LoRa/LoRaWAN Gateway Kit

LoRa is a perfect long-range wireless solution to create low-power, wide area networks.So far we have released several “LoRa” boards such as Seeeduino LoRaWan and Grove LoRa Radio etc. However if you want to build you own LoRa network, there are 3 things that you should prepare to get started: a Gateway, at least one Node and a local server where you can monitor all your devices.

This kit provides all the basic elements you need: a Raspberry Pi 3, a Seeeduino LoRaWAN with GPS and a gateway & local server that allows you to collect and transfer data among all your LoRa nodes. By connecting the gateway with Seeeduino LoRaWAN and Grove modules, you can build your IOT prototype within minutes.

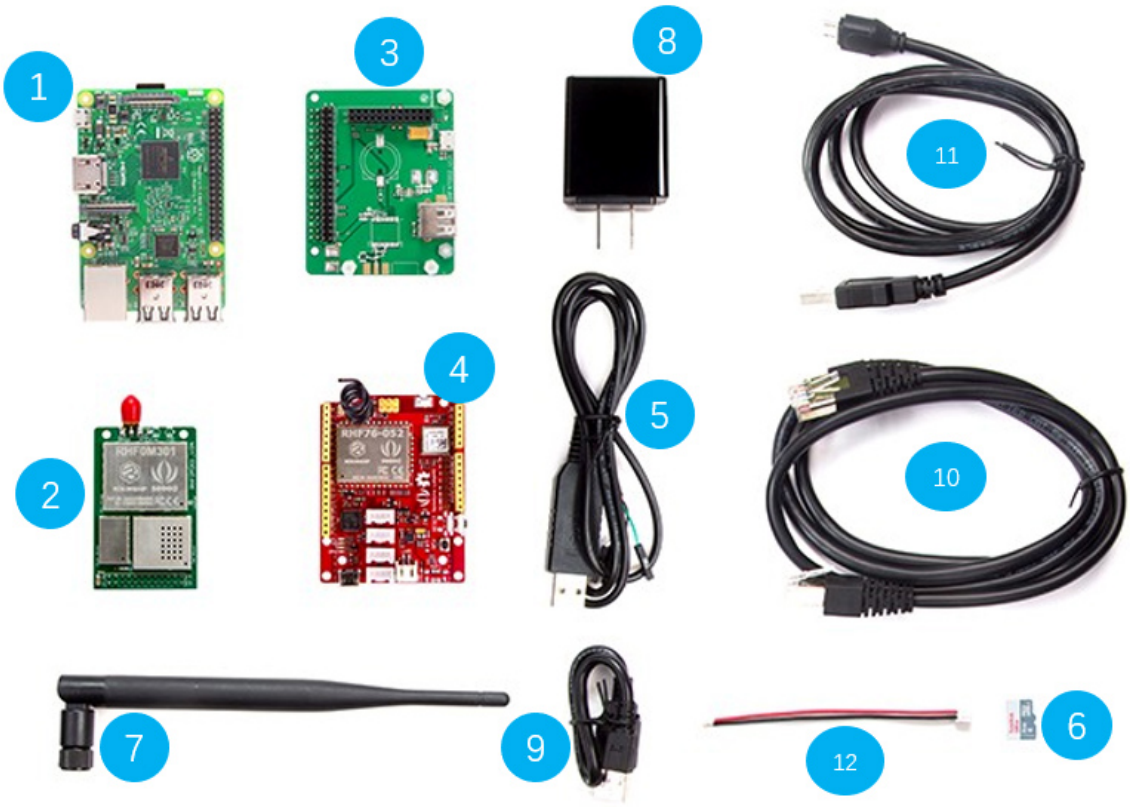
Regarding the gateway module RHF0M301, it is a 10 channel(8 x Multi-SF + 1 x Standard LoRa + 1 x FSK) LoRaWan gateway moduel with a 24pin DIP port on board, users can easily connect the RHF0M301 with PRI 2 bridge RHF4T002, adapter for Raspberry Pi 3 and RHF0M301. We also included a 868MHz antenna, an 8GB SD card and USB cables, Ethernet Cables and other accessories.

Caution
Please always plug 3.7V Lipo battery in case USB power supply is not sufficient. We use 868MHZ kit in this wiki, but this wiki works for both 868MHz kit and 915MHz kit.

Features¶

- Low power consumption & wide area
- Industrial standard reliability
- Economic solution to build LoRa /LoRaWAN network
- Rich Accessories of sensor and actuator
- Real time monitoring

Hardware Overview¶



Partlist¶

Parts number	Parts name	Quantity
1	Raspberry Pi 3	1 PCS
2	Gateway module RHF0M301–868	1 PCS
3	PRI 2 Bridge RHF4T002	1 PCS
4	Seeeduino LoRaWAN with GPS (RHF76-052AM)	1 PCS
5	USB to UART Adapter	1 PCS
6	upgrade to 16GB Micro SD Card – Class 10	1 PCS
7	0dBi Rubber Duck Antenna	1 PCS
8	5V/2.1A American Standard Adapter with Micro USB Connector	1 PCS
9	Micro USB Cable 20cm	1 PCS
10	Micro USB Cable 100cm	1 PCS
11	RJ45 Ethernet Cable 200cm	1 PCS
12	JST2.0 Cable 10cm	1 PCS

Application Ideas¶

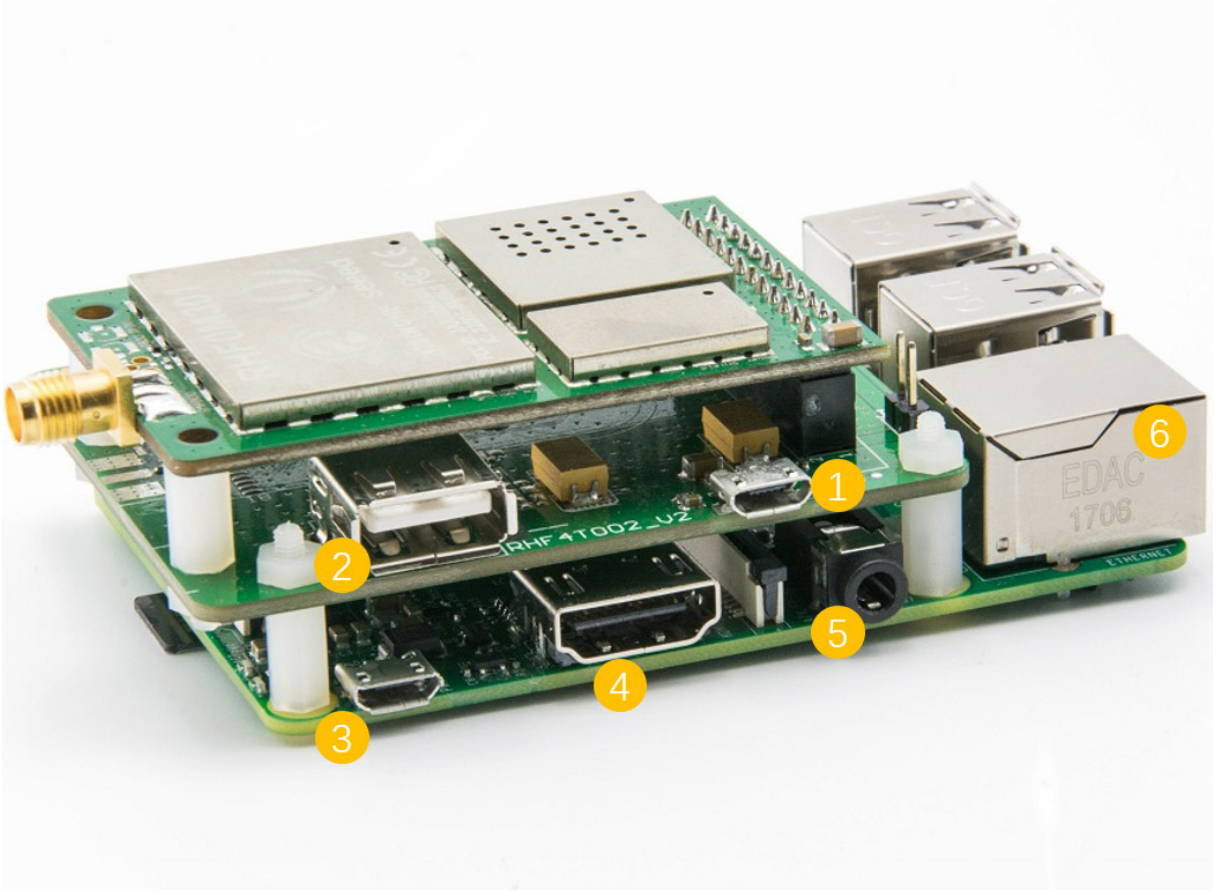
- Internet of Things
- Smart House
- Security
- Smart Grid
- Intelligent Farm
- Intelligent Park

