INTELLIGENT TRANSPORTATION SYSTEM

A PROJECT REPORT

Submitted by

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In partial fulfilment for the award of the

degree of

BACHELOR OF ENGINEERING

IN

ELECTRONIC AND COMMUNICATION ENGINEERING

SRI ESHWAR COLLEGE OF ENGINEERING, COIMBATORE-641 202

ANNA UNIVERSITY: CHENNAI 600 025

MARCH 2021

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ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

The success of a work depends on a team and cooperation. We take this opportunity to express our gratitude and thanks to everyone who helped us in our project. We would like to thank the management for excellent facilities and the constant support provided by them to complete this project.

It is indeed our great honour bounded duty to thank our beloved Chairman **Mr. R. Mohanram,** for his academic interest shown towards the students. We are indebted to our Director **Mr. R. Rajaram,** for motivating and providing us with all facilities. We wish to express our sincere regards and deep sense of gratitude to **Dr. SudhaMohanram, M.E, Ph.D.,** Principal, for the excellent facilities and encouragement provided during the course of the study and project.

We are indebted to **Dr. N. Shanmugasundaram, M.E., Ph.D,** Head of Electronics and Communication Engineering Department, for having permitted us to carry out this project and giving the complete freedom to utilize the resources of the department. We express our sincere thanks to our project guide **Ms. K. SUGANYADEVI M.E, Ph.D.,** Assistant Professor ECE, for his valuable guidance and encouragement given to us for this project.

We solemnly express our thanks to all the teaching and non-teaching staff of the Electronics and Communications Engineering Department, family and friends for their valuable support which inspired us to work on this project.

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Vehicular ad-hoc networks (VANET) technology has emerged as an important area over the Vehicular communication system. A Vehicular Ad-Hoc Network or VANET is a sub form of Mobile Ad-Hoc Network or MANET that provides communication between vehicles and between vehicles and road-side base stations with an aim of providing efficient and Intelligent transportation.VANETs have now been established as reliable networks that vehicles use for communication purpose on highways or urban environments.In this paper, we analyze the delay of the message delivery from a vehicle to a downstream vehicular gateway in a sparse vehicle Ad-hoc network (VANET) by the use of the real time navigation map in Simulation of Urban Mobility (SUMO) and Network Simulator(NS3).In this paper, we analyze the end-to-end delay of downstream message deliveries using different routing protocols Optimized Link State Routing(OLSR)Ad-hoc On-Demand Distance Vector (AODC) Destination Sequenced Distance Vector (DSDV).Therefore, by using the novel method, low delay and more reliable communication scenarios can be provided in Vehicular Ad-hoc Network.

Keywords: Wireless-Communication,Vehicular Ad-hoc Network (VANET),Delay,Vehicular Communication,Routing protocols,Mobility

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SUMO	SIMULATION OF URBAN MOBILITY
VANET	VEHICLE AD-HOC NETWORK
KPI	KEY PERFORMANCE INDICATOR
GUI	GRAPHICAL USER INTERFACE
XML	EXTENSIBLE MARKUP LANGUAGE
TCL	TELEPHONE COMMUNICATION LIMITED
NS3	NETWORK SIMULATOR 3
ITS	INTELLIGENT TRANSPORTATION SYSTEM
V2V	VEHICLE TO VEHICLE
V2I	VEHICLE TO INFRASTRUCTURE
I2I	INFRASTRUCTURE TO INFRASTRUCTURE
RSU	ROADSIDE UNITS
OSLR	OPTIMIZATION LINK STATE ROUTING PROTOCOL
AODC	AD HOC ON DEMAND DISTANCE VECTOR
DSDV	DESTINATION SEQUENCE DISTANCE VECTOR

CHAPTER - 1
INTRODUCTION

1. INTRODUCTION

1.1 OBJECTIVE

A Vehicular Ad-Hoc Network (VANET) is the same as a mobile network which is been formed by the moving vehicles as nodes. VANET changes every vehicle into a node and forms a network range where they will be tested with different routing protocols. When a car changes its direction or road form then the range of the signal get drop and a replacement network is going to be formed by the mobile Internet are often created. it's assumed that the primary systems during which it'll be integrated are police vehicles to vehicles, speak with each other to supply safety. it's utilized in endless sort of connected nodes. Traditional applications emerge in many various sorts of VANET connections. They are often characterized by different topology, mobility, one-time interactions. VANETs are characterized by the nodes and therefore the direction and form a mini-hub.
–Vehicle to Vehicle (V2V) is communication between vehicles with no external source.
–Vehicle to Infrastructure (V2I) provides communication between the vehicle and therefore the infrastructure.
–Infrastructure to Infrastructure (I2I) provides communication between different infrastructure.

1.2 EXISTING METHOD

The existing methodology has multiple sensors to detect every movement of every OBU that passes by a traffic signal (RSU). Let us look for the movements which are violating the red light of the traffic signal. On such violations the traffic management system can provide a warning to the OBU, register a fine to the OBU owner against the vehicle number and force the owner to be interrogated for the action, within a small span of time, say a week or 10 days, else the fine gets multiplied. On interrogation if the owner or driver claims to have not broken the protocols then the vehicle automated system should be examined for the reason of violation and check for the logs. If in one day any OBU violets rules multiple times the traffic monitoring system can automate the traffic management system to disable the vehicle and prevent the vehicle from moving further. On disabling, the management system gets a call for manual inspection. This is how the traffic management system can control the traffic red light violation and get away from manual inspection directly by humans. Many researchers have addressed the issue of distributed detection and propagation of traffic congestion information also some researchers proposed a system that uses vehicle based GPS systems to discover and disseminate traffic congestion information. The cooperative approach to traffic congestion detection with complex event processing and VANET are explained in. The work focuses on an event-driven architecture (EDA) as a novel mechanism to get insight into VANET messages to detect different levels of traffic jams; furthermore, it also takes into account environmental data that come from external data sources, such as weather conditions.

1.3 PROPOSED METHOD

In a VANET, the amount of interference from neighboring nodes to a communication link is governed by the vehicle density dynamics in vicinity and transmission probabilities of terminals. It is obvious that vehicles are distributed non - homogeneously along a road segment due to traffic controls and speed limits at different portions of the road. The common assumption of homogeneous node distribution in the network in most of the previous work in mobile ad-hoc networks thus appears to be inappropriate in VANETs. In light of the inadequacy, we present in this paper an original methodology to study the performance of VANETs with practical vehicle distribution in urban environment. Specifically, we introduce the stochastic traffic model to characterize the general vehicular traffic flow as well as the randomness of individual vehicles, from which we can acquire the mean dynamics and the probability distribution of vehicular density. As illustrative examples, we demonstrate how the density knowledge from the stochastic traffic model can be utilized to derive the throughput and progress performance of three routing strategies in different channel access protocols. We confirm the accuracy of the analytical results through extensive simulations. Our results demonstrate the applicability of the proposed methodology on modeling protocol performance, and shed insight into the performance analysis of other transmission protocols and network configurations in vehicular networks. Furthermore, we illustrate that the optimal transmission probability for optimized network performance can be obtained as a function of the location space from our results. Such information can be computed by road-side nodes and then broadcasted to road users for optimized multi-hop packet transmission in the communication network.

