I. INTRODUCTION

The usage of LPWAN in recent years is rising for communication across the sensor node in Wireless Sensor Network (WSN) technology (U. Raza, P er al.,2017) Low-Power Wide-Area Network (LPWAN) is radio frequency technology that can transmit long-range signals for wide area coverage using low power resources. This feature is very powerful for indoor or outdoor communication protocol with a wide area and many obstacles(D. Croce et al, 2018). One of the technologies that implement the LPWAN mechanism is LoRa. This technology is very cheap for LPWAN technology compared to Sigfox or NB-IoT (I. W. K. Bima et al, 2020). LoRa used unlicensed radio frequency and each country has the regulation about the LoRa radio frequency.

The LoRa technology can reach up to 5 KM in an urban area and 15 km in rural areas (R. Oliveira, L. et al, 2017) . LoRa network topology can be applied in two modes, there is star and mesh topology. Each topology has a gateway that used to get all data from all nodes that connect in LoRa Network. The gateway is also useful as a packet forwarder from non-IP based network to an IP based network. This research will used mesh topology for communication between nodes. A single node (end node) when transmitting data to gateway need to communicate with each other node. Each other node with the closest distance will forward data from the end node to the gateway. The other node that closest distance and help end node to forward data called by Base Station (BS)(H. Lee and K. Ke, 2018). The LoRa network have some configuration in physical layer, there are Carrier Frequency (CF) for setting the radio frequency from LoRa, Spreading Factor (SF) for determining the number of chirps used to represent a symbol, Bandwidth (BW) for representing the amount of frequency when transmitting, Coding Rate (CR) for handle packet error rate (M. Turmudzi et al, 2019).

One feature in radio-based communication is can be used as a localization system. The localization system usually using GPS to get the latitude and longitude from objects to mark its position on earth (L. J. V. Uffelen et al, 2016). GPS has some drawbacks when detecting the location in the NLOS environment. First, The GPS not working well in indoor location because the satellite signal will block by building material like brick, metal, stone or wood (K. Lam et al, 2017). Second, The GPS considers the mountains or hilly area to be a noise because the contour of the area is bumpy so the GPS is difficult to get signal from satellite (B. C. Fargas and M. N. Petersen, 2017). Based on the problem, this research uses other technology to implement a localization system that supports for NLOS environment.

This research will use LoRa to build a localization system. LoRa is based on radio frequency, the radio signal from LoRa has a Received Signal Strength Indicator (RSSI) as signal strength parameter (G. A. Naik et al, 2012). The parameter can be used to determine the position of the object when it enters the LoRa network. The advantage used of LoRa for the localization system is a wide range of area coverage and low power usage. The other advantage is LoRa is cheap and easy for use because of no requiring additional processing power (É. Morin et al, 2017).

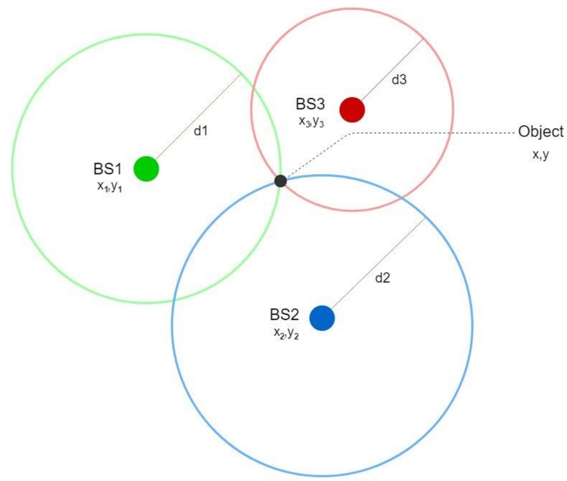

Fig. 1. Determine position from object using RSSI (N. A. Azmi et al, 2018)

The popular method for localization system based on radio frequency is RSSI, but this method needs an algorithm to process RSSI data into a location of objects (K. Lam et al, 2018). Trilateration can process RSSI values that have been converted into distances to be processed into coordinates of objects. This algorithm needs a three-point coordinate of BS from LoRa (M. Md. Din et al, 2018). Each BS from LoRa has a radius, so it can be described as a circle. Trilateration is calculated as the intersection point of the three circles from LoRa BS to determine the (x,y) coordinate from the object. The determination of the position of an object using three BS of LoRa can be seen in Fig 1.