



life.augmented

# STM32Wx助力物联世界

STM32 全国研讨会

2020年9月



- 1 STM32 无线通信技术
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- 3 STM32WL: 长距离SubGHz无线多协议开放MCU
- 4 STM32Wx 生态系统
- 5 举例: STM32Wx助力物联家居
- 6 要点总结

# 无线通信技术

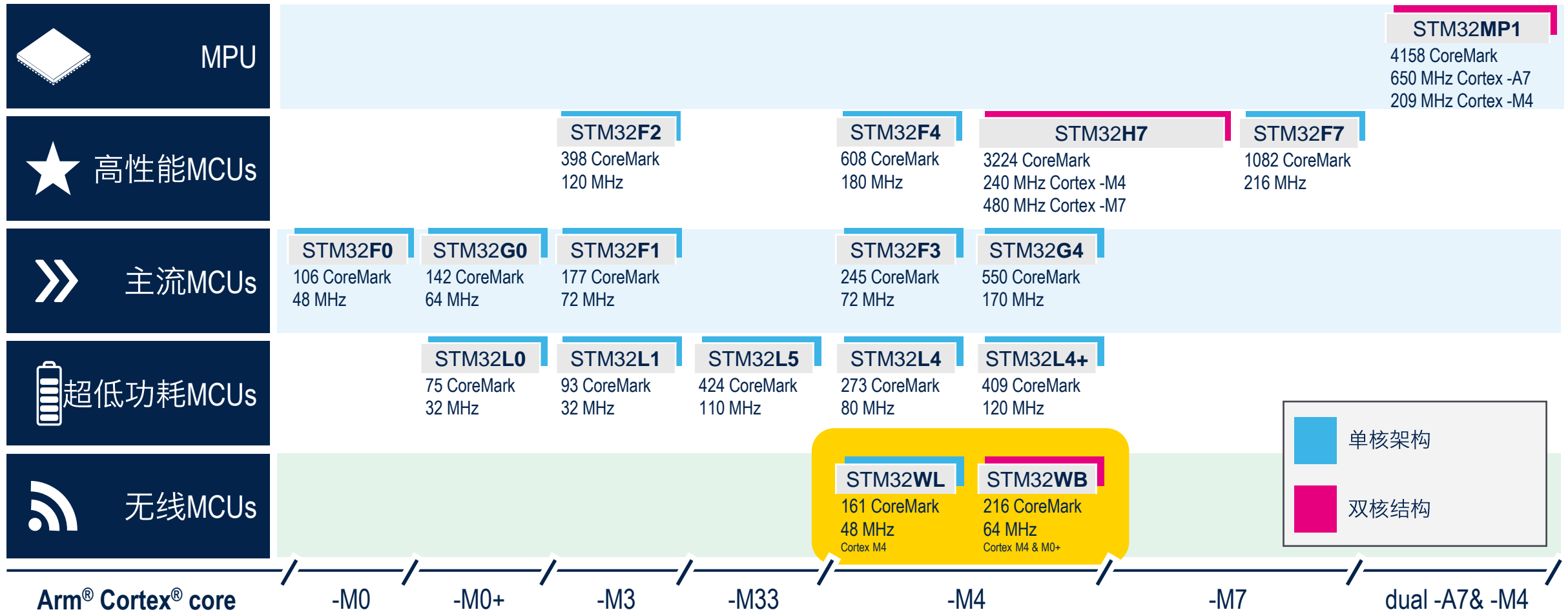


# STM32 无线通信技术



# STM32家族

## Arm® Cortex®-M 32-bit 通用MCU领导者



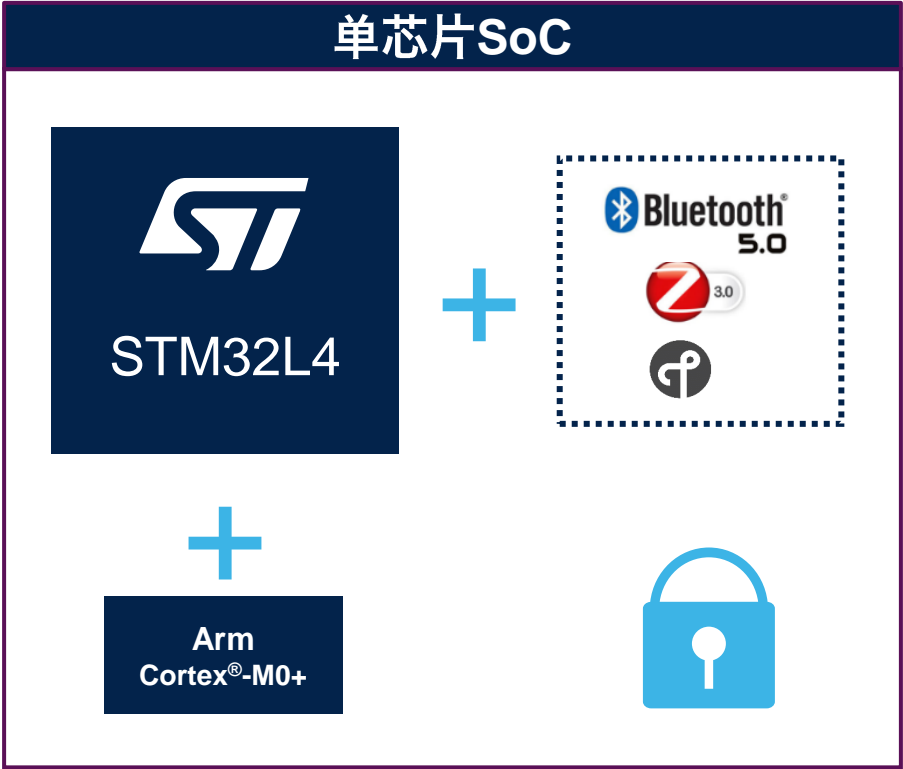
40,000+ 客户 / 自2007年至今已发货40亿 STM32

# STM32WB



# 短距离2.4GHz无线多协议双核MCU释放无限创造力

短距离2.4GHz无线多协议双核MCU :释放无限创造力



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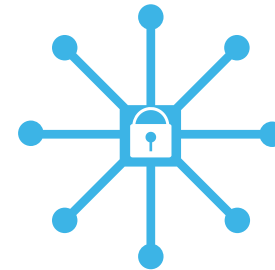
# STM32WB八大产品特性



开放射频  
多协议并发



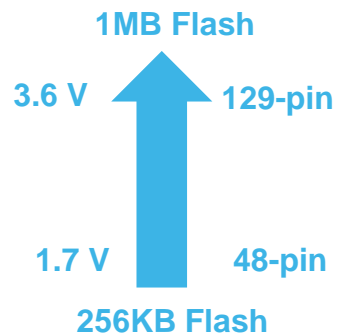
双核全面控制



IoT安全防护



大规模集成  
节省成本



产品种类丰富



超低功耗



先进的射频开发和功耗控制工具  
C代码配置生成编译下载工具



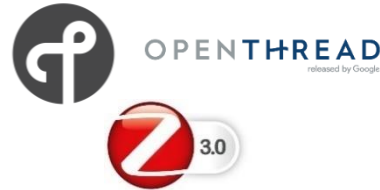
10年供货保证,  
免除后顾之忧!



