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# A Survey on Efficient Energy Routing Protocols for AODV in MANET

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**Abstract:** ***Mobile Ad-hoc network(MANET) is a self configured and self organized network that does not require any infrastructure support. MANET deals with mobile nodes that moves randomly which tends to make the network to have an unpredicted topology. Mobile nodes run on batteries, which as a result makes energy as an important challenging factor in MANET. Due to changes in the topology, the network is prone to link break. This survey paper is aimed at reviewing different enhanced AODV routing protocols in terms of energy. The conventional AODV is concern about finding the shortest path without taking energy into consideration.***

**Keywords:** MANET, AODV, E-AODV , MANET Routing Protocols

## 1. Introduction

MANET (mobile ad-hoc network) deals with mobile nodes which are connected through a wireless links that doesn't have any infrastructure support. MANET is an urgent required network that is helpful in disaster hit areas, military field e.t.c

Mobile nodes in MANET consist of mobile phones, laptops , personal digital assistance, in MANET nodes serves as router due to the absence of an infrastructure nodes communicate directly with each other, as a result dynamic change of the topology in the network, the routing protocol makes an important role where by these protocols have the capabilities to support changes in topology of the network.[11]

Routing protocols are term as a rules which decides how a message can be delivered successfully from source to destination. In MANET routing protocols determine and search for routes between nodes. Routing protocols needs to perform efficiently in a dynamic environment.

Mobile nodes in MANET are battery driven, so resources must be managed efficiently interms of battery power of each nodes and bandwidth.[1]

## 2. Routing Protocols in MANET

Routing protocols in MANET consist of mobile nodes to search for a route to connect to each other and share the data packets. Protocols are set of rules in which two or more devices (mobile nodes, computers or electronic devices) can communicate to each other. There are several kind of routing protocol in MANET. These routing protocols are categorized into Reactive, Proactive and hybrid.

I. **Reactive Protocols:** Reactive protocols are protocols that are also called on demand. These routing protocols established routes based on demand. In this type of routing protocols routes are acquired by sending route request RREQ through the network. Reactive protocols consist of two phases , route discovery phase and route maintenance phase. Routes are established at route discovery phase and maintained at route maintenance phase. Example of reactive protocols are AODV Ad-hoc on demand distance vector protocol, DSR destination sequence ratio protocol

II. **Proactive Protocols:** Proactive routing protocols are called table driven routing protocol. These routing protocols periodically update their routing table where by each node maintains atleast one or more routing table for each entry. These routing protocols create the route even before demand, there is no delay if it happens that a node wants to communicate with each other in the network. One of the major setback of these routing protocols is that there is more overhead and more bandwidth consumption, this is due to the fact that each node contain information about the network topology even without requiring it. One of the advantage of these routing protocols is that nodes can easily get routing information and it can easily start a session example of these routing protocols are OLSR (optimized link state routing) protocol, DSDV(destination sequence distance vector routing) protocol.

**III. Hybrid protocols:** The hybrid routing protocols are the trade-off between the reactive and proactive routing protocols, where by these routing protocols are the combination of reactive and proactive. A reactive protocol have more delay but with less overhead while a proactive routing protocols have less delay but with larger routing overhead. A hybrid routing protocol is categorized into zones. Incase of the outer zone a reactive routing protocol is performed while in the inner zone a proactive routing is performed examples of a hybrid protocols are ZRP and SHRP.

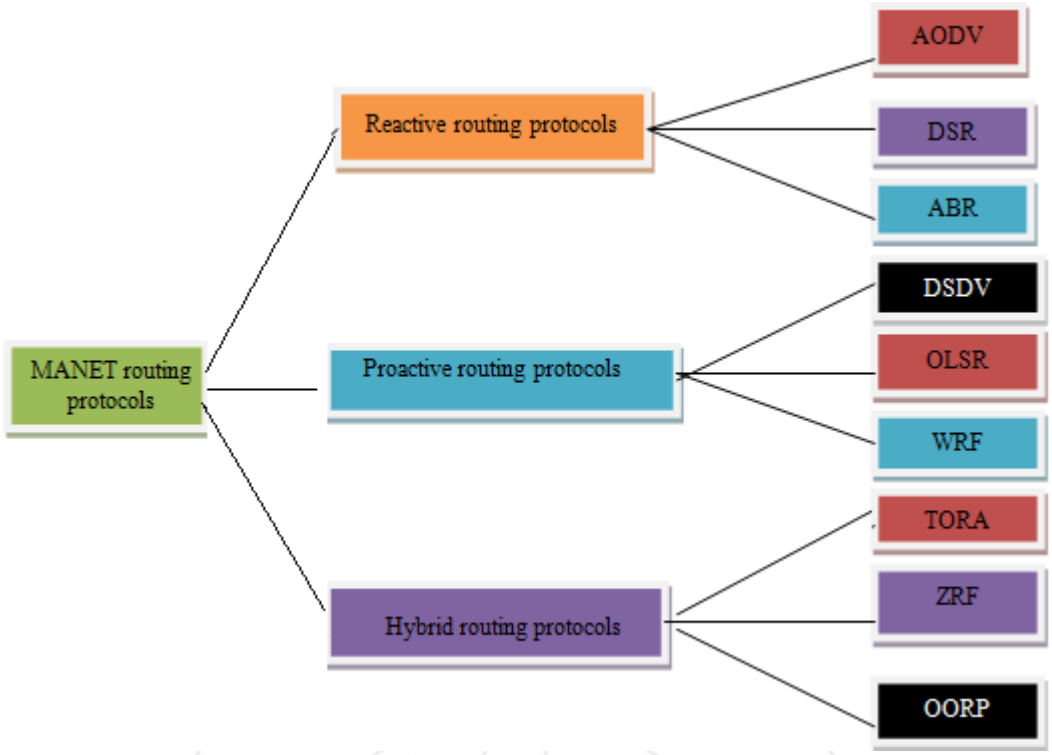


**Figure 1:** Classification of MANET routing protocol

## 3. Related Work

The concern of this paper is about AODV routing protocol and its enhancement incase of the network lifetime and energy efficiency.

