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# User Association for Energy Harvesting Based on D2D Communication

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**Abstract:** Device to device (D2D) communications are when two user equipment are close enough to each other, the devices may communicate directly or via base station assistance. D2D technology enables a direct link (uplink or downlink resources) between user equipment (UEs). The performance of D2D communication using an UER in cellular networks has also been investigated, the best UER selection strategy is proposed exploiting channel state information for cooperative UERs and ordering UERs. So, this process uses the transmission node selection strategy. To improve the efficiency and low complex transmission mode selection strategy for the D2D-EHHN, which includes the best UER selection in D2D mode. The ultimate aim in this paper is to improve the throughput in cellular network D2D communication and it measuring the efficiency of D2D performance. And also, the frequency reuse for D2D pairs in the cell by dividing cell into sectors.

**Keywords***:* D2D, AP, UER, 5G, Throughput, Efficiency, Energy harvesting

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## I. INTRODUCTION

Communication is the process by which two or more people exchange ideas, facts, feelings, or impressions in ways that each gains a common understanding of the meaning, intent, and use of messages. The term "communication" stems from the Latin word "communism" - meaning common. Thus, communication is conscious attempt to share information, ideas, attitudes, and the like with others. In short, it is the act of getting a sender of the message and a receiver of the message tuned together for a particular message, or a series of messages. For two or more people to engage in a common, co-operative effort, they must be able to communicate with each other. Thus, good communication consists of creating understanding of the message. In computerized technology, we need to transfer the data from one another without any problem like security and quality. To improve the communication in mobile ad-hoc network there is a need to test the proposed method is working well or not by using system modelling. System modelling refers to an act of representing an actual system in a simply way.

System modelling is extremely important in system design and development, since it gives an idea of how the system would perform if actually implemented. As one of next-generation wireless communication systems, Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) is committed to provide technologies for high data rates and system capacity. Further, LTE-Advanced (LTE-A) was defined to support new components for LTE to meet higher communication demands. Local area services are considered as popular issues to be improved, and by reusing spectrum resources local data rates have been increased dramatically. However, the unlicensed spectrum reuse may bring inconvenience for local service providers to guarantee a stable Initially modelling the randomness in location of APs and UEs, and use the biased cell association scheme to offload traffic between different tiers. However, it is generally not possible to obtain those information from all distributed UERs in the network due to the feedback overhead, and an UE may only be able to obtain information of limited number of UERs. However, together with the privacy problem, the power consumption at an UER has been an issue, since the UER needs to use its own power to forward the information of other UEs. So, the modified resource management, methods to enhance the network throughput include optimal proportion of time to activate the D2D communication optimal portion of spectrum allocated to the D2D communication and joint spectrum scheduling and power control. In this project, a D2D communication provided EH heterogeneous cellular network which is composed of APs of different tiers that are differed by transmit power and spatial density. D2D mode, may not always have better performance than the direct communication to AP mode. The performance of D2D communication using an UER in cellular networks has also been investigated, the best UER selection strategy is proposed exploiting channel state information for cooperative UERs and ordering UERs. So, this process uses the transmission node selection strategy.

This chapter consists of five chapters. First chapter consists of the overview of the paper with its motivation and proposed system. First is the study of D2D with its brief history and its applications. It presents why D2D communication has become important in our modern world and what its real-time uses are. Then the study is done on NS2 (Network Simulator 2), how the results will be shown when NS2 is used. It describes how NS2 works and how code is written in it, with some examples of the code. Next is the description on how NS2 is used to create a simulation of D2D communication with all the network elements. Different modules are used in NS2 in order to create a network. Last segment consists of the performance evaluation and the conclusion, for performance evaluation by using NS2.

