Relevance Based Approach with Virtual Queue for Vehicular Adhoc Networks

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Abstract:

Vehicular adhoc networks are subclass of mobile adhoc network. Broadcast is a commonly used technique for communication. Different techniques are proposed for broadcast but they can't consider the importance of message except relevance based approach. Relevance based approach is the only scheme that forward relevant message for sharing and discard the surplus messages. The relevance based approach using 802.11e does not provide internal resorting of the packets in a packet queue. This paper presents an idea of virtual queue at application level to overcome this problem.

Keywords: Vehicular Ad hoc Networks (VANETs), Broadcast, Urban MultiHop Broadcast (UMB), Multi-Hop Vehicular Broadcast (MHVB).

1. Introduction:

In Vehicular Ad-Hoc Networks, vehicles communicate with each other from time to time and require no base station, no router for their communication. They can share information either directly or through intermediate nodes.

Vehicular Ad-Hoc Networks (VANETs) are a special case of Mobile ad Hoc Networks (MANETs) [1]. VANETs like MANETs are distributed; self-organizing communication networks, that do not need any infrastructure. [2]

VANETs have some distinctive properties that discriminate it from MANETS and some other types of adhoc networks [3].It includes very high speed of vehicles, no battery restriction reliability and security problems, and movement of vehicles is limited.

Mostly in VANETs, vehicles are interested in the same kind of information for example information about any accident, road block and weather situation of particular route.

Broadcast is frequently used in vehicular adhoc network for information sharing. [4]. It is mechanism through which a vehicle in VANETS send message to all its neighbor vehicles in the same VANETs. Sharing safety, weather, and road information, advertisements and announcements are through on broadcast. [5] Broadcast in VANETs is used by different multicast and unicast protocols to establish and maintain their route. Dynamic Source Routing (DSR), Ad Hoc On Demand Distance Vector (AODV), Zone Routing Protocol (ZRP), and Location Aided Routing (LAR) are the example of unicast routing protocols.

Broadcast Techniques like simple flooding [6] have shortcoming such as redundant rebroadcasts, collision, contention, Multi hop Vehicular broadcast [7] have Scalability problem. All existing techniques do not consider the importance of message except the relevance based approach.

The relevance based approach using 802.11e also have one problem that it does not provide internal resorting of the packets in a packet queue.[8] This paper presents an idea of virtual queue with relevance based approach using 802.11e to overcome this problem. This paper is organized as follows: In section 2, related work and relevance based approach using 802.11e is described. In section 3, enhanced due to virtual queue is given. In section 4, simulation study and results are shown. Lastly in section 5 conclusions is given.

2. Related Work

Multicast and unicast protocols in VANETs use broadcast for network control and route establishment. Simple flooding, probabilistic scheme, area based scheme etc. are proposed but they do not consider the importance of message. So the relevance based approach is the only technique that forwards the packet according to its relevance value.

Simple flooding is a simple technique for broadcast but it has redundant, collision and contention problems. In this scheme, a vehicle sends a message to all of its neighbors and its neighbors in return send message to its neighbors. This process ends when all the vehicles get the same message. [6]

Probabilistic scheme is similar to flooding but in order to control the redundant message and avoid contention it broadcast the message is broadcast with some fixed probability. It works fine in dense network and save the resources but its performance is similar to flooding in sparse network [9].

In Area Based Scheme, a vehicle records the received redundant messages to determine the additional coverage area. If a vehicle calculate sufficient additional coverage area with broadcast then it will rebroadcast else not. [9]

Neighbor Knowledge method is based upon neighbor information. Every vehicle maintains the table of neighbor information. With help of this information a vehicle decide to rebroadcast a massage or not. Vehicles share hello packets among themselves to get neighbor information. Hello packets influence the performance of Neighbor Knowledge method. If the vehicles share hello packet with short interval it will cause contention and collision. If the interval is large its performance degrades due to mobility. [10]

Urban MultiHop Broadcast Protocol [11] is IEEE 802.11 based protocol which resolves the broadcast storm, hidden node, reliability problems. The most important thing is that it works without exchanging the information among neighboring nodes.

A Mobility-Centric Data Dissemination Algorithm for Vehicular Networks (MDDV) [3] is a mobility centric scheme that merge the idea of opportunistic forwarding, trajectory based forwarding and geographical forwarding.

