



A REVIEW ON VEHICULAR AD HOC NETWORK (VANET) USING CLUSTERING BASED TECHNIQUE

Surender Pal (M.Tech Scholar)

Department of Electronics & Communication Engineering, MietMohri, Kurukshetra University, Haryana, India

Email id: surenderkamboj36@gmail.com

Ramanjeet Panjeta (Assistance Professor)

Department of Electronics & Communication Engineering, MietMohri, Kurukshetra University, Haryana, India

Email id: rpanjeta@gmail.com

Abstract: The goal of this study is to describe vehicle-to-vehicle communication is a relatively new concept in the field of road traffic safety, an increasing number of worldwide studies and research being performed on the subject. Traffic safety has become a priority and with the development of communication technologies and wireless networks, VANET networks have emerged. VANET or Vehicular Ad-hoc Network ensures a communication protocol between close vehicles or between a vehicle and infrastructure (indicator, traffic light, road junction). The main goal of VANET networks is the development of distributed applications and oriented public safety, in order to save lives and improve traffic conditions.

Keywords – VANET, RSU, SUMO, VMA5C-LTE, CLUSTERING

I. INTRODUCTION

WSN consists of a large number of sensor nodes, moreover these sensor nodes run on non-rechargeable batteries. So to help the objective of fault-tolerance, load balancing and network connectivity, grouping of nodes is required. Clustering is a process of dividing sensor nodes into groups on the basis of various parameters, and selecting a group leader from every group. The groups are called clusters and group leaders are called Cluster Heads (CHs) of the clusters. Parameters for forming the clusters include distance between cluster head and its member, intra-cluster communication cost, remaining energy of sensor nodes, location of node with respect to BS etc.

Data transmission in cluster-based routing protocols is divided into two main stages namely intra-clustering data transmission and inter-clustering data transmission. Intra-clustering communication, where member nodes transmit collected data to their respective cluster-heads. All member nodes are mostly two hops away from their cluster-heads, while in some cases one or multiple hop(s) is required for members to reach their destination. On the other hand, in inter-clustering communication cluster-heads transmit their data with the gathered data from their respective members in order to deliver it to a faraway base-station. Clustering provides an effective method for increasing the lifetime of a WSN.

WSN applications can be classified into two categories: monitoring and tracking. Monitoring applications comprise indoor or outdoor environmental monitoring, health and wellness monitoring, power monitoring, inventory location monitoring, factory and process automation, and seismic and structural monitoring. Tracking applications include tracking objects, animals, humans, and vehicles.

A critical aspect in a simulation study of VANETs, is the need for a mobility model which reflects, as close as possible, the real behavior of vehicular traffic. When dealing with vehicular mobility modeling, we distinguish between macro-mobility and micro-mobility descriptions. 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, or the traffic signs description establishing the intersections crossing rules. Micro-mobility instead refers to the drivers' individual behavior, when interacting with other drivers or with the road infrastructure: traveling speed in different traffic conditions; acceleration, deceleration and overtaking criteria, behavior in presence of road intersections and traffic signs, general driving attitude related to driver's age, sex or mood, etc. It would be desirable for a trustworthy VANETs simulation that both macro-mobility and micro-mobility descriptions be jointly considered in modeling vehicular movements.

The communications in VANETs can be categorized in the following two modes: (1) vehicle-to-vehicle (V2V) communication and (2) vehicle-to roadside (V2R) communication. Communication can be through direct link or through multi-hop links. If the destination node is present within the transmission range of the source node then the

direct link is established for communication and this type of communication is known as single-hop communication. In one-hop communication each member node is at most 1-hop distance far from a central coordinator said as the cluster head. That is why each member node remains at most 2-hops distance far from each other within a logical cluster. If the destination node is present outside the transmission range of the source node then the intermediate nodes are used to deliver the message up to the destination and this type of communication is known as multi-hop communications.

