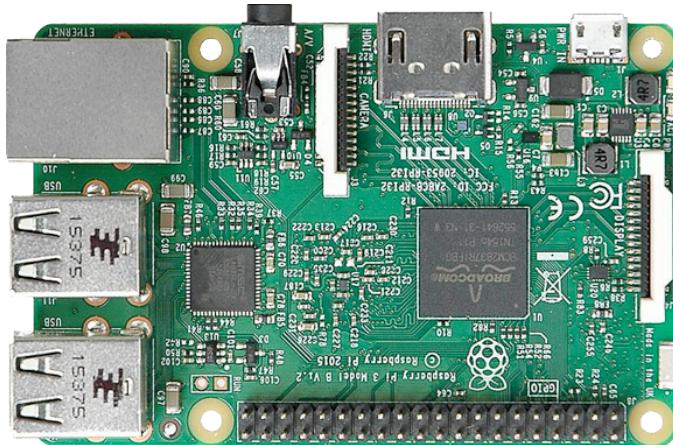




last update September 4th, 2018

## TO BUILD THE GATEWAY

- Raspberry: we recommend a RPI3 model B



You also need an 8GB SD card **class 10**

RPI3 has built-in WiFi and Bluetooth 4.0,

if you get or already have the RPI2 and want WiFi and Bluetooth, get dongles, but it is not mandatory. Dongles that have been tested successfully are:



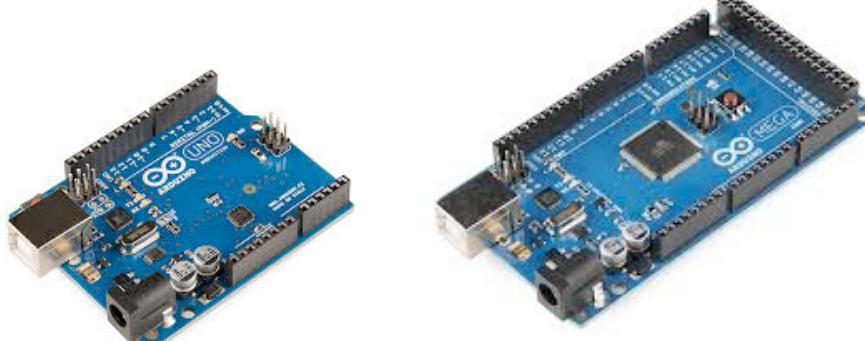
WiFi: TP-LINK  
TL-WL725N



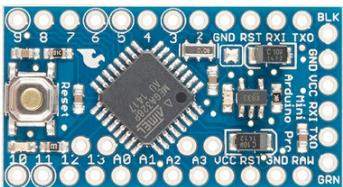
Bluetooth 4.0: CSR  
dongle or Konig dongle

## TO BUILD THE IOT DEVICE

- For prototyping and development tests Arduino Uno/MEGA2560



- For integration phase: Arduino Pro Mini (take the 3.3v, 8MHz version). Original version is from Sparkfun



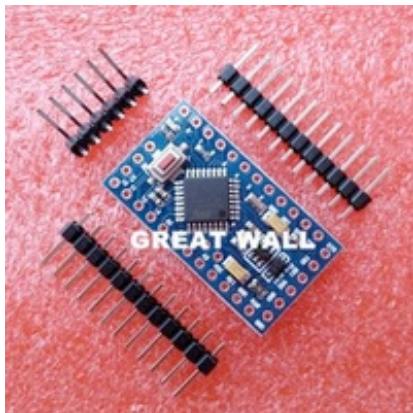
3.3v and 8MHz version

Can be bought as low as 1.5€ from Chinese manufacturers

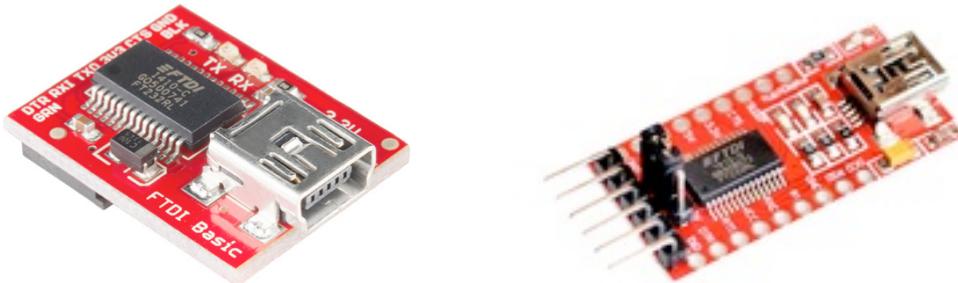
<http://www.aliexpress.com/popular/arduino-pro-mini-328.html>

