ADS-270

How to build a LoRaWAN IoT telemetry application

Vers. 1.4 – Sep 2020

1. Introduction

This document is dedicated to the **ADS-270** LoRaWAN unit, designed for IOT telemetry solutions. It is a low power device designed to operate on battery or mains power. The unit incorporates a Microchip Rn2483 (EU) or RN2903 (North America) LoRaWAN module that features a unique MAC ID.

In order to realize LoRaWAN systems a gateway with internet connectivity, an appropriately configured backend system to manage transmitted data and a front end to visualize and manage data are required.
This document describes in brief how to,

- setup 2 different models of LoRaWAN gateways,
- configure devices on the The Things network (TTN) backend.
- connect devices to Infinite's cloud platform the WaT (web aided telemetry)

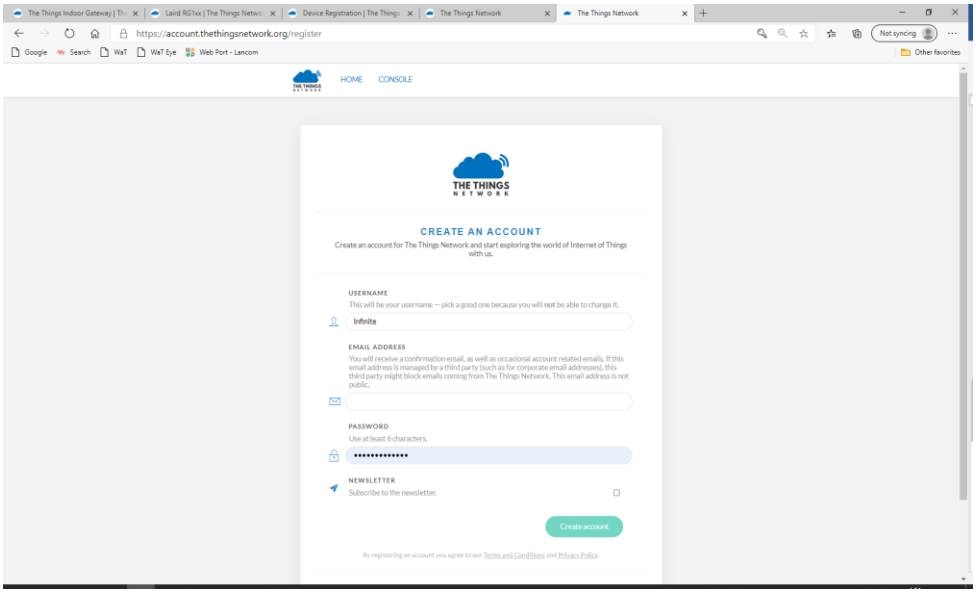
The Things Network backend runs an open Internet of Things infrastructure supported by a global ecosystem of thousands of developers, IT integrators, hardware manufacturers, universities and governments.

In order to successfully configure and register the device the user must prepare the following identification credentials,

- Device EUI (8 digit HEX) printed on a sticker inside the device
- Application EUI (8 digit HEX) acquired from the TTN platform
- Network Session Key (16 digit HEX) acquired from the TTN platform
- Net App Session Key (16 digit HEX) acquired from the TTN platform
- Device address (8 digit) acquired from the TTN platform

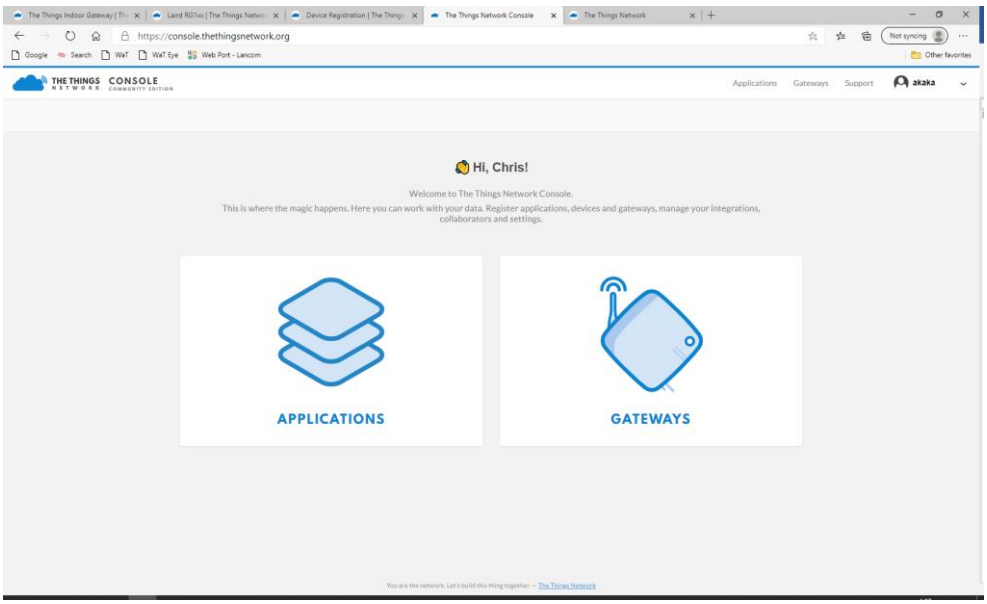
2. How to set up gateways

In order to configure a gateway, an account with the TTN must be created first. Go to,
https://account.thethingsnetwork.org/register



and create an account.

Once logged in, in the console you can register your gateway and application.



2.1 The Things Indoor Gateway

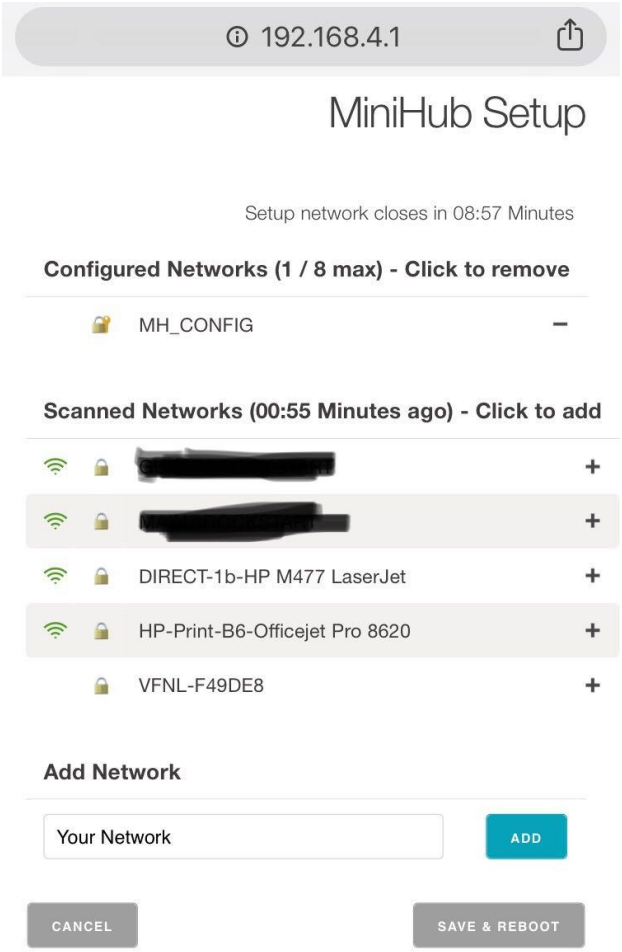
The Things Indoor Gateway (TTIG) is designed to be a fully compliant, ultra low-cost LoRaWAN gateway, with Wi-Fi as the backhaul. The gateway comes with a wall plug, and can be powered over USB-C on 900mA, making the gateway even suitable for applications that require dynamic coverage.

Features:

- An 8 channel LoRaWAN indoor gateway.
- Supports the state-of-the-art BasicStation Protocol.
- Supports LBT.
- Simple setup steps taking lesser than 5 mins.
- Can connect to any network backend of choice.
- Setup and Connectivity over Wi-Fi.
- Can be powered up via a USB-C cable or via an elegant connector to the power outlet.
- Built-in omnidirectional antenna for indoor use.
- EU868, US915, AS923 and CN470 versions available.
- Security via a range of modes.

Activate the gateway

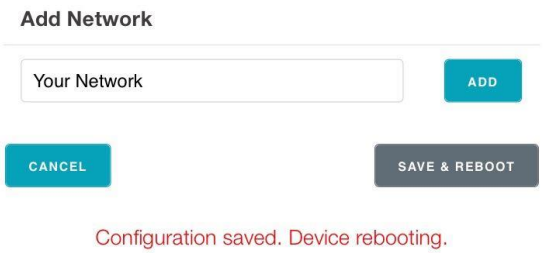
1. Press the reset button (small button at the back of the gateway next to the USB-C port) for 5 seconds until the LED blinks rapidly GREEN<->RED for a couple of times.
2. Hold the SETUP (button at the top of the gateway, next to the LED) for 10 seconds until the LED blinks rapidly in RED.
3. The gateway now exposes a Wi-Fi AP whose SSID is MINIHUB-xxxxxx where xxxxxx is the last 6 digits of the gateway ID.
4. The password for this network is printed on the back panel of the device under Wi-Fi PW.
5. After connecting to this network go to 192.168.4.1 using a web browser to access the Wi-Fi config page.

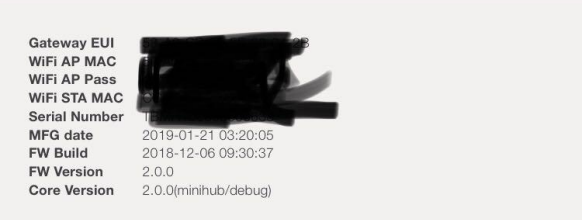


6. Select the Wi-Fi network and enter the password if it's a closed network.
7. Select the "Save and Reboot" option.
8. If your config is right,
9. The gateway will blink GREEN for a few seconds while it connects to this network.
10. Then, it will blink GREEN<->RED for a few seconds while it connects to the CUPS endpoint and fetches the necessary information to connect to the LNS traffic endpoint.
11. If your configuration was successful, the LED will be solid GREEN which means that the gateway is connected to the LoRaWAN network and is ready to handle packets.

Connection to the The Things Network Backend

1. To connect this gateway to the The Things Network console, register the gateway by checking the "I'm using the Legacy Packet Forwarder" option.
2. The EUI of the gateway is NOT the Wi-Fi MAC address printed on the back of the gateway but is derived from the first number on the top of the sticker below the QR code.
3. This number can also be obtained from the Wi-Fi Setup Page





4. To derive this take the code for example *5BA0CB80042B* and insert *FFFE* to after the first 6 characters to make it a 64bit EUI such as *5BA0CBFFFE80042B*
5. This is the value to be entered in the Gateway ID field on the console.
6. Enter in other details such as location, frequency plan and router.
7. If your configuration was successful, you should start receiving packets (if there are LoRaWAN nodes transmitting nearby).

Operating Modes

Configuration Mode (CONF)

- In this mode, the device acts as a Wi-Fi AP to which users can connect and configure a Wi-Fi network(s) to which the gateway will connect to during normal operation. The device cannot route LoRaWAN packets in this mode.

Gateway Mode (GW)

- In this mode, the device acts as a gateway to route traffic between the LoRaWAN Device and the Network. The Wi-Fi AP for configuration is not available in this mode.

LED states

Color(s)	Illumination Pattern	Operation Mode	Meaning
GREEN	Blinking (freq 1 sec)	GW	Wi-Fi not connected (or trying to connect)
GREEN	Blinking (freq 1/4 sec)	GW	Connected to Wi-Fi, establishing connection to LNS/Configuring radio
GREEN	Solid	GW	Connected to Wi-Fi, connected to LNS backend, listening for Packets
GREEN/RED	Alternate Blinking (freq 1/4 sec)	CONF	Scanning Wi-Fi networks, setting up Config AP
RED	Blinking (freq 1/4 sec)	CONF	Config AP Active

Button Actions

There are three possible button actions on the TTIG

- SETUP Button pressed for 10s:
  - Switch to CONF mode if in GW mode.
- SETUP Button pressed for 5s:
  - Reboot if in CONF mode, do nothing in GW mode.
- RESET Button pressed for 5s:
  - Factory reset (wipe out Wi-Fi and LNS credentials, though CUPS credentials are retained).

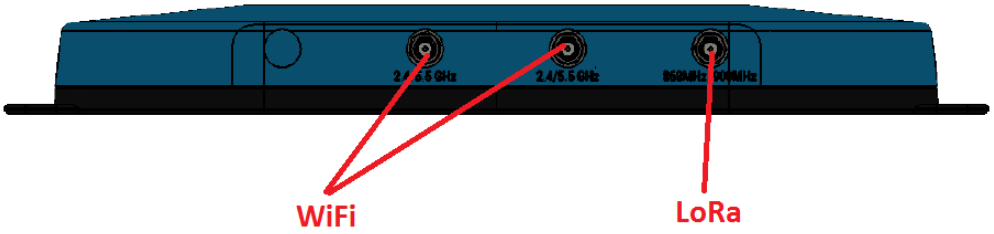
2.2 Laird RG1xx Gateway

The Sentrius RG1xx LoRa-Enabled Gateway from Laird is the ultimate in secure, scalable, robust LoRa solutions for end-to-end control of your private LoRaWAN network. Leveraging Laird's field-proven and reliable 50 Series "Wireless Bridge" certified module, it also offers enterprise dual-band Wi-Fi, BT v4.0 (BLE and Classic) and wired Ethernet for complete design freedom. Based on the Semtech SX1301/SX1257 chipset designs, it offers a LoRa range up to 10 miles and pre-loaded LoRa Packet Forwarder software, perfect for highly scalable, flexible IoT networks. The Sentrius RG1xx Gateway works with Laird's Sentrius RM1xx Series LoRa+BLE certified modules for simple out-of-the-box integration and is compatible with 3rd party Cloud and LoRa partners, as well as any LoRaWAN certified client devices.

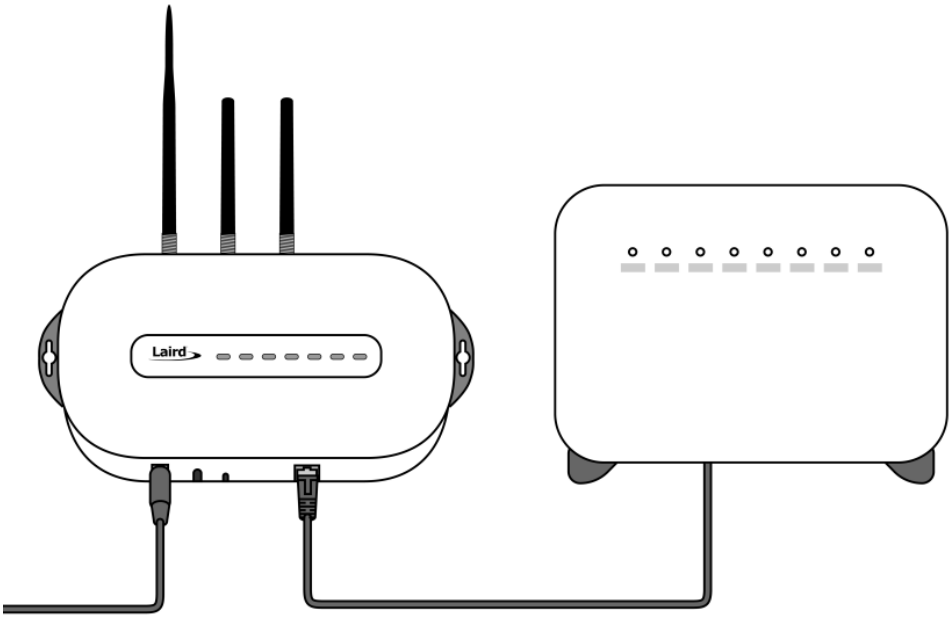
It is also available in an outdoor IP67 rated case

Connecting the RG1xx

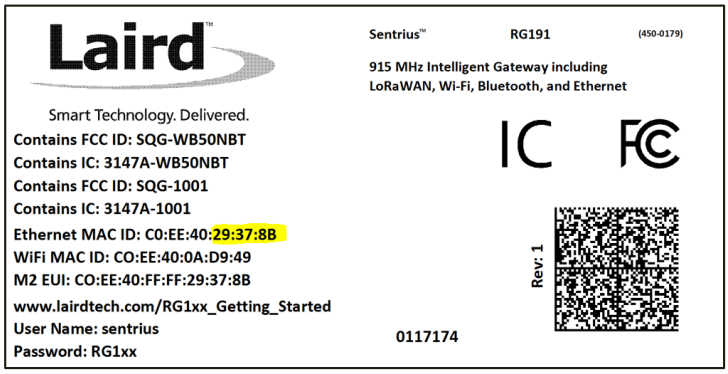
A 12v 2A power supply is included with the gateway and an ethernet cable. Attach the antennas to the unit, the LoRa antenna needs to be connected to the 868/915MHz port and the two Wi-Fi antennas need to be connected to the 2.4/5.5GHz ports. Laird RG1xx antennas.



