INTEL-IRRIS

Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture

This project is part of the PRIMA Programme supported by the European Union

Intel-IrriS

PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Intelligent Irrigation System for Low-cost Autonomous Water Control in Small-scale Agriculture

Intel-IrriS

Building the INTEL-IRRIS LoRa IoT platform
Part 2: edge-enabled gateway

PRIMA
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UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR

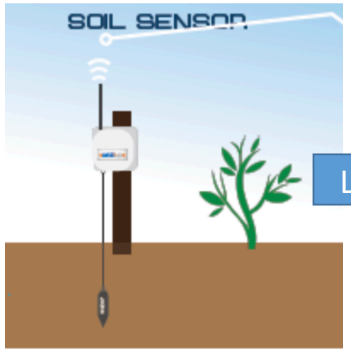
LIUPPA

WAZIUP
IoT – from idea to reality
WAZIHUB

Review: Technology components

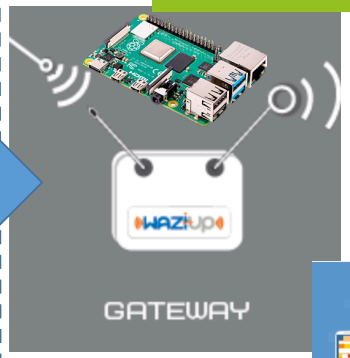
Sensor part

Intel-IrriS



LPWAN

Control part



Embedded Database

Software updates

Embedded User Interface

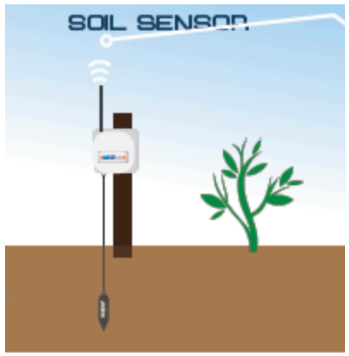
Wifi

SMS

Review: Low-cost sensors

Sensor part

Intel-IrriS



- Build on low-cost, low-power IoT expertise
- Increase accuracy of low-cost sensors by automatic and remotely controlled procedures for advanced calibration
- Enable deployment of several complementary low-cost sensors
- Include agricultural models / knowledge with corrective & predictive analytics

Review: Smart embedded control

- Build on low-cost embedded & open IoT gateway expertise
- Implement the “Intelligent Irrigation in-the-box” with "plug-&-sense" approach
- Model complex water-soil-plant interaction
- Embed Decision Support System (DSS) and disruptive Artificial Intelligence (AI)
- Integration of various knowledge streams
- Fully autonomous

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INTEL-IRRIS starter-kit

- "Intelligent Irrigation in-the-box", "plug-&-sense"
- From idea to reality!

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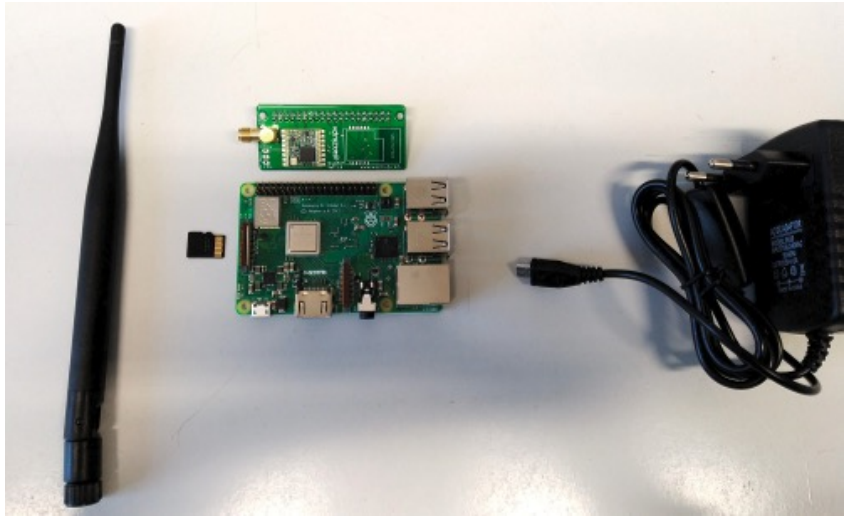
WaziGate

- WaziGate is an IoT LoRa Gateway developed by WAZIUP
- WaziGate implements the edge-enabled IoT gateway approach
  - customized applications can be directly hosted in the gateway
  - the gateway can easily work without Internet connectivity
  - data are available to end-users in an embedded database
  - web-based visualization module provides graphical user interface
- You can find all the WaziGate documentation on the WaziGate documentation page. There are 4 main sections describing the generic WaziGate main features:
  - Quick start: https://www.waziup.io/documentation/wazigate/v2/quick_start/
  - Installation: https://www.waziup.io/documentation/wazigate/v2/install/
  - LoRaWAN: https://www.waziup.io/documentation/wazigate/v2/lorawan/
  - WaziApps: https://www.waziup.io/documentation/wazigate/v2/waziapps/
  - Look at the generic installation video: https://youtu.be/DvGdmdsGZHA

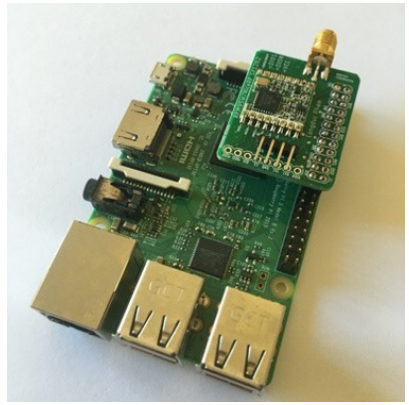
Install your gateway (1)

- **INTEL-IRRIS gateway distribution (RPI3B/3B+/4B)**
  - comes pre-configured with a soil sensor device
  - will work out-of-the box with the INTEL-IRRIS soil sensor device
  - will be updated to host the INTEL-IRRIS irrigation application
  - **Download the INTEL-IRRIS gateway SD card image from project website**
  - http://intel-irris.eu/results
  - Image uses EU868 frequency band
  - EU533 can be configured afterwards
  - Flash the SD card image on 8GB SD card class 10

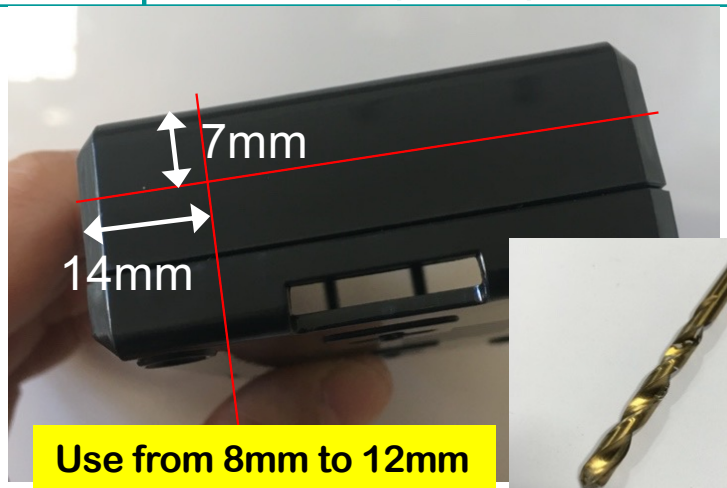


Look at the INTEL-IRRIS gateway video
Video n°4 at t=124s: https://youtu.be/j-1Nk0tv0xM?t=124

Install you gateway (2)



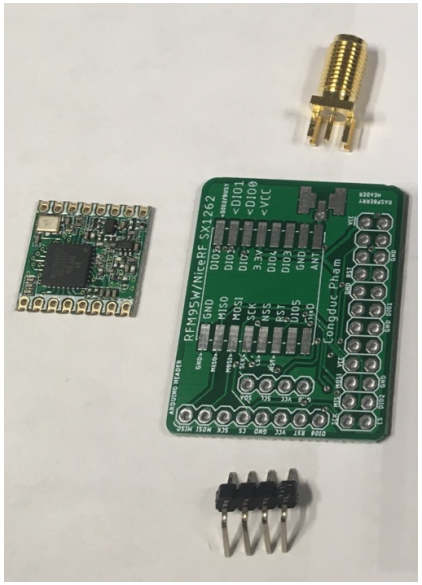
- Recommended RPI model is RPI3B
  - plug in the radio LoRa hat
  - The OLED screen is optional but highly recommended
- Drill a hole for the SMA connector on the RPI enclosure, at the SD card slot side
- https://fr.aliexpress.com/item/32718435597.html

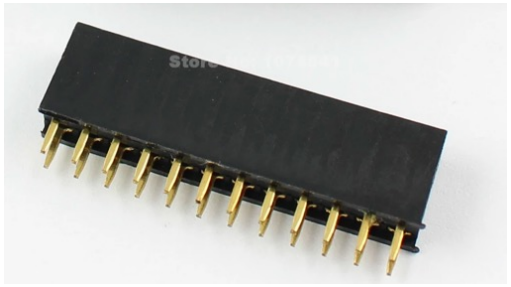


Use from 8mm to 12mm drill bit for metal

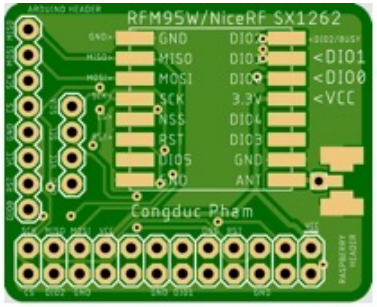
The LoRa radio hat

https://github.com/CongducPham/PRIMA-Intel-IrriS/blob/main/Tutorials/Intel-Irris-PCB.pdf



