

How to use the P2P - SPIRIT1 X-CUBE-SUBG1 Sub-1 GHz RF communication software expansion for STM32Cube

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Introduction

X-CUBE-SUBG1 - Sub-1 GHz RF communication software expansion for STM32Cube is [here](#), at the end of the page.

In this manual we explain the way to use the example **P2P** (point-to-point) that is present in the package **X-CUBE-SUBG1**.

For do the test we use the [NUCLEO-L053R8](#) and the expansion board [X-NUCLEO-IDS01A4](#) (868MHz).

For use the **P2P** example are necessary two [NUCLEO-L053R8](#) and two [X-NUCLEO-IDS01A4](#).

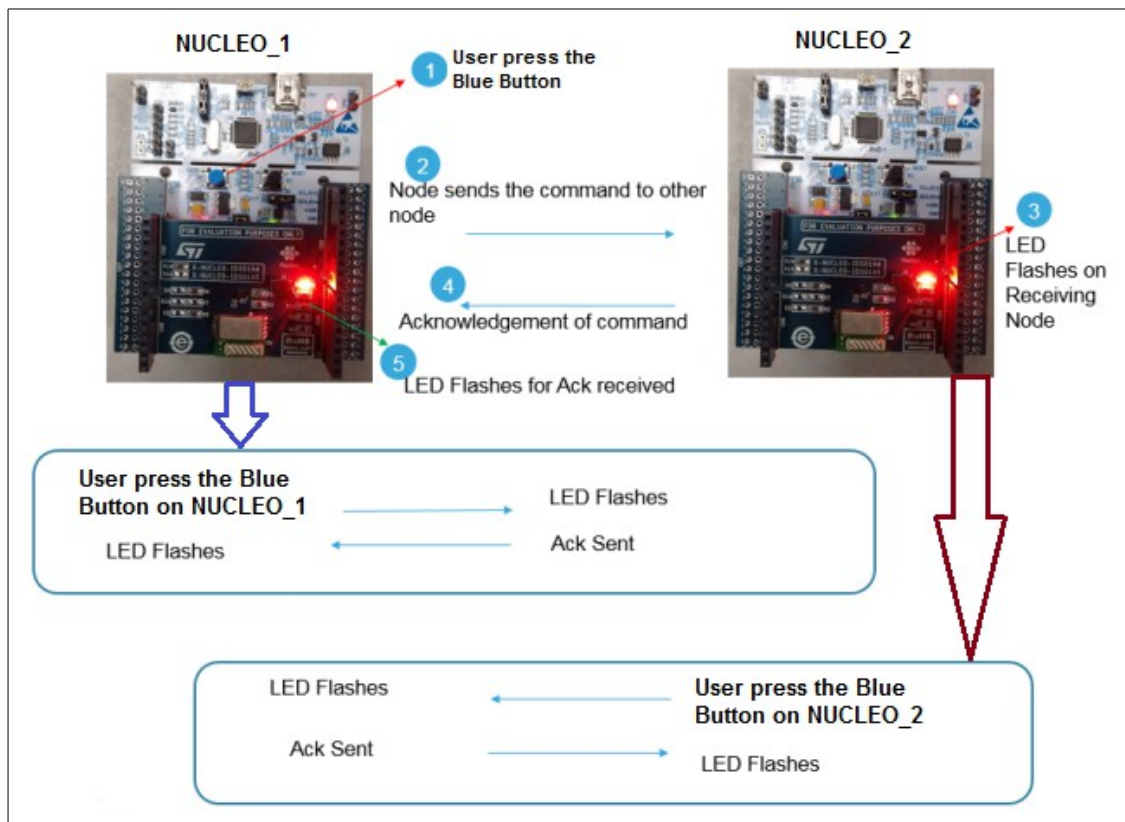
How P2P works

In the P2P example, the two node, working in the same way.

If you press the Blue Button on the NUCLEO_1 it send a message to the NUCLEO_2.

