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Improved Energy Efficiency using Multipath AODV Routing Protocol over MANET

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Abstract: A Mobile Ad-hoc Network (MANET) is the network of self-configuring nodes without having any fixed infrastructure. In mobile ad hoc network all the node have limited battery & lifetime in the network. Node movement is frequent. Every node is host as well as router. In mobile ad hoc network (MANET), energy consumption is one among the foremost vital restrictions that deteriorate the performance of the whole network. Multi-path routing is better than the single path routing in ad hoc networks, because multi path routing allows the establishment of multiple path between a single source and single destination node. . This paper shows the introduction of MANET and review on various methods of multipath AODV routing protocol over MANET.

Keywords: Mobile Ad-hoc network, Routing protocol, AODV, Multipath Routing, Dos attack.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless devices moving in seemingly random directions and communicating with one another without the aid of an established infrastructure. All the node in the mobile ad hoc network have limited battery, bandwidth & life time. Each node need the help of other node to forward their packetThus, the
communication may be via multiple intermediate nodes from source to destination. Topology changes occur unpredictably. Topology control is needed to determine appropriate topology in adhoc network which saves energy, reduce interference between nodes and extends the lifetime of the network. Based on connectivity, efficiency of energy, robustness to mobility and throughput the quality of topology is determined. Single path routing protocol uses only single best path from available of all paths. Single path routing have many disadvantages. These Protocol does not balance the load of traffic if they have resources are available. Multi path protocols learn routes and select more than one path to reach the destination. They are better for load balancing.

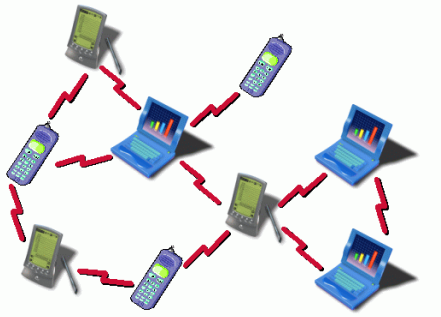


Figure 1 : Mobile Ad Hoc Network [1]

1.1Characteristics of MANET[2]:

Dynamic topology : Nodes might move resulting the topology changes. So that screen shot of netwrork is valid only some time of period.

Power Constraints: Mobile nodes are run on battery power. Therefore while designing routing protocol than we consider power consumption and power management function also.

Multihop routing: In manet every node is host as well as router so that if one node forward the packet to another node than its uses the intermediate node and its called multihop routing.

Autonomous terminal: In manet there is no centralized controller available so that each node is free to move from one network to another network. Node can join or leave network without any type of permission.

1.2Application of Manet[2][3]:

Figure 2 :Application of Mobile Ad Hoc Network [2]

Military battlefield: Ad-Hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information head quarter.

Disaster recovery: Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire, flood, or earthquake.

local level: Ad-Hoc networks can autonomously link an instant and temporary multimedia network using notebook computers to spread and share information among participants at a e.g. conference or classroom.

Commercial Sector: Emergency rescue operations must take place where non-existing or damaged communications infrastructure and rapid deployment of a communication network is needed

1.3Challenges of manet[3]:

Limited bandwidth
Dynamic topology

Routing Overhead
Hidden terminal problem
Packet losses due to transmission errors
Battery constraints

1.4 CLASSIFICATION OF ROUTING PROTOCOLS IN MANET[3]

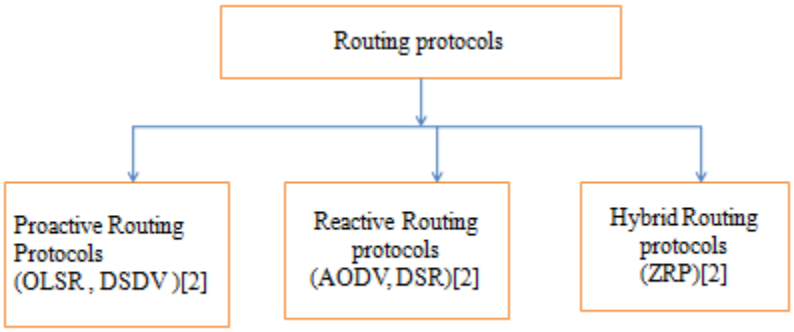


Figure 3. MANET routing protocols [2]

Proactive Routing Protocols:

Proactive protocols allow a network node to use the routing table to store routes information for all other nodes, each entry in the table contains the next hop node used in the path to the destination, regardless of whether the route is currently needed or not. The table must be updated frequently to reflect the network topology changes. These protocols cause more overhead especially in the high mobility network as they share routing information with the neighbors .ex. DSDV and OLSR.

