

# Quick Start Guide

## Prerequisites

### What do you need?

1. RAK2245 Pi HAT WisLink LPWAN Concentrator
2. Raspberry Pi 3B+ or Raspberry Pi 4
3. 16GB SD Card + Card Reader
4. 5V at least 2A Micro USB Power Supply or USB C Power Supply
5. A Windows/Mac OS/Linux Computer

### What's included in the Package?



Figure 1: Package Contents

## Product Configuration

### Accessing your Gateway

After burning the image into the SD Card, make sure you have inserted the SD Card with the Latest Firmware installed to the **Raspberry Pi 3B+ / 4 with the RAK2245 Pi Hat LPWAN Concentrator Module** and the LoRa and GPS Antenna attached to it. After which, you can now safely power on the gateway. In this document, several ways in accessing the gateway are provided to have different alternatives for you to choose depending on the availability of the requirements needed.

**⚠ WARNING**

Before powering the Raspberry Pi 3B+ or 4 you should install the LoRa and GPS antennas. Not doing so might damage the boards.

### Wi-Fi AP Mode

By default, the Gateway will work in Wi-Fi AP Mode which means that you can find an SSID named like "Rakwireless\_XXXX" on your PC Wi-Fi Network List.



Figure 2: RAKwireless Access Point

**NOTE:**

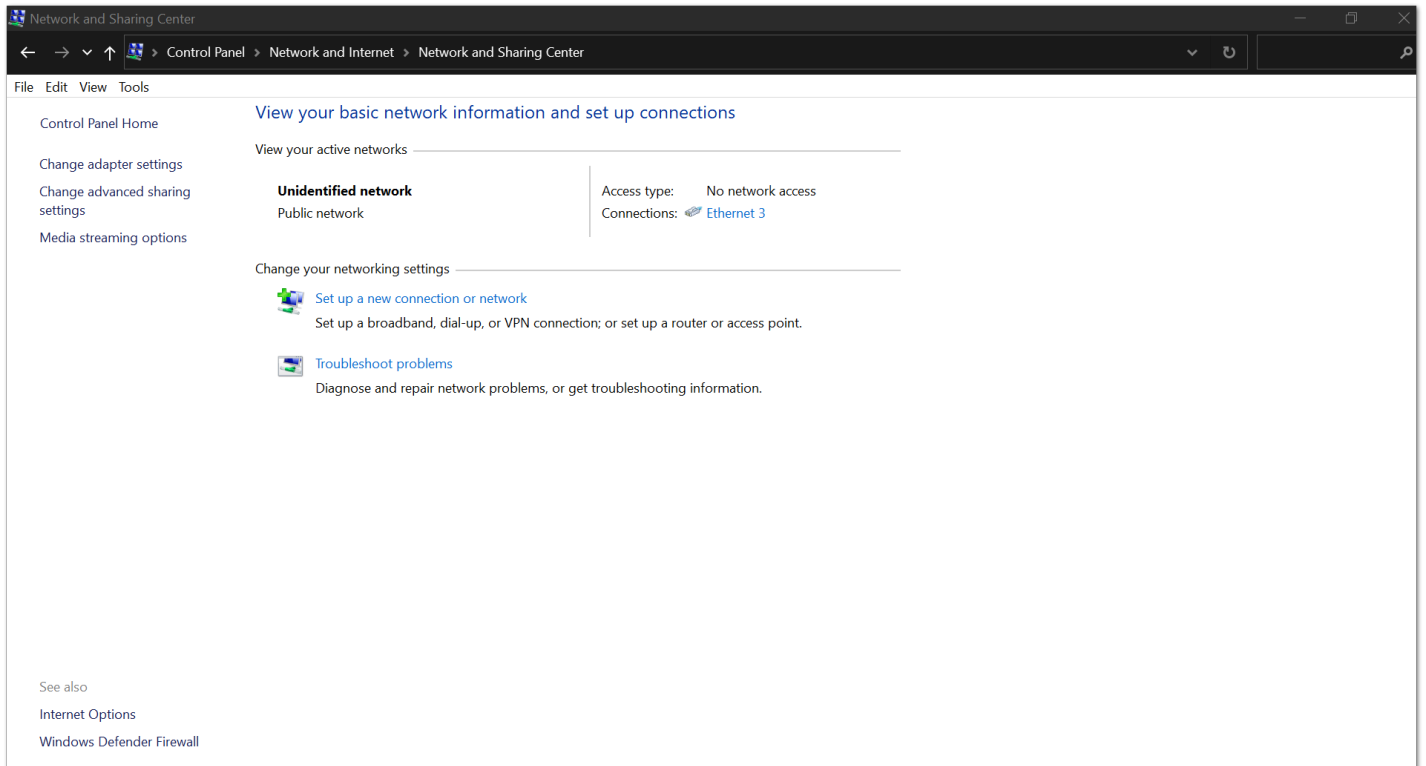
“XXXX” is the last 2 bytes of your Raspberry Pi WiFi MAC address with the RAK2245. Connect to this Wi-Fi SSID using the password provided below. Take note also of the default IP address of the Gateway provided below as this will be needed in connecting via SSH.

- **Wi-Fi Password:** rakwireless
- **Default IP Address:** 192.168.230.1

## Via the Ethernet Port on the Raspberry Pi

You can also connect your PC with the Gateway through an Ethernet cable. By default, the IP address of the 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 .

- To do this in Windows, go to Control Panel -> Network and Internet -> Network and Sharing Center and Click **Ethernet**.



**Figure 3:** Network and Sharing Center

- Click **Properties** then Choose **Internet Protocol Version 4 (TCP/IPv4)**.

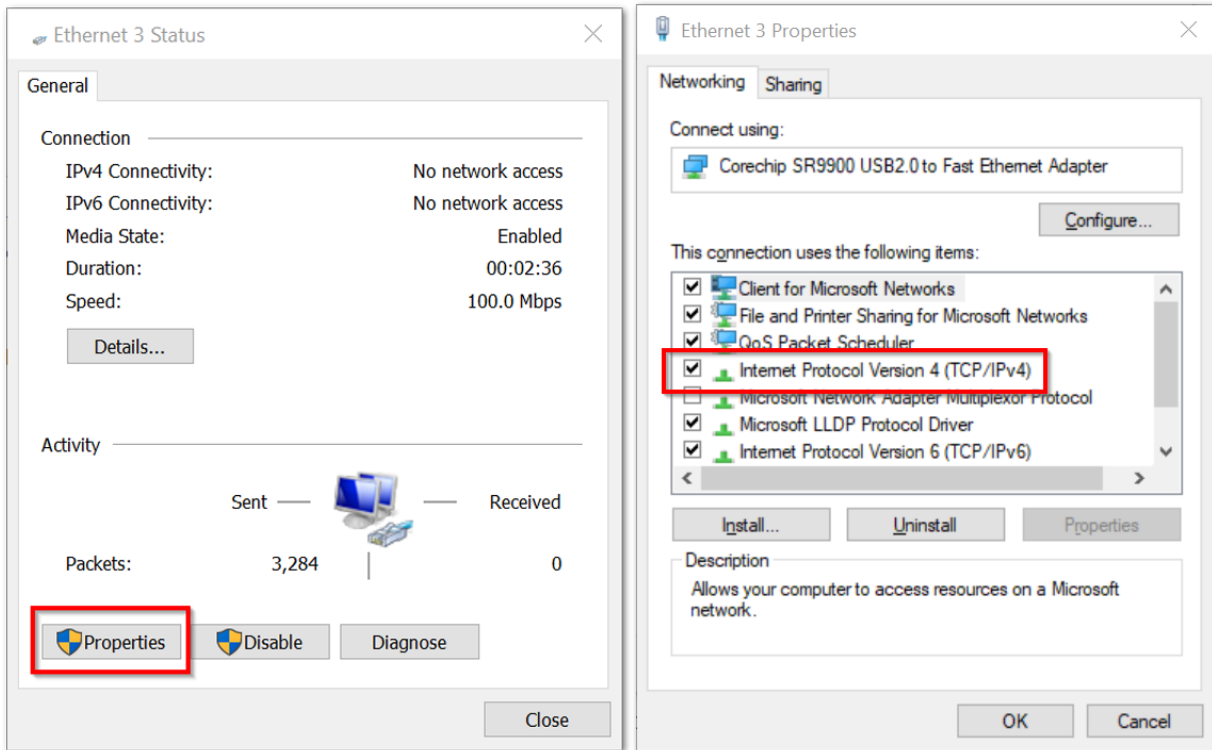


Figure 4: Ethernet Properties

- By default, it will obtain an IP Address automatically. Click the Option "Use the following IP Address" and enter the IP Address: `192.168.10.20` and press OK.

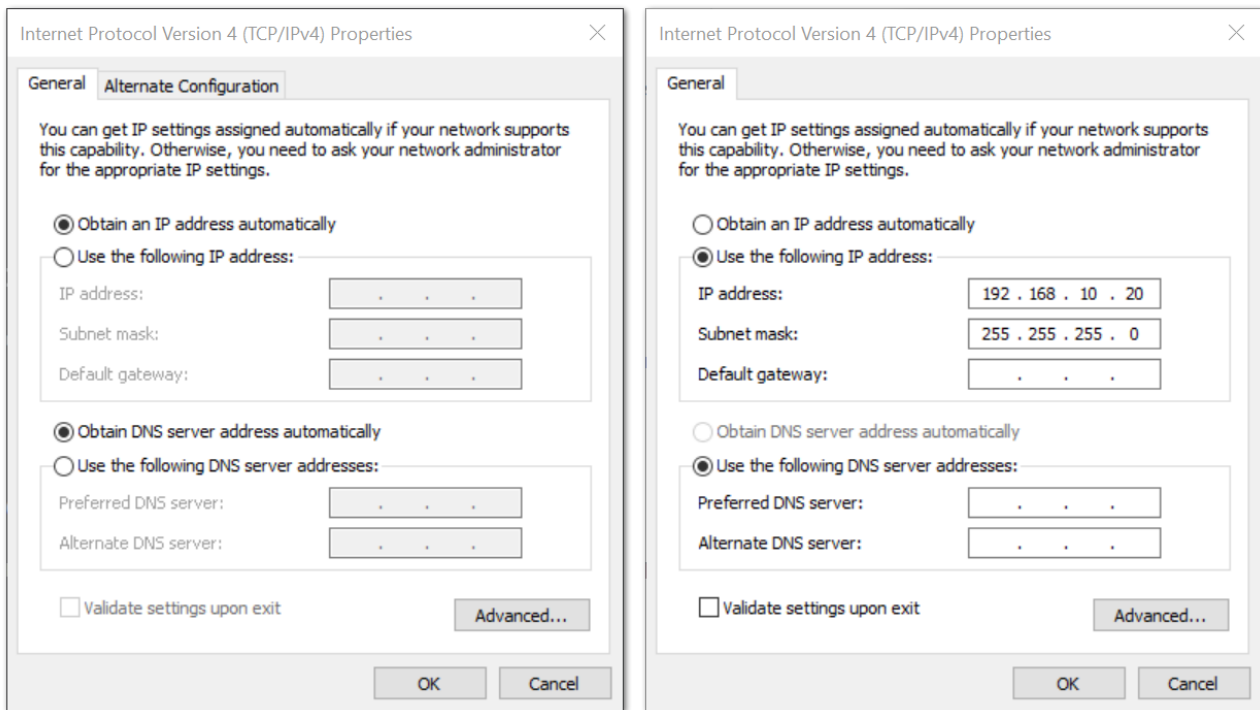


Figure 5: TCP/IPv4 Properties

Now , you should be able to access your Gateway from your PC successfully using the IP Address `192.168.10.10` through SSH.

## Log into the Gateway

### 1. Windows OS

SSH (Secure Shell) is typically used to log in to a remote machine and execute commands. There are a lot of free and good SSH Clients out there namely **Putty**, **BitVise SSH Client**, **MobaXterm** and many more. Feel free to choose one that fits your needs. You will be using Putty for this guide.

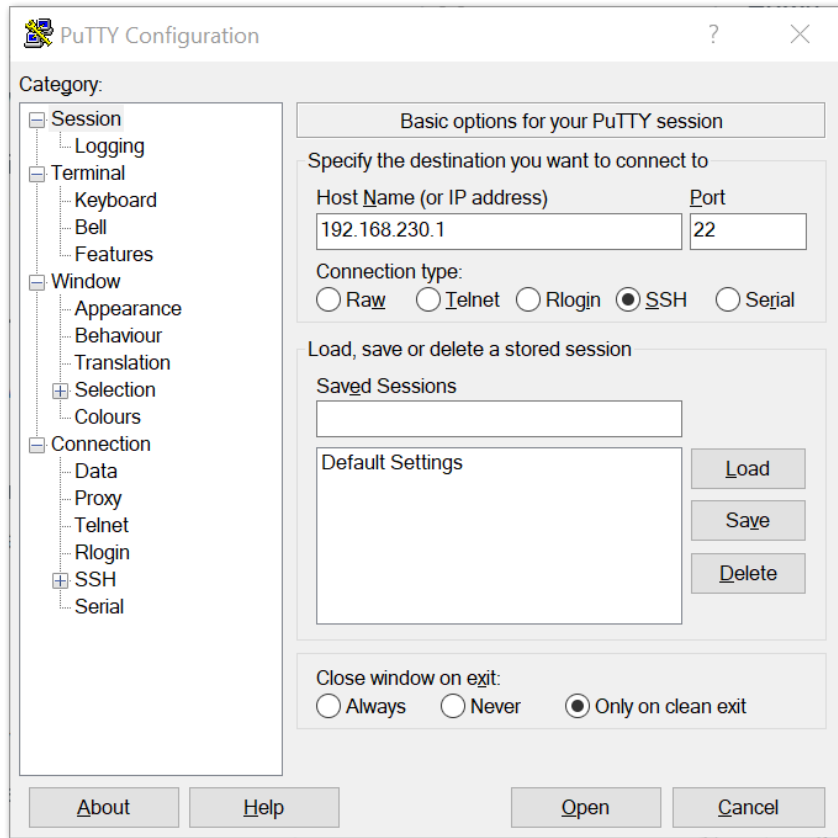


Figure 6: Putty Software for SSH in Windows

- If you have connected to the Gateway through **Wi-Fi AP Mode**, the IP Address is `192.168.230.1`
- If you have connected to the Gateway through **Ethernet**, the IP Address is `192.168.10.10`
- It will then prompt you to enter the username and password. The default username and password is provided below:
  - **Username:** pi
  - **Password:** raspberry

