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A Maximum Transmission Range and Relative Energy Based Multipath Routing Strategy in Manet's

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Abstract

Manet's are networks which can be setup on demand where mobile nodes rely on the finite energy. Considering the limited available energy as a restraint numerous methods have been emerged from time-to-time to expand the lifetime of a network by effective utilisation of energy. The highest favoured and competent mechanism to lengthen the lifetime of network is by transmission power management theory which contemplates nearby nodes with merest power level. This scheme doesn't reduce the energy utilisation and communication overhead of the network. Based on our inquiry it is erect that routing procedure is to be altered relatively than controlling the transmission power and permitting only certain nodes in routing process. Routing mechanism is to be changed based on the assessment of received signal strength and relative remaining energy. Using this only specific nodes in the network are permitted to receive and validate the routing request. Aforementioned form of routing procedure is adopted to Ad-hoc on-demand multipath distance vector (Ad-hoc-OMDV) routing protocol and a maximal transmission range and remaining energy based multipath protocol called AOMDV_RR is proposed and analysed under various dimensions of network. Commendable dissimilarity in capabilities are found and the suggested AOMDV_RR shows better performance than the normal AOMDV with reference to all the selected QoS entities.

Keywords: MANET, relative energy, multipath distance vector, transmission power, network lifetime, AOMDV, energy efficiency

1. Introductions

Mobile ad-hoc networks allows users to setup the network anywhere and anytime since these doesn't have any predefined structure. Wireless networks are different type's single hop and multi-hop. When the adjacent neighbour node is the destination node then it is said to be single hop and the communication is with intermediate nodes involvement then it is called multi-hop ad-hoc network. This kind of ad-hoc networks can be used where the conditions for setting up of fixed network is convincingly futile. The most decisive peculiarities that are delineated by corson and macker [1] for MANET's are energy bound operation, vigorous topologies, finite physical security and bandwidth bounded operation.

In MANET's each node can be operated as a terminal and as a router also, since it forwards the packets received from other nodes. The mobile nodes have random mobility which makes the network topology to be changed dynamically. Thus the MANET's protocols should be adaptive and be able to maintain routes even though the connectivity of the network is not constant. These networks are helpful in military and some typical applications like emergency disaster relief or exploration missions.

The major issues to be focussed in MANET routing protocols are the design and analysis. The exploratory intent of the route discovery in MANET is to choose an effective path between two nodes for delivering the desired message. There are many routing protocols which have been proposed for ad-hoc networks. MANET protocols are of two categories: on-demand and table driven.

On-demand or reactive routing protocols doesn't have routing table to maintain routing information hence these do not update the routing table information systematically. But each mobile node will update a route cache which will store the recently traversed paths from origin node to designated node. The route from Origin node to designated node is entrenched on demand. Different on-demand MANET routing protocols are AdhocODV, Ad-hocOMDV, Dynamic Source Routing, TORA etc.

Table driven or proactive protocols where every node will have one or more routing tables to capture routing information to all the nodes in the network. The data's in the routing tables are amended systematically to save the current network scenario.

2. Related Work

The power aware routing protocols found in the literature are focussed mainly on reducing the transmission power by selecting a minimum power route from sender to receiver. The power –aware route optimization (PARO) [2] algorithm considers minimum transmission power and network lifetime as metrics. This algorithm calculates distribute routes for variable range power and finds larger number of shorter length hops. The reinforcement algorithm's main purpose is to minimize the transmitting power by limiting each mobile node power level. By assuming that there is an understanding among the power levels of nodes and to that of signal-to-noise ratio of the current transmission is being maintained [3].

Xiang et al have employed "generic algorithm" for rectifying the issue of minimum power level related to the node in on-demand networks. This [18] "permutation-encoded" model is apt for secure transportation of data in a network [4]. Compared to common-range transmission control [5] the variable range of transmission power control [6] in on-demand networks makes emphasis on the link distance and it finds out a route with numerous hops. This uses an alternative of Bellman–Ford algorithm. Charya et al. have essayed a scheme [18] in which nodes uses up more energy when related to dynamic selection of nodes. In progressive selection less power is drained up and the network failures are rarely as the transmission rate is increased the network performance is decreased [7]. Kaojung et al. [18] considered the problem of minimum-energy multicasting in ad-hoc networks. This Multicasting referring to communication of nodes with nodes or different links in network. Each link will have a required energy for data transmission."Branch and bound or cutting planes" approaches are employed for finding the path having lowest transmission power with minimum number of hops to destination [18]. This issue of control of power was not seemed well because of the multicasting in the Network [8]. A combined power control, rate control and link scheduling algorithm was presented in [9] where the optimization theory [18] of convex is employed by Zheng et al,. This algorithm revolves around the issue of interference and limited power in link scheduling process, and monitors the congestion in transport layer. This kind of scheme is not suggestible for wider networks [9]. Thus there needs to have a greater efficiency in the routing strategy for multiple paths and by considering the node energies in the path.

