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A Novel Approach on Energy Efficient AODV Algorithm for MANETs

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ABSTRACT: MANETs are a collection of unstructured wireless mobile nodes which provides independence and scalability for mobile networks. It is composed of moving mobile nodes that are battery operated. In AODV routing protocol, first of all broadcast the hello message to discover the Neighbor node and then source node broadcast RREQ (Route Request) packet to Neighbor node for finding path to the destination node. If The Neighbor node having less energy, as well broadcast RREQ and it lifetime expires after some certain time (i.e. node goes down), it cannot forward RREP (Route Reply) on reverse path and also cannot carry the data from the source node that's why source node has to rebroadcast RREQ that results is overhead of the RREQ message, less packet delivery ratio and throughput and more energy consumed. These problem have to be solved so here can proposed energy efficient AODV algorithm based routing protocol. In this paper proposed, source node does not send any data packet; until no enough energy (battery life time) of intermediate node and received RREP of its neighbouring exceeds a particular threshold. In this paper also suggested two approaches for making energy efficient algorithm. The performance of the proposed protocol will simulate with the help of NS-2.34 simulator for various scenario using different parameter, also survey on energy efficient algorithm. At last finally we concluded that the proposed protocol improves energy efficiency, network throughput and network lifetimes.

KEYWORDS: MENET routing;AODV;energy consumption;RREQ;RREP;beacon(Hello) messages

I. INTRODUCTION

The Mobile AdHoc Network is described by random Movement of mobile nodes in wireless scenario, in order to find the best possible path between sources to destination; Mobile Ad Hoc Networks (MANETs) are communication networks built up of a collection of mobile devices which can communicate through wireless connections as shown in Fig.1

The wireless networks are mainly composed of two type's infrastructure based network and Ad-hoc network. In case of infrastructure based networks there is a central station called access point (AP) which provide a wireless link between AP and a mobile data terminal equipment having antenna (can be a laptop or notepad computer).The routing procedure is also controlled by these access points, in such environment range of transmission is fixed. While in case of Ad-hoc networks the base station or access point is absent. Every node present in the network performs all the functions of base station and routing decisions are also taken by them. MANET or the mobile ad-hoc network is a flexible and self-configuring network containing large number of wirelessly connected independent nodes[2][6]. A number of routing protocols using a variety of routing techniques have been suggested for use in MANETs.

Routing protocols are used in wireless communication. As there is no dedicated path between the nodes a routing strategy is helpful in exploring the shortest path. Hence, routing algorithms should be robust and adaptive in a decentralized and self-organizing way. Due to the nature of mobile ad hoc networks it is non-trivial problem to find path from source to the destination and performs the communication between nodes for a long period of time. The types of routing protocol are Proactive and reactive routing protocol. In proactive routing protocol is table driven, it

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means each node has a table corresponding to every other node present in the network and the shortest path from source to destination is found using these tables. Where In the Reactive protocols are on demand routing protocols, it means whenever a node has any information to send to some other node then only it finds the most suitable path. AODV and DSR are the type of reactive protocol which is mostly used in research work [3]. A lot of works on this network is done by researchers in order to have energy efficient routing protocols.

Fig.1 Ad-hoc Network

Organization of the paper is as follows. Section I describes MANET and routing protocol. Description of the AODV is found in Section II. Section III, related work done on AODV. Problem statement obtains in Section IV. Proposal for making an energy efficient AODV describe in Section V. Section VI present the proposed algorithm to enhanced aodv routing protocol. Conclusion and future work in Section VII.

