Device to Device (D2D) Communication: Interference Management Perspective

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***Abstract*-**Evolution of devices has lead mobile generations into revolution. User's demands like gaming, advertisement, content sharing, and downloading speed insist cellular operators to move on new research paradigm that can fulfil these requirements. These demands of users have put cellular operators to pacify the demands in cellular traffic over coming years. Hence, to cope with mentioned problems researchers left with reduction of cell size. The most reasonable method is via Pico cells which demands installation of new base stations. To preclude this overhead cost cellular offloading of data becomes a solution. In such a scenario, Device-to-device (D2D) communication gained its popularity which is offloading of cellular traffic whenever the users are in proximity. Moreover, advantages like spectral efficiency, Quality of Service and cell edge performance have attracted the man more. In this paper, we briefly describe the concept of D2D and different scenario's in which D2D can work. Then, we move towards its hurdles and challenges which are interference management, resource utilization, power control, and mode selection. However, most of the paper is contributed towards interference types, management issues and techniques used by different researchers.

***Keywords*-**Device-to-device Communication, Cellular Users, Interference Management, Spectrum Efficiency, Power Control, Mode Selection

I. Introduction

Telecom gives birth to old wired telephone system when voice transfer is the only demand. Interference, call drop and poor quality of service (QOS) are the accepting challenges. The above-mentioned data is first generation (1G) then we move towards sending short messages which is fruitful effect of second generation (2G). Addition of features on daily basis comes up with integrated internet service which becomes third generation (3G). Then, high capacity multimedia and World Wide Web access demand lead us to fourth generation (4G) and fifth generation (5G). Fig. 1 shows evolution towards 5G.

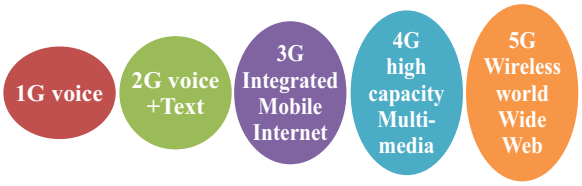

Fig. 1. Evolution towards 5G

These escalating demands of users have moved telecom operators from old telephony systems to today's technologies of third generation partnership project (3GPP) [i],Long term evolution advance (LTE-A) and 5G [ii] but data demands of users are still not pacified because expansion of 5G has provided the need of high connectivity speed with existing mobile networking standards. In such environment researchers found many ways to solve problem like installation of Pico cells which require additional Capital expenditures(CAPEX), operating expenses(OPEX) and base stations. It increases overhead cost. Second method is Green communications. It is a vital technology which implements virtualization, upgrades older system and provide high efficiency. It lies with still one of major disadvantage i.e. system design. Then, researchers go to a new versatile technique i.e. device to device (D2D) communication. On the other hand, increased momentum towards effective design approaches proves that modern age demands are cost effective and need high connectivity traitsas shown in Table I [iii].

TABLE I
Yearly Increased Number of Users

Year	World population	Connected Devices	Connected Devices per Person
2003	6.3 billion	500 million	0.08
2010	6.8 billion	12.5 billion	1.84
2015	7.2 billion	25 billion	3.47
2020	7.6 billion	50 billion	6.58

Numbers of users in 2003 were 6.3 billion but connected devices per user were 0.08 which are increased to 3.47 in 2015 i.e. almost four times above. In such a scenario, D2D has paved its way. The revolutionary concept of D2D can be delineated as direct communication between two devices without infrastructure. The concept of base station (BS) will be declined as it will only be a supplier to some users then they will serve to other devices. A BS will give a signal to user then user will connect to other devices. For example on small scale we can understand it by Wi-Fi-direct [iv]while on large scale; In 5G all data is offloaded to D2D pairs without passing through central controller. Hence, comfortably deal with proximity problem.

