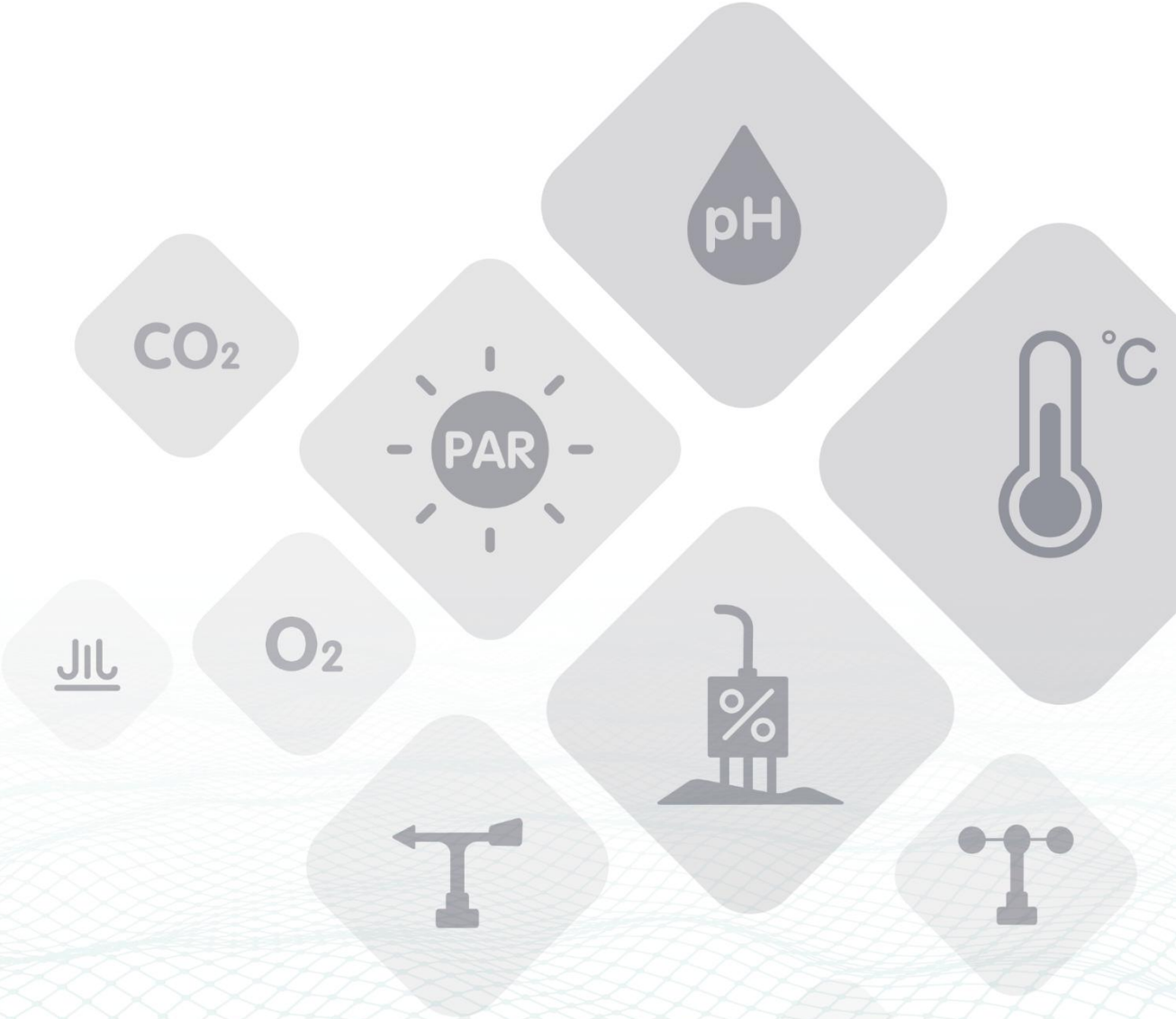
SENSECAP

LoRaWAN Gateway User Guide

Version: V1.4



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1 Product Introduction

SenseCAP is an industrial wireless sensor network that integrates easy-to-deploy hardware and data API services, enabling low-power, long-distance environmental data collection. SenseCAP includes several versions, such as LoRaWAN, LoRaPP, etc.

SenseCAP LoRaWAN Gateways is based on the LoRaWAN protocol, it can realize one-to-many, long-distance networking and bilateral communication. The LoRaWAN Gateway supports Ethernet and 4G.

Main Features:

- High-performance Cortex A8 1GHz processor
- Multiple methods to connect to the Internet: 4G, Wi-Fi and Ethernet
- Supports third-party TTN account and server
- Super long-distance communication: 10km in the line-of-sight scenario, 2km in the urban scenario
- Industrial protection rating IP66-rated enclosure, suitable for the outdoor environment at -40℃~70℃
- Easy-to-deploy, enabling people without engineering background to install the devices quickly

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LoRaWAN Outdoor Gateway:

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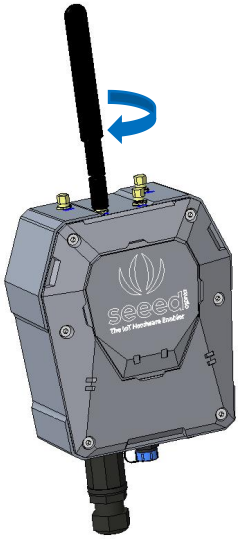
2 Gateway Network Configuration

2.1 The gateway connects to the Internet

2.1.1 Installing Antenna

Screw clockwise to install the 4G and LoRa antennas onto the gateway.



2.1.2 Connecting to the Internet

There are two ways to connect to the Internet. Choose the one that works for you .

(1) Connecting to Ethernet Cable
Unscrew to open the protection cap, plug the Ethernet cable through the cap and then into the Ethernet port. Screw to fasten this part.

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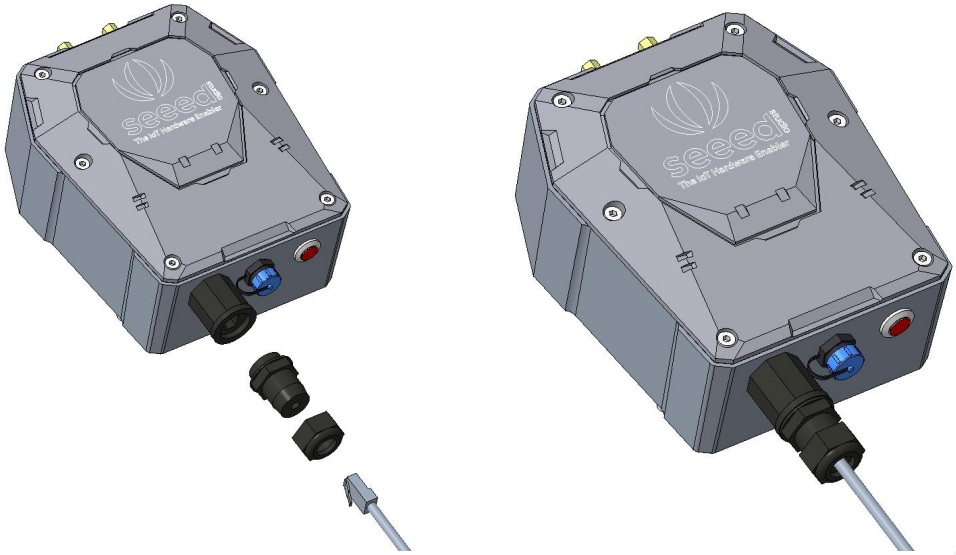
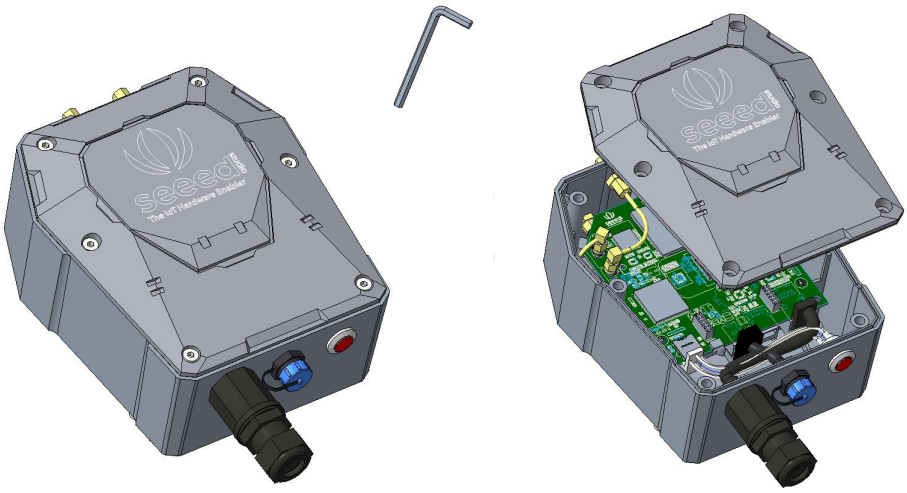
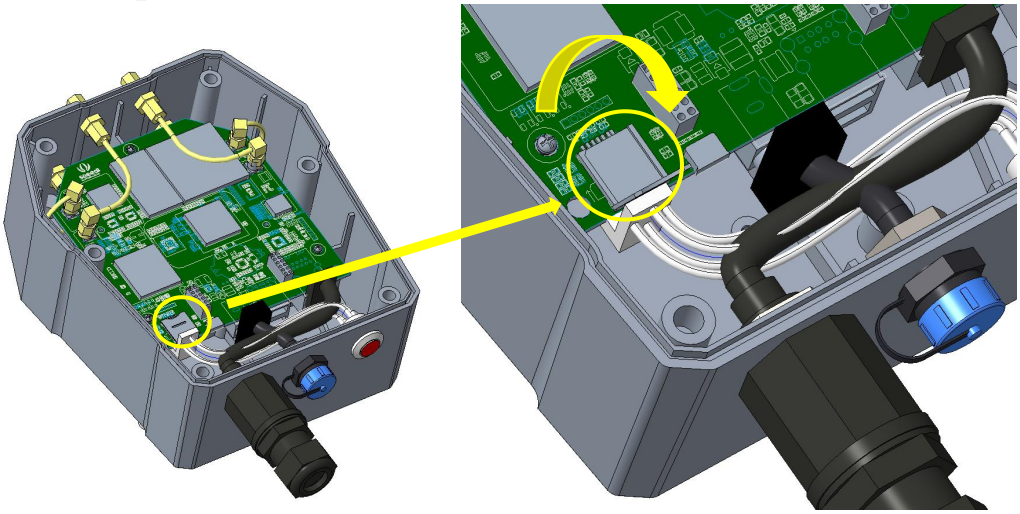


(2) Connecting to 4G

Use the hex key (included in the package) to unscrew the 6 screws and open the lid.



Swipe downward to open the SIM card socket, insert the Micro SIM card and swipe upward to lock the SIM card socket. Make sure it is installed correctly and close the lid with the screws.



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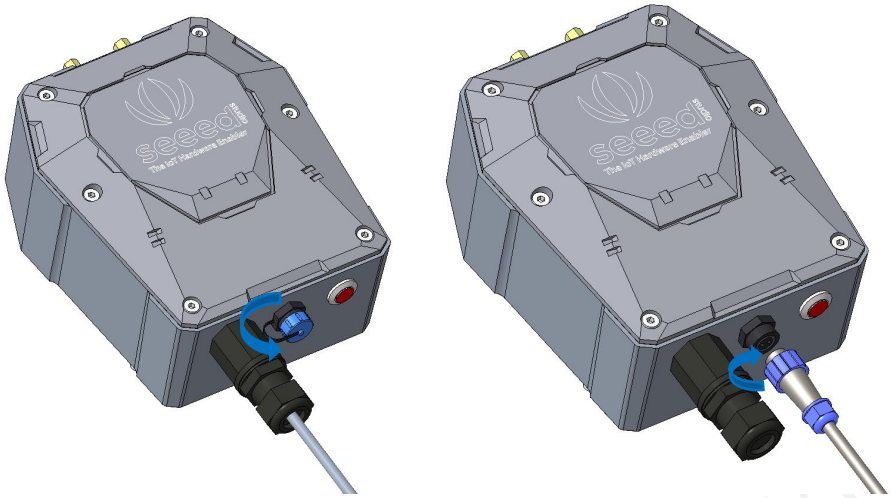
2.1.3 Connecting to Power Cable

Unscrew to take off the power cap, plug in the extension cord and screw to fasten it onto the gateway. The other end of the extension cord is connected to the power adapter.



Notice: Make sure all antennas are correctly installed before powering on the gateway. Please note the device should be POWERED OFF when installing the antenna, or the antenna circuits might be damaged.

2.1.4 The Function of the Red LED

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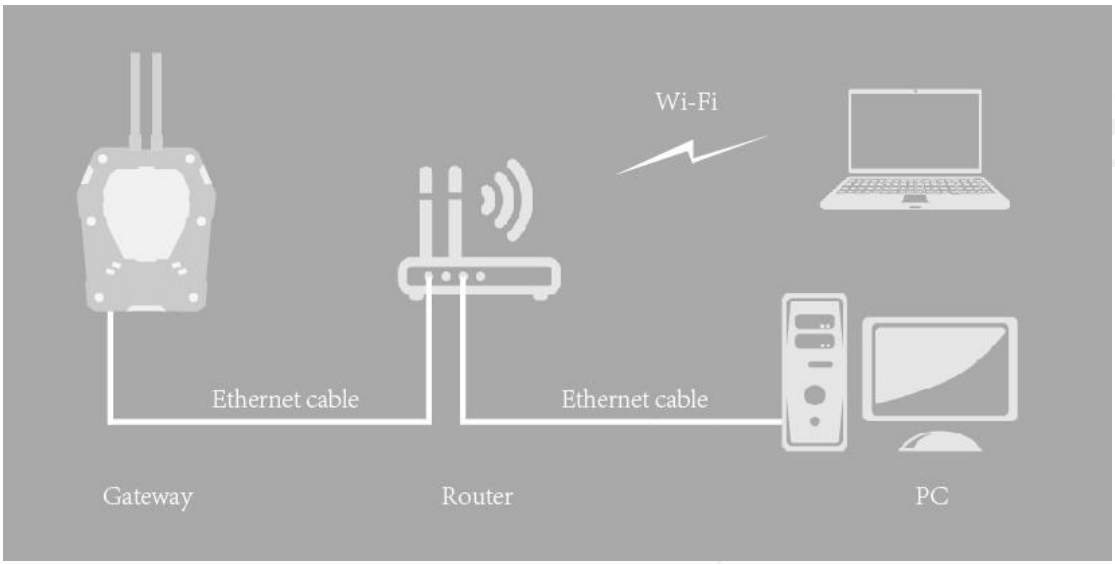
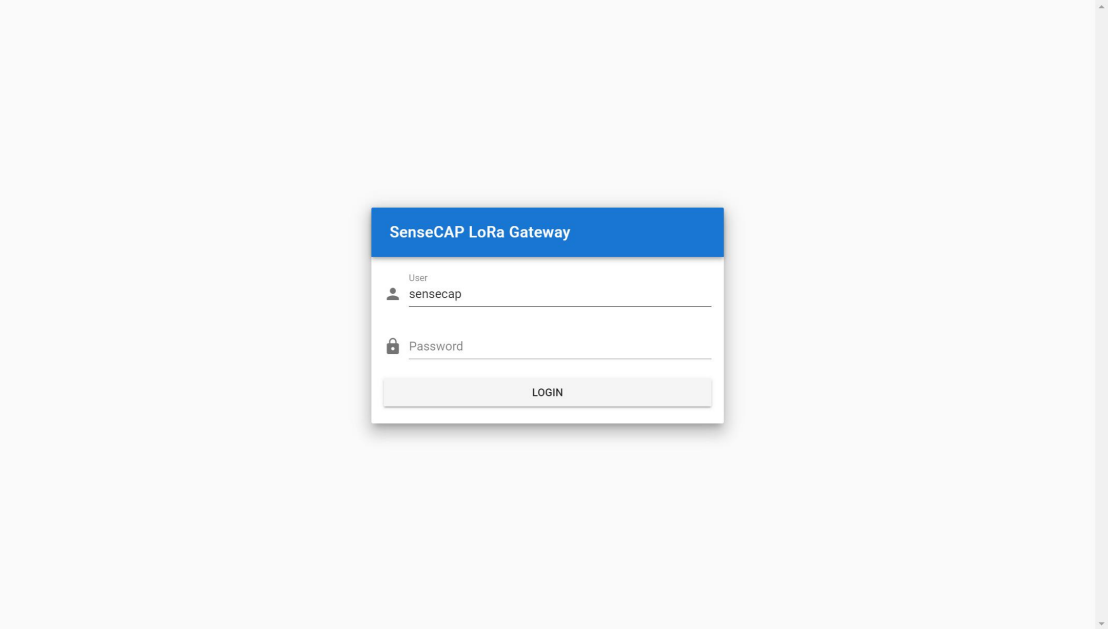
2.2 Setting the APN

Prepare a router, and the network connection is shown in the figure:



(1) Check the IP of "sensecap" in the background of the router.
(2) Enter IP in the browser: IP:8000
If the IP is 192.168.1.1, enter 192.168.1.1:8000



(3) User: sensecap
Password: sensecap!!!
(4) Click the “Cellular” button.

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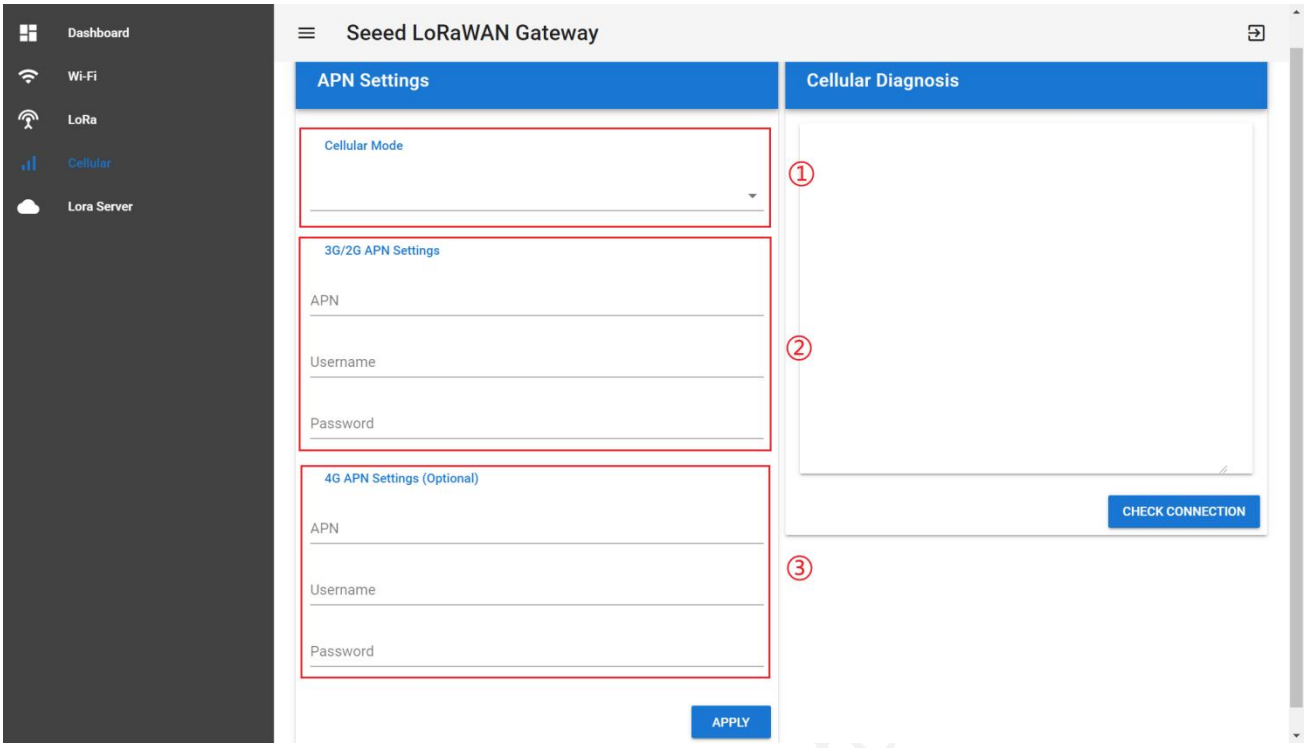
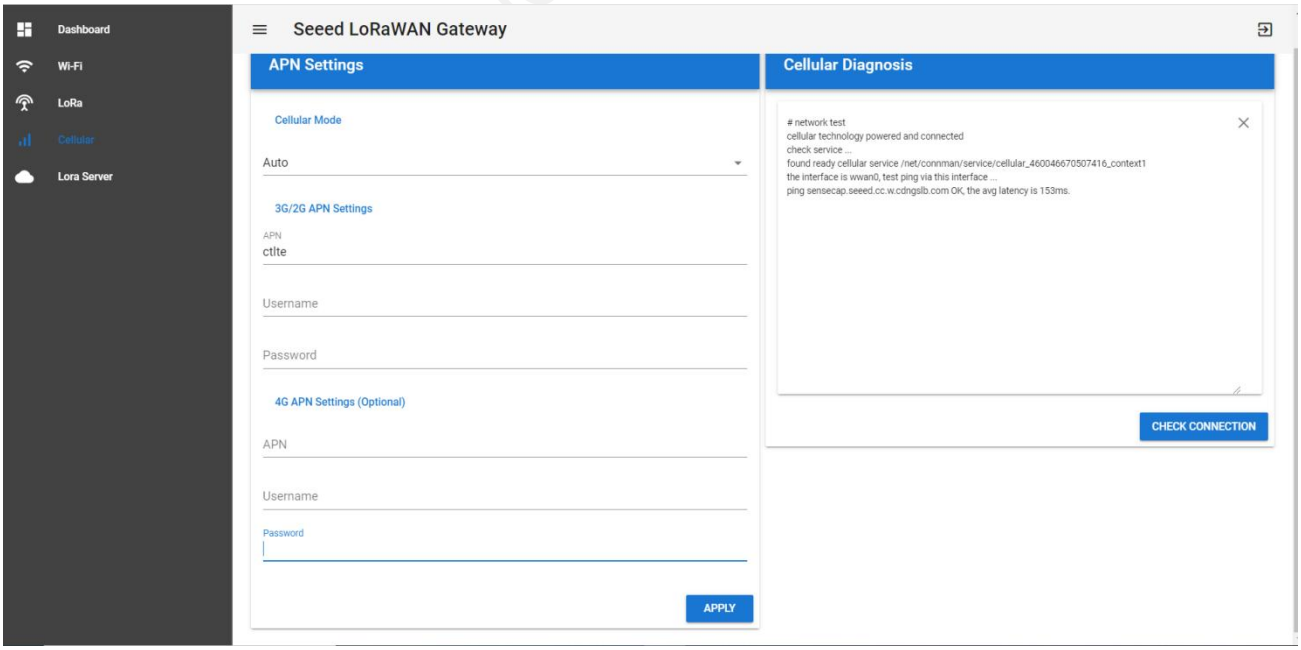


① Cellular Mode: AUTO(default), Gateway automatically selects mode.

