

Performance Enhancement of DSR Routing Protocol in VANET

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ABSTRACT: VANET is the technology for building a strong Ad-Hoc network between mobile vehicles and between mobile vehicles and fixed roadside units. This type of network should be carefully checked before distribution in the real world because it involves a lot of risks. The testing should be executed using computer simulations. In this paper the DSR routing protocol performance will be enhanced according to the two parameters (number of collision and send down packet) by combining two separate simulators SUMO as traffic simulator to simulate the traffic motion & OMNET++ as a network simulator. The improved protocol called ENC-DSR routing protocol which the enhancement has been made to NRR-DSR (NonPropRouterRequest-DSR) and TCS-DSR (TableCachedSize-DSR) parameters. This enhanced protocol has improved the performance of the DSR routing protocol in these parameters. The collected results show that ENC-DSR reduces the number of collisions and sent down packet depending on the variation of the speed and number of vehicle and MAC protocol.

KEYWORDS: Vehicular Ad hoc Network (VANET), Mobile Ad-hoc Network (MANET), Vehicle to vehicle (V2V), Road Side Unit (RSU), Dynamic Source Routing protocol (DSR).

I. INTRODUCTION

VANET is a new communication model that allows the communication between vehicles that move with changing velocities. It is a unique situation of the general Mobile Ad-hoc Network (MANET) to endure communications among close vehicles and between vehicles and close fixed roadside equipment. In VANETs, Vehicle to vehicle (V2V) and the vehicles with the Road Side Unit (RSU) can be procedure communication. These types of communications benefit to avoid the accidents, the traffic jam, etc. by letting vehicles to share and broadcast safety data with other vehicles to caution the car driver and so [1,2]. VANETs take lots of options for new choice of applications which can not only make the road safer but also fun. Applying a dynamic routing protocol is one of the major challenges within the VANET which will facilitate the broadcast of the data from vehicle to another. A routing protocol is a scale that controls how nodes choose how to route the received packets between vehicles in a wireless domain and further illustrious in many types. Routing in VANET is different to the traditional MANET routing because of very dynamical topologies [3]. Few protocols that were previously used for MANET environment are verified on VANET. The challenge, however, stays as how to decrease delay related with passing the data from vehicle to another. The rendering of the routing protocols in VANETs influenced by external factor (such as: road tracks, traffic regulations, environmental factors) and inner factors (such as: vehicle mobility, disruption in the network route and highly paned network) [6]. The efficient routing protocol is the one that could deliver the message in a short time without consuming a lot of bandwidths.

After analyses and evaluate the performance of four routing protocols (AODV, DSR, GPSR, and OLSR) in different VANET networks scenarios using five performance parameters: Throughput, End-to-End Delay (EED), Number of the collision, Send and receive bits and Sent down packets with varying the number and speed of vehicles using three MAC protocols: IEEE802.11g, IEEE802.11p, and IEEE802.11n [4,5]. The results showed the DSR routing protocol has an acceptable throughput and sent and received bit with an intermediate end to end delay and high number of collision and sent down packet when compared it with other routing protocols.

In this paper a study of how to improve the DSR routing protocol will be presented. After this brief introduce the rest of this paper is organized as follows. Section (II) presents DSR routing protocol. The modified proposals of routing protocol are described in Section (III). Section (IV) is dedicated to the simulation setup. Section (V) shows the simulation results, and conclusion is given in section (VI).

II. DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

One of the reactive routing protocols is the Dynamic Source Routing protocol (DSR). It is an efficient routing protocol intended specifically to be used in multi-hop wireless ad-hoc networks. The network is completely self-organizing and self-configuring, and no need for infrastructure or administration network [8,9]. In DSR each intermediate node that transmits a route request (RREQ) packet tag its own address to a list involved in the packet. The received node produces route replay (RREP) message that contains list of addresses received in route request and retransmits it by using same pathway to the source. The source route of this network need two main methods (Route Discovery and Route Maintenance) [10,11]. Route Discovery as shown in figure (1) used when source A goes to transmit data to a destination J that does not know the route. Route Maintenance used when source needs to transmit packets to destination with known route.

