A Survey Analysis on Manet Routing Protocols and Mobility Models for Various Networks

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Abstract—*Ad-hoc network is a collection of wireless mobile nodes which dynamically form a temporary network without the use of any existing network infrastructure. It may connect hundreds to thousands of mobile nodes. The primary goal of such an ad-hoc network is correct and efficient route establishment between a pair of nodes so that message can be delivered easily and in a timely manner. The main objective of this paper is to address different MANET routing protocols and different types of mobility models used in MANETs. This paper also put emphasis on the work done by various researches using routing protocols and mobility models. This paper would be great help for the people who are conducting research for the problems in MANETs.*

Keywords— MANET, AODV, DSR, DYMO, Random Waypoint mobility, group mobility model, Manhattan mobility model, city section mobility model.

I. INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless links as shown in figure 1. These spontaneous networks, normally called ad hoc networks, which provide mobile users with ubiquitous communication capacity and information access regardless of the location. The communication network is formed from the collection of a number of wireless terminals without the use of any fixed infrastructure. So, each and every node can be treated as a source and destination also [6]. It consists of mobile nodes which are directly connected to each other, to deliver timely messages.

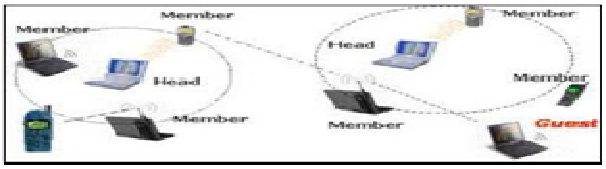

Fig.1:Typical structure of MANETs [7]

CHARACTERISTICS OF MANETS

- In MANET, each node acts as both host and router. It is autonomous in behavior.
- Multi-hop radio relaying- When a source node and destination node for a message is out of the radio range, the MANETs are capable of multi-hop routing.
- Mobile nodes are characterized with less memory, power and light weight features.
- The reliability, efficiency, stability and capacity of wireless links are often inferior when compared with wired links. This shows the fluctuating link bandwidth of wireless links.

APPLICATIONS OF MANETS

Commercial and Local level

Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire, flood, or earthquake and can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers

Personal Area Network (PAN)

Short-rangeMANET can simplify the intercommunication between various mobile devices such as a PDA, a laptop, and a cellular phone.

This paper is structured as follows: Section I discusses the introduction of MANETs. Section II concentrates on the MANET routing protocols and their properties Section III concentrates on mobility models. Finally, Section IV pays emphasis on related work. Section V concludes the paper with conclusion work and finally section VI is a future work required in survey paper.

II. ROUTING PROTOCOLS IN MANETS

AODV

AODV is a combination of on-demand and distance vector i.e. hop-to-hop routing methodology [15]. When a node needs to know a route to a specific destination it creates a ROUTE REQUEST. Next the route request is forwarded by intermediate nodes which also create a reverse route for itself for destination. When the request reaches a node with route to destination it creates again a REPLY which contains the number of hops that are require to reach the destination. All nodes that participate in forwarding this reply to the source node create a forward route to destination. This route created from each node from source to destination is a hop-by-hop state and not the entire route as in source routing

DSR

DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad-hoc networks of mobile nodes [15]. It allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad-hoc network. Each data packet sent then carries in its header the complete ordered list of nodes through which the packet must pass, allowing packet routing to be a trivially loop free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. With the inclusion of this source route in the header of each data packet, other nodes forwarding or overhearing any of the packets may easily cache this routing information for future use.

DYMO

DYMO is a reactive routing protocol in which basic operations are route discovery and route maintenance. During route discovery Route REQUEST (RREQ) message is broadcasted to the network. Every intermediate node participates in hop-by-hop dissemination of this message and records a route to the originator. When a destination node receives this RREQ message, it responds with a Route REPLY (RREP) message uni -cast towards the originating node. Every node receiving this message creates a route to the destination node and finally

This RREP message arrives at the originator of the RREQ message. When a change occurs in the network, topology nodes maintain their routes and monitor their links. When a data packet is received for a route or link that is no longer available the sources of packet generates a Route ERROR (RERR) message and send this RERR message to packet source [4].

Properties of ad-hoc routing protocols [1]

Distributed operation

As ad-hoc networks are self-dependent and autonomous systems, they demand for a routing protocol which will be able to maintain the desired criterion

Quality of Service Support

This is a very crucial property of ad- hoc networks. Some kind of Quality of service is important to include into the routing protocol. This property additionally helps to find what these networks will be used for.

III. MOBILITY MODELS IN MANETs

Mobility is one of the key characteristic of the class of wireless networks called mobile ad-hoc networks. Mobility models represent the movement of mobile users, and how their location, velocity and acceleration change over time. Such models are frequently used for simulation purposes when new communication or navigation techniques are investigated [9].

