

Movable Base Station V.S. Fixed Base Station



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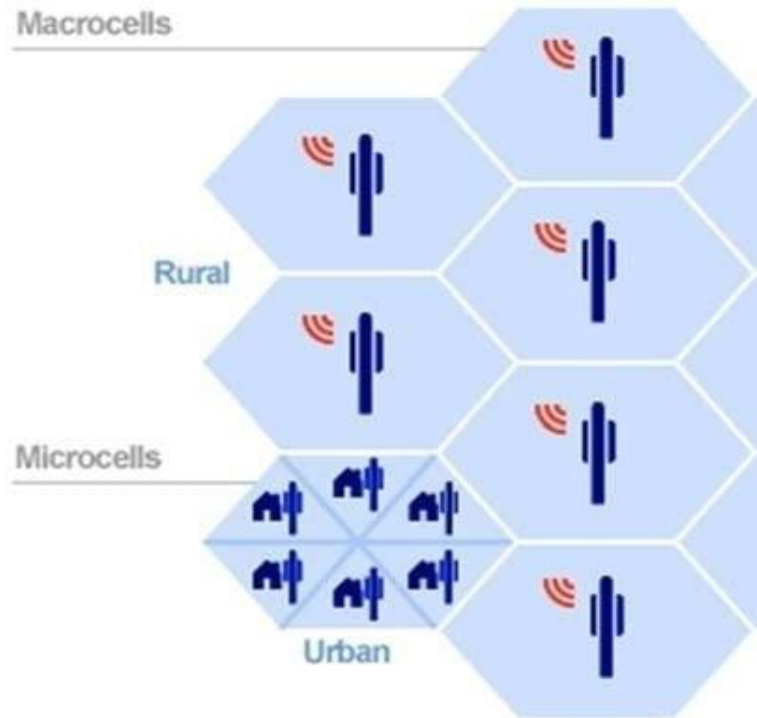
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Journées non thématiques du GDR RSD

Outline

- ▶ Motivation
- ▶ System model
- ▶ Performance comparison

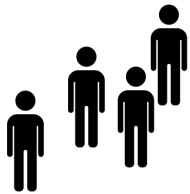
Fixed BS



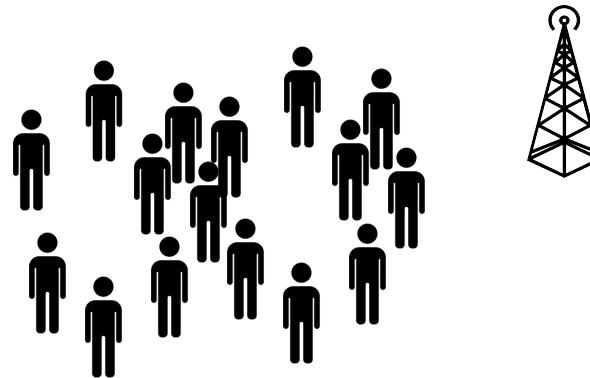
- ▶ Carefully planned
- ▶ Deploy and maintain by humans
- ▶ Fixed position & capacity

Limit for Fixed BS

- ▶ Human intervention needed when unpredicted event comes



Problem of infrastructure



Network saturation

Movable BS

- ▶ Many researches on this issue
 - ▶ To optimize the movable BS placement [1]
 - ▶ To maximize the movable BS coverage [2]
 - ▶ ...
- ▶ A literature of ~60 papers, no one has compared the performance of a movable BS and a fixed BS.

[1] M. Mozaffari, W. Saad, M. Bennis, and M. Debbah, "Efficient Deployment of Multiple Unmanned Aerial Vehicles for Optimal Wireless Coverage," *IEEE Communications Letters*, vol. 20, no. 8, pp. 1647-1650, 2016.

[2] A. Al-Hourani, S. Kandeepan, and S. Lardner, "Optimal LAP Altitude for Maximum Coverage," *IEEE Wireless Communications Letters*, vol. 3, no. 6, pp. 569-572, 2014.

Context

- ▶ ANR DEMON project (leader : Razvan Stanica)
- ▶ Auto-deployable mobile network with movable base stations
- ▶ How to manage the base station mobility ?

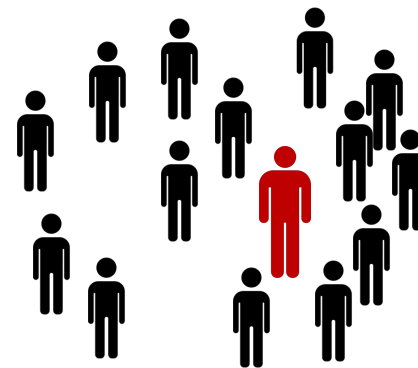
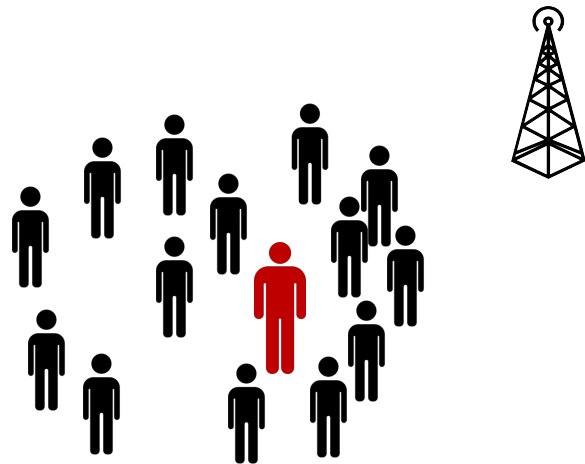
- ▶ First of all, is movable base station better than fixed base station ?
What does it bring us ?



