EMB-LR-PICOCELL

DOCUMENTATION

Rev 1.3

Embit s.r.l.

Document information

Versions & Revisions

Revision	Date	Author	Comments
1.0	2021-02-09	Embit-AM	Initial release
1.1	2021-06-17	Embit-DL	Added installation guide
1.2	2022-11-21	Embit	Aligned to the new Hardware release
1.3	2023-03-7	Embit	Aligned to new web interface

1 Index

2 Introduction

The **EMB-PICOCELL** uses LoRa® technology and complies with the Semtech® 868MHz protocol stack which aims to emulate LoRaWAN® behavior. It enables IoT (Internet of Things) implementations mandating worldwide interoperability and battery-powered end devices over long-distance connectivity. The gateway is an IP67-grade outdoor product, with a plastic case.

This guide explains how to start using the **EMB-PICOCELL**. The **EMB-PICOCELL** gateway is designed to meet IoT (Internet of Things) and M2M (Machine-2-Machine) scenarios. It enables LoRa® connectivity, having the role of fully compliant Gateway.

It provides the LoRaWAN® packet forwarder functionality.

The radio section is based on the EMBIT Mini PCI-express board, EMB-LR1302-mPCIe. It starts to operate as a LoRa® base station, receiving radio packets and forwarding them to a LoRa® Network Server. It has a TCP/IP connection through Ethernet. Its functionalities will be described in details in the following paragraphs.

Thanks to the Semtech® SX1302 performances and the efficient Embit RF design, the possible radio ranges are up to 15 km in the country side and up to 3 km in urban areas.

The OS system is Linux based, and the customer can configure it according to his needs, with a complete root access. The **EMB-PICOCELL** provides a web interface to manage and configure the connectivity with the different network protocols.

Figure 1 EMB-PICOCELL

3 Hardware Specification

- Processor: Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz

- RAM Memory: 16 GB, LPDDR2 SDRAM

- LAN Connection: Gigabit Ethernet over USB 2.0 (maximum throughput 300Mbps)

- LoRa® Connectivity: EMB-LR1302-mPCIe

- Receiver Sensitivity: down to -141 dBm @ SF12 BW 125kHz

- Power Source: 5 VDC

- Ports: Ethernet 10/100/1000 RJ 45 / 1 SMA Antenna Connector

- Operating System: Linux 9.8 Stretch (or later version)

4 Gateway Installation Guide

4.1 Ethernet connection

In order to exploit the Ethernet connection of the **EMB-PICOCELL**, you have to simply plug the proper cable (not provided) in the Ethernet port.

4.2 Power consumption

The gateway average power consumption is around 9 Watts.

4.3 Grounding and Cables Section

The **EMB-PICOCELL** does not require ground connection.

5 Operating System

EMB-PICOCELL Operating System is Linux 9.8 Stretch.

It is allowed full SSH root access to the final user, using as username and password:

Username: user

Password: embit

The final user can install, uninstall, upgrade every single program.

Pay attention, each action may stop irretrievably the functionalities of the system.

6 LoRa® 868MHz Feature

In this network Architecture, three main roles are defined:

- **End-Device**: endpoints with sensors embedded;

- **Gateways**: they provide LoRa® wireless connectivity to the devices. They are the connection between the devices and the IP backhaul network to the Network Server;

- **Network Server**: the intelligence of the network. It is centralized radio controller, which performs radio management, the provisioning and authentication of devices, and the delivery of the data to one or multiple application servers through a set of Application Programming Interfaces (APIs).

