

ISP2053-AX

Application note AN220301



Long Range Demo with ISP2053-AX module



Scope

This application note describes a demo that can be used to easily test the Bluetooth 5.2 Long Range feature with the ISP2053-AX module. The demo was inspired by the demo available on the following link related to the nRF5340dk Zephyr sample:

https://developer.nordicsemi.com/nRF_Connect_SDK/doc/latest/nrf/samples/bluetooth/central_and_peripheral_hr/README.html

Contents

1. Recommended Documentation.....	2
1.1. Nordic Semiconductor Documents.....	2
1.2. Software Dev Kits.....	2
1.3. Other Insight SiP documents.....	2
2. Hardware Content	3
2.1. Peripheral.....	3
2.2. Central.....	4
3. Test setup	5
3.1. Application Development	5
3.2. Parameters configuration	7
3.3. Hardware Setup.....	8
4. Test condition and results	9
5. About this project	11



1. Recommended Documentation

The following Nordic Semiconductor documents and Software Dev Kits are required to understand the complete setup and programming methods.

1.1. Nordic Semiconductor Documents

- nRF5340 Development kit User Guide, hardware section should be partially ignored – Insight SiP development kit hardware replaces Nordic Semiconductor hardware.
- nRF5340 Product Specification – make sure you have the last document version updated.
- nRF Connect SDK for software development on nRF53 Series.

To access documentation and information, go to:

- The official Nordic Semiconductor website: <http://www.nordicsemi.com>
- The Nordic Semiconductor Infocenter is a “comprehensive library” containing technical documentation: <http://infocenter.nordicsemi.com/index.jsp>
- Find documentation about nRF Connect SDK here: https://developer.nordicsemi.com/nRF_Connect_SDK/doc/latest/nrf/index.html
- Ask any Nordic related question and get help: <https://devzone.nordicsemi.com/f/nordic-q-a>
- For any question, you can also open a ticket here: <https://devzone.nordicsemi.com/support/add>

1.2. Software Dev Kits

- nRF Connect SDK v1.9.1 which includes Zephyr based source code as well as SES project files.
- nRF Connect for Desktop: <https://www.nordicsemi.com/Products/Development-tools/nRF-Connect-for-desktop>
- nRF Programmer tool
- nRF Toolchain Manager tool

1.3. Other Insight SiP documents

To complete the above, following documents are available on Insight SiP website or/and on request:

- AN220301 App Note – this document.
- AN211001 App Note – Use of ISP2053 Development Board App Note.
- BLE module data sheet.
- BLE Test Board Schematic.
- ISPI30603 Interface Board Schematic.

2. Hardware Content

The demo requires to have two devices to measure the range between them: the central and the peripheral. Since the measurements are taken outside, a system based on a LED visualization has been setup, allowing to know if the devices are always connected.

2.1. Peripheral

For the peripheral, the hardware content is the following:

- 1 x ISP2053-AX Test Board
- 1 x ISPI30603 Interface Board
- 1 x external battery
- 1 x FPC jumper cable 22 pin
- 1 x FPC jumper cable 14 pin
- 1 x FPC jumper cable 10 pin
- 1 x USB cable
- 1 x Computer for programming

For more details of each component, please refer to the App Note "Use of ISP2053 Development Board AN211001".