Scenario



Unlimited backhaul capacity

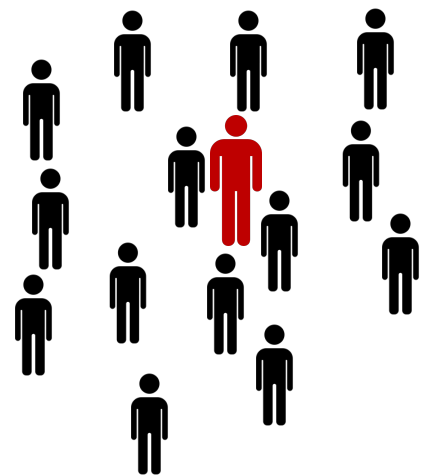


Leader



Member

Scenario



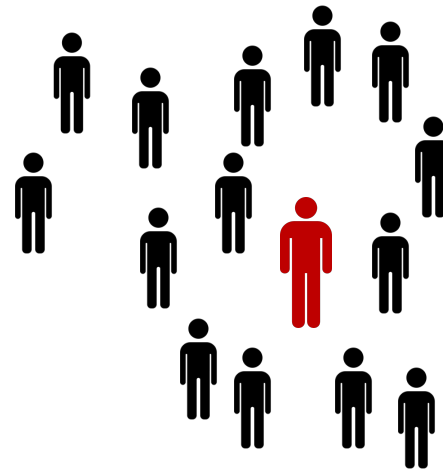
Leader



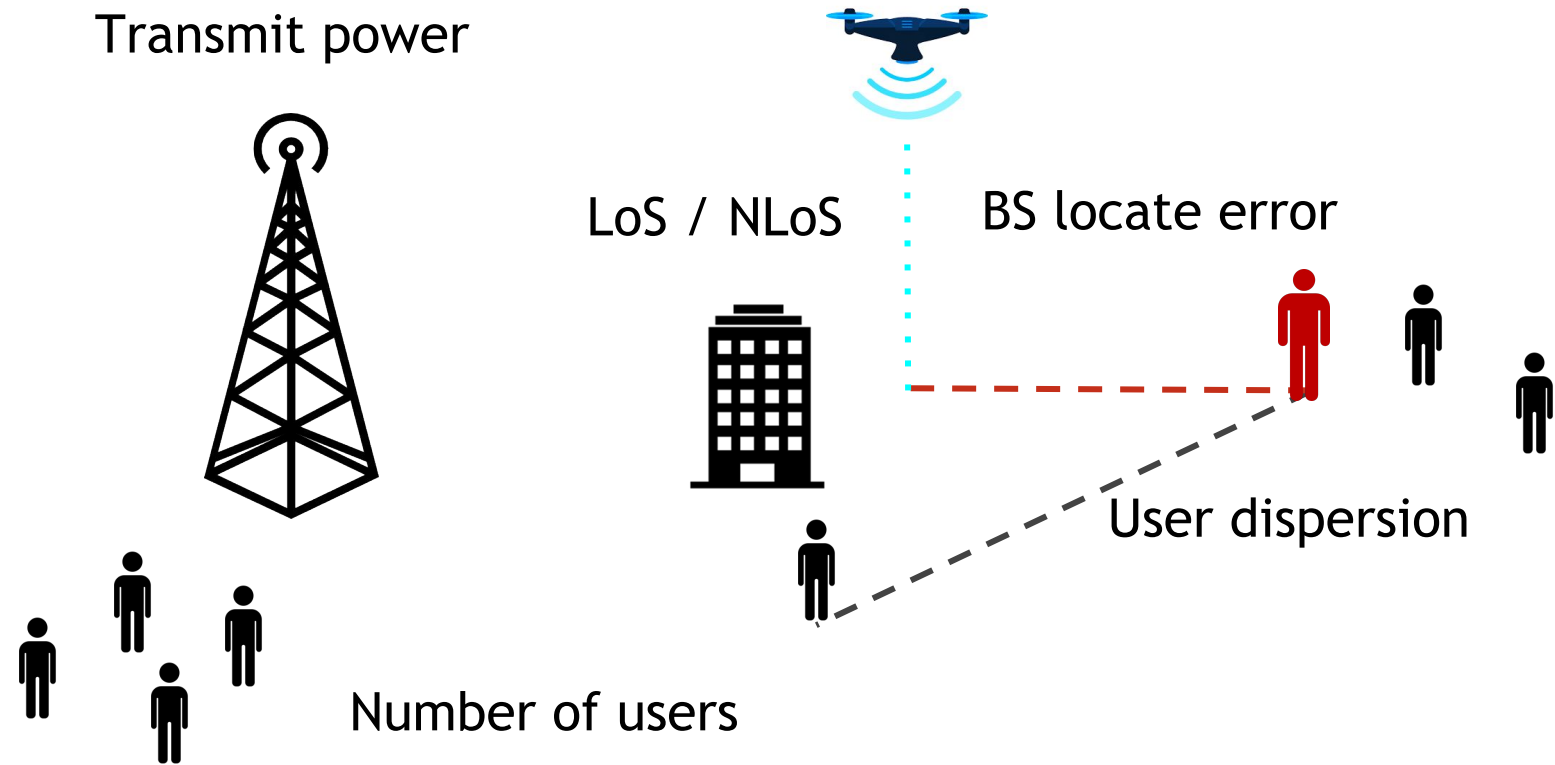
Member



Unlimited backhaul capacity

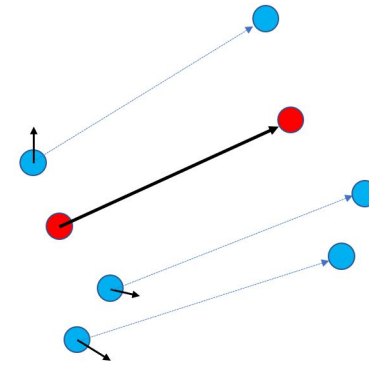


Variable Parameters



User Group Mobility Model

- ▶ We adopt the RPGM (Reference Point Group Mobility) [3]
 - ▶ Point based group mobility with individual group member movements
- ▶ Mobility of the group leader : group mobility
- ▶ Mobility of a group member : group mobility + individual mobility



Simulation setup

▶ Input :

- ▶ Target area (20km x 20km), number of users (N=15)
- ▶ BS altitude (30m), Signal frequency (3.5GHz), Bandwidth (B=5MHz), Noise (-104.01 dBm), Transmit power (40dBm)
- ▶ Initial user dispersion (20m)
- ▶ Propagation condition (LoS/NLoS)
- ▶ Duration (30min)

▶ Generate:

- ▶ Initial position for each user
- ▶ Move speed and direction

▶ Compute :