## II. DEVICE-TO-DEVICE (D2D) COMMUNICATION

In principle, exploiting direct communication between nearby mobile devices will improve spectrum utilization, overall throughput, and energy efficiency, while enabling new peer-to-peer and location-based applications and services. D2D-enabled LTE devices have the potential to become competitive for fullback public safety networks that must function when cellular networks are not available or fail. Introducing D2D poses many new challenges and risks to the long-standing cellular architecture, which is centred around the base station (BS). Prof. Jeff Andrews, Xingqin Lin, Amitava Ghosh, and Rapeepat Ratasuk provided an overview of D2D standardization activities in 3GPP, identified outstanding technical challenges, drew lessons from initial evaluation studies, and summarized "best practices" in the design of a D2D-enabled air interface for LTE-based cellular networks

The proposed model adopts a Proximity Service (ProSe) communication scenario where both ProSe-Enabled UEs are connected to the same PLMN/cell. The eNB operates as a D2D controller, and as such, it is responsible for the following: (i) the D2D RA and PC and (ii) the peer discovery and tuning for the D2D peers. Potentially, the capability for D2D transmission is provided to all UEs of the network; however, the UEs that implement our D2D scheme will be referred to as eUEs (enhanced UEs). Similar to UEs, eUEs request resources for D2D communications from the eNB. For each one of the D2D requests, eNB launches a peer discovery procedure, while only the valid D2D pairs (with successful peer discovery procedure) are considered in the D2D RA and PC procedures. Differing from the conventional RA procedure, in the D2D RA one the eNB informs both D2D transmitter and receiver about the allocation grant, tuning them to the allocated resources. However, this tuning requires the eNB to know the identity of the D2D receiver.

Conventionally, identities, such as the destination IP addresses, or destination IMSI/S-TMSI identities (International-/Subscriber-Temporary Mobile Subscriber Identity), or other upper explicit level identities (e.g., SIP addresses), are not available locally at the eNB and thus, cannot be used without the involvement of the core network. Thus, the introduction of a new identity for each eUE is required. The new identity is generated by each eUE during its initial access to the network, and any transmitting eUE device has the ability to produce the D2D identity of its target eUE. When an eUE wants to establish a D2D connection, the D2D identity of the target eUE is included in the D2D resource request. The serving eNB, having a one-to-one mapping between standardized and D2D identities, uses the former identities in order to inform both D2D transmitter and receiver about the resource allocation. The adopted D2D model can be summarized as follows: eUEs make D2D spectrum requests using the standard spectrum, request procedure, including, however, the D2D identity of the target D2D receiver. The eNB launches a peer discovery procedure for the requested D2D pair. The eNB allocates cellular resources to valid D2D pairs and informs both D2D peers, tuning them indirectly at the same spectrum portion. The D2D RA combined with a PC scheme guarantees the interference free conditions between cellular and D2D system. The eUE transmitter sends its data using the spectrum region that has been allocated by the eNB, while the eUE receiver tunes to the same spectrum region to receive the transmitted data. The eUE receiver acknowledges the reception (or not) of the data through the eNB following the conventional-standardized procedure.


Proposed D2D communication model

## III. SYSTEM ANALYSIS

Generally, it is not possible to obtain those information from all distributed UERs in the network due to the feedback overhead, and an UE may only be able to obtain information of limited number of UERs. However, together with the privacy problem, the power consumption at an UER has been an issue, since the UER needs to use its own power to forward the information of other UEs

The concept of mobile user equipment (UE) relay (UER) has been introduced to support device-to-device (D2D) communications for enhancing communication reliability. However, as the UER needs to use its own power for other UE's data transmission, relaying information in D2D communication may be undesirable for the UER. To overcome this issue, motivated by the recent advances in energy harvesting (EH) techniques, proposed D2D communication provided EH heterogeneous cellular network (D2D-EHHN), where UERs harvest energy from an access point and use the harvested energy for D2D communication. The UER distribution is derived, and a transmission mode selection scheme including the efficient UER selection method is proposed. The network outage probability is derived in close form to measure the performance of D2D-EHHN. Based on the analysis results, the effects of network parameters on the outage probability and the optimal offloading bias in terms of the outage probability. Particularly, a high EH efficiency enhances the performance of D2D-EHHN, but can also degrade, especially for dense network.

