

## Getting started with the STMicroelectronics X-CUBE-SUBG2 software package for STM32CubeMX

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### Introduction

This document provides the guidelines to configure and use the X-CUBE-SUBG2 software package V4.2.0 for STM32CubeMX (minimum required version V6.2.0). The document contains a description of the provided sample application, a description of the steps required to configure a generic project using the X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1 expansion board with a Nucleo board, as well as a description of the steps to configure and use the sample application provided in the package.

Information and documentation related to the S2LP components, the X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1 expansion board and the ST expansion software for S2LP are available on [www.st.com](http://www.st.com).

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# 1 Acronyms and abbreviations

*Table 1 List of acronyms*

Acronym	Description
GHz	Giga Hertz
P2P	Point-to-Point communication
RF	Radio frequency
HAL	Hardware Abstraction Layer
SPI	Serial peripheral interface
NVIC	Nested Vectored Interrupt Controller
WSN	Wireless sensors network
BSP	Board support package
LED	Light emitting diode
IPv6	Internet Protocol vers. 6
UDP	User Datagram Protocol
TCP	Transmission Control Protocol
6LoWPAN	IPv6 over Low -Power Wireless Personal Area Networks
RPL	Routing Protocol for Low-Power and Lossy Networks
MAC	Medium Access Control
CSMA	Carrier-sense multiple access
USART	Universal Synchronous Asynchronous Receiver Transmitter

## 2 What is STM32Cube?

STM32Cube™ represents an original initiative by STMicroelectronics to ease developers' life by reducing development effort, time and cost. STM32Cube covers the STM32 portfolio. Version 1.x of STM32Cube includes:

- STM32CubeMX, a graphical software configuration tool that allows the generation of C initialization code using graphical wizards.
- A comprehensive embedded software platform, delivered per series (such as the STM32CubeF4 for STM32F4 series).
  - STM32Cube HAL, an STM32 abstraction layer embedded software, ensuring maximized portability across the STM32 portfolio;
  - a consistent set of middleware components, such as RTOS, USB, TCP/IP, graphics;
  - all embedded software utilities, including a full set of examples.

## 3 License

The software provided in this package is licensed under [Software License Agreement SLA0077](#).

## 4 Sample Application Description

In this section, a short overview of the sample applications and examples included in the X-CUBE-SUBG2 pack is provided. For more info kindly refer User Manual of X-CUBE-SUBG2 available on [www.st.com](http://www.st.com)

The sample applications/examples:

- are ready-to-use projects that can be generated through the STM32CubeMX for any Nucleo board and using the X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1 expansion board.
- show the users how to use the APIs to correctly initialize and use the S2-LP

### 4.1 P2P (Point to Point) Application

This application provides a Point-to-Point communication example which involves sending a buffer from one node to another and acknowledgments using the features in S2LP.

### 4.2 Contiki-NG based Applications

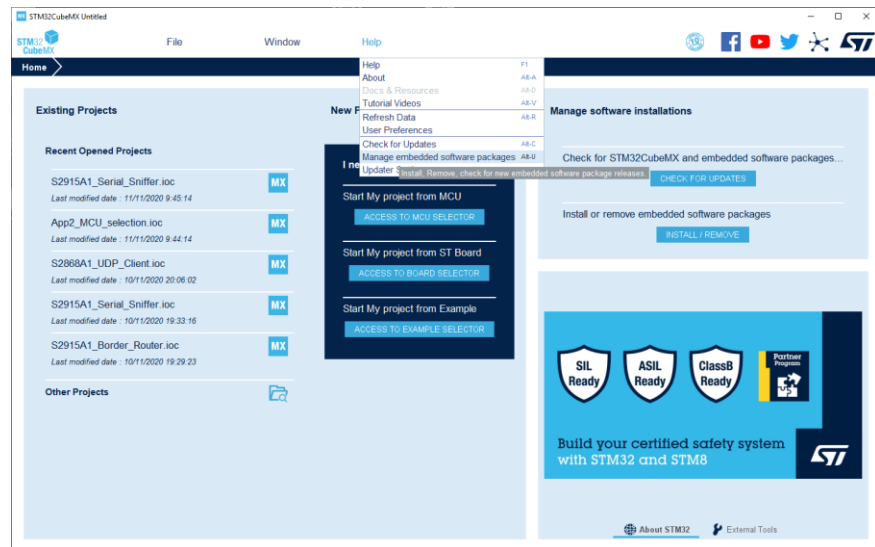
Contiki-NG [2] is a middleware that provides 6LoWPAN communication on top of the S2-LP radio. This involves MAC layers, RPL routing protocols, 6LoWPAN adaptation sub-layer, IPv6 network layer, UDP/TCP and above protocols.

- UDP Client: sends periodic UDP messages to a UDP Server and receives a UDP response (if any).
- UDP Server: receives UDP messages and replies with another UDP message.
- Border Router: connects the wireless 6LoWPAN with the IPv6 protocol stack of a host PC.
- Serial Sniffer: captures RF packets and sends them via serial line to Wireshark application running on a host PC.

## 5 Installing the X-CUBE-SUBG2 pack in STM32CubeMX

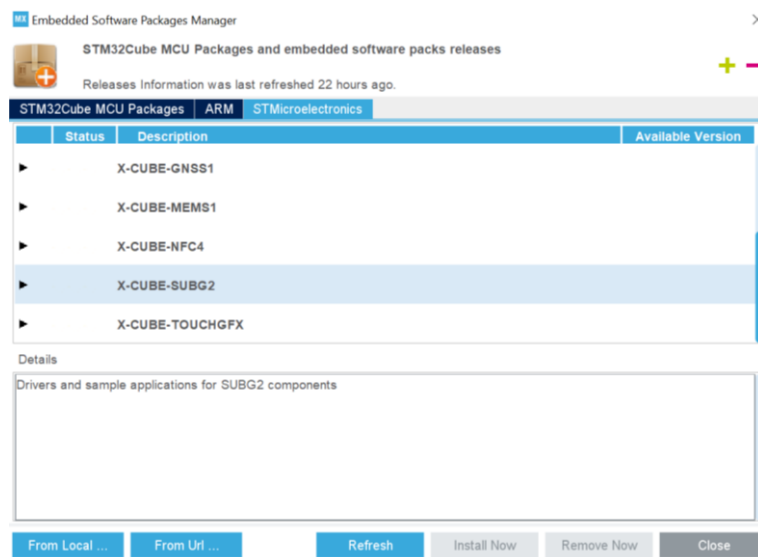
After downloading (from [www.st.com](http://www.st.com)), installing and launching the STM32CubeMX (V≥6.2.0), the X-CUBE-SUBG2 pack can be installed in few steps.

1. From the menu, select Help > Manage embedded software packages



**Figure 1** Managing embedded software packs in STM32CubeMX

- From the Embedded Software Packages Manager window, press the 'Refresh' button to get an updated list of the add-on packs. Go to the 'STMicroelectronics' tab to find the X-CUBE-SUBG2 pack.



**Figure 2** Installing the X-CUBE-SUBG2 pack in STM32CubeMX

- Select it checking the corresponding box and install it pressing the 'Install Now' button. Once the installation is completed, the corresponding box will become green, the 'Close' button can be pressed and the configuration of a new project can start.

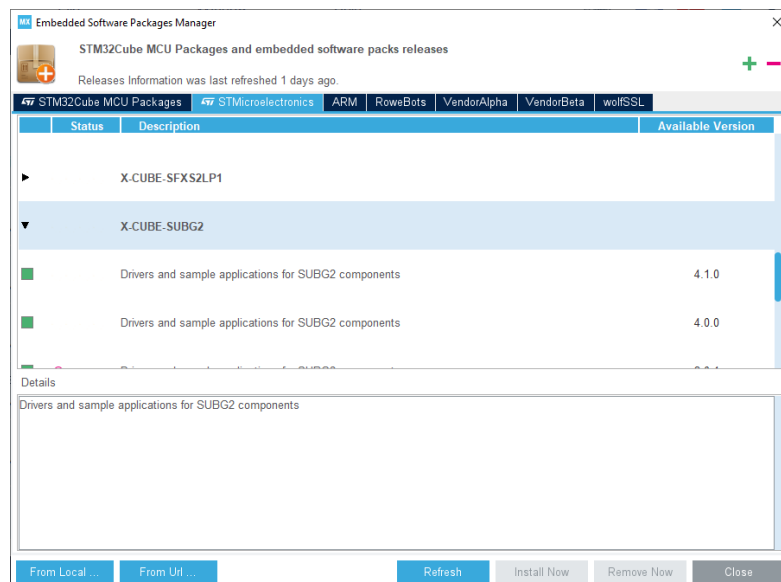


Figure 3 The X-CUBE-SUBG2 pack in STM32CubeMX

## 6 Starting a new project

After launching the STM32CubeMX, you can choose if starting a [New Project](#) from the MCU Selector or from the Board Selector.

