IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 18, Issue 2, Ver. I (Mar-Apr. 2016), PP 62-75
www.iosrjournals.org

Energy Secure Dynamic Source Routing (ESDSR) Protocol For (MANET)

Hina Khalid[1], Tahir Nawaz[2]
[1] *(Department of Computer Science, University of Lahore, Sargodha Campus, Pakistan)*
[2] *(Department of Computer Science, University of Lahore, Sargodha Campus, Pakistan)*

Abstract : *MANET (Mobile Ad-hoc Network) is an unstructured, self-organized and self-deployment network. It can be set up anywhere, anytime because there is no need of centralize base station. Nodes in MANET are connected by one another via wireless medium. In most cases node's life is limited due to its power resource, therefore to limit the power consumption is a critical issue in MANET. This study analyzes performance of Dynamic Source Routing protocol (DSR) which is one of the most popular protocols in MANET, on the basis of energy consumption by using a mechanism in which nodes having less energy will not use in route selection to prolong the life time of network. This Energy Secure DSR (ESDSR) uses basic mechanism of existing DSR with little modification to optimize DSR performance in the sense of energy consumption as well when ESDSR is compared with some additional parameters like delay, throughput and packet delivery ratio and it showed better performance than DSR. For the analysis of result and simulation, NS-3 has been used. Simulation has run for two scenarios. In both scenarios ESDSR showed better performance in contrast DSR in case of energy consumption as well as delay, throughput and packet delivery ratio.*

Keywords: *DSR, Energy Consumption, MANET, Ns-3, Routing Protocols,*

I. Introduction

Mobile wireless networks are classified into two categories, the first category belongs to infrastructure and other belongs to without infrastructure mobile networks. The first type of network uses fixed and wired gateways with one one-hop wireless network. The Second type uses mobile nodes as a gateway and is multi-hop, called MANETs. In MANETs, all nodes are dynamically located and do not require fixed infrastructure. Users can be in touch with one another lacking physical infrastructure despite any geological location. The network topology transforms rapidly, because of fast inclusion and exclusion of the nodes. The network is not controlled by a centralized entity therefore; organization and message delivery of nodes is done by individual nodes [1].

Mobile ad-hoc networks have become an important exploration area on account of its challenges; these include Multicasting, Routing, Scalability, Quality of Service, Security, Self-Organization, Deployment considerations, Medium Access Scheme and Energy Management Fig. 1 [2].

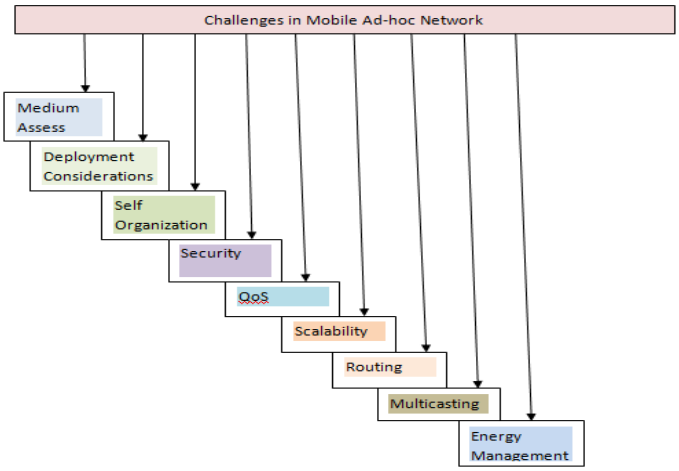

Fig. 1 challenges in mobile ad-hoc network [2]

There are different applications of MANETs such as Tactical networks (military communication, automated battlefield), Emergency services (rescue operations and disaster recovery), Commercial and civilian (E-commerce, dynamic database access, inter-vehicle networks), Education (Universities/campus setting, virtual classrooms), Home and enterprise services (Home/office wireless networking). Mostly MANETs is used in critical situations where quick deployment is required for example integrated cellular and wireless sensor networks Fig. 2 [2].

Fig. 2 MANET applications [2]

Mobile nodes can work as routers and hosts. Source and destination nodes are called host nodes and nodes that come at intermediate and are employed to transfer packets from source node to destination node are called routers [2].

Routing is difficult in Mobile Ad-hoc Network due it's frequently change topology. Although packet routing is necessary and important in the network but to design such protocols which consume less energy during route selection is a big challenge. The operation time of mobile node depends on its battery capability. The energy of a mobile node is consumed when the node sends or receives packets (called active period) as well as energy is consumed when a node is in an idle state while listening a wireless medium (inactive period). The purpose of the energy proficient routing protocol is to reduce the energy of active and inactive periods. Communication energy of active period can be lessened if radio power of each mobile node is adjusted in such a way that it should adequate enough to reach at the receiving end, not more [3].

In each network, battery life is the main resource and in MANETs nodes are power constrained [2]. Mobile nodes have limited battery energy that is why it is hard to prolong the lifetime of the nodes. If the transmission power is controlled to conserve the energy then the life time of node, in addition, network's lifetime can be increased [4]. Some solutions are proposed to manage the sleep state of the node for energy conservation. Many routing protocols are proposed to make an efficient use of the energy and to save power of the battery of mobile node. Some proposals are entirely new; some did the addition of energy aware matrices to the protocols that already exist for example AODV, DSR, and OLSR [5].

Numerous routing protocols are suggested in favor of MANETs, yet no one showed great achievement in all situations for example with different mobility patterns, traffic loads in addition distinct network sizes. Classifications are done according to their characteristics. The most popular characterization strategy depends in what way steering information is picked up plus kept up by movable nodes. According to this MANETs protocols are separated into two routing protocols, reactive and proactive. Proactive protocols require periodic announcements of link state and every node keeps up a routing table that holds all probable destinations. That is why proactive protocols have large routing overhead and consume extra energy comparatively reactive protocols which do not maintain a routing table and discover routes on demand. For this reasons reactive protocols experience delay when to discover routes [2, 3, 6, 7].

Routing protocols which are presented for mobile ad-hoc networks like DSR and AODV it is assume that all nodes cooperate in the route selection. The foremost aim is to balance usage of energy among all nodes to increase lifetime of nodes and network. In an on-demand classification of protocols, a discovery of route is done only if a source node wishes. In reactive protocols, a route is discovered by two procedures that are *Route discovery* and *route maintenance.*

The purpose of this study is to concentrate on the energy consumption problem of existing Ad-hoc routing protocol DSR and study is evaluated by a mechanism in which nodes having less energy will not include in route selection that will minimize energy consumption.

