# Research Paper on hybrid model of AODV& MTPR for MANET

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**ABSTRACT**

**Mobile Ad-hoc NETwork (MANET) is an autonomous system of mobile hosts connected by wireless links. The nodes in these networks have several constraints such: limited bandwidth, transmission range and mobility. Another parameter that significantly affects the network performance is the limited battery power of the nodes. This paper proposes a novel routing protocol that considers two parameters: Hop count and Total Transmission loss. On the basis of these two route metrics an optimal path is proposed. The proposed protocol is implemented in MATLAB 2013a and our result also shows that our proposed protocol is better than other standard protocols such as MTPR (Minimum Total Transmission Power Routing) and AODV (Ad-hoc On demand Distance Vector routing).**

**Keywords: MANET, MTPR, AODV, Hop Count, Transmission loss, Routing Protocols, Power Saving.**

## 1. INTRODUCTION

**1.1. MANET** "A mobile ad-hoc network (MANET) is a self-configuring network of mobile routers and associated hosts connected by wireless links." [1]. MANET is more vulnerable than wired network due to mobile nodes, threats from compromised nodes inside the network, limited physical security, dynamic topology, scalability and lack of centralized management. Because of these vulnerabilities, MANET is more prone to malicious attacks. MANET is the new emerging technology which enables users to communicate without any physical infrastructure regardless of their geographical location, that's why it is sometimes referred to as an "infrastructure less" network. Ad hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. Due to nodal mobility, the network topology may change rapidly and unpredictably over time. Message routing is a problem in a decentralize environment where the topology fluctuates. While the shortest path from a source to a destination based on a given cost function in a static network is usually the optimal route, this concept is difficult to extend in MANET.

The traffic types in ad-hoc networks are quite different from those in an infrastructure wireless network, including:

1) Peer-to-Peer: Communication between two nodes which are within one hop. Network traffic (Bps) is usually consistent.
2) Remote-to-Remote: Communication between two nodes beyond a single hop but which maintain a stable route between them. This may be the result of several nodes staying within communication range of each other in a single area or possibly moving as a group. The traffic is similar to standard network traffic.
3) Dynamic Traffic: This occurs when nodes are dynamic and moving around. Routes must be reconstructed. This results in a poor connectivity and network activity in short bursts.

**1.2 MANET FEATURES**

MANET has the following features:

1) Autonomous terminal
2) Distributed operation

3) Multi-hop routing
4) Dynamic network topology
5) Fluctuating link capacity
6) Light-weight terminals

## 1.5 MANET CHALLENGES

Regardless of the attractive applications, the features of MANET introduce several challenges [2,3]as followings:

**1) Routing:** Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Most protocols should be 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.

**2) Congestion:** A critical issue for MANETs is that nodes are normally power constrained and leads huge congestion in the network. The power control problem in wireless ad-hoc networks is that of choosing the transmit power for each packet in a distributed fashion at each node. It determines the range of a transmission. Thus determines the magnitude of the interference it creates for the other receivers which causes congestion.

**3) Security and Reliability:** The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wireless medium (e.g. hidden terminal problem), mobility-induced packet losses, and data transmission errors [4].

**4) Power Consumption:** For most of the light-weight mobile terminals, the communication-related functions should be optimized for lean power consumption. Conservation of power and power-aware routing must be taken into consideration.

**5) Internetworking:** In addition to the communication within an ad hoc network, internetworking between MANET and fixed networks (mainly IP based) is often expected in many cases. The coexistence of routing protocols in such a mobile device is a challenge for the harmonious mobility management [5].

## 2. ROUTING PROTOCOLS DEFINED

Routing is the most fundamental research issue in MANET and must deal with limitations such as high power consumption, low bandwidth, high error rates and unpredictable movements of nodes [6,7]. Generally, current routing protocols for MANET can be categorized as:

- Proactive (table-driven)
- Reactive (on-demand)
- Hybrid

### 2.1. Proactive (Table-Driven) Routing Protocols
In proactive routing, each node has one or more tables that contain the latest information of the routes to any node in the network. Each row has the next hop for reaching to a node/subnet and the cost of this route.

**Advantage**
Advantage of Proactive protocols is that routes are readily available when there is any requirement to send packet to any other mobile node in the network.

**Disadvantage**
Disadvantages are ofProactive routing tends to waste bandwidth and power in the network. Furthermore, as the number of nodes in the MANET increases, the size of the table will increase; this can become a problem in and of itself.

