# A NEW REALISTIC MOBILITY MODEL FOR MANET TO IMPROVE THE DATA DELIVERY RATIO

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**Abstract**

In this paper, we present a new mobility model for multi-hop Adhoc networks. We show that group motion occurs frequently in ad hoc networks, and introduce a novel group mobility model called Multi Mobility Model (MMM) to represent the relationship among mobile hosts. MMM can be readily applied to many existing applications. This model gives the best coverage across the country irrespective of the area type-rural, urban and city. This model takes into consideration both static and dynamic nodes. We have applied our MMM model to different network transmission scenarios, clustering, time, speed, steady state and routing, and have evaluated network performance under different mobility patterns and for different implementations. In order to illustrate the feasibility of hybrid mobility model, it is compared with the existing mobility models based on the routing algorithms. Through extensive simulations on MMM, we demonstrate up to 90% improvement in packet delivery rate.

**Keywords: Mobility Model, MANET, Routing, Ns-2.**

## 1. Introduction

Mobile Ad hoc networks are maintaining a dynamic interconnection topology between mobile users. Ad hoc networks are expected to play an increasingly important role in real time settings. The short range transmissions of nodes are often results in a multi-hop communication and distributive scenario to retransmit packet before it reaches its destination. The mobility of nodes in MANET often results in a highly dynamic topology leads to the task of routing in an ad hoc network more difficult. Managing of large number of mobile units, topological changes, delay, bandwidth, multimedia transmission, and speed access are some of the important points to be considered. The nodes in an ad hoc network move according to various patterns. In mobile ad hoc networks, communications are often among teams which tend to coordinate their movements. Messages are forwarded through multiple hops due to the restriction of radio transmission range in every mobile.

Dynamic routing protocols will then distribute this best route information to other routers running in the same routing protocol, thereby extending the information on what networks exist and can be reached [2]. This gives dynamic routing protocols the ability to adapt to logical network topology changes. This model combines the advantages from proactive and reactive routing. It takes the advantage of pro-active discovery within a node's local neighborhood, and using a reactive protocol for communication between these neighborhoods. Routing is an essential mechanism to support multiple hop radio transmissions. However, node mobility and limited communication resources make routing in MANETs very difficult. Mobility causes frequent topology changes and may break existing paths.

A routing protocol should quickly adapt to the topology changes and efficiently search for new paths. On the other hand, the limited power and bandwidth resources in MANETs make quick adaptation very challenging. Thus, we are developing a flexible mobility framework which allows us to model different applications and network scenarios to identify the impact of mobility on different scenarios such as clustering motion and individual decisions of nodes. The proposed mobility framework is called Multi Mobility Model (MMM). In the model, mobile hosts are organized as group of clusters. A new mobility model is implemented for generating a trace, i.e., hybrid mobility model. In order to illustrate the feasibility of hybrid mobility model, it is compared with the existing mobility models based on the routing algorithm, DSR, FSR and ZRP, by using network simulator (NS-2).

## 2. Routing Protocols

### 2.1. Dynamic Source Routing (DSR)

DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. All aspects of the protocol operate entirely on-demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to handle changes in the routes currently in use. The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in routing its packets, for example to balance load or to increase robustness [5].

### 2.2. Fisheye State Routing (FSR)

FSR is an implicit hierarchical routing protocol. The eye of a fish captures with high detail the pixels near the focal point. In routing, the fisheye approach translates to maintaining accurate distance and path quality information about the immediate neighborhood of a node, with progressively less detail as the distance increases. Through this exchange process, the table entries with larger sequence numbers replace the ones with smaller sequence numbers. When network size grows large, the update message could consume considerable amount of bandwidth, which depends on the update period. In order to reduce the size of update messages without seriously affecting routing accuracy, FSR uses the fisheye technique.

## 3. Mobility Models

### 3.1. The Random Waypoint Model

The Random Waypoint Model was first proposed by Johnson and Maltz. Soon, it became a 'benchmark' mobility model to evaluate the MANET routing protocols, because of its simplicity and wide availability. To generate the node trace of the Random Waypoint model the setdest tool from the CMU Monarch group may be used. This tool is included in the widely used network simulator Ns-2.

In the network simulator (Ns-2) distribution, the implementation of this mobility model is as follows: as the simulation starts, each mobile node randomly selects one location in the simulation field as the destination. It then travels towards this destination with constant velocity chosen uniformly and randomly from *[0, V]*, where the parameter *V* is the maximum allowable velocity for every mobile node. The velocity and direction of a node are chosen independently of other nodes. Upon reaching the destination, the node stops for a duration defined by the 'pause time' parameter. If *T=0*, this leads to continuous mobility. The whole process is repeated again and again until the simulation ends as shown in Figure 1.