II. Manet Routing Protocols

Dynamic nature of mobile nodes causes frequently topology changes and sometimes creates an unpredictable network. Because of frequent topology changes routing unpredictability between the movable nodes boost in the network. Accordingly, conventional algorithms and routing protocols are not considered adequate for effective steering in mobile ad-hoc network. Routing of the mobile ad-hoc network is affected by many factors such as route selection, a location of the source node, a location of the destination node, topology plus fundamental characteristics which serve as a heuristic in searching the path rapidly as well as efficiently.

Routing area and routing protocols have become a vigorous research area in the mobile ad-hoc network. From last decays many routing protocol and routing algorithms have propounded and their execution is analyzed under a variety of network and traffic situations.

MANET routing protocols are generally classified into three approaches:

1. Topology-based approach
2. Location based approach
3. Power/energy-aware approach

1.1. Topology-based approach

This approach depends on the topologies of various routing protocols and accentuation on the condition of the network links. This methodology employs information of immediate connectivity of nodes in a network and based on the routing information update mechanism.

In this method on the premises of time, at which routes discovery and updating of routes occur, routing protocols are classified into following three groups [2, 8].

- Proactive Routing Protocol (Table Driven)
- Reactive Routing Protocol (On-Demand)
- Hybrid Routing Protocol

- **Proactive Routing Protocols**

Proactive protocols also identified as table driven protocols as theses protocols keep regular and new information of routes among every pair of nodes in tables. Nodes are mobile therefore whenever topology changes table updates its information about the routes. This approach is consequent from conventional routing protocols. The main feature of the proactive approach is that every network node keeps a path to every other node in network entire time.

Creation and maintenance of route are obtained via some mixture of recurrent and event-triggered routing updates. The periodic update consists of routing data which trades among nodes on set time intervals. Apart from mobility and traffic characteristics updates take place at specific intervals in the network. Whenever events occur in the network like link addition or link removal then event triggered updates are transmitted.

The routing tables are only called when there comes any change in the network topology. Mobility has a direct impact on the event-triggered updates because when nodes will move links will also change. Proactive protocols have a benefit of having the routes whenever they are needed. However, these protocols also have a disadvantage of overhead in large networks and in that networks where nodes have high mobility. Examples of Proactive routing protocol include DSDV, WRP, OLSR and FSR.

- **Reactive Routing Protocols**

Reactive routing protocols have a very dissimilar approach as of proactive routing protocols. Routing table is not part of reactive protocols to follow the path instead theses protocols establish route when there is a need in the network because of this reason these also recognized as on-demand routing protocols.

Reactive protocols because these protocols do not have routing table In a wired network it is beneficial to use proactive protocol because all information of the routes is available in the table already and when to use a new route it become easy due to already present route. But in mobile ad-hoc networks topologies rapidly change so here to use reactive routing is more beneficial as compared to proactive routing.

Reactive approaches do not maintain a route among all couples of nodes in network continuously in its place routes are just created when they are required. If source node desires to consign packet to a destination it will check its cache first and if the route is present then it uses that route otherwise send route request to its neighbors to find the route. If nodes have no need to communicate which others then they will not utilize their resources to maintain a path between them.

Point of interest of this methodology is that it reduces the overhead that comes in a proactive approach. It has also a drawback that if there is large network then delay comes to create a session between source and

destination nodes because there is no pre-searched route present and source has to create route on demand. Examples of Proactive routing protocol includes: DSR, AODV and TORA.

- **Hybrid Routing Protocols**

When Proactive as well reactive protocols combine as a result hybrid routing protocols are obtained. Hybrid protocols integrate attributes of reactive and proactive protocols. Key thought of hybrid routing protocols is to utilize reactive protocols at the global network level and proactive routing in a node's local neighborhood. Examples of Hybrid routing protocol includes ZRP and ZHLS.

1.2. Location based approach

This approach employs additional geographic position information of the mobile nodes to build routing verdicts. To find out the exact position of source node, destination node and neighbor node, this approach uses location services and information of area can be attained via GPS. It maintains location information of nodes and find out the exact coordinates of the nodes in any geographical direction and it direct to route discovery process.

Routing protocols of this approach do need to have a routing table and also these protocols do not require the foundation also maintenance of the routes because it uses location services and some kind of forwarding strategies to do all its activities. Forwarding strategies are used to forward the packets from source nodes.

It is known as geo-casting because by using this approach packets are conveyed to each node in a specified region of geographic. There are three types of packet forwarding strategies used in this approach: 1) greedy forwarding 2) directional flooding and hierarchical approach.
Examples of location based routing protocol includes LAR, ALARM, GPSR and GLS.

1.3. Power/energy-aware approach

Network's lifetime is measured via lifetime of the nodes in the network. Portability of wireless node is being critical therefore it is compulsory to keep the sizes of batteries to a basic necessary. Since battery capacity is fixed but a wireless mobile node is exceptionally power constrained. Hence, all transactions that are related network must be energy aware of being able to make well-organized use of overall energy resources of the network.

Typical routing protocols use minimum hop count metrics consume specific nodes of battery resources and fails to consider the power usage of nodes. This depletion of energy directs to the node failures and results in a poor lifetime of networks.

There are many energy aware metrics defined to solve the problem of energy consumption. Now these metrics are used in many reactive and proactive protocols. These metrics are

- cost / packet Decrease energy consumed / packet
- Increase time to Network Partition
- lessen variation at node power levels
- Minimize

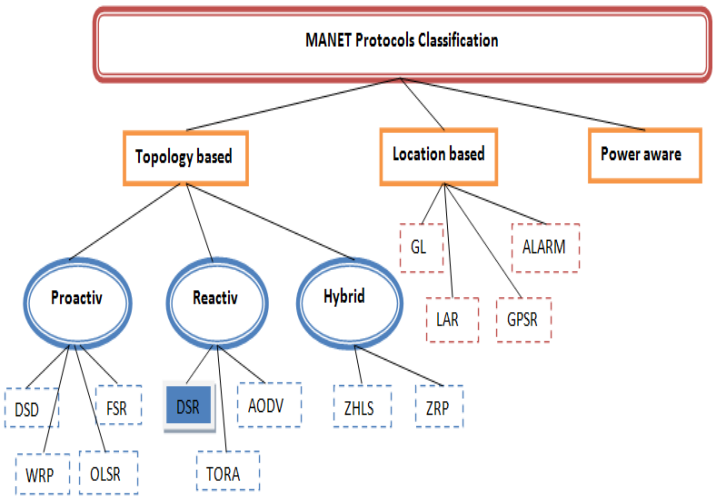

Fig. 3 MANET protocol classification [2, 8]

III. Dynamic Source Routing Protocol (DSR)

DSR [9] is standout significant routing protocol for MANETs. It works efficiently when there is high mobility between nodes. It is a straightforward and an efficient routing protocol that is planned specifically for multi-hop wireless ad hoc mobile networks. It is a simple protocol thus many energy proficient routing protocols are delineated that are based on its basic method. It is a source routing protocol therefore route is established only when source requires and once route is established then all the packets follow same way from source to destination. To reach at destination, each packet's header holds entire sequence of intermediate nodes.

