



Performance Evaluation of DSR, OLSR and ZRP using NETSIM Simulator

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Abstract: Mobile ad hoc network (MANET) is a self sufficient system containing a collection of mobile nodes which can dynamically change their network topology. All the mobile nodes in the network are connected by wireless links and nodes are free to move randomly and organize themselves into a network. Mobile ad hoc networks (MANETs) are infrastructure less, dynamic network consisting of a bunch of wireless mobile nodes that communicate with each other. This paper aims to evaluate the performance of the three MANET routing protocols ZRP, DSR and OLSR in terms of throughput and delay for different node density. Random Waypoint is used as mobility model in it. Simulations are carried out using NETSIM simulator and lastly, we present simulation results that illustrate how the performance drastically changes, as a result of changing the different protocols. The conclusion which routing protocol is best in each of the varying mobility is also stated.

Keywords: MANET; DSR; OLSR; ZRP; NETSIM

I. INTRODUCTION

Mobile ad-hoc network is a group of wireless mobile sites forming a temporary network and provide communication between the nodes without any central authority, rather every node act as router. These features enable the MANETs two of its most desirable characteristics; quick to deploy and adaptable [1, 2]. Mobile ad-hoc network have features such as wireless connection, distributed operation, continuously changing topology, and ease of deployment. Fixed routers are not there in Ad hoc networks. So, all nodes are capable of movement and can be connected dynamically in an arbitrary manner. The system may operate in isolation, or may have gateways to interface with a fixed network [3]. Nodes of these networks, which act as routers, discover and maintain routes to other nodes in the network and topology of this depends on the transmission power of the nodes and the location of the mobile nodes. Because of this the Ad hoc networks are used where wired network and mobile access is not possible. A few possible examples include: earthquake prone areas, soldiers in a temporary environment, biological detection, tracking of rare animal, where infrastructure is destroyed, virtual classrooms, space exploration, and undersea operations. Since mobile ad hoc networks change their topology regularly, routing in such networks is exigent task. This leads to problem in ad hoc networking is how to deliver data packets among networks efficiently without centralized control, which is the main objective of ad hoc routing protocols [4]. Mobile Ad Hoc Networks are kind of distributed network systems such as the Internet, World Wide Web, social networks, and biological systems. It allows people and devices to share the resources seamlessly [5]. The fundamental objective of this paper is to evaluate the performance of three different types of routing Protocols: Dynamic Source Routing (DSR), Optimized Link State Routing (OLSR) and Zone Routing Protocol (ZRP) which are reactive, proactive and hybrid routing protocols. These routing protocols are compared in terms of performance metrics such as Throughput (Mbps) and Delay (microseconds).

II. MANET ROUTING PROTOCOLS

a. DSR

The Dynamic Source routing algorithm is the advanced approach for routing in a MANET in which nodes communicate along paths stored in source routes carried by the data packets. In DSR, mobile nodes maintain route caches that contain the source routes. Entries in the route cache are continually updated as new routes are performed. It is referred as one of the purest examples of an on demand protocol [6].

b. OLSR

The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol used for mobile ad hoc networks. OLSR is a proactive link-state routing protocol. It uses hello and topology control (TC) messages to discover and then spread the link state information throughout the mobile nodes of the ad hoc network. Nodes are using this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths [7].

c. ZRP

Zone routing protocol is a hybrid routing protocol. It combines the best features of proactive and reactive routing protocol [8, 9]. The reactive global search is done efficiently by querying only a selected set of nodes in the network. Each node defines a zone around itself and the zone radius is the number of hops to the perimeter of the zone [10]. The number of nodes required is $\lceil \frac{r_{\text{zone}}}{r_{\text{network}}} \rceil^2$ and is equal to number of nodes queried for a network-wide flooding process [8]. Unless the zone radius is carefully chosen, a node can be in multiple zones and zones overlap.

