# NODE ENERGY AWARENESS IN MOBILE AD-HOC NETWORK

[1]Praveen Sharma, [2]Amit Sinhal, [3]Sanjay K. Mishra
[1]Mtech Scholar, [2]Prof. and Head, [3]Asst. Professor
[1]Department of Information technology,
[1]TIT, Bhopal, India

***Abstract— Wireless ad-hoc networks are power constrained since nodes operate with limited battery energy. If some nodes are die early due to loss of energy, they cannot communicate with each other. Energy efficient routing scheme deals with efficient utilization of energy resources. By regulating the early reduction of battery, adapt the power to set the appropriate energy level of a node and consolidate the minimum energy policy into the protocols used in various layers of protocol stack. In fact, nodes residual energy utilization after threshold should be increase the energy utilization of networks. In this paper alert mechanism for node energy awareness is proposed. In this mechanism, To enhance lifetime of nodes in the network when nodes periodically consume or rely on battery power during the transmission proposed approach decides limit of remaining battery power of nodes. When nodes battery power reach to the limit they stops additional events such as participation in routing or forwarding of other nodes data. In this case, node involves only own transmission rather than others.***

***Keywords— MANET, DSR, Energy Consumption, PDR, AODV, Routing Protocols.***

## I. INTRODUCTION

An ad hoc network is novel category of wireless network in which set of mobile devices are communicated in limited transmission range. An ad hoc network does not use centralized administration such as cellular network. It ensure that the network will desist functioning just because one of the nodes are travels out of the range of other . Nodes should be able to enter and leave the network as they wish [1]. Because of the defined transmitting range of the nodes, multiple hops are generally needed to reach other nodes. The topology of ad hoc networks varies with time as nodes move, join or leave the network. This topological instability requires a routing protocol to run on each node to create and maintain routes among the nodes. Mobile ad-hoc networks can be deployed in areas where a wired network infrastructure may be inadmissible due to reasons such as cost or convenience.

## II. LITERATURE SURVEY

Several techniques have been developed to address the energy efficiency issues in ad hoc networks. limitations. The problem of maximizing the network lifetime of a MANET, i.e. the time period during which the network is fully working. they presented an original solution called EPAR which is basically an improvement on DSR[1]. the authors explore power-aware metrics to use with routing protocols on top of their MAC power savings protocol [2], PAMAS [3], They indicate that the strategy followed by the different routing protocols that are not power conscious would lead to fast depletion of battery power and hence quick degradation of the network operation. In their simulations, the authors used sparsely populated networks and they did not consider mobility in their simulations. Their reason behind not using mobility is that the evaluation is done for power management and not routing.

In our view, mobility has a considerable effect on the performance of power efficient mechanisms. The authors do not seem to have considered idle energy consumption in their simulations either. The authors show an added improvement of 5-15% on top of what PAMAS offers. The results also show that the improvements are best when the load conditions are moderate and are negligible in case of low or high load conditions.

**Power-Aware Routing Protocol**

A power-aware routing protocol that distributes power consumption evenly over nodes and minimizes the overall transmission power is proposed[4]. The authors propose route selection mechanisms for routing protocols based on a new metric, the drain rate[5]. They propose the Minimum Drain Rate (MDR) mechanism which incorporates their new metric into the routing process. They also introduce the Conditional Minimum Drain Rate (CMDR) as MDR by itself does not guarantee that the total transmission energy is minimized over a given route.

- CDMR attempts to enhance the nodes and connections lifetime while minimizing the total transmission energy consumed per packet.
- Each node monitors the energy consumption and calculates the drain rate (DR).

The route is then chosen based on the highest lifetime value of the different paths where max lifetime of a path is calculated as the minimum value of the cost function over the path. Due to variations in energy drain rate over time,

The Conditional MDR (CMDR) chooses a path with minimum total transmission energy among all paths constituted by nodes with a lifetime higher than a certain value. When no route matches this condition, MDR is used. The authors used the DSR routing algorithm [9] to implement their algorithm. They used the energy model of with modifications to the parameters. They did not include some of the model's elements and they did not include the idle energy in their calculations of the drain rate. Instead of idle energy, they included energy consumed in overhearing only. We consider this to be a source of significant inaccuracy in their method that would affect the results especially in the case of sparse networks. Amongst other modifications to the DSR algorithm.

localized power aware routing algorithms are devised on the assumption that each network node has accurate information about the location of its neighbors and the destination node[6]. Nodes exchange location information via control messages. Three algorithms are proposed: power-efficient routing, cost-efficient routing and power-cost efficient routing algorithms.

