Performance Evaluation Of Routing Protocols In Vanets By Using Tcp Variants On Omnet++ Simulator

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ABSTACT

Vehicular Ad-Hoc network is a type of Mobile ad-hoc Networks, vanet help in developing communication between near vehicles and between vehicles and roadside equipment. The paper aims to investigate the performance of the routing protocol in vanet by using tcp variants that is tcp reno, tcp new reno and tcp tahoe.In the performance evaluation two different routing protocols On-Demand Distance Vector (AODV) and Optimized Link State Routing (OLSR) have been considered with three different TCP variants. Delay and Throughput are the two parameters that are consider to grade the routing protocol.. Conclusions are drawn based on the evaluation results using OMNET++ and SUMO simulator. The results clearly show that the both AODV and OLSR achieve acceptable performance. However, the merits of AODV over OLSR or vice versa depend on the network environment such as TCP variant used, traffic load, number of nodes with the required parameter in the evaluation delay or the throughput. The results clearly show that selecting best protocol is depend upon network condition because olsr protocol achieve better performance compare to aodv protocol from the throughput point of view and matter is different in case of delay.

Keywords— Ad-hoc Networks, TCP variants, routing Protocols, AODV, OLSR

1. INTRODUCTION

VANETs are kind or subset of manet that provide vehicle to vehicle (V2V) and vehicle to roadside wireless communications, this means that every node means vehicle in the network can move freely within n/w and stay connected with each other that means every nodes can communicate with each other in network to avoid accidents etc. for this each Vehicles are equipped with wireless transceivers and computerized control modules are used that are essential for cooperative driving among communicating vehicles. Vehicles function as communication nodes and relays, forming dynamic networks with other near-by vehicles on the road and highways. While Mobile ad hoc Networks (MANETs) are mainly linked with mobile laptops or wireless handheld devices, whereas VANET is concerned with vehicles (such as cars, vans, trucks, etc). Mobile ad hoc networks (MANETs) are a type of wireless network that does not require any complicated infrastructure. MANETs are attractive for situations where communication is required, but deploying a complicated infrastructure is impossible. But in case of VANET technology each moving cars is consider as nodes in a network to create a mobile network with a wide range in which cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a Mobile Internet is created. And this technology will also integrated with police so that fire vehicles can communicate with police for safety purpose.. Other purposes include essential alerts and accessing comforts and entertainment used. VANET bring new challenges to design an efficient routing protocol for routing data among vehicles, called V2V or vehicle to vehicle communication. And in this context, we evaluate the performance of routing protocol with tcp variants (TCP reno, TCP new reno, TCP tahoe) by using omnet++ (network simulator) and sumo (traffic simulator) on basis of parameter throughput and delay.

2. PROBLEM DEFINATION

As Vehicular Ad-Hoc network or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node. So the main issue with VANET is due to the frequently changing topology. As the topology changes frequently, because of high mobility of vehicles, so there is no fixed infrastructure and nodes changes their locations. Due to this, disruption is occurred between the nodes. So opportunistic routing model performance must be evaluated on the basis of throughput and delay. So in this we evaluate the performance of routing protocol(AODV and OLSR)with respect to TCP variants by developing coupling between omnet++ (network simulator) and sumo (traffic simulator) by using trace as a interface.

2.1 TCP variants

TCP is transport layer is the reliable connection orientated protocol that provides reliable transfer of data between the nodes. It ensures that the data is reached the destination correctly without any loss or damage. The data is transmitted in the form of continuous stream of octets. The reliable transfer of octets is achieved through the use of a sequence number to each octet. Another aspect of TCP is the tree way handshakes mechanism to establish a connection between the nodes. Furthermore, TCP uses the port assignment as an addressing mechanism to differentiate each connection for the cases of more TCP connection between nodes are required. After the introduction of first version of TCP several different TCP variants exist. The most famous implementation of TCP called Tahoe, Reno and New-Reno.

