ISSN: 2321-7782 (Online)
Volume 4, Issue 4, April 2016
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Node Energy Aware Protocol for Energy Efficient Routing in MANET

Poonam G. Landge[1]
Department of Electronics
KIT's college of Engineering
Kolhapur – India

Atul R. Nigavekar[2]
Department of Electronics
KIT's College of Engineering
Kolhapur – India

Abstract: ***MANET has gained a lot of importance in wireless communication. MANET's are characterized as networks without any physical connection. The different issues like power consumption, security, bandwidth consideration, etc. are taken for research. This paper concentrates on routing algorithm. As the nodes in MANET are mobile there is constant change in network topology hence dynamic routing protocols are needed for such networks. Numbers of routing protocols are proposed to accomplish this task. In this paper we consider AODV routing protocol. AODV routing protocol prefers shortest path for route establishment irrespective of node energy. If certain path is selected repeatedly the nodes in that particular path will exhaust faster than others resulting in death of node. To avoid this problem we propose node energy aware protocol which takes into account residual energy of nodes. The simulation is performed using network simulator 2. Simulation results shows that our proposed protocol provides better improvement in terms of energy consumption, packet delivery ratio, & throughput than existing AODV protocol.***

Keywords: MANET, AODV, Energy efficient routing, Residual energy, RREQ.

I. INTRODUCTION

In recent years MANET has become very important technology due to its widespread use in wireless networks. MANET is a group of wireless mobile nodes without any fixed infrastructure or centralized administration. Due to lack of fixed infrastructure these networks are self organized. The nodes in MANET are mobile & can move freely in open environment. The mobile nodes that are within transmission range of each other can communicate directly otherwise a node in MANET has to rely on intermediate node to route a packet to the destination node. This means working of MANET is based on nodes cooperation. In MANET mobile nodes acts as both host & router.

Following are the characteristics of MANET [5]:

1] Dynamic topologies: - Nodes are free to move arbitrarily thus the network topology which is typically multihop may change randomly & rapidly at unpredictable times & may consist of both bidirectional & unidirectional links.

2] Bandwidth constrained, variable capacity links: - Wireless links will continue to have significantly lower capacity than their hardwire counterparts. In addition realized throughput of wireless communication after accounting for the effects of multiple access, fading, noise & interference conditions etc. is often much less than a radio's maximum transmission rate .

3] Energy constrained operation: - Some or all of the nodes in MANET rely on batteries or other exhaustible means for their energy. For these nodes the most important system design criterion for optimization may be energy conservation.

4] Limited physical security: - Mobile wireless networks are generally more prone to physical security threats than are fixed cable nets. The increased possibility of eavesdropping, spoofing & denied of service attacks should be carefully considered.

MANET applications:

- Military or police exercises
- Disaster relief operations
- Urgent business meetings
- Mine cite operations

II. OVERVIEW OF AODV

AODV is reactive routing protocol. Reactive routing protocols are based on finding roots between two nodes when required. Like proactive routing protocols AODV does not need to maintain roots to destinations that are not in active communication. The distinguishing feature of AODV is its use of destination sequence number for each root entry. Destination sequence number is created by destination. This destination sequence number & broadcast id are included along with any root information which is sent to any requesting node. If two or more roots are available to a destination a requesting node should select a route with greatest sequence number.

As long as two nodes have valid routes to each other AODV does not play any role. If a node wants to communicate with another node about which it has no routing information then AODV starts root discovery process by broadcasting RREQ. The requesting node will use its own IP address as originator address & for broadcast IP limited (255.255.255.255) address is used.

Working of AODV

The working of AODV involves two phases one for discovering path towards an unknown destination & other for maintaining the established path which are explained below.

A. Root discovery

In AODV when a node wants to communicate with another node for which it has no routing information it broadcasts root request (RREQ) control packet to its neighbors . The node receiving RREQ acts as intermediate node & forward RREQ to its neighbors. While forwarding intermediate node records the address of node from which it has received first copy of RREQ in their root table in order to establish reverse path. When RREQ reaches destination node it will respond by unicasting RREP back to the originator node. When RREP reaches originator node it means a valid communication route has been established between two communicating nodes & now they can exchange data.

