EFFECT OF MOBILITY MODELS ON ROUTING PROTOCOLS IN AD-HOC NETWORK

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ABSTRACT :

MANET is an infrastructure-less network formed with the help of mobile nodes carrying wireless devices capable of communicating each other. MANET has dynamic topology due to node mobility. In this paper, basically three scenarios are considered one in which no mobility model is applied, other where random mobility model is applied and third one where file mobility model is applied. The aim is to determine the performance measures like throughput, packet delivery ratio, delay and protocol overhead that are commonly used in MANET for evaluating ad-hoc routing protocols- DSDV, AODV and ZRP with realistic mobility model. The routing protocols under realistic mobility model provide higher Throughput, Packet Delivery Ratio and lower Normalized Routing Overhead & Average Delay. AODV routing protocol performs better than DSDV and ZRP Routing protocol. Also it is concluded that random mobility pattern gives better result than file mobility model.

Keywords: AD-HOC network, AODV, DSDV,ZRP, File Mobility Pattern, Random Mobility Model.

1. INTRODUCTION

Wireless networking is an emerging technology that allows various users to access information and services electronically regardless of their geographic position. Wireless networks can be classified in two types.

1.1. Infrastructure Networks:

Infrastructure network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating.

1.2. Infrastructure less (Ad hoc) Networks:

In ad hoc networks [1] all nodes are mobile and can be connected dynamically in an arbitrary manner. Mobile Ad-hoc networks are self-organizing and self-configuring multi hop wireless networks where, the structure of the network changes dynamically. This is mainly due to the mobility of the nodes [3].

2. ROUTING PROTOCOLS DISCRIBTION IN AD-HOC NETWORKS:

This ad-hoc routing protocols [2] can be divided into three categories:

Table-Driven Routing Protocols: In table driven routing protocols, consistent and up-to-date routing information to all nodes is maintained at each node. These protocols are also called as proactive protocols since they maintain the routing information even before it is needed [4].

On-Demand Routing Protocols: In On-Demand routing protocols, the routes are created as and when required. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet [5].

Hybrid Routing Protocols: It combine the best features of the above two categories. Nodes within a certain distance from the node concerned, or within a particular geographical region, are said to be within the routing zone of the given nodes. For routing within this zone, a table-driven approach is used. For nodes that are beyond this zone, an on- demand approach is used.

2.1. Destination Sequenced Distance Vector (DSDV) Protocol:

The destination sequenced distance vector routing protocol is a proactive routing protocol which is a modification of conventional Bellman-Ford routing algorithm. This protocol adds a new attribute, sequence number, to each route table entry at each node. Routing table is maintained at each node and with this table; node transmits the packets to other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast-changing network, incremental packets can grow big so full dumps will be more frequent. DSDV protocol guarantees

loop free paths and Count to infinity problem is reduced in DSDV [6].On the contrary in DSDV there is Wastage of bandwidth due to unnecessary advertising of routing information even if there is no change in the network topology [7] also DSDV doesn't support Multi path Routing. It is difficult to determine a time delay for the advertisement of routes [8].

2.2. Ad-hoc On-Demand Distance Vector (AODV) Protocol:

AODV is a very simple, efficient, and effective routing protocol for Mobile Ad-hoc Networks which do not have fixed topology. This algorithm was motivated by the limited bandwidth that is available in the media that are used for wireless communications. It borrows most of the advantageous concepts from DSR and DSDV algorithms. The on demand route discovery and route maintenance from DSR and hop-by-hop routing, usage of node sequence numbers from DSDV make the algorithm cope up with topology and routing information. Obtaining the routes purely on-demand makes AODV a very useful and desired algorithm for MANETs [9]. AODV [2] discovers routes on an as needed basis via a similar route discovery process. However, AODV adopts very different mechanism to maintain routing information. It uses traditional routing tables, one entry per destination. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. Without source routing, AODV relies on routing table entries to propagate an RREP back to the source and, subsequently, to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops.

2.3. Zone Routing Protocol (ZRP):

Hybrid routing combines characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient [11]. Mostly hybrid routing protocols are zone based; it means the number of nodes is divided into different zones to make route discovery and maintenance more reliable for MANET. The need of these protocols arises with the deficiencies of proactive and reactive routing and there is demand of such protocol that can resolve on demand route discovery with a limited number of route searches. ZRP limits the range of proactive routing methods to neighboring nodes locally; however ZRP uses reactive routing to search the desired nodes by querying the selective network nodes globally instead of sending the query to all the nodes in network. ZRP uses "Intrazone" and "Interzone" routing to provide flexible route discovery and route maintenance in the multiple ad hoc environments. Interzone routing performs route discovery through reactive routing protocol globally while intrazone routing based on proactive routing in order to maintain up-to-date route information locally within its own routing range. The overall characteristic of ZRP is that it reduces the network overhead that is caused by proactive routing and it also handles the network delay that is caused by reactive routing protocols and perform route discovery more efficiently.

