Energy Saving Technique in Wireless Mobile Ad-hoc Network for Reliable Communication

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***Abstract*—** Mobile Ad hoc Network (MANET) consists of a group of mobile nodes that can be communicated with each other wirelessly without the need to any existed communications. Mobile Ad hoc Network (MANET) consists of a group of mobile nodes that can communicate with each other without the need of infrastructure or central controller. In link breakage prediction, a link breakage can be predicted before its real occurring so route maintenance can start before the occurring of the problem avoiding the problems that come with a link breakage. The movement of nodes in MANET is random; therefore MANETs have a forceful topology. Because of this forceful topology, the connection breakages with unreliable data delivery are very common problem in MANET environment. This problem degrade the performance of the network like data delivery, throughput and increases the drop rate and delay, for that problem resolution we proposed novel approach for routing establishment that work according to threshold as well as average energy base scheme and provide the more reliable communication, in this approach we increases the route life time and packet delivery ratio, throughput and decreases data drop, routing load and end-to-end delay. This approach has been implemented on the well-known Dynamic Source Routing protocol (DSR). This new mechanism was able to decrease the packet loss and delay that occur in the original protocol.

Keywords— **MANET, Energy, DSR, Throughput, Routing**

I. INTRODUCTION

Mobile Ad hoc Network (MANET) consists of a group of mobile nodes that can be communicated with each other wirelessly without the need to any existed communications. MANETs in general are known with its forceful topology. The nodes are mobile and their movement is random. MANET's dynamic topology makes connection breakages a frequent routine. This routine causes many problems such as data loss, delay, and others which degrade the performance of the MANETs protocols. In order to reduce the damage size of this observable fact, the idea of connection breakage prediction has appeared.

In link breakage prediction, a link breakage can be predicted before its real occurring so route maintenance can start before the occurring of the problem avoiding the problems that come with a link breakage. In the connection breakage prediction, a node in an active route can expect if the link between it and its previous hop will break soon. In this case it can inform the source node about the problem and the source node, if still needs the route, will be able to construct a new route which avoids this soon to be broken link. It has been found that this procedure has made a good improvement in the performance of the mobile ad hoc network's protocols, but the problem is that the focusing during constructing a new route was only on excluding the link that was predicted to have a link breakage [1]. This mechanism may cause constructing a new route with some or all bad links from the current used route which are weak but did not predicted to be broken so far. These connections may break during or directly after the constructing of the new route which will cause a high reduce in the packet delivery ratio and a high increase in the packet loss and delay. In order to improve the idea of link breakage prediction, this paper has proposed a new approach for link breakage prediction in MANETs. In this new approach, the source node of an active route, after being informed about a connection breakage in its present used route, will construct a new route which avoids the use of any link from the current used route. That means excluding all the links in the current route, or in other words, excluding the whole current used route not just the soon to be broken link. So, the new constructed route will be completely different from the current used one. This approach is novel and it has been implemented on the well-known reactive routing protocol Dynamic Source routing Protocol (DSR).

The paper organization is as follows: section 2 describes the related work is described in section 3. Routing protocol and AODV routing is described in section 4 and the proposed solution modified AODV according to proposed algorithm is described in section 5and 6. Network simulation results are presented in section 7 followed by conclusions and future work in section 8.

II. LITERATURE REVIEW

Number of researchers has investigated the area of link breakage prediction in mobile ad hoc networks and energy utilization.

Khalid Zahedi [1] in this title a new approach of link breakage prediction in MANETs is anticipated. This new techniques has been implemented on the well-known Dynamic Source Routing protocol (DSR). This new technique was able to reduce the packet loss and delay that occur in the original protocol.

Peyman Arebi[2] This title we proposed novel method based on energy estimation to restore broken links and reconstruct the paths of them. So examine Effect of broken

links on topology control and routing process in Ad Hoc network. It was indicated that these special effects were destructive in the mentioned couple of network portions. In this title has been used Hardware Method for estimation energy in ad-hoc node, so this method has a high speed.

Ramesh et al. [3] have studied the problem of link breakage prediction in the DSR routing protocol. Their idea is that during the route discovery process, the source node builds two routes which are the source route and another route can be used as an alternative backup. The backup route can be used if the primary route (source route) was predicted to have a link breakage soon.