Source routing characteristic makes this protocol loop free and there is no need of periodic messages of link states because route discovery process is separate from route maintenance in this protocol.DSR protocol does not use any routing table as in table driven routing protocols instead it uses cache to hold routes. DSR is on demand protocol that is why it uses two mechanism, route discovery and route maintenance, to select the route from source to destination. Both mechanisms work together to discover and maintain the route.

1.4. Route Discovery

Route discovery process completes by using two steps that are Route Request and Route Reply.

1.4.1. Route Request

When source nodes wants to convey the packet to destination and it does not have any pre-established path in its cache then route request process is used. Route request packet is broadcasted from source. This route request holds addresses of source, destination moreover an inimitable request ID determined via the source. Each one node gets the packet although it is destination node or not and in the event that it is not the destination then it frontwards the packet to the gregarious links in the wake of including its own particular address within the header of the packet. Each node has identification number that helps to avoid duplication of route request (produced by the same source) because a node just frontwards that route request which has not yet been seen inside the route request among the similar identification number Fig. 3.1.

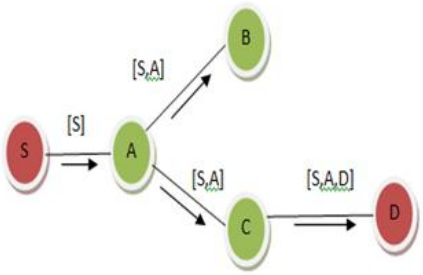

Fig. 4 DSR Route Request [31]

1.4.2. Route Reply

At the point when route request packet arrives at destination node then a route reply packet is generated. As the request packet not only contains the addresses of intermediate nodes but also the sequence number of all intermediate nodes. Route reply is produced through destination by putting route record (contained in the route request) into route reply and Route reply is unicasted to source.

If destination knows the route to source then it will use that route otherwise a route request message is created from destination to source if link is asymmetric. On receiving the route reply from destination intermediate nodes affix their route record and forward it to its contiguous nodes Fig 3.2.

1.5. Route Maintenance

When source route is discovered from source to destination and during the communication topology of the network changes then route maintenance mechanism helps to source node to detect that whether route is reliable and capable of carrying packet on it or route is no longer exists. This process of detection is executed by the use of route error packets and acknowledgements. When route maintenance indicates a fatal transmission problem then source node tries to use another route from its route cache, if there does not exist any route from source to destination then source invokes route discovery mechanism again.

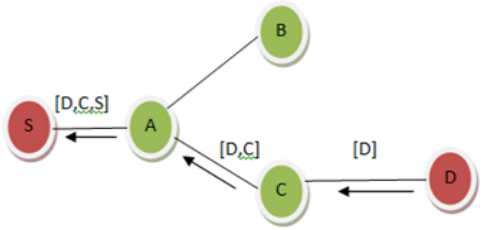

Fig. 5 DSR Route Reply [31]

IV. Literature Review

Since last few years numerous energy aware routing protocols are proposed for MANET. It is hard to curb technologies and researches excavating for optimal solutions therefore, various researchers have done improvement in DSR to make it an energy proficient routing protocol just like other energy proficient routing protocols. Here few routing protocols are portrayed which are made in the wake of doing some change in traditional DSR protocol.

In [10] a straightforward approach is suggested which used a power associated metric also tried to discover an optimal energy efficient course by using global information. This power aware routing algorithm is named as Global Energy-Aware Routing. Disadvantage of using GEAR is that, It is not guaranteed that selected path is optimal always because it may happened that best path arrived later and some other path is selected within specified time.

LEAR [11] is based on the basic mechanism of DSR protocol. In traditional DSR, nodes do not have any choice to be selected in route selection. In LEAR each mobile node has choice and it depends on the node's willingness that it will be selected in route selection or not. Therefore in the communication only those nodes will be considered which are willing to participate. This modified DSR uses a special parameter that is "willingness" to discover the route from source to destination moreover this parameter is determined by remaining battery power.

EEDSR [12] is an energy proficient routing protocol based on traditional DSR protocol. EEDSR is compared with MDR (Minimum Drain Range) approach and LEAR (Local Energy Aware Routing) approach and result showed the better performance on the basis of energy consumption than other two approaches. This protocol is almost similar to LEAR the only difference is that its willingness factors are different from LEAR. Purpose of willingness factor is to decide whether nodes should participate in forwarding packet or not to prevent the nodes from sharp battery drop. The basic concept behind this algorithm is that only those nodes will participate in route selection which will have high residual battery power.

In [13] energy efficient DSR protocol is proposed which is based on another version of DSR which is minimum-hop fixed-transmit power. In its mechanism protocols used two approaches first is transmission power control other is load balancing. Hop-by-hop power control mechanism may be used to secure energy consumption of network during transmission of packets. For load balancing the protocol will select the underutilized nodes having highest residual power which increased network lifetime. This protocol avoids the additional computations which are required to find out the route and also avoids send multiple replies to source. A route will be selected by avoiding the nodes which have tendency to die out early.

Modified Power saving DSR, by name it is understood that, this protocol is a modification of DSR protocol. In this modified power saving DSR protocol [14] two modifications are proposed in traditional DSR protocol to secure energy and to boost the life span of MANETs. DSR is modified on the basis of initial energy.

The basic goal of PADSR is that, this waiting time (delay) ought to be inversely proportional to a residual energy level of the node during that minute, instead of random. In this method the first RREQ that will reach at destination is considered, that it will have maximum energy contrast to all other conceivable ways from source to destination. In second enhancement nodes will accept the packets on certain threshold value of initial energy.

IDSR [15] is an optimization of DSR to make it intelligent in terms of route selection to prolong life time of network. Purpose behind this protocol is to exploit the remaining energy of nodes to select a route. As DSR protocol works by using two mechanisms route discovery and route maintenance, this protocol has made modification in route discovery phase only. During route discovery process a node that is receiving RREQ is enabled or disabled on premise of its residual battery power. . Remaining energy of node is compared with the average energy and nodes which have less energy than that average energy are disabled. IDSR used the parameter of average energy to compare it with conventional DSR.

Two power saving algorithms span-DSR and DSR-PSM [16] are proposed for ad-hoc wireless networks by using source mechanism. Experiments showed that span-DSR reduced power utilization furthermore needed alluring fairness properties and this protocol also maintained a connected backbone on nodes while routing packets. In the comparison of basic dynamic source routing protocol span-DSR increased network lifetime and also maintained loss rates under the clogging. Second proposed 'DSR-PSM' algorithm is a simple and uses reactive methodology and showed a significant energy savings as compare to basic DSR.

