ht-AODV – A Hop count and Time based Hybrid MANET Protocol

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Introduction

MANETs (Mobile Ad-hoc Networks) consist of independent mobile nodes and operate without the support of the infrastructure. Many research studies were carried out over past years in carrying out the possibility of data transfer using MANETs. MANETs are usually used in military, disaster management, personal area networking etc.

Routing is a key issue in MANETS because of the dynamic nature of the network and new routing protocols are often proposed to solve the routing problem. AODV (Ad hoc On demand Distance Vector) is one of the popular routing protocol because of its efficiency. AODV uses hop-count to choose the best route for packets during the route discovery.

In this work we propose a new extension of AODV protocol called as ht-AODV which uses a new technique to discover efficient routes using hop count along with a new time based variable called packet-travel-time (PTT). ht-AODV chooses an efficient route among the available routes to get a better packet delivery ratio in bigger networks and more importantly to achieve a better end-to-end delay than AODV.

AODV Inefficient Scenarios

Intermediate Node Route Updating Scenario

In AODV, an important factor is the reverse path and the forward path route entries maintained by intermediate nodes. Each intermediate node will make an entry of a reverse path, when a RREQ is received and also makes a forward path entry when a RREP is received. Let us consider a scenario shown

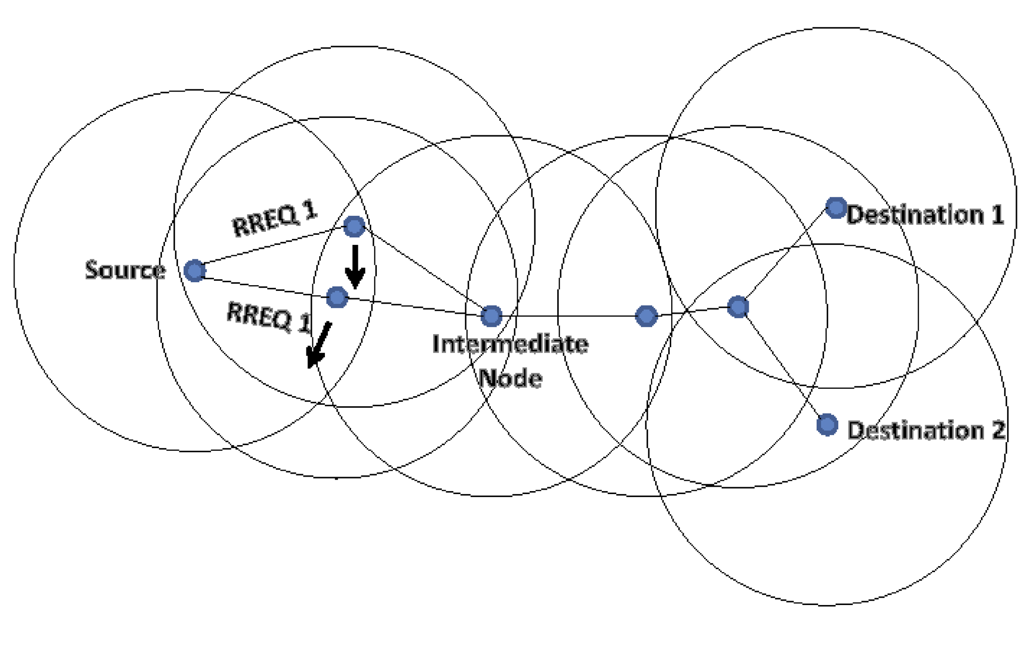


Fig. 1. Source node sends RREQ 1 packet to find a route to Destination 1

in Fig. 1, where a given Source node generates RREQ 1 to Destination 1 and broadcasts RREQ 1. When an intermediate node receives RREQ 1, this node will make a reverse path entry in its routing table. As shown in the Fig. 1, arrows indicate that the nodes are moving in the respective directions. Now let us assume that the same Source node generates another RREQ 2 to find a route towards Destination 2. As shown in Fig. 2, the same Intermediate Node shown in Fig. 1 receives the RREQ 2 through a different path with the same number of hops in the similar manner, the RREQ 1 was received.

AODV Inefficient Scenarios contd.

But, the newer path, which has just been found, is shorter in distance because of the mobility of the nodes, the nodes which were previously closer to the intermediate node are now have moved to a longer distance and nodes which were away from the intermediate nodes have now come closer.

