Getting Started Guide for

LoRaWAN™ Developer Gateway RAK7244

Version V1.0 | December 2019

www.RAKwireless.com

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Table of Contents

1. Overview

This document complements the RAK7244 with LTE.

More document information please visit our official site, the document hub, the RAKwireless online store, and/or the forums:

https://www.rakwireless.com/en-int/

https://doc.rakwireless.com/

https://store.rakwireless.com

http://forum.rakwireless.com/

What do you need to prepare?

RAK7244 with LTE

https://store.rakwireless.com/

A 16G SD card, a card reader, and a PC.

Install a writing software on the PC which can be used to burn firmware onto the SD card, for example, you can use Etcher, which can be download freely from here:

https://www.balena.io/etcher/

Install an SSH tool on the PC If you are using Windows you can use Putty, which can be download freely from here:

https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html

If your OS is Linux or Mac OS, there is a built-in SSH tool already.

Download the latest firmware from RAK website (the name is “RAK7243_LTE…”):

https://downloads.rakwireless.com/en/LoRa/Pilot-Gateway-Pro-RAK7243/Firmware/Raspberry-Pi-4/

2. Burning the SD card

You can refer to this document for instructions on burning an image onto an SD:

http://docs.rakwireless.com/en/LoRa/RAK2245-Pi-HAT/Tool/How_to_write_LoRa_Gateway_Image_to_Micro_SD.pdf

When you complete it, insert the SD card into your LoRaWAN Gateway, and power it on.

3. Connecting to the Gateway

There are two ways to connect your PC with the LoRaWAN Gateway:

3.1. Wi-Fi AP mode

By default, the LoRaWAN Gateway will work in Wi-Fi AP mode which means that you can find a SSID named like “Rakwireless_XXXX” on the Wi-Fi network list, for example:

You can connect this Wi-Fi SSID by using “rakwireless” as the default password. The default IP address of the LoRaWAN Gateway’s Wi-Fi is 192.168.12.1, and your PC will obtain an IP address automatically from DHCP if it connects successfully.

3.2. Ethernet cable

You can also connect your PC with the LoRaWAN Gateway through an Ethernet cable. By default, the IP address of the LoRaWAN Gateway’s Ethernet interface is 192.168.10.10, so you need to set the IP address of your PC’s Ethernet to the same network segment, for example, 192.168.10.20.

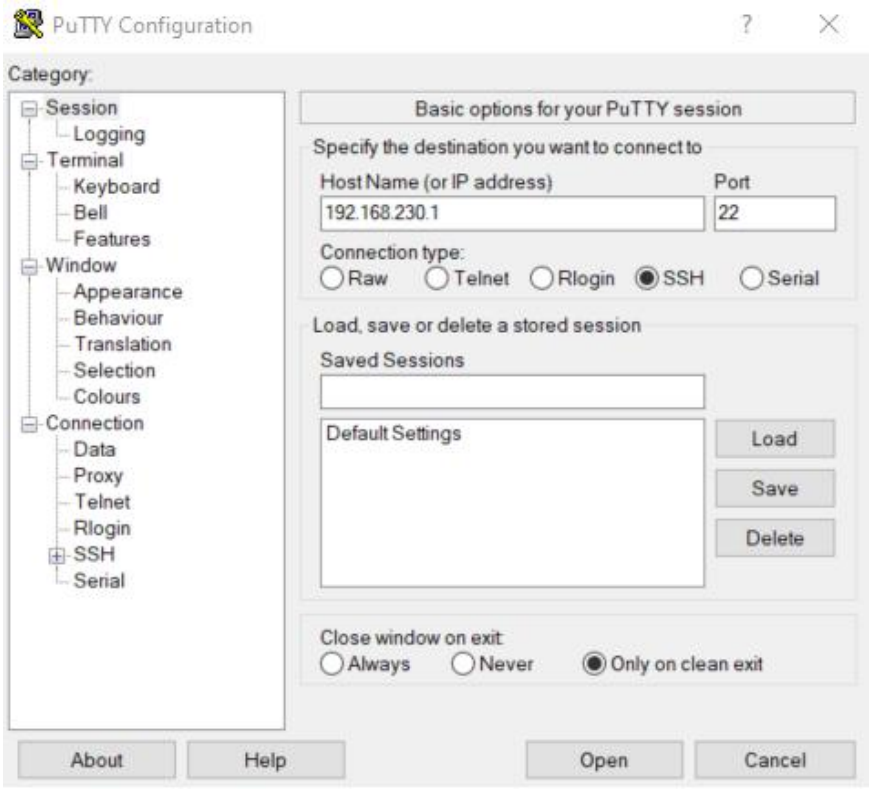
OK, now, you should be able to ping the LoRaWAN Gateway from your PC successfully. If this is indeed so, you can log into the LoRaWAN Gateway through SSH from your PC.

4. Logging into the Gateway through SSH

There are 3 possible cases depending on the OS you are using:

4.1. Windows

Open the SSH tool on your PC (in this document, we assume you are using Putty) and connect with the LoRaWAN Gateway through Wi-Fi AP mode which means the IP address is 192.168.230.1, as the following picture shows:



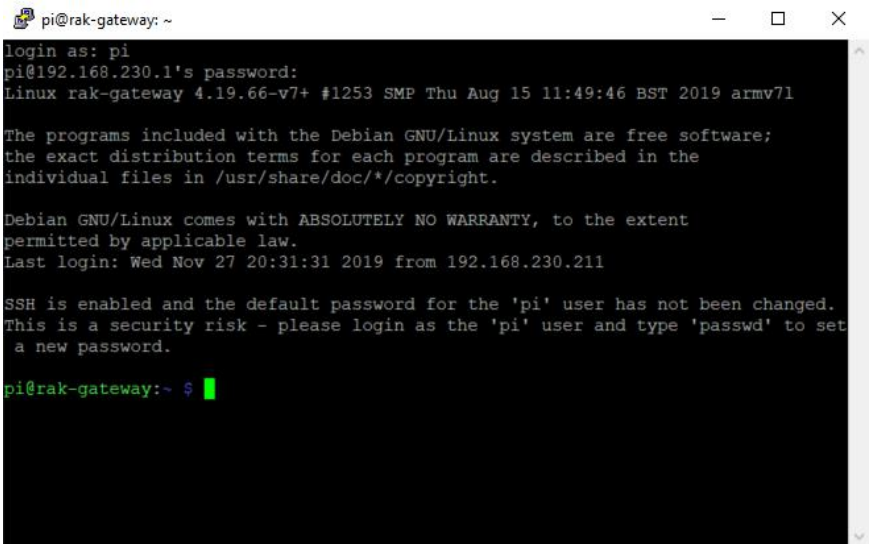
Note: If you connect with the LoRaWAN Gateway through an Ethernet cable, the IP address of should be 192.168.10.10.

Next enter the username and password:

The default username is “pi”, and the default password is “raspberry”.

