Review Of D2D Communication

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Abstract: Intelligent transport management is one among the remedies that could be employed for the betterment of the roads. Along with betterment of roads, it ensures safety. It is an advanced application which without much intelligence provides advanced services relating to traffic management and various modes of transport. This enables the user to be alert and make smarter and safer decisions. This paper talks about the survey on various techniques used for the vehicle to vehicle communication. Discussion is made on the comparison of the various simulators that can be used for the system and thereby deriving inferences based on them.

Index Terms: D2D, eNB, OMNeT++, SimuLTE, SUMO, WAVE, WBSS

1 Introduction

Intelligent Intersection Management is a constituent of Intelligent Transportation System. The number of vehicles in today's transportation scenario has increased tremendously from the past few decades. Along with this the increase in vehicles, the safety at intersections, although a relatively small part of the network of roads, has decreased. This is why ITS was initiated and developed. The Autonomous Vehicles in co-operation with ITS have come up with solutions that are automated and control the flow of vehicles. The initial solution of installing traffic lights at intersections was successful. But, it did not prove to be helpful during peak traffic hours as the signal lights could not be updated to real time traffic. At intersections, during low congestion conditions, the presence of head-on crashes is more prevalent. While, on the other hand, during high congestion conditions, the severity of crashes is not much even though the frequency is high. Thus for the safety of people and property during high and low traffic congestion conditions, the ITS has proposed several other techniques that are widely used in today's traffic scenario. Through this paper we highlight some of the major work done on the technologies to implement vehicle to vehicle communication. Based in this study we categorize the different simulators used for the system and also infer the major advantages of the cellular LTE for a vehicle to vehicle communication.

2. Different techniques

In [1] the author proposed a system to detect the collision probability at the intersection based on VANET. The system uses ICU (Intelligent Control Unit) and vehicle-to-vehicle communication. ICU is stationary control unit in a RSU (Road Side Unit) which actually predicts the probability of the collision for a vehicle by continuously monitoring any vehicle that comes in its range. The ICU sets a threshold value of a distance or a speed and allows the RSU to send an alert message to the vehicles who exceed that value. In order to validate the scheme, the simulations were done using the SUMO 0.21.0, OMNET++ 4.5 and VEINS 3. In [2] the author talks about the vehicular network for intersection collision avoidance. On approaching the intersection, the vehicle communicates with a centralized system that is with the Intersection Manager. This central system manager is the infrastructure which facilitates the vehicle to infrastructure (VtoI) communication. The paper gives the collision probability for the vehicles moving in the same lane while approaching the intersection. It uses a Collision Detection Algorithm for Intersection(CDAI) which predicts the trajectory which will be occupied by the vehicle. The occurrence of a collision is possible if the two vehicles, occupying the same trajectory approach the intersection. It also provides an overview of the intersection protocols like Stop-Sign protocol and Throughput Enhancement protocol. Groove net, a sophisticated hybrid vehicular network simulator has been used to assist these protocols. In [3], the author gives a detailed discussion on WAVE, a system architecture developed by IEEE. A WAVE system comprises of RSUs and OBUs. RSUs are mounted on poles and traffic lights while OBUs are located in vehicles. These units' function either independently or as small networks called WBSS which consists of a mix of these units. When these units operate independently they exchange data through CCH. On the other hand, WBSS operate through SCH. The system consists of two types of protocol stacks - WAVE Short Message Protocol and IPv6. With the help of the protocol stacks, the system allows information to be exchanged in two methods. The information frames that are exchanged are - Management frames and Data frames. Data frames are used to exchange data information. These frames are exchanged through WAVE Short Messages throughout either SCH or CCH. However, IP messages are exchanged through SCH. The Management frames consists of Application registration, WBSS Management, Channel usage monitoring, IPv6 configuration, RCPI monitoring and MIB maintenance. In [4], the author provides details on WAVE and its components, combined with DSRC. All devices that are registered with WAVE are entered in Provider Service Table and are uniquely recognized by PSID. The WAVE Service Management consists of the following options:

- Application Registration and Removal: The registered devices have entries of devices from local UST or PST. These devices obtain their services from WME.
- WBSS Management: It helps in discovering nearby WAVE devices and accordingly provide a connection between the devices. It also maintains the status of applications as either active, inactive or unavailable.
- WBSS Join Policies: It maintains a set of policies that WAVE is based on. It was initiated after WME compares its services with the services of the newly discovered WAVE device.
- WBSS Status Transaction and Maintenance: WME maintains the status of all registered applications. The default status is inactive. Instead of removing an application, it changes its status to unavailable.
- Channel Activity and Usage Monitor: MLME monitors the activity of the channel.

