



life.augmented

# STM32WL MCU series Wireless System-on-Chip

## Long range communications





# STM32 MCU “Wireless” series

More than **60,000 customers**

Over **6 billion STM32** shipped since 2007



MPU

**STM32MP1**

4158 CoreMark  
650 MHz Cortex –A7  
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

Optimized for mixed-signal Applications



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

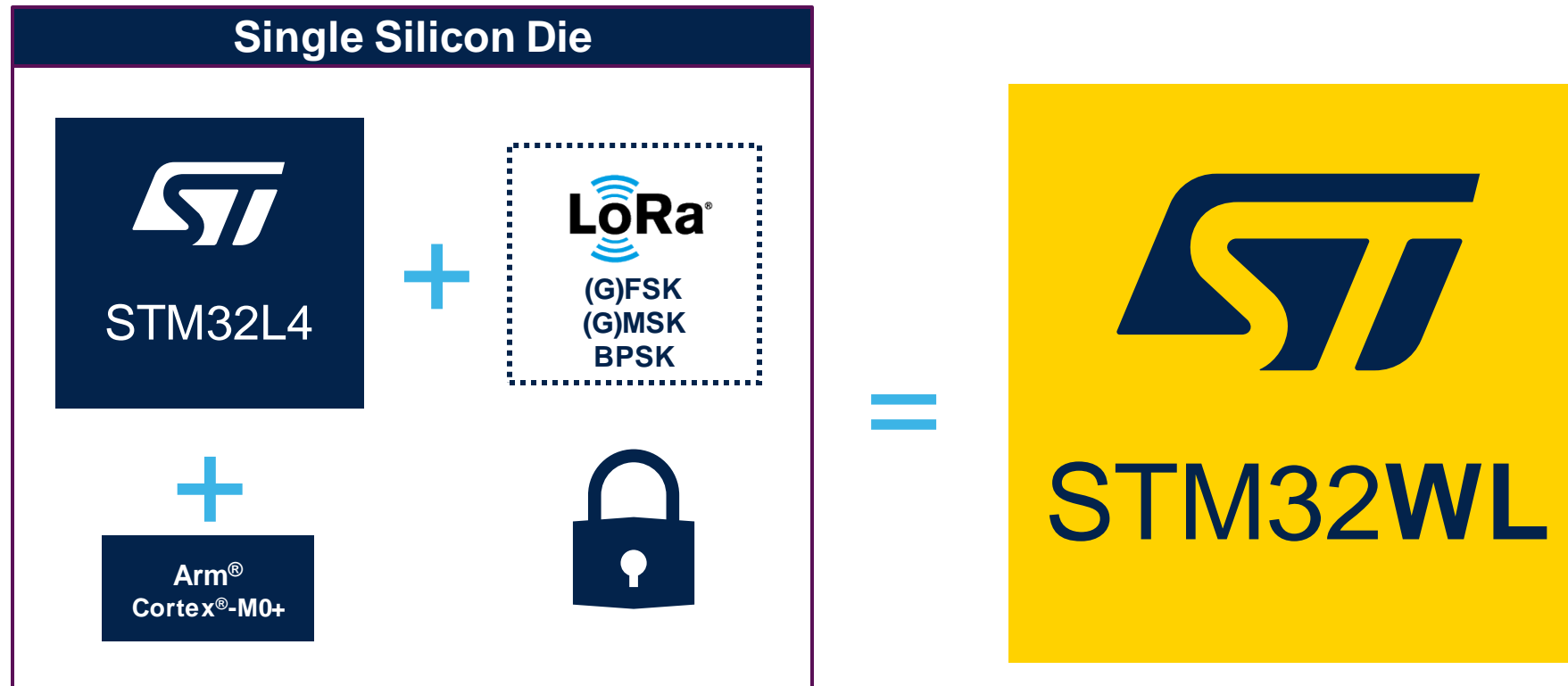
● Dual-core architecture: Cortex-M4 and M0+



# System-on-chip made for versatility

A long-range wireless microcontroller: one die, many IoT possibilities

**World first!**



# The integration pyramid

**STM32WL**

Sole LoRa-enabled SoC in the world

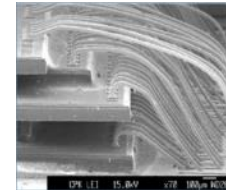


**System-on-Chip (SoC)**

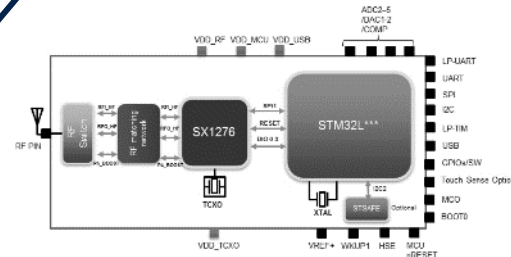
Only one **Silicon die** in one package

**System-in-Package**

*Different **silicon dice** inside the same package*



Source: PTI Blog



*Different **packages** on a very tiny piece of re-packaged PCB*

**Module**

**PCB**

*Different discrete **packages** on a BIG electronic board*



# Make the choice of the STM32WL series

## The 8 key points that make the difference



(G)FSK  
(G)MSK  
BPSK

Multi-modulation



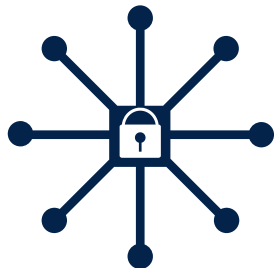
Massive integration  
Cost saving



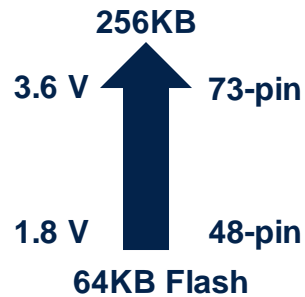
Open dual-core platform



Ultra-low-power



STM32 Security



A large offer



End-to-end ecosystem  
(advanced RF testing tool,  
C code generation tool...)



No matter what!

# Deep integration for a wide range of applications



# 4 modulations - many protocols



LoRa®

LoRaWAN®  
LoRa® - based proprietary

(G)FSK

sigfox M-Bus wireless mioty  
ZETA Proprietary

(G)MSK

Proprietary

BPSK<sub>TX</sub>

sigfox + proprietary



# STM32WLEx Line - a rich feature set

Control	Arm® Cortex®-M4 DSP 48 MHz	Memory
Power supply 1.8 to 3.6 V w/ DCDC+ LDO POR/PDR/PVD/BOR	Nested vector interrupt controller (NVIC)	Up to 256-Kbyte Flash
Crystal oscillators 32 MHz (Radio + HSE) 32.768 KHz (LSE)	Memory protected unit (MPU)	Up to 64-Kbyte SRAM
Internal RC oscillators 32,768 KHz + 16 MHz + 48 MHz ± 1% acc. over V and T(°C)	JTAG/SW debug	Boot Lock
RTC/AWU/CSS		Boot loader
PLL	ART Accelerator™	
SysTick timer	AHB Bus matrix	Timers
2 watchdogs (WWDG/IWDG)	2x DMA 7 channels	1 x 32-bit timer
43 GPIOs	Radio	3x 16-bit timers 3x ULP 16-bit timers
Cyclic redundancy check	LoRa®, (G)FSK, (G)MSK, BPSK	Analog
Voltage scaling (2 modes)	+15dBm & +22dBm Power Outputs -148 dBm sensitivity (LoRa)	1x 12-bit ADC SAR 2.5 Msps
	150 MHz to 960 MHz	12-bit DAC
		2x ULP comparators
		Temperature sensor
Security		Connectivity
AES 256-bit + TRNG + PCROP		2x SPI, 3x I2C
Tamper detection		2x USART LIN, smartcard, IrDA, Modem control
		1x ULP UART

## KEY FEATURES

- Arm® Cortex®-M4 & DSP up to 48 MHz
- Up to 256 KB Flash and 64 KB SRAM
- **Sub-GHz Radio**
  - Multi-modulation: LoRa, (G)FSK, (G)MSK, BPSK
  - 2 embedded power amplifiers:
    - 1 output up to +15 dBm
    - 1 output up to +22 dBm
  - LoRa RX sensitivity: -148 dBm (SF12, BW=10.4kHz)
  - RX: 4.82mA and TX: 15mA (at 10dBm) / 87mA (at 20dBm) [3.3V]
- **Ultra-Low Power consumption**
  - < 71µA/MHz Active mode (3V - RF OFF)
  - 1 µA Stop2 mode with RAM retention
  - 390 nA Standby mode with RTC
  - 31 nA Shutdown mode
- **Peripherals**
  - 3xI2C, 2xUSART, 1xLP-UART, 2xSPI
  - 7x timers + 2x ULP Comparators

