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A Performance Comparison of Energy Efficient AODV Protocols in Mobile Ad hoc Networks

P. S. Karadge[1], Dr.S.V.Sankpal[2]

Student, Dept.of Electronics and tele-communication, D.Y.Patil College Engg and Tech, Kolhapur, India [1]

Associate professor, Dept. of Electronics and tele-communication,D.Y.Patil College Engg and Tech, Kolhapur, India [2]

ABSTRACT: **Energy Conservation is a very important design issue for mobile ad hoc networks (MANET) since mobile nodes are powered by batteries with limited capacity. The typical routing protocols of MANETs are mainly the shortest path routing protocols and do not consider the energy aware issue. Power failure of a node affects the overall network lifetime. So this paper describes improvement of the conventional routing protocol by utilizing high energy paths in the network. We present a comparative analysis of existing AODV protocol and energy efficient AODV protocol which is modified to improve network lifetime as well as packet delivery ratio. Simulation results indicate that the routing scheme of proposed method is more efficient than existing well-known routing protocols.**

Keywords: MANET, Energy efficient Routing, Power Consumption, Residual energy.

I. INTRODUCTION

Mobile Ad-Hoc Networks (MANETs) are wireless networks where a collection of mobile nodes can dynamically vary the topological structure. With respect to the more widely used mobile cellular networks (e.g., CDPD or GSM), MANETs do not use any form of fixed infrastructure or centralized administration. A set of ad hoc routing protocols has been proposed in the IETF's MANET [2] group to ensure the network connectivity. They operate in either proactive or reactive modes. Building such routing algorithms poses a significant technical challenge, since the devices are battery operated. The devices need to be energy conserving so that battery life is maximized. The shortest path is the most common criteria adopted by the conventional routing protocols ,in which that nodes along shortest paths may be used more often and exhaust their batteries faster. The consequence is that the network may become disconnected leaving disparity in the energy, and eventually disconnected sub networks. This paper proposes an energy efficiency routing protocol, MEL-AODV based on the basis of the classical routing protocol, Ad hoc On-Demand Distance Vector (AODV) in Ad Hoc network. The Maximum Energy Level Ad Hoc Distance Vector (MELAODV) introduces maximum energy path on the network layer, combining all link nodes overall residual energy has been adopted as an important parameter for route selection. Highest combined residual energy will be a better path for routing over the ad hoc network. In this work, we measure and compare the energy consumption behavior of two routing protocols; Ad-hoc on demand distance vector(AODV) and the Maximum Energy Level Ad Hoc Distance Vector (MELAODV). Our basic methodologies consisted of first selecting the most representative parameters for a MANET, then defining and simulating a basic scenario, and finally, by varying the number of nodes, generate and evaluate different scenarios. The two selected parameters were: 1) network lifetime 2) data delivery ratio.

II. RELATED WORK:

Due to the limited energy resources, there has been research on improving the energy efficiency of wireless ad hoc network. Several ad hoc routing algorithms such as Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector Routing (AODV), Temporally-Ordered Routing (TORA) and Destination Sequenced Distance vector (DSDV) have been evaluated in term of energy consumption [3]. Link quality is a metric that is used by Signal stability based adaptive routing (SSA) [4] to select best link quality route among many different routes. In addition to link quality, SSA also uses location stability as metric. Power aware localized routing [5] achieves the goal by controlling the transmit power of the communication device. Furthermore, power-aware routing is proposed to find a low cost route instead of the shortest routing path [6]. In [7], a RED-based Minimum Energy Routing (REDME) is described, which uses MAC layer buffer queue length as an indicator of the degree of congestion. AODV-RSS (AODV with received Signal Strength) [8] uses the received signal strength and changing rate to find a route that can sustain longer. Cross based Power aware cross layer design is based on intermediate nodes to judge its ability to forward the RREQ packets or drop it [9]. Other routing algorithms also prefer the low cost route can be found in [10] [11].

A. Overview of AODV

AODV is an on-demand routing protocol. It does not maintain routes for every node to every other node in the network. Whenever a route to the destination is needed, it initiates a route discovery process and the routes remains as long as they are necessary. AODV is loop free at all times. The initial design of AODV is based on Destination-Sequenced Distance-Vector (DSDV) routing algorithm. AODV is essentially a combination of both DSR and DSDV. It borrows the basic on-demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by hop routing, sequence numbers, and periodic beacons from DSDV.