② 3G/2G APN Settings: when the mode is 3G/2G, the APN information of SIM card operator needs to be filled in.

③ 4G APN Settings: optional.

(5) Click “APPLY”. Then “CHECK CONNECTION”, if return “cellular technology powered and connected”, it means ok.



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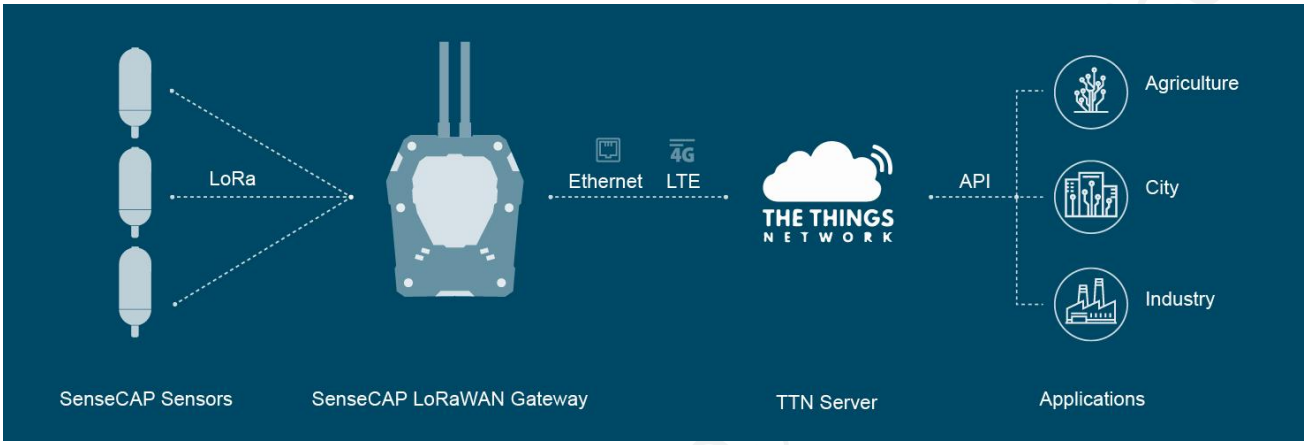
3 Add Gateway to User's TTN Server

The SenseCAP LoRaWAN Gateway supports connecting to the user's own The Things Network account and server.

Learn more about TTN: https://www.thethingsindustries.com/docs/



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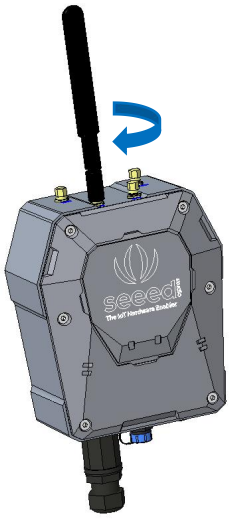
3.1 Gateway Network Configuration

3.1.1 Installing Antenna

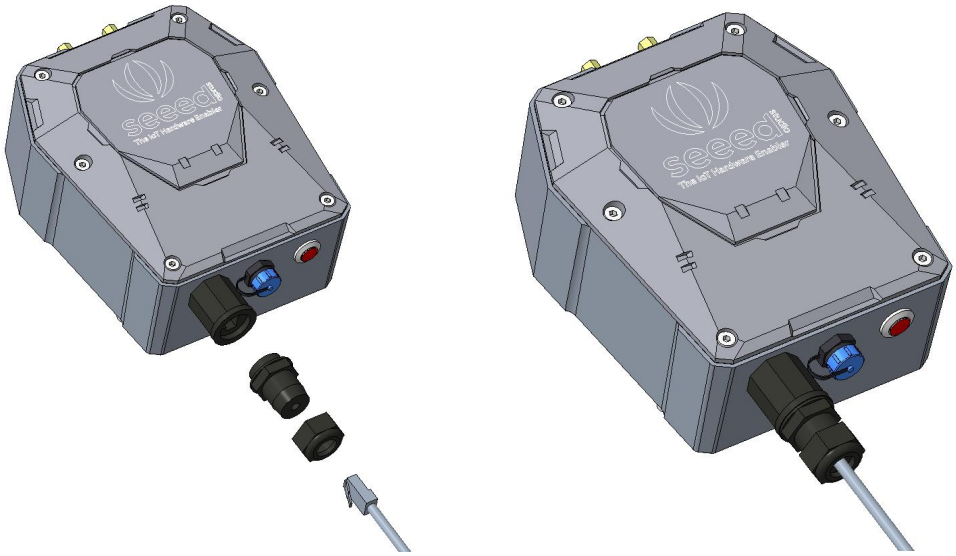
Screw clockwise to install the 4G and LoRa antennas onto the gateway.



3.1.2 Connecting to the Internet

There are two ways to connect to the Internet. Choose the one that works for you.

(3) Connecting to Ethernet Cable
Unscrew to open the protection cap, plug the Ethernet cable through the cap and then into the Ethernet port. Screw to fasten this part.



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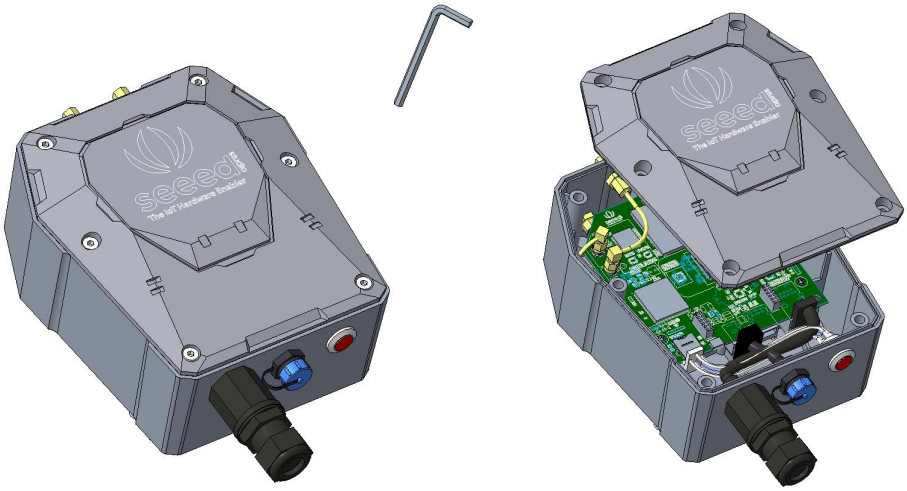
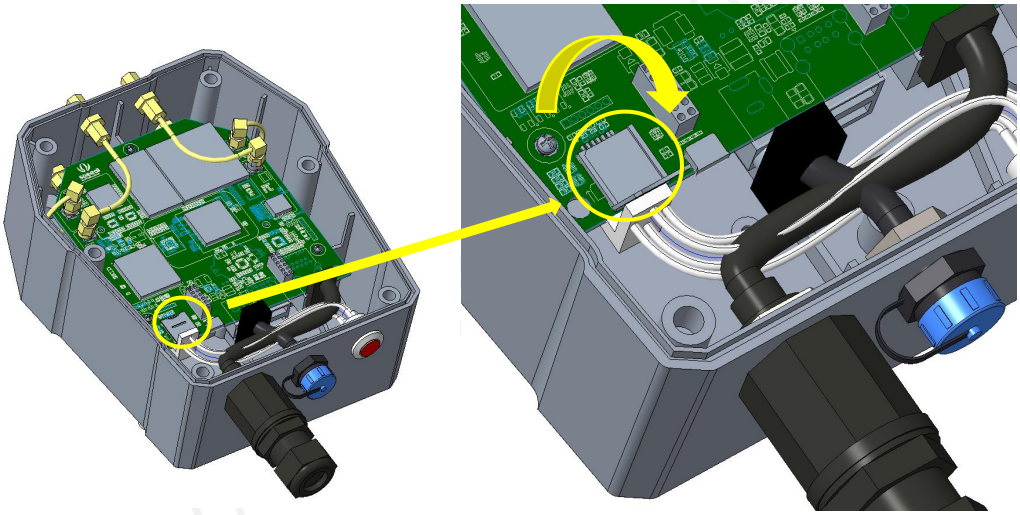
(4) Connecting to 4G

Use the hex key (included in the package) to unscrew the 6 screws and open the lid.



Swipe downward to open the SIM card socket, insert the Micro SIM card and swipe upward to lock the SIM card socket. Make sure it is installed correctly and close the lid with the screws.



3.1.3 Connecting to Power Cable

Unscrew to take off the power cap, plug in the extension cord and screw to fasten it onto the gateway. The other end of the extension cord is connected to the power adapter.

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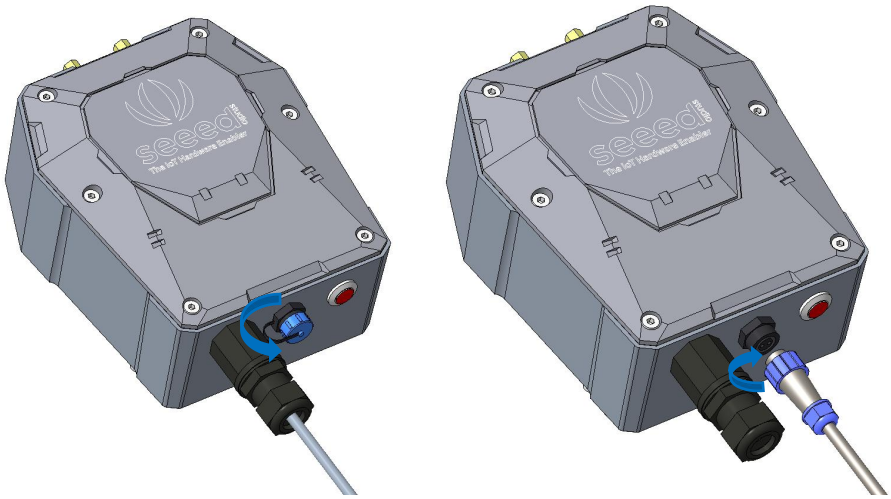

Notice: Make sure all antennas are correctly installed before powering on the gateway. Please note the device should be POWERED OFF when installing the antenna, or the antenna circuits might be damaged.

3.1.4 The Function of the Red LED

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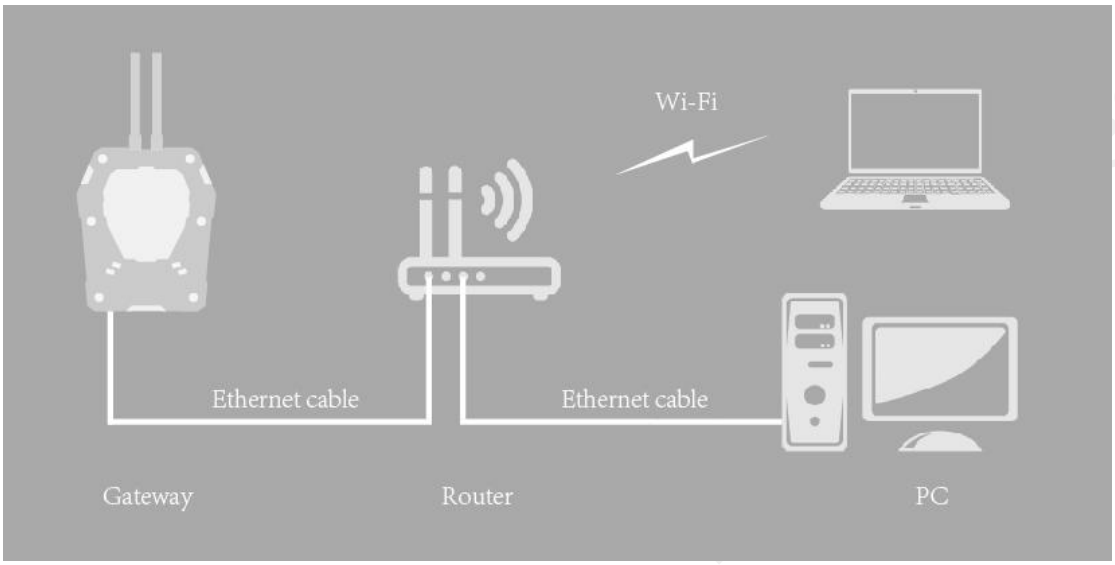
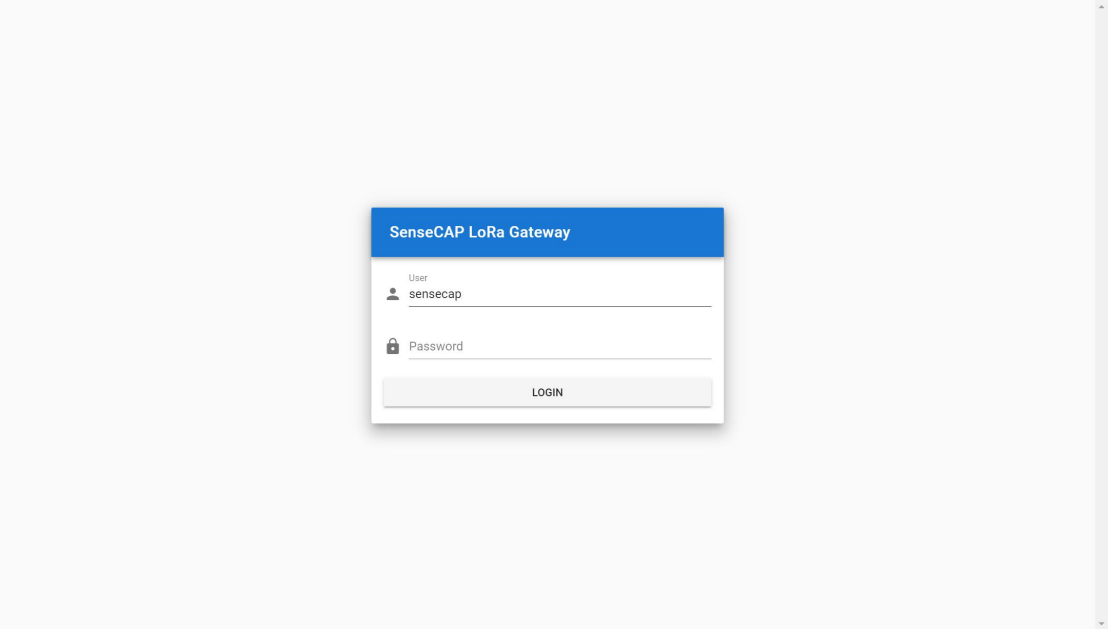
3.2 Setting the Gateway Service Address

Prepare a router, and the network connection is shown in the figure:



(6) Check the IP of "sensecap" in the background of the router.
(7) Enter IP in the browser: IP:8000
If the IP is 192.168.1.1, enter 192.168.1.1:8000



(8) User: sensecap
Password: sensecap!!!
(9) LoRa→Use Seeed's Server→Off Button

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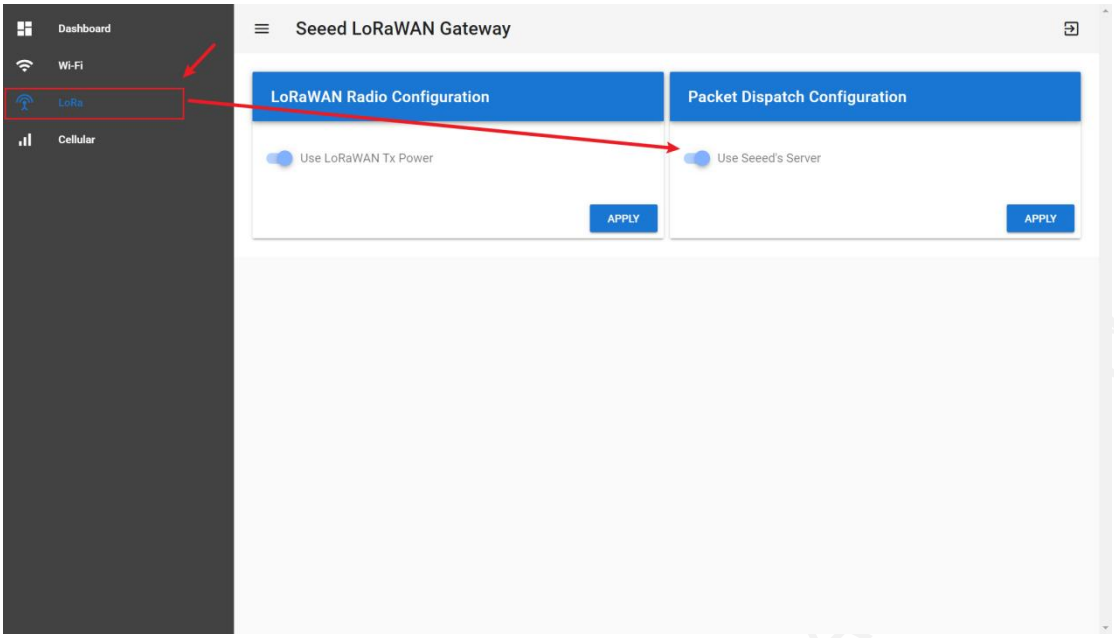
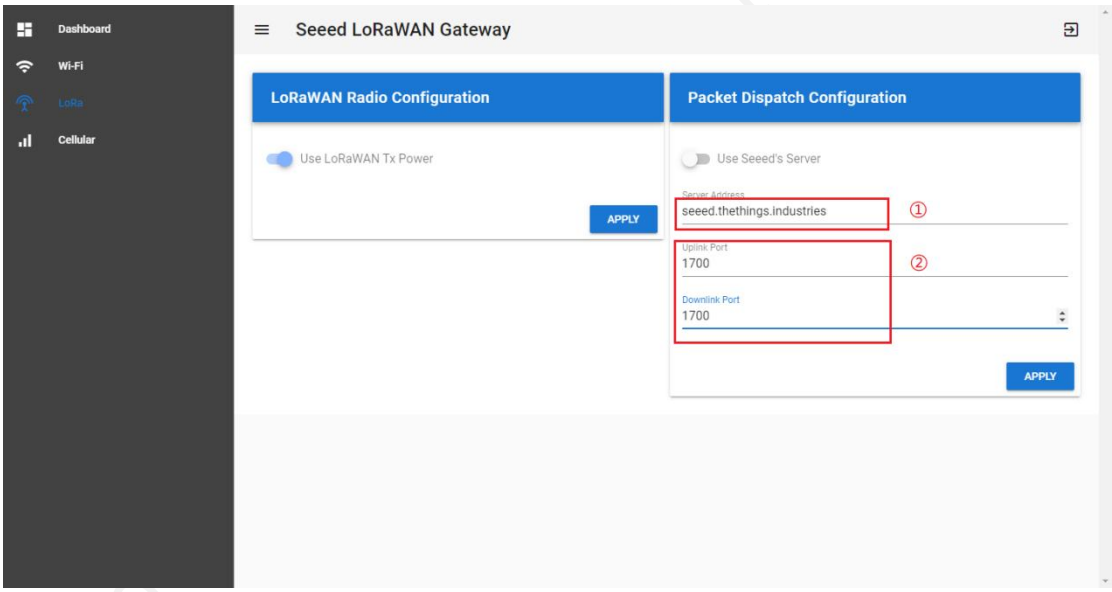
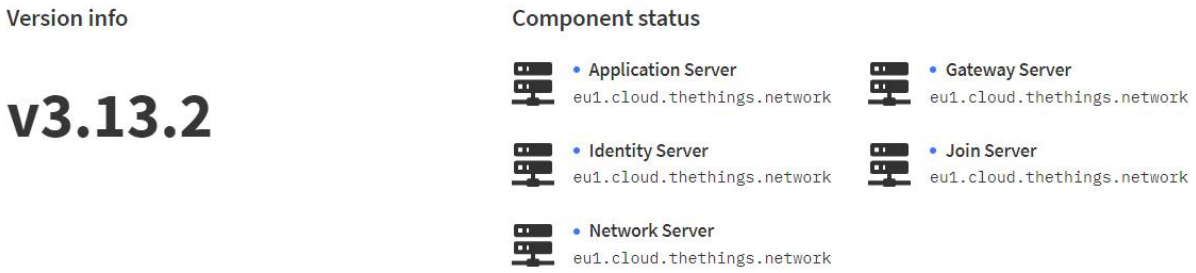


(10)



① Server Address: Please input your Server Address.
Refer to the website:



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Uplink / Downlink Port (default): **1700**

(11) APPLY.