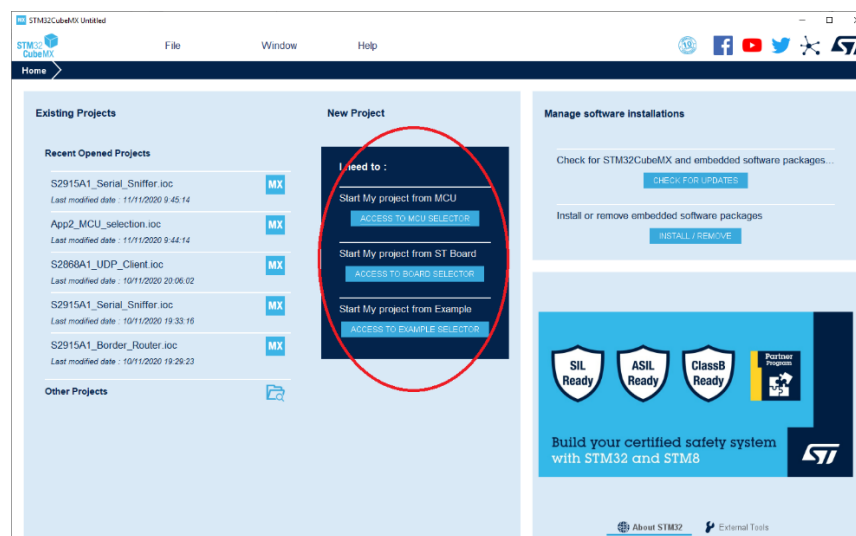
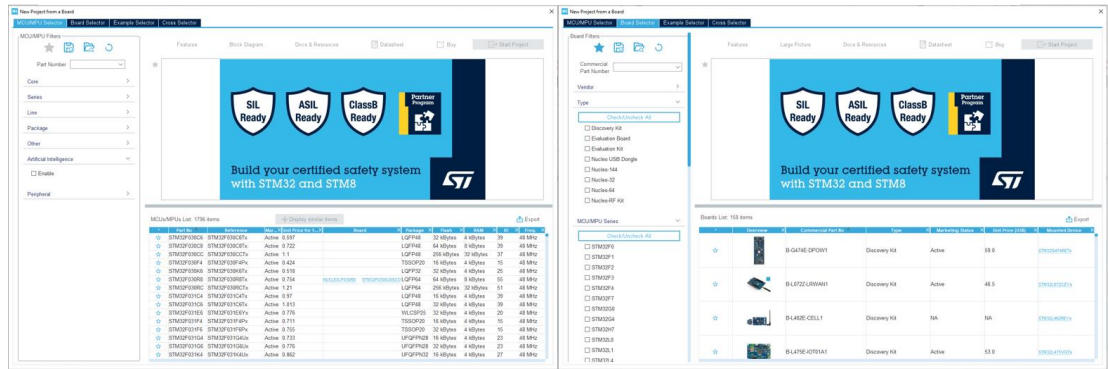


Figure 4 STM32CubeMX main page

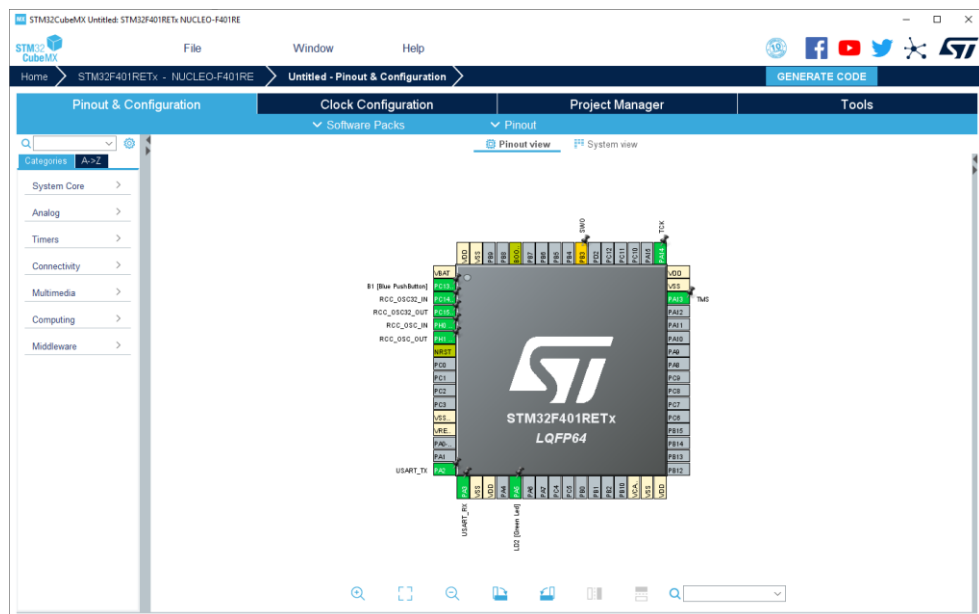
The **MCU/Board selector** window will pop up. From this window, the STM32 MCU or platform can be selected.





**Figure 5 STM32CubeMX MCU/Board Selector windows**

After selecting the MCU or the Board, the selected STM32 pinout will appear. From this window the user can set up the project, by adding one or more Additional Software and peripherals and configuring the clock.



**Figure 6 STM32CubeMX Pinout & Configuration window**

To add the X-CUBE-SUBG2 additional software to the project, the “Software Packs” and then “Select Components” button must be clicked. From the Software Pack Component Selector window, the user can either choose to generate, for the selected MCU/Board, one of the enclosed sample applications or a new project. In this latter case, the user must just implement the main application logic without bothering with the pinout and peripherals configuration code that will be automatically generated by STM32CubeMX.

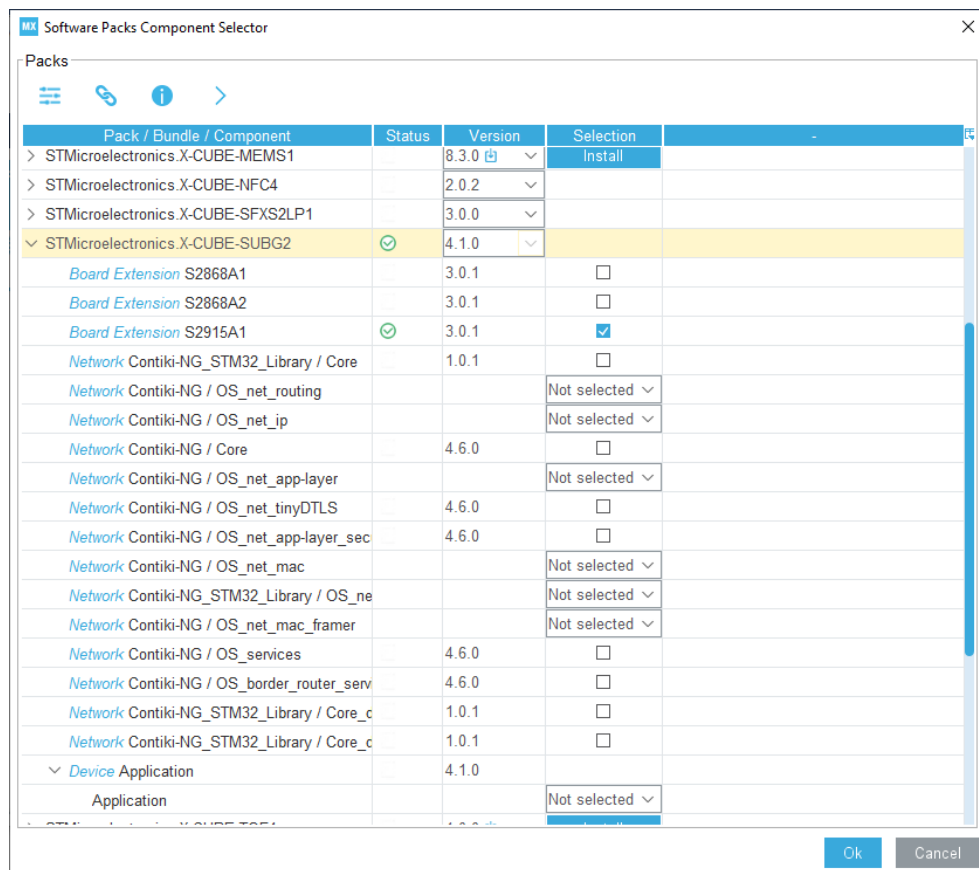
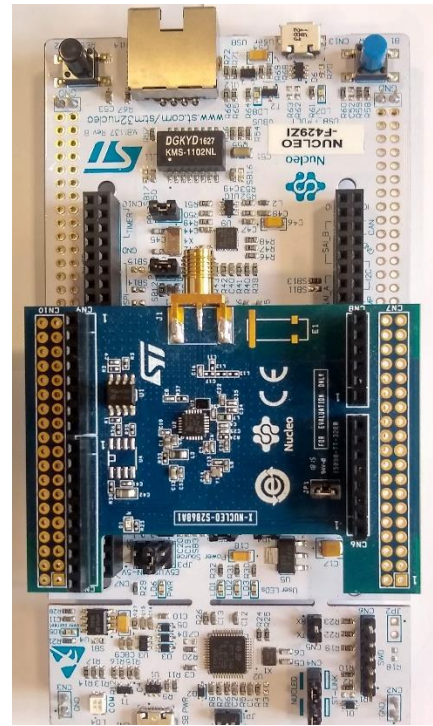


Figure 7 STM32CubeMX Software Pack Component Selector window

## 7 STM32 Configuration Steps

The X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1 interfaces with the STM32 microcontroller via the SPI bus.

