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Review on D2D Network Glitches and 5G Technology Implications

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Abstract-As the number of people who use mobile devices continues to climb, there has been an increase in the need for proximity services that provide a high data rate. The fifth-generation (5G) wireless systems has the potential to develop the current state-of-the-art technology in a manner that is congruent with the needs of the future and to give a road map for solutions that are reliable and that save resources. Device-to-device, or D2D, communication has been envisioned as a potential related technology for 5G wireless networks. This communication would allow for the provision of services such as live data and video sharing. A device-to-device (D2D) communication method increases the possibilities of device-centric communications by making use of direct D2D connections rather than relying only on cellular connectivity. The shifting of traffic from typical network-centric entities to D2D networks not only increases the capacity of the network, but it also reduces the amount of processing complexity at the base station. However, there are a lot of obstacles in the way of direct-to-device connection. In this article, we provide an overview of the methodologies that are presently being used in D2D networks for the management of interference, the discovery of networks, the provision of proximity services, and the maintenance of network security. In our conclusion, we provide new insights on D2D communication and indicate areas that need future exploration.

Keywords: Network discovery, proximity services (ProSe), simultaneous wireless and information power transfer (SWIPT), device-to-device (D2D) communication, millimeter wave (mmWave), and vehicle-to-vehicle (V2V) communication.

1. INTRODUCTION

The introduction of wireless technology of the fourth generation, or 4G, provided us with the much-needed foundation we need to go toward faster data transfer rates and more reliable communication standards. Because of the continuously growing need for data services, such as internet access on mobile user equipment (UE), new wireless communication protocols have been created. Two of these protocols are known as Long-Term Evolution (LTE) and microwave access. Recent estimates suggest, on the other hand, that the amount

ISSN: 2057-5688

of time spent online on mobile devices will dramatically grow in the years to come.

With the introduction of the concept of 5G technology, there has been offered the possibility of a solution for applications that make use of high data rate peer-to-peer (P2P) connections. The internet of things (IoT), device-to-device (D2D) networks, heterogeneous networks (HetNets), and machine-to-machine communications are some of the technologies that are slated to be standardized as part of the creation of the 5G network. The efforts that are being put into the standardization of 5G have as their primary objective the determination of the basic structure of 5G in order to meet the demands of fresh applications and the possibilities for commercialization. Network operators have shown a great willingness to spearhead the development of 5G and take the initiative to do so. One of the primary objectives of 5G is to enhance mobile broadband via the provision of additional services such as virtual reality and live video sharing.

It discusses in great detail both the taxonomy associated with LTE-A as well as the manner in which D2D networks are used within this technology. The authors have presented an overview of the existing works that are relevant to D2D networks and have classified the works into two categories: in band D2D, and out band D2D, in order to assist readers in better comprehending the concept of D2D networks. In addition to that, new ProSe realization processes are provided. The emergence of the emerging concept of 5G networks has resulted in the need to conduct an analysis of the D2D network protocols using a 5G network as the frame of reference. We expand on the ideas that were covered in the aforementioned paper, offer our insights regarding the flaws in existing techniques, and make suggestions for improvements in order to give the reader a more comprehensive understanding of how current techniques need to be evolved in order to function in future 5G D2D networks. We do this in order to give the reader a more comprehensive understanding of how current techniques need to evolve in order to function in future 5G D2D networks. In order to inform the reader of the new research trends in D2D networks, a special emphasis is placed on aspects such as vehicle-to-vehicle (V2V) communications, millimeter wave (mmWave) technology, simultaneous wireless and information power transfer (SWIPT), and social trust based networks. These are all areas that have not been focused on in previous surveys.

2. D2D Standardization Overview

The 3rd Generation Partnership Project, sometimes known as 3GPP, is an initiative that brings together organizations that work on developing standards to analyze and propose new standards. The first connection of the D2D technology was made to LTE-A, which is a component of 3GPP Release 12. Qualcomm presented their suggestions for standardizing D2D communication within the context of the more comprehensive LTE-direct protocol in collaboration with other partners of the 3GPP. It was addressed in 3GPP Rel. 12 and Rel. 13, which also stressed the development of the D2D notion for V2V communications, the ProSe that is based on D2D communication. A multi-hop relay network for D2D communication is

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made possible by Rel. 13, which also provides specifications for push-to-talk applications that are required to have mission-critical priority control. In addition to this, the process of locating a network has been expanded to include scenarios with complete, partial, and no coverage.

