SCRUTINY OF BROADCASTING PROTOCOLS IN VANET

Rohini Nere[1] and Prof Uma Nagaraj [2]

[1]*Department of Computer Engineering, MIT Academy of Engineering Alandi,Pune*
rohini.nere9@gmail.com
[2] *Department of Computer Engineering,MIT Academy of Engineering Alandi,Pune*
umanagaraj67@gmail.com

ABSTRACT

Definitive broadcasting in vehicular ad hoc networks is one of the keys to success for services and applications on intelligent transportation system. Many trusted broadcasting protocols have been proposed but none of them has been evaluated in realistic scenario. In this paper, we discuss these reliable broadcasting protocols on VANET. Basic mechanism in broadcasting, and also we are providing collective research of Broadcasting protocols in vanet in that some real time protocols with their pros cons we have studied.

KEYWORDS **:** VANET, BROADCASTING PROTOCOLS , FLOODING, DSR, UMB, AODV, MDDV.

1. NEED OF BROADCASTING IN VANET

A conventional approach for broadcasting is simple flooding. As soon as node receive broadcast message receiving node rebroadcasts the message immediately. This approach can provide very high rate of data distribution. It is also simple as it does not require neighbour's information. However, it does not execute well in dense and sparse areas. Particularly, in dense area such as traffic jam during rush hours, the simple flooding can cause high collision, leading to low reliability with a lot of dispensable broadcast messages. This problem also has been found on route request (RREQ) mechanism of AODV on VANET environment. In sporadic area such as highways during night time, vehicles move fast and possibly have no neighbour in their transmission range. The effortless flooding in such disconnected network is useless as there is no neighbour being able to receive and convey the message VANET safety mechanism depend on interchanging the safety information among vehicles i.e. car to car (C2C communication) or between Vehicle to infrastructure i.e. car to infrastructure.(C2I Communication) using the control channel, as you can see in figure 1.

Figure 1: Basic idea of VANET.

VANET as comfort communication can be made by two means: Periodic Safety Message (in this paper we refer them as Beacon) and Event Driven Message (refereed as Emergency Message here), both messages share only one control channel. The Beacon messages are messages about status of sender vehicle. Status information includes position, speed, heading towards, etc., about sender. Beacons provide resent or latest information of the sender vehicle to the all present vehicles in the network which will help them to know the position of the current network and anticipate the movement of vehicles. Beacons are sent antagonistically to neighbouring vehicles 10 messages each second. Emergency Messages are messages sent by a vehicle who defect a potential dangerous situation on the road, this information should be dispersed to alarm or worn other vehicles about a feasible danger that could affect the incoming vehicles. VANET is a high mobile or volatile network where the nodes are keep changing their position and they are moving in speeds, which means that this vehicles may be get influence, even if these vehicles are very far from the danger, they will reach near to danger very soon, in this case fraction of seconds will be very important to avoid the danger [6, and 7].

In VANET Emergency messages are delivered in broadcasting way. Purpose behind this is all the vehicle within the communication range of the sender should receive the message. Message is hardly reaches a 1000m (which is the DSRC communication range) which is coverage area of sender and it is not enough as due to attenuation and fading effects. Critical information should receive by vehicles which are out of senders range. By using this information they can avoid the danger. In short distances the prospect of message reception i.e. percentage of message reception can reach 99% and as we move forward it decreases up to 20% at half of the communication range (Moreno, 2004). Therefore, there is requirement of a technique to increase the emergency message reception with high reliability and availability. Due to the high movement of vehicles, the distribution of nodes within the network changes swiftly and unexpectedly that wireless links initialize and break down customarily and randomly. Therefore, broadcasting of messages in VANETs plays a pivotal rule in almost every application and requires novel solutions that are different from any other form of Ad-Hoc networks. Broadcasting of the messages in VANETs is an open investigation challenge and needs some efforts to reach an optimum solution .

The broadcasting requirements are high reliability and high dissemination speed with short latency in single-hop as well as multi-hop communications.

