



TEKTELIC Communications Inc.  
7657 10th Street NE Calgary, Alberta  
Canada, T2E 8X2

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# STORK/CHICKADEE

## End-to-End Device Onboarding

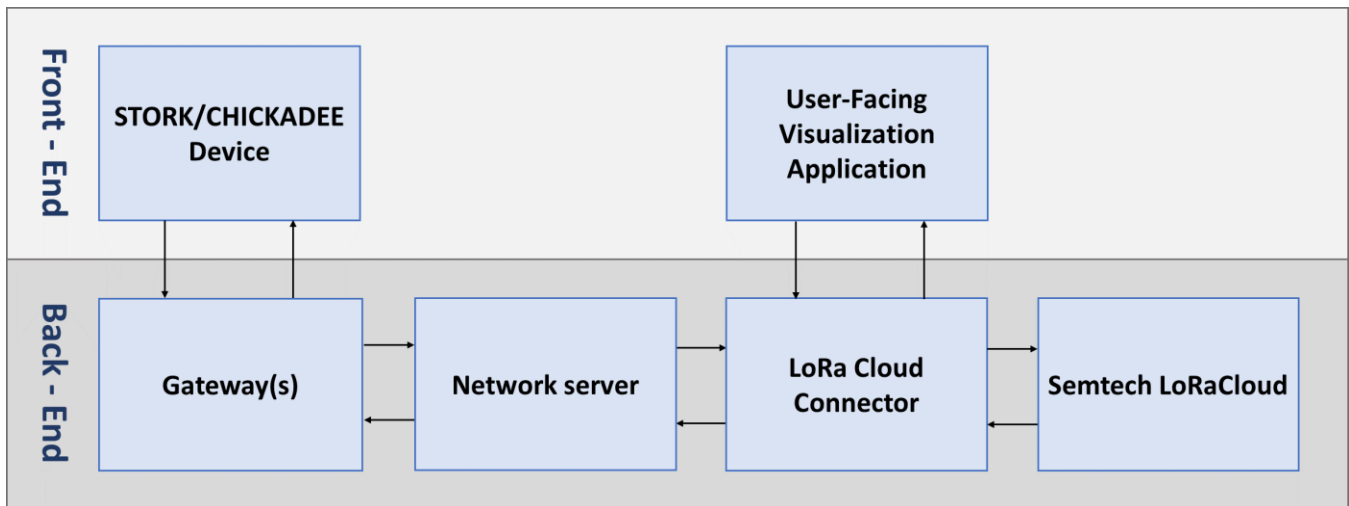
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# 1. Introduction

## 1.1. Setup components

This document describes the components involved and the steps required to set up and work with a STORK/CHICKADEE device end-to-end from edge device to user-facing application. The main components of the solution are described in the picture:



Described architecture is based on [recommended by Semtech](#) (creators of LoRaCloud and the LR1110 based family of devices) method to build a complete system.

## 1.2. Setup steps

The setup involves steps that will be described in further sections of this document:

1. **Onboard devices to LoRaWAN network:** using LeapX or straight on the Network Server.
2. **Setup LoRa Cloud Account:** create a new account or use your current one for managing the setup.
3. **Configure your HTTP server:** making it available for public network, install Docker application and ensure “key.pem” file is available.
4. **Integrate LoRa Cloud with Network Server:** Creating a connection between LoRaWAN network and the Semtech LoRa Cloud service to facilitate the WiFi and GPS localization:
  - a. GPS/WiFi scan uplink to LoRa Cloud;
  - b. Almanac updates downlink to device;
  - c. Some other device back-end management.
5. **Connect visualization application:** Creating a connection between LoRa Cloud Connector and Application to visualize device location to the end-user.

This document will provide extended instruction on how to use Tektelic solution with minimal programming (using full Tektelic solution) and some guidance on different deployment options.

## 2. Setup flow

This option will work for you if:

- You're using both devices and LoRa infrastructure (gateways and Network Server) from Tektelic
- One of 2 options of user-facing visualization application works for you:
  - Using AWS visualization
  - Integrating your own application to AWS Service (for guidance on how to do this after described steps, please contact AWS IoT Core)

### 2.1 Onboarding the device to LoRaWAN Network with LeapX

You can use Tektelic custom LeapX application for devices onboarding to LoRaWAN network. LeapX mobile application gives users the ability to securely onboard the Device by simply scanning a QR code and visualize data. To add device to the network using LeapX App please use [LeapX Quick Start Guide](#).

As a result of this step, you will have the device onboarded to LoRaWAN Network.

### 2.2 Semtech LoRa Cloud™ Flow Guide

#### 2.2.1 Introduction to Semtech LoRa Cloud™

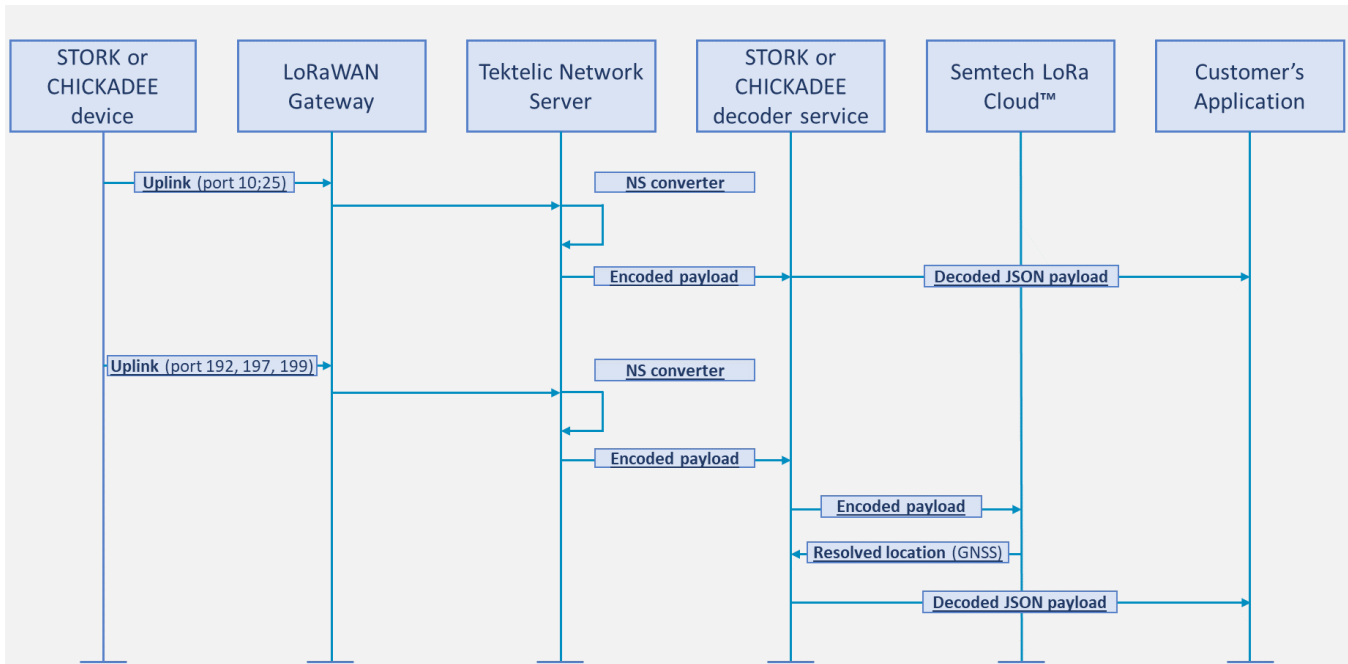
Tektelic Semtech's LoRa Cloud™ Flow is a service provided as a Docker image that acts as the Connector between Tektelic LoRaWAN network server, LoRa Cloud, and Application server. The Tektelic Semtech's LoRa Cloud™ Flow Guide can be used to deploy the service on the cloud or on-premise.

