A New Approach for Optimizing Energy Issues in MANET Using DSR Protocol

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Abstract— **Mobile ad-hoc network (MANET) is wireless networks primarily composed of mobiles nodes which don't have any fixed architecture. The energy consumption has always been an open research issue in the area of mobile ad hoc networks and various energy conserving routing conventions have already been proposed. Mostly of them focused on reducing the transmit energy to the minimum level. In this paper, an innovative method has been proposed which effectively increases the reliability of the system, thus proving phenomenal for optimizing energy issues. This method is based on the convention of DSR (Dynamic Source Routing) which has been further modified with specific threshold to execute IE-DSR convention. In our method, no extra control message is required and it has been demonstrated that by utilizing IE-DSR convention, energy can be reduced to an extent. During experimentation, the proposed method reduces the flooding of RREQ (route request) packets in the network to a great extent. The results of our extensive simulation experiments in NS-2 shows that IE-DSR consumes notably around 75.3% less energy as compared with the DSR and other state of the art methods with taking the standard evaluation metrics such as packet delivery ratio, delay and throughput. Finally, we show that IE-DSR is the one of the best approach to reduce the cost estimation of the network while assuring high reliability of the system.**

Keywords- Adhoc networks; IE-DSR; flooding; RREQ; Routing protocols;

I. INTRODUCTION AND RELATED WORK

In the current years, there has been developing enthusiasm for Mobile Ad Hoc Network (MANET) as a method for giving moment networks administration to a gathering of portable nodes which may not be inside the transmission scope of each other. In MANET, portable nodes speak with each other in a multi-hop fashion. That is why the availability of each mobile node is equally important for the proper operation of the whole network. The failure of a Single mobile node can greatly affect the overall performance of the network. Since every mobile node has an extremely constrained battery life, one of the significant reasons of node failure is the battery exhaustion. It has been demonstrated that even under the ideal conditions, the throughput for every node declines quickly towards zero while the quantity of nodes is expanded. Because ad-hoc networks do not rely on existing infrastructure and are self organizing, they can be rapidly deployed to provide robust communication in variety of hostile environments [1].A remote specially appointed network comprises of different portable self - sorted out and battery worked remote gadgets having distinctive battery limit and power scattering. Thus Battery lifetime turns into a key variable that influences the exhibitions of versatile ad-hoc network. Different route disclosure mechanisms utilizing DSR for MANET have been given in writing. In [2] the creator proposed a network for parkway condition which depends on the component of vehicle development. The work done in [3] proposes a route determination instrument and portability forecast for making DSR a energy effective directing convention, in this creator researched the effect of versatility on the execution of an on-request control mindful routing convention. In [4] creator proposed a calculation which chooses a route having the best accessible data transfer capacity. Flooding administration in mobile adhoc network by controlling the versatility and transmission power is appeared in [5]. Different impromptu directing convention and their examination is appeared in [6]. In [7] author proposed the mechanism for reducing the route request flooding attack. The design and performance evaluation of a secure on-demand ad-hoc network routing protocol has been shown in [8]. It prevents many types of denial-of-service attacks. In [9] creator proposed a strategy that can lessen the directing overhead by using earlier routing histories. The work in [10] proposes another modified DSR protocol which is aimed to prolong the network life time by using basic two approaches of power consumption, one is transmission power control approach and the second one is load balancing approach. The work in [11] proposes MDSR protocol aimed to reduce overhead by reducing the number of routing reply packets and a fixed header size for the data packets and acts itself as one of the energy efficient routing protocol. In [12] creator has proposed some new structure for the control packets to change the behavior of the nodes

implements a new Energy table and creates a new algorithm for route cache and route selection. The simulation result shows that E2DSR has better performance than DSR. And it has left many doors opened for future studies and research works because all these metrics described above, have not been implemented yet for a large scenario.

