



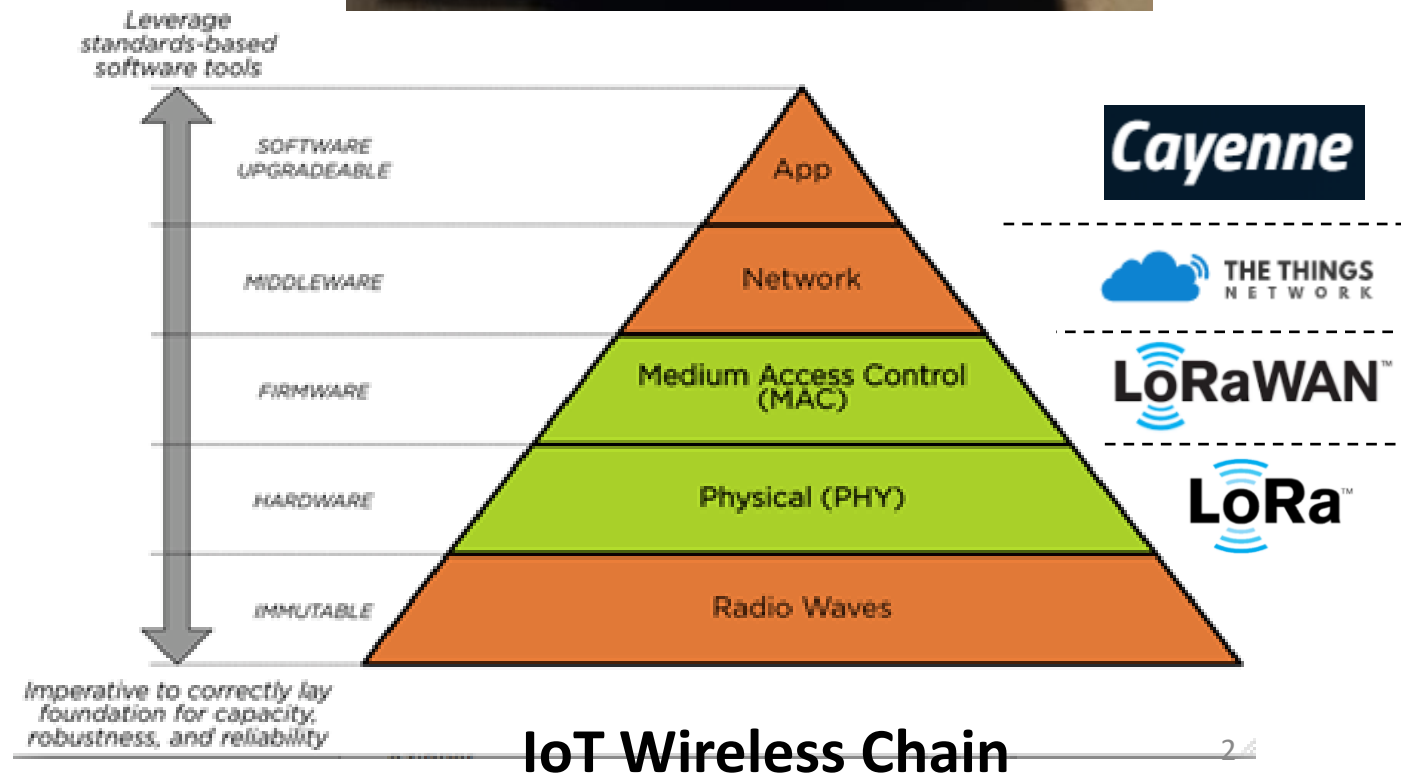
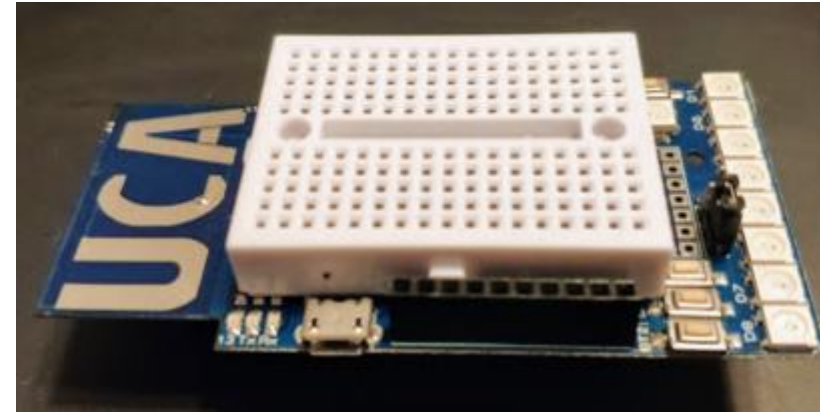
LoRaWan tutorial : Register a device on TTN V3