Requirements:

- 1.The TEKTELIC LoRaWAN® gateway that is onboarded on the TEKTELIC Network Server and is online.
- 2.The TEKTELIC LoRaWAN® device, STORK or CHICKADEE, that is onboarded on the TEKTELIC Network Server and is online.
- 3.The user's HTTP server is available via a public network.
- 4.The Docker application is installed on the user's HTTP server.
- 5."key.pem" file with the public key of the user's HTTP server is available.

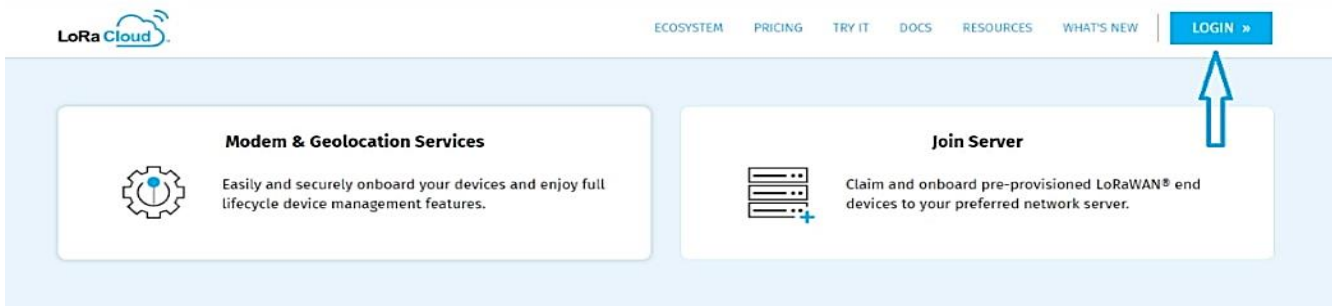
Please use this link to manually download the service's docker image: <https://hub.docker.com/r/tektelicdocker/stork-payload-decoder>

## Integration Flow



### 2.2.2 Semtech LoRa Cloud™ Account Setup

1. Open Semtech LoRa Cloud™ instance: <https://www.loracloud.com/> and click on the “**Login**” button.



### Modem & Geolocation Services



Modem & Geolocation Services enable you to securely onboard and get the most of your LoRaWAN end devices thanks to a set of full lifecycle device management features. Enjoy a simplified process to develop your ultra low-power geolocation solution enabling unprecedented use cases.

**Geolocation Services** help you obtain the latitude and longitude of devices through either the LoRa Edge™ Platform or TDOA (Time Difference of Arrival) Geolocation. The LoRa Edge™ Platform runs on two combined technologies to fully cover your entire device journey:

- Wi-Fi for indoors
- GNSS (GPS and BeiDou) for outdoors

The LoRa Edge Platform significantly reduces power consumption by solving the location of the asset in a Cloud-based solver instead of on the device itself. Additional power is saved by removing all downlinks to the device. Consequently, the device's battery life can reach up to 10 years.

**Modem Services** complement your device management solution by giving you fine grain control of your LoRaWAN end devices. Obtain modem status information such as: *system status, firmware version, voltage, downlink signal quality and time since last downlink*.

And send control commands to the modem such as: *rejoin, reset, set ADR and mute*.

Modem Services provide two protocols to reliably receive application data from the reporting devices without ever losing data: large file upload and streaming. These protocols go by the name Advanced Transport Services and ensure applications can send their data as over a socket.

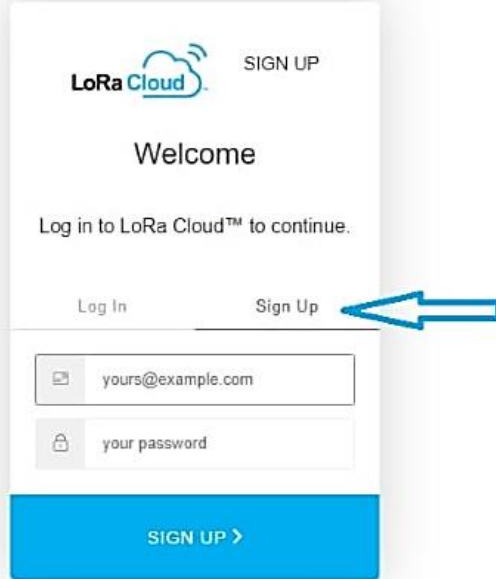
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[GEOLOCATION SERVICES OVERVIEW »](#)

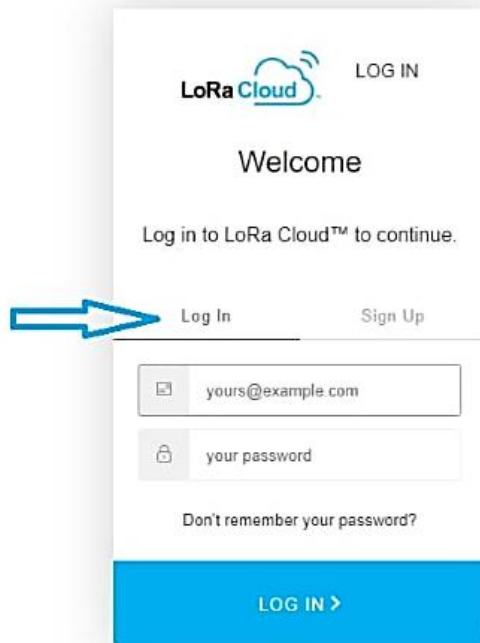
[MODEM SERVICES OVERVIEW »](#)

[VIEW DOCUMENTATION »](#)

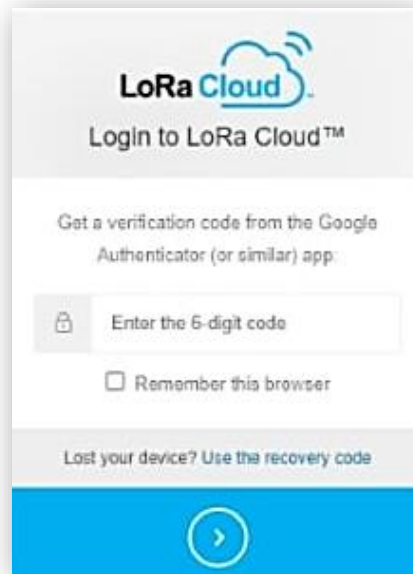
2. For users that already have a Semtech LoRa Cloud™ account, please choose the “Log In” option and fill out the fields with the account credentials. Click on the “**Log In**” button to enter your Semtech’s LoRa Cloud™ account.



3. For new users of Semtech LoRa Cloud™, please choose the “**Sign Up**” option and fill out the fields with the credentials that will be used for the account. Click on the “Sign Up” button to proceed with the account registration.



4. After the registration part has been successfully finished/the user has successfully entered the existing Semtech's LoRa Cloud™ account, please complete the 2FA verification using either Google Authenticator or the SMS message sent to the user's mobile number mentioned during the registration part.



5. After the user has successfully entered their Semtech LoRa Cloud™ account, click on the “Services” section and choose the “Modem & Geolocation Services” option.