We tested this one:

[https://fr.aliexpress.com/store/product/Free-Shipping-1pcs-pro-mini-atmega328-Pro-Mini-328-Mini-ATMEGA328-3-3V-8MHz-for-Arduino/731260\\_32340942669.html?spm=2114.12010608.0.0.4LfFx2](https://fr.aliexpress.com/store/product/Free-Shipping-1pcs-pro-mini-atmega328-Pro-Mini-328-Mini-ATMEGA328-3-3V-8MHz-for-Arduino/731260_32340942669.html?spm=2114.12010608.0.0.4LfFx2)



You will also need the FTDI breakout (3.3v version) to program the board. You need only one to program all your boards. Original product from Sparkfun is here: <https://www.sparkfun.com/products/9873>



We tested a Chinese one (on the right) that can be set either at 5v or 3.3v. Much cheaper!

[https://fr.aliexpress.com/store/product/Free-shipping-FT232RL-FT232-FTDI-USB-3-3V-5V-to-TTL-Serial-Adapter-Module-Mini/1735233\\_32648254875.html?spm=2114.12010608.0.0.PizHXM](https://fr.aliexpress.com/store/product/Free-shipping-FT232RL-FT232-FTDI-USB-3-3V-5V-to-TTL-Serial-Adapter-Module-Mini/1735233_32648254875.html?spm=2114.12010608.0.0.PizHXM)

## LORA RADIO MODULES

- You can take the Modtronix inAir9 with 6mm pin header already soldered (see the available option on the modtronix web page); and the 868MHz whip antenna

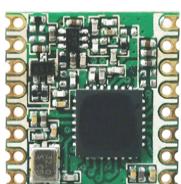


<http://modtronix.com/inair9.html>

<http://modtronix.com/ant-f105-868.html>

The screenshot shows a product page for the Wireless SX1276 LoRa Module. The main image displays the module with its gold whip antenna. The price is listed as USD15.95. A dropdown menu indicates "Header Type: 6.0mm Pin Header (+USD1.00)". Below the price, it says "No Pin Header: inAir9" and "No headers are assembled". A red arrow points to the "Description" section, which contains a note about releasing a new version with integrated antennas. The page also includes a "PayPal Express Checkout" button and a sidebar with related products like a relay module and a wire interface module.

- The RFM95 LoRa module from HopeRF is also a very popular module that you can buy from many Chinese manufacturers. It however require sa breakout board as it is very small. Its advantage is to be easily integrated on a PCB board



HopeRF RFM95W

- Antenna for gateway

Ground plane,  $\frac{1}{2}$  wave dipole (e.g. sleeve dipole, center-fed), or fiberglass antennas are best choice for the gateway if you need a cable extension to put the antenna outdoor.



[https://fr.aliexpress.com/store/product/868mhz-antenna-3dBi-omni-fiberglass-antenna-best-price-factory-outlet-antenna-basestation-antenna/2201026\\_32801738509.html?spm=2114.12010612%2Fitm2home-1.8148356.17.3b56c2deuuEg0k](https://fr.aliexpress.com/store/product/868mhz-antenna-3dBi-omni-fiberglass-antenna-best-price-factory-outlet-antenna-basestation-antenna/2201026_32801738509.html?spm=2114.12010612%2Fitm2home-1.8148356.17.3b56c2deuuEg0k)



<https://www.lextronic.fr/antennes/507-antenne-868-mhz-ground-plane-pour-base.html>



Sleeve dipole such as this one (SMA male connector):

<https://fr.aliexpress.com/item/ALLISHOP-868Mhz-5dbi-Gain-OMNI-Antenna-SMA-Male-19cm-Rotatable-Omni-Wireless-Wifi-Antenna-SMA-Male/32771698006.html?spm=a2g0s.9042311.0.0.62876c37iHwvko>



