RAK® Documentation Center

RAK7268 Supported LoRa Network Servers

Amazon Web Services (AWS)

Execute the following steps to set up your AWS account and permissions:

Set up Roles and Policies in IAM

Add an IAM Role for CUPS Server

Adding an IAM role will allow the Configuration and Update Server (CUPS) to handle the wireless gateway credentials.

This procedure needs to be done only once, but must be performed before a LoRaWAN gateway tries to connect with AWS IoT Core for LoRaWAN.

1. Go to the IAM Roles page on the IAM console.
2. Choose **Create role**.
3. On the Create Role page, choose **Another AWS account**.
4. Enter your **Account ID**, then select **Next: Permissions**.
5. In the search box next to the Filter Policies, type ***AWSIoTWirelessGatewayCertManager***.
    - If the search results show the policy named ***AWSIoTWirelessGatewayCertManager***, select it by clicking the checkbox.
    - If the policy does not exist, create one.
        - Go to the IAM console .
        - Choose **Policies** from the navigation pane.
        - Choose **Create Policy**, then select the **JSON** tab to open the policy editor.
        - Replace the existing template with trust policy document.

```json
{
"Version": "2012-10-17",
"Statement": [
{
"Sid": "IoTWirelessGatewayCertManager",
"Effect": "Allow",
"Action": [
"iot:CreateKeysAndCertificate",
"iot:DescribeCertificate",
"iot:ListCertificates",
"iot:RegisterCertificate"
         ],
"Resource": "*"
          }
      ]
}
```

    - Choose **Review Policy** to open the Review Page.
    - For the Name, type ***AWSIoTWirelessGatewayCertManager***.

> 📝 **NOTE:**
>
> You must enter the name as ***AWSIoTWirelessGatewayCertManager*** and must not use a different name. This is for consistency with future releases.

  - For the Description, enter a description of your choice.
  - Then choose **Create policy**. You will see a confirmation message showing the policy has been created.

6. Choose **Next: Tags**, then **Next: Review**.

7. In Role name, enter ***IoTWirelessGatewayCertManagerRole***, and then choose to **Create role**.

> 📝 **NOTE:**
>
> You must not use a different name. This is for consistency with future releases.

8. In the confirmation message, choose ***IoTWirelessGatewayCertManagerRole*** to edit the new role.
9. In the **Summary**, choose the **Trust relationships** tab, and then choose **Edit trust relationship**.
10. In the **Policy Document**, change the **Principal** property to represent the IoT Wireless service:

```json
"Principal": {
"Service": "iotwireless.amazonaws.com"
},
```

- After changing the Principal property, the complete policy document should look like the following:

```json
{
"Version": "2012-10-17",
"Statement": [
    {
"Effect": "Allow",
"Principal": {
"Service": "iotwireless.amazonaws.com"
        },
"Action": "sts:AssumeRole",
"Condition": {}
    }
    ]
}
```

11. Choose **Update Trust Policy** to save your changes and exit. At this point, you have created the ***IoTWirelessGatewayCertManagerRole*** and you won't need to do this again.

> 📝 **NOTE:**
>
> The examples in this document are intended only for dev environments. All devices in your fleet must have credentials with privileges that authorize only intended actions on specific resources. The specific permission policies can vary for your use case. Identify the permission policies that best meet your business and security requirements. For more information, refer to **Example Policies** and **Security Best Practices**

Add IAM Role for Destination to AWS IoT Core for LoRaWAN

Creating a Policy

Creating a policy gives the role permissions to describe the IoT endpoint and publish messages to AWS IoT.

1. Go to the IAM console .
2. Choose **Policies** from the navigation pane.
3. Choose **Create Policy**, then choose the **JSON** tab to open the policy editor. Replace the existing template with this trust policy document:

```json
{
"Version": "2012-10-17",
"Statement": [
   {
"Effect": "Allow",
"Action":
[
"iot:DescribeEndpoint",
"iot:Publish"
],
"Resource": "*"
   }
   ]
}
```

4. Choose **Review Policy** to open the Review page.
5. For **Name**, enter a name of your choice.
6. For **Description**, enter a description of your choice.
7. Choose **Create policy**. You will see a confirmation message indicating that the policy has been created.

Creating the Role

1. In the **IAM console**, choose **Roles** from the navigation pane to open the Roles page.
2. Choose **Create Role**.
3. In **Select type of trusted entity**, choose **Another AWS account**.
4. In **Account ID**, enter your AWS account ID, and then choose **Next: Permissions**.
5. Search for the **IAM policy** you just created by entering the policy name in the search bar.
6. In the search results, select the checkbox corresponding to the policy.
7. Choose **Next: Tags**.
8. Choose **Next: Review** to open the Review page.
9. For **Role name**, enter an appropriate name of your choice.
10. For **Description**, enter a description of your choice.
11. Choose **Create role**. You will see a confirmation message indicating that your role has been created.

Updating your Trust Policy

Update your role's trust relationship to grant AWS IoT Core for LoRaWAN permission to assume this IAM role when delivering messages from devices to your account.

1. In the IAM console, choose **Roles** from the navigation pane to open the Roles page.
2. Enter the name of the role you created earlier in the search window, and click on the role name in the search results. This opens up the Summary page.
3. Choose the **Trust relationships table** to navigate to the Trust relationships page.

4. Choose **Edit trust relationship**. The principal AWS role in your trust policy document defaults to root and must be changed. Replace the existing policy with this:

```json
{
"Version": "2012-10-17",
"Statement": [
{
"Sid": "",
"Effect": "Allow",
"Principal": {
"Service": "iotwireless.amazonaws.com"
},
"Action": "sts:AssumeRole",
"Condition": {}
   }
   ]
}
```

5. Choose **Update Trust Policy.** Under Trusted entities, you will see: *The identity provider(s) iotwireless.amazonaws.com*.

Add the Gateway to AWS IoT

Requirements

To complete setting up your gateway, you need the following:

- LoRaWAN region. For example, if the gateway is deployed in a US region, the gateway must support LoRaWAN region US915.
- Gateway LNS-protocols. Currently, the LoRa Basics Station protocol is supported.
- Gateway ID (GatewayEUI) or serial number. This is used to establish the connection between the LNS and the gateway. Consult the documentation for your gateway to locate this value.
- Add minimum software versions required, including Basics Station 2.0.5.

Add the LoRaWAN Gateway

To register the Gateway with AWS IoT Core for LoRaWAN, execute these steps:

1. Go to the AWS IoT console .
2. Select **Wireless connectivity** in the navigation panel on the left.
3. Choose **Intro**, and then choose **Get started**. This step is needed to pre-populate the default profiles.
4. Under **Add LoRaWAN gateways and wireless devices**, choose **Add gateway**.
5. In the **Add gateway section**, fill in the **GatewayEUI** and **Frequency band (RF Region)** fields.
6. Enter a descriptive name in the **Name** – optional field. It is recommended that you use the GatewayEUI as the name.
7. Choose **Add gateway**.
8. On the **Configure your Gateway** page, find the section titled **Gateway certificate**.
9. Select **Create certificate**.
10. Once the **Certificate created and associated with your gateway** message is shown, select **Download certificates** to download the certificate (*xxxxx.cert.pem*) and private key (*xxxxxx.private.key*).
11. In the section **Provisioning credentials**, choose **Download server trust certificates** to download the **CUPS (cups.trust)** and **LNS (lns.trust)** server trust certificates.
12. Copy the CUPS and LNS endpoints and save them for use while configuring the gateway.
13. Choose **Submit** to add the gateway.

Add a LoRaWAN Device to AWS IoT

Requirements:

- Locate and note the following specifications about your endpoint device.
  - **LoRaWAN Region**: This must match the gateway LoRaWAN region. The following Frequency bands (RF regions) are supported: o EU868 o US915 o EU433
  - **MAC Version**: This must be one of the following: o V1.0.2 o v1.0.3 o v1.1
  - OTAA v1.0x and OTAA v1.1 are supported.
  - ABP v1.0x and ABP v1.1 are supported.
- Locate and note the following information from your device manufacturer:
  - For OTAA v1.0x devices: DevEUI, AppKey, AppEUI
  - For OTAA v1.1 devices: DevEUI, AppKey, NwkKey, JoinEUI
  - For ABP v1.0x devices: DevEUI, DevAddr, NwkSkey, AppSkey
  - For ABP v1.1 devices: DevEUI, DevAddr, NwkSEnckey, FNwkSIntKey, SNwkSIntKey, AppSKey

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.

1. Navigate to the AWS IoT console . In the navigation pane, choose **Wireless connectivity**.
2. In the navigation pane, choose **Profiles**.
3. In the **Device Profiles** section, there are some pre-defined profiles listed.
4. Check each of the profiles to determine if one of them will work for you.
5. If not, select **Add device profile** and set up the parameters as needed. For US 915 as an example, the values are:
   - MacVersion 1.0.3
   - RegParamsRevision RP002-1.0.1
   - MaxEirp 10
   - MaxDutyCycle 10
   - RfRegion US915
   - SupportsJoin true
6. Continue once you have a device profile that will work for you.
7. In the **Service Profiles** section, there are some pre-defined profiles listed. Check each of the profiles to determine if one of them will work for you.
8. If not, select **Add service profile** and set up the parameters as needed. As an example, the default service profile parameters are shown below. However, only the ***AddGwMetadata*** setting can be changed at this time.
   - UlRate 60
   - UlBucketSize 4096
   - DlRate 60

- DlBucketSize 4096
- AddGwMetadata true
- DevStatusReqFreq 24
- DrMax 15
- TargetPer 5
- MinGwDiversity 1

9. Proceed only if you have a device and service profile that will work for you.

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 on Destinations, refer to the AWS LoRaWAN Developer Guide .

A destination consists of a Rule and a Role. To set up the destination, execute the following steps:

1. Navigate to the AWS IoT console . In the navigation pane, choose **Wireless connectivity**, and then **Destinations**.
2. Choose **Add Destination**.
3. On the Add destination page, in the **Permissions** section, select the IAM role you had created earlier, from the drop-down.
4. Under **Destination details**, enter ***ProcessLoRa*** as the Destination name, and an appropriate description under **Destination description – optional**.

> 📝 **NOTE:**
>
> The Destination name can be anything. For getting started and consistency, choose ProcessLoRa for the first integration with AWS IoT Core for LoRaWAN.

5. For **Rule name**, enter ***LoRaWANRouting***. Ignore the section **Rules configuration – Optional** for now. The Rule will be set up later in the "Hello World" sample application. See Create the IoT Rule for the destination.
6. Choose **Add Destination**. You will see a message "*Destination added*", indicating the destination has been successfully added.

Register the Device

Now, register an endpoint device with AWS IoT Core for LoRaWAN as follows:

1. Go to the AWS IoT console .
2. Select **Wireless connectivity** in the navigation panel on the left.
3. Select **Devices**, then choose **Add wireless device**.
4. On the **Add device** page, select the LoRaWAN specification version in the drop-down under **Wireless device specification**.
5. Under **LoRaWAN specification and wireless device configuration**, enter the **DevEUI** and confirm it in the **Confirm DevEUI** field.
6. Enter the remaining fields as per the OTAA/ABP choice you made above.
7. Enter a name for your device in the **Wireless device name – optional field**.
8. In the **Profiles** section, under **Wireless device profile**, find a drop-down option that corresponds to your device and region.

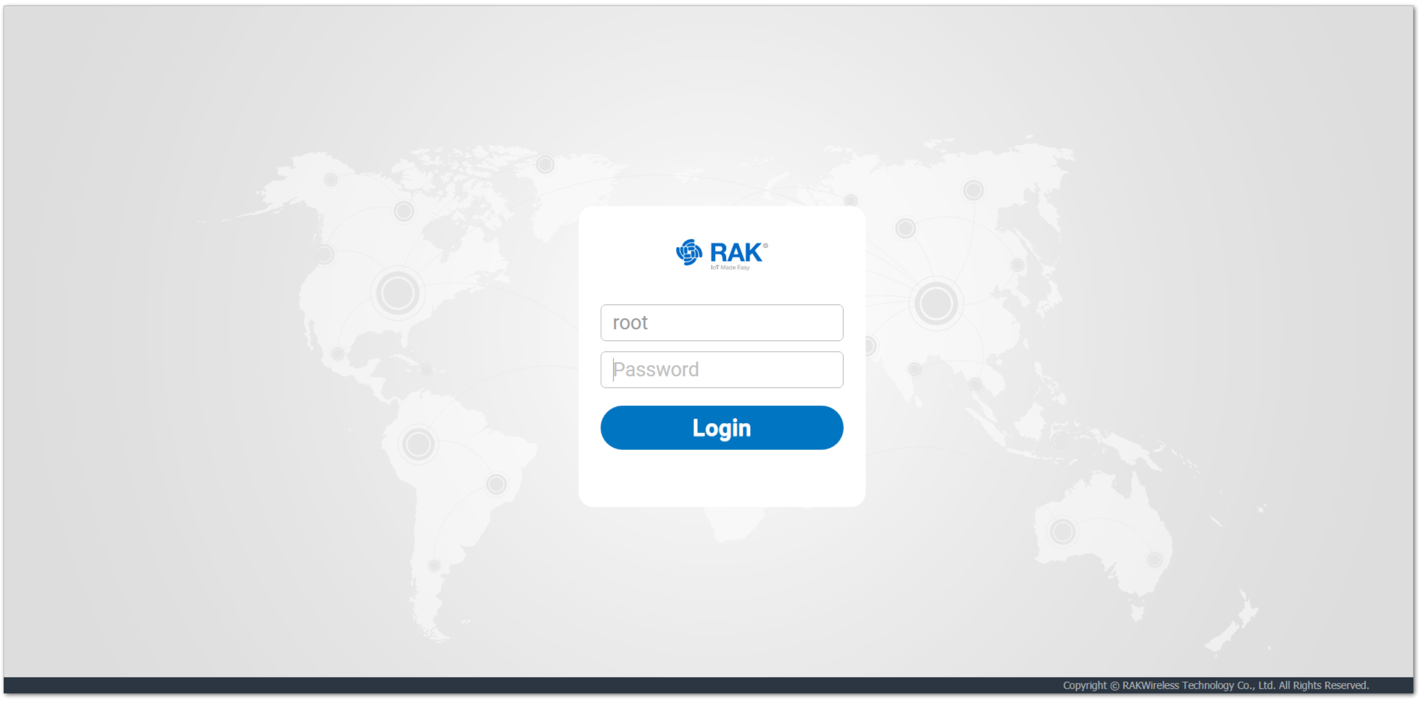
> 📝 **NOTE:**
>
> Compare your device details to ensure the device profile is correct. If there are no valid default options, you will have to create a new profile. See the Verify Profiles section.

9. Choose **Next**.
10. Choose the destination you created earlier (*ProcessLoRa*) from the drop-down under **Choose destination**.
11. Choose **Add device**.
12. You will see a message saying "*Wireless device added*", indicating that your device has been set up successfully.

Configure the Gateway Device

1. Using your preferred Web browser, input the aforementioned IP Address and you should see the same Log-in Page shown in the following image. Login the credentials provided below:

- Username: **root**
- Password: **root**



root

Password

RAK
Login
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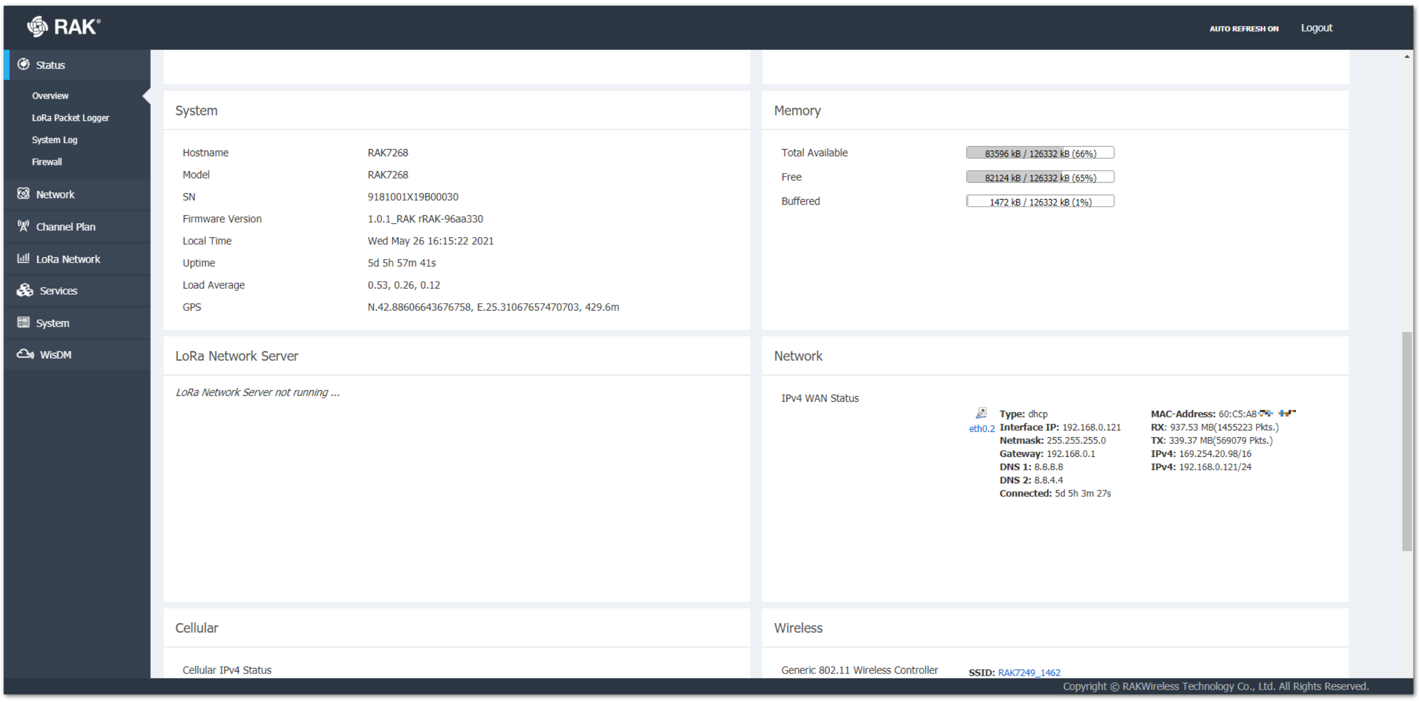
Figure 1: Web User Interface Log-in

2. The firmware version 1.0.1_RAK rRAK-96aa330 on the gateway supports AWS IoT Core for LoRaWAN, and it can be verified on **Status** > **Overview** > **System** > **Firmware Version**.



System

Hostname	RAK7268
Model	RAK7268
SN	9181001X19B00030
Firmware Version	1.0.1_RAK rRAK-96aa330
Local Time	Wed May 26 16:15:22 2021
Uptime	5d 5h 57m 41s
Load Average	0.53, 0.26, 0.12
GPS	N.42.88606643676758, E.25.31067657470703, 429.6m

Memory

Total Available	83596 kB / 126332 kB (66%)
Free	82124 kB / 126332 kB (65%)
Buffered	1472 kB / 126332 kB (1%)

LoRa Network Server

LoRa Network Server not running ...

Network

IPv4 WAN Status

eth0.2
Type: dhcp
Interface IP: 192.168.0.121
Netmask: 255.255.255.0
Gateway: 192.168.0.1
DNS 1: 8.8.8.8
DNS 2: 8.8.4.4
Connected: 5d 5h 3m 27s

MAC-Address: 60:C5:A8[redacted]
RX: 937.53 MB(1455223 Pkts.)
TX: 339.37 MB(569079 Pkts.)
IPv4: 169.254.20.98/16
IPv4: 192.168.0.121/24

Cellular

Cellular IPv4 Status

Wireless

Generic 802.11 Wireless Controller **SSID:** RAK7249_1462

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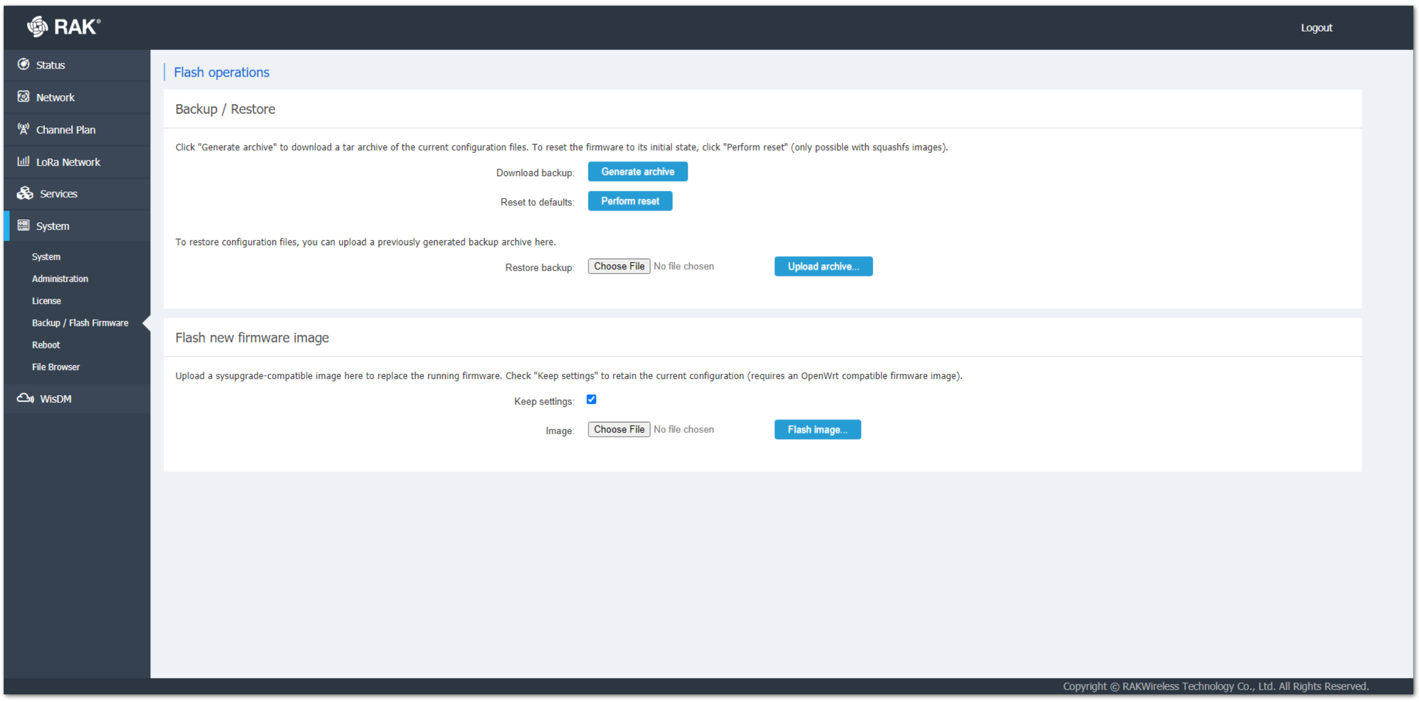
Figure 2: Checking the Firmware Version

3. If the firmware version is prior to 1.0.1_RAK rRAK-96aa330, upgrade the firmware. Navigate to **System** > **Backup/Flash Firmware** > **Flash new firmware image** > **Choose File** > **Flash Image...**.