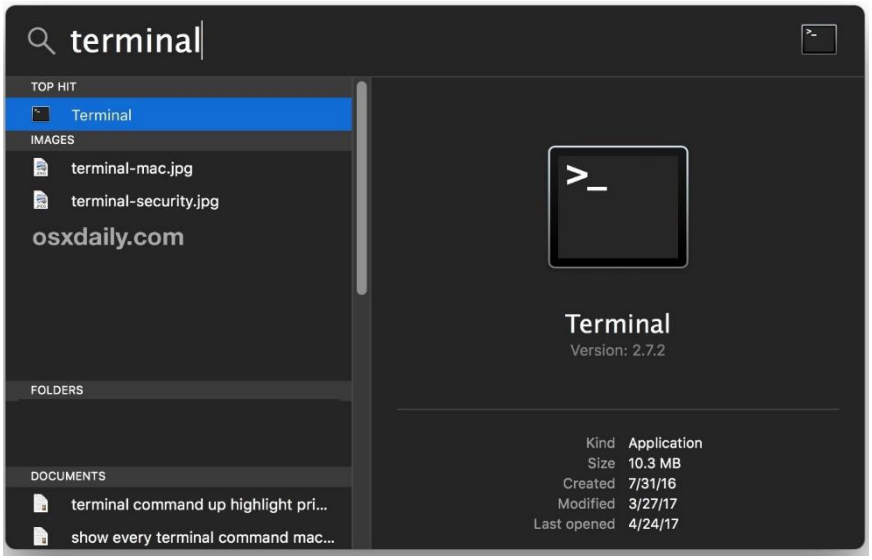
If there is a message to let you enter “yes” or “no”, choose “yes”.

OK, now, you have logged into the LoRaWAN Gateway through SSH successfully:



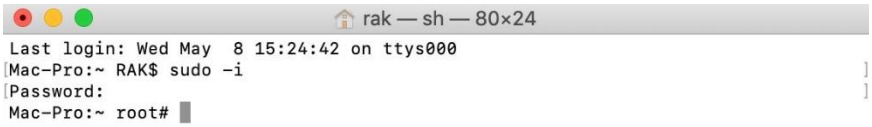
4.2. Mac OS

Open the terminal of Mac OS. Launch the Terminal application, which is found in /Applications/Utilities/ directory but you can also launch it from Spotlight by hitting Command + Spacebar and typing “Terminal” and then return:

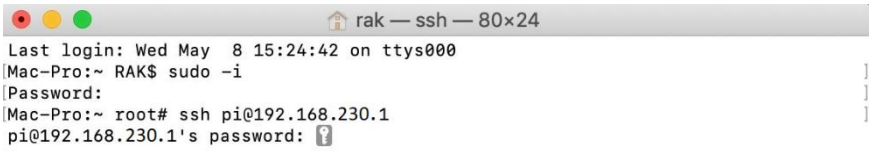


If you are not in root mode, please enter *“sudo -i”*:

Enter the password, and you will be in root mode:

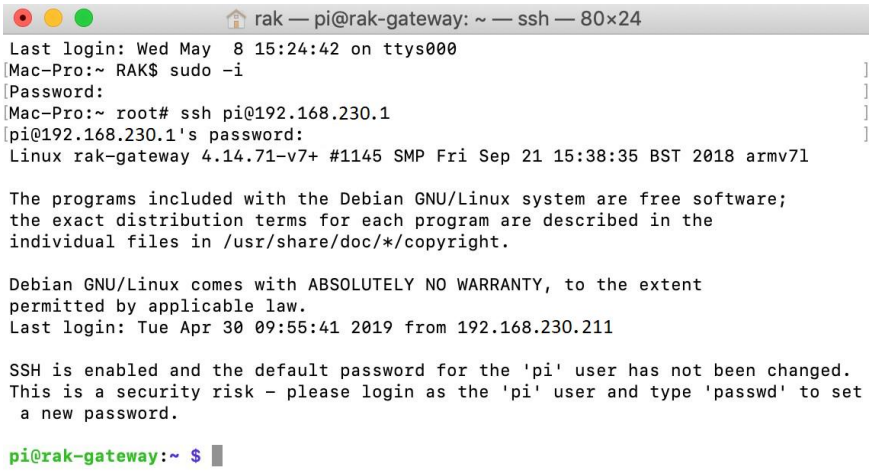


Enter “ssh pi@192.168.230.1” to logged into the LoRa Gateway, the default password is “raspberry”:



Note: If you connect your PC with the LoRa Gateway through Ethernet cable, you should enter “ssh pi@192.168.10.10” in this step.

OK, you have logged into the LoRa Gateway through SSH successfully:



4.3. Linux

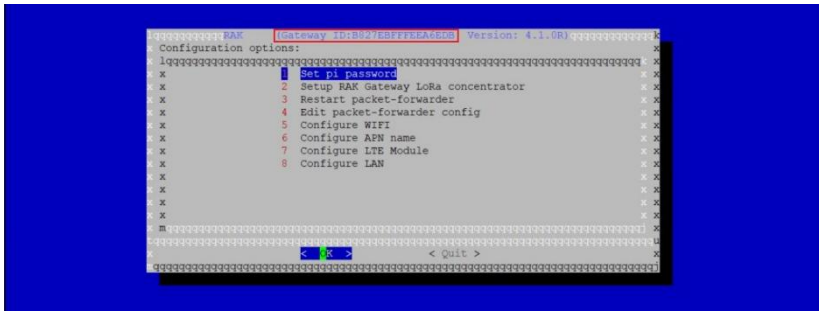
If you are using Linux the procedure is the same as the one for Mac OS.

5. Configuring the Gateway

You should now be logged into the Gateway's Raspbian OS.

Enter the following command to start the configuration wizard:

sudo gateway-config



Item 1

Set a new password for the Gateway;

Item 2

Configure the Regional Frequency which the Gateway will work on, and the LoRa Server which the Gateway will work with;

Item 3

Open the *global_conf.json* file, which includes the detailed configuration parameters (for advanced users only);

Item 4

Restart the Packet Forwarder process;

Item 5

Configure the Wi-Fi interface;

Item 6

Configure the Ethernet interface;

Item 7

Configure the APN name of pppd;

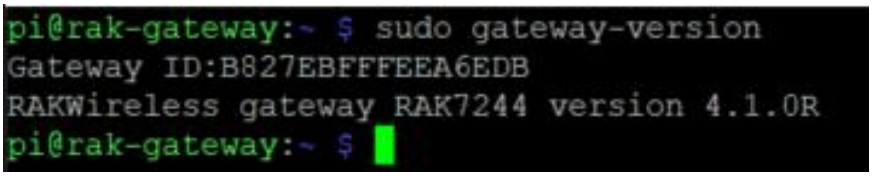
Item 8

Turn on/off the automatic LTE connection on boot.

Note: The Gateway ID (EUI) squared in red in the image above is an important parameter that you will need in order to register the device with a LoRa Server.

You can also get the Gateway EUI by entering the following command:

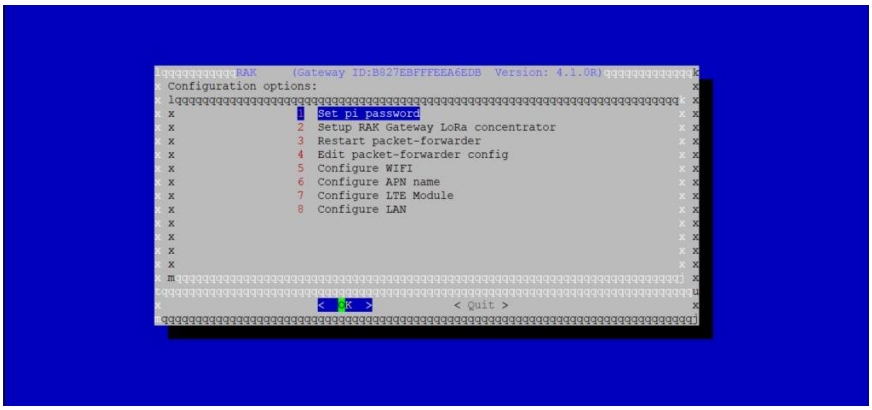
sudo gateway-version



5.1. Set a new password for the Gateway

The default password is “raspberry”, which is the same for all Raspberry Pi devices, so it is considered a good practice to change it.

