Study on Indoor and Outdoor environment for Mobile Ad Hoc Network: Random Way point Mobility Model and Manhattan Mobility Model

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ABSTRACT

Most of MANET simulations based on random mobility models, e.g. random waypoint model, models insufficient to reflect the environmental constraints. In this paper we have used a combine mobility model to analyze the effect of diverse mobility pattern (Random Waypoint Mobility Model and Manhattan Mobility Model) in indoor and outdoor environment to get a realistic simulation. In these models the movements of mobile nodes are either influenced by building or restricted to street. We demonstrate the utility of our test suite by evaluating various MANET routing protocols, including DSR, AODV and DSDV. Our results show that the protocol performance may vary across mobility models and performance rankings of protocols may vary with the mobility models used. The results shown that the environment factors such as spatial constraints may cause significant impact on the network performance.

Keyword: Mobility model, Mobile Adhoc Networks, Simulation.

1 INTRODUCTION

A Mobile Ad hoc NETwork (MANET) is considered to be an autonomous system of self-organised mobile nodes without relying on any infrastructure. Node mobility is one of the key characteristics of MANET, and it is also one of the critical factors that have significant influence on the performance of MANET protocols, mainly the routing protocols. Conventional mobility models proposed for MANET can be classified into two categories: Entity model and Group model. Entity models are used to represent the movement of an individual mobile node. Among Entity models, the Random Waypoint model (RWP) [1] is the most popular model used in this field. However, the interaction among the mobile nodes cannot be reflected by Entity models. Group models are therefore proposed. A typical mode is the Reference Point Group Mobility (RPGM) model [2]. A major drawback of conventional models is that some environment factors such as spatial constraints, speed limits, etc are ignored. Street traffic system could be an example environment. Cars are moving along the roads and choose one way out if a junction is met. The people follow the routes to building, spend some time there then go out from one of the room exits. Moreover, in some certain environment such as arts exhibition, the destinations of visitors are not random, but more or less deterministic in that they always visit some places more attractive to them. These mobility scenarios cannot be handled properly by most of existing models. In this paper, two particular environments in the realistic world are studied. Accordingly, two environment-aware mobility models are introduced and simulated. The Random Waypoint model is used to model the movement in buildings in the simulation area. The Manhattan model can be used to construct streets such as in a city area. The remainder of this paper is organised as follows. Section 2 briefly reviews related research in the area of mobility modelling. The two mobility models (Manhattan and RWP) are overviewed in section 3. Description of the intensive simulations and a study of the results are given in section 4 and the last section presents the conclusion.

2-Random Waypoint and Manhattan Mobility Model

Random Way Point mobility model (RWP) [3][4][5][6] is a simple, widely used, model in the many simulation studies of ad hoc routing protocols. In this model each node is assigned an initial position uniformly distributed within a region (rectangular region). Then, each node chooses a destination uniformly inside the region, and selects a speed uniformly from [minspeed, maxspeed] independently of the chosen destination. That means the distributions of nodes' speeds and locations are stationary. To avoid the transient period from the beginning, one solution is to choose the nodes' initial locations and speeds according to the stationary distribution, Another one is to discard the initial time period of simulation to reduce the effect of such transient period on simulation results. The node then moves toward the chosen destination with the selected speed along a straight line starting from current waypoint. After reaching the destination, the node stops for a duration called "pause time", and then repeats the procedure. All nodes move independently of each other at all times.

The MH model is used to emulate the nodes movement on streets defined by maps [4][5]. The map is composed of a number of horizontal and vertical streets. Each street has two lanes, one in each direction (North and South for vertical streets, and East and West for horizontal ones). Each node is only allowed to move along the grid of horizontal and vertical streets. At an intersection of horizontal and vertical streets, a mobile node can turn left, or right, or go straight with probabilities 0.25,0.25, and 0.5, respectively. The speed of a mobile node is temporarily dependent on its previous speed If two mobile nodes on the same freeway lane are within the Safety Distance (SD), the velocity of the following node cannot exceed the velocity of preceding node Mobility models capture the geographic restrictions**.** The speed of a node s (t) is updated according to: s (t + 1) = min (Smax, max (0, s (t) + a (t) * X)) where X Uniform [−1, 1], and a (t) is Acceleration Speed.