Getting Started¶

Hardware¶

Interfaces overview¶

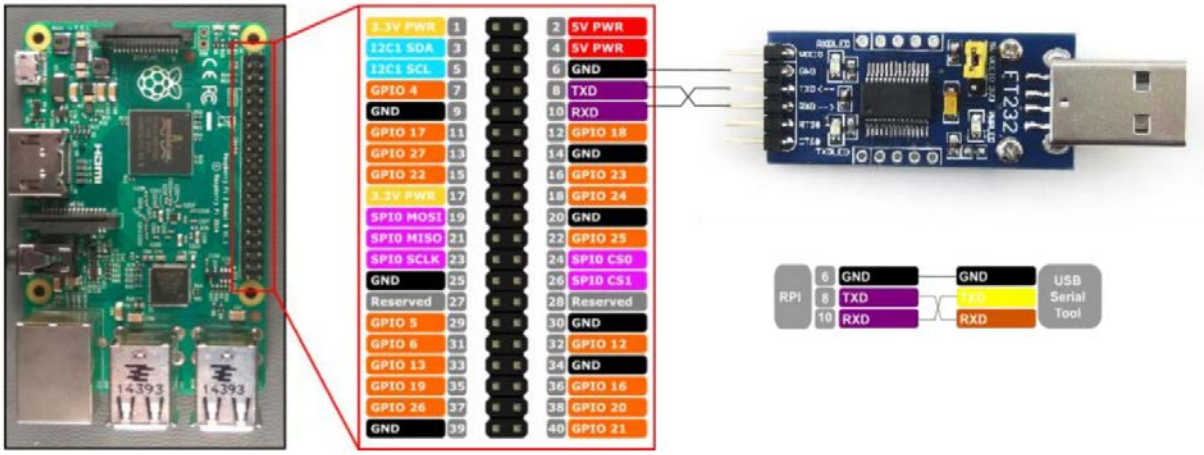
Since there are many interfaces here, it is necessary to know the capabilities of these interfaces. Please refer to the following figure for details.



- 1 **Micro-USB Input:** The whole system use this Micro-USB interface for power supply.
- 2 **USB HOST Connector:** Output power to supply for Raspberry Pi
- 3 **Raspberry Pi power input:** Input power for Raspberry.
- 4 **HDMI:** HD digital video output interface.
- 5 **Headphone jack:** 3.5mm Headphone jack
- 6 **Ethernet interface:** You can use the Ethernet interface to connect this system to the Internet. Or you can use Wifi after you configured the wireless network.

Hardware connection¶

- Step 1. Plug **Gateway module RHF0M301–868** into **PRI 2 Bridge RHF4T002**.
- Step 2. Plug **PRI 2 Bridge RHF4T002** into **Raspberry Pi 3**.
- Step 3. Connect 2 and 3 via the 20cm Micro-USB cable.
- Step 4. Connect the **USB to UART Adapter** to the GPIO of **Raspberry Pi 3**. Please connect them as the picture shown below.



- Step 5. Plug the **USB to UART Adapter** into your PC.
- Step 6. Connect 1 with 5V/2.1A Standard Adapter via 100cm Micro-USB cable.

When you finished all the steps, the whole system should be like the picture below.

Software¶

Software Tool¶

In the following guide, below tools will be needed, please install it to your computer.

- **Arduino**, portable serial tool, used to open the serial port of Seeeduino LoRaWAN with GPS (RHF76-052AM) and send AT commands to it.
- **PuTTY**, terminal tool include both serial and SSH terminal, used to control Raspberry Pi.
- Internet browser, used to access RHF2S001 integrated LoRaWAN server (It is recommended to use Chrome or Firefox).

Note
You may have your other favorite serial tools,of cause you can use them.However if you are not sure about your tools.Pleae use the ones we recommend.

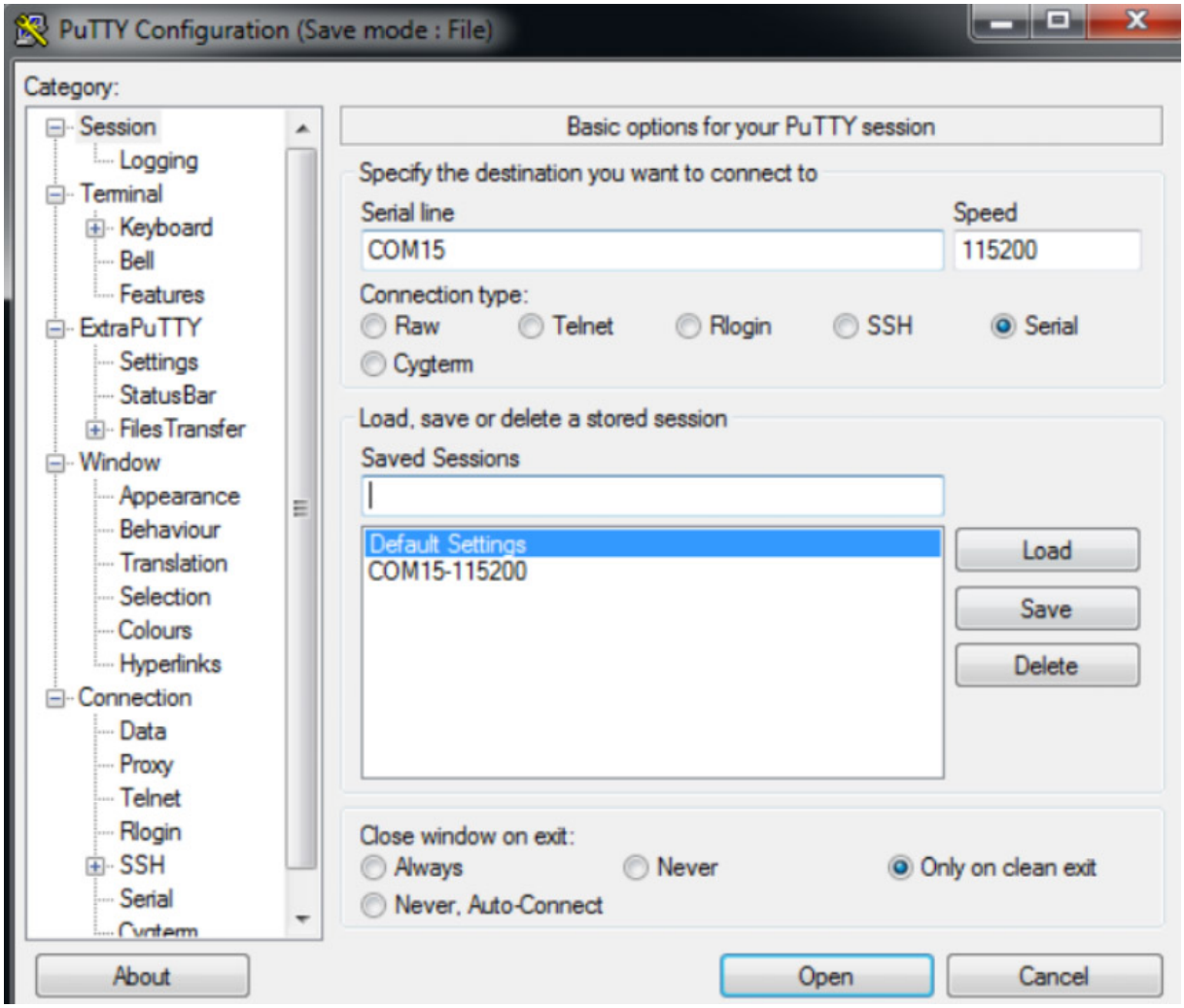
Connect To Local Server¶

Step 1. Power up and connect to putty¶

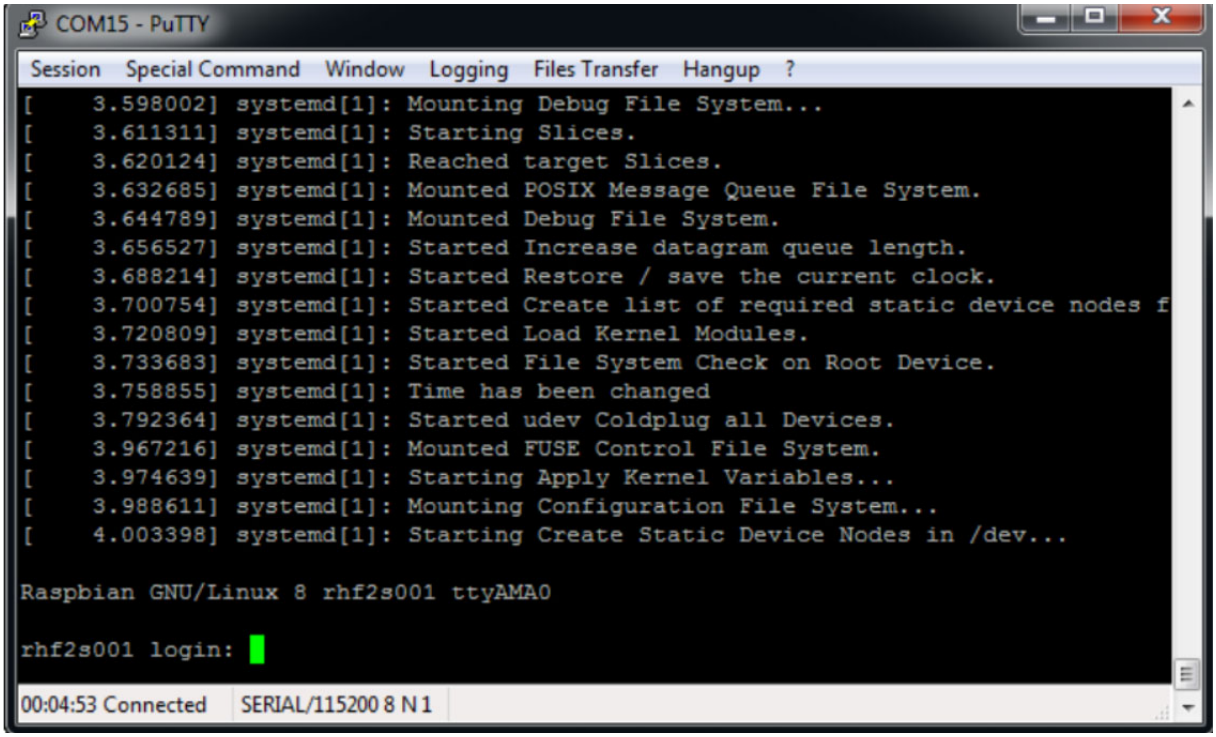
a) First, make sure the serial tool and RPi (RHF4T002 Adapter) are connected correctly.

