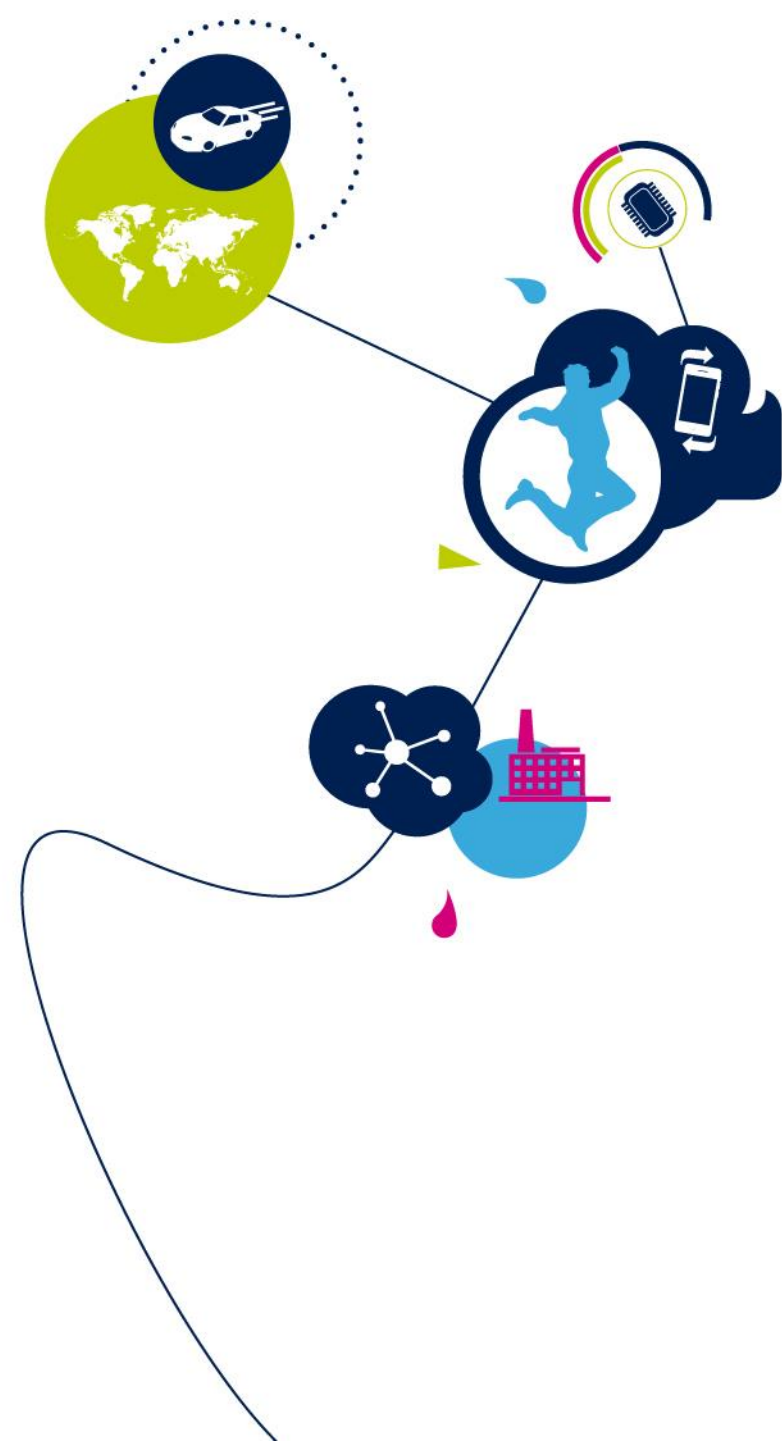




新一代无线微控制器STM32WB

Marketing : Andre Tan

FAE : Willee Gong & Min Du



STM32 的产品布局与定位

2

17条产品线，超过60个产品线，千款型号，I/O兼容





新一代无线微控制器STM32WB

3



高性能

多协议并发

安全

低功耗

低成本

快速进入市场



选择 STM32WB 系列

4

七大产品特性，改变开发现状

动态多协议并发

Bluetooth®5
⌈HREAD
ZigBee®

开放的2.4 GHz 射频
多协议

高性能

低功耗



双核 / 全面控制
超低功耗

安全



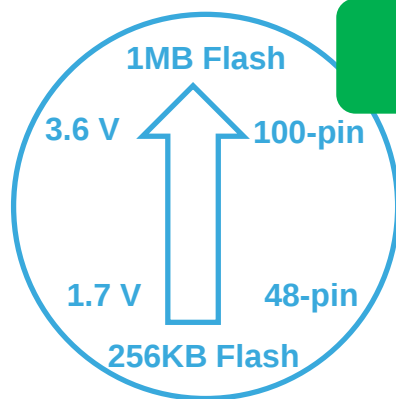
物联网保护

低成本



大规模集成
节省成本

快速进入市场



产品种类丰富



先进的射频开发和功耗控制
工具、能够生成C代码



10年供货保证，
免除后顾之忧



高性能



高性能

STM32 灵活的 BLE 解决方案



STM32 产品系列包括600多个型号，从ARM Cortex-M0 +内核到M7可选
闪存从8KB到2MB，连接性，强大的模拟性能和多种封装选择

前所未有的MCU组合，实现独特的组合



高性能

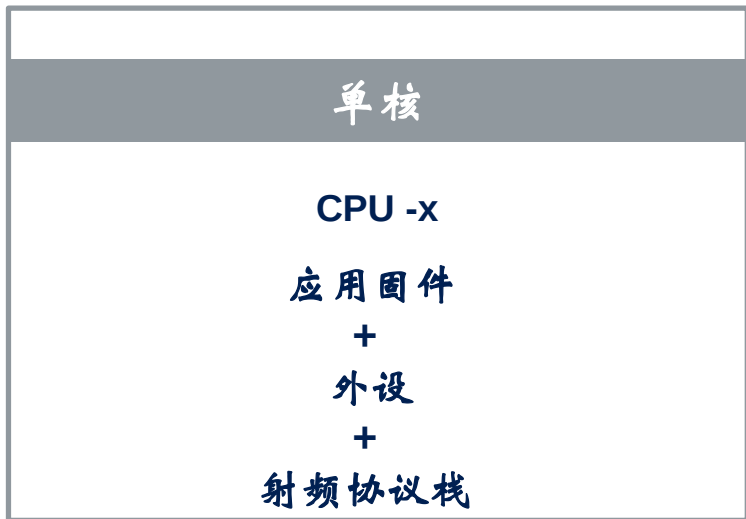
超低功耗与射频结合的微控制器

7



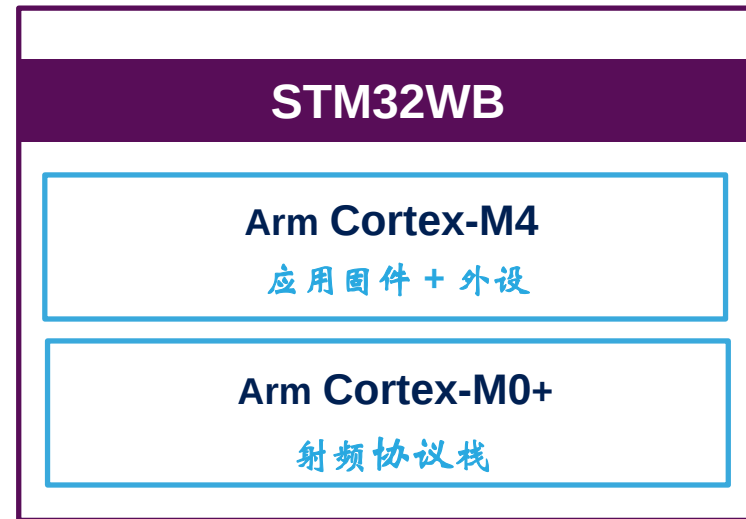
新一代无线微控制器STM32WB

2个独立处理器内核，保证实时处理



• 缺点

- 分时共享
- 任务处理时间长 - 功耗高
- 需要配套 MCU (成本增加)



• 优势

- 单系统芯片方案 (只有一颗裸片)
- 高灵活度 - 开发简易 - 用户体验好
- 延长电池续航时间
- 全合一方案 - 节省成本
- 加快产品上市





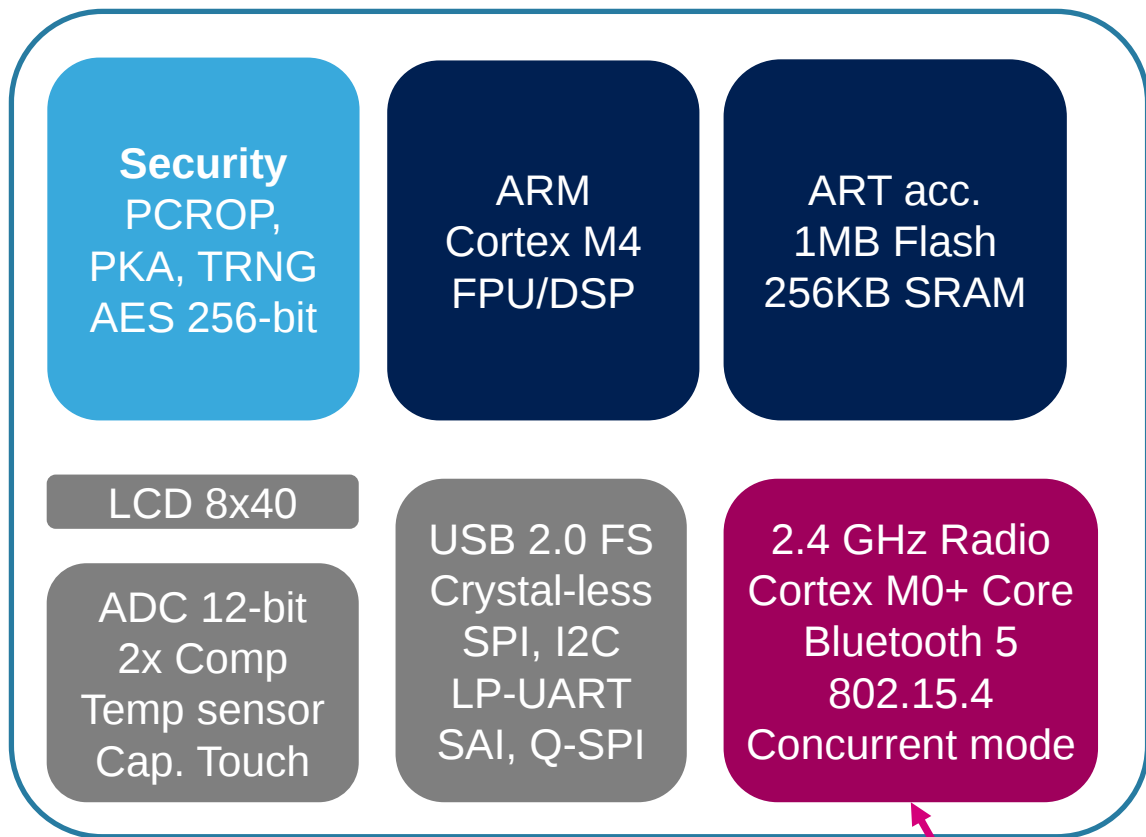
高性能

功能特性丰富

9

主要特性

- 2颗独立内核，实时执行任务
- 超低功耗
 - 工作模式 < 53 μ A/MHz (3.0V)
 - 停止模式 2.1 μ A (射频待机 + 256KB RAM)
 - 关闭模式 < 13 nA
- 外设
 - 2x I²C, 1x USART, 1x LP-UART, 2x SPI, 1x USB 2.0 FS device 支持充电检测, 1x SAI, Q-SPI (XIP), 6x 16-bit 定时器 (包括 LPWM 和低功耗定时器)
- 工作电压 1.71 至 3.6V (DC/DC, LDO)
- 工作温度 -40°C 至 +105°C