3- Description of Combined Mobility Model

This section introduces a combined model of Manhattan and Random Waypoint, the movements of a node switch from one mobility model (Manhattan or Random Waypoint) to another based on its location in the network. when the nodes are on the street, they move as Manhattan mobility model movement pattern, when they are located in the building, they will move as Random Waypoint model. The movement nodes are divided in two groups depending on their speed a "pedestrian" group with a low speed and a "vehicular" group with a higher speed. The pedestrian group of users is moving with a normal distributed speed with a mean of 3 km/h and a standard deviation of 0.3 km/h [4]. The vehicular group of users has also a normal distributed speed but with a mean of 50 km/h and a standard deviation of 2.5 km/h. At each cross-road, users of both groups have can either continue straight with the probability Pr (straight) = 0.5 or turn left/right with the probability Pr (right) = Pr (right) = 0.25.To represent the movement of mobile nodes in outdoor environment (streets) and indoor environment (buildings) we have used Finite State Machine (FSM) to explain the movement of mobile nodes by using state diagram and state transition table as shown in figures (1) and (2) respectively.

Current State/ Condition	MH state	RWP state
Condition indoor	RWP	RWP
Condition outdoor	MH	MH

Figure1. State Transition Table of Random Waypoint and Manhattan Mobility Model

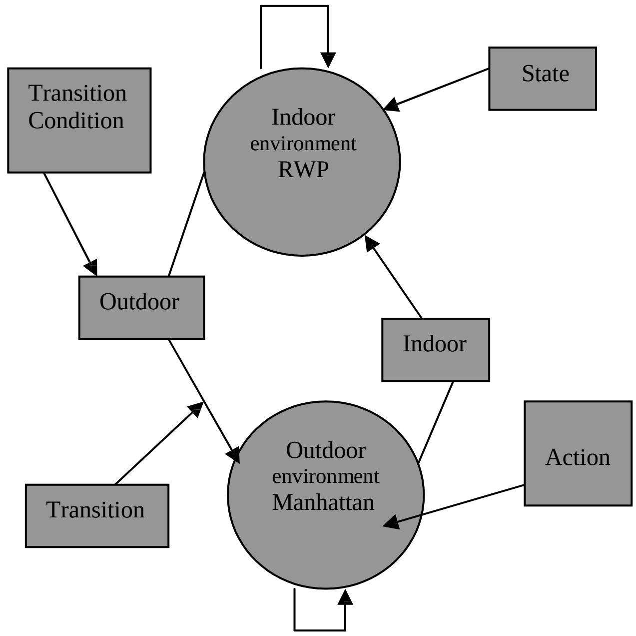

Figure2. State Transition Diagram of Random Waypoint and Manhattan Mobility Model

In this paper, we limit the study to an urban area modelized by a Manhattan and RWP mobility model. The area is wrapped around North-South and West-East and the grid is composed of 3 by 3 buildings. The buildings are 300x300 m and the street has two opposite lane, the distance between lane 1 m and the width of lane 6 meter. Figure.3 shows the layout of indoor and outdoor environments in urban area and the movement of nodes. Figure 4. shows the movement of nodes in simulation area using manhattan and Random Waypoint mobility models..