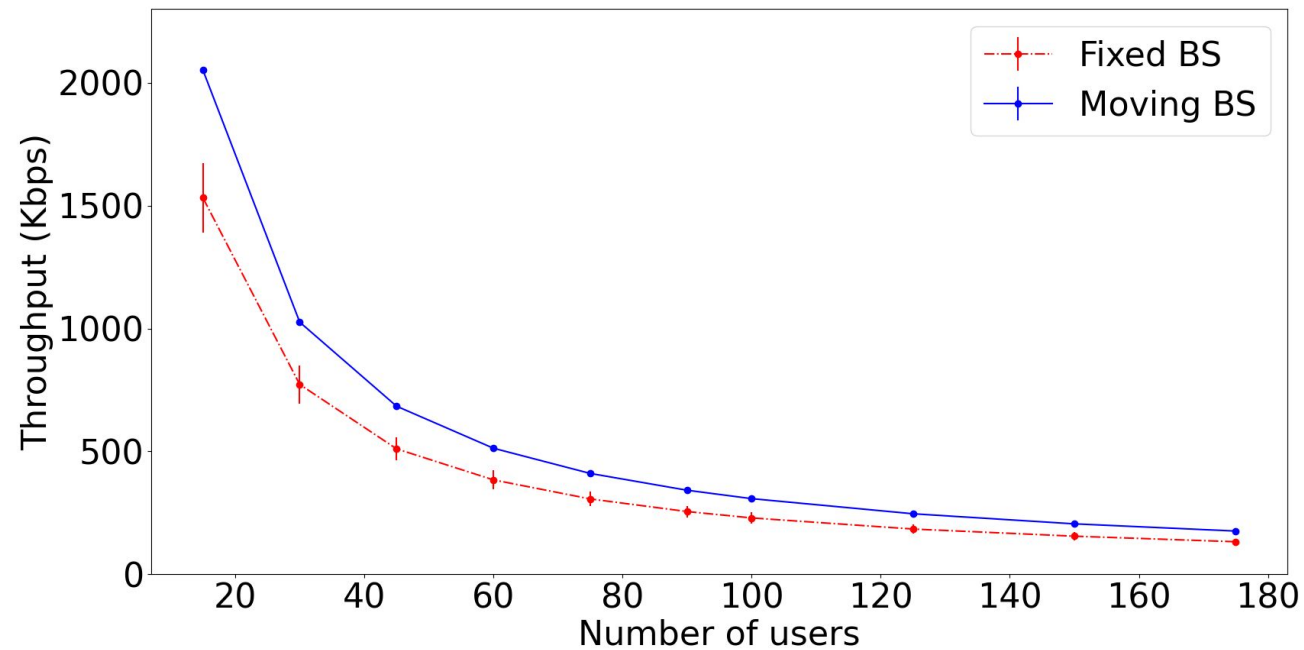
- ▶ New position for each user
- ▶ Distance between the BS and each user
- ▶ Path loss, SNR

▶ Output:

- ▶ Average throughput for a user with a bandwidth of B/N (100 simulations)
- ▶ Confidence Interval = 95%

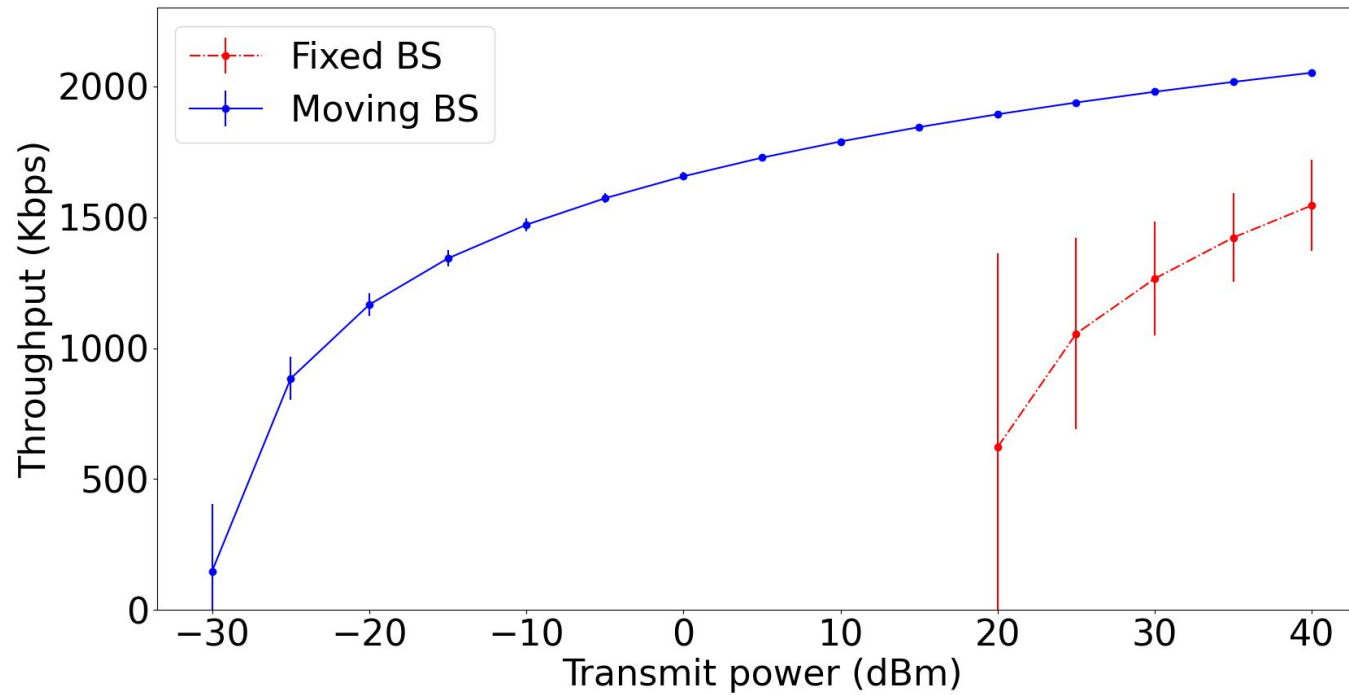
Results (LoS)

- ▶ Impact of number of users **Throughput increase up to 33% with movable BS.**



Results (LoS)