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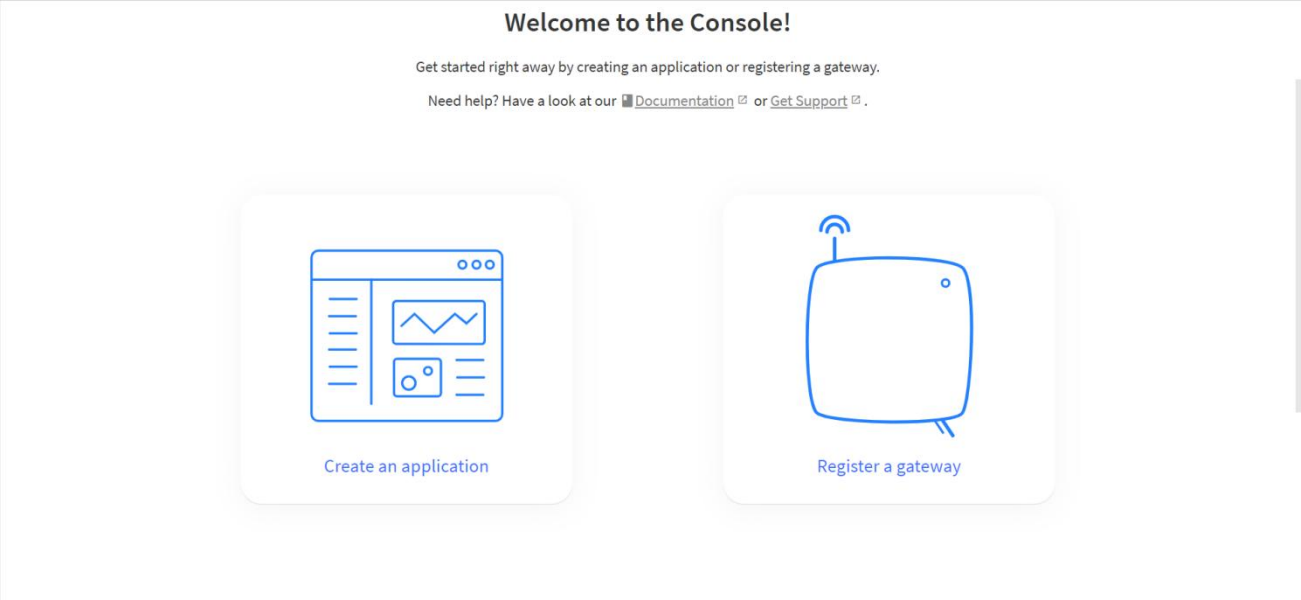
3.3 Gateway Registration on TTN

TTN website: https://www.thethingsnetwork.org
TTN console: https://console.cloud.thethings.network/
Tip: v2 will be discontinued and v3 is recommended.
(1) Follow the instruction to create your account, and access "Console".



(2) Register Gateway

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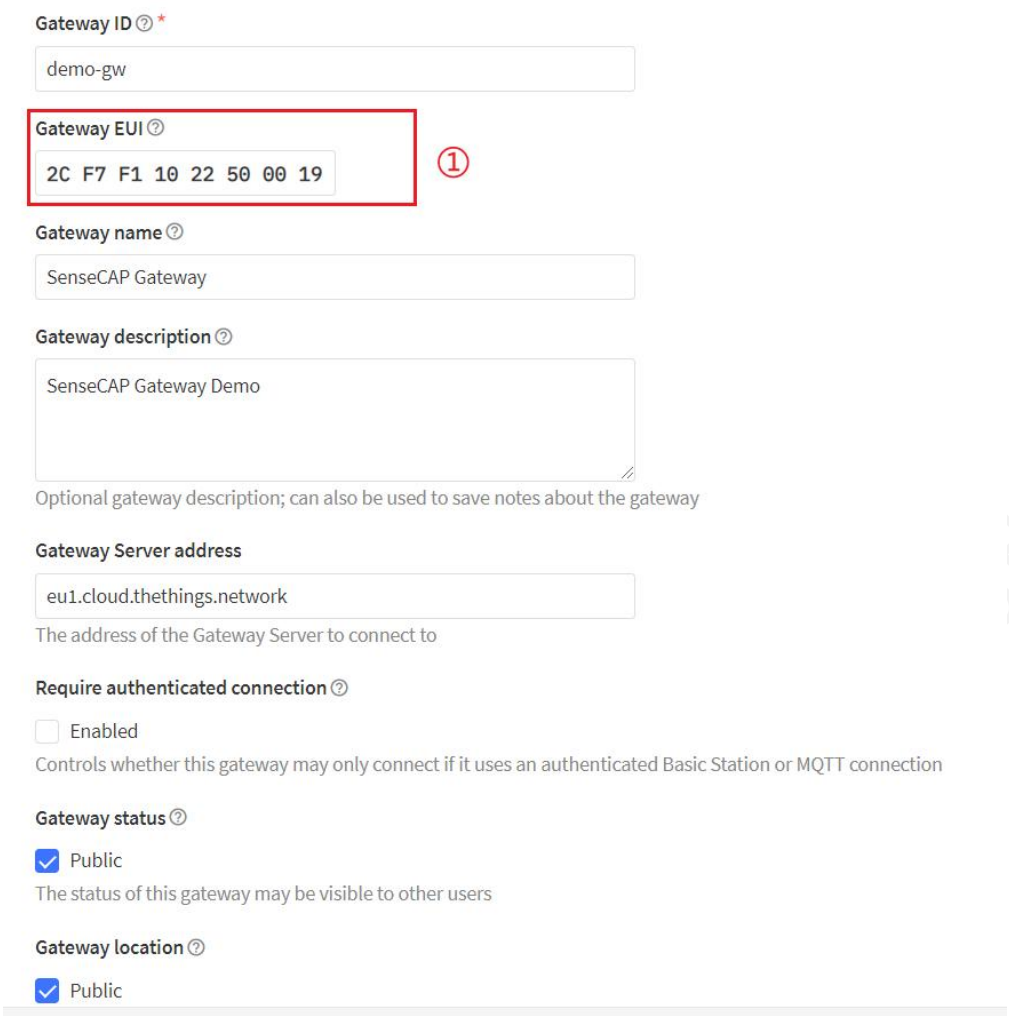

① Gateway EUI: View the labels on the gateway.
Select 'I'm using the legacy packet forwarder'.

② Frequency Plan: View the labels on the gateway.

EU868	Europe 863-870 MHz (SF9 for RX2 -recommended)
US915	United States 902-928 MHz, FSB 2 (used by TTN)
AU915	Australia 915-928 MHz, FSB 2 (used by TTN)
AS923-1	Asia 920-923 MHz
AS923-2	Asia 923-925 MHz

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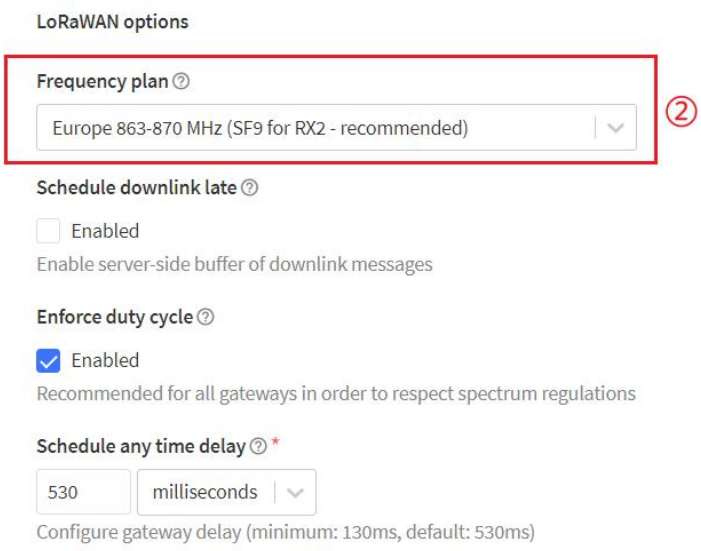
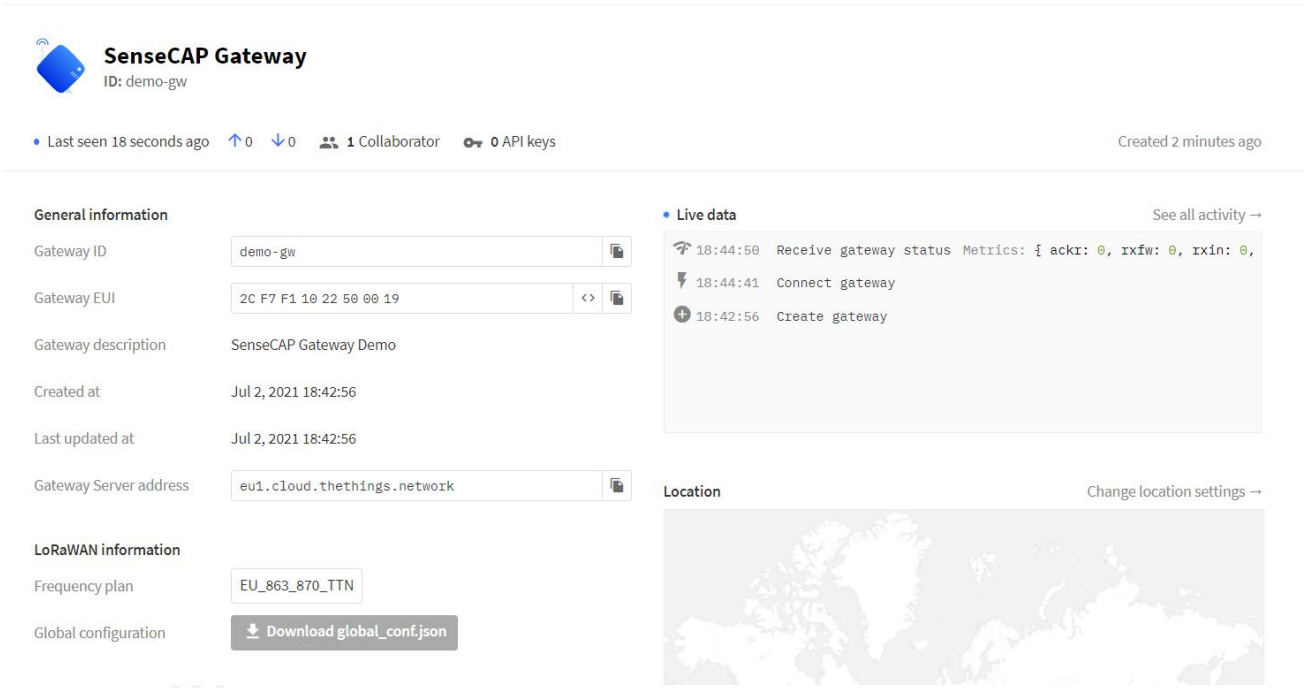


③ Other use default.

④ Create Gateway.

Gateway Status displays connected, indicating successful registration.



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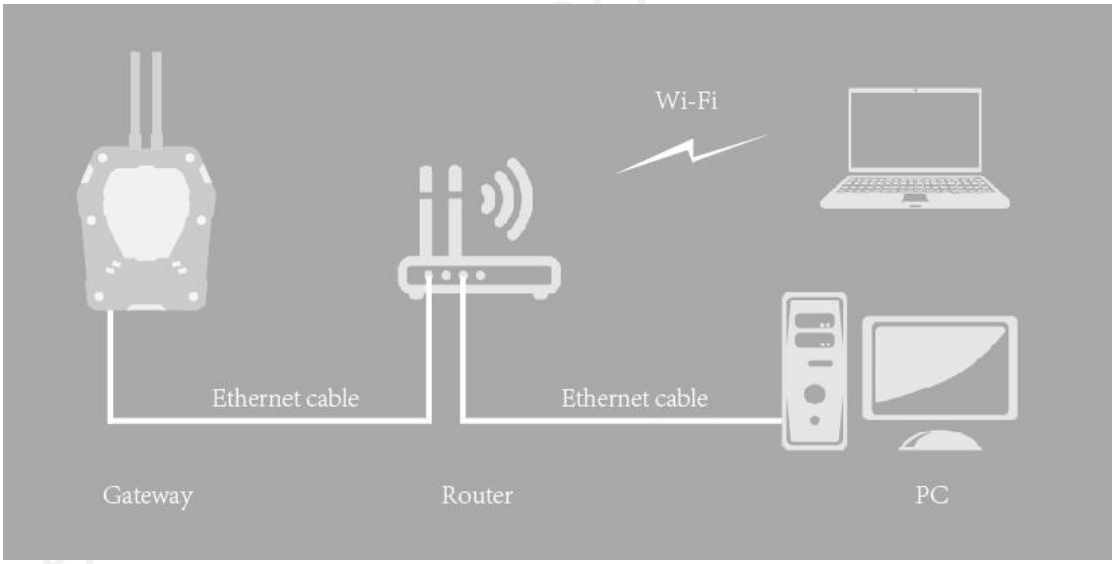
4 Add Gateway to ChirpStack LoRaWAN Network Server Stack

ChirpStack provides open-source components for LoRaWAN networks. Together they form a ready-to-use solution including an user-friendly web-interface for device management and APIs for integration.

SenseCAP LoRaWAN Gateway has already integrated with ChirpStack LoRaWAN Network Server stack (hereinafter called the "ChirpStack LoRa Server"). The following LoRa Server components are accessible and configurable in Gateway: ChirpStack Gateway Bridge, ChirpStack Network Server and ChirpStack Application Server.

4.1 Turn on ChirpStack LoRa Server Mode

Prepare a router, and the network connection is shown in the figure:



(1) Check the IP of "sensecap" in the background of the router.
(2) Enter IP in the browser: IP:8000
If the IP is 192.168.1.1, enter 192.168.1.1:8000

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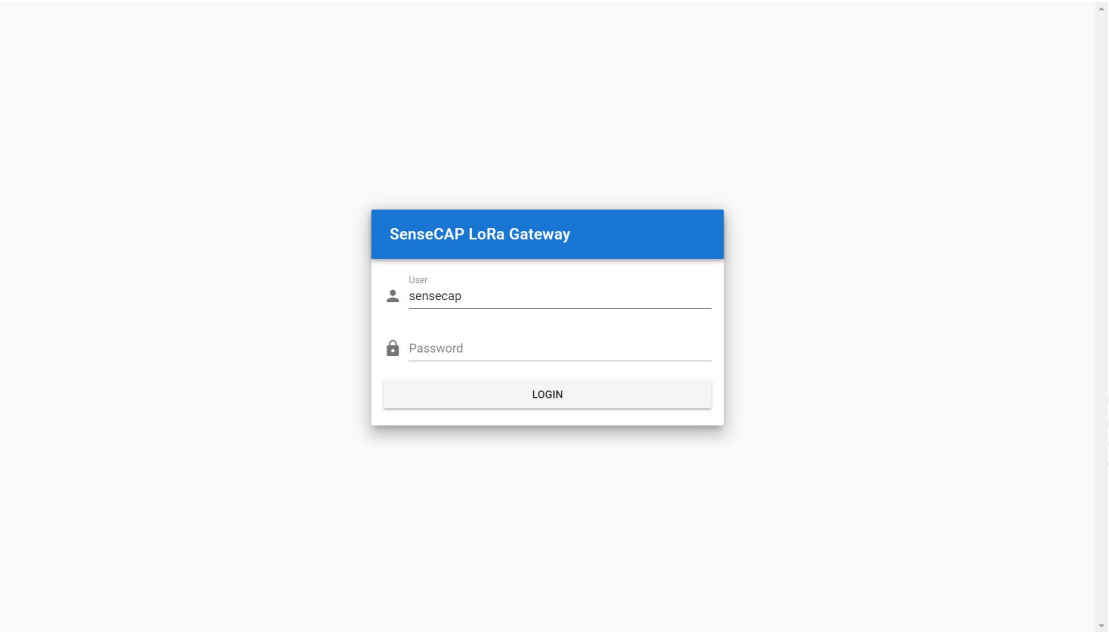
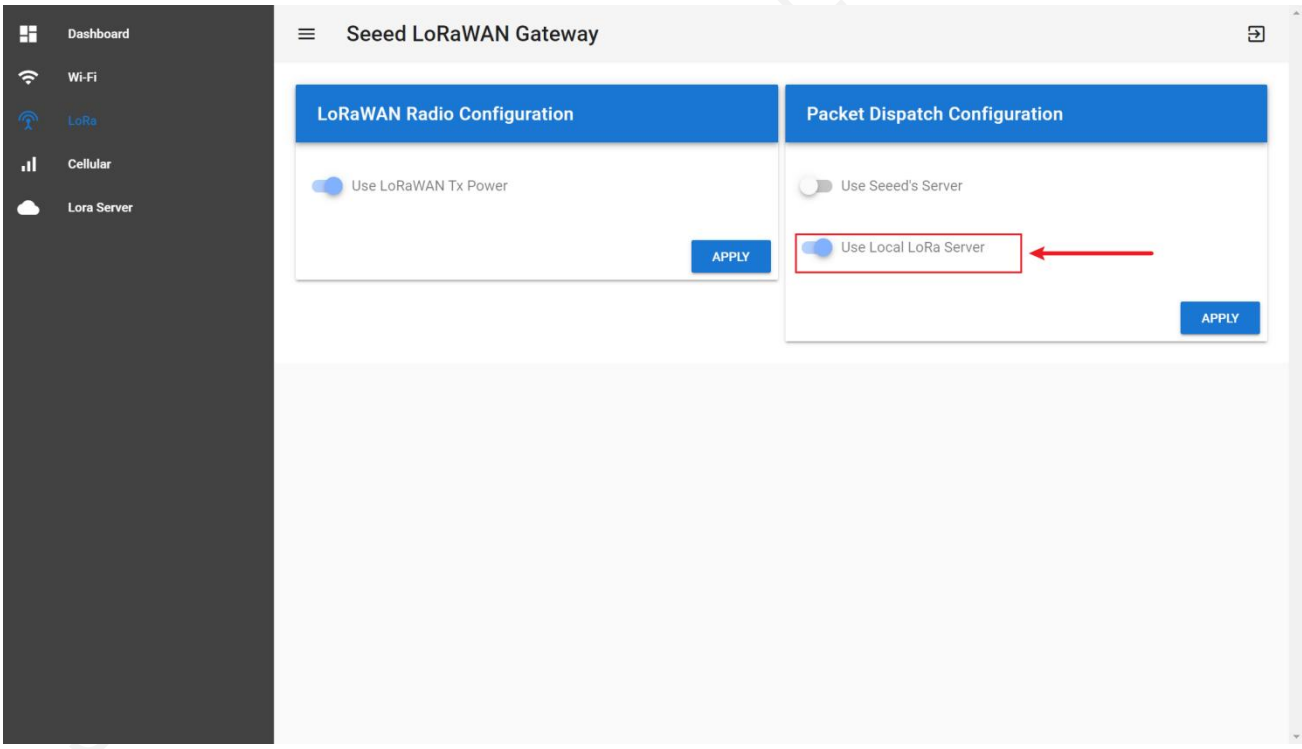


(3) User: sensecap
Password: sensecap!!!

