LoRaWAN Configuration Guide

User Manual

Version 1.3.0
February 2023

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Document Information

This document was created to help set up Peplink LoRaWAN gateway functionality. The guide provides step by step guides on how to connect gateways using LoRa Basics™ Station or the Semtech UDP Packet Forwarder to some of the most popular LoRaWAN Network Servers (LNS).

Naming Conventions

The term **downlink device** or **endpoint device** is used in this document to refer to a LoRaWAN end device that connects to a LoRaWAN Gateway. The **Gateway** in turn, connects to a LoRaWAN server.

Revision History

Version	Date	Description of change
1.0.0	Dec 29, 2021	Initial release.
1.2.0	Jan 31, 2023	Updated overview section Added configuration examples for Senet server. Updated B20x WEB configuration screenshots. Updated The Things Network configuration examples.
1.3.0	Feb 8, 2023	Added configuration examples for AWS IoT Core.

Hardware Description

Standard Kit Contents for LoRaWAN FlexModule Mini

1x LoRaWan FlexModule Mini
1x Antenna

Balance 20X SD-WAN router is sold separately. For more information please refer Peplink WEB pages:

- Balance 20X
- LoRaWan FlexModule Mini

How to reset Balance 20X to factory default settings

- Hold the reset button for 5-10 seconds. Once the LED status light turns RED, the reset button can be released.

Balance 20X default login

The default WEB login settings are:

- User: admin
- Password: admin
- IP address: 192.168.1.1

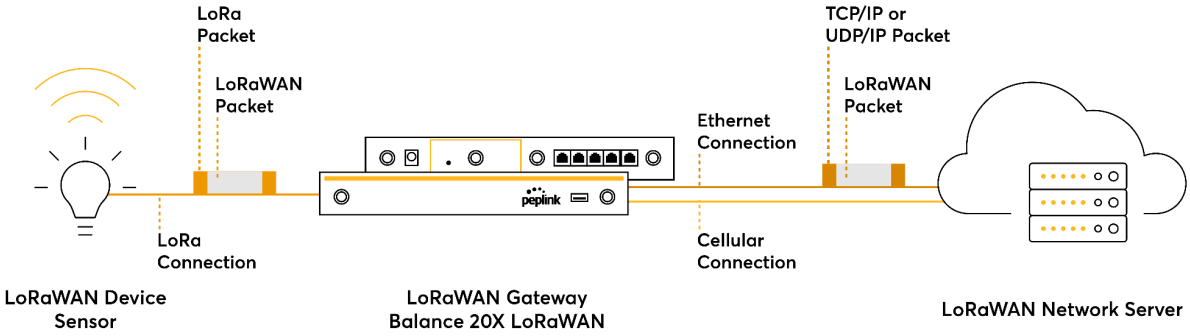
Overview

LoRa and LoRaWAN

LoRaWAN is a low-power wide-area network (LPWAN) protocol optimized for low power end devices and long distance transmissions that functions on LoRa technology. It is best suited for small-sized payload transmissions (e.g. sensor data). The LoRaWAN specification is open so anyone can set up and operate a network.

LoRa is a physical layer protocol. It operates in a license-free radio frequency spectrum. Depending on a country or a region the different spectrum range is available to use. The unique thing about LoRa is related to its spread spectrum modulation which allows it to achieve a very long-range communication at the cost of a narrow bandwidth.

The typical LoRaWAN solution consists of three components: end device (sensor) Gateway (converting RF to IP) and a server.



Peplink SW WAN routers with reliable backhaul connectivity stands in the center of the whole solution. The purpose of this guide is to provide the basic steps on how to get it started. This guide details the configurations of several of the most common LoRaWAN scenarios and provides step-by-step explanations to help you get started if you are new to LoRaWAN.

*Note: Certain 3rd party solutions were used (e.g. Senet, The Things Network) during the creation of this document. It is important to note that the 3rd party WEB UI pages used in this document may look different in the future.

Frequency Band selection

Peplink has two SKU options for LoRaWAN FlexModule Mini. The supported bands are listed below:

- EXM-MINI-LORA-EU > EU868, IN865, RU864
- EXM-MINI-LORA > US915, AU915, AS923, AS925, KR920

Getting Started with Senet

Requirements

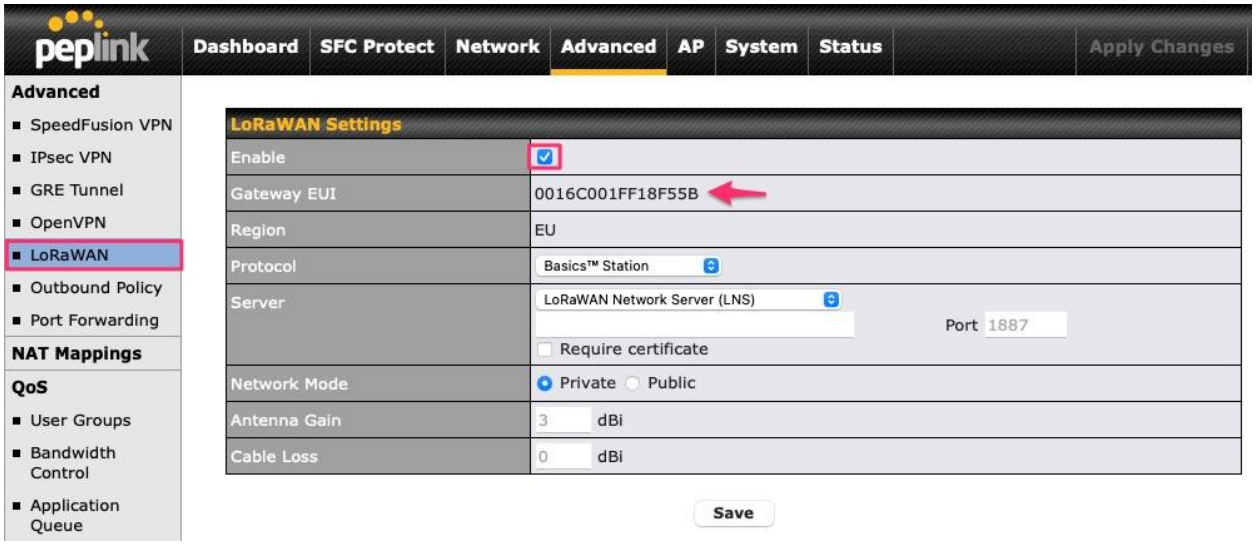
- LoRaWAN FlexModule Mini.
- Balance 20X router.
- LoRaWAN sensor (in our example we used Dragino LHT65).
- Senet account.

Note: The LoRaWAN FlexModule Mini comes in two options: EU868 and US915. Please make sure you order the correct one for your region.

Set up LoRa Basics™ Station packet forwarder

Step 1. Enable LoRaWAN protocol on your router

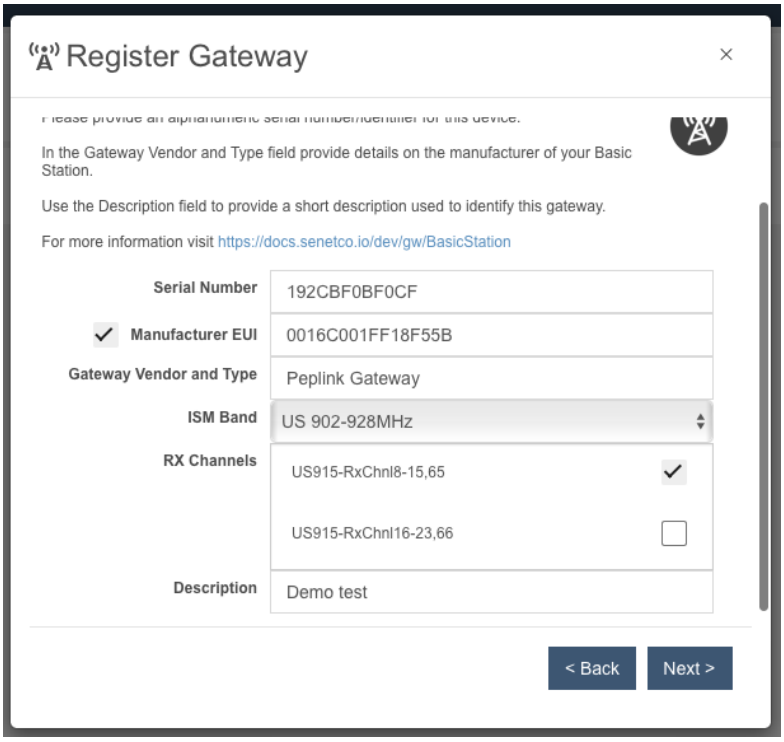
1. On your Peplink router's web admin page, go to the **Advanced** tab along the top bar.
2. Find the **LoRaWAN** tab along the left navigation bar.
3. In **LoRaWAN** settings, tick the **Enable** checkbox and write down the Gateway EUI, this will be needed for registering a gateway later on.



Step 2. Add gateway to the Senet server

1. In our example we are using Senet Developer Portal. Opening an account for testing purposes is free of charge. Here is the link to begin with.
2. Click on plus sign and select register gateway as in picture below.

3. Gateway registration has several steps and you will be asked to fill up certain fields. We will cover the most important ones.
    - **Gateway Type**, select **Semtech Basic Station**.
    - **Gateway information**:
        - Serial number: add Peplink router S/N without dashes. Instead of xxxx-xxxx-xxxx you should enter xxxxxxxxxxxx.
        - Manufacturer EUI: add Peplink Gateway EUI (see Step 1).
        - Gateway Vendor and Type: enter Peplink Gateway name.
        - ISM band: select based on your region.
        - RX Channels: select preferred LoRaWAN channel. The example is for the US region and for testing purposes we select US915-RxChnl8-15,65. Other regions might have a single channel only.
        - Description: additional notes about gateway.