## Modem & Geolocation Services

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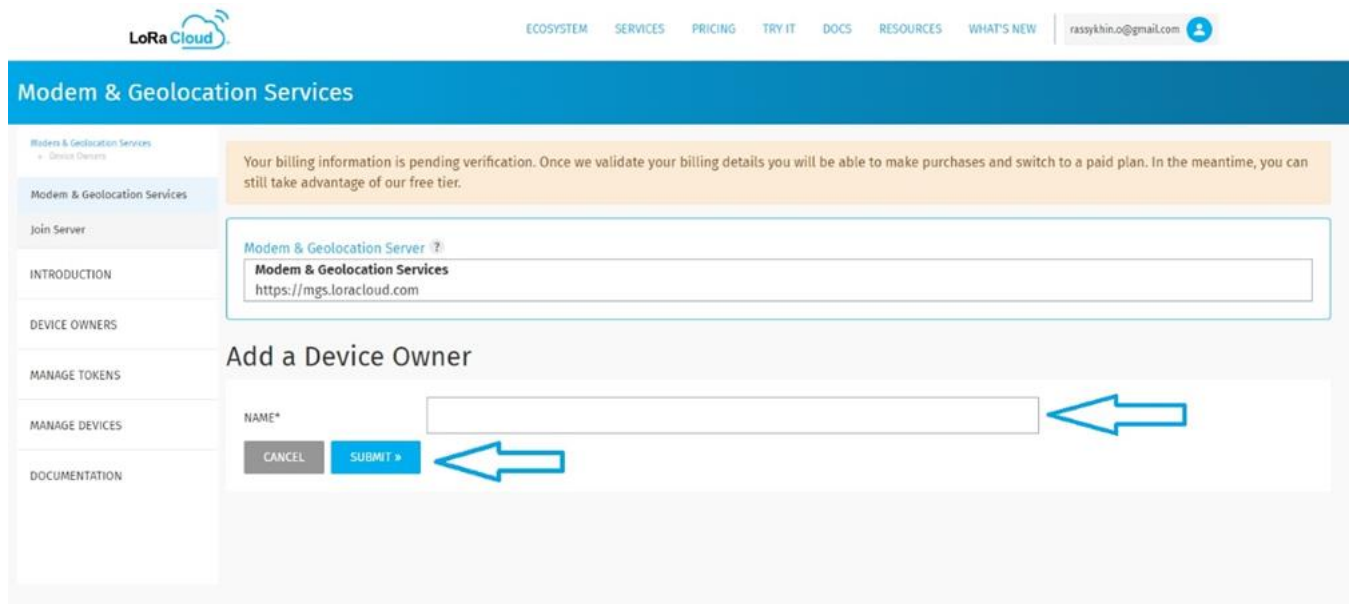
6. On the “Modem & Geolocation Services” page, choose the “Device Owners” section.

7. On the “Manage Device Owners” screen, click on the “Create New Owner” button.

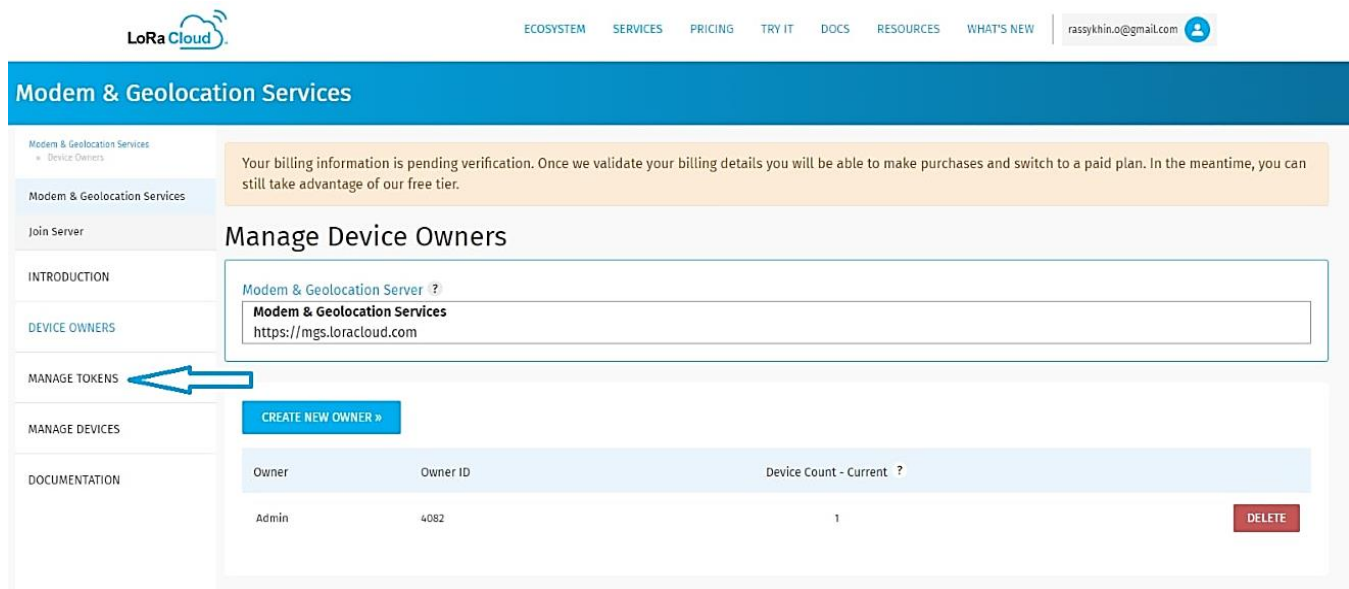
Owner	Owner ID	Device Count - Current ?	
Admin	4082	1	DELETE



8. Enter the name that will be used for the “Device Owner” and click on the “Submit” button to save the “Device Owner” entity.



9. After the new device owner entity has been successfully created, choose the “Manage Tokens” section.



10. On the “Manage Tokens” page, find the first generated token on the list and click on the “Copy” button to save the token. This token will be used in the future.



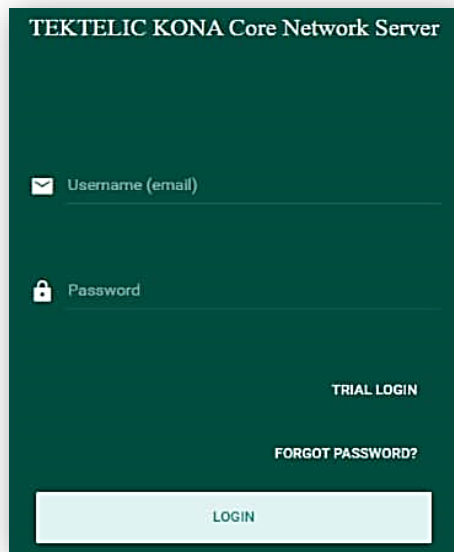
- To validate that the server has been successfully booted, execute the following command: `docker ps`
  3. To check the logs from the server, execute the following command:

`docker logs XX`

where "XX" is the first two ID numbers of the created Docker container

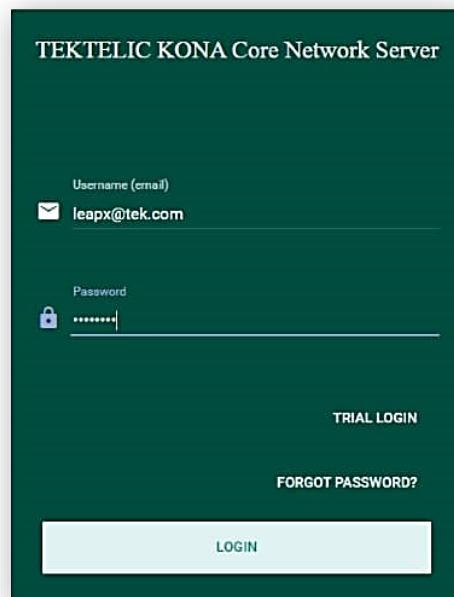
## 2.2.4 TEKTELIC Network Server Integration

