

LOW-COST LORA IOT ANTENNA TUTORIAL FOR GATEWAY



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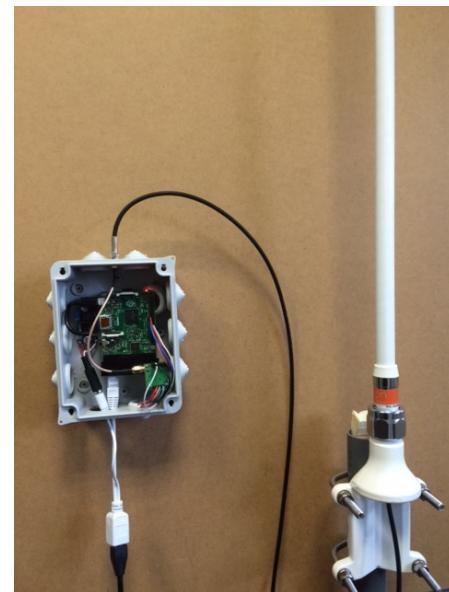
RF INTRODUCTION

- You may want to look at these introductory documents on radio transmission:
 - RF essential by Jared Hofhiens (Digi)
 - http://www.mouser.com/pdfdocs/RF_Essentials.pdf
 - Maximizing range
 - Application note XST-AN010a from Digi
 - <http://ftp1.digi.com/support/images/XST-AN010a-MaximizingRange.pdf>
- And update your knowledge on basic of radio transmission is needed.

CONTENTS

- We will show how to make a custom antenna cable for your gateway if you need to adapt the connectors of the cable to match those of the antenna or the radio module

Outdoor antenna & gateway



Outdoor antenna & indoor gateway

FIRST, YOU SHOULD KNOW THAT...

- ... it is better to have the antenna directly connected to the radio module
 - But higher gain antennas usually use N connectors
 - But you want to put the gateway inside for simplicity
- So, for the best reception conditions:
 - avoid long cables, 15m is really a maximum
 - take a high quality cable (e.g. less than 20dB attenuation every 100m) if you need more than 10m
 - avoid additional extra adaptors between the antenna and the radio module
 - If there are already some antenna on the mas, place the antennas at various height (1m to 50cm difference)



CABLE

- Antenna cables are usually coaxial cable with 50ohms impedance
- There are lists of commonly found cable here:
 - https://en.wikipedia.org/wiki/Coaxial_cable
 - <http://amat-01.r-e-f.org/p13-les-coax.htm>
- Attenuation increases with frequency
- If possible, use low-loss or low attenuation cable
 - « cheap » cable can have attenuation above 90dB for 100m, so if you need 3m, it is 2.7dB (e.g. RG174)!
 - Medium-quality cable are about 45dB/100m. 3m->1.35dB (e.g. RG58)
 - High-quality cable can have 15dB/100m. 3m->0.45dB
- tradeoff between price, quality and length: 3m is quite reasonable

ANTENNA CONNECTORS

- There are 2 main types of connectors for antenna: SMA connectors & N connectors
- Both use coaxial cable. Connection to a radio module is usually done with an SMA connector, while the N connector is rather used for the antenna part



SMA CONNECTORS

- SMA connectors have 2 versions, « normal » and Reverse (RP). In each version, there are genders: male or female.
- You cannot mix version! Even if you can screw the Male RP-SMA to the Female SMA, you see that the signal pin is not connected!