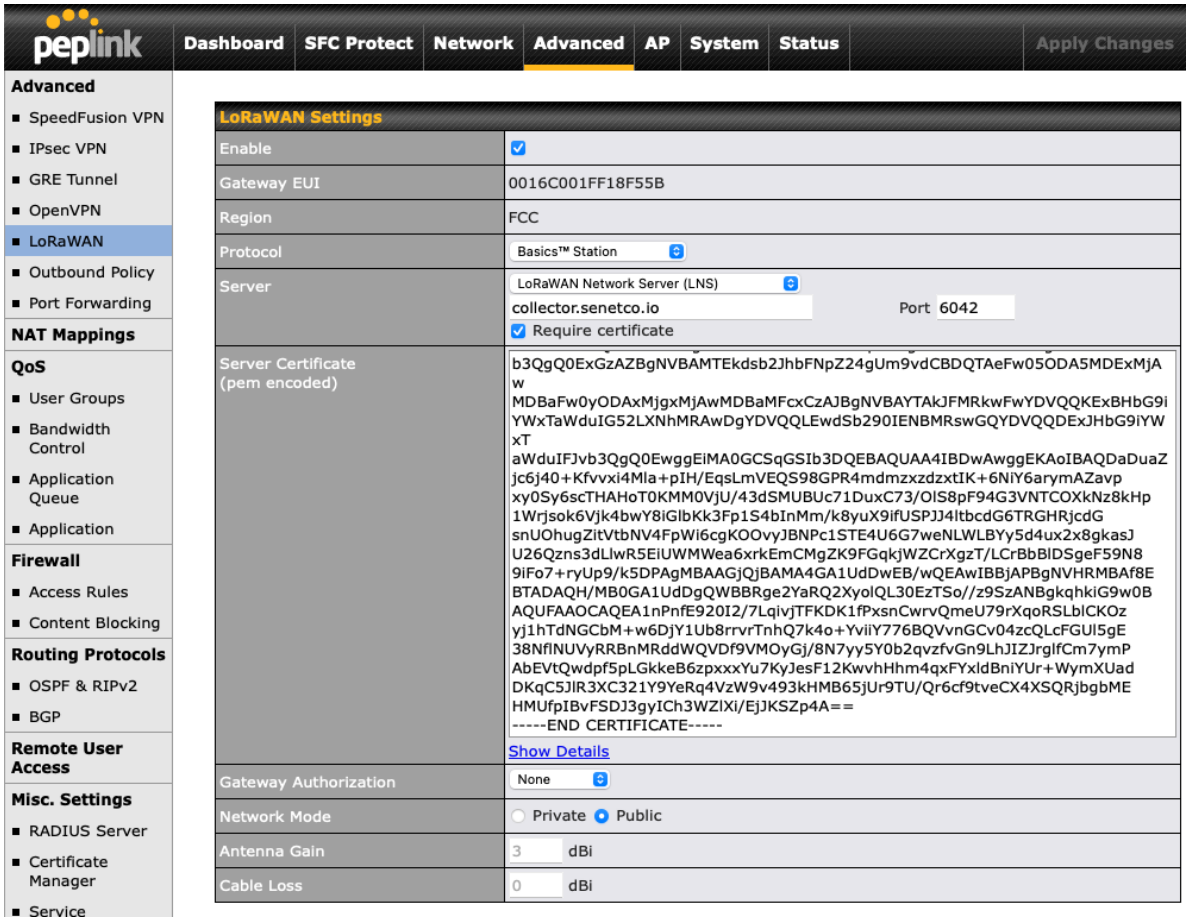


    - Installation information: fill up based on your installation.

Once completed, review the information. If it is correct and then click **Done**.

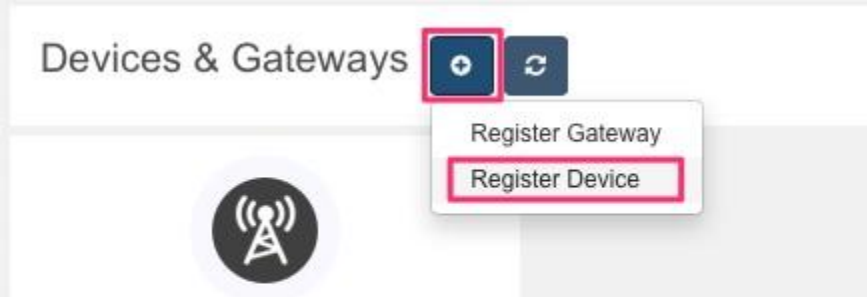
Step 3. Connect your gateway to the Senet server

1. Download a TLS Certificate provided by Senet. It can be downloaded here.
2. On your Peplink router, go to the **Advanced** tab along the top bar.
3. Find **LoRaWAN** settings along the left navigation bar and enter the following settings:
   - Protocol: **Basic Station**.
   - Server: **LoRaWAN Network Server (LNS)**.
   - Server address: **collector.senetco.io**
   - Port: **6042**
   - Server Certificate (pem encoded): copy the TLS Certificate provided by Senet.
   - Gateway Authorization: Select **None**.
   - Network Mode: **Public**.
   - Antenna Gain: enter your antenna Gain (for Peplink antenna enter 2).
   - Cable loss: enter cable loss if there is a cable between antenna and LoRa module
4. Click **Save** and **Apply Changes**. Below you will find a Balance 20x configuration example for your reference.



Step 4. Add Device (sensor)

1. Click on plus sign and select register gateway as in picture below.



2. For Device registration you will need to fill up certain fields.
   - Device EUI
   - Join EUI
   - Application Key
   - Description (Optional)
   - Device Type (default type is Other)
   - Click the **Supports Senet Packet** check-box if the end device supports the Senet Packet Format. For supported devices please contact Senet support.
   - Device Notes (Optional)
   - Click **Register New Device** once finished

3. Depending on your sensor, you may need to activate the device (join network). To connect the LHT65 sensor, begin by pressing the ACT button 5 times quickly. This will deactivate the end device and it will display a solid RED LED for 5 seconds. Press and hold the ACT button for more than 3 seconds and a GREEN LED should blink 5 times. The device will begin operating and initiate connection to the LoRaWAN network. The GREEN LED will turn a solid green for 5 seconds after it successfully joins the network.

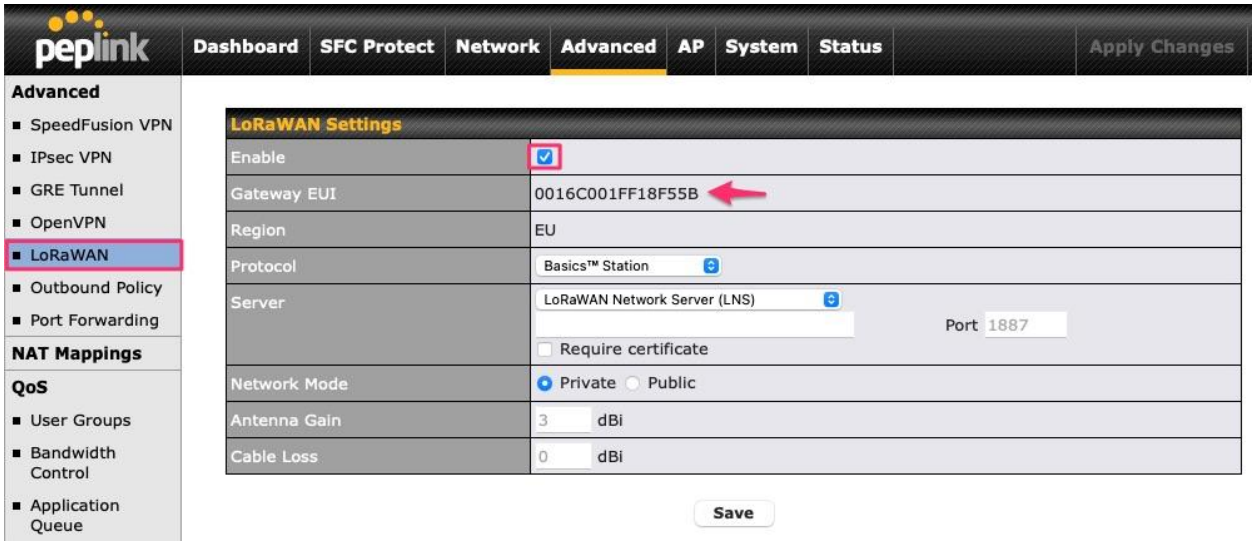
Set up UDP Packet Forwarder

Important: UDP packet forwarder is not recommended and suggested to use only for testing purposes. Semtech Basic Station option provides a better security and channel plan configuration through the Network Server, while Semtech Packet Forwarder uses unsecured UDP communication and any channel plan configuration should be done manually through the Gateway.

Note: The steps for adding sensors and connecting to data visualization is identical to the UDP Packet forwarder type and therefore are not covered here. You may refer to Steps 4 of the previous section.

Step 1. Get a LoRaWAN Gateway EUI

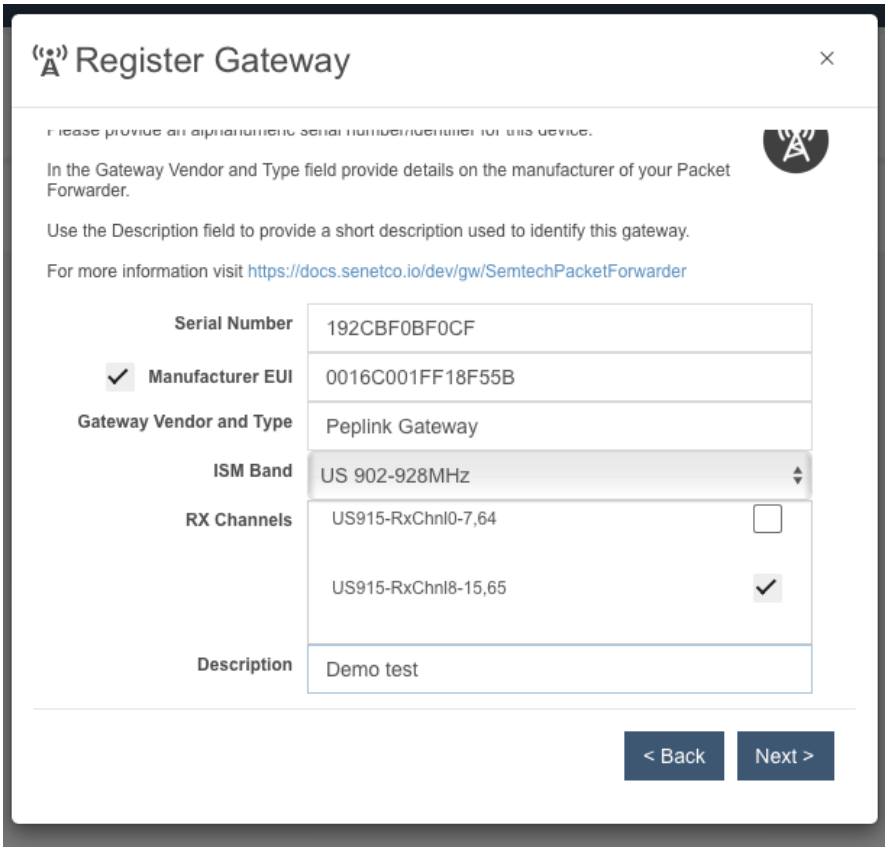
1. On your Peplink router's web admin page, go to the **Advanced** tab along the top bar.
2. Find the **LoRaWAN** tab along the left navigation bar.
3. In **LoRaWAN** settings, tick the **Enable** checkbox and write down the Gateway EUI, as this will be needed for registering a gateway later on.



Step 2. Add gateway to the Senet server

1. In our example we are using Senet Developer Portal. Opening an account for testing purposes is free of charge. Here is the link to begin with.
2. Click on plus sign and select register gateway as in picture below.