You can also use a cheap, general purpose antenna such as this type of omni-directional antenna, but performance is far from optimal. We tested this one (SMA male connector):

<https://fr.aliexpress.com/item/868MHZ-915MHZ-GSM-3G-antenna-small-sucker-7dbi-aerial-3meters-SMA-male-2/32512220307.html?spm=a2g0s.9042311.0.0.27426c37eBDSMw>

If you use a sleeve dipole antenna, you will also need a cable antenna. Take an RG58 cable, SMA male to SMA female



<https://fr.aliexpress.com/item/SMA-Male-to-SMA-Female-Plug-Rightangle-Connector-Extension-Cable-RG58-2M/32543987605.html?spm=a2g0s.13010208.9999999.258.14bb3c002VqZWY>

You can select 2m or 5m, avoid more than 5m

If you want to build your own antenna or adjust the length of the antenna cable, then you will need the following items.

- SMA connectors (for cable model RG58) for custom antenna cable



SMA Female



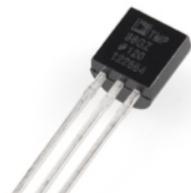
SMA Male

- Coax crimping tool (with RG58 format) and RG58 coax cable

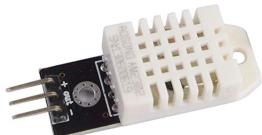


## SIMPLE PHYSICAL SENSOR FOR TEST AND DEMONSTRATION

- Simple temperature sensor: take a simple LM35DZ or TMP36 (from local electronic stores)



- More sophisticated temperature/humidity sensors: DHT22 or the AM2305 which is compatible with the DHT22

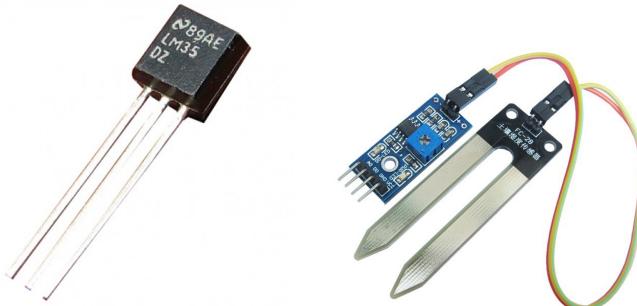


DHT22



AM2305

- Simple Soil humidity sensor: take a low-cost one from AliExpress



## WIRES, CASING, AND VARIOUS ADDITIONAL PARTS

- Breadboard cables: need both M-F and F-F

M-F



F-F



take those that are about 10cm to 20cm maximum.

- Water-proof cases: electric out-door cases for instance



<http://www.lextronic.fr/P34821-botier-tanche-avec-3-presses-toupes.html>

<http://www.lextronic.fr/P22453-botier-tanche-115-x-65-x-40mm.html>

or any water-proof casing you can find suitable from your local hardware/electric stores

For the gateway, we are using this waterproof box, but other box would do



<http://www.mhzshop.com/shop/Accessoires-MHz/Boites-etanches/Boite-etanche-avec-fixation-mat-203x203x65mm-GentleBOX-JE-200.html>

You may need your own cable gland to have a real customized case



(search on AliExpress)

- Some standoffs/spacer and associated screws for the gateway



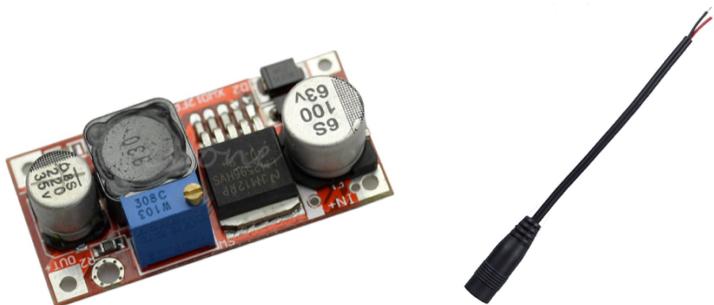
take 10mm to 20mm maximum

- PoE gland & injector



(search on AliExpress)

- LM2596 DC-DC down stepper & DC 5.5x2.1mm female power jack



(search on AliExpress)

- 4-AA battery couplers for the IoT device



(see on AliExpress)

- Simple waterproof switch



or

(search on AliExpress)

