STM32 Connectivity Expansion Pack User Guide

Version 1.0

Overview

The STM32 Connectivity Expansion Pack is an extension of the CMSIS-Pack standard established by Arm. The pack is compliant with the full CMSIS-Pack standard, with additional requirements/restrictions on the final pack to meet the STM standard. This pack uses libraries from the ModusToolbox environment. For more details, refer to https://www.cypress.com/products/modustoolbox. You can select and configure the pack in the STM32CubeMX tool, make choices appropriate for your design, such as which CYW43xxx device to use, and then generate a project from your selection.

Expansion Pack Contents

The following table shows the components and their versions included with the expansion pack:

Component Name	Version	Details
wifi-host-driver	1.93.0	The WHD (Wi-Fi Host Driver) is an independent, embedded Wi-Fi Host Driver that provides a set of APIs to interact with Cypress WLAN chips. The WHD is an independent firmware product that is easily portable to any embedded software environment. Therefore, the WHD includes hooks for RTOS and TCP/IP network abstraction layers.
wcm	2.0.1	WCM (Wi-Fi Connection Manager) is a library which helps application developers to manage Wi-Fi Connectivity. The library provides a set of APIs that can be used to establish and monitor Wi-Fi connections on Cypress platforms that support Wi-Fi connectivity.
wifi-mw-core	3.0.0	This Wi-Fi Middleware Core Library comprises core components needed for Wi-Fi connectivity support. The library bundles FreeRTOS, lwIP TCP/IP stack, and mbed TLS for security, Wi-Fi Host Driver (WHD), Secure Sockets interface, configuration files, and associated code to bind these components together.
whd-bsp-integration	1.1.1	WHD (WiFi Host Driver Board) library provides some convenience functions for connecting to a Board Support Package (BSP) that includes a WLAN chip. This library initializes the hardware and passes a reference to the communication interface on the board into WHD. It also sets up the LwIP based network buffers to be used for sending packets back and forth.
connectivity-utilities	3.0.1	The connectivity utilities library is a collection of general purpose middleware utilities such as: JSON parser, Linked list, String utilities, Network helpers, Logging functions, Middleware Error codes. Several connectivity middleware libraries shall depend on this utilities library.
core-lib	1.1.4	The Core Library provides basic types and utilities that can be used between different devices. This allows different libraries to share common items between themselves to avoid reimplementation and promote consistency.
abstraction-rtos	1.3.0	The RTOS abstraction layer provides simple RTOS services like threads, semaphores, mutexes, queues, and timers. It is not intended to be a full features RTOS interface, but the provide just enough support to allow for RTOS independent drivers and middleware.
LwIP	2.1.2	lwIP is a small independent implementation of the TCP/IP protocol suite. The focus of the lwIP TCP/IP implementation is to reduce the RAM usage while still having a full scale TCP. This making lwIP suitable for use in embedded systems with tens of kilobytes of free RAM and room for around 40 kilobytes of code ROM.

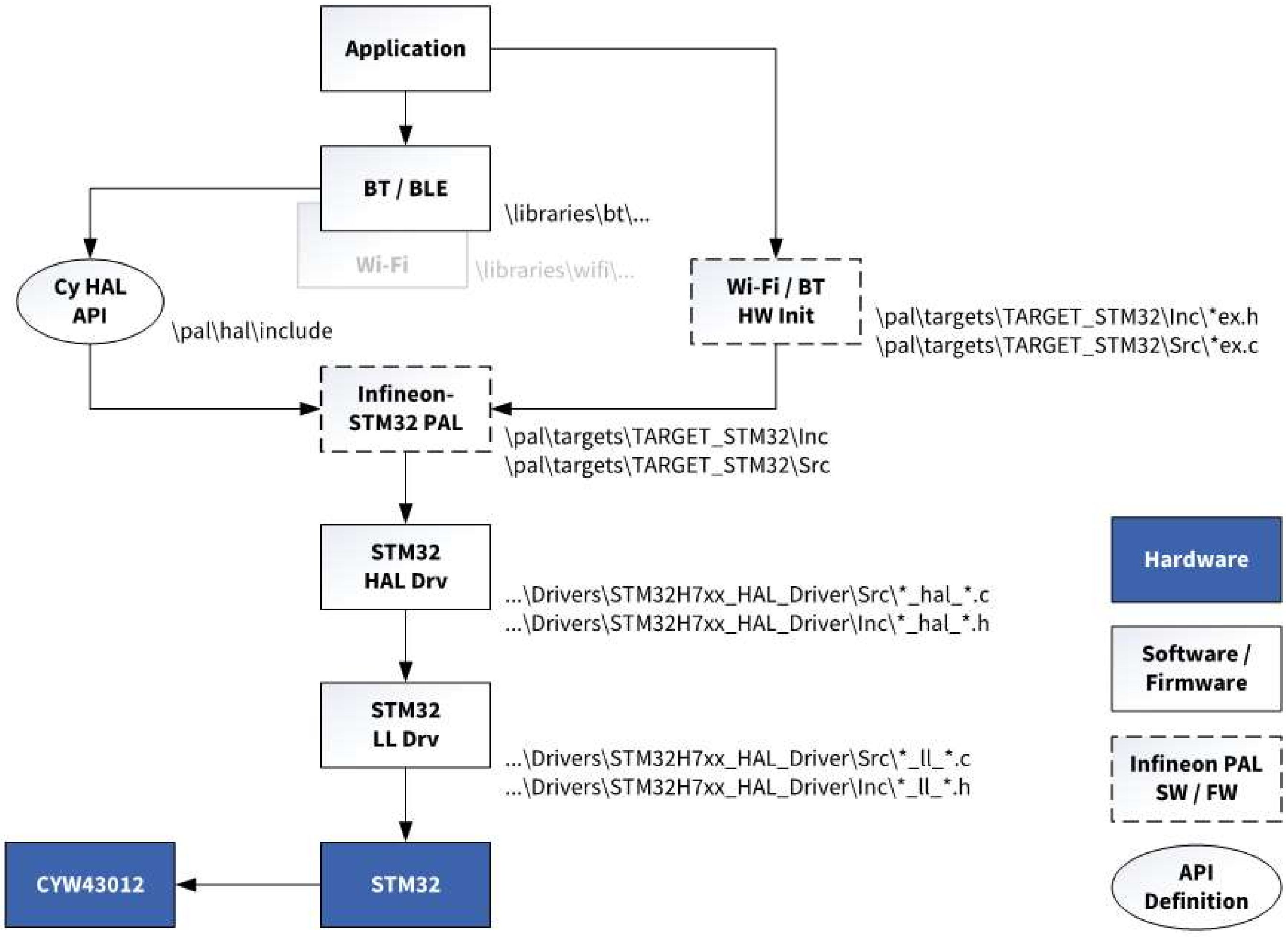
Component Name	Version	Details
pal	1.0.0	Infineon-STM32 Platform Adaptation Layer (PAL)
device	1.0.0	Selects appropriate CYW43xxx firmware and drivers for selected connectivity device.

Infineon-STM32 Platform Adaptation Layer (PAL)

The Infineon-STM32 PAL is based on the STM32 Driver MCU Component HAL, and it offers the minimum set of (required) APIs for Infineon-STM32 PAL. The supported HAL versions are:

STM32Cube HAL Package	STM32Cube MCU Verified Package Version
STM32H7 Series	1.8.0

The PAL integrates the STM32 HAL APIs underneath the Infineon HAL APIs expected by the Infineon Connectivity Libraries. The figure below shows the architectural intent of the Infineon-STM32 PAL:


Application
BT / BLE
\libraries\bt\...
Wi-Fi
\libraries\wifi\...
Cy HAL API
\pal\hal\include
Wi-Fi / BT HW Init
\pal\targets\TARGET_STM32\Inc\*ex.h
\pal\targets\TARGET_STM32\Src\*ex.c
Infineon-STM32 PAL
\pal\targets\TARGET_STM32\Inc
\pal\targets\TARGET_STM32\Src
STM32 HAL Drv
...\Drivers\STM32H7xx_HAL_Driver\Src\*_hal_*.c
...\Drivers\STM32H7xx_HAL_Driver\Inc\*_hal_*.h
STM32 LL Drv
...\Drivers\STM32H7xx_HAL_Driver\Src\*_ll_*.c
...\Drivers\STM32H7xx_HAL_Driver\Inc\*_ll_*.h
CYW43012
STM32
Hardware
Software / Firmware
Infineon PAL SW / FW
API Definition

We created the Infineon-STM32-PAL to meet the following guidelines:

- Developers will continue to use STM32CubeMX and/or STM32 HAL APIs to configure STM32 MCU hardware.

- Developers will communicate to the PAL what STM32 hardware that they have selected and configured for communicating with a CYW43xxx via an initialization API.
- Infineon-STM32 PAL adapts only the minimum set of Infineon HAL APIs to STM32 HAL in order to communicate and control Infineon's CYW43xxx Connectivity device(s).
- The Infineon PAL layer behaves like the Infineon HAL as much as possible to minimize impact to the Infineon libraries
- The Infineon PAL adapts the following STM32 HAL Drivers:
    - GPIO
    - LPTimer
    - SDIO
    - SPI
    - TRNG
    - UART

Supported STM32 MCUs

- STM32H7xx

Supported STM32 Boards

- STM32H747I-DISCO Discovery kit

Supported Connectivity Modules

Infineon's CYW43xxx Wi-Fi-Bluetooth combo chip family:

- CYW43012
- CYW4343W / CYW43438
- CYW4373

Compatible Software

- STM32 CubeMX 6.1.1
- STM32 CubeIDE 1.5.1
- IAR EWARM 8.50.4

Downloading the Expansion Pack

Download the expansion pack from GitHub in the Cypress Semiconductor organization:

https://github.com/cypresssemiconductorco/stm32-connectivity/releases/tag/release-v1.0.0

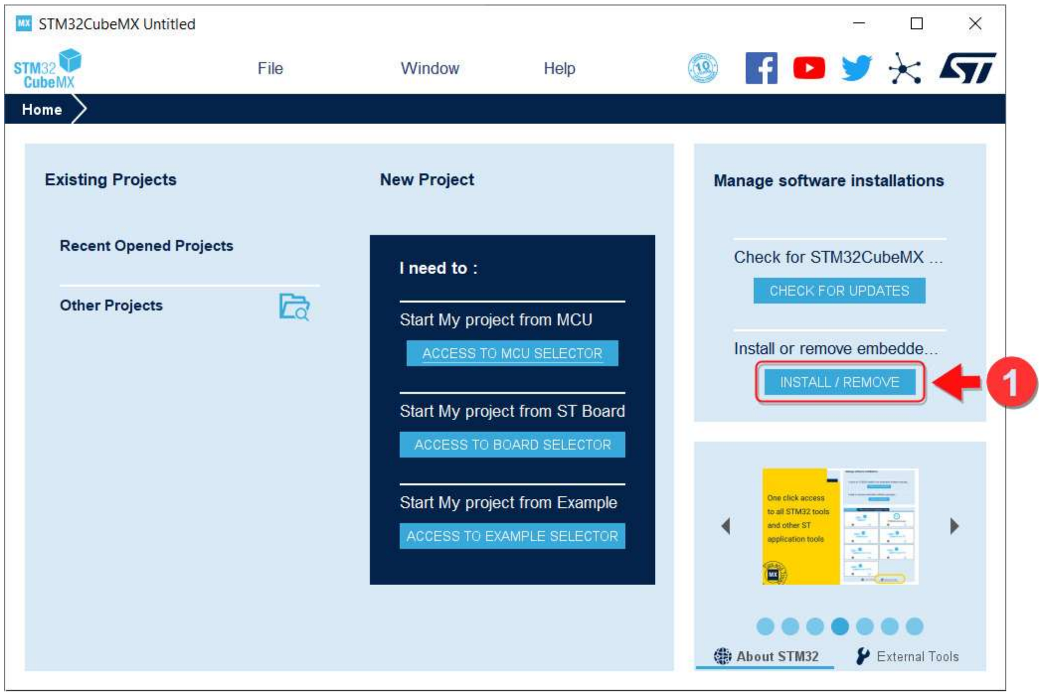
The file name is:

Infineon.Connectivity-STM32.1.0.0.pack

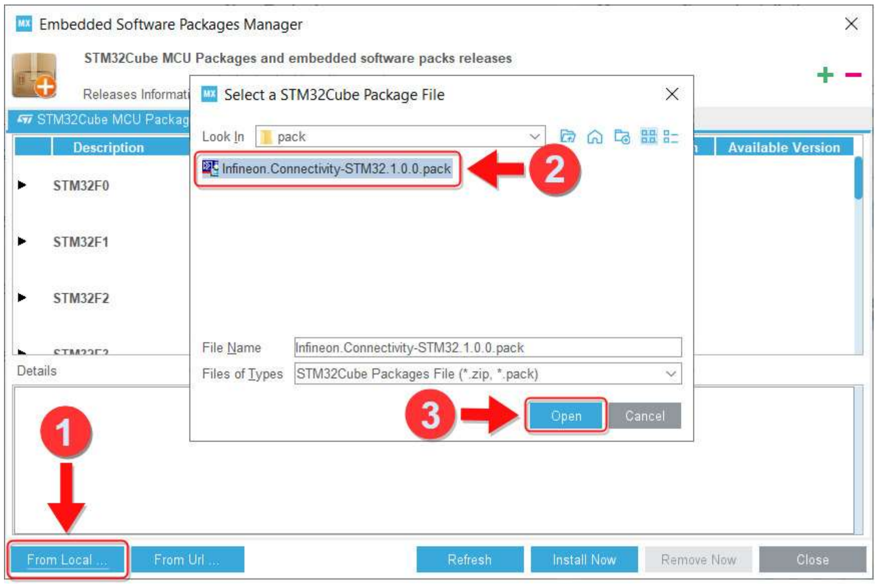
Installing/Importing the Pack

Perform these steps to add the expansion pack to the STM32 development environment:

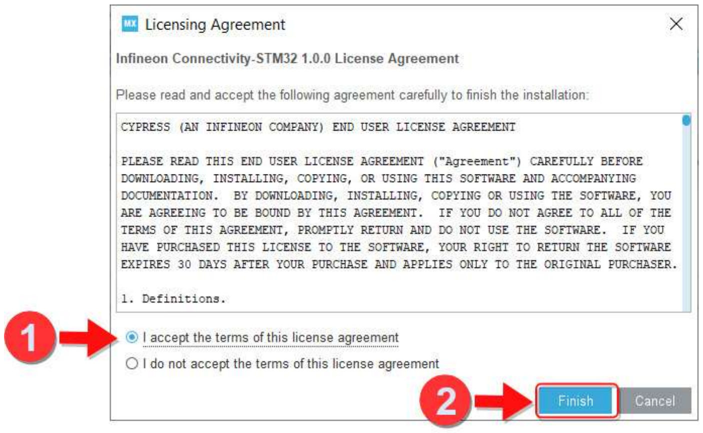
1. Run the STM32CubeMX tool.
2. Navigate to **Home > Manage software installations** and select **Install/Remove**.



3. Select **From Local…**, navigate to the downloaded pack file, and select **Open**.


Embedded Software Packages Manager
STM32Cube MCU Packages and embedded software packs releases
Releases Informati
STM32Cube MCU Packag
Description
STM32F0
STM32F1
STM32F2
Available Version
Details
Select a STM32Cube Package File
Look In
pack
Infineon.Connectivity-STM32.1.0.0.pack
2
File Name
Infineon.Connectivity-STM32.1.0.0.pack
Files of Types
STM32Cube Packages File (*.zip, *.pack)
3
Open
Cancel
1
From Local ...
From Url ...
Refresh
Install Now
Remove Now
Close

4. Accept the license agreement and select Finish.



Licensing Agreement

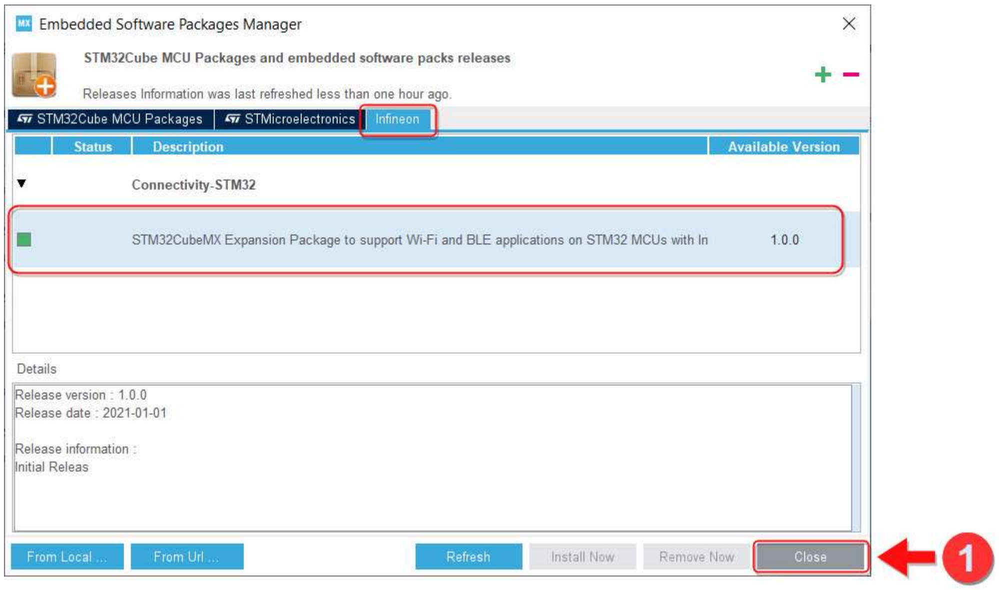
Infineon Connectivity-STM32 1.0.0 License Agreement

Please read and accept the following agreement carefully to finish the installation:

```
CYPRESS (AN INFINEON COMPANY) END USER LICENSE AGREEMENT

PLEASE READ THIS END USER LICENSE AGREEMENT ("Agreement") CAREFULLY BEFORE
DOWNLOADING, INSTALLING, COPYING, OR USING THIS SOFTWARE AND ACCOMPANYING
DOCUMENTATION.  BY DOWNLOADING, INSTALLING, COPYING OR USING THE SOFTWARE, YOU
ARE AGREEING TO BE BOUND BY THIS AGREEMENT.  IF YOU DO NOT AGREE TO ALL OF THE
TERMS OF THIS AGREEMENT, PROMPTLY RETURN AND DO NOT USE THE SOFTWARE.  IF YOU
HAVE PURCHASED THIS LICENSE TO THE SOFTWARE, YOUR RIGHT TO RETURN THE SOFTWARE
EXPIRES 30 DAYS AFTER YOUR PURCHASE AND APPLIES ONLY TO THE ORIGINAL PURCHASER.

1. Definitions.
```

[✓ I accept the terms of this license agreement] I do not accept the terms of this license agreement

5. The tool shows an **Infineon** tab with the installed Expansion Pack displayed. Click **Close**.



Embedded Software Packages Manager

STM32Cube MCU Packages and embedded software packs releases

Releases Information was last refreshed less than one hour ago.