Problems associated with regular broadcasting algorithms are the high possibility of collision in the broadcasted messages and the absence of feedback and the hidden node problem. In this paper we concerned with proposing a new intelligent broadcasting technique for the emergency message in VANET aiming to increase the reception of the emergency information.

In section II and section III we are simply collecting all possible information about research done in broadcasting protocols. In that section II is dedicated to schemes of existing broadcasting protocols. And section III is describing some real time examples of broadcasting protocols with their pros and cons.

2. Basic Broadcasting Schemes Comparison

A variety of broadcasting schemes exist such as simple flooding, probability based approaches, area based approaches etc., In this section we will concisely discuss all the broadcast schemes and their pros and cons. *Flooding* is a simple broadcast technique for communication. Vehicles send information to other vehicle and this process continues until all vehicles get same information. It works fine in sparse network but in dense network it produces collision, contention and redundant messages Flooding is simple and easy to implement and it can be costly in terms of network performance, and one of the main problem that rise in flooding is "Broadcast Storm Problem". Figure 2 is showing difficulty with flooding vehicle in yellow colour first send message .Which is again come back after some interval from different user's repetition of message take place which results into wastage of bandwidth.

Figure 2. Broadcast storm problem

Probabilistic scheme reduces the collision, contention and redundant messages in dense network as it broadcast the messages with some fixed probability. But in sparse network, all the vehicles can't receive the same packets with small probability. If the probability is increased it works much like flooding Hence, its performance becomes greater in dense network as compare to sparse network. *Counter based technique* is used to analyse the redundant messages. We use counter to record the dispensable message. Whenever the redundant i.e. dispensable message is received, we increment the counter by one. We distinguish the counter with certain threshold value if it is less than it we forward the packet otherwise the packet is discarded. *Distance based schem*e first calculates the distance between itself and its neighbour vehicles. Then it compares the distance with threshold. If the distance is greater than threshold it forward the packet otherwise it ignore the message. *Location based scheme* first quantify the coverage area with help of sender location. The vehicle will ignore the packet if area is smaller than a threshold value, otherwise the packet will be broadcast. *Neighbour knowledge methods* maintain a table that contains the information of its neighbour node. A vehicle decision depends upon this information to forward message or not. All vehicles share hello packets with their neighbours to get current information. They store this information in their table for future use. Neighbour knowledge methods totally rely on the exchange of hello packet. Contention and collision can be happen if the interval is short and large interval degrades the performance of network due to mobility.

2.1. Probe of Broadcasting Protocols in Vanet

Basic mechanisms in which consist of three main modules. There are *preferred node selection algorithm*, *beaconing* and *waiting timeout calculation*. The preferred *node selection algorithm* can make the difference to protocols' efficiency and overhead. If the protocol selects the right vehicle, any vehicles in the same road section will be able to receive the broadcast message in each time of rebroadcasting. The *waiting timeout calculation* is the main mechanism to circumvent broadcasting collision for reliable broadcasting protocol but waiting timeout can increase a lot of retard. We also found that the waiting timeout of some protocols is the reason of broadcast storm problem. The last module is *beaconing* which is the solution to redeem neighbour nodes' information. Although it is useful, it can consume the limited wireless network resource, which causes broadcast storm problem which reduce reliability and efficiency of protocols. We then evaluate the reliable broadcasting protocols in terms of reliability, overhead and speed of data distribution by simulation.

In the reference no [8], a street-based broadcast scheme is proposed by authors in that scheme vehicle employs neighbours' information by exchanging hello messages among vehicles, A warning message is broadcasted to all neighbours when any probable danger is detected. As a forwarder the farthest vehicle is selected. This selection will be depending on the information gained from the hello message, if the forwarder which is preselected, receives the message, it will broadcast it again.

In a case of high mobile highly volatile network like VANET Depending on just one forwarder is not good option always. Furthermore, authors didn't depend on beacons to gain the information. They anticipated using hello message, which creates a chance to raise the channel load. The contention period schemes (which are a waiting time that the receiver waits before rebroadcasting the original message received from the sender) are proposed by many researchers [9], [10], [11], [12], [13], [14] and [15].