Li et al. [4] have studied the link prediction in the AODV routing protocol by establishing a signal intensity threshold which is Pr-Threshold. If the received signal intensity is lower than the threshold, the upstream node will calculate the distance between it and the sending node through the intensity of the received packet signal, and estimate the relative velocity between it and the sending node through the time difference of the neighbouring received data and the intensity of the packet signal. Then, according to the relative position and the relative velocity with the sending node, a node can estimate when to send a RRER to the sending node to warning it about a link failure. When the transmitter node received this route reply message, it will start its restored process searching its routing table and find another route to the destination.

Qin & Kunz [5] have dealt with the problem of link failure prediction by proposing an equation to calculate the exact time that a link breakage can occur. They named their method the link breakage prediction algorithm. In their idea, each node maintains a table that contains the previous hop node address, the value of the received packet signal power, and the time which this data packet has been received. After receiving third data packets, a node will calculate the connection breakage time and evaluate it with a fixed threshold. If the node predicted that the link with its previous neighbor will have a link breakage soon, it will transmit a caution message to the source node of the active route to warn it about the link breakage probability. If the source still needs the route it will perform a route discovery process to establish a new route to the destination. Their idea has been implemented using DSR routing protocol.

Hoi, W., Nam, J., Choi et al. [6] has dealt with the problem of link breakage prediction in vehicular ad hoc network. They proposed an algorithm to predict a link breakage possibility using the value of the RSSI (Received Signal Strength Indicator). Each vehicle in the network periodically scans the received signals from its neighbors and uses the collected value to calculate the distance, the velocity, and the acceleration of its next hop which it receives data packets from. By calculating these receives three packets, the node can predict if a link breakage will occur, and can determine if the effected link can be maintained or a new link is needed to be constructed. If the effected vehicle found that a link breakage in the link with its next hop will occur, it will use one of its neighbors which has the highest value of RSSI with (that means the one which is the nearest to it) to build a new link with before the previous link with its other neighbor becomes broken.

Goff et al. [7] have studied the link breakage problem in the DSR routing protocol. They defined a region they named it the pre-emptive region, and they also defined a threshold which they named it the pre-emptive threshold, they defined this threshold as the signal power of the received packets at the edge of the pre-emptive region. When a node enters the pre-emptive region it will send a warning message to the source node of the active route in order to inform it that a link breakage will soon occur. So if the source is still interesting with the route, it will generate a route discovery process to establish a new route without that soon to be broken link.

Ouni et al. [8] studied the problem of connection breakage prediction in the DSR routing protocol and try to researcher propose a solution by proposing a check model composed of two modules. The first module includes performing different simulations to have an idea about the nodes behavior and by this allowing determining the appropriate routes to use, while the second model checks the path availability and the limit delay fulfilment. This check model was also used to predict the validity periods of the selected path and the satisfaction of the delay constrains.

Lu et al. [9] have worked on the DSR routing protocol and proposed a mechanism for switching to a new route if the current route is found to have a connection breakage soon. This mechanism which is named DSR-link switch (DSR-LS) first detects a connection breakage between a nod and its next hop to the source by measuring the power of the received packets. If a link failure is detected to occur soon, the node, using this mechanism, will send a link switch request (LSRE) in one hop range to search suitable nodes that act as relaying stations or connection nodes. This LSRE request will be sent by including it in the Request to send and Clear to send packets of the MAC layer during the current communication. After finding a new strong links, the current route will be shift to a more stable path.

III. DYNAMIC SOURCE ROUTING (DSR)

The aim of energy-aware routing protocols is to reduce energy consumption in transmission of packets between a sender and a receiver, to avoid routing of packets through intermediate nodes with low residual energy, to optimize flooding of routing information over the network and to avoid interference and medium access collisions. Numerous energy efficient routing protocol proposals were originally studied for MANET networks, where the restricted energy of nodes is a strong constraint; in mobile ad-hoc network, however, the requirements are dissimilar: a node has generally more hardware resources (capable of

better performance, but consuming more energy) and the protocol must preserve the resources of every node in the network (not only a separation of them, because each node can be, at some time, sender or receiver of data). A single node failure in wireless networks is usually insignificant if it does not lead to a loss of sensing and communication coverage; ad-hoc networks, instead, are oriented towards personal communication and the loss of connectivity to any node is significant [10].

