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# OSS: AN ONTOLOGY BASED SPECTRUM SHARING FOR D2D COMMUNICATION IN CELLULAR NETWORK

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## ABSTRACT
Device-To-Device (D2D) communication be primarily proposed into cellular networks when a new archetype to upgrade network performance. The emergence of new application includes, among others, proximity and subsequently triggers different devices (location-aware advertisements, smart communication between vehicles, local exchange of information and so on) introduced new use cases and scenarios for device-to-device communication in cellular networks. The primary studies exhibit that device-to-device communication has support increased spectral efficiency and communication performance. Despite, this device-to-device communication mode acquaints new complication in terms of interference control and protocols. In this article, ontology based on the device-to-device communicating spectrum and reviews the possible literature broadly under the proposed ontology. Furthermore, we provide intuition into the explored areas which guide us to identify research problems and related issues of D2D communication in cellular networks

**Keywords:** D2D Communiqué, spectral efficiency, Cellular Networks, Ontology

## 1. INTRODUCTION

In this paper, we investigate the cooperation issue via spectrum sharing when employing physical layer security concept into the device-to-device (D2D) communications under laying cellular networks. First, we derive the optimal joint power control solutions of the cellular communication links and D2D pairs in terms of the secrecy capacity under a simple cooperation case and further propose a secrecy-based access control scheme with the best D2D pair selection mechanism. Then, we consider a more general case that multiple D2D pairs can access the same resource block (RB) and one D2D pair is also permitted to access multiple RBs, and provide a novel cooperation mechanism in the investigated network.

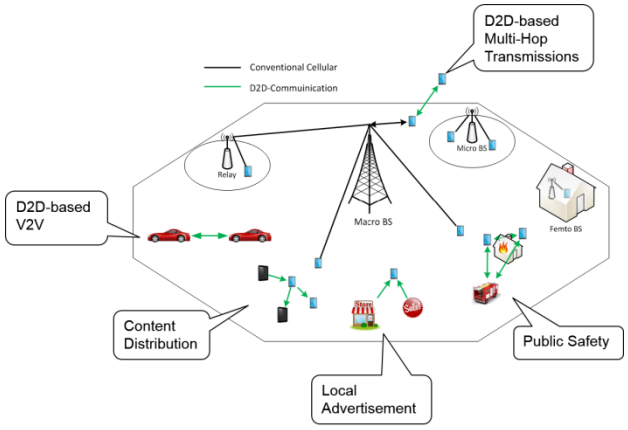


***Figure 1. D2D Communication architecture***

Furthermore, we formulate the provided cooperation mechanism among cellular communication links and D2D pairs as a coalitional game. Then, based on a newly defined max-coalition order in the constructed game, we further propose a merge-and-split-based coalition formation algorithm for cellular communication links and D2D pairs to achieve efficient and effective cooperation, leading to improved system secrecy rate and social welfare. Simulation results indicate the efficiency of the proposed secrecy-based access control scheme and the proposed merge-and-split-based coalition formation algorithm. The increasing data rate demand for local area

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services and dramatically increased spectrum congestion have motivated research efforts for improving spectral efficiency in cellular networks. D2D communication, which behaves as an underlay to cellular networks, can achieve cellular controlled short-range direct data transmission for local area services by reusing the cellular resources. In recent years, D2D communication employed in cellular networks has become a hot research topic in both academia and industry due to its advantages in improving resource utilization, enhancing cell capacity, increasing energy efficiency, and decreasing transmission delay among local user

## 2. LITERATURE SURVEY

In this work, we consider Quality of Service (QoS) guarantee for Device to Device (D2D) users co-existing with a cellular system where the D2D communication links are sharing radio spectrum resources with macro cell users in the downlink. Despite the lofty advantages associated with D2D communications, one major concern is the resulting interference from the D2D users, which should not infringe on the service quality requirements of the User Equipments (UEs). In this work, we investigate the scenario in which D2D communications operates simultaneously with downlink transmissions from the Evolved Node B (eNB). Power control problem for the D2D users is formulated in order to optimize the energy efficiency of the eNB users as well as to ensure that QoS of D2D devices and UEs does not fall below the acceptable target. The feasible conditions of the power control problem are derived and then the centralized and the distributed solutions are obtained. We further suggest jointly designed dynamic power control and channel re- allocation algorithm that will guarantee the priority of the UEs. Effectiveness of the proposed scheme is demonstrated through extensive simulations.