Attach the ethernet cable between the gateway and network interface, then connect the power cable.



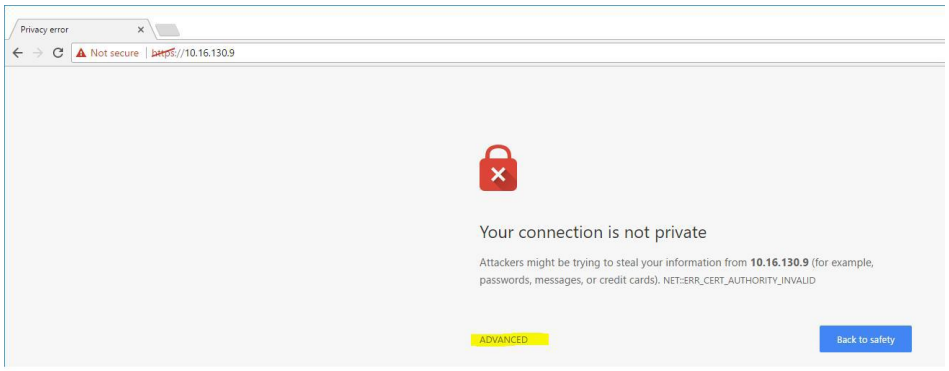
1. Determine the last three bytes of your gateway's Ethernet MAC address. This can be found on the label on the bottom of the gateway; the last three bytes are highlighted.



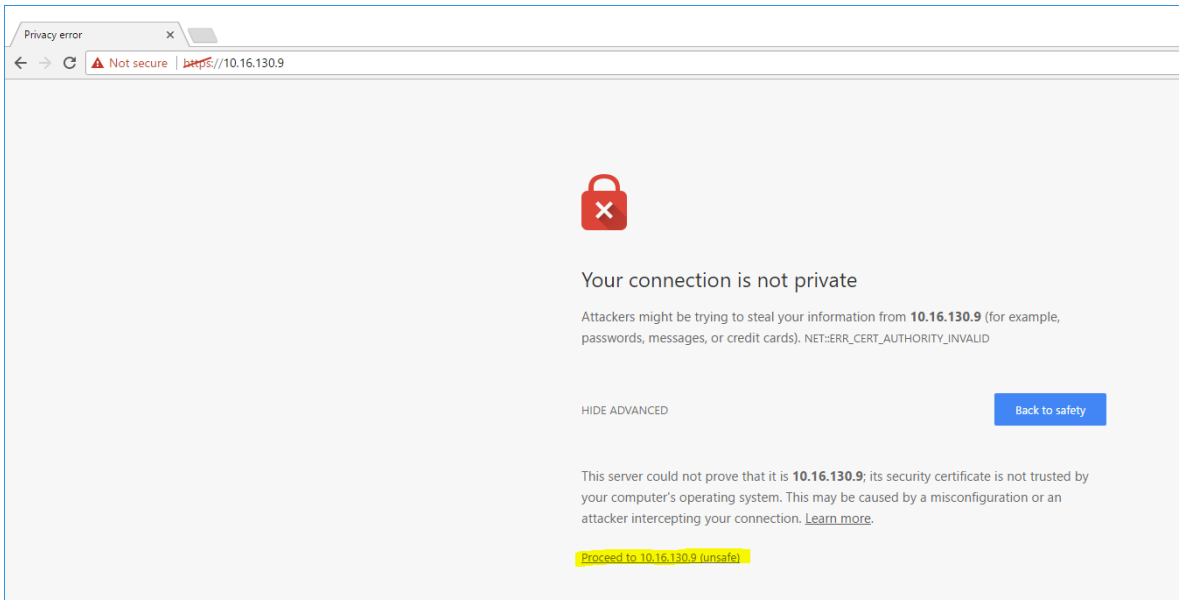
2. Enter the URL into the web browser to access the web interface. For example, for the gateway used in this guide, the URL is https://rg1xx29378B.local, where "29378B" are the last 6 digits of the Ethernet MAC address. Note that to do this requires an operating system which supports mDNS such as a Linux distribution with Avahi, Windows 10 or newer, or Mac.

3. Accept the self-signed security certificate in the browser.

4. Click Advanced.



5. Click Proceed.



6. Login to the gateway using the username sentrius and password RG1xx

   It is recommended that the default password is changed for security reasons. The password can be changed on the Wi-Fi -> Advanced web page.

Alternatively, a connection to the gateway can be made using Wi-Fi Quick Config, to do this:

1. Depress and hold the user button (see #2 below) for 7 seconds.

2. From a wirelessly enabled device perform a scan.
3. Connect to the access point rg1xx29378B, where “29378B” are the last 6 digits of the Ethernet MAC address found on the label on the bottom of the gateway. The network is secured with WPA2 with a password that is the same as the SSID.
4. Open a web browser to https://192.168.1.1
5. Login to the gateway using the username sentrius and password RG1xx
6. It is recommended that the default password is changed for security reasons. The password can be changed on the Wi-Fi -> Advanced web page.

Connecting the Gateway to the Internet

Setting Up Ethernet

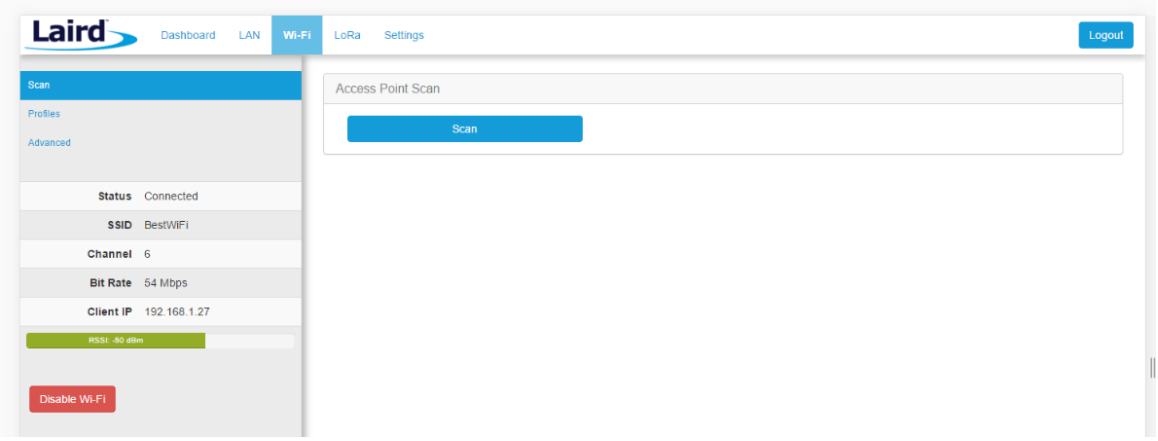
By default, the Ethernet port is set up for DHCP addressing. Connect the Ethernet cable to a network with internet access. If more advanced Ethernet configuration is needed, please see the Sentrius RG1xx User Manual in the documentation tab of the RG1xx product page at lairdtech.com: http://www.lairdtech.com/products/rg1xx-lora-gateway

Setting Up Wi-Fi

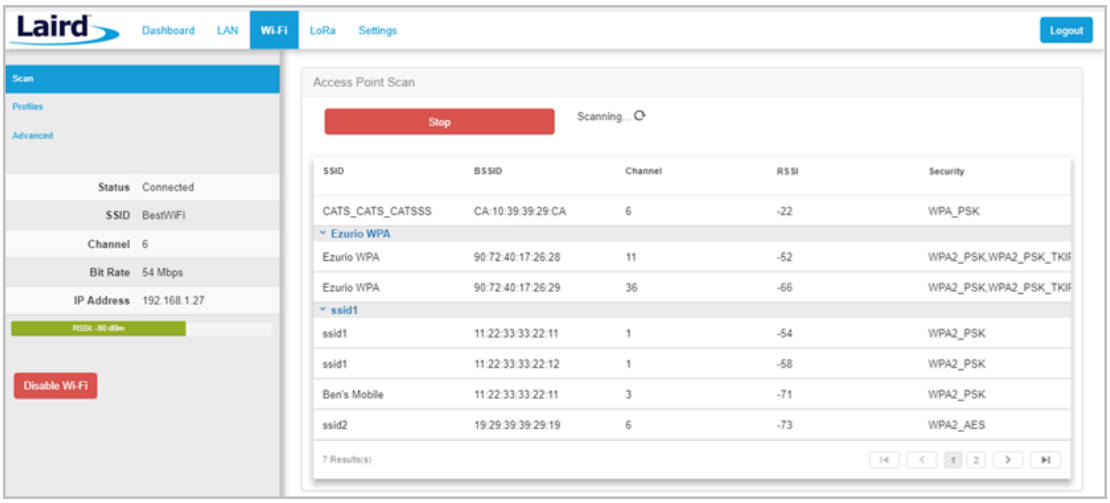
By default, the Wi-Fi in the gateway is not configured to connect to a Wi-Fi network. You must access the web interface on the gateway via the Ethernet interface to setup the Wi-Fi connection.

To set up the Wi-Fi, follow these steps:

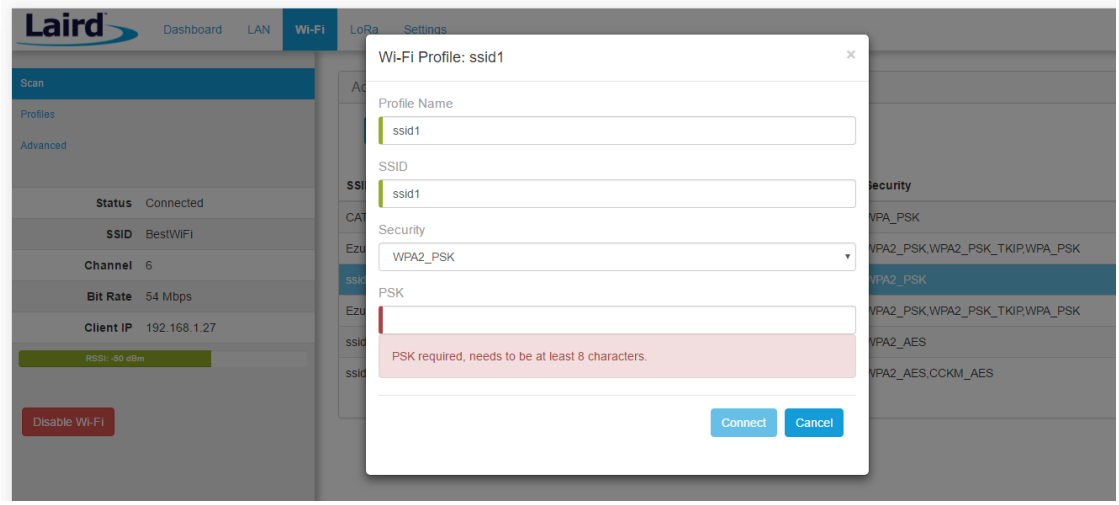
1. Once logged into the web interface, navigate to the Wi-Fi page.



2. To connect to a Wi-Fi network, click Scan to scan for nearby Wi-Fi networks. Scanning continues until you click Stop or select one of the scan results in the list. Scanning for networks



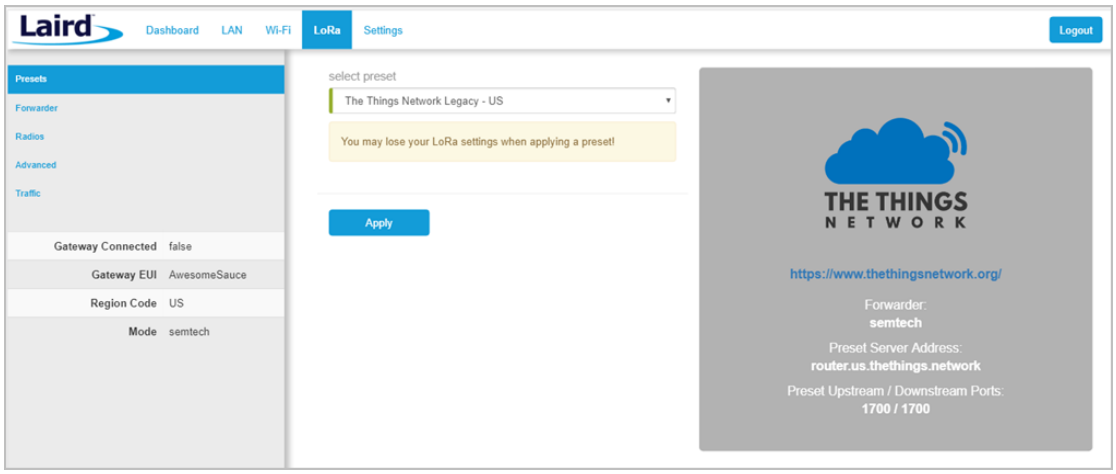
3. Click on the applicable scan result.
4. Enter the information for the Wi-Fi network.



LoRa Packet Forwarding Setup

To set up LoRa packet forwarding on the gateway, follow these steps:

1. Click the LoRa tab in the main menu. LoRa Configuration



2. In the dropdown labeled Select Preset, select the preset for The Things Network Legacy (TTN).
3. Click Apply.

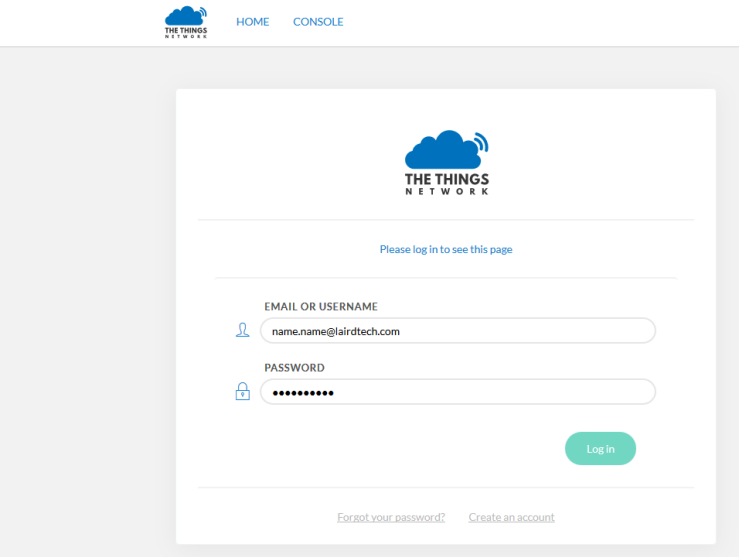
The network server must be compatible with the packet forwarder being used on the gateway. The packet forwarder can be custom configured on the forwarder, radios, and advanced pages. If the LoRa network operated on a different channel plan it is also necessary to program this into the gateway on the radios page.

3. Configuration with The Things Network

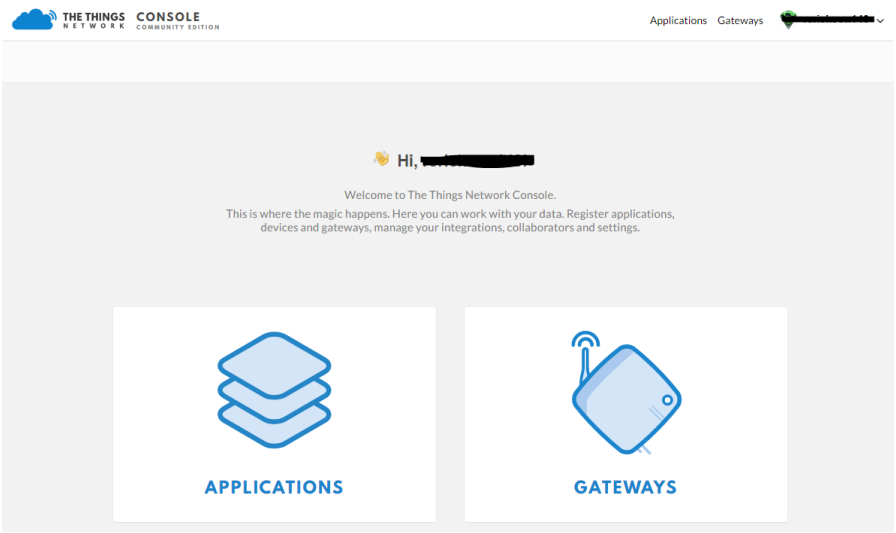
3.1 Set up your account with The Things Network

To set up your account with The Things Network, follow these steps:

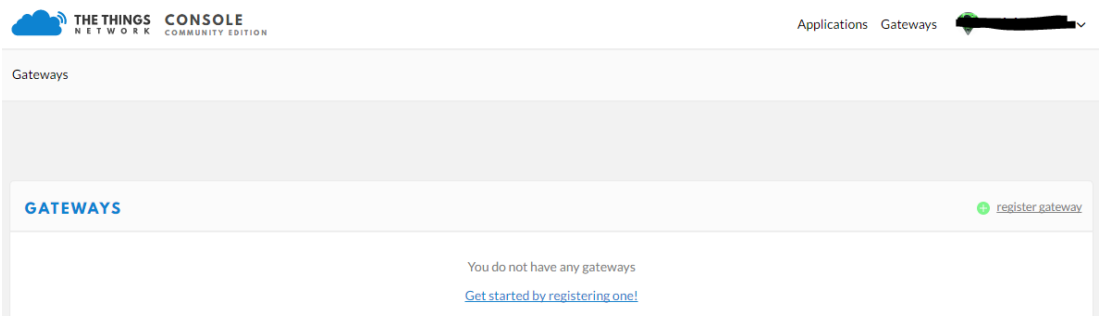
1. Go to https://www.thethingsnetwork.org/.
2. Create an account or log in to your existing account,



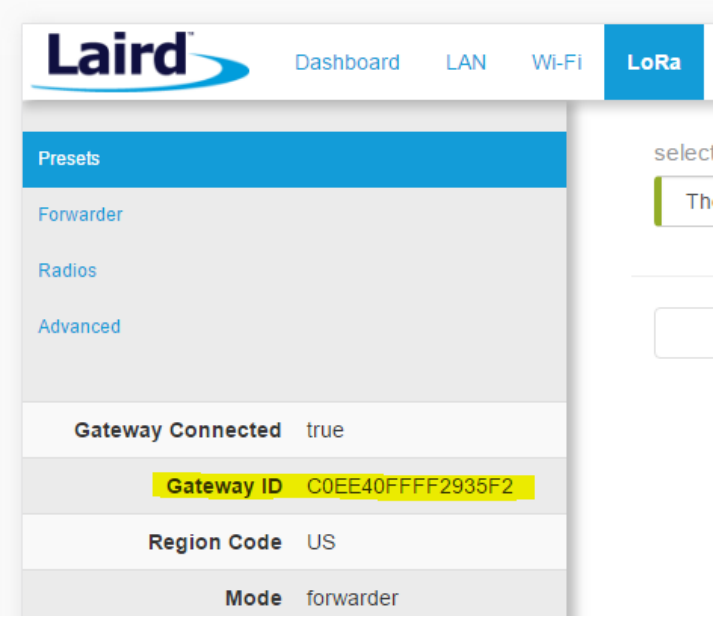
3. Click Console.
4. Register your gateway:
    1. From the console screen, click Gateways.

