Building an IoT device for outdoor usage: a step-by-step tutorial

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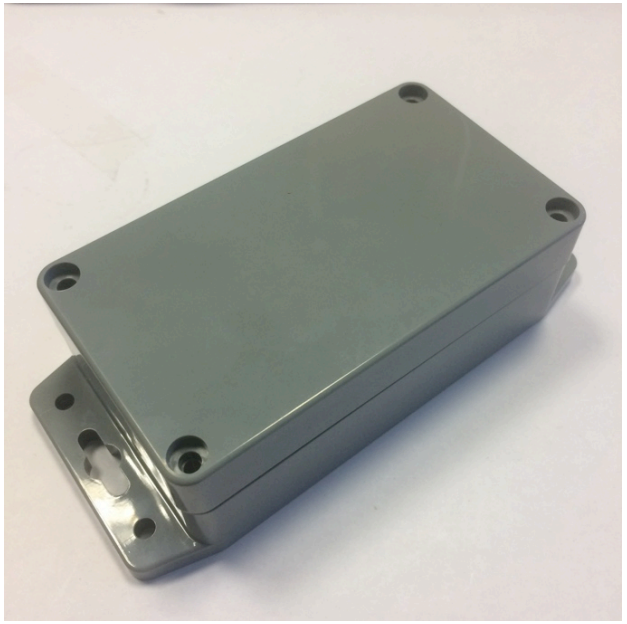
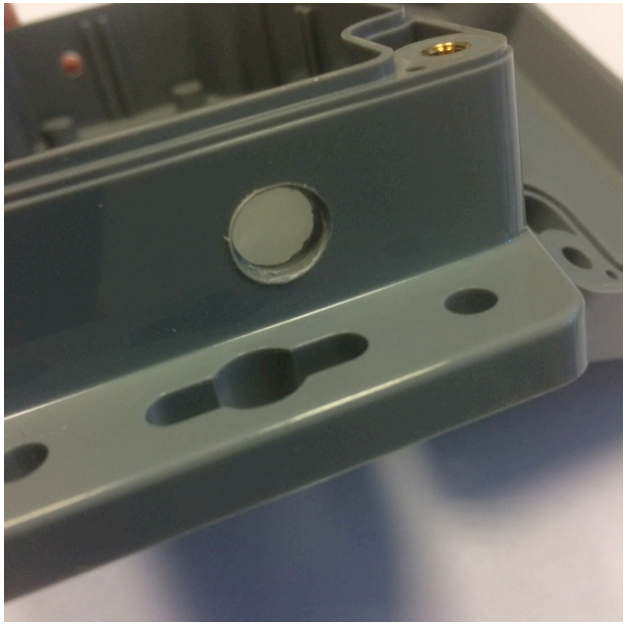
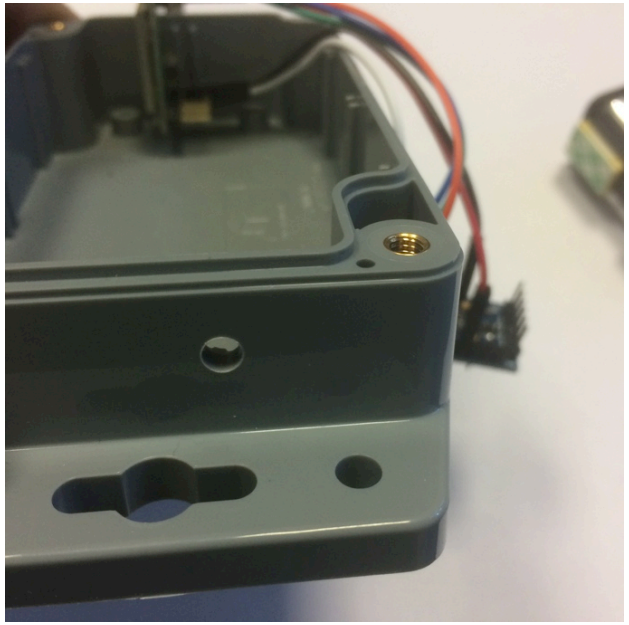
Contents

- This could be seen as a second part of « Low-cost LoRa IoT device: a step-by-step tutorial »
- We will show here how fit the IoT device for out-doot usage, again, at a very low cost
- Let's get started…