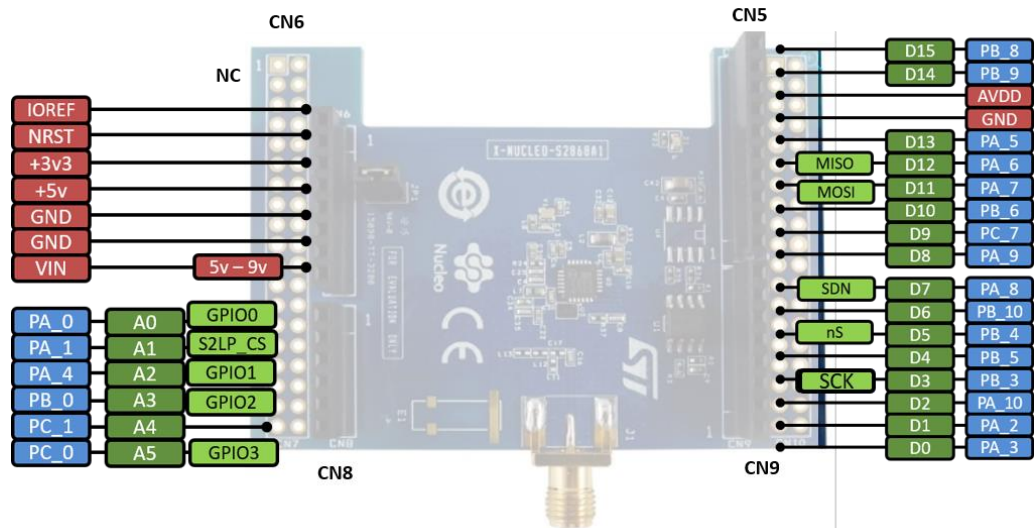
Hence, assuming a user wants to interface the ST X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1 expansion board with a STM32 Nucleo 64 pins board (e.g. a Nucleo-F401RETx) no particular hardware modification must be done.



**Figure 8** STM32 Nucleo 64 & Nucleo 144 with X-NUCLEO-S2868A1

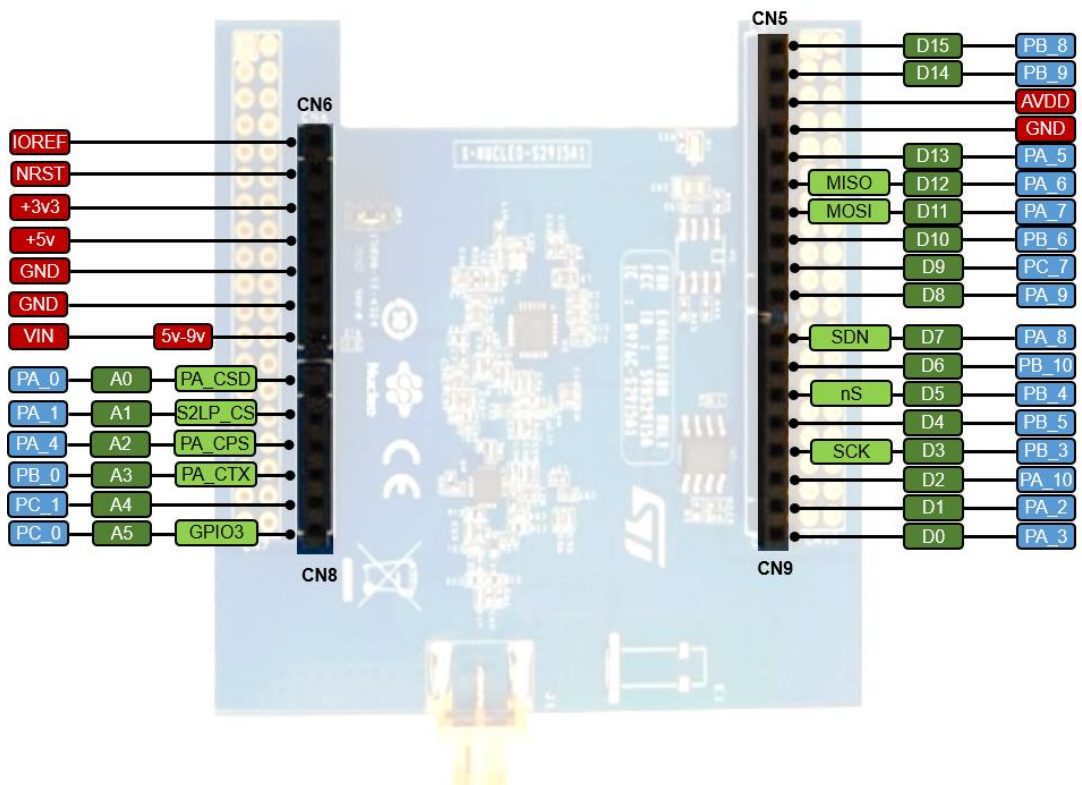


**Figure 9** X-NUCLEO-S2868A1 & X-NUCLEO-S2915A1



**Figure 10** X-NUCLEO-S2868A1 pinout

Note that the X-NUCLEO-S2868A1 and X-NUCLEO-S2868A2 have the same pinout. However, the pinout of the X-NUCLEO-S2915A1 are different and depicted in Figure 11.



**Figure 11** X-NUCLEO-S2915A1 pinout

## 7.1 P2P Application based on X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1

This section outlines how to configure STM32CubeMX with X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1 when the use of the P2P sample example is required. With such setup, only driver layers will be configured.



To add the X-CUBE-SUBG2 additional software to the project, the “Software Packs” and then “Select Components” button must be clicked. From the “Software Pack Component Selector” window, the user has to select the example from the “Device” class and “Board Extension” class as shown in the figure below.

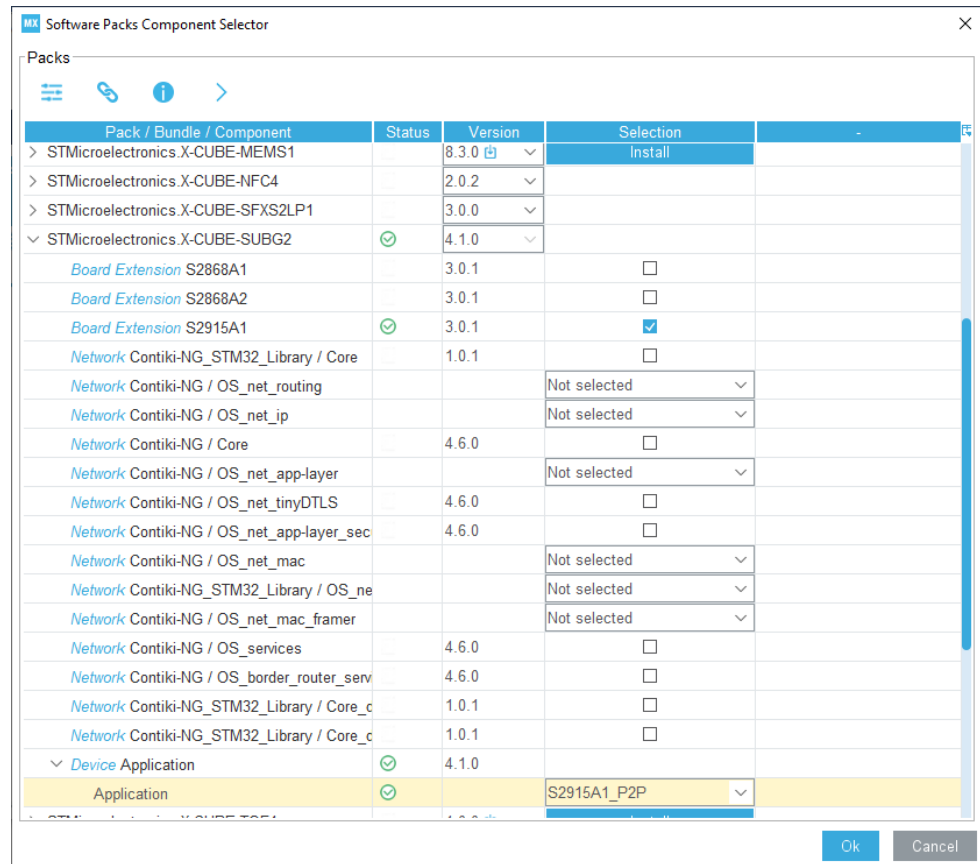


Figure 12 STM32CubeMX Software Pack Component Selector window example for S2915A1

From the **Pinout & Configuration** tab, set the SPI according to Table 2.