The Long Term Evolution- Advanced (LTE Advanced) networks are being developed to provide mobile broadband services for the fourth generation (4G) cellular wireless systems. Device to- device (D2D) communications is a promising technique to provide wireless peer- to-peer services and enhance spectrum utilization in the LTE- Advanced networks. The D2D communications user equipments (UEs) be acceptable to directly communicate linking each other with reusing the cellular resources rather than usinguplink also downlink resources in the cellular mode when communicating via the base station. However, enabling D2D communications in a cellular network poses two major challenges. First, the interference caused to the cellular users by D2D devices could critically affect the performances of the cellular devices. Second, the minimum quality-of-service (QoS)requirement of D2D communications needs to be guaranteed. In this article, we introduce a novel resource allocation scheme (i.e. joint resource block scheduling and power control) for D2D communications in LTE-Advanced networks to maximize the spectrum utilization while addressing the above challenges. First, an overview of LTE-Advanced networks, and architecture and signaling support for provisioning of D2D communications in these networks are described. Furthermore, research issues withthe current up to date of D2D communications be discussed. Then, a resource allocation scheme based on a column generation method is proposed for D2D communications. The objective is to maximize the spectrum utilization by finding the minimum transmission length in terms of time slots for D2D links while protecting the cellular users from harmful interference and guaranteeing the QoS of D2D links. The performance of this scheme is evaluated through simulations.

**Related Works**

One of the most important issues in D2D communication is the interference problem caused by the resource sharing between the D2D communications and cellular communications. Thus, most literature on D2D communication focus on interference management and resource allocation to investigate how to enable the most potential benefits of D2D communications in cellular networks. In these works, interference caused by resource sharing is regarded as a harmful effect that needs to be eliminated or mitigated via various methods. However, most recently, some works have proposed to utilize this interference to enhance the secrecy performance when introducing physical layer security issue into D2D communications under laying cellular scenario. The basic idea of physical layer security is to develop the physical characteristics of wireless channels near provide safe communications. This line of work was pioneered by Wiener , who introduced the wiretap channel and the secrecy capacity, and showed that when the wiretap channel is a degraded version of the main channel, the two legitimate users can exchange secure messages at a non- zero rate without relying on a private key. In follow-up work, Wyner's result was generalized to a non degraded discrete memory less broadcast channel with common messages sent to both the receivers and confidential messages sent to only one of the receivers. In , the secrecy capacity of Gaussian wiretap channel was studied, and in , the secrecy capacity of

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quasistatic fading channel was investigated in terms of the outage probability. Note that the secrecy capacity is defined as the maximum achievable rate with perfect secrecy . In recent works, cooperative relaying and cooperative jamming , have been regarded as two promising means to effectively improve the secrecy capacity in a cooperative manner. Back to the physical layer security issue in D2D communications underlaying cellular scenario, when we focus on the secrecy performance of cellular communication links,D2D pairs in the cellular network can act as friendly jammers to provide efficient jamming service via spectrum sharing. In , the authors for the first time introduced D2D communications into the secrecy performance of the cellular communication asinterference against eavesdropping and derived the optimal transmission power of the D2D pair in terms of secrecy outage probability.

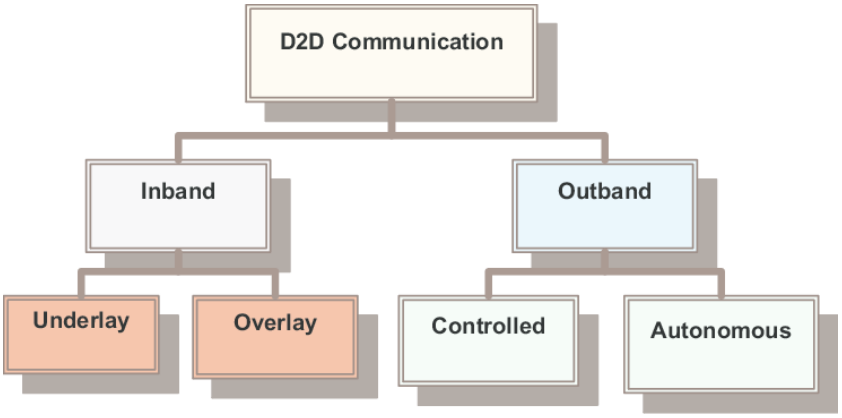


***Fig 2. Relay Communication***

In, the authors [4], utilized a weighted bipartite graph to formulate the one-tone pairing and resource allocation problem between cellular users and D2D pairs with respect to the secrecy concern of cellular users. In, the authors [7], derived the secrecy outage probability for the D2D and cellular system in the presence of a multi- antenna eavesdropper. Although physical layer security issue in D2D communications under laying cellular networks has been investigated in some existing works, the investigated interference scenario in all these related works (as in) is only a simple one, in which on one resource block (RB), at most one D2D pair can access it to help improve the secrecy performance of the corresponding cellular communication link and one D2D pair cannot access multiple RBs. In this paper, we investigate the physical layer security issuein D2D communications under laying cellular networks from a cooperation perspective. We formulate this cooperation as a coalition formation game which can achieve efficient and effective cooperation among cellular communication links and D2D pairs to both sides' benefits. Besides, different from previous related works, we consider a more general interference scenario that multiple D2D pairs can access the same RB and one D2D pair is also permitted to access multipleRBs.