	Status	Description	Available Version
▼		Connectivity-STM32	
	🟩	STM32CubeMX Expansion Package to support Wi-Fi and BLE applications on STM32 MCUs with In	1.0.0

Details

Release version : 1.0.0
Release date : 2021-01-01

Release information :
Initial Releas

Hardware Setup

Using STM32H747 DISCO Kit

STM32H747 Disco Kit setup requires three discrete boards to create a setup where an STM32H747 hosts Infineon's CYW43xxx connectivity device. The three boards and links are:

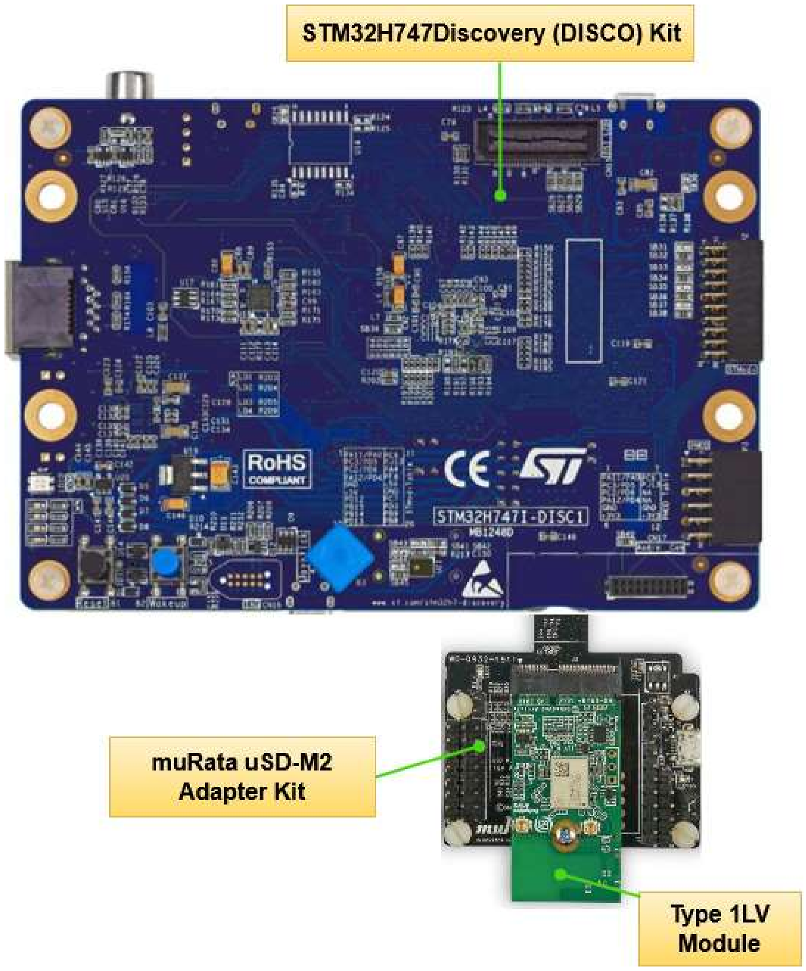
- STM32H747 Discovery (DISCO) Kit: The STM32H747I-DISCO Discovery kit is a complete demonstration and development platform for STMicroelectronics STM32H747XIH6 microcontroller, designed to simplify user application development.
- muRata uSD-M2 Adapter Kit: muRata's uSD-M.2 Adapter Kit with Embedded Artists' Wi-Fi/Bluetooth M.2 Modules enable users with a simple plug-in solution. The Embedded Artists' Wi-Fi/Bluetooth M.2 Modules are based on Murata modules using Cypress Semiconductor's Wi-Fi/Bluetooth chipsets.

  Current Wi-Fi/Bluetooth EVB support include

  - Murata Type 1DX M.2 (CYW4343W)

- Type 1MW (CYW43455)
- Type 1LV M.2 (CYW43012)

- Embedded Artists 1LV M.2 Module: Embedded Artists Type 1LV M.2 EVB is designed to work with the Murata uSD-M.2 Adapter.



Set Up Type 1LV Module

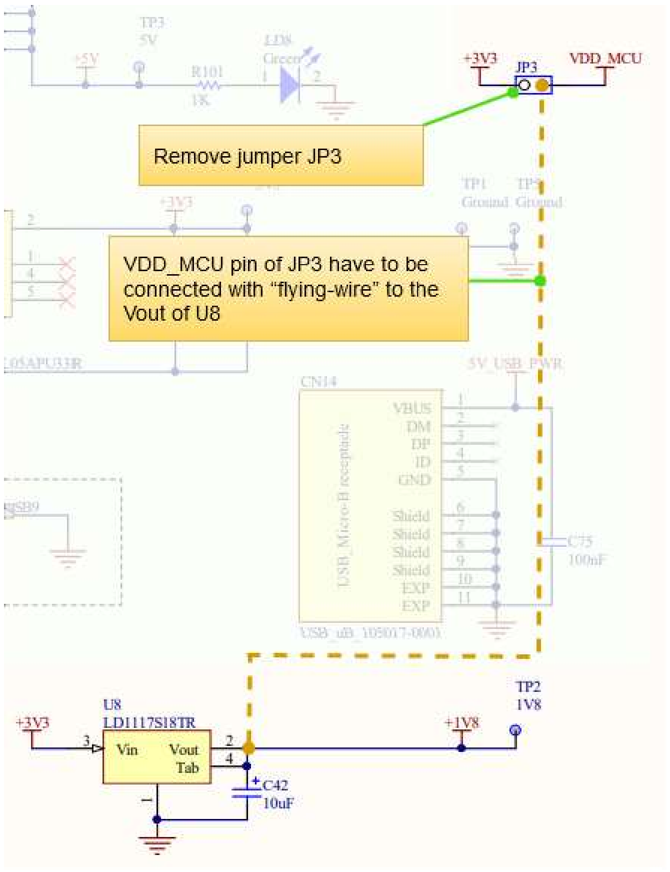
Model	Embedded Artists 1LV M.2 Module	
Features	■ 802.11 a/b/g/n/ac-friendly™ and Bluetooth/LE 5.0 ■ SDIO 3.0 interface, SDR40@80MHz ■ Chipset: Infineon CYW43012	
Datasheet	1LV M.2	

Board preparations

The 1LV module operates at 1.8 V VIO only (chipset limitation). The following preparation on STM32H747 DISCO Kit and muRata uSD-M2 Adapter are required:

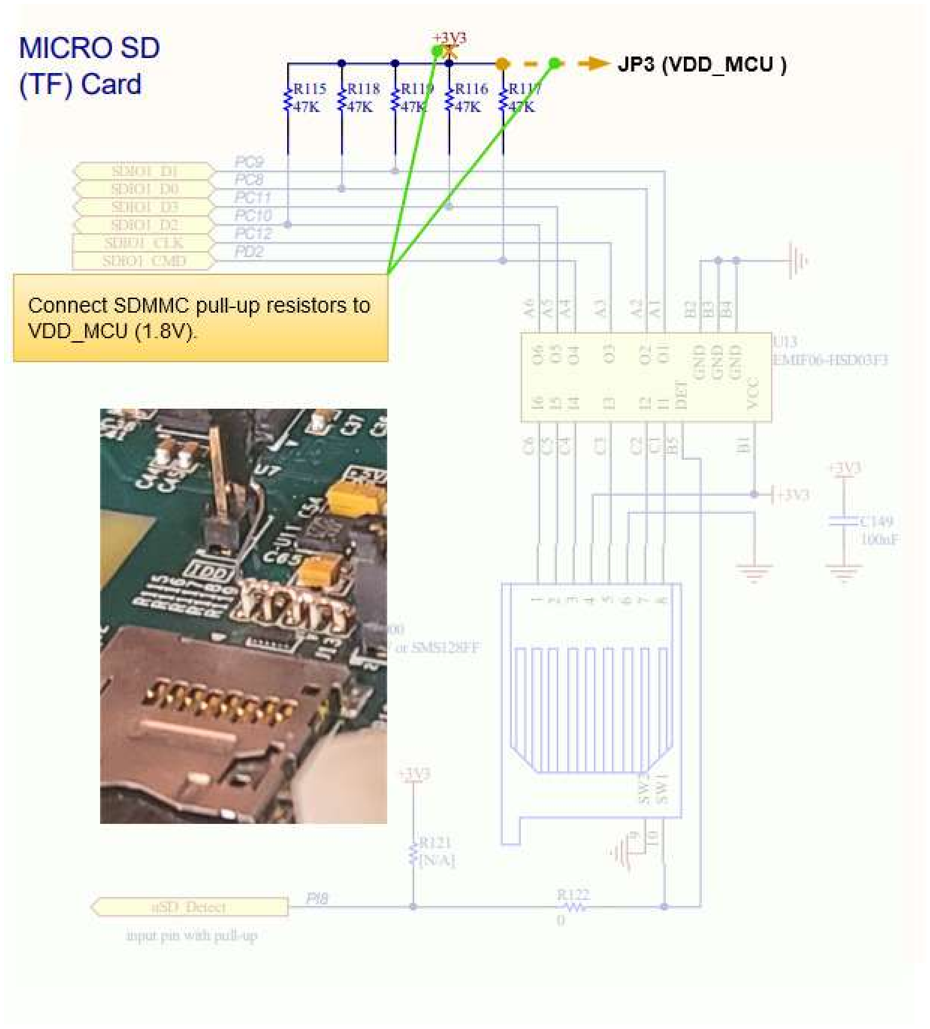
1. Modify STM32H747 Disco Kit to operate on 1.8 V.

   Remove the jumper JP3 and connect the VDD_MCU pin of JP3 with “flying-wire” to the Vout of U8 linear voltage regulator (which is effectively a 1.8 V source).



2. Connect SDMMC pull-up resistors to VDD_MCU (1.8V) on STM32H747 DISCO Kit.

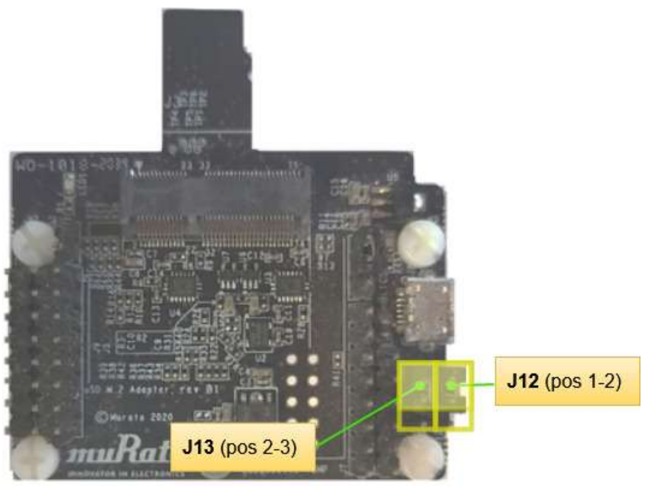
   SDMMC pull-up resistors R115-R119 must be unsoldered from the 3.3 V point and soldered vertically. The tops of these resistors have to be soldered to "flying-wire" and connected to JP3 at the side of VDD_MCU.



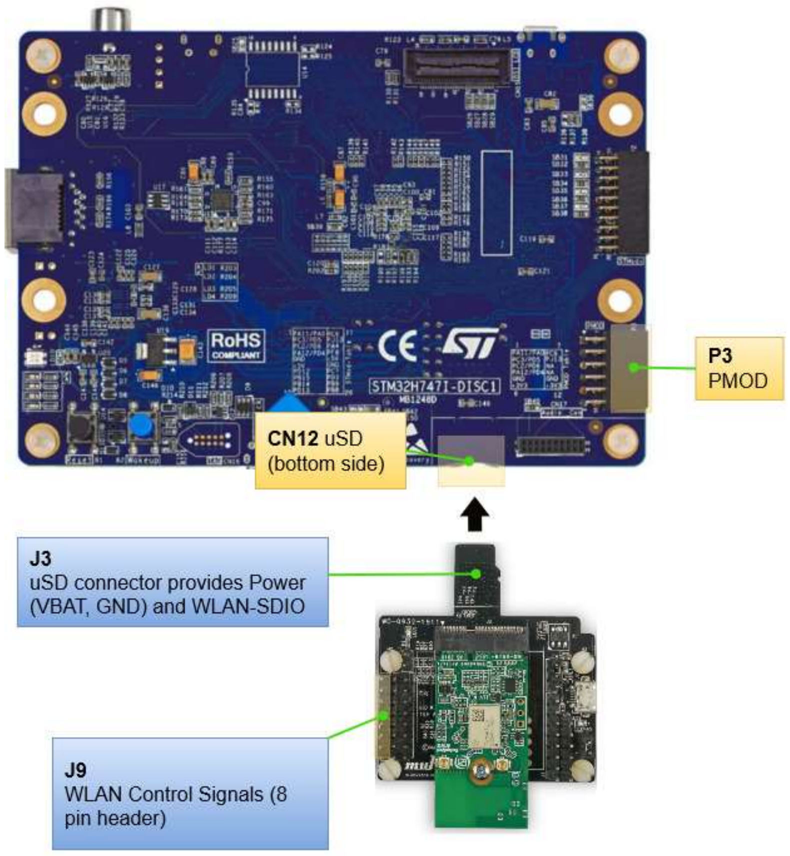
3. Modify muRata uSD-M2 Adapter to operate at 1.8V.

   To switch muRata uSD-M2 Adapter to 1.8V the following jumpers have to be configured:

   - J12 to pos 1-2 (M2 IO Voltage for 1.8V VDDIO)
   - J13 to pos 2-3 (Host IO Voltage for 1.8V)



Wire connections


P3
PMOD
CN12 uSD
(bottom side)
J3
uSD connector provides Power (VBAT, GND) and WLAN-SDIO
J9
WLAN Control Signals (8 pin header)

Connection	Operation	STM32H747 Disco Kit		muRata uSD-M2 Adapter	Note
		Connector	STM32 GPIO		
VBAT (3.3V)	VCC	CN12		J3	VBAT, GND connected via microSD connector
GND	GND				

Connection	Operation	STM32H747 Disco Kit		muRata uSD-M2 Adapter	Note
		Connector	STM32 GPIO		
WL_REG_ON_HOST	Wi-Fi	P3.7 (PMOD#11)	PC6	J9.3	Enables/Disables WLAN core: Active High
WL_HOST_WAKE_HOST	Wi-Fi	P3.8 (PMOD#12)	PJ13	J9.5	WLAN Host Wake: Active Low (OOB IRQ)
SDIO	Wi-Fi	CN12	PC8, PC9, PC10, PC11, PC12, PD2	J3	uSD connector pins: provides Power (VBAT, GND) and WLAN-SDIO (DATA0, DATA1, DATA2, DATA3, Clock and Command)

Set Up Type 1DX M.2 Module

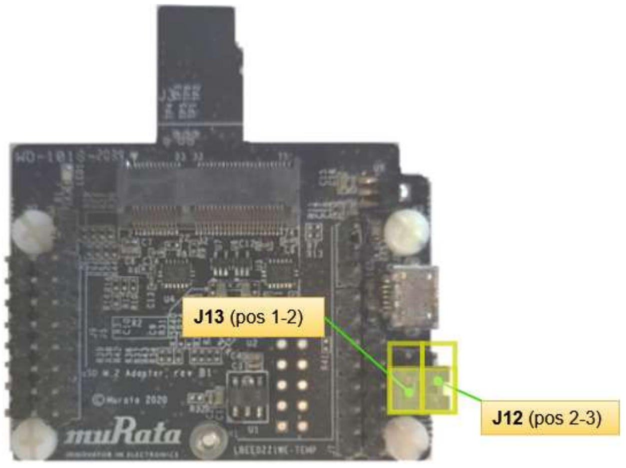
Model	Embedded Artists 1DX M.2 Module
Features	■ 802.11 b/g/n and Bluetooth/LE 4.2 ■ SDIO 2.0 interface, SDR25@50MHz ■ Chipset: Infineon CYW4343W
Datasheet	1DX M.2

Board preparations

This module does not require the host to provide 1.8 V on the SDIO signals. It can operate on 3.3V/1.8V. This makes board preparation simpler.