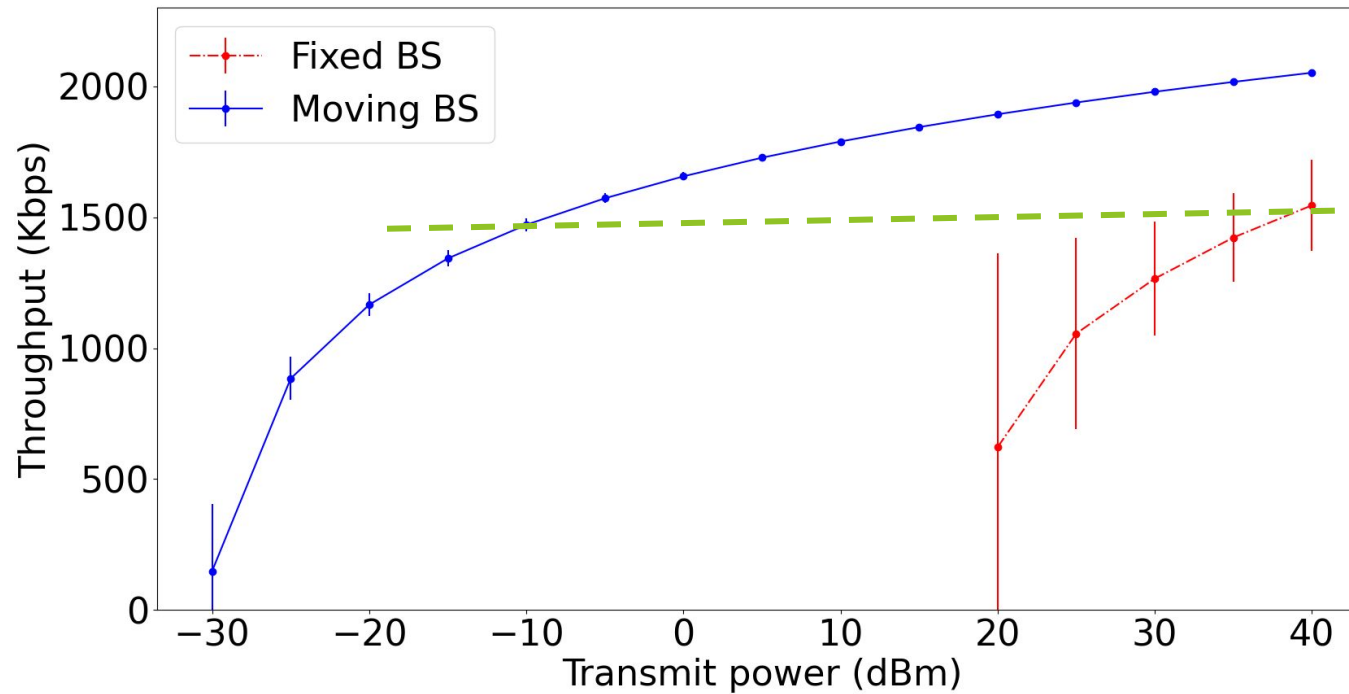
► Impact of transmit power



Results (LoS)

Transmit power can be reduced up to 50dBm with movable BS.

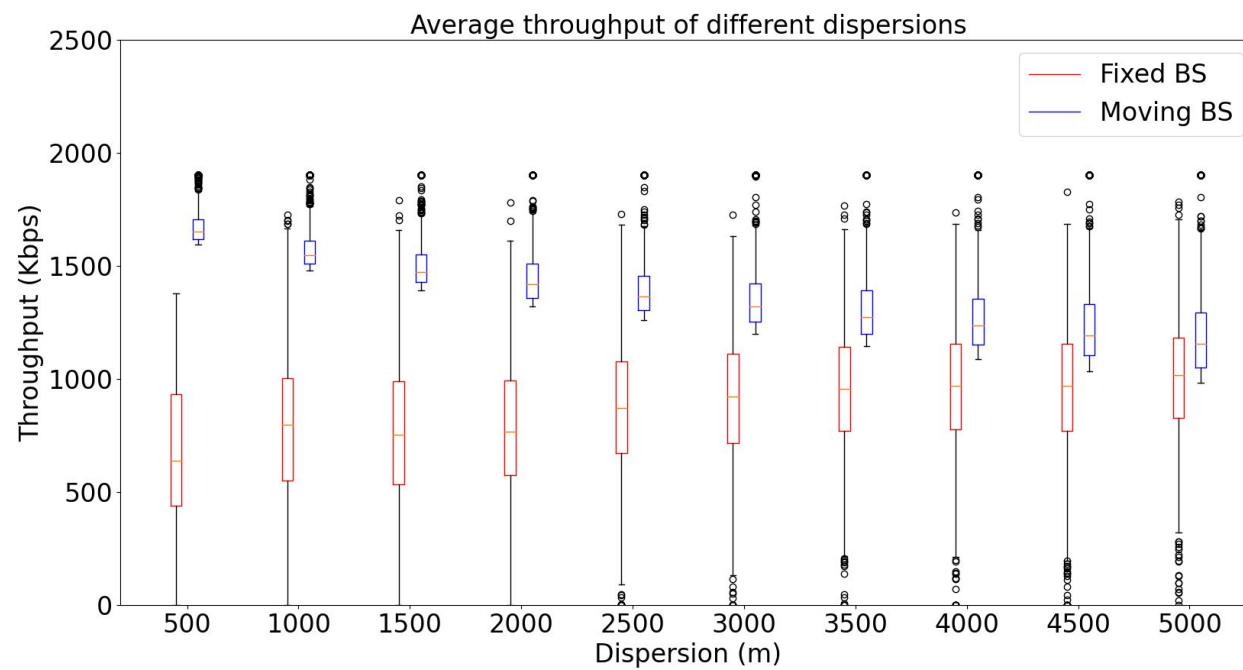
► Impact of transmit power



Results (LoS)

