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Analyze the Impact of Mobility on Performance of Routing Protocols in MANET Using OPNET Modeller

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Abstract: MANET stands for Mobile Ad hoc Network. An ad hoc network is often referred to as an "infrastructure less" network, because the network does not need fixed routers [1]. These nodes are mobile communicating through wireless medium. Each ad hoc node may be capable of acting as a router. It's characterized by multi-hop wireless connection and frequently changing networks. In this paper we evaluate the performance the performance of ad hoc routing protocols i.e AODV (Ad hoc On-demand Distance Vector), OLSR (Optimized Link State Routing) and GRP (Gathering Based Routing Protocol) under Random Way Point and Vector Mobility model by undertaking three parameters such as delay, network load, and throughput.

Keywords- MANET, AODV, OLSR, GRP, OPNET, Random Way Point Mobility, Vector Mobility

I. INTRODUCTION

Mobile Ad hoc Network (MANET) is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed, and can work at any place without the help of any infrastructure. This property makes these networks highly exile and robust. In mobile ad hoc network, nodes do not rely of any existing infrastructure. instead, the nodes themselves form the network and communicate through means of wireless communications. Mobility causes frequent topology changes and may break existing paths. routing protocols for ad hoc networks can be classified into two major types: proactive and on-demand. Proactive protocols attempt to maintain up-to-date routing information to all nodes by periodically disseminating topology updates throughout the network. on demand protocols attempt to discover a route only when a route is needed. The general problem of modelling the behaviour of the nodes belonging to a mobile network has not a unique and straightforward solution. Mobility and disconnection of mobile hosts pose a number of problems in designing proper routing schemes for effective communication between any source and destination. The mobile ad hoc networks are envisioned to support dynamic and rapidly changing the multihop topologies which are likely to be composed of relatively bandwidth constrained wireless links. a generic framework to systematically analyse the impact of mobility on the performance of routing protocols for MANET has become important.

With Vector Mobility model many realistic mobility scenarios could be modelled and generated with this framework by properly choosing the checkpoints along the preferred motion path of the mobile nodes. if those checkpoints can reflect the motion behaviour in realistic scenarios then the vector model provides a general framework for describing and modelling mobility patterns. The mobility of node is expressed by a vector (V_x, V_y)(V_x, V_y) in Cartesian which represents 2D velocity components of mobile node. In random-based mobility simulation models, the mobile nodes move randomly and freely without 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 mobility management, the **Random waypoint model** is a random model for the movement of mobile users, and how their location, velocity and acceleration change over time Mobility models are used for simulation purposes when new network protocols are evaluated. The Random waypoint model was first proposed by Johnson and Maltz It is one of the most popular mobility model and the "benchmark" mobility model[3] to evaluate other Mobile ad hoc network (MANET) routing protocols, because of its simplicity and wide availability.

II. SIMULATION SETUP

We check these protocols by three parameters such as throughput, delay and traffic sent. We used two scenarios i.e. 75 nodes, and 150 nodes.

Table 1.1: Simulation parameters

Statistic	Value
Simulator	OPNET 14.5
Routing Protocols	AODV,OLSR and GRP
802.11 data rate	11 Mbps
Node	75, 150
Scenario Size	3.5*3.5 km
Application Traffic	FTP and HTTP
Simulation Time	300 second
Channel Type	Wireless channel
Network Interface Type	Phy/WirelessPhy
Performance Parameter	Throughput, Delay, Network Load

III. RELATED WORK

1) N.Aschenbruck, et.al (2008), "A Survey on mobility models for Performance analysis in Tactical Mobile networks," Journal of Telecommunication and Information Technology, Vol.2 pp.54-61, 2008, [2] various mobility models for MANETs have been discussed. These are required to model mobile nodes in various scenarios in simulation software and show their varying speeds and connectivity.
2) In Bai, Fan, et.al, (2006) "A Survey of Mobility Models in Wireless Adhoc Networks."(Chapter 1 in Wireless Ad-Hoc Networks. Kluwer Academic. 2006); [3] it is discussed that mobility model plays a very important role in determining the protocol performance in. Beside the commonly used Random Waypoint model and its variants, we also discuss various models that exhibit the characteristics of temporal dependency, spatial dependency and geographic constraint V(maximum allowable velocity) and T(pause time)are the two keyparameters that determine the mobility behaviour of nodes for every mobile node.