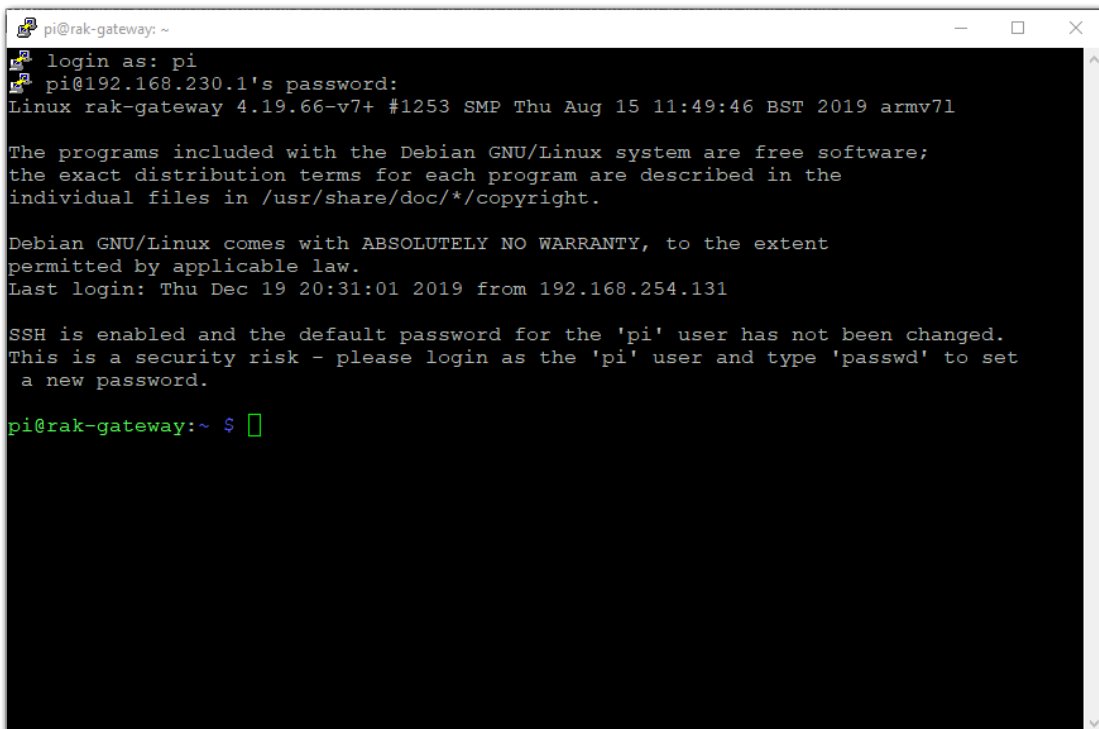


Figure 7: Command line after log in

## 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:

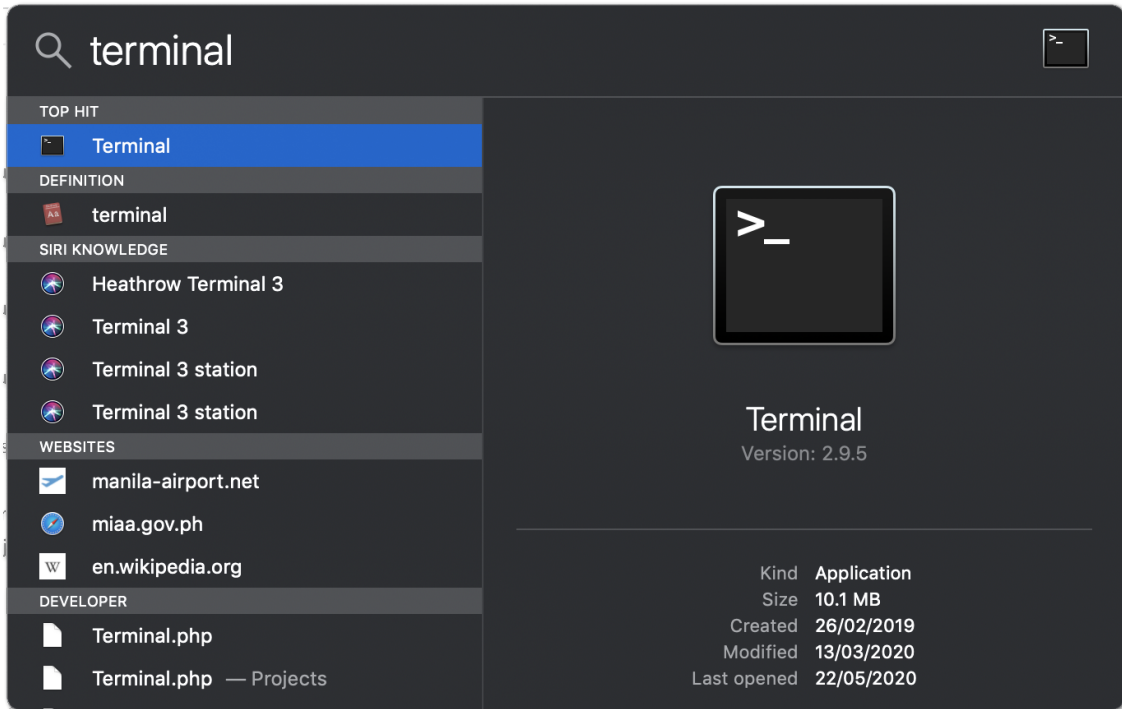


Figure 8: Opening Terminal in Mac OS

Open the terminal of Mac OS. Enter **root mode** by typing the following command: " `sudo -i` "



Figure 9: SSH in Mac OS

- If you are not in root mode, enter " `ssh pi@192.168.230.1` " in the terminal to login to your Gateway, the default password is "raspberrry".
- If you connect your PC with the Gateway through Ethernet Cable, you should enter " `ssh pi@192.168.10.10` ", the default password is "raspberrry".

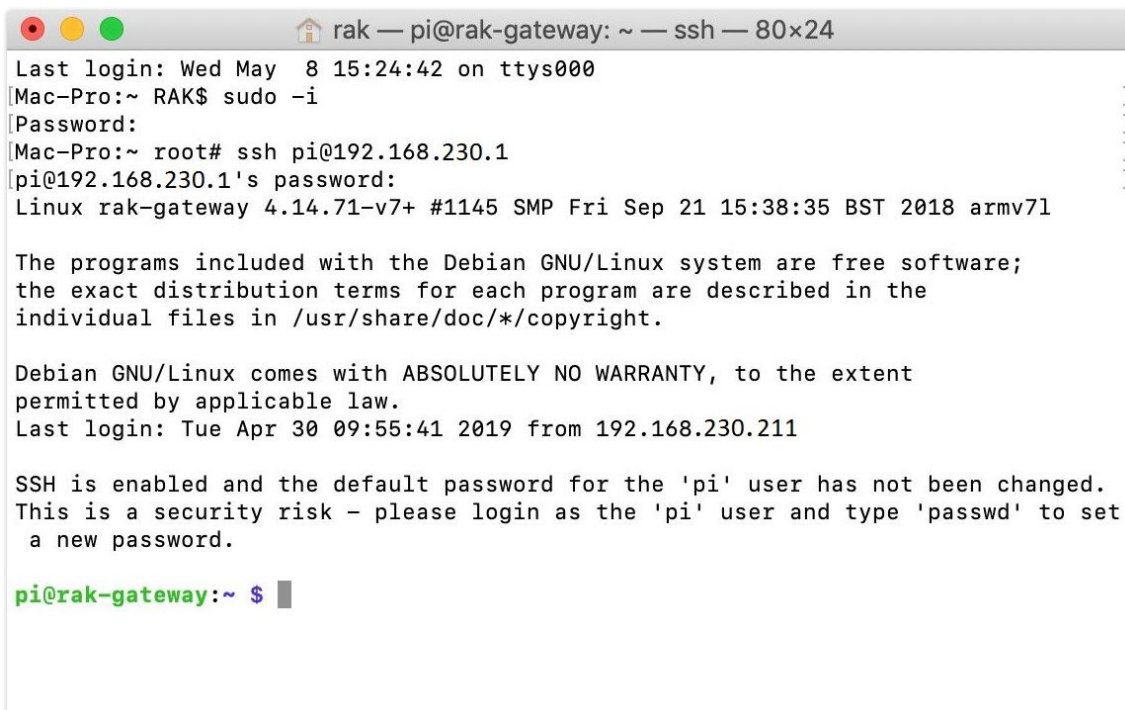


Figure 10: Log-in Successful Notification

### 3. Linux OS

If the OS of your PC is Linux, you should do the same as the Mac OS, except the root mode.

## Accessing the Internet

Assuming you have successfully logged into your Gateway using SSH. Enter the following command in the command line:

```
sudo gateway-config
```

sh

You will now then see a page like the following picture below:

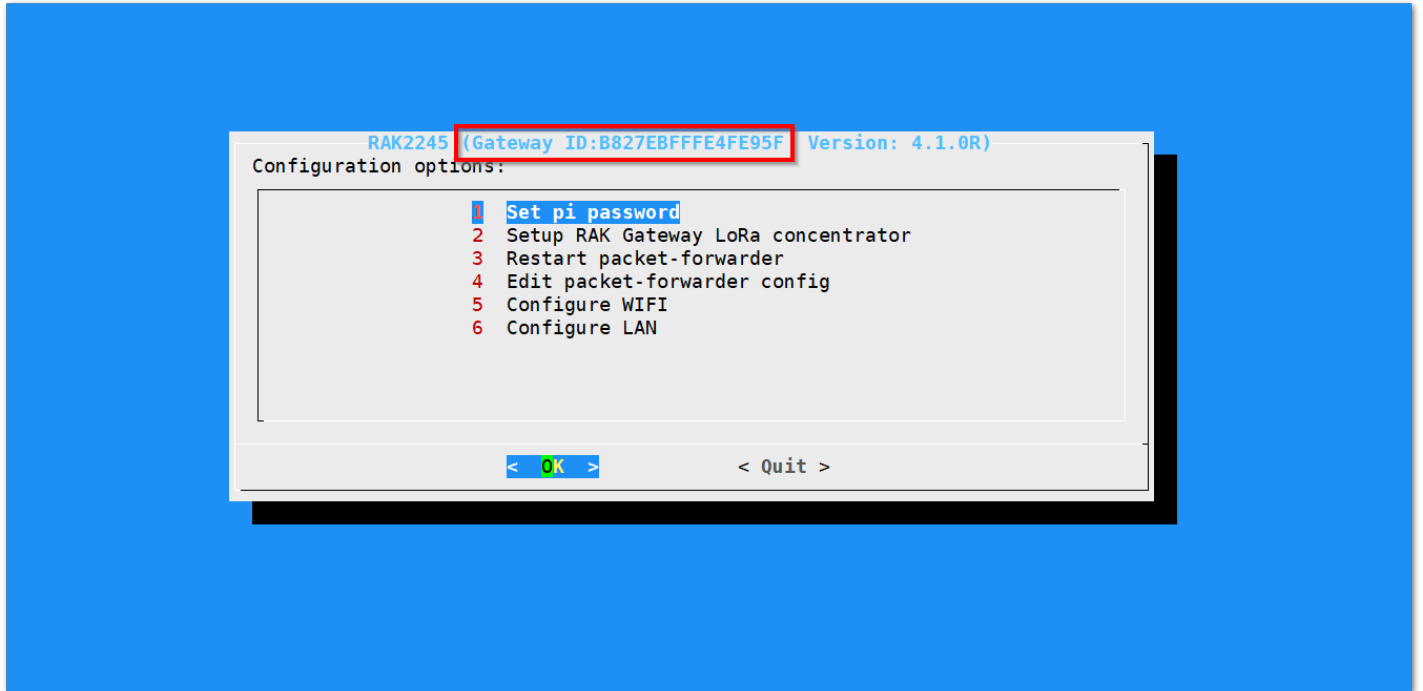


Figure 11: Configuration Options for the Gateway

1. **Set pi password** - used to set/change the password of the Gateway.
2. **Set up RAK Gateway LoRa Concentrator** - used to configure the frequency, which the Gateway will operate on, and the LoRaWAN Server which the Gateway will work with.
3. **Restart packet -forwarder** - used to restart the LoRa packet forwarded process.
4. **Edit packet-forwarder config**- used to open the global\_conf.json file, in order to edit parameters manually.
5. **Configure Wifi** - used to configure the Wi-Fi settings in order to connect to a network.
6. **Configure LAN** - used to configure the Ethernet adapter settings.

## Connect through Wi-Fi

If you want to connect through Wi-Fi, it can easily be done with the Wireless capabilities of the Raspberry Pi 3B+/4 by choosing "**5 Configure WIFI**". By default, the RAK2245 Pi HAT Edition LPWAN Gateway Concentrator Module works in Wi-Fi AP Mode. In order for the Gateway to connect to the router, it must work in Wi-Fi Client Mode.

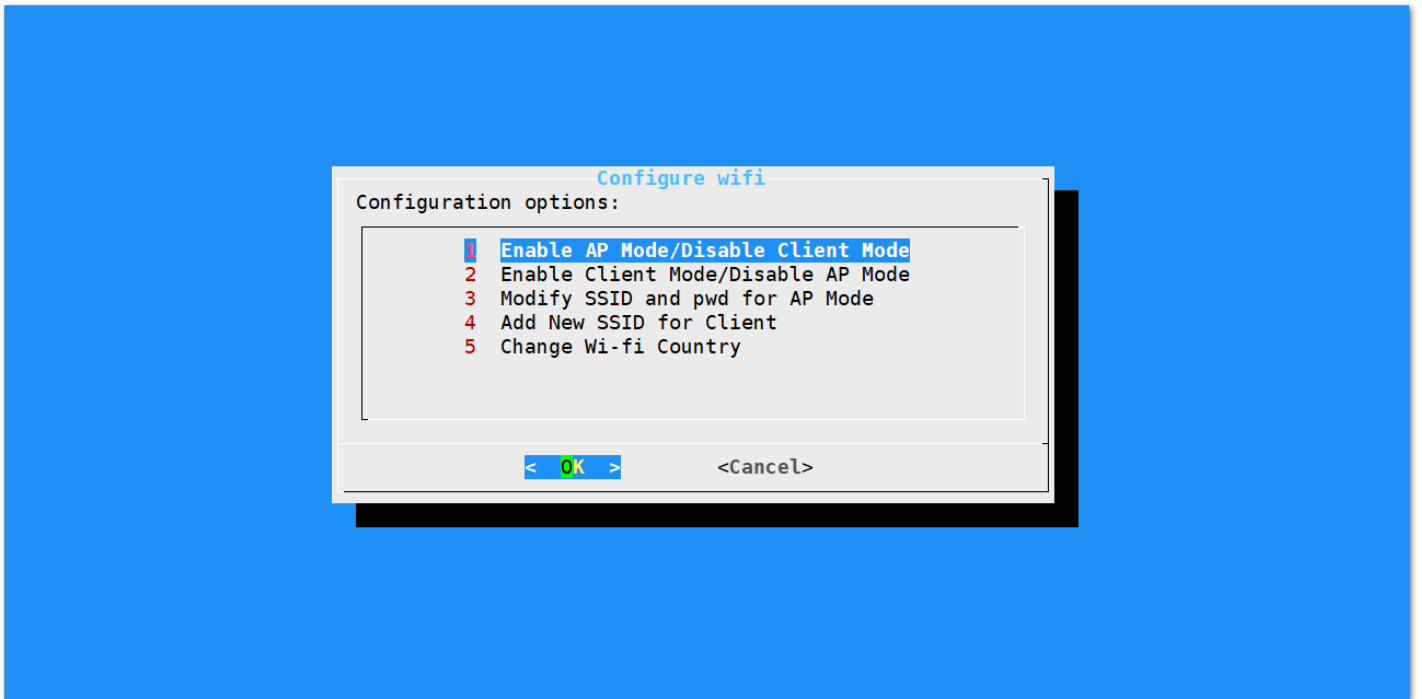


Figure 12: Configuration options for WIFI

There are 5 options to choose from in the Wi-Fi configuration menu:

1. **Enable AP Mode/Disable Client Mode** - the Gateway will work in Wi-Fi Access Point Mode after rebooting while the Wi-Fi Client Mode will be disabled (this is the default mode).
2. **Enable Client Mode/Disable AP Mode** - the Gateway will work in Wi-Fi Client mode after rebooting, while Wi-Fi AP Mode will be disabled.
3. **Modify SSID and pwd for AP Mode** - used to modify the SSID and password of the Wi-Fi AP. Only works if the Wi-Fi AP Mode is enabled.
4. **Add New SSID for Client** - this is used if you want to connect to a new Wi-Fi Network. Only works in Wi-Fi Client mode.
5. **Change Wi-Fi Country** - this is used to modify the Resident Country to match with Wi-Fi standards.

**⚠ WARNING**

In order to enable Wi-Fi Client Mode, you have to disable first the AP Mode.