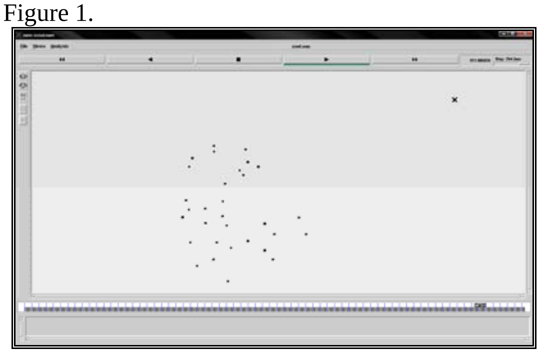

**Fig.1 Ns-2 Simulation of random waypoint Mobility model**

The measure of relative speed between node *i* and *j* at time *t* is,

$$RS(i,j,t) = |\vec{V}_i(t) - \vec{V}_j(t)|$$

the Mobility metric is calculated as the measure of relative speed averaged over all node pairs and over all time. The formal definition is as follows,

$$\overline{M} = \frac{1}{|i,j|}\sum_{i=1}^{N}\sum_{j=i+1}^{N}\frac{1}{T}\int_{0}^{T} RS(i,j,t)\,dt$$

### 3.2. Random Walk Model

The Random Walk model was originally proposed to emulate the unpredictable movement of particles in physics. It is also referred to as the Brownian Motion. Because some mobile nodes are believed to move in an unexpected way, Random Walk mobility model is proposed to mimic their movement behavior as shown in Figure 2. The Random Walk model has similarities with the Random Waypoint model because the node movement has strong randomness in both models. We can think the Random Walk model as the specific Random Waypoint model with zero pause time. However, in the Random Walk model, the nodes change their speed and direction at each time interval [1]. For every new interval t, each node randomly and uniformly chooses its new direction from (*0,V*). In similar way, the new speed follows a uniform distribution or a Gaussian distribution from [0, V]. This effect is called border effect. The Random Walk model is a memoryless mobility process where the information about the previous status is not used for the future decision. That is to say, the current velocity is independent with its previous velocity and the future velocity is also independent with its current velocity.

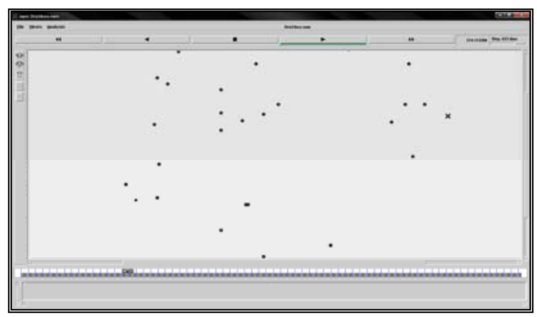

**Fig. 2 Ns-2 Simulation of random walk mobility model**.

### 3.3. Reference Point Group Mobility Model

In line with the observation that the mobile nodes in MANET tend to coordinate their movement, the Reference Point Group Mobility (RPGM) Model is proposed in. One example of such mobility is that a number of soldiers may move together in a group or platoon. Another example is during disaster relief where various rescue crews (e.g., firemen, policemen and medical assistants) form different groups and work cooperatively. In the RPGM model, each group has a center, which is either a logical center or a group leader node as shown in Figure 3. For the sake of simplicity, we assume that the center is the group leader. Thus, each group is composed of one leader and a number of members. The movement of the group leader determines the mobility behavior of the entire group.

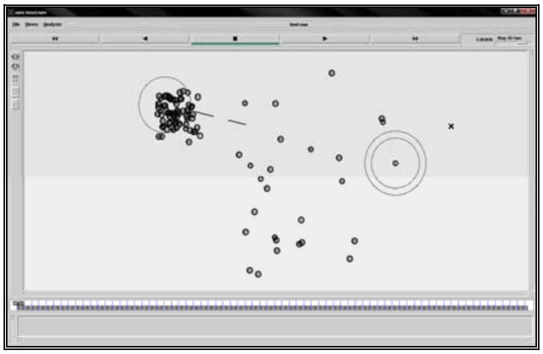

**Fig.3 Ns-2 Simulation of RPGM mobility model**

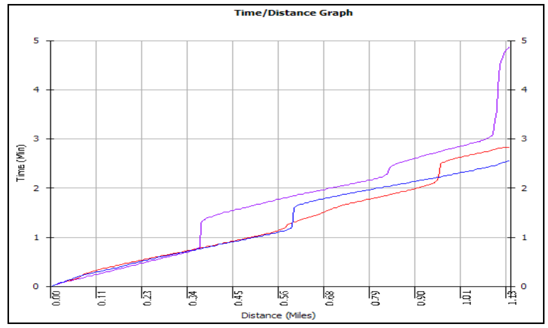


**Fig. 5 Time Vs Distance of node to travel**

The movement can be characterized as follows:

$$\begin{cases} |V_{member}(t)| = |V_{leader}(t)| + random() * SDR * \max\_speed \\ \theta_{member}(t) = \theta_{leader}(t) + random() * ADR * \max\_angle \end{cases}$$

where 0<SDR, ADR<1.SDR is the Speed Deviation Ratio and ADR is the Angle Deviation Ratio. SDR and ADR are used to control the deviation of the velocity (magnitude and direction) of group members from that of the leader. By simply adjusting these two parameters, different mobility scenarios can be generated [4].

**4. Model Design**

Specifically, the MMM Model has the highest data packet delivery ratio than Random waypoint mobility model, the lowest delay, and the lowest average hop count compared to the Random Walk Mobility Model and Random Direction Mobility Model. These results exist since MNs using the Random Waypoint Mobility Model are often traveling through the Cluster Header of the simulation area. The Random Direction Mobility Model has the highest average hop count, the highest end-to-end delay, and the lowest data packet delivery ratio since the Random Direction Mobility Model has each MN move to the border of the simulation area as shown in Figure 4 before changing direction. The performance of DSR when using the Random Walk Mobility Model falls between these two extremes.

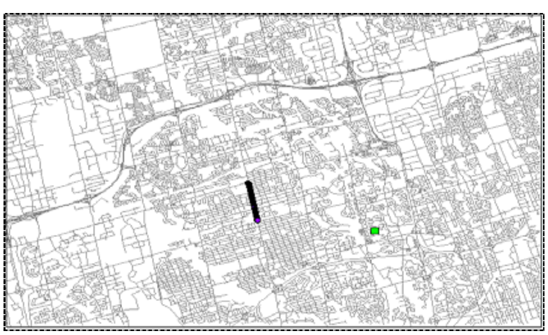

**Fig.4 City scenario**

The MMM with only intercluster communication has approximately the same hop count as the Random Waypoint Mobility Model. As mentioned, both a group's movement and an MN's movement within a group in the MMM model is done via the Random Waypoint Mobility Model. Thus, we would expect the node counts for received packets to be similar between these two simulations. In MMM model within the cluster the transmission has a much lower data packet delivery ratio and higher end-to-end delay than the results for the Random Waypoint Mobility Model as shown in Figure 5 as distance increases the time to reach the destination also increases drastically and we are not able to get the constant speed as shown in Figure 6.

Since all communication is between groups, the performance of the mobility model in terms of packet delivery, delay, speed, stability and randomness will suffer from transient partitions that exist in the network. The MMM model with both intercluster and intra cluster communication has the lowest average hop count**,** since 80% of the packets transmitted are sent within the cluster(cluster stability) as shown in Figure 7. The packet delivery to neighboring cluster is not however, as high as one would expect; since 20% of the packets are transmitted between groups, these packets are sometimes dropped due to the link failures and randomness of the nodes.

**Table 1. Traffic Analysis**

| Run No | Length (Miles) | Travel Time (M:S) | Avg Spd (MPH) | No. of Stop | Stopped Delay (M:S) |
|---|---|---|---|---|---|
| C1 | 1.12 | 2:34 | 26 | 1 | 0:23 |
| C2 | 1.13 | 2:50 | 24 | 1 | 0:18 |
| C3 | 1.14 | 5:10 | 13 | 4 | 2.18 |

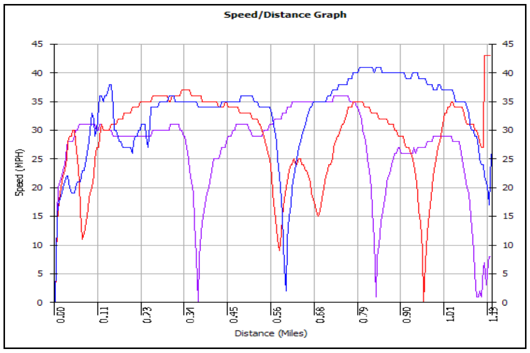


**Fig.6 Speed Vs Distance**

Since the MMM model with clustering communication has the lowest hop count, this model requires the least amount of overhead. MNs moving with the Random Walk Mobility Model and the Random Direction Mobility Model have the highest average hop count, and as a result these two models require the highest amount of overhead as shown in Figure 8.