F. Ferrero, Professor @UCA

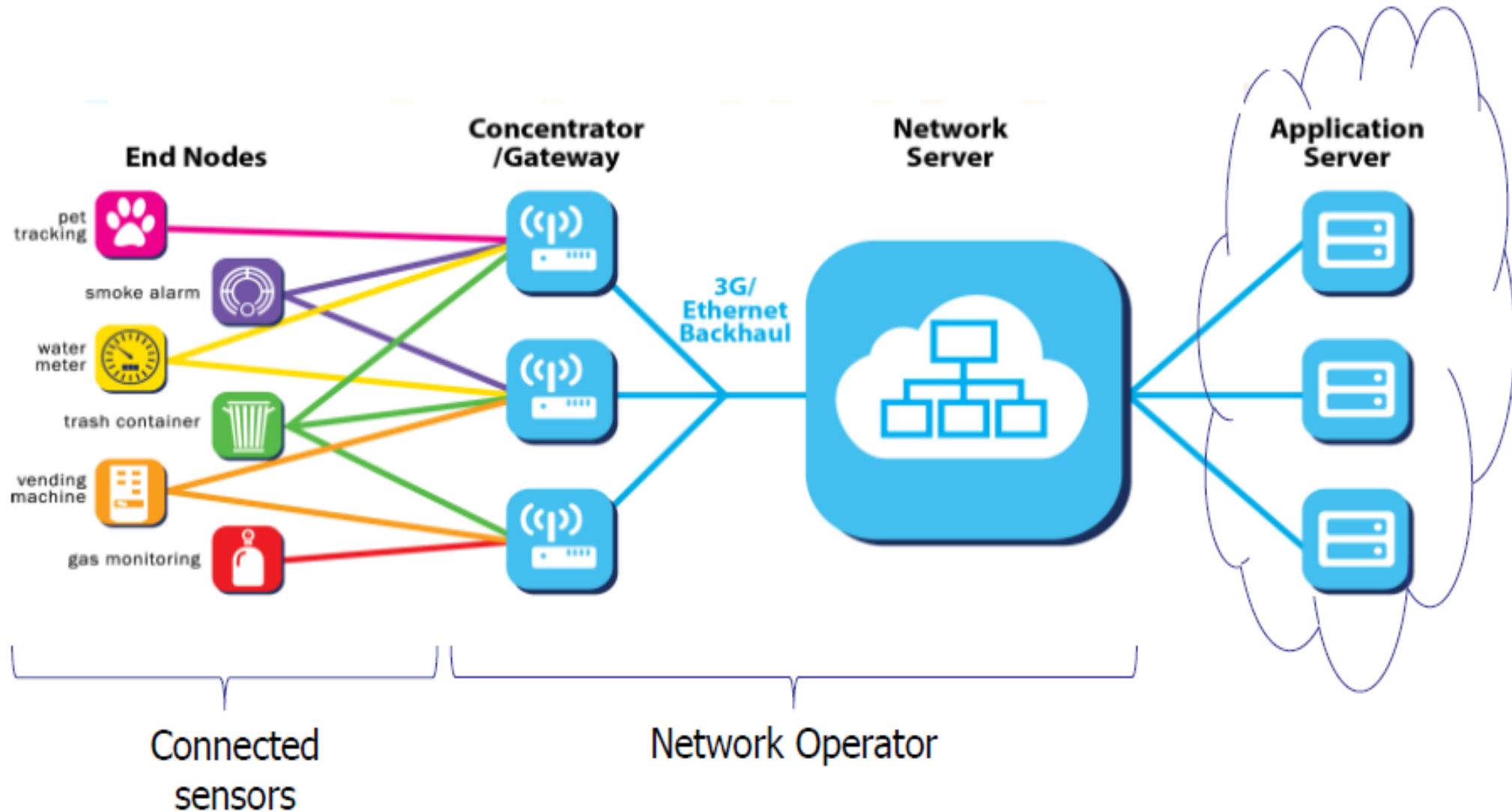
LoRaWan Tutorial Objectives

In this tutorial, you will :

- Use the UCA Education Board
- Program a microcontroller in C with Arduino IDE
- Register the board to a network server
- Transmit data with LoRa modulation
- Push data to an application server