A recent study carried out by [20] proposes a novel Cluster based algorithm with lesser energy consumption and evaluates improvements over the existing systems by using the dismissal conditions for any given network

Above methodologies suggest that energy aware routing protocols save energy. In any case, that convention brings about extra control overhead this can expend superfluous transmission capacity of the network. Extra equipment or programming is required in a few conventions, which may not be plausible for the portable nodes since versatile nodes ordinarily have low preparing force and constrained equipment assets. In this paper, we propose a base energy directing convention called Improvised Energy Dynamic Source Routing (IEDSR) convention. Our approach is to keep away from extra control message. Existing control packets of DSR convention have been utilized as a part of request to execute the IEDSR convention. The IEDSR convention works in two stages' route disclosure and connection by connection control change. Two power levels have been utilized amid the route revelation period of the convention. At initial, a source node starts the route revelation to discover a route to its goal by communicating a request packet at low power level. On the off chance that the source node finds a way utilizing that power level, it set up the association utilizing that power level. On the off chance that a source node can't find a route to its goal utilizing that low power level in the wake of starting route disclosure for a specific number of times, it accept that the goal is not reachable at that power level. At that point it increases the power level to a higher esteem and starts the route disclosure again at that power level.

In present work we have proposed a proficient and basic calculation which lessens the quantity of RREQ packets overflowed keeping in mind the end goal to improve the execution of an Ad-hoc organize. This calculation considers the change in route revelation instrument at halfway nodes. The modification procedure incorporates the checking of parameters like portability, leftover battery and got flag quality of node itself by the characterized condition. In this procedure those nodes are disposed of which don't have the characterized conditions. In this way those nodes won't further forward route request for packets. Subsequently blockage in network will lessen. In the section 2 we will clarify requirement for lessening the route requests for in specially appointed network. In section 3, we will clarify the DSR convention in brief. In section 4, we will display the IEDSR convention in detail. In section 5 we will demonstrate some simulation results and section 6 will conclude our works.

II. Requirement for Reducing the Route Request in Ad-hoc Network

The dynamic source directing convention (DSR) is a reactive MANET routing protocol. When imparting a goal node which is absent in the route store of the source node, it will buffer the information packets and communicate a route request (RREQ) into the network. The other middle of the road DSR nodes communicates the RREQ packet to the expected goal node. The goal node then will send a Route Reply (RREP) on the turnaround route back to the source node.

In the event that no RREP is received after a settled number of endeavors and within the inside net_traversal_time, the information packets from the buffer will be dropped. On the off chance that more information packets are gotten, another course revelation process will be started. Expanding number of route requests will soak the system which makes it incapable for further transmission of information packets [6].

Reactive routing protocol by and large requires less routing overhead than proactive routing protocols since they take a shot at request. Proactive routing protocols are no influenced by expansive number of flooding of course demand in light of the fact that if the goals are not discovered, information packets are dropped at the source or any middle of the road nodes. However, it can truly corrupt the execution of reactive routing protocols and influence a node in the following ways:

- During the procedure of route revelation the information packets are supported in the memory. Furthermore, if the expansive quantities of information packets beginning from application layer are really inaccessible, veritable information packets in the support memory might be supplanted by these inaccessible information packets.
- The expanded number of RREQ packets in the network brings about more impacts and therefore, blockage and in addition postpone increment for the information packets in the network.

Power and transfer speed administration is vital in MANET and transmission of substantial number of RREQ can build the power and data transfer capacity utilization.

III. Basic DSR Operation

Because of the versatility of the nodes in specially appointed system, the directing conventions implied for wired systems are unacceptable for MANETs. For this, DSR (Dynamic Source Routing) [9] [4] can be utilized which takes after two components –

A. Route Discovery
B. Route Maintenance.

It is an on-demand routing convention with no occasional routing promotion messages. Despite the fact that DSR convention barely gives any QoS support, multicasting and security, it can undoubtedly adjusts to changes like host development without requiring extensive convention overheads. DSR can switch effectively between the outrageous circumstances where development of hosts is snappy and visit i.e. where flooding might be the best technique, and also occasional developments which are practically static i.e. where regular routing conventions are generally reasonable.

