

# IOT ONLINE COURSE

## Fundamentals of IoT

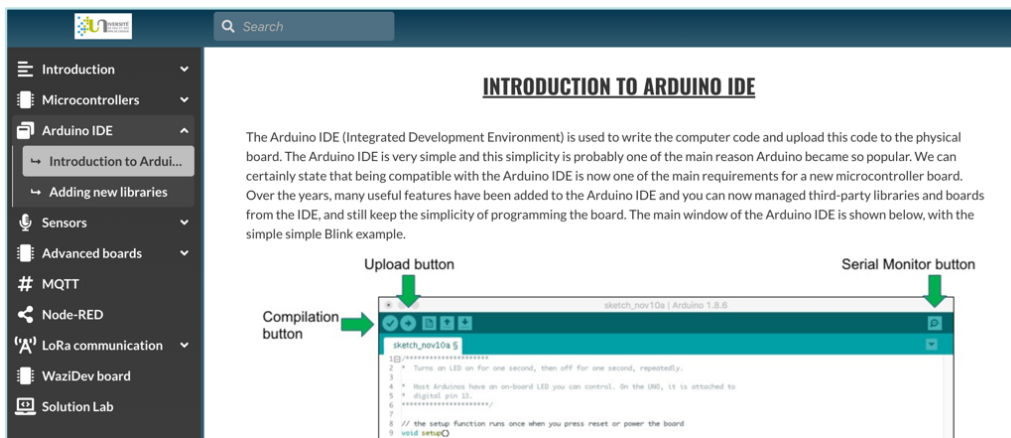
### F-IOT-2a-hands-on: WiFi and LoRa on microcontroller boards

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<http://www.univ-pau.fr/~cpham>  
Université de Pau, France



- ⦿ If needed, install Arduino IDE
- ⦿ If you are not familiar to Arduino IDE, read the tutorial

[https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/introduction\\_arduino\\_ide/introduction\\_arduino\\_ide/](https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/introduction_arduino_ide/introduction_arduino_ide/)



- ⦿ Download all the examples and install them in your workspace

## Continue with the examples

You can download all examples of this tutorial [here](#). The .zip archive also contains all the required libraries for the examples. Unzip the archive to get a `sketch` folder and set in your Arduino IDE (Preference menu) the sketch folder to this folder in order to have access to all examples in the sketchbook menu.

# Boards with WiFi

🔗 <http://diy.waziup.io>

# Demo with Heltec ESP32

[https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/advanced\\_boards/board\\_with\\_wifi/](https://cpham.perso.univ-pau.fr/LORA/HUBIQUITOUS/solution-lab/arduino-lora-tutorial/advanced_boards/board_with_wifi/)

**DEMO**



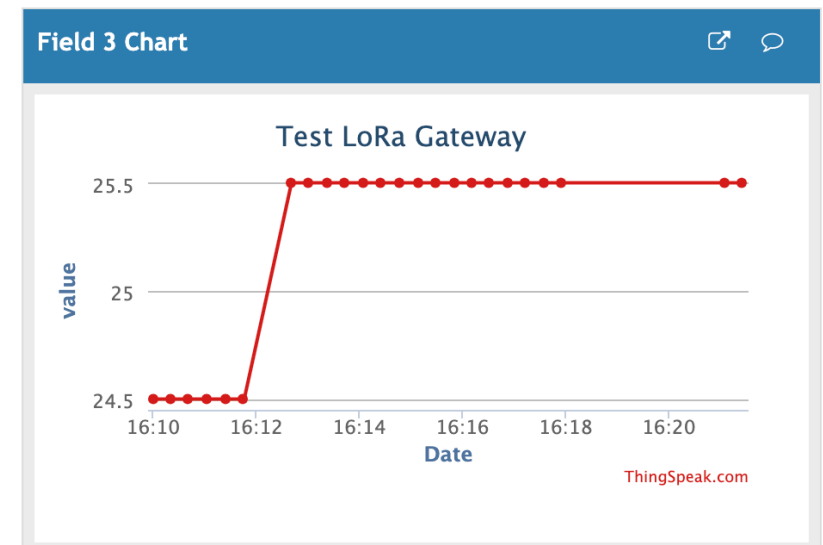
⦿ Connect to a WiFi network & upload data to a ThingSpeak channel