An energy conscious routing protocol is proposed by modifying dynamic source routing protocol. Proposed protocol is given the name ECDSR [17]. This protocol used traditional DSR protocol's concept and imposed its two important characteristics first energy saving and second is energy survival in DSR. Proposed protocol prolonged system lifespan and increased overall performance of network. Prime target of ECDSR was to pick the path from source to destination by considering only those nodes which had more elevated amount of energy at a specified time.

The technique which is used by PCDSR [18] was that to forward the request packet and receive the packets reply it needed a high number of coordination for computing the cost of paths. Proposed extension to DSR protocol consumed fewer resources and increased the network lifetime as well assigned an energy cost to each edge to decrease the number of coordination that is essential to compute the cost of a minimum energy path during route discovery process. For reliable communication connectivity of links along a route is considered by proposed PCDSR approach. The combination of the relay region and enclosure graph in traditional DSR algorithm allowed DSR to decide the routing paths in such a method that the network is connected as well energy-cost of network is lessened.

Two energy aware routing algorithms are proposed, one is e-AODV and other is e-DSR. Performance of both proposed algorithms is compared with AODV and DSR [19]. These four protocols are compared in terms of distinct parameters for example energy consumption, delay and drop packets. Outcomes showed that proposed protocols are capable to work finest in terms of energy utilization and delay with fluctuating mobility speeds. It is concluded that in terms of average energy utilization and delay, e-DSR was capable to work best over varying mobility speeds.

Modified Energy Saving Dynamic Source Routing (MESDSR) [20] is presented for MANETs which effectively used the battery force of the mobile nodes that it increased network lifetime. An algorithm is designed with different route request process whether route reply process is same as DSR has. Simulation is done by considering few parameters: Packet delivery ratio, energy consumption, throughput and delay. Simulation results showed proposed MESDSR more energy efficient as compare to basic DSR.

An energy efficient management approach is used in traditional DSR protocol to enhance the nodes life time to increase network lifetime [21]. A flow chart and an algorithm are proposed which described the working of proposed approach to maximize network life time. It is observed that the alterations realized, in the current DSR decreases delay and amount of control packets which is the entirety of RREQ, RREP and Route Error packets as it is watched that the changes don't lessen the packet delivery ratio. There is shown an improvement of power management in the DSR protocol because of the alterations made and subsequently it can be viewed as a power proficient protocol.

Proposed Power Efficient Dynamic Source Routing (PEDSR) protocol fulfilled less energy utilization from the perspectives of nodes and in terms of network [22]. To achieve fancied objective, first DSR protocol is examined by utilizing execution/performance and energy aware metrics. The simulation results demonstrated that the energy aware routing protocol, PEDSR beats the first DSRP in majority of the situations and assessment metrics. In proposed Power Efficient Dynamic Source Routing (PEDSR) protocol transmission power control approach is employed and to decrease transmission power a hop-by hop power control mechanism is used by author. Author calculated minimum power that is required the node for communication during the route discovery process. Multiple RREQ messages reached to the destination and destination node made decision regarding the best route selection to send RREP messages. Numerous replies to the source and extra calculation that are required to discover the route are avoided in PEDSR.

Minimum Energy Dynamic Source Routing Protocol (MEDSR) [23] is proposed by modifying control messages present in the basic DSR protocol therefore MEDSR avoided additional control messages. An analytical model is presented to show that by employing MEDSR significant part of energy can be saved. Per packet power consumption is minimized in MEDSR and hence MEDSR could send more useful data packets in the comparison of basic DSR protocol.

V. Proposed Energy Secure DSR (ESDSR)

Key goal of ESDSR is to pick a way from source to destination in a manner that every middle node will contain more elevated amount of energy at a specified time. So as opposed to taking minimum hop count technique in the process of node discovery stage, ESDSR selects ways whose intermediary nodes have high left over battery power.

When volume of any node arrives at minimum threshold rate, another way will be picked keeping in mind end goal to proceed with the correspondence with no intrusion.

Therefore the proposed algorithm has presented an energy saving element as well as presented an energy endurance trademark for every low energy node. Subsequently presented calculation is more prone to be energy secure during building up an association through numerous intermediate nodes. Energy is saved at the point when source node has a few packets to transmit at destination moreover needs to hold the highest energy productive route amongst all conceivable way at the result of which communication can be completed for a drawn out stretch of time. That is why route discovery phase of ESDSR uses energy secure route which carries higher energy intermediate nodes instead of minimum hop count. Basic concern of this modified DSR is to focus on to calculate average remaining energy in joules at each node.

Threshold value in ESDSR is set 1J if any node has low energy than value of certain threshold it avoids itself from taking an interest as an intermediary node in route selection and conveys an error message to source

node. In this manner new way in ESDSR contains the route with greatest summation of aggregate residual energy of the intermediary nodes which thus gives a high probability of more extended communication with no interference of connection break unless any intermediary node goes out of the scope of its contiguous node. In this technique RREQ packets reaches at destination having extreme total of remaining energy.

It is never been consider in DSR that connection lost or retransmission of packet might be brought about by low remaining power. Hence whenever packet lost or route lost it was considered that these may be caused by either congestion or due to mobility. That is why in ESDSR case nodes mobility possibility is neglected, which might be one cause of packet retransmission or path loss and focus is only on the left over energy of the nodes to increase lifetime of network because it may also a reason of decreasing network lifetime and packet lost as well route breakage may also occur due to low residual energy. In this way energy consumption on all intermediate nodes will also be managed. Till communication ends all intermediate nodes used continuously and remaining battery energy also depleted continuously. The minute at which any intermediate node discovers its own remaining battery power underneath or equivalent to particular threshold esteem, then it tells to all its contiguous nodes that it is not any more prepared to get or to forward packets. It is knowledgeable via alert message produced from same node plus demands to source node to discover a new node for the same destination. Hence threshold value in ESDSR is set as 1J therefore when any intermediate node has its residual power 1 J it sets low energy field to 1 and this field included with error control message. Neighboring nodes will simply dispose that route (which contains affected nodes) when it will receive this error message with 1 low energy field. Source begins searching for another route existing in its route cache else it will go for a route discovery method, when it receives this error message. In this way, before any route break happen, affected node notifies to source node to locate another route to continue communication without any interference.

Another vital point of preference of ESDSR is that it saves the node to dead entirely. Nodes with low energy (when compare with threshold esteem) remain alive which can likewise be utilized as a part of some other significant correspondence in future.

