Demo: Novel Round Trip Time estimation in 5G NR using OpenAirInterface

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***Abstract*—The fifth generation new radio (5G NR) technology is expected to fulfill reliable and accurate positioning requirements of industry use cases, such as autonomous robots, connected vehicles, and future factories. The Third Generation Partnership Project (3GPP) introduced positioning techniques from Release-16 based on time, angle, and signal strength using reference signals. Timing-based 5G position methods include Enhanced cell ID (E-CID), Downlink time difference of arrival (DL-TDoA), Uplink time difference of arrival (UL-TDoA), and Multi-cell or single-cell round trip time (RTT). Unlike TDoA methods, RTT-based methods do not require tight synchronization among participating base stations. In this demo, we showcase a prototype that implements our proposed novel round trip time estimation mechanism for next-generation 5G systems. The proposed mechanism allows to obtain multiple channel measurements at the gNB that can be combined coherently. The complete 5G radio access network solution is based on open-source software from OpenAirInterface.**

I. Prototype Description

The setup consists of a base station (gNB) and user equipment (nrUE) leveraging the OpenAirInterface (OAI) 5G NR protocol stack [1]. The prototype incorporates a novel round trip time (RTT) mechanism introduced in [2], [3]. The mechanism involves the nrUE synchronizing with the downlink synchronization signal block (SSB) and transmitting a wideband reference signal known as a sounding reference signal (SRS), as depicted in Figure 2. More details on the proposed RTT estimation scheme and the performance results at high and low SNR scenarios can be found in [2], [4].

A real-time implementation of the proposed method using OAI will be demonstrated using a rfsim mode, where the over-the-air transmission between the gNB and nrUE is simulated by transferring the time domain orthogonal frequency division multiplexing (OFDM) waveform over a socket as shown in Figure. 1. The variation in the distance between the gNB and nrUE can be simulated in real-time using a graphical tool, and the estimated distance will be displayed. The system parameters used for this demonstration are specified in Table. I.

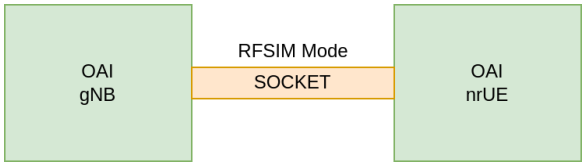

Figure 1. Block diagram of the demo setup.

Table I
System Parameters

Parameters	Values
System bandwidth	38.16 MHz
Subcarrier Spacing	30 KHz
Centre frequency	3.69 GHz
Sampling rate	46.08 MHz
FFT size	1536
Cyclic prefix	132
SSB bandwidth	7.2 MHz
SRS bandwidth	37.44 MHz
SRS comb size	2

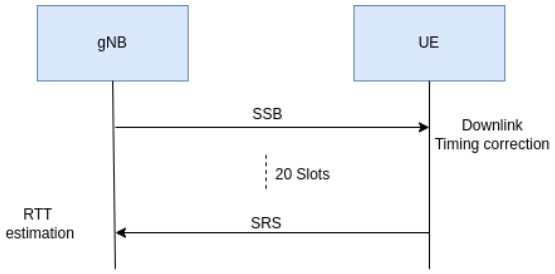

Figure 2. RTT implementation in OAI phy-test mode.

References

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