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IMAGE TRANSFER USING MODIFIED D2D OF 5G TECHNOLOGIES IN ADHOC NETWORK

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ABSTRACT

D2D (Device-to-Device) communication is being used for the transfer of Image from source to destination. D2D is the 5G technology used for stable Networks. Here we are using the same D2D technology for Adhoc Network, wherein we are assuming the Device components are roaming and changing their position with respect to time. In this transaction, we will get to know about the performance of D2D technology in Adhoc Networks.

KEYWORDS:*D2D (Device-to-Device), 5G (5th Generation Communication Technology), UL(Uplink), DL(Downlink), SL(Side Link), EUTRAN(Evolved Universal Terrestrial Radio Access), EPC (Evolved Packet Core)*

Article History

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1. INTRODUCTION

D2D scenario is an application wherein the Mobile devices or User equipments in Cellular Networks are interacting among themselves without the use of E-UTRAN and EPC connectivity. Each User Equipment will be having dedicated Bandwidth with which it communicates with each other. Since the network will not be stagnant and stable, we are employing here Adhoc Routing Protocol of AODV for routing among the User Equipment devices. This experiment was conducted in simulation using MATLAB.

D2D technology is the 5th Generation of Mobile Technology, wherein networking is provided by both EUTRAN and EPC. The various features of D2D technology are dedicated Bandwidth, secured Network and Stable Cellular Network employs eNodeB and other components, Secured Handoff of User Equipment using Cellular Network etc.

Considering D2D communication in Adhoc network requires many parameters to be changed. Here we need to abort the Network availability by EUTRAN and EPC. We have to switch from Normal Routing Protocol to Adhoc Routing Protocol. We have implemented Adhoc Routing using AODV Protocol in the absence of Network availability from EUTRAN and EPC. But the difference between pure Adhoc network and the scenario for our research work that we are supported by dedicated Bandwidth.

The Transaction paper is organized as follows. Section-I am Introduction which speaks about the 5G technology implementation for Adhoc Networks. Section-II speaks about the scenario for the simulation of the transaction. Section-III

speaks about the merits of the simulation system if implemented. Section-IV demonstrates the results of the transaction. Section V speaks about the conclusion and future enhancements.

2. SCENARIO OF SIMULATION

In the transaction carried out we are considering the Modified D2D technology of 5G. Modified D2D technology with a sense that network from EUTRAN and EPC is considered to be NIL with only network form User Equipments having dedicated Bandwidth. Figure 1 shows the interfaces in D2D Technology, wherein we are considering only PC5 Interface between different User Equipments. The Network from EUTRAN and EPC and Prose Function is considered to be absent in our experiment. This situation resembles the disaster hit area wherein we are left with only User Equipments Network and Networks from EUTRAN, EPC and Prose get aborted due to infrastructure damage. This scenario is in the case of natural disaster of earthquake, cyclone etc or due to severe bombardment in a war like situation when all the base station Tower stops working due to damage. If people are trapped in the rubble and want to contact the rescue squad they can communicate through the User Equipments to User equipments only.

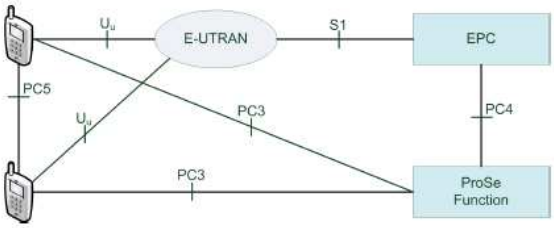

Figure 1: Interfaces and Entities in D2D in 5G

PC5-Direct Ue-to-UE Interface

PC3-Interface between UE and ProSe Server

PC4-Interface between ProSe server and EPC

S1-Interface between EUTRAN and EPC

Uu-Interface between UE and EUTRAN

The 3GPP Test Specification specified in Release-14 and Release-15 speaks of dedicated channels for ProSe discovers and ProSe communication between Devices. The Figure.2 show the different control and Data Channels used in ProSe Communication in D2D communication [5].