**Power-Efficient Routing Algorithm**

In the power-efficient routing algorithm, each node decides to forward packets that are intended for a certain destination to a neighbor based on the minimum transmission power between this sending node and its neighbors.

**Cost-Efficient Routing Algorithm**

In the cost-efficient routing algorithm, the node chooses the neighbor to send to, if the destination is not within reach, based on a cost function that can consist, for example, of the sum of the cost of sending to this neighbor plus the estimated cost of the route from the neighbor up to the destination. This latter part of the cost is assumed to be proportional to the number of hops in between.

**Power-Cost Efficient Routing Algorithm**

The power-cost efficient routing algorithm uses a combination of the two above metrics, in the form of either the product or the sum of these metrics. The authors ran their experiments on networks with high connectivity.

In their evaluation, the authors showed all their methods to have limited success with large area sizes. Therefore, they modified them to get nodes to forward to neighbors only if they are closer to destination. This increased delivery rate to around 95% from highest of 59% before modification. Their results showed that nodes with the cost-efficient and power-cost efficient methods last longer than with the power-efficient method. And of all methods, the power-cost routing methods provide highest energy savings.

Selecting the transmission path dynamically through regular updating of pheromone of transmission path expects to improve routing performance[7]. RREQ message packets can be termed as pheromone in terms of standard algorithm of ACO used by the ants[8].

## III. PROBLEM DEFINITION

The nodes in an ad hoc network are constrained by battery power for their operation.

In ad-hoc network each node has limited battery power and every power sources have a limited lifetime. Power availability is one of the most important constraints for the operation of the Ad hoc network. Every node consume amount of energy for per transmission of data. Note that each message transmission and reception drains battery power [9]. If a node drains its energy and is unable to forward any message, it moves out of the network. In this case, the route is brake and routing protocol finds an alternate route via another route discovery. However, nodes dying such as this adversely affect the operational life time of ad hoc network. Firstly where the dying nodes will communicate with end points will fail. Secondly, even when the dying nodes are not the communicating end points, network connectivity will become sparser and network partition becomes more likely.

Nodes in the ad-hoc network consume battery power during the transmission and amount of periods the battery power of node is drains out that makes the probability of data loss, interrupt transmission and causes network partitions. To overcome or resolve those problem several techniques is advised with routing protocol. These technique aware or inform about the energy power of each node in the network during the discovery of routes. Some more additional approaches are suggested for efficient routing with power awareness and improving lifetime of network.

## IV. PROPOSED SOLUTION

Power consumption during communication between nodes is mainly due to transmit-receive module. Whenever a node remains alive, energy gets consumed at the time of transmission and reception of packets. Even when the node is not actively participating in communication, but is in the listening mode waiting for the packets, the battery keeps discharging[26]. The computation power indicates that the power spent in calculation takes place in the nodes during routing and power adjustments.

To solve the data loss problem due to node battery depletion, an approach named as remaining battery power acknowledge is proposed. To enhance lifetime of nodes in the network when nodes periodically consume or rely on battery power during the transmission proposed approach decides limit of remaining battery power of nodes. When nodes battery power reach to the limit they stops additional events such as participation in routing or forwarding of other nodes data. In this case, node involves only own transmission rather than others. In the proposed approach to enhance lifetime of nodes as well as network that influence due to lack of knowledge about battery depletion of nodes. Proposed approach has also motive to transmission of data by themselves rather than other nodes transmission if battery of these reach to limit. The proposed approach works by deciding limit of battery power of node to stop additional transmission. The value of limit of battery power treat as alert signal for the nodes for involving these in additional communication or not. If nodes battery reach at limit then nodes only do these own transmission rather than others.

.