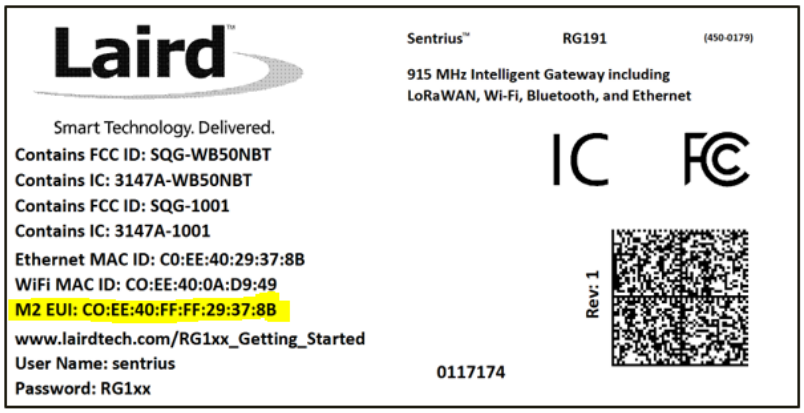


    2. Click register gateway.



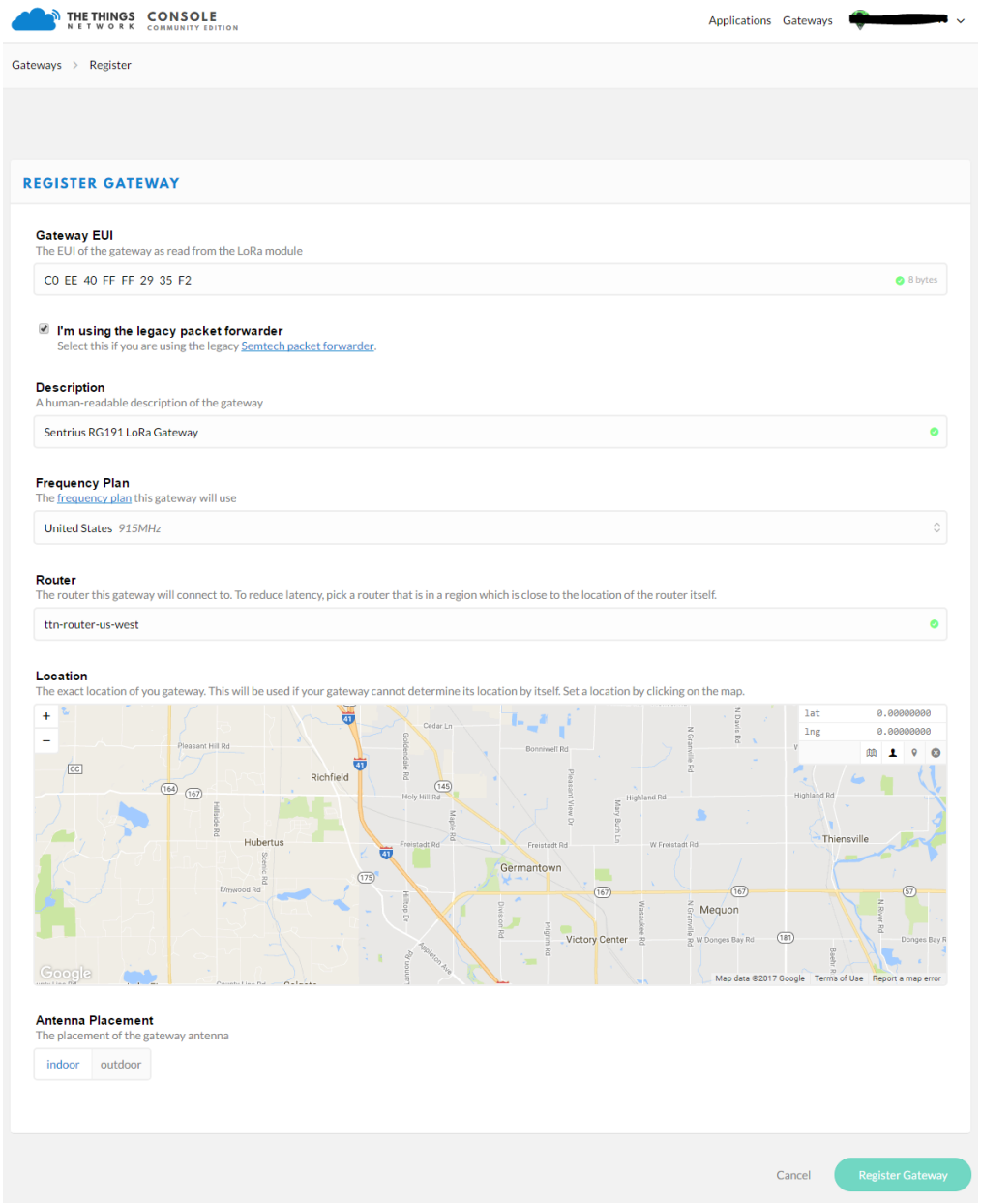
3. Obtain the gateway ID from the Sentrius RG1xx web interface or from the bottom label on the Gateway.





4. Fill in the information to register the gateway as shown below.

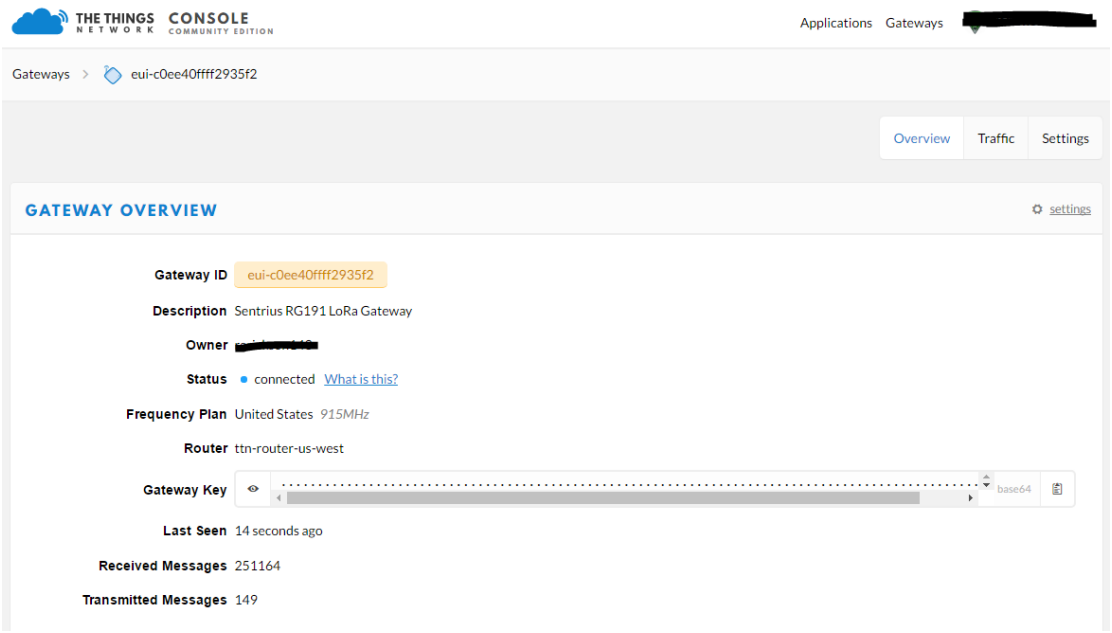
If the gateway is set to use “The Things Network Legacy” preset, be sure to check “I’m using the legacy packet forwarder”. Otherwise, the gateway can use the <The Things Network> preset and the checkbox should be left unchecked



1. Click Register Gateway.

If using an RG186 gateway, be sure to select an EU router.

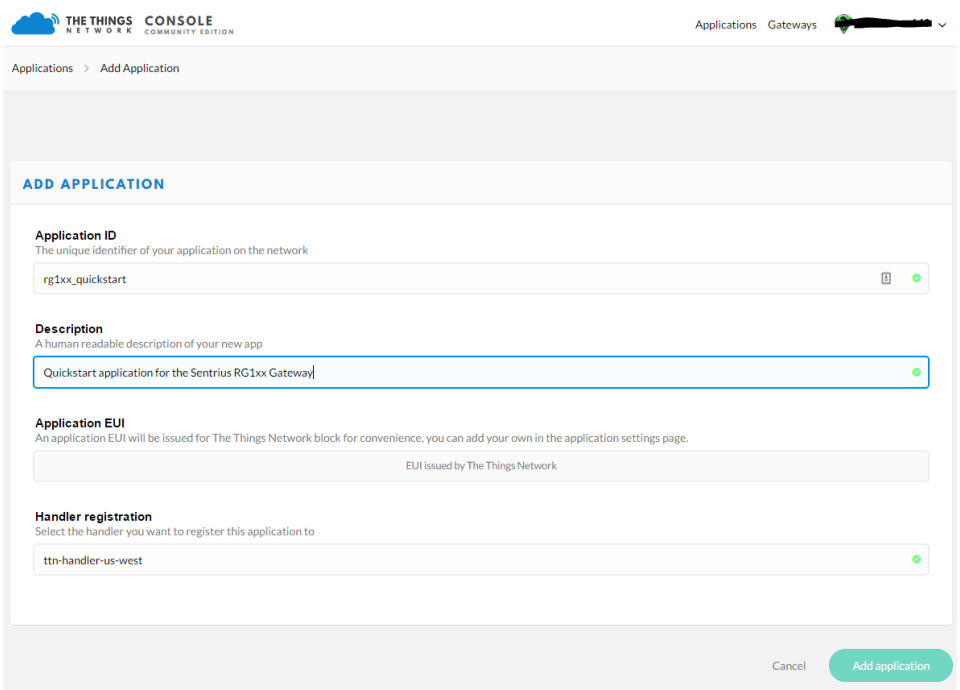
Once the gateway is registered, and if the gateway is communicating to The Things network, the status should display as connected.


THE THINGS NETWORK CONSOLE COMMUNITY EDITION
Applications Gateways
Gateways > eui-c0ee40ffff2935f2
Overview Traffic Settings
GATEWAY OVERVIEW
settings
Gateway ID eui-c0ee40ffff2935f2
Description Sentrius RG191 LoRa Gateway
Owner
Status connected What is this?
Frequency Plan United States 915MHz
Router ttn-router-us-west
Gateway Key base64
Last Seen 14 seconds ago
Received Messages 251164
Transmitted Messages 149

3.2 Create an Application with TTN

To create an application that can receive data from your LoRa-enabled gateway, complete the following steps:

1. At The Things Networks website, click Applications in the top right of the menu.
2. Click Add Application
3. Complete the field as shown below. Note that **application ID** should be in lower case and used to uniquely identify your application on the network.



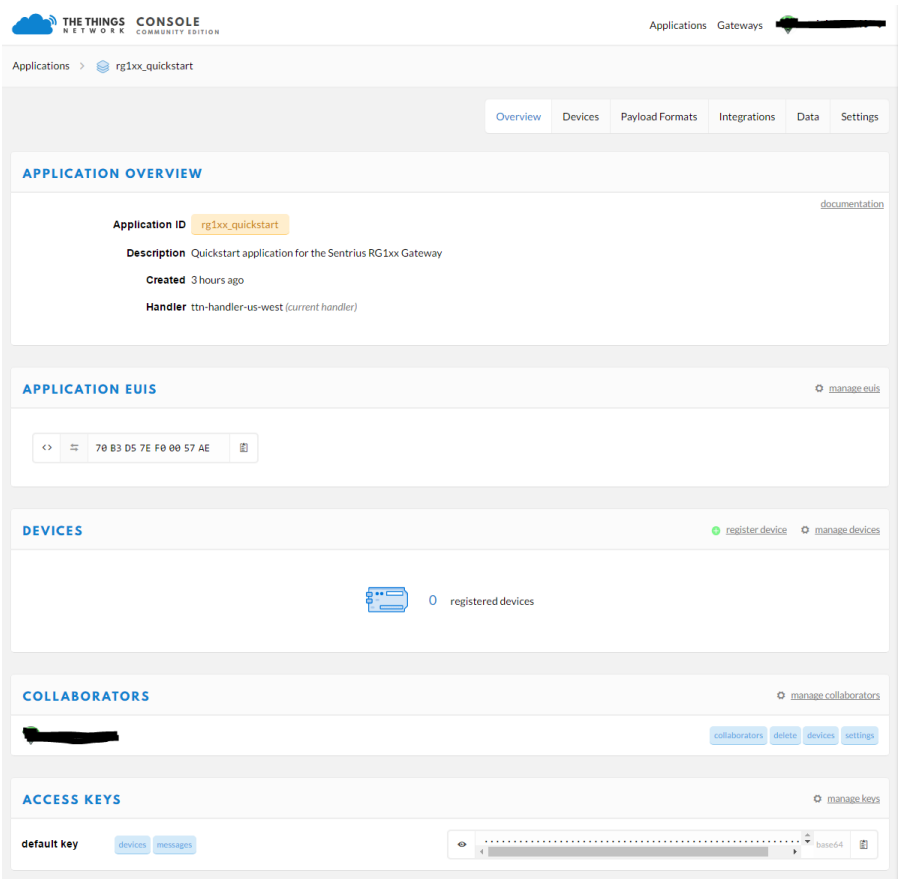
Note: If using an RG186 gateway, be sure to select an EU Handler registration.

Once you have created your application, click Add application to save it.