Some of the wide used quality models are described

Random Waypoint mobility model

Random waypoint model was 1st proposed by Johnson and Maltz is a random mode designed for the movement of mobile users, and the way their location, speed and acceleration change over time [10]. The Random Waypoint mobility Model includes pause times between changes in direction and/or speed. A mobile node begins by staying in one location for a certain period of time (i.e., a pause time). Once this time expires, the mobile node chooses a random destination in the simulation area and a speed that's uniformly distributed between [min-speed, max-speed].

Figure-2 shows the movement of nodes in a random waypoint mobility model. in this every node moves along a zigzag line from one waypoint Pi to the next Pi+1. The waypoints are uniformly distributed over the given convex area, e.g. unit disk. At the start of every leg a

Random velocity is drawn from the velocity distribution, (in the essential case the velocity is constant 1). The nodes may have so-called "thinking times" when they reach every waypoint before continuing on following leg.

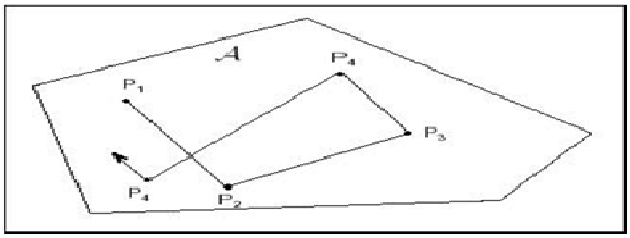

Fig.2: Node movements in a Random Waypoint mobility model [11].

Group mobility model

Group mobility refers to the scenarios that multiple mobile stations (MSs) move in a group at the same time, generally in the same direction with a short distance of separation. When the group of MSs moves out of the coverage of the current serving BS and into that of another BS, multiple handovers processes should be performed at almost the same time [12].

In ad-hoc networks, there are many situations where it is necessary to model the behavior the mobile nodes as they move together. For e.g. a group of soldiers in military scenarios may be assigned the task of searching a particular plot of land in order to destroy landmines or to capture the enemy attackers. For this purpose group mobility models are used. Figure-3 shows the movement of nodes in a group mobility model. In this figure the mobile nodes move in a group following random movement. The nodes move from subgroup BS1 (base station) to subgroup BS 2.

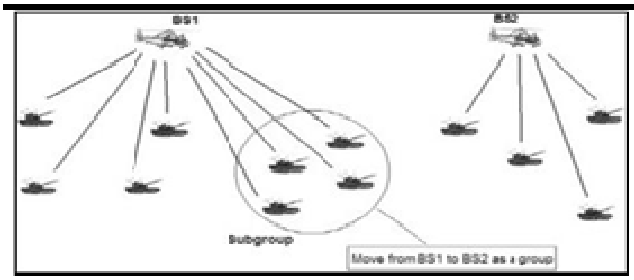

Fig.3: Movement pattern of nodes in a group mobility model [13]

Manhattan mobility model

The Manhattan mobility model usually used to emulate the movement pattern of mobile nodes on streets. This model uses its own map. The map is composed of a number of horizontal and vertical streets. Each street has two lanes for each direction (north and south direction for vertical streets, east and west for horizontal streets) . The mobile node is allowed to move along the grid of horizontal and vertical streets on the map. At an intersection of a horizontal and a vertical street, the mobile node can turn left, right or go straight.

The velocity of a mobile node at a time slot is dependent on its velocity at the previous time slot. In addition, a node's velocity is restricted by the velocity of the node preceding it on the same lane of the street. The Figure-4 shows the map used for Manhattan mobility model [14].

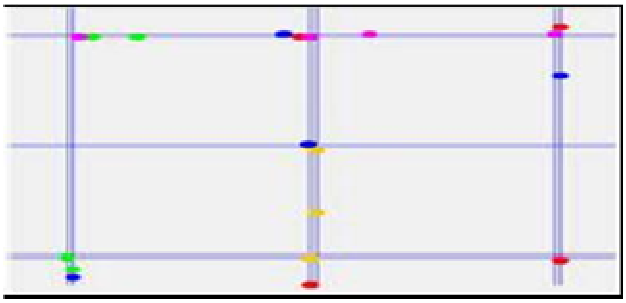

Fig.4: Diagram shows the node movement pattern in Manhattan mobility model [14]

Proba Walk Mobility Model

This model uses a probability matrix to determine the position of a particular Mobile node in the nest time step, which is represented by three different states for position x and three different states for position y. State 0 represents the current (x or y) position, and state 2 represents the mobile node next position if the mobile continues to move in the same direction. The values within this matrix are used for updates for to both the mobile node's x and y positions.

