ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
Vol. 2, Special Issue 15, March 2016

REDUCING INTERFERENCES IN COOPERATIVE VEHICLE SAFETY SYSTEM FOR VANETs

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Abstract- Mobile ad hoc networks (MANETs) are networks that are created on the fly (*ad hoc*) between different mobile nodes and do not require roads. The mobile nodes can move around, and the network would repeatedly reconfigure itself to permit connectivity. Vehicular ad hoc networks (VANETs) are a subclass of MANETs that is likely to have a key task in the intelligent transportation systems of the expectations. VANETs give vehicle-to-vehicle and vehicle-to-roadside communication in order to support safety and comfort applications. Although being a subclass of MANETs, VANETs have basically different activities. This paper presents a scheme consisting of a Media Access Control (MAC) protocol and a clustering algorithm designed to decrease interferences in VANETs. This scheme, which is planned for safety applications in highway environments, employs dynamic multi hop clustering, allows better operation of network resources, and improves network performance

Index terms **–** Clustering infrastructure, Interference Reduction, multi hop network, vehicular ad hoc network (VANET).

I. INTRODUCTION

Vehicular Ad hoc Networks (VANETs) are a class of wireless networks that is expected to have a key role in the intelligent transportation systems of the future. Already in recent years, the U.S. Federal Communications Commission and the European Telecommunications Standards Institute have allocated spectrum for such systems, and an IEEE communications standard for them is under development.
Fig(1) shows VANETs provide vehicle-to-vehicle and vehicle-to-roadside communication in order to support two main types of applications: safety applications such as road-hazard notification and sending emergency messages from an accident site, and comfort applications such as advertisements, parking space availability, traffic estimation, and traffic-jam notifications.

Despite being a subclass of mobile ad hoc networks (MANETs), VANETs have fundamentally different behaviour [1] in that their nodes are limited to move along roads, have no power constraints, have small network diameter, and may undergo rapid topology changes, for example when cars bypass each other in an intersection or when highways split before an interchange. VANETs also have different requirements for routing. While MANETs usually use topology-based table or source routing algorithms , these are not applicable for VANETs because of their highly dynamic nature. Most VANET routing algorithms use geographic-based routing and opportunistic carry-and-forward techniques to overcome this challenge. Vehicular sensor nodes are carried by the vehicles. These nodes are supposed to sense the real phenomena e.g. the velocity of the vehicle. The sensor readings are to be sent to the base stations via RSS nodes. These nodes can communicate with each other or the roadside sensor via short-range communication.

Side Sensors are deployed in a fixed distance beside the road. RSSs act as cluster heads for vehicular nodes. RSS (Road side sensor) nodes receive the data from mobile nodes and retransmit towards the BS(Base Station). These nodes are equipped with two kinds of antenna, unidirectional and bidirectional. Unidirectional antenna is for broadcasting and directional antenna are intended for geo-casting.

VANET STRUCTURE

The Primary goal of VANET is to provide road safety measures where information about vehicles current

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International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
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speed, location coordinates are passed with or without the deployment of Infrastructure. VANET also provides value added services like email, audio, video sharing etc. There are three communication types in VANET are shows in fig1 i.e. vehicle to vehicle (V2V), vehicle to road side (V2R), infrastructure to vehicle communication. The first communication type vehicle to vehicle communication in which vehicle communicates with each other by sending the message. The second communication type is vehicle to road side (V2R) in which vehicle communicates with road side unit. Third type is vehicle to infrastructure (V2I) or infrastructure to vehicle (I2V) in which message share between vehicle and road side unit. Also vehicle is providing information about navigation and internet is as shown in fig 1.

