Comparative Study of Mobility Models Using MANET Routing Protocols under TCP and CBR Traffic

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Abstract: - **A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point or administration. MANET, a mobile ad-hoc network has some characteristics but different challenges and problems those need to be considered. To evaluate ad-hoc network routing protocols routing in MANET is one of the issues. We require a routing protocol to establish a wireless or an ad-hoc network because they are capable to handle all the changes in environment of ad-hoc network. No protocol is having the capabilities to handle the complexities of environment changes during time, nodes moving and frequent topology changes. The working of routing protocols and the various mobility models in a simulated environment against the different network parameters are proposed. Simulation is the research tool of choice for a majority of the mobile ad hoc network community. MANET's are infrastructure less and can be set up anytime, anywhere An attempt has been made to compare the performance of one On-demand reactive routing protocol AODV which works on an algorithm to constantly update network topology information available to all nodes for MANETs on different scenarios under TCP and CBR traffic patterns using NS-2. In this paper comparison is made on the basis of performance metrics such as throughput, routing overhead and end-to-end delay, and the simulator used is NS-2 in Ubuntu operating system (Linux).The simulations are carried out by varying speed of nodes and the results are analyzed.**

Keywords :- *MANET, NS2, AODV, CBR.*

I. INTRODUCTION

An Ad-Hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of existing network infra-structure or centralized administration [1][4]. MANET is a kind of wireless network and self configuring network of moving routers associated with wireless network. The routers are free to move randomly and organize themselves arbitrarily, thus, the network's wireless topology may change rapidly and unpredictably. Mobile Ad-Hoc network is an infra-structure less network due to mobile routers. Each node or router must forward the packets unrelated to its own use.[2] Main challenges to maintain the Mobile Ad-Hoc network are: No central controlling authority, limited power ability, continuously maintain the information required to properly route traffic.

This infra-structure less network is managed using the routing protocols. Routing is the process of selecting best paths in a network along which to send data. Routing forwards the logically addressed packets from their source toward their destination through intermediary nodes. So routing protocol is the routing of packets based on the defined rules and regulations. Every routing protocol has its own algorithm on the basis of which it discovers and maintains the route. In every routing protocol, there is a data structure which stores the information of route and modifies the table as route maintenance is requires. A routing metric is a value used by a routing algorithm to determine whether one route should perform better than another. Metrics can cover such information as bandwidth, delay, hop count, path cost, load, reliability and communication cost. The routing table stores only the best possible routes while link-state or topological databases may store all other information as well [1][6][13].

The main objective of ad-hoc routing protocols is to deliver data packets among mobile nodes efficiently without predetermined topology or centralized control. The various mobile ad-hoc routing protocols have been proposed and have their unique characteristics. Hence, in order to find out the most efficient routing protocol for the highly

dynamic topology in ad-hoc networks, the behavior of routing protocols has to be analyzed with varying node speed under different traffic patterns [16].

II. MOBILE ADHOC ROUTING PROTOCOLS

There are two main approaches for routing process in ad-hoc networks. The first approach is a proactive approach which is table driven and attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. Proactive protocols present low latency, but high routing overhead, as the nodes periodically exchange control messages and routing-table information in order to keep up-to-date route to any active node in the network. The second approach is re-active, source-initiated or on-demand. Reactive protocols create routes only when desired by the source node. When a node requires a route to a destination, it initiates a route discovery process within the network. Reactive protocols do not maintain up-to-date routes to any destination in the network and do not generally exchange any periodic control messages. Thus, they present low routing overhead, but high latency as compared to proactive protocols. The DSDV is a proactive protocol and AODV, DSR, and TORA are reactive protocols. The mobile ad-hoc routing protocols considered in this study are described below [2].