Another role is the **Application Server**. It is managed by the final customer and it is put on top of the Network Server. Full Network Image follows.
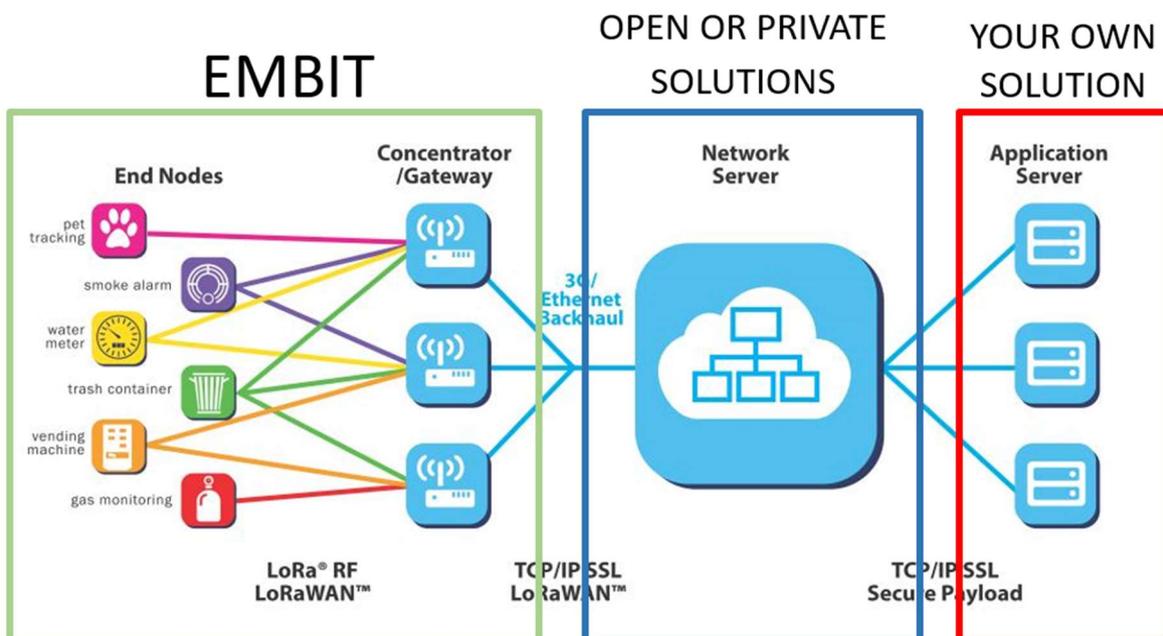
Figure 2 LoRa® Network Architecture

Each communication is fully encrypted with three keys, each one with a length of 128 bits. The algorithm used for it is AES-128. These algorithms have been analysed by the cryptographic community for many years, are NIST approved and widely adopted as a best security practice for constrained nodes and networks.

EMB-PICOCELL provides LoRa® 868 MHz connectivity up to 3 km in urban area and up to 15 km in rural environment.

The RF path is fully compliant to Semtech® specifications and it is able to achieve a Receiver Sensitivity up to -137 dBm.

7 Gateway Configuration Web Interface

EMB-PICOCELL provides a web interface, which allows to select and configure the desired LoRa® packet forwarder.

It is reachable at *https://[gateway_IP_address]:10000*. The default data access is:

username: user

password: embit
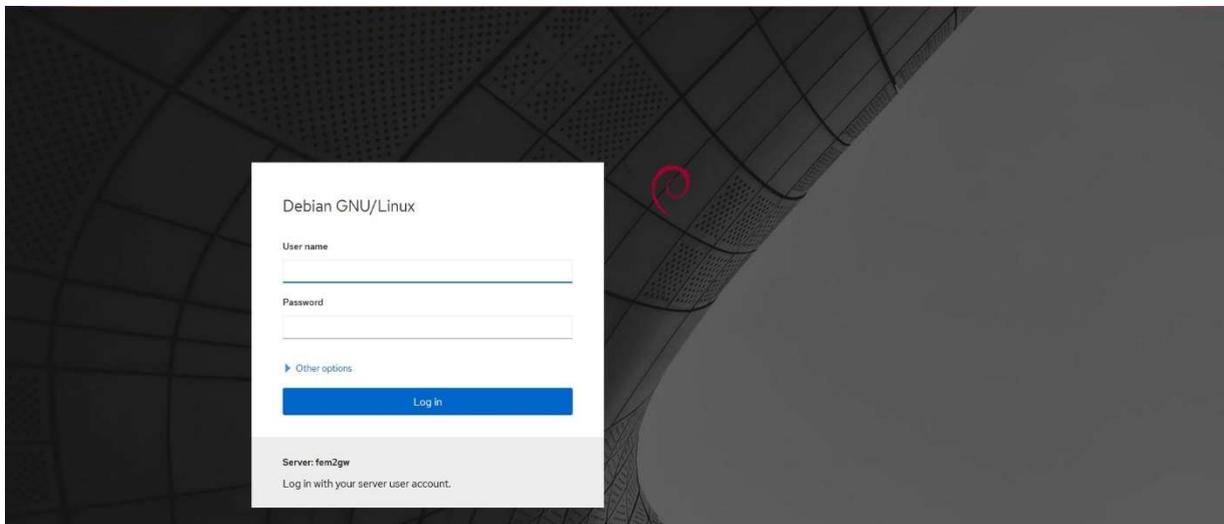
Figure 3 Log In Page
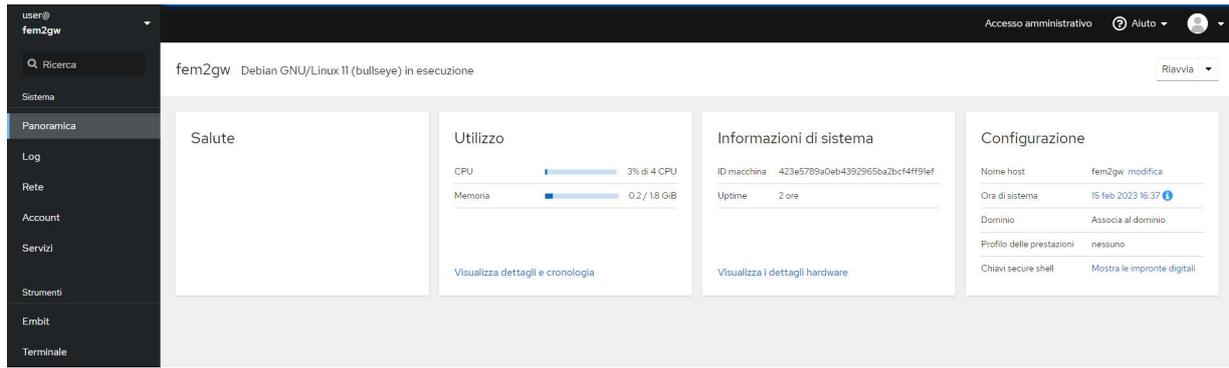
Figure 4 Main Page