## SOLDERING MATERIALS THAT ARE NOT MANDATORY BUT ARE ALWAYS GOOD TO HAVE!

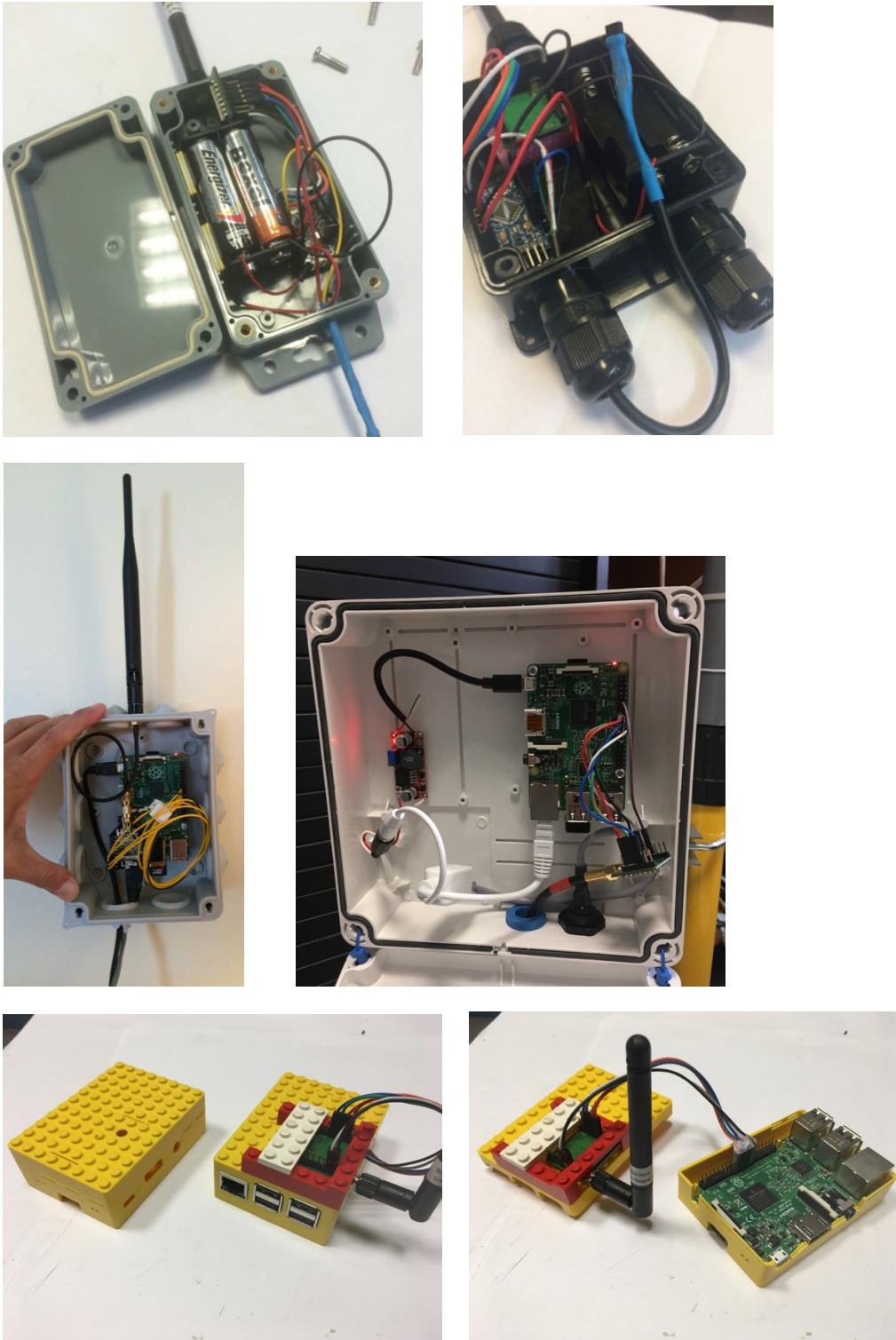
- A simple soldering iron (or station if you want to invest) with thin solder wire



- A set of heat-shrink tubes to isolate wires / silicon for joints



## RESULTS:



Enjoy!

C. Pham, University of Pau, France

(\*) provided web links to some vendors are only given as example.  
You can search from other vendor to optimize item cost and shipping cost