



THE THINGS
NETWORK



The Things Summer Academy

WORKSHOP

Building and connecting your LoRaWAN gateway



August 16 - 20



Online



→ Instructor

Xose Pérez

External Consultant at
RAKwireless



@xoseperez



xose.perez@rakwireless.com



→ Instructor

Marc Pous

Developer Advocate at **balena.io** &
Initiator of **IoT Barcelona**



@gy4nt



marc@balena.io

Workshop

One part of theory

Two parts of hands-on

Hopefully a tasty workshop!



Hardware required for the Hands-on part:

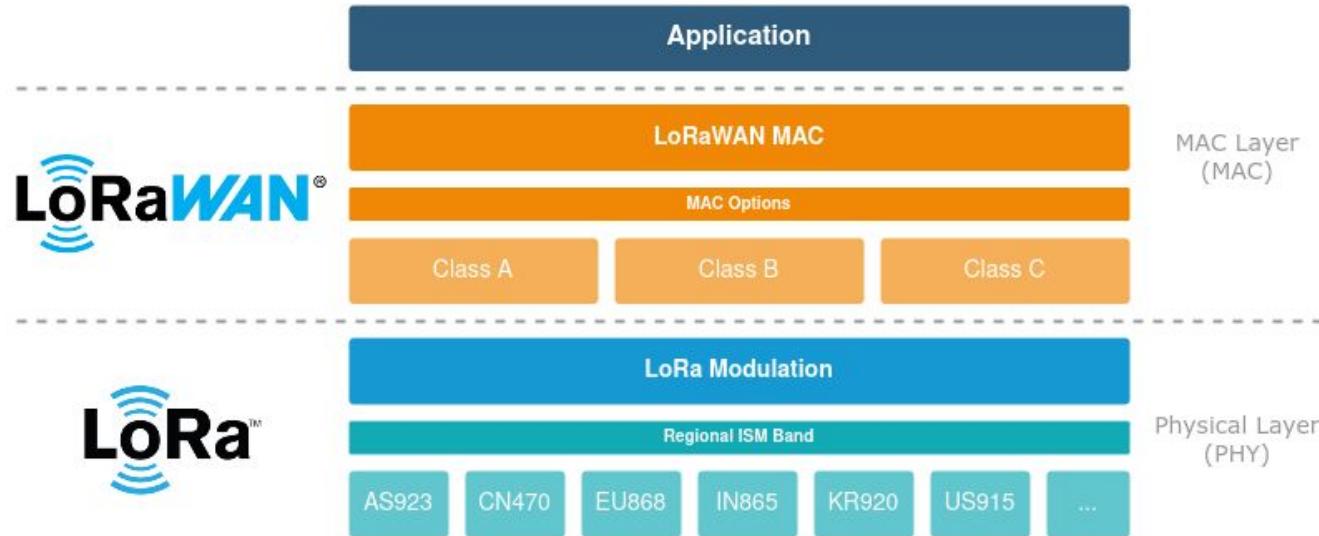
- Raspberry Pi 3 or 4
- LoRa concentrator
- An antenna connected to the concentrator
- SD card
- Power supply
- Ethernet cable or WiFi Access Point for Internet connectivity

Software / services required for the Hands-on:

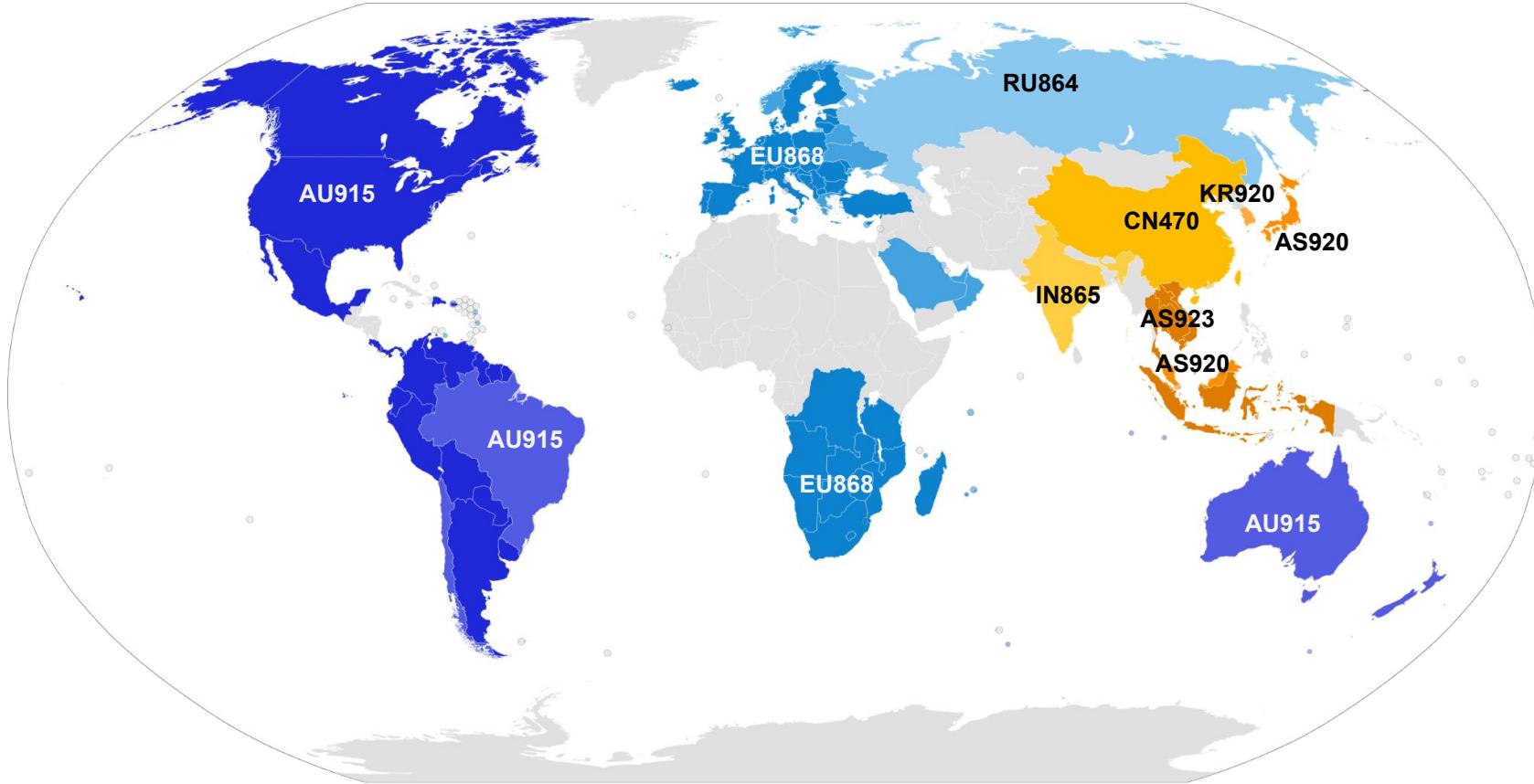
- [balena.io](#) account
- [balenaEtcher](#)

Some theory

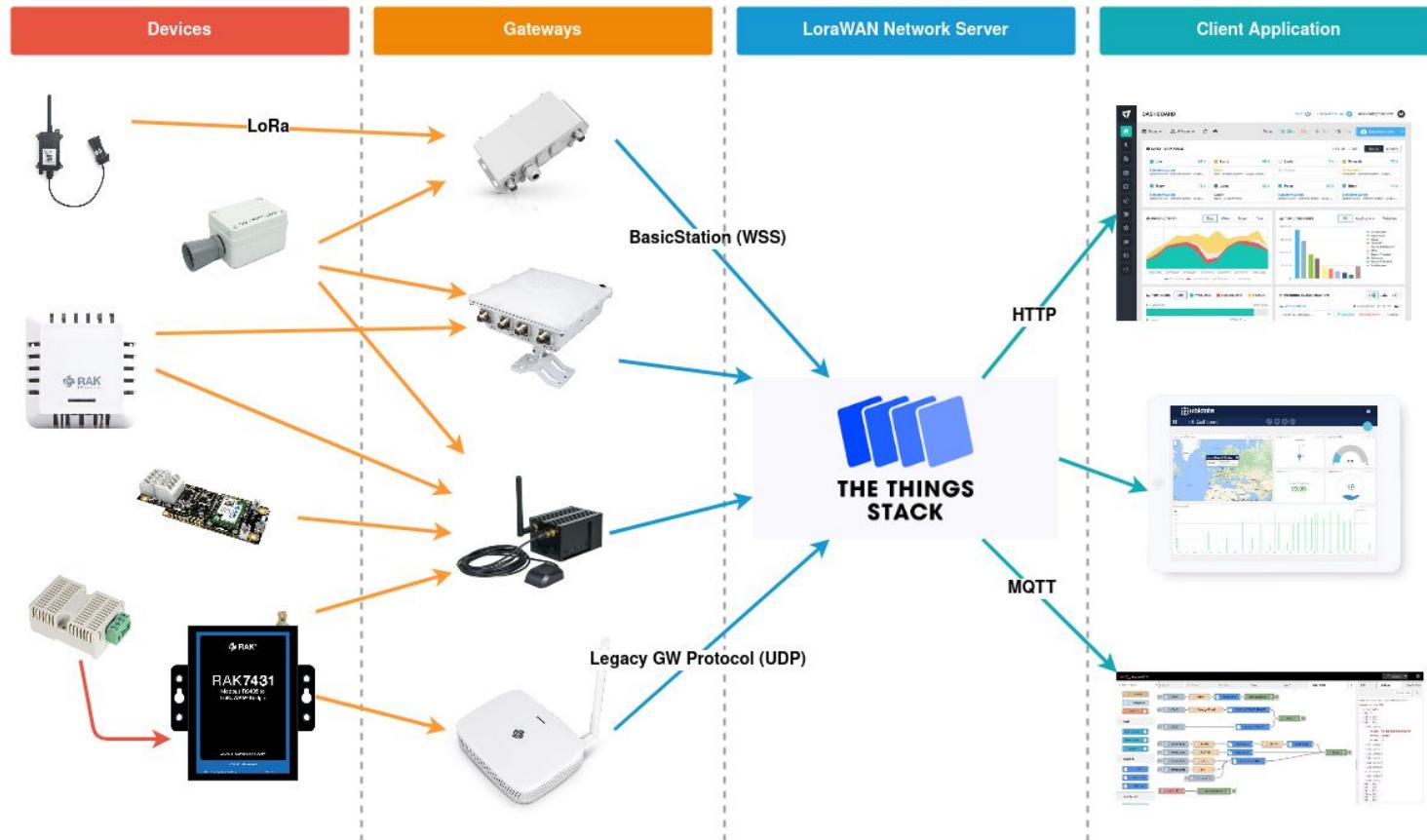
- LoRa is a **radio modulation** meant for Long Range communication using very little power
- LoRaWAN is a **Media Access Layer (MAC) protocol**. A **software layer** that defines how devices use LoRa to transmit and receive messages on a network.



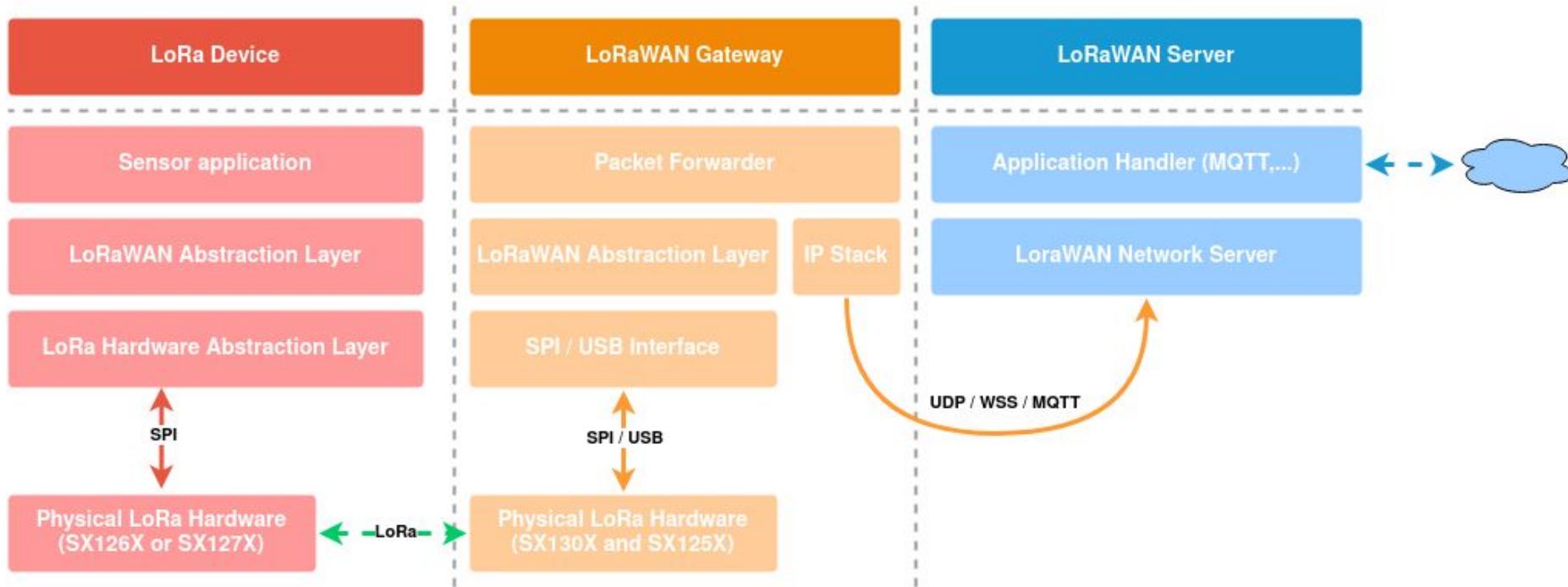
Regional frequencies



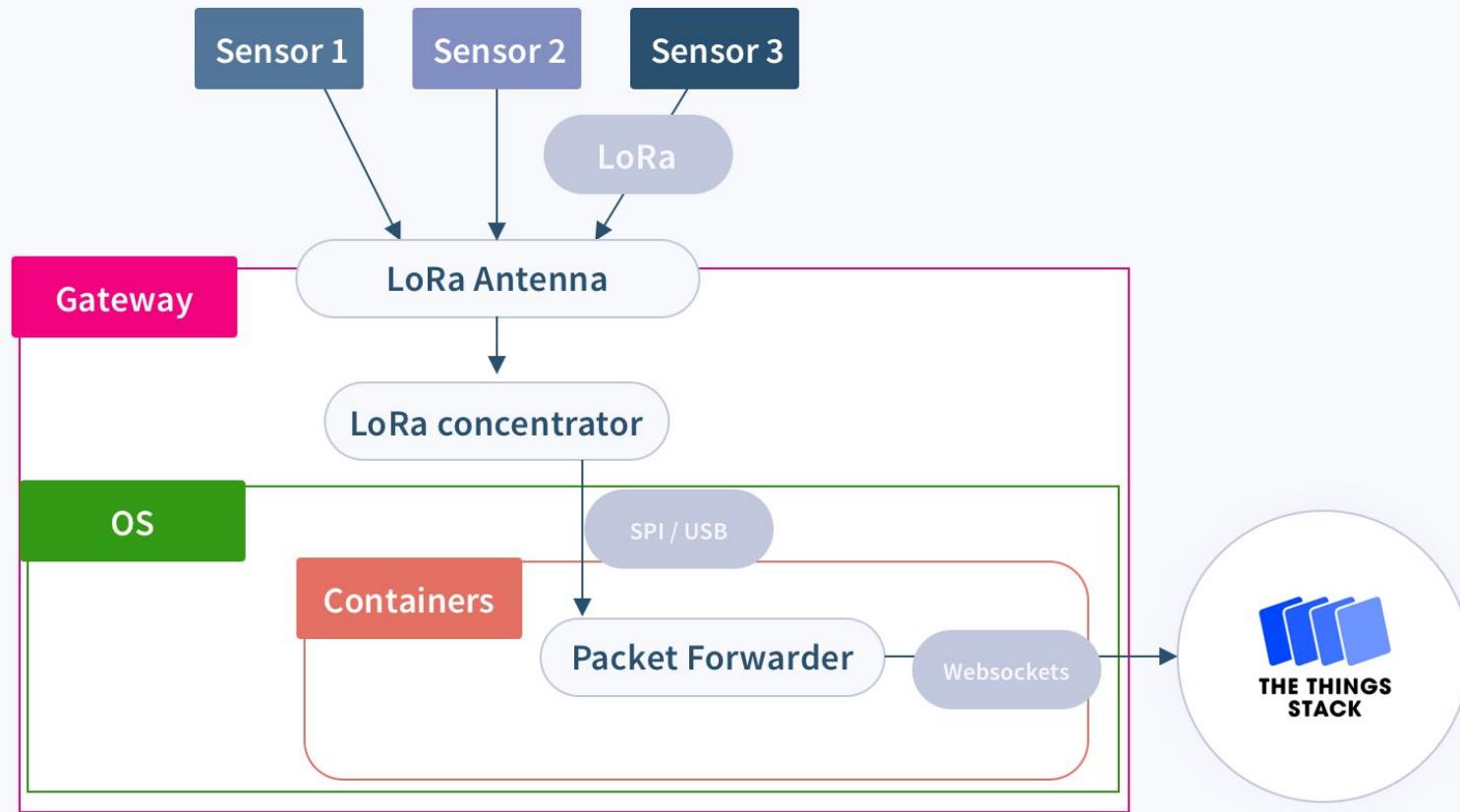
LoRaWAN Network Architecture



What is a LoRaWAN gateway?



