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Survey on Drive Assist in VANET

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Abstract: Vehicular Ad Hoc Networks (VANETs) are a completely wireless network connected through the nodes, which usually has dynamic topologies. VANETs are expected to play a key role in the intelligent transportation system (ITS). It can be employed in many applications such as traffic control, safety related message dissemination, and entertainment. With the increasing number of vehicles on the road, a need for an efficient communication and transmission of emergency messages in VANET is required. In this survey, the approach to improve clustering and communication are discussed.

Keywords: VANET, Clustering, Message transmission

I. INTRODUCTION

The main goal of the survey is to improve and explore the possibilities in clustering of VANET groups and communication applications in the VANET. Clustering vehicles to notable VANET groups show better versatility since bunches can introduce simple factual control components and improve verbal trade execution. Single Hop clustering allows vehicles grouped into a cluster of a particular constraint to communicate within them whereas Multihop clustering algorithms make communication in more larger area possible through the communication between the clusters. Message dissemination of alerts and safety applications in VANETs works in a broadcast fashion because the safety information is beneficial to all the vehicles around the sender. With the rise of VANET, it is necessary for it to be improved further.

II. THEORY

A. VANET

Vehicular Ad hoc Network (VANET) is a sub-class of MANET (Mobile Adhoc Network). It is deployed on the road, where vehicles constitute mobile nodes. It is an infrastructure-less network in which the nodes can communicate with a Road Side Unit(RSU) or other moving vehicles. Every vehicle in the VANET is to be equipped with an On Board Unit (OBU), making the communication possible. In a VANET, communication between nodes can be classified as vehicle-to-vehicle (V2V), vehicle-to-roadside (V2R), or vehicle-to-infrastructure (V2I). Roadside units (RSUs) are static nodes deployed along the road, to improve connectivity and service provision. RSUs can be connected to a core network and the Internet. Intelligent Transport System (ITS) is an application of VANET. Applications of VANET, need suitable vehicle-to-vehicle communication technology, especially routing technology. Routing protocol needs to be designed to address challenges of VANET such as, high mobility of nodes, random topology, and heterogeneous networks.

B. Clustering

Network partition or topology fragmentation frequently occurs in vehicular environments due to the sparse vehicle distribution. to overcome these characteristics of VANETs, An efficient organization in terms of communication between nodes is required. So, many clustering schemes have been proposed to organize a VANET into a hierarchy with a view to improve the efficiency of transmission. The idea behind clustering is to group the network nodes into a number of overlapping clusters. Clustering makes a hierarchical routing in which paths are recorded between clusters instead of nodes. This increases the routes lifetime, thus decreasing the amount of routing control overhead. Each cluster has a Cluster Head (CH) as the coordinator within the substructure taking charge of its cluster. Cluster Member (CM) nodes are nodes that belong to the same cluster. The members that belong to more than one cluster are gateway (GW) nodes, which are generally used for communication between clusters. Road Side Units (RSU) can be utilized for communications between non-overlapped clusters

C. On Board Unit (OBU)

An On-Board Unit is a DSRCS transceiver that is normally mounted in or on a vehicle, or which in some instances may be a portable unit. An OBU can be operational while a vehicle or person is either mobile or stationary. The OBUs receive and contend for time to transmit on one or more radio frequency (RF) channels. Except where specifically excluded, OBU operation is permitted wherever vehicle operation or human passage is permitted. The OBUs mounted in vehicles establishes the connection with the Road Side Unit (RSU) and the other OBUs on nearby vehicles for communication.

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D. Road Side Unit (RSU)

Road Side Unit is a DSRC communication unit that is located aside the roads. It serves as a gateway between OBUs and the communications infrastructure. Vehicles can connect to Roadside Units (RSUs), which in turn are connected to the wired Internet and may also be interconnected with each other via a high capacity mesh network. The RSU wired and wireless backbone network can be used to bridge network partitions in the VANET. It provides connectivity and information support to passing vehicles, including safety warnings and traffic information. RSUs are deployed to extend vehicle coverage and to improve network performance in vehicular networks . Vehicles' communication capabilities highly depend on the number of RSUs deployed and their coverage.

