STM32WL series MCU
long-range wireless
system-on-chip
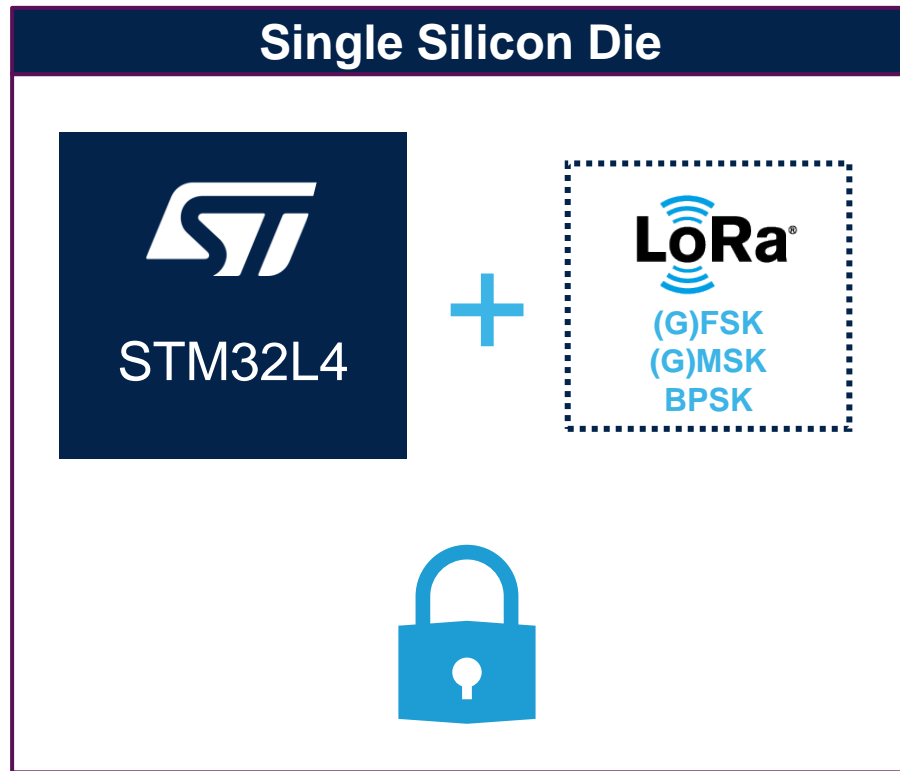
System-on-chip made for versatility

A Long-Range Wireless Microcontroller:
one die, many IoT possibilities

World First!

Single Silicon Die

STM32L4 **+** LoRa®
(G)FSK
(G)MSK
BPSK

= STM32**WL**

Make the choice of STM32WL series

The 7 key points that will make the difference

LoRa

(G)FSK
(G)MSK
BPSK

Multi-modulation

$

Massive integration
Cost saving

Open platform

Ultra-low-power

STM32 Security

256KB

3.6 V   73-pin

1.8 V   48-pin

64KB Flash

A large offer is coming

LONGEVITY
10 YEARS
COMMITMENT
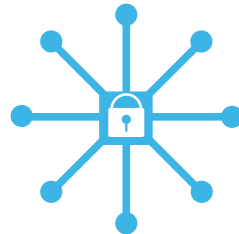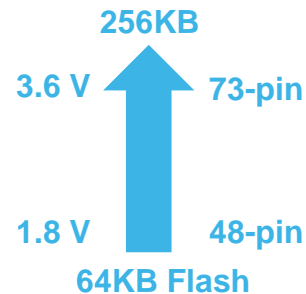
No matter what!