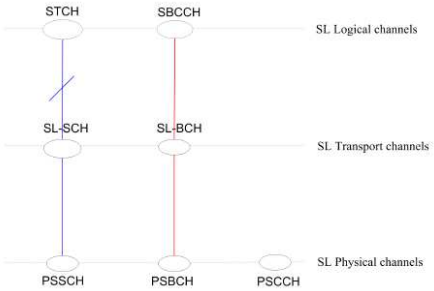

Figure 2: Dedicated (Red Control and Blue Data Channels) in Different Layer for ProSe Communication

Side link Physical Layer Channel operates at Physical layer, Side link Transport Channels operate in

MAC(Medium Access Control) layer and Side link Logical Channels operate in RLC(Radio Link Control) layers. Let us now find what are those dedicated Channel in Different Layers [5].

Physical Layer

PSSCH: Physical SideLink Shared Control Channel (Data Channel)

PSBCH: Physical SideLink Broadcast Channel (Control Channel used in Direct Discovery in D2D)

PSCCH: Physical SideLink Control Channel (Control Channel)

MAC Layer:

SLBCH: SideLink Broadcast Channel (Control).

SLSCH: SideLink Shared Channel (Data).

RLC Layer:

STCH: SideLink Traffic Channel (Data).

SBCCH: SideLink Broadcast Control Channel (Control Channel for Direct Discovery in D2D).

We had implemented the experiment in terms of Side link Channel. Side Link channels are those which are exclusively taken from Uplink Channels. Because the Downlink Channel has a limited Bandwidth to support thousands of UEs in a Cell. So the Downlink Channels are always busy either in data or Control information Transfer. Hence, in 3GPP uplink Channels are preferred for communication between D2D.This is because most of the PRBs (Physical Resource Blocks) are left unused in Uplink. Hence we can utilize the free PRBs for our D2D communication. But these Uplink Channels are also meant to support Uplink cellular traffic. Hence we need to Reserve the PRB in Cellular and D2D technologies as per mentioned in 3GPP test Specification. Every Uplink Control and Data Channel is being exclusively reserved for both Cellular Traffic and D2D traffic in terms of PRBs. Then This Uplink Channels are named as Side link Channel what we meant for communication in D2D. The Figure 3 depict the side link Channels for D2D communication with Prose technology [5].

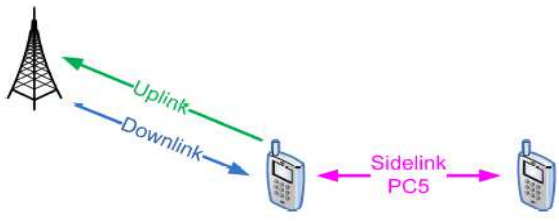

Figure 3: ProSe Side Link Channels with PC5 Interface

The Channel, which are named as Side link Chennel will be accommodating both Cellular Traffic as well as D2D communication Traffic with exclusively reserved PRBs in each and every channel. Let us have a look at one of side link Channel PRB distribution, which catering both Cellular traffic as well as D2D communication. PUCCH stands for Physical Uplink Control Channel, which carries the control Information. Here in Figure 4 we can see that some of PRBs (Physical Resource Blocks) are reserved for Cellular Traffic and some are reserved for D2D communication using PC5 Interface [1-5].

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The PRBs reservation is necessary for the UE Device has to cater for both the kind of Traffic i.e. Cellular as well as D2D Communication using PC5 Interface. This is done to avoid the conflict between Cellular and D2D Networks [1-5].

The Protocol Stack Layer does not Include RRC (Radio Resource Control Layer) which is required for the PC3 and S1 Interface. This is because in our experiment we are considering only Direct Prose discovery with Direct Communication between UEs. The Requirement of Control Channels from RRC layer is not required in our experimentation as we are not experimenting on the S1 Interface between EUTRAN and UEs [1-5]. The NAS Layer (Non Access Stratum Layer) is also not required as we are not Considering the Prose server and EPC as entities in our experiment. Hence we do not require PC3 and PC4 Interfaces for our D2D communication [1-4]. The Protocol stacks for our Experiment is depicted in Figure 5.

