# RAK815(RAK813 BreakBoard) User Manual V1.1

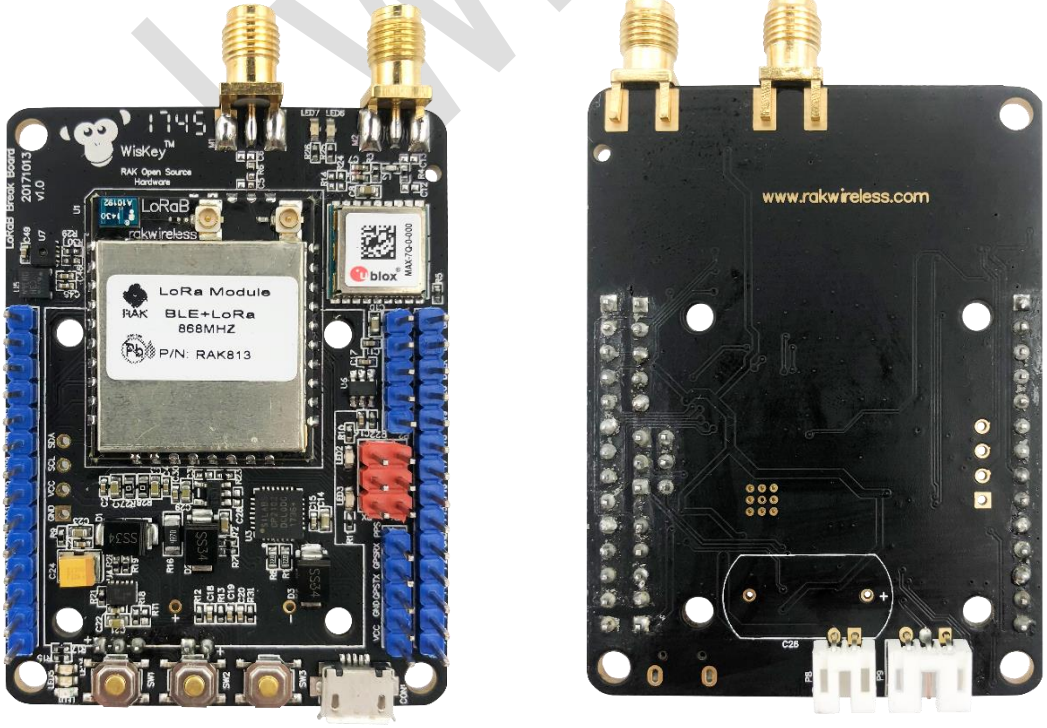
# Contents

# 1. Introduction

RAK815(RAK813 BreakBoard) is a wireless remote solution based on the RAK813 + GPS + MEMS + HT+LCD design. It integrates the latest LoRaWAN 1.0.2 protocol and the latest Bluetooth 5.0 protocol, supports LoRaWAN working mode, supports Bluetooth transparent transmission, Bluetooth up to 300 meters away..

RAK815(RAK813 BreakBoard) built-in GPS, acceleration, temperature and humidity sensors, expanded I2C LCD interface. We provide case applications that can configure LoRaWAN parameters using Bluetooth, display sensor data using LCD, and upload sensor data to the LoRaWAN network. And all the code open source. Users can find all the open source code in github. We also designed three customizable buttons and two customizable LED lights for our users, allowing users to implement they idea with open-source code.

RAK815(RAK813 BreakBoard) is also a support for battery-powered products. Greatly expanded product application scenarios. We also designed the function to enter the low power mode when the device is detected to be stationary to ensure battery life. The device also supports RAK831 + Ri3 gateway to use, you can graphically display the various data of the sensor in the Cayenne platform, but also support the real-time observation of sensor data on the phone.



# 2. Open Source Project

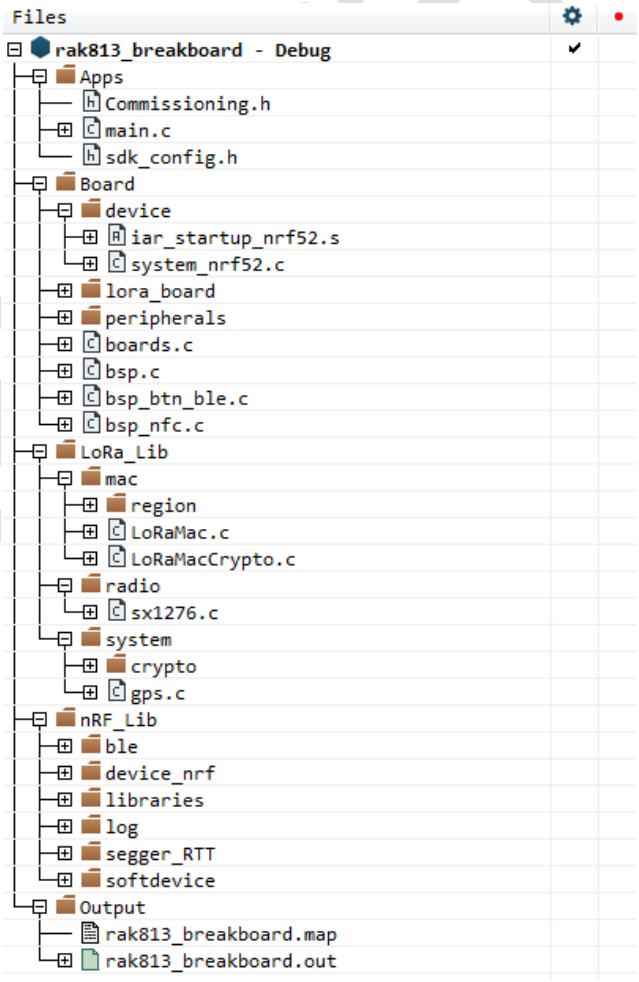
RAK815(RAK813 BreakBoard) is an open source hardware. So the user can get all the information about the product. Includes schematics and program code. Here for everyone a brief introduction to the structure and basic use of open source code.

About the open source project, we can download it here:
https://github.com/RAKWireless/RAK813-BreakBoard

This open source project is based on the official code LoRaWAN1.0.2 and Nordic nRF5 SDK 14.0.0 modified to support IAR8.11 and Keil5. The project mainly provides how to read the sensor data and turn on the Bluetooth transparent transmission function to receive the LoRaWAN configuration data. After the LoRaWAN connection is successful, the sensor data is uploaded to the LoRaWAN server.

## 2.1 Project Structure

Because of the similar project structure of IAR8.11 and Keil5, we introduce the project structure of IAR8.11 as an example.



Apps

-main.c application code

-Commissioning.h LoRaWAN parameter configuration file

-sdk_config.h nRF52832 chip configuration file

Board

-device

- iar_startup_nrf52.s system_nrf52.c nRF52832 startup file

-lora_board

-./* Control LoRa chip hardware related file

-peripherals

-./* Driver peripheral related file

-boards.c bsp.c... nRF52832 Hardware related files

LoRa_Lib

-mac

-LoRaMac.c LoRaMacCrypto.c lora mac driver

-region

-./* The region defined by LoRaWAN1.0.2

radio

-sx1276.c support the semtech sx1276 driver

system

-crypto

-./* lora transmit security use AES and cmac check

-gps.c Parse GPS data files

nRF_Lib

-ble

-./* Driver Bluetooth library related files

-device_nrf

-./* nRF52832 interface library files

-libraries

-./* nRF52832 function use case library files

-log

-./* nRF52832 log print information related files

-segger_RTT

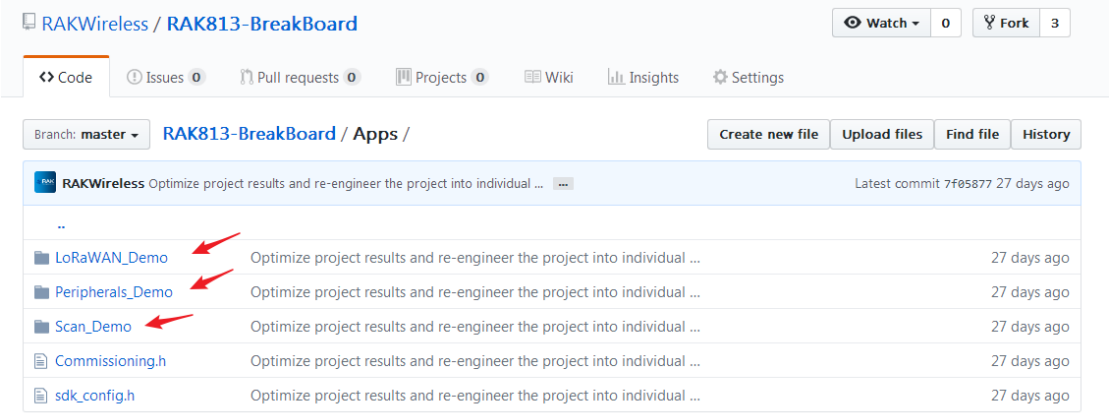
-./* Use j-link RTT to print log related files