Deep integration
wide purposes

4 modulations - many protocols

STM32**WL**

LoRa® → LoRa**WAN**®

LoRa® - based proprietary

(G)FSK → sigfox * + proprietary

(G)MSK → Proprietary

BPSK$_{TX}$ → sigfox * + proprietary
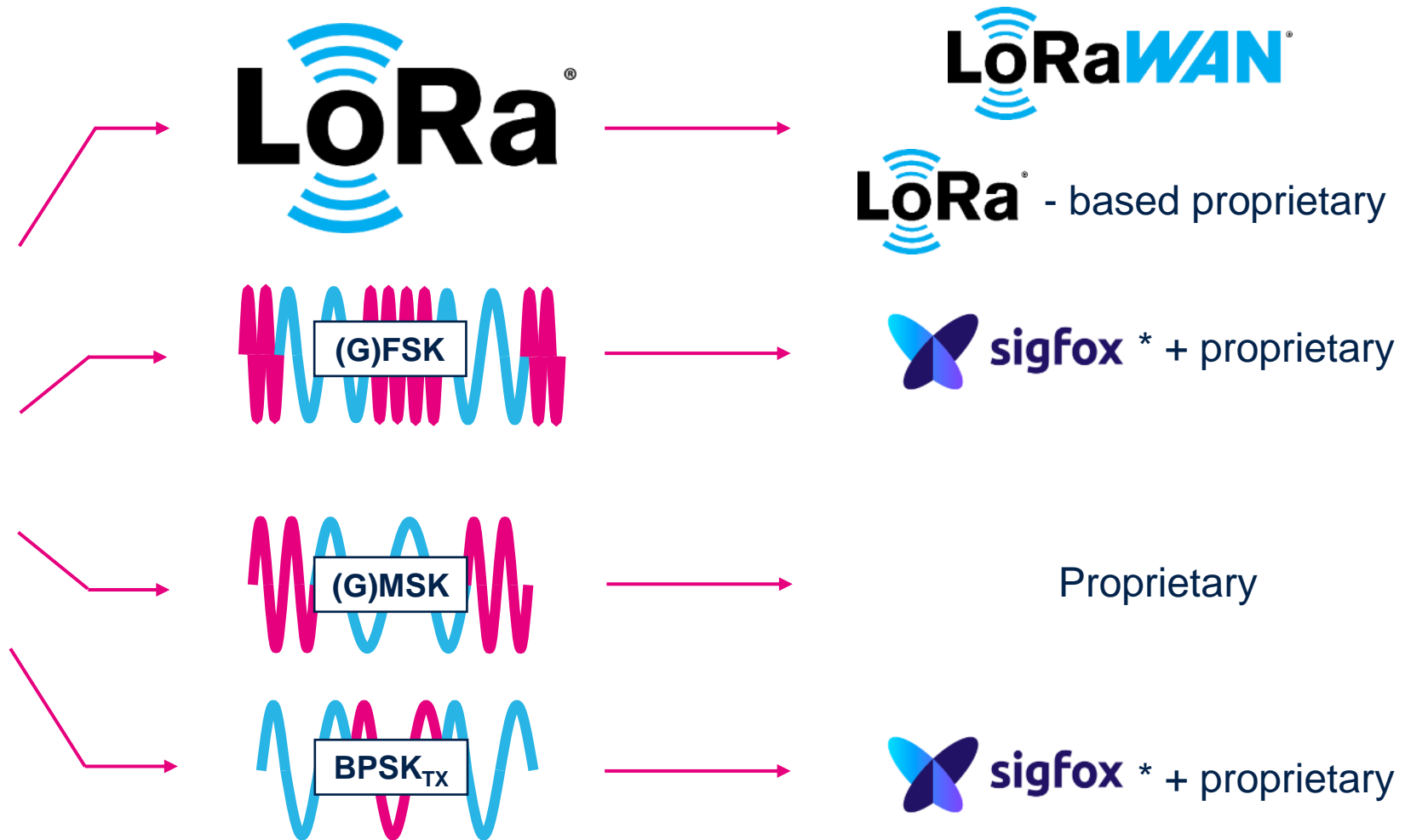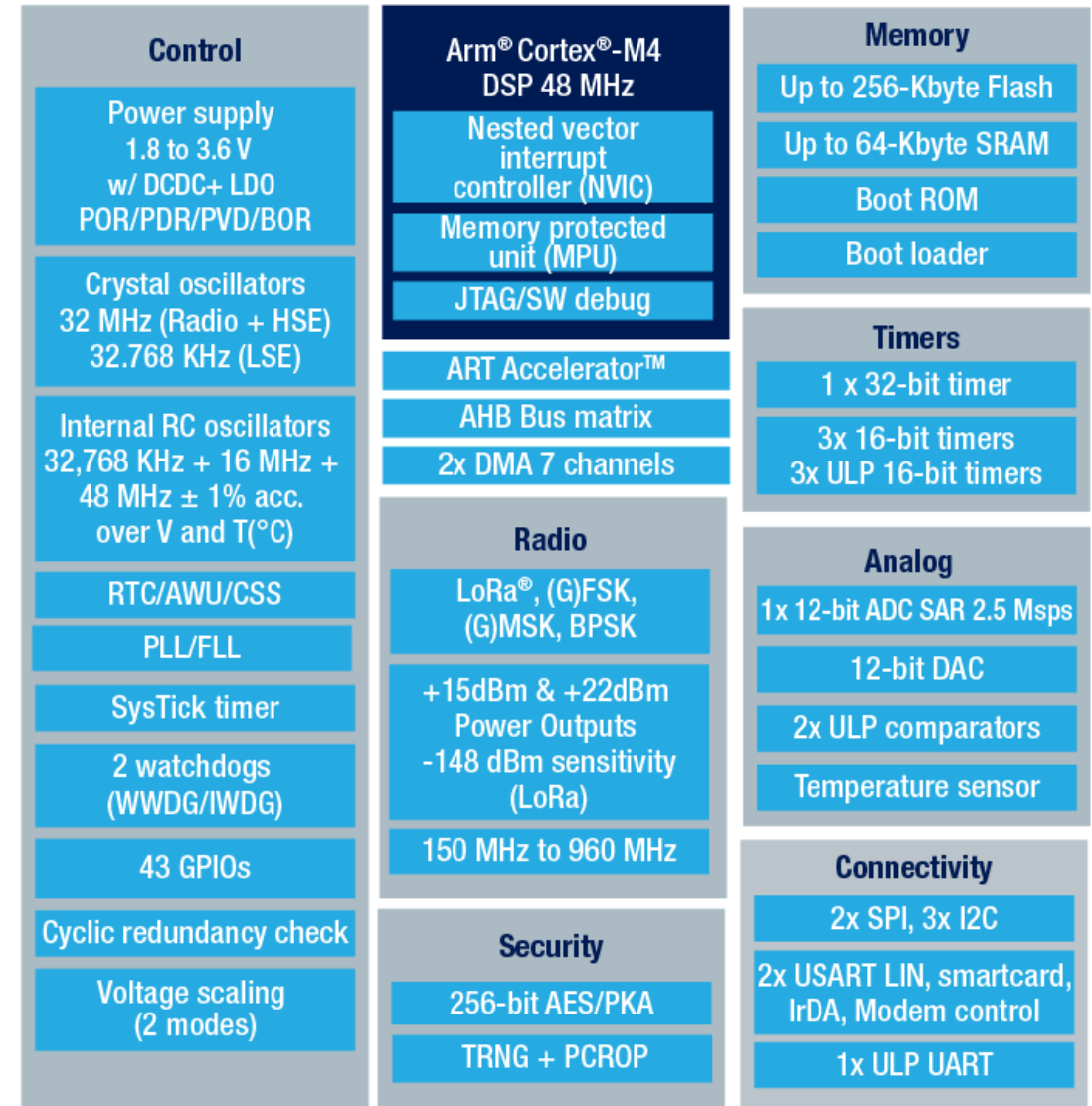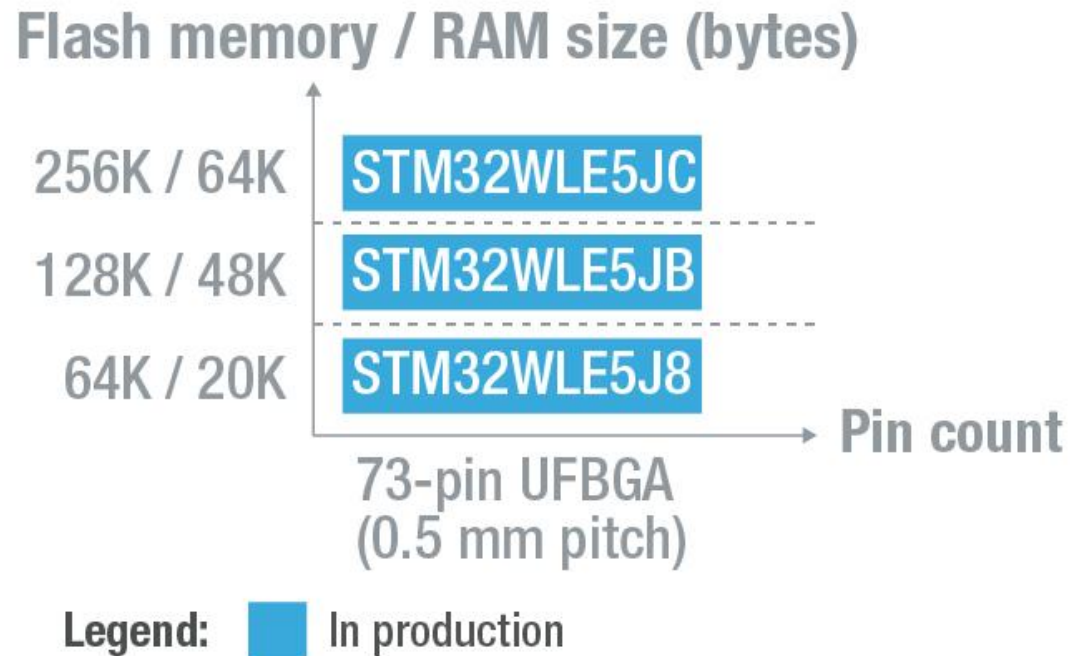
* Coming soon