CHAPTER – 2
LITERATURE SURVEY

2. LITERATURE SURVEY

[1] SECURITY CHALLENGES IN VANET

VANET is an emergent technology with promising future as well as great challenges especially in its security. In this paper, we focus on VANET security frameworks presented in three parts. The first presents an extensive overview of VANET security characteristics and challenges as well as requirements. These requirements should be taken into consideration to enable the implementation of secure VANET infrastructure with efficient communication between parties. We give the details of the recent security architectures and the well-known security standards protocols. The second focuses on a novel classification of the different attacks known in the VANET literature and their related solutions. The third is a comparison between some of these solutions based on well-known security criteria in VANET. Then we draw attention to different open issues and technical challenges related to VANET security, which can help researchers for future use.

[2]ISSUES AND CHALLENGES OF CLUSTERIN IN VANET

VANET is an immerging technology in which the world looks something different from twenty first century. VANET uses a different mobile nodes to create a network.it turns participating node into wireless node allowing 150 to 350 meters of each other to connect. As node falls out of the signal range another node can join forming a network. Vehicles can be grouped in a cluster for communication. Clustering in VANET is a control scheme to manage media access and make VANET as a global topology. Most algorithms and protocols are derived from Mobile Ad-hoc Network (MANET) which have some challenges and regarding issues. This paper is a literature survey for providing the challenges and issues of Clustering in VANET with clustering based routing protocols to increase the scope of research in VANET.

[3] DELAY PERFORMANCE IN VANET

Low delay performance in VANT need to an intensive study. In this article, we proposed a novel priority method to reduce transmission delay of one-hop in VANET. A priority was marked to each message based on static factors, dynamic factors and size of the message. Messages scheduling was implemented based on the priority of messages. The performance of proposed method was analysed in highway scenario on the average delay and waiting delay in queue. Simulation results are consistent with theoretical deriving. Therefore, by using the novel method, low delay and more reliable communication scenarios can be provided in Vehicular Ad-hoc Network

[4]VANET: RESEARCH METHODOLOGIES,CHALLENGES

A Vehicular Ad-Hoc Network or VANET is a sub form of Mobile Ad-Hoc Network or MANET that provides communication between vehicles and between vehicles and road-side base stations with an aim of providing efficient and safe transportation. e Vehicular Networks can provide wide variety of services, range from safety-related warning systems to improved navigation mechanisms as well as information and entertainment applications. So lot of research work is being conducted to study the problems related to the vehicular communications including network architecture, protocols, routing algorithms, as well as security issues. In order to stimulate the 'beginners in research', here we present a paper on an overview of Vehicular Ad-hoc Networks. VANETs comprise vehicle-to-vehicle and vehicle-to-infrastructure communications based on wireless local area network technologies. e distinctive set of candidate applications, resources, and the environment make the VANET a unique area of wireless communication. Due to their unique characteristics such as high dynamic topology and predictable mobility, VANETs attract so much attention of both academia and industry. In this paper, we provide an overview of the main aspects of VANETs from a research perspective. is paper starts with the basic architecture of networks, then discusses research issues and general research methods, and ends up with the analysis on challenges and applications of VANETs.

[5]VEHICULAR AD-HOC NETWORKS (VANETS) AN OVERVIEW AND CHALLENGES

Vehicular ad-hoc networks (VANETs) technology has emerged as an important research area over the last few years. Being ad-hoc in nature, VANET is a type of networks that is created from the concept of establishing a network of cars for a specific need or situation. VANETs have now been established as reliable networks that vehicles use for communication purpose on highways or urban environments. Along with the benefits, there arise a large number of challenges in VANET such as provisioning of QoS, high connectivity and bandwidth and security to vehicle and individual privacy. This article presents state-of-the-art of VANET and discusses the related issues. Network architecture, signal modeling and propagation mechanism, mobility modeling, routing protocols and network security are discussed in detail. Main findings of this paper are that an efficient and robust VANET is one which satisfies all design parameters such as QoS, minimum latency, low BER and high PDR.

VEHICULAR AD-HOC NETWORK

3.VEHICULAR AD-HOC NETWORK

3.1What is VANET

A Vehicular Ad-Hoc Network or VANET is a technology that has moving vehicles as nodes in a network for creating a mobile network. We can say that VANET turns each and every vehicle into a wireless node, allowing cars to connect to each other which are 100-300 metres apart and, in turn, create a wide range of network. As cars fall out due to signal range and drop out of the present network, other cars can join in to connect vehicles to one another so a mobile Internet can be created. It is assumed that the first systems in which it will be integrated are police and fire vehicles, to communicate with one another to provide safety. It is a term which is used to describe the spontaneous ad hoc network that is formed over vehicles moving on the roads. Vehicular networks are very fast emerging for deploying and developing new and traditional applications. It is characterized by rapidly changing topology, high mobility, and ephemeral, one-time interactions. Both MANETs and VANETs are characterized from the movement and self-organization of the nodes (i.e., in the case of VANETs it is Vehicles)

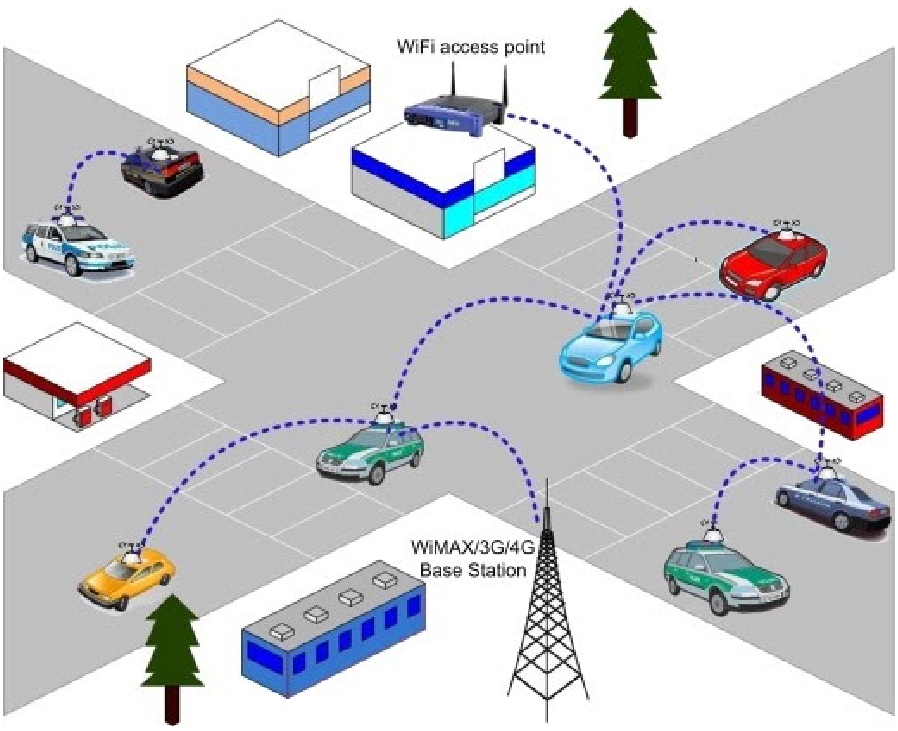


Fig.1 VANET ARCHITECTURE

3.2 PROPERTIES OF VANET

The moving vehicles are the main component in VANET. These vehicles are known as nodes in VANET. The following properties of vehicles are used for better operation in VANET. They are following.

a) Sensing: The different types of sensor are used for sense the Different vehicular and environmental conditions (state of the vehicle, state of road, weather condition, pollution and others).

b) Processing: the data or information coming from the different sensors are processed by the vehicles.

c) Storage: to store the different type of data and processing results for future uses require a large storage space.

d) Routing: The vehicles (nodes) should have the potential to communicate with each other in the VANET (IP or Cellular for example).