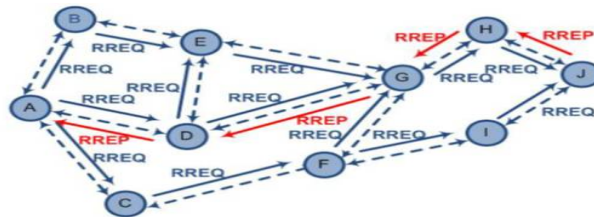


Fig. 1. Route Discovery in DSR

The NonPropagating Route Request (NPRR) was explained by Johnson [8,13] that is one of the DSR parameter that affect its performance. A NPRR is an initial point of a route discovery. A car using NPRR sends its first route request attempt for other vehicles using a hop limit of 1, in same way, any vehicle receiving the first transmission of the RREQ will not retransmit the requests to another car by rebroadcasting the request. After period time, if no route reply received, then the car transmits a broadcasting RREQ for the destination car [14]. Rapid replies from vehicles can be a source for collision at the first vehicle that called route reply storm. Additionally, The Route Cache Table (RCT) must be used in each vehicle implementing DSR routing protocol. it containing routing information which the vehicle needs. A vehicle adds entry to its route cache table inform when a new path between vehicles in the ad-hoc network added, for example, a vehicle may pick up of new paths when it gets a packet that has an RREQ or RREP source routes. DSR searching routes in route cache of the vehicles is called RCing [15].

III. MODIFIED PROPOSALS OF DSR ROUTING PROTOCOL

The number of collisions, sent down packet and end to end delay metrics are important parameters in VANET which they must be as low as possible to ensure that the destination receives the transmit packet fast, efficiently and successfully. In this paper, we will improve the performance of DSR routing protocol according to two metrics (number of collision and sent down packet). The improved DSR routing protocol called ENC-DSR by enhancement of two parameters: NPRR-DSR and TCS-DSR parameters.

A. NPRR-DSR

as explained in section (2) the nonpropagating route request is one of the DSR parameter that affect its performance. When one vehicle sends the Route Request to many other vehicles in the same local area network, they can respond with Route Replay. Instantaneous replies by vehicles can cause a collision at the first vehicle called route reply storm. so, to solve this issue each vehicle should wait sending the message reply by random by define the Waiting

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Time (WT) that is variable. If no RREP is arrived within the interval time, a new RREQ will be directed. The waiting time premeditated by supposing that the packet header has the position of the source vehicle. numerous vehicles are using navigation systems. By defining its own site, a receiver measured the WT according to the distance to the source, such that the waiting time is shorter for farther vehicles. therefore, vehicles at the margin of the coverage area take part in forwarding the packet rapidly.

B. TCS-DSR

as explained in section (2) the route cache table must be used in each vehicle implementing DSR routing protocol. a large value of TCS refers that the route cache saves incorrect routes. So, by dropping the value of TCS we solved the issue of saves incorrect routes.

IV. SIMULATION SETUP

Two separate simulators SUMO as traffic simulator to simulate the traffic motion & OMNET++ as a network simulator to simulate different VANET applications are combined together to run the VANETs simulation. The ENC-DSR routing protocol has been examined in two environments: highway and city, with varied speed and number of vehicles with using three MAC protocols (IEEE 802.11g, IEEE 802.11p and IEEE 802.11n) in each one. Table (1) shows the traffic metrics in each environment. Table (2) shows the value of the network metrics for the three MAC protocols.

Table -1 traffic metrics in the highway and city environments

Table -2 network metrics in the highway and city environments

Parameter	Values	
	Highway	City
Maxspeed of the Vehicle	80,100,120,140 km/h	40,60,80,100 km/h
Vehicles Number	50, 125, 200,250,300	75, 150, 200,300,500.
Acceleration	2.6 m/s ²	2.6 m/s ²
Deceleration	4.5 m/s ²	4.5 m/s ²
Vehicle Length	5 meter	5 meter
Number of lanes	3	3
Highway Length	5 km	-

Parameter	Value		
	IEEE 802.11g	IEEE 802.11p	IEEE 802.11n
Carrier Frequency	2.4GHz	5.9GHz	5GHZ
Bit rate	54 Mbps	27 Mbps	65 Mbps
Propagation Model	Two Ray Ground		
Mobility Model	Traci Mobility Model		
Packet Length	512 Byte		
Traffic Type	UDP		
Simulation Time	6000 sec		
Routing Protocols	ENC- DSR . DSR		

V. SIMULATION RESULTS

In order to get the performance of ENC-DSR routing protocol in VANET, two performance parameters have been selected:

- Number of Collision: which is the number of packets crashes to each other because of the crowding.
- Sent Down Packets: It refers to the total number of data packets that could not arrive at the destination node. Congestion, faulty hardware, and queue overflow are the main reasons for down packets.