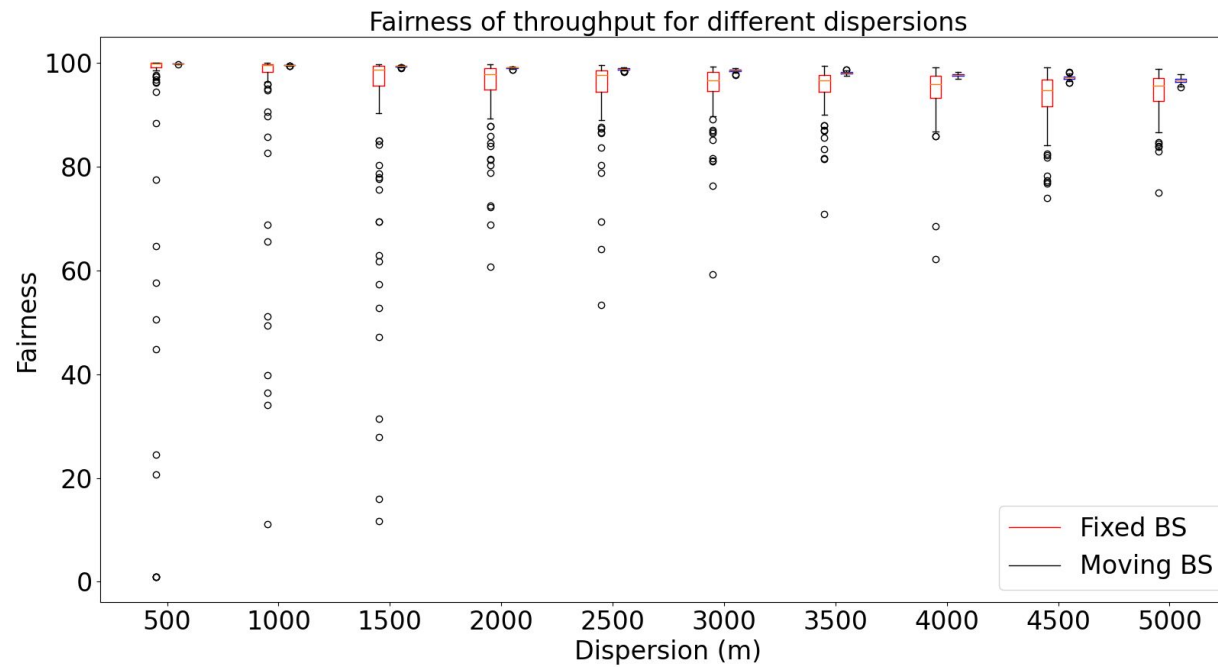
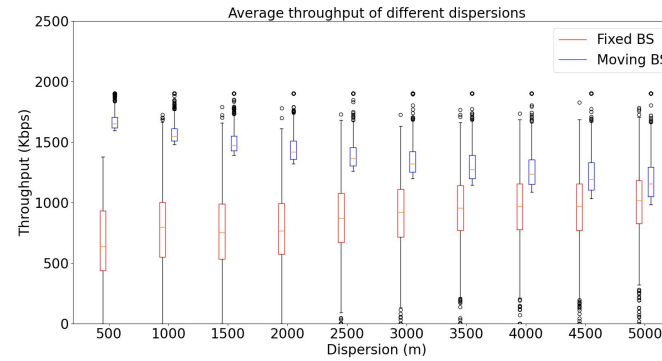


► Impact of user dispersion



Results (LoS)

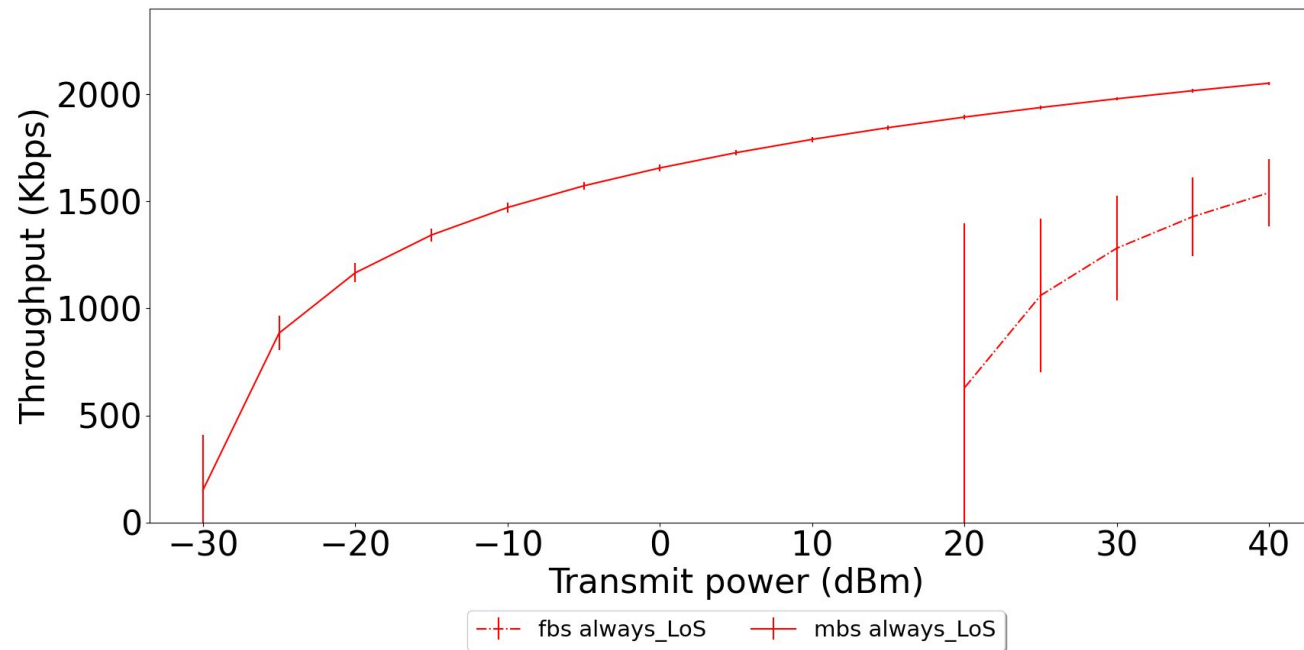
► Impact of user dispersion



Results (NLoS)

4 environments for NLoS : Suburban, Urban, Dense Urban, high-rise Urban
Use ITU recommendation [4] to model LoS probability.

