INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY
ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 3)
Available online at: www.ijariit.com

Smart contention management for the urban traffic management of multidirectional vehicular network

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ABSTRACT

The congestion is rapidly rising across the globe because a larger number of vehicles are adding to the urban traffic every year. The rising numbers of vehicles are elevating traffic problems in the cities, which is causing the slower speeds of vehicular movements across the city roads. In this paper, the proposed model is designed to ease the urban traffic by using the smart traffic management, which is primarily based upon the contention management. The contention management is the model to determine the balanced time slots for the smoother movement of the vehicles across the squares (or light points). The dynamic time slot allocation for the particular direction is entirely based upon the vehicle density assessment mechanism, which provides the information to the time slot allocation algorithm for contention management across the city. This paper evaluates the vehicles moving on the average speed between 1 and 9 KMPH, which imitates the busiest roads of the metro cities and pushes the effort to clear as many as possible vehicles in the lowest possible time using the smart contention mechanism.

Keywords—*Smart contention management, Contention window control, Vehicular network, Traffic management*

1. INTRODUCTION

A vehicular ad hoc network, or VANET, is a technology that uses moving cars as nodes in a network to create a mobile network. A 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. Vehicular networks have been developed to improve the safety, security, and efficiency of the transportation systems and enable new mobile applications and services for the traveling public. Vehicular networks are becoming a crucial component for the future intelligent road traffic management system. Future intelligent road traffic management systems are expected to offer several key advantages compared to the current traffic management systems.

The key advantages are improved knowledge-based real-time traffic signaling systems, improved safety of vehicular traffic and reduced vehicular emissions. Researchers in communications engineering and traffic management systems are engaged for more than a decade to develop suitable Vehicular Ad-hoc Networks (VANET) for traffic safety systems.

VANETs can be seen as a self-organizing autonomous system which can distribute traffic and emergency information to vehicles in a timely manner. VANETs have several advantages over the conventional wireless networks such as UMTS, LTE, and Wi-MAX networks. Main advantages are the low cost of implementation and maintenance, self- organization and lower local information dissemination time VANET is evolving as one of the practical applications of MANETs in the future. This vehicular network is interconnected with vehicles which have a wireless interface. The vehicle can easily provide the required power for wireless communication and adding antennas or additional communication hardware does not cause major problems. The goal of VANET is to develop a vehicular communication system to provide quick and cost-efficient distribution of data for the benefit of passenger safety and comfort. Vehicular delay-tolerant networks rely on opportunistic contacts between network nodes to deliver data in a store carry – and - forward DTN paradigm that works as follows. A source node originates a data bundle and stores it using some form of persistent storage until a communication opportunity (i.e., a contact) arises. This bundle may be forwarded when the source node is in contact with an intermediate node that can help bundle delivery. Afterward, the intermediate node stores the bundle and carries it until a suitable contact opportunity occurs. This process is repeated and the bundle will be relayed hop by hop until reaching its destination (eventually and over time).

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2. LITERATURE REVIEW

Dias .A.J. et al. proposed (2011) "Test bed-based Performance Evaluation of Routing Protocols for Vehicular Delay-Tolerant Networks" [4]. According to the paper on VDTNs (vehicular delay tolerant networks), the testbed valuation of DTN-based routing protocols is used. The target has judged and perceives however common routing ways go through in distributed or divided opportunistic transport network situations. The paper is representing Spray and Wait for the protocol. In a network, the physical process of moving of automobile and opportunistic connectivity to vehicle data between disconnected elements is the idea of this protocol. According to suggested protocol, the buffer size is decreased as a result of this protocol accomplished the flooding sending a single copy of message however affected from long delivery delay (Joao A bias, 2011).