Each node moves randomly with a preset average speed. With the defined value, a mobile node may take a step in any way of the four possible directions (ie. north, south east, or west) as long as it continues to move (i.e., no pause time). Figure-5 shows movement pattern of nodes in Proba Walk mobility model [14].

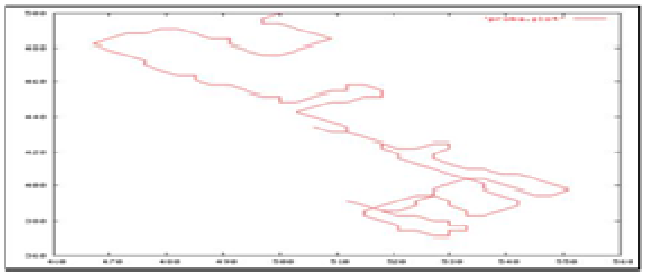

Fig.5:Diagram shows movement pattern of nodes in Proba Walk mobility model [14]

City Section Mobility Model

In the City Mobility Model, the simulation area is a network that represents the section of a city where the ad hoc network exists. Each mobile node begins the simulation at a defined point of some street. The movement algorithm from the current destination to the new destination locates a path corresponding to the shortest travel time between the two points; in addition, there are safe driving characteristics such as a speed limit and a minimum distance allowed between any two mobile nodes. While reaching the destination, the Mobile Node pauses for a specific time and then randomly chooses another destination (i.e., a point of some street) and repeats the process. This model does not allow for traffic lights or congestion. Nodes are allowed to drive each other. Figure-6 the movement pattern of nodes in a city section mobility model [14].

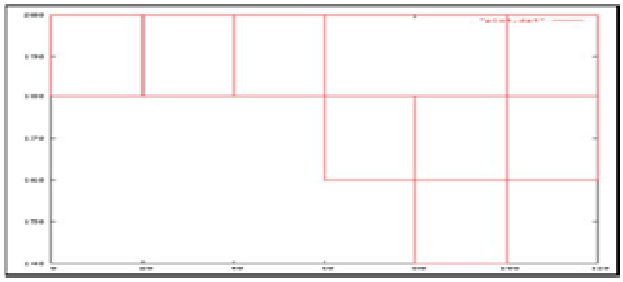

Fig.6: Diagram shows movement patterns of nodes in City Section mobility model mobility model [14]

IV. RELATED WORK

Fan Bai, et.al, [5] evaluated the impact of different mobility models on the performance of MANET routing protocols. They proposed various protocol independent metrics to capture interesting mobility characteristics, including spatial and temporal dependence and geographic restrictions. In addition, also a rich set of parameterized mobility models were introduced including Random Waypoint, Group Mobility, Freeway and Manhattan models. They demonstrated the utility of their test suite by evaluating various MANET routing

protocols, including DSR, AODV and DSDV. The results showed that the protocol performance may vary drastically across mobility models and performance rankings of protocols may vary with the mobility models used. They also proposed a framework to analyze the impact of mobility pattern on routing performance of mobile ad -hoc network in a systematic manner.

Dr.Sridhar Aithal et.al, [15]compared the effect of mobility in case of on-demand reactive routing protocols for mobile ad-hoc network AODV with traditional proactive routing protocol DSDV. The performance was analyzed using varying number of connections in the network, mobility pause and speed of the node. The simulations were carried out using NS2 simulator. The results were analyzed for packet delivery ratio, normalized routing and average end-to-end delay by varying the number of connections, speed and pause time.

Shaily Mittal et.al, [19] compared the performance evaluation of three different routing protocols (AODV, DSR and ZRP) in variable pause times of some routing protocols for Mobile Ad-Hoc networks (MANET's). Mobility of the different nodes makes the situation even more complicated. The well known commercial simulator Qual-Net was used to perform simulations. Performance evaluation of AODV, DSR and ZRP was evaluated based on Average end to end delay, TTL based hop count and Packet delivery ratio. Three performance metrics were average end to end delay; average TTL based hop count and packet delivery ratio. AODV shows best results in measuring end to end delay and packet delivery ratio.

S.R Biradar et.al,[16]compared the performance of two on-demand routing protocols for mobile ad-hoc networks Dynamic source routing (DSR) and Ad-hoc On Demand Vector routing (DYMO). They demonstrated that even though DSR and AODV both were on-demand protocol, the differences in the protocol mechanics can lead to significant performance

Ashish Shrestha et.al, [2] focused on the performance investigation of reactive and proactive MANET routing protocols, namely AODV, DSR, TORA and OLSR. Hence, the main investigation done in this paper was of the discrete feature and routing in MANET. The simulations were performed using OPNET modeler 14.5. The protocols were tested using the same parameters with high CBR traffic flow and random mobility. Performance of protocols with respect to scalability was also analyzed. Results showed that, AODV and OLSR experienced higher packet delay and network load compared to TORA. However, AODV showed better efficiency to deal with high congestion and it scaled better by successfully delivering packets over heavily trafficked network compared to OLSR and TORA.