b) Plug FT232 tool to PC (If COM port is not recognized correctly, please refer to Virtual COM Port Drivers)

c) Open **Device Manager** of your PC to get the right COM port. Like COM15 for example. Configure ExtraPuTTY according to below picture (Speed 115200, others use defaults), click **Open**. As the gateway is still not opened, so there is nothing in the terminal.



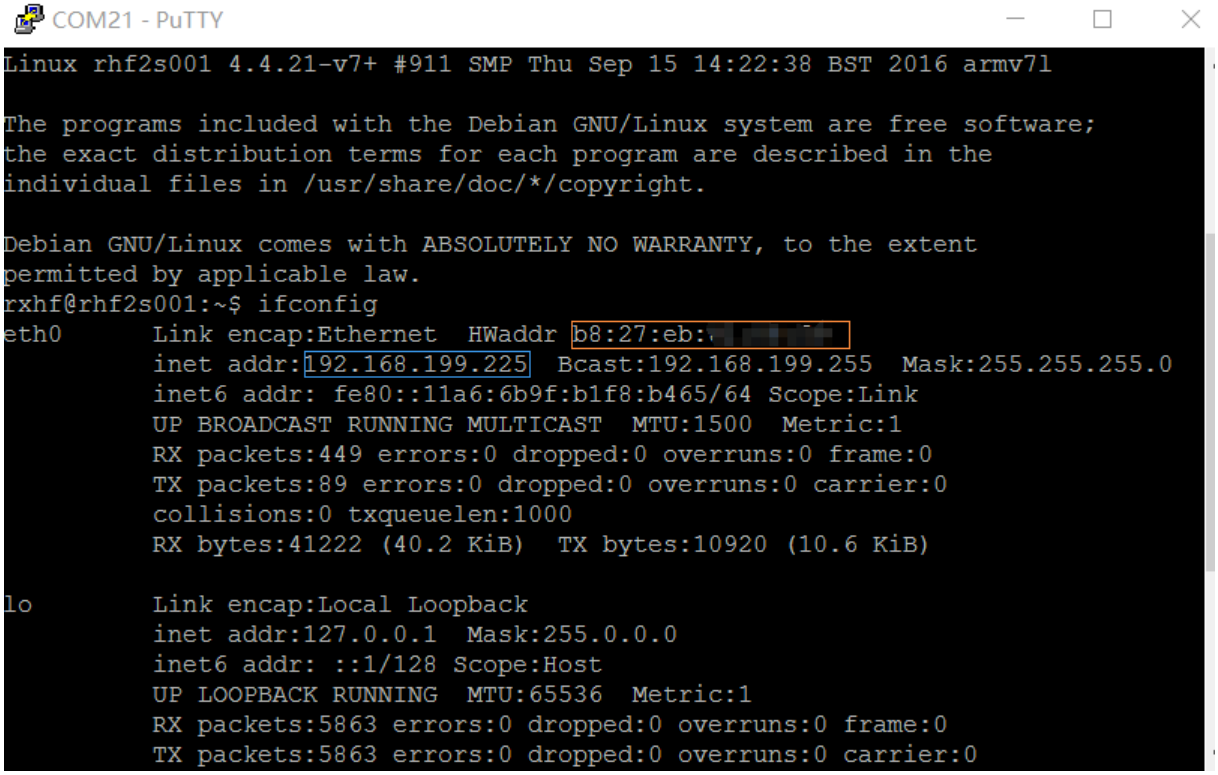
d) Power the gateway up. Booting log will be showed in the PuTTY terminal, in the end it will prompt you to input your log in name. Please note it takes 1 or 2 minutes to get the prompt information.



e) Please use RHF2S001 default user name and password to log in. (Username: **rxhf**, Password:**risinghf**). Note, when input the password, there is no any echo

f) Connect RHF2S001 with router through ethernet cable

g) Run **ifconfig** to check the ip address and mac address.



IP IS IN THE BLUE SQUARE, MAC ADDRESS IS IN ORANGE SQUARE (FORMAT: B8:27:EB:XX:XX:XX)¶

Note
After you get the IP, it is recommended to login RHF2S001 again through SSH. Because SSH is faster (Ethernet than UART) and stable. We normally use serial tool to get the IP. Reopen PuTTY, use the SSH module to connect again.

To login through SSH, you need to fill in the Hostname with the IP address you've just got.And use port 22,choose the SSH connection type. Just leave the other options by default. Then simply click **Open**.

Step 2. Expand SD Card File System¶

By default, the image enables only 2GB for Raspbian System, it is recommended to expand to use the whole SD card (8GB or 16GB). Or the SD card will be full soon. Run below command in the PuTTY terminal to start raspi-config,

```
1sudo raspi-config
```

Choose “Expand Filesystem”, when finished reboot to make it effect. Run below command in the PuTTY terminal to know the SD card capacity and usage.

```
1df -h
```

Please refer to Raspberry Pi raspi-config tool instruction for details.Click here see more.

Step 3. Use RHF2S001 integrated LoRaWAN server¶

a) Connect Gateway with internal server

Run below commands in the PuTTY terminal, and check the status:

```
1sudo systemctl status pktfwd
```

If pktfwd service is not active, run below command to start it:

```
1sudo systemctl enable pktfwd
2sudo systemctl restart pktfwd
```

b) Frequency Plan

Frequency Plan for EU868

	EU868	Uplink DR
CH0	867.1	DR0 ~ DR5
CH1	867.3	DR0 ~ DR5
CH2	867.5	DR0 ~ DR5
CH3	867.7	DR0 ~ DR5
CH4	867.9	DR0 ~ DR5
CH5	868.1	DR0 ~ DR5
CH6	868.3	DR0 ~ DR5
CH7	868.5	DR0 ~ DR5

Frequency Plan for US915 HYBRID

	US915	Uplink DR
CH0	902.3	DR0 ~ DR3
CH1	902.5	DR0 ~ DR3
CH2	902.7	DR0 ~ DR3
CH3	902.9	DR0 ~ DR3
CH4	903.1	DR0 ~ DR3
CH5	903.3	DR0 ~ DR3
CH6	903.5	DR0 ~ DR3
CH7	903.7	DR0 ~ DR3
CH64	903.0	DR4