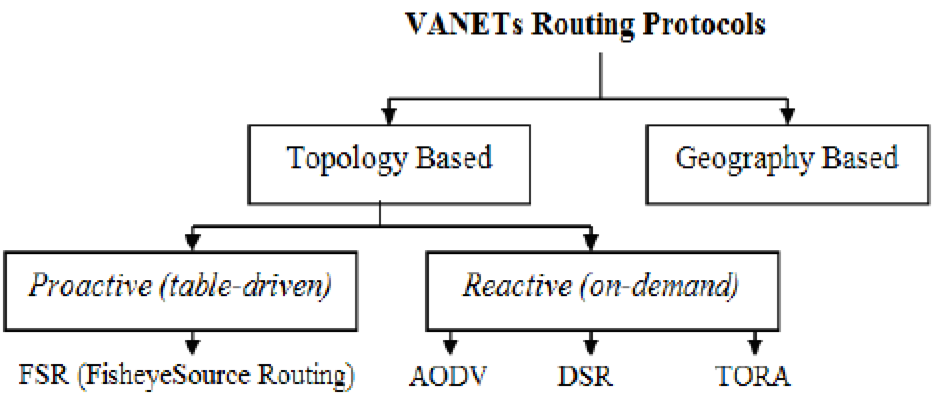


Fig.2 VANET ROUTING PROTOCOLS

3.3 Types of Communications in Vanet

3.3.1 **Vehicle to vehicle communication**

Vehicle-to-vehicle (V2V) communications comprises a wireless network where automobiles send messages to each other with information about what they're doing. This data would include speed, location, and direction of travel, braking, and loss of stability. Vehicle-to-vehicle technology uses dedicated shortrange communications (DSRC), a standard set forth by bodies like FCC and ISO. Sometimes it's described as being a Wi-Fi network because one of the possible frequencies is 5.9GHz, which is used by Wi-Fi, but it's more accurate to say "Wi-Fi-like." The range is up to 300 meters or 1000 feet or about 10 seconds at highway speeds (not 3 seconds as some reports say).

V2V would be a mesh network, meaning every node (car, smart traffic signal, etc.) could send, capture and retransmit signals. Five to 10 hops on the network would gather traffic conditions a mile ahead. That's enough time for even the most distracted driver to take his foot off the gas.On the first cars, V2V warnings might come to the driver as an alert, perhaps a red light that flashes in the instrument panel, or an amber then red alert for escalating problems. It might indicate the direction of the threat. All that is fluid for now since V2V is still a concept with several thousand working prototypes or retrofitted test cars. Most of the prototypes have advanced to stage where the cars brake and sometimes steer around hazards. Why? It's more exciting for a legislator or journalist to see a car that stops or swerves, not one with a flashing lamp. It uses two types of broadcasting i.e.

1. Naive broadcasting

In naive broadcast, the vehicle detecting an emergency event starts sending warnings periodically. Upon receiving it, the other vehicles start sending their own periodical warnings if the message they received come from their front. In intelligent broadcast with implicit acknowledgement, both the initiator as well as the repeaters cancels their periodical transmission when they hear the same warning coming from a node at their back. All receivers wait for a random time before starting to send their own warnings to see whether another node starts before them. If they do, they come to the conclusion that the warning has already propagated successfully, and do not start sending messages.

2. Intelligent broadcasting

In this more intelligent version, the first vehicle initiates its sequence as in naive broadcast, but it stops sending messages as soon as it overhears another vehicle at its back sending the same message, which is a sign showing that the warning has successfully propagated further down the 12 road. The repeaters also start their sequence as in naive broadcast, but they, too, stop if they overhear others at their back repeating the warning. In addition to their periodic broadcast interval, the repeaters must also wait for a random duration t(wait) , where 0<t(wait)<t(max) and t(max) is the maximum waiting time, before sending their messages. If, while they are waiting, the stopping condition is satisfied, they cancel their sequence immediately since there is no need to repeat the warning any more.In an emergency situation like the possible collision of vehicles, it is of extreme importance that the application in charge of delivering the warning does the right thing. Thus, the effectiveness metric is defined as the percentage of the vehicles having received the collision warning in a timely manner at the end of the simulation. There are four performance criteria to measure the effectiveness of these

algorithms:-

i. Warning Effectiveness

In an emergency situation like the possible collision of vehicles, it is of extreme importance that the application in charge of delivering the warning does the right thing. Thus, the effectiveness metric is defined as the percentage of the vehicles having received the collision warning in a timely manner at the end of the simulation.

ii. Warning Efficiency

This metric is about evaluating the algorithms' ability to do things right. It is measured by observing two phenomena. The first one is the number of messages generated per vehicle until all reachable vehicles have been warned. If all the vehicles in the network can actually be reached before the simulation ends, this number gives us a per-vehicle average of the number of required warnings for a particular algorithm to cover completely the safety area. Otherwise, it gives us the average number of warnings to be sent by each vehicle to reach all the reachable vehicles.

iii. Warning Propagation

The time required to reach all vehicles, or the last reachable vehicle in case not all are reachable, is the time for the algorithm to complete. So the propagation metric gives us an idea about how quickly the warning messages are disseminated throughout the vehicular network and, thus, how quickly the algorithm converges.

iv. Warning Overhead

Based on the volume of the traffic generated by the broadcast algorithm, other network applications may be affected by the safety warning application in various levels

3.3.2 Vehicle to infrastructure communication

Vehicle to Infrastructure provides solution to longer-range vehicular networks. It makes use of preexisting network infrastructure such as wireless access points (Road-Side Units, RSUs). Communications between vehicles and RSUs are supported by Vehicle-to-Infrastructure (V2I) protocol and Vehicle-to-Roadside (V2R) protocol. The Roadside infrastructure involves additional installation costs. The V2I infrastructure needs to leverage on its large area coverage and needs more feature enhancements for Vehicle Applications.The characteristic of highly dynamic topology makes the design of efficient routing protocols for VANET is challenging. The routing protocol of VANET can be classified into two categories such as Topology based routing protocols & Position based routing protocols.

1. POSITION-BASED ROUTING PROTOCOL

Position-based routing provides multi-hop communication in a wireless ad hoc network. It assumes that every node knows its geographic position, e.g. by GPS, and maintains a location table with ID and geographic positions of other nodes as soft state. PBR comprises three core components: beaconing, a location service, and forwarding

2. TOPOLOGY BASED ROUTING PROTOCOLS

Topology based routing protocols use link's information within the network to send the data packets from source to destination. Topology based routing approach can be further categorized into proactive (table-driven) and reactive (on-demand) routing.

Proactive (table-driven):

Proactive routing carries the distinct feature: the routing information such as the next forwarding hop is maintained in the background regardless of communication requests. Control packets are constantly broadcast and flooded among nodes to maintain the paths or the link states between any pair of nodes even though some of paths are never used. A table is then constructed within a node such that each entry in the table indicates the next hop node toward a certain destination. The advantage of the proactive routing protocols is that there is no route discovery since route to the destination is maintained in the background and is always available upon lookup.

Reactive (On Demand):

Reactive routing opens a route only when it is necessary for a node to communicate with another node. It maintains only the routes that are currently in use, thereby reducing the burden on the network. Reactive routings typically have a route discovery phase where query packets are flooded into the network in search of a path. The phase completes when a route is found.

