muted** (we'll mute all in beginning).
- **Use CHAT window** of the Teams meeting to ask questions or highlight a problem during all the chapters and hands-on exercises.
  - Please mention slide number in case the question is related to specific slide.
  - Questions will be answered by facilitators in written form inside the CHAT window directly in real time.
  - Specific questions will be read by the facilitator at the end of each chapter and answered in spoken way by all the facilitators.
- In case of more complex issues private CHAT session can be started.
- Don't use any AI tools / plug-ins to monitor this session. All slides and recording will be shared with you in a post event email.

LET’S START!!!

Find out more at STM32 Wireless Microcontrollers



Welcome to

STM32WL3 series workshop

Explore the flexible and ultra-low power STM32WL3x sub-GHz SoC

Workshop team

The STM32 portfolio

Five product categories

Wireless MCU

Short- and long-range connectivity

Ultra-low-power MCU

Mainstream MCU

High-performance MCU

32-bit general-purpose microcontrollers: from 75 to 3,360 CoreMark score

Embedded MPU

32- and 64-bit microprocessors





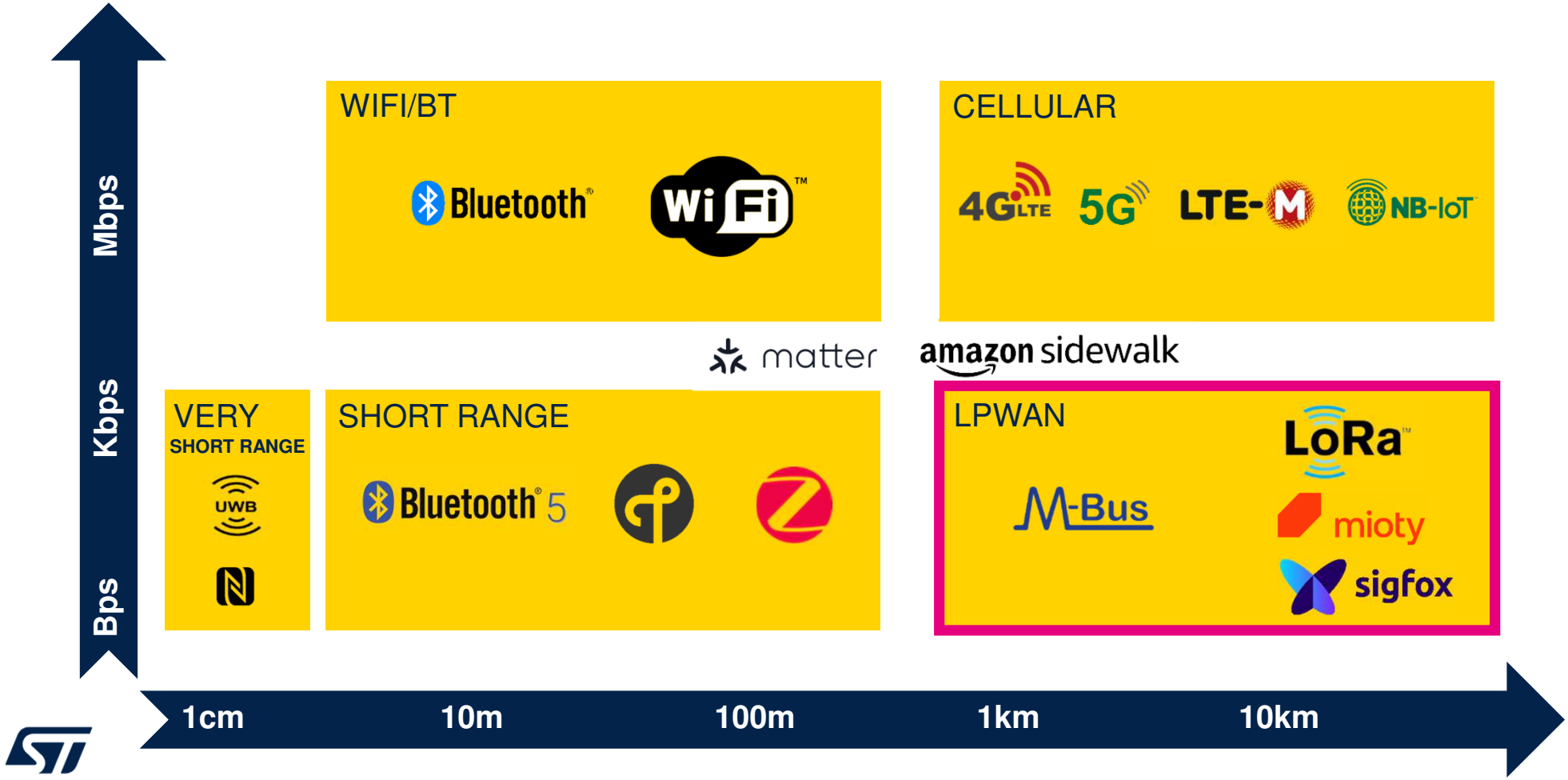
Enabling edge AI solutions

Scalable security

MPU portfolio

MCU portfolio

Communication technologies



sub-GHz connectivity in wireless applications

Smart industries	Smart cities	Smart agriculture	Smart homes
			
Asset tracking	**Metering**	**Alarm systems**	**Remote Control**