(4) Turn off the “Use Seeed’s Server”, and turn on “Use Local LoRa Server”.



(5) Turn on the “Use LoRa Server” button, and apply. (“LoRa Server” is the name of ChirpStack LoRa Server)

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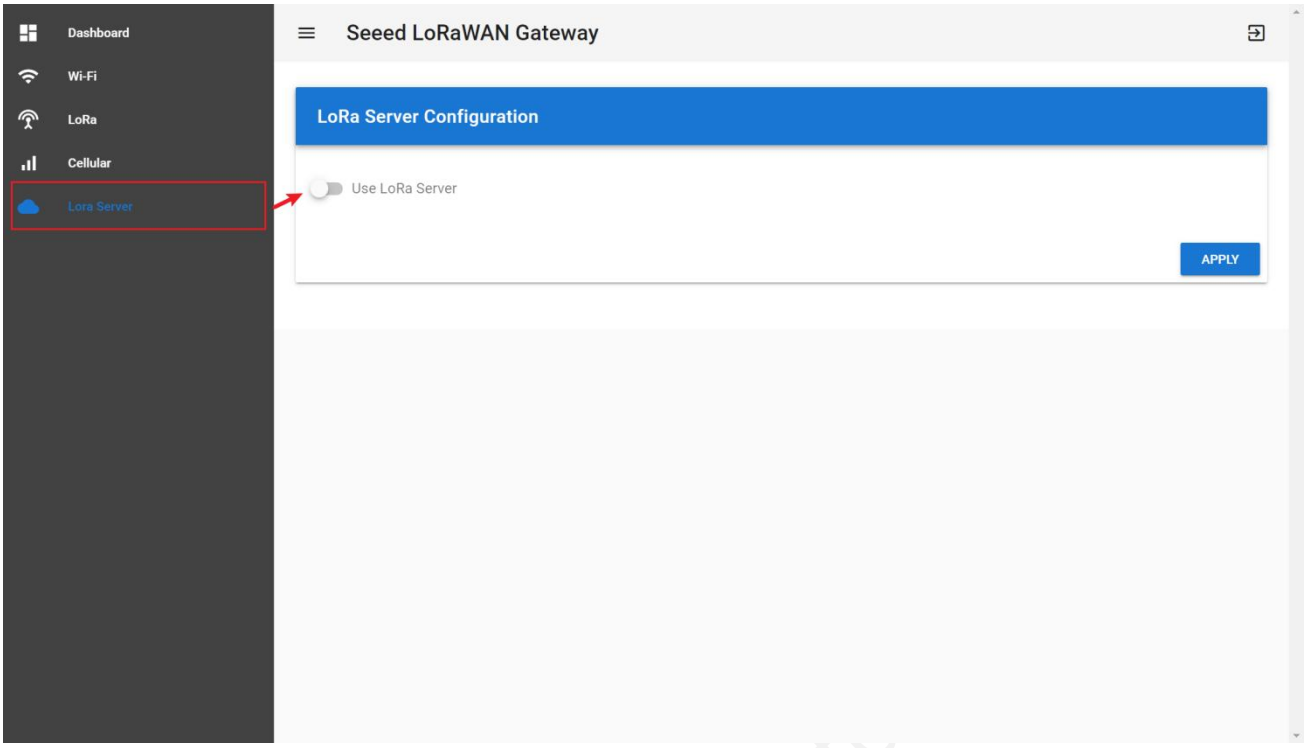

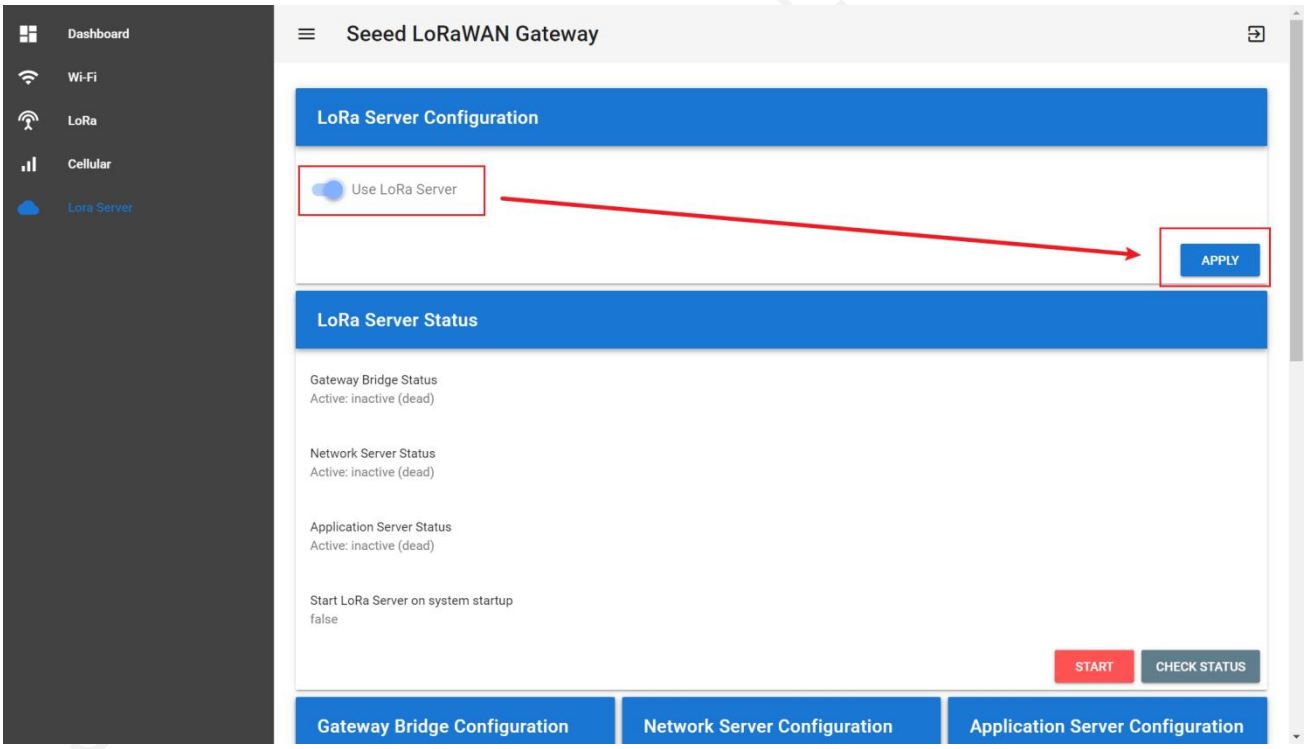

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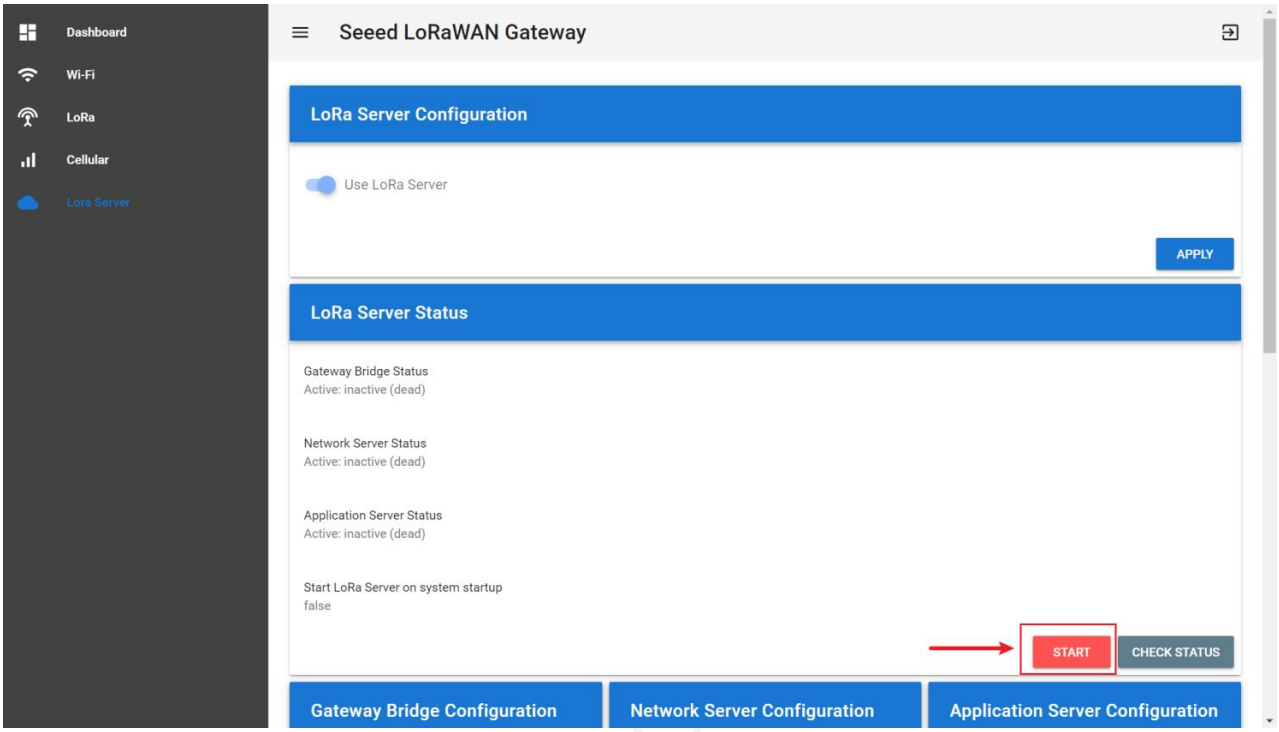
4.2 ChirpStack LoRa Server Configuration

First, click the “Start” button to start the service.

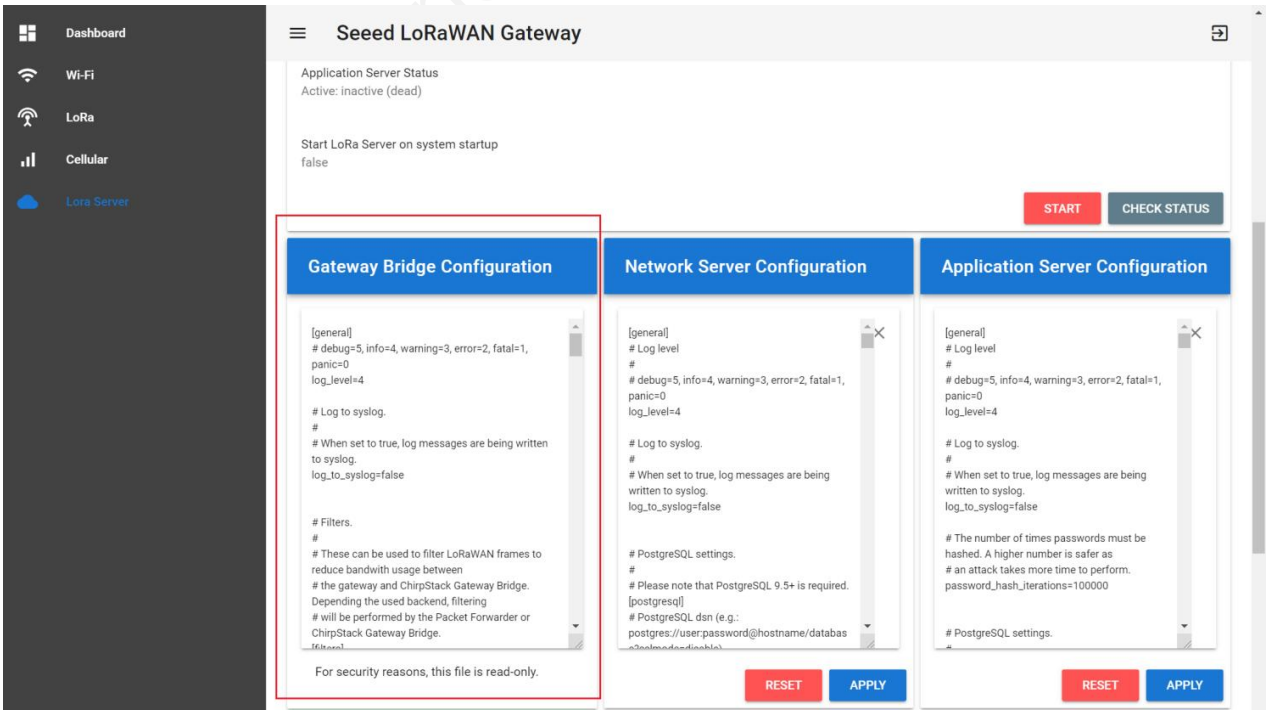


(1) ChirpStack Gateway Bridge:

Refer to: https://www.chirpstack.io/gateway-bridge/

It converts LoRa® Packet Forwarder protocols into a ChirpStack Network Server common data-format (JSON and Protobuf).

For security reasons, this file is read-only.



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(2) ChirpStack Network Server:

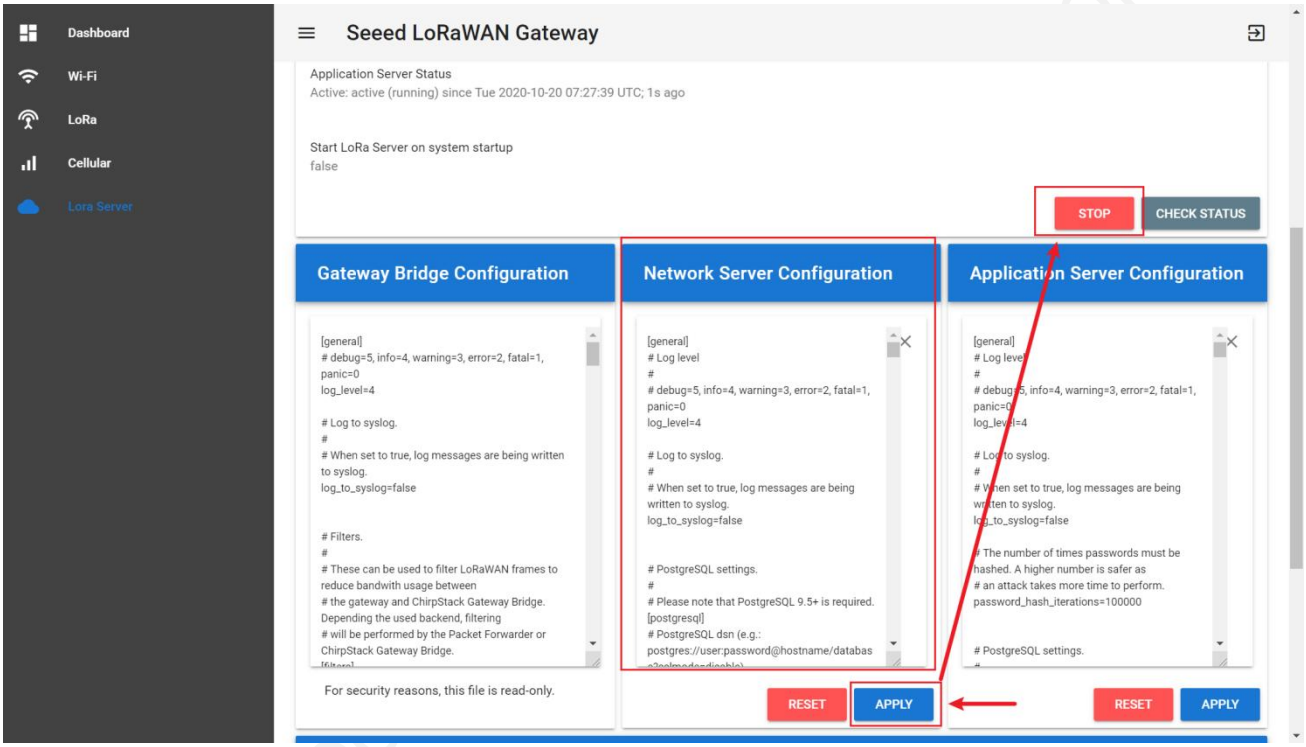
Refer to: https://www.chirpstack.io/network-server/

The responsibility of the Network Server component is the de-duplication of received LoRaWAN frames by the LoRa® gateways and for the collected frames handle the: Authentication; LoRaWAN mac-layer (and mac-commands); Communication with the ChirpStack Application Server; Scheduling of downlink frames.

In general, the default configuration is used. Please refer to the official tutorial before making any modifications.

Click "APPLY" to save the configuration after making changes.

Then, click "STOP" in "Application Server Status" and finally click "START" to make the configuration take effect.



(3) ChirpStack Application Server:

Refer to: https://www.chirpstack.io/application-server/

It is responsible for the device “inventory” part of a LoRaWAN infrastructure, handling of join-request and the handling and encryption of application payloads.

In general, the default configuration is used. Please refer to the official tutorial before making any modifications.

Click "APPLY" to save the configuration after making changes.

Then, click "STOP" in "Application Server Status" and finally click "START" to make the configuration take effect.

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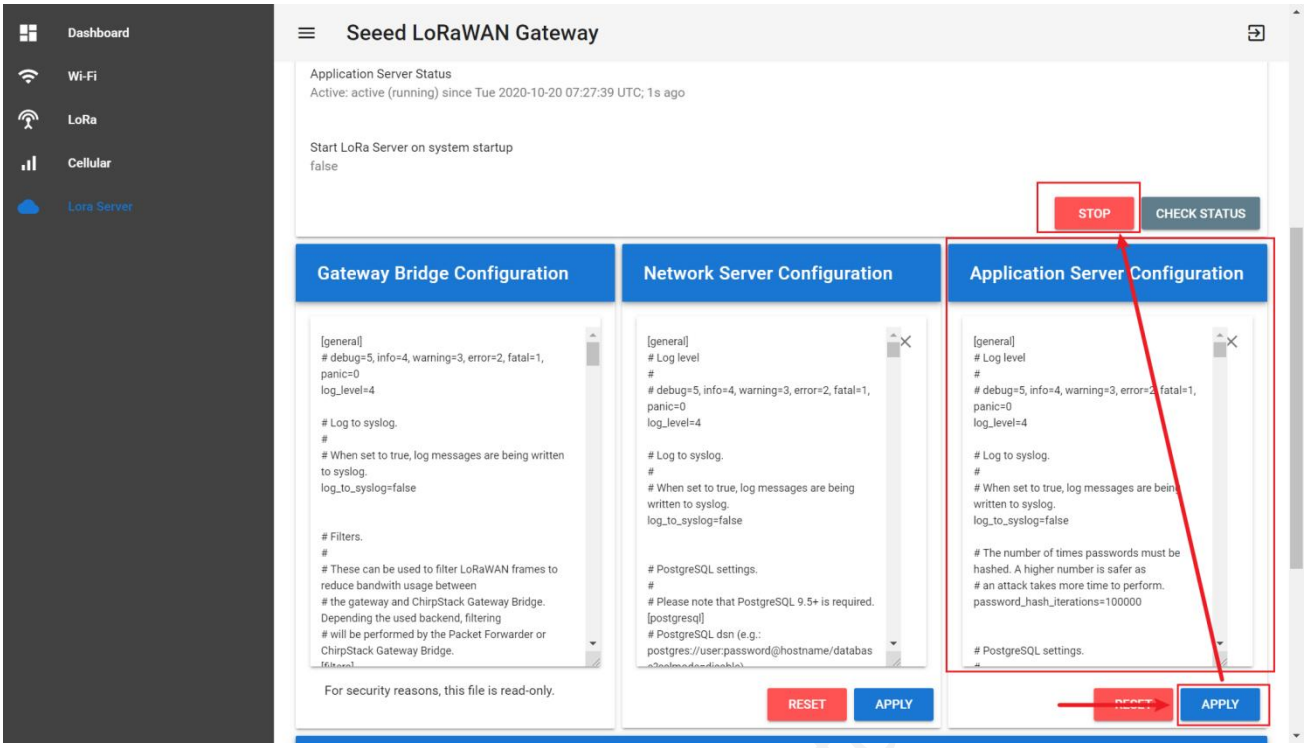

(4) If you have the wrong configuration, click "RESET" to restore the default configuration.

