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# Efficient Technique for on Time Message Delivery in VANET

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**Abstract**

VANET is a multi-hop mobile network designed to provide a wide range of road applications such as safety warning, congestion avoidance or mobile infotainment. One of the most important applications of VANET is the broadcast of event-driven emergency warning messages like accident and hazard warning. This needs the routing of the warning message efficiently and immediately 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. This results in 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 type of mobile ad-hoc network (MANET) that provides vehicle-to-vehicle and vehicle-to-roadside communications. It was first introduced by the US Department of Transportation. Indeed. The VANET example includes the Car-2-Car Communication, Honda's Advanced Safety Vehicle Program. The impetus of VANET is that in the not so-distant future vehicles equipped with computing, communication and sensing capabilities will be organized into a ubiquitous and pervasive network that can provide numerous services to travelers, ranging from improved driving safety and comfort (the original goal), to delivering multimedia content on demand, and to other similar value-added services. The initial intention is to provide safety and convenience for passages. Safety-improvement applications are motivated by the need to inform fellow drivers of actual or imminent road conditions, delays, congestion, hazardous driving conditions and other include traffic status reports, collision avoidance, emergency alerts and cooperative driving. The applications such as driver assistance, accident rescue, online payment services, online shopping are examples of convenience applications that propagate message from vehicle to vehicle [1].

VANET include remote keyless entry devices, personal digital assistants (PDAs), laptops and mobile telephones. As mobile wireless devices and networks become increasingly important, the demand for Vehicle-to-Vehicle (V2V) and Vehicle-to-Roadside (VRC) or Vehicle-to-Infrastructure (V2I) Communication will continue to grow . VANET's can be utilized for a broad range of safety and non-safety applications allow for value added services such as vehicle safety, automated toll payment, traffic management, enhanced navigation, location-based services such as finding the closest fuel station, restaurant or travel lodge and infotainment applications such as providing access to the Internet [2].

VANET is a multi-hop mobile network designed to provide a wide range of road applications such as safety warning, congestion avoidance or mobile infotainment. One of the most important applications of VANET is the broadcast of event-driven emergency warning messages like accident and hazard warning. For example, after two vehicles collided with each other on a highway, or traffic congestion happens because of heavy rain or snow, the upcoming vehicles need to be notifying immediately [3]. In both cases, the WMs should be disseminated out with short delay to vehicles that are up to several kilometers away, not only to prevent more possible accidents, but also to enable the vehicles to make a detour as early as possible to avoid congestion. According to Channel and the Dedicated Short Range Communication (DSRC), the typical one-hop broadcast delay requirement for many event-driven messages varies from 100 to 500 ms within an one-hop communication range from 200 to 300 m, while the typical delay of periodical safety messages is smaller than 100 sms. In situations where the one-hop communication range of a vehicle does not reach the intended distance of a warning message, multi-hop broadcast is necessary to disseminate those time-sensitive warning messages through VANET. For the delay requirement of multi-hop broadcast WMs, it is natural to extend those of single-hop WMs [3]. However, in real VANET's these goals are hard to achieve simultaneously. The major challenge comes from the lossy wireless transmissions, which undermine the reliability of one-hop broadcast [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. 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.