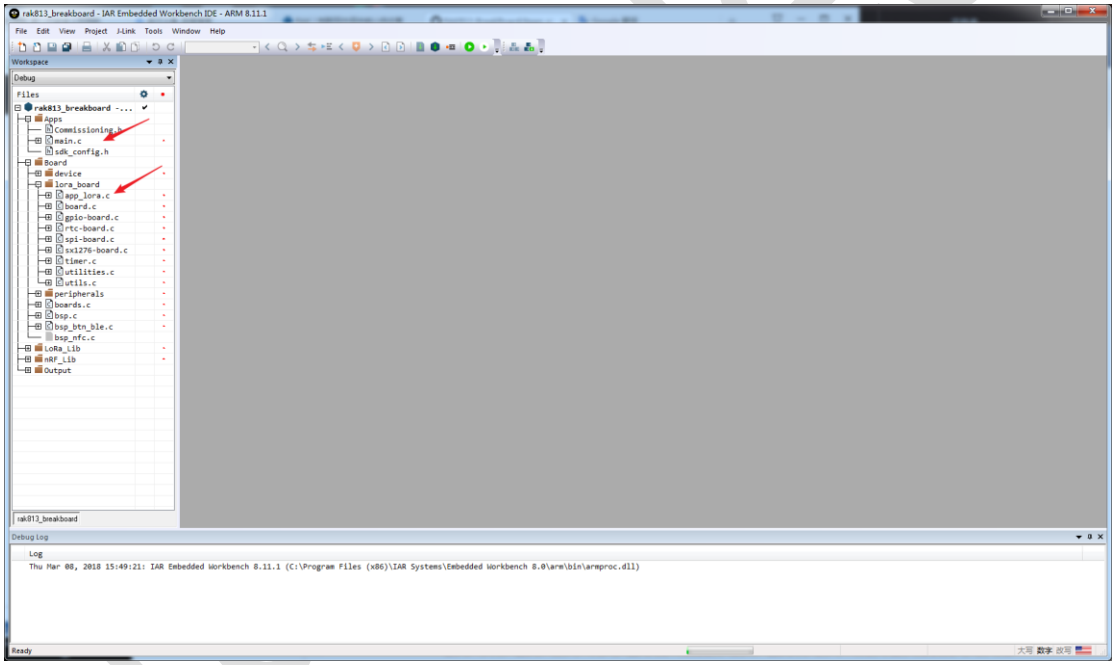
-softdevice

-./* Bluetooth protocol stack driver files

## 2.2 Application Switch

In the open source project, there are three Demo cases. Users only need to replace the main.c and app_lora.c files in the project to switch between different applications.

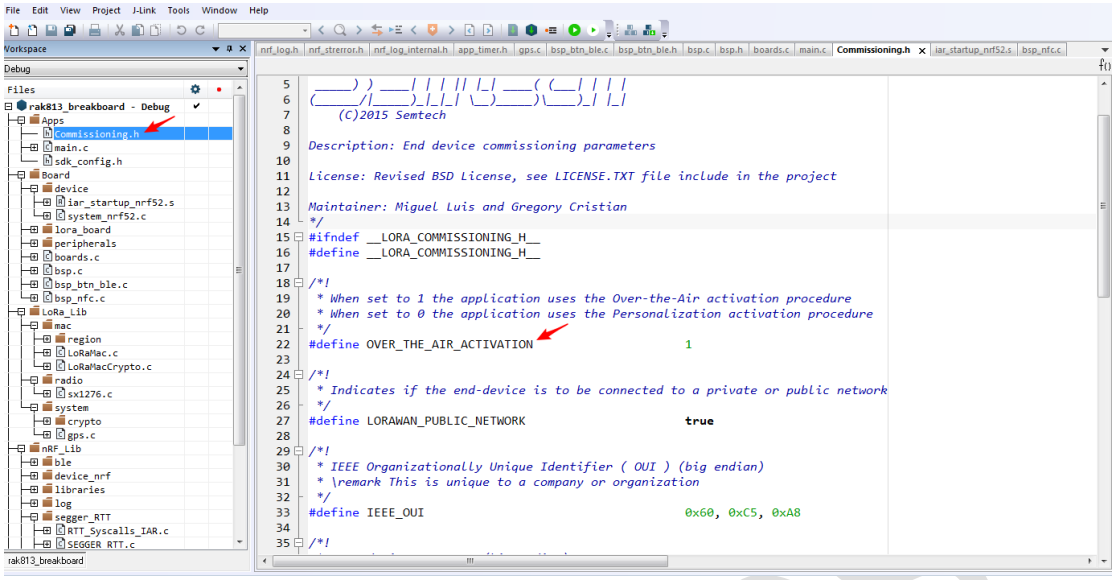


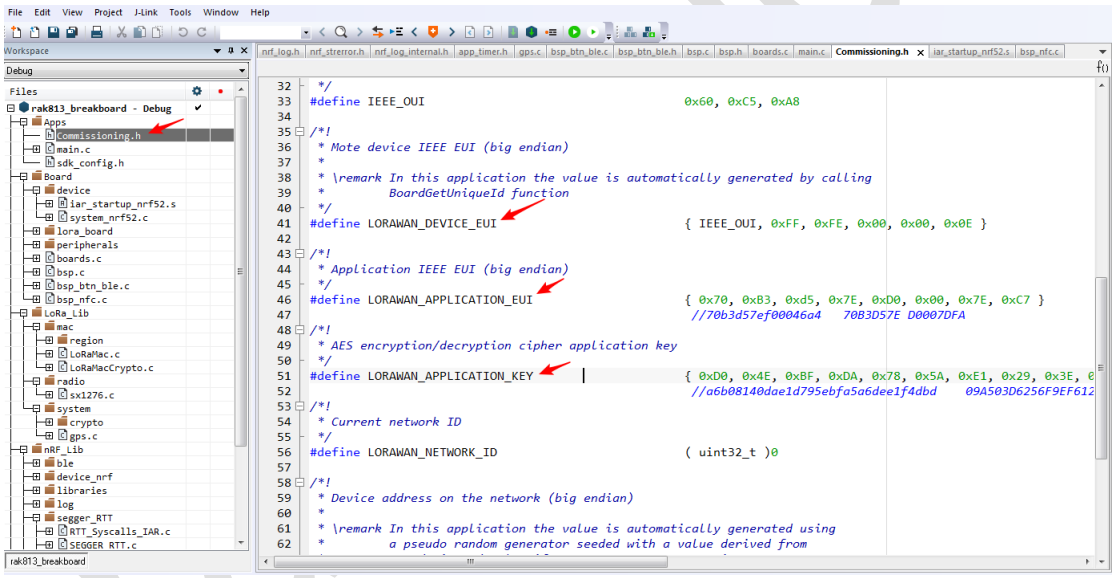
## 2.3 Configuration LoRaWAN Parameters

In the project, if you want to modify the way(OTAA or ABP) the device joins the network and the parameters of joining the network, these parameters include Dev_EUI, APP_EUI, APP_KEY, DEV_ADDR, NWKS_KEY, APPS_KEY. You can modify it in the Commissioning.h file.

If you want to modify the way(OTAA or ABP) to join the network, please modify this parameter:



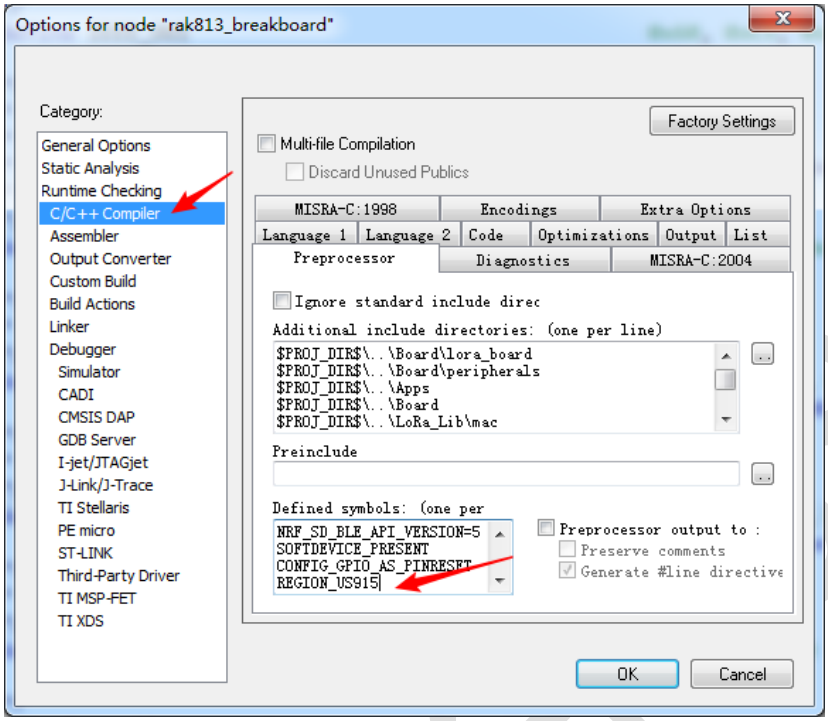

If you want to modify Dev_EUI, APP_EUI, APP_KEY, DEV_ADDR, NWKS_KEY, APPS_KEY these parameters, please modify here:



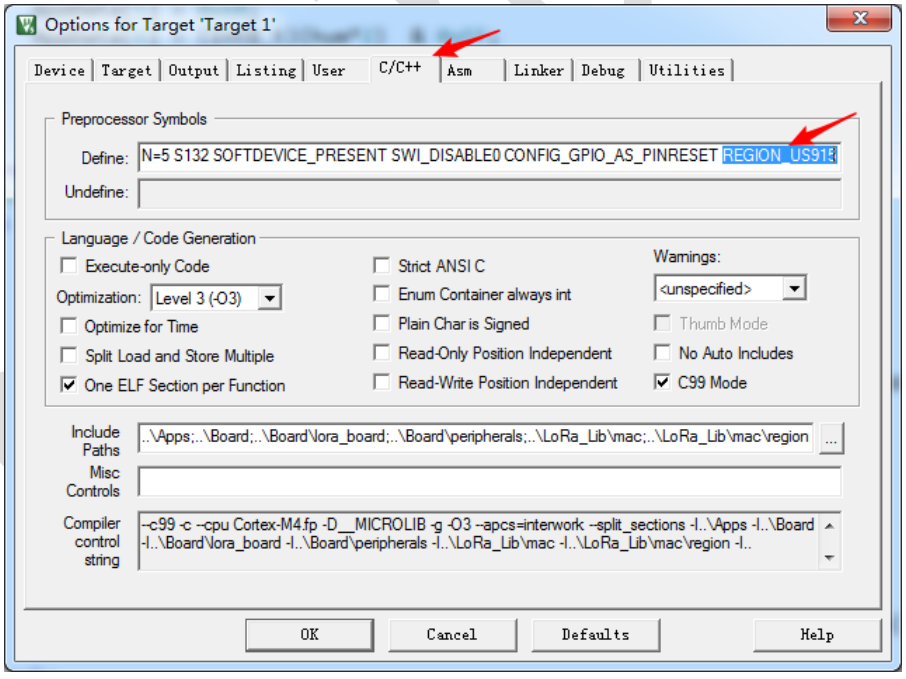

## 2.4 Modify LoRaWAN Region

The open source code is based on LoRaWAN1.0.2 modified from, so the supported regions have: EU868, US915, AS923, AU915, IN865, KR920. If you want to modify the region, you can modify the macro definition.