### 5. Intermediate Mobility Model

The intermediate mobility determines the communication between vehicles and static centers. The intermediate mobility depends on the number of intermediates, vehicle wait-time in signals, speed of vehicle and number of road intermediates. If there is no traffic control at an intermediate, more number of vehicles would be trying to share the road at the peak time.

#### 5.1. Random Motion

The term Random motion is used to describe the movement of a nodes subjected to meet each other. Macroscopically, the position z*(t)* of the node can be modeled as a stochastic process satisfying a second-order differential equations.

$$ky''(t) + py'(t) + my(t) = G(t) \quad m>1 \qquad \text{-- (1)}$$

where *G(t)* is the collision force, m is the mass of the node, *p* is the state of conflict and *my(t)* is an force which we assume proportional to y*(t)*. G*(t)* can be viewed as masking agent with zero mean and power spectrum,

$$SF(\varphi) = 2kTf \qquad \text{--- (2)}$$

where *T* is the temperature of the medium and $k=1.37*10^{-23}$ Joule-degrees is the Boltzmann constant. We shall determine the statistical properties of y*(t)* for various cases.

#### 5.2. Boundary motion

We assume first that the restoring force my*(t)* is different from 0. For sufficiently large *t*, the position y*(t)* of the node approaches a stationary state with zero mean and power spectrum,

$$Q_x(\varphi) = \frac{2kTf}{(c - m\varphi^2)^2 + f^2\varphi^2} \qquad \text{--- (3)}$$

We shall do so under the assumption that the roots of the equation $kv^2+lv+m=0$ *are complex,*

$$S_{0,1} = -\alpha \pm \beta y \qquad \alpha = \frac{f}{2m}$$

$$\alpha^2 + \beta^2 = c/m$$

Thus, for a specific *t*, *x(t)* is a normal RV with mean 0 and variance $R_x(0)= kT/c$. Hence its density equals

$$f_x(x) = \sqrt{\frac{c}{2\pi kT}} e^{-cx^2/2kT} \qquad \text{--- (4)}$$

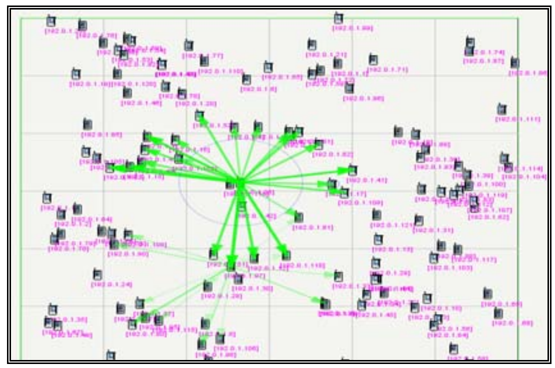

**Fig.8 Broadcast Transmission**

The conditional density of *x(t)* assuming $x(t_0)=x_0$ is a normal curve with mean ax0 and variance P where

$$a = \frac{R_x(\tau)}{R_x(0)} \qquad P = R_x(0)(1-a^2)$$

$$\tau = t - t_0$$

### 7. Simulation Results

In this section, the performance of the ad hoc routing based on the Multi Mobility Model is studied. The MMM is simulated on NS-2 & Qualnet. The performances of DSR, FSR and ZRP based on Hybrid mobility mode is estimated respectively. Suppose a 200 nodes network in a place with dimensions 1000m * 1000m. Traffic sources are CBR (continuous bit-rate) 512 byte data packets. There are 30 source-destination sessions are chosen randomly over the network. Simulations are run for 2000 simulated seconds.

As shown in Figure 9 the overall performance of our new mobility model is better than other models and it will give successful transmission between nodes. Figure 10 & 11 shows the details regarding amplitude of the signal reception and transmission happening at MAC layer for every node.

