

INTERFERENCE AWARE RESOURCE ALLOCATION FOR UNDERLAY D2D-BASED DATA OFFLOADING IN 5G CELLULAR NETWORK

Meriam Hmila, Supervised by Manuel Fernández Veiga

Affiliation: Network lab. Of AtlantTIC Research Center, Department of Telematics Engineering (University of Vigo)

Motivation

Underlay Device to Device (D2D) in 5G cellular network is a new paradigm used to alleviate traffic growth. It allows users in close proximity to communicate directly without the intervention of the base station using resource blocks already allocated to cellular user. It increases network capacity, spectral and energy efficiency but it causes harmful interference to cellular users. Moreover, these devices have limited life battery [1].

Our main interest is underlay device to multi device (D2MD), here devices form a cluster/group with one device as head cluster for data offloading. This model inherits single transmitter to single receiver (unicast) challenges and poses more as: weakest receiver, head cluster selection, and users grouping. These points are poorly addressed in the literature compared to unicast cases and need more investigation [2,4].

Objectives

Our main objective is the application of underlay multicast D2D communication for data offloading in 5G cellular networks. Mainly, we focus on providing low complexity algorithms for relay selection, resource allocation, and devices clustering. We intend to use optimization techniques and game theory to model and solve these problems considering energy consumption reducing and interference mitigation. Moreover, we will apply an experimental methodology that combines theoretical analysis with extensive simulations.

Activities

Contribution in an article [3]
Research proposal
General literature review

Deep state of the art (PA)
System modelling
Experimental tests
Results [4,6]

Deep state of the art (RA)
System modelling
Experimental tests
Game theory approach

System modelling
Experimental tests
Thesis writing

2014-2015

2015-2016

2016-2017

2017-2018

Research Plan

- Literature review and knowledge about the field (5G cellular network, D2D communication, data offloading) and challenges definition.
- Literature review and knowledge about interference management, resource allocation, D2D communication in data offloading.
- Deeply investigate cooperative offloading to define novel and efficient criteria for:
 - Power allocation (PA).
 - Resources allocation (RA).
 - Devices grouping and relay selection.
- Use optimization techniques and game theories and models to formulate the previous problems.
- Design and implement new algorithms to solve the previous problems.
- Evaluate our approaches with extensive simulation.
- Publish our results in international workshops, conferences, journals.

Results and Discussion

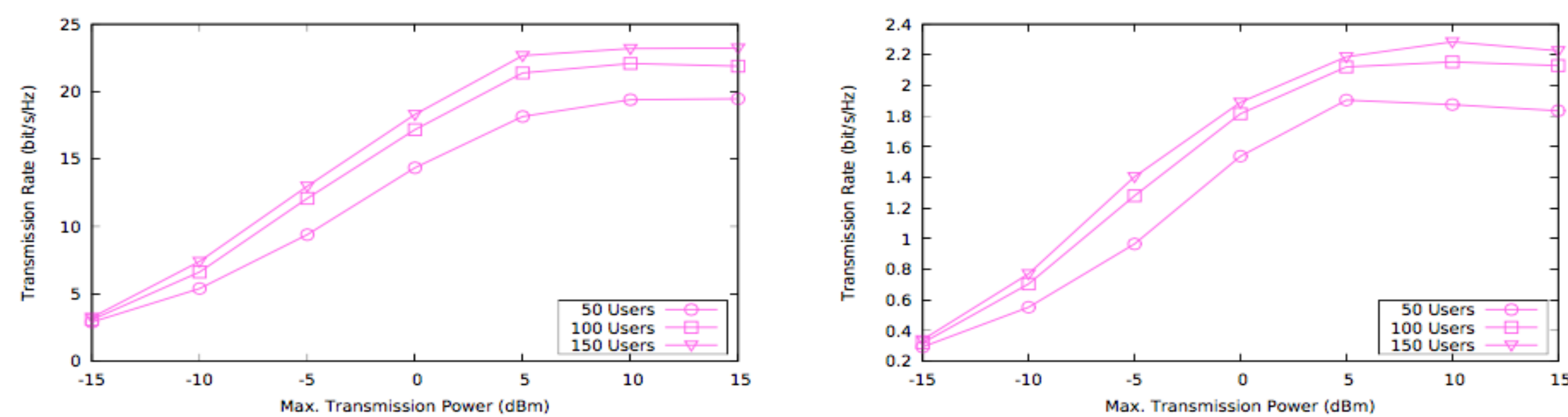


Fig. 1: Global and Maximum Minimum rate vs. transmission power in KNN.