独立的2.4GHz
射频子系统



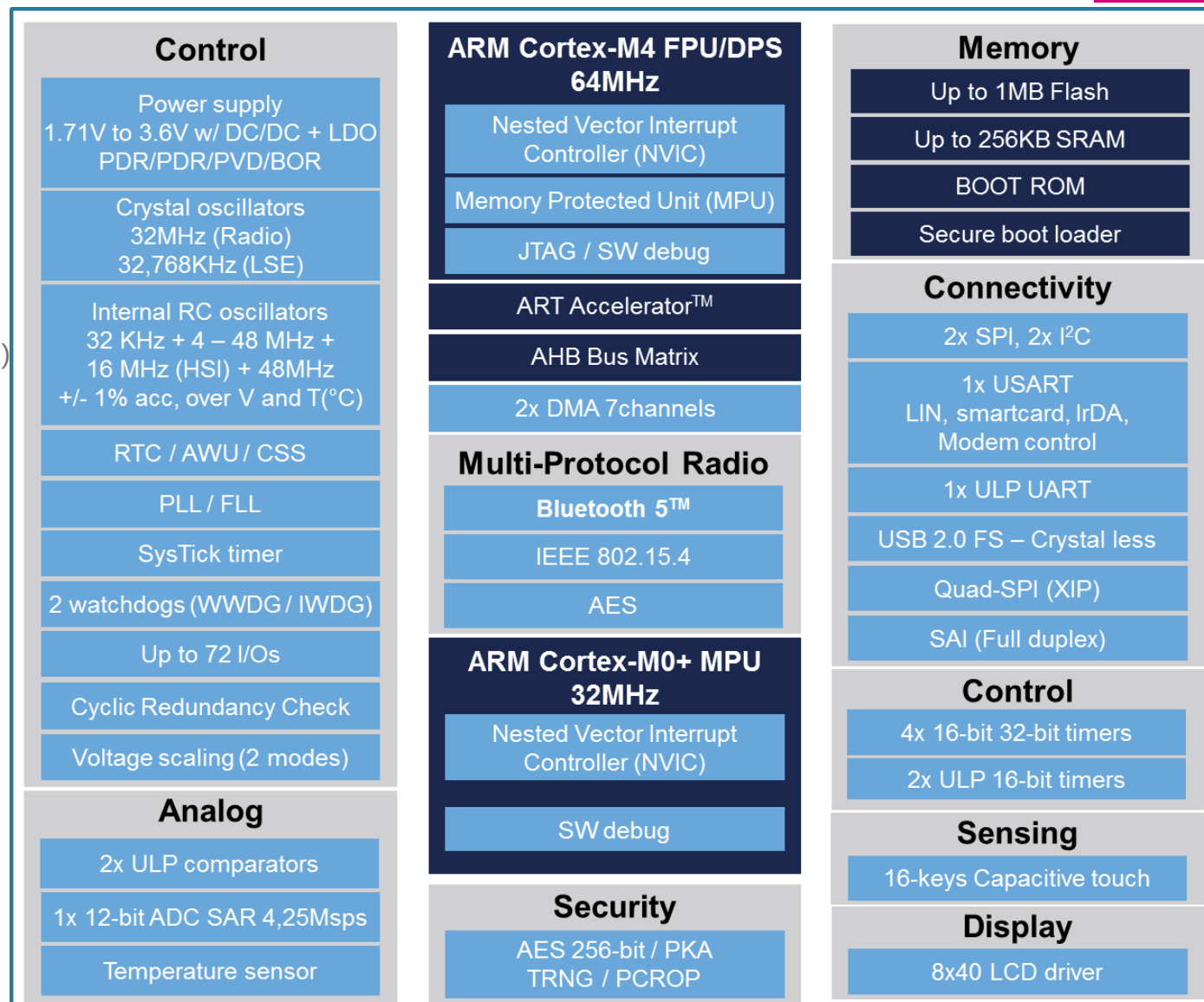
高性能

主要特征

- CM4 DSP/FPU 高达**64MHz**
- 高达1MB Flash 和256KB SRAM
- 射频集成平衡不平衡器(Balun)
 - 低功耗蓝牙**5.0** 和802.15.4
 - 输出功率: **+6.0** dBm (支持外部PA)
 - BLE 接收灵敏度: -96 dBm @ 1Mbps (102dB链路预算)
 - 802.15.4 接收灵敏度: -100 dBm @ 250kbps (106dB链路预算)
 - 接收(RX): 4.5mA 和发送(TX): 5.2mA (0dBm)
- 外设
 - 2xI2C, 1xUSART, 1xLP-UART, 2xSPI, 1xUSB 2.0 FS device, 1xSAI, Q-SPI (XIP)
- 6x 定时器: 包括2x LP-16-bit
- 2x 超低功耗比较器
- 工作电压1.71V 至3.6V (DC/DC, LDO)
- 工作温度-40°C 至+105°C
- 功耗
 - 运行模式< 53μA/MHz (3V - RF ON)
 - 停止模式2.1 μA (射频待机+ 256KB RAM)
 - 待机模式0.6 μA (射频待机+ 32KB SRAM2a)
 - 关闭模式< 13nA

STM32WB55 – 框图

10



• 封装: QFN48, QFN64, QFN68, WLCSP100, BGA129



动态多协议开发



动态多协议开发



动态多协议开发

多协议和开放射频

12



 **Bluetooth
5**

- 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OpenThread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，射频链路预算102dB
- 接收功耗仅为4.5mA，发射功耗5.2mA(@ 0dBm)，适合能耗敏感的应用
- 集成balun巴伦平衡器，降低物料清单成本

应用

配置文件

ZCL

层2



Bluetooth
5



ZigBee®

6LoWPAN
(RPL)



THREAD

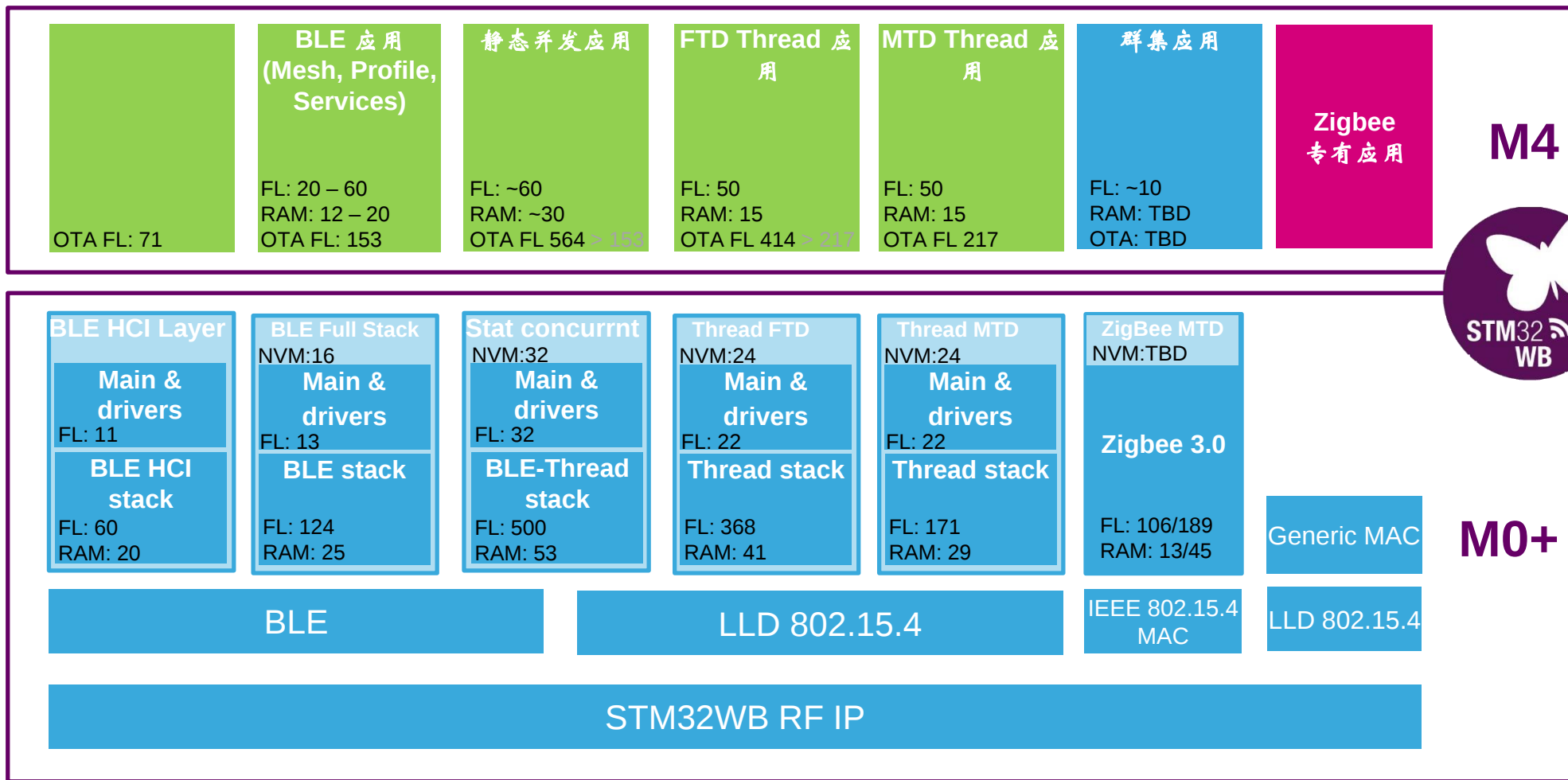
层1

IEEE 802.15.4 MAC

LLD 802.15.4



STM32WB 多协议内存占用



BootLoader / Security 占用此处未显示(M0 FL: 56 / RAM: 28 KB)

Thread Stack配置 = Router / 10 child, 全功能

BLE Link Layer配置 = 8 links

BLE Mesh 应用

Main & Drivers: IPCC, BLE cmd, NVM 驱动和 Main

HCI (主机控制器接口): 支持低功耗蓝牙主机协议栈的标准接口

源代码
“黑盒子”
单位: KB

* 即使基于开放源代码, 也没有计划以源代码交付



动态多协议开发

STM32WB 内存占用分析

帮助你的客户选择正确的内存配置

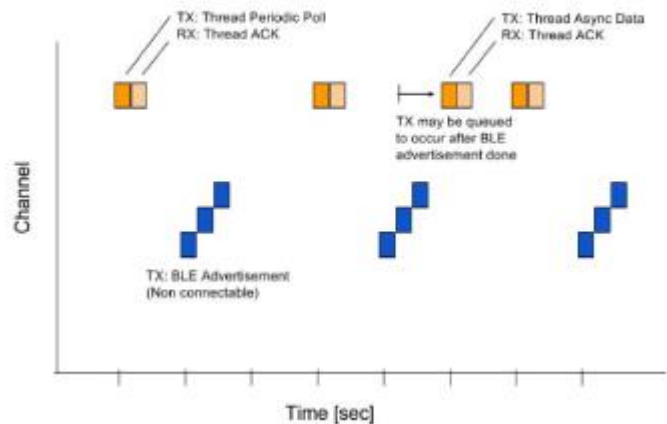
Memory Footprint	STM32WB55		
	density 1	density 2	density 3
Flash	256 kB	512 kB	1 MB
SRAM1	64 kB	192 kB	192 kB
SRAM2a	32 kB	32 kB	32 kB
SRAM2b	32 kB	32 kB	32 kB

	BLE Alert notification		BLE Mesh		Thread Router full feature		BLE / Thread static concurrent mode	
FL / RAM w/o OTA (KB)	209 / 45		246 / 46		464 / 56		670 / 88	
FL / RAM w/ OTA (KB)	362 / 45		399 / 46		878(681) / 56		1234(823) / 100	
STM32WB55 density 1	w/ OTA	No OTA	w/ OTA	No OTA	w/ OTA	No OTA	w/ OTA	No OTA
STM32WB55 density 2	w/ OTA	No OTA	w/ OTA	No OTA	w/ OTA	No OTA	w/ OTA	No OTA
STM32WB55 density3 (RSS: 56k)	w/ OTA	No OTA	w/ OTA	No OTA	w/ OTA	No OTA	w/ OTA	No OTA



