Claims

What is claimed is:

1. A method for ranging using orthogonal frequency division multiplexed (OFDM) signals, the method comprising:

receiving a first OFDM signal at a receiver at a first bandwidth;

measuring a signal power of each of a plurality of symbols of subcarriers for the first OFDM signal;

determining a signal anomaly in the first OFDM signal based on the signal power of each of the plurality of symbols in the first OFDM signal;

increasing the first bandwidth to a second bandwidth;

receiving a second OFDM signal at the second bandwidth;

calculating a range from a transmitter of the second OFDM signal to the receiver based on the second OFDM signal at the second bandwidth.

2. The method of claim 1, wherein the first OFDM signal and the second OFDM signal comprise at least one of 4G. 5G LTE, or WiFi signals.

3. The method of claim 1, wherein the first bandwidth comprises a first number of subcarriers being assigned to the receiver and the second bandwidth comprises a second number of sub-channels greater than the first number of subcarriers being assigned to the receiver.

4. The method of claim 1, wherein the signal anomaly comprises multipath signal propagation and the determining comprises:

measuring a difference between the highest measured signal power and the lowest measured signal power for the plurality of symbols and comparing the difference to a threshold flatness value.

5. The method of claim 1, wherein the plurality of symbols comprise positioning reference signals of the OFDM.

6. The method of claim 1, wherein the plurality of symbols comprise positioning reference signals and at least one other symbol of the OFDM.

7. The method of claim 6, wherein the at least one other symbol of the OFDM comprises a data symbol encoding transmitted data from the transmitter to the receiver.

8. The method of claim 1, further comprising:

measuring a signal power of each of a plurality of symbols of subcarriers for the second OFDM signal;

determining a slope corresponding to the difference in phase of the plurality of symbols of subcarriers for the second OFDM signal relative to frequency of the OFDM signal; and

calculating a transmission delay based on the slope that is used to determine the range.

~~9. A method for ranging using orthogonal frequency division multiplexed (OFDM) signals, the method comprising:~~

~~receiving at a receiver a first OFDM signal having a first signal to noise ratio (SNR);~~

~~determining a first number of reference symbols to use to determine a first range between a transmitter of the first OFDM signal and the receiver;~~

~~receiving at the receiver a second OFDM signal having a second SNR that is greater than the first SNR;~~

~~determining a second number of reference symbols to use to determine a second range between a transmitter of the second OFDM signal and the receiver, wherein the second number of reference symbols is greater than the first number of reference symbols.~~

~~10. The method of claim 9, wherein the first number of reference symbols comprises a single position reference signal (PRS) of the first OFDM signal and the first range is determined using an observed time difference of arrival correlation method relative to the single PRS.~~

~~11. The method of 2xl, wherein the second number of reference symbols comprises a plurality of PRSs and the second range is determined using a calculated slope of the phase differences of the plurality of PRSs.~~

12. The method of claim 9, further comprising:

receiving at the receiver a third OFDM signal having a third SNR that is greater than the second SNR; and

determining a third number of reference symbols to use in relation to determine a third range between a transmitter of the third OFDM signal and the receiver, wherein the third number of reference symbols is greater than the second number of reference symbols.

13. The method of claim 12, wherein the third number of reference symbols comprise a plurality of PRSs and at least one other symbol of the third OFDM signal and the third range is determined using a decision feedback approach.

14. The method of claim 13, wherein the at least one other symbol of the OFDM signal comprises a data symbol encoding transmitted data from the transmitter to the receiver.

15. A method for ranging using orthogonal frequency division multiplexed (OFDM) signals, comprising:

first receiving a first OFDM signal having at least one positioning reference signal (PRS);

determining a coarse time reference using an observed time difference of arrival (OTDOA) correlation applied to the first OFDM signal;

second receiving a second OFDM signal having a plurality of positioning reference signals;

determining a phase slope of the plurality of positioning reference signals (PRSs) relative to frequency based on the coarse time reference; and

calculating a fine time reference having an accuracy greater than the coarse time reference using the phase slope of the plurality of PRSs.