A Review on various Mobility Models over Vehicular Ad hoc Network

Rakhi[1], Lalit Bansal[2]

[1] Dept. of Computer Science and Engg.
GNIT, Mulana (Haryana), India .
[2] Asst. Professor, Dept. of Computer Science and Engg.

Abstract

A Vehicular Ad-Hoc Network or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. The characteristics of a vehicular ad hoc network are unique compared to other mobile ad hoc networks. While its intriguing features enable VANETs to be installed in many situations where traditional networks are unavailable, destroyed or impossible, they pose several problems which arise due to the shared nature of the wireless medium, limited transmission range of wireless devices, node mobility and energy constraints etc. Mobility models define the movement of mobile nodes with respect to location, velocity and acceleration in VANET.

Keywords: VANETS, QoS.

1. INTRODUCTION

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. we are moving from the Personal Computer (PC) to the Ubiquitous Computing age in which individual users utilize, at the same time, several electronic c platforms through which they can access all the required information whenever and wherever they may be [4]. This has led to rapid growth in the use of wireless technologies for the Local Area Network (LAN) environment. Beyond supporting wireless connectivity for fixed, portable, and moving statio ns within a local area, wireless LAN (WLAN) technologies can provide a mobile and ubiquitous connection to Internet information services. WLAN products consume too much power and have excessive range for many personal consumer electronic and computer devices.

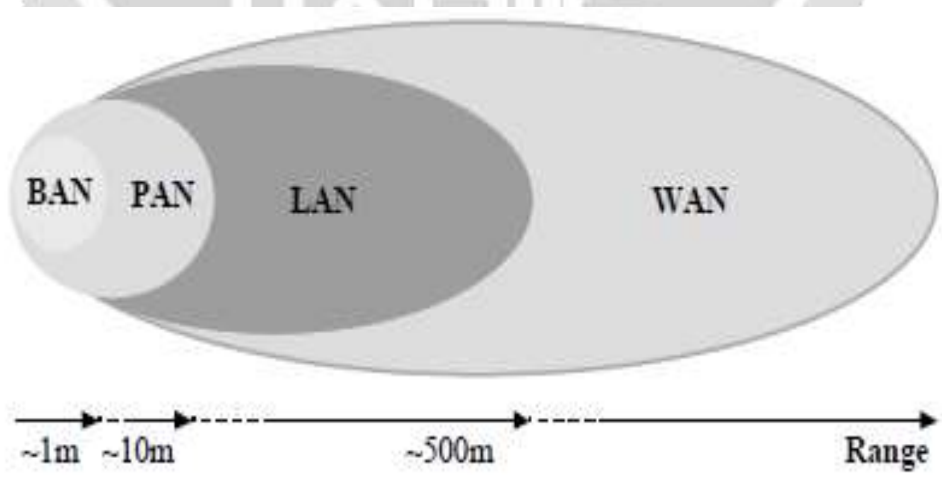

Figure 1.1: Taxonomy of Wireless Ad hoc network.

An ad-hoc wireless network is a collection of wireless nodes that self organize in to a network without the help of an existing infrastructure. Some or possibly all of these nodes are mobile. Ad-hoc networks can be classified in three categories based on applications:

i. Mobile Ad-hoc Networks (MANETs)
ii. Wireless Mesh Networks (WMNs)
iii. Wireless Sensor Networks (WSN).

A. Mobile Ad-hoc Network

An ad-hoc wireless network is a collection of wireless nodes that self organize in to a network without the help of an existing infrastructure. Some or possibly all of these nodes are mobile. Ad-hoc networks can be classified in three categories based on applications; Mobile Ad-hoc Networks (MANETs), Wireless Mesh Networks (WMNs), Wireless Sensor Networks (WSN).An ad-hoc wireless network is a collection of two or more devices equipped with wireless communications and networking capability. Such devices can communicate with another node that is immediately within their radio range or one that is outside their radio range. For the latter scenario, an intermediate node is used to relay or forward the packet from the source toward the destination. An ad-hoc wireless network is self-organizing and adaptive. This means that a formed network can be deformed on the fly without the need of any system administration. The term “ad-hoc’ tends to imply “can be mobile, standalone, or networked.” Ad hoc nodes or devices should be able to detect the presence of other such devices and to perform the necessary handshaking to allow the sharing of information and services. A mobile ad-hoc network is self-created and self-organized by a set of mobile nodes called hosts. The nodes are interconnected by single-hop or multiple hop wireless connection, and each node may serve as a packet level router for other nodes in the mobile ad hoc network [5,7].