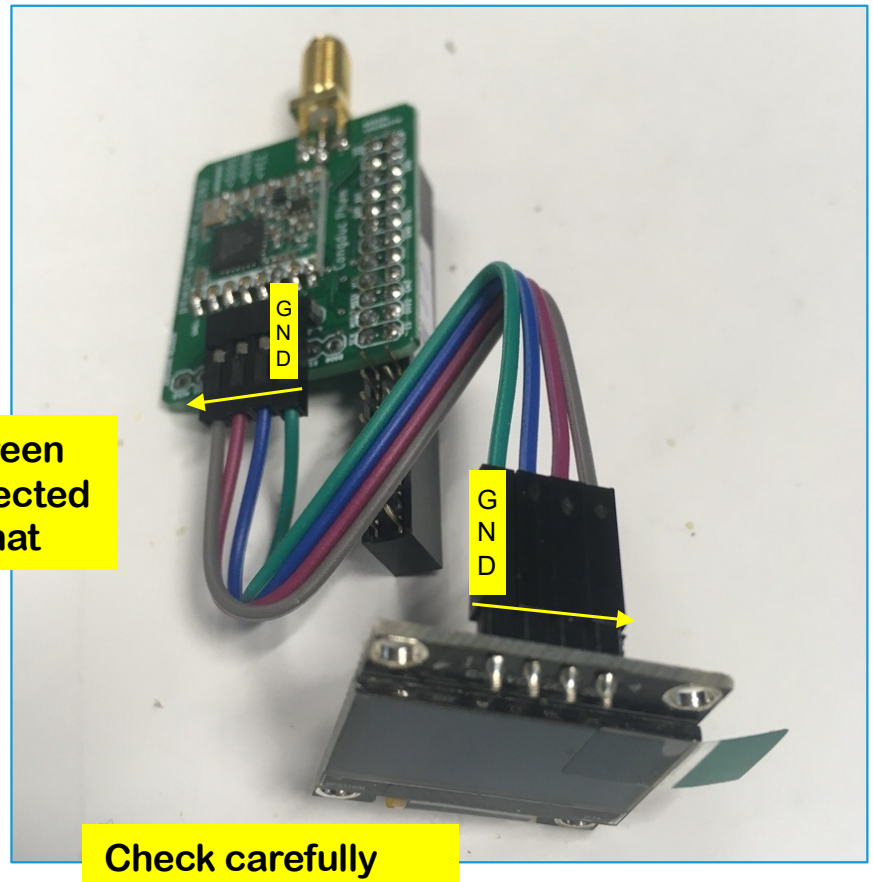


2-row 12-pin header
or
2 X 1-row 12-pin header



RFM95W/NiceRF SX1262 breakout

Installing OLED



An OLED screen can be connected to the radio hat

Check carefully the pin order which is reversed

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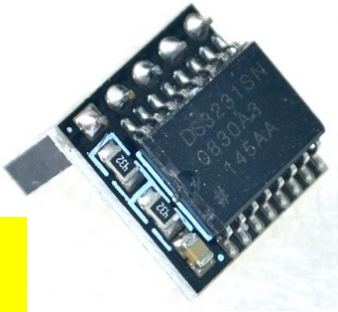
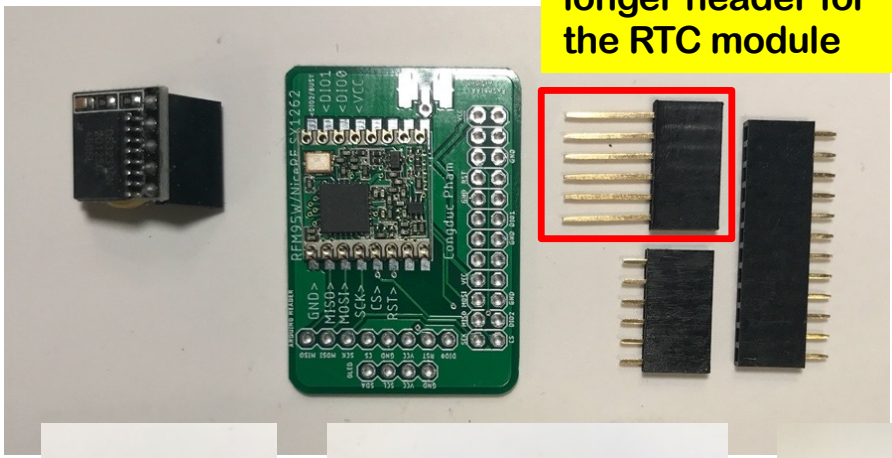
Connecting an RTC module

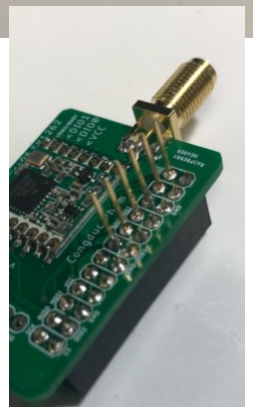


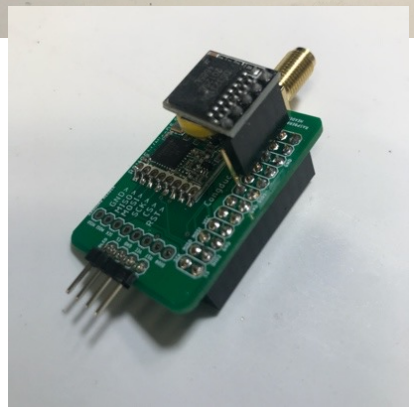
- Several possibilities depending on availability of components

Solder a header with longer pins to connect the RTC module. You can then cut the remaining pins if you want

Or use only a 6-pin longer header for the RTC module

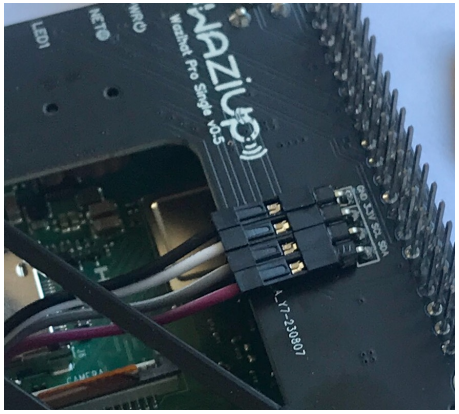




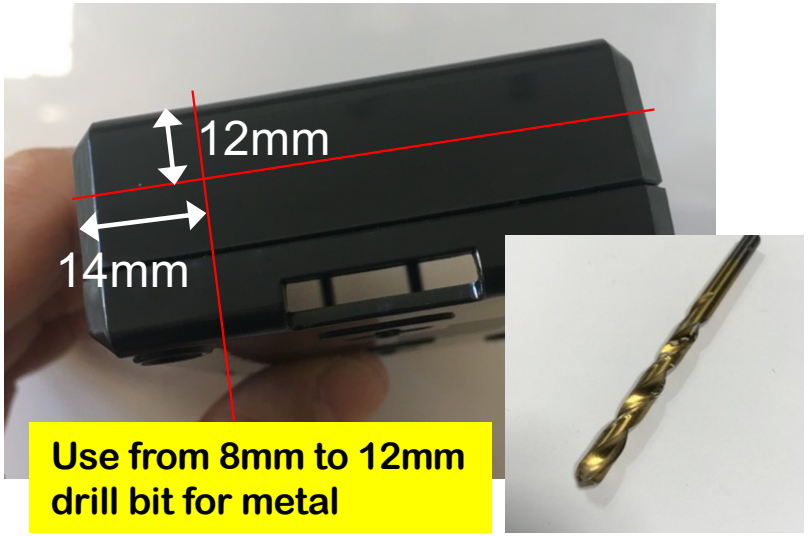


With WAZIUP LoRa gateway hat

LoRa gateway hat with on-board RTC, no need for external RTC module



An OLED screen can directly be connected to the radio hat



Use from 8mm to 12mm drill bit for metal

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http://www.univ-pau.fr/~cpham

Gateway power consumption

- RPI3B consumes less than 300mA
- There can be peak up to 800mA when booting
- However, a 2.5A micro USB charger is needed to avoid undervoltage