IV. RESULTS AND DISCUSSION

Throughput: is the time the total size of useful packets that received at all the destination nodes. It is the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.
It is observed that:

a. OLSR protocol overweighs both AODV and GRP protocol in 25 node simulation setup.
b. OLSR under vector mobility model gives better results than random Way Point Model.
c. GRP under Vector Mobility starts with a burst but gradually its performance decreases. GRP protocol has same throughput characteristics for both less and more no of nodes which is not very high.
d. OLSR and AODV have different strengths and weaknesses when it comes to node mobility in MANETs. Unlike wired networks, the topology in wireless ad hoc networks may be highly dynamic, causing frequent path breaks to on-going sessions. When a path break occurs, new routes need to be found. As OLSR always have up-to-date topology information at hand, new routes can be calculated immediately when a path break is reported. Because AODV is a *reactive* protocol, and GRP also work as reactive in initial, this immediate new route calculation is not possible, so a route discovery must be initiated. In situations where the network traffic is sporadic, OLSR offers less routing overhead due to having found the routes proactively. AODV and GRP on the other hand, will have to first discover a route before the actual information can be transmitted. Most control overhead in AODV and in GRP is related to route discovery.

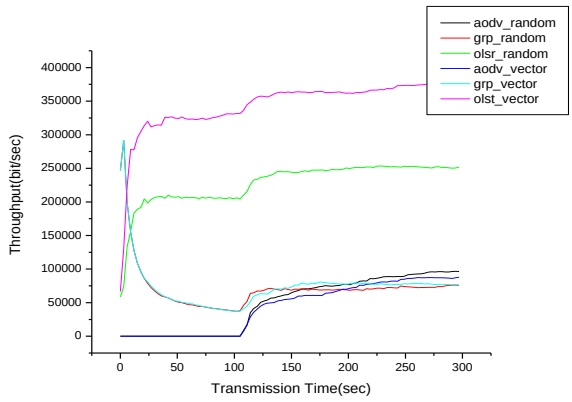

Fig. 1.1: Throughput (25 Nodes)

Table 1.2: Comparison Table

Throughput	AODV		OLSR		GRP	
	Random	**Vector**	**Random**	**Vector**	**Random**	**Vector**
25 Nodes	42,643	43,808	243,652	363,492	71,810	74,707
50 Nodes	200,130	223,102	12,523,652	21,254,326	210.231	221,326