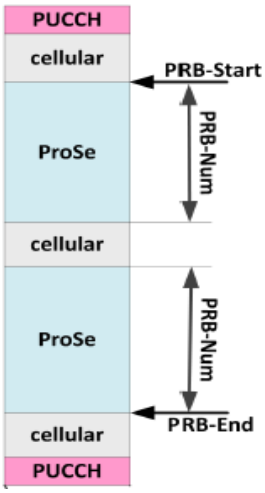

Figure 4: PRBs Reserved as Per Cellular and D2D Traffic for PUCCH

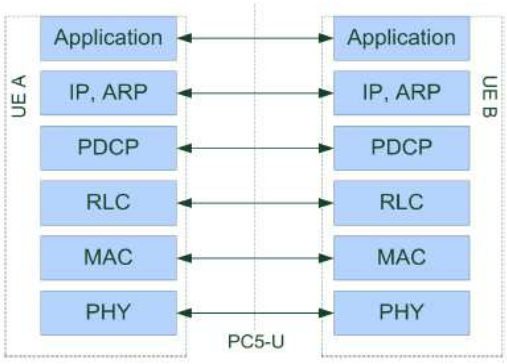

Figure 5: Protocol Stack for D2D Communication

Let us now list the Layers with the functions carried out by them

- **Physical Layer:** Air Interface Communication
- **MAC Layer:** Scheduling of Transport Block
- **RLC Layer:** Segmentation and Reassembly
- **PDCP Layer:** Header Compression and Ciphering
- **IP/ARP Layer:** Networking
- **Application Layer:** Application to be developed accordingly

In our Experimentation we are considering these 6 Layers for each UE to find a Networking path and Transfer an Image [1-5].

3. MERITS OF TRANSACTION IMPLEMENTATION

The Modified D2D Transaction will help us to come up with a solution for Disaster Management to save people left trapped in debris and rubbles by connecting through the User Equipment when the Network from other sources like base station gets aborted. The results of simulation carried out are also encouraged to carry out product development and further research in this Modified D2D communication.

For the simulation and Product development it does not require starting from scratch as the Adhoc Routing has been a developed field having various Protocols already implemented in different scenarios. D2D technology is also maturing by having support from the Researchers from companies working for 5G Technology. By combining these two technologies and getting into white papers such as produced by Rohde & Schwarz GmbH & Co. KG it was easy to implement the transaction in Mat lab code.

We can implement self configuration of Adhoc Network the disaster Management situation when each User Equipment or Mobile is being assigned a unique Network ID by the Base Station before being getting aborted. Assigning the Network ID is a well established phenomenon and the User Equipments will retain their Network IP address after the collapse of the Network Infrastructure other than PC5 Interface.

The PC5 Interface is used Prose technology, i.e. Proximity Technology. Prose Technology is matured and well developed for components like Mobile User Equipment. Thus we can say that the involved technologies are well versed and developed, matured enough to start with the simulation or Product development for disaster management.

4. RESULTS OF THE TRANSACTION

The results of Transaction carried out for Modified D2D communication are based on Mat lab simulation. The plots of this transaction are depicting how well the scenario of Modified D2D communication can be implemented. Here we will discuss the reason for better performance than the traditional Adhoc Network.

The Figure 6 shows the randomly distributed User Equipments which are considered as Nodes in Mat lab scenario. These User Equipments cum Nodes keep on changing its position and hence satisfies the criteria of Infrastructure less MANETs.