II. ROUTING PROTOCOLS IN VANET

There are three kinds of routing protocols in VANET, topology-based protocol, position based protocol, and map-based protocol. In topology-based protocol, a link must be established from source node to destination node before data transmission. Ad-hoc On-demand Distance Vector routing (AODV) is a typical representative of this type. It will send a large quantity of redundant data packets and increase routing overhead by blind flood. Preferred Group Broadcasting (PCB) is proposed to decrease the routing overhead in paper, but the implement of PCB protocol needs high complexity. On the contrary, position-based protocol needs no fixed link before data transmission, every hop between source and destination can be selected instantaneously and independently. Greedy Perimeter Stateless Routing (GPSR) is one of this kinds but it has two shortcomings. Firstly, the neighbor table maybe not matches the actual position without considering the node mobility. Secondly, the position of destination have never updated after encapsulating in the data packets. The last one, map-based protocol is applied seldom at the present. It uses the GPS system and digital map to select the best route.

III. Related work

Seyhan Ucar et al 2013-Clustering is an effective mechanism to handle the fast changes in the topology of vehicular ad hoc networks (VANET) by using local coordination. Constructing stable clusters by determining the vehicles sharing similar mobility pattern is essential in reducing the overhead of clustering algorithms. In this paper, he introduces VMaSC: Vehicular Multi-hop algorithm for Stable Clustering. VMaSC is a novel clustering technique based on choosing the node with the least mobility calculated as a function of the speed difference between neighboring nodes as the cluster head through multiple hops. Simulation experiments performed using ns-3 with the vehicle mobility input from the Simulation of Urban Mobility (SUMO) demonstrate that novel metric used in the evaluation of the least mobile node and multi-hop clustering increases cluster head duration by 25% while decreasing the number of cluster head changes by 10%. A stable multi-hop clustering technique based on the changes in the relative mobility of the vehicles is calculated by finding the average of the relative speed of all the same direction neighbours.

B. Hassanabadi et al 2014 presents a mobility-based clustering scheme for Vehicular Ad hoc Networks, which forms clusters using the Affinity Propagation algorithm in a distributed manner. This proposed algorithm considers node mobility during cluster formation and produces clusters with high stability. Cluster performance was measured in terms of average cluster head duration, average cluster member duration, average rate of cluster head change, and average number of clusters. The proposed algorithm is also robust to channel error. He proposed a novel and stable mobility-based clustering algorithm called APROVE elects cluster heads by using affinity propagation. The algorithm finds clusters that minimize both the relative mobility and the distance from each cluster head to its cluster members. The clusters created are stable and exhibit long average cluster member duration, long average cluster head duration, and low average rate of cluster head change.

Ram shrinagar et al 2014 derived a mathematical model to estimate path duration using border node-based most forward progress within radius (B-MFR), a position based routing protocol. The mathematical model for estimation of path duration consists of probability of finding next-hop node in forwarding region, estimation of expected number of hops, probability distribution of velocity of nodes, and link duration between each intermediate pair of nodes. The analytical results for the path duration estimation model have been obtained using MATLAB. The result analysis show that path duration increases with the increase in transmission range and node density and decreases with the increase in the number of hops in the path and velocity of the nodes. He derived a mathematical model for estimation of path duration between source and destination nodes using position-based routing concept.

Seyhanucar et al 2015 derived 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 neighboring vehicles, cluster connection with minimum overhead by introducing direct connection to the neighbor 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

IV. VANET COMMUNICATION DOMAINS

The communication between vehicles and the RSU and the infrastructure form three types of domains:-

4.1 In-vehicle domain: This domain consists of an OBU and one or many Application Units(AU). The connection could be wired or wireless using WUSB or UWB; an OBU and an AU can in a single device. The OBU provides a communication link to the AU in order to perform one or more of a set of applications provided by the application provider using the communication capabilities of the OBU.