Reactive Routing Protocols

On demand or reactive routing protocols were designed to overcome the overhead that was created by proactive routing protocols in case of large and highly dynamic network. Reactive routing protocols establish the route only when it is required for a node to communicate with another node. Only the routes that are currently in use are maintained which reduces the burden in the network. Only AODV and DSR routing protocols designed for reactive routing

Hybrid Routing

Need of these protocols arises with the deficiencies of proactive and reactive routing and there is demand of such protocol that combines good characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient. ZRP hybrid ad hoc routing protocols

II. AODV ROUTING PROTOCOL

AODV routing protocol works purely on demand basis. When a source node needs to communicate with another node, it starts route discovery process by broadcasting a route request message to its neighbor including the last known sequence number for that destination. Each node that forwards the route request also creates a reverse route for itself back to the source node. When the route request reaches a node with a route to destination node that node generates a route reply that contains the number of hops necessary to reach destination and the sequence number for destination most recently seen by the node generating the reply. The state created in each node along the path from source to the destination is hop-by-hop state; that is each node remembers only the next hop and not the entire route, as would be done in source routing. The main features of AODV are quick response to link breakage in active route and loop-free routes by using destination sequence numbers.

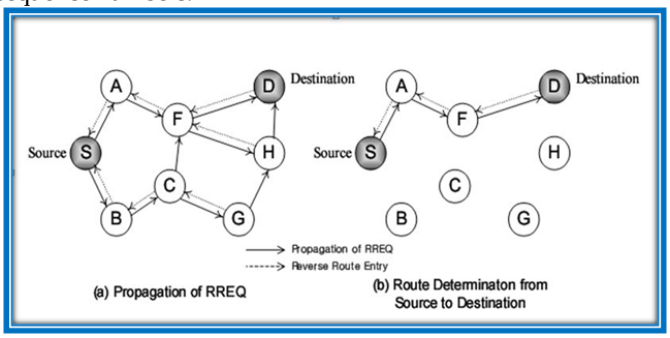


Figure 4. AODV routing protocol [4]

III. SURVEY OF TECHNIQUES

3.1 MERR-AOMDV[5]

This protocol finds the minimal nodal residual energy of nodes of each path. Then selects the path with maximal residual energy to forward the data packets. This Protocol have mainly two components .The computation of nodal residual energy of each route during the route discovery process. The sorting of routes by decending order of their nodal residual energy. This Protocol uses maximum nodal residual energy route for forwarding data packets.MMRE-AOMDV routing protocol performed better than AOMDV in terms of packet delivery fraction, throughput,and network lifetime. But this protocol does not evaluate the energy consumption and its impact on network performance, knowing that the network life depends on the node expiration .

3.2 ZD-AOMDV[6]

This protocol tries to discover the distinct paths between source and destination nodes with using Omni directional antennas, to send information through these simultaneously. This protocol counts the number of active neighbors for each path, and finally it chooses some paths for sending information in which each node has lower number of active neighbors all together. Here, active neighbors of a node are defined as nodes that have previously received the RREQ (Route Request).The aim of this work is to try to improve the energy efficiency of ad hoc networks. The simulation results show that the proposed scheme can achieve a great improvement of the network lifetime by reducing end-to-end delay and overhead.

3.3 AODV-LM[7]

AOMR-LM is a multipath routing protocol based on AOMDV protocol, with a new path classification mechanism according to the energy level of the nodes forming these paths, which can be high, average, or low.The idea is to build homogeneous paths in terms of energy.This can balance the consumption of energy of nodes and avoid links failure due to nodes energy depletation.This protocol sets a threshold and coefficient value to classified class of nodes. This idea helps to improve network lifetime and energy performance in MANET.

3.4 Modified AOMDV[8]

AODV protocol is modified and converted to work on multiple paths to send data .First we modified route discovery process of AODV when a destination receives a RREQ packed it replies for all the RREQ packets received even for same sequence number using back path.The proposed technique uses a filter to detect misbehaving nodes and reduces their impact on network performance. The aim of the filter is to limit the rate of RREQ packets. Each node maintains two threshold values. The threshold values are the criterion for each node' s decision of how to react RREQ 1 message. The RATE_LIMIT parameter denotes the number of RREQs that can be accepted and processed as normal per unit time by a node.The BLACKLIST_LIMIT parameter is used to specify a value that aids in determining whether a node is acting malicious or not. This scheme decrease the routing overhead and flooding attack in network.

3.5 Enhanced AODV[9]

In order to make AODV energy efficient, its enhancedversion EERP is proposed in this section. All three phases of AODV protocol have been modified for this purpose.

1. Route establishment: In route establishment phase, the modifications has been done in second segment viz. processing and forwarding route requests which includes comparison of current threshold value of RSS with the received signal value. This comparison will decide whether this node will work as forwarding node or not.

2. Route handling: In route handling phase, changes have been made in processing and forwarding route reply process. Here, the current RSS value of signal is compared with the threshold value. On the basis of it, transmission power of nearby node is reduced in the route reply phase.

3. Route Termination: In the route termination phase, changes have been made in route expiry process which resets the transmission power of node. The subsequent sections describe the different function to execute the EERP protocol.