TABLE II
COMPARISON OF WIRELESS TECHNOLOGIES IN INDUSTRIAL APPLICATIONS

Featured Technology	Standard	Spectrum range	Max. transmission range	Max. data rate	Uniformity of service provision	Application	Backhaul	cost
D2D	3GPP LTE-A	Licensed band	1,000m	1 Gbbps	Yes	Offload traffic	No	No
Wi-Fi direct	802.11	2.4 GHZ	200 m	250 Mbps	No	Context sharing, group gaming	No	No
NFC	ISO 13157	13.56 MHZ	0.2m	424 kpbs	No	Bluetooth, Wi-Fi connection	No	No
ZigBee	802.1504	868/915 MHZ, 2.4 GHZ	10-100m	250 kpbs	No	Home entertainment And control environment monitoring	No	No
Bluetooth	Bluetooth SIG	2.4 GHZ	10-100m	24 Mbps	No	Object exchange peripherals connection	No	No
UWB	802.1503a	3.1-10.6 GHZ	10m	480 Mbps	No	Wireless USB etc.	No	No
Multi-Cell	3GPP (release 9,10,11)	Licensed band for LTE-A	1-2 Km	100-500 Mbps	No	Better coverage	Central controller require	High cost

A. D2D versus Ad Hoc Network

Recently, IEEE 802.11 standard based technologies such as Wi-Fi, Wi-Fi direct [iv]which are wireless local area network technologies (WLAN) and Bluetooth, Ultra-Wide band (UWB), etc. are wireless personal area network (WPAN) technologies which have gained popularity because of its fastest speed and low cost. They use unlicensed band i.e. industrial, scientific, and medical (ISM) radio bands. These technologies are limited to small range because a small interference between devices can break the connection. Further, they are using unlicensed part of band where interference issues are not managed by the cellular user. Hence, interference management is a great hurdle to overcome the advantages of their usage because there is no proper cellular network to control all activities. However, in licensed band interference issues are more complicated but can be managed. Multi-cells technologies are part of licensed band.

Following is the summary of the technologies.

a) Wi-Fi and Bluetooth work in unlicensed part of band. So, a small interference can deteriorate the whole communication.
b) Global synchronization is a major issue in Wi-Fi Direct.
c) Multi-cells technology is backhauled based technology that needs cost and time.

When we review all technologies, we come to an effective result of D2D technology where range, efficiency and cost issue can be minimized. The comparison of the mentioned technologies [v] is given in Table II.

The organization of this paper is as follow: Section II deals with classification of D2D communication. Section III describes implementation of D2D communication.

Section IV analyzes interference management which is the main focus of paper. Challenges and issues are discussed in Section V while Section VI is dedicated to conclusion.

II. Classification of D2D Communication

D2D technique has been classified into two categories as shown in Fig. 2. In-band and out-band. In-band remains inside cellular spectrum while out-band remain outside [vi]. Following is the detailed discussion about it.

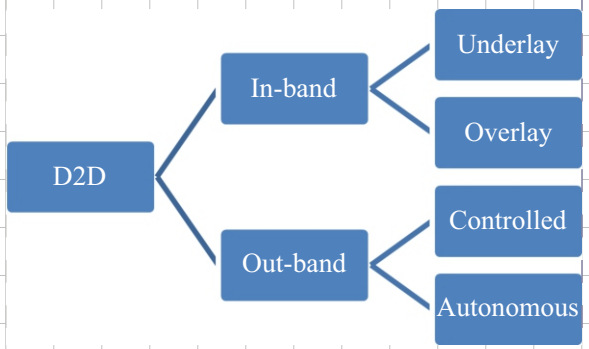

Fig. 2. Types of D2D communication

1) In-Band

It deals with licensed part of band. More work is done on this type of communication [xxv-xxvi] as it is easy to manage interference because it is highly controlled cellular link. Moreover, QOS and spectral efficiency [vii] are highly guaranteed here. In-band D2D is further categorized into two types i.e. underlay [viii] and overlay [ix-x]. In underlay [xi] both cellular users (CU) and D2D users use same spectrum resources while in overlay [ix], [xii-xiii], dedicated resources are used for D2D and cellular users as shown in Fig. 3. Here comes a disadvantage of resource wastage but still due to interference management it is an attracting concept.