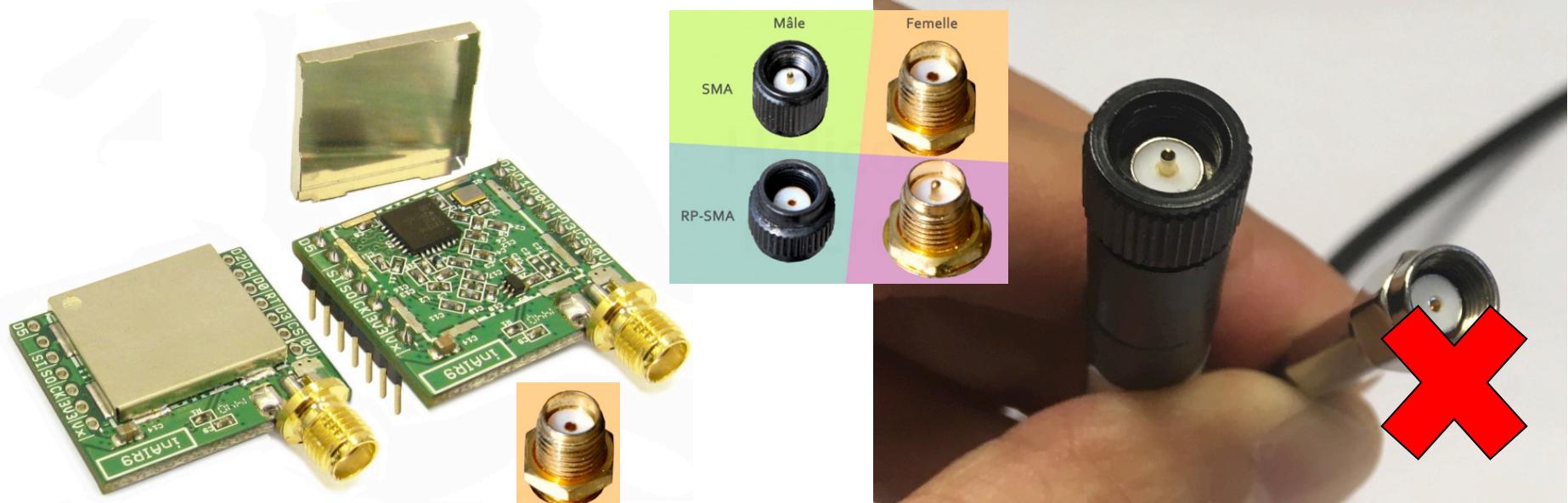


N CONNECTORS

- N connectors are often used for connecting the cable to a bigger antenna part



VERIFY YOUR RADIO MODULE WAZIUP SMA VERSION & GENDER

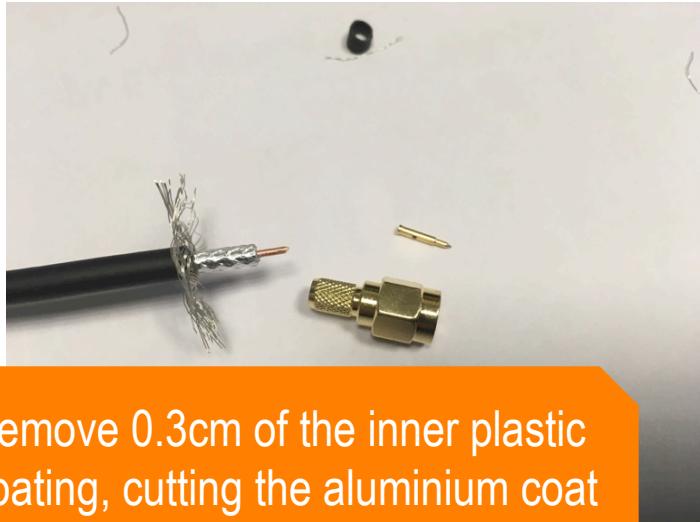


Depending on your radio module, you need a specific version of the SMA connector. For instance, the inAir9 from Modtronix is in female SMA so you need for the antenna a male SMA. The original antenna shipped with the radio module is in male SMA. So if you have an RP male SMA at your cable end you have to change it.

Remember that a long cable or having intermediate adaptors dramatically increase the attenuation, thus the quality at the reception!