Group	Nucleo boards	SPI_SCK	SPI_MISO	SPI_MOSI	SPI_Instance
<b>BG1</b>	F030R8, F070RB, F072RB, F091RC, F334R8, F303RE, F401RE, F411RE, F446RE, F410RB, L010RB, L053R8, L073RZ, L152RE, L452RE, L476RG, G070RB, G071RB, G431RB, G474RE	“PB3”	“PA6”	“PA7”	SPI1
<b>BG2</b>	F103RB	“PA5”	“PA6”	“PA7”	SPI1
<b>BG3</b>	F302R8 L412RB-P, L452RE-P, L433RC-P	“PB13”	“PB14”	“PB15”	SPI2

<b>BG4</b>	F429ZI, F446ZE, F207ZG, F746ZG, F767ZI, H743ZI, F722ZE, F303ZE, F412ZG, F413ZH, L552ZE-Q, WB-55	“PA5”	“PA6”	“PA7”	SPI1
<b>BG5</b>	L496ZG-P, L496ZG, L4R5ZI, L4R5ZI-P	“PE13”	“PA6”	“PA7”	SPI1
<b>BG6</b>	H753ZI, H743ZI2, H745ZI-Q, H755ZI-Q	“PA5”	“PA6”	“PB5”	SPI1

**Table 2** SPI Configurations for different Nucleo Boards

For example, using the Nucleo F401RE,

- from the **Pinout** scheme, click on PA6 and set it as SPI1\_MISO;
- from the **Pinout** scheme, click on PA7 and set it as SPI1\_MOSI;
- from the **Pinout** scheme, click on PB3 and set it as SPI1\_SCK;
- enable the SPI1 as SPI from the “Connectivity” category;

While using X-NUCLEO-S2868A1 or X-NUCLEO-S2915A1 or X-NUCLEO-S2868A2 with boards under “**BG2**”, “**BG3**”, “**BG4**” and “**BG6**” groups presented in Table 2 (i.e., F103RB, F302R8, L412RB-P, L452RE-P, L433RC-P, F429ZI, F446ZE, F207ZG, F746ZG, F767ZI, H743ZI, F722ZE, F303ZE, F412ZG, F413ZH, L552ZE-Q, WB-55, H753ZI, H743ZI2, H745ZI-Q and H755ZI-Q), the SPI clock (i.e., SPI\_SCK) is available on pin D13 instead of D3. In these cases, the following modification are required to correctly set the SPI clock.

- Remove R11 and Connect R6.

(a)

(b)

**Figure 13** STM32CubeMX Additional Software settings for P2P application: Mode and Configuration view a) for X-NUCLEO-S2915A1 b) for X-NUCLEO-S2868A2 (or X-NUCLEO-S2868A1)

As shown from Figure 12, the power amplifier configurations are only needed for the X-NUCLEO-S2915A1.

From the **Software Packs** category, press the 'Stmicroelectronics.X-CUBE-SUBG2.4.2.0' item, enable the "Board Extension" checkbox from the "Mode" view and set the following Platform Settings from the "Configuration" view (take into account that according the example chosen some settings can appear or not) based on Table 3.

**Table 3** Platform Settings configurations

Name			BSP_API	Supported Ips	Nucleo 64	Nucleo 144
S2868A1	S2868A2	S2915A1				
S2868A1_BUS_IO_driver	S2868A2_BUS_IO_driver	S2915A1_BUS_IO_driver	BSP_BUS_DRIVER	SPI: SPI	SPI1(2)	SPI1
S2868A1_GPIO3	S2868A2_GPIO3	S2915A1_GPIO3	HAL_EXTI_DRIVER	GPIO:EXTI	A5	
S2868A1_S2LP_CS	S2868A2_S2LP_CS	S2915A1_S2LP_CS		GPIO:Output	A1	
S2868A1_SDN	S2868A2_SDN	S2915A1_SDN		GPIO:Output	D7	
BSP_BUTTON	BSP_BUTTON	BSP_BUTTON	BSP_COMMON_DRIVER	GPIO: EXTI	PC13	
BSP_LED	BSP_LED	BSP_LED		GPIO:Output	PA5(PB13)	PB7
S2868A1_EEPROM_CS	S2868A2_EEPROM_CS	S2915A1_EEPROM_CS	BSP_COMMON_DRIVER	GPIO:Output	D5	
S2868A1_LED	S2868A2_LED	S2915A1_LED		GPIO:Output	D9	
		S2915A1_PA_CSD		GPIO:Output	A0	
		S2915A1_PA_CPS		GPIO:Output	A2	
		S2915A1_PA_CTX		GPIO:Output	A3	

Table 4 presents the "BSP LED" pin names for different Nucleo Boards.

**Table 4** BSP LED pin names for different Nucleo Boards

Nucleo Board	BSP LED
F030R8, F070RB, F072RB, F091RC, F103RB, F303RE, F334R8, F401RE, F410RB, F411RE, F446RE, L010RB, L053R8, L073RZ, L152RE, L452RE, L476RG	"PA5"
F302R8, L452RE-P, L433RC-P, L412RB-P	"PB13"
WB-55	"PB0"
Nucleo-144 boards	"PB7"

For the P-NUCLEO-WB55 board, the "BSP BUTTON" should be set to "PC4" and not to "PC13".

The A0, A1, A2, A3, A5, D9, D7 and D5 pins depend on the Nucleo Board and their appropriate names are recapitulated in Table 5.

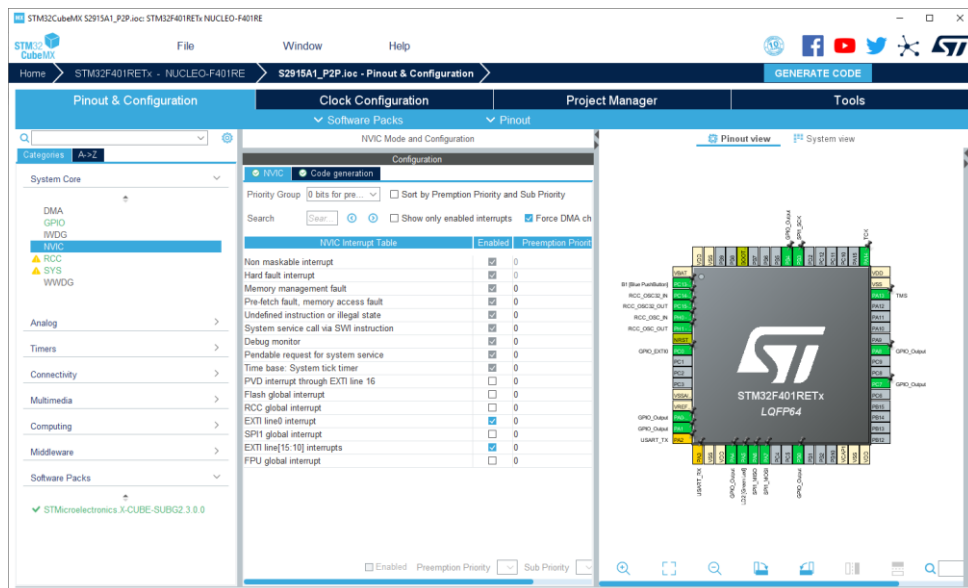
**Table 5** A0, A1, A2, A3, A5, D9, D7 and D5 pin names for different Nucleo Boards

Boards	A0	A1	A2	A3	A5	D9	D7	D5
1) F030R8 2) F070RB 3) F072RB 4) F091RC 5) F303RE 6) F334R8	PA0	PA1	PA4	PB0	PC0	PC7	PA8	PB4
7) F401RE 8) F410RB 9) F411RE 10) F446RE	PA0-WKUP							
11) L053R8 12) L073RZ	PA0							
13) L152RE	PA0-WKUP1							
14) L452RE 15) L476RG	PA0							PB4 (NJTRST)
16) F302R8 17) L010RB	PA0	PA1	PA4	PB0	PC0	PC7	PA8	PB4
18) G070RB 19) G071RB 20) G431RB 21) G474RE	PA0	PA1	PA4	PB1	PB12	PC7	PA8	PB4
22) L412RB-P 23) L452RE-P 24) L433RC-P	PA0	PA1	PC3	PC2	PC0	PA8	PC7	PA15 (JTDI)
25) F103RB	PA0-WKUP	PA1	PA4	PB0	PC0	PC7	PA8	PB4



26) F207ZG 27) F429ZI 28) F446ZE 29) F722ZE 30) F746ZG 31) F767ZI	PA3	PC0	PC3	PF3	PF10	PD15	PF13	PE11
32) H743ZI			PC3_C					
33) L496ZG 34) L496ZG-P 35) L4R5ZI 36) L4R5ZI-P 37) F412ZG 38) F413ZH	PA3	PC0	PC3	PC1	PC5	PD15	PF13	PE11
39) F303ZE	PA3	PC0	PC3	PD11	PD13	PD15	PF13	PE11
40) H753ZI	PA3	PC0	PC3_C	PB1	PF10	PD15	PG12	PE11
41) L552ZE-Q	PA3	PA2	PC3	PB0	PC0	PD15	PF13	PE11
42) WB55	PC0	PC1	PA1	PA0	PC2	PA9	PC13	PA15

From the **Pinout & Configuration** tab, click on “System Core” category and then on NVIC item to enable the EXTI line interrupts.