2) Out-Band

It deals with unlicensed part of band. Here, it seems easy to handle interference between D2D and cellular spectrum as D2D uses unlicensed part of band [xiv]. Exploitation of the unlicensed band needs another interface to communicate. Bluetooth, ZigBee and Wi-Fi direct etc. are suitable examples of it. Researchers have categorized that out-band falls into two categories i.e. controlled [xv], [xxii] and autonomous [xvii]. In former, researchers prefer to give control to cellular networks [xviii], [xxiii], [xxiv] while in latter D2D communication usage is left on users [v]. Fig. 3 depicts a schematic diagram of D2D types.

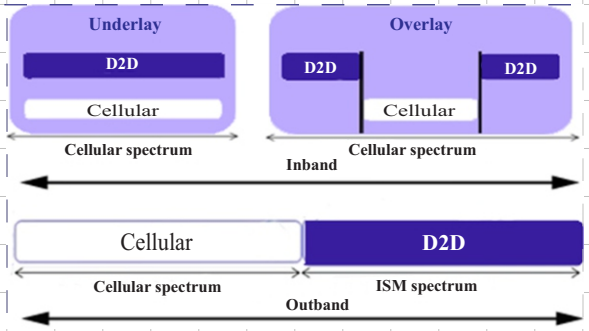

Fig. 3. Schematic diagram of D2D types

Researchers come to decision that core network is required where low data rates applications (short message service and voice calls) are implemented but people are moving towards high data rate demands such as live video streaming, gaming, content distribution, broadcasting and advertisement [xix]. Hence, D2D is a cost cutting and infrastructure less technology and becomes a reasonable solution to increasing demands of users. Moreover, D2D not only increases spectrum efficiency but also increases resource utilization [xx], system throughput [xxi], QOS [vii] and degree of freedom [xxii]. A lot of work has been done in the field of D2D such as machine to machine communication [xxiii], peer-to-peer communication [x], relative positioning system [xxiv], cellular offloading [xix],catastrophic conditions [xxv] and many more as shown in Table III.

III. Implementation of D2D Communication

The need and Implementation of D2D is required as it is well suited in proximity condition [i]. Fig. 4 shows four scenarios' in which D2D can be implemented and is advantageous to implement.

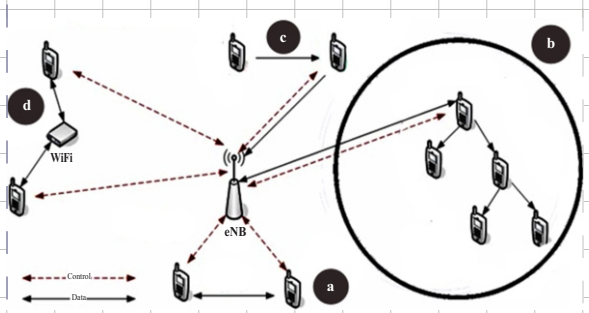

Fig. 4. Different scenario's where D2D can be used

Scenario (a) shows two devices which are in proximity to each other. They are controlled by eNB but data can be easily shared between two without interruption from controller. Issues like latency, load and data sharing can be easily handledby it but limited by range. Scenario (b) shows a broadcasting or advertisement case in which single device is controlled

by eNB. This device broadcasts the information to every other user e. g. we want to send an advertisement to people in a stadium. Scenario (c) represents a case in which device is not in range of controller, here device is connected to eNBand can act as a relay to un-ranged device. Scenario (d) represents a data offloading case to Wi-Fi (an opposite scenario to (a)). D2D is still facing many challenges to overcome such as optimum power consumption, interference and resource utilization. Most of the work in D2D is concentrated on interference management but question is whether the connection is in-band or out-band. Majority of the work is contributed to underlay (type of in-band) i.e. cellular spectrum and D2D uses same resources than overlay (type of in-band) in which D2D is allocated a separate spectrum which results in resource wastage [xl], [ix]. Some researchers are interested to work without-band because here D2D works on entirely different radio resource which is assumed unlicensed part of band (e.g. Bluetooth, Wireless fidelity (Wi-Fi) direct but it has its own limitations of power expenditure.

