Migrating between STM32WB30/35/50/55 microcontrollers

Introduction

For designers of STM32 microcontroller applications, being able to smoothly replace one microcontroller type by another from the same product family is an important asset. Migrating an application to a different microcontroller is often necessary when product requirements grow, putting extra demand on memory size, or increasing the number of I/Os. Cost reduction objectives are also an argument to switch to smaller components and shrink the PCB area.

This application note analyzes the related existing design and the steps required for migrating between STM32WB30/35/50/55 microcontrollers. The five aspects that must be considered for the migration steps are the hardware, the peripherals, the firmware, security and tools. To better understand the information in this application note, the end-user should be familiar with the STM32WB30/35/50/55 microcontrollers (see documents R1 and R2).

Table 1. Applicable products

Type	Part numbers
Microcontrollers	STM32WB30CE, STM32WB35CC, STM32BW35CE, STM32WB50CG,STM32WB55CC, STM32WB55CE, STM32WB55CG, STM32WB55RC, STM32W55RE, STM32WB55RG, STM32WB55VC, STM32WB55VE, STM32WB55VG, STM32WB55VY

1 General information

This document applies to STM32WB30/35/50/55 microcontrollers Arm® Cortex®-M4/M0 core-based microcontrollers.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

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Table 2. Reference documents and tools

Reference	Title
R1	Multiprotocol wireless 32-bit MCU Arm®-based Cortex®-M4 with FPU, Bluetooth® Low Energy and 802.15.4 radio solution (RM0434) reference manual(1)
R2	Multiprotocol wireless 32-bit MCU Arm®-based Cortex®-M4 with FPU, Bluetooth® 5 and 802.15.4 radio solution (DS11929) datasheet(1)
R3	STM32CubeMX: video(1)
R4	ST firmware upgrade services for STM32WB Series (AN5185) application note(1)
R5	Getting started with touch sensing control on STM32 microcontrollers (AN5105)(1)

1. *Available at www.st.com.*

2 Hardware migration

This section presents a summary of the major hardware changes during the migration process.

2.1 Package overview

The table below details the available packages for STM32WB30/35/50/55 microcontrollers.

Table 3. Package information

Package[1]	Number of pins	STM32WB55	STM32WB35	STM32WB50	STM32WB30	Part numbers
UFQFPN48	48	X	X	X	X	STM32WB55CxU STM32WB35CxU STM32WB50CGU STM32WB30CEU
VFQFPN68	68	X	-	-	-	STM32WB55RxV
WLCSP100	100	X	-	-	-	STM32WB55VxY
UFBGA129	129	X	-	-	-	STM32WB55VxQ

1. *"x" = available, "-" = device is not produced with this package.*

2.2 RF performances

The STM32WB30/35/50/55 microcontrollers embed a powerful and ultra-low power radio compliant with Bluetooth® Low Energy stack and with IEEE 802.15.4- 2011.

Table 4. Bluetooth Low Energy on-air data rate versus device

Bluetooth Low Energy on-air data rate	STM32WB55	STM32WB35	STM32WB50	STM32WB30
2 Mbit/s	X	X	-	-
1 Mbit/s	X	X	X	X

Note: For more details regarding RF electrical characteristics refer to R2.

