Preemptive Multipath-Adhoc On Demand Distance Vector Routing Protocol

Manoj Kumar Singh  
Department of CSIT  
Moradabad Institute of Technology, Moradabad  
Uttar Pradesh (India)  
Email: manojaswal1982@yahoo.com

Chiranjeev Kumar  
Department of CSE  
Indian School of Mines (ISM), Dhanbad  
Jharkhand (India)  
Email: k_chiranjeev@yahoo.co.uk

Brajesh Kumar  
Department of CSIT  
MJP Rohelkhand University, Bareilly  
Uttar Pradesh (India)  
Email: sainibrajesh@gmail.com

Manish Gupta  
Department of CSIT  
Moradabad Institute of Technology, Moradabad  
Uttar Pradesh (India)  
Email: manishymca2007@gmail.com

Abstract- A mobile ad hoc network (MANET) [1] consists of a set of mobile hosts capable of communicating with each other without the assistance of base stations. The topology of ad-hoc networks changes rapidly. The Ad hoc On Demand Distance Vector (AODV) [2] routing protocol and other on-demand routing protocols suffer with many problems like delay and packet loss caused due to link break, time required in route re-discovery, and high routing overhead. Preemptive routing protocol tried to solve this problem by initiating route re-discovery before the actual link break occurs. But time requires in finding new route increases delay in data transfer. In this paper, Preemptive Multipath-AODV (PM-AODV) routing protocol is proposed to enhance the performance of AODV routing protocol by overcoming the listed inherited problems. Our proposed scheme PM-AODV uses the concept of Ad hoc on demand multipath distance vector (AOMDV) [3] and Preemptive routing protocol. Similar to AOMDV routing protocol, PM-AODV stores multiple disjoint routes from source to destination during route discovery phase. Route maintenance phase of PM-AODV is similar to preemptive routing protocol but instead of starting new route discovery source node switch to alternate already stored path for data transfer. This switching to previously stored alternate path reduces route re-discovery latency time. A comparison of the proposed scheme with AODV and preemptive routing protocol is also presented. The proposed scheme reduces global flooding and increases bandwidth utilization. It also reduces number of packet drops caused by link break in AODV.

Keywords: Ad Hoc Networks, Proactive Routing, Reactive Routing, preemptive routing, multipath routing, Ad hoc On-Demand Distance Vector (AODV), Preemptive Multipath – Ad hoc On-Demand Distance Vector (PM-AODV).

1. INTRODUCTION

Wireless mobile ad-hoc networks consist of a collection of mobile nodes that form a network and are capable of communicating with each other without help from stationary infrastructure such as access points. Nodes within each other’s radio range communicate directly via wireless links, while nodes that are not in their radio range use other nodes as intermediate routers to forward packets through multiple-hop routing. The nodes that communicate directly are said to be neighboring nodes. Furthermore, due to the movement of nodes, the network topology changes rapidly. Therefore, an efficient routing protocol is needed in order to do better communication between the nodes in ad hoc network. Existing routing protocols in ad hoc networks are divided into two categories: proactive (Table driven) routing protocols [3], and reactive (On Demand) routing protocols [2,7]. Proactive protocols maintain consistent, up-to-date routing information about all nodes in the network. Proactive protocols require periodic dissemination of routing table information throughout the network. Due to this periodic broadcast of routing information bandwidth utilization, throughput and power usage reduces. The advantage of proactive routing is that routes to any destination are always available without the overhead of a route discovery. In contrast, in Reactive routing, the traffic overhead is less than proactive protocols but source have to wait until a route has been discovered. Generally, on-demand routing requires less overhead than table-driven routing [8, 9, 10, 11], but it incurs a path discovery delay whenever a new path is needed. In both types of protocols, an alternative path is sought only after an active path breaks. The cost of detecting a link break is
high. Preemptive routing finds alternate path when a link is in danger of breaking (but before the disconnection occurs). Source node finds alternate path after receiving a route warning message, which increases the route discovery latency time. It increases the delay also. In this paper we proposed a Preemptive-AODV protocol which stores multiple disjoint routes from source to destination during route discovery phase. Hence in our proposed scheme when a source node receive a route warning message it switches to already stored alternate path which saves time and bandwidth wastes in performing route re-discovery in preemptive routing.

The paper is organized as follows. The proposed scheme is discussed in Section 2. The comparisons of proposed and existing schemes are presented in section 3. Finally, the conclusions of the paper are presented in Section 4.

2. PROPOSED SCHEME

In this section, we present the operation details of the proposed scheme. The proposed scheme description is based on AOMDV [5], and preemptive routing [4] to improve its performance.

2.1 PREEMPTIVE MULTIPATH-AODV

This section discusses about the improvements that can be made to the original AODV protocol using multipath routing and preemptive routing [4] in Ad hoc networks. In this section, we will discuss about the new scheme Preemptive Multipath-Adhoc On Demand Distance Vector (PM-AODV) of route. We have used RFC 3561 of AODV standard [6]. We propose a new scheme in which source node stores multiple paths to the destination in its routing table similar to AOMDV [5].

The proposed scheme has introduced a new message header called Route Warning message (RWRN). A new flag w in RERR message is also introduced. RWRN message is a RERR message with flag w. Flag w in RWRN message indicates that the route to destination node mentioned in RWRN message is in danger and can break any time. A flag w is also added in the routing table. It is used to indicate that the route is in danger, and can break any time. Extended routing table is as shown in Figure. 1c.