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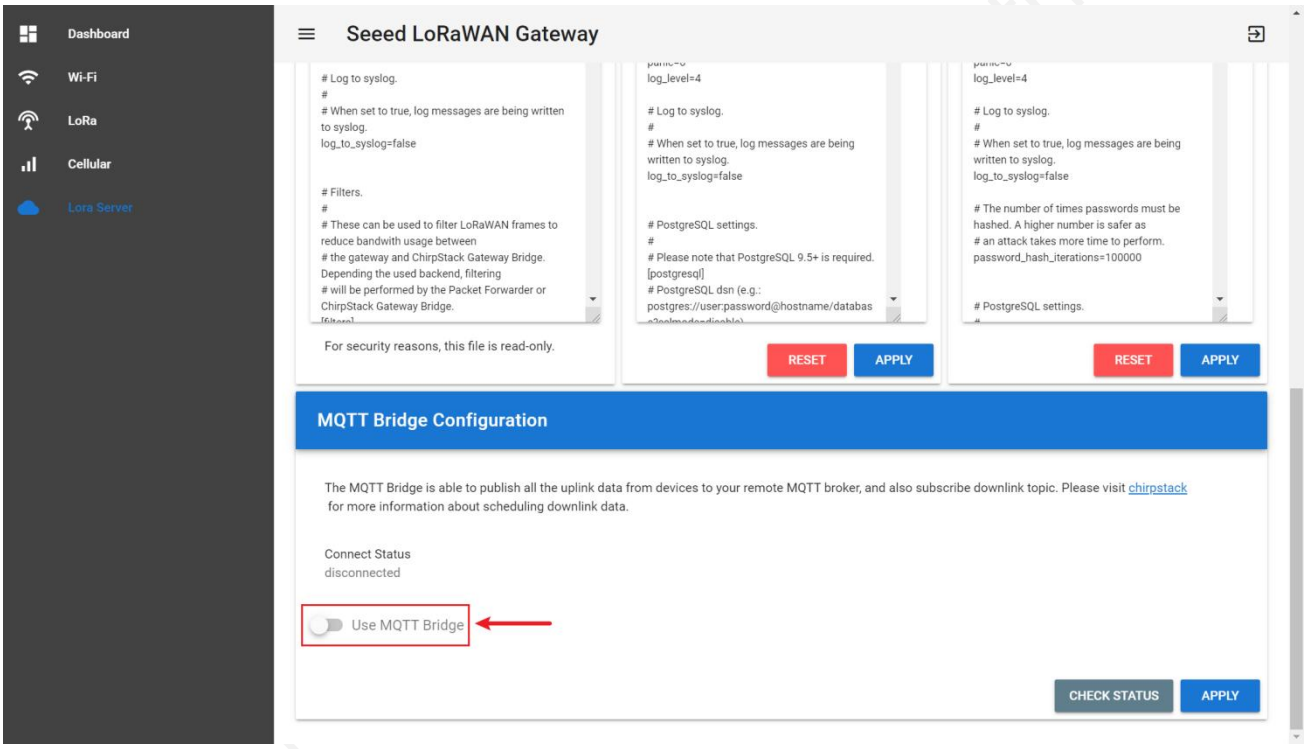
4.3 MQTT Bridge Configuration

The MQTT Bridge is able to publish all the uplink data from devices to your remote MQTT broker, and also subscribe downlink topic. Please visit ChirpStack(https://www.chirpstack.io/application-server/integrations/mqtt/) for more information about scheduling downlink data.

4.3.1 Gateway Configuration

(1) Click “Use MQTT Bridge”.



(2) After filling in each parameter, click "APPLY".

①

MQTT Server address: mqtt://xxx.xx or mqtts://xxx.xx

If xxx.xx (IP) is 111.230.200.102, the address is mqtt://111.230.200.102 or mqtts://111.230.200.102
If xxx.xx (url) is mybroker.com, the address is mqtt:// mybroker.com or mqtts:// mybroker.com

②

MQTT Server ‘s Port.
In general, mqtt corresponds to port 1883 and mqtts to port 8883.

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③

Keepalive:
60 is default value. When the MQTT connection between the Gateway and the Server is disconnected over 60 seconds, it determines that the client is offline.
0 means turn off the keepalive function.

④

CleanSession:
true: the gateway reconnects to the network after a power outage or disconnection, and cannot receive data from MQTTpub to the gateway for that period.
false: the gateway reconnects to the network after a power outage or disconnection, and can receive data from MQTTpub to the gateway for that period.

⑤

Username: Null if none, depending on the server configuration.

⑥

Password: Null if none, depending on the server configuration.

⑦

Client ID: Custom the name, and each Client ID is unique to the same MQTT server.

⑧

Publish QoS: 0, 1 or 2. (refer to the MQTT rules)

⑨

Subscribe QoS: 0, 1 or 2. (refer to the MQTT rules)

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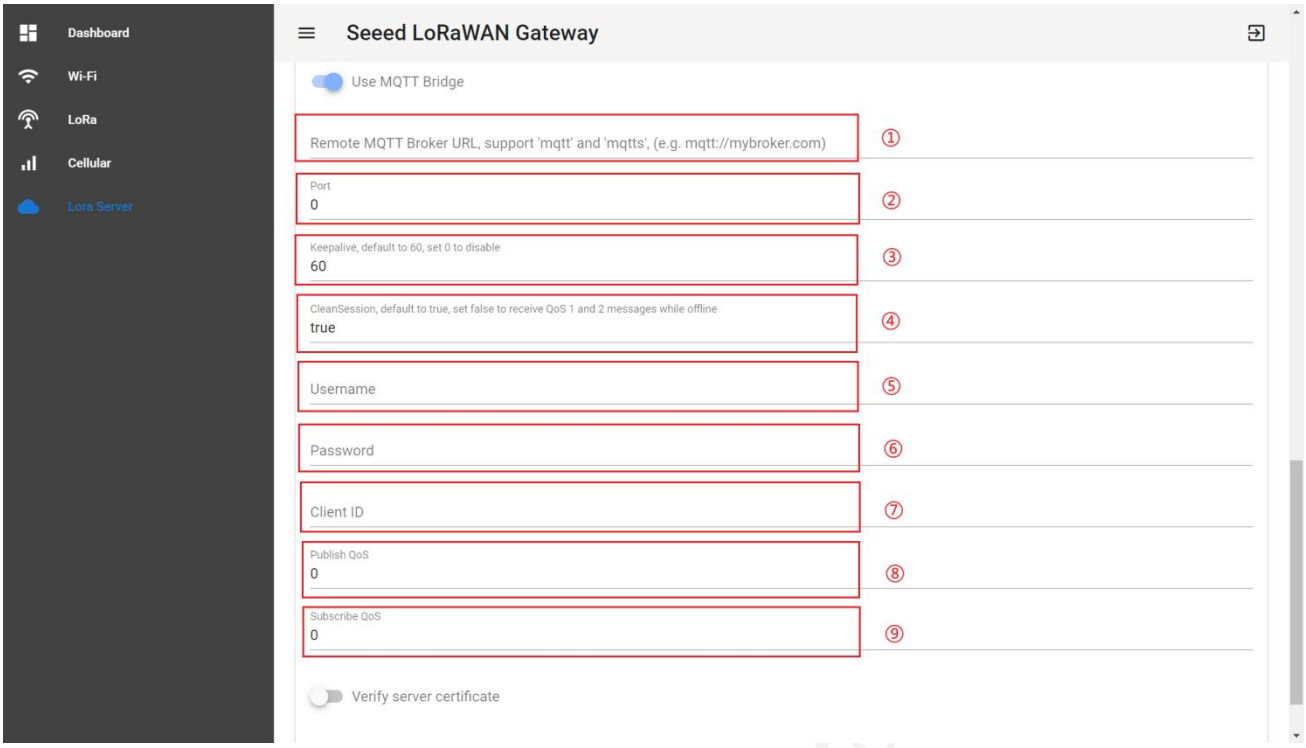

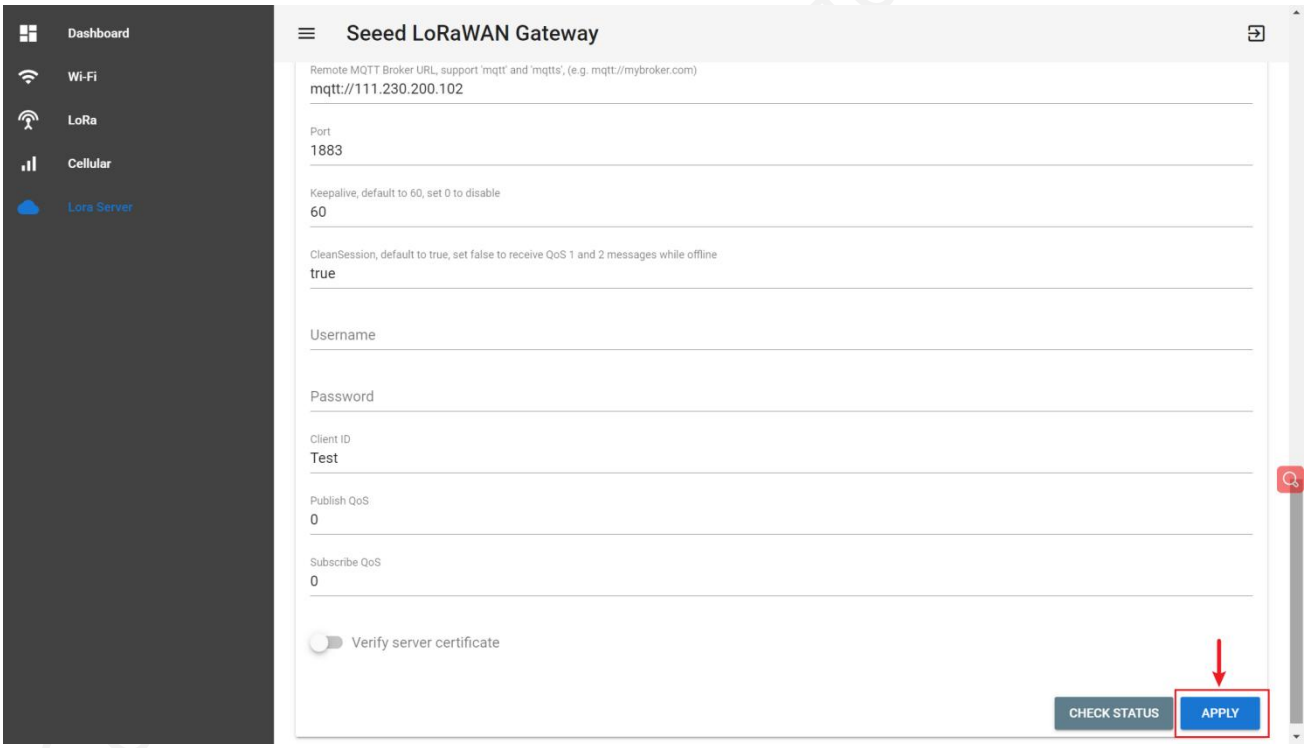

(3) It is off by default and can generally be ignored: Verify server certificate.
If true, the server certificate is verified against the list of supplied CAs.
If false, the server certificate is verified against your self-signed certificate.

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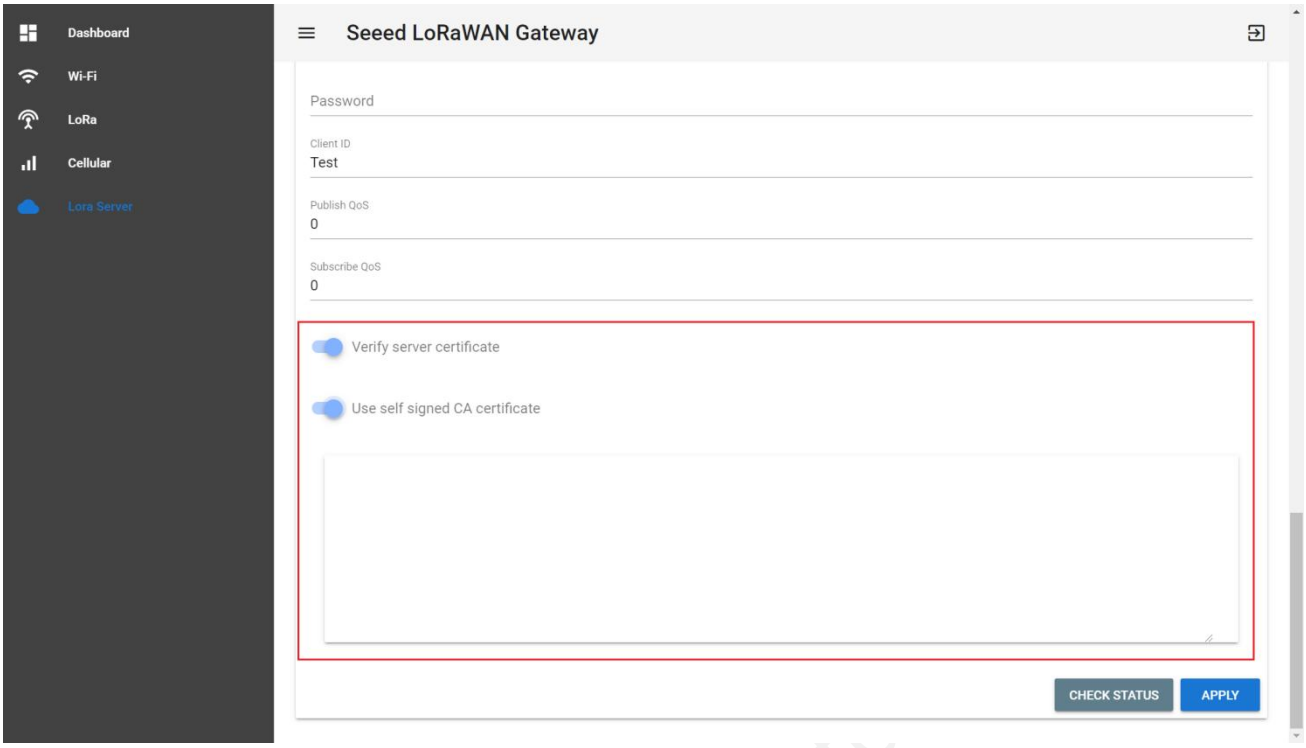
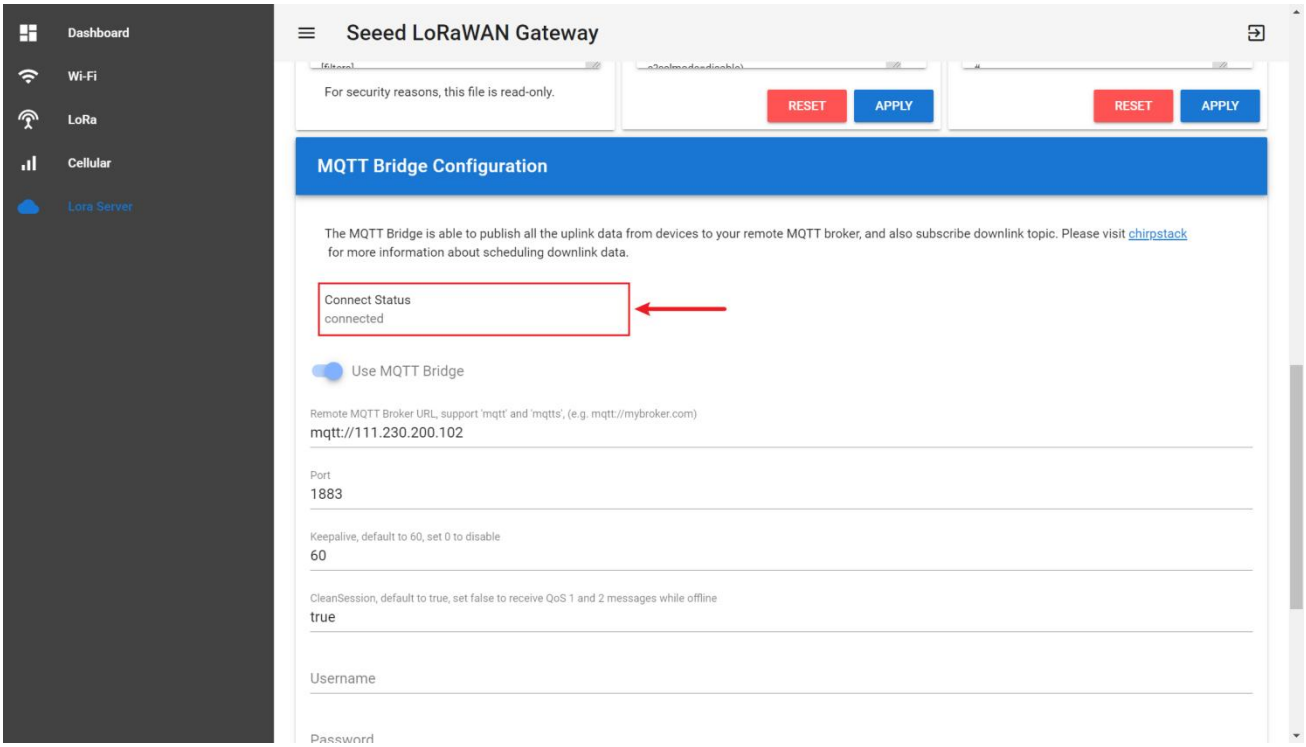


(4) Check Status: Disconnected / Reconnecting / Connected.



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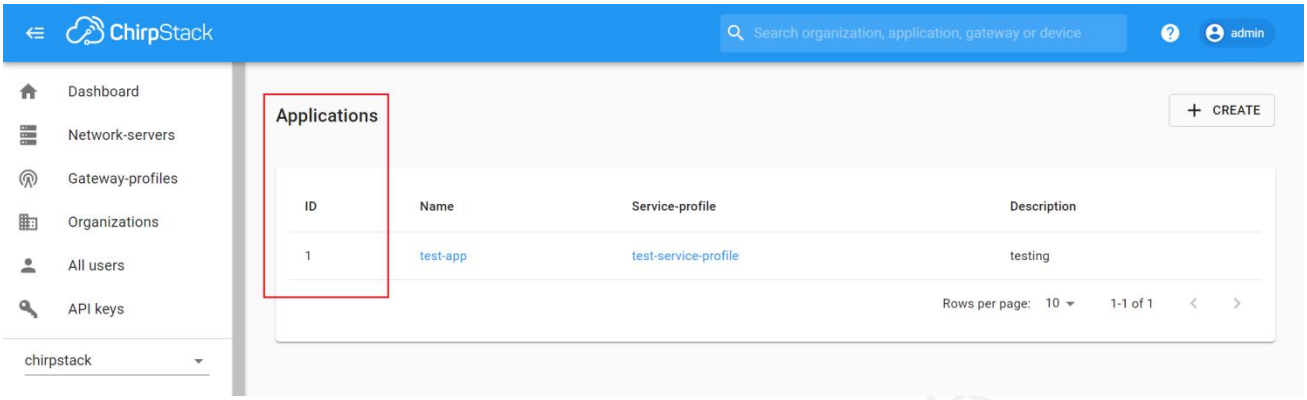
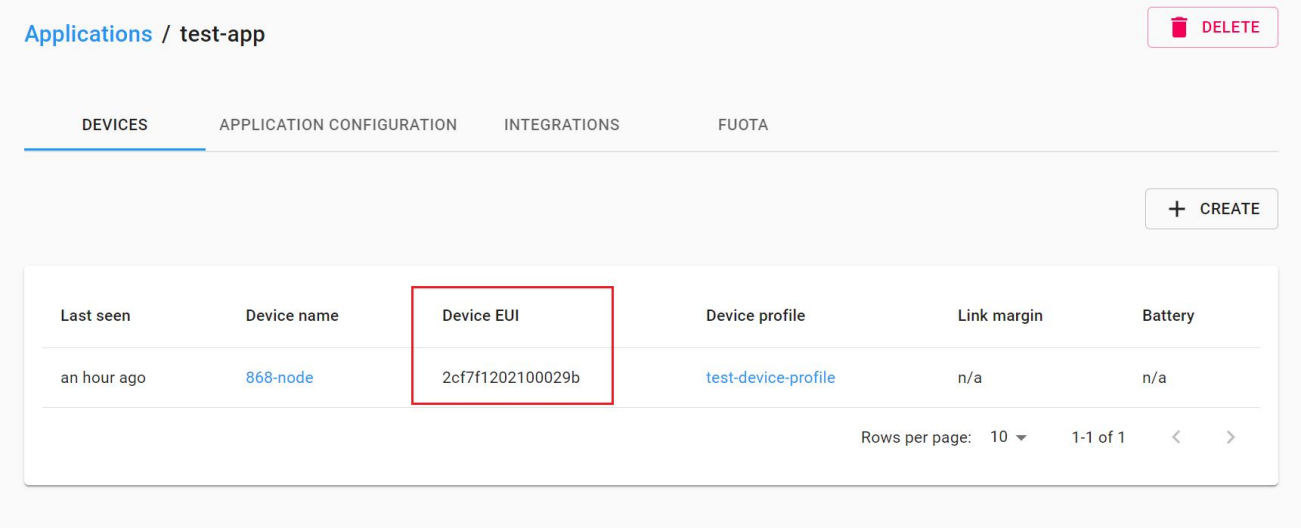
4.3.2 MQTT Client Configuration

For details, please refer to: https://www.chirpstack.io/application-server/integrations/events/#ack

ApplicationID: the Application ID.