Clicking "services" you can reach the "*Packet Forwarder*" page, the system state information is reported. In this page is possible to manage and monitor the LoRa® packet forwarder status.

It is recommended to turn off the packet forwarder before configuring new parameters, and turn it back on afterwards.
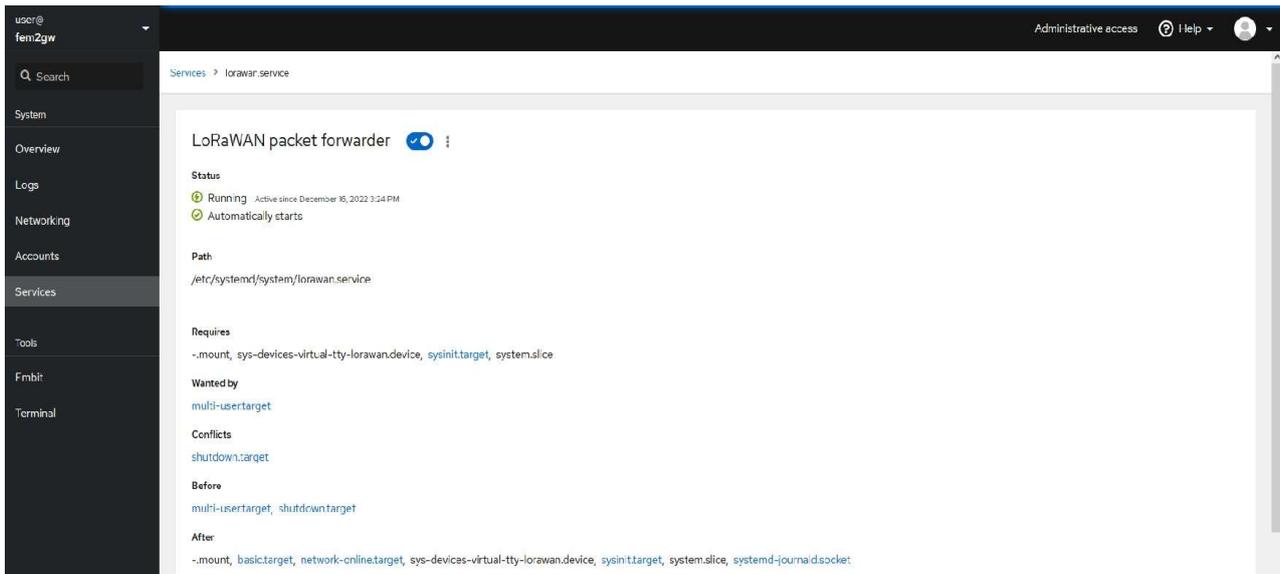