GET A CASE FOR OUT-DOOR USAGE



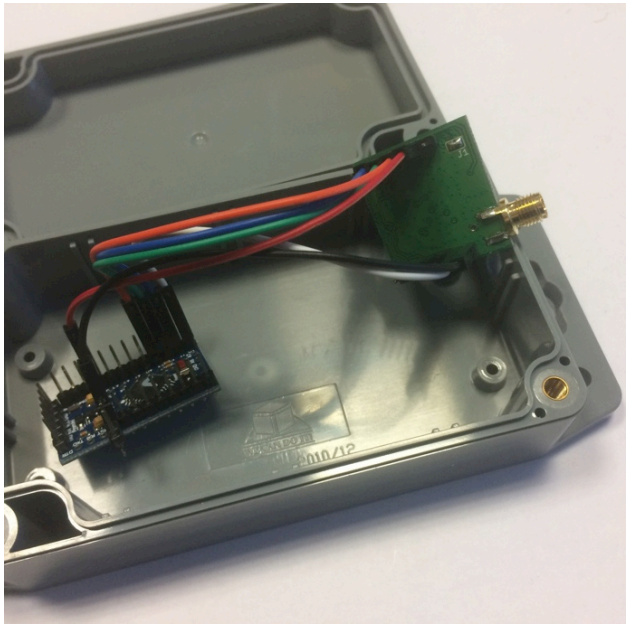


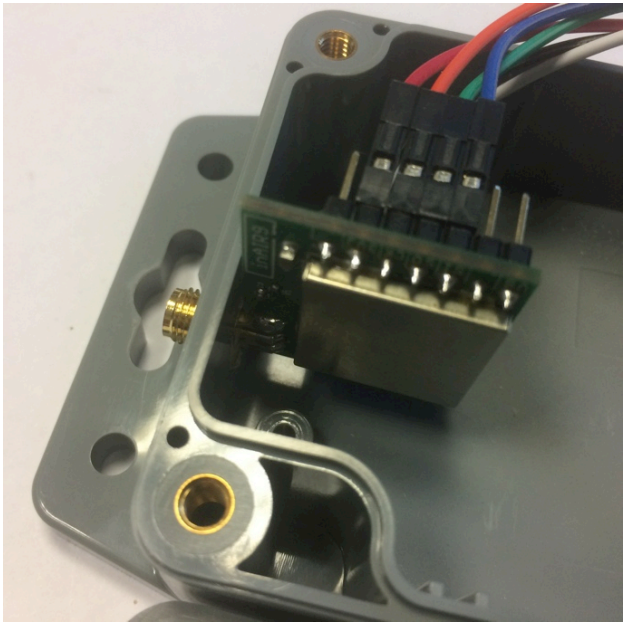


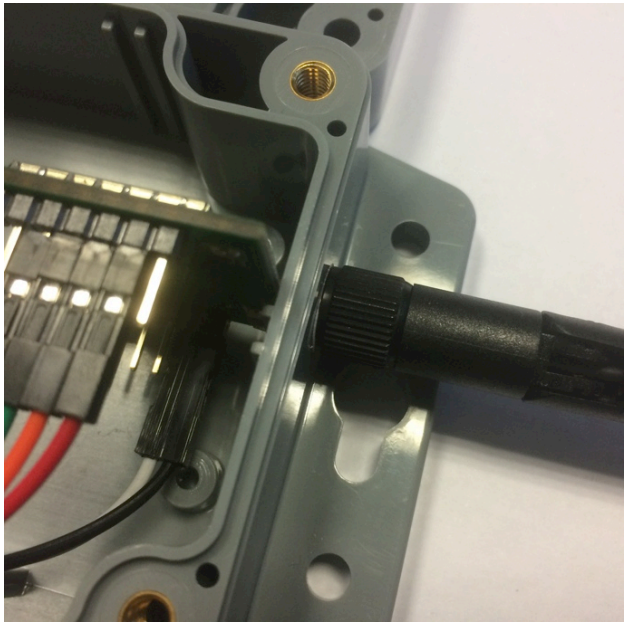
I got mine from Lextronic (http://www.lextronic.fr/P22453-boitier-etanche-115-x-65-x-40mm.html). It is an IP65 box which dimension is 115 x 65 x 40mm.

First thing is to drill a 8mm hole for the radio module and the antenna. At the other end, drill a smaller hole (4mm or 5mmm) for the sensor wire. Drill as many holes as needed.

PUTTING THE ANTENNA



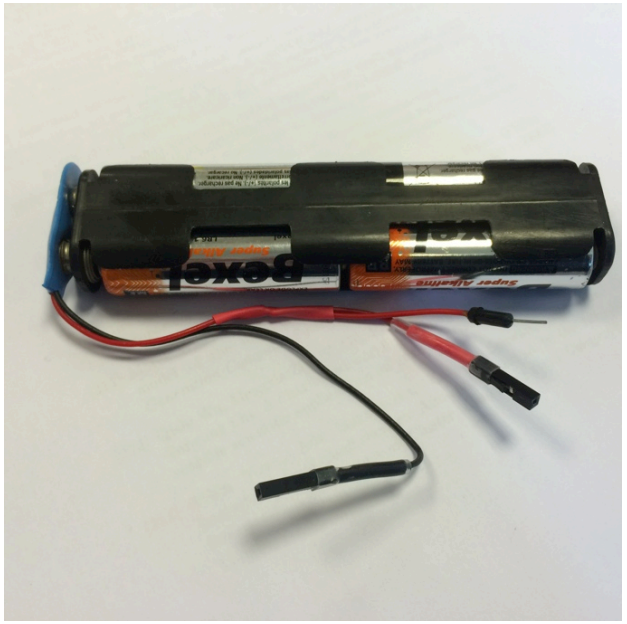


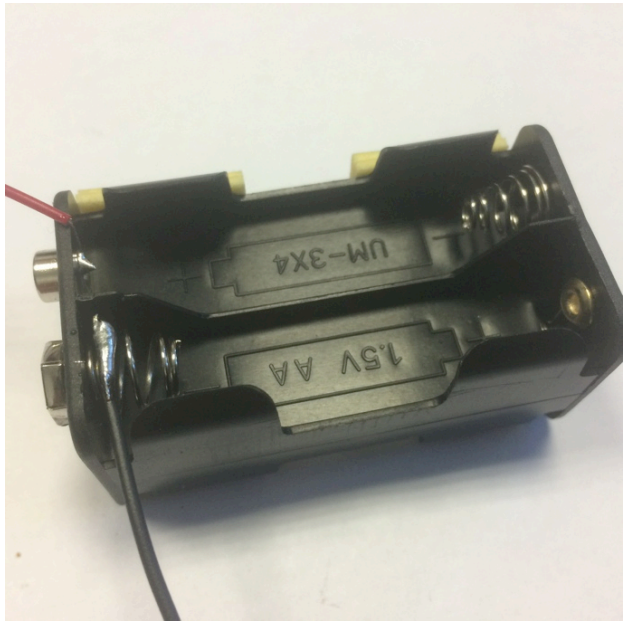


Take the IoT device that has been built previously with the « Low-cost LoRa IoT device: a step-by-step tutorial ».

Put the antenna plug through the 8mm hole. Screw the antenna, but not too firmly, the radio module should be a bit loose here before closing the box.