First, derive the outage probabilities in AP and D2D modes and the best UER location. Then the transmission mode selection strategy with the best UER selection strategy. It needs to consider UERs in the FUR, which is the region that UERs located inside can guarantee the intended UE to achieve smaller outage probability in D2D mode than that in the AP mode. This transmission mode selection scheme can be helpful to exploit the EH-D2D communication efficiency. So, it can get reduce outage probability achieved. Moreover, in the D2D-EHHN, the UER density increases with as well, which provides more UER for D2D communication. It is observed that for reduce the outage probability difference ofD2D-EHHN and HCN without EH-D2D is also larger, which indicates that D2D-EHHN can handle more load Density is increased, Secure level is high, boost up the Battery power, Increase overall throughput. , Fast recovery

## IV. BASIC ARCHITECTURE OF NS2

NS2 provides users with an executable command ns which takes on input argument, the name of a Tcl simulation scripting file. Users are feeding the name of a Tcl simulation script (which sets up a simulation) as an input argument of an NS2executable command ns. In most cases, a simulation trace file is created, and is used to plot graph and/or to create animation. NS2 consists of two key languages: C++ and Object-oriented Tool Command Language (OTcl). While the C++ defines the internal mechanism (i.e., a backend) of the simulation objects, the OTcl sets up simulation by assembling and configuring the objects as well as scheduling discrete events. The C++ and the OTcl are linked together using Tool Command Language (TCL). NS2 provides a large number of built in C++ objects. It is advisable to use these C++ objects to set up a simulation using a Tcl simulation script. However, advance users may find these objects insufficient. They need to develop their own C++ objects, and use a OTcl configuration interface to put together these objects. After simulation, NS2 outputs either text-based or animation-based simulation results. To interpret these results graphically and interactively, tools such as NAM (Network AniMator) and XGraph are used. To analyze a particular behaviour of the network, users can extract a relevant subset of text-based data and transform it to a more conceivable presentation

## V. MODULES

- Network Design
- Resource allocation
- Power allocation

**Network Design**

Here it is designed the network with UE and NBs. The UE is nothing but the User Equipment, which is the application devices. NBs is nothing but the node base station, which is used to share the data from one UE to another UE. Potentially, the capability for D2D transmission is provided to all UEs of the network.