Hung c.c. et al. proposed (2008) "Mobility Pattern Aware Routing for Heterogeneous Vehicular Networks" [7]. According to the paper, conventional protocols of ad hoc routing have no similar temperament for this highly dynamic network. The author suggests a modern Heterogeneous Vehicular Network (HVN) design and a mobility pattern aware routing for Heterogeneous Vehicular Network (HVN). According to paper VANET technology with Wireless Metropolitan Area Network (WMAN) integrates by Heterogeneous Vehicular Network (HVN) and keeps benefits of higher coverage in WMAN and maximum rate in vehicular ad hoc network. Automobile in HVN is communicating with one another and use internet everywhere. The prime target of the routing matter for HVN, the routing protocol result for HVN is totally divergent than VANET or MANET. They tell about the Mobility Pattern Aware Routing Protocol (MPARP) for HVN to supply a lot of trustworthy vehicular to vehicular (V2V) service. In line with this protocol, the 802.16 is used because the base station that stores data table. The data table contains every vehicle's id, present speed, and present location. When any location updating happens in the network then data table update automatically. Some formats of this protocol are used for sending messages.

Ghaleb F. et al. proposed (2013) "Security and Privacy Enhancement in VANETs Using Mobility Pattern" [19].According to the paper in a VANET, a mobility pattern based mistreatment detection approach. The offender is often categorized as outsider and insider. Outsider is a type of interrupter goal to intercept, wrong use or interrupt of the communications link between VANET's nodes. Insider, on another hand, could be a legitimate node would possibly intentionally or unintentionally create unauthorized or undesirable acts (Mistreatment), like update or change, fabricate, drop the messages additionally to, and impersonate different node identities. Mistreatment or wrong behavior in VANETs is often two views of the point: (i) physical movement and (ii) information security perspectives. The unknown Location-Aided Routing in MANET (ALARM) is employed for automobile network that depends on the corresponding time and position information. With the help of the algorithms, we detected mistreatment of vehicles.

Prasad O. et al. Proposed (2012) "Cross-Layer Optimization of VANET Routing with Multi-Objective Decision Making" [20]. According to the paper Vehicular Ad-hoc Network (VANET) and alternative mobile ad-hoc (MANET) network have completely different characteristics from each other. Because of the dynamic position of the automobile, the routing becomes a complicated issue because they behave as routers and radio links are connected with purchasers. First, he suggests CO-GPSR (Cooperative GPSR), updating of older GPSR (Greedy Perimeter Stateless Routing) that uses relay nodes that exploit radio path diversity during a vehicular network to upgrade routing performance. Then he formulates a Multi-objective decision-making issue to pick optimum packet relaying nodes to upgrade the routing performance additional. For the optimization method, he uses cross-layer information. The paper tells us the traditional routing protocols in ad-hoc networks applied to the VANET domain will have prime failures. In VANETs the behavior of radio environment is unpredictable and dynamic that routing turning into a complicated issue than the standard mobile Ad-hoc networks. Furthermore attributable to continues dis-connectivity within the VANET topology it made packet delivery tougher. For routing, authors suggest that three methods use cooperative relays during an ad-hoc network. First one is relay-by-flooding: the message is propagated by flooding and multiple hops. The second one is relay-assisted-routing: uses cooperative nodes of the available path. The third one is relay-enhanced routing: adds cooperative nodes to the existing path. There is a number of system models: A. Cooperative GPSR, B. Cross-layer optimization as a Multi-Objective decision-making problem. The paper gave the reason that they tested cross-layer optimization for a grip position based greedy protocol like GPSR whereas the past similar work was supported routing table based on proactive protocols like AODV. They need to know the cross-layer routing optimization issue in VANET as a Multi-objective decision making issue wherever for increasing objectives the past methods were used to relay nodes with single criteria.