EXAMPLE 1: N CONNECTOR OK, CHANGE SMA SIDE

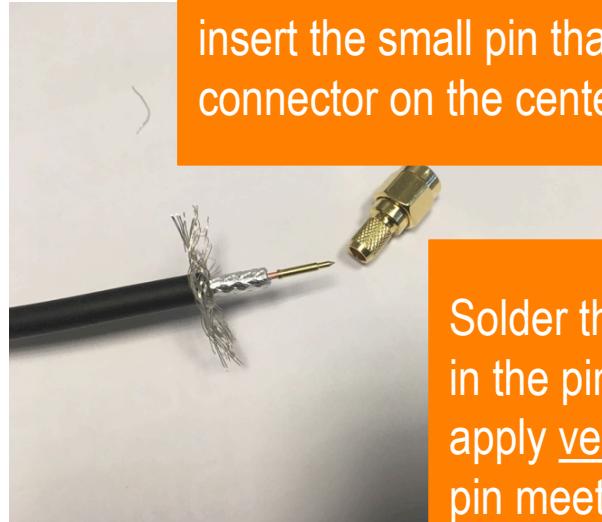




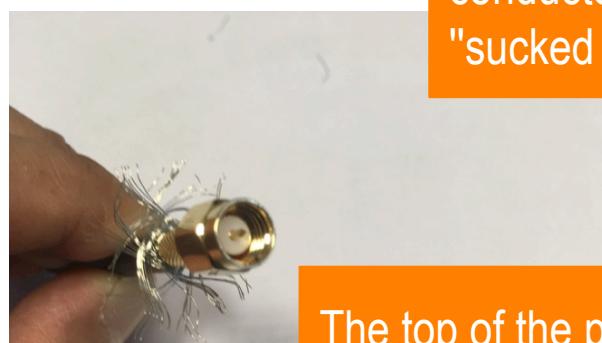
Remove 0.3cm of the inner plastic coating, cutting the aluminium coat as well. You see the signal wire



Insert the SMA connector, the pin goes in the center hole. Normally if you removed 1.3cm of coating plastic, it should fit just fine



insert the small pin that came with the connector on the center signal wire

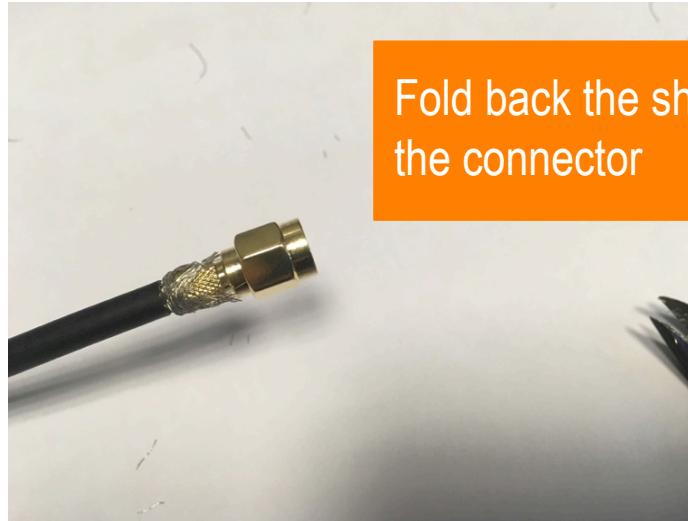


Solder the pin, there is a tiny hole in the pin, just heat up the pin and apply very little solder where the pin meets the center conductor...the solder will be "sucked in"

The top of the pin should not be "higher" than the connector, but also should not be too low



Cut about 4mm to 5mm of the shielding wire to make them shorter



Fold back the shielding wire on the connector



slide the sleeve so the shielding wire are being "stuck" between the connector and the sleeve, making good contact



trim any shielding wire that may come out of the sleeve at the end

Then use a crimper tool, see next slide



the crimper will squeeze the sleeve on the connector, start first at the end close to the connector. Be careful to not push the connector. Here we use the .213 hexa hole



Repeat the operation several time along the metal sleeve so that the entire sleeve is crimped, turning the cable to crimp at various places



This is what you get at the end. Now you have a custom antenna cable at the length that you need and with the correct SMA version to avoid using adaptors.

OTHER TUTORIALS

- <https://www.youtube.com/watch?v=yFEzE1H9kgQ>
- <https://www.youtube.com/watch?v=-ecWChhWTj4>
- Warning: you have to adapt these tutorials to the hardware part or model that you actually have

EXAMPLE 2: YOU NEED TO PUT AN N CONNECTOR

- Carefully choose the N connector. Take one where the pin (male or female) can be removed to be soldered to ensure maximum contact for better reception quality
- Here is a sample of the male version that will be used in this tutorial





As previously, remove the outer plastic coating and then the inner plastic coating. It may depend on your N connector model but this time cut the inner plastic coating very close to the shielding wire that should be folded back.