IAR:

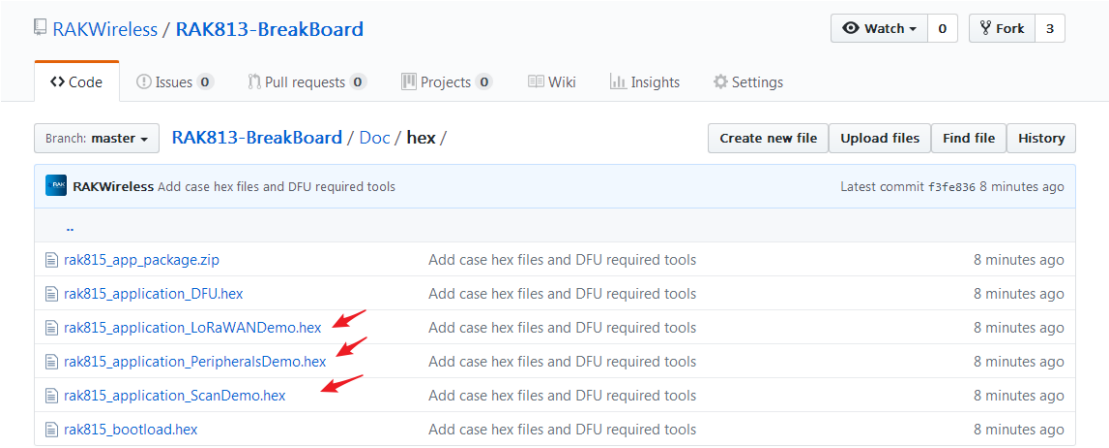



Keil:



# 3. Demo instructions

The following describes the use of open source project demo. The Demo firmware see the open source project. How to download the open source project firmware, Please see RAK815(RAK813 BreakBoard) Firmware download manual document.

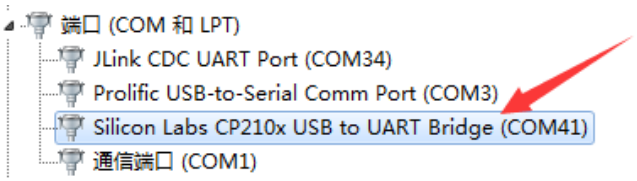



## 3.1 Log Information

When you finish writing Demo firmware. You can view the Log information through the serial port defined by Demo firmware. But first, you need to connect Pin3-> Pin5, Pin4-> Pin6 on the UART switch interface(see RAK815(RAK813 BreakBoard) Datasheet).

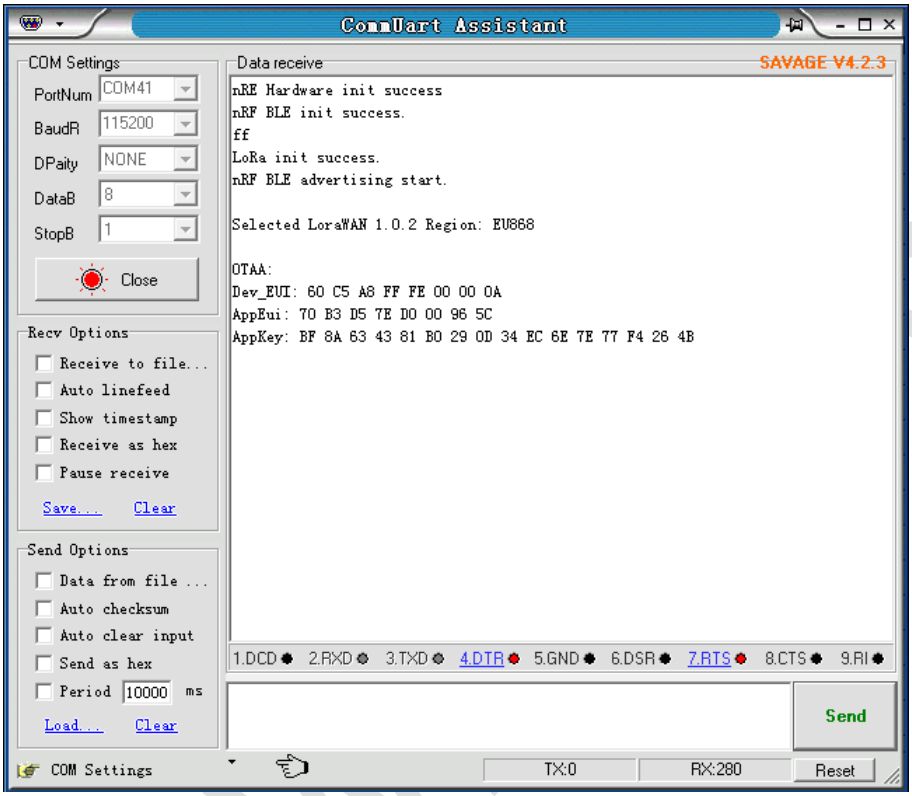
### 3.1.1 Install Serial Port Driver

This device uses USB to serial port chip CP2102, so after the device is connected to the computer, the driver will usually be installed automatically, if you find that your computer is not automatically installed, please go to this link to download the driver: http://passport.rakwireless.com/stat/en/RAK811%20BreakBoard/Tool/CP210x_Windows_Drivers.zip



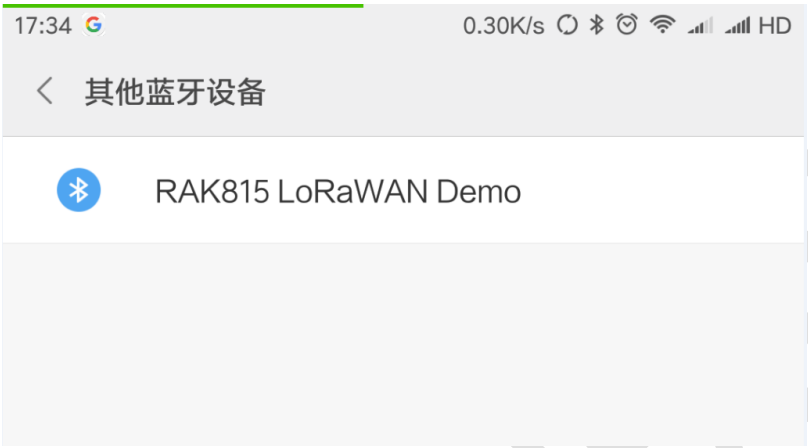
### 3.3.2 See Log infomation

After the driver is installed successfully, Connect the device to the PC via the Micro USB connector. then reset(The reset Butten is defined SW3) device will see the following log information in the serial port.

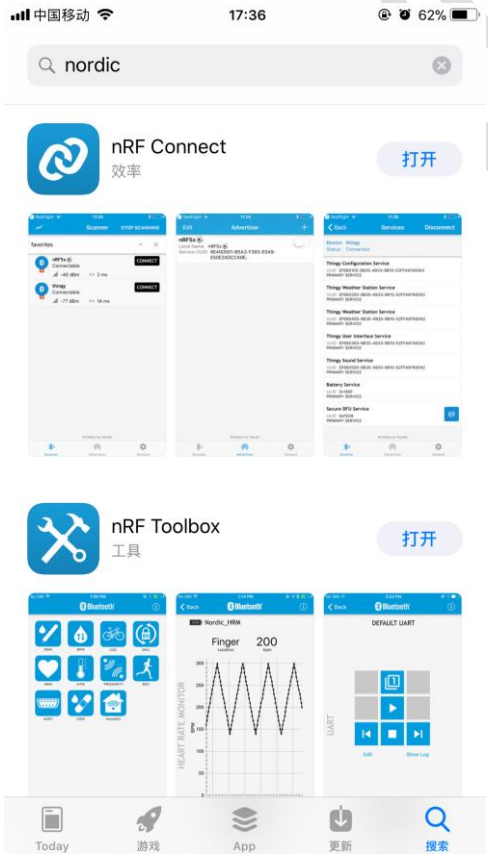


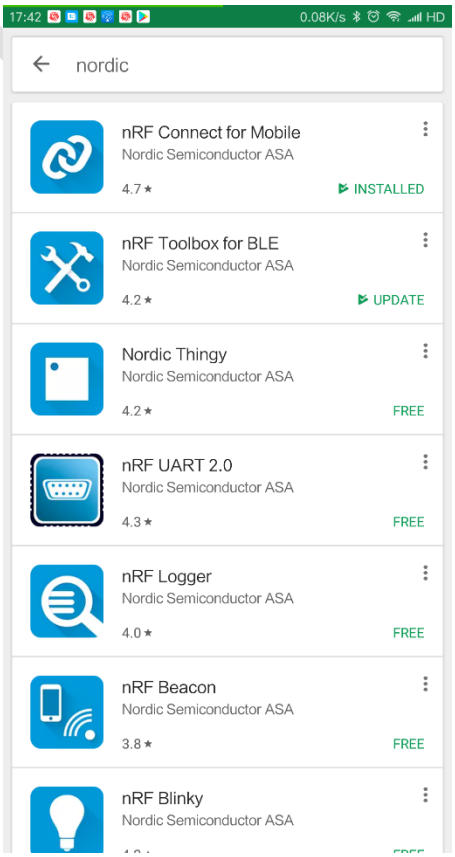
## 3.2 LoRaWAN Demo

If you use the application LoRaWAN Demo,When the device is activated, a Bluetooth radio with the device name "RAK815 LoRaWAN Demo" will be activated. You can view the device via the phone's Bluetooth.