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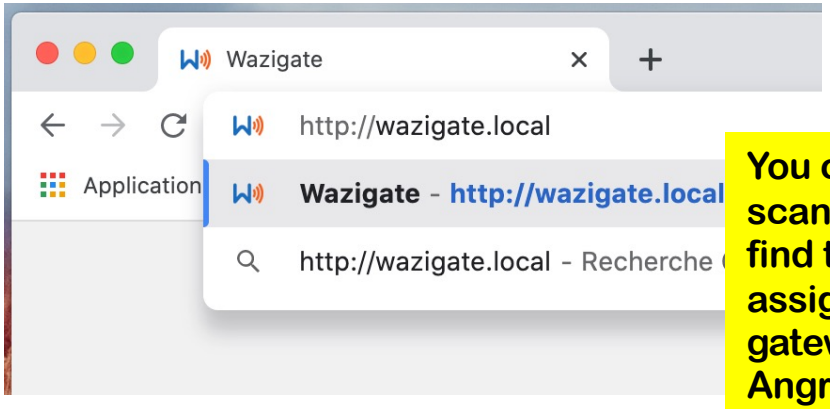
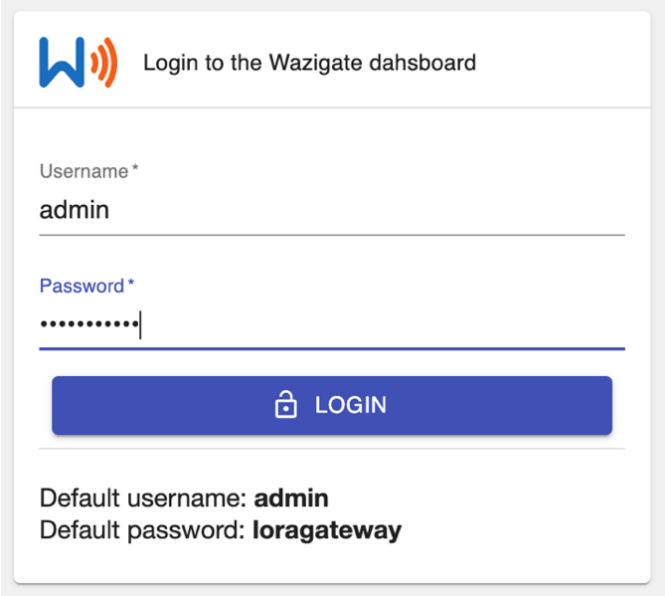
http://www.univ-pau.fr/~cpham

Checking the gateway (Ethernet)

- Connect the gateway to your laptop which has Internet
- Enable Internet sharing, laptop provides IP address to gateway
- Power the gateway, wait 3-4mins for boot process
- Open web navigator. Go to http://wazigate.local or use IP address



You can use an IP scanner program to find the IP address assigned to your gateway (such as Angry IP Scanner)



- Use default login to connect
  - User: admin
  - Password: loragateway

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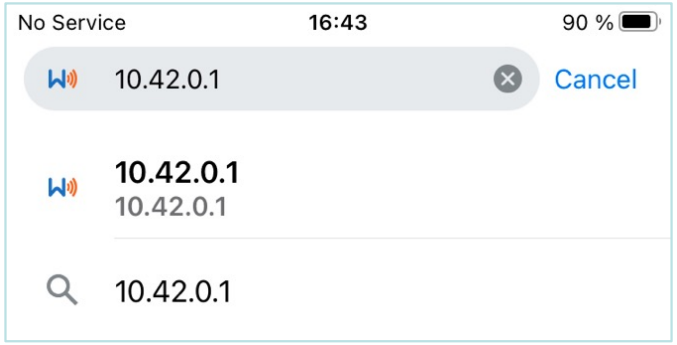
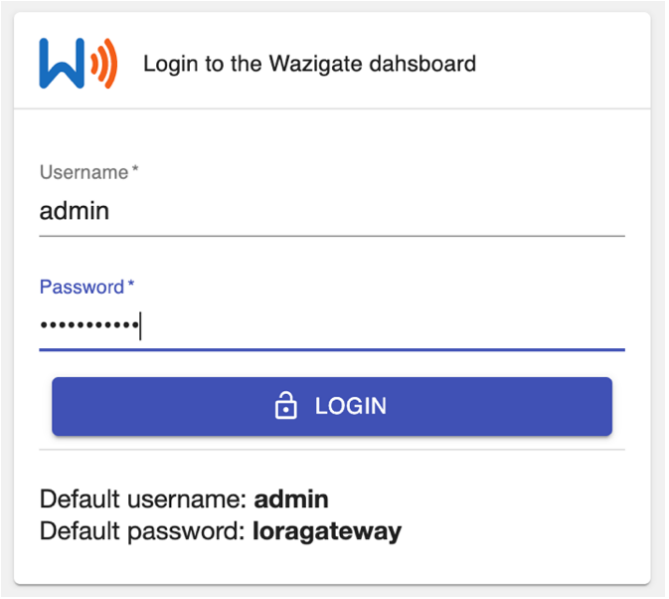
Checking the gateway (WiFi)

- Use a smartphone to check access to gateway through WiFi
- Connect to WAZIGATE_XXXXXXXXXXXX WiFi network
  - default WiFi password is loragateway
- Open web navigator. Go to http://wazigate.local or http://10.42.0.1 or flash QR code

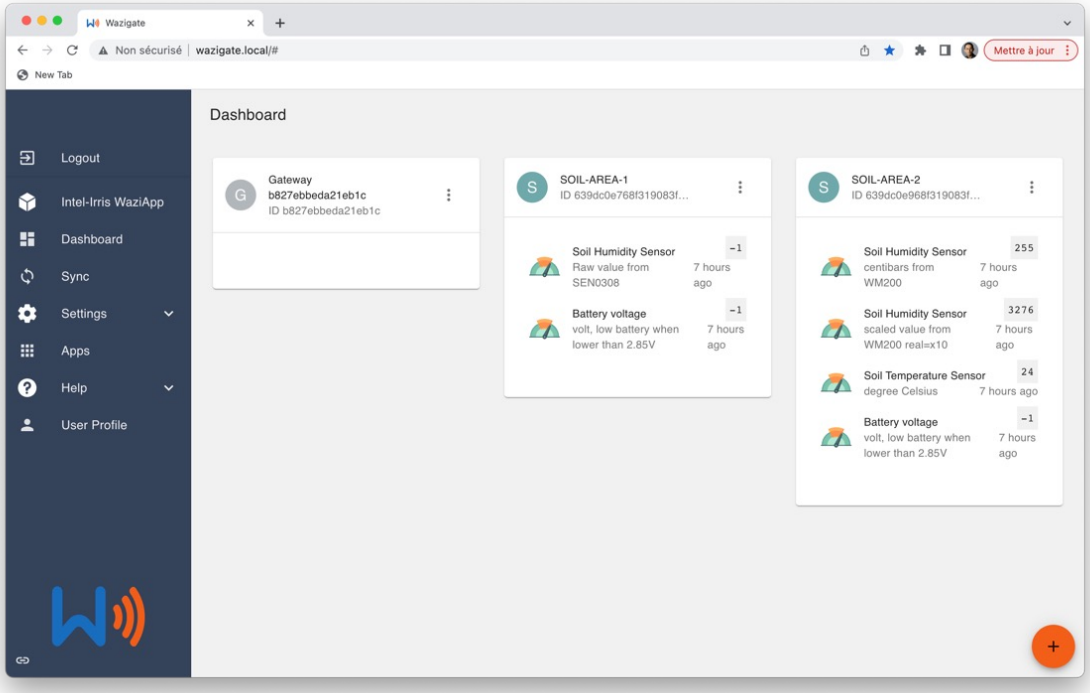




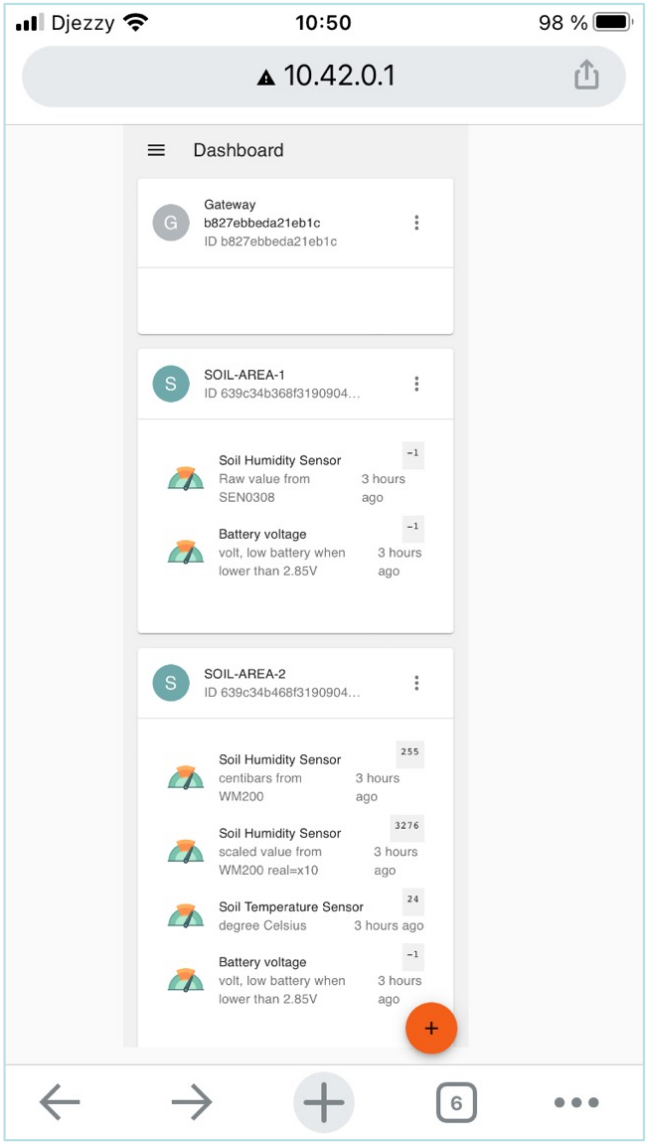
- Use default login to connect
  - User: admin
  - Password: loragateway