DevEUI: Device EUI.



(1) Device data subscription

application/[ApplicationID]/device/[DevEUI]/event/up e.g. application/1/device/ 2cf7f1202100029b/event/up

(2) Join packet subscription

application/[ApplicationID]/device/[DevEUI]/event/join e.g. application/1/device/ 2cf7f1202100029b/event/join

(3) Status packet subscription

application/[ApplicationID]/device/[DevEUI]/event/status e.g. application/1/device/ 2cf7f1202100029b/event/ status

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4.3.3 Scheduling a Downlink

The default topic for scheduling downlink payloads is:

```
application/[ApplicationID]/device/[DevEUI]/command/down
```

The ApplicationID and DevEUI of the device will be taken from the topic.
Example payload:

```
{
    "confirmed": true,        // whether the payload must be sent as confirmed data down or not
    "fPort": 10,              // FPort to use (must be > 0)
    "data": "...."            // base64 encoded data (plaintext, will be encrypted by ChirpStack Network Server)
    "object": {               // decoded object (when application coded has been configured)
        "temperatureSensor": {"1": 25},     // when providing the 'object', you can omit 'data'
        "humiditySensor": {"1": 32}
    }
}
```

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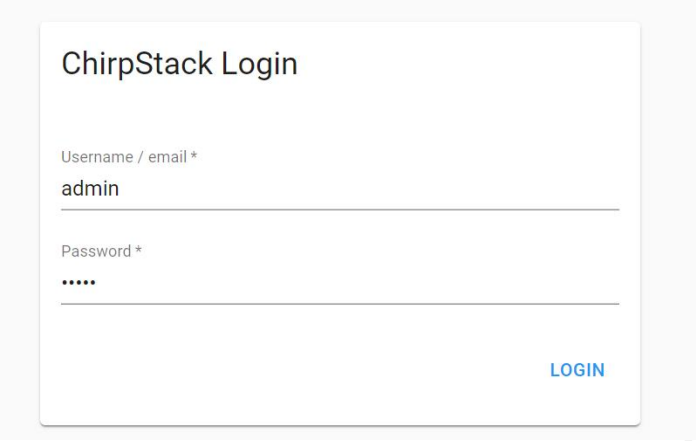
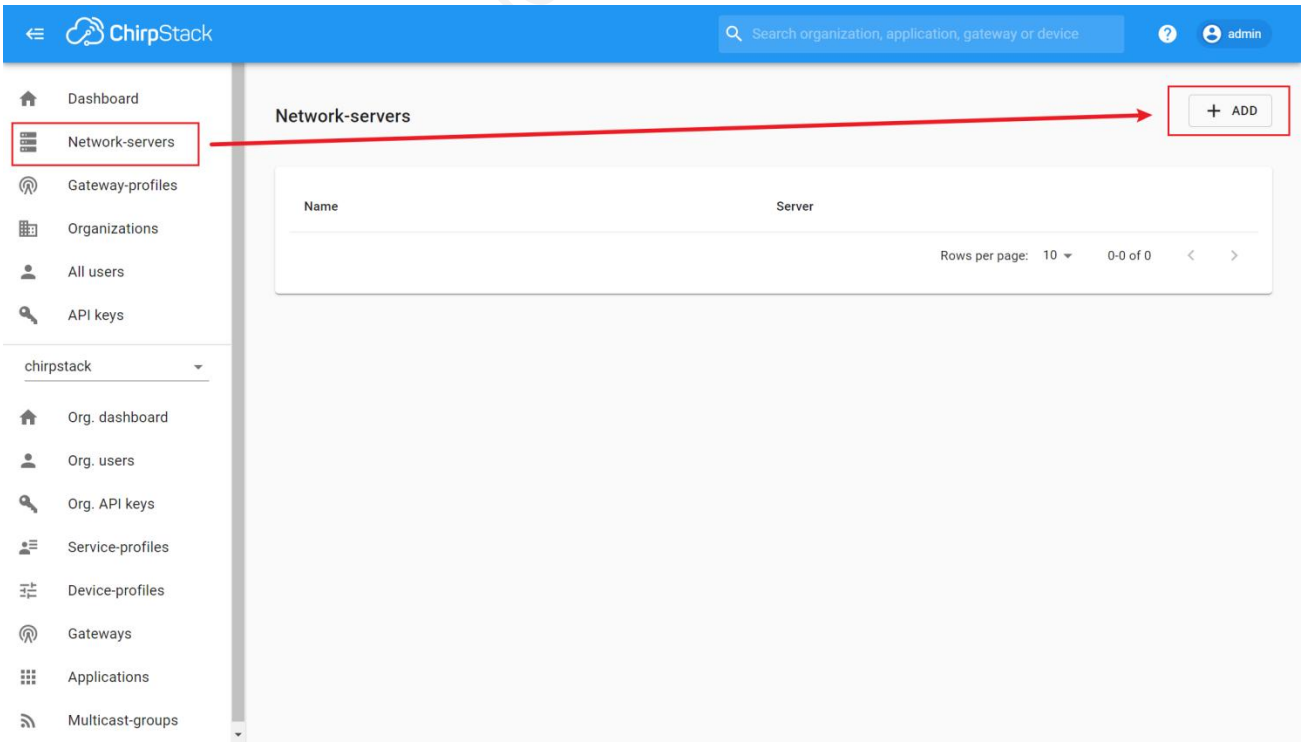
4.4 ChirpStack Application Server

4.4.1 Log on to the background

According to the Gateway IP obtained in Section 4.1, log in the Web UI.
The login address: IP:8080 (if IP is 192.168.8.100, enter 192.168.8.100:8080)
Username(default): admin
Password(default): admin



4.4.2 Add the Network-servers



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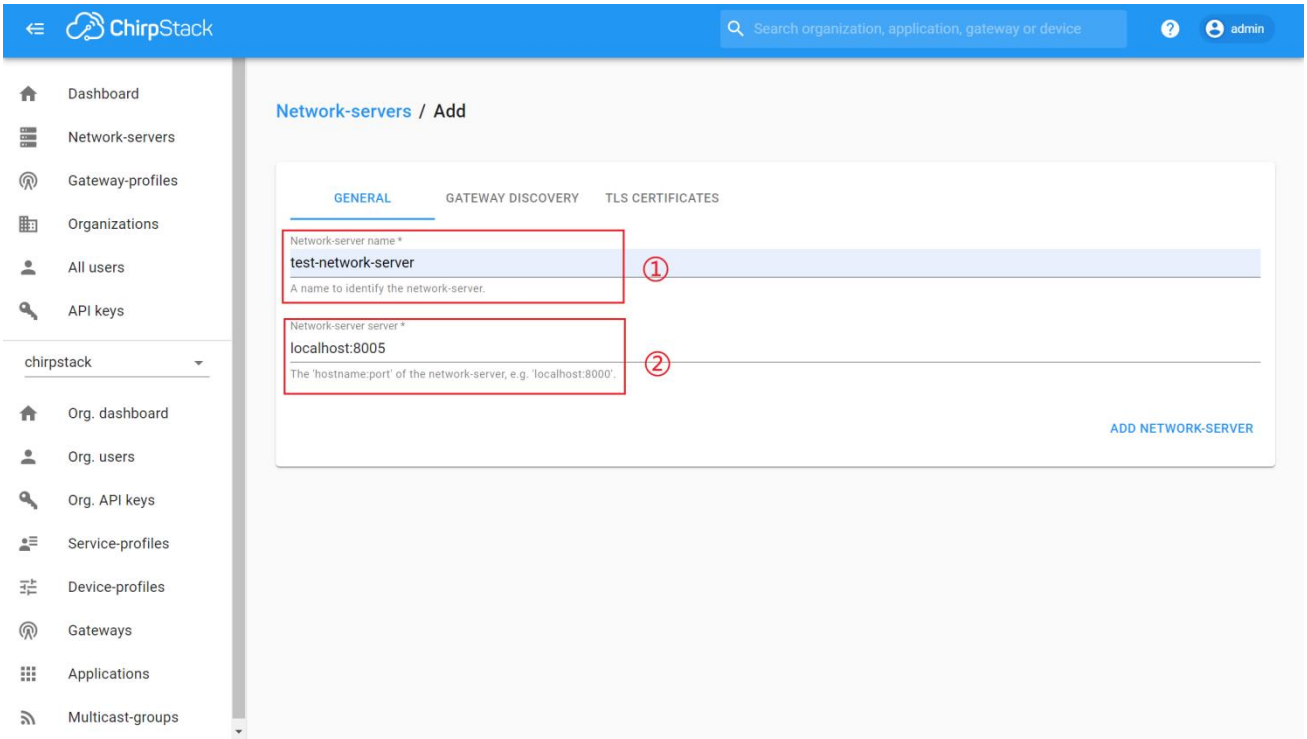
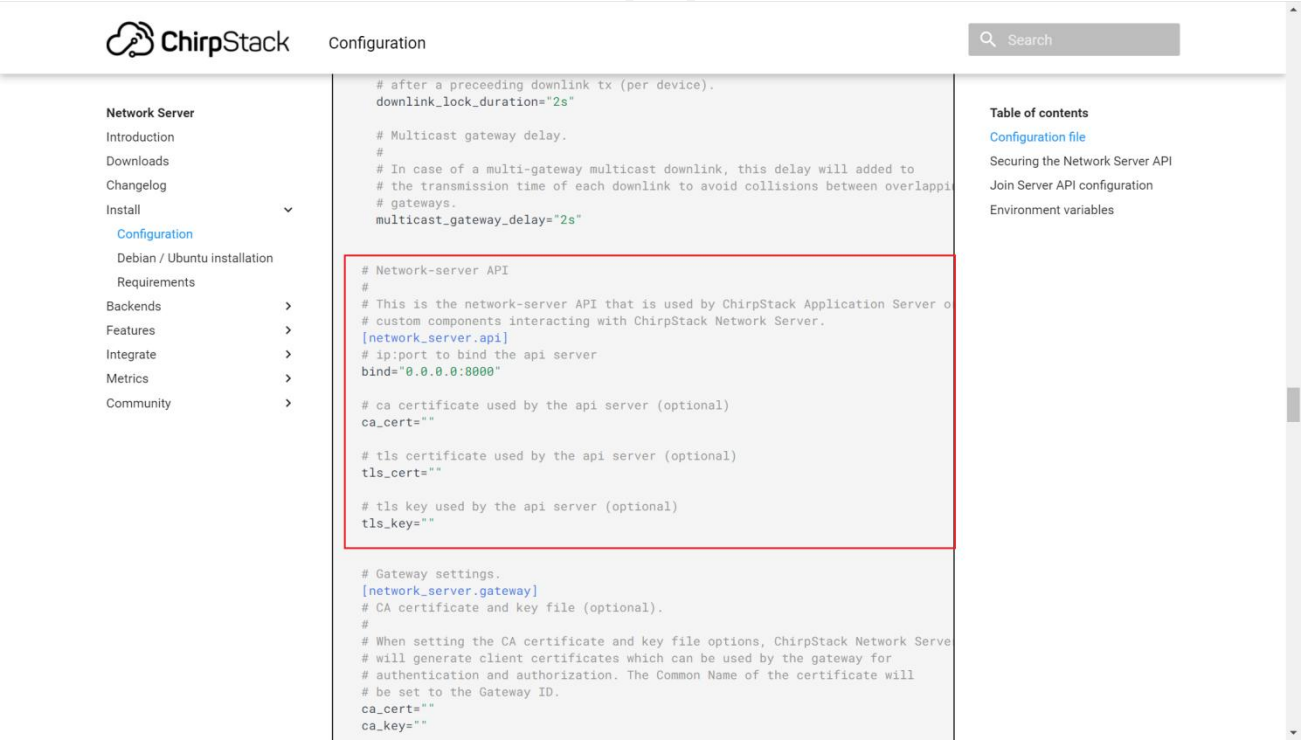


① Network-server name: custom name.

② Network-server server: the default value is localhost:8005

Refer to: https://www.chirpstack.io/network-server/install/config/ . You can modify it in the "Network Server Configuration".



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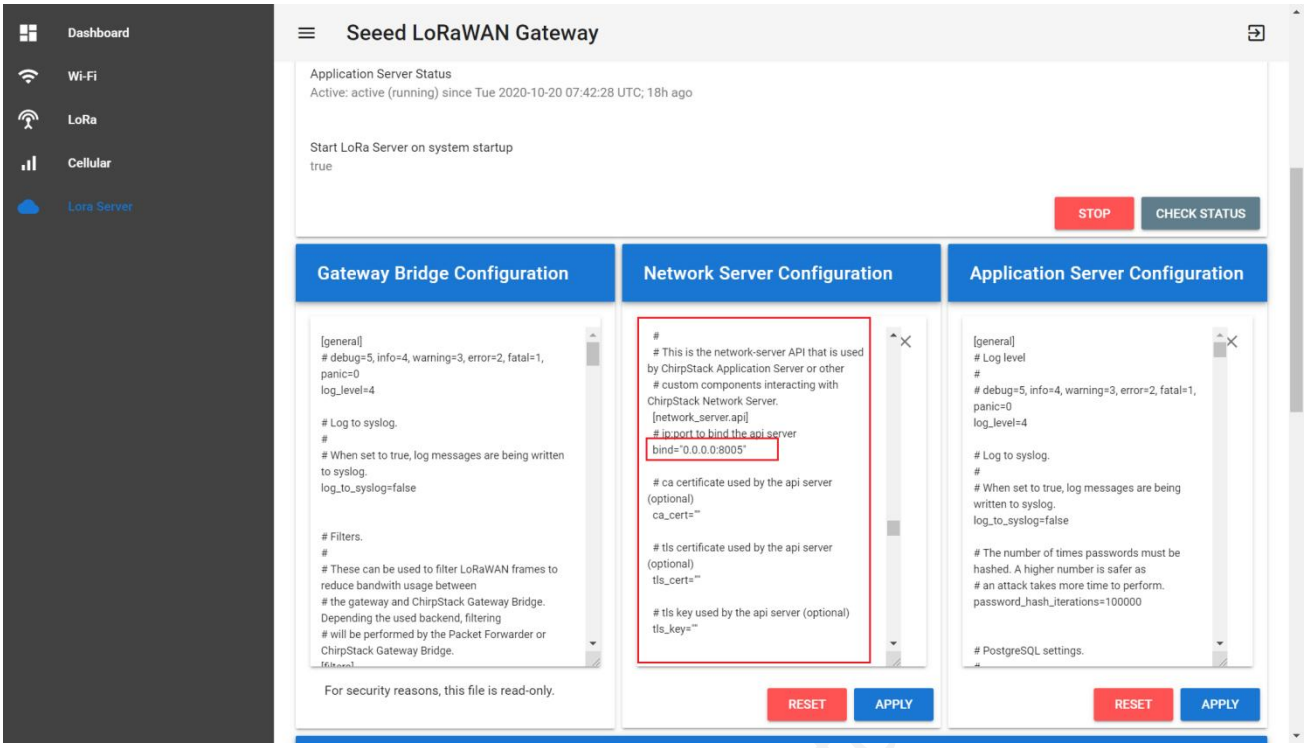
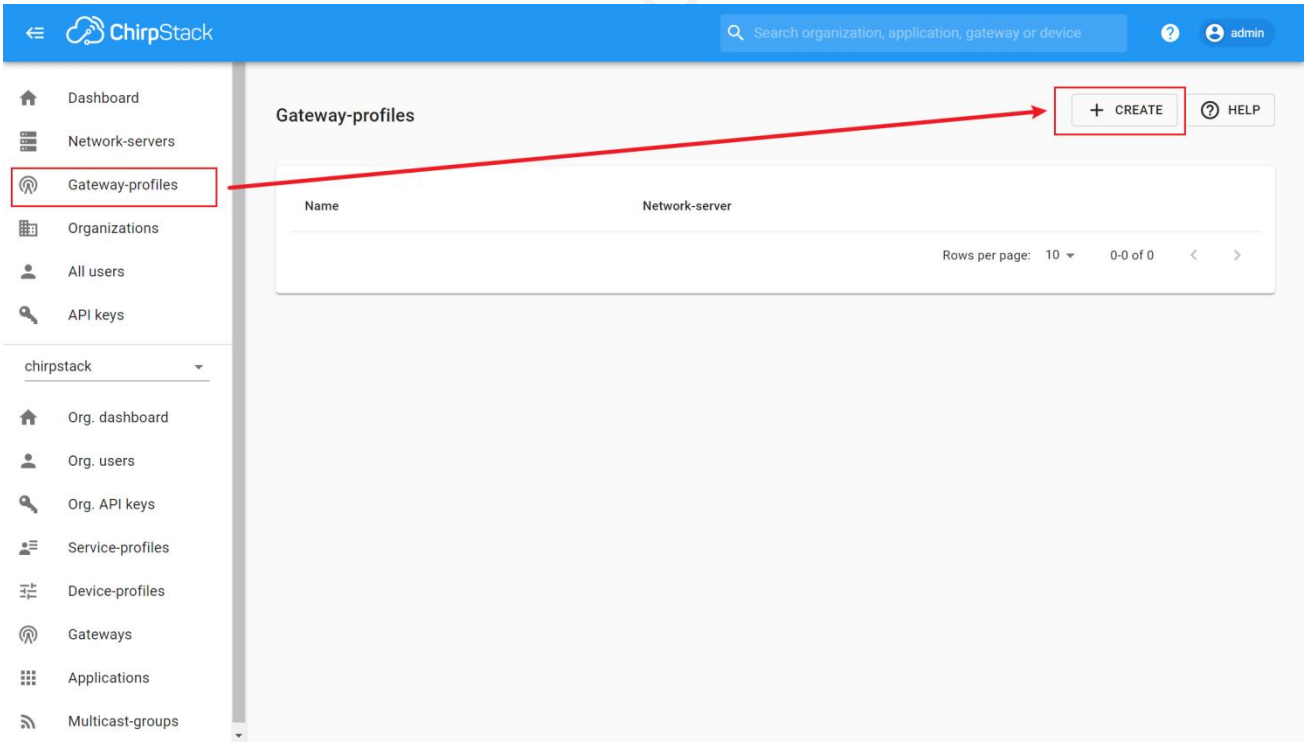


4.4.3 Create the Gateway-profiles



① Name: custom name.