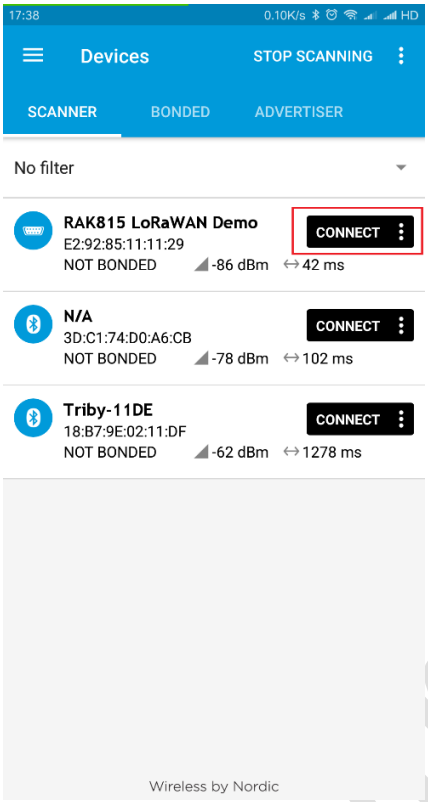


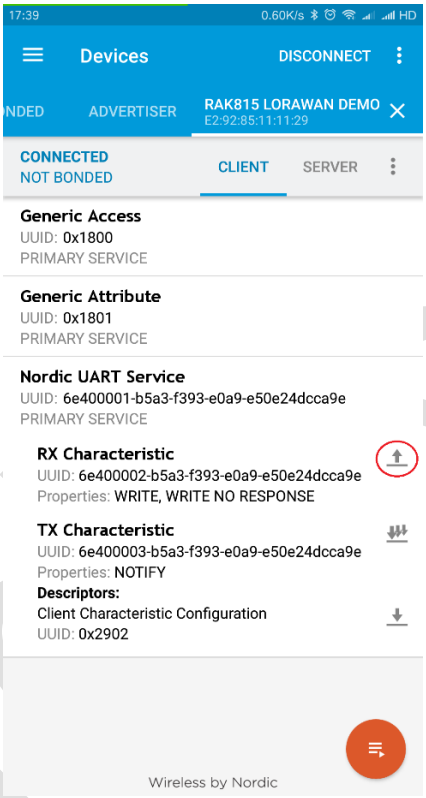

If you want to achieve Bluetooth transmission data capabilities, you need to download Nordic official mobile APP “nRF Connect”. If you are an Apple phone, Directly search for "nordic" at the Apple Store, if you are an Android phone, you also can search for "nordic" from the Google Store. For details, please refer to the official website: http://www.nordicsemi.com/eng/Products/Nordic-mobile-Apps



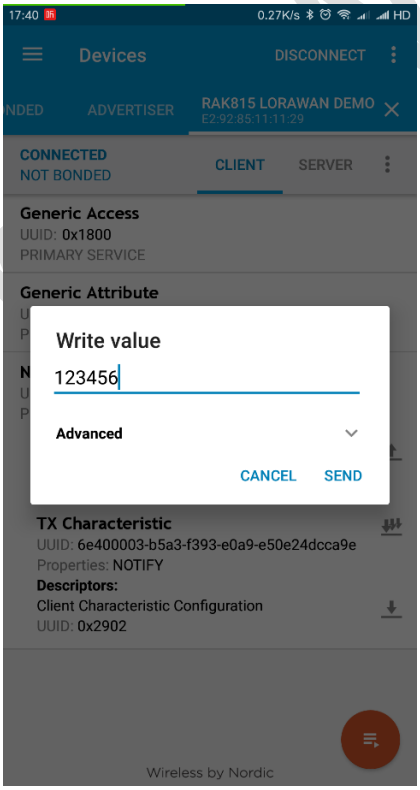



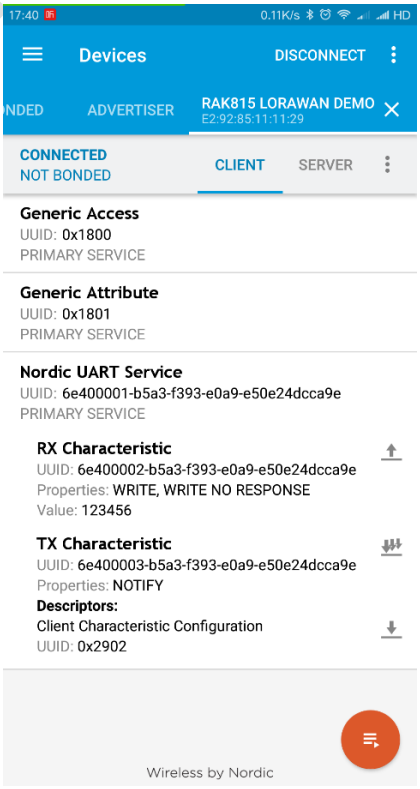
After installing APP, open the APP, select the device's Bluetooth radio "RAK813 BreakBoard" connection. After the connection is successful, click RX Characteristic to send the data.



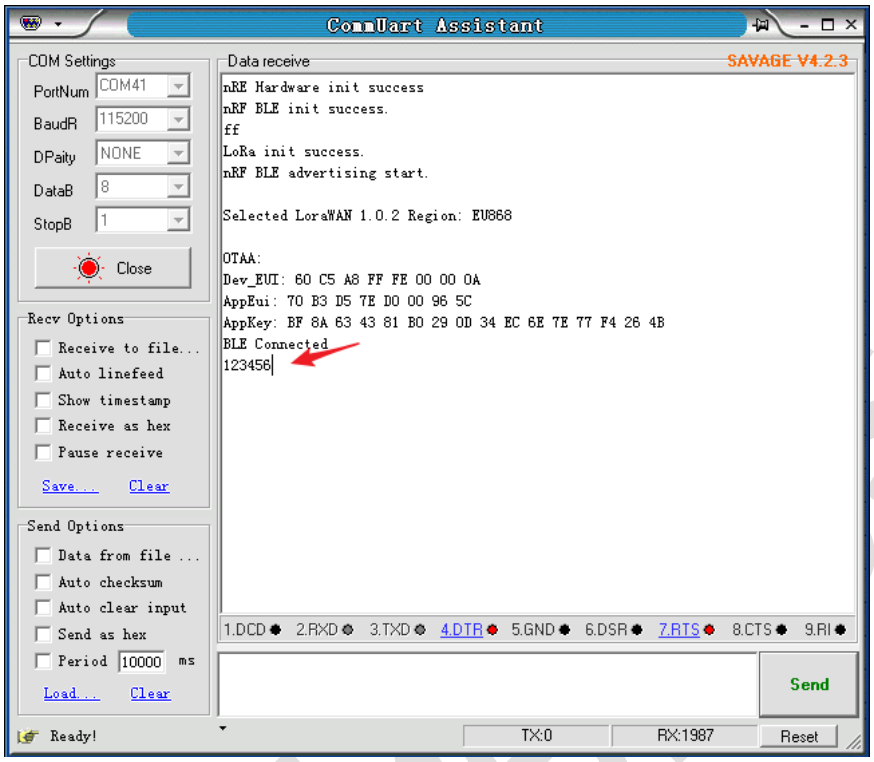




Here to send 123456 as an example to demonstrate.



After sending, you will see the data in the serial port of Log information of the device.

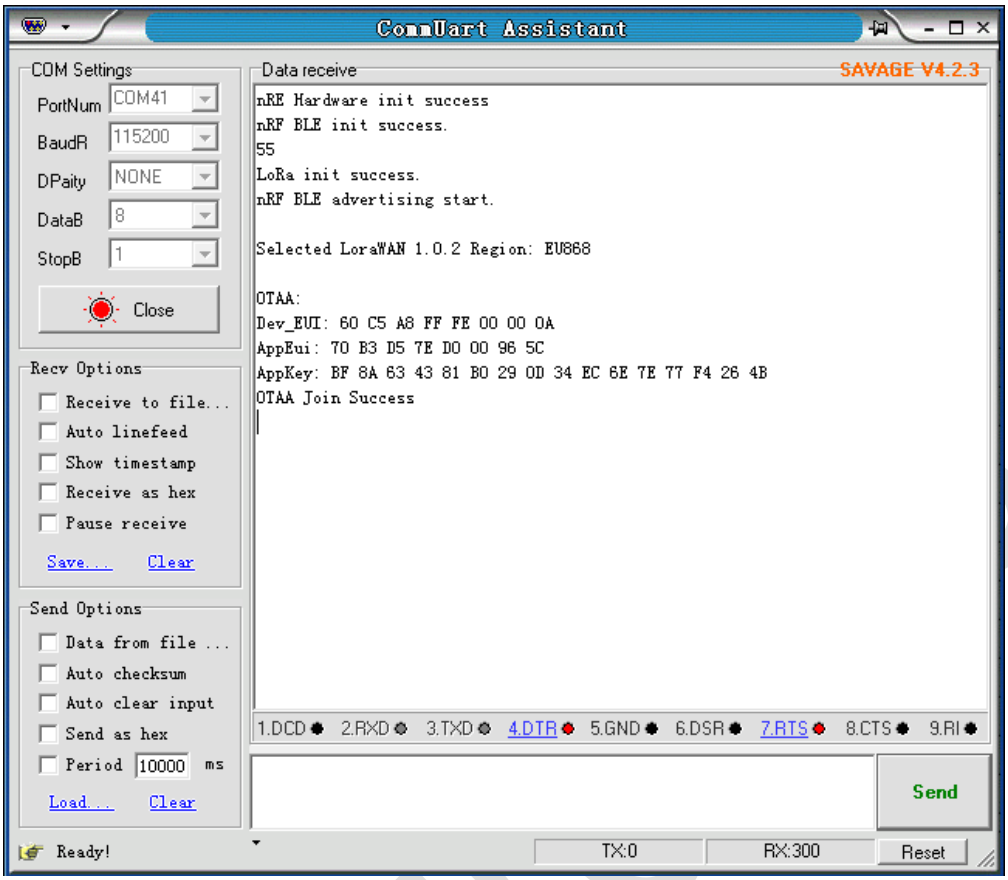



The next demonstration uses this feature to configure the LoRaWAN parameters:

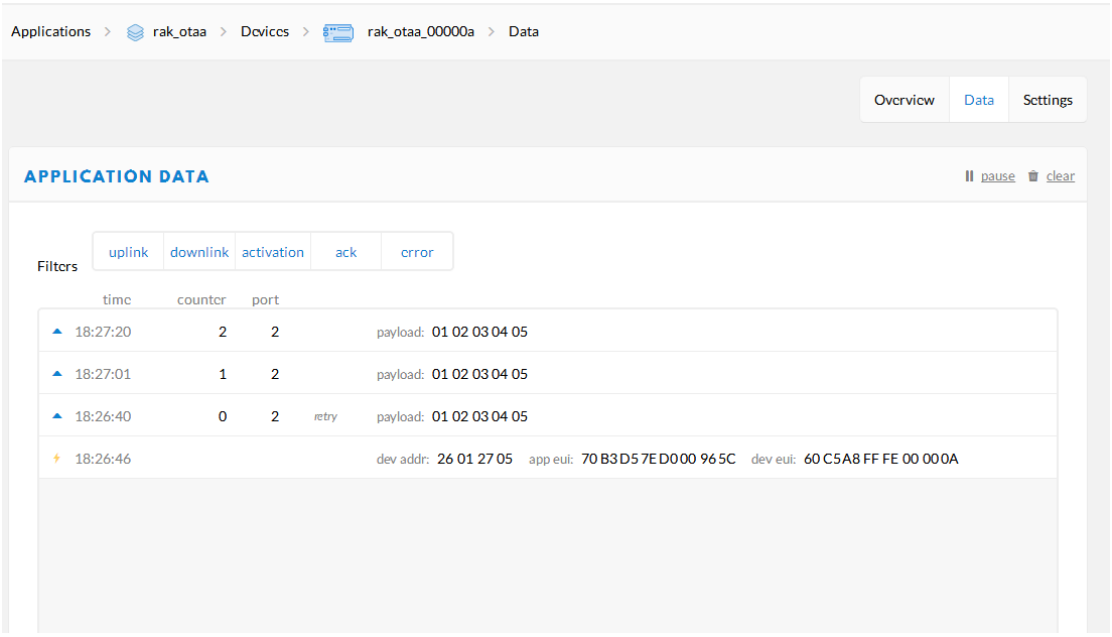
The LoRaWAN web server provider selected for this case is TTN and if you do not know how to set up a LoRa gateway device to connect to the TTN, check here:
https://www.thethingsnetwork.org/labs/story/rak831-lora-gateway-from-package-to-online

After getting OTAA or ABP parameters of LoRa device from TTN. You can write data into the flash of RAK815(RAK813 BreakBoard) by the function of transmitting data through Bluetooth, The format of the data you are sending must be as shown below:
lora_cfg:dev_eui=xxxxxxxxxxxxxxxx&app_eui=xxxxxxxxxxxxxxxx&app_key=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx&dev_addr=xxxxxxxx&nwkskey=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx&appskey=xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
(Log information serial port will not print the information of this configuration because the information is too long.)

When the device parameters are configured successfully, You will see in the log message serial port: “LoRaWAN parameters configured successfully”. Then reset the device, if your LoRa gateway device is ready, then RAK815(RAK813 BreakBoard) will send join request to LoRaWAN network server. You can in the Log information Serial to see the success of joining the information.

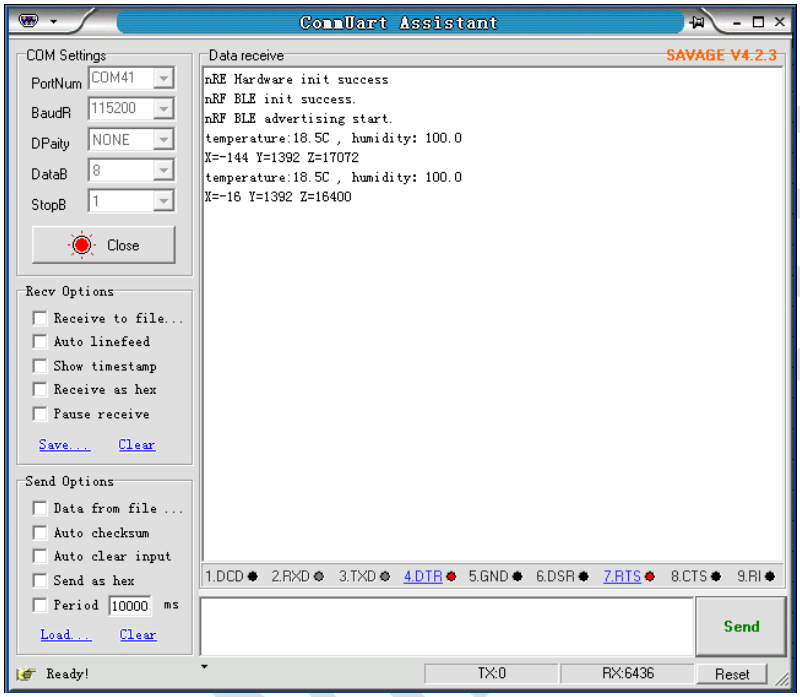



You can also see the data sent by the device on the TTN:

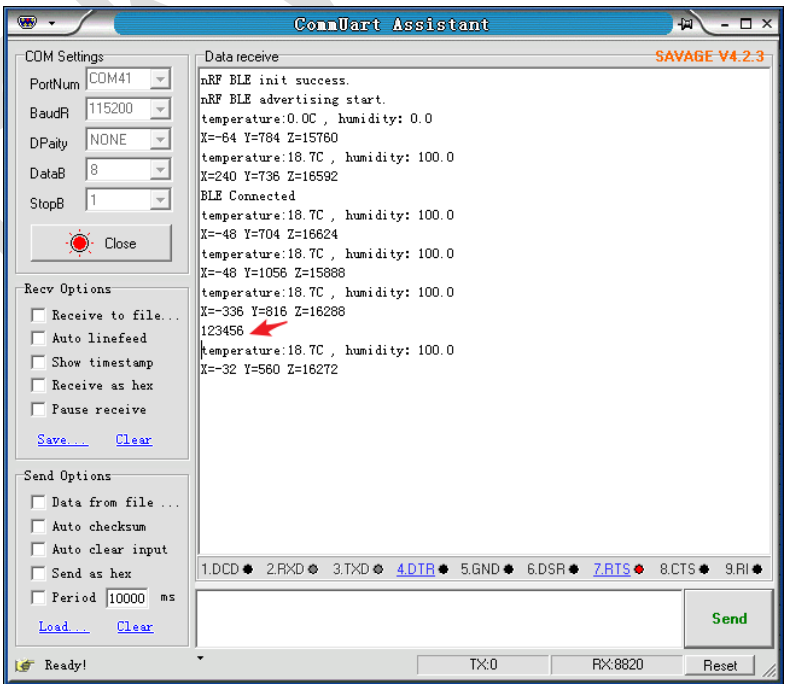


## 3.3 Peripherals Demo

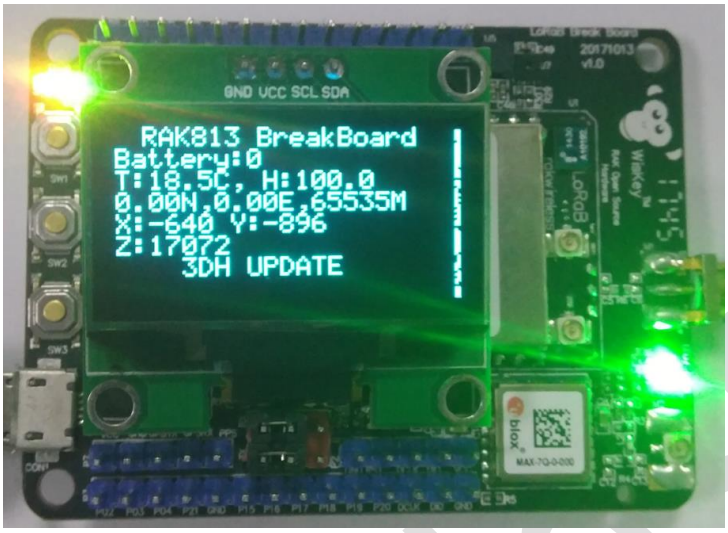
If you use the application Peripherals Demo, When the device is activated, a Bluetooth radio with the device name "RAK815 Peripherals Demo" will be activated, and the device's log information serial port will print the device's sensor information every five seconds.




Through the aforementioned method, using the mobile phone APP to connect the device Bluetooth, you can also send data to the device's serial port through the mobile phone.