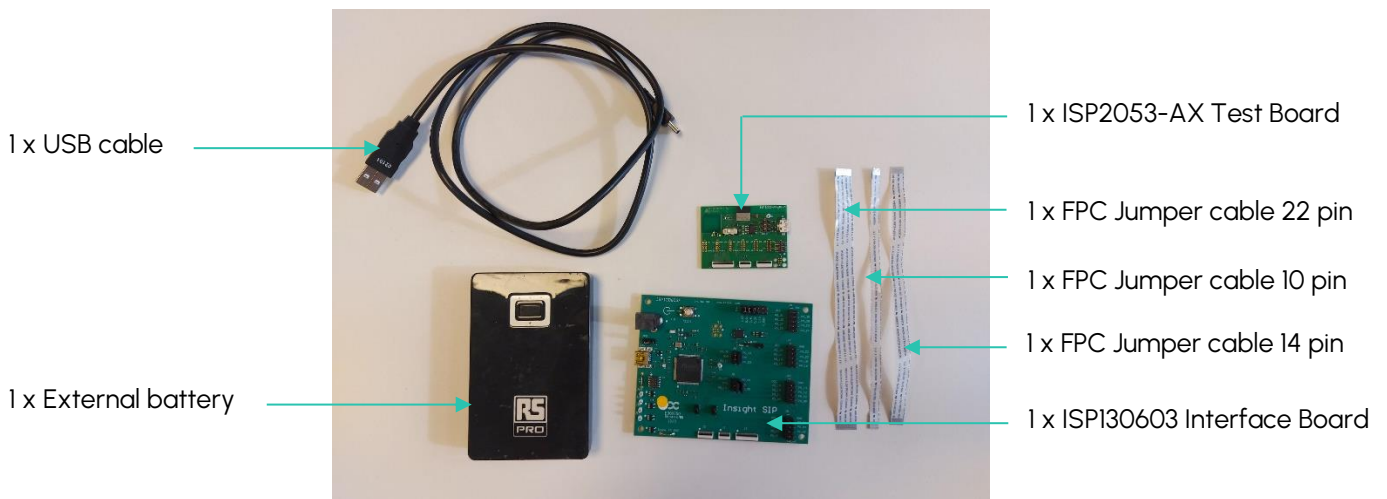


Figure 1 - Peripheral hardware content

2.2. Central

For the central, the hardware content is the following:

- 1 x ISP2053-AX Test Board
- 1 x ISPI30603 Interface Board
- 1 x External battery
- 1 x FPC jumper cable 22 pin
- 1 x FPC jumper cable 14 pin
- 1 x FPC jumper cable 10 pin
- 1 x USB cable
- 1 x LED Test Board (you must have your own board)
- 1 x cable to connect GPIO LED
- 1 x computer for programming

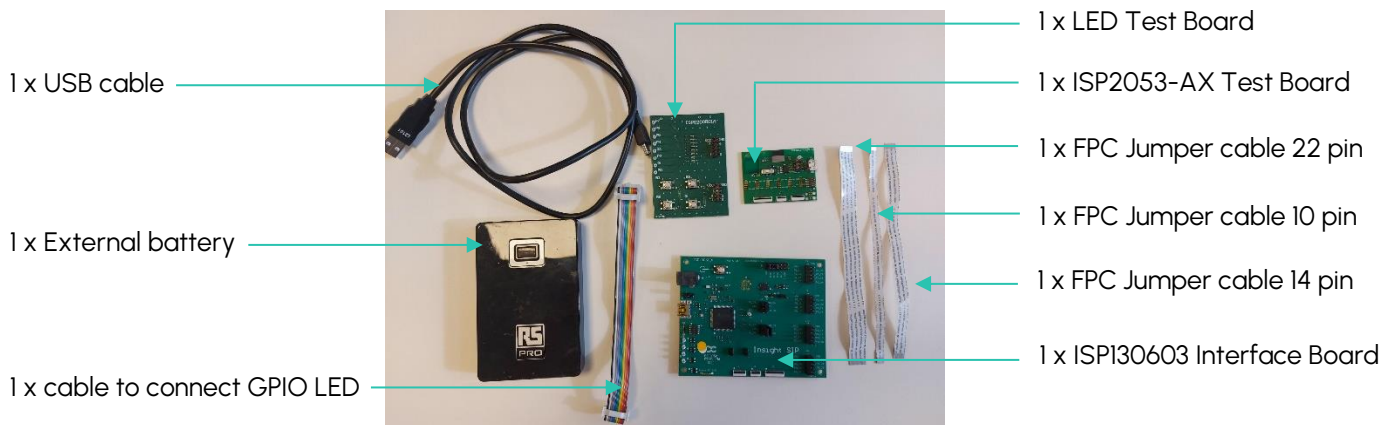


Figure 2 - Central hardware contents

3. Test setup

3.1. Application Development

The demo uses the Zephyr RTOS with nRF SDK 1.9.1.

For the installation of nRF Connect Desktop, Programmer, Toolchain manager tools and the SDK, please refer to the App Note "Use of ISP2053 Development Board AN211001".

The application is based on the "peripheral_hr_coded" and "central_hr_coded" examples found in the SDK of Nordic. It is rewritten to control a LED on the central side. This LED stays on while the central is connected to the peripheral. The application is also rewritten for the two devices to modify the Bluetooth parameters (rate and transmit power).