# 多协议和开放射频



- 完全认证的BLE 5.0 协议栈
- 数据速率提高2倍，支持2Mbps高速模式
- 支持BLE Mesh网状网络技术，提高网络覆盖面



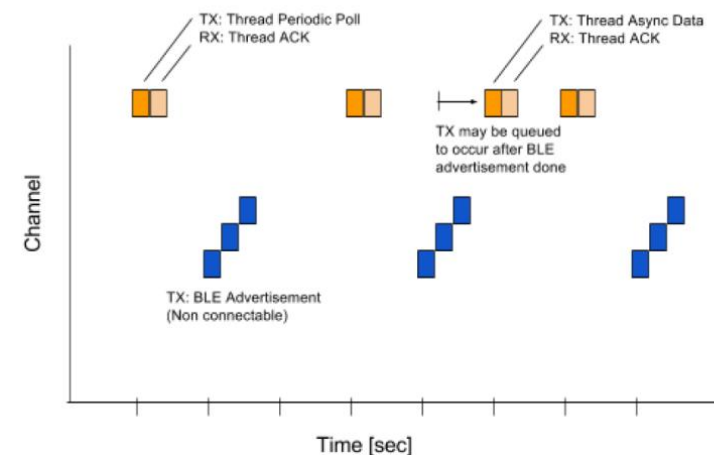
- 支持最新的 IEEE 802.15.4无线通信标准
- OpenThread协议栈，ZigBee 3.0协议栈
- 支持BLE和基于802.15.4协议的动/静态并发模式

**2.4 GHz**  
开放

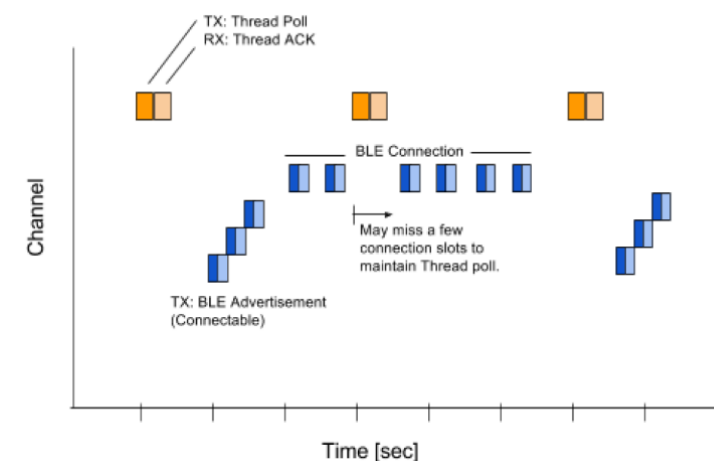
- 支持私有协议栈 (例如BLE或802.15.4)
- 同类最好的射频收发器，输出功率高达+6dBm，接收灵敏度高达-96dBm
- 接收功耗仅为4.5mA，发射功耗5.2mA(@ 0dBm)，适合能耗敏感的应用
- 内部集成巴伦，降低物料清单成本

# 多协议并发

- 静态多协议并发 (切换)
  - 以独占方式从BLE模式切换到Thread模式
  - Thread可进行数据收/发
  - 但是BLE只能发广播
- 动态多协议并发 (并发)
  - 以轮询方式从BLE模式切换到Thread模式
  - Thread可进行数据收/发,
  - 但是BLE可保持连接, 可进行BLE数据收/发

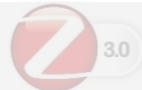


Thread 轮询 + BLE Beacon



Thread 轮询 + BLE 连接

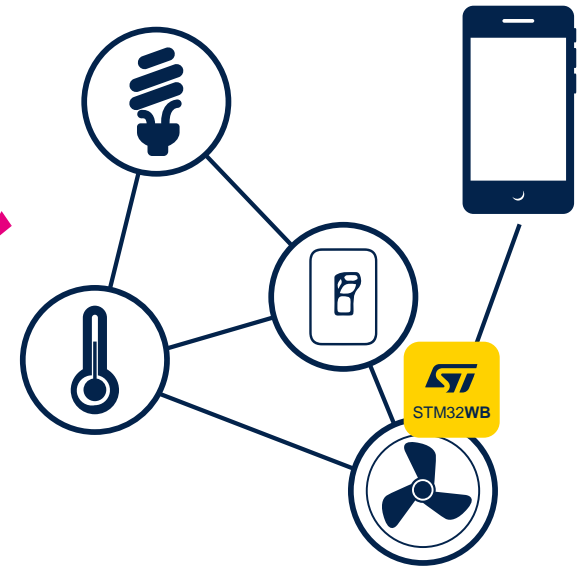
# 灵活的 BLE 和 Thread Mesh 网状网络



2.4 GHz

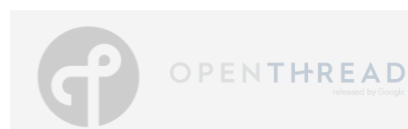
开放

Q4'2020



- ST首个允许**BLE + Thread Mesh**应用方案
- WB同时赋能BLE和Thread Mesh网状网络
- 享受智能手机BLE连接的好处
- 同时享受接入Thread网络的好处

# 灵活的 BLE 和 Zigbee Mesh 网状网络



2.4 GHz

开放

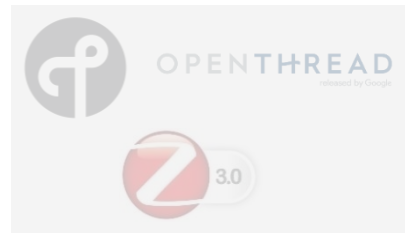
Q4'2020

- ST首个允许**BLE + Zigbee Mesh**应用方案
- WB同时赋能BLE和Zigbee Mesh网状网络
- 享受智能手机BLE连接的好处
- 同时享受接入Zigbee网络的好处
- 解决接入Zigbee网络的痛点

# 灵活的 BLE 和 802.15.4 Mesh网状网络



 **Bluetooth®**



**2.4 GHz**

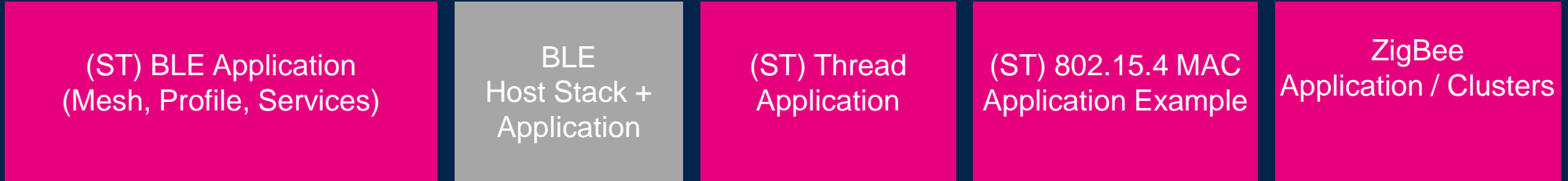
开放

Q4'2020

- ST首个允许**BLE + 802.15.4 Mesh** 应用方案
- WB同时赋能BLE和802.15.4 Mesh网状网络
- 享受智能手机BLE连接的好处
- 同时享受接入802.15.4私有网络的好处

# 免费的各种协议栈和参考源码

## CM4



## CM0+

Full BLE 5.0 stack

- 8 connection point
- 2 slaves / 6 masters
- Full beaconing feature

Lightweight BLE 5.0 stack

- Slave only
- Secure Connections
- Privacy + White List
- Adv + scan only beacon mode

(ST) BLE 5.0  
"full stack"

(ST) BLE 5.0  
"Light stack"