1. Open the TEKTELIC Network Server instance



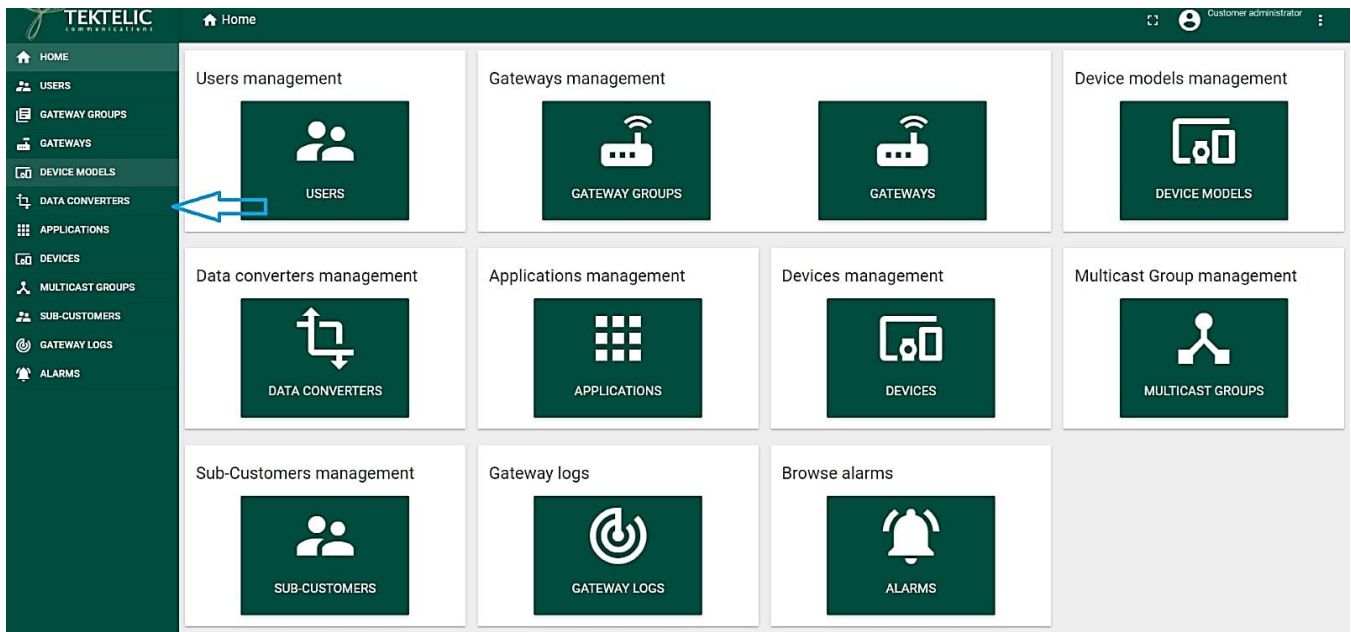
The screenshot shows the login interface for the TEKTELIC KONA Core Network Server. The page has a dark green background with white text. At the top, it says "TEKTELIC KONA Core Network Server". Below this, there are two input fields: "Username (email)" with an envelope icon and "Password" with a lock icon. To the right of the password field, there are two links: "TRIAL LOGIN" and "FORGOT PASSWORD?". At the bottom, there is a large white button labeled "LOGIN".

2. Log in using the TEKTELIC Network Server credentials.

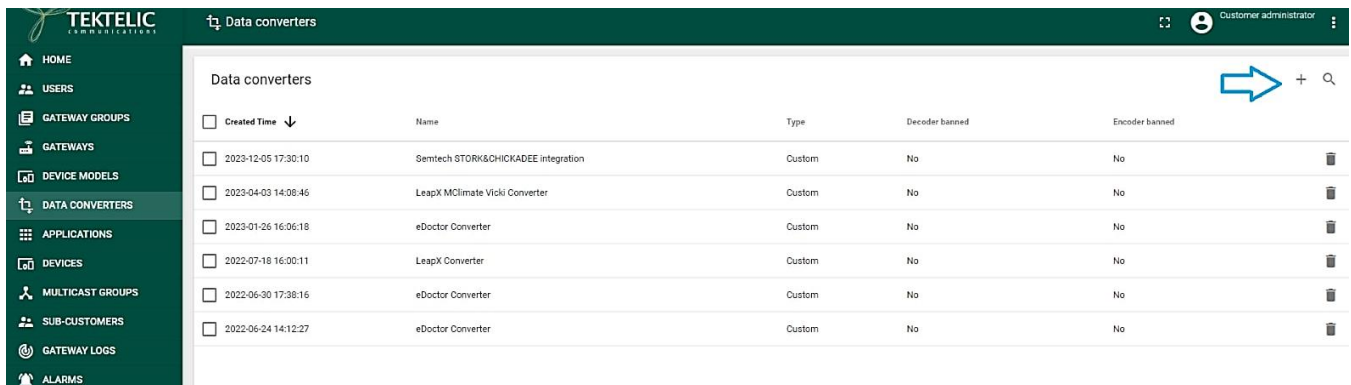


This screenshot shows the same login page as the previous one, but with the email address "leapx@tek.com" entered in the "Username (email)" field and a password of seven asterisks in the "Password" field. The "LOGIN" button is now highlighted in white, indicating it is ready to be clicked.

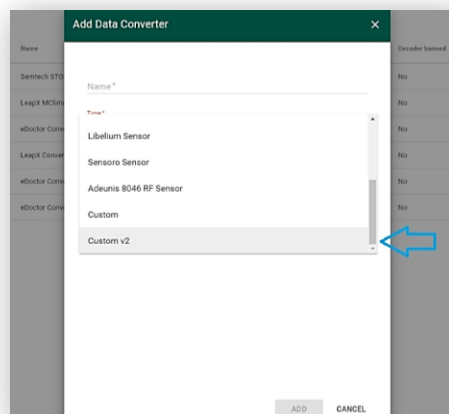
3. Choose the “Data Converters” section.



4. Click on the “+” button to add a new data converter.



5. Click on the “Type” drop-down list and choose “Custom”.



6. Replace values in the decoder/encoder fields with next values:

**Decoder:**

```
var arr = [];  
for (var i = 0; i < bytes.length; ++i) {  
  arr.push(bytes[i]);  
}  
return {"bytes": JSON.stringify(arr), "port": port, "payload length": bytes.length};
```

**Encoder:**

```
// Encode downlink messages sent in  
// Base64 format as an array or buffer of bytes.  
function atob(input) {  
  var chars = 'ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789+/';  
  var str = String(input).replace(/=[^$]/, ""); // #31: ExtendScript bad parse of /=  
  if (str.length % 4 !== 1) {  
    throw new InvalidCharacterError("'atob' failed: The string to be decoded is not correctly encoded.");  
  }  
  for (  
    var bc = 0, bs, buffer, idx = 0, output = "";  
    buffer = str.charAt(idx++);  
    ~buffer && (bs = bc % 4 ? bs * 64 + buffer : buffer, bc++ % 4) ? output += String.fromCharCode(255 & bs >> (-2 * bc & 6)) : 0  
  ) {  
    buffer = chars.indexOf(buffer);  
  }  
  return output;  
}  
'function base64ToArray(base64) {  
  var binary_string = atob(base64);  
  var len = binary_string.length;  
  var result = [];  
  for (var i = 0; i < len; i++) {  
    result.push(binary_string.charCodeAt(i));  
  }  
  return result;  
}  
if (data.params) {  
  var bytes = base64ToArray(data.params.data);  
  return {"port": data.params.port, "bytes": bytes};  
}  
return {"port": 0, "bytes": [0x00]};
```

