# A NOVEL ROUTING PROTOCOL FOR MOBILE AD HOC NETWORKS

**K.Vanaja**
Research Scholar in Bharathiar University,
Assistant Professor in M.C.A,
Vivekanandha College of Arts and Sciences for Women,
Tiruchengode, Tamil Nadu.
kvanaj@yahoo.com

**Dr. R. Umarani**
Research Supervisor,
Associate Professor in Computer Science,
Sri Sarada College for Women, Salem, Tamil Nadu.
umainweb@gmail.com

**ABSTRACT**

A Mobile Ad-hoc Network (MANET) is a temporary wireless network composed of mobile nodes, in which an infrastructure is absent. If two mobile nodes are within transmission range, they can communicate with each other directly. Otherwise, the nodes in between them have to forward the packets. In such a case, every mobile node has to function as a router to forward the packets for others. Thus, routing is a basic operation for the MANET. With the dynamic and mobile nature of ad hoc wireless networks, links may fail due to topological changes by mobile nodes. As the degree of mobility increases, the wireless network would suffer by more link errors. Ad hoc routing protocols that use broadcast to discover routes may become inefficient due to frequent failures of intermediate connections in an end-to-end communication.

An important feature of Ad hoc On demand Distance Vector (AODV) is the maintenance of time-based states in each node: a routing entry not recently used is expired. The topology of mobile ad hoc networks is time-varying, so traditional routing techniques used in fixed networks cannot be directly applied here. There are various techniques for tracking changes in the network topology and re-discovering new routes when older ones break. In case of a route break the neighbours should be notified. In this paper, the source can discover and change to better path even if the current path is not broken, and is named as Highly Dynamic AODV (HDAODV). Thus this paper discusses about the improved routing mechanism of AODV by introducing path updation even when the link is not broken. The Network Simulator NS2 is used for the simulation.

***Keywords*** - Ad-Hoc, AODV, NS2, HDAODV.

## 1. INTRODUCTION

In the recent years communication technology and services have advanced. Mobility has become very important, as people want to communicate anytime from and to anywhere. In the areas where there is little or no infrastructure available or the existing wireless infrastructure is expensive and inconvenient to use, Mobile Ad hoc Networks, called MANETs, are becoming useful. They are going to become integral part of next generation mobile services.

A MANET is a collection of wireless nodes that can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure. It has many important applications, because in many contexts information exchange between mobile units cannot rely on any fixed network infrastructure, but on rapid configuration of a wireless connections on-the-fly. Wireless ad hoc networks themselves are an independent, wide area of research and applications, instead of being only just a complement of the cellular system.

Routing[2] is the most challenging problem in ad hoc networking. Much work has been done in this area and many protocols have been proposed. Of particular interest is the class of on-demand, source-initiated protocols, which set up and maintain routes from a source to a destination on an “as needed” basis.

Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Most of the routing protocols are based on reactive routing instead of proactive. Multicast routing is another challenge because the multicast tree is no longer static due to the random movement of nodes within the network. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

The node mobility and limited communication resources make routing in MANETs very difficult. Mobility causes frequent topology changes and may break existing paths. A routing protocol should quickly adapt to the topology changes and efficiently search for new paths. On the other hand, the limited power and bandwidth resources in MANETs make quick adaptation very challenging.

## 2. AODV - THE AD HOC ON_DEMAND DISTANCE – VECTOR PROTOCOL

AODV[6] is a routing algorithm used in ad hoc networks. Unlike Dynamic Source Routing (DSR) [7], it does not use source routing, but like DSR it is on-demand. In AODV, each node maintains a routing table which is used to store destination and next hop IP addresses as well as destination sequence numbers. Each entry in the routing table has a destination address, next hop, precursor nodes list, lifetime, and distance to destination. To initiate a route discovery process a node creates a route request (RREQ) packet. The packet contains the source node's IP address as well as the destination's IP address. The RREQ contains a broadcast ID, which is incremented each time the source node initiates a RREQ. The broadcast ID and the IP address of the source node form a unique identifier for the RREQ. The source node then broadcasts the RREQ packet and waits for a reply. When an intermediate node receives a RREQ, it checks to see if it has seen it before using the source and broadcast ID's of the packet. If it has seen the packet previously, it discards it. Otherwise it processes the RREQ packet. To process the packet the node sets up a reverse route entry for the source node in its route table which contains the ID of the neighbour through which it received the RREQ packet. In this way, the node knows how to forward a route reply packet (RREP) to the source if it receives one later. When a node receives the RREQ, it determines if indeed it is the indicated destination and, if not, if it has a route to respond to the RREQ. If either of those conditions is true, then it unicasts a route reply (RREP) message back to the source. If both conditions are false, i.e. if it does not have a route and it is not the indicated destination, it then broadcasts the packet to its neighbours. Ultimately, the destination node will always be able to respond to the RREQ message. When an intermediate node receives the RREP, it sets up a forward path entry to the destination in its routing table. This entry contains the IP address of the destination, the IP address of the neighbour from which the RREP arrived, and the hop count or distance to the destination. After processing the RREP packet, the node forwards it toward the source. The node can later update its routing information if it discovers a better route.

