INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 3)
Available online at: www.ijariit.com

Device-to-device communication for LTE advanced network

Neha Vinod Khadilkar
nehakhadilkar50@gmail.com
N. B. Navale Sinhgad College of Engineering, Solapur, Maharashtra

Marathe V R
vks.marathe@gmail.com
N. B. Navale Sinhgad College of Engineering, Solapur, Maharashtra

ABSTRACT

Device-to-Device (D2D) communication is an advancement technology that offers various advantages for the LTE advanced network such us wireless peer-to-peer services and higher spectral efficiency. It is used in so many different fields such as network traffic offloading, public safety, social services and applications such as gaming and military applications. However, mobile users in today's cellular networks use high data rate services (e.g., video sharing, gaming, proximity-aware social networking) in which they could potentially be in range for direct communications (i.e., D2D). The objective of this paper is to present advances on the current 3GPP LTE-advanced system related to Device-to-Device (D2D). In this paper, we provide an overview of the D2D types based on the communication spectrum of D2D transmission, namely Inband D2D communication and Outband D2D communication. Then we present the proposed work for D2D communication. Hence, D2D communications in such scenarios can greatly increase the spectral efficiency of the network. The advantages of D2D communications go beyond spectral efficiency; they can potentially improve throughput, energy efficiency, delay, and fairness.

Keywords: *Device to device communication, Mode selection, Spectrum sharing, Cellular network.*

1. INTRODUCTION

D2D communication in cellular networks is defined as direct communication between two mobile users without traversing the Base station (BS) or core network. D2D communication is generally non-transparent to the cellular network and it can occur on the cellular frequencies (i.e., inband) or unlicensed spectrum (i.e., outband).

In D2D communication system transmission of information over a short distance benefits from less path-loss effect & thus increases the communication reliability & reduces information retransmission [1].

D2D communication is a new paradigm in cellular networks it allows user equipment (UEs) in close proximity to communicate using a direct link rather than having their radio signal travel all the way through the base station (BS) or the core network. One of its main benefits is the ultra-low latency in communication due to a shorter signal traversal path. Various short-range wireless technologies like Bluetooth, Wi-Fi Direct and LTE Direct (defined by the Third Generation Partnership Project (3GPP) can be used to enable D2D communication. They differ mostly in the data rates, the distance between 1-hop devices, device discovery mechanisms and typical applications. For example, Bluetooth 5 supports a maximum data rate of 50 Mbps and a range close to 240 m, Wi-Fi Direct allows up to 250 Mbps rate and 200 m range while LTE Direct provides rates up to 13.5 Mbps and a range of 500 m. D2D connectivity will make operators more flexible in terms of offloading traffic from the core network, increase spectral efficiency and reduce the energy and the cost per bit [2].

1.1 Methodology

Spectrum Allocation: In terms of spectrum usage, D2D communication is primarily classified into two types. They are inband and outband.

[A] Inband D2D communication:

Here, cellular communication and D2D communication use the same spectrum licensed to the cellular operator. The licensed spectrum may be either divided into non-overlapping portions for D2D and cellular communication respectively (overlay) or may not be divided at all (underlay). Overlay scheme is easier to implement but underlays scheme leads to opportunistic and hence, more efficient spectrum use and more profit to operators.

[B] Outband D2D communication

Here, D2D communication uses unlicensed spectrum (e.g., the free 2.4 GHz ISM band or GHz mm-Wave band) where cellular communication does not occur. It helps in eliminating the interference between D2D and cellular users although interference is still present from other electronic devices (like Bluetooth and WiFi) operating in this band. In fact, operators can control interference when using licensed spectrum but that is infeasible for outband scheme. Outband technology is further divided into controlled and autonomous types. In the former, the radio interface for D2D communication is controlled by the cellular network while in the latter, the cellular network controls only the cellular communication leaving the control of D2D communication to the users.

1.2 Classification of D2D Communication

Fig.1 Classification of D2D Communication

1.3 D2D communication in LTE-Advanced

3GPP Rel. of the LTE-Advanced standard specifies a general concept of proximity-based services (ProSe) that allows physically close devices to discover themselves and communicate via direct links. The prose is meant for public safety communication as well as commercial applications although the emphasis in Rel. is on the public safety only. D2D discovery and D2D communication are defined as a support for ProSe. It is also known as LTE Direct since it supports direct communication between UEs using licensed spectrum and the global LTE ecosystem. Three scenarios for D2D communication are considered: (1) all UEs involved in the D2D communication is within network coverage, (2) only some of the UEs in D2D communication is within network coverage, and (3) none of the UEs in D2D communication are within network coverage.