Low-power, **global coverage, roaming.** Combined with sensing applications (accelerometer, pressure sensors)	Multiprotocol and low power **10 years from non-rechargeable battery** Fuild flow sensing LCD driver	Ultra-low-power Rx profile (**Rx sniff mode**) radio with combination of proprietary protocol support	**Efficient Transmitter** Ultra-low-power modes with wake-up and retention capability

STM32 sub-GHz product families

sub-GHz MCU dual core			**STM32WL55**
sub-GHz MCU single core		**STM32WL3x** (NEW)	**STM32WLE5**
sub-GHz transceiver	1st generation **SPIRIT1**	2nd generation **S2-LP**	
	General-purpose sub-GHz radio	Ultra-low-power sub-GHz radio	
Modulations	2 (G)FSK (G)MSK - OOK ASK -	2/4 (G)FSK (G)MSK BPSK (Sigfox) OOK ASK DSSS + IQ I/F (STM32WL3 only)	2 (G)FSK (G)MSK BPSK (Sigfox) - - LoRa ®
Protocols	M-Bus, 6LoWPAN	M-Bus, 6LoWPAN, KNX, sigfox, Wi-SUN, mioty	M-Bus, 6LoWPAN, KNX, sigfox, Wi-SUN, mioty, LoRaWAN

What the STM32WL3 series offers

Highly integrated, low-power MCU for long-range connectivity

Arm® Cortex® M0+ core
up to 64 MHz
+ sub-GHz dual radio

Lower design complexity

One single die in packages down to 5 x 5 mm integrating:

- 256 Kbytes of flash memory
- 2 radios: sub-GHz multimodulation radio & wide band wake-up radio
- Analog sensing peripherals
- LCD driver

Flexibility

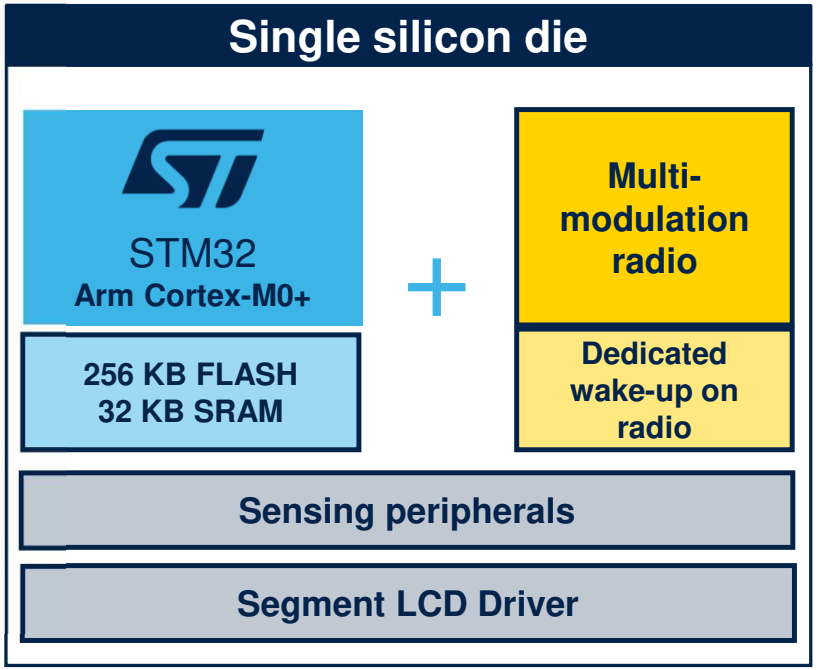
- Simple and ultra flexible platform with multiple modulation support: 4-(G)FSK up to 600 Kbps, 2-(G)FSK, (G)MSK, DBPSK, DSSS, OOK, ASK
- IQ interface to develop your own modulation for even more flexibility
- OOK always on wake-up radio