IV. Interference Management

The Synchronization between D2D pair and cellular user cause serious interference issues to cellular user. Cellular networks are always on priority and hence these issues should be addressed to take advantage of D2D.

Interference results in efficiency degradation. Hence, efficiency of system is an important parameter in D2D communication. It can be achieved by interference management which in return can be controlled by resource allocation, power control and mode selection techniques. It is better to describe the well-known types of interference which are categorized based on network and frequency reuse. Based on network, they are classified into two types: homogenous and heterogeneous interference while based on frequency reuse they are classified into types: Uplink and downlink as depicted in Fig. 5. Further, they fall in four scenarios' which we will describe later in this paper.

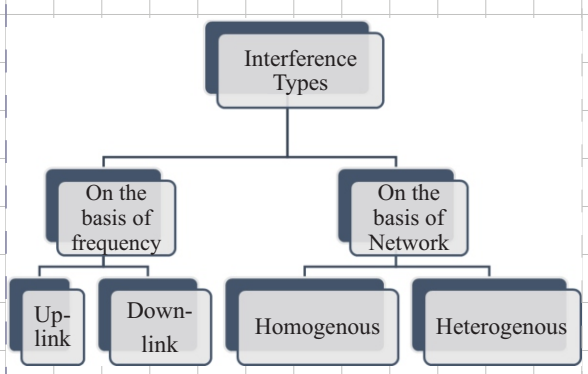

Fig. 5. Types of interference hierarchy

TABLE III
Literature Overview of Objectives Achieved by D2D

Objective	Analytical techniques	Direction		Evaluation	Achieved gain
		Uplink	Downlink		
Spectrum efficiency [22],[26],[27], [28],[29]	-Time division scheme. -channel based grouping algorithm and distance based grouping algorithm. -Massive MIMO. -coalition formulation game and algorithm. -Graph-coloring based algorithm	✓ ✓ ✓ ✓ ✓	✓	-Numerical simulation -system level simulation	-A gain of 31.8% is shown to be attainable at a reasonable transmit signal power -Increases system sumrate by 20%-65% with maintaining resource sharing
Improving QOS[30], [31],[32],[33]	-Rate calculation -clustering algorithm -CILP greedy algorithm -Radio Resource allocation method -joint mode selection and resource allocation scheme -QOS driven optimal power allocation scheme	✓ ✓	✓	-Simulations -Monte-Carlo Simulation -Numerical and simulation analysis	-Increased number of D2D by 50%
Improving system throughput [34],[35]	-Interference Aware Graph Based Resource Allocation -Time Division Scheduling Algorithm	✓	✓	-Simulations	
Improving security [36],[37]	-security embedded scheme -symbol error probability analysis -stochastic geometry			-Simulations	
Cell Edge Performance [38],[39]	-D2D communication assisted interference alignment (DIA) -Interference suppression area	✓	✓	-Simulations	

A. Classification based on Network

a) Homogenous Interference: It is between two D2D or CU [xli] with in a cell. D2D in a cell can disturb other D2D in the same cell. Moreover, it can disturb other CU present within range as shown in Fig. 6.

b) Heterogeneous Interference: It is between two different D2D or CU from different cells [xlii-xliii] as depicted in Figure 6.D2D from one cell can cause interference to D2D in another cell or CU of another cell.