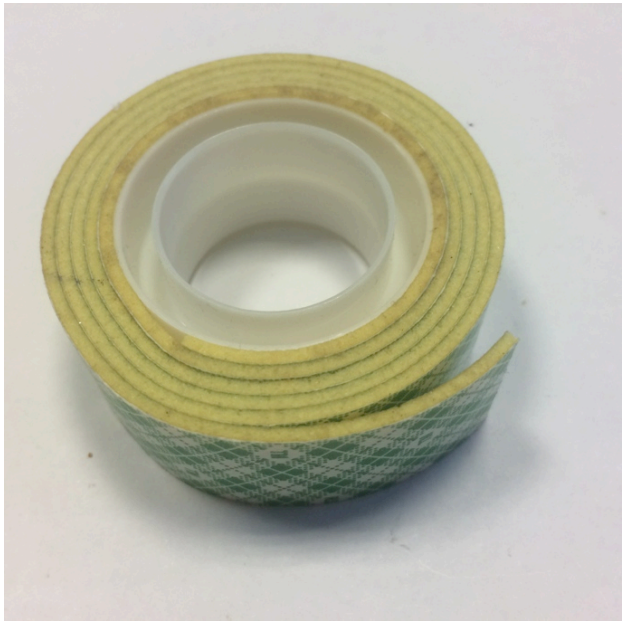
ADD THE POWER SUPLLY

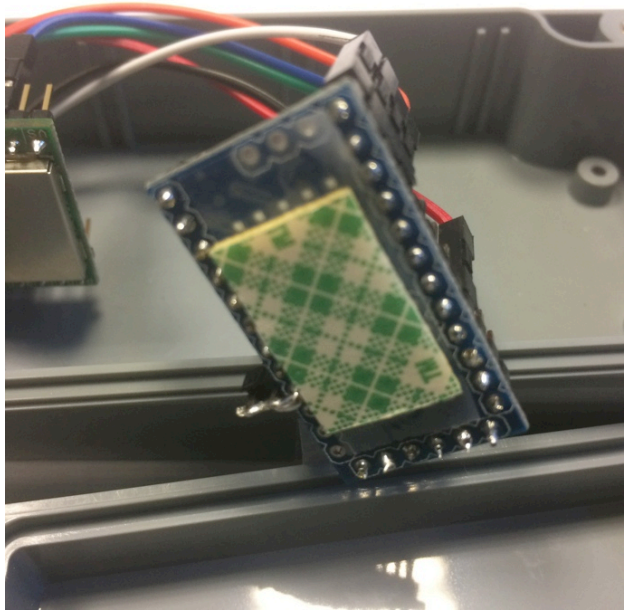


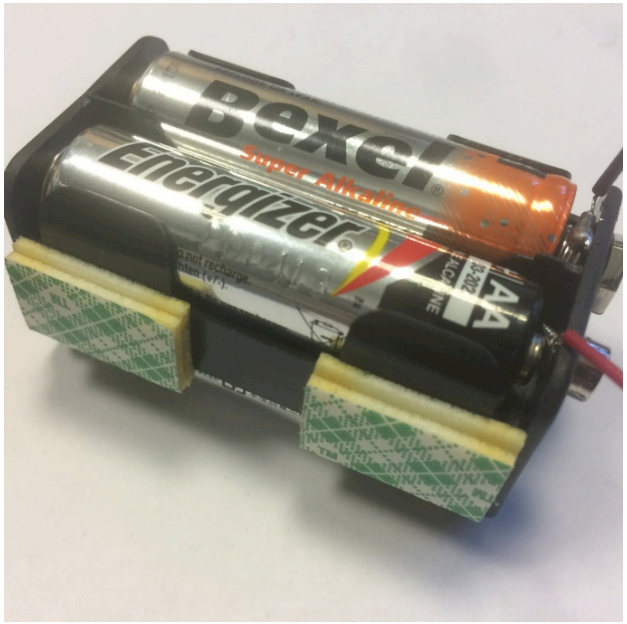


Instead of the long 4-AA battery coupler used in the previous tutorial, use a more compact version and solder 2 wires for the + (Vcc) and the - (GND) or use a connector. The voltage with 4-AA batteries is about 6v. The - wire should have a female connector at the other end to be plugged on the Pro Mini board directly. For the + wire, use whatever you want but it is advise to not connect the + to the board directly but rather use an other wire to easily switching ON/OFF.

Fixing the components

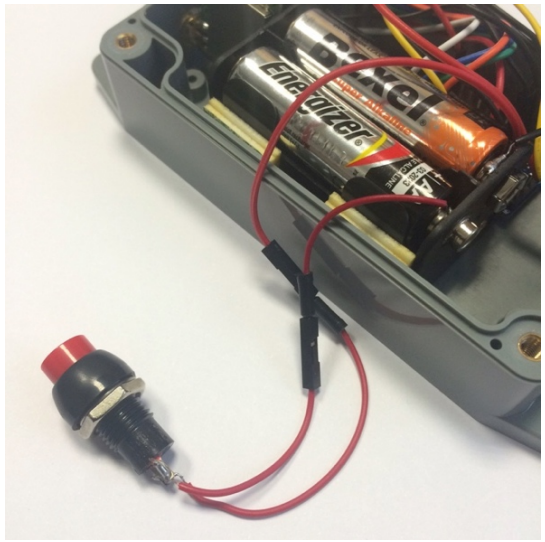






To firmly fix the board and the power supply in the box, I use double-side tape, the one used to fix mirror on the wall. For the board, it is better to use regular tape first between the board and the double-side tape because such tape can be very sticky and hard to remove.

PUTTING EVERYTHING IN THE CASE



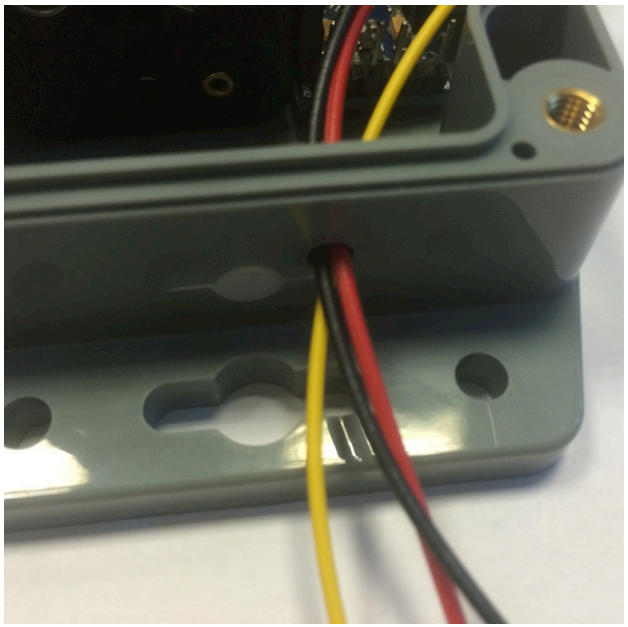
Now, put the board and the power supply in the box.

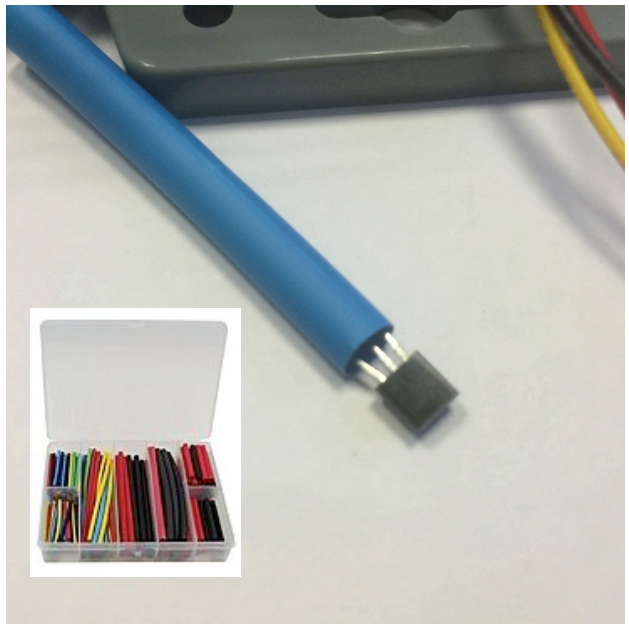
See how the Vcc is connected using an intermediate wire to ease manipulation.

