Routing Algorithm For Power Awareness In MANET

Dave Yogeshkumar Mukundray [1] Amit R. Sharma[2]
[1] P.G. Stdudent, Department of Electronics and Communication Engineering
[2]Associate Professor and Head, Faculty of Engineering, Shree Saraswati Education Sansthan's Group of Institutions,
Rajpur-382740, INDIA

Abstract--- In Mobile Ad hoc networks (MANETs), portable mobile nodes communicate directly with each other without any central infrastructure. In the absence of central infrastructure, a node establishes communication network and act as router as well. Nodes are battery operated and mobile hence network topology changes frequently.

In MANET, resources are limited. Battery power of the node is one of the important resources. Ad hoc On demand Distance Vector AODV is a reactive protocol which establishes the network connection when needed. When any node has some data for communication, AODV protocol will establish the route. In AODV, route breaks when nodes run out of battery power. Purpose of this work is to maximize the network lifetime by avoiding the routing through nodes with less battery power. Routing will be through the nodes with sufficient battery power.

Power aware routing algorithm is developed and simulated using NS-2. Further more we have compared the results with conventional AODV and demonstrated that remaining battery energy of the nodes increases.

Keywords:
AODV, Power aware routing Mobile Ad hoc Networks, Network lifetime

I. Introduction

A mobile ad-hoc network (MANET) consists of a group of autonomous mobile wireless nodes distributed in a bound area

forming a temporary (ad-hoc) network with none infrastructure. Therefore each node may have to be compelled to function the intermediate node to relay the packets between a pair of nodes geographically far enough. Any failure of node could lead to disconnection between a pair of communicating nodes.

The recent fast development of mobile communications led to variety of commercial applications of ad-hoc networks. Building such ad hoc networks poses a significant technical challenge as a result of the numerous constraints imposed by the surroundings. Thus, the devices employed in the field must be lightweight. Furthermore, since MANET devices are battery operated, they need to be energy preserving in order that battery life is maximized. Recent studies have stressed the requirement for designing protocols to make sure longer battery life.

Battery power is one of the crucial factors that needs to be researched as network life time, network route continuity, data transmission distance etc are dependent on the battery capacity of the nodes in MANET.

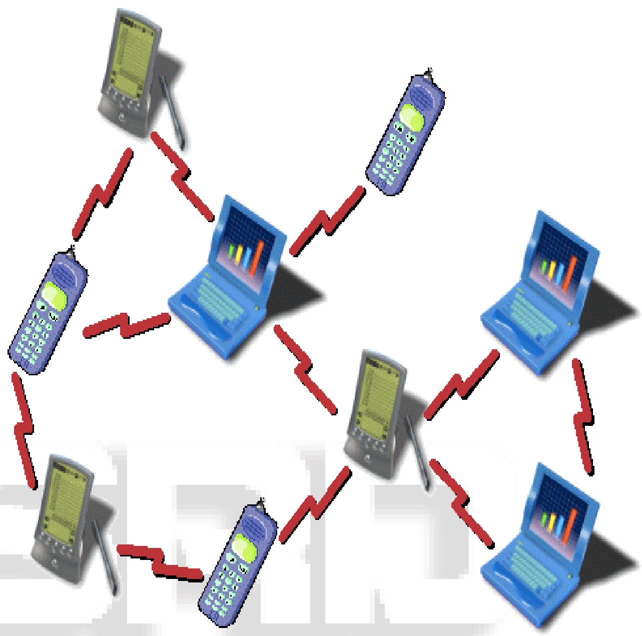


Figure 1: MANET

If the nodes are run out of battery power the link brakeage, link failures will occur and nodes needs to find new alternative path and retransmit the information, which will cost even more in terms of energy required. Hence in order to get better network lifetime by means of providing stable, sufficient energy links to avoid link failures and retransmission, we are proposing the algorithm and trying to optimize conventional AODV routing algorithm for MANET to be power aware by considering minimal energy path based on residual energy of a nodes. Section 2 presents some of the existing works. Outline of the proposed model is presented in section 3. Experimental setups are presented in section 4. Section 5 presents the results of the proposed model. Conclusions and further work are presented in section 6.

II. Existing Work

[2] Presents an energy level based routing protocol-ELBRP. The main idea function of ELBRP is, when a node receive a request packet, it will hold the packet and for the period of time which is inversely proportional to its energy level. This implies, the higher the energy level of a node, the shorter the delay time it will hold the packet. After the delay time period, the node will send the request packet to its neighbours.

