Performance of AODV and OLSR Protocols with Different Mobility Models

K. C. Kullayappa Naik, Ch. Balaswamy, P. Ramana Reddy

Abstract: ***The Mobile and ad hoc wireless network has a set of nodes and is a low power, wireless infrastructure less, self-organized and limited distance communicating network devices. The nodes are always changing their characteristics over time results into a different network topology. So, it is very difficult to predict the mobile ad hoc network performance. In this research paper we proposed comparative analysis and estimate the performance of network amongst the mobile nodes by reducing the control overhead. Main intention of the paper is to relate and estimate the performance of different network routing protocols under diverse mobility models. The routing protocols performance metrics are examined with varying node speed and node density of network amongst different mobile nodes. NS-3 is used as a network simulator with version 3.25 (NS-3.25) to carry out the research simulation results.***

Index Terms: MANETs, Routing Protocols, Mobility Models, Network Simulator.

I. INTRODUCTION

The current wireless and mobile communication cannot be imagined without everyday usage of low power operating devices. The examples of such devices are MANETs and VANETs with mobile nodes, whereas Wireless Mesh Networks (WMNs) and Wireless Sensor Networks (WSN) with static nodes. In MANETs [1], the characteristics of a node are always changing over each time interval results into a different network topology thereby decreasing the network protocol performance. Therefore, an efficient mobility models are used to obtain protocols performance in a better manner. In MANET, mobility plays a vital role in simulation and analytical based studies of routing protocols.

New mobility models based on present and future MANETs are categorized into different groups [2]. In the existing literature work, MANET simulation and study of various routing protocols are done using Individual and Group Mobility Models like, RWP, RDM and RW as a reference point mobility model in MANET. All these mobility models are not good for developing the realistic mobility pattern. So, if we neglect the pattern of mobility, the performance may over or under-estimate.

Therefore, it is necessary to incorporate an additional mobility model that is Gauss-Markov model (GMM) [4] provides better protocol performance when compared to existing mobility models of MANETs.

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C. Kullayappa Naik, Research Scholar, JNTUCE, JNTUA , Aanatapur, A.P, India.

Dr. Ch. Balaswamy, Professor, ECE Dept., Gudlavallure Engg. College, Gudlavallure, A.P, India.

Dr. P. Ramana Reddy, Professor & HOD ECE Dept., JNTUCE, JNTUA, Anantapur, A.P, India.

Gauss-Marcov Mobility model is a memory-based model and node maintain the direction and speed and also it depends on past values. In this research paper, we compared the performance of network protocols by RWP model and Gauss-Markov model using AODV and OLSR protocols. The protocols performance can be obtained in terms of sent packets, received packets, lost packets, average delay, routing overhead and throughput.

The paper remains planned as: Section 2 will discuss the impact of MANET mobility and the ad hoc routing protocols are described in Section 3. The parameters used in simulation of MANET mobility models and simulation outputs are described in section 4 and 5. Finally, conclusion and future scope will be provided in section 6.

II. IMPACT OF MANET MOBILITY MODELS

Mobility is most broadly used parameter in MANETs for obtaining the performance [5]. In MANET, node is always affecting in reality and the movement might be different and it is often not possible to predict how the nodes are going to move in reality. However, there are different ways and different models can be adopted to imagine the mobility of different nodes. The mobility models and network topology both plays a vital role for influencing the better protocol performance of a MANET.

A. Random Waypoint Mobility Model

RWP is generally used for analysis purpose and as well as for simulation of MANETs and also it introduces a pause time between the nodes. In RWP model node speed and direction changes each time interval and node pauses for a specific amount of spell when node reaches to end point. After expiring the pause time, node selects new direction, with varying speed and constant pause time and repeat the process again and again until the simulation stop time. This model is inadequate to detention the characteristics of mobility. So, it produces a quite stable network when related to RW model.

B. Gauss – Markov Mobility Model

GMM model [8] remains a quite modest memory-based type having tuning parameter, alpha (α), it calculates the quantity of memory and to differ the degree of chance in the pattern of mobility in order to eliminate the abrupt breaks. The tuning parameter value is always in the range of 0 to 1 ($0 < \alpha < 1$).