III. RELATED WORK

Here we introduce each papers based on the technologies used in the Drive Assist in VANET and they are arranged in technologies bases:

This paper [1] proposes a solution to ensure the safety of drivers while changing lanes on highways. Efficient and fast tracking systems can play an important role in the use of ITS, protecting both drivers and passengers and thus maintaining a safe environment on the road. Here, lane changing in dynamic mobility is achieved by the Driver Assistance System in Intelligent Transport System by communication of information based on vehicle speed and minimum gap between the vehicles. Here, the focus is on the development of an Intelligent Transportation System that provides reliable and timely information to the drivers and the concerned authorities.
Simulations of the model were performed, on Four Lane Road in Neemrana-India, along with real-time network parameters to increase QoS (Quality of Service) and performance using SUMO and NS-2. In this model the status of nearby vehicles is only considered for changing the lane.
This paper [2] ,aims to guarantee the stable and reliable communication between nodes. Here, they propose a novel data dissemination scheme based on Clustering and Probabilistic Broadcasting (CPB). A clustering algorithm is first presented according to the driving directions of vehicles, by which vehicles could exchange their data in a clustered way with sufficient connection duration. In the constructed clustering structure, a probabilistic forwarding is presented to disseminate data among vehicles. Each cluster member forwards the received packet to its cluster head with a calculated probability which is associated with the number of times the same packet is received during one interval. When receiving the sent packet, the elected cluster header continues to disseminate it toward the transmission direction. Simulation results show that our proposed protocol CPB outperforms the existing schemes in terms of information coverage, average message delay and packet delivery ratio. However, For different applications with various QoS requirements, the data fusion and then forwarding by the cluster head and the direct forwarding by the cluster member, should be jointly considered. For example, an accident notification needs fast and long-range distribution even making the channel congested and many packets drops.
The paper [3], a novel clustering algorithm is proposed that guarantees efficient clustering to overcome the issue of Broadcast storm problem in VANETs as it lacks of central management. Here, descriptions and calculations of the three parameters are proposed. The AHP is utilized to calculate weight value for each node in consideration of three metrics including relative speed, distance-considered connectivity, and reciprocal mean expected transmission count. The node with the smallest weight value is elected as the CH in the corresponding neighborhood. Consequently, cluster formation and maintenance mechanisms are proposed. Thereafter, it show how the messages are transmitted in proposed cluster structure using an emergency message which is activated by certain event, such as airbag inflation, tire blown, or sudden braking. Finally, the simulation study confirms the availability and efficiency of the proposed clustering algorithm.
This paper [4] proposes a hybrid architecture, namely VMaSC-LTE, combining IEEE 802.11p based multi-hop clustering and the fourth generation cellular system, Long Term Evolution (LTE), with the goal of achieving high data packet delivery ratio and low delay while keeping the usage of the cellular architecture at minimum level. In VMaSC-LTE, vehicles are clustered based on a novel approach named VMaSC: Vehicular Multi-hop algorithm for Stable Clustering. The features of VMaSC are cluster head selection using the relative mobility metric calculated as the average relative speed with respect to the neighbouring vehicles, cluster connection with minimum overhead by introducing direct connection to the neighbour that is already a head or member of a cluster instead of connecting to the cluster head in multiple hops, disseminating cluster member information within periodic hello packets, reactive clustering to maintain cluster structure without excessive consumption of network resources, and efficient size and hop limited cluster merging mechanism based on the exchange of the cluster information among the cluster heads. These features decrease the number of cluster heads while increasing their stability therefore minimize the usage of the cellular architecture. From the clustered topology, elected cluster heads operate as dual-interface nodes with the functionality of IEEE 802.11p and LTE interface to link VANET to LTE network. Using various key metrics of interest including data packet delivery ratio, delay, control overhead and clustering stability, they demonstrate superior performance of the proposed architecture compared to other

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proposed hybrid architectures and alternative routing mechanisms including flooding and cluster based routing via extensive simulations in ns-3. The proposed architecture also allows achieving higher required reliability of the application quantified by the data packet delivery ratio at the cost of higher LTE usage determined by the number of cluster heads in the network.

