Localization is an interesting topic with lots of potential applications nowadays. Global positioning system (GPS) provides worldwide localization but it requires line of sight to multiple satellites. Indoor scenarios or other situations in which GPS is ineffective need to be covered. It is wanted to provide an accurate localization method for those situations.

The location method proposed is estimated by the time difference of arrival (TDOA). To calculate the TDOA it is necessary one central base station (CBS), which computes it, and cooperative relays, at least two. The traditional way consists on sending the whole signal, received by the relays, to the CBS, and then do the cross correlation to estimate the TDOA.

Cooperative communications play an important role in this scenario, forwarding the signal to the CBS. In non line of sight conditions, they can forward the information to the CBS and could improve the communication due to the spatial diversity.

Indoor localization requires a high precision estimation. To perform a system that could provide that precision it is worked with ultra wide band (UWB), which allows accuracy on the range of centimeters. Orthogonal frequency division multiplexing (OFDM) technology is a multicarrier technique with block structure which has a good time resolution due to wideband transmission, is the technology used on the communication protocol.

The conventional method has two main problems that are the large amount of bandwidth required for the localization process and the power consumption for the cooperative mobile relays, which is a critical resource for them. Those problems are as a consequence of working with the whole transmitted data. The scope of this thesis is to provide a new method which could provide an accurate TDOA estimation for localization and to be bandwidth and computational efficient in order to save power consumption for the mobile devices.

Two new methods are provided.

The first one is called Feature Method. Taking advantage of the block structure of the OFDM technology it is possible to extract a statistic feature for each received symbol, and join together all of them to create the “feature signal” which will be the signal transmitted and cross correlated to estimate the TDOA, instead of using the raw data. Different features were tested, like mean, variance, skewness, kurtosis, mean of the symbol phase, variance of the symbol phase, and peak to average power ratio (PAPR). PAPR is the feature which has the best performance as a consequence of its high value feature signal, the most robust against noise. It is a bandwidth efficient method and provides better results in low SNR conditions than the conventional one.

The second one and the most important contribution of this thesis is the “trigger relay with pilot signal method”. It is proposed a new relay called trigger relay, which forwards a known OFDM signal, called pilot signal, at the moment when it receives the incoming signal from the source. This idea provides a simple system for the cooperative relays which made this method the most bandwidth and computational efficient. Different parameters of the pilot signal could be modified in a tradeoff between improving TDOA accuracy and losing efficiency. The most important one is the amplitude. Even in low SNR conditions, increasing the amplitude could provide acceptable TDOA estimations with a tradeoff of increasing the power consumption.