⦿ Example

⦿ SSID: iPhoneD

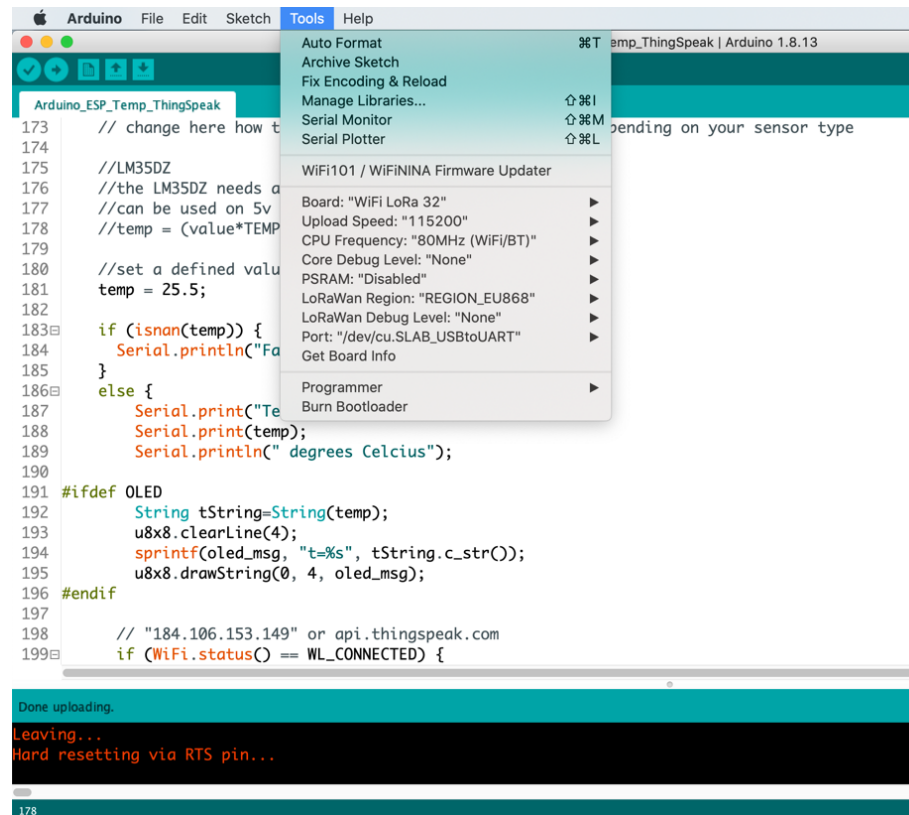
⦿ Password: 345hello

⦿ <https://thingspeak.com/channels/66794>



# Flash the board

- ⦿ Read instructions to install required board manager and libraries
- ⦿ Open Arduino\_ESP\_Temp\_ThingSpeak sketch