Longer battery life for IoT devices

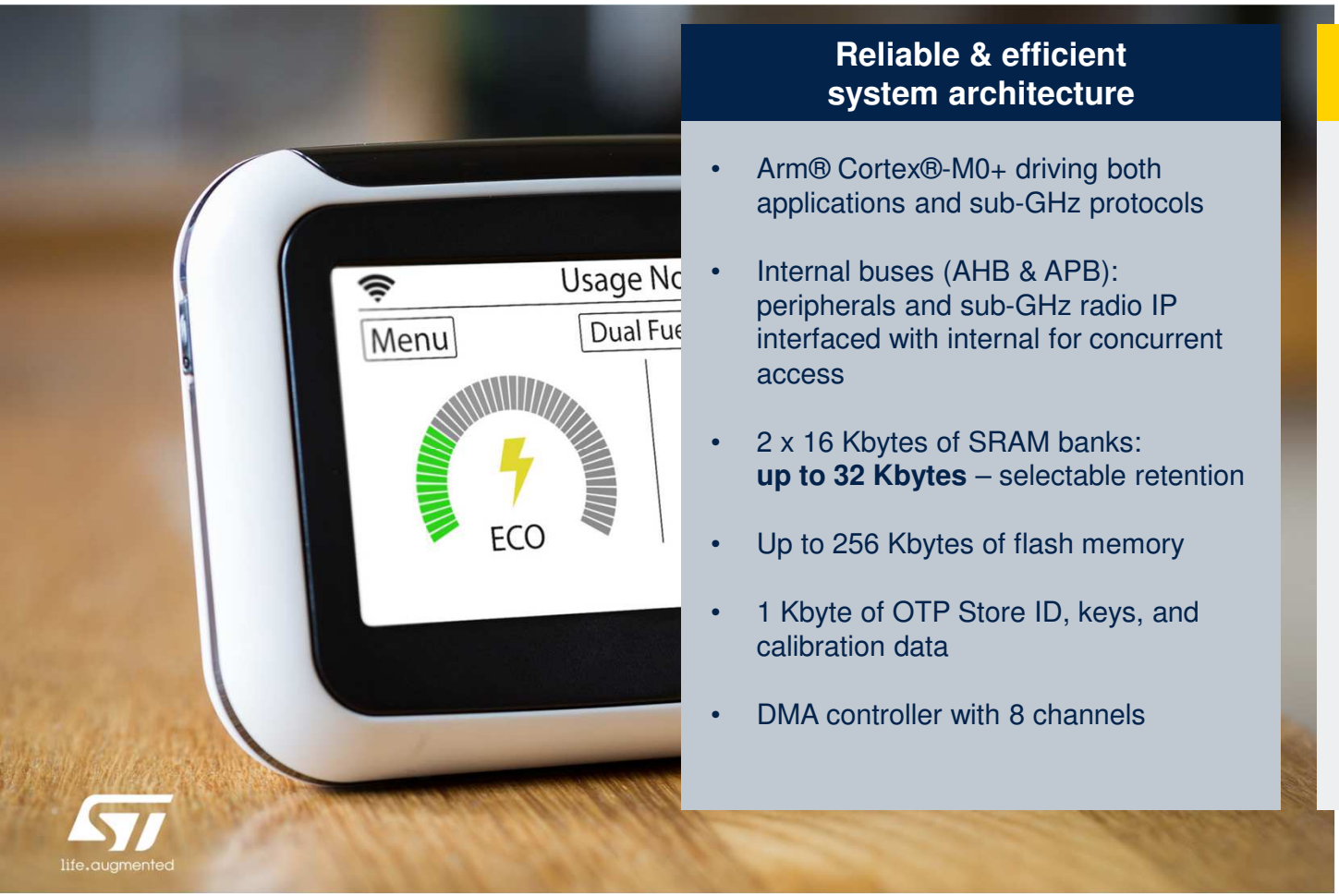
- Low power consumption radio down to 5.6 mA (Rx) and 10mA (Tx at 10 dBm)
- Additional dedicated wake-up on radio with 4.2 µA always-on receiver for system wake-up
- Shutdown down to 14nA

Wireless MCU combining multiprotocol sub-GHz radio & application features

PACKAGES
- QFN48 6 x 6 mm
- QFN32 5 x 5 mm



High integration for reduced design complexity



Reliable & efficient system architecture

- Arm® Cortex®-M0+ driving both applications and sub-GHz protocols
- Internal buses (AHB & APB): peripherals and sub-GHz radio IP interfaced with internal for concurrent access
- 2 x 16 Kbytes of SRAM banks: **up to 32 Kbytes** – selectable retention
- Up to 256 Kbytes of flash memory
- 1 Kbyte of OTP Store ID, keys, and calibration data
- DMA controller with 8 channels

Integrated peripherals

- Standard peripherals (2 x SPI, 2 x I²C, UART, low-power UART)
- 12-bit ADC (1 Msps frequency, 8 channels, single-ended & differential, temperature, and battery level)
- Timers: 2 general purpose 16-bit timers, 4+1 PWMs, watchdog timer, RTC and one LP timer
- Analog comparator and 6-bit DAC (threshold)
- Analog LC sensor
- Up to 20-pin LCD driver