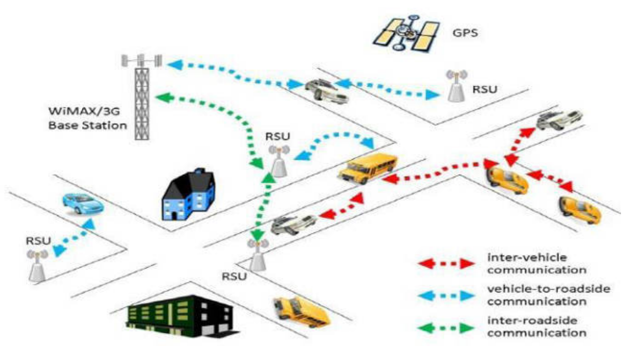

Fig 1 Vehicular Adhoc Network

2.VANET APPLICATIONS AND CHARACTERISTICS

To deploy VANETs, there must be some commercial applications that benefit from them. The applications where VANET can play major role can be categorised into two broad categories.

2.1. Safety Related Application

These applications are used to increase the safety on the roads. These applications can be further categorised in following way.

Collision Avoidance: According to some studies, 60% accidents can be avoided if drivers were provided a warning half a second before collision . If a driver get a warning message on time collision can be avoided.

Cooperative Driving: Drivers can get signals for traffic related warnings like curve speed warning, Lane change warning etc. These signals can co-operate the driver for an Un interrupted and safe driving.

Traffic optimisation: Traffic can optimised by the use of sending signals like jam, accidents etc. to the vehicles so that they can choose their alternate path and can save time.

CHARACTERISTICS OF VANET

VANET is an application of MANET but it has its own distinct characteristics which can be summarised as:

High Mobility: The nodes in VANETs usually are moving at high speed. This makes harder to predict a node's position and making protection of node privacy.

Rapidly changing network topology: Due to high node mobility and random speed of vehicles, the position of node changes frequently. As a result of this, network topology in VANETs tends to change frequently.

Unbounded network size: VANET can be implemented for one city, several cities or for countries. This means that network size in VANET is geographically unbounded.

Frequent exchange of information: The ad hoc nature of VANET motivates the nodes to gather information from the other vehicles and road side units. Hence the information exchange among node becomes frequent.

Wireless Communication: VANET is designed for the wireless environment. Nodes are connected and exchange their information via wireless. Therefore some security measure must be considered in communication.

Time Critical: The information in VANET must be delivered to the nodes with in time limit so that a decision can be made by the node and perform action accordingly.

Sufficient Energy: The VANET nodes have no issue of energy and computation resources. This allows VANET usage of demanding techniques such as RSA, ECDSA implementation and also provides unlimited transmission power.

II. RELATED WORK

Several distributed MAC protocols have been designed for inter-vehicle communications. They can be classified into three categories, the contention based medium access method CSMA/CA such as IEEE 802.11p [1], and the contention- free medium access method using Time Division Multiple Access TDMA.

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In [2] the authors propose a contention-free medium access control protocol for VANET called VeMAC. Vehicles in VeMAC are equipped with two radio interfaces, where the first is always tuned to the control channe CCH while the second one can be tuned to any service channel. CCH slot allocation is performed in a distributed manner where each vehicle randomly gets an available time slot.

Günter and al. [3] propose a cluster based medium access control protocol (CBMAC). In their protocol each cluster head is responsible for time slot assignment to its cluster members for messages transmission. The aim of this protocol is to limit the effect of the hidden node problem and offer a fair medium access.

In [4], the authors introduce the Dedicated Multi-channel MAC (DMMAC) protocol. The DMMAC architecture is similar to WAVE MAC with the difference that in DMMAC, the CCH Interval is divided into an Adaptive Broadcast Frame (ABF) and a Contention-based Reservation Period (CRP). The ABF period composed of time slots, each time slot is dynamically reserved by an active vehicle as its Basic Channel (BCH) for collision free delivery of the safety message or other control messages. The CRP Employs CSMA/CA to organize its channel access.