Flash operations

Backup / Restore

Click "Generate archive" to download a tar archive of the current configuration files. To reset the firmware to its initial state, click "Perform reset" (only possible with squashfs images).

Download backup: Generate archive

Reset to defaults: Perform reset

To restore configuration files, you can upload a previously generated backup archive here.

Restore backup: Choose File No file chosen Upload archive...

Flash new firmware image

Upload a sysupgrade-compatible image here to replace the running firmware. Check "Keep settings" to retain the current configuration (requires an OpenWrt compatible firmware image).

Keep settings: ☑

Image: Choose File No file chosen Flash image...

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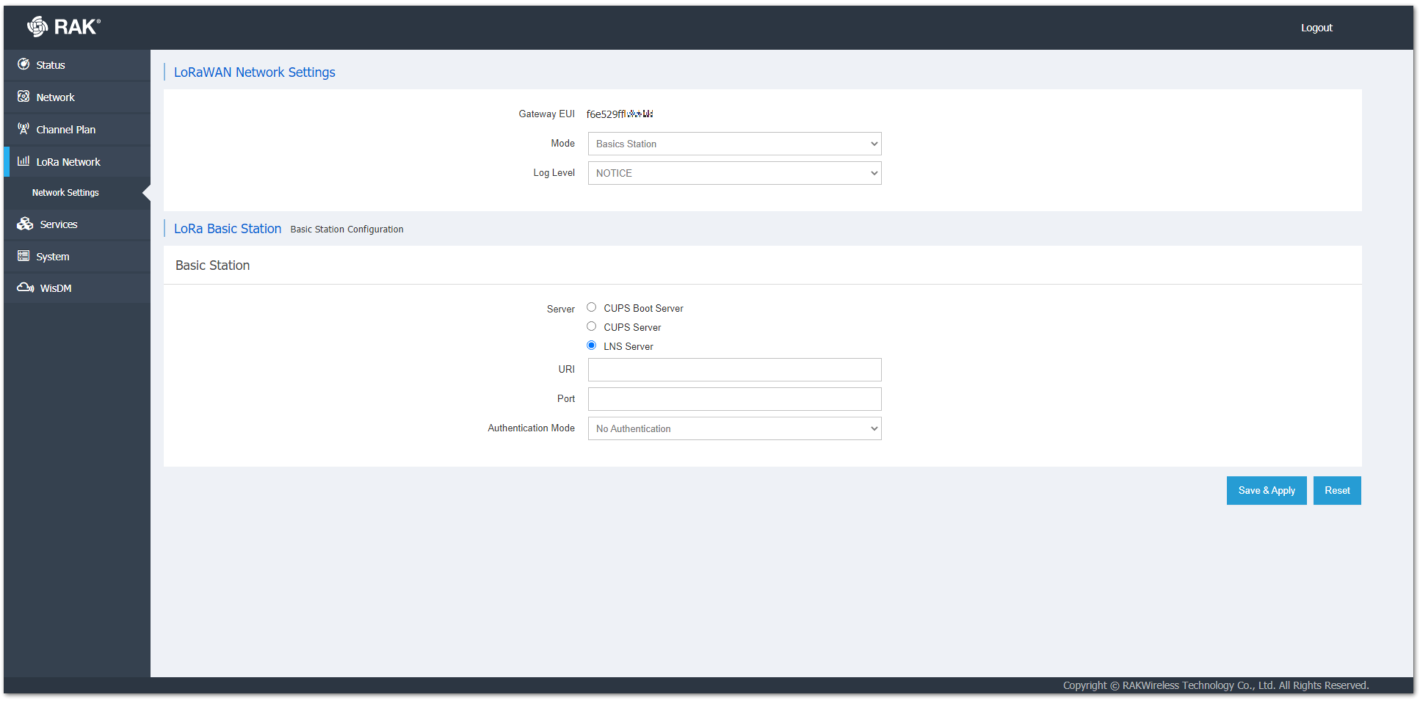
Figure 3: Flashing the Firmware

4. Configure Network Mode to Basics Station. Navigate to **LoRa Network** then **Network Settings**.
   - Change the Mode in LoRaWAN Network Settings to Basic Station.
   - Select **LNS Server** from Server, then choose **TLS Server and Client Authentication** from Authentication Mode.



RAK® Logout

- Status
- Network
- Channel Plan
- LoRa Network
  - Network Settings
- Services
- System
- WisDM

LoRaWAN Network Settings

Gateway EUI: f6e529ff[redacted]

Mode: Basics Station

Log Level: NOTICE

LoRa Basic Station Basic Station Configuration

Basic Station

Server: ○ CUPS Boot Server ○ CUPS Server ● LNS Server

URI:

Port:

Authentication Mode: No Authentication

Save & Apply Reset

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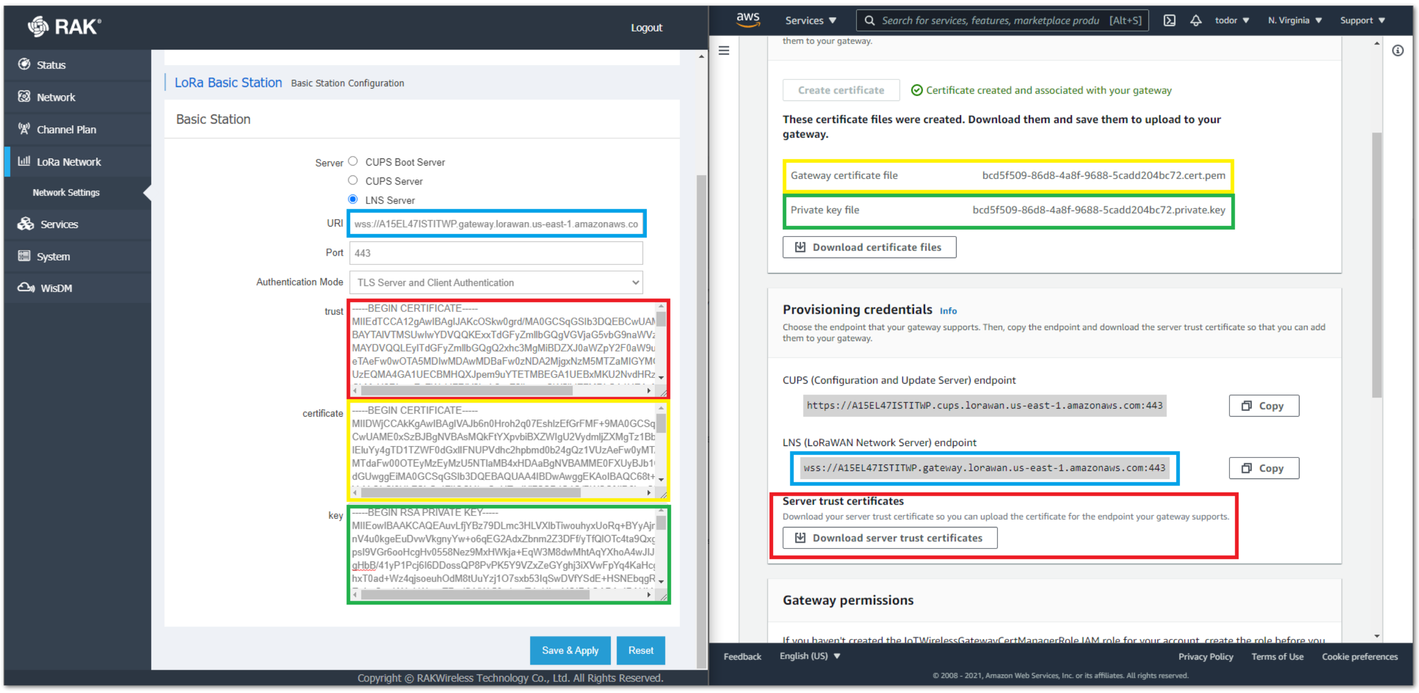
Figure 4: Configuring Network Mode to Basics Station

5. Configure URI, Port, and Authentication Mode.



RAK® Logout

- Status
- Network
- Channel Plan
- LoRa Network
  - Network Settings
- Services
- System
- WisDM

LoRa Basic Station Basic Station Configuration

Basic Station

Server: ○ CUPS Boot Server ○ CUPS Server ● LNS Server

URI: wss://A15EL47ISTITWP.gateway.lorawan.us-east-1.amazonaws.co

Port: 443

Authentication Mode: TLS Server and Client Authentication

trust:

```
-----BEGIN CERTIFICATE-----
MIIEdTCCA12gAwIBAgIJAKcOSkw0grd/MA0GCSqGSIb3DQEBCwUAM
BAYTAlVTMSUwIwYDVQQKExxTdGFyZmllbGQgVGVjaG5vbG9naWVz
MAYDVQQLEyITdGFyZmllbGQgQ2xhc3MgMiBDZXJ0aWZpY2F0aW9u
eTAeFw0wOTA5MDIwMDAwMDBaFw0zNDA2MjgxNzM5MTZaMIGYM
UzEQMA4GA1UECBMHQXJpem9uYTETMBEGA1UEBxMKU2NvdHRz
```

certificate:

```
-----BEGIN CERTIFICATE-----
MIIDWjCCAkKgAwIBAgIVAJb6n0Hroh2q07EshlzEfGrFMF+9MA0GCSq
CwUAME0xSzBJBgNVBAsMQkFtYXpvbiBXZWIgU2VydmljZXMgTz1Bb
IEluYy4gTD1TZWF0dGxlIFNUPVdhc2hpbmd0b24gQz1VUzAeFw0yMT
MTdaFw00OTEyMzEyMzU5NTlaMB4xHDAaBgNVBAMME0FXUyBJb1
dGUwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQC68t+
```

key:

```
-----BEGIN RSA PRIVATE KEY-----
MIIEowIBAAKCAQEAuvLfjYBz79DLmc3HLVXlbTiwouhyxUoRq+BYyAjr
nV4u0kgeEuDvwVkgnyYw+o6qEG2AdxZbnm2Z3DFf/yTfQIOTc4ta9Qxg
psI9VGr6ooHcgHv0558Nez9MxHWkja+EqW3M8dwMhtAqYXhoA4wJIJ
gHbB/41yP1Pcj6I6DDossQP8PvPK5Y9VZxZeGYghj3iXVwFpYq4KaHc
hxT0ad+Wz4qjsoeuhOdM8tUuYzj1O7sxb53IqSwDVfYSdE+HSNEbqgR
```

Save & Apply Reset

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them to your gateway.

Create certificate ✓ Certificate created and associated with your gateway

These certificate files were created. Download them and save them to upload to your gateway.

Gateway certificate file	bcd5f509-86d8-4a8f-9688-5cadd204bc72.cert.pem
Private key file	bcd5f509-86d8-4a8f-9688-5cadd204bc72.private.key

Download certificate files

Provisioning credentials Info

Choose the endpoint that your gateway supports. Then, copy the endpoint and download the server trust certificate so that you can add them to your gateway.

CUPS (Configuration and Update Server) endpoint

`https://A15EL47ISTITWP.cups.lorawan.us-east-1.amazonaws.com:443` Copy

LNS (LoRaWAN Network Server) endpoint

`wss://A15EL47ISTITWP.gateway.lorawan.us-east-1.amazonaws.com:443` Copy

Server trust certificates

Download your server trust certificate so you can upload the certificate for the endpoint your gateway supports.

Download server trust certificates

Gateway permissions

If you haven't created the IoTWirelessGatewayCertManagerRole IAM role for your account, create the role before you

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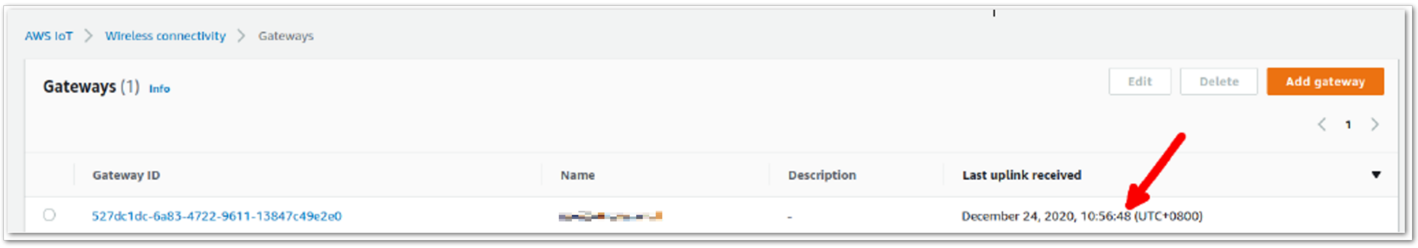
Figure 5: Configuring URI, Port, and Authentication Mode

6. Verifying Operation. Check if the gateway is online in AWS IoT console.



AWS IoT > Wireless connectivity > Gateways

Gateways (1) Info

Edit Delete Add gateway

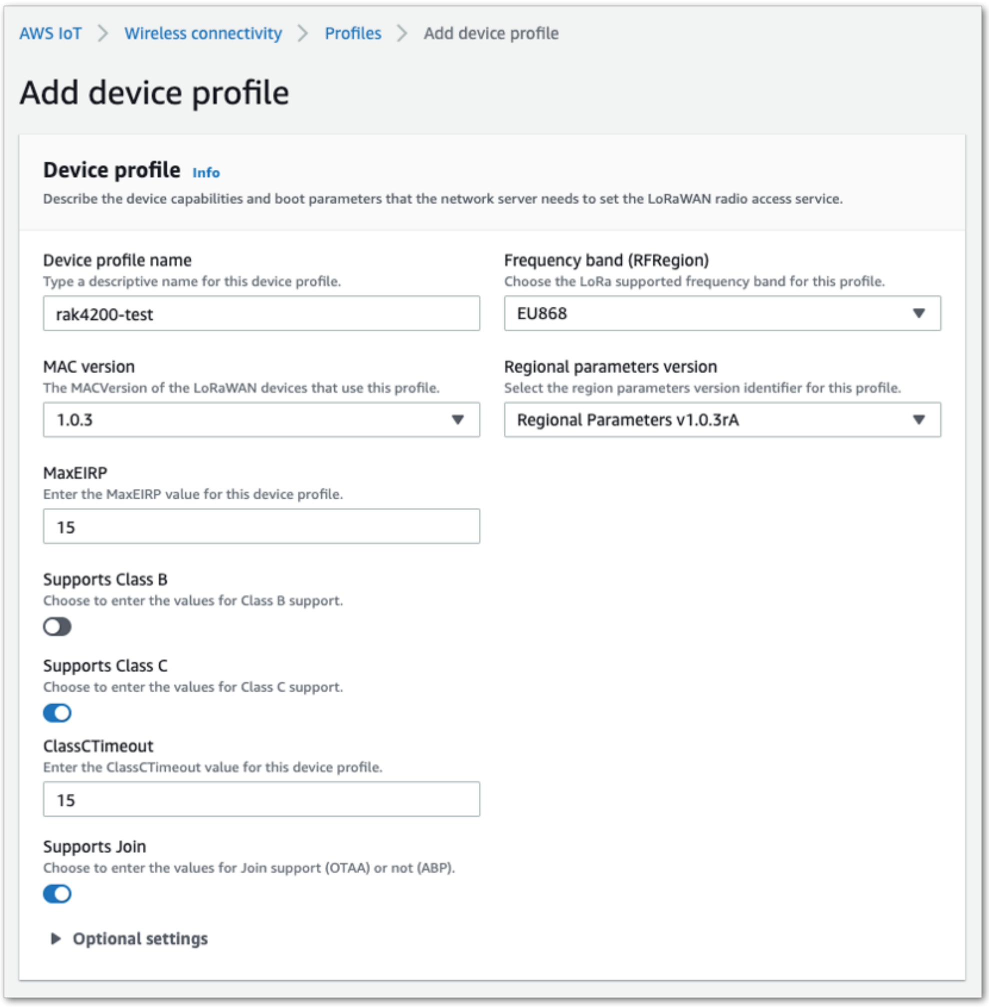
	Gateway ID	Name	Description	Last uplink received
○	527dc1dc-6a83-4722-9611-13847c49e2e0	[redacted]	-	December 24, 2020, 10:56:48 (UTC+0800)

Figure 6: Verifying Operation

Add End Devices

This section shows an example of how to join the AWS IoT LoRaWAN server.

1. Add Device Profile.



AWS IoT > Wireless connectivity > Profiles > Add device profile

Add device profile

Device profile Info

Describe the device capabilities and boot parameters that the network server needs to set the LoRaWAN radio access service.

Device profile name
Type a descriptive name for this device profile.
rak4200-test

Frequency band (RFRegion)
Choose the LoRa supported frequency band for this profile.
EU868

MAC version
The MACVersion of the LoRaWAN devices that use this profile.
1.0.3

Regional parameters version
Select the region parameters version identifier for this profile.
Regional Parameters v1.0.3rA

MaxEIRP
Enter the MaxEIRP value for this device profile.
15

Supports Class B
Choose to enter the values for Class B support.

Supports Class C
Choose to enter the values for Class C support.

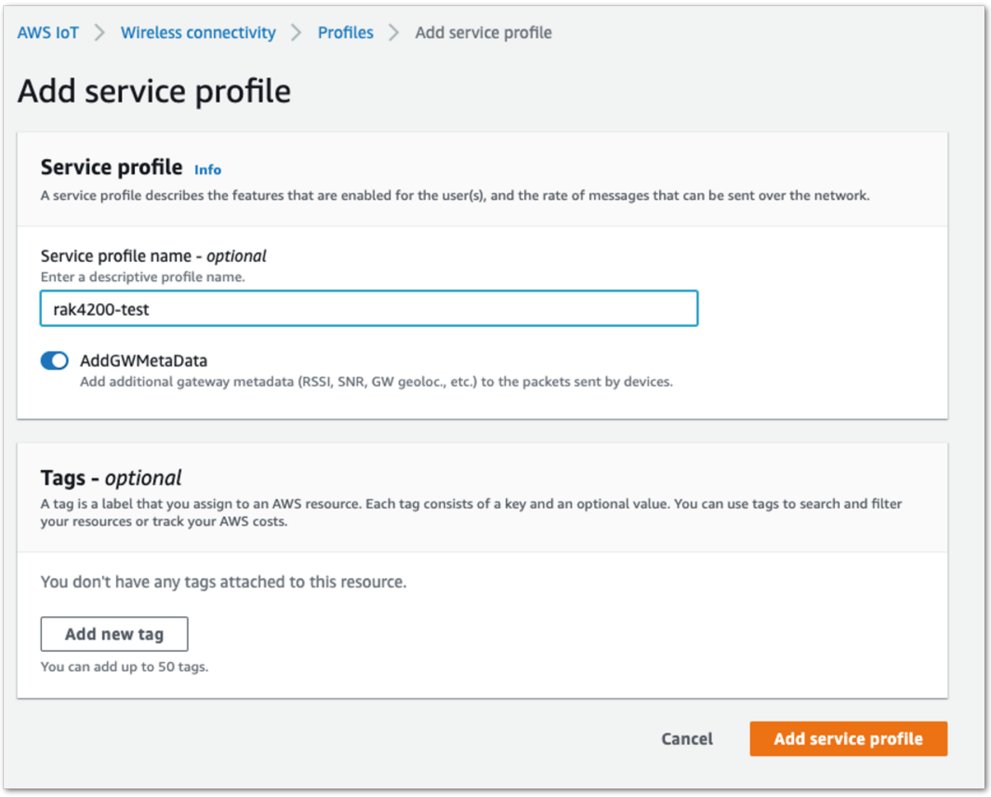
ClassCTimeout
Enter the ClassCTimeout value for this device profile.
15

Supports Join
Choose to enter the values for Join support (OTAA) or not (ABP).