Once Wi-Fi AP Mode has been disabled by choosing "**2 Enable Client Mode/Disable AP Mode**", you can now then connect to a new Wi-Fi Network by choosing "**4 Add New SSID for Client**":



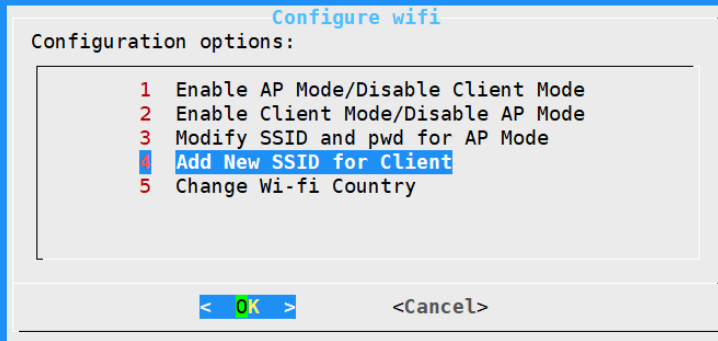


Figure 13: Add a new SSID

- Start by selecting your country of residence:

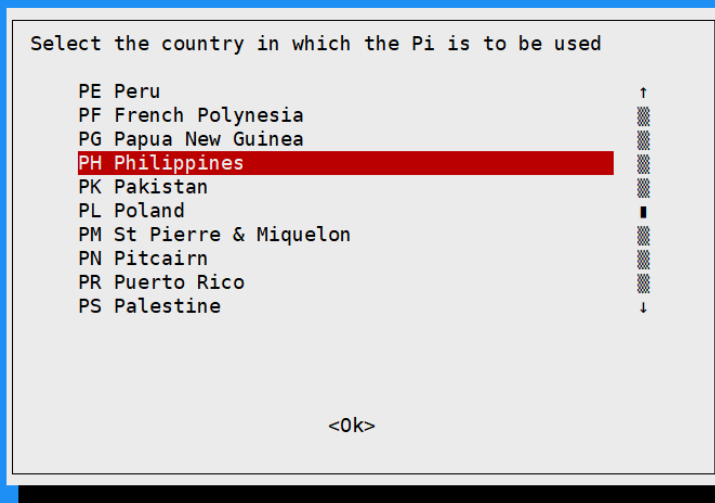


Figure 14: Selecting Country of Residence

- Enter the SSID of the network you want to connect:

**⚠ WARNING**

Please ensure to input the correct Wi-Fi SSID and Password or you will not be able to connect to the RAK2245 Pi hat again via SSH in Wi-Fi AP Mode. If stuck in this situation, please follow this procedure listed in the Reverting to Wi-Fi AP Mode section which is applicable for all Raspberry Pi based gateways to work again in Wi-Fi AP mode.



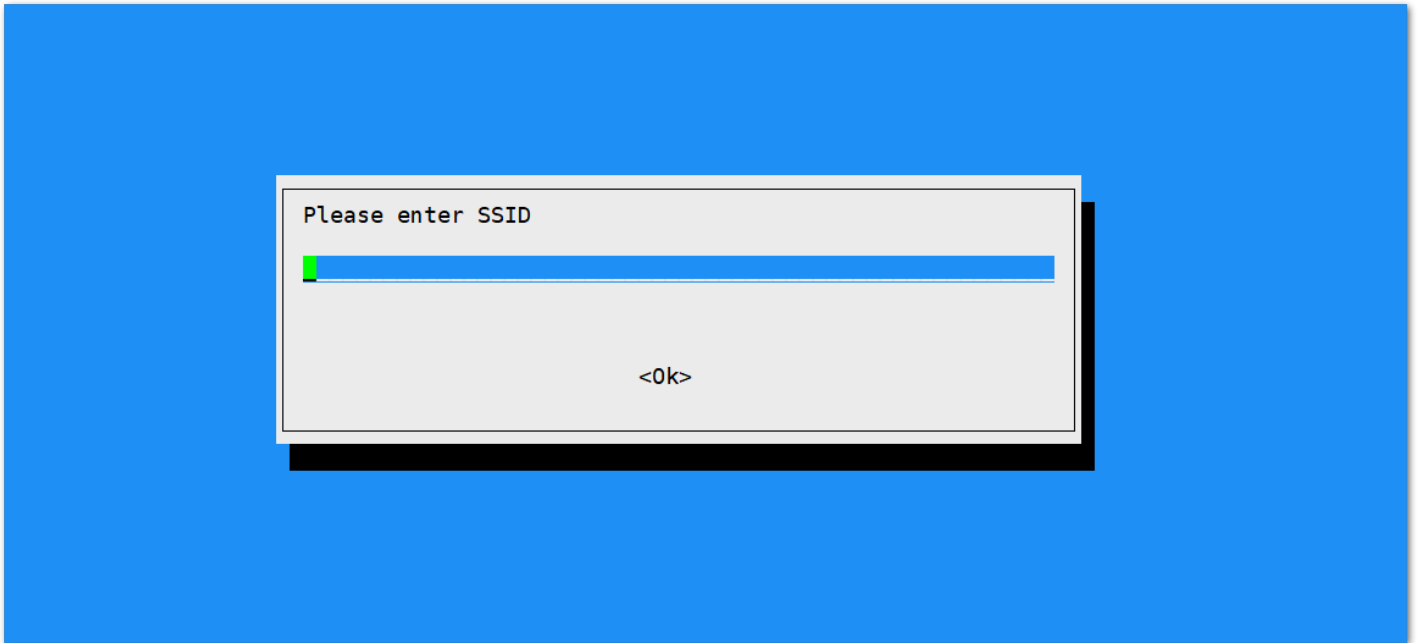


Figure 15: SSID of the Network you want to connect to

- Enter also the password. Just leave it empty if None.

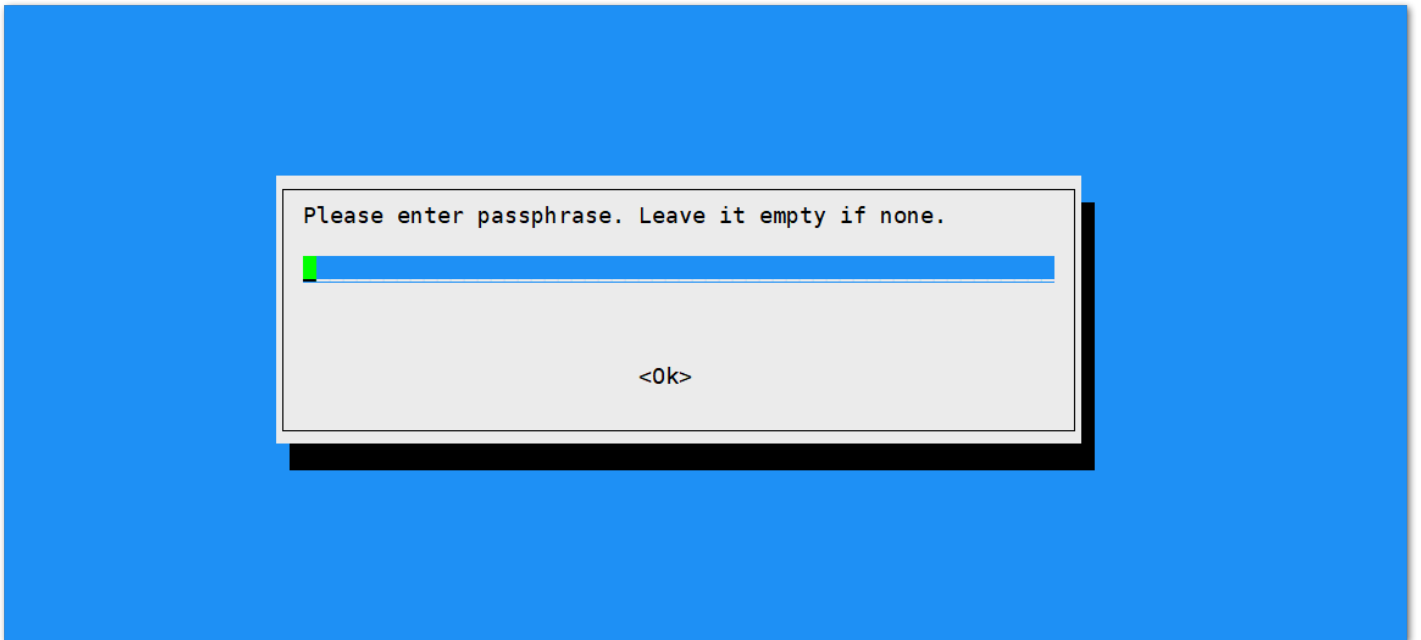


Figure 16: Password of the Wi-Fi

## Connect through Ethernet

If you want to connect to router through Ethernet Cable, do the following steps:

- In the main configuration menu, choose "**6 Configure LAN**". This will let you set up a static IP address for the Gateway's Ethernet adapter.
- Just fill a static IP Address according to the IP address of the router you want to connect. Please note 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 is `192.168.10.10`

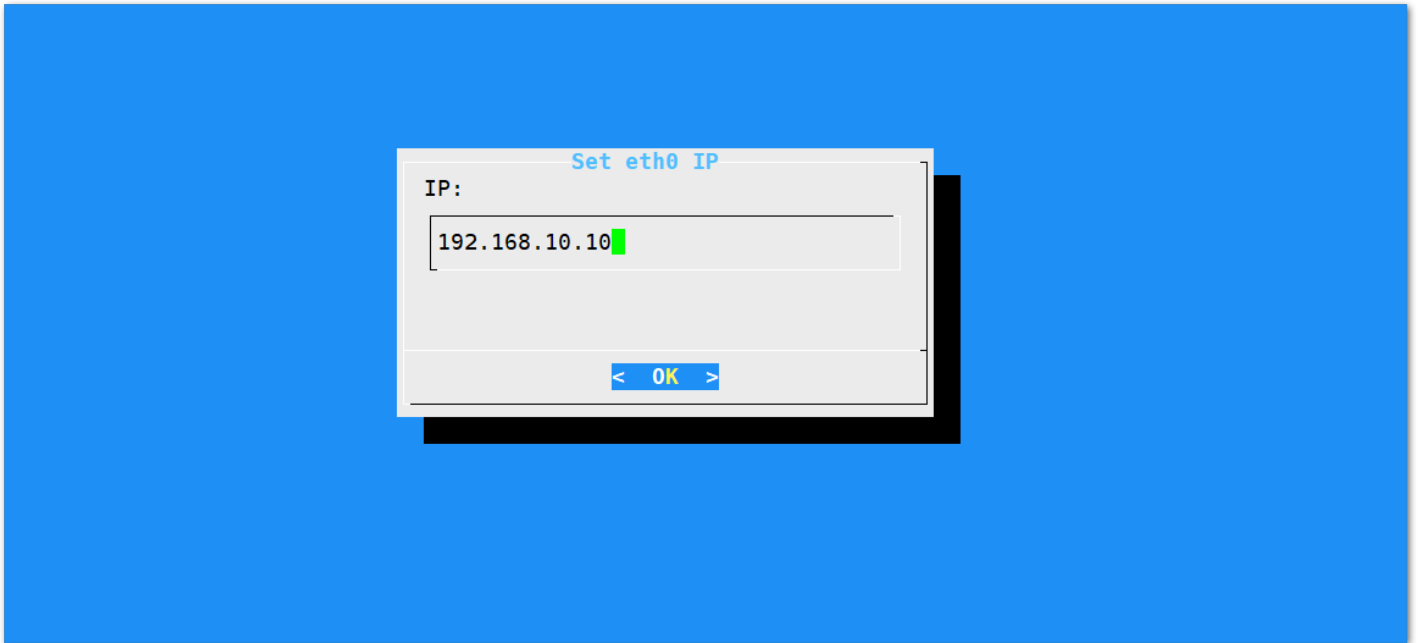


Figure 17: Default Gateway Ethernet IP Address

- Then configure the IP address of the Router. This is the LAN Interface IP address of the router.

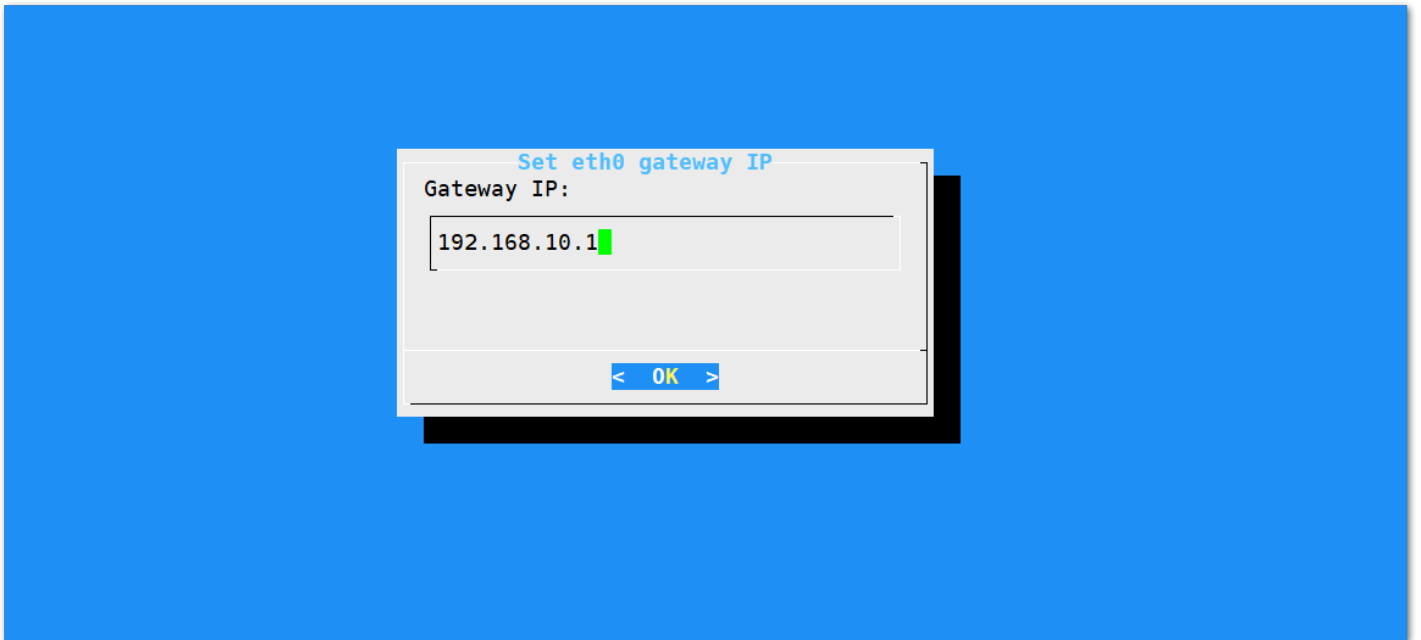


Figure 18: LAN Interface IP Address of the Router

- Press OK then the success message will appear.
- Lastly, reboot the Gateway using the command " `sudo reboot` " in the command line and it will connect to the router successfully through Ethernet.

```
sudo reboot sh
```

## Optional Configurations

These configurations under this section are only optional and situational.

### Reverting to Wi-Fi AP Mode

In the event that you have entered either or both incorrect Wi-Fi SSID and Password in the Wi-Fi Client Mode setup for the RAK2245 Pi HAT Edition LPWAN Gateway Concentrator Module to connect to the router, follow these set of steps for you to work again in Wi-Fi AP Mode and redo the setup.

- Remove the SD Card from your Raspberry Pi with the RAK2245 Pi HAT and insert it into your PC. Your PC should be able to detect it same with the image below:

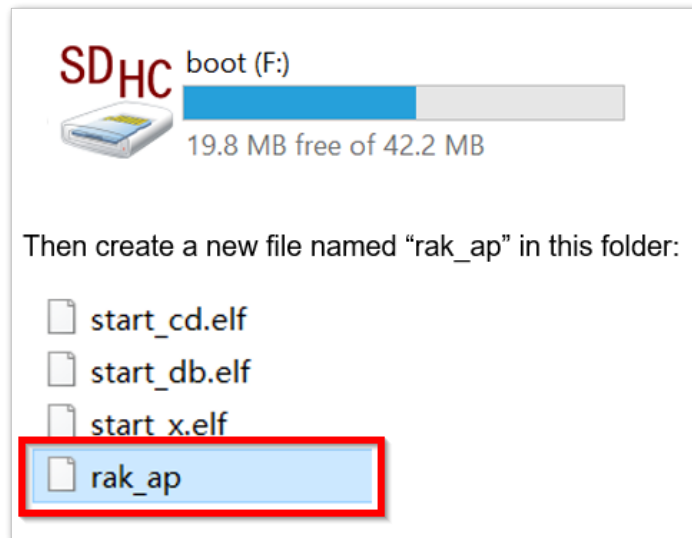


Figure 19: Creating rak\_ap file to your SD Card

- Using your "Command Prompt" or "Terminal", navigate to your SD Card and type this command to generate the "rak\_ap" file.

```
cd > rak_ap
```

- Check if the rak\_ap file is created successfully. If so, re-insert the SD Card into your Raspberry Pi with the RAK2245 Pi HAT Edition LPWAN Gateway Concentrator Module and it should work again in Wi-Fi AP Mode.