VI. Simulation Results

For modified DSR simulation, Network Simulator (NS-3) has been used. Ns-3 simulator [24, 25] is a discrete-event network simulator that is primarily used for research and educational proposes. It is started in 2006. Ns-3 is an open source project and the project attempted to keep up an open domain for researchers to contribute and share their software's.

1.6. Simulation Setup

Ns-3 provides versatile simulation environment for wireless mobile systems and also defines topology of the network in a significant way. Ns-3 supports TCP and UDP. For simulation UDP is selected as it is faster than TCP and also consumes less energy as compared to TCP [26].UDP uses CBR (Constant Bit Rate) traffic. In CBR from source to destination data packets are transferred with set size and interval moreover destination node does not send acknowledgement messages to source on receiving data packets. MAC (Medium Access Control) protocol depends on IEEE 802.11 standard. Network is considered with 50 nodes. Simulation time is taken 100 and 150 seconds to check and compare results with respect to time. Area is taken 1000 x1000 and mobility model is taken Random Way Point that is commonly used. This model illustrates the movement pattern of autonomous nodes in a simple way. Energy model is used with initial energy of 50 and 70 joules for each node. The main parameter taken in this simulation to compare proposed protocol ESDSR and basic DSR is average energy consumed. Additional comparison of both proposed and basic protocol is based on delay or latency, packet delivery ratio and throughput. Rest of simulation parameters are specified in table 4.1. Two scenarios considered for these simulations are:

First scenario: 50j energy is put as initial energy and simulation is keep running for 100s.

Second scenario: 70j energy is put as initial energy and simulation is keep running for 150s.

Results of both simulations showed that ESDSR outperforms traditional DSR on the basis of average consumed energy, average remaining energy additionally on the premises of throughput, PDR and delay or latency.

Table 1 General Simulation Parameters

Simulator	**Ns-3**
Protocol	DSR
Packet size	2000 bytes
Traffic	UDP
Simulation time	100-150 seconds
Number of nodes	50
Initial energy	50-70 joules
Simulation area	1000 X 1000
Mobility Model	Random way point

MAC	802.11

1.7. Simulation Results

Scenario with varying simulation time and initial energy is discussed. Results of both simulations are showed in the form of graphs. Results showed that proposed ESDSR protocol consumed less energy when compared with traditional DSR. Their resultant graphs are given below.

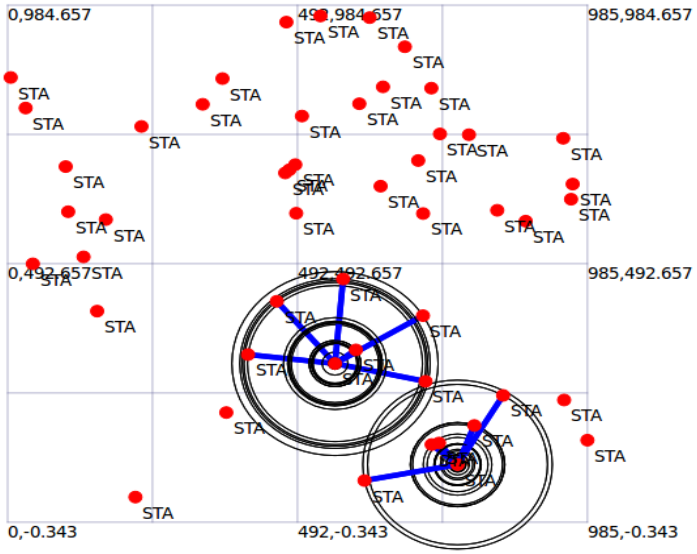

Fig. 6 50 nodes

First Scenario

Comparison graphs of 1st scenario with simulation time 100 sec and initial energy 50j are as follow.

Energy Analasis

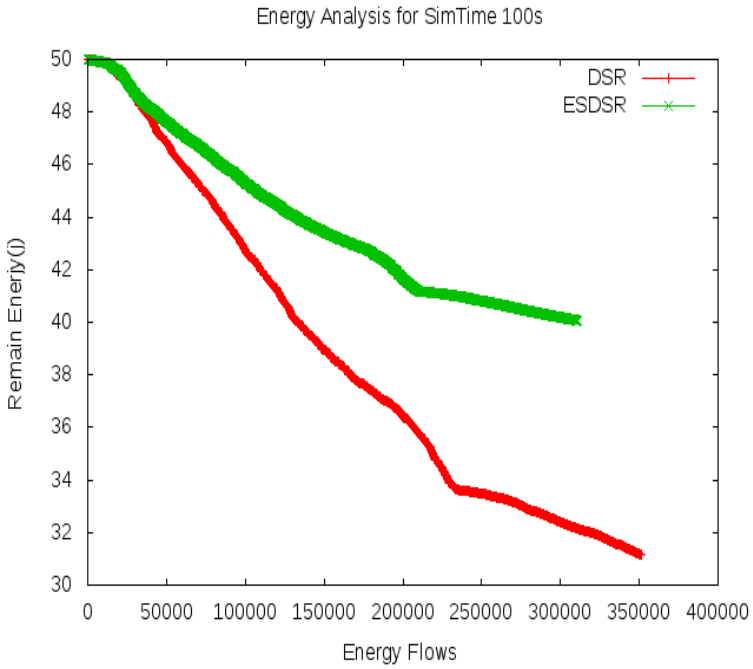

Fig. 7 Energy Comparison Graph

Here in this graph it is clear that remaining energy of DSR is left 31.1413 and remaining energy of EDSR is left 40.0644 hence 28.65% energy is saved in ESDSR in the comperison of DSR which shows the improvement in proposed DSR.

Throughput Analysis

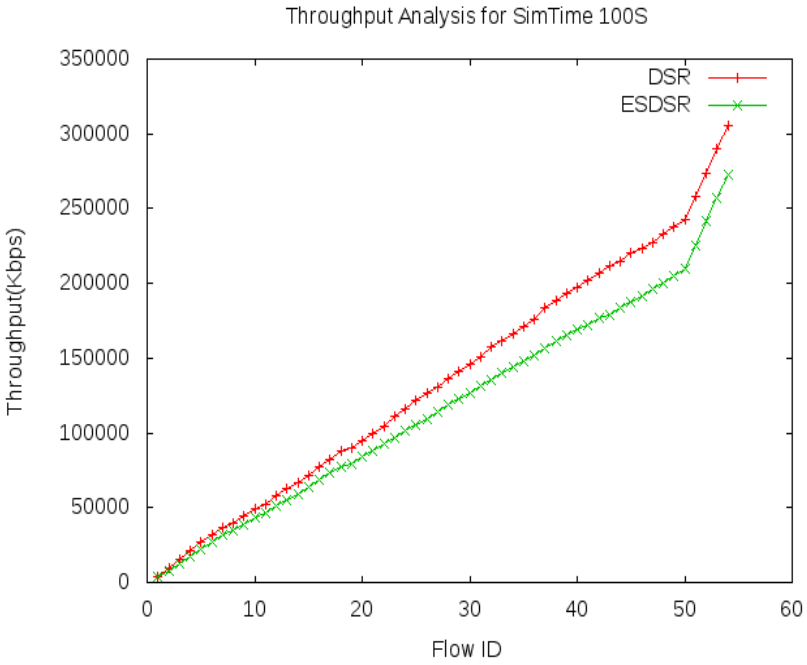

Fig. 8 Throughput Comparison Graph

Throughput is the rate at which a message is delivered successfully from source to destination over a correspondence channel.