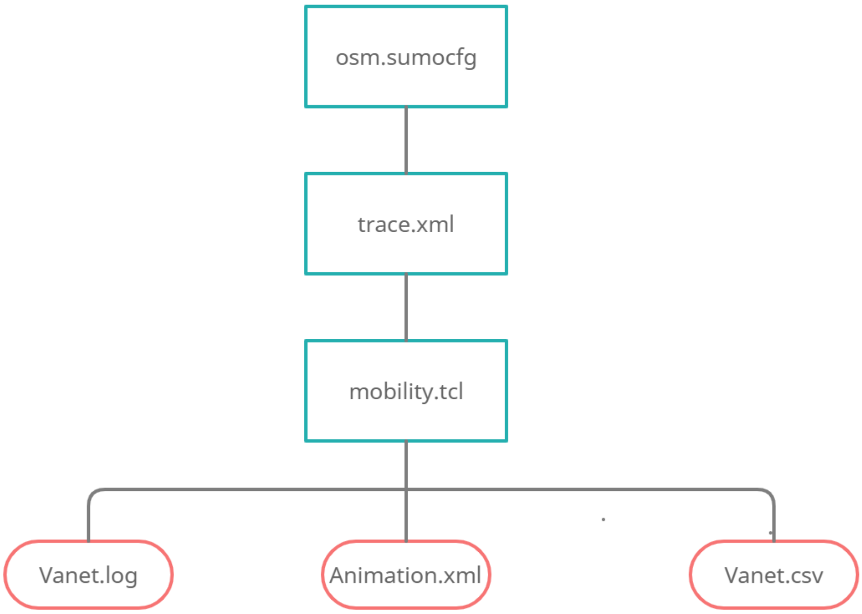


Fig.3 PROCESS FLOW

4.SIMULATION OF URBAN MOBILITY

4.1 INTRODUCTION

"Simulation of Urban MObility", or "SUMO" for short, is an open source, microscopic, multi-modal traffic simulation. It allows to simulate how a given traffic demand which consists of single vehicles moves through a given road network. The simulation allows to address a large set of traffic management topics. It is purely microscopic: each vehicle is modelled explicitly, has an own route, and moves individually through the network. Simulations are deterministic by default but there are various options for introducing randomness.

4.1.1 FEATURES

Includes all applications needed to prepare and perform a traffic simulation (network and routes import, DUA, simulation)

- Simulation
  - Space-continuous and time-discrete vehicle movement
  - Different vehicle types
  - Multi-lane streets with lane changing
  - Different right-of-way rules, traffic lights
  - A fast openGL graphical user interface
  - Manages networks with several 10.000 edges (streets)
  - Fast execution speed (up to 100.000 vehicle updates/s on a 1GHz machine)
  - Interoperability with other application at run-time
  - Network-wide, edge-based, vehicle-based, and detector-based outputs
  - Supports person-based inter-modal trips
- Network Import
  - Imports VISUM, Vissim, Shapefiles, OSM, RoboCup, MATsim, OpenDRIVE, and XML-Descriptions
  - Missing values are determined via heuristics
- Routing
  - Microscopic routes - each vehicle has an own one
  - Different Dynamic User Assignment algorithms
- High portability
  - Only standard C++ and portable libraries are used
  - Packages for Windows main Linux distributions exist
- High interoperability through usage of XML-data only

4.1.2 SOFTWARE DESIGN CRITERIA

Two major design goals are approached: the software shall be fast and it shall be portable. Due to this, the very first versions were developed to be run from the command line only - no graphical interface was supplied at first and all parameter had to be inserted by hand. This should increase the execution speed by leaving off slow visualisation. Also, due to these goals, the software was split into several parts. Each of them has a certain purpose and must be run individually. This is something that makes SUMO different to other simulation packages where, for instance, the dynamical user assignment is made within the simulation itself, not via an external application like here. This split allows an easier extension of each of the applications within the package because each is smaller than a monolithic application that does everything. Also, it allows the usage of faster data structures, each adjusted to the current purpose, instead of using complicated and ballast-loaded ones. Still, this makes the usage of SUMO a little bit uncomfortable in comparison to other simulation packages. As there are still other things to do, we are not thinking of a redesign towards an integrated approach by now.

4.2 APPLICATIONS OF SUMO

Application Name	Short Description
sumo	The microscopic simulation with no visualization; command line application
sumo-gui	The microscopic simulation with a graphical user interface
netconvert	Network importer and generator; reads road networks from different formats and converts them into the SUMO-format
netedit	A graphical network editor.
netgenerate	Generates abstract networks for the SUMO-simulation
duarouter	Computes the fastest routes through the network, importing different types of demand description. Performs the DUA
jtrrouter	Computes routes using junction turning percentages
df router	Computes routes from induction loop measurements
marouter	Performs macroscopic assignment
od2trips	Decomposes O/D-matrices into single vehicle trips
polyconvert	Imports points of interest and polygons from different formats and translates them into a description that may be visualized by sumo-gui
activitygen	Generates a demand based on mobility wishes of a modeled population
emissionsMap	Generates an emission map
emissionsDrivingCycle	Calculates emission values based on a given driving cycle
Additional Tools	There are some tasks for which writing a large application is not necessary. Several solutions for different problems may be covered by these tools.

Table.1 Application of SUMO

4.3NETWORK BUILDING

SUMO road network	
Filename extension	.net.xml
Type of content	Map
Open format?	Yes
SUMO specific?	Yes
XML Schema	net_file.xsd

Table.2 Network Building

A SUMO network file describes the traffic-related part of a map, the roads and intersections the simulated vehicles run along or across. At a coarse scale, a SUMO network is a directed graph. Nodes, usually named "junctions" in SUMO-context, represent intersections, and "edges" roads or streets. Note that edges are unidirectional. Specifically, the SUMO network contains the following information:

- every street (edge) as a collection of lanes, including the position, shape and speed limit of every lane,
- traffic light logics referenced by junctions,
- junctions, including their right of way regulation,
- connections between lanes at junctions (nodes).

Also, depending on the used input formats and set processing options, one can also find

- districts,
- roundabout descriptions.

Although being readable (XML) by human beings, a SUMO network file is not meant to be edited by hand. Rather you should use SUMO XML description files together with netconvert. You can also convert an existing map from various formats using netconvert or generate geometrically simple, abstract road maps with netgenerate. To modify an existing *.net.xml*-file you may load it with netconvert along with patch files You may also use netedit for building own road networks or for reworking the ones obtained from netconvert or netgenerate.

4.4 ROUTING IN SUMO

Routing dynamically in the running simulation may be adequate in the following situations:

- there is not enough time / computing power to wait for the dynamic user equilibrium
- changes to the net occur while the simulation is running
- vehicles need to adapt their route while running

In this case sumo may be used directly for routing with either routes or trip files (or a mix) as input.

This routing approach works by giving some or all vehicles the capability to re-compute their route periodically. This routing takes into account the current and recent state of traffic in the network and thus adapts to jams and other changes in the network.

The options listed below allow configuring which of the vehicles shall be equipped, how often rerouting decisions shall be made and how the estimation of travel times is computed from current and recent knowledge.