3. Gateway registration has several steps and you will be asked to fill up certain fields. We will cover the most important ones.
    - **Gateway Type**, select **Semtech Packet Forwarder**.
    - **Gateway information**:
        - Serial number: add Peplink router S/N without dashes. Instead of xxxx-xxxx-xxxx you should enter xxxxxxxxxxxx.
        - Manufacturer EUI: add Peplink Gateway EUI (see Step 1).
        - Gateway Vendor and Type: enter Peplink Gateway name.
        - ISM band: select based on your region.
        - RX Channels: select preferred LoRaWAN channel. The example is for the US region and for testing purposes we select US915-RxChnl8-15,65. Other regions might have a single channel only.
        - Description: additional notes about gateway

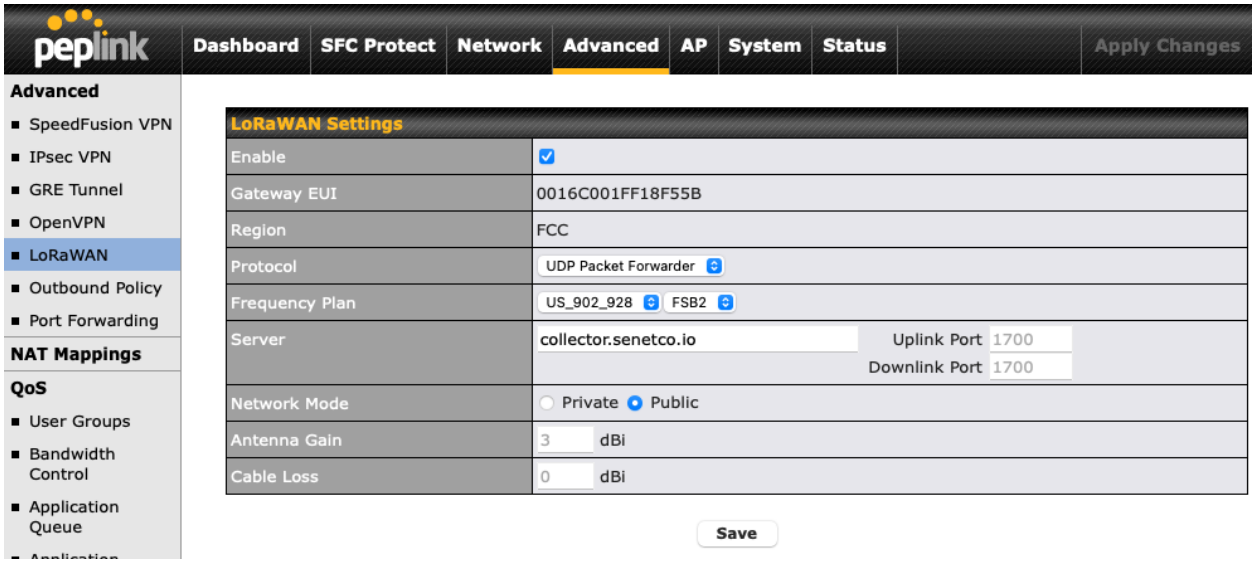


    - Installation information: fill up based on your installation.

On your final steps review the information if it is correct and then click **Done**.

Step 3. Connect your gateway to the Senet

1. On your Peplink router, go to the **Advanced** tab along the top bar.
2. Find **LoRaWAN** settings along the left navigation bar and enter the following settings:
   - Protocol: **UDP Packet Forwarder**
   - Frequency plan: should match the selected in Senet settings.
   - Server: collector.senetco.io
   - Uplink Port/Download Port: 1700
   - Network Mode: **Public**
   - Antenna Gain: enter your antenna Gain. (for Peplink antenna enter 2).
   - Cable loss: enter cable loss if there is a cable between antenna and LoRa module.
3. Click **Save** and **Apply Changes**.



Getting Started with AWS IoT Core

Requirements

- LoRaWAN FlexModule Mini.
- Balance 20X router.
- LoRaWAN sensor (in our example we used Dragino LHT65).
- AWS account.

Notes 1: The LoRaWAN FlexModule Mini comes in two options: EU868 or US915. Please make sure you order the correct one for your region.

Setup AWS

If you don't have an AWS account, refer to the instructions in the guide here. The relevant sections are **Sign up for an AWS account** and **Create a user and grant permissions**.

Step 1. Setup overview

The high-level steps to get started with AWS IoT Core for LoRaWAN are as follows:

1. Setup AWS
2. Onboard your Gateway
3. Onboard your Device(s)
    a. Verify device and service profiles
    b. Set up a Destination to which device traffic will be routed and processed by a rule.

These steps are detailed below. For additional details, refer to the AWS LoRaWAN developer guide.

Step 2. Preparation

Refer to the online guide for steps required prior to onboarding your gateway. Also, make sure Peplink router is running 8.3.0 or later Firmware version.

Step 3. Frequency Band selection and Role setup

Peplink LoRaWAN FlexModule Mini comes in two SKU versions listed. Make sure you choose the one which is suitable for your region:

- EXM-MINI-LORA-EU: EU868, IN865, RU864
- EXM-MINI-LORA: US915, AU915, AS923, AS925, KR920

Refer to the online guide for information on selecting an appropriate frequency band.

Follow the instructions in the section **Add an IAM role to allow the Configuration** and **Update Server (CUPS) to manage gateway credentials** in the online guide.

Step 4. Add the LoRaWAN Gateway

To register the Gateway with AWS IoT Core for LoRaWAN, follow the steps in this online guide under the section Add a gateway using the console.

Add a LoRaWAN Device to AWS IoT

Step 1. Preparation

Refer to the instructions in the section **Before onboarding your wireless device** in the online guide.

Step 2. Verify Profiles

AWS IoT Core for LoRaWAN supports device profiles and service profiles. Device profiles contain the communication and protocol parameter values the device needs to communicate with the network server. Service profiles describe the communication parameters the device needs to communicate with the application server.

Some pre-defined profiles are available for device and service profiles. Before proceeding, verify that these profile settings match the devices you will be setting up to work with AWS IoT Core for LoRaWAN. For more details, refer to the section **Add profiles to AWS IoT Core for LoRaWAN** in the online guide.

Step 3. Set up a Destination for device traffic

Because most LoRaWAN devices don't send data to AWS IoT Core for LoRaWAN in a format that can be consumed by AWS services, traffic must first be sent to a Destination. A Destination represents the AWS IoT rule that processes a device's data for use by AWS services. This AWS IoT rule contains the SQL statement that selects the device's data and the topic rule actions that send the result of the SQL statement to the services that will use it.

For more information, refer to the online guide (sections titled **Add a destination using the console** and **Create an IAM role for your destinations**). Also refer to **Create rules to process LoRaWAN device messages** in the online guide.

Step 4. Add device

Then follow the instructions in the section **Add your wireless device to AWS IoT Core for LoRaWAN** here.

Set up the Gateway

Step 1. Set up Gateway hardware

Peplink Balance 20X is a SD-WAN branch router with an option to add LoRaWAN gateway functionality using a LoRaWAN FlexModule Mini.

Note: LoRaWAN FlexModule Mini must be inserted when Balance 20X power is turned off.

Balance 20X delivers excellent routing throughput with an embedded cellular modem, making it an easy to use, all-in-one router for indoor deployments. It is easy to install and configure using a WEB based user-friendly interface.

For LoRaWAN gateway, internet connection is a must so that it could transmit messages received from end devices. Peplink Router Balance 20X has several WAN options:

- Cellular connectivity
- Ethernet

Ethernet connection also supports Virtual WAN (license needed) which allows connecting several WAN options separated by using VLAN.

To turn on the Balance 20X router, please plug in the power supply (AC/DC adapter is supplied with the device). Once the **Status** LED becomes green, the device is ready for configuration. You connect to device WEB based GUI or use InControl for configuration.

Step 2. Set up Gateway Software

One the LoRaWAN FlexModule Mini is inserted into Balance 20X, no need to make any additional configuration to enable LoRaWAN gateway functionality.

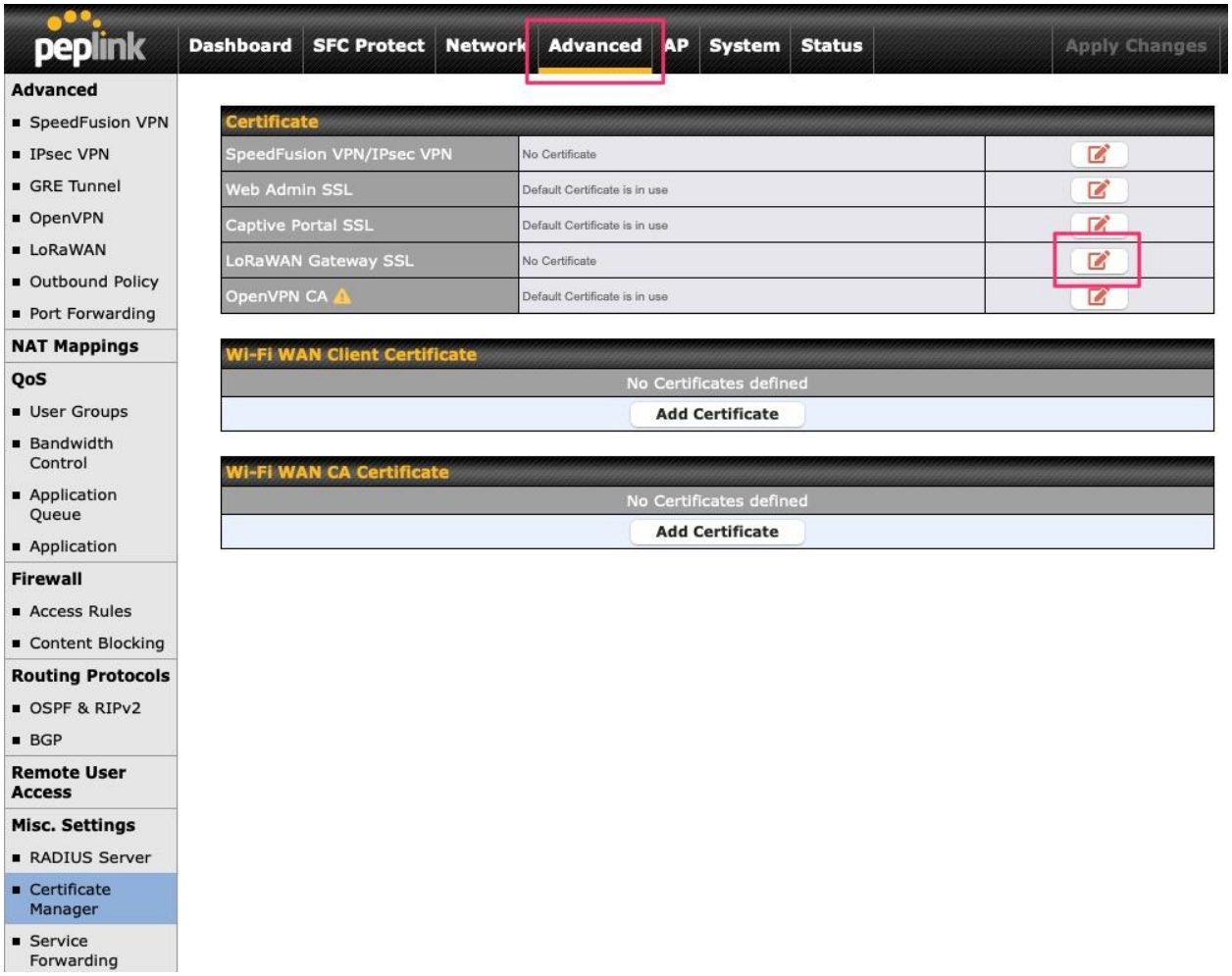
IMPORTANT: make sure Balance 20X is running 8.3.0 or newer FW version. Please go here, to download the latest FW version and the latest configuration manual.

