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Intelligent Transportation System using Secure Vehicular Communication

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***Abstract*— Intelligent Transportation System is a vision which offers safe, secure and smart travel experience to drivers. This futuristic strategy aims to enable vehicles, roadside transportation infrastructures, pedestrian smart-phones and other devices to communicate with one another to provide safety and convenience services. Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication in Intelligent Transportation System offers ability to exchange speed, heading angle, position and other environment related conditions amongst vehicles and with surrounding smart infrastructures. In this intelligent setup, vehicles and users communicate and exchange data with random untrusted entities (like vehicles, smart traffic lights or pedestrians) whom they don't know or have met before. The concerns of location privacy and secure communication further deter the adoption of this smarter and safe transportation. In this a secure and trusted V2V and V2I communication approach using edge infrastructures where instead of direct peer to peer communication, it introduces a trusted cloudlet to authorize, check and verify the authenticity, integrity and ensure anonymity of messages exchanged in the system. Moving vehicles or road side infrastructure are dynamically connected to nearby cloudlets, where security policies can be implemented to sanitize or stop fake messages and prevent rogue vehicles to exchange messages with other vehicles.**

Keywords*— *Vehicle to Vehicle (V2V), Vehicle to Infrastructure (V2I)

I. INTRODUCTION

The Future smart world will be equipped with technologies and autonomous devices which collaborate among themselves with minimal human interference. Automotive industry is one of the front runners that has quickly embraced this technological change. Connected vehicles (CVs) and smart cars have been introduced, with a plethora of on-board sensors and applications with internet connectivity to offer safety and comfort services to users. Intelligent transportation for smart cities envision moving entities interacting and exchanging information with other vehicles, infrastructures or on-road pedestrians. Federal and private agencies are defining communication standards and technologies for Intelligent Transportation System (ITS) to ensure safety, and address security and privacy concerns of end users.

Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) are two technological innovations which can change current transportation. V2V will enable vehicles to exchange information about speed, location, position, direction, or brake status with other surrounding vehicles where receiving vehicles will aggregate these messages and make smart decisions using on-board applications which will warn drivers about accidents, over-speed, slow traffic ahead, aggressive driver, blind spot or a road hazard. V2I will enable road side units (RSUs) or traffic infrastructures to transmit information about bridge permissible height, merging traffic, work zone warning or road hazard detection to complement V2V applications. Vehicle to pedestrian (V2P) is also envisioned to cater to pedestrians, such as with visual or physical impairments, and send corresponding alerts to approaching vehicles.

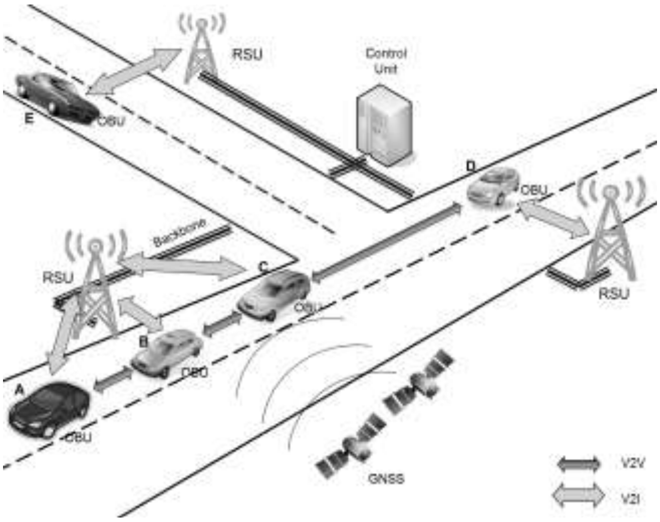

Figure 1. V2V and V2I Communication

These communication technologies will use Dedicated Short Range Communications to exchange data packets, called Basic Safety Messages, with nearby vehicles and entities between 300-500 meters' range. Messages will be sent up to 10 times per second providing a 360- degree view of proximity, with on-board applications using the information for triggering alerts and warnings. US Department of Transportation and National Highway Traffic Safety Administration estimate around 80% of non-impaired collisions and 6.9 billion traffic hours can be reduced by using V2V, V2I and V2P communications. Vehicles in ITS are communicating and exchanging information with external entities including toll booths, gas stations, parking lots, and other vehicles, which raises security and privacy issues

II. LITERATURE SURVEY

In [1], this paper presents, Importance of Realistic mobility models for VANET Simulation which is considered one of the most important part in ITS. This paper provides The importance of choosing a suitable real world scenario for performances studies of routing protocols in this kind of network so Comparative study between two mobility models, mobility pattern generator for VANET. And provides VANET, Mobility Model, Simulations, Real World, NS-2 etc.

The next cordoned-off ITS is Active Safety Test Area). It was set up in 2014 in Sweden, and it is an open environment where vehicle OEMs, research institutes and universities perform development and research. The research topics are new active safety functions for road vehicles. The test field contains a city area, 700 m multilane road, 5.7 km long rural road and 1 km high-speed area [2].