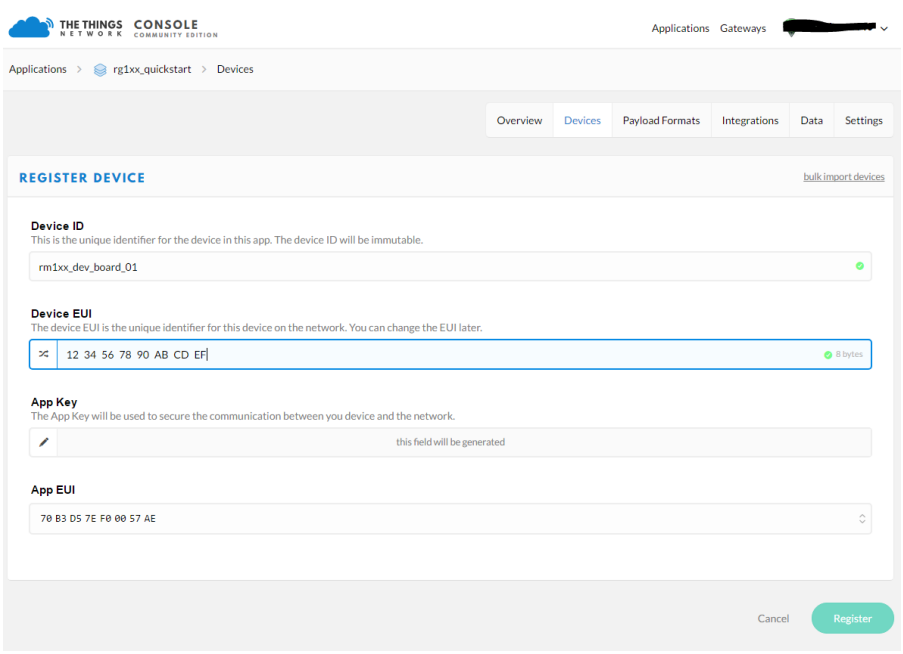
3.3 Register your end-device with TTN

To register your end-device as the device that will send data to TTN, follow these steps:

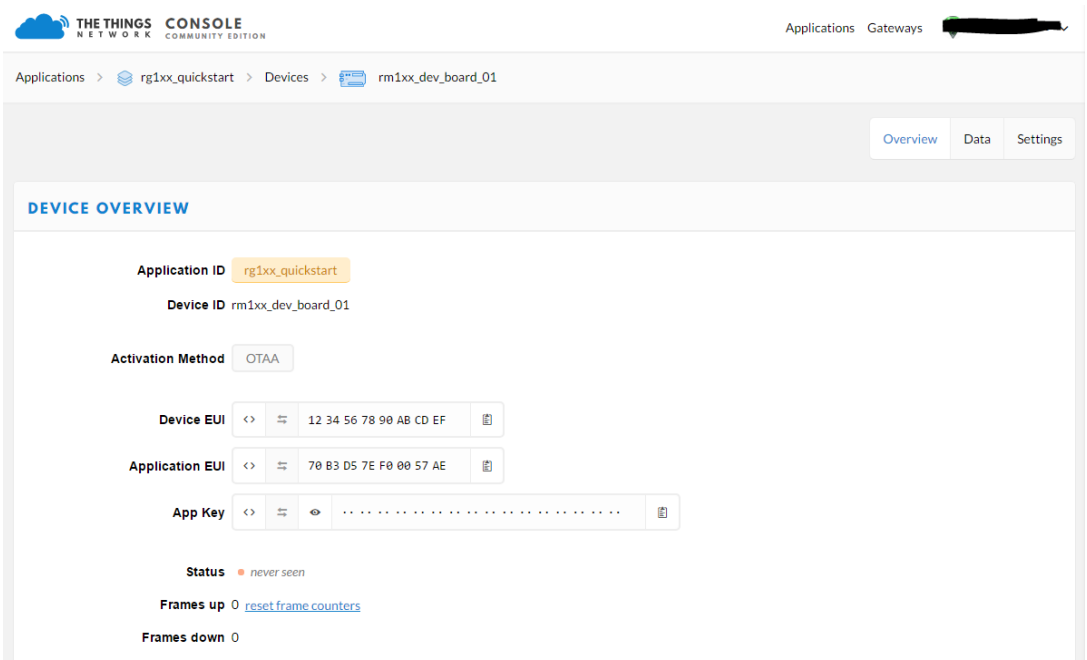
1. From the applications screen, select the application that you added in the previous section.
2. Click register device.



3. Choose and enter a **Device ID**. For Device ID, choose a - for this application - unique ID of lower case, alphanumeric characters and nonconsecutive - and _.
4. Leave the **App Key** to be generated.
5. For **App EUI**, select the generated EUI from the list.
6. For an eight-byte **Device EUI**. Infinite recommends using the MAC ID of the ADS-270 as a Device EUI.



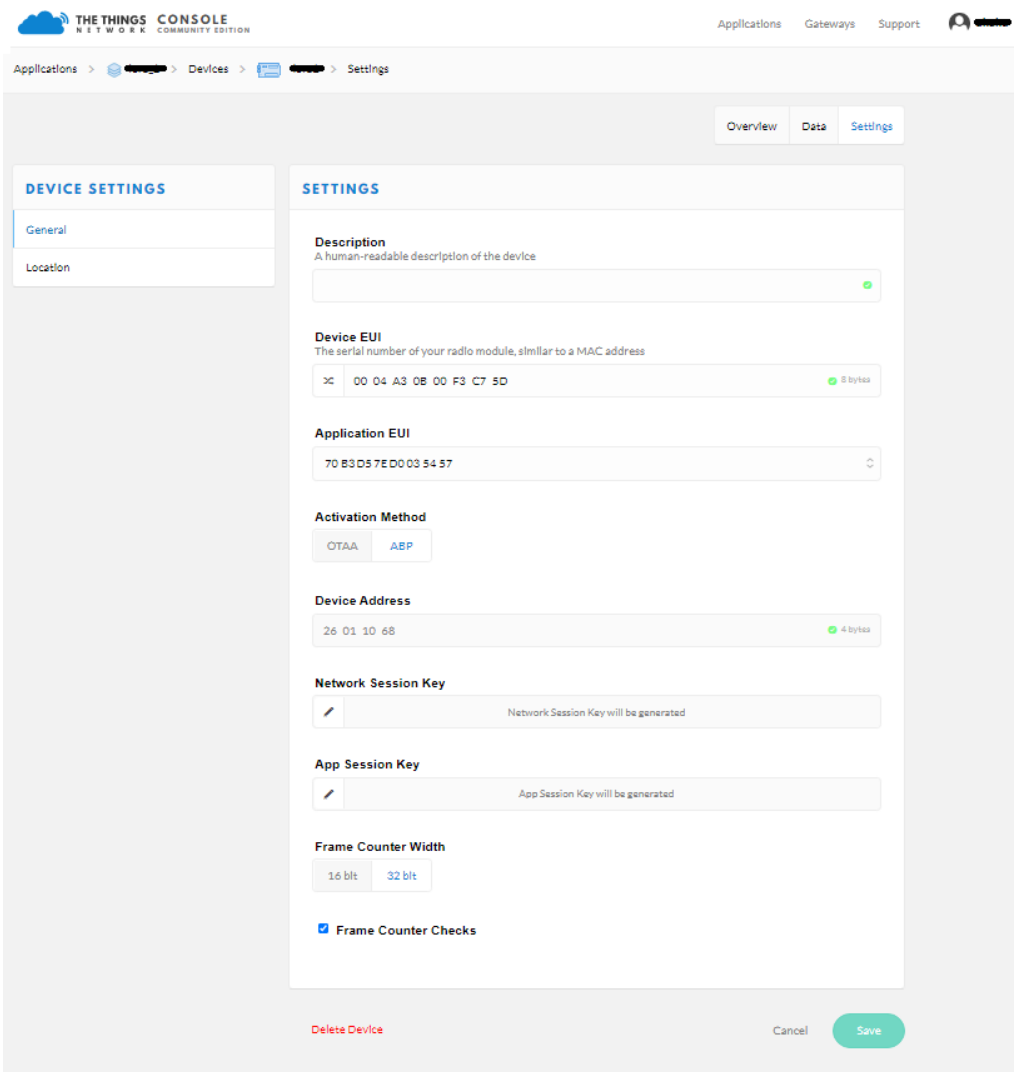
7. Click Register.
8. You will be redirected to the newly registered device where you can find the generated **App Key** needed to activate the device.
9. Make note of the **Device EUI, Application EUI, and the App Key**. These keys are needed later to set up the ADS-270.



Personalize device for ABP

The ADS-270 supports Activation by Personalisation (ABP). With ABP you don't have to wait for a downlink window to become available to confirm the activation.

1. In the Console, go to the device you'd like to personalize.
2. From the top right menu, select Settings.
3. For Activation method, click ABP.
4. Leave the Network Session Key and App Session Key to be generated for you or click customize it if you'd like to set them yourself.



5. Click Save to finish.

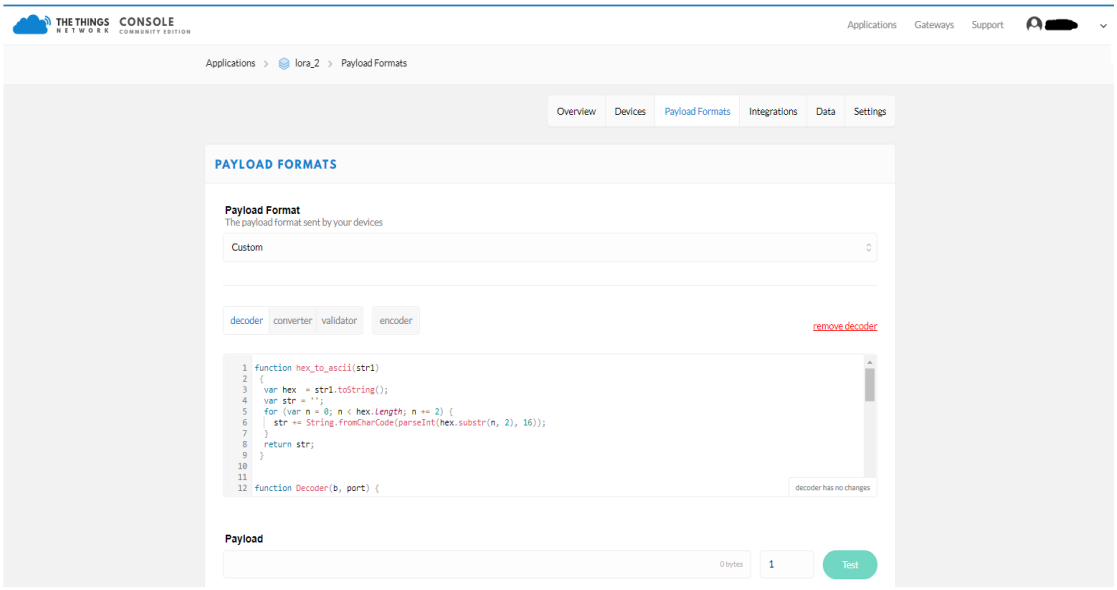
You will be redirected back to the device, where you will find the **Device Address** and **session keys** (Network Session Key and Net App Session) needed to activate the device.

Payload Format

The device payload must be decoded into a more readable and usable format for data storage and visualization.

1. Go to your device and select “Payload Formats” from the menu.
2. Click on the decoder.
3. Copy and paste the decoder script below into the decoder's integrated text editor and click save.

```
function hex_to_ascii(str1)
 {
        var hex  = str1.toString();
        var str = '';
        for (var n = 0; n < hex.length; n += 2) {
                str += String.fromCharCode(parseInt(hex.substr(n, 2), 16));
        }
        return str;
 }

function Decoder(b, port) {

     var temp = {};
     var a = {};
     var s = {};

     if (b.length==12){
     for (var i=0; i<b.length; i++){
                a[i] = b[i].toString(16);
           }

    temp = a[0]+a[1];
    s.channel = hex_to_ascii(temp);
    s.sign = hex_to_ascii(a[2]);
    temp = a[3]+a[4]+a[5]+a[6]+a[7]+a[8]+a[9]+a[10];
    temp = hex_to_ascii(temp);
    s.value = temp.replace(/\x20/g, "");
    s.di = hex_to_ascii(a[11]);
     }

     else if (b.length==1){

       s.payload = "test";
     }

     else{
       s.payload = "error";
     }
    return s;
    }
```


THE THINGS NETWORK CONSOLE COMMUNITY EDITION
Applications
Gateways
Support
Applications > lora_2 > Payload Formats
Overview
Devices
Payload Formats
Integrations
Data
Settings
PAYLOAD FORMATS
Payload Format
The payload format sent by your devices
Custom
decoder
converter
validator
encoder
remove decoder
function hex_to_ascii(str1)
{
var hex = str1.toString();
var str = '';
for (var n = 0; n < hex.length; n += 2) {
str += String.fromCharCode(parseInt(hex.substr(n, 2), 16));
}
return str;
}
function Decoder(b, port) {
decoder has no changes
Payload
0 bytes
1
Test

3.4 Configuring the ADS-270 unit

The ADS-270 needs to be configured with the,

- Device EUI (8 digit HEX) printed on a sticker inside the device
- Application EUI (8 digit HEX) acquired from the TTN platform
- Network Session Key (16 digit HEX) acquired from the TTN platform
- Net App Session Key (16 digit HEX) acquired from the TTN platform
- Device address (8 digit) acquired from the TTN platform

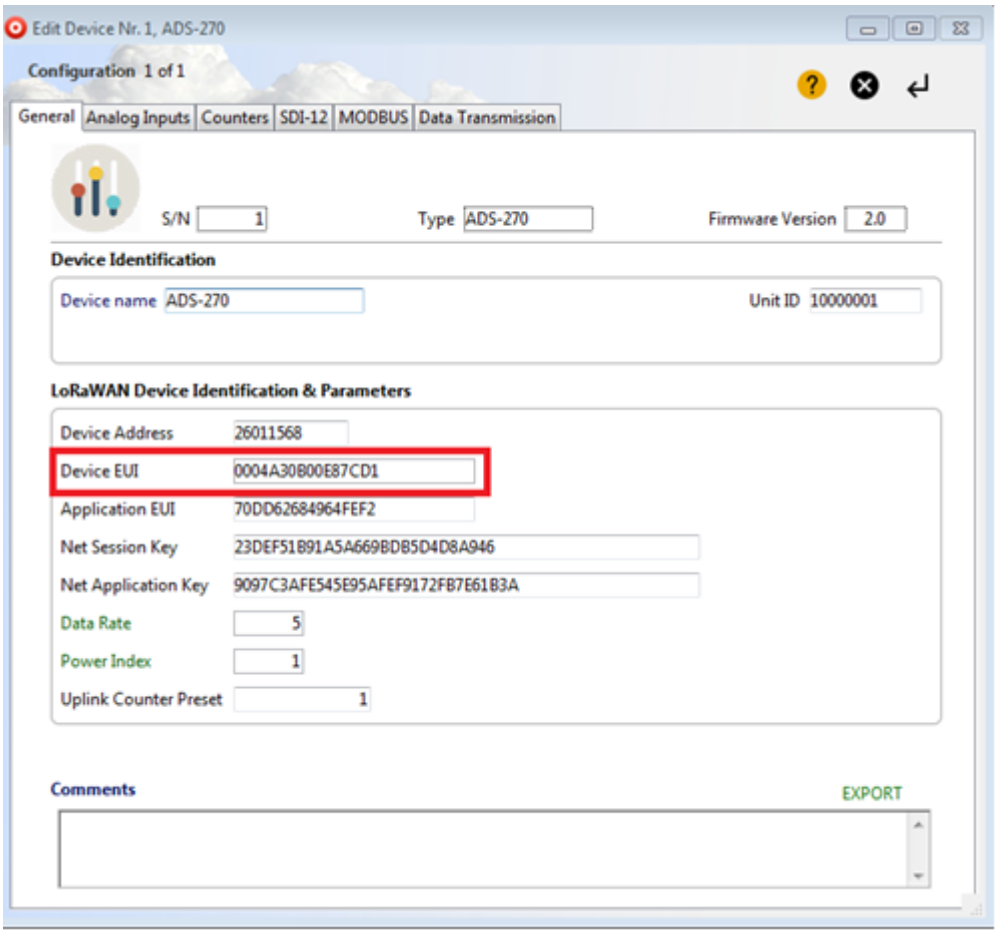
The way to enter the unit setup mode is the following:

1. Install the USB driver on a PC.
2. Connect the USB port to a PC. The Status LED is lighting for 2 sec.
3. Place a Jumper on JMP1. The Status LED starts blinking, indicating setup mode. Program execution is suspended.

There are two ways to program the unit:

1. Connecting the unit to a PC and using a terminal program to pass the ASCII commands to the unit, according to the scheme: "Command, Parameters <CR>". The terminal settings should be: Baud rate: 115200 bps, Data bits: 8, Parity: none, Stop bits: 1, Flow control: none.
2. Connecting the unit to a PC and using the WA Manager software. This is the most convenient way. The Device EUI, which is necessary for connecting the unit to the LoRaWAN network, is automatically read during downloading the parameter file to the device. The Device EUI is also printed on a label in the device interior.

The user needs to configure the remaining credentials and download the configuration to the ADS-270.



