Effect of manhattan and Gauss-markov mobility model for MANET's using DSR

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Abstract

A Mobile Ad-hoc network (MANET) is a consisting of set of wireless mobile nodes forming a self-configuring network without using any established infrastructure. The nodes are battery operated and therefore energy is a scarce resource in MANET. Many routing algorithms are proposed in literature and evaluated under different scenarios. The Performance of MANETs not only depends upon the routing mechanism but also on mobility model chosen. Mobility model is used to represent the mobility of individual node and it plays a crucial role when evaluating the performance of routing protocols. The energy being limited is crucial for MANET operations. Although both mobility and energy issues have been addressed so many times but mobility based energy consumption studies are not performed that much. The aim of this research work is to study the impact of mobility model on the energy consumption in MANET routing protocols. The energy consumption under Manhattan and Gauss-Markov mobility Model is evaluated through simulation using NS2. The well-known DSR protocol is taken as the candidate protocol for performing experiments under different scenarios.

Keywords- Mobile Ad-hoc Networks, Mobility Models, DSR, GM, MH.

1. INTRODUCTION

Advances in wireless communications and small, lightweight, portable computing devices have made mobile computing possible. In coming years, information technology will be mainly based on wireless technology. One of the unique features of wireless networks compared to wired network is that data is transmitted from one point to another through wireless links i.e. there is no need of wired link between the two nodes for transmission. Communication takes place through wireless links using antennas. Network nodes just need to be in the transmission range of each other. But due to transmission limitations all the nodes may not be able to communicate with one another directly. Hence a multi-hop scenario occurs, and several nodes may need to relay a packet before it reaches to its final destination. MANETs are complex distributed systems consist of wireless links between the nodes and each node also works as a router to forwards the data on behalf of other nodes. Whenever a node is in the range of several base stations then it connect to any one of them on the bases of some criteria [1]. The nodes are free to join or left the network without any restriction. Thus the networks have no permanent infrastructure.Routing is an important process for the operations of MANETs [2]. A number of routing protocols have been proposed in the literature. AODV [3] is one of the most widely used routing protocols in MANETs. It minimizes the number of broadcasts by creating routes based on demand. When any source node wants to send a packet to a destination, it broadcasts a route request (RREQ) packet. The neighboring nodes in turn broadcast the packet to their neighbors and the process continues until the packet reaches the destination. During the process of forwarding the route request, intermediate nodes record the address of the neighbor from which the first copy of the broadcast packet is received. This record is stored in their route tables, which helps for establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. The reply is sent using the reverse path for route maintenance.

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2 REVIEW OF WORK

A number of studies evaluating the performance of traditional ad hoc routing protocols like DSDV [4], DSR etc. under different mobility models are found in literature. Madhusudan Singh et al [5] has discussed some Mobility Models and their impact on various networks and routing parameters. They used discrete-event simulation language PARSEC for the following simulation and used AODV, DSR, and ZRP protocols for the experiments. Authors found that the topology and movement of the nodes in the simulation are key factors in the performance of the network protocols under study.

May Zin Oo et al [6] evaluated and compared AODV and AOMDV protocols under Manhattan Grid mobility model. They used TCP as a source traffic and measured the performance in terms of throughput, packet loss rate, average delay, and normalized routing load by varying node speed, offered traffic load and node density. Authors found that as the number of nodes increases, maintaining multiple routes to destinations in the routing tables and bringing next hop routes in RREQ message significantly reduces routing load of AOMDV. On the other hand, the throughput of AOMDV is significantly higher than AODV in all background changes, whereas the average delay and packet loss rate of AOMDV is not good enough under the variations of the offered traffic loads.

Doshi et al. [7] extended the DSR protocol to support energy efficient routing. A working path is first identified through a power-unaware route-discovering circle. Each node that is not on the identified working path sends a reply message to the source node if it would be power-efficient by inserting itself onto the route. The source can then draw a partial view of network state by using information extracted from the received reply.