**Figure 14** STM32CubeMX NVIC Configuration

From the **Pinout & Configuration** tab, click on “Connectivity” category and then select SPI instance and set the SPI Prescaler (for Baud Rate), SPI instance and prescaler will vary depending on the pinout and Clock configuration of STM32. Maximum SPI Clock speed supported by S2LP is 10 MHz. Hence, the prescaler (for Baud rate) should be such that Clock Speed on STM32 NUCLEO is less than 10Mhz. In Figure 13, NUCLEO-F401RE is taken into account, since HCLK is 84 MHz and so the prescaler set for SPI is 16.

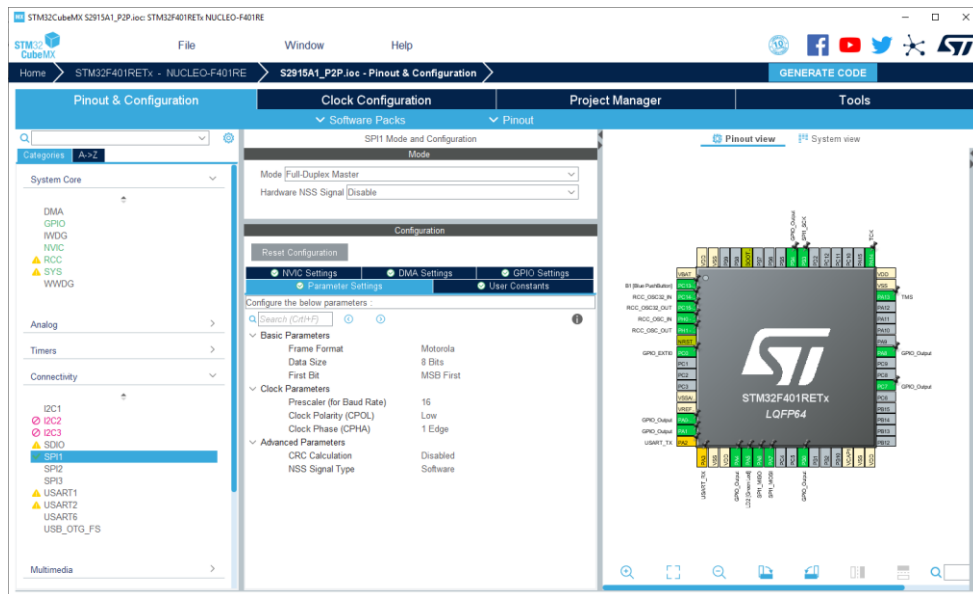


Figure 15 STM32CubeMX SPI Configuration

Once all the above described steps have been performed, the source code of the project using the **STMicroelectronics.X-CUBE-SUBG2** software can be generated clicking the “GENERATE CODE” button.

## 7.2 Contiki-NG applications based on X-NUCLEO-S2868A1 or X-NUCLEO-S2868A2 or X-NUCLEO-S2915A1

All the configurations steps described in the previous section apply as the base also for the Contiki-NG based application, for what concerns the Power Amplifier and the BSP.

In this case, more components can be selected in order to have the applications working.

For any Contiki-NG based application to work, three components **must** always be selected:

- Contiki-NG\_STM32\_Library / Core
- Contiki-NG / Core
- Contiki-NG / OS\_services

There are other components that are optional or can be configured. We can highlight a common suggested configuration for UDP Client and UDP Server. In **Figure 16** this configuration is reported:

- Contiki-NG / OS\_net\_routing configured as **rpl\_lite**
- Contiki-NG / OS\_net\_ip configured as **Ipv6**
- Contiki-NG / OS\_net\_mac configured as **csma**
- Contiki-NG / OS\_net\_mac\_framer configured as **framer\_802\_15\_4**

This is the common configuration meaning that Ipv6 protocol is enabled, “lite” version of the RPL routing protocol is used, Contiki-NG CSMA protocol is chosen for mac layer and standard 802.15.4 framer layer is selected.

This configuration can be used also to build other applications based on Contiki-NG.

It is important to note that the configuration of these 4 components must match in all the nodes to make them able to communicate.

The user can optionally choose to change the RPL routing protocol version by using:

- Contiki-NG / OS\_net\_routing configured as **rpl\_classic**

but the same choice must be done for all the nodes to communicate.

The configuration of the following components (that enable usage of LED and Button):

- Contiki-NG\_STM32\_Library / Core\_dev\_leds

- Contiki-NG\_STM32\_Library / Core\_dev\_buttons is optional for UDP applications.

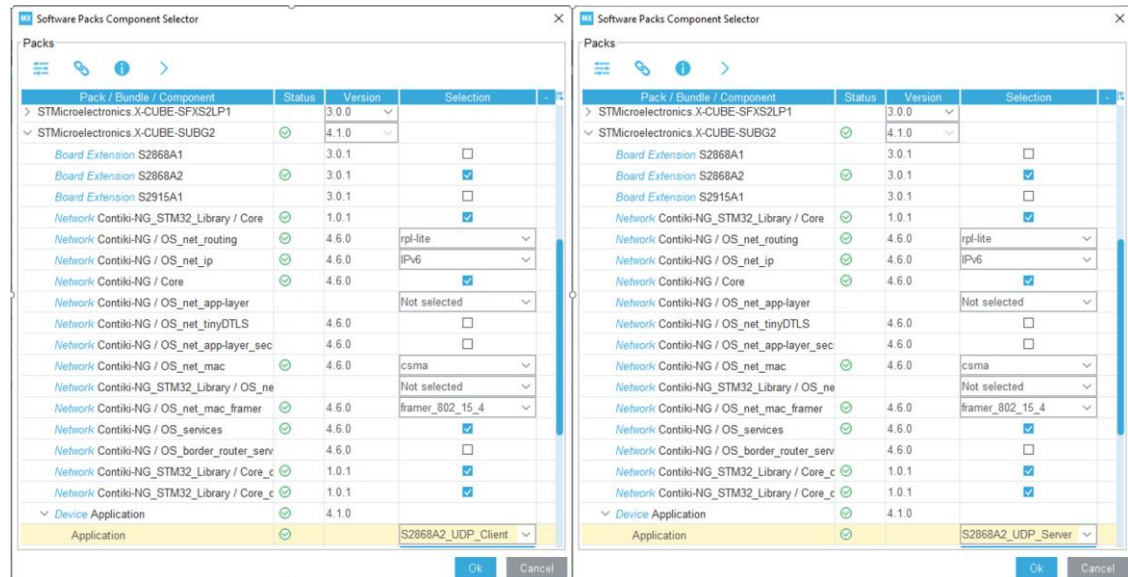


Figure 16 Contiki-NG configuration for UDP applications

From the **Software Packs** category, press the 'Stmicroelectronics.X-CUBE-SUBG2.4.2.0' item, enable the "Board Extension", "Contiki-NG" related and "Application" checkboxes from the "Mode" view. For the BSP parameters to be set Platform Settings from the "Configuration" view, you can check previous section (related to P2P Example).

In the Contiki-NG case, User Button and LED (if enabled) can be found in the Contiki-NG section.

As shown in **Figure 17** the two main differences are the TIMER and the USART, that must be selected for Contiki-NG based applications.

From the **Pinout & Configuration** tab, click on "Timers" category and then select TIM instance and enable the Internal Clock checkbox. No other configuration is needed since the actual initialization will be done from the application (taking into account the RTIMER\_ARCH\_SECOND parameter to compute the prescaler: default value should be left). **Figure 18** shows the TIM final configuration.

From the **Pinout & Configuration** tab, click on "Connectivity" category and then select USART instance and enable it by choosing *Asynchronous* mode. Baud Rate=115200 bps, Word Length=8 bits, Parity=None and Stop Bits=1 parameters must be chosen. It is important to go in "System Core" category and then on NVIC, "Code Generation" tab and ensure no code generation is selected for the chosen USART, since the application will take care of it. **Figure 19** shows the USART final configuration (left) and the NVIC settings (right).