One more mechanism is added that each node accepts only earlier request packet and discards later duplicate requests which most likely will ensure that the request from node with higher energy level will be received first and processed and request from lower energy will be received later on will be discarded. In [8] proposed a model called a power-aware routing algorithm for MANET using gateway node. It is assumed that Gateway node has enough power to transmit the packets. When the source node wants to send packet, it will send it to nearby Gateway node and then gateway node will send the packet to destination node. In [10], Authors have presented a unique power-aware routing algorithm based on mobile agents. A couple of mobile agents move in the network and communicate with every node. They collect the network information of remaining battery life, neighbouring node, and agent visiting history etc to create the global information matrix of nodes. The routing algorithm then chooses a shortest path if all nodes in all possible routes have enough battery capacity. The proposed algorithms in [4] adapt the existing AODV routing protocol to select the optimal route based on the basis of the maximum energy of each route. The proposed algorithm selects the minimum cost and highest energy path. In [3], Authors have stated that there are two main ideas of energy saving routing algorithm for Ad hoc routing protocols:

1. The first one is to send each packet with minimum energy consumption.
2. The second is to maximize the network lifetime as much as possible.

EA_AODV Algorithm proposed in [3] avoids invalid routing discovering, reduces the probability of link breaking after routing is discovered, and protects low-energy nodes, achieves longer network lifetime and minimizes network energy consumption compared to the traditional AODV protocols. In [13], proposed a scheme to reduce the energy consumption in route maintenance. The route is created locally with the neighbouring highest energy node of the upstream node. If the link breaks, the upstream node sends the local route request LRREQ to the neighbouring nodes and link will be created locally with highest energy node. In [14], Threshold values of these parameters are used to decide in forwarding of RREQ at each intermediate node. Nodes calculate the accumulated energy AE and accumulated path stability APST, update the header and forward the RREQ. At the destination the RREQs are received only for time t as per timer set and find the minimum objective values and RREP is sent to source node. In [14] local link maintenance is used which “makes before breaks”. Here if the nodes battery is about to drained down it will send the HLP messages to neighbouring nodes, nodes will reply with energy levels and the highest energy node will be selected and data packet routing will start via new link.

III. PROPOSED ALGORITHM

We are proposing below algorithm for AODV to be power aware. There are mainly two parts in algorithm sender and intermediate nodes during route request phase. And second phase is at destination node which will decide the routing path from all received RREQs.

```
Sender()
  {
 In RREQ phase
   assume threshold_blevel = 0.25
// means 25 % battery capacity
   min_blevel=0
   call RREQ_BCAST
 Repeat for all adjacent_paths
   calculate blevel =
1/(available_battery_level)
   if blevel > threshod_blevel
     if min_blevel <blevel
       min_blevel = blevel
     then store the min_blevel of
that node in a vector
   else if
      discard that route
 End Repeat
  }
destination()
 {
  for all RREQ packets received
from adjacent paths
    Store their min_blevel into
cache
    optimized path = find
Maximum (out of all min_blevels)
  send_ack on optimized path
}
```

Steps for the algorithm are explained as per below.

Step-1 Source node initiate the RREQ and send to all its neighbour nodes. RREQ has added a parameter to store the battery level of node. The initial battery level is set by source is zero.

Step-2 Upon receiving the RREQ, the intermediate node will check its battery level. The threshold battery level is set 25% in AODV algorithm, which is modified.

Step-3 If the battery level of the node is below the threshold value i.e. remaining battery energy is less than 25%, the RREQ will be discarded by node and that node will not take part in routing and data transfer.

Step-4 If the battery level of the node is above threshold level i.e. remaining battery energy is more than 25%, the node will take part in routing and data transfer.

Node now compares its own battery level with the battery level mentioned in the RREQ battery level parameter. If the battery is level of the node is greater than the battery level in received RREQ, it will not change the battery level in RREQ.

But, if the node's remaining battery level is less than the battery level in received RREQ, it will modify the RREQ with its own battery level. Which is a new minimum battery level
(bmin) of that routing path.