II. OVERVIEW AND OPERATION OF AODV

Challenges in Mobile Ad-hoc Network

In MANET the qualities that make Ad hoc networks a distinct type of wireless network are only the big challenges for Ad hoc networks and are discussed in this section. Some of the basic challenges of Ad hoc networks are as limit wireless network: in these packet losses due to transmission error and limited wireless range also overhead of routing is the main issues. The size of the network is not fixed due to the Ad hoc nature of network. At one end, old nodes can leave the network; on the other side new nodes can join the network. Another is the Mobility of Nodes in which nodes may or may not be mobile so it is difficult to design topology of network and induce the route changes [12]. Dynamic Topology is directly connected between nodes can be broken and renewed rapidly due to mobility. As compared to the wired network topology of these networks changes very frequently, where topology changes is generally due to occasional link failure or link re-establishment. Participant nodes in Ad hoc networks can change dynamically and can join or leave the network independently. Due to this nature of ad hoc networks it is difficult to provide centralized control. Therefore No Centralized Control is occurred. All nodes share a common channel, thus, only a fraction of bandwidth this available for every node. Hence effective Bandwidth requirement is more. The remaining battery power of a node plays a major role in enhancing the lifetime of a network. Due to power loss, node goes down and link to reach destination path will be failure. Thus, maintaining residual power of a node is also a big challenge. Other challenges are Auto configuration issues, Security issues, New Applications/services.

Overview of AODV

There are number of routing protocols used in network layer. Here opted AODV an on-demand routing protocol to make it energy efficient. The AODV routing protocol, provides a dynamic and multi-hop routing topology among the mobile nodes [7]. AODV is used for route discovery process of that particular destination node [7]. Whenever source wants to send data to destination, it must first determine path for data transmission. Every node maintains two separate counters: i) A node sequence number and ii) A broadcast-id. AODV algorithm worked using Route Request Messages (RREQ) and Route Reply Messages (RREP). If nodes are not in range with a source node that it wants to talk, it sends a RREQ to its neighbouring node.

The RREQ message contained source IP address, sequence number, destination IP address and sequence number, also life span of the RREQ field. As shown in Fig.2 that source node sends a RREQ message to its Neighbor node. If a

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Neighbor of the source node doesn't know a route of the destination node, it rebroadcast the RREQ message. If a Neighbor node does know the route of the destination node, it sends a RREP back to the source node which is shown in Fig 3. Here in this Fig. destination node (D) reply back to the source node(s) via Neighbor node C. Once source node receives the RREP from its Neighbor node (C) , it store the route to destination node and sends the data packet on that route as shown in Fig 3.When link breaks between source and destination, intermediate node which lost path sends route error (RRER) toward source. Route error message consist of an Unreachable Destination IP Address and Unreachable Destination sequence number. Each intermediate hop deletes broken routes and forward RRER to the source node. When source node receives RRER message, it determines whether it needs path towards the destination node. If source node needs, it generates RREQ message and starts with route discovery process. Route maintenance: This phase is responsible for maintaining the routes.