To open the project and modify it, follow the next steps:
When Segger is open, click on *file -> Open nRF Connect SDK Projects...*:

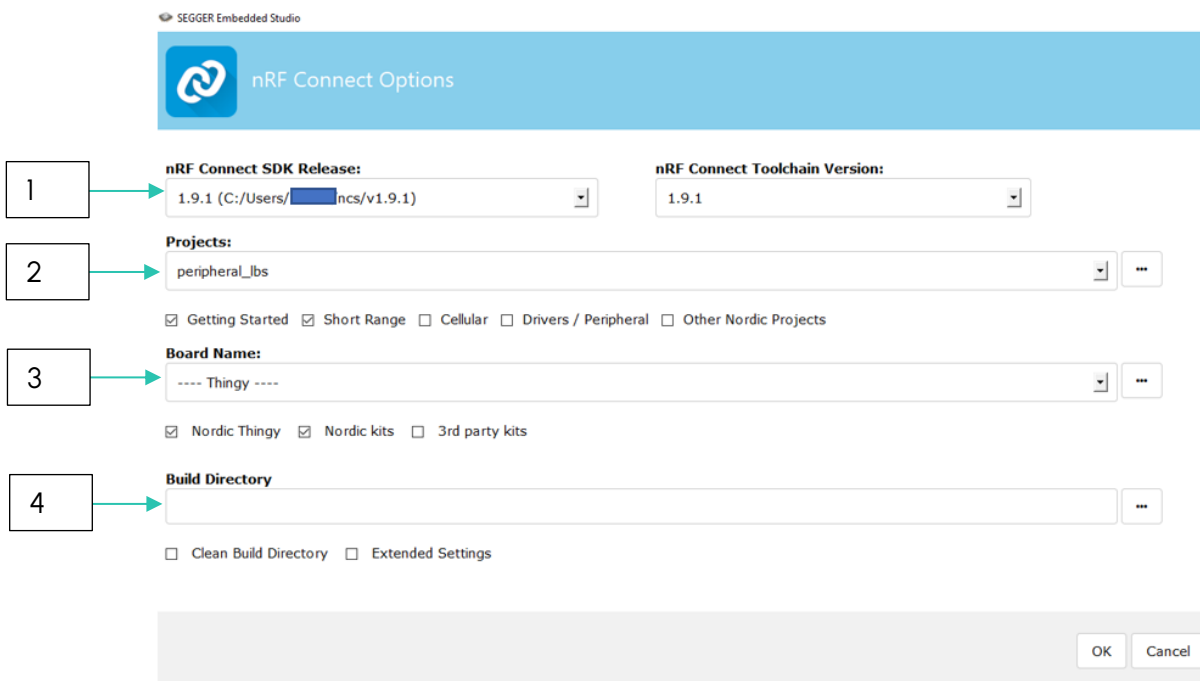


Figure 3 - Open a project on nRF SDK v1.9.1

1. Where the SDK directory was installed.
2. Projects examples that exist on the SDK directory. You will select the desired project from here.
3. Board selection. For ISP1507-AX, you need to select nRF5340dk_nRF5340_cpuapp.
4. Where is the build folder for .hex files to program the ISP1507-AX.

To select the project example, click on Projects case, and browse the `ncs/v1.9.1` directory to select "peripheral_hr_coded" or "central_hr_coded" project directory:

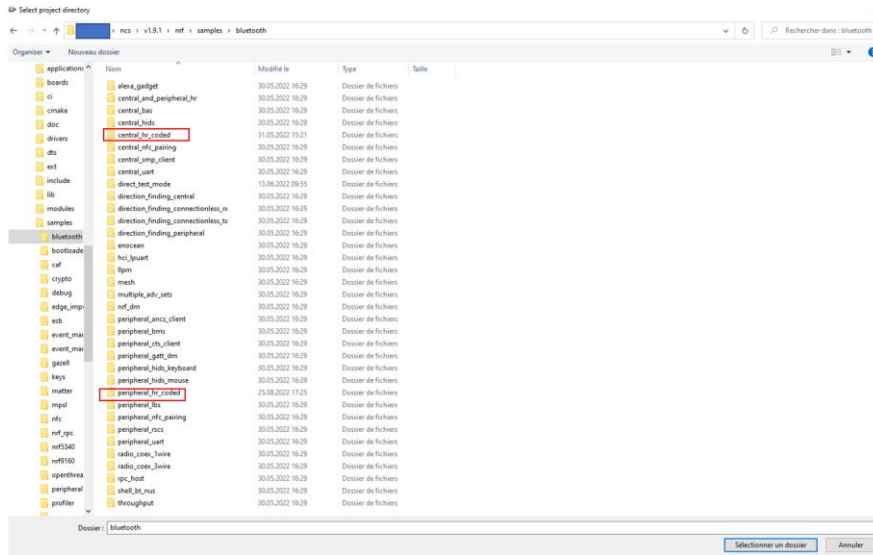


Figure 4 - Select project example

Then, select the board and watch your build directory (this is where you will pick up the .hex files for programming):