STM32WL3 ultra-low-power dual radios

Highly efficient sub-GHz radio

Two radios
One single chip

Dedicated ultra-low-power Wideband wake-up radio called LPAWUR**

Main radio (RX/TX)
Rx current (LPM): 5.6 mA*
Tx current (10 dBm): 10 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
(100 MHz – 2.4 GHz)
Rx OOK at -50 dBm

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

*: Including MCU core consumption (in WFI mode)
**: LPAWUR = Low-power autonomous wake-up radio

STM32WL3x main radio for long range communication

Transmission: dual-output architecture

Up to +16 dBm output power (low-power optimized)

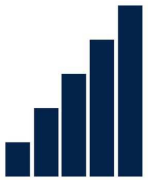
Up to +20 dBm output power (long-range capable)

Frequency range
159-185 MHz*
/ 413 – 479 MHz / 826 - 958 MHz

Optimized for your country regulation

Reception: single ended architecture

32 bits I/Q sampling: better sensitivity, interference robustness (adjacent channel blocking)

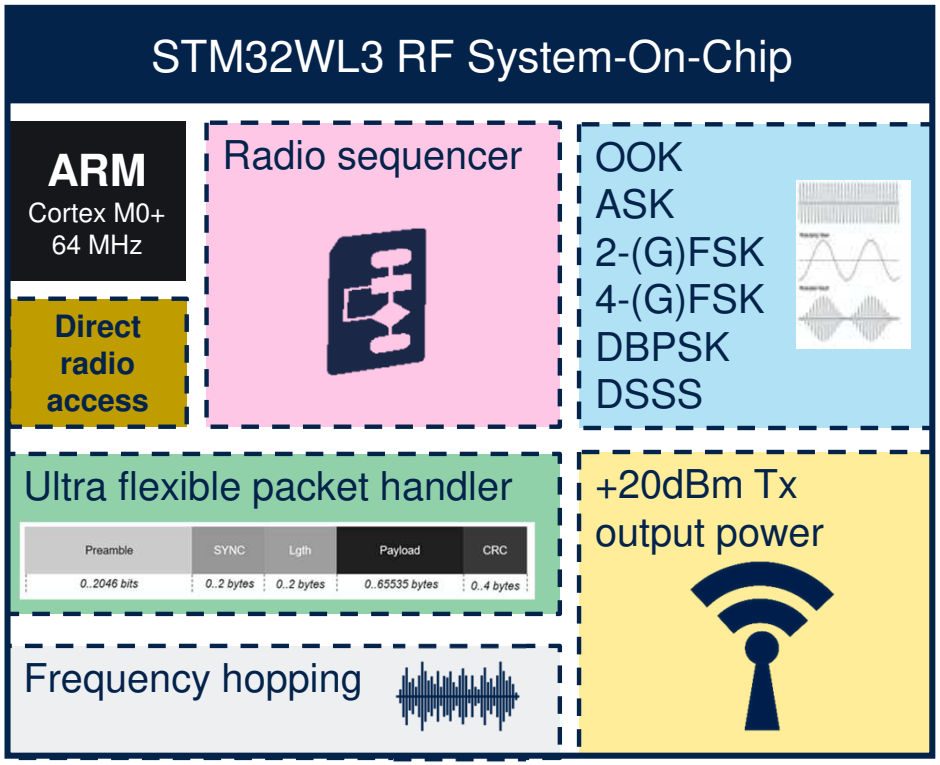


Rx sensitivity 2(G)FSK
-128 dBm at 0.3 kbps
-113 dBm at 38.4 kbps

Top-class RF performance

*: Available on dedicated P/N: STM32WL33xxxxxA

STM32WL3 main radio offers great versatility



One single platform

Multiple Protocol capable

Many application possibilities

WATER & GAS METERS

- **Ultra-low-power MCU**
  960 nA stop mode
  LC sensors an LCD Controller
- **Worldwide deployment**
  Dual power output: +14 dBm & +20 dBm
  WW RF Bands: 169MHz*, 433MHz, 868MHz, 915/320MHz

ASSET TRACKING

- Ultra-low-power **wake-up radio**
  ➔ 4.2 µA **always on** receiver
  ➔ (100 MHz to 2.4 GHz) Rx OOK at -50 dBm

ALARM SYSTEMS

- **Low-power main radio**
  Rx current (LPM): 5.6 mA
  Tx current (10 dBm): 10 mA

STM32**WL3x**

HEAT COST ALLOCATORS

- **Internal LCD driver**
  Up to 12x8 or 16x4 matrix elements
- **Outstanding Sensitivity**
  -132 dBm (OOK) / -128 dBm (FSK)