2.1.1 TCP Tahoe

TCP Tahoe was released in 1998. Congestion control plays an important role in flow control objective in transport layer protocol TCP. . TCP Tahoe (1989) release has the following features: slow start, congestion avoidance and fast retransmit. The idea of TCP Tahoe is to start the congestion window at the size of a single segment and send it when a connection is established. If the acknowledgement arrives before the retransmission timer expires, add one segment to the congestion window. This is a multiplicative increase algorithm and the window size increases exponentially. The window continues to increase exponentially until it reaches the threshold that has been set. This is the Slow Start Phase. Once the congestion window reaches the threshold, TCP slows down and the congestion avoidance algorithm takes over. Instead of adding a new segment to the congestion window every time an acknowledgement arrives, TCP increases the congestion window by one segment for each round trip time. This is an additive increase algorithm. To estimate a round trip time, the TCP codes use the time to send and receive acknowledgements for the data in one window. TCP does not wait for an entire window of data to be sent and acknowledged before increasing the congestion window. Instead, it adds a small increment to the congestion window each time an acknowledgement arrives. The small increment is chosen to make the increase averages approximately one segment over an entire window. When a segment loss is detected through timeouts, there is a strong indication of congestion in the network. The slow start threshold is set to one-half of the current window size. Moreover, the congestion window is set to 1 segment, which forces slow start.

2.1.2 TCP RENO

This Reno retains the basic principle of Tahoe, such as slow starts and the coarse grain re-transmit timer. However it adds some intelligence over it so that lost packets are detected earlier and the pipeline is not emptied every time a packet is lost. The TCP Reno can be considered as an enhancement of the TCP Tahoe. In the enhancement fast retransmit procedure has been enhanced through the inclusion of fast recovery. TCP Reno improves the TCP Tahoe performance for the single packet loss within a window of data except multiple packet losses case within a window data. Reno requires that we receive immediate acknowledgement whenever a segment is received. The logic behind this is that whenever we receive a duplicate acknowledgment, then his duplicate acknowledgment could have been received if the next segment in sequence expected, has been delayed in the network and the segments reached there out of order or else that the packet is lost. If we receive a number of duplicate acknowledgements then that means that sufficient time has passed and even if the segment had taken a longer path, it should have gotten to the receiver by now. There is a very high probability that it was lost. So Reno suggests an algorithm called **'**Fast Re- Transmit'**.**

2.1.3 TCP New-Reno

TCP New-Reno is a modification of the TCP Reno through the use of retransmission process. This is occurred in the fast recovery phase of the TCP Reno. In the improvement, TCP New Reno can detect multiple packet losses. Furthermore, through the period the fast recovery, all unacknowledged segments received and the fast recovery phase is terminated. Having achieved this modification, several reductions in the congestion window size will be avoided in the cases of multiple packet losses occurrence. Furthermore, the congestion window size is set up to slow start threshold the congestion avoidance phase will be resumed and next segment will be retransmitted when partial acknowledgment is received . It is worth to mention that, in partial acknowledgments, all outstanding packets at the onset of the fast recovery are generated.

2.2. ROUTING PROTOCOLS

2.2.1 Ad Hoc On-demand Distance Vector (AODV)

AODV is a reactive routing protocol that is basically designed to reduce the traffic messages via maintaining information for active routes only. This has been achieved at the cost of increased latency to find the new routes. In AODV routes are determined and maintained for nodes that require sending data to a particular destination. In AODV, source routed on-demand protocol; each data packets carry the complete source to destination address. Furthermore, each intermediate node forwards the packets according to the information kept in the packet header. This will avoid the storage and update of routing information for each active route and avoiding the forwarding of packet towards the destination. AODV is based on Dynamic Source Routing DSR algorithm and each packet carry the full address from source to the destination. Thus, it can be said that AODV is table based with all the information about the routes in the network is stored in this table. The routing table has the following entries i.e. DSN, flag, next hop, IP address, State, hop count, the list of precursors, Life time and network interface. Furthermore, nodes do not need to maintain neighbour connectivity through periodic beaconing messages. The major benefit of this type of reactive routing is that routes are adaptable to the dynamically changing environment such as MANETs. This is because AODV is based on Dynamic Source Routing DSR algorithm and each packet carries the full address from source to the destination. This suggest that AODV has an advantages since each node can update its routing table when they receive fresher topology information and hence forward the data packets through the new and better routes. However, the performance in large networks is bad. This is because the number of intermediate nodes in each route grows and the raise of the probability of route failure. AODV uses the periodic beaconing and sequence numbering procedure of Dynamic Source Distance Vector DSDV and a similar route discovery procedure as in DSR.