### 2.2 Reactive (On-Demand) Protocols
On-Demand Protocols do not maintain or constantly update their route tables with the latest route topology. This discovery packet is called the Route Request (RREQ) packet and the mechanism is called Route Discovery. The destination replies

with a Route Reply (RREP) packet [8]. As a result, the source dynamically finds the route to the destination. The discovered route is maintained until the destination node becomes inaccessible or until the route is no longer desired.

**Advantage**
Reactive Protocolare bandwidth efficient protocols. Routes are discovered on demand basis. Less Network communication overhead is required in this protocol.

**Limitations**
Reactiveprotocols have very high response time as route is needed to be discovered on demand, when there is some packet to be sent to new destination which does not lie on active path.

### 2.3 Hybrid Routing Protocols
Both the proactive and reactive protocols work well for networks with a small number of nodes.Hybrid protocols [9] attempt to assimilate the advantages of purely proactive and reactive protocols. As the number of nodes increases, hybrid reactive/proactive protocols are used to achieve higher performance. The key idea is to use a reactive routing procedure at the global network level while employing a proactive routing procedure in a node's local neighbourhood.

The selection of the path is made on the consideration of following parameters.

1.  Proper Hop-Count
2.  Power optimization
3.  Reduced congestion
4.  Less end-to-end delay

## 3. Needed Routing Protocols

### 3.1 Minimum Total Transmission Power Routing (MTPR)
Due to considerations such as radio power limitations, power consumption, and channel utilization, a mobile host may not be able to communicate directly with other hosts in a single-hop fashion. Ad hoc networks mostly operated on battery; so the power-efficiency becomes an important issue. To maximize the lifetime of ad hoc networks, the power consumption rate of each node must be minimized. MTPR protocol [10]is the solution for less power consumption in multi-hop communication.

### 3.2 Ad-hoc Reactive Distance Vector routing (AODV)
Ad-hoc Reactive Distance Vector (AODV) Routing is a routing protocol for mobile ad-hoc networks (MANETs) and other wireless ad-hoc networks. It uses shortest path scheme which is based on Dijkstra algorithm [2]. The AODV routing protocol is a reactive routing protocol that uses some characteristics of proactive routing protocols. Routes are established on-demand, as they are needed. However, once established a route is maintained as long as it is needed. Reactive (or on-demand) routing protocols [11] find a path between the source and the destination only when the path is needed.

**Advantage**: The advantage of this approach is that the routing overhead is greatly reduced. The other advantage of AODV is that it creates no extra traffic for communication along existing links.

**Disadvantage**: Its disadvantage is that a large possible delay from the moment the route is needed until the time the route is actually acquired. Other one is that, In AODV, the network is silent until a connection is needed.

### 3.3 Hybrid Routing Protocols
Hybrid protocols combine the features of reactive and proactive protocols. These protocols have the advantage of both proactive and reactive routing protocols to balance the delay. Main feature of Hybrid Routing protocol [12] is that the routing is proactive for short distances to shorten the routing discovery time and toReduce the memory size whereas reactive for long distances to reduce the size of the routing table and overhead as long distance destination nodes do not maintain routing information due to large overhead.

## 4. IMPLEMENTATION OF PROPOSED ROUTING SCHEME

Mobile Ad-hoc NETwork (MANET) is an autonomous system of mobile hosts connected by wireless links. The nodes in these networks have several constraints such: limited bandwidth, transmission range and mobility. Another parameter that significantly affects the network performance is the limited battery power of the nodes. On the basis of these two route

metrics an optimal path is proposed. Our proposed protocol is better than other standard protocols such as MTPR (Minimum Total Transmission Power Routing) and AODV (Ad-hoc On-demand Distance Vector routing). Here we also proposed a routing scheme which is hybrid of MTPR and AODV. We are of the opinion that MTPR strategy decreases total transmission power but at the same time introduces congestion that can be avoided by AODV routing protocol.