LoRaWAN Gateway Today running on balena with containers

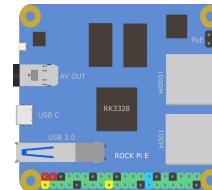
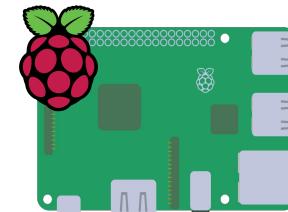
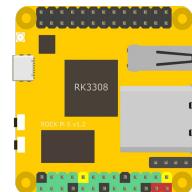
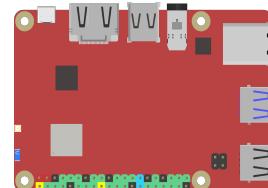
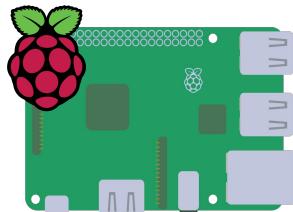
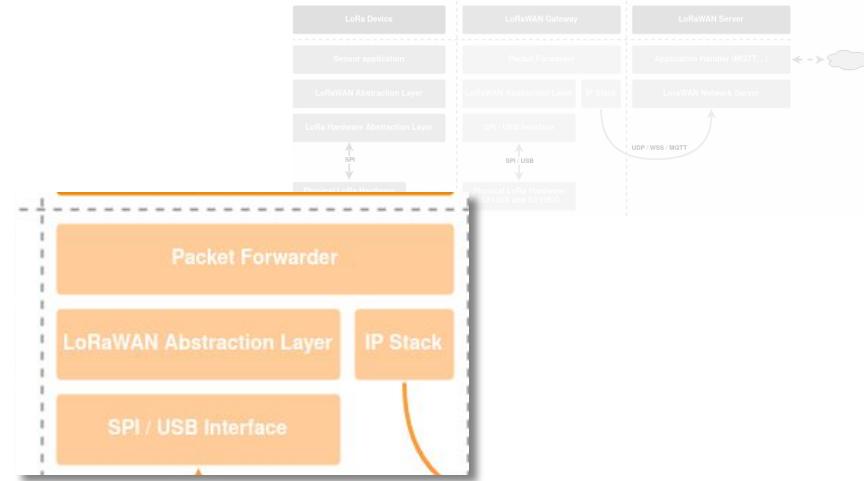


LoRaWAN Gateway Hardware

The Host

The **host** is usually a linux machine responsible to run the LoRa and LoRaWAN abstraction layers and the packet forwarder service to forward packets to the LoRaWAN Network Server.

In this workshop we will use a **Raspberry Pi** running **Balena OS** with a **Basics™ Station** service as packet forwarding.



LoRa Concentrator



IMST iC880A



RAK2245



RAK2247

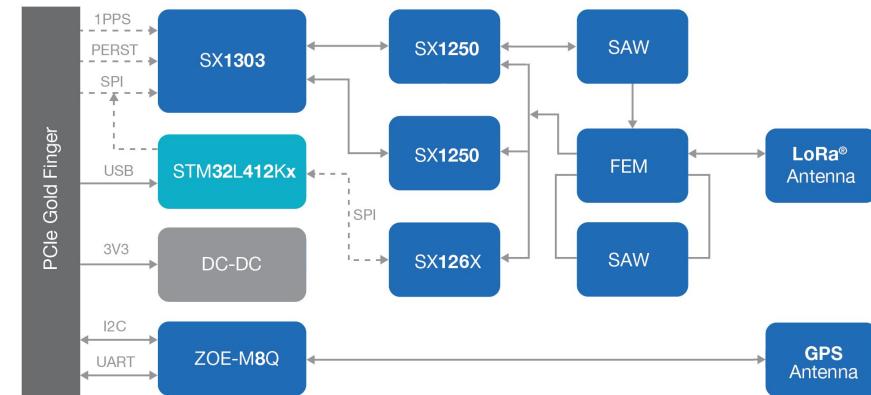
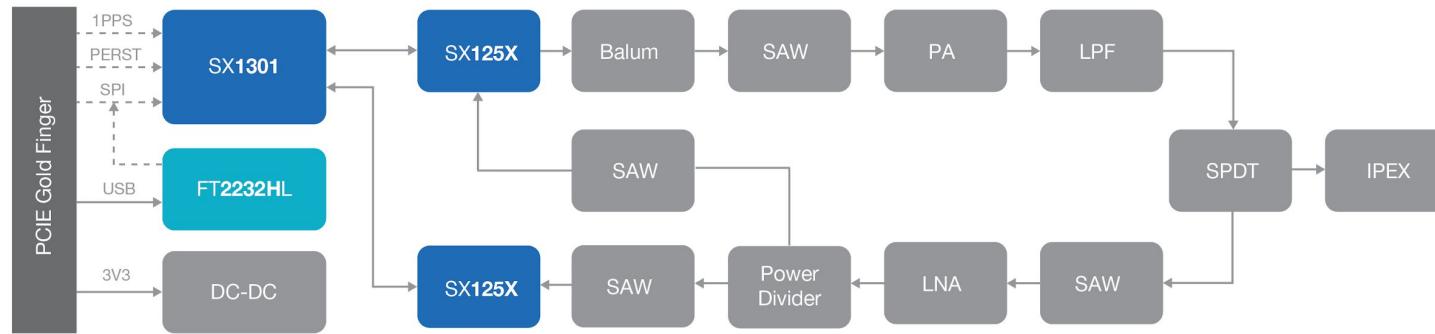


RAK2287

RAK5146



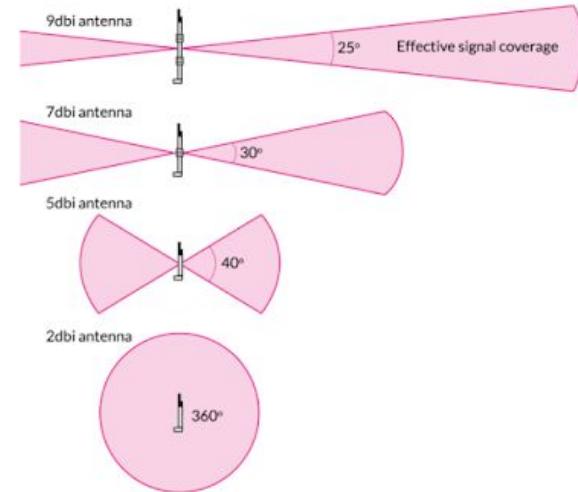
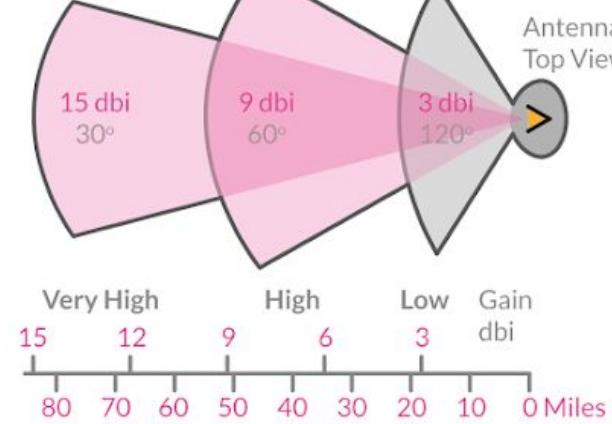
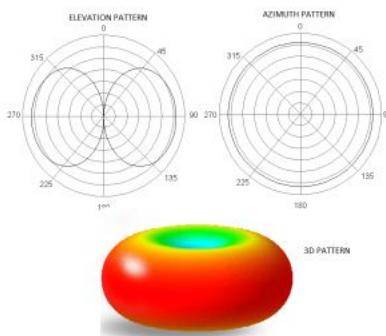
LoRa Concentrator



The Antenna - Gain and directionality

An antenna does not “create” energy, it just **radiates it unevenly depending on the direction**. The gain is the relative radiated power in the direction of maximum radiated power related to an isotropic antenna. The more gain, the more directionality.

Prior to choose the gain we want, we should analyze the node distribution around the antenna.



The Antenna - Connectors



TNC



BNC



Type N



SMA



RP-SMA



uFL / iPEX

Power supply

Finally we will need a **power supply** that can provide at least 10W (specially if its a Raspberry Pi 4). The official Raspberry Pi power supply is perfect. Optionally you might want to use **PoE** (Power Over Ethernet), especially if you plan to use Ethernet as a backhaul. At RAK we also have a great PoE hat you can use for this project.



Bare minimum

- Raspberry Pi
- Concentrator
- Antenna
- Power supply



Extras

- Case
- PoE
- GPS
- External antenna (and pigtail)
- Waterproof connectors
- Pressure vent
- ...



Commercial solutions



RAK7243/C



RAK7246/G

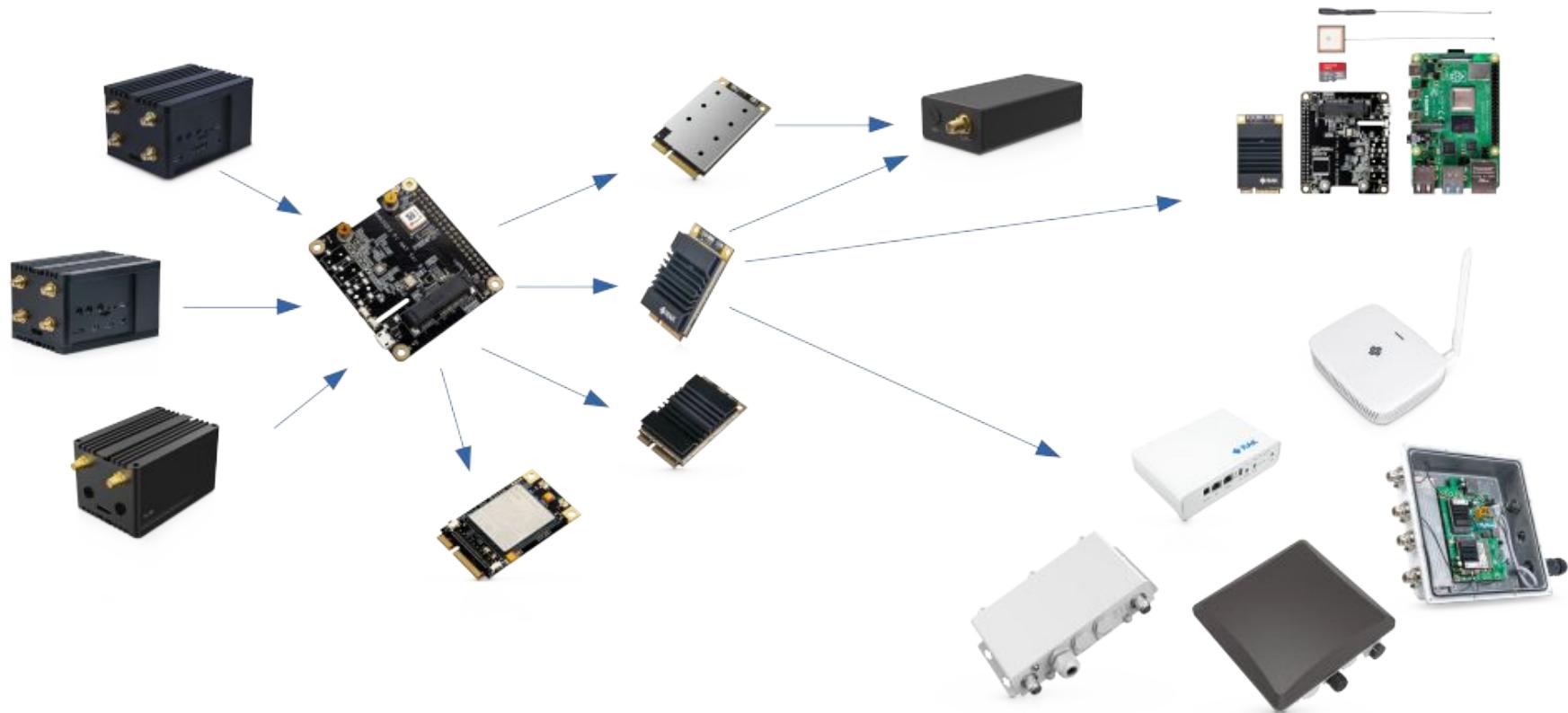


RAK7248



RAK7244/C/P

Commercial solutions



LoRaWAN™

Which one is the BEST gateway for me?

These are the critical key factors for your gateway:

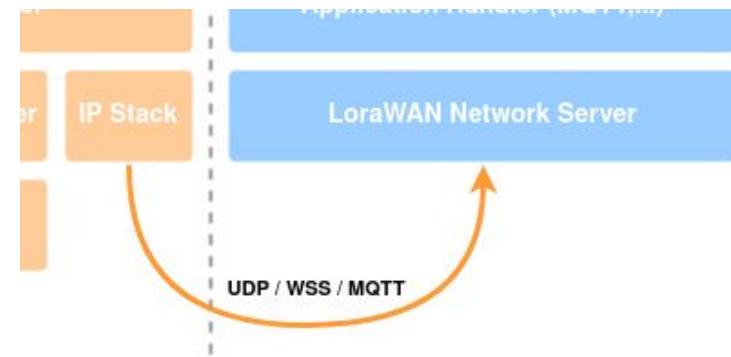
- Convenience (already available parts, form factor, price, backhaul options...)
- Software maintenance and remote management
- Concentrator hardware (same chips, same base design)
- Antenna (frequency adaptation, reflection, frequency bandwidth, gain, short or no cables)
- Location (good view, no obstacles, certain high, ground connection)

LoRaWAN® Gateway Software

What is a LoRa Packet forwarder?

A **LoRa packet forwarder** is a service (software) running on the host of a LoRa-based gateway (with or without GPS). It forwards RF packets received by the concentrator (uplinks) to a *LoRaWAN Network Server* (LNS) through an IP link. It also transmits RF packets sent by the LNS (downlinks) through the same link to one or multiple devices.