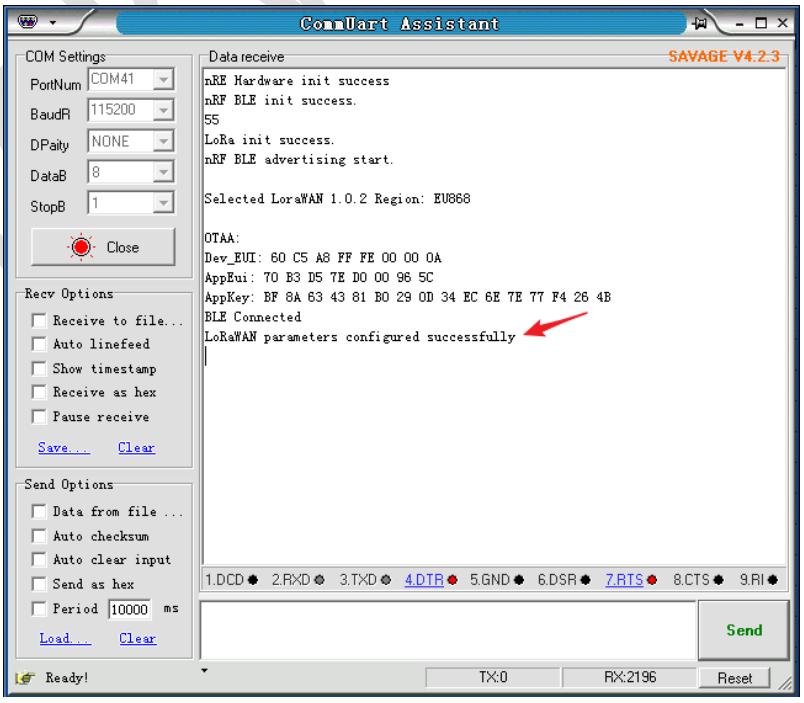


If you connect the LCD to the LCD's expansion interface, you can also see the data for each sensor on the LCD display.

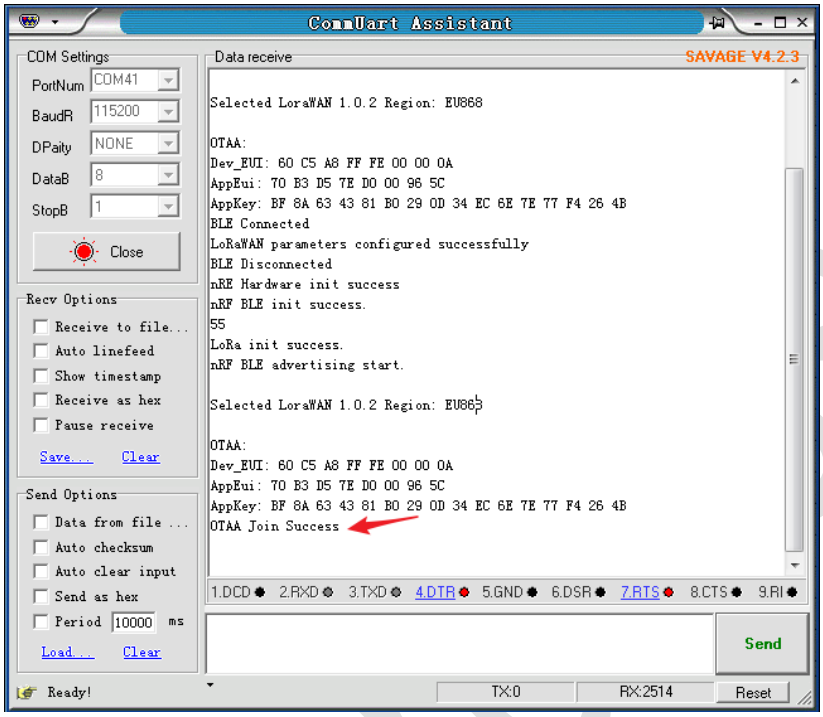



## 3.4 Scan Demo

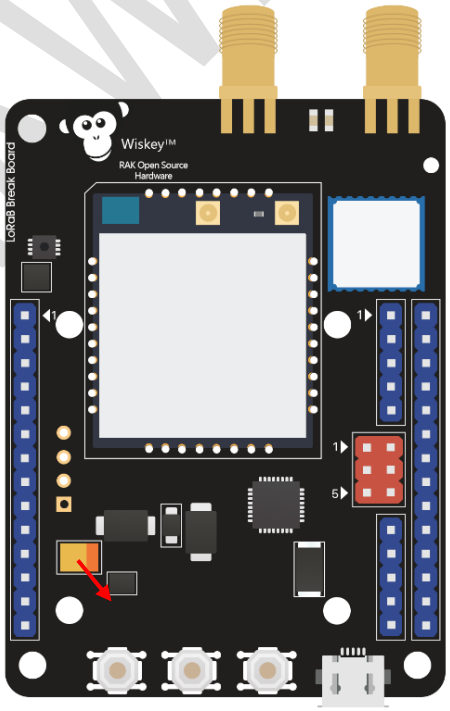
If you use the application Scan Demo, When the device is activated, a Bluetooth radio with the device name "RAK815 Scan Demo" will be activated. As mentioned earlier, you can also use the mobile phone APP nRF Connect to connect to the device's Bluetooth and send LoRaWAN parameters to configure the device. When the device parameters are configured successfully, You will see in the log message serial port: “LoRaWAN parameters configured successfully”.



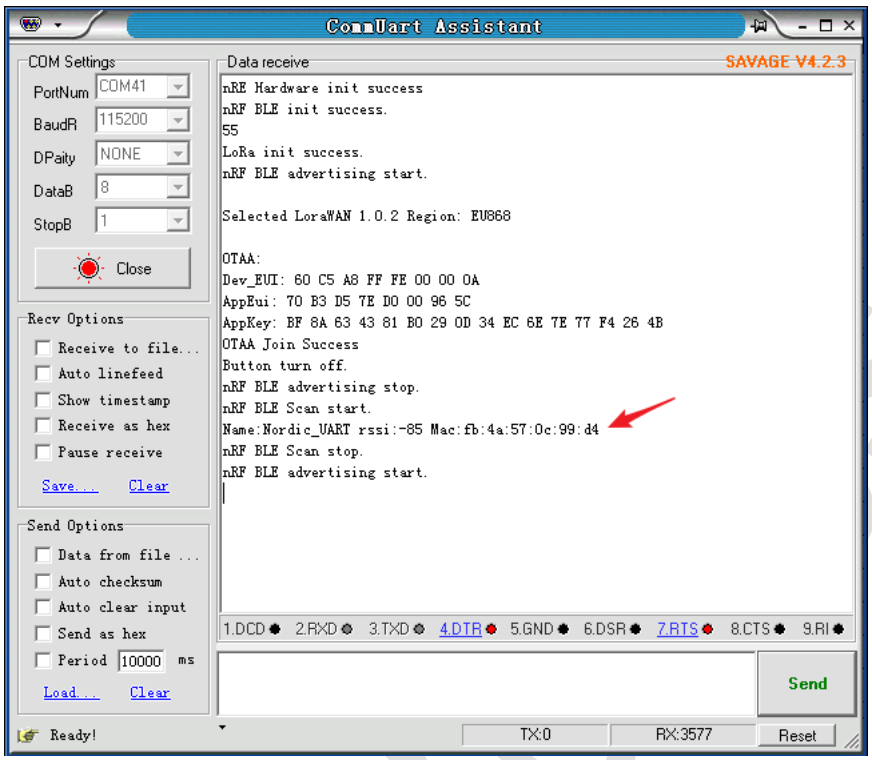
After the configuration parameters are successful, if your LoRaWAN gateway has been set in advance, reset the device at this time and you will receive the message that the device OTAA has joined successfully.



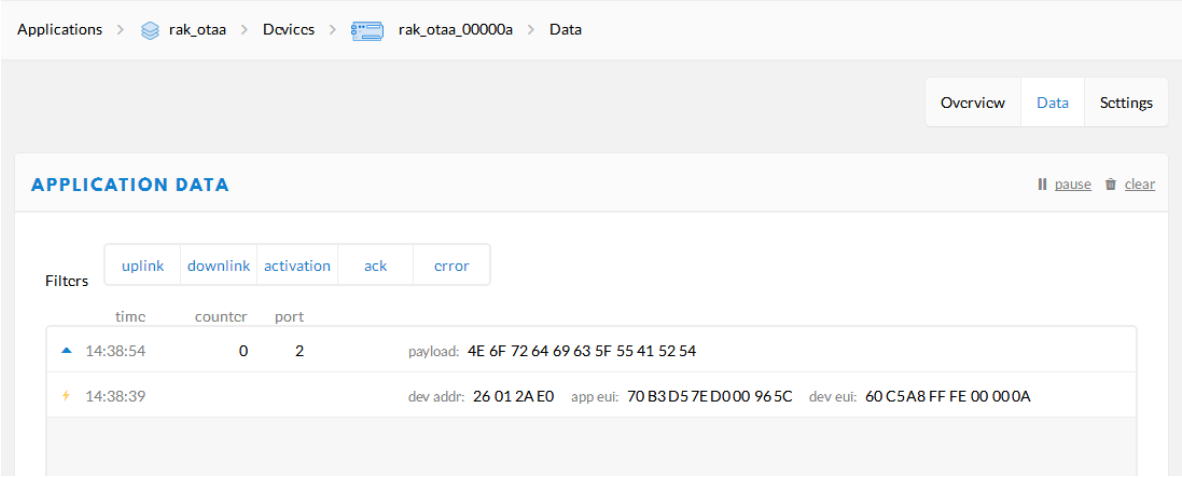

Next, if you press the first button of the device, see the figure below. The device will scan the surrounding Bluetooth device for 1s. (Note: This device's Bluetooth BLE device ,So can only scan Bluetooth BLE devices.)



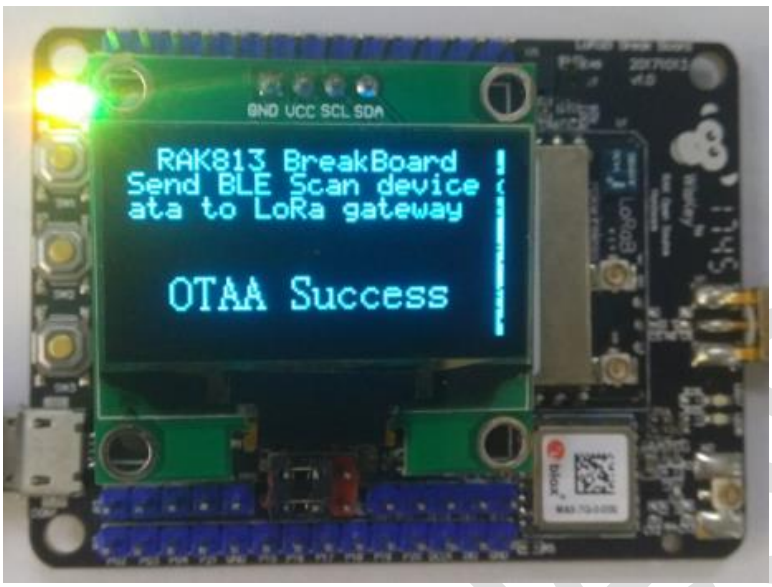
If the device scans a Bluetooth BLE device, the scanned device information is printed out from the log information serial port.