② Enabled channels: 0, 1, 2

EU channels: 0, 1, 2

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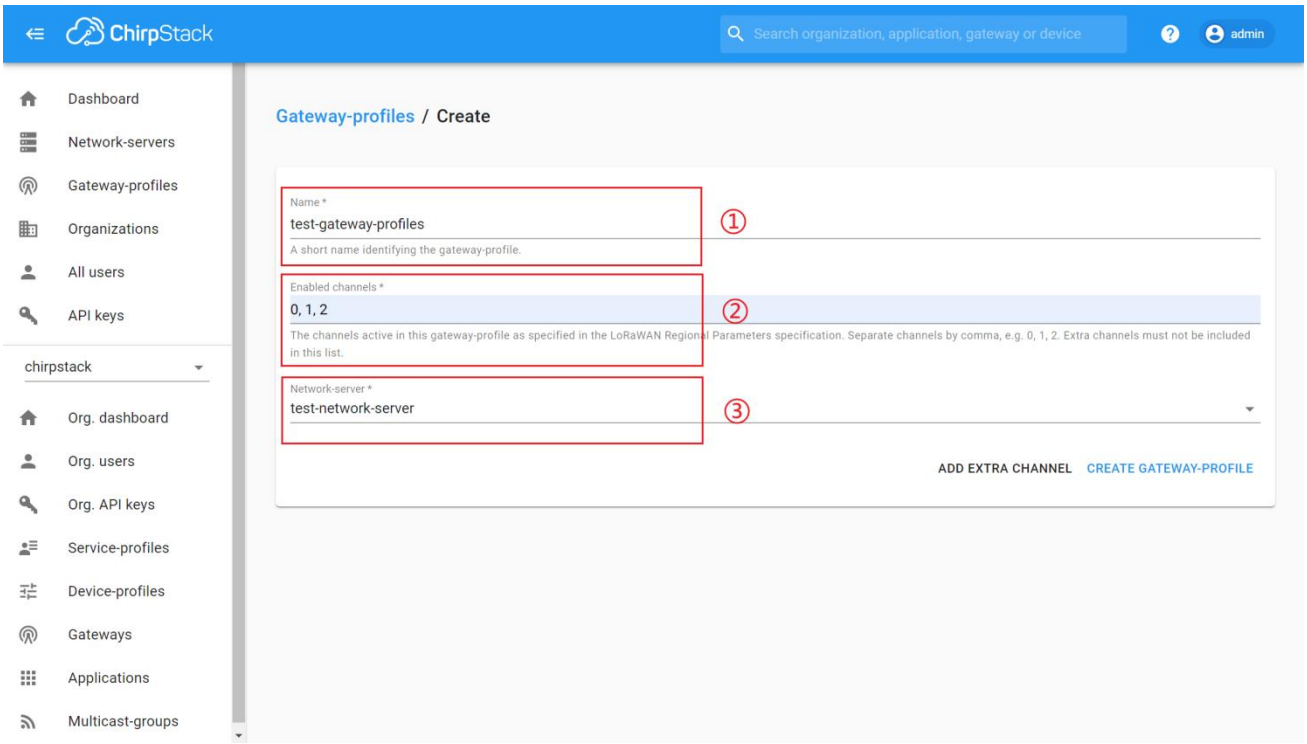
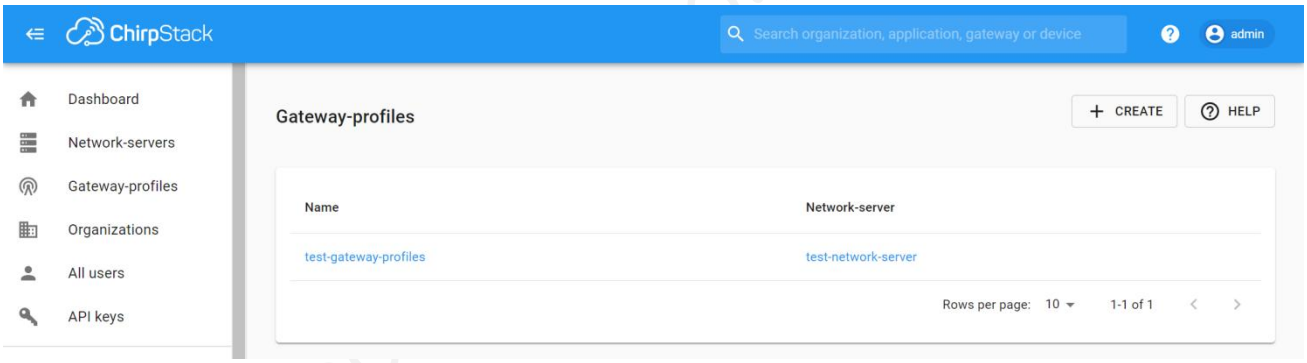
US902-923 channels (sub-band 2): 8, 9, 10, 11, 12, 13, 14, 15, 65

③ Network-server: select the Network-server you created earlier.



Click the “GREATE GATEWAY-PROFILE”.



4.4.4 Create the Service-profiles

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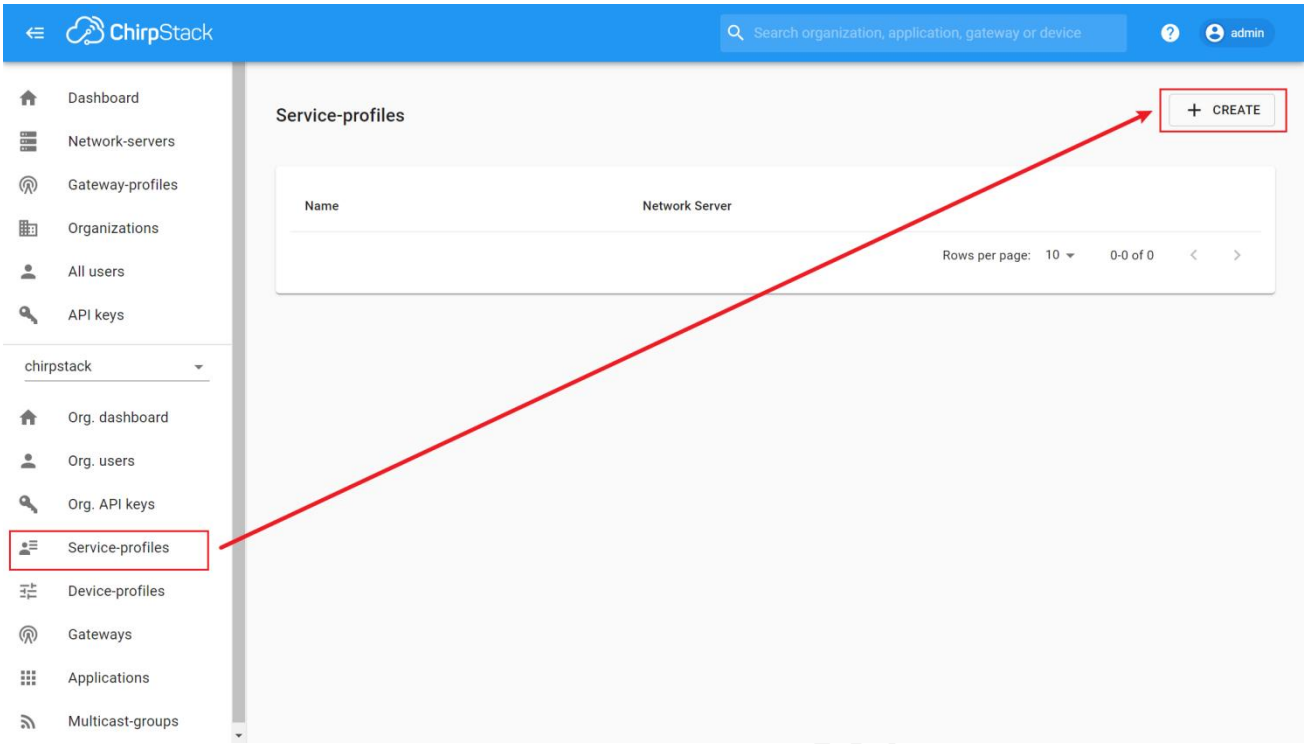

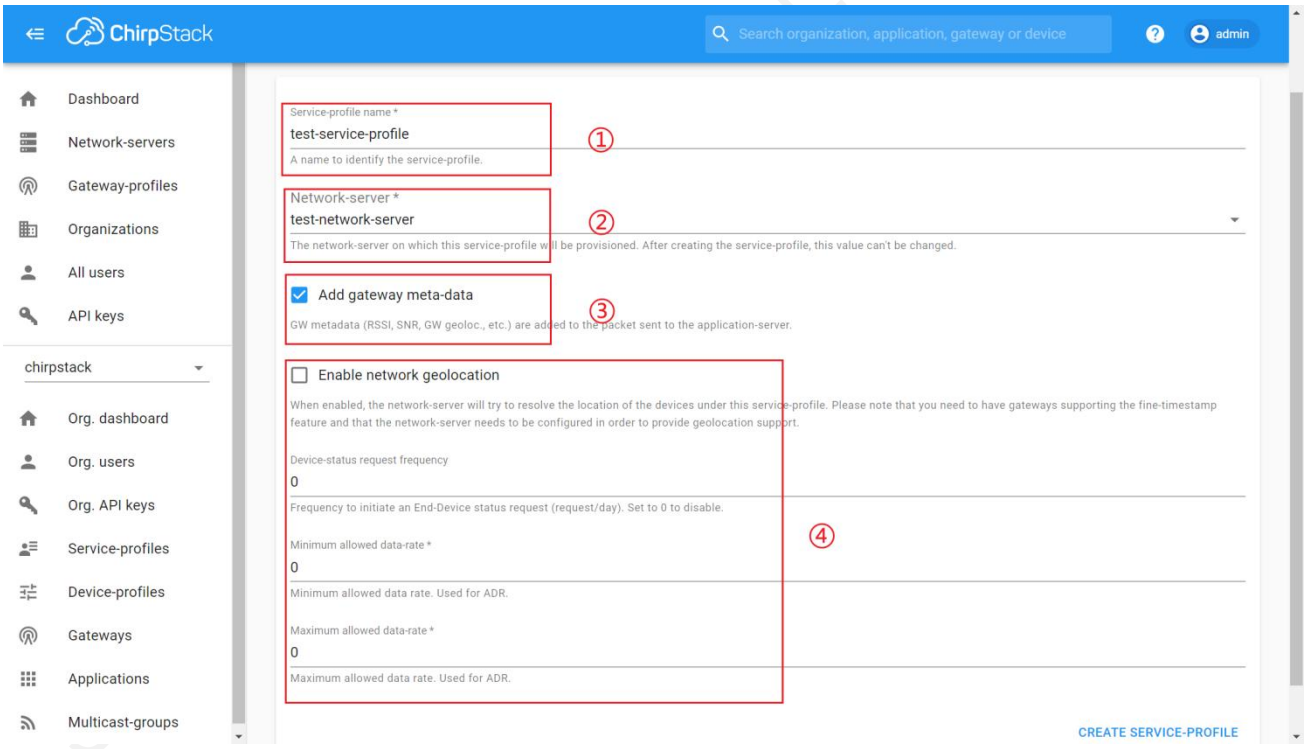

① Service-profile name: custom name.
② Network-server: select the Network-server you created earlier.
③ Add gateway meta-data: select it.
④ Default values are usually used.

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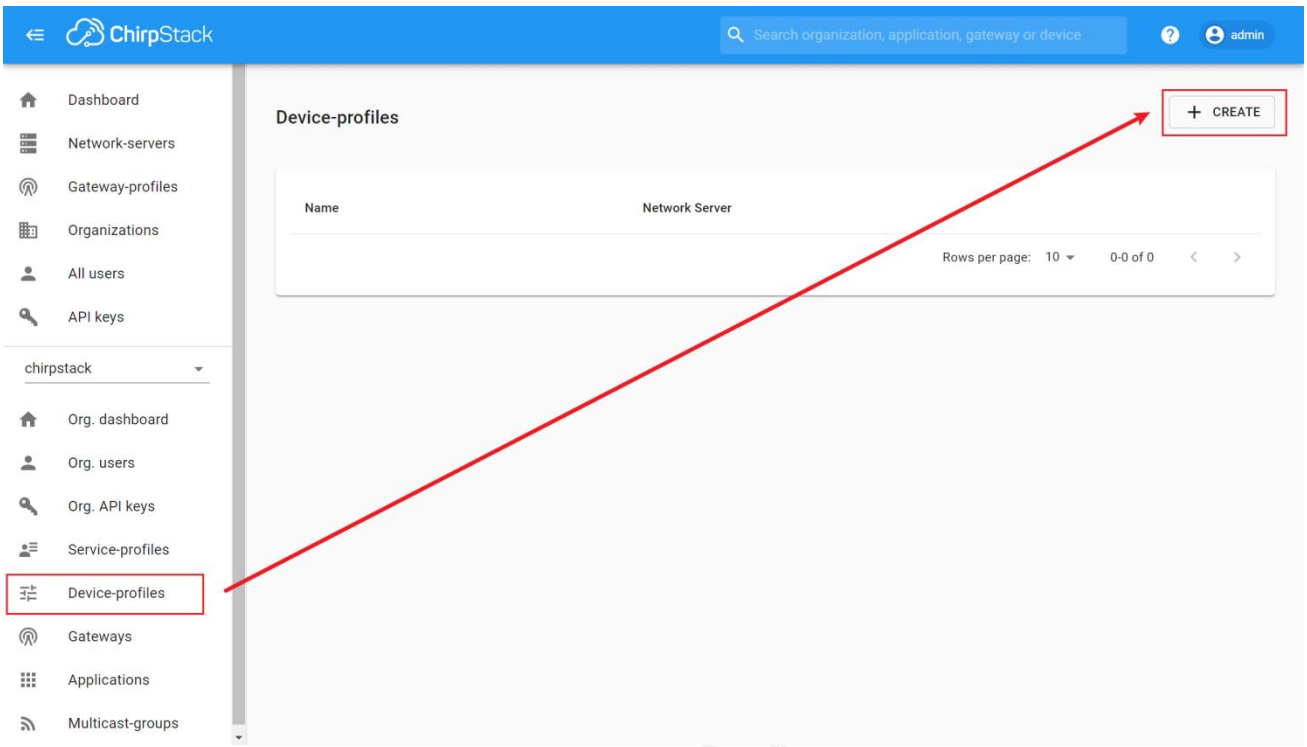
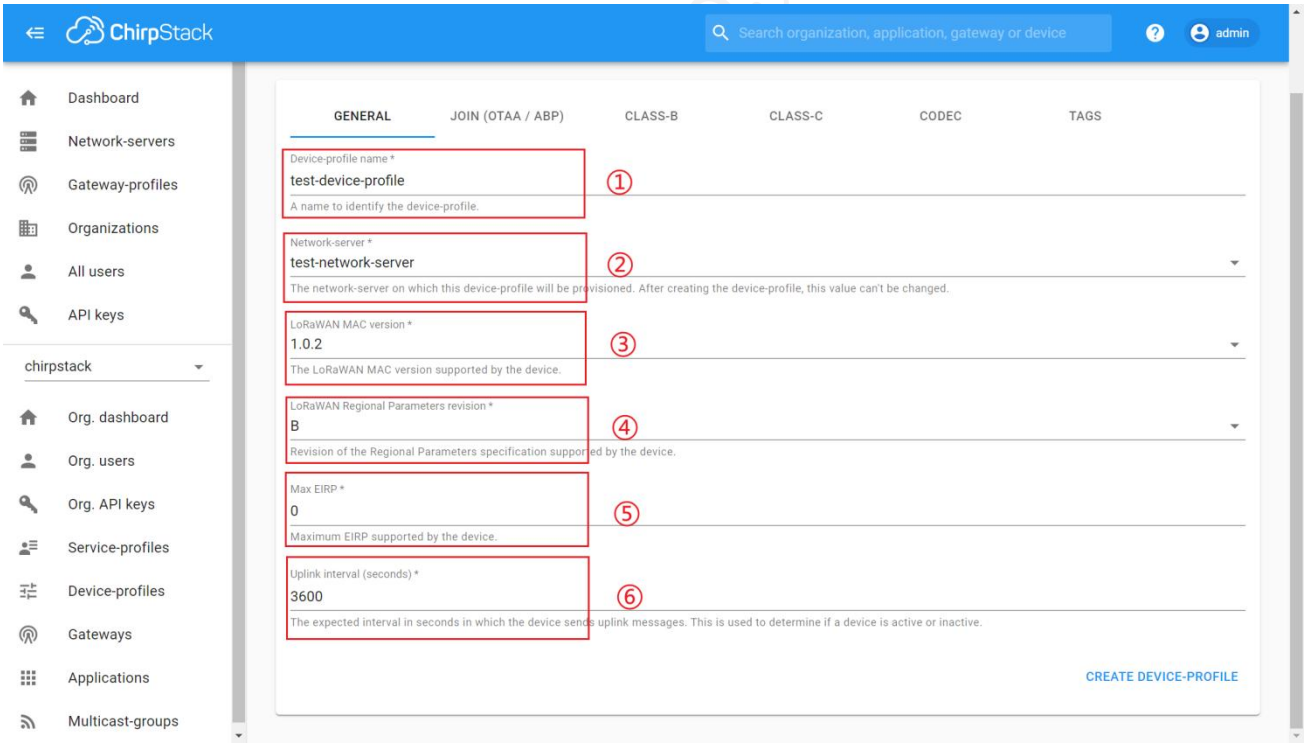
4.4.5 Create the Device-profiles





① Device-profile name: custom name.
② Network-server: select the Network-server you created earlier.
③ LoRaWAN MAC version: 1.0.2 (only for SenseCAP Node)
④ LoRaWAN Regional Parameters revision: B (only for SenseCAP Node)

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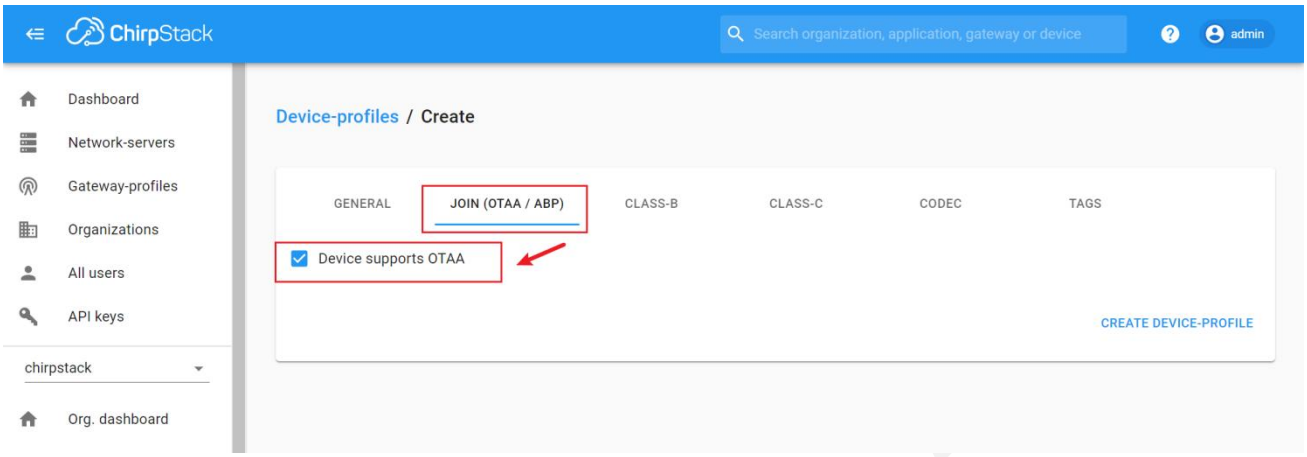
⑤ Max EIRP: 0

⑥ Uplink interval (seconds): 3600
Be consistent with the node's upload interval.

Click the “JOIN(OTAA/ABP)”, and select “Device supports OTAA”.



To get a SenseCAP Sensor Node on quick decoding, we provide a piece of code.

Click the “CODEC”, and select “Custom JavaScript codec functions”.