REMOTE CONTROL

- **Battery Life extension**
  14nA Shutdown mode with 6 wake-up pins
- 450nA Ultra-deep-stop with RAM retention
- **Worldwide deployment:**
  433MHz, 868MHz, 915/920MHz

SMART HOMES

- **Multiple modulations, protocols**
  4-(G)FSK up to 600 Kbps, 2-(G)FSK, (G)MSK, DBPSK, DSSS, OOK, ASK
- **+ IQ interface**

* 169MHz available on dedicated P/N (STM32WL3xxxxxA)

STM32WL3x product lines tailored for your application needs

	Applications	Flash	Package	Radio	SPI/ UART	I2C	ADC	LCD/LCSC/ COMP/DAC
STM32WL33x Metering line	Water/ Gas meters Heat cost allocators	Up to 256 KB	QFN32 and QFN48	Main radio + wake-up on radio	✓	✓	✓	✓
STM32WL31x IoT line	IoT sensors IoT asset tracking	Up to 128 KB	QFN32 and QFN48	Main radio	✓	✓	✓	
STM32WL30x Modem line	Open co-processor	Up to 128 KB	QFN32	Main radio	✓			

STM32WL3x low-power modes

Low-power mode	DEEP STOP with LPAWUR*	DEEP STOP	SHUTDOWN
Current	4.2µA	960nA	14nA
Wake-up sources	Wake-up radio + All GPIO	All GPIO	Wake-up pin + RST
RAM retention	Up to 32KB SRAM	Up to 32KB SRAM	N/A
STM32WL33x Metering line	✓	✓	✓ Up to 1 Wake-up Pin
STM32WL31x IoT line		✓	✓ Up to 1 Wake-up Pin
STM32WL30x Modem line		✓	✓ Up to 1 Wake-up Pin

*LPAWUR = Low-power autonomous wake-up radio

STM32WL33: *Metering line* (1/2)

ARM® Cortex®-M0+ Up to 64MHz	Memory	Connectivity	Main radio
Nested vector interrupt controller (NVIC) Memory protected unit (MPU) SWD interface	Flash up to 256 KB 10k cycles, 2 KB page	Up to 2x SPI (with 1x I2S) 2x I2C 1x USART 1x LPUART	8mA @ + 10dBm Tx 4mA Rx
	RAM up to 32 KB (full retention)	Up to 32 GPIOs	2-(G)FSK, 4-(G)FSK, (G)MSK, OOK, ASK, DSSS, DBPSK
	1 KB OTP		Up to + 20dBm Tx power -132dBm Rx sensitivity
Accelerators	**Security**	**Timers**	413-479MHz, 826-958MHz, 159-185MHz*
CRC calculation unit	AES 128 16-bit TRNG 64-bits unique ID	2x 16-bit GP timers 1x LP timer RTC	16-bit IQ access
DMA 8 channels	Secure boot with SWD disabling	Watchdog: IWDG Systick	Direct radio registers access
	Bootloader with write and readout protection		
System	**Analog**	**Display**	**Wake-up on Radio**
48MHz (Radio + HSE) 64MHz HIS 32.768 kHz (LSE) Internal 32kHz RCO (LSI)	12-bit ADC SAR 1 Msps	LCD driver 12x8 / 16x4	RX OOK @-50dBm
RTC 20bytes backup registers	Temperature sensor	**Fluid sensor controller**	100MHz- 2.4GHz
LDO, POR/PDR/PVD/BOR VDD 1.7-3.6V	Analog comparator + DAC	2x LC channel (wheel rotation) 1x LC channel (tamper)	Down to 4ua Always on

Extending battery lifetime in smart metering applications

Multi-band support

169MHz*, 433MHz, 868MHz, 915/920MHz

Dual Radio

Main Radio + Wake-up on Radio

Ready for analog metering

ADC + DAC + COMP

LC-based measurement of fluid flow metering (AFE + Digital)