4.5 TRAFFIC SIMULATIONS

In traffic research, four classes of traffic flow models are distinguished according to the level of detail of the simulation. In *macroscopic* models traffic flow is the basic entity. *Microscopic* models simulate the movement of every single vehicle on the street, mostly assuming that the behavior of the vehicle depends on both, the vehicle's physical abilities to move and the driver's controlling behavior (see ChowdhurySantenSchadschneider2000). Within SUMO, the microscopic model developed by Stefan Krauß is used (see Krauss1998_1, Krauss1998_2), extended by some further assumptions. *Mesoscopic* simulations are located at the boundary between microscopic and macroscopic simulations. Herein, vehicle movement is mostly simulated using queue approaches and single vehicles are moved between such queues. *Sub-microscopic* models regard single vehicles like microscopic, but extend them by dividing them into further substructures, which describe the engine's rotation speed in relation to the vehicle's speed or the driver's preferred gear switching actions, for instance. This allows more detailed computations compared to simple microscopic simulations. However, sub-microscopic models require longer computation times. This restrains the size of the networks to be simulated.

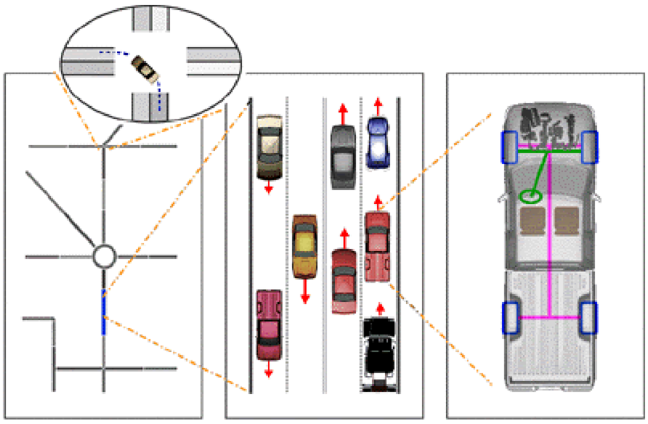


Fig.4 VANET NETWORK

Fig.4: The different simulation granularities; from left to right: macroscopic, microscopic, sub-microscopic (within the circle: mesoscopic)

Within a *space-continuous* simulation each vehicle has a certain position described by a floating-point number. In contrast, *space-discrete* simulations are cellular automata. They divide streets into cells and vehicles driving on the simulated streets "jump" from one cell to another.

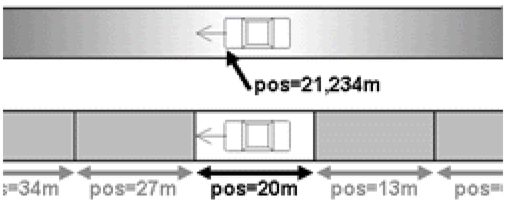


Fig.5: The difference between a space-continuous (top) and a space-discrete (bottom) simulation

Almost every simulation package uses its own model for vehicle movement. Almost all models are so-called *"car-following-models"*: the behavior of the driver is herein meant to be dependent on his distance to the vehicle in front of him and of this leading vehicle's speed.

4.6 SUMO-GUI

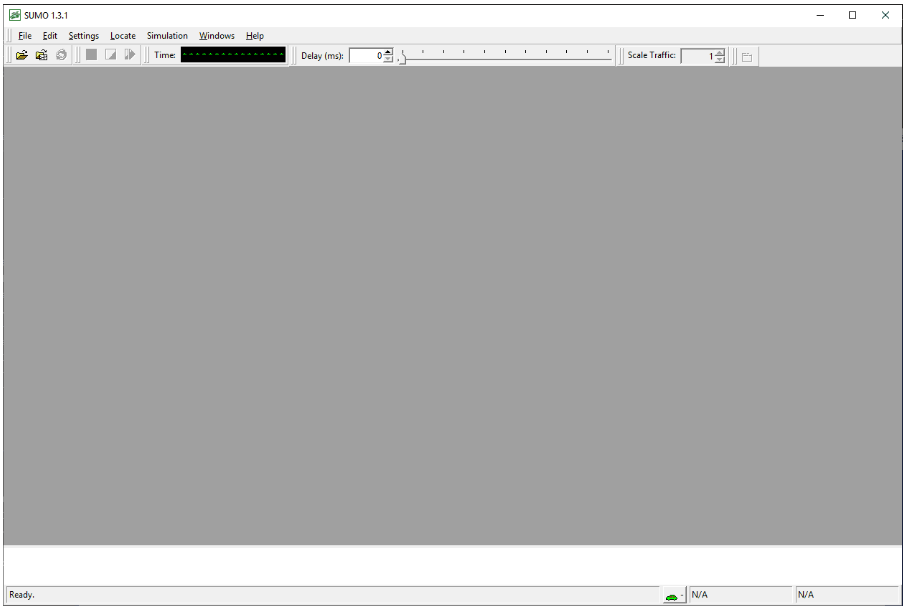


Fig.5 SUMO-GUI

Being a window-based application, sumo-gui is started by a double click with the left mouse button on Windows, on Linux probably with a single click. After this, an empty window should show up, similar to the one shown in the image.

Using either the "File->Open Simulation..." menu entry or by using the "open"-icon (), you should be able to load an existing sumo configuration file, if it has the proper extension ".sumocfg". If the sumo configuration file is erroneous, the errors are reported, otherwise your network referenced within the configuration file should be shown. Now you can start to simulate by pressing the "play" button (). The simulation works as if being started on the command line. The simulation can be halted using the "stop" button () and continued by pressing the "play" button again. When stopped, also single steps may be performed by pressing the "single step" button ().

If the simulation is running, the current simulation second is shown in the "digital digits" field, right to "Time:" (

). By clicking on the word "Time:", the display can be toggled between showing <seconds> and <hour:minute:seconds>.

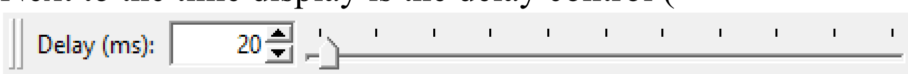
Next to the time display is the delay control (

Fig .6). This allows you to slow down the simulation by waiting for the given number of milliseconds between simulation steps.

Note

By default the delay is set to 0. This can result in a simulation that runs too fast to see any vehicles. Increase the delay value if this happens.

Besides loading simulation configurations, it is also possible to load networks by using either the "File->Open Network..." menu entry or by using the "open network"-icon ( ). Please note, that normally sumo-gui assumes networks have the extension ".net.xml", but also accepts other extensions.

Both, the loaded simulation or the loaded network may be reloaded using the "reload" button ( ) or the menu entry "File->Reload".

If a network or a simulation are loaded, the navigation through the network is possible with the mouse or with the keyboard. One can drag the network with the left mouse button pressed into all directions and zoom either by using the mouse wheel or by pressing the right mouse button and moving the mouse up and down. For fine grained zooming (half zoom speed) press the "Control" key while using the mouse wheel, for double speed use "Shift".

BASIC NAVIGATIONS

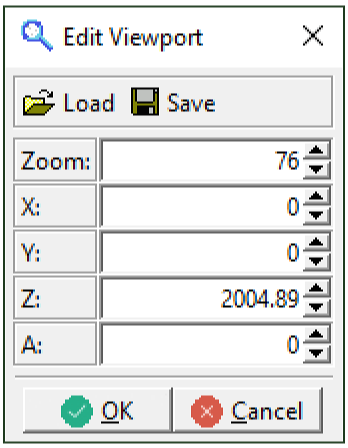


Fig.7 BASIC NAVIGATIONS

As soon as a network is displayed, one can interact with the view. Pressing the left mouse button within the view and moving the mouse with the button pressed, will shift the network. Moving the mouse up and down while pressing the right mouse button changes the zoom of the network. It is also possible to change the zoom by using the mouse wheel (holding *<SHIFT>* increases the zooming speed and holding *<CTRL>* lowers it). Zooming is either focused on the center of the screen or on the cursor position. The zoom style can be selected with the button.