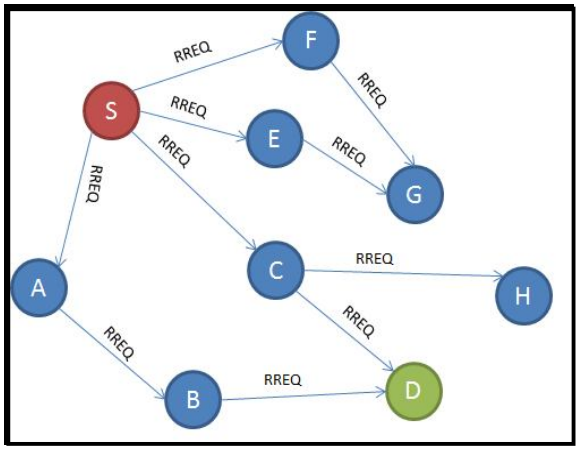

Fig.2.RREQ phase of AODV Routing Protocol

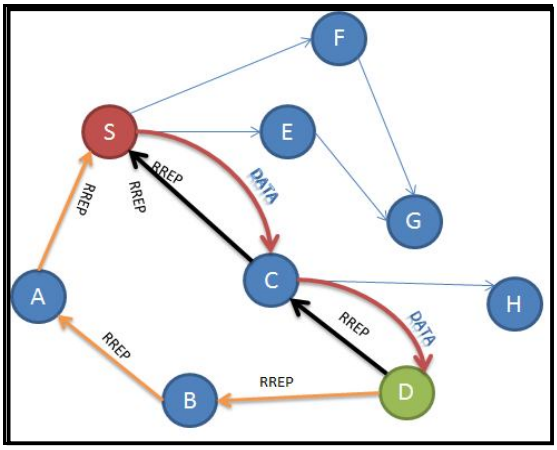

Fig.3.RREP phase of AODV Routing Protocol

Hello messages are used by AODV algorithm for determining link connectivity. If source node passing data to destination node by some of its neighbours, and node moves away from source node at any instant of time, then source node has to get path to destination by discovering new path to destination. Instead if every node keeps information about its neighboring nodes then it helps particular node to take better routing decision [7]. These are simple messages that nodes send at certain time intervals to all its neighbors to let them know that it is still there; also it creates or refreshes the routing table entry to the Neighbor [8]. If a source node stops reply from hello messages from one of its neighbors, it shows that node no longer exists.

Two variables control the determination of connectivity using hello messages: HELLO INTERVAL and ALLOWED HELLO LOSS. HELLO INTERVAL specifies the maximum time interval between the transmissions of hello messages. ALLOWED HELLO LOSS specifies the maximum number of periods of HELLO INTERVAL to wait without receiving a hello message before detecting a loss of connectivity to a neighbor. The recommended value for HELLO INTERVAL is one second and for ALLOWED HELLO LOSS is two [8].In other words, if a hello message is not received from a neighbor within two seconds of the last message, a loss of connectivity to that neighbor is determined.

Limitation of AODV

As mobile communications devices in ad hoc network are batteries operated and have limited energy, so the network is an energy constrained system. But while optimizing the routing with lowest delay, AODV algorithm does not consider the power usage as a metrics. If the nodes have many neighbors so RREQ get rebroadcast.so it's more complicated. That's why sequence numbers and life spans of the node more complicated. From the perspective of energy, the shortest path is not always the optimal path. Due to cost optimality, if the same paths are being utilized repeatedly, the nodes energy along these routes will be consumed quickly and they may exhaust their batteries faster. As a consequence, the device gets switched off and goes out of network leading to disconnected sub-networks. Therefore,

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energy usage should also be considered as the major metric in selecting the optimal path. [3] Data packets may be delivered to too many nodes that do not need to receive them so wastage of more energy. Rapidly Broadcasting Hello Messages when network is stable it consumes more energy.

III. LITERATURE REVIEW

A lot of related work has been done on energy efficient AODV routing algorithms in MANET.Dr. Annapurna P Patil et al [13] have a conducted study on battery life of the nodes in IEE_AODV protocol has been efficiently utilized by choosing a path with maximum energy. It has also been analytically proved that, the amount of remaining energy helps to probabilistically determine an efficient path.
Uma Rathore Bhatt et al [14] analysis of AODV & DSR routing protocols is done to understand that which one performs well in which set of conditions. Focus is mainly done on the network parameters like throughput, end to end delay and jitter. By changing the mobility, scenario, no. of nodes & MAC protocol it is seen that as the mobility is increased DSR performs well. Secondly, in the scenario with multiple zones & single destination for CSMA & ALOHA MAC layer protocols, AODV is far better. In the scenario with single source & multiple destinations, DSR outperforms.
Priyanka Jain et al [10] Enhanced Version of AODV presented EERP protocol to reduce the transmission power of a node which is part of an active route if next hop node is closer. The distance can be calculated based on RSS (received signal strength) from next hop during the route reply process. In request phase, if the RSS is high than threshold value then that node will consider for forwarding the packet. In reply phase, if the RSS is high, it implies that nodes are closer; as a result lesser transmission power will be required to send data. At this point reduce the transmission power of the node. This in turn reduces battery consumption. This energy efficient routing mechanism is incorporated into AODV and provided EERP. Transmission power control which reduces interference extend the battery lifetime of network.

Hannan Xiao et al [9] proposed a set of performance metrics in evaluating network performance in terms of energy efficiency at different network layer including application, routing and MAC layers and by different operation mode including idle, transmit and receive. The simulation results shown in the figures are the average of five different simulations that were executed using the same representative parameters but with different mobility scenarios.

Bhabani Sankar Gouda [1] presented a new Energy Optimal approach in Mobile Ad Hoc Network on Demand routing protocol, which modifies broadcast mechanism of conservative AODV routing protocol. Successful delivery of RREP is significant in MANET to improve network throughput, energy efficiency and network lifetime as well as minimize end to end delay.