So, choose “*1 Set pi password*” as in the picture below:

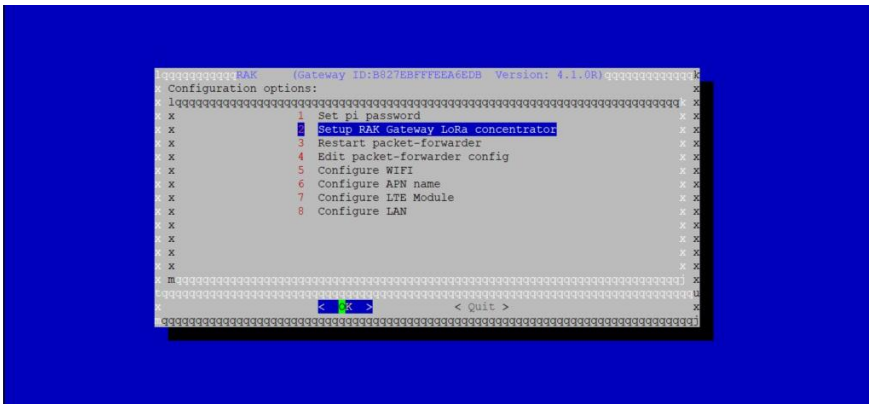


After pressing “*Yes*” you need to enter a new password twice:

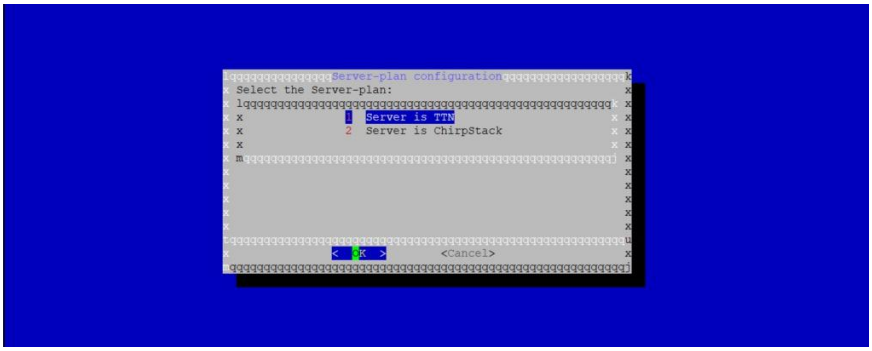
The figure below indicates that the change has been successful.

5.2. Configure the Regional Frequency and the LoRa Server

As the image below shows, choose "*Setup RAK Gateway LoRa concentrator*":

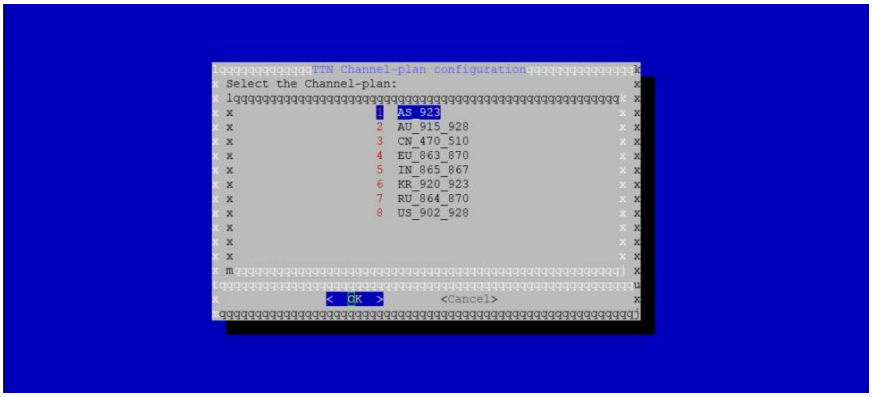


You can choose one of two supported LoRa Servers here: TTN or ChirpStack.



5.2.1. Server is TTN

If you choose TTN as the LoRa server, you will see the page below where you need to select your *Regional Frequency Band*.

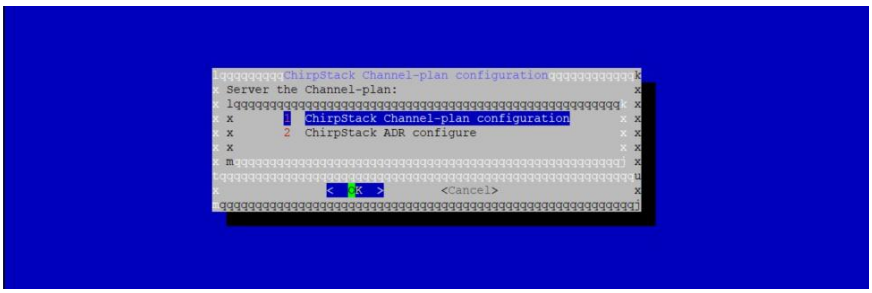


You should get the massage in the image below if all went right.

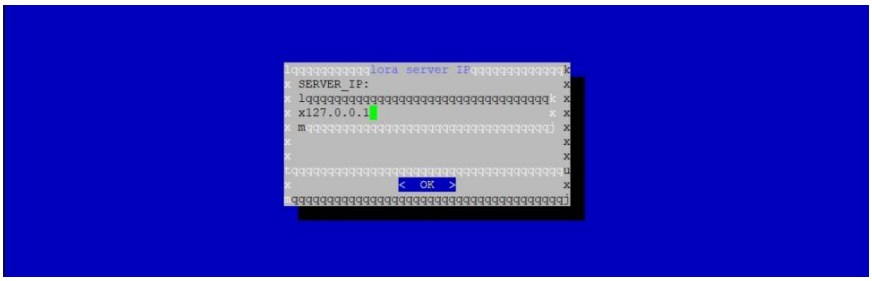
5.2.2. Server is ChirpStack

If you choose ChirpStack as the LoRa server, you will see the following page:

Choose Option 1 to select your *Regional Frequency Band*.

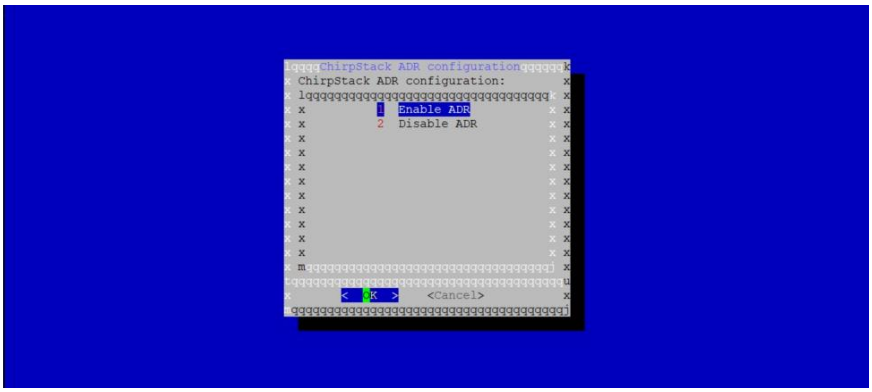


Next, you need to set an IP address of the ChirpStack which you want your LoRaWAN Gateway to work with:



The default IP address is “127.0.0.1” which means you will be using the built-in LoRa Server. If you want to use an independent LoRa Server running on another device or a cloud based LoRa Server, you need to set it to the corresponding IP address.