Figure 5 LoRaWAN packet forwarder Tab

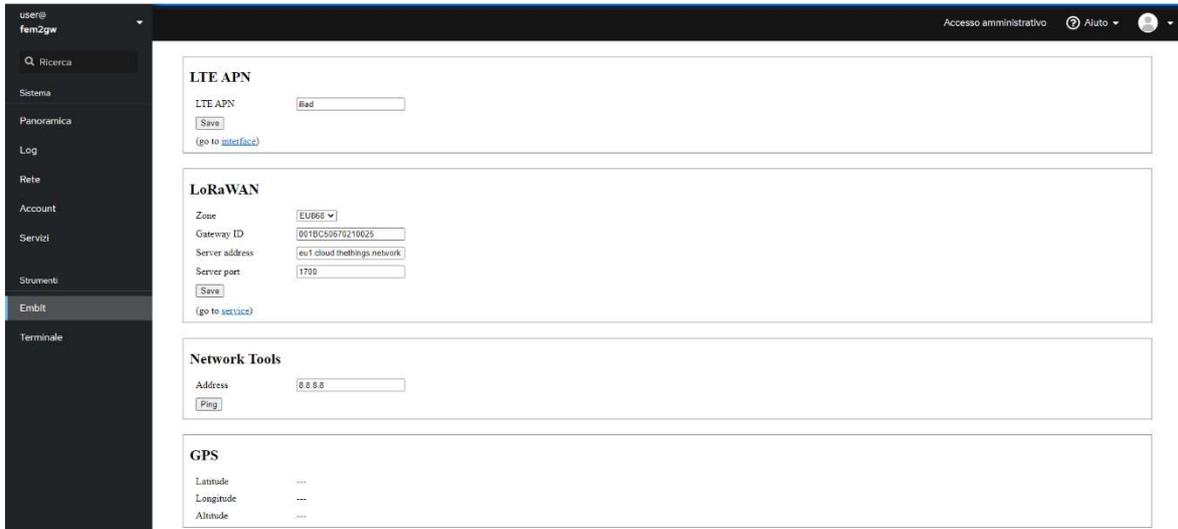"*Embit Gateway Configuration*" is located in the left menu, in the category Tools.

Figure 6 Embit Gateway Configuration Main Tab

In the configuration tab, it is possible to customize the network parameter of the LoRaWAN® packet forwarder:

- Zone → 868 MHz \ 915 MHz \ 490 MHz – (Certified only for Europe 868 MHz)

- Gateway EUI →8-bytes (hex) – usually Gateway S/N

- Network Server Address

- Network Server Port

Once all parameters are set, click "save" to confirm.

The following figure shows the TTN (The Thing Network) configuration for the European 868 MHz frequency band:

Figure 7 Embit Gateway Configuration Main Tab

8 LoRa® 1302 Gateway EUI

EMB-PICOCELL connects to the LoRa® network with a Gateway EUI (Extended Unique Identifier) written in the label. Gateway EUI can be changed using the LoRa® 1303 Gateway Configuration Web Interface.

Step 1: Take your Unique Gateway EUI

The Unique Gateway EUI is a number which allows the Network Server to identify your gateway. This parameter is written in the label of the **EMB-PICOCELL** Gateway. It can be changed, according to your preferences, through Embit Gateway Configuration Web Interface, under the "Configuration Tab".

9 Example: The Things Network LoRaWAN® Network Server

This section provides a brief explanation to register a new gateway in a LoRaWAN® Network Server.

The LoRaWAN® Network Server taken into account for this example is "The Things Network" network server.

The references to all the complete procedure to be carried out can be found on The Thing Industries website in the "Registering Gateways" tab, at the link: [The Things Industries](#)

Step 1: Sign up with your Account or register a new one
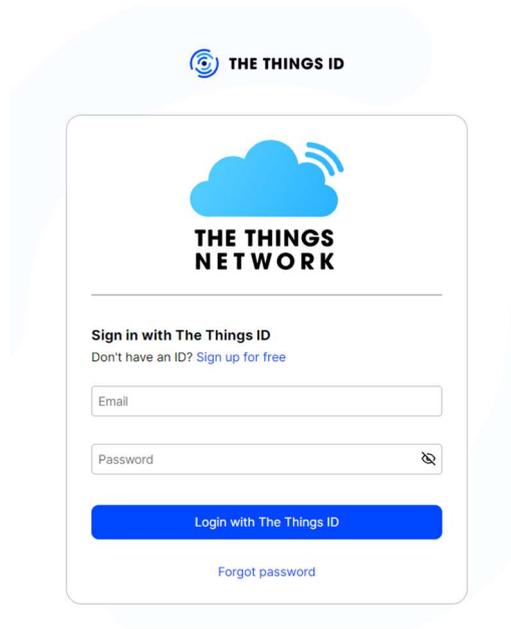
Figure 8 TTN Login Page

Step 2: Add a new gateway

Once you are logged in, click on your profile name, go to "Console" and select your cluster (Example: Europe).