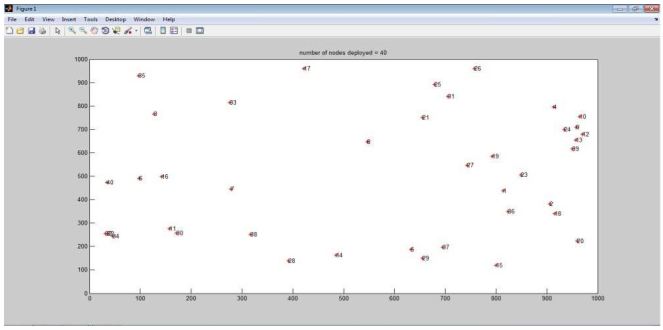

Figure 6: Randomly Distributed UE's in Mat Lab Simulation

Figure 7 shows how the routing is being carried for MANET Nodes which are User Equipment in a broad sense. Whenever there is a change in the position of the Source and destination nodes the values in the Routing table needs to be flushed and replaced with the most recent values of distance parameters.

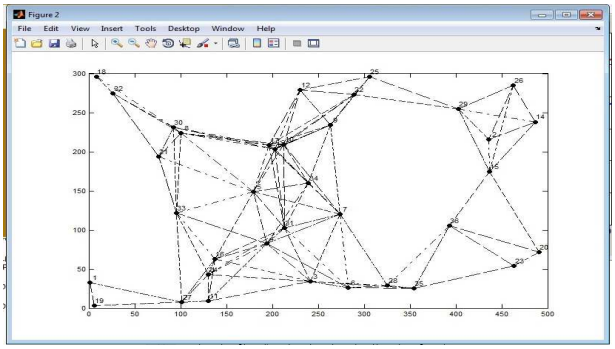

Figure 7: Routing using AODV Protocol from Source to Destination using D2D Technology

Figure 8 shows the execution of the transaction wherein the Image from the Source Node gets transferred to the destination Node using AODV Routing and dedicated Bandwidth. We need to put the destination IP address with Port number in Source Node and only port number in destination Node.

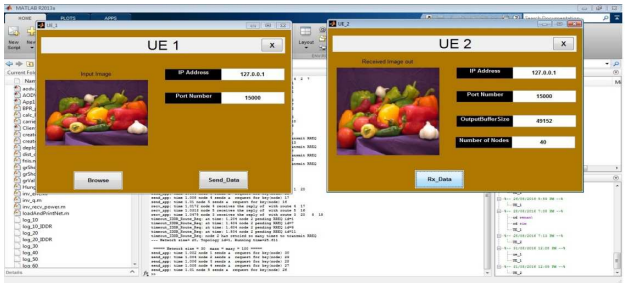

Figure 8: Transfer of Image from Source to Destination using Modified D2D Technology

Figure 9 demonstrates the number of performed by each of the node denoted by their Node IDs along the X axis and the number of hops along Y axis. Since the number of hops executed by each node is a random process which depends on the location of destination Node which always keep on moving.

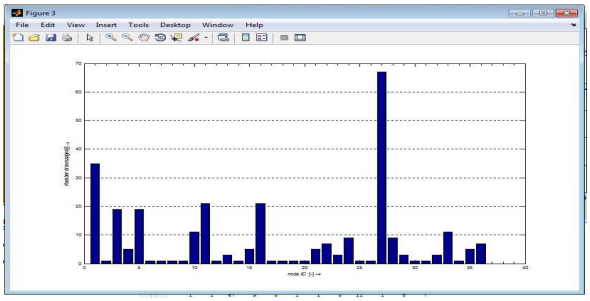

Figure 9: Node ID versus Number of Hops While AODV Routing

Figure 10 shows the plot of comparison for Throughput versus a number of iterations between traditional MANET system and Modified D2D technology for MANETs with dedicated Bandwidth. The performance in the plot shows that the Modified D2D approach has improved performance in terms of throughput. This increased performance in throughput in Modified D2D communication is due to dedicated Bandwidth.