LCD driver supporting up to 96 segments

PACKAGES
QFN48 6 x 6 mm
QFN32 5 x 5 mm

Water & Gas Metering

Heat cost allocators

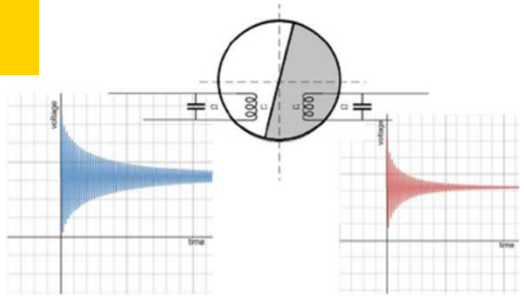
Radio features

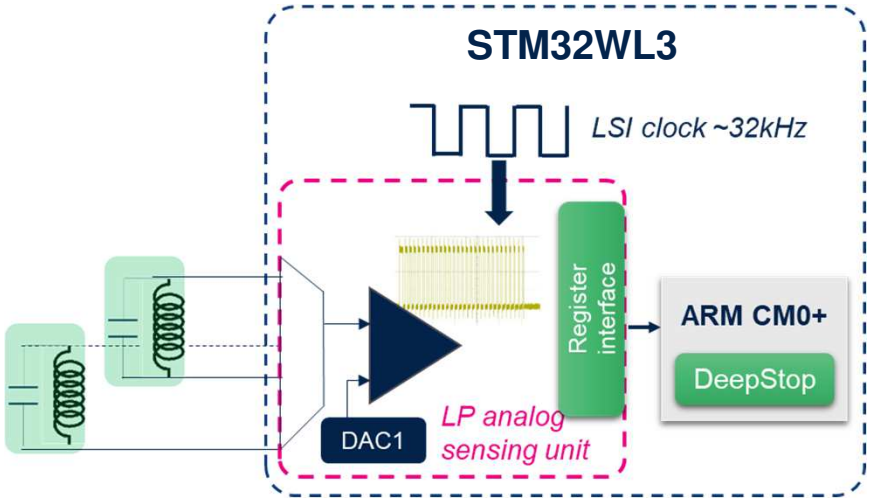
* 159-185MHz on dedicated P/N (STM32WL3xxxxxA)

STM32WL33 for metering applications (2/2)

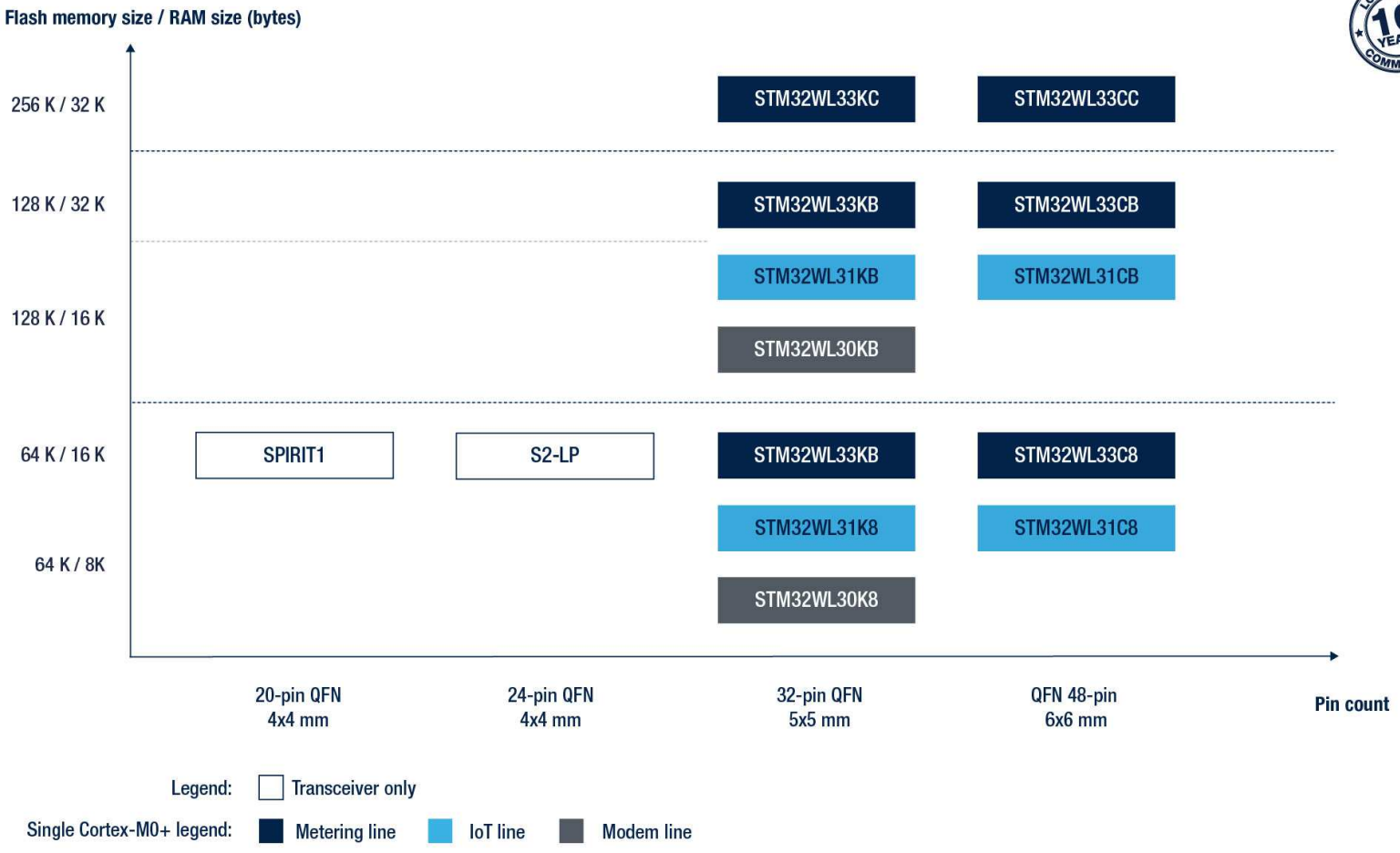
Ultra-low-power analog sensing unit based on L-C sensor controller for monitoring fluid flow