Additional Software References

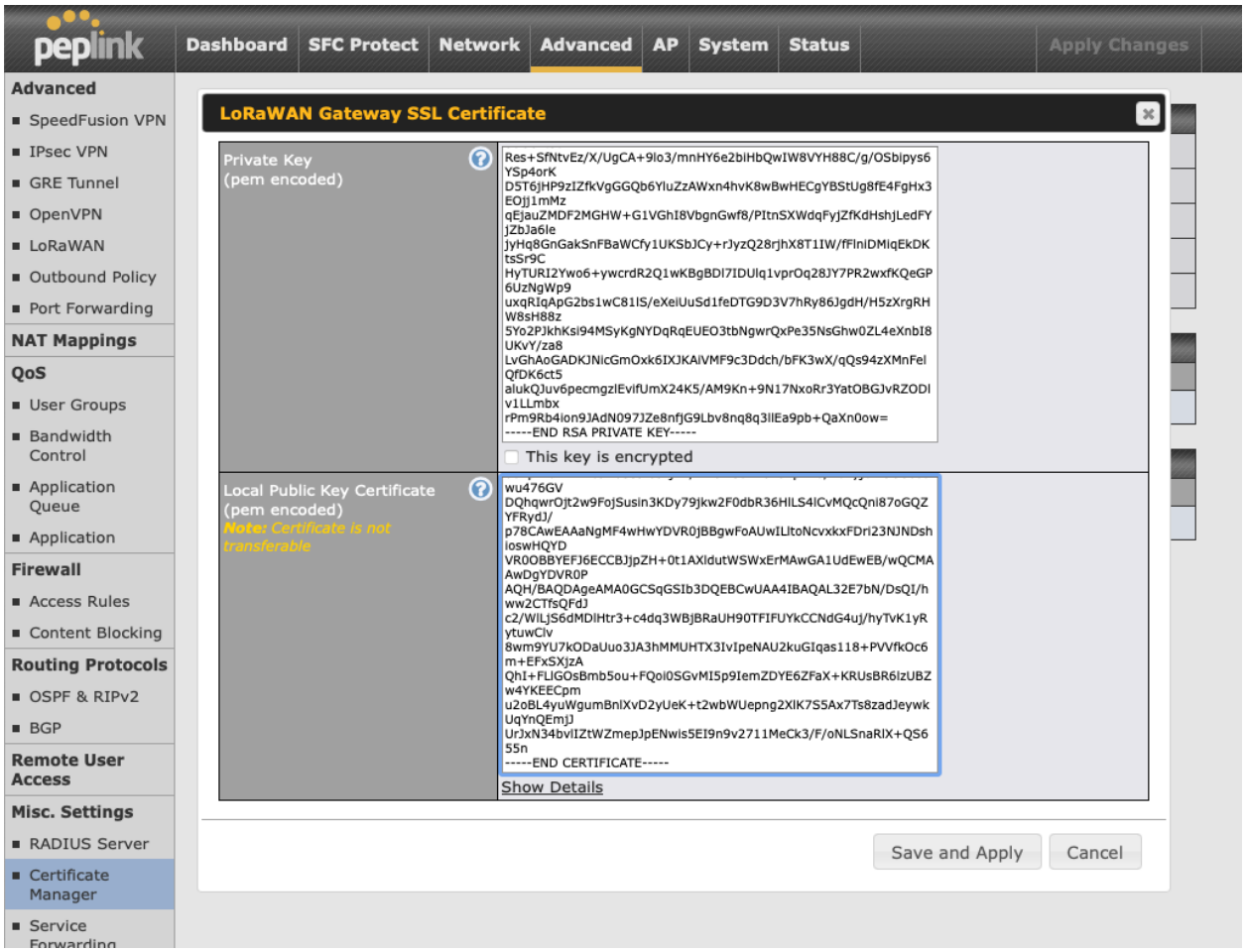
In case there will be any additional questions, we suggest visiting the Peplink community page which can be found here.

Step 3. Configure the Gateway device

1. On your Peplink router's web admin, navigate to the **Advanced** tab along the top navigation bar.
2. Open up the **Certificate Manager** settings along the left navigation bar.
3. Click on the Edit icon for the **LoRaWAN Gateway SSL**.



4. Open the **Private key** file (.key) with a text editor and copy and paste all of the text into the **Private Key** field.
5. Open the **Gateway certificate** file (*.pem) and copy and paste all of the text into the **Local Public Key Certificate** field.



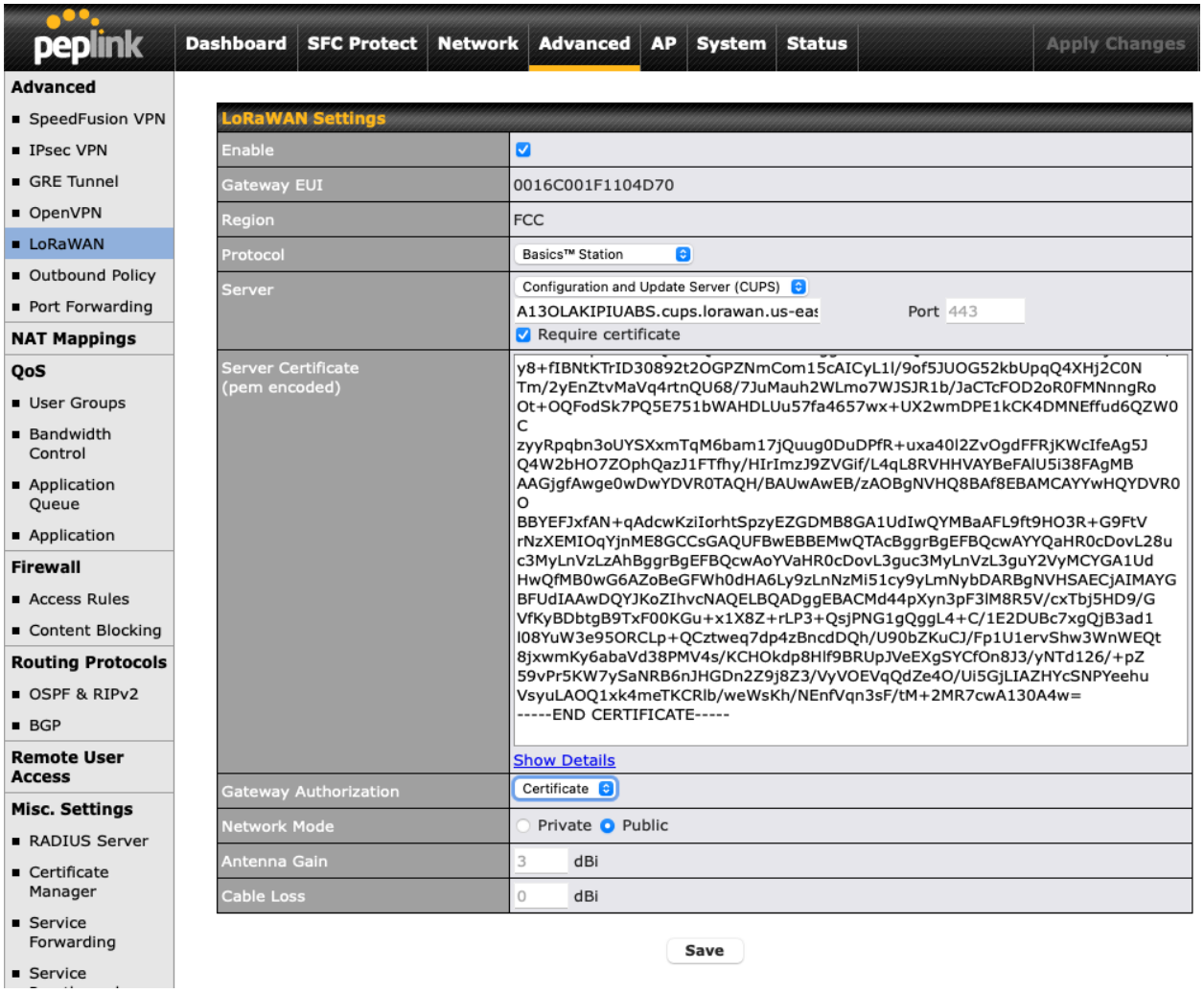
6. Click on **Save and Apply**.
7. Navigate to **LoRaWAN** settings along the left navigation bar.
8. Select the **Protocol** named **Basic™ Station**.
9. Copy the **CUPS** endpoint into the **Configuration and Update Server (CUPS)** field. Copy the URL address without the protocol and port information as shown in the example below.

- ~~https://~~**A13OLAKIPIUABS.cups.lorawan.us-east-1.amazonaws.com**~~:443~~

  Note: The address is provided by AWS and may differ depending on a region.

10. Enter port 443
11. Tick the checkbox **Require certificate**.
12. Open the **CUPS certificate** (*.trust) with a text editor and copy and paste all of the text into the **Server Certificate** field.
13. Change the **Gateway Authorization** to **Certificate**.
14. For **Network Mode**, select **Public**.

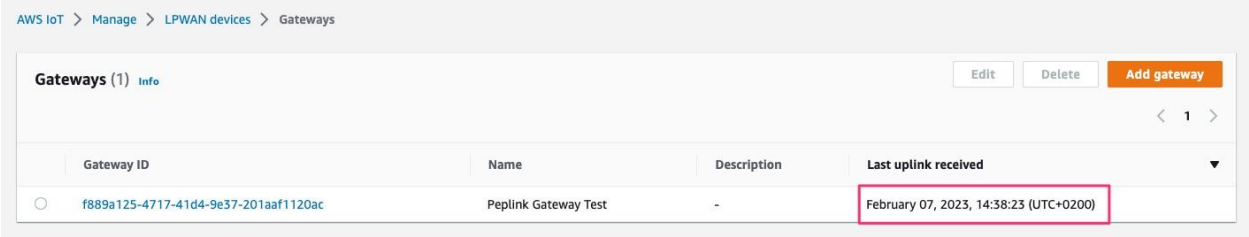
15. Enter your antenna Gain (for Peplink antenna enter 2).
16. Enter cable loss if there is a cable between antenna and LoRa module
17. Click on **Save** and **Apply Changes**.



Step 4. Connect the Gateway and verify the connection status

Follow the instructions in the online guide to connect your gateway to AWS IoT Core for LoRaWAN.

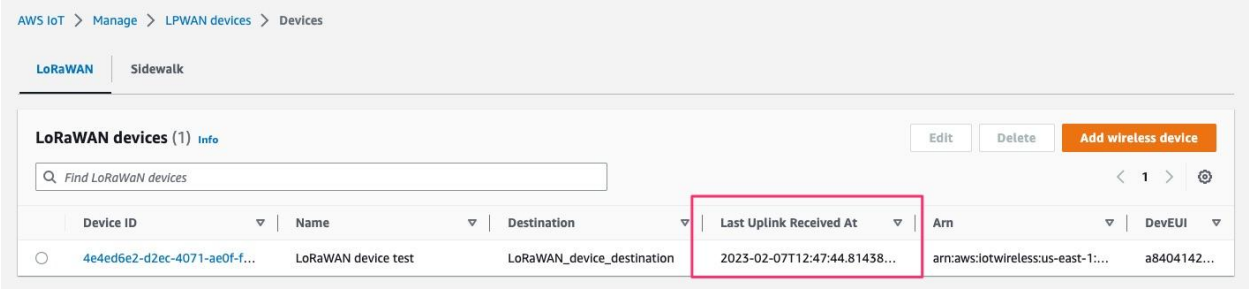
Navigate to **Gateways**, where all of your gateways are displayed. In the column **Last uplink received**, you should see a timestamp.



