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A REVIEW PAPER ON HREF BASED ROUTE SELECTION IN AODV FOR MANETS

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ABSTRACT

Mobile ad hoc networks are self-organizing networks composed of independent mobile nodes. All mobile nodes act as router as well as hosts. The most important characteristic of MANETs is their dynamically changing topology. This characteristic has a huge impact on the performance of various MANET routing protocols. Thus, in order to efficiently calculate the performance of various MANET routing protocols, we need efficient mobility models to mimic the dynamically changing topology of MANETs. In this paper we are presenting a survey of three different types of Mobility Models and the performance of various MANET routing protocols with these mobility models.

KEYWORDS— Mobility, MANET, Routing, Mobile Nodes.

INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is an autonomous ad-hoc wireless networking system consisting of independent nodes that can move in any direction, and will therefore change its links to other devices frequently. MANET is an infrastructure-less network where the communication capabilities of the network are limited by the battery power of the nodes. No static or fixed infrastructure exists in MANET. The network can be formed anywhere, at any time, as long as two or more nodes are connected and communicate with one another either directly when they are in radio range of each other or via intermediate mobile nodes [7]. The mobile nodes can perform the roles of both hosts and routers. The ever changing network topology and resource-poor devices makes routing in MANET quite challenging and it has become a popular research area. Energy conservation is also an important issue in MANET because mobile nodes are often battery powered and cannot function without enough power level. As devices are being designed to be smaller, communication energy cost becomes a more significant portion of the total power consumed [2]. Figure1 shows a simple mobile ad-hoc network with 7 nodes. Although,

Node 1 and Node 7 in fig. 1 are not in transmission range of each other but still they can communicate with each other via nodes 2, 3 and 6.

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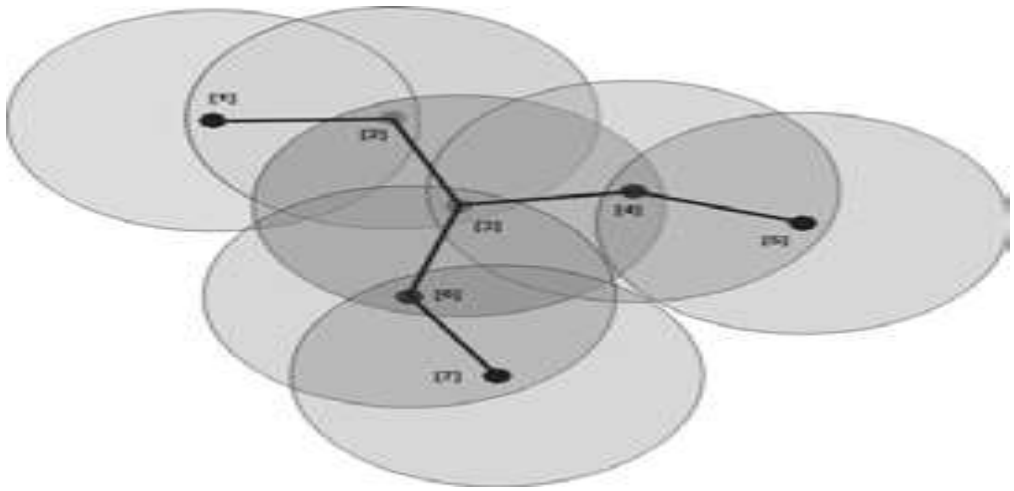

Fig. 1: An Example of a MANET With 7 Nodes

A. Characteristics of MANETs

Following are the characteristics of mobile ad-hoc networks:

[1] Dynamic Topology: Nodes are free 1. to move arbitrarily in any direction thus the network topology change is unpredictable.

[2] 2. Limited Bandwidth: The bandwidth available for wireless network is generally lower than that of wired networks.

[3] 3. Low Throughput: The throughput of these networks is generally lower due to various noises and fading effects.

[4] 4. Energy constrained operation: The nodes are portable devices and are dependent on batteries. This is the most important design consideration of MANETs.

[5] 5. Security: Wireless networks are more prone to threats than wired networks. The increased possibility of various security attacks like eavesdropping, denial of service should be handed carefully.