In [9], authors proposed the Link-based Distributed Multi-hop Broadcast (LDMB), in which all the receivers of the emergency message are potential forwarders. Each forwarder calculates and waits for contention time, if the contention time ends the forwarder will start to rebroadcast the emergency message this concept I am going to use for my further research.

In [11] and [12], where authors proposed position-based message forwarding strategy by sending the emergency message in a broadcast style, and choosing the best forwarder available. All vehicles which receive that message are potential forwarders. So as to decide which node forwards the message all receivers will be allocated a contention window (waiting time); the contention window size will be the smallest for the farthest node and the biggest size for the nearest node i.e., this protocol will give priority for the farthest node to be the next forwarder.

The problem of the last two protocols that all the message receivers will compute the waiting time and wait to make the rebroadcast even the closest vehicles to the sender will do and this will make the entire network vehicles busy for any message received.

Another protocol proposed by [13] called Emergency Message Dissemination for Vehicular (EMDV) protocol, by allowing the farthest vehicle within the transmission range to make the rebroadcasting of the emergency message.

Choosing one forwarder vehicle is not suitable in a high mobile network like VANET as the position is always changing, and the receiver vehicle may become out of range when sending the message or simply the receiver can't receive the message because of the channel problems like jam or denial of service, see figure 3.

In [10] authors proposed that the receivers of the message will select random waiting times and make acknowledgment to avoid the re-transmissions from nodes closer to the original sender.

The acknowledgment scheme causes delay to the rebroadcast. In [14] authors proposed the Contention-Based Forwarding (CBF) protocol where a vehicle sends a packet as a broadcast message to all its neighbours. On receiving the packet, neighbouring vehicle will contend for forwarding the packet. The node which is having the maximum progress to the destination will have the shortest contention time and will first rebroadcast the packet. If other nodes accept the rebroadcast message, they will stop their conflict and will delete the previously received message. This protocol is mainly proposed for forwarding the periodic safety message (Beacons).

The problem of this protocol that there should be a management technique to manage the contention for all the neighbouring vehicles, and there is a chance that the nearest vehicle to the sender may not hear the rebroadcast of another vehicle, then this vehicle will rebroadcast the message and this called (hidden node problem (Tobagi and Kleinrock, 1975)) also it may lead to broadcast storm problem that makes the protocol useless.

Figure 3.Sender utilizing EMDV

In [15] authors suggested that the emergency message will be rebroadcasted by the receivers located at farther distances from the sender by the selection of shorter waiting times, see equation 1.
In [7] authors proposed the Contention Based Broadcasting (CBB) protocol for increasing the emergency message reception and for increasing the performance, the emergency message will be broadcasted in multi-hop fashion, and those multi-hop forwarders will be selected before the original message is sent. CBB proven to achieve superiority over the EMDV protocol as it chooses more than one forwarder to rebroadcast the emergency information and this gives the message a chance to overcome the preselected forwarder failure.
The standards of choosing the forwarders depends on the progress and on the segment localization, see figure 4, where all the vehicles located in the final; none-empty segment are a potential forwarder.

Figure 4. Emergency message Sending and transmission range

Another way to rebroadcast the message is to splits the network into segments proposed in [16, 17, and 18].
In [16] authors proposed a protocol called Urban Multi–hop broadcast (UMB) which aims in maximizing the message development, and avoiding hidden node, broadcast storm and reliability problems. The protocol assigns the duty of forwarding and acknowledging the broadcast packets to only one vehicle by dividing the road portion inside the transmission range into segments and choosing the vehicle in the furthest non-empty segment without prior topology information. Source node transmits the broadcast control packet, called Request to Broadcast (RTB), which contains the position of the source and the segment size. On reception of the RTB packet, nodes compute the distance between the sender and the receiver. Then, nodes transmit black–burst which is a channel jamming signal, that contains several time–slots equal to their distance from the source (in number of segments) farther the distance, longer is the black–burst. Each node transmits its black-burst and senses the channel; if there is no other black-burst in the channel it concludes that it is the farthest node from the source. A Clear–to–Broadcast (CTB) control packet is returned by node, containing its identifier (ID), to the source.
The Smart Broadcasting Protocol [17] addressed the same objective as UMB using a different methodology. Upon the reception of RTB message, each vehicle should decide its segment and set a random back-off time. Each of the segment has its own contention window size, i.e., if this segment has a contention window size (4) TS (time-slot); vehicles in the furthest segment should randomly choose a back-off time between (0) to (3) TS. Vehicles in the next nearer segment choose a value

ISSN : 2394-0905

between (4) to (7) TS, and so on, as vehicles near the sender should wait for longer time.