7. Choose the name for this data decoder and further click on the “Add” button.

**Add Data Converter**

Name\*  
decoder 1

Type\*  
Custom v2

Decoder  
function decodeUpLink(input) {  
1 // input object structure:  
2 // - bytes - int[]  
3 // - fPort - int  
4 // - recvTime - Date (needs type check)  
5 // - tektelicMetadata - Object  
6  
7- if (input.recvTime instanceof Date) {  
8 // date operations  
9 }  
10  
11 // output object structure:  
}  
}

Encoder  
function encodeDownLink(input) {  
1 // input object structure:  
2 // - data - Object (customer-defined)  
3  
4  
5 // output object structure:  
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ADD CANCEL

8. Choose the “Applications” section

TEKTELIC COMMUNICATIONS

Home Customer administrator

HOME

USERS

GATEWAY GROUPS

GATEWAYS

DEVICE MODELS

DATA CONVERTERS

APPLICATIONS

DEVICES

MULTICAST GROUPS

SUB-CUSTOMERS

GATEWAY LOGS

ALARMS

Users management  
USERS

Gateways management  
GATEWAY GROUPS  
GATEWAYS

Device models management  
DEVICE MODELS

Data converters management  
DATA CONVERTERS

Applications management  
APPLICATIONS

Devices management  
DEVICES

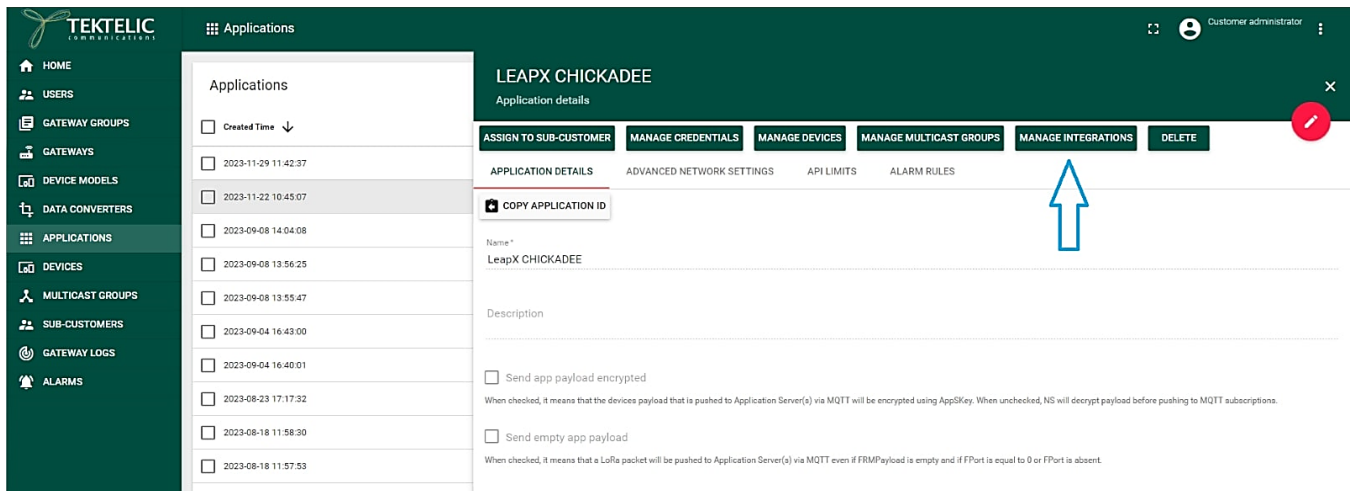
Multicast Group management  
MULTICAST GROUPS

Sub-Customers management  
SUB-CUSTOMERS

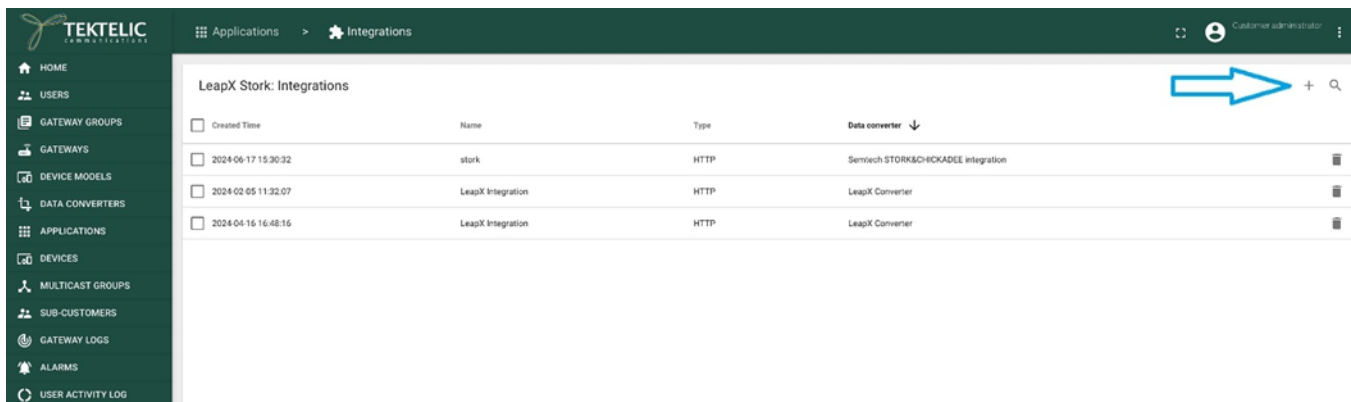
Gateway logs  
GATEWAY LOGS

Browse alarms  
ALARMS

- Click on the application where your STORK or CHICKADEE device is located to open the pop-up menu. Choose **“Manage Integrations.”**



- Click on the **“+”** button to add a new integration.