If you have instead selected Option 2 you can enable/disable the Adaptive Data Rate (ADR) functionality:



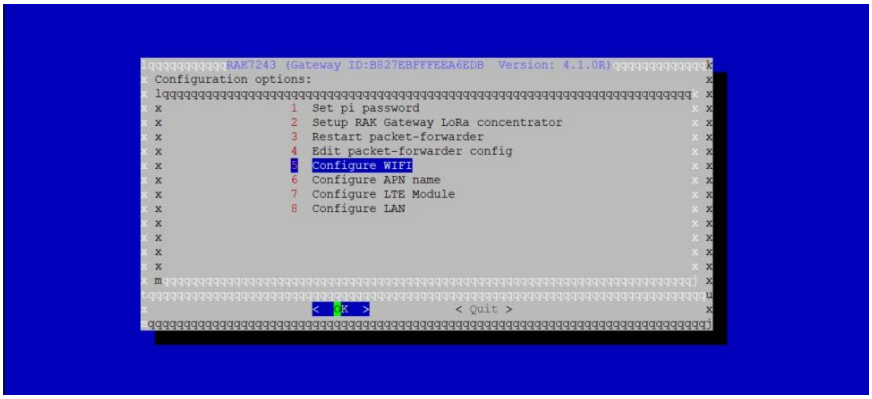
5.3. Connect the LoRaWAN Gateway to a router

If you want to use TTN or an independent LoRa Server which may be deployed in a local area network or in a remote one, you need to connect your LoRaWAN Gateway to a router.

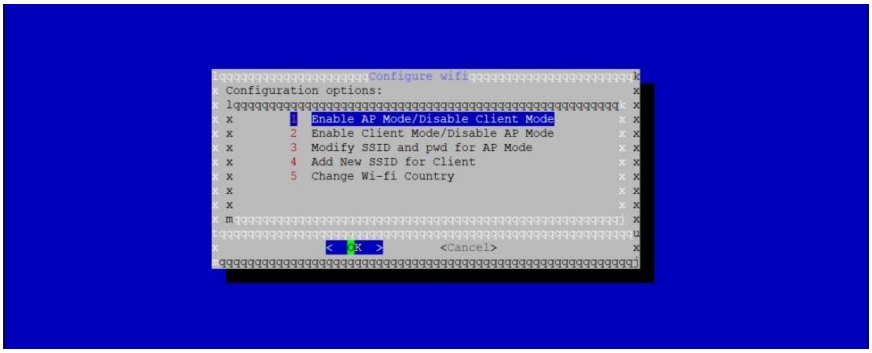
There are 2 ways to connect your Gateway to a router:

5.3.1. Connect to a Router via Wi-Fi

In the main configuration menu choose "*5 Configure WIFI*":

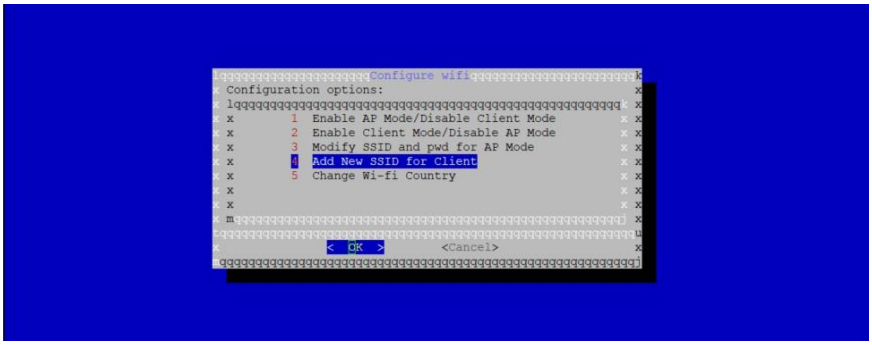


You will see the following page:



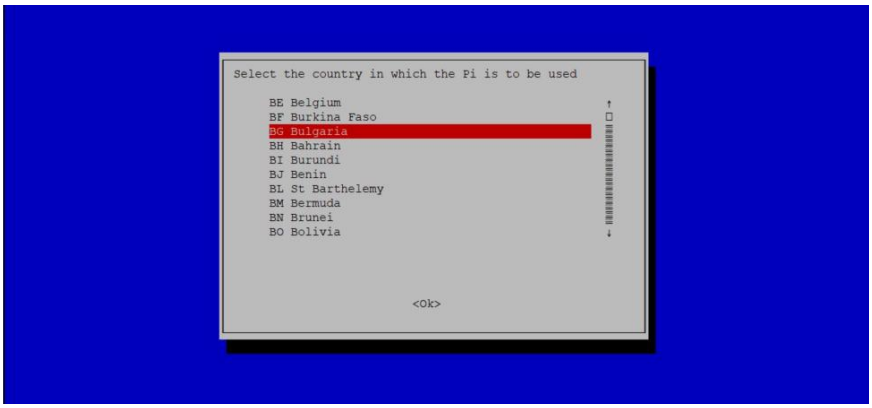
Note: Item 1 and Item 2 are used to set the Wi-Fi mode, which the Gateway works in. If you choose Item 1, it means that the Gateway will work in Wi-Fi AP Mode after rebooting, while the Wi-Fi Client Mode will be disabled. If you choose Item 2, it means that the Gateway will work in Wi-Fi Client Mode after rebooting, while Wi-Fi AP Mode will be disabled. Item 3 is used to modify the SSID and password of the Wi-Fi AP, and it is valid when the Gateway works in Wi-Fi AP mode. Item 4 is used to configure the Wi-Fi SSID and password, which the Gateway will connect using after rebooting, if the Gateway works in Wi-Fi Client Mode. Item 5 is used to change the Resident Country to match with Wi-Fi standards.

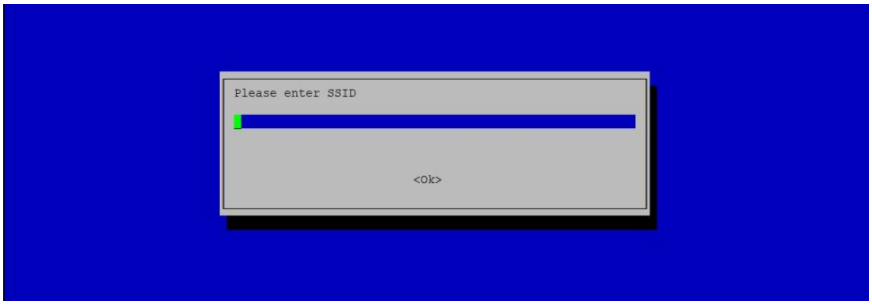
Choose Item 2 to enable Wi-Fi Client Mode, then choose Item 4 to configure the Wi-Fi SSID and password. Fill those in accordance with your router's Wi-Fi network credentials.