Tashakkori H. et al. purposed "Load Balanced VANET Routing in City Environment" (2012) [21]. According to the paper VLBR (VANET Load Balance Routing) protocol is used for VANET as a result of several routing protocols is planned for VANET. Many of them have centered on geographical routing attributable to VANETs technical specifications. By achieving congestion response from the network and changing to lower congested traffic routes by using the k-Shortest methods algorithmic rule VLBR equalization the congestion among all communication route. The results of simulation results indicate better delivery throughput and ratio compared to different VANET protocols. Contrast to different routing method, in a huge traffic burden VLBR maintains its maximum delivery ratio without enforcing additional overhead for a network. According to the paper, transport communications help sorts of mobile distributed applications, principally classified in the subsequent three types: the first one is traffic, the second one is safety and the third one is entertainment applications. Getting data regarding car parking space or near food services, road route data and even multi-streaming and gaming are some of the examples. Moreover, Ad-hoc network architecture is required to help correct transmission among nodes. The Vehicular Ad Hoc Networks (VANET) that is the focus of the paper. According to VLBR, there is general place in VANET geographical routing protocols. First, every node is responsive to its geographical location and might map this location on the preloaded roadmap. Additionally, authors suppose that the road or route maps not just include the route data, however additionally consist of data or regarding every road's automobile density at definite. VLBR uses three stages that are: first is finding the trail (route) between a source and a destination, second is routing between intersections, and last is equalization traffic victimization k-shortest methods. The paper concludes that before

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beginning the association of connection and sends the packets to the first intersection every node search more than one route between itself and therefore the destination. In the route, every intermediate node sends the packet by the situation of the road. If the traffic is finding on the road then a warning packet is going to be sent to the source, to vary its route onto a lower loaded route. When the nodes of the vehicular ad hoc network go through with a similar routing plan, then the burden of the network is going to be balanced among all connected routes.

Smara G. et al. Proposed (2010) “Security Analysis of Vehicular Ad Hoc Network (VANET)” [22]. According to the paper number of protection issues, difficulties and complications of VANET have examined and explore. According to the author of the paper additionally, settle these difficulties and issues to analyze a set of solution. Each vehicle or car has OBU (On Board Unit). The onboard unit via DSRC connects vehicles with RSU. The device TPD (Tamper Proof Device) is also used in it. The TPD keeps the vehicle secrets such as keys, speed of vehicle, identity of driver, detail of trip, route. Numbers of attacks mentioned as DOS, Replay Attack, Alteration Attack, Fabrication Attack and a number of the offender are Malicious Attackers, Selfish Drivers, and Pranksters Attackers. Consistent with this paper number of transport network issues are mobility, Volatility, Privacy VS Authentication, Network scalability, Privacy VS Liability and numerous security necessities are Authentication, availability, Privacy, Integrity, Confidentiality and No repudiation.

3. EXPERIMENTAL DESIGN

The vehicular traffic handling mechanism is used for the decongestion of the traffic among the downtown regions or business hubs of the metro cities, where traffic chaos is causing unexpectedly longer delays for the commuters. The traffic decongestion becomes very important in this case in order to increase the productivity of the workforce by not engaging them in the useless traffic jams across the city roads. The contention estimation phase is responsible for tracking the density of the vehicular nodes originating from one direction on an intersection. The vehicular node information updated on the intersection roadside unit (RSU) as soon as the node reaches in its range, which is used to measure the traffic density in the particular direction at the various intervals. The newly added nodes in the lines and the migrating nodes from the lines are used to manage the vehicular count and statistics of the vehicular routing across the target point. In the contention management phases, the density of the nodes is observed in the particular direction, and the percentage of the vehicular to be allowed from a particular direction is based upon that contention calculation. The following algorithm defines the call traffic handling mechanisms in detail:

Algorithm 1: Contention Management for Vehicular Management

1. Vehicular nodes load the existing node information table to the memory of intersection RSU
2. Vehicular nodes load the initially learned node information table into the memory of the intersection RSU
3. Location of the current vehicular node is observed by the RSU in order to know its direction of arrival and departure
4. Also, RSU computes the physical distance of the vehicular node from the intersection in order to know the queue strength using the following equation:

   i = Linear 0∫N

   distance=fx(i,0∫Nj)   if missing point found

   distance $= \infty$ if missing doesn’t reply till wait period

   fx(i,j) = $\sqrt{(x_i - x_i')^2 - (y_i - y_i')^2}$
5. Contention mechanism computes the percentage of vehicular being allowed from each direction
6. Calculate the time slots for each direction using the distance of the last vehicle according to the contention window for a particular direction
7. Forward the vehicles according to the computed time slots
8. Perform the steps 1 to 7 every time for the smart traffic management

