Simulation based Assessment of Realistic Mobility Pattern in Ad Hoc Networks

Arvind Kumar Shukla
Research Scholar,
Department of AIM &ACT, Banasthali Vidyapith,
Rajasthan, India

C.K.Jha, Ph.D
Associate Professor,
Department of AIM &ACT, Banasthali Vidyapith,
Rajasthan, India

ABSTRACT
Mobility is a natural personality of Ad Hoc networks. A realistic simulation of user movement in Ad Hoc Network is very important to the network performance. The difficult movement pattern of nodes is significant in the study of Ad hoc Networks. As the existing mobility models cannot realistically model the recognized movement patterns and characteristics of node in any complex area scenarios, this manuscript proposes a person area mobility model that realistically represents the movements of nodes in a personal area scenario. In this manuscript we have used a combine mobility model to analyze the effect of diverse mobility pattern (Random Waypoint Mobility Model and Manhattan Grid Mobility Model) in campus environment to get a realistic simulation. The mobility model is evaluated and compared to existing mobility models in ns-2 simulations with the help of DSR. Therefore, by using mobility a model, this is an important aspect in enhancing the self-confidence in the simulation result of the networks. The results show that Chain Mobility Models better the available mobility model for any site situation.

Keywords
Ad Hoc Network, Mobility models, Mobility patterns, ns 2.34, Performance parameters, Boonmotion[2.0].

1. INTRODUCTION
We An Ad Hoc Network to construct a self-configurable network without existing communication infrastructure; e.g. are search and rescue operations, military deployment in unfriendly environment, and several types of operations [7, 9, 10]. This instruction Individual mobility has been widely studied in many areas like urban planning, traffic forecasting and avoiding the spread of biological and mobile viruses [8, 13, 15]. It's also an essential topic used to improve the Performance of wireless Ad Hoc network. Mobility is a natural character of Ad Hoc networks. A realistic simulation of user movement in Ad Hoc Network is very important to the network performance.

The usually used mobility model is the Random Way point model. In this model, every node selects a random point in the simulation area as its destination, and a speed V from an input range [V_{min}, V_{max}]. The node then moves to its destination at its selected speed. When the node reaches its destination, it rests for a few silence times. At the end of this gap times, it selects a fresh destination and velocity and resumes movement. The properties of the random waypoint model have been extensively studied [1, 2 ,4,5]. One of the interesting results of these studies addresses the node spatial distribution of the random waypoint model. It is exposed that, due to the uniqueness of the model, the application of nodes follows a cyclical pattern through the lifetime of the network. The nodes have a tendency to assemble in the middle of the simulation area, resulting in non-uniform network density. The mobility model is the nodes movement, is the first step to perform mobility management. Different mobility models have different focuses and different application scenarios [1, 2, 3]. Moreover random mobility models, to get enhanced performance, some emerging mobility research papers have modified a method to organize the movement of a small part of elected nodes and develop this movement to improve the network's overall performance. The Ad Hoc mobility models rarely reflect actual movement patterns. There are a few models for delineating the mobility of Mobile Users. The common approaches for modeling human movements are described below. Among these are fluid flow model, diffusion model, gravity model, and chain mobility model [8,16,17,18]**.** For site, the movement of person is affected by its behavior and each person's mobility differs which can be challenging for mobility modeling. A main problem of conventional models is that some location factors such as spatial constraints, speed limits, etc are overlooked. Street traffic system could be an example environment. Buses are moving beside the roads and prefer one way out if a junction is met. The person 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 exhibition, the destinations of visitors are not random, but more or less deterministic in that they constantly visit various places more attractive to them. These mobility scenarios cannot be handled accurately by most of existing models. There are still some common facts that could be used to represent person movement pattern for site. 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 Grid model can be used to construct streets such as in a campus area In this paper, we discuss various characteristics of individual mobility. Section Three and four discusses simulation results and finally paper is concluded in section five**..**

2. MOBILITY MODELS USED
In this part the mobility models used in the studies are presented, compared and explained for which situations is more suitable one than another and a combined model of

Manhattan Grid mobility model and Random Waypoint, the movements of a node switch from one mobility model to another based on its location in the network and has been verify to be a good approximation of human walk in network environments.

