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Energy Aware and Multipath base Reliable Communication in MANET

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ABSTRACT: In MANET (Mobile Ad hoc Network) nodes are battery operated with self-motivated network topology due to mobility of nodes. Therefore energy efficiency is an important design deliberation to extend the lifetime of networks. A critical issue in routing strategy design the MAX energy based multipath routing network apart from conventional ad hoc networks is energy conservation and prolonging network lifetime while maintaining connectivity. If the one path in normal energy based routing is break that causes the heavy packet loss because that kind of link breaks are occur suddenly or without any information and also neighbor are not aware about this kind of condition. To address this issue, we propose a multi-path MAX energy based routing scheme that reduces the congestion and improves the energy efficiency and the reliability in data delivery. In this scheme the multipath AOMDV protocol reduces the possibility of congestion by using the concept of dynamic queue and MAX energy based routing always selecting the node for routing that has maximum energy. Each data packet is delivered to the neighbor by one or more multiple paths according to proposed scheme. The balance among multiple paths that considers the energy usage at neighbors is further considered in path selection, which leads to efficient utilization of the relay nodes and prevents early death of heavily involved nodes. Simulation results show that proposed energy aware path selection, a more even MAX energy consumption among nodes is developed and leads to longer network life time.

Keywords**:** MANET, AOMDV, MAX Energy, Dynamic queue length

I. INTRODUCTION

Mobility and the lack of any fixed infrastructure make Mobile Ad-hoc Networks (MANETs) very gorgeous for new age applications. There are a lot of issues and challenges in designing a MANET network. At transport layer, end-systems can gather information about each used path: congestion state, capacity and latency. This information can then be used to react to congestion events in the network by moving the traffic away from congested paths [1].

There are a lot of issues and challenges in designing a MANET network. Because active topology structure and node change every second on its position, one of the measure challenges is congestion, in MANET if sender node want to send data into the some specific receiver so very first broadcast routing packet onto the network and get destination through the shortest path, if we apply AODV) [2] or minimum intermediate hop, if we use DSR [3] after getting path sender sends actual data through uni-path link but at the same time more than one sender share common link so congestion occur onto the network that is measure issue for MANET.

In multipath technique sender sends data through more than one path to receiver node that increases the performance of the network are control the single share path congestion after that we also analyze data rate of sender if sender rate greater than the receiver node so we minimize the sending rate on the bases of transport layer technique.

To answer those challenges, many routing algorithms in MANET. There are different dimensions to categorize them: proactive routing versus on-demand routing, or single-path routing versus multipath routing. In proactive protocols, routes between every two nodes are established in advance even though no transmission is in Demand and in reactive routing routes between every two nodes are established when needed. Figure 1 represents the ad hoc network, here first connection will established in between sender S and destination D then transfer data through intermediate nodes.

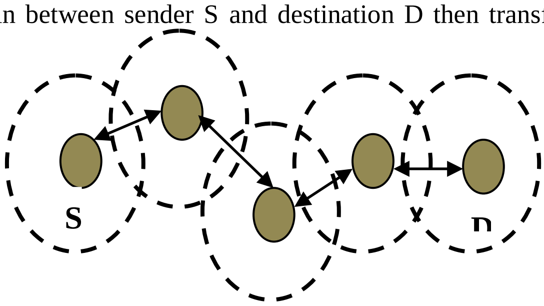

Fig. 1 Ad hoc Network

Our motivation is that congestion is a cause for packet loss in MANETs mostly packets will loss cause of congestion only. Our aim is to control congestion and enhance energy utilization in MANET.

II. PERSONALIZED SOCIAL SEARCH

Typically, reducing packet loss involves congestion control [4]. Congestion in routing in MANETs may lead to the following problems:

1. **Long delay:** It takes time for a congestion to be detected by the congestion control mechanism. In severe congestion situations, it may be better to use a new route. The problem with an on-demand routing protocol is the delay it takes to search for the new route.
2. **High overhead:** In case a new route is needed, it takes processing and communication effort to discover it. If multipath routing is used, though an alternate route is readily found, it takes effort to maintain multiple paths.
3. **Many Packet Losses:** Many packets may have already been lost by the time congestion is occurred or detected. A typical congestion control solution will try to reduce the traffic load, either by decreasing the sending rate at the sender or dropping packets at the intermediate nodes or doing both.