4. RESULT ANALYSIS

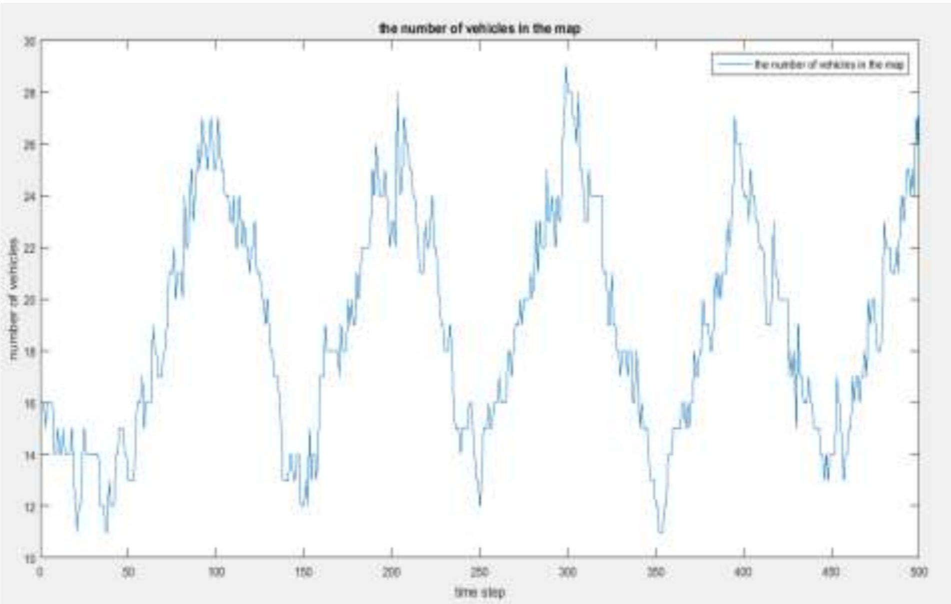

Fig. 1: Number of Vehicles in the frame during the simulation timeline

In figure 1, the number of vehicles in the frame is observed during each second of the simulation time. During each second, the vehicle count shows the situation of traffic, when there is a lesser number of vehicles, it may indicate the slow-moving traffic and vice versa. Also, the possible jamming situation can be caused by the rising traffic volumes.

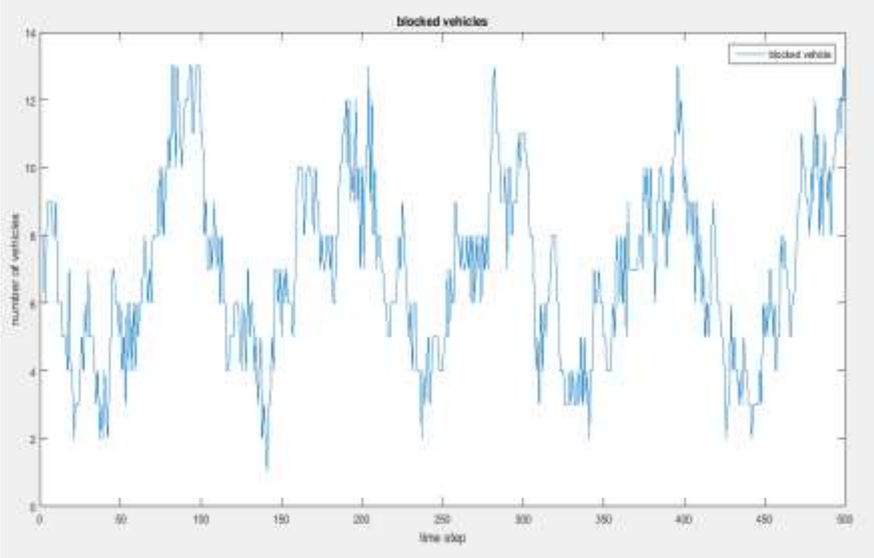

Fig. 2: Number of Blocked Vehicles during the simulation timeline

In figure 2, the number of blocked vehicles is also observed from the simulation on each second of the timeline. The number of blocked vehicles is used to determine the intensity of the traffic and possibility of a jam in the road network of the given area. The simulation shows the blocked vehicles ranging between 1 and 13 on different occasions, which is directly proportional to the number of vehicles in the frame (i.e. figure 1). The higher number of vehicles is blocked, when there are more vehicles running on the roads of the given region of the city.