Vehicles will decrement their back off timers by one in each time-slot while listening to the physical channel. If any vehicle receives a valid CTB message,while waiting, it will be exiting the contention time phase and listen to the incoming broadcast. In contrast, if any node finishes its back off timer, it will send the CTB containing its identity and rebroadcast any incoming broadcast.

While in [18] authors proposed the Geographic random forwarding (GeRaF) protocol, in which the network is divided into equally adjacent sectors, the transmitter (source) elects the sectors starting from the farthest [extremely remote] one, by sending RTB message, all the nodes in the elected sectors reply by CTB message, and if one node reply the CTB message, then this node will be the next forwarder, if there are more than one node sent the CTB message the source issue a collision message and make a collision-resolution procedure to select the next forwarder depending on a probabilistic rule.

In [20]researcher has categorised the message in priority message in which structure of the emergency message is as shown in fig 5 where three inputs, namely *Cid*, *MinB* and *MaxB*, are added to help the receiver vehicle determine what action to take after receiving the emergency message.

Sen ID	Code	MinB	TS	MaxB	Msg ID	Data	Cid

Figure 5.Message Format

Where Sen ID : sender id, Code : Message Code, TS : Time Stamp, Msg ID : Message ID, Data : Data sent, Cid : Forwarder Candidate ID, MinB : Minimum Boundary, MaxB : Maximum Boundary.

3. Some Real Time Examples Of Broadcasting Protocols

4.1 Edge-Aware Epidemic Protocol (EAEP)

Each of vehicles has its own geographical knowledge which is piggybacked to broadcast messages. By this solution, EAEP operates without beaconing. Upon reception of a new rebroadcast message, EAEP uses number of transmission from front nodes and back nodes in amount of time to calculate the probability for making decision whether nodes will rebroadcast the message or not. By this method, at the edge of each transmission will be preferred area to rebroadcast messages. But EAEP does not address the intermittent-connectivity issue. Specifically, a node would by no means know whether it has missed some messages its new neighbours have or its neighbours have missed some messages it has. EAEP outperforms the simple flooding in terms of reliability and overhead. However, it provides slow speed of data dissemination. (According to the simulation results shown in [9], it takes more than 30 seconds to deliver a broadcast message to the majority of vehicles)

4.2 Preferred Group Broadcast (PGB)

PGB is not a reliable broadcasting protocol but it is a solution to prevent broadcast storm problem from route request broadcasting in AODV. Each node in PGB will sense the level of signal strength from neighbour broadcasting. The signal strength is being used for waiting timeout calculation. Shorter waiting timeout will be set by nodes in the edge of circulated broadcast. Only node with shortest timeout will rebroadcast the message. PGB can decrease numbers of RREQ broadcasting. But a problem on low density area still exists.

4.3 AckPBSM

AckPBSM is a modified version of PBSM, which is the parameter less broadcast in static to highly mobile ad-hoc networks. It uses periodic beacons for exchanging information between nodes. Nodes at the head or tail of each vehicles cluster will set shorter waiting timeout as they are preferred to do the next rebroadcasting. These nodes are in Connected Dominating Set (CDS) or called gateway nodes. Other nodes that are not in CDS will set longer waiting timeout. While the nodes are waiting, they hear from beaconing if their neighbours have already received the messages. If all of their neighbours received the messages, the nodes will not perform any rebroadcast. So AckPBSM need high frequent of beacon to accurately operate. To address intermittent connectivity issue, acknowledgements of broadcast messages are piggybacked in periodic beacons so nodes can rebroadcast only if their neighbours have not received the broadcast messages. It is reported in that AckPBSM outperforms PBSM and DVCAST in terms of reliability and overhead..