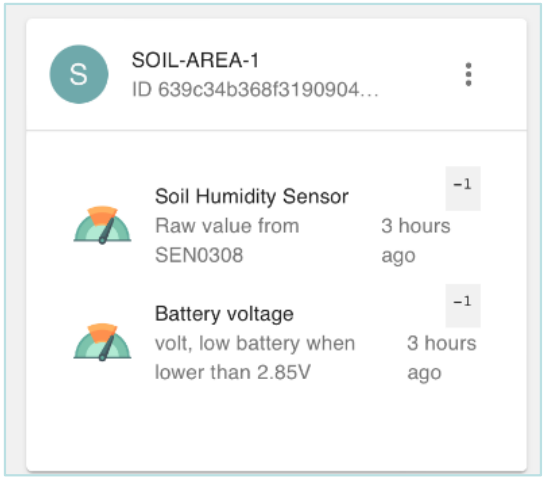
Default gateway configuration (1)

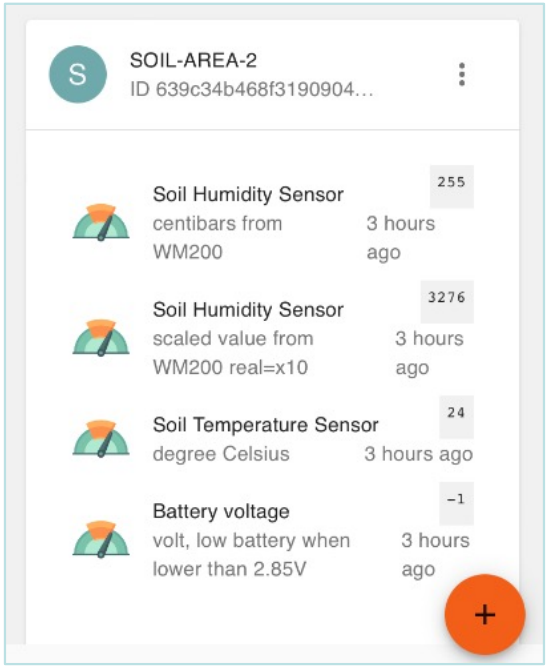
- For the starter-kit, the INTEL-IRRIS gateway will be ready for
  - 1 capacitive sensor named SOIL-AREA-1 with address 26011DAA
  - 1 tensiometer sensor named SOIL-AREA-2 with address 26011DB1
- Capacitive device will show humidity and battery values
- Tensiometer device will show centibar, raw resistance, soil temperature and battery values



Default gateway configuration (2)





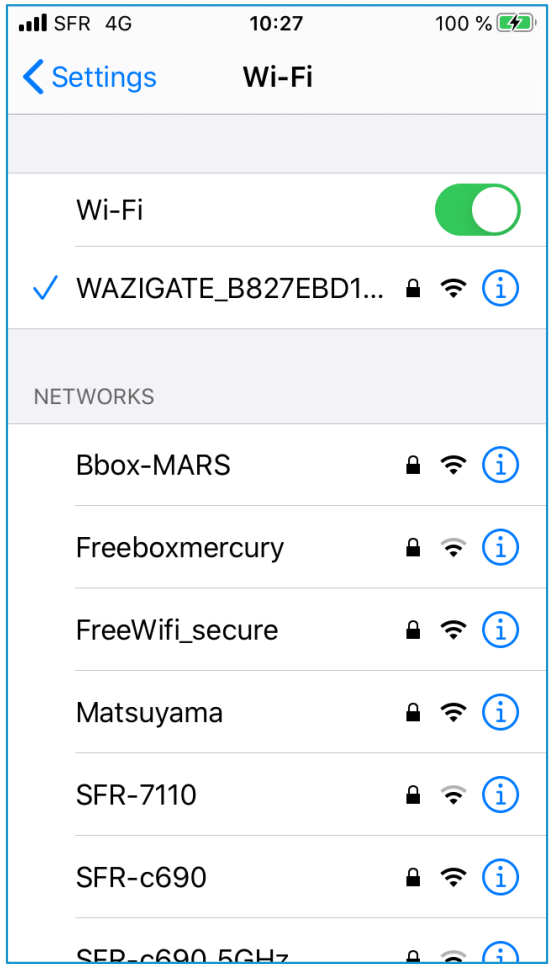


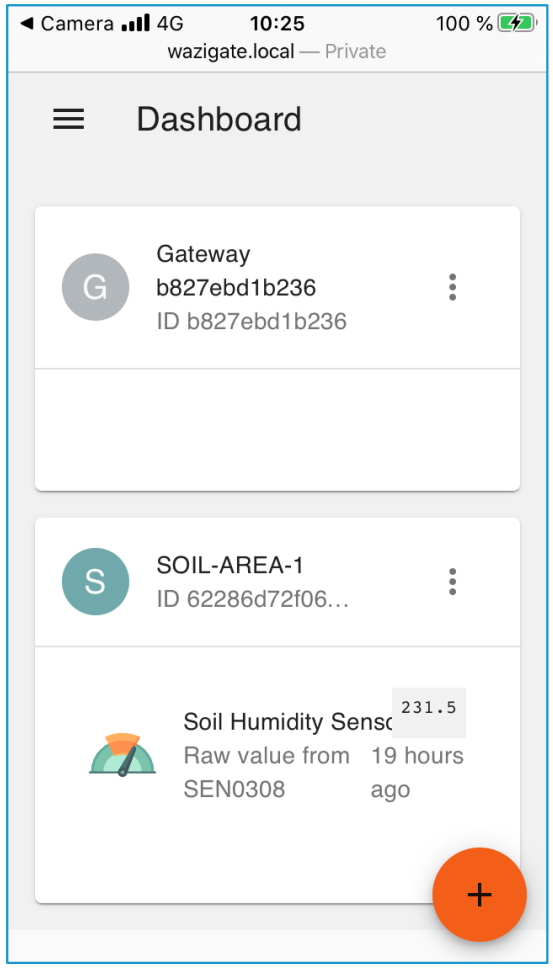
Default values for the SEN0308 capacitive sensor

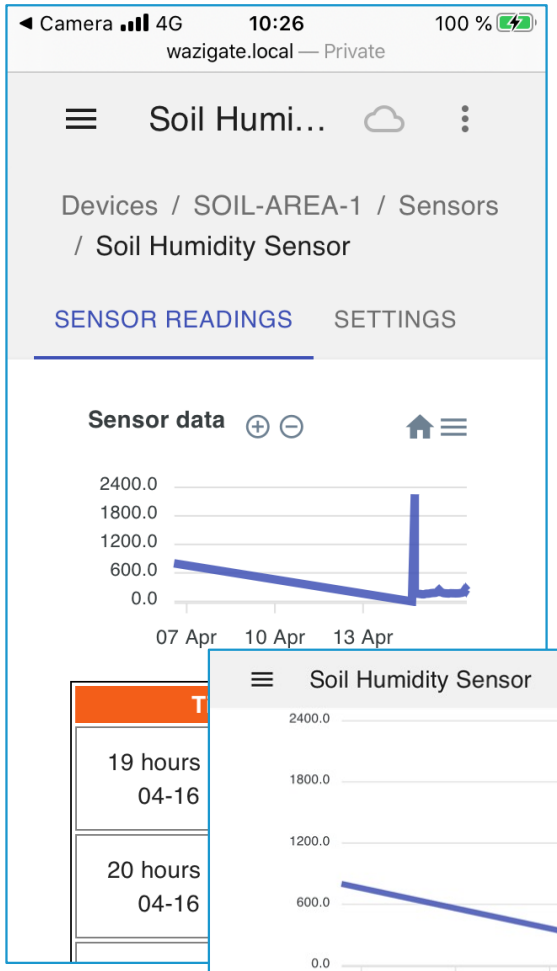
Default values for the WM200 tensiometer sensor