Additionally, it may transmit beacon signals used for time coordinating devices within the network. These beacons may be transmitted GPS-synchronously across the entire network.



Semtech UDP packet forwarder

- This is the original LoRaWAN gateway packet forward protocol, developed as a proof of concept.
- **No built-in authentication or encryption.**
- Relies on a simple IP **UDP** protocol to one port.
- Makes it difficult to cross some firewalls and NAT
- No standardized gateway management options

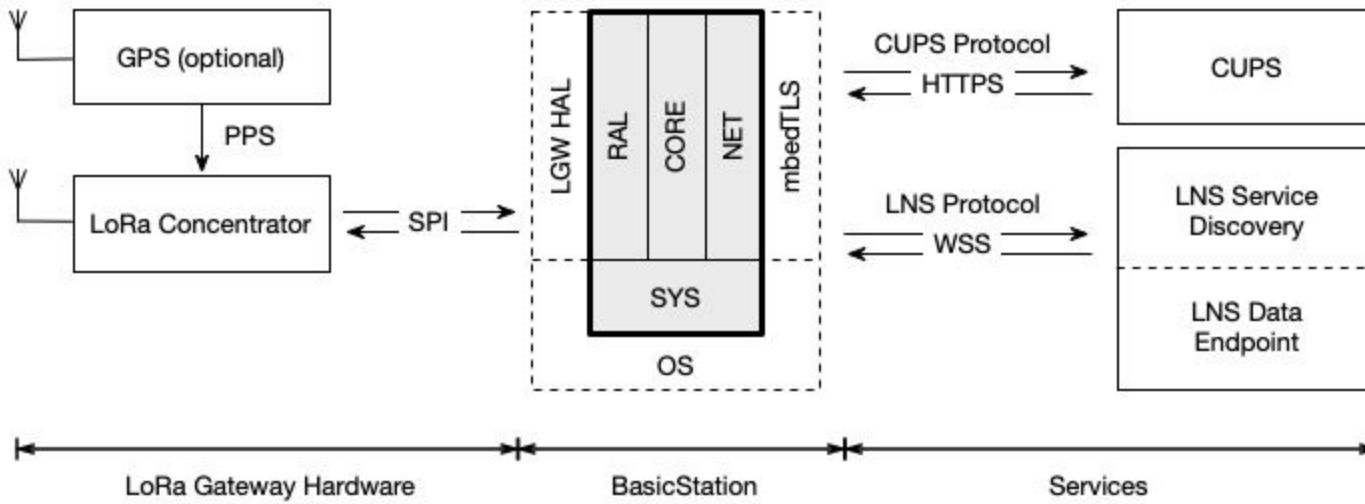
Poly packet forwarder

- UDP packet forwarder sending messages to different LNS at the same time

Multiprotocol packet forwarder

- Same as the poly packet forwarder but
- includes support for TTN Gateway Connector protocol over MQTT(S).

BasicStation — System Overview



<https://doc.sm.tc/station/>

To use the LNS backend protocol to connect to a LoRaWAN Network Server using Basics Station we will need:

- The **URL** of the LNS entry point
- A root or intermediate **certificate** to validate the communication
- A gateway **key** generated by the LNS to authorise the gateway connection

We will be using these parameters shortly in the hands-on part of this workshop...

How to deploy Basics™ Station Packet Forwarding service on your gateway?

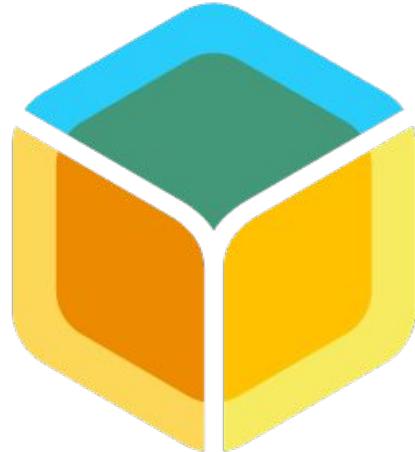
The **DIE HARD** method



<https://github.com/lorabasics/basicstation>

How to deploy Basics™ Station Packet Forwarding service on your gateway?

The **KEEP CALM AND USE BALENA** method

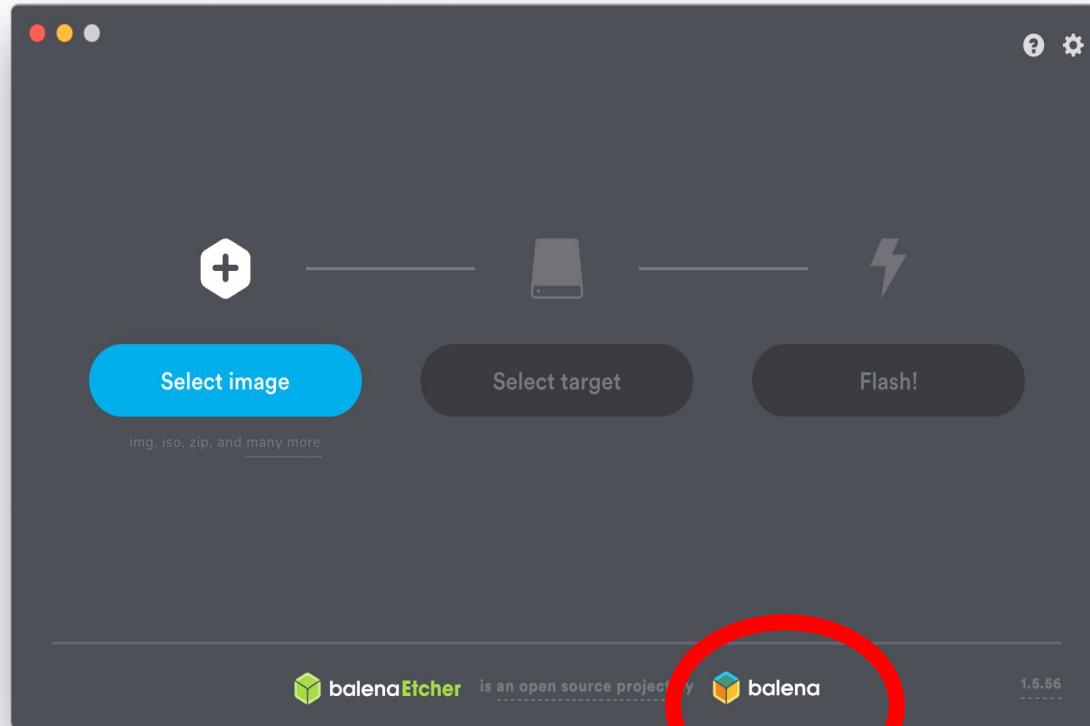


balena

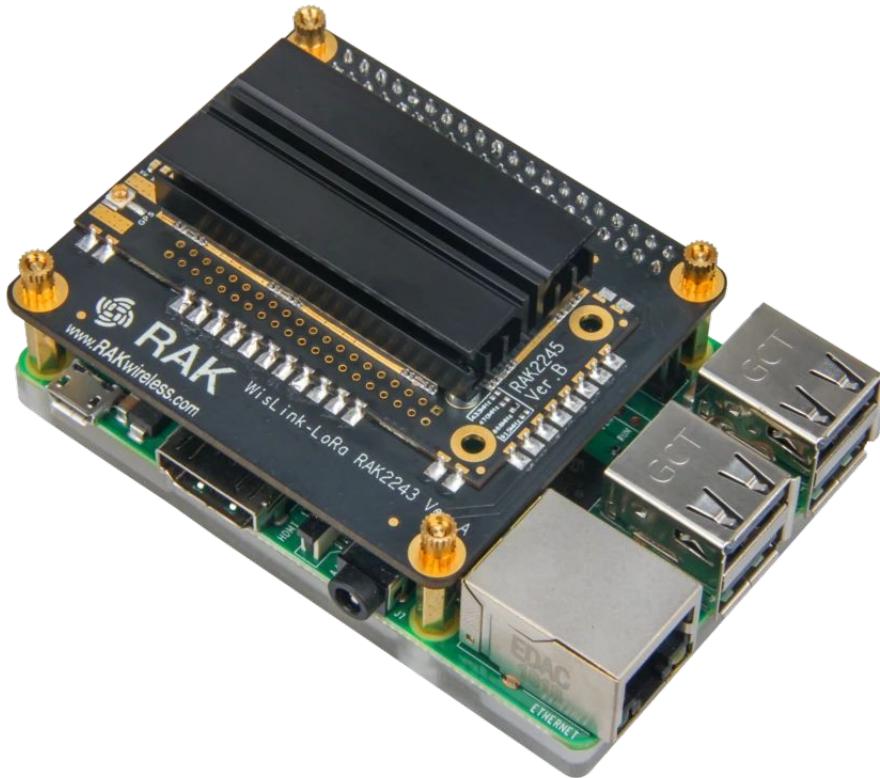
<https://github.com/mpous/basicstation>

**Hands-on
Are you ready?**

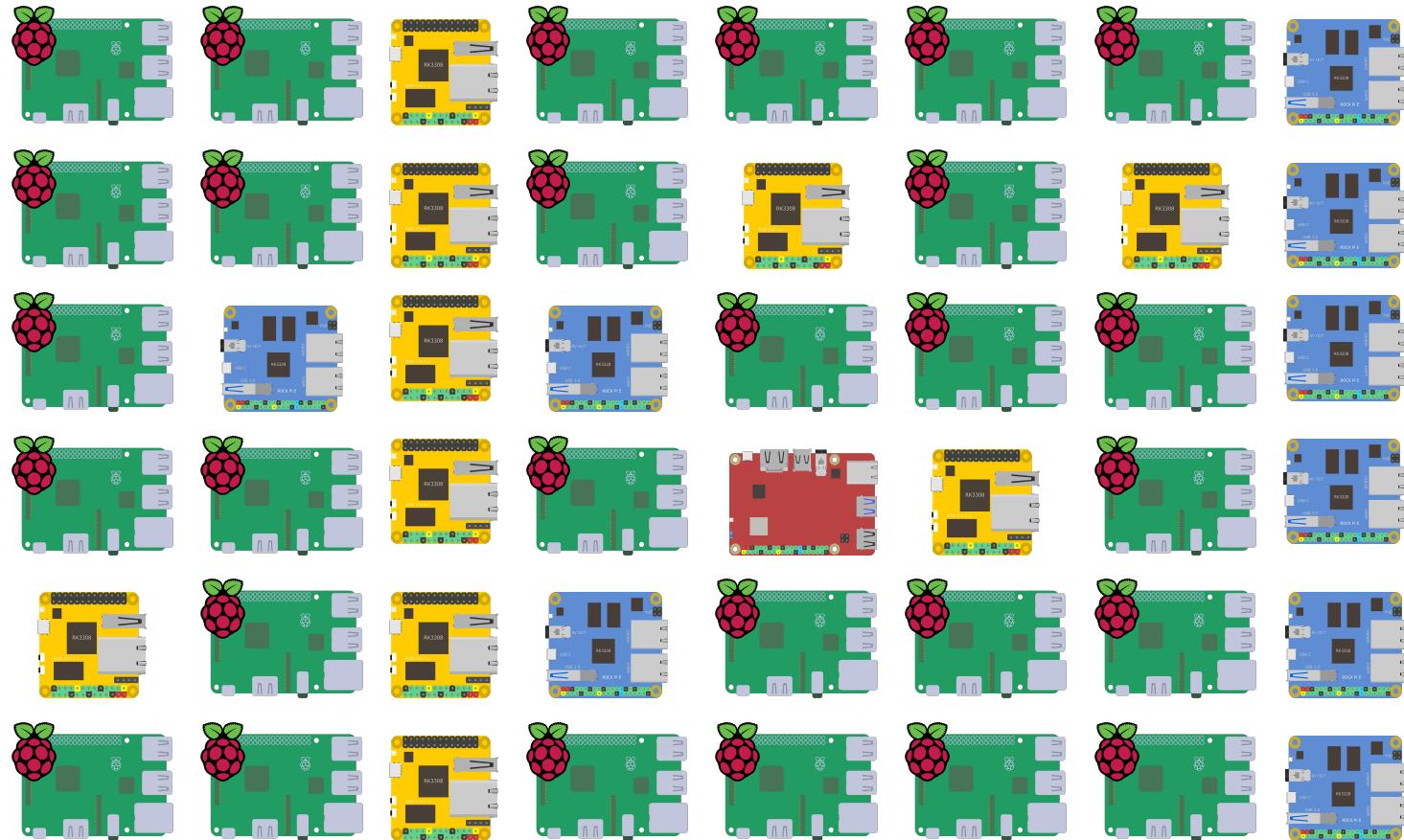
What is balena?



Why balena?



Manage your fleet of devices



Manage your fleet of devices

Manage your fleet of devices

Get Started Docs Forums Status

David Tischler DT

Applications > DemoApplication

Fleet Location

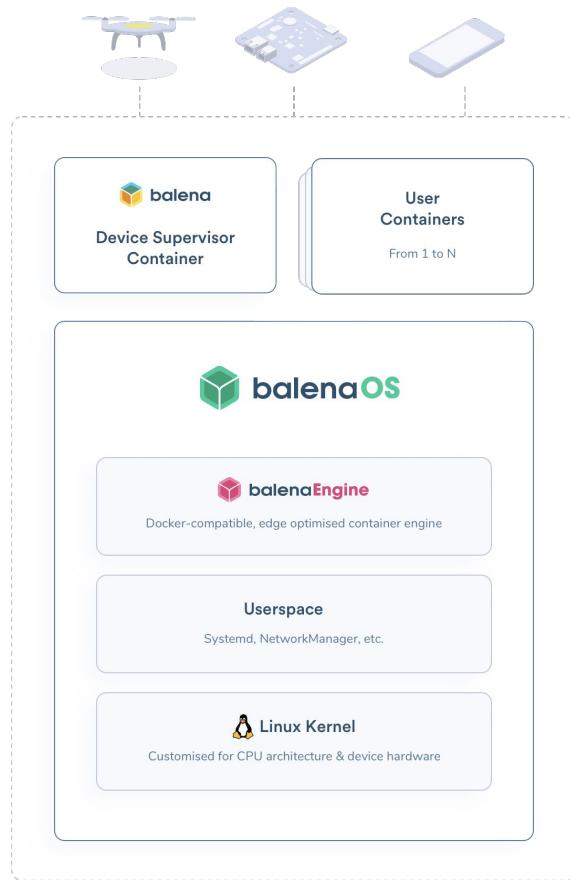
Devices Fleet Configuration Environment Variables Service Variables Releases Location Members