## 3. IMPROVEMENT ON AODV : HIGHLY DYNAMIC AODV (HDAODV)

The proposed modification of the protocol is due to change in topology by the migration (mobility) of a node which is a part of the path already.

Nodes in AODV do not update the current link if it is not broken. It may slack many optimal paths. Each node in AODV maintains a routing table and neighbour list [1]. Knowing one node's routing table and neighbour list may lead to discover a new optimal route (with less number of hops) or accumulated paths [3] through that node. Accumulated paths are not on-demand paths but can be discovered with no additional cost. There is a possibility that the next on-demand destination can be reached by one of those accumulated paths. In this case, source can transmit packet immediately instead of discovering a new route. This can reduce the delay time and routing overhead for the network.

This paper proposed a modification by incorporating the learning information from new neighbour nodes mechanism in AODV which is termed as Highly dynamic AODV (HDAODV). In order to evaluate the new modification, we created detail packet levels simulations in NS2 to compare its performance with the original one. AODV can be modified to use effectively the routing information provided by the new neighbour nodes, each time a node discovered a new neighbour node. These two nodes exchange the necessary information. For each routing table entry, we extracted destination address, number of hop towards that destination, sequence number and expire time of that entry. The extracted entries are formed into the destination table to exchange with the new neighbour node. For each entry, look up its destination address in the routing table. If the destination is found, it means that besides the current path in the routing table, there exists an alternate path through the new neighbour node. The number of hops of these two paths is then compared. Consider the number of hops of the old path and new path are $hop_{old}$ and $hop_{new}$ respectively.

If $hop_{old} > hop_{new}$ then
alternate path is better (with smaller number of hops),
swap the current path by new path;
otherwise
No change.
End if

If the destination is not found in the routing table and neighbour list, an entry toward that destination is created in the routing table as a new accumulated path. The updated and accumulated path both obtain the sequence number, number of hop and expire time from the destination table

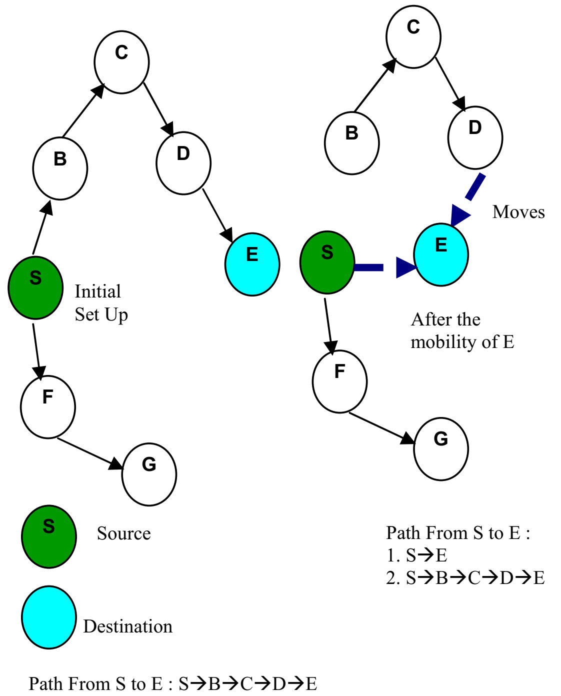


**Figure 1. Proposed Scenario**

With this modification, source can discover and change to a better path even if the current path is not broken. The accumulated paths will also decrease the number of Route Discovery cycles and reduce the delay time for finding a path. This design therefore improves the performance of AODV.

## 4. SIMULATION AND RESULTS

The simulations use 5 different movement patterns (pause time 0, 20, 40, 100 seconds) and 4 different traffic patterns (5, 10, 15, and 20 sources). These patterns create 20 scenarios; each scenario combines a movement pattern and a traffic pattern. A wide variety of node scenario files and CBR scenario files were generated to evaluate varying network conditions. The main objective of our simulation is to show that proposed algorithm is better than AODV. The results are as follows based on average time delay as metric.

