International Journal of Engineering Sciences Paradigms and Researches (IJESPR)
Vol. 48, Issue 02, Quarter 02 (April-May-June 2019)
(An Indexed, Referred and Impact Factor Journal)
ISSN (Online): 2319-6564
www.ijesonline.com

Efficient Message Delivery Technique in VANET for Rural and Urban Areas

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Publishing Date: May 04, 2019

Abstract

VANET is a highly mobile adhoc network and extremely useful in road applications to avoid congestion etc. A critical use of VANET is to transfer any urgent warning message to the destination in case of accident or emergency. This requires highest prioritized message transfer to the destination. The existing routing protocols are not capable of communicating with the RSU (road side units). This work introduces the communication of OBU with RSU. The simulation using the NS2 and comparison against existing protocols shows the efficient performance of algorithm in rural as well as urban areas.

Keywords: *VANET, REC, MREC, OBU, RSU.*

1. Introduction

Vehicular Ad-hoc Network (VANET) is a sort of versatile specially appointed system (MANET) that gives vehicle-to-vehicle and vehicle-to-roadside interchanges. It was first presented by the US Department of Transportation. The VANET precedent incorporates the Car-2-Car Communication, Honda's Advanced Safety Vehicle Program. The stimulus of VANET is that not long from now vehicles furnished with registering, correspondence and detecting capacities will be sorted out into a universal and unavoidable system that can give various administrations to explorers, extending from improved driving security and solace (the first objective), to conveying interactive media content on interest, and to other comparative esteem included administrations. The underlying expectation is to give wellbeing and accommodation to sections. Security improvement applications are spurred by the need to illuminate individual drivers regarding genuine or unavoidable street conditions, delays, clog, unsafe driving conditions and other incorporate traffic status reports, impact evasion, crisis cautions and agreeable driving. The applications, for example, driver help, mishap salvage, online installment administrations, internet shopping are instances of comfort applications that proliferate message from vehicle to vehicle [1]. VANET incorporate remote keyless passage gadgets, individual computerized collaborators (PDAs), PCs and cell phones. As versatile remote gadgets and systems become progressively significant, the interest for Vehicle-to-Vehicle (V2V) and Vehicle-to-Roadside (VRC) or Vehicle-to-Infrastructure (V2I) Communication will keep on developing. VANET's can be used for an expansive scope of security and non wellbeing application take into consideration esteem included administration, for example, vehicle wellbeing, robotized toll installment, traffic the executives, upgraded route, area based administrations, for example, finding the nearest fuel station, café or travel cabin and infotainment applications, for example, giving access to the Internet [2].

VANET is a multi-bounce portable system intended to give a wide scope of street applications, for example, wellbeing cautioning, clog evasion or versatile infotainment. A standout amongst the most significant uses of VANET is the communicated of occasion driven crisis cautioning messages like mishap and risk cautioning. For instance, after two vehicles slammed into one another on a parkway, or traffic clog happens as a result of substantial downpour or snow, the up and coming vehicles should advise promptly [3]. In the two cases, the WMs ought to be spread out with short deferral to vehicles that are as much as a few kilometers away, not exclusively to forestall progressively conceivable mishaps, yet in addition to empower the vehicles to make a reroute as right on time as conceivable to dodge blockage. As per Channel and the Dedicated Short Range Communication (DSRC), the ordinary one-jump communicate defer prerequisite for some, occasion driven messages fluctuates from 100 to 500 ms inside a one-bounce correspondence run from 200 to 300 m, while the run of the mill deferral of periodical security messages is littler than 100 sms. In circumstances where the one-bounce correspondence scope of a vehicle does not achieve the planned separation of a notice message, multi-jump communicate is important to scatter those time-delicate cautioning messages through VANET. For the defer prerequisite of multi-jump communicate WMs, it is normal to expand those of single-bounce WMs [3]. In any case, in genuine VANET's these objectives are difficult to accomplish all the while. The real test originates from the lossy remote transmissions, which undermine the dependability of one-bounce communicate [3].