- 1.8 to 3.6V voltage range (DC/DC, LDO)
- -40 to up to +105°C temperature range



-> Packages: QFN48, BGA73



# STM32WL5x Line - a rich feature set

## Dual-core and enhanced security

<b>Control</b> <ul style="list-style-type: none"> <li>Power supply 1.8 to 3.6 V w/ DCDC+ LDO POR/PDR/PVD/BOR</li> <li>Crystal oscillators 32 MHz (Radio + HSE) 32.768 KHz (LSE)</li> <li>Internal RC oscillators 32,768 KHz + 16 MHz + 48 MHz ± 1% acc. over V and T(°C)</li> <li>RTC/AWU/CSS</li> <li>PLL</li> <li>SysTick timer</li> <li>2 watchdogs (WWDG/IWDG)</li> <li>43 GPIOs</li> <li>Cyclic redundancy check</li> <li>Voltage scaling (2 modes)</li> </ul>	<b>Arm® Cortex®-M4 DSP 48 MHz</b> <ul style="list-style-type: none"> <li>Nested vector interrupt controller (NVIC)</li> <li>Memory protected unit (MPU)</li> <li>JTAG/SW debug</li> </ul>	<b>Memory</b> <ul style="list-style-type: none"> <li>Up to 256-Kbyte Flash</li> <li>Up to 64-Kbyte SRAM</li> <li>CM4 or CM0 Boot Lock</li> <li>Boot loader</li> <li>Hide protect</li> </ul>
<b>Security</b> <ul style="list-style-type: none"> <li>AES 256-bit + TRNG + PCROP</li> <li>Tamper detection</li> <li>Secure Areas</li> <li>Secure FW Install</li> <li>Debug control</li> <li>Boot Selection</li> <li>Secure Sub-GHz, MAC Layer, SFI</li> <li>Key Management Services</li> </ul>	<b>Arm® Cortex®-M0+ 48 MHz</b> <ul style="list-style-type: none"> <li>Nested vector interrupt controller (NVIC)</li> <li>Memory protected unit (MPU)</li> <li>SW debug</li> </ul>	<b>Timers</b> <ul style="list-style-type: none"> <li>1 x 32-bit timer</li> <li>3x 16-bit timers 3x ULP 16-bit timers</li> </ul> <b>Analog</b> <ul style="list-style-type: none"> <li>1x 12-bit ADC SAR 2.5 Msps</li> <li>12-bit DAC</li> <li>2x ULP comparators</li> <li>Temperature sensor</li> </ul> <b>Connectivity</b> <ul style="list-style-type: none"> <li>2x SPI, 3x I2C</li> <li>2x USART LIN, smartcard, IrDA, Modem control</li> <li>1x ULP UART</li> </ul>
<b>Radio</b> <ul style="list-style-type: none"> <li>LoRa®, (G)FSK, (G)MSK, BPSK</li> <li>+15dBm &amp; +22dBm Power Outputs -148 dBm sensitivity (LoRa)</li> <li>150 MHz to 960 MHz</li> </ul>	<b>ART Accelerator™</b> <ul style="list-style-type: none"> <li>AHB Bus matrix</li> <li>2x DMA 7 channels</li> </ul>	

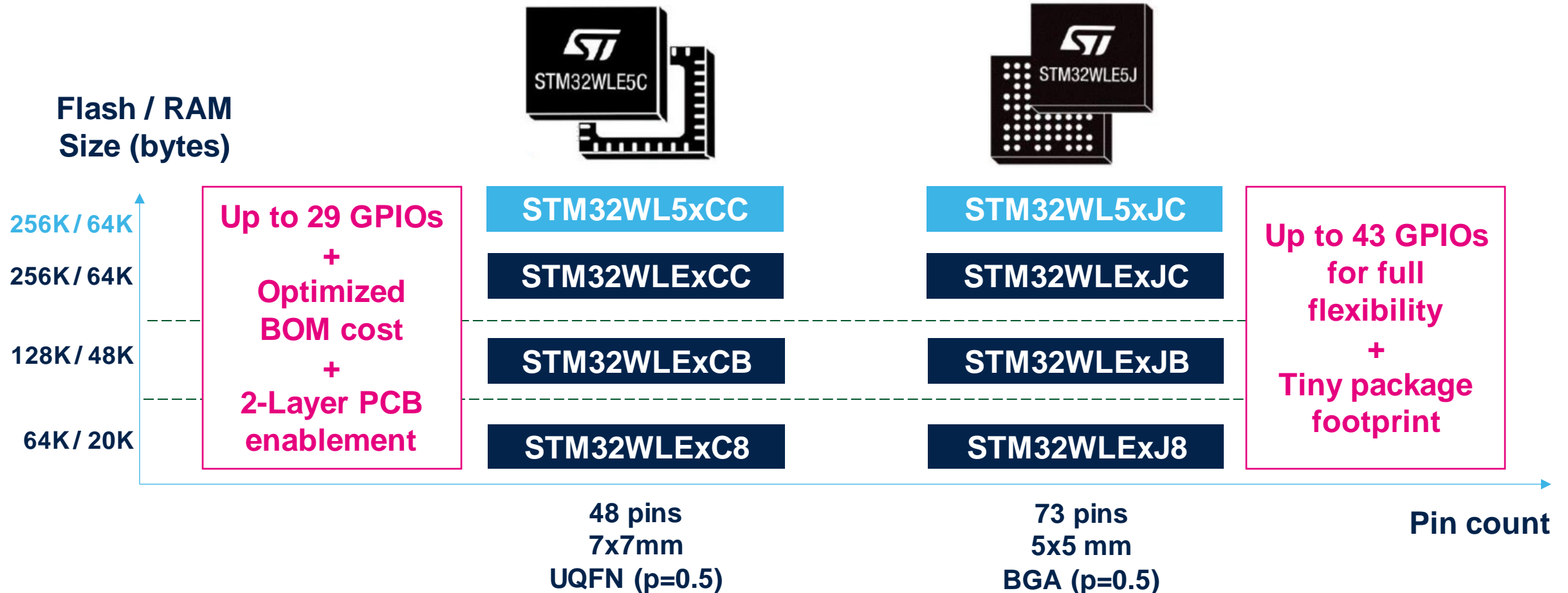
### KEY FEATURES

- Arm® Cortex®-M4 & DSP up to 48 MHz
- Up to 256 KB Flash and 64 KB SRAM
- Arm® Cortex®-M0+ up to 48 MHz
- **Sub-GHz Radio**
  - Multi-modulation: LoRa, (G)FSK, (G)MSK, BPSK
  - 2 embedded power amplifiers:
    - 1 output up to +15 dBm
    - 1 output up to +22 dBm
  - LoRa RX sensitivity: -148 dBm (SF12, BW=10.4kHz)
  - RX: 4.82mA and TX: 15mA (at 10dBm) / 87mA (at 20dBm) [3.3V]
- **Ultra-Low Power consumption**
  - < 71µA/MHz Active mode (3V - RF OFF)
  - 1 µA Stop2 mode with RAM retention
  - 390 nA Standby mode with RTC
  - 31 nA Shutdown mode
- **Peripherals**
  - 3x I2C, 2x USART, 1x LP-UART, 2x SPI
  - 7x timers + 2x ULP Comparators
- **Advanced security features**
  - 1.8 to 3.6V voltage range (DC/DC, LDO)
  - -40 to up to +105°C temperature range



-> Packages: QFN48, BGA73

# STM32WL Sub-GHz - portfolio



 Dual core

 Single core

**Note:**

x = 5 all modulations available

x = 4 all modulations available except LoRa

# Ideal for multiple applications in the LPWAN market

- Worldwide compatibility **150 to 960 MHz** Linear Range
- Multi-protocol capable
- ST Longevity commitment program: continuous supply for **10 years**

- Up to +22 dBm output power for wide coverage
- **-148 dBm** sensitivity with LoRa: **Robust RF Link**
- **Reduced BOM cost**

- **Unique-IDs** for enhanced traceability
- Down to 390 nA mode with RTC and 32KB of RAM for extended Battery lifetime
- Small form factor with **UFBGA 5x5 package**



Utilities



Smart  
Cities & Buildings



Logistics



Industrial IoT



Smart Ag



Smart Home



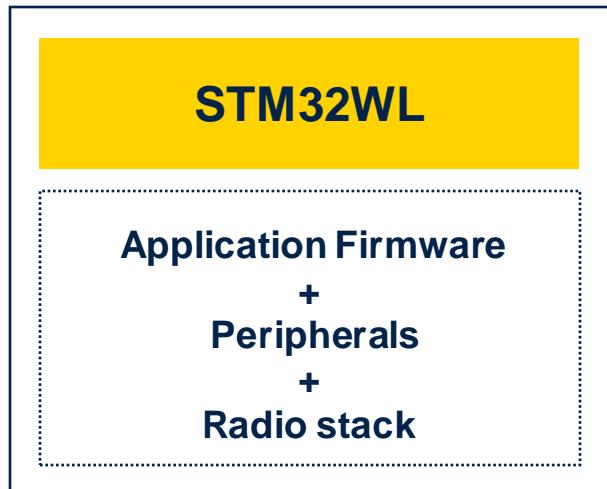
- Up to **105 °C** MCU capable
- **Only 5 µs wakeup time** for best latencies
- Only 4.82 mA as LoRa RX consumption for battery optimization

- Link Budget > **160 dB** = Very long ranges
- Excellent battery lifetime: Only 15 mA for LoRa TX consumption @ 10 dBm
- **PCROP, ECC, TRNG, PKA**, for best design robustness

- Down to 71 µA/MHz in Run mode for efficient action
- < 1 µA Stop mode with full RAM for **battery life** optimization
- 12-bit ADC & DAC for mixed applicative use cases

# A higher level of integration


## MCU + Radio 2-in-1 solution




**VS**

**Standalone  
MCU**

**Standalone  
transceiver**

- 
- SoC solution (**1 single die**)
  - **All-in-1** solution - cost saving
  - Simplified development helps speeding up time to market
  - Mono-core or dual-core version for excellent security