(ST) BLE  
LL HCI

OpenThread  
stack

ZigBee Stack

(ST) 802.15.4 MAC

(ST) 802.15.4 – LLD

BLE - PHY

802.15.4 - PHY

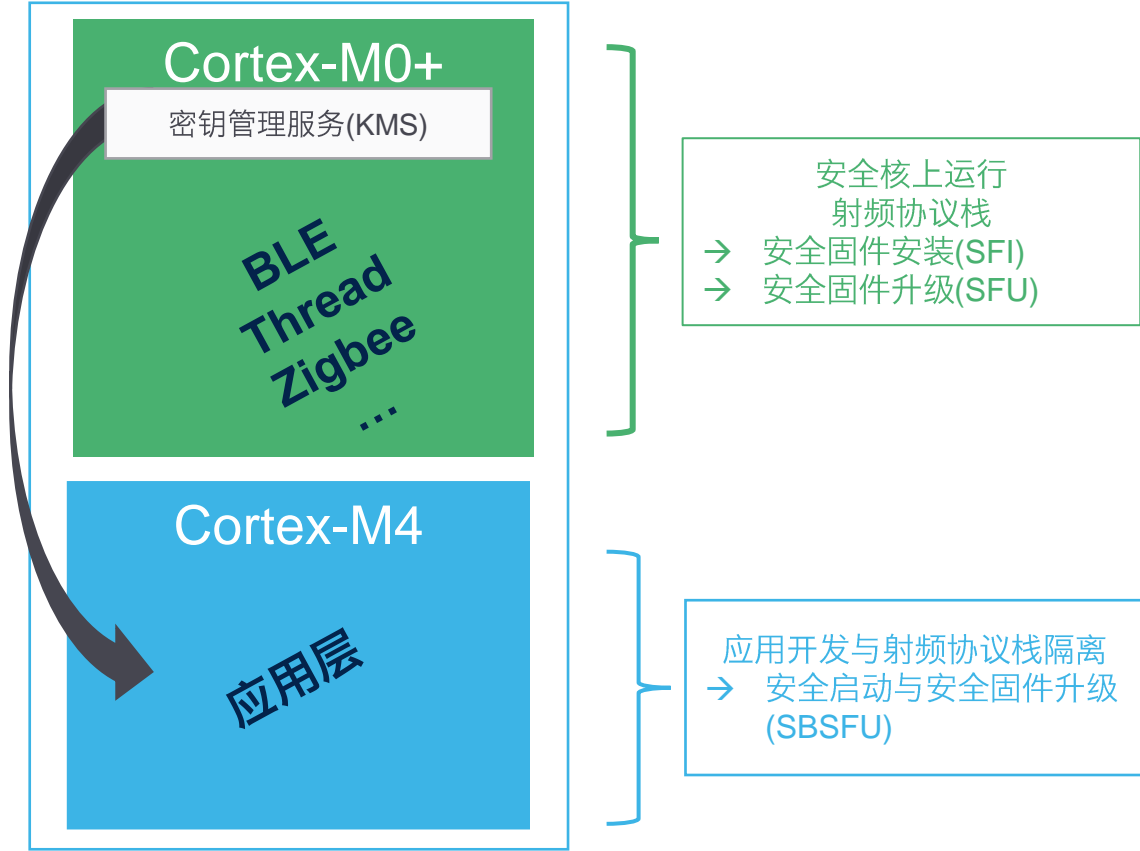
STM32WB RF IP





# 双核架构 – 固件隔离

- Cortex-M4 (非安全)
  - 非安全区 / 开放调试功能
  - 运行用户应用程序
- Cortex-M0+ (安全)
  - 安全区域代码和数据 / 禁止调试
  - 射频协议栈与应用程序隔离
  - 安全固件升级功能 (ST密钥)
  - 为运行在CM4的应用程序提供客户密钥管理服务 (客户密钥)
- KMS(密钥管理服务)
  - 密钥长度:长达256位
  - 1 主密钥+100 简单密钥 (可由主密钥加密或明文)





# 双核架构 – 安全分区

## SBSFU

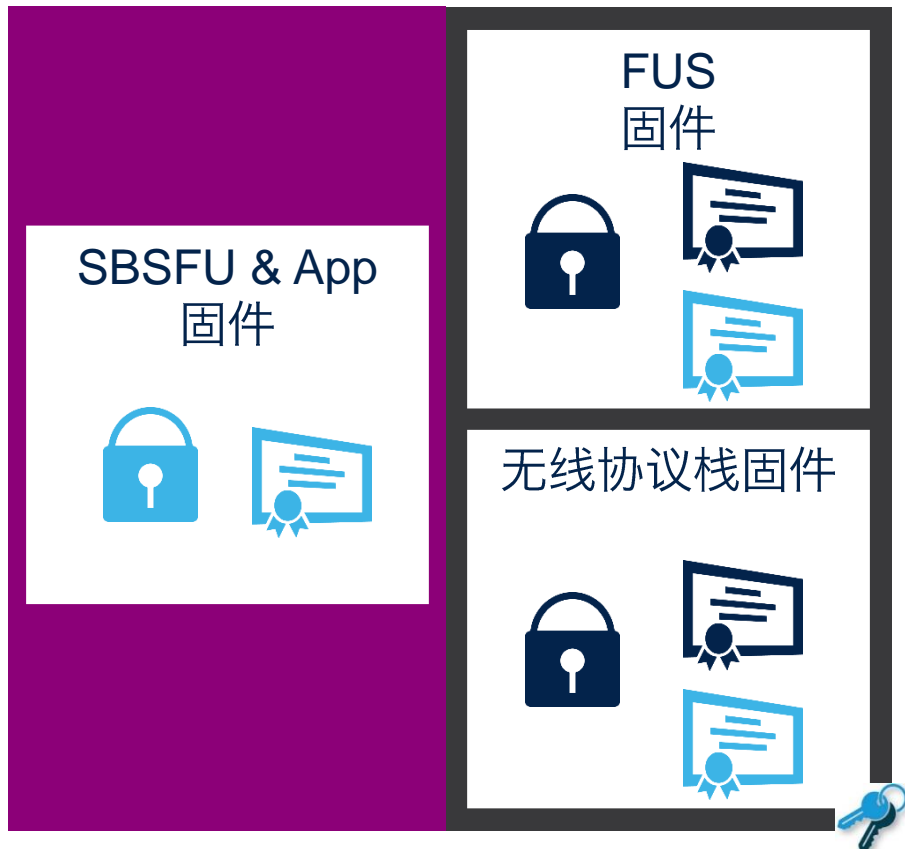
- ✓ 信任根
  - 用户固件的真实性和完整性
- ✓ 信任链
  - 代码运行时逐级校验

## App 固件

- ✓ 由开发者管理
- ✓ 通常由客户通过SBSFU加密和签名



加密固件  
签名固件



APP 子系统  
由Cortex M4  
Core FPU/DSP  
驱动

RF子系统  
由Cortex M0+  
Core & RF  
独立驱动

## FUS 固件

- ✓ 由ST加密和签名
- ✓ 还可由客户进行二次签名(可选)

## 无线协议栈固件

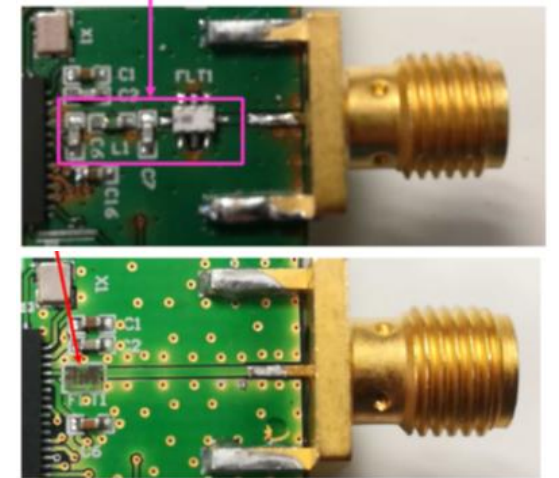
- ✓ 由ST加密和签名
- ✓ 还可由客户进行二次签名(可选)





# 专用于STM32WB的集成滤波器

- 集成滤波器最大化了多协议射频性能，且占用PCB面积是分离方案的1/7
- 集成滤波器MLPF-WB55-0xE3 集成了：
  - 阻抗匹配网络 – 转换为50Ω阻抗
  - 谐波滤波器 – 减少带外TX谐波发射，提高RX灵敏度



MLPF-WB55-01E3 (QFN48,QFN68)  
MLPF-WB55-02E3 (WLCSP100)