Mobile ad hoc networks consist of wireless hosts that communicate with each other in the absence of a fixed infrastructure. Routes between two hosts in MANET may consist of hops through other hosts in the network. The task of finding and maintaining routes in MANET is nontrivial since host mobility causes frequent unpredictable topological changes. A number of MANET protocols for achieving efficient routing have been recently proposed. They differ in the approach used for searching a new route and/or modifying a known route, when hosts move. It is assumed that each node is aware of the geographic location of all other nodes in MANET. Of course, for this work all nodes must be able to see all the other nodes of the network, to be able to establish communication with them. When a node goes out of range, it just looses connection with the rest of ad-hoc network. The vision of mobile ad hoc networking is to support robust and efficient operation mobile wireless networks by incorporating routing functionality into mobile nodes [2]. Mobile Ad hoc Networks are broadly divided into following categories :

- Vehicular Ad-hoc Networks (VANETs) are used for communication among vehicles and between vehicles and roadside equipment. For example, a university bus system, if the buses are connected. The buses travel to different parts of a city to pick up or drop off students, and make an ad-hoc network.
- Internet Based Mobile Ad-hoc Networks (iMANET) are ad-hoc networks that link mobile nodes and fixed Internet-gateway nodes. In such type of networks normal adhoc routing algorithms don't apply directly.
- *Intelligent vehicular ad-hoc networks* (InVANETs) are a kind of artificial intelligence that helps vehicles to behave in an intelligent manner during vehicle-to-vehicle collisions, accidents, drunken driving etc.

B. Vehicular Ad-hoc Networks (VANETs)

A Vehicular Ad-Hoc Network or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 metres of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes.The characteristics of a vehicular ad hoc network are unique compared to other mobile ad hoc networks.

The distinguishing properties of VANET offer opportunities to increase network performance, and at the same time it presents considerable challenges. A VANET is fundamentally different from other MANETs. First, a VANET is characterized by a rapid but somewhat predictable changing topology. Second, fragmentation of the network frequently occurs. Third, the effective network diameter of a VANET is small. Fourth, redundancy is limited both temporally and functionally. Fifth, a VANET poses a number of unique security challenges.

II. MOBILITY MODELS

Mobility is anything that causes a change in the topology, able to move or be moved freely or easily. A mobility generation tool called "setdest" is developed by CMU for generating random movements of nodes in the wireless network of NS-2 is used to generate mobility model and USC mobility generator tool for generating mobility model for Random Point Group Mobility (RPGM), Manhattan (MHM) and Freeway (FWM) model for varing scalability and offered load Scenarios.There are many mobility models proposed. We are going to use the following four mobility model for our research [2].

Random Trip Mobility Model (RWPM)

A simple mobility model based on random directions and speeds. In this mobility model, an MN moves from its current location to a new location by randomly choosing a direction and speed in which to travel. The new speed and direction are both chosen from predefined ranges, [speedmin; speedmax] respectively. If an MN which moves according to this model reaches a simulation boundary, it bounces off the simulation border with an angle determined by the incoming direction. The MN then continues along this new path. This model can be configured such that the nodes continue along their path for a set amount of time or a set distance. At every instant, a node randomly chooses a destination and moves towards it with a velocity chosen randomly from a uniform distribution [0,V_max], where V_ max is the maximum allowable velocity for every mobile node. After reaching the destination, the node stops for a duration defined by the 'pause time' parameter. After this duration, it again chooses a random destination and repeats the whole process until the simulation ends. A mobile node begins the simulation by waiting a specified pause-time. After this time it selects a random destination in the area and a random speed distributed uniformly between 0 m/s and V max m/s [5,7]. After reaching its destination point, the mobile node waits again pause-time seconds before choosing a new way point and speed. The mobile nodes are initially distributed over the simulation area. This distribution is not representative to the final distribution caused by node