- Set up the name for the integration

**“Type”**: “HTTP”;

**“Data Converter”**: choose the data converter created beforehand;

**“Application Address”**: use the address of the HTTP server with the Docker container;

**“Port”**: 443; **“Base Path”**: /; **“Enable HTTPS”**: checked.

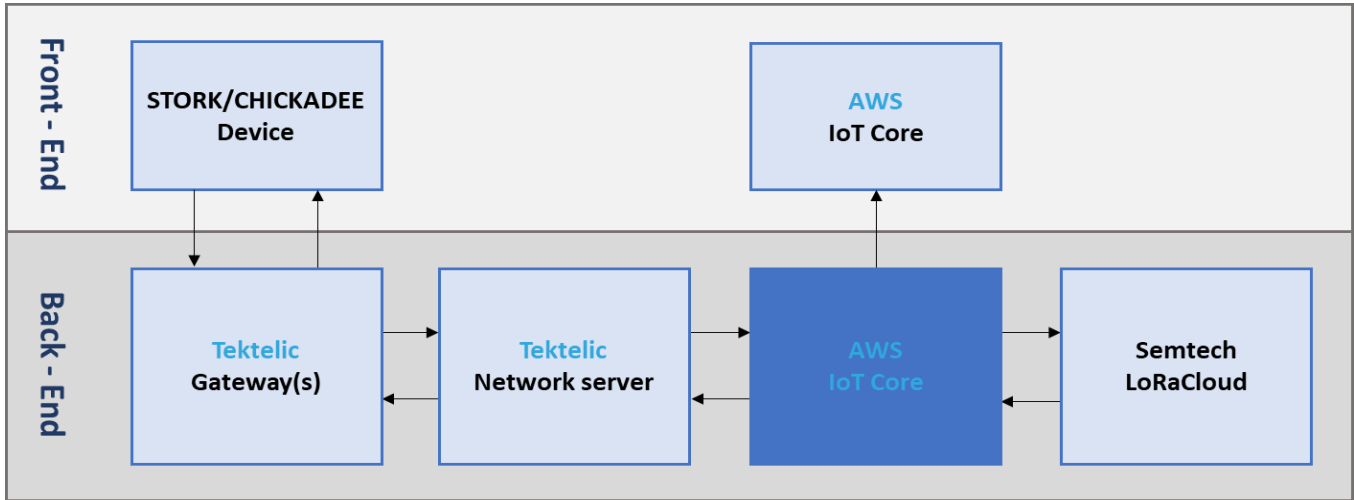
- Click on the **“Add”** button to create an integration.

## 2.3 End-to-End Solution Using AWS (Amazon Web Services)

The AWS IoT Core - Device Location Service provides a scalable solution for using STORK and CHICKADEE, requiring some programming and cloud computing knowledge.

If you don't have an AWS account, refer to the instructions in the guide here. The relevant sections are Sign up for an AWS account and create an administrative user. Once you have administrative user already set up, proceed with the steps described below.

As a result, you will have the device onboarded to AWS IoT where some visualization is available. After this step system diagram for this particular case will look like this:

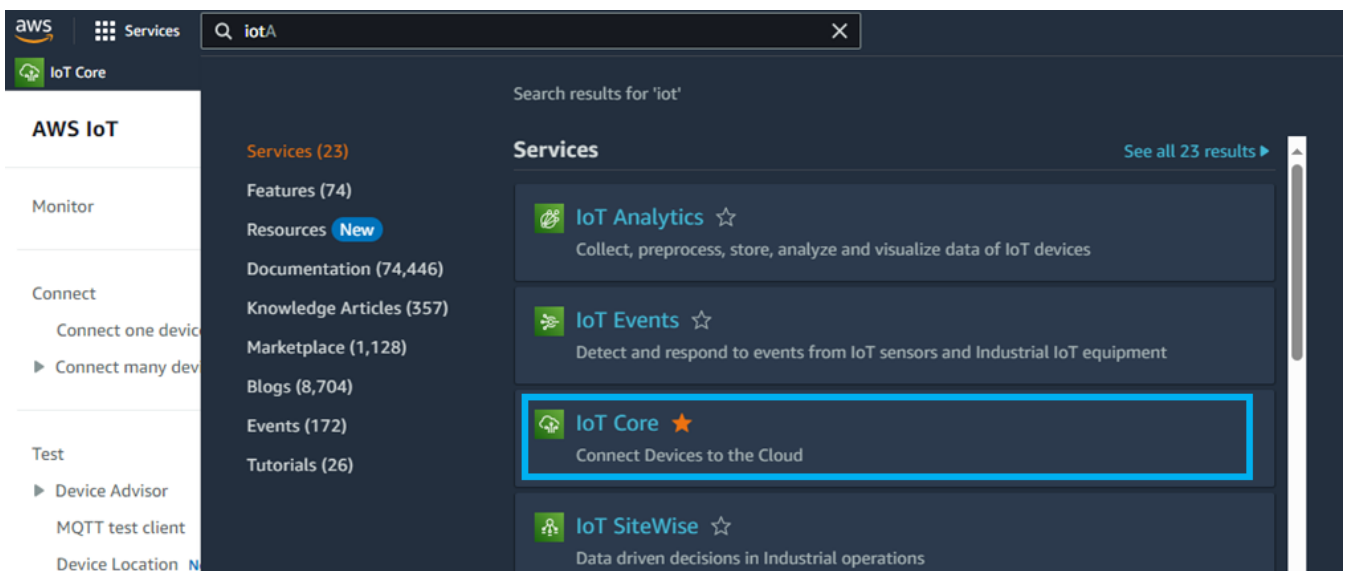


### 2.3.1 Onboard the LoRaWAN gateway to AWS IoT Core for LoRaWAN

The gateway commissioning process can be found here: Onboard your gateways to AWS IoT Core for LoRaWAN - [AWS IoT Core](#) (amazon.com)

