Track 8: "5G in open-plan office (off-site)" Special features

1. Organizational aspects:

Database/dataset download

Measured samples are at https://evaal.aaloa.org/2023/data
Competitors can only use the data provided for the competition in the website. Performing any additional on-site calibration is not allowed.

2. Track description

Positioning is one of the main characteristics of the 5G system to enable smart applications across different industries based on locations. Track 8 is dedicated to explore high accuracy 5G positioning in typical indoor open-plan office scenario.
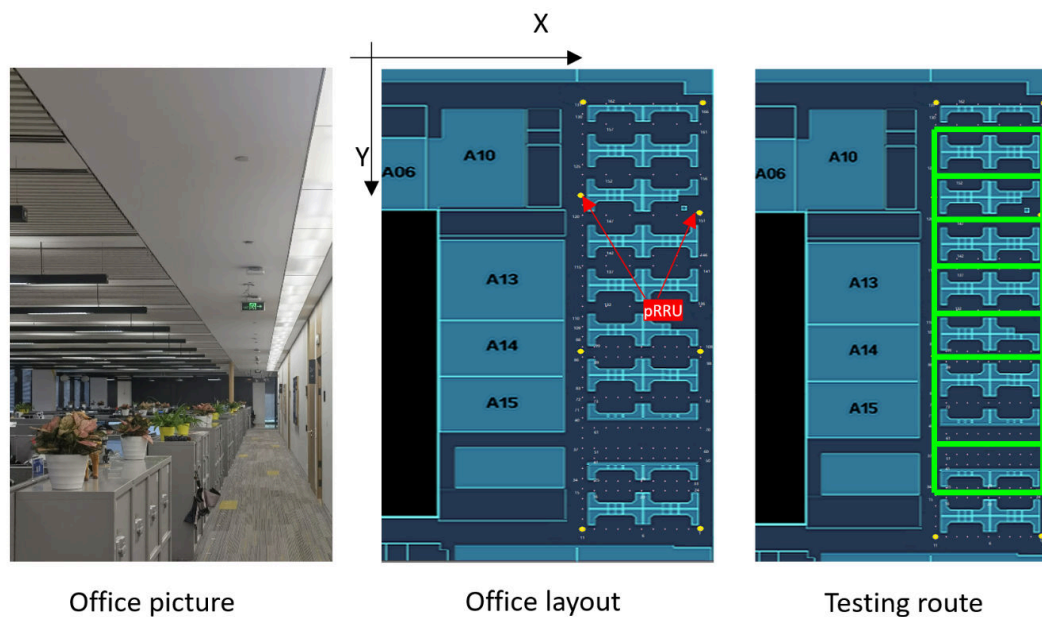

Office picture   Office layout   Testing route

Figure 1: Testing environment

The Huawei 5G positioning system is deployed in an indoor office in the Huawe-Chengdu Research Center. The testing area is about 15 meters width and 40 meters long. Eight pico Remote Radio Units (pRRUs) with known locations are mounted on the ceiling as shown in the above figure (yellow dots). The User Equipment (UE) is a Huawei Mate 40 mobile phone. The testing route is shown as green lines in the right figure above. There are different kinds of objects scattered within the office, including desks, chairs, separator plate, cabinet and even flowers with height ranging from 0.5m to 1.5m. These scatters might cause dense multipath making it a critical environment for high accuracy positioning.

During the testing, different cases have been considered, including a person holds the phone,

the phone is fixed on a stick and the phone is in the pocket. The data is collected modeling the normal situations in the office, such as straight walking, speed up, slow down, stops and turns. During the testing route, the line-of-sight (LOS) path between UE and some pRRUs might be blocked by those objects. Hence there may exist a mixture of LOS and none-line-of-sight (NLOS) channels. Strong multi-paths may also exist due to reflections from the environment such as concrete walls, metallic cabinets, and other objects.

3. Measurement information

The UE transmits Sounding Reference Signal (SRS) in a period of 240 ms. Based on the SRS, the pRRUs measure the uplink time-of-arrival (ToA) and reference signal receiving power (RSRP), which could be used for location calculation. Eight sets of data are collected and divided into four groups, i.e., Test A, Test B, Score A and Score B. Each group contains two sets of measurements and each set contains about 3000 measurements (about 10 minutes long) with 200-300 ground-truth positions. Ground-truth positions are only given for the testing sets. The ToA is measured by using the MUSIC algorithm with a known accuracy about 1ns in a LOS environment. There are existing timing errors between the pRRUs, called time alignment errors (TAEs). The TAEs between the pRRUs are unknown, but should be within the range [-100ns, 100ns].

4. Potential localization approaches

- UL-TDOA: The approach is to develop advanced algorithms to estimate UE locations as well as TAEs based on the measurements.

- Energy-based position: Based on the relationship between the received signal power and propagation distance, the distance relationship between the UE and different pRRUs can be obtained and used for localization.

- AI localization: AI positioning has been widely studied and it is able to build a mapping scheme between location and measurements by machine-learning algorithms and neural-networks.

- Other innovative approaches are not limited to achieve high-accuracy positioning.

5. Description of the Datasets
The data set is a .csv file containing multiple columns of ToA and RSRP measurements as shown in Figure 2

Figure 2: Dataset illustration

Column A to column C show the timestamps of each measurement:

- Column A: the timestamp in hour-minute-second

- Column B: the SRS system frame number of the 5G system

- Column C: the SRS subframe number of 5G the system

Column D to column K show the ToA measurements of all the pRRUs from pRRU1 to pRRU8, respectively. The ToAs are given in unit of ns.

Column L to column S give the RSRP measurements of all the pRRUs from pRRU1 to pRRU8, respectively. The RSRP measurements are given in unit of dBm.

Column T and column U denotes the x and y coordinates of the UE in unit of centimeter, respectively. It should be noted that (0, 0) denotes that the ground truth location is unknown and none zero values represent the ground truth location.

The coordinates of the pRRUs' locations are shown in the following table.

Table 1: The coordinates of the pRRUs

pRRU ID	X (m)	Y (m)	Z (m)
1	999	2532	312
2	278	2536	312
3	367	3410	312
4	1000	3414	312
5	1000	100	312
6	264	89	312
7	276	1420	312

8	996	1423	312

6. Description of the output

The estimated 2-D location (x,y) of the UE at each row with unit of centimeter. During the location estimation, the UE's height can be fixed as 1.5m. Organizer will check the positioning error of all the points with ground truth locations in the scoring sets. The competitor with smaller positioning error at 75% CDF wins.

7. Evaluation criterion

The organizer provides the true UE location, and calculate the location errors.

8. Contact information criterion

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