5. COMPARATIVE ANALYSIS

The proposed model is compared to the existing models based on the fuel consumption and CO2 emissions. Both of the analysis factors are important in order to analyze the vehicular performance in the given urban area, as more fuel consumption increases the expense of the public as well as government, and the high pollution can cause the variety of health hazards for the public residing in the target urban areas.

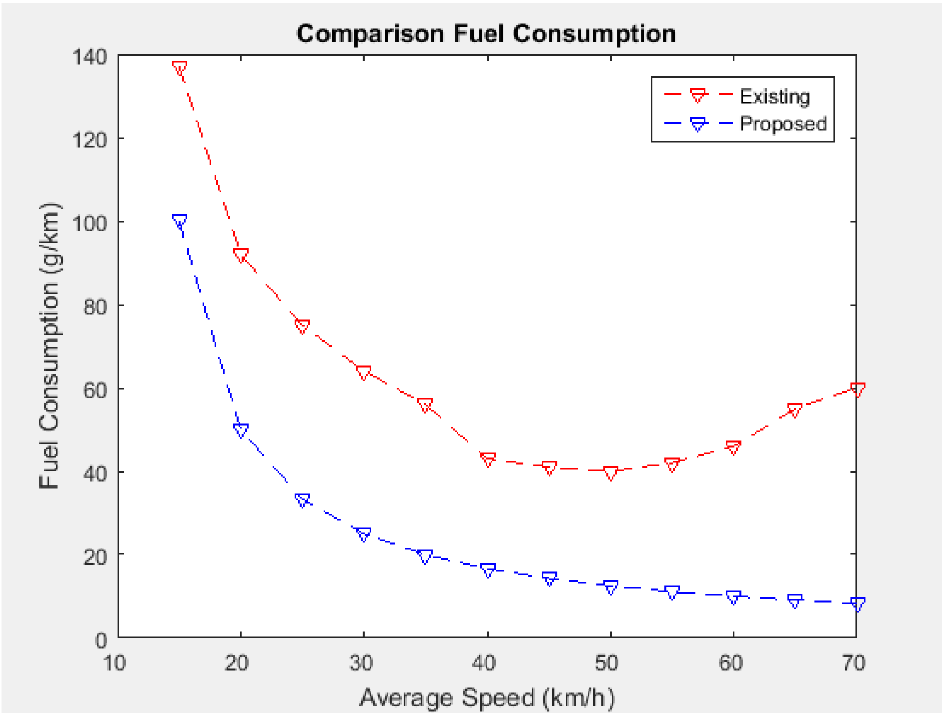

Fig. 3: Comparison of fuel consumption w.r.t. average speed

In the above figure, the proposed model is found consistently lower on the fuel consumption than the existing models on the different speeds, which is caused by the efficient routing of the vehicles on the urban roads. The fuel consumption is recorded with respect to the average speed (kilometers per hour aka. kmph), where the higher kmph (maximum at 70 kmph) is found the most efficient point opposing the existing model, where the fuel consumption again rises above approx. 50 kmph. The existing model is hazardous, as the vehicles are known to perform their level best on fuel consumption around the speeds between 60 and 80 kmph. Hence, the proposed model is found to be more efficient than the existing model for the fuel consumption.