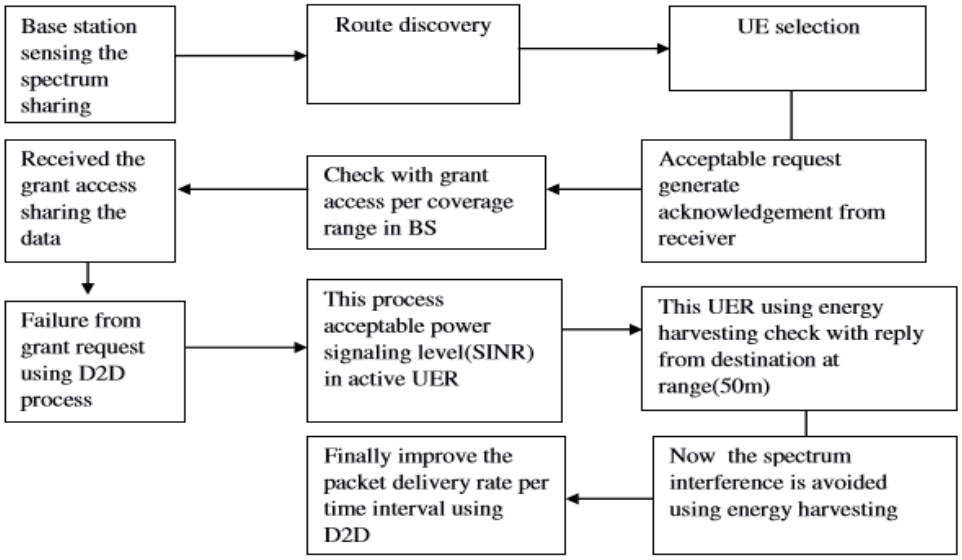
**Resource Allocation**

The UEs request resources for D2D communications from the Nubiform each one of the D2D requests, NB launches a peer discovery procedure, while only the valid D2D pairs (with successful peer discovery procedure) are considered in the D2D RA and PC procedures. The D2D allocation grant is also transmitted to the target UEs (D2D receivers) to inform them about the appropriate spectrum region in which they will receive the D2D data. The very first D2D request is used for device discovery purposes. The NB allocates an empty D2D request. This is used by the D2D transmitter to send a signal toward checking if it can reach the D2D receiver. In that way the extra spectrum space can be used in case the D2D receiver is reached.

**Power Allocation**

The power control is one of main factor to avoid the spectrum interference. Each UE can get know the information about UE receiver available distance the appropriate power for the pilot signal transmission is fixed and depends on the range of the D2D connections that the NB allows inside its cell. The maximum number of D2D devices that can transmit concurrently with a UE transmitter located at a distance of half the cell radius from the NB. The UE, through the power control procedure, transmits with the minimum power that guarantees to reach the target.

## VI. BLOCK DIAGRAM




**ALGORITHM:**

D2D energy harvesting Algorithm:

Algorithm (LTE)

**BS function**

If BS broadcast the adv message

a. Init message

i. Set the status 0-> 1

ii. Start the beacon timer with time Tbi =0; beacon generation

b. Adv is Active message

i. If MN ∈cov

1. Update expire time & position info

ii. Else

1. Create new entry for MN

c. Bs is sched_req

i. If MN ∈ Cov_list

1. Generate grant_info d. MN cov is status message

i. Update request grant_tx→grant_reciv

ii. Data transmission to destination.

**MN function**

If MN in active a. Received the adv

If Mn need to transfer the data a. If BS = cov i. Send con_req to b

If MN recv pkt a. Beacon i. If BS ∈ Covlist 1. Update the expire time ii. Else 1. Add the new entry for BS in list b. Data i. Accept the data & keep in transferring mode.

**Algorithm (D2D)**

If BS broadcast the adv message

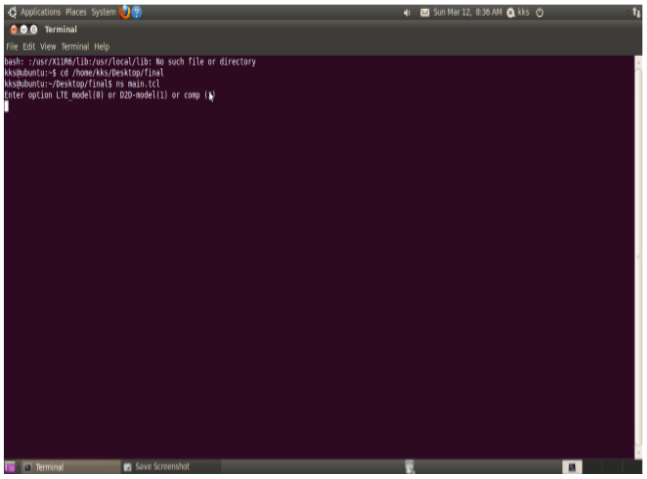
A. Init message
iii. Set the status 0-> 1
iv. Start the beacon timer with time Tbi =0; beacon generation
B. Adv is Active message
v. If MN ∈Cov
1. Update expire time & position info
vi. Else
1. Create new entry for MN
C. Bs is sched_req
vii. If MN ∈ Cov_list
1. Generate grant_info
D. MN cov is status message
e. i. If MN ∈ GRANT_INO
1 .Update request $granttx \rightarrow grantreciv$
ii. Else
1. Generate the UER selection request update tx_failed