c) RHF76-052AM Settings

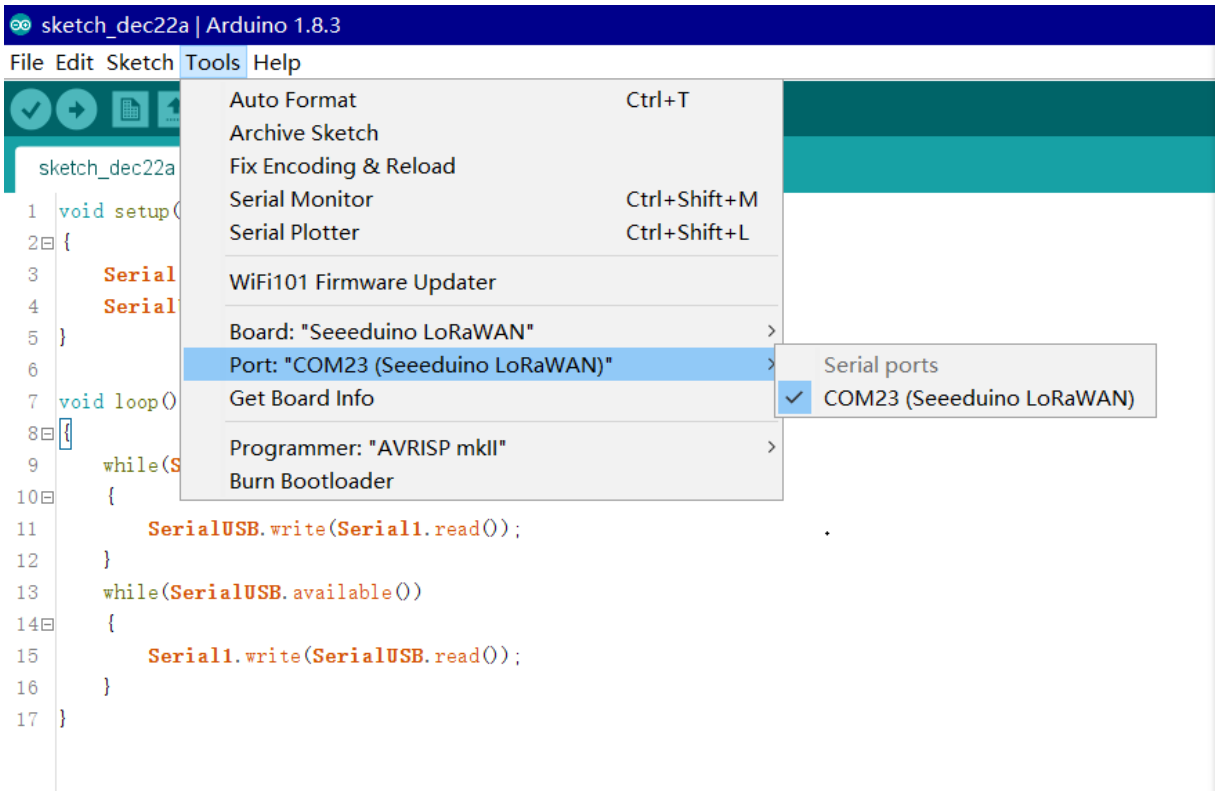
Now let's configure the Seeeduino LoRaWAN with GPS (RHF76-052AM).

- Firstly, you need to connect Seeeduino LoRaWAN GPS to your PC.
- Secondly, open the **Arduino** IDE, and copy the code blew into a new skech.

```
void setup()
{
    Serial1.begin(9600);
    SerialUSB.begin(115200);
}

void loop()
{
    while(Serial1.available())
    {
        SerialUSB.write(Serial1.read());
    }
    while(SerialUSB.available())
    {
        Serial1.write(SerialUSB.read());
    }
}
```

- Then choose the right serial port of Seeeduino Lora GPS, and choose the board **Tool->Board->Seeeduino_LoRAWAN**. After that you can click the upload button.If you can not find Seeeduino_LoRAWAN in the board list or do not know how to update the code,please click here for more information.



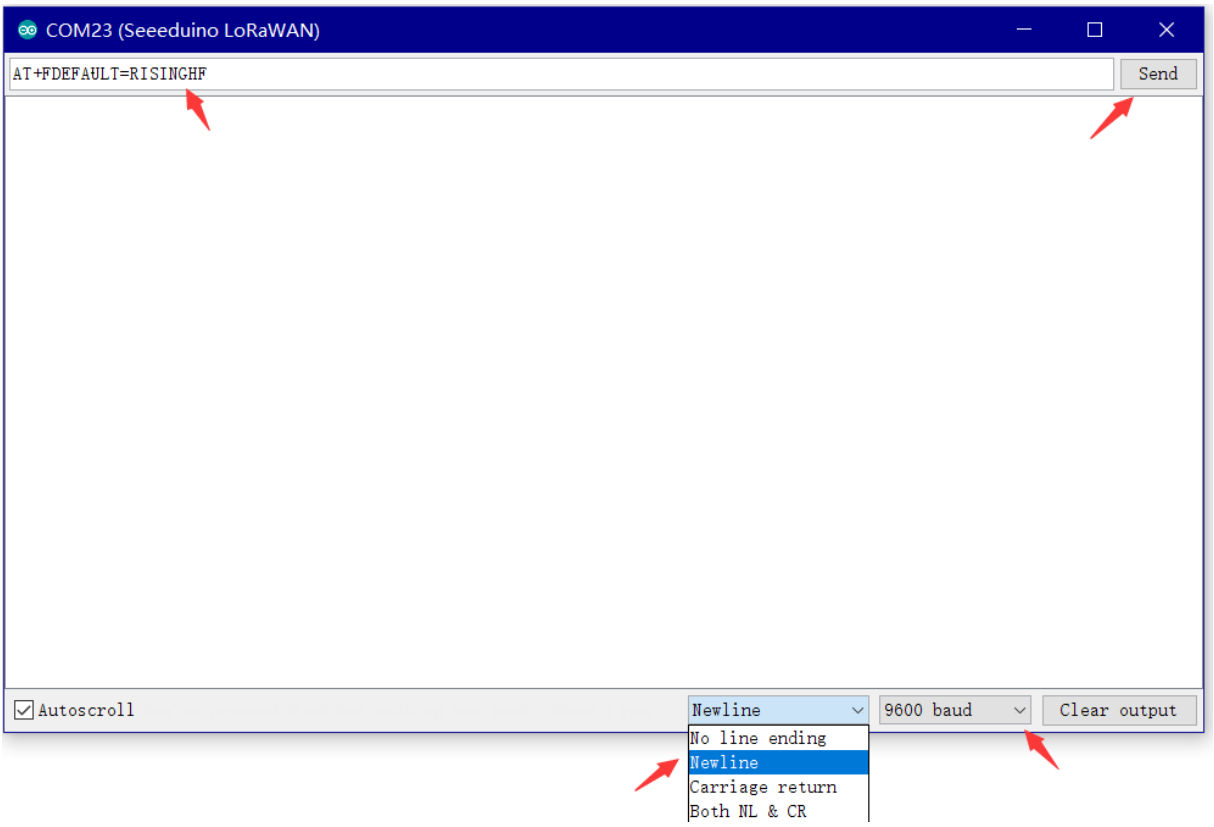
- Now please open the serial monitor in the upper right corner (or you can press Ctrl+Shift+M at the same time).Choose **Newline** (This option will add "\r\n" at the end of each command.), set the baud rate 9600.Then tap the commands below and press **send**.

For EU868

```
1AT+FDEFAULT=RISINGHF
2AT+DR=EU868
```

For US915

```
1 AT+FDEFAULT=RISINGHF
2 AT+DR=US915HYBRID
3 AT+RXWIN2=923.3,DR8
```

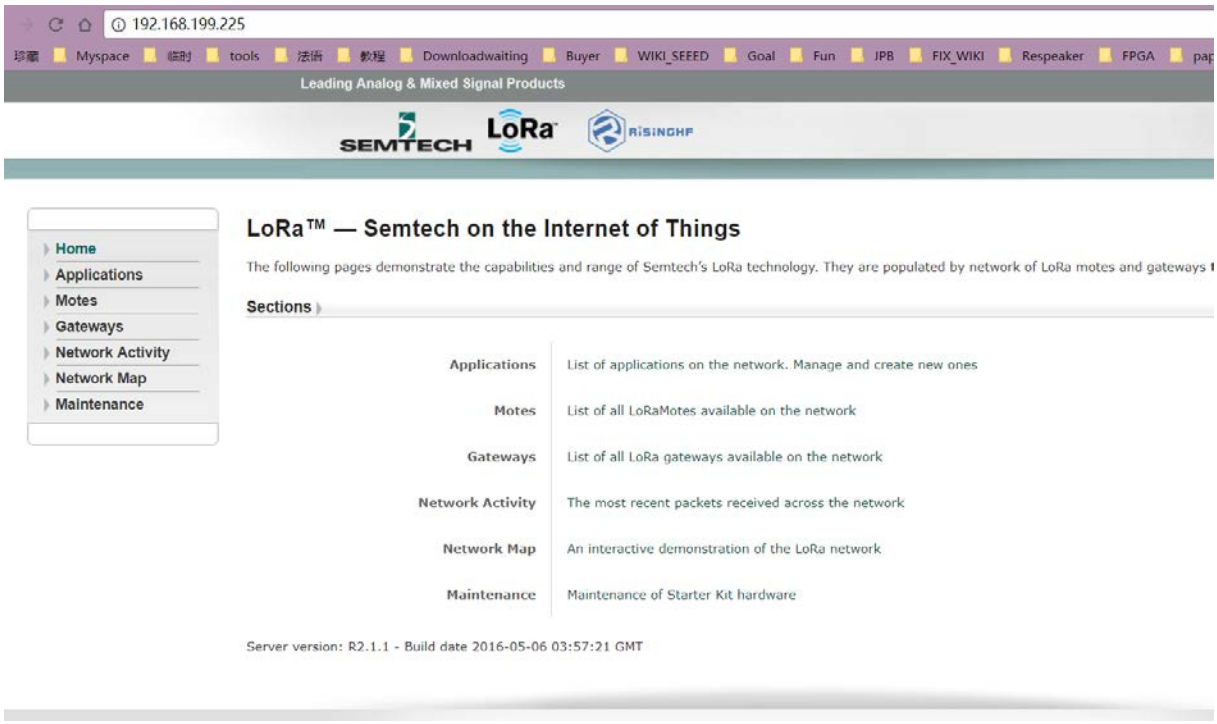


Caution

After you plug Seeeduino LoRaWAN with GPS into your computer, you may find two serial Ports. One is for raspeberry with putty, one is for Seeeduino LoRaWAN GPS with SSCOM, please choose the right one.

d) Access Internal Server Console

Fill your browser with the IP address (IP of your gateway) ,it Will jump to the website below.