RELATED WORK

Several researchers have evaluated and presented performances of MANET routing protocols in thepresence of various mobility models. Several conclusions have been drawn with regard to the performance of routing protocols in presence of this mobility models. Fahim Manet al.[6] carried out a simulative study on MANET routing protocols and various mobility models in ns-2 simulator using a number of reactive and proactive routing protocols including AODV, DSR, DSDV, OLSR and DYMO. The results of simulations clearly indicate the impact that node mobility has on routing performance. Also, the increase in network size and number of nodes has similar impact on all protocols under various mobility patterns, i.e. a degradation of the network performance. Pragya Guptaet al.[4] studied and evaluated the effect of mobility on the routing protocols viz. AODV, DSDV, DSR and OLSR in terms of packet delivery ratio, average end-to-end delay and normalized routing load. Ion Gabriel Toudoracheet al.[9]presented a new realistic mobility model called Marginal Mobility Model and showed using simulation that DSR, AODV, LAR1, DYMO and Bellman Ford do not support this mobility model. Deepak Kumar et al. [5] compared the performance of Fish-eye, LANMAR, OLSR and AODV routing protocols for different mobility models like RWP mobility model, RPGM model, etc. using QualNet simulator. DharamViret al.[12] provided the comparative analysis of various routing protocols under the effect of various mobility models: viz. File, Group and Random Way Point Mobility Model. The results show significant impact of mobility models on performance of routing protocols.

MANET ROUTING PROTOCOLS

A routing protocol is a set of rules which governs the journey of message packets from source to destination in a network. Routing protocol specifies how routers communicate with each other, spreading information that enables them to select routes between any two nodes in a network. MANET routing protocols can be characterized into three different categories, namely proactive, reactive and hybrid. Fig. 2 shows the classification of routing protocols in MANETs.

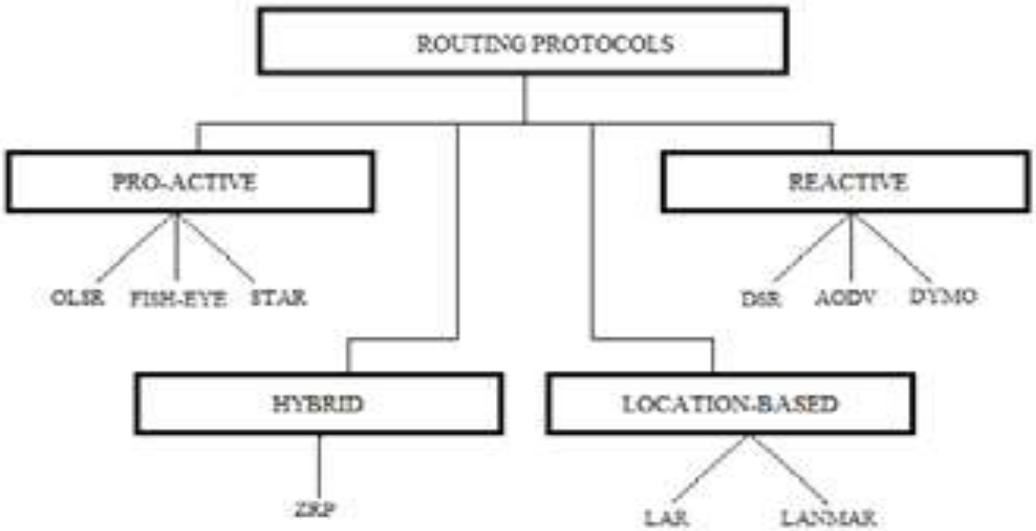

Fig. 2: Classification of MANET Routing Protocols

1. Pro-Active (or Table Driven) Routing Protocols employ classical routing strategies such as distance –vector or link state routing and any changes in the link connection are updated periodically throughout the network. The mandate that nodes in the MANET should keep track of routes to all possible destinations so that when the packet need to be forwarded, the known route can be used immediately. This allows pro-active routing protocols to transmit less overall control packets, keeping the routing load minimum [4].However, when frequency of link breakage is high, the proactive protocol needs a higher rate of routing table updates, which lowers the network performance. Pro-active protocols include Optimized Link State Routing (OLSR) protocol, Fish-eye State Routing protocol and Source Tree Adaptive Routing (STAR) protocol.