Hrudya et al. [8] studied the impact of mobility on the performance of various routing protocols in terms of different parameters. Authors found that mobility greatly affects the performance of routing. Among the studied routing models, the RPGM model was found best.

3. MOBILITY MODELS

To thoroughly and systematically study a new Mobile Ad hoc Network routing protocol, it is important to simulate the protocol and evaluate its performance. Among other parameters mobility is an important parameter for MANETs routing protocols evaluation

3.1 Manhattan Mobility Model

An approach to restrict the movement area geographically is to use information from road maps. Manhattan model was introduced to emulate the movement pattern of mobile nodes on streets. It can be useful in modeling movement in an urban area [9].

The scenario, as shown in Figure. 3.1 [10], is composed of a number of horizontal and vertical streets. Nodes are modeled as pedestrians moving on the vertices of the squares (streets). Initially the nodes are randomly distributed on the streets. Each node chooses a direction and a velocity. At an

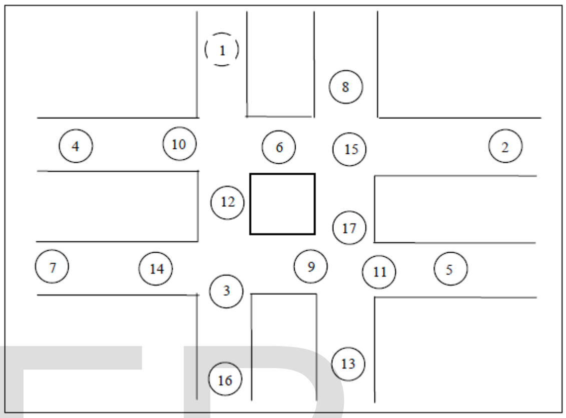

Figure 3.1 Movements of Nodes for Manhattan Mobility Model

Intersection of a horizontal and a vertical street, the mobile node can turn left, right or go straight with certain probability. If a node reaches a corner, the node changes direction with a certain probability. The velocity is changed over time.

3.2 Gauss-Markov Mobility Model

The Gauss-Markov Mobility Model was first introduced by Liang and Haas [11] and widely utilized. In this model, the velocity of mobile node is assumed to be correlated over time and modeled as a Gauss-Markov stochastic process. Initially for each node position, velocity, and direction are chosen uniformly distributed. The movement of each node is variated after an interval δt .Velocity and direction of the future depend on the current values. Velocity of mobile node at time slot t is dependent on the velocity at time slot t-1. Therefore, the Gauss-Markov model is a temporally dependent mobility model whereas the degree of dependency is determined by the memory level parameter α. α is a parameter to reflect the randomness of Gauss-Markov process. Further details can be found in [12].

4 EXPERIMENTAL RESULTS AND ANALYSIS

The routing protocols are evaluated using Network Simulator-2 (NS-2) [13] in its version 2.34. The network consists of varying nodes spread over an area of 1000m*1000m with a constant in speed 20m/s the details is given Table 4.1. One more tool Bonn-Motion [14] is used to generate node movements for different mobility models.

TABLE 4.1 Simulation parameters

Mobility Model	Manhattan Grid, Gauss Markov
Queue Length	50
Interface Queue	Drop Tail/Priori Queue
Traffic Type	CBR
Number of Connection	70% of the nodes
Packet Rate	8 packets/second
Pause Time	10 seconds
Speed of Nodes	20 m/s
Antenna	Omni directional
Simulation Area	1000m x 1000m
Number of Nodes	10, 20, 30, 40, 50
Initial Node Energy	1000 joules
Simulation Time	900 seconds

Following performance metrics have been used to analyze the energy utilization behavior of routing protocols.