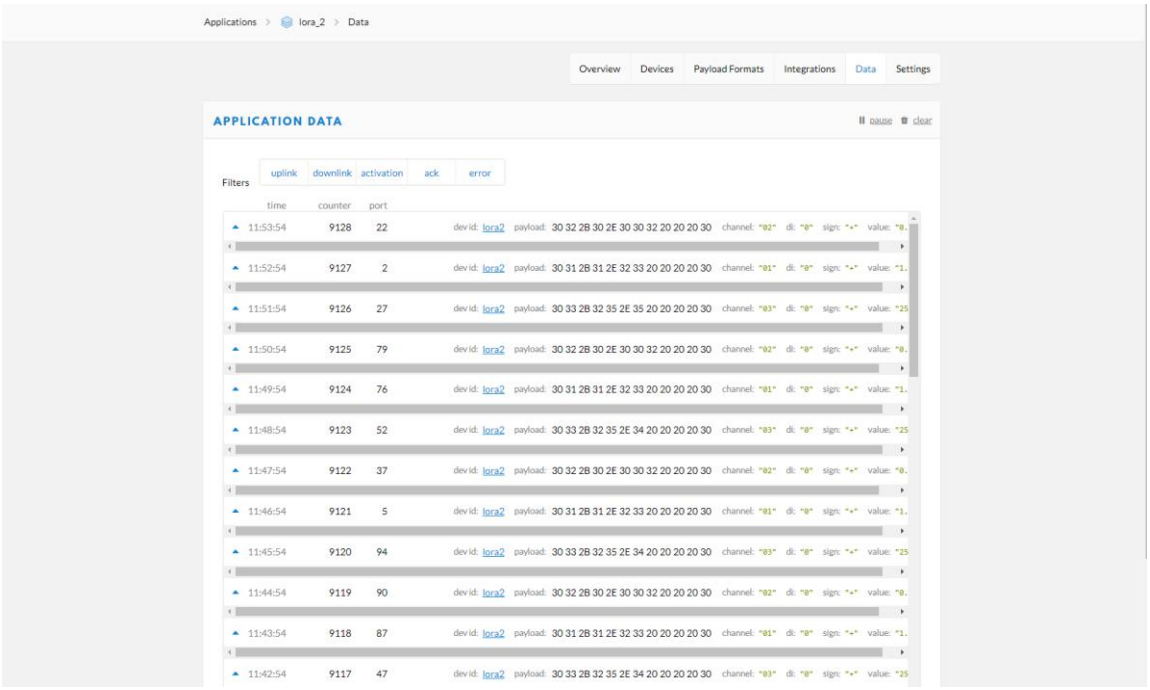
For sensor configuration, transmission rates, battery life and all the functions of the ADS-270 please consult the device manual.

Removing the Jumper at JMP1 will exit the configuration mode and set the device in operation mode.

3.5 Configuring an integration at the TTN

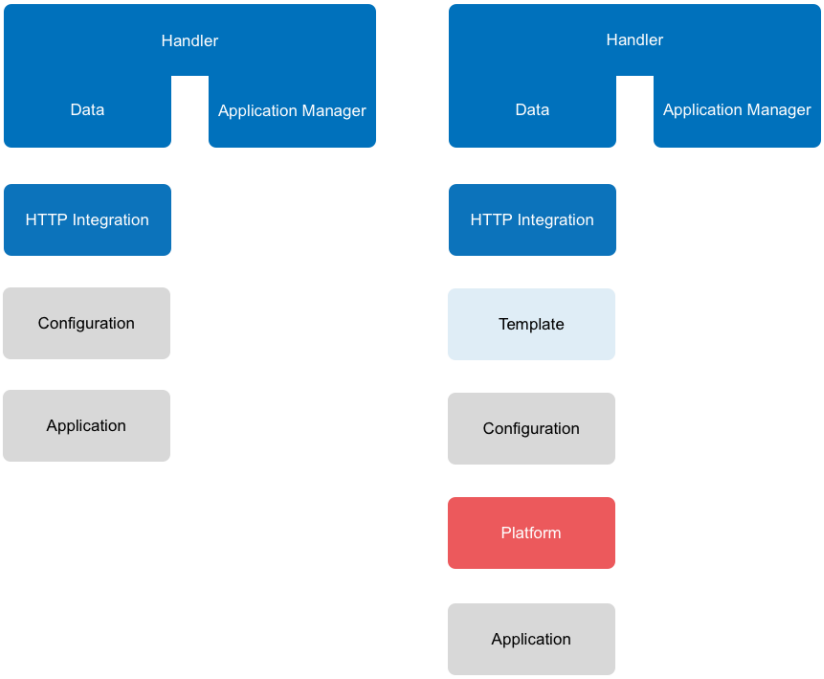
When successfully configured the ADS-270 will transmit data via the gateway to the TTN backend.

Data can be seen at the application data section of applications at the TTN console.

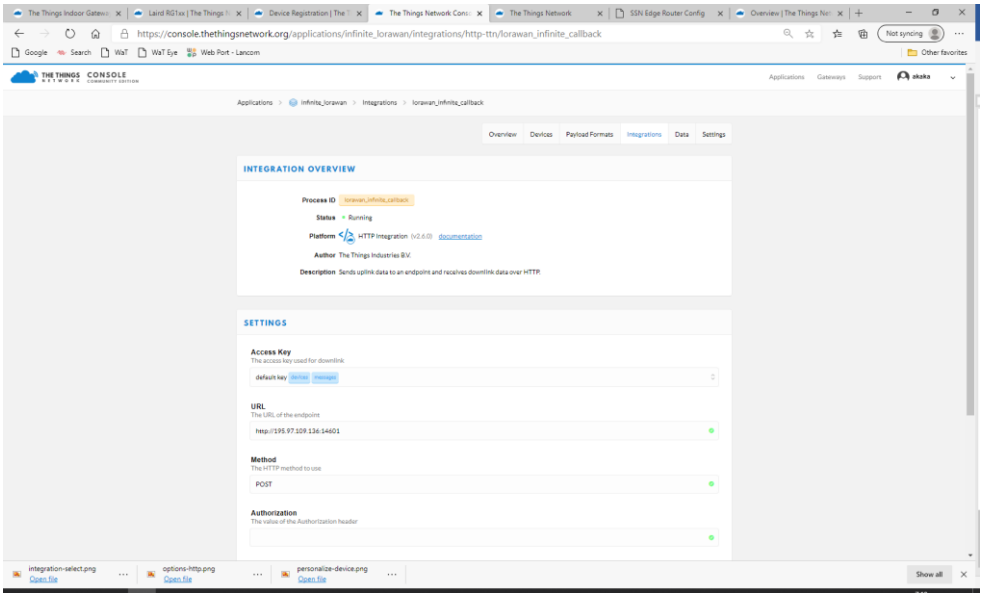


In order to forward the data to a front-end application for data management and visualisation an integration must be configured.

Integrations are the easiest way to connect your devices to applications.
A common integration is to forward messages to some webhook or other messaging endpoint (uplink messages). For these situations we provide a set of messaging integrations which act as a bridge between the Handler Data API and any endpoint you configure. It also provides you with an endpoint to send messages back to devices (downlink messages). Easy to configure and use is the HTTP Integration.



1. Go to applications and select an application in the Console.
2. Select Integrations from the top-right menu.
3. Click the add integration link.
4. Click to select the integration you'd like to add. Select HTTP integration and to connect to the WaT configure URL : http://195.97.109.136:14601



5. Click Create integration to finish.

4. Configuring an ADS-270 with Infinite's cloud applications.

Infinite offers a variety of cloud applications to manage and visualise device data.

These include

- The WaT (web aided telemetry platform). Accessible at

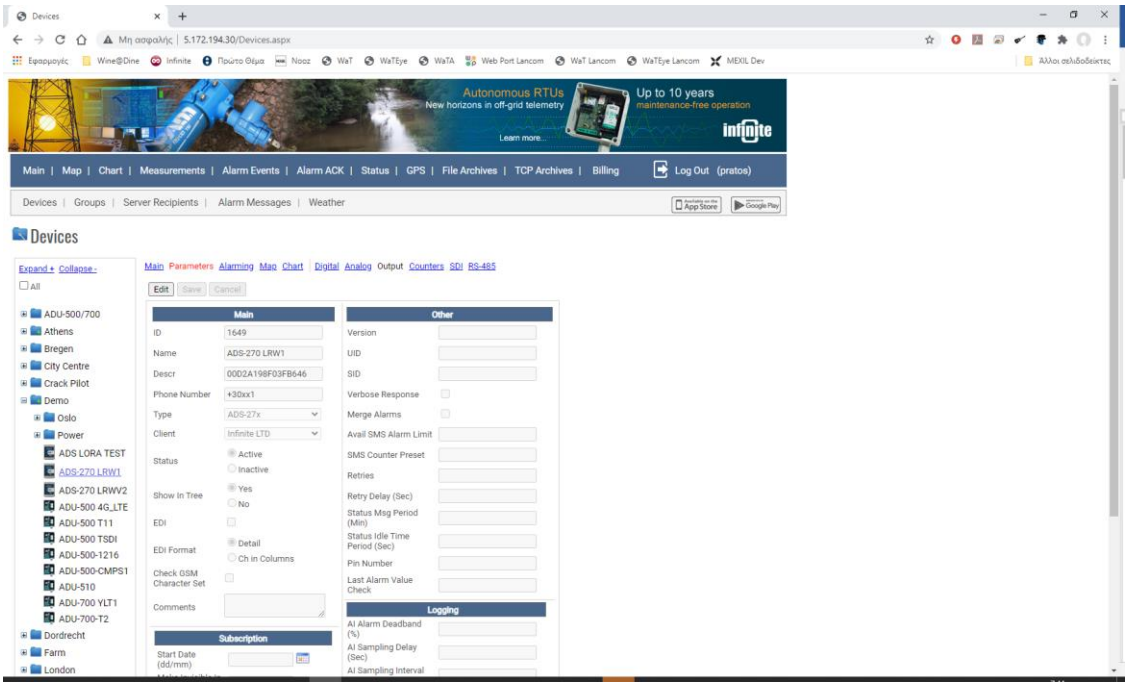
www.cloud-telemetry.com

- The WaT Eye (live weather data dashboard). Accessible at

http://91.138.204.120:14616/

- The WaT smart applications for IOs and Android phones and tablets.

The only perquisite for an ADS-270 to be recognised automatically by the above applications is to configure at the device parameters at the Descr field the Device EUI.



5. Lossant Enterprise IoT platfrom

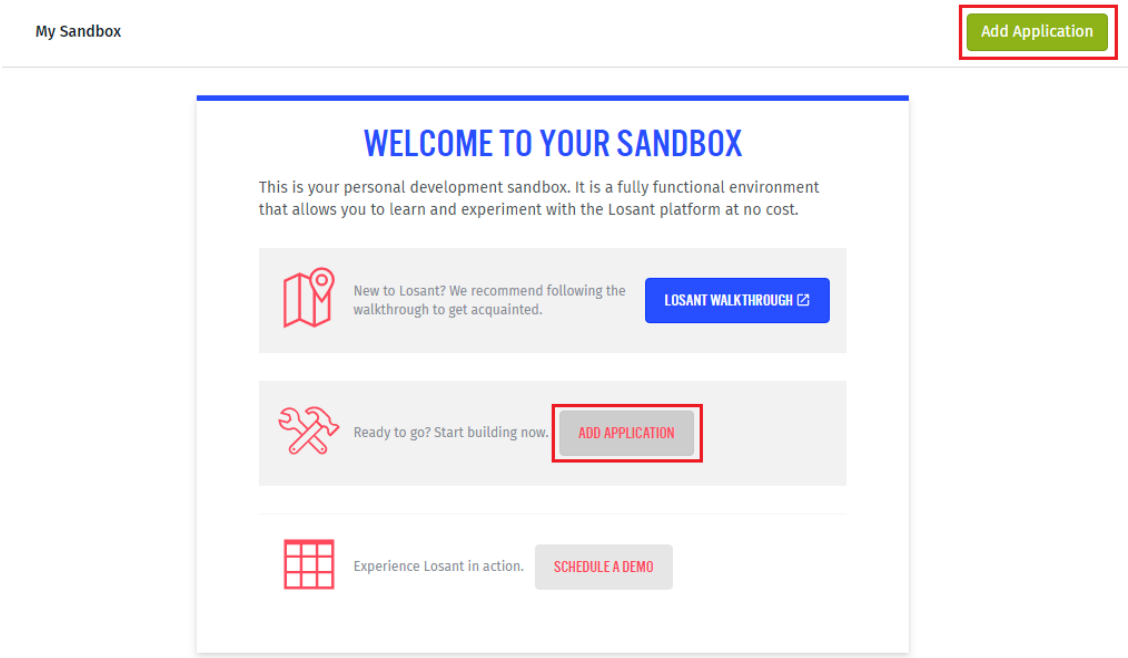
An example integration to a 3rd party cloud platform will be given to demonstrate the capabilities of the ADS-270 LoraWan unit. For this demonstration the Losant platform was chosen.

Losant is an easy to use, modern, and powerful Enterprise IoT platform designed to allow rapid build of real time connected solutions.

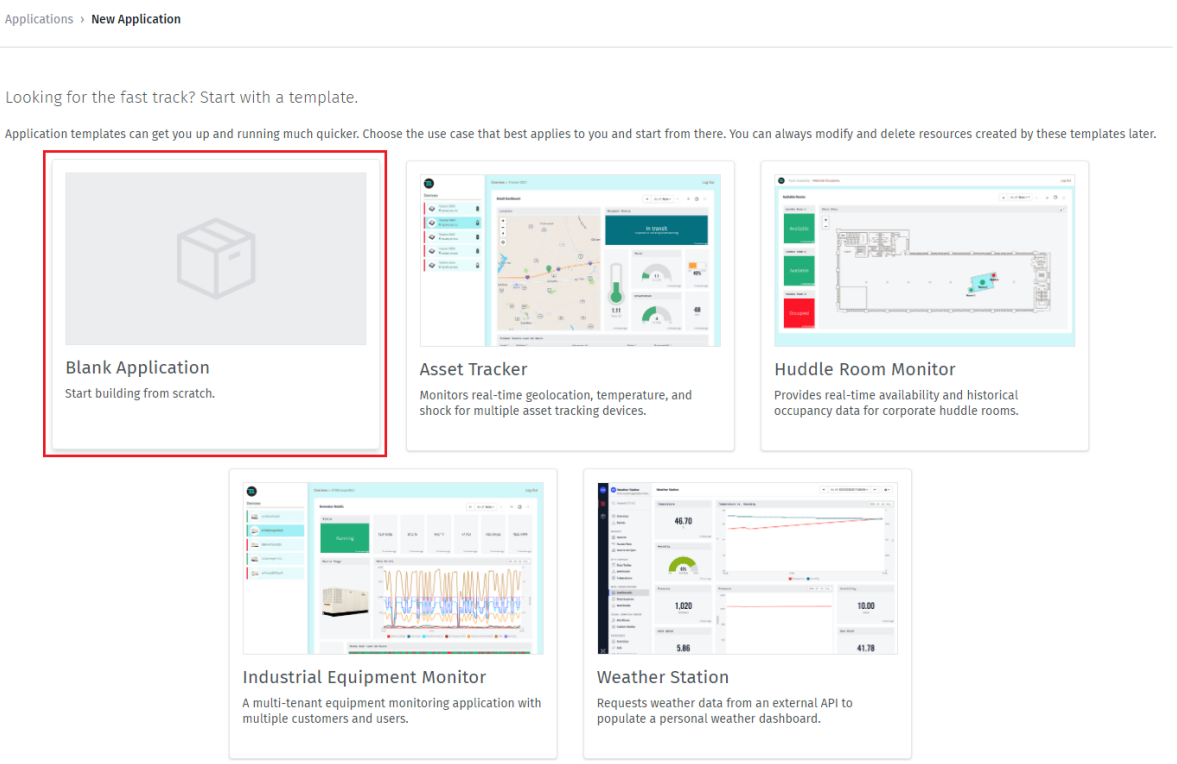
It is an application enablement platform which allows enterprises to effectively build applications that securely scale to millions of devices. With real-time stream processing and batch processing capabilities, users can create dynamic experiences and perform complex analytics.

5.1 Create Application

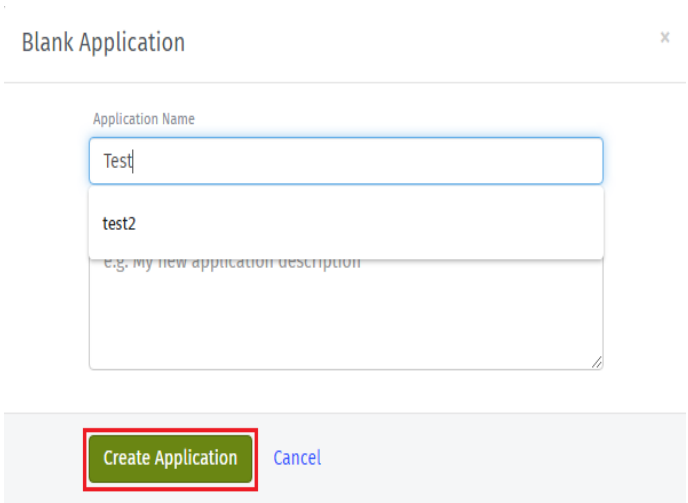
A free user account with Losant is required. An account can be created at www.losant.com After creating an account, the user will be prompted to create an application. Select “Add Application” to create a new application.



Select the “Blank Application” template.