It can be clearly seen in the above graph that throughput in DSR is high as compare to ESDSR. Throughput rate of DSR is 305586 and throughput rate of ESDSR is 273068. This difference shows that throughput is decreased 11.90% in proposed approach ESDSR.

PDR Analysis

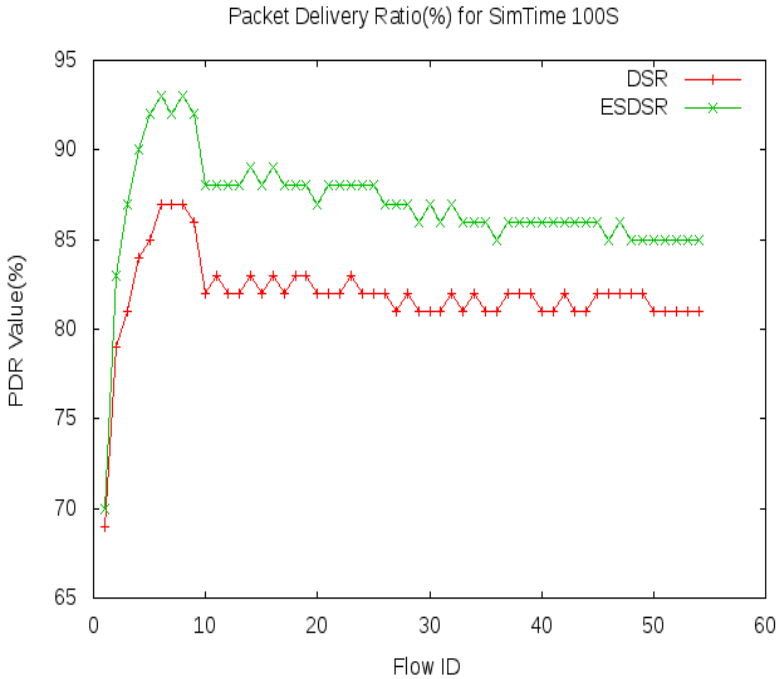

Fig. 9 PDR Comparison Graph

The proportion of packets that are effectively transmitted to a destination contrasted with the quantity of packets that have been send out by the sender is called PDR.

Larger rate of PDR shows improved performance of the protocol. It is shown in the above graph that PDR ratio of DSR is 81% and PDR ratio of ESDSR is 85. That shows 4.93% improvement in ESDSR.

Latency Analysis

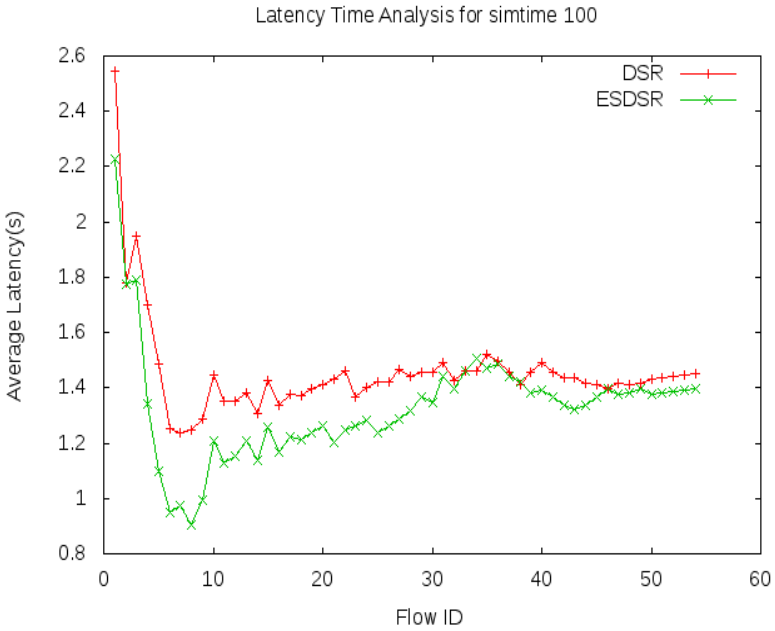

Fig. 10 Latency Comparison Graph

Round Trip Time between a source and destination or in general term delay between an action and reaction is called latency.

Lesser amount of latency is considered good in a network and in above latency comparison graph latency of DSR is shown 1.45186 and latency of ESDSR is 1.39744 that describes that there is 3.89% less latency is found in ESDSR.

Second Scenario

In this scenario simulation time is extended from 100 to 150 seconds but increase in energy is done less as compare to the 1st scenario to check the efficiency of the proposed DSR protocol. Resultant graphs of 2nd scenario are as follow.

Energy Analysis

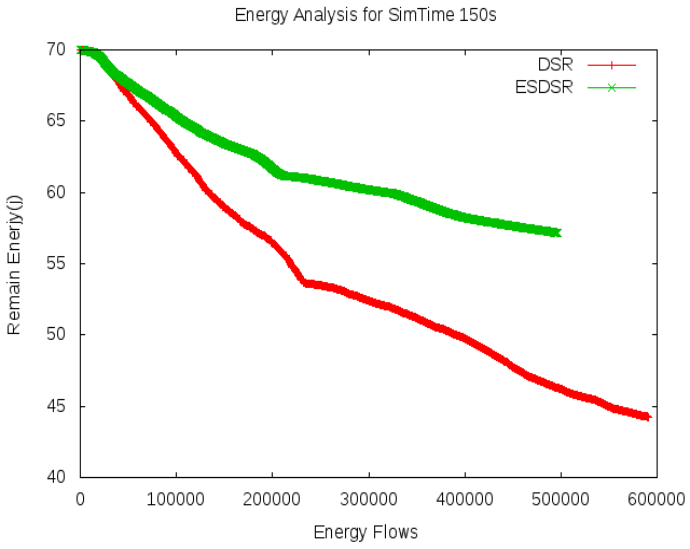

Fig. 11 Energy Consumption Comparison

In 2nd scenario ESDSR outperforms DSR as in 1st scenario remaining energy of DSR is left 44.2343 and remaining energy of EDSR is left 57.149 which shows that 29.19% energy is saved in ESDSR when compare to DSR.