4.1 Transmission energy: It is the energy consumed by a network node in transmitting packets across the network. The total network energy utilized in transmitting different packets by the network nodes is calculated by taking the sum of transmission energy of individual nodes. Average transmission energy is defined by the equation (4.1).

$$\text{Average Transmission Energy} = \frac{\text{Total Transmission Energy}}{\text{Total number of nodes}} \quad (4.1)$$

4.2 Receiving energy: It is the energy consumed by a network node in receiving different packets from other nodes. The total network energy consumption in receiving the packets is computed by taking the sum of energy consumed by individual nodes in receiving the packets from other nodes in the network. Average energy used in receiving is defined by the equation (4.2).

$$\text{Average Receiving Energy} = \frac{\text{Total Receiving Energy}}{\text{Total number of nodes}} \quad (4.2)$$

4.3 Idle energy: The network nodes do not always transmit or receive; sometimes they just do nothing but still consume some energy. The total idle energy is the sum of the energy consumed by all the individual network nodes in idle state. Average idle energy consumed is defined by the equation (4.3).

$$\text{Average Idle Energy} = \frac{\text{Total Idle Energy}}{\text{Total number of nodes}} \quad (4.3)$$

4.4 Remaining energy: This is the energy left with the network nodes at the end of the simulation time. The total remaining energy is the sum of the remaining energies of all the individual network nodes. Larger remaining energy indicates longer the network lifetime. Average remaining energy is given by equation (4.4).

$$\text{Average Remaining Energy} = \frac{\text{Total Remaining Energy}}{\text{Total number of nodes}} \quad (4.4)$$

The routing protocols are simulated using NS-2 and results are obtained by varying number of nodes, speed (m/s), and transmission range. The performance metrics are average energy consumed, average remaining energy Figure 4.1, figure 4.2, figure 4.3 and figure 4.4 summarizes the Average consumed energy under two different mobility models. It can be observed that Average consumed energy on AODV protocol for two models Manhattan mobility model best among the two mobility models studied in different scenario.