III. MULTIPATH ROUTING

Multipath routing has been explored in several different contexts. Traditional circuit switched telephone networks used a type of multipath routing called alternate path routing. In alternate path routing, each source node and destination node have a set of paths (or multi-paths) which consist of a primary path and one or more alternate paths. Alternate path routing was reposed in order to decrease the call blocking probability and increase overall network utilization.

AOMDV Procedure

The AOMDV uses the basic AODV route construction process. In this case, some extensions are made to create multiple link-disjoint paths. The main idea in AOMDV is to compute multiple paths during route discovery. It consists of two components:

- A route update rule to establish and maintain multiple loop-free paths at each node.
- A distributed protocol to find link-disjoint paths.

In AOMDV [5] each RREQ, respectively RREP arriving at a node defines an alternate path to the source or destination. Just accepting all such copies will lead to the formation of routing loops. In order to eliminate any possibility of loops, the “advertised hop count” is introduced. The advertise hop count of a node i for a destination node d represents the maximum hop count of the multiple paths for node d available at i. The protocol only accepts alternate routes with hop count lower than the advertised hop count, alternate routes with higher or the same hop count are discarded. The advertised hop count mechanism establishes multiple loop-free paths at every node. These paths still need to be disjoint. We use the following:

When a node S floods a RREQ packet the network, each RREQ arriving at node I via a different neighbour of S, or S itself, define a node-disjoint path from I to S.

In AOMDV this is used at the intermediate nodes. Duplicate copies of a RREQ are not immediately discarded. Each packet is examined to see if it provides a node-disjoint path to the source. For node-disjoint paths all RREQs need to arrive via different neighbours of the source. This is verified with the first hop field in the RREQ packet and the first hop-list for the RREQ packets at the node.

At the destination a slightly different approach is used, the paths determined there are link-disjoint, not node-disjoint. In order to do this, the destination replies up to k copies of the RREQ, regardless of the first hops. The RREQs only need to arrive via unique neighbours.

IV. PREVIOUS WORK

Various research works in that filed for minimization of congestion from network. In this section we focus on previous work that had done on this field.

This paper [6] developed an energy-aware congestion control algorithm for multipath TCP, called ecMTCP. ecMTCP moves traffic from the most congested paths to the more lightly loaded paths, as well as from higher energy cost paths to the lower ones, thus achieving load-balancing and energy-savings. The simulation results show that ecMTCP can achieve greater energy-savings compared to MPTCP, and preserve fairness to regular TCP.

The protocol EOCTC [7] is a cross layered and power conserved routing topology for congestion tolerance and control, which is an extension to our earlier cross layered and power conserved routing topology in short EOCC. The proposed protocol can be referred as Energy Efficient Ordered Congestion Tolerant and Control (EOCTC) Routing Topology. The experiment results emerged as an evidence for EOCTC performance and scalability. Better resource utilization, energy efficiency can be observed in data transmission and congestion tolerance achieved due to path restoration strategy and congestion control is effective.

Suresh Singh and C. S. Raghavendra [8] proposed the PAMAS protocol that uses two different channels to separate data and signaling. The Suresh Singh, Mike Woo and C.S. Raghavendra [9] presented several power-aware metrics that do result in energy-efficient routes.

The Minimum Total Transmission Power Routing (MTPR) [10] was initially developed to minimize the total transmission power consumption of nodes participating in the acquired route. The

Min-Max Battery Cost Routing (MMBCR) [11] considers the remaining power of nodes as the metric for acquiring routes in order to prolong the lifetime of network. C.K.Toh [11] presented the Conditional Max-Min Battery Capacity Routing (CMMBCR) protocol, which is a hybrid protocol that tries to arbitrate between the MTPR and the MMBCR.

The several multipath proactive routing protocols were developed. These protocols use table-driven algorithms (link state or distance vector) to compute multiple routes. But they do not consider the power aware metrics and these protocols generate excessive routing overhead and perform poorly because of their proactive nature. The on-demand routing is the most popular approach in the MANET. Instead of periodically exchanging route messages to maintain a permanent route table of the full topology, the on demand routing protocols build routes only when a node needs to send the data packets to a destination.

The standard protocols of this type are the Dynamic Source Routing (DSR) [3] and the Ad hoc On-demand Distance Vector (AODV) [2] routing. However, these protocols do not support multipath. The several multipath on demand routing protocols were proposed. Some of the standard protocols are the Ad hoc Ondemand Multipath Distance Vector (AOMDV)[5], the Split Multipath Routing (SMR) [12], the Multipath Source Routing (MSR) [13], the Ad hoc On-demand Distance Vector Multipath Routing (AODVM) [14] and the Node- Disjoint Multipath Routing (NDMR)[15]. These protocols build multiple routes based on demand but they did not consider the power aware metrics.