A. City Environment

In this environment, the number of vehicles is set to 100 when changing the vehicle speed. However, the maximum vehicle speed is set to 100 km/h when varying the number of vehicles. Figure (2) shows the number of collision of the

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ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the number of vehicles respectively. It shows that the number of collision of the ENC-DSR routing protocol is lower than original DSR.

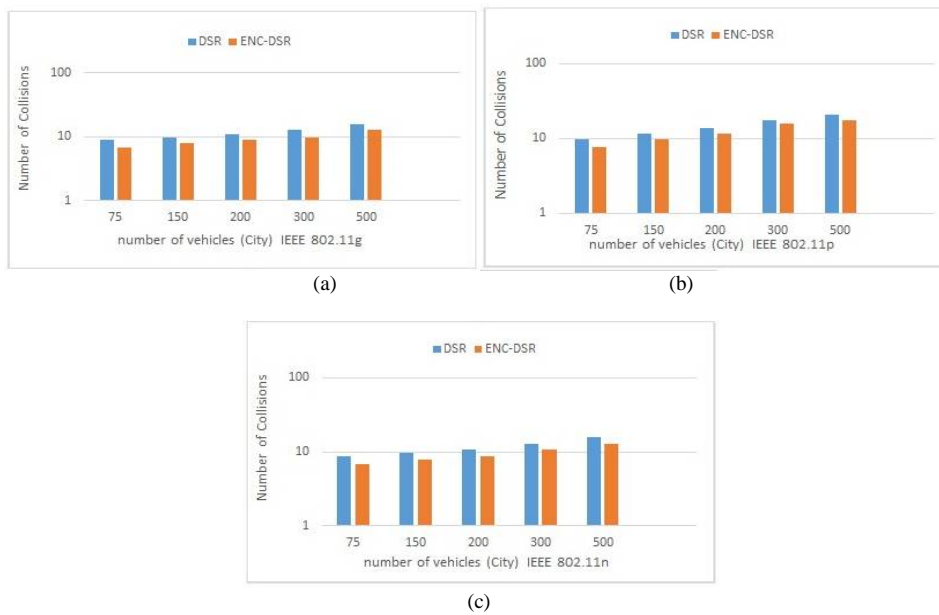


Fig. 2. Number of collision vs. Number of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

Figure (3) shows the sent down packet of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the number of vehicles respectively. It shows that the sent down packet of the ENC-DSR routing protocol is lower than original DSR.

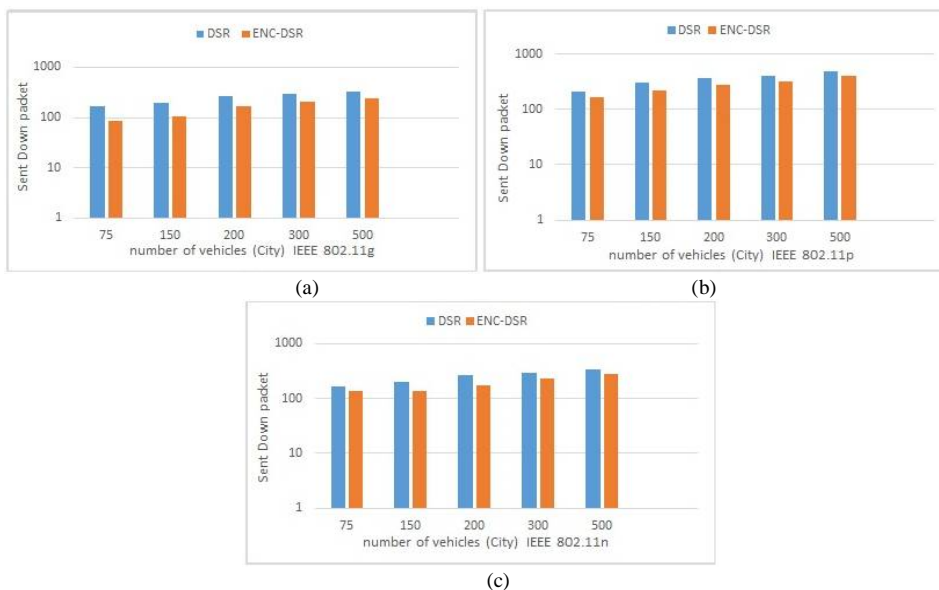


Fig. 3. Sent down packet vs. Number of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

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Figure (4) shows the number of collision of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the vehicles speed respectively. It shows that the number of collision of the ENC-DSR routing protocol is lower than original DSR.