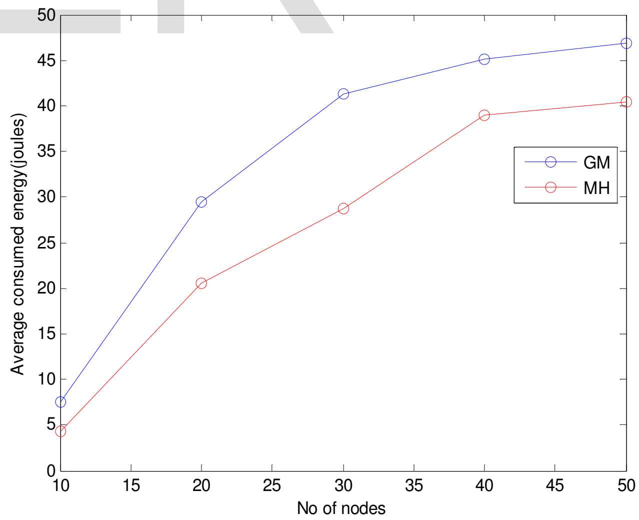

Figure 4.1 Energy consumption on transmission mode

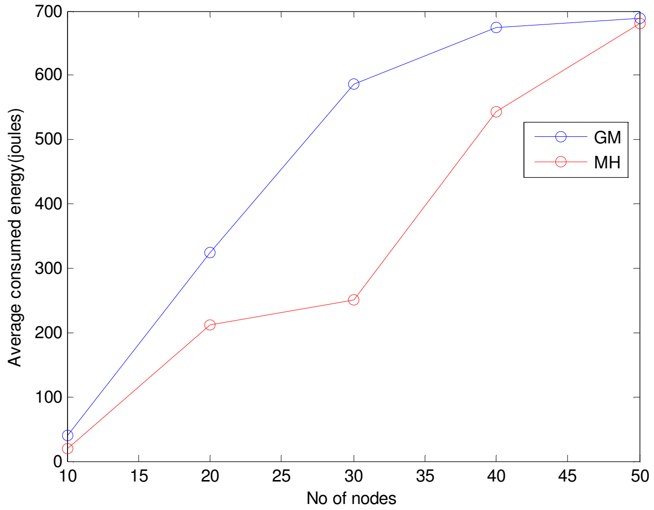

Figure 4.2 Energy Consumption in Receive Mode

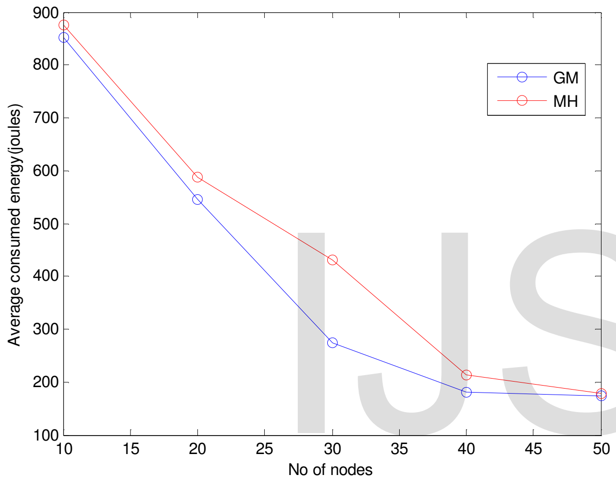

Figure 4.3 Energy Consumption in Idle Mode

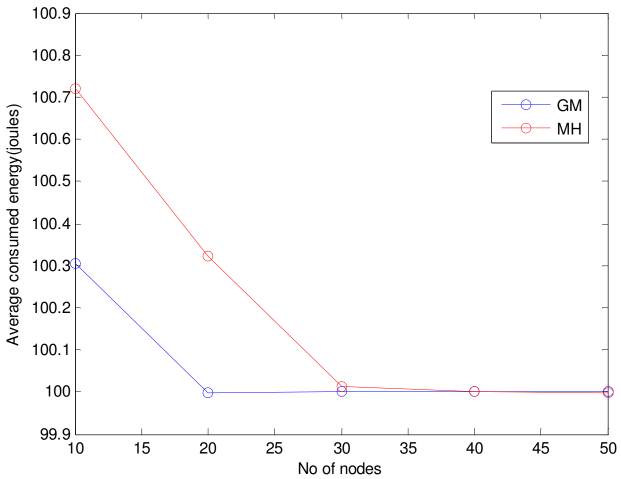

Figure: 4.4 Average Remaining Energy

5 CONCLUSION

In this research work, the impact of mobility on the energy consumption of routing protocols in mobile ad hoc networks have been analysed through extensive simulation studies. The DSR routing protocol have been evaluated over different mobility models Gauss Markov and Manhattan Grid at varying node density. The network simulator NS-2 was used to simulate the mobile ad hoc network and Bonn motion tool was used to generate node movements for different mobility models. The results node movements for different mobility models.

The results were obtained for different modes of energy consumption by varying node density from 10 nodes to 50 nodes in a simulation area of 1000m×1000m. By analyzing the results obtained, the following conclusions are drawn:

- **Transmission Mode**: It is found that Manhattan grid is the most efficient model for this mode of operation. The GM is clearly worst model in the simulated scenario.
- **Receive Mode**: Like transmission mode, the Manhattan grid and GM are again the most efficient and worst models respectively for receiving operation.
- **Idle Mode**: In idle mode the energy consumption of Manhattan grid and GM models is interestingly reversed. GM is most efficient while Manhattan grid is poorest model in the idle mode.
- **Remaining Mode:** In Remaining mode the Manhattan grid is the constant remaining energy.

Overall it is found that Manhattan mobility model best among the two mobility models studied. So it can be concluded that energy consumption is very much affected by the mobility model in use and Manhattan grid is the most efficient mobility model as far as energy consumption is concerned.

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