# STM32WB产品线

4大产品线 – 还有更多



STM32WB55



STM32WB35

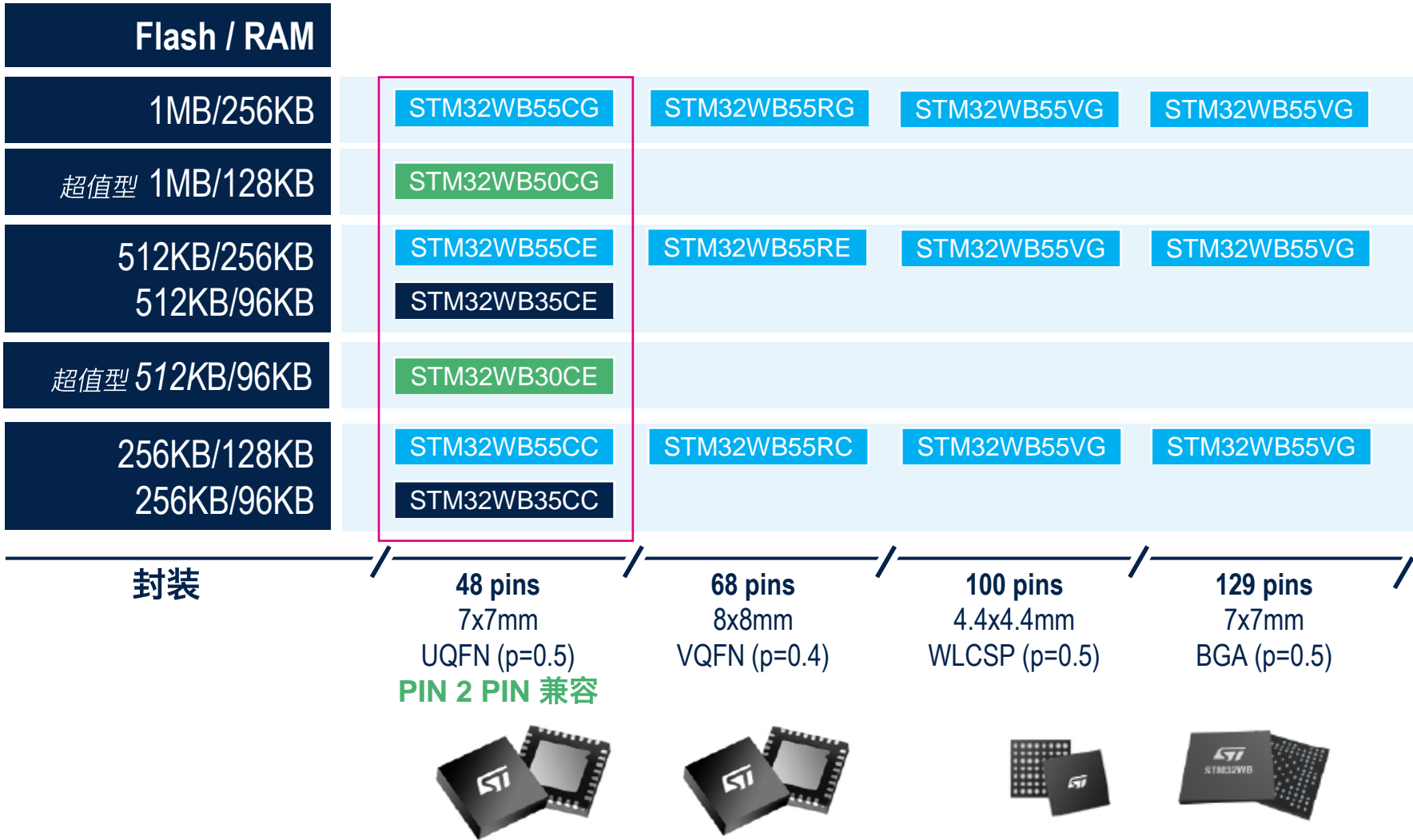


STM32WB50



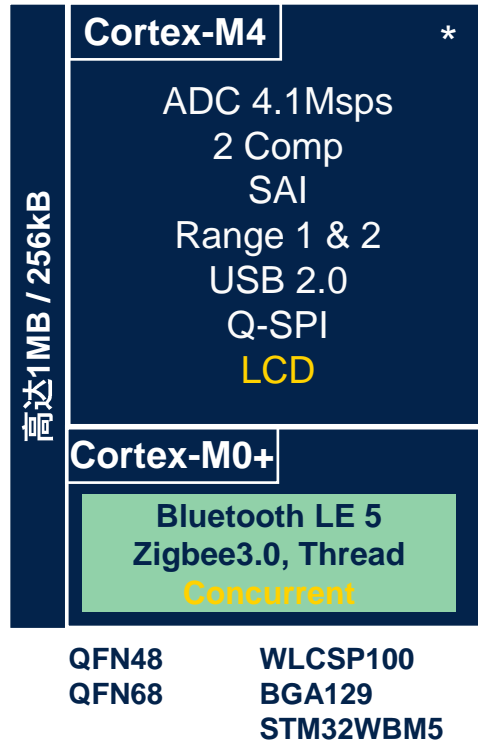
STM32WB30

# STM32WB 产品系列

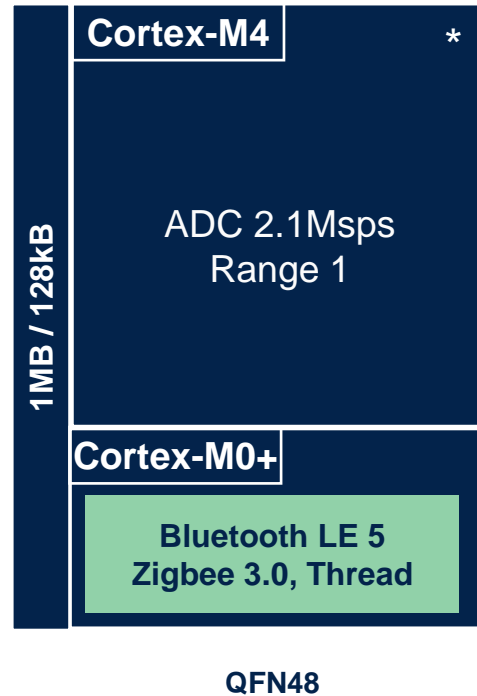


# STM32WB 系列比较

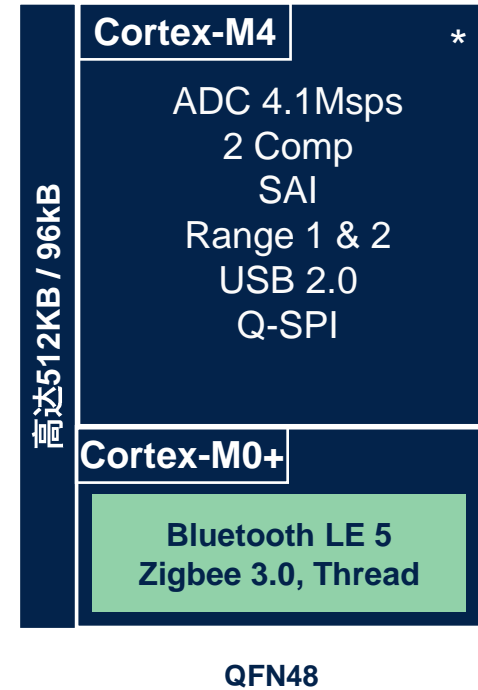
## STM32WB55



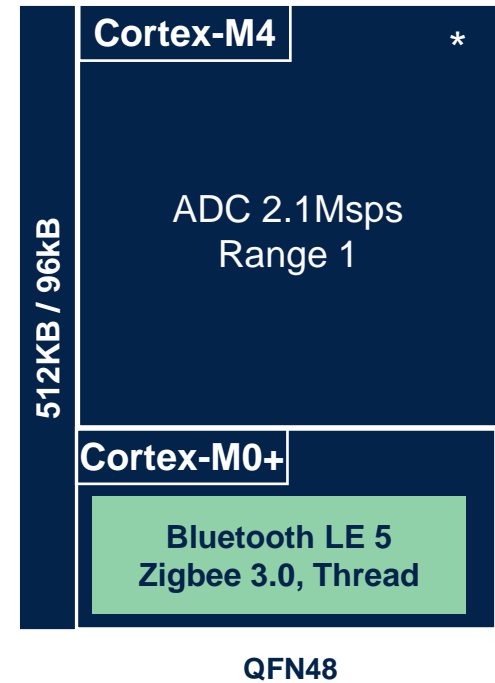
## STM32WB50



## STM32WB35



## STM32WB30



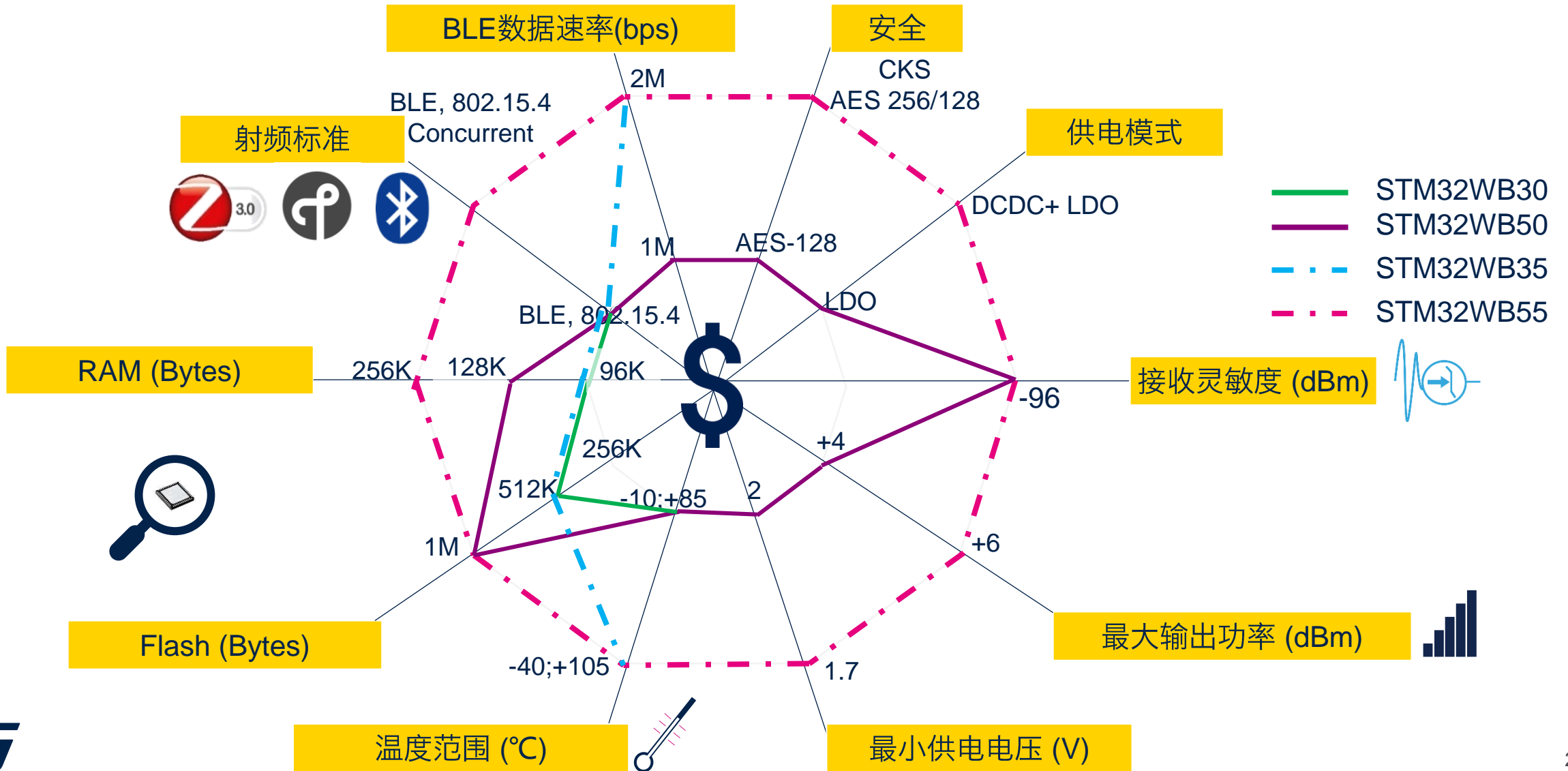
# STM32WBx5 系列比较

IPs	STM32WB55	STM32WB35
Radio	BLE 5.0 ready (2Mbps) and 802.15.4	BLE 5.0 ready (2Mbps) and 802.15.4
Core	CM4 FPU/DSP @ 64MHz CM0+ @ 32MHz	CM4 FPU/DSP @ 64MHz CM0+ @ 32MHz
Open dual core option	Optional (by HW architecture)	Optional (by HW architecture)
Flash	1MB	512KB
RAM	256KB	96KB
ART	Yes	Yes
I2C	2	2
SPI	2	2 (1x I2S)
USART	1	1
LP-UART	1	1
USB 2.0	Yes	Yes
LCD	8x40	No
Q-SPI	Yes	Yes
SAI	2ch	2ch
Touch	7x4	1x4
RTC V2.1	Yes	Yes
AES	256-bit	256-bit
TRNG	Yes	Yes
PCROP	Yes	Yes
FUS	Yes	Yes
SBSFU	Yes	Yes
ADC	12-bit 4.1Msps	12-bit 4.1Msps
Comparators	2	2
Timers	4x 16-bit, 2x ULP 16-bit	4x 16-bit, 2x ULP 16-bit
IR Timer	Yes	Yes
Tempensors	Yes	Yes
CRC	Yes	Yes
HSI	16MHz	16MHz
MSI	48MHz	48MHz
LSI	32KHz	32KHz
HSE	32MHz	32MHz
