International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 - 5161

Available at http://inpressco.com/category/ijcet

Research Article

Performance Evaluation of Optimized Link State Routing Protocol for Different Mobility Models in Vehicular Ad-hoc Network

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Accepted 02 May 2014, Available online 01 June 2014, **Vol.4, No.3 (June 2014)**

Abstract

Vehicular Ad hoc network (VANET) is an exclusive part of MANET in which collection of mobile nodes that are randomly located so that the connections between nodes are dynamically changing. In VANET mobile nodes form a temporary network without the use of any existing network infrastructure or centralized administration. A routing protocol is used to find routes between mobile nodes to facilitate communication within the network. An extensive range of routing protocols for VANETs has been proposed by researchers to overcome the limitations of routing protocols. In this paper we perform & evaluated the performance of OLSR (Optimized link state routing) protocol using Random Waypoint mobility model (RWP) and Reference Point Group Mobility Model (RPGM). The simulation is performed by using network Simulator. Performance of OLSR is evaluated based on Average end to end delay, Packet delivery ratio, Normal Routing load and Throughput for the different pause time.

Keywords: *Random Waypoint, Reference Group Mobility Model.*

Introduction

OLSR is a proactive, link-state routing protocol employing periodic message transmission to update topological information in each node in the network. The characteristic with a proactive in nature shows that routes are always available whenever it needed. OLSR is based upon the traditional link state optimize algorithm. Each node maintains topology information about the network by periodically exchanging link state messages.

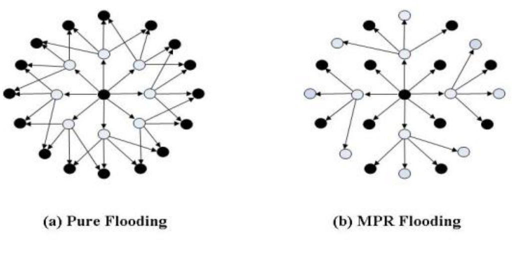

Fig.1: MPR Flooding

Multipoint Relay (MPR) have distinctive feature as compare to another protocols. OLSR protocol uses Multipoint Relays to reduce the possible overhead in the network. The idea behind MPR is to reduce flooding of broadcasts by reducing the same broadcast in some regions in the network topology. Multipoint relays (MPR) are designated for link state updates and packet forwarding. In a typical pure flooding-based approach, a node broadcasts a message either if it is the originator or if it has not received this message before. Thus, the number of messages transmitted in the network is almost as large as the number of the nodes in the network. Figure 1a shows a typical flooding scenario. Figure 1b shows the flooding in the entire network when using MPRs. The link state information is generated only by nodes that are elected as MPRs, and each MPR must have report on the state of links between itself and its selectors. Every node in this protocol is periodically broadcasts two types of messages: HELLO messages and Topology Control (TC) messages. A HELLO message includes two lists in which one list contains the addresses of the neighbors to which there exists a valid bi-directional link and the other list Contains the addresses of the neighbors from which control traffic has been heard but bidirectional links are not confirmed. After receiving the HELLO message, a node examines list of addresses, if its own address is in the list, it is confirmed that bidirectional communication has been established with the sender. HELLO messages also allow each node to maintain information describing link between neighbor node and nodes which are two-hop away. The set of nodes among the one-hop neighbors with a bi-directional link are chosen as multipoint relays (MPRs). On the reception of HELLO messages, each node maintains a neighbor table which contains one-hop neighbor information, their link Status information and a list of two hop neighbors. A TC message contains the list of neighbors who have selected the sender node as a multipoint relay and is used to diffuse topological

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information to the entire network. Based on the information contained in the neighbor table and the TC message, each node maintains a routing table which includes destination address, next-hop address, and number of hops to the destination

Mobility Models

A mobility model represents the movement behavior of considered application scenarios should incorporate and is an important feature that may change characteristics of mobile nodes. It describes how speed, velocity and direction of the node changes over time. In order to check the performance of various mobility model the result of a protocol for an ad hoc network mobility model plays an important role.