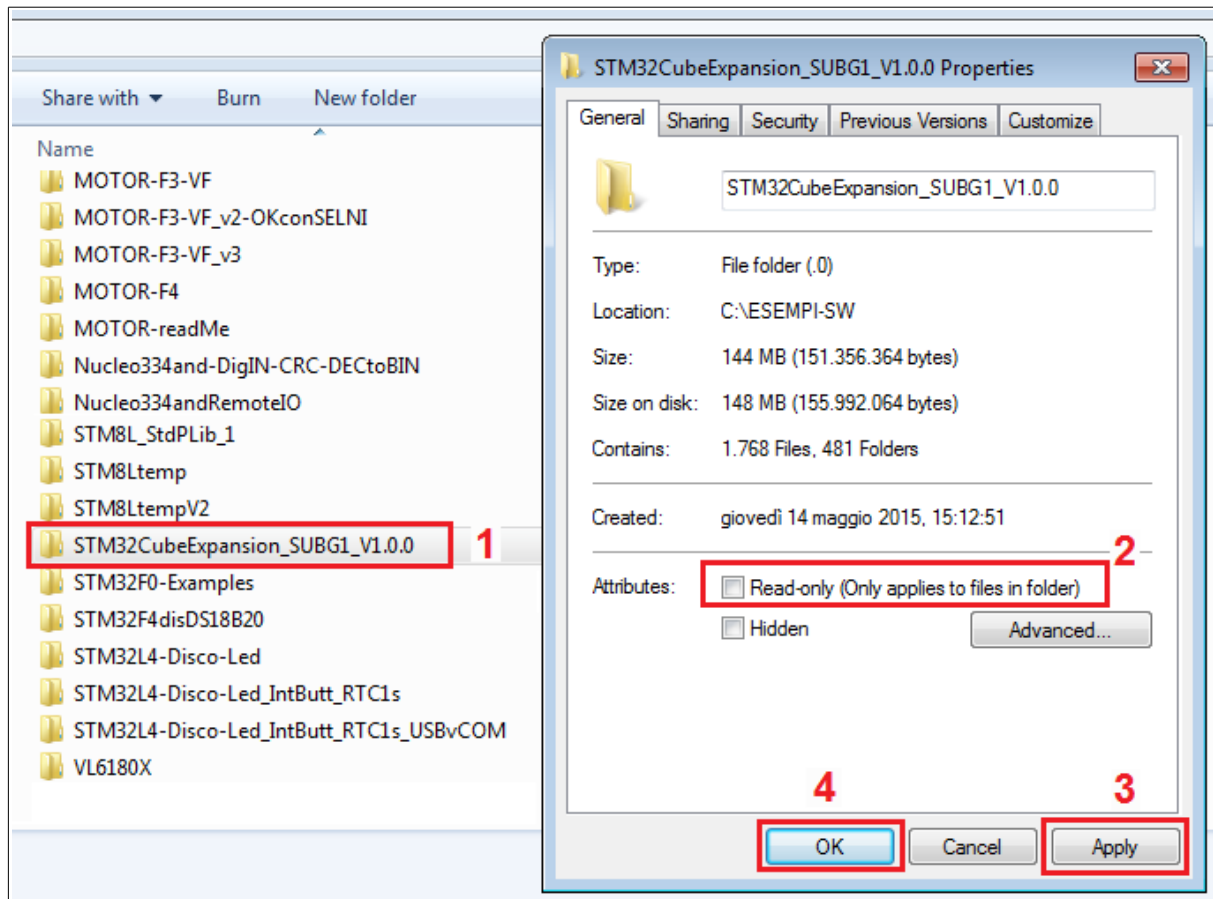
If NUCLEO_2 receives the transmission, flashes a LED and send back an ACK.

At this point, on the NUCLEO_1, flashes a LED that means that NUCLEO_2 has received the message sent before. See the diagram below.



How to use the P2P SW

After downloaded the SW, unzip it where you want but remember to remove the protection of the directory, see below.



C Compiler - IDE

We want to use [KEIL](#) because is free for [STM32F0xx](#) and [STM32L0xx](#).

NUCLEO board and Working directory

We want to use the [NUCLEO-L053R8](#), the related **P2P** example is present in this directory:

```
C:\...\STM32CubeExpansion_SUBG1_V1.0.0\Projects\Multi\Examples\P2P_demo\MDK-ARM\STM32L053R8-Nucleo
```

How to open the project

For open the project double click on the: **Project.uvprojx**

Test if all is OK

First, for test if all is OK, compile the project.