A. Route Discovery

It is an instrument for finding the route to transmit information packets to a goal when the correct route is obscure to the sender. It utilizes flooding for route request (RREQ). Subsequent to accepting RREQ, every node rebroadcasts it further, till the final goal is reached. In the wake of getting the packet the goal replies back to the source with route reply (RREP). The route request records the route navigated so far in the route record list (RRL) for sometime later. The RREP takes after that way in reverse to back to the source.

B. Route Maintenance

Every one of the nodes in the system is refreshed with the directing data at customary interims. DSR gives two sorts of packets to keeping up these routes

1) RouteError Packets (REP) – these are utilized to inform about any softened connection up the system. The node getting the REP expels every one of those routes from its directing table, which utilizes the broken connection and another Route Discovery Process is started by the node.
2) ACKs – which recognizes the receipt of the REP packets.

IV. Proposed IEDSR Algorithm

The flow chart of proposed algorithm viz. IEDSR is shown in figure 1.

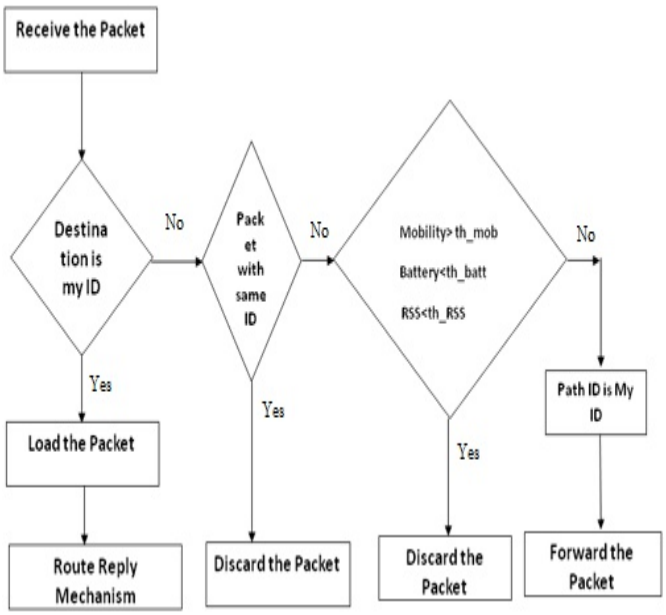


Figure 1. Flow Chart of Route Discovery Mechanism in IEDSR

It demonstrates the instrument of sending the route request for packets by the transitional nodes. For proposed IEDSR the alterations made in route revelation handle just, which is as per the following:

Step 1. When RREQ flooded, it reaches to the nodes which are in the transmission range of source node. When a node receives a RREQ packet, following conditions/possibilities will be checked:

If it is the destination node, it sends a route reply to the sender.

Else

Step 2. if this node receiving the route request has recently seen another route request message from this initiator bearing the same request identification and target address, or if this node's own address is already listed in the route record in the route request, this node discard the request.

Else:

Step 3. If {value of the speed of the node is greater than 10.41 m/sec OR value of the residual battery is less than the threshold value of residual battery i.e. = 142 Joule OR value of the received signal strength is less than the threshold received signal strength i.e. = - 85 dBm}

Step 4. Discard the request.

Else

Step 5. The node adds its own address in the request packet and forwards it.

V. Simulation Result

A. NS2

A network simulator is software that predicts the behavior of a computer network. In simulators, the computer network is typically modeled with devices, links, applications etc. and the performance is analyzed. Typically, users can then customize the simulator to fulfill their specific analysis needs [13].

A large portion of the business simulators are GUI driven, while some network simulators are CLI driven. The network model / setup depict the condition of the network (hubs, switches, switches, and links) and the events (information transmissions, packet errors and so forth). An important output of simulations is the trace files. Trace files log every packet, every event that occurred in the simulation and are used for analysis. Network simulators can also provide other tools to facilitate visual analysis of trends and potential trouble spots. Most network simulators use discrete event simulation, in which a list of pending "events" is stored, and those events are processed in order, with some events triggering future events such as the event of the arrival of a packet at one node triggering the event of the arrival of that packet at a downstream node. Simulation of networks is a very complex task. For example, if congestion is high, then estimation of the average occupancy is challenging because of high variance. To estimate the likelihood of a buffer overflow in a network, the time required for an accurate reply can be extremely large.