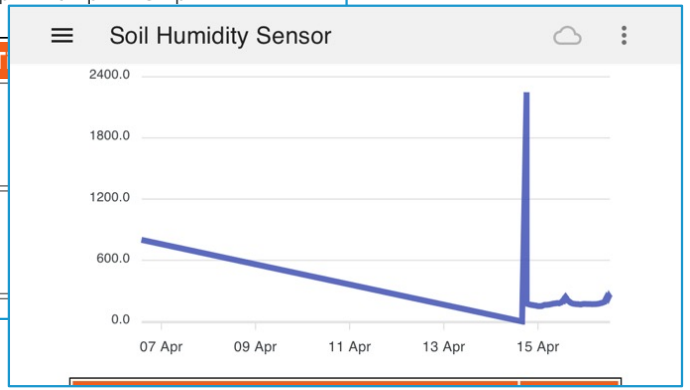
Display sensor data

All these steps with a smartphone





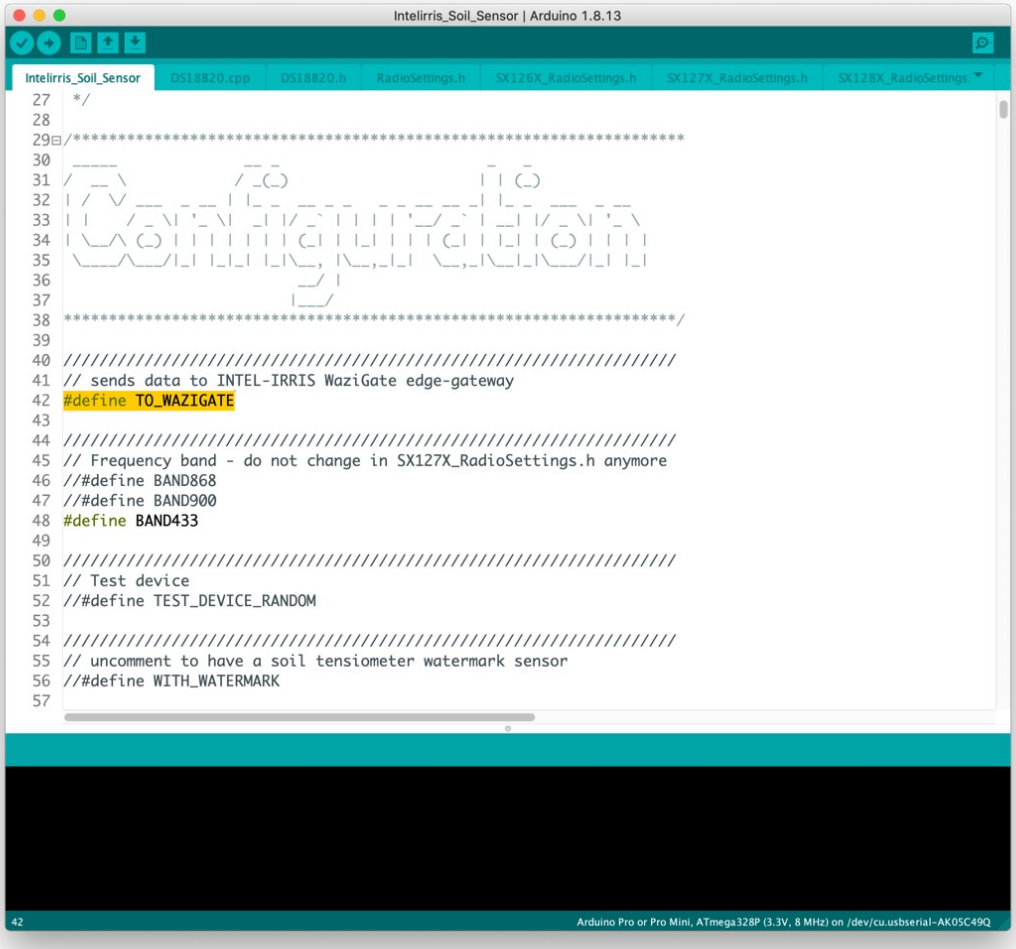




QR code for connecting to WiFi

- The gateway WiFi is WAZIGATE_XXXXXXXXXXXX where XXXXXXXXXXXX is the MAC address of the RPI
- For instance WAZIGATE_B827EBD1B236
- With the OLED, a QR code for joining the WiFi network is dynamically generated at boot time and displayed for 10s before the main screen so that users can automatically join with a smartphone
- Then, users can scan the static QR code on the gateway sticker to connect to the gateway's dashboard or the INTEL-IRRIS IIWA App

Configure soil device for gateway

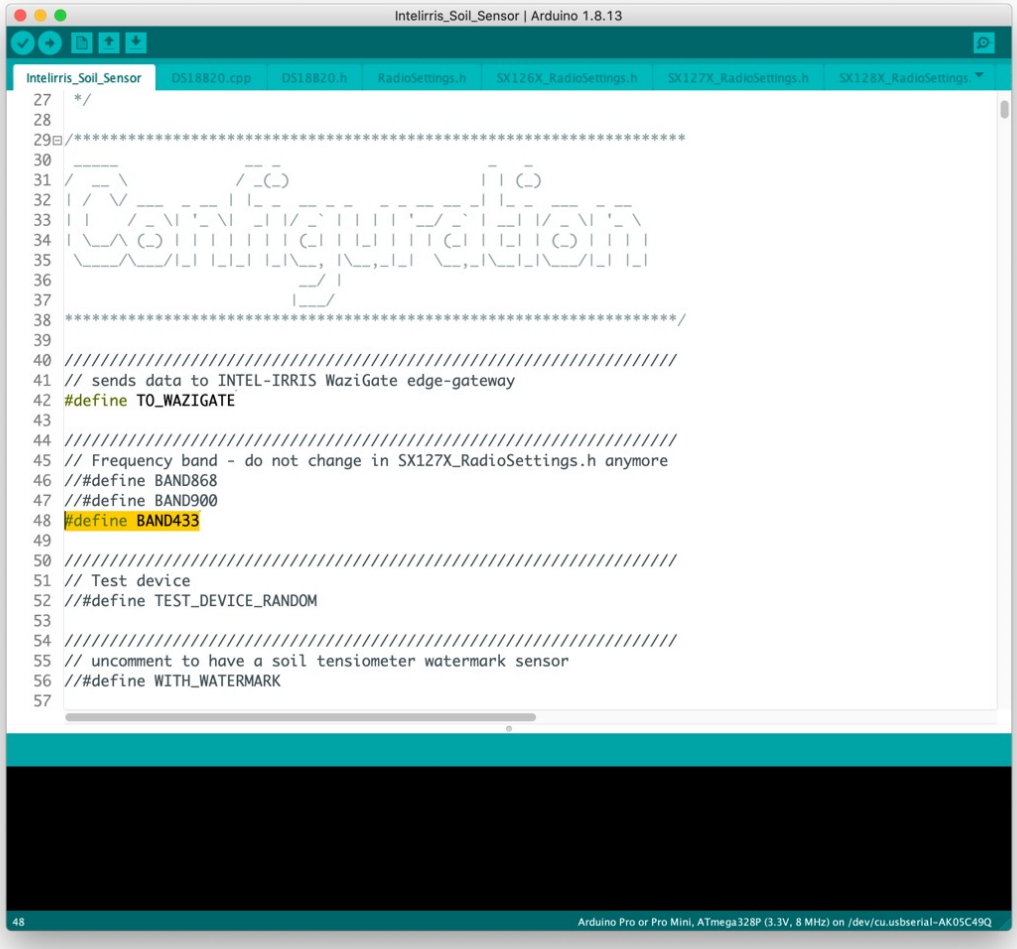


Be sure that

`#define TO_WAZIGATE`

is uncommented

Configuring for EU433 band



If you use the EU433 band

make sure that

`#define BAND433`

is the only uncommented band option

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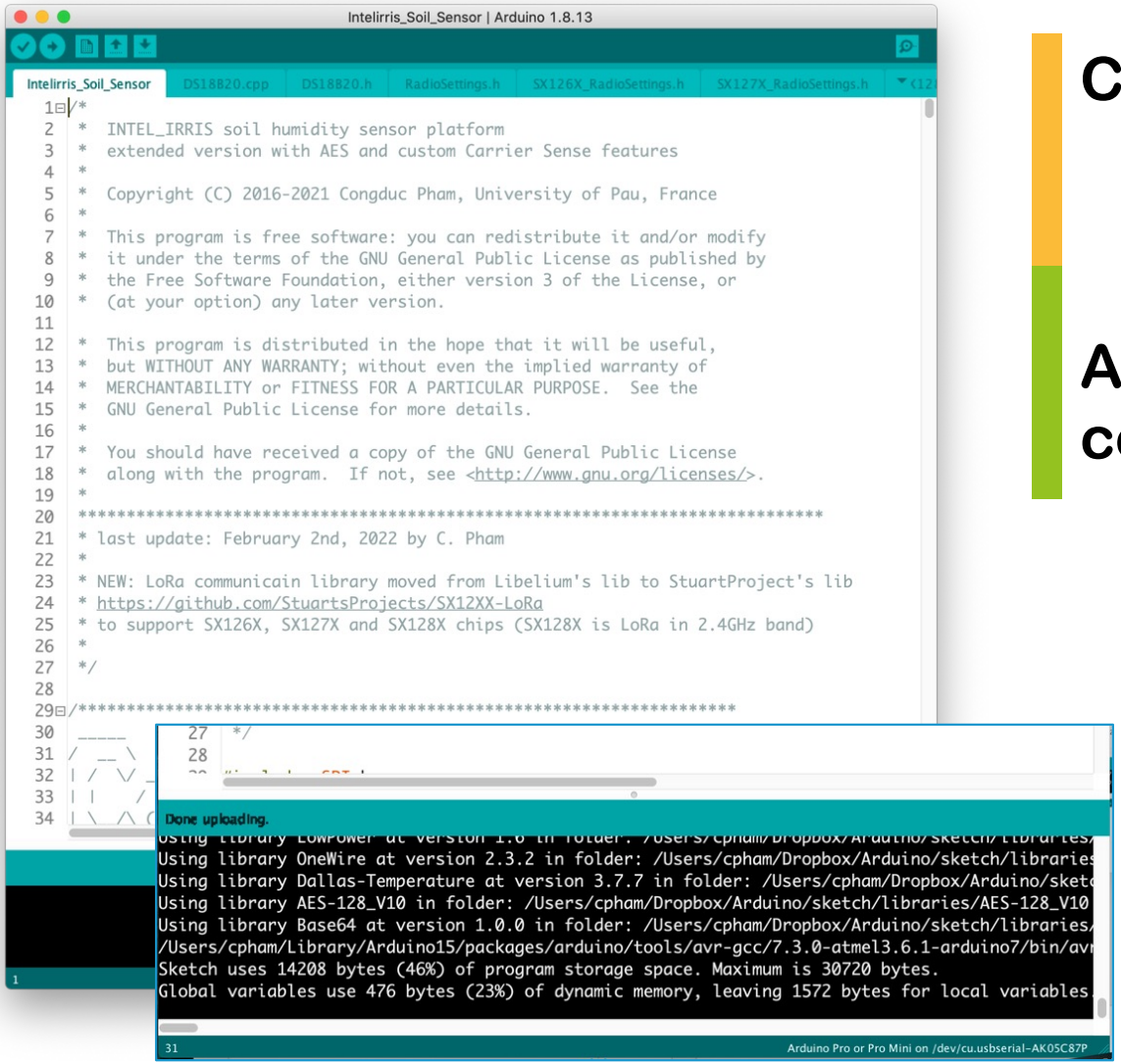
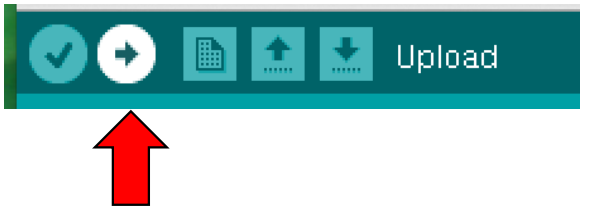
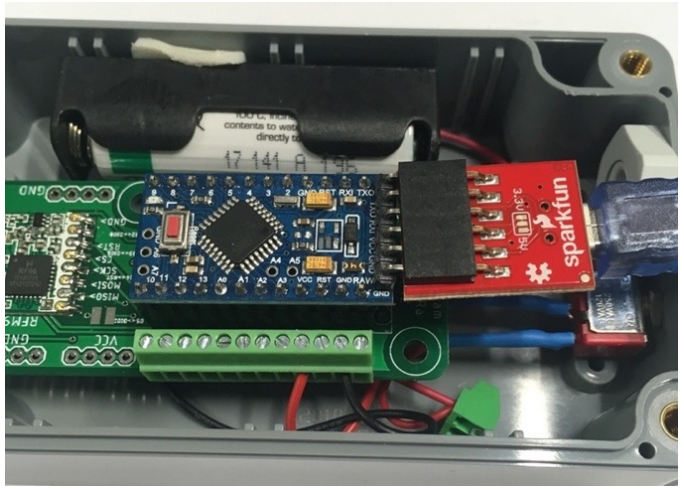
Uploading to your board