Ensure that the muRata uSD-M2 Adapter is set to operate at 3.3V, with this jumper configuration:

- ☐ J12 to pos 2-3 (M2 IO Voltage for 3.3V VDDIO)
- ☐ J13 to pos 1-2 (Host IO Voltage for 3.3V VDDIO)



Wire connections

The Type 1DXM module uses the same wire connections as Type 1LV modules. Refer to the Wire connections section for Type 1LV Modules.

STM32 Wi-Fi Scan Example Project

We provide the following example project to get started using the pack. This example demonstrates how to configure different scan filters provided in the Wi-Fi Connection Manager (WCM) middleware and scan for the available Wi-Fi networks.

The example initializes the Wi-Fi device and starts a Wi-Fi scan without any filter and prints the results on the serial terminal. The example starts a scan every 3 seconds after the previous scan completes.

This example demonstrates how an STM32H7 can be used to host CYW43xxx connectivity devices.

Hardware

Refer to section the STM32 hardware configuration descriptions as appropriate:

Using STM32H747 DISCO Kit

Other Software

Install a terminal emulator if you don't have one. Instructions in this document use Tera Term.

Project Components

The following are the only components used in this project:

- wifi-host-driver (WHD)
- wifi-connection-manager (WCM)
- abstraction-rtos (configured for the FreeRTOS kernel)
- connectivity-utilities
- core-lib
- pal (minimum interface to ST HAL to enable connectivity)
- whd-bsp-integration
- wifi-mw-core

Example Project Start/Import

You can open the Wi-Fi Scan example by copying the example from the Pack to an appropriate location. Once you have copied the example, you can then open it in STM32CubeMX and export to your IDE using the following steps:

1. Copy the code example from the pack directory to your local directory.

   The default path for installed packs is:

   C:\Users\<USER>\STM32Cube\Repository\Packs\

   Copy the wifi_scan example from the appropriate directory. For instance, for STM32H747I-DISCO:

   C:\Users\<USER>\STM32Cube\Repository\Packs\Infineon\Connectivity-STM32\0.1.0\Projects\STM32H747I-DISCO\Applications\wifi_scan

   Paste into your working folder. For example:

   C:\Users\<USER>\STM32Cube\Example

2. Open *wifi_scan.ioc* file in the root folder of project.

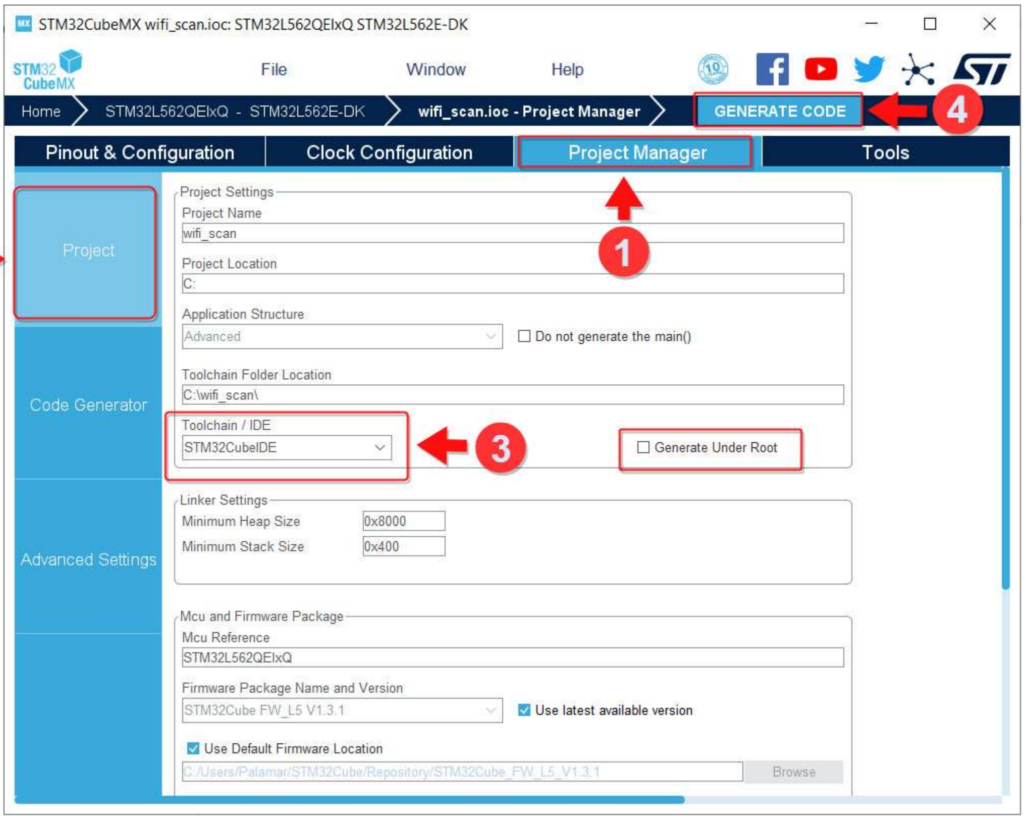
   C:\Users\<USER>\STM32Cube\Example\wifi_scan\wifi_scan.ioc

3. Click **OK** to accept.

Generate Code

Follow these steps to generate code:

1. Select the appropriate option under **Toolchain / IDE**.
2. Select the **Generate Under Root** check box.
3. Click **GENERATE CODE**.

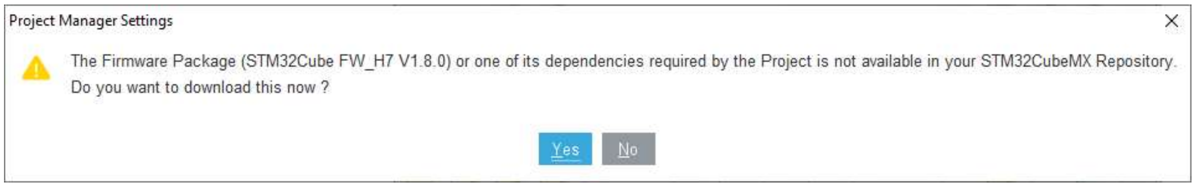


Project Settings
Project Name: wifi_scan
Project Location: C:
Application Structure: Advanced
☐ Do not generate the main()
Toolchain Folder Location: C:\wifi_scan\
Toolchain / IDE: STM32CubeIDE
☐ Generate Under Root

Linker Settings
Minimum Heap Size: 0x8000
Minimum Stack Size: 0x400

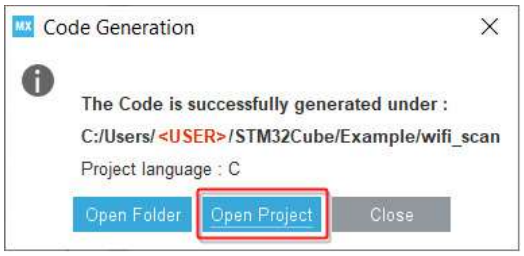
Mcu and Firmware Package
Mcu Reference: STM32L562QEIxQ
Firmware Package Name and Version: STM32Cube FW_L5 V1.3.1
☑ Use latest available version
☑ Use Default Firmware Location
C:/Users/Palamar/STM32Cube/Repository/STM32Cube_FW_L5_V1.3.1
Browse

If a message displays about missing packages, select **Yes**:


Project Manager Settings

The Firmware Package (STM32Cube FW_H7 V1.8.0) or one of its dependencies required by the Project is not available in your STM32CubeMX Repository. Do you want to download this now ?

4. After the code is generated, you will see this dialog. Select **Open Project**.

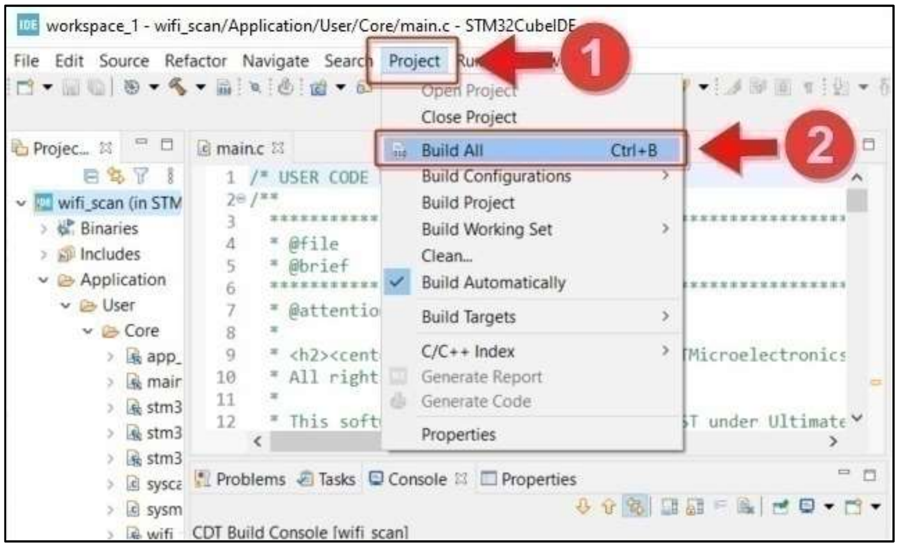

Code Generation

The Code is successfully generated under :
C:/Users/ <USER> /STM32Cube/Example/wifi_scan
Project language : C

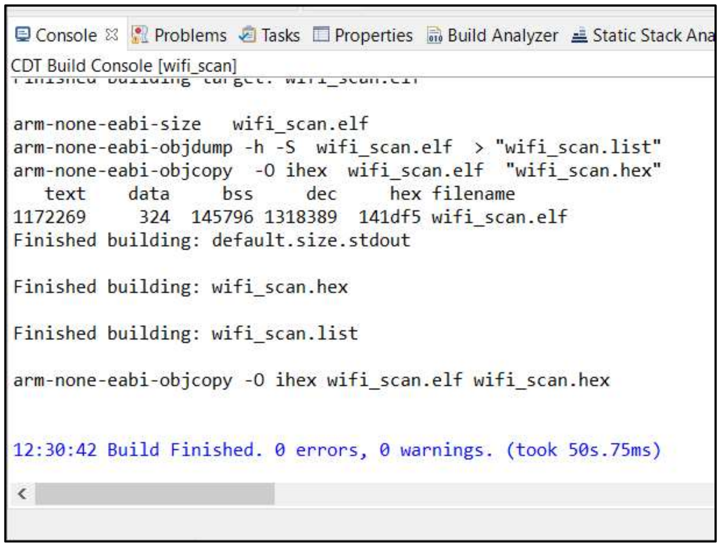
Build the Project

The build step and expected output are illustrated here for each IDE.

STM32CubeIDE:

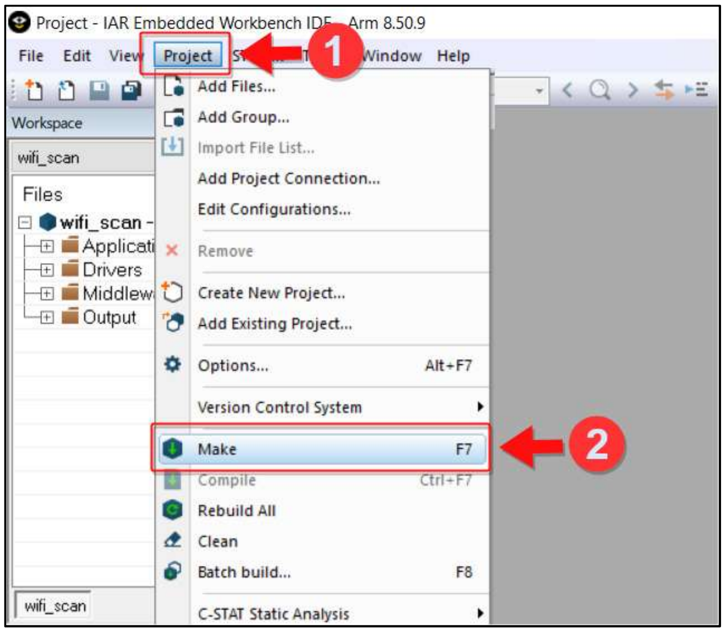

workspace_1 - wifi_scan/Application/User/Core/main.c - STM32CubeIDE
File Edit Source Refactor Navigate Search Project Run
1
2
Open Project
Close Project
Build All Ctrl+B
Build Configurations
Build Project
Build Working Set
Clean...
Build Automatically
Build Targets
C/C++ Index
Generate Report
Generate Code
Properties
Problems Tasks Console Properties
CDT Build Console [wifi_scan]

Example output from a successful build:

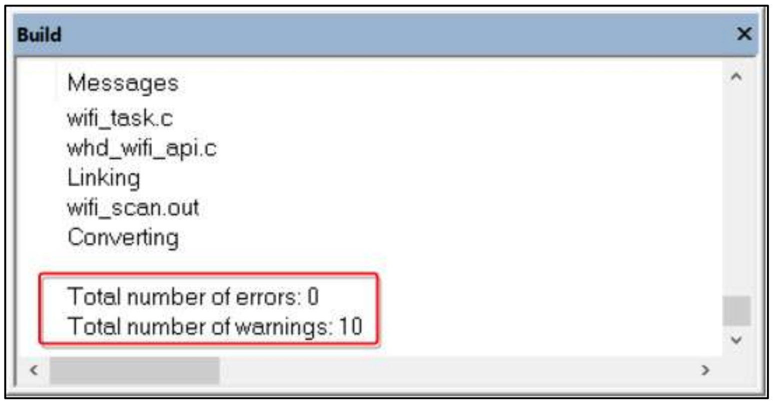

Console Problems Tasks Properties Build Analyzer Static Stack Ana
CDT Build Console [wifi_scan]

```
arm-none-eabi-size   wifi_scan.elf
arm-none-eabi-objdump -h -S  wifi_scan.elf  > "wifi_scan.list"
arm-none-eabi-objcopy  -O ihex  wifi_scan.elf  "wifi_scan.hex"
   text    data     bss     dec     hex filename
1172269     324  145796 1318389  141df5 wifi_scan.elf
Finished building: default.size.stdout

Finished building: wifi_scan.hex

Finished building: wifi_scan.list

arm-none-eabi-objcopy -O ihex wifi_scan.elf wifi_scan.hex


12:30:42 Build Finished. 0 errors, 0 warnings. (took 50s.75ms)
```

IAR EWARM:



The project should build without errors. There are 10 warnings in the lwIP library.



```
Messages
wifi_task.c
whd_wifi_api.c
Linking
wifi_scan.out
Converting

Total number of errors: 0
Total number of warnings: 10
```

Project Hardware Setup

Refer to section Hardware Setup.

Terminal Display

The terminal display is used by the application to provide status and network information.

You will need a terminal emulator such as Tera Term (https://ttssh2.osdn.jp/index.html.en) to display the output.

Serial Terminal Setup

The terminal interface is a virtual COM port which is part of the ST-LINK (CN2) USB connection. Terminal emulator configuration:

- BaudRate: 115200
- Data Length: 8 Bits
- Stop Bit(s): 1

- Parity: None
- Flow control: None

Example Output

```
****************** WiFi-Scan app ******************

    Insert CYW43xxx into microSD card slot

    Push blue button to continue...

    CYW43xxx detected

WLAN MAC Address : E8:E8:B7:9F:CC:EAWLAN Firmware : wl0: Sep  9 2020 01:22:10 version 13.10.271.253
(c4c4c7c CY) FWID 01-79301becWLAN CLM            : API: 18.2 Data: 9.10.0 Compiler: 1.36.1
ClmImport: 1.34.1 Creation: 2020-09-09 01:19:03 WHD VERSION  : v1.93.0 : v1.93.0 : IAR 8050009 :
2020-12-21 13:24:03 +0530
----------------------------------------------------------------------------------------------------
  #                   SSID                     RSSI   Channel       MAC Address              Security
----------------------------------------------------------------------------------------------------
  1   Private                                   -72      11      1C:AF:F7:26:8D:A8         WPA2_MIXED_PSK
  2   Private                                   -73      11      74:DA:88:29:F2:27         WPA2_MIXED_PSK

----------------------------------------------------------------------------------------------------
  #                   SSID                     RSSI   Channel       MAC Address              Security
----------------------------------------------------------------------------------------------------
  1   Private                                   -68      11      74:DA:88:29:F2:27         WPA2_MIXED_PSK
  2   Private                                   -73      11      1C:AF:F7:26:8D:A8         WPA2_MIXED_PSK
```

Special Options and Setup

STM32H7xx – Using Serial Flash

There may be a need for extra internal Flash space when running applications on STM32H7xx. The significant amount of internal Flash can be saved if Wi-Fi stack is placed on external Serial Flash memory module.

The STM32H747I-DISCO board has MT25QL512ABB8ESF-0SIT memory IC present for this purpose.

