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# A Study of Energy-Aware Routing Techniques in Mobile Adhoc Networks

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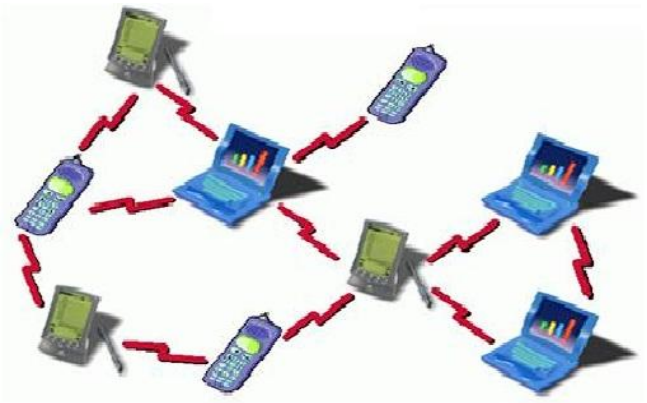
***Abstract*— A Mobile Adhoc Networks (MANETs) is composed of a group of mobile and wireless nodes which does not use a centralized structure or base station system. There are several issues needed to be addressed for smooth and effective functioning of MANET. One such issue for almost all kinds of mobile nodes supported by battery powers is Energy Saving. Energy is a limited resource; hence, how to extend the lifetime of batteries is an important issue, especially for MANET, which is totally supported by batteries. In this paper, various ways for getting energy efficient AODV (Ad-hoc On-demand Distance Vector) routing protocol, have been studied which could be modified to improve the networks lifetime in MANET. A solution can be proposed based on considering the energy of each node because each node's energy state has a huge influence on the entire network lifetime.***

**Keywords: MANET, AODV,energy efficiency, network lifetime, routing protocols**

## I. INTRODUCTION

A Mobile Ad Hoc Network (MANET) is a set of mobile nodes that perform basic networking functions like packet forwarding, routing, and service discovery without the need of an established infrastructure. All the nodes of an ad hoc network depend on each another in forwarding a packet from source to its destination, due to the limited transmission range of each mobile node's wireless transmissions. There is no centralized administration in ad hoc network. It guarantees that the network will not stop functioning just because one of the mobile nodes moves out of the range of the others.



### Mobile Ad-hoc Network (MANET)

As nodes wish, they should be able to enter and leave the network. Multiple intermediate hops are generally needed to reach other nodes, due to the limited range of the nodes. Each and every node in an ad hoc network must be keen to forward packets for other nodes. This way, every node performs role of both, a host and a router. The topology of ad hoc networks is dynamic and changes with time as nodes move join or leave the ad hoc network. This unsteadiness of topology needs a routing protocol to run on each node to create and maintain routes among the nodes.

Routing in a MANET is fundamentally different from traditional routing found on infrastructured networks. Routing in a MANET is based on many factors including dynamic topology, selection of router nodes, initiation of request and specific fundamental characteristic that could act as a heuristic in finding the path quickly and efficiently. The low resource availability needs efficient utilization and hence the motivation for optimal routing in ad hoc networks. Also, the highly dynamic nature of these networks imposes severe restrictions on routing protocols specifically designed for them, thus motivating the study of protocols which aim at achieving routing stability.

The remainder of this survey paper consists of the review of the energy efficient routing protocols in MANET which is discussed in section-II, Section-III covers the previous works on energy efficient AODV, while section IV covers the concluding part of the survey.

## II. REVIEW OF ENERGY EFFICIENT ROUTING PROTOCOLS IN MANET

Building MANET 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 proposed in the MANET Working Group. The problem is 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 subnetworks. Therefore, the shortest path is not the most suitable metric to be adopted by a routing decision. Other metrics that take the power constraint into consideration for choosing the appropriate route are more useful in some scenarios (e.g. sensor networks). The author has selected reactive routing schemes, since they are less expensive in terms of energy consumption than proactive schemes. In this survey, three energy efficient routing algorithms (LEAR-AODV, PAR-AODV, and LPR-AODV) [3] have been surveyed.

The first on-demand routing protocol called LEAR-AODV(Local Energy-Aware Routing based on AODV)[3] is proposed to balance energy consumption among all participating nodes[2]. In LEAR-AODV, for the route discovery process, each node determines whether or not to accept and forward the RREQ message depending on its remaining battery power(Er)[3].When it is lower than a threshold value $\theta$($Er \leq \theta$),the RREQ is dropped;otherwise the message is forwarded. Route Maintenance is needed either when the connections between some nodes on the path are lost due to node mobility,or when the energy resources of some nodes are depleting too quickly.