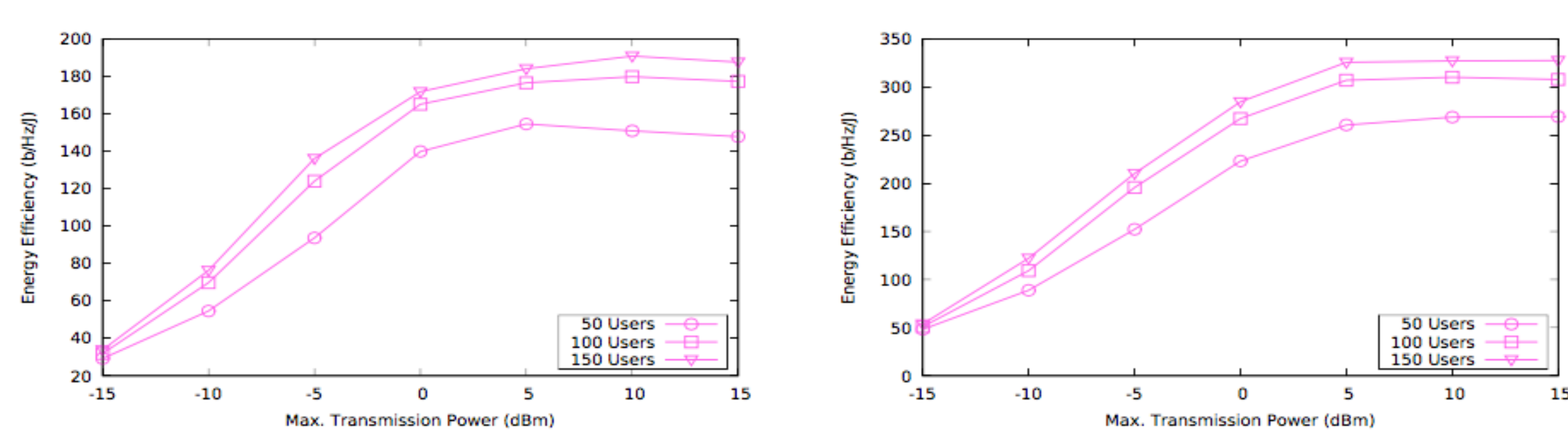


Fig. 2: Global and Maximum Minimum EE vs. Transmission power in KNN.

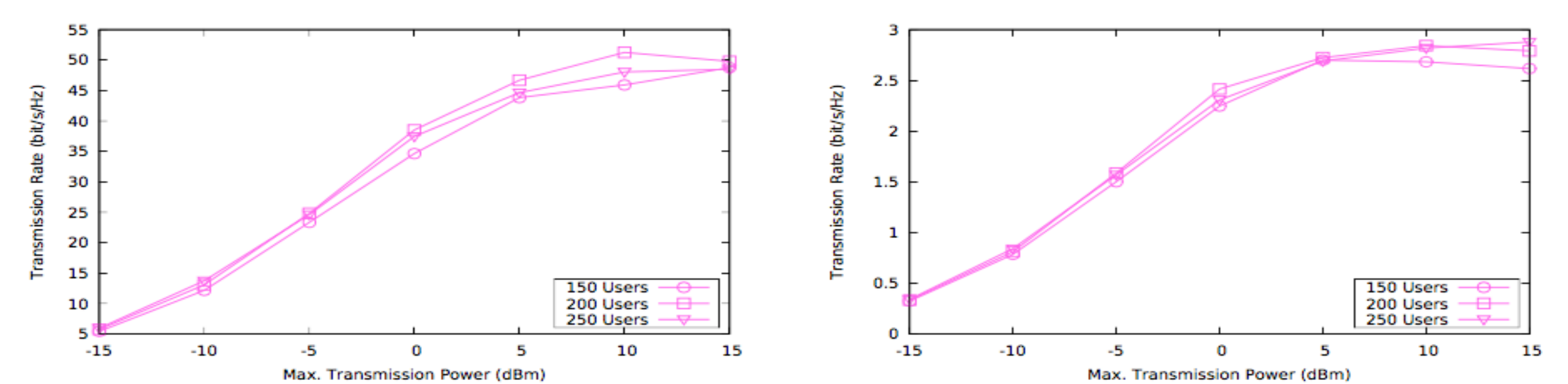


Fig. 3: Global and Maximum Minimum Rate vs. Transmission Power in DL.