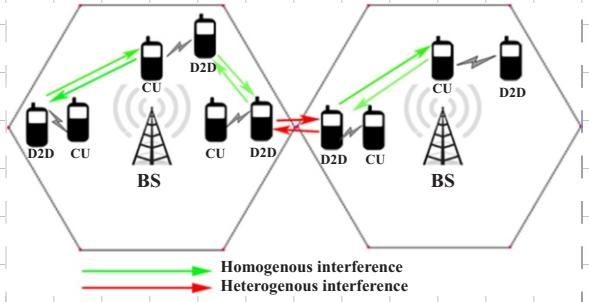

Fig. 6. Network Based interference types

B. Classification based on Frequency

Frequency reuse is additional challenge between D2D and CU for both uplink and downlink. It comes up with four scenarios when D2D is used. Scenario (I) represents the case when frequencies in the uplink are re-allocated to D2D user in the cell, BS receives interference from the D2D user transmitter. Moreover, scenario (II) represents the case in which D2D receiver receives interference signal from the cellular user transmitter. When frequencies in downlink as shown in scenario (III) are re-allocated to D2D user, cellular user receiver receives interference from D2D user transmitter and D2D user receiver receives interference from the BS transmitter is represented by scenario (IV). Here, it is important to ponder that downlink resources are user requirement because of high data demands. More traffic is present on downlink which causes congestion and in return becomes a stumbling block. Further, interference can be understood through its scheme and control level.

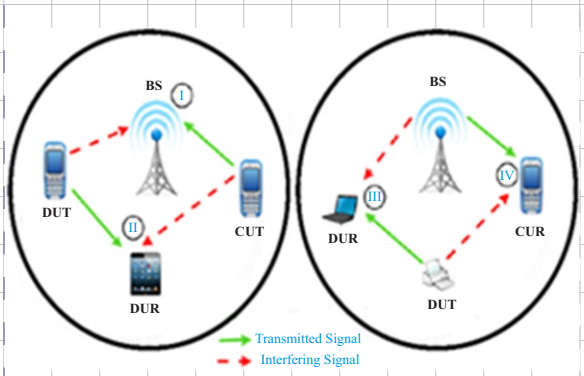

Fig. 7. Frequency based interference types

C. Interference Control Level

Interference control level fall into two categories i.e. centralized and distributed:

Centralized: In the centralized scheme [xliv], a central controller is present which manages channel state information, feedback, quality of service and noise management for individual user in the network. Necessary actions like resource allocation and power control are controlled by it [xlv]. However, it has a disadvantage, as it deals with everyone separately so it requires an extra overhead cost.

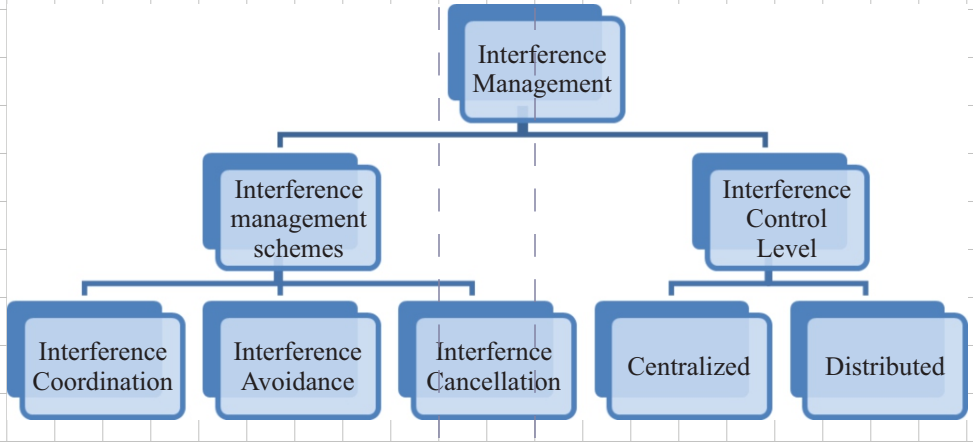

Fig. 8. Interference schemes and control level in D2D communication

Distributed: This type has no central control as every D2D is independent in making its decision [xxxiv]. Hence, it reduces over computational cost [xlvi] and used for large D2D networks.

D. Interference management Schemes

Three interference management schemes are mostly used i.e. Coordination, Cancellation and Avoidance. Authors deal with interference through different strategies as discussed in [xxxix-xl],[lii] in order to increase spectrum efficiency. In [lii] authors have managed interference without having knowing the exact location of the D2D and CU from BS but the distance is known. On the technique, special attention is given to D2D or CU which is allocated, not to use the same resource when it is used by other CU and D2D. Authors of [liii] have discussed two types of interference alignment scheme. First is interference free (IF) scheme and second is interference limiting (IL) scheme. In former, few sub channels of eNB are free and orthogonal space is created while in latter threshold level is designed. Results and simulation have proved that IL is best where large numbers of D2D are present. In [ix] interference-aware interference mitigation algorithm is used. This algorithm controls the interference through network assistance.

