# A Comparative Study & Analysis of Random Waypoint and Reference Point Group Mobility Model in Ad-hoc networks

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***Abstract*— Mobile Ad-hoc network (*MANET)* is a collection of wireless mobile nodes configured to communicate amongst each other without the aid of an existing infrastructure. Several Mobility models are used in evaluating the performance of a protocol in ad-hoc networks. A mobility model is designed to describe the movement pattern of mobile users. The mobility patterns usually play a significant role in determining the performance of the protocol, it is desirable for mobility models to follow the node mobility in a reasonable way. In this paper we consider two mobility models and their comparative analysis in AODV by using various performance parameters.**

***Index Terms*—AODV, MANET, RWPM, RPGM.**

## I. INTRODUCTION

MANET's are *Multi-Hop* wireless networks since one node might not be in direct communication range of other node. In these types of cases the data from the original sender has to travel a number of hops (hop is one communication link) in order to reach the destination. The intermediate nodes act as routers and forward the data packets till the destination is reached [1]. There are two activities involved in this concept. First is determining optimal routing paths and transferring the packets through an internetwork. The packets are transferred through an internetwork which is called as packet switching. Routing protocols are used to calculate the best path for routing the packets using several metrics like calculating the number of hops, which are then used by the routing algorithms, in determining the optimal path for the packet to reach its destination. Routing is mainly divided into static routing and dynamic routing. Static routing refers to the routing which is being stated manually or statically and it is permanent. Dynamic routing refers to the routing which is automatically done by the choice of router. It can route the traffic on any route depending on the routing table.

The routing protocols [2] in MANET's can be classified as:

- Reactive (Demand routing protocol)
- Proactive (Table-driven protocol)
- Hybrid

Reactive protocols - In the reactive routing protocols communication is possible only when the source node needs to communicate with the destination or other nodes, routes are build only when they have to communicate. These MANET protocols are mostly meant for nodes that transmit data rarely or with a high mobility. The reactive routing protocols are AODV and DSR

Proactive protocols – These types of routing protocols are known as table driven routing protocols. These protocols identify the layout of the network very actively and the routing table can be maintained at each node from which route can be determined with less delay. These protocols provide good reliability on the available network topology [3]. The Proactive routing protocol is DSDV. In this paper we will discuss about AODV protocols and ns2 Simulator.

## II. AODV PROTOCOL

**Ad hoc on demand distance vector routing protocol** being a reactive protocol that is it establishes the connection only when a source wants to initiate transmission with another node as destination in the network, control messages are used to find a route to the destination node in the network. It will provide the information about the route for the node. Fig.1 shows the message routing for AODV protocol. Node "A" wants to send messages to another node "F". It will generate a Route Request message (RREQ) and forwarded to the neighbors, and those node forward the control message to their neighbors' nodes. Whenever the route to destination node is located or an intermediate node have route to destination. They generate route reply message (RREP) and send to source node. When the route is established between "A" and "F", node then they communicate with each other [3].

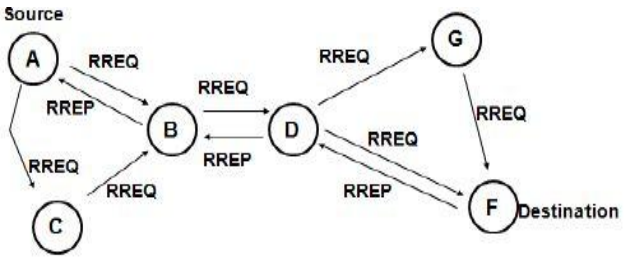


Fig 1. Message routing in AODV

## III. MOBILITY MODELS

To evaluate the performance of a protocol on ad-hoc network, it is necessary to test the protocol under realistic conditions, especially including the movement of mobile nodes. The mobility models are designed to describe the movement pattern of mobile users, and how their location, velocity and acceleration changes over the time. Since mobility patterns may play a significant role in determining the performance of the protocol, it is desirable for mobility models to emulate the movement pattern of targeted real life



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applications in a reasonable way. Mainly there are two types of mobility models. These are:

- Entity/ Individual mobility models
- Group mobility models

Entity/Individual mobility models: In this, nodes movements are independent of each other such as Random waypoint, Random direction, Random walk.

