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AN EFFECTIVE CVS SYSTEM FOR V2V/V2I COMMUNICATION IN INTELLIGENT VANET

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ABSTRACT

In today's era vehicular Adhoc Networks (VANETs) provides a significant potential which enables the diverse applications that associated with traffic safety, as traffic congestion is one of the major issue everywhere in the world. To improve the traffic efficiency many sensors and devices have been designed and still in research with new upcoming which is one of the new interesting field for the researchers. In network, vehicle directly communicates with one another and also with the infrastructure. New requirements necessitate the life safety applications; includes expectations with high packet delivery rates and low packet latency. The prospect of awareness for the vehicle or driver drastically increases. CVS plays a major role in safety applications. Cooperative Vehicle Safety Systems (CVSSs) rely on vehicular ad-hoc networks which delivers the critical vehicle tracking information. The NS 2 simulation result shows increase in success ratio, reduces message delay, handover traffic and handover delay by considering speed of vehicle with 10kmph, 20kmph .

Keywords: *V2V and V2I Communication, CVS System, AODV protocol, DSRC.*

1. INTRODUCTION

A Vehicular Ad-Hoc Network (VANET) is a technology that uses moving vehicles as nodes in a network to create a mobile network. It is an important emerging application of mobile ad hoc network [6]. VANET turns every participating vehicle in a wireless network as a router or node which allows vehicles to connect each other around 100 to 300 meters and, in turn, creates a wide range network [7-8]. VANET includes V2V and V2I communications and is important component of ITS. The dedicated short-range communication (DSRC) is a fundamental set of short to medium - range communication channels and a set of standard protocols that are specifically designed for V2V communication which provides reliable communication in a high dynamic time varying channels. The V2I Vehicle to Infrastructure communication is for exchange of critical safety and operational data between vehicles and roadside infrastructure [1]. Cooperative Vehicle Safety systems are used in road safety application (fig 1), where vehicles broadcast its physical state information through a shared wireless network which allows their neighbors to track them and predict the possible collisions. Certain parameters in CVS are responsible for control and directly impact the overall performance of the system.

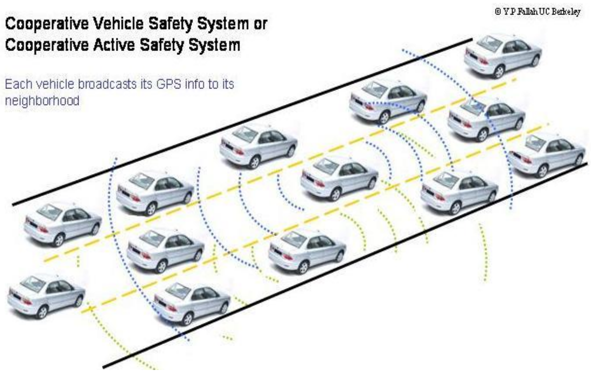


Fig. 1: Cooperative Vehicle Safety System in VANET.

In this paper we describe the design of safety system and traditional methods of building such cooperative safety systems which relied on separate design of the cyber and physical components. The separation in components is indeed one of the reasons behind successful and quick development of many technologies and solutions; nevertheless, the success of such designs is quickly overturned if resources are limited to a level with physical components and sub-components that leads to significant performance degradation. To elaborate on this issue we examine the case of CVS in VANET.

2. RELATED WORKS

The hybrid architecture of vehicular ad hoc networks (VANETs) and roadside unit with wireless sensor networks (WSN) that relies on a fully distributed approach without any centralized infrastructure elements for coordinating of communication and data storage. It focuses on accident prevention and post accident investigations. The value is the maximum tolerable latency limit for communicating most emergency events [2-9].Wave architecture was defined to promote standards and rules for vehicular communication networks.

Sok-Ian Sou el, at [3] analyze and quantify the improvement of VANET connectivity, when a small number of roadside units (RSUs) are deployed in investigating the routing performance for broadcast-based safety applications. And categorized even with a limited number of RSUs, the performance of network connectivity is significantly improved in highway VANET scenarios.

