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EMERGENCY MESSAGE DISSEMINATION IN URBAN VEHICULAR ADHOC NETWORKS

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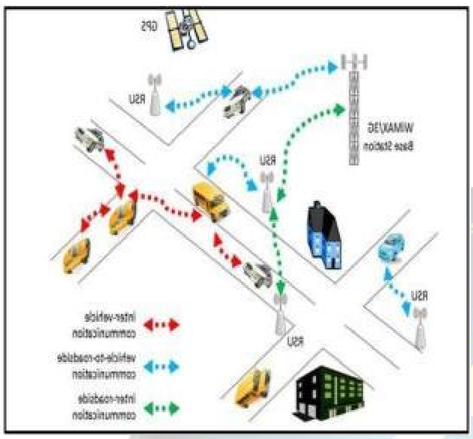
***Abstract*— Dissemination of emergency messages is one of the most important applications in vehicular ad hoc networks to avoid traffic fatalities. To achieve cooperative driving in vehicular ad hoc networks (VANET), broadcast transmission is usually used for disseminating safety-related information among vehicles. In this paper, we proposed a novel dissemination scheme called Nearest Junction Located (NJL) that is completely based on the topology of the roadmap, allowing vehicles to rebroadcast a message only if they are the nearest vehicle to the geographical coordinates of any junction obtained from the integrated maps. We first design a novel composite relaying metric for relaying node selection, by jointly considering the geographical locations, physical layer channel conditions, moving velocities of vehicles. We further apply IEEE802.11e EDCA to guarantee QoS performance of safety related services. Finally, simulation results are given to demonstrate that CLBP can not only minimize the broadcast message redundancy, but also quickly and reliably disseminate emergency messages in a VANET. . This approach is to disseminate emergency messages in a vehicular ad hoc network by using the Unicast and the Broadcast modes alternatively. Simulation results show that performances are good compared to the existing protocols.**

Keywords: VANET, QOS, Cross layer Broadcast Protocol, Vehicular Ad hoc Networks.

I. INTRODUCTION

Vehicular ad hoc Networks (VANETs) are wireless communication networks supporting cooperative driving among vehicles on the road. Vehicles act as communication nodes and relays, forming dynamic vehicular networks together with other nearby vehicles. In this work, we focus on traffic safety and efficient warning message dissemination, where the main goal is to reduce the latency and to increase the accuracy of the information received by nearby vehicles when a dangerous situation occurs. We consider that adapting the dissemination policy to the specific environment, accounting for the current vehicular density as well as for the scenario where the vehicles are located, can be beneficial to reduce broadcast storm related problems, and to increase the efficiency of the warning message dissemination process[1]. In this paper, we propose an adaptive algorithm that automatically chooses the best dissemination scheme to adapt the warning message delivery policy to each specific scenario. Our mechanism uses as input parameters the vehicular density and the topological characteristics of the environment where the vehicles are located, using them to decide which dissemination scheme to use. The main goal is to maximize the message delivery effectiveness while generating a reduced number of messages and, thus, avoiding or mitigating broadcast storms. In addition, we also propose the Nearest Junction Located (NJL), our novel warning message dissemination scheme specially designed for being used in highly congested urban areas.



II. LITERATURE SURVEY

In the networking literature, we can find several works that present adaptive mechanisms specially designed to enhance message dissemination in vehicular communications. In this section, we present some of the most representative works.

Junliang Liu et al proposed an on-time warning delivery mechanism for VANET using IEEE 802.11p. This mechanism is based on receiver's agreement on forwarding strategies in two dimensional vehicular networks. The results of simulation show that the number of collisions is lesser and the performance of reliability and delay are higher for warning message dissemination overriding broadcast storm problem.

Celimuge Wu et al proposed a Backbone Broadcast (BBBR) protocol for data dissemination in VANET with dynamic backbone selection. This protocol reduces the MAC contention time at each node with high data dissemination ratio. Both theoretical and simulation results show that the throughput and delay are improved.