Author of [lv] have used the concept of peak and average interference. In first type, signaling overhead increases due to location information while in second type without knowing location D2D users use uplink resources. In[lvi] a limit is set on power transmission so that D2D near base station can communicate directly through it which decreases interference. In [xxxix] interference-suppression-area method is used.The given area is divided into two regions i.e. peak interference region and low interference region. Then, peak interference in DL and UL is controlled through the mentioned technique. Authors of [v] have revealed a new idea of interference temperature. Game theory approach is used to achieve its performance in which BS (leader) sells its interference to D2D while D2D (follower) to increase its payoff; purchase it. Further, two pricing schemes have used i.e. uniform and differentiated. Former deals with small information while latter deals with large information. In [xi] authors have done the work efficiently in an inter-tier environment i.e. user and BS. Dynamic programming is used to control user traffic demands. This technique has proved through numerical evaluation.

A. Resource Allocation

Interference issue can be resolved by another parameter of spectrum efficiency technique i.e. Resource Allocation. Resource allocation is efficient use of resources in term off requency, power and bandwidth. Many techniques like spatial reuse gain, game theory and graph theory are used for better efficiency, good sum rate and better outage probability. In spatial reuse gain concept; if frequency is dedicated to D2D then it cannot be used by any other CU [lx] which is wastage of resource. The techniques we are going to discuss in this paper are graph theory and game theory.

***Game theory**: A* well-known technique has added its attribute to D2D and mitigate hurdle of interference. Price auction [ii], [iii] method is a type of game theory in which most resources are sold to bidders. Authors of [lxi] have discussed bandwidth (BW) allocation through broker, supplier and demander. They are reusing the bandwidth used by users and BS. They offer a price auction scheme to overcome inter and intra-tier interferences. Resource utilization is increased through orthogonal and non-orthogonal sharing mode (NOS). In low interference environment D2D and CU can use same resources through NOS mechanism while in high interference environment orthogonal frequency mechanism is used. It is achieved through Nash equilibrium. Adding to this another price auction technique is Sequential Second Price Auction method in which the block is sold to highest price bidder and pay the price of second highest bidder [lxii]. Author of [lxiii] also deal BS as player and competitor for supplying demand to D2D. Coalition game strategy in [lxiv] is used to achieve maximum utility function on large scale. Authors in [lxv] use Bayesian technique to overcome resource utilization by introducing three market concepts. A matching system is designed to market so that core of the game will not remain empty. Simulation results have proved its performance and achieved sum rate of 20%-65%. Authors of [lxvi] have used the game theory to resolve the problem of energy efficiency and interference by maintaining a coalition between them.

Graph theory: In contrast to game theory, Graph theory is one of the popular methods in showing relationship between networks and different parameters. Authors of [lxvii] and [lxviii] have worked through graph theory in order to achieve optimal performance. They have resolved problem in term of three attributes: cluster, link and resource. Cellular communication and D2D are taken as parameters to draw a relationship and show the interference between them. Another category of graph theory is graph coloring scheme [xxix], same resources are allocated to different D2D pairs. In this scheme, firstly a feedback system is introduced then resources are allocated. Based on defined work, the sum rate and outage probability is improved. A combine work of game and graph theory is presented in [lxix],where a single network and multi D2D users are assumed. Their spectrum efficiency and equilibrium is achieved through both techniques.

B. Power Control

Power control is another technique of resource utilization to mitigate the effect of interference.

