

Performance Analysis of AODV with the constraints of Varying Terrain Area and Pause Time in Wireless Sensor Networks using NS-3 Simulator

By

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ABSTRACT

Mobile Ad Hoc Networks (MANETs) are wireless networks, where there is no requirement for any infrastructure support to transfer data packets between mobile nodes. These nodes communicate in a multi-hop mode; each mobile node acts both as a host and router. The main job of Quality of Service (QoS)[1][2] routing in MANETs is to search and establish routes among different mobile nodes for satisfying QoS requirements of wireless sensor networks as PDR, Average end-to-end delay, Average Throughput. The QoS routing protocols efficient for commercial, real-time and multimedia applications are in demand for day to day activities[2].

Keywords: MANETs; AODV; PDR; Average Throughput; Average End to End Delay.

1. INTRODUCTION

MANETs are wireless networks, which do not need infrastructure support for sending and receiving data packets between various mobile nodes, it can be an access point or a base station. Each mobile node acts both as a host as well as a router. The limitations in conventional wireless networks are more probable in MANETs due to varying topological changes, the energy constraint, limitation of bandwidth and the lack of information for a current network state.

A wide range of applications exist for Ad Hoc networks among them are distributed computing, disaster recovery, mobile access Internet, military applications, vehicles communication, healthcare providers, sensor networks and multimedia applications are some examples. AODV and DSR are Reactive Routing Protocols; here we are analyzing AODV.

2. Ad Hoc On-Demand Distance Vector Protocol.

Ad hoc On Demand Distance Vector (AODV) [3] is a reactive routing protocol enables dynamic, self-starting. AODV allows mobile nodes to select routes quickly and respond to link breakages and changes in the network topology efficiently. AODV uses destination sequence number for each route entry and contains four different packets HELLO, Route Request (RREQ), Route Reply (RREP), and Route Error (RERR).

These control messages (packets) are received via UDP and IP header processing.

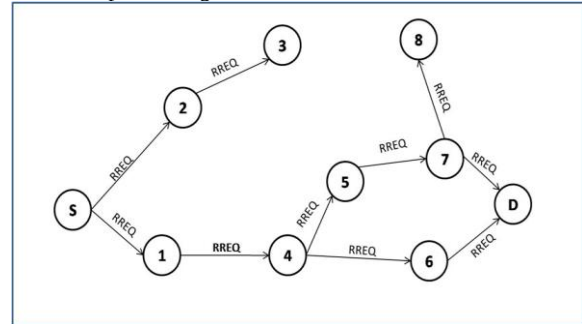


Fig. 1 RREQ propagation of AODV routing protocol.

When source nodes wish to determine a route to a destination node. It broadcasts a route request (RREQ) packet to all its neighboring nodes with packet id and the destination sequence number. The RREQ packet is flooded through the network through the neighboring nodes until it reaches the destination nodes. Once the destination receives the RREQ, the destination node reply with RREP packet back through the source node through the neighboring nodes as updated in the routing table by each mobile node. The Fig 1 and Fig 2 systematically depict the RREQ and RREP packets propagation mechanism of AODV routing protocols. Upon the reception of RREP packet, the source node starts transmitting data to the destination node with minimal hop count.

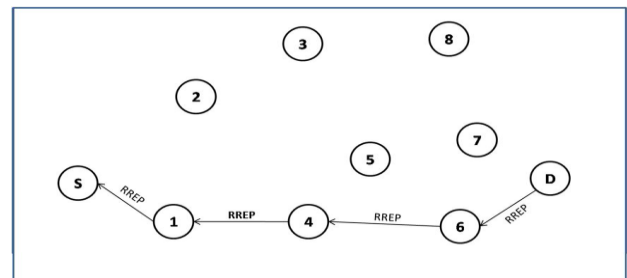


Fig. 2 RREP propagation of AODV routing protocol.

2.1 Performance Metrics

In this paper, the performance matrix includes the following QoS parameters.[4,5]

2.1.1 Packet Delivery Ratio (PDR):

It is the ratio of the data packets delivered to the destinations to those generated by the CBR sources. The PDR shows the efficiency of a protocol to deliver packets from source to destination. The higher value give us better results.

2.1.2 Average End to End Delay:

It is the average time utilized by a data packet to reach from source to destination node. First total delay is calculated by subtracting the time taken by the packets from reaching source to destination. Then we find the ratio of total delay to the number of packets received.

2.1.3 Throughput:

It is the ratio of total number of data packets delivered or received to the total duration of simulation time.

2.1.4 Normalized Routing Load: The Normalized Routing Load is the ratio of all routing control packets send by all source nodes to a number of received data packets at the destination nodes.

3 SIMULATION ENVIRONMENTS

3.1 Mobility Model

Mobility model describes changes in the stations velocity and acceleration over time and their movement. Basic parameters related to node movement are mobility speed, the number of nodes, sending rate, pause time, the number of connections, simulation duration. Mobility models can be categorized in two types group and entity models. The motions of mobile stations in entity models are independent from each other, but in group models the movements of stations are dependent on each other [6].

In our article we chose the Random Waypoint Mobility, generated by the software Bonn Motion [7]. It is an entity model. A station in this can select any random velocity and any random destination. The station begins moving towards the chosen destination station. After obtaining the destination station, the station stops for a small amount of time defined by the "Pause Time" attribute and again the station repeats the process until the simulation stops.