Or use an ON/OFF push button if you want.

You can also install an external switch with a waterproof cap.

Preparing for the temperature sensor

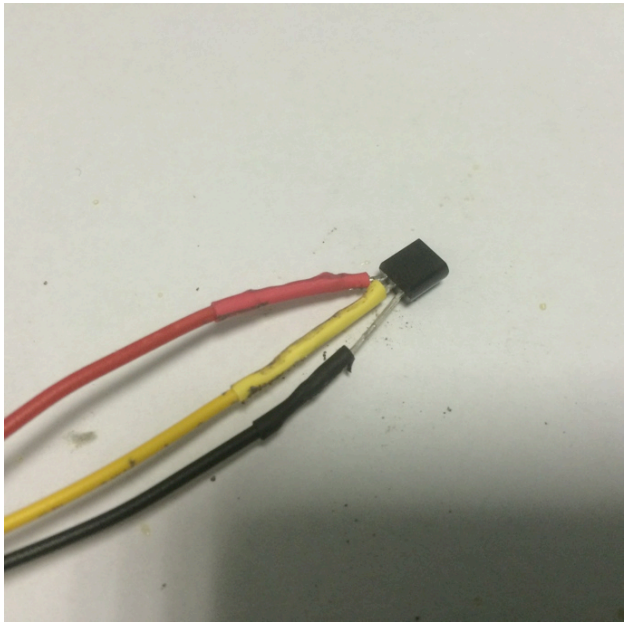


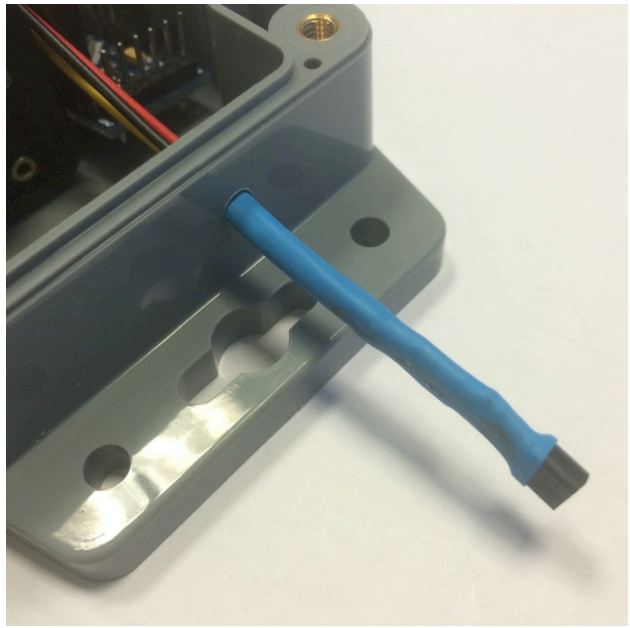


We will use the same temperature sensor than in the previous tutorial. We need 3 wires and we also need to make the design a bit more water and dust proof. First, use 3 wires with a female connector at one end that will be plugged into the board. Pass the wires through the smaller hole, leaving the female-connector side in the box.

To protect the sensor, use heat-shrink sleeve. Use a diameter that is large enough for the plastic part of the sensor to go through.

Preparing for the temperature sensor (2)

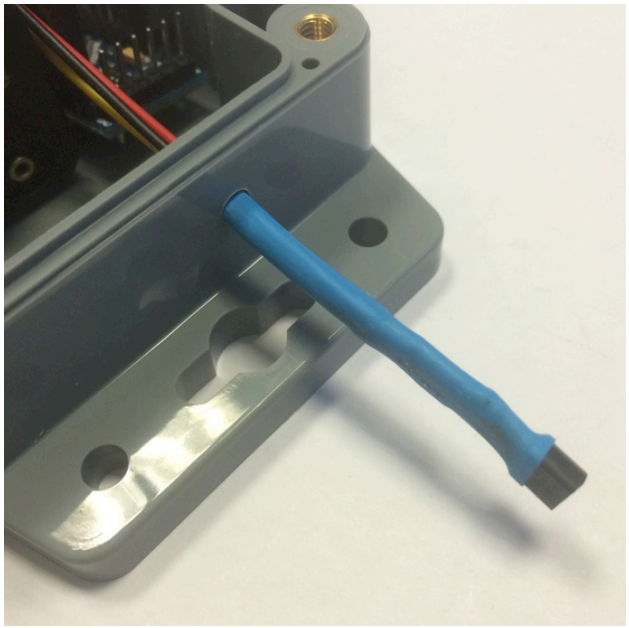


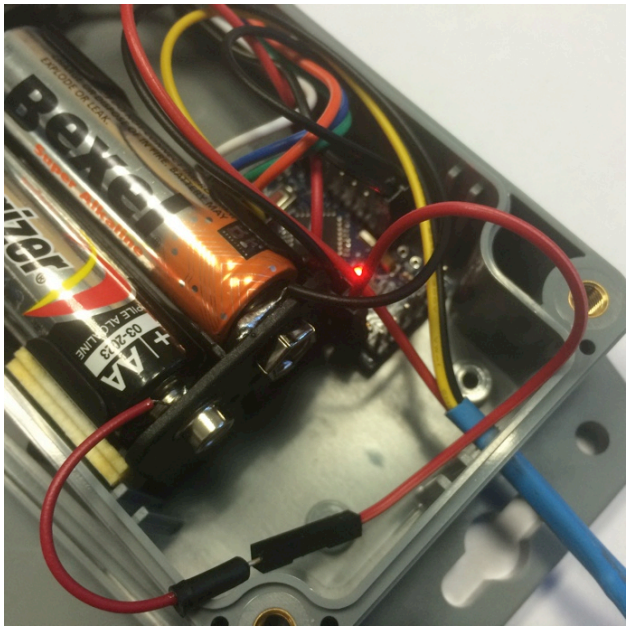


At the other end of the wire, you can just solder. Once again heat-shrink sleeves is great to isolate the wires.