Qu Lei et al [11] this paper, give an improved algorithm with energy levels and Hello mechanism, it effectively extend the network's lifetime, improve the successful packet rate, overcome the defects of other algorithms which not fully considering the factors of Routing Price Function.
Fahamida Firoze et al the aim of this paper is to evaluate the performance of energy aware routing protocol, called MECB-AODV (Modified Energy Constraint protocol Based on AODV) which derives from the AODV protocol and which is based on the local decisions of intermediate stations to maintain the connectivity of the network as long as possible and try to make equal energy of the node [15].

Reena Singh et al [3] paper proposes an EEAODV routing protocol which is an enhancement in the existing AODV routing protocol. The routing algorithm has enhanced the RREQ and RREP handling process to save the energy in mobile devices. EE-AODV considers some level of energy as the minimum energy which should be available in the node to be used as an intermediary node (or hop). When the energy of a node reaches to or below that level, the node should not be considered as an intermediary node, until and unless no alternative path is available. Simulation results that lifetime of network increased in EEAODV as compared to AODV.

Dr. Pardeep Kumar Mittal et al [16] this paper presented that The greatest challenge in the design of wireless ad hoc networks is the limited availability of the energy resources and to overcome the problem of energy conservation there

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exist a lot of routing protocols. Performance of the protocol varies according to the variation in the network parameters and network properties. So, the choice of the protocol is the basis to perform in a particular type of network.

Prerna Malhotra et al proposes an Energy based Ad-Hoc on-Demand Routing algorithm that balances energy among nodes so that a minimum energy level is maintained among nodes and the lifetime of network is increased [17]. In this paper survey about different Energy efficient AODV routing algorithms.

Dr.S.V.Sankpal et al [4] this paper describes improvement of the conventional routing protocol by utilizing high energy paths in the network and 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. The proposed MELAODV 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.

Seema Verma et al attempts to modify the popular on demand routing protocol AODV to make it energy aware, also varies the transmission power between two nodes as per their distance also finds the best route and increases the lifetime of the network [5]. The protocols are simulated using Network Simulator (NS-2.34).
Shwetha Ramasamy et al [6] in these protocol initiate route discovery only when a route is required and maintain active routes only when they are used, unused routes are deleted. In other words, it discovers and maintains routes on demand. The routing protocols would be evaluated in the forms of metrics like User Datagram Protocol (UDP) traffic by utilizing the Network Simulator (NS2). This paper analysed AODV routing protocol at various configurations in different constraints for a set of network topology and mobile nodes.

Tejas Vasavada et al [7] this papers studies performance of AODV routing protocol in two cases: (i) when nodes do not keep track of changing neighborhood (ii) when nodes do. Packet Delivery Ratio and residual energy are the two performance matrices of interest.in highly mobile environment use of hello message helps us to get better PDR than without using hello message, but it also requires little bit more energy of a node. If reception ratio of hello message is equal to data packets, then increase the effectiveness of hello message.

IV. PROBLEM STATEMENT

In general conservative AODV routing algorithm, when source node wants to communicate with the destination node it broadcasts RREQ message to its neighbor node. If intermediate nodes' energy is not much of carry the data or as we can say that couldn't reply back to the source node. Hence, the source node would have to rebroadcast the Route Request (RREQ) message in order to find an proper path for communicating to the destination node. This may consumption more energy of the node and network goes down earlier.so energy efficient problem have to be solved in research area for MANETs.

V. NEW PROPOSALS TO ENHANCE THE AODV PROTOCOL

The modification and enhancement to the AODV protocol in order to make it energy efficient routing algorithm as follows.

A. Changes proposed in route request phase to make it energy efficient.

In AODV when route establish phase occurred and need to communicate with another node there is no routing information is present in its routing table. Whenever a source node(S) sends RREQ to its neighbors for identify the path of the destination node (D), first neighbor node of the source node should send its energy level in response to that RREQ message, if path to destination node (D) is available. If the source node gets value of energy from its neighbor which contains the threshold energy value or less than that, then discard that node from packet delivery and find another path to send the data as well as ensure that the maximum energy level as its next hop.so add threshold energy field at the end of RREQ datagram or we can use Reserved bit for this and make it energy efficient.

