



Indoor Geolocation with LoRa 2.4 GHz

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Outline

- Context, general issues and methodology
- Technologies used
- Existing solution : Ranging
- Our code changes, protocol and measurement results
- Conclusion

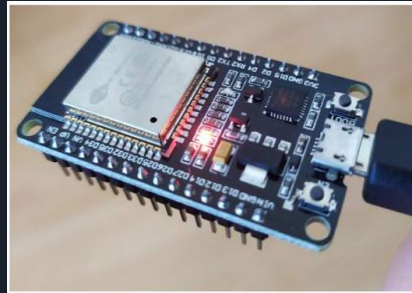


Context, general issues and methodology

- Context : several tools of geolocation (GPS , ...) sometimes very expensive
- Our project : test the accuracy of the measurement of distances between transmitter and receiver with LoRa 2.4
- Divide the project into different stages :
 - 1) Understand the issues, technologies and material test
 - 2) Take note of existing solutions and define our measurement protocol
 - 3) Measuring, studying results and find conclusions

Technologies Used

- LoRa 2.4GHz : Wireless platform of IoT. Allow to transmit small quantities of data over large distances
- TinyGS, ESP-32 and antennas : all the material that we need to take measures ...
- Arduino: Software and useful libraries



Existing Solution: Ranging

- Based on Round Trip Time-of-Flight (RTToF)

- Distance can be calculated using

$$\text{Distance} = \text{Speed} * \text{Time}$$

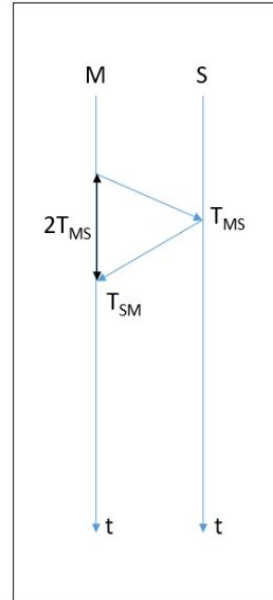


Figure 3: RTToF Distance Measurement



Our code changes, protocol and measurement results

- Protocol : choose 2 points in a map, theoretical calculation, a lot of measures with different conditions
- Code changes : RTT calculation
- Ranging code and measures : different places and modification of spreading factor and bandwidth
- Interpretation of results :

-The value of the Spreading factor can influence the distance between slave and master

-The value of bandwidth can also modify the measures.

Master output example for a SP = 10 and BW = 800

```
Start Ranging
Valid,Register,11755,Distance,529.8 m, ,RSSIReg,33,RSSI,-117dBm
Start Ranging
Valid,Register,11408,Distance,514.2 m, ,RSSIReg,32,RSSI,-118dBm
Start Ranging
Valid,Register,11624,Distance,523.9 m, ,RSSIReg,33,RSSI,-117dBm
Start Ranging
Valid,Register,11738,Distance,529.1 m, ,RSSIReg,33,RSSI,-117dBm
Start Ranging
Valid,Register,11163,Distance,503.1 m, ,RSSIReg,33,RSSI,-117dBm,TotalValid,34,TotalErrors,91,AverageRAWResult,11537,AverageDistance,520.0
Start Ranging
```



Conclusion

- LoRaWAN can be an alternative to the geolocation tools we already know
- Measures around 500 meters are very precise but the accuracy decrease with distance
- Obstacles between the two cards can cut communication (Fresnel Zone)
- LoRa network allows independence from US satellites