In the routing protocol design of mobile nodes, a lot of issues need to be considered in order to offer many important properties such as routing table maintenance, scalability, Quality of Service support, security, minimum energy consumption etc. We focus on the energy issues facing some important aspects going from the energy model definition for the computation of the energy utilization to energy-aware metrics definition and routing protocol design. If a network composed of mobile nodes communicating using a wireless radio link and where each mobile node can communicate with each other using the other mobile nodes as relay nodes is assigned in a communication system, many challenging design issues need to be addressed. MANET technology became, in the last few years, more commercial as well as emergency related data delivery in comparison with the past where it was used for military purpose and this implies more additional features to offer to the end- user with particular reference to quality of service, security and to node lifetime period (energy utilization base life time prediction). Energy saving techniques at network layer and the routing strategies that allow better energy expenditure and load distribution in order to prolong the network lifetime are considered. After defining a simple energy consumption model to use as reference for the protocol performance evaluation and after introducing some well-known energy based parameter, a few routing protocols belonging to dissimilar type of routing strategies are briefly describe in related work. In particular we refer to proactive routing protocols with particular reference to OLSR, reactive routing with reference to AODV, DSR and LEAR, hybrid routing with reference to GAF, and scalable routing strategies based on the concept of clustering or topological hierarchy.

IV. Objective

The energy at the network layer can be conserved by reducing the energy consumed for two main operations, namely, communication and computation. The communication related power consumption is mainly due to transmit-receive module present in the nodes. Whenever a node remains active or live, that is, for the duration of transmission or reception of a packet, power gets consumed. Even when the node is not actively participating in communication, but is in the receiving mode waits for the packets, the battery keeps utilized. The processing power refers to the power spent in calculations that take place in the nodes during routing and power adjustments. And communication power refer to utilize energy in transmission, receiving and sensing time etc. so our aim to efficient utilize energy of each mobile node and increases the reliability of the network

V. Problem Statement

Mobile Ad-hoc Network partitioning interrupts communication sessions and can be caused by node movement or by node failure due to energy depletion. Whereas the former cannot be controlled by the routing protocol, the latter can be avoided through appropriate routing decisions. Operational lifetime is therefore defined in this survey as the time until network partitioning occurs due to battery outage.

A few reasons for energy deterioration in MANETs are Limited battery of the mobile nodes, crucial for Replacing the Batteries, Lack of Central Coordination, Constraints on the energy Source, choice of optimum Transmission Power utilization, and Channel utilization. All of them is big challenge to manage energy issue in MANET environment, so our aim to efficient as well as reliable communication using energy management and restoration broken link technique.

VI. PROPOSED IDEA

In our propose scheme we use the energy module and set the initial energy to all node and also set transmission power, receiving power, idle power and sleep power required by the each node , according to various paper we set decreasing power of energy level and simulate the result of mobile nodes.

After that we use the threshold scheme (10 joule) and average energy scheme, very first we call routing module and broadcast routing packet that time we use energy aware base routing and flood routing packet on the network that time we check node energy with threshold value if energy greater than 10 joule so node in route and till the destination that work continually run, after that if we find more than one route from source to destination (all are greater than 10 joule energy) than we calculate average energy of each path and get maximum average energy path from source to destination and then sends actual data packet from that path, but MANET is dynamic nature so if any node out-of range so same work follow recursively, but this work provide more reliable as compare to previous work.

Ad hoc wireless networks are power constrained since nodes operate with limited battery energy. If some nodes die early due to lack of energy, they cannot communicate with each other. Therefore, inordinate consumption of nodes' energy should be minimizing. In fact, nodes energy utilization should be balanced in order to increase the energy awareness of networks. Here we proposed a new energy aware deterioration and management scheme in MANET. In this scheme we set a threshold value for energy consumption by mobile nodes in our network. If the energy level of any node/s in the network reaches to threshold level that are not participated in communication means it will be inactive in the network. According to our proposed approach a new energy aware deterioration (EADM) routing to make aware our network

about the energy of nodes by that we remove the problem of suddenly loss of session to recognize the unfaithful nodes and extend the life cycle of network.