Recently several Energy Aware On-demand Multipath Routing protocols have been proposed. The Grid-Based Energy Aware Node-Disjoint Multipath Routing Algorithm (GEANDMRA) [16] considers energy aware and node-disjoint multipath**,** it uses grid-head election algorithm to select the grid-head which is responsible for forwarding routing information and transmitting data packets. The Ant-based Energy Aware

Disjoint Multipath Routing Algorithm (AEADMRA) [17] is based on swarm intelligence and especially on the ant colony based Meta heuristic.

The Multipath Energy-Efficient Routing Protocol (MEER) [18] prolongs the network lifetime by using a rational power control mechanism, the route discovery phase in which the source is finding energy-efficient routes is similar to that of SMR [12]. The Lifetime-Aware

Multipath Optimized Routing (LAMOR) [19**]** is based on the lifetime of a node which is related to its residual energy and current traffic conditions.

V. PROBLEM STATEMENT

Mobile ad-hoc network are work under dynamic topology base and same time multiple sender share a common path that is not avoidable of congestion from network so that work to motivate in the new innovative idea of congestion control method and we solve the problem of congestion, here we use multipath routing an bandwidth estimation (rate base) scheme and control the congestion through the network. MANETs lack fixed infrastructure and nodes are typically powered by batteries with a limited energy supply wherein each node stops functioning when the battery drains. Energy efficiency is an important consideration in such an environment. Since nodes in MANETs rely on limited battery power for their energy, energy-saving techniques aimed at minimizing the total power consumption of all nodes in the group (minimize the number of nodes used to establish connectivity, minimize the control overhead and so on) and at maximizing the life span should be considered.

VI. PROPOSED WORK

Steps by Step Explanation of Problem with its Solution

In MANET our major concern is on energy, that’s why first we discuss the different ways by which energy consumption can be done.

Energy consumption of the nodes can be done by:-

- Transmission Power (T_x)
- Receiving Power (R_x)
- Ideal Power
- Sensing Power
- Sleep (Power Consumption in sleeping mode)

Given example is showing energy consumption in MANET

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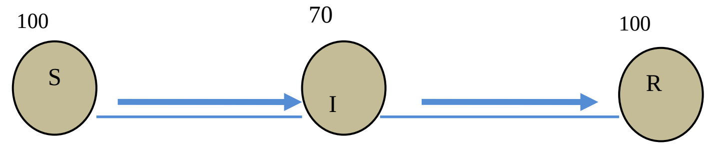

Fig. 2 Example showing energy consumption in MANET

Figure 2 shows an example, where **S** is a sender which wants to send data to the receiver **R** through the intermediate node **I**.

- (T_X) is the Transmission Power required to transmit a single packet
- (R_X) is the Receiving Power required to receive a single packet

Sender (S) needs only Transmission power (T_X) to send packet. Receiver (R) needs only Receiving power (R_X) to receive packet Suppose,

(R_X) = 1 Joule/Packet
(T_X) = 1.5 Joule/Packet

- **For Sender,**

Initial Energy (available Power) = 100 Joule
Power require to transmit 1 packet = 1 Joule

= 100/1
= 100 packets

- **For Receiver,**

Initial Energy (available Power) = 100 Joule
Power require to receive 1 packet = 1.5 Joule

= 100/1.5
= 66 packets

- **For Intermediate Node,**

Initial Energy (available Power) = 70 Joule
Intermediate node Receive and Transmit packets, so energy used by intermediate node per packet = ($R_X + T_X$)
= 1 +1.5
= 2.5 Joule/packet g

= 70/2.5
= 28 packets

From the above calculation it is clear that,

1) Sender can send 100 packets
2) Receiver can receive 67 packets
3) Intermediate node can forward 28 packets

Energy after transmission of 1 packet,
1) For Sender = total - =100-1
= 99 Joule

Above equation gives the remaining energy after transmission of the packets after the transmission time (**Time**) for Sender, Receiver and Intermediate node respectively.

We had discussed the threshold value based scheme and Max energy value based scheme which works well for best path selection. But both of these schemes have some disadvantages and in some of the cases it will get fail. So, we need some scheme which works well in all scenarios and in this section we are providing one scheme which uses advantages of both this scheme as well as advantages of AOMDV algorithm and Max min scheme for selection of best path. Our proposed scheme is a combination of,

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AOMDV algorithm (for alternative path selection)
+
Maximum energy value based scheme.