2.3 Pinout differences

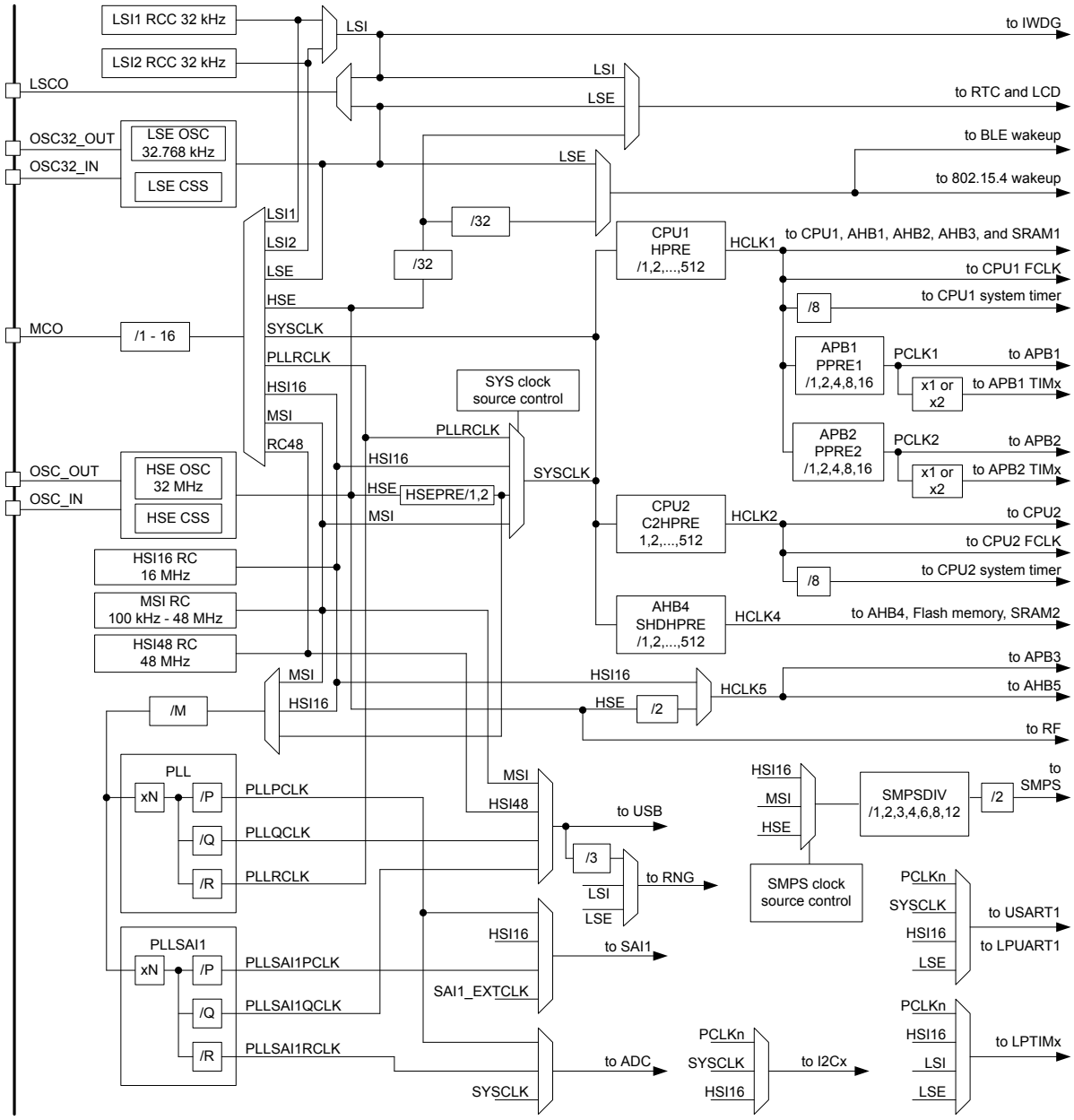
The STM32WB30/35/50/55 microcontrollers have different packages, therefore migrating between devices requires a particular attention regarding GPIOs and their associated alternate functions. The following microcontrollers are pin-to-pin compatible when migrating (for other packages refer to R2).

- STM32WB55 in UFQFPN48 package is pin-to-pin compatible with the STM32WB35 in UFQFPN48 package.
- STM32WB50 in UFQFPN48 package is pin-to-pin compatible with the STM32WB30 in UFQFPN48 package.

2.4 Clock tree

The clock tree for STM32WB35 and STM32WB55 is the same. For more details refer to Figure 1.