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B. Changes proposed in timer variation to make it energy efficient.

A simulation of the Ad-hoc on demand Distance Vector routing algorithm to simulate the effectiveness of hello messages for monitoring link status. Hello packet transmits at every second therefore it consumes more energy. Instead of transmit very second to specify some time interval to transmit hello messages it will give better result of throughput also save the energy. Control the Hello packets Timer Expire field which broadcasts the packets after every second to discover route.

VI. PROPOSED ALGORITHM

The general operation of on demand protocol is loop-free, and by avoiding the counting to infinity problem offers immediate convergence after the ad hoc network topology changes. The protocol that is proposed in this paper integrates the concept of threshold enegy into AODV in order to make it energy efficient.The main messages are Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) types defined by reactive routing. On demand protocols builds directions using a route request / route reply messages.

The proposed algorithm shown in Fig.4. which is said that when source node want to communicate with the destination node first of all to identify the neighbor of the sender node through the broadcasting Hello messages that explain above the section II.If the neighbors are detect then send RREQ message to communicate with the destination node.After receive the RREQ message to check the valid route is there to reach destination.so Intermediate node must be RREP back to the source node with its energy level. That knows that the intermediate node have how much lifetime or enough energy to carry the data or not.This done to add throshold energy field in RREQ message format,if below the energy level then find another route for route discovery and if above the threshold level then send the data packet on that route.

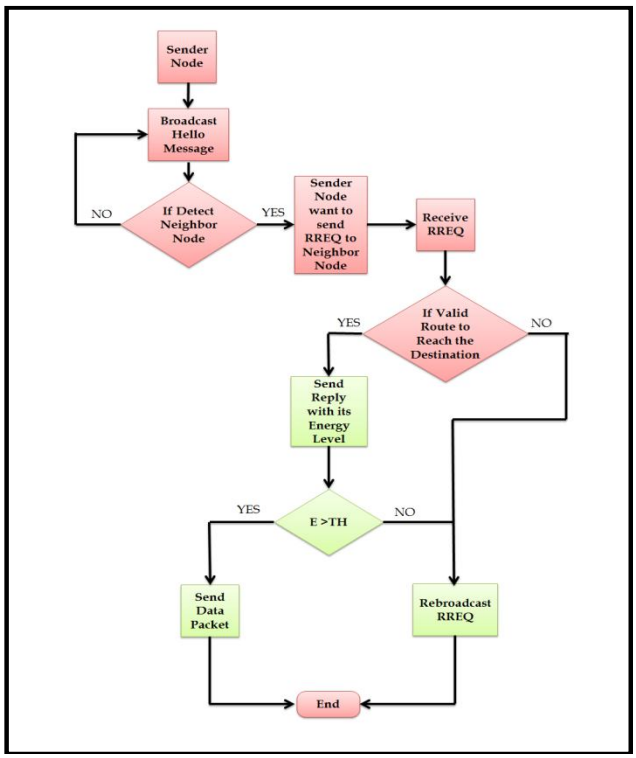

Fig.4.Proposed Algorithm

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Here TH stands for threshold energy and E stands for energy level of the node. Therefore implement this may be we can reduce the consumption of the energy without lossing throughput and whole network will be energy efficient.reduce the consumption of the energy without lossing throughput and whole network will be energy efficient.

VII. CONCLUSION AND FUTURE

In this paper we provided an overview of MANETs and discussed how energy is one of the important constraints for mobile ad-hoc networks. The objective of the proposed work is to develop an Energy Efficient AODV routing algorithm in a way that an optimal route from source to destination can be selected by keeping energy consumption factor as an important parameter. So, if the optimal path is available through the intermediary node having less power and source node has one more route as an alternative to send data. Then second route should be opted by the source node.

My next job is to design an algorithm that reduces energy of the number of node that are lost due to requests sent and received to or from the source or destination. The future work we'll solve the energy consumed during the transmission from the source and destination also provided a significant path of data sent to a destination. We can also extend this work proposing more efficient methods. Further work in this area can be carried out in a direction to save energy of the nodes when they are in idle mode. As it is merely wastage of energy.

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