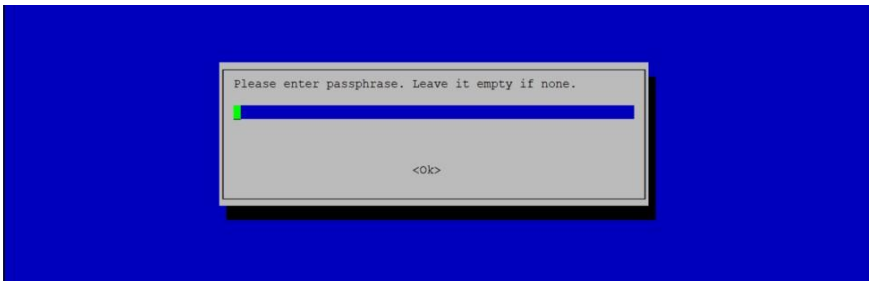


Remember that in order to enable Wi-Fi Client Mode, you have to first disable AP mode first (you will otherwise see the notification below):

One Wi-Fi AP Mode has been disabled you can enable and set up Wi-Fi Client Mode.
Start by selecting your country of residence, followed by the SSID, and lastly enter the passphrase:



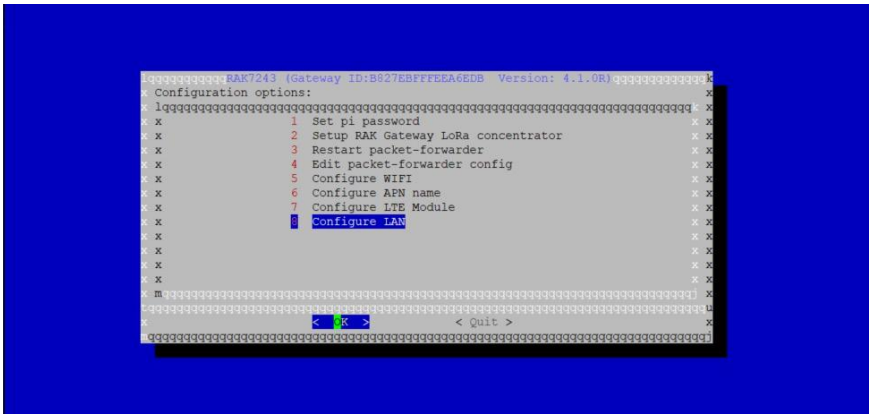




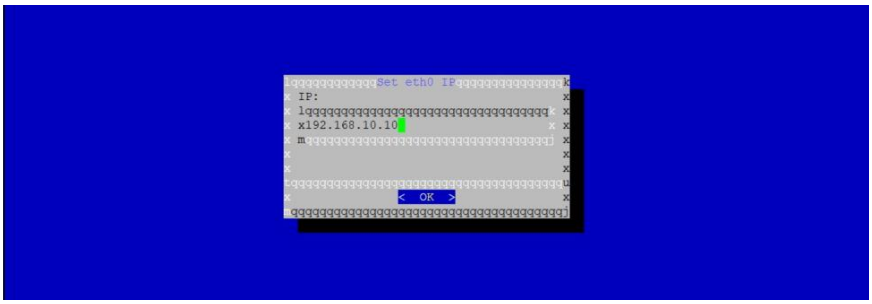
Once you are done with all of the steps above, you can reboot the Gateway. Once booted the system will automatically connect to the router using the Wi-Fi network.

5.3.2. Connect to a Router via the Ethernet interface

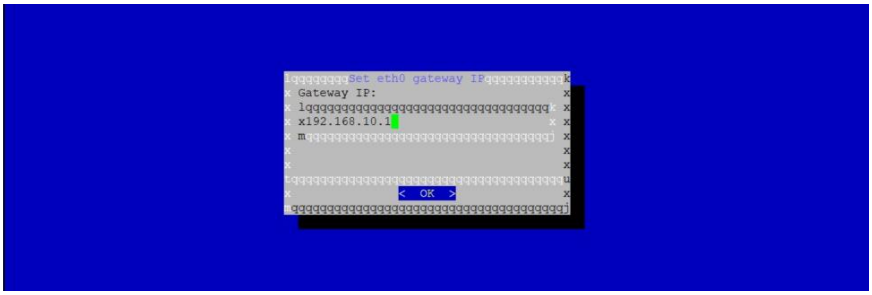
In the main configuration menu choose "*8 Configure LAN*". This will let you set up a static IP address for the Gateway's Ethernet adapter.



In the page that follows you need to fill in the IP address you want to assign to the Gateway. Keep in mind that the Gateway and the Router must be in the same network segment, otherwise the connection will fail. By default, the IP address of the Gateway's Ethernet card is 192.168.10.10:



Next, configure the Router's IP address. This is going to act as the Internet Gateway address for the LoRaWAN Gateway.



You should get a message as the one below, is all went without errors.

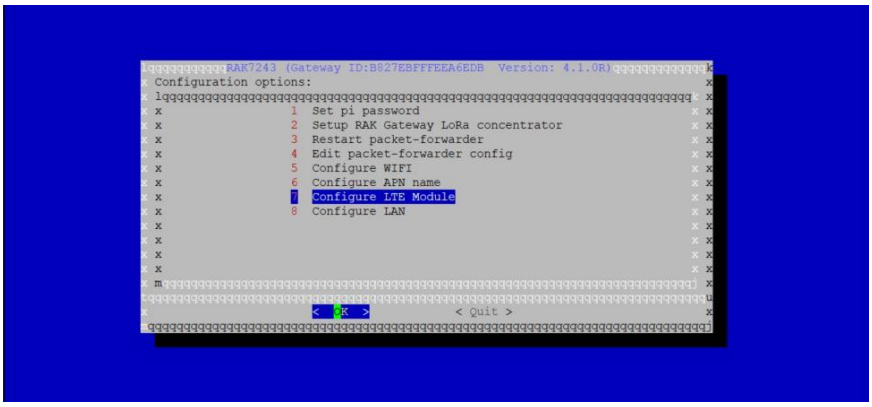
Now, just reboot the Gateway and it will connect to the Router through the Ethernet interface.

5.4. Connect to an LTE network

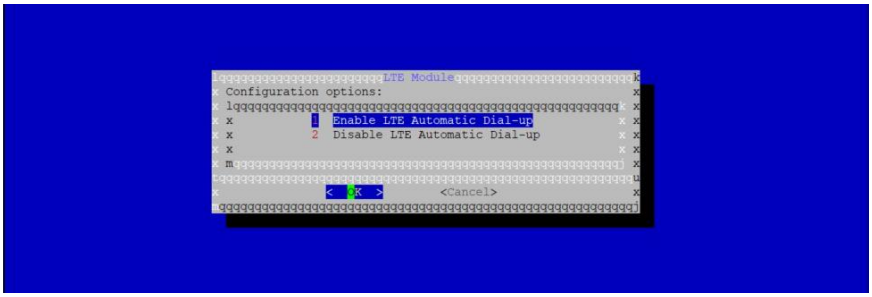
First, insert a SIM card of the appropriate type and size into the SIM card slot. Power on the Gateway.

Second, log into the Gateway through SSH, and enter the command "*sudo gateway-config*".

Then, in the main configuration menu choose "*7 Configure LTE Module*":



In the following menu you will have 2 options:



Item 1 enables automatic connection on start-up.

Item 2 disables automatic connection on start-up.

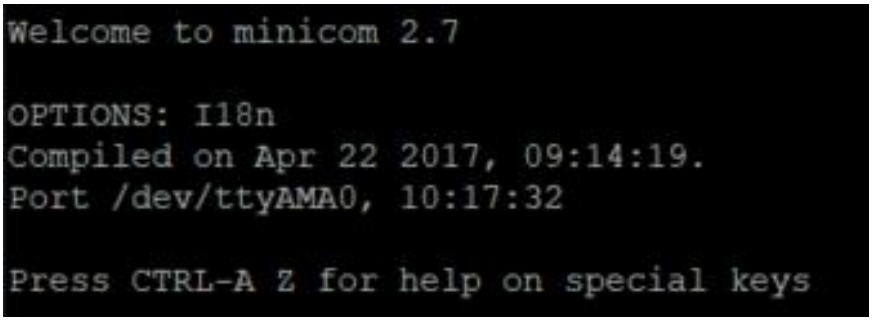
Note: By default, the first option is active, which means the Gateway will connect to LTE automatically when it starts up (provided it is properly configured).

Next, you need to configure the LTE network operator's information. Before starting, make sure to disable the automatic connection on start-up feature.