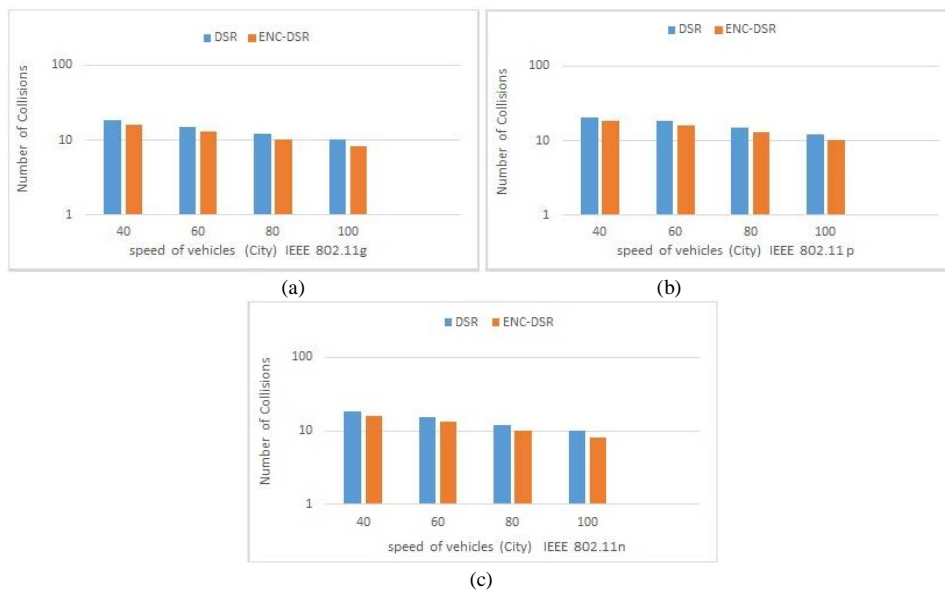


Fig. 4. Number of collision vs. Speed of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

Figure (5) shows the sent down packet of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the vehicles speed respectively. It shows that the sent down packet of the ENC-DSR routing protocol is lower than original DSR.

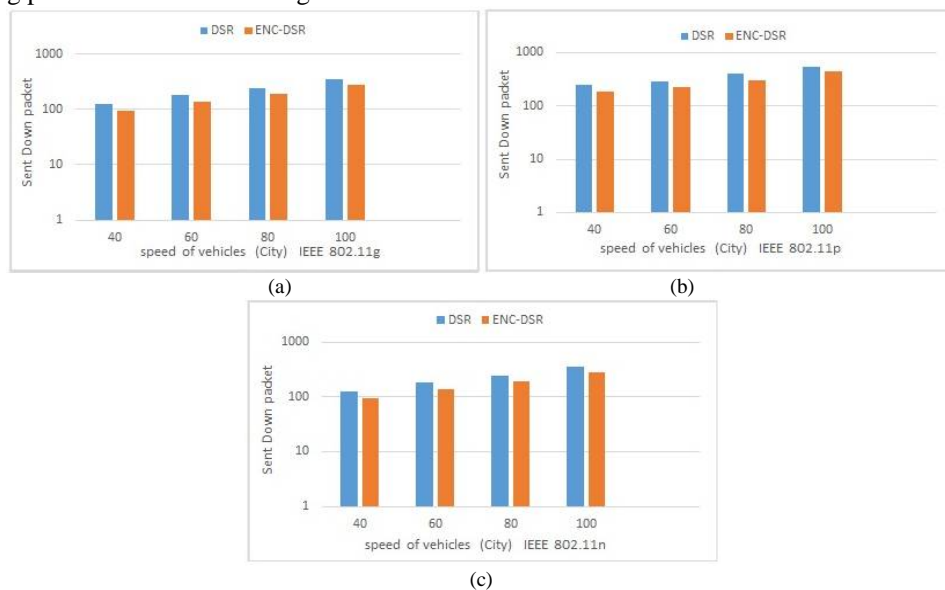


Fig. 5. Sent down packet vs. Speed of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

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B. HIGHWAY ENVIRONMENT

In this environment, the number of vehicles is set to 100 when changing the vehicle speed. However, the maximum vehicle speed is set to 100 km/h when varying the number of vehicles.

Figure (6) shows the number of collision of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the number of vehicles respectively. It shows that the number of collision of the ENC-DSR routing protocol is lower than original DSR.