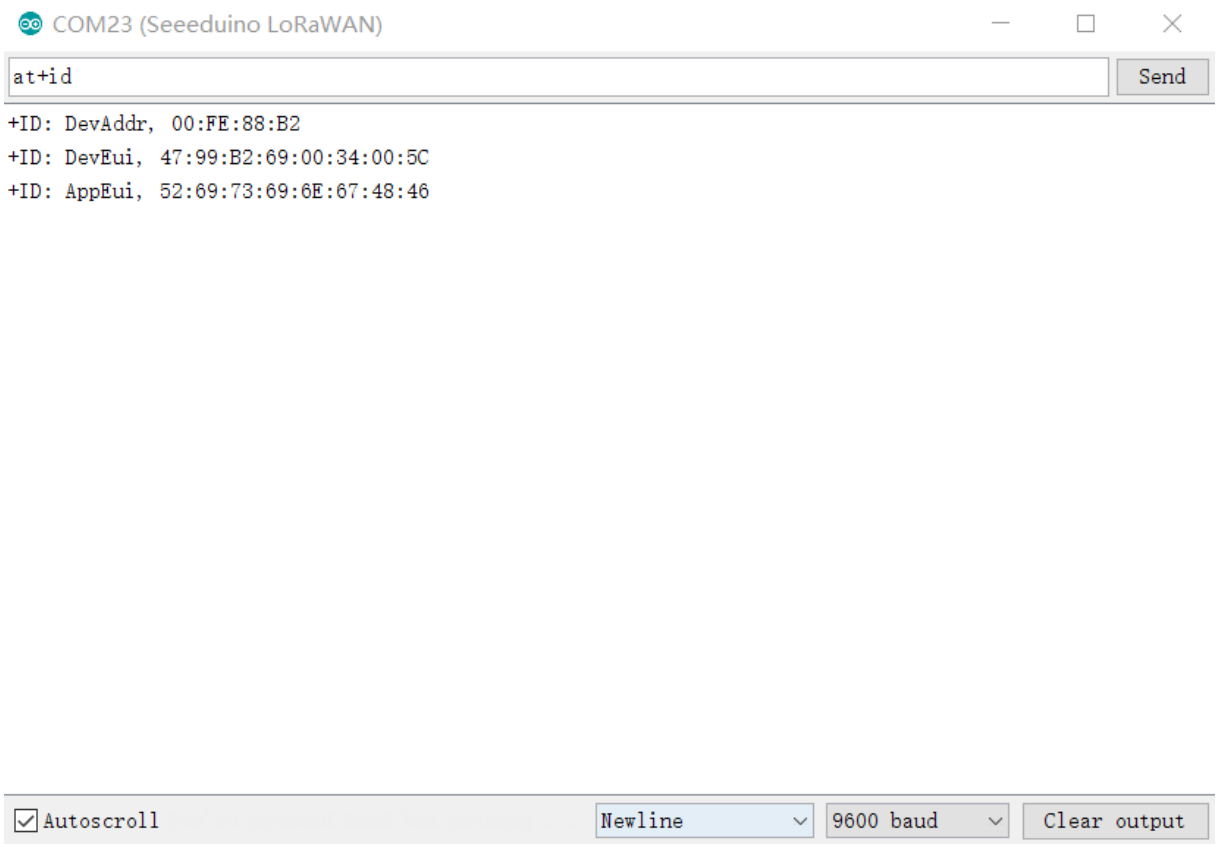
Step 4. Use Seeeduino LoRaWAN GPS(RHF76-052AM) access LoRaWAN server¶

There are two modes,in this wiki we only talk about the ABP Mode(This Mode is free for anyone),for more information about OTAA Mode(This model is commercial, you need to pay for it),you can click here.

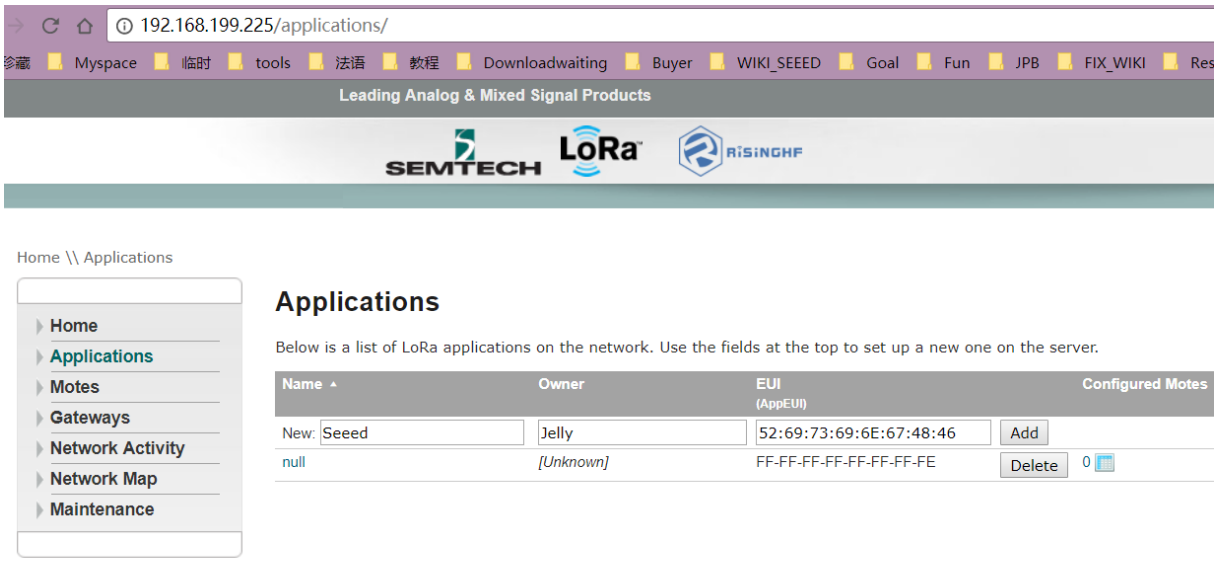
a) Find the "Application" button in the upper right corner of the website above, click it and you will see a new page.

b) Now you need **APPEui**,**DevAddr**,**DevEui** of Seeeduino LoRaWAN to add a new application. In order to get the ID information of Seeeduino LoRaWAN, you need to tap the command below in the serial monitor of Arduino IDE.Click **Send**, you will get the ID then.

```
1at+id
```

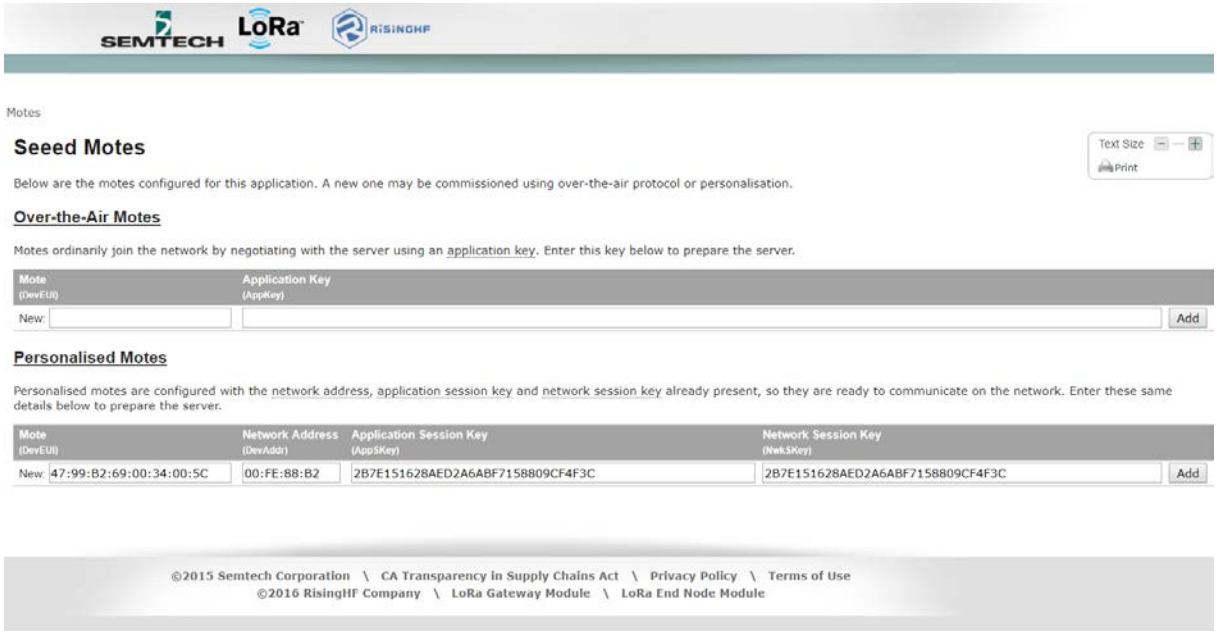


c) Fill in the blank with the ID info. you just get. You can fill in the name and owner as your wish (here we use Seeed and my nick name：), use the APPEui you've just got. Then click **Add** button.