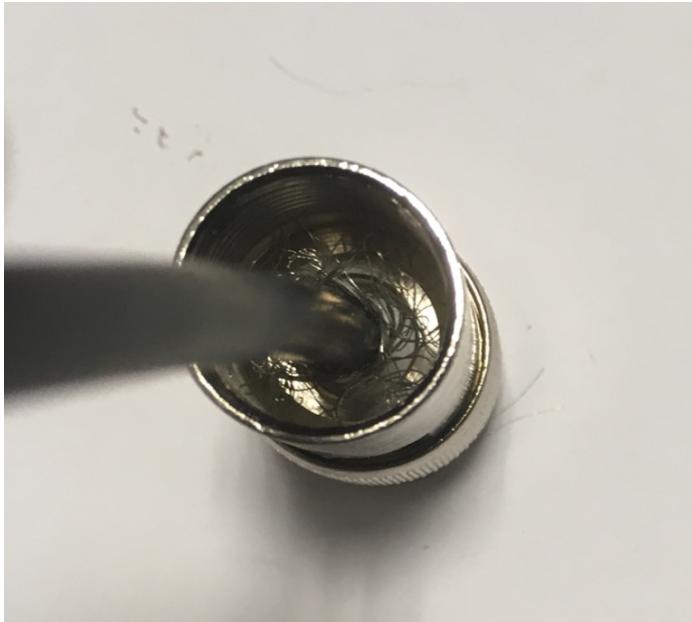
Look for the required length for the signal wire (mark where the pin stops). Here, it is about 5mm. Cut the signal wire to that length and the pin should now arrive very close to the coating. Be sure to not make any contact between the pin and the shielding wire.



Here again, solder the pin, there is a tiny hole in the pin, just heat up the pin and apply very little solder close to the hole. The solder will be "sucked in". As the pin is very close to the shielding wire, avoid applying solder where the pin stops, apply close to the hole.



This is what you have now, remember to pass all the screwing parts in the cable. The first element is usually a cone that will press the shielding wires to an inner cone in the connector.



Insert the pin in the center hole until it stops by itself. Normally the shielding wires should arrive right to the inner cone.



Screw firmly so that the shielding wires are pressed again the inner cone, making contact with the metal body of the connecteor..





At the end, we have a nice cable at the right length with the correct connector for the antenna and the radio module, without any intermediate adaptors.

Ex 3, BASIC WHIP ANTENNA WITH LONGER CABLE

- ☐ Taking the Modtronix inAir9, the antenna that you can buy with the module is usually a simple whip antenna in male SMA version



- ☐ The antenna can be connected directly to the radio module of the gateway but then gateway location is crucial

WAZIUP M SMA<-->F SMA CABLE

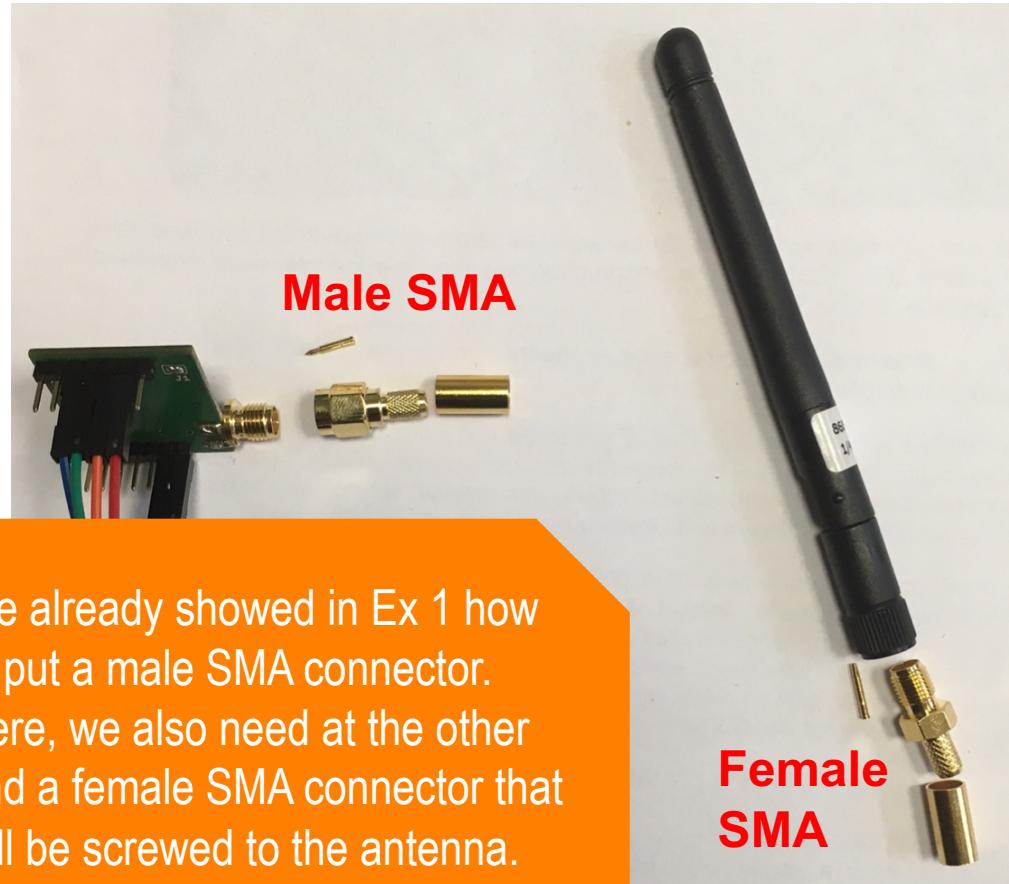


Outdoor antenna & indoor gateway



We already showed in Ex 1 how to put a male SMA connector. Here, we also need at the other end a female SMA connector that will be screwed to the antenna.