You can also control which part of the network is visible by directly setting the network coordinates which shall be at the center of the screen along with the zoom (given a value of 100 the whole network will fit onto the screen). These settings can be changed by opening the viewport editor using the button. From this editor, it is possible to save the current settings () or load previously saved ones (within the viewport editor).

The viewport is defined as following: <viewport zoom="<ZOOM>" x="<X>" y="<Y>"/>. It can be loaded as a part of viewsettings.

Pressing the center-button () from the menu bar at the top of the view, will reset the viewport so that the complete network is shown.

Breakpoints

The simulation can be stopped automatically to allow investigating specific points in time. Breakpoints can be set via any of the following methods:

- via menu *Edit->Breakpoints*
- by setting option --breakpoints TIME1,TIME2,...
- by loading Configuration Files with breakpoint information

Keyboard Shortcut

- Ctrl-LeftClick: toggle selection status of object under cursor
- Arrow Keys: move the view
- Ctrl + Arrow keys: move the view less
- PageUp / PageDow: move the view up/down (a lot)
- Shift + PageUp / PageDow: move the view left/right (a lot)
- +/-, Keypad +/-: zoom in/out
- Home/Keypad Home: recenter view
- F9: open view settings dialog
- Shift-LeftClick:
  - vehicle: start tracking
  - rerouter: change routeProbReroute probabilities

Object Properties / Right-Click-Functions

Right-clicking simulation objects gives access to additional information:

- copy object id
- object parameter dialog (menu item *Show Parameter*)
- position information (x,y and lat,lon)
- select/deselect object

The following objects can be accessed by right-click:

- Vehicles (some attributes are only availabe when using a specific simulation model, i.e. MESO or sublane model)
- Persons
- Lanes
- Junctions
- Traffic Lights (by clicking on the green/red colored bars)
- Detectors
- Rerouters
- Variable Speed Signs
- POIs
- Polygons
- Simulation (by clicking the background where there is no other object). Also accessible by clicking the  button

SIMULATION & OUTCOME

5.SIMULATION & OUTCOME

5.1 INTRODUCTION

Network simulator is a tool used for simulating the real world network on one computer by writing scripts in C++ or Python. Normally if we want to perform experiments, to see how our network works using various parameters. We don't have required number of computers and routers for making different topologies. Even if we have these resources it is very expensive to build such a network for experiment purposes.

So to overcome these drawbacks we used NS3, which is a discrete event network simulator for Internet. NS3 helps to create various virtual nodes (i.e., computers in real life) and with the help of various Helper classes it allows us to install devices, internet stacks, application, etc to our nodes.

Using NS3 we can create PointToPoint, Wireless, CSMA, etc connections between nodes. PointToPoint connection is same as a LAN connected between two computers. Wireless connection is same as WiFi connection between various computers and routers. CSMA connection is same as bus topology between computers. After building connections we try to install NIC to every node to enable network connectivity.

When network cards are enabled in the devices, we add different parameters in the channels (i.e., real world path used to send data) which are data-rate, packet size, etc. Now we use Application to generate traffic and send the packets using these applications.

Ns3 gives us special features which can be used for real life integrations. Some of these features are:

1. **Tracing of the nodes:**

   NS3 allows us to trace the routes of the nodes which helps us to know how much data is send or received. Trace files are generated to monitor these activities.

2. **NetAnim:**

   It stands for Network Animator.It is an animated version of how network will look in real and how data will be transferred from one node to other.

3. **Pcap file:**

   NS3 helps to generate pcap file which can be used to get all information of the packets (e.g., Sequence number, Source IP, destination IP, etc). These pcaps can be seen using a software tool known as wireshark.

4. **gnuPlot:**

   GnuPlot is used to plot graphs from the data which we get from trace file of NS3. Gnuplot gives more accurate graph compare to other graph making tools and also it is less complex than other tools

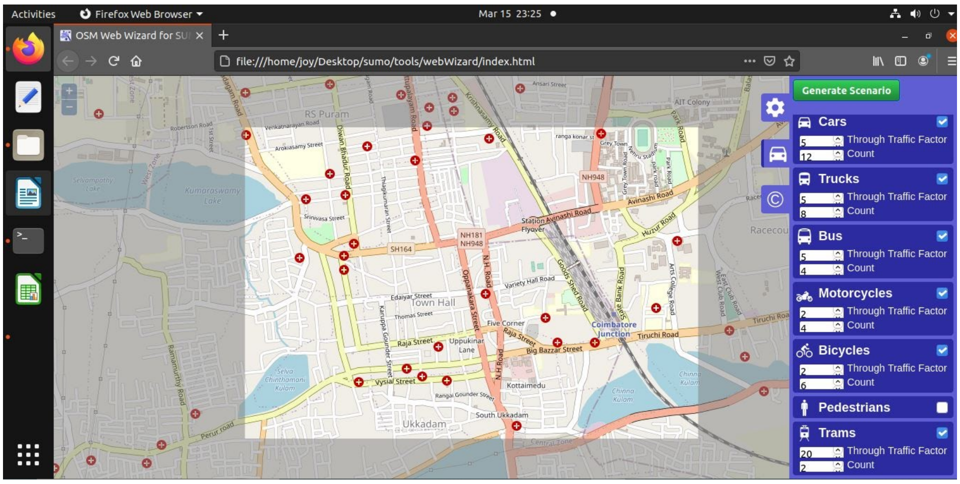


Fig.8 SUMO WEBWIZARD

Here we choose the map from the SUMO simulator tools to form the RoadMap and use them for the NS3 simulation of the outcome.

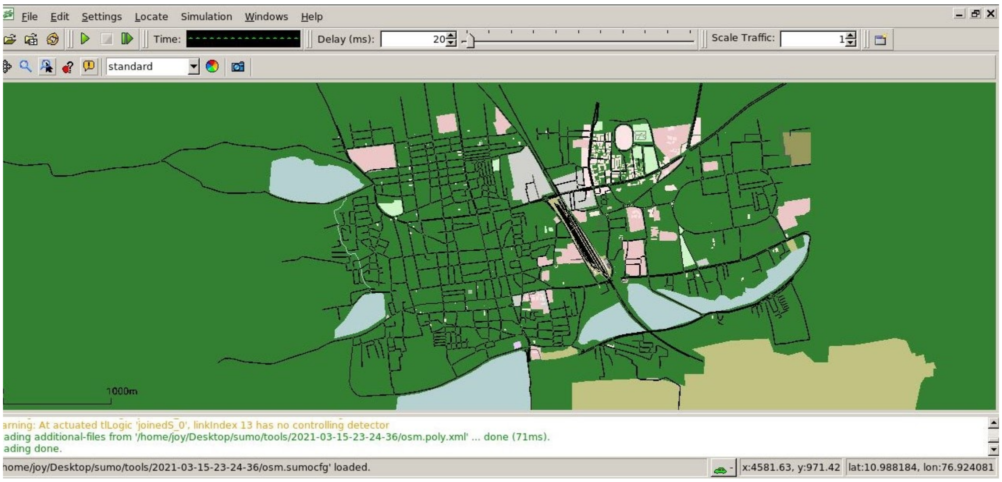


Fig.9 SUMO SOFTWARE

The SUMO software will be giving the different format of the files which are to be used for the different format of the .xml(Fig.11) files and the the .tcl files which can be used for the simulation of the system.

The NetAnim will be helpful in the formation of the output(Fig.12)gives the different Packets and gives the KPIs and nodes in the process.