You must see something like below, this means that all is OK.

```
Build Output
Program Size: Code=31256 RO-data=792 RW-data=344 ZI-data=1936
FromELF: creating hex file...
".\Spirit1_Point-To-Point\Spirit1_Point-To-Point.axf" - 0 Error(s), 0 Warning(s).
Build Time Elapsed: 00:00:32
```

Important file for the configurations

The file:

spirit1_appli.h

contain the SPIRIT1 parameters, that can be modified by the user according to the application.

For a deep description see this [manual](#) (UM1904).

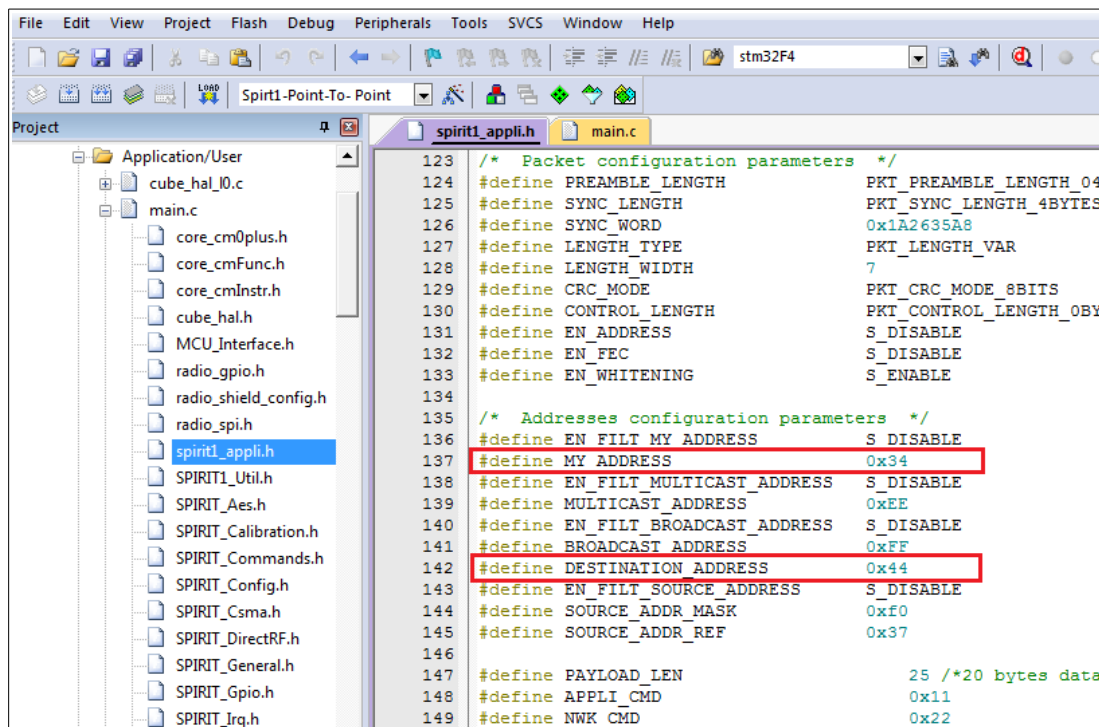
We are interest on this two define, see below:

#define MY_ADDRESS 0x34

#define DESTINATION_ADDRESS 0x44

MY_ADDRESS is the address of the transmitter

DESTINATION_ADDRESS is the address of the receiver



```
File Edit View Project Flash Debug Peripherals Tools SVCS Window Help
stm32F4
Spirit1-Point-To-Point
Project
Application/User
  cube_hal_i0.c
  main.c
  core_cm0plus.h
  core_cmFunc.h
  core_cmInstr.h
  cube_hal.h
  MCU_Interface.h
  radio_gpio.h
  radio_shield_config.h
  radio_spi.h
  spirit1_appli.h
  SPIRIT1_Util.h
  SPIRIT1_Aes.h
  SPIRIT1_Calibration.h
  SPIRIT1_Commands.h
  SPIRIT1_Config.h
  SPIRIT1_Csma.h
  SPIRIT1_DirectRF.h
  SPIRIT1_General.h
  SPIRIT1_Gpio.h
  SPIRIT1_Irq.h
123 /* Packet configuration parameters */
124 #define PREAMBLE_LENGTH PKT_PREAMBLE_LENGTH_04
125 #define SYNC_LENGTH PKT_SYNC_LENGTH_4BYTES
126 #define SYNC_WORD 0x1A2635A8
127 #define LENGTH_TYPE PKT_LENGTH_VAR
128 #define LENGTH_WIDTH 7
129 #define CRC_MODE PKT_CRC_MODE_8BITS
130 #define CONTROL_LENGTH PKT_CONTROL_LENGTH_0BY
131 #define EN_ADDRESS S_DISABLE
132 #define EN_FEC S_DISABLE
133 #define EN_WHITENING S_ENABLE
134
135 /* Addresses configuration parameters */
136 #define EN_FILTER_MY_ADDRESS S_DISABLE
137 #define MY_ADDRESS 0x34
138 #define EN_FILTER_MULTICAST_ADDRESS S_DISABLE
139 #define MULTICAST_ADDRESS 0xEE
140 #define EN_FILTER_BROADCAST_ADDRESS S_DISABLE
141 #define BROADCAST_ADDRESS 0xFF
142 #define DESTINATION_ADDRESS 0x44
143 #define EN_FILTER_SOURCE_ADDRESS S_DISABLE
144 #define SOURCE_ADDR_MASK 0xF0
145 #define SOURCE_ADDR_REF 0x37
146
147 #define PAYLOAD_LEN 25 /*20 bytes data
148 #define APPLI_CMD 0x11
149 #define NWK_CMD 0x22
```

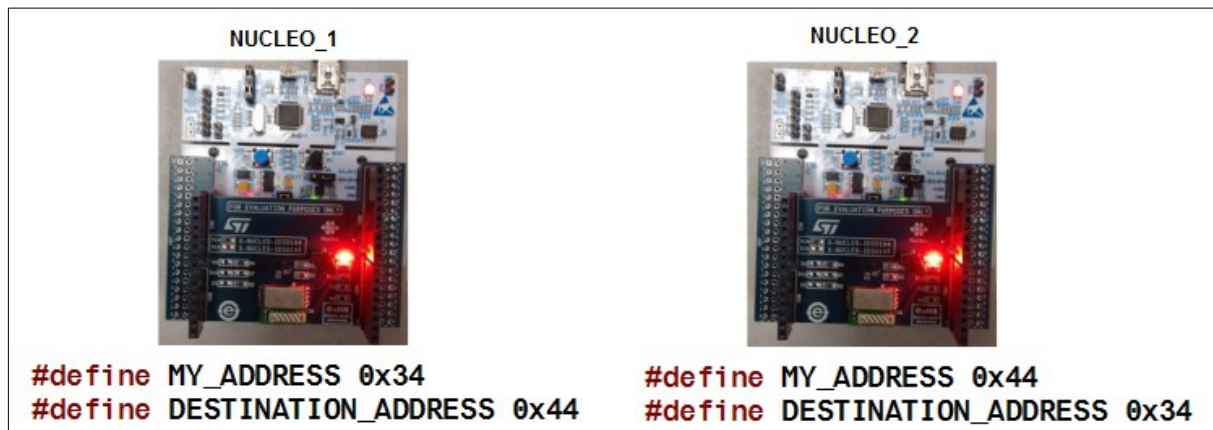
The changes that are necessary for configure the two NUCLEO-L053R8

It is clear that we must program the **first** NUCLEO-L053R8 with this two define:

```
#define MY_ADDRESS 0x34  
#define DESTINATION_ADDRESS 0x44
```

and program the **second** NUCLEO-L053R8 with this two define that are inverted respect the first one:

```
#define MY_ADDRESS 0x44  
#define DESTINATION_ADDRESS 0x34
```



Now you are ready to test the P2P communication.