## Configuring the Gateway

Assuming you have successfully logged into your Gateway using SSH, enter the following command in the command line:

```
sudo gateway-config
```

sh

You will now then see a page like the following picture below

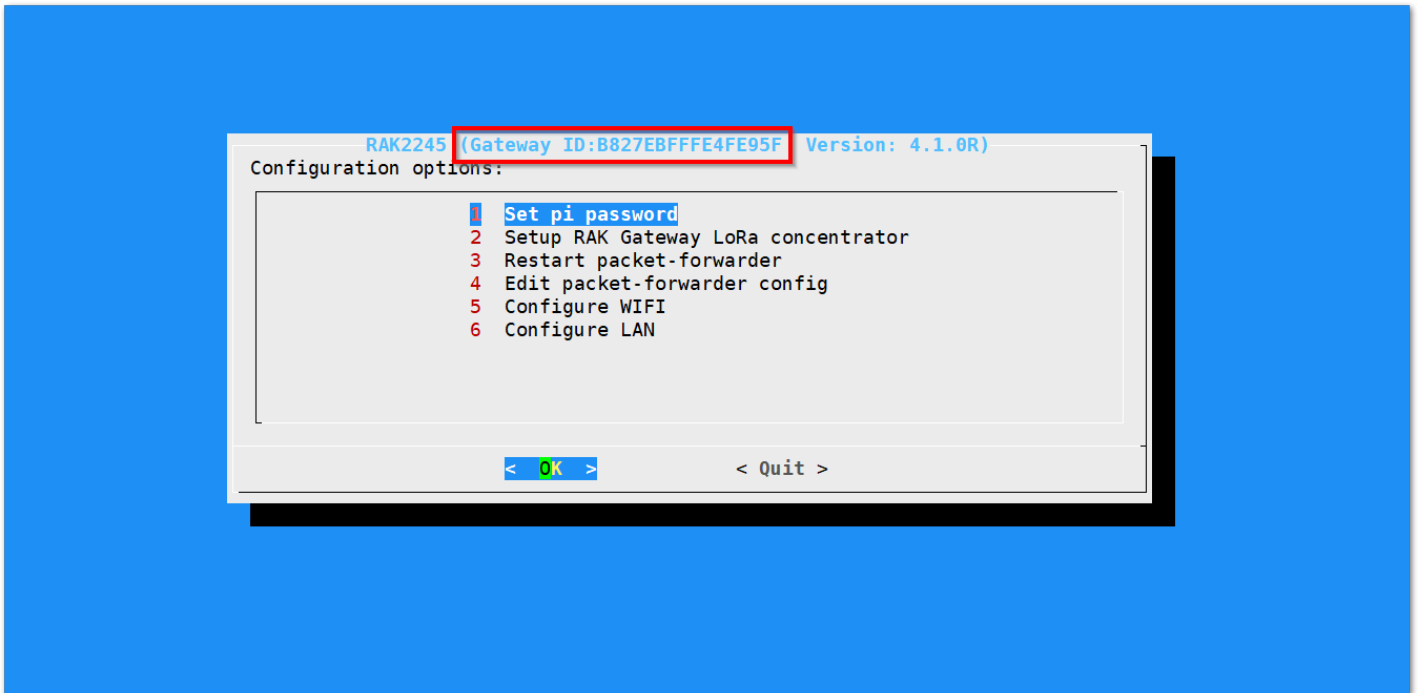


Figure 20: Config Options for the Gateway

1. **Set pi password** - used to set/change the password of the Gateway.
2. **Set up RAK Gateway LoRa Concentrator** - used to configure the frequency, which the Gateway will operate on, and the LoRaWAN Server which the Gateway will work with.
3. **Restart packet-forwarder** - used to restart the LoRa packet forwarded process.
4. **Edit packet-forwarder config**- used to open the global\_conf.json file, in order to edit LoRaWAN parameters manually.
5. **Configure Wifi** - used to configure the Wi-Fi settings in order to connect to a network.
6. **Configure LAN** - used to configure the Ethernet adapter settings.

 **NOTE:**

A unique ID will be generated in for Gateway. This is also called Gateway EUI squared in red in the figure above and is essential for registering the gateway with any LoRa Network Server (TTN, ChirpStack)

There is also another way to get your "Gateway ID", just enter the command below in the command line:

```
sudo gateway-version sh
```

```
pi@rak-gateway:~ $ sudo gateway-version
Gateway ID:B827EBFFFE4FE95F
RAKWireless gateway RAK7243 version 4.1.0R
pi@rak-gateway:~ $ █
```

Figure 21: Gateway ID using the command line

## Setting a new password for the Gateway

It is a good security practice to change the default password "**raspberrypi**" which is the same on all Raspberry Pi devices.

1. First, choose "**1 Set pi password**" option referred on the image below.

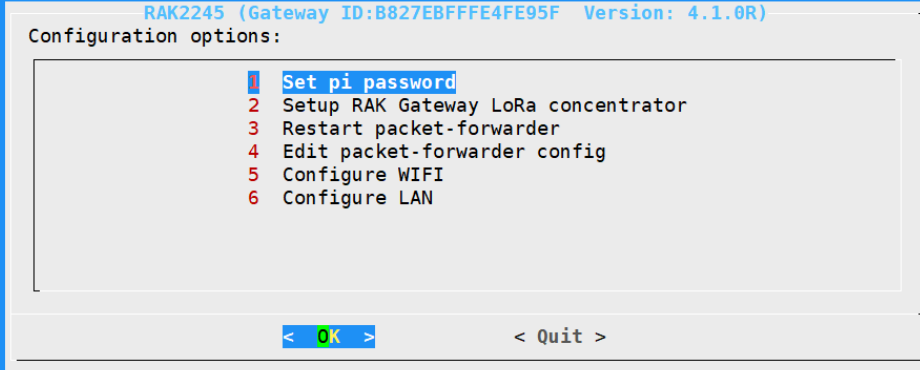


Figure 22: Set Pi Password

2. Next, press "Yes" and you will be asked to enter your new password twice then press "Enter".

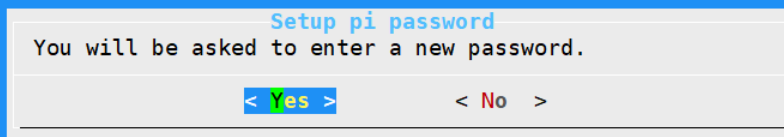


Figure 23: Confirm Password Change

3. Alright, the success message for changing password will then pops up.

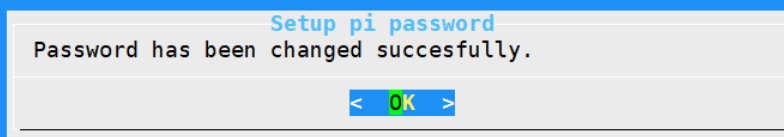


Figure 24: Successful Password Change

## Setup RAK Gateway LoRa Concentrator

This menu allows you to select your LoRa frequency band and one of the two available Networks Server options by choosing "2 Setup RAK Gateway LoRa concentrator"

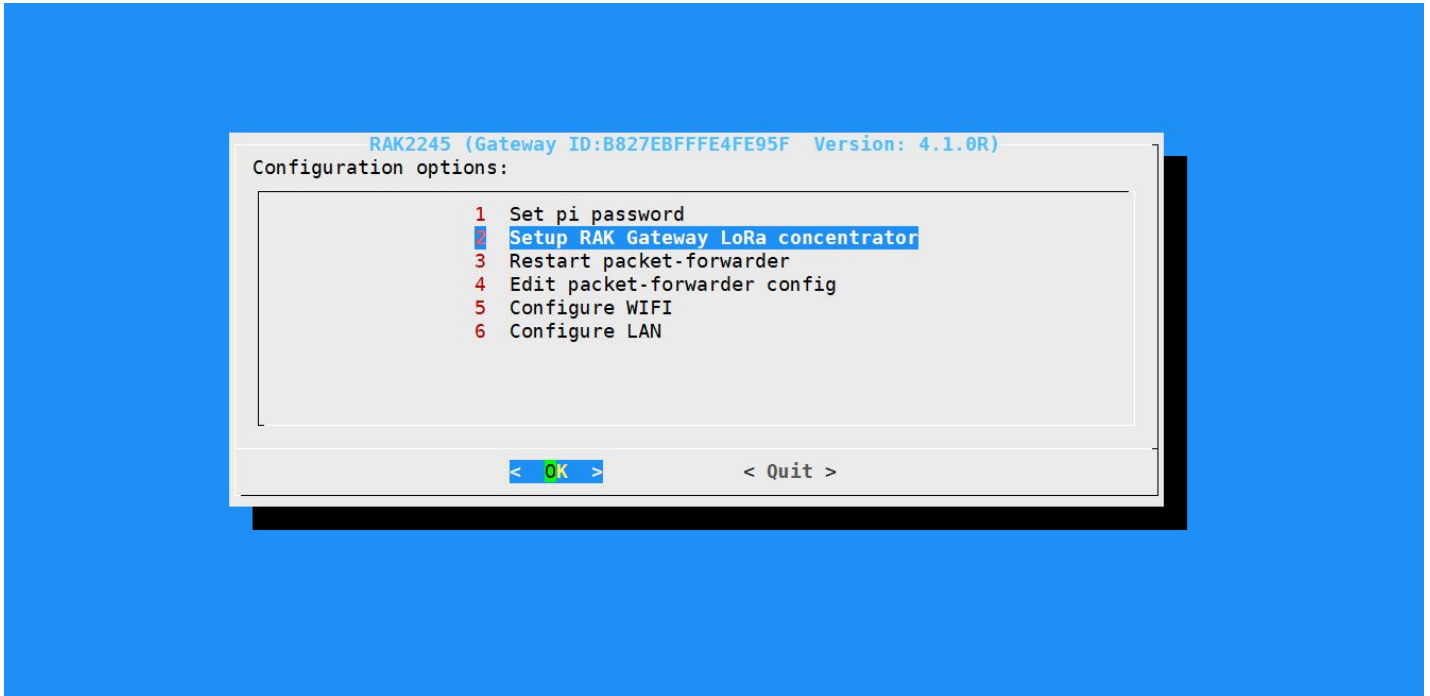


Figure 25: Choosing Setup RAK Gateway LoRa concentrator

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

## Server is TTN

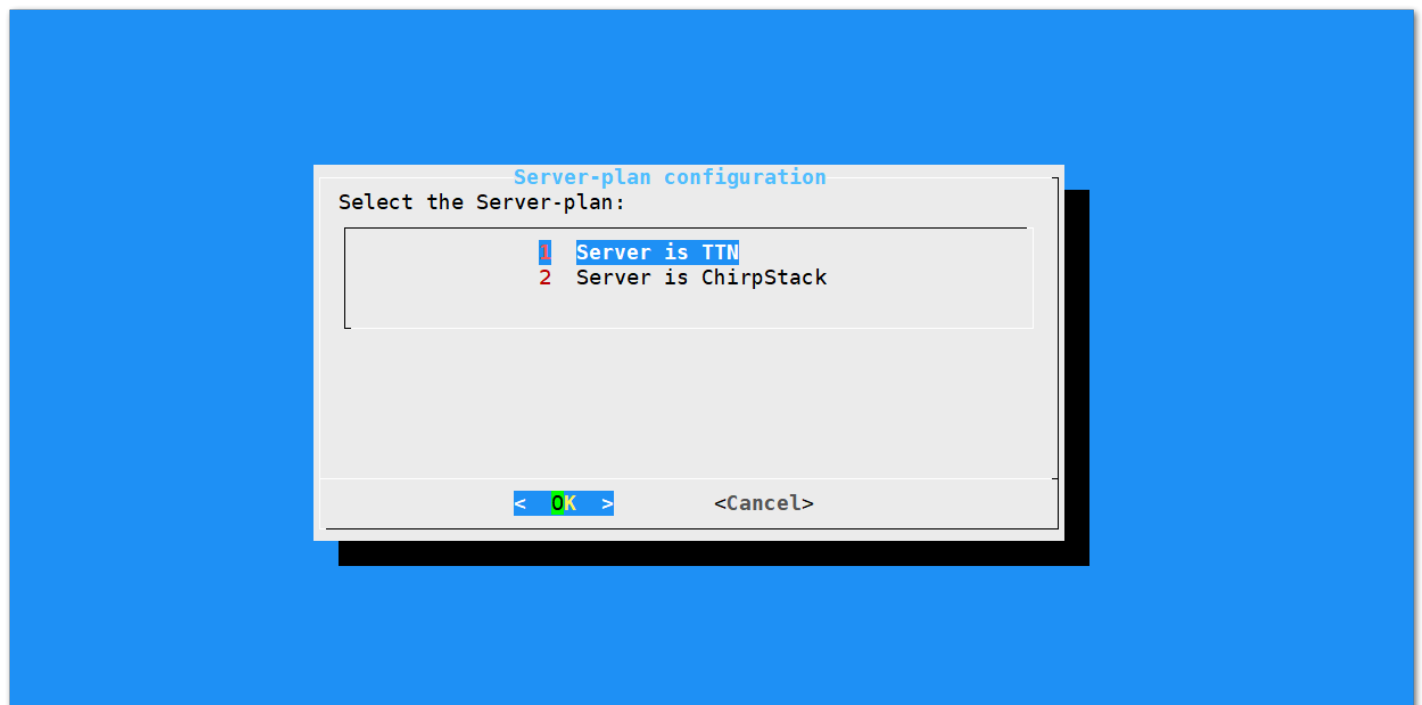


Figure 26: Server is TTN

- **TTN (The Things Network)** - If you choose TTN as the LoRa Server, you will see the following page. Visit this [article](#) for more information on your local TTN frequency plan. This will allow you to choose the correct plan.

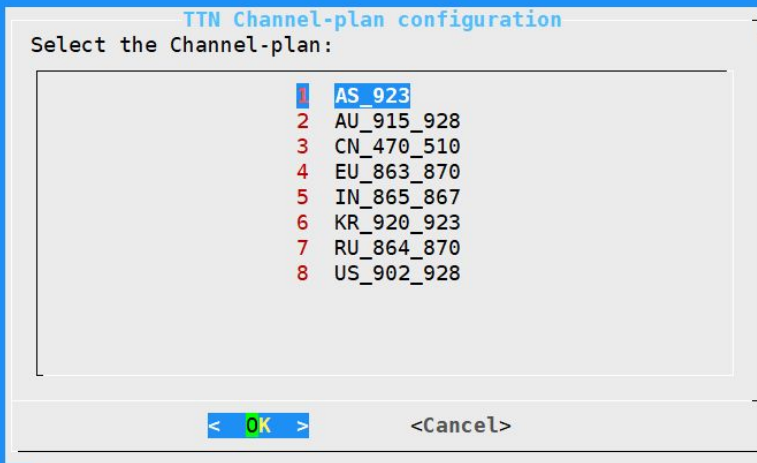


Figure 27: Selecting the TTN Channel Plan

After choosing the correct frequency, the success message will appear as shown below.