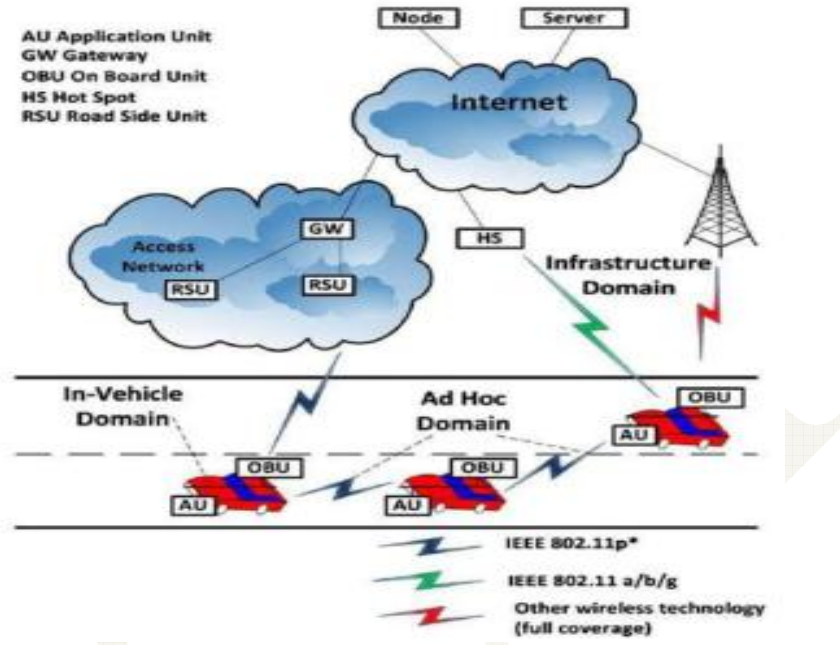


Figure: Communication domains in VANET

4.2 Ad hoc domain: The ad hoc domain on VANET is composed of vehicles prepared with OBUs and a station along the road side, the RSU. Two types of communications are available in the ad hoc domain:

Vehicle communicates with another vehicle directly if there is a direct wireless connection available between them, form a **single hop vehicle to vehicle communication (V2V)**. When there is no direct connection between them a committed routing protocol is used to forward data from one vehicle to another until it reach the destination point, forming **multi-hop vehicle to vehicle communication**.

Vehicle communicate with an RSU in order to enlarge the range of communication by sending, receiving and forwarding data from one node to another or to benefit from the ability of the RSU to process special application forming **vehicle to infrastructure communication (V2I)**.

4.3 Infrastructural domain: The RSU can connect to the infrastructural networks or to the Internet, allowing the OBU to way in the infrastructure network; in this case it is possible that the AUs are register with the OBU to connect to any internet based host

V. DESIGN ISSUES

The research issues related to the VANET implementation, themain problems in the implementation are routing, security and privacy.

5.1 Routing: The entities of the system plays an important role. However due to the characteristics of the VANET like mobility with high speed and topology the existing routing algorithm which supports the MANET does not support VANET. Depending on the number of vehicles the routing strategies may fall in three methods Broadcasting, Unicasting and Multicasting.

5.1.1 Broadcasting: Broadcasting is a communication in which the message is sent to all vehicles in the range. This type of communication is used when there is a need for sending alert message to known and unknown destination.

5.1.2 Unicasting: Unicasting is a communication in which the message is sent to a vehicle in the range. Here with the unicast based communication many routing mechanisms are there like greedy traffic-aware routing they normally used for one to one communication.

5.1.3 Multicasting: Multicasting is a communication in which the message is sent to a group of nearby vehicles in the range. The Multicast based communication is needed among a group of vehicles in case of roadblock; traffic slow down, accidents etc.

5.2 Privacy and Security:- Intelligent VANET and some traffic management system has onboard application which stores a lot of important personal information and data about the vehicle, which may reveal individuals' behavior, practice, and traces. These problems have to be eliminated before the VANET system is deployed. Otherwise, the trustworthiness, fidelity, and the acceptance range among individuals are expected to be very low, because an invader or attacker might get the information about the individuals and about the vehicle.