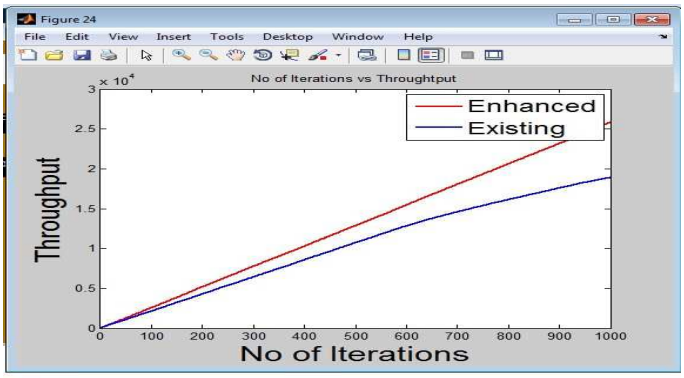

Figure 10: Comparison for Throughput versus Number of Iterations

Figure 11 shows the comparison between Traditional MANET and modified D2D for MANET for energy consumption. The Traditional MANET Networks consume, the more amount of energy then our proposed scheme of modified D2D approach. This is the experimental simulation result and the cause for improved performance of the modified D2D scheme may be dedicated Bandwidth.

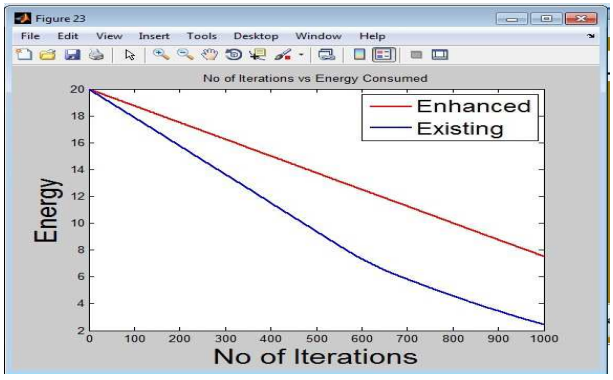

Figure 11: Comparison for Consumption of Energy versus Number of Iterations

Figure 12 shows the comparison for Nodes left alive after some iteration have been passed in both the cases of traditional MANET and Modified D2D for MANETs scenarios. Since the Energy consumption of Nodes in the case of our proposed scheme is less Nodes keep on alive more time than what they have time for traditional MANETs. This in a sense

of communication is greatly advantageous as more number of the Nodes keep on working for large time then what they do in Traditional MANETs.

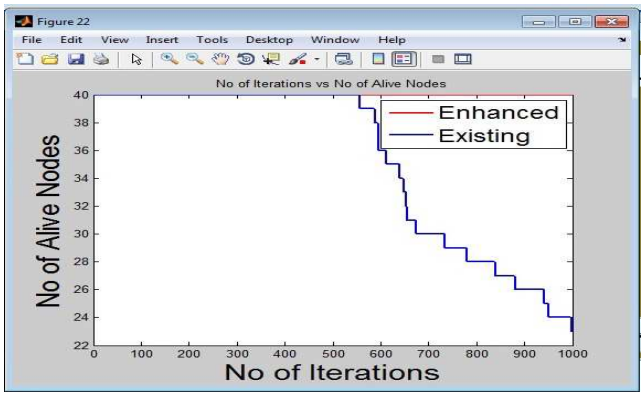

Figure 12: Comparison for Alive Nodes versus Number of Iterations

Figure 13 shows the comparison for dead Nodes after some iteration have been passed in both the cases of traditional MANET and Modified D2D for Manet's scenarios. Since the Energy consumption of Nodes in the case of our proposed scheme is less Nodes keep on alive more time than what they have time for traditional MANETs. More number of Nodes will be dead in case of the Traditional MANET network.