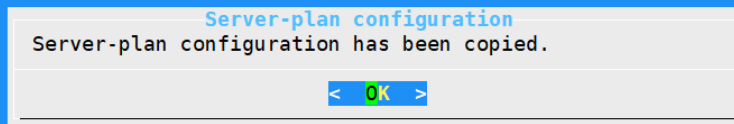


Figure 28: Successfully Changed the Frequency

## Server is Chirpstack

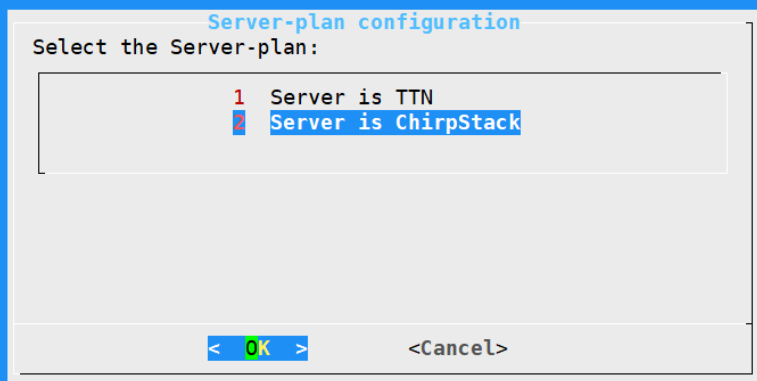


Figure 29: Server Is Chirpstack



**ChirpStack** - If you choose Chirpstack as your LoRa Server, you will see the following page with two options available:

- **ChirpStack Channel Plan Configuration** - used to configure your Regional Frequency Band.
- **ChirpStack ADR Configure** - used to enable/disable the Adaptive Data Rate (ADR) functionality.

First, select "**1 ChirpStack Channel-plan configuration**" for configuring your frequency channel. Then, set the IP address of the ChirpStack.

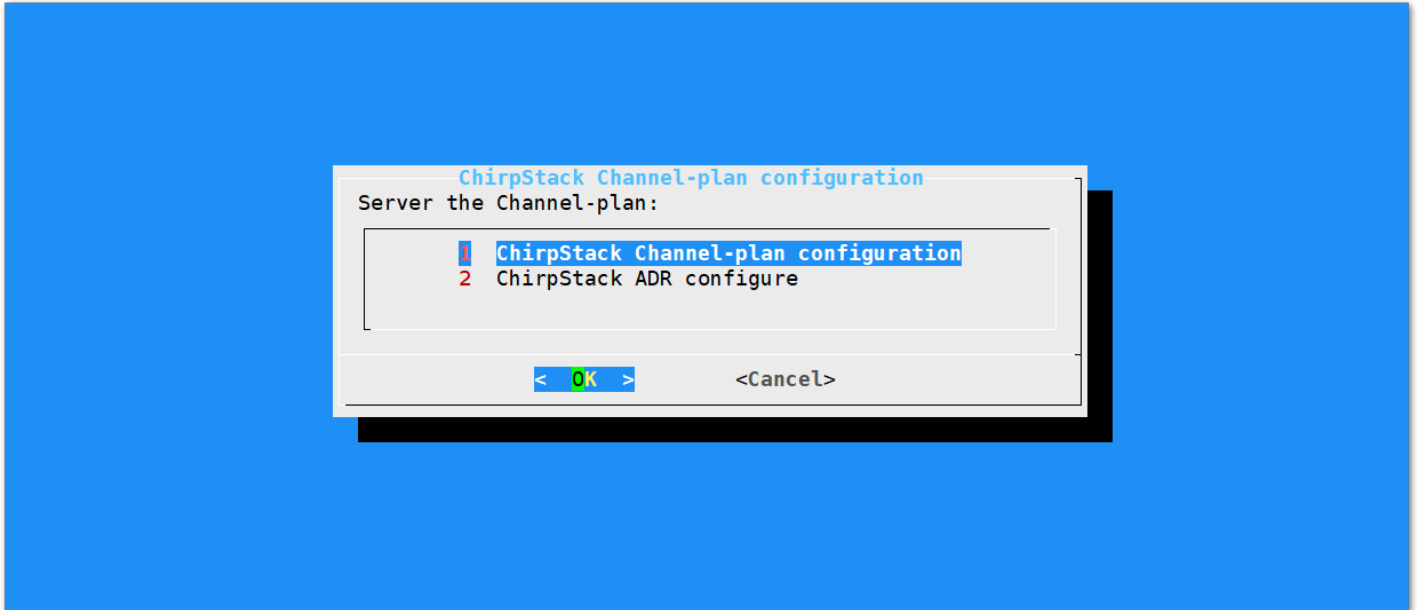


Figure 30: Regional Frequency Band Option

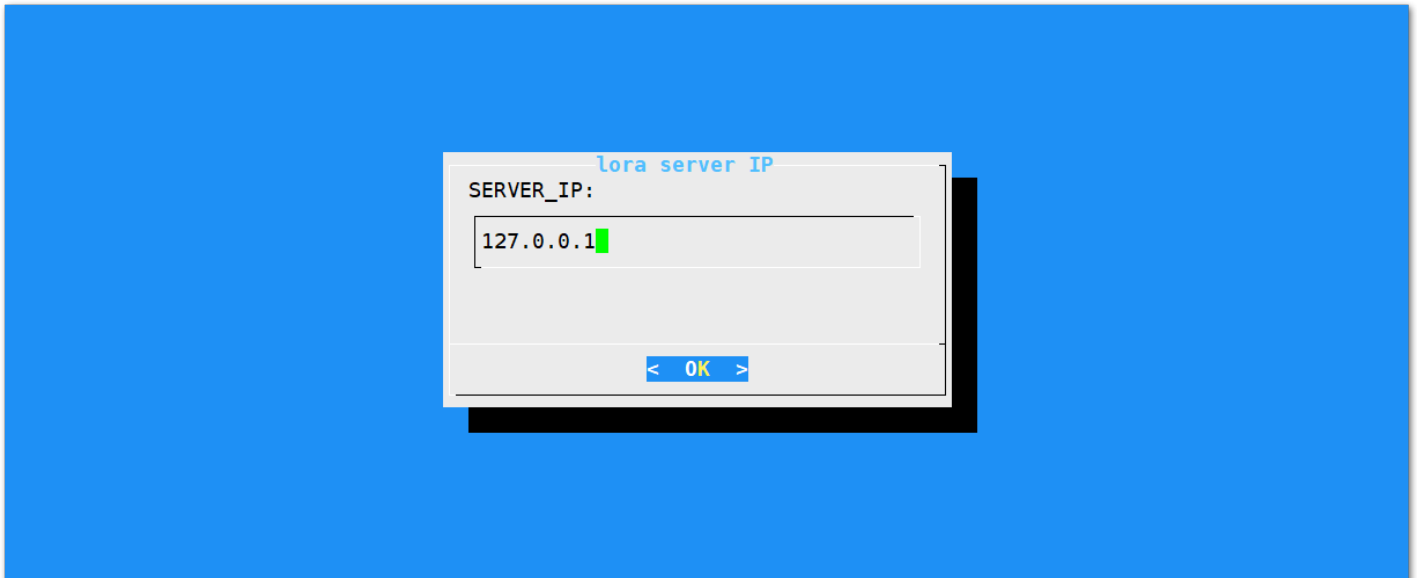


Figure 31: Default LoRaServer IP Address

 **NOTE**

The default IP Address is " 127.0.0.1 ". If you want to use an external LoRaServer, you need to set it to its IP Address.

- If you have instead selected "**Chirpstack ADR Configure**" you can enable/disable the Adaptive Data Rate (ADR) functionality:

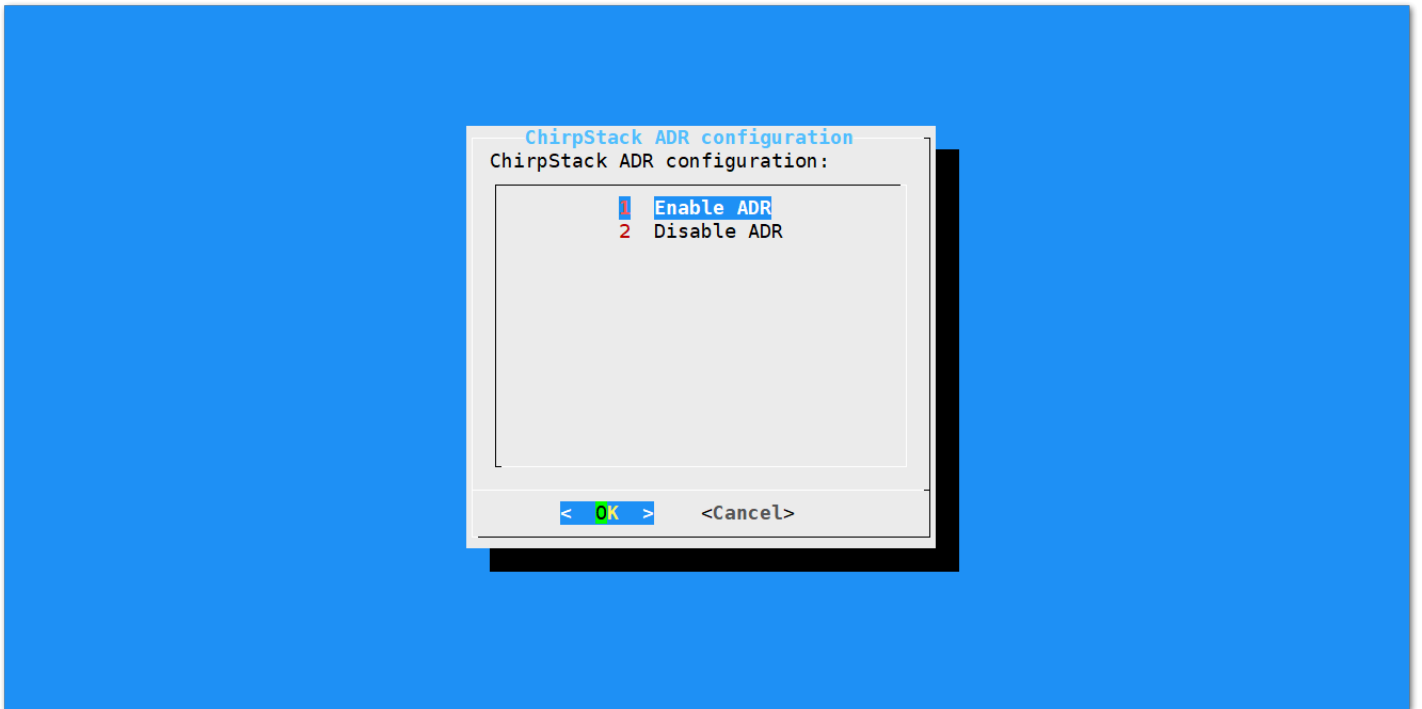


Figure 32: Chirpstack ADR Enable/Disable

## Connecting to the Things Network (TTN)

The Things Network is about enabling low power devices to use long range gateways to connect to an open-source, decentralized network to exchange data with Application. Learn more about the Things Network [here](#).

- First, you should have connected your Gateway to the router in order to access the internet according to the method which has been introduced in the [Accessing the Internet](#) document.
- Second, config your Gateway and choose TTN as the LoRa Server and choose a correct frequency according to the method which has been introduced in the [Configuring the Gateway](#) document.
- Now go to the [TTN Website](#) and Login. You will then see the following page:

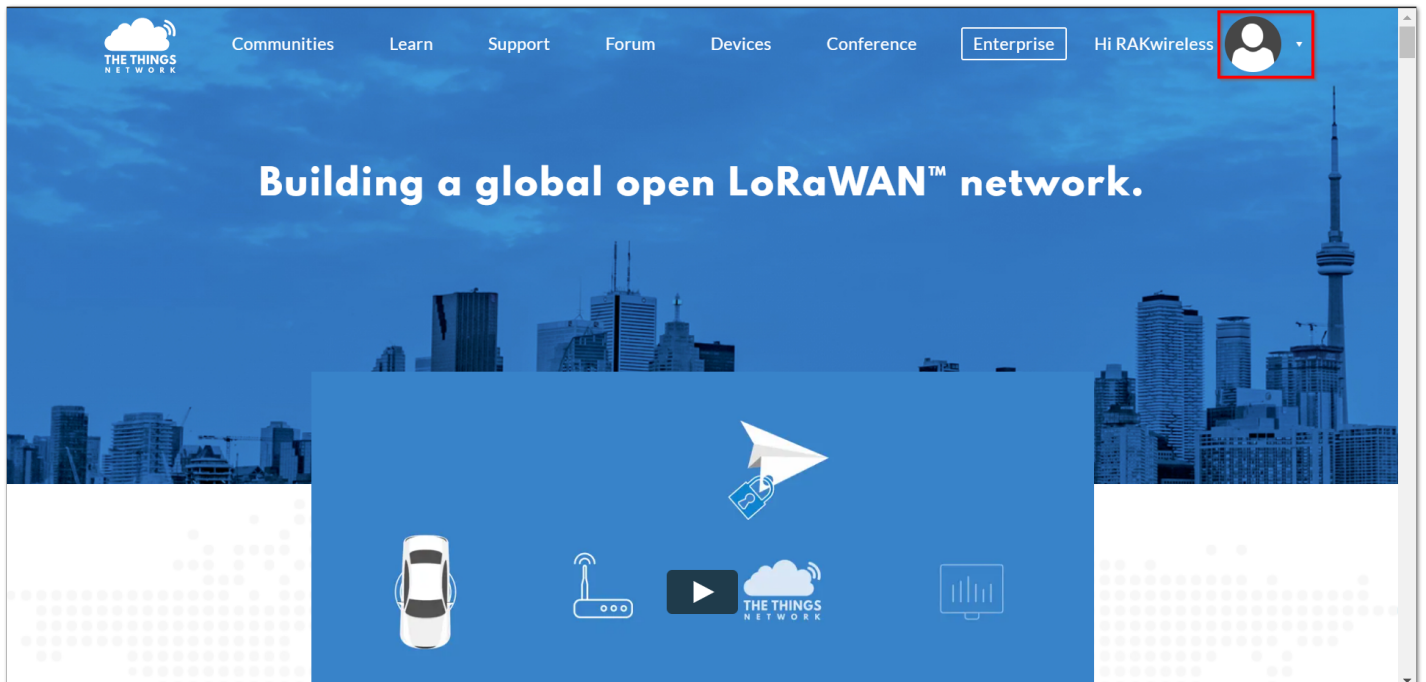


Figure 33: The Things Network Home Page

- Choose Console then Click Gateways.