3. Inference

Based on the detailed study of the various resources we summarize some of the majorly used simulators for the simulation of vehicle to vehicle communication and also

compare the efficiency of these simulators. One of the most efficient simulators is simuLTE which allows the vehicle to vehicle communication through LTE.

SimuLTE Framework: -

- INET provides the concept of Network Interface Card(NIC) modules. To model communication protocol, simuLTe can be integrated within modules in network devices. The extension of wireless NIC modules uses most of the simuLTE features. The LTE capabilities to a node are allowed to be added by simuLTE in the simulation. UEs and eNBs are made by simuLTE. As shown in the above figure [1] both the UE and eNB contain LTE NIC, together with modules implementing upper layer protocols, taken from NIC. The eNB is connected to the other eNBs using the X2 interface and to the Internet though PPP (Point to Point Protocol). The LTE NIC module in both the models - UE and the eNB is used to implement the whole LTE protocol stack, as one submodule per layer. The layers are, from the bottom PHY, MAC, Radio Link Control (RLC) and Packet Data Convergence Protocol(PDCP) as shown in figure [1]. Binder monitors which are resources are used for uplink and downlink transmission by UEs and eNBs respectively. The LTE node can access the Binder to share common information via direct method calls. Between the LTE NICs, air transmissions, in the simuLTE are modelled by the Channel Models class. On reception of the message, the Channel Model computes the Signal-to-Interference-and-Noise Ratio(SINR) recognized by the node. The Channel Quality Indicator (CQI) of the UEs is computed and reported by the channel model. The D2D communication is established using the SimuLTE. The other simulators which are available as an open source tool and which aid in this communication are briefly described below. Most of them have been used for simulation as a tool for this communication.

3.1. SIMULATORS

a. OMNeT++

It is an object oriented event simulation framework which itself is not a simulator but infrastructure and tools for writing simulations. It basically uses 3 types of files:

- NED file (Network Description file) which contains various modules which can be used to draw the network through GUI design and by the source code written in C++ code.
- Source file - It contains the C++ code written for the behavior of the network and also describes the interaction of the nodes.
- Initialization File - (init) This file is used to initialize the ned file and link the source file to it. The simulation can only run when this file is generated.

b. Sumo

An open source continuous road traffic simulator which allows you to simulate how the vehicle is modeled to move through a given road network. It uses 3 files-node, route and edge. Traci (Traffic Control Interface), one of the python libraries used with sumo which allows to retrieve values of simulated objects and allows to manipulate the behavior written in the simulation.

c. Veins LTE

Integration of SUMO, OMNeT++ and Simulte. To setup and interactively run the simulation, the IDE and GUI of sumo and OMNeT++ is utilized. This method examines the influence of vehicular networks on the road traffic and complex interactions between both domains.

4. CONCLUSION

We finally conclude that Cellular v2x is the best and the latest technique because of the advantages and uses. Released in 2017, Cellular v2x has scope for more enhancements that could be more supportive and useful. The latest releases enhance the Sidelink modes to provide more support for out-of-coverage (mode 4) and in-coverage (mode 3) situations. In mode 3 scenarios, either a single or multiple evolved NodeBs (eNBs) interference management and resource scheduling for all the v2v devices. To attain maximum network capacity, the base stations, adopt the spatial reuse of the Resource Blocks. The synchronization of the ENBs help in estimating the position of each vehicle. Thus the resource allocation is performed by the base stations. In out-of-coverage scenarios, there is no role for the eNBs since, according to Release 14, v2v communication should take place even with no network coverage. The resource allocation is done by an autonomous resource selection procedure. The application of real time measurements of the received power is performed by the algorithm. Apart from in-coverage and out-of-coverage advantage of Cellular v2x, it is also more reliable and has high performance and thus it more preferred amongst all the techniques that are used. The figure 1 is Simulating device-to-device communications in OMNeT++ with SimuLTE: scenarios and configurations simulation can only run when this file is generated.

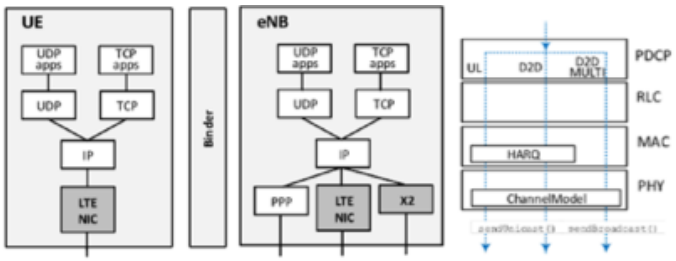

Figure 1: *Simulating device-to-device Communication.*

5. References

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