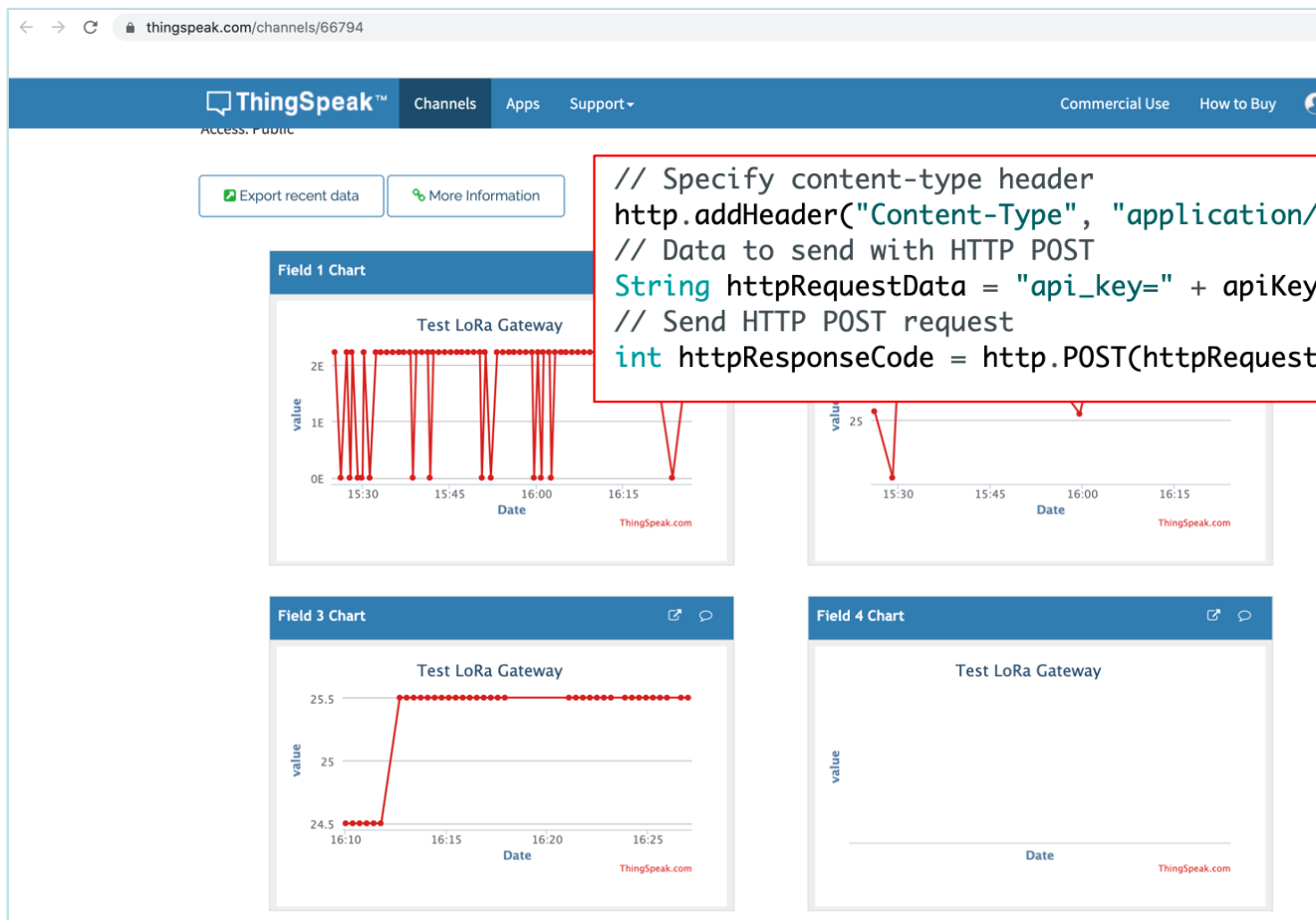


The screenshot shows the Arduino IDE interface. The 'Tools' menu is open, displaying various options such as 'Auto Format', 'Archive Sketch', 'Fix Encoding & Reload', 'Manage Libraries...', 'Serial Monitor', 'Serial Plotter', 'WiFi101 / WIFININA Firmware Updater', 'Board: "WiFi LoRa 32"', 'Upload Speed: "115200"', 'CPU Frequency: "80MHz (WiFi/BT)"', 'Core Debug Level: "None"', 'PSRAM: "Disabled"', 'LoRaWan Region: "REGION\_EU868"', 'LoRaWan Debug Level: "None"', 'Port: "/dev/cu.SLAB\_USBtoUART"', 'Get Board Info', 'Programmer', and 'Burn Bootloader'. The sketch editor shows the following code:

```
173 // change here how t
174
175 //LM35DZ
176 //the LM35DZ needs a
177 //can be used on 5v
178 //temp = (value*TEMP
179
180 //set a defined valu
181 temp = 25.5;
182
183 if (isnan(temp)) {
184   Serial.println("Fa
185 }
186 else {
187   Serial.print("Te
188   Serial.print(temp);
189   Serial.println(" degrees Celcius");
190
191 #ifdef OLED
192   String tString=String(temp);
193   u8x8.clearLine(4);
194   sprintf(oled_msg, "t=%s", tString.c_str());
195   u8x8.drawString(0, 4, oled_msg);
196 #endif
197
198 // "184.106.153.149" or api.thingspeak.com
199 if (WiFi.status() == WL_CONNECTED) {
```

At the bottom of the IDE, a status bar indicates 'Done uploading.', 'Leaving...', and 'Hard resetting via RTS pin...'. The line number 178 is visible at the bottom left of the IDE window.

- See how we upload to "field3" of ThingSpeak channel 66794



The screenshot shows the ThingSpeak interface for channel 66794. It features four charts labeled "Field 1 Chart", "Field 2 Chart", "Field 3 Chart", and "Field 4 Chart", all titled "Test LoRa Gateway".

- Field 1 Chart:** Shows a series of red data points that fluctuate between 0E and 2E.
- Field 2 Chart:** Shows a single red data point at 25.
- Field 3 Chart:** Shows a red line that starts at 24.5 and jumps to 25.5.
- Field 4 Chart:** Shows no data points.