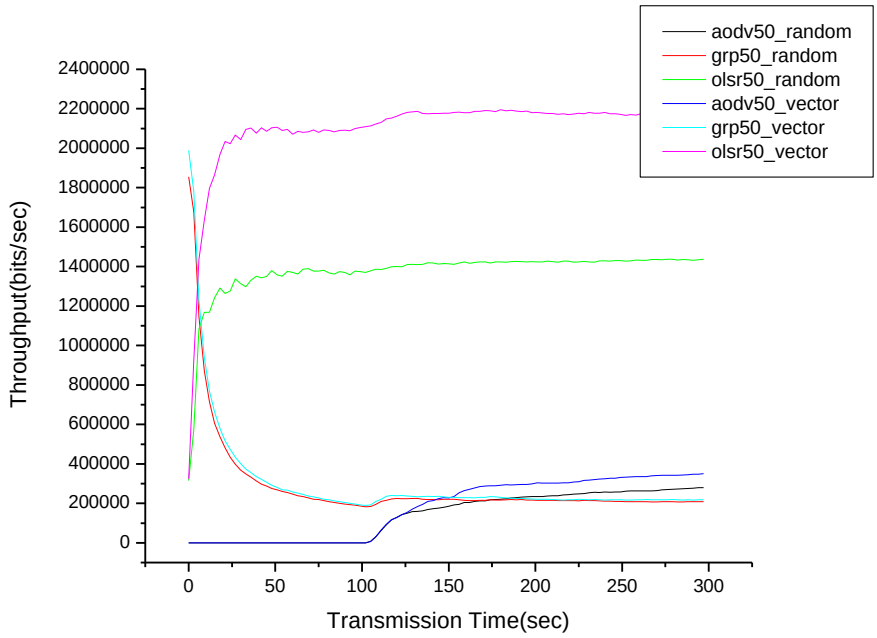

Fig. 1.2: Throughput (50 Nodes)

Delay: Delay indicates how long it a packet takes to travel from the CBR source to the application layer of the destination. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times of data packets.
It is observed that:

a. Again OLSR outperforms both AODV and GRP in terms of end to end delay experienced in the network. We observe in that OLSR consistently presents the lowest delay, regardless of network size. This may be explained by the fact that OLSR, as a proactive protocol, has a faster processing at intermediate nodes. When a packet arrives at anode, it can immediately be forwarded or dropped because OLSR protocol proactively holds routes to all destinations in its table, regardless of topology changes.
b. In reactive Protocols, if there is no route to a destination, packets to that destination will be stored in a buffer while a route discovery is conducted (forwarded hop by hop). In other words, a route discovery process has to be activated, because AODV is a routing protocol that has no available route when needed. Because of inefficient route maintenance, delay is the largest for AODV. Accordingly as the network size is increased AODV have more delay.
c. GRP, being a hybrid protocol, typically shows values of network load which lie in between the reactive and proactive protocols because of its initial on-demand nature.
d. For all the routing protocols random waypoint mobility have the high delay with compare to vector mobility because of unpredictable movement of the nodes in the network.

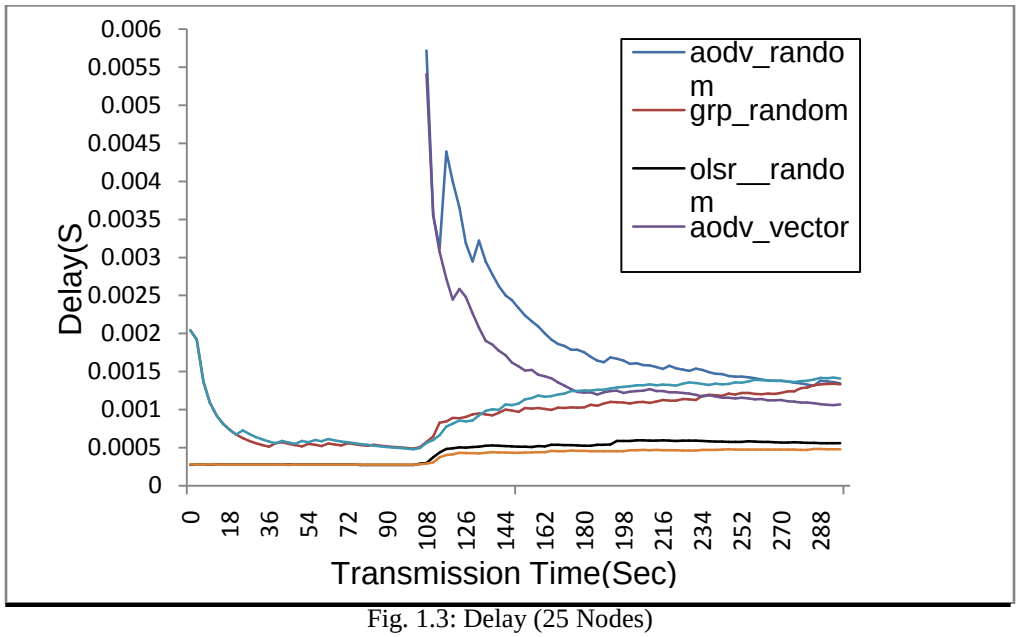

Fig. 1.3: Delay (25 Nodes)