In paper [5], an advanced technology is explored for communication. Vehicles communicate with each other through wireless networks. However, the deployment of new generation of mobile networks 5G needs a major upgradation of its existing systems such as 4G, LTE and other infrastructure. Therefore, in the paper, it is proposed to introduce advanced technology of 5G networks upgradation in Vehicle to Vehicle communication. Massive MIMO have the important role for the DSRC (Dedicated Short Range Communication) wireless technology. This mechanism works on the vehicle-to-vehicle communication such as the vehicle relative speed, range transmission etc., base station (tower) and RSU control and monitor of the vehicle to vehicle communication. Road styles such as square, straight, triangle and any other are designed and tested through simulation program using MATLAB 2017, in the research.

In this paper [6] , they have analyzed various challenges and existing solutions used for clustering in VANETs. Firstly, a complete taxonomy on clustering in VANETs has been provided based upon various parameters. Based upon this categorization, a detailed discussion is provided for each category of clustering which includes challenges, existing solutions and future directions. Finally, a comprehensive analysis of all the existing proposals in literature is provided with respect to number of parameters such as topology selected, additional infrastructure requirements, road scenario, node mobility, data handled, and relative direction, density of the nodes, relative speed, communication mode, and communication overhead.

According to the paper [7], VANET emergency messages need to be communicated on priority and should have minimal delay. In the existing system, infrastructure is not used in optimum for emergency message communication also vehicle movement is not much explored, to overcome this problem in the proposed work the dissemination of emergency messages is taken on priority using vehicle to infrastructure communication along with vehicle to vehicle communication. The delay in the emergency message communication should be minimized along with the availability of the network either through the infrastructure like Road Side Units (RSUs) or with the help of neighboring vehicles. While communicating the messages through neighboring vehicles, their role needs to be considered for their wish to be a part of the communication. For emergency messages communication prediction of the vehicle movement should be done so that the vehicles approaching in near future towards the place of the accident should get the message about the accident and they should be able to change the route to avoid the congestion at the accident spot. In this proposed work fuzzy logic is used to predict the vehicle movement as there are many factors which cannot be considered in only two states like true and false.

In paper [8], a traffic-aware routing protocol (TARCO) that considers integrated real-time traffic conditions for constructing delivery paths over a vehicular environment is presented. The goal was achieved through three mechanisms: cooperative traffic information collection, lightweight real-time road scoring and adaptable data route construction. An accurate overall view of the real-time traffic conditions was obtained from the cooperation between information aggregators at junctions and information collectors on road segments. Each road segment was then assigned a weight according to the overall view of the traffic conditions and updated periodically to reflect traffic variations. Finally, the road segments providing efficient and reliable data routes were used to construct a routing path with guaranteed connectivity and a short delivery delay to the destination. Simulation results showed that the use of TARCO leads to high network performance in terms of the packet delivery ratio, end-to-end delay and communication overhead.

The paper [9], presents a novel relative mobility metric for mobile ad hoc networks (MANETs). It is based on the ratio of power levels due to excessive receptions at each node from its neighbors. We propose a distributed clustering algorithm, MOBIC, based on the use of this mobility metric for selection of cluster heads, and demonstrate that it leads to more stable cluster formation than the “least cluster head change” version of the /well known Lowest-ID clustering algorithm 131. It shows reduction of as much as 33% in the rate of cluster head changes owing to the use of the proposed technique. In a MANET that uses scalable cluster-based services, network performance metrics such as throughput and delay are tightly coupled with the frequency of cluster reorganization. So, they believe that using MOBIC can result in a more stable configuration, and thus yield better performance.