The discussion that took place under 3GPP Rel. 14 centered on enhancing LTE in order to pave the way for the establishment of 5G networks in the future. The final specifications for Release 14 were made public in June of 2017. The development plan that was formed under Rel. 14 addressed a wide range of issues, including as emergency services, LTE for vehicle-to-everything (V2X), location services, and latency reduction tactics. The 3GPP is now working on the next phase, which will consist of the publication of Rel. 15, which will focus on the deployment of the 5G network. In particular, Rel. 15 might be considered the jumping off point for the process of establishing 5G standards. The International Telecommunication Union Radio Communication Sector laid the groundwork for the introduction of a comprehensive 5G standard in 2020 by initiating research as part of the International Mobile Telecommunication System (IMT 2020) program. This action opened the way for the standard's introduction. The concept of a D2D network that makes use of Wi-Fi Direct technology was taken into consideration by the IEEE 802.11 protocol specifications. The capability of the device to dynamically take on the function of an access point and/or a client is one of the most significant advantages that can be gained by using Wi-Fi Direct in D2D networks. Wi-Fi Direct technology has lately become more widespread in mobile devices; as a result, it will be simpler to build D2D networks that make use of Wi-Fi Direct. Because direct connection between devices (D2D) is regarded to be a useful technology for location-based data sharing services, it may be included into future 5G networks. Instead of using cellular lines, direct communication between devices is preferred since it offers benefits in terms of proximity and variety. Additional categories for D2D communication include in band D2D communication and out band D2D communication.

Inband D2D:Communication occurs on a section of the cellular spectrum that has been licensed for that purpose. D2D is advantageous in terms of spectral efficiency in band since users of the technology share licensed spectrum with users of cellular technology. The eNB is in charge of the quality-of-service management system, which plays a role in mitigating issues such as interference. Within the band D2D, other categories including underlay and overlay may be found. Underlay direct-to-device communication, as opposed to overlay D2D communication, makes use of the same spectrum resources as cellular users. In overlay D2D communication, the spectrum resources are reserved exclusively for D2D users. Underlay D2D communication creates challenges when it comes to the management of interference and the allocation of resources between D2D and cellular users (CUs). In spite of the fact that overlay D2D communication solves the issues described above, it is unable to guarantee efficient use of available resources because of the stringent assignment of resources.

ISSN: 2057-5688

Out band D2D:For the purpose of communication, unlicensed spectrum, such as the ISM band, is used. Wi-Fi Direct is one of the options that might be considered for use in Outband D2D communication. However, in order for Outband D2D to work, the hardware of the devices being used for communication must be compatible. The actual communication that takes place between the devices takes place in unlicensed spectrum; nevertheless, the eNB is the one that supplies the control signals. Even if interference from CUs is eliminated by using out-of-band D2D, there is still interference from devices, which makes addressing interference a more challenging and complex task. Another kind of Out band D2D deployment paradigm is cluster communication. In this approach, the cluster head (CH) node is the one responsible for sending and receiving signals.

2. INTERFERENCE MANAGEMENT

A. Interference Avoidance

The manipulation of transmissions is one of the interference avoidance tactics that is used to stop communication between nodes that are causing interference. The proposed method prevents CUs located in the same geographical area as D2D users from broadcasting at the same time those users do by imposing transmission restrictions within that region. At the D2D receiver, the measurements of the interference-to-signal ratio are compared with a predetermined threshold in order to determine whether or not ILA is present. The assumption that the channel state information (CSI) would be available at the base station (BS) in impending 5G D2D networks is not a feasible one, as this article will show. It is impossible for two D2D pairs to transmit at the same time inside the same ILA since this would cause interference. ILA-C is the abbreviation for the ILA for CUs, while ILA-DP1 and ILA-DP2 are the abbreviations for the regions that have been specified for D2D pairings (DP) 1 and 2, respectively. There is a good chance that Perfect CSI is well-known at the BS. A cumulative distribution function (CDF) of system capacity demonstrates that the recommended technique will result in greater performance overall. It is possible to adjust the levels of transmit power in order to better control the amount of interference that is experienced by the communication lines. Users using CU and D2D have the ability to adjust the transmit power that they use to reduce interference. The suggested method calculates the maximum allowable SINR-T for D2D and CU communications and then changes the transmit power levels in order to keep interference levels within acceptable boundaries. The recommended method performs better in terms of throughput according to CDF curves when compared to the conventional power control techniques. In order to create the recommended system, a deterministic scenario that has a very low node density has been chosen. The design of a scenario, also known as an interaction between deterministic and stochastic models, would be an essential stage in the process of developing interference avoidance strategies for future 5G networks. Scenarios are used to simulate possible outcomes of a situation.