STMicroelectronics.X-CUBE-SUBG2.4.1.0 Mode and Configuration

Mode

☒ Board Extension S2868A2

☒ Network Contiki-NG STM32 Library

☒ Network Contiki-NG

☒ Device Application

Configuration

Reset Configuration

☒ Parameter Settings

☒ User Constants

☒ Platform Settings

Platform proposal

Contiki-NG

Name	IPs or Components	Found Solutions
TIMER	TIM1_8:Internal Clock	TIM5
BSP BUTTON	GPIO:EXTI	PC13-ANTI_TAMP [B1 [Blue PushButton]]
BSP USART	USART:Asynchronous	USART2
BSP LED	GPIO:Output	PA5 [LD2 [Green Led]]

BSP

Name	IPs or Components	Found Solutions
S2868A2_SDN	GPIO:Output	PA8
S2868A2_LED	GPIO:Output	PC7
S2868A2_S2LP_CS	GPIO:Output	PA1
S2868A2_EEPROM_CS	GPIO:Output	PB4
S2868A2_GPIO	GPIO:EXTI	PC0
S2868A2 BUS IO driver	SPI:Full-Duplex Master	SP11

Figure 17 STM32CubeMX Additional Software settings for Contiki-NG application: Mode and Configuration view

STM32CubeMX TIM5 Mode and Configuration

Mode

Slave Mode

Trigger Source

☒ Internal Clock

Channel1

Channel2

Channel3

Channel4

Combined Channels

☐ XOR activation

☐ One Pulse Mode

Configuration

Reset Configuration

☒ User Constants

☒ NVIC Settings

☒ DMA Settings

NVIC Interrupt Table

Enabled

Preemption Priority

Sub Priority

TIM5 global interrupt

STM32CubeMX RTIMER Mode and Configuration

Mode

☒ Board Extension S2868A2

☒ Network Contiki-NG STM32 Library

☒ Network Contiki-NG

☒ Device Application

Configuration

Reset Configuration

☒ Parameter Settings

☒ User Constants

☒ Platform Settings

Configure the below parameters

Basic Settings

S2868A2 GPIO

GPIO3 EXTI line

Granularity for contiki-NG rti...

Figure 18 STM32CubeMX TIM Configuration (left) and RTIMER parameter (right)

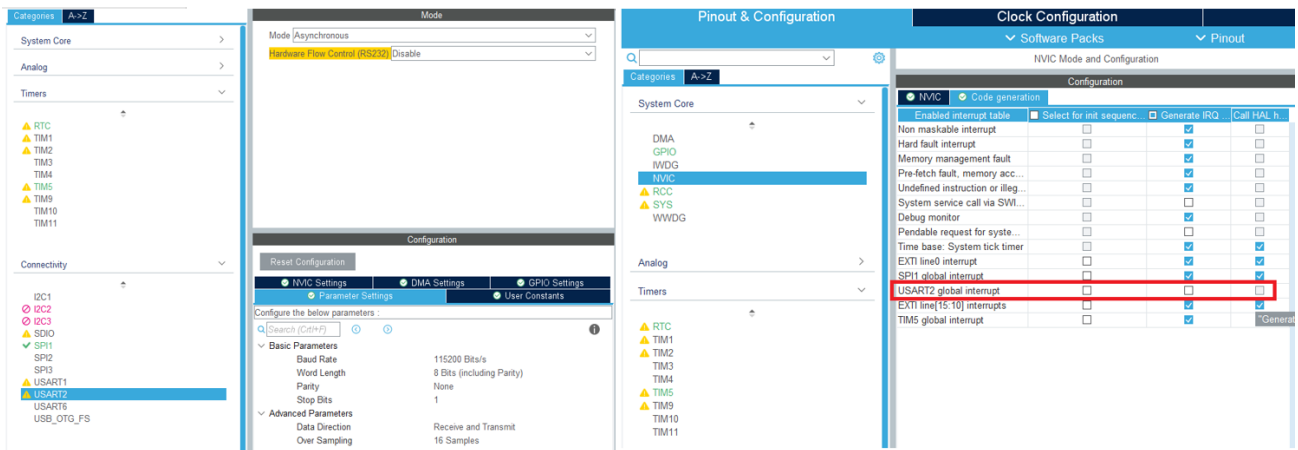


Figure 19 STM32CubeMX USART Configuration

For the Border Router application the same base configuration of the UDP applications is used, adding the following component:

- Contiki-NG / OS\_border\_router\_services

For this application the Button component:

- Contiki-NG\_STM32\_Library / Core\_dev\_buttons

is also required.

The Border Router configuration is shown in **Figure 20**.