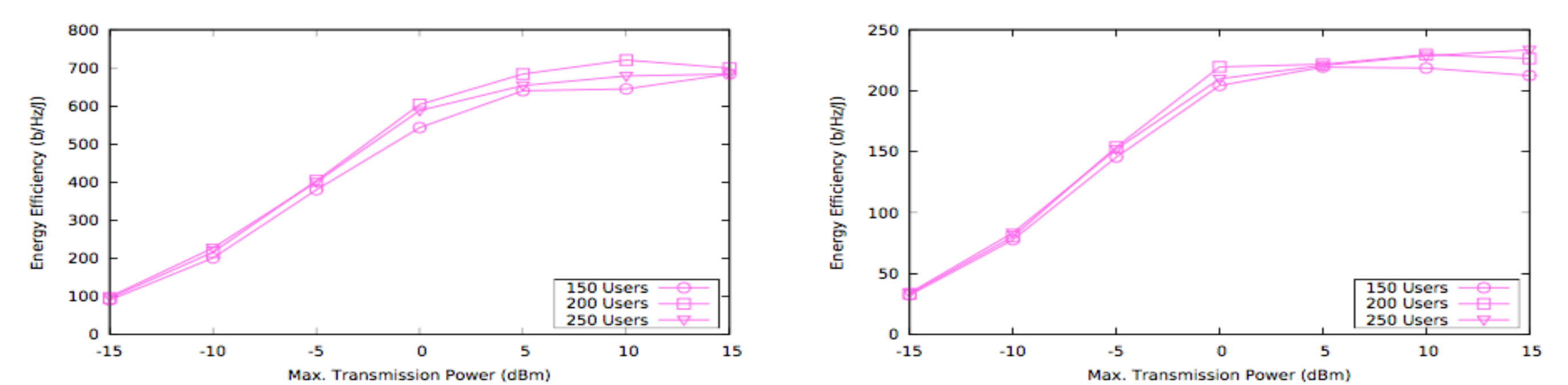
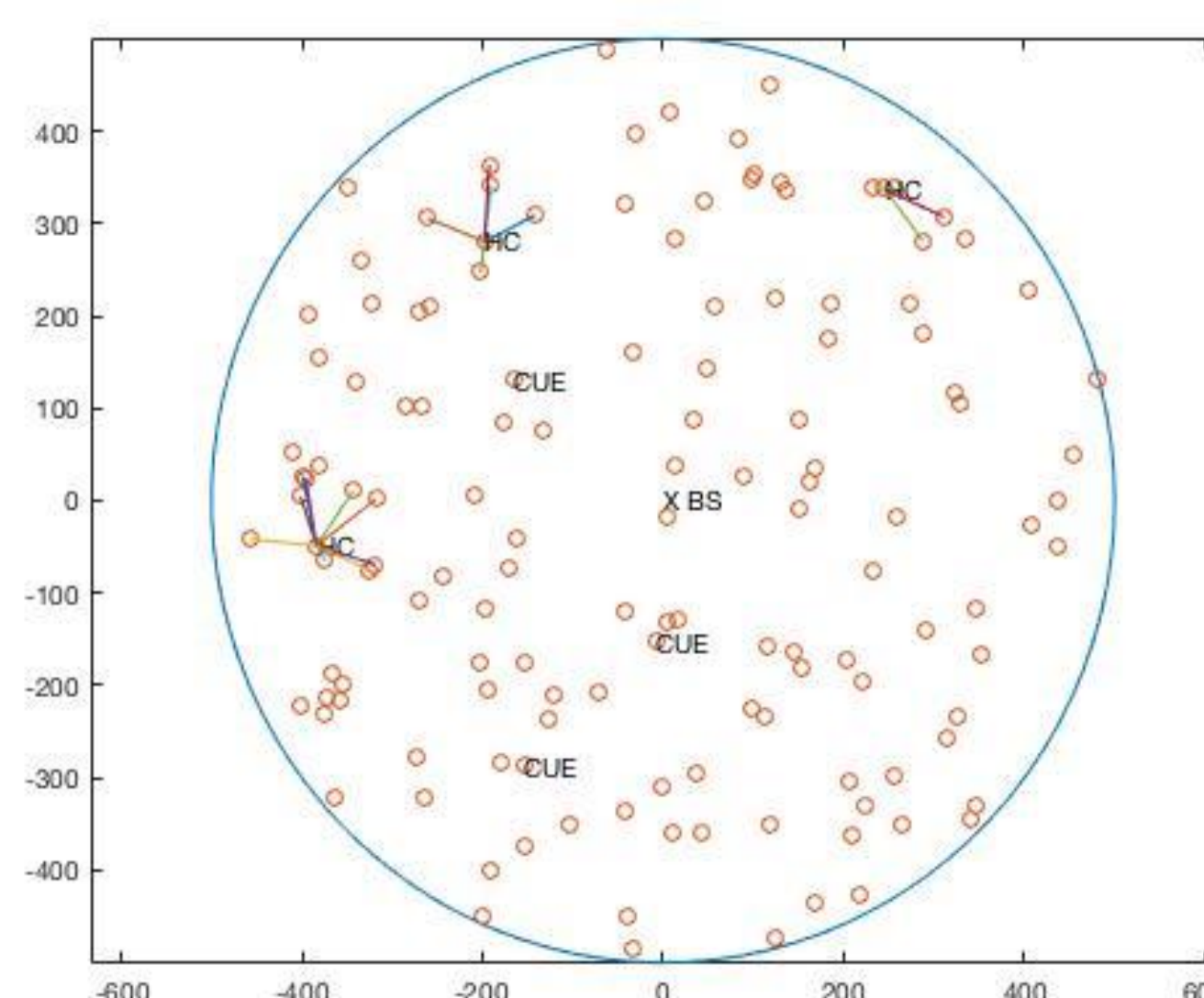