**A. AODV (Ad-hoc on demand distance vector routing) protocol:**
Ad-hoc on demand distance vector (AODV) routing protocol enables dynamic, self starting, multi hoping routing between participating mobile nodes wishing to establish and maintain an ad-hoc network. AODV allows mobile nodes to obtain routes quickly for few destinations and does not require nodes to maintain routes to destination that are not in active communications. AODV allows mobile nodes to respond to link breakages and changes in the network topology in a timely manner.[4]

AODV routing works based on two phases i.e route discovery phase and route maintenance phase, route are created or formed at route discovery phase and routes are maintained at route maintenance phase. In AODV when a source node has a data packets to send to destination it first checks if there is an existing route, if such route exist it will then use that route for data packet transmission, otherwise it will initiate a route discovery in order to find a route. To initiate a route discovery the source node has to create a RREQ route request packets. The RREQ packets contain the destination node IP address , source IP address i.e the current sequence number, hop count and RREQ ID which is used to detect a duplicate of RREQ after creating the RREQ message the source node will broadcast it to the intermediate nodes. When the RREQ reaches the destination. The destination node will replies back by uni casting on reverse path with the following fields in the packet destination IP address, destination sequence number, type, hop count, originator IP address and life time. The source node will start sending packets to destination.

**B. Optimized AODV (OAODV):** The optimized AODV unlike the conventional AODV does not find routes by sending RREQ message, it does so if there is sufficient energy and until the node density in its surrounding exceeds a particular threshold. OAODV uses two threshold values, the first threshold is responsible for the broadcast of RREQ based on the battery level of the node, while the second threshold value is responsible for the density of the node in the environment. In OAODV intermediate nodes receive RREQ while checking the node battery level, if the node battery level is greater than the threshold value then it will have a route to destination but if the battery level is less than the threshold value then a node will drop it

**C. Lifetime Prediction Routing Protocol(LPR-AODV):** This routing protocol is based on AODV that uses an approach of dynamic distributed load balancing thereby avoiding power congested nodes and choose path which are lightly loaded. This routing protocol favors a route that has a maximum lifetime. It also finds route based on route discovery phase, whereby it does not contain a node with a weak predicted lifetime. LPR-AODV also keeps tracks of the activity of each node in the past and its residual energy value too.[5]

**D. EEPR-AODV:** This protocol stands for energy efficient path routing protocol based on AODV. This protocols works based on the principle of not allowing a node to exhaust its energy. This protocol uses a Min-Max formulation for calculating the energy of the nodes, it does so by selecting a path with the highest energy between nodes i.e the path with maxium energy. EEPR favors the path whose lifetime is maximum and thus increases the network lifetime[11]. The function for EEPR is

Max Ek(t) = Min Es(t) i€k
Where Ek (t) = residual energy of path
Es (t) = residual energy of node I in path k

**E. Power Aware Routing- AODV (PAR-AODV):** This protocol solvesthe problem of searching a route $\pi$, at a route discovery time t,and the cost function is

$$C(\pi, t) = \sum ci(t)$$

A node that wants to begin communication will first flood the network with a RREQ message after which a node will calculate the link cost Ci and instantly add it to the RREQ packet header, whenever an intermediate nodes receives the RREQ message it keeps the cost in the packet header as Min-cost. when the destination node receive the RREQ it will reply back a RREP message like the conventional AODV. So the route maintenance is initiated whenever an intermediate node has a value less than the threshold.[9]

**F. Enhanced AODV (E-AODV)**
Like the conventional AODV, E-AODV also start by sending a RREQ message to the intermediate nodes in search for routes. When the destination node receive the RREQ message it will not RREP route reply back, but has to choose a path that has a highest residual energy between the nodes. E-AODV uses a link strength formulation with respect to residual energy while trying to select the reliable path.[1]

Link strength = $\frac{Eresidual\ 1}{Eresidual\ 2}$

Where Eresidual 1 < Eresidual 2. If Eresidual1 = Eresidual 2 then ignore the path and choose another path based on hop count, it does so by comparing with a link stability parameter. The link stability parameter has a range $0 \leq \lambda \leq 1$, link stability parameter $\lambda$ has a value of 0.4, $\lambda = 0.4$. if the residual energy between nodes for a selected path is less than the link stability parameter then that particular path does not have enough energy to forward packets of data else it will choose the path that hasa residual energy of the nodes which are greater than the link stability parameter.

## 4. Conclusion and Future Work

Based on the discussion in this paper. It can be concluded that AODV routing protocol can balance the energy consumption efficiently by making a minor change in the route discovery phase of AODV.

In E-AODV a future work interms of reliability factor should be introduced in terms of energy and bandwidth utilization that would further increases the performance of E-AODV and also prevents the unstable link from participating in the route discovery process.

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