B. Interference Coordination

In network configurations that make use of

ISSN: 2057-5688

in-band D2D communication, interference coordination strategies take on a considerably more significant role. The base station (BS) is in responsible of centralized interference coordinating, often known as CIC. The D2D nodes take part in the coordination process in decentralized interference coordination (DIC) systems, although there is only little control from the BS. Wen et al. discuss a CIC strategy that integrates resource allocation, power management, and mode selection into a single framework. The multi-pronged technique that was presented has the potential to serve as a blueprint for the development of more complex 5G D2D networks. The user-matching system is responsible for ensuring that resources are allocated to D2D users in addition to CU users. When compared with the exhaustive searching, allocation, and matching technique (ESAM), the GAAM strategy uses CDF versus system throughput charts. The processing involved in GAAM is far simpler, and the throughput it provides is comparable to that of the ESAM approach. The research, on the other hand, is solely relevant to the scenario of the uplink network. It would be quite interesting to investigate the possibility of adapting the algorithm such that it may operate in a downlink network setting.

C. Interference Cancellation

Intelligent cancellation solutions make it possible for the receiver to decode the message by mitigating the negative impacts that interference has. The sequential interference cancellation (SIC) system, together with a greedy algorithm-based approach to resource allocation, is shown here. At the receiver, the SIC technique is used in order to get rid of any interference caused by users communicating with one another. The authors have brought attention to the disadvantages of the proposed technique, namely the added computational overhead and the use of energy. It is anticipated that future 5G networks would be environmentally friendly and have a reduced base station overhead. In order to adhere to the proposed layout for future D2D networks, the limits indicated above will need to be taken into consideration throughout their construction.

The coordinated multipoint (CoMP) technology has the potential to minimize intracellular interference between a D2D user and a CU by making use of the zero-forcing approach. A processing unit in centralized CoMP examines data such as the precoding matrix index and rank indication [36] to decide whether or not the D2D operation should be performed. Because it simulates a scenario with many CUs and D2D pair connections, the solution that has been described is especially useful for 5G D2D networks. In the future, it is possible that an investigation into the efficacy of the approach that was recommended in an environment with dense node deployment may be conducted in order to shed light on the consequences of interference.

In order to support future 5G multitier systems, the interference management techniques that are now in use will need to be upgraded, particularly with regard to HetNets. Figure 1 depicts a multitiered system that comprises macrocells, picocells, femtocells, and D2D pairs, as well as relay-aided D2D at cell boundaries in the event that deep fading links between D2D and CUs are seen. This kind of

ISSN: 2057-5688

linkage would indicate that the system is multitiered. It will be necessary to use distinct power distribution algorithms for the uplink and the downlink in order to mitigate the negative impacts of interference.

D. Network Discovery

The setup of the D2D communication protocol includes network discovery, which allows D2D users to detect nodes in the immediate vicinity. Shared beacon signals allow for the transmission of device IDs and other information between different devices. In order to assess whether or not it is feasible to create a pair, users of D2D will also share their respective CSIs with one another. Additional classifications are possible for network discovery methodologies that are device centric (DC) and network centric (NC). The concept of NC discovery for use in network circumstances when coverage is available was addressed in 3GPP Release 12. In 3GPP Release 13, the network discovery algorithms have been improved to enable partial network coverage as well as out-of-coverage scenarios. This improvement was made with a particular emphasis on public safety

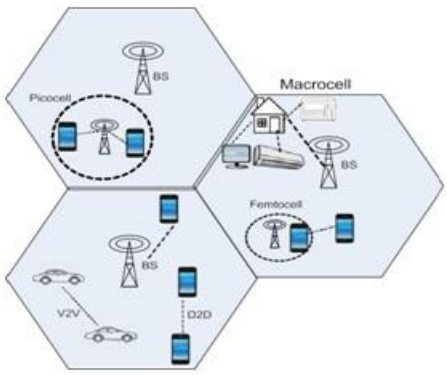

Fig.1. 5G Het Nets (Multitier system)

networks. D2D users collaborate on the process of device discovery by exchanging with one another a time-frequency resource block referred to as a discovery resource block, or DRB.