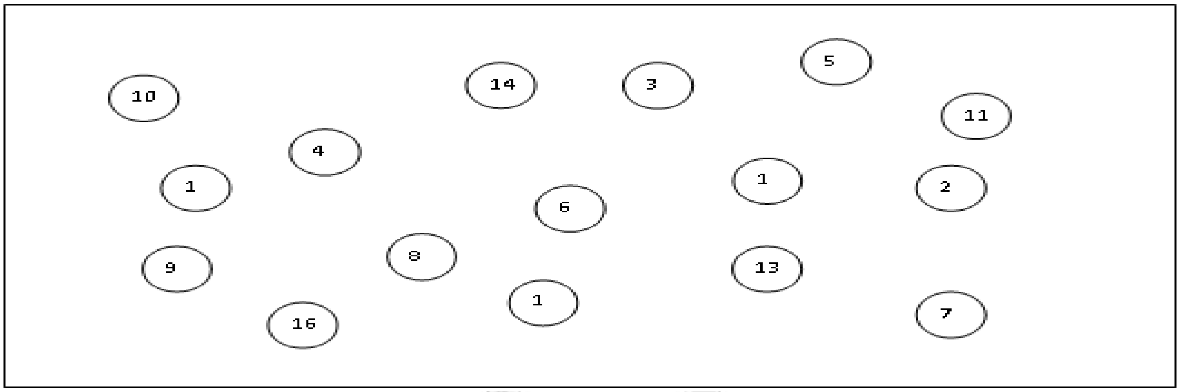

Figure 3: Random Trip Mobility Model [5].

The Random Waypoint model is the most commonly used mobility model in research community. At every instant, a node randomly chooses a destination and moves towards it with a velocity chosen randomly from a uniform distribution [0,V_max], where V_ max is the maximum allowable velocity for every mobile node. After reaching the destination, the node stops for a duration defined by the 'pause time' parameter. After this duration, it again chooses a random destination and repeats the whole process until the simulation ends.

Random Point Group Mobility (RPGM)

The group mobility model we proposed here is called Random Point Group Mobility (RPGM) model. Each group has a logical "center". The center's motion defines the entire group's motion behavior, including location, speed, direction, acceleration etc. Thus, the group trajectory is determined by providing a path for the center. Usually, nodes are uniformly distributed within the geographic scope of a group [2].

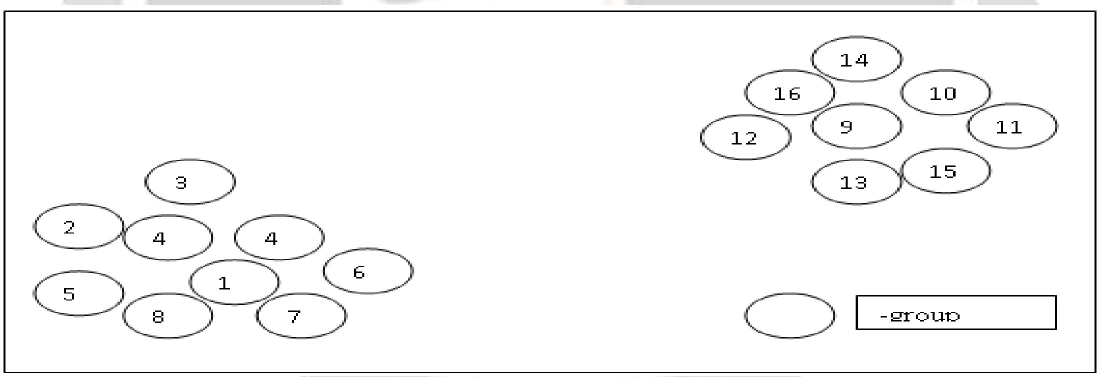

Figure 2: Random Point Group Mobility Model [2].