B. Root maintenance

AODV also provides mechanism for maintaining the roots. The nodes in AODV can detect link breakages by monitoring the link status of next hop in active routes. When any intermediate node or destination node moves out then upstream node initiates root error (RERR) message to affected upstream nodes. This RERR message is propagated until it reaches the originator node. When originator node detects link break it can either stop sending data or reinitiate the root discovery process.

III. LIMITATIONS OF AODV

As the nodes in the network are batteries operated the routing protocol should take into account power usage as routing metric. AODV routing protocol optimizes routing with lowest delay. As the AODV routing protocol is energy constrained shortest path is not always optimal path. If same route is used repeatedly the nodes in that particular route would discharge faster than other nodes in the network. As a result node gets switched off & the link breaks resulting in disconnected sub networks. If originating node still wants to communicate with the destination node it has to reestablish the route. This frequent root establishment leads to excess energy consumption.

IV. MODIFIED AODV

As AODV optimizes routing with lowest delay it does not takes into account residual energy of nodes while establishing the route. Thus if any intermediate node in the active route turns off due to battery run outs link break occurs. So the source node has to reestablish the route for further data communication. The example for basic root finding mechanism is shown in figure 1.

As seen from the figure 1 node N1 broadcasts RREQ to find a route to node N5. Nodes N2, N3, & N4 receive & forward RREQ & while forwarding catches a route to source node. When node N5 receives RREQ it sends RREP back to source node. Thus a valid route is established & node N1 starts sending data towards N5. In between communication node N4 turns off due to battery run out. Node N3 detects link break & send no route error to upstream nodes. Thus for further communication node N1 have to reestablish the route.

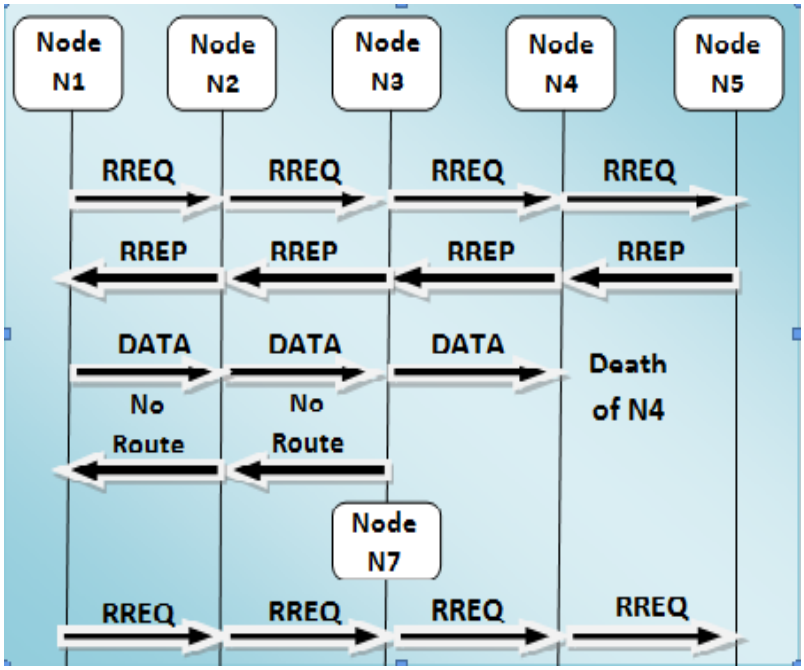


Figure 1: Basic AODV root finding mechanism

To avoid the energy loss in repeated root establishment we propose modified AODV protocol called node energy aware protocol. This modified AODV protocol modifies basic RREQ packet structure by adding one more field called energy field. This energy field contains the threshold value of energy required to complete a particular communication event without any link break. This energy field is set by the originating node. Following figure shows basic & modified RREQ packet structure.