It is possible that network discovery delay will have an effect on the performance of the system. In [48], a strategy for discovering devices is provided that may be used in either an indoor or an outdoor network scenario. According to the findings of the investigation into the proposed technique, the higher use of the spectrum by D2D users causes cochannel interference, which in turn hinders network identification.

The success of 5G D2D networks over the long run depends on the speed with which networks can be identified. Because of the limits imposed by D2D UEs' batteries, quick network identification is essential in order to provide the maximum feasible lifetime for the network. In addition, the transfer of a node may result in the termination of already active connection sessions. It is essential to have a dynamic strategy that can employ both network-assisted and UE-initiated network discovery based on the shifting circumstances in order to quickly establish a connection. This is because the conditions are always changing. It's possible that the communication costs connected with the discovery process will bring down the capacity and performance of the network as a whole. The emphasis of research in the future should be on creating methods for quick network discovery that take into consideration the issues that have been discussed before.

ISSN: 2057-5688

3. PROXIMITY AND CONTEXT-AWARE SERVICES

On D2D networks, several ProSe would be feasible, which would provide customers with a one-of-a-kind connected experience. Linked to forthcoming 5G D2D networks is ProSe, which may be seen in Figure 2. When viewed from the point of view of the company that provides the network service, the proximity multimedia services are of utmost importance since they would open up several new income opportunities. Additionally, since cellular offloading frees up spectrum, the base station (BS) has the potential to accommodate a greater number of customers and services. Context-aware services are particularly important for networks that are based on smartphones, since smartphones may form their own local networks for the purpose of sharing shared material.

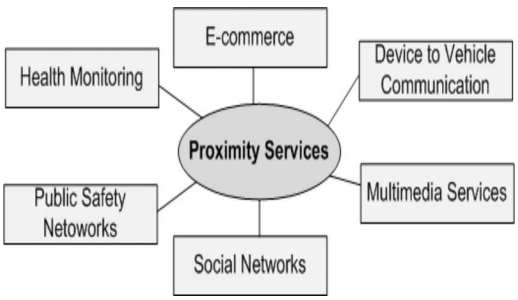

Fig. 2. D2D proximity services.

The problems of resource allocation for context-aware systems have been researched by several authors and examined at the physical layer. The BS will refer to the information correlation matrix in order to establish the priority of the transmissions it makes. We give preference to users of D2D who have a greater information correlation. The system is simulated such that it can generate a random distribution of D2D pairs and CUs. The proposed strategy is advantageous for effectively providing context-aware services, and it also provides direction for developing context-aware networks that will support 5G. When it comes to data rates and reliability, proximity-based multimedia services really must have more than the former. It draws attention to the projected capacity bottleneck produced by high-data-rate multimedia services, which might be seen as a potential threat. An investigation is being conducted on the design needs for future technical standards for device detection, pairing procedures, and interference control in D2D networks. The authors underline the need of creating service-specific standards in addition to the typical technical requirements for D2D networks. Because the majority of traffic on future 5G ProSe networks will be video, it is necessary to determine the requirements unique to each service.

Self-interference cancellation is one of the many advantages that the FD technology brings to the table for ProSe. A distinct environment characterized by Rayleigh fading with uniform distribution is used to simulate an FD model. The cumulative throughput (bits/Hz) is used as a comparison tool between the traditional D2D network and the FD D2D network, which highlights the superior performance of the FD technology. The FD technology may be used in ProSe, such as live multiplayer gaming amongst D2D users, in order to offer the required data rate together with an integrated interference reduction feature. When it comes to ProSe, the importance of D2D networks is boiled down, and the impending challenges are pointed out. Link selection that is supported by relaying mode selection based on the QoS measure (data rate

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threshold) is what supports network sustainability for ProSe, and this is especially true in the context of a D2D cluster. In one of many variations on the cluster-based technique, a CH is chosen to make direct contact with the BS. Due to the fact that the CH supervises the flow of information between the BS and the other D2D users, this is an effective technique for 5G D2D ProSe. To ensure that everyone is treated fairly and that the network operates at its full potential, a cluster-based D2D network requires an appropriate approach for scheduling its resources. a technique of content distribution in a direct-to-user (D2D) network that is based on mobile cloud (MC), and in which the nodes that are close together establish a cooperative network by leveraging connections that are in close proximity to one another. The application of the recommended algorithms in the test bed provides insightful results about the operation of the network.