Huang, Ching-Ling el. [4] propose an inter vehicle communication framework for the cooperative active safety system (CASS), a closed- loop with on demand protocol which robust the performance of network and operation is based on the dissemination of each vehicle's state information. The paper assumes that all vehicles in the network are equipped with onboard communication devices with multiple scalar linear time-invariant dynamical systems that track each other over a multi access channel, and then, propose a rate adaptation algorithm that distribute the control of self-information broadcast behavior of each vehicle.

3. VANET ARCHITECTURE

The cooperative vehicle safety architecture contains a communication subcomponent which is responsible for sending and receiving safety messages, the computing subcomponent is responsible for tracking neighboring vehicles in the network for estimation process like generating safety messages and managing communication time (Transmission Control Logic) and it issue warning indicators to the user interface subcomponent when collision is detected.

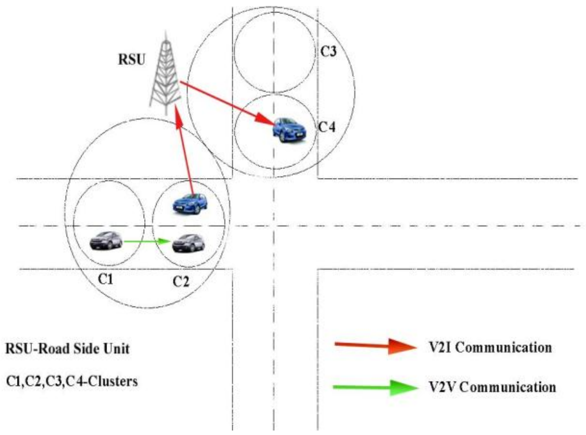


Fig. 2: Architecture Diagram of VANET

According to this, it is suggested that vehicles should transmit tracking messages every 100ms, to a distance of at least 150m (avg. 250m). The DSRC radio power is set to reach the suggested distance. Given the issues of the above design in crowded networks, several enhancements have recently been proposed to improve the performance of CVS systems beyond the early solutions set forth by VSCC [11] highway and thus reserves bandwidth for emergency messages with higher priorities.

4. CVS SYSTEM

4.1 COOPERATIVE VEHICLE SAFETY BASED ON DSRC

In the active safety systems, vehicles must continuously be aware of their neighborhood around few hundred meters and monitor their possible threats. The task can be achieved by frequent real time communication between vehicles over a dedicated short range communication (DSRC) channels. The main requirement of the active safety systems is the possibility of delivering real-time acquired information to and between vehicles at latencies of lower than few hundred milliseconds. CVS systems use two types of safety messages:

1. Even driven emergency messages,
2. Frequent vehicle tracking and collision avoidance messages.

The main objective of vehicle tracking is to accurately track neighboring vehicles in real-time. This can be achieved by the current design DSRC, the DSRC channel may become quickly saturated and the performance significantly reduced if the network is highly crowded (e.g. in a congested highway). To understand where the problem is originated and how to redesign the system to combat this issue, a CVS system are put together and what are the possible avenues of improvement. Traditional methods of building cooperative safety systems relied on separate design of the cyber and physical components.

4.2 COOPERATIVE VEHICLE SAFETY SYSTEM FOR AODV

Ad hoc on Demand Distance Vector (AODV) is a reactive routing protocol which establishes a route from the source to destination when a demand occurs for the transmission of the data [12]. It does not contain any loop. AODV routing protocol contains route request and reply < RREQ, RREP> pair of message which finds out the route. AODV updates the relevant neighboring node(s) instead of broadcasting every node of the network which enhance the cooperative road safety system to perform with its nature to share information among neighboring vehicles.

The requesting vehicle in the network broadcasts an RREQ to all vehicles within range. The receiving vehicle first checks whether the current RREQ is not a duplicate packet and then check if the RREQ is from the same group. If it is, it will then check whether it can provide the requested data or whether it has knowledge of a path that can provide the requested data. If it does then it will produce an RREP or it will add its own address to the request packet and rebroadcast the packet.