- STM32H747I-DISCO has serial Flash in dual-bank Quad-SPI mode
- STM32H7 has QSPI HW block

Additional settings which are needed to enable placing Wi-Fi stack firmware on external memory:

- Linker script (*.ld) has external memory address defined:

```
QSPI      (rx)   : ORIGIN = 0x90000000,    LENGTH = 131072K
```

- Linker script has section name defined where WiFi stack will be located during linkage:

```
.whd_fw :
{
__whd_fw_start = .;
KEEP(*(.whd_fw))
__whd_fw_end = .;
} > OSPI
```

- Preprocessor macro name added:

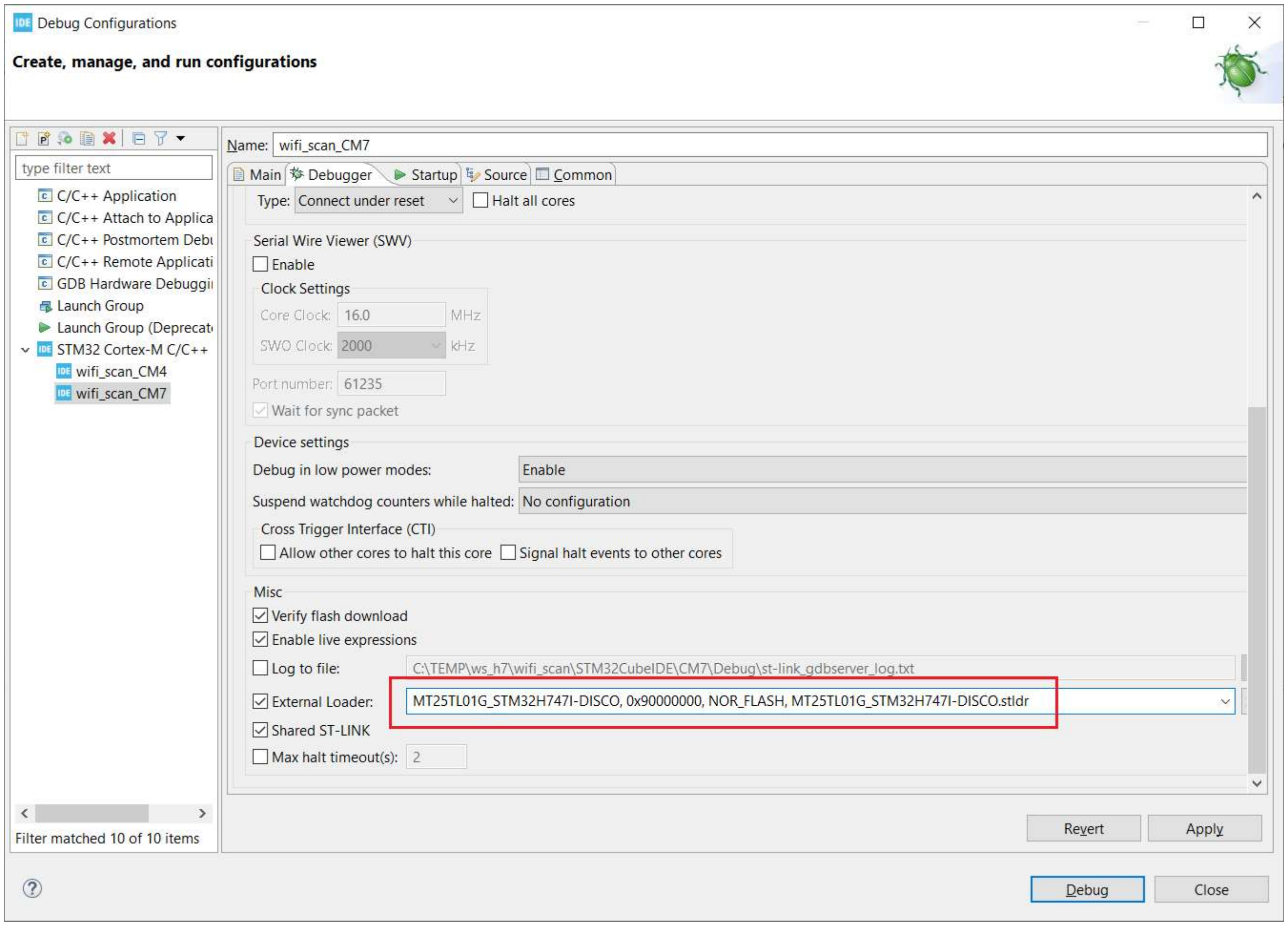
```
CY_STORAGE_WIFI_DATA=".whd_fw"

BSP-files have to be added:
 BSP\stm32h747i_discovery_qspi.c
BSP\stm32h747i_discovery_qspi.h
```

```
BSP\Components\mt25tl01g\mt25tl01g.c(*.h)
BSP\Components\mt25tl01g\mt25tl01g.c(*.h)
BSP\Components\mt25tl01g\mt25tl01g_conf.h
```

- BSP Initialization routine call have to be added:

```
/* Configure External Memory to Memory Mapped Mode*/
    /* QSPI info structure */
   BSP_QSPI_Info_t pQSPI_Info;
   uint8_t status;
  /*##-1- Configure the QSPI device ##########################################*/
   /* QSPI device configuration */
   BSP_QSPI_Init_t init ;
   init.InterfaceMode=MT25TL01G_QPI_MODE;
   init.TransferRate= MT25TL01G_DTR_TRANSFER ;
   init.DualFlashMode= MT25TL01G_DUALFLASH_ENABLE;
   status = BSP_QSPI_Init(0,&init);
   if (status != BSP_ERROR_NONE)
   {
        printf("\r\n    ERROR: BSP_QSPI_Init() failed \r\n");
        Error_Handler();
   }
   /*##-2- Read & check the QSPI info #######################################*/
   /* Initialize the structure */
   pQSPI_Info.FlashSize          = (uint32_t)0x00;
   pQSPI_Info.EraseSectorSize    = (uint32_t)0x00;
   pQSPI_Info.EraseSectorsNumber = (uint32_t)0x00;
   pQSPI_Info.ProgPageSize       = (uint32_t)0x00;
   pQSPI_Info.ProgPagesNumber    = (uint32_t)0x00;
   /* Read the QSPI memory info */
   BSP_QSPI_GetInfo(0,&pQSPI_Info);
   /*##-6-Memory Mapped Mode ###############################################*/
   status = BSP_QSPI_EnableMemoryMappedMode(0);
   if (status != BSP_ERROR_NONE)
   {
        printf("\r\n    ERROR: BSP_QSPI_EnableMemoryMappedMode() failed \r\n");
        Error_Handler();
   }
```

Programming of the Serial Flash should be performed with appropriate Flash Loader selection:



Debug Configurations

Create, manage, and run configurations

Name: wifi_scan_CM7

Type: Connect under reset ☐ Halt all cores

Serial Wire Viewer (SWV)
☐ Enable
Clock Settings
Core Clock: 16.0 MHz
SWO Clock: 2000 kHz
Port number: 61235
☑ Wait for sync packet

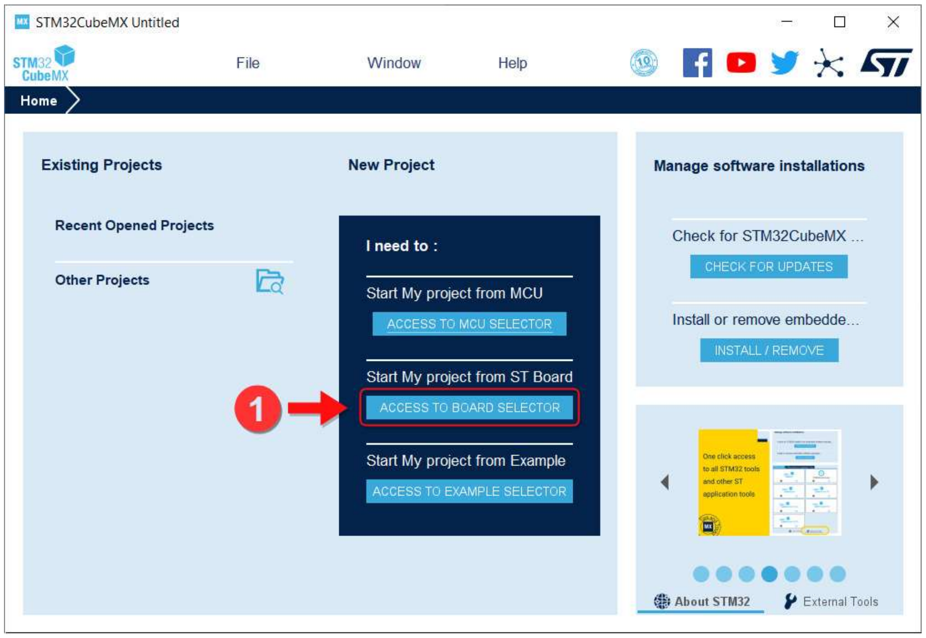
Device settings
Debug in low power modes: Enable
Suspend watchdog counters while halted: No configuration
Cross Trigger Interface (CTI)
☐ Allow other cores to halt this core ☐ Signal halt events to other cores

Misc
☑ Verify flash download
☑ Enable live expressions
☐ Log to file: C:\TEMP\ws_h7\wifi_scan\STM32CubeIDE\CM7\Debug\st-link_gdbserver_log.txt
☑ External Loader: MT25TL01G_STM32H747I-DISCO, 0x90000000, NOR_FLASH, MT25TL01G_STM32H747I-DISCO.stldr
☑ Shared ST-LINK
☐ Max halt timeout(s): 2

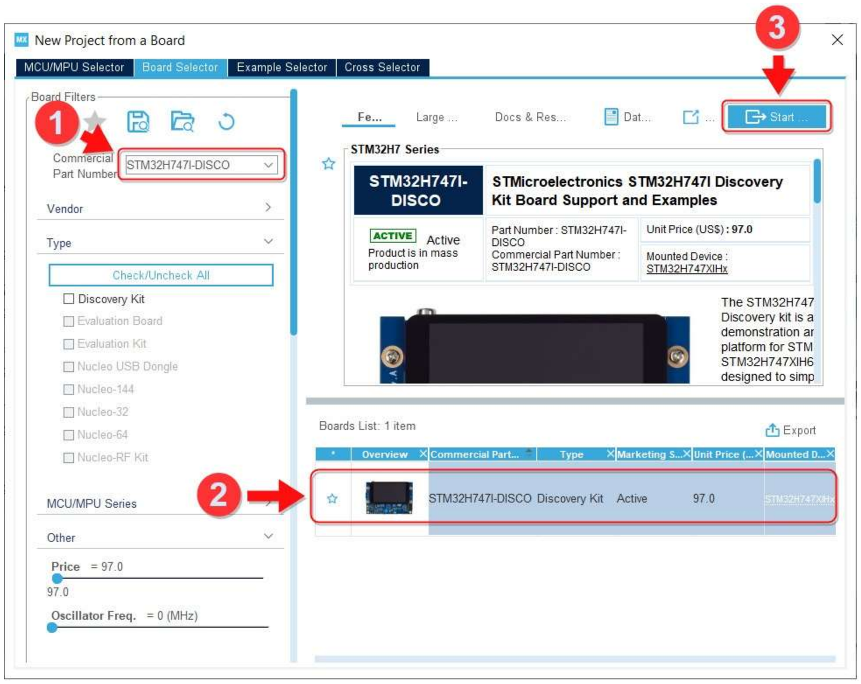
Creating a New Project

The pack should also appear when creating a new project in ST32CubeMX, as illustrated here:

1. Start creating a project via the Access to Board Selector option.

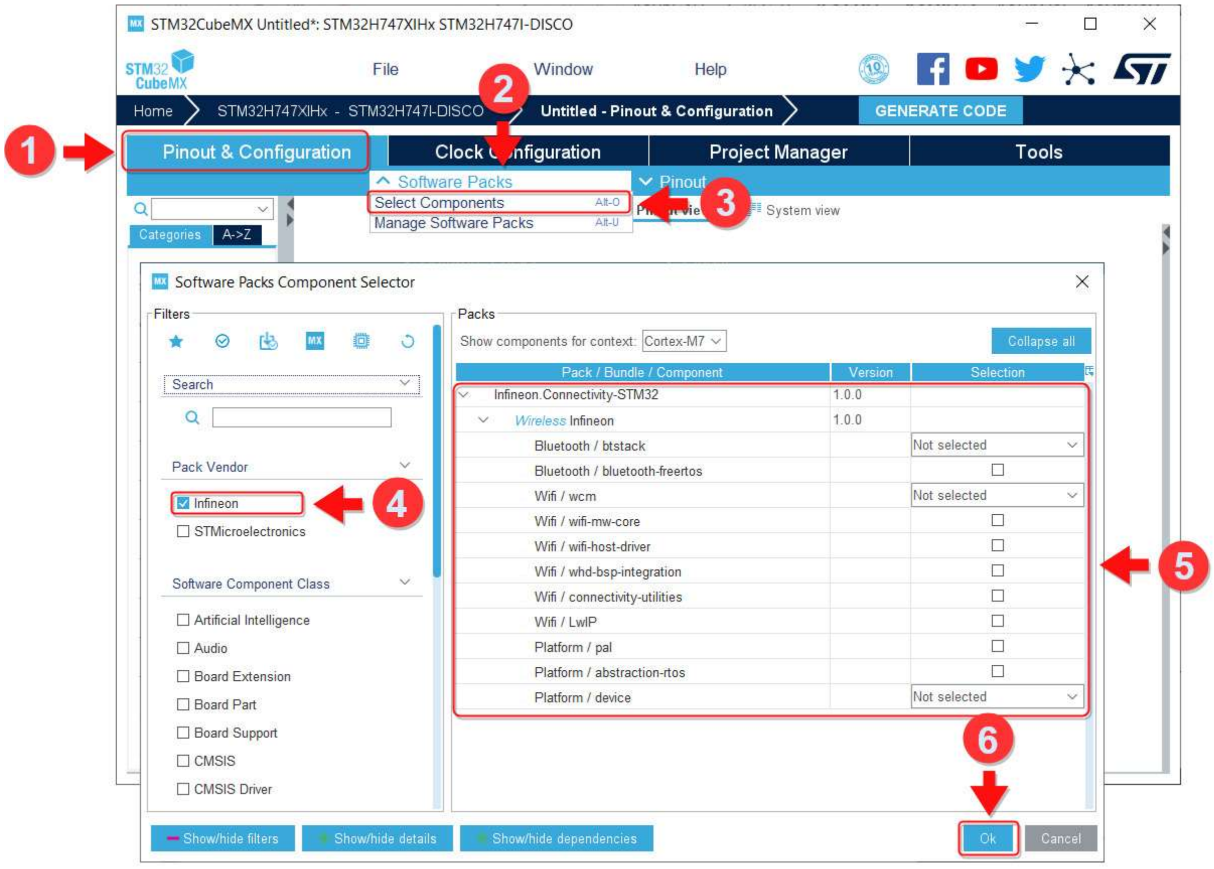


2. Select a board.
   - Enter/select the board number and click on your selected board.
   - Select **Start Project**.



Enable Software components from STM32 Connectivity Expansion Pack

1. Select Software Components.
   - Select the **Pinout & Configuration** tab.
   - Select **Software Packs > Select Components**. This will show a list of the installed packs and their contents.



Software Packs Component Selector

Filters: Search; Pack Vendor: [✓ Infineon] STMicroelectronics; Software Component Class: Artificial Intelligence, Audio, Board Extension, Board Part, Board Support, CMSIS, CMSIS Driver

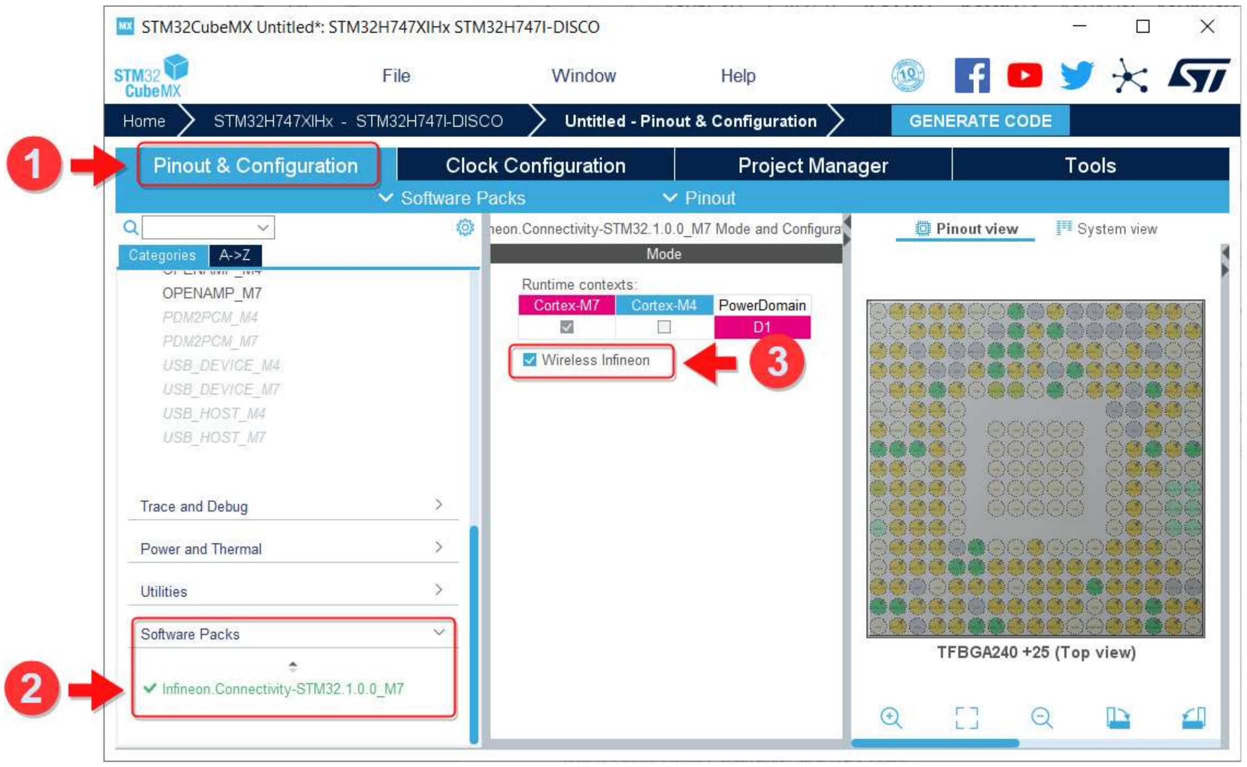
Packs — Show components for context: Cortex-M7 — Collapse all

Pack / Bundle / Component	Version	Selection
Infineon.Connectivity-STM32	1.0.0	
Wireless Infineon	1.0.0	
Bluetooth / btstack		Not selected
Bluetooth / bluetooth-freertos		☐
Wifi / wcm		Not selected
Wifi / wifi-mw-core		☐
Wifi / wifi-host-driver		☐
Wifi / whd-bsp-integration		☐
Wifi / connectivity-utilities		☐
Wifi / LwIP		☐
Platform / pal		☐
Platform / abstraction-rtos		☐
Platform / device		Not selected

Show/hide filters | Show/hide details | Show/hide dependencies | Ok | Cancel

   - Select the components you need for your project – all of the ‘Platform’ and ‘Wifi’ components.
     - For the ‘Platform / device’ component, select the appropriate connectivity device for your system (CYW43012, CYW4343W or CYW43438).
     - For the ‘Wifi / wcm’ component, select the appropriate variant (LWIP or LWIP/WPS/MBEDTLS).
     - LWIP Variant compiles only Wi-Fi connection manager files which provides set of APIs that can be used to establish and monitor Wi-Fi connections on Cypress platforms that support Wi-Fi connectivity
     - LWIP/WPS/MBEDTLS Variant also includes APIs to connect to a Wi-Fi network using Wi-Fi Protected Setup (WPS) methods which uses MBED TLS security stack.