If your device is in a LoRaWAN connection state. At this point your device will send the Bluetooth BLE device information you scanned to the LoRaWAN server.

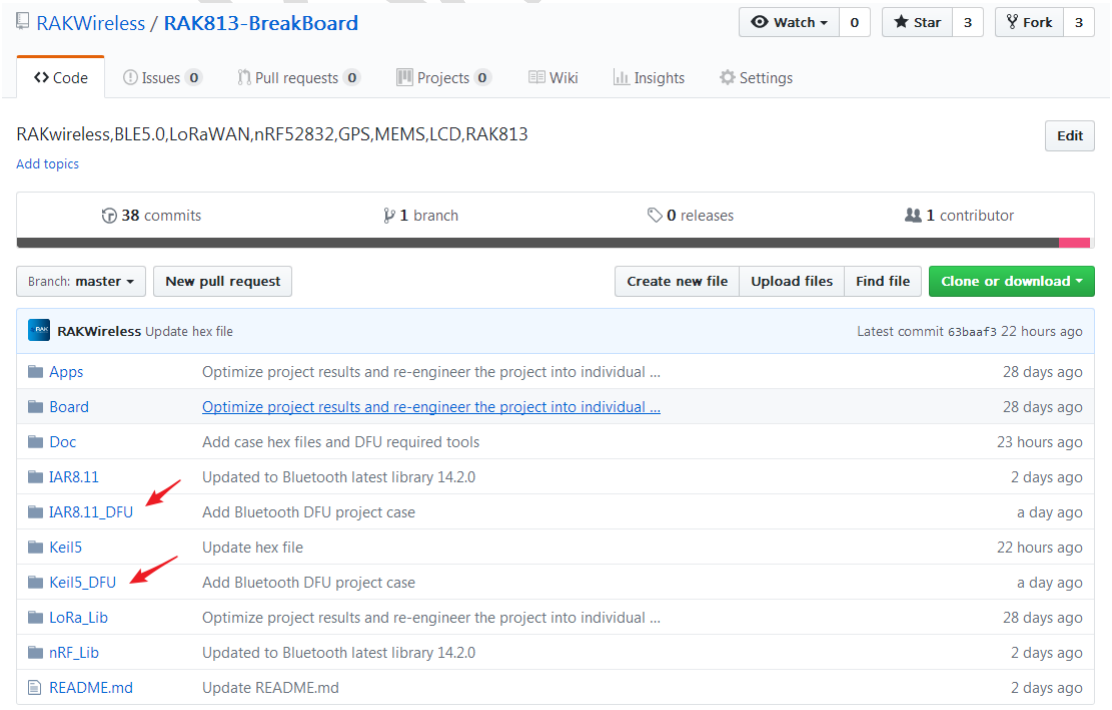


In addition, if you connect the LCD to the device LCD expansion interface, you can view the real-time status of the device on the LCD.

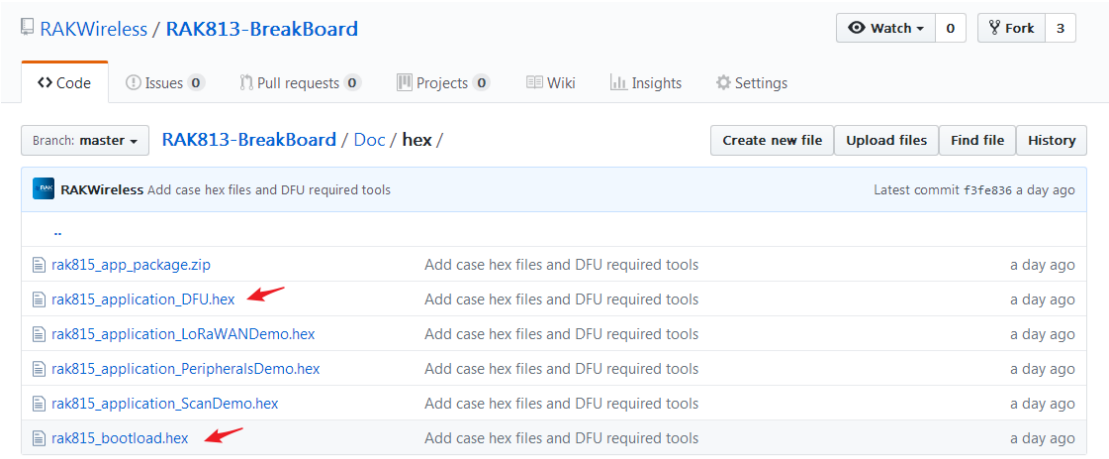



# 4. DFU Function

DFU full name Device Firmware Upgrade, this is a way to upgrade the firmware. In the open source project, we have created a new project specifically for the DFU project. The following shows how to upgrade using the DFU function.



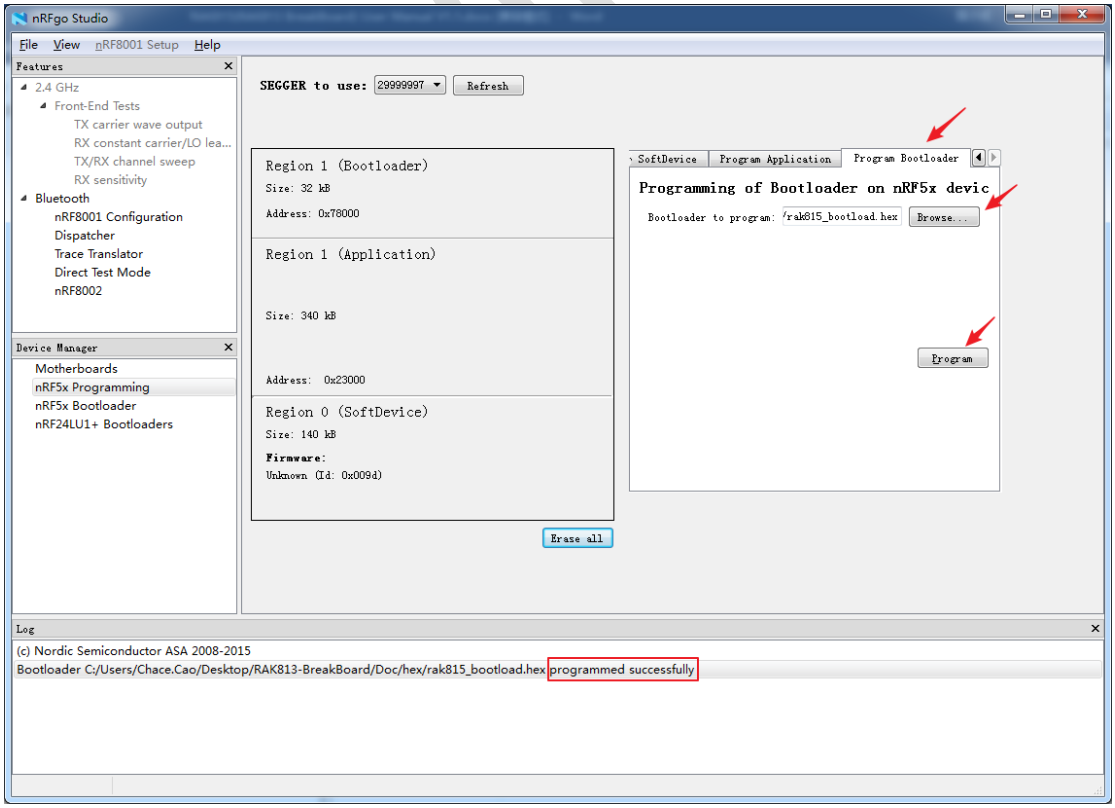
We provide users with hex files, which users can find in the open source project Doc folder.




However, it should be noted that using the DFU function of the nRF, unlike the previous firmware programming method, the bootloader firmware must be programmed. Therefore, three firmwares need to be programmed to use the DFU function. They are the Bluetooth protocol stack firmware, the DFU application firmware, and the bootload firmware. Bootload firmware can be found in open source functions.

For details on how to program the Bluetooth protocol stack and application firmware, see: RAK815(RAK813 BreakBoard) Firmware download manual.

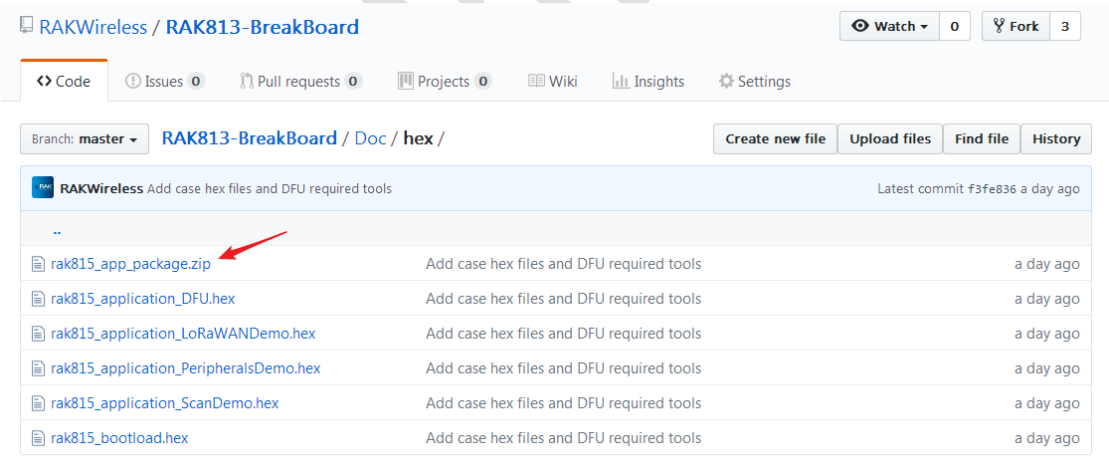
The following figure shows how to program bootloader firmware:



After all firmware is written, the device will automatically restart. At this time, use your mobile phone Bluetooth scan, you will see a device named "RAK813_DFU".