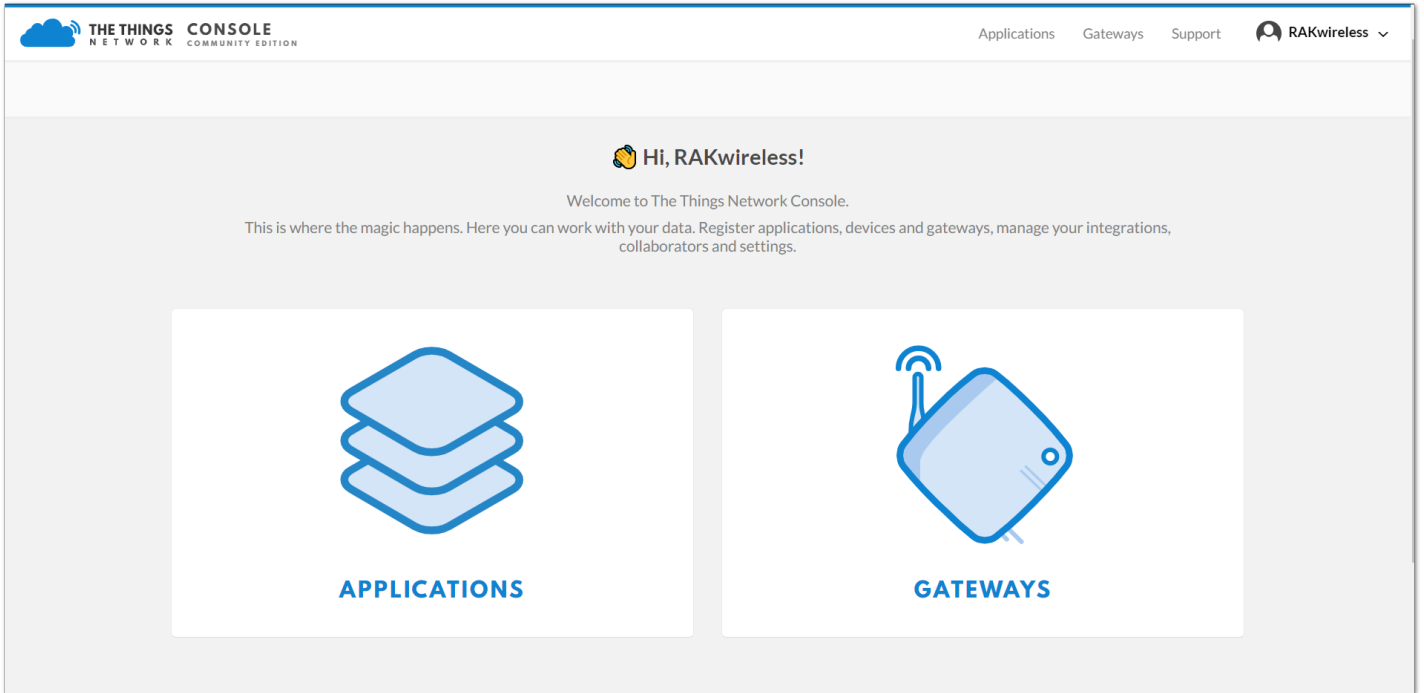


Figure 34: The Things Network Console Page

- All of your Registered Gateways will be displayed here in this page. Click "register gateway"

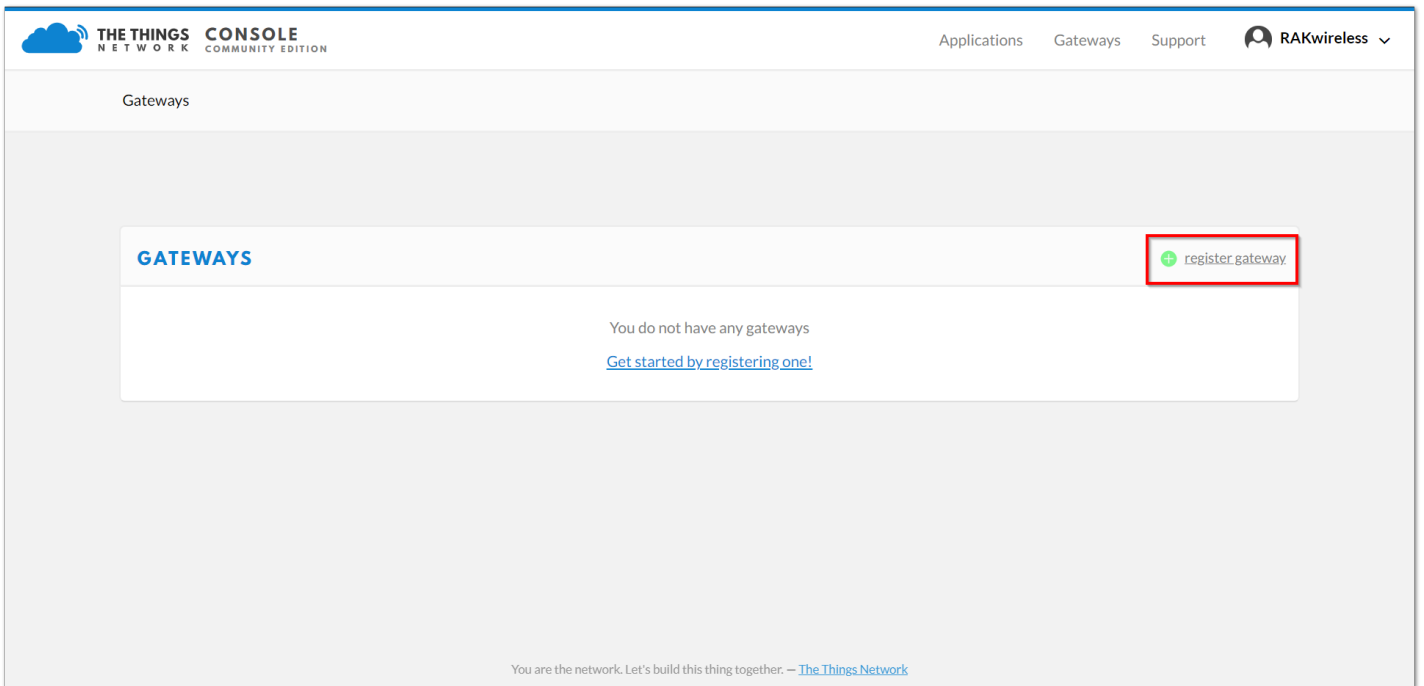
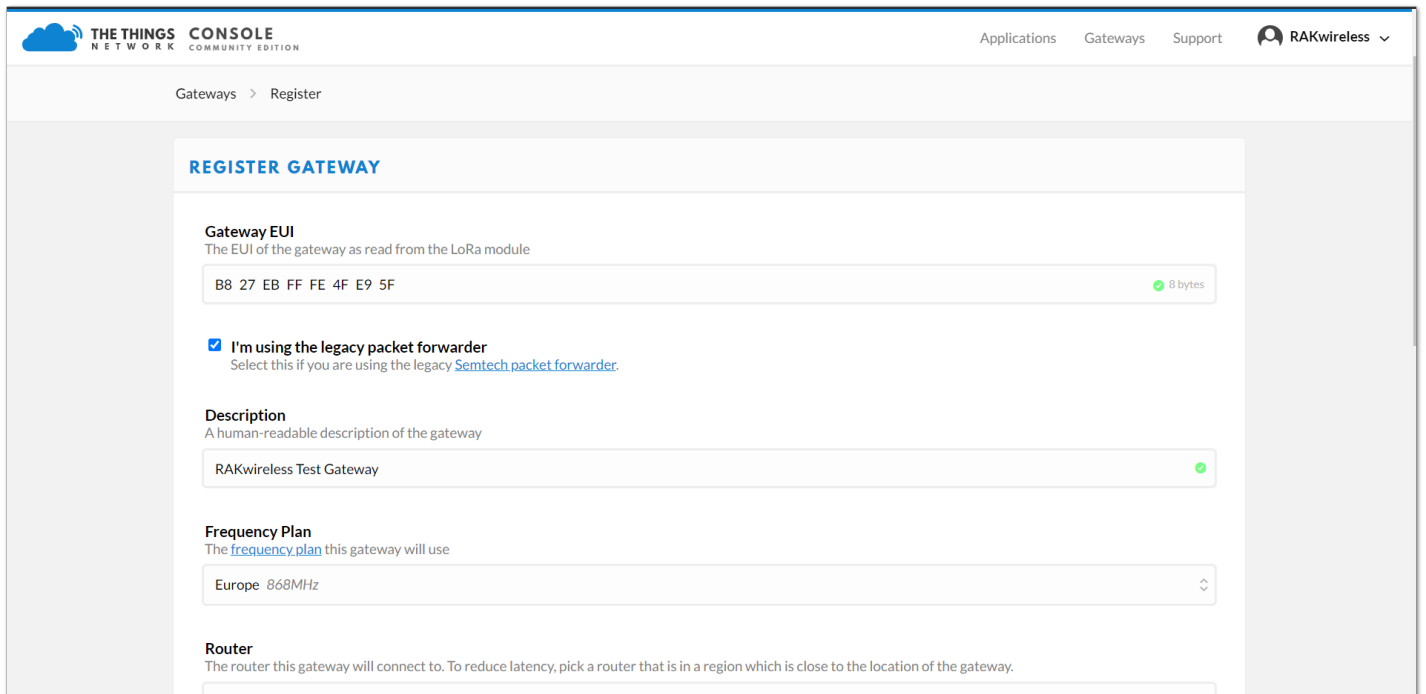
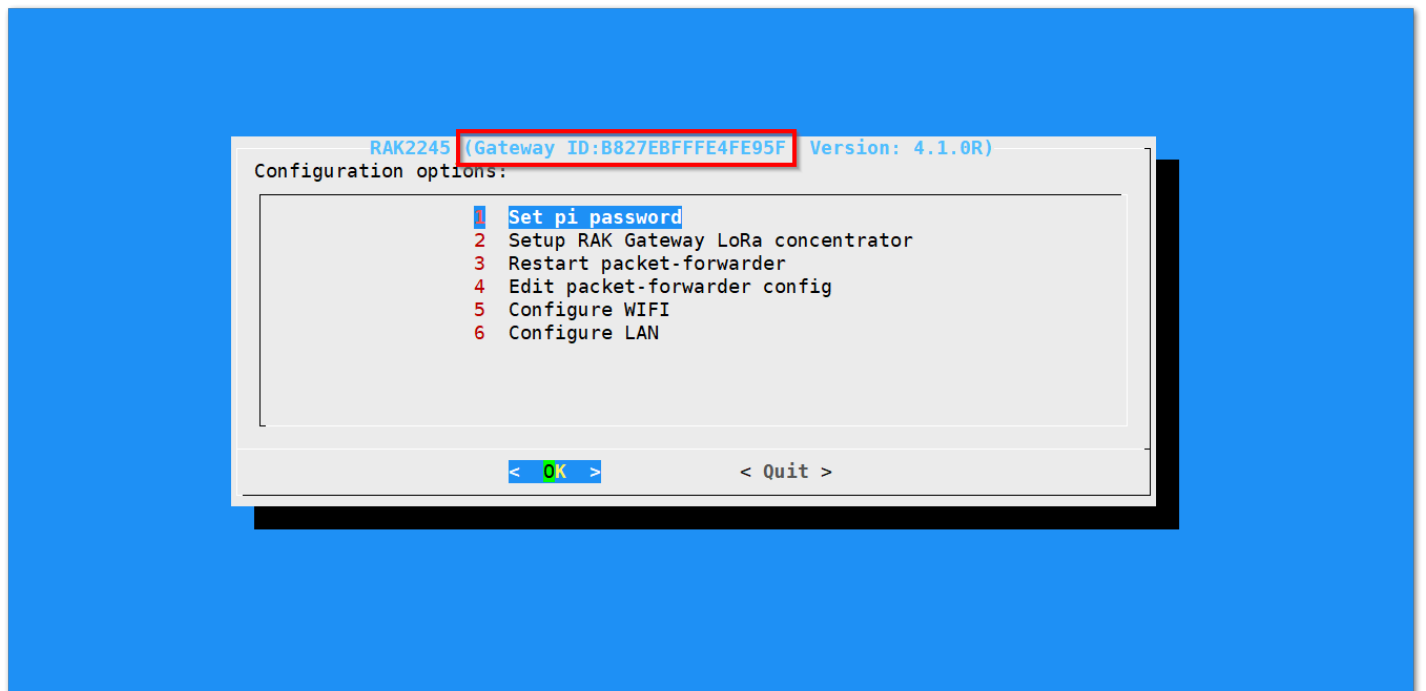


Figure 35: Adding a Gateway to TTN



**Figure 36:** Registering your Gateway

- **Gateway EUI** - refers to the Gateway ID you obtained from the previous steps. In case you forgot, just type `gateway-version` in the command line. This must be the same with the Gateway's True Gateway ID otherwise you will fail to register your Gateway on TTN.



**Figure 37:** RAK2245 Pi Hat Gateway ID in SSH

**NOTE:**

Make sure to select the "I'm using the legacy packet forwarder" check box.

- **Description** - A human readable description of your Gateway.
- **Frequency Plan** - This is the frequency you want to use and it must be the same with Gateway and the Node.
- **Router** - The router this gateway will connect to. To reduce latency, pick a router that is in a region which is close to the location of the gateway.
- **Location** - Choose the location of the Gateway by entering its coordinates. This is reflected on the Gateway World Map.
- **Antenna Placement** - Where is your antenna placed? Is it placed indoors or outdoors?

Click Register Gateway and wait for a couple of minutes . If the status of your gateway is **Connected**, Congratulations! 🎉 Your Gateway is now connected to the The Things Network (TTN).

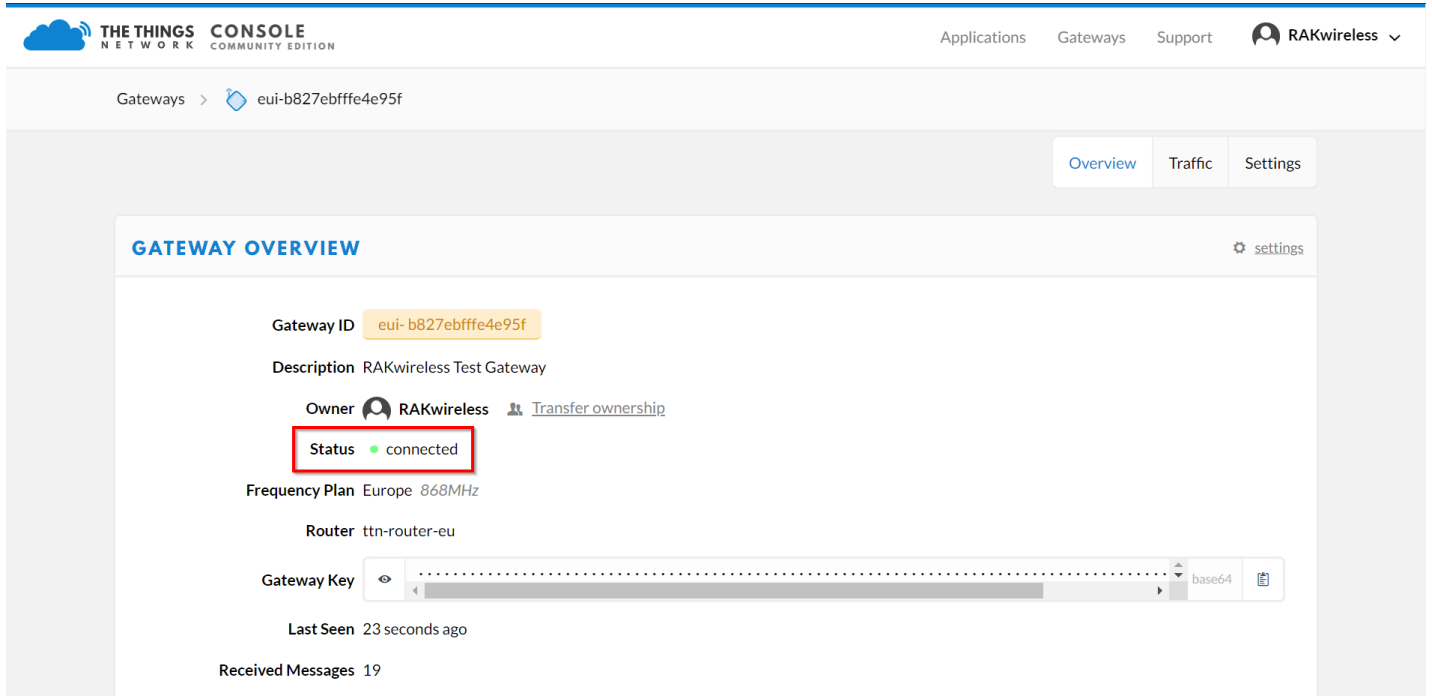


Figure 38: RAK2245 Pi Hat TTN Connection Success

## Connect the Gateway with Chirpstack

The ChirpStack or previously known as LoRaServer project provides open-source components for building LoRaWAN networks. You can learn more about ChirpStack [here](#).

For the RAK2245 Pi HAT Edition LPWAN Gateway Concentrator Module, there are 2 ways to use the ChirpStack:

### 1. Using the built-in ChirpStack

There is a built-in ChirpStack in every RAK Developer gateway if you use the latest firmware.

