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Review on Energy Efficient Techniques in MANETs

Balinder Kaur[1*], Sunil Nagpal[2]

[1,2]Computer Science, Baba Farid College of Engineering and Technology, Bathinda, India

[*]*Corresponding Author: balindersoni@gmail.com, Tel: +91-81018-10003*

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***Abstract* -** MANET is a type of infrastructure-less wireless communication network system that can be set up at any time and anywhere. Dynamic and infrastructure fewer networks. Power consumption is one of the most crucial design concerns in Mobile Ad-hoc networks as the nodes in MANET are battery limited. The major constraint of this type so networks are Energy optimization because the nodes involved in this type of networks are battery operated. This paper presents different works done in the past to improve the lifetime and other parameters of the mobile ad hoc networks.

***Keywords* -** MANET, DSR, energy efficiency, power consumption

I. INTRODUCTION

The basic architecture of MANET consists of nodes that are dynamically self-organized into arbitrary and temporary network topology without any infrastructure support. The advantage of employing MANET is to offer a large degree of freedom at a minimal cost in comparison to other networking solutions. The ease and speed of deployment of these networks make them ideal for recovery after a natural or manmade disaster, business associates sharing information during a meeting or conference, and military communications on a battlefield. For a wireless network, the devices operating on battery try consume the energy while performing the various tasks on devices or nodes. Utilizing the battery power is not the only factor for deciding energy efficiency also for how much time the network maintained a certain performance level which is usually called the network lifetime. Hence routing to maximize the network lifetime is different from minimum energy routing. Minimum energy paths have more issues like the devices in these paths exhaust their energy very fast. Therefore, the nodes cannot perform any task due to energy consumption. In another way, Routing with large lifetime maintains all the paths and nodes globally so that the network balances certain performance level for a longer time. Hence, energy efficiency is not only measured by the power consumption but in more general it can be measured by the duration of time over which the network can maintain a certain performance level. The energy efficient routing may be the most important design issue for MANET's since mobile nodes will be operated by batteries with limited capacity. Power failure of a mobile node not only affects the node itself but also its ability to forward packets on behalf of others and thus the overall network lifetime has been affected.

Maximizing the network lifetime is a more fundamental goal of an energy efficient routing algorithm: given alternative routing paths, select the one that will result in the longest network operation time. This paper presents various works done in the past to improve the lifetime and other parameters of the mobile ad hoc networks. The broadcasting and congregation of data in wireless sensor network networks are done by employing the electromagnetic waves. As of late, wireless networks are receiving notable importance subsequently because of its flexibility, straightforwardness and amazingly undeviating and cost-saving organization. Wireless networks are getting outstanding because of their comfort. In the case of the wired networks, the users are restricted to communicate at those places where the wired connections are available. In such kind of networks, the clients have difficulty moving freely. Whereas the wireless networks provide users the opportunity to move freely, thus giving more value to the customers. Mobile Ad-Hoc Networks are self-governing wireless frameworks. MANETs include mobile nodes that are allowed to move in the network. A mobile telephone, portable PC, individual computerized help, MP3 player and PC can be considered as nodes. These nodes can go about as host/switch or both all the while. They can structure self-emphatic topologies depending upon their availability with each other in the framework. These nodes are able to put together themselves and due to this interesting capacity, they can be conveyed earnestly without requiring any foundation. Various protocols used for MANETs are AODV, OLSR, and DSR and so on.

A. Applications of MANET

1. Tactical networks
   - Military communication, automated battlefields
2. Emergency Services

- Search and rescue operations
- Disaster recovery – Earthquakes.

3. Educational
   - Virtual classrooms or conference rooms.
   - Set up ad hoc communication during conferences, meeting, or lectures
4. Home and Entertainment
   - Home/office wireless networking.
   - Personal Area network

B. Characteristics of MANET

1. Infrastructure-free: MANET is a self-organized network. It is independent of any established infrastructure and centralized network administration. Here each individual node plays as a router and operates in a distributed manner.
2. Multi-hop routing: Due to the absence of any dedicated router, here every node act as a router and aids in forwarding packets to the destination node. That's how information sharing among mobile nodes is made available.
3. Dynamic network topology: The topology of MANET changes frequently as MANET nodes move randomly in the network, hence leading to regular route changes, network partitions, and possibly packet losses.