Execute the following command in the console:

```
pi@rak-gateway:~ $ sudo minicom -D /dev/ttyAMA0 -b 115200
```

This will start the minicom tool:



Try to enter the command “at”, if it returns “OK”, it means you have opened the serial port successfully:

Note: If you cannot see the “at”, which you just entered, try to hold “CTRL+A”, then press “Z”, then press “E”. This should allow you to go to the command entering mode.

Next, execute the AT command *“at+cops=?”* to query all LTE networks in range:

You might have to wait a couple of seconds. When done, you can see some information similar to what is shown below:

Note: The above picture is just an example that applies to China in Asia. You can see there are 3 LTE network operators, including China Mobile, China Unicom, and China Telecom. You can expect different results depending on your location (compare the picture below, which is for a location in Bulgaria in the EU).

```
OK
at
OK
at+cops=?
+COPS: (2,"VIVACOM","VIVACOM","28403",7),(1,"Vivacom BG","Vivacom","28403",2),(1,"Vivacom BG",
```

Next, execute the AT command *"at+cops=1,0,XXX,YYY"* to set the information of the LTE network operator that you want to use. "XXX" is the operator identifier, for example, "CHINA MOBILE", "CHN-UNICOM", or "CHN-CT" in the above picture ("Vivacom BG", "Telenor BG", or "Mtel" for the EU example). "YYY" is the last value of every operator, choose the one with the 0 value as this is the currently used network.

Now let's take the EU example this time:

```
at+cops=?
+COPS: (2,"VIVACOM","VIVACOM","28403",7),(1,"Vivacom BG","Vivacom","28403",2),(1,"Vivacom BG","Vivacom","28403",0)
```

Now using the command as described above for the example:

at+cops=1,0,XXX,YYY

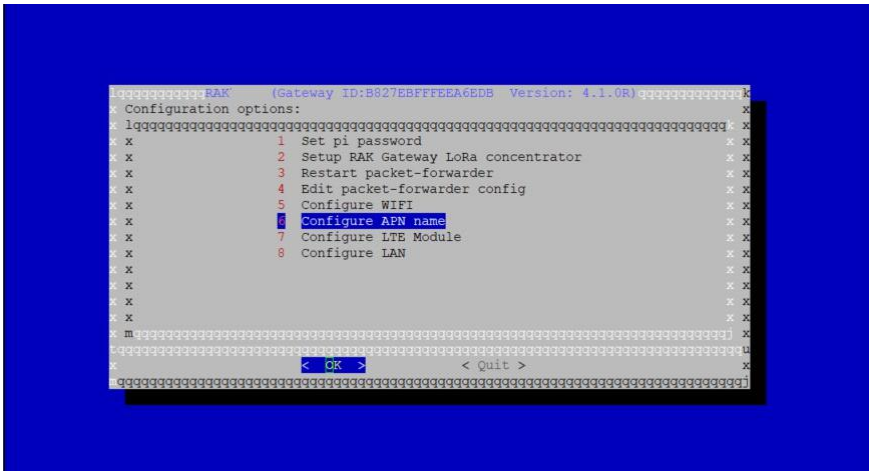
```
at+cops=?
+COPS: (2,"VIVACOM","VIVACOM","28403",7),(1,"Vivacom BG","Vivacom","28403",2),(1,"Vivacom BG","Vivacom","28403",0)

OK
at+cops=1,0,Vivacom BG,0
OK
```

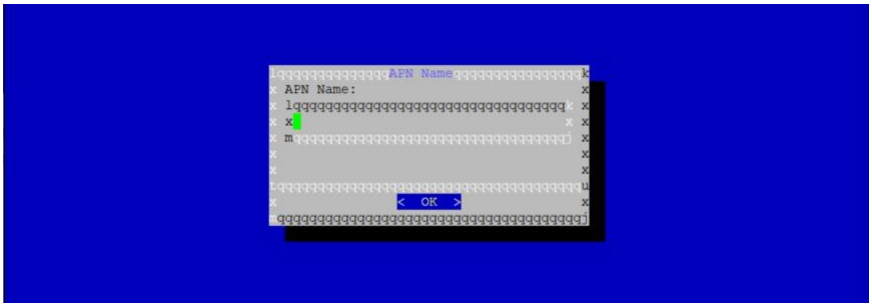
Getting "OK" as the output of the command, means you have successfully configured the LTE network.

Proceed to setting the APN name for the *pppd* process.

In the main configuration menu choose "6 Configure APN name":

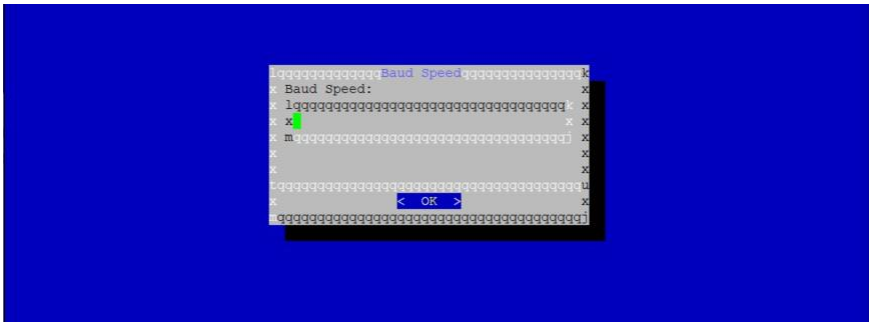


You will be sent to the following screen:



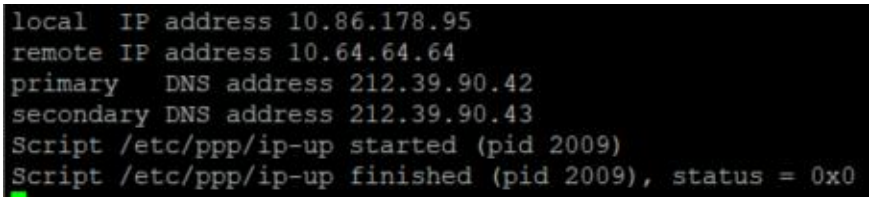
You can leave it as it is by default, just remember that if you choose to modify it you should use a real and valid APN name.

Lastly, set the baud rate, the default value is 115200:



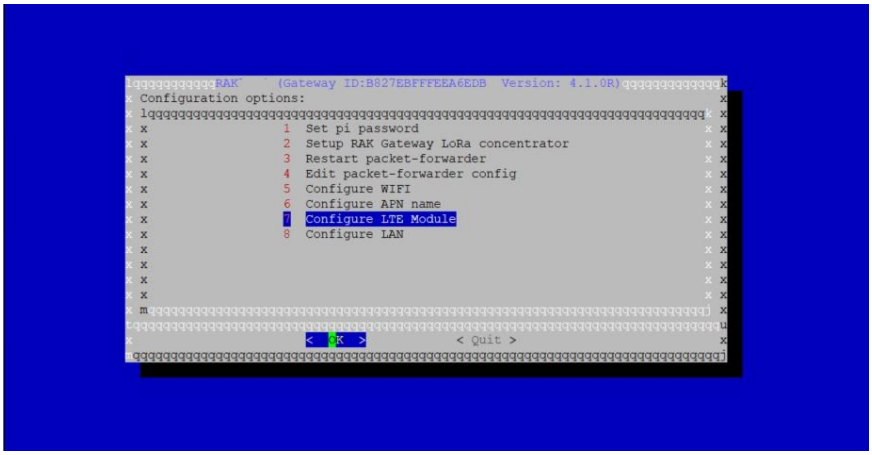
This finishes the LTE network configuration portion. Now let us test the connection. Execute the command "*sudo pppd call gprs*":