Step 5. Verify device connection status

In our example, we will use the LHT65 Temperature & Humidity sensor. To connect the LHT65 sensor, begin by pressing the ACT button 5 times quickly. This will deactivate the end device and it will display a solid RED LED for 5 seconds. Press and hold the ACT button for more than 3 seconds and a GREEN LED should blink 5 times. The device will begin operating and initiate connection to the LoRaWAN network. The GREEN LED will turn a solid green for 5 seconds after it successfully joins the network.

Navigate to **Devices**, where all of your devices are displayed. In the column **Last uplink received At**, you should see a timestamp.



Building a sample IoT Solution

For details, please check the AWS guide online. The guide will list the steps necessary to build a real-time dashboarding solution for visualizing connection quality data from your LoRaWAN end devices. After deploying the sample solution in your AWS account, you will be able to access the following Grafana dashboards:

Getting Started with The Things Network /The Thing Industries

Requirements

- LoRaWAN FlexModule Mini.
- Balance 20X router.
- LoRaWAN sensor (in our example we used Dragino LHT65).
- The Things Networks or The Things Industries account.

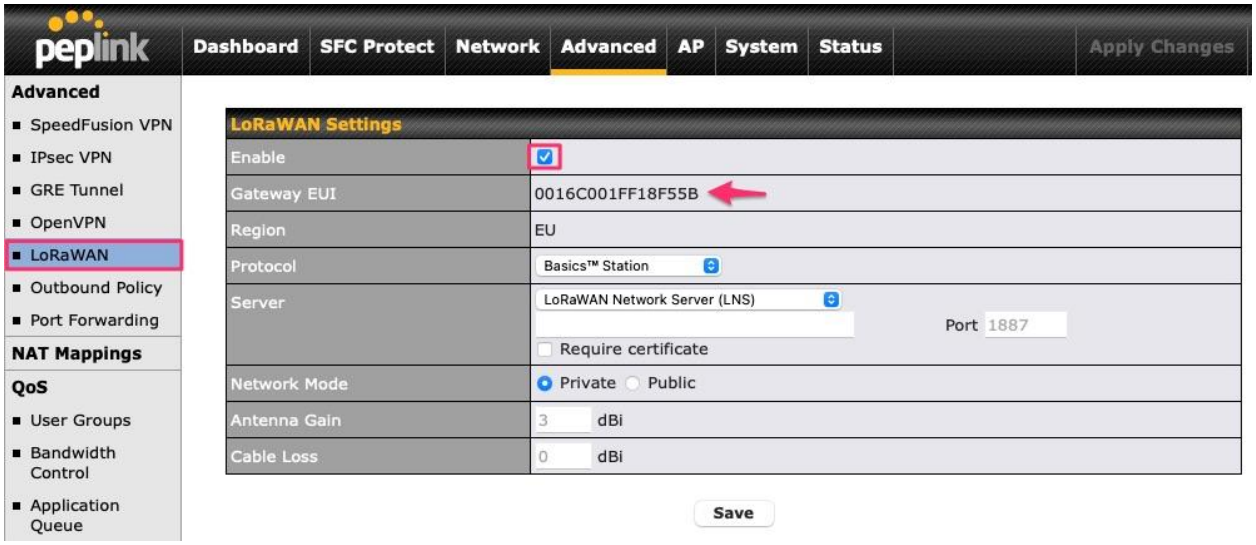
Note 1: The LoRaWAN FlexModule Mini comes in two options: EU868 and US915. Please make sure you order the correct one for your region.

Note 2: In this example we provide The Things Network public server configuration examples. The Things Industries configuration WEB based UI configuration is very similar.

Set up LoRa Basics™ Station packet forwarder

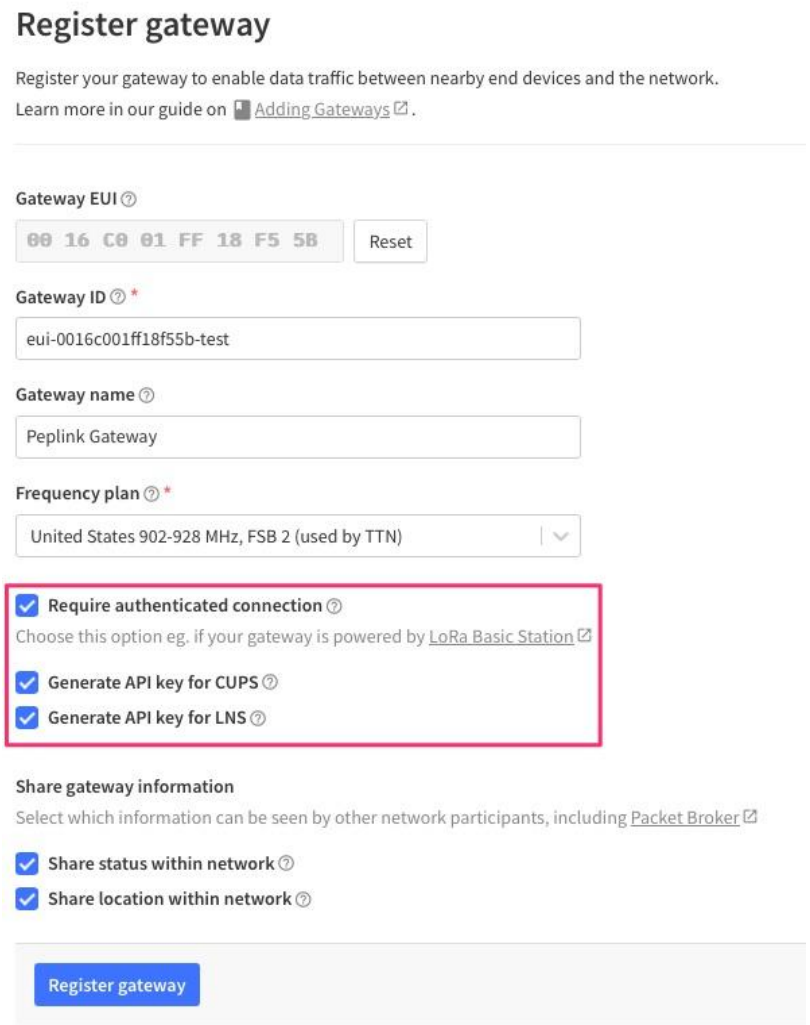
Step 1. Enable LoRaWAN protocol on your router

1. On your Peplink router's web admin page, go to the **Advanced** tab along the top bar.
2. Find the **LoRaWAN** tab along the left navigation bar.
3. In **LoRaWAN** settings, tick the **Enable** checkbox and write down the Gateway EUI, this will be needed for registering a gateway later on.

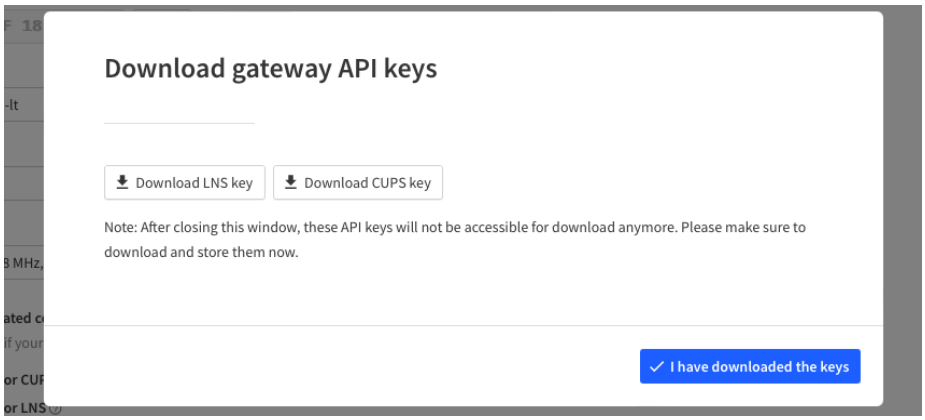


Step 2. Add gateway to the TTN server

1. In this example we will use The Things Network account. To create a new visit TheThingsNetwork.org
   Once registered, you will be able to see a **Console** tab at the top of your screen (or go to https://console.cloud.thethings.network/).
2. Choose an appropriate server
3. Click on **Go to gateways**
4. Select **Register Gateway**.
   - Enter the **Gateway EUI** and then click **Confirm**.
   - Select a **Frequency plan** according to your region.
   - You may change your **Gateway ID**. This can be any name that you want to use to identify the gateway.
   - Mark **Require authenticated connection, Generate API key for CUPS** and **Generate API key for LNS** checkboxes.
   - When you are finished, click on **Register gateway** at the bottom of the page.



5. On your next step a new window with CUPS and LNS keys will show up. Save them for Gateway configuration.

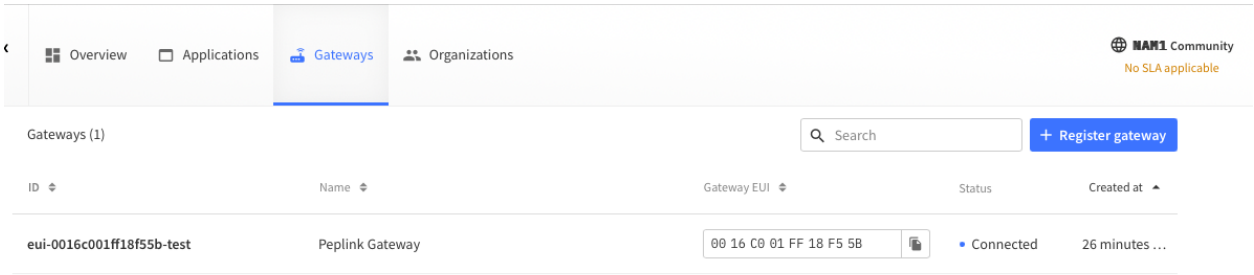


Step 3. Connect your gateway to the TTN cloud server

1. Download a common root SSL certificate used in The Things Stack, issued by trusted certificate authorities (CAs). You can find them from *The Things Network* page. For our example we used **ISRG Root X1** certificate.
2. On your Peplink router, go to the **Advanced** tab along the top bar.
3. Find **LoRaWAN** settings along the left navigation bar and enter the following settings:
   - Protocol: **Basic Station**.
   - Server: **Configuration and Update Server CUPS**.
   - Server address: copy the address from your created gateway on TTN.
   - Server Certificate (pem encoded): copy the downloaded **ISRG Root X1** certificate.
   - Gateway Authorization: Select **Token** and then copy CUPS key from Step 1 (item 5).
   - Network Mode: **Public**.
   - Antenna Gain: enter your antenna Gain (for Peplink antenna enter 2).
   - Cable loss: enter cable loss if there is a cable between antenna and LoRa module
4. Click **Save** and **Apply Changes**. Below you will find a Balance 20x configuration example for your reference.