2. Enable Software pack in the **Pinout & Configuration** tab.



3. After generating the code, three include files will need to be added to the code base:
   - FreeRTOSConfig.h
   - lwipopts.h
   - cybsp.h

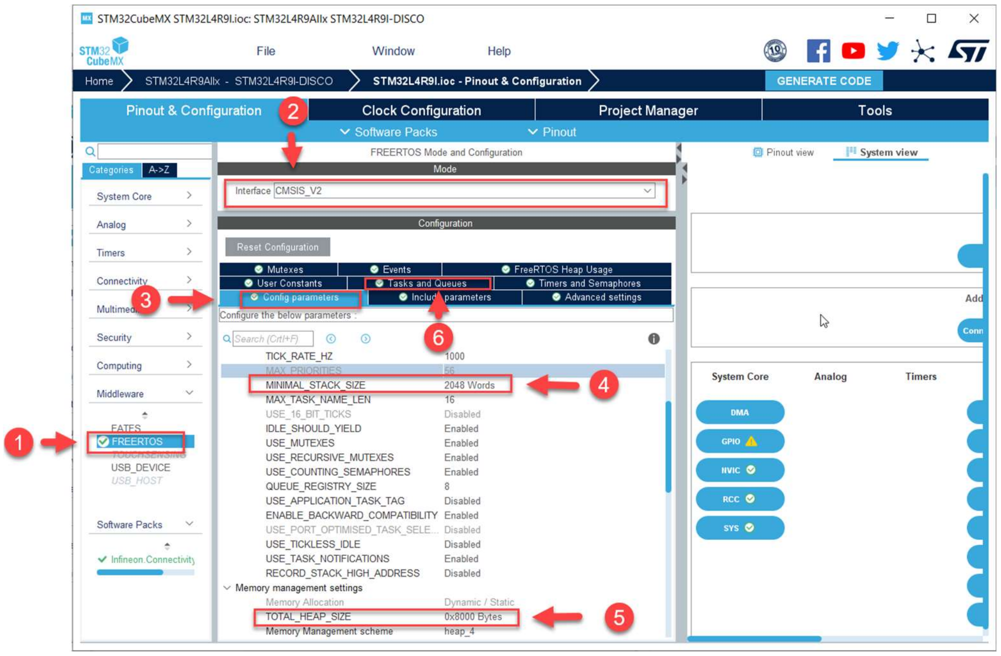
   Examples of these files can be found in the appropriate example project in the pack directory. The files can be located in the equivalent directory for the newly created project.

   STM32H747I-DISCO:

   STM32Cube\Repository\Packs\Infineon\Connectivity-STM32\1.0.0\Projects\STM32H747I-DISCO\Applications\wifi_scan\CM7\Core\Inc

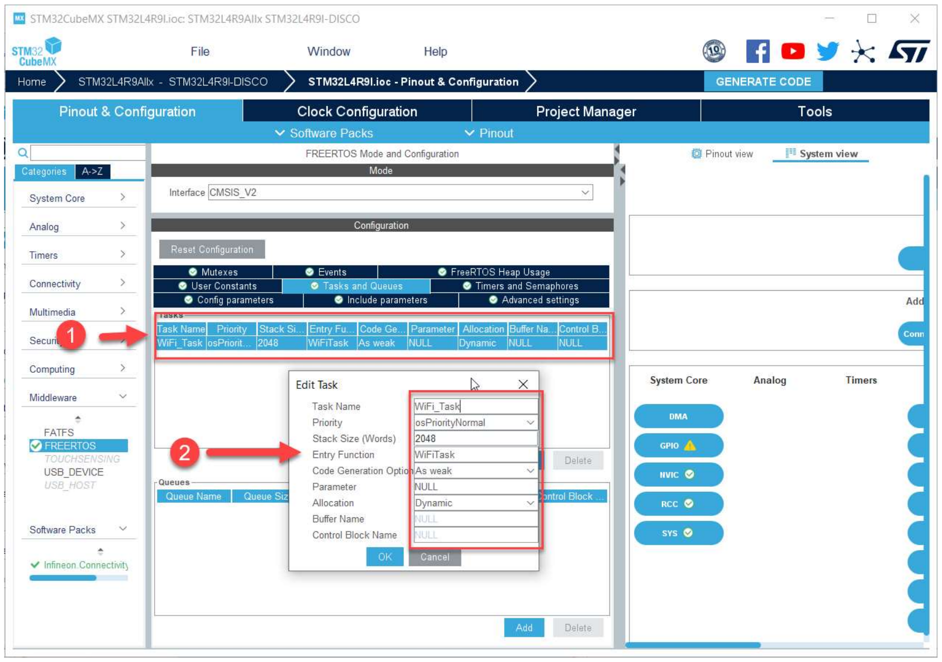
FreeRTOS Configuration

1. Select FreeRTOS version and configure Stack Size and Heap size as required for the application.
2. Configure Default task and its stack size



Interface: CMSIS_V2

TICK_RATE_HZ	1000
MAX_PRIORITIES	56
MINIMAL_STACK_SIZE	2048 Words
MAX_TASK_NAME_LEN	16
USE_16_BIT_TICKS	Disabled
IDLE_SHOULD_YIELD	Enabled
USE_MUTEXES	Enabled
USE_RECURSIVE_MUTEXES	Enabled
USE_COUNTING_SEMAPHORES	Enabled
QUEUE_REGISTRY_SIZE	8
USE_APPLICATION_TASK_TAG	Disabled
ENABLE_BACKWARD_COMPATIBILITY	Enabled
USE_PORT_OPTIMISED_TASK_SELE...	Disabled
USE_TICKLESS_IDLE	Disabled
USE_TASK_NOTIFICATIONS	Enabled
RECORD_STACK_HIGH_ADDRESS	Disabled
Memory management settings	
Memory Allocation	Dynamic / Static
TOTAL_HEAP_SIZE	0x8000 Bytes
Memory Management scheme	heap_4



Interface: CMSIS_V2

Tasks

Task Name	Priority	Stack Si...	Entry Fu...	Code Ge...	Parameter	Allocation	Buffer Na...	Control B...
WiFi_Task	osPriorit...	2048	WiFiTask	As weak	NULL	Dynamic	NULL	NULL

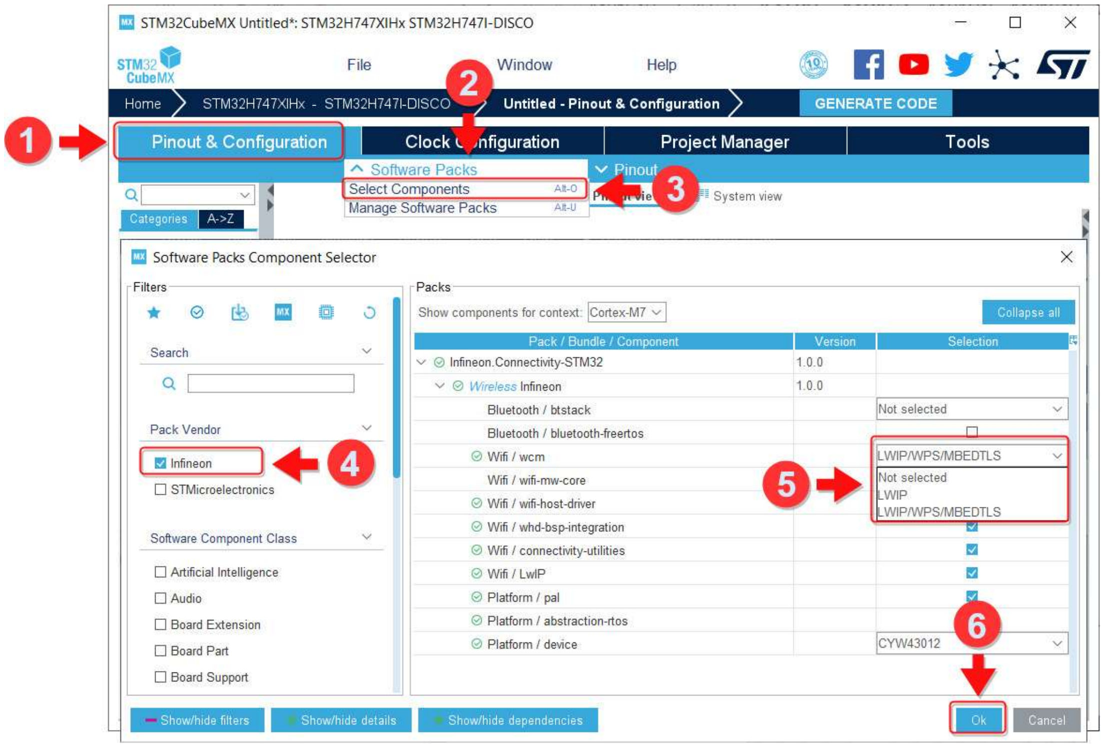
Edit Task

Task Name	WiFi_Task
Priority	osPriorityNormal
Stack Size (Words)	2048
Entry Function	WiFiTask
Code Generation Option	As weak
Parameter	NULL
Allocation	Dynamic
Buffer Name	NULL
Control Block Name	NULL

MbedTLS Configuration

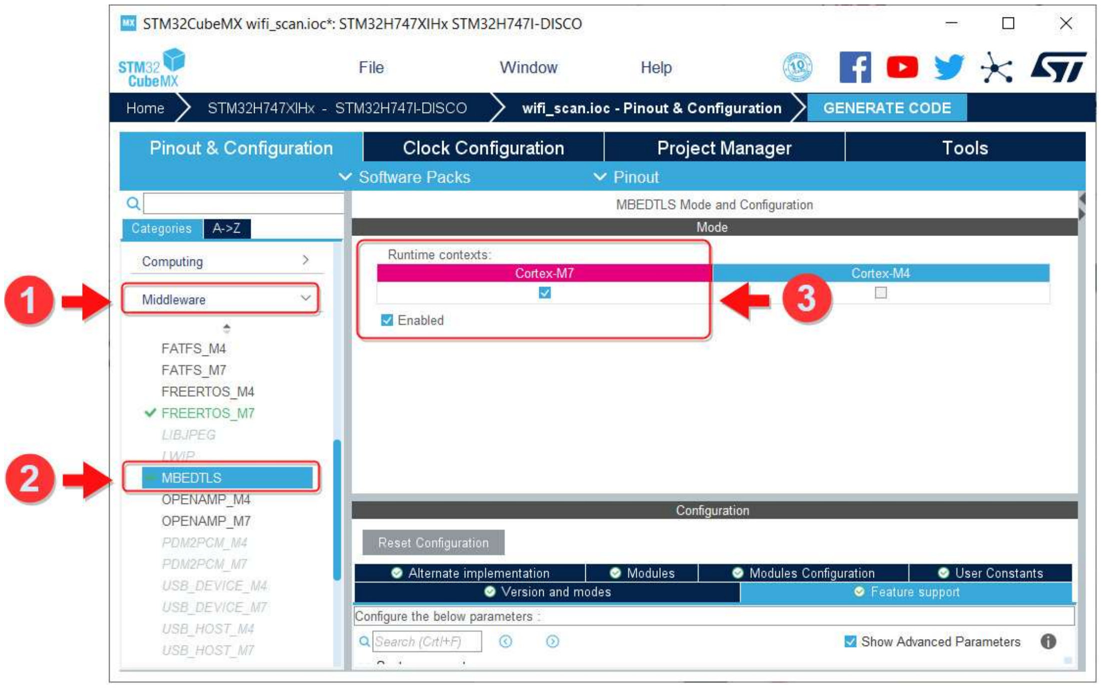
The mbedTLS is required by LwIP (Lightweight IP) WCM (WiFi Connection Manager) Pack's components. To enable mbedTLS:

1. Open the project's *.IOC file w/ STM32CubeMx.
2. Navigate to Infineon Pack's components and switch LWIP to LWIP/WPS/mbedTLS.



Pack / Bundle / Component	Version	Selection
Infineon.Connectivity-STM32	1.0.0	
Wireless Infineon	1.0.0	
Bluetooth / btstack		Not selected
Bluetooth / bluetooth-freertos		☐
Wifi / wcm		LWIP/WPS/MBEDTLS (Not selected / LWIP / LWIP/WPS/MBEDTLS)
Wifi / wifi-mw-core		
Wifi / wifi-host-driver		
Wifi / whd-bsp-integration		✓
Wifi / connectivity-utilities		✓
Wifi / LwIP		✓
Platform / pal		✓
Platform / abstraction-rtos		
Platform / device		CYW43012

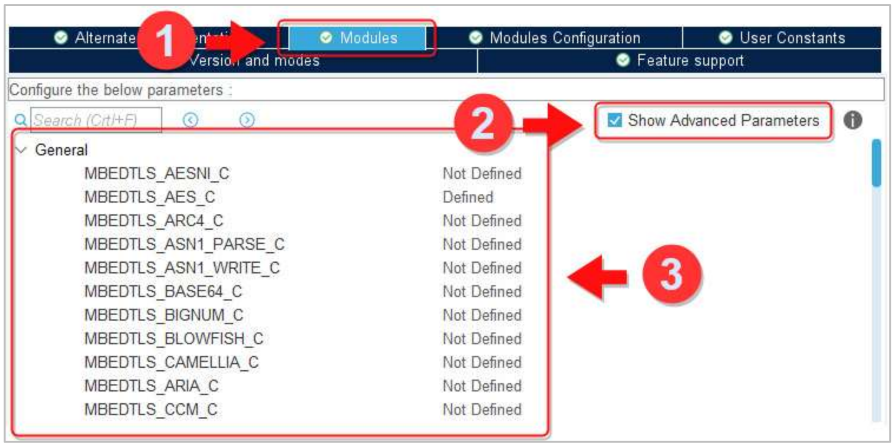
3. Navigate to **Select Components**, select **Middleware** and then select **MBEDTLS** for CM7 and select the **Enabled** check box.



4. Ensure following features and modes are enabled:

   MBEDTLS_ENTROPY_HARDWARE_ALT
   MBEDTLS_AES_ROM_TABLES
   MBEDTLS_CIPHER_MODE_CBC
   MBEDTLS_NO_PLATFORM_ENTROPY
   MBEDTLS_ENTROPY_FORCE_SHA256
   MBEDTLS_AES_C
   MBEDTLS_SHA256_C

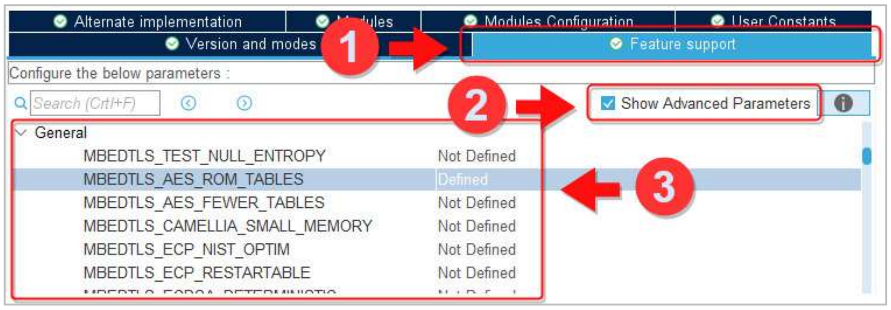
   Note Set "Not defined" for unneeded modes to reduce memory consumption and eliminate unused code.