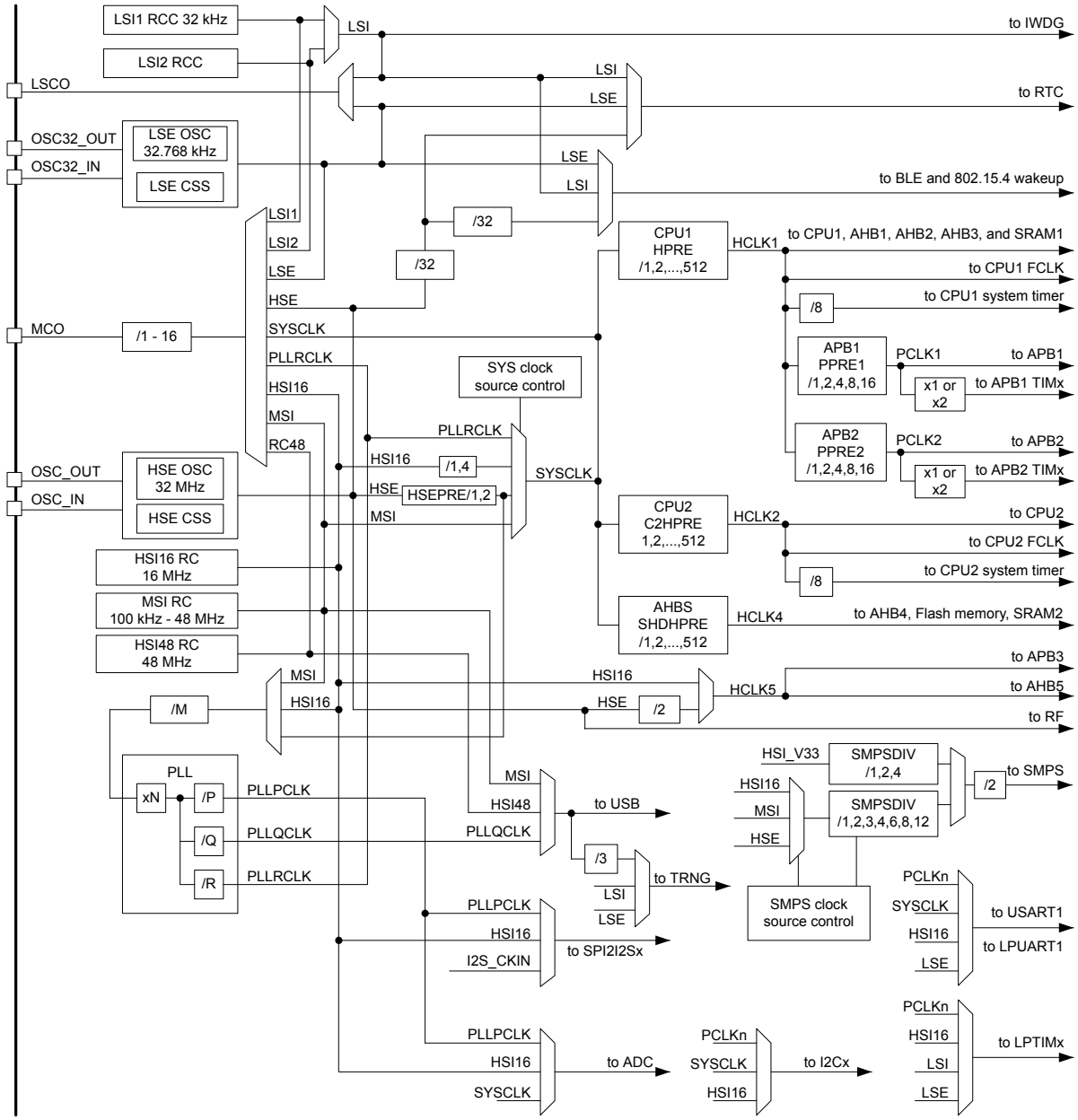
Figure 1. STM32WB55 and STM32WB35 clock tree



Note: The LCD is not available on STM32WB35xx devices.

The clock tree for STM32WB30 and STM32WB50 is the same. For more details refer to the figure below.

Figure 2. STM32WB50 and STM32WB30 clock tree



3 Peripheral migration

The table below summarizes the peripheral compatibility and features changes when migrating between STM32WB30/35/50/55 microcontrollers.