2.2.2 Optimized Link State Routing protocol (OLSR)

OLSR uses flooding techinque that diffuses topology information throughout the network. This makes all nodes in the network to retransmit received packets. However, this may lead to loop. So this can be avoided by using a sequence number technique. The sequence number guarantee that the packet is not transmitted more than once time. Furthermore, the sequence number must registered by receiving nodes to achieve the reliable transmission. However, the packet will not transmitted when the node receives a packet with a sequence number lower or equal to the last registered retransmitted packet from the sender. With multi-hop network, nodes may retransmit packets on the same interface that it arrived. This is because of condition and properties of wireless multi-hop networks. However, duplicated packet may be received from symmetric neighbour. OLSR is one of a type of link state algorithm with proactive routing protocol optimized for mobile ad hoc networks. It has an advantage of having routes available when needed due to its proactive nature. The Multipoint Relay (MPR) can be used to retransmit control messages with the aid of selected nodes. This will reduce the overhead in the OLSR and the number of retransmissions in the flooding. Other feature of OLSR, shortest path routes is computed using partial link state provided. The reactivity in to topology change can be optimized in OLSR via maximum time interval for periodic control message transmission reduction. It is worth to mention about the good features of OLSR that the protocol is performing very well with heavy and dense network. This is because OLSR routes to all destinations in the network are continuously maintained. Furthermore, overhead and complexity in OLSR have been reduced since there is no need for sequenced transmission of messages.

3. SIMULATION ENVIRONMENT AND RESULT ANALYYSIS

In simulation there are three type of different scenarios based on the number of nodes. In the investigation a comparison between two routing protocols AODV and OLSR with different types of TCP variants Reno, New-Reno and the Tahoe based on ad-hoc wireless networks of 20, 60 and 100 nodes . The investigation involves the measurement of delay and throughput of the network in each of the above cases. Finally, the results achieved for each case of routing algorithm with different TCP variant, number of nodes in the networks will be assessed. Table 1 shows a summary for the scenarios' considered in the investigation. To keep clear analysis, each scenario has been considered separately.

Types of Scenario	Description
Scenario 1 (Small Size Network)	In Scenario 1 a network environment designed with different entities, configured for a network size of 20 nodes, Thereafter, different VANET routing protocols and TCP variants are employed in the network and their performance is evaluated for the small-sized network (i.e. node size = 20), based on the analysis of the performance metrics.
Scenario 2 (Medium Size Network)	Scenario 2 represents a medium-sized network where the network model is designed with 60 nodes. The intention is to observe the performance of the routing protocols and the TCP variants through varying the node sizes from 20 to 60.
Scenario 3 (Large Size Network)	This network scenario (Scenario 3) is similar to that of Scenario 1 and Scenario 2, except that the network size is increased to 100 nodes, so as to observe the impact of scalability in VANET.

Table1. Summarization of scenario

3.1Throughput

In this paper, AODV and OLSR protocols are simulated with different routing TCP variants such as TCPNEW RENO, TCPRENO, TCPTAHOE for the different number of mobile nodes and networks sizes. We measured the throughput of every scenario. Following tables and graphs are showing the average throughput performance for AODV and OLSR with TCP-Reno, TCP-NEW RENO and TCP-TAHAO.

Throughput (bits/sec)				
Protocols	TCP VARIANTS	20 NODES	60 NODES	100 NODES
AODV	TCP RENO	1000	840	780
OLSR	TCP RENO	1020	1140	1090
AODV	TCP NEW RENO	1000	970	780
OLSR	TCP NEW RENO	1050	1180	1090
AODV	TCP TAHOE	1000	980	780
OLSR	TCP TAHOE	1060	1180	1180

Based on these readings we prepared following performance comparison graphs for throughput performance:

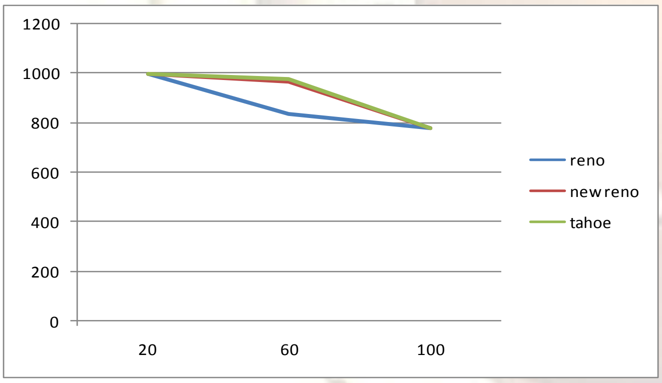

Fig 1 **AODV-Throughput Performance vs. Network Scenario**

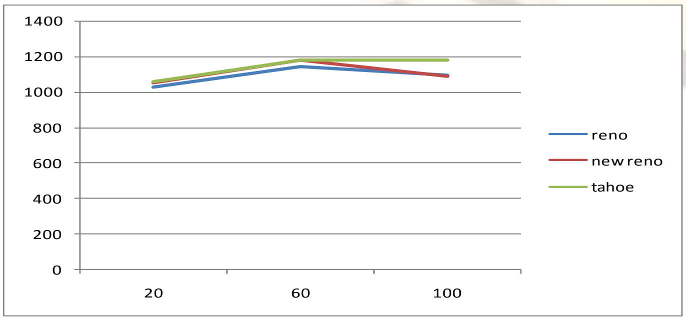

Fig 2 **OLSR-Throughput Performance vs. Network Scenario**

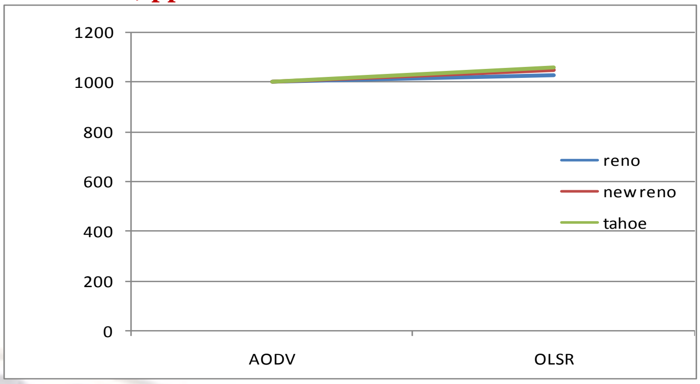

Fig3 **AODV-OLSR-20 nodes-Throughput Performance vs. TCP Variants**

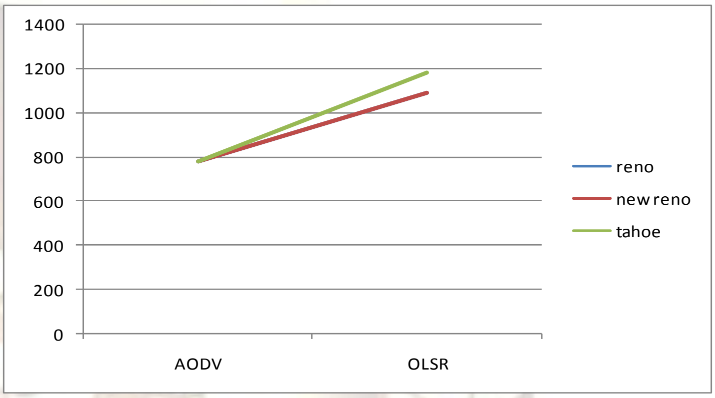

Fig4 **AODV-OLSR-100 nodes-Throughput Performance vs. TCP Variants**

From above results is cleared that with TCP tahoe the AODV achieve better throughput for small size network, whereas OLSR achieve better throughput as network size increases. with TCP RENO the AODV achieve better throughput for small sized network, whereas OLSR achieve better throughput as network size increases Whereas with TCP NEW RENO, aodv achieve better throughput for small sized network and OLSR achieve better throughput as network size increases.

3.2 Delay

This one more performance metrics which we calculated here for all the routing protocol with the different tcp variants and with different network scenarios. Following table shows the average end to end delay for this cases which will explain the performance effects of TCP variants with AODV and DSDV network routing protocols:

Protocols	TCP VARIANTS	20 NODES	60 NODES	100 NODES
AODV	TCP RENO	0.0052	0.010	0.002
OLSR	TCP RENO	0.0043	0.007	0.002
AODV	TCP NEW RENO	0.0053	0.015	0.005
OLSR	TCP NEW RENO	0.0043	0.020	0.002
AODV	TCP TAHOE	0.0052	0.012	0.002
OLSR	TCP TAHOE	0.0029	0.002	0.002

Based on these readings we prepared following performance comparison graphs for delay performance:

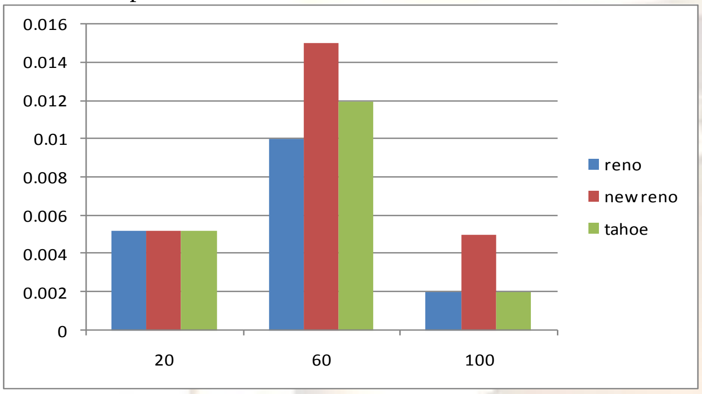

Fig.5**AODV-Delay Performance vs. Network scenario**

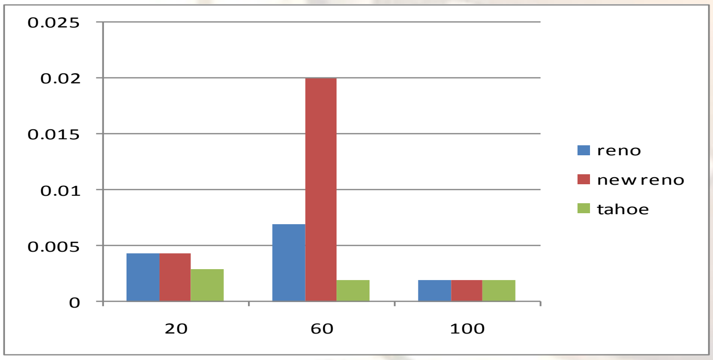

Fig6 **OLSR-Delay Performance vs. Network scenario**

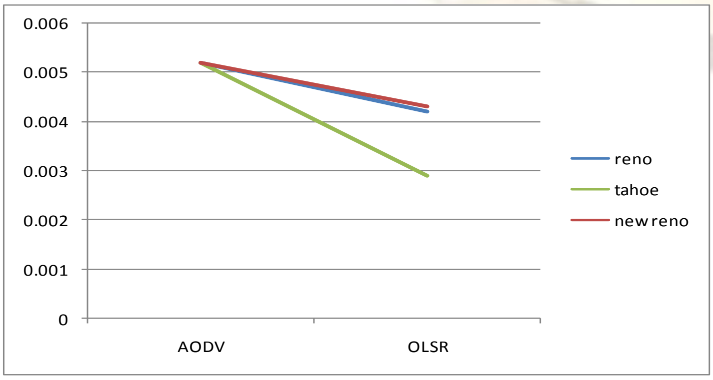

Fig7 **AODV-OLSR-20 nodes-Delay Performance vs. TCP Variants**

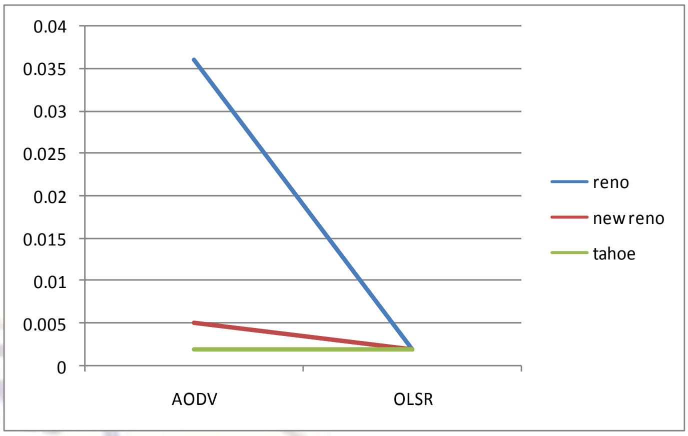

Fig8 **AODV-OLSR-100 nodes-Delay Performance vs. TCP Variants**

From above result it is clear that with TCP tahoe OLSR shows more delay as the no of nodes increases means OLSR have very less delay for small scale network whereas as the network size increases AODV become less delay as compare to OLSR with TCP RENO the OLSR have less delay for small scale network whereas AODV become less delay as network size increase, with NEW RENO the OLSR have less delay for small scale network, whereas as network size increases AODV become less delay compare to OLSR.

4. CONCLUSION AND FUTURE WORK

So from above investigation the OLSR routing protocol achieve better performance compare to the AODV protocol from the throughput point of view in vanet but the matter or case is quite different when considering the delay as a performance parameter. So selection or choice of routing protocol is completely depend upon the network conditions. And in future work As I have selected these numerous routing protocol of interest by simulation in an OMNET++ tool, another possibility of doing the same work can be done through another tool like NS-3, Qualnet. Also, selection of other routing protocol and tcp variants can be use for the performance evaluation or other parameters of performance could be considered for simulation.

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