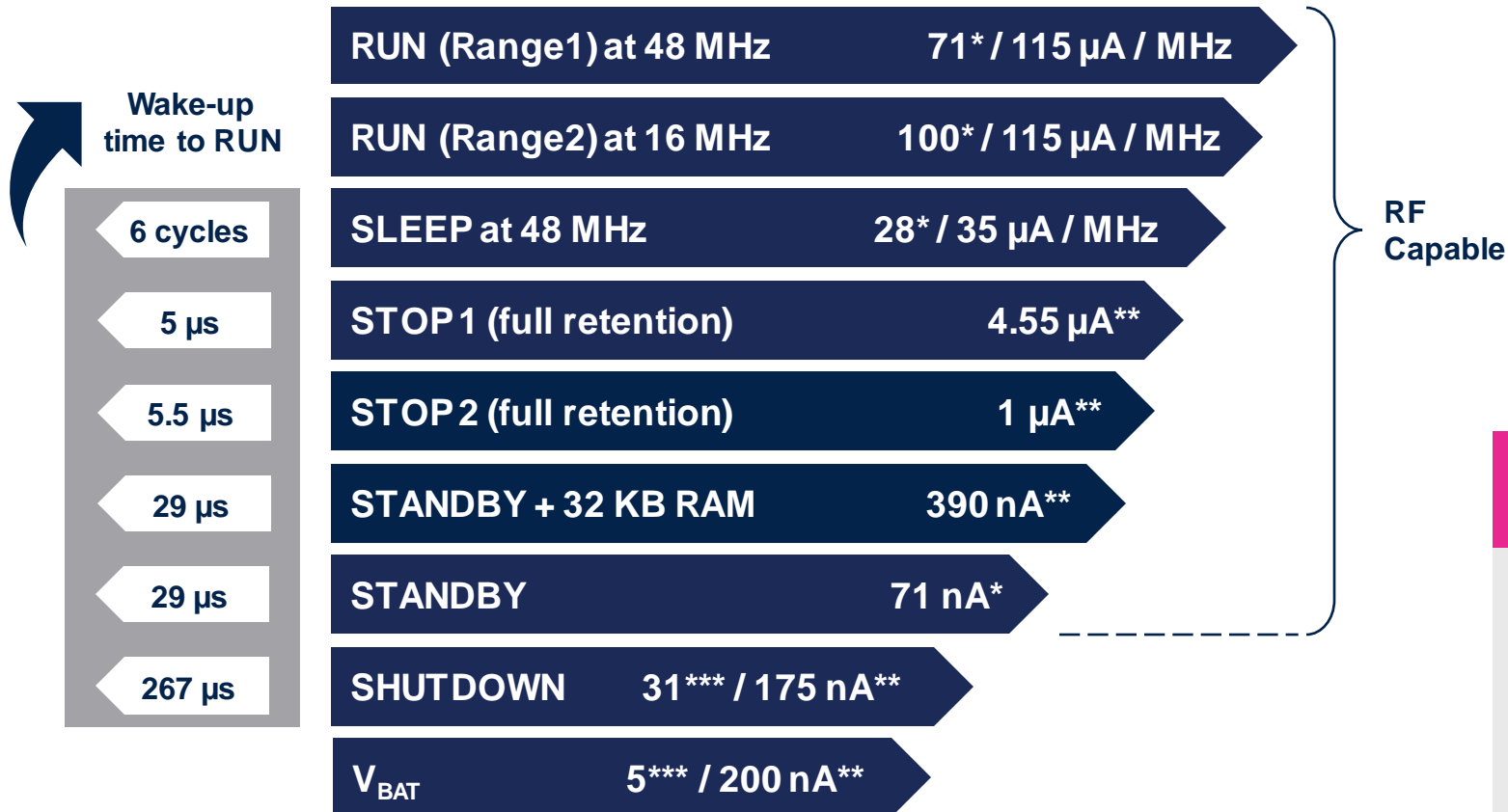
- 
- **2 standalone chips, or dice (SiP)**
  - Bigger final PCB (increased cost)
  - Wired communication more exposed

# A flexible power scheme



# Flexible power scheme FlexPowerControl

Typ with LDO @  $V_{DD} = 3\text{ V}$  @  $25\text{ }^{\circ}\text{C}$



\* Typical values with SMPS, RF OFF

\*\* with RTC on LSE Bypass

\*\*\* All OFF

## Benchmark scores

- High Efficiency  
→ CoreMark score = 162
- Ultra Low-Power Platform  
→ ULPBbench score  $\approx 204$

# Flexible power scheme matching your application needs

## LPWANs made easy through Ultra-Low-Power tradeoffs

Power mode	Arm® Cortex®-M4 and/or Cortex-M0+	Peripherals	RAM Retention	RF
Run	✓	✓	✓	✓
Sleep	✗	✓	✓	✓
Stop 0 Stop 1 Stop 2	✗ ✗ ✗	✓ ✓ Subset	✓ ✓ ✓	✓ ✓ ✓
Standby	✗	✗	✓	✓
Shutdown	✗	✗	✗	✗

Seamless toolbox  
(I<sup>2</sup>C, SPI, USART, ADC/DAC,  
Timers, Comparators etc.)

RF available  
In all power modes

Back-up registers are  
**always** available



# Efficient power management STOP modes comparison

## Flexible peripherals: power mapping

		STOP0	STOP1	STOP2
<b>Consumption</b> (without Real Time Clock)		Typ, 25 °C, 3 V, LDO		
		400 µA	4.55 µA	1 µA
<b>Wakeup time to 48 MHz</b>	Flash	2.2 µs	5 µs	5.5 µs
	RAM	2.2 µs	5.1 µs	5.5 µs
<b>Wakeup clock</b>		≤ 48 MHz		
<b>Regulator</b>		Main or Low-Power regulator		Low-power regulator
<b>Peripherals</b>		All	All	CSS, RTC, 3 Tamper Pins, 1x LPUART, 1x I <sup>2</sup> C, VREFBUF, 2x COMP, 1x LPTIM, Dual-WDG, CRC, EXTI

No impact on  
wakeup time from  
embedded DCDC

# Ultra-low power & IoT-ready for worldwide applications

## Best LoRa-enabled IP on the market

Transmission		
Parameter	Settings	Value
TX	+10 dBm 868/915 MHz	15 mA DCDC
TX	+20 dBm 868/915 MHz	87 mA DCDC

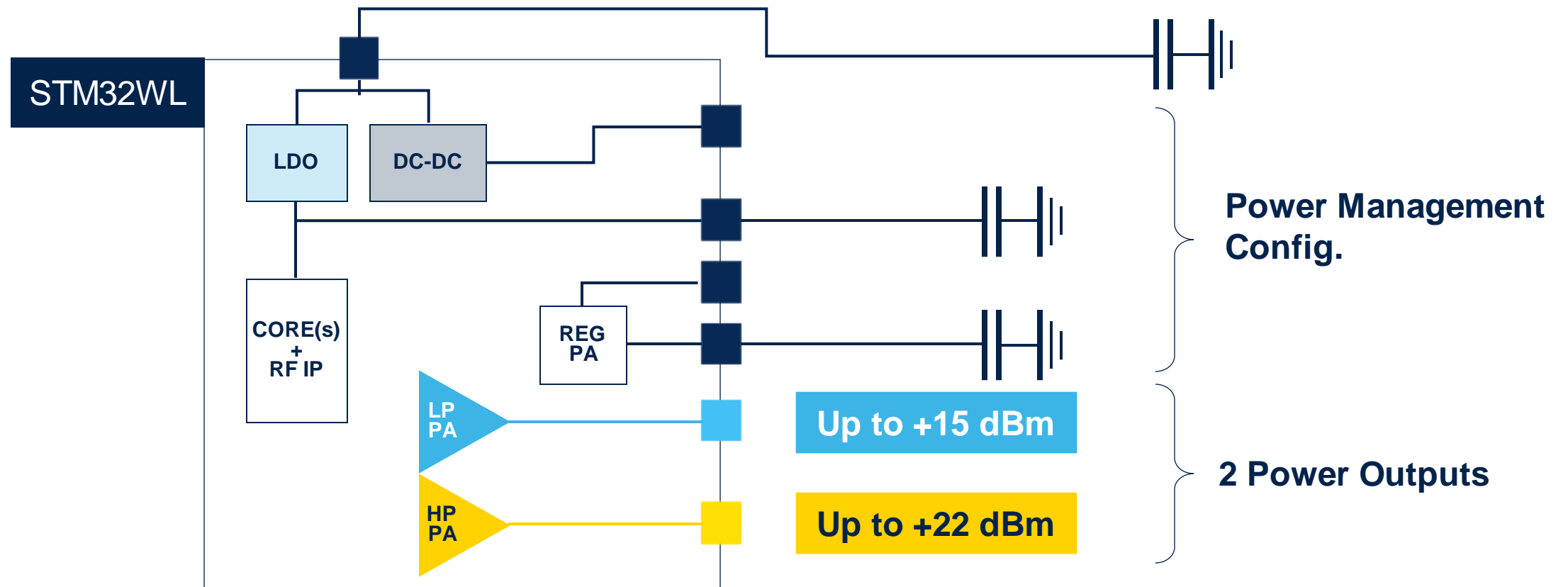


**Worldwide  
compatibility**

Reception		
Parameter	Settings	Value
LoRa Sensitivity	BW_L = 10.4 kHz SF = 12	-148 dBm
2-FSK Sensitivity	BR_F = 0.6 kb/s FDA = 0.8 kHz BW_F = 4 kHz	-125 dBm
RX	FSK 4.8kb/s buck 100mA max	4.47 mA DCDC 8.18 mA LDO
RX	LoRa® 125 kHz	4.82 mA DCDC 8.9 mA LDO