Configure the below parameters :

General

MBEDTLS_AESNI_C	Not Defined
MBEDTLS_AES_C	Defined
MBEDTLS_ARC4_C	Not Defined
MBEDTLS_ASN1_PARSE_C	Not Defined
MBEDTLS_ASN1_WRITE_C	Not Defined
MBEDTLS_BASE64_C	Not Defined
MBEDTLS_BIGNUM_C	Not Defined
MBEDTLS_BLOWFISH_C	Not Defined
MBEDTLS_CAMELLIA_C	Not Defined
MBEDTLS_ARIA_C	Not Defined
MBEDTLS_CCM_C	Not Defined



Configure the below parameters :

General

MBEDTLS_TEST_NULL_ENTROPY	Not Defined
MBEDTLS_AES_ROM_TABLES	Defined
MBEDTLS_AES_FEWER_TABLES	Not Defined
MBEDTLS_CAMELLIA_SMALL_MEMORY	Not Defined
MBEDTLS_ECP_NIST_OPTIM	Not Defined
MBEDTLS_ECP_RESTARTABLE	Not Defined

By performing those steps:

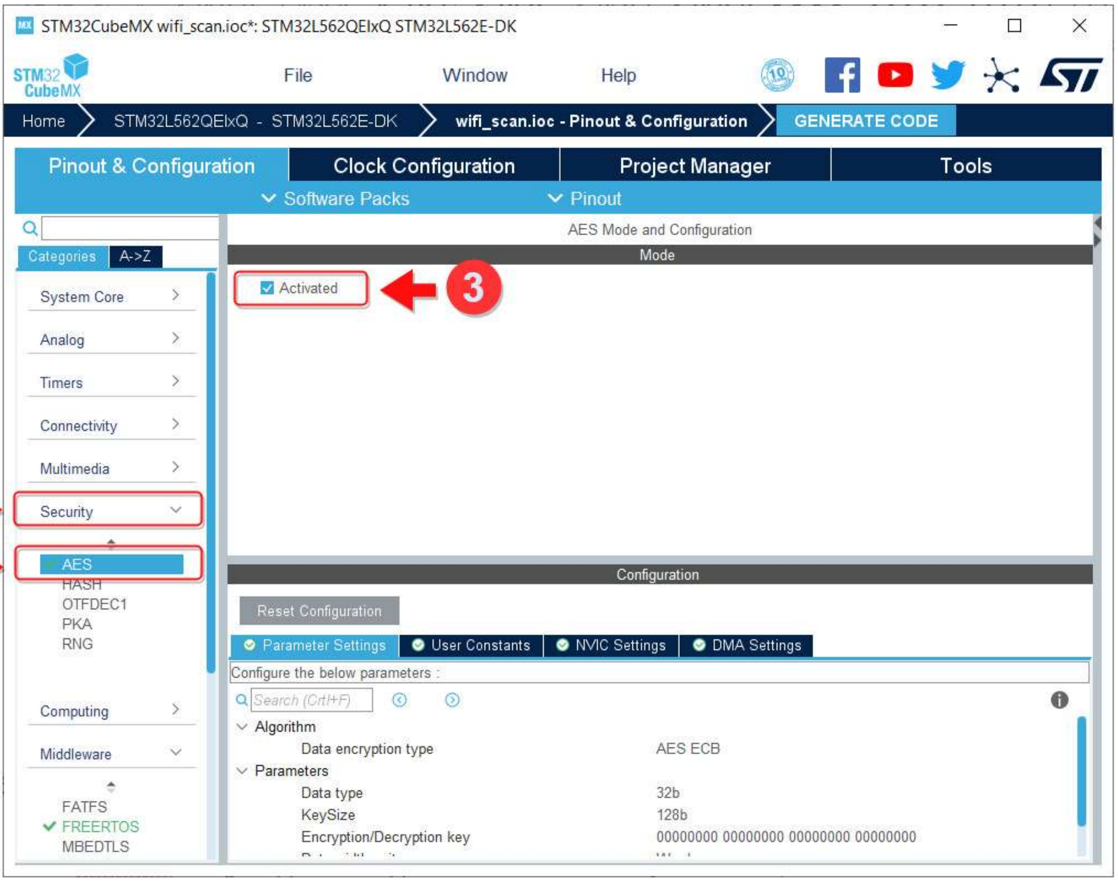
- mbedTLS sources are added to CM7 application
- mbedTLS config is applied to support Infineon's connectivity middleware

Crypto HW Acceleration

STM32 offers HW acceleration for following crypto-related functions:

	STM32H7	Notes
RNG	+	
AES		AES-128/256 (ECB, CBC, CTR, GCM GMAC, CCM)
HASH		SHA1, SHA224, SHA256, MD5 HMAC SHA1, HMAC SHA224, HMAC SHA256, HMAC MD5
PKA		Public Key Cryptography
OTFDEC1		On-the-fly decryption of Octo-SPI external memories (AES-128)

The IP modules listed above must be enabled (Activated) from the "Security" section of STM32CubeMX configurator.

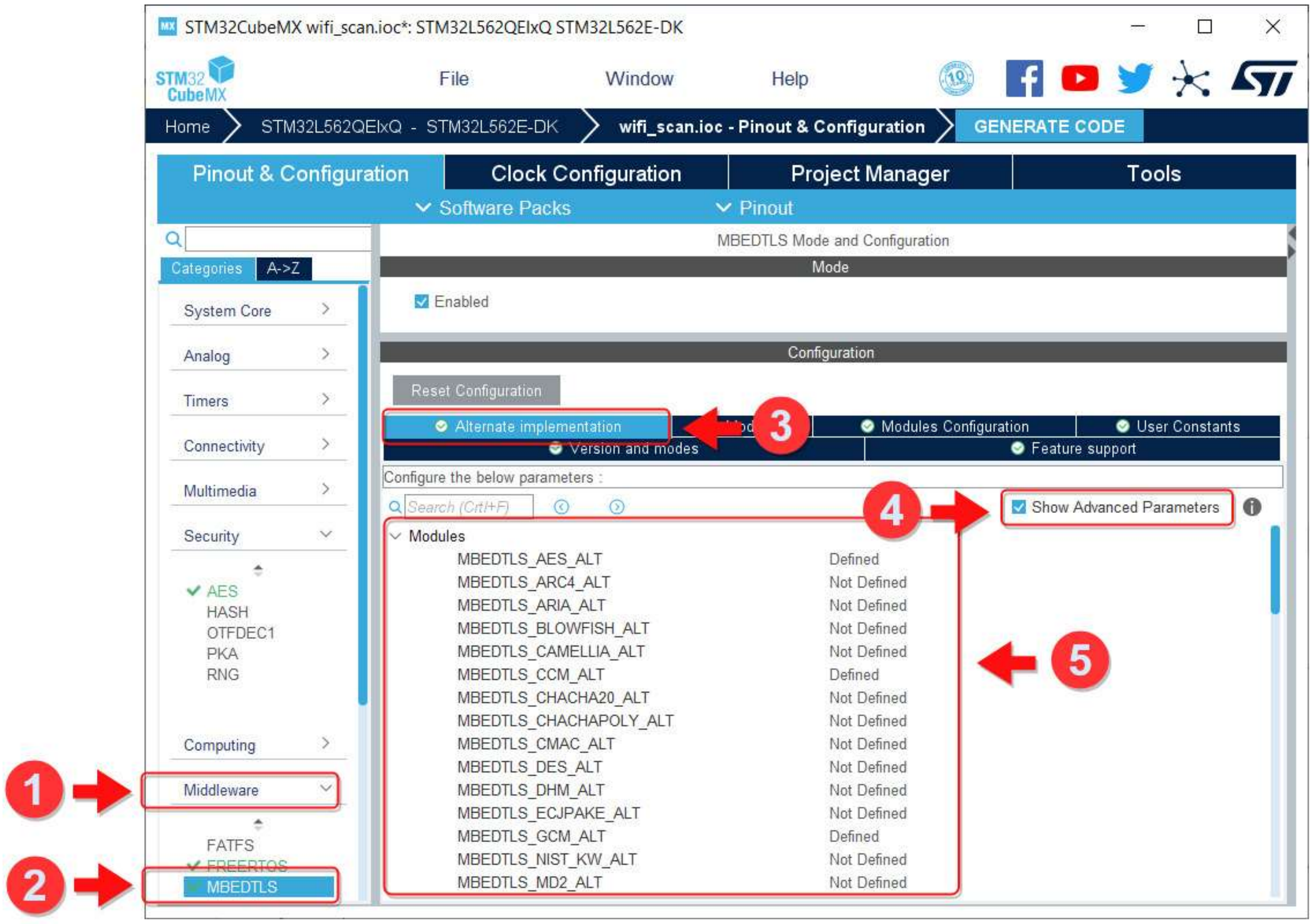


Algorithm
- Data encryption type: AES ECB

Parameters
- Data type: 32b
- KeySize: 128b
- Encryption/Decryption key: 00000000 00000000 00000000 00000000

To enable HW acceleration the following literals have to be defined for mbedTLS (should be done in STM32CUbeMX configurator):

MBEDTLS_AES_ALT
MBEDTLS_CCM_ALT
MBEDTLS_GCM_ALT
MBEDTLS_MD5_ALT
MBEDTLS_SHA1_ALT
MBEDTLS_SHA256_ALT
MBEDTLS_ENTROPY_HARDWARE_ALT



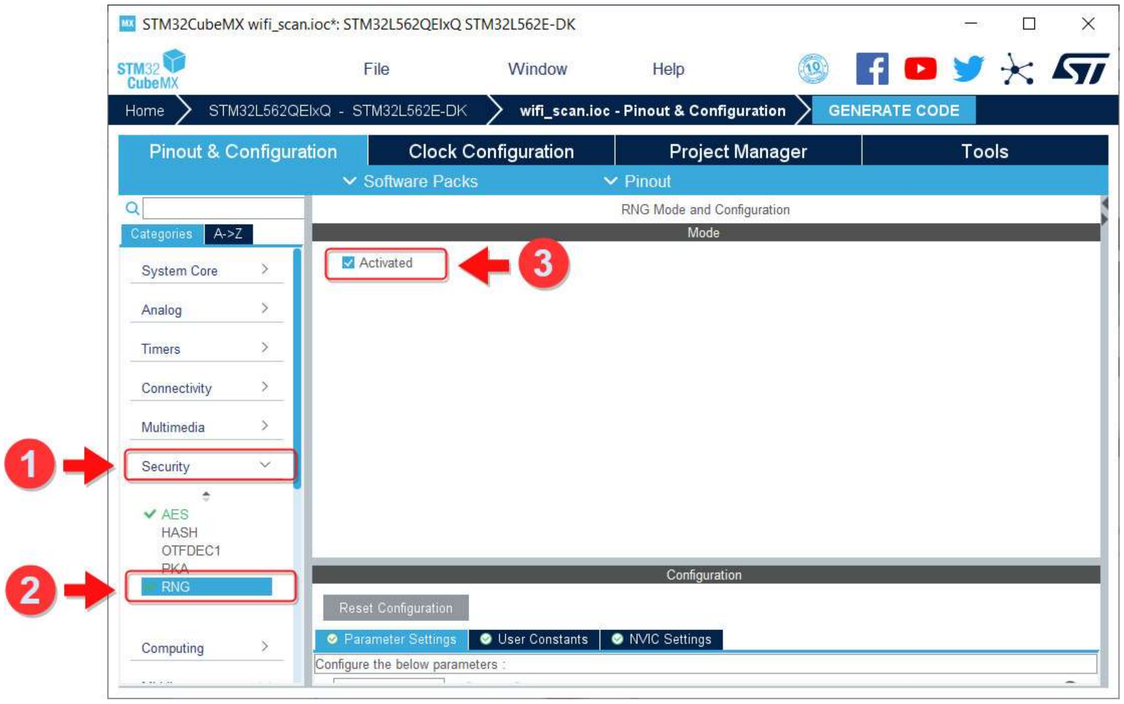
MBEDTLS_AES_ALT	Defined
MBEDTLS_ARC4_ALT	Not Defined
MBEDTLS_ARIA_ALT	Not Defined
MBEDTLS_BLOWFISH_ALT	Not Defined
MBEDTLS_CAMELLIA_ALT	Not Defined
MBEDTLS_CCM_ALT	Defined
MBEDTLS_CHACHA20_ALT	Not Defined
MBEDTLS_CHACHAPOLY_ALT	Not Defined
MBEDTLS_CMAC_ALT	Not Defined
MBEDTLS_DES_ALT	Not Defined
MBEDTLS_DHM_ALT	Not Defined
MBEDTLS_ECJPAKE_ALT	Not Defined
MBEDTLS_GCM_ALT	Defined
MBEDTLS_NIST_KW_ALT	Not Defined
MBEDTLS_MD2_ALT	Not Defined

After these steps, source files marked with *_alt suffixes (meaning "alternative", not the original mbedTLS version) will be added into the user's project. They will provide an interface between thembedTLS crypto functions and its HAL HW counterpart.

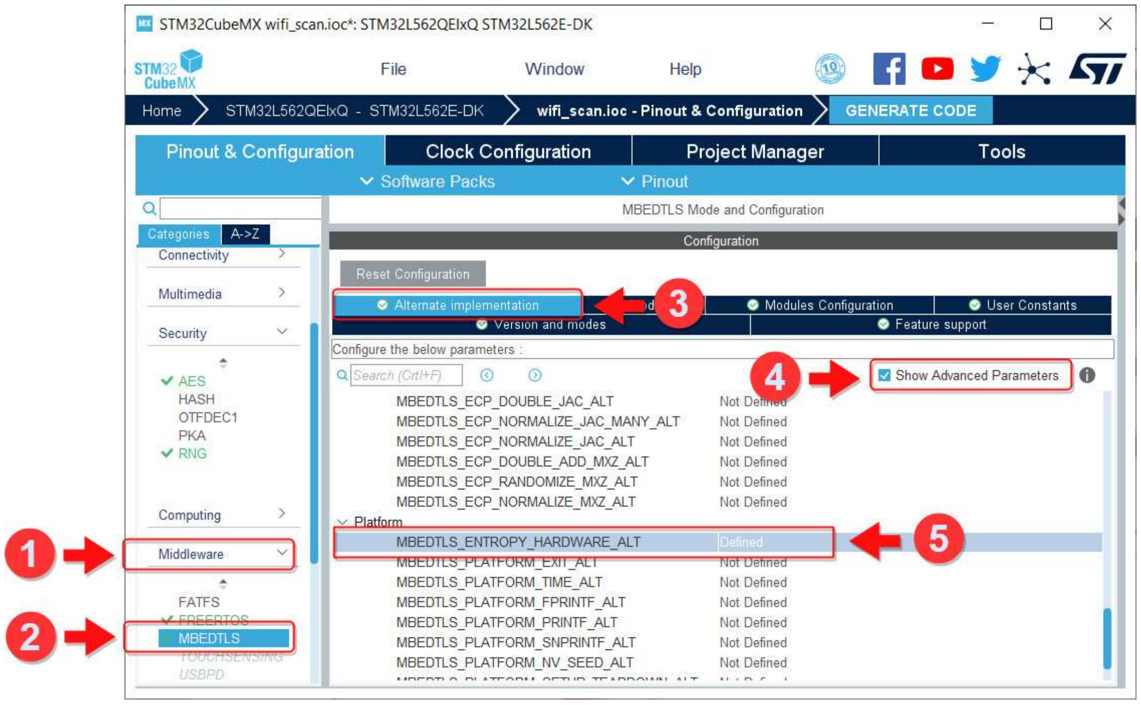
HW Source of Entropy Example

To obtain a good source of entropy used for a public/private key generation and other cryptographic functions:

1. Enable the RNG module in the STM32CubeMX configurator.



2. Set MBEDTLS_ENTROPY_HARDWARE_ALT to "Defined" in the STM32CubeMX configurator:



MBEDTLS_ECP_DOUBLE_JAC_ALT Not Defined
MBEDTLS_ECP_NORMALIZE_JAC_MANY_ALT Not Defined
MBEDTLS_ECP_NORMALIZE_JAC_ALT Not Defined
MBEDTLS_ECP_DOUBLE_ADD_MXZ_ALT Not Defined
MBEDTLS_ECP_RANDOMIZE_MXZ_ALT Not Defined
MBEDTLS_ECP_NORMALIZE_MXZ_ALT Not Defined
Platform
MBEDTLS_ENTROPY_HARDWARE_ALT Defined
MBEDTLS_PLATFORM_EXIT_ALT Not Defined
MBEDTLS_PLATFORM_TIME_ALT Not Defined
MBEDTLS_PLATFORM_FPRINTF_ALT Not Defined
MBEDTLS_PLATFORM_PRINTF_ALT Not Defined
MBEDTLS_PLATFORM_SNPRINTF_ALT Not Defined
MBEDTLS_PLATFORM_NV_SEED_ALT Not Defined

3. The tool will add hardware_rng.c source file to the user's project.
4. This will provide the mbedtls_hardware_poll() implementation, which relies on the devices' HW RNG IP block.

5. A call to the standard STM32 HAL RNG API (HAL_RNG_GenerateRandomNumber()) will be used by the system to fulfill the mbedTLS entropy pool.