▶ Optional settings

Figure 7: Adding the Device Profile

2. Add Service Profile.



AWS IoT > Wireless connectivity > Profiles > Add service profile

Add service profile

Service profile Info

A service profile describes the features that are enabled for the user(s), and the rate of messages that can be sent over the network.

Service profile name - *optional*
Enter a descriptive profile name.
rak4200-test

AddGWMetaData
Add additional gateway metadata (RSSI, SNR, GW geoloc., etc.) to the packets sent by devices.

Tags - *optional*

A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.

You don't have any tags attached to this resource.

Add new tag

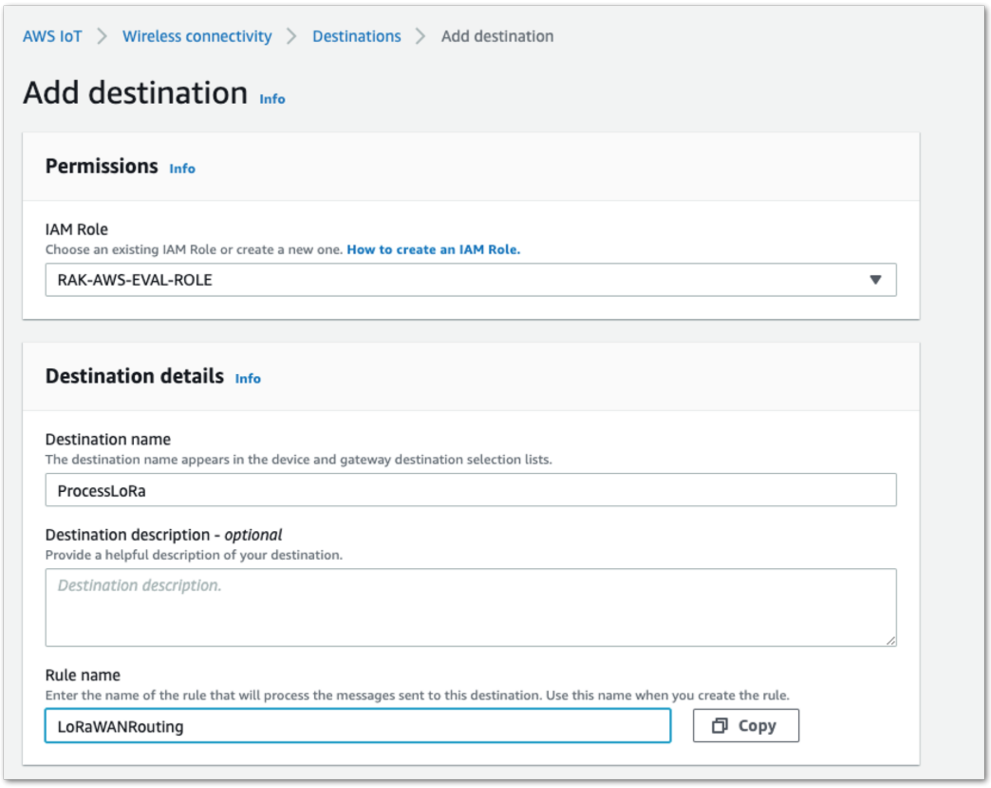
You can add up to 50 tags.

Cancel | Add service profile

Figure 8: Adding the Service Profile

3. Add Destination.

Before adding the destination, follow the Add IAM role for Destination to AWS IoT Core for LoRaWAN section to configure IAM policy and role.



AWS IoT > Wireless connectivity > Destinations > Add destination

Add destination Info

Permissions Info

IAM Role
Choose an existing IAM Role or create a new one. How to create an IAM Role.
RAK-AWS-EVAL-ROLE

Destination details Info

Destination name
The destination name appears in the device and gateway destination selection lists.
ProcessLoRa

Destination description - *optional*
Provide a helpful description of your destination.
Destination description.

Rule name
Enter the name of the rule that will process the messages sent to this destination. Use this name when you create the rule.
LoRaWANRouting

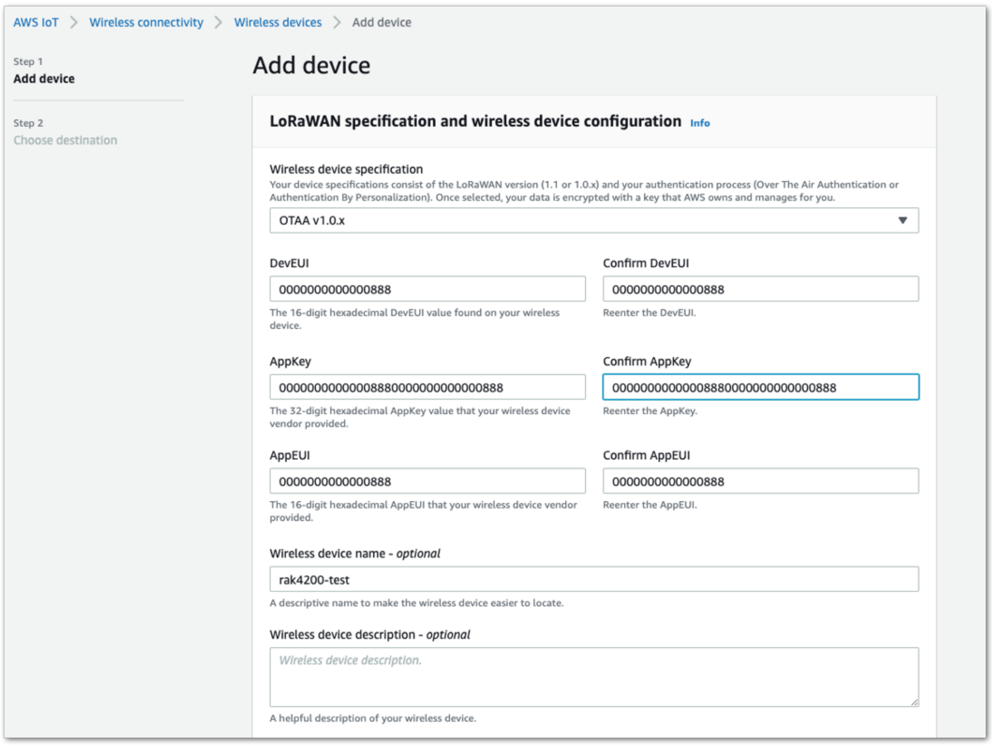
Figure 9: Adding Destination

4. Add Device.

Before adding a device to AWS IoT, retrieve the **DevEui**, **AppEui**, and **AppKey** from the end Device's console. You can use AT command `at+get_config=lora:status` to obtain the information.

For more AT commands, refer to the **RAK4200 AT Command Manual**.

```
at+get_config=lora:status\r\n
OK Work Mode: LoRaWAN
Region: EU868
Send_interval: 600s
Auto send status: false.
MulticastEnable: true.
Multi_Dev_Addr: 260111FD
Multi_Apps_Key: F13DDFA2619B10411F02F042E1C0F356
Multi_Nwks_Key: 1D1991F5377C675879C39B6908D437A6
Join_mode: OTAA
DevEui: 0000000000000888
AppEui: 0000000000000888
AppKey: 00000000000008880000000000000888
Class: C
Joined Network:false
IsConfirm: unconfirm
AdrEnable: true
EnableRepeaterSupport: false
RX2_CHANNEL_FREQUENCY: 869525000, RX2_CHANNEL_DR:0
RX_WINDOW_DURATION: 3000ms
RECEIVE_DELAY_1: 1000ms
RECEIVE_DELAY_2: 2000ms
JOIN_ACCEPT_DELAY_1: 5000ms
JOIN_ACCEPT_DELAY_2: 6000ms
Current Datarate: 4
Primeval Datarate: 4
ChannelsTxPower: 0
UpLinkCounter: 0
DownLinkCounter: 0
```



AWS IoT > Wireless connectivity > Wireless devices > Add device

Step 1
Add device

Step 2
Choose destination

Add device

LoRaWAN specification and wireless device configuration Info

Wireless device specification
Your device specifications consist of the LoRaWAN version (1.1 or 1.0.x) and your authentication process (Over The Air Authentication or Authentication By Personalization). Once selected, your data is encrypted with a key that AWS owns and manages for you.
OTAA v1.0.x ▼

DevEUI: 0000000000000888
The 16-digit hexadecimal DevEUI value found on your wireless device.

Confirm DevEUI: 0000000000000888
Reenter the DevEUI.

AppKey: 00000000000008880000000000000888
The 32-digit hexadecimal AppKey value that your wireless device vendor provided.

Confirm AppKey: 00000000000008880000000000000888
Reenter the AppKey.

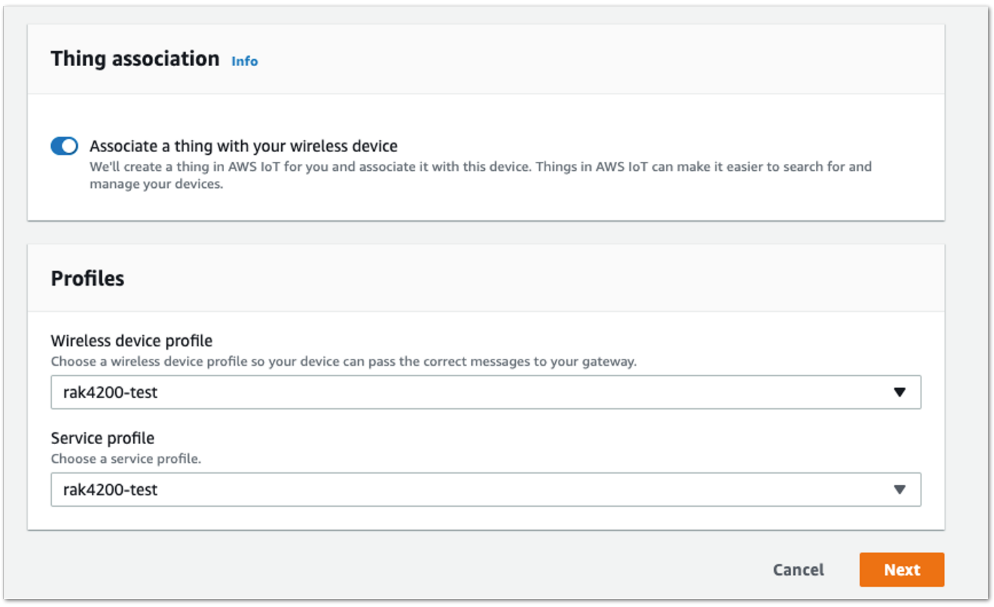
AppEUI: 0000000000000888
The 16-digit hexadecimal AppEUI that your wireless device vendor provided.

Confirm AppEUI: 0000000000000888
Reenter the AppEUI.

Wireless device name - *optional*: rak4200-test
A descriptive name to make the wireless device easier to locate.

Wireless device description - *optional*: *Wireless device description.*
A helpful description of your wireless device.

Figure 10: LoRaWAN Specifications and Wireless Device Configuration



Thing association Info

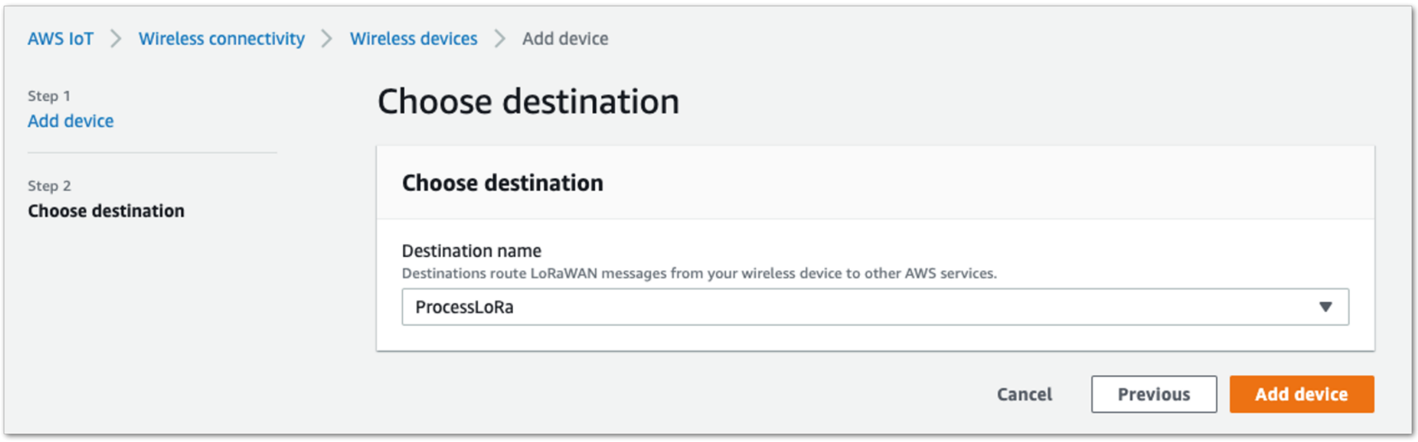
● Associate a thing with your wireless device
We'll create a thing in AWS IoT for you and associate it with this device. Things in AWS IoT can make it easier to search for and manage your devices.

Profiles

Wireless device profile
Choose a wireless device profile so your device can pass the correct messages to your gateway.
rak4200-test ▼

Service profile
Choose a service profile.
rak4200-test ▼

Figure 11: Choosing a Wireless Device Profile



AWS IoT > Wireless connectivity > Wireless devices > Add device

Step 1
Add device

Step 2
Choose destination

Choose destination

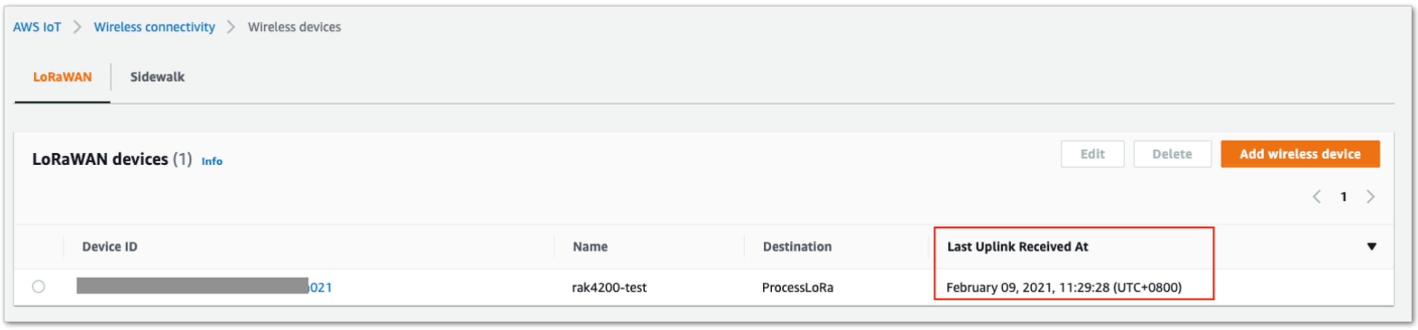
Choose destination

Destination name
Destinations route LoRaWAN messages from your wireless device to other AWS services.
ProcessLoRa ▼

Figure 12: Choosing a Destination

5. Restart the end Device, and it should join the AWS IoT LoRaWAN server.

```
EVENT:0:STARTUP
SYSLOG:4:OTAA Join Request
SYSLOG:4:OTAA Join Success
EVENT:1:JOIN_NETWORK
SYSLOG:4:LoRa Tx :
```



AWS IoT > Wireless connectivity > Wireless devices

LoRaWAN | Sidewalk

LoRaWAN devices (1) Info

Edit | Delete | Add wireless device

	Device ID	Name	Destination	Last Uplink Received At
○	[redacted]021	rak4200-test	ProcessLoRa	February 09, 2021, 11:29:28 (UTC+0800)

Figure 13: Choosing a Destination

6. Use the AT command `at+send:lora:1:1234567890` to send an uplink message.

Here is the console log after sending uplink message:

```
1
OK
SYSLOG:4:LoRa Tx : 1234567890
EVENT:3:LORA_TX_DONE:1:OK
```

Verifying Operation

Once setup is completed, provisioned OTAA devices can join the network and start to send messages. Messages from devices can then be received by AWS IoT Core for LoRaWAN and forwarded to the IoT Rules Engine.

Instructions for a sample Hello World application are given below, assuming that the device has joined and is capable of sending uplink traffic.

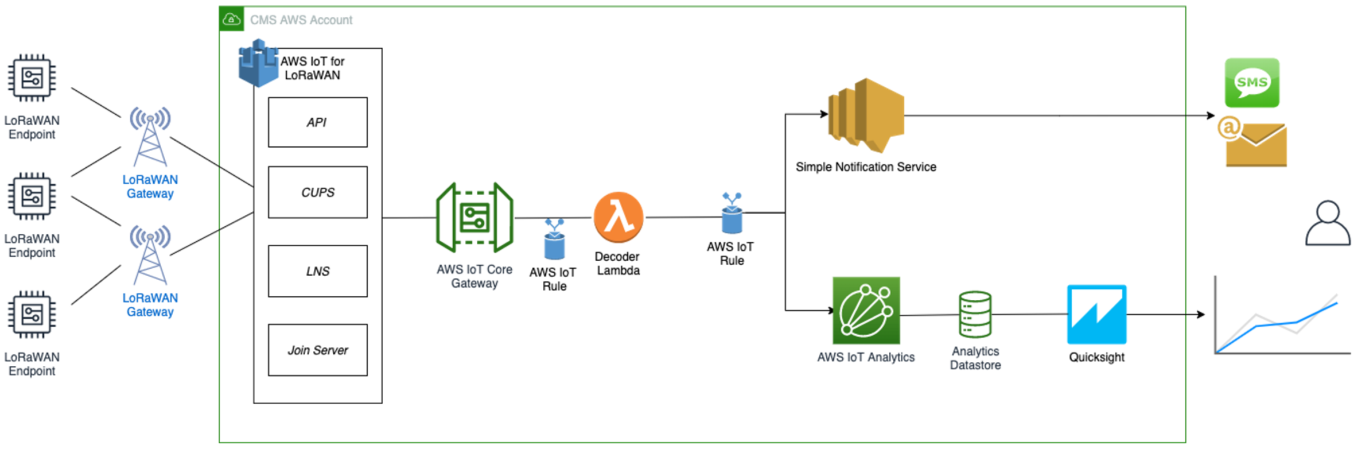


Figure 14: Sending Uplink Architecture

Create a Lambda Function for Destination Rule

Create the lambda function to process device messages processed by the destination rule.

1. Go to the AWS Lambda console .
2. Click on **Functions** in the navigation pane.

3. Click on **Create function**.
4. Select **Author** from scratch.
5. Under **Basic Information**, enter the function name and choose ***Runtime Python 3.8***. from the drop-down under **Runtime**.
6. Click on **Create function**.
7. Under **Function code**, paste the copied code into the editor under the ***lambda_function.py*** tab.

```py
import base64
import json
import logging
import ctypes
import boto3

# define function name

FUNCTION_NAME = 'RAK-HelloWorld'

# Second Byte in Payload represents Data Types
# Low Power Payload Reference: https://developers.mydevices.com/cayenne/docs/lora/

DATA_TYPES = 1

# Type Temperature

TYPE_TEMP = 0x67

# setup iot-data client for boto3

client = boto3.client('iot-data')

# setup logger

logger = logging.getLogger(FUNCTION_NAME)
logger.setLevel(logging.INFO)

def decode(event):
    data_base64 = event.get('PayloadData')
    data_decoded = base64.b64decode(data_base64)
    result = {
        'devEui': event.get('WirelessMetadata').get('LoRaWAN'
                ).get('DevEui'),
        'fPort': event.get('WirelessMetadata').get('LoRaWAN'
                ).get('FPort'),
        'freq': event.get('WirelessMetadata').get('LoRaWAN'
                ).get('Frequency'),
        'timestamp': event.get('WirelessMetadata').get('LoRaWAN'
                ).get('Timestamp'),
        }

    if data_decoded[DATA_TYPES] == TYPE_TEMP:
        temp = data_decoded[DATA_TYPES + 1] << 8 \
            | data_decoded[DATA_TYPES + 2]
        temp = ctypes.c_int16(temp).value
        result['temperature'] = temp / 10

    return result


def lambda_handler(event, context):
    data = decode(event)
    logger.info('Data: %s' % json.dumps(data))
    response = client.publish(topic=event.get('WirelessMetadata'
                              ).get('LoRaWAN').get('DevEui')
                              + '/project/sensor/decoded', qos=0,
                              payload=json.dumps(data))
    return response
```

8. Once the code has been pasted, choose **Deploy** to deploy the lambda code.
9. Click on the **Permissions** tab of the lambda function.
10. Change the **Lambda Role Policy** permission.
    - Under **Execution role**, click on the hyperlink under **Role name**.
    - On the **Permissions tab**, find the policy name and select it.
    - Choose **Edit policy**, and choose the **JSON** tab.
    - Append the following to the Statement section of the policy to allow publishing to AWS IoT.

```json
 {
   "Effect":"Allow",
   "Action":[
      "iot:Publish"
   ],
   "Resource":[
      "*"
   ]
}
```

- Choose **Review Policy**, then Save changes.