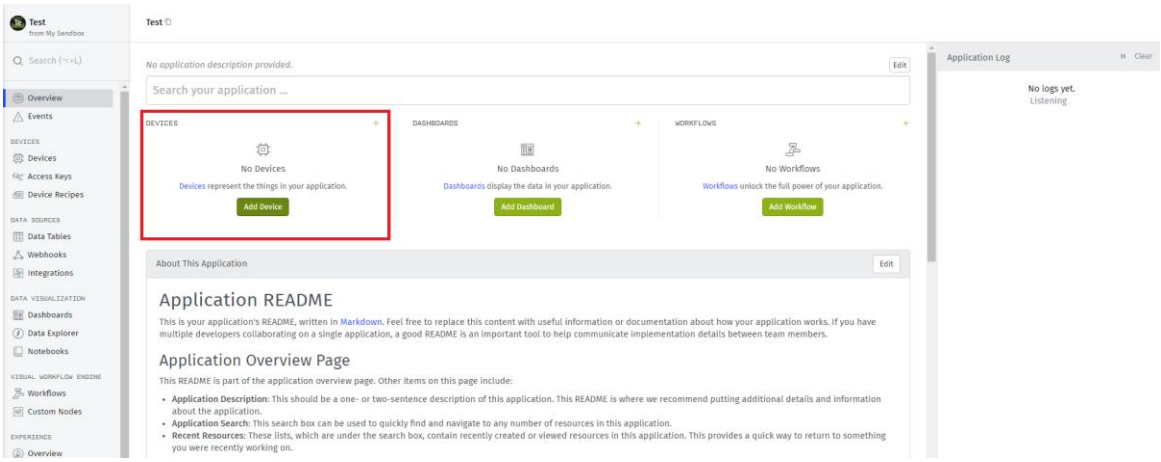


Provide a name and an optional description for the application and then select “Create Application”.

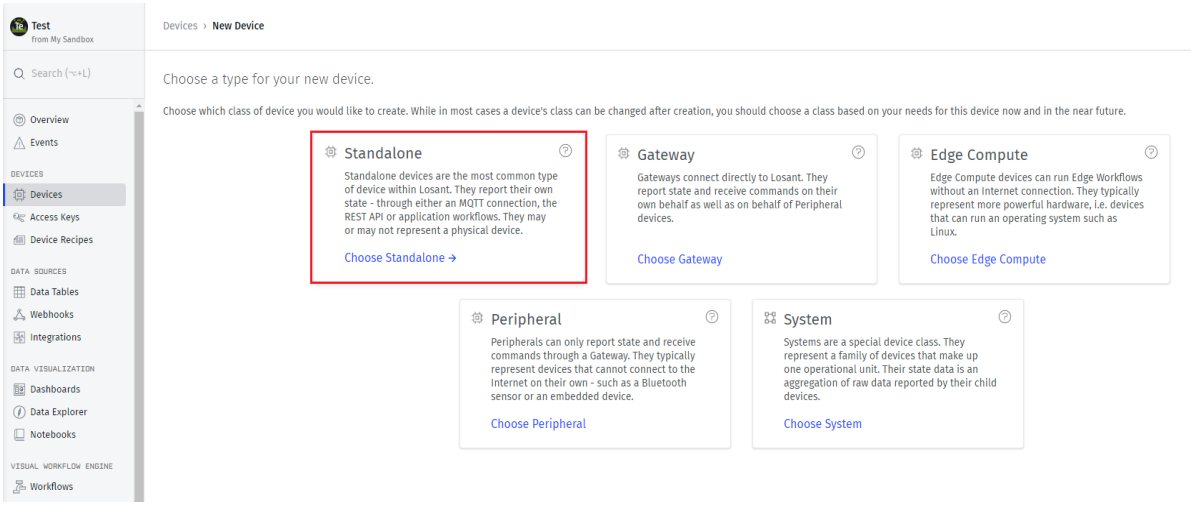


5.2 Add the Device

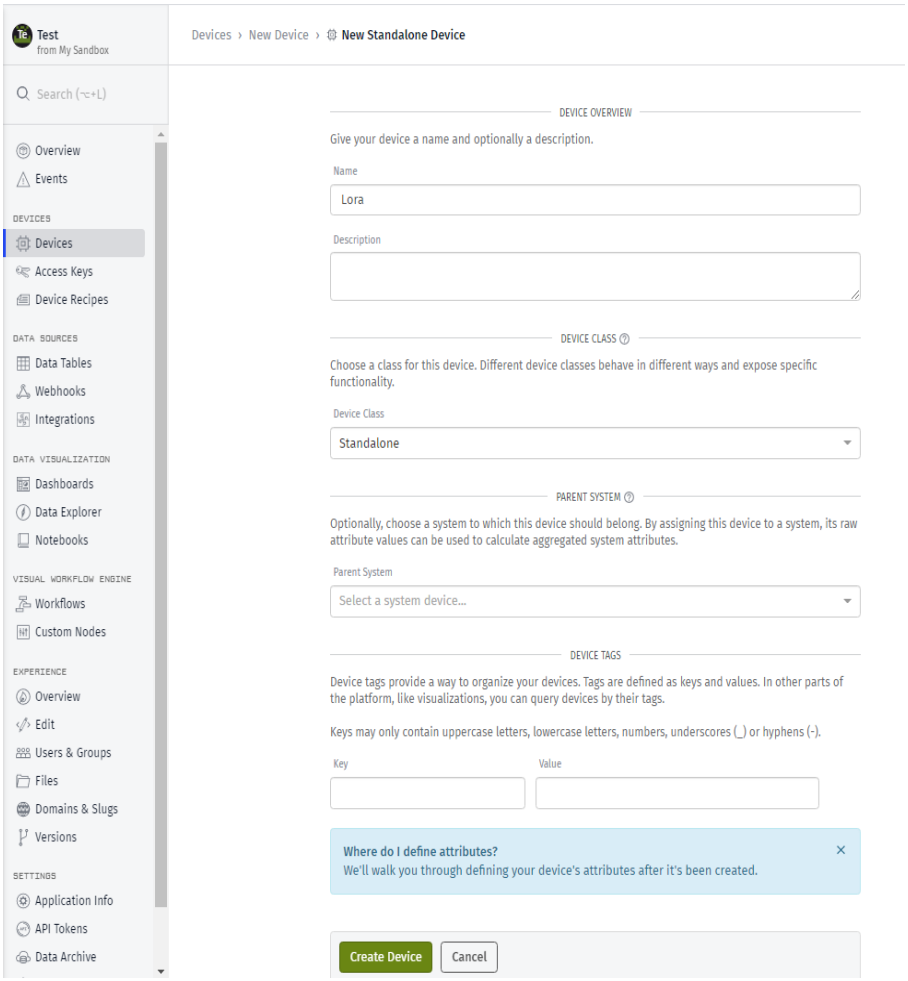
Select “Add Device” from the Application Overview page.



When creating the device, **select “Standalone” as the Device Class.**



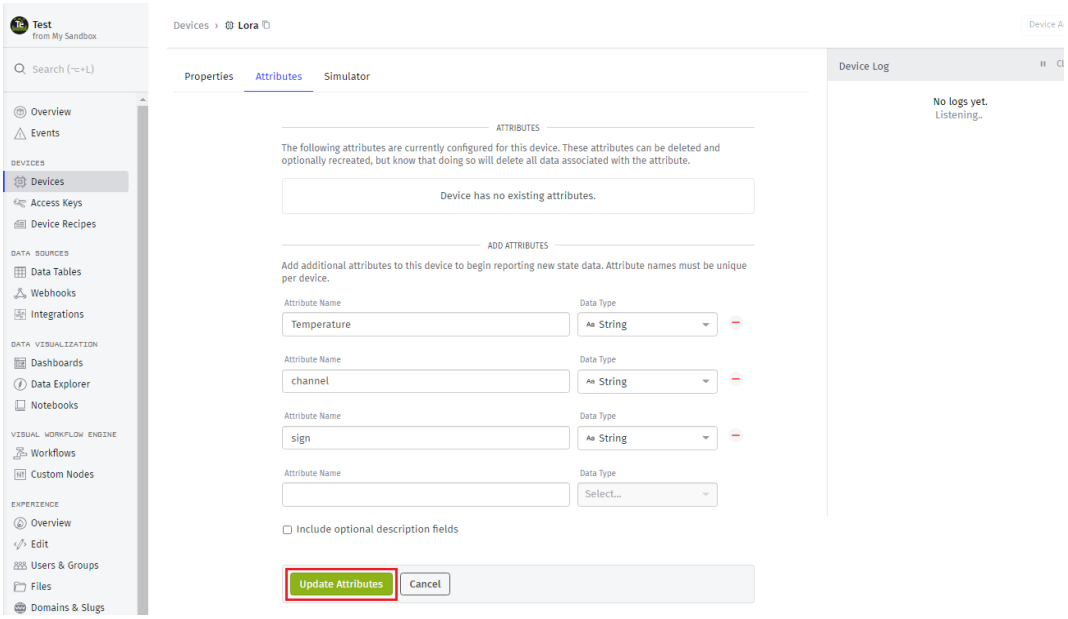
A device must be configured. Provide a name and an optional description for the device.



Select "Create Device" to configure the attributes for the new device.

Device attributes describe each data point the device is collecting. Attributes are used by Losant to identify the data this device will report and store in Losant's time-series database.

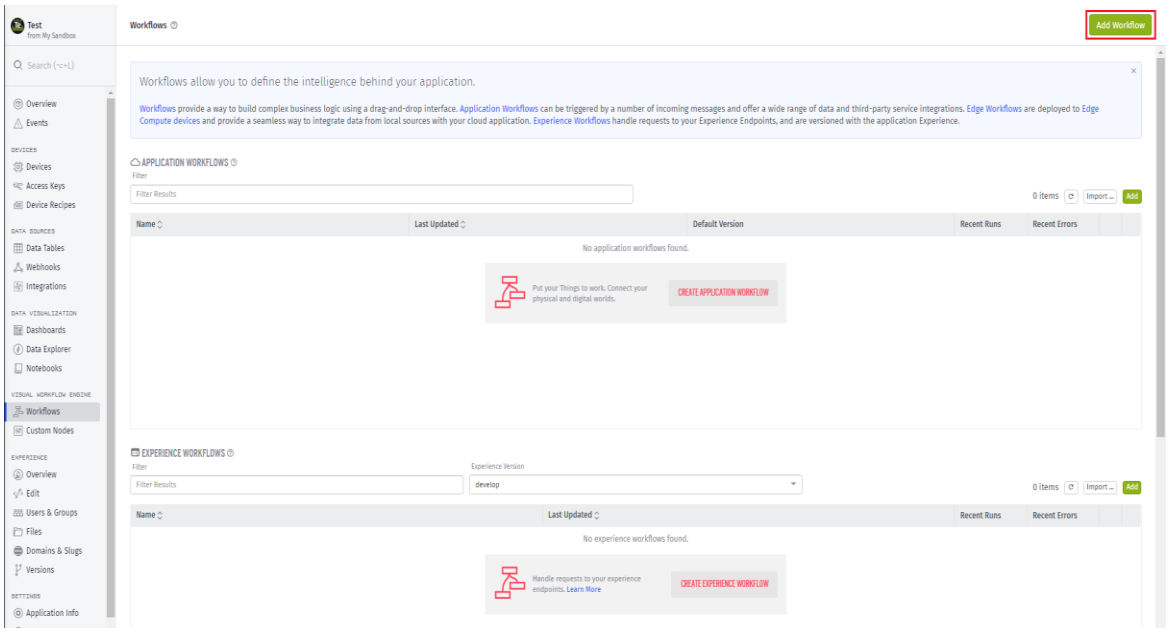
Add attributes and then press the "Update Attributes" button.



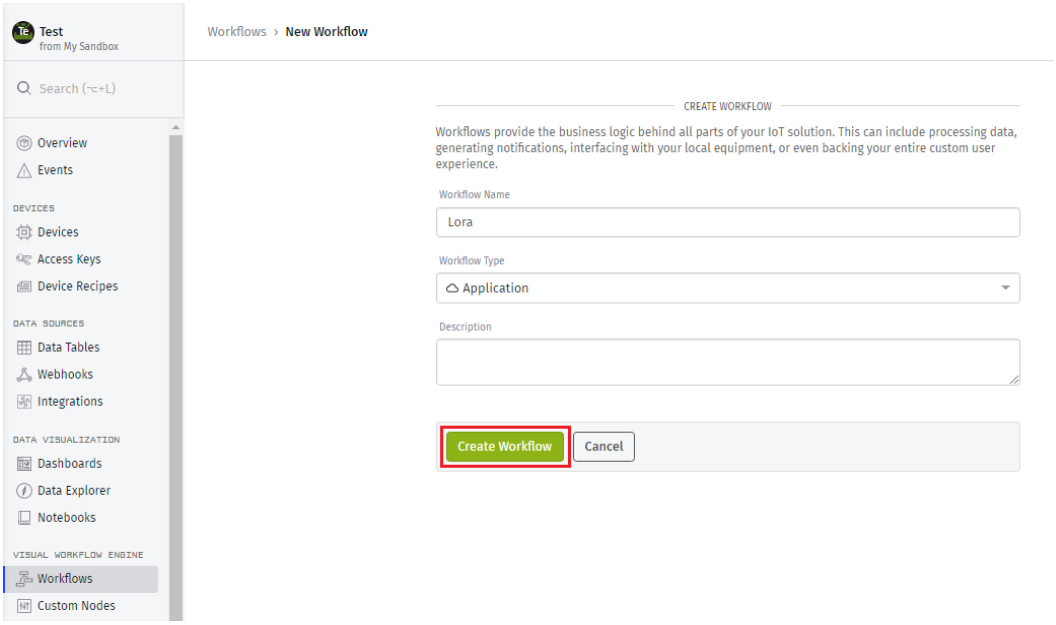
5.3 Workflows

Workflows help describe the logic for applications.

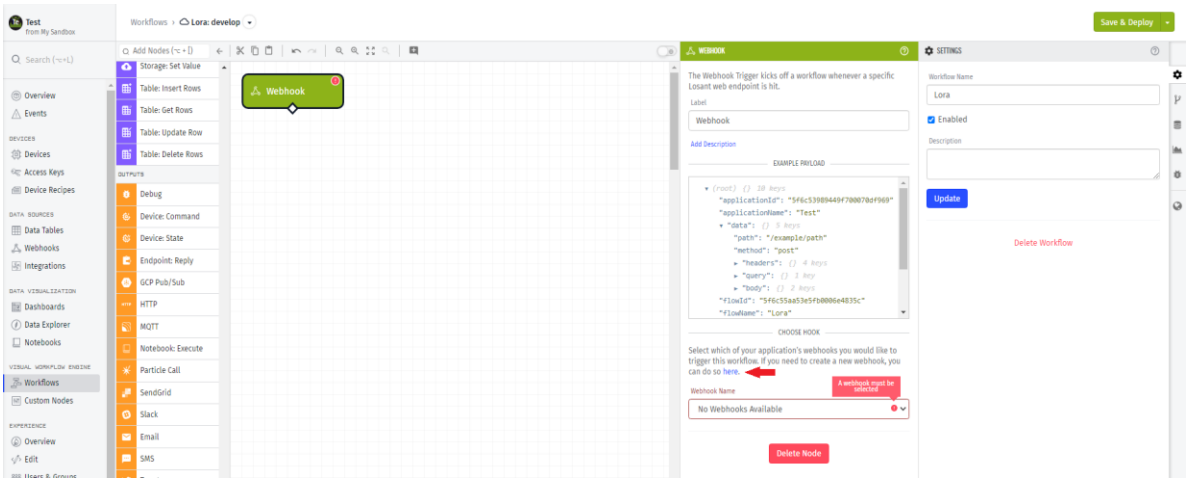
To create a workflow, select "Workflows" from the Application Menu. Then, select "Add Workflow."



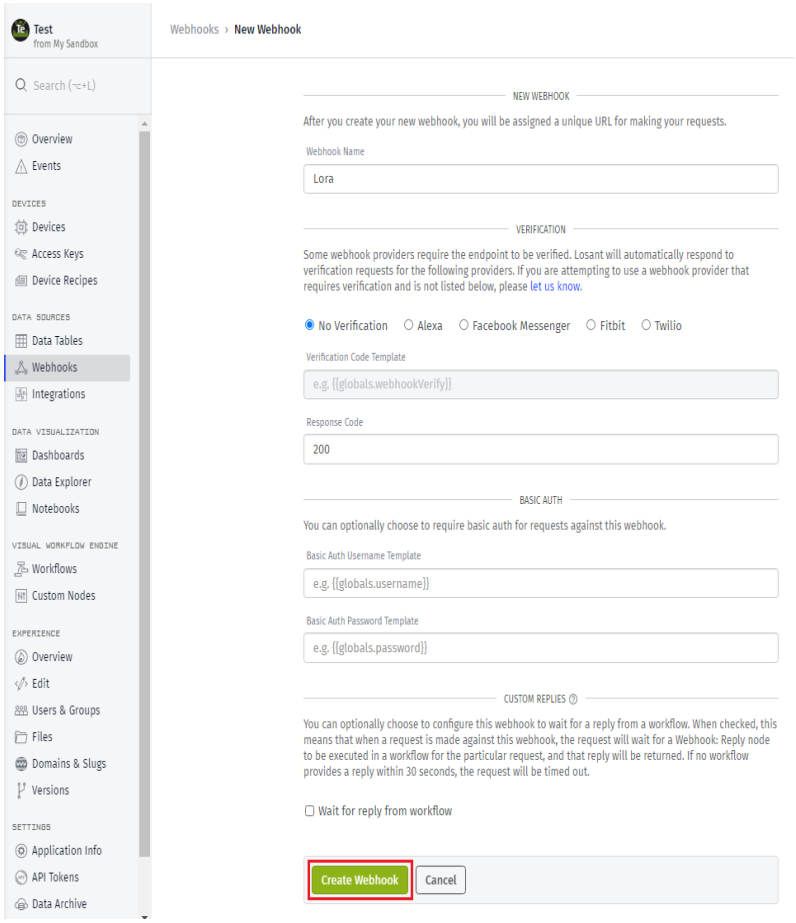
Name the workflow and select Application Workflow as the workflow type, then press the "Create Workflow" button.