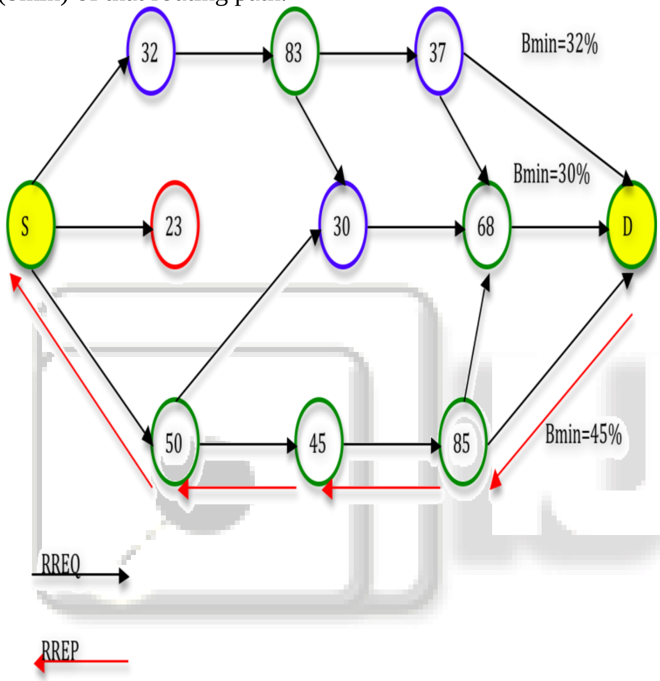


Figure 2: Optimized AODV power aware routing

Above figure is the simple scenario of a MANET for better understanding of the optimization proposed. S and D are source and destination node respectively. The number inside the circles shows their respective battery levels in percentage.

Source initiates the RREQ and sends to all its neighboring nodes. As can be seen the neighboring nodes have the battery levels 32, 23(red) and 50. The node with battery level 23, which is colored in red, discards the RREQ since its battery level is below 25, the threshold level. While nodes with battery level 32 and 50 take part in routing and data transfer and forwards the RREQ.

Each intermediate node will check its own battery level and compares it with bmin parameter in RREQ. If nodes battery level is less than bmin of the RREQ it has received, it will update this parameter prior forwarding it to its neighboring nodes toward destination. If the bmin is greater than the node's battery level it will forward the RREQ as it is.

Now as can be seen at the destination node, it receives many RREQs, particularly three in above scenario. Three RREQs have different bmin, which are 32, 30 and 45. Destination node will select the RREQ with maximum bmin among all RREQ received. Hence, in above scenario, the RREQ with bmin = 45 is selected and RREP will be sent to the destination via that route.

IV. SIMULATION SETUP

Simulation used NS2.35, setdest, cbrgen.tcl, GNU plots etc tools. These tools were installed on fedora 17 operating system.

Parameter	Value
Simulator	NS-2.35
Number of Nodes	5, 10, 20, 35, 50,60
Simulation Time	200 seconds
Traffic Type	CBR
Simulation Area	652x752
Packet Size	512 Bytes
Mobility Model	Random Way Point Mobility
Routing Protocol	AODV
Initial Energy	100 Units
Channel Type	802.11b

Table 1: Simulation Parameter Setup

Random way point mobility model is selected in setdest tool and traffic generated using cbrgen.tcl

Coding for Energy model was done in AODV along with proposed algorithm to ensure the trace file print the energy values of nodes.

V. SIMULATION RESULTS.

We have done simulation for remanning energy of nodes, average end to end delay and average throughput.

Below graph shows the results of simulation for Energy remaining of nodes versus different number of nodes.

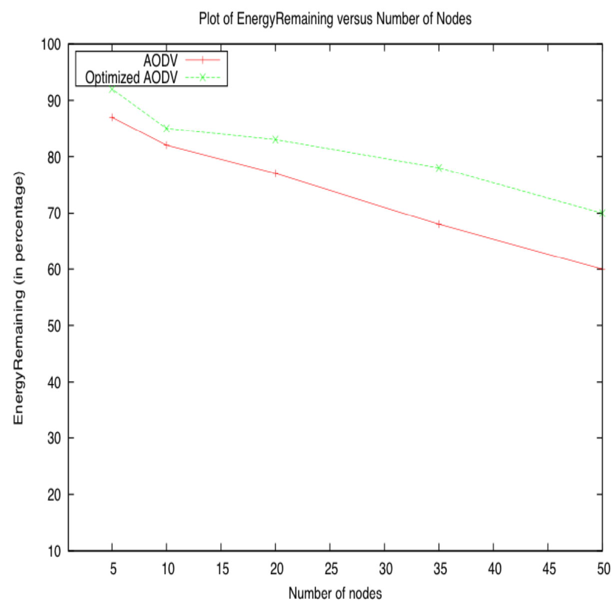


Figure 3:
Percentage Energy Remaining vs number of nodes

From the graph its clearly visible that optimized AODV performed better than the conventional AODV. With number of nodes are 5 the improvement is 5%. Performance weakens when the number of nodes are 10. Now as the number of nodes increases the performance increases. For 40 and 50 nodes, the performance of optimized AODV is better by 10% as compared with conventional AODV.