2. Broadcasting

The main purposes of ITS include providing real-time and comprehensive traffic information, and to give driving directions. In general, the traffic information can be classified into three categories: beforehand information, real-time information and afterward information. One of the most important services among them is emergency message dissemination. Emergency messages are useful for drivers in hazardous situations, e.g., dangerous road surface conditions, accidents and unexpected fog banks. Such messages are usually time sensitive and localized [4]. These messages can be disseminated to intended locations through multi-hop broadcast. Broadcast is a frequently used method for applications running on wireless environments. However, uncontrolled broadcasts will lead to broadcast storm problems [5], which cause severe packet collisions and redundancy and hidden terminal problems. Due to the high density and mobility of vehicles, designing an efficient broadcast protocol for VANET's in urban areas is a big challenge. Recently, there are many researches working on multi-hop broadcast problems in the VANET's. The two major challenges of broadcast are to ensure the reliability of messages while disseminating messages over the intended regions and keeping the delay time within the requirements of the applications. The design of broadcast protocols should exploit the peculiar features that differentiate VANET's from MANET's [6]. A geographic broadcast distributes data packets by flooding, where vehicles re-broadcast the packets if they are located in the geographic area determined by the packet [7].

The primary goal of a broadcasting task is to deliver the message to all nodes in a network (to achieve high delivery ratio) while minimizing the total number of retransmissions. There exists a body of knowledge about centralized broadcasting, in which source node knows the whole network topology and can determine the whole broadcast process. However, collecting the required global knowledge demands unacceptable communications overhead for dynamic networks. [8] Initially the source node is colored black, and all the other nodes are white. In each slot, color of a node is changed from white to black if at least one of its neighbors is colored black in earlier time slot. We assume that the broadcasting process must complete within a finite time *T*. When time *T* expires, black nodes are exactly those that could have received the message from the source node. Then the reliability of a particular protocol is the percentage of black nodes that received the message. This gives more accurate results for reliability since it is impossible for nodes that are always disconnected to receive a message and therefore they are not considered. Moreover, it also considers nodes that may not be connected to the source at any given moment in time but could receive a message from the source. For instance, if another node moves between the areas where a source and destination node is located and carries the message [9]. The application of broadcasting algorithms help to minimize overhead by reducing the occurrence of broadcast storms. Data and control packet forwarding must be loop-free and in the direction of the destination or target area location. Several past routing efforts have investigated the design of ad hoc routing algorithms suitable for operation in a VANET environment to deal with: a node's mobility, by discovering new routes (reactive routing algorithms), updating existing routing tables (proactive routing algorithms), using geographical location information (position-based routing algorithms), detecting stable vehicle configurations (clusters), using a vehicle's movements to support message transportation and using broadcasting to support message forwarding. Vehicles periodically broadcast short packets with their identifiers and current geographic position. Upon receipt of such beacons, a vehicle stores the information in its location table. It is therefore possible to design a Cooperative Collision Avoidance (CCA) system that can assist in collision avoidance by delivering warning messages. When an emergency situation arises, a vehicle needs to broadcast a message to all of the vehicles behind it. The vehicles that receive this message selectively forward it based upon the direction from which it came which ensures that all members of the platoon eventually receive this warning [10].

3. Broadcasting Protocols in VANET

During the last few years, a lot of broadcasting protocols for VANET's have been reported in the literature. They can be generally classified into two main categories according to the spreading of information packets in the network. These categories are-:

3.1 Single-hop Broadcasting

In single-hop broadcasting, information packets are not flooded by vehicles. Instead, when a packet is received by a vehicle, information is kept in the vehicle's on-board database. Periodically, every vehicle selects some of the records stored in its database to broadcast. Hence, in single-hop broadcasting, each vehicle carries the traffic information with itself as it travels, and this information is transferred to all other vehicles in its one-hop neighborhood in the next broadcast cycles. Ultimately, vehicle's mobility is involved in spreading the information in single-hop broadcasting protocol [11].