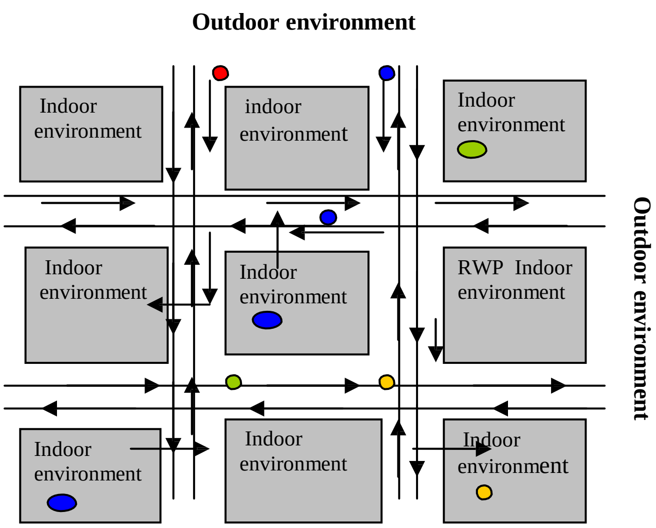

Figure3. Layout of Urban environment

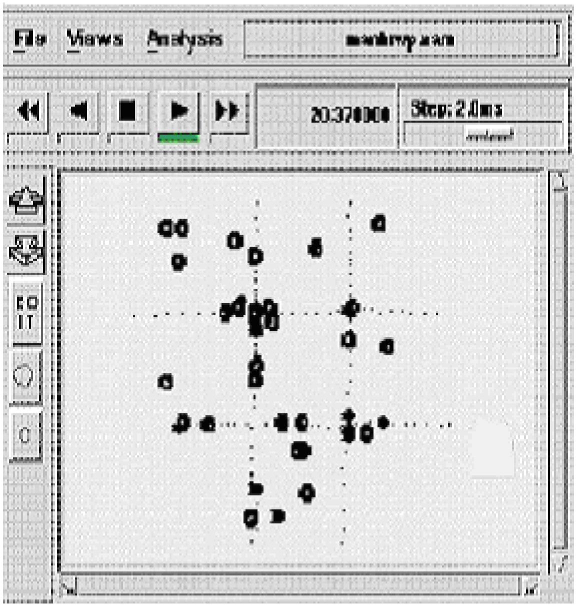

Figure.4 Movement of Nodes in Simulation Field using Manhattan and Random Waypoint

4- Simulation

4-1 Simulation Description

A variety of routing protocols have been proposed for the MANET environment. In this section, we study the most popular routing protocols, Dynamic Source Routing (DSR) [7] and Ad hoc On Demand Distance Vector (AODV) [8], Destination-Sequenced Distance-Vector (DSDV) [9] in the environments where MH and RWP exist. Our evaluations are based on the simulation using ns2 [10] and we extract the useful data from trace file using C++, then the graphs are generated using Matlab.Simulation environment consists of 10 wireless nodes forming an ad hoc network, moving about over a 1000 X 1000 flat space for 900 seconds of simulated time. Each run of the simulator accepts as input a scenario file that describes the exact motion of each node and the exact sequence of packets originated by each node, together with the exact time at which each change in motion or packet origination is to occur. We have generated different scenario files with varying movement patterns and traffic loads (CBR), and then ran all three routing protocols against each of these scenario files. After that we compared the performance results of the three protocols. When Nodes in street they are move according to manhattan model otherwise they move as Random Waypoint model .The movement scenario files we used for each simulation are characterized by a max speed. Each simulation ran for 900 seconds. We ran our simulations with movement patterns generated for 6 different maximum speeds, 10, 20, 30, and 40,50,60 with constant pause time. In comparing the protocols, we chose to evaluate them according to the following metrics: packet sent, throughput, packet delivery ratio, packet overhead, packet dropped.

4-2 Simulation Results

The simulation results bring out some important characteristic differences between the routing protocols. We conducted our simulations on changing the parameters for mobile nodes' movement scenarios and their connection pattern files. We supposed different speed for "movement scenarios" files. Figures below demonstrate the simulation results by applying different maximum movement speeds of mobile nodes..Figure5 shows AODV and DSDV give us better performance than DSR when throughput is considered as metric. Since DSR pre-computes the routes before sending the packets its packet delivery ratio is better than other protocols as shown In Figure6. Routing overhead of DSDV and DSR protocols is significantly low as indicated in Figure7 DSR drops few packets as shown in figure8 but its throughput is very low. DSDV is better than AODV protocol in dropping packets as indicated in figure8. The significant observation shows that the simulation results agree with expected results based on theoretical analysis.