- 静态多协议

Thread Polling + BLE Beacon

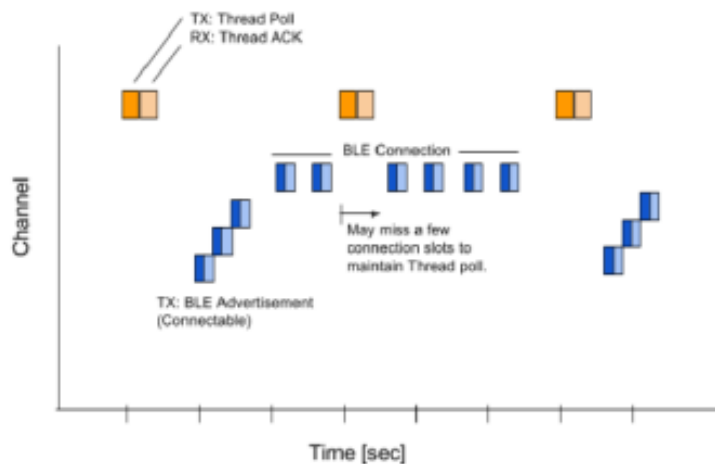


Bluetooth® 5 + THREAD
(static)



- 动态多协议

Thread Polling + BLE Connection



Bluetooth® 5 + THREAD
(dynamic)

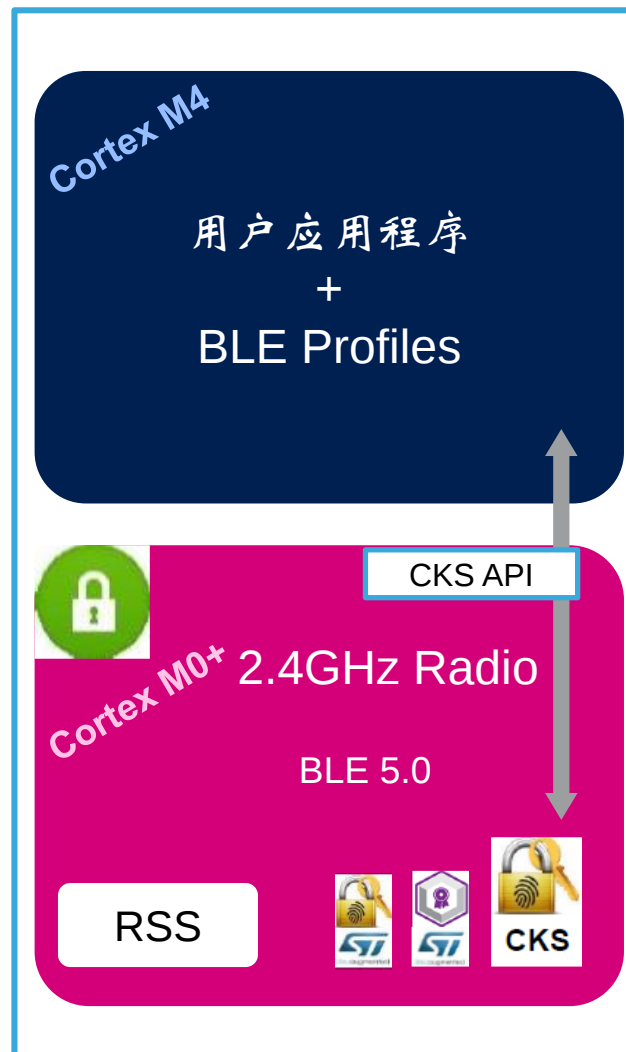


安全



安全

- Cortex-M4 (非安全)
 - 非安全区 / 开放调试功能
 - 运行用户应用程序 + BLE配置文件
- Cortex-M0+ (安全)
 - 安全区域代码和数据 / 禁止调试
 - BLE 射频协议栈与应用程序隔离
 - 带有安全固件升级功能 (w/ ST keys)
 - 为运行在CM4的应用程序提供客户密钥存储功能(CKS)
- CKS “Customer Key Storage 客户密钥存储”
 - 密钥长度: 可达256-bits (典型长度为128或256-bits)
 - 密钥数量
 - 1 主密钥
 - 100 简单密钥 (可由主密钥加密或明文)



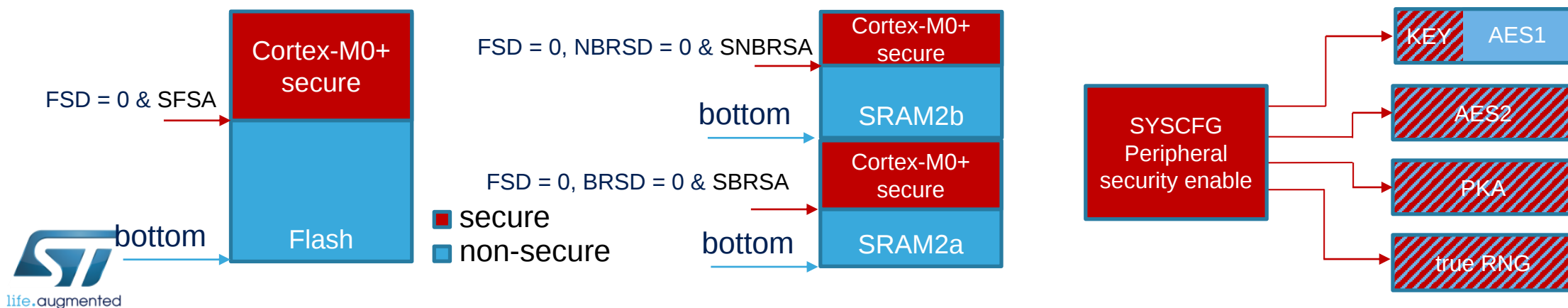
应用程序

→ 安全启动与
安全固件升级(SBSFU)

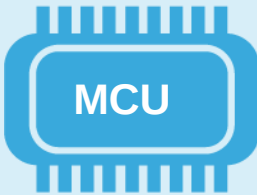
射频协议栈

→ 安全固件安装(SFI)
→ 安全固件升级(SFU)

- 保护闪存的上部让Cortex-M0+独占访问。
 - 由安全用户选项FSD和SFSA定义。
- 使能全局安全性。
 - 允许通过安全用户选项SBRD和SBRSA添加SRAM2a上部安全性
 - 允许通过安全用户选项SNBRD和SNBRSA添加SRAM2b上部安全性
 - 允许在SYSCFG中启用外设安全性。



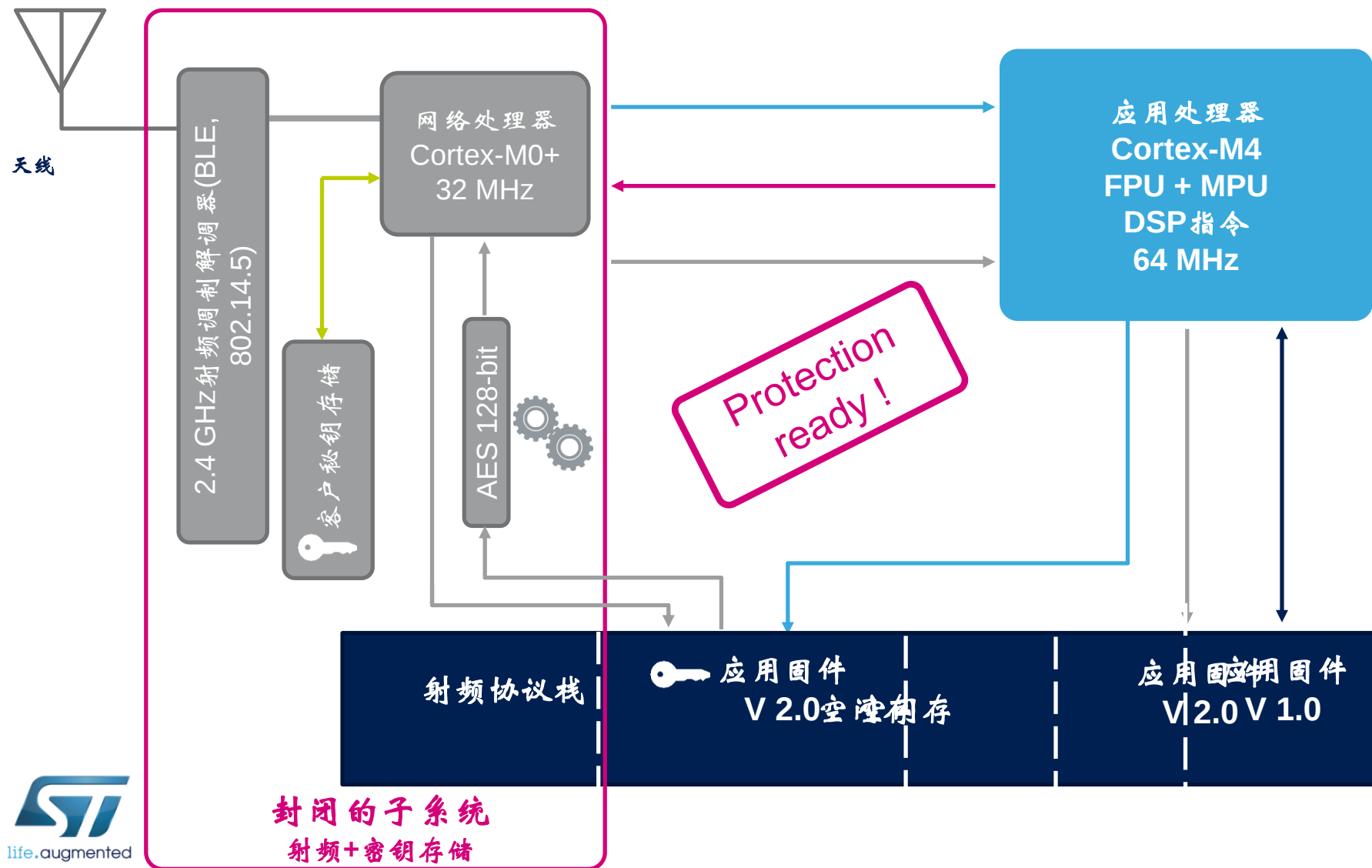


攻击	攻击描述	STM32WB防御措施
非入侵式攻击 	- 篡改工作环境 - 温度 - 电压 - 时钟 - 注入错误信号(小故障....) - 利用调试功能 - 侧信道攻击、功耗分析 ...	- 温度传感器 - 电源完整性监控器 - 时钟安全系统 - 防篡改焊盘 - 内存ECC, 奇偶校验 - RTC报警, 寄存器, SRAM批量擦除 - JTAG读出保护 - 仅限从闪存启动
软件攻击 	- 底层软件验证/加密 - 提取密钥 - 利用应用测试功能 - 恶意软件/病毒软件 - 重放或权限升级攻击	- 客户密钥存储 (CKS) - RNG, 加密加速器, CRC - 内存写入保护 - 内存读取保护 - 存储保护单元 (MPU) - 根安全服务 (RSS) - 安全固件安装和更新 (SFI和SFU) - 专有代码读取保护 (PCROP) 96位ID



物联网保护功能 (1/2)

射频协议栈和应用固件更新



- ① 新固件包下载成功
- ② 发现新固件包
启动更新程序
- ③ 应用处理器发送固件包签名和
密钥进行验证
- ④ 如果验证签名与设置的密钥不匹配，
更新过程终止，设备重置
- ⑤ 用专有密钥对新固件包进行解密，
设备开始烧写代码





低功耗



超低功耗



低功耗

唤醒时间

9 cycles
9 cycles
1.7 μ s
4 μ s (19 μ s)
5 μ s (20 μ s)
14 μ s (25 μ s)
14 μ s (25 μ s)
50 μ s

() 典型值SMPS模式

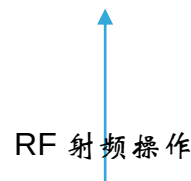


RUN (Range1) at 64 MHz	117 (53) μ A / MHz**
RUN (Range2) at 16 MHz	109 μ A / MHz**
LPRUN at 2 MHz	103 μ A / MHz**
SLEEP at 64 MHz	41 μ A / MHz
LPSLEEP at 2 MHz	45 μ A / MHz
STOP 0 (full retention)	100 μ A
STOP 1 (full retention)	9.2 μ A / 9.6 μ A*
STOP 2 (full retention)	1.8 μ A / 2.1 μ A*
STANDBY + 32 KB RAM	320 nA / 600 nA*
STANDBY	110 nA / 440 nA**
SHUTDOWN	13 nA / 315 nA*
VBAT	2 nA / 300 nA*