- Designed for **cost-effective** mechanic-wheel fluid metering
  - Measuring of L-C network oscillations enable detection of fluid flow metering
- Feature is based on L-C network oscillation measurement
  - Supporting up to 3x L-C networks
  - Autonomous metering circuitry (no CPU intervention, Arm® Cortex® M0+ in deep stop)
  - Very few µA average current for continuous L-C metering



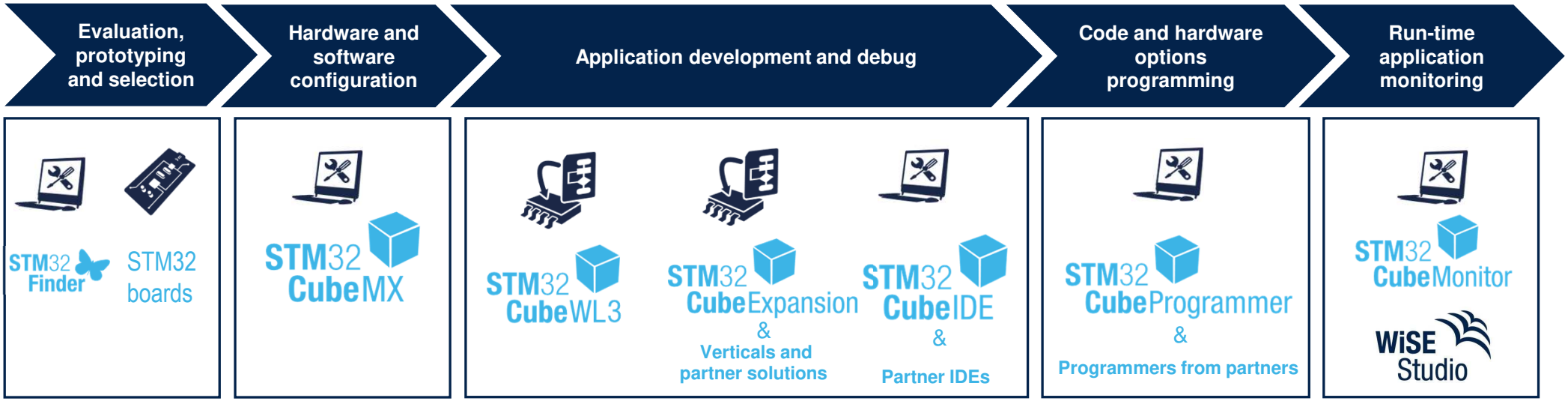


STM32WL3x portfolio



STM32WL3 ecosystem

Tools and software supporting you throughout all your design steps



Worldwide support channels

STM32CubeWL3
Wireless protocols overview

wM-BUS	OMS	Proprietary & 802.15.4g	mioty	sigfox
wM-BUS Applications Meter and concentrator mode T2, C2, S2 and Concurrent (T+C) examples.	**OMS stack** OMSv4.5.1 Ready For end device & For Gateway Devices Application Layers (APL) Transportation Layers (TPL) Authentication & Fragmentation Extended Data Link Layers STACKFORCE embedded.connectivity.solutions	**Sub-GHz Radio Examples** 802.15.4g & basic mode based on Flexible packet handler Rx sniff mode, CSMA, LBT based on RF Sequencer Wakeup radio and low-power applications.	**Mioty stack** Modes Z (UL) et A (UL & DL) Uplink (UL) Encoding Interleaving, FEC, symbol mapping Downlink (DL) via IQ I/F Demodulation & Decoding Fraunhofer	**Sigfox™ Applications** CLI interface for Sigfox commands. Push-button transmission demo. **Sigfox™ Middleware** Compliant with Sigfox network standards. Includes RF test protocol for validation..
wM-Bus Middleware Supports physical and data link layers. Enables unidirectional & bidirectional and communications.				