STM32WL - a rich feature set

- Key features
- Arm® Cortex®-M4 DSP up to 48 MHz
- Up to 256 KB Flash and 64 KB SRAM
- Sub-GHz Radio – Multi-modulations
  - 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: 5.4mA and TX: 15mA (at 10dBm) / 87mA (at 20dBm) [3.3V]
- 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
  - 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

Control

Power supply
1.8 to 3.6 V
w/ DCDC+ LDO
POR/PDR/PVD/BOR

Crystal oscillators
32 MHz (Radio + HSE)
32.768 KHz (LSE)

Internal RC oscillators
32,768 KHz + 16 MHz +
48 MHz ± 1% acc.
over V and T(°C)

RTC/AWU/CSS

PLL/FLL

SysTick timer

2 watchdogs
(WWDG/IWDG)

43 GPIOs

Cyclic redundancy check

Voltage scaling
(2 modes)

Arm® Cortex®-M4 DSP 48 MHz

Nested vector interrupt controller (NVIC)

Memory protected unit (MPU)

JTAG/SW debug

ART Accelerator™

AHB Bus matrix

2x DMA 7 channels

Radio

LoRa®, (G)FSK, (G)MSK, BPSK

+15dBm & +22dBm
Power Outputs
-148 dBm sensitivity
(LoRa)

150 MHz to 960 MHz

Security

256-bit AES/PKA

TRNG + PCROP

Memory

Up to 256-Kbyte Flash

Up to 64-Kbyte SRAM

Boot ROM

Boot loader

Timers

1 x 32-bit timer

3x 16-bit timers
3x ULP 16-bit timers

Analog

1x 12-bit ADC SAR 2.5 Msps

12-bit DAC

2x ULP comparators

Temperature sensor

Connectivity

2x SPI, 3x I2C

2x USART LIN, smartcard, IrDA, Modem control

1x ULP UART

STM32WL Sub-GHz - portfolio

Flash memory / RAM size (bytes)