Typ @ VDD = 1.8 V @ 25 °C

* with RTC

** from SRAM1



多种低功耗模式

23

灵活的功耗控制

- 高效运行
- 8 个低功耗模式, 几个子模式
- 高灵活性

应用程序优势

- 高性能
→ CoreMark 分数= 215
- 卓越的功耗效率
→ ULPBench 分数= 175



低成本



低成本



低成本

大幅节省成本

25

片上集成的功能特性越多，物料清单成本降幅越大！

芯片成本

- 射频巴伦: 内置
- 外部器件: 7 (包括晶体)
- 32MHz单晶体运行
- 32 kHz主时钟输出
- USB 2.0 FS 晶体: 内置
- LCD升压器: 内置
- 电容触控器: 内置
- 电路板成本: 只需2层印刷电路板(QFN48,BGA129)

生态系统成本

- BLE 5协议栈: 免费
- ZigBee协议栈: 免费
- OpenThread协议栈: 免费
- Generic 802.14.5 MAC: 免费
- Generic HCI驱动软件: 免费
- STM32CubeMX: 免费
- STM32CubeMonitor-RF: 免费
- IDE (Atollic, AC6: SW4STM32): 免费
- BLE和802.15.4并发避免使用第二个射频微控制器





26

AN 5165



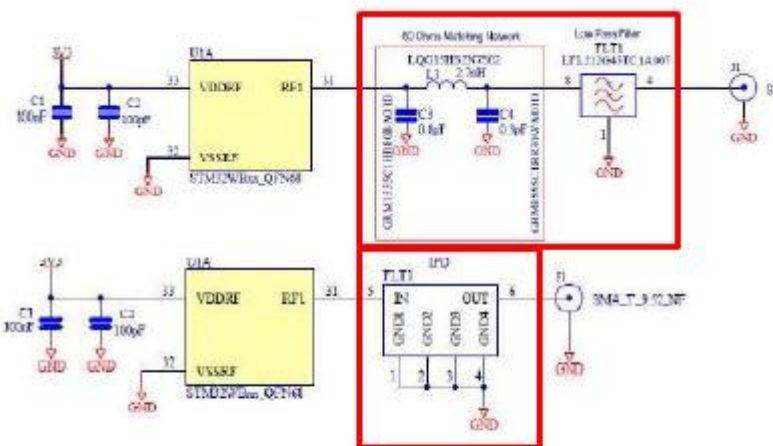


低成本

IPD* - MLPF-WB55-01E3

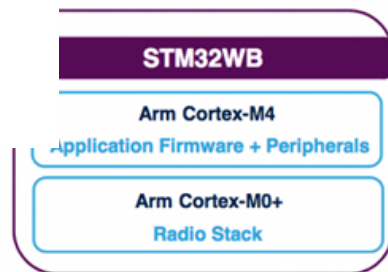
27

集成阻抗匹配谐波滤波器

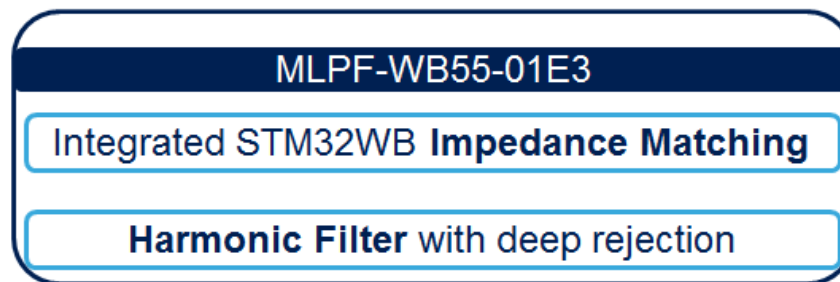
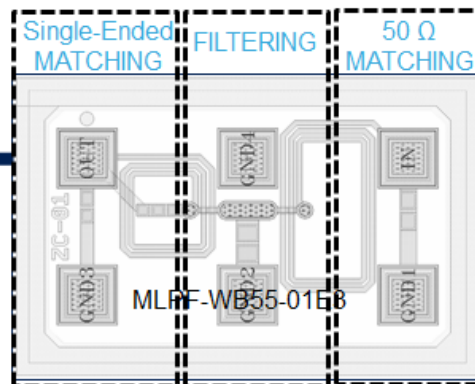


Integrated Balun

*IPD : Integrated Passive Device
→ Integrating matching + filter

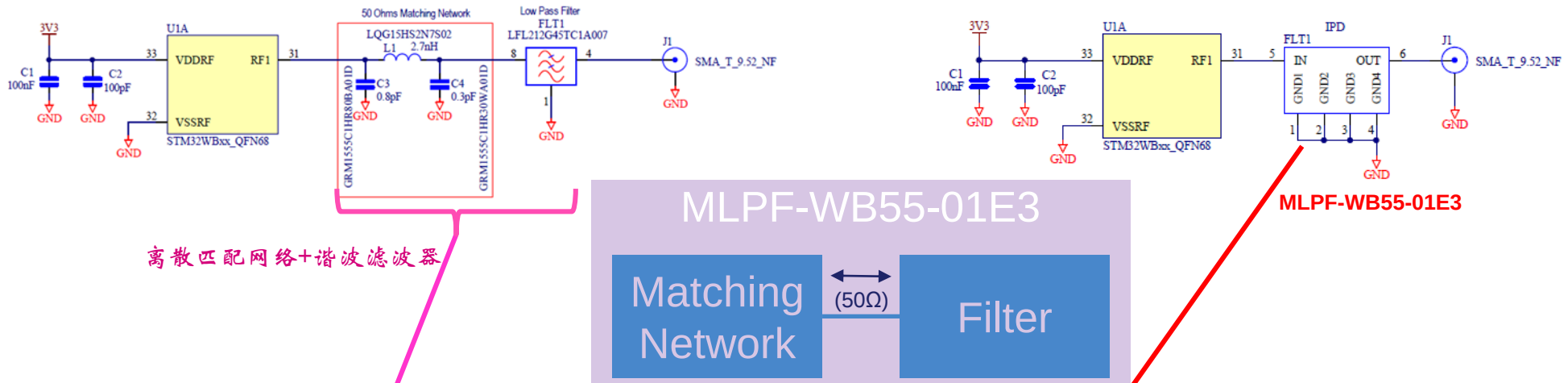


MLPF-WB55-01E3



LTCC-like assembly
0.5mm pitch

- 以集成无源器件替代离散匹配网络+集成滤波器，可至少达到相同的TX/RX性能



离散匹配网络+谐波滤波器

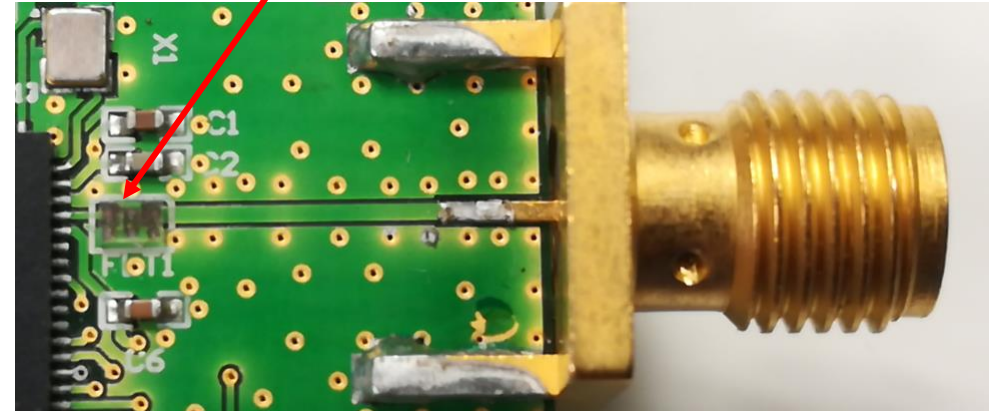
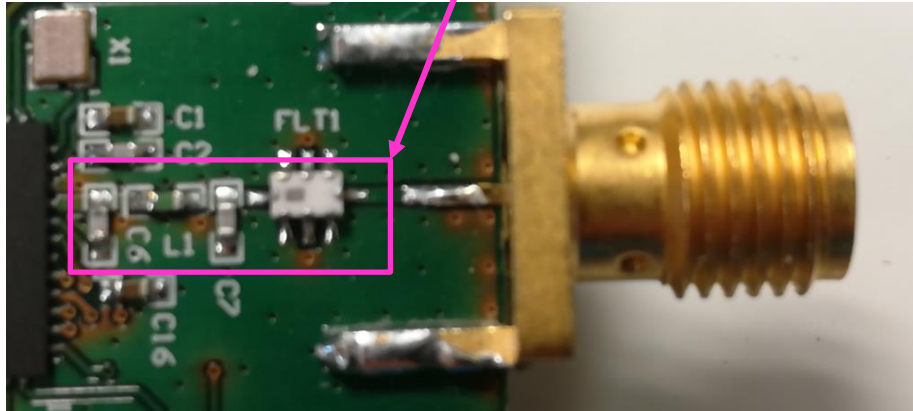