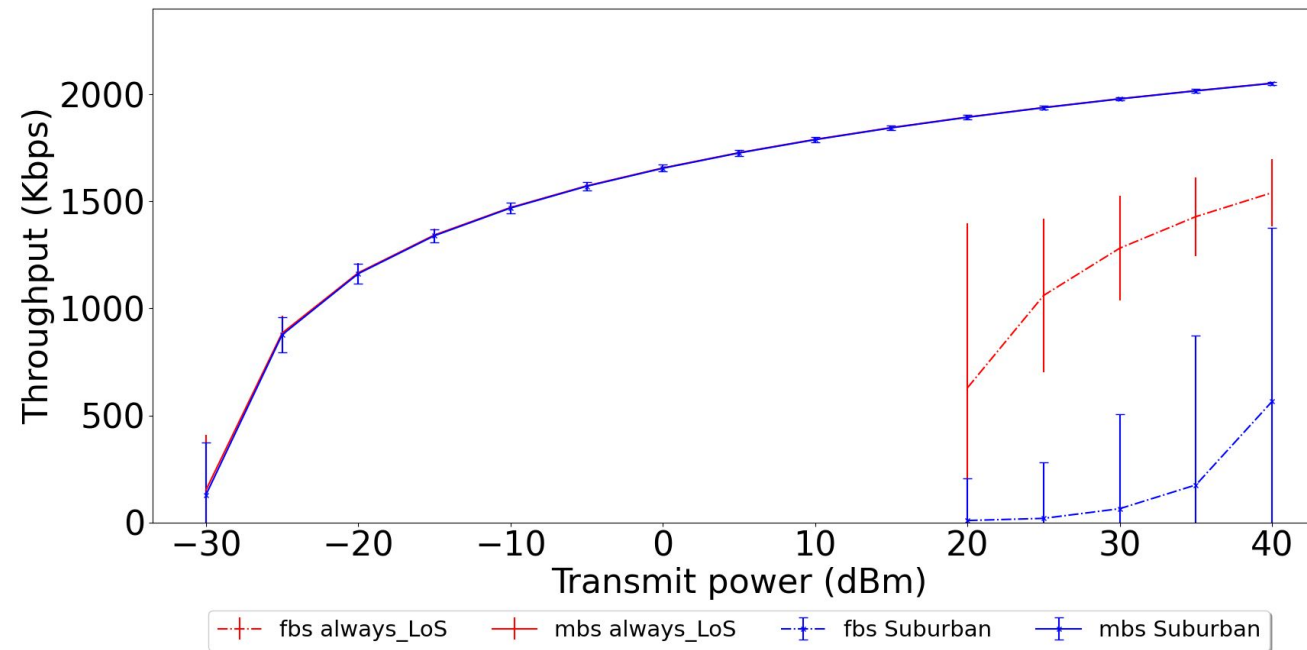
► Impact of transmit power



Results (NLoS)



► Impact of transmit power

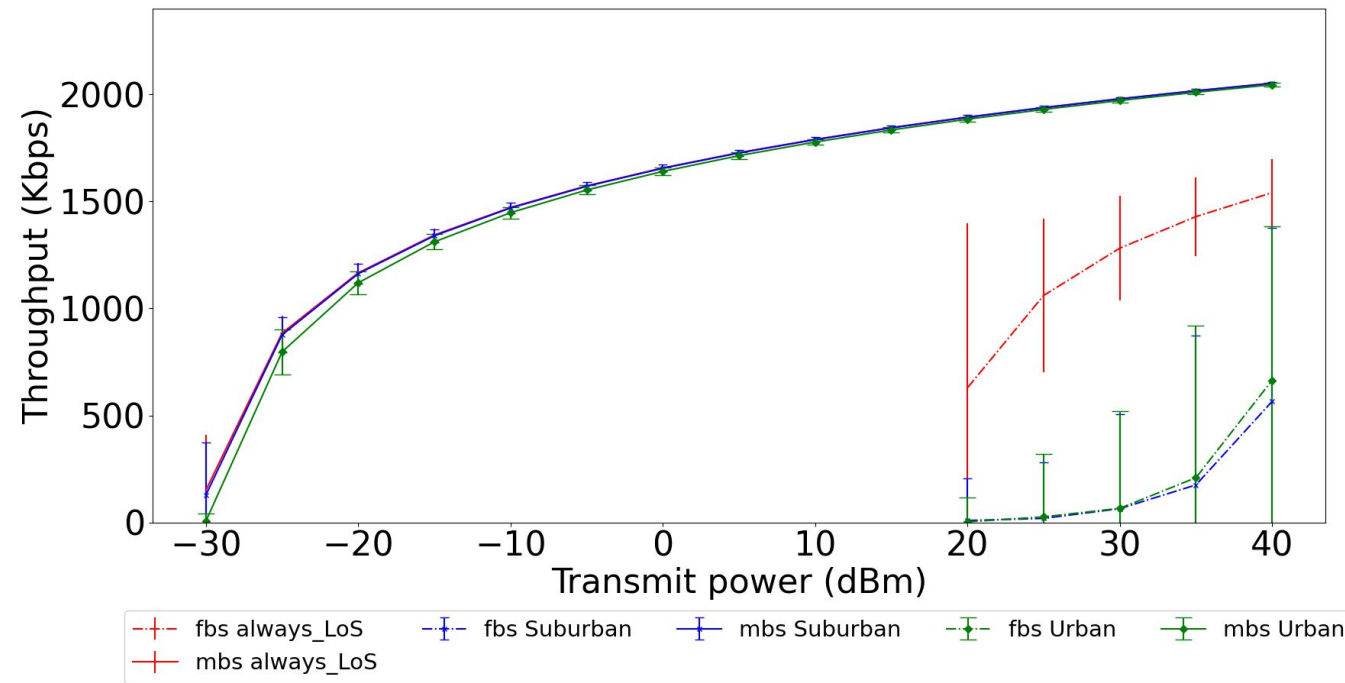


Results (NLoS)

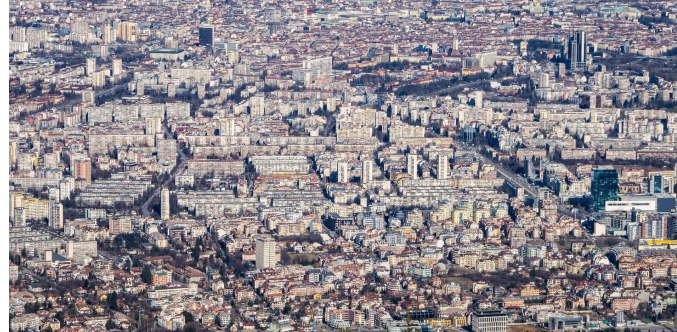


Suburban

► Impact of transmit power



Results (NLoS)

