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Modified AODV Routing in Multi-Lane Changing Models in VANET

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Abstract

Vehicular Ad-hoc Network (VANET) is emerging as a standard routing protocol as a countermeasure for rapidly changing topology and high mobility of vehicles. An ad-hoc routing protocol could play a crucial role in VANET applications, safeguarding both drivers and passengers. When dealing with vehicular mobility modeling, we distinguish between macro-mobility and micro-mobility. This paper proposes modification in AODV for the lane changing models and their analysis so that the proposed roadmap gives large impact on generation of traffic.

Keywords: *Vanet, Multi-lane, Macro-Mobility, Micro-Mobility.*

1. Introduction

A Vehicular Ad-Hoc Network (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, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, create a` network with a wide range. As 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. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes [1].

VANET is playing a vital role in the future safety and ease of our roads. VANETs will enhance driver safety and reduce traffic deaths and injuries by implementing collision avoidance and warning systems. In addition, VANETs can relieve traffic congestion by providing a driver with live routes that avoid road hazards and bottleneck areas. The vast sensor network that VANETs will create, is inciting countless other applications, and making VANETs a hot topic in ad hoc networking today[2].VANETs are one of the most promising application areas of MANETs. VANET communication is normally accomplished through special electronic devices placed inside each vehicle so that an ad hoc network of the vehicles is formed on the road. A vehicle equipped with a VANET device should be able to receive and relay messages to other VANET device equipped vehicles in its neighborhood. VANET applications can be broadly classified into two categories: safety applications and comfort applications [3]. An example of a safety application is on-board active safety systems to assist drivers with information (like accidents, road surface conditions, intersections, highway entries and etc) about the road ahead. Comfort applications are those applications that can provide noncritical services like weather information, gas station or restaurant locations, mobile e-commerce, Internet access, music downloads and etc.

VANET offers countless benefits to organizations of any size. Automobile high speed Internet access would transform the vehicle's on-board computer from a nifty gadget to an essential productivity tool, making virtually any web technology available in the car. While such a network does pose certain safety concerns (for example, one cannot safely type an email while driving), this does not limit VANET's potential as a productivity tool. It allows for "dead time"—time that is being wasted while waiting for something—to be transformed into "live time"—time that is being used to accomplish tasks. A commuter can turn a traffic jam into a productive work time by having his email downloaded and read to him by the on-board computer, or if traffic slows to a halt, read it himself. While waiting in the car to pick up a friend or relative, one can surf the Internet. Even GPS systems can benefit, as they can integrated with traffic reports to provide the fastest route to work. Lastly, it would allow for free, VoIP services such as Google Talk or Skype between employees, lowering telecommunications costs [4]. While the Internet can be a useful productivity tool, it can also prove to be quite distracting, resulting in safety and actually time-wasting concerns. Like cellular phones, the Internet can be tempting and can distract users from the road. Checking emails, surfing the web or even watching YouTube videos can engross drivers and lead to accidents. Similarly, while drivers may have the opportunity to do work while on the road, they also may use this opportunity to engage in other leisurely tasks, such as VoIP with family, watch news highlights or listen to podcasts [4].

2. Mobility Models [5]

When dealing with vehicular mobility modeling, we distinguish between macro-mobility and micro-mobility descriptions.

2.1 Macro-Mobility

For *macro-mobility*, we intend all the macroscopic aspects which influence vehicular traffic: the road topology, constraining cars movement; the per-road characterization, defining speed limits, number of lanes, overtaking and safety rules over each street of the aforementioned topology; the traffic signs description, establishing the intersections crossing rules; the car class dependent constrains, providing differentiation in the above rulings for different types of vehicles; the traffic patterns delineation, outlining the popularity of different locations as traffic destinations during different hours of the day and for different classes of drivers, etc.