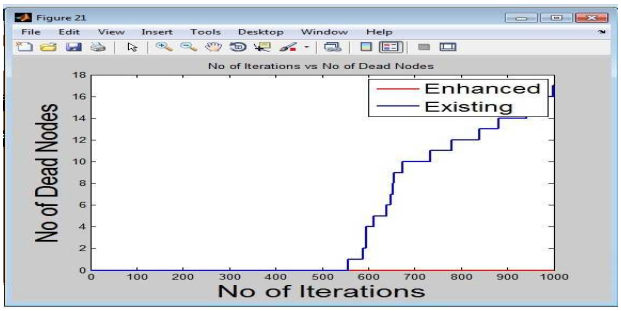

Figure 13: Comparison for Dead Nodes versus Number of Iterations

Figure 14 shows the comparison of delay in terms of a second for a proposed Modified D2D scheme for MANETs (Enhanced) with the traditional MANETs (Existing) scheme. The Delay incurred is more in case of a traditional MANET scheme when compared with our enhanced scheme. This shows the model we proposed for MANET routing with dedicated Bandwidth using Modifies D2D scheme is very superior.

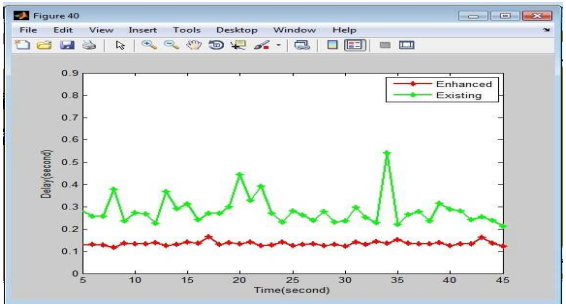

Figure 14: Comparison for Delay Incurred in Second

Figure 15 shows Residual Battery Energy against Nodes left after the execution of task of transferring images from the source Node to destination Node. Since we consider the number of nodes as 100 and they are picked for hopping

and iteration depending upon their position. Hence the power consumed by each node is not sequential according to their Node IDs. But Instead Power consumed is random and hence the Residual Power in Batteries of 100 Nodes is also Random but very less amount of power is consumed.

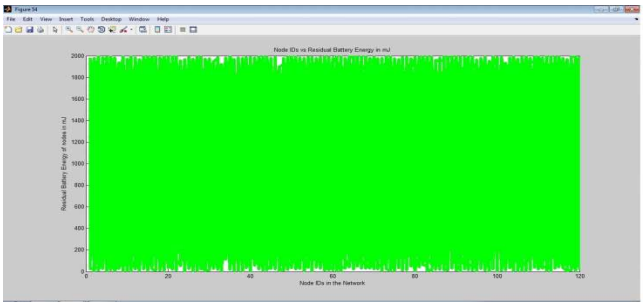

Figure 15: Residual Battery Energy against Nodes after Transfer of Image for Proposed Model

Figure 16 shows the Battery power consumed in mJ of the 100 Nodes which were used for transaction in Mat lab after transfer of the Image. This depicts that most of the energy remains intact even after the transfer of image suggesting that very less power is being consumed in the proposed scheme.

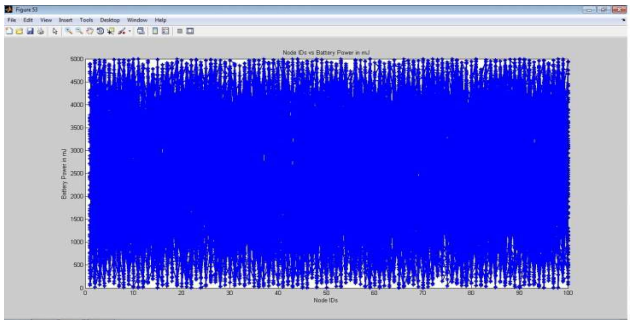

Figure 16: Battery Power in mJ Against Nodes after Transfer of Image for Proposed Model

Figure 17 shows the comparison of number of Hops against iterations for existing and enhanced schemes where the enhanced scheme is our proposed model. Here we can see that the proposed model outperforms the traditional MANET network in terms of number of Hops. In our Proposed Models the number of Hops is less leading to less consumption of power.