Figure 4. Optimized solution with discrete components

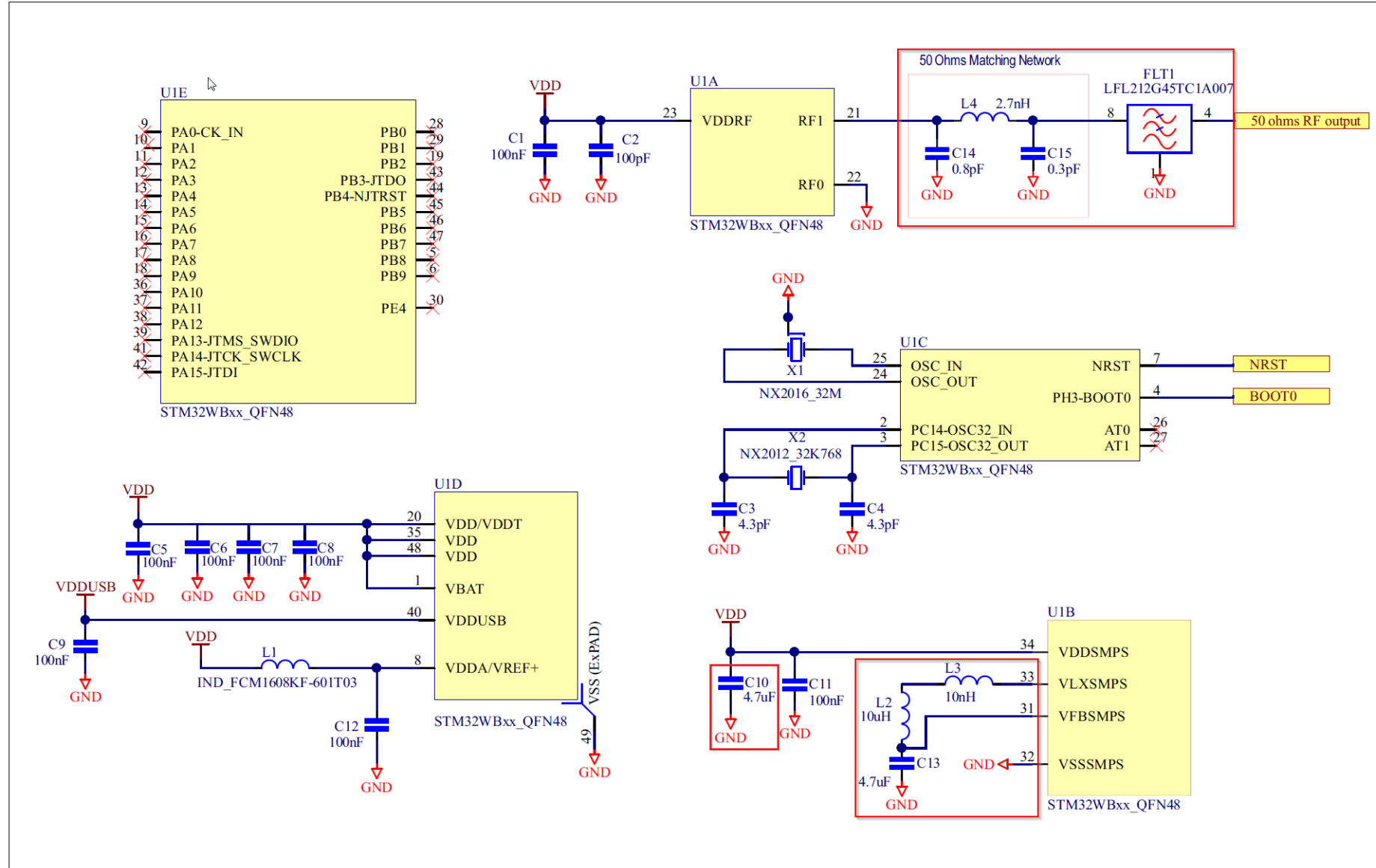


Figure 5. Optimized solution with IPD

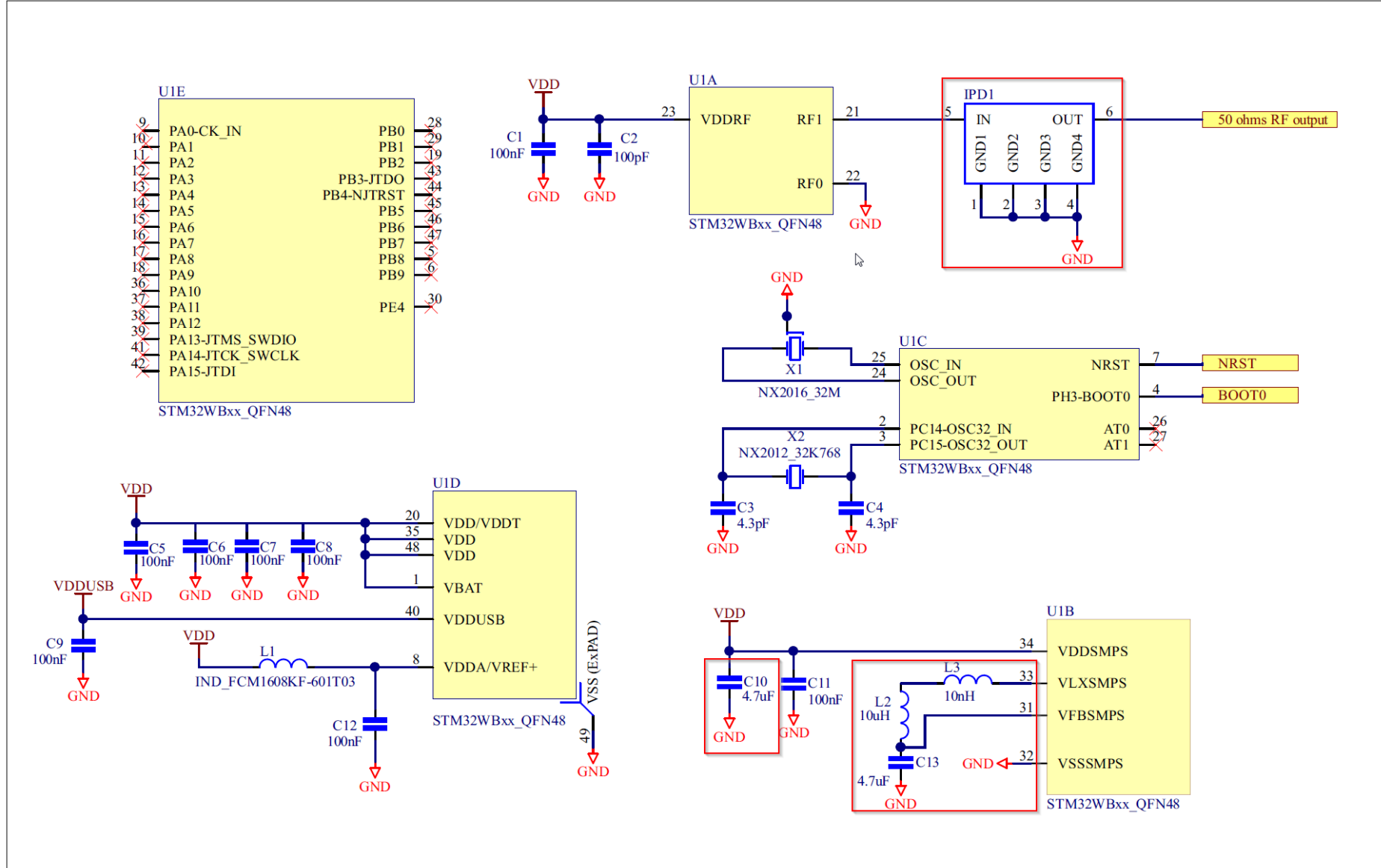
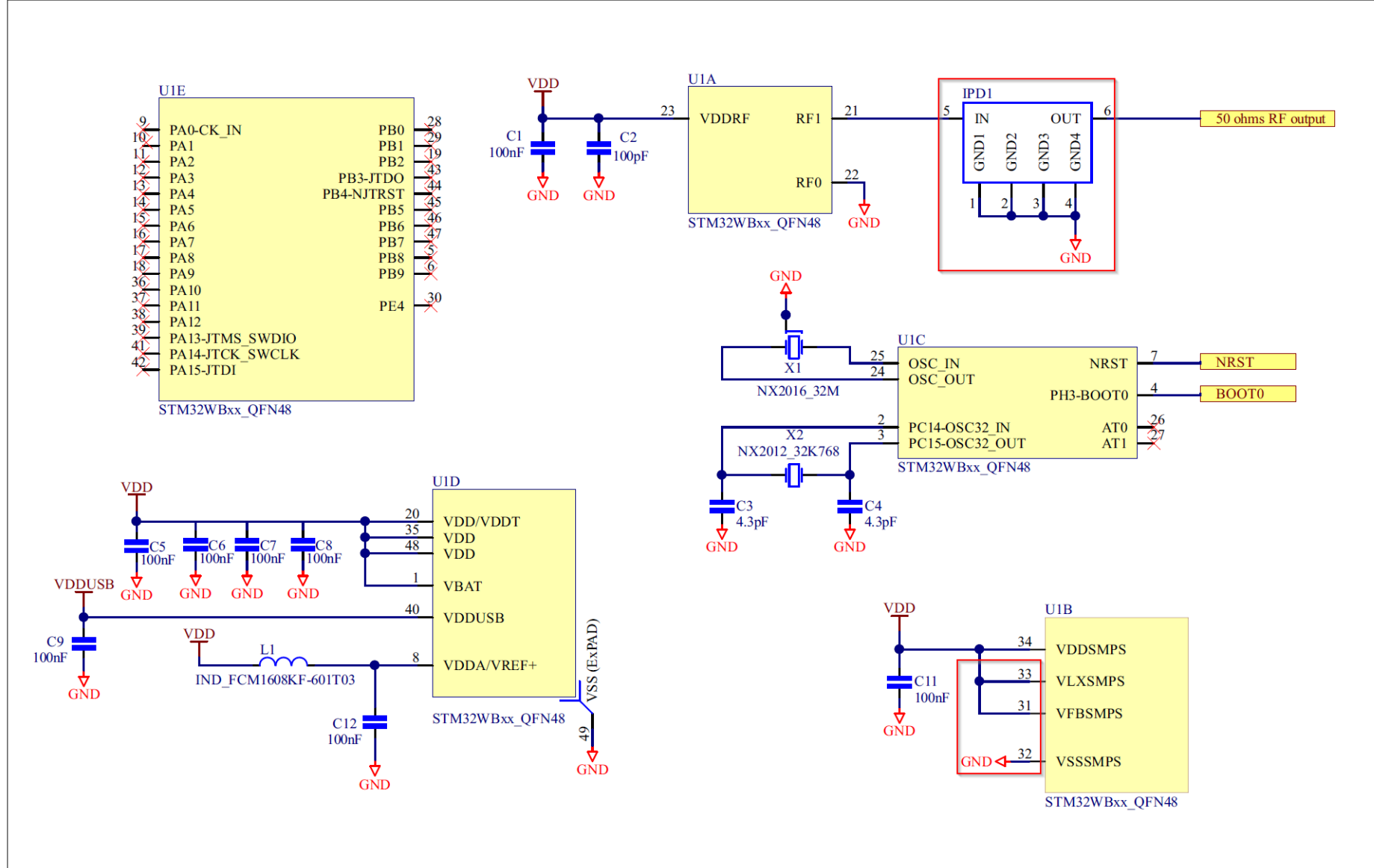


Figure 6. Solution without SMPS





产品快速上市



产品快速上市



产品快速上市

STM32WB55 开发套件

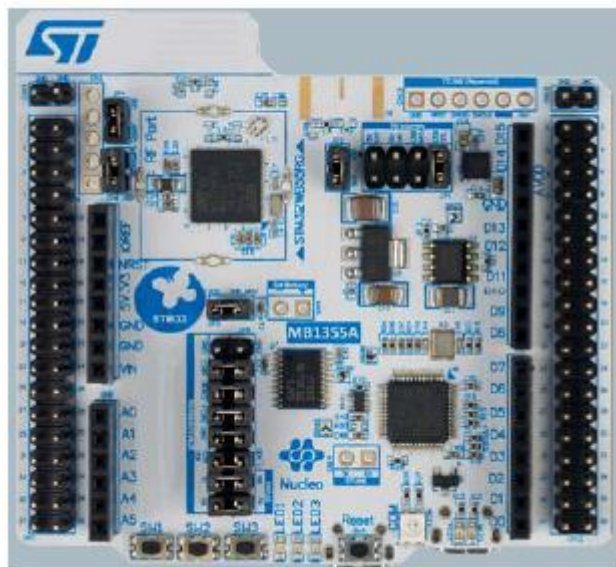
33

Wireless and ultra-low-power
BLE 5.0 & IEEE 802.15.4

Includes:

STM32WB55 FEATURES

- Arm® Cortex®-M4 MCU with **64 MHz/80 DMIPS** and dedicated Arm® Cortex®-M0+ radio co-processor at **32 MHz**
- **Multiprotocol:** BLE 5.0, 802.15.4, concurrent mode
- 1 Mbyte of Flash memory
- 256 Kbytes of SRAM
- **High RF performances** : RX - 96dBm/-100dBm; TX + 6dBm



NUCLEO BOARD FEATURES

- **STM32WB55RGV6 MCU**
- PCB Antenna and SMA connectors
- Flexible power supply supporting CR2032
- Dual USB Port (Application/debug)
- Multiple USER switch/LEDs
- Supports Arduino™ and ST Morpho connectors
- Embedded ST-LINK/V2-1 debugger and programmer
- Arm® Mbed Enabled™



USB DONGLE

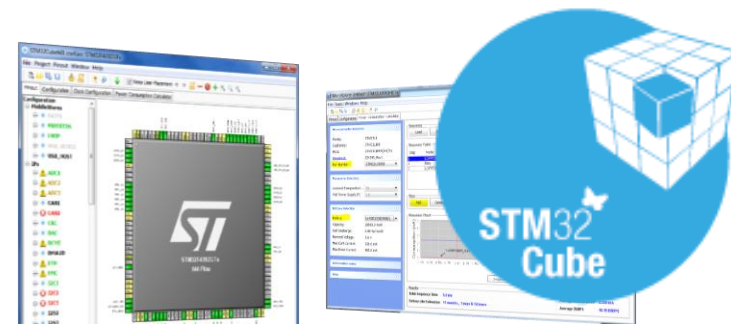
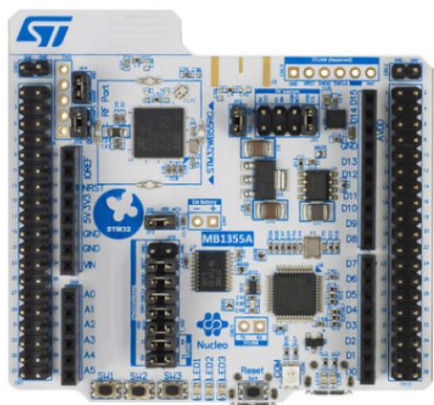
- **STM32WB55CGU6 MCU**
- PCB Antenna and UFL connectors
- Seccable PCB