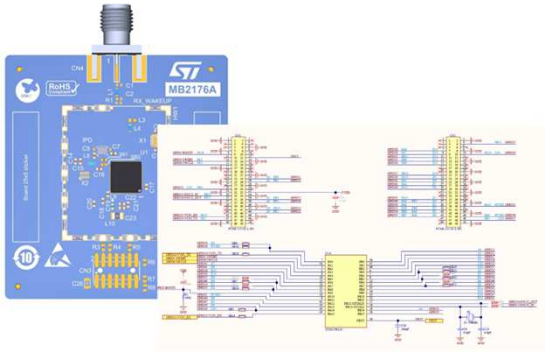
Low Layers & HAL Radio Drivers

Available via partners

Available in STM32CubeWL3

Development tools for the STM32WL3x

Speed-up evaluation, prototyping, and design



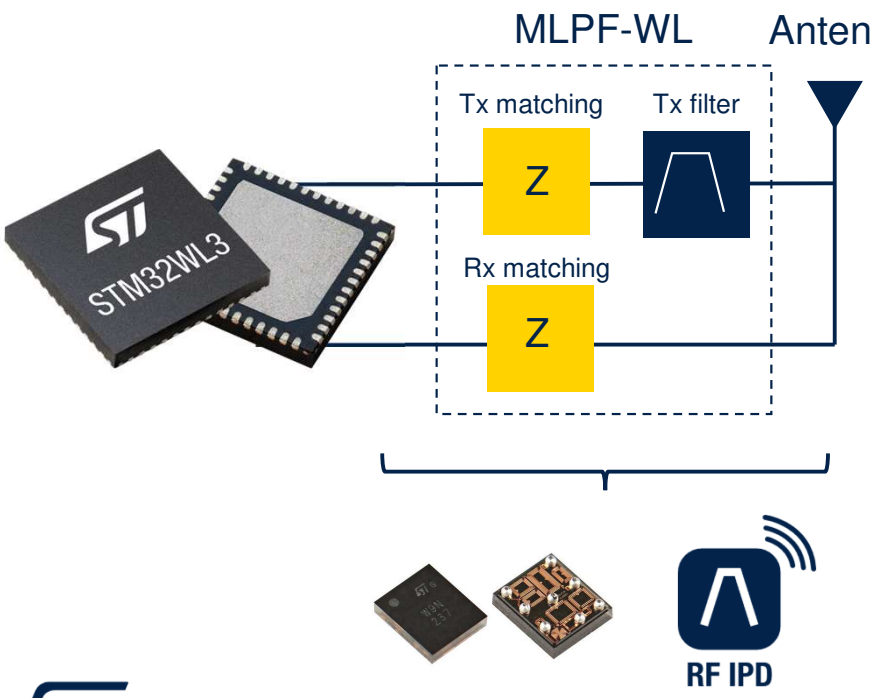
Highly affordable NUCLEO-WL33CC1	NUCLEO-WL33CC2
High band 826-958 MHz	**Low band** 413-479 MHz

Reference designs STDES-WL3xxxxx
Resources to get you started: schematics, layout, BoM, and firmware examples

All bands supported, including 169MHz

Integrated Passive Devices (IPD) list

RF IPD* products as companion chips to the STM32WL3



How to pick the right one?

868 920MHz bands — 826-958 MHz

- Low-Power mode 16dBm
  - 4-layer PCB → MLPF-WL-01D3
  - 2-layer PCB → MLPF-WL-05D3
- High-Power mode 20dBm
  - 4-layer PCB → MLPF-WL-02D3
  - 2-layer PCB → MLPF-WL-06D3

433MHZ bands — 413-479 MHz

- Low-Power mode 10dBm
  - 4-layer PCB → MLPF-WL-03D3
  - 2-layer PCB → MLPF-WL-03D3
- High-Power mode 16dBm
  - 4-layer PCB → MLPF-WL-04D3
  - 2-layer PCB → MLPF-WL-08D3

*: IPD, Integrated Passive Devices

How ST could help in your wireless journey ?

ST RF Support

Senior expertise in wireless communication

Knowledge on your application

Pre-certification capabilities with dedicated application labs

ST support you to make the right choice

ST technical support for wireless connectivity project

ST Product **Selection**	ST Product **Evaluation**	SW and HW **Development**	**Testing and certification**	**Industrialization**
• 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

Wiki by ST

STM32 MCU

SubGHz product roadmap

STM32**WL3x**

STM32WL3 takeaways

Wireless	Multi-modulation radio and dedicated wake-up on radio, up to 20dBm out. power
Integration	RF SOC with 256 Kbytes flash memory, 2x radios, Analog sensing and LCD
Flexibility	Multiprotocol support, IQ interface and OOK wake-up radio
Power efficiency	Low power mode for extended battery lifetime, autonomous mode
Free ecosystem	Fully integrated in STM32 ecosystem for faster time to market and enhanced design journey

Our technology starts with You

Find out more at www.st.com