Path Discovery: The Path Discovery process is initiated whenever a source node needs to communicate with another node for which it has no routing information in its table. Every node maintains two separate counters: a node sequence number and a broadcast id. The source node initiates path discovery by broadcasting a route request (RREQ) packet to its neighbours.

Route maintenance: This phase is responsible for maintaining the routes. If the route is not available, then error message will be sent, and all nodes will be notified.

B. Deficiency of AODV

AODV algorithm does not consider the power usage of node it optimize the routing with lowest delay. The mobile communications devices in ad hoc network are batteries operated and have limited energy, so the network is an energy-constrained system. From the perspective of energy, the shortest path is not always the optimal path. If the same paths are being utilized repeatedly due to the minimum number of route, the nodes energy along these routes will be consumed quickly and they may exhaust their batteries faster. The energy conservation of the network system is a key problem especially in the situation such as military areas, disaster relief, classrooms and conferences. The consequence is that the network may become disconnected leaving disparity in the energy, and eventually disconnected sub-networks. Therefore, the shortest path algorithm is not necessary the most suitable metric to be adopted for routing decision in ad hoc networks.

III. . PROPOSED WORK: **MEL-AODV**

We propose a routing algorithm, The Maximum Energy Level Ad Hoc Distance Vector (MELAODV) based on alternate maximum remaining energy routes in each node to increase the network lifetime and to achieve efficient utilization of node energy. The proposed algorithm selects the minimum cost and highest energy path.

A. Assumptions of MEL-AODV protocol

1. The node has randomly distributed initial energy level, movement and position.
2. The node's link layer read the power information from the physical interface and could reply to the network layer.
3. Wireless channel is bidirectional and symmetrical, in other words, while the two nodes are communicating, the signal attenuation is the same.

Based on the assumptions above the remaining energy level of the network nodes can be extracted when network nodes send and transmit packets among each other. Most of the routing protocols only consider delay, data delivery, loss ratio, but neglect the energy remain in the nodes along the link, causing the partial nodes repeatedly to appear in many routes and prematurely "death". The proposed routing protocol always chooses the highest energy route in route table for data transmission, thus energy consumption of nodes in the network could be effectively balanced and the average survival time of nodes in the network could be improved.

B. Routing Algorithm

The energy-saving routing algorithm which is adopted in Maximum Energy Level Ad Hoc Distance Vector protocol (MEL-AODV) has enhanced the RREQ handling process. MEL-AODV considers node remaining energy as a routing metric. The RREQ process for MEL-AODV to achieve higher energy efficiency is as below:

1) The path discovery process is initiated whenever a source node needs to communicate with another node for which it has no routing information in its table.
2) Every node maintains two separate counters: a node sequence number and a broadcast id. In this routing, we

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maintain intermediate nodes receive one RREQ and discard other RREQ
3) However we allow destination nodes to accept more than one route request. Meanwhile it obtains current node energy information and adds to accumulated energy field route request packet This process is continuing until destination node receive RREQ packet or intermediate nodes have route information towards destination.
4) Upon receiving first RREQ packet, the node will calculate and update accumulated energy field on destination node route table. If there are better energy route received, destination node will continue update its route table. This process continue until 2 to 3 route requests before destination node send route reply packet (RREP) to source node.
5) Then node unicast RREP to the source node reversely after getting route information with satisfying condition.
6) After receiving RREP, the source can send data through the highest energy route.

When a node sends and receives packet, the networks interface of the node decrements the available energy according to the parameters: txPower and rcvPower represent energy usage for every packet antenna transmits and receives; txtime and rcvtime are time needed to transmit and receive a packet which calculated from packet size divided by bandwidth. So equation (1) (2) (3) and (4) are used to calculate and deduct transmission and reception energy. By multiply transmit Power (txPower) with transmit time (txtime), we can know the amount of energy consumed during packet transmission. Then we can get remaining energy of transmit node after successful transmission. This case is similar to receiving node where it can get remaining energy by deducting its energy with total energy used for receiving packets.