Map data ©2020 | Terms of Use

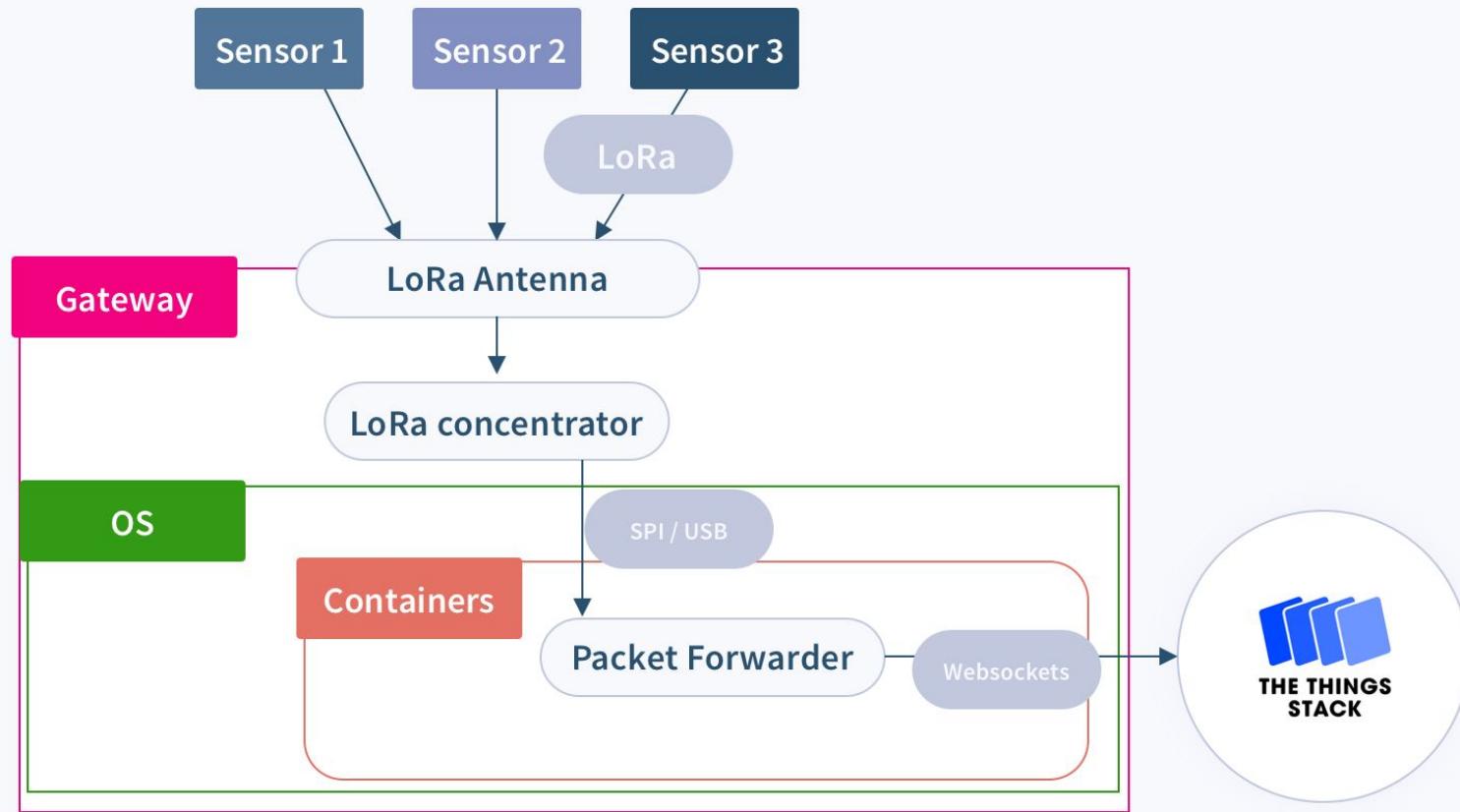
LoRaWAN

The screenshot shows the balenaCloud dashboard interface. On the left, a vertical sidebar lists navigation options: Home, Devices, Fleet Configuration, Environment Variables, Service Variables, Releases, Location (which is highlighted in dark blue), and Members. The main content area is titled "Fleet Location" and features a world map. Yellow circular markers represent device locations, primarily clustered in North America, Europe, and Asia. The map also shows major oceans and continents. At the bottom right of the map, there are links for "Map data ©2020" and "Terms of Use". A small "Need help?" button is located at the bottom right corner of the sidebar.

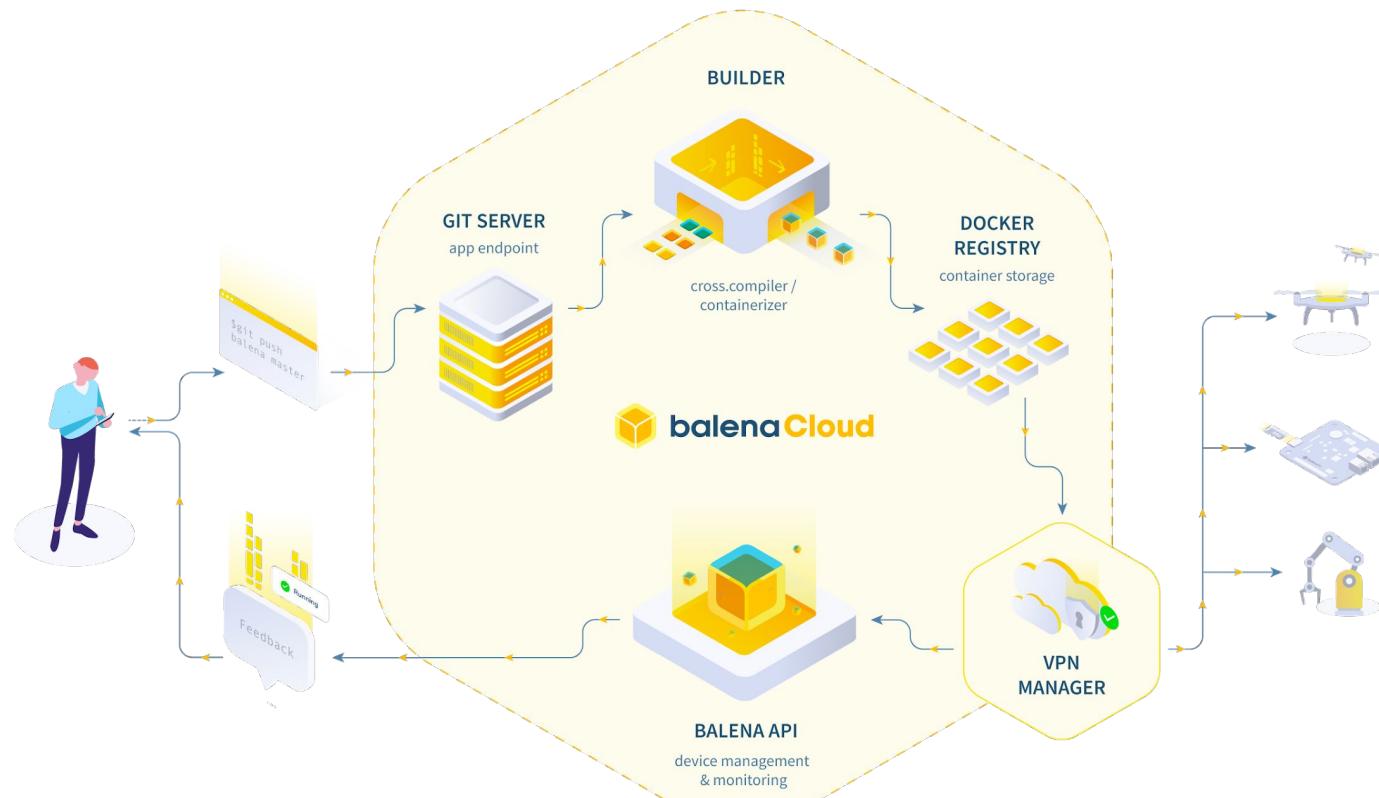
How does balena work?



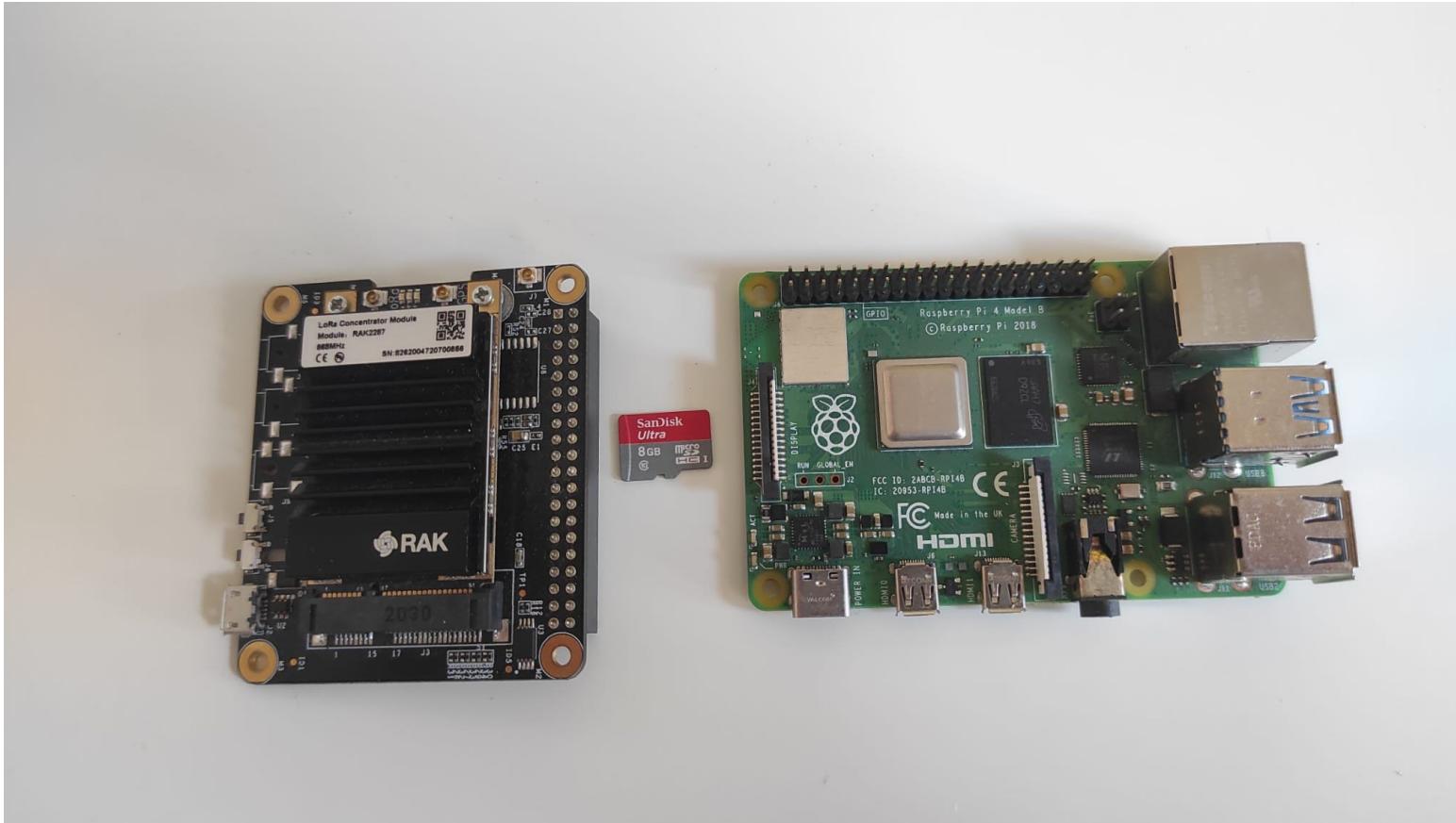
LoRaWAN Gateway Today running on balena with containers



How does balena work?



The hardware i'm using



- 1 Go to hub.balena.io and find the Basics™ Station gateway app
 - 2 Deploy a Basics™ Station Gateway on balena and connect with The Things Stack
- BONUS** -----
- 3 Add the WiFi-Connect container along the Gateway with balena CLI
 - 4 More ideas

1

Go to hub.balena.io and find the Basics™ Station gateway app

Deploy the Basics Station gateway balena fleet

The screenshot shows the balenaHub website interface. The top navigation bar includes links for 'Fleets', 'Projects' (which is currently selected), and 'Blocks'. Below the navigation is a search bar labeled 'Search entries...'. A 'Submit a project' button and a 'Add filter' button are also present. The main content area displays a 3x4 grid of project cards:

- uk-train-departure-dis...** by chris's world: A balenaCloud Raspberry Pi app to display replica near real-time UK railway station departure data on SSD1322 screens. Works with: nano, rpi.
- gpsTime** by mail1's Organization: Uses attached GPS UART with PPS to provide accurate time via chrony ntp server. Works with: rpi, esp32, esp8266, nrf52.
- agriaiv-v2** by Arjit Das: Pest detection and classification made using Edge Impulse and balena. Works with: rpi.
- basicstation-gateway-...** by Marc Pouc: Deploys the The Things Stack LoRaWAN gateway with Basics Station Packet Forward protocol on SX1301 or SX1302 LoRa concentrators. Works with: rpi, esp32, esp8266, nrf52.
- balena-ads-b** by Ketil: Track the flight traffic over your head with a Raspberry Pi running balena and a cheap RTL-SDR USB dongle. Works with: nano, rpi, esp32, esp8266.
- kerberos** by Kerberos.io: Video surveillance and video analytics for people and enterprises making this world a safer and smarter place. Works with: rpi, esp32, esp8266.
- home-urbit** by gh_olydiam's Organization: Urbit is a new OS and peer-to-peer network that's simple by design, built to last forever, and 100% owned by its users. Urbit is your last computer. Works with: arm, rpi.
- TTS-network-server** by Jose Pérez: Deploys the The Things Stack LoRaWAN Network Server Open Source Edition. Works with: rpi, esp32, esp8266, nrf52.
- wifi-repeater** by balenaLabs: Easily create a WiFi Access Point or WiFi repeater with balenaOS. Works with: rpi.
- balenaLocating** by Will Phlison: Use Raspberry Pi's and Bluetooth BLE beacons to ensure you never lose your important stuff again. Works with: rpi.
- TTS-network-server-ba...** by Xose Pérez: Deploys the The Things Stack LoRaWAN Network Server alongside BasicStation Gateway Protocol. Works with: rpi.
- bird-watcher-balena-fin** by g_mithun, das's Organization: Build a Smart Bird Feeder powered by Edge Impulse and Balena. Works with: rpi.

<https://hub.balena.io/projects>

Hands-on - Deploy the Basics Station gateway balena fleet

The screenshot shows a web browser window with the URL <https://hub.balena.io/marc6/basicstation-gateway-tts>. The page is titled "basicstation-gateway-TTS" by Marc Pous. It includes sections for "Description", "Works With", "Usage instructions", and "Version". At the bottom, there are links for social media and a "Terms of use" link.

Fleets [Back to Projects](#)

basicstation-gateway-TTS by Marc Pous

Description

Deploys the The Things Stack LoRaWAN gateway with Basics Station Packet Forward protocol on SX1301 or SX1302 LoRa concentrators.