11. Create a test event that will allow you to test the functionality of the lambda function.
    - In the drop-down, for the ***Select a test event***, choose **Configure test events**.
    - Enter a name for the test event under the **Event name**.
    - Paste the following sample payload in the area under Event name:

```json
    {
    "WirelessDeviceId": "65d128ab-90dd-4668-9556-fe47c589610b",
    "PayloadData": "AWf/1w==",
    "WirelessMetadata": {
    "LoRaWAN": {
    "DataRate": "4",
    "DevEui": "0000000000000088",
    "FPort": 1,
    "Frequency": "868100000",
    "Gateways": [
            {
    "GatewayEui": "80029cffXXXXXXXX",
    "Rssi": -109,
    "Snr": 5
            }
        ],
    "Timestamp": "2021-02-08T04:00:40Z"
        }
    }
    }
```

12. Choose **Create** to save the event.
13. Navigate to the AWS IoT console, choose **Test** on the navigation pane, and select **MQTT client**.
14. Configure the MQTT client to subscribe to "#" (all topics).
15. Click on **Test** in the Lambda function page to generate the test event you just created.
16. Verify the published data in the AWS IoT Core MQTT Test client:

    - Open another window. Go to **AWS IoT Console**, select **Test** under Subscription Topic, **enter #** and select to **Subscribe to topic**.

- The output should look similar to this:

```json
000000000000000088/project/sensor/decoded      February 09, 2021, 14:45:29 (UTC+0800)
{
    "devEui": "000000000000000088",
    "fPort": 1,
    "freq": "868100000",
    "timestamp": "2021-02-08T04:00:40Z",
    "temperature": -4.1
}
```

Create the Destination Rule

In this section, create the IoT rule that forwards the device payload to your application. This rule is associated with the destination created earlier in Set up a Destination for Device Traffic section.

1. Navigate to the AWS IoT console .

2. In the navigation pane, choose **Act**, then select **Rules**.

3. On the Rules page, choose **Create**.

4. On the Create a rule page, enter as follows:

   - Name: **LoRaWANRouting**
   - Description: **Any description of your choice**.

   > 📝 **NOTE:**
   >
   > The **Name of your Rule** is the information needed when you provision devices to run on AWS IoT Core for LoRaWAN.

5. Leave the default Rule query statement: '**SELECT * FROM 'iot/topic**' unchanged. This query has no effect at this time, as traffic is currently forwarded to the rules engine based on the destination.

6. Under Set one or more actions, choose **Add action**.

7. On the Select an action page, choose **Republish a message to an AWS IoT topic**. Scroll down and choose **Configure action**.

8. On the Configure action page, for Topic, enter ***project/sensor/decoded***.The AWS IoT Rules Engine will forward messages to this topic.

9. Under **Choose or create a role to grant AWS IoT access to perform this action**, select **Create Role**.

10. For Name, enter a name of your choice.

11. Choose **Create role** to complete the role creation. You will see a "**Policy Attached**" tag next to the role name, indicating that the Rules Engine has been permitted to execute the action.

12. Choose **Add action**.

13. Add one more action to invoke the Lambda function. Under **Set one or more actions**, choose **Add action**.

14. Choose **Send a message to a Lambda function**.

15. Choose **Configure action**.

16. Select the Lambda function created earlier and choose **Add action**.

17. Then, choose **Create rule**.

18. A "**Success**" message will be displayed at the top of the panel, and the destination has a rule bound to it.

You can now check that the decoded data is received and republished by AWS by triggering a condition or event on the device itself.

- Go to the AWS IoT console. In the navigation pane, select **Test**, and choose **MQTT client**.
- Subscribe to the wildcard topic '#" to receive messages from all topics.
- Send message from endDevice using AT command: `at+send:lora:1:01670110` .
- You should see traffic similar to that shown below.

```json
    393331375d387505/project/sensor/decoded           February 09, 2021, 14:47:21 (UTC+0800)
    {
    "devEui": "393331375d387505",
    "fPort": 1,
    "freq": "867100000",
    "timestamp": "2021-02-09T06:47:20Z",
    "temperature": 27.2
    }
```

```json
 project/sensor/decoded    February 09, 2021, 14:47:21 (UTC+0800)
    {
        "WirelessDeviceID": "6477ec22-9570-31d5981da021",
        "PayloadData": "AWcBEA==",
        "WirelessMetadata": {
            "LoRaWAN": {
                "DataRate": "4",
                "DevEui": "393331375d387505",
                "FPort": 1,
                "Frequency": "867100000",
                "Gateways": [
                    {
                        "GatewayEui": "ac1ff09fffe014bd5",
                        "Rssi": -103,
                        "Snr": 8.5
                    }
                ],
                "Timestamp": "2021-02-09T06:47:20Z"
            }
        }
    }
```

a

Configuring Amazon SNS

You will be using the Amazon Simple Notification Service to send text messages (SMS) when certain conditions are met.

1. Go to the Amazon SNS console .
2. Click on the menu in the left corner to open the navigation pane.
3. Select **Text Messaging** (SMS) and choose **Publish text message**.

4. Under Message type, select **Promotional**.
5. Enter your phone number (phone number that will receive text alerts).
6. Enter "Test message" for the Message and choose **Publish** message.
7. If the phone number you entered is valid, you will receive a text message and your phone number will be confirmed.
8. Create an Amazon SNS Topic as follows:
   - In the navigation pane, choose Topics.
   - Select Create topic.
   - Under Details, select Standard.
   - Enter a name of your choice. Here, you will use "*text_topic*".
   - Choose Create topic.
9. Create a subscription for this topic:
   - On the page for the newly created text_topic, choose the **Subscriptions** tab.
   - Choose **Create subscription**.
   - Select **Protocol** as SMS from the drop-down.
   - Under Endpoint, enter the previously validated phone number to receive the SMS alerts.
   - Choose Create subscription. You should see a "***Subscription to text_topic created successfully***" message.

Add a Rule for Amazon SNS Notification

Now, add a new rule to send an Amazon SNS notification when certain conditions are met in a decoded message.

1. Navigate to the AWS IoT console .
2. In the navigation pane, choose **Act**. Then, choose **Rules**.
3. On the Rules page, choose **Create**.
4. Enter the Name as *text_alert* and provide an appropriate Description.
5. Under the **Rule query statement**, enter the following query:

```
SELECT devEui as device_id, "Temperature exceeded 25" as message, temperature as temp, timest
```

6. Choose **Add action**.
7. Choose **Send a message as an SNS push notification**.
8. Choose **Configure action**.
9. Under SNS target, select *text_topic* from the drop-down.
10. Select RAW under **Message format**.
11. Under **Choose or create a role to grant AWS IoT access to perform this action**, choose **Create role**.
12. Enter a name for the role and choose **Add action**.
13. Choose **Create rule**. You should see a "**Success**" message, indicating that the rule has been created.

Test the Rule for Amazon SNS Notification

After adding the rule for Amazon SNS notification, you should receive a text message when hitting the event.

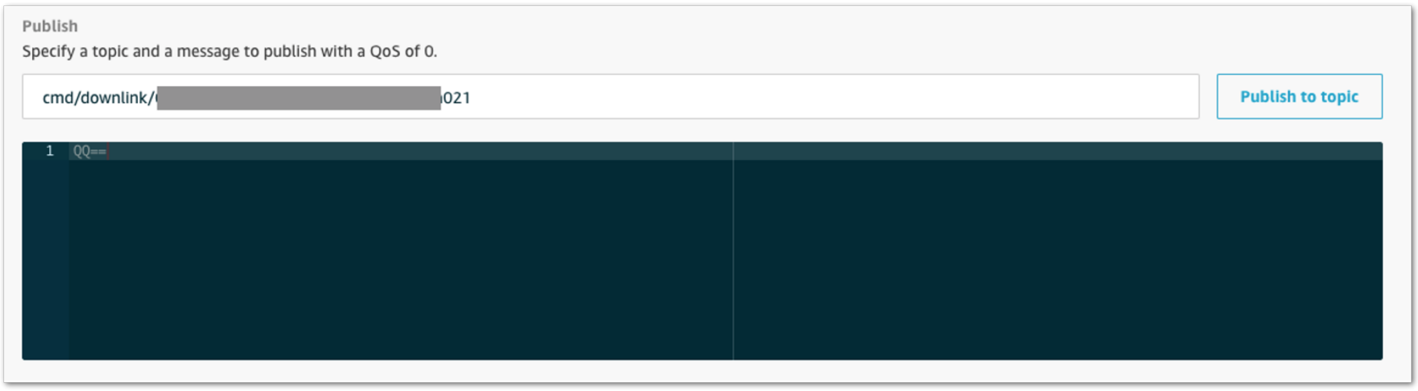
Send message from endDevice using AT command: `at+send:lora:1:01670110` . Here is the message from mobile after sending an uplink message.

```json
{
    "device_id": "393331375d387505",
    "message": "Temperature exceeded 25",
    "temp": 27.2,
    "time": "2021-02-22T07:58:54Z"
}
```

Send Downlink Payload

This section shows how to send downlink payload from AWS IoT LoRaWAN Server to end Device.

1. Install the AWS SAM CLI .
2. Deploy SAM template to AWS .
3. Send Payload to End Device.
    - Go to the AWS IoT console.
    - In the navigation pane, select **Test**, and choose **MQTT client**.
    - Subscribe to the wildcard topic '#" to receive messages from all topics.
    - Specify the topic to ***cmd/downlink/{WirelessDeviceId}*** and a base64-encoded message.



Publish

Specify a topic and a message to publish with a QoS of 0.

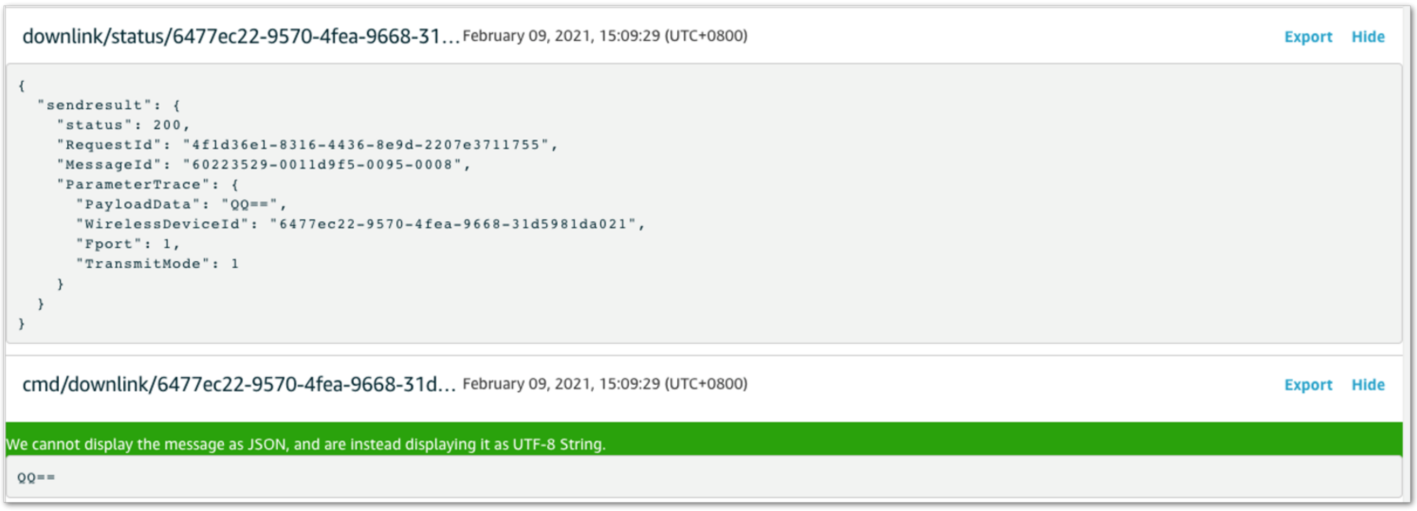
cmd/downlink/[redacted]021

```
QQ==
```

Figure 15: Specifying a Topic

4. You should see traffic on AWS similar, as shown below:

```json
downlink/status/6477ec22-9570-4fea-9668-31d5981da021   February 09, 2021, 15:09:29 (UTC+08
{
    "sendresult": {
        "status": 200,
        "RequestId": "4f1d36e1-8316-4436-8e9d-2207e3711755",
        "MessageId": "60223529-0011d9f5-0095-0008",
        "ParameterTrace": {
            "PayloadDate": "QQ==",
            "WirelessDeviceId": "6477ec22-9570-4fea-9668-31d5981da021",
            "Fport": 1,
            "TransmitMode": 1
        }
    }
}
```



downlink/status/6477ec22-9570-4fea-9668-31… February 09, 2021, 15:09:29 (UTC+0800)

```
{
  "sendresult": {
    "status": 200,
    "RequestId": "4f1d36e1-8316-4436-8e9d-2207e3711755",
    "MessageId": "60223529-0011d9f5-0095-0008",
    "ParameterTrace": {
      "PayloadData": "QQ==",
      "WirelessDeviceId": "6477ec22-9570-4fea-9668-31d5981da021",
      "Fport": 1,
      "TransmitMode": 1
    }
  }
}
```

cmd/downlink/6477ec22-9570-4fea-9668-31d… February 09, 2021, 15:09:29 (UTC+0800)

We cannot display the message as JSON, and are instead displaying it as UTF-8 String.

```
QQ==
```

Figure 16: Traffic on AWS

5. You should see traffic on your console of end device similar, as shown below.

```
SYSLOG:4:LoRa rX : 41 - 14
SYSLOG:4:LoRa Tx :
```

IoT Analytics

You will use IoT Analytics to visually display data via graphs if there is a need in the future to do further analysis.

Create an IoT Analytics Rule

Create a Rule First

1. Navigate to the AWS IoT console .
2. In the navigation pane, choose **Act** and then, choose **Rules**.
3. On the Rules page, choose **Create**.
4. Enter the Name as **Visualize**, and provide an appropriate Description.
5. Under the Rule query statement, enter the following query:

```
SELECT * FROM 'project/sensor/decoded'
```

6. Choose **Add action**.
7. Select **Send a message to IoT Analytics**.
8. Choose **Configure Action**.
9. Choose **Quick Create IoT Analytics Resources**.
10. Under **Resource Prefix**, enter an appropriate prefix for your resources, such as *LoRa Choose Quick Create*.
11. Once the Quick Create Finished message is displayed, choose **Add action**.
12. Choose **Create rule**. You should see a Success message, indicating that the rule has been created.

Configure AWS IoT Analytics

Set up AWS IoT Analytics

1. Go to the AWS IoT Analytics console .

2. In the navigation panel, choose **Data sets**.

3. Select the data set generated by the Quick Create in Create an IoT Analytics Rule

4. In the Details section, edit the **SQL query**.

5. Replace the query with as follows:

~~~
```
SELECT devEui as device_id, temperature as temp, timestamp as time FROM LoRa_datastore
```
~~~

6. Under Schedule, choose **Add schedule**.

7. Under Frequency, choose **Every 1 minute**, and then click **Save**.

Configure Amazon QuickSight

Amazon QuickSight lets you easily create and publish interactive BI dashboards that include Machine Learning-powered insights.

1. Go to AWS Management console .
2. From the management console, enter **QuickSight** in the "*Search for services, features..*" search box.
3. Click on QuickSight in the search results.
4. If you haven't signed up for the service before, go ahead and sign up, as there is a free trial period.
5. Select the **Standard Edition**, and choose Continue.
6. Enter a unique name in the field QuickSight account name.
7. Fill in the Notification email address.
8. Review the other checkbox options and change them as necessary. The **AWS IoT Analytics** option must be selected.
9. Choose **Finish**. You will see a confirmation message.
10. Choose **Go to Amazon QuickSight**.
11. Select **Datasets**.
12. Select **New dataset**.
13. Select **AWS IoT Analytics**.
14. Under Select an AWS IoT Analytics data set to import, choose the data set created in **Create an IoT Analytics Rule**.
15. Choose **Create data source**, and then choose **Visualize**.
16. Select the dataset created, then select **Refresh** or **Schedule Refresh** for a periodic refresh of the dataset.

Testing your "Hello Word" Application

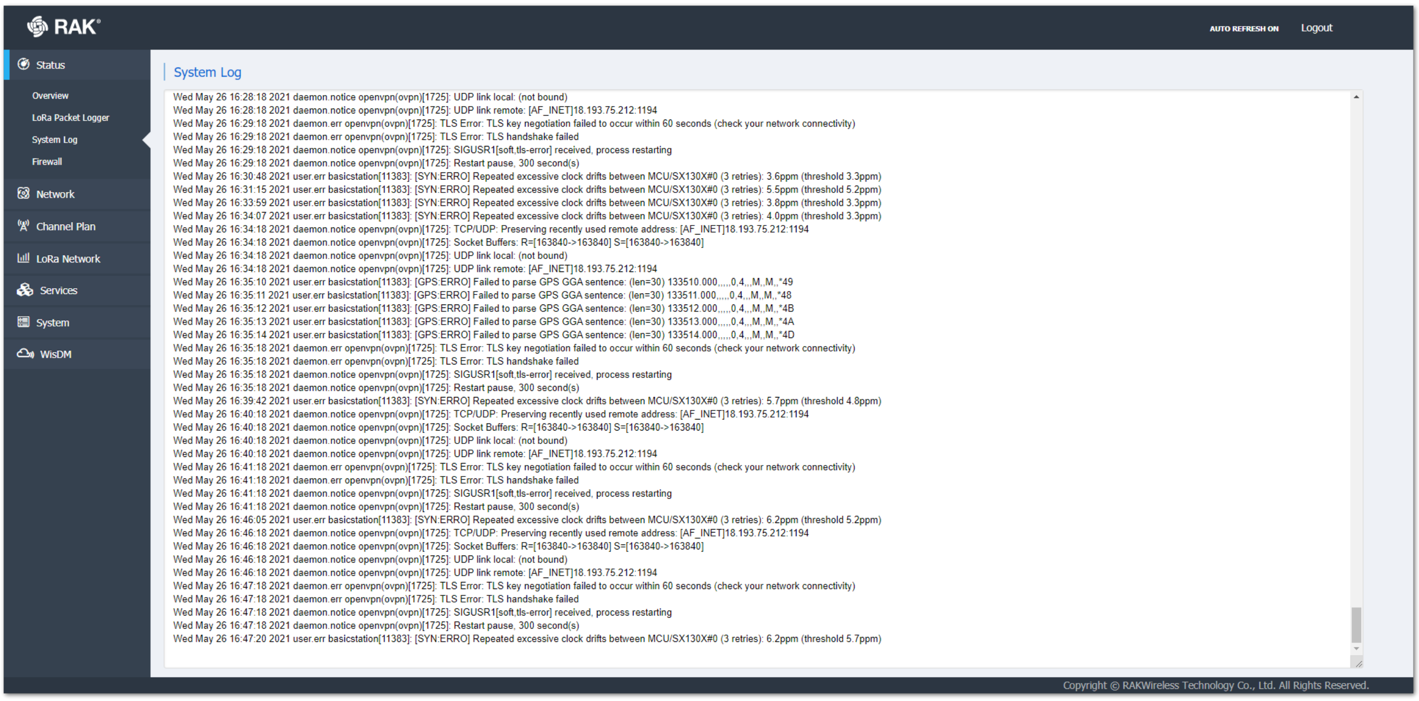
Using your device, create a condition to generate an event such as a high-temperature condition. If the temperature is above the configured threshold then you will receive a text alert on your phone. This alert will include key parameters about the alert.

You can also visualize the data set as follows:

1. Go to the AWS IoT Analytics console .
2. Choose **Data sets**.
3. Select the dataset created earlier.
4. Select **Content** and ensure there are at least few uplink entries available in the data set.
5. Go to the **QuickSight console** .
6. Choose **New analysis**.
7. Choose the dataset created in **Create an IoT Analytics Rule**.
8. Select time on the X-axis, Value as temp (Average) and Color as device_id to see a chart of your dataset.