LS E	32KHz - Xtal	32KHz - Xtal
Range for Run mode	2	2
Retention flop	Yes	Yes
LDO/SMPS	Yes/Yes	Yes/Yes
Package	BGA129, WLCSP100, QFN68, QFN48	QFN48

# STM32WBx5 vs STM32WBx0

IPs	STM32WBx5	STM32WBx0
Core	Dual core CM4/CM0+	Dual core CM4/CM0+
Radio stacks	Bluetooth LE 5.0 + 802.15.4	Bluetooth LE 5.0 or 802.15.4 No concurrency mode, or proprietary
Data rate	Up to 2Mbps	1Mbps
VDD range	1.71 – 3.6V	2 – 3.6V
Temp range	-40 to +105 °C	-10 to +85 °C
Flash	256KB up to 1MB	WB30=512KB, WB50=1MB
RAM	98KB up to 256KB	WB30=96KB, WB50=128KB
Max output power	+6 dBm	+4 dBm
Sensitivity	-96dBm (BLE 1Mbps) -100 dBm (802.15.4)	-96dBm (BLE 1Mbps) -100 dBm (802.15.4)
Peripherals	UP to 2x I2C, Up to 2x SPI, Up to 2x USART USB 2.0, SAI (2ch), LCD, Q-SPI, Cap-touch 12-bit ADC 4.1Msps, 2x COMP, 2x DMA (14ch) DC/DC and LDO	1x I2C, 1x SPI, 1x USART <b>Removed:</b> USB, SAI, PLL2, LCD, Q-SPI 12-bit ADC 2Msps, No COMP, 1x DMA (7ch) no DC/DC, LDO only
Security feature	Full Security package( FUS, CKS, SBSFU, OTA) 3x AES block	FUS, RF stack update No AES for CM4
Run mode range	2	1
Package	BGA129, CSP100/4x, QFN68/48	QFN48
Others	Nucleo, Discovery, FastROM	No dedicated HW tools, No FastROM