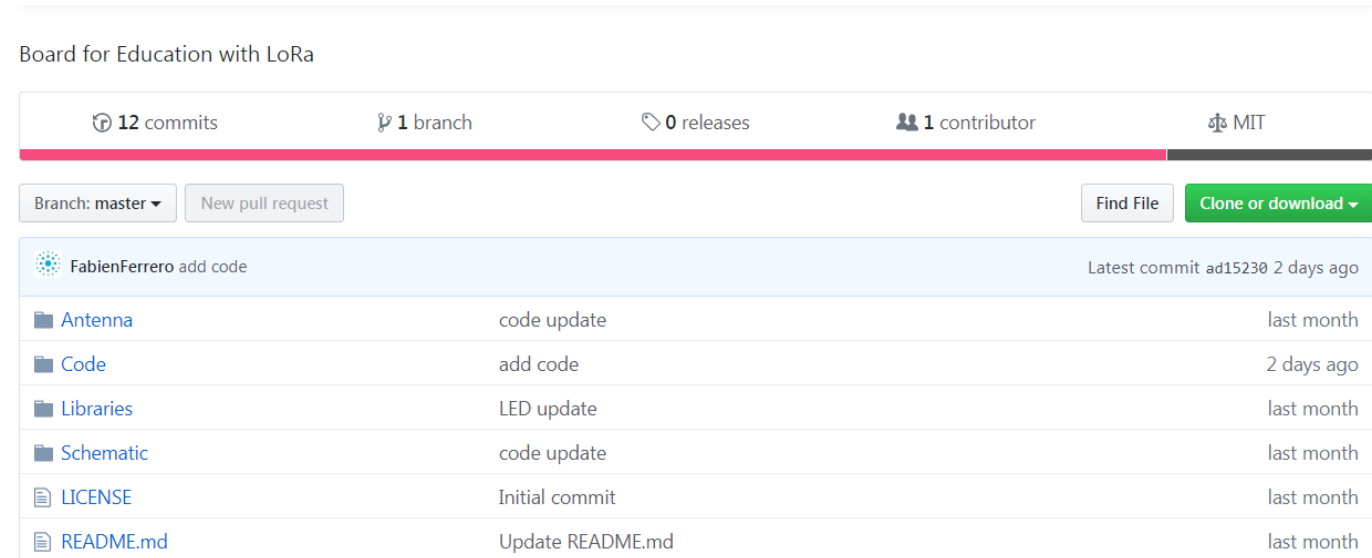


LoRaWan Tutorial Objectives



Downloading Arduino code on Github

- For this tutorial, you are going to use Arduino codes
- Codes are available on : <https://github.com/FabienFerro/UCA21>
- You can click on “Clone or Dowload” and “download zip”
- Then unzip it
- If you are using Github Desktop, you can use “open in Desktop”

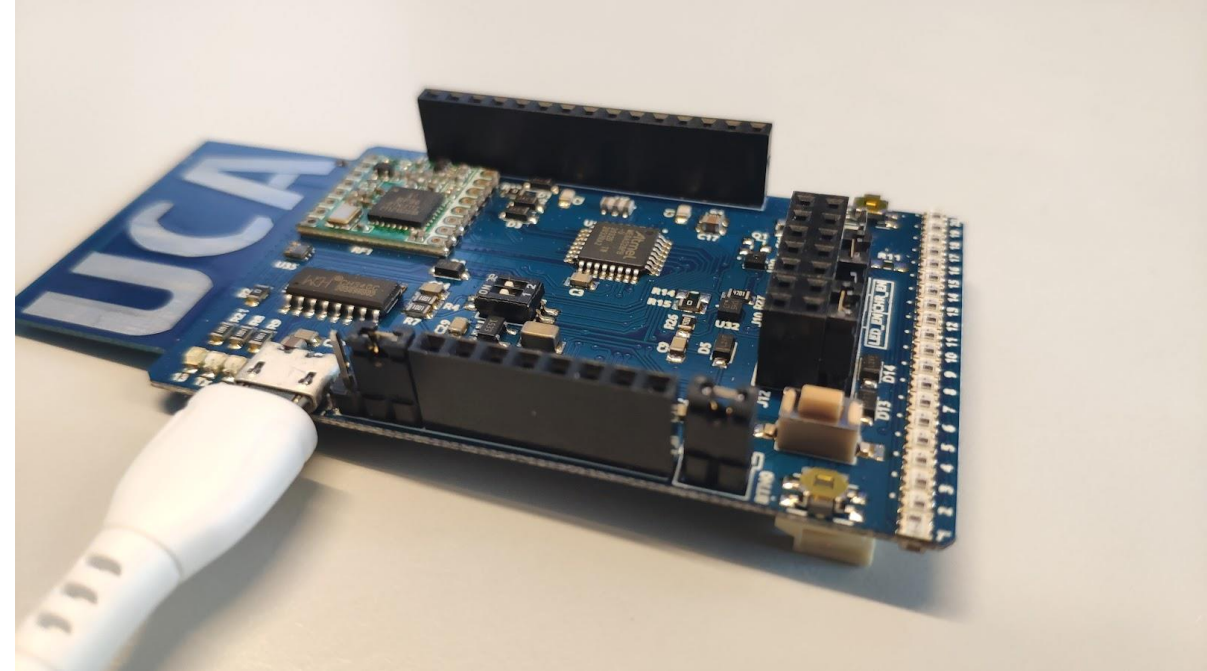


Configuring your Arduino IDE

- After downloading the archive (.zip) and extracting the archive
- Copy the file from : UCA21\Libraries to /Document/Arduino/ Libraries/