A red-bordered box contains the following code snippet:

```
// Specify content-type header
http.addHeader("Content-Type", "application/x-www-form-urlencoded");
// Data to send with HTTP POST
String httpRequestData = "api_key=" + apiKey + "&field3=" + String(temp);
// Send HTTP POST request
int httpResponseCode = http.POST(httpRequestData);
```

# Board with LoRa

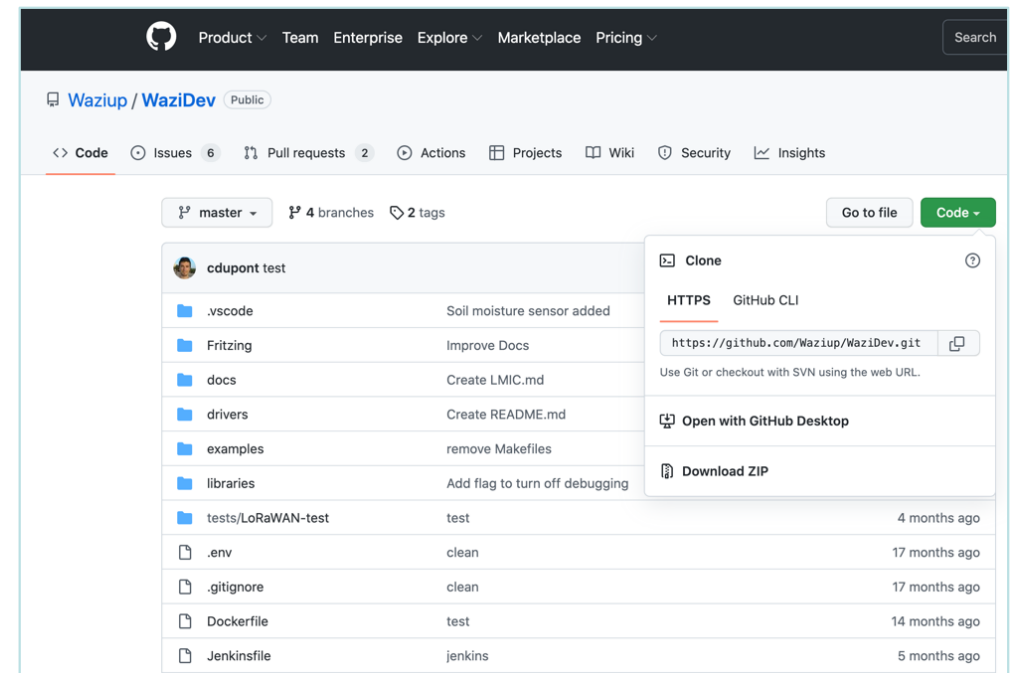
- ⦿ We will use WaziDev board



- ⦿ Latest info on <https://www.waziup.io/documentation/wazidev/user-manual/>

# WaziDev GitHub

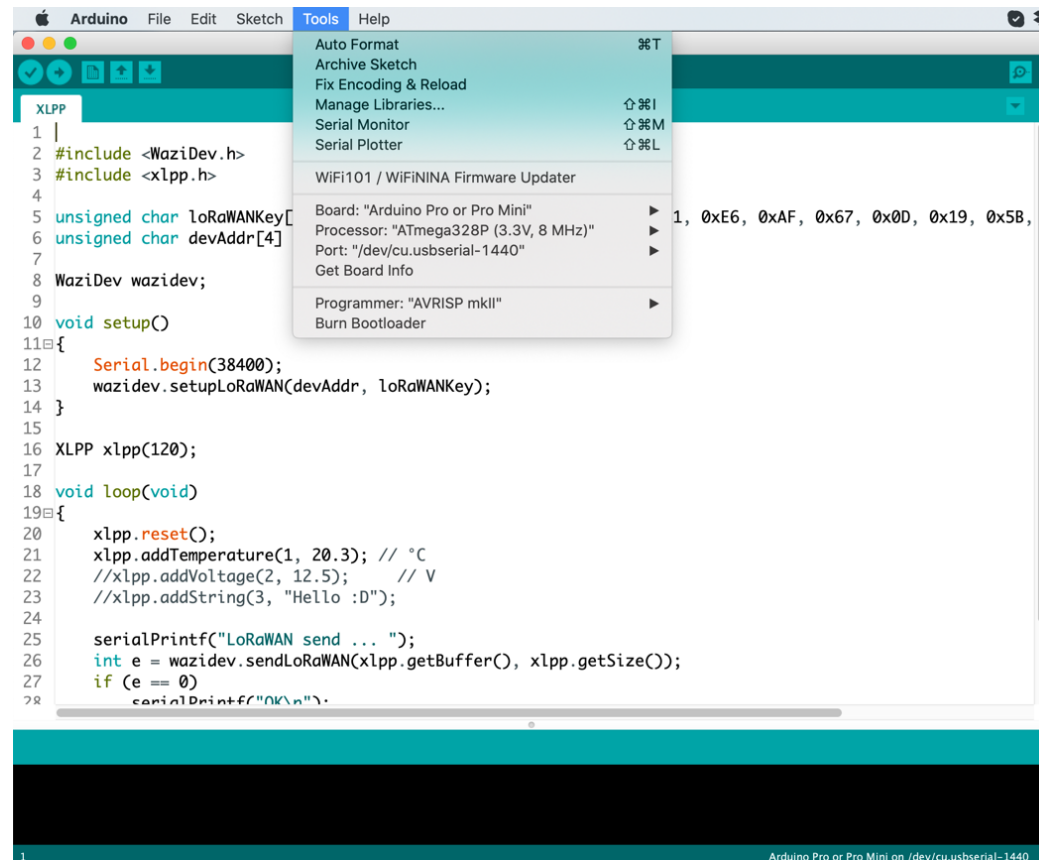
- ① <https://github.com/Waziup/WaziDev>
- ① Download .zip and unzip it
- ① Copy content of **libraries** into your **sketch/libraries** folder
- ① Copy content of **examples** into your **sketch** folder
- ① Quit Arduino IDE if necessary
- ① And run it again so that new files are taken into account