Random Waypoint Model

It is an entity model where a node can choose any random velocity and any random destination. In the network simulator, this mobility model work implies such that when the simulation begins, each mobile node randomly selects one location in the simulation field as the destination. Finally it travels towards this destination with constant velocity chosen uniformly and randomly from (0, Vmax) where the parameter V is the maximum allowable velocity for every mobile node.

Reference Point Group Mobility Model

RPGM is a group mobility model where the nodes form a specific group and then moving in a coordinate manner such that every node follows a logical center (group leader) that determines the group's motion behavior. It also represents not only the random motion of a group of mobile nodes but also the random motion of each individual mobile node within the group. The nodes in a different group are usually randomly distributed around the reference point. Group movements in this model are based upon the path traveled by a logical center for the specific group.

2. Simulation Environment

Simulator	NS-2.34
Simulation Duration	100 sec
Simulation area	1500
Protocol	OLSR
Number of Nodes	50
Movement Models	RWP , RPGM
Mac layer	IEEE 802.11
Max. Speed	20m/s
Packet rate	4packet/sec
Traffic type	CBR
Mobility Models	RWP,RPGM
Pause Time	10,20,30,40,50

Performance Metrics

Analyzing the OLSR protocol, we focused on four performance metrics for evaluation. They are Packet Delivery Fraction (PDF), Average End-to-End Delay, Normalized Routing Load (NRL) and Throughput.

Throughput: - It is the average number of messages successfully delivered per unit time number of bits delivered per second. The throughput is measured in bits per second (bit/s or bps).Throughput shown in Figure 1.4.According to our simulation, OLSR perform better in RPGM than in RWP. For pause time 50, OLSR delivers data packet at higher rate in Reference Point Group Mobility. The performance of throughput is better in RPGM than RWP.

Average End To End Delay: - It is the average time from the transmission of a data packet at a source node until packet delivery to a destination which includes all possible delays caused by buffering during route discovery process, retransmission delays, queuing at the interface queue, propagation and transfer times of data packets.

$$\text{Average End to End Delay} = \frac{\sum(\text{Time received} - \text{Time Sent})}{\text{Total Data Packets received}}$$

The Average End to End Delay from source to destination's application layer shown in Figure.1.5. According to our simulation result, OLSR perform below 500 milliseconds delay for both RPGM and RWP. It is below 300 milliseconds. Best performance is shown by OLSR having lowest end to end delay with a maximum delay of 150 milliseconds. Hence Random waypoint mobility Model shows better Average end to end delay than RPGM.

Normalised Routing load: - The normalized routing load (NRL) it is the ratio of all routing control packets send by all nodes to number of received data packets at the destination nodes. Normalised Routing load against pause time shown in figure 1.7. According to our simulation result, OLSR perform better in Random waypoint than the performance in the Reference point group mobility model.

$$\text{Normalised Routing Load} = \frac{\text{Total Routing packets Sent}}{\text{Total Data packets received}}$$

Packet Delivery Ratio: - The packet delivery ratio is defined as the fraction of all the received data packets at the destinations over the number of data packets sent by the sources and is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source. For correct routing protocol, it needs to be better. The Packet Delivery Ratio is shown in Figure 1.7.According to our simulation result, RPGM perform better Result than RWP for OLSR Protocol. When Pause time increases from 10sec to 50 sec OLSR deliver Variation in Random Waypoint Model while In RPGM it gives better result.

$$\text{Packet Delivery Ratio} = \frac{\text{Total Data packets Received}}{\text{Total Data Packets sent}}$$