2.2 Micro-Mobility

Micro-mobility instead refers to the individual behavior of drivers, when interacting with other drivers or with the road infrastructure: traveling speed in different traffic conditions; acceleration, deceleration and overtaking criteria; conduct in presence of road intersections and traffic signs; general driving attitude, related to driver's age, sex and mood, etc. The distinction between macro- and micro-mobility we propose is not to be confused with the difference between the macroscopic and microscopic scales commonly employed in traffic flow theory, and in physics in general. In that contest, macroscopic descriptions model gross quantities of interest, such as density or mean velocity of cars, treating vehicular traffic according to fluid dynamics, while microscopic descriptions consider each vehicle as a distinct entity, modeling its behavior in a more precise but computationally more expensive way.

3. Proposed Work

When considering large number of vehicles to be simulated in vehicular applications, road with single lane cannot be fixed factor. In real world, road can be of multilane and movement of vehicles on this topology is different than single lane road. Therefore we proposed roadmap which is multilane structure and flow of vehicles is not in one direction or in one lane only. In other words lane changing models are analyzed. It gives large impact on generation of traffic since city scenarios such as bridge (flyover) is common in road layout.

The proposed is done by introducing two fields in the packet format of the aodv i.e no of lanes on road and the lane no on which vehicle is moving. Due to this change every vehicle know the about the about the no of lanes on the road and the current lane. A vehicle receives the packet transmitted by any other vehicle. Due to the field present in the packet the vehicle gets to know about the number of vehicle in current lane and in neighbour lanes. This allows any vehicle to change its lane.

If the reply packet contains the lane change i.e. LC=1 then the lane can be changed otherwise lane cannot be changed.

3.1 Proposed Algorithm

1. Input: REQ Request Packet
2. If (LC REQ Received) then:
   a) If LC No. of REQ ≠ LC No. of Current-1(if exists) and LC No. of REQ ≠ LC No. of Current+1(if exists), then:
      Lane change can occur. Send REP with field LC=1.
   b) Else

Send REP with field LC=0.
[End if.**]**

3. Else:
Conventional AODV works.
[End if]

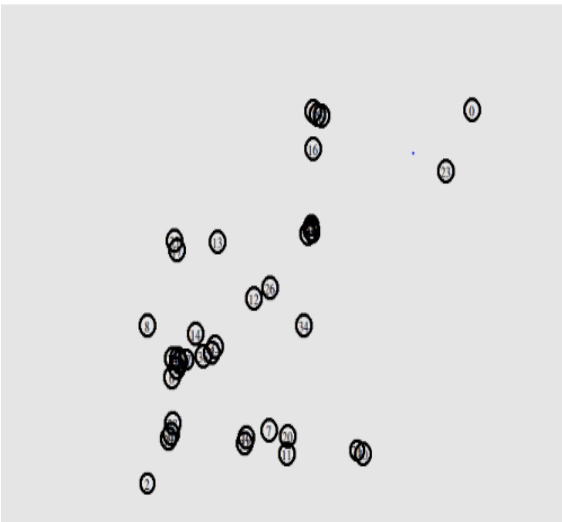
4. Exit

Where REQ= Request Packet, LC=Lane Change, REP=Reply Packet. In this algorithm, a request packet is generated by the vehicle i.e. REQ which contains the information of lane number of the vehicle and total lane numbers.

In the network the vehicle which receives this request packet will check that whether the lane number is the same as its own. If the number is same then it will send an acknowledgement reply i.e. REP which sets the value of lane change LC to 0. But if the lane number of requesting vehicle is different than lane change takes place after sending the acknowledge message REP with lane number.