### Average Time Delay

The above figure 2 shows the comparison of average time delay of AODV and HDAODV. The modified solution has less time delay in most of the cases. It is because HDAODV creates accumulated paths, therefore, with high traffic the possibility of using accumulated paths increases. Original AODV does not have accumulated paths so it will take time to discover the route if traffic required is not found in the routing table.

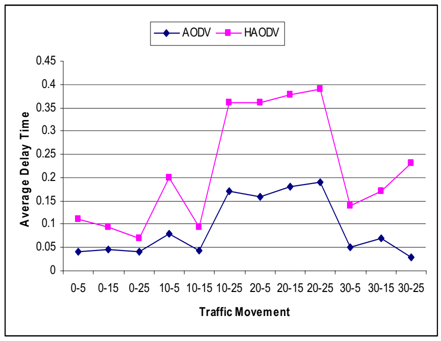


**Figure 2. Average Delay Time**

### Packet Delivery Ratio

Figure 3 presents the comparison of Packet Delivery Ratio. We can see that NPAODV performs better in most of the case. The reason is NPAODV updates the path immediately when it has chance to do so while original AODV keeps the link until it is broken. Because of that, there will be more broken link in original AODV, which creates more packet loss than the one in modified AODV.

Packet Delivery ratio (PDR)[4] = ((Number of Packets Received/Number of Packet Sent)*100)

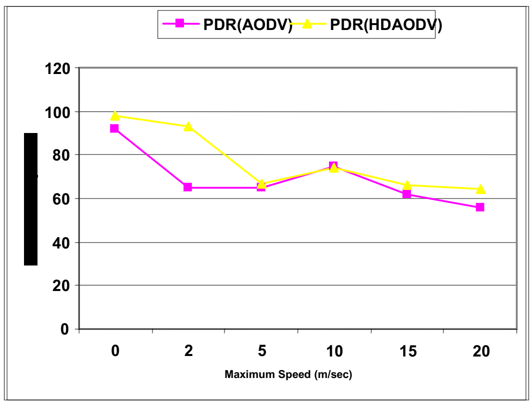


**Figure 3. Packet Delivery Ratio : AODV Vs HDAODV**

## 5. CONCLUSION

Providing convenient connectivity for mobile computers, in ad-hoc computers is a challenge that is only now being met. We have presented an innovative approach of AODV, which models the mobile computers as routers, which are cooperating to forward packets as needed to each other. We make good use of the properties of the wireless broadcast medium. Our approach can be utilized for the environment with less scalability and mobility[8].

In this paper the AODV routing protocol has been reviewed. As a reactive protocol AODV transmits network information only on-demand. Though the current path is not broken, the proposed protocol HDAODV which swaps path information if exists an optimal path.

## 6. FUTURE WORK

The implemented preliminary version of this change in the protocol AODV can be utilized with mobile computers, with less scalability. Currently we are making necessary modifications using NS2 simulator, for use in creating the appropriate simulation environment for our needs. We hope to discover good operational values via simulation for the following metrics: **Delay time, Energy value, Packet Delivery Fraction**[5]**, Throughput, and End to End Delay by introducing clustering on the topology.**


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## BIOGRAPHY

**Ms. K.Vanaja received** her M.Phil., degree from Bharathidasan University, Trichy in July 2005. She is working as Assistant Professor in M.C.A. Department, Vivekanandha College of Arts and Sciences for women, Tiruchengode, Tamil Nadu. India. She is currently guiding M.C.A, M.Phil research scholars of various universities. She has presented 10 papers in National Conference and 2 papers in International Conference. Her areas of interest include Networks - information security, mobile computing, and Artificial Intelligence.

**Dr.R.Uma Rani** received her Ph.D., Degree from Periyar University, Salem in the year 2006. She is a rank holder in M.C.A., from NIT, Trichy. She has published around 40 papers in reputed journals and national and international conferences. She has received the best paper award from VIT, Vellore , Tamil Nadu in an international conference. She has done one MRP funded by UGC. She has acted as resource person in various national and international conferences. She is currently guiding 5 Ph.D., scholars. She has guided 20 M.Phil., scholars and currently guiding 4 M.Phil., Scholars. Here areas of interest include information security, data mining, fuzzy logic and mobile computing.