Performance Evaluation of Beacons Control Data Dissemination Protocol in Handover Scenario for VANET

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Performance Evaluation of Beacons Control Data Dissemination Protocol in Handover Scenario for VANET

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Abstract—For minimizing road accidents, traffic jams, car parking and other significant scenarios related to cost effectiveness and safety in VANET, the communication between vehicle to vehicle and vehicle to road side unit (RSU) should achieve the service quality, high data receive ratio and low latency. However, the probability of TCP disruption increases by the increasing distance between source and destination due to the high mobility of vehicles. Therefore, for increasing the reliability of TCP connection, the communication should follow the automatic connection and disconnection mechanism during the contact time between RSU and vehicle. In this research study, the beacons control data dissemination protocol has been proposed for reducing the impact of TCP disruptions on the network performance during handover. Network simulator 2 has been used to implement this protocol and analyses the performance on different traffic density, routing protocols of MANET and traffic type. The result shows that dedicated routing protocols in MANET are suitable for proposed protocol in VANET and AODV routing protocol has found more reliable from DSDV and AOMDV. In addition, the traffic type is not much affected on the data receive ratio (DRR) and the performance of proposed protocol degraded for high density of vehicles.

Keywords—Vehicular Ad hoc Network (VANET), Road Side Unit (RSU), Handover, Beacons, Routing Protocols, Delay, Throughput, Data Receive Ratio (DRR)

I. INTRODUCTION

As per the current report of world health organization (WHO) 2016, the 1.25 million people die in every year due to the road accidents. For reducing accidents, traffic management, car parking and other significant applications, the communication among vehicles, RSU’s and other equipments plays a vital role to increase the QoS in VANET. The researchers are working on the data transmission protocols, routing protocols, handover mechanism to reduce the delay, improve data receive ratio (DRR), throughputs and develop the efficient methods and techniques in VANET.

X. Wei and L. Qing-Quan [1] has been evaluated the performance of data dissemination for highway scenario in VANET and according to the results, the routing protocols, which are dedicated for MANET, are unsuitable in VANET. Researchers have been used three routing protocols i.e., AODV, DSDV and DSR. The packet delivery ratio has been found to vary from minimum 0.3 to maximum 0.8 for all three routing protocols. The results have been achieved for vehicle-to-vehicle communication scenario.

S. M. Shakeel, M. Ould-Khaoua and O. M. Hussain [2] have been proposed the performance evaluation of vehicle position accuracy with the help of GPS and beacons delivery ratio by increasing the distance between nodes. This experiment is based on real time scenario. Researcher has been observed the plenty of noise in the received data and displayed the miscalculated vehicle location. As per the second observation, the average delay increases by the increasing beacons packets size. The beacons delivery delay has been found as 12 milliseconds for the packets 512 bytes.

D. Sutariya and S. Pradhan [3] have been proposed a work based on the comparative study of routing protocols in real time traffic scenario. The four routing protocols have been used such as AODV, AOMDV, DSDV and DSR. According to the observed results, the AODV has been found most appropriate routing protocol as compared to the others. The researchers did not define the parameters under which the TCP connection starts and stops and the scenario based on the vehicle to vehicle communication. condition for handover from one RSU to another.

S. Tiennoy and C. Saivichit [4] have been proposed the data dissemination protocol and located in RSU. The performance has been compared based for No-RSU-1lane, No-RSU-2 lane, RSU-1lane and RSU-2lane. The obtained result shows that the traffic load and total dissemination interval decreases and the data throughput increases with the RSU in compare with the non RSU communication.

S. S. Manvi has been evaluated [5] the comparison of the MANET routing protocols based on mobility, load and size of the network in VANET environment. Researcher has been used the random way point model in which each node remains stationary for few times, moves again, and found that AODV and DSR have not been suitable for VANET. However, swarm intelligence routing protocols have been given satisfactory results in terms of packet delivery ratio on different packet size.

The aforementioned studies as past have been confirmed that the MANET routing protocols can be affected the performance of data dissemination in VANET and data complete data dissemination time decreases with the presence of RSUs. It can also be envisioned that noise or misleading messages can be very precarious in VANET. However, within
the framework set forth by this research study on the performance evaluation of handover scenario between RSU and vehicle for automatic TCP connection and disconnection, the investigation scope of current literature is still limited. Particularly, the available research focused on the data dissemination between vehicle to vehicle and vehicle to RSU, however handover scenarios have not been considered during the communication between RSU and vehicle.

In this paper, the beacons control data dissemination protocol has been proposed and evaluated the performance on different traffic densities, traffic type and routing protocols dedicated to MANET. The network simulator (NS-2) uses to model the proposed scenario.

The rest of paper is organized as follows. Section II describes the proposed model. Section III discusses the simulation settings. Section IV provides the analysis of the simulation results. Conclusion is given at the end.

II. PROPOSED MODEL

The proposed model is based on the three modes i.e., broadcast, active, TCP connection/disconnection during handover. According to the Fig. 1, the vehicle moves in a single lane road and communicates with the RSU’s. All RSUs broadcast the beacons in periodic manner. The RSUs broadcast the beacons one hop manner only, however, the vehicles can transmit multi hop forwarding.