Because there is no demand for new infrastructure to support 5G D2D networks, widespread use of smartphones will make it simpler to implement these networks. The projection made by Cisco is that user-to-user video sharing will constitute three-fourths of all network traffic in the near future. Caching strategies can prove to be highly helpful in the development of local video-sharing systems. The most watched video content is given higher storage priority, and the most effective caching approach is used to ensure that content is delivered. The authors point out that the speed of the network has an effect on the interference characteristics of the cell, which in turn has an effect on the amount of time it takes for information to disseminate. Using data obtained from social networks, a social graph is constructed with the purpose of locating noteworthy individuals and developing a caching mechanism. In a manner comparable to this, social network-based context-aware caching may exploit user demand patterns to their advantage in order to save backhaul costs. In the future, research need to concentrate on making sure that ProSe is safe, since this is essential for getting devices to cooperate with one another. Because the network providers would have to share any incentives or payments that were received with the devices that were cooperating, it would be challenging to design pricing mechanisms for ProSe.

4. NC And Network Security

A. Network Coding

Transmission of data from beginning to finish has a better likelihood of being successful in cooperative D2D networks that make use of NC assistance.The NC is used in communication networks that are D2D and are aided by a BS. In the style of operation that has been proposed, the BS acts as a relay for two users of the D2D protocol. While the base station performs an exclusive OR (XOR) operation and transmits in the third time slot, D2D users send their data in the first and second time slots, respectively.

Jayasinghe et al. [69] provide the concept of physical layer network coding (PNC), which is used in D2D communication networks to successfully regulate interference in a constructive manner. Many people have the misconception that interference is a lack. In order to generate a code, the PNC system just involves the

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superimposition of electromagnetic (EM) waves. The PNC procedure is broken up into two different time frames when dealing with a network that has two sources and one relay. During the first time slot, the D2D users will have the opportunity to communicate with the relay and exchange their messages X1 and X2. During the second allotted period of time, the relay transmits the encrypted message X3 while also applying PNC. PNC-assisted two-source relay networks exchange information in just two time slots, as opposed to the three time slots that are utilized by traditional two-source relay networks. This results in an increase in the capacity of the network.

The authors show a range of advantages that are made feasible by NC in circumstances that include a high density of D2D nodes. In addition, research is being done to determine whether or not live data transmission might benefit from cooperative D2D with NC assistance. It's possible for devices to work together to download complete files by first collecting essential data chunks and then collectively sharing those chunks. The strategy that was recommended contributes to the saving of energy and eliminates transmission delays. a communication protocol that is bidirectional, D2D, adaptive, cooperative, and NC-based, with the goal of assisting users in sharing downloaded content. In addition, the authors provide a tradeoff analysis and place an emphasis on the features of cellular networks that are known to influence outband D2D performance. In D2D communication networks, the importance of resource allocation and collaborative network control (NC) has been emphasized. According to the findings of the CDF analysis for spectral efficiency and end-to-end SINR, D2D networks have superior performance. As the authors come to a conclusion, they declare that the proposed technique will be advantageous in forthcoming 5G D2D networks. A relaying approach that was presented by Maher and Hassan [74] involves finding inactive nodes and using them as relays in the scheme. When contrasted with the traditional D2D communication networks, NC, when paired with the proper choice of relays, produces higher overall rates. The recommended strategy is especially helpful in scenarios in which several D2D users are looking for materials that are similar to one another.

B.D2D Network Security

Because of the nature of the information that is shared on the internet, network security for D2D networks has become an extremely important concern. Nodes that are close to one another in a D2D network may share sensitive data, such as user IDs and other private information. Any anyone who overhears this potentially sensitive information might potentially utilize it for unlawful activity. As a direct consequence of this, network security standards for D2D networks have been developed, making it possible for users to restrict the disclosure of sensitive information. The most significant obstacle in the process of creating secure D2D networks is the need for dynamic modifications brought on by the mobility of D2D users. It is conceivable for former users to leave the coalition while new users might join it; thus, it is necessary to have an adaptable approach for ensuring the safety of the D2D network.