# STM32WB定位



# STM32WB55 模组

## 易集成，轻认证

尺寸: 7.3x11mm

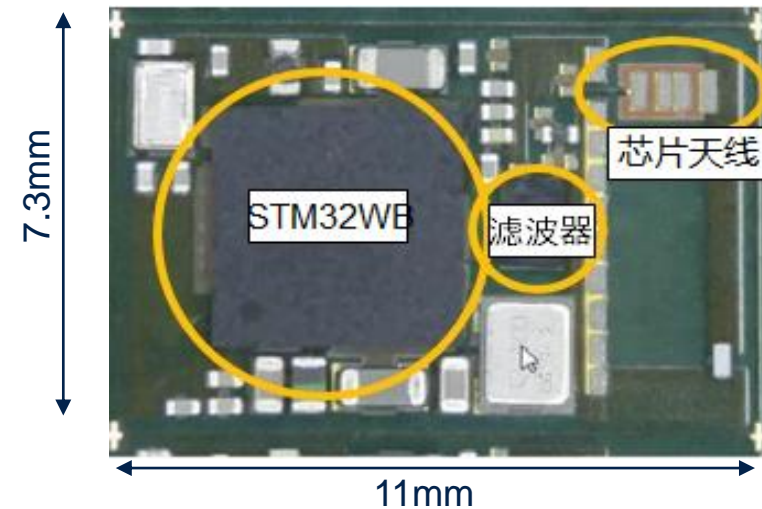
特征:

- 射频: BLE 5.0 , Zigbee PRO/ ZCL 3.0, Thread, Generic 802.15.4
- 主控: STM32WB55VG(WLCSP100, 1MB Flash, 256KB RAM)
- STM32WB55相同的外设IP (USB, LCD, Q-SPI...)
- STM32WB55相同的安全特性
- 内置32MHz 和32kHz RTC 晶振, 集成滤波器, 芯片天线
- 2层 PCB仅适用第一环, 4层PCB包括中心的 LGA(平面网格阵列)
- 工作范围: -40°C至 85°C/ 1.71V 至 3.6V
- 认证: FCC, CE, TELEC, CCC, IC, ISED, KC, BSMI, MIC

全面接入STM32WB 生态系统

开发可始于STM32WB55 Nucleo 板

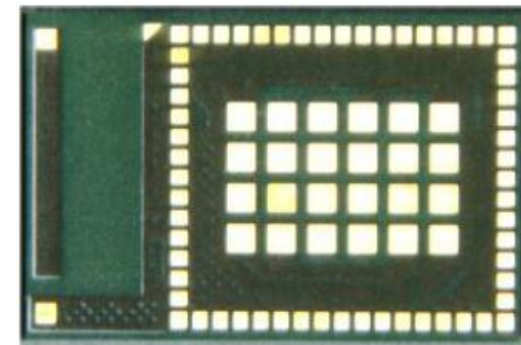
顶视图(无盖)



顶视图(有盖)



底视图





# STM32WL



# 长距离SubGHz无线多协议开放MCU释放无限创造力

长距离SubGHz无线多协议开放MCU :释放无限创造力

世界首款  
World First!



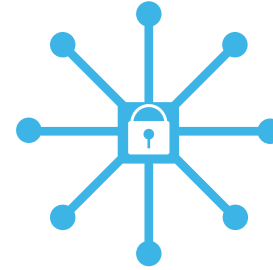
# STM32WL八大产品特性



开放射频  
多协议



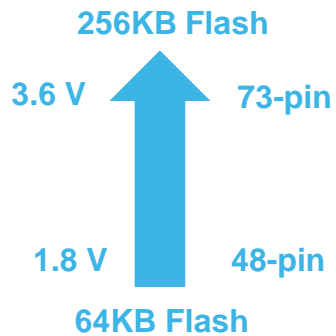
开放平台  
全面控制



IoT安全防护



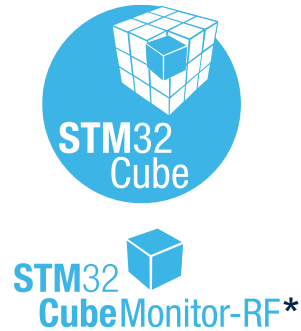
大规模集成  
节省成本



产品种类丰富



超低功耗

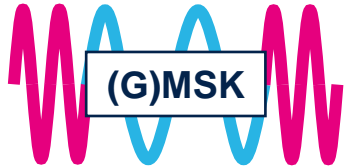
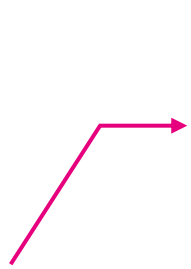


先进的射频开发和功耗控制工具  
C代码配置生成编译下载工具

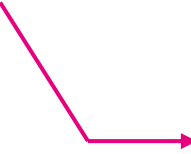


10年供货保证,  
免除后顾之忧!

# 4种调制方式 & 多种协议



Proprietary



\* 即将到来

# STM32WL – 芯片 & 协议栈开发模型

开放芯片, 开放协议栈



- 开放平台
- 开放协议栈



认证过的 LoRaWAN 协议栈

# STM32WL SoC 集成度更高

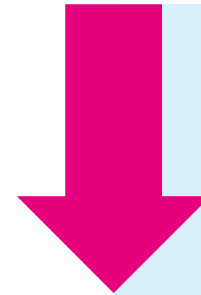
## MCU + Radio 2-in-1 解决方案



VS

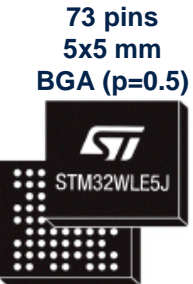
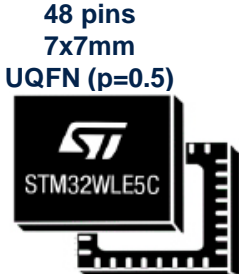
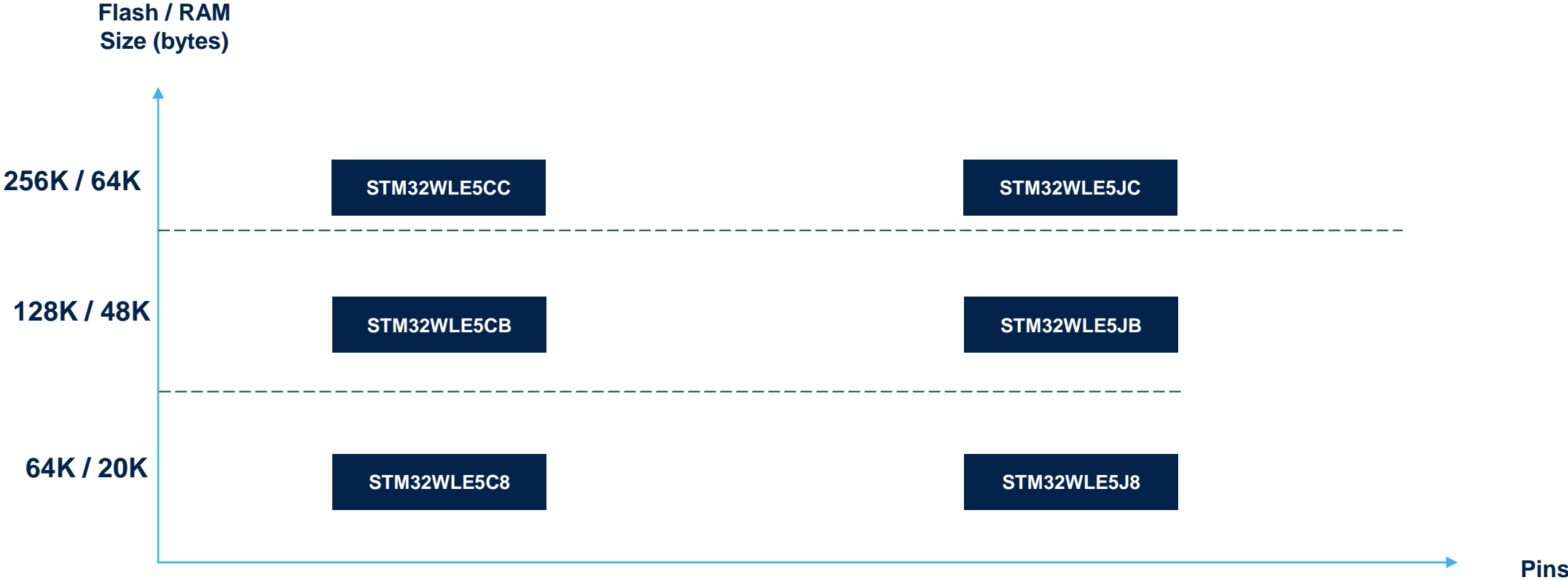