Specialized techniques such as "control variants" and "importance sampling" have been developed to speed simulation [14].

Simulation Procedure:

- Simulation Object Creation
- Tracing (Simulation Object - NAM)
- Topology Formation
- Communication Agent
- Traffic Model
- Error Model
- Algorithm Designing
- Run the Object

These are all steps for completing the simulation modeling process for entire common research work.

B. *Energy Consumption Model*

A generic expression to compute the energy required to transmit packet p is: E(p) = i*v*tp Joules, where: i is the present utilization, v is the voltage utilized, and tp the time required to transmit the packet. We assume that every cell phone is furnished with IEEE 802.11b system interface cards (NICs). The energy utilization esteems were received by contrasting business items and the trial information announced in [11].

The qualities utilized for the voltage and the packet transmission time was: v = 5V and tp = (ph/2*106 + pd/11*106) sec, where ph and pd are the packet header and payload measure in bits, separately. We computed the energy required to transmit and get a packet p by utilizing:

$$Etx(p) = 280mA * v * tp \text{ and } Erx(p) = 240mA * v * tp$$

Besides, we represent energy spent by nodes catching packets. As appeared in [11], we accept the energy utilization brought on by catching information transmission is the same as that devoured by really getting the packet. With the end goal of assessing the impact of catching, we changed the energy model to account not for the energy use because of transmission and gathering additionally the battery cost to be consumed by catching the remote channel. Therefore, the aggregate sum of energy, E(ni), consumed at a node ni is determined as:

$$E(ni) = Etx(ni) + Erx(ni) + (N-1) * E(1) \quad (1)$$

Where Etx, Erx, and Eo mean the measure of energy use by transmission, gathering, and catching of a packet, individually. N speaks to the normal number of neighboring nodes influenced by a transmission from node ni. Eq.(1) infers that when the system is more thick, the packet catching causes more energy utilization.

C. *Simulation Analysis*

An extensive simulation has been carried out to define the threshold value of residual battery, speed and RSS for IEDSR (shown in table 1). To estimate threshold value of residual energy level, two cases are considered as follows:

TABLE I. PROPOSED MODIFICATION IN DSR BY ALTERATION IN ROUTE DISCOVERY MECHANISM

Parameter	Routing protocol-DSRI
Threshold value of residual battery	142 Joule
Threshold value of speed of node (m/sec)	10.41 m/sec
Threshold value of RSS	-85 dBm

- Case I: Initial energy supply to each node 300 joules, simulation time 250 seconds.

TABLE II. SUPPLIED PARAMETER

Parameters	Power
Idle Power	1.0 w
Receiving Power	1.1 w
Transmission Power	1.65 w
Sleep Power	0.001 w
Transition Power	0.6 w

The energy consumption with DSR and IEDSR (with threshold 142 joule) is as follows:

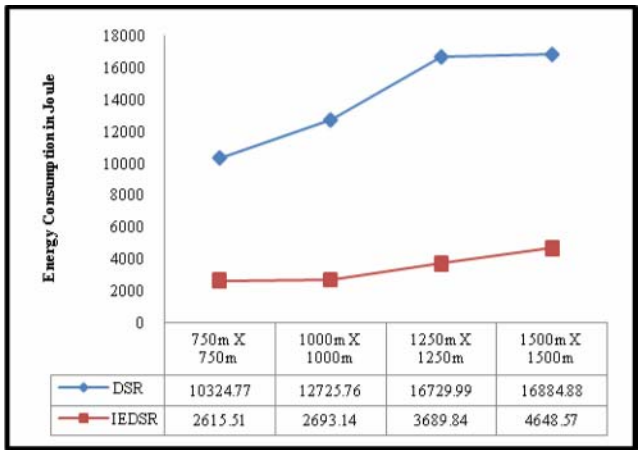


Figure 2. Energy Consumption by 100 Mobile Nodes in DSR and IEDSR

From fig. 2we can conclude that Energy consumption is increased by 74.7% from 750m x 750m to 1000m X 1000m