In the paper [10], they present a framework for dynamically organizing mobile nodes in wireless ad hoc networks into clusters in which the probability of path availability can be bounded. The purpose of the (a; t) cluster is to help minimize the far-reaching effects of topological changes while balancing the need to support more optimal routing. Here, a mobility model for ad hoc networks is developed and is used to derive expressions for the probability of path availability as a function of time. It is shown how this model provides the basis for dynamically grouping nodes into clusters using an efficient distributed clustering algorithm. Since the criteria for cluster organization depends directly upon path availability, the structure of the cluster topology is adaptive with respect to node mobility. Consequently, this framework supports an adaptive hybrid routing architecture that can be more responsive and effective when mobility rates are low and more efficient when mobility rates are high.

In this paper [11], they proposed a completely distributed and infrastructure-free mechanism for road density estimation.

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The proposed solution is adaptive and scalable and targets city traffic environments. The approach is based on the distributed exchange and maintenance of traffic information between vehicles traversing the routes. The solution revolves around the core idea of information relaying between groups of vehicles rather than individual vehicles. Vehicles are arranged into location based groups. Each road (section of street between two intersections) is dissected into small fixed area cells, each defining a group. The cell size depends on the transmission range of vehicles (around 250m) and the cell ID depends on the road ID. Cells, overlap in such a way that any vehicle moving from one cell to the next belongs at least to one group. The closest vehicle to the cell center is considered as the group leader for a given duration. The performance analysis of the proposed mechanism shows the accuracy of the algorithm for different traffic densities. This paper also gives insights into the promptness of information delivery in the mechanism based on delay analysis at road intersections.

This paper [12], describes and presents three different application layer scenarios on the road, which they developed using the network simulator ns2. The paper provides the descriptions and simulation snapshots of the implementation. The scenarios are: A-The Braking Scenario, B-Changing Lane Scenario and C-Braking with Changing Lanes Combined. They also described the limitations of ns2 as it concerns VANET simulations and their implemented solution. First, a modification is added to the ns2 simulator in order to enable it to realistically simulate dynamic VANET scenarios. With the braking algorithm, they made sure that nodes behind the braking car decrease their speed gradually and gracefully. The second scenario, which concerns changing lane scenarios aimed at ensuring safe lane changes by the cars on the highway in order to minimize and even eliminate potential accidents. The third and final scenario was the combination of the previous two scenarios and intended to simulate more realistic traffic conditions, in which events would happen successively and wise decisions would be taken. It is worth noting that convenience-related applications can be added in the future and security threats can be accounted for without impacting the current implementation significantly. Finally, they acknowledged that in the descriptions of the implemented scenarios they may have implied that the car will react to the various conditions by taking braking and lane change actions autonomously. However, In real-life, the onboard system in the car will have to engage the driver through warnings and sometimes using alarms when the situation worsens (i.e., when an action on the driver’s part is deemed by the system to be causing a potential accident).

In this paper [13], we classify and survey broadcast protocols for vehicular communication networks. Vehicular networks have many safety-based applications where reliability is of utmost importance. Specifically, these protocols address the broadcast storm problem by reducing packet redundancy, wireless contention, and collisions in the network. Each protocol has its limitations and assumptions that may cause certain issues. For instance, the concept of node selection for multihop relay based on node distance (MFR), although reducing the total number of traveling hops, incurs a reliability trade-off with lower packet reception rates due to the loss in radio power from longer propagation distances. Another shortcoming for some methods explored is the assumption that GPS is readily available to provide location position to neighboring vehicles. Hence, the feasibility of these vehicular communication network applications will depend largely on the technology adoption and market penetration rates of vehicles equipped with capabilities, GPS devices, or both. This paper also concludes that reducing message flooding serves as a fundamental method to alleviate the broadcast storm problem and increase the reliability and efficiency of disseminating safety messages to other vehicles.

The paper [14], presented the notion of a communication path and probability in a general framework that handles the nature of multi-hop routing in a VANET. An algorithm to pre-compute the probability that the communication is possible between specified source and destination in a VANET, under certain mathematical assumption, is proposed in this paper. The communication probability is proven computed accurately by this algorithm, STEADYTRAFFIC. This quantity can be used to decide a good packet forwarder in a real VANET. The proposed new protocol for multi-hop communication refers to a lookup table containing the pre-computed data to decide a good packet forwarder quickly. The simulated results show that the probabilistic protocol improves the performances much in a very challenging testbed, after the algorithm is refined for the practical issues.