# Flash the board

- ⦿ Read instructions to install required board manager and libraries
- ⦿ Open XLPP example



```

Arduino File Edit Sketch Tools Help
┌───────────┴───────────┐
Auto Format ⌘T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... ⇧⌘I
Serial Monitor ⇧⌘M
Serial Plotter ⇧⌘L
WiFi101 / WIFININA Firmware Updater
Board: "Arduino Pro or Pro Mini"
Processor: "ATmega328P (3.3V, 8 MHz)"
Port: "/dev/cu.usbserial-1440"
Get Board Info
Programmer: "AVRISP mkII"
Burn Bootloader
└───────────┬───────────┘

1
2 #include <WaziDev.h>
3 #include <xlpp.h>
4
5 unsigned char LoRaWANKey[
6 unsigned char devAddr[4]
7
8 WaziDev wazidev;
9
10 void setup()
11 {
12   Serial.begin(38400);
13   wazidev.setupLoRaWAN(devAddr, LoRaWANKey);
14 }
15
16 XLPP xlpp(120);
17
18 void loop(void)
19 {
20   xlpp.reset();
21   xlpp.addTemperature(1, 20.3); // °C
22   //xlpp.addVoltage(2, 12.5); // V
23   //xlpp.addString(3, "Hello :D");
24
25   serialPrintf("LoRaWAN send ... ");
26   int e = wazidev.sendLoRaWAN(xlpp.getBuffer(), xlpp.getSize());
27   if (e == 0)
28     serialPrintf("OK\n");