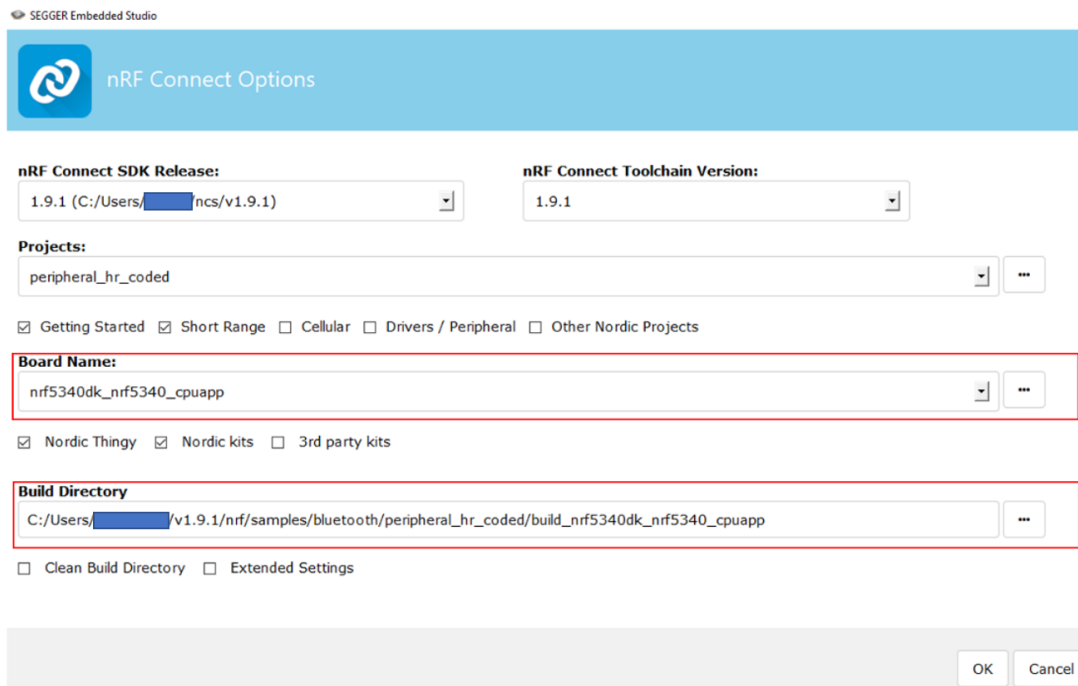


Figure 5 - Board selection and build directory

Click on Ok, no error must appear.

Modify the code for your application.

If it's complete, you can build the solution. On Segger *Build* -> *Build Zephyr/Zephyr/merged.hex*

Then two .hex files are generated and are found on the Build Directory. Indeed, the nRF5340 contains two CPUs (refer to the App Note "Use of ISP2053 Development Board AN211001").

If no error appears during building, you can program the central and the peripheral devices.

For programming, follow the steps:

a) For the two devices: connect the ISP130603 Interface Board to the ISP2053-AX test Board with FPC jumper cables and the ISP130603 Interface Board to the computer (refer to the App Note "Use of ISP2053 Development Board AN211001").

b) For the peripheral: open the Programmer tool, program the two .hex files that you can find here:
- one on "*peripheral_hr_coded/build_nrf5340dk_nrf5340_cpuapp/hci_rpmsg/zephyr/zephyr.hex*"
- and the other on "*peripheral_hr_coded/build_nrf5340dk_nrf5340_cpuapp/zephyr/zephyr.hex*".
Then erase and write.

c) For the central: open the Programmer tool, program the two .hex files that you can find here :
- one on "*central_hr_coded/build_nrf5340dk_nrf5340_cpuapp/hci_rpmsg/zephyr/zephyr.hex*"
- and the other on "*central_hr_coded/build_nrf5340dk_nrf5340_cpuapp/zephyr/zephyr.hex*".
Then erase and write.

3.2. Parameters configuration

The default parameters for this demo are the following:

Peripheral

- Coded Phy (Rate: 125 kbps)
- Transmit power: 3 dBm
- Connectable advertising

Central

- Coded Phy (Rate: 125 kbps)
- Transmit power: 3 dBm
- Scanning
- Output: GPIO LED.

3.3. Hardware Setup

For the peripheral:



Figure 6 - Peripheral hardware setup

1. Connect the USB cable from the Interface Board ISP130603 to the external battery
2. Connect the BLE Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables.
3. Fix the boards and the battery on the surface box.
4. Fix the box on the tripod.