According to paper [15], active safety related data dissemination in vehicle-to-vehicle (V2V) communication requires reliable and real-time transmission. Also, broadcasting and relaying safety messages to alert the surrounding vehicles about critical driving situations is considered to be timely reaction. The goal of the paper is to enhance Real-time, collision-free and cooperative media access control (MAC) protocols to guarantee single and multi-hop data dissemination in the vehicular networks. The paper presented, media access mechanism for efficient multihop broadcasting. A relaying metric is embedded in the vehicular nodes to assure self-organizing, fast reacting and collision-free medium access mechanism. Here, two different MAC protocols are studied. The first protocol uses periodical beaconing messages exchanged among the individual nodes and the second protocol does not require those beaconing messages. For both of the cases, the distributed relay-competition and adaptive back-off schemes are simulated on multi-lane dense traffic. Network simulator (ns-3) simulation results are used to compare the two protocols with and without beaconing messages versus their success rates and network connectivity. To enhance applicability of the protocols, positioning of the vehicular nodes are assumed to be subject to GPS drift and instead of precise position information, sector value is considered.

In this paper [16], they propose and justify a distributive robust scheme for DSRC one-hop safety-critical services. The new scheme proposed aims to enhance broadcast reliability using dynamic receiver-oriented packet repetitions and mini-slot within DIFS in IEEE 802.11 for one-hop emergency warning message dissemination. The paper presents the ROR

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scheme designing DSRC control channel for possible safety critical services. It is assumed that each vehicle has access to the information of its location, speed and moving direction through an installed Global Positioning System (GPS) or Inertial Navigation System. Through exchanging periodic beacon messages, each node in the network maintains a list and mobility information of all one-hop surrounding nodes, which includes identification number, position, speed and moving direction. In this way, the receiver will be able to easily calculate its distance to the sender. Moreover, each receiving node is able to distinguish copies of the broadcast packet from the newly generated packets through a 12-bit sequence number of the received message in the MAC header of IEEE 802.11.

In this scheme, an emergency message is sent through one-hop multi-cycle broadcast. This one-hop message broadcast serves to alert or warn all surrounding vehicles to avoid further damages or accidents. Several important metrics will be defined and derived analytically for evaluation and comparison of performance and reliability of these broadcast services. Performance For One-hop One-cycle Broadcast Once an emergency message is generated, it will be sent out right away if the channel is sensed idle or right after the current beacon transmission is completed if the channel is sensed busy. In addition, they investigated the reliability and performance of the proposed broadcast scheme for DSRC VANET safety-related services on highway analytically and by simulations. The analytic model accounts for the impact of the beacon message broadcast and the fading channel conditions on the reliability and performance.

According to paper [17], due the high mobility and density of a car network scenario, specific solutions need to be devised to choreograph a fast-delivery multihop broadcast. To this aim, they developed a practical and efficient technique that allows cars to estimate their communication range with the help of a very limited message exchange and exploit this information to reduce the number of transmissions, as well as the hops to be traversed, and hence the time, required by a broadcasted message to reach all the cars following the sender within a certain distance. Interferences caused by environmental conditions and cars' mobility are taken into account by dynamically computing cars' transmission ranges, whose estimated actual values are exploited to minimize the number of hops to be traversed, as well as the number of message re transmission, during the broadcast activity. Preliminary results show that broadcasted messages reach the end of their area-of-interest with as few transmissions as possible, thus reducing the required delivery time.