```

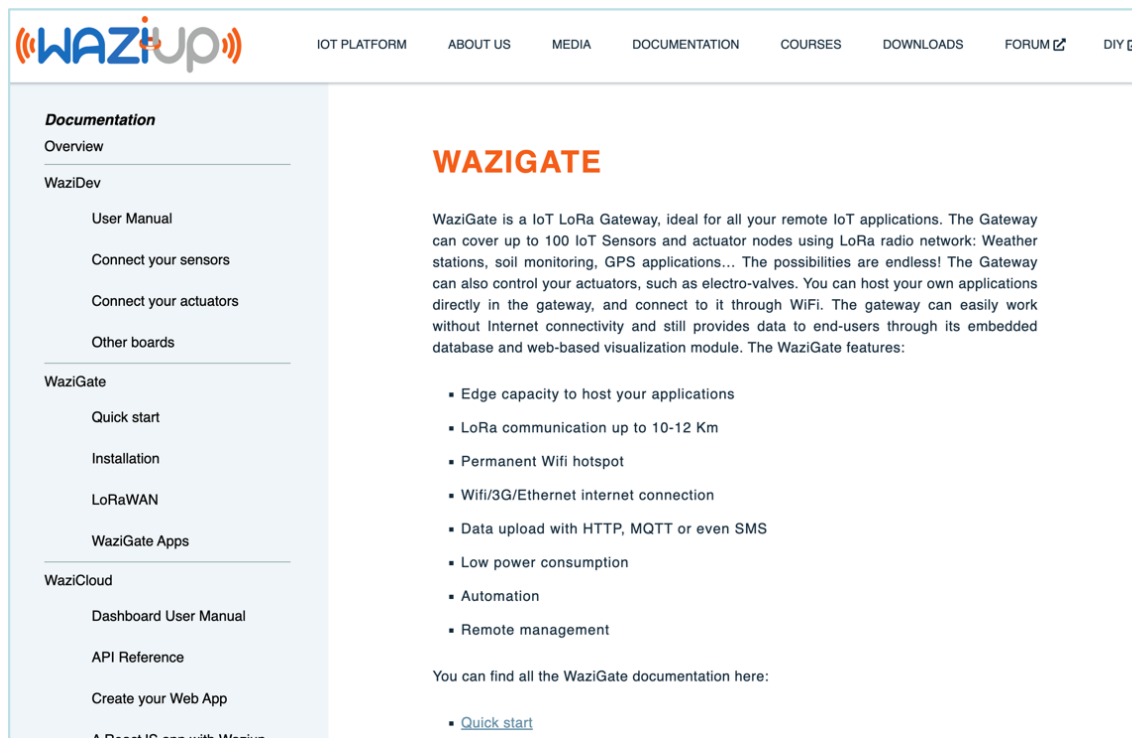
# XLPP example

- ⦿ Comment the following 2 lines

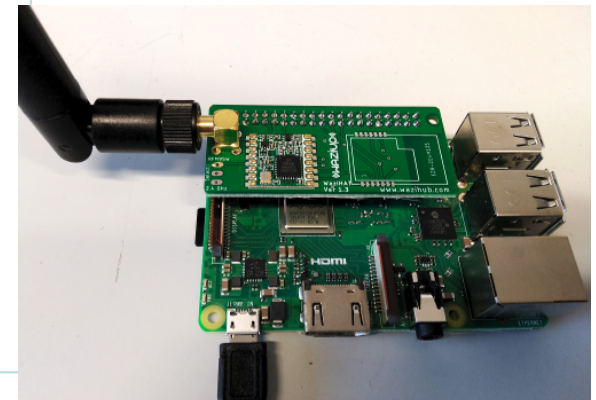
```
18 void loop(void)
19 {
20     xlpp.reset();
21     xlpp.addTemperature(1, 20.3); // °C
22     //xlpp.addVoltage(2, 12.5);    // V
23     //xlpp.addString(3, "Hello :D");
24 }
```

- ⦿ Then, flash the WaziDev
- ⦿ The XLPP example is:
  - ⦿ a simple LoRaWAN example
  - ⦿ using Cayenne LPP data format
  - ⦿ to send a test data (20.3) to an IoT LoRaWAN gateway
  - ⦿ with default frequency of 868.1MHz
  - ⦿ and LoRa parameters BW125, SF12 and CR4/5

- ◉ Install a WaziGate distribution on a Raspberry PI:  
<https://www.waziup.io/documentation/wazigate/>