产品快速上市

硬件开发工具

34



STM32
CubeMonitor-RF

硬件

评估板套件

STM32CubeMX

代码生成

功耗计算

STM32CubeMonRF

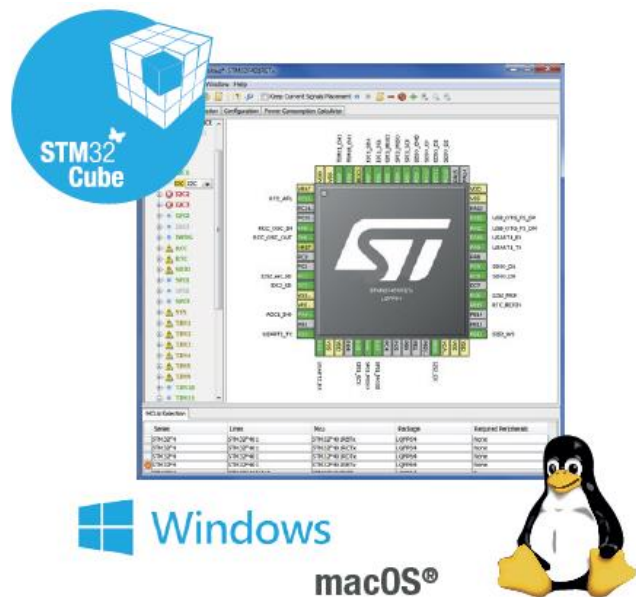


产品快速上市

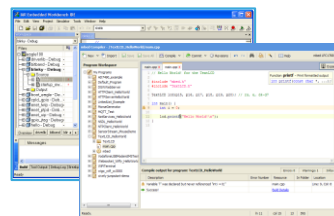
软件开发工具

35

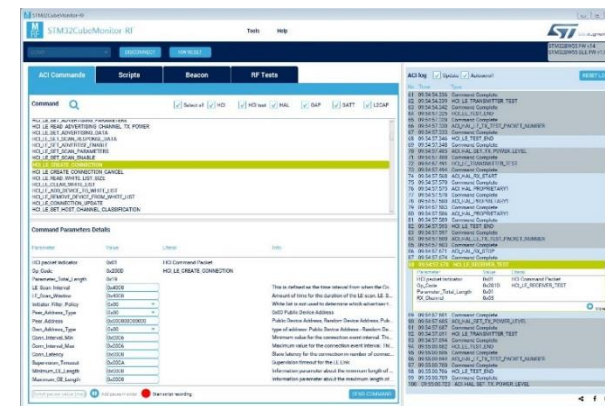
从配置到监测的完整开发流程



FREE
IDE's



大众市场发布后还将有更多工具推出



STM32CubeMX
配置和生成代码

合作伙伴的IDE环境
编译与调试

STM32CubeMonRF
监测



产品快速上市

生态系统

36

Fully part of the STM32 existing wide ecosystem

HW tools + Demos



Nucleo + USB dongle



Discovery + USB dongle



Dev tools

STM32CubeMX

STM32CubeProgrammer

Partners IDE

STM32CubeMonitor-RF



Stacks

Bluetooth 5

Thread

ZigBee 3.0

HomeKit

WorkwithNest

OS

RTOS

mBed



产品快速上市

免费智能手机软件

37

- 智能手机 – STM32WB官方支持的软件

- ST BLE Sensor - Google Play / Apple Store

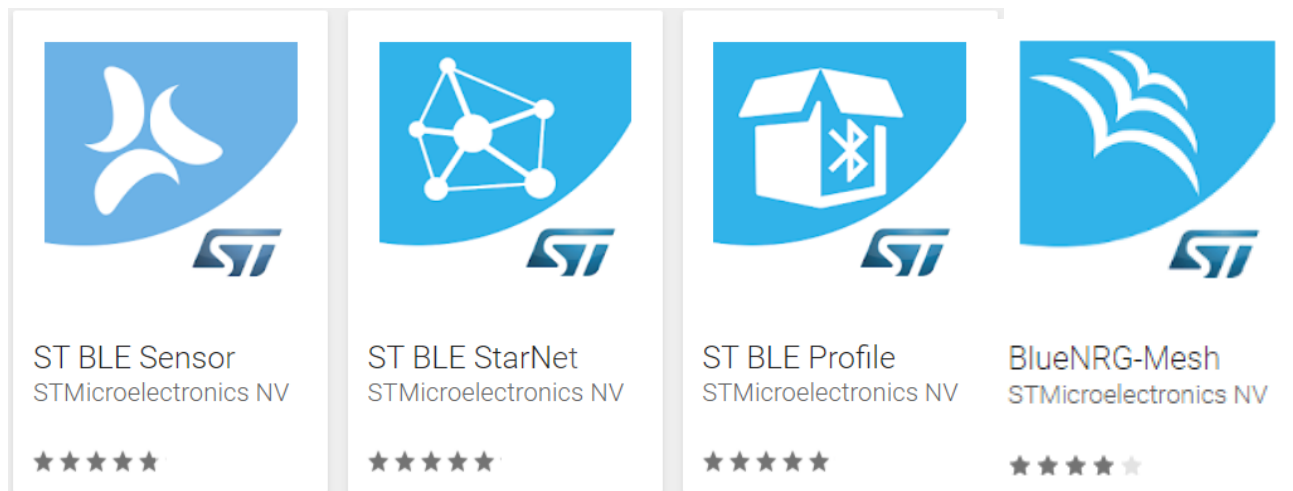
- https://github.com/STMicroelectronics/STBlueMS_Android
- https://github.com/STMicroelectronics/STBlueMS_iOS

- ST BLE StarNet - Google Play / Apple Store

- https://github.com/STMicroelectronics/STSensNet_Android
- https://github.com/STMicroelectronics/STSensNet_iOS

- ST BLE Mesh – Google Play / Apple Store

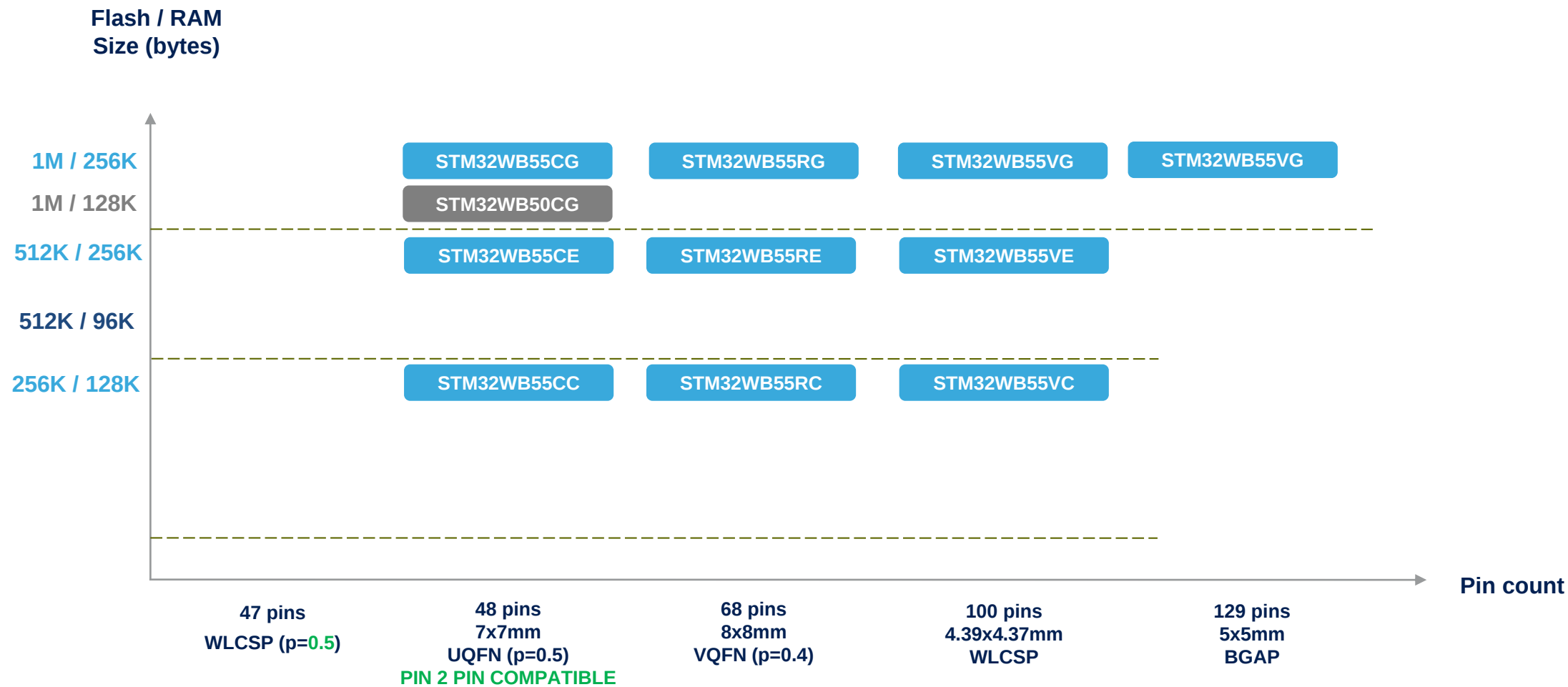
- https://my.st.com/content/ccc/resource/technical/software/application_sw/group0/00/b6/03/c2/7a/9d/4c/bb/STSW-BNRG-Mesh/files/STSW-BNRG-Mesh.zip/jcr:content/translations/en.STSW-BNRG-Mesh.zip





STM32WB 产品系列

38



STM32WB50 Value line in QFN48 Production: Jul'19



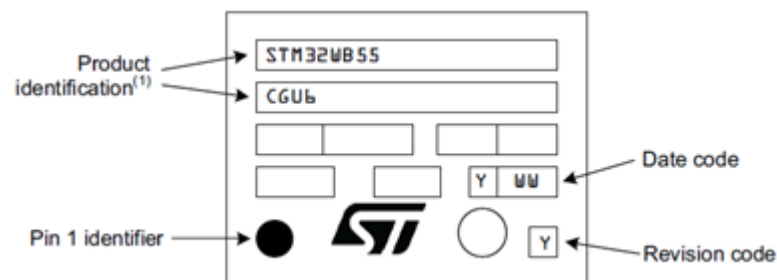
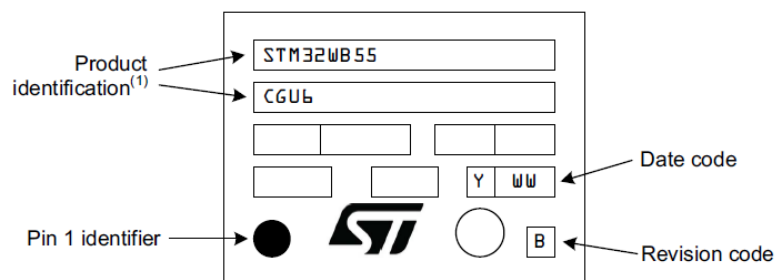
- ST Slaes 可在系统里直接申请样品

—欧盟区外需要EUC文档 (因为WB有加密模块)

- cut 2.1样品

QFN48, QFN68, WLCSP100

Package	Product	Revision	MML
UFQFPN48 7 x 7 mm (with solder pad)	STM32WB55CxUy	Y	19w9
VFQFPN68 8 x 8 mm (with solder pad)	STM32WB55RxVy	Y	19w9
WLCSP100 0.4 mm pitch	STM32WB55VxYy	Y	TBC