3.2 Multi-hop Broadcasting

On the other hand, in multi-hop broadcasting strategy, a packet is spread in a network by the way of flooding. In general, when a sender vehicle broadcasts an information packet, a number of vehicles within the vicinity of the sender will become the next relay vehicles by rebroadcasting the packet further in the network. Similarly, after a relay vehicle (node) rebroadcasts the packet, some of the vehicles in its vicinity will become the next relay nodes and perform the task of forwarding the packet further. As a result, the information packet is able to propagate from the sender to the other distant vehicles [11].

4. Receiver Consensus (REC)

The main concept behind REC is that receiving node retransmits immediately if it considers itself as the best forwarder. When a node receives a broadcast message, based on its local knowledge, it ranks the potential forwarders according to their geographical locations. The procedure of ranking is based on distance to an ideal forwarder, located at the centroid of remaining neighboring vehicles. The node considered as best forwarder retransmits immediately as it receives the packet, while other nodes would take action if better ones fail to complete their tasks [13].
In *REC* the current node determines forwarders based on Receiver Consensus. It is assumed that each vehicle is GPS-enabled. Each vehicle periodically broadcasts a beacon containing basic information including geographic position.

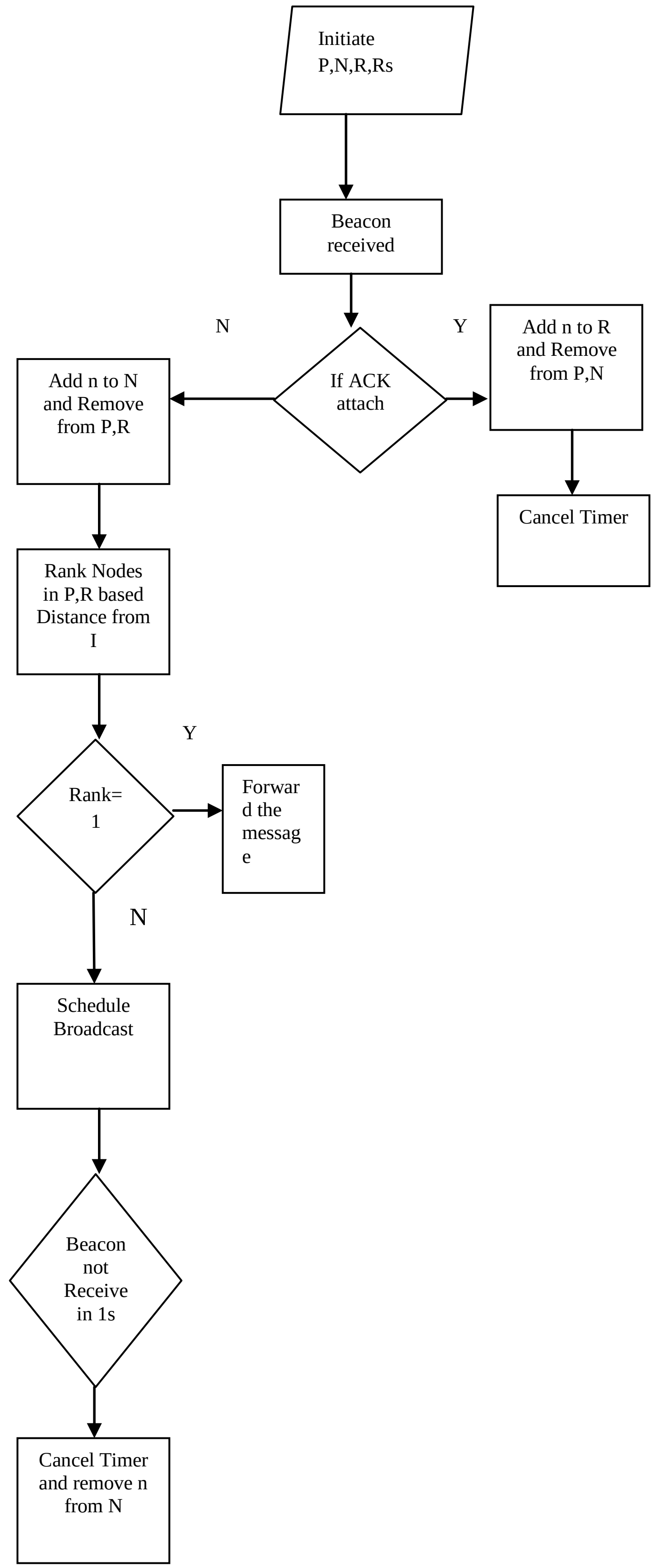

Fig. 1: Flow Chart of REC

Nodes also use one bit in their beacons to exchange their status [12]. Nodes send beacons at different times to avoid collisions. Every round is divided into *T* time slots where each slot consist warning message. The *ReC* consists of two components, one is location-based ranking and the other is acknowledgement-based neighbor elimination. The former enables fast propagation without unnecessary waiting time latency at every hop, and the latter guarantees reliability while reducing the number of retransmissions considerably. In both components, receivers utilize local knowledge to achieve consensus on forwarding strategies.

5. Proposed Work(MREC)

The existing algorithm REC is not capable of communicating with the RSU (road side units). So in the rural areas the communication using REC is not efficient as there is no regular traffic flow. For the efficient working of the REC algorithm, the communication of OBU with RSU is introduced. This will results in efficient performance of algorithm in rural as well as urban areas. If there is no OBU left to get the message still the node is not able to transmit the message to any OBU then the message will be broadcasting to the RSU and the RSU will transfer the message to other OBU or RSU. This process will goes on until the message is not broadcasting to any neighbor. The process can be explained by the following algorithm

5.1 Proposed Algorithm

MREC at each node c for a message *m*
Initialize A,B,C are empty

