

# SatDuino – Range tests

## Testing of the communication system used in the SatDuino project.

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LoRa communication range tests were carried out with different libraries, antennas, different hardware and at different distances, comparing results on an equal footing so that we can draw conclusions as accurately as possible.

### OBJECTIVES:

- ❖ Find the best-performing library.
- ❖ Define which antenna is the highest performance and find out if the measuring tape antenna used in the PoketQube is suitable for communication.
- ❖ Find possible stability differences with different hardware.
- ❖ Check whether sending data through a data structure is effective.

### LIBRARIES AND HARDWARE:

The tests were performed with the following hardware:

- 1- CPU ATmega 32U4 with RF95 module
- 2- CPU ESP8266 with RF96 module
- 3- CPU ESP32 with LoRa SX1278 chip
- 4- BME 280 and GY 9250 sensors

5- 3dBi gain antennas, 5dBi gain antennas and a measuring tape antenna

The following libraries were tested:

- 1- LoRaNow
- 2- RadioHead
- 3- Heltec

### TEST CONDITIONS:

Tests with different hardware and software were performed on two different occasions, under the same conditions, to ensure reliable results. On the first occasion, the hardware used as emitter was at a height of 17m a.s.l., and the receiver (ESP32 with SX1278) was at a height of 9m a.s.l. in 4.9km tests and 7m a.s.l in 9.8km tests. On the second occasion, the hardware used as emitter was at a height of 1209m a.s.l., and the receiver was at a height of 9m a.s.l. in the 5.8km, 10km and 15.6km tests.

- In both cases, the parameters used in terms of RF transmission were:
- Frequency: 433MHz
- Spreading Factor(SF): 11
- Transmission power: 13dBm (20mW)
- Bandwidth: 500kHz

### CONCLUSIONS:

From the results obtained we can conclude that the LoRaNow library does not work properly. Over short distances it behaves in an unstable manner, sometimes without even being able to establish a communication, and at distances of 5km or more you cannot establish a communication using it. On the other hand, the Heltec and RadioHead libraries have an even performance, but the latter can be defined as the most suitable due to its simplicity, organization and greater compatibility.

In the same way, there were also no significant differences in the use of different hardware, using the ESP32 with LoRa SX1278 chip, or ATmega 32U4 with RF95 module with or without sensors (different payload) as an emitter, similar results were obtained. With the exception of the ESP8266 with RF96 module, with which a test communication could not be established at 5km or more. Reading sensors, sending through a data structure, receiving and uploading data to the internet was successful over the three distances evaluated. As for the antennas, a slight superiority in the signal strength received on the 3dBi antenna was observed over the 5dBi antenna. Finally, the measuring tape antenna used in the PoketQube performed well, with stable reception and no packet loss, although with a signal strength slightly lower than the other antennas.

### REFERENCES

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