Table 5. Peripheral compatibility and features on STM32WB30/35/50/55

Peripheral/Features	STM32WB55				STM32WB35	STM32WB50	STM32WB30
	UFQFPN48	VFQFPN68	WLCSP100	UFBGA129	UFQFPN48	UFQFPN48	UFQFPN48
Bluetooth 5	Yes				Yes	Yes	Yes
IEEE 802.15.4	Yes				Yes	Yes	Yes
Concurrent mode	Yes				Yes	No	No
Dual core CPU Arm Cortex-M4 + Cortex-M0	Yes				Yes	Yes	Yes
Flash memory	Up to 1 Mbyte				Up to 512 Kbytes	1 Mbyte	512 Kbytes
SRAM (in Kbytes)	Up to 256				96	128	96
QUADSPI	1				1	0	0
DMA	2 (14 channels)	2 (14 channels)	2 (14 channels)	2 (14 channels)	2 (14 channels)	1 (7 channels)	1 (7 channels)
16-bit advanced timer TIM1	1				1	1	1
32-bit general purpose timers TIM2	1				1	1	1
16-bit general purpose timers TIM16/TIM17	2				2	2	2
16-bit low-power timer LPTIM1/ LPTIM2	2				2	2	2
Watchdog timer	2				2	2	2
SysTick timer	1				1	1	1
SPI	1	2	2	2	1	1	1
I^2C (inter-integrated circuit)	2				2	1	2
USART (can be used as SPI)	1				1	1	1
LPUART	1				1	No	No
SAI (serial audio interface)	1 (dual channel)				1 (dual channel)	No	No
USB FS	1				1	No	No
RTC	1				1	1	1
Tamper pins	1	3	3	3	1	1	1
Wakeup pins	2	5	5	5	2	2	2
LCD (COMxSEG)	Yes (4 × 13)	Yes (4 × 28)	Yes (8 × 40 or 4 × 44)	Yes (8 × 40 or 4 × 44)	No	No	No
GPIOs	30	49	72	72	30	30	30
TSC (capacitive touch sensing)	No	6	18	18	No	No	No
12 bits ADC	13 channels	19 channels	19 channels	19 channels	13 channels	10 channels	13 channels

Peripheral/Features	STM32WB55				STM32WB35	STM32WB50	STM32WB30
	UFQFPN48	VFQFPN68	WLCSP100	UFBGA129	UFQFPN48	UFQFPN48	UFQFPN48
Internal Vref	Yes				Yes	Yes	Yes
Analog comparator (COMP)	2				2	No	No
Max CPU frequency	64 MHz				64 MHz	64 MHz	64 MHz
JTAG/SW-DP	1 / 1				1 / 1	0 / 1	0 / 1
ETM	Yes				No	No	No
PLL	2				1	1	1
Operating temperature range 1	-40 °C to +85°C				-40 °C to +85 °C	-10°C to +85°C	-10 °C to +85 °C
Operating temperature range 2	-40 °C to +105°C				-40 °C to +105 °C	No	No
Operating voltage	1.71 V to 3.6 V				1.71 V to 3.6 V	2 V to 3.6 V	2 V to 3.6 V
SMPS	Yes				Yes	No	No

3.1 Hardware changes description

This section provides further details regarding the modified or suppressed features during the migration process between STM32WB30/35/50/55 microcontrollers.

3.1.1 Flash memory mapping

Different Flash memory sizes are available according to the package selected, for more information refer to the table below.

Table 6. Flash memory sizes and their mapping

Device	Flash memory size (Kbytes)	Mapping addresses	Description
STM32WB55	256, 512, 1000	0x0800 0000 – 0x080F FFFF	The Flash memory start addresses are the same for all STM32WB30/35/50/55 microcontrollers.
STM32WB50	1000	0x0800 0000 – 0x080F FFFF	
STM32WB35	256, 512	0x0800 0000 – 0x0807 FFFF	
STM32WB30	512	0x0800 0000 – 0x0807 FFFF	

3.1.2 SRAM memory mapping

As shown in the table below the SRAM1 density is reduced between the STM32WB55 and STM32WB35 as well as between STM32WB50 and STM32WB30 microcontrollers.