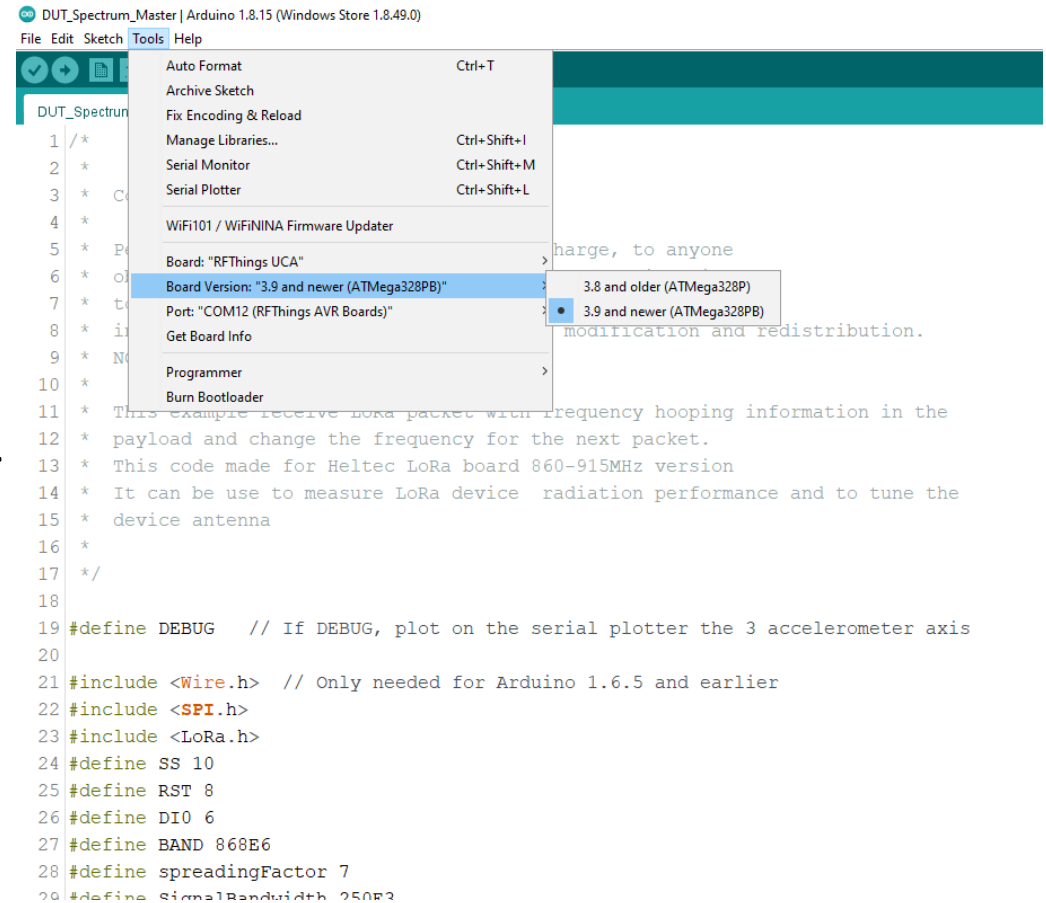
It will install the libs needed during the tutorial

- If your using Windows or Mac, your may need to install the board USB driver (CH340C) : drivers are available [here](#)



