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Comparison of Mobile Ad Hoc Network Protocols Under the Random Walk Mobility and Random Way Point Model With Respect to Delay in Networking

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***Abstract*- Mobile adhoc Network consists of mobile networks which create an underlying architecture forcommunication without the help of traditional fixed-position routers. MANET is group of mobile nodes which uses multi hop transmission for communication. Routing in MANET is challenging task, moreover presence of malicious nodes make the overall network very insecure furthermore dynamic nature of moving nodes adds to the complexity. Mobility of the nodes has substantial influence on the network performance. In this Paper, we study the impact of Random Walk and Random Way Point model. We focus on performance comparison of Proactive routing protocol by focusing on Optimized Link State Routing (OLSR) and Reactive Routing Protocol by focusing on Ad Hoc on Demand Distance Vector (AODV) and Temporally Ordered Routing Algorithm (TORA). In the present paper the performance of these routing protocols is analyzed by how long a packet takes time to travel from source to theapplication layer of the destination. The performance analysis of three Mobile Ad Hoc Network (MANET) routing protocols under the two mobility models i.e. Random Walk Mobility Model and Random Way Point has been made.**

***Keywords*- MANET, AODV, OLSR, TORA, OPNET 14.5, Random Walk Mobility Model, Random Way Point Mobility Model.**

I. INTRODUCTION

MANET stands for Mobile Ad hoc Network. It is a decentralized autonomous wireless system which consists of free nodes. MANET sometimes called mobile mesh network, is a self configurable wireless network. A MANET consists of mobile nodes, a router with multiple hosts and wireless communication devices. The wireless communication devices are transmitters, receivers and smart antennas. These antennas can be of any kind and nodes can be fixed or mobile. The term node referred to as, which are free to move arbitrarily in every direction. These nodes can be a mobile phone, laptop, personal digital assistance, MP3 player and personal computer. These nodes can be located in cars, ships, airplanes or with people having small electronic devices. Nodes can connect each other randomly and forming arbitrary topologies. Nodes communicate to each other and also forward packets to neighbor nodes as a router [1]. The ability of self configuration of these nodes makes them more suitable for urgently required network connection.

AD-HOC ROUTING PROTOCOLS

This section describes the main features of three protocols AODV (Ad hoc On-demand Distance Vector) ,OLSR (Optimized Link State Routing) and Temporally Ordered Routing Protocols Algorithm (TORA)deeply studied using OPNET 14.5.

A. AODV (Ad hoc On-demand Distance Vector)

AODV is an on-demand routing protocol. The AODV algorithm gives an easy way to get change in the link situation. For example if a link fails notifications are sent only to the affected nodes in the network. This

notification cancels all the routes through this affected node. It builds unicast routes from source to destination and that's why the network usage is least. Since the routes are build on demand so the network traffic is minimum. AODV does not allow keeping extra routing which is not in use. If two nodes wish to establish a connection in an ad hoc network then AODV is responsible to enable them to build a multi-hop route. AODV uses Destination Sequence Numbers (DSN) to avoid counting to infinity that is why it is loop free. This is the characteristic of this algorithm. When a node send request to a destination, it sends its DSNs together with all routing information. It also selects the most favorable route based on the sequence number [2-4].

B. OLSR (Optimized Link State Routing)

It is a proactive routing protocol and is also called as table driven protocol because it permanently stores and updates its routing table. OLSR keeps track of routing table in order to provide a route if needed. OLSR can be implemented in any ad hoc network. Due to its nature OLSR is called as proactive routing protocol. All the nodes in the network do not broadcast the route packets. Just Multipoint Relay (MPR) nodes broadcast route packets. These MPR nodes can be selected in the neighbor of source node. Each node in the network keeps a list of MPR nodes.

This MPR selector is obtained from HELLO packets sending between in neighbor nodes. These routes are built before any source node intends to send a message to a specified destination. Each and every node in the network keeps a routing table. This is the reason the routing overhead for OLSR is minimum than other reactive routing protocols and it provide a shortest route to the destination in the network. There is no need to build the new routes, as the existing in use route does not increase enough routing overhead. It reduces the route discovery delay [5].