In the next page, click on "Go to gateways" (Figure 19) and then click on "Register gateway" (Figure 20).

Walk right through to your applications and/or gateways.

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

Figure9 Gateway selection

Figure 10 Register gateway button

In the next window, you have to compile all the fields required (Figure 11). The Gateway EUI is the hexadecimal EUI written on the label "Gateway EUI" in the Embit Gateway Configuration Tab from the Gateway Web Interface.

Here your ID name will appear

Configured Gateway EUI

Gateway ID – Auto generated (can be modified)

Gateway name

Can select frequency according to your location

Figure 11 Add gateway settings

Once that all the settings are completed, click on "Register gateway" button.

Step 3: Check your connection

After that the adding procedure is completed, a general overview will appear (Figure 12)
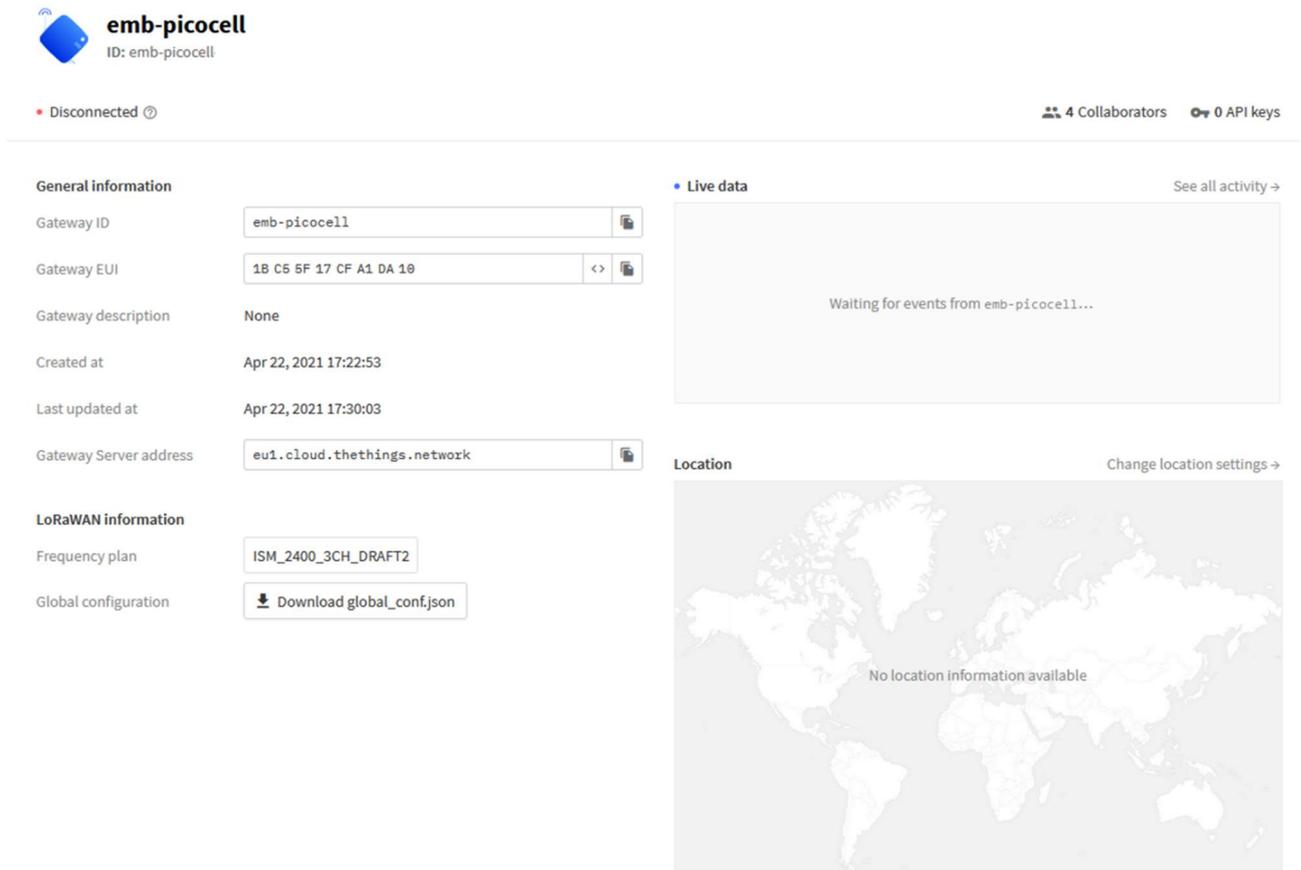
Figure 12 General overview of the added gateway

When your Gateway is connected, a green dot is showed in the upper side of the info. Near the connection status, you can also find the list of the collaborators of the new gateway and, by clicking "Collaborator" you can add a new member.