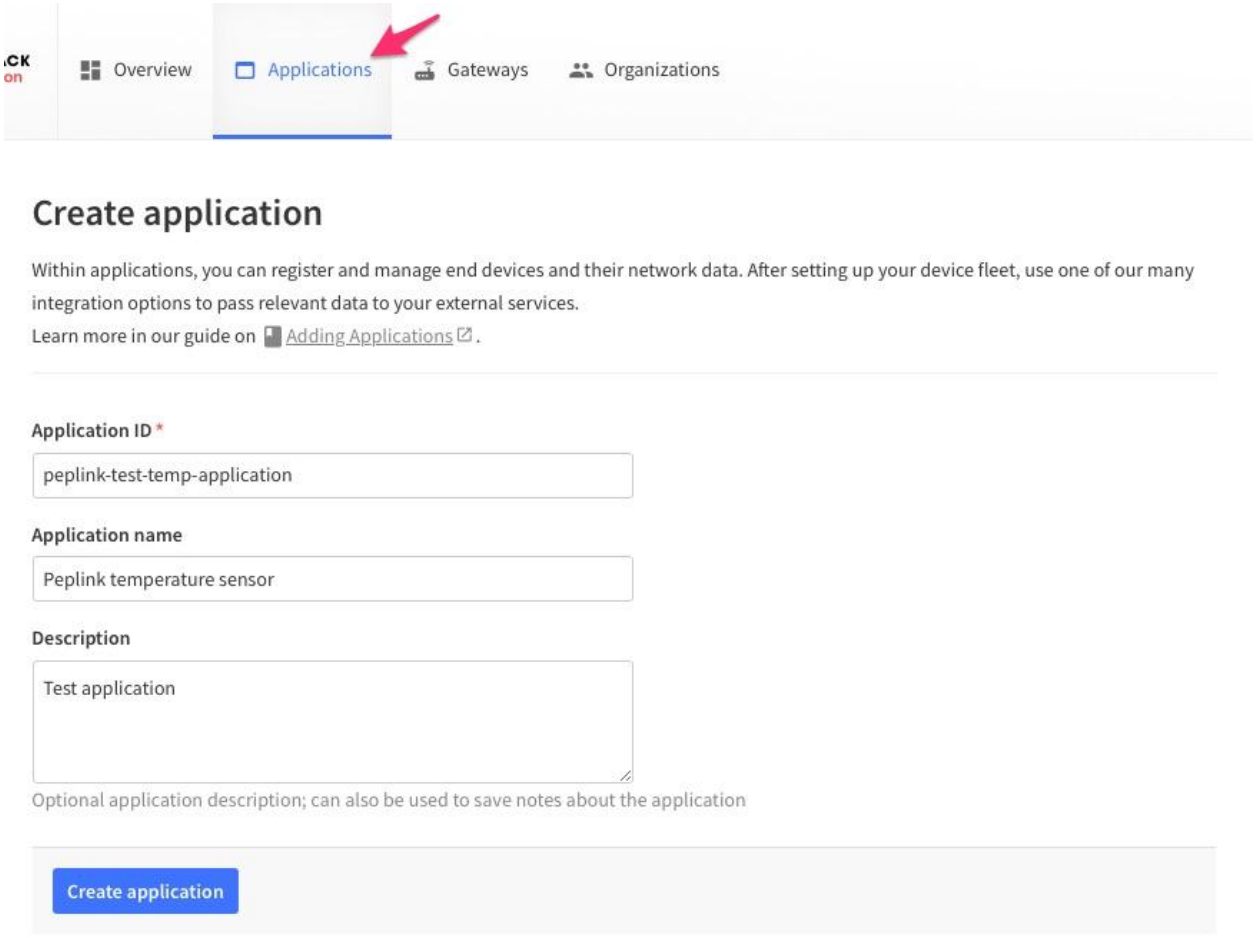
LoRaWAN Settings	
Enable	☑
Gateway EUI	0016C001FF18F55B
Region	FCC
Protocol	Basics™ Station
Server	Configuration and Update Server (CUPS) nam1.cloud.thethings.network Port 443 ☑ Require certificate
Server Certificate (pem encoded)	B5T0Y3HsLuJvW5iB4YlcNHlsdu87kGJ55tukmi8mxdAQ4Q7e2RCOFvu396j3x+UC B5iPNgiV5+I3lg02dZ77DnKxHZu8A/lJBdiB3QW0KtZB6awBdpUKD9jf1b0SHzUv KBds0pjBqAlkd25HN7rOrFleaJ1/ctaJxQZBKT5ZPt0m9STJEadao0xAH0ahmbWn OlFuhjuefXKnEgV4We0+UXgVCwOPjdAvBbI+e0ocS3MFEvzG6uBQE3xDk3SzynTn jh8BCNAw1FtxNrQHusEwMFxIt4I7mKZ9YIqioymCzLq9gwQbooMDQaHWBfEbwrbw qHyGO0aoSCqI3Haadr8faqU9GY/rOPNk3sgrDQoo//fb4hVC1CLQJ13hef4Y53CI rU7m2Ys6xt0nUW7/vGT1M0NPAgMBAAGjQjBAMA4GA1UdDwEB/wQEAwIBBjAPBgNV HRMBAf8EBTADAQH/MB0GA1UdDgQWBBR5tFnme7bl5AFzgAiIyBpY9umbbjANBgkq hkiG9w0BAQsFAAOCAgEAVR9YqbyyqFDQDLHYGmkgJykIrGF1XIpu+ILlaS/V9lZL ubhzEFnTIZd+50xx+7LSYK05qAvqFyFWhfFQDlnrzuBZ6brJFe+GnY+EgPbk6ZGQ 3BebYhtF8GaV0nxvwuo77x/Py9auJ/GpsMiu/X1+mvoiBOv/2X/qkSsisRcOj/KK NFtY2PwByVS5uCbMiogziUwthDyC3+6WVwW6LLv3xLfHTjuCvjHIInNzktHCgKQ5 ORAzI4JMPJ+GslWYHb4phowim57iaztXOoJwTdwJx4nLCgdNbOhdjsnvzqvHu7Ur TkXWStAmzOVyyghqpZXjFaH3pO3JLF+l+/+sKAIuvtd7u+Nxe5AW0wdeRlN8NwdC jNPElpzVmbUq4JUagEiuTDkHzsxHpFKVK7q4+63SM1N95R1NbdWhscdCb+ZAJzVc oyi3B43njTOQ5yOf+1CceWxG1bQVs5ZufpsMljq4Ui0/1lvh+wjChP4kqKOJ2qxq 4RgqsahDYVvTH9w7jXbyLeiNdd8XM2w9U/t7y0Ff/9yi0GE44Za4rF2LN9d11TPA mRGunUHBcnWEvgJBQl9nJEiU0Zsnvgc/ubhPgXRR4Xq37Z0j4r7g1SgEEzwxA57d emyPxgcYxn/eR44/KJ4EBs+lVDR3veyJm+kXQ99b21/+jh5Xos1AnX5iItreGCc= -----END CERTIFICATE----- Show Details
Gateway Authorization	Token NNSXS.4C7OGLSXQTIQ443ZRM5IFEZMAQLW32QUX4MYDUA.5JG7W4N Q5VLT4XATFXHXQKRXGW2IVBGLL2ISOGY3IJSBNWVYAPAQ
Network Mode	○ Private ◉ Public
Antenna Gain	3 dBi
Cable Loss	0 dBi

5. Go to the console page on *The Things Network* and navigate to the **Gateways** tab. Once there, you should be able to see that your gateway is connected to the network.



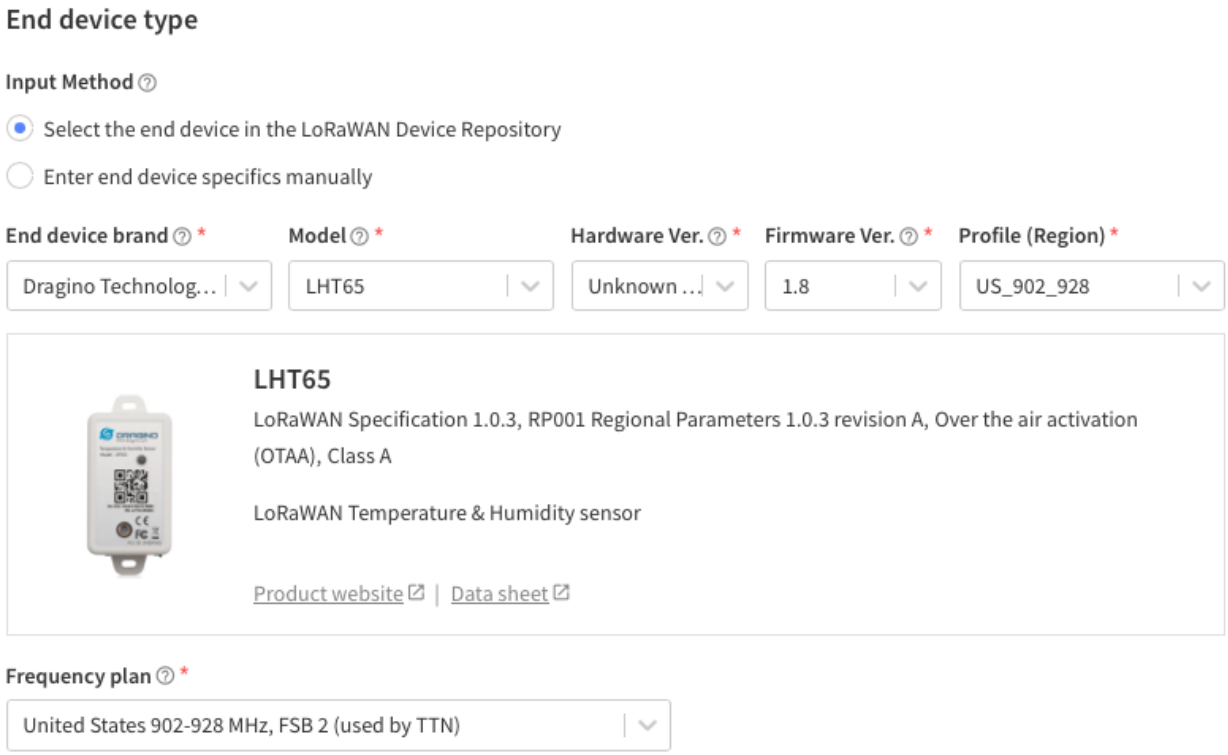
Step 4. Add Device (sensor)

1. Create a new application in the TTN console by navigating to the **Applications** tab and clicking **Create application**.
2. Enter an **Application ID**. The other fields are optional.
3. Click on **Create application.**