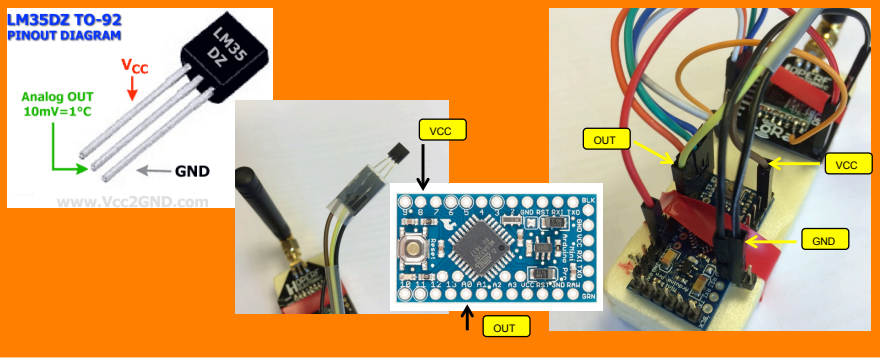
Once all wires have been soldered, place the larger heat-shrink sleeve and protect all wires. BE CAREFULL, you have to place the sleeves before soldering, then slice them in place before heating.

CONNECTING THE SENSOR



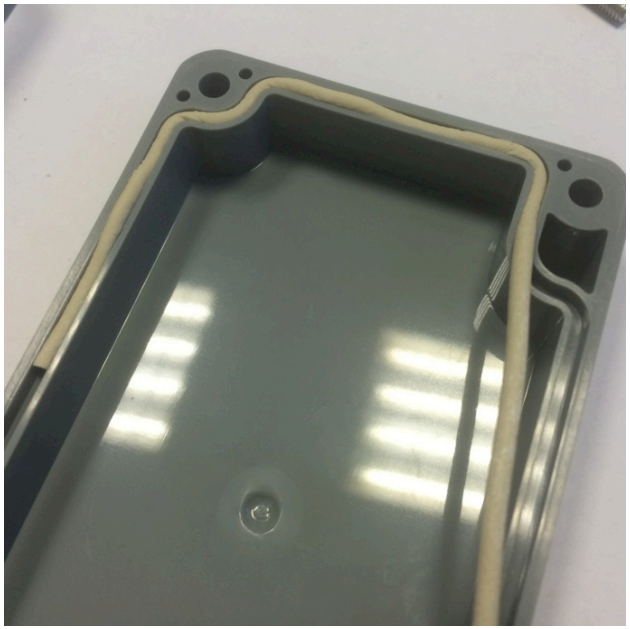


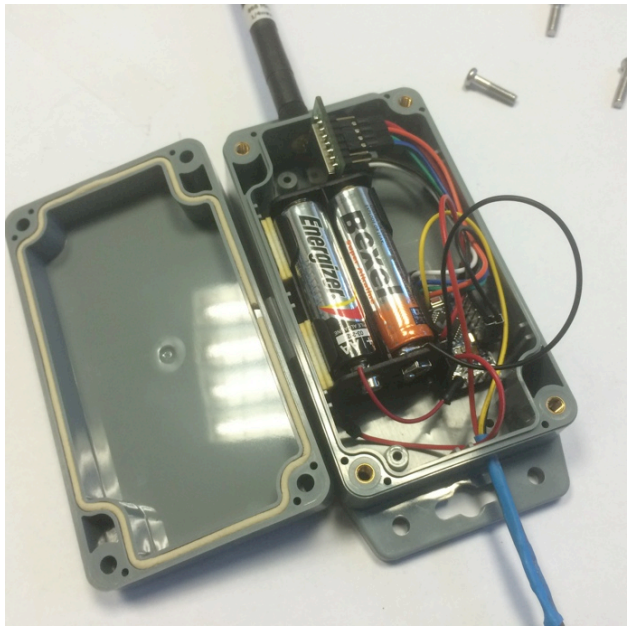
Connect the sensor's wires as described in the previous tutorial.

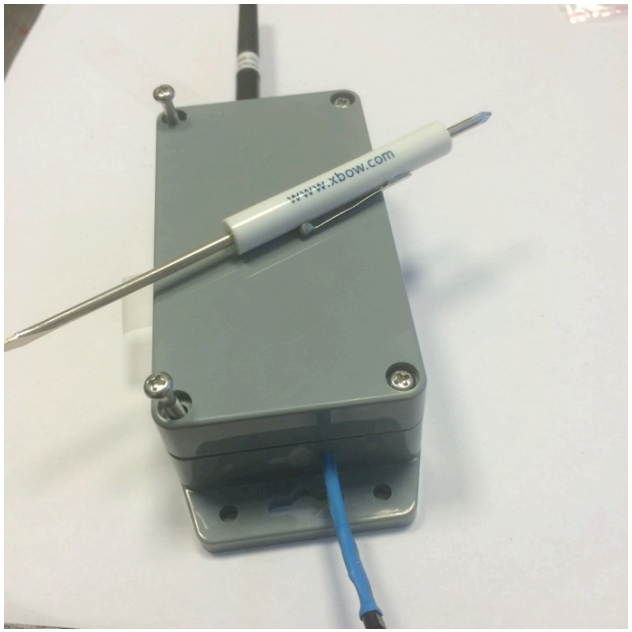


The GND should be connected to one of the board's GND, the VCC should be connected to the analog A8 pin and the OUT pin should be connected to the analog A0 pin.