Manhattan Model (MHM)

The Manhattan model can be useful in modeling movement in an urban area .The scenario is composed of a number of horizontal and vertical streets. Given below is example topography showing the movement of nodes for Manhattan Mobility Model with seventeen nodes. The map defines the roads along the nodes can move[2].

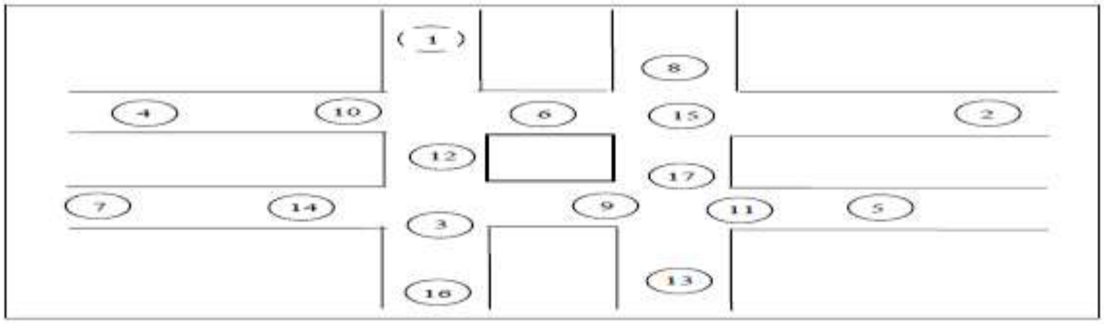

Figure 3: Manhattan mobility model [2].

Gauss-Markov Mobility Model (GMMM)

- Gauss-Markov model,the mean velocity vector mu is not specified directly; instead, the norm is speciedusing \-a" and a random vector with this norm is assigned to each station. Of course, a normof 0 yields only the vector (0,0). The implementation also allows the user to specify a maximum speed. A velocity vectors with a larger norm will be multiplied with an appropriate scalar to reduce the speed to the maximum speed. The model has been adapted to deal with scenario borders in the following way: If station moves onto the border, its velocity vector as well as its expected velocity vector are “mirrored".Given below is example topography showing the movement of nodes for Freeway Mobility Model with twelve nodes: The main commonalties are that for each mobile node, two separate values are maintained instead of one speed vector: The mobile's speed and its direction of movement. Also the default method of handling mobile nodes that move out of the simulation area is closely related to [5, 9]: Nodes may continue to walk beyond the area boundary, which causes the next movement vector update not to be based on the prior angle, but on an angle that brings the nodes back onto the end. Therefore, the old size is automatically adapted to the node movements after scenario generation. The main difference to [5,9] is that new speed and direction of movement are simply chosen from a normal distribution with a mean of the respective old value (the standard deviations specified on the command line using -a and -s). Speed values are constrained to a certain interval that can be specified on the command line using -m and -h: If a newly chosen speed value is outside of this interval, it is changed to the closest value inside of the interval.

I. III. LITERATURE REVIEW

Sreerama and Das et al. [1] explains an ad hoc network is often defined as an “infrastructure less” network, meaning a network without the usual routing infrastructure like fixed routers and routing backbones. Typically, the ad hoc nodes are mobile and the underlying communication medium is wireless. Each ad hoc node may be capable of acting as a router. It’s characterized by multihop wireless connection and frequently changing networks. We compare the performance of on-demand routing protocols for mobile ad-hoc networks are distributed cache updating for the dynamic source routing protocol(DSR) and ad hoc on-demand distance vector routing (AODV).the simulation model of the medium access control(MAC) layer is evaluating the performance of MANET protocols.DSR and AODV protocols share similar behaviors.

Sreerama et al. (2011) et al. [2] explains that Ad hoc Network (MANET) was formed without any existing network; it’s allocated dynamically based on the network model nodes are generated dynamically. In Random Waypoint Model, transmitting the data from source to destination in multiple ways to require an available path between source node to destination node. A node that includes pause times between changes in destination and speed. A node begins with a point in one location for a certain period of time. The route can be selected as randomly. If the route is not available on selected path, node is choosing the available path. Every node has the available path, when the node is start. each and every node randomly choose the path and reach the destination certain period of time. in this analysis is to perform the better transmission over the dynamic network topology. and also evaluate the better response over the Non Random based method(Not reserved nodes in dynamic network).the existing problem of network is route maintenance and traffic problems.