In the Random Waypoint mobility model the movement of node environment is usually modeled by radio propagation and interferences phenomena simplifications. The user activities can be captured by his mobility and the travel where the node moves. In this sense, entity and group mobility models have been proposed. In the entity mobility pattern, movements of nodes are independent of the movements of the rest of the nodes that belongs to the same network. On the other hand, in the group mobility models, the travels of dissimilar nodes are associated. One of the most extended individual mobility models is the Random Way Point [17,18,19].According to this pattern, the nodes of an ad hoc network move along a straight line between two destination points placed in a finite space. In this paper, this gap is normally bi-dimensional and constrained to a rectangular area of dimensions x_{max} and y_{max}. Once a node reaches a destination point, a new one is homogeneously selected from this area. The speed for a movement is also chosen from a uniform distribution in the interval [v_{min}, v_{max}]. Both speeds and waypoints are generated independently of all the earlier destinations and speeds. In addition, the model allows nodes to pause between two successive trips for a certain period of time. This period (Pause Time) is habitually fixed to a constant value. By varying the values of x_{max}, y_{max}, v_{min}, and the pause time, it is possible to control the movement conditions of the simulated scenario [6,7,8,10].Two problems of the Random Way Point mobility model are sharp turn and sudden stop [6]. Sharp turn occurs whenever there is a direction change in the range [7, 8,9]. Sudden stop occurs whenever there is a change of speed that is not relative to the previous speed. These problems can be eliminated by allowing the past speed and direction to effect the upcoming speed and direction.

With the help of, Manhattan Grid mobility model can solve these problems to get more realistic movement of mobile nodes. This mobility model was mostly proposed for the movement in urban area, where the streets are in a planned manner. The mobile nodes move in horizontal or vertical direction on an urban map [10, 11, 12, 18, 19].

The Manhattan Grid model employs a probabilistic approach in the selection of nodes movements since, at each crossroads; a vehicle chooses to keep moving in the same direction. The pause probability and maximum time of pause can also be defined so to model different situations such as traffic light [8, 9]. The minimum speed the vehicles will present after a pause can also be defined as well as their mean speed and its standard deviation. To help to represent several situations in the city, also the speed change probability is parameters we can choose, so in fluent it will not modify a lot, but in case of traffic skip this probability should be higher. Nodes are initially randomly placed in street inter-sections being the main difference from this model to the city section model, is that the Manhattan model relies on probabilities to let a node opt for a specific direction. For instance, if a node has two different options available then the node has 50% probability to choose for a change. If the node instead has four different options then it can choose for a specific change with 25% of probability [19]. It is important emphasize that in Manhattan mobility model, a node's velocity is always limited by the velocity of the node preceding it on the same lane of the street [18,19].

If we apply both mobility models property we get the more and, much realistic movement of mobile nodes at site environment, for this we use Chain model, it is not a model itself but a concatenation of implemented models described .In some cases it is necessary to model scenarios in which mobile nodes behave in different ways depending on time and position. With the Chain model, the mobile nodes' final position of the N-1-th scenario is linked to the initial position of the N-th scenario. The Chain model works in the following way: it permits to specify a few known models (e.g., Random Waypoint, Manhattan, RPGM, Random direction etc.), each one with its own set of parameters. The chain model could help to model a scenario from reality, consider a city with a campus (could be a factory, university, site etc.). It could be interesting to model mobility inside the campus, and after a few time, to see what happens when users move from site to their homes. When the nodes are on the street, they travel as Manhattan mobility model movement model, when they are located in the building, site or campus, they will move as Random Waypoint model. The movement of nodes is divided in to two groups depending on their speed a "pedestrian (person on foot)" group with a lower speed and a "vehicular" group with a high speed. The pedestrian group of users is moving with a normal distributed speed with a mean of 4 km/h and a standard deviation of 0.4 km/h. The vehicular group of users (uses the campus road) has also a normal distributed speed but with a mean of 45 km/h and a standard deviation of 2.589 km/h. At each cross-road, users of both groups have can either continue straight with the probability Pr (in a straight line) = 0.5 or turn Left / Right with the probability Pr (Right) = Pr (Right) = 0.25.To represent the movement of mobile nodes in outside environment streets or any predefined path and inside environment (University buildings ,factory etc.).