A highly simplified model for D2D communication based on ProSe reference architecture (non-roaming case) is shown in The BS or eNB, as it is called in 3GPP, connected to the Evolved Packet Core (EPC), can communicate with a UE directly using cellular communication. Additionally, UEs can communicate via direct D2D links. In terms of the channel structure, the direct link between two UEs is called a *sidelink* which can operate by frequency division duplex or time division duplex. The UEs on being powered up first synchronize with the eNB or other UEs. For this purpose, several synchronization signals are defined in 3GPP Rel [2] [4].

Coming back to the architecture in various ProSe applications (APPs) can be installed in a UE and they may exchange data with the ProSe APPs in a remote ProSe APP server. When a UE wants to communicate with its peer UE, the ProSe APP in it requests for expression codes of itself and its target peer from the server. Alternatively, a UE can obtain the expression codes from the Proximity Function in the eNB. After the expression codes are retrieved, the UE initiates the discovery procedure by announcing its own expression code or inquiring if the target UE (identified by the retrieved expression code) is present. After device discovery, the UEs can communicate directly. In terms of the air interface for D2D signal and data transmission, resources are allocated either by the eNB or by the UEs randomly from a preconfigured pool of resources. D2D communication occurs using open-loop communication in the layer, i.e., a D2D receiver does not send any fee.

1.4 Single Hop & Multi hop Networks

Generally, a D2D link connects a transmitter UE with its intended receiver UE resulting in a *single-hop* communication. One can also have a *multi-hop* network composed of D2D links, reminiscent of a mobile ad hoc network (MANET). In a multi-hop D2D

network, the intermediate UEs act as relays either between a BS and a UE or between two UEs variant of the first scenario could be a cooperative cluster of UEs in which the BS transmits a data item to the cluster head which then group casts it to other UEs in the cluster (perhaps with network coding to improve throughput). 3GPP Rel. enables UE-to-network relay while 3GPP Rel. adds support for vehicular communication (i.e., high speed and high density of nodes) based on D2D technology.

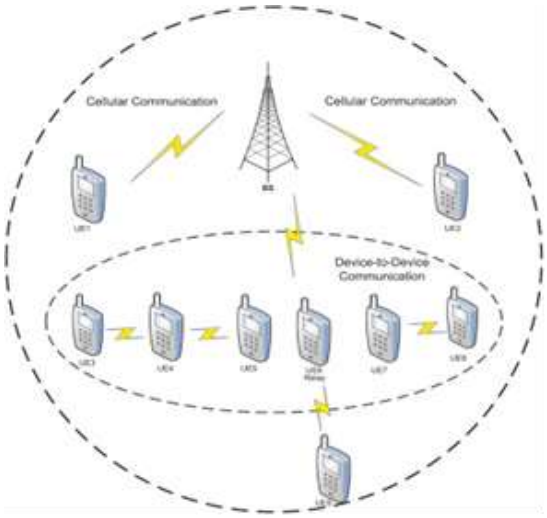
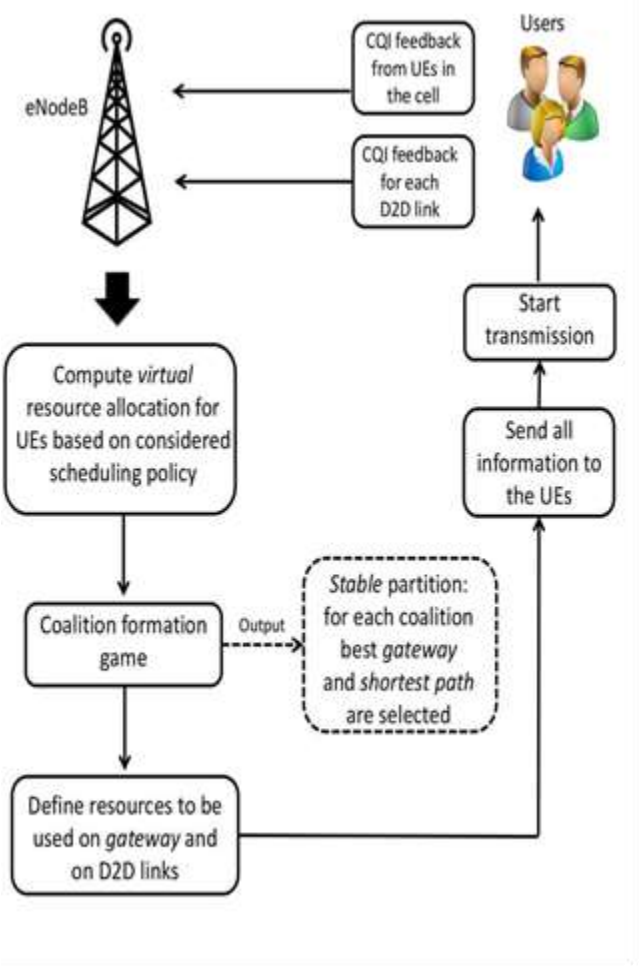


Fig.2. Cellular communication and D2D communication. Both single-hop and multi-hop (including D2D relay) networks formed by D2D links are shown.