When a beacon is received from node say n
if ACK(m) present in beacon
    then
    Update CDS status and add n to C
    Remove n from A,B.
        If broadcast of m is scheduled
        If B=ϕ then
    cancel scheduled broadcast
        else
    add n to B and remove n from A
        end if
        else
perform ideal_loaction_ranking
end if
when message received from neighbor or generated by source node say s
    add s to C and remove s from A,B.
    add nodes in B within communication range of s to A and remove them from B
    add other neighboring nodes of c to B
    if c=s then
        forward message
    else
        if B is not empty then
            perform ideal_loaction_ranking
        else
            cancel scheduled broadcast
end if
end if
function RSU_Broadcasting
    Rs<- Set of RSU
    Put all the RSU in the range of n to P.
    Broadcast message m.
    if ACK(m) received then
        add RSU to R and remove it from P, N.
    else
    Insert RSU to N and remove it from P,R.
For all RSU in R
    Broadcast the message from RSU
    and **Re-Initialize.**
Procedure :ideal_loaction_ranking
Rank nodes in A+C based on distance to I .
if c's ranking=1 then
    forward message
else
    schedule broadcast
if beacon not received from n for a while
    if B contained only n then
        cancel timer
    remove n from B.
    End if

Some modification is done in the REC algorithm by adding the RSU's which are in the range of n. All the RSU's are put in the P list which are in the range. After that we broadcast the message m then if acknowledgement attached, put that RSU in the R list and removed from the P,N list. If acknowledgement not attached then put RSU in the N list and remove this from the R,P list.

6. Implementation and Results

The proposed technique is implemented in NS-2.34 Simulator in Linux environment. The tcl file is executed and it generates a .nam file which can be viewed in Network Animator tool of ns2 simulator.

6.1 Parameter Analyzed

- **Reception Ratio**

The ratio of the number of delivered data packet to the destination. This illustrates the level of delivered data to the destination.

∑ Number of packet receive / ∑ Number of packet send

- **Average Delay**

  The average time taken by a data packet to arrive in the destination. It also includes thedel
  -ay caused by route discovery process and the queue in data packet transmission. Only the data packets that successfully delivered to destinations that counted.

∑ (arrive time – send time) / ∑ Number of connections

- **Number of Transmission**

  It is the average number of the packets transmitted by a node to transfer the packet from source to the destination.

The graphical comparison confirms the better performance of the proposed protocol is better than the existing protocol. The packet delivery ratio is increased and the number of transmissions also gets reduced and the delay gets increased. The increase in the reception ratio and reduction in the number of transmission shows enhanced performance of MREC as compared to the REC.