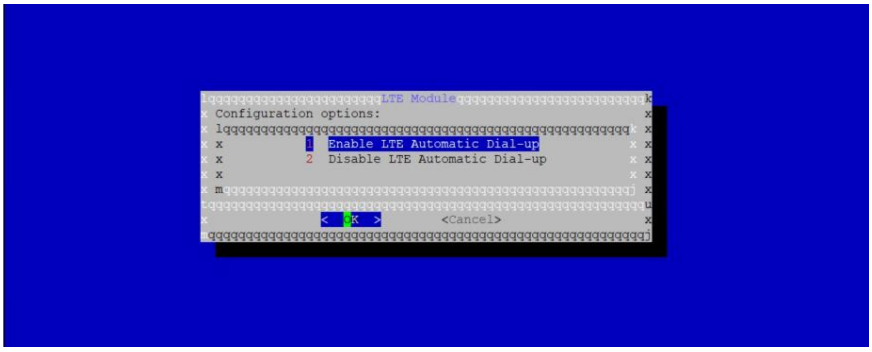
There will be a long log, most importantly however, you should see the following information at the end (this is again for the EU example):



You have been assigned an IP address (local and remote) as well as DNS addresses. If you have this information as per the image, your connection has been established.

Do not forget to re-enable the automatic LTE connection on start-up.





On, now we are able to connect via one of the 3 interfaces (Wi-Fi, Ethernet, Cellular), so let us proceed to some example on how to get some application data.

6. Connecting the Gateway to TTN

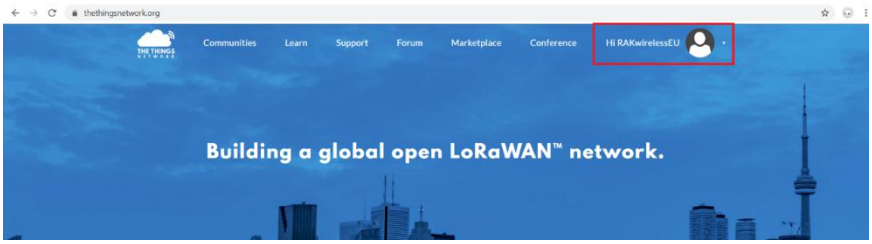
6.1. Configuring the Gateway

Make sure your Gateway is connected either via LTE, Wi-Fi or Ethernet, as per the instructions in the previous chapter. You should also be able to access it via SSH.

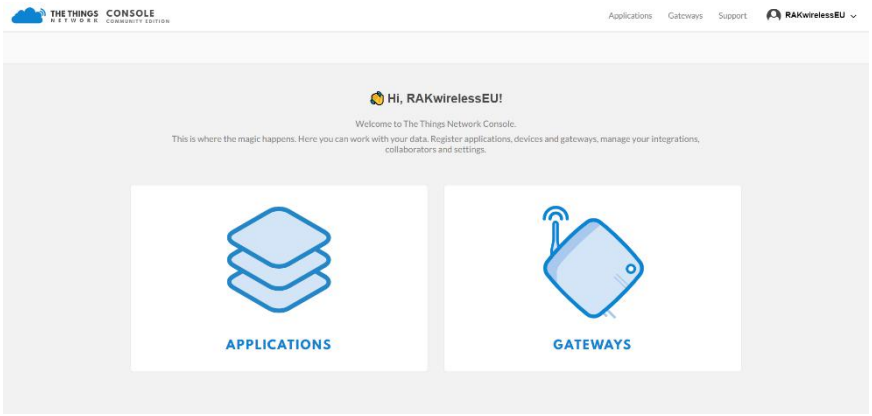
Next configure your Gateway to use TTN as a server (follow Section 5.2, subsection 5.2.1). In our example we are going to be using the EU863-870 band.

6.2. Registering the Gateway in TTN

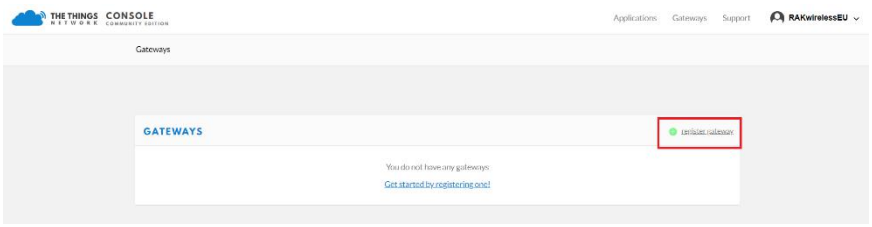
Open the TTN website https://www.thethingsnetwork.org/, and log in (you need to have created an account first). After logging in (creating an account), you should see the page in the image below. In the upper left corner as shown in the red square, there is a drop-down menu with a "*Console*" tab you need to access.



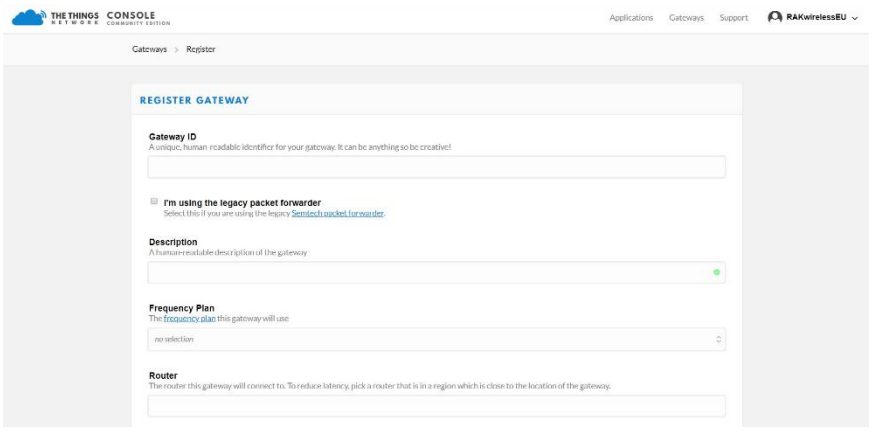
Can you see this page? Click on "*GATEWAYS*":



Click on register gateway":

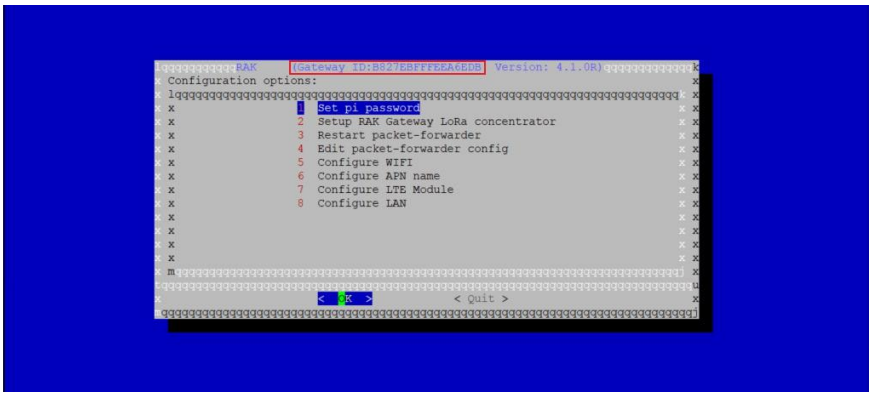


Fill in the requested fields:



Gateway ID:

This is a unique identifier of your Gateway. This should have the same values as the one shown in the Gateway Configuration Wizard (see image below). Make sure to select the "*I'm using the legacy packet forwarder*"



Description:

The is no strict format or uniqueness for this field, you can enter whatever you like (*RAK7244 Indoor Gateway* for our example).