2. PROPOSED WORK



2.1 Problem Statement

Cellular network is now four generations old. Need for fast multimedia-rich data exchange along with high quality voice calls has been the primary motivation in this forward journey. As newer and more demanding applications arise and subscriber base increases exponentially, there is an urgent requirement for more novel techniques to boost data rates and reduce latency. *D2D communication* is a new paradigm in cellular networks. It allows user equipments (UEs) in close proximity to communicate using a direct link rather than having their radio signal travel all the way through the base station (BS) or the core network [3]. One of its main benefits is the

ultra-low latency in communication due to a shorter signal traversal path. Various short-range wireless technologies like Bluetooth, Wi-Fi Direct and LTE Direct (defined by the Third Generation Partnership Project (3GPP)) can be used to enable D2D communication. They differ mostly in the data rates, distance between -hop devices, device discovery mechanisms and typical applications. For example, Bluetooth supports a maximum data rate of Mbps and a range close to m, Wi-Fi Direct allows up to Mbps rate and m range while LTE Direct provides rates up to 13.5 Mbps and a range of m. D2D connectivity will make operators more flexible in terms of offloading traffic from the core network, increase spectral efficiency and reduce the energy and the cost per bit illustrates how cellular communication and D2D communication function. Till recently D2D communication did not appear financially viable to cellular network providers. But the current boom in context-aware and location discovery services is bringing a rapid change to this situation. Readers will find a list of authoritative surveys and original research on D2D communication. We do not attempt another survey here but only provide a high-level tutorial-style overview of the field [1].

3. CONCLUSION

Device-to-device (D2D) communications is seen as new paradigm that will be implemented in the next generations of mobile networks to provide high performance in cellular network, improving coverage, provide spectral efficiency, high data rates and offer new peer-to-peer services. In this paper, we present the different categories of D2D communication called Inband and Outband, we discuss Methodology, proposed work, Problem statement. In our future paper, we will use different statistical models and traffic models to study and analyze the different requirements to achieve high speed download, high capacity, and Quality of service guarantees for D2D communication.

4. REFERENCES

[1] Xingqin Lin, Jeffrey G. Andrews, Fellow, IEEE, and Amitava Ghosh, Senior Member, IEEE, Spectrum sharing for Device to Device communication in Cellular Networks.
[2] Sala, Doumiati, Hassan Artail & Karim Kabalan, A Framework for clustering LTE devices for Implementing group D2D communication & Multicast capability.
[3] Shao-chou Hung, Xin Zhang, Andreas Festag, Kwang-Cheng Chen, Gerhard Fettweis, An Efficient Radio Resources Re-Allocation Scheme for Delay Guaranteed Vehicle to Vehicle Network.
[4] Magri Hicham1, Noreddine Abghour2, and Mohammed Ouzzif, DEVICE-TO-DEVICE (D2D) COMMUNICATION UNDER LTE-ADVANCED NETWORKS.
[5] Qiaoyang Ye, Mazin Al-Shalash, Constantine Caramanis and Jeffrey G. Andrews, Resource Optimization in Device-to-Device Cellular Systems Using Time-Frequency Hopping
[6] Networks Lab, TCS Research, TSDSI SG1 F2F meeting, IEEE Bangalore, July 2015, Device-to-Device (D2D) Communication
[7] E.SREE HARSHA1, T. TIRUPAL2 "LTE-Advanced Cellular Networks for D2D Communications"International Journal of Scientific Engineering and Technology Research Volume.03, IssueNo.18,August-2014.
[8] M. Corson, R. Laroia, J. Li, V. Park, T. Richardson, G. Tsirtsis, "Toward proximity-aware internetworking", IEEE Wireless Communications 17(6), 26–33 (2010).
[9] J. Seppälä, T. Koskela, T. Chen and S. Hakola, "Network controlled Device-to-Device (D2D) and cluster multicast concept for LTE and LTE-A networks," 2011 IEEE Wireless Communications and Networking Conference, Cancun, Quintana Roo, 2011, pp. 986-991.
[10] Chithra B Das "A Study on Device To Device Communication in Wireless Mobile Network" International Journal of Modern Communication Technologies & Research (IJMCTR) ISSN: 2321-0850, Volume-3, Issue-3, March 2015.