10   IP Backhaul Connection

EMB-PICOCELL supports one kind of backhaul IP connection:

- Ethernet IP connectivity.

The system is connected to the Ethernet Network through Ethernet Cable. IP address is assigned through DHCP.

11 End Device configuration on Network Server

In case you want to build a complete network consisting of a gateway and end devices (only with end devices "Embit Development Kit"), the additional configurations to be made on the Network Server are as follows:

11.1 Create New Application

Once you have configured your gateway, click on your profile name and then go to "Console". In this page, click on "Go to applications" (Figure 17) and in the next page click on "Create application" (Figure 18).
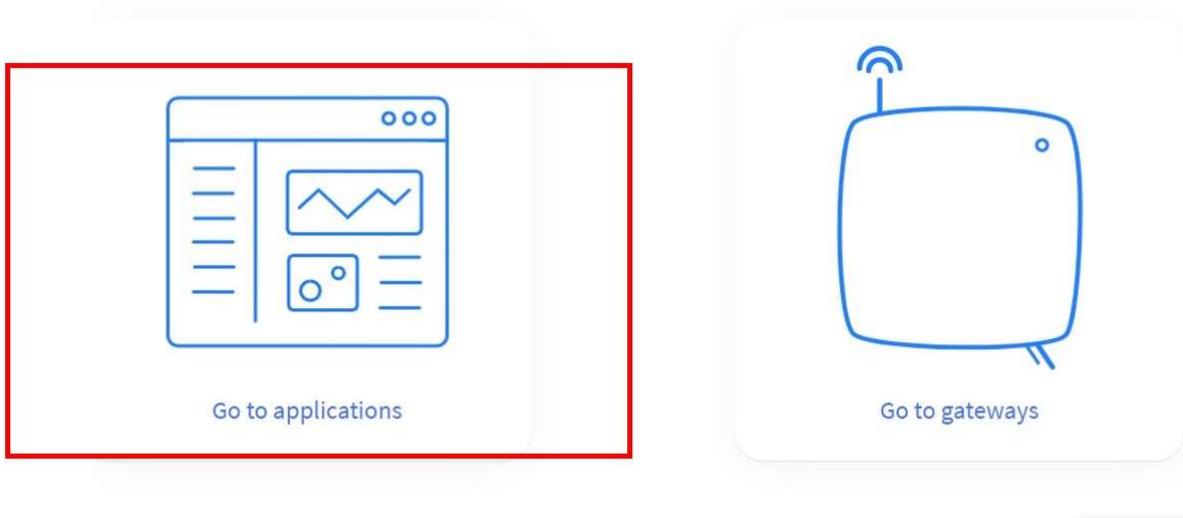
Figure 17 TTN Console view
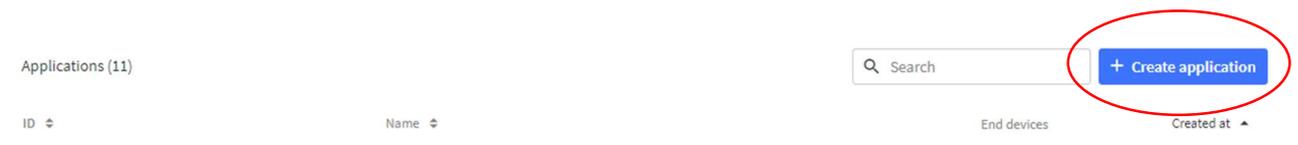
Figure 18 Add application button

A window like the one in Figure 19 will be opened.

Figure 19 Add new application procedure

"Application ID" and "Description" are human-readable string. Fill all the fields with your personal information and then press "Create application" button.