3. MOBILITY MODELS IN WIRELESS AD-HOC NETWORKS:

The mobility model is basically designed to describe the movement pattern of mobile nodes, and how their location, velocity and acceleration changes over time. As mobility patterns play a significant role in determining the protocol performance, it is desirable for mobility models to emulate the movement pattern of targeted real life applications in a reasonable way. Mobility models are used for simulation purposes when new network protocols are evaluated.

3.1. RANDOM MOBILITY MODEL:

In random-based mobility simulation models, the mobile nodes move randomly and are free to move without any restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes. This kind of model has been used in many simulation studies. In this Mobility model, the nodes of the network select random locations as their destinations and start moving towards these destinations by selecting velocity from the predefined range [0,Vmax] and keep on moving. As the node reaches its destination, it waits for some time known as pause time and selects new destination. It repeats the above process as the pause time is over and keeps on repeating the whole procedure until the simulation ends as shown in Figure-1 [13]

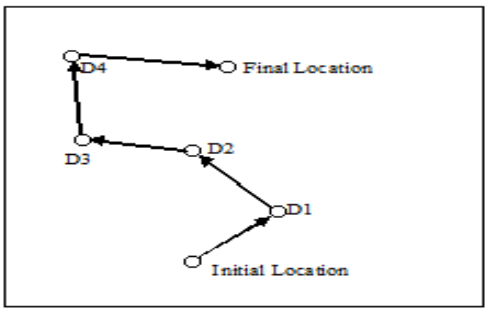

Figure [1]

3.2. FILE MOBILITY MODEL:

The nodes move according to a file specifying node movement at different simulation times. The file contains waypoints for each node specifying node's next position, time at which the node arrives at the location and orientation (optionally). The node moves from one position to the next in a straight line at a constant speed as shown in Figure-2.

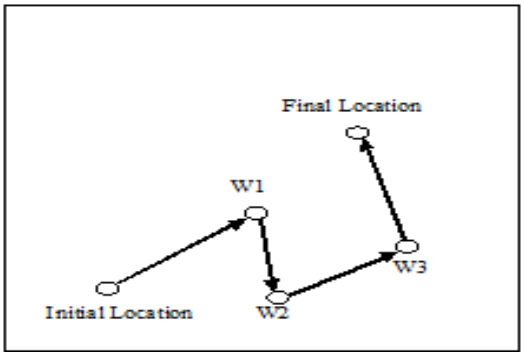

Figure [2]

4. SIMULATION TOOL:

The collaboration of imminent research objectives and its related scope in this study are also collapsed into same influence of simulation environment for generating some authenticated outcomes. For this purpose, the adopted methodology for the results of this research work (specifically comparative routing analysis) is based on simulations near to the real time packages before any actual implementation. QualNet is a comprehensive suite of tools for modeling large wired and wireless networks. QualNet enables users to Design new protocol models, Optimize new and existing models, Design large wired and wireless networks using preconfigured or user-designed models, Analyze the performance of networks and perform what-if analysis to optimize them. QualNet (6) is the preferable simulator for ease of operation.

5. PERFORMANCE METRICS:

5.1. Throughput

It is one of the dimensional metrics of the network which gives the fraction of the channel capacity used for useful transmission selects a destination at the beginning of the simulation i.e., information whether or not data packets correctly delivered to the destinations[12].

5.2. Average end to end delay:

The average end-to-end delay of data packets is the interval between the data packet generation time and the time when the last bit arrives at the destination. This metrics exclusively deals with the network speed and communication effectiveness. Higher the delay, lower is the speed and possibility of packet drop and so needs the fault tolerance approach of selecting these protocols [12].

PARAMETRS	VALUE
No. Of Source Nodes	4,6,8,10,14
Mobility Models	Random Mobility Model, File Mobility Model
Routing Protocols	AODV , BELLMANFORD and ZRP
Pause Time	30 sec
Node Density	100
Data Traffic Pattern	CBR
Simulation Time	30 Sec
Terrain	1500 * 1500
Speed	0 - 30 Sec
CBR Traffic Rate	1 packet/sec
Packet Size	512 bytes
MAC Layer	802.11
Start Time	1
End Time	101

Table [1] Simulation Parameters:

5.3. Overhead or Average routing head (ARH):

Average routing overhead is the total number of routing packets divided by total number of delivered data packets [16].

ARH = Total no of routing packets/Total no of delivered data packets.

5.4. Average Jitter:

The jitter is the variation of data communication packets in the network [14].is the variation in the time between packets arriving, caused by network congestion, timing drift, or route changes [15].