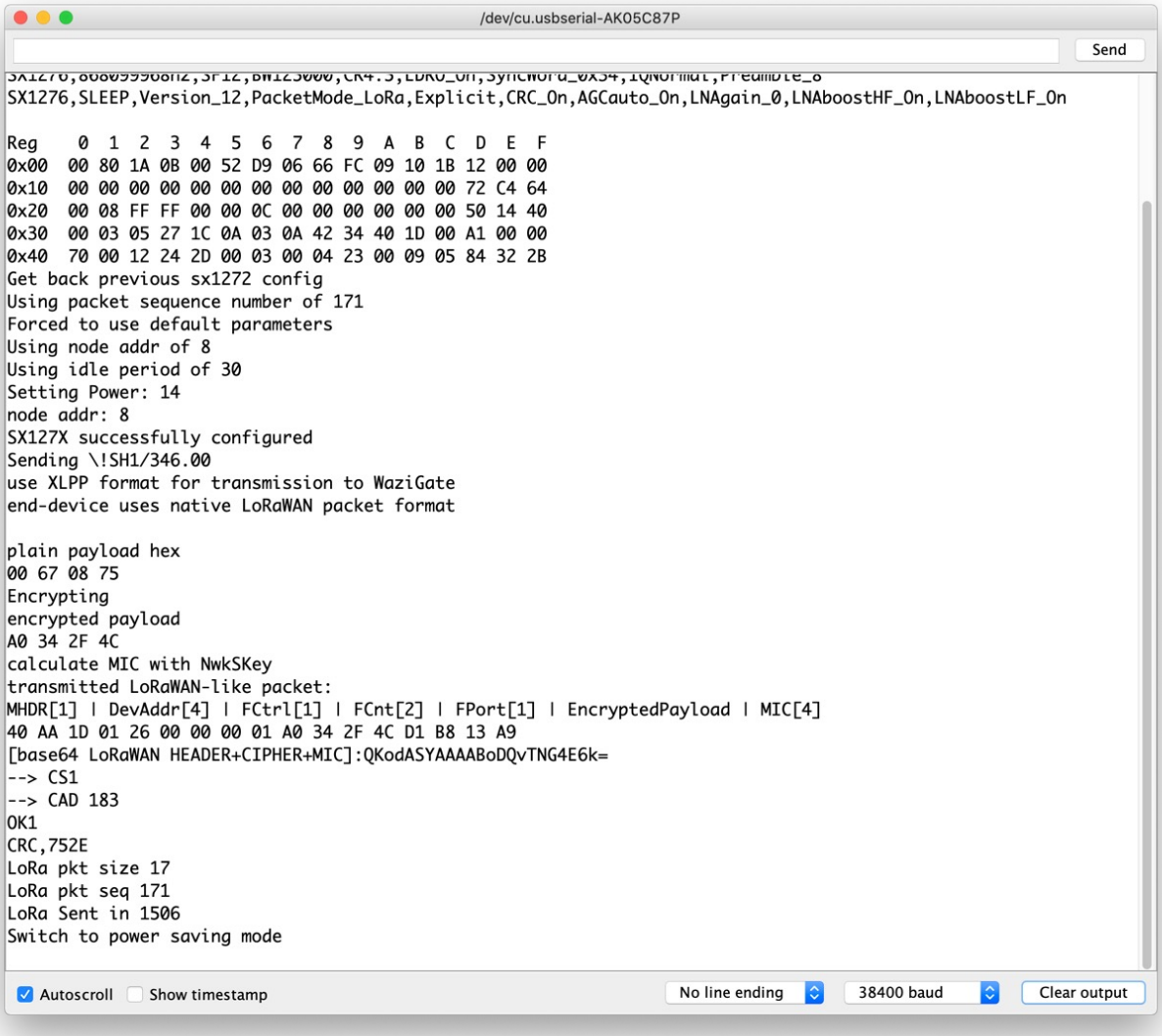
Click on the "upload" button



And wait until upload is completed



Checking that device is operational



- Open serial monitor
- Set baud rate to 38400
- See output from board
- Check that transmission is OK

Transmission to gateway

Parameters for
INTEL-IRRIS gateway

SF12BW125
868.1MHz | 433.175MHz
Node id is 26011DAA
1 msg/60mins
1 sensor
XLPP data

This dedicated video will show all these steps, from connecting the SEN0308 to testing transmission to the gateway
Video n°4: https://youtu.be/j-1Nk0tv0xM