. These all the things defined in below algorithm.

```
Algo BPA(N[], BP[])
N[], BP[], is array of nodes and battery power
{
 Declare Sbp=0.8J ,Rbp=0.5J, Fbp=0.3J, Dbp=0.2, Sbp=0.1J;
 Declare i, j, B_LIMIT=0.8J , B=100J;
     Repeat i to N
     {
        BP[i]=B;
     C:  If ( N[i]->Send(D, N[j]))
            BP[i]=BP[i]-Sbp;
          Else If ( N[i]->Recieve(D, N[j]))
            BP[i]=BP[i]-Rbp;
           Else If ( N[i]->Forward(D, N[j]))
              BP[i]=BP[i]-Fbp;
           Else If ( N[i]->Drop(D))
               BP[i]=BP[i]-Dbp;
             Else
```

```
            BP[i]=BP[i]-Sbp;
      IF (BP[i]==B_LIMIT)
       {
          Alert (N[i]);
        }
     Else
 Continue  C;
   }
```

## V. RESULT ANALYSIS

We get Simulator Parameter like Number of nodes, Dimension, Routing protocol, traffic etc.

According to below table 5.1 we simulate our network.

| | |
|---|---|
| Number of nodes | 100 |
| Dimension of simulated area | 800×600 |
| Initial node energy ( joules) | 100 |
| Threshold value(joule) | 25 |
| Minimum threshold value(joule) | 1 |
| Simulation time (seconds) | 150 |
| Radio range | 250m |
| Traffic type | CBR, 3pkts/s |
| Packet size (bytes) | 512 |
| Number of traffic connections | 4, 30 |
| Maximum Speed (m/s) | 35 |
| Node movement | Random |
| Tx energy consumption | 1.5J |
| Rx energy consumption | 1.0J |

The performance of proposed approach is evaluated by considering of various network parameters such packet delivery ratio, throughput, routing overhead, remaining enrgy etc.

Packet Delivery Ratio

Packet Delivery Ratio is a ratio of number of received packets from number of sent packets by sender. We formulize this as

$$PDR = \left(\frac{Rx}{Send}\right) * 100$$

If packet delivery ratio is higher it means our performance is best. Updated energy mechanism gives better PDR as compare to the previous energy mechanism till the end of simulation shown in fig 5.1

.

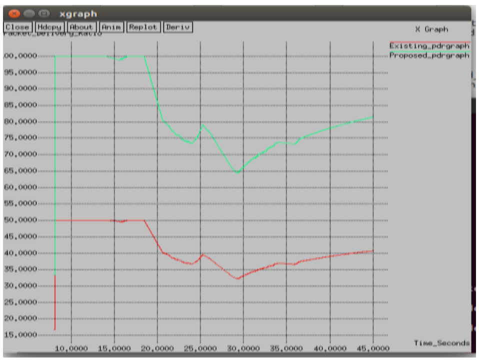


Fig 5.1 Packet Delivery Ratio Comparison

Routing Load Comparison

Routing load is the one of the most important factor of analysis. Here we clearly see that routing load in normal case are nearly equal as compared to energy update case because in normal case nodes are lost their energy and the energy of all the nodes are random then if two or three nodes are lost their energy out of fifty then communication is only possible among less than fifty number of nodes then more number of routing packets are transmitted for connection establishment. But in energy update case after threshold value each node will generate their energy means routing load is less.

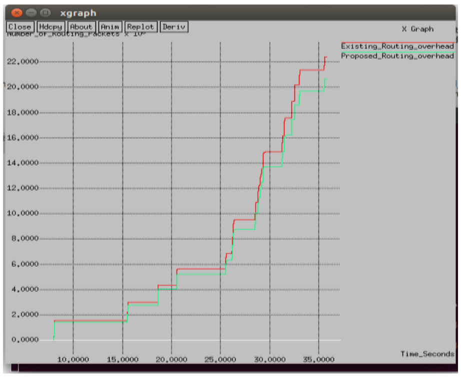

Fig 5.2 Routing Load Comparison

Remaining Energy and Throughput

Figure 5.3 A and B show the remaining energy of each node in the network after implementing proposed energy. Remaining energy represents with respect of node number in x title and energy in joule in y title.