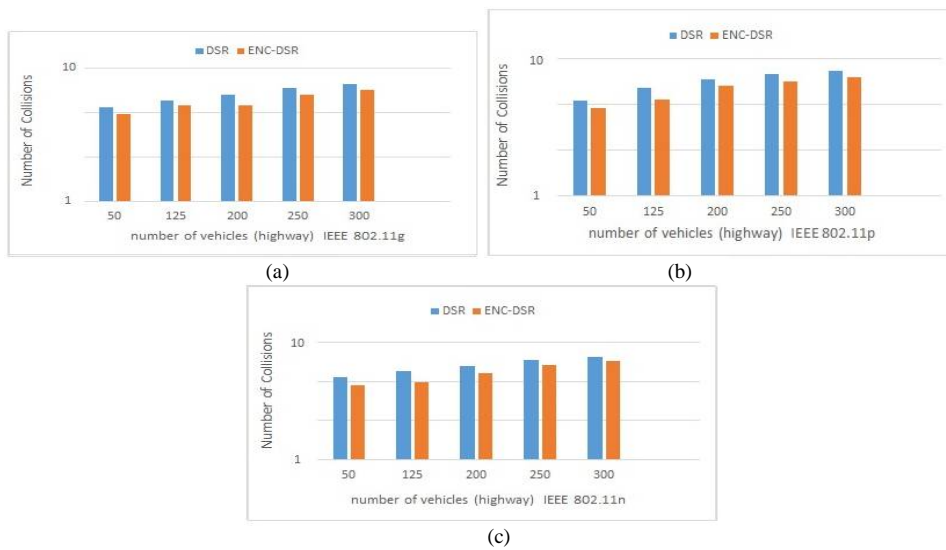


Fig. 6. Number of collision vs. Number of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

Figure (7) shows the sent down packet of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the number of vehicles respectively. It shows that the sent down packet of the ENC-DSR routing protocol is lower than original DSR.

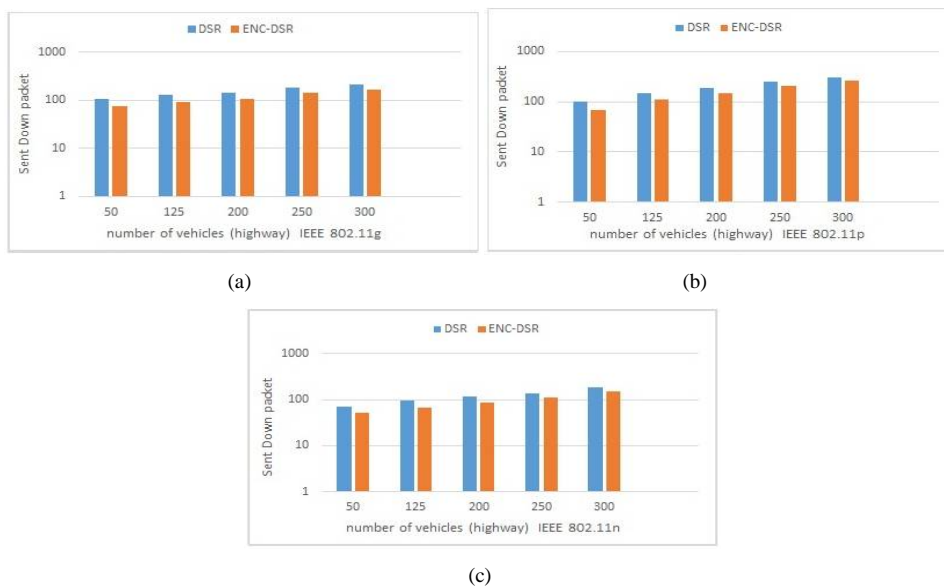


Fig. 7. Sent down packet vs. Number of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

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Figure (8) shows the number of collision of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the vehicles speed respectively. It shows that the number of collision of the ENC-DSR routing protocol is lower than original DSR.