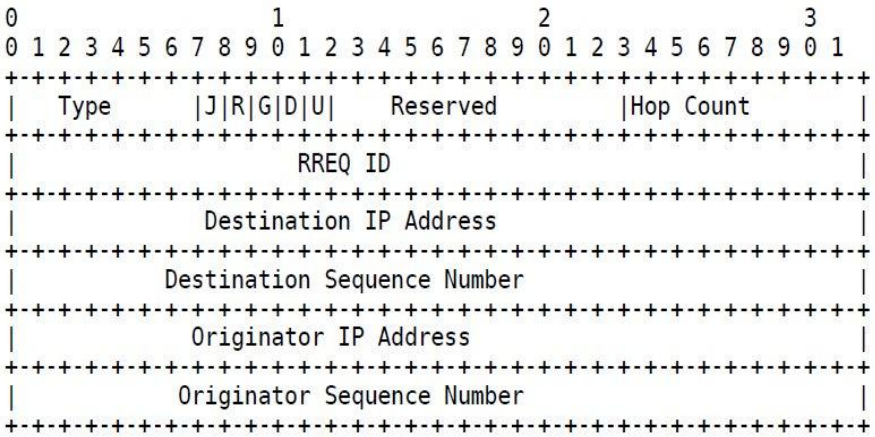


Figure 2: Basic RREQ packer structure

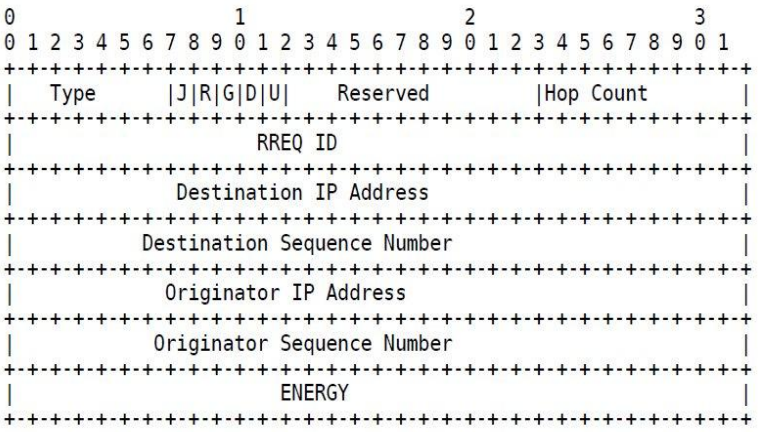


Figure 3: Modified RREQ packet structure

In proposed protocol for root establishment the originating node broadcasts this modified RREQ packet containing threshold energy value. Each receiving node calculates its residual energy & compares with the value in the energy field. If residual energy of node is greater than the value in the energy field then only that node is selected as intermediate node & will forward the RREQ to its neighbors otherwise it will drop RREQ. Thus nodes with sufficient amount of energy for communication will be selected as intermediate nodes. So there are negligible chances of route reestablishment. So modified AODV protocol spend less energy for root establishment as compared to existing AODV protocol. Thus modified AODV protocol is more energy efficient than the existing AODV routing protocol.

Following figure shows root establishment procedure for modified AODV protocol. From figure as the residual energy of N3 is less than threshold value of energy it will drop the RREQ packet. Instead node 6 with required energy is selected as intermediate node.

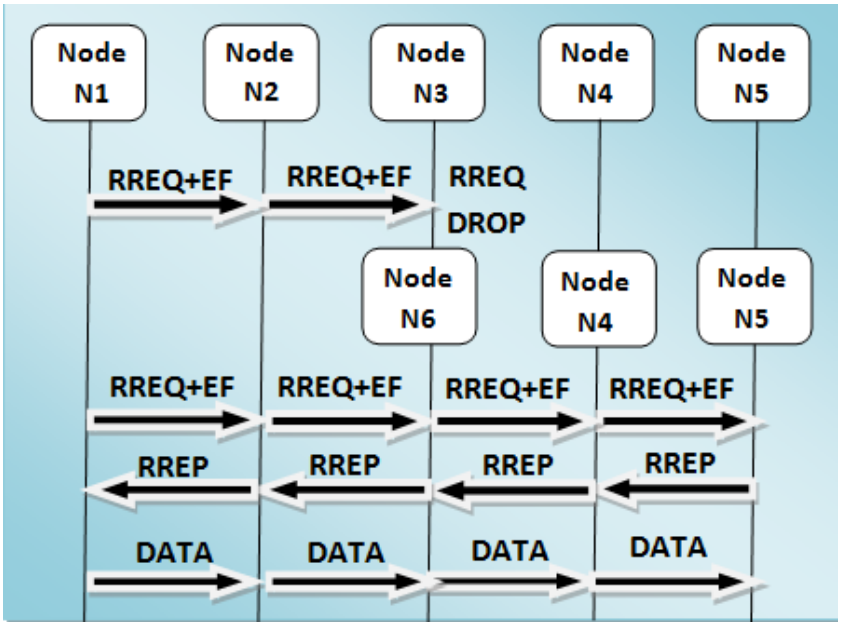


Figure 4: Modified AODV root establishment procedure

Residual energy calculation

Residual energy gives information about remaining energy of node. It can be calculated as follows.