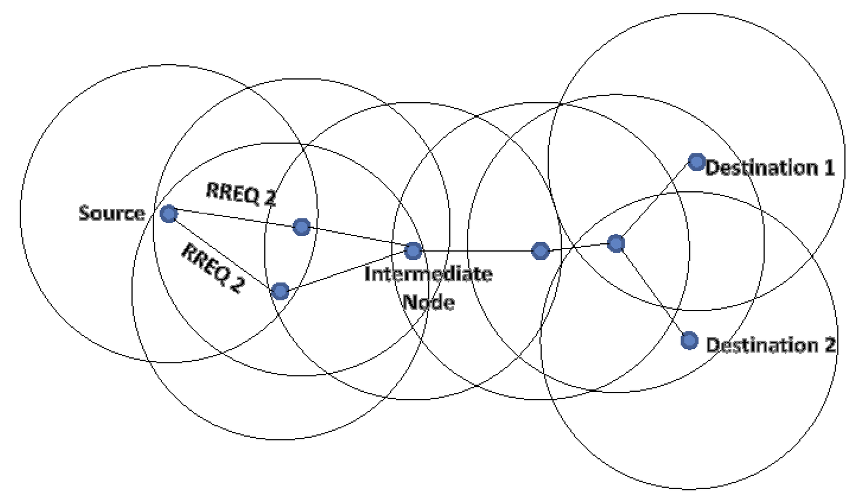


Fig. 2. Source node sends RREQ 2 packet to find a route to Destination.

Similar situation may arise when a given destination node generates and broadcasts a RREP towards a source node. When an intermediate node receives this RREP message, the intermediate node will make a forward path entry in its routing table. If the same destination node generates another RREP towards a different source node, and if the intermediate node receives the second RREP through a different path with same number of hops as like the first RREP was received from a node which is closer to it, the intermediate node will not make any updates to the routing entry.

Multiple RREQ Scenario

In this scenario we consider a network which includes a source node, a destination node and other nodes. We assume that the source node tries to send packets to the destination node and there exist routes between the two nodes with equal number of hops as shown in Fig. 3.

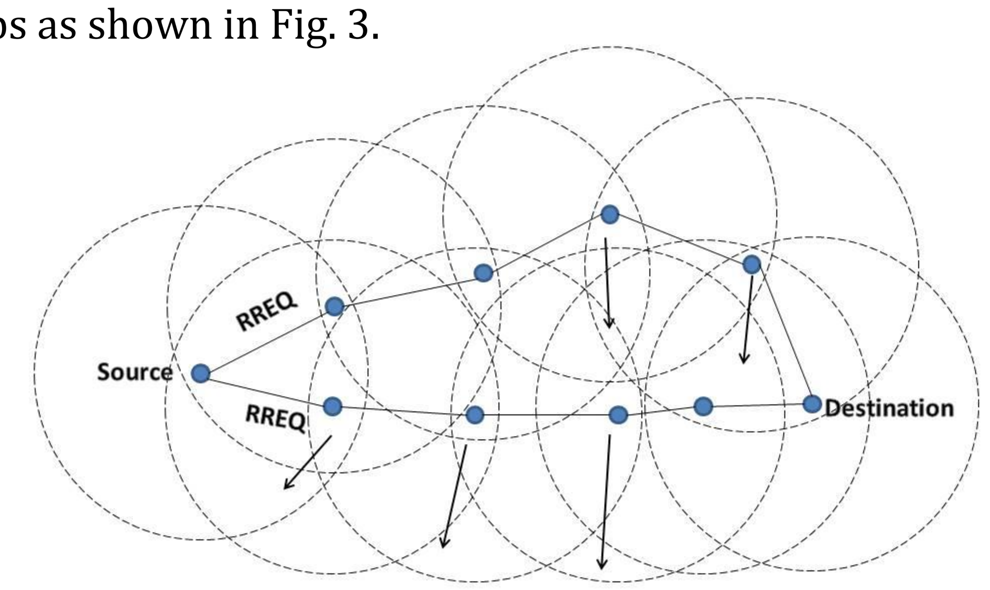


Fig. 3. Position of nodes when the first RREQ packet is flooded and the directions of node mobility.

The source node broadcasts the first RREQ message. There are two paths available in this network with equal number of hops. Though AODV chooses the route randomly, the path shown in the bottom of the Fig. 3 would be a shorter path based on the proximity of the nodes.