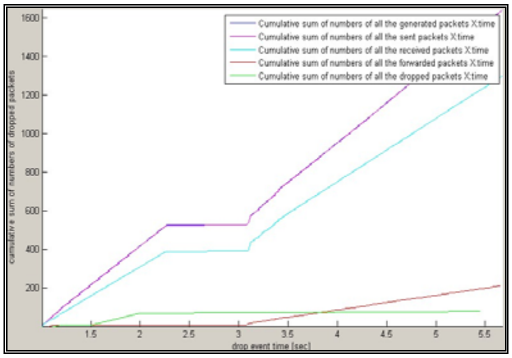


**Fig.9 Cumulative packet distribution ratio**

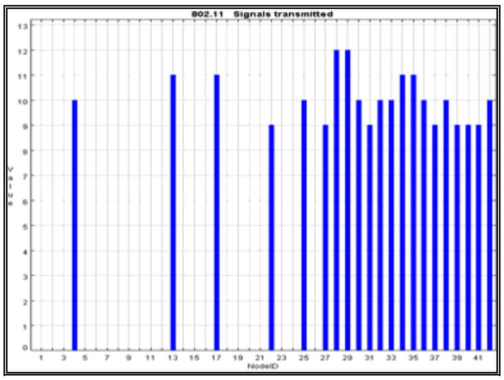


**Fig.10 802.11 Signals transmitted**

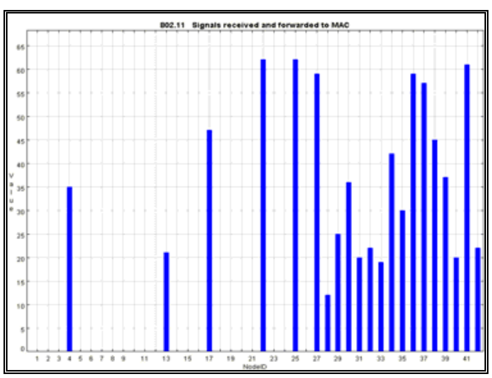


**Fig.11 802.11 Signal reception and forwarding to MAC**

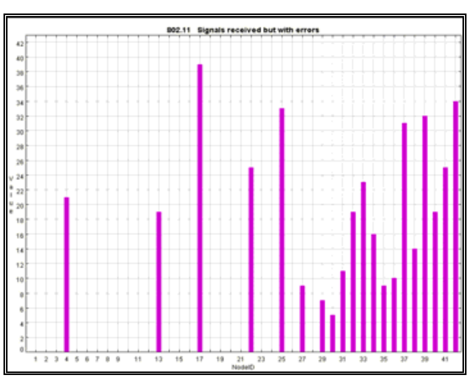


**Fig.12 Error signals**

## 8. Conclusion

The goal of this paper is to analyze the impact of the real world mobility on the link and route lifetime of mobile ad hoc networks with different packet delivery ratios at different layers. For this purpose, the data gathered from a real ad hoc network of buses, car and pedestrians is analyzed using 802.11 wireless interfaces. A general framework to model the link and route lifetimes was developed. With the help of this framework, the various metrics were compared. The congestion, traffic signals, speed, direction of mobility has completely different impact on the lifetime of links and routes. Finally, the routing and the lifetime network in different traffic conditions; in rural, urban and city scenarios are presented with different types of protocols. The generated model can be integrated (i.e., executed) directly in the network simulator Ns-2 and Qualnet. It provides an efficient way for the simulations of network protocols on a new mobility model. In the near future, we plan to design tools to generate various trace models for network simulation for the same.

## 9. References


[1] Fan Bai and Ahmed Helmy, "A Survey of Mobility Models in Wireless Adhoc Networks", University of Southern California, U.S.A.

[2] David B. Johnson and David A. Maltz. "Dynamic Source Routing in Ad Hoc Wireless Networks," Tomasz Imielinski and Hank Korth (Eds.), pp. 153-181, 1996.

[3] Biao Zhou, Kaixin Xu and Mario Gerla, "Group and Swarm Mobility Models for Ad Hoc Network Scenarios Using Virtual Tracks", Computer Science Department, University of California, Los Angeles, In Proceedings of MILCOM'04, pp. 289-294, 2004.

[4] Tracy Camp, Jeff Boleng, Vanessa Davies "A Survey of Mobility Models for Ad Hoc Network Research", Wireless Communications & Mobile Computing (WCMC)-2002.

[5] D. Johnson and D. Maltz. "Dynamic source routing in adhoc wireless networks". In T. Imelinsky and H. Korth, editors, Mobile Computing, pp 153–181, 1996.

[6] V. Davies. "Evaluating mobility models within an ad hoc network", Colorado School of Mines, 2000.

[7] Orlik P.V, Rappaport S.S, "Traffic performance and mobility modeling of cellular communications with mixed platforms and highly variable mobility's," IEEE Proc, vol.86, 1998.

[8] Yu F, Leung V, "Mobility based Predictive Call Admission Control and Bandwidth Reservation in Wireless Cellular Networks," pp.577-589, 2002.

[9] Chandra A, Bansal D, Shirey R, et al. "Characterization of mobility patterns based on cell topography in a cellular radio system", ICPWC'99 IEEE Intl. Conf., pp. 428-432,1999.