Procedure is quite similar to the male SMA case of Ex 1.



THAT CAN BE ALSO USED FOR END-DEVICES



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

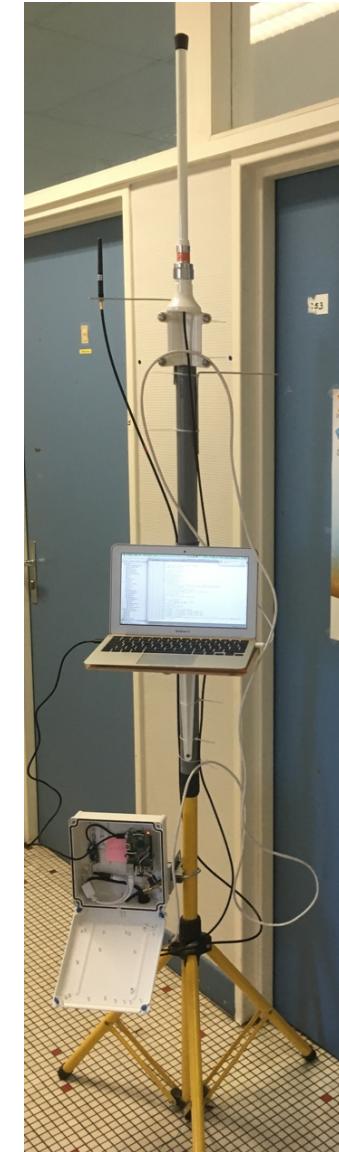
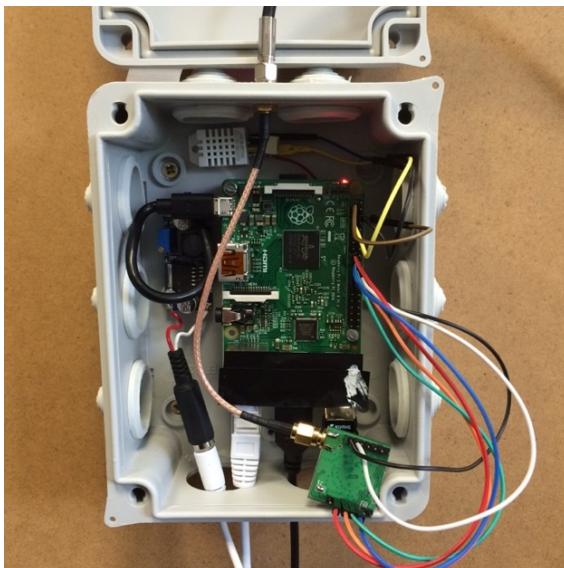
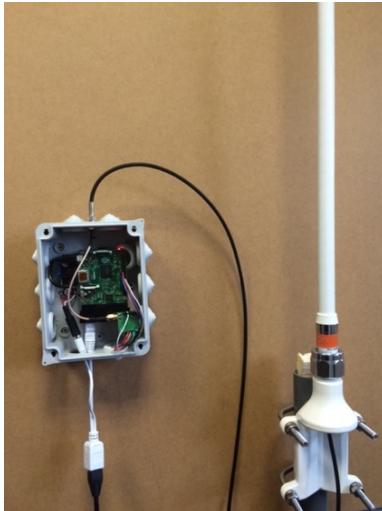
It is possible to use 1m or 2m of antenna coaxial cable. Take a good quality (e.g. RG58 minimum) to limit attenuation. 2m is reasonable but try to have it the shortest possible.



Look at the IoT device tutorial for instructions on how to build your end-device



OUR TEST BED



OTHER TUTORIALS

- https://www.youtube.com/watch?v=cAV_xhP3FNA
- <https://www.youtube.com/watch?v=WLzDsR31nws>
- <https://www.youtube.com/watch?v=AuqnCJByj78>
- Warning: you have to adapt these tutorials to the hardware part or model that you actually have