11.2   Add New Device

Once that your application is created, in the relative box you can find all the information related to the selected application and add a new device, by clicking on the "Register end device" button (Figure 20).
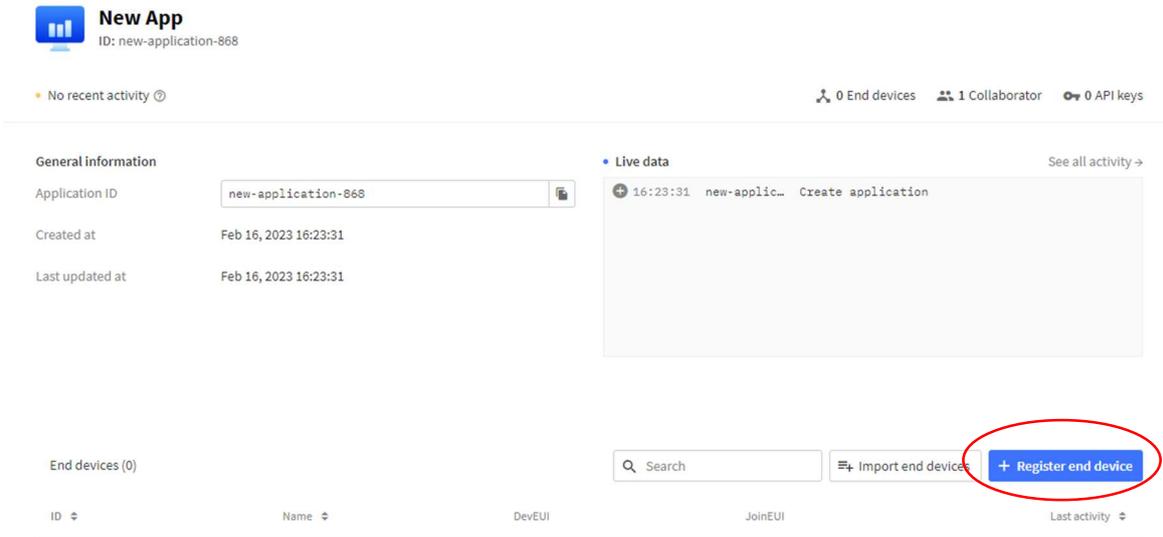
Figure 20 Add a new end device

In the next window, select "Enter end device specifics manually" (Figure 21)
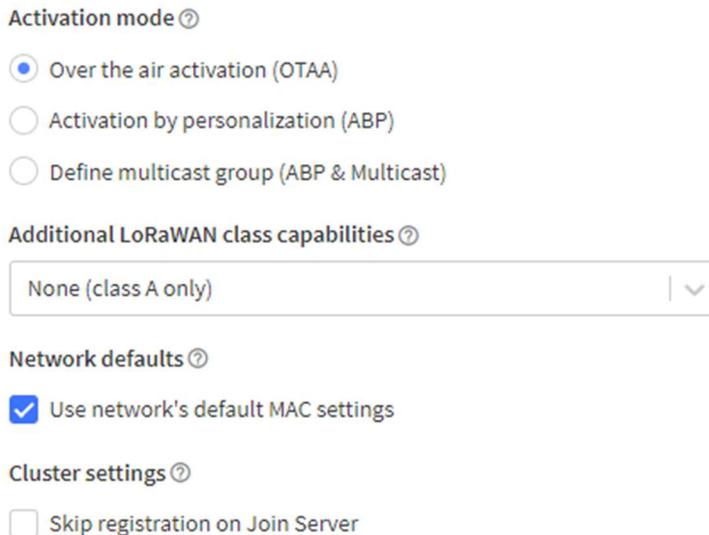

Figure 21 Register end device window

Now further settings will be proposed. Select a proper "frequency plan" and 1.0.3 LoRaWAN version. If the correct parameters have been selected, the ability to add advanced settings for configuration will be displayed (Figure 22)
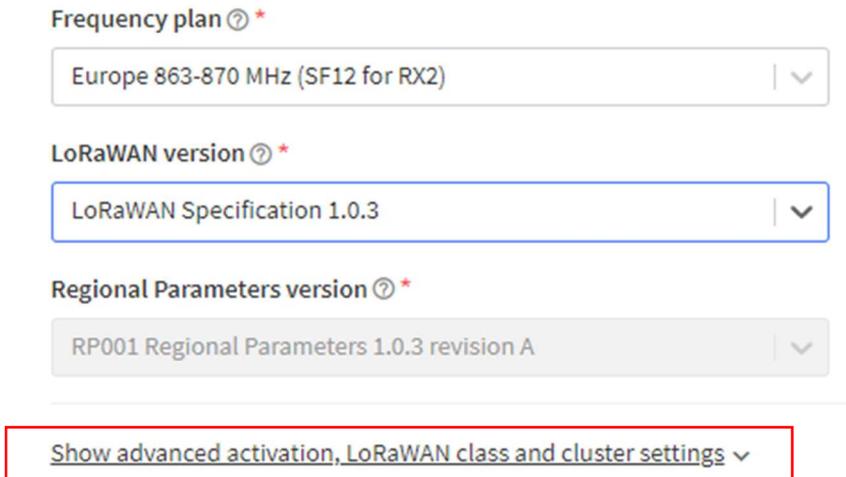
Figure 22 New device initial settings