topology area, which is further increased up to 78.8% from 1000m X 1000m to 1250m X 1250m topology area respectively. The energy consumption per data packet increases in DSR protocol as the network size increases. The reason is that the data packets are traveling more hops in this protocol when we place the same number of nodes in larger network size.

The percentage of energy saving in IEDSR protocol compared to DSR protocol is shown in fig.3 It is shown that the energy saving is maximum when the network size is small which is almost 74.7 % when the network size is 750m by 750m. That saving in energy decreases with the network size. When the network size is 1500m by 1500m, the energy saving in IEDSR protocol is nearly 72.5%

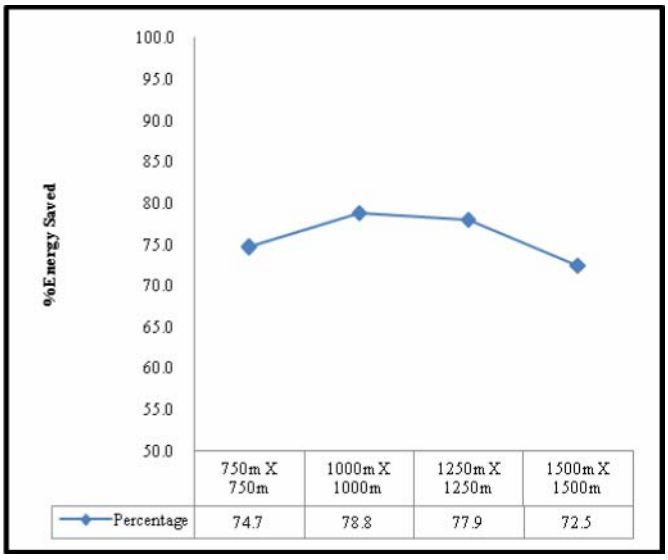


Figure 3. Percentage Energy Saving in IEDSR

- Case II: Initial energy supply to each node 300 joules, simulation time 250 seconds.

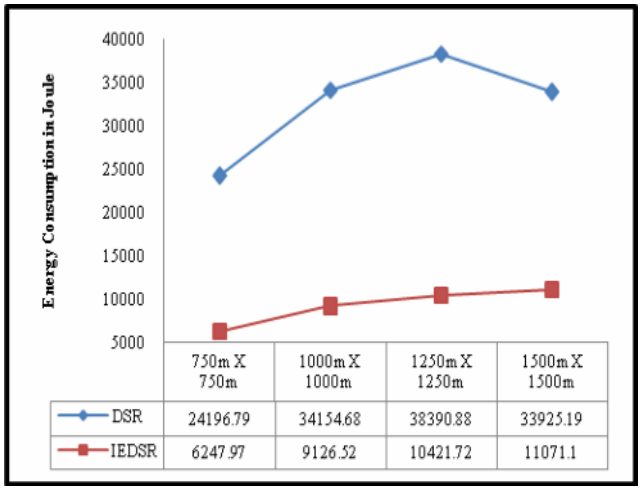


Figure 4. Energy Consumption by 150 Mobile Nodes in DSR and IEDSR

From fig. 4 we can conclude that Energy consumption is 74.1% in 750m x 750m which decreases to 73.28% in 1000m X 1000m topology area, which further decreases to 67.37% from 1000m X 1000m to 1250m X 1250m topology area respectively. The energy consumption per data packet increases in DSR protocol as the network size increases. The reason is that the data packets are traveling more hops in this protocol when we place the same number of nodes in larger network size.