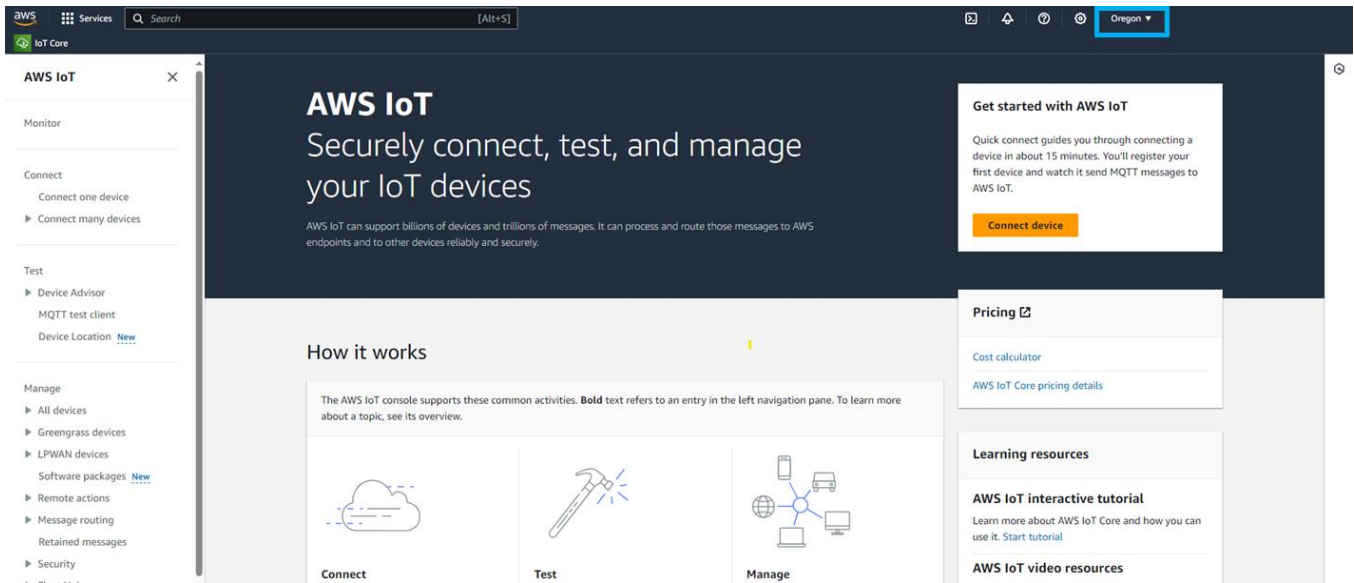
### 2.3.2 Getting Started Guide

1. On the AWS Console, navigate to the search box and search for **IoT Core**.

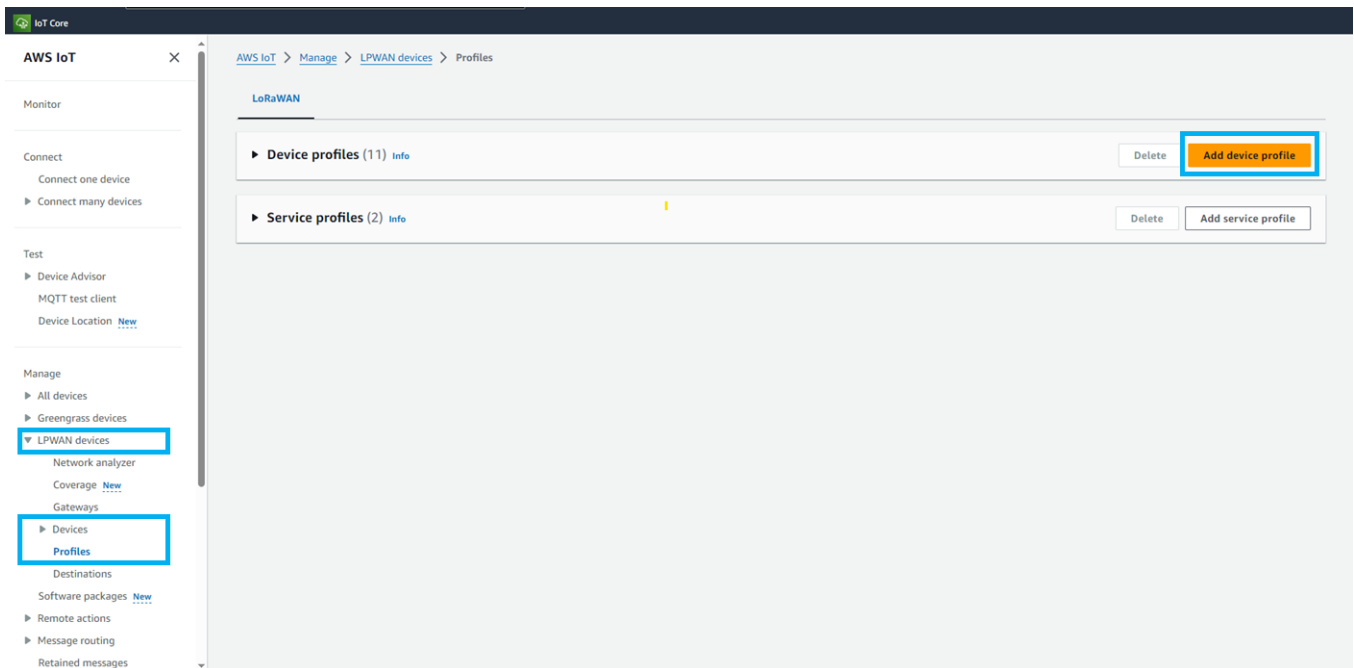




- Please also confirm that AWS IoT core is available upon your selection of region, this guide used Oregon (us-west-2).



- Navigate to the drop-down menu on the left, expand LPWAN devices, and finally select Profiles.



- Choose "Add device profile" and input your device profile accordingly. Currently STORK uses LoRaWAN version 1.0.3 and regional parameter v1.0.3rA. Name your profile ("example" in this document). Once finished, click on "Add service profile".

AWS IoT > Manage > LPWAN devices > 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.

**Select a default profile and customize - optional**  
Default profiles are based on your selected LoRaWAN OTAA device class and your LoRaWAN radio frequency band. You may need to customized your profile per your device vendor specifications.

Select default profile ▼

**Device profile name**  
Type a descriptive name for this device profile.  
Example OTAA

**Frequency band (RFRegion)**  
Choose the LoRa supported frequency band for this profile.  
US915

**MAC version**  
The MACVersion of the LoRaWAN devices that use this profile.  
Choose a MAC version ▼

**Regional parameters version**  
Select the region parameters version identifier for this profile.  
RP002-1.0.1 (recommended) ▼

**MaxEIRP**  
Enter the MaxEIRP value for this device profile.  
13

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

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

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

▶ Optional settings

**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 device profile**

5. Navigate to the drop-down menu on the left, expand LPWAN devices, and finally select “Destinations”. Choose “Add destination”.

AWS IoT

AWS IoT > Manage > LPWAN devices > Destinations

**Destinations (4)** Info Edit Delete **Add destination**

Filter destinations

Destination name	Expression	ExpressionType
<input type="radio"/> AWS_device_location_rule_test_location_data	Device_Location_Rule_position_data	RuleName
<input type="radio"/> AWS_IoT_Core_Device_Location_Test	Device_Location_Rule	RuleName
<input type="radio"/> newSemtechLoRaCloudMGS	newSemtechLoRaCloudMGS	RuleName
<input type="radio"/> SemtechLoRaCloudMGS	SemtechLoRaCloudMGS	RuleName

Monitor

Connect

- Connect one device
- Connect many devices

Test

- Device Advisor
- MQTT test client
- Device Location New

Manage

- All devices
- Greengrass devices
- LPWAN devices
  - Network analyzer
  - Coverage New
  - Gateways
  - Devices
  - Profiles
  - Destinations**
  - Software packages New
- Remote actions
- Message routing
- Retained messages

6. Name your destination (“example2” in this document). Please, make sure that the “Enter a rule name” option is selected and give it a rule name. Also please make sure the “Create a new service role” is checked. Once finished, click on “Add destination”.

**Add destination** Info

**Destination details** Info

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

example2

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

Destination description.

Enter a rule name  
Enter the name of the rule or a rule/topic that will process the messages sent to this destination.

example2

Publish to AWS IoT Core message broker  
If you need a publish/subscribe broker to distribute messages to multiple subscribers.

► Advanced

**Rule configuration - optional** Info

Your destination will need a rule to process the messages it receives. If you entered the name of a new rule, you can create that rule now, or you can skip this step and create a rule with that name later.

To create the rule now, copy the value from the rule name field and choose **Create rule**.

**Permissions**

Create a new service role

Select an existing service role

Role name - optional  
Leave blank to generate a random name.

Choose a custom role name.

A new role named "AWSIoTWirelessDestination-zsT\_vVvU" will be created.

**Tags - optional**

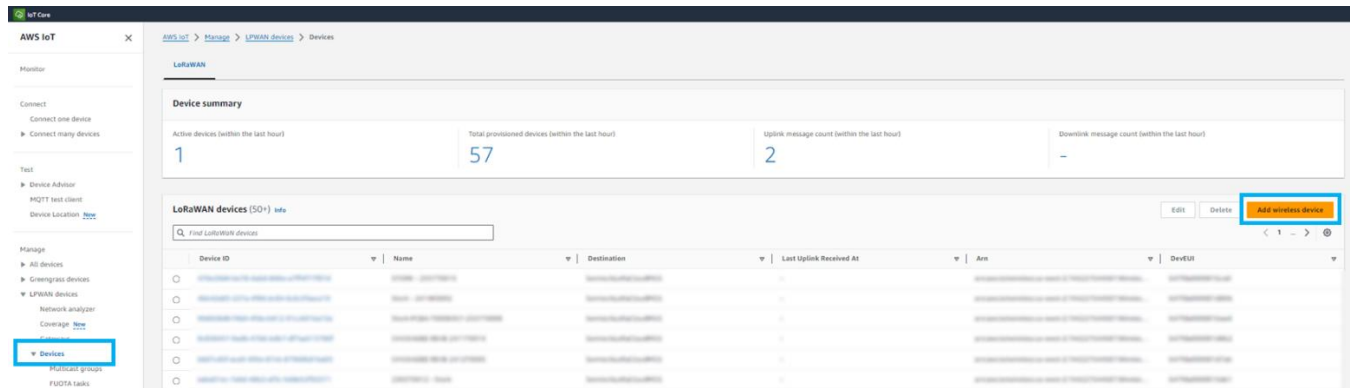
A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.