In this manuscript, we limit the study to a campus scenario by using a Manhattan Grid and RWP mobility model. The area is wrapped around North-South and West- East and the grid is composed of 4 by 4 buildings. The buildings are 400x400 m and the street has two opposite lane, the distance between lane 5 m and the width of lane 8 meter.

3. ANALYZING THE RESULTS

NS-2.34 is an actually absolute network simulator, but it generates complex trace files and do not give the user any tool to extract results from the thousands of code lines generated. Thus, some scripts to examine the outcome were produced with AWK.

3.1 *Performance Parameters:*

Simulations have been carried out by the Network Simulation version 2.34 [4]. Hardware and operating system (ubunto 12.04 LTS) configuration for performing simulations is specified in Table 1. The basic mobility scenario generation tool is BONNMOTION [5]. We have generated mobility scenarios for Random Waypoint Mobility Model and Chain Models (with the use of RWM and Manhattan Grid mobility model) using the ns 2.34 are given below, so that they can be incorporated into TCL scripts. Random traffic associates of CBR can be setup between mobile nodes using a traffic-scenario generator script.

For this study, we have used the Chain Models and random waypoint mobility model for the node having pause time of 2± 3 sec. and speed varying between 0-100 m/sec with minimum speed of 5m/s and maximum speed of 20m/s for simulation time of 300Sec. Here the Table .1 Shows the performance parameters.

Parameter	**Value**
Channel type	Wireless channel
Simulator	NS 2 (Version 2.34)
Protocols	AODV
Simulation duration	300s
Number of nodes	10,20,30,40
Transmission range	250m
Movement Model	Random way Point, Manhattan Grid
MAC Layer Protocol	802.11
Pause Time (s)	2 ± 3 s
Maximum speed	25
Minimum speed	0.5
Packet Rate	4 packet/s
Traffic type	CBR(Constant Bit Rate)
Data Payload	512 bytes/packet
Max of CBR connections	10,20,40,60
Environment Size	400m * 400m

Table.1

For each simulation, the position and movements of the nodes are put randomly as well as the traffic between them. BONNMOTION is the responsible for the random properties of the positions and movements of the nodes and for the traffic NS-2.34 random variables are used. Setting the random variables accurately is a key point because if this is done incorrect, some simulations can be connected and we can come up with bad results even if we think we have performed a sufficient amount simulation to describe a general case.

The presentation of routing protocols is using the following important Quality of Services (QoS) metrics:

3.1.1. *Packet Delivery Ratio (PDR):* It is the ratio of data packets delivered to the destination to those generated from the sources. It is calculated by dividing the number of packets received by destination through the number packet originated from the source[8,9].

PDF = (Pr /Ps)*100

Where Pr is total Packet received & Ps is the total Packet sent.

3.1.2. *Throughput:*

It is the average number of messages successfully delivered per unit time number of bits delivered per second [6,9,10].

$$\text{Throughput} = \frac{\text{Total Received Packets}}{\text{Total Simulation Time}} \quad \text{(kbits/sec)}$$

Where N is the number of data sources.

3.1.3. *Average End-to-End Delay:* This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times. It is defined as the time taken for a data packet to be transmitted across an Ad Hoc from source to destination [8,9,10].

D = (Tr –Ts), Where Tr is receive Time and Ts is sent Time.

4. RESULT ANALYSIS

Here in case of performance analysis we have consider above performance parameters. In Figure1, 2, 3 the simulations are focusing in analyzing the performance on routing overhead, packet delivery ratio and throughput. The results also compared with two mobility models that we had chosen .The result will show the performance for mobility models with respect to protocols that had been selected under different mobility models, which is shown in fig. 1-3.