According to the Fig 2, step 1 indicates that the vehicle receives the beacon from RSU and retrieves the RSU id and starts to transmit data as per step 2. The scenario has been modeled in NS-2. In simulation, the contact time adjusts according to the speed of the vehicle. The vehicle transmits packets until the end of the contact time between RSU and vehicle. At the end of the contact time, vehicle stops transmission and tries to connect with the next RSU in 0.10 sec. After the successful established the connection with the next RSU, the vehicle resumes packet transmission with the RSU. It means vehicle takes 0.01 sec in the complete handover and resume the services.

Handover conditions:

1. Stop transmission in \( T_1 \) sec
   \[ T_1 = \text{[Contact time between RSU and Vehicle]} \]

2. Disconnect TCP connection and start connect with the next RSU in \( T_2 \) sec
   \[ T_2 = \text{[Contact Time + 0.10]} \]

3. Resume data transmission in \( T_3 \)
   \[ T_3 = \text{[Contact Time +0.11]} \]

is also helpful for reducing the congestion which should be helpful for a good connectivity in the network. On the contrary, if the contact time will be long then due to limited bandwidth of the RSU, the less number of vehicles can able to connect with the RSUs. The contact time is the important factor that would affect in the performance of such system. Longer contact time results in depositing the more amounts of the data to be deposited at the RSU.

The algorithm has been developed for handover scenario between RSU and vehicle. The proposed algorithm is based on the three conditions. When the vehicle approaches the RSU and receives beacon, vehicle extract the RSU id and starts the packets transmission with the RSU. The fixed contact time has been taken in this research study according to the speed of the vehicle. At the end of the contact time, vehicle stops transmission and tries to connect with the next RSU in 0.10 sec. After the successful established the connection with the next RSU, the vehicle resumes packet transmission with the RSU. It means vehicle takes 0.01 sec in the complete handover and resume the services.

III. SIMULATION SETTINGS

NS-2.34 [6] is used for implantation the proposed beacons control data dissemination protocol [8][9]. Table I. shows all the parameters have been taken in this experiment. There are 10 numbers of nodes used in which 6 are vehicles and 4 are RSUs. Three different types of routing protocols have been used. The simulation runs for
different routing protocols by varying number of vehicles and different traffic types have been used. The AODV protocol makes delay in the route discovery. If route request fails from vehicle, then, for finding another route after the next routing scheduling, it consumes plenty of seconds. Therefore, during this time interval, the vehicle simply across the transmitting range of the particular RSU and if the vehicles try to send data, after crossing the previous RSU, then packets drops. In many cases under fast moving scenario and under congested condition, nodes unable to establish the connection with the RSU within its available contact time. On the contrary, In DSDV protocol, the every node maintains the routing information for all known destinations and updated periodically. The drawback of this protocol is to maintain the routes which are never used. However, there is no latency to discover the route in this protocol. Moreover, AOMDV is defined as the on-demand multipath distance vector routing protocol. AOMDV maintains multiple loop free paths while AODV is single path protocol. These three protocols with their own merits and demerits have been used with the proposed data dissemination protocol [10] to evaluate the performance.

The simulations outputs have been observed in terms of data receive ratio, end-to-end delay, and throughput. These are performance metrics to evaluate the performance of the network protocols. The performance of the proposed protocol has been analyzed during handover by using different type of routing protocols in NS-2. The calculation of the performance metrics during these experiments explain as follows:

Data receive ratio (DRR) is defined as the ratio of successful received packets and total number of generated packets.

\[
DRR = \frac{\sum_{i=1}^{N} D_i}{\sum_{i=1}^{N} S_i} \times 100 \quad (1)
\]

Where \( S_i \) is the number of generated packets of node i, and \( N \) is the number of maximum nodes. \( D_i \) is the number of received packets. It shows, if DRR is high, the performance of the protocol should be acceptable. Total delay time (TDT) is defined as the total end to end delay of all packets which reach to the destination divided by the DRR.

\[
TDT = \frac{(T_1 - T_f)}{DRR \times 100} \quad (2)
\]

Where \( T_1 \) is the total end to end delay of last node which receives the last packets of the system and \( T_f \) is the total end-to-end delay of the first node, which initiate as the first packet sender. It means high end-to-end delay, the performance of the protocol decreases. Throughput is defined as the ratio of total number of data packets and total delay time.

\[
Throughput = \frac{(\text{Packet Size} \times \sum_{i=1}^{N} D_i)}{TDT} \quad (3)
\]

For high number of packets received, the throughput also increases.

**IV. SIMULATION RESULTS**

As per discussion in section III, the simulation results are based on the three performance metrics such as data receive ratio (DRR), end-to-end delay and throughput for different traffic generator i.e., CBR, FTP. According to the Fig. 3, the packets dropped for AOMDV and DSDV is approximately equal while less number of packets has been dropped in AODV compare to other two.