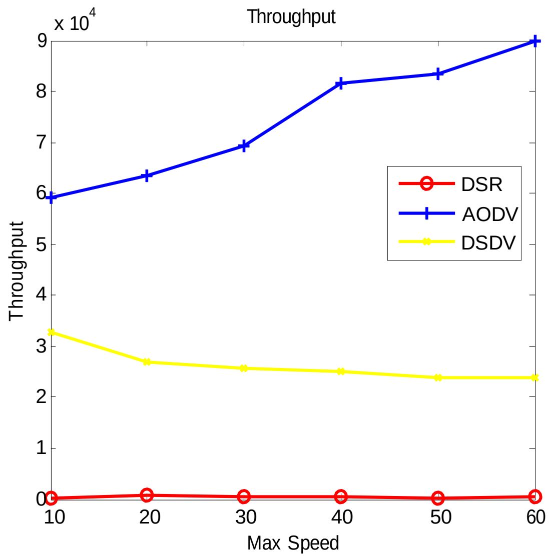

Figure5.Throughput

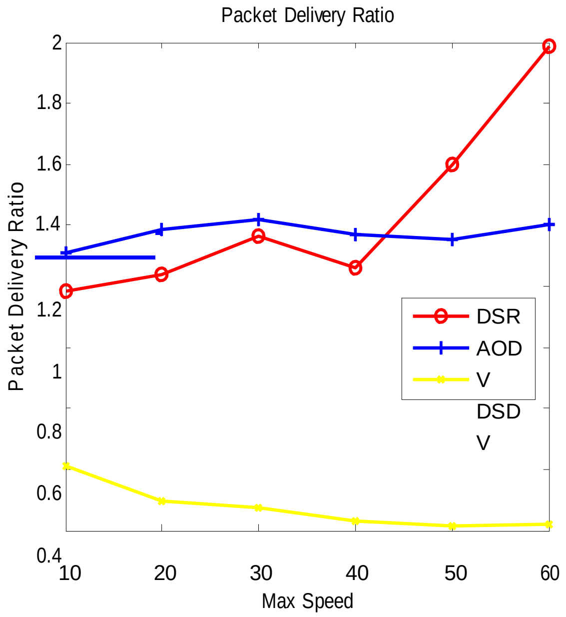

Figure6. Packet Delivery Ratio

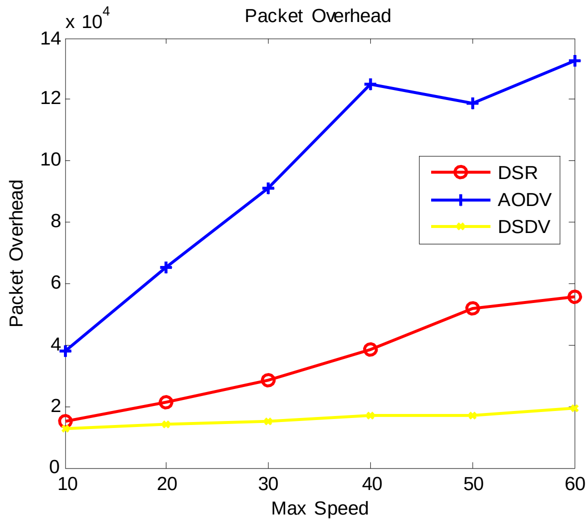

Figure7.control packet overhead

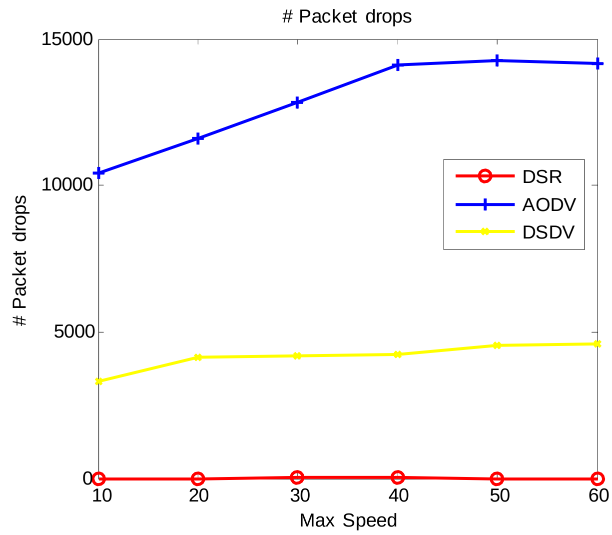

Figure8. Dropped Packets

5- CONCLUSION

The area of ad hoc networking has been receiving increasing attention among researchers in recent years, as the available wireless networking and mobile computing hardware bases are now capable of supporting the promise of this technology. We have introduced the Random Waypoint and Manhattan Model a mobility model for vehicular and pedestrian movement in urban environments (Indoor and Outdoor environment).As an output our simulator provides a trace-file, which can be used for ns-2 simulations. We evaluated the nodes movement under different parameters and explained their influence. We compared Adhoc routing protocols performance variety of metrics, Number of Transmitted Packets, Packet Delivery Ratio and

Ratio of forwarded packets/send packets (Routing Overhead). Also the simulations were run by changing different running parameters of DSR,AODV and DSDV protocols in two categories: "movement scenarios" and "communication patterns". For movement scenarios case, we supposed Max Speed; and for communication patterns, our simulations' parameters were Maximum Connection and Transmission Rate. Research has shown that the simulation results are highly dependent on the movement behaviours of mobile nodes. the most important factors(diversity)related to the simulation environment are taken into account for more realistic .To develop further insight as to which characteristics of mobility models dominate ,we plan to evaluate link analysis across these different mobility models