# Flexible power implementation

Tailor STM32WL to the requirements of IoT applications

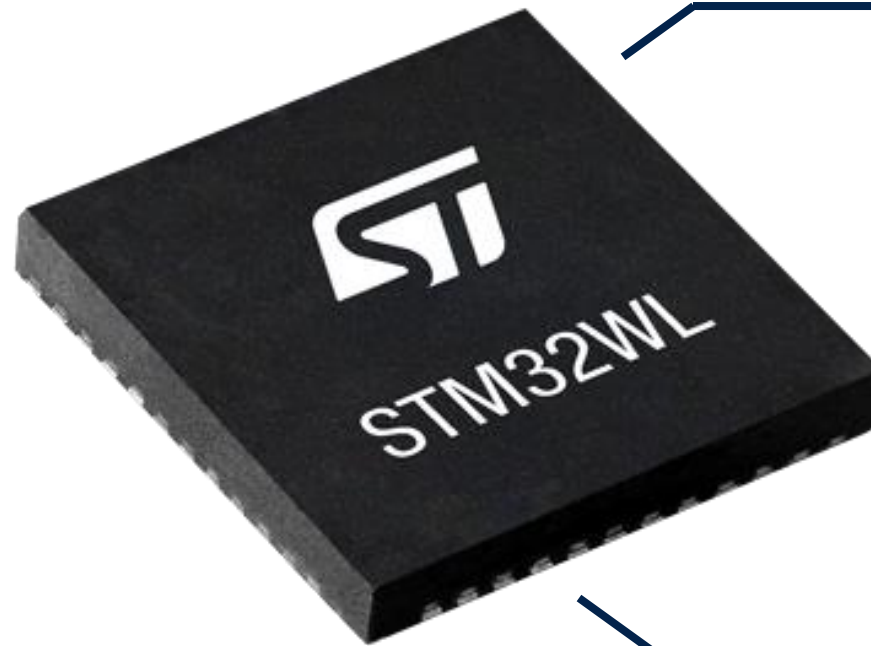


# STM32WL: Get rid of TCXO!

Minimize your BOM costs, maximize your revenues



AND / OR



**No need for TCXOs:  
a simple crystal  
(XO) is all you need**

# Advanced features, security and stacks



# STM32WL - safety and security

Secure your application with embedded safety & security



# STM32WL - extended security

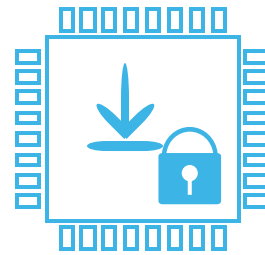
## Dual-core security features



Data encryption

### Secure Key Management Services

- Store keys in a dedicated memory area
- Secure memory area size is programmable
- Any type of key or secure object can be stored



Secure download

### Secure Firmware Install or Update

- Embedded Secure Firmware Install (SFI) to secure manufacturing from untrusted manufacturer
- Customizable In-the-field update (SBSFU) to perform extremely secure upgrade of the platform



Firmware IP Protection

### Secure Boot (Root of trust)

- Boot from the right secure memory location
- Each application firmware is authenticated before being executed



Authentication

### Crypto

- Embedded HW crypto accelerators for high performances. Supports ECC signature generation and verification
- True Random Generator
- Software Crypto Library to support additionally DES/TDES, ARC4, HASH, Poly, CHACHA, MD5 etc.



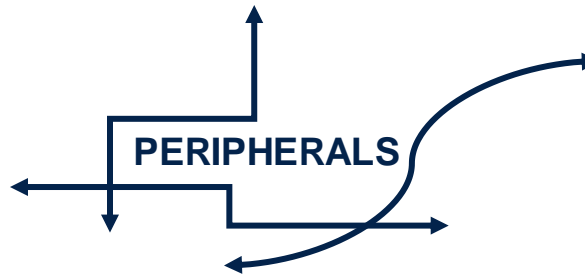
# STM32WL

## the most secure Sub-GHz SoC in the world

### Security in every corner with a dual-core architecture



- Secure System Flash Area (SFI/RSS)
- Memory Privilege watermarking, controlled by Secure Areas for the Flash and SRAM areas + Hide Protected Area (HDPa)
- Cortex-M0+ SRAM execution prevention



- Secure Area-aware configurable peripherals :
  - AES, PKA, TRNG, SPI3
  - DMA/DMAMUX channels
- Security by Option Bytes



- Independent configurable debug access to CM4 and CM0+
- Customer Secure Boot can be protected against debug
- Cortex-M0+ debug:
  - Can be disabled by User Option.
  - Disabled when executing system Flash SFI/RSS services



**Configurable Flash Interface**

**Secure Areas & Interrupt Controllers**

**Power Controller**

# STM32WL - secure boot and chain of trust

Firmware start and execution are always trusted



Reset



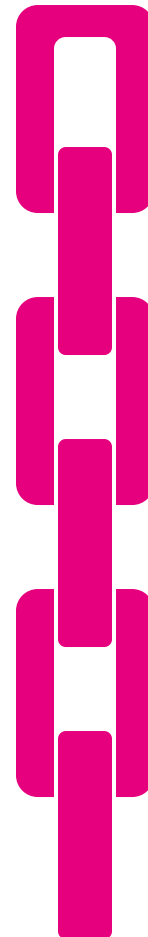
Secure Boot



Authentication



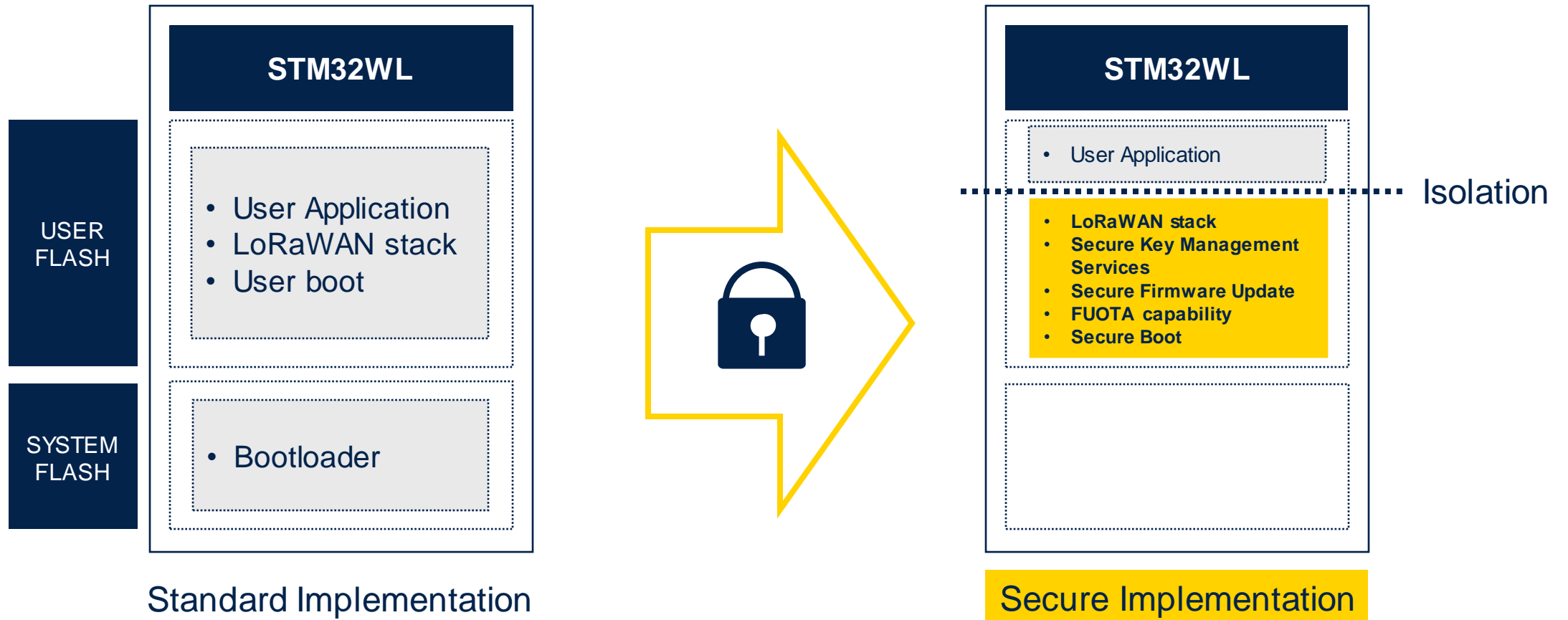
Execution



- A secure Boot, locked and protected against debug, is executed first at reset
- Next steps are authenticated and certified (RF stack & User Application)
- Next execution steps can then be started in a trusted way