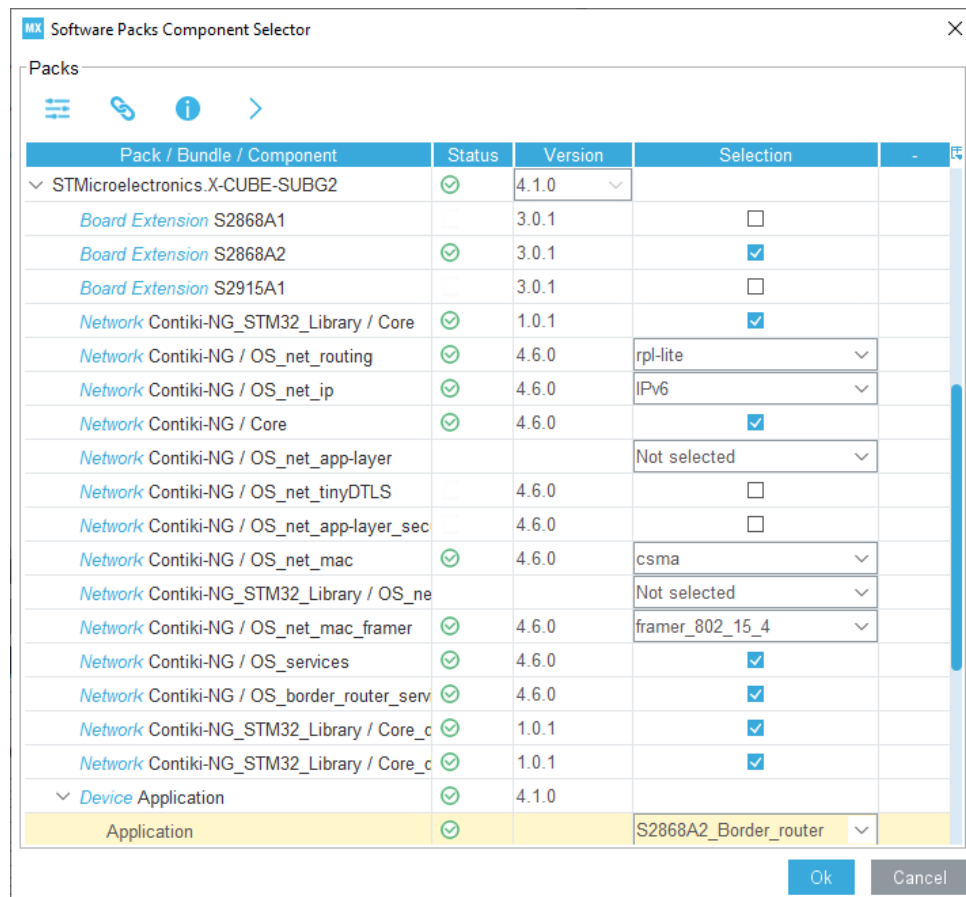


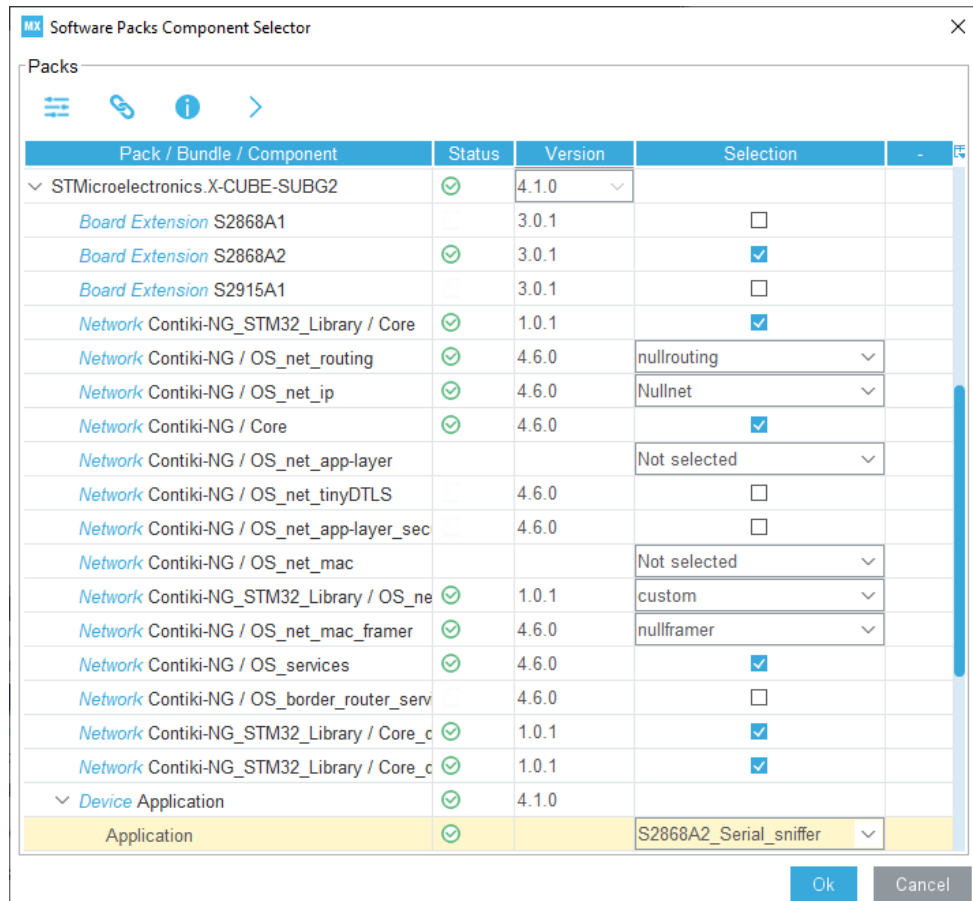
Figure 20 Contiki-NG configuration for Border Router application

The Serial Sniffer application differs in term of basic configuration since there is no need of a

full protocol stack to process packets that just need to be captured and sent to Wireshark application.

So, the configuration for the Serial Sniffer application must be as follows (and as summarized in **Figure 21**):

- Contiki-NG / OS\_net\_routing configured as **nullrouting**
- Contiki-NG / OS\_net\_ip configured as **nullner**
- Contiki-NG / OS\_net\_mac **Not selected**
- Contiki-NG\_STM32\_Library / OS\_net\_mac configured as **custom**
- Contiki-NG / OS\_net\_mac\_framer configured as **nullframer**



**Figure 21** Contiki-NG configuration for Serial Sniffer application

The Contiki-NG\_STM32\_Library / OS\_net\_mac component implements an almost empty MAC layer that simply forward the captured packets.

For this application the Button component:

- Contiki-NG\_STM32\_Library / Core\_dev\_buttons

is also required.

To experiment with different settings, not allowed in the provided applications, the user can choose not to select any application, like shown in **Figure 22**. It is important to notify that these configuration options are not fully tested so it might be difficult to get a fully working scenario.

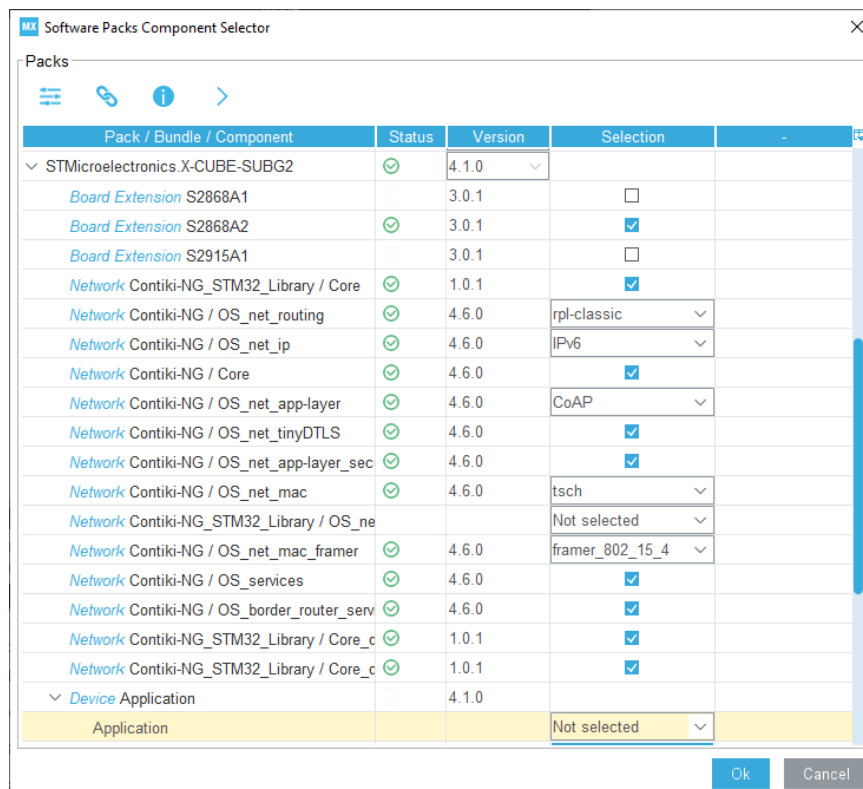


Figure 22 Contiki-NG configuration not linked to any application

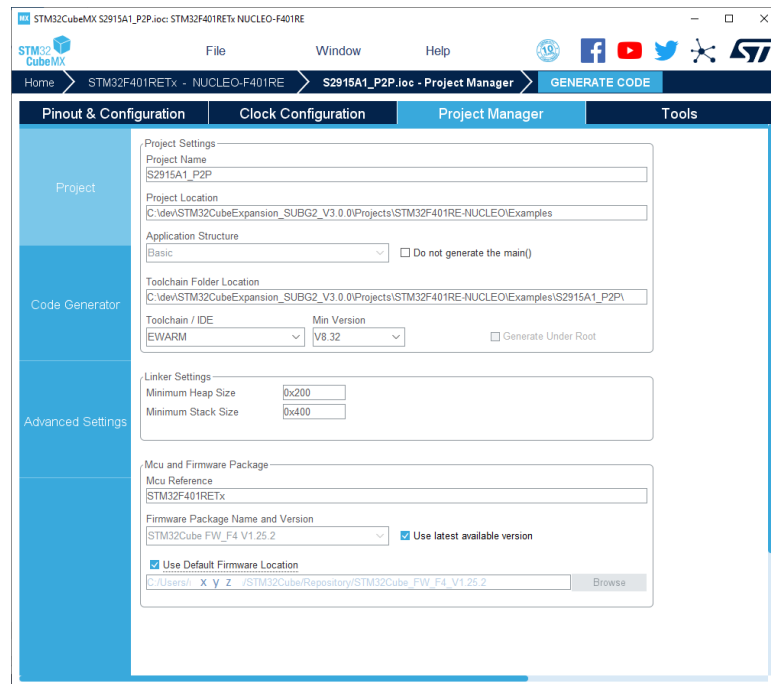
For all the Contiki-NG based applications the source code can be generated using the “GENERATE CODE” button like in the P2P Example case.

## 8 Generated Folders Structure

When generating a project, two models of folders structure can be adopted when using a high level firmware component (i.e. a middleware in the STM32Cube MCU package):

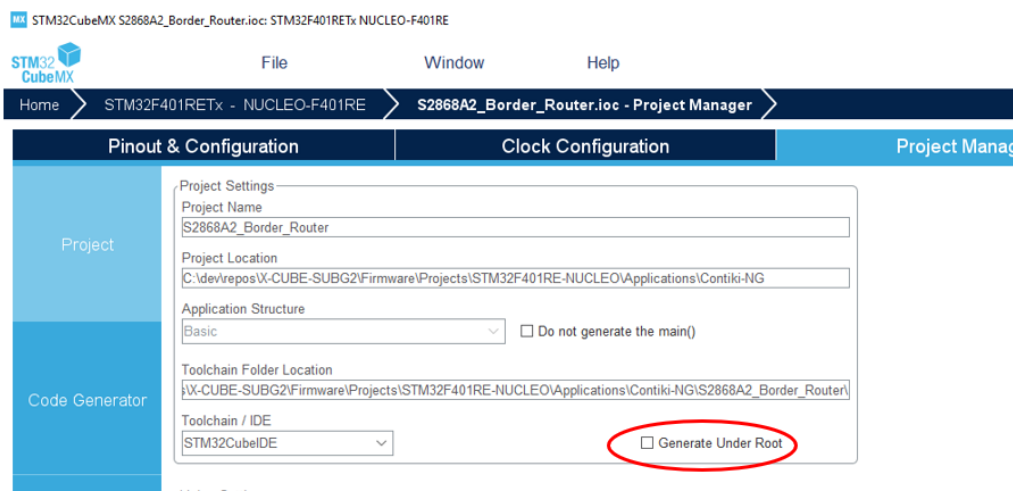
- **Basic Structure:** the basic structure is often used with HAL examples and single package projects. This structure consists of having the IDE configuration folder in the same level as the sources (organized in *Inc* and *Src* subfolders).
- **Advanced Structure:** the advanced structure provides a more efficient and organized folders model that allows ease middleware applications integration when several packages are used.