**4.1 Proposed Routing Scheme-**Here we will explain the concept of proposed routing scheme.
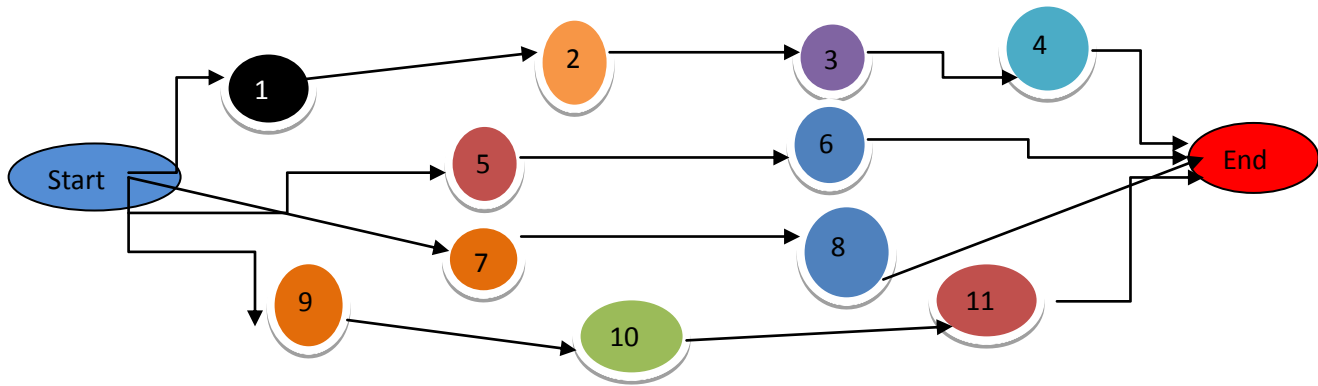


**Fig. 4.1: Various available paths between source and destination**

Let us consider the above given diagram, here Start is SOURCE node and End is DESTINATION node where we want to forward the packet. All 1-2-3-4, 5-6, 7-8, 9-10-11 are various intermediate nodes for various possible paths. The distances between various nodes are given by a path matrix are shown in table 4.1.

**Table 4.1:  Path matrix for giving distances between various nodes**

| Nodes | Start | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | End |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 20 | -- | -- | -- | 20 | -- | 10 | -- | 20 | -- | -- | -- |
| 1 | -- | 0 | 15 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 2 | -- | -- | 0 | 15 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 3 | -- | -- | -- | 0 | 15 | -- | -- | -- | -- | -- | -- | -- | -- |
| 4 | -- | -- | -- | -- | 0 | -- | -- | -- | -- | -- | -- | -- | 15 |
| 5 | -- | -- | -- | -- | -- | 0 | 5 | -- | -- | -- | -- | -- | -- |
| 6 | -- | -- | -- | -- | -- | -- | 0 | -- | -- | -- | -- | -- | 10 |
| 7 | -- | -- | -- | -- | -- | -- | -- | 0 | 20 | -- | -- | -- | -- |
| 8 | -- | -- | -- | -- | -- | -- | -- | -- | 0 | -- | -- | -- | 5 |
| 9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 20 | -- | -- |
| 10 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 20 | -- |
| 11 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 | 5 |
| End | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0 |

It is well known that the total transmission power scales with transmitted distance as $d^2$ to $d^4$ depending on environmental conditions. Here we consider total transmission loss is taken as $kd^2$. The losses of selected paths from source to destination may be as follows:

The path1 (Start-1-2-3-4-End) has total transmission loss as $= k (20 * 20 + 15 * 15 + 15 * 15 + 15 * 15 + 15 * 15) = 1300k$ units

The path2 (Start-5-6-End) has total transmission loss as $= k (20 * 20 + 5 * 5 + 10 * 10) = 525k$ units

The path3 (Start-7-8-End) has total transmission loss as $= k (10 * 10 + 20 * 20 + 5 * 5) = 525k$ units

The path4 (Start-9-10-11-End) has total transmission loss as $= k (20 * 20 + 20 * 20 + 20 * 20 + 5 * 5) = 1225k$ units

Here we will find mean between MTPR path and AODV path i.e. mean of a path with maximum number of intermediate hops and a path with minimum number of intermediate hops. Here MTPR path is path1 and AODV path is path2 and path3 (any one of them can be consider). Thus mean is given as $[(4+2)/2] = 3$

Now again difference between number of intermediate node for an adopted path and mean value calculated is considered to select the proposed optimal path. We can easily understand with a table as given below:

**Table 4.2: To select optimized path with proper Hop_count and min. transmission loss**

| Path available | Number of intermediate nodes existed | Mean calculated | Required difference |
|---|---|---|---|
| Path1 | 4 | 3 | $\mid 4\text{-}3 \mid = 1$ |
| Path2 | 2 | 3 | $\mid 2\text{-}3 \mid = 1$ |
| Path3 | 2 | 3 | $\mid 2\text{-}3 \mid = 1$ |
| Path4 | 3 | 3 | $\mid 3\text{-}3 \mid = 0$ |

Thus path4 (Start-9-10-11-End) with "0" calculated difference is proposed path with minimum power transmission loss as there is proper Hopcount. This path also reduces congestion problem of a network also.