The percentage of energy saving in IEDSR protocol compared to DSR protocol is shown in fig.5. It is shown that the energy saving is maximum when the network size is small which is almost 74.18 % when the network size is 750m by 750m. That saving in energy decreases with the network size. When the network size is 1500m by 1500m, the energy saving in IEDSR protocol is nearly 67.37%

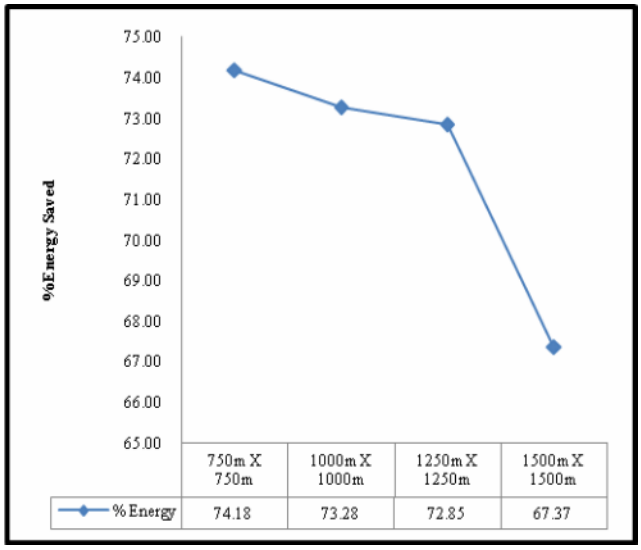


Figure 5. Percentage Energy Saving in IEDSR

- Case III: Initial energy supply to each node 300 joules, simulation time 250 seconds.

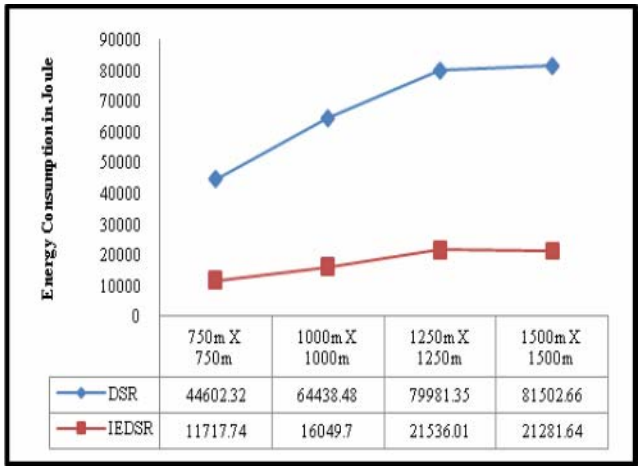


Figure 6. Energy Consumption by 200 Mobile Nodes in DSR and IEDSR

From fig. 6 we can conclude that Energy consumption is 73.73% in 750m x 750m which increases to 75.09% in 1000m X 1000m topology area, which further decreases to 73.07% in 1000m X 1000m and increases in 73.89 1250m X 1250m topology area respectively. The energy consumption per data packet increases in DSR protocol as the network size increases. The reason is that the data packets are traveling more hops in this protocol when we place the same number of nodes in larger network size.

The percentage of energy saving in IEDSR protocol compared to DSR protocol is shown in fig.7. It is shown that the energy saving is maximum when the network size is 1000m by 1000m which is almost 75.09 %. That saving in energy decreases with the network size. When the network size is 1500m by 1500m, the energy saving in IEDSR protocol is nearly 73.89%