# Bring more security to your LoRaWAN apps

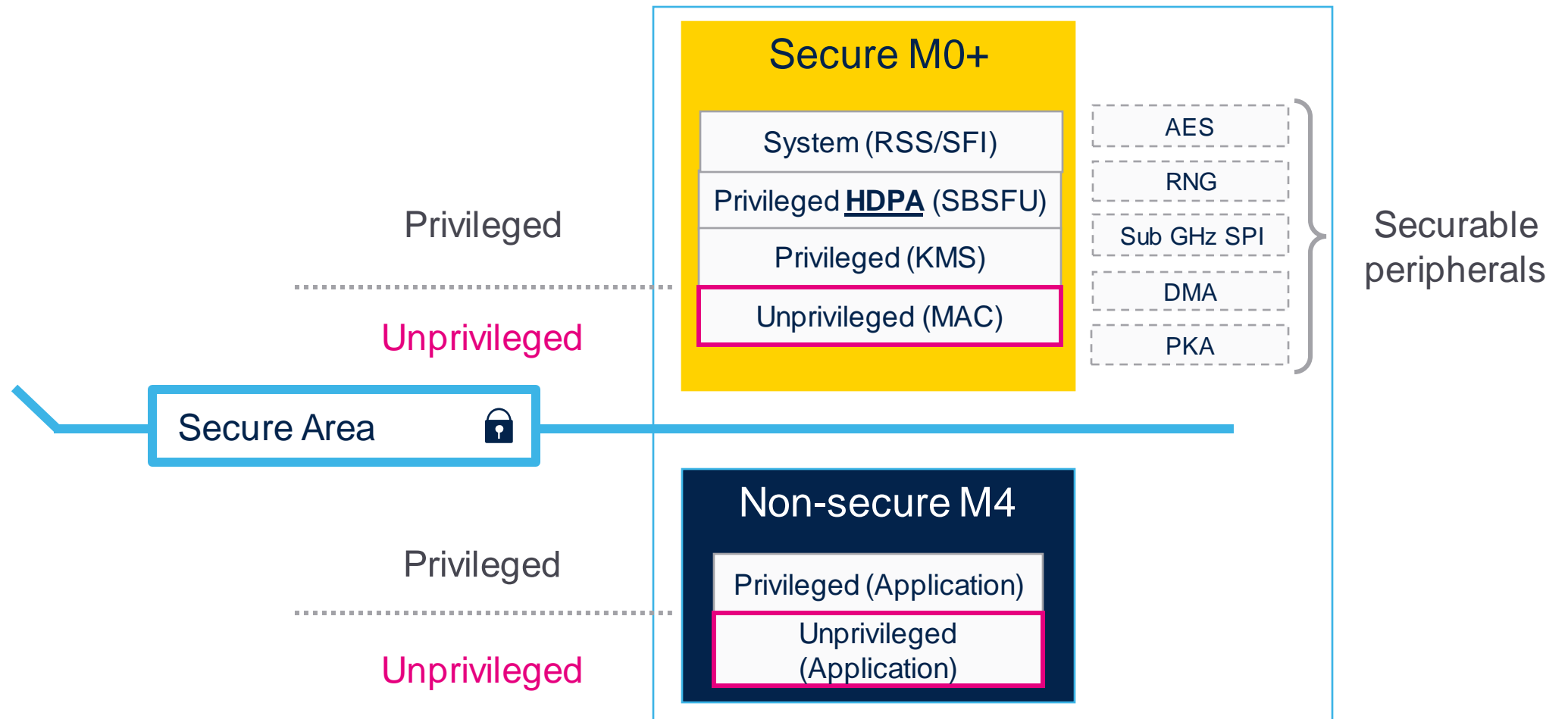
Your implementation, your choice



# Security overview

## Dual-core secure implementation example

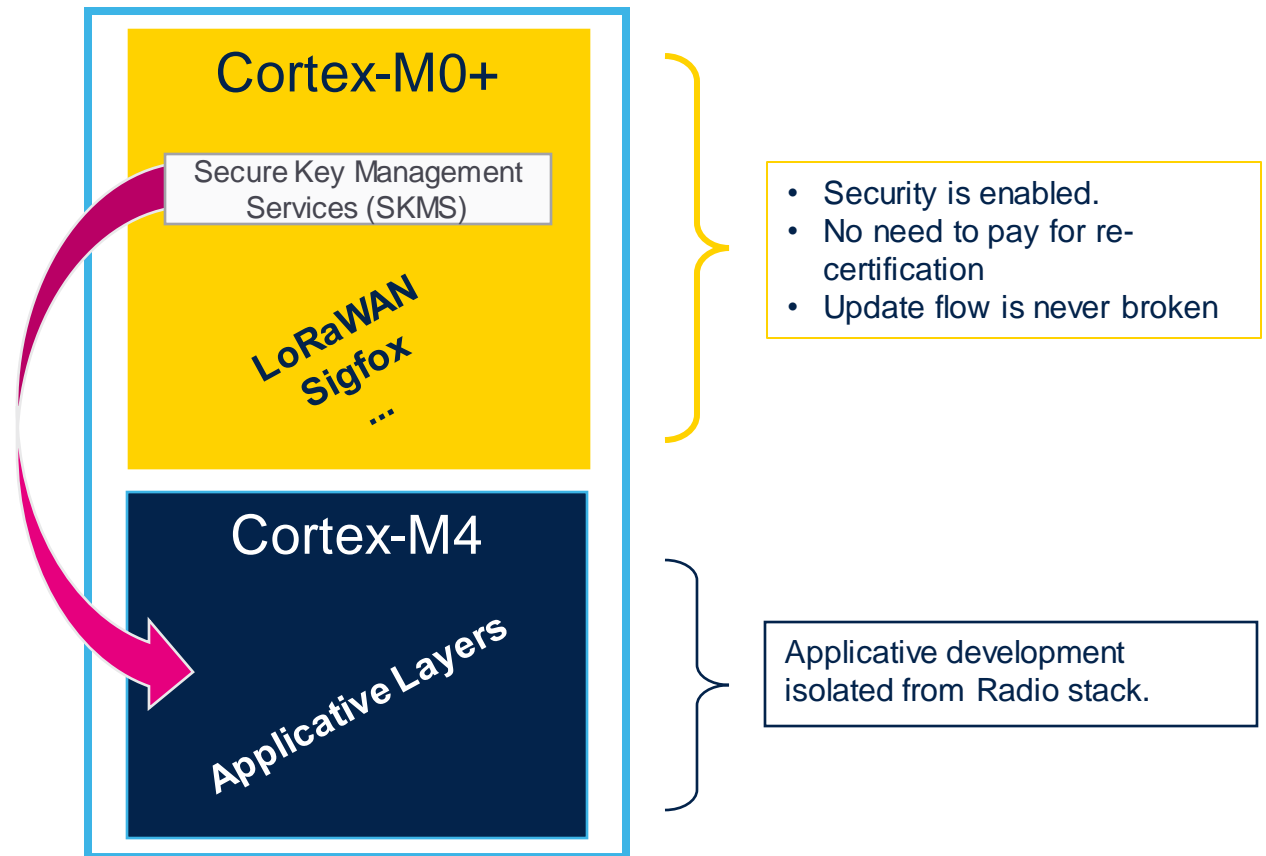
### 6 security domains for Hardware + Software Isolation



# Dual-core firmware isolation example

## How to ensure devices are IoT-ready with radio certification in mind

- Cortex-M4 (non-secure)
  - Non-secure / Open debug
  - Intended for Application Code
- Cortex-M0+ (secure)
  - Secure code & data / Closed debug
  - Intended for radio stack isolated from Application
  - Secure FW Upgrade included (with ST keys)
  - Key Management Services for Application side (CM4) (Customers Key)



# Memory security & privilege access

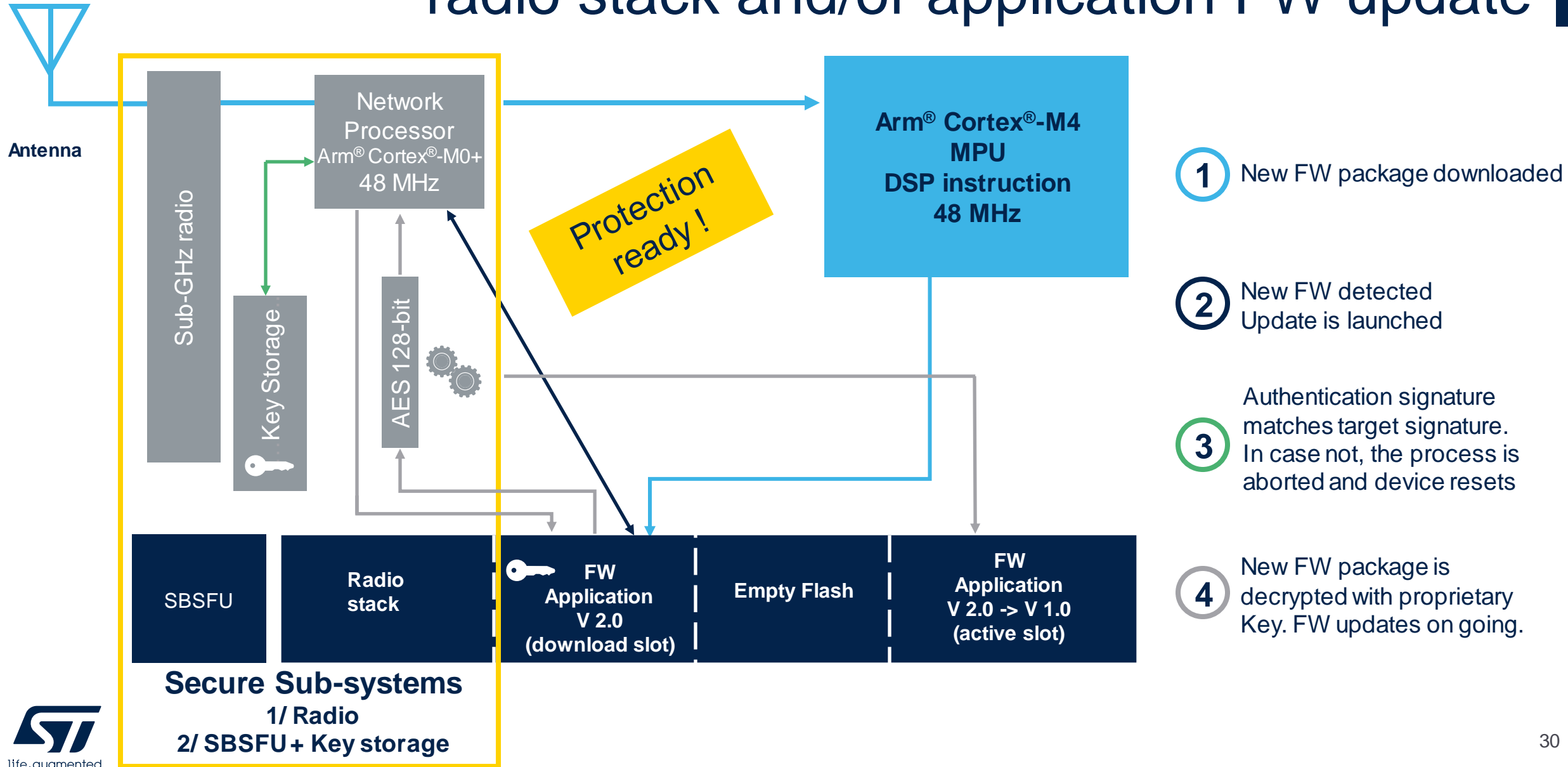
## Firmware development made secure

Core / DMA Memory Area			M0+ Hide Protection Secure	M0+ Secure	M0+ UNPRIVILEGED	M4 Non-Secure	M4 Non-Secure UNPRIVILEGED	DMA Secure	DMA Secure UNPRIVILEGED	DMA Non-Secure	DMA Non-Secure UNPRIVILEGED
Flash	X	Hide Protection Secure	✓	✗	✗	✗	✗	RW	✗	✗	✗
	SRAM	Secure	✓	✓	✗	✗	✗	RW	✗	✗	✗
	X	Secure UNPRIVILEGED	✓	✓	✓	✗	✗	RW	R	✗	✗
	SRAM	Secure UNPRIVILEGED	✓	✓	✓	✗	✗	RW	RW	✗	✗
		Non-Secure	RW	RW	✗	✓	✗	RW	✗	RW	✗
		Non-Secure UNPRIVILEGED	RW	RW	RW	✓	✓	RW	RW	RW	RW