In [78], an original approach to use

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interference signals for the sake of security is discussed. It is common practice to think of interference as a barrier; nevertheless, it may also be used to improve security by obstructing the eavesdropping node [79], [80]. Because of the channel improvements, it is difficult for control units to precisely locate the eavesdropping node. If a CU suspects that someone is eavesdropping, it could switch to the D2D mode, which makes it much more difficult for the person to listen in on the conversation. The D2D user prohibits listeners from being able to eavesdrop, which results in increased security. It is determined how likely it is that there will be a breach of confidentiality, and the transmit power of D2D users who are attempting to block the spying node is computed. In a similar fashion, nodes could change their operational modes and cease collaborating with one another in order to hide communications from the listening node. This is done to circumvent the eavesdropping node. Users using D2D may potentially learn how to avoid the loss of information by drawing on the knowledge gained from previous transmissions. These networks are particularly useful in circumstances when there is a need for reliability in transmission. When it comes to security, especially in regard to networks utilized for public safety, ProSe puts a strong focus on the issue. Those who possess the proper key are the only ones who are able to listen to the broadcasts. The recommended strategy is applied to a multicast scenario, which is built. The authors have highlighted the performance gains that may be achieved in comparison to earlier solutions in terms of the amount of computational overhead involved.

It is essential that security for future 5G direct-to-device networks be provided with the smallest amount of additional overhead as is humanly achievable. When deploying dense nodes, the most important thing to focus on is safety. Eavesdropping nodes might potentially be avoided by using certain strategies for the physical layer of security. The technique is very realistic and useful due to the fact that it is anticipated that the CSI estimate would be inaccurate. On the other hand, a scenario that is relatively simple and has a modest node density is taken into consideration. Additional research on the preliminary work done on physical layer security solutions is required in order to design a system that would be capable of meeting the needs of future 5G networks. In addition to this, the security mechanism has to be able to be constantly modified in line with the present condition of the network.

CONCLUSION

In this study, we provided an overview of the challenges posed by D2D networks and presented potential solutions to these issues in order to meet the requirements of impending 5G communication networks. An overview of the existing methodologies that apply to important aspects of D2D communication has been presented. These aspects include interference management, network discovery, proximity and context-aware services, network connectivity, and security. The approaches are being explored in terms of their ability to produce a D2D network that is trustworthy and efficient in its use of resources. Certain newly developed components of D2D networks have also been investigated in the context of 5G D2D networks. These components include V2V communications,

ISSN: 2057-5688

mmWave technology, social D2D networks, energy harvesting and SWIPT, pricing and incentive, and future directions.

REFERENCES:

[1] "Cisco visual networking index: Global mobile data traffic forecast up- date, 2015–2020," Cisco, San Jose, CA, USA, Dec. 2016. [Online].
[2] Available: www.cisco.com
[3] S. Mumtaz and J. Rodriguez, "Introduction to D2D communication," in Smart Device to Smart Device Communication. New York, NY, USA: Springer, 2014, pp. 1–22.
[4] S. Talwar, D. Choudhury, K. Dimou, E. Aryafar, B. Bangerter, and K. Stewart, "Enabling technologies and architectures for 5G wireless," in Proc. IEEE MTT-S Int. Microw. Symp., 2014, pp. 1–4.
[5] P. Pirinen, "A brief overview of 5G research activities," in Proc. 1st Int. Conf. 5G Ubiquitous Connectivity, 2014, pp. 17–22.
[6] P. Phunchongharn, E. Hossain, and D. I. Kim, "Resource allocation for device-to-device communications underlaying LTE-Advanced net- works," IEEE Wireless Commun., vol. 20, no. 4, pp. 91–100, Aug. 2013.
[7] L. Goratti, G. Steri, K. M. Gomez, and G. Baldini, "Connectivity and se- curity in a D2D communication protocol for public safety applications," in Proc. 11th Int. Symp. Wireless Commun. Syst., 2014, pp. 548–552.
[8] H. Tang, Z. Ding, and B. C. Levy, "Enabling D2D communications through neighbor discovery in LTE cellular networks," IEEE Trans. Sig- nal Process., vol. 62, no. 19, pp. 5157–5170, Oct. 2014.
[9] L. Wan, G. Han, J. Jiang, C. Zhu, and L. Shu, "A DOA estimation ap- proach for transmission performance guarantee in D2D communication," Mobile Netw. Appl., vol. 22, pp. 1–12, 2017.