Group mobility models: In this, nodes movements are dependent of one another like Reference group mobility model, Column, Nomadic, Pursue and Exponential correlated. Under this also comes the Geographic based models, these are Pathway, Manhattan, Freeway, Obstacle. In this thesis, we will concentrate on the Random waypoint model and Reference point Group mobility model as these have great significance in the paper.

### *A. Random Waypoint mobility model:*

A mobile node begins the simulation after waiting for a specified pause time. After this time it selects a random destination in the area and a random speed distributed uniformly between 0m/s and Vmax. After reaching its destination point, the mobile node waits again pause-time seconds before choosing a new way point and speed. In other words, we can say that a node is free to select its destination, speed and direction independent of neighboring nodes. This model is the model that is used widely and analyzed in simulation of ad hoc routing protocols because of its simplicity and availability [4].

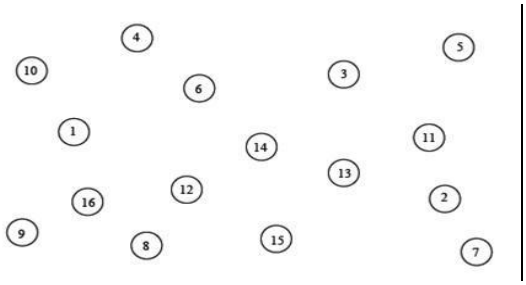

Fig2. Random Waypoint Mobility Model

### B. Reference Point Group Mobility Model

The main use of this model is in military battlefield. In this model nodes are divided into groups and each group has a leader. The leader's mobility follows the random way point and the members of the group follow the leader's group mobility closely with the same deviation. Fig.3 shows topography showing the movement of nodes for Reference Point Group Mobility Model. Each node deviates from its velocity (both speed and direction) randomly from that of the leader. Because of the inherent characteristic of spatial dependency between nodes, the RPGM model is expected to behave different from the Random Waypoint model [5].

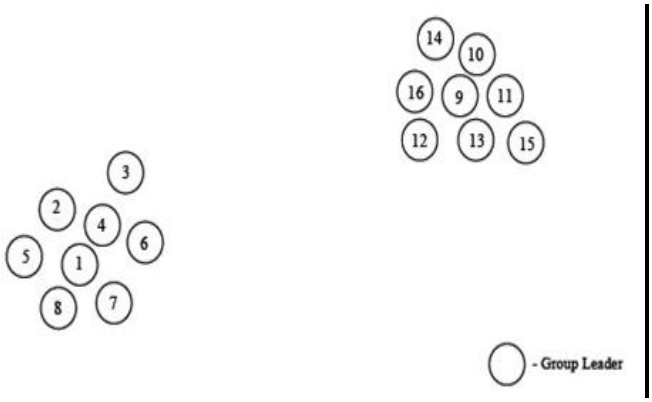


Fig.3. Reference Point Group Mobility Model

## IV. SIMULATION ENVIRONMENT

We have used the Bonnmotion tool to create Mobility for different number of nodes and ns2 simulator is used for simulation. Then the graphs are created and compared for performance parameters [6].

The simulation setup we used as follows:

| Parameter | Value |
|---|---|
| Simulator | ns2 |
| Wireless MAC | 802.11 |
| Number of nodes | 10,20,30,40,50 |
| Mobility Models | Random Waypoint mobility model, Reference point group mobility model |
| Routing Protocol | Ad-hoc on demand distance vector routing protocol |
| Simulation Time | 60 sec |
| Traffic | CBR |

Table 1: Simulation Parameters

## V. EXPERIMENTS & ITS RESULTS

**Throughput:** The average rate at which the total number of data packets is delivered successfully from one mobile device to another device over a communication network is known as throughput. The result is found as per kbps.

**Average End-to-End Delay**: This is defined as the average delay in transmission of a packet between two mobile devices. The higher value of end-to-end delay means that the network is congested and hence the routing protocol does not perform well. Delays due to route discovery, queuing, propagation and transfer time are included in the delay metric.

**Jitter**: The term jitter is often used as a measure of the variability over time of the packet latency across a network. A network with constant latency has no variation (or jitter). Packet jitter is expressed as an average of the deviation from the network mean latency.

**Packet Load**: This is the ratio between the numbers of routing Packets transmitted to the number of packets actually received. Higher value of network load shows that overhead



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of routing packets is high. It is the sum of all control packets sent by all the mobile devices of the MANET to discover and maintain routes [7, 8, 9].