Energy aware deterioration and management routing scheme deals with efficient utilization of energy resources and provide reliable communication of them. By controlling the early depletion of the battery, adjust the power to decide the proper power level of a node and incorporate the low power strategies into the protocols used in various layers of protocol stack. There are little issues and solutions which witnesses the need of energy aware routing in ad hoc wireless networks.

VII. PROPOSED ALGORITHM

On the basis of proposed algorithm any node in the network are always select the nodes that has a maximum energy value. It means that it solves the problem of link breakages in network. The problem in normal energy efficient routing is that nodes in the network are not aware about the energy values of nodes. If the sender has selected the low energy value node which has not trustful for communication then in that case the session between the nodes are suddenly expire by that the huge amount of energy is wasted. But in this proposed algorithm these chances are negligible it means that sender are not do the normal routing in network it apply the maximum (MAX) energy selection method and ignores minimum (MIN) value of nodes in network. And if the path in between the sender and destination is established then also compare the energy value of alternative path and select the best one on the basis of MAX energy value.

If we compare it with threshold based energy efficient scheme then in case of threshold the energy remains in network after threshold are wasted and for best result it is necessary to apply optimal threshold/s value.

This proposed method provides the reliable and strong connection between the sender and receiver by the energy utilization are increases and unnecessary energy consumption reduces.

Step 1: Create mobile node = M;
Step2: Set routing protocol = DSR; // for Routing Protocol
Step3: Set of M = { N_s, N_d, N_i, N_j, N_k, N_l, ... N_n}
// Number of mobile node's
Step4: Set of Intermediate vertex or node's N_i, N_j, N_k, N_l, ... $N_{n \in I}$, but not N_s, N_d
Step5: Set sender = N_s ; // N_s € MN
Step6: Set Destination = N_d; // N_d € MN
Step7: Initialize RR (radio range)= 550m;
Step8: Set MAC (Wireless) = 802.11; // for Media access control
Step9: Set initial energy of each node E = { e_s, e_d, e_i, e_j, e_k, e_l, ... e_n }
Step10: Compute Route (N_s, N_d, E, RR)
Step11 :{ If (radio-range <= RR && next-hop != N_d && E > Threshold)
{
Step12: If (path exist from N_s to N_i, && N_i != N_d)
Increment pointer N_i as N_s and N_j as N_i
Flood route packet to next hop
Step13: if (path from N_i to N_j && N_j != N_d)
{
Flood route packet to next hop
Increment pointer N_i and N_j
Goto step 13;
}
Step14: If (N_j == N_d)
{
Create rtable in N_d Node
Create energy table N_s-N_i-N_d
}
Step15: If (path > 1) // Average energy path
Step16: {
if (path N_{sijd} from S to D && path N_{skld} from S toD)
{
generate rtable N_s via path N_{ij} to N_d
generate energy table e_s via path e_{ij} to e_d
generate rtable N_s via path N_{kl} to N_d
generate energy table e_s via path e_{kl} to e_d
}
Step17: discover energy (e_i, e_j)
Step18: discover energy (e_k, e_l)
Step19: Compare-energy (e_{ij}, e_{kl})
Step20: {
If (energy (e_{ij} max) // Energy MAX.
choice route N_s via path N_{ij} to N_d
}
} }

VIII. SIMULATION ENVIRONMENT AND RESULTS

The simulation described in this paper was tested using the network simulator-2, which allows users to deploy random network topologies [11]. By changing the logical topology of the network, ns-2 users can conduct tests in an ad hoc network without having to physically move the nodes, only set mobility of nodes. NS-2 controls the test scenarios through a wireless interface, while the ad hoc nodes communicate through a wireless interface. Here we are taking the some essential simulation parameters. The results are calculated on the basis of these parameters. In our Simulation parameters to make the scenario of routing protocols in this work are as follows