It is a memory-based model, because current direction and node speed depends up on previous values. The new node speed and direction can be calculated using the general expression as

$$s_n = \alpha s_{n-1} + (1-\alpha)\bar{s} + \sqrt{(1-\alpha^2)}s_{n-1} \quad (1)$$

$$d_n = \alpha d_{n-1} + (1-\alpha)\bar{d} + \sqrt{(1-\alpha^2)}d_{n-1} \quad (2)$$

In above equations d_n and s_n are called the new direction and speed of a mobile node. Similarly, the parameter d and s represent the mean direction and speed and α indicate the tuning parameter and in the range between 0 and 1. The values d x_{n-1} and S x_{n-1} indicates the random variables from continues distribution that gives new speed and direction respectively. There are two special cases to identify the model based on the value of α they are

i) If α = 0, then GMM is a memory less model. Then obtain the new values are

$$s_n = \bar{s} + Sx_{n-1} \quad (3)$$
$$d_n = \bar{d} + dx_{n-1} \quad (4)$$

ii) If α = 1, then GMM movement is predictable and all randomness values are going down. The new values are given by

$$s_n = s_{n-1} \quad (5)$$
$$d_n = d_{n-1} \quad (6)$$

III. AD-HOC ROUTING PROTOCOLS

Ad hoc wireless networks are class of distributed wireless networks are also known as infrastructure less networks. It is also known as Multi-hop networks due to infrastructure less behavior and information can be transmitted through intermediate nodes in a network. Ad hoc wireless routing protocols are generally classified into two main categories: first one is proactive type routing protocol and the other one is reactive type routing protocol. Proactive type routing is basically continuously learned the network topology by exchanging topological evidence or data among the different nodes. This type of protocol is also popularly called as table-driven protocols. Examples are AODV and DSR. Reactive type protocols on other side function through a query reply dialogue mechanism, that means, that whenever it is required, they are going to determine path to the intended destination and that data is going to be used for routing the packets otherwise again the path discovery is going to take place. Examples are OLSR and DSDV.

A. Ad hoc On-Demand Distance Vector Protocol

AODV [3] [6] is a reactive type and reduces the number of transmissions by generating routes based on demand manner. So, this name stands for it, so it is on demand. So, basically whenever there is a demand the route is going to be discovered. During the process, sending the route request packet to the destination node through intermediate node and store the address of neighboring node from which the initial copy of the transmission packet received successfully. AODV is not a source routing protocol. AODV basically has tables and these tables will maintain the information about what are the neighbor nodes so that, neighbor information can be used to send the reply back.

B. Optimized Link State Routing protocol (OLSR)

In this type of protocol inhales the stability of the link state algorithm. So, OLSR [7] basically belongs to the link state routing protocol and all the neighbor node links are declared and are flooded in the total network. So, OLSR protocol diminishes the size of control packets by stating only a subcategory of the links with the node neighbors through multi-point relays instead of all the available links in network. So, what it does is it challenges to optimize the flooding more specifically and minimize the flooding of traffic flow.

IV. NETWORK SIMULATION SETUP PARAMETERS

In order to conduct meaningful simulation and analysis of mobile and wireless ad hoc network need to use network simulator that is NS-3.25. The NS-3.25 is a new, open source type and discrete event network simulator for obtaining the performance metrics. The performance metrics are examined with varying node speed and network density. The simulation model parameters are summarized in below Table 1.

TABLE- I: NETWORK SIMULATION MODEL PARAMETERS

Parameter	*Assigned Value*
Network Simulator Type	NS - 3.25
Network Area	500 m^2
Number of nodes	60
Traffic Type	CBR
Transmission range	500 m
MAC Protocol	IEEE 802.11b
Propagation Model	Log Distance
Simulation Time	100 Sec
Data Rate	1024 Kbps
Transport Layer Protocol	UDP
Mobility Models	RWP and GMM
Routing Protocol	AODV and OLSR
Packet Size	512 bytes
Wi-Fi Channel	Yans Wi-Fi

V. SIMULATION RESULTS

The simulation output for AODV and OLSR protocol under Random waypoint and GMM model for 50 packets are forwarded at different values of nodes, number of received packets and average delay are noted and plotted the simulation graphs using GNUPLOT. The experiment run for 100 seconds and the results are stored in trace file. The calculated values are tabulated in below Table 2.

TABLE- II: CALCULATED VALUES FOR AODV & OLSR.

Protocol	No. of Nodes	RWP Mobility Model		GM Mobility Model	
		Rec. Packets	Ave. Delay (ms)	Rec. Packets	Ave. Delay (ms)
AODV	20	42	79	43	67
	40	37	83	39	74
	60	32	94	33	86
OLSR	20	41	69	40	65
	40	35	78	37	71
	60	29	87	31	82

For obtaining the GNUPLOT we wrote the following command on the terminal as follows.

C->Gnuplot

C-gnuplot > set terminal png size 500, 800.

C-gnuplot> set output “delay.png”

C-gnuplot> set xlabel “Number of nodes”

C-gnuplot> set ylabel “Delay in Seconds”

C-gnuplot> set title “Average delay”

C-gnuplot> plot “delay.out” using 1:2 with title “delay.out” using 1:3 with linespoints

C-gnuplot> exit

After this we get a file with extension.png. Open that files and get the graphs as shown in below figure.

a. Average End-to-End Delay

The below figure 1.1 shows the plot of average end-to-end delay for AODV and OLSR routing protocol using RWP model and GMM model at different values of nodes. It is observed that the OLSR with GMM model has lesser delay compared to other models. This indicates that the proposed mobility model provides better protocol performance compared to RWP model.