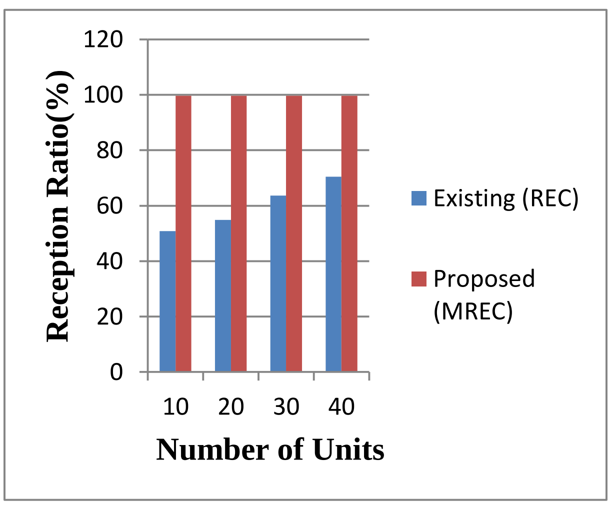

Fig. 2: Comparison of Reception Ratio between REC And MREC

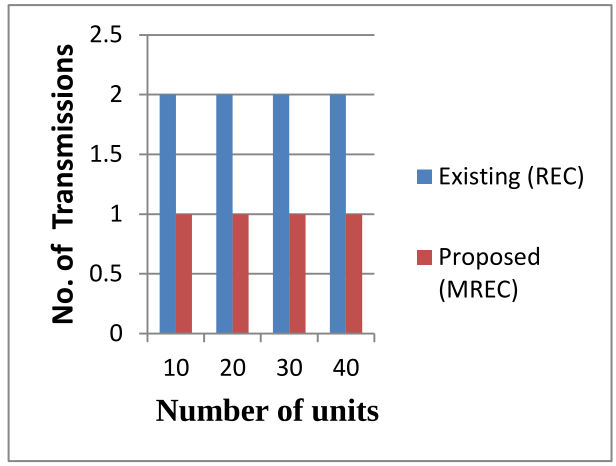

Fig. 3: Comparison of Number of transmission between REC And MREC

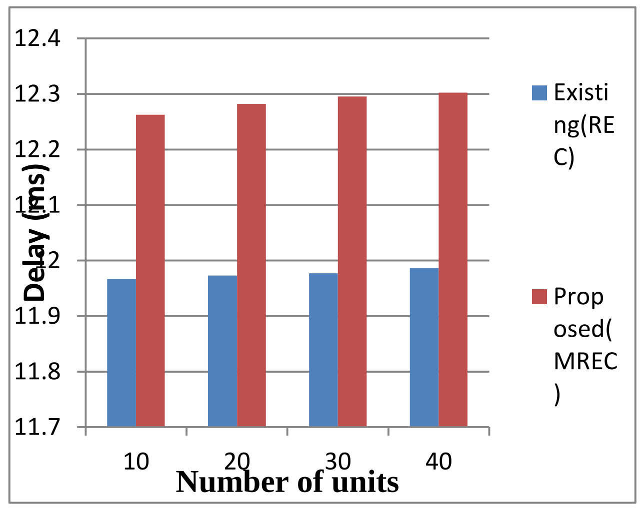

Fig. 4: Comparison of Average Delay between REC And MREC

7. Conclusion

The work modified a broadcasting scheme based on Receiver Consensus (REC), which is a fully distributed and effective warning delivery algorithm suitable for VANETs with all mobility and density scenarios. The existing algorithm REC is not capable of communicating with the RSU (road side units). So in the rural areas the communication using REC is not efficient as there is no regular traffic flow. For the efficient working of the REC algorithm, the communication of OBU with RSU is introduced. This will results in efficient performance of algorithm in rural as well as urban areas. The increase in the reception ratio and reduction in the number of transmission shows enhanced performance of MREC as compared to the REC. In future following work can be done, the work can be extended to decrease the delay. It can also be extended to improve the security.

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