- When you use it for the first time after burning the latest firmware, the Gateway will work in the EU868 Band and use the built-in ChirpStack as its default LoRa Server. If you don't want to change the frequency or LoRa Server, you don't have to do anything as this will be configured automatically when the Gateway boots.
- However if it is not the first time and you want to use the built-in ChirpStack as the LoRa Server, follow the steps discussed in [Configuring the Gateway](#) the Gateway section.
- **Optional:** If ever you disabled the AP Mode and you have connected it to your own Wifi network (Client Mode). You can search for your gateway's IP Address via [Advanced IP Scanner](#). Copy the IP Address of your Gateway, it should have a Manufacturer name of **Raspberry Pi Foundation**:

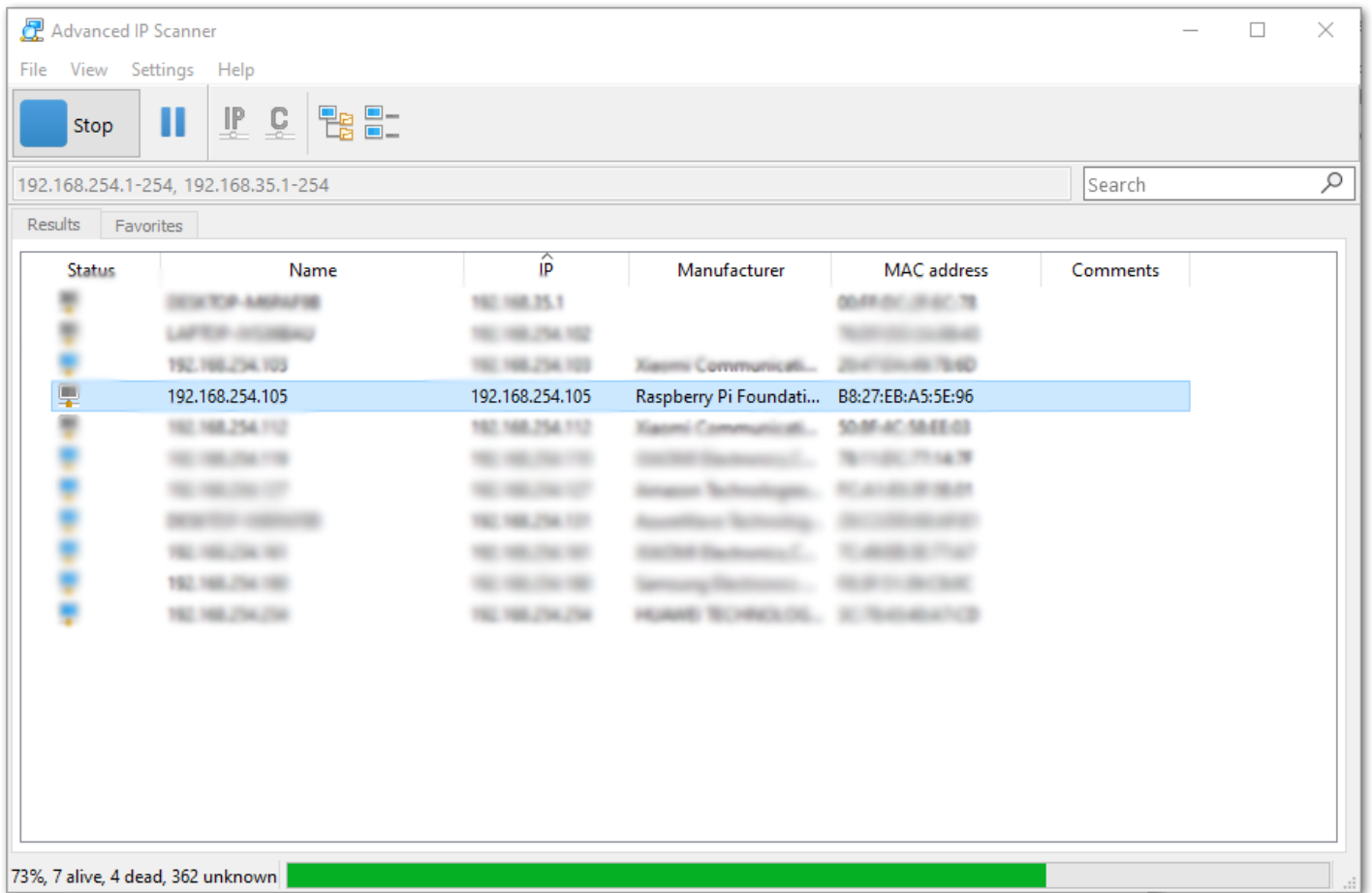


Figure 39: IP address of your Raspberry Pi with the RAK2245 Pi Hat using IP Scanner

- There is a Web-based UI that comes with the ChirpStack instance. Simply open a browser and enter the following credentials:
  - **Browser Address:** <Gateway IP address>:8080 (Example: http://192.168.254.176:8080)
  - **Username:** admin
  - **Password:** admin

**⚠️ WARNING**

It is advisable to change your password to tighten the security of your account. You can change this by clicking the "change password" button at the user icon.

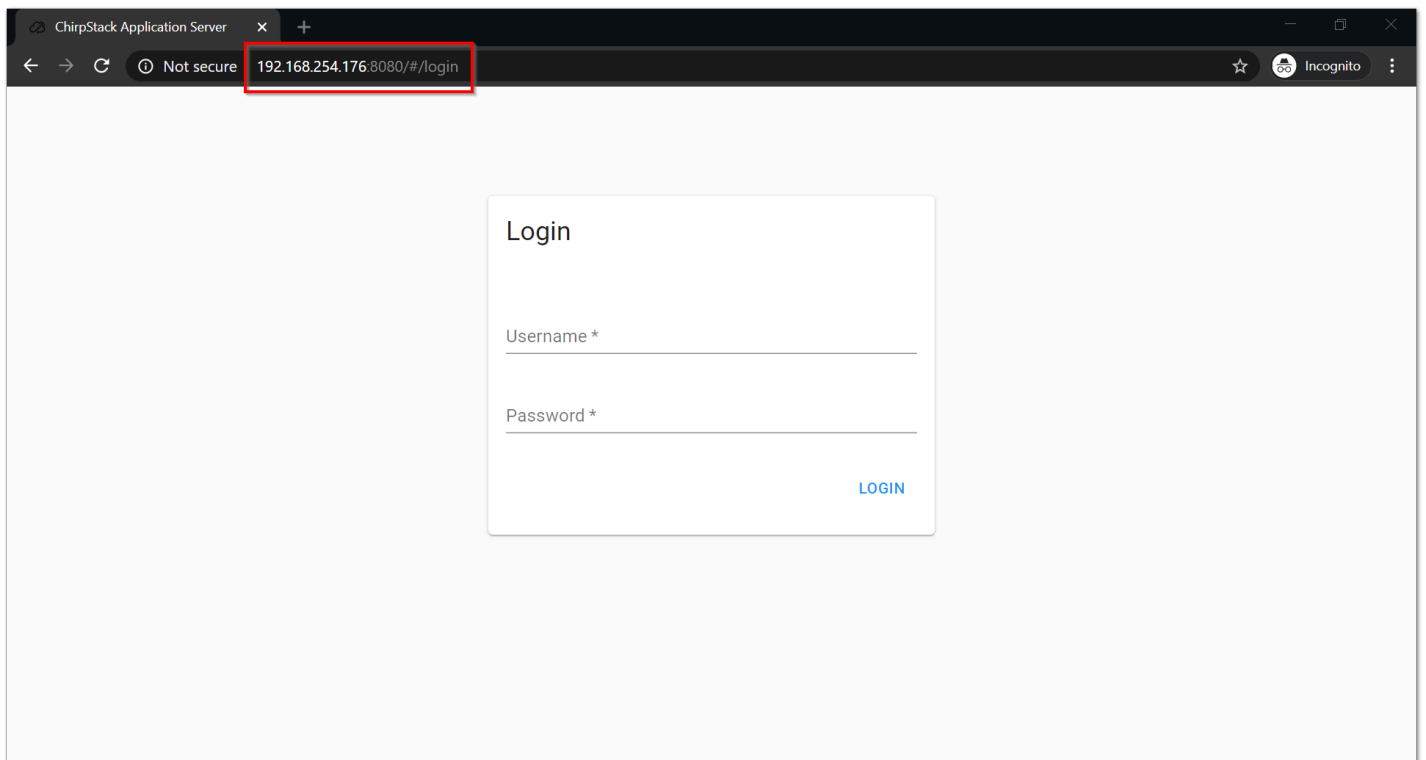


Figure 40: ChirpStack Web-based UI

- 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.

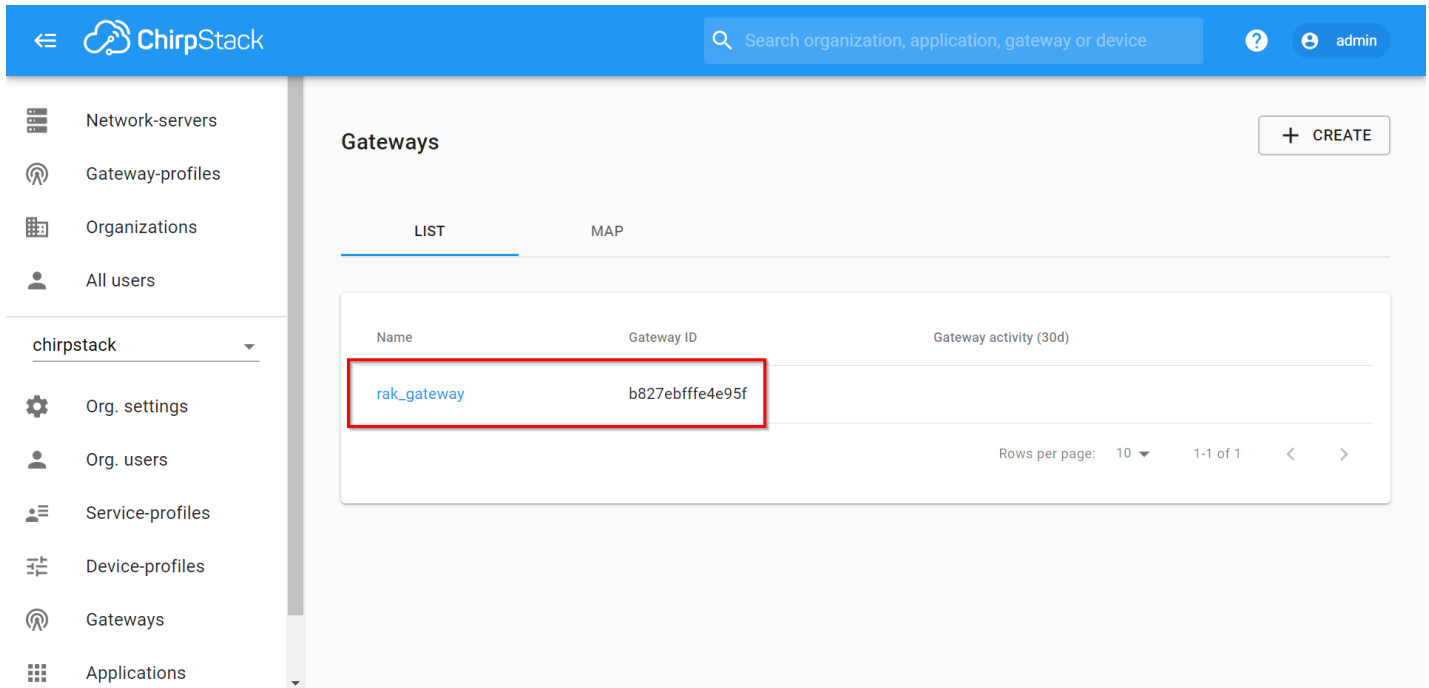


Figure 41: Available Gateways in Chirpstack

- Go to the rak\_gateway and see the "Last seen" status. It must be a few seconds ago which signifies that the Gateway is visible in the ChirpStack server.

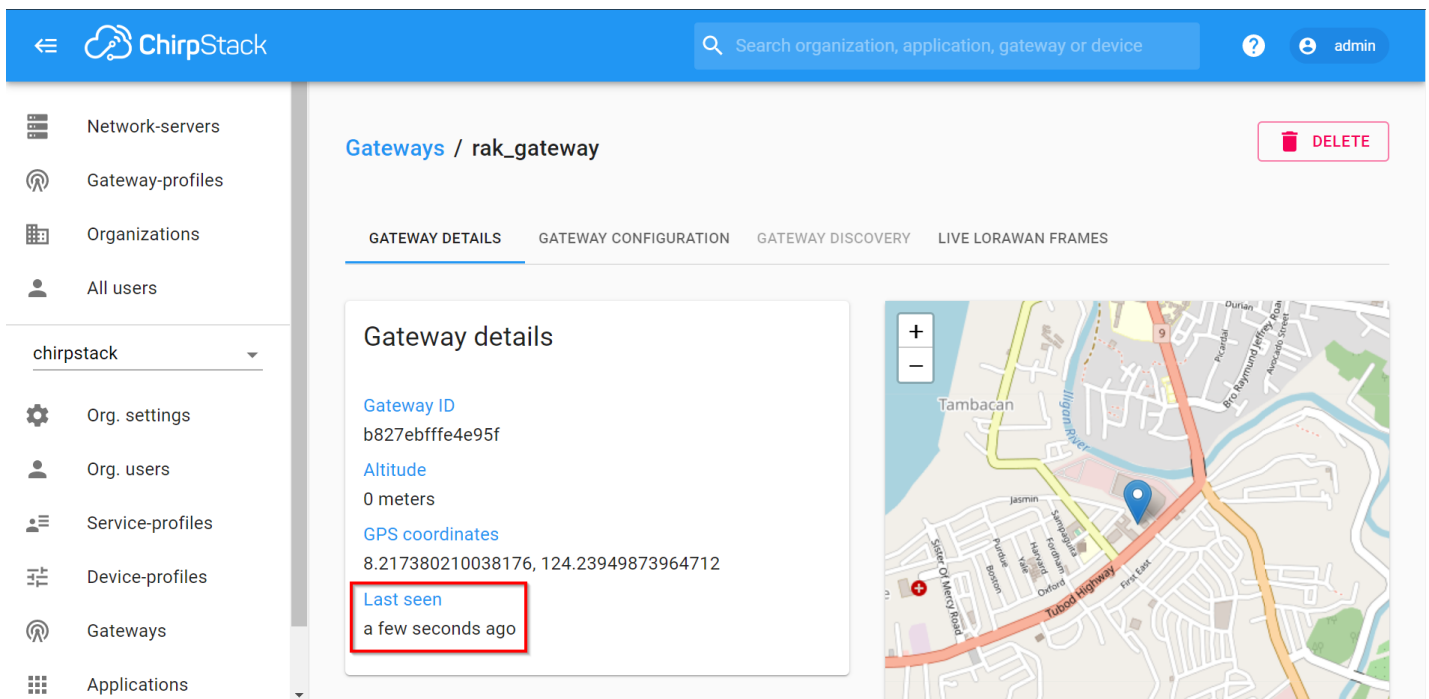


Figure 42: Last Seen Status

## 2. Using an Independent ChirpStack

You can setup an Independent ChirpStack by yourself. This is a lot more complicated having to deploy a remote ChirpStack by yourself but Chirpstack provided a detailed guide on how to do it [here](#).