4.4 Density-Aware Reliable Broadcasting Protocol (DECA)

It does not require position knowledge. DECA employs only local density information of 1-hop neighbours obtained by beaconing. Before broadcasting, the node selects one neighbour which has the highest local density information to be the next rebroadcast node. And other nodes will randomly set their waiting timeout. If they don't hear anyone rebroadcasting the message before the timeout expiration, they will rebroadcast the message. Also, identifiers of the received broadcast messages are included into periodic beacons so that a node can discover its neighbours, which have not received the messages and consequently rebroadcast the messages for those neighbours. The advantage of DECA is it does not require position knowledge to operate so it is more flexible to suit any operating environment.

4.5 Position-Aware Reliable Broadcasting Protocol (POCA)

It uses adaptive beacon to get neighbours' position and velocity. When nodes want to broadcast the messages, they will select neighbours in preferred distance to rebroadcast the message. That preferred distance is based on the distance between nodes and selector nodes. The selected node will rebroadcast the message instantaneously. In case those selected nodes do not rebroadcast the message, other nodes which are having set waiting timeout since they received message will do this task instead. The waiting timeout is being calculated depending on the distance between node and precursor node. So the node which is closest to selected node will rebroadcast the messages. POCA too piggybacks the message identifier to beacon to handle intermittent connectivity. Nodes can know if the neighbours miss some messages and rebroadcast the message to them by set waiting timeout. Hence a node in the same road section will be rebroadcasting the messages to neighbours.

4.6 BROADCOMM

BROADCOMM [24] is based on hierarchal structure which is used for highway network. In this protocol, the highway is segmented to virtual cells which move along with the vehicles. There is two level of hierarchy for the nodes which are in the highway. All the nodes which are in a cell are included in first level. Cell reflectors (few nodes in each virtual cell) represent the second level, which are responsible for handling messages within its cell nodes and forwarding or receiving the messages to or from neighbouring cell reflectors.

4.7 Secure Ring Broadcasting (SRB)

In Secure Ring Broadcasting (SRB) [5] classifies nodes into three groups based on receiving power as Outer Nodes, Inner Nodes, and Secure Ring nodes. The nodes which are close to sending node are considered as Inner Nodes, far away from sending node is consider Outer Nodes and preferable distance from sending node is consider Secure Ring nodes.

4.8 Parameter Less Broadcasting In Static To Highly Mobile Wireless Ad Hoc(PBSM)

In Parameter less broadcasting in static to highly mobile wireless ad Hoc (PBSM) [26] nodes does not need to know neighbour information. To eliminate redundant broadcasting it uses connected dominating sets (CDS) and neighbour elimination concepts. Two lists of neighbouring vehicles: R and NR is maintained by each vehicle which helps to detect neighbours that already received and that which did not receive the packet. When timeout occurs then rebroadcast the packet.

4.9 Distributed Vehicular Broadcast Protocol (DV-CAST)

DV-CAST [8] is based on the connectivity as sparsely connected, well connected and totally disconnected neighbourhood that divides vehicles into three categories. For well-connected neighbourhood persistence scheme is used, for sparsely connected neighbourhood vehicles can immediately rebroadcast with vehicles moving in the same direction after receiving the broadcast message, for totally disconnected neighbourhood vehicles store the broadcast message until another vehicle enters into transmission range. When time is terminated then remove the packets. In DV-CAST protocol to check whether the packet is redundant or not each vehicle uses a flag variable.

4.10 Urban Multihop Broadcast Protocol(UMB)

UMB [28] is designed to solve collision and hidden node problems during message circulation in multi

ISSN : 2394-0905

hop broadcast. In this protocol without any previous topology information sender node tries to select the furthest node in the broadcast direction for forwarding and acknowledging the packet. It achieves well in higher packet loads & vehicle traffic density.

REFERENCES

[1] Ghassan Samara, R Sures, Wafaa AH Al-Salihy "Security Issues and Challenges of Vehicular Ad Hoc Networks (VANET)", 4th International Conference on New Trends in Information Science and Service Science (NISS), 2010, 393-398.