Then you will jump into the configure page. In this page, we choose Personalised Motes. Fill in the **DevEUI** and **DevAddr** with ID info. of your Seeeduino LoRaWAN GPS. And set the **NWKSKEY**and **APPSKEY** by default. You can refer to the picture below.

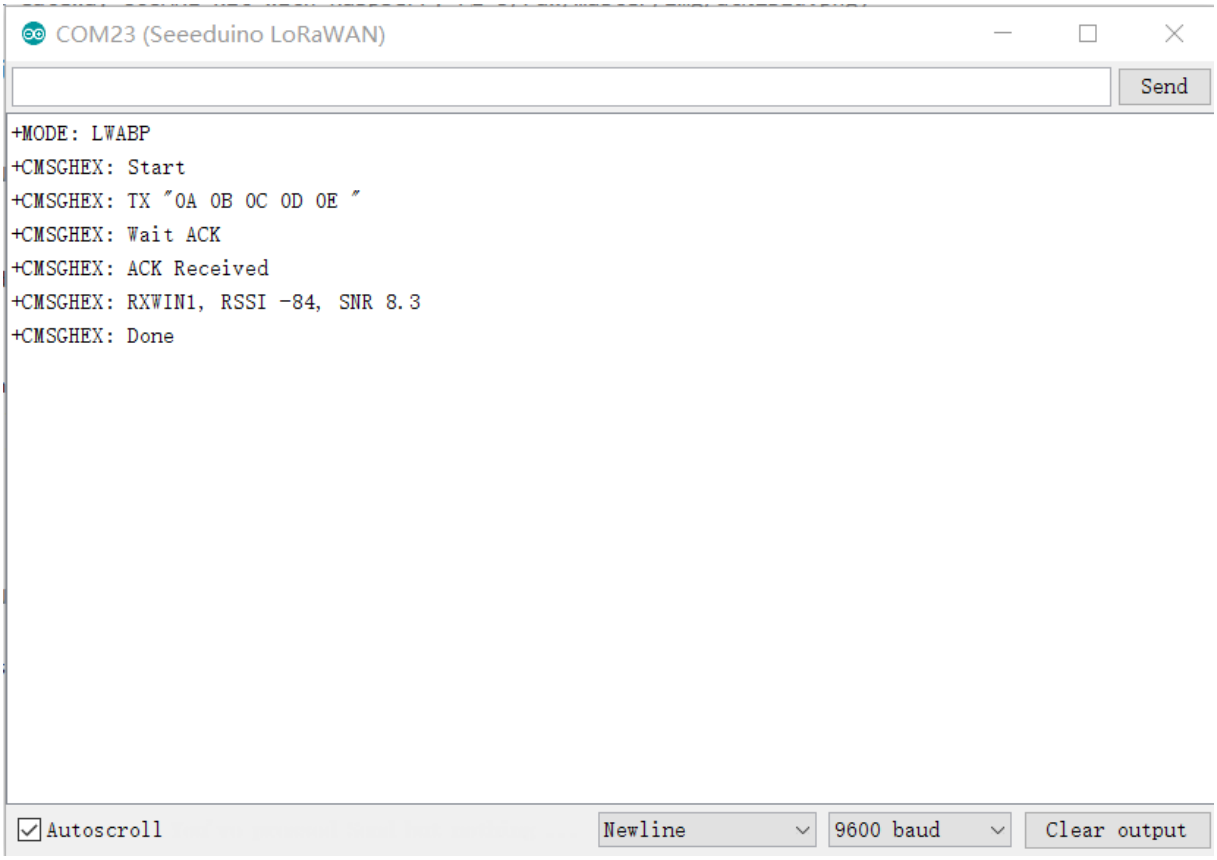
- DevEui： Seeeduino LoRaWAN GPS get through AT+ID command
- DevAddr: Seeeduino LoRaWAN GPS get through AT+ID command
- NWKSKEY：Default value 2B7E151628AED2A6ABF7158809CF4F3C
- APPSKEY：Default value 2B7E151628AED2A6ABF7158809CF4F3C



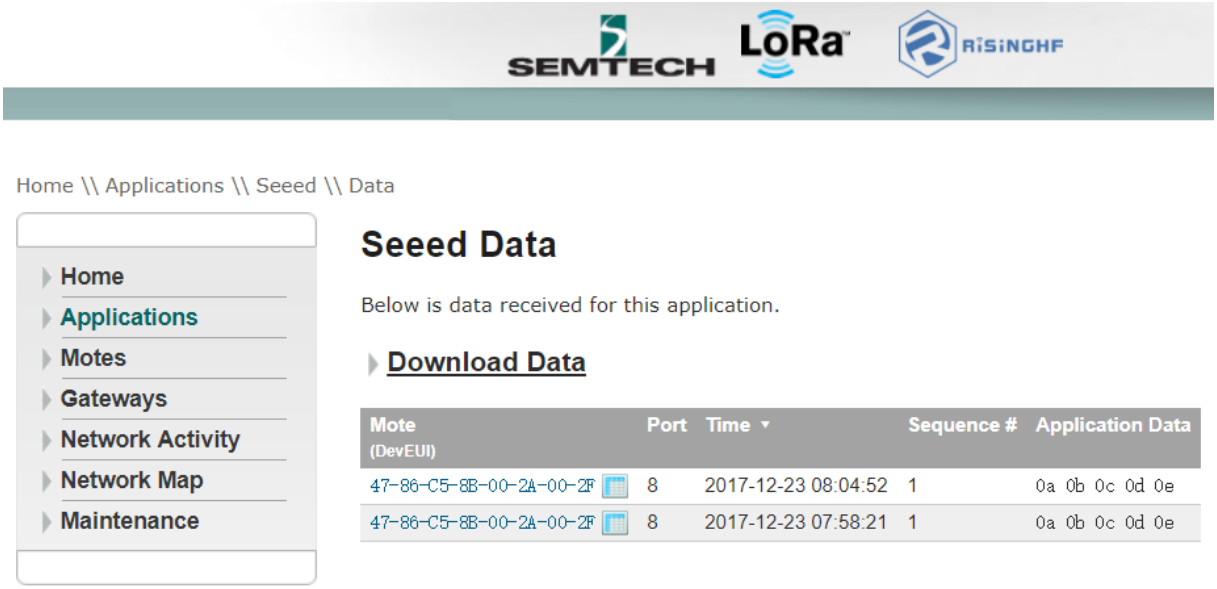
d) To test whether you add the device successfully, you can use the serial monitor of Arduino IDE tap the command below.

```
1at+mode=lwabp
2
3AT+CMSGHEX="0a 0b 0c 0d 0e"
```

It should like something below.



Then turn to the website, click **Application->Seeed(the name of the Application you just added)->View application data**, you will see the data you've just sent form the Seeeduino_LoRAWAN. congratulations! Job done!



Connect To Loriot Server¶

Step.1 Loriot Server Gateway Registration¶

a) New user need register an account first, click **registration address** . Fill in UserName, Password and email address to register, after registration an email will be sent to you, please follow the instruction in the email to activate.

b) After successful activation, click **here** to log in. Default tier is “Community Network”, it supports 1 Gateway (RHF2S001) and 10 nodes.

c) Enter **Dashboard -> Gateway**, click **Add Gateway** start to add Gateway.

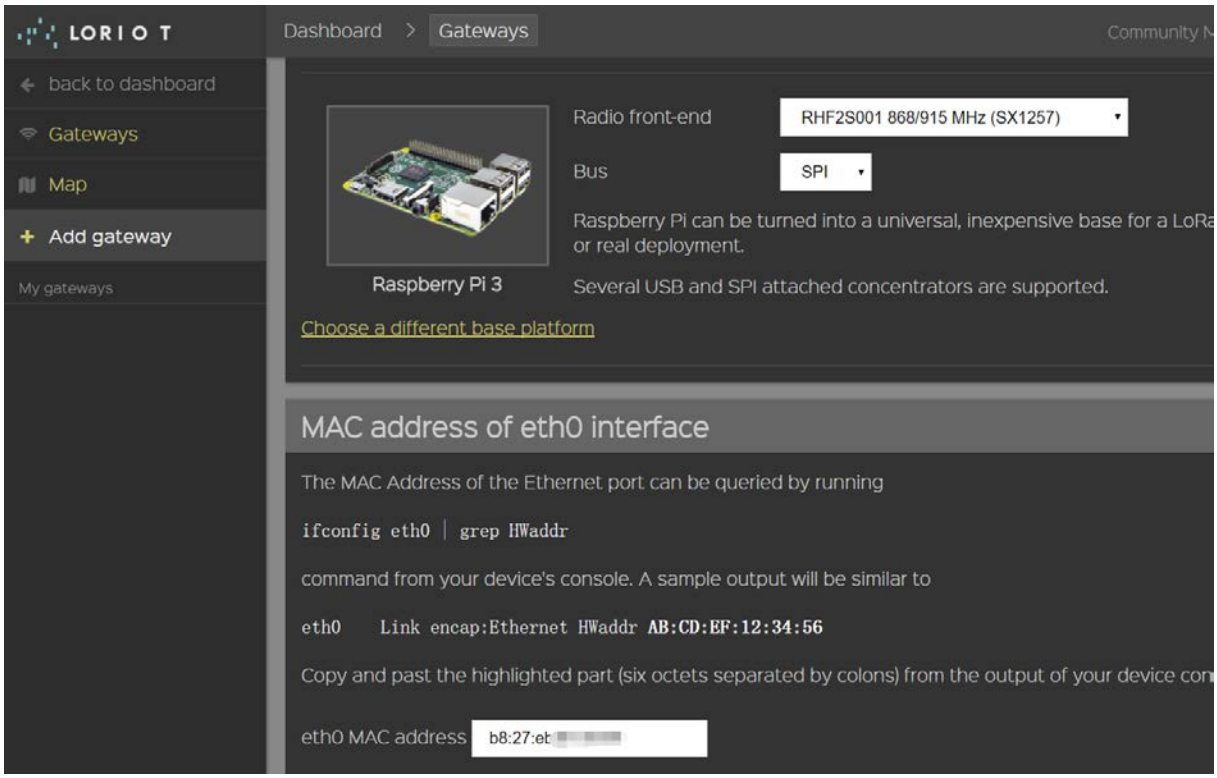
d) Select **Raspberry Pi 3**

e) Set as below:

- Radio front-end -> RHF2S001 868/915 MHz(SX1257)
- BUS -> SPI

f) Fill in the MAC address of your RHF2S001, should be in format of b8:27:eb:xx:xx:xx. And also input Gateway Location information.

g) Click “Register Raspberry Pi gateway” to finish the registration.

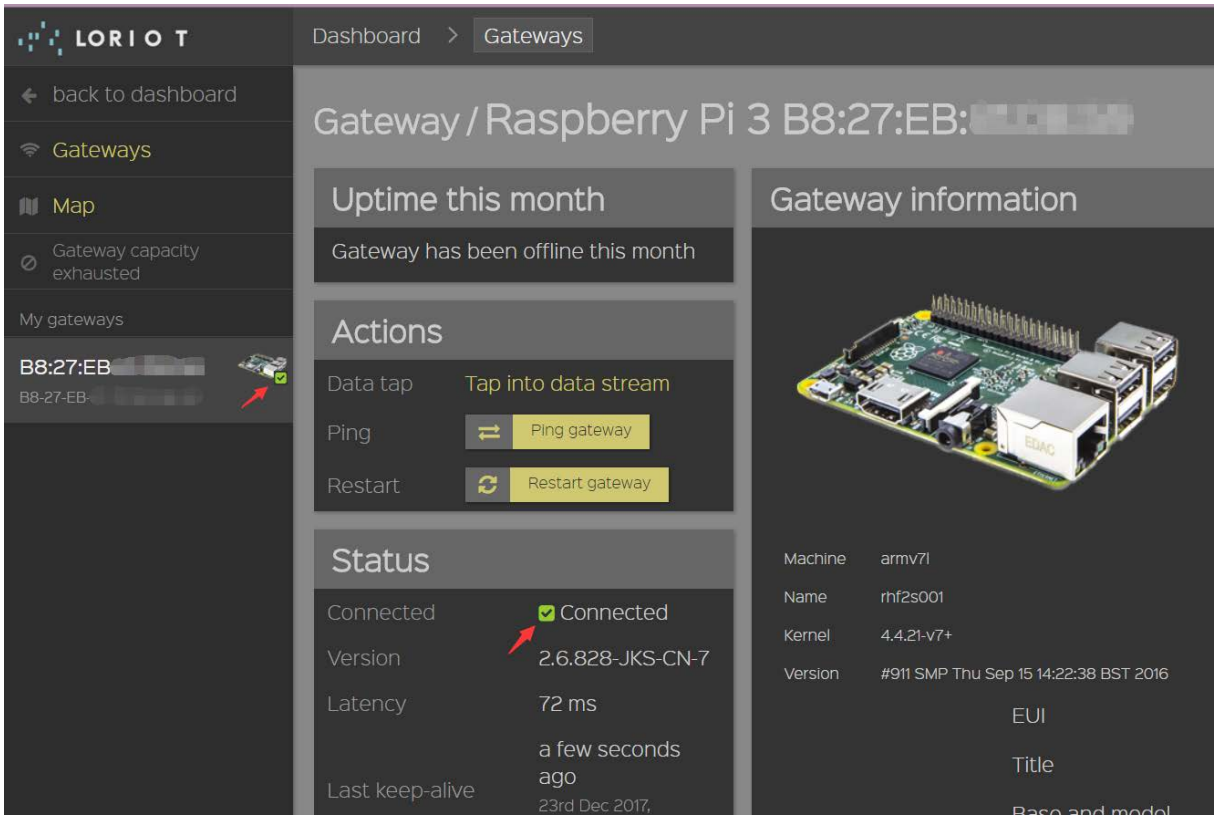


h) Click the registered gateway to enter configuration page, switch “Frquency Plan” manually, your plan here is decided by the type of your RHF2S001 type, available plan are CN470, CN473, CN434, CN780, EU868, after selected please refresh the page to get the exact channel.In this wiki we choose **EU868**.

i) Run the command in the putty terminal：

```
1cd /home/rxhf/loriot/1.0.2
2sudo systemctl stop pktfwd
3sudo gwrst
4wget https://cn1.loriot.io/home/gwsw/loriot-risinghf-rhf2s008-rhf1257-SPI-
50-latest.bin -O loriot-gw.bin
6chmod +x loriot-gw.bin
 ./loriot-gw.bin -f -s cn1.loriot.io
```

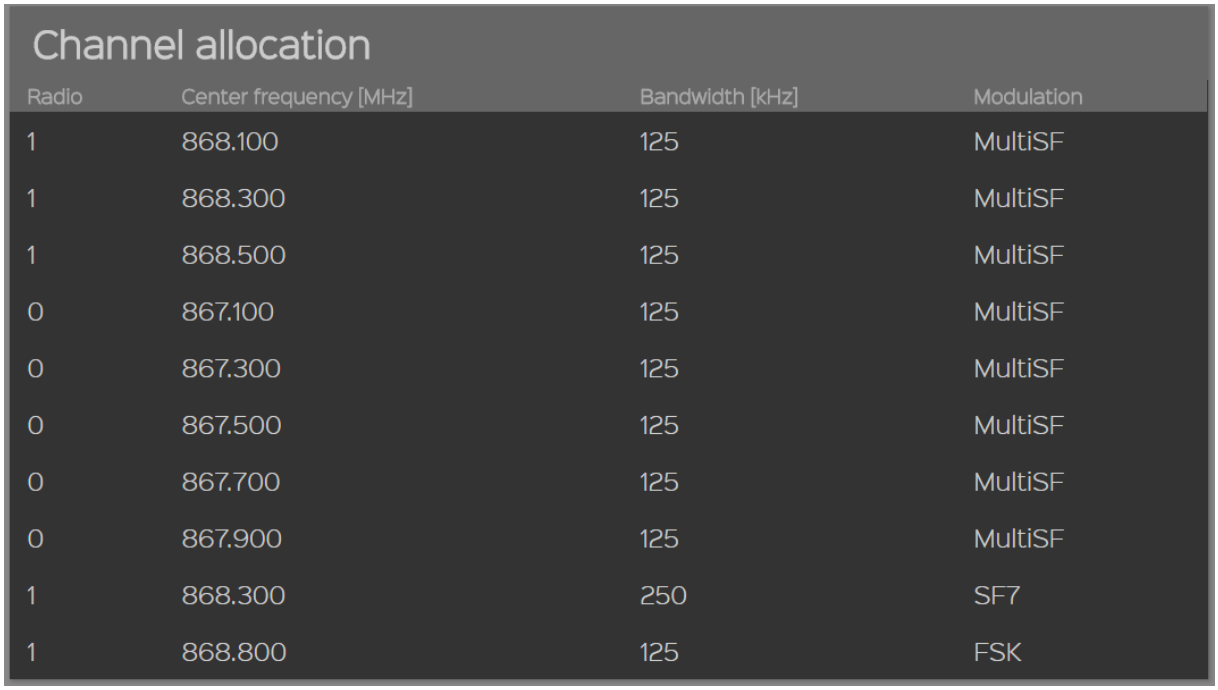
j) Finish gateway registration. You will see the gateway is Connected now. Next is to register node.



Step 2. Loriot Server Connect Node device¶

a) Get the available gateway channels

Current gateway channels could be got from **Dashboard -> Gateway -> Your Gateway** , you can see the available channels as the picture below.



Channel allocation

Radio	Center frequency [MHz]	Bandwidth [kHz]	Modulation
1	868.100	125	MultiSF
1	868.300	125	MultiSF
1	868.500	125	MultiSF
0	867.100	125	MultiSF
0	867.300	125	MultiSF
0	867.500	125	MultiSF
0	867.700	125	MultiSF
0	867.900	125	MultiSF
1	868.300	250	SF7
1	868.800	125	FSK

b) Seeeduino LoRAWAN GPS(RHF3M076) Configuration

Open the serial monitor of Arduino IDE, tap the command below.

```
1at+ch
```

To confirm the default channel of your Seeeduino_LoRAWAN GPS, you will get 3 channels. If there is no available channel, you can change the channels of Seeeduino_LoRAWAN by the command below.