Table 1.3: Comparison Table

Delay	AODV		OLSR		GRP	
	Random	**Vector**	**Random**	**Vector**	**Random**	**Vector**
25 Nodes	0.0039	0.0048	0.00048	0.00042	0.00015	0.00011
50 Nodes	0.0037	0.0028	0.00043	0.00041	0.0015	0.00018

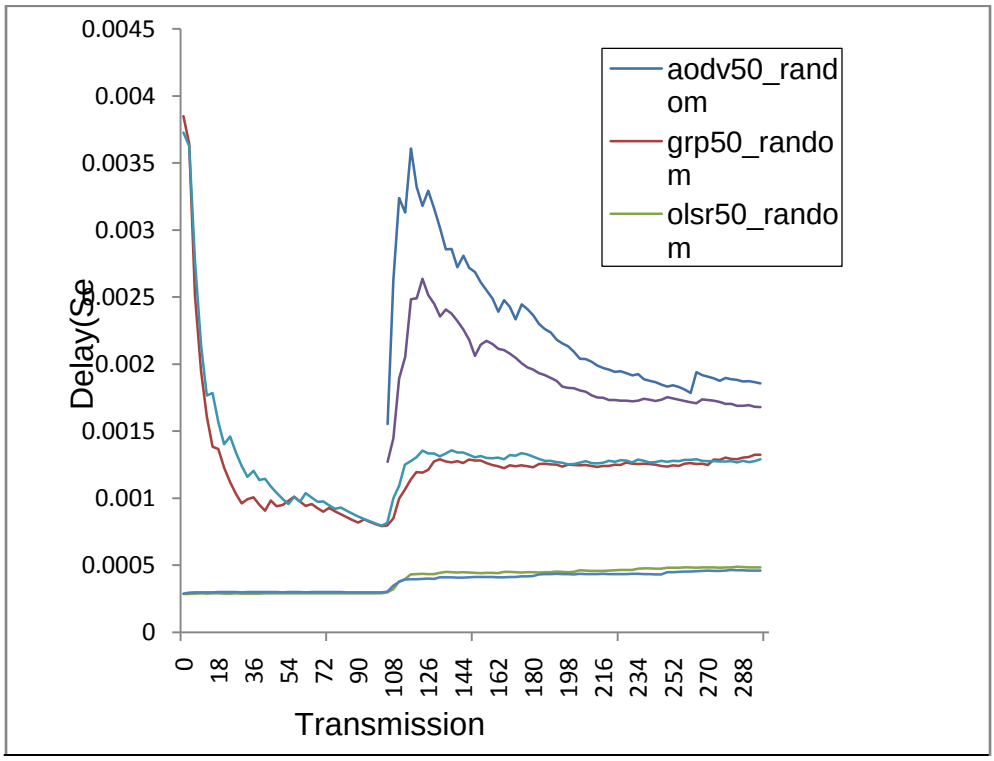

Fig. 1.4: Delay (50 Nodes)

V. Conclusion

We have evaluated the three performance measures i.e. Network Load, End-to-end delay and Throughput with different mobility models (Vector Mobility model and and Random Waypoint Mobility model) and HTTP as traffic type while taking 25 and 50 as the node density. From the extensive simulation results, it is found that OLSR shows the best performance in terms of throughput, and end-to-end delay. Moreover, Vector Mobility Model outperforms Random Way Point Model for all three routing protocols i.e. AODV, OLSR and GRP. In future, the node density can be varied to study its impact on the performance of the routing protocols and thus check their efficiency as the nodes increase. Doing so would bring out the contrast between the two mobility models and thus help in making reaching accurate conclusions.

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