Debugging

After login to the device using the web browser, the system log can be viewed from **Status** > **System Log**.



```
Wed May 26 16:28:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link local: (not bound)
Wed May 26 16:28:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link remote: [AF_INET]18.193.75.212:1194
Wed May 26 16:29:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS key negotiation failed to occur within 60 seconds (check your network connectivity)
Wed May 26 16:29:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS handshake failed
Wed May 26 16:29:18 2021 daemon.notice openvpn(ovpn)[1725]: SIGUSR1[soft,tls-error] received, process restarting
Wed May 26 16:29:18 2021 daemon.notice openvpn(ovpn)[1725]: Restart pause, 300 second(s)
Wed May 26 16:30:48 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 3.6ppm (threshold 3.3ppm)
Wed May 26 16:31:15 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 5.5ppm (threshold 5.2ppm)
Wed May 26 16:33:59 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 3.8ppm (threshold 3.3ppm)
Wed May 26 16:34:07 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 4.0ppm (threshold 3.3ppm)
Wed May 26 16:34:18 2021 daemon.notice openvpn(ovpn)[1725]: TCP/UDP: Preserving recently used remote address: [AF_INET]18.193.75.212:1194
Wed May 26 16:34:18 2021 daemon.notice openvpn(ovpn)[1725]: Socket Buffers: R=[163840->163840] S=[163840->163840]
Wed May 26 16:34:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link local: (not bound)
Wed May 26 16:34:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link remote: [AF_INET]18.193.75.212:1194
Wed May 26 16:35:10 2021 user.err basicstation[11383]: [GPS:ERRO] Failed to parse GPS GGA sentence: (len=30) 133510.000,,,,,0,4,,,M,,M,,*49
Wed May 26 16:35:11 2021 user.err basicstation[11383]: [GPS:ERRO] Failed to parse GPS GGA sentence: (len=30) 133511.000,,,,,0,4,,,M,,M,,*48
Wed May 26 16:35:12 2021 user.err basicstation[11383]: [GPS:ERRO] Failed to parse GPS GGA sentence: (len=30) 133512.000,,,,,0,4,,,M,,M,,*4B
Wed May 26 16:35:13 2021 user.err basicstation[11383]: [GPS:ERRO] Failed to parse GPS GGA sentence: (len=30) 133513.000,,,,,0,4,,,M,,M,,*4A
Wed May 26 16:35:14 2021 user.err basicstation[11383]: [GPS:ERRO] Failed to parse GPS GGA sentence: (len=30) 133514.000,,,,,0,4,,,M,,M,,*4D
Wed May 26 16:35:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS key negotiation failed to occur within 60 seconds (check your network connectivity)
Wed May 26 16:35:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS handshake failed
Wed May 26 16:35:18 2021 daemon.notice openvpn(ovpn)[1725]: SIGUSR1[soft,tls-error] received, process restarting
Wed May 26 16:35:18 2021 daemon.notice openvpn(ovpn)[1725]: Restart pause, 300 second(s)
Wed May 26 16:39:42 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 5.7ppm (threshold 4.8ppm)
Wed May 26 16:40:18 2021 daemon.notice openvpn(ovpn)[1725]: TCP/UDP: Preserving recently used remote address: [AF_INET]18.193.75.212:1194
Wed May 26 16:40:18 2021 daemon.notice openvpn(ovpn)[1725]: Socket Buffers: R=[163840->163840] S=[163840->163840]
Wed May 26 16:40:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link local: (not bound)
Wed May 26 16:40:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link remote: [AF_INET]18.193.75.212:1194
Wed May 26 16:41:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS key negotiation failed to occur within 60 seconds (check your network connectivity)
Wed May 26 16:41:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS handshake failed
Wed May 26 16:41:18 2021 daemon.notice openvpn(ovpn)[1725]: SIGUSR1[soft,tls-error] received, process restarting
Wed May 26 16:41:18 2021 daemon.notice openvpn(ovpn)[1725]: Restart pause, 300 second(s)
Wed May 26 16:46:05 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 6.2ppm (threshold 5.2ppm)
Wed May 26 16:46:18 2021 daemon.notice openvpn(ovpn)[1725]: TCP/UDP: Preserving recently used remote address: [AF_INET]18.193.75.212:1194
Wed May 26 16:46:18 2021 daemon.notice openvpn(ovpn)[1725]: Socket Buffers: R=[163840->163840] S=[163840->163840]
Wed May 26 16:46:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link local: (not bound)
Wed May 26 16:46:18 2021 daemon.notice openvpn(ovpn)[1725]: UDP link remote: [AF_INET]18.193.75.212:1194
Wed May 26 16:47:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS key negotiation failed to occur within 60 seconds (check your network connectivity)
Wed May 26 16:47:18 2021 daemon.err openvpn(ovpn)[1725]: TLS Error: TLS handshake failed
Wed May 26 16:47:18 2021 daemon.notice openvpn(ovpn)[1725]: SIGUSR1[soft,tls-error] received, process restarting
Wed May 26 16:47:18 2021 daemon.notice openvpn(ovpn)[1725]: Restart pause, 300 second(s)
Wed May 26 16:47:20 2021 user.err basicstation[11383]: [SYN:ERRO] Repeated excessive clock drifts between MCU/SX130X#0 (3 retries): 6.2ppm (threshold 5.7ppm)
```

Figure 17: System Log

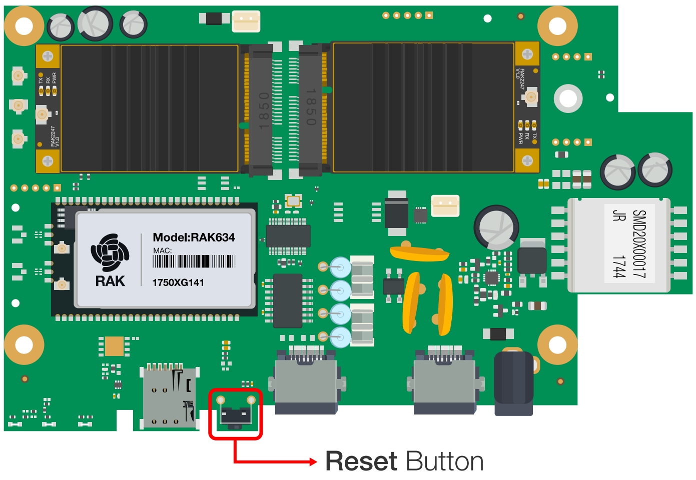
Troubleshooting

1. Unable to see the web login:

   - Check that your wifi is connected to **RAK7268_XXXX**.
   - Try ping **192.168.230.1**.

2. Lost password to login to the web login.

   - Hold the reset button for 10 seconds to factory reset the device



Reset Button

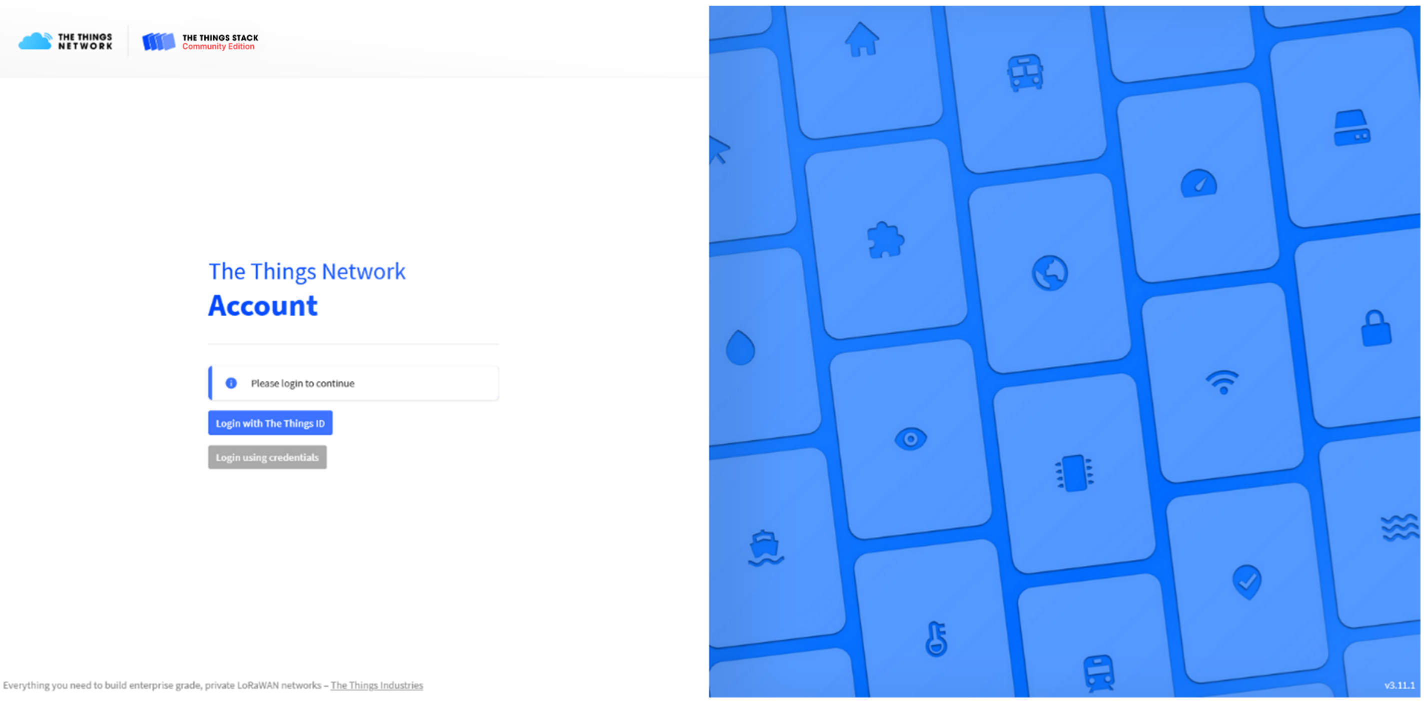
Figure 18: Troubleshooting

The Things Network (TTN)

At The Things Conference 2021, it was announced that The Things Network is upgrading to The Things Stack v3.

In this section, it will be shown how to connect RAK7268 WisGate Edge Lite 2 to TTNv3.

To login into the TTNv3, head on here . If you already have a TTN account, you can use your The Things ID credentials to log in.



The Things Network
Account

Please login to continue

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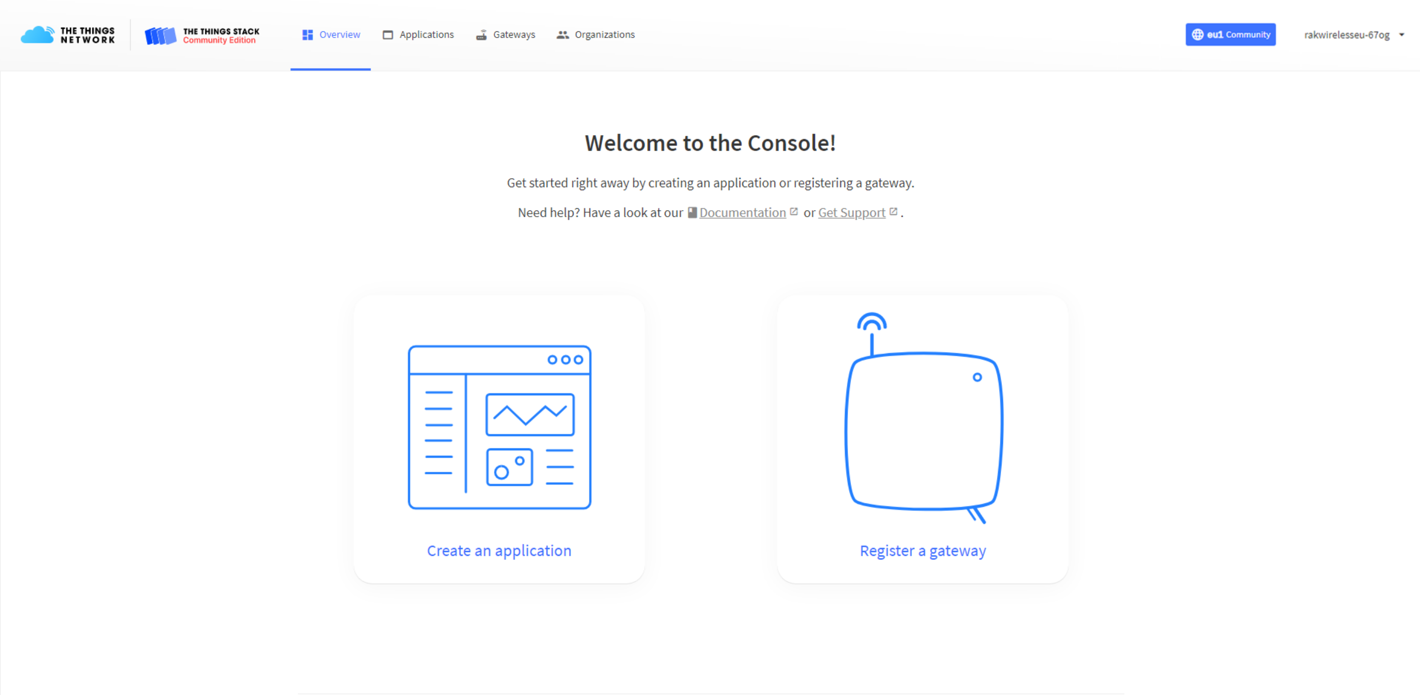
Figure 19: The Things Stack Home Page

> 📝 **NOTE**
>
> This tutorial is for the EU868 Frequency band.

Registering the Gateway

1. To register a commercial gateway, choose **Register a gateway** (for new users that do not already have a registered gateway) or go to **Gateways** > **+ Add gateway** (for users that have registered gateways before).



Welcome to the Console!

Get started right away by creating an application or registering a gateway.

Need help? Have a look at our Documentation or Get Support.

Figure 20: Console Page after successful login

2. Fill in the needed information:

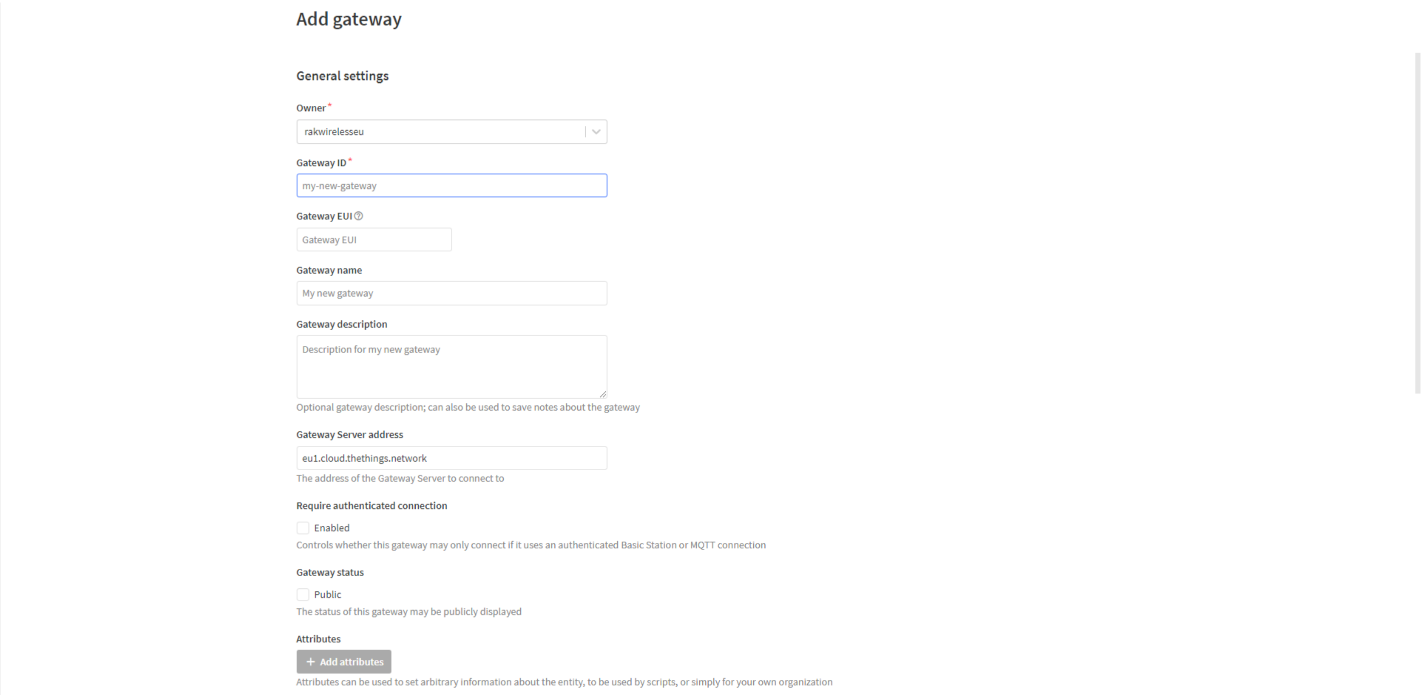
- **Owner** – Automatically filled by The Things Stack, based on your account or created Organization.
- **Gateway ID** – This will be the unique ID of your gateway in the Network. Note that the ID must contain only lowercase letters, numbers, and dashes (-).
- **Gateway EUI** - A 64 bit extended unique identifier for your gateway. The gateway's EUI can be found either on the sticker on the casing or by going to the **LoRa Network Settings** page in the **LoRa Gateway** menu accessible via the Web UI. Instructions on how to access your gateway via Web UI can be found in the product's Quickstart Guide .
- **Gateway name** – A name for your gateway.
- **Gateway description (optional)** - Optional gateway description; can also be used to save notes about the gateway.
- **Gateway Server address** - The address of the Gateway Server to connect to.

> 📝 NOTE
>
> This tutorial is based on using the EU868 frequency band, so the server address will be: eu1.cloud.thethings.network.

- **Frequency plan** - The frequency plan used by the gateway.

> 📝 NOTE
>
> For this tutorial, we will use Europe 863-870 MHz (SF9 for RX2 - recommended).

- The other settings are optional and can be changed to satisfy your requirements.



Add gateway

General settings

Owner*
rakwirelesseu

Gateway ID*
my-new-gateway

Gateway EUI
Gateway EUI

Gateway name
My new gateway

Gateway description
Description for my new gateway
Optional gateway description; can also be used to save notes about the gateway

Gateway Server address
eu1.cloud.thethings.network
The address of the Gateway Server to connect to

Require authenticated connection
□ Enabled
Controls whether this gateway may only connect if it uses an authenticated Basic Station or MQTT connection

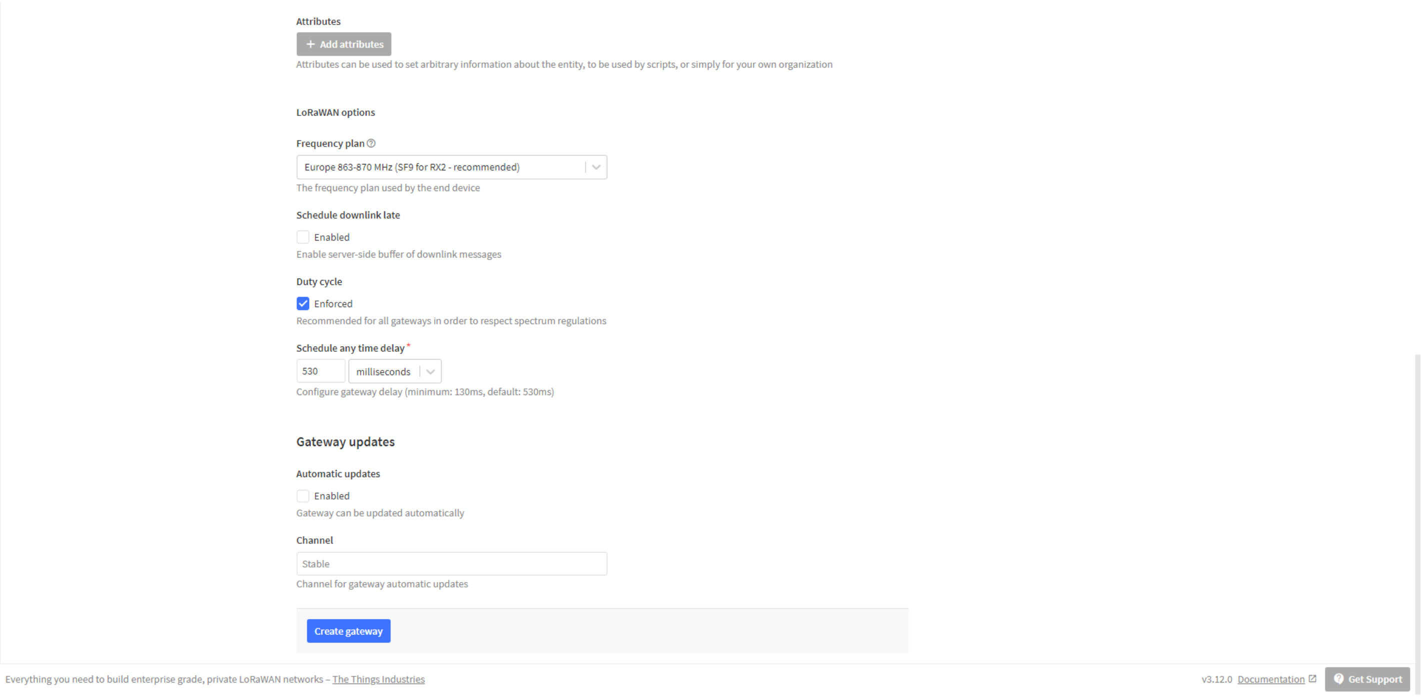
Gateway status
□ Public
The status of this gateway may be publicly displayed

Attributes

Attributes can be used to set arbitrary information about the entity, to be used by scripts, or simply for your own organization

Figure 21: Adding a gateway

3. To register your gateway, scroll down and click **Create gateway**.



Attributes

Attributes can be used to set arbitrary information about the entity, to be used by scripts, or simply for your own organization

LoRaWAN options

Frequency plan

Europe 863-870 MHz (SF9 for RX2 - recommended)

The frequency plan used by the end device

Schedule downlink late

□ Enabled

Enable server-side buffer of downlink messages

Duty cycle

☑ Enforced

Recommended for all gateways in order to respect spectrum regulations

Schedule any time delay *

530 milliseconds

Configure gateway delay (minimum: 130ms, default: 530ms)