Then view https://github.com/Seeed-Solution/TTN-Payload-Decoder/blob/master/decoder.js , please copy the code to “function decode” FUNC.

```
function Decoder (bytes, port) {
  // init
  var bytesString = bytes2HexString(bytes)
        .toLocaleUpperCase();
…….

return binaryData.toString()
          .replace(/,/g, "");
}
```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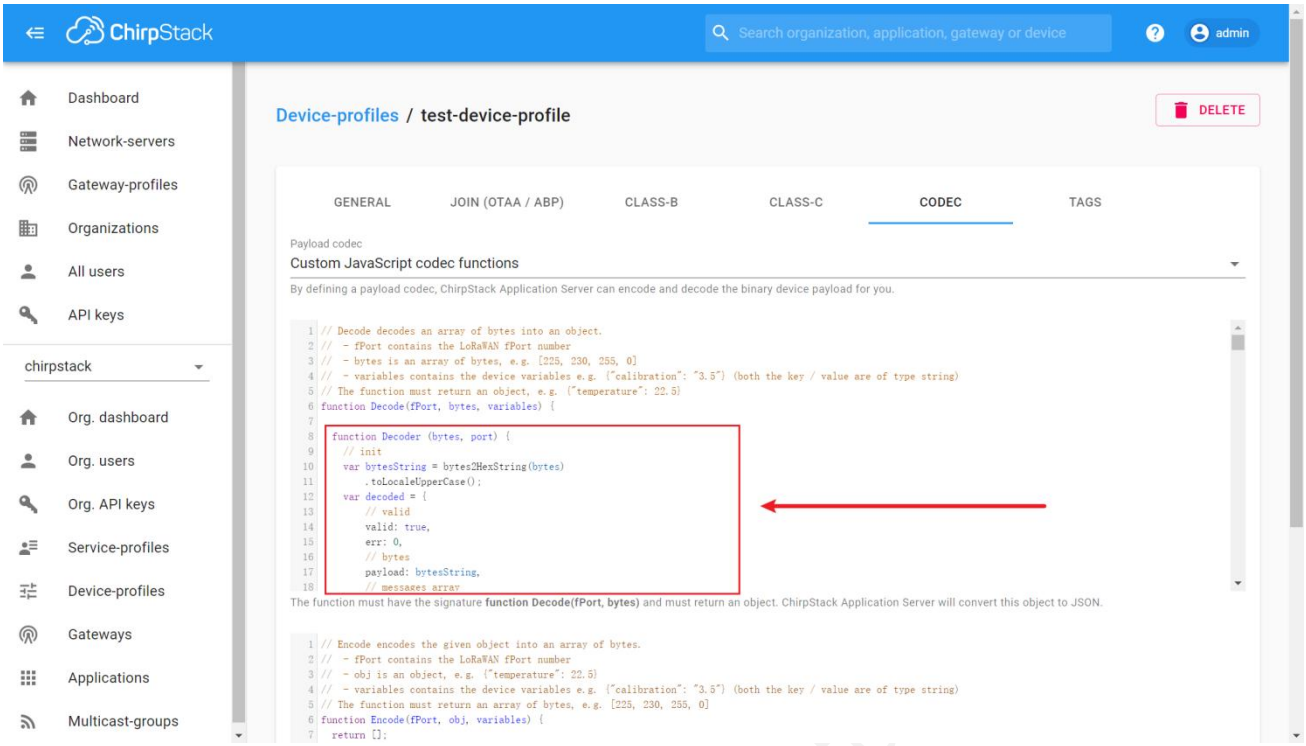
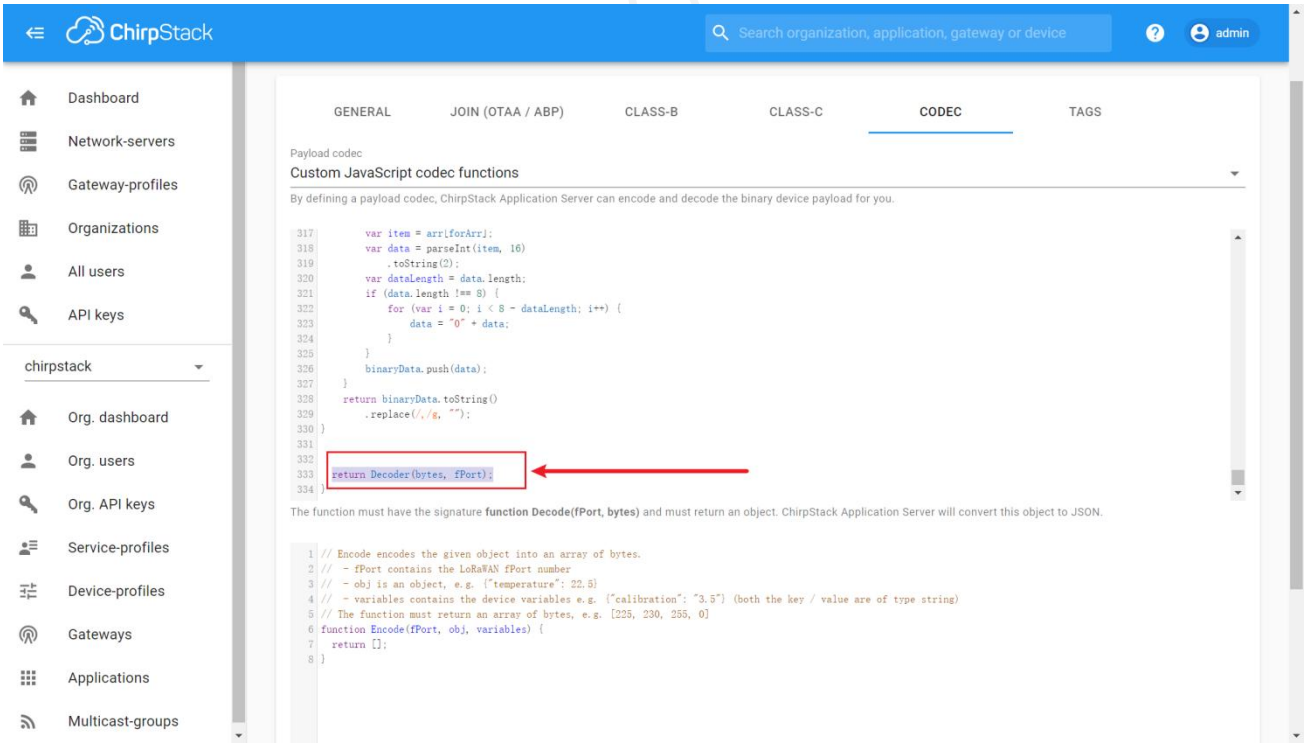


Add the return value at the end:

```
return Decoder(bytes, fPort);
```



Finally, click “Create”.

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5 Device Installation

In this chapter, we will introduce the gateway,its respective installation processes, as well as the dos and don’ts. Before installing, please check the part list to ensure nothing is missing.

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5.1 Part List

5.1.1 Gateway Part List

The LoRa Gateway comes with a standard antenna. If you need ultra-long-distance communication, you will need to purchase a high-gain fiberglass antenna.

Item	Name	Quantity
1	LoRa Gateway	1
2	LoRa Antenna	1
3	4G Antenna	1
4	Allen Hex Key	1
5	Mounts	4
6	Power Adapter	1
7	Power Extension Cable (5M)	1
8	Ferrules / Aluminum piece	2 / 2
9	M5 Self-drilling Screw	8
10	Antenna Lightning Protector (*Optional)	1
11	LoRa Fiberglass Omni Antenna (*Optional)	1
12	LoRa Antenna Brackets (*Optional)	1

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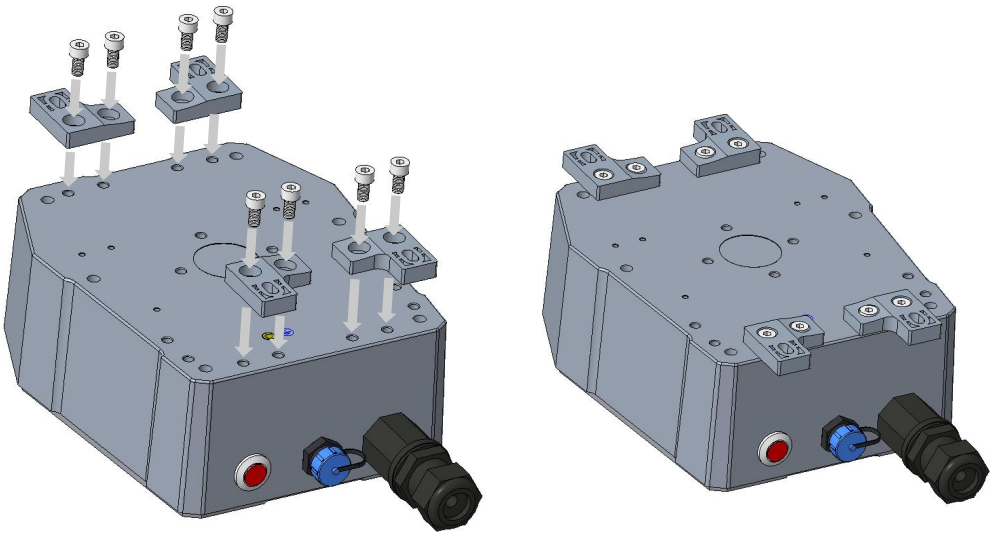
5.2 Gateway Installation

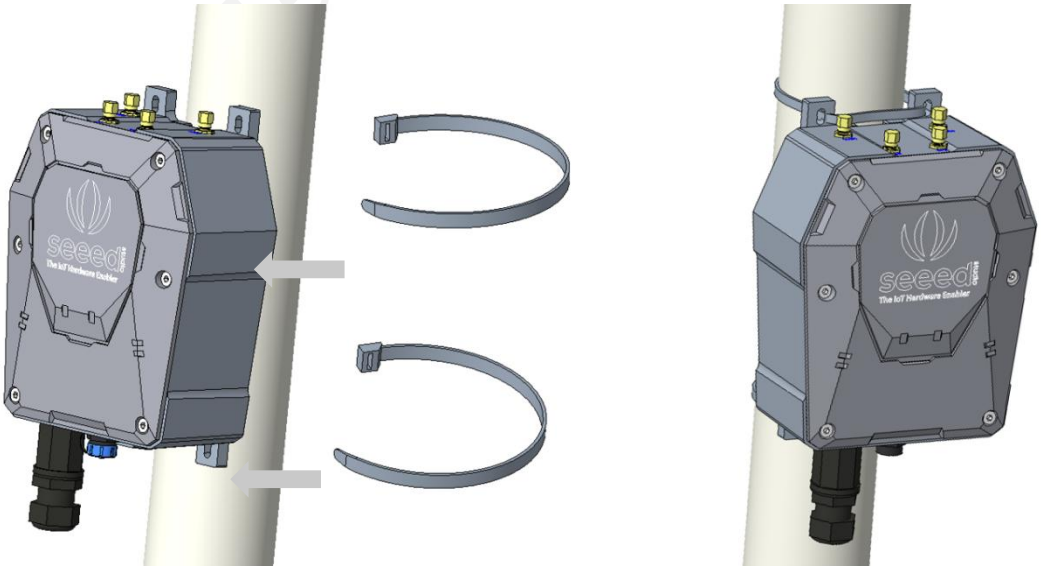
5.2.1 Gateway Installation Methods

- **Installing on a pole (Use the Mounts)**

Firstly, use M5 self-drilling screws (included in the package) to fasten the 4 brackets onto the gateway. And then use cable ties to fasten the gateway onto the pole. The recommended pole diameter is 70mm.



Put cable ties through the holes of the bracket and pull to fasten onto the pole. To get a better communication range, it is recommended to mount the gateway 3 meters above the ground. If there are tall buildings around, the gateway should be kept away from the building or mounted on top of the tall building.



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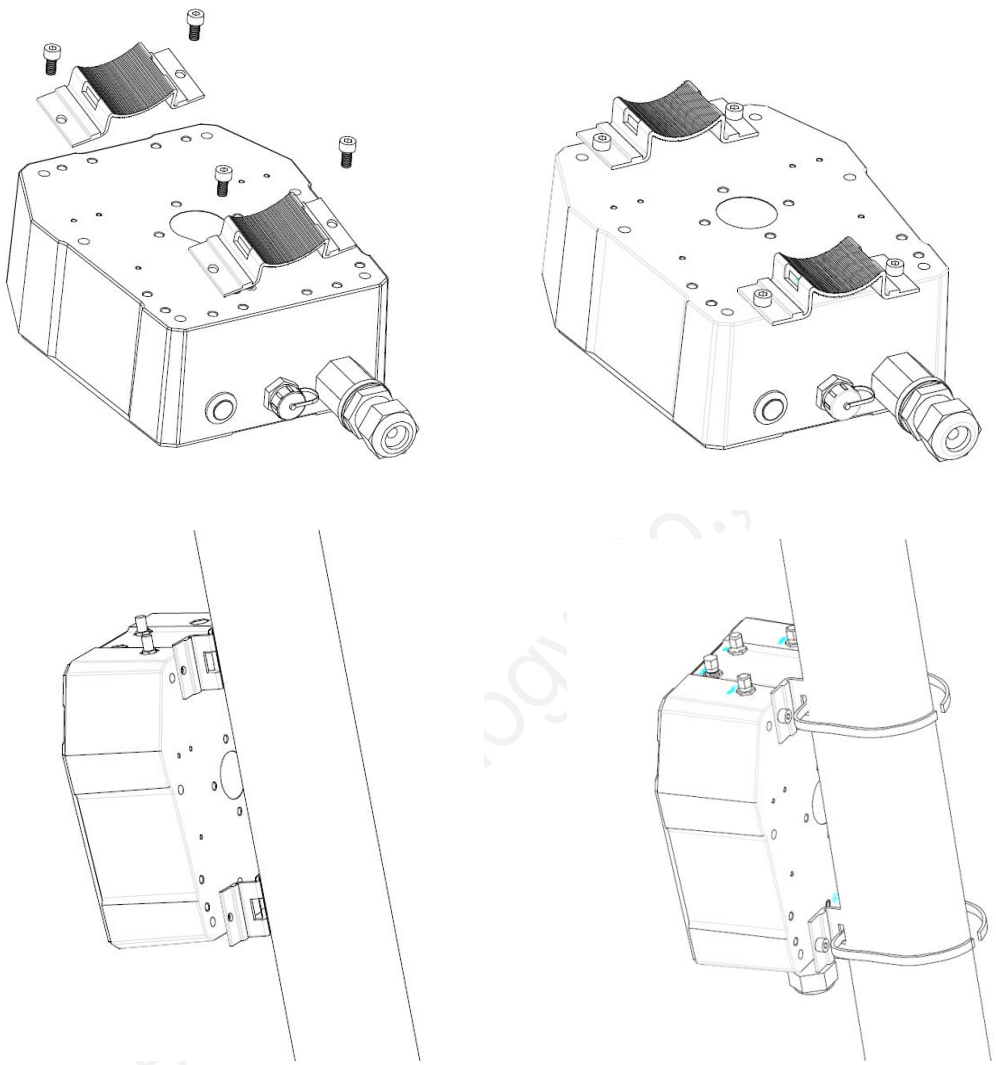
- **Installing on a pole (Use the Ferrules and Aluminum pieces)**

Firstly, use M5 self-drilling screws (included in the package) to fasten the 2 Aluminum pieces onto the gateway. And then use ferrules to fasten the gateway onto the pole. The recommended pole diameter is 76mm.



Note: If the pole is made of metal, the antenna should be pulled higher than the metallic part of the pole, or the communication signal will have interfered.

- **Installing on the Wall**

Firstly, use M5 self-drilling screws (included) to fasten the 4 brackets onto the enclosure of the gateway (refer to the image below for directions). And then fasten the gateway onto the wall with screws.

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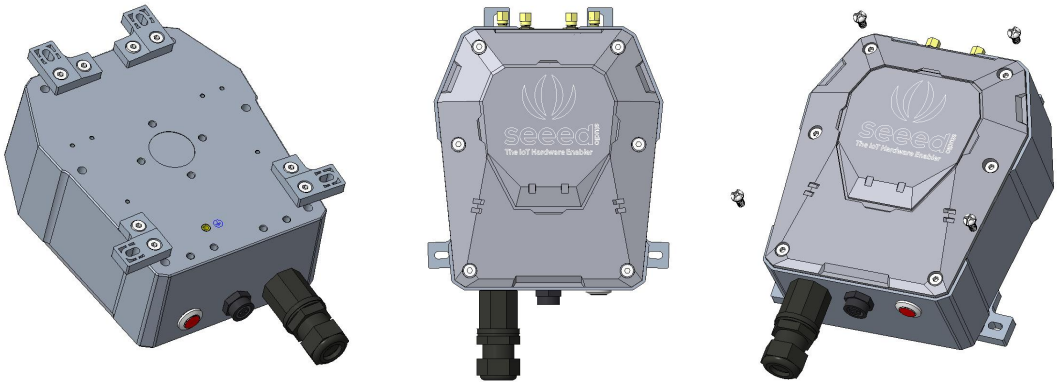
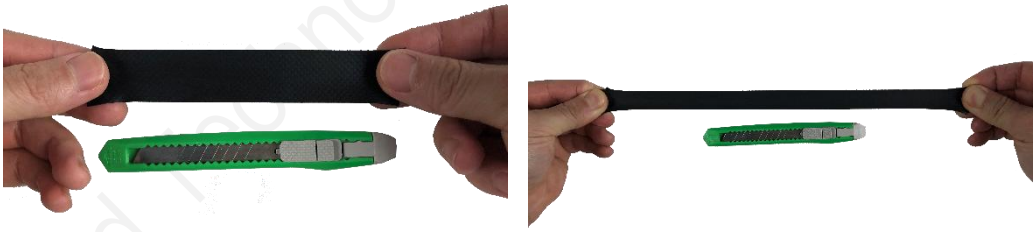


Note: The screws (that fasten gateway onto the wall) are not included in the package. Please prepare screws according to the wall materials (recommended screw diameter: 6mm).

5.2.2 Installation Precautions

1) In mountainous or thunderstorm-stricken areas, please take lightening protection measures. For the fiberglass LoRa antenna, you will need to install a lightening arrester and make sure it is connected to the ground. Besides, the gateway should be mounted lower than the lightening rod.

2) When installing the gateway in the outdoor environment, the connected part should be protected with waterproof tape, to enhance waterproof performance and lengthen device lifespan. As shown below, use self-adhesive tape to protect the connection. Take a rubber tape at the length of 10cm ~ 15cm, pull it to twice of that length



wind the tape clockwise to the connected part of the antenna.

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Note: The tape must be wound clockwise because the antenna is fastened clockwise. Otherwise, the antenna may loosen.

If the sensor has wires, install threaded tubes:

5.2.3 Installing Fiberglass LoRa Antenna

There are two kinds of LoRa antennas: the normal LoRa antenna (included in the package), and the fiberglass LoRa antenna (to be purchased separately). We will introduce how to install the fiberglass LoRa antenna.

1) Fasten the lightening arrester onto the antenna port.

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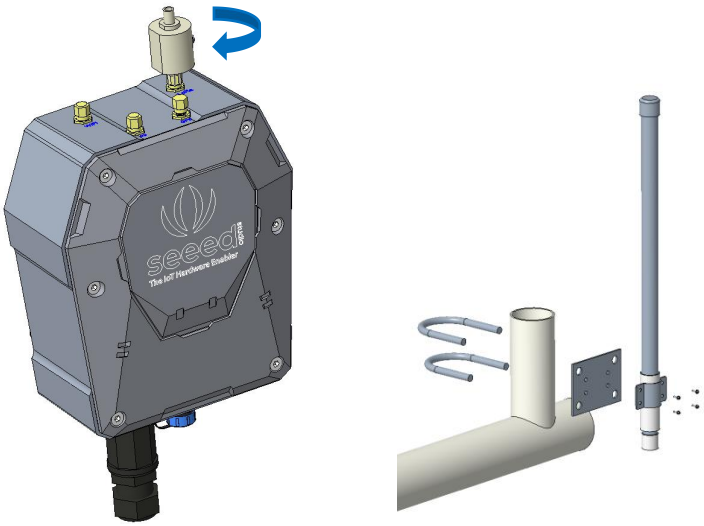
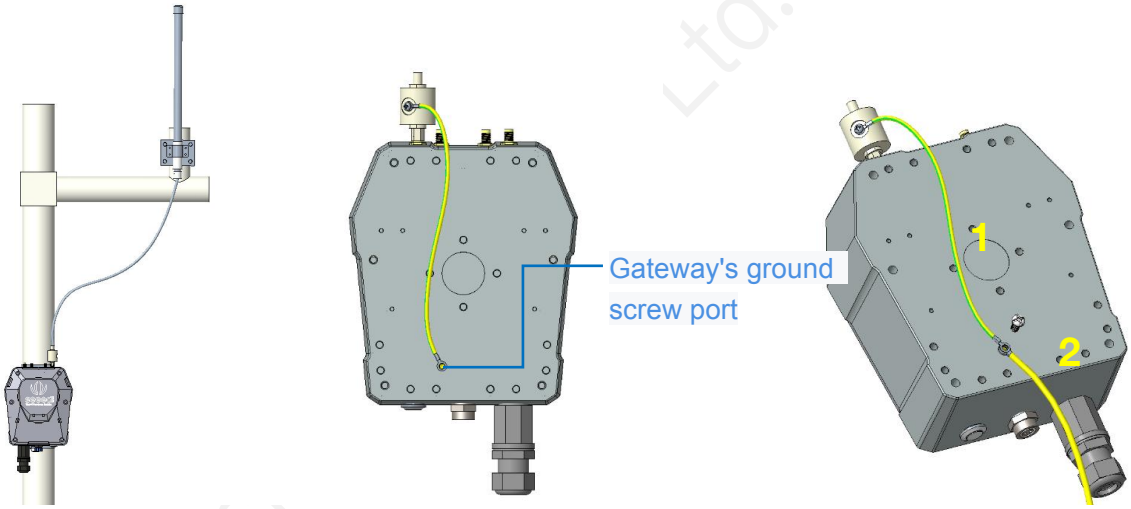


2) As shown in the image below, please fasten the fiberglass antenna onto the base part, and then fasten the whole part onto the vertical cylinder (maximum cylinder diameter: 50mm).

3) Use a 1-meter antenna feed line to connect the lightening arrester with the fiberglass antenna.



5.2.4 Installing Ground Cable

Here we will connect the lightening arrester to the GND screw port on the gateway with a ground cable, and then connect the whole device to the ground. The image below shows the location of the GND port at the backside of the gateway.

1) Prepare two copper cables, a shorter one (approx. 30cm) for connecting the lightening arrester with the GND screw port (on the gateway), and a longer one for connecting the device to the ground.

2) Fasten the lightening arrester to the short copper cable with screws, and then connect the two copper cables to the GND screw port. Use the screw to connect and fasten them.

3) Once the two cables are connected, connect the other end of the long cable to the ground. Depending on your actual installation environment, you can connect it to the ground directly or connect it to the copper ground bars.

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