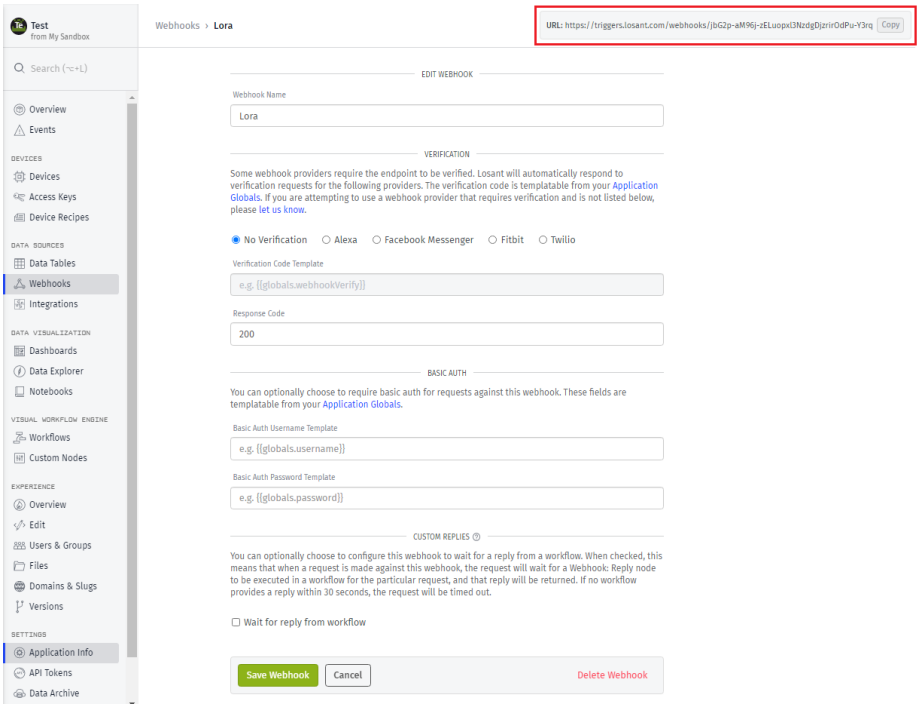
After creation the workflow canvas is enabled.



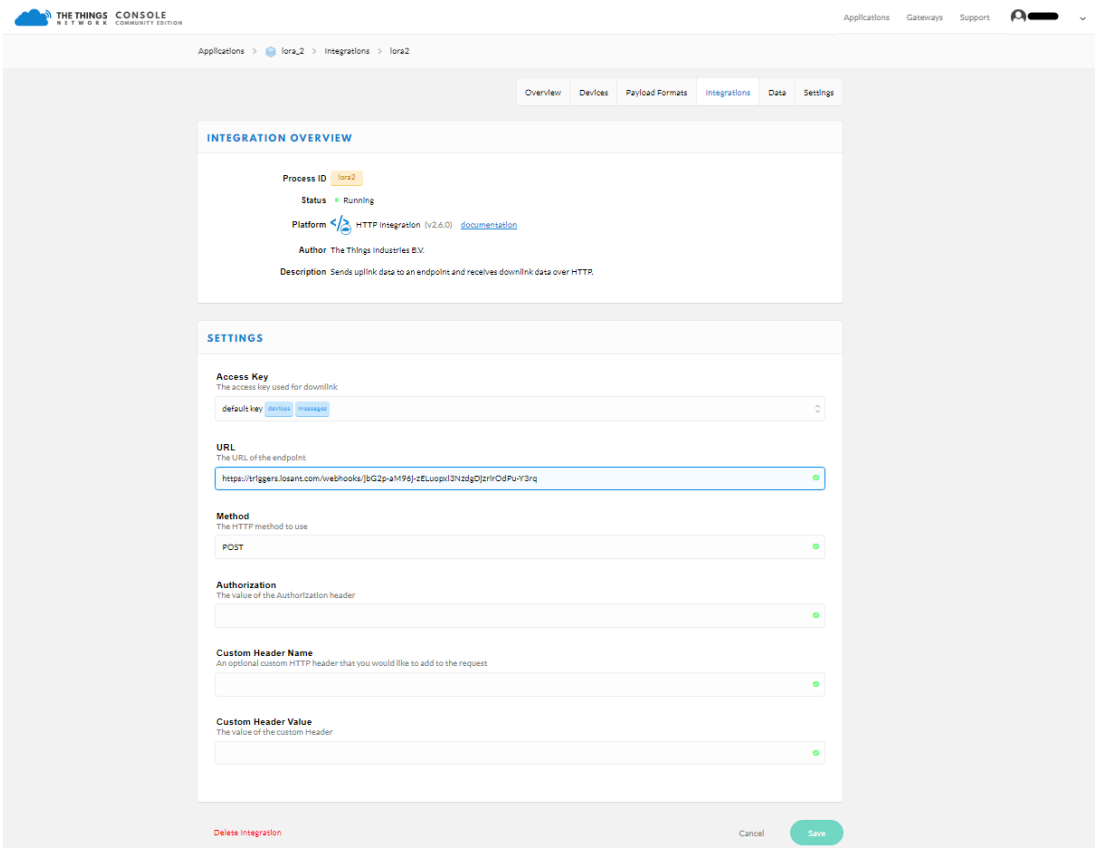
Select “Webhook Trigger Node” and click where the red arrow is pointing.



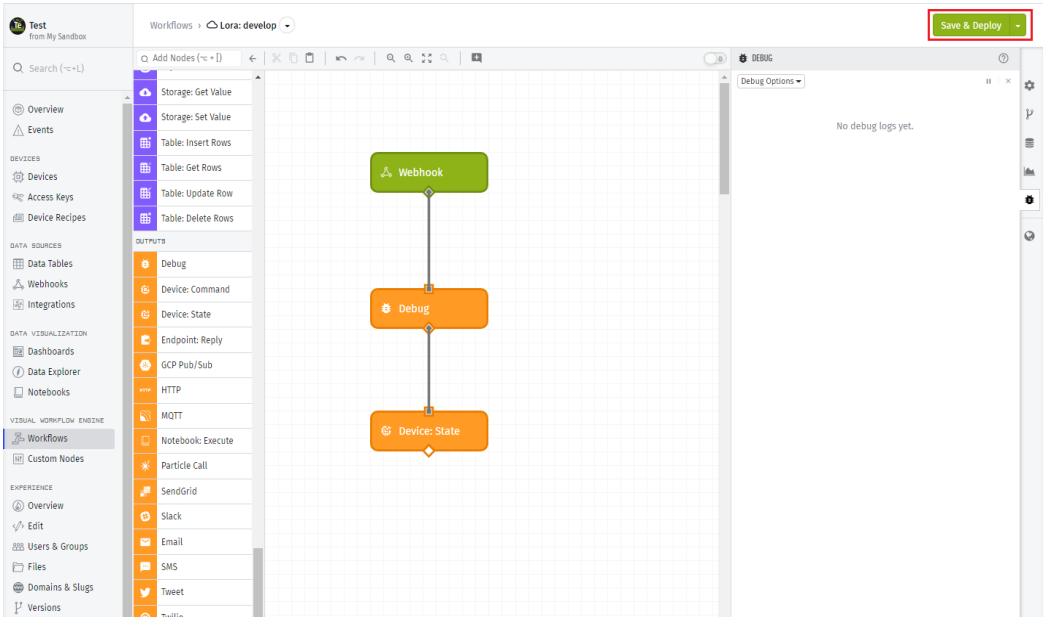
Name the Webhook and press the “Create Webhook” button. After that a URL will appear. Copy this URL.



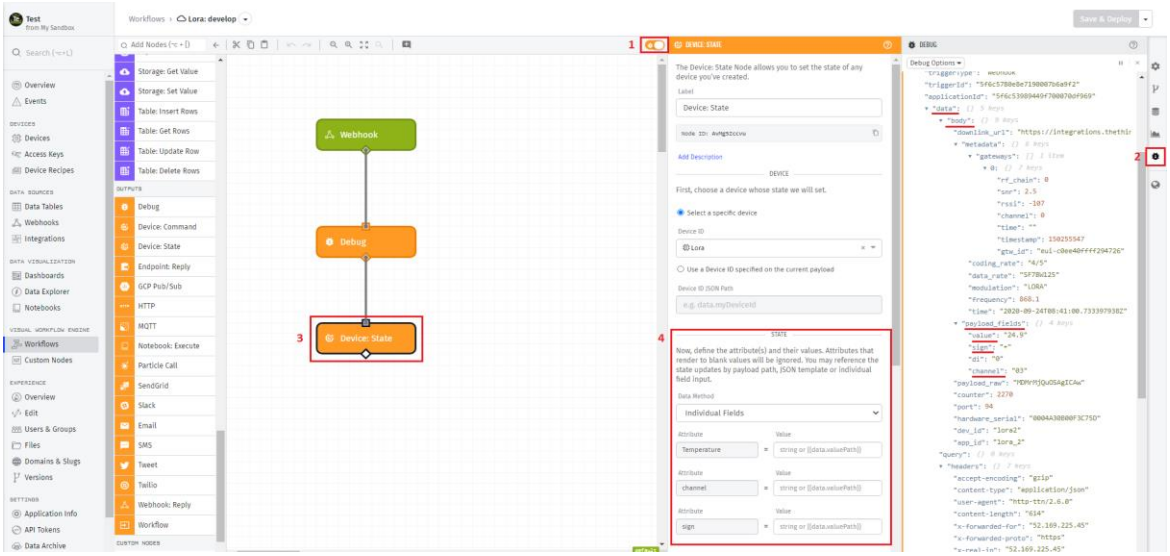
Navigate to The Things Network Console, select your application and then the integrations of this application and fill the gap “URL” with the URL that appeared after the creation of the webhook.

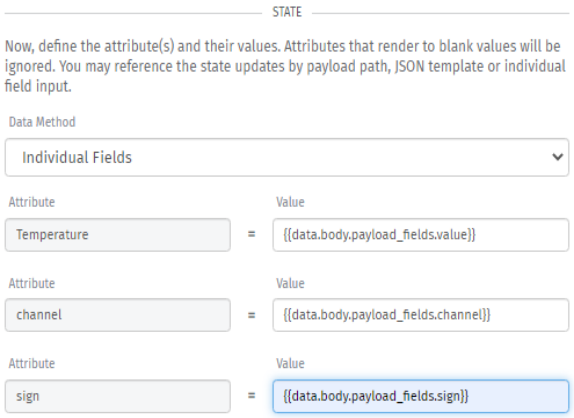


Back to workflow select the Debug Node and the Device State Node. Connect all the nodes together and press “Save & Deploy” button.



Turn on the switch “Toggle live debug stream” (1), select “Debug” (2), click on the Device State Node (3) and define the attributes and their values (4).

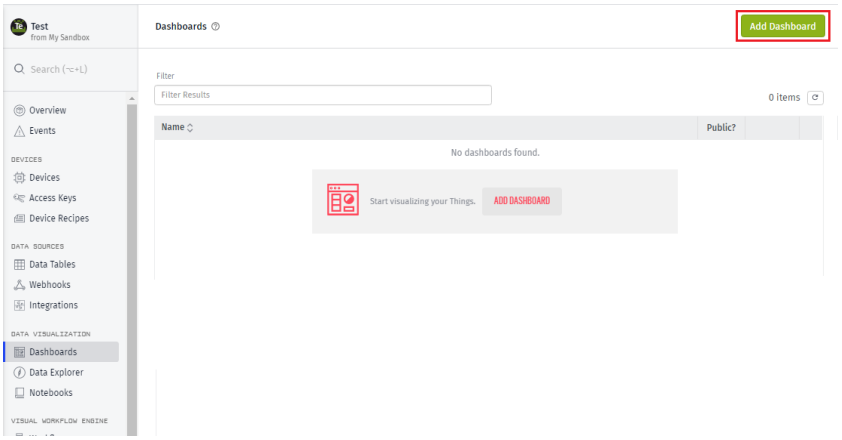




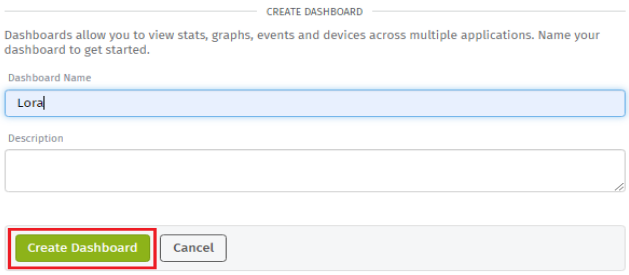
At the end select “Save & Deploy”.

5.4 Create a Dashboard

A dashboard is made up of blocks. Each block offers a different way to present data. Create a new dashboard by selecting “Dashboards” from the application menu and then select “Add Dashboard”.

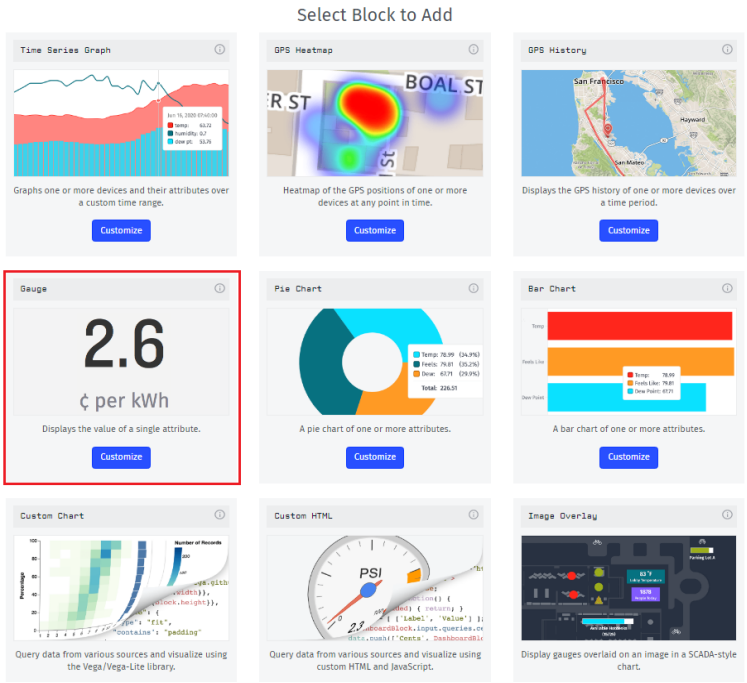


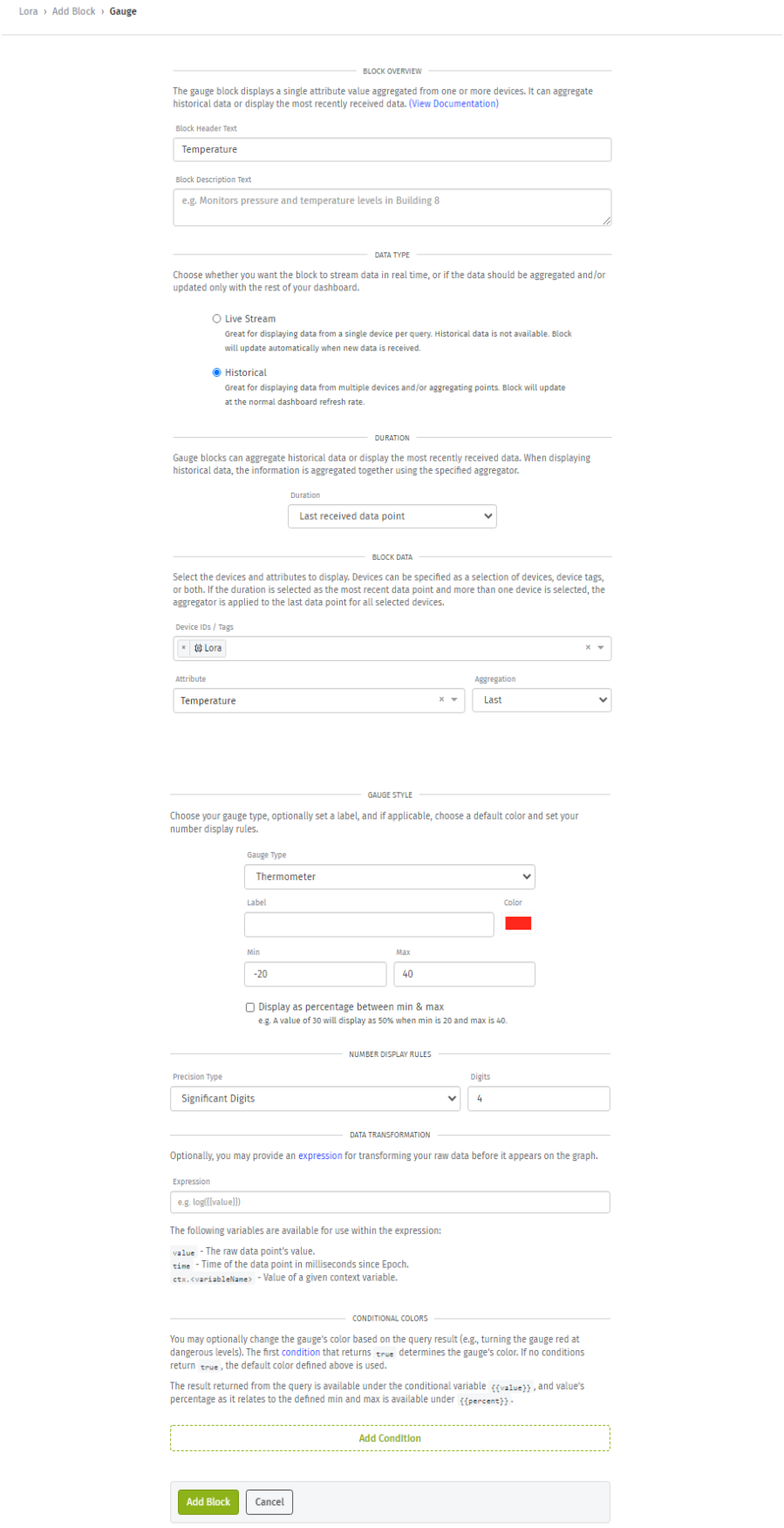
Name the new dashboard and press “Create Dashboard” button.