Gateway updates

Automatic updates

□ Enabled

Gateway can be updated automatically

Channel

Stable

Channel for gateway automatic updates

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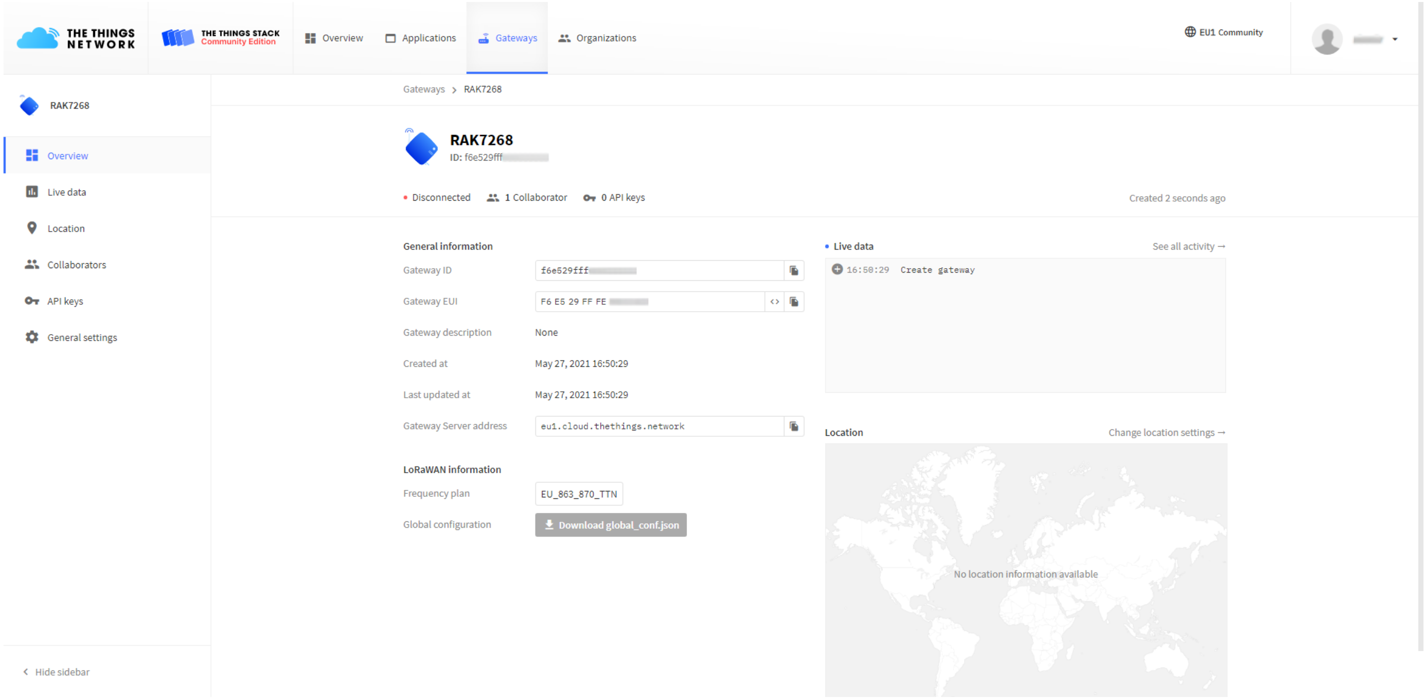
Figure 22: Registering the gateway

TTNv3 supports TLS server authentication and Client token, which requires a trust file and a key file to configure the Gateway to successfully connect it to the network.

Generating the Token

1. To generate a key file, from the **Overview page** of the registered Gateway navigate to **API keys**.



RAK7268

ID: f6e529fff[redacted]

• Disconnected 1 Collaborator 0 API keys

Created 2 seconds ago

General information

Gateway ID: f6e529fff[redacted]

Gateway EUI: F6 E5 29 FF FE [redacted]

Gateway description: None

Created at: May 27, 2021 16:50:29

Last updated at: May 27, 2021 16:50:29

Gateway Server address: eu1.cloud.thethings.network

LoRaWAN information

Frequency plan: EU_863_870_TTN

Global configuration: Download global_conf.json

• Live data

See all activity →

16:50:29 Create gateway

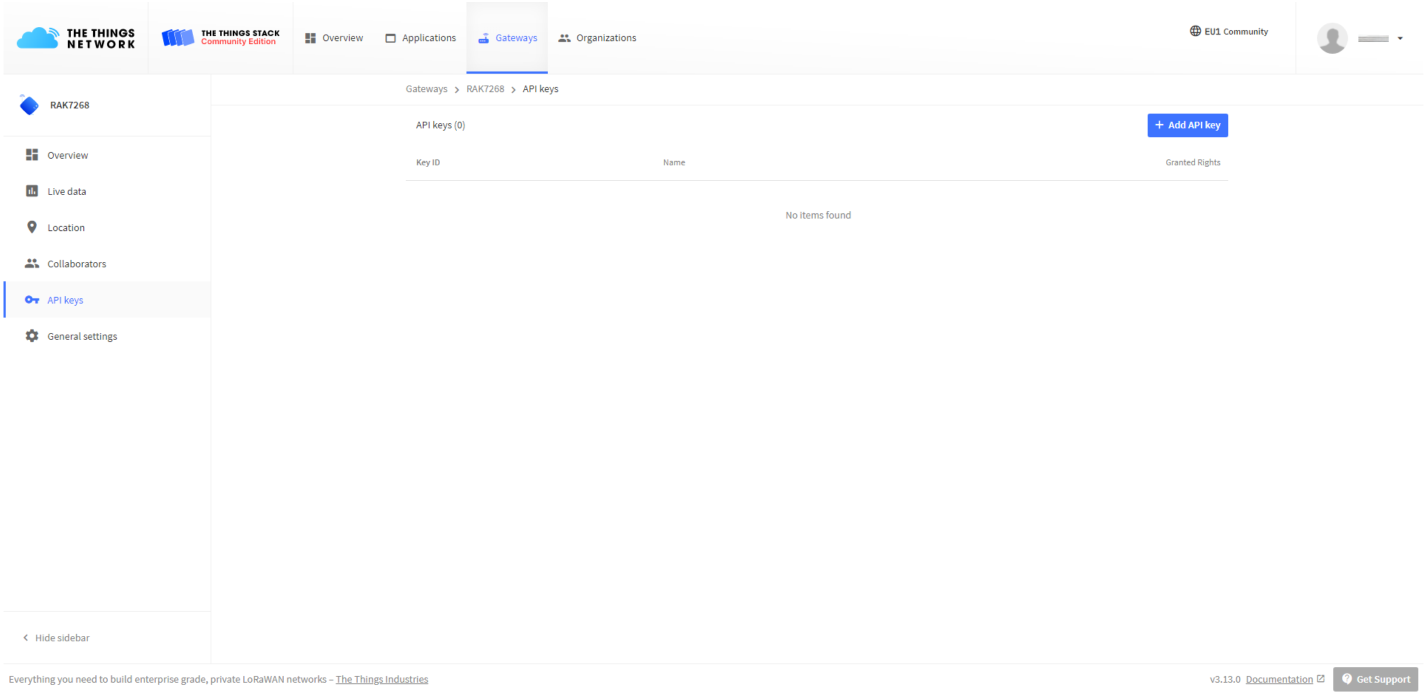
Location

Change location settings →

No location information available

Figure 23: Overview page

2. On the **API keys page**, choose **+ Add API key**.



API keys (0)

Key ID	Name	Granted Rights

No items found

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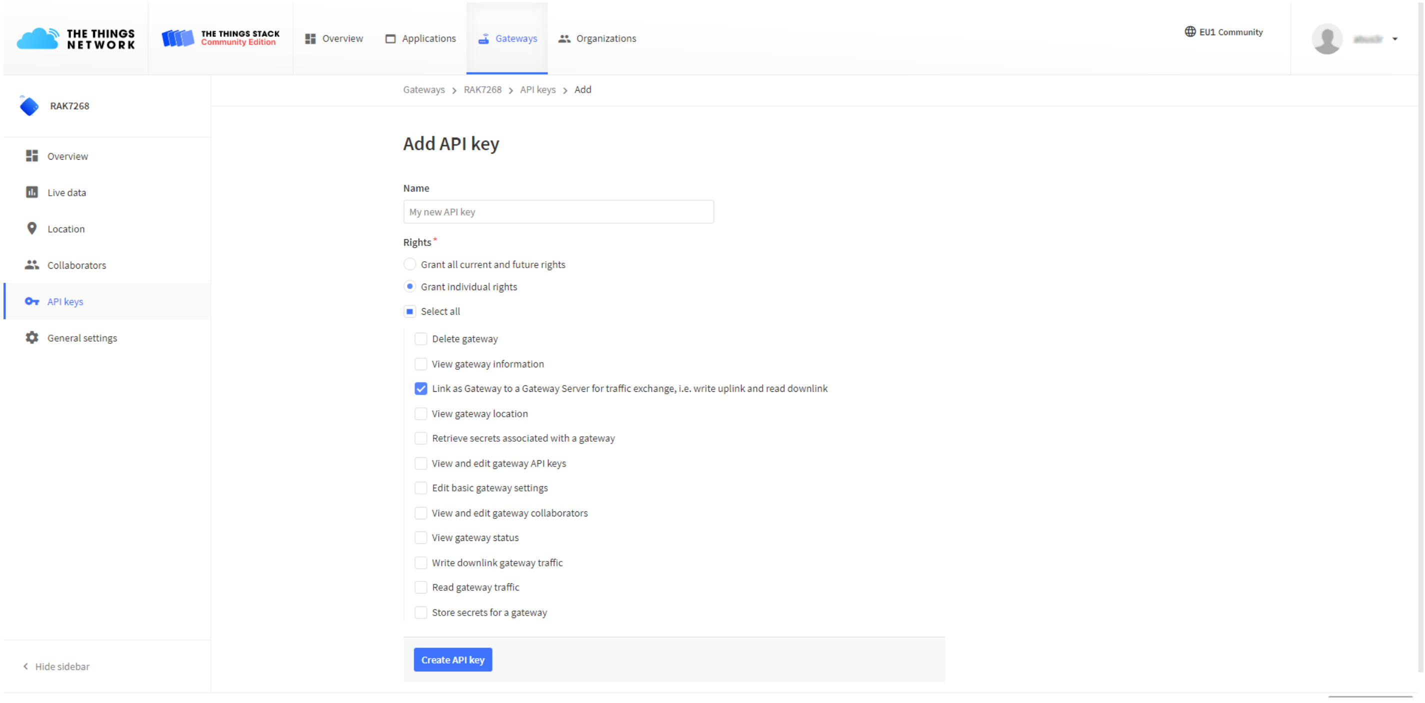
v3.13.0 Documentation

Figure 24: API key page

3. In the **Name field** type the name of your key (for example - mykey). Choose **Grant individual rights** and select **Link as Gateway to a Gateway for traffic exchange, i.e. read uplink and write downlink**.



Add API key

Name

My new API key

Rights*

○ Grant all current and future rights

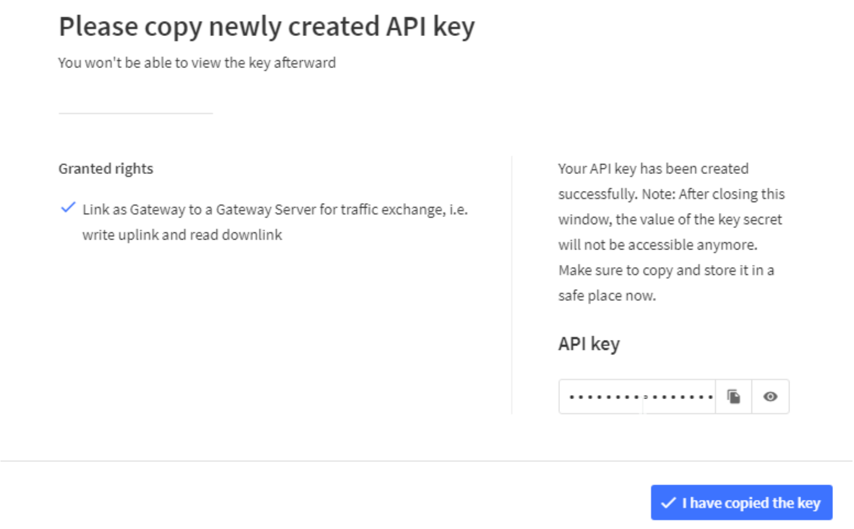
● Grant individual rights

■ Select all

- □ Delete gateway
- □ View gateway information
- ☑ Link as Gateway to a Gateway Server for traffic exchange, i.e. write uplink and read downlink
- □ View gateway location
- □ Retrieve secrets associated with a gateway
- □ View and edit gateway API keys
- □ Edit basic gateway settings
- □ View and edit gateway collaborators
- □ View gateway status
- □ Write downlink gateway traffic
- □ Read gateway traffic
- □ Store secrets for a gateway

Figure 25: Generating an API key

4. To generate the key, choose **Create API key**. The following window will pop up, telling you to copy the key you just generated.



Please copy newly created API key

You won't be able to view the key afterward

Granted rights

✓ Link as Gateway to a Gateway Server for traffic exchange, i.e. write uplink and read downlink

Your API key has been created successfully. Note: After closing this window, the value of the key secret will not be accessible anymore. Make sure to copy and store it in a safe place now.

API key

Figure 26: Copying the generated key

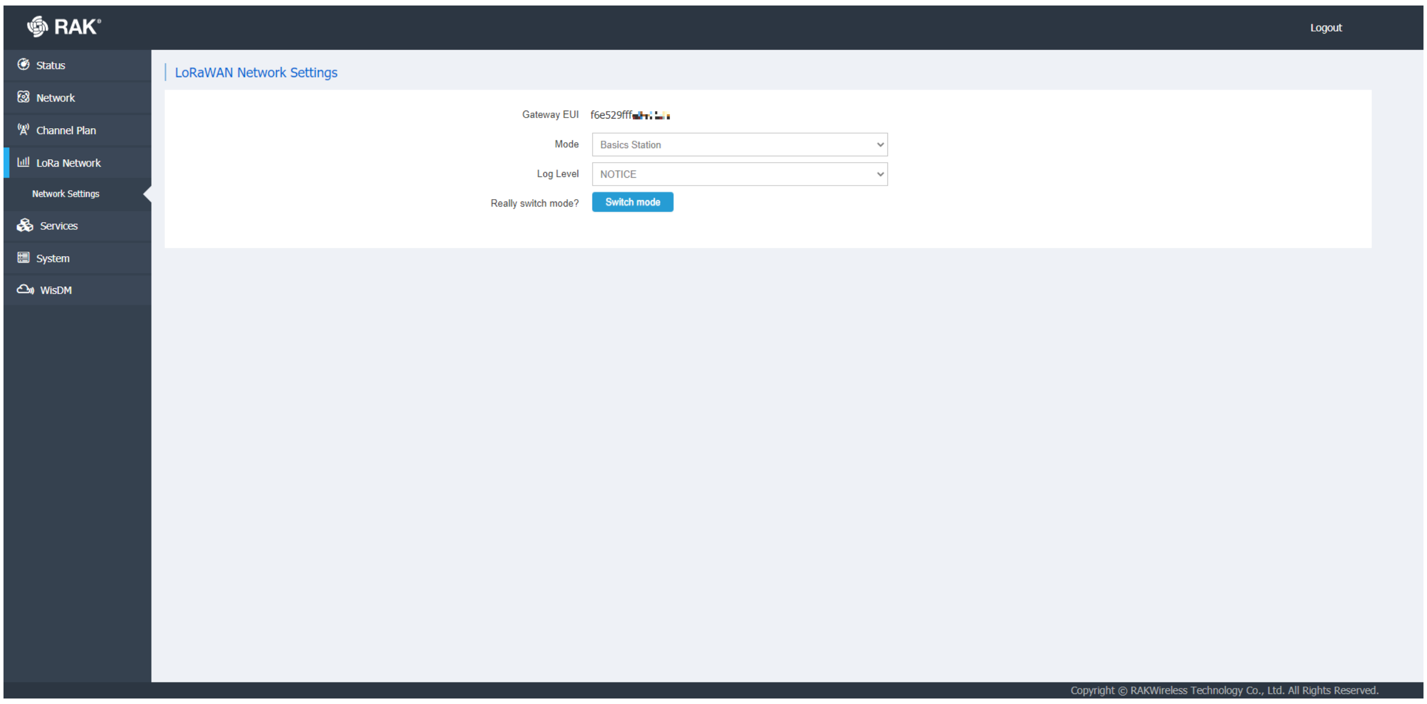
> ⚠️ **WARNING**
>
> Copy the key and save it in a .txt file (or other), because you won't be able to view or copy your key after that.

5. Click **I have copied the key** to proceed.

Configuring the Gateway

1. To configure the gateway access it via the Web UI. To learn how to do that check out the device's Quickstart Guide mentioned before.

2. Navigate to **LoRa Network** > **Network Settings** > **Mode** drop-down menu > choose **Basics Station**.



LoRaWAN Network Settings

Gateway EUI f6e529fff[redacted]

Mode: Basics Station

Log Level: NOTICE

Really switch mode?

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Figure 27: Changing the working mode

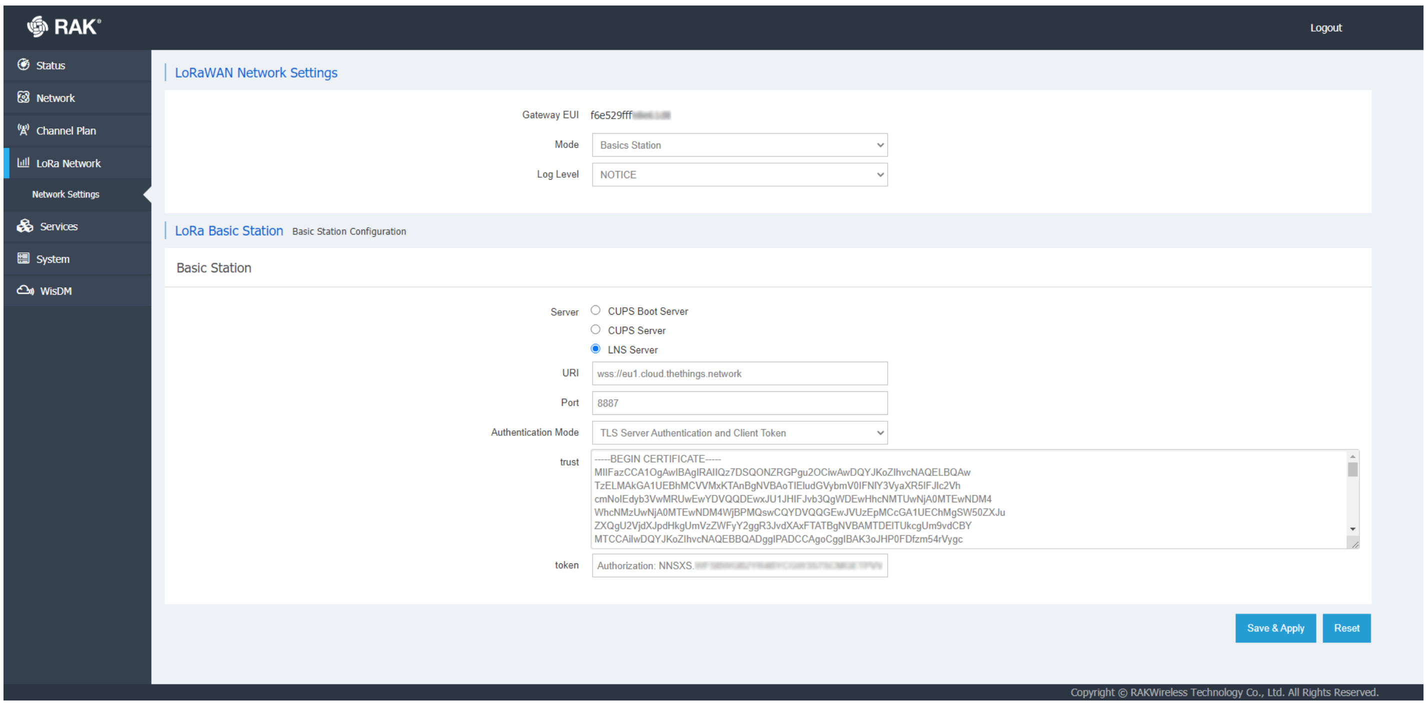
3. Select **Switch mode** to apply the change. After that, the **Basics Station Configuration** pane settings will show up. To connect the Gateway to TTNv3, the following parameters must be configured:

- **Server** – For server choose **LNS Server**.
- **URI** – This is the link to The Things Stack server. Note that, for this tutorial, we are connecting the gateway to the European cluster. For Europe fill in the following: wss://eu1.cloud.thethings.network
- **Port** – The LNS Server uses port 8887. Type in **8887**.

- **Authentication Mode** – Choose **TLS server authentication and Client token**. When selected, the trust and the token field will show up.
- **trust** – For trust we will use the **Let's Encrypt ISRG ROOT X1 Trust** certificate. The file with the certificate can be found here .
- **token** - This is the generated **API key**. The key must start with **Authorization:**. Example:

```
Authorization: YOUR_API_KEY
```

> 📝 **NOTE**
>
> Replace **YOUR_API_KEY** with the key generated previously. Have in mind that there should be a "space" between **Authorization:** and **YOUR_API_KEY**, as shown in the example.