SPiRiT1 packet handler overview

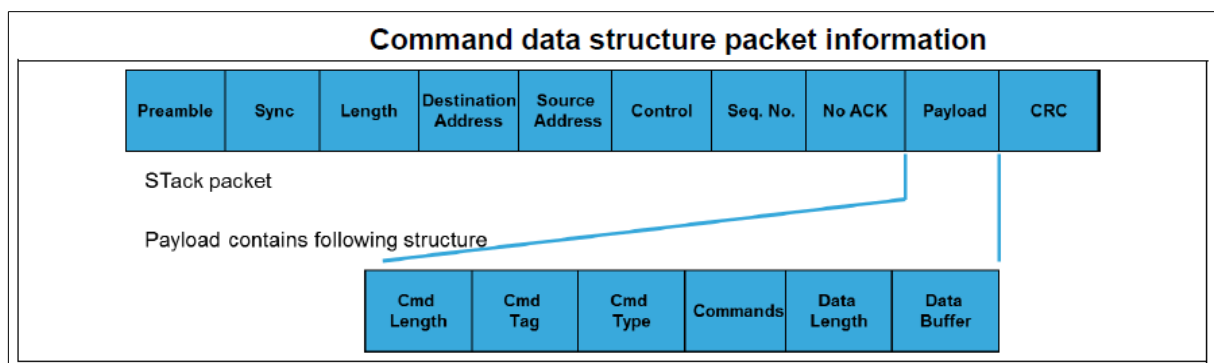
Before on-air transmission, raw data is arranged in a packet structure. The SPiRiT1 offers a highly flexible and fully programmable packet: the structure of the packet, the number, the type, and the dimension of the fields inside the packet depend on one of the possible configuration settings.

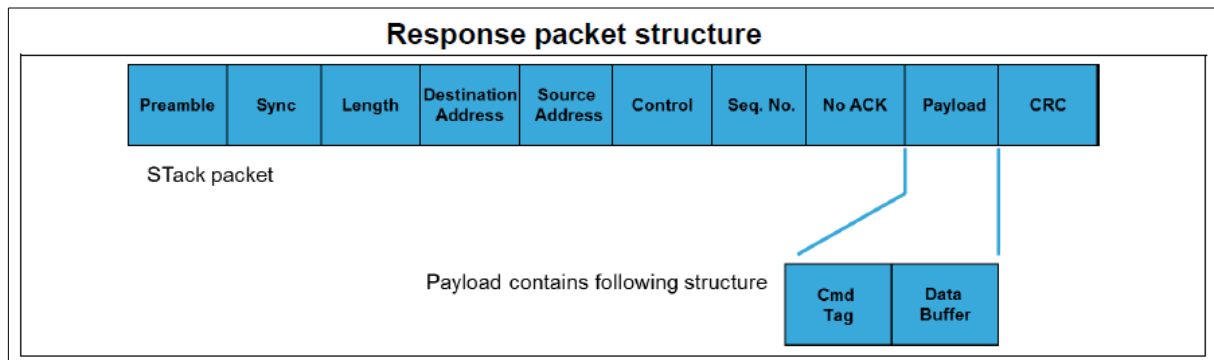
Packet handler feature comparison			
Features	STack	WM-Bus	Basic
Destination address filtering	Yes	No	Yes
Broadcast and multicast addressing	Yes	No	Yes
Source address filtering	Yes	No	No
Custom filtering	Yes	No	Yes
CRC filtering	Yes	No	Yes
⁽¹⁾ LLP: automatic acknowledgment	Yes	No	No
⁽¹⁾ LLP: automatic acknowledgment with piggybacking	Yes	No	No
⁽¹⁾ LLP: automatic retransmission	Yes	No	No

1. Link layer protocol

A detailed description of the SPiRiT1 embedded packet handler is given in the SPiRiT1 datasheet.