Table 7. SRAM memory sizes and their mapping

Device	SRAM(1)	SRAM size (Kbytes)	Mapping addresses	STM32WB5x versus STM32WB3x
STM32WB55 (SRAM density)	SRAM1 SRAM2a SRAM2b	64/192(2) 32 32 Total: 128/256	0x2000 0000 - 0x2002 FFFF 0x2003 0000 - 0x2003 7FFF 0x2003 8000 - 0x2003 FFFF	• SRAM1 size can be reduced from 192 Kbytes to 32 Kbytes. SRAM1 starts at the same address on STM32WB55 and STM32WB35. • SRAM2a and SRAM2b have the same size and start at the same address on STM32WB55 and STM32WB35.
STM32WB35 (SRAM density)	SRAM1 SRAM2a SRAM2b	32 32 32 Total: 96	0x2000 0000 - 0x2000 7FFF 0x2003 0000 - 0x2003 7FFF 0x2003 8000 - 0x2003 FFFF	
STM32WB50 (SRAM density)	SRAM1 SRAM2a SRAM2b	64 32 32 Total: 128	0x2000 0000 - 0x2000 FFFF 0x2003 0000 - 0x2003 7FFF 0x2003 8000 - 0x2003 FFFF	• SRAM1 size is reduced from 64 Kbytes to 32 Kbytes. SRAM1 starts at the same address on STM32WB50 and STM32WB30. • SRAM2a and SRAM2b have the same size and start at the same address on STM32WB50 and STM32WB30.
STM32WB30 (SRAM density)	SRAM1 SRAM2a SRAM2b	32 32 32 Total: 96	0x2000 0000 - 0x2000 7FFF 0x2003 0000 - 0x2003 7FFF 0x2003 8000 - 0x2003 FFFF	

1. *SRAM2a is retained in standby mode for all STM32WB5x and STM32WB3x.*
2. *There are two possible configurations according to the device part number.*

3.1.3 Peripheral migration compatibility

This section presents a complete view of the number of peripherals available when migrating between STM32WB30/35/50/55 microcontrollers. For more details regarding peripheral electrical characteristics refer to R2.

Table 8. Peripheral compatibility analysis between STM32WB30/35/50/55

Peripheral	STM32WB55				STM32WB35	STM32WB50	STM32WB30
	UFQFPN48	VFQFPN68	WLCSP100	UFBGA129	UFQFPN48	UFQFPN48	UFQFPN48
QUADSPI	1	1	1	1	1	0	0
DMA (7 channels)	2	2	2	2	2	1	1
SPI	1	2	2	2	1	1	1
I^2C (inter-integrated circuit)	2	2	2	2	2	1	1
SAI (serial audio interface)	1	1	1	1	1	0	0
LPUART(1)	1	1	1	1	1	0	0
USB(2)	1	1	1	1	1	0	0
ADC(3)	1 × 13 channels	1 × 19 channels	1 × 19 channels	1 × 19 channels	1 × 13 channels	1 × 13 channels	1 × 13 channels
COMP	2	2	2	2	2	0	0
GPIOs(4)	30	49	72	72	30	30	30
TSC(5)	0	6	18	18	0	0	0
LCD(6)	4 × 13	4 × 28	8 × 40 or 4 × 44	8 × 40 or 4 × 44	0	0	0
Tamper pins	1	3	3	3	1	1	1
JTAG/SWD(7)	1 / 1	1 / 1	1 / 1	1 / 1	1 / 1	0 / 1	0 / 1
ETM (embedded trace macrocell)	No	No	Yes	Yes	No	No	No
PLL (phase-locked loop)	2	2	2	2	2	1	1