Now below graphs is for average end to end delay versus number of nodes.

A. Average End-to-End Delay:

Average end-to-end delay is average of the delay difference of received time and sent time of every data packet.

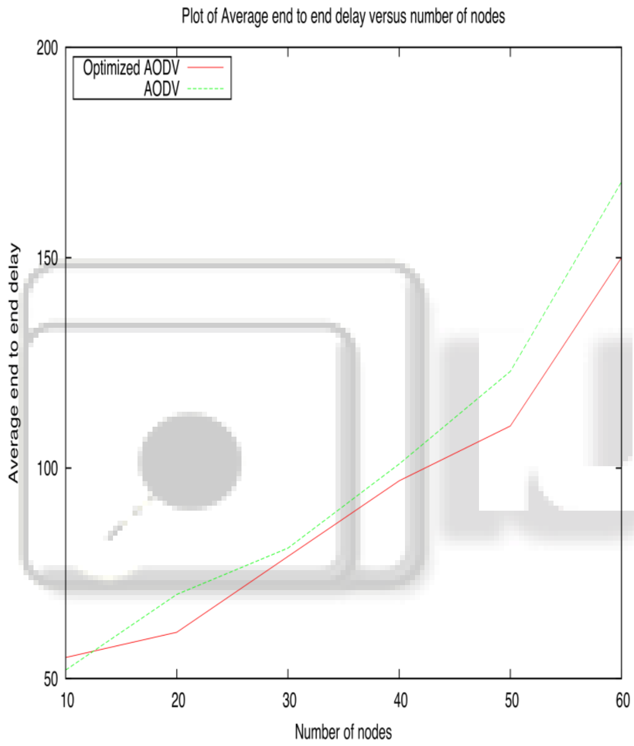


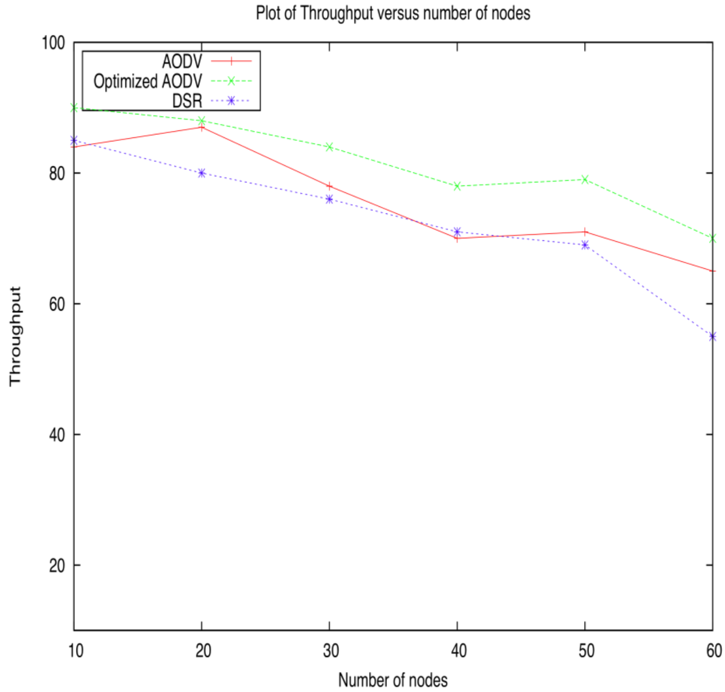
Figure 3: average end-to-end delay vs number of nodes

From the graphs we can see when the number of nodes are less than 20, the conventional AODV performs better in terms of end to end delay. As the number of nodes increases, optimized AODV out performs the conventional AODV. Improvement achieved is up to 10%.

Another simulation results we have are for average throughput versus number of nodes.

B. Throughput:

Throughput of the network is total number of data packets received by all nodes in the network per second.



For average throughput, we have also taken simulation results of DSR protocol. Optimized AODV out performs both conventional AODV and DSR both. We are achieving the improvement by 8%.