Since the P2P communication requires the destination address of the receiving node, the **P2P demo is based on STack and Basic packet handlers.**





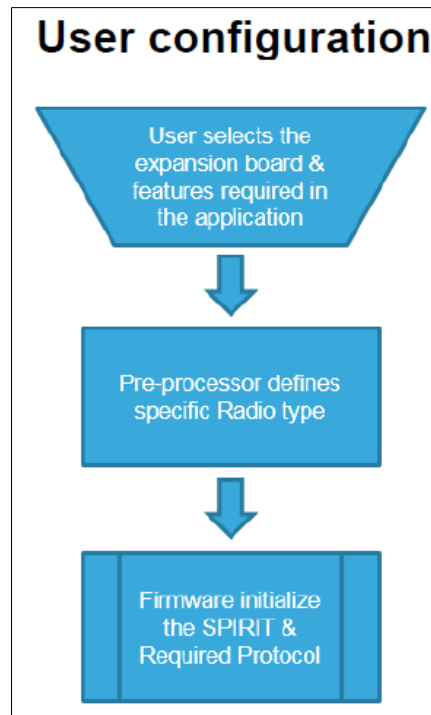
User configuration

The file:

spirit1_appli.h

contain the SPIRIT1 parameters, that can be modified by the user according to the application.

For a deep description see this [manual](#) (UM1904).



Selecting SPIRIT1 expansion board, see below.

```
50
51 /* Platform definition : Uncomment the used Shield */
52
53 #define X_NUCLEO_IDS01A4
54 // #define X_NUCLEO_IDS01A5
55
56 #if defined(X_NUCLEO_IDS01A4)
57     #define USE_SPIRIT1_868MHz
58 #elif defined(X_NUCLEO_IDS01A5)
59     #define USE_SPIRIT1_915MHz
60 #else
61 #error SPIRIT1 Expansion Board is undefined or unsupported
62 #endif
```


Radio configuration parameters, see below.

```

94  /* Radio configuration parameters */
95  #define XTAL_OFFSET_PPM          0
96  #define INFINITE_TIMEOUT        0.0
97
98  #ifndef USE_SPIRIT1_433MHz
99  #define BASE_FREQUENCY           433.0e6
100 #endif
101
102 #ifndef USE_SPIRIT1_868MHz
103 #define BASE_FREQUENCY           868.0e6
104 #endif
105
106 #ifndef USE_SPIRIT1_915MHz
107 #define BASE_FREQUENCY           915.0e6
108 #endif
109
110 #define CHANNEL_SPACE             20e3
111 #define CHANNEL_NUMBER           0
112 #define MODULATION_SELECT        FSK
113 #define DATARATE                 38400
114 #define FREQ_DEVIATION           20e3
115 #define BANDWIDTH                100E3
116
117 #define POWER_DBM                11.6
118 #define POWER_INDEX              7
119 #define RECEIVE_TIMEOUT          2000.0 /*change the value for required timeout period*/
120
121 #define RSSI_THRESHOLD            -120

```

Packet configuration parameters, see below.

```

123 /* Packet configuration parameters */
124 #define PREAMBLE_LENGTH          PKT_PREAMBLE_LENGTH_04BYTES
125 #define SYNC_LENGTH              PKT_SYNC_LENGTH_4BYTES
126 #define SYNC_WORD                0x1A2635A8
127 #define LENGTH_TYPE              PKT_LENGTH_VAR
128 #define LENGTH_WIDTH             7
129 #define CRC_MODE                 PKT_CRC_MODE_8BITS
130 #define CONTROL_LENGTH           PKT_CONTROL_LENGTH_0BYTES
131 #define EN_ADDRESS               S_DISABLE
132 #define EN_FEC                   S_DISABLE
133 #define EN_WHITENING             S_ENABLE

```

Setting address of the nodes, see below.

```

135 /* Addresses configuration parameters */
136 #define EN_FILT_MY_ADDRESS        S_DISABLE
137 #define MY_ADDRESS               0x34
138 #define EN_FILT_MULTICAST_ADDRESS S_DISABLE
139 #define MULTICAST_ADDRESS        0xEE
140 #define EN_FILT_BROADCAST_ADDRESS S_DISABLE
141 #define BROADCAST_ADDRESS        0xFF
142 #define DESTINATION_ADDRESS      0x44
143 #define EN_FILT_SOURCE_ADDRESS   S_DISABLE
144 #define SOURCE_ADDR_MASK         0xF0
145 #define SOURCE_ADDR_REF          0x37