III. NETSIM SIMULATOR

NETSIM is network simulation software used for protocol modeling and simulation. NETSIM is being used by the world's most prestigious institutions such as IIT's, NIT's, renowned universities and Indian army for network lab experimentation and research. This software is used to analyze computer networks with supreme depth, power and flexibility. NETSIM has an open, modular and flexible architecture [11]. NETSIM provides simulation of many protocols working in

various networks such as Internetworks, Advanced Wireless Networks, Cellular Networks, Cognitive Radio Networks, MPLS Networks, Wireless Sensor Networks, Personal Area Networks and LTE Networks [12]. NETSIM simulator software was developed by the privately owned company TETCOS having headquarters in Bangalore.

IV. SIMULATION SETUP

We have used NETSIM simulation software version 9.0 for the evaluation of our work. The results indicate evaluation in performance by taking MANET routing protocols such as DSR, OLSR and ZRP. Under these protocols, Throughput (Mbps) and Delay (microseconds) are used as performance metrics. Our simulation setup is a network with randomly placed mobile nodes within an area of 500 * 500 (in meters).

Table I. Simulation Parameters

SIMULATION PARAMETERS	
Simulator	NETSIM 9.0
Protocols Used	DSR, OLSR, ZRP
Performance Metrics	Throughput (Mbps), Delay (microseconds)
Number of Nodes	5 and 10
Environment Area	500 * 500 (in meters)
Traffic Type	Custom
Simulation Time	100 seconds
Mobility	Random Way Point
Mobility Speed	10 m/s

In each scenario, node 1 and node 5 are used as source node and as destination node for sending and receiving data. The scenarios for the mobile nodes are shown in figure 1 and figure 2.



Figure 1. Network scenario with 5 nodes.

Figures 3 and 4 shows the throughput and delay of this network with respect to total simulation time which is considered as 100 seconds for which the simulation is performed.



Figure 2. Network scenario with 10 nodes.

. In this simulation, the network is adjusted to 5 and 10 nodes, and the traffic type is custom. The parameters used for carrying out simulation are summarized in the Table I.

V. RESULTS AND DESCUSION

a. Throughput

Throughput is the most important metric to examine the performance of routing protocols. Throughput is a measure of how fast data packet successfully reaches a receiver node. It is the rate of successfully transmitted data packets in unit time in the network during the simulation. It is measured in Mbps and should be more for the network. Unreliable wireless channels, frequent topology changes and limited resources affect throughput in MANETs [13]. Mathematically it is represented as follow:

$$\text{Throughput} = \frac{\text{Number of delivered packets} * \text{packet size} * 8}{\text{Total Duration of Simulation}}$$

Results in Throughput of all the three protocols are easily analyzed from the figure 3 and figure 4.

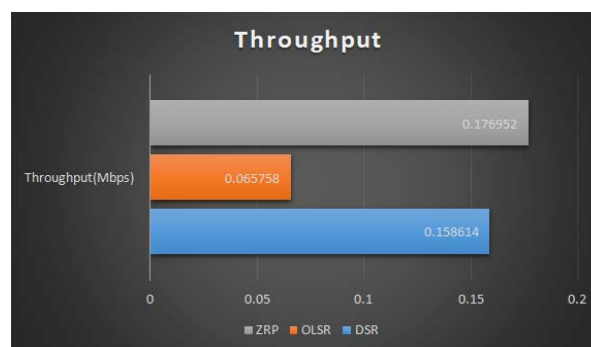


Figure 3. Throughput for 5 nodes.

Performance of ZRP is better as compared to DSR and OLSR in both scenarios of throughput. DSR performs better than OLSR. Throughput (in Mbps) of DSR, OLSR and ZRP is .158614, .065758 and .176952 in case of first scenario which contains 5 nodes.

In second scenario, it contains 10 mobile nodes where Throughput (in Mbps) of DSR, OLSR and ZRP is .090637, .018571 and .113413 as shown in Table II.