Works With

Version - View code | last updated at: 24 Jun 2021

Fork this fleet | Report issue

Usage instructions

Fork this fleet and deploy the project on a balenaCloud application. Once the project released on a device, you'll need to get the EUI of the device and create a gateway on The Things Stack (v3). For detailed instructions on how to use/configure your LoRaWAN gateway check out the [readme here](#).

balenaHub A project by balena.io

Twitter Facebook Instagram YouTube

Terms of use

<https://hub.balena.io/marc6/basicstation-gateway-tts>



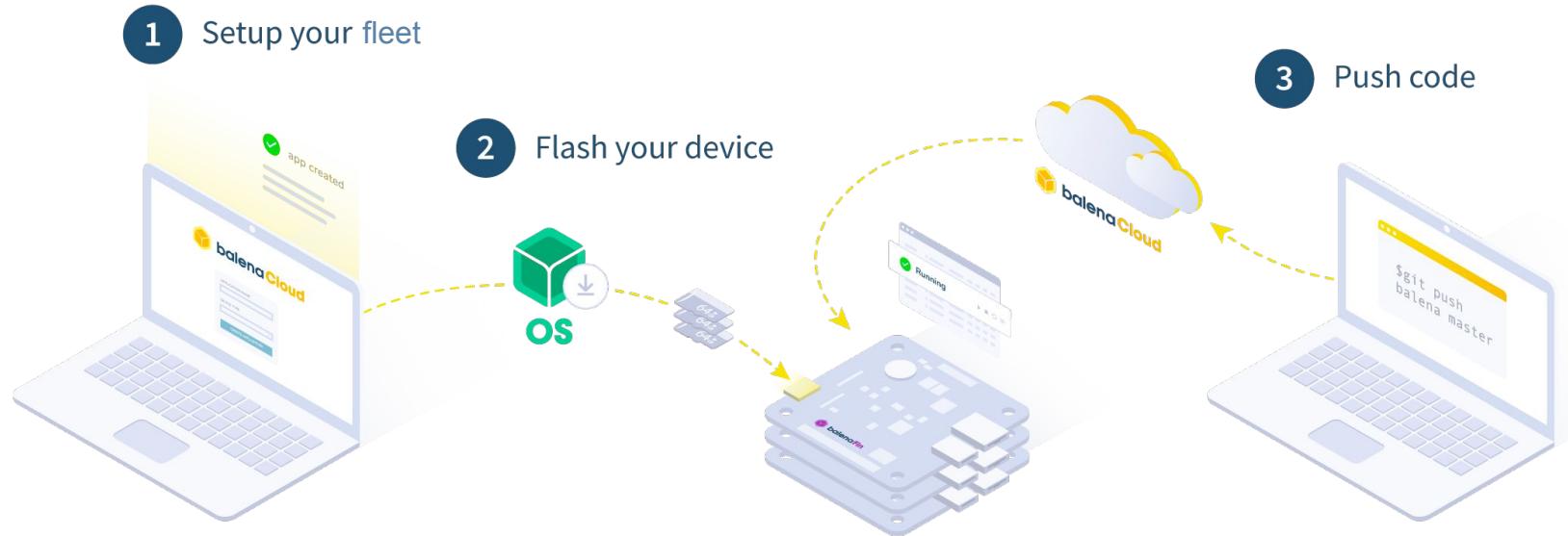
Hands-on - Deploy the Basics Station gateway balena fleet

The screenshot shows a web browser window with the URL <https://hub.balena.io/marc6/basicstation-gateway-tts>. The page is titled "basicstation-gateway-TTS" by Marc Pous. It includes sections for "Description", "Usage instructions", and "Works With". A prominent blue button labeled "Fork this fleet" is circled in red at the top right of the main content area. The footer contains links for Twitter, Facebook, Instagram, and YouTube, along with a "Terms of use" link.

<https://hub.balena.io/marc6/basicstation-gateway-tts>



How does balena work?



Let's deploy a LoRaWAN gateway

- 1 Go to hub.balena.io and find the Basics™ Station gateway app
- 2 Deploy a Basics™ Station Gateway on balena and connect with The Things Stack

Sign up at balenaCloud

The screenshot shows a web browser window for dashboard.balena-cloud.com. At the top, the balenaCloud logo is displayed with the text "Your first ten devices are fully-featured and free". Below the logo, there is a callout box for "The Things Stack Gateway" by balenalabs. The callout box contains the text: "To continue, login to balenaCloud" and "Deploys the The Things Stack LoRaWAN gateway with Basics Station Packet Forward protocol on SX1301 or SX1302 LoRa concentrators." To the right of the callout box, there is a "Log in" section with "Log in with GitHub" and "Log in with Google" buttons, followed by a "or log in with" section for Email and Password. A "Forgot password?" link is also present. A "Need help?" button is located in the bottom right corner. The overall theme is light blue and white.

To continue, login to balenaCloud

**The Things Stack
Gateway**

by balenalabs

Deploys the The Things Stack LoRaWAN gateway with Basics Station Packet Forward protocol on SX1301 or SX1302 LoRa concentrators.

Log in

New to balena? [Sign up for free.](#)

[Log in with GitHub](#) [Log in with Google](#)

or log in with

Email*

Password*

Forgot password?

Need help?

Create and deploy the Basics Station gateway balena fleet

The screenshot shows the balenaCloud Applications dashboard. A modal window is open in the center, titled "Create and deploy to application". The modal contains fields for "Organization" (set to "Marc Pous"), "Application" (set to "TTN_summer-camp-basicstation"), "Default device type" (set to "Raspberry Pi 4 (using 64bit OS)"), and "Application type" (set to "Microservices"). There is also an "Advanced" toggle switch. At the bottom of the modal are "Cancel" and "Create and deploy" buttons. The background shows a list of existing applications, including "rosetta-at-home-armv7hf", "balenaSound", "Inkyshot2020", "inkyshot", "Helium_sx1302", "helium-2287-w", "helium", "wifi-repeater", "WiFiConnect", "validators-helium", "uptime-robot-dash", "uk-train-departure-display", "TTS-Stack-Fin", "TTS-Stack", and "TTS-LoRaWAN-gateway". The "TTS-Stack" entry is highlighted with a red border.

App name	Device type	Created On	Total devices	App type	Architecture	Organization	Owner
rosetta-at-home-armv7hf	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
balenaSound	Raspberry Pi 4 (using 64bit OS)	Jun 18th 2021, 11:40 am	1	Microservices	armv7hf	balenaLabs	Marc Pous
Inkyshot2020	Raspberry Pi 4 (using 64bit OS)	Jun 30th 2021, 11:14 am	1	Microservices	armv7hf	balenaLabs	Marc Pous
inkyshot	Raspberry Pi 4 (using 64bit OS)	May 13th 2021, 11:15 pm	2	Microservices	armv7hf	balenaLabs	Marc Pous
Helium_sx1302	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	aarch64	balenaLabs	Marc Pous
helium-2287-w	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
helium	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
wifi-repeater	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
WiFiConnect	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
validators-helium	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
uptime-robot-dash	Raspberry Pi 4 (using 64bit OS)	Jul 26th 2021, 2:48 pm	1	Microservices	armv7hf	balenaLabs	Marc Pous
uk-train-departure-display	Raspberry Pi 3	Jul 26th 2021, 2:48 pm	1	Microservices	b416e6e	armv7hf	Marc Pous
TTS-Stack-Fin	Balena Fin (CM3)	Jun 18th 2021, 11:40 am	1	Microservices	ee7aa88	armv7hf	Marc Pous
TTS-Stack	Raspberry Pi 4 (using 64bit OS)	Jun 30th 2021, 11:14 am	1	Microservices	e8f15d9	aarch64	balenaLabs
TTS-LoRaWAN-gateway	Raspberry Pi 4 (using 64bit OS)	May 13th 2021, 11:15 pm	2	Microservices	ece699c	aarch64	Marc Pous

Download the balenaOS image on balenaCloud

The screenshot shows the balenaCloud interface with a modal window titled "Add new device".

Device Type: Raspberry Pi 4

OS Type: balenaOS ESR

Version: v2021.04.0 (next, recommended)

Edition: Production (selected)

Network Connection: Ethernet only

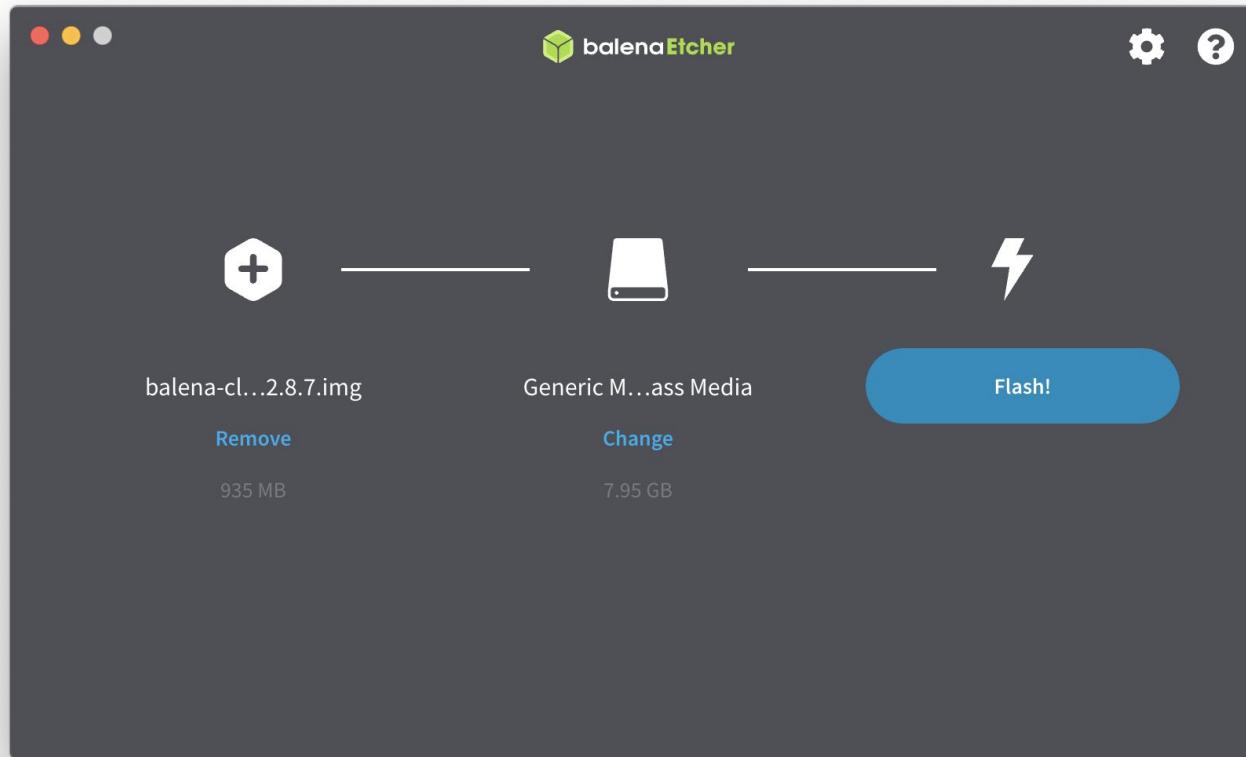
Instructions:

- 1 Use the form on the left above to configure and download balenaOS for your new device.
- 2 Write the OS file you downloaded to your SD card. We recommend using Etcher.
- 3 Insert the freshly burnt SD card into the Raspberry Pi 4.
- 4 Connect your Raspberry Pi 4 to the internet, then power it up.
- 5 Your device should appear in your application dashboard within a few minutes. Have fun!

For more details please refer to our [Getting Started Guide](#).

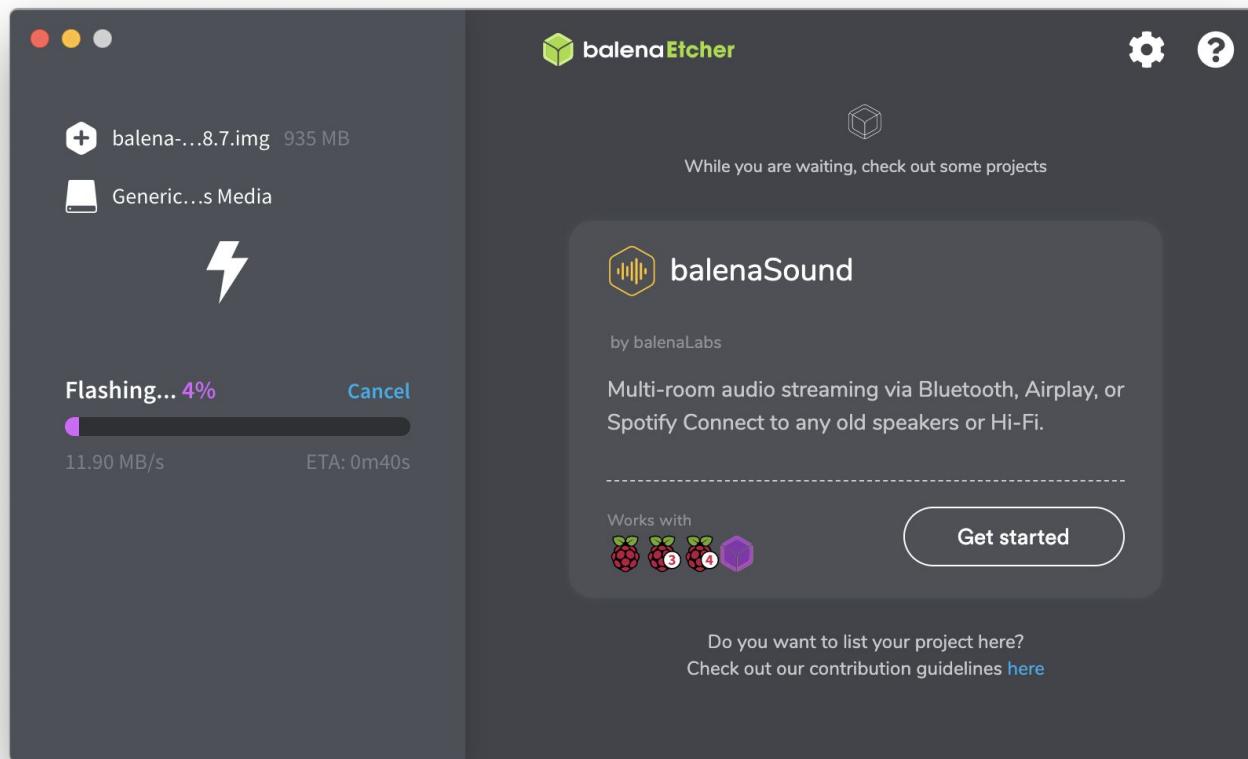
Download balenaOS

Flash SD card for the Basics Station gateway



<https://www.balena.io/etcher/>

Flash SD card for the Basics Station gateway



New release deployed on the balenaCloud fleet

The screenshot shows the balena dashboard interface for the application "TTN-summer-camp-basicstation".

- Left sidebar:** Shows the organization "Marc Pous" and the application "TTN-summer-camp-basicstation" selected.
- Top navigation:** Includes links for "Getting Started", "Docs", "Forums", "Status", and user "Marc Pous".
- Central content area:**
 - Devices:** Shows 0 devices. A message says "You don't have any devices yet. How about adding one?" with a "+ Add device" button.
 - Releases:** Shows 1 release named "The Things Stack Gateway". A "Create release" button is available.
- Bottom right corner:** A "Need help?" button with a question mark icon.

New device appeared on the balenaCloud fleet

The screenshot shows the balenaCloud dashboard interface. On the left, a sidebar menu includes options like Organizations, Marc Pous, Applications, TTN-summer-camp-basicstation (selected), Summary, Devices, Releases, Variables, Fleet Configuration, Actions, Settings, Members, and Location. The main content area displays a card for the application 'TTN-summer-camp-basicstation' with a Raspberry Pi icon and the number '4'. It shows the architecture as aarch64 and was created on Jul 28th 2021, 4:44 pm. Below this is a table of devices:

Name	Status	Device type	Last seen	UUID	OS version	OS variant	Supervisor version	IP address	Public addr
long-resonance	Online	Raspberry Pi 4 (using 64bit OS)	Online (for 3 minutes)	4a2b2f9	balenaOS 2.80.5+rev1	Development	12.8.7	192.168.1.44	2.137.81.41

On the right, there are sections for 'Devices' (1 device) and 'Releases' (1 release, 'The Things Stack Gateway'). A 'Create release' button is available. A 'Need help?' button is located in the bottom right corner.

New device appeared on the balenaCloud fleet

The screenshot shows the balenaCloud dashboard interface for a device named "long-resonance".

Device Summary:

- Status:** Online (green checkmark)
- UUID:** 4a2b2f9
- Type:** Raspberry Pi 4 (using 64bit OS)
- Online For:** 3 minutes
- HOST OS VERSION:** balenaOS 2.80.5+rev1 (development)
- SUPERVISOR VERSION:** 12.8.7
- CURRENT RELEASE:** 6dee174 (green checkmark)
- TARGET RELEASE:** 6dee174
- LOCAL IP ADDRESS:** 192.168.1.44
- PUBLIC IP ADDRESS:** 2.137.81.41
- MAC ADDRESS:** DC:A6:32:B1:67:42
CA:32:5E:29:B9:A0
- TAGS:** EU: dca632ffeb10742
- PUBLIC DEVICE URL:** (Switch off)

NOTES: Add device notes...