Throughput Anaylsis

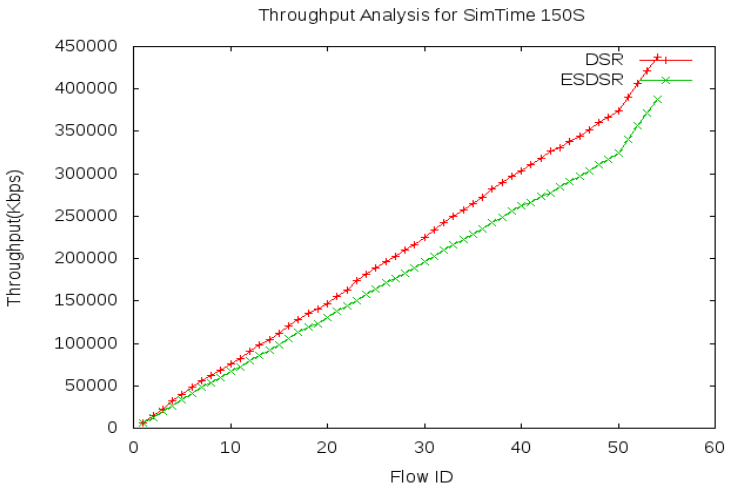

Fig. 12 Throughput Comparison

It is observed in the above graph that throughput in DSR is high as compare to ESDSR. Throughput rate of DSR is 437676 and throughput rate of ESDSR is 388030. This difference shows that throughput is decreased 12.90% in proposed approach ESDSR.

PDR Analysis

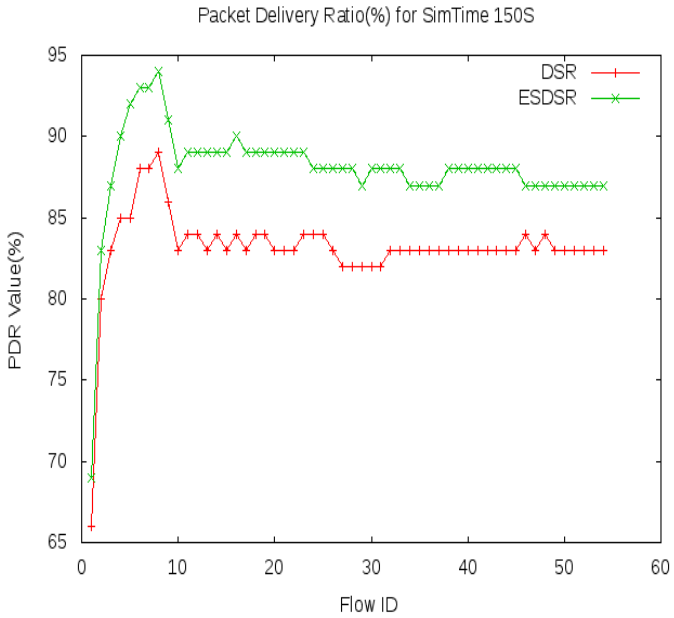

Fig. 13 PDR Comparison

In the above PDR graph larger rate of packet delivery ratio shows improved performance of the ESDSR. It is shown in the above graph that PDR ratio of DSR is 83% and PDR ratio of ESDSR is 87%. That shows 4.81% improvement in ESDSR.

Latency Analysis

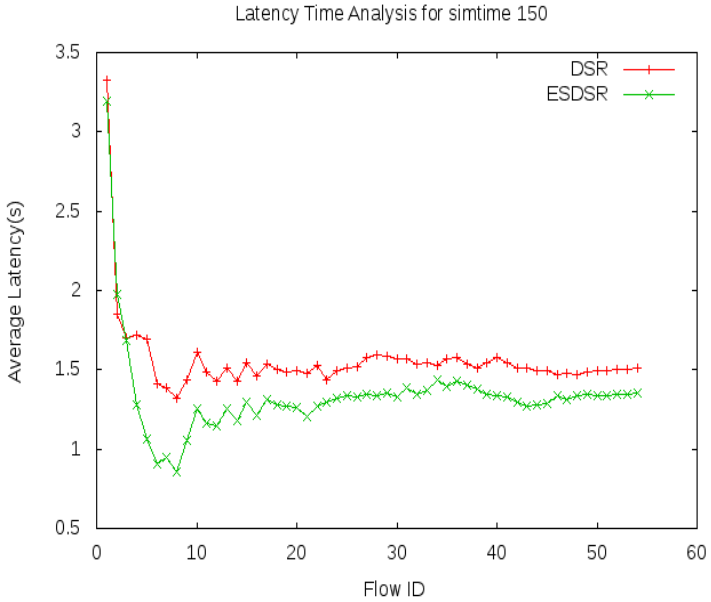

Fig. 14 Latency Comparison

In above latency comparison graph latency of DSR is shown 1.50705 and latency of ESDSR is 1.35171 that describes that there is 11.49% less latency is found in ESDSR. That clearly shows that ESDSR outperformed on the basis of latency.

Table 3 Parameter Evaluation with 100sec and 50j

Protocols	**Parameters**			
	Remained Energy (j)	**Throughput (kbps)**	**PDR (%)**	**Latency (sec)**
DSR	31.1413	305586	81	1.45186
ESDSR	40.0644	273068	85	1.39744

Table 4 Parameter Evaluation with 150sec and 70j

Protocols	**Parameters**			
	Remained Energy (j)	**Throughput (kbps)**	**PDR (%)**	**Latency (sec)**
DSR	44.2343	437676	83	1.35171
ESDSR	57.149	388030	87	1.50705

VII. Conclusion

Energy consumption in MANETs is a challenge. Minimum hop count produces overhead and also consumes more energy during the communication. Therefore, energy efficient routing protocols are required to defeat this issue. Numerous energy proficient routing protocols are proposed therefore it tough to do comparison between all of them because they all have the different parameters (like delay, energy consumption, remaining energy, energy loss, packet delivery ratio, packet drop ratio and jitter) to obtain the ambition. For example to reduce the energy consumption some proposed protocol adjusted transmission power and some considered underutilized nodes in communication. Developing new power aware routing protocols, DSR routing protocol has been discovered exceptionally valuable amongst the energy efficient routing protocols. Therefore DSR can be made energy efficient by modifying its structure of control packets and by considering some new energy aware metrics.

Some energy efficient routing protocols that are described are based on the mechanism of traditional DSR routing protocol. Proposed protocols have demonstrated that their proposed solutions reduce the energy consumption than traditional DSR because traditional DSR does not concern energy utilization. There is a tradeoff between all of these proposed DSR based energy efficient routing protocols because different techniques and different energy metrics are used in different scenarios. And all of proposed protocols have proved the better performance than DSR on the basis of energy consumption.