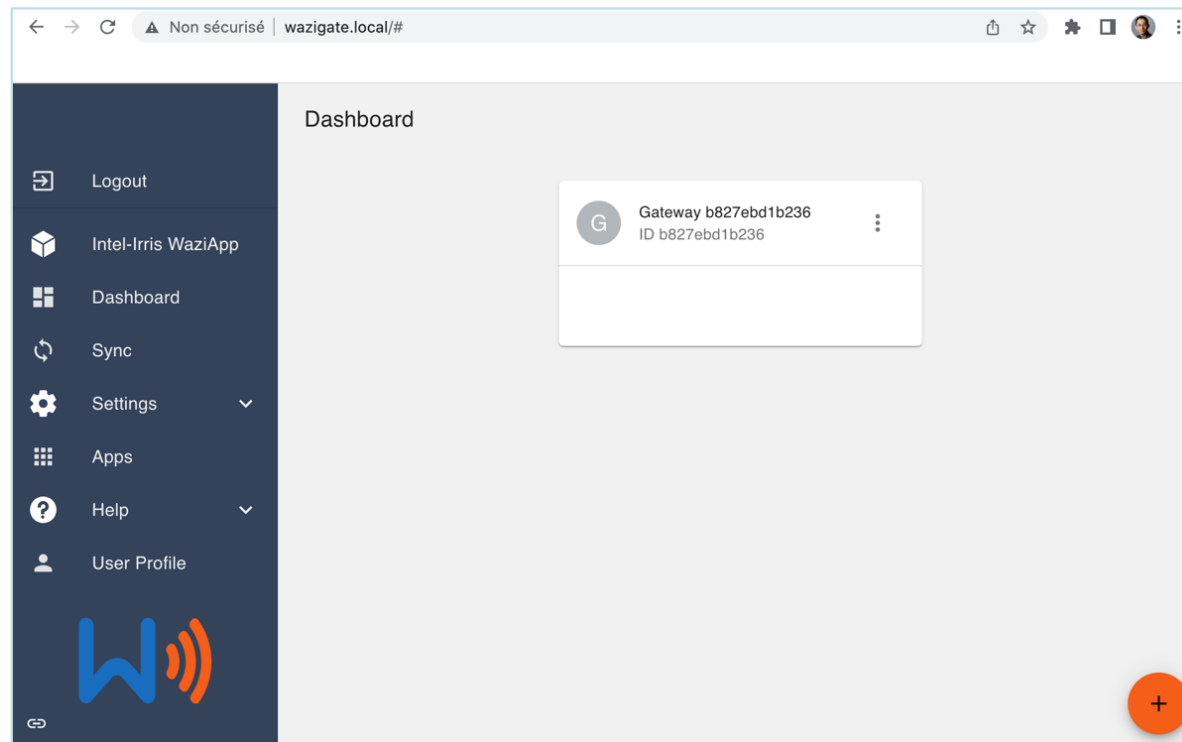


The screenshot shows the Waziup website's documentation page for WaziGate. The page has a navigation bar with links for IOT PLATFORM, ABOUT US, MEDIA, DOCUMENTATION, COURSES, DOWNLOADS, FORUM, and DIY. The left sidebar contains a 'Documentation' menu with items like Overview, WaziDev, User Manual, Connect your sensors, Connect your actuators, Other boards, WaziGate, Quick start, Installation, LoRaWAN, WaziGate Apps, WaziCloud, Dashboard User Manual, API Reference, Create your Web App, and A ReactJS app with Waziup. The main content area is titled 'WAZIGATE' and describes it as an IoT LoRa Gateway. It lists features such as edge capacity, LoRa communication up to 10-12 Km, permanent WiFi hotspot, WiFi/3G/Ethernet internet connection, data upload with HTTP, MQTT or even SMS, low power consumption, automation, and remote management. It also provides a link to the 'Quick start' documentation.



# Connect to WaziGate dashboard

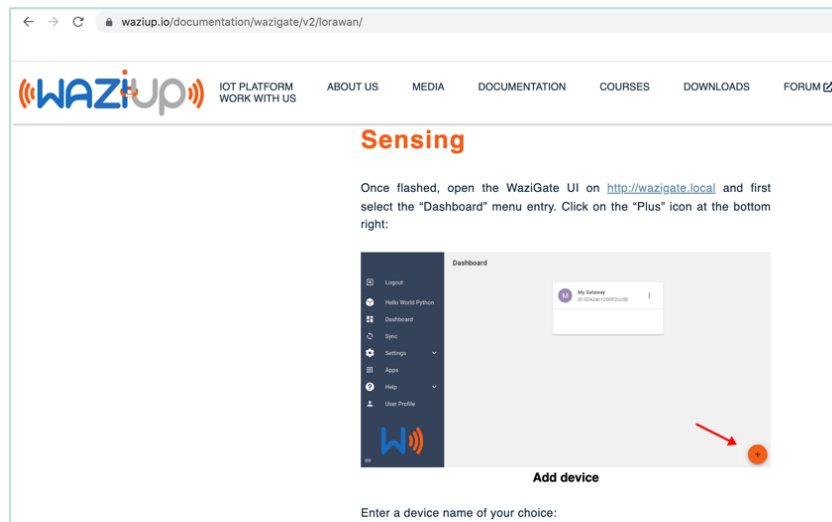
- ⦿ Connect to the WaziGate WiFi (password: loragateway)
- ⦿ Connect to the WaziGate dashboard
  - ⦿ <http://wazigate.local> or <http://10.42.0.1>