C. TORA (Temporally Ordered Routing Algorithm)

TORA is a routing algorithm. It is mainly used in MANETs to enhance scalability. TORA is an adaptive routing protocol. It is therefore used in multi-hop networks. A destination node and a source node are set. TORA establishes scaled routes between the source and the destination using the Directed Acyclic Graph (DAG) built in the destination node. This algorithm does not use "shortest path" theory, it is considered secondary. TORA builds optimized routes using four messages. Its starts with a Query message followed by an Update message then clear message and finally Optimizations message. This operation is performed by each node to send various parameters between the source and destination node. The parameters include time to break the link (t), the originator id (oid), Reflection indication bit (r), frequency sequence (d) and the nodes id (i). The first three parameters are called the reference level and last two are offset for the respective reference level. Links built in TORA are referred to as "heights", and the flow is from high to low. At the beginning, the height of all the nodes is set to NULL i.e. (-,-,-,-,i) and that of the destination is set to (0,0,0,0,dest). The heights are adjusted whenever there is a change in the topology. A node that needs a route to a destination sends a query message with its route required flag. A query packet has a node id of the intended destination. When a query packet reaches a node with information about the destination node, a response known as an Update is sent on the reverse path [6].

In 2012, Vishal Sharma *et.al* [3] have evaluated the performance of AODV and DSR reactive routing protocols in MANET network using GSM quality voice traffic by calculating matrices such as voice end-to-end delay, network load, throughput and number of hops per route, route discovery time, and voice traffic-sent and -received using OPNET Modeler 14.5. From this paper it is concluded that AODV routing protocol has lowest end-to-end and lower network load as compare to DSR. Also, AODV has maximum average throughput and traffic received as compare to DSR. The DSR routing protocol does not scale well with large sized networks. Simulation results also showed that AODV reactive routing protocol is the best suited for MANET networks in dense population of nodes,

whereas, DSR has very poor QoS in high populated node networks with GSM voice traffic data. In 2009, Liu Tie-yuanetal *et.al* [7] presented a comparative study on entity mobility models. Firstly, both the advantages and disadvantages of four typical entity mobility models are summarized; these models include the Random Walk model (RW), the Random Way Point model (RWP), the Random Direction model (RD)and the Markov Random Path model (MRP). Secondly, focus on primary parameters of these models, effects of both the speed and the pause time on the performance metric of MANET routing protocols are analyzed. Finally, with the help of the NS-2 simulator, the effect of different entity mobility models on the performance of MANET routing protocols is analyzed.

II. SIMULATION SETUP

We have analyzed and observed the performance of MANET network under two scenarios with varying number of nodes and specific performance parameters.

Table I
Simulation parameters

Parameter	Value
Simulator	Opnet 14.5
Area	3.5×3.5 Km
Wireless MAC	802.11
Number of Nodes	50, 100
Mobility Model	Random Walk, Random waypoint Mobility
Data Rate	11 Mbps
Routing Protocols	AODV,OLSR and TORA
Simulation Time	5 Minutes
Traffic	CBR, VBR, TCP

III. RESULTS AND DISCUSSION

Delay: Delay indicates how long a packet takes time to travel from the CBR, VBR or TCP source to theapplication 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.

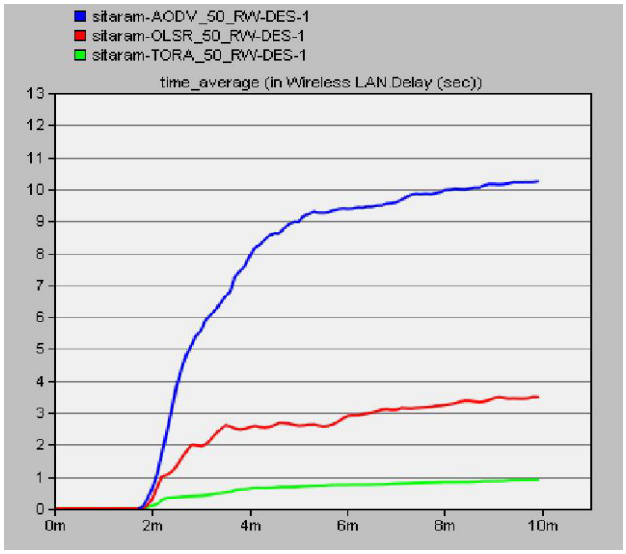

Fig. 1 Delay (50 Nodes Random Walk)

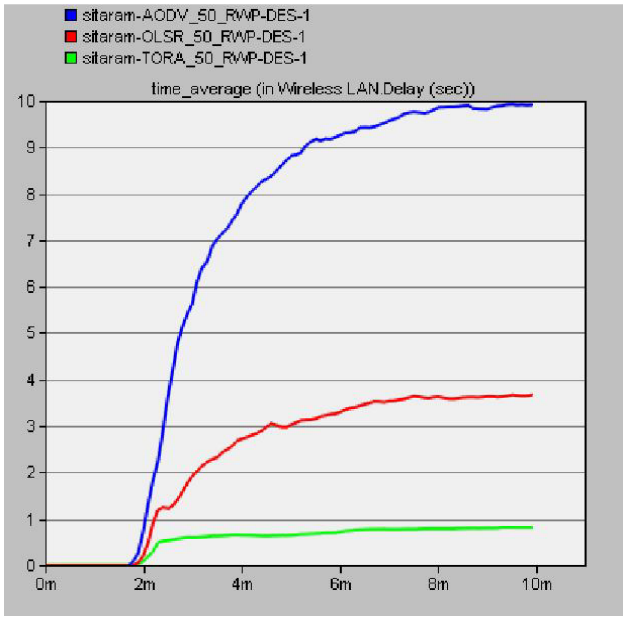

Fig. 2 Delay (50 Nodes Random Way Point)