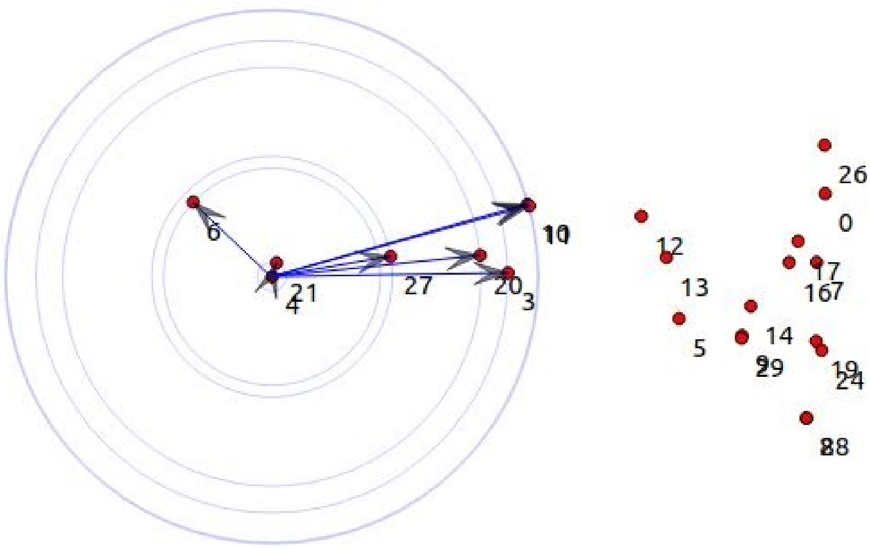


Fig.10 SIMULATION OUTPUT

The table can be found that the different type of the routing protocols and the different specification and sent packets.

Spec\Protocol	OLSR	AODC	DSDV
Total sent packets	3942	10568	5936
Total Received Packets	3527	8171	3504
Total Lost Packets	415	2397	2432
Packet Loss ratio	10.00%	22.00%	40.00%
Packet delivery ratio	89.00%	77.00%	59.00%
Average Throughput	2.55059kps	4.07215kbps	1.72772kbps
End to End Delay	13404257631	411298944083	14604725191
End to End Jitter delay	11357784759	149552736351	11563819227

Table.3 KPIs of VANET

CONCLUSION

VII. CONCLUSION

One of the goals of our research was to provide a simple framework for testing the performance of VANETs. Since in NS-3 there is no suitable solution for obtaining important KPIs for VANETs, the users have no other option than to create their own KPIs calculators, which leads to inconsistent and unreliable results that often differ among researchers. Therefore, we have proposed a framework that provides a standardised and easy-to-use environment in which researchers can obtain fair comparisons of their results. Although the proposed framework is tested in a V2V communication in the VANET city scenario, it can be also used with various other network topologies and scenarios. For instance, V2I simulations are easily implemented using stationary nodes as RSUs. However, additional source and sink applications must be installed in the RSU nodes to simulate communication with the vehicles. In our opinion, the proposed framework is a useful contribution to researchers who want to use NS-3 as a tool for evaluating new protocols and metrics. This work is an initial step towards creating a comprehensive solution for VANETs performance analysis. Future versions of the framework will include lacking routing protocols for VANETs for testing both V2V and V2I solutions. Support is also needed for various applications (such as safety, efficiency, infotainment applications), which have different QoS requirements so that new solutions targeting specific VANETs applications can be tested.

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JOURNAL PAPER

IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 3, March 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.488

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 3, March 2021 ||

| DOI: 10.15680/IJIRCCE.2021. 0903074 |

Intelligent Transportation System Using VANET

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ABSTRACT: Vehicular ad-hoc networks (VANET) technology has emerged as a crucial area over the Vehicular communication system. Vehicular ad-hoc networks(VANET) helps to speak between vehicles and road-side unit stations or another vehicle and supply Trafficless and Intelligent transportation. VANET is been employed by many researchers and networkers to offer better vehicular communication within the highways and road stations. They are often characterized by different topology, mobility, one-time interactions. we analyze the delay and therefore the different characteristic performance of the vehicle to vehicle communication using VANET in Simulation of Urban Mobility (SUMO) and Network Simulator(NS3).In this paper, we use the different routing protocols like OLSR,AODV and DSDV and obtain the key performance indictor like delay,packets ,message delivery speed..etc to form the better VANET Network.

KEYWORDS: Wireless Communication, Vehicular Ad-hoc Network (VANET), Delay, Vehicular Communication, Routing protocol, Mobility, Network Simulator

I. INTRODUCTION

A Vehicular Ad-Hoc Network (VANET) is the same as a mobile network which is been formed by the moving vehicles as nodes. VANET changes every vehicle into a node and forms a network range where they will be tested with different routing protocols. When a car changes its direction or road form then the range of the signal get drop and a replacement network is going to be formed by the mobile Internet are often created. it's assumed that the primary systems during which it'll be integrated are police vehicles to vehicles, speak with each other to supply safety. it's utilized in endless sort of connected nodes. Traditional applications emerge in many various sorts of VANET connections. They are often characterized by different topology, mobility, one-time interactions. VANETs are characterized by the nodes and therefore the direction and form a mini-hub.

–Vehicle to Vehicle (V2V) is communication between vehicles with no external source.

–Vehicle to Infrastructure (V2I) provides communication between the vehicle and therefore the infrastructure.

–Infrastructure to Infrastructure (I2I) provides communication between different infrastructure.

II. LITERATURE SURVEY

2.1 SECURITY CHALLENGES IN VANET

VANET is a rising technology with an amazing future & also has great challenges, especially in its security. we specialise in VANET inter security which is presented in the upcoming three parts. The primary of these paper gives an in-depth overview and idea of VANET security characteristics and requirements. The requirements are taken to enable the security of VANET infrastructure and also with efficient communication between the parties. We give the small blueprint of the updated security architecture and then well-known security standard protocols. The third part may be a comparison between the solutions supported by well-known security criteria in VANET.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 3, March 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0903074 |

2.2 DELAY PERFORMANCE IN VANET

Jin Tian has suggested that delay plays the important role in the message transfer of the VANET network .The efficiency is been marked by the every single message of the VANET network transfer.Lower the delay will be forming the changes in the theoretical deriving of the system and the architecture of the reliable communication system.The different simulation of the VANET using the different protocol provided that the better performance characteristics.

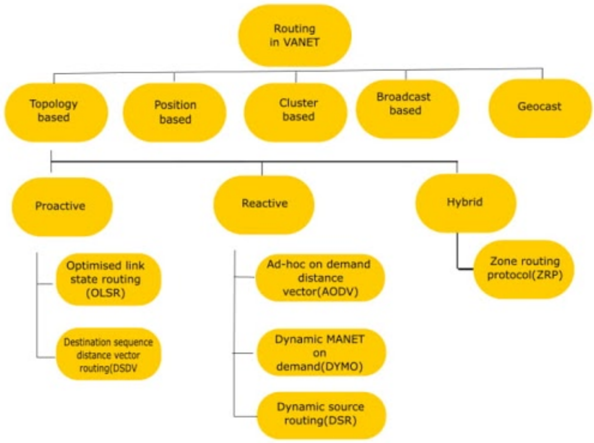

Fig.1 Routing in VANET

III. PROPOSED METHODOLOGY

3.1Simulators used for VANET

Simulation is the easy way to implement on the real-life activities especially in networks like VANETs, the implementation is quite hard. Network simulators is used to easily analyse the performance of network protocols which is under different network topologies. Though many types of simulators are there in existing the commercial and open-source ones are mainly concentrated on simulation modelling for VANETs. In this paper, we have mainly focused on simulators that supports IEEE 802.11p standard for VANETs. Based on the literature, NS-2 is one of the foremost used network simulators,but in recent times, OMNET++ and NS-3 simulator rapidly grown like anything. NS-3is a single language simulator which is written in C++, introduces several advantages that provides more reliable results than NS-2. Eventhough it's a completely new simulator, it has inherited NS-2 popularity, so that it's not surprising that the everyday number of NS-3 users is increasing and many researchers choose it for his or her research. An analysis of the suitability of using the NS-3 simulator in evaluating the performance of VANET, it is concluded that the NS-3 simulator is a good start line for the simulation of VANET.