Fig. 4 shows the positions of nodes when they start moving. At this moment, the path at the bottom of the Fig. 4 becomes longer than the path at the top of the figure. Therefore choosing the path at the top would lead to a faster data transmission.

AODV Inefficient Scenarios contd.

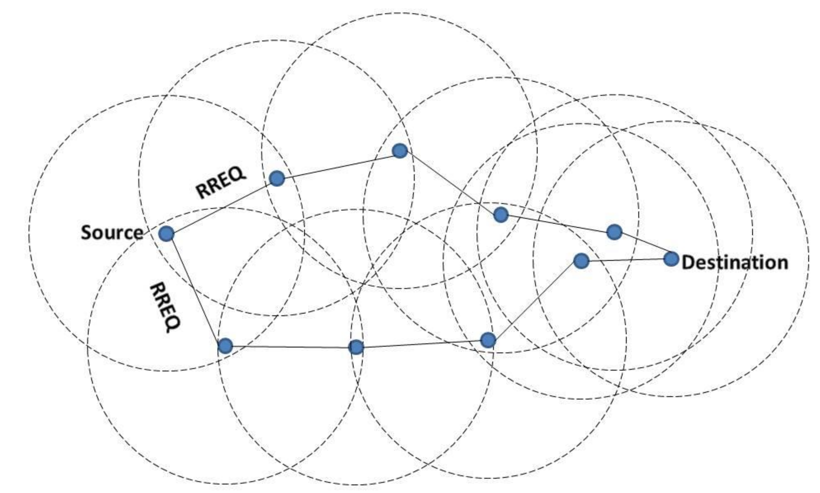


Fig. 4. Position of nodes when the second RREQ packet is flooded to find a route towards the destination node

ht-AODV Our Proposed Algorithm

We Define

$$PTT = CT - OT$$

- PTT is the Packet Travel Time
- CT is the Current Time Stamp
- OT is the Packet origination Time Stamp

Result: Route Table entry with shortest path from the current node to destination node
Input: $seqnum_i^d$ is the sequence number which is in the routing table at node i to node d
Input: $seqnum_j^d$ is the sequence number of Routing Packet (RREQ,RREP) which is from node d from a neighbour node j
Input: ptt_i^d is the PTT value in the routing table at node i for destination d
Input: $hopcount_i^d$ is the hopcount in the table at node i to d
Input: $hopcount_j^d$ is the hopcount of the routing packet which came through node j
Define: ptt_j^d is the PTT value for destination d which the routing packet came through the node j ;
Define: Current Time Stamp CTS;
Define: Packet Originated Time Stamp OTS;

begin
 set $ptt_j^d \leftarrow CTS - OTS$;
 if $(seqnum_i^d < seqnum_j^d)$ **then**
  $seqnum_i^d \leftarrow seqnum_j^d$;
  $hopcount_i^d \leftarrow hopcount_j^d + 1$;
  $nexthop_i^d \leftarrow j$;
  $ptt_i^d \leftarrow ptt_j^d$;
 else if $(seqnum_i^d = seqnum_j^d)$ **then**
  if $(hopcount_i^d > hopcount_j^d)$ **then**
   $seqnum_i^d \leftarrow seqnum_j^d$;
   $hopcount_i^d \leftarrow hopcount_j^d + 1$;
   $nexthop_i^d \leftarrow j$;
   $ptt_i^d \leftarrow ptt_j^d$;
  else if $(hopcount_i^d = hopcount_j^d)$ **then**
   if $(ptt_i^d > ptt_j^d)$ **then**
    $seqnum_i^d \leftarrow seqnum_j^d$;
    $hopcount_i^d \leftarrow hopcount_j^d + 1$;
    $nexthop_i^d \leftarrow j$;
    $ptt_i^d \leftarrow ptt_j^d$;
   end
  end
 end
end

Experimental Setup and Performance Evaluation

Simulation Parameters	
Protocols Tested	AODV, AOMDV, ht-AODV
Simulation Time	1800 Seconds
Simulation Area	1000 x 1000 meters
Number of Nodes	50, 60, 70, 80, 90, 100
Transmission Range	100 meters
Mobility Model	Random Waypoint
Bandwidth	2Mbps
Pause Time	10 seconds
Node Movement Speed	10 m/s

Performance Metrics

Packet Delivery Ratio (PDR): is defined as the ratio of number of packets received at the destination to the number of packets sent from the source.