TABLE IV
LITERATURE OVERVIEW OF INTERFERENCE MANAGEMENT

Objective	Used Network	Analytical Method	Direction	
			Up-link	Down-link
Interference Coordination[15],[41], [47],[48]		Graph theory -Almost blank sub frames -Power Control Strategy -Self optimization		
Interference Cancellation[49],[50]		-Optimization Algorithm -Greedy algorithm successive interference cancellation		
Interference Avoidance[29],[51]		-Graph Coloring Algorithm -Resource allocation and power control		
Interference management [41],[58], [15],[49],[59],[60],[56], [34],	**-LTE -LTE-A -LTE advance -OFDMA**	-Dynamic Programming Model and Algorithm -Almost blank sub-frames -Graph theory & pseudo-code algorithm -Iterative algorithm -Radio Resource Allocation policy -Low Complexity Heuristic Algorithm -interference aware graph based resource allocation,	✓ ✓ ✓	✓

Different researches are done in uplink and downlink to control the problem of resources utilization. Auction game approach is used in [lxxiv] to control power problem same as [ii-iii]. While, the authors of [xl] have increased network utility through iterative algorithm and scheduling which are interference cancellation (IC) schemes. IC receivers are used for multi D2D and one CU. As every time resources, must be allocated so a scheduling approach is used. Further to solve the scheduling problem, as every time, it is not possible for it to allocate resource. So, iterative algorithm is introduced to resolve the problem. Authors of [lxxv] have considered D2D and CDMA where both are using same resources through iterative algorithm. Stackelberg game [lxxvi-lxxvii] theory approach is used to maximize the number of D2D underlay user with BS and CU. Game procedure takes place in two steps to approach equilibrium. As age is moving towards LTE and 5G, multi-tier system is the increasing demand of present age. Author of [lxxviii] have faced a three-tier interference. To overcome this problem, Network-assisted Device-decided (NDD) methodology is used in heterogeneous environment. This technique involves broadcasting of resources of macro eNB to users. Then, favorite channel is selected. NDD is compared with fixed and network assisted schemes and proves its performance. Throughput is another factor forwhich a lot of struggle is done.

Authors of [xliv] have increased throughput with distributed algorithm. A two-layerapproach is used in which one layer deals with inter call updates and other layer deals with intra cell updates. Leading to throughput, localization and network life time are other tasks need to be controlled in D2D issues. Authors in [lxxix] have added its attributes in D2D through cooperative wireless network localization. The authors have divided the problem of optimization into two stages, infrastructure and cooperation phases.

Distributed power allocation scheme is used to achieve the accuracy of localization and optimal power usage. The author in [lxxx] also works for wireless network but for duplex networks. Ergodic capacity is achieved in this paper. Nonlinear programming method [lxxxi] is used to improve quality of service (QOS) through power control. Authors in [vii] have also dealt wireless network localization but in a different manner. They think that most of the research is far from reality so they work in smaller and divided manner i.e. they have divided the resources in small blocks. Then, buffer is focus in whole paper. Its size is reduced and then scheduling is done as it is previously done by [xxxix]. To prove his results and QOS, OPNET is used for verification. Particle Swarm optimization technique [lxxxii] is used for QOS through gradual remove mechanism for channel assignment and power control.

C. Mode Selection

Relays are widely used in D2D communication for interference mitigation, spectrum efficiency and power constraints. They are widely used because interference is a big hurdle in D2D communication. It can be used in overlay and underlay both mode [lxxxv]. Mostly three cases are selected reuse mode, dedicated mode and cellular mode. The authors of [lxxxv] have considered a multi cell scenario with both shared and no relays. It has observed that reuse mode has higher optimal power. Relays help in reducing transmission power. Authors have considered the distance and location of devices and CU. Adding to this, [lxxxvi] have used primal-dual technique to reduce the computational problem while maintaining QOS. The authors of [lxxxvii] have divided the whole area into two regions i.e. inner and outer region. Inner region is specified for CU and outer region is defined for D2D. Graph theory is used here for resource allocation so easily area can be divided into sub areas. Major focus of this work is on average UL edge users and resource allocation to manage interference. It is not always necessary that slots are available for D2D communication so in [lxxxviii] a