Number of nodes	40
Dimension of simulated area	800×800
Routing Protocol	DSR
Simulation time (seconds)	100
Transport Layer	TCP ,UDP
Traffic type	CBR , FTP
Packet size (bytes)	1000 /sec.
Number of traffic connections	10
Maximum Speed (m/s)	Random
Transmit energy	1.5
Receiving energy	1.0

Idle energy	0.1
Sense energy	0.17

Table 1: Simulation Parameter

A. Packet Delivery Ratio Analysis

Packet Deliver Ratio (PDR) is represents the successful percentage of data delivery in network. In this graph the PDR are represents the performance of proposed E-DSR and normal energy based Energy based (EDSR) scheme in MANET. Packet delivery ratio is also the one of the important factor measure the performance of network. Here in case of proposed scheme the PDF is about more than 90 % but in case of proposed scheme the PDF is about at some time instances are 100%, it means there is not a major difference in performance in measurement of PDF. It means that the PDF only counts the packet percentage this one is more or less depend on the number of received packets with respect to send packets.

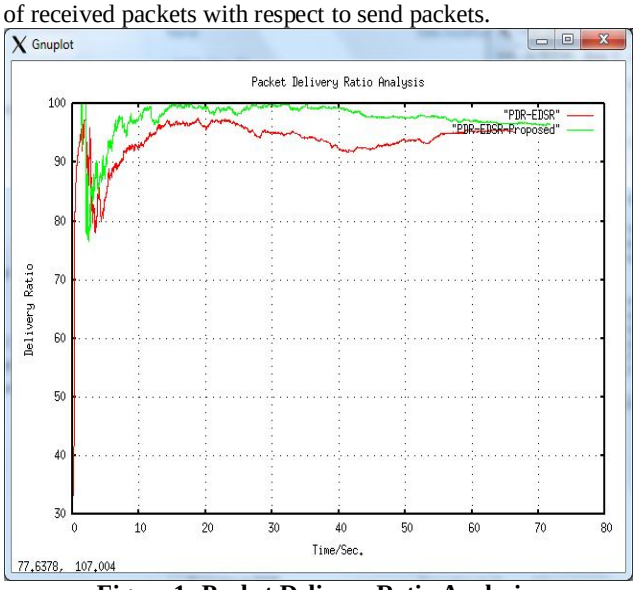

Figure 1: Packet Delivery Ratio Analysis

B. Routing Load Analysis

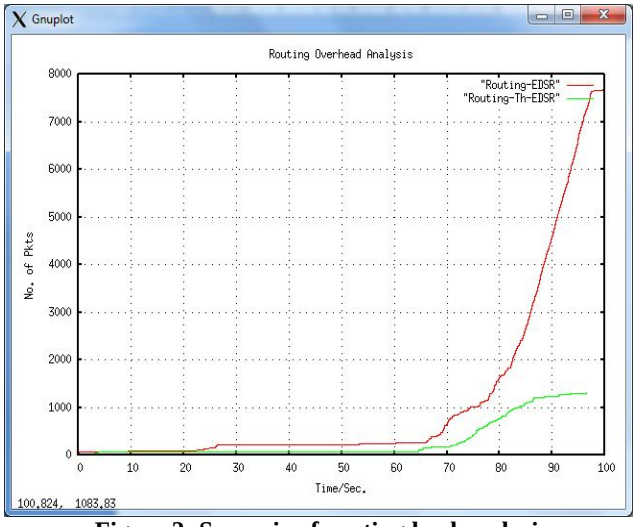

Figure 2: Scenario of routing load analysis.

Routing overhead are measured on the basis of number of rotuing apackets are deliver in network for connection establishment in network. The routing packets are also consumes the energy it means less packets are showing the better performance in terms of energy saving. This graph represents the routing overhead in case of previous E-DSR and proposed E-DSR scheme. Here we clearly visualized that in case of old scheme about more then 7500 routing packets are deliver in network but in case of proposed Max Energy based Route Selection always the route establisded with the higher and maximum enery based, by that always in route selection method the higher energy level of nodes are selected then the routing load is minimum. Now in proposed scheme only about 600 routing packets are deliver in network it means that the energy consuption of nodes as compare to normal energy based routing are too less. It means the energy utilization in proposed scheme is more and consuption is reduced.