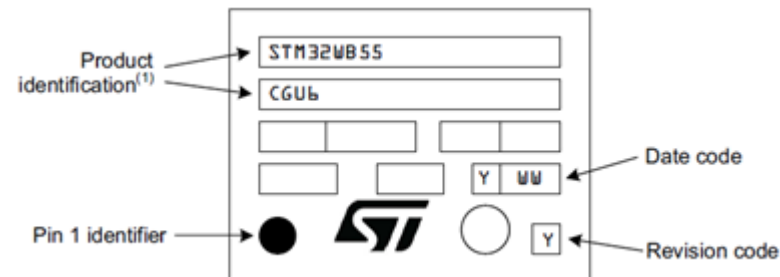
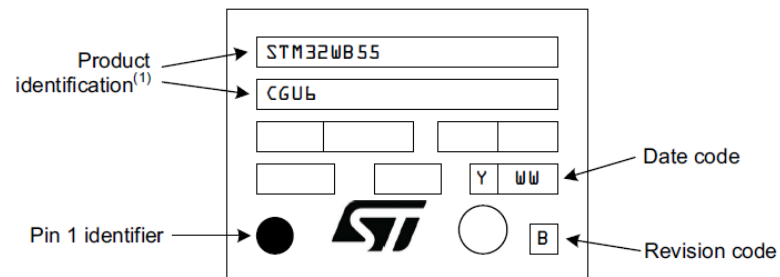


Example:

	STM32	WB	55	V	G	V	6	TR
Device family	STM32 = Arm [®] based 32-bit microcontroller							
Product type	WB = Wireless Bluetooth [®]							
Device subfamily	55 = Die 5, full set of features							
Pin count	C = 48 pins R = 68 pins V = 100 pins							
Flash memory size	C = 256 KB E = 512 KB G = 1 MB							
Package	U = UFQFPN48 7 mm x 7 mm V = VFQFPN68 8 mm x 8 mm Y = WLCSP100 0.4 mm pitch							
Temperature range	6 = Industrial temperature range, -40 to 85 °C (105 °C junction) 7 = Industrial temperature range, -40 to 105 °C (125 °C junction)							
Packing	TR = tape and reel xxx = programmed parts							

- 通过客户服务团队订购STM32WB55 Nucleo Pack(包括一块Nucleo 和一块USB dongle): europe.toolsmanufacturing@st.com
- 欧盟区外需要EUC文档 (因为WB有加密模块)

- STM32WB55 Nucleo Pack with cut2.1 Product: P-NUCLEO-WB55



Example:	STM32	WB	55	V	G	V	6	TR
Device family	STM32 = Arm [®] based 32-bit microcontroller							
Product type	WB = Wireless Bluetooth [®]							
Device subfamily	55 = Die 5, full set of features							
Pin count	C = 48 pins R = 68 pins V = 100 pins							
Flash memory size	C = 256 KB E = 512 KB G = 1 MB							
Package	U = UFQFPN48 7 mm x 7 mm V = VFQFPN68 8 mm x 8 mm Y = WLCSP100 0.4 mm pitch							
Temperature range	6 = Industrial temperature range, -40 to 85 °C (105 °C junction) 7 = Industrial temperature range, -40 to 105 °C (125 °C junction)							
Packing	TR = tape and reel xxx = programmed parts							



产品快速上市

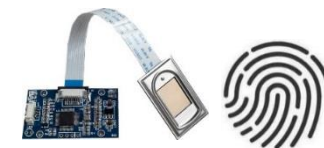
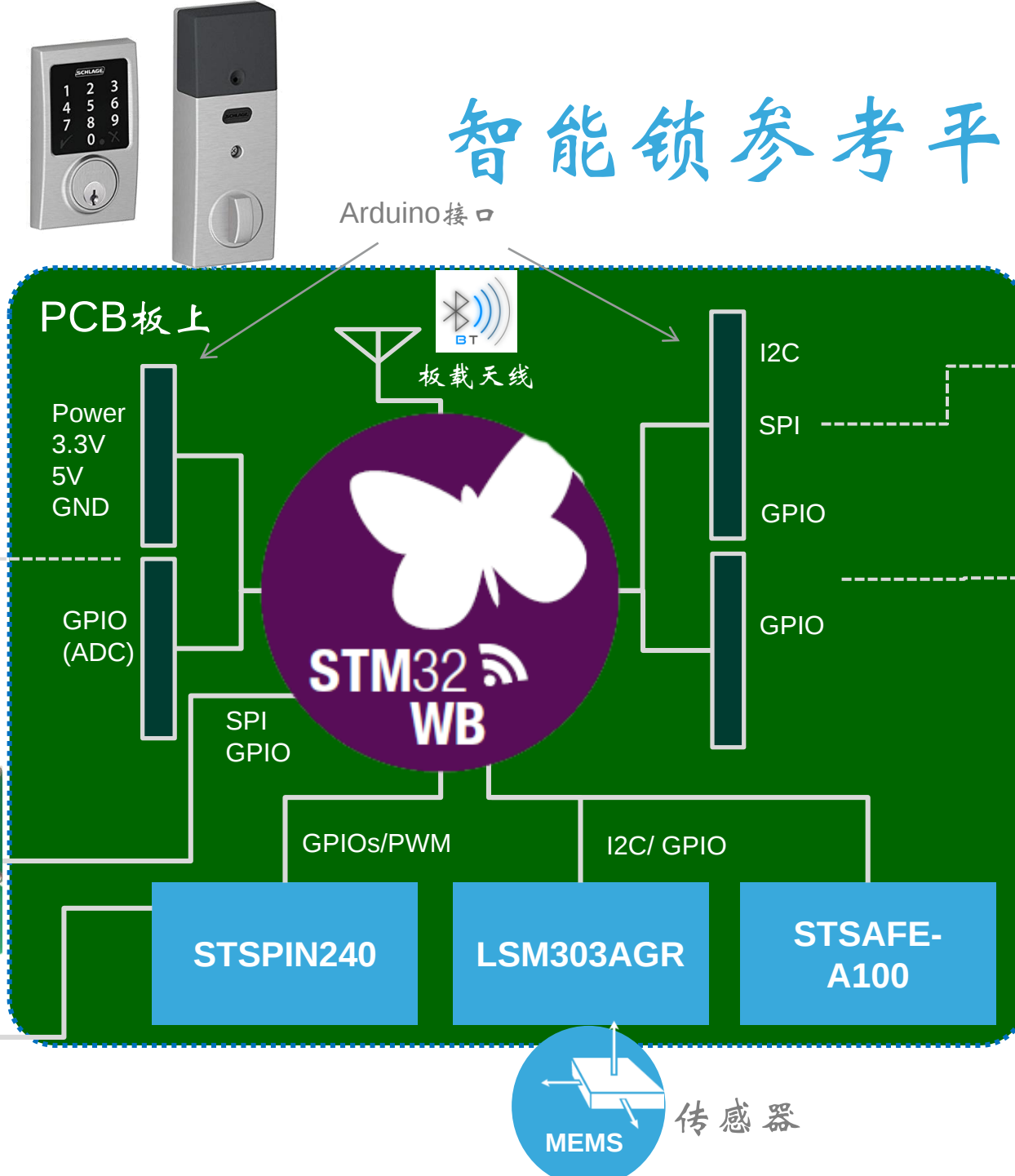
智能锁参考平台(1/2)

41

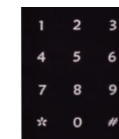
<http://club.stmcu.com.cn:8080/smartlock/>

Arduino Shield
e.g. wifi, lora,
sensors, ...

可通过Arduino接口
外接其它模块



可通过Arduino接口
外接指纹模块



可通过Arduino接口
外接触摸按键模块

NFC 读卡器

Ⓜ NFC Ⓜ



ST25R3913
NFC 读卡器
扩展板



直流电机



STSPIN240

LSM303AGR

STSAFE-
A100

GPIOs/PWM

I2C/ GPIO

PCB板上

Arduino接口

板载天线

STM32 WB

I2C

SPI

GPIO

GPIO

Power
3.3V
5V
GND

GPIO
(ADC)

STSPIN240

LSM303AGR

STSAFE-
A100

GPIOs/PWM

I2C/ GPIO

MEMS

传感器

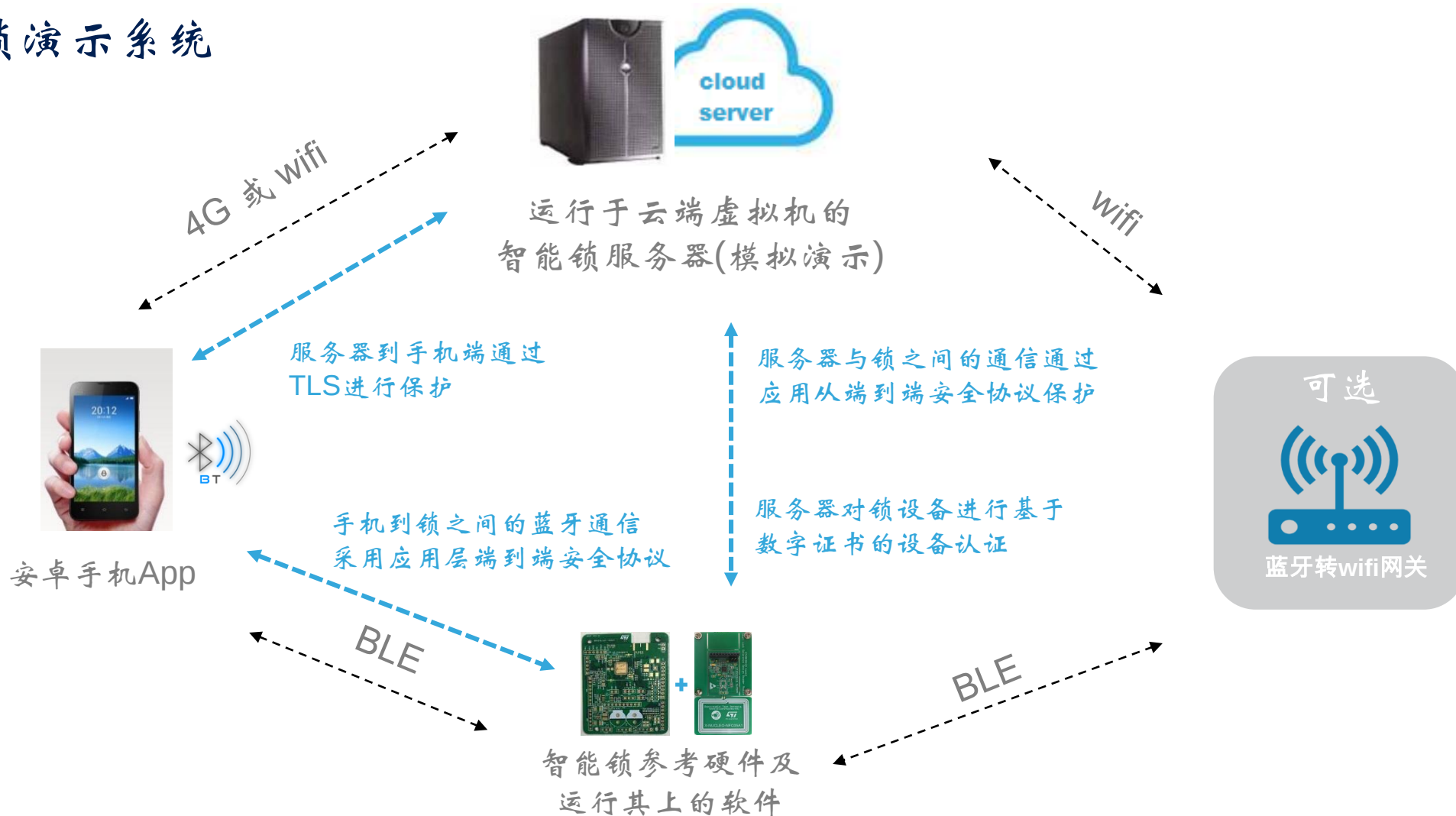


安全元件



电机驱动

智能锁演示系统





产品快速上市



Central

Peripheral

Central



Home
Controller
(Router)