2. Reactive (or on-demand) Routing Protocol employs a lazy approach whereby nodes only discover routes to destination on demand. In other words, a route is discovered only when needed. A source node initiates route discovery by broadcasting route query or request messages into the network. All nodes maintain the discovered routes in their routing tables. However, only valid routes are kept and old routes are deleted after an active route timeout [8]. A serious issue for MANETs arises when link failures occur due to high node mobility; at the same time new links may also be established between previously distant nodes. This significantly increases the network broadcast traffic with rapid link make/break effect of intermediate nodes. Therefore, reactive routing protocols are subjected to an increase in network control overhead. Reactive protocols include Dynamic Source Routing (DSR), Ad-hoc On-demand Distance vector (AODV) routing and dynamic on-demand MANET (DYMO) routing protocol.

3. Hybrid Routing Protocols for MANETs are zone based, in which the network is partitioned or seen as a number of zones by each node where proactive maintains route within a zone and reactive maintains route in between zones through reactive flooding [8]. The drawback of hybrid protocols is that success depends on amount of nodes participating and reaction to traffic depends on gradient of traffic volume. Example of hybrid routing protocols is Zone Routing Protocol (ZRP).

4. Position-Based Routing Protocols rely on geographic position information. It is based on the idea that source sends data to the geographic location of the destination instead of using network address. Position based routing requires that each node can determine its own location and the source is aware of the location of the destination. The examples of position-based routing are Location Aided Routing (LAR) protocol and Landmark Ad-hoc Routing (LANMAR) protocol.

MOBILITY MODELS

The mobility patterns are the key criteria that influence the performance characteristics of the mobile ad hoc networks. The mobility model is designed to mimic the movement pattern of mobile nodes, and how their location, velocity and acceleration change over time. Since mobility patterns may play a significant role in determining the protocol performance, it is necessary to choose the proper underlying mobility model. Mobility models are broadly classified into three categories: Entity Mobility Models (that represents mobile nodes whose movements are independent of each other), Group Mobility Models (that represent mobile nodes whose movements are dependent on each other) and Realistic Mobility Models (that are based on realistic mobility patterns of mobile nodes).
Table 1 shows various mobility models that are to be discussed in this paper and the categories to which they belong.

Table 1: Classification of Mobility Models

Category	Mobility Models
Entity Mobility Models	• Random Walk Mobility Model • Random Way Point Mobility Model • Random Direction Mobility Model • Gauss-Markov Mobility Model • Boundless Simulation Area Mobility Model
Group Mobility Models	• Reference Point Group Mobility Model • Column Mobility Model
Realistic Mobility Models	• Marginal Mobility Model

A. Entity Mobility Models

In entity mobility model, the individual movement of each mobile node in a mobile ad hoc network is considered in the analysis of mobility pattern based on speed, direction, transition length, etc.[7]. Each model will have its own statistical properties and mobility metrics.

1. Random Walk Mobility Model

Random Walk Mobility Model was developed to mimic the unpredictable movement of some natural entities [3]. In this mobility model, a mobile node moves from its current location to a new location without taking pause and by randomly choosing a direction and speed to travel. Each node is assigned an initial location (x0,y0) and a destination (x1, y1). The speed is chosen from predefined ranges (V0,V1) independently from all previous destinations, speeds and directions in the range $(0,2\pi)$. If mobile node reaches the simulation boundary, it bounces off with an angle determined by the incoming direction and then continues along its new path. Fig. 3 shows the travelling pattern of mobile node using Random Walk Mobility Model.