C. Throughput Analysis

Throughput is the number of packets sends or receives in per unit of time in network. The packet receiving per unit of time are considered here for measuring the performance of both the protocols. This graph represents the throughput in case of proposed EDSR and previous EDSR schemes, here the throughput performance in case of propose schemes are much better than normal energy based routing. In case of proposed scheme the nodes in network are utilizes their energy in communication not for waste in retransmission. It means that the nodes are utilizes their energy properly in proposed scheme. The highest throughput value in case of proposed scheme is about 2700 packets in per unit of time but in case of normal the value is about 2200 packets per unit of time. It means the life of network and packets sending in network are more in proposed scheme.

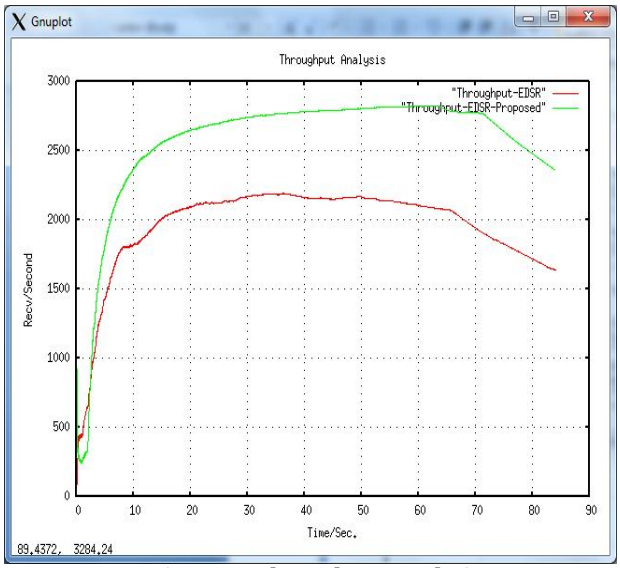

Figure 3: Throughput Analysis

D. Energy Utilization in case of Old scheme and Proposed Scheme

This graph represents the energy utilization of nodes in case of previous EDSR and proposed EDSR scheme. Here the X - Axis represents the nodes that energy utilizes in network and the Y - Axis represents the energy of nodes in Joules. Here we clearly visualised the benaviour of graph of both the schemes. In proposed scheme the energy utilization is more, it means that the life time of node in network are more as compare to previous. All the nodes in network are show the better energy utilization and enhnace the life of node.

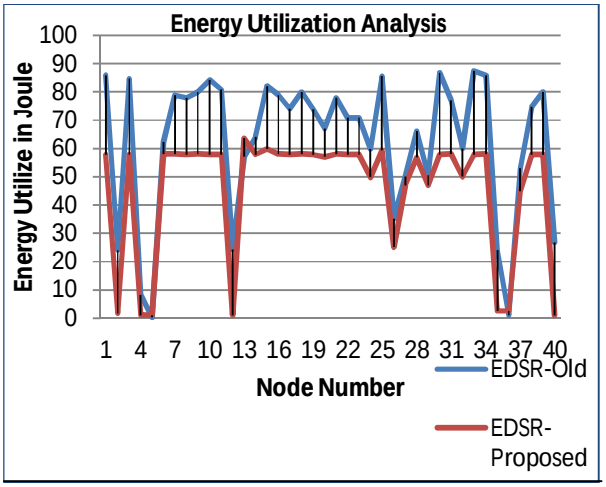

Figure 4: Energy Utilization Analysis

E: Remaining Energy Analysis in case of Old scheme and Proposed Scheme

This figure represents the initial and end energy of nodes in case of proposed E-DSR and previous E-DSR scheme. Here we best analyse the performance of both the routing protocol on the basis of initial and end energy of nodes. Now the figure 1 entries are clearly shown that the energy consumption of nodes in old scheme is more than in proposed case. we notice that the nodes has more end energy it means it will work some more time in network as compare to previous scheme.