Mobility-based clustering algorithm (MOBIC) [5] is a popular clustering algorithm mentioned in various studies. This approach is based on the lowest-ID algorithm; yet, it uses a signal power level mobility metric that is derived from successive receptions. MOBIC does not scale well in VANETs because it is a simple algorithm designed for MANETs; nevertheless, it is frequently

Compared with other VANET clustering algorithms. Hafeez et al. [6] proposed a novel clustering algorithm for VANETs by considering speed as the main influential factor to form clusters. These researchers also attempted to improve cluster stability via the fuzzy processing of speed. The algorithm introduced by Hafeez et al. chooses the second optimal vehicle as the temporary CH when the original one becomes unavailable. The algorithm is applied to high-mobility scenarios, but CHs frequently change when they move fast. The rapid change in network topology induces the unstable performance of temporary CHs, which results in unstable clusters.

The aggregate local mobility (ALM) algorithm [7] is a new beacon-based clustering scheme that aims to extend the lifetime of clusters by using ALM to decide cluster reorganization.

Meanwhile, Rawashdeh and Mahmud [8]considered speed and relative direction to present a novelspeed-overlapped clustering algorithm for highways. This system also depends on location services.

The authors in [9] introduced a prediction-based routing (PBR) protocol for VANETs. It is Specifically considered for the mobile gateway scenario and takes advantage of the predictable mobility pattern of vehicles on highways. PBR predicts way lifetimes and preemptively creates new routes before the existing routes fail. The link lifetime is predicted based on the range of contact, vehicles' location, and related velocities. Since a route is composed of one or more links, the route duration is the minimum of all its connect lifetimes. PBR allows the processing of multiple routing requests to check all the available routes to the target. If the source node receives various replies, then it uses the route that has the maximum predicted route lifetime.

An exception in this respect is formed by [10], introducing an explicit definition of interference and establishing trade-offs between the concepts of congestion, power consumption, and dilation. With [10] more attention is also being paid to the fact that—if nodes are capable of adapting their transmission power, an assumption already made in early work that can be considered originators of topology control considerations [11, 12]—interference ranges corre- late with the length of communication links. More precisely the interference range of a link depends on the transmission power levels chosen by the two nodes communicating over the respective link.

III. SYSTEM DESIGN

The project Propose a scheme for reducing interferences in VANETs in highway environments. We use the Highway Model and treat the vehicles as moving on a single line. MAC scheme then uses clustering and medium access control (MAC) methods to achieve low interference between the vehicles. we propose a scheme for reducing interferences in Unlike some other schemes that assume that only some percentage of the vehicles transmit safety messages at any given time our scheme guarantees channel access for all of the vehicles, allowing all nodes constantly transmit safety data and enabling even the most demanding safety applications such as crash avoidance.

The project use the Highway Model and treat the vehicles as moving on a single line. MAC scheme then uses unique clustering and media access control (MAC) methods to achieve low interference between the vehicles. Unlike most other works that measure interference using the Receiver-Centric Model our scheme uses the original (to the best of our knowledge) Neighborhood Interference Model. Topologies that have low interference calculated using the Receiver-Centric Model may have higher interference when the Neighborhood Interference Model is used. Finally, we provide simulative analysis of our scheme and discuss its performance in different scenarios. Fig 2 shows the work flow of this project.

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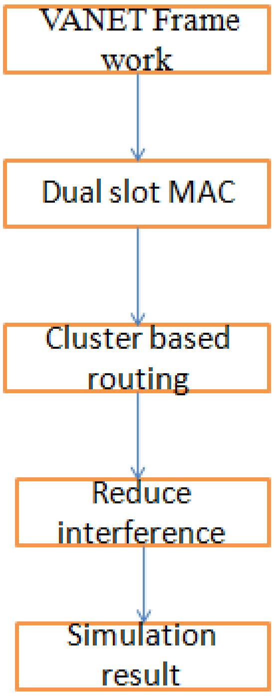

Figure 2 . System Configuration

A. FRAME WORK OF VANET

VANETs present vehicle-to-vehicle and vehicle-to-roadside communication in order to support two main types of applications safety applications such as road-hazard announcement and sending urgent situation messages from an accident site VANETs have fundamentally different behavior in that their nodes are limited to move along roads, have no power constraints, have small network diameter, and may undergo rapid topology changes, for example when cars bypass each other in an intersection or when highways split before an interchange. VANETs also have different requirements for routing. Fig 3shows the VANET frame work with number of vehicles movement.