IV. PROPOSED SYSTEM

Parameters:-

Max_Energy_Node : Maximum energy of a node so far.
Max_Energy_TS : Timestamp when a node had maximum energy.
This_Energy_Node : Energy of a Node at this moment.
Req_Energy_Node : Energy of a Node which has sent a Route Request Packet.
Reg_Energy_TS :Timestamp when a node had Req_Energy_Node energy.
Threshold : To define critical energy level

Algorithm:-

On_Receiving_RReq()

{
Determine Max_Energy_Node, This_Energy_Node from itself.
Determine Req_Energy_Node from packet header of RReq.
Case 1:- // Discard RReq if a node itself is not capable to survive long.
If (This_Energy_Node < Max_Energy_Node X Threshold)
{
Discard RReq Packet // Prediction is that current node may become off soon. Then there is no meaning of flooding the network which generate route entries with a node which is dead.
}
Case 2:- // Discard RReq if the source itself is not capable to survive long.
If (Req_Energy_Node < Max_Energy_Node X Threshold)
Discard RReq Packet // Prediction is that source node may become off soon. Then there is no meaning of flooding the network to find a route for a dead node.
}

Case 3:- // A node may get more energy by external supply
If (This_Energy_Node > Max_Energy_Node)
{
Max_Energy_Node = This_Energy_Node
// This is the case when user provides external power to the node and so battery gets charging. In this case, maximum energy of a node can be set to the highest level.
}
Case 4:- // Predicate what will be the energy of a source node
Using energy degradation of current node and values of Req_Energy_Node and Req_Energy_TS, a predication can be made to identify current energy level of RReq sender node. If it is below Threshold, RReq can be discarded}

V.SIMULATION ENVIRONMENT

In order to validate my analysis in result I have conducted a simulation experiment. I have used NS2 network simulator version 2.35. Table shows the parameter used in my experiments. Here I used random way point mobility model. An extensive simulation model having scenario of n (user defined) mobile nodes.

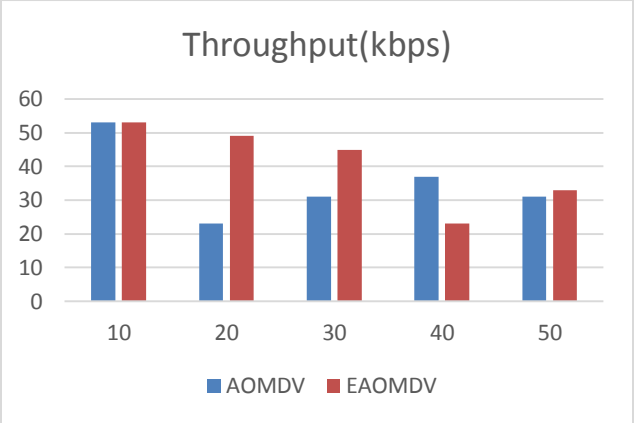
Parameter	**Value**
Channel Type	Wirelesschannel
Network Interface	Phy/Wirelessphy
MAC Type	Mac/802_11
Antenna Model	Omniantenna

Routing Protocol	AOMDV/EAOMDV
Link Layer Type	LL
X & Y Dimension Of Topology	500 * 500
Radio Propagation Model	Propagation/Tworayground
Simulation time	100 ms

✓ **Throughput**

Throughput is a measure of the date rate (bits per second) generated by the application. It is defined as the average no of packet received by the destination node per second. Throughput is equal to the total data transferred divided by the total time it took for the transfer.

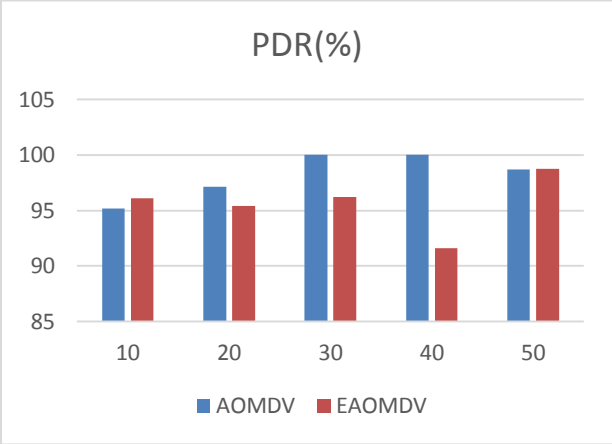
$$\text{Throughput (kbps)} = \frac{\sum(\text{Packet Size})}{(\text{Packet Arrival} - \text{Packet Start})}$$



✓ **PDR**

Packet delivery ration is the ratio of the total number of packet received by destination to total number of packet sent by source.

$$\text{PDR (\%)} = \frac{\sum(\text{Number of packet received})}{\sum(\text{Number of packet sent})}$$



VI. CONCLUSION

In this article we have discussed, one of the important issue that is energy consumption problem in MANET. As the traditional routing mechanisms like minimum hop count produces not only overheads in the networks but also consume more power in the networks during the communication..And hence it is required to have some any energy efficient routing protocols to be designed in order to overcome this problem. This paper has also expounded few energy efficient routing protocols which are explicitly based on the AODV routing protocol. This paper has also revealed that a single routing protocol cannot stand strongly against the major constraint of MANET that is power consumption until it is integrated with some other techniques like power consumption, load balancing, transmission control, multi path routing and many more. The combination of all these techniques can surely turning out be an efficient solution for energy constraint.

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