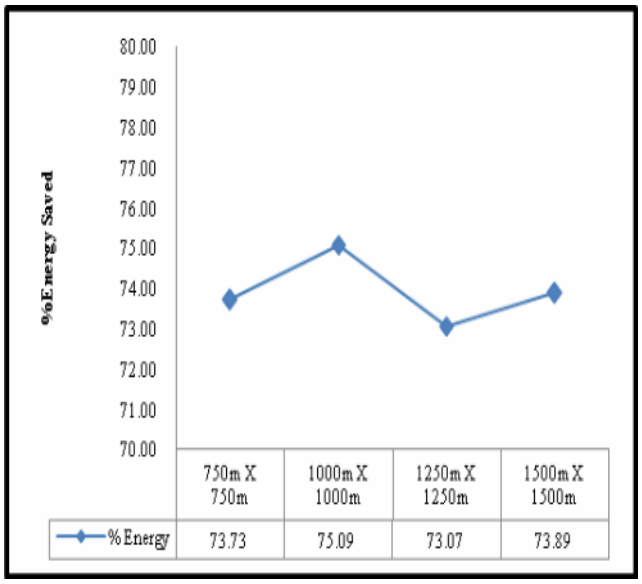
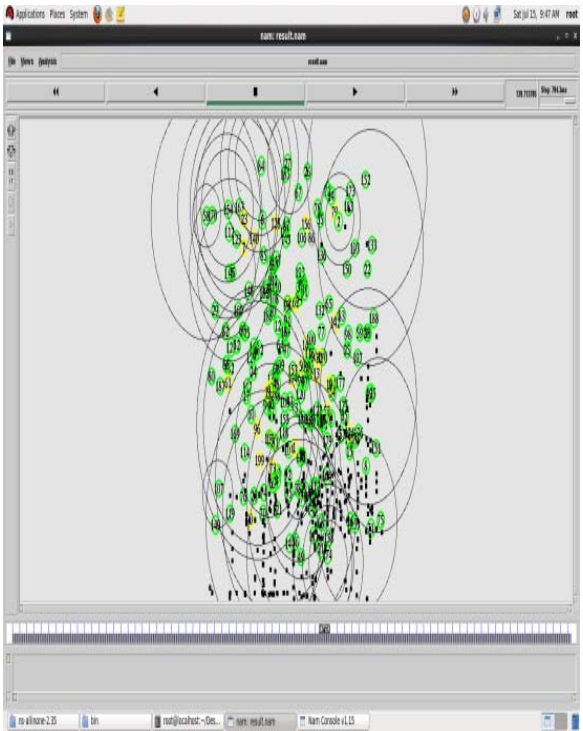