5.5. Packet Delivery Ratio:

Packet Delivery Ratio (PDR): The number of data packets sent from the source to the number of received at the destination [16].

PDR = (control packets sent-delivery packet sent) / control packets sent.

6. RESULT and DISSUSSION:

6.1. THROUGHPUT ANALYSIS:

In the figure no-3 the overall evaluation of the performance of routing protocol is plotted against the performance metrics (throughput) on three scenarios on one axis (x) where RM signifies the scenario under random mobility model , FM signifies file mobility model and simple name of routing protocols signifies the scenario under no mobility pattern.

The experiment result shows that for the case of AODV and with random mobility model the best results are noted and the AD-HOC network works best in this condition with high traffic load. It in turn means that at random mobility model and AODV protocol, maximum number of packet can be seen. It can be seen so because as it is an on demand routing protocol.

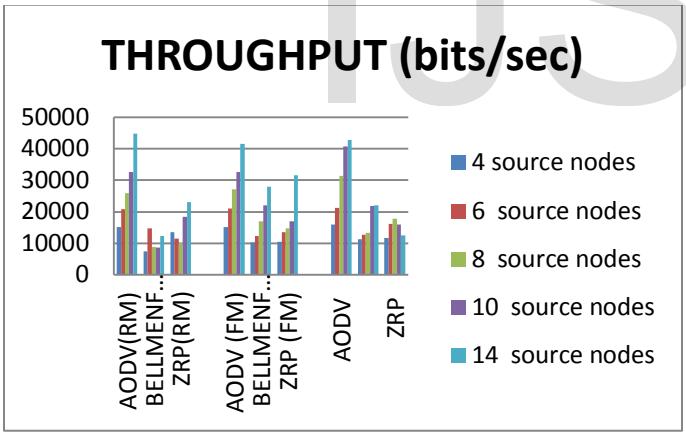

Figure [3]

6.2. AVERAGE END TO END DELAY:

When we havecombined the result of all three scenarios we able to notice that bellman ford routing protocol gives minimum amount of average end to end delay. Also we able to notice that for the case of random mobility model we able to recognize the good results as compared to the file mobility model. Here we have also note that there is the linear variation between the average end to end delay and number of source nodes.

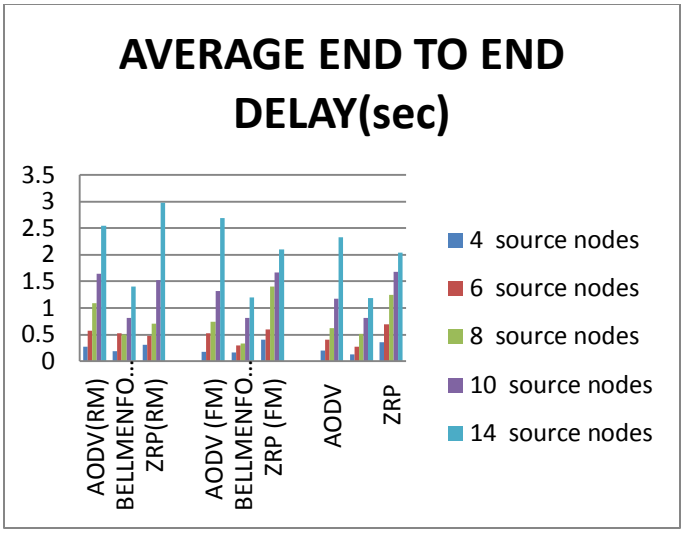

Figure [4]

6.3. AVERAGE ROUTING OVERHEAD:

When combined result is taken into consideration we notice that minimum number of overhead is observed in random mobility model scenario with two routing protocol i.e. ZRP and Bellman ford. But to acquire an order of magnitude of the reduction in the overhead generated by the MANET routing protocols after applying hierarchical routing structure is needed and same we observe the same in the analysis that ZRP has minimum value of overhead in random mobility model.

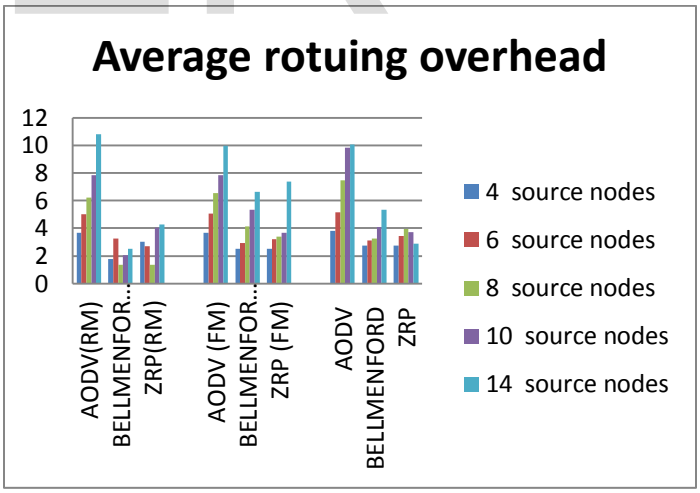

Figure [5]