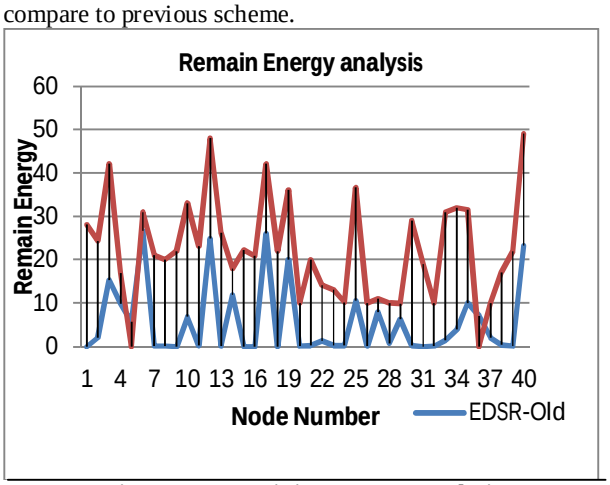

Figure 5: Remaining Energy Analysis

IX. CONCLUSION

Our proposed methodology under threshold base energy deterioration and maximum energy routing that provide reliable communication and provide energy of each node that work provide maximum data delivery in each session and increases the performance of the network like packet delivery ratio, throughput and minimize the end-to-end delay, will It will also gives each node's energy value, required transmission power and receiving power. Energy based routing protocol always gives accuracy of the result and also increases life time of the network. Many approaches have been proposed to deal with the idea of link breakage prediction, but the problem is that all the previous approaches were building a new route that avoids using only the same soon to be broken link, but no one of these approaches was able to build a new route which avoids all the other links in the old route. In this paper, a new approach for solving the problem of link breakages in MANET has been proposed and implemented on the Dynamic Source Routing (DSR) routing protocol. In this approach, the Received Signal Strength Indicator (RSSI) value will be used by a node along an active route to predict a link breakage in its link with its next hop to the source node of this active route. The node will warn the source node, and the source (if it still needs the route) will discover a new route without using any link from the current route which has a soon to be broken link. The idea behind this is to reduce the probability of constructing a route with bad links which can break during or directly after the constructing of a new route. It has been found that this approach was able to increase the packet delivery ratio and decrease both the packet loss and the end to end delay comparing to the DSR routing protocol. So, this approach was able to improve the performance of the protocol.

The sufficient energy of nodes and less consumption of energy by nodes in communication approach, order to maintain a connected topology of the network. The transmit power of a mobile node is controlled for the entire lifetime of the network. The idea behind this is to determine the best possible route between the source and the destination or finding the route that has a sufficient amount of energy which minimizes the power consumed during the transmission of packets along this route. The failure of a single node can significantly affect the performance of the ad hoc network as a whole. Again, the performance of the network greatly depends upon application specific parameter like nodes energy. The main aim of this research is the links in network are not broken due to insufficient energy of mobile nodes. We are not consider here bandwidth, location etc.

X.FUTURE WORK

As a future work, this work can be extended by using other metrics for making the comparisons between the original and modified DSR routing protocols such as the terrain size, packet size, packet sending rate, and others. Also, the traffic mode can be changed from CBR to VBR and find the difference. Another change can be made to the mobility model. In this work the mobility model that has been used is the random way point mobility model, so

another research can be done by using other mobility models such as the random walk mobility model, or the random direction mobility model, and see the difference.

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ACKNOWLEDGEMENT

It gives us a great sense of pleasure to present the report of the Master of Technology project undertaken during MTECH Final year. We own a special debt of gratitude to Er.Jitendra Kumar Gupta, (Asst. Professor) Department of computer Science and Engineering, College of Science and Engineering, Jhansi, for his constant support and guidance throughout the course of our work. His sincerity, thoroughness and perseverance have been a constant source of inspiration for us. It is only her cognizant efforts that our endeavours have been light of the day.

We also take the opportunity to acknowledge the contribution of Er.Jitendra Kumar Gupta (Asst. Professor and project coordinator) and Er.Deepak Bhatnagar (Asst professor and Head of the Department) of Computer Science and Engineering, College of Science and Engineering, Jhansi for their full support and assistance during the development of the project.

We also do not like to miss the opportunity to acknowledge the contribution of all faculty members and lab staff of the department for their kind assistance and cooperation during the development of our project.