Frequency Plan:

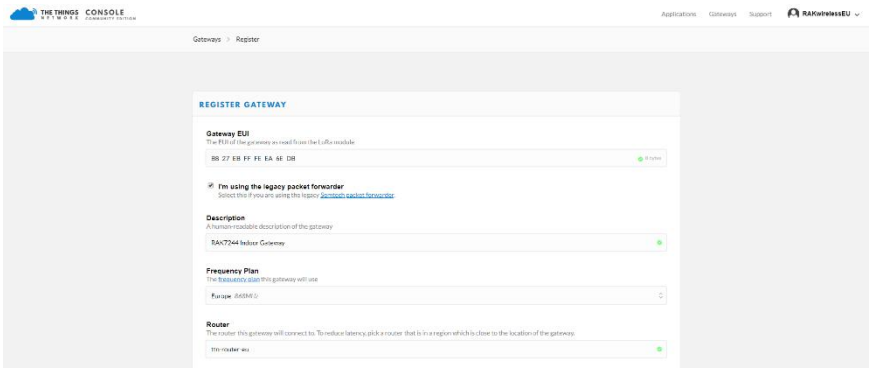
This should correspond to the Gateway Hardware and the region you are in.

Router:

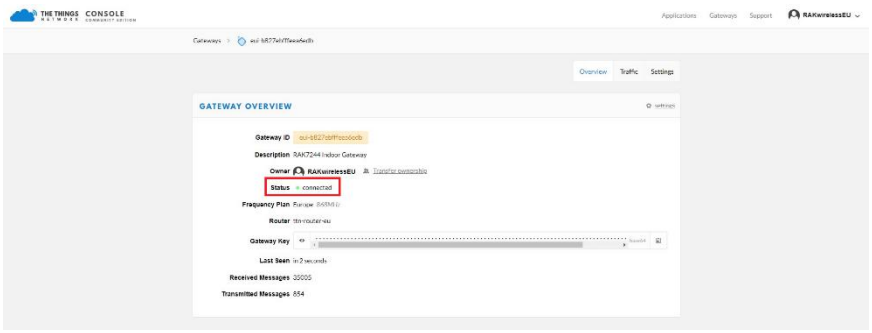
This will be automatically populated once you select the *Frequency Plan*.

The rest of the fields (*Location* and *Antenna Placement* are optional).

You should end up with something like the configuration in the following image:



Finalize by clicking on the "*Register Gateway*" button. If the process was successful you will be redirected to the overview page where you should be able to see your Gateway status as "*connected*". If it is indeed so, your Gateway is connected to TTN and is ready to forward data.



7. Connecting the Gateway to ChirpStack

ChirpStack is an open source LoRa Server stack. RAKwireless Developer Gateways have 2 methods for using ChirpStack.

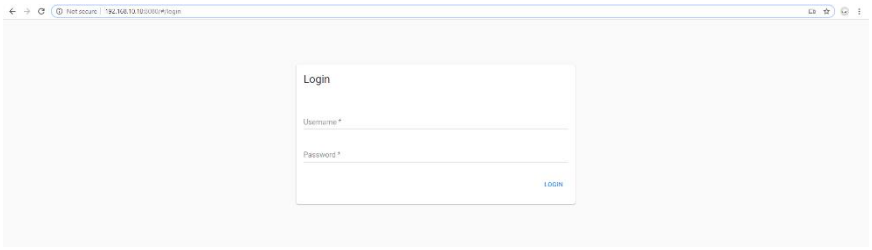
7.1. Built-in ChirpStack

There is a built-in ChirpStack in every RAK Developer Gateway that comes with the Official RAKwireless Firmware.

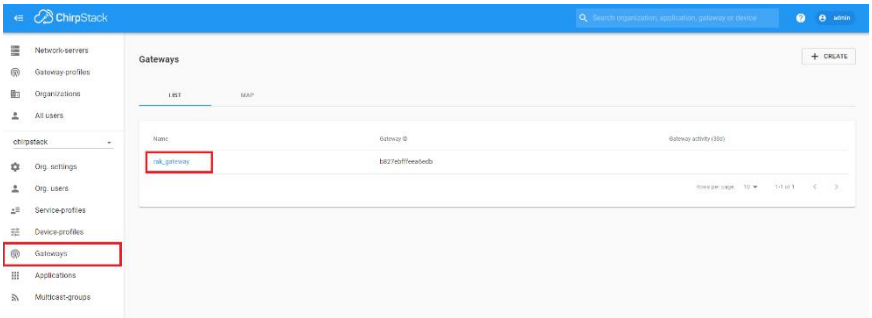
By default, after burning the firmware and accessing the Gateway for the first time it is configured to use the Built-in ChirpStack as its LoRa Server. It is set up to work in the EU863-870 band. Unless you are in aa region that uses this band, you should change it.

In case you have used TTN and you now want to return to the Built-in ChirpStack you can go back to Section 5.2, subsection 5.2.2 in order to go through the steps of configuring ChirpStack again.

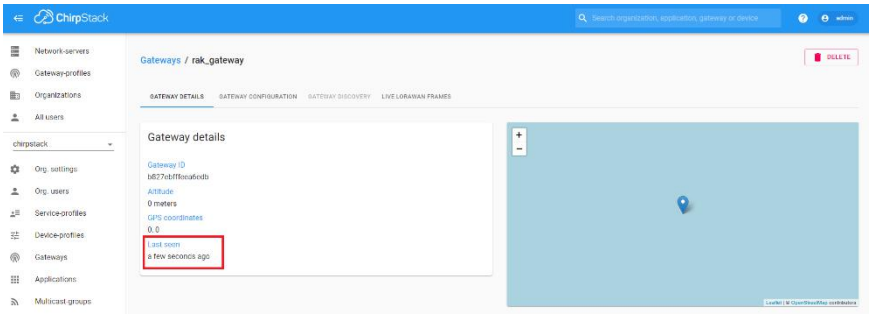
There is a Web-based UI that comes with the ChirpStack instance. Simply open a browser and enter the LAN IP address:8080 of the LoRaWAN Gateway's (for the interface you are using to connect it to the network). Make sure not to forget to use the 8080 port. The default username and password are "*admin*".



Everything should be pre-configured: Device profiles have been created, the Gateway has been registered with the server, etc. If you go to the *Gateways* tab and click on *rak_gateway*, you should see the *Gateway details* page.



The "*Last seen*" status should show as a few seconds, meaning that the gateway is visible to the Built-in ChirpStack (LoRa Server).



7.2. Remote ChirpStack

There are 2 easy ways (there are plenty more) to get a remote ChirpStack instance to work with your Gateway: use RAK's cloud testing ChirpStack or setup a remote ChirpStack instance by yourself (Cloud service hosted or your own Hardware).

If you want to use RAK's cloud testing ChirpStack, you can contact the RAKwireless team on the forums for support.

Deploying a remote instance by yourself is a little more complicated, however RAKwireless provides a ChirpStack image, that you can install on an X86 machine. Detailed instructions on how to deploy can be found here.

Note: The image mentioned above is an entire operating system (Ubuntu OS) and installing it will erase all data on the drive you are using.

8. Is there source code?

RAKwireless Developer Gateway firmware is a fully open project. It can be downloaded from the GitHub repository.

Please contact us if you need technical support or want to know more about our products using the links below:

Support center: https://forum.rakwireless.com/

***Email us*:** info@rakwireless.com

9. Revision History

Revision	Description	Date
1.0	Initial version	2019-12-11

10. Document Summary

Prepared by	Checked by	Approved by
Todor	Vladislav	