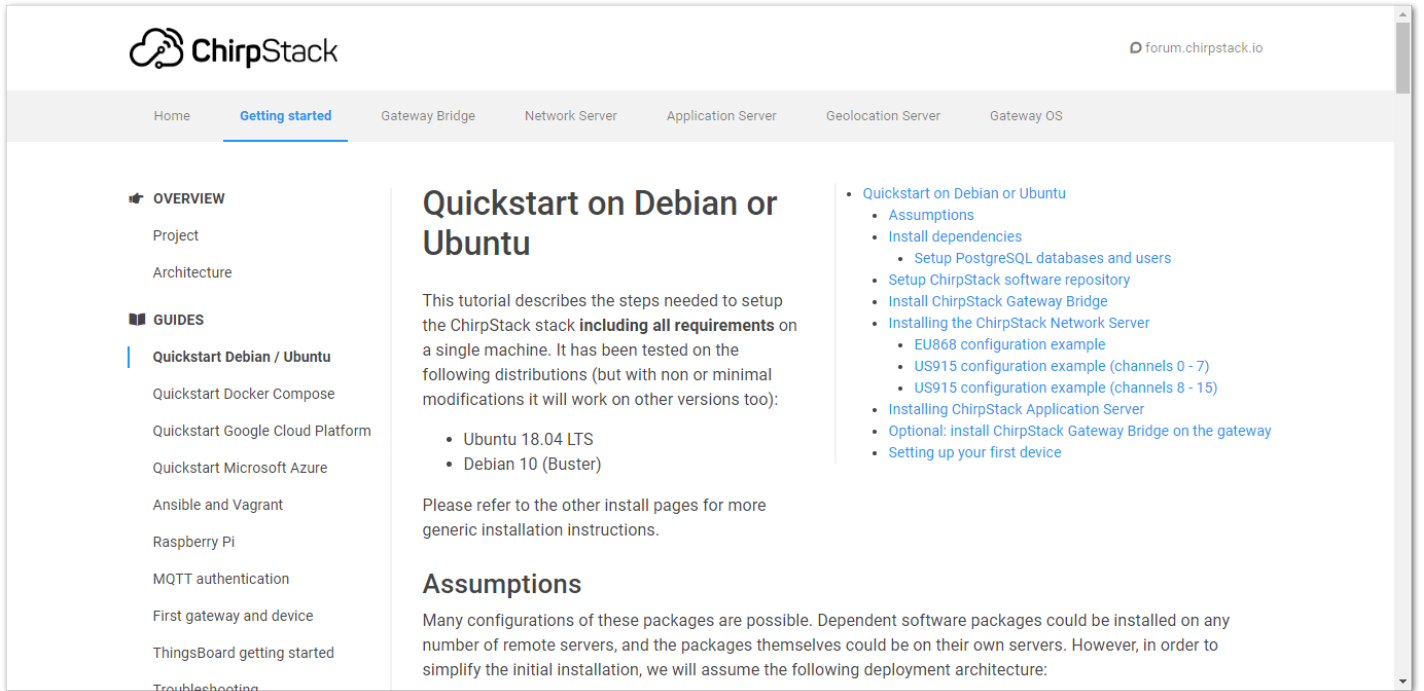


Figure 43: Chirpstack Getting Started Guide on Ubuntu

**⚠ WARNING**

Remember to run the " `sudo gateway-config` " command in the CLI and point the Gateway to the IP address of the machine you just installed Chirpstack on. This can be done in item 2 in the menu Setup RAK Gateway LoRa concentrator.

- Assuming you have set it up correctly, Login to your ChirpStack to register your Gateway by opening the ChirpStack's web page in a browser by entering:
  - **Browser Address:** `<IP Address of ChirpStack>:8080`
  - **Username:** admin
  - **Password:** admin

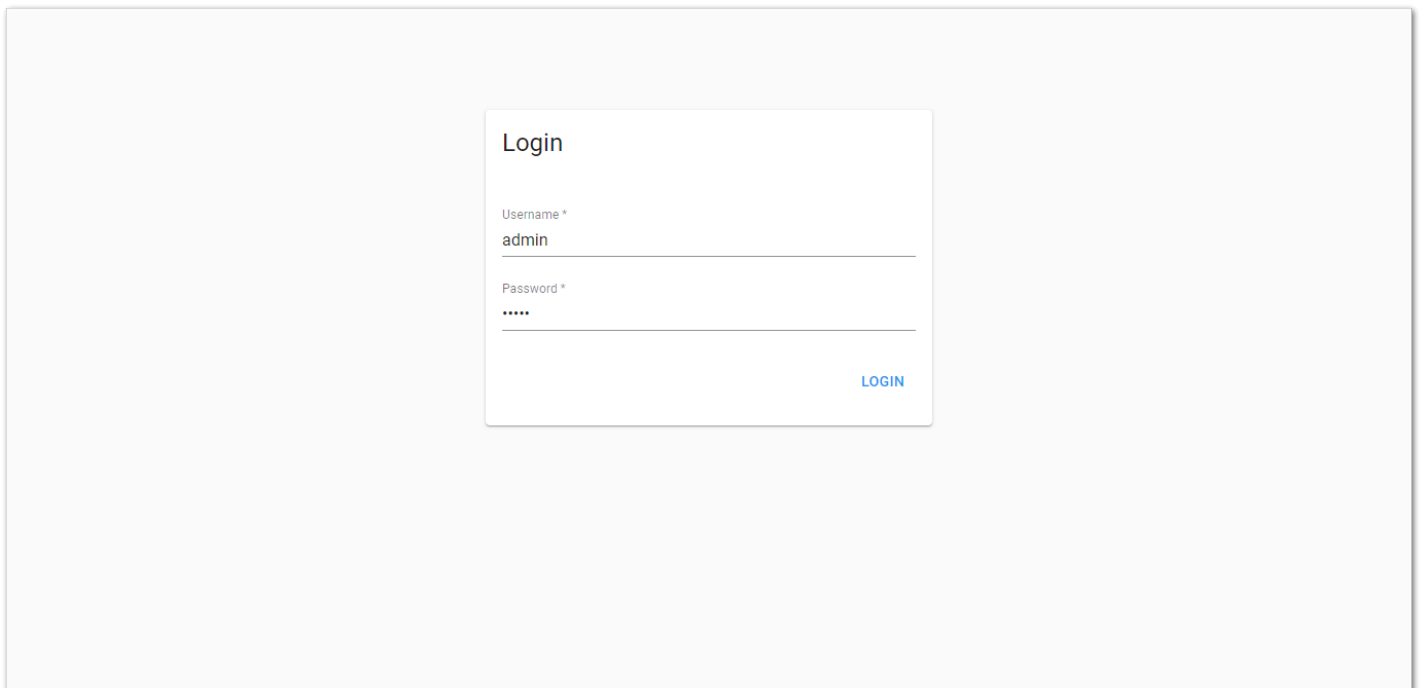
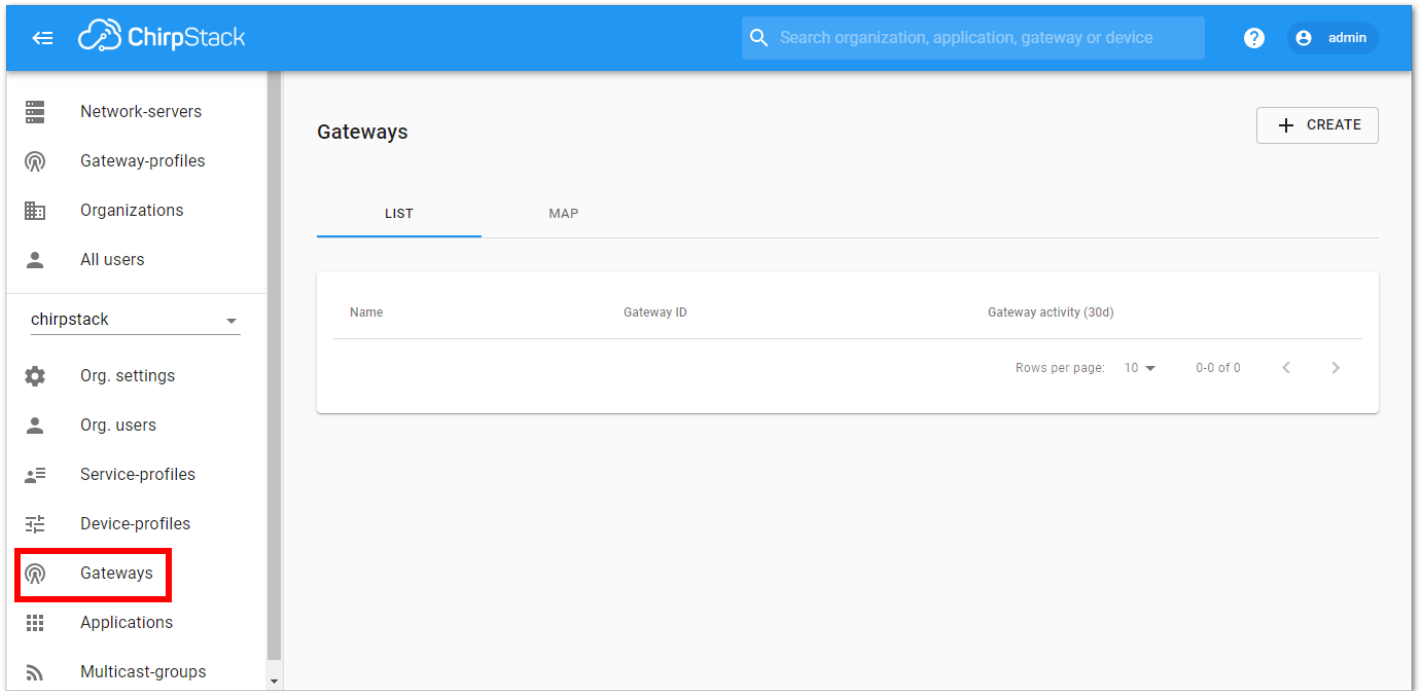


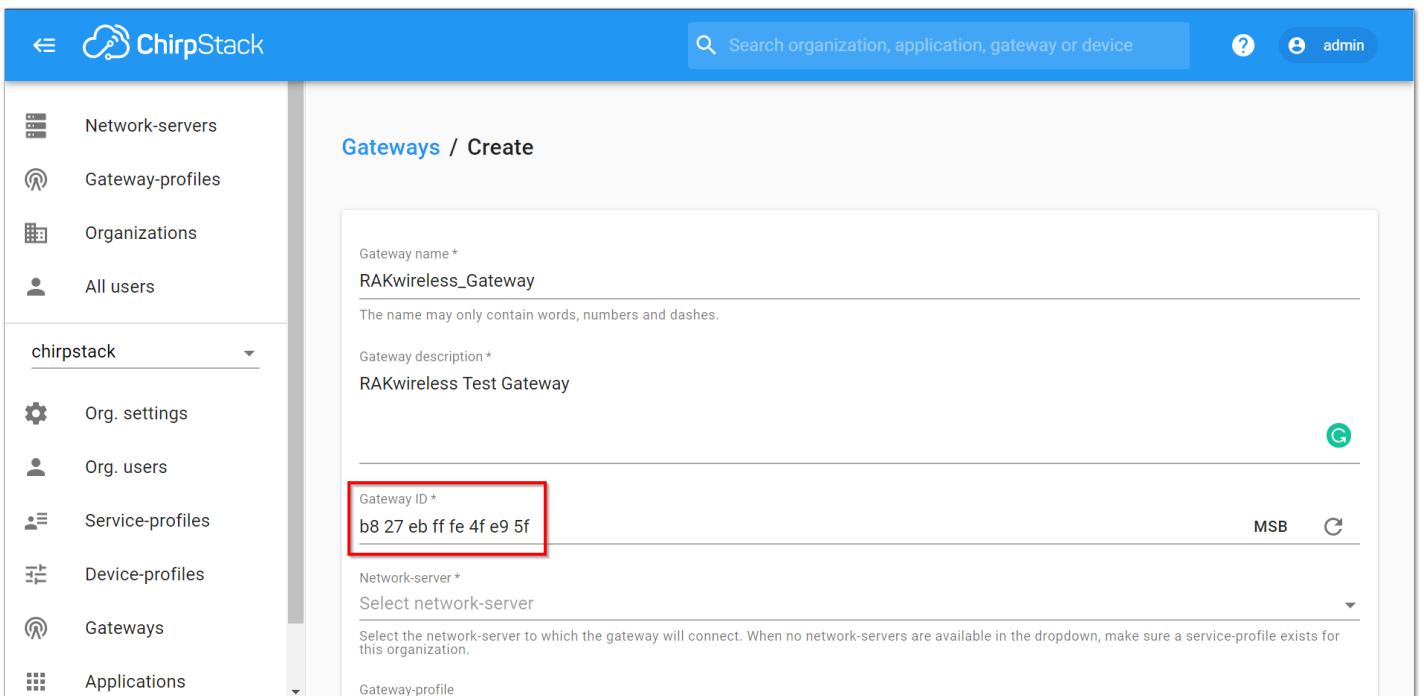
Figure 44: ChirpStack Login Page

- Click "**Gateways**" and Press "+ **CREATE**" to register your Gateway



**Figure 45:** ChirpStack Registered Gateways

- Click "**Create**" to register your Gateway and fill up the necessary information.



**Figure 46:** Registering your own Gateway

- Fill in the Gateway ID that we got from the [Configuring the Gateway](#) document, also called Gateway EUI.
- If you have properly configured your Gateway and there is a network connection between the external ChirpStack and your Gateway, you should see the following page and status:

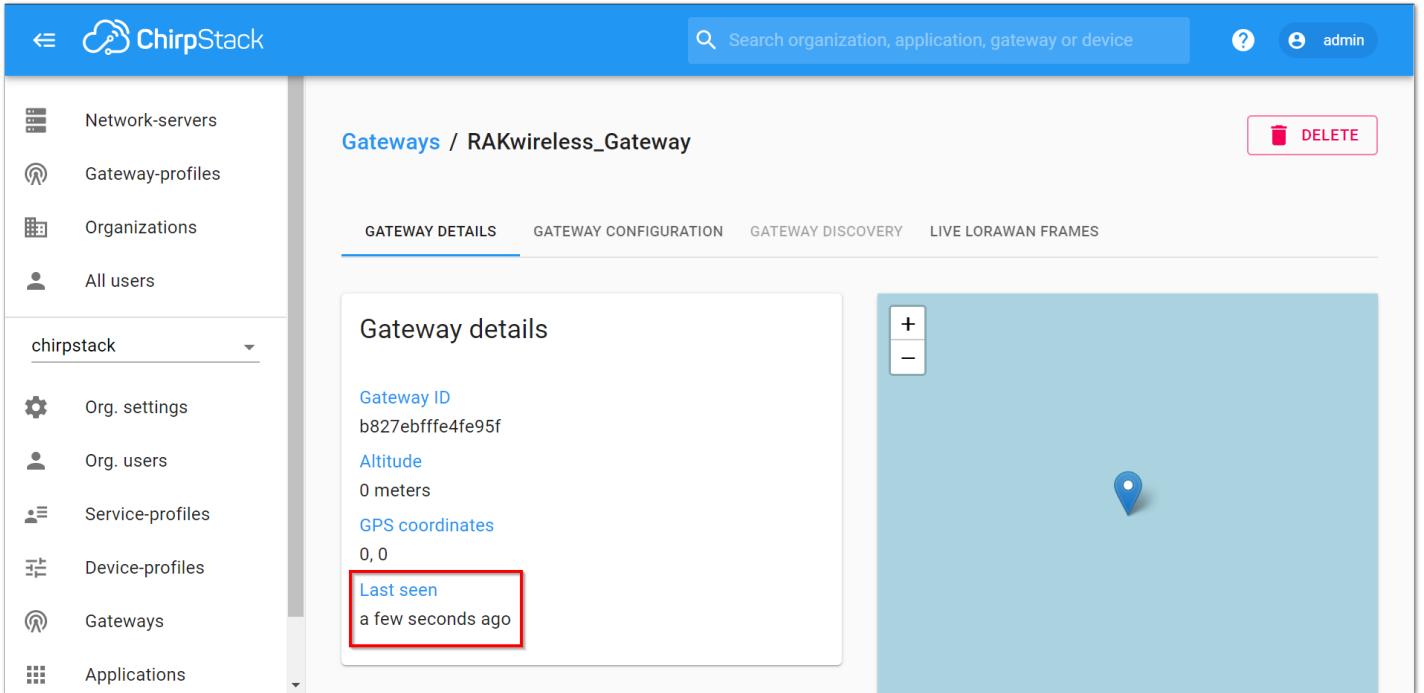


Figure 47: Successfully Registered the Gateway

**Congratulations!** 🎉 You have connected your Gateway to an external ChirpStack Successfully!

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