The RREP is reached at the source (requesting) vehicle, where the most suitable path is chosen to obtain the data from it. A new route discovery is always initiated prior to the link being expired. The Required Data field defines the requested data. The Required Time field defines the time needed for the data to be transmitted.

5. PROPOSED METHODOLOGY

In Proposed Methodology consists of following modules:

- Framework of vanet

- Platoon for inter and intra mechanism
- Cluster based topology design
- Finding geographical route by OBU
- Link scheduling algorithm
- Simulation results

5.1 FRAMEWORK VANET

Network will consist of nodes (mobile vehicles), Links (connecting nodes and RSU), Road side units and Server, Formations of node (with respective to X and Y axis), Operations on node (algorithm implementation, deciding to whom the packet should be delivered), Establishing the communication, Transmission of data packet, Analysis the transmission on different parameter (handover delay, handover traffic, message delay, throughput) by graph plotting commands, Stopping the communication.

The simulation experiments were conducted on NS 2.34 [5] and IEEE 802.11 with a transmission rate of 2Mbps and a transmission range of 250m was used as the underlying MAC layer. We used two ray ground to generate a 4 x 4 flat grid topology of a 1000m by 1000m area. In each simulation run, we randomly selected two to three data packet delivery, using 512-byte constant bit rate (CBR), an TCP-based packet generation application. The running time of each run is 5m/sec. Table 1 summarizes the parameters used in the simulations.

Table 1. Simulation Parameter

Network simulator	NS2
Mobility simulator	SUMO
Simulation area	1000m x 1000m
Simulation runs	3-4
CBR rate	512bytes/second
802.11 rate	2Mbps
Avg. vehicle speed	10km/hr
Transmission range	250m
Simulation time	500 to 1000 sec
Number of vehicles	120

5.2 PLATOON FOR INTER AND INTRA MECHANSIM

Intra platoon mechanism is the method of communication between the vehicles which are available in same cluster. Inter platoon mechanism is the way of communication between the nodes of different cluster area.

5.3 CLUSTER BASED TOPOLOGY DESGIN

Vehicles broadcast their physical state information over a shared wireless network to allow their neighbors to track them and predict possible collisions.

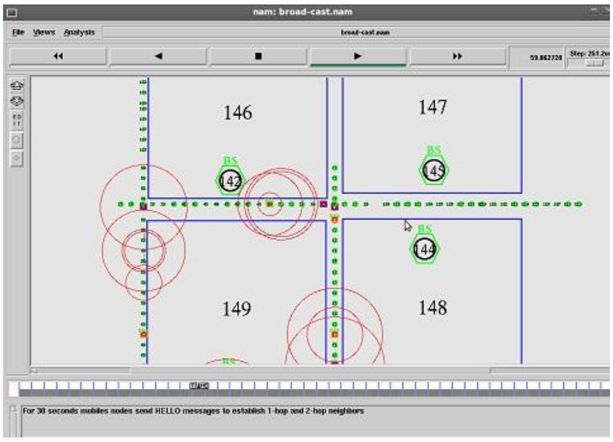


Fig.3 Cluster based topology design

There are certain parameters that are controllable and directly form group of cluster to impact the overall performance of the system.

- Safety distance and speed advice.
- Wrong way driver detection.
- Obstacle detection and frontal collision detection.

5.4 FINDING GEOGRAPICAL ROUTE BY OBU

The data of the wireless sensor node may consists of a set of data, including a period of quantities collected over a time-span and make the data more plausible and trigger a safety warning message. Then the vehicle detects a geographical region defined by a geometric shape and broadcasts the message to its neighbor vehicles. The communication system of the vehicles ensures that the data packet is reliably distributed to all vehicles located within a region. As a result, vehicles that receive the information are warned about dangerous spots ahead of time and can take appropriate countermeasures distance for RSU and Vehicle.