The Second on-demand routing protocol called PAR-AODV (Power-Aware Routing based on AODV)[3] is proposed to extend the useful service life of an ad hoc network. In the route discovery process for PAR-AODV,all nodes except the source & the destination calculate their link cost Ci,[3] and add it to the path cost in the header of the RREQ packet.When the destination node receives a RREQ packet,it sends a RREP packet to the source.The route maintenance in PAR-AODV is same as in LEAR-AODV.

The last on-demand routing protocol called LPR-AODV(Lifetime Prediction Routing based on AODV)[3] is proposed to favour the route with maximum lifetime. LPR-AODV[2] uses battery lifetime prediction.Each node tries to estimate its battery lifetime based on its past activity[3]. In LPR-AODV,all nodes except the destination & the source calculate their predicted lifetime Ti. Also the route maintenance is needed either when a node becomes out of direct range of a sending node or there is a change in its predicted lifetime.

For all the three algorithms mentioned above for different scenarios the network lifetime was compared with primitive AODV as they were derived from it. Two cases were considered i.e Fixed node & mobile node. From the experimental results stated in the work we note that for AODV,the first nodes dies earlier than in LEAR-AODV & LPR-AODV respectively.Also for mobile nodes it is seen that the proposed algorithms are always better than AODV in terms of dead nodes. The performance of the algorithms are evaluated using GloMoSim 2.0. It can further be carried out in NS2 simulator. In order to improve the survivability of the network, the variance of energies between all the nodes should be reduced to the minimum. Also as the velocity of node movement increases,rate of energy consumption in the network goes up.However as the node mobility increases, the difference between primitive AODV[1] and the stated algorithms decreases.

## III. Previous Work on Energy efficient AODV

The distributed nature and dynamic topology of Wireless Sensor Networks (WSNs)[4] introduces very special requirements in routing protocols that should be met. The most important feature of a routing protocol, in order to be efficient for WSNs, is the energy consumption and the extension of the network's lifetime. During the recent years, many energy efficient routing protocols have been proposed for WSNs. In this paper, energy efficient routing protocols are classified into four main schemes: Network Structure, Communication Model, Topology Based and Reliable Routing.

Energy awareness for computation and protocol management is becoming a crucial factor in the design of protocols and algorithms. On the other hand, in order to support node mobility, scalable routing strategies have been designed and these protocols try to consider the path duration in order to respect some QoS[7] constraints and to reduce the route discovery procedures. Often energy saving and path duration and stability can be two contrasting efforts and trying to satisfy both of them can be very difficult. In this paper, a novel routing strategy is proposed. This proposed approach tries to account for link stability and for minimum drain rate energy consumption.

The paper presents Multicasting through Time Reservation using Adaptive Control for Energy efficiency (MC-TRACE)[5], an energy-efficient real-time data multicasting architecture for mobile ad hoc networks. MC-TRACE is a cross-layer design, where the medium access control layer functionality and the network layer functionality are performed by a single integrated layer. The basic design philosophy behind the multicast routing part of the architecture is to

establish and maintain an active multicast tree surrounded by a passive mesh within a mobile ad hoc network.

In mobile ad hoc networks (MANETs), every node overhears every data transmission occurring in its vicinity and thus, consumes energy unnecessarily. However, since some MANET routing protocols such as Dynamic Source Routing (DSR) [6]collect route information via overhearing, they would suffer if they are used in combination with 802.11 PSM. Allowing no overhearing may critically deteriorate the performance of the underlying routing protocol, while unconditional overhearing may offset the advantage of using PSM.

## IV. CONCLUSION

The proposed algorithms stated in this survey paper reduce energy consumption and lead to a longer battery life at the terminals. They are based on one of the most important routing protocols, AODV (Ad hoc On-Demand Distance Vector). They focus on issue for almost all kinds of portable devices supported by batteries is power saving. Without power, any mobile device will become useless. Battery power is a limited resource, and it is expected that battery technology is not likely to progress as fast as computing and communication technologies do. Hence, how to lengthen the lifetime of batteries is an important issue, especially for MANET, which is all supported by batteries. Routing and power consumption are intrinsically connected. In conventional routing algorithms, which are unaware of energy budget, connections between two nodes are established through the shortest routes. By comparison of the result,it is concluded that LPR-AODV is better than PAR-AODV since LPR-AODV not only takes into account the residual battery capacity,but also the rate of energy discharge.

Hence it is concluded that the mentioned AODV extension increase the network survivability and leads to a longer battery life of the terminals .They achieve balanced energy consumption with minimum overhead.

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