Project Hardware Configuration

The following Peripherals and I/O lines required for host MCU to communicate to Infineon connectivity device(s):

- SDIO
- Control Pins

Configure resources for WIFI Connectivity

SDIO

SDIO is used as an interface with Infineon Connectivity devices.

The SDMMC HAL component is required for STM32 host MCU to access/control Infineon connectivity device(s).

1. Add the API call at initialization with appropriate handle passed in:

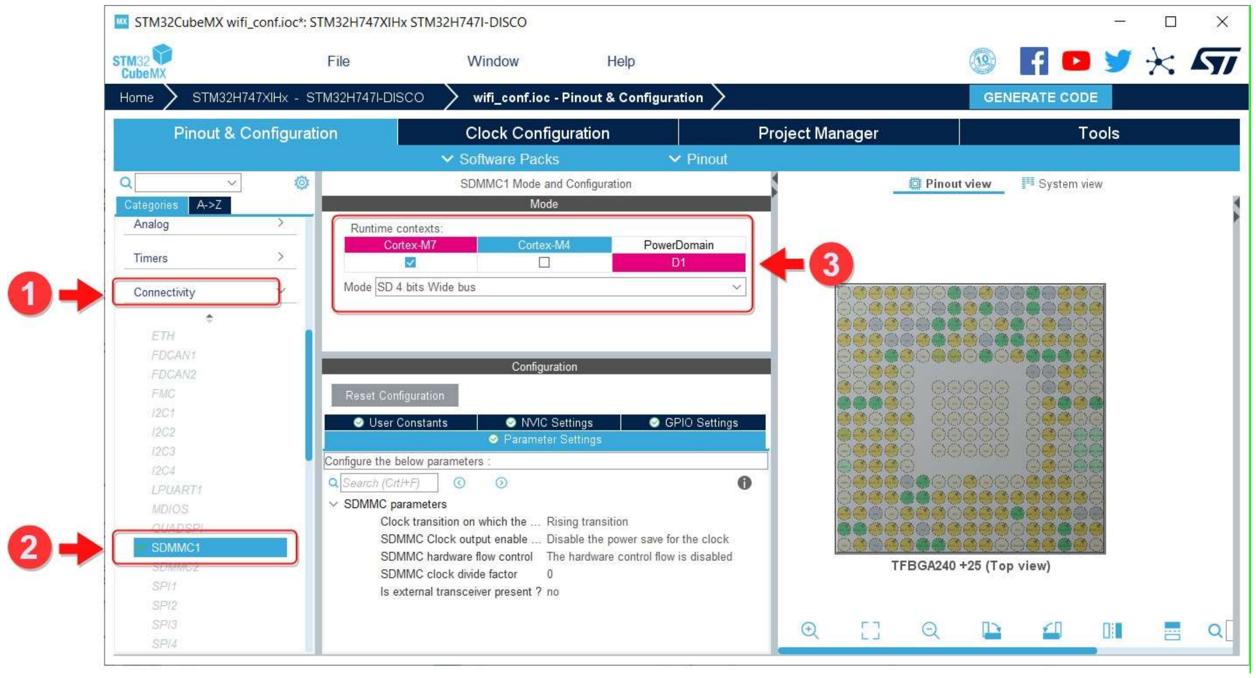
```
SD_HandleTypeDef SDHandle = { .Instance = SDMMC1 };
cy_rslt_t result = stm32_cypal_wifi_sdio_init(&SDHandle);
```

2. SDMMC Interrupt handler must be overwriting in application and call stm32_cyhal_sdio_irq_handler function:

```
void SDMMC1_IRQHandler(void)
{
    stm32_cyhal_sdio_irq_handler();
}
```

Make sure the SDMMC instance selected has its pins routed to the Infineon Connectivity device. The following steps should be done to enable/configure SDIO in STM32CubeMX:

1. Enable SDMMC block in **STM32CubeMX > Pinout & Configuration > Connectivity**.



SDMMC1 Mode and Configuration

Mode

Runtime contexts:

Cortex-M7	Cortex-M4	PowerDomain
✓	☐	D1

Mode: SD 4 bits Wide bus

Configuration

Reset Configuration

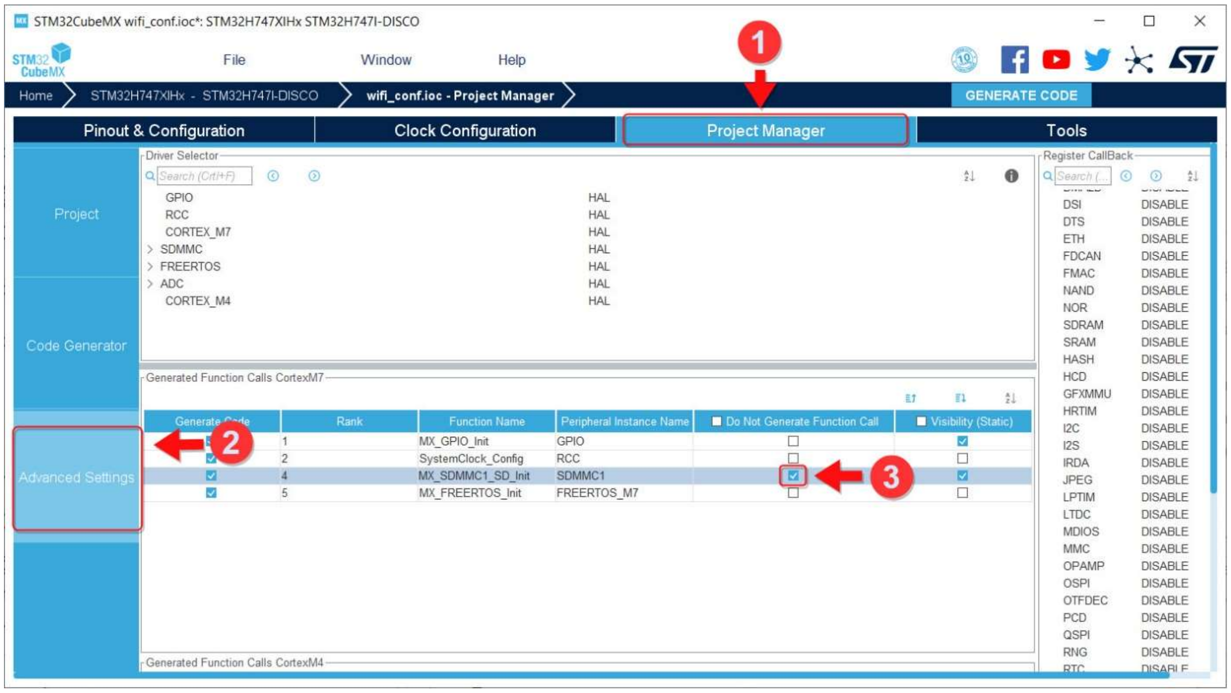
User Constants | NVIC Settings | GPIO Settings | Parameter Settings

Configure the below parameters :

SDMMC parameters

Clock transition on which the ...	Rising transition
SDMMC Clock output enable ...	Disable the power save for the clock
SDMMC hardware flow control	The hardware control flow is disabled
SDMMC clock divide factor	0
Is external transceiver present ?	no

2. Disable generation function call of SDMMC initialization (MX_SDMMC_SD_Init).



Driver Selector

GPIO	HAL
RCC	HAL
CORTEX_M7	HAL
SDMMC	HAL
FREERTOS	HAL
ADC	HAL
CORTEX_M4	HAL

Generated Function Calls CortexM7

Generate Code	Rank	Function Name	Peripheral Instance Name	Do Not Generate Function Call	Visibility (Static)
✓	1	MX_GPIO_Init	GPIO	☐	✓
✓	2	SystemClock_Config	RCC	☐	☐
✓	4	MX_SDMMC1_SD_Init	SDMMC1	✓	✓
✓	5	MX_FREERTOS_Init	FREERTOS_M7	☐	☐

Generated Function Calls CortexM4

Register CallBack

DSI	DISABLE
DTS	DISABLE
ETH	DISABLE
FDCAN	DISABLE
FMAC	DISABLE
NAND	DISABLE
NOR	DISABLE
SDRAM	DISABLE
SRAM	DISABLE
HASH	DISABLE
HCD	DISABLE
GFXMMU	DISABLE
HRTIM	DISABLE
I2C	DISABLE
I2S	DISABLE
IRDA	DISABLE
JPEG	DISABLE
LPTIM	DISABLE
LTDC	DISABLE
MDIOS	DISABLE
MMC	DISABLE
OPAMP	DISABLE
OSPI	DISABLE
OTFDEC	DISABLE
PCD	DISABLE
QSPI	DISABLE
RNG	DISABLE
RTC	DISABLE

Control Pins

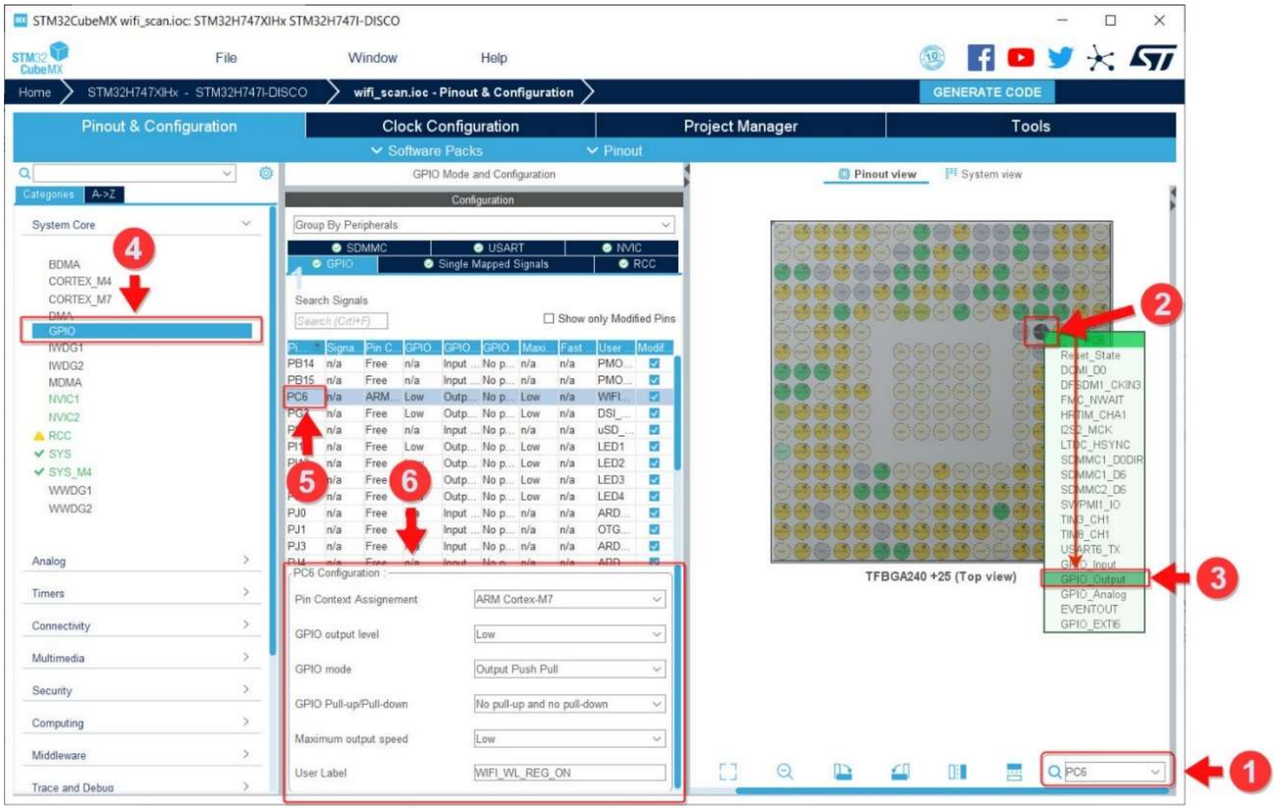
Infineon Connectivity devices require control lines to be connected to host MCU:

Line Name	FW Name	Description
WL_REG_ON	WIFI_WL_REG_ON	This is a power pin that shuts down the device WLAN section.
WL_HOST_WAKE	CYBSP_WIFI_HOST_WAKE	WLAN Host Wake: Active Low (OOB IRQ)
WL_DEV_WAKE		WLAN Device Wake

WL_REG_ON

A power pin that shuts down the device WLAN section. WL_REG_ON must be configured as output with following parameters:

GPIO Parameter	Value	Note
Direction	GPIO_Output	
Pin Context Assignment	ARM Cortex-M7	Assign to core, where Connectivity run.
GPIO output level	Low	
GPIO mode	Output Push Pull (PP)	
GPIO Pull-up/Pull-down	No pull-up and no pull-down	
Maximum output speed	Low	
User label	WIFI_WL_REG_ON	



Pi...	Signa...	Pin C...	GPIO...	GPIO...	GPIO...	Maxi...	Fast ...	User ...	Modif...
PB14	n/a	Free	n/a	Input ...	No p...	n/a	n/a	PMO...	✓
PB15	n/a	Free	n/a	Input ...	No p...	n/a	n/a	PMO...	✓
PC6	n/a	ARM...	Low	Outp...	No p...	Low	n/a	WIFI...	✓
PG[illegible]	n/a	Free	Low	Outp...	No p...	Low	n/a	DSI_...	✓
P[illegible]	n/a	Free	n/a	Input ...	No p...	n/a	n/a	uSD_...	✓
PI1[illegible]	n/a	Free	Low	Outp...	No p...	Low	n/a	LED1	✓
P[illegible]	n/a	Free	[illegible]	Outp...	No p...	Low	n/a	LED2	✓
[illegible]	n/a	Free	[illegible]	Outp...	No p...	Low	n/a	LED3	✓
[illegible]	n/a	Free	[illegible]	Outp...	No p...	Low	n/a	LED4	✓
PJ0	n/a	Free	[illegible]	Input ...	No p...	n/a	n/a	ARD...	✓
PJ1	n/a	Free	[illegible]	Input ...	No p...	n/a	n/a	OTG...	✓
PJ3	n/a	Free	[illegible]	Input ...	No p...	n/a	n/a	ARD...	✓
PJ4	n/a	Free	n/a	Input	No p...	n/a	n/a	ARD...	✓

PC6 Configuration :

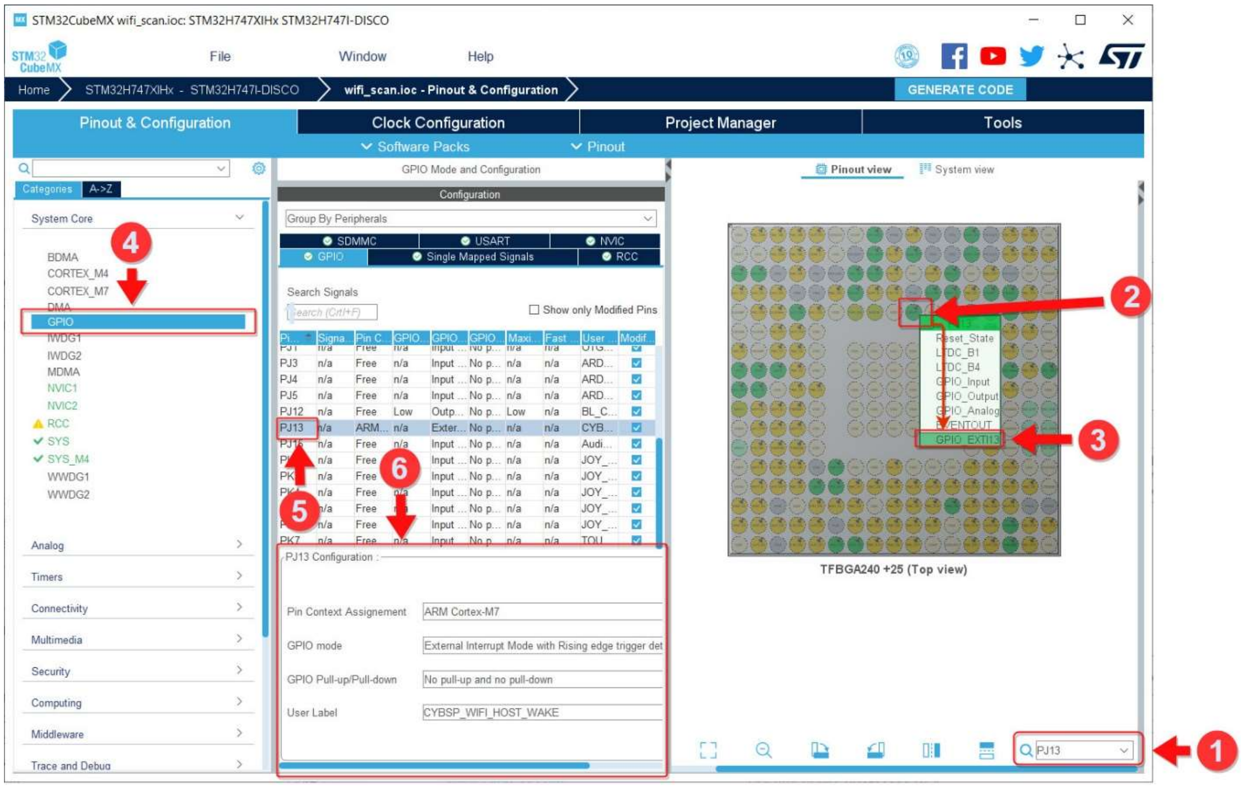
Pin Context Assignement	ARM Cortex-M7
GPIO output level	Low
GPIO mode	Output Push Pull
GPIO Pull-up/Pull-down	No pull-up and no pull-down
Maximum output speed	Low
User Label	WIFI_WL_REG_ON