3. Simulation Results

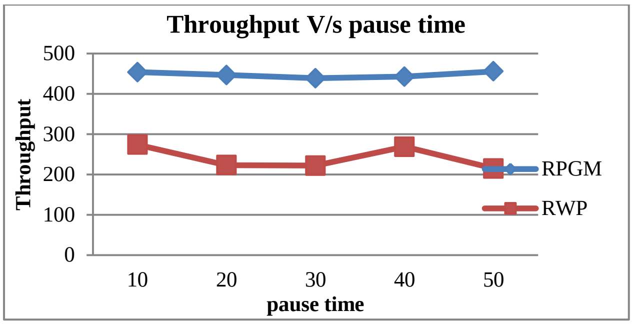

Fig. 2 Average Throughput v/s Pause Time

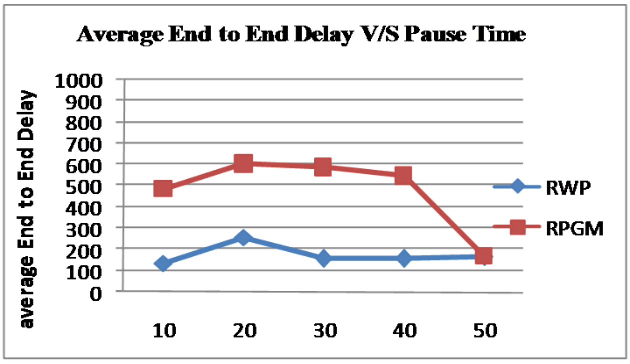

Fig. 3 Average End to end delay v/s Pause time

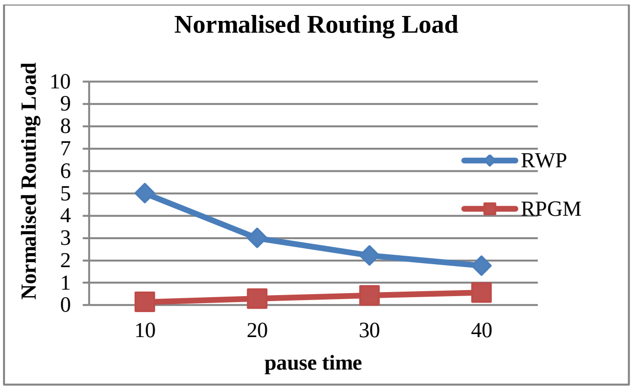

Fig.4 NRL v/s pause Time

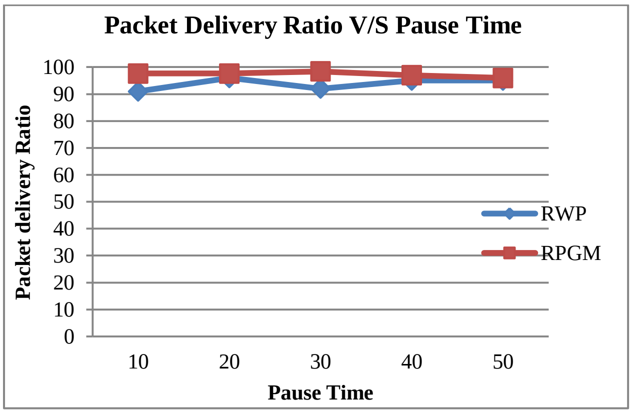

Fig.5 PDR v/s pause Time

4. Conclusion

On evaluating the performance of OLSR across the Random Waypoint and Reference point group mobility model it is observed that the mobility model may majority affect protocol performance. On using OLSR as a descriptive example it shows as the Pause Time increases from 10 to 50 for packet Delivery ratio the OLSR performs well in Reference point Mobility model.

It is observed that OLSR achieve the good end to end delay with Random way point Model and good throughput with Reference point group mobility.

The results of this work clearly show that RPGM has low normalized routing load with Random waypoint as compared to RPGM. Hence the Mobility model affects the Performance of Routing protocol. These simulation results show the picture of the performance of VANET routing protocols. Hence it is important to choose an appropriate mobility model for a given performance evaluation of protocol.

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