**4.2 Algorithm**

Hybrid scheme based on MTPR and shortest path uses different performance metrics such as hop countcomparision, packet delivery ratio and probability of reliability for all possible pair of source and destination. The algorithm shown under helps in calculating the above mentioned metrics. The nodes considered here are variable. A variable count is used to count the number of paths formed or are feasible. If path exists between Start-End pair the value of count variable is incremented by 1. If path exists between Start-End pair then determines all the feasible paths between source destination pair using MATLAB function Fsible_paths (). Shortest_path (), MTPR_path () and Optimal_path () are the functions that are used to determine the Shortest path, MTPR path and optimal path from the feasible paths. Send the packets through each of the above mentioned paths using the function Send_data ().This process is repeated for all Start-End pairs. A variable called Data_packet is used to find cumulative value of packet received by destination through each of the paths.

**4.3 MATLAB Simulation Parameters**

Table4.3 Shows the values of various set up parameters used for simulation purpose in our paper

**Table 4.3: MATLAB Simulation Parameters**

| Parameter | Value |
|---|---|
| Nodes Location | Random |
| Nodes& Step Size | Varied from 40 to 60 Step size of 10 |
| Routing Algorithm | Dijkstra's Shortest Path Algorithm |
| Packet transmission time | 0.1sec |
| Mobility Model | Random Walk |
| Number of packet sent | 50 |
| Number of iteration | 4 |
| Routing Protocol used | MTPR, AODV,DSR,HYBRID |

**4.3 Simulation Results**

1. **Probability of Reach ability (PoR):** Fig. shows the change in PoR with increase in the nodes concentration.

**Inferences**
1. Value of PoR increases as the concentration of nodes increases in the simulation region.
2. As the number of nodes increases, the likelihood of path formation between the nodes those are largely separated increases.
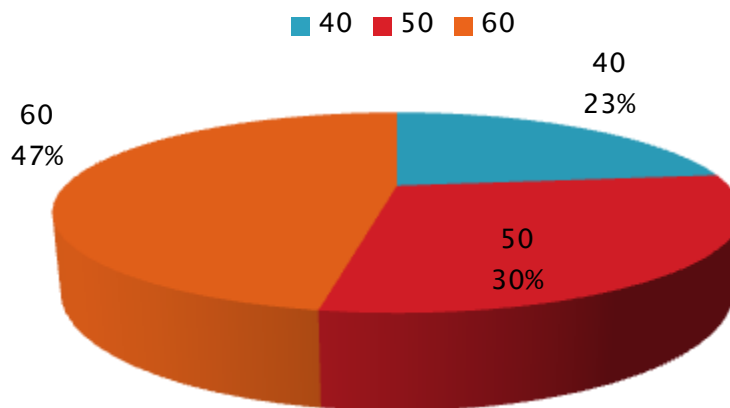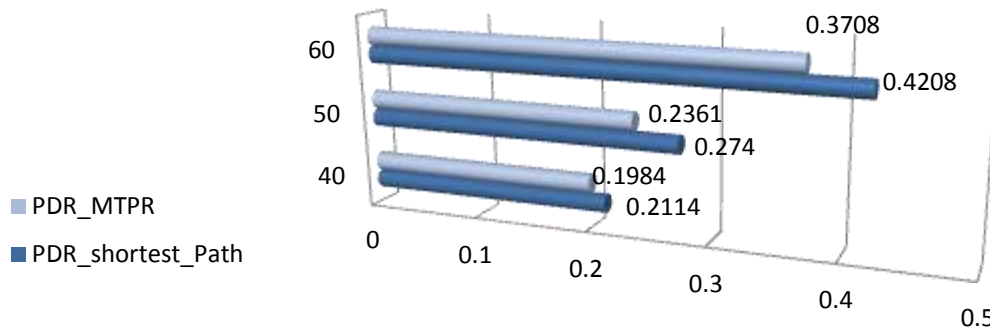


**Packet Delivery Ratio (PDR) comparison :**Fig. shows the change in PDR values for different paths with the increase in the node concentration.