II. LITERATURE SURVEY

A. Modified DSR

The authors of this paper proposed the modification for route discovery mechanism in normal DSR protocol for energy efficient route establishment. In M-DSR the authors have modified RREQ packet by adding one field into it, the value of energy consumed for transmission and reception of the single packet. When this packet is received by the node, it adds this energy consumption information of sending node into its routing table. When routing table is updated, as normally done in DSR, this node will forward this received MRREQ packet further to reach it up to the destination by replacing energy field in the MRREQ packet with a newly calculated value of energy consumption for transmission and reception of the single packet. As this MRREQ packet propagates along the nodes in the network, all the neighboring nodes of a particular node will have knowledge of energy consumption of this node for single packet transmission and reception, which is stored in their routing table.

When MRREQ reaches to destination node up to which route is being discovered, will send RREP. This RREP follows the route in a unicast manner by selecting low energy consuming nodes in the route rather that following multiple paths as in normal DSR protocol.

This assures selection of nodes in the route having minimum energy consumption rather than having a minimum number of hops in route with high energy consumption. This also assures in minimization of routing overhead by omitting propagation of RREP from multiple paths.

B. ERMP

In this paper [2], the authors have proposed an energy-aware random multipath routing protocol (ERMP) based on AODV. ERMP consists of the following four parts.

1. Avoid using low battery nodes: If possible, the authors have proposed not to use the low battery nodes in the processing of route discovery.
2. The route with multi-path: Except for the shortest path, find other paths for routing.
3. Detect the quality of links: ERMP uses ETX (Expected Transmission Count) metric to detect the delivery ratio among nodes in the path. To decrease the cost of packets losing, the source node can be informed that the link is going to fail.
4. Distribute power consumption: Considering the lowest battery node in the path, the path which has less residual battery energy will forward fewer packets.

These four parts works in different stages in ERMP route choosing. In route discovery, the nodes with low battery are avoided to prevent the network partitioning. In packet forwarding, multi-path routing is used to distribute power consumption. In route maintenance, ETX metric

Is used to detect the quality of links. Furthermore, in packet forwarding, ERMP uses probabilistic packet forwarding algorithm based on the residual power of nodes. Compared to directing distribution, probabilistic forwarding is easier to implement and the effect is similar. ERMP presents better performance on network lifetime, the standard deviation of residual power and average end-to-end delay by comparing with AODV.

C. *M-EALBM*

In this research paper, the authors have provided a novel solution to transfer server load from one server to another server. The proposed solution will not only distribute complete transmission traffic to multiple routes but will also filter out inefficient routes according to energy status. This filtration will avoid undesirable link break because of node's poor performance. This work proposed a residual energy-based algorithm to overcome the load traffic problem. The network is deployed initially and configuration of Battery and Energy Model to every node and server is done with default values. It continuously monitors server load after 2 sec of the commencement of the communication. When server residual energy reduces from the default value to 40 it transfers 50% of incoming traffic to server 2. When Residual energy power of server 1 reduces from less than 20 it forward all incoming traffic to server 2 and shift server 1 into passive condition.

Deepti Badal, Rajendra Singh khushwah (2015)

Modification in DSR protocol can make it considerable and it can improve energy efficiency to enhance the lifetime of battery operated mobile ad-hoc networks. This paper

proposes the modification for route discovery mechanism in normal DSR protocol for energy efficient route establishment. Modified DSR protocol shows good performance in terms of enhancement in energy efficiency as compared to DSR, AODV and DSDV protocol. DSR protocol has an increasing size of the header as message propagates in the network during the route discovery mechanism. Enhancement can be done in modified DSR along with load sharing mechanism using energy efficient paths. It can increase the lifetime of the network by equal energy consumption strategy among all nodes.

Abhilasha Gupta, Raksha Upadhyay, Uma Rathore Bhatt (2014)

The paper aims to minimize the number of route requests (RREQs), which is a significant source of overhead for the DSR. In this paper, the modification of the DSR algorithm is done to enhance its performance. In the proposed modified DSR i.e. Mobile internetwork broadcast infrastructure technique (MIKBIT) multicasting approach is used to reduce packet overheads. The performance parameters such as throughput, average end-to-end delay, average jitter and packet delivery ratio are evaluated for the proposed algorithm and compared with that of existing DS routing protocol. Comparing the proposed protocol with the DSR protocol, it is found that MIKBIT performs better than DSR protocol because it reduces route request packets.