SERVICES:

Service	Status	Release
main	Running	6dee174

Metrics:

- CPU: -3%
- Temperature: -57C
- Memory: 292 MB/7.7 GB
- Storage: 321 MB/6.5 GB

Logs:

Search entries... UTC Timestamps Views

- 28.07.21 16:54:03 (+0200) [balena] 2021-07-28 14:54:03.526 [TCE:VERB] Connecting to MUX5...
- 28.07.21 16:54:03 (+0200) [balena] 2021-07-28 14:54:03.728 [AIO:ERR0] [3] WS upgrade failed with HTTP status code: 400
- 28.07.21 16:54:03 (+0200) [balena] 2021-07-28 14:54:03.728 [AIO:DEBU] [3] WS connection shutdown...
- 28.07.21 16:54:03 (+0200) [balena] 2021-07-28 14:54:03.728 [TCE:VERB] Connection to MUX5 closed in state 3
- 28.07.21 16:54:03 (+0200) [balena] 2021-07-28 14:54:03.728 [TCE:INFO] INFOS reconnect backoff 10s (retry 1)

Terminal:

Select a target ▾ Start terminal session

Need help ?

Copy the gateway EUI

The screenshot shows the balena dashboard interface for a device named 'long-resonance'. The left sidebar contains navigation links for Organizations, Applications, and the current device. The main panel displays device status, hardware information, and logs.

Device Status:

- Status: Online (green checkmark)
- UUID: 4a2b2f9
- Type: Raspberry Pi 4 (using 64bit OS)

Hardware Information:

- Online for: 3 minutes
- HOST OS VERSION: balenaOS 2.80.5+rev1 (development)
- SUPERVISOR VERSION: 12.8.7
- CURRENT RELEASE: 6dee174 (green checkmark)
- TARGET RELEASE: 6dee174
- LOCAL IP ADDRESS: 192.168.1.44
- PUBLIC IP ADDRESS: 2.137.81.41
- MAC ADDRESS: DC:A6:32:B1:67:42
CA:32:5E:29:B9:A0
- PUBLIC DEVICE URL: (disabled)

Tags: EUI: dca632ffeb10742 (highlighted with a red circle)

Services:

Service	Status	Release
main	Running	6dee174

Logs: Shows a list of log entries from July 28, 2021, at 14:54:03.728 UTC. The log includes messages related to connecting to MUX5 and W5 upgrade failed.

Terminal: A terminal session window is shown, with a message to 'Select a target'.

Registering LoRaWAN gateway at The Things Stack

The screenshot shows the 'Overview - Console - The Thing' page of The Things Stack. At the top, there are tabs for 'Overview', 'Applications', 'Gateways', and 'Organizations'. The 'Overview' tab is selected. On the right, there's a sidebar with 'EU1 Community' and 'Fair use policy applies' and a user profile for 'Marc Pous'. The main content area features a welcome message 'Welcome back, Marc Pous! 🙌' and a brief introduction: 'Walk right through to your applications and/or gateways.' It includes links to 'Documentation' and 'Get Support'. Below this are two large buttons: 'Go to applications' (with a dashboard icon) and 'Go to gateways' (with a LoRaWAN gateway icon). At the bottom, there are sections for 'Version info' and 'Component status' (Application Server and Gateway Server).

<https://eu1.cloud.thethings.network/console/>

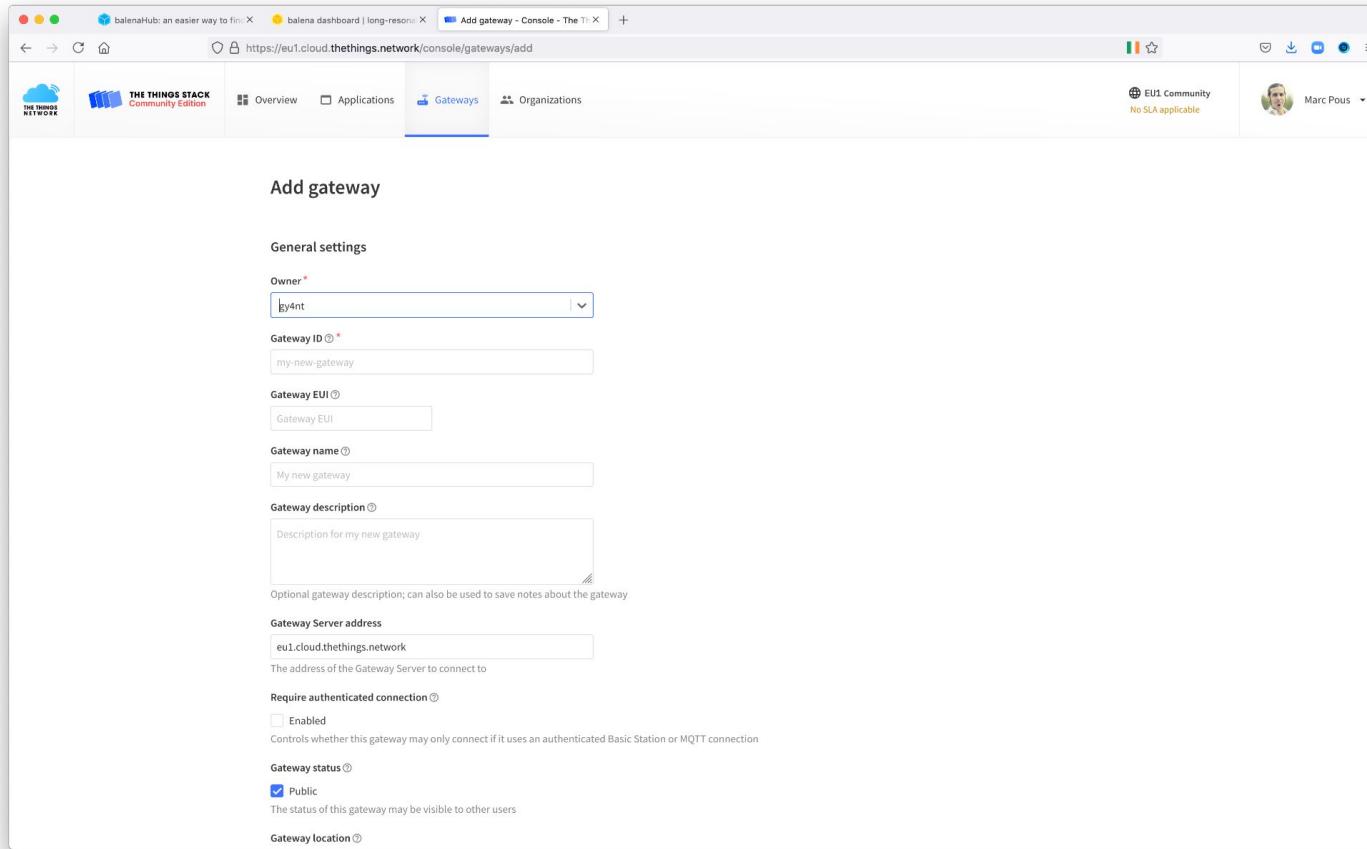
Registering LoRaWAN gateway at The Things Stack

The screenshot shows the 'Gateways' page in the The Things Stack Community Edition console. The URL is https://eu1.cloud.thethings.network/console/gateways. The top navigation bar includes links for Overview, Applications, Gateways (which is underlined), and Organizations. On the right, there's a user profile for 'Marc Pous'. A banner at the top right states 'EU1 Community Fair use policy applies'. The main content area displays a table header for 'Gateways (0)' with columns: ID, Name, Gateway EUI, Frequency plan, and Status. Below the table, a message says 'No items found'.

Everything you need to build enterprise grade, private LoRaWAN networks - [The Things Industries](#)

v3.14.0 [Documentation](#) [Get Support](#)

Registering LoRaWAN gateway at The Things Stack



The screenshot shows a web browser window with the URL <https://eu1.cloud.thethings.network/console/gateways/add>. The page is titled "Add gateway". The top navigation bar includes links for Overview, Applications, Gateways (which is the active tab), and Organizations. On the right, there are user profile and community status indicators (EU1 Community, No SLA applicable). The main content area is titled "Add gateway" and contains several input fields:

- General settings**
 - Owner***: A dropdown menu showing "by4nt".
 - Gateway ID ⓘ***: An input field containing "my-new-gateway".
 - Gateway EUI ⓘ**: An input field containing "Gateway EUI".
 - Gateway name ⓘ**: An input field containing "My new gateway".
 - Gateway description ⓘ**: A text area with placeholder text "Description for my new gateway".

Optional gateway description; can also be used to save notes about the gateway
- Gateway Server address**: An input field containing "eu1.cloud.thethings.network".

The address of the Gateway Server to connect to
- Require authenticated connection ⓘ**: A checkbox labeled "Enabled".

Controls whether this gateway may only connect if it uses an authenticated Basic Station or MQTT connection
- Gateway status ⓘ**: A checkbox labeled "Public".

The status of this gateway may be visible to other users
- Gateway location ⓘ**: A small input field.

LoRaWAN gateway registered at The Things Stack

Screenshot of the The Things Stack console showing the registration of a LoRaWAN gateway.

The URL is <https://eu1.cloud.thethings.network/console/gateways/ttn-summer-camp>.

Overview - TTN Summer Camp

THE THINGS STACK Community Edition

TTN Summer Camp gateway

General information

- Gateway ID: ttn-summer-camp
- Gateway EUI: DC A6 32 FF FE B1 07 42
- Gateway description: None
- Created at: Jul 28, 2021 18:17:18
- Last updated at: Jul 28, 2021 18:17:18
- Gateway Server address: eu1.cloud.thethings.network

LoRaWAN information

- Frequency plan: EU_863_870_TTN
- Global configuration: Download global_conf.json

Live data

Created 18 seconds ago

See all activity →

18:17:18 Create gateway

Location

No location information available

[Change location settings →](#)

< Hide sidebar

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v3.14.0 [Documentation](#) [Get Support](#)



Add The Things Stack API Key

Screenshot of the The Things Stack API Key addition interface.

The screenshot shows the "Overview - TTN Summer Camp" page in the The Things Stack Community Edition dashboard. A red circle highlights the "0 API keys" link under the gateway summary.

TTN Summer Camp gateway
ID: ttn-summer-camp

Disconnected | 1 Collaborator | 0 API keys

General information

Gateway ID	ttn-summer-camp
Gateway EUI	DC A6 32 FF FE B1 07 42
Gateway description	None
Created at	Jul 28, 2021 18:17:18
Last updated at	Jul 28, 2021 18:17:18
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 →

18:17:18 Create gateway

Location

Change location settings →

No location information available

[Hide sidebar](#)

Everything you need to build enterprise grade, private LoRaWAN networks - [The Things Industries](#)

v3.14.0 [Documentation](#) [Get Support](#)

Add The Things Stack API Key

The screenshot shows a web browser window with the URL <https://eu1.cloud.thethings.network/console/gateways/ttn-summer-camp/api-keys>. The page is titled "API keys - TTN Summer Camp". The left sidebar has a "TTN Summer Camp gateway" section with "Overview", "Live data", "Location", "Collaborators", "API keys" (which is selected and highlighted in blue), and "General settings". The main content area shows a table header for "API keys (0)" with columns "Key ID", "Name", and "Granted Rights". A message "No items found" is displayed below the table. At the top right, there is a "EU1 Community Fair use policy applies" notice and a user profile for "Marc Pous". A blue button labeled "+ Add API key" is located in the top right corner of the main content area.

Add The Things Stack API Key

The screenshot shows a web browser window with the URL <https://eu1.cloud.thethings.network/console/gateways/ttn-summer-camp/api-keys/add>. The page is titled "Add API key".

The left sidebar shows a navigation tree for the "TTN Summer Camp gateway": Overview, Live data, Location, Collaborators, API keys (selected), and General settings.

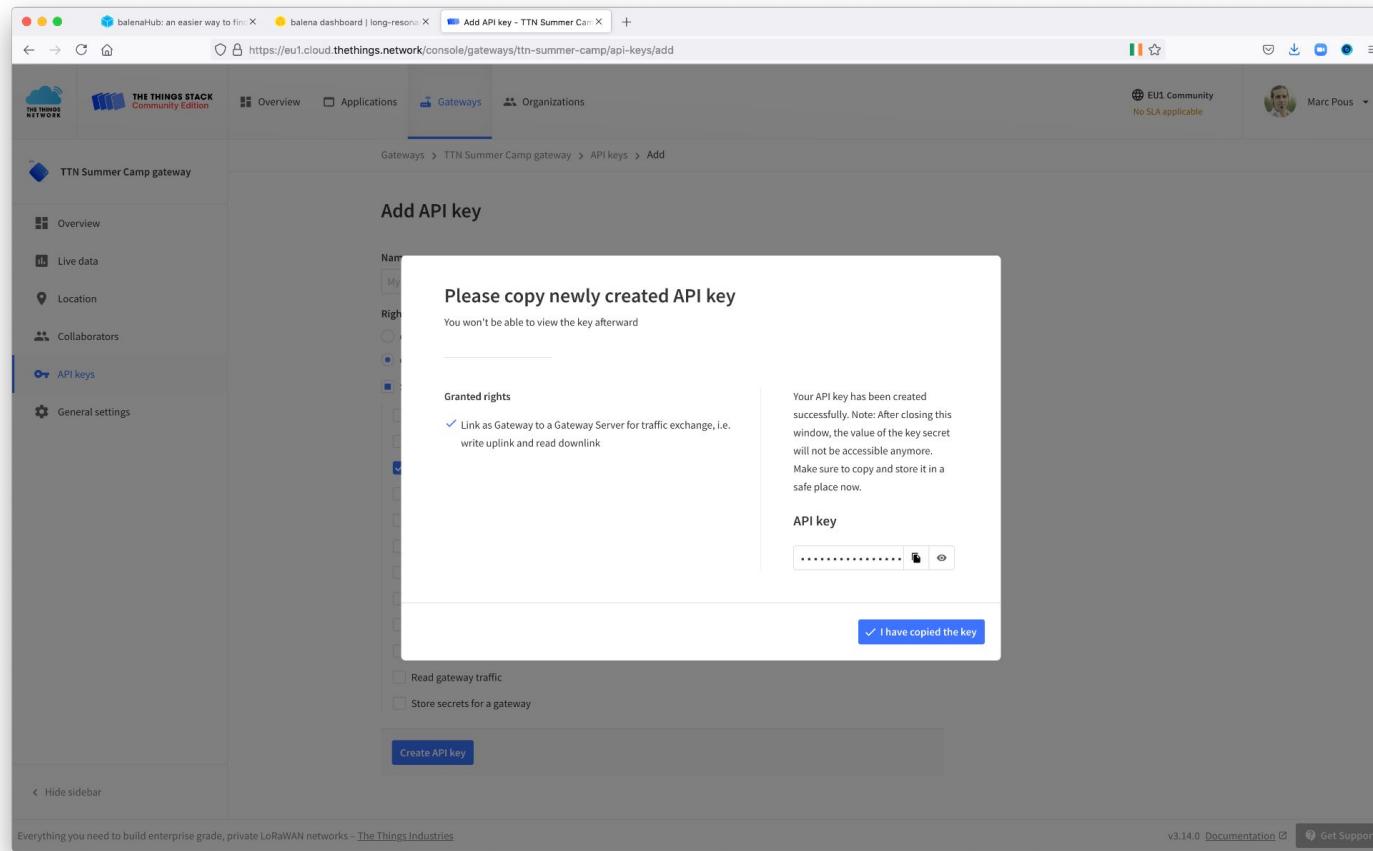
The main content area has the following fields:

- 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

A blue "Create API key" button is at the bottom of the form.

At the bottom of the page, there is a footer with links: "Everything you need to build enterprise grade, private LoRaWAN networks - [The Things Industries](#)", "v3.14.0 [Documentation](#) [Get Support](#)", and a "LoRaWAN" logo.