```

Setting user defined commands, see below.

```
147 // Setting user defined commands
148 #define PAYLOAD_LEN          25 /*20 bytes data+tag+cmd_type+cmd+cmdlen+datalen*/
149 #define APPLI_CMD            0x11
150 #define NWK_CMD              0x22
151 #define LED_TOGGLE           0xff
152 #define ACK_OK               0x01
153 #define MAX_BUFFER_LEN      96
154 #define TIME_TO_EXIT_RX     3000
155 #define DELAY_RX_LED_TOGGLE  200
156 #define DELAY_TX_LED_GLOW    1000
157 #define LPM_WAKEUP_TIME     100
158 #define DATA_SEND_TIME     30
159
```

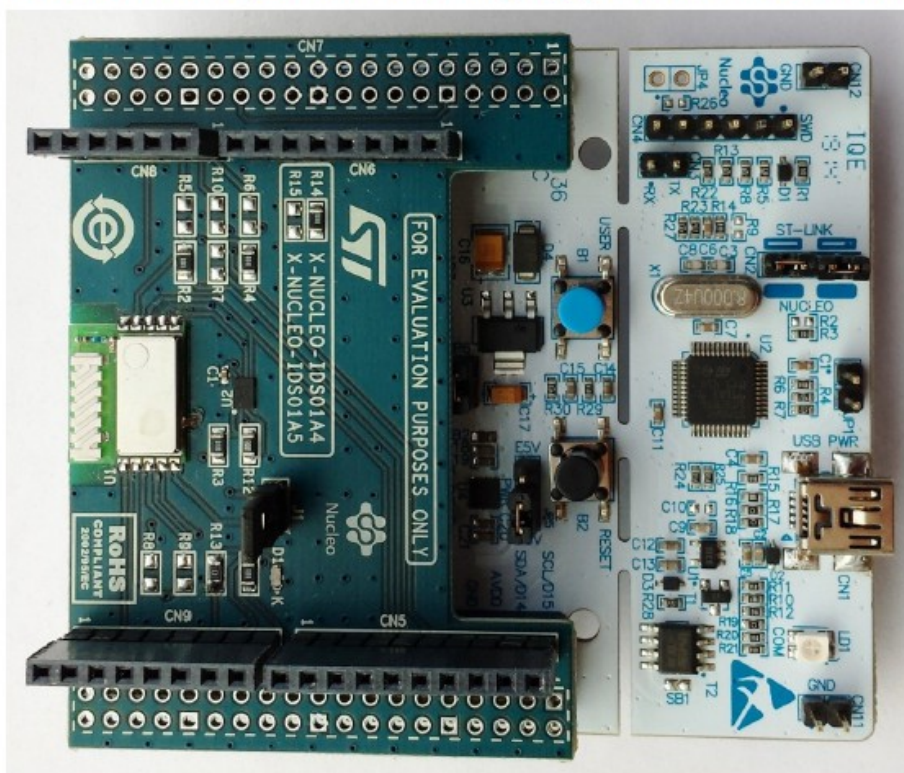
Hardware description

The **X-NUCLEO-IDS01Ax** is a demonstration kit for evaluating the features and capabilities of **SPSGRF** module (available at 868 MHz or 915 MHz), based on the **SPIRIT1** low data rate, low power sub-1 GHz transceiver device.

The expansion board includes on board **SPI EEPROM** for saving parameters and user interface LED.

For more info see [this](#) manual (UM1872).

X-NUCLEO-IDS1Ax expansion board plugged to STM32 Nucleo board



Acronyms and abbreviations

Acronym	Description
AMR	Automatic meter reading
BSP	Board support package. Generally referred to the hardware interface layer.
EEPROM	Electrically erasable programmable read only memory
GHz	Giga Hertz
GUI	Graphical user interface
HAL	Hardware abstraction layer
LED	Light emitting diode
MCU	Microcontroller unit
P2P	Point-to-Point communication
RF	Radio frequency communication
SPI	Serial peripheral interface
USB	Universal serial bus
WM-Bus	Wireless metering bus
WSN	Wireless sensors network