- SoC 方案 (系统级单芯片)
- **All-in-1** 解决方案 – 大幅降低成本
- 简化开发加速产品上市时间



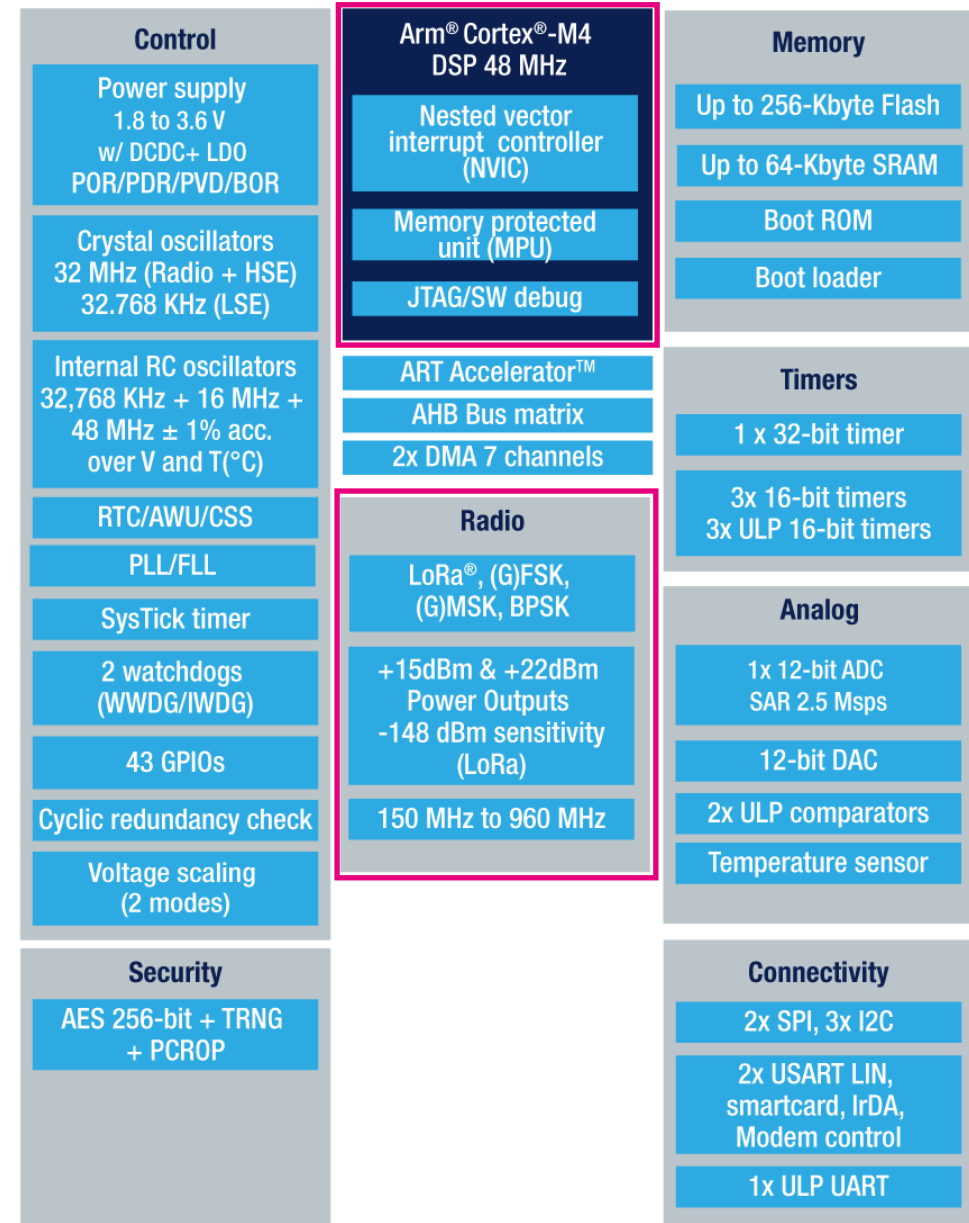
- 2 个独立芯片或 SiP(系统级封装)
- 更大的PCB (增加成本)
- 有线通信更加暴露

# STM32WLE5产品系列



# STM32WLE5主要特征

- Arm® Cortex®-M4 DSP 高达48 MHz
- 高达256 KB Flash 和 64 KB SRAM
- Sub-GHz Radio – 多种调制
  - LoRa, (G)FSK, (G)MSK, BPSK
  - 2种集成功率放大器:
    - 1路输出高达+15 dBm
    - 1路输出高达+22 dBm
  - LoRa 接收灵敏度: -148 dBm (SF12, BW=10.4kHz)
  - RX: 4.82mA
  - TX: 15mA (@ 10dBm) / 87mA (@ 20dBm) [3.3V]
- 外设
  - 3xI<sup>2</sup>C, 2xUSART, 1xLP-UART, 2xSPI
- 7x timers + 2x ULP 比较器
- 电压范围: 1.8 至 3.6V (DC/DC, LDO)
- 温度范围: -40 至 高达+105 °C
  - 功耗
    - 运行模式: < 71µA/MHz (3V – R关闭)
    - Stop2模式: 1 µA (带RAM保持)
    - 待机模式: 390 nA (带RTC)
    - 关闭模式: 31 nA
- 封装: QFN48, BGA73