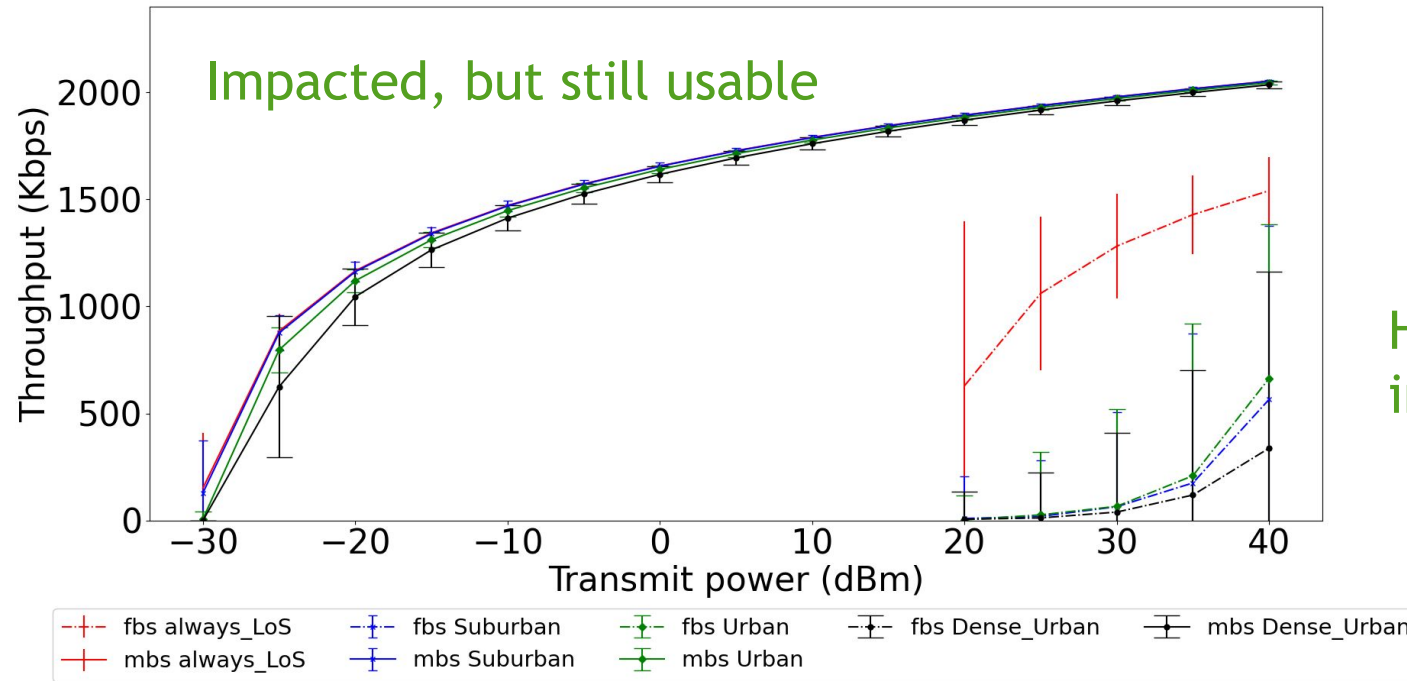


Suburban



Urban

► Impact of transmit power



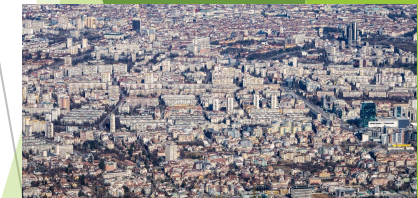
Results (NLoS)