In the Advanced mode *Src* and *Inc* are generated under folder *Core*.



**Figure 23 STM32CubeMX Application Structure Configuration**

If using STM32CubeIDE please deselect the (by-default enabled) “Generate Under Root” option, like reported in **Figure 24**.



**Figure 24 Generate Under Root option to be disabled**

## 9 Known Limitations and workarounds

- The Contiki-NG based projects for STM32CubeIDE must use “Standard C” library instead of the default “Reduced C”: Properties, C/C++ Build, Settings, MCU Settings, Runtime library => Standard C, like shown in next figure.



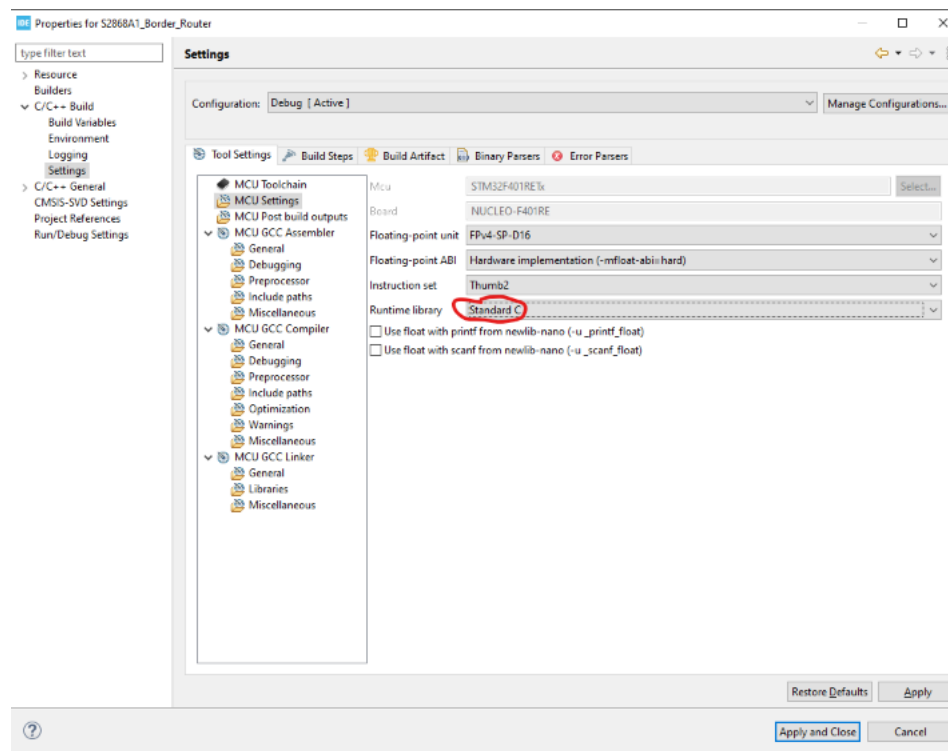


Figure 25 Library to be enabled for Contiki-NG based projects in STM32CubeIDE 1.6.x

- If a project has been generated for P2P, to modify it for a Contiki-NG based application that uses LED or Button, it is required to deselect any application and save the .ioc project file before choosing the new Application.
- For the **NUCLEO-F303ZE** Board, the Arduino Pin “A5”, corresponding to the “PD13” MCU pin, should be configured as “GPIO\_EXTI13” for the “S2868A1\_GPIO3”, “S2868A2\_GPIO3” and “S2915A1\_GPIO3” for S2868A1, S2868A2 and S2915A1, respectively. At the same time, the user button, corresponding to “PC13”, should be also configured as “GPIO\_EXTI13”. Given the fact that only one pin can be configured as “GPIO\_EXTI13”, we exclude this board from the list of boards, or you can use different S2868A1 or S2868A2 or S2915A1 GPIO pin for the Interrupt event.
- For the **NUCLEO-F302R8**, **NUCLEO-L412RB-P**, **NUCLEO-L452RE-P** and **NUCLEO-L433RC-P** Board, the user should configure “SPI2” with the following details:
  - a. SPI2\_MOSI ← D11 (PB15)
  - b. SPI2\_MISO ← D12 (PB14)
  - c. SPI2\_SCK ← D13 (PB13)

With this setting, we have the following problem. The “D13”, corresponding to “PB13” MCU pin, is also used by the P2P example as “GPIO\_Output” for the “BSP LED”. Due to the fact that we can configure “PB13” either as “GPIO\_Output” or as “SPI2\_SCK”. So, for LED indication, one can use LED of the X-NUCLEO (S2868A1 or S2868A2 or S2915A1) connected to PC7 by mounting R17 with 0-ohm resistor.

Following will be change in software, to reflect (S2868A1 or S2868A2 or S2915A1) LED instead of BSP LED on NUCLEO-F302R8 or NUCLEO-L412RB-P or NUCLEO-L452RE-P or NUCLEO-L433RC-P.

1. Replace BSP\_LED\_Init (LED2) with S2868A1\_LED\_Init, S2868A2\_LED\_Init and S2915A1\_LED\_Init for S2868A1\_LED, S2868A2\_LED and S2915A1\_LED, respectively, in MX\_SUBG2\_P2P\_Init.

2. Replace BSP\_LED\_Toggle (LED2) with S2868A1\_LED\_Toggle, S2868A2\_LED\_Toggle and S2915A1\_LED\_Toggle, for S2868A1\_LED, S2868A2\_LED\_Toggle and S2915A1\_LED\_Toggle, respectively.
  3. Replace BSP\_LED\_On (LED2) with S2868A1\_LED\_On, S2868A2\_LED\_On and S2915A1\_LED\_On for S2868A1\_LED, S2868A2\_LED and S2915A1\_LED, respectively.
  4. Replace BSP\_LED\_Off (LED2) with S2868A1\_LED\_Off, S2868A2\_LED\_Off and S2915A1\_LED\_Off for S2868A1\_LED, S2868A2\_LED and S2915A1\_LED, respectively.
- For the **NUCLEO-F103RB** Board, the user should configure “SPI1” with the following details:
    - a. SPI1\_MOSI ← D11 (PA7)
    - b. SPI1\_MISO ← D12 (PA6)
    - c. SPI1\_SCK ← D13 (PA5)

Following will be change in software, to reflect (S2868A1 or S2868A2 or S2915A1) LED instead of BSP LED on NUCLEO-F103RB.

1. Replace BSP\_LED\_Init (LED2) with S2868A1\_LED\_Init, S2868A2\_LED\_Init and S2915A1\_LED\_Init for S2868A1\_LED, S2868A2\_LED and S2915A1\_LED, respectively, in MX\_SUBG2\_P2P\_Init.
  2. Replace BSP\_LED\_Toggle (LED2) with S2868A1\_LED\_Toggle, S2868A2\_LED\_Toggle and S2915A1\_LED\_Toggle, for S2868A1\_LED, S2868A2\_LED\_Toggle and S2915A1\_LED\_Toggle, respectively.
  3. Replace BSP\_LED\_On (LED2) with S2868A1\_LED\_On, S2868A2\_LED\_On and S2915A1\_LED\_On for S2868A1\_LED, S2868A2\_LED and S2915A1\_LED, respectively.
  4. Replace BSP\_LED\_Off (LED2) with S2868A1\_LED\_Off, S2868A2\_LED\_Off and S2915A1\_LED\_Off for S2868A1\_LED, S2868A2\_LED and S2915A1\_LED, respectively.
- For platforms with very little FLASH memory it may happen that the generated binary does not fit into it. If using STM32CubeIDE try the Release configuration instead of the Debug one. Other possibilities are to disable not required components (via STM32CubeMX) or to change some parameters at compile time (project-conf.h file and Contiki-NG configuration files).
  - In MDK-ARM projects for STM32H7 series, if no log message is printed on the serial terminal, enable the Use MicroLib option in the project settings.
  - On dual-core STM32 series this expansion software can be used on both cores but exclusively.

## 10 References

- [1] [UM2669](#) – User Manual – *Getting started with X-CUBE-SUBG2, Sub-1 GHz RF software expansion for STM32Cube*
- [2] [Contiki-NG GitHub repository](#)

## 11 Revision history

*Table 6 Document revision history*

Date	Version	Changes
21-Nov-2019	1	Initial release
04-Feb-2020	2	Add S2868A2 and S2915A1 support Improvement in the table of configuration of pins
11-Nov-2020	3	Added Contiki-NG middleware and related applications
11-Feb-2021	4	Updated info for v4.0.0
21-Apr-2021	5	Updated info for v4.1.0
14-June-2021	6	Updated info for v4.2.0

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