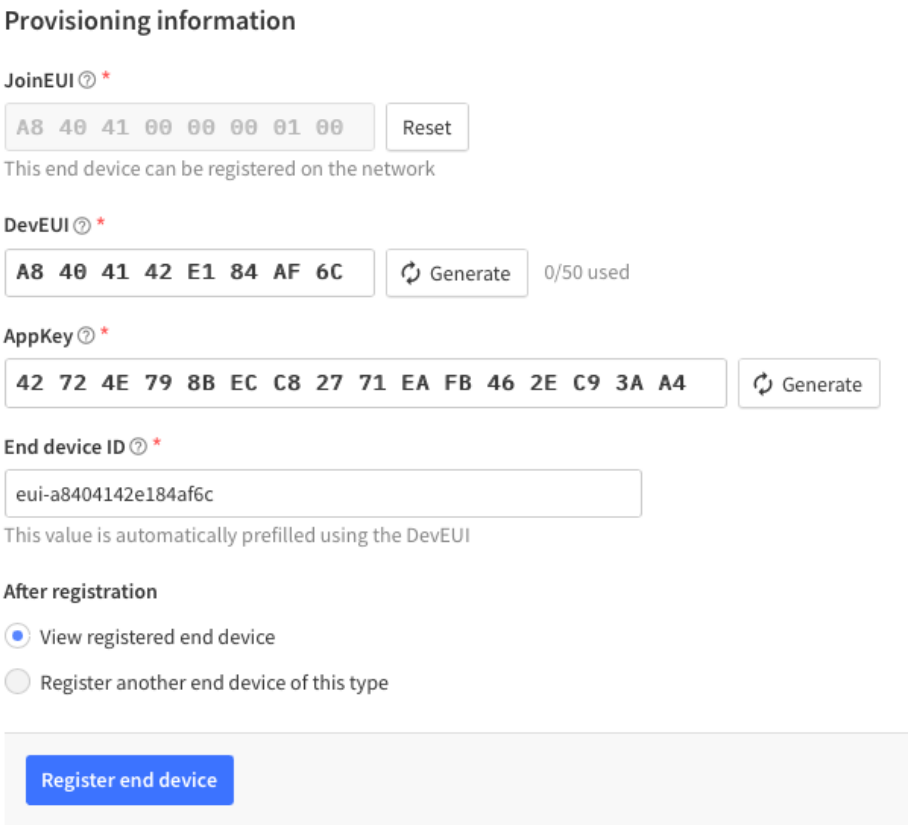


4. Once the application has been created, you will be directed back to your application page. Click on **End Devices** (left side menu), then click the **Register end device** button.

5. In our example, we will use the Dragino LHT65 Temperature and Humidity sensor. When registering a sensor or an end device, you may choose either **From The LoRaWAN Device Repository** or **Manually**. Displayed below is a screenshot of when the sensor is selected through the Repository.

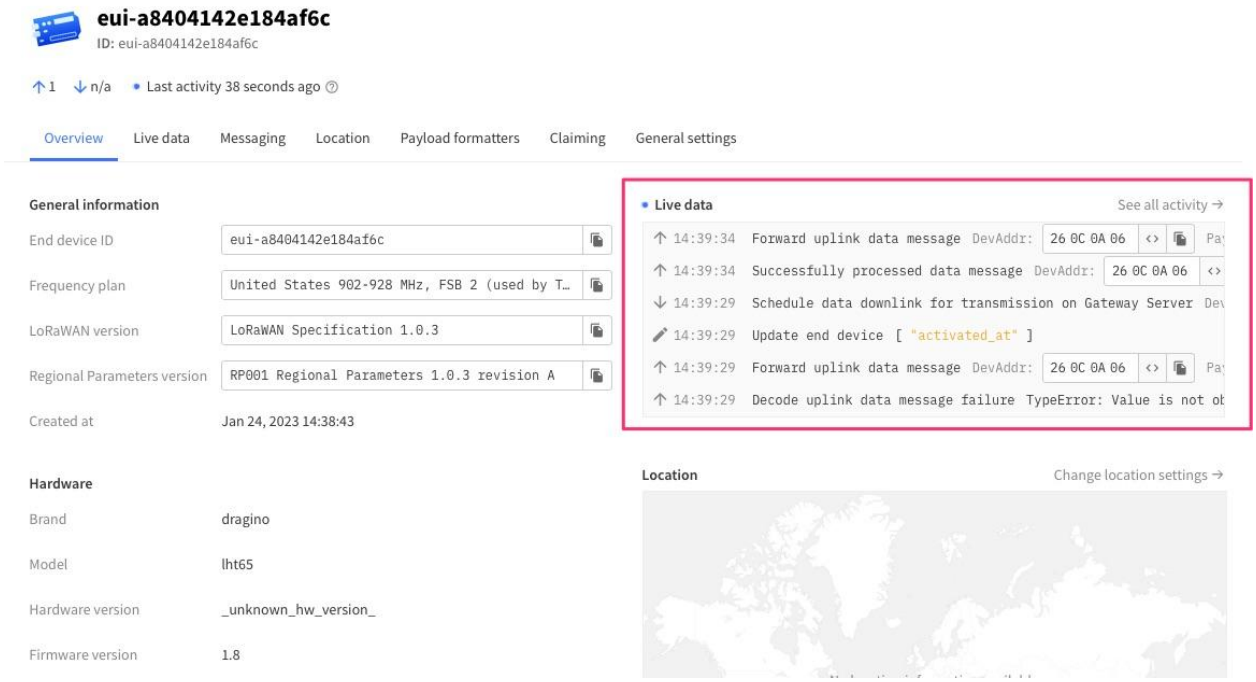


6. The **Frequency plan, JoinEUI (AppEUI)**, **DevEUI** and **AppKey** are provided with the end device. The **End Device ID** can be any value. Once completed, click the **Register end device** button to register your device. Displayed below is a screenshot with filled sensor data.



7. Depending on your sensor, you may need to activate the device (join network). To connect the LHT65 sensor, begin by pressing the ACT button 5 times quickly. This will deactivate the end device and it will display a solid RED LED for 5 seconds. Press and hold the ACT button for more than 3 seconds and a GREEN LED should blink 5 times. The device will begin operating and initiate connection to the LoRaWAN network. The GREEN LED will turn a solid green for 5 seconds after it successfully joins the network.

8. Once the sensor joins the network, you will be able to see uplink messages from your end device in the **Live Data** field. See the screenshot below.



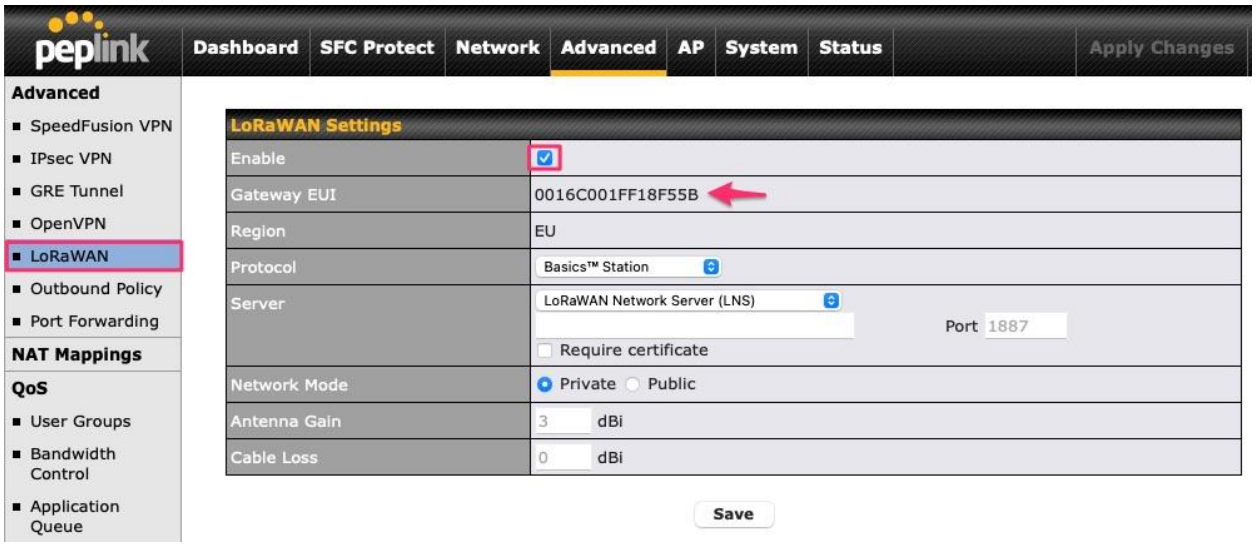
Set up UDP Packet Forwarder

Important: UDP packet forwarder is not recommended and suggested to use only for testing purposes. Semtech Basic Station option provides a better security and channel plan configuration through the Network Server, while Semtech Packet Forwarder uses unsecured UDP communication and any channel plan configuration should be done manually through the Gateway.

Note: The steps for adding sensors and connecting to data visualization is identical to the UDP Packet forwarder type and therefore are not covered here. You may refer to Steps 4 of the previous section.

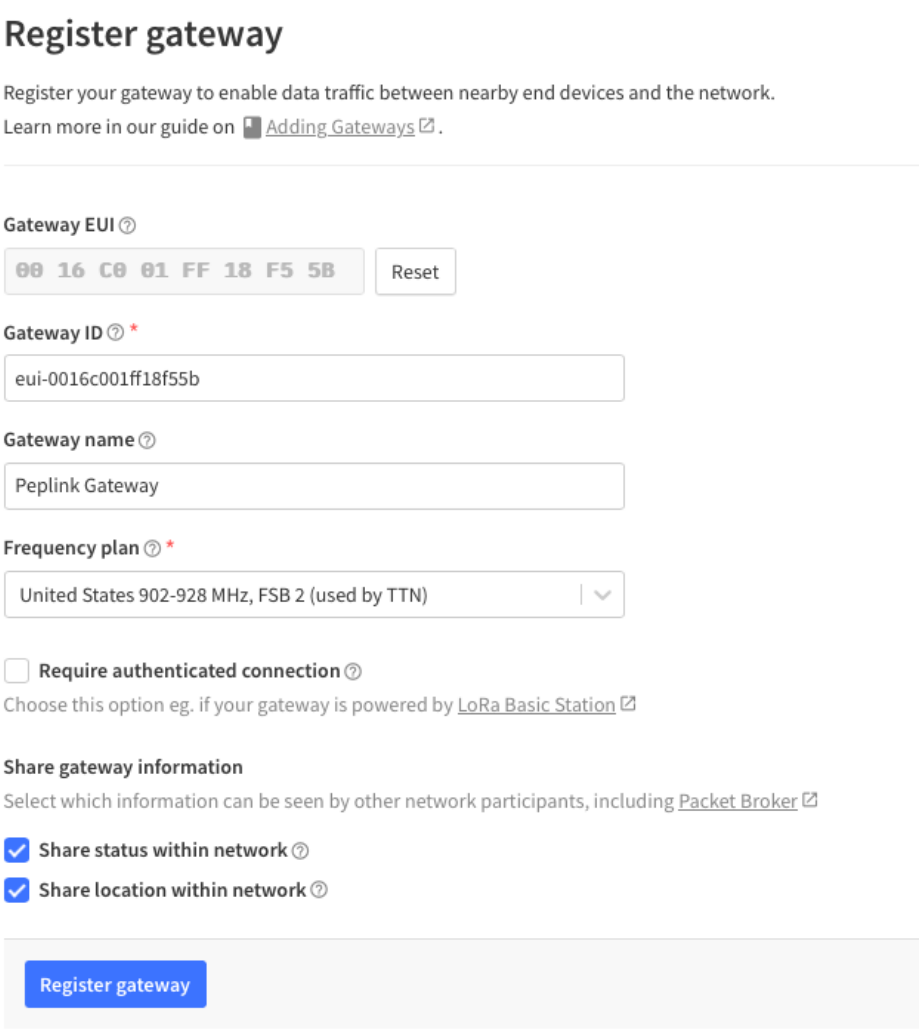
Step 1. Get a LoRaWAN Gateway EUI

4. On your Peplink router's web admin page, go to the **Advanced** tab along the top bar.
5. Find the **LoRaWAN** tab along the left navigation bar.
6. In **LoRaWAN** settings, tick the **Enable** checkbox and write down the Gateway EUI, this will be needed for registering a gateway later on.