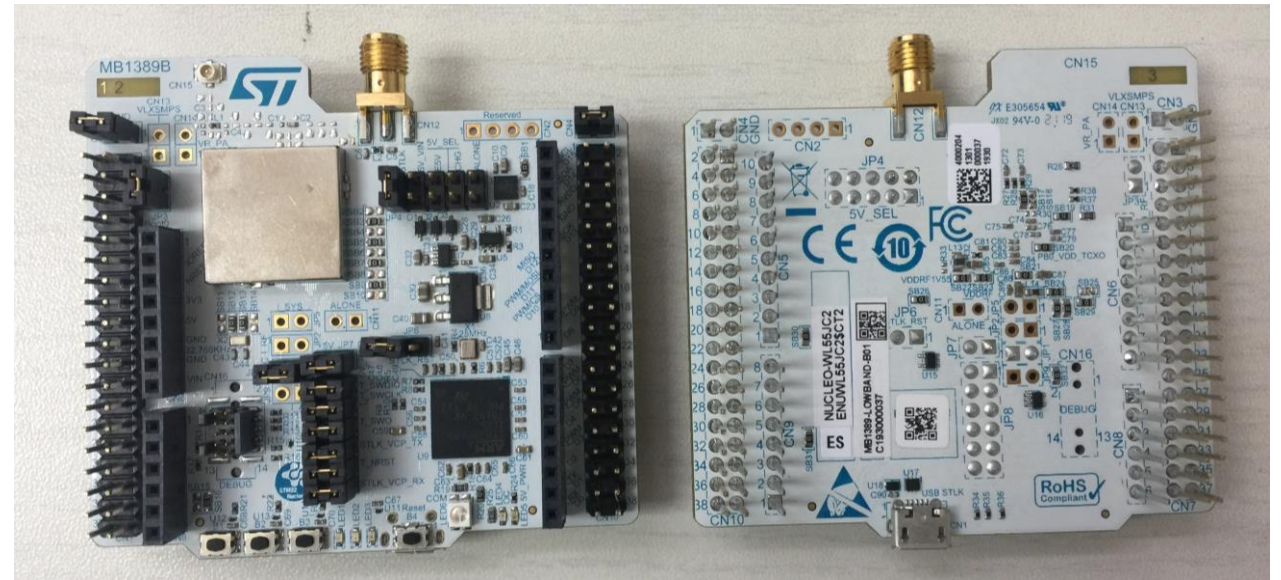
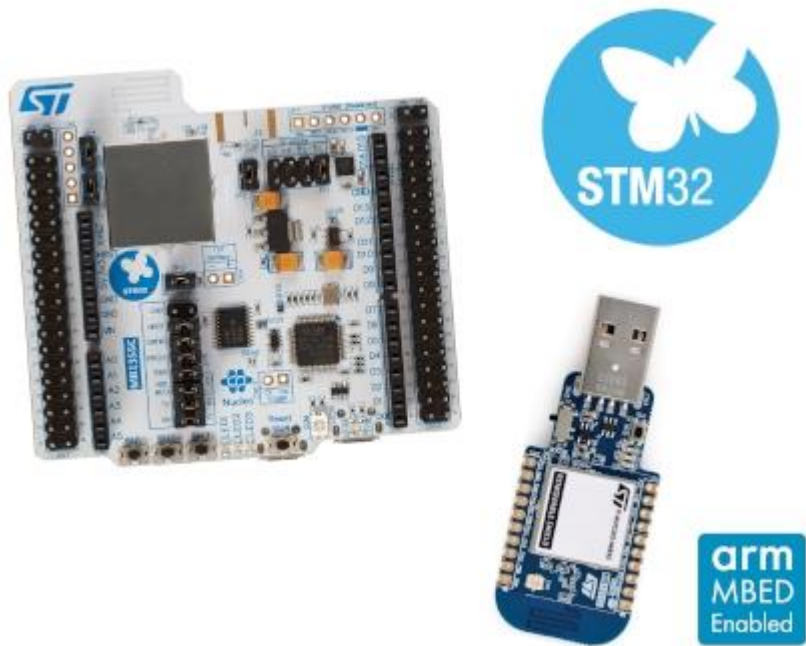




# STM32Wx 生态系统



# STM32Wx开发板



P-NUCLEO-WB55

NUCLEO-WL55JC1 (高频段 865-928MHz)  
NUCLEO-WL55JC2 (低频段 433-510MHz)

# 生态系统不仅仅有免费的协议栈!

配置

开发

下载

监控



STM32CubeIDE

STM32CubeMX



STM32CubeWB

STM32CubeWL



STM32CubeIDE

STM32CubeProgrammer



STM32CubeMonitor

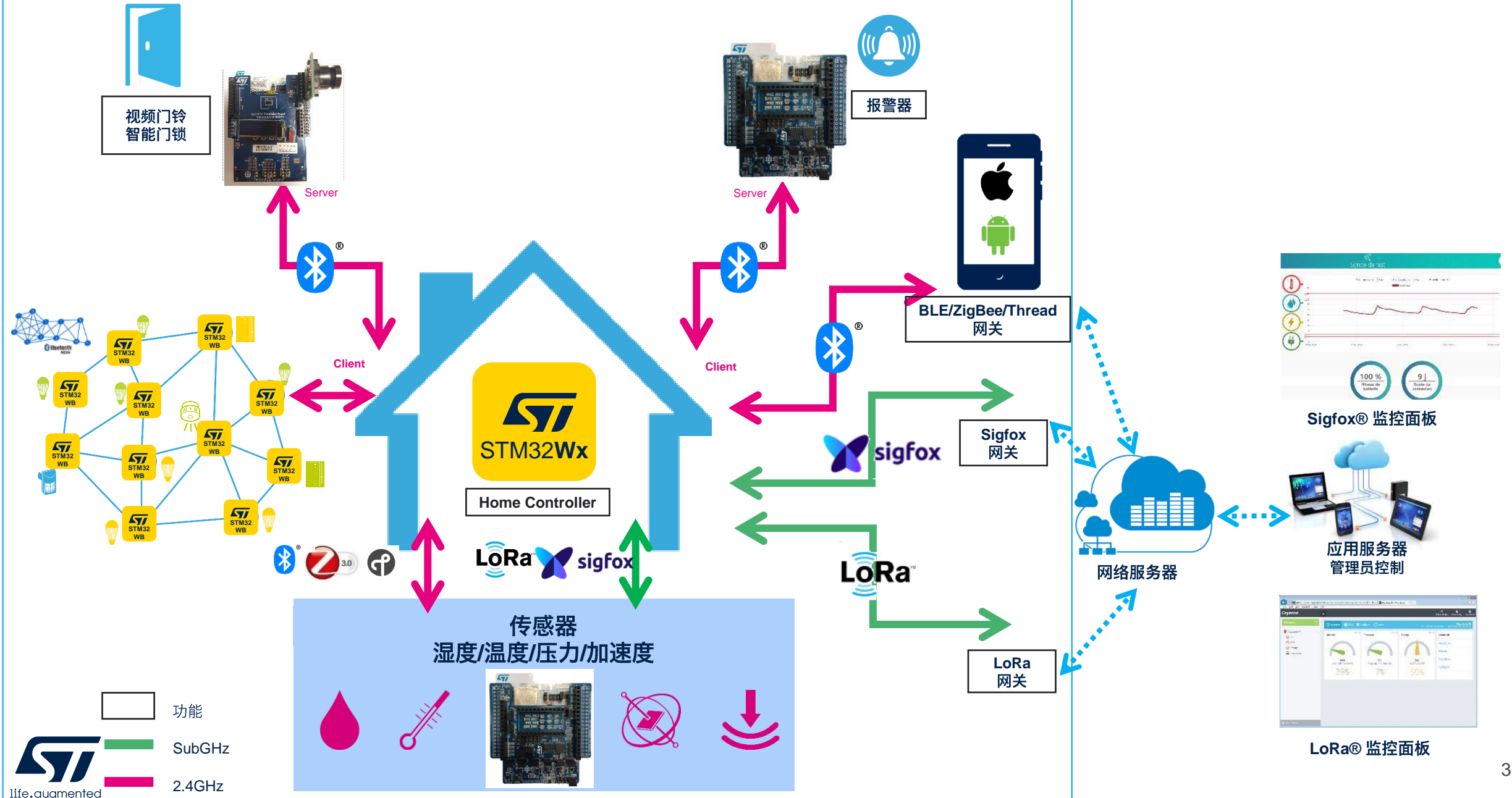
STM32CubeMonitor-RF



# STM32Wx 助力物联家居



# 基于BLE+ZigBee+Thread+Mesh+LoRa+Sigfox的物联网家居



## STM32 无线通信技术

### STM32WB: 短距离2.4GHz无线多协议双核MCU

- STM32WB 八大产品特性
- 开放射频, 多协议并发
- IoT安全防护, 助力物联安全
- 高集成度, 节省成本
- 多款不同配置(可兼容)的STM32WB型号+模块可选, 释放无限创造力

### STM32WL: 长距离SubGHz无线多协议开放MCU

- STM32WL 八大产品特性
- 开放射频, 多协议
- 开放平台, 开放协议栈, 全面控制
- 高集成度, 节省成本
- 多款不同配置(可兼容)的STM32WL型号可选, 释放无限创造力

## STM32Wx 生态系统



# Thank you

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