Last step to deploy your IoT device



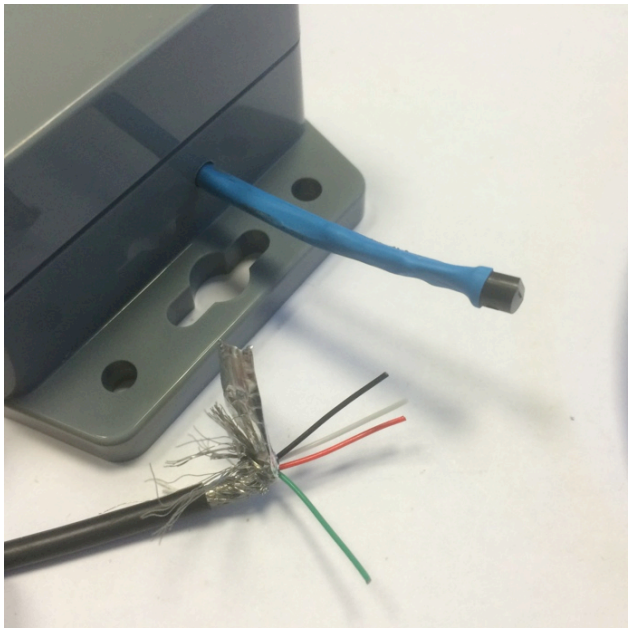


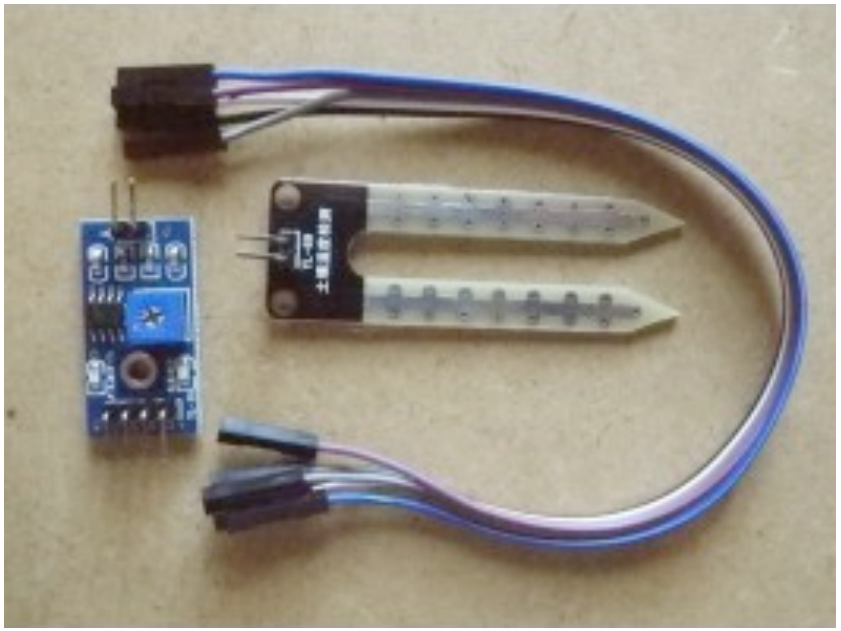


Program your board to have duty-cycle for low-power operation mode. Connect the Vcc wire, check that you receive the data on the gateway and then close the box. You can now screw a bit more firmly the antenna.

With 1 sample every hour, your device should be capable of running for several months.

Use longer cable for your sensor

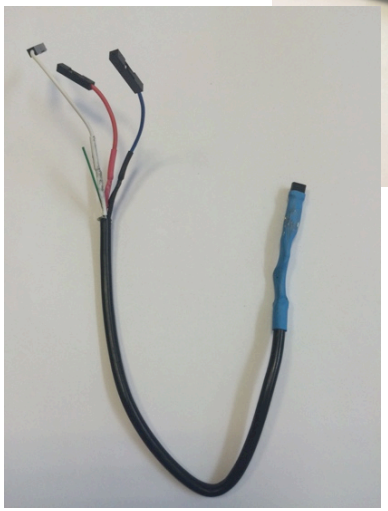


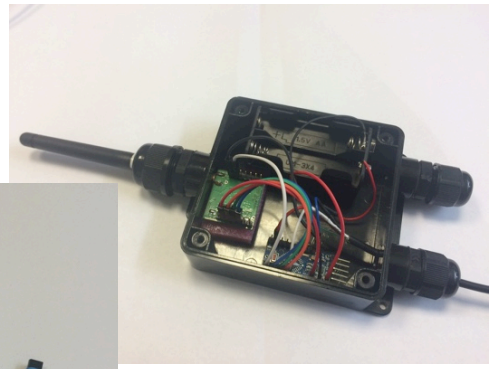


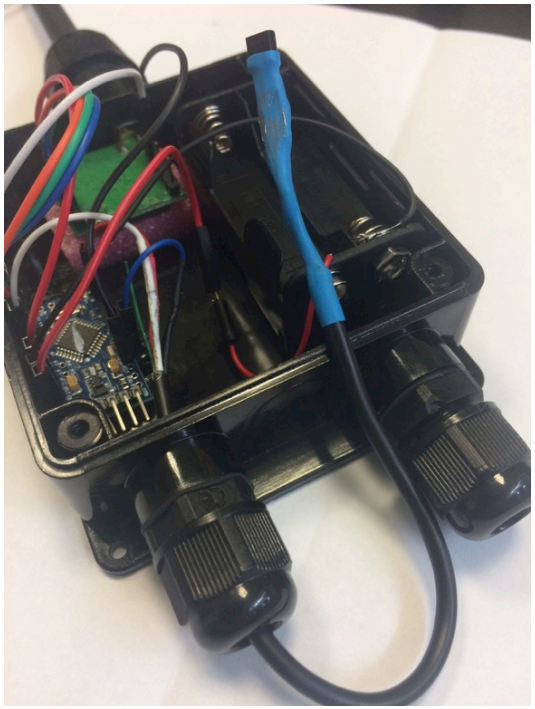
If you need longer cable for your sensor (like more than a meter, for instance for soil humidity sensor) it is of course not convevient to use heat-shrink sleeve to protect the wire.

A very low-cost solution is to use an old USB cable (there are plenty of them unused!) that already has the necessary plastic coating and that contains 4 wires for your own usage.