Izhak Rubin et al proposed a system for critical public safety message broadcasting. In this system, the RSU in highway broadcasts critical safety messages to the vehicles in its vicinity and to the vehicles over the vicinity using VBN. The authors used vehicular Carrier Sense Multiple Access/ Collision Avoidance (CSMA/CA) access scheme and spatial reuse Time Division Multiple Access (TDMA) to emulate the system. This system forwards the messages with high throughput and low end-to-end delay.

Muhammad Awais Javed et al proposed a multi-hop broadcast protocol for emergency warning notification in highway VANET. This paper attempts to overcome broadcast storm, severe interference and hidden node problems. The results of simulation show that this protocol performs better in terms of number of multi-hop transmissions and dissemination delay.

Izhak Rubin et al proposed a Lane Based Election (LBE) algorithm for the relay node selection by using VBN structure in highway VANET. This paper focuses on optimal selection of the relay nodes. The simulation results on analytical expressions show that these algorithms perform better for more number of lanes with varied vehicle densities. [8] discussed about a Secure system to Anonymous Blacklisting. The secure system adds a layer of accountability to any publicly known anonymizing network is proposed. Servers can blacklist misbehaving users while maintaining their privacy and this system shows that how these properties can be attained in a way that is practical, efficient, and sensitive to the needs of both users and services.

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Francesca Cuomo et al proposed a protocol for dissemination scheme by using VANET structure called VBN for achieving high throughput. The authors presented both analytical and simulation analysis by using IEEE 802.11p CSMA/CA MAC protocol[6]. The protocol achieves high throughput and low end-to-end delay. This approach is done for a linear highway and it needs to be extended for two-dimensional highway systems.

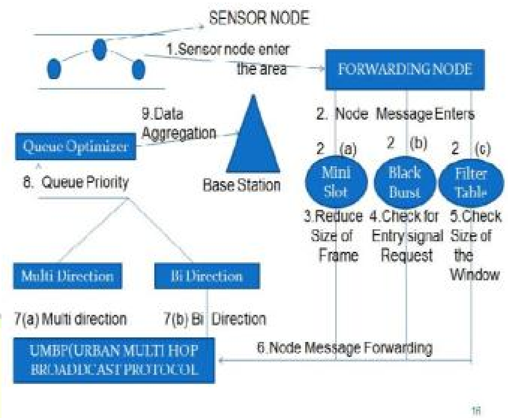
It is learned from the above works that (i) Multi-hop broadcasting with relay nodes in VBN structure in highway VANET will improve dissemination performance of time critical emergency warning messages. (ii) Extending the coverage area of RSU improves notification percentage and end-to-end delay. (iii) By extending the coverage area, the number of RSUs required is minimized. (iv) Reliability of EWM broadcasting is improved. (v) Reception of EWM by farthest vehicles is assured.

A. Problem Statement

The problem statement for reliable protocols is to design a protocol that can deliver a message from a single source to every node in the own transmission range with the highest possible reliability and minimum delay. Successful message dissemination in VANETs needs an efficient decision mechanism to maximize reliability, and keep the overhead low. The decision criterion about when and how a safety message should be delivered or repeated is an open issue.

Given the requirements of safety applications (i.e., low delay and effective reliability), and the limitations of vehicular communications (i.e., short-lived connectivity links), selective broadcast or multicast strategies seem more applicable than either unicast routing or flooding. In fact, the latter generates a high overhead without increasing the success rate substantially. Several solutions have been made to introduce intelligence to the basic broadcast concept, and make it more selective and, thus, more efficient in its resource usage.