Check data reception on OLED

YOU CAN ALSO VIEW ON DASHBOARD

Default values for the SEN0308 capacitive sensor

Testing with capacitive device

Default values for the WM200 tensiometer sensor

VALUES ARE ONLY INDICATIVE

Testing with tensiometer device

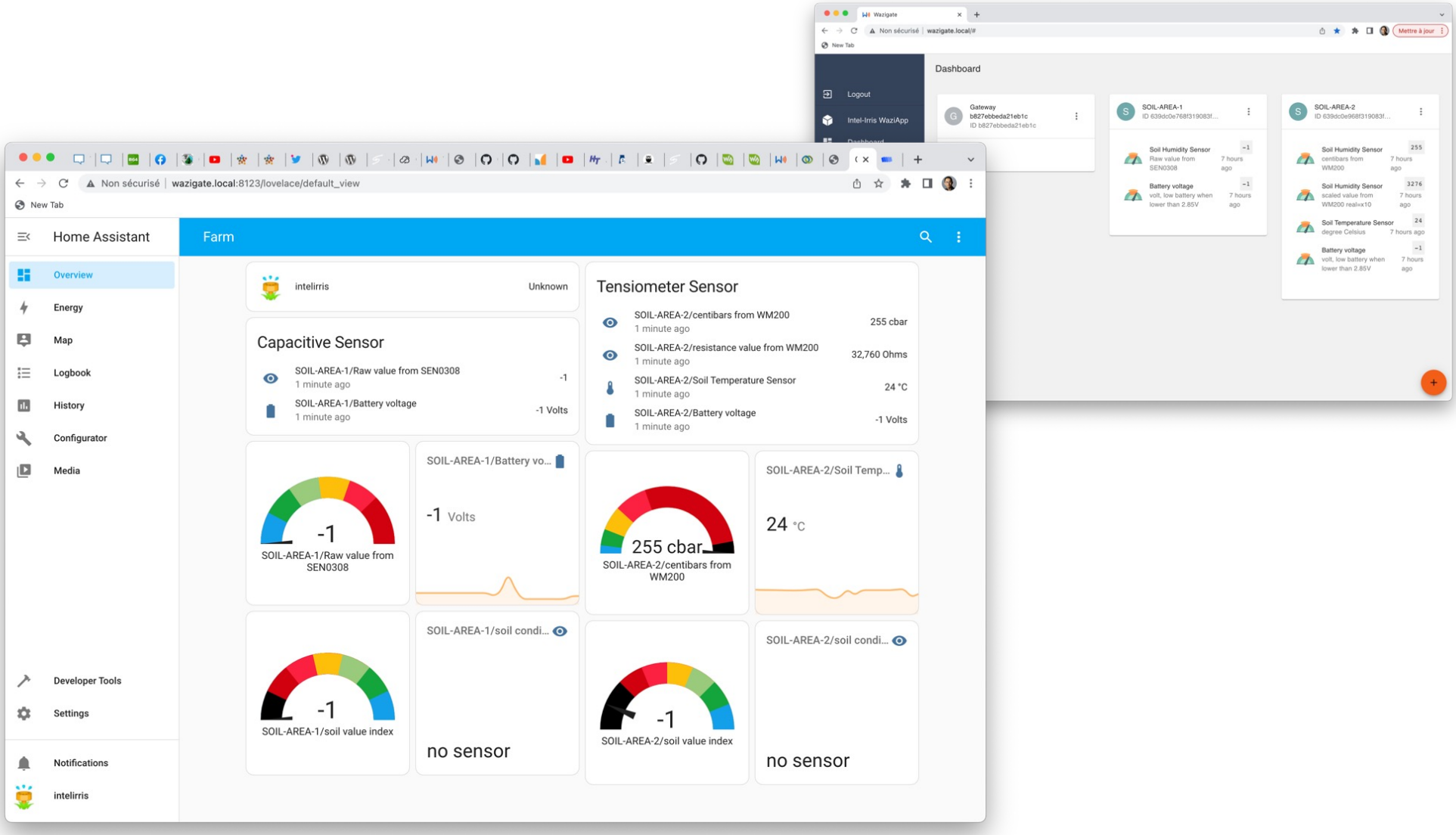
Soil sensor information on OLED

- The OLED displays the latest received sensor data for the end-user: the device name, the time of last received data, the sensor raw value and the soil condition
- The main screen is displayed for 6s every 30s. Then a screen saver display will show a shorter version of these information with a 5-bar visual
- 5 bars: saturated | 4 bars: wet
- 3 bars: wet | 2 bars: dry
- 1 bar: dry | 0 bar: very dry

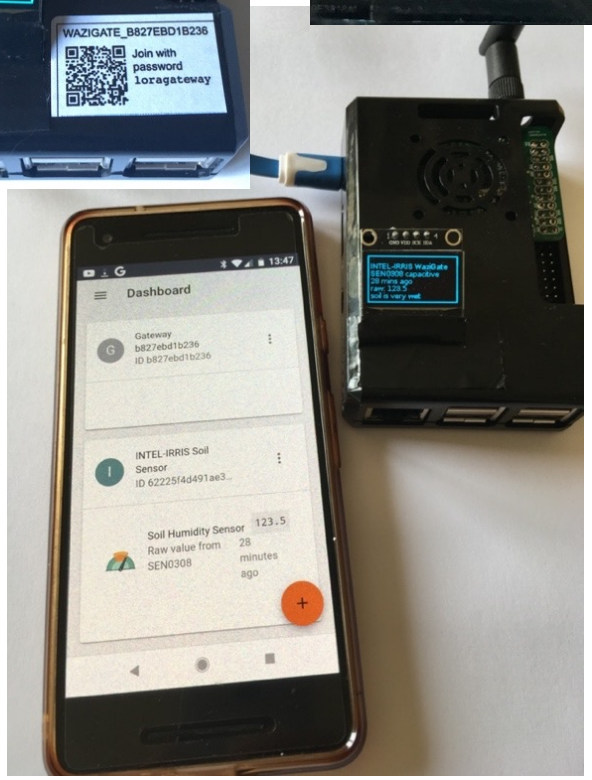
Home Assistant integration

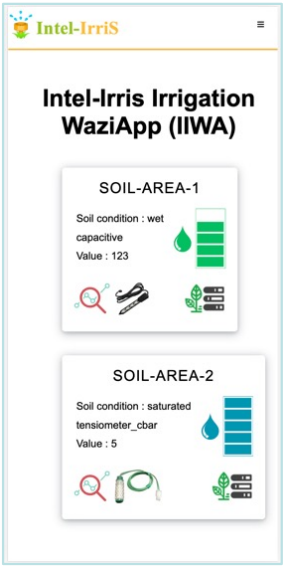
- Download the INTEL-IRRIS gateway **w/HA integration** SD card image from the project website: http://intel-irris.eu/results
- Power & boot your RPI
- When connected to the gateway (either with wired Ethernet or through the gateway's WiFi), open a web browser and open
  - http://wazigate.local:8123 if wired Ethernet
  - http://10.42.0.1:8123 if through gateway's WiFi
- The HA login page should appear
  - User: intelirris
  - Password: intelirris
- The HA default dashboard shows the default configuration of the starter-kit
- Of course, the gateway default dashboard is still available

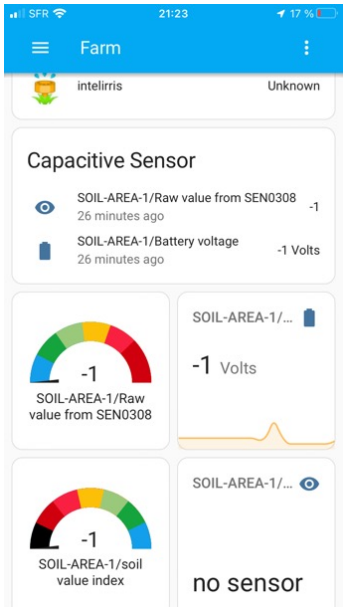
Home Assistant dashboard

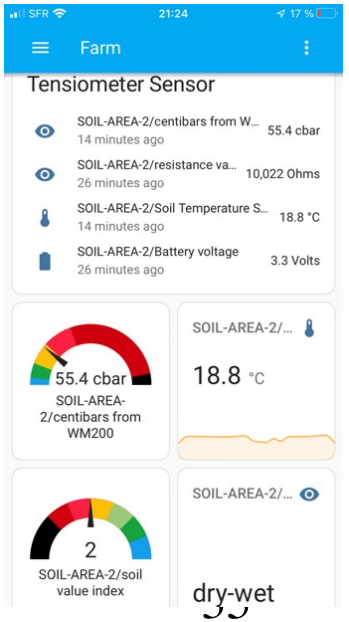


Summary of INTEL-IRRIS gateway various User Interfaces





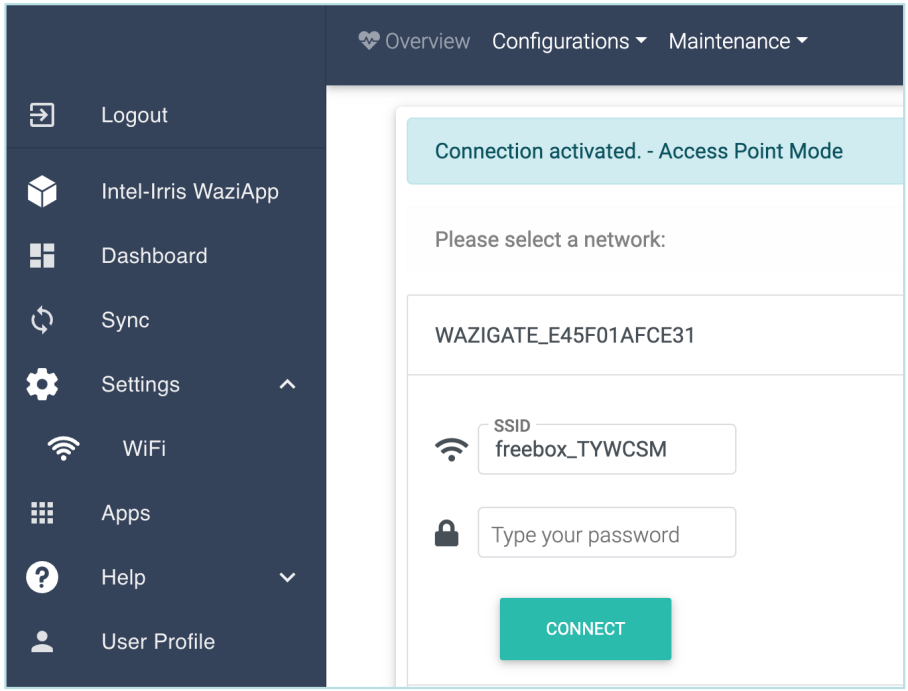


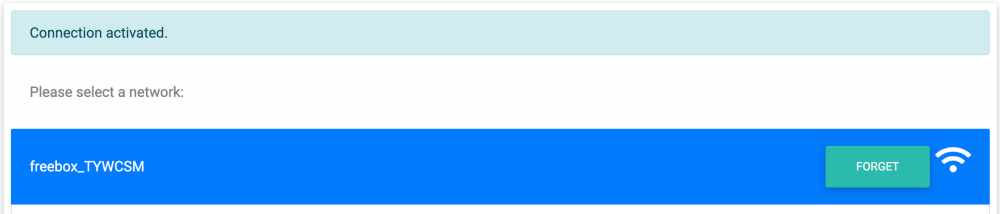


Advanced configuration

connect gateway to a WiFi network

- By default, the gateway acts as a WiFi Access Point
- To connect the gateway to a WiFi network, go to Setting/WiFi to list all available WiFi networks
- Then select the one you want in order to provide the WiFi password
- Ex: connect to freebox_TYWCSM
- Once connected, gateway is in WiFi Client mode





Advanced configuration

connect gateway to a WiFi network, con't

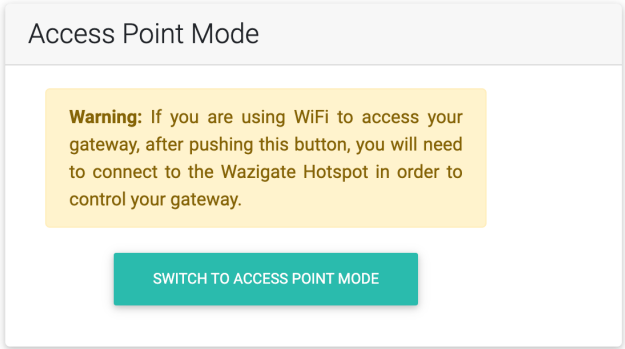
- You can connect to several WiFi networks, one after another, to have a list of known WiFi networks
- They will be memorized and if the current WiFi network is not available, another available network in the list of known WiFi networks will be selected
- If there are no available WiFi networks in the list of known WiFi networks anymore, then the WaziGate switches back to Access Point mode

Advanced configuration

switch gateway back to WiFi access point mode

- To get back to Access Point mode, got to Setting/WiFi and simply click on "Forget" for the current WiFi network

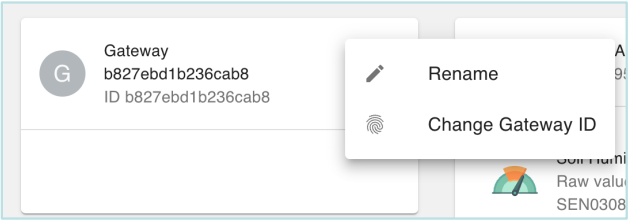
- If you previously added several WiFi networks, click on "Forget" for ALL known & memorized WiFi networks
- DO NOT USE the "SWITCH TO ACCESS POINT MODE" option
- IT IS NOT STABLE!