Suburban

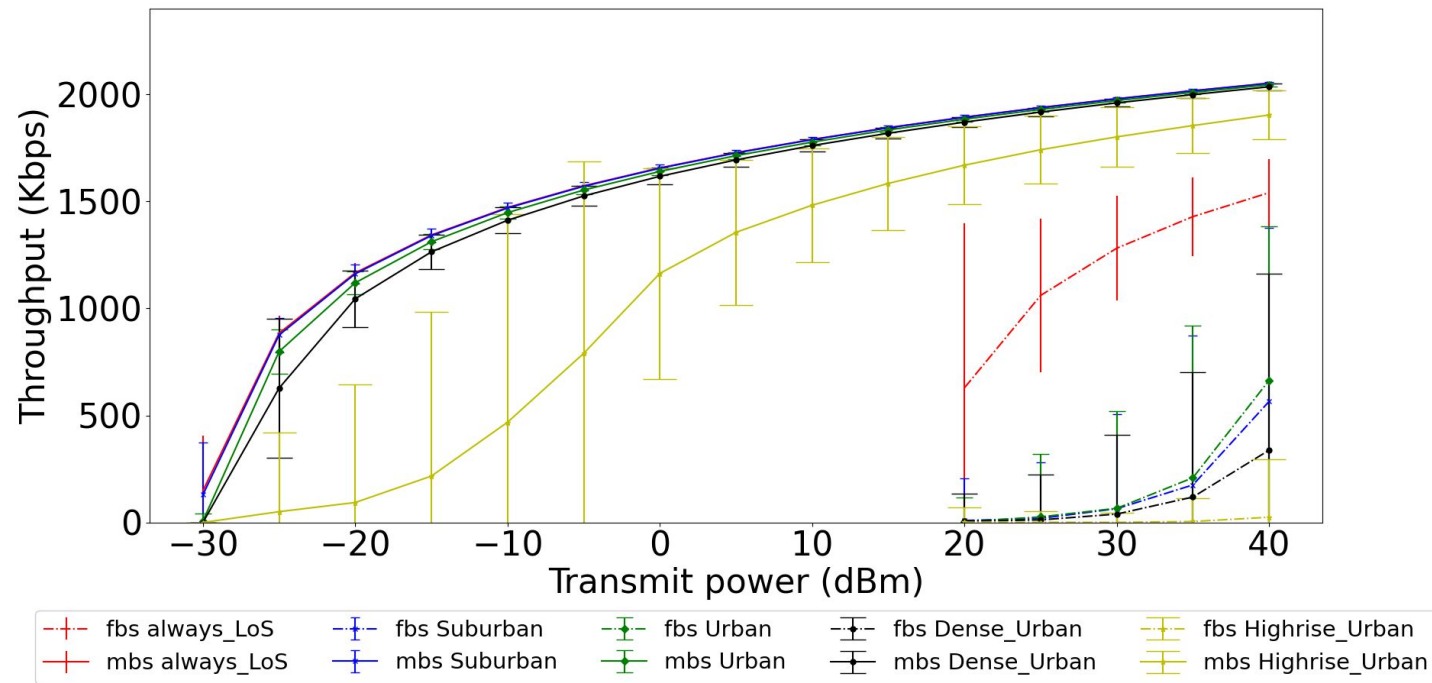


Urban

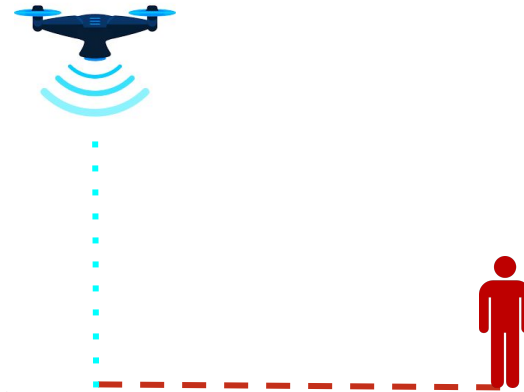


Dense Urban

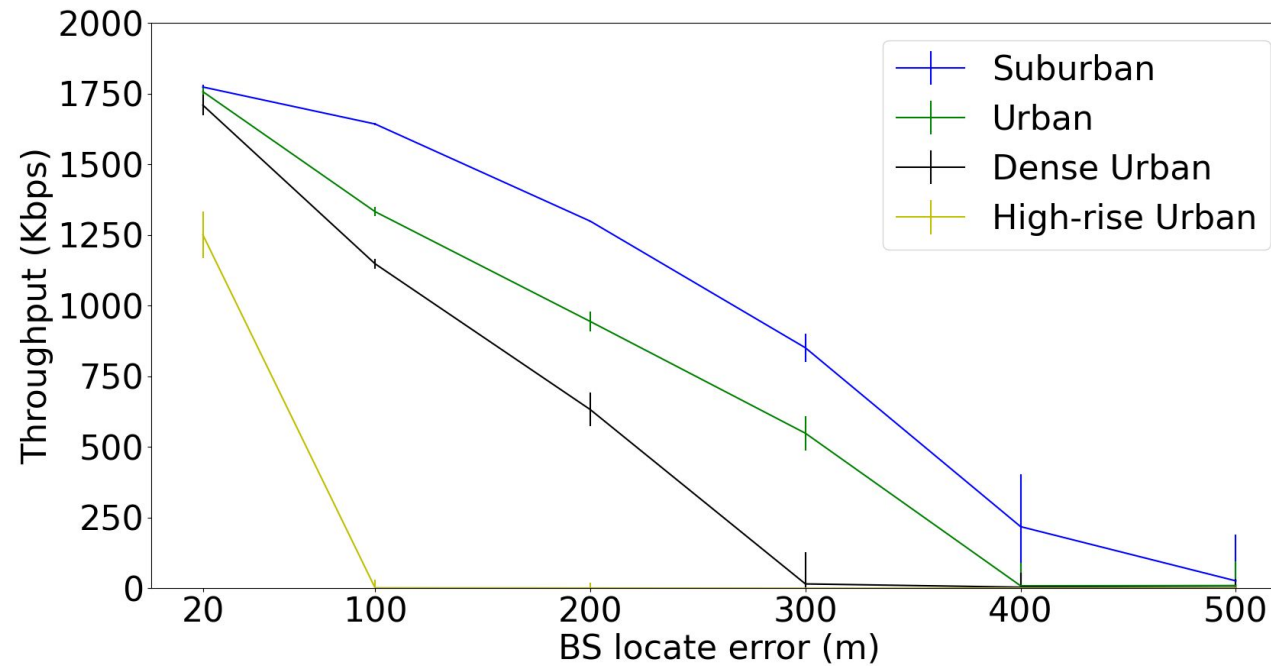
► Impact of transmit power



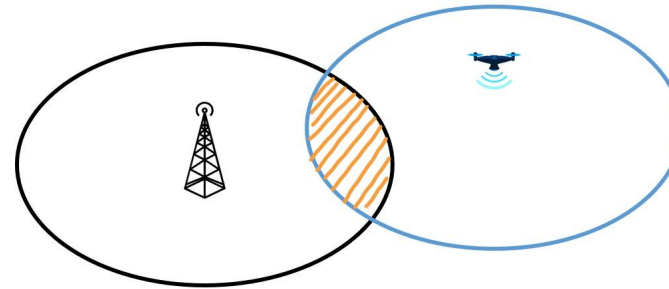
Results (NLoS)



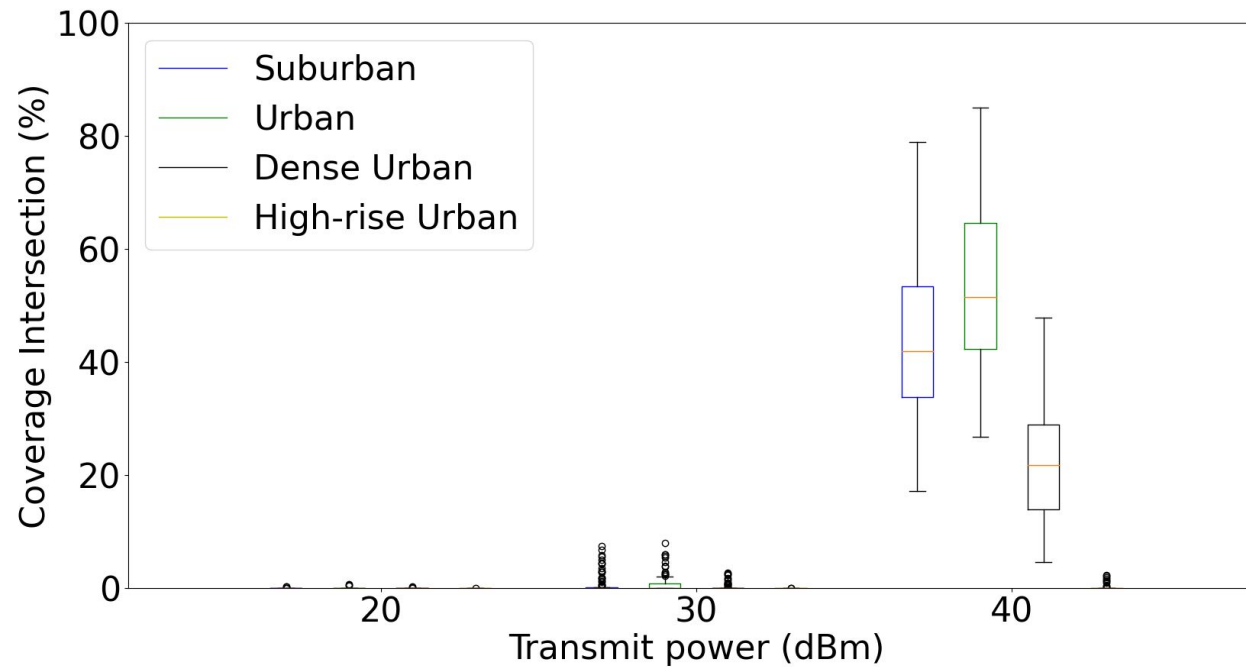
- Impact of BS locate error (Tx power = 10dBm)



Results (NLoS)



► Coverage intersection



Conclusion & Perspective

- ▶ When users in a group and move with the group
Using movable BS is better than fixed BS
 - ▶ Shorter distance between users and the BS
 - ▶ Greater throughput at a fixed transmit power / Less transmit power required to achieve a comparable throughput
 - ▶ Fairer throughput among users
- But
 - ▶ Need to follow the mobility of the leader
 - ▶ Coverage of the movable BS rarely overlap with coverage of the fixed BS
- ▶ In the future
 - ▶ More groups (split group / merge users)
 - ▶ More movable BS with limited backhaul capacity

Q&A