## 3. PROPOSED METHOD

We first derive the optimal power control solutions for the cellular communication links and D2D pairs to maximize the secrecy capacity performance of the investigated cellular communication under a simple cooperation case and further propose a secrecy-based access control scheme with best D2D pair selection mechanism. Note that this derivation is under the same interference channel model assumption as that in. Although also obtained the optimal transmission power of D2D communications, our work differs with from at least two aspects: 1) The power control solution we obtain is a joint consideration of the transmission power of both cellular communication links and D2D pairs in different channel conditions, while only considered the transmission power of D2D pairs; 2) the optimization objective is the secrecy capacity in our work, while focused on the secrecy outage probability.

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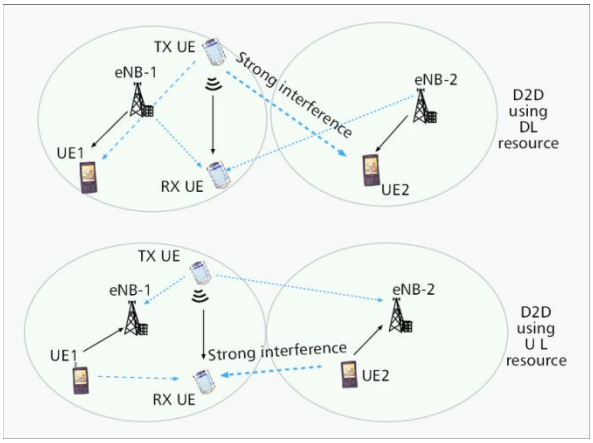


***Fig of 3.D2D Resource Allocation***

We provide a novel cooperation mechanism to investigate the physical layer security problem in the D2D communications under laying cellular network. Cooperation via spectrum sharing among cellular communication links and D2D pairs can yield mutual benefits in the presence of an eavesdropper. When information secrecy is a concern, cellular communication links may benefit from simultaneous transmissions of D2D pairs via spectrum sharing to increase the secrecy capacity, while D2D pairs can also benefit from spectrum sharing permission to transmit their individual data. Also different from the existing related works, in our proposed cooperation mechanism, D2D pairs have its own utilities to pursue and they are positive partners rather than selected‖or—matched‖candidates asin.

## 4. SIMULATION AND PERFORMANCE ANALYSIS

In this section we consider the uplink transmission of a seven-cell system with intersite distance ISD = 500 m, in which D2D (candidate) pairs and cellular UEs (i.e. UEs transmitting to an eNB) are dropped according to a surface uniform distribution in a series of Monte Carlo experiments. To gain an insight into the reuse and proximity gains, we are interested in the performance of the system in two extreme cases. When all the D2D candidates operate in cellular mode, they communicate via their respective serving eNBs. In contrast, when the D2D candidates in each cell operate in D2D mode, they use a direct D2D link using cellular uplink resources.

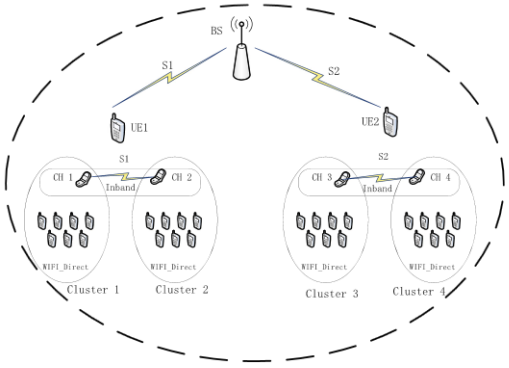


***Fig of 4.One cellular cell with the maximum number of UEs***

The cellular UEs (i.e. the UEs that are not candidates for D2D communications) always transmit to their respective serving eNBs using a cellular uplink. For resource sharing, we assume that in cellular mode the resources allocated to the UEs are orthogonal also in timeotherwise in frequency, while in D2D mode PRBs are reused by cellular and D2D links. For ease of presentation, we are primarily interested in the system performance as the function of the maximum D2D distance (i.e. the distance among the devices), other thanand as the function of the distance between the cellular UE with the serving eNB. The main performance measure of interest is the (uplink) power efficiency, that is the required sum transmit power in the system to realize a

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capacity (spectrum efficiency) target. Depending on the actual outcome of the Monte Carlo experiment, and depending on the mode selected for the D2D candidates (D2D or cellular) this capacity target may not be feasible, because the required transmit power would grow infinitely large. Indeed, the infeasibility of a capacity target is a key performance measure when minimizing the sum power consumption. Therefore, the second performance measure of interest is the probability of the infeasibility of the capacity target.

## 5. Conclusion

In this paper, we investigated the cooperation issue when employing physical layer security concept into the D2D communications underlaying cellular networks. First, we derived the optimal power control solutions of cellular communication links and D2D pairs under a simple case to maximize the secrecy capacity and further proposed a secrecy-based access control scheme. Then, we considered a more general case and provided a cooperation mechanism, based on which, we formulated the cooperation problem among cellular communication links and D2D pairs as a coalitional game. In addition, we proposed a merge-and-split based on coalition formation algorithm newly designed Max- Coalition order which can achieve efficient and effective cooperation process and obtain both improved system secrecy rate and social welfare. Simulation results validated the efficiency of our proposed secrecy based access control scheme and merge-and-split based coalition formation algorithm.

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