6.4. AVERAGE JITTER:

When the comparative analysis is done between all the three scenarios it is noted that there is not linear variation among all three routing protocols at various number of sourced nodes and hence it is quite difficult to analysis , but it can be seen from the figure that the average result of less jitter can be observed for the case of bellman ford

routing protocol i.e. also for the case when no mobility model is applied but as mobility pattern is applied it is noticed that ZRP values have minimum values as compared to all other routing protocols. And best mobility model for the scenario is random mobility model.

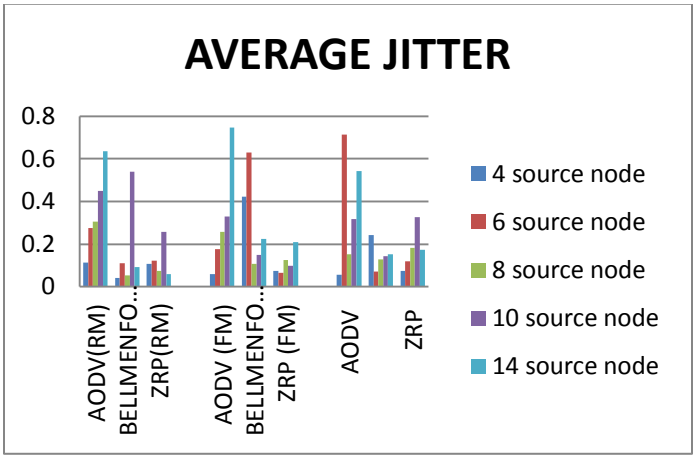

Figure [6]

6.5. PACKET DELIVRY RATIO:

When the comparative analysis is done between all the three scenarios it is noted that there is not linear variation among all three routing protocols at various number of sourced nodes and hence it is quite difficult to analysis , but it can be seen from the figure that the average result of less jitter can be observed for the case of bellman ford routing protocol i.e. also for the case when no mobility model is applied but as mobility pattern is applied it is noticed that ZRP values have minimum values as compared to all other routing protocols. And best mobility model for the scenario is random mobility model

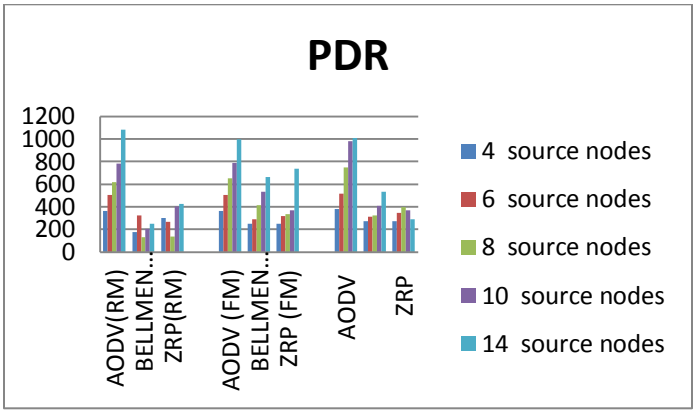

Figure-7

7. CONCLUSION:

Figure.9 shows the overall comparison of various routing protocols as Table Driven, On Demand and Hybrid routing protocols.

7.1 On Demand routing protocols shows higher value of Average Jitter followed by Table Driven and Hybrid routing protocols.

7.2. The value of average end to end delay is higher for On Demand routing protocol followed by Table Driven and Hybrid routing protocol.

7.3. The value of throughput is higher for On Demand routing protocol followed by Table Driven and Hybrid routing protocol.

7.4. On Demand routing protocols shows highest value of packet delivery ratio followed by Table Driven and Hybrid routing protocols.

7.5. RWP mobility model has highest value of each parameter followed by File mobility.

PARAMETER	TABLE DRIVEN PROTOCOL(DSDV)			ON-DEMAND PROTOCOL(AODV)			HYBRID PROTOCOL(ZRP)		
	RWP	FILE	NOMM	RWP	FILE	NOMM	RWP	FILE	NOMM
THROUGHPUT	Low	Medium	Medium	High	High	High	Medium	Low	Low
AVERERAGE END TO END DELAY	Low	Low	Low	Medium	High	High	Medium	Very Low	Low
AVERERAGE JITTER	Medium	Medium	Low	High	High	High	Low	Low	Medium
AVERERAGE OVERHEAD	Low	Low	Medium	High	High	High	Medium	Medium	Low
PDR	Medium	Low	Medium	Very High	Very High	High	Medium	Medium	Low

Table [2]

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