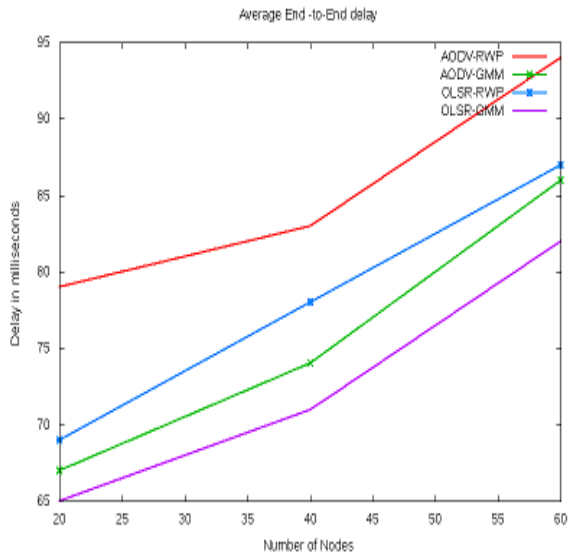

Figure 1.1: Average End -to- End Delay

b. Packet Delivery Ratio

The below figure 1.2 shows the plot of PDR for both the protocols and compared using RWP and GMM models. We observed that in the proposed mobility model that is AODV with GMM model has good packet delivery ratio and compared with other existing mobility models.

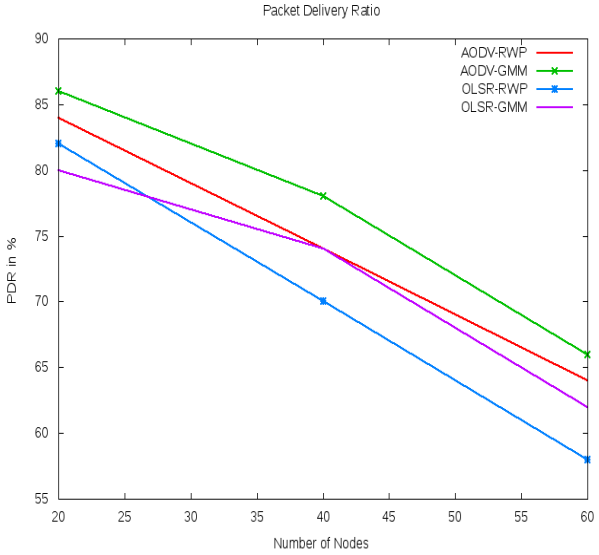

Figure 1.2: Packet Delivery Ratio

c. Throughput

The below figure 1.3 shows the plot for throughput of a network, it is observed that the proposed mobility model gives highest throughput compared to existing mobility models. Here, AODV with GMM model has high throughput compared to other type of models. The higher throughput gives the better protocols performance of network.

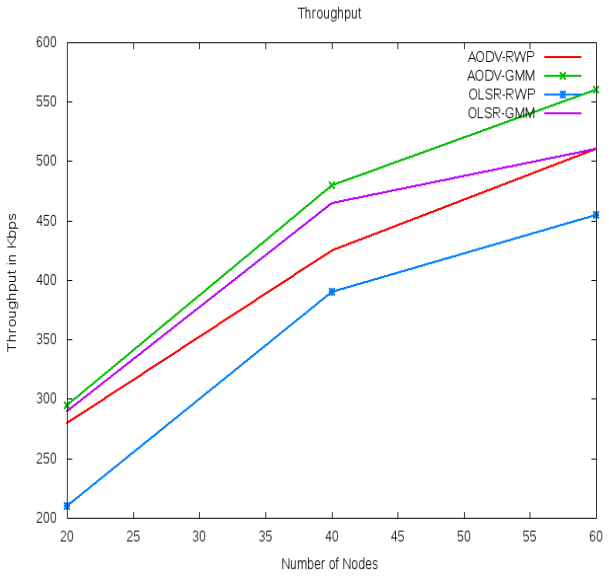

Figure 1.3: Throughput

VI. CONCLUSION AND FUTURE SCOPE

The mobility models play an important role in determining the performance of MANET. In this research paper we analyzed the performance of MANET mobility models using ad hoc routing protocols like AODV and OLSR and compared the simulation results. The simulation results are carried out using NS-3.25 simulator and plotted the graphs using GNUPLOT. Finally, we observed that GMM based mobility model gives better protocol performance when compared to RWP model in terms of PDR, average end-to-end delay and Throughput. In the future research work it is planned to introduce advanced mobility models for improving the performance with lower routing overhead using new network simulation tools.

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