$E_{Residual} = E_{Initial} - E_{consumed}$

Where $E_{Initial}$ & $E_{consumed}$ indicate the initial energy of node & consumed energy of node respectively till time.

V. Simulation Setup

The existing AODV & modified AODV is simulated using network simulator 2. The necessary simulation setup is as follows.

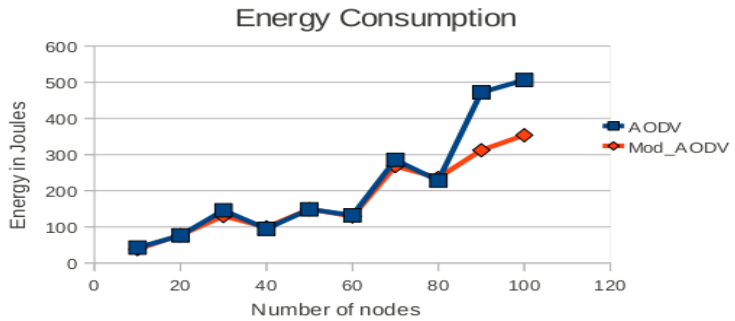
No of Nodes	10-100
Traffic Model	CBR
Radio propagation model	Two ray ground
Data Packet Size	512 bytes
Initial energy	11 J
Simulation Time	100 sec
MAC Layer Type	IEEE 802.11
Radio Propagation Model	Two Ray Ground
Radio Range	250m
Speed	20m/s

VI. Results and Analysis

This section presents comparison of results between existing AODV & modified AODV. The simulation is performed for 10 – 100 nodes. The performances metrics used for comparing existing AODV & modified AODV are as follows.

1] Energy consumption:

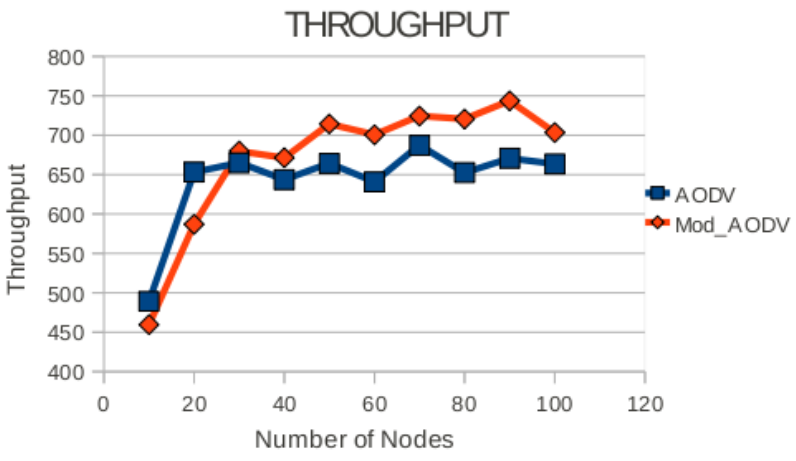
Energy consumption is energy consumed by network for all packets received by the destination. Energy consumption is plotted against various numbers of nodes. The graph is plotted for 10-100 nodes.



It can be seen from above graph that modified AODV consumes less energy as compared to existing AODV because of using residual energy as routing metric & avoiding repeated root establishment.

Throughput:

It is defined as the total number of packets delivered over the total simulation time.



