Fachgebiet Kommunikationstechnik

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Bachelor/Master Thesis

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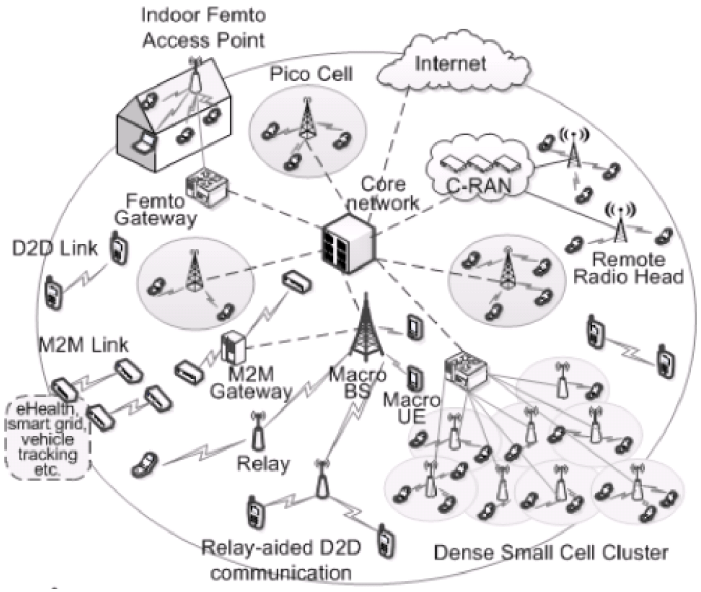
System Analysis and Design for Future Mobile Networks using Random Matrix Theory

Future mobile networks will experience a huge growth in traffic while satisfying higher and higher requirements for latency and reliability. Additionally, the Machine-to-Machine and Internet-of-Things devices will introduce the necessity of real-time processing for a huge amount of data, and so the need of massive connectivity strategies. Therefore, in order to meet all demands, the mobile network should take advantage of solutions considering this high dimensionality.

In our project, we investigate techniques for future mobile networks which consider diverse engineering solutions such as multi-antenna (MIMO) systems, advanced coordination, cloud computing etc. and design models and algorithms for them such as hierarchical beamforming and user scheduling. Additionally, in order to enable fast and reliable analysis and design for the high dimensional systems, we apply random matrix theory (RMT).

As the name suggests, RMT is a study of multivariate random variables which can be seen as a combination of probability theory with spectral theory. Therefore, its theorems provide us with understanding of high-dimensional random processes and allow us to predict some of their properties, such as eigenvalues and eigenvectors.

The advantage of analyzing the random processes with RMT is that we obtain closed-form expressions which can greatly simplify the analysis. These closed-form expressions provide us with accurate approximations which can be used in communication systems to predict reliably diverse system parameters. Additionally, RMT is very advantageous from practical perspective, since excessive averaging techniques, like the Monte Carlo, can be omitted. This contributes to big time and computational savings by offering remarkable accuracy.



Source: Proposed Technologies for Solving Future 5G Heterogeneous Networks Challenges, I. Al-Qasrawi

Tasks

- Understanding the concepts of RMT
- Deriving certain system parameters and/or designing suitable algorithms
- Simulation results and their documentation

Requirements

- Knowledge in linear algebra and probability theory
- Basics in communication and information technology
- Expertise in MATLAB

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