Using the "advanced settings" section, you will be able to select OTAA (Over-The-Air-Activation), and the end-device LoRaWAN Class. (Figure 23)

Figure 23 New device advanced settings

In the "Provisioning Information" section below the advanced settings you have to configure the device specific parameters and addresses (Figure 23):

- "JoinEUI" (formerly "App EUI") is an 8-bytes (hex) value used by the server for the join procedure. It is related to your application (it can be the same for every device registered for the application) and, if it is not provided by the manufacturer, it can be generated through to the appropriate button.
- "Dev EUI" is a unique 8-bytes (hex) value given by the manufacturer.
- "AppKey" is a 16-bytes (hex) key used by the network server for encrypt operation. It can be generated or directly created by the user and can be the same for every device registered for the application).

Figure 24 Provisioning Information Setting

The "End device ID" is automatically generate from the "Dev EUI" but it can be modified using any name.

Once all parameters have been set, you can complete the registration clicking on "Register end device" (Figure 24).

Now an overview page will open. Please, check if all the parameters are correctly set (Figure 25).

After that the configuration is finished, in "Live data" section is possible to see all the packets which we are sending/receiving to/from the network server.
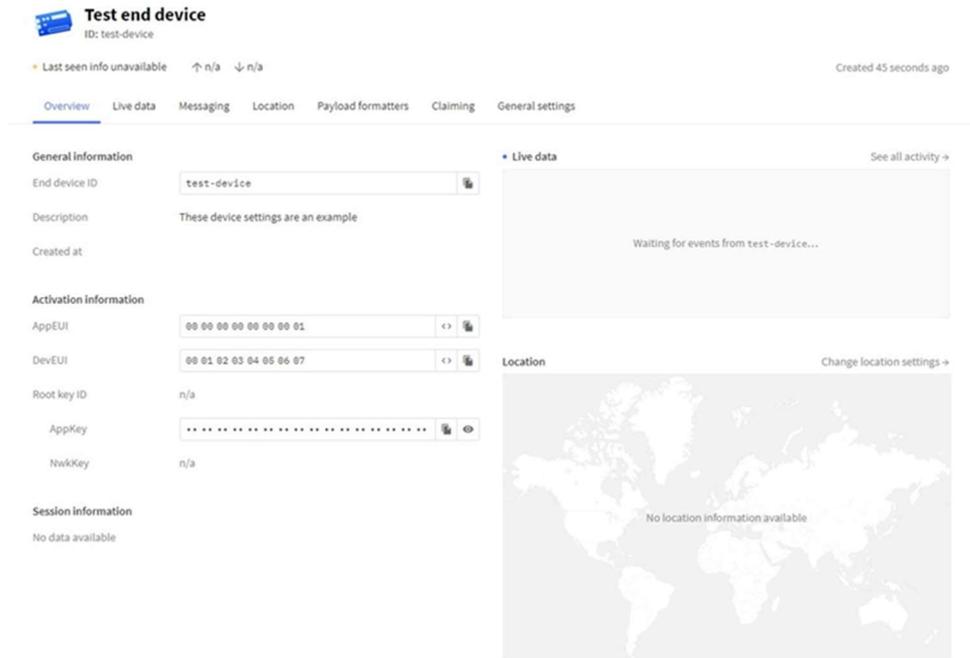

Figure 25 End device overview

13 Disclaimer of liability

The information provided in this and other documents associated to the product might contain technical inaccuracies as well as typing errors. Regulations might also vary in time. Updates to these documents are performed periodically and the information provided in these manuals might change without notice. The user is required to ensure that the documentation is updated and the information contained is valid. Embit reserves the right to change any of the technical/functional specifications as well as to discontinue manufacture or support of any of its products without any written announcement.

13.1 Disclaimer of liability

The user must read carefully all the documentation available before using the product. In particular, care must be taken in order to comply with the regulations (e.g., power limits, duty cycle limits, etc.).

13.2 Handling Precautions

This product is an ESD sensitive device. Handling precautions should be carefully observed.

13.3 Limitations

Every operation involving a modification on the internal components of the module will void the warranty.

13.4 Trademarks

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