Figure 7. Percentage Energy Saving in IEDSR



VI. SIMULATION DEPLOYMENT DIAGRAM

Figure 8. Some Nodes Start to Fall in Middle Energy Level

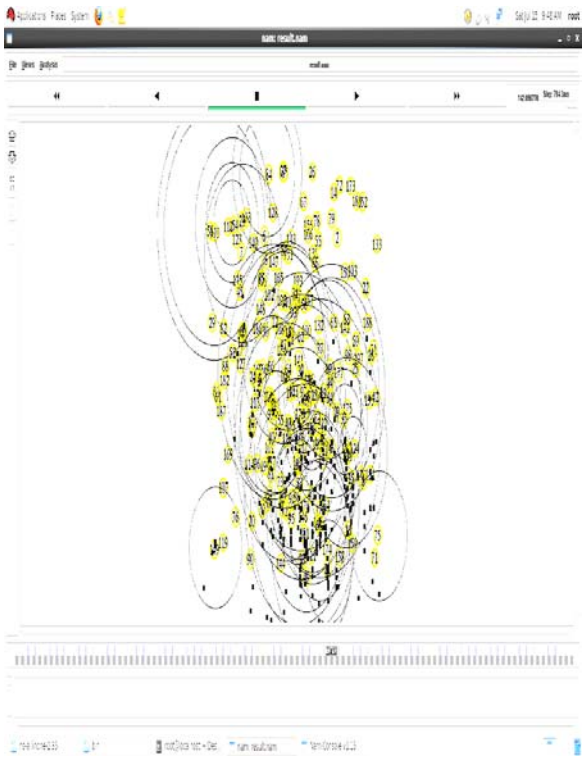


Figure 9. All Nodes Fall in Middle Energy Level

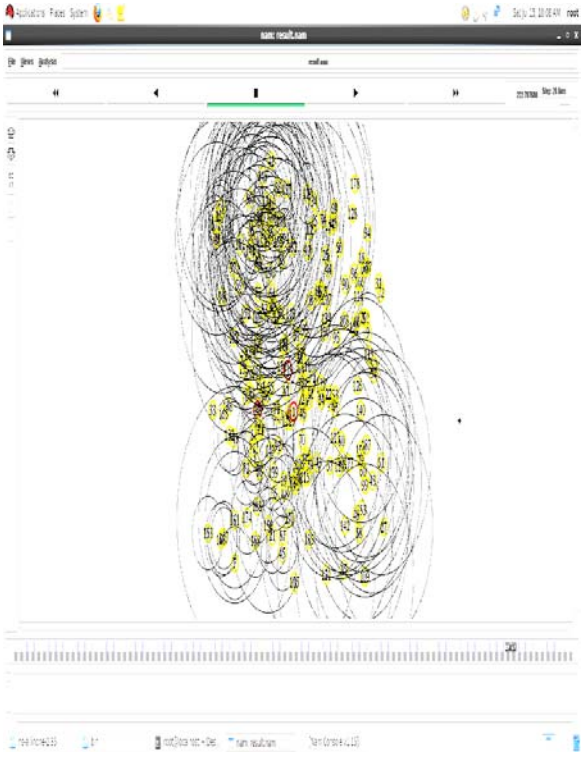


Figure 10. Some Nodes Start to Fall in Low Energy Level

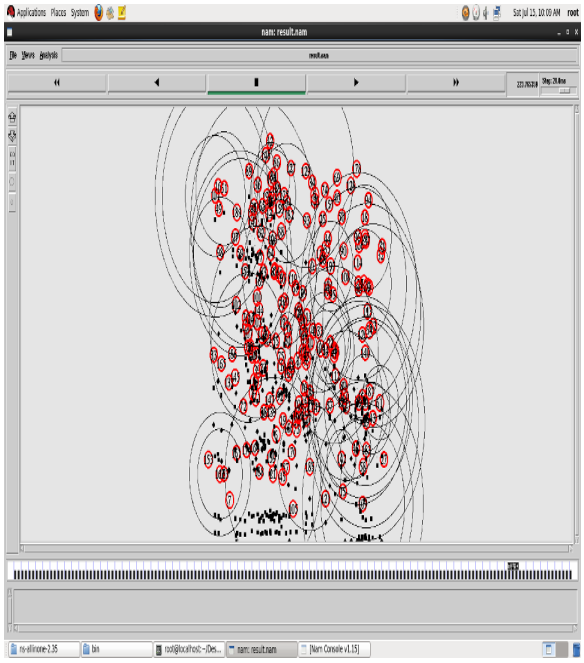


Figure 11. All Nodes Fall in Low Energy Level

On 200 nodes with initial energy of 300 joules simulated for 250 seconds. Initially all nodes have high energy level indicated by green color in the network animation. As shown in fig. 8 at 139.73 seconds few nodes start to fall in middle energy level shown by yellow color in network animation. Fig. 9 depicts that at 142.09 seconds all nodes fall in middle energy level shown by yellow color in network animation. By fig. 10 at 222.78 seconds few nodes start to fall in low energy level shown by red color in network animation. Finally at 223.76 seconds all nodes fall in low energy level shown by red color in network animation as shown in fig.11.

VII. CONCLUSION AND FUTURE WORK

In this paper, we described an innovative method Improvised Energy Dynamic Source Routing (IE-DSR) in mobile ad hoc networks. Its main goal is to control the flooding of RREQ in the MANET system. Flooding causes high energy and delay in the system. The IEDSR gives a mark-able solution for the above problem. This method effectives prune those nodes having lesser battery and power since they will have less lifetime in the system. It also frames out novel method for route discovery useful for reducing energy consumption. The method successfully demonstrates a remarkable increase in network life and ensures that useful packets are conveyed to the destination. The simulation results shows that by keeping the low initial energy of node, IEDSR consumes approx.75.3% less energy than the state of the art methods. It has high impact for high density nodes and lower delay expectations. In future work, this work may be extended by implementing on a large scenario on various evaluation metrics.

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