**Legend:**  Secure  Non-Secure  UNPRIVILEGED Unprivileged execution (privileged otherwise)

# IoT protection ready (1/2)

## radio stack and/or application FW update





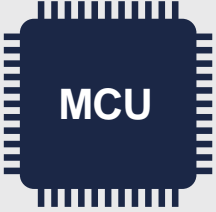

# IoT protection ready (2/2)

## STM32WL counter measure against attacks

Advanced

Basic



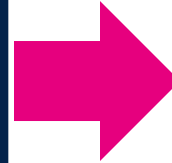
Attacks	Forms of attacks	STM32WL countermeasures
<b>Non-Invasive Attacks</b> 	<ul style="list-style-type: none"> <li>• Environment modification <ul style="list-style-type: none"> <li>• Temperature</li> <li>• Voltage</li> <li>• Clock</li> <li>• ...</li> </ul> </li> <li>• Fault injection (glitches...)</li> <li>• Exploit debug features</li> <li>• Side channel, power Analysis...</li> </ul>	<ul style="list-style-type: none"> <li>• Temperature sensor</li> <li>• Power supply integrity monitor</li> <li>• Clock security system</li> <li>• Tamper pads</li> <li>• Watchdog</li> <li>• Memory ECC, Parity check</li> <li>• RTC alarm, Backup registers, SRAM mass erase</li> <li>• JTAG Read out protection</li> <li>• BOOT from Flash only</li> </ul>
<b>Software Attacks</b> 	<ul style="list-style-type: none"> <li>• Low Authentication / Encryption</li> <li>• Extract keys</li> <li>• Exploitation of applicative test features</li> <li>• Malware / Virus</li> <li>• Replay, privilege escalation</li> </ul>	<ul style="list-style-type: none"> <li>• Key Storage (KS)</li> <li>• RNG, Crypto accelerator, CRC</li> <li>• Write memory protection (WRP)</li> <li>• Read Out memory protection (RDP)</li> <li>• Memory Protection Unit (MPU)</li> <li>• Secure Areas</li> <li>• Secure Boot (SB)</li> <li>• Secure Firmware Update (SFU)</li> <li>• Proprietary Code Read-Out Protection (PCROP)</li> <li>• 96-bit ID</li> </ul>

# Security takeaways

2 independent cores for maximum flexibility

## Application benefits

- ST Secure Firmware Install (SFI/RSS)
- Secure Boot (SB)
- Secure Firmware Update (SFU)
- Secure Key Management Services (KMS)
- Secure radio MAC layer communication
- Up to 6 Security domains
- Chain of trust

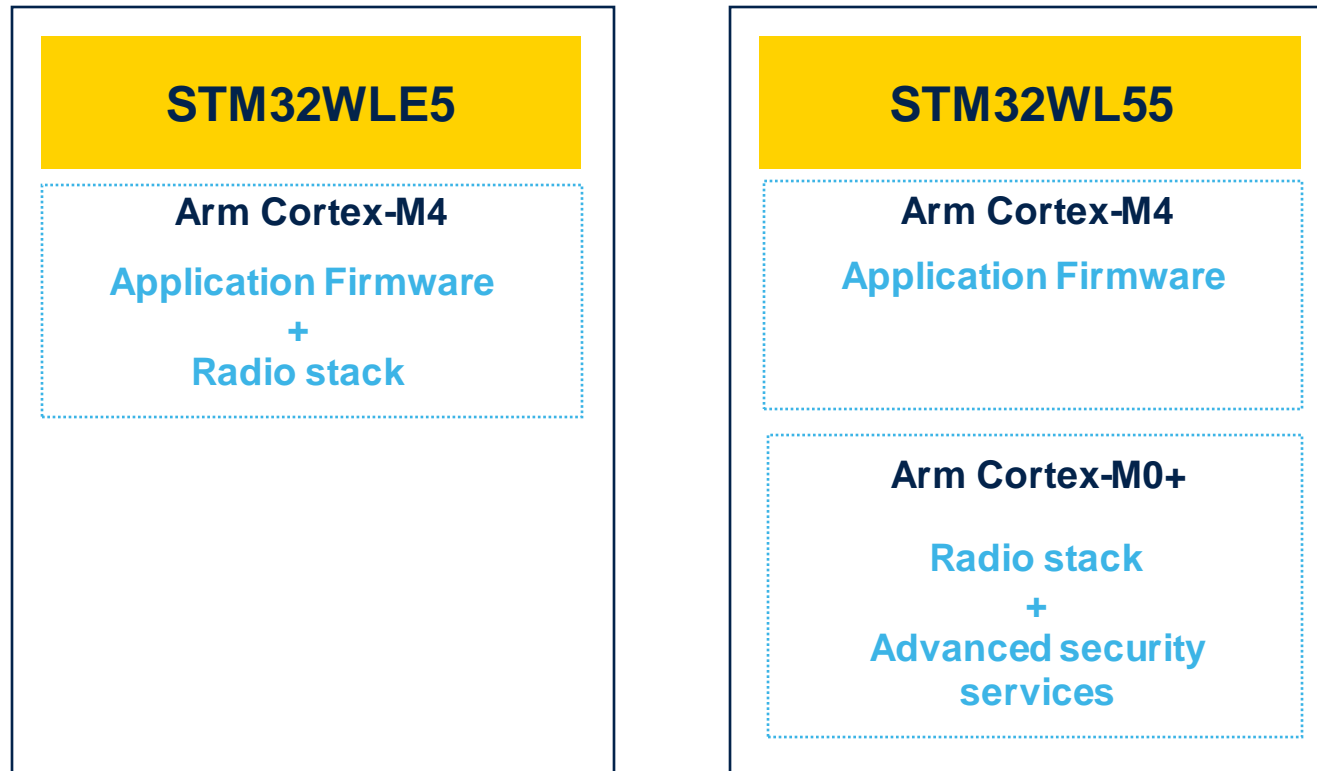


## Customer benefits

- ➔ Flexible Security implementation
- ➔ IP protection
- ➔ Non cloneable device
- ➔ Trustability of the device, anti-hacking
- ➔ Trustable fleet maintenance

# LoRaWAN - Chips & stacks delivery model

## Open chips, takeaway stacks



### Certified LoRaWAN stack

- *Open stack*
- *Available from [st.com/STM32CubeWL](https://st.com/STM32CubeWL)*

# Enjoy Sigfox wherever you are

An open SoC for a global network



**sigfox**

**STM32WLE5**

Arm Cortex-M4

Application Firmware

+

Radio stack

**STM32WL55**

Arm Cortex-M4

Application Firmware

Arm Cortex-M0+

Radio stack

+

Advanced security  
services

**Certified stack from RC1 to RC7  
+ Monarch certified!**

- *Open stack*
- *Available from [st.com/STM32CubeWL](https://st.com/STM32CubeWL)*