1. *No LPUART on STM32WB50 and STM32WB30 microcontrollers.*
2. *No USB on STM32WB50 and STM32WB30 microcontrollers.*
3. *For the ADC sampling rate refer to Table 9.*
4. *STM32WB30/35/50/55 microcontrollers in UFQFPN48 package are pin-to-pin compatible.*
5. *Number of keys including the shield that can be drived with the TSC peripheral. For more information about TSC and sensors connection refer to R5.*
6. *LCD is not available in STM32WB35, STM32WB50 and STM32WB30 microcontrollers.*
7. *For all devices, JTAG if present, is performed using five GPIOs: PA13, PA14, PA15, PB3, PB4. SWD interface is performed using only two GPIOs, PA13 and PA14.*

Table 9. ADC sampling rate

AD sampling rate (Mbit/s)						
Sampling rate resolution	STM32WB55		STM32WB35		STM32WB50	STM32WB30
	Fast channels	Slow channels	Fast channels	Slow channels	-	
12 bits	4.26	3.36	4.26	3.36	2.13	2.13
10 bits	4.92	4.00	4.92	4.00	2.46	2.46
8 bits	5.81	4.57	5.81	4.57	2.91	2.91
6 bits	7.11	7.11	7.11	7.11	3.55	3.55

4 Software migration

This section gives an overview of the possible use-cases as well information on the available free memory space for Flash memory and SRAM when implementing the different scenarios.

The radio firmware can be upgraded over-the-air (OTA feature).

4.1 Memory density

Table 10. Flash memory and SRAM density

Memory footprint (Kbytes)	STM32WB55				STM32WB35		STM32WB50	STM32WB30
	Density 1	Density 2	Density 3	Density 4	Density 1	Density 2	Density 1	Density 1
Flash memory	256	512	640	1024	256	512	1024	512
SRAM1	64	192	192	192	32	32	192	32
SRAM2a	32	32	32	32	32	32	32	32
SRAM2b	32	32	32	32	32	32	32	32

4.2 Memory space availability

Table 11 and Table 12 give the Flash memory and the Cortex-M4 SRAM free memory space available after implementing each scenario. The values of the memory size mentioned in these tables are estimated values and can be changed for each scenario.

Table 11. STM32WB55 free memory space

Scenario	STM32WB55 free memory space (Kbytes)															
	Density 1				Density 2				Density 3				Density 4			
	W/O OTA(1)		W OTA(2)		W/O OTA		W OTA		W/O OTA		W OTA		W/O OTA		W OTA	
	Flash	SRAM	Flash	SRAM	Flash	SRAM	Flash	SRAM	Flash	SRAM	Flash	SRAM	Flash	SRAM	Flash	SRAM
Bluetooth 5 full stack	39	61	-	-	295	125	135	125	423	125	263	125	759	125	599	125
OPenThread FTD	-(3)	-	-	-	122	122	-	-	250	122	-	-	586	122	246	122
OPenThread MTD	-	-	-	-	209	127	-	-	337	127	84	127	673	127	420	127
Zigbee FFD	-	-	-	-	133	161	-	-	261	161	-	-	597	161	298	161
Zigbee RFD	-	-	-	-	173	161	-	-	301	161	42	161	637	161	378	161
Bluetooth LE Mesh	-	-	-	-	230	109	69	109	358	109	197	109	694	109	533	109
S. C. M. Bluetooth LE/Thread FTD	-	-	-	-	-	-	-	-	39	80	-	-	375	80	215	80
S. C. M. Bluetooth LE/Zigbee FFD	-	-	-	-	-	-	-	-	95	18	-	-	431	18	270	18

1. *W/O OTA: means the firmware does not include the over-the-air feature.*
2. *W OTA: means the firmware includes the over-the-air feature.*
3. *"-": not supported.*