A. Classification of Routing Protocols

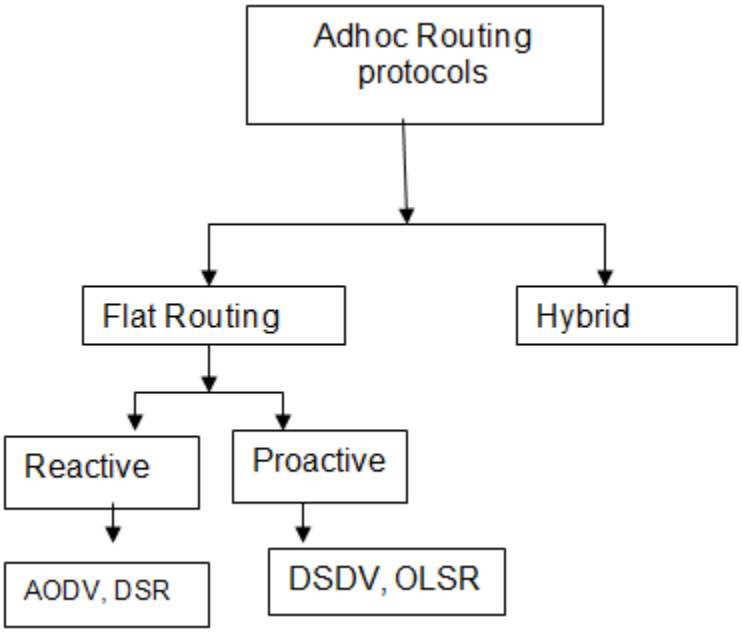

Figure 1: Classification of Ad Hoc Routing Protocol

Classification of routing protocols in mobile ad hoc network can be done in many ways, but most of these are done depending on routing strategy and network structure [13]. The routing protocols can be categorized as in figure 1.

Proactive Routing Protocols

These types of protocols are also called as "Table driven routing protocols" [13]. This Maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. The main disadvantages of such algorithms are:

1. Respective amount of data for maintenance.
2. Slow reaction on restructuring and failures.

An example of this protocol is Destination Sequenced Distance Vector (DSDV)

Reactive Routing Protocols

These types of protocols are also called as "On- demand routing protocols" [13]. This finds a route on demand by flooding the network with Route Request packets. The main disadvantages of such algorithms are:

1. High latency time in route finding.

2. Excessive flooding can lead to network clogging.

Examples of On-demand routing protocol are Dynamic Source Routing (DSR), Ad-hoc On-demand Distance Vector Routing (AODV)[1].

III. DESCRIPTION OF AODV PROTOCOL:

Ad-hoc On-demand Distance Vector [1][16] is a reactive routing protocol, which mixes the properties of DSR and DSDV. Routes are discovered as on-demand basis and are maintained as long as they are required. Each node of AODV maintains a routing table but unlike the DSDV protocol it does not necessarily maintain route for any possible destination in network. However, its routing table maintains routing information for any route that has been recently used within a time interval; so a node is able to send data packets to any destination that exists in its routing table without flooding the network with new Route Request (ROUTE_REQ) messages.

Like DSDV it maintains a sequence number, which it increases each time it finds a change in the topology of its neighborhood. This sequence number ensures that the most recent route is selected for execution of the route discovery. All routing packets carry these sequence numbers. AODV stores routing information as one entry per destination in contrast to DSR, which cashes multiple entries per destination. Without source routing, AODV relies on routing table entries to propagate an ROUTE_REPLY back to the source and, subsequently, to route data packets to the destination. AODV supports for both unicast and multicast routing, and also supports both bidirectional and unidirectional links.

IV. PROBLEM STATEMENT

The objective of our work is to compare the performance of four mobility models with one routing protocol based on On-demand behavior, namely, Adhoc On- Demand Distance vector (AODV) [1][15], for wireless ad hoc networks based on the performance, and comparison has been made on the basis of their properties like packet delivery ratio (PDR), End to End Delay and routing overhead with respect to various node speed and number of nodes fixed.

The general objectives can be outlined as follows:

1. Study of Ad-Hoc Networks.
2. Get a general understanding of MANET.
3. Study on different types of MANET routing.
4. Detailed study of AODV
5. Generate a simulation environment that could be used for simulation of protocols.
6. Simulate the protocol on the basis of different scenario by varying the speed of nodes.
7. Discuss the result of the proposed work and concluding by providing the best mobility model.

V. METHODOLOGY

5.1 Selection Techniques for Network Performance Evaluation:

There are three techniques for performance evaluation, which are analytical modeling, simulation and measurement . Simulation is performed in order to get the real-event results with no assumption as in case of analytical modeling.

5.2 Random Waypoint Mobility Model:

A node, after waiting a specified pause time moves with a speed between 0 m/s and vmax m/s to the destination and waits again before choosing a new way point and speed [15].