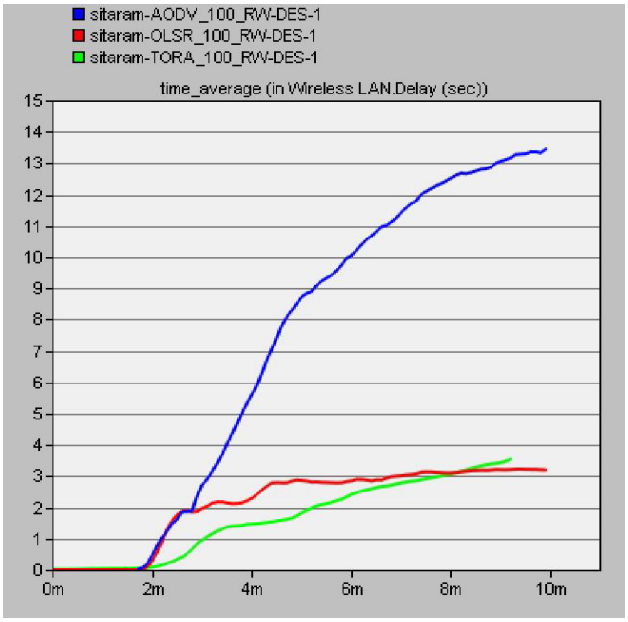

Fig. 3 Delay (100 Nodes Random Walk)

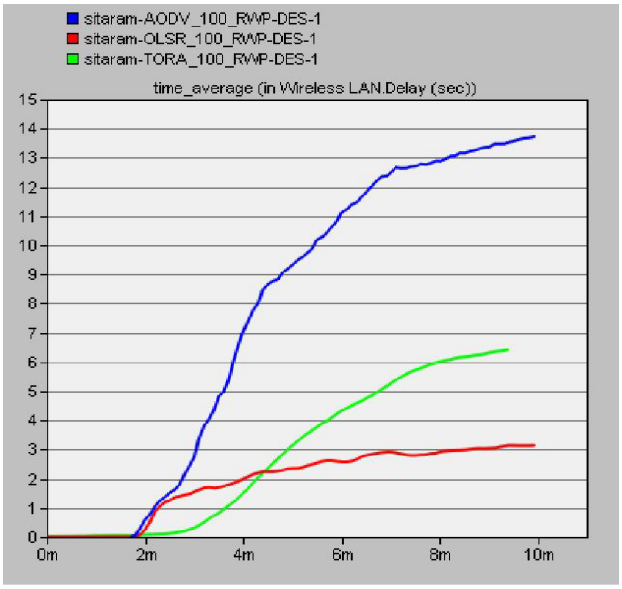

Fig. 4 Delay (100 Nodes Random Way Point)

Figures 1, 2, 3 & 4 provide comparative analysis for delay under both mobility models and varying density. Again OLSR outperforms both AODV and TORA in terms of end to end delay experienced in the network. AODV protocol under both Random Way Point and Random Walk Mobility Model experiences high delay. Thus it is observed that Random Walk Mobility model performs better than Random Way Point in terms of delay and OLSR remains more consistent than other two protocols.

Table II
Comparison Table

Delay	AODV		OLSR		TORA	
	Random Walk	Random Way Walk	Random Walk	Random Way Point	Random Walk	Random Way Point
50 Nodes	10.2	10.01	3.57	3.79	1	0.89
100 Nodes	13.36	13.65	3.12	3.32	3.37	6.45

IV. CONCLUSION

Present paper reports the performance of time delay of a packet with two different mobility models i.e. Random Walk model and Random Way point Mobility model and TCP, CBR and VBR as traffic type while taking 50 and 100 as the node density.

A comparison of above has been made in between three Ad-Hoc Routing Protocols AODV (Ad hoc On-demand Distance Vector), OLSR (Optimized Link State Routing) and Temporally Ordered Routing Protocols Algorithm (TORA) deeply studied using OPNET 14.5.

From the extensive simulation results, it is found that OLSR shows the best performance in terms of time delay experience of network. Moreover, Random Walk Mobility model performs better than Random Way Point in terms of delay and OLSR is more efficient than AODV and TORA.

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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