# Create a device for the example

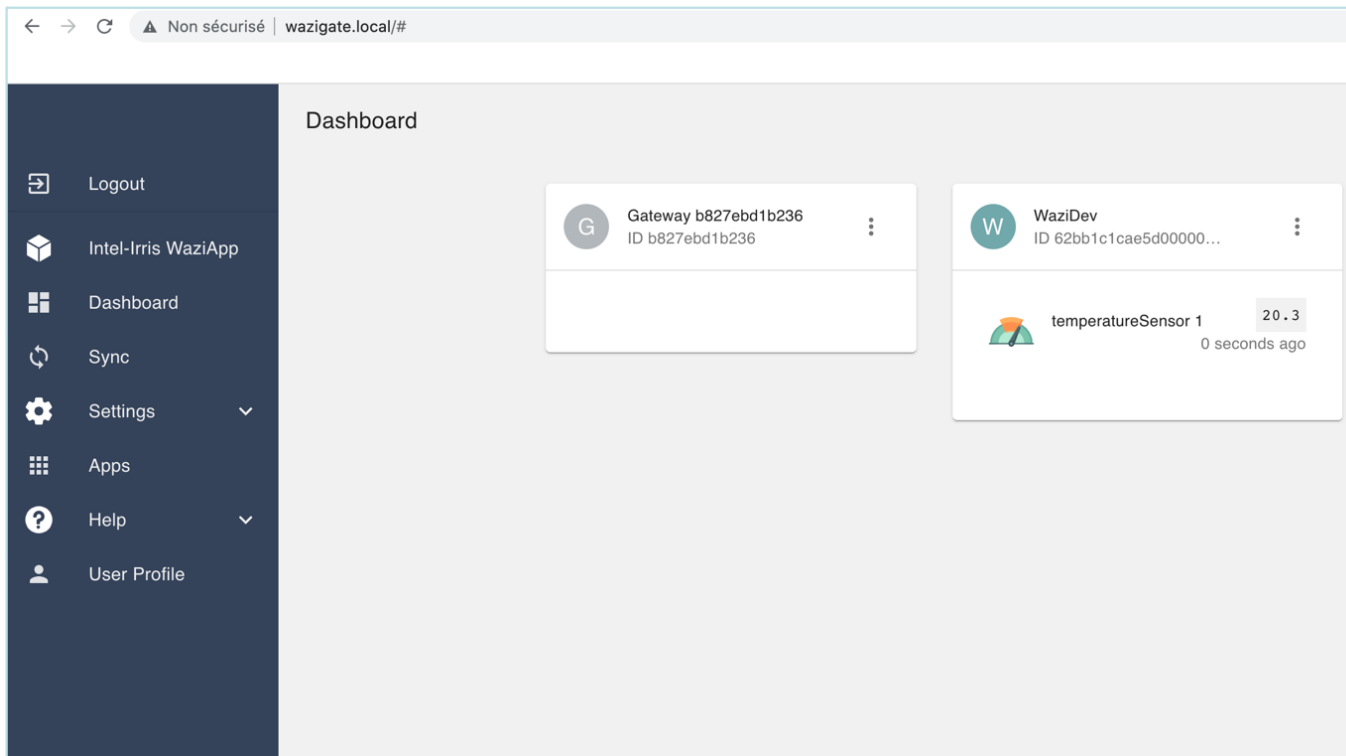
- ⦿ Create a device and called it "WaziDev"
- ⦿ Make it LoRaWAN enabled
- ⦿ Use device address 26011D87 & default keys
- ⦿ Define data codec as XLPP
- ⦿ See all these steps from WaziGate tutorial

<https://www.waziup.io/documentation/wazigate/v2/lorawan/>



# Check data reception

- ⦿ Press RESET on the WaziDev to trigger data transmission
- ⦿ Refresh the WaziGate dashboard to see new data reception



The screenshot shows a web browser window with the URL `wazigate.local/#`. The page title is "Dashboard". On the left, there is a dark sidebar menu with the following items: Logout, Intel-Irris WaziApp, Dashboard, Sync, Settings, Apps, Help, and User Profile. The main content area displays two cards. The first card is for "Gateway b827ebd1b236" with ID "b827ebd1b236". The second card is for "WaziDev" with ID "62bb1c1cae5d00000...". Below the WaziDev card, there is a sensor data entry: "temperatureSensor 1" with a value of "20.3" and a timestamp of "0 seconds ago".



# Assignment



- ① Install Arduino IDE on your computer
- ① Install all examples from <http://diy.waziup.io>
- ① Test the Arduino\_ESP\_Temp\_ThingSpeak example
- ① Install WaziDev examples
- ① Test the XLPP example
- ① Install a WaziGate distribution on a Raspberry Pi
- ① Test data reception
- ① If you don't have these hardware
  - ① You can just test compilation of examples

# IOT ONLINE COURSE

## Fundamentals of IoT

Continue with

F-IOT-2b: Understanding IoT Devices, Architecture & Ecosystem



IoT – from idea to reality