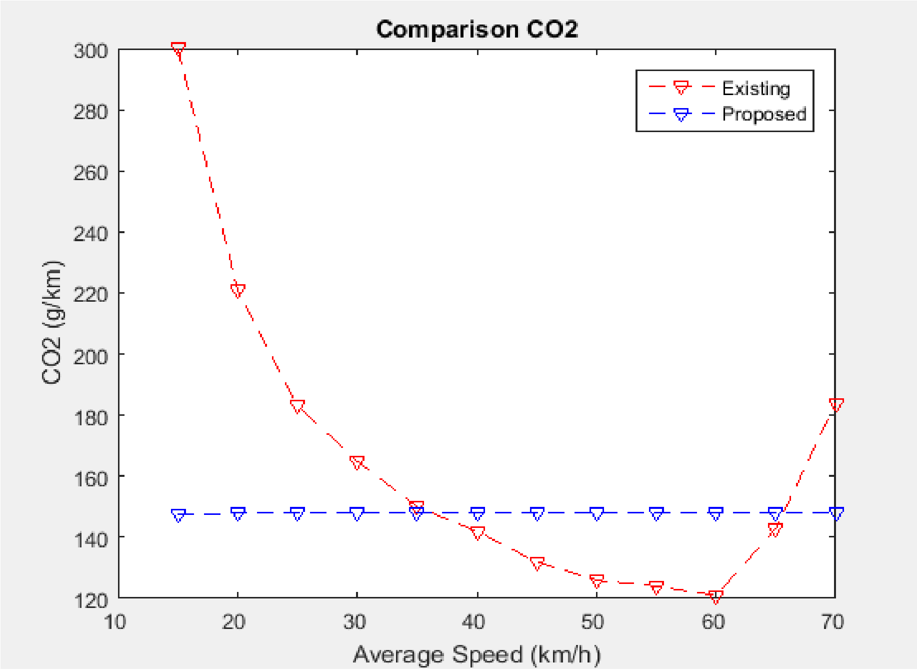

Fig. 4: Comparison of CO2 emission w.r.t. average speed

The proposed and existing models are also evaluated for the CO2 emissions caused by the vehicles moving in the urban areas. The proposed model is found to be constant whereas the existing model keeps on fluctuating at different speeds. The CO2 emissions are directly affected by the amount of fuel consumed by the vehicles multiplied by the number of vehicles. The proposed model is very effective to control the number of vehicles on the road, which is the factor controlling the fuel consumption across the given region on the urban roads. The average CO2 emission of the existing model is 165 g/km, which is outperformed by the proposed model's efficient CO2 emission value of 148 g/km. Hence, the proposed model is found efficient by nearly 10% in comparison with the existing model.

6. CONCLUSION

The vehicular networks are being popular every year and are evolving over the entire world. As the number of vehicles is rising across the megacity roads (metro cities particularly), the size of vehicular networks is also growing. The vehicular networks are taking the shape of dense mobility supported networks with every update, and can more efficiently provide the information about the vehicular density, which is used in this paper for the contention management. As the vehicular networks are rising, the network traffic volume is also rising, which produces the high requirement of the smart route prediction and decongestion mechanisms, such as dynamic contention window, which has to be applied over the intersections in order to reduce the traffic congestion across the busiest streets of metro cities. The proposed model has been designed for the decongestion of the vehicular traffic by using the congestion estimation and contention mechanism along with the incorporation of the quality of service mechanism. The proposed model has performed well to manage the traffic on the busiest streets, which is noticeable from the graphical representation of the results in the results section.