Bhavyesh Divecha et al.[3] observed the Impact of Node Mobility on MANET Routing Protocols Models. The performance of a routing protocol varies widely across different mobility models and hence the study results from one model cannot be applied to other model. Hence it has considered the mobility of an application while selecting a routing protocol. DSR gives better performance for highly mobile networks than DSDV. DSR is faster in discovering new route to the destination when the old route is broken as it invokes route repair mechanism locally whereas in DSDV there is no route repair mechanism. In DSDV, if no route is found to the destination, the packets are dropped.

Brent Ishibashi et al. [4] studied a number of characteristics concerning the links and routes that make up an ad hoc network. Several network parameters are examined, including number of nodes, network dimensions, and radio transmission range, as well as mobility parameters for maximum speed and wait times. In addition to suggesting guidelines for the evaluation of ad hoc networks, the results reveal several properties that should be considered in the design and optimization of MANET protocols. Overall, the results are cause for concern. Not only do many links break after a relatively short time period, but their short-lifespan is also propagated and exacerbated in the life spans of the routes. The shortness of the route life spans is a problem. With route building already an expensive proposition in MANETs, these rapid routing changes are a severe challenge to the network. For today's protocols, the challenge is insurmountable. Current MANETs simply cannot effectively handle that level of change .

Mona Ghassemian et al. [5] evaluated different proposed routing schemes for mobile ad hoc networks with respect to different mobility metrics. Mobility metrics applied for ad hoc protocol performance evaluations have been studied in this paper. Within an ad hoc network with unreliable links and connections, applying a precise mobility metric that captures the impact of mobility can lead to reliable results. In this paper a new mobility metric called link stability metric that can capture the random mobility of mobile nodes in an ad hoc network has been analyzed in an environment with a random waypoint mobility model .

Byung-jae Kwar et al. [6] described that the performance of a mobile ad hoc network is related to the efficiency of the routing protocol in adapting to changes in the network topology and the link status. However, the use of many different mobility models without a unified quantitative "measure" of the mobility has made it very difficult to compare the results of independent performance of routing protocols. In this paper, a mobility measure for MANET's is proposed that is flexible and consistent. It is flexible because one can customize the definition of mobility using a remoteness function. It is consistent because it has a linear relationship with the rate at which links are established or broken for a wide range of network scenario.

R. Manoharan et al. [7] analyzed the impact of mobility pattern on multicast routing performance of mobile ad hoc networks. They observe that in addition to the strengths and weaknesses of the individual multicast routing protocols, the mobility patterns does also have influence on the performance of the routing protocols. The connectivity of the mobile nodes, route setup and repair time are the major factors that affect protocol performance. This conclusion is consistent with the observation of the previous such studies on unicast routing protocols. There is no clear winner among the protocols in our case, since different mobility patterns seem to give different performance rankings of the protocols.

Sabina Baraković et al. [8] concluded that in low mobility and low load scenarios, all three protocols react in a similar way, while with mobility or load increasing DSR outperforms AODV and DSDV routing protocols. Poor performances of DSR routing protocol, when mobility or load are increased, are the consequence of aggressive use of caching and lack of any mechanism to expire stale routes or determine the freshness of routes when multiple choices are available.

IV. CONCLUSION AND FUTURE WORK

Vehicular Ad hoc Networks are recent advancements in wireless network environment for the development of Intelligent Transportation System. Mostly these networks find their applications built upon the data push communication model, in which information is disseminated to a particular set of vehicles. The applicability of VANET make it diverse and their potential communication systems need protocols that are systematic in nature. In this paper, VANETs would be considered as the future networking platform that will support the future vehicular networks and applications. In this paper, an extensive survey for various issues and architecture concept and possible mobility models is performed.. This approcach permit us to identify the various requirements which are unique to each application type and focus on the most important issues of mobility models, the routing are facing.

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