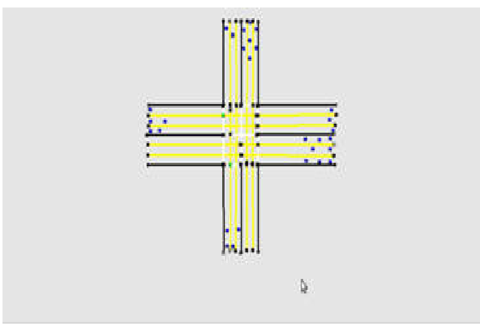

Figure 3 .Frame work of VANET

B. DUAL SLOT MAC LAYER

sTDMA allows simple and contention-less channel access and allows avoiding the hidden terminal problem by allocating unique time slots in two-hop radius around every node. However, when the destination of a message is several hops away, the message has to wait in every intermediate node while this node's TX slot arrives. We eliminate this delay by using the Dual-Slots layer. The Dual-Slots scheme assumes that each node may forward messages only to its Friends on the highway (Fig. 4). To enable multi-hop forwarding with minimal delay, every node selects two slots – an odd slot is used to forward messages in the direction of the traffic, and an even slot is used to forward messages in reverse direction. The number of slots per frame is determined by the clustering algorithm during the clustering process, and is given as input to the MAC Layer.

The slots are assigned to nodes in such a way that when a node receives a message traveling in a certain direction, it would immediately be able to forward the message to its next hop in the same direction (see Fig. 4). In the following notations slots are numbered from , and nodes are numbered starting from .

To reduce interference in the above stream of cars in such a way that would allow using all three of the possible message dissemination types while keeping low delay in the network. the carrier sense multiple access with collision avoidance (CSMA/CA)-based MAC is not efficient enough to handle the high message frequency of the smart driving application, but a TDMA-based MAC can theoretically do it. In order to achieve our goal, we propose a scheme consisting of two layers: a TDMA- based MAC layer designed for fast multihop channel access and a clustering layer that performs topology control and reduces interference while keeping the network connected.To enable multihop forwarding with minimal delay, every node selects two slots, i.e., an odd slot is used to forward messages in the direction of the traffic and an even slot is used to forward messages in the reverse direction. The number of slots per frame is determined by the clustering algorithm during the clustering process and is given as input to the MAC layer.

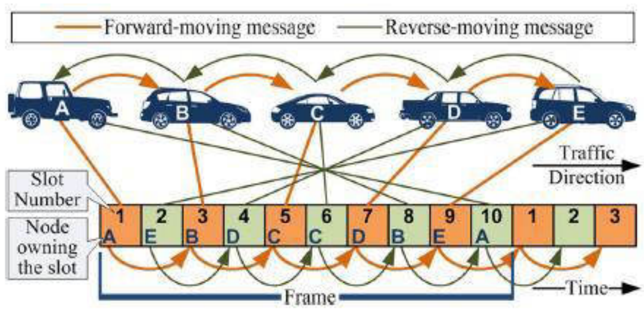

Figure 4 . Dual slot scheme

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
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C. CLUSTER BASED ROUTING