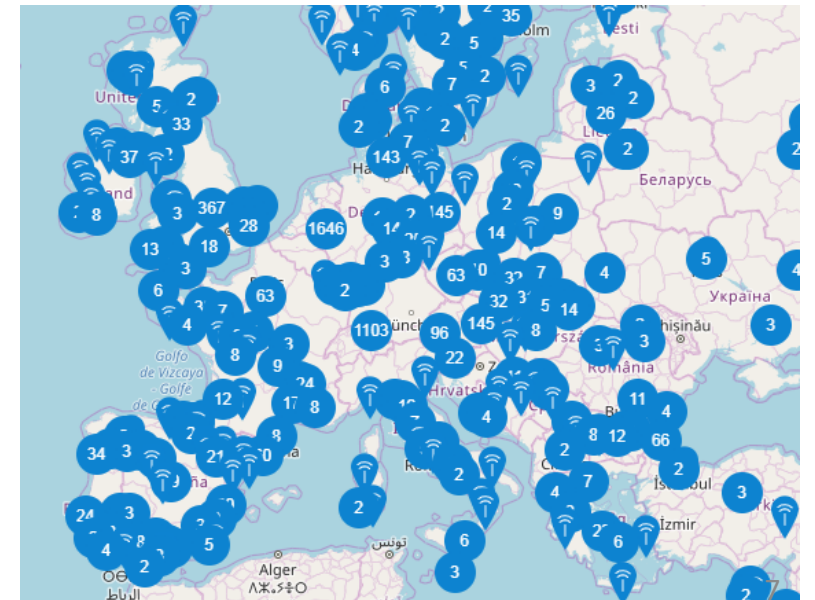
Configuring your Arduino IDE

- Start the Arduino IDE
- Go into Preferences
- Add "***https://rfthings.com.vn/wp-content/uploads/package_rfthings-avr_index.json***" as an "Additional Board Manager URL"
- Open the Boards Manager from the Tools -> Board menu and install "RFTHings AVR Boards by RFThings Vietnam"
- Select your RFTHings UCA board from the Tools -> Board menu
- Select Board version "3.9 and newer : AT328PB" from the Tools -> Board menu
- Select the port



LoRaWan with The Thing Network

- The Things Network is a **global**, open, crowd-sourced Internet of Things data network.
- **The Things Network Backend** route messages from Nodes to the right Application, and back
- TTN is free
- 10000 LoRa gateways are connected to TTN around the world
- Any TTN can use any GWs, it is a collaborative network




Create a TTN account

- First, you have to [register](https://www.thethingsnetwork.org/) to <https://www.thethingsnetwork.org/>
- Then, give me your USERNAME, I will add you as a collaborator in our application
- You can also join a local community :

[TTN Côte d'Azur](#)


[TTN Da Nang](#)




CREATE AN ACCOUNT

Create an account for The Things Network and start exploring the world of Internet of Things with us.


USERNAME
This will be your username — pick a good one because you will **not** be able to change it.



EMAIL ADDRESS
You will receive a confirmation email, as well as occasional account related emails. If this email address is managed by a third party (such as for corporate email addresses), this third party might block emails coming from The Things Network. This email address is not public.



PASSWORD
Use at least 6 characters.



NEWSLETTER
Subscribe to the newsletter. ☐

Adding a new device

- Go to « application » and choose the available application
- Click on « + Add end device »
- Select « Manually » for configuration
- Click on « Show advanced activation, LoRaWAN class and cluster settings_»
- Select « ABP »
- Generate DevEUI, Dev Adr, AppSkey, NetwSkey
- Choose a name for End Device ID
- Click on « Register end device » ! It's done

The screenshot displays the 'UCA Project' interface for a project named 'uca-project'. At the top, it shows project statistics: 'Last seen info unavailable', '0 End devices', '1 Collaborator', and '0 API keys', along with a timestamp 'Created 4 seconds ago'. The 'General information' section lists the 'Application ID' as 'uca-project', 'Created at' as 'Aug 16, 2021 22:48:07', and 'Last updated at' as 'Aug 16, 2021 22:48:07'. A 'Live data' section shows a recent event at '22:48:07' for 'uca-project' with a 'Create application' button. Below this, there's a search bar for 'End devices (0)' and buttons for 'Import end devices' and '+ Add end device'. The 'Register end device' section has two tabs: 'From The LoRaWAN Device Repository' and 'Manually' (which is selected). The form includes dropdowns for 'LoRaWAN version' (set to 'MAC V1.0.3'), 'Regional Parameters version' (set to 'PHY V1.0.3 REV A'), and 'Frequency plan' (set to 'Europe 863-870 MHz (SF9 for RX2 - recommended)'). A link 'Show advanced activation, LoRaWAN class and cluster settings ^' is present. The 'Activation mode' section has three radio buttons: 'Over the air activation (OTAA)', 'Activation by personalization (ABP)' (which is selected), and 'Define multicast group (ABP & Multicast)'. The 'Additional LoRaWAN class capabilities' dropdown is set to 'None (class A only)'. At the bottom, the 'Network defaults' section has a checked checkbox for 'Use network's Rx and frequency defaults'.

UCA Project
ID: uca-project

• Last seen info unavailable • 0 End devices • 1 Collaborator • 0 API keys Created 4 seconds ago

General information

Application ID: uca-project

Created at: Aug 16, 2021 22:48:07

Last updated at: Aug 16, 2021 22:48:07

Live data See all activity →

22:48:07 uca-project Create application

End devices (0) Search by ID Import end devices + Add end device

Register end device

From The LoRaWAN Device Repository Manually

LoRaWAN version ⓘ *
MAC V1.0.3

Regional Parameters version ⓘ *
PHY V1.0.3 REV A

Frequency plan ⓘ *
Europe 863-870 MHz (SF9 for RX2 - recommended)

Show advanced activation, LoRaWAN class and cluster settings ^

Activation mode ⓘ *

☐ Over the air activation (OTAA)

☒ Activation by personalization (ABP)

☐ Define multicast group (ABP & Multicast)

Additional LoRaWAN class capabilities ⓘ
None (class A only)

Network defaults ⓘ
☒ Use network's Rx and frequency defaults

Activation by Personalization (ABP)

- Go to settings
- Select ABP and save
- Go back to Overview
- You have now the Device Address and the two 128 AES keys
- You can click on Hex-C Style to have the key in the right format

Session information

Device address

26 0B 68 02



NwkSKey

0x18, 0x9A, 0x1C, 0x5B, 0xA...

msb ↔



SNwkSIntKey

.....



