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

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Motivation

1) Cellular network is continuously evolving to support the massive increase in number of users and to handle the sheer volume of data. It is expected that the current generation is soon to be congested [1].

2) D2D communication [1] in 5G is a new paradigm introduced to alleviate the traffic growth and to offload it to user equipment. It is possible to reduce cellular communications and replace it by short range D2D communication via cooperative content offloading.

3) Underlay D2D communication refers to the re-usage of resources already allocated to cellular networks for communication. This type of communication can cause harmful interference to cellular users. As well, the high dependency on one device to retransmit data to one or to a group of devices might drain its battery [2].

Objectives

Our main objective is the application of underlay D2D communication for data offloading in 5G cellular networks. Mainly, we focus on providing low complexity algorithms for relay selection, resource allocation, devices clustering in single or multi-hop offloading. These points are poorly addressed in the literature and need more investigation. We intend to use game theory to model and solve these problems considering energy consumption reducing, fairness, interference mitigation, and network heterogeneity. Moreover, we will apply an experimental methodology that combines theoretical analysis with extensive simulations.

Research Plan

Done:
1) Literature review and knowledge about the field (5G cellular network, D2D communication, data offloading) and challenges definition.
2) Literature review and knowledge about interference management, resource allocation, D2D communication in data offloading.

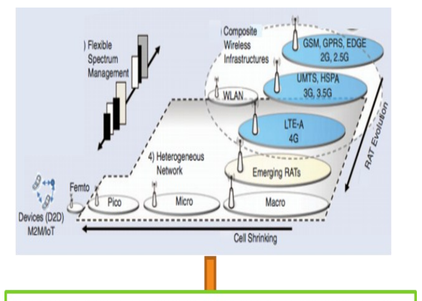
In Progress:
3) deeply investigate cooperative offloading to define novel and efficient criteria for:
   a) Relay selection.
   b) device grouping.
   c) resource allocation.
4) Use game theories and models to formulate the previous problems.
5) Design and implement new algorithms to solve the previous problems.
6) Evaluate our approaches with extensive simulation.
7) Publish our results in international workshops, conferences, journals.

Preliminary Results

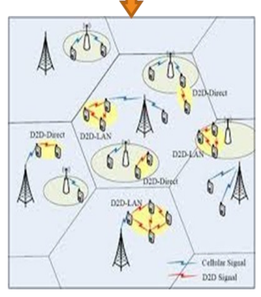
DONE

1. Literature review and challenges definition.
   a) 5G cellular network, D2D communication, data offloading.
   b) Interference management, resource allocation, D2D communication in data offloading
2. Investigate cooperative offloading:
   a)Relay selection
   b) Device grouping
   c) Resource allocation
   Use game theories and models
   Design and implement new algorithms
   Extensive simulation
3. Our goals are:
   a) Increase Data rate
   b) Reduce energy consumption

IN PROGRESS



UNDERLAY D2D-BASED DATA OFFLOADING IN 5G



Preliminary Results/Activities

During the last few months we managed to complete the following tasks:

1) Research context definition (5G cellular network, D2D communication, data offloading) and challenges definition.

2) Deeply investigate D2D communication issues as: interference management, resource allocation, D2D in data offloading.

3) Attendance of a workshop to collect more information.

4) Contributed in an article with preliminary results [3] titled as “Optimum Traffic Allocation in Bundled Energy Efficient Ethernet Links”, submitted to IEEE System Journal.

Next Year Plan

1) Prepare efficient resource allocation algorithms for D2D jointly relay selection and device grouping while considering energy consumption and the heterogeneous nature of 5G cellular network.
2)Analyze the model using game theory, and derive the throughput and the energy consumption.
3) Evaluate the models experimentally (via simulation).
4) Publish results in conferences and journals.

References

[1] Song, L., Niyato, D., Han, Z., & Hossain, E. (2015). *Wireless Device-to-Device Communications and Networks*. Cambridge University Press.

[2] Al-Kanj, L., Dawy, Z., & Yaacoub, E. (2013). Energy-aware cooperative content distribution over wireless networks: Design alternatives and implementation aspects. *IEEE Communications Surveys & Tutorials*, *4*(15), 1736-1760.

[3] S. Herrería Alonso, M. Rodríguez Pérez, M. Fernández Veiga, M. Hmila, y C. López García, (2015). Optimum Traffic Allocation in Bundled Energy Efficient Ethernet Links. IEEE System Journal.