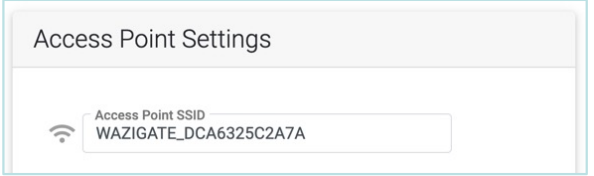


Advanced configuration

Synching your gateway to the cloud

- If you want to sync your gateway to the Waziup Cloud, look at this tutorial page
  - https://www.waziup.io/documentation/wazigate/v2/install/#registration-with-the-cloud
- You will need an account on Waziup Cloud dashboard
  - If you don't have one, you need to create one first
  - https://dashboard.waziup.io/
- Then, you NEED to change your gateway id
  - Use the unique MAC address of your gateway that appears in Settings/Configuration (it is used as your gateway's WiFi hotspot)
  - Here: DCA6325C2A7A
  - Add 0000 at the end to have 16 digits
  - -> DCA6325C2A7A0000

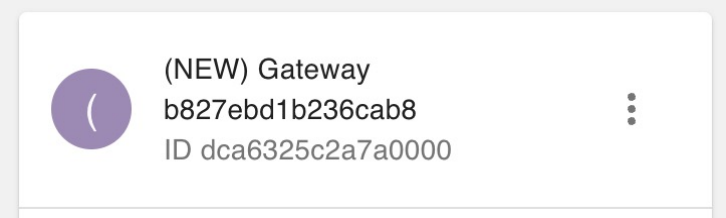


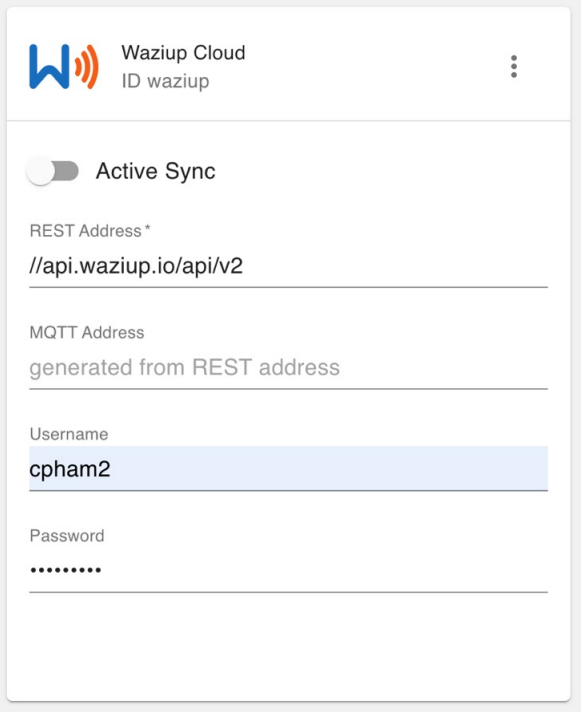


Advanced configuration

Synching your gateway to the cloud, con't

- You should have a new gateway on your dashboard with the new ID





- Enter your Waziup Cloud credentials in the Sync menu
- Then, just activate sync on your gateway which needs to be connected to Internet
- Log in the Waziup Cloud dashboard and check that you see your gateway and your device
- You can activate/deactivate synchronization at anytime

Advanced configuration

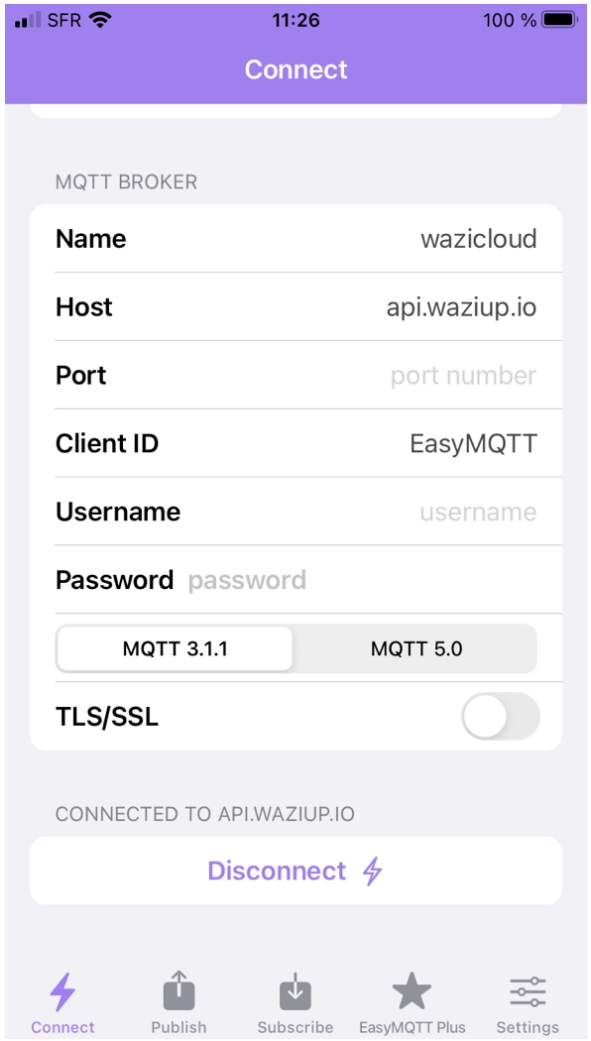
MQTT integration from WaziCloud

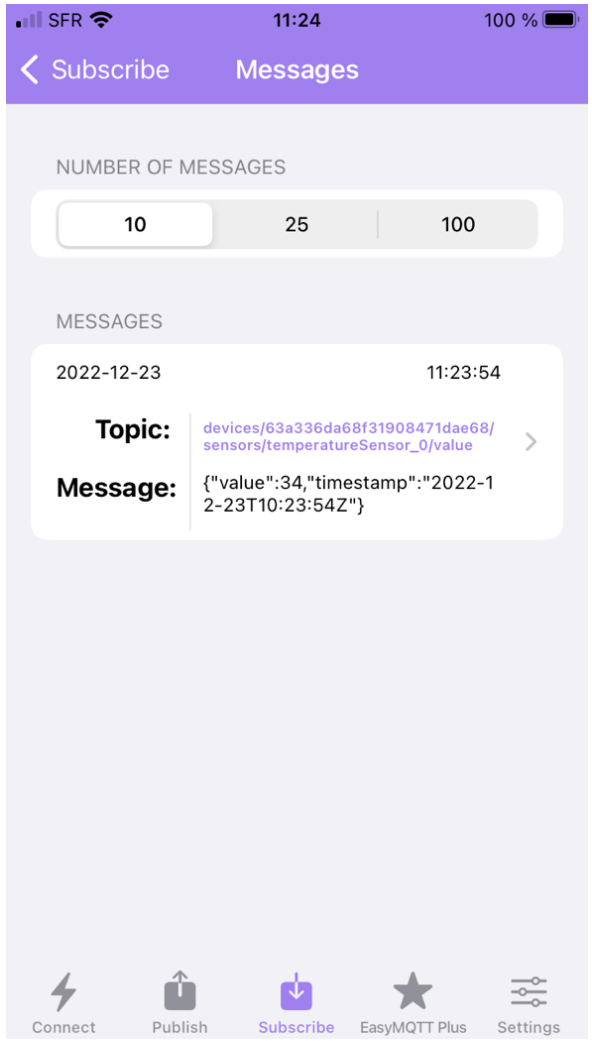
- With sensor data on WaziCloud, it is possible to subscribe to those data with MQTT protocol
- With command line `mosquitto_sub`
  - moquitto_sub
    -L "mqtt://api.waziup.io/devices/<deviceID>/sensors/<sensorID>/value"
  - mosquitto_sub
    -h api.waziup.io -t devices/<deviceID>/sensors/<sensorID>/value
- With other MQTT integration client/platform
  - Host: api.waziup.io
  - Topic: devices/<deviceID>/sensors/<sensorID>/value
- Output
  - `{"value":34,"timestamp":"2022-12-23T10:23:54Z"}`

Advanced configuration

MQTT integration – MQTT client on a smartphone

- Example with an MQTT client (EasyMQTT) on an IPhone7





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