This study has concentrated on MANETs with its properties plus difficulties in routing, likewise distinctive sorts of routing protocols and their properties are also described briefly. This work mulled over and investigated traditional DSR protocol and proposed a technique to make it energy effective. This work broke down novel proposed ESDSR and simulation results demonstrate that execution is superior to anything DSR.

This study finished up ESDSR lives up to expectations obviously better than DSR on the premise of providing more lifetimes to the system.

Basic concern to proposed ESDSR is to make DSR energy efficient as well when ESDSR is compared with some additional parameters like throughput, packet delivery ratio and latency, than it also outperforms these parameters.

Two scenarios were considered to compare DSR and ESDSR and results of both scenarios showed that ESDSR outperforms DSR on the basis of remaining energy which means that in both cases ESDSR saved energy as compare to DSR, PDR, throughput and latency.

Energy is saved in ESDSR 28.65% and 29.19 % in 1st and 2nd scenario respectively. Throughput and latency is decreased 11.90% &12.79% and 3.89% & 11.49 in ESDSR. Packet delivery ratio is increased in ESDSR by 4.93% and 4.81% in 1st and 2nd scenario respectively

Future Work

There is still a very high scope for researchers to optimize DSR on the basis of energy consumption. Traditional DSR protocol can be optimized by using different traffic types, mobility models and by changing more than one parameter at a time. As in this work mobility was not considered therefore in the next work it will be tried to make DSR energy efficient by applying mobility to nodes

.

References

[1] A. O. Bang and P.L. Ramteke, MANET: History, Challenges and Applications, International Journal of Application or Innovation in Engineering & Management (IJAIEM), 2 (9), 249-251, 2013.

[2] M. Karimi, Quality of Service (QoS) Provisioning in Mobile Ad-Hoc Networks (MANETs), in Prof. Xin Wang (Ed.), Mobile Ad-Hoc Networks: Protocol Design, 2,(2011), 23-39.

[3] Y. Wang, Study on Energy Conservation in MANETS, Journal of Networks (JNW), 5(6), 708-715, 2010.

[4] S. E. Kafhali and A. Haqiq, Effect of Mobility and Traffic Models on the Energy Consumption in MANET Routing Protocols, International Journal of Soft Computing and Engineering (IJSCE), 3(1), 2013, 242-249**.**

[5] M. Fotino and F.D. Rango, Energy Issues and Energy aware Routing in Wireless Ad-hoc Networks in Prof. Xin Wang (Ed.), Mobile Ad-Hoc Networks: Protocol Design, 15, (2011), 23-39.

[6] S. P. Setty and B. Prasad, Comparative Study of Energy Aware QoS for Proactive and Reactive Routing Protocols for Mobile Ad-hoc Networks, International Journal of Computer Applications, 31(5), 2011, 49-53.

[7] D. Nitnaware and A. Verma, Performance Evaluation of Energy Consumption of Reactive Protocols under Self- Similar Traffic, International Journal of Computer Science & Communication (IJCSC), 1(1), 2010, 67-71.

[8] B. R. Umashankar and R. K. Purnima, A Comparative Study of Topology and Position Based Routing Protocols in Mobile Ad Hoc Networks, International Journal of Advanced Research in Computer Science & Technology (IJARCST), 2(2), 2014, 72-75.

[9] D. B. Johnson et.al, The Dynamic Source Routing for Mobile Ad-hoc Wireless Networks, in Wesley (Ed), Ad Hoc Networking, edited by Charles E. Perkins, 5, 2001, 139-172.

[10] S. Baraković et.al, Comparison of MANETs Routing Protocols in Different Traffic and Mobility Models, Telfor Journal, 2(1), 2010, 8-12.

[11] S. Singh et.al, Power-Aware Routing in Mobile Ad Hoc Networks, Proc. 4th ACM/IEEE International Conf. on Mobile Computing and Networking, Dallas, Texas USA 1998, 181-190.

[12] J. E. Garcia et.al, A Novel DSR-based Energy-efficient Routing Algorithm for Mobile Ad-hoc Networks, Proc. 58th IEEE Vehicular Technology Conf. (VTC), Germany, 2003, 2849-2854.

[13] S. Kumari and M. Shrivastava, Secure DSR Protocol in MANETS Using Energy Efficient Intrusion Detection System, International Journal of Networks and Systems, 1(1), 2012, 6-11.

[14] M. S. Akhter and V. P. Singh , Modified Power Saving DSR Protocol For MANETS, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2(6), 2013, 2316-2323.

[15] Palak and N. S. Gill, A Power Saving Intelligent Dynamic Source Routing (IDSR) in MANETS, International Journal of Advanced Research in Computer and Communication Engineering, 3(7), 2014, 7556-7558.

[16] E. Krevat and A. Shahdadi, Energy-Efficient Dynamic Source Routing in Ad-Hoc Wireless Networks.

[17] N. Katkamwar and K. Rathi, Energy Conscious DSR in MANET", Progress In Science and Engineering Research Journal (PISER), 2(2), 2014, 57-67.

[18] A. Drif and A. Boukerram, Energy Efficient DSR Algorithm based on Topology for Mobile Ad-Hoc Network, International Journal of Computer Applications, 83(11), 2013, 1-4.

[19] A. Mesleh and N. Al-Zabin and J. Abdel-Jalil, AODV and DSR energy aware routing algorithms: a comparative study, IJCSI International Journal of Computer Science, 9(1), 2012, 266-271.

[20] S. Gautam and R. Kumar, Modified Energy Saving DSR Protocol for MANETs, International Journal of Electronics and Computer Science Engineering (IJECSE), 1(4), 2012, 1982-1992.

[21] M.Tamilarasi and S. Chandramathi and T.G. Palanivelu, Efficient Energy Management For Mobile Ad Hoc Networks, Ubiquitous Computing And Communication Journal, 3(5), 2001, 12-19.

[22] S. Mishra and B. K. Pattanayak, Power Efficient Dynamic Source Routing Protocol, International Journal of Multimedia and Ubiquitous Engineering, 9(7), 2014, 185-204.

[23] M. Tarique and R. Islam, Minimum Energy Dynamic Source Routing Protocol for Mobile Ad Hoc Networks, International Journal of Computer Science and network security (IJCSNS), 7(11), 2007, 304-311.

[24] [ns-3 [Online]. Available: https://www.nsnam.org/. Last visited: August 24, 2015.

[25] [Documentation<< ns-3 [Online]. Available: https://www.nsnam.org/documentation/. Last visited: August 24, 2015.

[26] S. Giannoulis et.al, TCP vs UDP performance evaluation for CBR traffic on wireless multihop networks, Simulation, 2009, 14-43.