3. The Multipath Range Routing (AOMDV_RR) Algorithm

The analysis [10] of the effect of transmission range by considering different dimensions on MANET routing protocols AdhocOMDV, AdhocODV, DSDV and MDART. Aforementioned protocols delivers good performance when the topological area of the network is double that of the transmission range. Hence we adopted AdhocOMDV a multipath distance vector protocol for improvement.

3.1 Ad Hoc on-Demand Multipath Distance vector (Ad-hoc-OMDV) Routing Protocol

A routing protocol concerned with multiple paths in ad-hoc networks with similar characteristics of the distance vector routing is the Ad-hoc-OMDV. The unique characteristic of AOMDV is that, it doesn't use source routing and will provide unique routes from origin to destination nodes. It computes alternate paths without much additional overhead than AODV and no coordination overheads between the nodes like some of the MANET routing schemes. The routing concept consists of two aspects searching for route to receiver node and when found the route that needs to be maintained.

In the route searching process, the origin node floods the route request packets (RREQ) to all the neighbouring nodes in the network with a distinct ID and destination sequence number. If destination nodes found then a route repeat packet (RREP) is destined to the origin node through the traversed path and if nodes in between receives the RREQ packet then if the node has the routing information about the receiver the it reacts with RREP packet, otherwise it will forward the packet to neighbours.

If the routing information is not available in the intermediate node's routing table or if any path failure occurs, a route error packet (RERR) is triggered to the origin node. Thus by following this procedure multiple routes from source to destination is found and a path with minimum hop count is chosen for transmission and if that route fail's then an alternate path with less hop count among the routes present in the routing cache is chosen for data transfer.

3.2 Received Signal Strength Calculation

The routing methodology is to be changed based on the received power calculation of nodes present in the path to destination node. This scheme of transmission power is used for estimation of the received signal strength at the nodes in the network to choose the region for routing. The transmission power of the node's are set as equal and the distance vector routing protocol assumes the links to neighbour nodes to be possible to transmit in both directions. The received signal strength estimation is done theoretically by considering the radio wave propagation models and device parameters. The models depicts the wave propagation as a distance function, frequency and some conditions to estimate the effective area covered by the transmitter. In the related survey different radio wave propagation models are discussed -two-ray ground reflection model, free space model and the shadowing model. First two models of radio wave propagation assumes the range of communication as an ideal circle. If both the source and destination are in visible distance to each other then it comes under the free space propagation model. The received signal strength (RSS) varies based on the changes in parameters like the transmission power, separation against the transmitter and receiver and the antenna gain. As the distance increases the RSS decreases.

Based on the calculation of cross-over distance d_{cros} and the separation between the transmitter and receiver (dist) radio propagation model is selected. If the separation distance (dist) is less than cross-over distance (d_{cros}) then free space radio propagation model is considered otherwise two-ray ground reflection model is used. The cross-over distance (d_{cros}) can be calculated by

$$\mathbf{d}_{cros} = \frac{4\pi \times Ath \times Arh}{\lambda} \quad (1)$$

The formula given by H.T.Friis [11] for calculating the received signal strength in free space at a separation dist is

$$Sp_r(dist) = \frac{SPt \times Tag \times Rag \times \lambda 2}{(4 \times \pi \times dist)2 \times SL} \quad (2)$$

Here SP_r and SP_t are the signal power of receiver and transmitter, Rag and Tag are the gain of the receiving and transmitting antennas, λ is the wavelength and SL is system loss.

When separation between the transmitter and receiver is more then, a radio model called two-ray ground reflection model is used by considering the line of sight path also. The equation presented below for calculating received signal strength when two-ray ground reflection model is selected.

$$SP_r(dist)= \frac{SPt \times Tag \times Rag \times Ath2 \times Arh2}{D4 \times L} \quad (3)$$

The algorithm for Received Signal Strength (RSS) Estimation by considering the distance d is Function FindRxSigSt atDistance (dist)

The Output:

SP_r The received signal power

Method:

(1)First Calculate CrossDist from Eqtn (1)

(2)If dist is lessthan CrossDist

(3)Then Calculate SP_r from Eqtn (2)

(4) Else

(5) Calculate SP_r from Eqtn (3)