Add The Things Stack API Key



The screenshot shows a web browser window with the URL <https://eu1.cloud.thethings.network/console/gateways/ttn-summer-camp/api-keys/add>. The page is titled "Add API key". A modal dialog box is open, prompting the user to copy the newly created API key. The dialog contains the following text:

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

.....  

I have copied the key

Below the modal, there are two unchecked checkboxes:

Read gateway traffic
 Store secrets for a gateway

At the bottom of the modal is a "Create API key" button.

Configure Device Variables on balenaCloud

The screenshot shows the balenaCloud web interface for managing device variables. On the left, a sidebar navigation includes 'Organizations', 'Marc Pous', 'Applications', 'TTN-summer-ca...', 'long-resonance', 'summary', 'Device Variables' (which is selected and highlighted in blue), 'Device Configuration', 'Actions', 'Diagnostics', and 'Location'. The main content area displays a table of current device variables:

Name	Application value	Device Value	Service name	Actions
GW_GPS	false	override	All services	
GW_ID	8	override	All services	
GW_KEY	9	override	All services	
GW_RESET_GPIO			services	
GW_RESET_PIN			services	
MODEL			services	
TC_KEY			services	
TTN_REGION			services	
TTN_STACK_VERSION			services	

A modal dialog titled 'Add variable' is open in the center, prompting for 'Service*' (set to 'All services'), 'Name*' (set to 'TC_KEY'), and 'Value*' (set to 'IB4TMKHEAQGVNNGAASUQ'). Below the input fields are 'Cancel' and 'Add' buttons. The URL in the browser address bar is <https://dashboard.balena-cloud.com/devices/4a2b2f972c54c1615dc07ba66205edc0/envvars>.

Configure Device Variables on balenaCloud

The screenshot shows the balenaCloud dashboard for a device named 'long-resonance'. The left sidebar includes links for Organizations, Marc Pous, Applications, TTN-summer-ca..., long-resonance (selected), and Summary. The main area displays a table of device variables:

Name	Application value	Device Value	Service name	Actions
GW_GPS	false	override	All services	
GW_ID	0	override	All services	
GW_KEY	0	override	All services	
GW_RESET_GPIO	17	override	All services	
GW_RESET_PIN	11	override	All services	
MODEL	SX1301	SX1302	All services	
TC_KEY	0	NNSXS.ADKHBY2QZ5IEHOT352TH5GAJVHNKAIW... ⓘ	All services	
TTN_REGION	eu1	override	All services	
TTN_STACK_VERSION	3	override	All services	

At the bottom right of the page is a 'Need help?' button.

New LoRaWAN gateway running the Basics Station on The Things Stack

The screenshot shows the balena dashboard interface for a device named "long-resonance". The left sidebar contains navigation links for Organizations, Applications, TTN-summer-ca..., long-resonance, Summary, Device Variables, Device Configuration, Actions, Diagnostics, and Location. The main content area is titled "Logs" and displays a list of log entries. The logs show the device performing various tasks such as joining a network, configuring regions, and handling join requests. A search bar at the top right allows filtering by timestamp or word. A "Views" dropdown is also present. The bottom right corner has a "Need help?" button.

```
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 2: enable=1 rf_chain=1 freq=0 bw=0 SF=0 sync_word=0/0
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 3: enable=1 rf_chain=0 freq=-400000 bw=0 SF=0 sync_word=0/0
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 4: enable=1 rf_chain=0 freq=-200000 bw=0 SF=0 sync_word=0/0
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 5: enable=1 rf_chain=0 freq=0 bw=0 SF=0 sync_word=0/0
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 6: enable=1 rf_chain=0 freq=200000 bw=0 SF=0 sync_word=0/0
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 7: enable=1 rf_chain=0 freq=400000 bw=0 SF=0 sync_word=0/0
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.676 [RAL:VERB] SX1302 lfchain 8: enable=1 rf_chain=1 freq=-200000 bw=5 SF=7 sync_word=0/0 [STD] Explicit header
28.07.21 18:19:33 (+0200) [main] 2021-07-28 16:19:33.678 [RAL:VERB] SX1302 lfchain 9: enable=1 rf_chain=1 freq=300000 bw=4 SF=50000 sync_word=0/0
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [RAL:VERB] Concentrator started (2s398ms)
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:INFO] Configuring for region: EU863 .. 863.0MHz..870.0MHz
28.07.21 18:19:36.085 [S2E:VERB] DR0 SF12/BW125
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR1 SF11/BW125
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR2 SF10/BW125
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR3 SF9/BW125
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR4 SF8/BW125
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR5 SF7/BW125
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR6 SF7/BW250
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR7 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR8 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR9 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR10 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR11 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR12 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR13 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR14 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] DR15 FSK
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] TX power: 16.0 dBm EIRP
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] 27.0 dBm EIRP for 869.4MHz..869.65MHz
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] JoinEul list: 0 entries
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] Netf filter: FFFFFFFF-FFFFFF-FFFFFF-FFFFFF
28.07.21 18:19:36 (+0200) [main] 2021-07-28 16:19:36.085 [S2E:VERB] Dev/test settings: nccae=1 nodc=1 nodwell=1
```

New LoRaWAN gateway running the Basics Station on The Things Stack

Screenshot of the The Things Stack dashboard showing a new LoRaWAN gateway named "TTN Summer Camp gateway".

The sidebar on the left shows the following navigation options:

- Overview
- Live data
- Location
- Collaborators
- API keys
- General settings

The main content area displays the following information for the "TTN Summer Camp gateway":

General information

- Gateway ID: ttn-summer-camp
- Gateway EUI: DC A6 32 FF FE B1 07 42
- Gateway description: None
- Created at: Jul 28, 2021 18:17:18
- Last updated at: Jul 28, 2021 18:17:18
- Gateway Server address: eu1.cloud.thethings.network

LoRaWAN information

- Frequency plan: EU_863_870_TTN
- Global configuration: Download global_conf.json

Live data

Recent activity log:

- 18:19:32 Receive gateway status Versions: { firmware: "2.0.4", package
- 18:19:32 Connect gateway
- 18:18:47 Create gateway API key
- 18:17:18 Create gateway

Location

No location information available.

Footer:

Everything you need to build enterprise grade, private LoRaWAN networks - [The Things Industries](#)

v3.14.0 [Documentation](#) [Get Support](#)



New LoRaWAN gateway running the Basics Station on The Things Stack

The screenshot shows the The Things Stack Community Edition dashboard for a gateway named "TTN Summer Camp gateway". The left sidebar includes options for Overview, Live data (selected), Location, Collaborators, API keys, and General settings. The main content area displays a table of live data with columns for Time, Type, and Data preview. The table shows the following entries:

Type	Time	Data preview
Receive uplink message	↑ 18:20:51	JoinEUI: 70 B3 D5 7E D0 03 23 66 DevEUI: 00 04 A3 0B 00 1B C0 3F Data rate: SF7BW125 SNR: 13.5 RSSI: -51
Receive uplink message	↑ 18:20:35	JoinEUI: 70 B3 D5 7E D0 03 23 66 DevEUI: 00 04 A3 0B 00 1B C0 3F Data rate: SF7BW125 SNR: 9.75 RSSI: -47
Receive gateway status	↑ 18:19:32	Versions: { firmware: "2.0.4", package: "2.0.4", platform: "corecell - Firmware 2.0.4 + Protocol 2", station: "2.0.5(corecell/std)" }
Connect gateway	↓ 18:19:32	
Create gateway API key	↑ 18:18:47	
Create gateway	↑ 18:17:18	

At the bottom of the sidebar, there is a "Hide sidebar" link. The footer contains links for Documentation and Get Support, along with a The Things Industries logo.



BONUS - Let's add more services along the LoRaWAN gateway

1

Go to hub.balena.io and find the Basics™ Station gateway app

2

Deploy a Basics™ Station Gateway on balena and connect with The Things Stack

BONUS

3

Add the WiFi-Connect container along the Gateway with balena CLI

- Install balena CLI → <https://www.balena.io/docs/reference/balena-cli/>
- Install github CLI → <https://github.com/cli/cli>

Clone on your computer the basicstation repository

The screenshot shows a GitHub repository page for `mpous/basicstation`. The repository is forked from `lorabasics/basicstation`. The main interface includes a navigation bar with links for Pull requests, Issues, Marketplace, and Explore. Below the navigation is a search bar and a header showing the repository name and a star count of 41. A code editor interface is visible, showing the `master` branch with 5 branches and 4 tags. A message indicates the branch is 91 commits ahead of `lorabasics:master`. The code editor displays a list of commits, including updates to README.md, dependencies, examples, and various configuration files like .gitignore and Dockerfiles. To the right of the code editor are sections for About, Releases, Packages, and Languages. The `About` section describes the repository as "LoRa Basics™ Station - The LoRaWAN Gateway Software" and provides a link to `doc.sm.tc/station`. The `Releases` section shows 4 tags, and the `Packages` section indicates no packages have been published. The `Languages` section shows C as the primary language at 78.7%, followed by Python, Shell, Makefile, and JavaScript.

<https://github.com/mpous/basicstation>



We are going to use the balenaBlock wifi-connect

The screenshot shows the GitHub repository page for `balenablocks/wifi-connect`. The repository has 4 stars, 16 forks, and 4 issues. It contains 10 branches and 3 tags. The `master` branch is selected. The repository description is "Easy WiFi setup for Linux devices from your mobile phone or laptop". It includes a `README.md` file and several configuration files like `Dockerfile.template`, `VERSION`, and `balena.yml`. The `README.md` file provides usage instructions for the `wifi-connect` block.

About
Easy WiFi setup for Linux devices from your mobile phone or laptop
[Readme](#)

Releases
3 tags
[Create a new release](#)

Packages
No packages published
[Publish your first package](#)

Contributors 6

Languages
Shell 100.0%

Code master 10 branches 3 tags Go to file Add file Code

CHANGELOG.md v0.0.4 10 days ago
Dockerfile.template Initial commit 11 months ago
README.md Use wifi-connect built-in configs 10 months ago
VERSION v0.0.4 10 days ago
balena.yml v0.0.4 10 days ago
docker-compose.yml Update docker-compose.yml 6 months ago
image-builder.sh Initial commit 11 months ago
logo.png updates 6 months ago
repo.yml add repo.yml 6 months ago
start.sh patch: fix inaccurate log message when internet connection not avail... 12 days ago

README.md

balenablocks/wifi-connect

The wifi-connect block is a docker image that runs `wifi-connect` which is a utility for dynamically setting the WiFi configuration on a Linux device via a captive portal.

Usage

<https://github.com/balenablocks/wifi-connect>

Clone the repositories and create a docker-compose.yml

- Create a folder *basicstation-wificonnect* (instructions for Linux / Mac)

```
% mkdir basicstation-wificonnect  
% cd basicstation-wificonnect  
% git clone git@github.com:mpous/basicstation.git
```

- Create a file called *docker-compose.yml* and edit it.

```
% vi docker-compose.yml
```

Create the docker-compose.yml file

```
version: "2.1"

services:
  wifi-connect:
    image: balenablocks/wifi-connect:aarch64
    restart: always
    network_mode: host
    privileged: true
    labels:
      io.balena.features.dbus: "1"
      io.balena.features.firmware: "1"

  basicstation:
    build: ./basicstation
    privileged: true
    restart: always
    network_mode: host
```

If you are using a Raspberry Pi3 or balenaFin (32 bits OS) you must change “aarch64” for “armv7h”

balena push results into Charlie the unicorn

```
% balena login  
% balena push TTN-summer-camp-basicstation
```

Use the same name of the app you created on the previous deployment.

```
[Success]    Release successfully created!  
[Info]      Release: 13e203422f23bf7589a6cd8f8fed924c (id: 1874142)  
[Info]  
[Info]          Service     Image Size   Build Time  
[Info]          wifi-connect 13.21 MB     3 seconds  
[Info]  
[Info]          basicstation 211.80 MB    2 minutes, 27 seconds  
[Info]  
[Info] Build finished in 3 minutes, 21 seconds  
\\  
 \\  
 \\\\  
 >\\v7  
 _..(6' \\  
 (=_____.'_/ \\  
 ) \\ |  
 / / |  
 / > /  
 j <_\\  
 _..'_ :  
 \\ r=_\\  
<\\ \\ \\  
 \\ r-7  
 \\,  
 \\/  
 ||  
 \\ \\ C  
 >\\ >  
,..'_>.  
<'_..'  
<'  
 marcpos@Marc-macbook basicstation-wificonnect %
```

New release and new services gets deployed into the devices of the balenaCloud fleet

The screenshot shows the balenaCloud device dashboard for a device named "long-resonance".

Device Status: Online (UUID: 4a2b2f9, Type: Raspberry Pi 4 (using 64bit OS))

Online For: 2 hours

HOST OS VERSION: balenaOS 2.80.5+rev1 (development)

SUPERVISOR VERSION: 12.8.7

CURRENT RELEASE: 13e2034 (green checkmark)

TARGET RELEASE: 13e2034

LOCAL IP ADDRESS: 192.168.1.44

PUBLIC IP ADDRESS: 2.137.81.41

MAC ADDRESS: DC:A6:32:B1:67:42

NOTES: EUI: dca632fffe10742

SERVICES:

Service	Status	Release
basicstation	Running	13e2034
wifi-connect	Running	13e2034

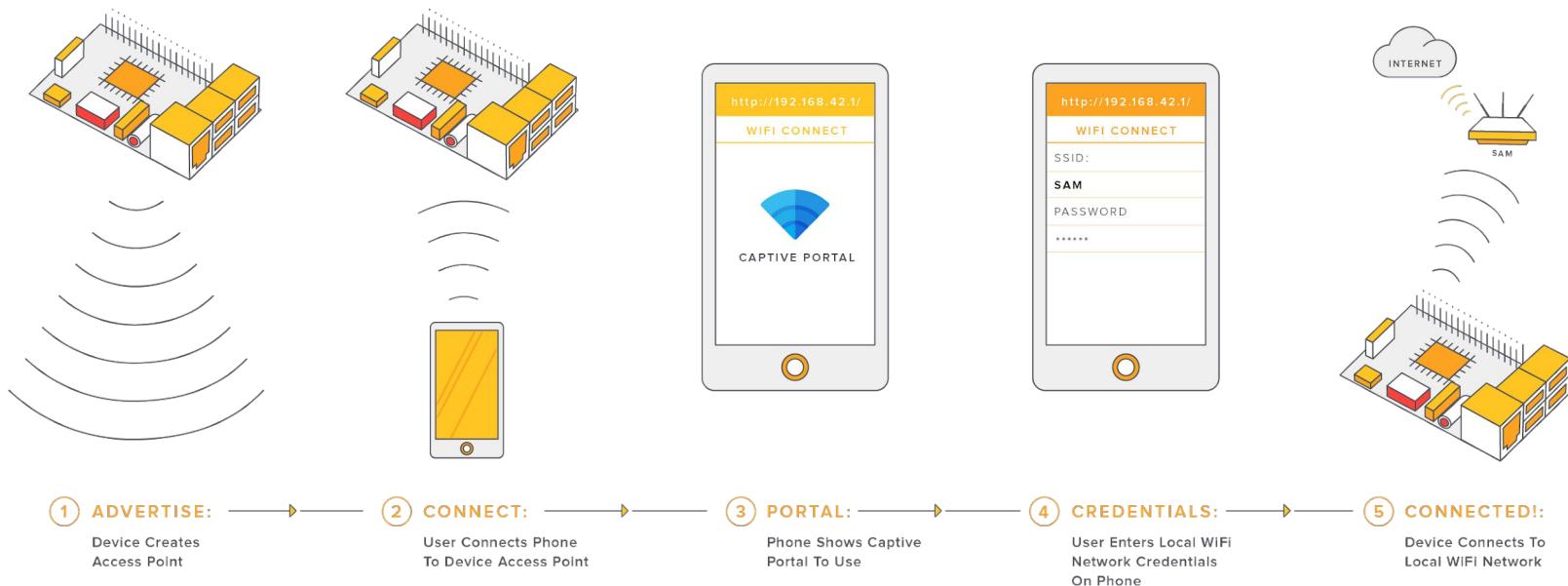
Metrics: CPU (~4%), Temperature (~63C), Memory (369 MB/7.7 GB), Storage (335 MB/6.5 GB)