VI. SIMULATION ASSUMPTIONS

The following assumptions are considered when building the TCL [10][16] script:

1. For simplicity, all flows in the system are assumed to have the two type of traffic source. One is TCP and other is constant bit rate (CBR) traffic.
2. The source node is fixed to 50 nodes with maximum connection is 60 nodes (to show a density condition) and speed of nodes are varied for the calculation it is mentioned in the area.

VII. PERFORMANCE METRICS [10]

A. Routing Overhead: Routing overhead can be defined as total number of routing packets produced by routing protocol during the simulation.

B. Average end-to-end delay of data packets: It is defined as the average end-to-end delay of data packets within a network. The sum of all time differences between the packet sent and received divided by the number of packets, gives the average end-to-end delay. The lower the end-to-end delay the better the application performance.

C. Packet Delivery Ratio
Packet delivery ratio is calculated by dividing the number of packets received at the destination by the number of packets originated at the source. For the best performance packet delivery ratio of routing protocol should be as high as possible [10]. If the ratio is 1, it will be the best delivery ratio of the routing protocol.
PDR= No. of received packets/No. of sent packets.

VIII. SIMULATION RESULTS AND PERFORMANCE COMPARISON

Performance of AODV routing protocol is evaluated under both TCP and CBR traffic pattern. Extensive simulation is done by using NS-2 simulator [10, 15].
one On-demand (Reactive) routing protocols namely Ad hoc On-Demand Distance Vector Routing (AODV) is used. The mobility models used are Random Walk (RW), Random Waypoint (RWP), Random Direction(RD) and Probabilistic random walk(PRW) mobility models.
The parameters for analysis are set as shown in Table on Linux Ubuntu Operating System. Ns2 was installed on Ubuntu platform.

Table 1: Simulation Setup

Platform	Ubuntu
NS version	ns-allinone-2.35
Pause time	10
Simulation time	900s
Number of nodes	50
Traffic pattern	TCP,CBR
Protocols	AODV
Simulation Area Size	200 * 200
Node speed	1m/s to 5m/s
Mobility model	RW,RWP,RD,PRW
Speed	1.5m/s,2m/s,2.5m/s,3m/s

8.1 Scenario 1: In this scenario, four mobility models are compared in a scenario in which speed of nodes is varied along with AODV protocol for TCP and CBR traffic in a network and number of nodes are fixed as 50 from which comparison graphs of AODV with TCP and CBR is obtained for these four mobility models.

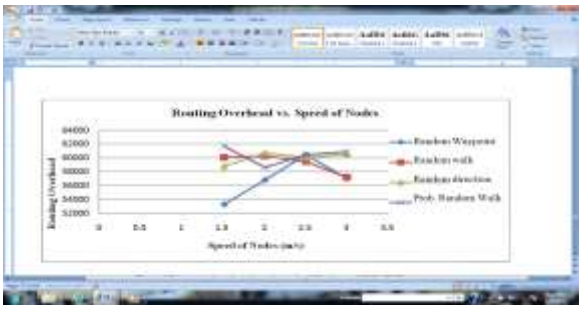

Figure 2: Comparison of Routing Overhead and Speed of Nodes (AODV, TCP)

In fig.2 Minimum overhead packets are produced for Random Waypoint whereas for Probabilistic Random Walk maximum overhead is produced as speed of node increases with AODV and TCP traffic.

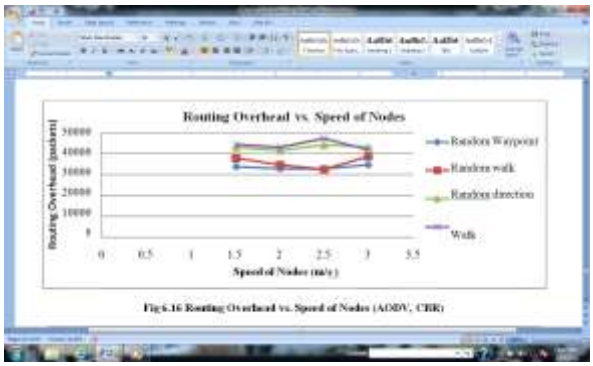

Figure 3: Routing Overhead (packets) with node speed (AODV, CBR)

Routing Overhead is very less for Random Waypoint for minimum and maximum speed of nodes whereas maximum overhead seen for Probabilistic Random Walk model for less speed but as node speed increases Random Direction is better for AODV with CBR traffic.