Cluster based Routing combines the features of static and dynamic clustering together. Static clusters are formed around the static sources located at the road signals, street corners and congested places known as static clusterhead. However buses are chosen as dynamic sources in our algorithm, having the predefined path and time chart to handle the high mobility situations known as dynamic clusterhead. Hierarchical clustering creates a layering environment that poses some of the main challenges in such ad hoc networks. Top layer consists of static clusterhead, middle layer consists of dynamic clusterhead and lower layer consists of ordinary vehicles. Because of highly dynamic vehicles network topology also changes. This in turn affects the performance of the network and also invokes protocol mechanisms to react to such dynamics. Mobility awareness deals with sudden changes in topology by responding against malfunctions in routing. Some of mobility metrics are considered for cluster construction in order to form a stable cluster structure thereby decreasing its influence on cluster topology. Vehicles Mobility behavior determines the architecture of the cluster. Vehicles are grouped in two different ways either by those vehicles which are in the communication ranges of dynamic sources or by those vehicles which are in the ranges of static sources mounted at traffic signals and road junctions. By doing so, the re-affiliation and re-clustering rate can be naturally decreased.

Each cluster is allowed to have a different frame length and has no hardcoded limit for the number of members. Once an arbitrary node v is connected to its available Friends, it begins to send REPLY messages to nodes whose beacons it receives. These nodes are not necessarily full neighbors but just nodes whose TX range covers our node v. using information from such REPLYs, it becomes easy for v to calculate its Interference Neighborhood INv .Cluster routes are discovered dynamically using the cluster membership information kept at each cluster head. By clustering nodes into groups, the protocol efficiently minimizes the flooding traffic during route discovery and speeds up this process as well Cluster Formation with three layer framework.

The goal of Cluster Formation is to impose some kind of structure or hierarchy in the otherwise completely disorganized ad hoc network. The algorithm is a variation of the simple "lowest ID" clustering algorithm in which the node with a lowest ID The exponentially weighted moving average (EWMA) scheme is employed for on-line updating nodal contact probability. Weighting factors which decrease exponentially. The weighting for each older data point decreases exponentially, giving much more importance to recent observations while still not discarding older observations entirely True contact probability. Subsequently, a set of functions including Sync (), Leave (), and Join () are devised to form clusters and select gateway nodes based on nodal contact probabilities.Fig 5 shows ,how the road side informations are stored in RSU

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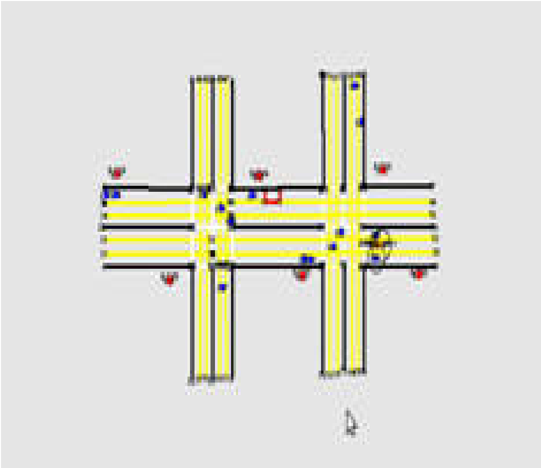

Figure 5 . RSU stores the information

D. TOPOLOGY DESIGN

This stage involves determining where to place the components and how to connect them. The (topological) optimization methods that can be used in this stage come from an area of mathematics called Graph Theory. These methods involve determining the costs of transmission and the cost of switching Simple topology configuration to familiarize yourself with its features in a test environment.

INPUT VALUE: Transmission Range,Network Size ,propagation .bandwidth, no of node, routing protocol, channel usage .Loss monitor tool usage in the agent through that we calculate he no of packet received and data loss and throughput

IV. CONCLUSION AND FUTURE WORK

A new multi hop clusterisng approach, which is fully distributed, uses local decisions, and does not require a cluster-head selection. Our GIM scheme allows contention less channel access for both collision avoidance and broadcasting applications. The interference measurements in our work use the Neighborhood Interference Model, which is more demanding (interference wise) than the Receiver Centric Model used in many other works, similarly to those

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International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
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same works, we assumed a simple transmission-range-based model to determine if nodes correctly receive each other. A direction for future work could be extending our scheme with more advanced RF models, which take signal-to-interference-plus-noise ratio into account.

When a link breakage occurs, a broken node would send a RERR message to a source node and again generate a new RREQ to find a new route

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