In this paper [18], they extended multi-hop relaying into vehicular communication in highways. They deployed a pre-coded transmission over multi-hop vehicle-to-vehicle links that is characterized by time- and frequency- selective fading. They proposed and investigate a transmission scheme where traveling vehicles are allowed to relay signals via neighboring vehicles to the final destination. With the aid of the precoded transmission and best relaying vehicular selection, they extracted the rich diversity gains that are inherent in these types of doubly selective fading channels (i.e., through time and frequency dimensions), and through space dimension using cooperative transmission. They developed a mathematical model and derived a tight upper bound expression for the pair-wise error probability for future studies and analysis. Computer simulations are used to verify the correctness and accuracy of the derived analytical error.

This paper [19], Due to certain reasons i.e. mobility and limited communication range of the nodes in VANET based system frequent breaking of the links occur so delivery of data packets is a challenging task. To overcome this, the paper successfully has proposed and implemented a fuzzy logic-based novel routing model FLMDLR to over perform the LAR and D-LAR protocols. Basically, fuzzy logic concept has used to select a best next-hop node towards the destination node. The best next-hop node establishes a stable path from the source S to the destination node D. The stable path delivers more data packets within minimum time. The proposed algorithm outperforms compared to LAR and D-LAR protocols for all the routing parameters. However, following observations are worthy to mention; for high node density the link duration in proposed algorithms is high, in dense network the next-hop distance is higher, average number of hops are minimum for dense network and finally, one hop delay is low for higher velocity and number of nodes. The proposed model FLMDLR reduced one hop delay so that it delivers data packet within small time interval.

In paper [20], they presented a novel model for trusting the safety message before disseminating it, through multi-hop V2V communication. It also ensured message high delivery rate with minimum time delay. To this end, they recommended the idea of dividing the digital roadmap of the interested area into small fixed size segments. To transmit the packets between vehicles, they depended on pairs of concatenated information composed of the beacon message and the safety message, where the sending time is arranged according to the road density. The model relies on the idea of using a forwarder to rebroadcast the safety message between segments. Choosing the best forwarder is thus based on a calculated weight value for links between the vehicles. Their contribution is achieved by adding two decentralized data trust stages: to entrust the safety message information in one-hop, and before disseminating it farther through multi-hop. The simulation results using NS2 and SUMO showed the effectiveness of the model. The two stages of the trust method are also verified.

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REFERENCES

[1]. J. Joshi, A. Singh, L. G. Moitra and M. J. Deka, "DASITS: Driver Assistance System in Intelligent Transport System," 2016 30th International Conference on Advanced Information Networking and Applications Workshops (WAINA), 2016, pp. 545-550, doi: 10.1109/WAINA.2016.80.

[2]. Lei Liu, Chen Chen, Tie Qiu, Mengyuan Zhang, Siyu Li, Bin Zhou, "A data dissemination scheme based on clustering and probabilistic broadcasting in VANETs",Vehicular Communications, Volume 13, 2018, Pages 78-88, ISSN 2214-2096, doi: /10.1016/j.vehcom.2018.05.002.

[3]. Jin, Dongxu & Shi, Fei & Song, J.S.. (2015). Cluster based emergency message dissemination scheme for vehicular Ad Hoc networks. ACM IMCOM 2015 - Proceedings. 10.1145/2701126.2701153.

[4]. S. Ucar, S. C. Ergen and O. Ozkasap, "Multihop-Cluster-Based IEEE 802.11p and LTE Hybrid Architecture for VANET Safety Message Dissemination," in IEEE Transactions on Vehicular Technology, vol. 65, no. 4, pp. 2621-2636, April 2016, doi: 10.1109/TVT.2015.2421277.

[5]. R. Ali, D. N. Hakro, M. R. Tanweer and A. A. Kamboh, "Simulation based Vehicle to Vehicle and base station communication," 2019 International Conference on Information Science and Communication Technology (ICISCT), 2019, pp. 1-6, doi: 10.1109/CISCT.2019.8777411.

[6]. Bali, Rasmeet & Kumar, Neeraj & Rodrigues, Joel. (2014). Clustering in vehicular ad hoc networks: Taxonomy, challenges and solutions. Vehicular Communications. 1. 10.1016/j.vehcom.2014.05.004.

