



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم



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جامعة عين شمس التوثيق الإلكتروني والميكروفيلم

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AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Electronics Engineering and Electrical Communications

Intelligent Resource Allocation for D2D Communication in 5G Heterogeneous Networks

A Thesis submitted in partial fulfillment of the requirements of the degree of

Doctor of Philosophy in Electrical Engineering

(Electronics Engineering and Electrical Communications)

by

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Statement

This thesis is submitted as a partial fulfillment of Doctor of Philosophy in Electrical Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

The evolving Fifth Generation (5G) cellular wireless network deployment is the main key platform of the next wireless cellular network evolution. Device-to-device communication (D2D) is one of the key technologies provided to enhance 5G performance. D2D is a direct communication between two devices without involvement of any central point. The wide deployment of 5G network, supported with D2D, can afford promising solution for vehicular communication systems.

Vehicular communication systems are networks in which vehicles and roadside units are the communicating nodes, which provide each other with certain information, such as speed, location, the direction of travel, braking, loss of stability, safety warnings and traffic information etc. This data can be effective in avoiding accidents and traffic congestion. Hence, the demanded kinds of networks shouldn't be considered as the traditional wireless ones. Vehicular networks need a high mobility and wide coverage networks with real time support to avoid crashes. Hence, 5G cellular network, supported with D2D technology, becomes a strong candidate to be the infrastructure for vehicular networks.

This thesis provides an intensive benchmarking of the integration of D2D into 5G cellular network focusing on the potential advantages, recent prototypes, classifications, applications, and possible challenges.

In addition, the thesis investigates resources allocation mechanisms for Vehicles-to-Infrastructure (V2I) and Vehicles-to-Vehicles (V2V), where V2I transmitters are considered as 5G Cellular Users (CUs) and V2V nodes are considered as D2D Users (DUs). Different QoS should

be achieved to enhance the network performance such as maximizing V2Is ergodic capacity, V2Vs reliability, and network utilization.

An optimization problem comes into place, which will be separated for simplicity and the following process will be executed for efficient runtime. First, MAX mechanism and OPT mechanism are proposed for power allocation mechanisms. Then, a novel analytical model is introduced based on the distance between nodes. Finally, Depth First Search Tree (DFST) algorithm is applied for organizing resource allocation process based on the mentioned mechanisms and the analytical model. DFST algorithm is supposed to solve the optimization problem with low cost processing. The results proved that DFST algorithm has better performance than the other algorithms in terms of network utilization, V2I ergodic capacity, reliability, and processing time.

Finally, this study is extended to operate over multiple channels where multiple V2Vs share the same resources with multiple V2Is. Three algorithms have been suggested for organizing resource allocation process based on the mentioned mechanism and the analytical model. These algorithms are largest-clustered algorithm, Depth First Search Tree with Depth length (DFST-DL) algorithm, and Round Robin with fitness function (RR-FF) algorithm. Offered algorithms simulation results indicated that the overall vehicular network performance is enhanced in terms of V2Is data rate, V2Vs reliability, and network utilization.

Key words:

5G Cellular Networks, Device-To-Device, Vehicular Networks, Resource Allocation, Power Optimization, Performance Evaluation.

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