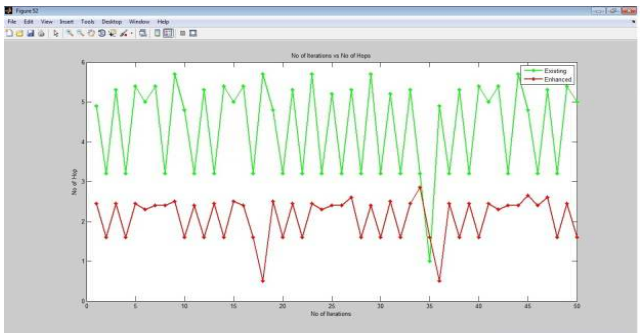

Figure 17: Comparison of Number of Hops against Iterations for Existing and Enhanced Schemes

Figure 18 shows the comparison of Energy consumed against iterations for flooding, enhanced flooding and Modified flooding, i.e. Modified D2D for MANETs, schemes. We can see that the proposed scheme consumes the least amount of power when compared to flooding and enhanced flooding algorithms. This is because the amount of hopping

for different iteration is least in our proposed model leading to very less amount of power consumption.

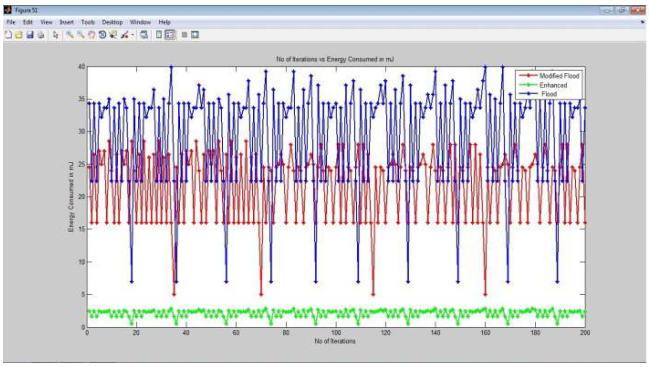

Figure 18: Comparison of Energy Consumed Against Iterations for Flooding, Enhanced Flooding and MODIFIED Flooding i.e. Modified D2D for MANETs, Schemes

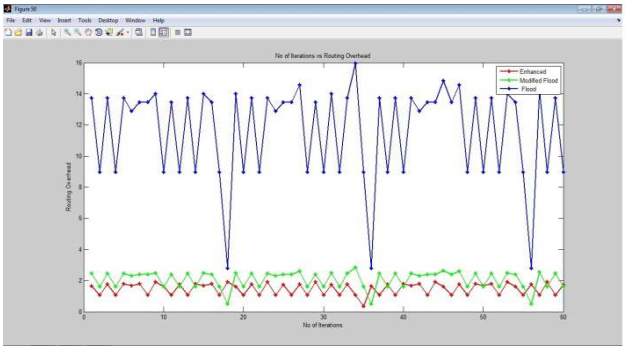

Figure 19: Comparison of Routing Overhead Against Iterations for flooding, enhanced Flooding and Modified Flooding i.e. Modified D2D for MANETs, Schemes

Figure 19 shows the comparison of Routing overhead against iterations for flooding, enhanced flooding and modified flooding, i.e. Modified D2D for MANETs, schemes. The Routing overhead is very high in case of flooding and lesser than this in enhanced flooding and least in our proposed scheme. This suggests that our Proposed scheme out performs the traditional MANET scenario.

5. CONCLUSIONS AND FUTURE ENHANCEMENT

We had carried this simulation experimentation of modified D2D communication for MANETs using Mat lab. The results we got from our proposed model is very encouraging to lead further research in this aspect. We found out the proposed Model of our modified D2D communication for MANETs outperforms in every aspect than the traditional MANET Network. We can clearly see that in terms of Energy Consumed by batteries of Nodes, Number of Hops, Routing overhead, Delay incurred during hopping while iteration is least and very small when compared with the traditional MANET scenario. Also, the throughput and residual Battery are more in our proposed Model after execution of a task when compared with the traditional Model for MANETs.

Further research can be carried in the self-configuration of Mobile Nodes and self-healing of Batteries in term of RF energy Harvesting, traffic offloading using smart Grid etc

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