This scheme will always give the best path for lifetime maximization and solve the problems and disadvantages of the other scheme .It works well in all scenario and always gives the selection of best path.

A. WORKING OF THE PROPOSED SCHEME

For the given network topology ,when some node wants to send packets to another node .It will first find all possible path between sender and receiver using AODV algorithm now we can transmit packets using any path but our objective is to select the best path for lifetime maximization. That's why first applying the threshold value based scheme and filtering out the path who's any of the node have energy value less than the threshold value. Now, next step is to calculate average energy value for the each available path and selecting the path which will have the maximum average energy value as well as Max-min energy for each path. Means the path is selected as the best path which has maximum average energy value as well as max-min energy value from the remaining path for lifetime maximization.

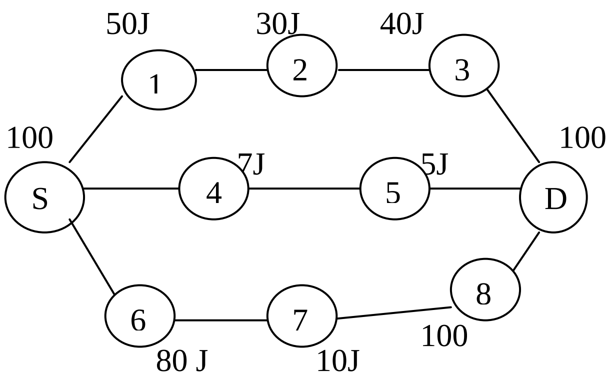

Fig. 3 Example showing the new proposed scheme

Now we will explain how this scheme works by using above example figure 3
Path 1= S-1-2-3-R
Path 2= S-4-5-R
Path 3 =S-6-7-8-R
After finding all possible number of paths, 1 step is to apply threshold value based scheme.
For the threshold value α=10, all nodes of Path 3 and Path 4 will pass (because they have energy value > α) but Path 2 will be discarded because node 4 & 5 has energy value less than threshold Value. Now, we have Path 1 and Path 3 remaining. Now applying MAX energy value scheme.
For Path 1 average energy = (50+30+40)/3
= 120 / 3
= 40 Joule
For Path 3 average energy = (80+10+100)/3
= 190 / 3
= 63 Joule

- Now, we will also apply Max-Min energy scheme before selecting any path based on average energy value based scheme.
- For Path 1, Node 1= 50 J, Node 2= 30 J, Node 3= 40 J Minimum energy node for Path 1 is 30 J for node 2. So, number of minimum packets that can be transferred using path 1= 30 /2.5 = 12 packets (means 12 second of lifetime).
- For Path 3,

Node 6= 80 J, Node 7= 10 J, Node 8= 100 J Minimum energy node for Path 2 is 10 J for node 7. So, number of minimum packets that can be transferred using path 3= 10 /2.5 = 4 packets (means 4 second of lifetime).

So Max energy based scheme will select the Path 1 because it has maximum of minimum energy value (e.g. 30 J) which is the best Path with the maximum lifetime of 12 seconds. Though the Path 3 has greater average energy value than Path 1 it is not selected because it is not giving us the maximum lifetime (e.g. lifetime of Path 3 is 4 seconds only).

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VII. SIMULATION AND RESULTS

NS2 is an open-source event-driven simulator designed specifically for research in computer communication networks. The simulator we have used to simulate the ad-hoc routing protocols in is the Network Simulator 2 (ns) from Berkeley [20].

A. SIMULATION PARAMETER

Table 1 are represents the following simulation parameters to make the scenario of routing protocols. The detailed simulation model is based on network simulator-2 (ver-2.31) [20], is used in the evaluation. The NS instructions can be used to define the topology structure of the network and the motion mode of the nodes, to configure the service source and the receiver etc.

Table 1 Simulation parameters will uses for simulation

Simulator Used	NS-2.31
Number of nodes	40
Dimension of simulated area	800m×600m
Routing Protocol	AOMDV
Simulation time	100 sec.
Traffic type (TCP & UDP)	CBR (3pkts/s)
Packet size	512 bytes
Number of traffic connections	5,30
Node movement at maximum Speed	random (20 m/s)
Transmission range	250m
Transmission Energy	1.5 Joule
Receiving Energy	1 Joule
Ideal Energy	.01 Joule
Sense Power	.175 Joule

B. PERFORMANCE PARAMETER

There are following different performance metrics have been considered to make the comparative study of these protocols through simulation.