**Inferences**

1. As the concentration of the nodes increases the PDR value enhances.
2. The PDR values for different paths are approximately same for node concentration equal to 40.
3. The difference in the PDR values for shortest path and optimal path is small in comparison to the difference in the PDR values of optimal path and MTPR path.

## Chart Title



|  | 40 | 50 | 60 |
|---|---|---|---|
| PDR_MTPR | 0.1984 | 0.2361 | 0.3708 |
| PDR_shortest_Path | 0.2114 | 0.274 | 0.4208 |

**Hop Count Comparison** Fig. shows the change in Hop Count values for different paths with the increase in the node concentration.

**Inferences**

1.   Value of hop count for each node concentration is minimum for shortest path and highest in the case of MTPR path and hop count value for optimal path lies between the two.
2.   With the increase in the node concentration the value of intermediate nodes (Hop count) involved in the path increases.

## Hop count Comparison
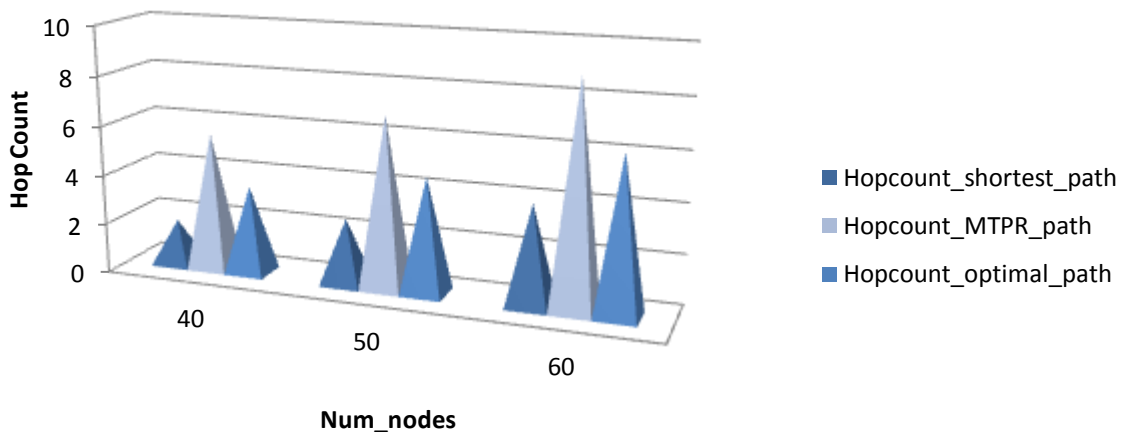


### 5 . CONCLUSION AND FUTURE SCOPE

**5.1 Conclusion**

This paper contains two parts: one is theoretical study and other is empirical study. In theoretical part it is clear that due to the random mobility of node, routing becomes a complex issue. Till now many routing protocols are used in MANET. Each routing protocol has unique features. Based on network environments, we have to choose the suitable routing protocol. Proactive routing protocols are best suited in small networks. In large and dense network, reactive routing approach plays a major role. Reactive routing protocols use destination sequence number and feasible distance to ensure a loop free routing. Hybrid routing protocols use reactive and proactive approach in routing operations

In simulation part, we make a comparison among MTPR, AODV and our proposed scheme using various metrics such as Packet Delivery Ratio (PDR), Hop_Count, Probability of Reachability (PoR). As MTPR follow the path with maximum hops and leads to minimum loss of transmission power but leads to congestion. On the other hand AODV follows shortest path which maximize power loss but less congestion problem is introduced. Thus we proposes a hybrid scheme which follow an intermediate path among these two and leads to minimum transmission power loss along with the congestion problem

### 5.2 Future Scope

Ad-hoc networks, the most provoke term in wireless technology, approach to be the emperor of future airs provided the vision of "anytime, anywhere" communications. At present, the general trend is toward mesh architecture and large scale. New applications call for both bandwidth and capacity, which implies the need for a higher frequency and better spatial spectrum reuse. Propagation, spectral reuse, and energy issues support a shift away from a single long wireless link (as in cellular) to a mesh of short links (as in MANET). Research on "multi-hop" architecture showed it a promising solution to the implementation of ad-hoc networks. As the evolvement goes on, especially the need of dense deployment such as battlefield and sensor networks, the nodes in MANET will be smaller, cheaper and capable [13]. Till today there are various issues in MANET, but at what speed new routing strategies are growing, soon ad-hoc networks will reach to its advance stage.

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