6- References

[1]. T. Camp, J. Boleng, and V. Davies, "A Survey of Mobility Models for Ad Hoc Network Research," in Wireless Communication and Mobile Computing

(WCMC): Special issue on Mobile Ad Hoc Networking: Research, Trends and Applications, vol. 2, no. 5, pp. 483-502, 2002.
[2]. X. Hong, M. Gerla, G. Pei, and C. Chiang. "A group mobility model for ad hoc wireless networks," In Proceedings of the ACM International Workshop on Modeling and Simulation of Wireless and Mobile Systems (MSWiM), August 1999.
[3] J. Yoon, M. Liu, and B. Noble, “Sound Mobility Models,” in Proc. ACM/IEEE Int’l Conf. Mobile Computing and Networking (MOBICOM ’03), pp. 205-216, September2003.
[4] F. Bai, N. Sadagopan, and A. Helmy, “IMPORTANT: A framework to systematically analyze the Impact of Mobility on Performance of RouTing protocols for Adhoc NeTworks,” in IEEE INFOCOM’03, San Francisco, March/April, 2003.
[5] F. Bai and A. Helmy, “A Survey of Mobility Modeling and Analysis in Wireless
[6]W. Navidi and T. Camp, “Stationary Distributions for the Random Waypoint Mobility Model,” IEEE Transactions on Mobile Computing ITMMC-3 (2004), pp. 99-108.
Adhoc Networks,” Book Chapter in submission to Kluwer Academic Publishers
[7]. David B. Johnson and David A. Maltz, "Dynamic SourceRouting in ad hoc wireless networks," In
Mobile Computing, 5 pages 153-181, Kluwer Academic Publishers, 1996
[8]. C. E. Perkins, E. Royer, and S. R. Das, "Ad hoc On Demand Distance Vector (AODV) Routing," In 2nd IEEE WorkShop on Mobile Computing Systems and Applications (WMCSA'99), pages 90-100, February 1999.
[9].C. Perkins and P. Bhagwat, "Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers", Proceedings of the SIGCOM'941 London, UK, pp. 234-244
[10] http://nile.wpi.edu/NS/