Relevance Based Approach using 802.11e is explained with help of simple scenario. Due to high speed of vehicles, it is not possible for one vehicle to share all its information with other vehicles. It can select only important and relevant messages for broadcast. Relevance based approach is only scheme that forward important and relevant message for sharing and discard the surplus messages.

The relevance-based approach is consisting of two methodologies. First, calculate the relevance value of data packets. Secondly, forward the messages only according to their relevance value. [12]

The Relevance-Based Approach using 802.11e for VANETS as shown in fig (1) is presented in [8] show that IEEE 802.11e standard has following shortcoming. Firstly the four queues of 802.11e do not give internal resorting of the packets in a packet queue. Packets are inserted into one of the four different priority queues according to their relevance value but for dequeuing it ignore the relevance value and follow only FIFO principle.

Secondly they are no mechanism for assigning priority to a given packet. They are limited queues and to sort packets into four queues are harmful, because data packets of high and low relevance value are inserted into the same queue.

Thirdly the performance of global benefit decreases because packets of less importance more often get the medium than the high relevance value due to no internal contention of four queues.

3. Proposed Approach

To overcome the above mention problems in Relevance Based approach with 802.11e,four virtual queues are made at application level as shown in fig (2). Packets are first entering into virtual queues according to their priorities and then queues are sorted. Most important messages are at the front of virtual queues. The length of 802.11e queues are adjusted equal to one or zero. So the most important and relevant message is passed to the one of the queues of 802.11e. If there is a message in the queue of 802.11e and the upcoming message have value higher than message in 802.11e. The upcoming message is placed in 802.11e queue and the message already present that has low relevance value is swap to the virtual queue.

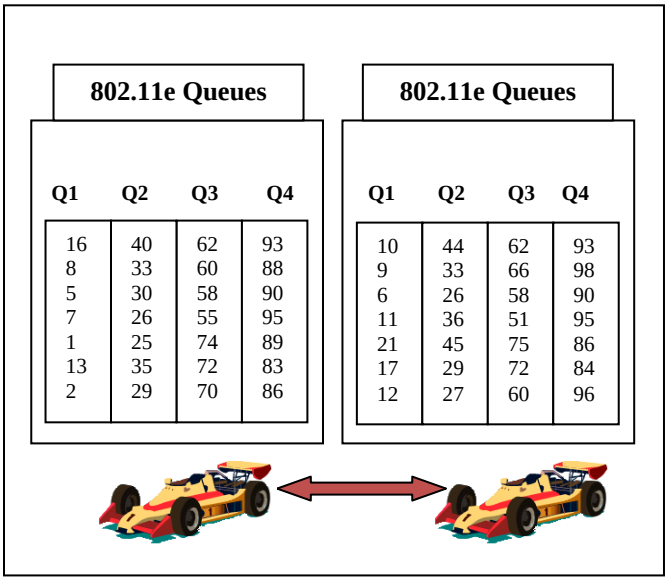

Fig: 1 Relevance Based Approach using 802.11e

4. Simulation Study and Results

In order to validate proposed scheme, we compare its performance with 802.11e. NS-2, a network simulator, is used to simulate the behavior for both broadcast schemes under different scenarios. Vehicles are moving at a speed of 40Km/hr to 70 Km/hr within an area of 2500m x2500m with transmission range of 300m. Mobility is generated using Rice Mobility generator and mobility trace file are available at [13] with 1188 number of roads and 383 number of intersections. Different types of messages like safety and route are exchange by vehicles and their performance is measured by following studies.

Global Benefit with 50 nodes

In this study 50 vehicles are exchanging information. Fig (3) shows simple 802.11e and virtual queue with 802.11e, safety messages and route messages are forwarded by vehicles. Safety messages should have more importance than route and are forwarded first. Safety messages are forwarded to virtual queue one and route messages are forwarded to virtual queue two which has lower priority than first queue. The priority of messages decreases due to message age. The most important and relevant message from virtual queue one is forward to 802.11e.In order to avoid sending surplus messages, sorting is perform two times. First when message is entering into virtual queue and second time when the message forwarded from virtual queue to 802.11e.These sorting allow the most important messages in queues and forward relevant message. The figure (3) shows the global benefit while using 802.11e and virtual queue with 802.11e