Sanjay Singh Kushwah et.al, [18] presented investigation regarding the performance comparison of routing protocols for varying node mobility in mobile ad-hoc network (MANETs). The simulated results were observed using NS2.The outcome of the investigation was that reactive protocols perform better than proactive protocols. Further DSR has performed well for the performance parameter namely delivery ration while AODV perform well in terms of average delay. They concluded that both reactive protocols perform well in terms of packet delivery ratio under high mobility scenarios than proactive protocols. They also concluded that DSR performed well compared to all other protocols.

S. Mohapatra et.al, [17] performance analysis was carried out on Ad-hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Optimized Link State Routing (OLSR) and Destination Sequenced Distance Vector (DSDV) protocols using NS2 simulator. The delay, throughput, control overhead and packet delivery ratio were the four common measures used for the comparison of the performance of above protocols. The different parameters were number of nodes, different speed of nodes and different size of network. The results concluded that DSR protocol performs the best in terms of average PDR. For high mobility condition of nodes DSR gives better packet delivery ratio than other protocols making it suitable for highly mobile random networks.

S. Sagar, et.al, [20] evaluated and compared the performance of two routing protocols, one was reactive, Dynamic MANET on Demand (DYMO) and other is proactive, Optimized Link State Routing (OLSR) in Mobile Ad-hoc Networks (MANETs) and Vehicular Ad-hoc Networks (VANETs). Performance of these protocols was analyzed using three performance metrics; Packet Delivery Ratio, Normalized Routing Overhead and End-to-End Delay against varying scalabilities of nodes. The SUMO simulator was used to generate a random mobility pattern for VANETs. It was observed that DYMO performs better than OLSR for both VANETs and MANETs at the cost of delay. The simulation also resulted that the performance of reactive protocol (DYMODEF and DYMO-MOD) was better than proactive protocol (OLSR-DEF and OLSR-MOD) in both MANETs and in VANETs.

Banoj kumar Panda et.al, [3] described a detailed analysis of performance affected due to change in mobility in different terrain area. The parameter describing the reason of variation in performance was the number of packets delivered. The simulator used in this work for the calculation of performance metric was GLOMOSIM. The comparison was made considering two types of routing protocols AODV and DSR. From the analysis it was

observed that in the Low terrain area and high density network the number of link break in AODV & DSR are comparatively less because nodes are confined within a small terrain area and they are within the transmission range of each other. Hence the Packet delivery fraction was less than 100% because of hidden and exposed terminal problem of MANET, in all mobility condition.

Veena Anand et.al, [21] reported results of NS2 simulation of three important routing protocols: AODV, DSR and DSDV. They analyzed performance using average throughput and average end -to-end delay when number of nodes, and also their mobility, was varied. For node movement, a popular model, random waypoint was considered while Constant Bit Rate (CBR) traffic pattern was assumed. Also framework was proposed to analyze the impact of mobility pattern on routing performance of different protocols in MANET through various simulation experiments. They observed that the mobility pattern does influence the performance of MANET routing protocols. The Average Throughput of AODV was found to approach to 91%, the Average throughput of DSDV descends obviously when the routing change was frequent and the routing discovery of DSDV became more difficulty.

RESEARCH GAPS

- There was no paper that made comparison among the mobility models.
- Energy factor was not taken into account.
- It was not clear whether reactive routing protocols performed well at high mobility or low mobility.

V. CONCLUDING REMARKS

Mobile ad hoc networks are gaining lot of popularity due to their wide spread use in various fields. There are three categories of routing protocols on the basis of the services provided by them. These are generally Reactive, Proactive and Hybrid routing protocols. In this paper, we have discussed some reactive routing protocols of MANETs and some mobility models. We have also discussed the contributions and works of various researches in the area of MANETs. The main objective of this paper is to address the different MANET routing protocols and different mobility models used in MANETs. By studying various mobility models, we attempt to conduct a survey of the mobility modeling and analysis techniques in a thorough and systematic manner. We believe that the set of mobility models included herein reasonably reflect the state-of-art researches and technologies in this field. This paper will give the brief idea regarding MANET to the people who are conducting research in MANETs.

VI. FUTURE WORK REQUIRED IN SURVEY PAPER

In the future, we can propose a methodology and a framework to systematically analyze the impact of mobility models on the Performance of routing protocols in Ad-hoc networks. We can also make a comparison among various mobility models using energy, battery as parameters.

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