3.2 Simulation Parameters:

We elaborate the experiments for the evaluation of the performance of ad hoc routing protocols AODV, with varying Pause Time and Terrain Area in NS-3[8]. We have 45 simulations run in total out of which 45 trace files are generated for Random Waypoint Mobility each. We studied all performance metrics in our simulation under varying Pause Time (20 Sec to 100 Sec) and Terrain Area (250x250,500x500, 1000x1000) and while other attributes are fixed. Table 1 presents the simulation parameters adapted to our simulation.

Table 1. Simulations parameters

Parameter	Value
Simulator	NS – 3 .17
Number Of Nodes	100
Simulation Time	100 Sec
Simulation Area	250 X 250 ;500 X 500; 1000X1000
Packet Size	1000 Bytes
Packet Rate	5 packet/sec
Mobility Model	Random Way Point Mobility Model
Routing Protocol	AODV
Node Speed	20 m/s
Pause Time	20 Sec,40 Sec,60 Sec,80 Sec,100 Sec

Table 2. PDR for varying Pause Time and Terrain Area

Pause Time(sec)→ Topology ↓	20	40	60	80	100
250 M x 250 M	96	96	96	96	96
500 M x 500 M	97.0	97.0	97.0	96.5	96.5
1000 M x 1000 M	96	95	95	94	94

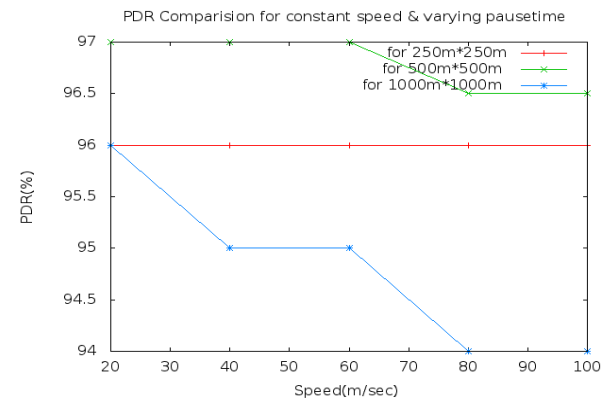


Fig. 3. PDR for varying Pause Time and Terrain Area.

Table 3. Average throughput for varying Pause Time and Terrain Area

Pause Time(sec)→ Topology ↓	20	40	60	80	100
250 M x 250 M	4873	4547	4584	4639	4739
500 M x 500 M	4998	4951	4947	4878	4863
1000 M x 1000 M	4410	4403	4408	4405	4401

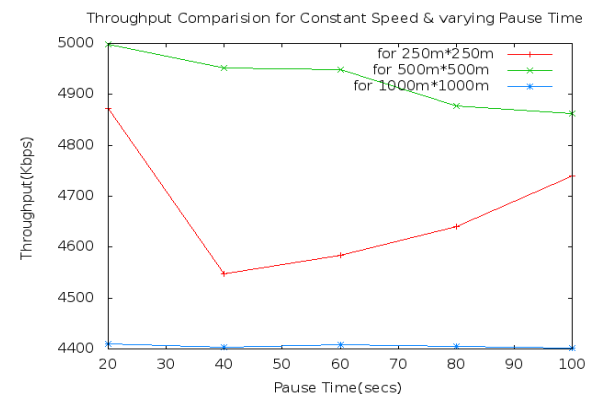


Fig. 4.Average throughput for varying Pause Time and Terrain Area .

Table 4. Average Delay for varying Pause Time and

Terrain Area					
Pause Time(sec)→ Topology ↓	2 0	4 0	6 0	8 0	1 0 0
250 M × 250 M	0.0258894	0.0260785	0.0258000	0.0257813	0.025880
500 M × 500 M	0.0126093	0.0126199	0.0126172	0.0163440	0.017649
1000 M × 1000 M	0.00124358	0.00124223	0.00124151	0.0013455	0.001597

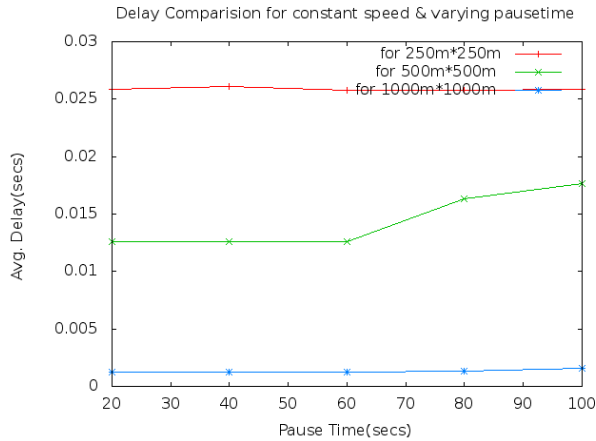


Fig.5. Average Delay for varying Pause Time and Terrain Area.

4 CONCLUSION AND FUTURE DIRECTIONS

In this paper, the comparison is based upon the different parameters and performance metrics. We examine that PDF for small terrain areas is nearly constant and decreases with larger terrain area. Average throughput for varying Pause Time and Terrain Area decreases with larger terrain area. Average Delay for varying Pause Time and Terrain Area for small terrain areas is nearly constant and decreases with larger terrain area. In protocol performance, AODV has better performance in networks with high mobility and size. For real time traffic AODV is preferred over DSR and DSDV.

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