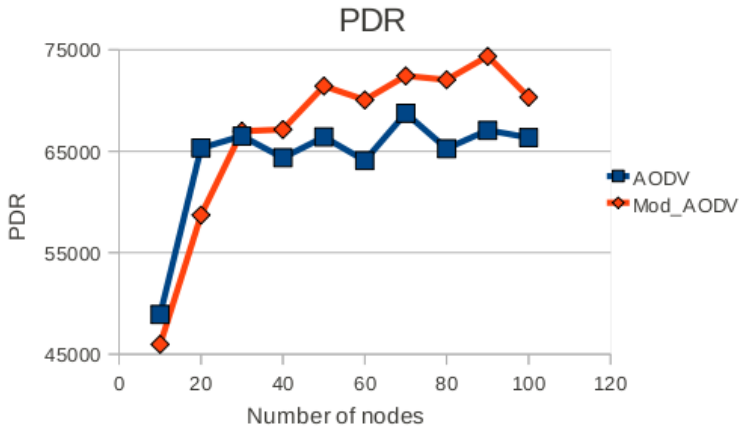
Packet delivery ratio:

The packet delivery ratio is the number of packets received by the destination to the number of packets generated by the source node.

Mathematically it can be calculated as,

Throughput=$\frac{R}{S}$

Where R is sum of packets received by each destination & S is sum of data packets generated by each source node.



As seen from the results & analysis modified AODV protocol performs better than the existing AODV protocol.

VII. Conclusion

As the ad hoc networks are energy constrained the routing protocol should be energy efficient. The existing AODV routing protocol is improved by modifying RREQ packet structure. The modified AODV protocol considers residual energy of nodes as routing metric. According to this modified protocol the source node sets threshold energy required for a particular communication event. Thus only those nodes are selected in the root establishment that would not exhaust until the entire communication event is completed. Thus we can avoid the wastage of energy in root reestablishment. It can be seen from simulation results that modified AODV consumes less energy than existing AODV. Additionally modified AODV gives better performance in terms of throughput & packet delivery ratio compared to existing AODV. Thus the proposed Modified AODV protocol is more energy efficient than the existing AODV.

References

1. Ajay shah, Hitesh Gupta, Mukesh Baghel "Energy efficient routing protocol for mobile ad hoc networks" International journal of engineering research & application Vol.2 Issue 4 July –August 2012 pp.1342-1346.
2. P.S. Karadge, Dr, S. V. Sankpal "A performance comparison of energy efficient routing protocols on mobile ad network" International journal of advanced research in computer & communication engineers Vol.2 Issue 1 Jan 2013 pp. 2278-1021.
3. Can Tunca, Sinan Isik, M.Yunus Donmez, Cem Ersoy "Ring routing: an energy efficient routing protocol for wireless sensor networks with a mobile sink" IEEE transactions on mobile computing .
4. C. Perkins Ad hoc on demand distance vector routing rfc 3561.
5. S.Corson MANET rfc 2501.
6. C Yu. B Lee, & H. Y. Youn "Energy efficient routing protocols for mobile ad hoc networks" wireless communications & mobile computing Vol.3 No.8, pp.959-973, 2003.
7. Akhilesh Tripathi, Rakesh Kumar "MECB-AODV A modified energy constrained based protocol for mobile ad hoc networks" International journal of distributed & parallel systems Vol.3, No.6 Nov 2012.
8. Preeeti Bhati "An efficient agent-based AODV routing protocol in MANET" International journal of computer science &engineering Vol.3, No. 7, July 2011.
9. Venetis Kanakaris, David Ndzi, Kyriakos Ovaliadis "Improving AODV performance using dynamic density driven route request forwarding" International journal of wireless & mobile networks Vol.3, No. 3, June 2011.
10. Patil V. P."Efficient AODV routing protocol for MANET with enhanced packet delivery ratio & minimized end to end delay" International journal of scientific & research publications Vol.2 Issue 8 August 2012.

11. Volkan Rodoplu, Teresa H.Meng "Mimimum energy mobile wireless networks" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS Vol.17, No.8 August 1999.

12. Reena Singh, Shilpa Gupta "EE-AODV Energy efficient AODV routing protocol by optimizing root selection process" International journal of research computer & communication technology Vol.3, Issue 1, pp. 2278-5841 Jan 2014.

13. Sajal Sarkar, Raja Dutta "A trusust based protocol for energy efficient routing in self organized MANET's" IEEE 2012.

14. Ojashvi Shivwanshi, Rahul Patel, Preetika Saxena "Es AODV: Implemation & design of secure &efficient AODV for WSN" International journal of engineering sciences & research technology March 2016.