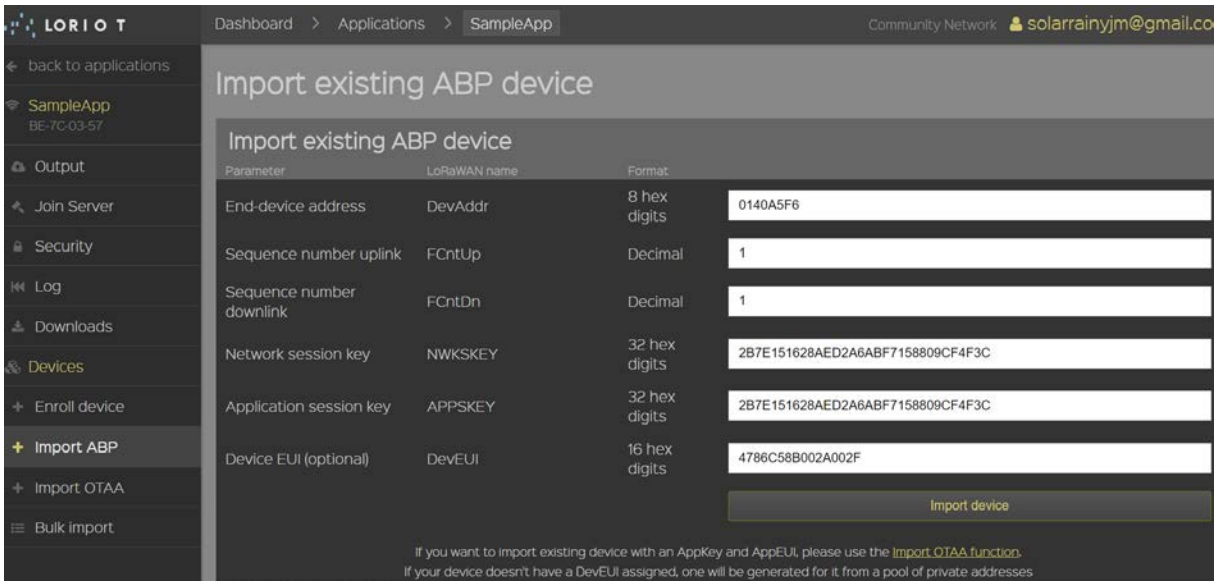
```
1at+ch=0,868.1
2at+ch=1,868.3
3at+ch=2,868.5
```

Then you can use **at+ch** again to check.

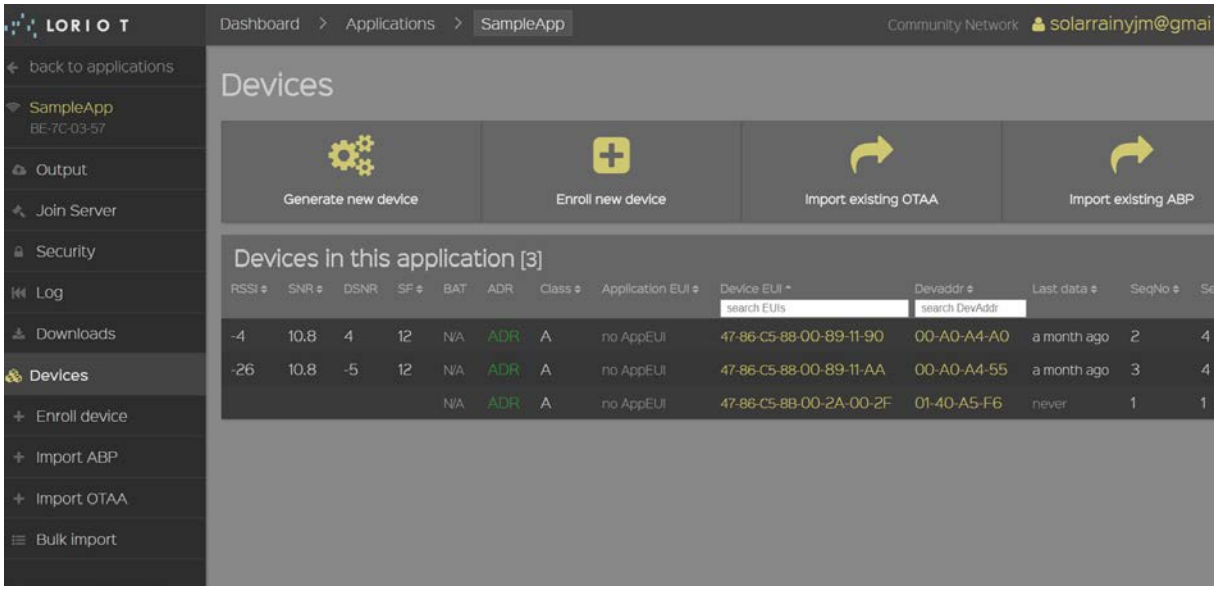
c) Add Seeeduino_LoRAWAN GPS as an ABP Node

Log in Loriot server , Click **Dash Board->Applications->SimpleApp** . Click **Import ABP** ， input below items：

- DevAddr: Seeeduino_LoRAWAN GPS get through "AT+ID" command (Note: Loriot doesn't support colon connector, need remove manually)
- FCntUp：Set to 1
- FCntDn：Set to 1
- NWKSKEY：Default value 2B7E151628AED2A6ABF7158809CF4F3C
- APPSKEY：Default value 2B7E151628AED2A6ABF7158809CF4F3C
- EUI：DEVEUI, Seeeduino_LoRAWAN GPS get through "AT+ID" command



Click **Import Device** button to finish the device import. Now choose **Dashboard -> Applications -> SampleApp** , you will see the new ABP Node you've just added.

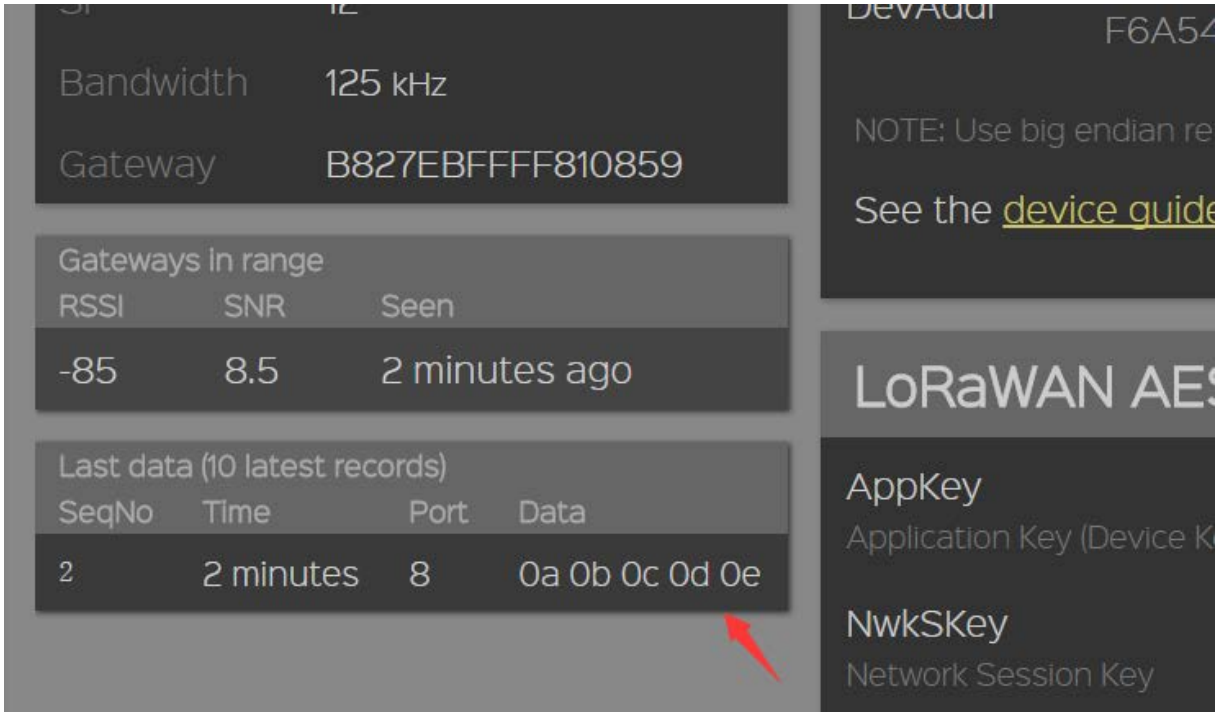


d) Send data from Seeeduino_LoRAWAN

Back to serial monitor of Arduino IDE, send command:

```
1AT+CMSGHEX="0a 0b 0c 0d 0e"
```

Then go to **Dashboard -> Applications -> SampleApp ->Device** , click the Node Device EUI or DevAddr, you will find the data you've just sent here.



.