Energy in transmit mode (Etx) = txPower × txtime (1)

Energy Remaining (Enode)= current energy – Etx (2)

Energy in receive mode (Ercv) = rcvPower × rcvtime (3)

Energy Remaining (Enode)= current energy - Ercv (4)

IV. Simulation Environment

The simulation results in this paper were obtained using Network Simulator 2 version 2.35 (NS2) to perform comparison between MEL-AODV protocol and AODV. NS2 is a discrete event, object oriented, simulator developed by the VINT project research group at Carnegie Mellon University [12] which includes: nodes mobility, a realistic physical layer that includes a radio propagation model, radio network interfaces and the IEEE 802.11 Medium Access Control (MAC) protocol using the Distributed Coordination Function (DCF). NS2 is one of most popular network simulator tools worldwide. The NS2 was installed under Ubantu 10.0 as a simulation platform. The transmission range is assumed to be 250m and the packet size is fixed at 512 bytes. In order to have performance result, we use 10 to 50 nodes on the simulation separately.

TABLE I
SIMULATION PARAMETERS

V. Results

1	MAC layer Type	IEEE802.11
2	Reception queue length	50
3	Radio propagation model	Two Ray Ground
4	Transmission Power	0.6W
5	Reception Power	0.3W
6	Initial Energy	3.8Joule
7	Packet Size	512 bytes
8	Total simulation time	10min

The simulation is conducted with 10 to 50 nodes for comparing performance of AODV and MEL-AODV protocol separately. First we evaluated the MEL-AODV protocol energy saving effect by comparing the nodes lifetime. Figure 1 has shown 10-50 nodes simulation result separately under the 1 m/s speed. Every node has random initial energy. Table II shows that the survival time of MEL-AODV protocol is higher than AODV. We also can conclude that the performance of network lifetime is better by increasing number of nodes because destination node able to receive higher energy routes thus energy saving routing protocol has prolonged the node's lifetime. Figure 2 shows successful packet delivery ratio for 10 to 50 nodes. From graphs below, we can make conclusion that MELAODV has played an important role in prolonging node's lifetime and improved the data

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delivery ratio. In both graphs numbers of nodes are on X-axis and second parameter is on Y-axis.

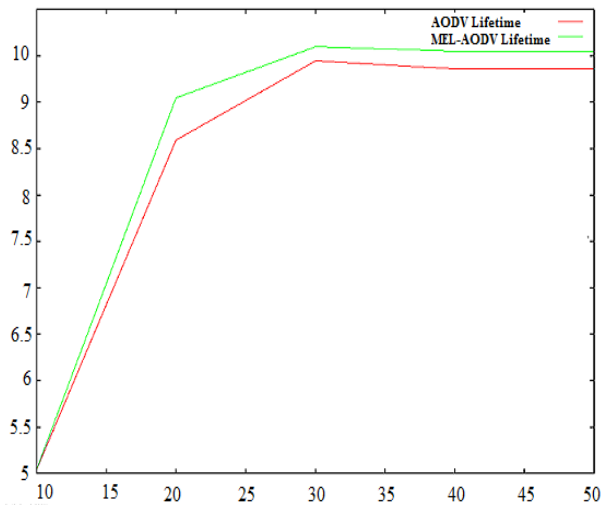

Fig.1 Network Lifetime vs number of nodes

TABLE II

NETWORK LIFETIME (sec)

Number of nodes	MELAODV	AODV
10	5.04	5.04
20	9.04	8.59
30	9.6	9.45
40	9.55	9.35
50	9.55	9.35

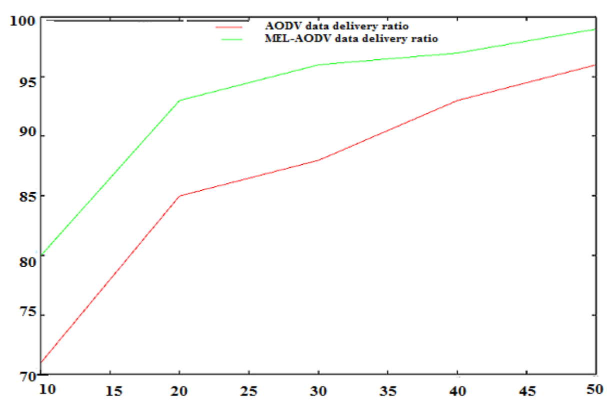

Fig.2 Data delivery ratio vs number of nodes

TABLE III

DATA DELIVERY RATIO

Number of nodes	MELAODV	AODV
10	0.8	0.71
20	0.93	0.85
30	0.96	0.88
40	0.97	0.93
50	0.99	0.96