Another box example



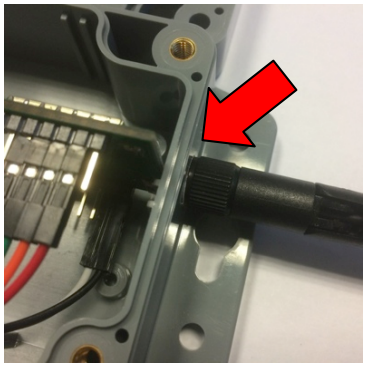


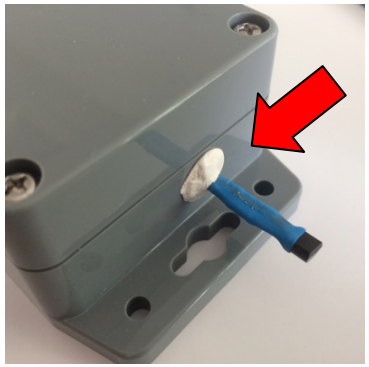


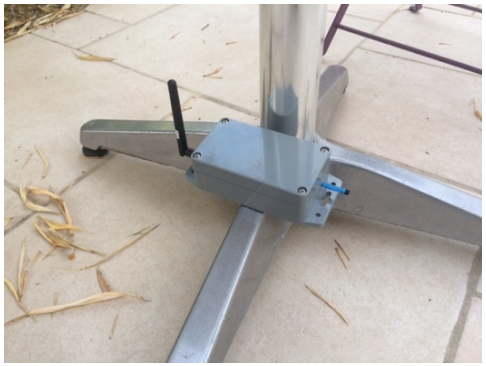
This box comes with 3 cable glands that are very convenient for the antenna and the sensor cables. Got it from here: http://www.lextronic.fr/P34821-boitier-etanche-avec-3-presses-etoupes.html

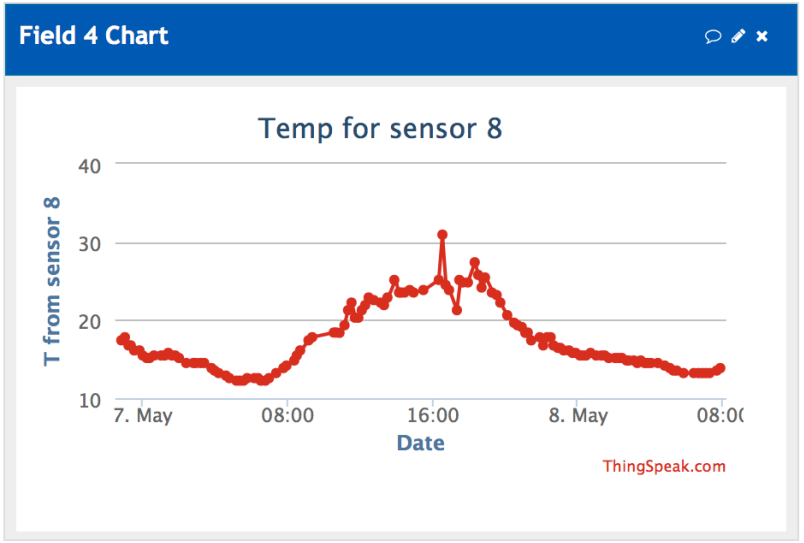
An old USB cable (with some soldering work) is used to connect the temperature sensor: 3 wires from the 4 available are used.

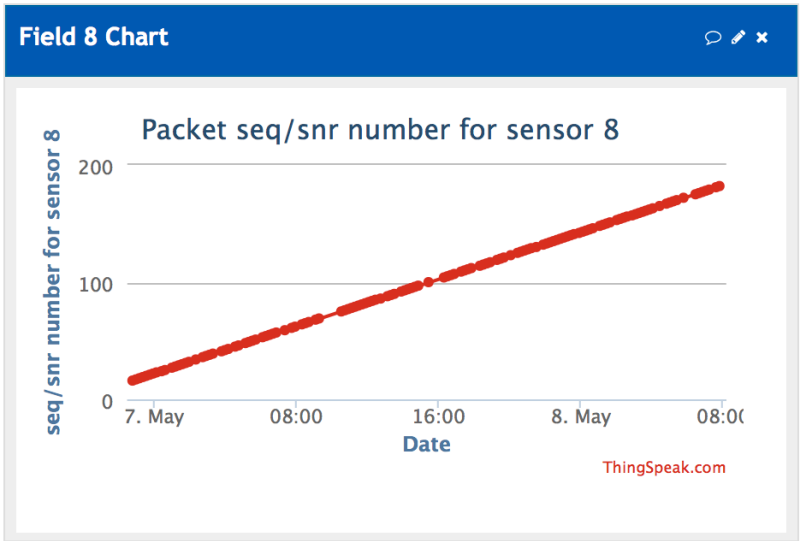
First outdoor tests







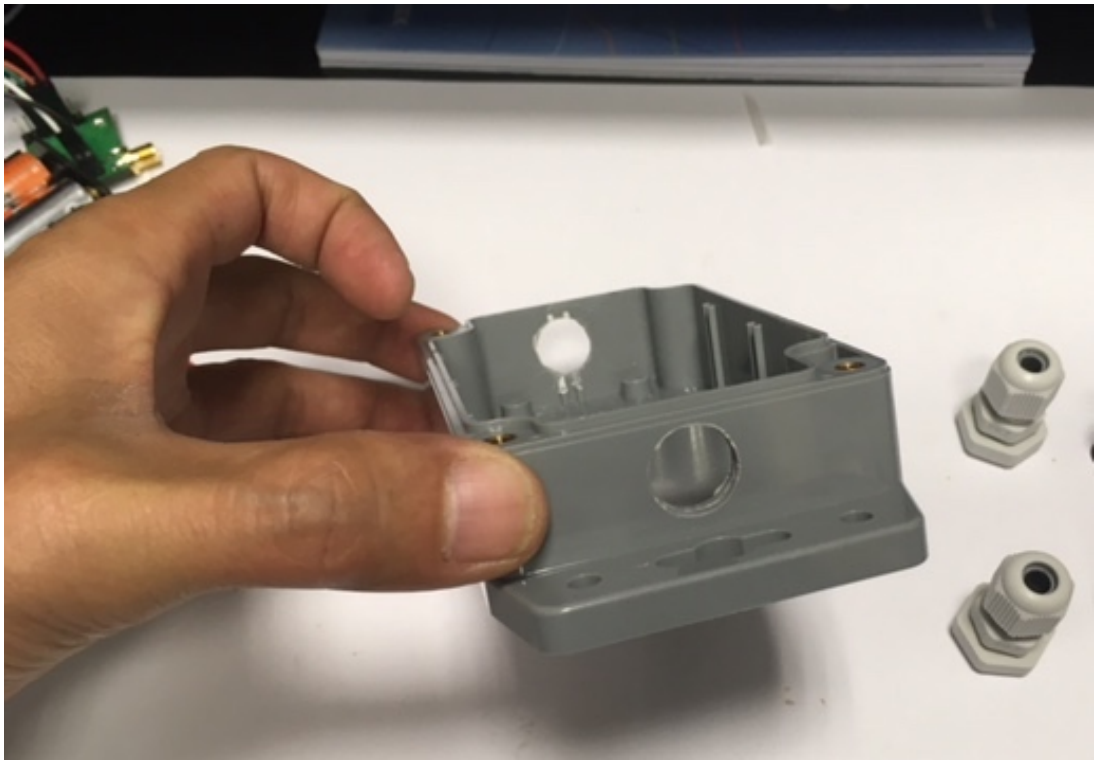




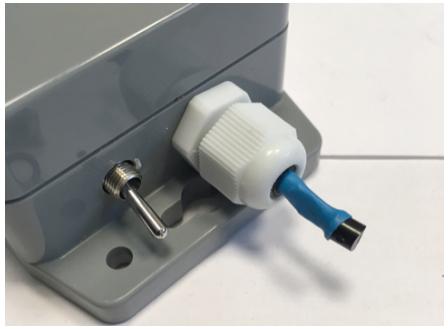
Put some silicone/putty at the antenna and sensor wire junction to avoid humidity in the box. After closing the box, tight the antenna now if needed.