256K / 64K	STM32WLE5JC
128K / 48K	STM32WLE5JB
64K / 20K	STM32WLE5J8

Pin count

73-pin UFBGA
(0.5 mm pitch)
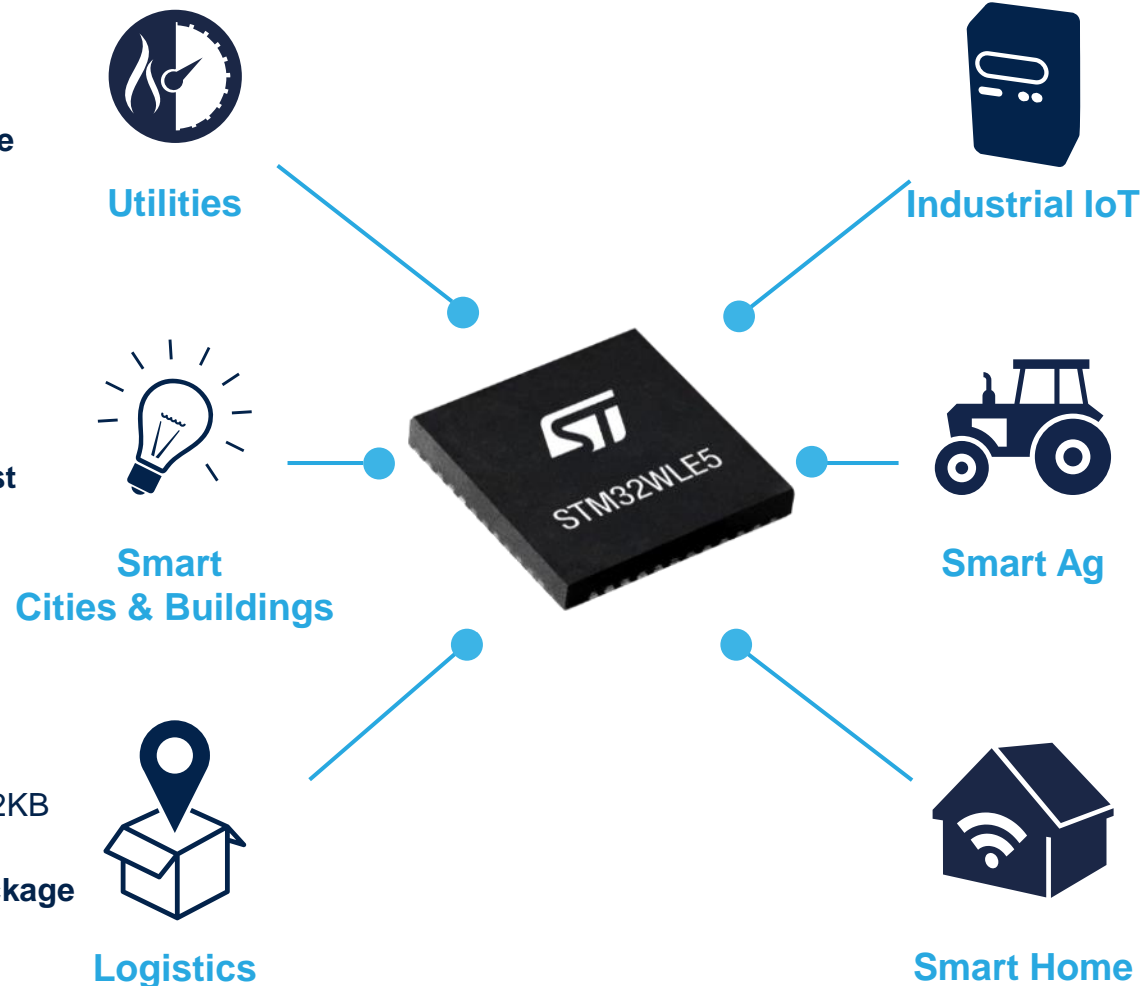
Legend: ▢ In production

STM32WLE5

**Up to 43 GPIOs for full flexibility
+
Tiny package footprint**

Best suited for many LPWAN market

- Worldwide compatibility **150 MHz to 960 MHz** Linear Range
- Multi-protocol capable
- ST Longevity commitment: **10 years life time**

Utilities

- Up to **105 °C** MCU capable
- **Only 5 µs wakeup time** for best latencies
- Only 5.4 mA as LoRa RX consumption for battery optimization

Industrial IoT

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

Smart Cities & Buildings

STM32WLE5

- 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

Smart Ag

- **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**

Logistics

- 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

Smart Home

Flexible power scheme

Flexible power scheme flexpowercontrol

Typ with LDO @ V_{DD} = 3 V @ 25 °C

Wake-up time to RUN

Wake-up time	Mode	Value
6 cycles	RUN (Range1) at 48 MHz	71* / 115 µA / MHz
5 µs	RUN (Range2) at 16 MHz	100* / 115 µA / MHz
5.5 µs	SLEEP at 48 MHz	28* / 35 µA / MHz
29 µs	STOP 1 (full retention)	4.55 µA**
29 µs	STOP 2 (full retention)	1 µA**
267 µs	STANDBY + 32 KB RAM	390 nA**
	STANDBY	71 nA*
	SHUTDOWN	31**** / 175 nA**
	V_{BAT}	5**** / 200 nA**

RF Capable

* Typical values with SMPS, **RF OFF**
** with RTC on LSE Bypass
*** Able to maintain RF context
**** All OFF

Benchmark Scores

- High Efficiency
  - → CoreMark score = 162[1]
- Ultra Low-Power Platform
  - → ULPBbench score ≈ 204[1]

[1] Pending certification

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Flexible power scheme matching your application needs

LPWANs made easy through Ultra-Low-Power tradeoffs

Seamless toolbox
(I²C, SPI, USART, ADC/DAC,
Timers, Comparators etc.)