(6) Return SP_r

3.3 Relative Remaining Energy Calculation

At the starting of the simulation all the node energies are considered to be same. The energy consumption model described in [17] at the transmitter is the energy utilised for signal processing and amplification and the receiving side only the energy is consumed for signal processing. For two nodes, E_{TX} the energy consumed at the transmitter is

$$E_{TrX} = \begin{cases} Eelec + \mathcal{E}fs\ d2\ , & \text{if } d < 0 \\ Eelec + \mathcal{E}mp\ d4\ , & \text{if } d > 0 \end{cases}$$

And E_{RX} energy consumed at the receiver is

$$E_{RvX} = E_{elec}$$

The current energy level of the node is the difference between the initial energy and the node energy at the present state of the network. Thus the relative remaining node energy can be estimated by taking the ratio of the energy remaining in the node and the energy of the node at the starting time. The ratio of the remaining energy to the initial energy is the power cost.

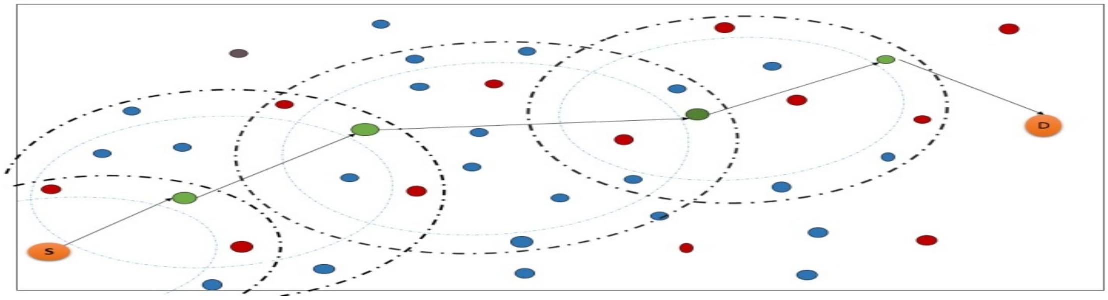

Figure 1. Range Routing Representation

3.4 The Modified AOMDV Range Routing with Relative Energy Estimation

Every node in the network will have certain transmission power by default which facilitates the nodes to reach up to a fixed distance. By using this only certain nodes in edge of the transmission range of a node are allowed to receive and process the routing request thus increases the one hop distance which will reduce the path length as the number of hops are reduced.

Let us consider R be the area covered by the transmission from the origin node S. with the node's default transmission power that a node can transmit up to a radius rad_2 and an area R_1 covered by the radius rad1.let R_2 be the small area at the edge of the communicable range of the origin node.

$$R_2 = R — R_1$$

Thus the nodes in the small are R2 are allowed to receive and process the routing requests minimises the overall path length. The multiple routes are found by using the above process and then the relative remaining energy is also calculated for those paths. Then by using the relative remaining energy estimation the paths are categorised into three levels. These levels are labelled as good, warn and danger levels. Paths in the Good level should have greater than 50% of the starting node energies, warn level has paths with 10%—50% of the starting node energies and the danger level which has paths with less than 10% of the starting energy.

If all the paths are in good level then delay will be considered for path selection and a path with minimum path length is selected and if certain paths doesn't contain the good level of energy will be neglected. If all the paths are in warn level then a path with minimum path cost is selected and if some paths are in danger level then other paths will be selected. Finally if all the paths are in danger level then the source will abort the transmission since if a transmission is initiated there may be maximal loss of data packets.

3.5 Modifications Done in the Proposed AOMDV_RR

The preliminary aim of our work is to modify the routing strategy which is done by improving the routing request and routing reply packets processing steps of the algorithm.

The following pseudo code will show sequential flow of routing message processing section of the algorithm.

When packet is received following method is to be used

Method:

(1)If the type of packet is of AdhocMDV and

(2)If that is a Route Request Packet

(3)Then rad2 is Distance (DefaultTransPower)

(4) rad1 is rad2-Width and

(5)RxSigSt1= FindRxSigStatDistance of rad1

(6)RxSigSt2= FindRxSigSt atDistance of rad2

(7)If RxSigSt greaterthan RxSigSt and

(8) RxSigSt Lessthan RxSigSt2

(9) Then Process the request

(10)Else Drop the request

(11)Else if condition not satisfied

(12)Process other AdhocMDV Packets

(13)Else Process non AOMDV Packets

(14)End

(15)End

The above process is repeated for multiple nodes in the region 'W' which helps to find multiple routes to destination. The received signal strength estimation is done simultaneously during the route discovery process and these routes are categorised based on their estimated relative remaining energies of all the mobile nodes in each path.