NwkSEncKey

.....



AppSKey

0x43, 0xB4, 0x29, 0x8D, 0x3...

msb ↔



Activation by Personalization (ABP)

- Open the code UCA21\Code\LORAWAN\ABP\Basic\UCA-ABP_Basic\UCA-ABP_Basic.ino
- Copy/Paste DEVADDR from your TTN window with « 0x » for Hex style
- Copy/Paste NWKSKEY and APPSKEY using C-style from your TTN window

```
#include <lmic.h>
#include <hal/hal.h>
#include <SPI.h>

// LoRaWAN end-device address (DevAddr)

static const u4_t DEVADDR = 0x00000000;

// LoRaWAN NwkSKey, network session key
// This is the default Semtech key, which is used by the early prototype TTN
// network.
static const PROGMEM u1_t NWKSKEY[16] = { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 };

// LoRaWAN AppSKey, application session key
// This is the default Semtech key, which is used by the early prototype TTN
// network.
static const u1_t PROGMEM APPSKEY[16] = { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 };
```

Activation by Personalization (ABP)

- Compile and download the code on your board
- Look at the TTN device overview
- Frames up should increment each half minute as your board is sending an uplink each 30s (« TX_INTERVAL »)
- Have look on Data
- For each uplink, you can look many details as RSSI, SNR, airtime, modulation, coding rate, GW ID, etc ...
- Click on the blue triangle

Status ● 25 seconds ago

Frames up 0 [reset frame counters](#)

Frames down 0

Activation by Personalization (ABP)

Frame counter security

- Now reset you board (click on the right button on your board)
- TTN is no more receiving the data
- Click on « General setting» and expand « Network layer », expand « Advanced MAC settings »
- Enable « Reset Frame counter » options
- As you can see, frame counter is a security features to avoid replay attack (done by capturing and re-transmitting the messages)
- Frame counter can be disabled for debug test in Settings

Downlink

- Open your serial monitor
- In TTN messaging, go to downlink, add a payload like « BABA » and click on « Schedule downlink», and go to Data
- After the next uplink, you should see the number of byte received in downlink

```
Packet queued
41330173: EV_TXCOMPLETE (includes waiting for RX windows)
Received 2 bytes of payload
Payload Value : BABA
```

Overview			Live data		Messaging		Location		Payload formatters		Gener	
Time		Type		Data preview								
↓ 22:43:24		Forward downlink data message		FPort: 1		Payload:		BA BA				

Activation by Personalization (ABP)

Change SF, power, payload ...

- At the end of the arduino code, you can find :

`LMIC_setDrTxpow(DR_SF12,14);`

- You can change Spreading Factor(SF) from DR_SF7 to DR_SF12
- You can change the power from 2 dBm to 20 dBm
- Payload is in mydata[], and you can change the text.
- You can convert the payload in Hex to normal text using this online [tool](#)
- Change SF and Payload text ! What is the effect on Time on Air ?

ABPand sensor

- You are now going to use a built-in sensor
- Select in
UCA_Education_Board\Code\LORAWAN\ABP\UCA-
ABP_Sensor



Over the Air Activation (OTAA) and data

- Select in UCA_Education_Board\Code\LORAWAN\ABP\UCA-ABP_Sensor
- The code is using [Cayenne LPP format](#)
- Now you can see sensor data in the uplink packet

↑ 09:15:56 Forward uplink data message

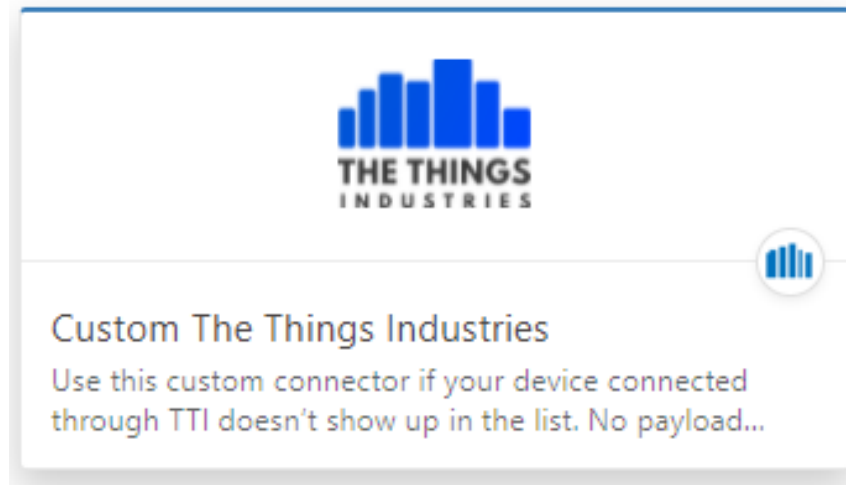
Payload: { accelerometer_4: {...}, analog_in_3: 3.36, luminosity_4: 4889, relative_humidity_2: 48, temperature_1: 29.8 }

01 67 01 2A 02 68 60 03 ...