VI. CONCLUSION

We presented the results of comparing the energy consumption behaviour of two routing protocols respectively, Ad hoc on demand distance vector (Ad-hoc) and Maximum energy level AODV(Mel-Aodv).The results obtained from the simulation allow us to conclude that network lifetime and data delivery ratio are better in MEL-AODV than AODV protocol. The proposed MEL-AODV protocol combines the overall node energy on the link as route selection metric. Protocol extends the system lifetime and also improves the packet delivery ratio.

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REFERENCES

[1] S. Corson and J. Macker, "*Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations"*, RFC 2501, January 1999

[2] IETF MANET WG *(Mobile Ad hoc NETwork)*, www.ietf.ora/html.charters/manet-charter.html

[3] Juan-Carlos Cano and Pietro Manzoni, "*A Performance Comparison of Energy Consumption for Mobile Ad Hoc Network Routing Protocols,"* Eighth International Symposium on Modeling, Analysis and Simulatio of Computer and Telecommunication Systems (MASCOTS 2000), Aug 2000.

[4] R.Dube, C.D. Rais, K-Y Wang and S.K. Tripathi, "*Signal Stabiliity-based Adaptive Routing (SSA) for Ad Hoc Mobile Networks*", Techical Report CSTR-3646, UMIACS-TR-96-34, August 28, 1996.

[5] Ivan Stojmenovic and Xu Lin, "*Power-aware localized routing in wireless networks*," IEEE Transactions on Parallel and Distributed System, *vol. 12*, no.10, October 2001

[6] S,Singh, M.Woo, and C.S Raghavendra, "*Power aware Routing in Mobile Ad Hoc Networks*," International Conference on

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Vol. 2, Issue 1, January 2013

Mobile Computing and Neworking (Mobicom'98), pp. 181-190, October 1998

[7] X.Jin, W.Cai and Y.Zhang, "*A RED based minimum energy routing algorithm for wireless ad-hoc networks*,"Proceedings of International Conference on Wireless Communications Networking and Mobile Computing, 2005, vol. 2, pp. IV757-IV761.

[8] Ruav-Shiung Chang, Slnng-Jiuan Leu, "*Long-lived Path Routing With Received Signal Strength for Ad Hoc Networks*," In Proceeding of the 1st International Symposium on Wireless Pervasive Computing. Jan 2006.

[9] Rekha Patil and Dr A.Damodaram, "*Cost Based Power Aware Cross Layer Routing Protocol for Manet*," IJCSNS International Journal of Computer Science and Network Security, *vol. 8,* No.12, December 2008.

[10] Jae-Hwan Chang and Leandros Tassiulas, "*Energy Conserving Routing in Wireless Ad Hoc Networks*," The Conference on Computer Communications (IEEE Infocom 2000), pp.22-31, 2000

[11] Ram Ramanathan, Regina Rosales-Hain, "*Topology Control of Multihop Wireless Networks using Transmit Power Adjustment*," The Conference on Communications (IEEE Infocom 2000)

[12] Juan-Carlos Cano and Pietro Manzoni, "*A Performance Comparison of Energy Consumption for Mobile Ad Hoc Network Routing Protocols*," Camino de Vera, Valencia, SPAIN. August 2008

Biography

Karadge P S. is currently working towards her M.E (Electronics and telecommunication) at D. Y.Patil college of engg. and Tech, affiliated to shivaji university Kolhapur, India. She received her B.E (Elecrtonics) from Walchand college of Engg and technology Sangali, in 2007. Her research interest include Ad Hoc networks.

Dr.Mrs.Sankpal S.V. is currently working as associate professor at D.Y.Patil college of Engg. and Tech, Kolhapur. She has total 27 years of experience. She has completed her B.E .and M.E.in Electronics and earned her Ph.D. from Shivaji University, Kolhapur. She has published totally 20 national conference papers, 23 international conference papers, 12 international journal papers.