RF available
In all power modes

Power mode	Arm® Cortex®-M4	Peripherals	RAM Retention	RF
Run	✓	✓	Yes	✓
Sleep	X	✓	Yes	✓
Stop 0	X	✓	Yes	✓
Stop 1	X	✓	Yes	✓
Stop 2	X	Subset	Yes	✓
Standby	X	X	Yes	✓
Shutdown	X	X	X	X

Back-up registers are **always** available

Flexible peripherals power mapping

	STOP0	STOP1	STOP2
Consumption (without Real Time Clock)	Typ, 25 °C, 3 V, LDO		
	400 µA	4.55 µA	1 µA
Wakeup time to 48 MHz / Flash	2.2 µs	5 µs	5.5 µs
Wakeup time to 48 MHz / RAM	2.2 µs	5.1 µs	5.5 µs
Wakeup clock	≤ 48 MHz		
Regulator	Main or Low-Power regulator		Low-power regulator
Peripherals	All	All	CSS, RTC, 3 Tamper Pins, 1x LPUART, 1x I²C, 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	5 mA DCDC 8.7 mA LDO
RX	LoRa® 125 kHz	5.4 mA DCDC 9.45 mA LDO

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Flexible power implementation

Tailor STM32WL to your IoT needs

STM32WL

- LDO
- DC-DC
- CORE + RF IP
- REG PA
- LP PA
- HP PA

Power Management Config.

2 Power Outputs

Up to +15 dBm

Up to +22 dBm
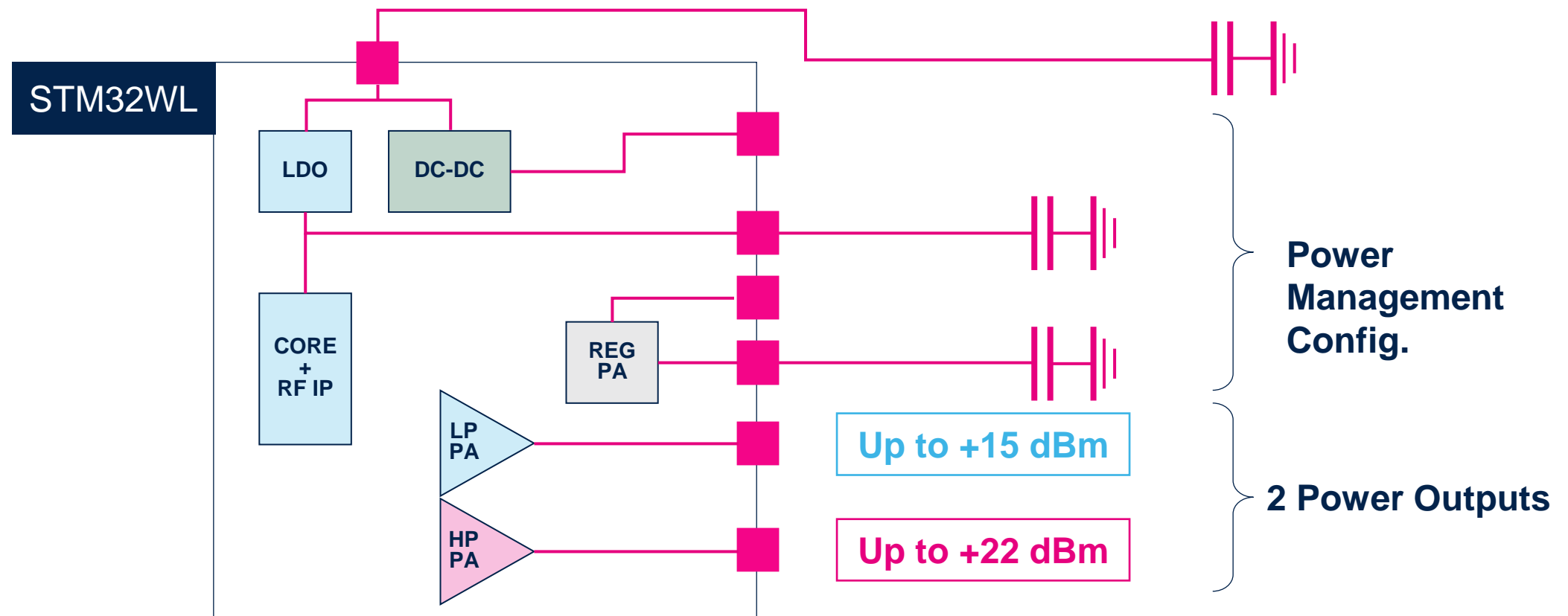
Advanced features and ecosystem