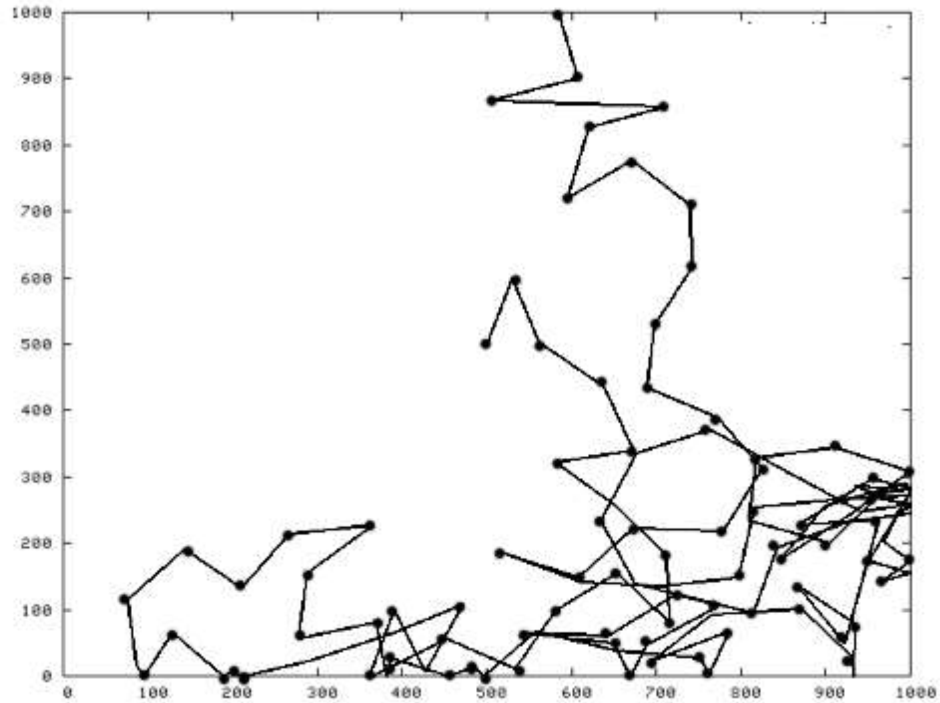

Fig. 3: Travelling Pattern of Mobile Nodes Using Random Walk Mobility Model

2. Random Waypoint Mobility Model

Random Waypoint Mobility Model is the most widely used mobility model in the study of ad hoc networks. This model includes pause times between changes in the direction and/or speed of mobile nodes [3]. This model is represented using a 3-tuple: (Vmax, T, Vi); where the speed of the mobile node varies between 0 to Vmax, T is the pause time and Vi is the direction vector. In Random Waypoint Mobility Model, the mobile node randomly chooses a destination, called a waypoint, and moves towards that point in a straight line with a randomly selected speed between 0 to Vmax. After reaching that point, the mobile node pauses for some predefined time T, called Pause Time. After the pause time, the mobile node repeats the same procedure. Fig. 4 shows the travelling pattern of mobile node using Random Waypoint Mobility Model.