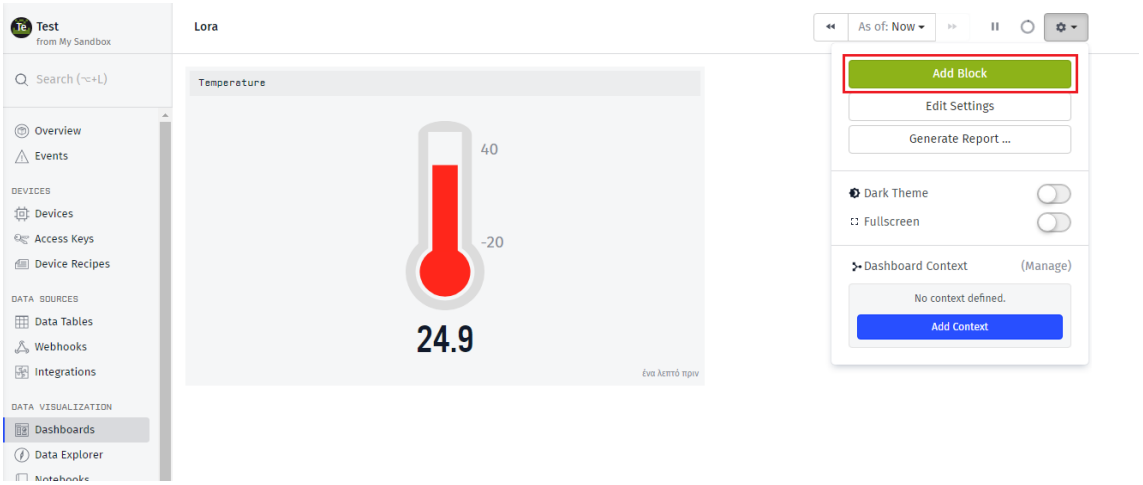


Select a block. For each block, you can configure what device state data to display within the block.

At this example we used Gauge Block.




Lora › Add Block › Gauge
BLOCK OVERVIEW
The gauge block displays a single attribute value aggregated from one or more devices. It can aggregate historical data or display the most recently received data. (View Documentation)
Block Header Text
Temperature
Block Description Text
e.g. Monitors pressure and temperature levels in Building 8
DATA TYPE
Choose whether you want the block to stream data in real time, or if the data should be aggregated and/or updated only with the rest of your dashboard.
Live Stream
Great for displaying data from a single device per query. Historical data is not available. Block will update automatically when new data is received.
Historical
Great for displaying data from multiple devices and/or aggregating points. Block will update at the normal dashboard refresh rate.
DURATION
Gauge blocks can aggregate historical data or display the most recently received data. When displaying historical data, the information is aggregated together using the specified aggregator.
Duration
Last received data point
BLOCK DATA
Select the devices and attributes to display. Devices can be specified as a selection of devices, device tags, or both. If the duration is selected as the most recent data point and more than one device is selected, the aggregator is applied to the last data point for all selected devices.
Device IDs / Tags
Lora
Attribute
Temperature
Aggregation
Last
GAUGE STYLE
Choose your gauge type, optionally set a label, and if applicable, choose a default color and set your number display rules.
Gauge Type
Thermometer
Label
Color
Min
-20
Max
40
Display as percentage between min & max
e.g. A value of 30 will display as 50% when min is 20 and max is 40.
NUMBER DISPLAY RULES
Precision Type
Significant Digits
Digits
4
DATA TRANSFORMATION
Optionally, you may provide an expression for transforming your raw data before it appears on the graph.
Expression
e.g. log({{value}})
The following variables are available for use within the expression:
value - The raw data point's value.
time - Time of the data point in milliseconds since Epoch.
ctx.<variableName> - Value of a given context variable.
CONDITIONAL COLORS
You may optionally change the gauge's color based on the query result (e.g., turning the gauge red at dangerous levels). The first condition that returns true determines the gauge's color. If no conditions return true, the default color defined above is used.
The result returned from the query is available under the conditional variable {{value}}, and value's percentage as it relates to the defined min and max is available under {{percent}}.
Add Condition
Add Block
Cancel

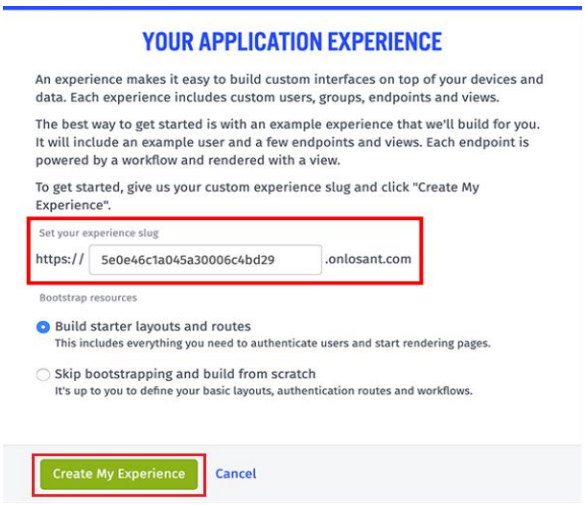


There is no limitation in the number of blocks that can be added.

5.5 Experiences

New application Experiences must first go through a short bootstrapping process before you starting to use the relative features.

5.5.1 Choose a slug.

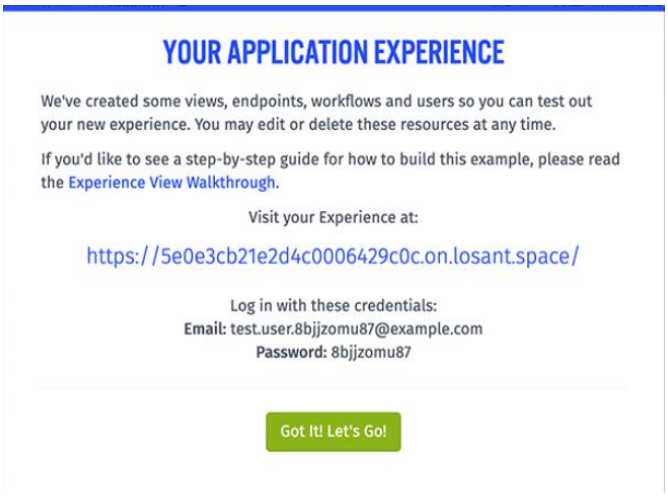


By default, the application experience includes a slug that matches your application ID; this slug cannot be deleted. You can also enter a custom slug during the bootstrapping process.

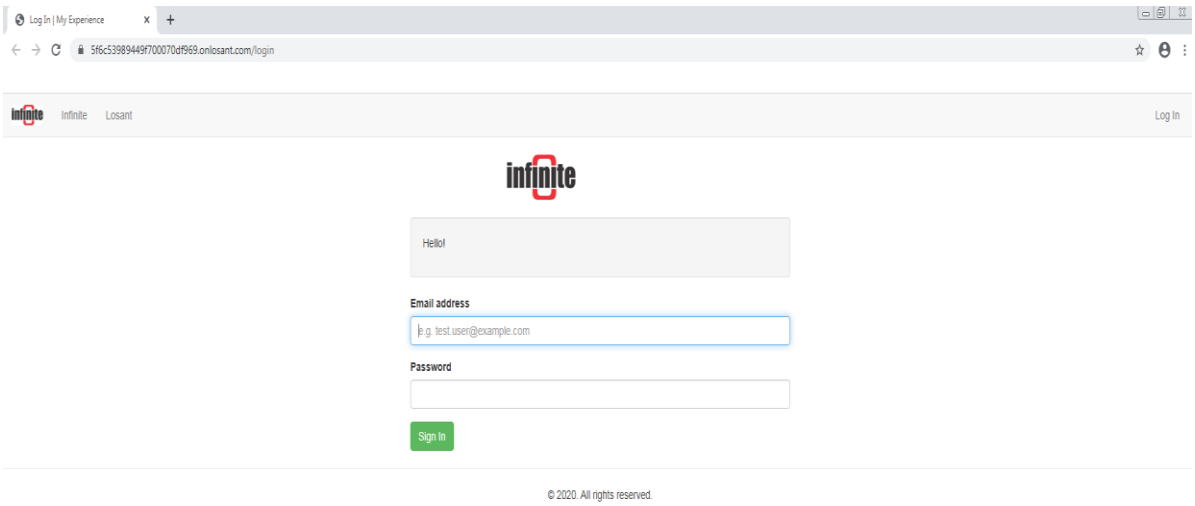
Click on "Create My Experience".

5.5.2 Test your Experience

If you chose to create the sample resources, you'll receive instructions for testing your new endpoints and views.

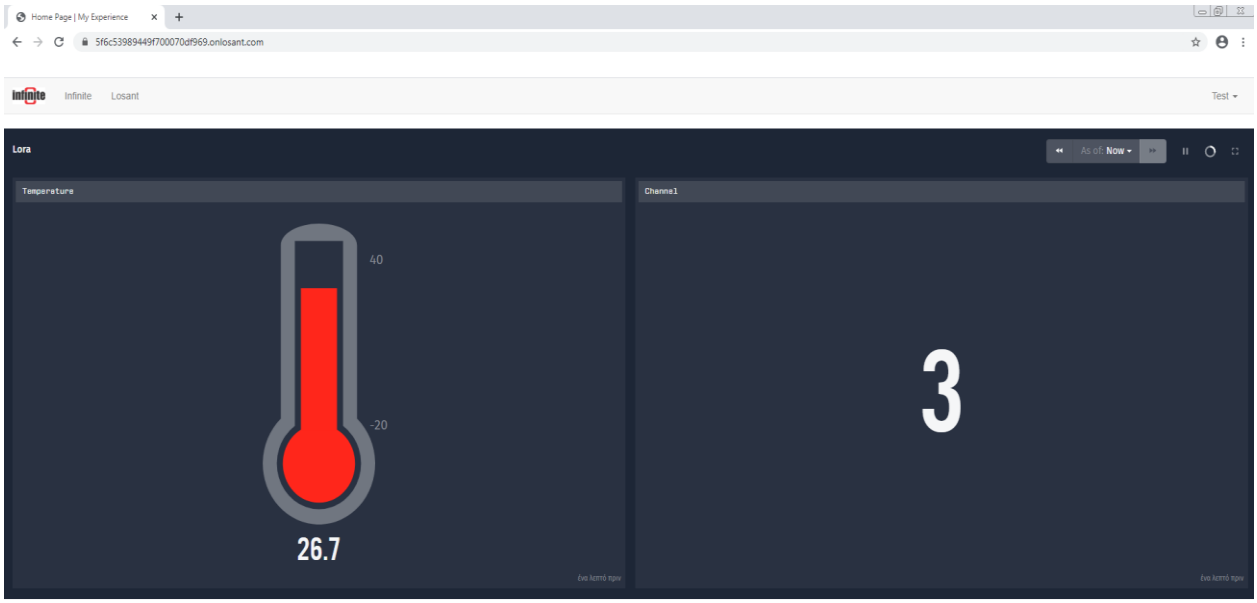


Click the link provided on the summary screen, which should redirect you to your new login page.



Sign in with the provided credentials and you will then see the placeholder home page.

The page will look like that.

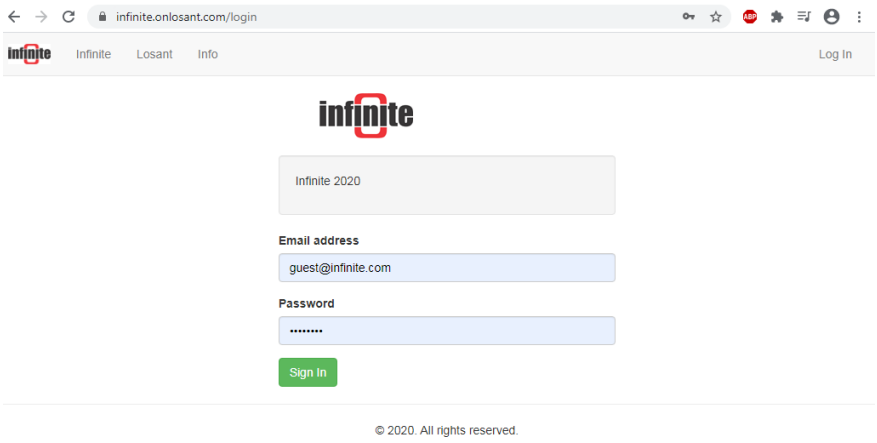


Try to log in to the page we created as an example for you to get a first impression of the result.

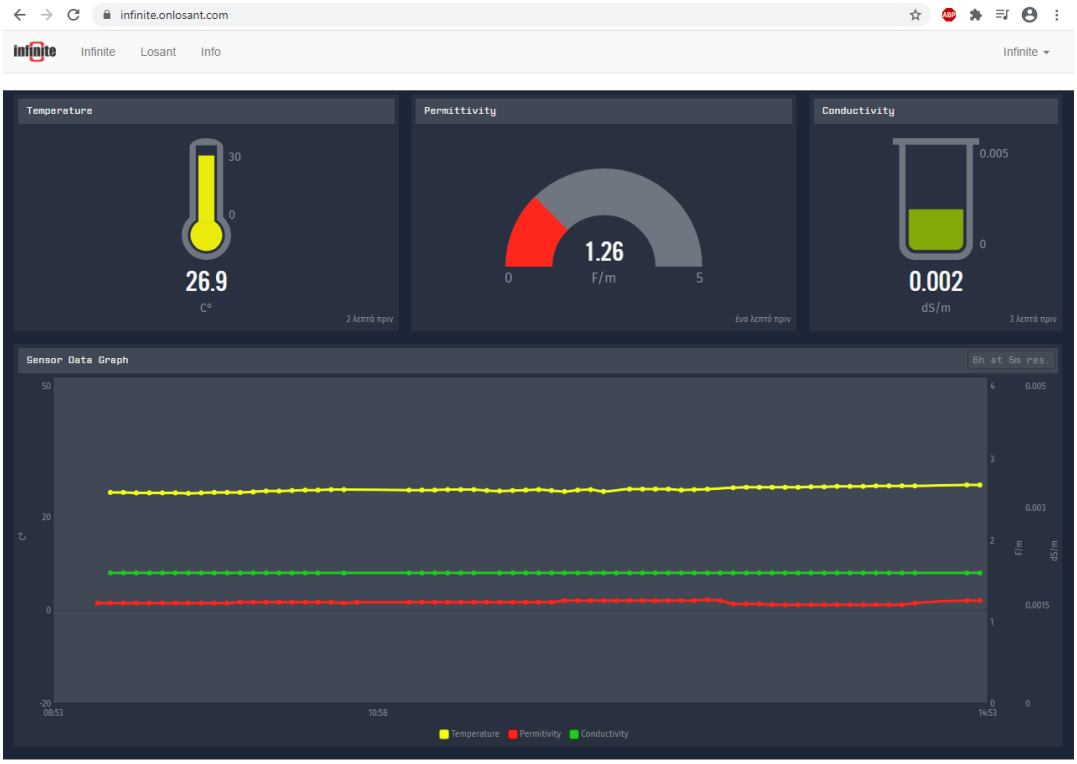
Navigate to,

https://infinite.onlosant.com/login

To log in, type “guest@infinite.com” for the email address and “infinite” for the password.



When you successfully log in, you will see the below home page.



Disclaimer:

Revision: 1.3

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