Benefits of Channel Sounding

Channel Sounding, previously referred to as High Accuracy Distance Measurement (HADM), uses Phase-Based Ranging (PBR), Round Trip Time (RTT), or both to accurately measure the distance between two Bluetooth Low Energy connected devices.

It enables connection-oriented 2-way ranging.

Supports up to four antenna paths between devices - minimizes multipath effects and enhances accuracy.

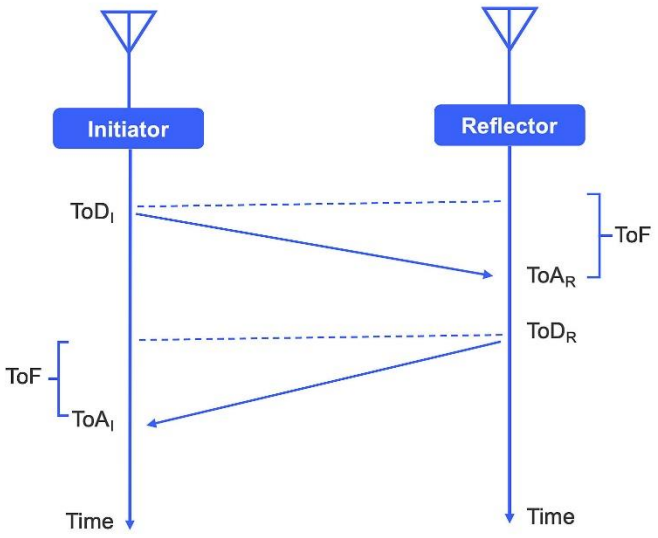
Offers enhanced built-in security features to mitigate the risks of man-in-the-middle or relay attacks.

How Does Channel Sounding Work?

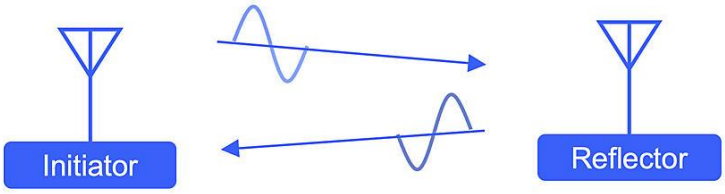
Channel sounding is a method for estimating distances between two devices, designated as the initiator and the reflector. They exchange information across 72 RF physical channels, with the initiator transmitting first, followed by the reflector's response. This alternating transmission and reception enable precise distance measurements. The technique employs Phase-Based Ranging (PBR) or Round-Trip Time (RTT) or both for accurate coordination across the 2.4 GHz spectrum. It also supports one to four antenna paths to improve measurement accuracy and reliability.

Round Trip Time (RTT)

Round trip time (RTT) in a communication channel refers to the duration a signal takes to travel from the initiator to the reflector and back again. By assessing the Time of Flight (ToF) — the time it takes for a packet to be exchanged between the initiator and the reflector — the distance can be estimated. To achieve this, both devices record the Time of Arrival (ToA) and the Time of Departure (ToD). Analyzing the differences between ToA and ToD for both the initiator and the reflector provides the data necessary for a reliable distance calculation. Additionally, in terms of security, since time cannot be reversed, RTT is considered highly secure.



$$RTT = 2\,ToF = (ToA_I - ToD_I) - (ToD_R - ToA_R)$$



Phase-Based Ranging (PBR)

Phase-Based Ranging (PBR) utilizes the principle of phase rotation in RF signals to determine distances. In this process, the initiator sends a signal with specific frequency and amplitude information, and the reflector measures the phase of this received signal before sending a response. By comparing the phase differences between the signals from both devices, their relative distance can be determined. PBR offers a significant security advantage, especially compared to methods like RSSI (Received Signal Strength Indicator). The complexity of manipulating phase information makes PBR a more secure technology for distance measurement.

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