For the central:



Figure 7 - Central hardware setup

1. Connect the USB cable from the Interface Board ISP130603 to the external battery
2. Connect the BLE Test Board to the ISP130603 Interface Board with the 10 pin, 14 pin and 22 pin FPC jumper cables.
3. Connect your LED test board to the ISP130603 Interface Board on a Jx jumper (depending what GPIO you use to control the LED) with the cable to connect GPIO LED.
4. Fix the boards and external battery on the surface box.
5. Fix the box on the tripod

Then walk until the LED is off.

4. Test condition and results

The demonstration took place on a beach located on the southeast coast of France named "Marina Baie des Anges". We have chosen this location to have a long distance (around 2.5 km) like open field with limited parasitic elements that could disturbing the signal.

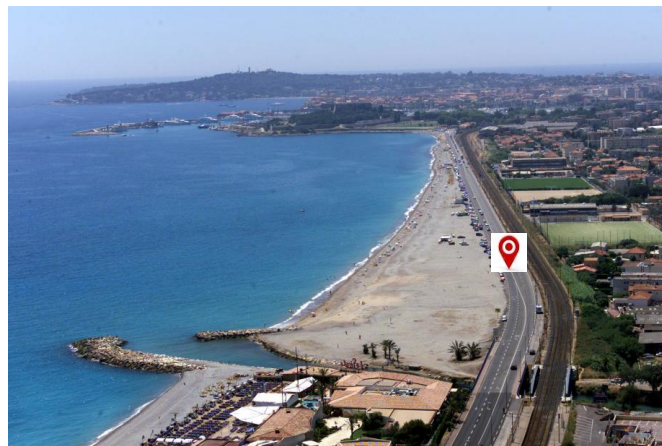


Figure 8 - Test location

The ISP2053-AX Test boards (Central and Peripheral) are placed at 2-meter distance from the ground. Please see the test set up on the pictures below:

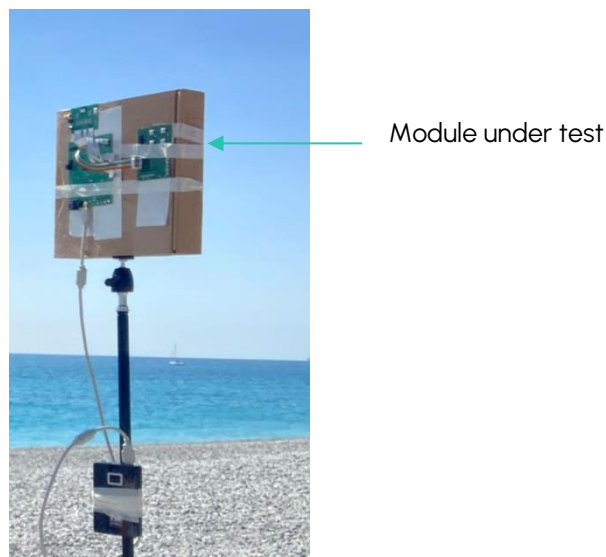


Figure 9 - Test setup

The range measurement was determined with google map and GPS position and the data were collected once the connection between the central and the peripheral was lost or when the data transfer was very slow.

Please see below the map with the range measurement:

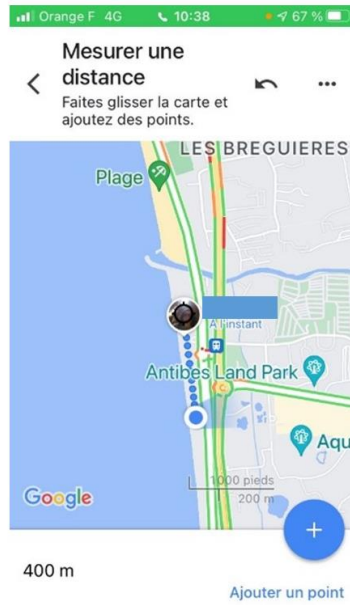


Figure 10 - Results showing the range obtained between Central and Peripheral devices

Range measurement between Central and Peripheral:

Central	Peripheral	Range (m)
ISP2053-AX (3 dBm / 125 kBits)	ISP2053-AX (3 dBm / 125 kBits)	~400

5. About this project

This application has been built by our support team from demo Nordic Semiconductor example. It has not necessarily been thoroughly tested, so there might be unknown issues. It is hence provided as-is, without any warranty.

However, you must modify the example to run your desired application (control a LED visualization for example).

The application is built to be used with the official nRF5 SDK, that can be downloaded from <https://www.nordicsemi.no>