Mustafa Ramadhan and Mark Davis (2009)

A cross-layer modification to the DSR protocol is presented in this work which is intended to enhance the global throughput performance of wireless mesh networks. In this work, we have employed the OPNET modeler simulator to investigate the performance of the modified DSR protocol on a series of randomly generated network topologies of different node densities. The simulator was run twice for each network topology. Incorporating this information into the DSR protocol serves to reduce the cost of Route Discovery and the overall performance of the network can be significantly improved. Using OPNET modeler as a network simulator showed that significant improvement in the global throughput of the network can be achieved through our modified DSR algorithm by discovering routes with a high throughput rather than a minimum hop-count.

N.M. Upadhyay, K.Gaurav and A. Kumar (2014)

MANET is a type of infrastructure-less wireless communication network/system that can be set up at any time, anywhere. In MANET each and every process consumes power. Power consumption is one of the most crucial design concerns in Mobile Ad-hoc networks as the nodes in MANET are battery limited. In this paper, a new route discovery mechanism is proposed to conserve the energy of nodes during route discovery and data transmission phase compare to original DSR protocol. The proposed work is verified using NS-2 simulator. In this paper, our main aim is to conserve the power during route discovery and data transmission in MANET using the DSR protocol. We have proposed a new solution in the route discovery of DSR and we named the new DSR protocol as MDSR i.e. Modified DSR protocol which conserves the energy during transmission compared to the original DSR protocol using the NS-2 simulator. The simulation result shows the objective is achieved.

Future work: As we know that the nodes in the Mobile Ad hoc networks are mobile in nature. Due to this, the topology of the network changes frequently. Due to the mobility of nodes, there is a probability of link failure during the transmission of packets in MANET. We also know that the energy consumption is one of the most important problems in MANET. In DSR protocol link failure happens due to the mobility of the node. During the route maintenance, the extra energy is required to establish the link between source and destination. Hence there is more improvement required in route maintenance and also in fastest and efficient route discovery process is required to improve the performance of DSR, which leads to more future research.

Sirisha Medidi and Peter Cappetto (2007)

History-based route selection's minimalism suits the needs of the portable wireless devices and is easy to implement. We implemented our algorithm and tested it in the ns2 environment. Our simulation results show that history-based route selection achieves higher packet delivery and improved stability than its length-based counterpart. In this paper, we have described a light-weight route selection algorithm augmenting existing reactive routing protocols. It extracts and collects statistics from the underlying routing layer at no extra cost. Using this information, it selects routes based on the quality of the nodes based on their performance history.

Mrs. Suganya Senthil, Dr.Palaniammal Senniappan (2011)

This paper presents a survey on power efficient routing protocols for Mobile Ad-Hoc Networks. This survey centered on recent progress on power saving algorithms. In addition, we suggest one energy efficient technique which will reduce energy consumption as well as increase the lifetime of the node and network. A Mobile Ad Hoc network (MANET) is a collection of nodes that can communicate with one another without any fixed networking infrastructure. Energy efficiency is one of the main problems in a MANET, especially in designing a routing protocol. In this paper, we surveyed and classified a number of energy-aware routing techniques. For instance, in the transmission power control approach, the power level is essential but the cost is not considered. The load distribution approach is efficient to improve the energy imbalance problem. There are different channels for sending data and control packets to reduce the energy consumption in power management approach but it increases the network traffic. The proposed power aware algorithm combines the features of existing techniques to decrease the energy consumption and increase the lifetime of the node & network.

P. Sivasankar, Dr.C. Chellappan, S. Balaji

MANET is a dynamic and infra structure with fewer networks. The major constraint of this type ad networks are Energy optimization because the nodes involved in these type of networks are battery operated. This paper presents an analysis of the effects of different design choices for this on-demand routing protocols in wireless ad hoc networks. The analysis of this paper is based on the Dynamic Source Routing protocol (DSR), which operates entirely on-demand. This paper compares an existing DSR protocol with the proposed two modified DSR protocols named Maximized Energy Efficient Routing protocol (MEER) and Cluster-Based Energy Efficient Routing protocol (CBEER). The DSR protocol has been implemented and compared with the modified energy aware MEER and CBEER protocols and it is observed that the improved performances of the ad-hoc network. It is found that the modified algorithm has a comparable performance with respect to Average Energy left, End to End Delay, Throughput and Control overhead with the existing DSR protocol. It has also been observed that by implementing a proper standardized energy model in the existing DSR protocol, our MEER and CBEER protocols are feasible and capable of better energy performance than the preset DSR protocol.