3.2 Routing protocols for VANETs

Choosing an adequate routing protocol is the main challenge in VANETs due to often changes within the topology caused by the fast movement of the vehicles. Routing protocols utilized in VANETs might be divided into five categories to perform packet forwarding, the topology-based routing protocols use link information that exists within the network. With the topology-based protocols, all sort of packets might be sent, unicast, multicast and broadcast. The small amount of resources and fewer bandwidth consumptions are needed than other protocol types.(Fig 1)On the opposite hand, these protocols provide more overhead due to the route discovery mechanism. Sometimes, the protocol fails to get a route due to the frequently moving nodes. it will be divided into three subgroups: proactive, reactive and hybrid. Proactive routing protocols are protocols during which all nodes have routes before the packet must be sent. These are table-driven protocols that attempt to keep a record of updated network routes all the time. The nodes exchange topology information so all of them have an equivalent view of network. This helps to detect topology changes. Whenever a node send a message, it search the routing table for trail to destination. REO routing protocols generate route discovery only it's needed. while node have data to send the nodes are established between route to

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destination. Source node initiates a route discovery mechanism. Compare to other protocols, reactive protocol is reduced; however, the route searching process that happens before data packets are continuous forwarded may cause source node to suffer long delays. Two widely used reactive protocols are AODV & DSR in highway & city scenario by vary the no.of vehicles in both city & highway scenario.AODV protocol can be found the efficient can be improved in the lecture . as an example, Urban-AODV protocol is for VANETs in urban environment.

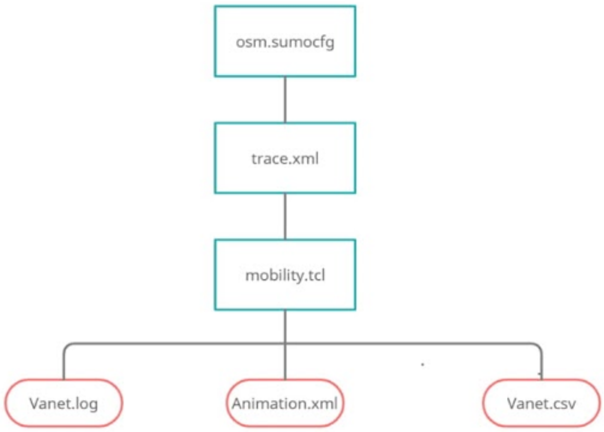

Fig 2 SUMO-NS3

3.3 NS-3 EXTENSIONS FOR VANET PERFORMANCE EVALUATION

In developing and evaluating new network protocols NS-3 simulator is used in many recent research studies. Though it is a very popular tool, NS-3 is a new simulator so it is still lagging back in some protocol models and features that are most essential for VANET simulations. NS-3 does not support routing metrics, so we developed a model for ETX metric inside the AODV protocol. Also, the NS-3 simulator does not give correct tools for the calculation of basic network KPIs like packet loss ratio,throughput, E2E delay, jitter, etc. Therefore a research person must develop and implement the solution to KPI calculations to know the understanding. This will lead to implementation differences and potential errors that will be difficult to compare with other research outputs. So, we have developed a framework for gathering simulation data which performs necessary statistical data processing and calculating KPIs, to efficiently analyse the performances of VANET networks.

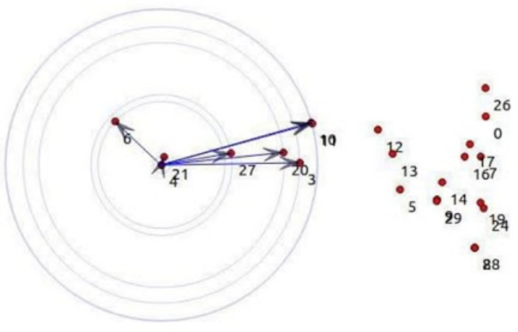

Fig 3 NetAnim Output of NS3

3.4 VANET FRAMEWORK AND PERFORMANCE

Regardless of the network type, the simulated scenario with reliable output statistics of basic network KPIs. is the important part of simulatoin. Many of them have opposite requirements. So, network can 't able to

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achieve the best results for all KPIs. KPIs network must be realistic and the network should be acceptable results in all KPIs. As of now, simulation data collected from NS-3 can be verified using plenty of methods. – The first method is Flow Monitor. This tool gives performance metrics on the network layer instead of the application layer and it is used only for unicast IP flows over TCP/UDP.Flow Monitor cannot be used properly if the user does not use TCP/UDP or uses broadcast packets. if there are one or more issues regarding the Flow Monitor then it does not work for all routing protocols, such as DSR. To export data from the simulator General trace mechanism uses trace sources and trace sinks. Trace sources which are embedded in NS-3 models provides a source of relevant information for simulator users. Simulation data can be processed by the Data Collection Framework(DCF) tool.Probes,Collectors,Aggregators are the elements which are in the DCF it gets embedded with the NS-3 Models and provide output of the generate graphics.Generate graphics collects the files from the store data in the aggregators.Network analysis can be used for the collector mechanism which provided the better KPI's.Even though the flow monitor can handle the some of the packets while broadcasting it is very slow and both the efficiency methods can be used for the concepts of analysis.DCF easy for the NS3 user can be made for tracing the flexibility of the different networks.

Spec\Protocol	OLSR	AODC	DSDV
Total sent packets	3942	10568	5936
Total Received Packets	3527	8171	3504
Total Lost Packets	415	2397	2432
Packet Loss ratio	10.00%	22.00%	40.00%
Packet delivery ratio	89.00%	77.00%	59.00%
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End to End Delay	13404257631	411298944083	14604725191
End to End Jitter delay	11357784759	149552736351	11563819227

Tab 1 Different Routing Protocols

IV. CONCLUSION

The goal of the paper is to get the key performance indicators of the VANET and analyze the different routing protocols.NS3 helps in obtaining the required end-to-end delay and other indicators(Tab 1) of the network created using the SUMO simulator. The framework of the VANET helps in providing a better network of nodes to get the occurred output. The KPI's found using the NetAnim can be used for the formation of the hub(connecting different nodes in the network with a single node), this will be further used for the development path of nodes, traffic management, ambulance freeway.This tool can be used with the Google Map for the real time traffic and accident message is possible.

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Published a paper entitled

Intelligent Transportation System Using VANET

in IJIRCCE, Volume 9, Issue 3, March 2021

Impact Factor 7.488
e-ISSN: 2320-9801
p-ISSN: 2320-9798
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Impact Factor 7.488

e-ISSN: 2320-9801
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Impact Factor 7.488

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in IJIRCCE, Volume 9, Issue 3, March 2021

Impact Factor 7.488

e-ISSN: 2320-9801
p-ISSN: 2320-9798

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