Enhanced Positioning with 5G Radio Access

Objective: Design positioning reference signals for 5G Radio Access Technology

Background: Location-based services and emergency call positioning drives the development of localization techniques in wireless networks. Global Navigation Satellite System (GNSS)-enabled terminals are capable of determining the outdoor positions within few meters of accuracy, and a plethora of applications and services in terminals take advantage of such accurate positioning (as shown in Figure 1). Positioning support in LTE (for 4G cellular networks) was introduced in 2008. It enables telecom operators to retrieve position information of users for location-based services and to meet regulatory emergency call positioning

Figure 1: Location Based Services

requirements. In currently deployed LTE networks, the User Equipment (UE) position is determined based on a combination of enhanced cell identity (E-CID), Observed Time Difference of Arrival (OTDOA) and Assisted GNSS (A-GNSS) information from the UE.
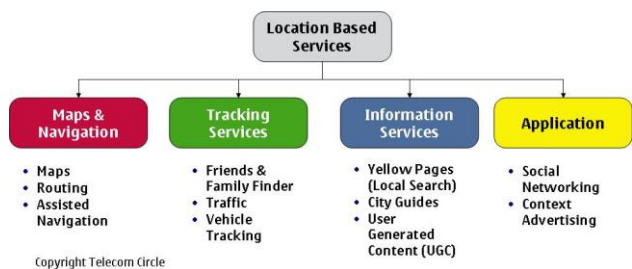
OTDOA is a UE-assisted method, in which the UE measures the time of arrival (TOA) of specific Positioning Reference Signals (PRS) transmitted by cellular base stations and reports the measured TOA estimates to the location server. The location server determines position of the UE using multilateration based on the TOA measurements of the PRS received from at least three base stations and known location of these base stations. Figure 2 gives a graphical illustration of OTDOA. Further details related to positioning via OTDOA method can be found in [1].
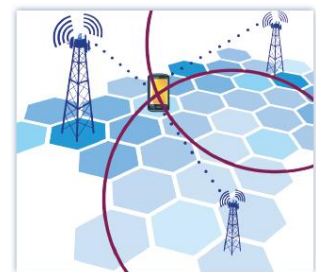

Figure 2: Multilateration

The positioning accuracy in OTDOA method depends on various factors e.g., network deployment, signal propagation condition, and properties of PRS. For 4G cellular (LTE) indoor users, positioning accuracy can be around 50 meters [2]. For upcoming 5G systems, positioning requirements are much stringent (less than 1 meter accuracy for both indoor and outdoor users which include humans, devices, machines, vehicles etc) [3], [4]. For a given deployment and propagation scenario, significant improvements in positioning accuracy is achievable by appropriately redesigning positioning reference signals for 5G radio access technology, termed as New Radio (NR). NR is currently being standardized and is expected to be operational by 2020.

Project Description & Required Skills: The project focuses on designing positioning reference signals and developing associated signal estimation/detection techniques to achieve the 5G target of sub 1 meter localization accuracy. This work involves theoretical and applied knowledge of signal synthesis, analysis, and estimation/detection, as well as proficiency in computer programming. The applicants for this project will be assessed based on the following merits:
- Desire to embrace challenging research work and produce timely results
- Strong background in Signal Processing, Estimation & Detection Theory
- Proficiency in both MATLAB and C++ Programming
- Prior experience or a decent understanding of OFDM waveform

References:

[1] http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.713.9158&rep=rep1&type=pdf

[2] Ericsson Research Blog: https://www.ericsson.com/research-blog/lte/indoor-positioning-in-lte/

[3] NGMN 5G White Paper:https://www.ngmn.org/uploads/media/NGMN_5G_White_Paper_V1_0.pdf

[4] 3GPP TR 38.913, "Feasibility study on scenarios and requirements for next generation access technologies".
https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=2996