Fig. 4: Global and Maximum Minimum EE vs. Transmission power in DL.

- We modeled the system as joint power and resource allocation problem.
- We proposed power allocation schemas in a single channel case to analysis network and devices EE (Global and Minimum).
- We used stochastic geometry to simulate three devices clustering techniques: K-nearest neighbor, distance limit and DBSCAN.
- We analyzed problem feasibility in different densities.
- We have identified the capacity region of D2MD.
- D2MD improves EE over simple D2D.
- We have applied an efficient heuristic to approximate the capacity region (EE-rate) of multi-channel case.



Next Year Plan

- Applying game theory approach to the current model
- Evaluate the models experimentally (via simulation).
- Publish results in conferences and journals.
- Write and defend the thesis.

References

- [1] Song, L., Niyato, D., Han, Z., & Hossain, E. (2015). Wireless Device-to-Device Communications and Networks. Cambridge University Press.
- [2] Bhardwaj, Ajay, and Samar Agnihotri. "A resource allocation scheme for device-to-device multicast in cellular networks." Personal, Indoor, and Mobile Radio Communication (PIMRC), 2015 IEEE 26th Annual International Symposium on. IEEE, 2015.
- [3] Rodriguez-Perez, Miguel, et al. "Optimum Traffic Allocation in Bundled Energy-Efficient Ethernet Links." IEEE (2015).
- [4] Militano, Leonardo, et al. "When D2D communication improves group oriented services in beyond 4G networks." Wireless Networks 21.4 (2015): 1363-1377.
- [5] M. Hmila and M. Fernández Veiga "Energy-efficient Power Control and Clustering in Underlay Device to Multi-Device Communications" (accepted) | WWIC 2017
- [6] M. Hmila and M. Fernández Veiga "Analysis of Optimal Power Control and Energy Efficiency in Multicast D2D Communications" (accepted) | ICCS 2017