4. Simulation Parameters and Results

Simulations are performed using NS3 on Ubuntu Linux operating system. The NS3 version used is ns-3.19. The NS3 coding for AOMDV routing is modified to behave like proposed AOMDV_RR. The random way point mobility model is installed to the mobile nodes and other simulation parameters are tabulated below.

Table 1. Simulation Parameters

Parameters	Values
Number of nodes	20
Transmission range	250m
Rx power	0.9w
Idle power	0
Initial node energy	100-300 J
Antenna Model	*Omni antenna*
Propagation model	Two ray ground
Parameters	Good level >200J Normal level <=150 Danger level <100
Transport protocol	UDP

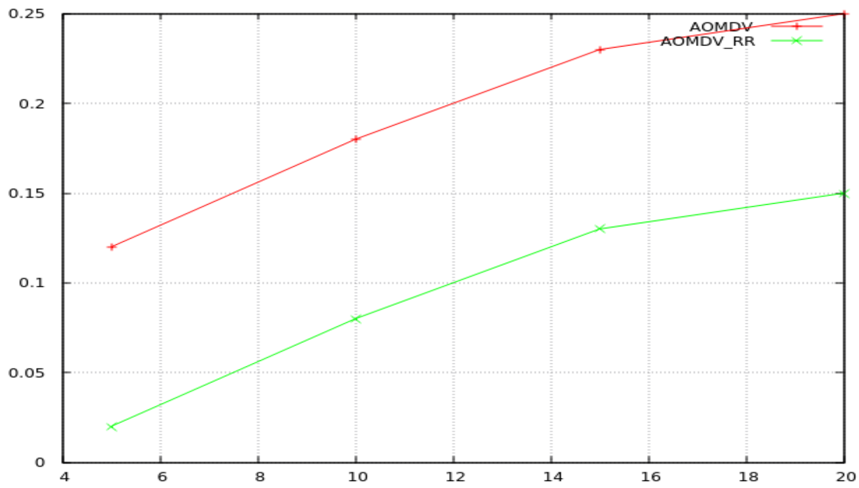

Figure (2). Comparison of AOMDV with AOMDV_RR with Nodes against End-to-End delay

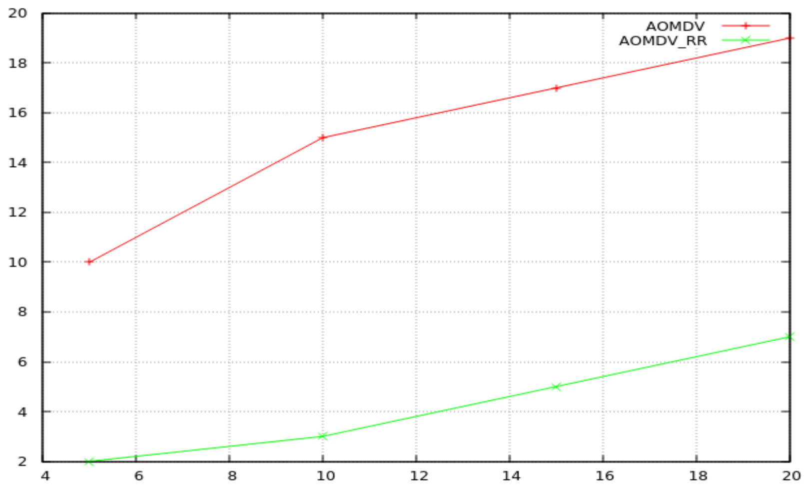

Figure (3). Comparison of AOMDV with AOMDV_RR with Nodes against Packet Delivery Fraction