**SYSTEM IMPLEMENTATION**

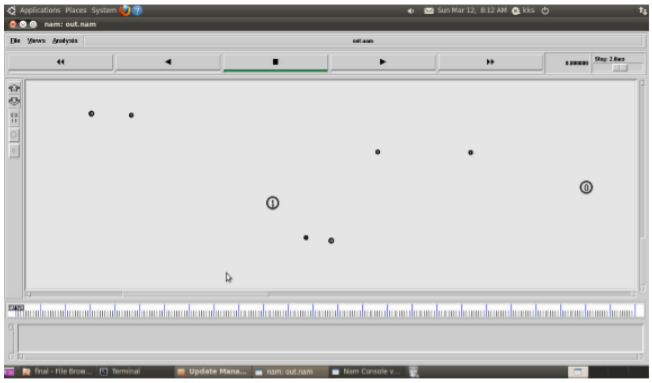
Implementation is a stage of project when the system design is turned into a working system. The stage consists of the following steps. Testing the developed program with sample data. Detection and correction of internal error. Testing the system to meet the user requirement. Feeding the real time data and retesting. Making necessary change as described by the user.

## VII. SETTING THE SIMULATION PARAMETERS

TERMINAL PAGE




DECLARING POSITION OF NODES

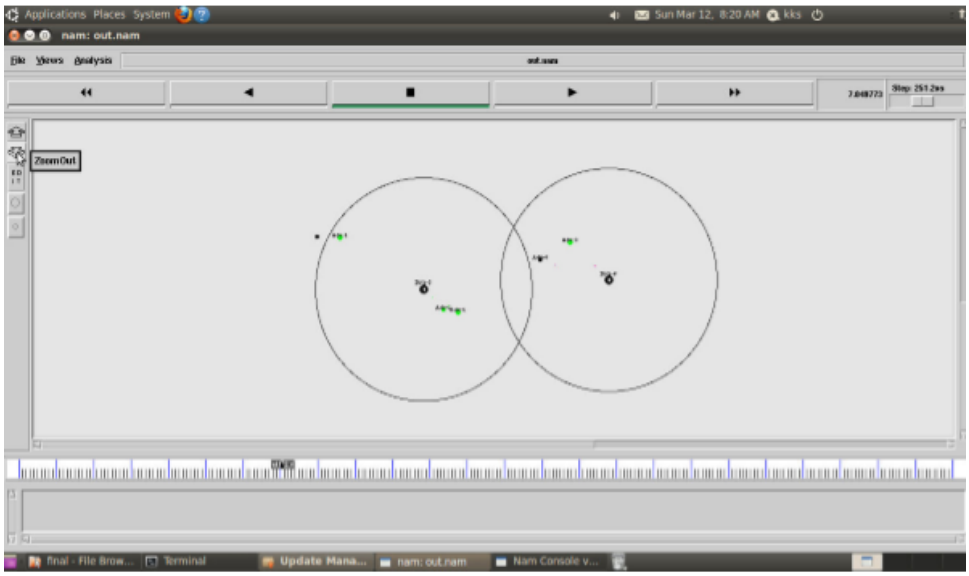



**CREATING MOVING FEATURES OF NODE**

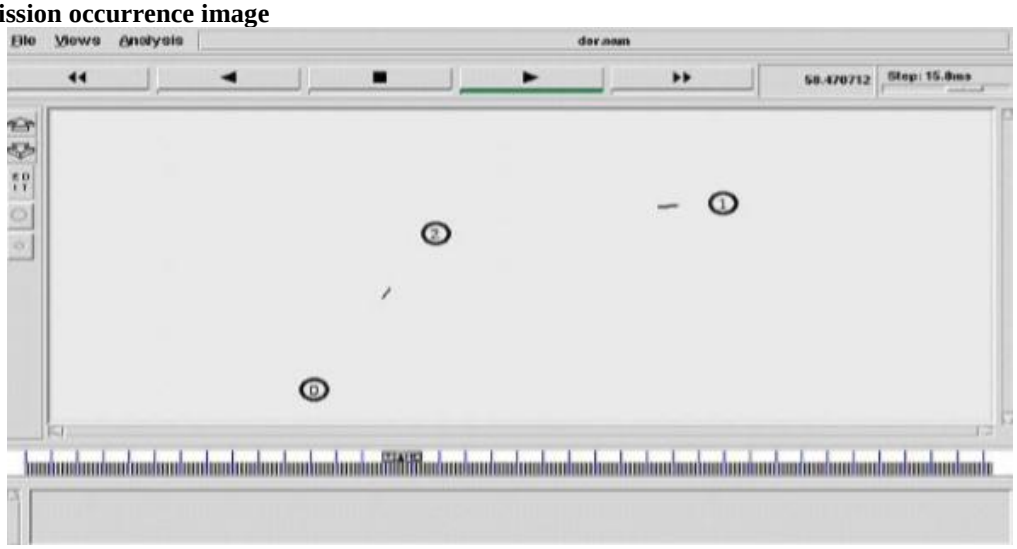
$NS_ AT 1 "$N(6) SETDEST 1563.61000000000 307.000000000000 80.000000000000"