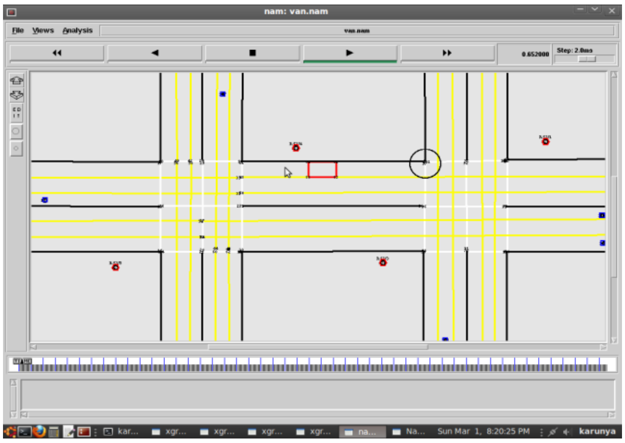


Fig.4 Geographical Route using RSU

5.5 LINK SELECTION ALGORTHIM

Link reliability is defined as the probability that a direct communication link between two vehicles will stay continuously available over a specified time period. Given a prediction interval *Tp* for the continuous availability of a specific link l between two vehicles at t, the link reliability value *r(l)* in Eq.1

r(l) = P{To continue to be available until t + Tp | available at t} - Eq.1

To calculate the link reliability, we utilize the vehicle's velocity parameter. It is assumed that the velocity of vehicles has a normal distribution.

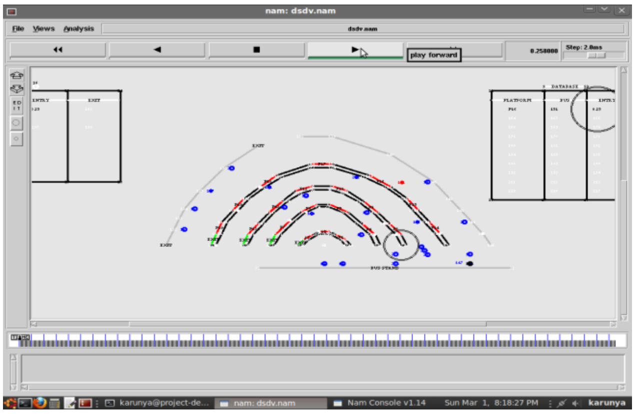


Fig.5 Link Selection

Link selection in fig.5 shows the bus stand scenario. If the vehicle is entering into bus stand to park in a platform, when the platform is busy the algorithm routes the vehicle into another platform.

Procedure Select main link ();
if change in (speed || direction) then
generate hello message;
if (node.id is in neighbor table) then
save the updated entry in table;
else create new row;
if (node.id is routing table) then
set destination vehicle = nodeid;
send(packet);
else if (node.id is in packet information table) then
set the next hop with node.id;
send(packet)
else
set destination with Broadcast.id
send(packet)
if (node.id receives vehicle id) then
read the data packet
else send data(packet)

Algorithm : Link Selection Algorithm

5.6 SIMULATION RESULTS

In this section, we evaluate the performance of the Link Selection algorithm through simulation results.

Success Ratio in fig.6 increases while comparing with existing system of IEEE 802.11. The proposed system uses the IEEE 802.11p with the WAVE Architecture. The level of increase in throughput is 110 x 10^{-3}.

In handover traffic fig.7, when the number of vehicles is minimum, the traffic is also low and when the number of vehicles increases the traffic is also increases.

The Handover Delay graph fig.8 is shown by comparing the speed and number of vehicles. Here speed is directly proportional to delay. when the speed is at 10kmph the delay is 4sec, while at 20kmph the delay is 6.

Message delay in fig.9 and energy consumption with the Link Selection algorithm, along with comparison among two under different simulation runs.

The link selection algorithm can significantly improve the packet delivery ratio as compared with existing algorithm. The figures shows the comparative results by plotting time on X axis and Parameters on Y axis.

