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Analyzing the Performance of Random Mobility Models with Opportunistic Routing

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Abstract

Mobility of connected wireless devices in ad hoc networks has been rising over these years leading to highly dynamic and unpredictable topology. Technology advancements have enabled these wireless devices to move in random directions with varying speeds. Routing of data packets from the source to the destination devices is a great challenge in these dynamic environments. Over these years researchers have proposed numerous routing protocols for efficient data delivery in these networks. Most of these protocols have been studied using simulations, in which mobility of devices are generated with different mobility models. Thus the accuracy of the performance analysis of routing protocols greatly depends on the respective mobility model used. The objective of this article is to analyze and compare the performance of the most popular random mobility models proposed for dynamic ad hoc networks using opportunistic routing.

Keywords: Opportunistic Routing; Performance Analysis; Random Mobility Models; Random Direction Mobility Model; Random Walk Mobility Model; Random Way Point Mobility Model;

1. INTRODUCTION

Routing of data packets from the source to the destination devices in Mobile Ad Hoc Networks (MANETs) [1-2] has been a challenging task for researchers over these years. With the continuous rise in mobility of the connected devices, reliable routing of data packets has become very difficult [3-6]. The performances of routing protocols proposed for MANETs are evaluated using simulations in which mobility of

devices are generated using different mobility models. Mobility models thus play a very important role in the accuracy of performance analysis of various routing protocols. Random mobility models [7-9] have been found to give better results among the various mobility models proposed for MANETs. This paper analyses and compares the performance of three popular mobility models; random way point, random walk and random direction mobility models using the latest opportunistic routing [10-14]. This result would further help in designing accurate mobility models for performance analysis of new routing protocols for dynamic MANETs.

The paper is organized as follows. Section 2 describes the random mobility models in detail. Section 3 presents the performance analysis of the random mobility models. Further this section discusses the results obtained in simulations using ns-2 [15]. The paper concludes in Section 4 with new research directions.

2. RANDOM MOBILITY MODELS

In random mobility models every node in the network moves freely in different directions without restrictions. All the mobility attributes like speed, direction and destination are selected randomly and independent of previous selection. These unique features have contributed to its growing popularity. This paper discusses three major ransom mobility models proposed for MANETs.

2.1 Random Way Point Mobility Model (RWPMM)

In the random way point mobility model, each device chooses a random location in the network. The device then moves to the selected destination position with a random speed. The speed of movement of the devices can be defined in the simulation. The device then stays at this location for a particular fixed time known as “pause time” before moving to the next random location.

2.2 Random Walk Mobility Model (RWMM)

In this mobility model a mobile device moves to a location randomly selected in the network and once it reaches there, it selects another random location and moves to the location in the network. The main difference of this mobility model compared to random way point is that this mobility model does not have any pause time.

2.3 Random Direction Mobility Model (RDMM)

This mobility model overcomes the problem of clustering of devices in different parts of the network faced by previous two mobility models. Using this model, a mobile

device selects a random direction and moves towards this direction until it reaches the boundary of the network. Once it reaches the border of the network it stays there for some time and then again selects a random direction and moves towards this random direction in the network until it reaches the boundary. Figure 1 depicts the movement pattern of a mobile device in the network with the three mobility models.

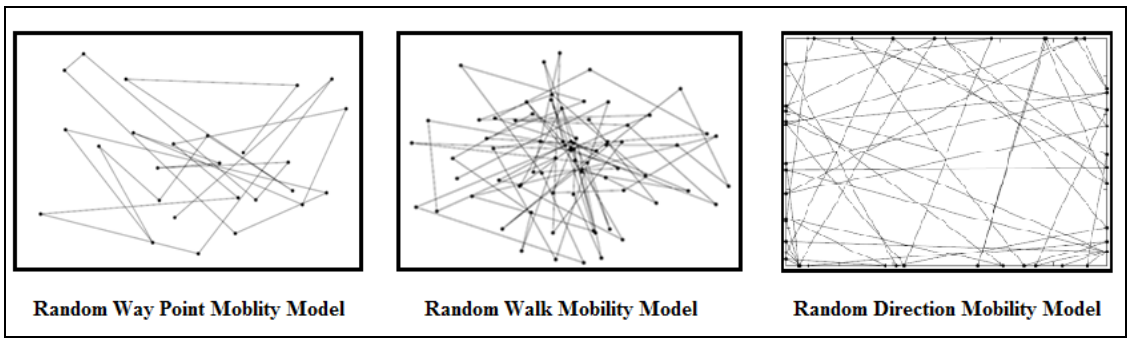

Figure 1: Mobility Patterns of the models

3. PERFORMANCE ANALYSIS

The MAC protocol used for the simulation is IEEE 802.11g. 100 nodes are deployed in a network area of 800×800 m^2 rectangular region. The transmission range of the nodes is set at 250 m. Constant Bit Rate (CBR) traffic is being generated from the source to the destination nodes in the network at a rate of 10 packets per second. The size of the data packet is 512 bytes. The simulation starts at 100 seconds and ends at 1000 seconds. ExOR [16] routing protocol is used for the performance analysis. Speeds of nodes are varied from 5 to 40 m/s and the corresponding Packet Delivery Ratio is measured. Figure 2 shows the PDR obtained by ExOR opportunistic protocol with the three mobility models.

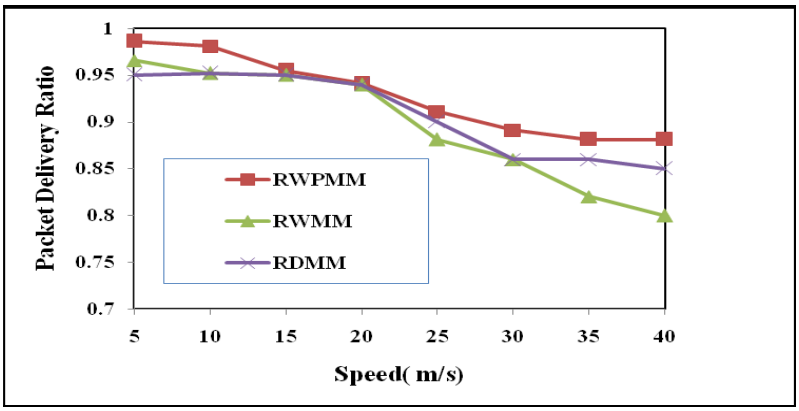

Figure 2: PDR vs Speed (m/s) with ExOR

From the results it is evident that the protocol gives higher performance with random way point mobility model compared to the other two mobility models. This is because of the pause time between the random movements of the nodes in the network. Random walk model is more suited for studying the performance of protocols in networks with moderate mobility. Random walk model generates networks with no pause time and highly mobile nodes. Therefore this model is suited for evaluating the performance of new routing protocols in highly dynamic networks. The nodes are placed at a greater distance in ransom direction models and this will help to evaluate the scalability support of the protocol in dynamic MANETs. As the three mobility models behave differently, results using all the three mobility models should be considered for the performance analysis and study of new routing protocols proposed for dynamic MANETs.

4. CONCLUSION

This research paper initially discussed the role of mobility models in the study and performance analysis of various routing protocols in dynamic MANETs. Design and working of the three popular random mobility models were presented. Performance analyses of the three random models were done using simulation in ns-2 with the ExOR opportunistic routing protocol. The study identified the need for using all the three random mobility models for accurate study and analysis of new routing protocols in dynamic MANETs. As the mobility of the connected devices are increasing rapidly, new mobility models matching the highly dynamic behavior needs to be developed for accurate analysis of the routing protocols. There is wide scope for research in this direction.

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