4.1 *Throughput:*

Random Waypoint Model and Chain model both have more or less same throughput. The high throughput is contributed the lower delay because of the lower number of hop.

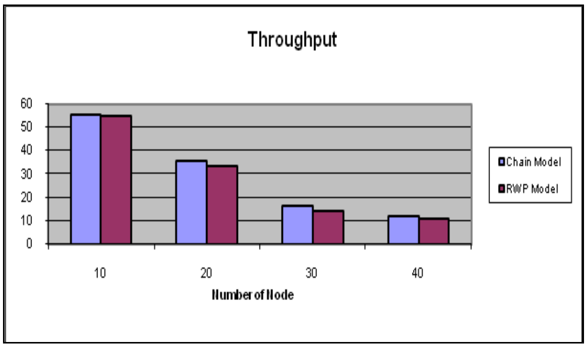

Figure 1: Throughput vs Number of node.

4.2 *Packet Delivery Ratio (PDR):*

Chain mobility models performed better in delivering packet data to destination by considering the pause time every time shifting their directions. The Chain mobility models are enhanced considerable with the increasing of the number of nodes because the number of load is small and the traffic is not heavy.

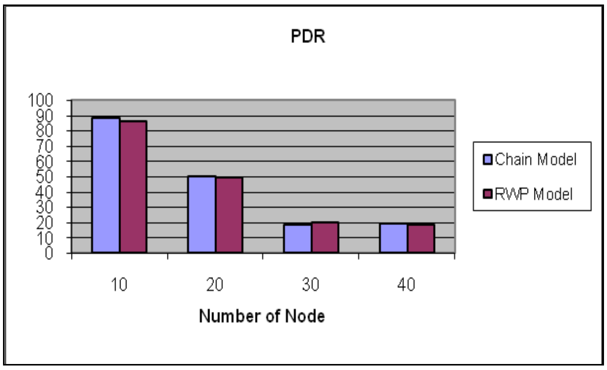

Figure.2: PDF versus number of nodes

4.3 *Average End To End Delays:*

it shows that the proposed mobility model is generated the highest routing overhead compared with the Random way point mobility model due to the movement of the each Mobile Node are being enforced to the border of the simulation area before changing track. Proposed Model performs lowest routing overhead and it's good for the routing communication.

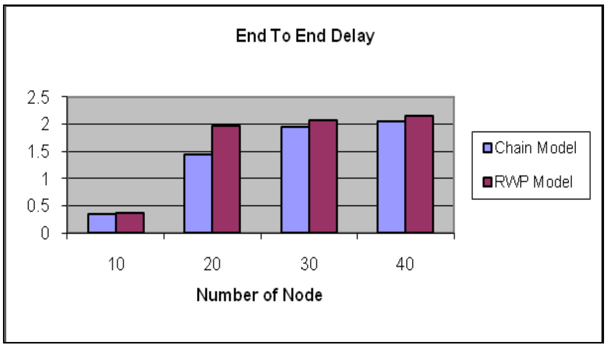

Figure.3: Routing Overhead vs. Number of Nodes

5. CONCLUSION

In this paper we have use Chain Mobility Model (Combination of Manhattan and random way point mobility model) for Ad-hoc Network. For most scenarios, including site, office buildings, shopping mall, University etc, and a random movement of nodes on straight lines is much over simplified. Here, we allow nodes to assume more than one role and provide an intuitive way to resolve their potentially inconsistent schedules and path state. This naturally lends itself to a greater diversity of mobility patterns while also being more in line with the way we think, which again facilitates the design of the anticipated scenario in the first place. In the chain model we have calculated the various Performance Parameters with respected to chain and Random Way point Mobility models using DSR routing protocol. In this manuscript we have given new mobility models which strongly capture the movement of common campus, factory, and university person. The chain model has shown better results in terms of Throughput, PDR and end to end delay where DSR has been taken as a routing protocol. The improvement in performance is achieved by better prediction of nodes movement. Thus we can say that Chain model can be used for the site, office buildings, and University etc. situation.