# STM32WL and W-MBUS

STM32WL is ideal for smart metering applications



*Please contact Stackforce Sales Office  
to get W-MBUS stack for STM32WL*

# STM32WL – W-MBUS Modes

STM32WL is ideal for smart metering applications



- **Mode S: Stationary**

868 MHz

- *Meters send data few times a day*

- **Mode T: Frequent Transmit**

868 MHz

- *Meters send data several times a day*

- **Mode C: Compact**

868 MHz

- *Higher data rate version of mode T*

- **Mode N: Narrowband**

169 MHz

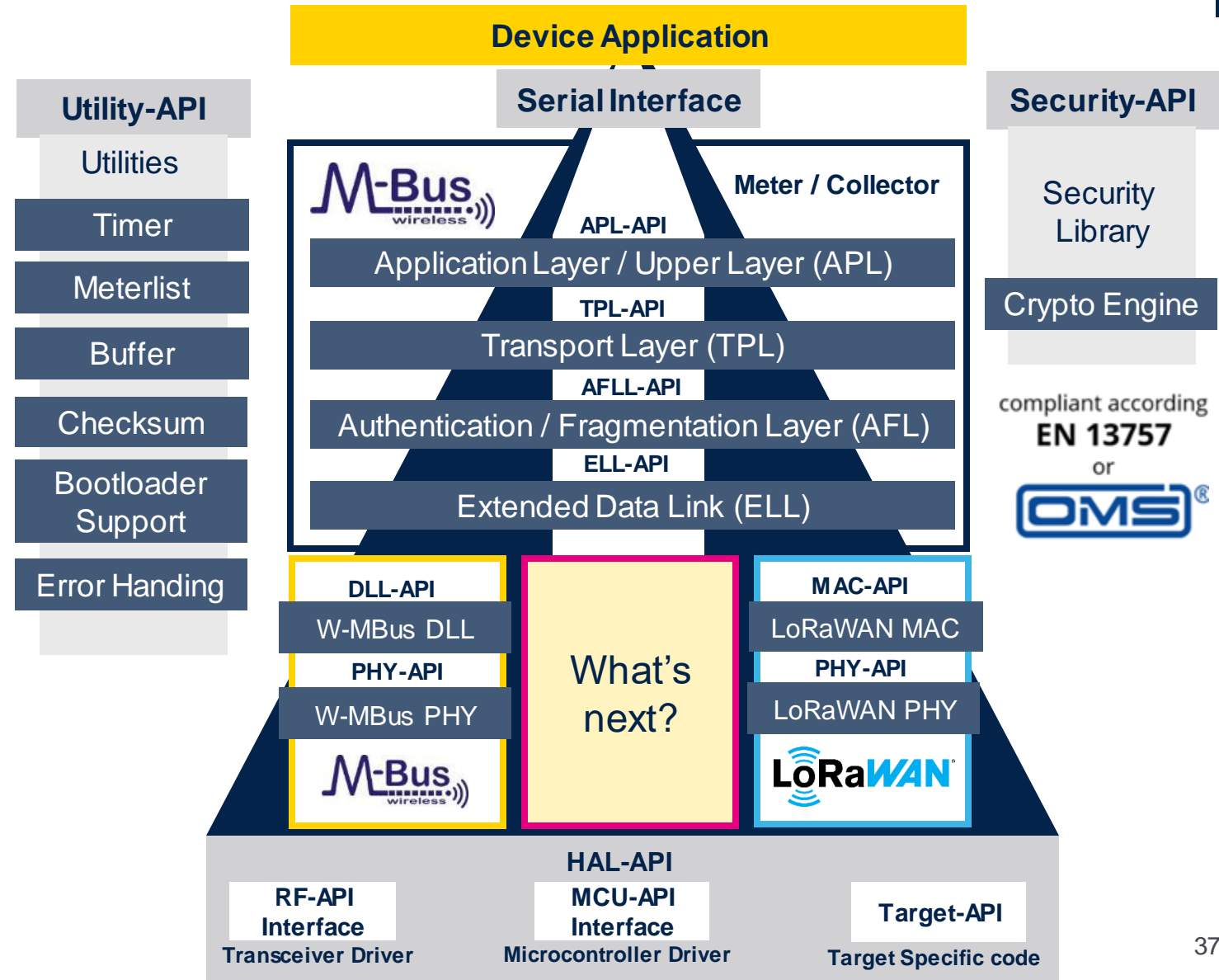
- *Long range, narrow band system*

# From W-MBUS to W-MBUS-over-LoRaWAN

## STM32WL for smart metering



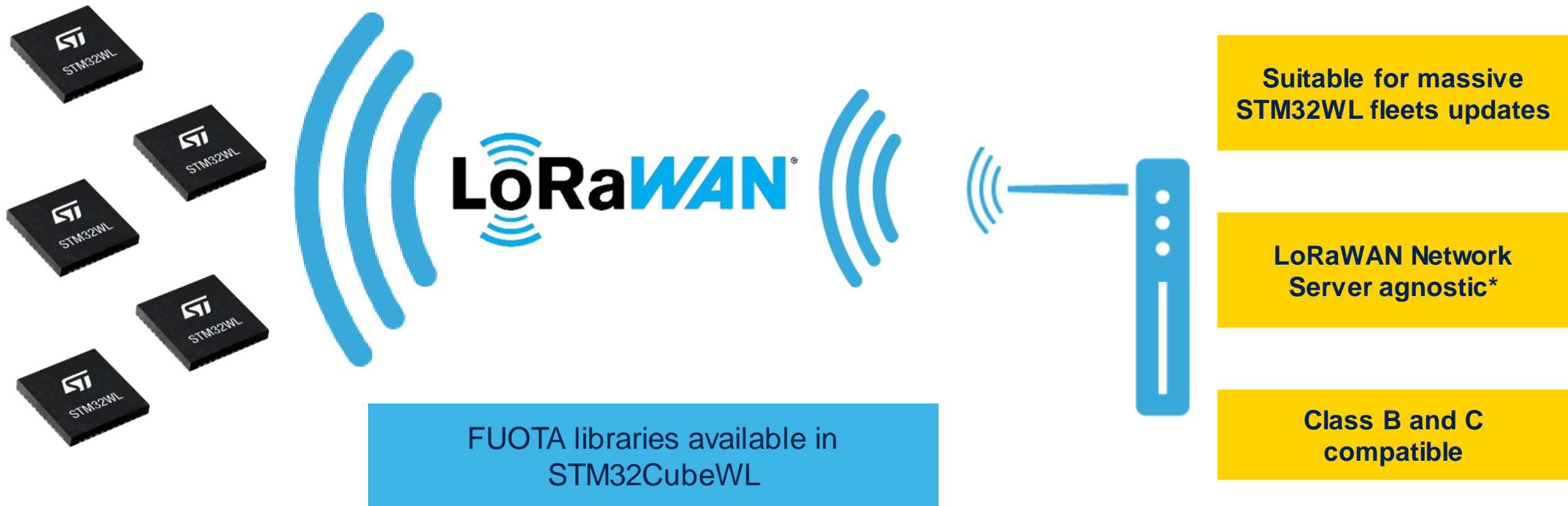
- W-MBUS MAC and PHY can be replaced by LoRaWAN Mac and PHY
- W-MBUS benefits from LoRaWAN long-range capabilities and flexibility
- Mioty stack offer also available





# STM32WL and FUOTA

## Firmware Update Over The Air

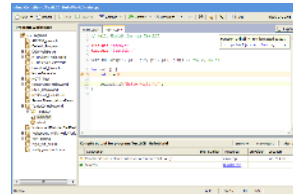


# STM32WL Ecosystem



# STM32WL – ecosystem overview

Fully integrated into the rich and market-proven STM32 ecosystem



**STM32 Nucleo-64**

**Flexible prototyping**

**Dev tools**

STM32CubeMX  
STM32CubeWL  
STM32CubeMonitor  
STM32CubeProg  
STM32CubeIDE + Partners IDEs

**Stacks**

LoRaWAN (ST)  
Sigfox (ST)  
Wireless-MBUS / Mioty (Stackforce)  
ZETA (Zifisense)

# Prototyping made as easy as 1,2,3



NUCLEO-WL55JC

Hardware Evaluation Tool  
Nucleo-64 board

**ST**  
STM32WL

**STM32**  
CubeMonitor



**STM32**  
CubeProgrammer

**STM32**  
CubeMX

STM32CubeMX/STM32CubeWL/  
STM32CubeProg & STM32CubeMonitor  
Code generation  
Power calculation



## Main Features

868/915/923 MHz

# 433/470 MHz

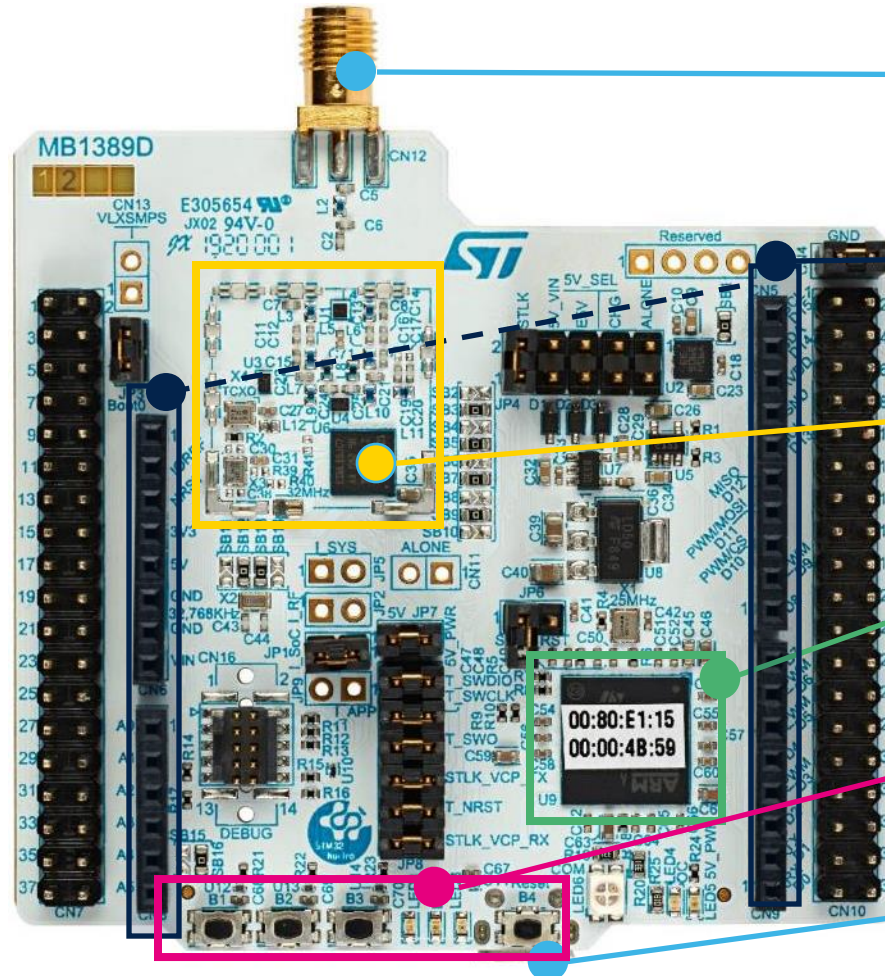
## Arduino™ extension connectors : easy access to add-ons

STM32WL  
(under a metallic shield)

Integrated ST-LINK/V3:  
mass storage device flash programming

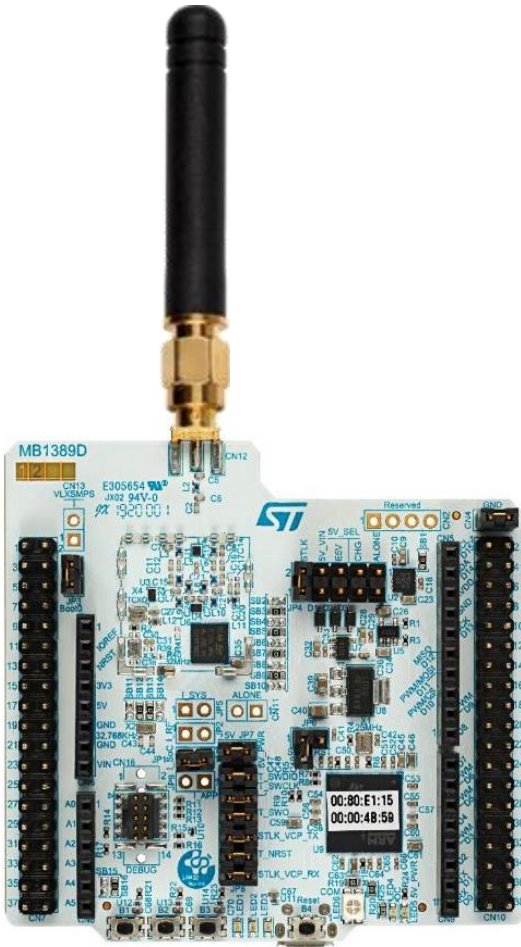
4 push buttons, 3 color LEDs,  
Jumper settings