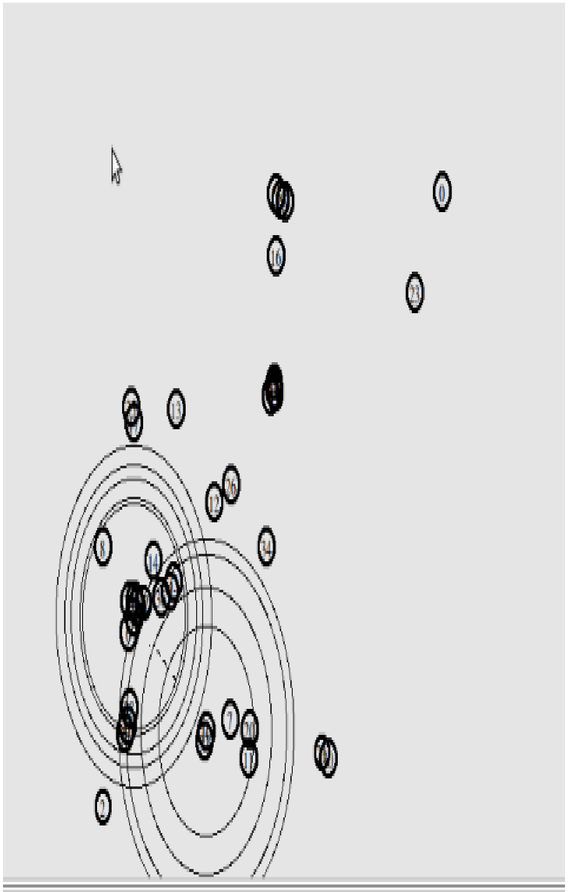
3.2 Different Snapshots

Diagram (a)



In diagram (a) movements of vehicles are shown in 2lane, vehicles are shown as nodes. Different vehicle have different numbering.

Diagram (b)



In diagram (b) links between different vehicles are shown in 4lane and information are transmitted through packets.

4. Results

To achieve the required results or to complete the proposed work performance of various lanes are analyzed. Following shows the analysis of different lanes:

Table-1: Performance Analysis on different lanes

No. of Lanes	Packet Generation	Received Packets	Packet Delivery Ratio (PDR)	Total Dropped Packets	Avg. End-to-end Delay (ms)
2	16602	16582	99.8795	13	54.5513
4	16600	16580	99.8795	3	64.6
6	8317	8297	99.7595	9	122.306

On the basis of above table, graphs are generated. Graph-1 is showing the performance of packets on the basis of lanes. In this graph packet delivery ratio (PDR) and End-to-end Delay (e-2-e delay) is represented and their values are improved from the existing system.

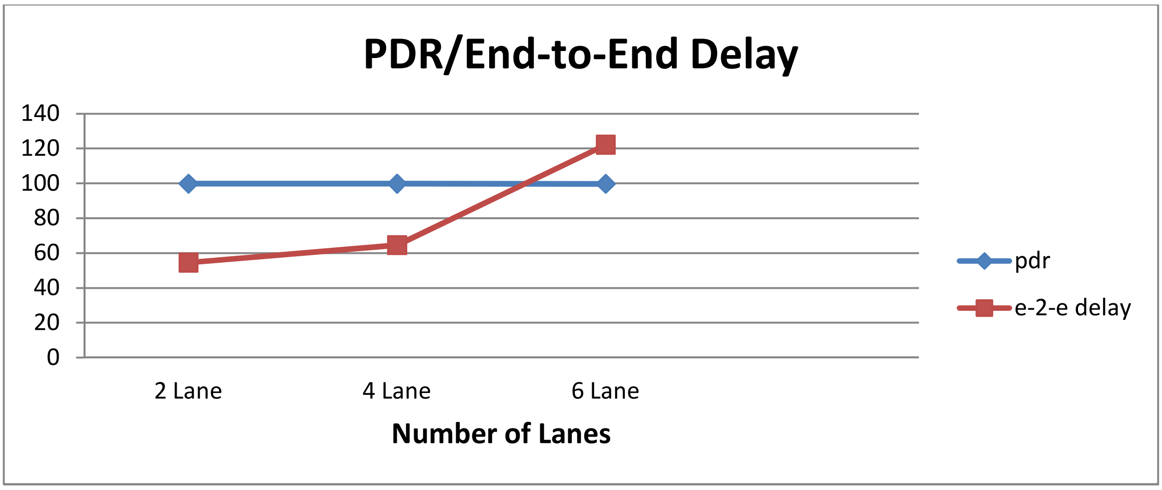


Figure 1: Graph showing results of PDR and End-to-end Delay

In the Graph-2, performance of packet generation, packet receiving and packet dropping is showing.