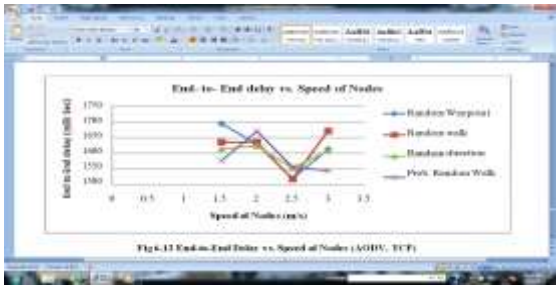

Figure4: End To End Delay(AODV,TCP)

In fig. 4 for minimum and maximum speed of nodes the Probabilistic random walk model is having superior results due to less average transmission time to transmit packets from source to destination for protocol AODV and TCP traffic.

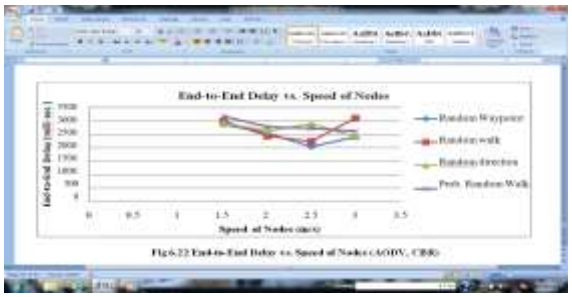

Figure 5: End To End Delay(AODV, CBR)

In fig. 5 it shows that at highest mobility, Random Waypoint model is better at low and high speeds from all other mobility models with minimum end-to-end delay. Whereas Random Walk is taking highest time for data transfer means it is providing highest delay as compared to other models at high speed.

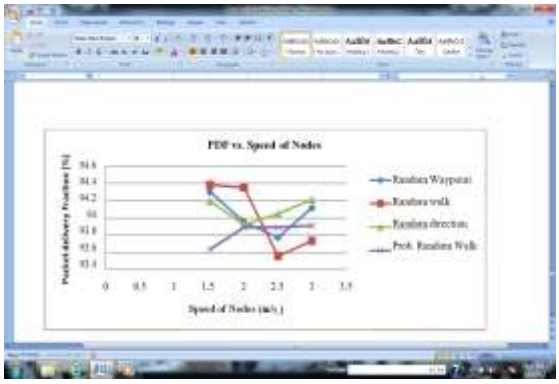

Figure 6: Packet Delivery Ratio (AODV, TCP)

In Fig. 6 we can see that at low values of node speed the Random Walk is having better result for protocol AODV and traffic TCP, whereas for high values of node speed, Random Direction model is having good results than other mobility models.

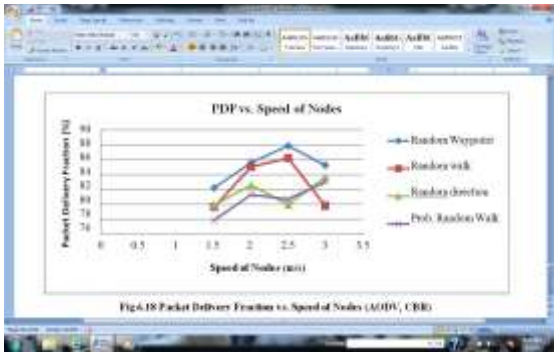

Figure 7: Packet Delivery Ratio (AODV, CBR)

In fig. 7 Random Waypoint model is having maximum successful packet delivery to destination for routing protocol AODV and traffic CBR. Packet delivery fraction is increasing in case of Random Waypoint and Random Walk models with increase in speed up to 2.5 m/s. After this, there performance is decreasing. Random Walk model is having minimum packet delivery fraction percentage at high speed.

IX. CONCLUSIONS AND FUTURE WORK

Conclusion: If all the random models are compared than overall Random Walk gives better result than other mobility models when node speed is maximum for AODV routing protocol when traffic is TCP. Whereas for CBR traffic and AODV protocol Random Waypoint model is better for all parameters.

Finally, from the above research work performance of AODV is considered best for real time and TCP network.

Future work: In this research work for only one routing protocol AODV and its scenario for different parameters are taken for the comparison of the different mobility models. As day-to-day new challenges come with new technology and advancement in the ad-hoc networks fields. So, in future more simulation can be done to investigate, the performance of various routing protocols also with multimedia, and HTTP and advance network simulator can be done. Simulation tool other than ns2 can be used and the windows platform can be used for implementing the simulation instead of Linux.

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