![Fig. 3. Packets Dropped-CBR](image)

DRR is very critical metric for the performance evaluation of proposed protocol. In Fig. 4, the DRR for AODV decreases from 99.51 to 95.30 by the increasing number of vehicles from 1 to 6 for traffic generator CBR. While for the other two protocols, the DRR values decrease from 98.88% to 90%. If consider throughput (3) as in Fig. 5, the performance of three protocols are same for less number of vehicles but when increase the vehicles from 4 to 6, the throughput has been found to increase for AODV and AOMDV in compare to DSDV. In Fig. 6, end-to-end delay (2) increases by the increasing number of vehicles. The delay for AOMDV and AODV is less in compare to DSDV. It means for traffic type CBR, the AODV and AOMDV had slightly better perform in terms of delay in compare to DSDV but difference is not so much. Now if consider the traffic generator FTP in Fig. 7, the dropped packets are very less for AODV in compare to the AOMDV and DSDV.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Simulated Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>NS-2.34</td>
</tr>
<tr>
<td>Simulation Time</td>
<td>500 sec</td>
</tr>
<tr>
<td>Antenna Model</td>
<td>Omni Directional</td>
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<tr>
<td>Radio Propagation Model</td>
<td>Propagation/Two Way Ground</td>
</tr>
<tr>
<td>Mac Type</td>
<td>Mac/802_11</td>
</tr>
<tr>
<td>Routing Protocol</td>
<td>AODV,AOMDV,DSDV</td>
</tr>
<tr>
<td>Number of vehicles</td>
<td>1,2,3,4,5,6</td>
</tr>
<tr>
<td>Packet Size</td>
<td>CBR=256 Byte</td>
</tr>
<tr>
<td>Vehicle speed</td>
<td>20 km/hr</td>
</tr>
<tr>
<td>Number of RSU’s</td>
<td>4</td>
</tr>
<tr>
<td>Traffic Generator</td>
<td>CBR (Constant Bit Rate), FTP (File transfer protocol)</td>
</tr>
<tr>
<td>RSU Beacon Size</td>
<td>10 Bytes</td>
</tr>
<tr>
<td>Distance Between RSU</td>
<td>400 Meters</td>
</tr>
</tbody>
</table>

Table I. Simulation parameters
The DRR value for AODV in Fig. 8 decreases from 99.55% to 96.69% by the increasing number of vehicles from 1 to 6 for traffic generator FTP. While other two protocols, DRR value decrease from 98.83% to 93.21%. The slight difference has been found in the throughput for AODV and AOMDV up to 4 numbers of vehicles but AODV performs well for large number of vehicles in compare to other protocols as shown in the Fig. 9. The DSDV performance has been degraded in terms of throughput compare to the other protocols for FTP. In Fig. 10, the end-to-end delay has been found to minimal increase for DSDV but approximately same for AODV and AOMDV. In Fig. 11, the average throughput for FTP has been observed to intensify in compare to the CBR. For individual traffic generator, the performance has been found to similar of all three routing protocols for CBR in terms of average throughput. In [3], AODV has been found better compare to the AOMDV and DSDV but in RSU broadcast beacons for single hop and beacons control data dissemination; there is slight difference for all three protocols for traffic generator CBR. However, in case of traffic generator FTP, the ADOV performs well in terms of throughput. For average end-to-end delay in Fig. 12, the delay has been found to high for FTP in compare to the CBR.
If evaluate individually, there are no much difference in delay for all three protocols. In Fig. 12, the average value of DRR for AODV using traffic generator CBR has been found as 97.34% while for DSDV and AOMDV have been found as 92.53% and 93.005%, respectively. The similar difference has been found for DRR value for FTP.

V. CONCLUSION

The beacons control data dissemination protocol has been proposed for handover scenario between RSUs and vehicles in VANET. The experiments has been performed in NS-2. The performance of proposed protocols has been evaluated by varying the traffic type, routing protocols dedicated for MANET and traffic density. According to the obtained results, the DRR value for AODV is 97.34% by using CBR and 98.29% by using FTP. Moreover, DRR value for other two protocols varies from 92% to 94%. There is minute difference among all three protocols in terms of throughput i.e., 131.44, 130.08, and 133.78 in kbps for CBR but in case of FTP, the AODV performs well and the throughput is 213.19 kbps while for DSDV the value is 181.5 kbps and for AOMDV the value is 208.9 kbps. For average end-to-end delay, there is no any big difference found among three protocols for both CBR and FTP. The dropped packets are 64 % low for AODV in compare to AOMDV and DSDV for both CBR and FTP. In conclusion, the routing protocols dedicated for MANET has found suitable for proposed protocol in VANET and AODV protocol found more reliable in compare to others two (DSDV and AOMDV).

The performance of proposed protocol has not been found much affected in terms of DRR for both CBR and FTP but for throughput and end-to-end delay, FTP has found more suitable in compare to CBR. It has been also observed that for high density of vehicles, the performance of proposed protocol degrades.

REFERENCES