Hassanali Nasehi et.al has proposed an algorithm in this research to find out the different paths between the source and destination nodes by the use of Omni directional antennas, to send or carry information through these antennas. So, for this method, the number of active neighbors is counted in each direction by using a strategy. These methods help to select the paths. The new approach depends upon the AODV routing algorithm, and at the end, the comparison has been done with the multipath routing protocols like AOMDV, AODVM, and IZM-DSR which are based on the AODV and DSR Protocols. The obtained simulation results show that by using this new algorithm, it creates a significant improvement in energy efficiency and reducing end-to-end delay.

III. OTHER RELATED WORKS

Patil and Gaikwad (2015) in a survey paper have talked about different protocols, their alteration, which incorporates energy effectiveness using the significance of energy effective directing procedures. They concluded that there is no such protocol that can provide the finest execution in an ad-hoc network. Execution of the procedure differs as per the variety in the network factors. Now and then, the portability of the node of the network is great, in addition to this, it is small yet energy of the node is a major worry.

Aashkaar and Sharma (2015) proposed an improvement in an AODV procedure, which is an upgrade in the current AODV procedure. The procedure computation, which is obtained by Energy Efficient Ad Hoc Distance Vector tradition (EE-AODV), has upgraded the RREQ and RREP taking consideration of system to save the essentialness in phones. In this paper AODV, the procedure is executed by using 30 nodes. The goal of this paper is to quantify the efficiency of protocol at 30 nodes. The execution estimations used for evaluation are conveyance proportion, throughput, framework lifetime and typical energy expended. The recreation was done using NS2.

Kuo *et.al*, (2016) investigated EE optimization as measured in bits per Joule for MANETs in light of the cross-layer outline paradigm. They showed that this issue as a non-arched blended integer nonlinear programming (MINLP) definition by jointly considering routing, activity scheduling, and power control. Since the non-raised MINLP issue is NP-hard largely, it is exceedingly hard to upgrade this issue. They devised a modified branch and bound (BB) procedure to productively take care of this issue. The originalities of their proposed BB procedure include upper and lower bounding plans and branching standard that are composed using the qualities of the nonconvex MINLP issue. Numerical outcomes demonstrated that the proposed BB calculation plot diminishes the optimality hole 81.98% and increases the best possible solution of 32.79% contrasted against the reference scheme. Besides, their outcomes not only gave insights into the plan of EE amplification calculations for MANETs by employing cooperation between various layers additionally serve as execution benchmarks for distributed conventions produced for genuine applications.

Yadav and salem *et.al* (2016) proposed a technique for improvement of the QoS performance of the load balancing method in addition to augmenting the network lifespan. The different categories of routing procedures are explained with diverse aims and intents for MANETs.

IV. EXISTING PROBLEM

The nodes in mobile ad hoc networks are battery driven and are mobile in nature. They continue to move from one position to another and their routing is governed mostly by the reactive routing protocols such as DSR and AODV. Since the reliability of data is very important so all the packets sent by the source node must reach the destination node intact otherwise it results in loss of data packets. The packets loss in the network can be due to packet collision, it may result due to the presence of some malicious node in the network, the packet loss may be resulting out of link breakage etc. The existing routing protocols provide the shortest path from source to a destination node in terms of hop count. These do not consider the energy efficient routes neither they consider the quality of the links while deciding the route between the source and the destination node.

The mobile nature of nodes in ad-hoc networks results in link breakage between the nodes. This is one of the factors that lead to packet loss and the results in a decrease in the throughput which is defined as the amount of data that is received at the destination node. In the study done by Navin Mani et al in "Modified DSR an Energy Conserving Approach to DSR Protocol in MANETs", the authors have

taken the remaining energy of the nodes into account while forming the route between source to destination node. In normal DSR the route between the source and destination is made on the basis of minimum hop count. The authors modified the route discovery process by taking the energy from the nodes into account. The path which has the highest remaining energy of the nodes is considered best path.