Logs: UTC, Timestamps, Views

```
.7ppm  
28.07.21 18:49:20 (+0200) 2021-07-28 16:49:20.543 [SYN:INFO] Time sync qualities: min=123 q90=192 max=1811 (previous q90=2147483647)  
28.07.21 18:49:22 (+0200) 2021-07-28 16:49:22.645 [SYN:VERB] Time sync rejected: quality=1829 threshold=192  
28.07.21 18:49:46 (+0200) 2021-07-28 16:49:45.749 [SYN:INFO] MCU/SX130X drift stats: min: +14.8ppm q50: +21.4ppm q80: +26.2ppm max: -382.0ppm - threshold q90: +26.7ppm  
28.07.21 18:49:46 (+0200) 2021-07-28 16:49:45.749 [SYN:INFO] Mean MCU drift vs SX130X#0: 1.3ppm
```

Terminal: Select a target, Start terminal session

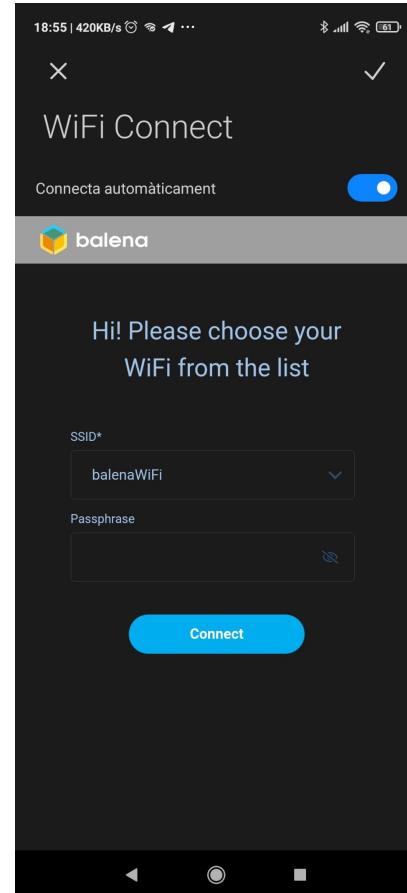
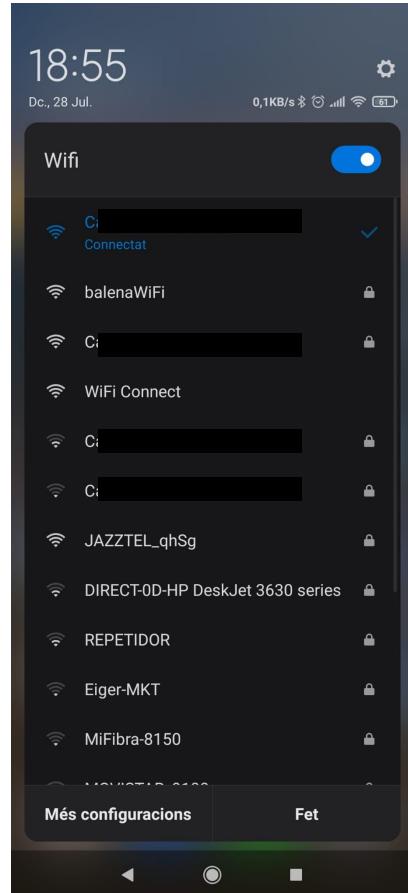
WiFi-connect diagram



Time to connect the LoRaWAN gateway over WiFi

And now let's unplug the Ethernet cable

- Check WiFis with your phone
- Click on WiFiConnect open WiFi.
- Introduce new WiFi credentials.
- The device will reboot and start with the new WiFi credentials.



The LoRaWAN gateway online again via WiFi

The screenshot shows the balenaCloud dashboard interface for a device named "long-resonance".

Device Summary:

- Status:** Online (green checkmark)
- UUID:** 4a2b2f9
- Type:** Raspberry Pi 4 (using 64bit OS)
- Online For:** 11 minutes
- HOST OS VERSION:** balenaOS 2.80.5+rev1 (development)
- SUPERVISOR VERSION:** 12.8.7
- CURRENT RELEASE:** 13e2034 (green checkmark)
- TARGET RELEASE:** 13e2034
- LOCAL IP ADDRESS:** 192.168.1.43
- PUBLIC IP ADDRESS:** 2.137.81.41
- MAC ADDRESS:** DC:A6:32:B1:67:42, DC:A6:32:B1:67:43
- TAGS:** EU: dca632fffeb10742
- PUBLIC DEVICE URL:** (disabled switch)

NOTES:

EUI : dca632fffeb10742

SERVICES:

Service	Status	Release
basicstation	Running	13e2034
wifi-connect	Running	13e2034

Metrics:

- CPU: ~4% Usage
- Temperature: -59C
- Memory: 370 MB/7.7 GB
- Storage: 335 MB/6.5 GB

Logs:

Search entries... UTC Timestamps Views

28.07.21 19:08:06 (+0200) wifi-connect Your device is already connected to the internet.
28.07.21 19:08:06 (+0200) wifi-connect Skipping setting up WiFi-Connect Access Point. Will check again in 120 seconds
28.07.21 19:08:12 (+0200) basicstation 2021-07-28 17:08:12.172 [SYN:VERB] Time sync rejected: quality=1790 threshold=199
28.07.21 19:08:28 (+0200) basicstation 2021-07-28 17:08:27.924 [SYN:INFO] MCU/SX130X drift stats: min: +0.0ppm q90: +3.5ppm q80: +5.2ppm max: +7.6ppm - threshold q90: -6.2ppm
28.07.21 19:08:28 (+0200) basicstation 2021-07-28 17:08:27.924 [SYN:INFO] Mean MCU drift vs SX130X#0: 0.0ppm

Terminal:

Select a target Start terminal session

Need help ?

The LoRaWAN gateway online again via WiFi

The screenshot shows the balena dashboard interface for a device named "long-resonance". The left sidebar contains navigation links for Organizations, Applications, and the current device. The main area is titled "Logs" and displays a list of log entries. The logs show the device attempting to connect to a WiFi access point, performing time sync checks, and handling various network and system events. The log entries are timestamped and color-coded by source.

```
28.07.21 19:12:06 (+0200) wifi-connect Skipping setting up WiFi-Connect Access Point. Will check again in 120 seconds
28.07.21 19:12:14 (+0200) basicstation 2021-07-28 17:12:14.762 [SYN:VERB] Time sync rejected: quality=1858 threshold=169
28.07.21 19:12:33 (+0200) basicstation 2021-07-28 17:12:33.665 [SYN:VERB] Time sync rejected: quality=184 threshold=169
28.07.21 19:12:37 (+0200) basicstation 2021-07-28 17:12:37.865 [SYN:VERB] Time sync rejected: quality=194 threshold=169
28.07.21 19:12:47 (+0200) basicstation 2021-07-28 17:12:47.316 [SYN:INFO] Time sync qualities: min=142 q90=187 max=1858 (previous q90=169)
28.07.21 19:12:50 (+0200) basicstation 2021-07-28 17:12:50.467 [SYN:INFO] MCU/SX130X drift stats: min: +0.0ppm q50: -0.5ppm q80: +3.8ppm max: +7.1ppm - threshold q90: +5.4ppm
28.07.21 19:12:58 (+0200) basicstation 2021-07-28 17:12:58.467 [SYN:INFO] Mean MCU drift vs SX130X#0: 0.6ppm
28.07.21 19:13:01 (+0200) basicstation 2021-07-28 17:13:00.969 [SYN:VERB] Time sync rejected: quality=238 threshold=187
28.07.21 19:13:11 (+0200) basicstation 2021-07-28 17:13:11.472 [SYN:VERB] Time sync rejected: quality=1474 threshold=187
28.07.21 19:13:34 (+0200) basicstation 2021-07-28 17:13:34.573 [SYN:INFO] MCU/SX130X drift stats: min: +0.0ppm q50: +2.9ppm q80: -5.1ppm max: -7.1ppm - threshold q90: +6.7ppm
28.07.21 19:13:34 (+0200) basicstation 2021-07-28 17:13:34.575 [SYN:INFO] Mean MCU drift vs SX130X#0: 0.1ppm
28.07.21 19:13:47 (+0200) basicstation 2021-07-28 17:13:47.176 [SYN:INFO] Time sync qualities: min=151 q90=187 max=1474 (previous q90=187)
28.07.21 19:14:06 (+0200) wifi-connect Checking internet connectivity ...
28.07.21 19:14:07 (+0200) wifi-connect Your device is already connected to the internet.
28.07.21 19:14:07 (+0200) wifi-connect Skipping setting up WiFi-Connect Access Point. Will check again in 120 seconds
28.07.21 19:14:07 (+0200) basicstation 2021-07-28 17:14:07.129 [SYN:VERB] Time sync rejected: quality=211 threshold=187
28.07.21 19:14:17 (+0200) basicstation 2021-07-28 17:14:17.631 [SYN:INFO] MCU/SX130X drift stats: min: +0.0ppm q50: -1.4ppm q80: +5.1ppm max: +7.6ppm - threshold q90: +7.6ppm
28.07.21 19:14:34 (+0200) basicstation 2021-07-28 17:14:34.436 [SYN:VERB] Time sync rejected: quality=1487 threshold=187
28.07.21 19:14:45 (+0200) basicstation 2021-07-28 17:14:44.939 [SYN:VERB] Time sync rejected: quality=1773 threshold=187
28.07.21 19:14:49 (+0200) basicstation 2021-07-28 17:14:49.149 [SYN:INFO] Time sync qualities: min=106 q90=231 max=1773 (previous q90=187)
28.07.21 19:14:54 (+0200) basicstation 2021-07-28 17:14:54.080 [S2E:VERB] RX 868.3MHz DR5 SF7/BW125 snr=13.8 rssl=-44 xtime=0xE8000042207682 - ireq MHdr=00 JoinEui=70b3:d57e:d083:c366 D evEui=4:a30b:1b:c03f DevNonce=16485 Mtc=1236895228
28.07.21 19:14:58 (+0200) basicstation 2021-07-28 17:14:58.130 [S2E:DEBU] ::1 diid=12592 [ant#0] - next TX start ahead by 944ms266us
28.07.21 19:14:59 (+0200) basicstation 2021-07-28 17:14:59.055 [S2E:VERB] ::1 diid=12592 [ant#0] - starting TX in 19ms920us
28.07.21 19:14:59 (+0200) basicstation 2021-07-28 17:14:59.080 [S2E:INFO] TX ::1 diid=12592 [ant#0] - dntxd: 868.3MHz 16.0dBm ant#0() DR5 SF7/BW125 frame=208A6D8C8892866B416D697F..F19422A
28.07.21 19:14:59 (+0200) basicstation 2021-07-28 17:14:59.147 [S2E:DEBU] Tx done diid=12592
28.07.21 19:14:59 (+0200) basicstation 2021-07-28 17:14:59.340 [S2E:VERB] RX 867.1MHz DR5 SF7/BW125 snr=13.8 rssl=-45 xtime=0xE800004270A2A9 - updf mhdr=40 DevAddr=26016302 FCtrl=00 FCn=t=0 Fots=[1] 01C6A80D..612E mic=707419252 (21 bytes)
28.07.21 19:15:03 (+0200) basicstation 2021-07-28 17:15:03.841 [SYN:INFO] MCU/SX130X drift stats: min: +0.0ppm q50: +0.5ppm q80: +4.3ppm max: -6.2ppm - threshold q90: -5.2ppm
28.07.21 19:15:03 (+0200) basicstation 2021-07-28 17:15:03.842 [SYN:INFO] Mean MCU drift vs SX130X#0: -0.2ppm
```

The LoRaWAN gateway online again via WiFi

Screenshot of the TTN Summer Camp gateway live data page on the The Things Network dashboard.

The sidebar shows the following navigation:

- Overview
- Live data** (selected)
- Location
- Collaborators
- API keys
- General settings

The main content area displays a table of received uplink messages:

Time	Type	Data preview
↑ 19:17:03	Receive uplink message	DevAddr: 26 01 63 02 FCnt: 2 FPort: 1 Data rate: SF7BW125 SNR: 13 RSSI: -49
↑ 19:16:01	Receive uplink message	DevAddr: 26 01 63 02 FCnt: 1 FPort: 1 Data rate: SF7BW125 SNR: 13.5 RSSI: -44
↑ 19:14:59	Receive uplink message	DevAddr: 26 01 63 02 FPort: 1 Data rate: SF7BW125 SNR: 13.75 RSSI: -45
↑ 19:14:54	Receive uplink message	JoinEUI: 70 B3 D5 7E D0 03 23 66 DevEUI: 00 04 A3 0B 00 1B C0 3F Data rate: SF7BW125 SNR: 13.75 RSSI: -44 Versions: { firmware: "2.0.4", package: "2.0.4", platform: "corecell - Firmware 2.0.4 - Protocol 2", station: "2.0.5(corecell/std)" }
↑ 18:56:22	Receive gateway status	Versions: { firmware: "2.0.4", package: "2.0.4", platform: "corecell - Firmware 2.0.4 - Protocol 2", station: "2.0.5(corecell/std)" }
↓ 18:56:22	Connect gateway	
↓ 18:56:22	Disconnect gateway	
↑ 18:48:18	Receive gateway status	Versions: { firmware: "2.0.4", package: "2.0.4", platform: "corecell - Firmware 2.0.4 - Protocol 2", station: "2.0.5(corecell/std)" }
↓ 18:48:18	Connect gateway	
↓ 18:47:13	Disconnect gateway	
↑ 18:29:31	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 8 FPort: 1 Data rate: SF7BW125 SNR: 13.75 RSSI: -44
↑ 18:28:29	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 7 FPort: 1 Data rate: SF7BW125 SNR: 14.25 RSSI: -35
↑ 18:27:27	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 6 FPort: 1 Data rate: SF7BW125 SNR: 13.25 RSSI: -45
↑ 18:26:24	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 5 FPort: 1 Data rate: SF7BW125 SNR: 11 RSSI: -40
↑ 18:25:22	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 4 FPort: 1 Data rate: SF7BW125 SNR: 9.75 RSSI: -45
↑ 18:24:20	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 3 FPort: 1 Data rate: SF7BW125 SNR: 13.25 RSSI: -44
↑ 18:23:17	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 2 FPort: 1 Data rate: SF7BW125 SNR: 13.5 RSSI: -44
↑ 18:22:15	Receive uplink message	DevAddr: 48 00 00 A5 FCnt: 1 FPort: 1 Data rate: SF7BW125 SNR: 13.75 RSSI: -48
↑ 18:21:13	Receive uplink message	DevAddr: 48 00 00 A5 FPort: 1 Data rate: SF7BW125 SNR: 10.25 RSSI: -49
↑ 18:21:07	Receive uplink message	JoinEUI: 70 B3 D5 7E D0 03 23 66 DevEUI: 00 04 A3 0B 00 1B C0 3F Data rate: SF7BW125 SNR: 13.5 RSSI: -49

Bottom footer:

- Everything you need to build enterprise grade, private LoRaWAN networks - [TheThingsIndustries](#)
- v3.14.0 [Documentation](#)
- [Get Support](#)

More ideas?

Take aways

Create the network and create community!

As a gateway managers deploy and manage gateways (or fleets of them) in a simple way.

The balena basicstation project is an open source project. Feel free to contribute!

Questions?



THE THINGS
NETWORK



The Things Summer Academy

WORKSHOP

Building and connecting your LoRaWAN gateway



August 16th 2021



Online