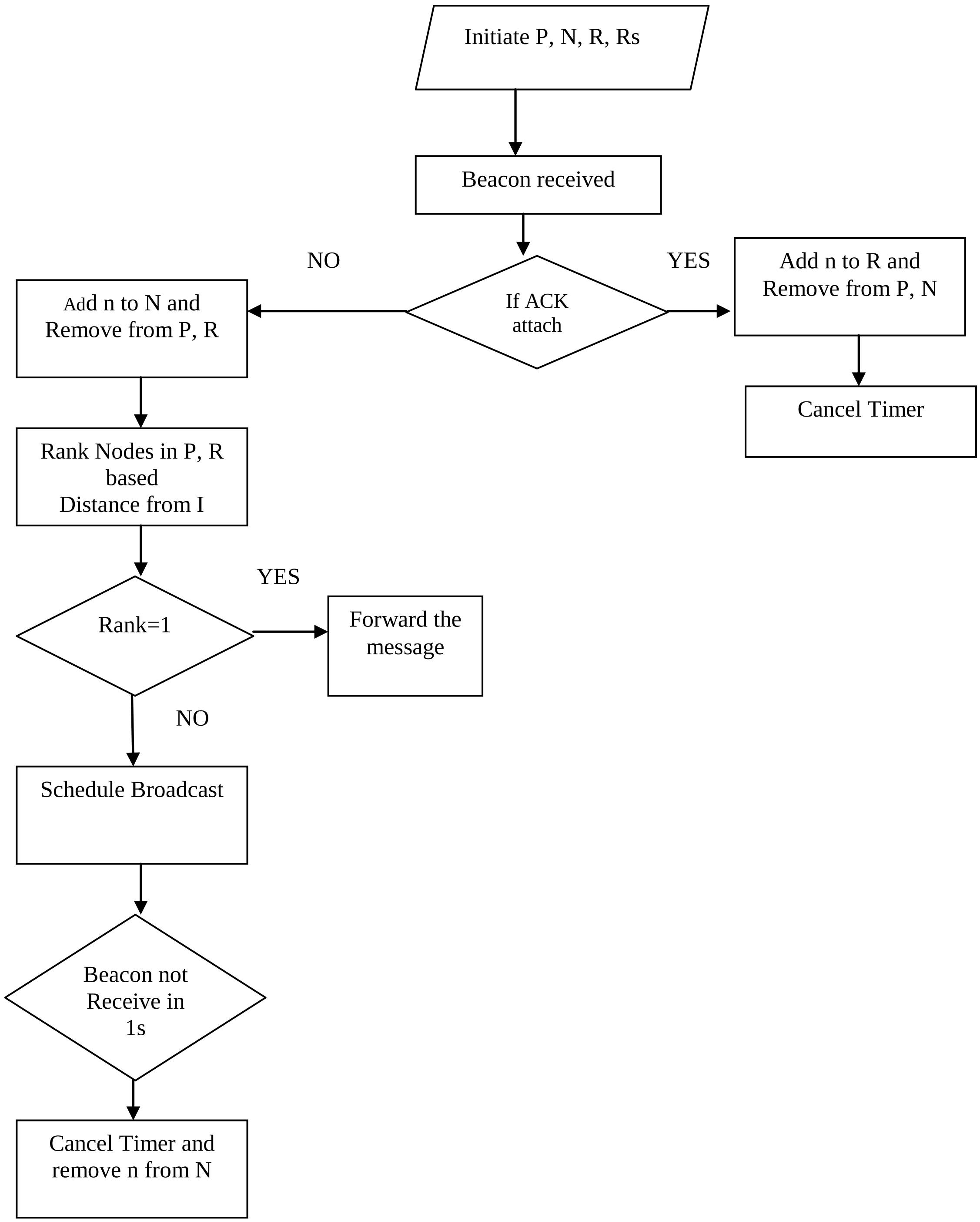


**Fig. 1: Flow Chart of REC**

## 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 the delay 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.

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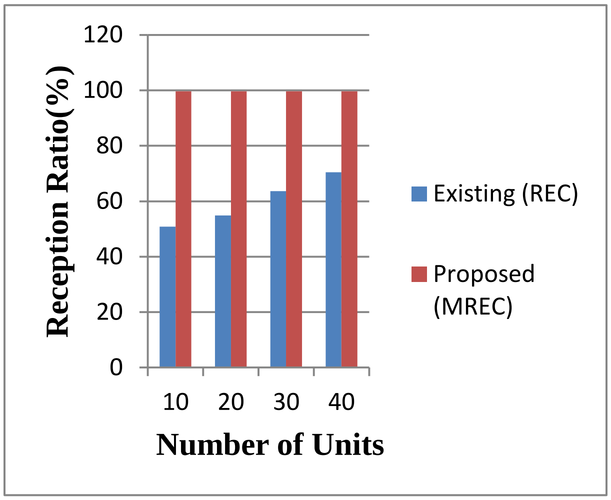


**Fig. 2: Comparison of Reception Ratio between REC and MREC**

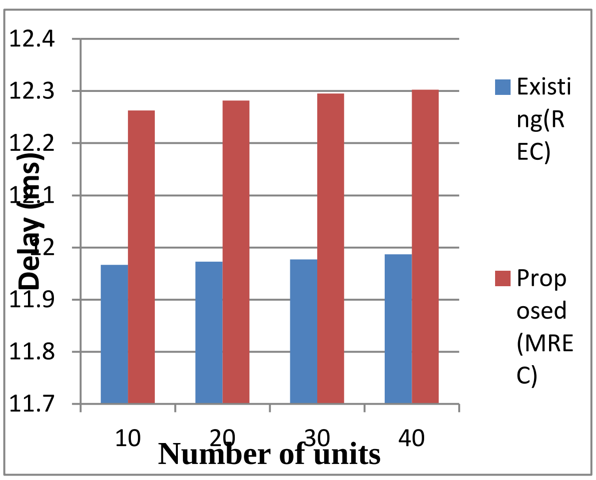


**Fig. 3: Comparison of Number of transmission between REC and MREC**

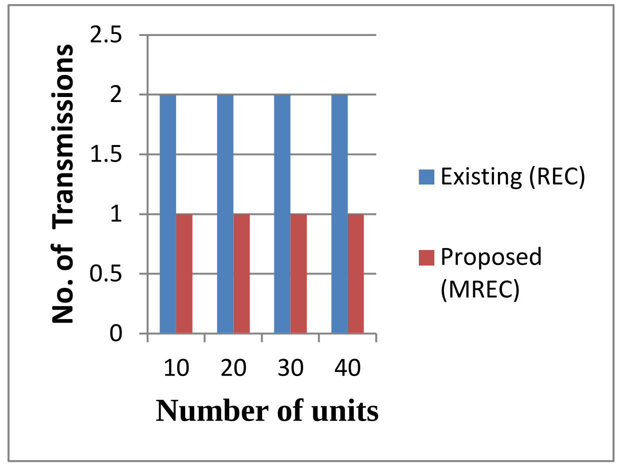


**Fig. 4: Comparison of Average Delay between REC and MREC**

## 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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