VI. VANET REQUIREMENT

6.1 Signal fading: Objects placed as obstacles between two communicating vehicles are one of the challenges that can involve the efficiency of VANET; these obstacles can be other vehicles or buildings distributed along roads especially in the cities. The impact is placed on preventing the signal from reaching its destination and increasing the fading in the transmitted signal.

6.2 Bandwidth limitations: Another key issue in the VANET is the absence of a central coordinator that controls the communications between nodes, and which has the task of managing the bandwidth and contention operation. Therefore it is necessary to utilize the availability of bandwidth efficiently. There is a high probability that channel congestion can occur, due to the limited range of bandwidth frequency (10-20 MHz) for VANET applications, particularly in a high density environment. The fair use of bandwidth has its force on reducing the time delay for disseminating messages; if a vehicle needs to send a message and finds there are no opportunities for transmission, it must remain for a time to have a chance for transmission, which will have a result on increasing the latency, especially in urban areas and with the increase in the types of application in VANET.

6.3 Connectivity: Due to the high mobility and rapid changes of topology, which direct to a frequent fragmentation in networks, the time duration required to get longer the life of the link communication should be as long as likely. This task can be accomplished by increasing the transmission power; however, that may lead to throughput degradation. Accordingly, connectivity is considered to be an important issue in VANET, although many studies in MANET have focused on solving this problem. Nevertheless, it still occupies a wide portion of the efforts gathered towards developing VANET.

6.4 Small effective Diameter: Due to the small effective network diameter of a VANET, that lead to a weak connectivity in the communication between nodes. Therefore, maintaining the complete global topology of the network is impossible for a node. The restricted effective diameter results in problems when applying existing routing algorithms to a VANET.

6.5 Security and privacy: Keeping a reasonable balance between the security and privacy is one of the main challenges in VANET; the receipt of trustworthy information from its source is important for the receiver. However, this trusted information can break the privacy needs of the sender.

6.6 Routing protocol: Because of the high mobility of nodes and rapid changes of topology, designing a capable routing protocol that can deliver a packet in a minimum period of time with few dropped packets is considered to be a critical challenge in VANET. Moreover, many researchers have concentrated on designing a routing protocol suitable for dense environments that have a high density of vehicles with close distances between them. Designing an efficient routing protocol has a blow on improving many factors; the first of these is enhancing the reliability of the system by leveraging the percentage of packets delivery, and secondly by reducing the extent of interference caused by high buildings in the city environment; the third factor is that taking scalability into consideration is essential to avoid conflict, if an instantaneous operation of unicast routing request has been initiated. Another factor is to deliver a packet in the shortest possible time, especially in the emergency situation; this factor is considered to be a very critical factor.

VII. CONCLUSION

Since most applications in VANETs favor broadcast transmission as opposed to point-to-point routing, routing protocols should be designed to address the broadcast storm problem to avoid unnecessary loss of important safety

related packets during a broadcast storm. In this article we have proposed three techniques that depend only on the local positions of the receiver and transmitter nodes. The algorithms are completely distributed and computationally efficient in that they require only minor computations. In the absence of the GPS signal, the proposed algorithms can also be modified to use the RSS of the packet received to determine whether or not the packet should be retransmitted, although this approach is not as efficient as the GPS approach. The proposed schemes are tested against single-lane and multilane topologies as opposed to generic two-dimensional square or torus topologies. The results show that the proposed slotted 1-persistence and slotted p-persistence schemes can reduce broadcast redundancy and packet loss ratio by up to 70 percent while still offering acceptable end-to-end delay for most multi-hop VANET applications (e.g., using a roadside unit to inform drivers about detours, construction)

VIII. Future Work

As future work, we aim to investigate the use of VMaSC-LTE in urban traffic scenarios and extend VMaSC-LTE architecture with data aggregation and calculation of the clustering metric with additional information such as the most probable path information of the vehicles. As a future work we would like to study the ratio of packets being lost due to collision which helps us in reducing the end-to-end delay, increase the delivery ratio and reduce the number of CH's in the system. Also we would like to test this algorithm for little more sparsely condition.

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