WL_HOST_WAKE

Host MCU Wake signal from WLAN section. WL_HOST_WAKE must be configured in External Interrupt mode / EXTI with following parameters:

GPIO Parameter	Value	Note
Direction	GPIO_EXTI13	
Pin Context Assignment	ARM Cortex-M7	Assign to core, where Connectivity run.
GPIO mode	External Interrupt mode with Rising edge trigger detection	
GPIO Pull-up/Pull-down	No pull-up and no pull-down	
User label	CYBSP_WIFI_HOST_WAKE	
NVIC for EXTI	Enable	

1. Configure in STM32CubeMX:

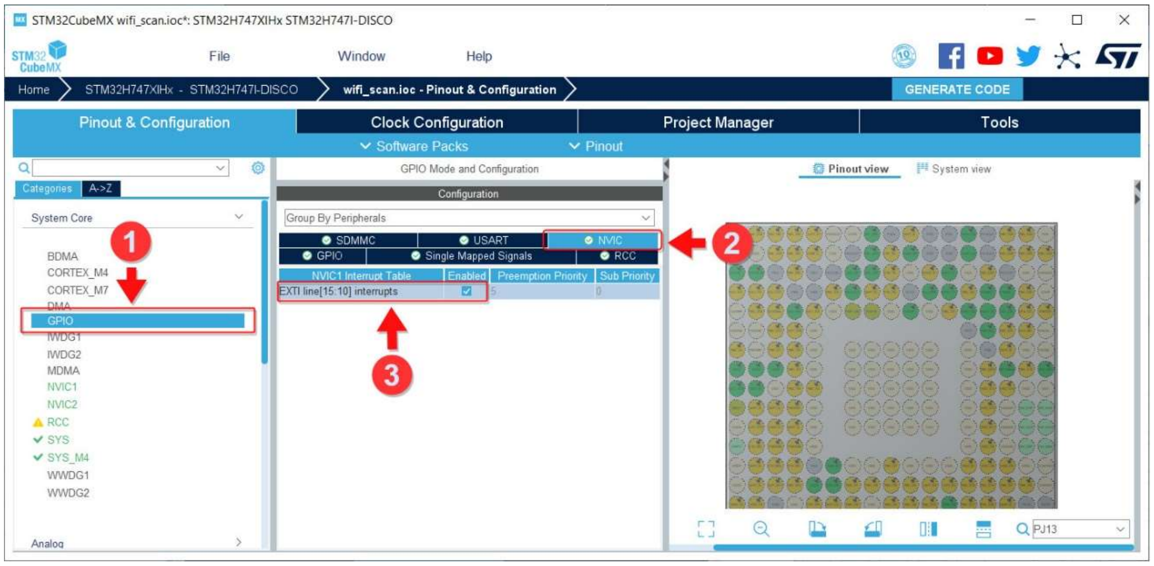


Pi...	Signa...	Pin C...	GPIO...	GPIO...	GPIO...	Maxi...	Fast ...	User ...	Modif...
PJ1	n/a	Free	n/a	Input ...	No p...	n/a	n/a	OTG...	✓
PJ3	n/a	Free	n/a	Input ...	No p...	n/a	n/a	ARD...	✓
PJ4	n/a	Free	n/a	Input ...	No p...	n/a	n/a	ARD...	✓
PJ5	n/a	Free	n/a	Input ...	No p...	n/a	n/a	ARD...	✓
PJ12	n/a	Free	Low	Outp...	No p...	Low	n/a	BL_C...	✓
PJ13	n/a	ARM...	n/a	Exter...	No p...	n/a	n/a	CYB...	✓
PJ1	n/a	Free	n/a	Input ...	No p...	n/a	n/a	Audi...	✓
P	n/a	Free		Input ...	No p...	n/a	n/a	JOY_...	✓
PK	n/a	Free		Input ...	No p...	n/a	n/a	JOY_...	✓
PK	n/a	Free	n/a	Input ...	No p...	n/a	n/a	JOY_...	✓
	n/a	Free		Input ...	No p...	n/a	n/a	JOY_...	✓
P	n/a	Free		Input ...	No p...	n/a	n/a	JOY_...	✓
PK7	n/a	Free	n/a	Input ...	No p...	n/a	n/a	TOU...	✓

PJ13 Configuration :

Pin Context Assignement	ARM Cortex-M7
GPIO mode	External Interrupt Mode with Rising edge trigger det
GPIO Pull-up/Pull-down	No pull-up and no pull-down
User Label	CYBSP_WIFI_HOST_WAKE

2. Enable NVIC interrupt for EXTI line:



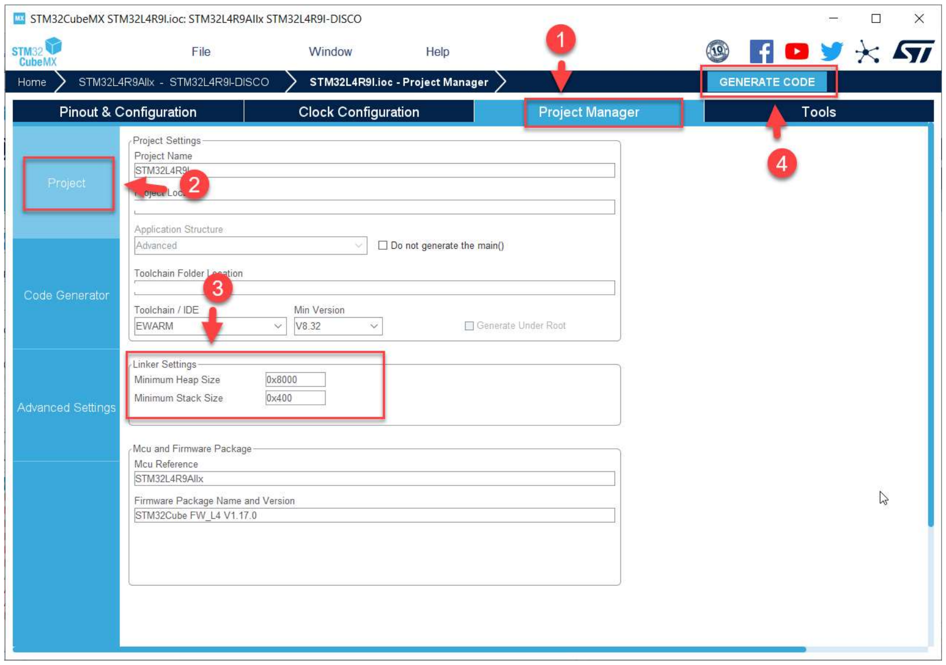
NVIC1 Interrupt Table	Enabled	Preemption Priority	Sub Priority
EXTI line[15:10] interrupts	✓	5	0

3. EXTI Callback handler must be overwriting in application and call stm32_cyhal_gpio_irq_handler function:

```
void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)
{
    stm32_cyhal_gpio_irq_handler(GPIO_Pin);
}
```

Heap and Stack Configuration

Configure Heap and Stack size required for the example app.



Project Settings
Project Name: STM32L4R9I
Project Location
Application Structure: Advanced
Do not generate the main()
Toolchain Folder Location
Toolchain / IDE: EWARM
Min Version: V8.32
Generate Under Root

Linker Settings
Minimum Heap Size: 0x8000
Minimum Stack Size: 0x400

Mcu and Firmware Package
Mcu Reference: STM32L4R9AIIx
Firmware Package Name and Version: STM32Cube FW_L4 V1.17.0

Generating the Code

1. After clicking **Generate Code**, copy the following files from existing examples provided along with the pack:
   - cybsp.h
   - lwipopts.h

   Location of these files in the pack:

   STM32Cube\Repository\Packs\Infineon\Connectivity-STM32\1.0.0\Projects\STM32H747I-DISCO\Applications\wifi_scan\Core\Inc

2. Add the following to the *FreeRTOSConfig.h* file:

```
/* Enable using CY_HAL for rtos-abstraction */
#define CY_USING_HAL
```

3. Update the following fields in the *cybsp.h* file to match the configurations done on Configuring Control pins section

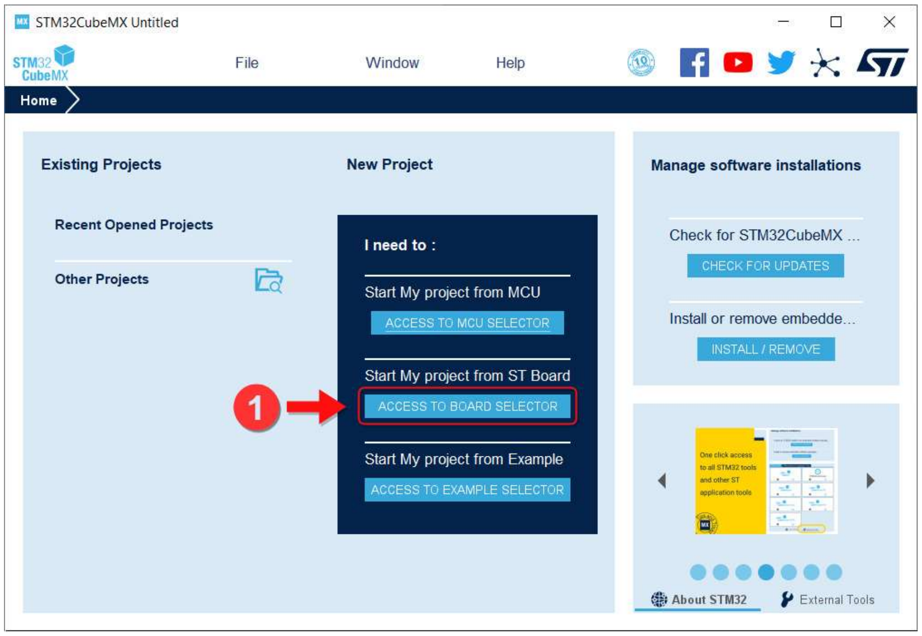
```
/** These names are explicitly referenced in the support libraries */
#define  CYBSP_WIFI_WL_REG_ON           ***
#define  CYBSP_WIFI_HOST_WAKE           ***
```

Example Project for Non-H7 MCU Boards

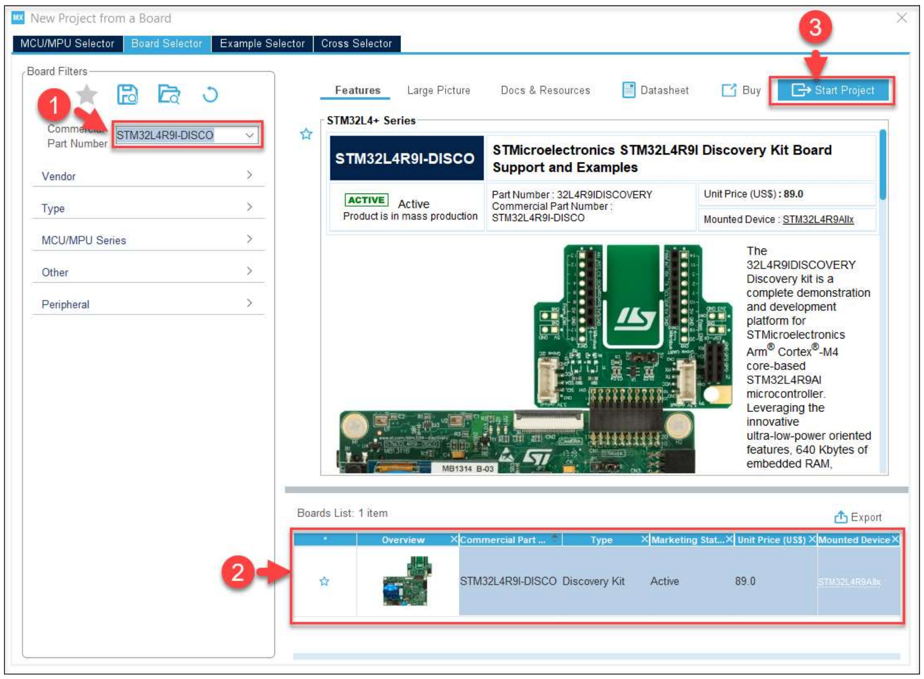
This Section explains how to create new example project for any non-H7 MCU boards using the expansion pack.

Creating a project

1. Start creating a project via the Access to Board Selector option.


STM32CubeMX Untitled
STM32 CubeMX
File
Window
Help
Home
Existing Projects
Recent Opened Projects
Other Projects
New Project
I need to :
Start My project from MCU
ACCESS TO MCU SELECTOR
Start My project from ST Board
ACCESS TO BOARD SELECTOR
Start My project from Example
ACCESS TO EXAMPLE SELECTOR
1
Manage software installations
Check for STM32CubeMX ...
CHECK FOR UPDATES
Install or remove embedde...
INSTALL / REMOVE
One click access to all STM32 tools and other ST application tools
About STM32
External Tools

2. Select a board like STM32L4R9I-DISCO
   - Enter/select the board number (STM32L4R9I-DISCO) and click on your selected board
   - Select Start Project.



STMicroelectronics STM32L4R9I Discovery Kit Board Support and Examples

Active
Product is in mass production

Part Number : 32L4R9IDISCOVERY
Commercial Part Number : STM32L4R9I-DISCO

Unit Price (US$) : 89.0
Mounted Device : STM32L4R9AIIx

The 32L4R9IDISCOVERY Discovery kit is a complete demonstration and development platform for STMicroelectronics Arm® Cortex®-M4 core-based STM32L4R9AI microcontroller. Leveraging the innovative ultra-low-power oriented features, 640 Kbytes of embedded RAM,

*	Overview	Commercial Part ...	Type	Marketing Stat...	Unit Price (US$)	Mounted Device
☆		STM32L4R9I-DISCO	Discovery Kit	Active	89.0	STM32L4R9AIIx

3. Select Software Components from STM32 Connectivity Expansion Pack
   - Select the **Pinout & Configuration** tab.
   - Select **Software Packs > Select Components**. This will show a list of the installed packs and their contents.
   - Platform/device is selected as CYW43438 for reference along with other components required for the Wi-Fi Example.
   - Enable Software components as required for the Wi-Fi Example.
   - Refer to Enable Software components from STM32 Connectivity Expansion Pack.

FreeRTOS Configuration

Follow same steps as mentioned in FreeRTOS Configuration.

Other Configurations

- Configure SDMMC (refer to SDIO).
- Configure Control Pins (refer to Control Pins).
- Configure Heap and Stack size (refer to Heap and Stack Configuration).

Changes required in PAL library

By default, Expansion pack supports only H7 MCU variant. The following changes are required to support other MCU variants.

- stm32_cyhal_common.h (Middlewares\Third_Party\Infineon_Wireless_Infineon\pal\targets\TARGET_STM32\Inc) folder

```
#elif defined (STM32L4R9xx)
    #define TARGET_STM32L4xx
#elif defined (TARGET_STM32L4xx)
    #include "stm32l4xx.h"
    #include "stm32l4xx_hal.h"
    #include "stm32l4xx_hal_def.h"
```

- stm32_cyhal_sdio_ex.h
  - Define STM32_RCC_PERIPHCLK_SDMMC based in the SDMMC* type supported by MCU variant.
  - For L4, it is RCC_PERIPHCLK_SDMMC1:

```
#elif defined (TARGET_STM32L4xx)
/* RCC clock for SDMMC */
  #define STM32_RCC_PERIPHCLK_SDMMC RCC_PERIPHCLK_SDMMC1
```

- stm32_cyhal_gpio.c

  Define “exti_table” based on the IRQn_Type defined in the stm32l4r9xx.h.

Changes required in main.c

To enable SDMMC to work with Wi-Fi connectivity device:

- The API call has to be added at initialization with appropriate handle passed in:

```
SD_HandleTypeDef SDHandle = { .Instance = SDMMC1 };
cy_rslt_t result = stm32_cypal_wifi_sdio_init(&SDHandle);
```

- SDMMC Interrupt handler must be overwriting in application and call stm32_cyhal_sdio_irq_handler function:

```
void SDMMC1_IRQHandler (void)
{
    stm32_cyhal_sdio_irq_handler();
}
```

- GPIO Interrupt handler must be overwriting in application and call stm32_cyhal_gpio_irq_handler function

```
void HAL_GPIO_EXTI_Callback (uint16_t GPIO_Pin)
{
    stm32_cyhal_gpio_irq_handler (GPIO_Pin);
}
```

DMA Configuration

PAL Library is currently supporting SDIO CMD53 transfer using Internal DMA Registers in SDMMC. If the MCU variant does not support IDMABASE, Use DMA Channels and Modify below functions to handle SDIO Command 53.

- cyhal_sdio_bulk_transfer
- stm32_cyhal_sdio_irq_handler

OctoSPI Configuration

STM32L4R9I-DISCO has external flash memory available and can be used for placing the Wi-Fi Firmware.

- Linker script (*.ld) change to address external memory:

```
OSPI      (rx)   : ORIGIN = 0x90000000,     LENGTH = 131072K
```

- Add Linker script with section name defining where WiFi Firmware needs to be placed:

```
.whd_fw :
{
__whd_fw_start = .;
KEEP(*(.whd_fw))
__whd_fw_end = .;
} > OSPI
```

- Add Preprocessor macro name:

```
CY_STORAGE_WIFI_DATA=".whd_fw"
```