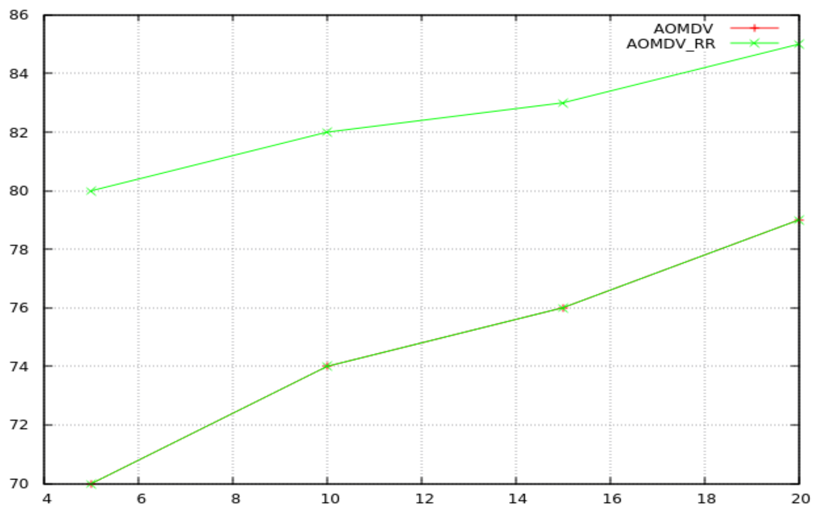

Figure (4). Comparison of AOMDV with AOMDV_RR with Nodes against Throughput

5. Conclusion and Future Scope

The proposed AOMDV_RR routing algorithm was simulated using NS3. The proposed routing strategy is applied to the nodes and the performance is evaluated. These evaluations revealed that the proposed routing scheme performs satisfactorily in terms of considered metrics. Future works may focus on the range routing in dynamic multipath routing protocols. Can also consider the dynamic estimation of transmission range/power and certain route selection schemes based on the energy utilisation of the nodes and network.

References

Acharya, T., Chattopadhyay, S., & Roy, R. (2007). Multiple disjoint power aware minimum connected dominating sets for efficient routing in wireless ad-hoc network. In *Proceedings of IEEE Conference on Information and Communication Technology. International Conference* (pp. 336–340). March 7–9.

Corson, S., & Macker, J. (1999). Mobile ad Hoc networking (MANET): Routing protocol Performance issues and evaluation considerations. Retrieved from http://www.ietf.org/rfc/rfc2501.txt.

Eltahir, Ibrahim Khider. (2007). The impact of different radio propagation models for mobile ad hoc NETworks (MANET) in urban area environment. *The 2nd international Conference on wireless broadband and ultra wideband communications* (AusWireless).

Gomez, J., & Campbell, A. T. (2007). Using variable-range transmission power control in Wireless ad hoc networks. *IEEE Transactions on Mobile Computing*, *6*(1).

Gomez, J., Campbell, A., Naghshineh, M., & Bisdikian, C. (2001). PARO: A power- Aware routing optimization scheme for mobile ad hoc networks, draft-gomez - paro-manet- 00. Txt. *IETF* (work in progress).

Jihen Drira Rekik, Leïla B., & Henda Ben G. (2011). Energy aware and Delay-aware QoS Routing in Mobile Ad-Hoc Networks. *Recent Trends in Wireless and Mobile Networks Communications in Computer and Information Science, 162*, 123-134.

Jing D., Yunghsiang S. H., & Po-Ning, Ch. (2007). Optimal Transmission Range for Wireless Ad Hoc Networks Based on Energy Efficiency. *IEEE TRANSACTIONS ON COMMUNICATIONS, 55*(9).

Kao, J. C., & Marculescu, R. (2007). Minimizing eavesdropping risk by transmission power control in multihop wireless networks. *IEEE Transactions on Computers, 56*, 1009–1023.

Long, C., Zhang, Q., Li, B., Yang, H., & Guan, X. (2007). Non-cooperative power control for wireless ad-hoc networks with repeated games. *IEEE Journal on Selected Areas in Communication, 25*(6), 1101–1112.

MANET.IETF mobile ad-hoc networking group.*http://www.ietf.org/html.charters/manet- charter.html.*

Schmitz, A., & Wangi, M. (2006). The effect of the radio wave propagation model in Mobile adhoc networks. *MSWiM'06*, Torremolinos, Malga, Spain, October 2–6, 2006.

Singh, S., Woo, M., & Raghavendra, C. S. (1998). Power aware routing in mobile ad hoc Networks. In *Proceedings of ACM MobiCom Conference* (pp. 181–190).

Singh, V. P. (2010). Literature Survey on Power Control Algorithms for Mobile Ad-hoc Network. *Wireless Personal Communications-April 2010.*

Vivek, B. K., & Kharat, M. U. (2013). Analysis of QoS for the AOMDV Routing Protocol ETASR – Engineering. *Technology & Applied Science Research, 3*(1), 359-362.

Wu, X., Wang, X., & Liu, R. (2008). Solving minimum power broadcast problem in Wireless ad-hoc networks using genetic algorithm. In *Proceedings of Conference on Communication Networks and Services Research* (pp. 203–207). May 8.

Zheng, V. W., Zhang, X., Liu, D., & Sung, D. K. (2007). A joint power control, link Scheduling and rate control algorithm for wireless ad-hoc networks. In *Proceedings of IEEE Conference on Wireless Communications and Networking* (pp. 3636–3640) March11–15. Retrieved from http://www.cubinlab.ee.unimelb.edu.au/jrid/Docs/Manuel-NS2/node196.html

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