V. TENTATIVE FUTURE WORK AND OBJECTIVES

The mobility of the nodes causes another issue, namely link breakage between the nodes. If the nodes are moving at high speed it results in link breakage between the nodes resulting in packet loss and the decrease of throughput. In future, we will take the mobility of the nodes into account to avoid the link breakage between the nodes and to increase the performance of the network.

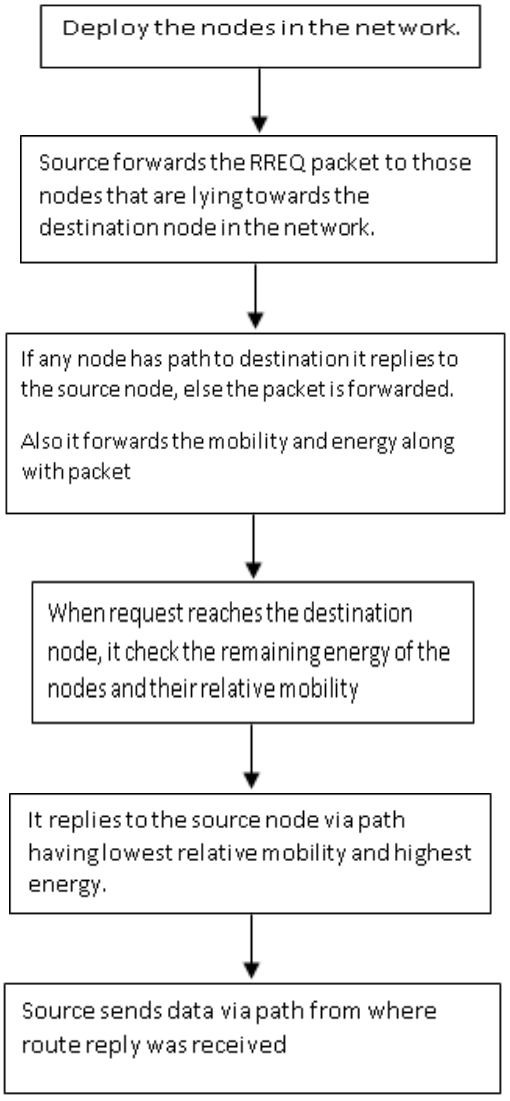

Figure 1: Flowchart

In order to reduce the energy consumption and link breakage of the network, the modified broadcasting and mobility of the nodes must be taken into account. In this study our main objectives will be:

1. To study various techniques focused on reducing the energy consumption of the network.
2. To analyze the performance of the network using Modified DSR in NS2.35.
3. To design an algorithm to reduce link breakage in MANETs.
4. To implement the proposed algorithm based on DSR in NS2.35.

To Compare the performance of the proposed scheme with Modified DSR on the basis of energy consumption, throughput and routing overhead.

VI. CONCLUSION

This paper has presented three approaches with a view to improving the performance of the mobile ad hoc networks. While M-EALBM focuses on balancing the load over the nodes, the ERMP, on the other hand, divides the whole operation into four parts with maximum preference being given to high energy nodes during the packet forwarding process. The M-DSR, on the other hand, has also worked on the energy efficiency of the network. But none of the approaches have considered the mobility of the nodes as the major reason for link failure, in future we would like to work on one of the approaches by considering the link failure issues to further improve the performance of the network.

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Authors Profile

Ms. Balinder Kaur pursed Bachelor of Technology in Computer Science from Guru ram dass instirute of Engineering and Technology, Bathinda, India in 2015. She is currently pursuing M.Tech. From Baba Farid College of Engineering and Technology in Computer Science since 2015. Her main research work focuses on MANET, Energy Eiffiency in MANET and Networking.

Mr. Sunil Nagpal pursed Masters of Technology from Yadavindra College of Engineering, Talwandi Sabo, India in year 2010. He is currently pursuing Ph.D. and currently working as Assistant Professor in Department of Computer Sciences, Baba Farid College of Engineering and Technology, Bathinda, India. He has published more than 6 research papers in reputed international journals. His main research work focuses on, Big Data Analytics, Data Mining, and Natural Language Processing based education. He has 10 years of teaching experience.