1) Routing overhead: This metric describes how many routing packets for route discovery and route maintenance need to be sent so as to propagate the data packets.

2) Average Delay: This metric represents average end-to-end delay and indicates how long it took for a packet to travel from the source to the application layer of the destination. It is measured in seconds.

3) Throughput: This metric represents the total number of bits forwarded to higher layers per second. It is measured in bps

4) Packet Delivery Ratio: The ratio between the amount of incoming data packets and actually received data packets.

Results

This section represents the results that have to be measure on the basis of simulation parameters and performance matrices.

C. *UDP PACKETS RECEIVES ANALYSIS*

This graph represents the analysis of User Datagram Packets (UDP). The behaviour of UDP connection is not deliver any acknowledgement after receiving data successfully and also is case of data drop, by that the graph of UDP packets are shown in continuous manner. Here the energy efficient routing with MAXIMUM energy based is proposed to increases the network life and energy utilization of nodes. The multipath protocol is used here for avoiding the condition of congestion also based on random queue length method. Now in case of normal multipath routing with energy about 1100 packets are deliver in network but in case of proposed MAXIMUM energy based routing more than 1200 packets are deliver in network. Now at time between 30 sec. to 60 sec. less number of packets are deliver as compare to previous scheme because of selecting reliable route but the packet loss in case of previous is more as compare to proposed scheme shown in figure 5.

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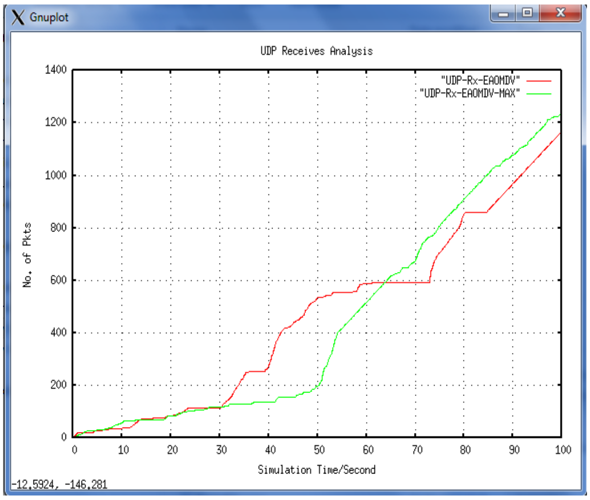

Fig. 4 UDP packet receive analysis.

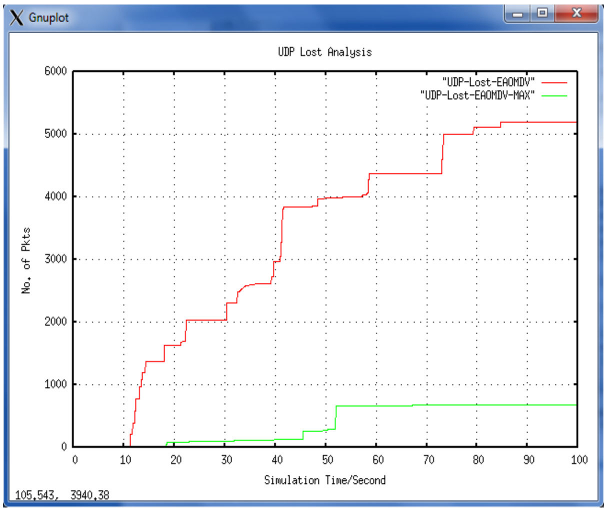

Fig. 5 UDP packet loss analysis

D. UDP PACKETS LOST ANALYSIS.

User Datagram Protocol (UDP) are showing in figure 5 are the reliability of network because this protocol is not reliable for communication for that this protocol is completely depend on network conditions. There are many different region of packet dropping like congestion collision etc. Now this graph represents the packet loss in case of previous and proposed MAXIMUM energy based routing. Here in case of previous scheme more than 5000 packets are drop in network; this one is the huge amount of loss. But in case of proposed scheme MAXIMUM energy based selection of nodes and handling the load on each node on applying varying queue length method only about 700 packets are drop in network by that the performance and utilization of energy are increase in network.