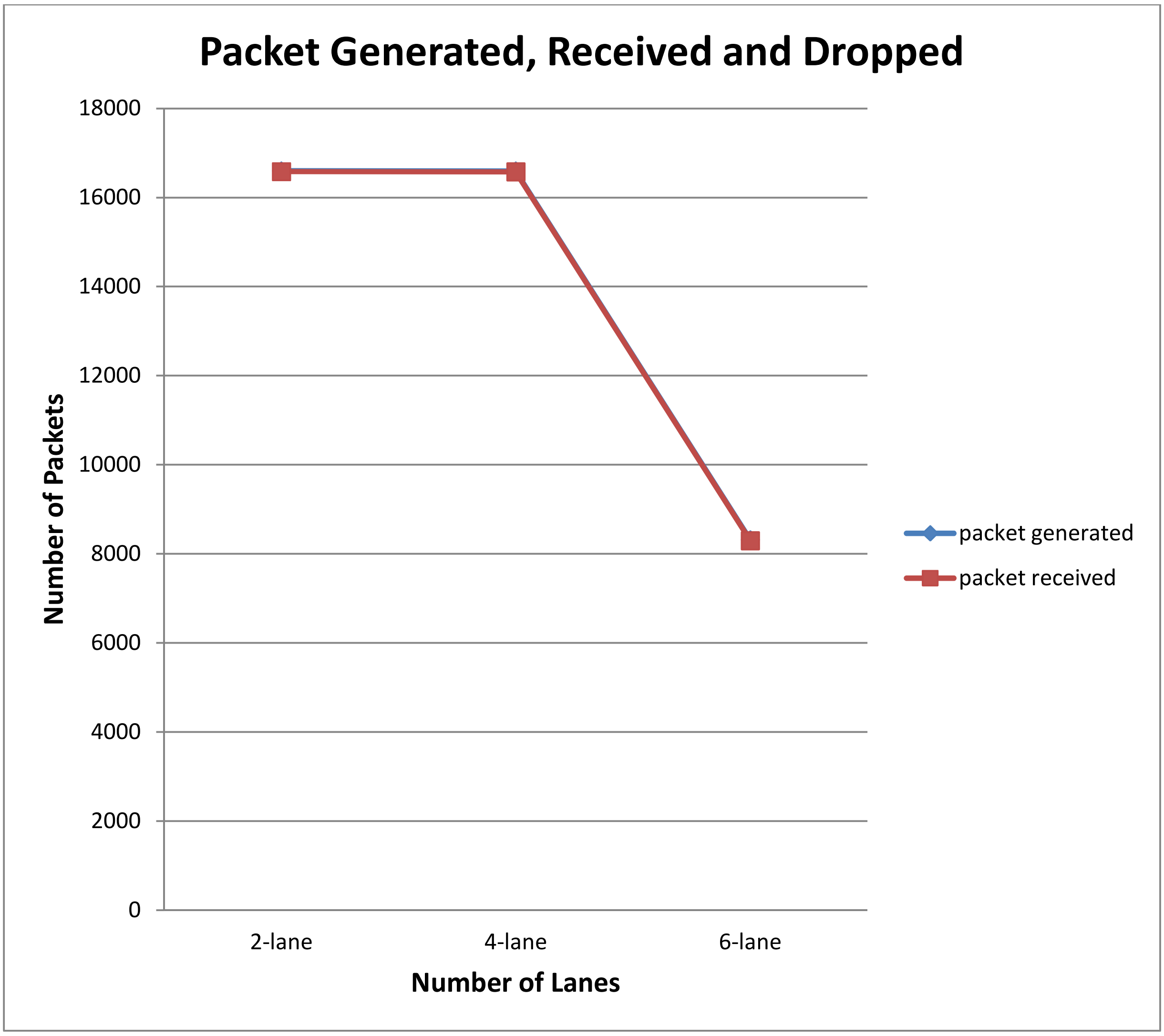


Figure 2: Graph showing results of packets generated, packets received and packets dropped

5. Conclusion

In this paper VANET and its mobility models are discussed. The proposed work performs well for the 2,4,6 lane models. The packet delivery ratio is above 99% and the end to end delay is larger in the 6 lane model. It means end 2 end delay increases as the number of lanes increases. In future the world implementation of proposed work can be done.

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