LoRaWAN Network Settings

Gateway EUI f6e529fff[redacted]
Mode: Basics Station
Log Level: NOTICE

LoRa Basic Station Basic Station Configuration

Basic Station

Server: ○ CUPS Boot Server ○ CUPS Server ● LNS Server
URI: wss://eu1.cloud.thethings.network
Port: 8887
Authentication Mode: TLS Server Authentication and Client Token
trust:

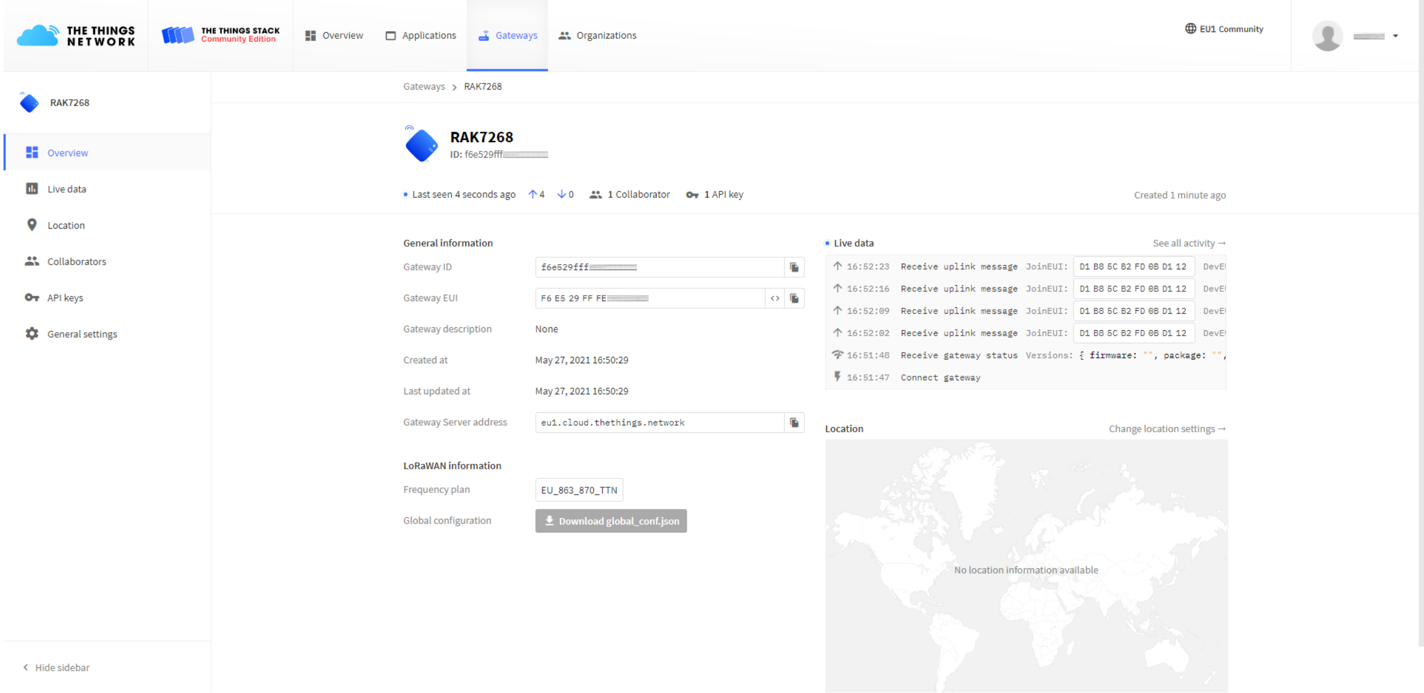
```
-----BEGIN CERTIFICATE-----
MIIFazCCA1OgAwIBAgIRAIIQz7DSQONZRGPgu2OCiwAwDQYJKoZIhvcNAQELBQAw
TzELMAkGA1UEBhMCVVMxKTAnBgNVBAoTIEludGVybmV0IFNIY3VyaXR5IFJlc2Vh
cmNoIEdyb3VwMRUwEwYDVQQDEwxJU1JHIFJvb3QgWDEwHhcNMTUwNjA0MTEwNDM4
WhcNMzUwNjA0MTEwNDM4WjBPMQswCQYDVQQGEwJVUzEpMCcGA1UEChMgSW50ZXJu
ZXQgU2VjdXJpdHkgUmVzZWFyY2ggR3JvdXAxFTATBgNVBAMTDEITUkcgUm9vdCBY
MTCCAiIwDQYJKoZIhvcNAQEBBQADggIPADCCAgoCggIBAK3oJHP0FDfzm54rVygc
```

token: Authorization: NNSXS.[redacted]

Figure 28: LoRa Basics Station settings

4. To save the changes click **Save & Apply**.

You can now see that your gateway is connected to TTNv3 as Basics Station:



RAK7268
ID: f6e529fff[redacted]

• Last seen 4 seconds ago ↑4 ↓0 1 Collaborator 1 API key Created 1 minute ago

General information

Gateway ID: f6e529fff[redacted]
Gateway EUI: F6 E5 29 FF FE[redacted]
Gateway description: None
Created at: May 27, 2021 16:50:29
Last updated at: May 27, 2021 16:50:29
Gateway Server address: eu1.cloud.thethings.network

LoRaWAN information

Frequency plan: EU_863_870_TTN
Global configuration

Live data

```
↑ 16:52:23  Receive uplink message  JoinEUI: D1 B8 5C B2 FD 0B D1 12  DevE
↑ 16:52:16  Receive uplink message  JoinEUI: D1 B8 5C B2 FD 0B D1 12  DevE
↑ 16:52:09  Receive uplink message  JoinEUI: D1 B8 5C B2 FD 0B D1 12  DevE
↑ 16:52:02  Receive uplink message  JoinEUI: D1 B8 5C B2 FD 0B D1 12  DevE
  16:51:48  Receive gateway status  Versions: { firmware: "", package: "",
  16:51:47  Connect gateway
```

Location

Figure 29: Successful connection

LORIOT

In this tutorial, you will learn how to connect RAK7268 WisGate Edge Lite 2 to LORIOT.

LORIOT provides an easy-to-use software platform that enables you to build, operate, and scale a secure IoT network suitable for long-range IoT solution deployments in every part of the world.

Prerequisites

Hardware

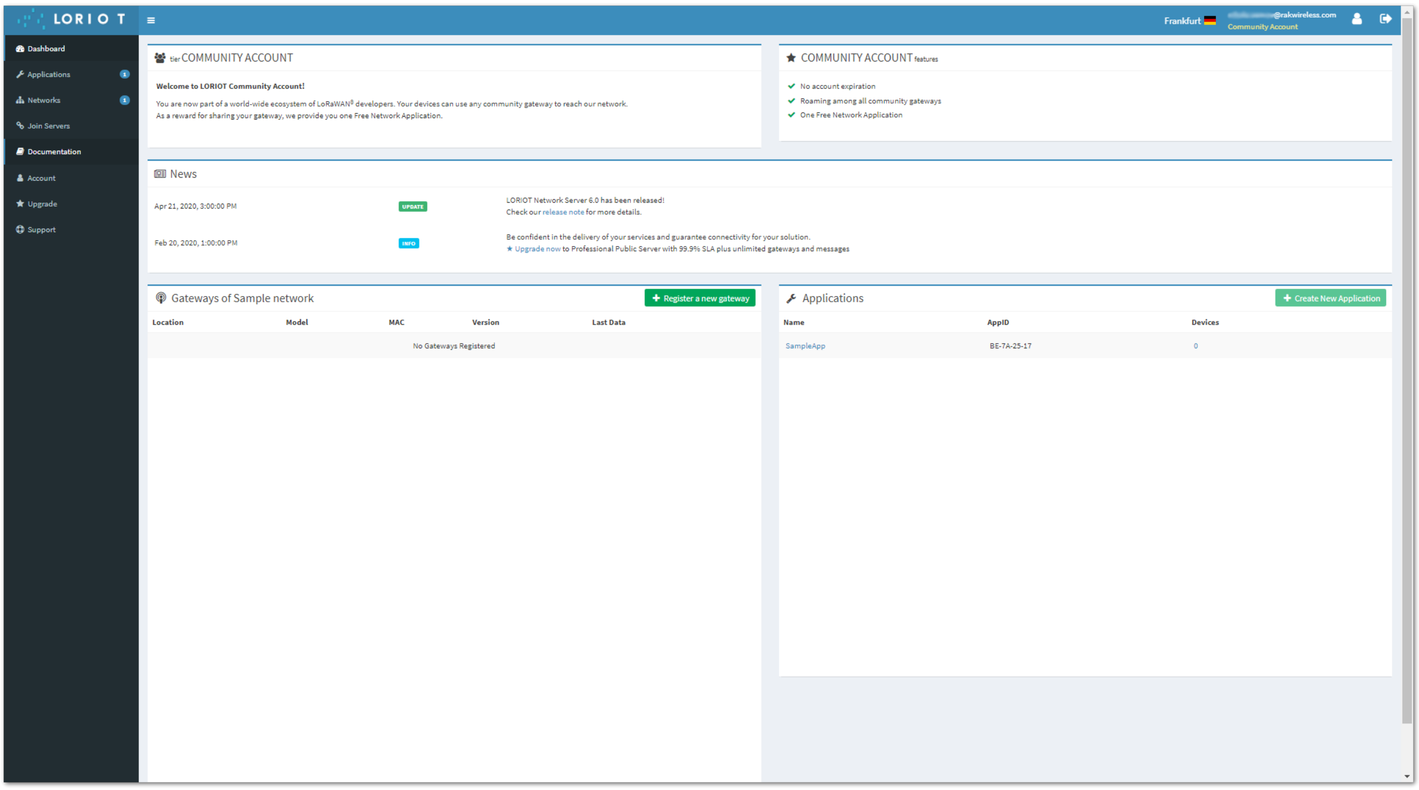
- RAK7268 WisGate Edge Lite 2

Software

- SSH Client (This tutorial will be done using PuTTY .)
- LORIOT Account

Registering the Gateway

1. Log into your LORIOT account.



tier COMMUNITY ACCOUNT

Welcome to LORIOT Community Account!

You are now part of a world-wide ecosystem of LoRaWAN® developers. Your devices can use any community gateway to reach our network.
As a reward for sharing your gateway, we provide you one Free Network Application.

COMMUNITY ACCOUNT features

- ✓ No account expiration
- ✓ Roaming among all community gateways
- ✓ One Free Network Application

News

Apr 21, 2020, 3:00:00 PM	UPDATE	LORIOT Network Server 6.0 has been released! Check our release note for more details.
Feb 20, 2020, 1:00:00 PM	INFO	Be confident in the delivery of your services and guarantee connectivity for your solution. ★ Upgrade now to Professional Public Server with 99.9% SLA plus unlimited gateways and messages

Gateways of Sample network

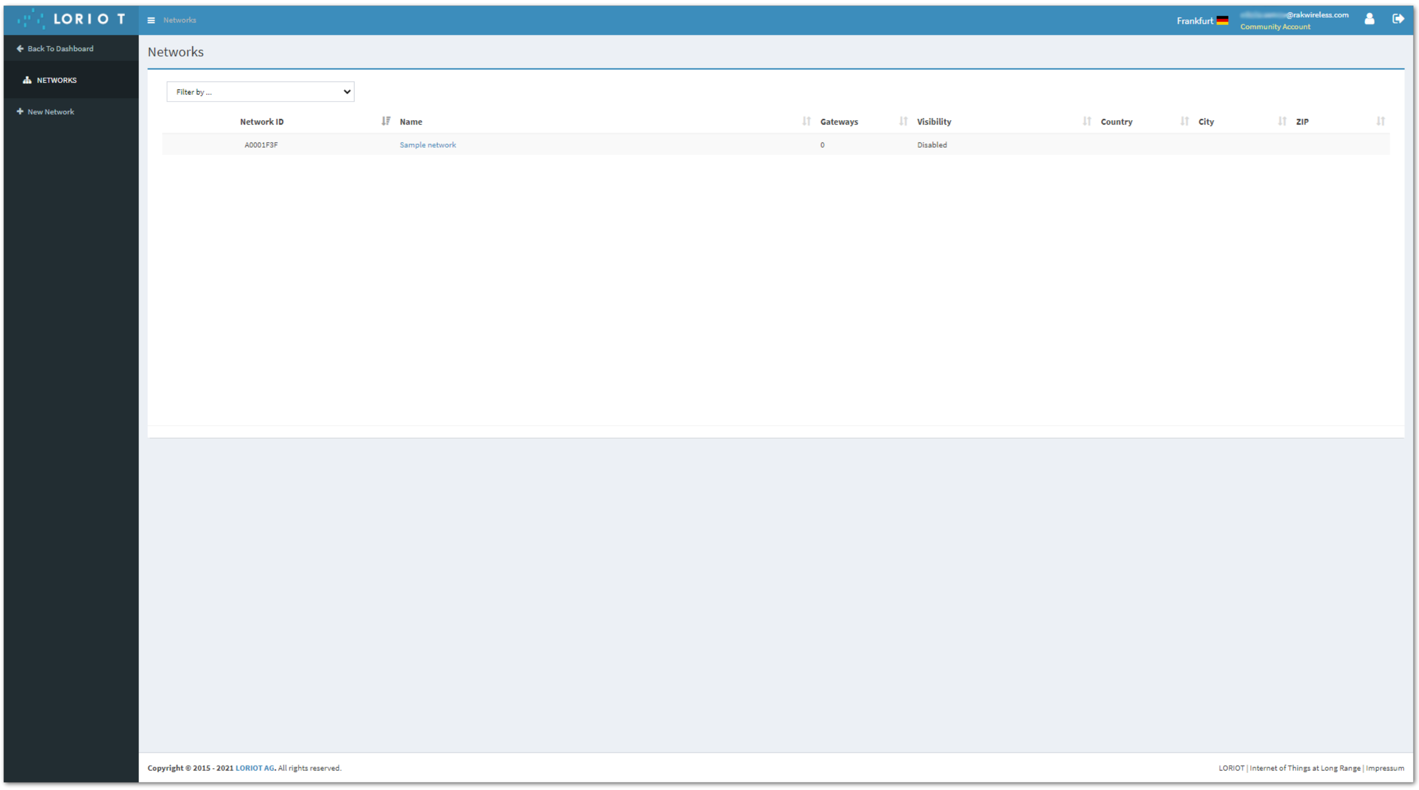
Location	Model	MAC	Version	Last Data
No Gateways Registered				

Applications

Name	AppID	Devices
SampleApp	BE-7A-25-17	0

Figure 30: LORIOT Homepage

2. Go to the **Networks** tab of the main menu on the left. You have the option to select **Simple network**, which is automatically generated when you create your account, or you can create a new one to use. For a beginner, it will be easier to use the **Simple network**.


LORIOT
Networks
Frankfurt
[redacted]@rakwireless.com
Community Account
Back To Dashboard
NETWORKS
New Network
Networks
Filter by ...
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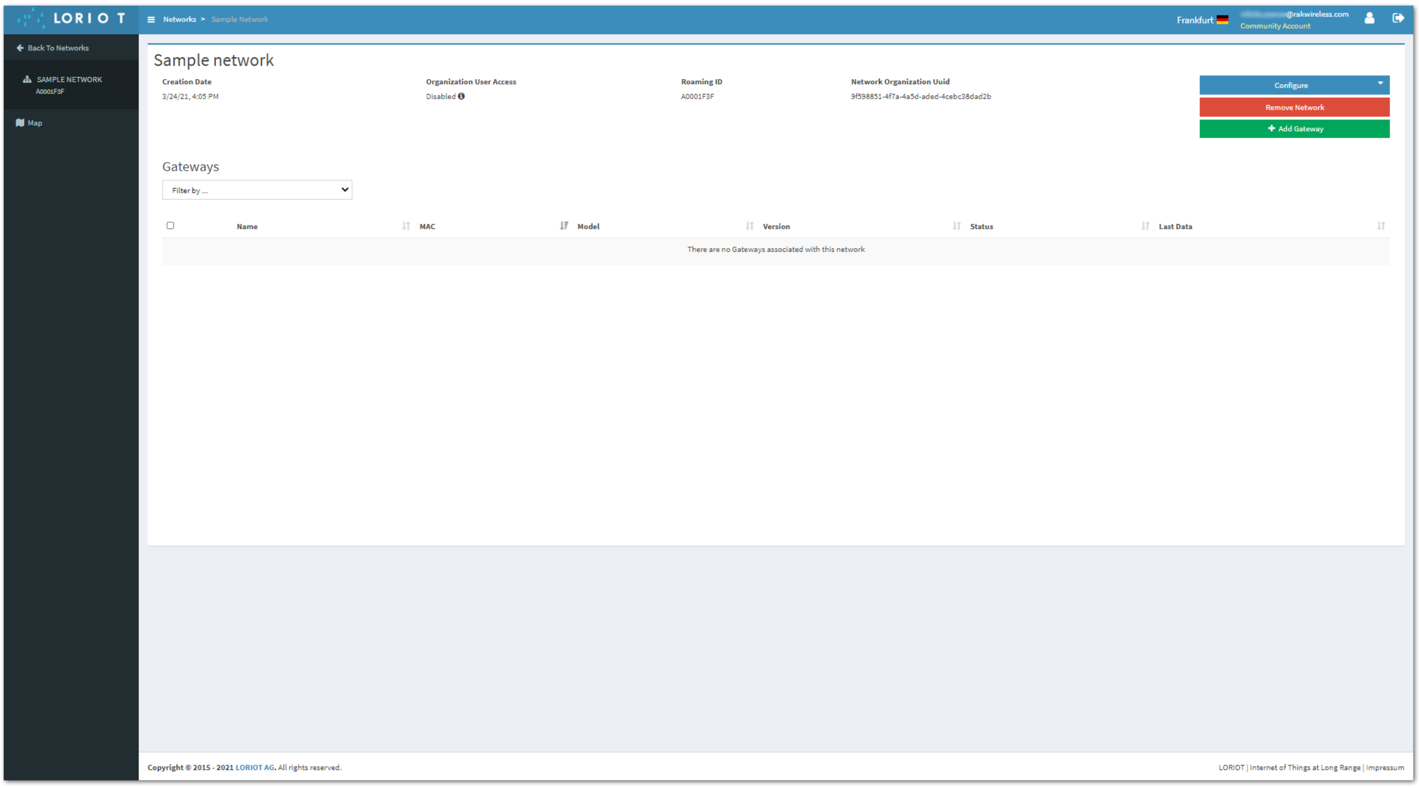
Network ID	Name	Gateways	Visibility	Country	City	ZIP
A0001F3F	Sample network	0	Disabled			

Figure 31: Networks List

3. Open the network by clicking once on its name. Then, click the **+ Add Gateway** button.


LORIOT
Networks > Sample Network
Frankfurt
[redacted]@rakwireless.com
Community Account
Back To Networks
SAMPLE NETWORK
A0001F3F
Map
Sample network
Configure
Remove Network
+ Add Gateway
Gateways
Filter by ...
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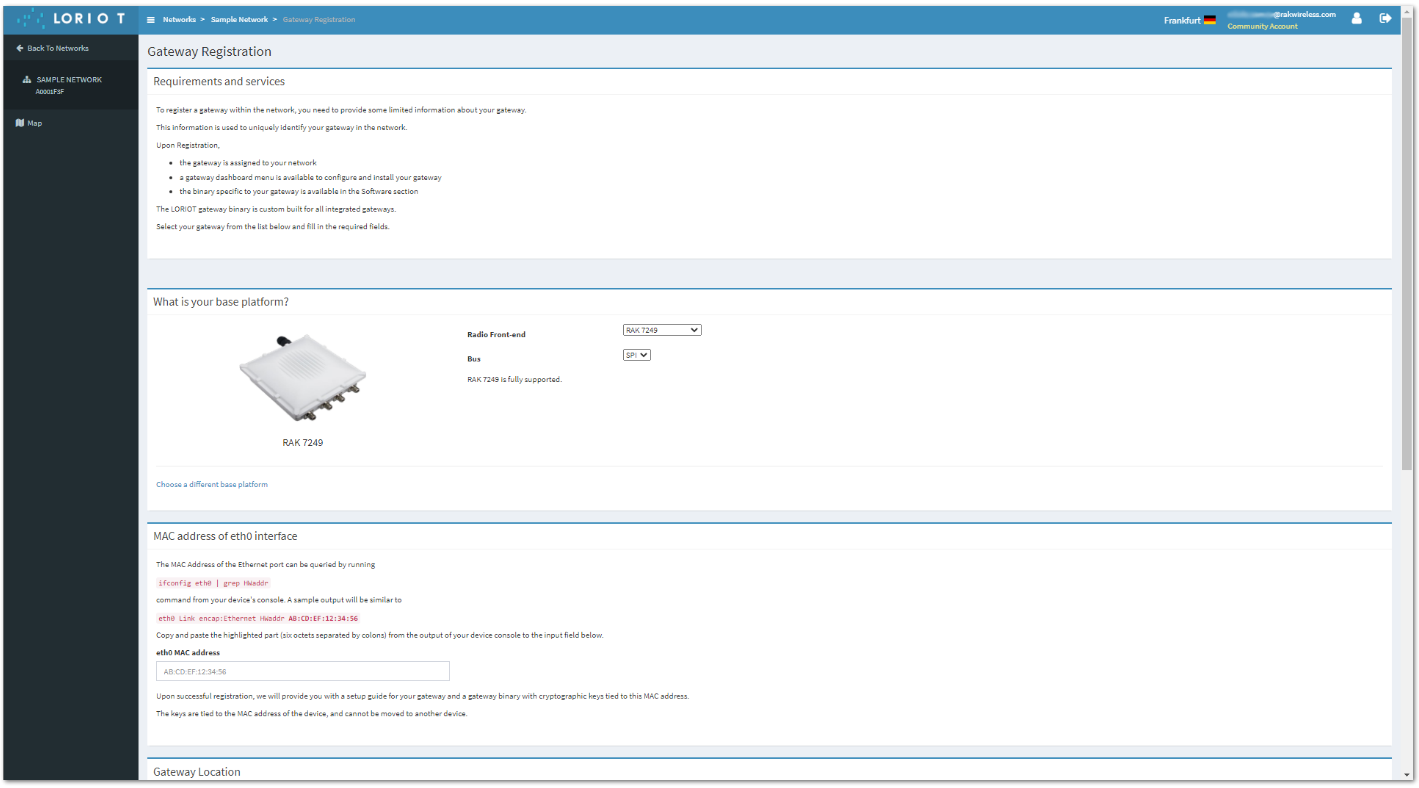
Creation Date	Organization User Access	Roaming ID	Network Organization Uuid
3/24/21, 4:05 PM	Disabled	A0001F3F	9f598851-4f7a-4a5d-aded-4cebc38dad2b

□	Name	MAC	Model	Version	Status	Last Data
There are no Gateways associated with this network						

Figure 32: Adding a gateway to the network

4. In the list of gateways, find and select RAK7249.

> 📝 **NOTE**
>
> If you are using another model gateway from the WisGate Edge series, you still need to select RAK7249 in this list. This won't affect the performance in any way.