Outdoor test from May 6th to May 8th, 2016

Installing your own cable gland



Drill a hole depending on the gland diameter (here PG7, 12mm, so hole of 13mm)



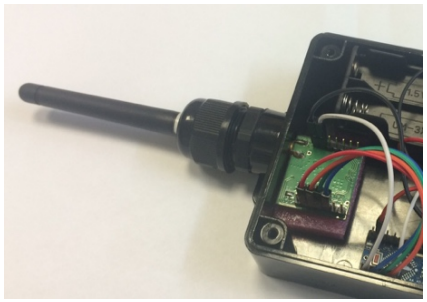
PROTECTING FROM DIRECT SUN

Any plastic cover would do ! But avoid transparent plastic. Here a CD cover with white paper. Do not completly cover with a plastic box neither.

CONNECTING AN ANTENNA TO THE SENSING DEVICE

- Taking the Modtronix inAir9 (868MHz), the antenna that you can buy with the module is usually a simple ¼ wave whip/monopole antenna (SMA-male)
- The antenna can be connected directly to the radio module of the end-device

But, as can be seen here, when the device is close to the ground, the antenna may be not in optimal position.



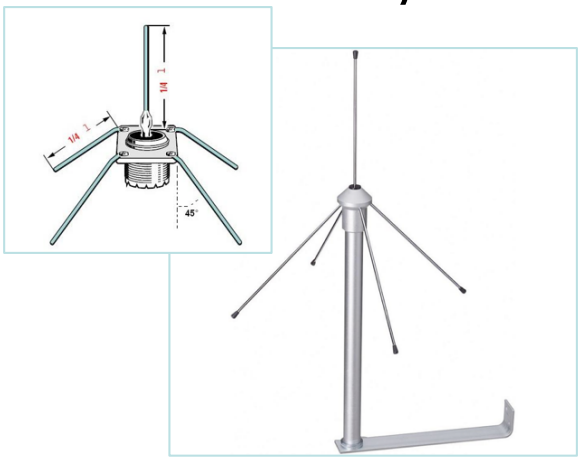
Improve antenna placement

- Using an extension coaxial cable between the antenna and the radio module greatly ease the deployment of device **but**:
  - Take a good quality cable (e.g. RG58 minimum) to limit attenuation
  - The antenna cable should not be too long to avoid high attenuation: 2m-3m
  - A ¼ wave monopole antenna will not provide good performance

Look at the antenna tutorial for instructions on how to build your own cable (with adequate connectors) at the correct length.

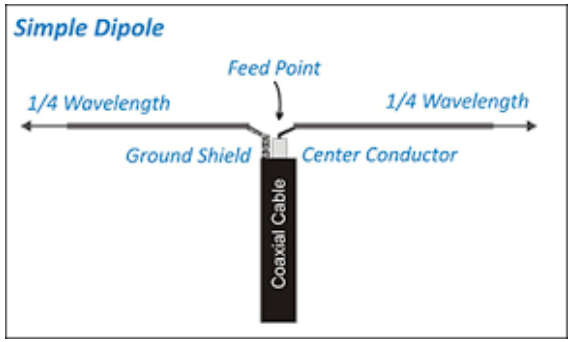
ANTENNA FOR DEVICE WITH A COAXIAL CABLE

- At the end of a coaxial cable, it is possible to connect a ground plane antenna (usually ¼ wave) or a ½ wave dipole antenna



Ground plane

Sleeve dipole



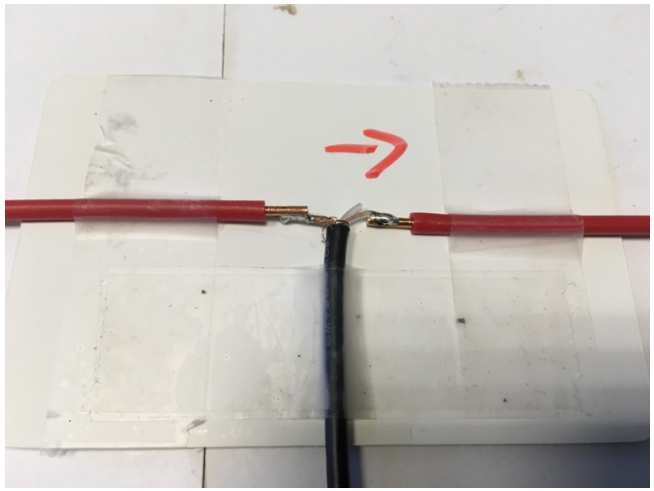
Simple dipole

More complex: collinear, array,…

- Some of them are easy to build (ground plane and simple dipole) and there are many tutorials

Simple ½ wave dipole antenna

- The very simple dipole can be made with 2 pieces of ¼ wave wires. ¼ wave in 868MHz is about 8.2cm.



- There is no balun here but it is still better than the ¼ wave monople if a coaxial cable is used
- You can buy a 3m RG58 cable (SMA-m to SMA-f for instance), keep the male side, cut the female side and solder the core conductor and the braid as shown.

SUMMARY OF ANTENNAS FOR SENSING DEVICE

- The best solution would be to buy a sleeve dipole for the frequency range you are operating.
- If you want to try the DIY approach, try first the simple dipole and then see if the range is acceptable.
- A ground plane antenna can be purchased or also made. You can test both solutions.
- Remember that RF transmissions depend a lot on the antenna location and the environment.

CABLE GLAND FOR ANTENNA CABLE

If a cable gland is used for the antenna cable, take at least PG9 so that the antenna connector can go through.