## OUTPUT DESIGN

**BROAD CAST OF THE BASE STATION**



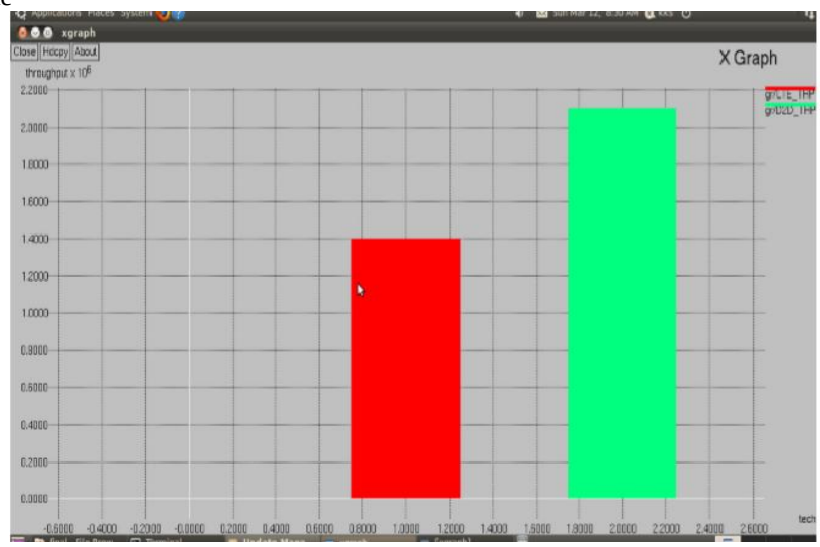

**Transmission occurrence image**




X-Graph

Provides the throughput comparison based on a graph which will be generated automatically based on the TCL coding

X-Graph for time




X-Graph for delay


The output generated by the system is often regarded as the criterion for evaluating the usefulness for the system. Here the output requirements use to be predetermined before going to the actual system design. The output design is based on the following: Determining the various outputs to be presented to the user. Differentiating between inputs to be displayed and those to be printed. The format for the presentation of the outputs

## VIII. CONCLUSION

The short distance between D2D transmitter and receiver provides better link conditions and, thus, more efficient connection with lower energy consumption. From the network's perspective, the use of spectrum and processing resources is reduced, since the intermediate transmissions to the BS are avoided. The introduction of the D2D communications has been done in respect to specific architecture, while the need for physical layer backward compatibility imposes the D2D-enabled UEs to utilize for their direct transmissions the current structure of the spectrum resources. In this proposed system, it utilizes the existing spectrum resources in D2D communication. And it is implemented and tested Heterogeneous network with the help of NS2 simulator

## IX. FUTURE WORK

In the future work, the network protocol will be implemented and effective use of security context information, could be explored for D2D communication with best UER strategy. Due to the time constraints implementation in real time is difficult, so in future it has to be properly tested before implementation. This implementation with the throughput and delay will be varied according to the type of network. To improve the more reliability bandwidth, the best UER strategy will be selected. It will try to reduce the packet loss with the help of D2D process.

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