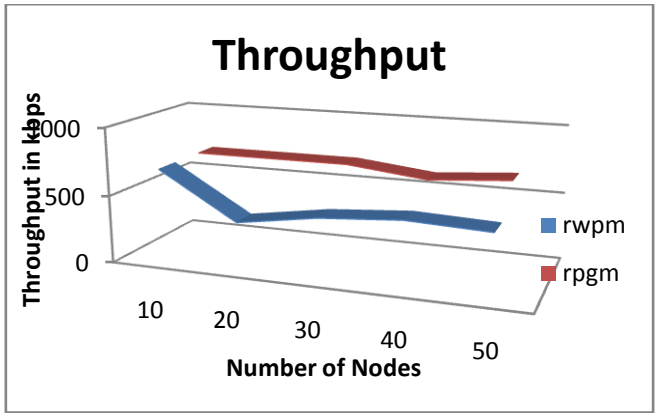


Fig 4. Graph between no. of nodes and throughput

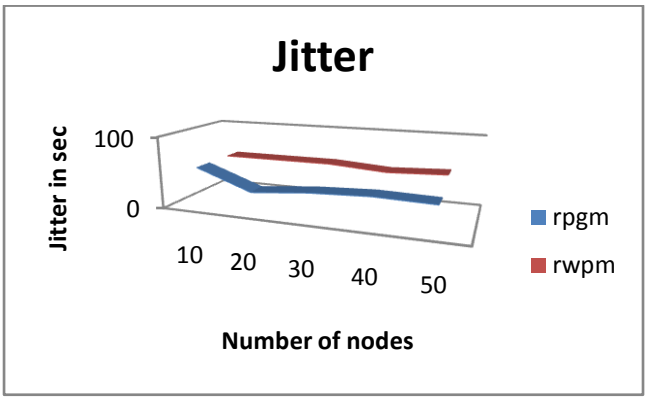


Fig 5. Graph between no. of nodes and jitter

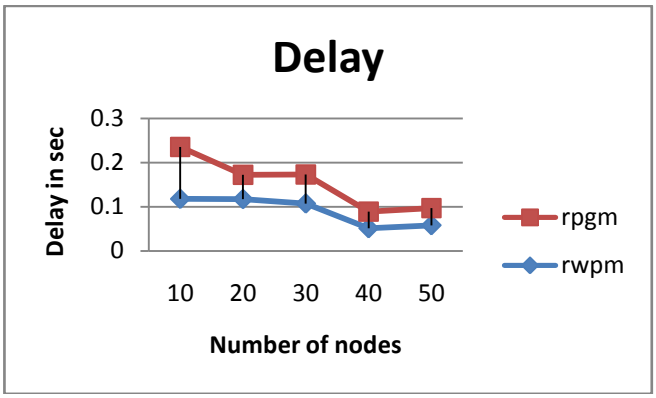


Fig 6. Graph between no. of nodes and delay

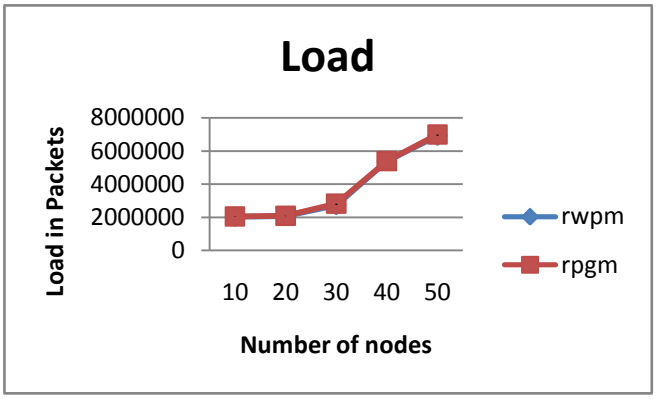


Fig 7. Graph between no. of nodes and packet load

## VI. Conclusion

The performance of AODV with RWPM is compared to AODV with RPGM by using various performance parameters like throughput, jitter, end to end delay, packet load by using different number of nodes i.e. 10, 20, 30, 40, 50. From this we concluded that the performance of RPGM is better than RWPM in every performance parameter case even when, in RPGM, the nodes mobility is in group mode. The comparison of performance parameters is done by using graphs and then comparing their values. It is concluded that throughput is high in RPGM. Delay is less in RPGM. Jitter is less in RPGM. Even when in all the cases we have the same packet load. So, above all RPGM is better in all respects than RWPM.

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