Flexible board power supply :  
through USB or external source



# STM32WL - certifications overview

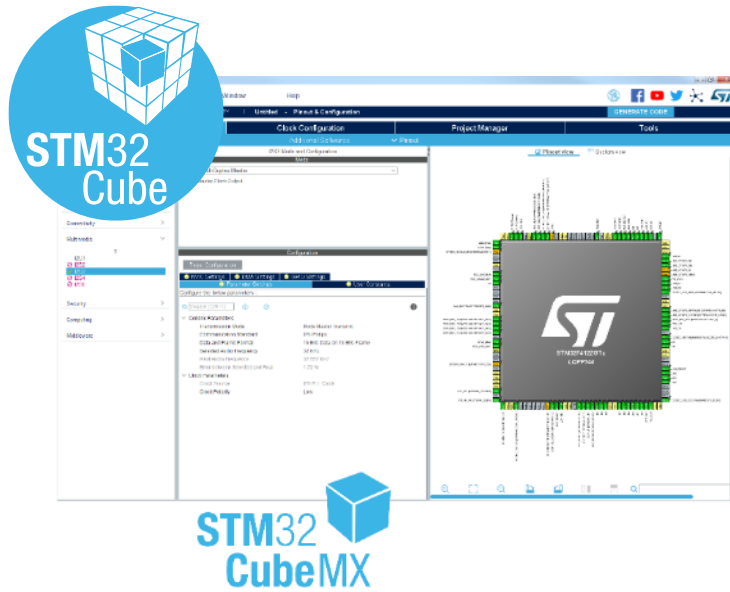
## Protocol and commercial certifications





# Software development tools

A complete flow, from configuration to monitoring

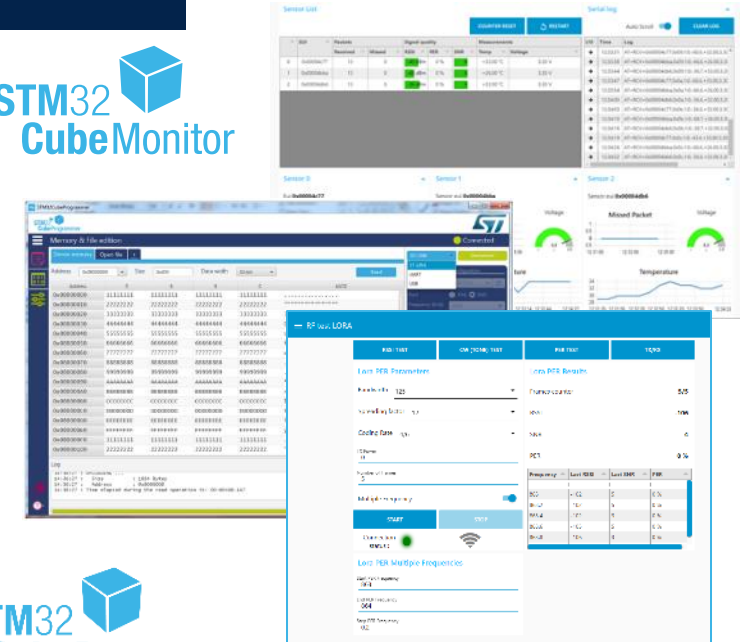


FREE  
IDE's



More to come after mass market launch

STM32  
CubeMonitor



**STM32CubeMX, GUI Builders**  
Configure & Generate Code

**ST and Partner IDEs**  
Compile and Debug

**STM32CubeProg/Monitor**  
Monitor, Program & Utilities



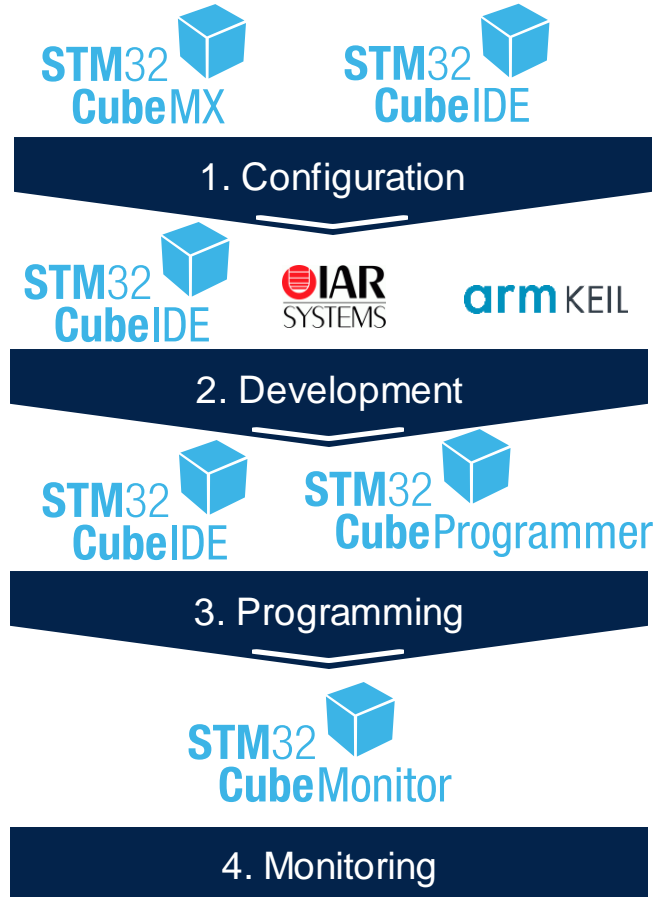




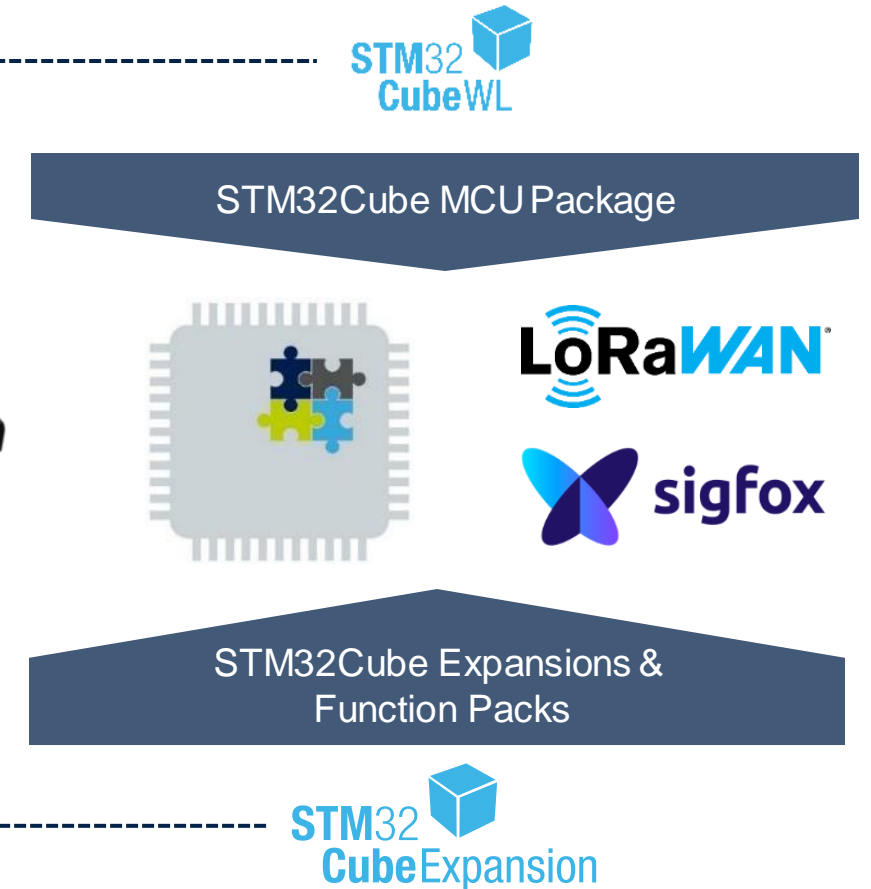
# Key takeaway: end-to-end ecosystem



## Software Tools



## Embedded Software



# Save on your application cost

## Integrated functionalities helps you drop the BOM down

### Optimization of the silicon cost

- Deep integration factor
- System-on-chip avoids to use a second radio
- Less external components
- Single 32 MHz crystal for CPU & embedded radio
- 32 kHz master clock output available
- Possibility to use a 32 MHz crystal (XO) instead of a temperature compensated crystal (TCXO)
- 2-layers PCB enablement with QFN package



### Free of charge ecosystem

- LoRaWAN stack: free of charge
- Sigfox stack: free of charge
- STM32CubeMX: free of charge
- STM32CubeMonitor: free of charge
- STM32CubeProg: free of charge

# STM32 rolling longevity commitment

Longevity commitment is renewed every year



Starting in 2021

- **STM32F1** (launched in **2007**)
- **STM32L1** (launched in **2009**)
- **STM32F2** (launched in **2010**)
- ...
- **STM32WB** (launched in **2018**)
- **STM32G0** (launched in **2018**)
- **STM32G4** (launched in **2019**)
- **STM32WL** (launched in **2020**)

22 years of commitment

20 years of commitment

19 years of commitment

11 years of commitment

11 years of commitment

10 years of commitment

10 years of commitment



# Releasing your creativity



[/STM32](#)



[@ST\\_World](#)



[community.st.com](#)



[www.st.com/STM32WL](#)



[wiki.st.com/stm32mcu](#)



[github.com/STMicroelectronics](#)



[STM32 Wireless – Video Playlist](#)



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# Our technology starts with You



Find out more at [www.st.com/STM32WL](http://www.st.com/STM32WL)

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