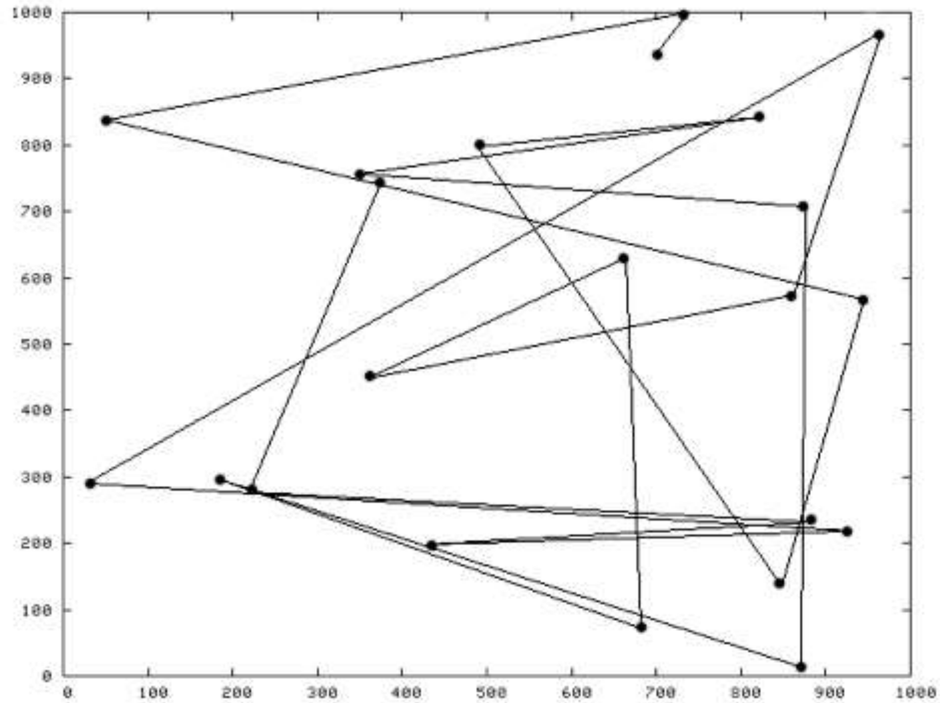

Fig. 4: Travelling Pattern of Mobile Node using Random Waypoint Mobility Model

Pragya Guptaet al. [4] evaluated the effects of Random Waypoint Mobility Model on AODV, DSDV, DSR and OLSR routing protocols in terms of packet delivery ratio, average end-to-end delay and normalized routing load.

Table 2 shoes the performance of these routing protocols with Random Waypoint Mobility Model.

Table 2: Performance of Various Routing Protocols with Random

Routing Protocols	Packet Delivery Ratio (in %)	Average endto-end Delay (in msec)	Routing Load (ratio of control packets to total simulation time)
AODV	100	2.30	0.3`
DSDV	45	2.31	0.9
DSR	95	2.42	0.1
OLSR	30	2.31	0.7

3. Random Direction Mobility Model

Random Direction Mobility Model was developed in order to overcome the clustering of nodes in the center of simulation area in case of Random Waypoint Mobility Model [3]. In this mobility model, a mobile node chooses a random direction and speed to travel, as in case of Random Waypoint Mobility Model. The mobile node continues to travel in that direction until it reaches the boundary of simulation area. On reaching the boundary, the mobile node pauses for a specified time and then chooses another angular direction between 0 and 2πand continues the process. Fig. 5 shows the travelling pattern of mobile nodes using Random Direction Mobility Model.

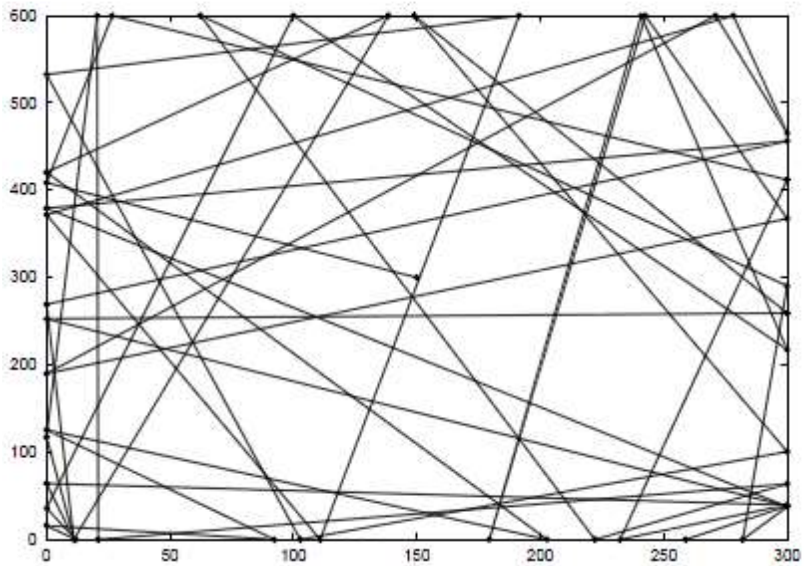

Fig. 5: Travelling Pattern of Mobile Node using Random Direction Mobility Model

4. Boundless Simulation Area Mobility Model

The Boundless Simulation Area Mobility Model prevents unnaturally straight walking behavior of mobile nodes as in Random Walk, Random Waypoint and Random Direction Mobility Models [7]. Random Walk, Random Waypoint and Random Direction mobility models produces very sharp turns but Boundless Simulation Area Mobility Model is lacking this property and is more likely be able to produce realistic movement. In order to achieve the goal of producing realistic mobility pattern, this mobility model slightly changes the direction of mobile node at every step. In this mobility model, the current speed and direction of travelling of mobile node is dependent on the previous speed and direction of travelling [3]. A velocity vector v= (v,θ) is used to describe a mobile node's velocity v as well as its direction θ. The mobile node's position is represented as (x, y). Both the velocity vector and the position are updated at every Δt time steps according to the following formulas:

$$v(t+\Delta t) = \min[\max(v(t)+\Delta v, 0), V_{max}] \quad (1)$$
$$\theta(t+\Delta t) = \theta(t)+\Delta\theta \quad (2)$$
$$x(t+\Delta t) = x(t)+v(t) * \cos\theta(t) \quad (3)$$
$$y(t+\Delta t) = y(t)+v(t) * \sin\theta(t) \quad (4)$$