2. REFERENCES

[1] R.La, "Distributional convergence of inter-meeting times under generalized hybrid random walk mobility model," IEEE Transactions on Mobile Computing, vol. 9, no. 9, 2010 pp. 1201–1211.

[2] 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, , March/April, 2003, San Francisco.

[3] Network Simulator NS2 and Network Animator NAM. [Online].accessible: http://www.isi.edu/nsnam.

[4] M. Gerharz, C. de Waal, "BonnMotion - a mobility scenario generation tool", University of Bonn, [Online]. accessible: www.cs.uni-bonn.de/IV/BonnMotion/.

[5] Sargolzaey H, Moghanjoughi AA, Khatun S. A review and comparison of reliable unicast routing protocols for mobile Ad-Hoc networks. Intern. J. Computer Sci. and Network Security. : 9(1): 2009.pp 186-196.

[6] Kumar S, Sharma S C, Suman B. Mobility metrics based classification & analysis of mobility model for tactical network. Intern. J. Of next-generation networks.: 2(3): 2010, pp 39-51.

[7] T. Camp et al., "A Survey of Mobility Models for Ad Hoc Network Research", Wireless Comm. & Mobile Computing: Special issue on Mobile Ad Hoc Networking: Research, Trends and Applications, vol. 2, 2002, pp. 483-502.

[8] Singh M, Singh D, Impact and Performance of Mobility Models in Wireless Adhoc Networks, Fourth Intern. Conference on Computer Sciences and Convergence Information Technology,; 2009,978-0-7695-3896.

[9] Arvind Kumar Shukla, C K Jha and Deepak Sharma. Article: The Efficiency Analysis of Mobility Model using Routing Protocols.IJCA Proceedings on International Conference on Advances in Computer Applications ICACA(1):2012,pp6-10, September. Published by Foundation of Computer Science, New York, USA.

[10] Seongik Hong Seong Joon Kim Injong Rhee Kyunghan Lee and Song Chong. Demystifying Levy Walk Patterns in Human Walks. Technical report, 2008.

[11] J. B. et al., A performance comparison of ad-hoc multi-hop wireless networks routing protocols", Proc. IEEE/ACM MOBICOM, 1998.

[12] Medina A, Gursun G, Basu P, Matta I."On the Universal Generation of Mobility Models", in Proc. IEEE/ACM MASCOTS 2010, Miami Beach, FL, 2010.

[13] Santosh Kumar ,S C Sharma and Bhupendra Suman ," Classification and Evaluation of Mobility Metrics for Mobility Model Movement Patterns in Mobile Ad-Hoc Networks ",International journal on applications of graph theory in wireless ad hoc networks and sensor networks (GRAPH-HOC) , September 2011,3(3).

[14] F. Bai, N. Sadagopan, and A. Helmy, Important: a framework to systematically analyze the impact of mobility on performance of routing protocols for ad hoc networks, in Proceedings of IEEE Information

Communications Conference (INFOCOM 2003), San Francisco.

[15] Fahim Maan Nauman Mazhar “MANET Routing Protocols vs. Mobility Models: A Performance Evaluation”, in Proceedings of IEEE Conference ICUFN, 2011, pp. 179-184.

[16] Medina A, Gursun G, Basu P, Matta I. ” On the Universal Generation of Mobility Models”, in Proc. IEEE/ACM MASCOTS 2010, Miami Beach, FL.

Arvind Kumar Shukla, C K Jha and Deepak Sharma.” An Estimation of Routing Protocols in Mobility Models used for Ad-Hoc Networks: Simulation Study”. IJCA Proceedings on International Conference on Advances in Computer Application 2013 ICACA: February 2013,21-27.

[17] J. G. Andrews, M. Haenggi, N. Jindal, “A primer on spatial modeling and analysis in wireless networks,” IEEE Communications Magazine, vol. 48, no. 11, November 2010, pp. 156–163,

[18] Fan Bai and Ahmed Helmy. Chapter 1 A SURVEY OF MOBILITY MODELS in Wireless Adhoc Networks. CiteSeerX - Scientific Literature Digital Library and Search Engine, 2008.