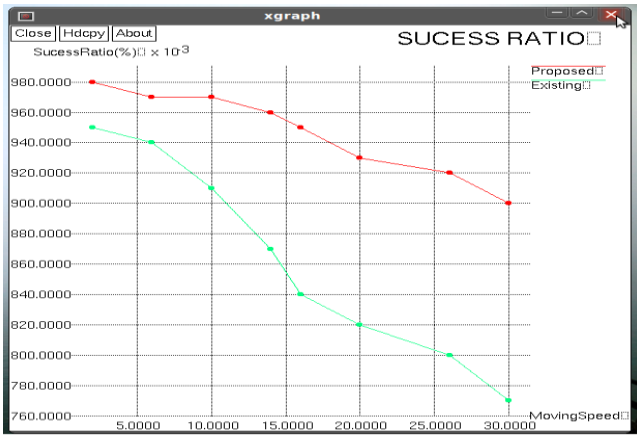
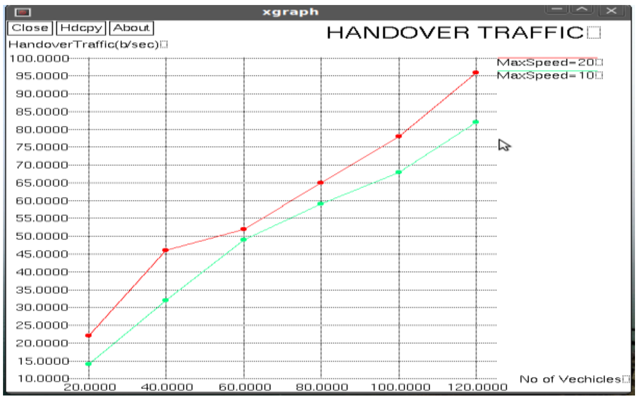


Fig.6 Comparative graph for Success Ratio



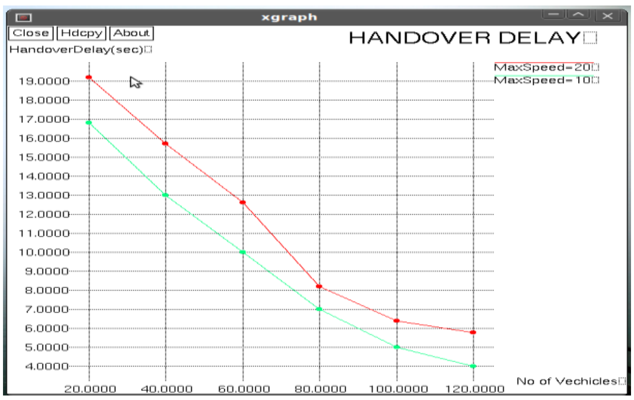


Fig.7 Comparative graph for Handover Traffic   Fig.8 Comparative graph for Handover Delay

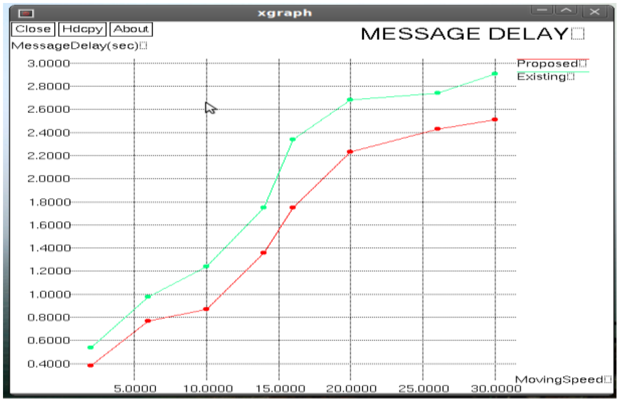


Fig.9 Comparative graph for Message Delay

6. CONCLUSION

In this paper, Ad-Hoc On Demand Protocol AODV with CVS which will make the system to improve the performance due to its active role in route mapping with RREQ and RREP from source to destination. In AODV, 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. So, in Cooperating Vehicle Safety System, Sensor senses the information and sends it to the On Board Unit. OBU send that message to the Road Side Unit. Then RSU send the message to all the vehicles. When a link failure occurs, RSU takes that role to send the message to the correct destination node.

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