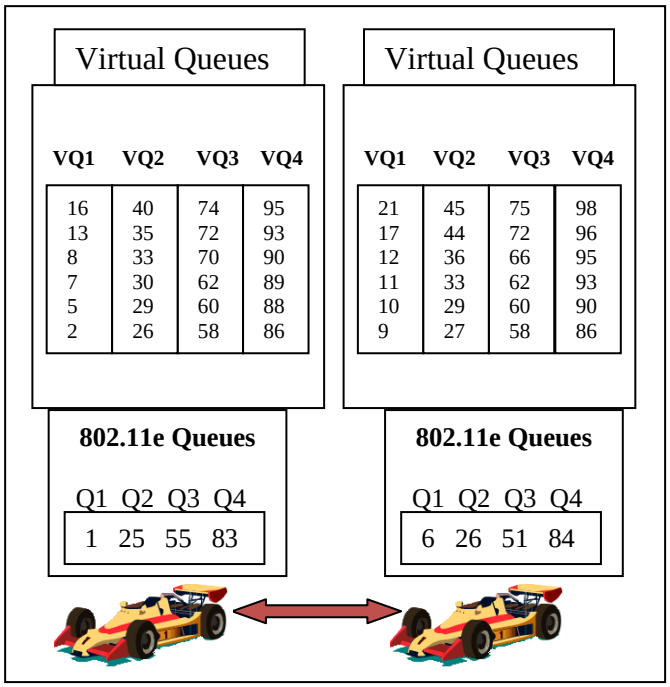

Fig: 2 Relevance Based Approach with Virtual Queue

Global Benefit with 150 nodes

Fig (4) shows simple 802.11e and virtual queue with 802.11, safety messages and route messages are forwarded by vehicles. In this study 150 vehicles randomly exchanging information. Safety messages should have more importance than route and are forwarded first. Safety messages are forwarded to virtual queue one and route messages are forwarded to virtual queue two which has lower priority than first queue. In safety message which message has greater priority forwarded first from virtual queue to 802.11e queue. Sorting is performed two times. First when message is entering into virtual queue and second time when message is forwarded from virtual queue to 802.11e.These sorting allow the most important messages in queues and forward relevant message only. The figure (4) shows the global benefit while using 802.11e and virtual queue with 802.11e.

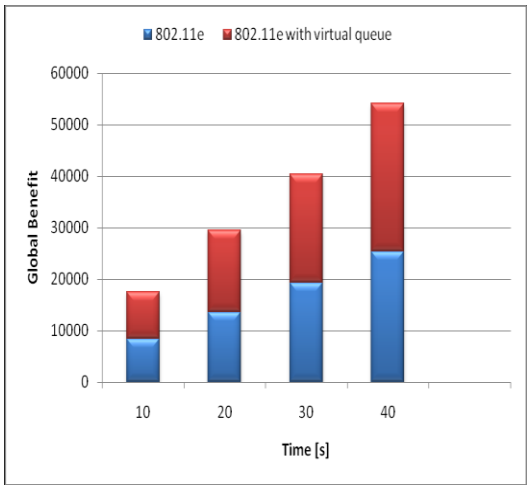

Fig (3) Global Benefit with 50 Vehicles using 802.11e and 802.11e with Virtual Queue

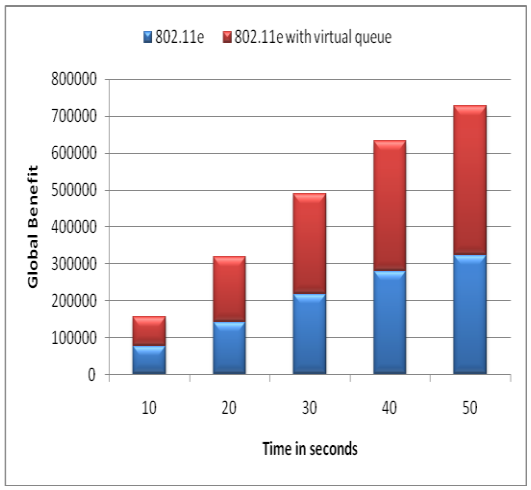

Fig (4) Global Benefit with 150 Vehicles using 802.11e and 802.11e with Virtual Queue

5. Conclusions

Relevance based approach is the only technique that recognize the importance of data packet and forward it according to its importance. It also removes the surplus messages. Relevance based approach with 802.11e has been improved with virtual queue and simulation shows the global benefit is improved by using virtual queue at application level.

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