7. REFERENCES

[1] Abdalla, Ghassan MT, Mosa Ali Abu-Rgheff, and Sidi Mohammed Senouci. "Current trends in vehicular ad hoc networks." Proceedings of UBIROADS workshop. 2007.
[2] Bibhu, Vimal, et al. "Performance Analysis of black hole attack in VANET." International Journal of Computer Network and Information Security (IJCNIS) 4.11 (2012): 47.
[3] Chen, Lu, Hongbo Tang, and Junfei Wang. "Analysis of VANET security based on routing protocol information." Intelligent Control and Information Processing (ICICIP), 2013 Fourth International Conference on. IEEE, 2013.
[4] Chim, Tat Wing, et al. "SPECS: Secure and privacy-enhancing communications schemes for VANETs." Ad Hoc Networks 9.2 (2011): 189-203.
[5] Chim, Tat Wing, et al. "Security and privacy issues for inter-vehicle communications in VANETs." Sensor, Mesh and Ad Hoc Communications and Networks Workshops, 2009. SECON Workshops' 09. 6th Annual IEEE Communications Society Conference on. IEEE, 2009. Dias, João A., et al. "Testbed-based performance evaluation of routing protocols for vehicular delay-tolerant networks."GLOBECOM Workshops (GC Wkshps), 2011 IEEE. IEEE, 2011.
[6] Douceur, John R. "The sybil attack." Peer-to-peer Systems. Springer Berlin Heidelberg, 2002. 251-260.
[7] Ghaleb, Fuad A., M. A. Razzaque, and Ismail Fauzi Isnin. "Security and privacy enhancement in VANETs using mobility pattern." Ubiquitous and Future Networks (ICUFN), 2013 Fifth International Conference on. IEEE, 2013.
[8] Guette, Gilles, and Ciarán Bryce. "Using TPMs to secure vehicular ad-hoc networks (VANETs)." Information Security Theory and Practices. Smart Devices, Convergence and Next Generation Networks. Springer Berlin Heidelberg, 2008. 106-116
[9] Guette, Gilles, and Bertrand Ducourthial. "On the Sybil attack detection in VANET." Mobile Adhoc and Sensor Systems, 2007. MASS 2007. IEEE International Conference on. IEEE, 2007.
[10] Hu, Yih-Chun, Adrian Perrig, and David B. Johnson. "Packet leashes: a defense against wormhole attacks in wireless networks." INFOCOM 2003. Twenty-Second Annual Joint Conference of the IEEE Computer and Communications. IEEE Societies. Vol. 3. IEEE, 2003.

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[11] Hung, Chia-Chen, Hope Chan, and EH-K. Wu. "Mobility pattern aware routing for heterogeneous vehicular networks." Wireless Communications and Networking Conference, 2008. WCNC 2008. IEEE. IEEE, 2008.
[12] Javed, Muhammad A., and Jamil Y. Khan. "A Geocasting technique in an IEEE802. 11p based vehicular ad hoc network for road traffic management." Australasian Telecommunication Networks and Applications Conference (ATNAC), 2011. IEEE, 2011.
[13] Khabazian, Mehdi, and M. K. Mehmet Ali. "Generalized performance modeling of Vehicular Ad Hoc networks (VANETs)." Computers and Communications, 2007. ISCC 2007. 12th IEEE Symposium on. IEEE, 2007.
[14] Leinmüller, Tim, et al. "Improved security in geographic ad hoc routing through autonomous position verification." Proceedings of the 3rd international workshop on Vehicular ad hoc networks. ACM, 2006.
[15] Lo, Nai-Wei, and Hsiao-Chien Tsai. "Illusion attack on VANET applications-A message plausibility problem." Globecom Workshops, 2007 IEEE. IEEE, 2007.
[16] Moser, Steffen, Simon Eckert, and Frank Slomka. "An approach for the integration of smart antennas in the design and simulation of vehicular ad-hoc networks." Future Generation Communication Technology (FGCT), 2012 International Conference on. IEEE, 2012.
[17] Mahmood, Raja, and A. I. Khan. "A survey on detecting black hole attack in AODV-based mobile ad hoc networks." High Capacity Optical Networks and Enabling Technologies, 2007. HONET 2007. International Symposium on. IEEE, 2007.
[18] Mahmood, Raja, and A. I. Khan. "A survey on detecting black hole attack in AODV-based mobile ad hoc networks." High Capacity Optical Networks and Enabling Technologies, 2007. HONET 2007. International Symposium on. IEEE, 2007.
[19] Malla, Adil Mudasir, and Ravi Kant Sahu. "Security Attacks with an Effective Solution for S Attacks in VANET."International Journal of Computer Applications 66.22 (2013).

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