FPort: 1 Data rate: SF7


Using TagIO to see you data



- Go to <https://tago.io/> and sign up
- Add a device by selecting LoRa/TheThingsNetwork and Cayenne LPP.
- Add a device and select « LoRaWAN TTI/TTN v3 »
- Select « Custom The Things Industries




Using TagoIO to see you data

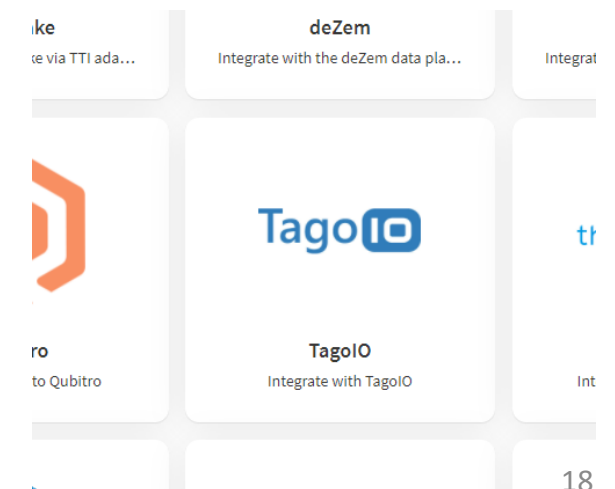
- Give a name to your device
- Add Device EUI
- Create an authorization and copy authorization

 **Service Authorization**
Create authorization to allow integration with other services [Read more here](#).

Name	Additional Parameter (Optional) 	Created at	Authorization 	
<input type="text" value="enter a name for this authorization"/>	<input type="text" value="enter an optional additional parameter"/>	<input type="text"/>	<input type="text"/>	<button>Generate</button>

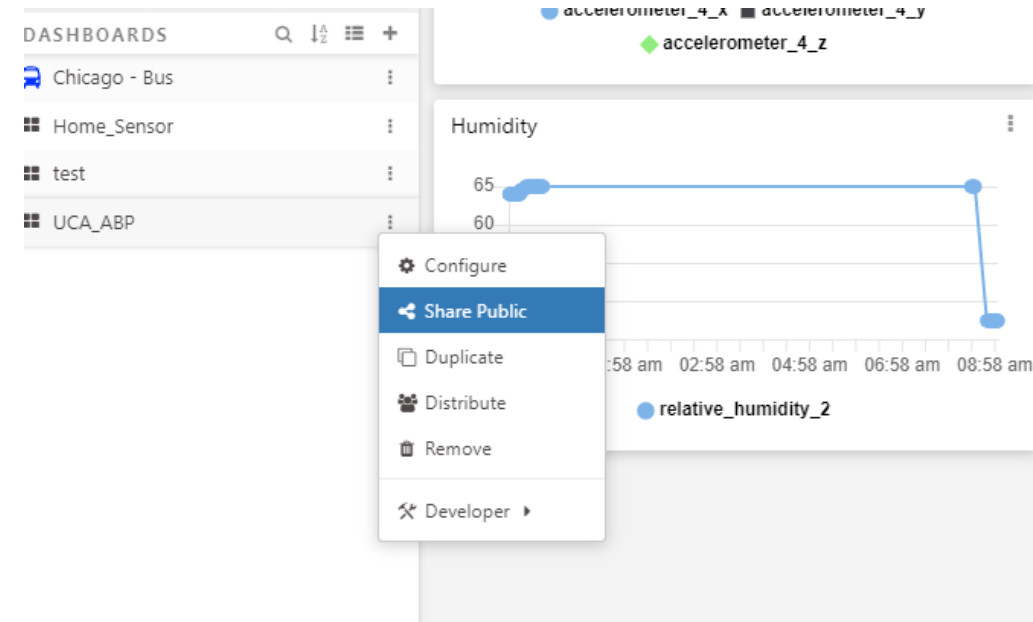
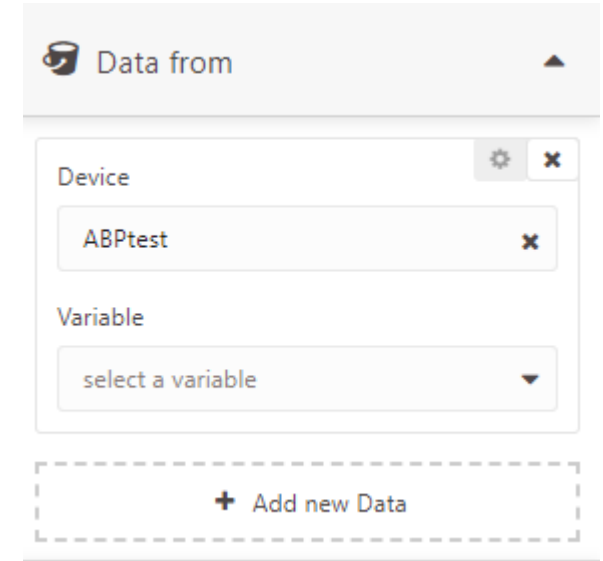
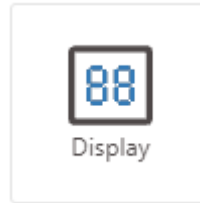
TTN	il y a un jour	<div>✓ Copied</div>	<div>—</div>	<div></div>
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- Go to TTN and click on Integration/Webhooks
- Click on « Add a Webhooks »
- Select TagoIO
- Enter a Webhooks ID (what you want) and copy authorization