[2] Ghassan Samara, R Sures, Wafaa AH Al-Salihy "Security Analysis of Vehicular Ad Hoc Nerworks (VANET)", Second International Conference on Network Applications Protocols and Services (NETAPPS), 2010, 55-60.

[3] Who, W. H. (2011), World Health Organization, http://www.who.int/roadsafety/decade_of_action/plan/en/index.html, visited on 30 Apr., 2014.

[4] M Raya, D. J., P Papadimitratos, I Aad, JP Hubaux (2006), Certificate Revocation in Vehicular Network. Laboratory for computer Communications and Applications (LCA) School of Computer and Communication Science, EPFL, Switzerland.

[5] Worldometers (2011), real time world statistics, www.worldometers.info, visited on 30 Apr., 2014.

[6] Ghassan Samara, WAHA Alsalihy, S Ramadass, "Increase Emergency Message Reception in VANET", Journal of Applied Sciences, 2011, Volume 11, Pages 2606-2612.

[7] Ghassan Samara, Sureswaran Ramadass , Wafaa Alsalihy, " Increasing Network Visibility Using Coded Repitition Beacon Piggybacking", World Applied Sciences Journal (WASJ), Volume 13, Number 1, pp. 100 - 108, 2011.

[8] Ching-Yi, Y. & Shou-Chih, L. (2010) Street Broadcast with Smart Relay for Emergency Messages in VANET. 24th International Conference on Advanced Information Networking and Applications Workshops (WAINA), 323-328, IEEE.

[9] Qiong, Y. & Lianfeng, S. (2010) A Multi-Hop Broadcast scheme for propagation of emergency messages in VANET. 12th IEEE International Conference on Communication Technology (ICCT), 1072-1075, IEEE.

[10] Biswas, S., Tatchikou, R., Dion, F. (2006), Vehicle-to-vehicle wireless communication protocol for enhancing highway traffic safety, IEEE Communication Magazine, 44, 74-82, IEEE.

[11] Torrent-Moreno, M. (2007), Inter-vehicle communications: assessing information dissemination under safety constraints, 4th Annual Conference on Wireless on Demand Network Systems and Services, WONS '07, 59 – 64, IEEE.

[12] Torrent-Moreno, M., Mittag, P. & Hartenstein, J., Santi, H. (2009), Vehicle-to-Vehicle Communication: Fair transmit power control for safety-critical information. Transactions on Vehicular Technology, 58, 3684-3703, IEEE

[13] Torrent-Moreno, M. (2007), Inter-Vehicle Communication: Achieving Safety in a Distributed Wireless Environment-Challenges, Systems and Protocols, (Ph.D Paper), Universitatsverlag Karlsruhe, ISBN: 978-3-86644-175-0.

[14] Füßler, H., Kasemann, M., Widmer, J., Mauve, M. & Hartenstein, H. (2003), Contention-based forwarding for mobile ad hoc networks, Ad Hoc Networks, 1 (2003), 351-369.

[15] Briesemeister, L., Schafers, L., Hommel, G. (2000), Disseminating messages among highly mobile hosts based on inter-vehicle communication, IEEE Intelligent Vehicles Symposium, IV 2000, 522 - 527, IEEE.

[16] Korkmaz, G., Ekici, E., Özgüner, F. & Özgüner, Ü. (2004), Urban multi-hop broadcast protocol for inter-vehicle communication systems, first ACM international workshop on Vehicular ad hoc network, ACM.

[17] Fasolo, E., Zanella, A., Zorzi, M. (2006), An effective broadcast scheme for alert message propagation in vehicular ad hoc networks, IEEE Int. Conf. on Communications ICC'06,(3960 – 3965), IEEE.

[18] Zorzi, M. & Rao, R. R. (2003), Geographic random forwarding (GeRaF) for ad hoc and sensor networks: energy and latency performance, IEEE transactions on Mobile Computing, (349-365) , IEEE.

[19] IEEE (2005), White Paper: DSRC technology and the DSRC Industry consortium (DIC) prototype team.

[20] Intelligent Emergency Message Broadcasting in VANET Using PSO.