Track8 - Long System Description

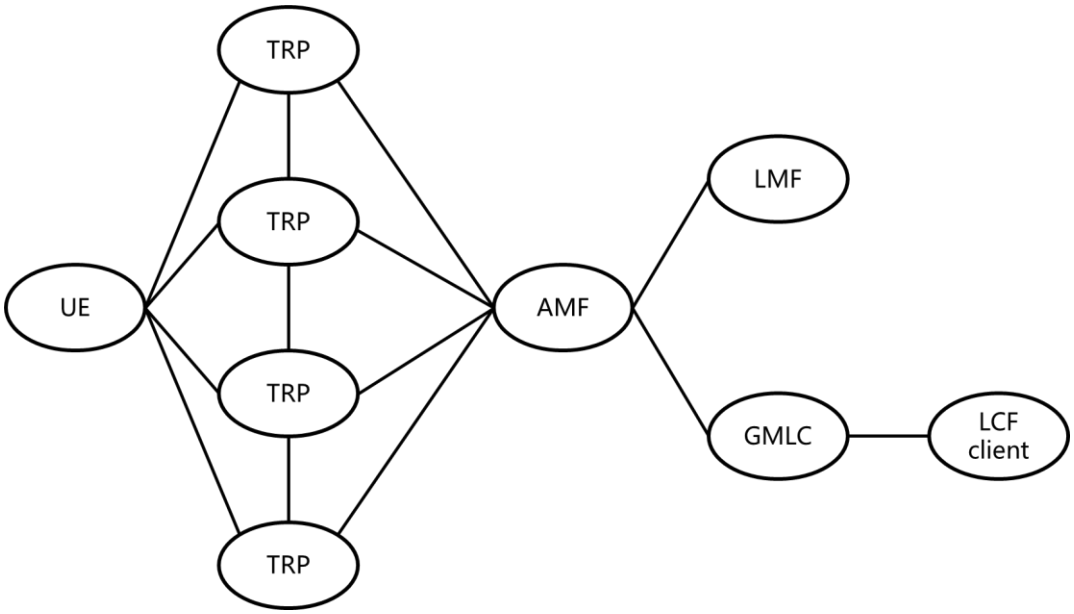
DYS-BUPT

In recent years, with the rapid development of mobile communication technology, location-based service (LBS) is playing an increasingly important role in people's daily life. As an essential field of LBS, indoor positioning and navigation have received widespread attention.
Researchers have proposed different indoor positioning technologies worldwide, including Wi-Fi, Bluetooth, UWB, Pedestrian Dead Reckoning (PDR), image, and mobile communication networks. Among them, indoor positioning technology based on cellular networks has the following advantages over other positioning technologies: 1. comprehensive coverage, 2. a unified standard, 3. no need for additional positioning equipment and terminals. As New radio (NR) positioning is becoming increasingly important in public and commercial use cases, the positioning services are classified into seven levels with accuracy ranging from 0.2m to 10 m depending on the service requirements.

Recently 3GPP approved a work item to study the requirements of devices with high accuracy positioning. All the standards in 3GPP are to enable NR positioning competitive with existing short-range positioning technologies in aspects of accuracy. Moreover, 5G positioning networks can be deployed as an additional feature to the existing 5G cellular network to enable positioning and communication functions to share the same network. Hence, NR positioning will cost lower than UWB or Bluetooth in network deployment.

So far, many 5G positioning techniques have been standardized for user equipment (UE) positioning using 5G signals. Above all those techniques， both downlink time difference of arrival (DL-TDoA) using positioning reference signal (PRS) and uplink time difference of arrival (UL-TDoA) using sounding reference signal (SRS) are becoming the better solutions for its higher accuracy.

For IPIN2022, the competition organizers require to use ToA measurements from TRP receiving the SRS to implement UL-TDoA to estimate the location of UE. UL-TDoA and DL-TDoA are very similar except for the signal resource and the signal flow. The positioning method process of UL-TDoA using SRS is shown in Figure 1:



The location management function (LMF) is the location server to perform location estimation based on UE measurements or transmit-receive point (TRP) measurements. The gateway mobile location center (GMLC) is the interface to Location service clients (LCS clients) for location requests or responses. The authentication management function (AMF) performs the routing function and can select which LMF to work for UE. For UL-TDOA positioning, TRP measures the TOA of the first path and related measurement quality in the uplink SRS and reports the measurements to LMF through the new radio positioning protocol A (NRPPa). As a result, LMF calculates TDOAs based on the measured TOAs and then estimates UE location based on the TDOAs.

Because the competition organizers have not provided the training set yet, we will only illustrate our ideal plan for the test scheme. According to the information provided by the Preliminary of Track 8, we can directly use ToA measurements measured from the four TRPs in the test scenario. Based on ToA data and actual positions at each timestamp, we will develop our error model after the training set is released, which will be implemented in the official contest. When the official contest begins, based on the error model we developed, we will calibrate the ToA data in the test set, which will make the estimation more accurate. After the calibration, the positioning system will eliminate the data points with significant biases to maintain the stability of the input data and thus ensure the robustness of the positioning estimations.

After completing the preprocessing of the input data in the test set, we will use input data to perform the position solving algorithm and use the approximate positioning range calculated by the RSRP to calibrate the results by removing the outliers. In addition, because the UE in the test scenario moves at a slow speed (0.2-0.5m/s), we will apply the Kalman filter to optimize the positioning result further to fulfill the expected performance.