Here, Vmax is the maximum velocity defined in the simulation, Δv is the change in velocity which is uniformly distributed between [-Amax * Δt, Amax* Δt], Amaxis the maximum acceleration of a given mobile node. Δθ is the change in direction which is uniformly distributed between [-α * Δt, α * Δt], and α is the maximum angular change in the direction the mobile node is traveling [3]. If a mobile node reaches the boundary of simulation area, it continues to travel and appear on the opposite side of simulation area. Fig. 6 shows the traveling pattern of a mobile node using Boundless Simulation Area Mobility Model.

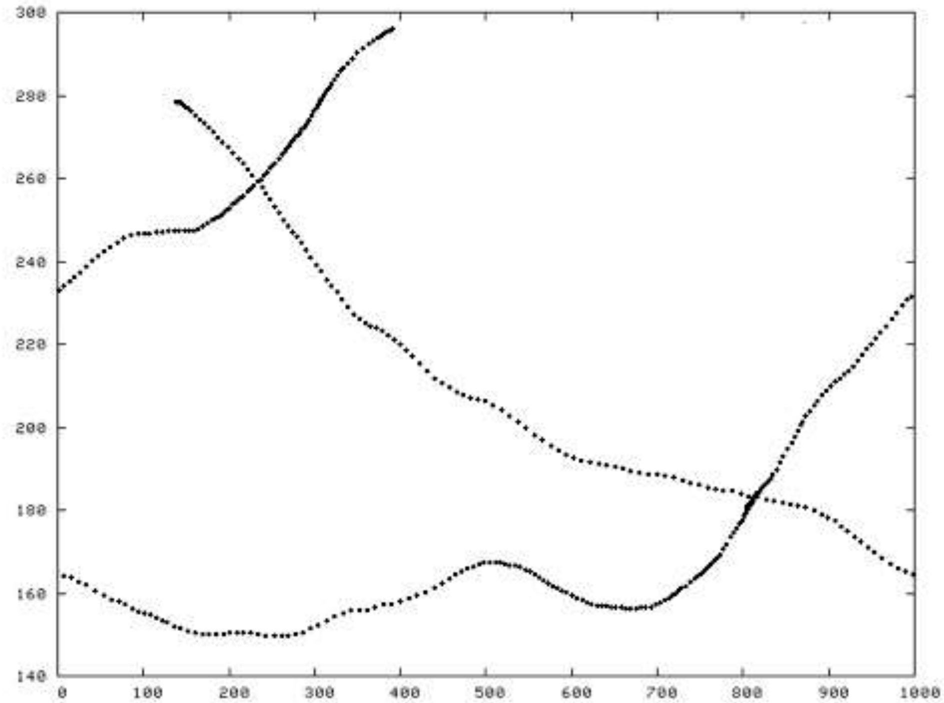

Fig. 6: Travelling Pattern of Mobile Node using Boundless Simulation Area Mobility Model

CONCLUSION

A mobility model represents a realistic behavior of each mobile node in the mobile ad hoc network. The entity mobility models **and** group mobility models are widely used for the performance evaluation of MANET routing protocols but most of them are either unrealistic or semi-realistic in nature. Since the mobility models directly impact the performance of routing protocols, so using unrealistic mobility models leads to inaccurate performance measurements. Thus, for the accurate evaluation of MANET routing protocols, we need to test them under some realistic mobility models. In this paper we have presented the performance of various routing protocols evaluated using three different types of mobility models. These routing protocols performed well with entity and group mobility models but there was a huge divergence in the case of Marginal Mobility Model which comes under the category of realistic mobility model. Future study should be focused on designing more realistic mobility models and improving the present routing protocols to perform well with realistic mobility models.

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