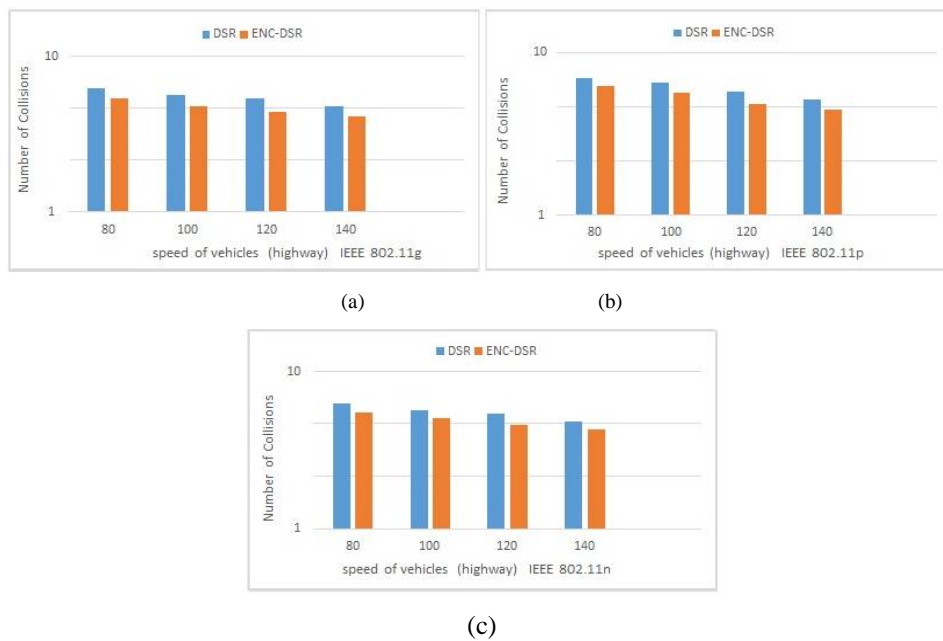


Fig. 8. Number of collision vs. Speed of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

Figure (9) shows the sent down packet of the ENC-DSR and the original DSR using IEEE 802.11g, IEEE 802.11p and IEEE 802.11n MAC protocols against the vehicles speed respectively. It shows that the sent down packet of the ENC-DSR routing protocol is lower than original DSR.

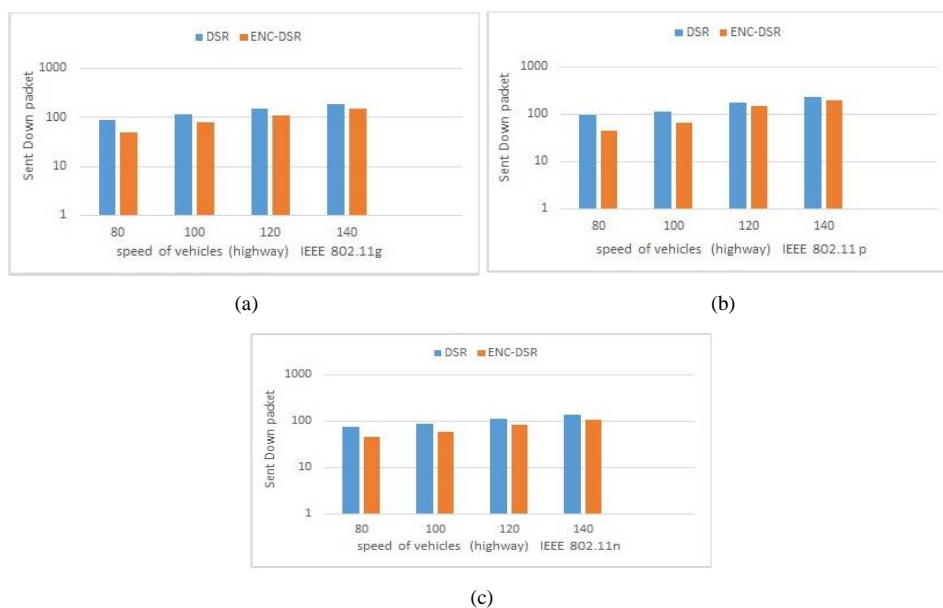


Fig. 9. Sent down packet vs. Speed of Vehicle(a) IEEE 802.11g (b) IEEE 802.11p (c) IEEE 802.11n

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VI. CONCLUSION

This paper concerned on enhancing the performance for the DSR routing protocol (that suffers from a large number of collision and send down packet with intermediate end to end delay value) in VANET. It was simulated using Two separate simulators SUMO & OMNET++ in two environments (highway and city). the simulation running with varying speed and number of vehicles in addition varying the MAC protocols (IEEE 802.11g, IEEE 802.11p and IEEE 802.11n). The performance of the ENC-DSR routing protocol outperform the performance of the original DSR three parameters as follows:

- In the city environment,
 - send down packet decreases with the percentage ranging from (-20.78% to -36.73%).
 - number of collision decreases with percentage range (-12.17% to -20.80%).
- In the highway environment,
 - send down packet decreases with the percentage ranging from (-19.24% to -29.46%).
 - number of collision decreases with percentage range (-27.98% to -39.75%).

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