STM32WL - safety and security

Secure you application with embedded safety & security

Safety

- Back-up clock circuitry
- Supply monitoring
- Dual watchdog
- Flash memory with ECC (address status register)
- SRAM Parity check
- Cyclic Redundancy Check
- Brown-out reset in all modes
- Clock Security System
- Backup byte registers

STM32**WL**

Security

- Anti-Tamper detection
- Boot Lock
- Read & Write protection
- Memory Protection Unit (MPU)
- Software IP Protection
- True Random Number Generator
- Private Key Accelerator
- Unique IDs (64- and 96-bit)
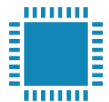
Device integrity   Data Integrity

Anti intrusion Traceability   Privileges Permission Management   Firmware IP Protection   Data encryption

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Chips & stacks delivery model

Open chips, takeaway stacks

STM32WL

Arm Cortex-M4

Application Firmware
+
Peripherals
+
Radio stack
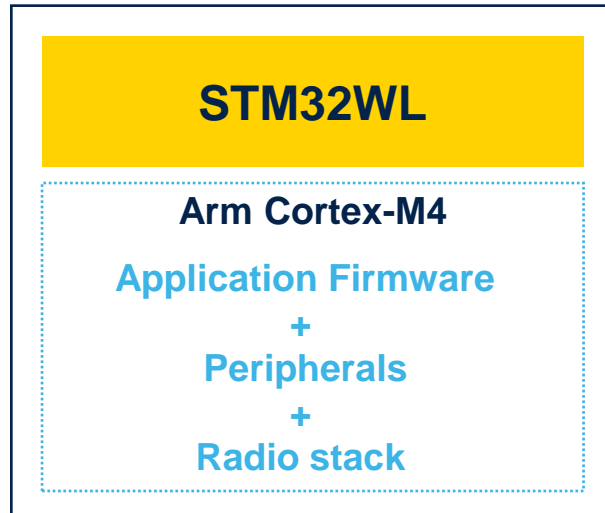
- **Open Platform**
- **Open stack**

LoRaWAN®

Certified LoRaWAN stack

Please contact your nearest ST
Sales Office for more information

A higher level of integration

MCU + Radio 2-in-1 solution

STM32WL

Arm Cortex-M4

Application Firmware
+
Peripherals
+
Radio stack

VS

Standalone MCU — Standalone transceiver
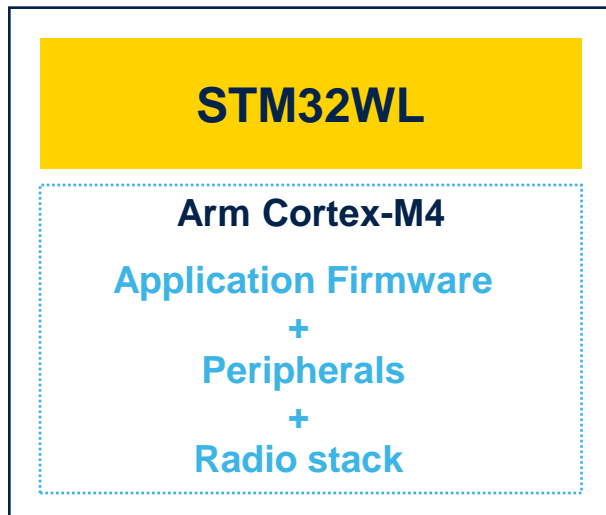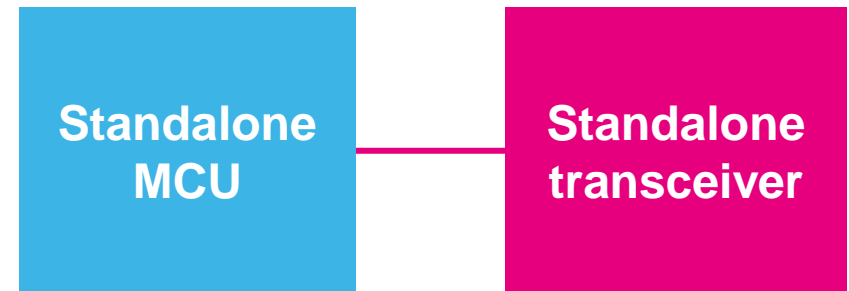
- SoC solution **(1 single die)**
- **All-in-1** solution - cost saving
- Simplified development helps speeding up time to market