III. ANALYSIS OF FRAMEWORK



Sensor node enters the area to forward nodes. It includes the node creation in the network. Node configuration essentially consists of defining the different node characteristics before creating them. They may consist of the type of addressing structure used in the simulation, defining the network components for mobile nodes, turning on or off the trace options at Agent/Router/MAC levels, selecting the type of ad-hoc routing protocol for wireless nodes or defining their energy model[3]. An efficient forwarding node selection scheme is presented to quickly select a remote neighboring node by utilizing iterative partition, mini-slot, black-burst, and asynchronous contention mechanisms, which greatly lowers emergency message transmission delay and reduces message redundancy[4]. At the first hop, the emergency message is bi-directionally broadcast to neighboring nodes if the source node locates on a straight road, and a single relaying node is selected to

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forward the message in either direction of the source node.

A. Algorithm

Algorithm for Optimal Broadcast Selection 1 forall b 2 B do
2 Pinf (b) = Inf10(b) · 0.5 + Inf30(b) · 0.3 + Inf120(b) · 0.2;
3 maxinf = max(Pinf (b)) 8 b 2 B
4 C = { }
5 forall b 2 B do
6 if (maxinf − Pinf (b)) <10% then C = C [{b}
/* Step 2: Minimize received messages */ 7 minrecv = min(Mrecv(b)) 8 b 2 C
8 forall b 2 C do
9 devinf (b) = maxinf − Pinf (b) devrecv(b) =
Mrecv(b) − minrecv minrecv 10
/* Step 3: Selection of the optimal broadcast scheme */
Optimalbcast = argmin b2C
(devinf (b) · K + devrecv(b)) 8 b 2 B 11

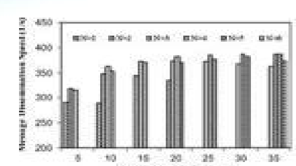
IV. EXPECTED OUTCOME

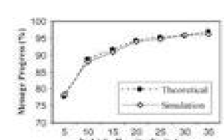
The most important metric to be considered when designing a warning message dissemination scheme for VANETs is the percentage of notified vehicles. We performed several experiments using roadmaps with different features and varying the density of vehicles. It is noticeable how the topology of the area and the number of vehicles are determinant factors affecting the performance of the broadcast scheme. The dissemination process develops faster in every situation when the vehicle density increases. The parameters used for the simulation of the scheme are tabulated in Table-1.

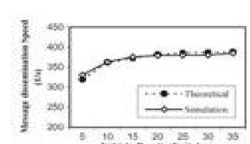
B. Table 1: Simulation Parameters

Parameters	Values
number of vehicles per km2	[25, 50, 100, 150, 200, and 250]
number of collided vehicles	3
roadmap size 2000m × 2000m	
warning message size	256B
beacon message size	512B
warning messages priority	AC3
beacon priority	AC1
interval between messages	1 second
MAC/PHY	802.11p
radio propagation model	RAV[7]
mobility model	Krauss[5]
channel bandwidth	6Mbps
max. transmission range	400m
dmin (used in distance-based, eSBR, and eMDR schemes))	200m

The simulator was also modified to make use of our Real Attenuation and Visibility (RAV) scheme, which proved to increase the level of realism in VANET simulations using real urban roadmaps in the presence of obstacles. As for vehicular mobility, it has been obtained with CityMob for Roadmaps (C4R), a mobility generator able to import maps directly from OpenStreetMap, and make them available for being used by the ns-2 simulator. With regard to data traffic, vehicles operate in two modes:(a) warning mode, and (b) normal mode.







V. CONCLUSION

In this paper, we proposed a quantitative algorithm that allows selecting the optimal broadcast scheme in a VANET scenario depending on two different metrics: (i) the percentage of informed vehicles, a particularly determinant factor in warning message dissemination, and (ii) the number of messages received by each vehicle, an important factor which indicates the channel contention and the possibility of broadcast storms during the dissemination of alert messages. In addition, we presented a new broadcast scheme called Nearest Junction Located (NJL), which was specially designed for scenarios presenting high vehicular densities or simple topologies, where broadcast storms are prone to occur. The NJL scheme is designed to reduce the number of messages received per vehicle without noticeably affecting the percentage of informed vehicles. We showed how our broadcast selection algorithm can select the optimal scheme in almost all the scenarios tested.

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