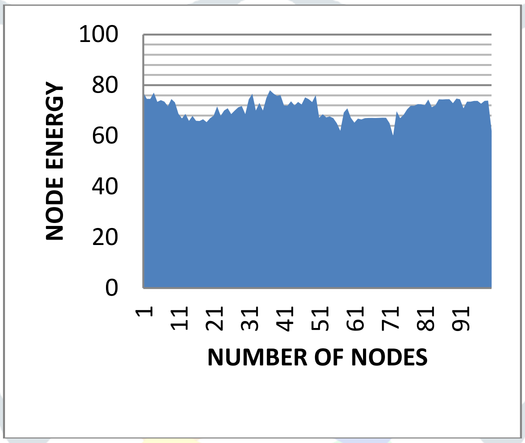

Fig 5.3 A- Proposed Remaining node energy

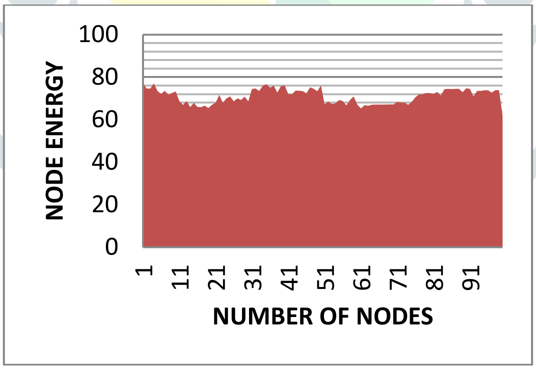

Fig 5.3 B- Existing Remaining node energy

| Number of Nodes | Average Throughput (Existing) | Average Throughput (Proposed) |
|---|---|---|
| 25 | 274 | 348.07 |
| 50 | 641 | 1055.3 |
| 75 | 689 | 803.6 |
| 100 | 686 | 866 |

Table 5.2 Average throughput comparison between existing and proposed approach

| Number of Nodes | Average Throughput (Existing) | Average Throughput (Proposed) |
|---|---|---|
| 25 | 80.922 | 97.040 |
| 50 | 71.942 | 89.806 |
| 75 | 70.678 | 88.843 |
| 100 | 70.217 | 85.217 |

Table 5.3 Average remaining energy- comparison between existing and proposed approach

## VI. CONCLUSION

Node energy is precious resources in mobile ad hoc network, network operation periods affected by power dissipation ratio of nodes. Battery power consumption depends on load of nodes because intermediate nodes work as routers which are receive data from downstream and send to upstream nodes. So this reason battery power of intermediate nodes is drained out earlier as terminal nodes. The power of intermediate nodes is drained out earlier then network partitioned and short communication periods occurred. Proposed mechanism minimized the dissipation of battery power of nodes that enables nodes to send prior data and alert about power status of nodes to discover new alternative ways. Proposed mechanism improved communication periods and minimize network partitioned.