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

STM32WL – introductory ecosystem

Fully integrated into the rich and market-proven STM32 ecosystem
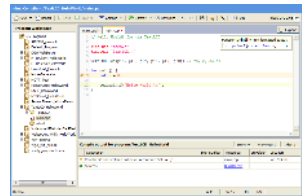
STM32 Nucleo-64	Dev tools	Stacks
Flexible prototyping	STM32CubeMX for pinout and clock configuration STM32CubeProg Partners IDE	LoRaWAN Sigfox[1] [1] Coming soon

Please contact your nearest ST
Sales Office for more information

Save on your application cost

Integrated functionalities helps you drop the BOM down

Optimization of the silicon cost

$

Optimization of the ecosystem cost

- Deep integration factor

- Less external components

- Single 32 MHz crystal for CPU
  & embedded radio

- 32 kHz master clock output available

- LoRaWAN stack: free of charge

- STM32CubeMX: free of charge

- STM32CubeProg: free of charge

- System-on-chip avoids to use a second radio

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STM32 rolling longevity commitment

Longevity commitment is renewed every year

Starting in 2020

- **STM32F1** (launched in **2007**) — **22 years** of commitment
- **STM32L1** (launched in **2009**) — **20 years** of commitment
- **STM32F2** (launched in **2010**) — **19 years** of commitment
- ...
- **STM32WB** (launched in **2018**) — **11 years** of commitment
- **STM32G0** (launched in **2018**) — **11 years** of commitment
- **STM32G4** (launched in **2019**) — **10 years** of commitment
- **STM32WL** (launched in **2020**) — **10 years** of commitment

Releasing your creativity

STM32

/STM32

@ST_World

community.st.com

www.st.com/STM32WL

Power consumption compare L073 – L431

MCU Settings / Results Summary

MCU	STM32L073CZTx	Sequence Time / Ta Max	3,601 s / 103.84 °C
V_{DD}	3.0 V	Average Consumption	2.41 µA
Datasheet	027096_Rev3	Average DMIPS	40.0 DMIPS
Battery	Battery not found	Battery Life Estimation	No battery set!

Sequence Table

Step	Mode	Vdd	Range/Sc...	Memory	CPU/Bus...	Clock Co...	Src Freq	Peripherals	Add. Curr...	Step Curr...	Duration	DMIPS	Voltage S...	Ta Max	Category
1	RUN	3.0	Range1-...	FLASH	32 MHz	HSEBYP...	16 MHz	I2C1 SPI1	0 mA	7.13 mA	1 s	30.4	Battery	103.84	In DS Table
2	STOP	3.0	NoRange	n/a	0 Hz	ALL CLO...	0 Hz		0 mA	430 nA	3600 s	0.0	Battery	105	In DS Table

Sequence Table

Step	Mode	Vdd	Range/Scale	Memory	CPU/Bus ...	Clock Config	Src Freq	Peripherals	Add. Current	Step Current	Duration	DMIPS	Voltage S...	Ta Max	Category
1	RUN	3.0	Range1-Hi...	FLASH	32 MHz	HSE BYP	32 MHz	I2C1 SPI1	0 mA	4.76 mA	1 s	0.0	Battery	104.19	In DS Table
2	STOP2	3.0	NoRange	n/a	0 Hz	ALL CLO...	0 Hz		0 mA	1.06 µA	3600 s	0.0	Battery	105	In DS Table

Thank you

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