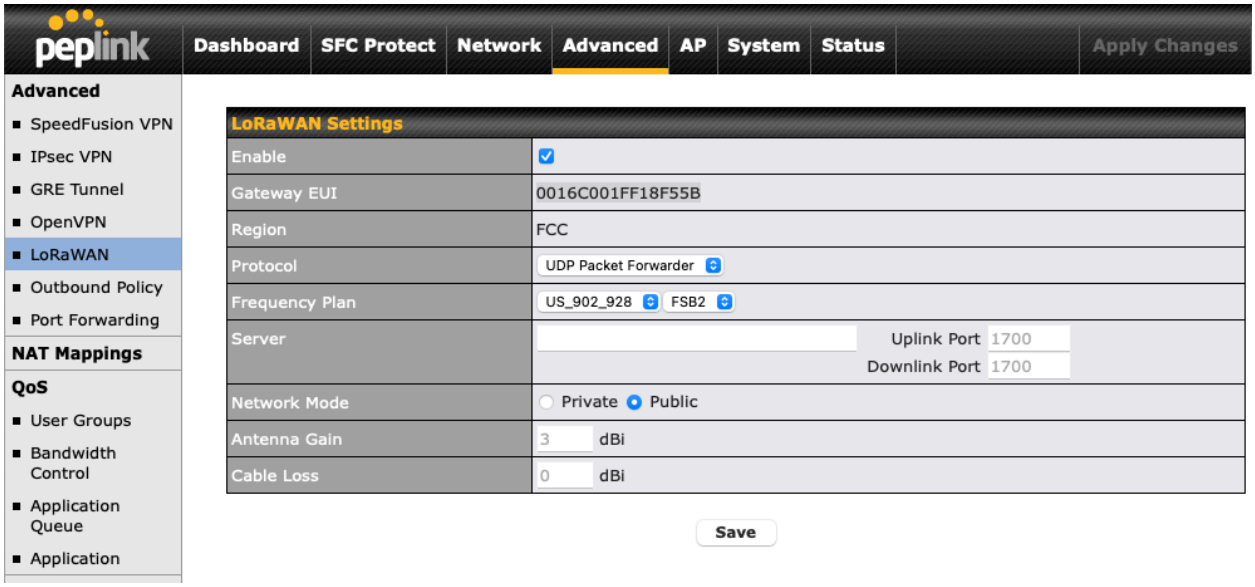
Step 2. Add gateway to the TTN server

1. In this example we will use The Things Network account. To create a new visit TheThingsNetwork.org
   Once registered, you will be able to see a **Console** tab at the top of your screen (or go to https://console.cloud.thethings.network/).
2. Choose an appropriate server.
3. Click on **Go to gateways**.
4. Select **Register Gateway**.
   - Enter the **Gateway EUI** and then click **Confirm**.
   - Select a **Frequency plan** according to your region.
   - You may change your **Gateway ID**. This can be any name that you want to use to identify the gateway.
   - Do NOT check **Require authenticated connection**.
   - When you are finished, click on **Register gateway** at the bottom of the page.

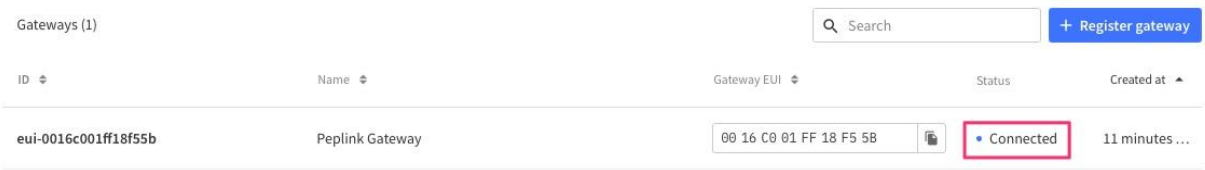


Step 3. Connect your gateway to the TTN server

1. On your Peplink router, go to the **Advanced** tab along the top bar.
2. Find **LoRaWAN** settings along the left navigation bar and enter the following settings:
   - Protocol: **UDP Packet Forwarder**
   - Frequency plan: should match the selected in TTN settings
   - Server: copy the address from your created gateway on TTN
   - Network Mode: **Public**
   - Antenna Gain: enter your antenna Gain (for Peplink antenna enter 2).
   - Cable loss: enter cable loss if there is a cable between antenna and LoRa module
3. Click **Save** and **Apply Changes**.

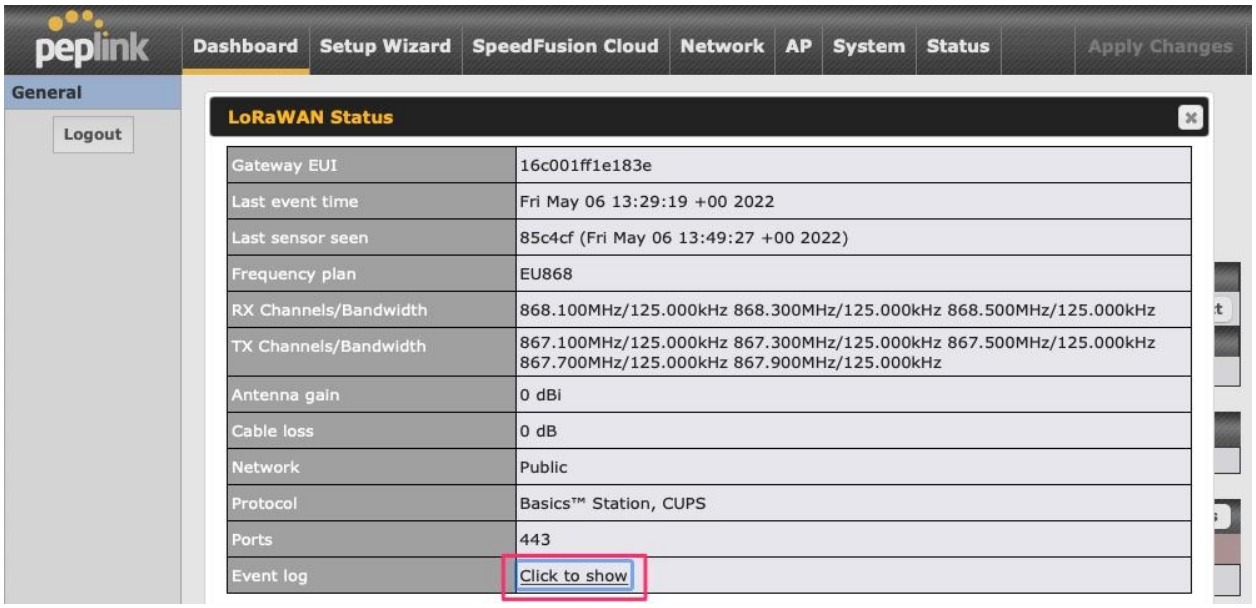


4. Go to the console page on *The Things Network* and navigate to the **Gateways** tab. Once there, you should be able to see that your gateway is **Connected** to the network.

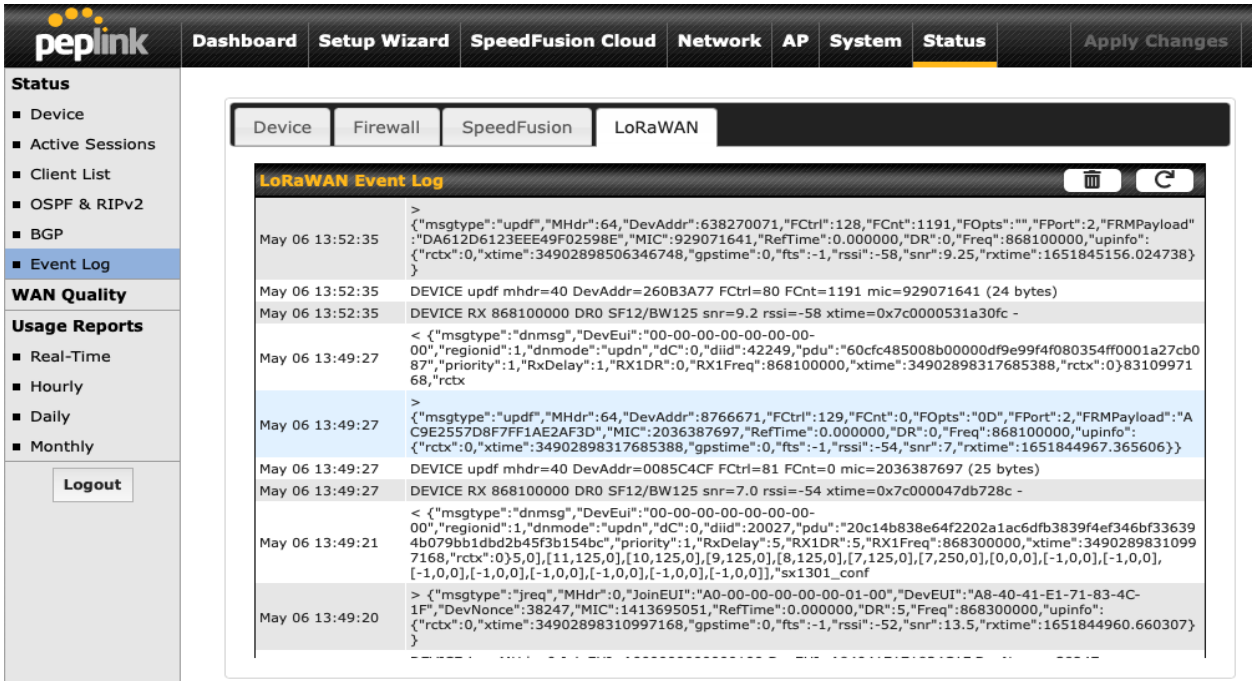


Debugging

For debugging purposes go to **Dashboard**, then click on the **Status** button in the **LoRaWAN** section. On a new window, next to the **Event log** text press on **Click to show**. This will open an Event log page. See pictures below for more details.



LoRaWAN Event Log page view shown below.



Troubleshooting

Most typical issues are related to:

- Mistaken certificates (e.g. mixed certificates Private key file (.key) with Gateway certificate.
- Incorrect CUPS or LNS server IP address.
- Private Network mode is selected. Make sure you select a Public one.

Firmware updates

- On your Peplink router's web admin page, go to the **System** tab along the top bar.
- Find the **Firmware** tab along the left navigation bar.
- Click the **Check for Firmware** button to see if there is newer Firmware available.
- Alternatively, a Device Firmware upgrade can also be done via Peplink InControl management system. Check the Peplink WEB page for more information.