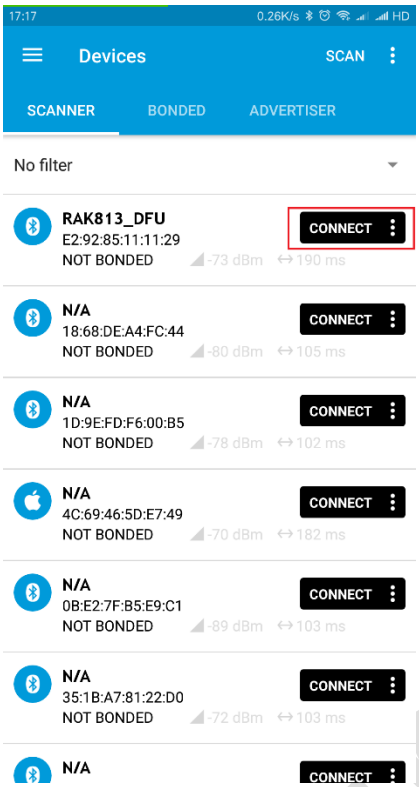

Use the nRF official phone app nRF Connect to connect to the device's Bluetooth. You can start DFU to upgrade the firmware.

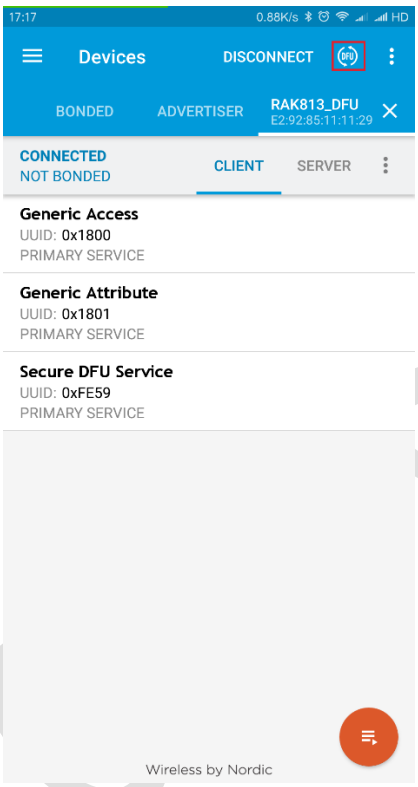
Before upgrading the firmware, you need to import the firmware you want to upgrade into your phone. Because the mobile phone APP will ask you to choose the firmware you need to upgrade. This upgrade file is a zip file, not a hex file generated directly after programming. This file needs to be created. Here we provide a test file, as shown below:



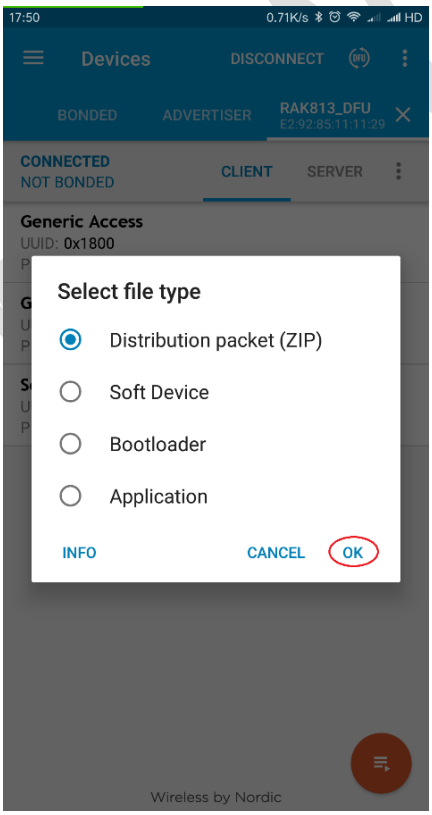

About how to make an upgraded zip file, and how to program DFU step by step, the official forum has a post detailing this method. Interested parties can view this link: https://devzone.nordicsemi.com/b/blog/posts/getting-started-with-nordics-secure-dfu-bootloader

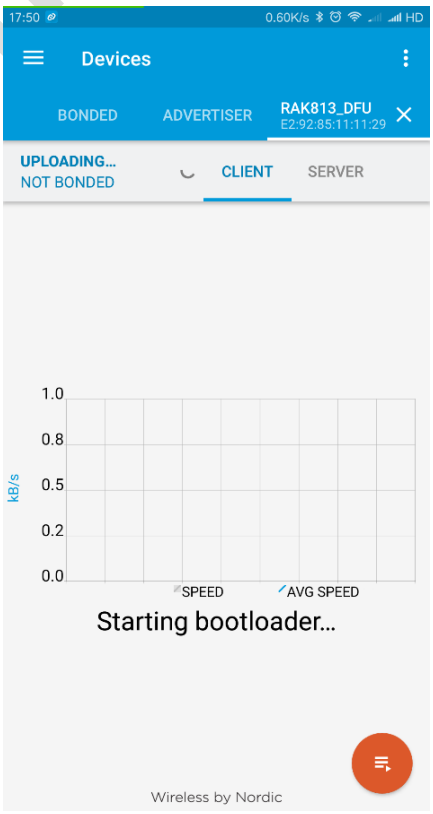
Use the phone APP to connect to the device's Bluetooth, click the DFU icon in the upper right corner.



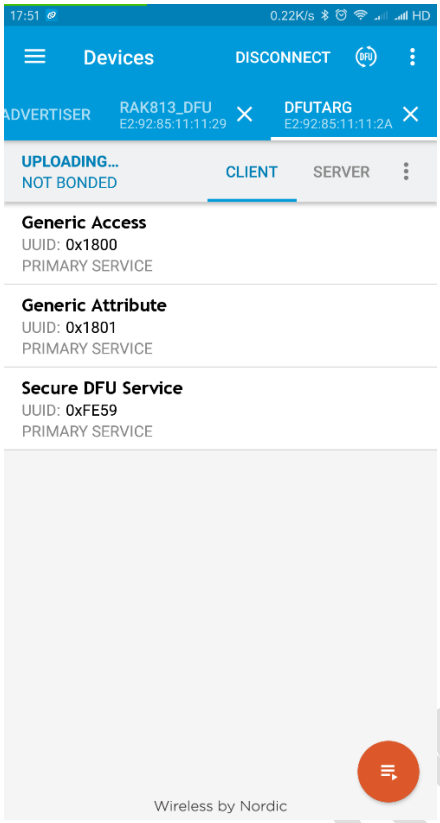



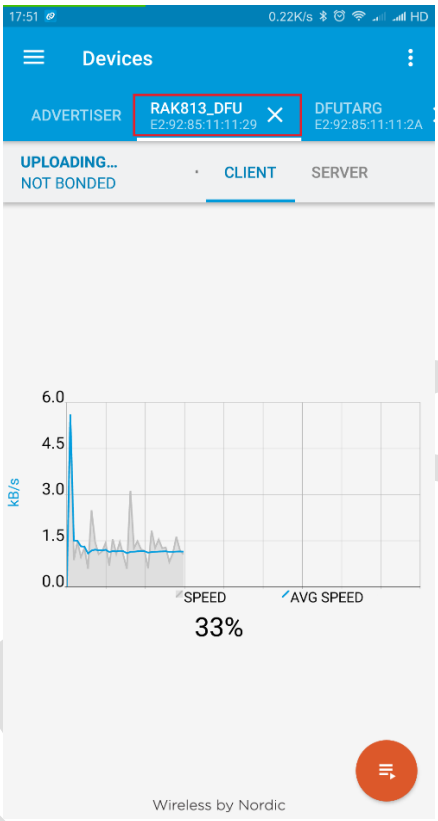

After selecting the imported zip upgrade firmware, the device will automatically start upgrading the firmware.



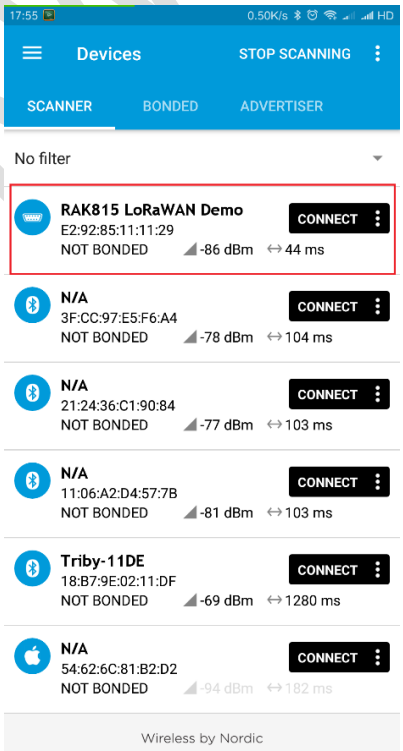



At this point the program will jump to the bootload, execute the bootload, click on the RAK813_DFU above, you can see the progress of the program sent.




After the program upgrade is complete, reset the device and you will see that your device's Bluetooth broadcast name has changed.



# 5. Contact information

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# 6. Revision History

| Version | Date | Change | Author |
|---|---|---|---|
| V1.0 | 2018-01-19 | First release | Chace |
| V1.1 | 2018-03-09 | Subdivided several cases and added DFU application | Chace |