E. PACKET DELIVERY RATIO

Packet Delivery Ratio (PDR) is one of the important performance parameter to measure the performance of network. This graph represents the performance of both the schemes in term of PDR. The performance of proposed scheme is much better as compare to previous scheme. Due to the huge loss of packets in network the performance of previous scheme are degraded, here the PDR is about 50% but in case of proposed schemes we include the factor of packet loss on the bases of queue length estimation, that is not include in previous scheme by that proposed MAXIMUM energy based scheme gives the PDF of about 90%. The performance of network in term of PDF are represents the big gap, it is about of the difference of 40 %. It means the performance of network is increases as compare to previous scheme.

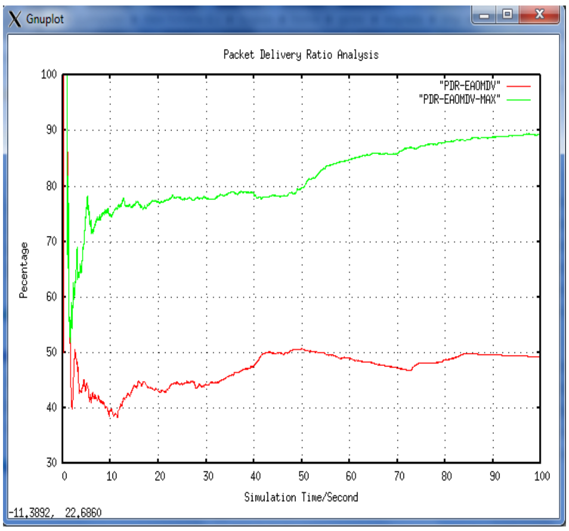

Fig. 6 Packet Delivery Ratio Analysis

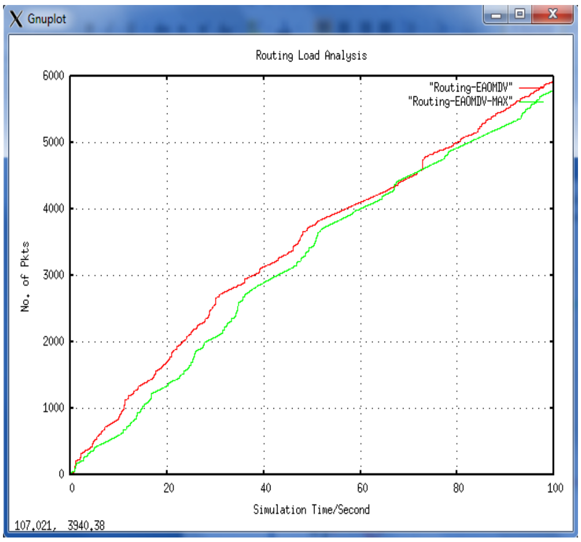

Fig. 7 Routing load analysis

F. ROUTING LOAD ANALYSIS

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This figure 7 represents the analysis of number of connection establishment or routing packets are delivering in network. The routing packets are delivering in network for established connection in between sender to destination after that the delivery of data packets started to deliver in between sender and receiver. Here in case of previous work and proposed work the routing packets are deliver in network are almost equal means slightly difference in routing packets. But here the successful packet delivery in case of proposed MAXIMUM energy based scheme is more as compare to previous scheme. It means that in equal number of routing packets the performance of proposed scheme is better and it also takes the advantage of flooding packets in network.

VIII. CONCLUSION AND FUTURE WORK

Recharging or replacing batteries will often not be possible. This makes the study in power-aware routing critical. The dispute in ad hoc networks is that even if a host does not communicate on its own, it still normally forwards data and routing packets for others, which reduces its battery. In this paper, proposed multi-path routing scheme constructs multiple paths from each node to reduce the possibility of congestion. Each data packet is delivered to the number of nodes or neighbor using one of the paths and established minimum more than two paths. The proposed energy based multipath path selection algorithm provides a MAX energy path that spending among nodes which therefore maximizes the network lifetime. The MAX energy spending will reduce the amount of energy consumption which is usually given to other nodes that follow the routing procedure to establish the route on the bais of MAX energy selection basis. The performance is enhanced in term of performance metrics that proves that the performances of proposed scheme are better than compared scheme.

Further, the balance among multiple paths based on the energy usage at neighbors is considered in the selection of the path. The multi-path and energy aware multi-path scheme show great potential in efficiently using the communicating nodes and evenly reduces energy consumption and providing optimal path.

In future we apply proposed scheme with any location aware protocol like DREAM or LAR and analyses the effect of location aware protocol on energy consumption and also apply the energy efficient routing scheme in WIMAX technology to find the proper energy consumption on it.

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