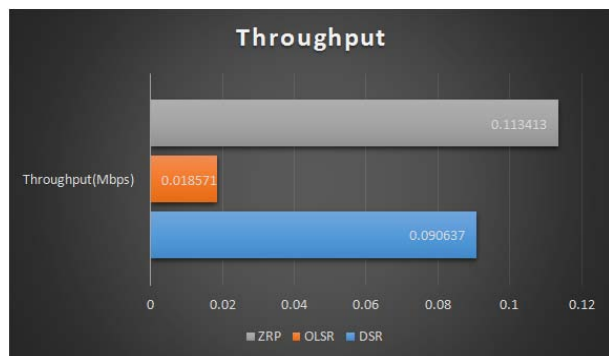


Figure 4. Throughput for 10 nodes.

b. Delay

Delay is the time that packet takes to traverse the network from source to destination. It is the time from the generation of data packet by source to destination nodes and expressed in seconds. It is measured in microseconds and should be less for the betterment of network. It is defined as the average time taken by the data packets to propagate from source to destination across a MANET. It includes all possible delays caused by routing discovery latency, queuing at the interface queue, and retransmission delays at the MAC, propagation and transfer times. Different types of delays are included during the transmission of packet from source to destination. Such as buffering during the route discovery process, retransmission at MAC layer, propagation delay and transfer time [13]. Mathematically, end-to-end delay can be shown as:

$$D_{\text{end-end}} = N [D_{\text{Trans}} + D_{\text{prop}} + D_{\text{proc}}]$$

It includes all the delays i.e. end to end delay is the combination of N time Transmission.

Delay (D_{Trans}), Propagation Delay (D_{prop}) and Processing Delay (D_{proc}).

$D_{\text{end-end}}$ = End-to-End Delay

D_{proc} = Processing Delay

D_{Trans} = Transmission Delay

D_{prop} = Propagation Delay

Figure 5 and 6 shows the simulation results of Delay in microseconds containing 5 and 10 nodes by taking MANET routing protocols such as DSR, OLSR and ZRP. Results of all the three protocols are easily analyzed from the figure 5, 6 and Table II.



. Figure 5. Delay for 5 nodes.

Performance of ZRP is better as compared to DSR and OLSR in the scenario of delay. OLSR performs better than DSR. Unlike Throughput, Delay should be less for the betterment of the network.



Figure 6. Delay for 10 nodes.

Delay (in microseconds) of DSR, OLSR and ZRP is 41236932.9, 36531376.5 and 35652199.1 in case of first scenario which contains 5 nodes.

In second scenario, it contains 10 mobile nodes where Delay (in microseconds) of DSR, OLSR and ZRP is 35248961, 31762274.7 and 29581263.1 as shown in Table II.

Table II. Values for throughput and delay.

	5 NODES		10 NODES	
	Throughput (Mbps)	Delay (microsec)	Throughput (Mbps)	Delay (microsec)
DSR	0.158614	41236932.9	0.090637	35248961
OLSR	0.065758	36531376.5	0.018571	31762274.7
ZRP	0.176952	35652199.1	0.113413	29581263.1

VI. CONCLUSIONS

This paper described the evaluation routing protocols in MANET. There are many routing protocols such as AODV, DSR, OLSR, GRP, ZRP, DSDV, TORA etc. Three Ad-Hoc Protocols such as Dynamic State Routing (DSR), Optimized Link State Routing (OLSR) and Zone Routing Protocol (ZRP) which are reactive, proactive and hybrid routing protocols were used with respect to their throughput in Mbps and delay in milliseconds as their performance metrics.

In terms of reliability and efficient use of network resources for MANET, the selected performance metrics were subjected to identify protocols effectiveness and suitability in the network. DSR, OLSR and ZRP were implemented in the scenario having 5 mobile nodes network and 10 nodes network. In each scenario, node 1 and node 5 was used as source node and as destination node for sending and receiving data. According to results, we analyzed and proved that ZRP is more reliable protocol in terms of delay and throughput than OLSR and DSR.

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Author's Profile



Gurpreet Singh received his B.Tech. degree in Information Technology from DAV Institute of Engineering & Technology, Jalandhar, Punjab, India in 2009 and M.Tech. in Computer Engineering from University College of Engineering, Punjabi University, Patiala, India in 2011. He was teaching as Assistant Professor at Rayat Bahra College of Engineering and Bio-Technology for Women, Mohali, Punjab, India. Presently, he is teaching as Assistant Professor at Guru Nanak Dev University, Regional Campus Fattu Dyinga (Sultanpur Lodhi), Kapurthala. He has more than 25 research publications in International, National Conferences and Journals. His research interest includes Wireless Communication, Network Security, Computer Networks and Data Communication.



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