Conclusions and Future Work

The major design challenge in MANET is energy. A major draw back of AODV protocol is that it is not power aware. Hence routing protocol should be design for power awareness. The algorithm discussed in this paper improves the network lifetime by means of increasing the remaining energy of nodes.

Along with energy, throughput and end-to-end day shows significant improvements than the conventional AODV.

In future there is a need to work to further optimize algorithm proposed in this paper. There could be a second option of routing should be worked out which could be added to this algorithm that can help continue routing in worst case scenarios such as all the neighbouring nodes of source node are having below threshold battery level. Current algorithm in such scenario couldn't complete routing and data transfer, because all the RREQs flooded, will be discarded by all the neighbouring nodes with below threshold battery level.

References

[1] Liansheng Tan, Peng Yang and Sammy Chan, "An Error-aware and Energy Efficient Routing Protocol in MANETs", Computer Communications and Networks, 2007. ICCCN 2007J

[2] LA-YUAN LI, FENG ZHENG, CHUN-LIN LI, PEI-YAN YUAN, "AN ENERGY CONSTRAINED ROUTING PROTOCOL FOR MANET", Machine Learning and Cybernetics, 2007 International Conference.

[3] AL-Gabri Malek, Chunlin Li, Li Layuan and WangBo, "New Energy Model: Prolonging the Lifetime of Ad-hoc On-Demand Distance Vector

Routing Protocols (AODV)", Future Computer and Communication (ICFCC), 2010 2nd International Conference, 2010R.

[4] Tai Hieng Tie, Chong Eng Tan, Sei Ping Lau, "Alternate Link Maximum Energy Level Ad Hoc Distance Vector Scheme for Energy Efficient Ad Hoc Networks Routing", Computer and Communication Engineering (ICCCE), 2010 International Conference, 2010
[5] Gholamhasan Sajedy Abkenari, Arash Dana, Mohammad Shokouhifar, "WEIGHTED PROBABILITY ANT-BASED ROUTING (WPAR) IN MOBILE AD HOC NETWORKS", Electrical and Computer Engineering (CCECE), 2011 24th Canadian Conference, 2011
[6] Muhammad Imran Malik, Shen Ting Zhi, Umar Farooq, "Latency Aware Routing Mechanism to Maximize the Life Time of MANETs", Computer Science and Network Technology (ICCSNT), 2011 International Conference, 2011
[7] RADHIKA D.JOSHI, PRITI P.REGE, "Distributed Energy Efficient Routing in Ad Hoc Networks", Wireless Communication and Sensor Networks, 2008. WCSN 2008. Fourth International Conference, 2008
[8] G.Varaprasad ,"New Power Aware Routing Algorithm for MANETs Using Gateway Node", Parallel and Distributed Systems, 2007 International Conference, 2007
[9] Yadu Kishore K, Ashish Tiwari, O G Kakde , "Optimization based Topology Control for Wireless Adhoc Networks to meet QoS requirements", Reliable Distributed Systems, 2010 29th IEEE Symposium, 2010
[10] ZHANG Yi, FENG Li, CHEN Wei, ZHU Lina, "Power-Aware Routing Algorithm based on Mobile Agents (PARAMA) in Mobile Ad Hoc Networks", Embedded Software and Systems Symposia, 2008. ICESS Symposia '08. International Conference, 2008
[11] Vijender Kaushik and Shikha Goel, "Reliable Multicasting in Ad-hoc Networks – An analysis of various protocols and the Open Issues", 4th
[12]. 2013International Conference on Emerging Trends in Engineering & Technology, October 25th - 27th, 2013
[13] T.Poongkuzhali, V.Bharathi, P.Vijayakumar, "An Optimized Power Reactive Routing based on AODV Protocol for Mobile Ad-hoc Network", IEEE-International Conference on Recent Trends in Information Technology, ICRTIT 2011 978-1-4577-0590- 8/11/$26.00 ©2011 IEEE MIT, Anna University, Chennai. June 3-5, 2011
[14] K. V. Arya, Senior Member, IEEE, and Kuldeep Narayan Tripathi, "Power Aware and Secure Routing in Mobile and Ad-Hoc Networks", 2013 IEEE 8th International Conference on Industrial and Information Systems, ICIIS 2013, Sri Lanka
[15] P. Srinivasan and P. Kamalakkannan, "Enhancing Route Maintenance in RSEA-AODV for Mobile Ad Hoc Networks", 7th International Conference on INTELLIGENT SYSTEMS AND CONTROL (ISCO'2013), Coimbatore, Tamil Nadu, India, 4-5 Jan