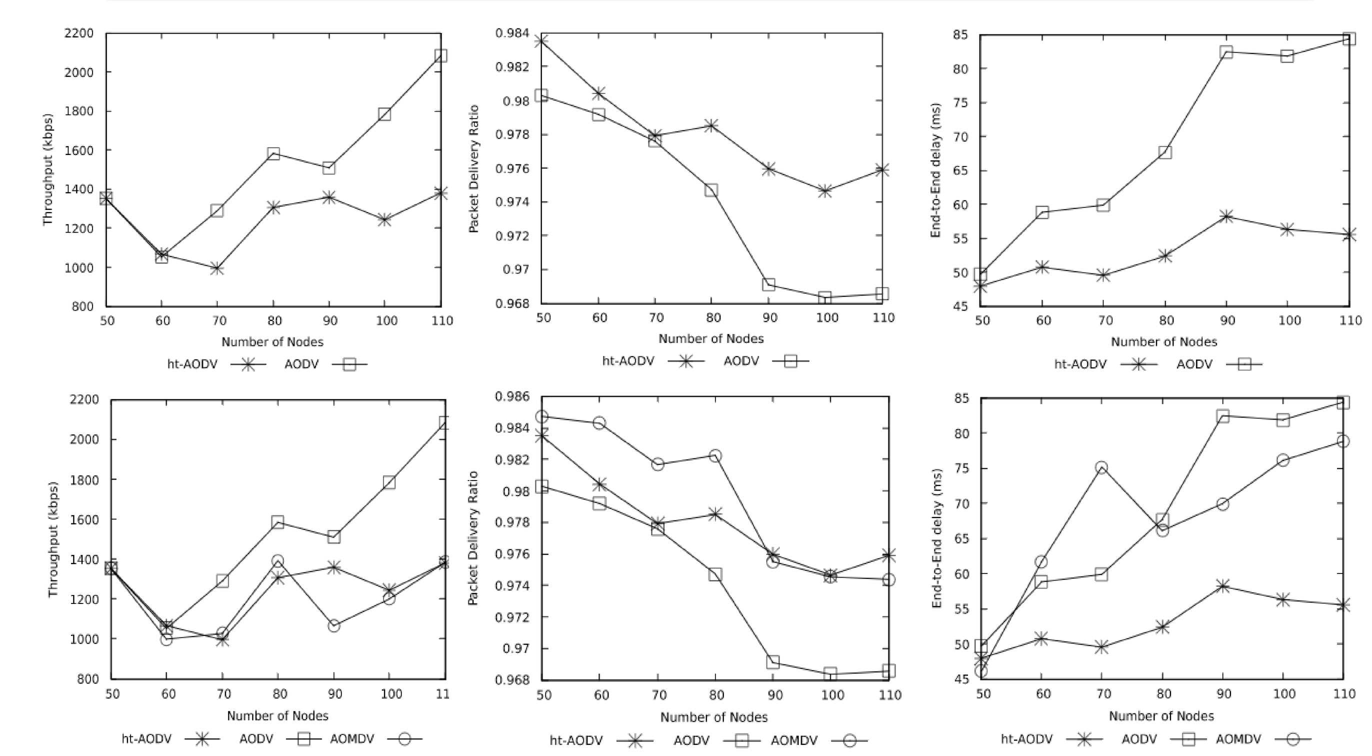
$$PDR = \frac{\sum Total\ packets\ received}{\sum Total\ packets\ sent}$$

End-to-End delay (E2E): is defined as the average time taken by a packet to route through the network from the source to destination.

$$E2E = \frac{1}{n}\sum_{i=1}^{n} Tr_i - Ts_i$$

$$Throughput = \frac{Total\_Rcvd\_Pkt\_Size}{StopTime - StartTime} \times \frac{8}{1000}$$

Results



Conclusion & Future Work

Our simulation based studies indicate that the ht-AODV achieves a lower end-to-end delay and a higher packet delivery ratio, when compared with AODV and AOMDV. We envision such an improvement to the ht-AODV would identify it as a better protocol when compared with many of the existing recent extensions to the AODV routing protocol. Our future work includes the investigation on how to improve the network Throughput of ht-AODV, when the node population increases.