LORIOT
Networks > Sample Network > Gateway Registration
Frankfurt
[redacted]@rakwireless.com
Community Account
Back To Networks
SAMPLE NETWORK
A0001F3F
Map

Gateway Registration

Requirements and services

To register a gateway within the network, you need to provide some limited information about your gateway.

This information is used to uniquely identify your gateway in the network.

Upon Registration,

- the gateway is assigned to your network
- a gateway dashboard menu is available to configure and install your gateway
- the binary specific to your gateway is available in the Software section

The LORIOT gateway binary is custom built for all integrated gateways.

Select your gateway from the list below and fill in the required fields.

What is your base platform?

Radio Front-end: RAK 7249

Bus: SPI

RAK 7249 is fully supported.

Choose a different base platform

MAC address of eth0 interface

The MAC Address of the Ethernet port can be queried by running

```
ifconfig eth0 | grep HWaddr
```

command from your device's console. A sample output will be similar to

```
eth0 Link encap:Ethernet HWaddr AB:CD:EF:12:34:56
```

Copy and paste the highlighted part (six octets separated by colons) from the output of your device console to the input field below.

eth0 MAC address

AB:CD:EF:12:34:56

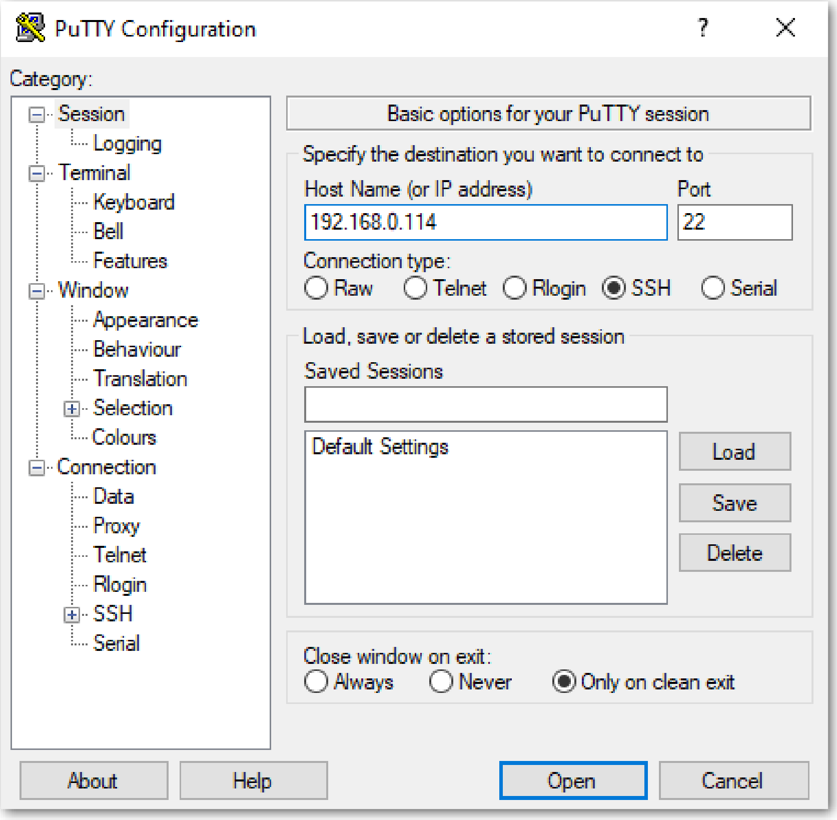
Upon successful registration, we will provide you with a setup guide for your gateway and a gateway binary with cryptographic keys tied to this MAC address.

The keys are tied to the MAC address of the device, and cannot be moved to another device.

Gateway Location

Figure 33: Selecting RAK7249

5. Now, you need to connect to your gateway via SSH. As mentioned, this tutorial will be done with the PuTTY SSH client. Open PuTTY and enter the IP address of your gateway. If your gateway is in AP mode, the address will be **192.168.230.1**.



Specify the destination you want to connect to

Host Name (or IP address): 192.168.0.114

Port: 22

Connection type: ○ Raw ○ Telnet ○ Rlogin ● SSH ○ Serial

Load, save or delete a stored session

Saved Sessions

Default Settings

Close window on exit: ○ Always ○ Never ● Only on clean exit

Figure 34: PuTTY Configuration

6. Log in with your root credentials.

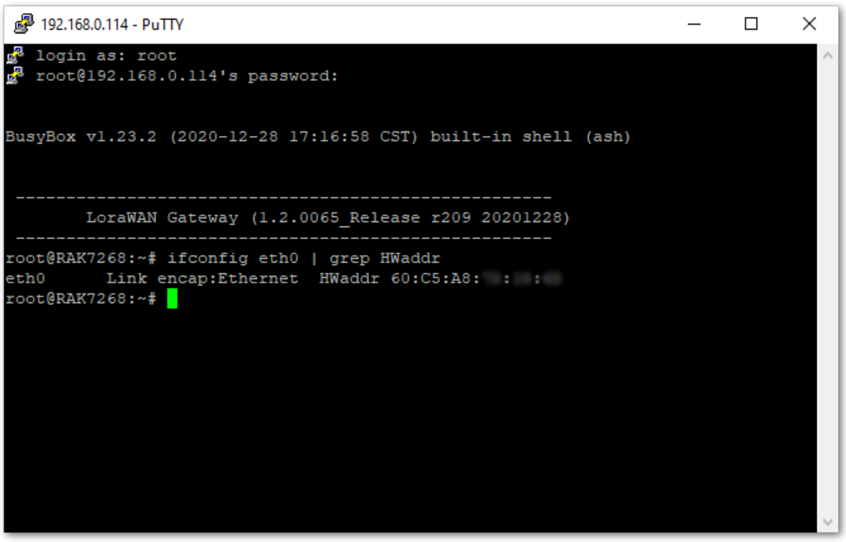
- Default username: **root**
- Password: **root**

To get the MAC address of your gateway, run the command:

```
ifconfig eth0 | grep HWaddr
```

The output should be similar to the following:

```
eth0      Link encap:Ethernet  HWaddr 60:C5:A8:XX:XX:XX
```



192.168.0.114 - PuTTY

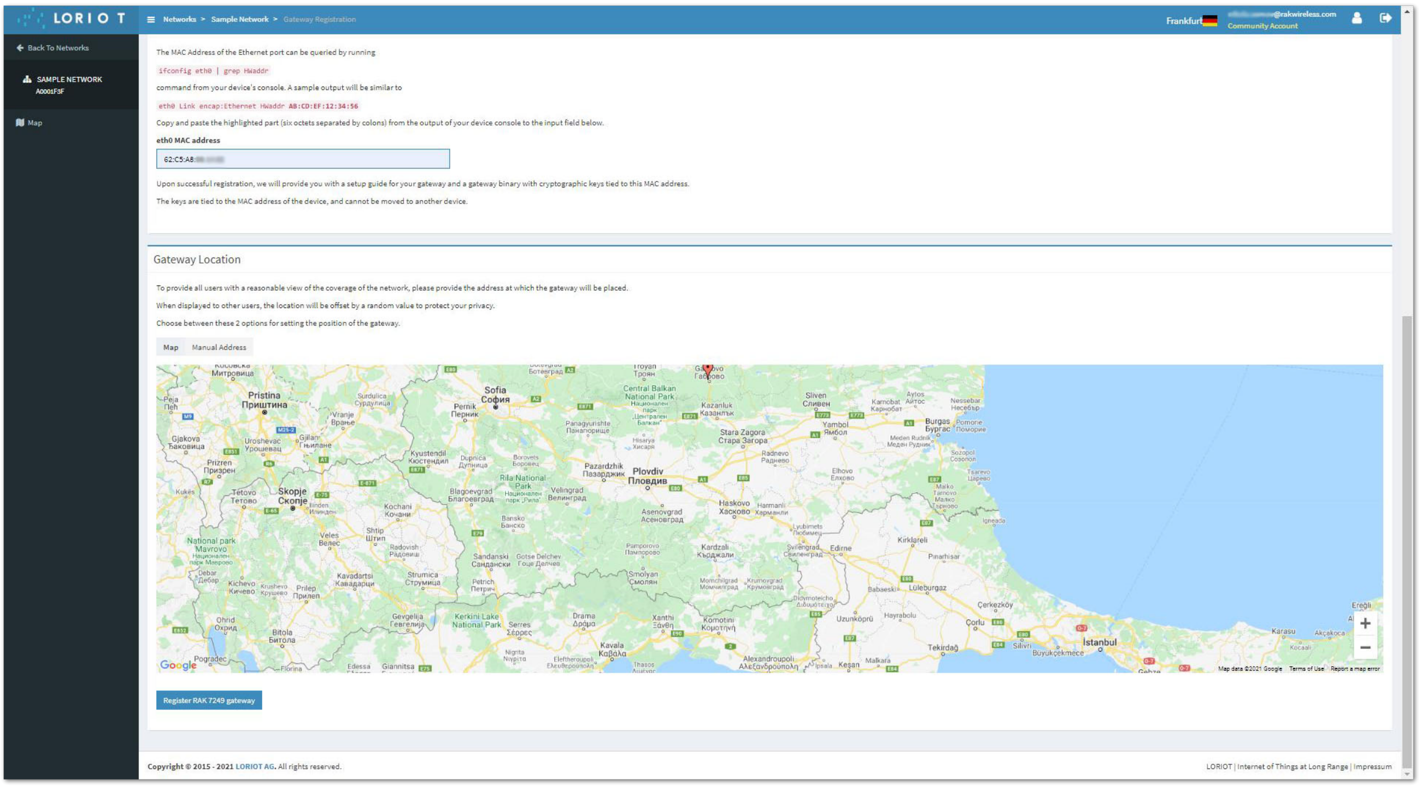
```
login as: root
root@192.168.0.114's password:


BusyBox v1.23.2 (2020-12-28 17:16:58 CST) built-in shell (ash)


 -----------------------------------------------------
        LoraWAN Gateway (1.2.0065_Release r209 20201228)
 -----------------------------------------------------
root@RAK7268:~# ifconfig eth0 | grep HWaddr
eth0      Link encap:Ethernet  HWaddr 60:C5:A8:[redacted]
root@RAK7268:~# 
```

Figure 35: Getting the MAC address of the gateway

7. Copy the MAC address and fill it out in the registration form for the gateway in LORIOT. Scroll down and press the **Register RAK7249 gateway** button.



LORIOT
Networks > Sample Network > Gateway Registration
Frankfurt
[redacted]@rakwireless.com
Community Account
Back To Networks
SAMPLE NETWORK
A0001F3F
Map

The MAC Address of the Ethernet port can be queried by running

`ifconfig eth0 | grep HWaddr`

command from your device's console. A sample output will be similar to

`eth0 Link encap:Ethernet HWaddr AB:CD:EF:12:34:56`

Copy and paste the highlighted part (six octets separated by colons) from the output of your device console to the input field below.

eth0 MAC address

62:C5:A8:[redacted]

Upon successful registration, we will provide you with a setup guide for your gateway and a gateway binary with cryptographic keys tied to this MAC address.

The keys are tied to the MAC address of the device, and cannot be moved to another device.

Gateway Location

To provide all users with a reasonable view of the coverage of the network, please provide the address at which the gateway will be placed.

When displayed to other users, the location will be offset by a random value to protect your privacy.

Choose between these 2 options for setting the position of the gateway.

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Figure 36: Filling out the MAC address

8. The gateway is now registered and you need to add a security layer to the connection. It is provided by LORIOT's Gateway Software. To get it installed, run the following set of commands in the PuTTY.

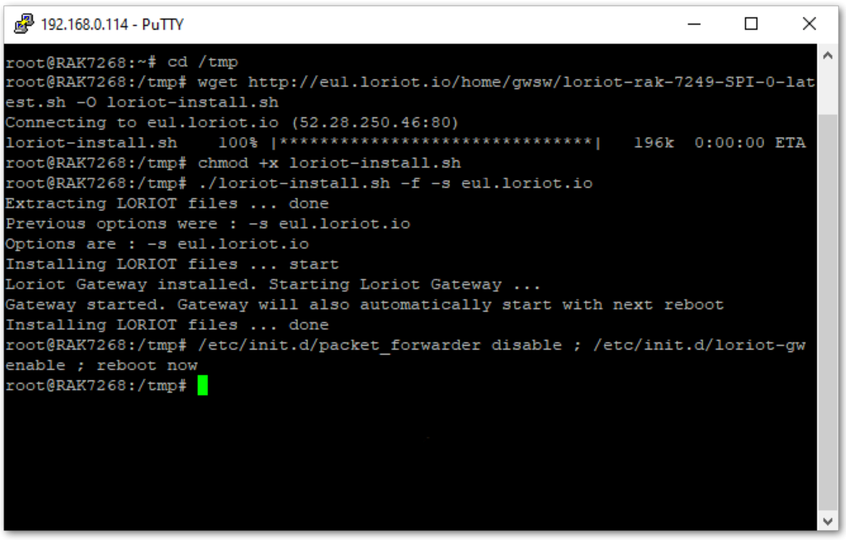
```
cd /tmp
```

```
wget http://eu1.loriot.io/home/gwsw/loriot-rak-7249-SPI-0-latest.sh -O loriot-install.sh
```

```
chmod +x loriot-install.sh
```

```
./loriot-install.sh -f -s eu1.loriot.io
```

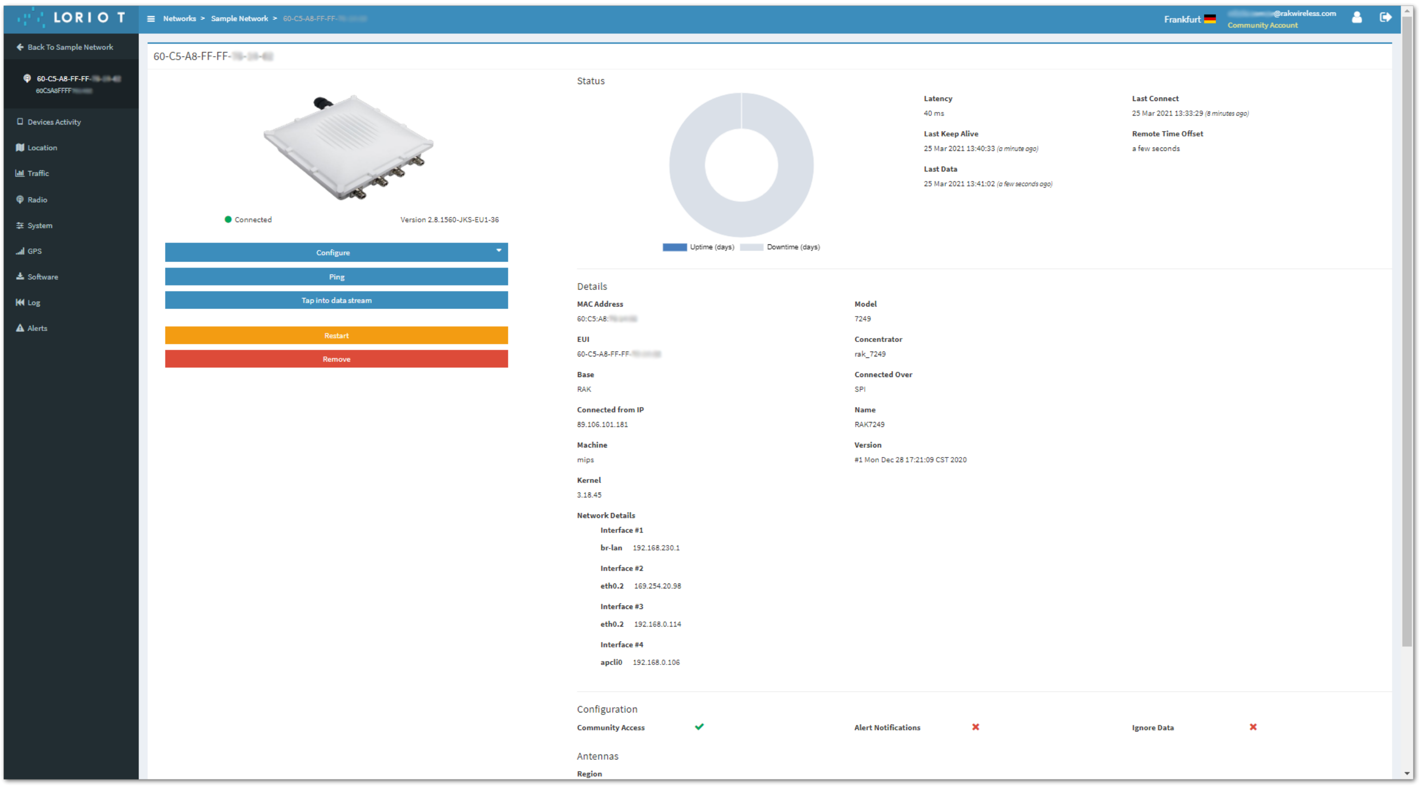
```
/etc/init.d/packet_forwarder disable ; /etc/init.d/loriot-gw enable ; reboot now
```



```
root@RAK7268:~# cd /tmp
root@RAK7268:/tmp# wget http://eu1.loriot.io/home/gwsw/loriot-rak-7249-SPI-0-lat
est.sh -O loriot-install.sh
Connecting to eu1.loriot.io (52.28.250.46:80)
loriot-install.sh    100% |*****************************|   196k  0:00:00 ETA
root@RAK7268:/tmp# chmod +x loriot-install.sh
root@RAK7268:/tmp# ./loriot-install.sh -f -s eu1.loriot.io
Extracting LORIOT files ... done
Previous options were : -s eu1.loriot.io
Options are : -s eu1.loriot.io
Installing LORIOT files ... start
Loriot Gateway installed. Starting Loriot Gateway ...
Gateway started. Gateway will also automatically start with next reboot
Installing LORIOT files ... done
root@RAK7268:/tmp# /etc/init.d/packet_forwarder disable ; /etc/init.d/loriot-gw
enable ; reboot now
root@RAK7268:/tmp# 
```

Figure 37: Installing LORIOT software

Your gateway is now registered and connected to LORIOT.



60-C5-A8-FF-FF-[redacted]

● Connected
Version 2.8.1560-JKS-EU1-36

Status

Latency
40 ms

Last Keep Alive
25 Mar 2021 13:40:33 *(a minute ago)*

Last Data
25 Mar 2021 13:41:02 *(a few seconds ago)*

Last Connect
25 Mar 2021 13:33:29 *(8 minutes ago)*

Remote Time Offset
a few seconds

Details

MAC Address
60:C5:A8:[redacted]

EUI
60-C5-A8-FF-FF-[redacted]

Base
RAK

Connected from IP
89.106.101.181

Machine
mips

Kernel
3.18.45

Model
7249

Concentrator
rak_7249

Connected Over
SPI

Name
RAK7249

Version
#1 Mon Dec 28 17:21:09 CST 2020

Network Details

Interface #1
br-lan 192.168.230.1

Interface #2
eth0.2 169.254.20.98

Interface #3
eth0.2 192.168.0.114

Interface #4
apcli0 192.168.0.106

Configuration

Community Access ✓ **Alert Notifications** ✗ **Ignore Data** ✗

Antennas

Region

Figure 38: Successful Connection

Last Updated: 9/17/2021, 11:16:42 AM