## REFERENCES

**[1]** Forman G, Zahorjan J, "The challenges of mobile computing. IEEE Computer 1994" Vol. 27 Issue 4, pp 38-47,1994.
**[2]** Perkins C, "Ad Hoc Networking", Addison-Wesley, pp 1-28, 2001
**[3]** N. Vassileva, F. Barcelo, “A Survey of Routing Protocols for Maximizing the Lifetime of Ad Hoc Wireless Networks,” International Journal of Software Engineering and Its Applications, Vol. 2, No. 3, pp. 77-89, 2008
**[4]** S. Singh, M. Woo, C. Raghavendra, “Power-aware Routing in Mobile Ad Hoc Networks,” ACM Mobile Computing and Networking Conference, Dallas, Texas, pp. 181-190, 1998
**[5]** [10] C. Toh, “Maximum Battery Life Routing to Support Ubiquitous Mobile Computing in Wireless Ad Hoc Networks,” IEEE Communications Magazine, pp. 2-11, 2001.
**[6]** L. M. Feeney and M. Nilsson, “Investigating the Energy Consumption of a Wireless Network Interface in an Ad Hoc Networking Environment,” IEEE INFOCOM 2001, Vol. 3, pp. 1548-1557, 2001
**[7]** V. Rishiwal, M. Yadav, S. Verma, S. K. Bajapai, “Power Aware Routing in Ad Hoc Wireless Networks, Journal of Computer Science and Technology, Vol. 3 Issue 6, pp. 1548-1557, 2005.
**[8]** Chintan kanani, Amit sinhal, "Ant Colony Optimization based Modified AOMDV for Multipath Routing in MANET", International Journal of Computer Applications, Vol .82, Issue 10, 2013.
**[9]** P. Misra, “Routing Protocols for Ad Hoc Mobile Wireless Networks”, 2006.
**[10]** Morteza Maleki, Kartik Dantu, Massoud Pedram “Life Time Prediction Routing in MANET”, Wireless Communications and Networking (WCNC), IEEE, pp. 1185-1190, 2005.
**[11]** D. Kim, J. J. Garcia-Luna-Aceves, K. Obraczka, J.-C Cano and P. Manzoni, “Routing Mechanisms for Mobile Ad Hoc Networks Based on the Energy Drain Rate”, IEEE Transactions On Mobile Computing, Vol. 2, Issue 2, pp 161-173, 2003.
**[12]** Eunkyu Lee, Minsoo Kim, ChansuYu, Myungchul Kim “Node Alarm Mechanism for Energy Balancing in Mobile Ad hoc Network”, Mobile Computing and Networking (Mobicom), pp. 85-96, 2002.
**[13]** C. K. Toh, “Maximum Battery Life Routing to Support Ubiquitous Mobile Computing in Wireless Ad Hoc Networks”, IEEE Communications Magazine, pages 2-11, 2001.
**[14]** David B. Johnson, David A. Maltz, Josh Broch, “DSR: The Dynamic Source Routing Protocol for Multihop Wireless Ad Hoc Networks”, in Ad Hoc Networking, edited by Charles Perkins, Addison-Wesley, pages 139 -172, 2001.
**[15]** S. Singh, M. Woo, and C. S. Raghavendra, “Power-aware Routing in Mobile Ad Hoc Networks”, ACM Mobile Computing and Networking Conference, Dallas, Texas, pages 181-190, 1998.
**[16]** C.S. Raghvendra and Suresh Singh, “PAMAS – Power Aware Multi-Access protocol with Signaling for Ad Hoc Networks”, ACM Computer Communications Review, Vol. 28, Issue 3, pages 5-26, 1998.
**[17]** Network Simulator- ns-2. http://www.isi.edu/ nsnam /ns/
**[18]** Shivashankar, Golla Varaprasad, Suresh Hosahalli Narayanagowda, “Implementing a new power aware routing algorithm based on existing dynamic source routing protocol for mobile ad hoc networks”, IET Networks, vol. 3, Issue 2, pp. 137-142, 2014.
**[19]** Alok Kumar Jagadev, Binod Kumar Pattanayak, Manoj Kumar Mishra, Manojranjan Nayak, " Power and Delay Aware On-Demand Routing For AdHoc Networks", (IJCSE) International Journal on Computer Science and Engineering. Vol.2, Issue 4, pp. 917-923. 2010.
**[20]** N. Carlson, D. L. Eager, "Non-Euclidian geographic routing in wireless networks" Ad-Hoc Networks. Vol. 2, Issue 7, pp 1173-1193, 2007.
**[21]** Abhishek Samanta, Dripto Bakshi,"Fault Tolerant Wireless Sensor MAC Protocol for Efficient Collision Avoidance", International journal on applications of graph theory in wireless ad hoc networks and sensor networks (GRAPH-HOC). Vol. 2, Issue 2, 2010
**[22]** N. Meghanathan, "Energy Consumption Analysis of the Stable Path and Minimum Hop Path Routing Strategies for Mobile Ad hoc Networks", International Journal of Computer Science and Network Security,, Vol. 7, Issue 10, pp 30-39, 2007.
**[23]** Divya Sharma, Ashwani Kush, "Power and Mobility Aware Protocol for Ad Hoc Network", IACSIT International Journal of Engineering and Technology. Vol. 3, Issue 2, 2011.
**[24]** Siva Rama Murthy, B S Manoj, "AdHoc Wireless Network Arcitectures and Protocols",Pearson Publication, 2007.
**[25]** Rekha Patil, Ashwini.D, " Cross Layer Design for P2P Overlay Network over MANET", International Journal of Emerging Technology and Advanced Engineering, Vol. 2, Issue 9, 2012.
**[26]** Chintan kanani, Amit sinhal, "Ant Colony Optimization based Modified AOMDV for Multipath Routing in MANET, International Jouranal of Computer Applications, Vol. 82, Issue 10, 2013.