Light
Controller

Peripherals



Temperature
Controller



Peripherals

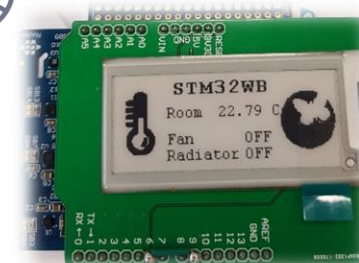
家庭自动化

4

Peripherals



Lock
Controller



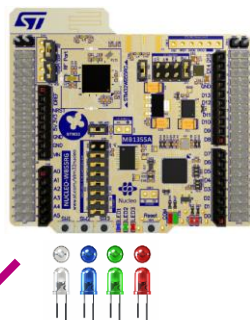


产品快速上市

Notification

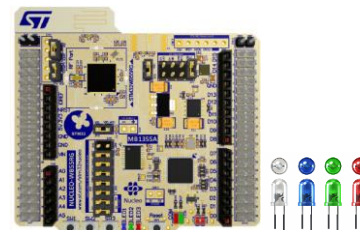
Command

P2P server 1
End Device 1
Adv Id = 0x83

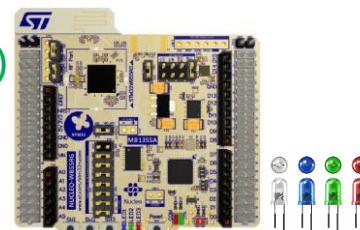


Peripheral(S)
Server

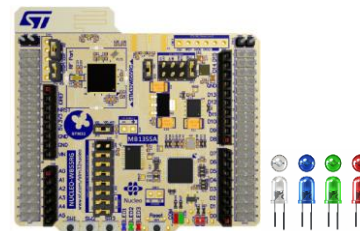
P2P Server 2
End Device 2
Adv Id = 0x84



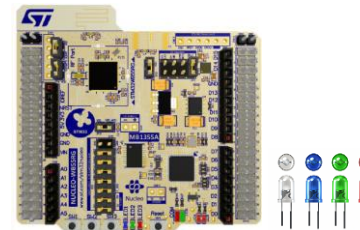
P2P Server 3
End Device 3
Adv Id = 0x87



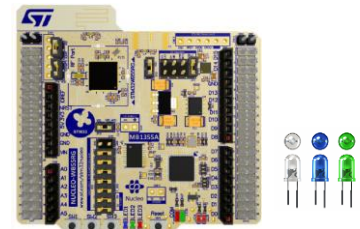
P2P Server 4
End Device 4
Adv Id = 0x88



P2P Server 5
End Device 5
Adv Id = 0x89



P2P Server 6
End Device 6
Adv Id = 0x8A



Client
Central(M)

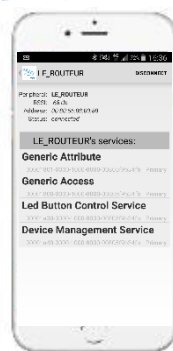
Peripheral(S)
Server

P2P Router
Adv Id = 0x85



Server
Peripheral

Smart
Phone



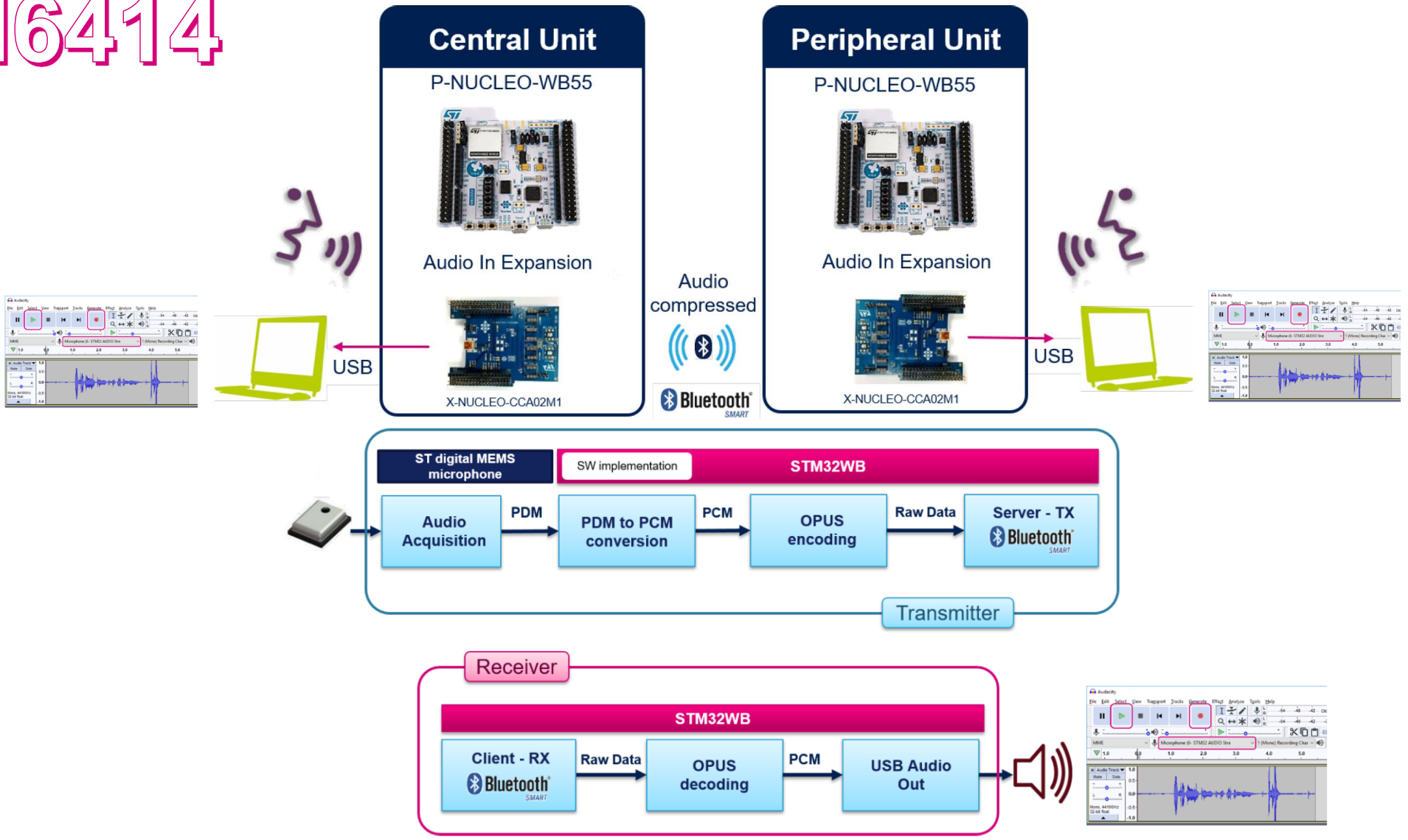
Central(M)
Client



产品快速上市

Full-duplex Audio Streaming over BLE5.0

UM6414



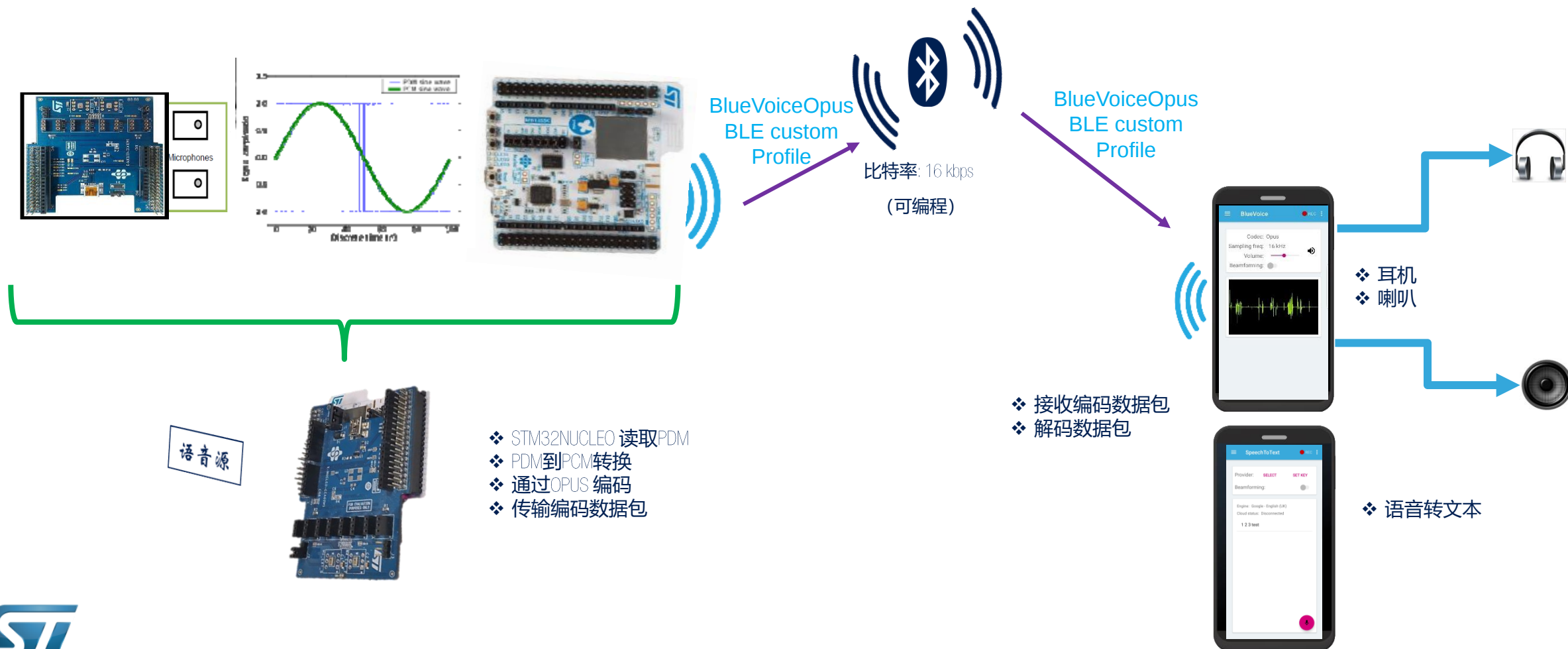


产品快速上市

UM6414

传输语音到安卓手机

46





产品快速上市

Mesh 网格网络

47

STM32Cube_FW_WB_Vx.x.x\Projects\P-NUCLEO-WB55.Nucleo\Applications\BLE\BLE_MeshLightingDemo

AN 5292

1 Download and Flash the Hex Image



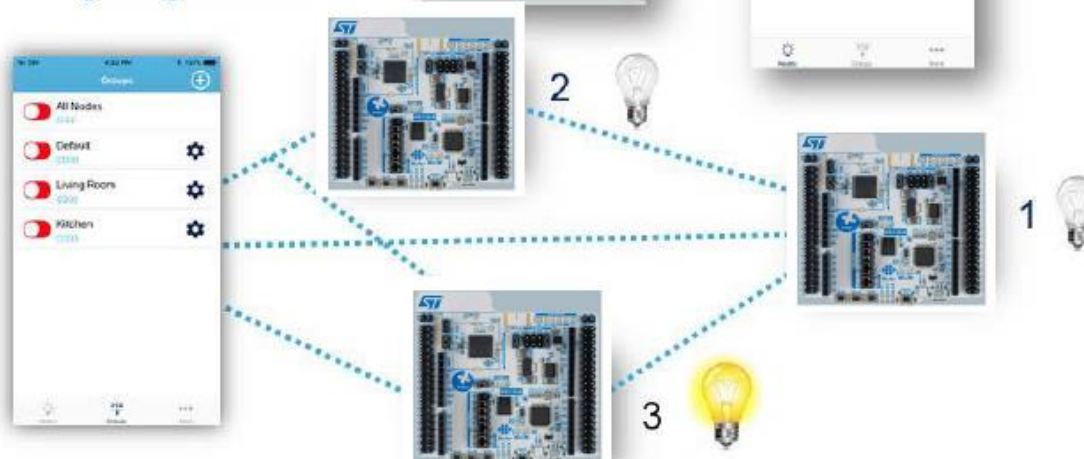
2 Install and Launch ST BlueNRG-Mesh iOS App



3 Provision the Devices



4 Control the Lighting Device





产品快速上市

UM2613

- view real-time motion and environmental (temperature, relative humidity, carbon monoxide) sensor data
- enables advanced functions such as the sensor data fusion and accelerometer-based real-time activity recognition
- develop specific wearable and environmental applications, or smart things applications in general

FP-SNS-MOTENVWB1

48