[7]. M. Mahajan and V. Vijayakumar, "Emergency Message Dissemination in Vehicular Ad-hoc Networks Using Vehicle Movement Prediction," 2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA), 2017, pp. 1-4, doi: 10.1109/ICCUBEA.2017.8463664.

[8].Lo, Chun-Chih & Kuo, Yau-Hwang. (2016). Traffic-Aware Routing Protocol with Cooperative Coverage-Oriented Information Collection Method for VANET. IET Communications. 11. 10.1049/iet-com.2015.1016.

[9].P. Basu, N. Khan and T. D. C. Little, "A mobility based metric for clustering in mobile ad hoc networks," Proceedings 21st International Conference on Distributed Computing Systems Workshops, 2001, pp. 413-418, doi: 10.1109/CDCS.2001.918738.

[10]. A. B. McDonald and T. F. Znati, "A mobility-based framework for adaptive clustering in wireless ad hoc networks," in IEEE Journal on Selected Areas in Communications, vol. 17, no. 8, pp. 1466-1487, Aug. 1999, doi: 10.1109/49.780353.

[11]. M. Jerbi, S. Senouci, T. Rasheed and Y. Ghamri-Doudane, "An Infrastructure-Free Traffic Information System for Vehicular Networks," 2007 IEEE 66th Vehicular Technology Conference, 2007, pp. 2086-2090, doi: 10.1109/VETECF.2007.438.

[12]. Hassan Artail, Malak Safieddine, Tania Safar, Malek El-Khatib, Tarek Ibrahim, Kassem Fawaz, "Dynamic Simulations of VANET Scenarios",2008

[13]. R. Chen, W. Jin and A. Regan, "Broadcasting safety information in vehicular networks: issues and approaches," in IEEE Network, vol. 24, no. 1, pp. 20-25, Jan.-Feb. 2010, doi: 10.1109/MNET.2010.5395779.

[14]. J. Fukuyama, "A Probabilistic Protocol for Multi-Hop Routing in VANETs," 2009 IEEE International Conference on Communications Workshops, 2009, pp. 1-6, doi: 10.1109/ICCW.2009.5208064.

[15]. Y. Pekşen and T. Acarman, "Multihop safety message broadcasting in VANET: A distributed medium access mechanism with a relaying metric," 2012 International Symposium on Wireless Communication Systems (ISWCS), 2012, pp. 346-350, doi: 10.1109/ISWCS.2012.6328387.

[16]. X. Ma, X. Yin and K. Trivedi, "A Robust Broadcast Scheme for VANET One-Hop Emergency Services," 2011 IEEE Vehicular Technology Conference (VTC Fall), 2011, pp. 1-5, doi: 10.1109/VETECF.2011.6093018.

[17]. C. E. Palazzi, S. Ferretti, M. Roccetti, G. Pau and M. Gerla, "How Do You Quickly Choreograph Inter-Vehicular Communications? A Fast Vehicle-to-Vehicle Multi-Hop Broadcast Algorithm, Explained," 2007 4th IEEE Consumer Communications and Networking Conference, 2007, pp. 960-964, doi: 10.1109/CCNC.2007.194.

[18]. M. F. Feteiha and M. H. Ahmed, "Multihop Best-Relay Selection for Vehicular Communication Over Highways Traffic," in IEEE Transactions on Vehicular Technology, vol. 67, no. 10, pp. 9845-9855, Oct. 2018, doi: 10.1109/TVT.2018.2856503.

[19]. Rana, K.K., Sharma, V. & Tiwari, G. "Fuzzy Logic-Based Multi-Hop Directional Location Routing in Vehicular Ad-hoc Network". Wireless Pers Commun 121, 831–855 (2021),doi: /10.1007/s11277-021-08661-3

[20]. Hanaa Sami Basheer, Carole Bassil, Bilal Chebaro, "TDSM: Trusted Dissemination Safety Messages in a Multi-hop V2V Communication", American Journal of Electrical and Computer Engineering. Vol. 4, No. 2, 2020, pp. 16-34. doi: 10.11648/j.ajece.20200402.11