Table 12. STM32WB35 free memory space

Scenario	STM32WB35 free memory space (Kbytes							
	Density 2				Density 3			
	W/O OTA(1)		W OTA(2)		W/O OTA		W OTA	
	Flash	SRAM	Flash	SRAM	Flash	SRAM	Flash	SRAM
Bluetooth 5 full stack	39	29	39	29	295	29	295	29
OPenThread FTD	- (3)	-	-	-	122	26	-	-
OPenThread MTD	-	-	-	-	209	31	-	-
Zigbee FFD	-	-	-	-	133	65	-	-
Zigbee RFD	-	-	-	-	173	65	-	-
Bluetooth LE Mesh	-	-	-	-	230	13	69	13
S. C. M. Bluetooth LE/Thread FTD	-	-	-	-	-	-	-	-
S. C. M. Bluetooth LE/Zigbee FFD	-	-	-	-	-	-	-	-

1. *W/O OTA: means the firmware does not include the over-the-air feature.*
2. *W OTA: means the firmware includes the over-the-air feature.*
3. *"-": not supported.*

Table 13. STM32WB50 free memory space

Scenario	STM32WB50 free memory space (Kbytes)			
	Density 1			
	W/O OTA(1)		W OTA(2)	
	Flash	SRAM	Flash	SRAM
Bluetooth 5 full stack	759	61	599	61
OPenThread FTD	586	58	246	58
OPenThread MTD	673	63	420	63
Zigbee FFD	597	97	298	97
Zigbee RFD	637	97	378	97
Bluetooth LE Mesh	694	45	533	45

1. *W/O OTA: means the firmware does not include the over-the-air feature.*
2. *W OTA: means the firmware includes the over-the-air feature.*

Table 14. STM32WB30 UFQFPN48 free memory space

Scenario	STM32WB30 free memory space (Kbytes)			
	Density 1			
	W/O OTA(1)		W OTA(2)	
	Flash	SRAM	Flash	SRAM
Bluetooth 5 full stack	295	29	135	29
OPenThread FTD	122	26	-(3)	-
OPenThread MTD	209	31	-	-
Zigbee FFD	133	65	-	-
Zigbee RFD	173	65	-	-
Bluetooth Low Energy Mesh	230	13	69	13

1. *W/O OTA: means the firmware does not include the over-the-air feature.*
2. *W OTA: means the firmware includes the over-the-air feature.*
3. *"-": not supported.*

4.3 HAL (hardware abstraction layer)

The STM32 hardware abstraction layer is available, the prototype of the HAL is for all devices while only its implementation differs. To update the implementation of the HAL, this is facilitated through STM32CubeMX, refer to R3 for more information.

4.4 Wireless stack

The wireless stack is available for each device and the setup uses the same process for all devices. For more information refer to R3.

4.5 FUS (firmware upgrade service)

The firmware upgrade service is available for each device and the setup uses the same process for all devices. For more information refer to R4.

5 Security and identifier migration

The table below summarizes security and identifier compatibility and features changes when migrating between STM32WB30/35/50/55 microcontrollers.

Table 15. Security and identifier compatibility

Features	STM32WBx5	STM32WBx0
Secure firmware installation (SFI) for Bluetooth Low Energy and 802.15.4 SW stack	Yes	Yes
Hardware encryption AES maximum 256-bit for the application, the Bluetooth Low Energy and IEEE802.15.4	3	2
Customer key storage/key manager services	Yes	Yes
HW public key authority (PKA)	Yes	Yes
Cryptographic algorithms: RSA, Diffie-Helman, ECC over GF(p)	Yes	Yes
True random number generator (RNG)	Yes	Yes
Sector protection against R/W operation (PCROP)	Yes	Yes
CRC calculation unit	Yes	Yes
Die information: 96-bit unique identifier	Yes	Yes
IEEE 64-bit unique identifier. Possibility to derive 802.15.4 64-bit and Bluetooth Low Energy 48-bit	Yes	Yes

6 Tools

The tools listed below are for all STM32WB30/35/50/55 devices and are backward compatible.

- STM32CubeMX
- STM32CubeProgrammer
- STM32CubeMonitor-RF

STM32CubeMX is recommended for the migration between STM32WB30/35/50/55 microcontrollers.

Revision history

Table 16. **Document revision history**

Date	Revision	Changes
03-Sept-2020	1	Initial release.

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