TABLE V
LITERATURE OVERVIEW OF RESOURCE ALLOCATION, POWER CONTROL AND MODE SELECTION

objective	Analytical Technique	Direction		Evaluation
		Up-link	Down-link	
Resource Allocation [69],[65], [71],[72],[73]	**-Greedy algorithm & dynamic programming algorithm -QOS resource allocation scheme -Discovery resource allocation scheme -NP hard resource allocation algorithm & iterative algorithm**	✓ ✓	✓	**-simulation -Numerical simulation**
Power Control [83], [84],[44]	**-Fractional Power control -Two layer power control algorithm -Binary Power Control Scheme -Centralized and distributed power control algorithm -Quantum particle swarm optimization -Modeling**	✓ ✓ ✓	✓	**-Simulation -Numerical simulation -Simulation -Numerical**
Mode selection [85],[86], [89],[90]	**-Modeling -deterministic and heuristic algorithm -Distributive iterative algorithm -Guard-zone mode**	✓	✓	**-Network throughput has increased 5.9-6.3 times.**

scheme or technique should be defined to handle such scenario's. Bursty Traffic Model is used when all the resources are occupied by CU. Here D2D has a choice to communicate through via BS or CU. Distributive iterative algorithm [lxxxix] is found to be fruitful solution in multi-antenna condition. Most of the literature in D2D is dedicated towards Single input single output system (SISO) while Multiple Input Multiple Output (MIMO) is used in four antenna environments. Here, to reduce complexity pre-coding scheme is required at each node. Moreover, authors of [xc] have done it through guard-zone based mode selection scheme. It works on the principle of guard radius which makes a zone around users. This method is verified through stochastic technique. The work in [xci] is an area of interest of study as number of users are increasing and our study is mostly related to small areas. The authors have dealt with game theory approach to catch the large distribution of mobile users. Queue state information is used to analyze the threshold level of BS because large number of users can decrease the efficiency of availing services.

V. Challenges and Open Issues

D2D implementation is still far from real world as it is facing many challenges like interference management, power control, resource allocation, modulation format, channel information, energy consumption and many more. One of the biggest challenge of D2D implementation i.e. interference management which already has been discussed in this paper but still some issues are left for future purpose. For example, Cell densification which results from increased number of users. In this concept, pico and femto cells are deployed which decreases transmission power as distance between sender and receiver decreases. It also decreases interference because of reduced transmission energy but increases back haul cost. However, interference becomes challenge when this small cell technology is implemented with underlay (in-band type). Throughout the literature we have focused on single-tier system while interference becomes uncontrollable in multi-tier system. Multi-tier system also depends on threshold noise level which is different in different scenarios. Still some issues need to be addressed after interference as we named before. First, we are going to address modulation format which is the most negligible issue but the most challenging one. It needs to be addressed because it deals with the compatibility of D2D with existing infrastructure. In existing structure of LTE, on downlink side CUs require OFDMA receiver while on uplink side a single carrier FDMA transmitter. So, same receiver and transmitter would be required when we use D2D. Second, channel information which makes an extra overhead cost is big challenge to address. Channel information on uplink and downlink between D2D pairs, D2D and CU, and CUT and D2R gives overhead to system because in conventional cellular uplink channel information is dealt through BS. Third is battery life time which is user's priority and is a post implementation challenge. Whenever CU wake up for connection request it consumes energy of CU. In future, interference from multi cells and multi-antenna concept at BS will be discussed. Moreover, D2D in more complex environment will be addressed.

VI. Conclusion

In this paper, we have done an extensive survey on D2D communication with major focus on interference management either it is in-band or out-band.Interference is a big obstacle in implementation of D2D because it causes severe disturbances to CU which results in performance degradation of CU. To understand D2D, we have discussed basic concepts of D2D. We gave its comparison with adhoc technologies

and why we preferred D2D over adhoc with its advantages. Then, we discussed interference types whether it is based on frequency or network. Moreover, controlling techniques in opinion of other authors is also discussed. In the last section, we have elaborated interference management in term of resource allocation, power control and mode selection.

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