2.2 ROUTE DISCOVERY IN PM-AODV

In our proposed scheme, PM-AODV, the route discovery phase is same as AOMDV protocol with slight modification. When a source node S wants to communicate destination node D, it prepares a RREQ packet and broadcast it to its neighbor. If a RREQ packet is received by an intermediate node i, it compares the received signal strength of RREQ packet with the preemptive signal threshold. If received signal strength of RREQ packet is greater than preemptive signal threshold, and it has route to destination, it sends a route reply packet, RREP, to source node S. Otherwise, it broadcast the RREQ packet to its neighbor. If RREQ is received by destination node, it sends a RREP packet if received signal strength of RREQ packet is greater than preemptive signal threshold. When RREP packet is received by intermediate node i, it makes an entry in its routing table for that destination and forward RREP packet towards source. When a source node S received a RREP packet, it makes an entry in its routing table. Source node maintains more than one route for the same destination in its routing table. The difference between PM-AODV and AOMDV route discovery is that in PM-AODV any node forwards the RREQ packet only when the signal strength of RREQ packet received is above the preemptive threshold value. Hence, the route obtained in PM-AODV is stronger than in AOMDV.

![Fig. 1: Structure of routing table entries for AODV, AOMDV and PM-AODV](image-url)
2.3 ROUTE DISCOVERY ALGORITHM IN PM-AODV

Suppose node S wants to communicate with Destination D. S broadcast a RREQ packet to its neighbors.

1. if (RREQ is received by an intermediate node i and it is not a duplicate packet)
   2. if (Received Signal strength of RREQ packet < Preemptive Signal Threshold)
   3. if node i has valid route to destination and flag w of that route is not set
      4. node i prepares a RREP packet and unicast towards source S
      5. else
         node i broadcast RREQ packet to its neighbor
      6. if (node i receives a duplicate RREQ packet)
         7. node i discard RREQ packet
      8. if RREQ is received by Destination node D
         9. node D prepares a RREP packet and unicast towards source S
     10. if (RREP is received by an intermediate node i)
         11. node i makes an entry in its routing table for that destination and forward the RREP packet towards source
         12. if RREP is received by source node S
         13. node S make an entry in its routing table for that destination.
     14. END

2.4 ROUTE MAINTENANCE ALGORITHM IN PM-AODV

Each node compares the signal strength of incoming data packet with the preemptive signal strength threshold. If it is less than threshold value, then that node send a route warning message (RWRN) to source node. When an intermediate node receive RWRN message it forward it towards source node and set the flag w (route warning flag) of that route in its routing table. When a source node receive a RWRN message, it also set the flag w of that route and search its routing table for another route to same destination. If it finds a valid route in its routing table it switch to that route. The source node than starts route discovery for that destination to store fresh backup route in its routing table.

2.5 ROUTE MAINTENANCE ALGORITHM IN PM-AODV

1. if data packet is received
   2. if (Received Signal strength < Preemptive Signal Threshold)
      3. Create and send RWRN message to the source node S.
   4. END
   5. END
   6. if RWRN message is arrived at the source node
      7. Source node searches its routing table for another route for same destination D.
      8. if (valid route exists)
         9. Source node drop the RWRN message.
         10. Switch to route having minimum hop count
         11. Start route discovery for that destination for fresh backup route.
      12. END
      13. END
   14. else if (RWRN message is arrived at the intermediate node)
      15. Set the flag w of that route in its routing table
      16. Forward RWRN message to source node
      17. END
   18. END

The preemptive warning is generated when the signal power of a received packet drops below preemptive threshold [4].

Illustration of route maintenance with example

Suppose node S is communicating with destination node D. Source node S has two routes to node D in its routing table shown in Table 1. Suppose node Q moves away from path, due to which the signal strength of the data packet received by node Q drops below preemptive threshold value. Node Q prepares a warning message, RWRN, and sends it to node S. Fig. 3. On receiving RWRN message source node S set the flag w of the corresponding route to
destination node D. Source node than search its routing table for alternate route to destination D. It finds alternate route to node D in its routing table whose flag \( w \) is zero. It than switch to that route and start sending data on that route. Fig. 4.

3. PERFORMANCE ANALYSIS OF PM-AODV

Various cases are considered for evaluating the performance of the proposed scheme and it is also compared with AODV [2], preemptive routing [4]:

**CASE 1: FAST ROUTE MAINTENANCE**

In PM-AODV source node came to know about link break before it breaks and switch to another route before link break. Hence route re-discovery time in case of link break is less in PM-AODV compare to AODV and preemptive routing.

**CASE 2: REDUCED DELAY**

Since Source node came to know about link break before it actually break and switch to another route, the delay caused in AODV and preemptive routing does not occur in PM-AODV

<table>
<thead>
<tr>
<th>DEST</th>
<th>NEXT HOP</th>
<th>HOP COUNT</th>
<th>......</th>
<th>FLAG W</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>C</td>
<td>3</td>
<td>......</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>B</td>
<td>5</td>
<td>......</td>
<td>0</td>
</tr>
</tbody>
</table>

**CASE 3: NUMBER OF PACKET DROP DUE TO LINK BREAK IS REDUCED**

Since source node switch to alternate route before the link break, there will be no packet drop in case of link break. Packet drop however still possible in case link break occur more frequently or in case alternate route is also break. But the overall packet drop in PM-AODV is less compare to packet drops in AODV and preemptive routing.
4. CONCLUSION

In this paper, PM-AODV scheme is proposed to improve an AODV routing protocol. PM-AODV uses a combined strategy of AOMDV and preemptive routing to improve the route maintenance scheme of AODV and preemptive routing protocol. PM-AODV reduces the route latency time when a warning message is generated. Hence improves the performance of AODV.

REFERENCES