Using TagIO to see you data

- Go to your dashboard and create a new normal dashboard
- Add a widget like a display
- Choose your Device and select a variable
- You can customize any widget and your dashboard.
- You can share your dashboard with
« Share Public »



Downlink using TagIO

- We are going to control LED color from a dashboard :

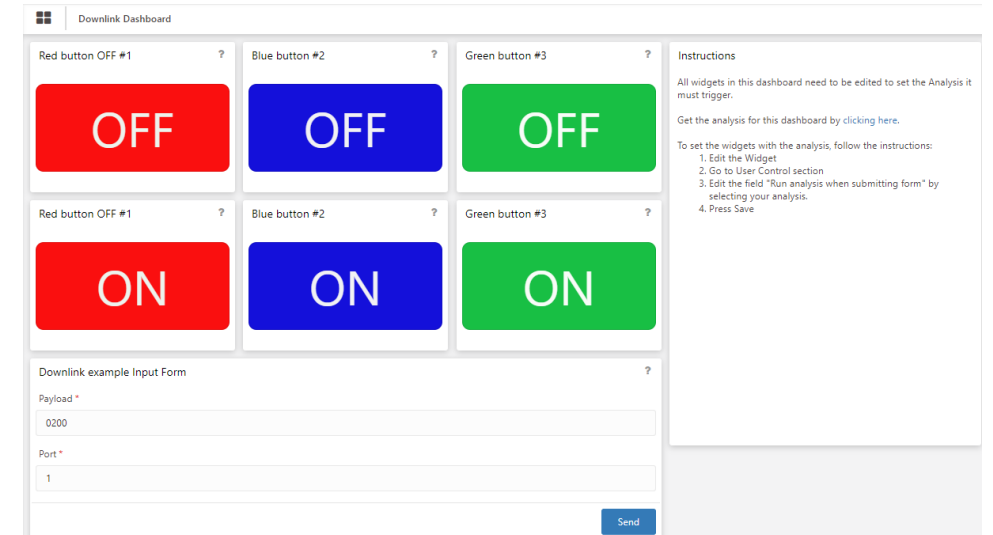
<https://docs.tago.io/en/articles/221>

- Upload the code :
UCA21\Code\LORAWAN\OTAA\LED_CONTROLLER
- Install a « analysis » code using this link :

<http://admin.tago.io/template/5f513aabd4555600277f858c>

- Install a dashboard template :

<https://admin.tago.io/template/615a93447b004f0019227064>



Downlink using TagoIO

- Move to edit mode
- Edit every buttons,

In Visualisation, update Run Analysis to « Sending Downlink using Dashboard »

- You need to create a Token from TagoIO account/Profile/Generate Token
- Copy/Paste to « account_token » environment variables in «Sending downlink using dashboard » analysis
- Check with live data in TTN

		Overview	Live data	Messaging	Location
Time	Type	Data preview			
↓ 20:56:56	Forward downlink data message	FPort: 1		Payload:	02 00

The screenshot displays the TagoIO dashboard interface for configuring a widget titled "Red button OFF #1". The left sidebar contains navigation options: Main Configuration, Visualization (selected), Variable Alias, Header, and Embed Widget. The main area shows a visualization of a red button with the text "OFF". Below this, the "Visualization" section allows defining data visualization options, including a checkbox for "Override colors with the conditions defined here" which is checked. The "Type of button" section shows "Bi-stable" and "Mono-stable" options, with "Mono-stable" selected. The "Run analysis" dropdown menu is set to "Sending Downlink using dashboard". At the bottom, there are tabs for "Configuration for the Default state" and "Configuration for the Temporary state".

Good luck for you projects !

This board as been funded by UCA

