

# Resource Allocation in NOMA-based D2D communications with both licensed and unlicensed bands

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## Abstract

Device-to-Device (D2D) communications are being used to improve the spectral efficiency and reduce the load of the base station (BS) by utilizing the licensed and unlicensed spectrum. Non-orthogonal multiple access (NOMA) is to support a higher number of users with the aid of non-orthogonal resource allocation. In this brief, we discuss the joint optimization problem of channel allocation and power control in NOMA-based D2D communications with both licensed and unlicensed bands.

## 1. Introduction

D2D communications sharing licensed spectrum with cellular users and/or unlicensed spectrum with the WiFi users was proposed to improve the special efficiency and reduce interference from D2D users to CUs [1,2]. Power-domain NOMA is able to improve the spectral efficiency on the standpoint of realizing a new power dimension for multiple access. Inspired by the potential benefits of D2D and NOMA, we study the joint optimization problem of channel allocation and power control in NOMA-based D2D communications with both licensed band and unlicensed band.

## 2. System model and proposed approach

As in Fig. 1, we consider a network, where NOMA applied for conventional cellular networks and D2D communications can utilize both cellular and WiFi radio resources. We further assume that the user devices support the D2D communication and LTE-U technology simultaneously.

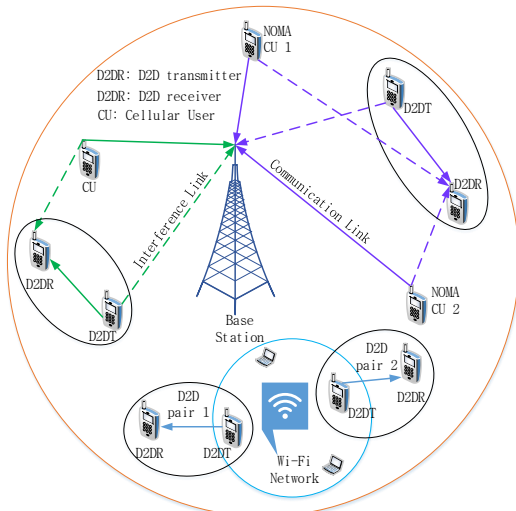


Fig. 1. A typical NOMA-based D2D network with both licensed and unlicensed bands.

Besides potential benefits, there exist some technical challenges in the considered problem:

- An efficient NOMA clustering algorithm is needed to maximize the cellular performance.
- Inter-cluster interference among cellular users (CUs) due to simultaneously using the same channel (e.g., NOMA CUs 1 and 2).
- D2D communications may cause interference to CUs (dotted lines in Fig.1), which may reduce their throughput.
- D2D transmission can be performed using unlicensed WIFI spectrum (e.g., D2D pairs 1 and 2). However, a critical question is to determine D2D pairs that should use unlicensed band. Another issue is how to guarantee the WiFi users' quality of service.

Since the optimization formulation is a mixed-integer non-linear programming problem, it is difficult to solve the problem optimally. We will apply a metaheuristic method, namely Whale Optimization Algorithm, to solve the problem.

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## References

- [1] G.G. Girmay, Q.V. Pham, and W.J. Hwang, "Joint Channel and Power Allocation for Device-to-Device Communication on Licensed and Unlicensed Band," *IEEE Access*, Vol. 7, pp. 22196-22205, 2019.
- [2] J. Xu, C. Guo, and H. Zhang, "Joint channel allocation and power control based on PSO for cellular networks with D2D communications," *Computer Networks*, Vol. 133, pp. 104-119, 2018.