Torres et al. [3] studied the feasibility of using V2V and V2I communications to broadcast a video stream from the accident location to the road traffic authority. Their proposal additionally considers vehicles as data relays, meaning that drivers can directly be provided with a clear view of the accident, improving the traffic flow and helping them to better react to dangerous situations. The authors also provided a simulation analysis, including a comparison of different dissemination mechanisms specially designed for wireless networks. The results obtained showed the feasibility of their proposal, especially in highways with medium and high vehicle densities, although the authors stated the necessity of proposing more suitable schemes in such environments.

Stanica et al. [4] presented a system able to adjust the minimum contention window according to the local vehicle density, thus improving the overall performance of 802.11. Additionally, they performed realistic simulations to compare different schemes able to estimate the local density in vehicular environments. More specifically, they presented the advantages and the limitations of each of them.

Knapik et al. [5] presented several tips to avoid vehicular crimes. In particular, they proposed the electronic decal, a security function based on V2X communications able to significantly reduce car theft rates. Moreover, they provided a solution to integrate their approach into the message format proposed by the European Telecommunications Standards Institute.

Miller [6] proposed a V2X architecture. In particular, he called it V2V2I, and it enhanced the performance of traditional V2I-based architectures in terms of fast queries and responses. In his system, only super vehicles are allowed to maintain communication with the central station or with other super vehicles; the rest of the vehicles are only allowed to communicate with the super vehicle in charge of the area to which they belong at a given time. Experiments evaluated the results obtained when varying the number and size of zones; additionally, the author presented the advantages of the V2V2I architecture compared to V2I or V2V-based architectures. Miller claimed that his proposal integrates the benefits of both V2V and V2I architectures, that is to say, the fault tolerance operation of V2V-based approaches and the accuracy and fast queries provided by V2I-based architectures.

The project Zala ZONE in Hungary has a cordoned-off proving ground as well as a real world ITS to the border to Austria. In the real world, the ITS covers the highway scenario. In the cordoned-off proving ground, it covers the scenarios of smart cities, high and low speed handling as well as high speed freeways and rural roads. The purposes are test and research in the field of autonomous and connected vehicles. For this, the test field is equipped V2X communication technique [7].

The project C-Roads CZ focused on the implementation of ITS units as well as the test and evaluation of its functionalities. The features of the ITS where situated related analysis (e.g. road works warning, in-vehicle information, slow and stationary vehicles, traffic jam ahead warning, hazardous location notification). For testing under real conditions, seven test fields have built in the Czech Republic. All this ITS solutions have been equipped with RSU which communicates with vehicles and a central processing system [8].

Another cordoned-off test facility for re-enacting and simulating traffic scenarios is implemented in the CARISSMA project in Ingolstadt. The test facility offers 4000 square meter experimental for researching on V2X communication, accident detection, accident consequences reduction as well as the automated driving functions [9].

III. METHODOLOGY

The proposed Methodology has five Stages

Stage1: Design a Vehicle to Vehicle communication model In this section we describe two models: Sign Model :In this model, Vehicles use STOP and CLEAR safety messages to inform other vehicles in range about their current situation and movement parameters. Performance Enhancement Model : In this model is intended to V2V communication without t utilizing any infrastructure devices. The objective is to improve the throughput at crossing points without bringing on accident. Vehicles again utilize STOP and CLEAR security messages for communication. Additional CONFIRM and DENY messages are utilized to perform clear handshaking between vehicles approaching the same intersection. Every vehicle affirms its choice to cross the crossing point by sending a CONFIRM or DENY message.

Stage 2: Collision Detection First identify the conditions required for two or more vehicles to collide at an intersection. Two vehicles being inside the same intersection at the same time is a necessary, but not sufficient condition for a collision. Collision occurs if the following conditions are all true: A. Same Intersection: vehicles are at the same intersection. Time Conflict: vehicles have overlapping time intervals. Space Conflict: vehicles occupy the same space while crossing the intersection.

Stage 3: Collision Detection Algorithm Collision Detection Algorithm for Intersections will be run on each vehicle that crosses a transaction, with information exchanged among vehicles approaching, crossing and leaving the intersection. The algorithm uses path prediction to determine any space conflicts with other vehicles trying cross the intersection. Each lane on the road is considered to be a polygon, which starts from the previous intersection and ends at the next approaching intersection.

Stage 4: Mobility Model This stage includes the traffic light model: Traffic-Light Model: The traffic-light model follows the same basic logic as the stop sign model except that stop signs are now replaced by traffic lights. The Green-Light Time of the traffic light has a default value that can be changed by the user.

Stage 5: V2V and V2I Communication Model It is a short-to-medium-range communications service that supports both public safety and private operations in V2I and V2V environments. The designed to help drivers travel more safely and reduce the number of losses due to road accidents.

CONCLUSION

The complexity and functionality of ITS has increased tremendously. Current systems can provide highly accurate information about individuals in traffic situations in real time. This development is a major breakthrough in the field of ITS. However, there are still improvements in the reliability, scalability and security of the required overall system. For this reason, further research at ITS should focus on more reliable perception of traffic with secure real-time distribution in a decentralized manner for high volumes of data, along with the use of modern sensors, plug and play mechanisms. In addition, to ensure the spirit of such systems, services with real added value to the wider public, along with autonomous and non-autonomous cars, have to be developed.

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