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

You can add up to 50 tags.

7. Please repeat step 6 to create a location data destination: Choose “Add destination” and name your destination for device location data (**locationData** in this document). Please make sure that the “Enter a rule name” option is selected and give it a rule name. Also please make sure the “Create a new service role” is checked. Once finished, click on “Add destination”.

8. Navigate to the drop-down menu on the left, expand LPWAN devices, select **Devices**, and click on **“Add wireless device”**.



9. In **“Add wireless device”**, enter the sensor name, description, DEVEUI, APPEUI, and APPKEY provided by TEKTELIC. Select the destination created in step 6 (**example2** in this document) and click **“Next”**.

**Configure LoRaWAN device**

LoRaWAN specification and wireless device configuration [info](#)

**Wireless device specification**  
 Your device specifications consist of the LoRaWAN version (1.1 or 1.0.4) 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 v1.1a

DeVEUI  
 647daa2b0c00d

The 16-digit hexadecimal DeVEUI value found on your wireless device.

AppKey  
 00000000000000000000000000000000

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

AppEUI/JoinEUI  
 AppEUI

The 16-digit hexadecimal AppEUI/JoinEUI that your wireless device vendor provided. For MAC version 1.0.4, please use JoinEUI. Otherwise please use AppEUI.

Wireless device name - optional  
 STORK/CHICKADEE

A descriptive name to make the wireless device easier to locate.

Wireless device description - optional

A helpful description of your wireless device.

**▶ FUOTA configuration - Optional**  
 Select a Fwmc part (Fwmc) through which the device is communicating status, version and package description to AWS IoT Core for LoRaWAN. Default Fwmc's have been populated for your reference.

**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.  
 example

Service profile  
 Choose a service profile.  
 LoRaWAN\_public\_network

**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.

You can add up to 50 tags.

**Choose destination**

Destination name  
 Destinations route LoRaWAN messages from your wireless device to other AWS services.  
 example2

10. Check the **Active** positioning option and select the **Position data destination** to the one you created in step 7. Finally, please click **“Add device”**.

**Set device position - optional** Info  
Specify the position information of your device or use solvers to accurately identify the position of your device.

**Position information - Optional**

**Add initial position of your device**  
Enter the static latitude and longitude coordinates to identify the position of your device. Optionally, enter a value for the altitude.

Latitude: -46.320207  
Longitude: -112.1072224  
Altitude: 0

**Geolocation - optional** Info  
By using geolocation, the position of your device can be accurately identified. See pricing info [Info](#)

**Activate positioning**  
Report the real-time position of your resource.  
 Active

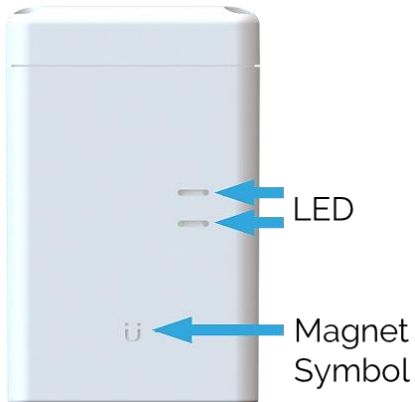
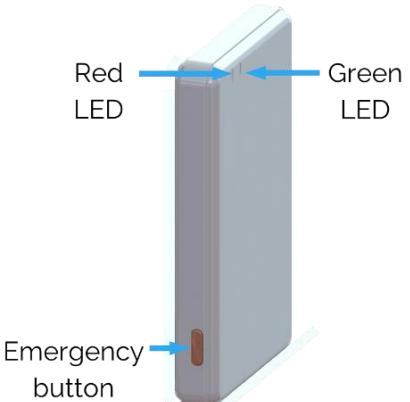
**Position data destination**  
Add a position data destination to describe the AWS IoT rule that processes a device's position data for use by AWS IoT Core for LoRaWAN.

Select your position data destination: locationData

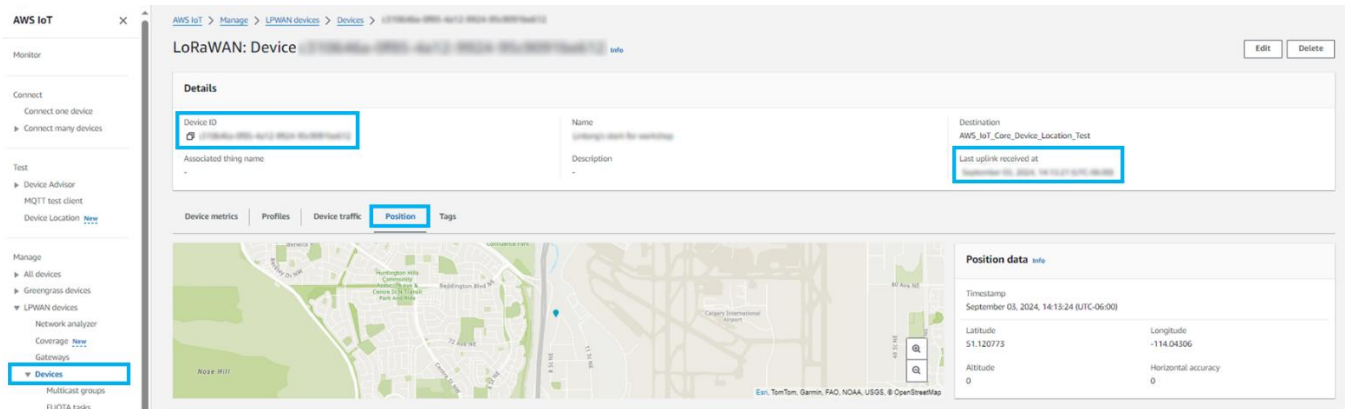
Cancel Previous **Add device**

11. Double check if gateway is online.

12. Activate the Tracker:

FOR STORK:	FOR CHICKADEE:
 <p>FOR STORK:</p> <p>LED</p> <p>Magnet Symbol</p>	 <p>FOR CHICKADEE:</p> <p>Red LED</p> <p>Green LED</p> <p>Emergency button</p>
<p><b>Step 1:</b> Apply Magnet on Magnet Symbol for 3-10 seconds and remove.</p>	<p><b>Step 1:</b> Press the button on the side of the device for 3-10 seconds and release.</p>
<p><b>Step 2:</b> LED will blink until device has joined Network Server.</p>	<p><b>Step 2:</b> LED will blink until device has joined Network Server.</p>

13. From **Devices** tab, click on the device ID. The Last uplink received at time should be a recent time. Go to the **Position** tab, the device geolocation should be displayed, assuming device has performed a GNSS and/or Wi-Fi scan successfully.



## 2.4 Connecting 3<sup>rd</sup> party LoRa Network Server to LoRa Cloud and Application server

### 2.4.1 General Guidance

You will have to write your own connector between the Third party LoRa Network Server, LoRa Cloud, and User-Facing Application. All possible options of deployment can't be covered in one document.

In general, the connector must achieve the following:

- Establish bidirectional connectivity with the LoRaWAN Network Server to receive uplinks and queue downlinks:
  - Forward localization-related uplinks to LoRa Cloud.
  - Queue downlinks to the device from LoRa Cloud.
- Establish unidirectional connectivity to User-Facing Application:
  - Forward resolved locations from LoRa Cloud to the User-Facing Application

For more details and guidance on your particular deployment case, please contact Tektelic and we will support your effort to the extend possible.