TARP (ECE3999)

FINAL REPORT

V2V COMMUNICATION TO REDUCE HIGHVEHICLE FUEL CONSUMPTION

By

K.Tarun Sai Chowdary – 18BEC0052

N.Raghavendra Rohith - 18BEC0192

Slot : TF2

Submitted to:

Dr.Shambavi K

ELECTRONICS AND COMMUNICATION ENGINEERINGSCHOOL OF ELECTRONICS ENGINEERING

Introduction

Traffic flow rate is one of the most important factor in transportation System. The flow of Traffic is always unpredictable as it changes dynamically. The main existing problem in Traffic is though congestion but due to whichcontinuous Greenhouse gases gets released, mainly from largevehicles.

These large vehicles emit more greenhouse gas when the driver stops the vehicle but doesn't off the engine. In this paper our main focus is on large vehicles i.e. priority vehicles so as to curb this situation and provide them with informationabout traffic status.

Our proposed work is applicable for autonomous vehicles with Wi-fi availability i.e. V2V & V2I. As such communication is highly advantages for all types of situations. So, in this paper we are integrating. The contribution of this paper is twofold: First, creating a2-Dimensional Traffic Network for a specific chosen area usingNetEdit and its simulation using SUMO (Simulation of Urban Mobility) which includes all kind of Traffic scenarios such as U-turn traffic light control, Bus only lanes, 4 Cross-roads intersection and so on. Second, Establishing a V2V & V2I communication networks for the chosen area, priority of largeand emergency vehicles over others.

The efficiency of the proposed work will be more efficient when one lane out of a road is given only for priority vehicles.

Problem Statement

Since the green house gases emitted by this large vehicle causing damage to environment and also there is a lot of fuel consumptiondue to lack of proper communication and lack of no idea of the traffic around him/her. If suppose truck driver supposed to take aturn, a vehicle is coming from that side truck driver should stop immediately after taking the turn. Again the driver should accelerate the vehicle to make it move. Also if there exits any damaged road the truck should stop there and have to take a U-turn. In this process a lot of fuel consumes and the statistics arementioned above.

Suggested Solution

To overcome the above problems the solution we implemented is communication between Truck to its surroundings as well as communication between Truck and infrastructure. To make this happens we implemented the scenario using software like SUMO and OMNET++ SIMULATOR implemented the V2V communicationbetween the vehicles of the traffic scenario created by us. Here wecan clearly monitor the speed of trucks when they reach closer to other vehicles, traffic lights, hospitals and damaged roads.

Literature Survey

In **[1]** Ntefeng Ruth Moloisane, Reza Malekian, Dijana Capeska Bogatinoska described that the current trending technology in traffic in Intelligent transportation Systems(ITS)uses to reduce traffic, accidents, fuel consumption and to increase efficiency of vehicles and safety. M2M communication is between main system and remote systems to know automation of real time processes. In traffic management M2M comm is group of vehicles under a network sends data to gateway.V2V is domain under M2M Vehicular ad-hoc networks is used to gather the traffic density at the junctions. The advanced level of it is it collects speed info and GPS to optimize waiting period at the junctions. We can reduce traffic consumptions by implementing a system which reduces the average stopping period of vehicles. We can reduce fuel consumption in this way too. The main agenda is to build a good communication between humans, vehicles and road infrastructure by implementing a network connecting sensors, wireless communication with algorithms.

In **[2]** Li Shengguang, Tan Lin, Zhu Yuanshuo, Zhang Rucai stated that some transport vehicles need extra security for this by using RFID readers, building a safe warehouse. RFID uses a to connect the information and goods. A RFID reader the readsthe RFID tag present in the vehicle and the data goes to server. Using wireless communication sends the information from server to vehicle when necessary. Some researches shows everything digital like number plate, license, electronic signs.

In **[3]** Borut Jereb, Samo Kumperščak, Tadej Bratina proposedthat the main reason of the pollutions is traffic flow. Due to lack of proper planning in traffic management continuously braking and accelerating of vehicles takes place which leads to exceeds more greenhouse gases. For fuel consumption large data should be taken considering its average velocity, time taken to reach 50km/h, its engine capacity, weight of the loadalso plays a role in fuel consumption. As per the survey average consumption(l/m) for heavy goods vehicle is 0.0002350.The accurate way to measure the consumption is by factor.Factor = consumption during acceleration/avg consumption.

In **[4]** Chereddy Sekhar, K Kranthi, M Kalyan Chakravarthi stated that in these days GMS based vehicles can be stopped by using a mobile. Police can catch the people who deregulatethe rules using this system. This paper mainly focuses on the halting vehicles using IoT. Suppose if a vehicle crosses traffic signal by violating rules then the data goes to gateway when the user enters the registration number of vehicle then it stopsautomatically using throttle valve. By blocking the valve usingthe IoT is the main moto of this paper.

In **[5]** Vijayaraman P, Dr. P Jesu Jayarin stated that increase inpopulation leads to increase in traffic every day. This leads to increase pollution, accidents, time consumption, skindiseases. Transportation of public like buses, autos, cabs and individuals are impacted by IOT in high scale. According to the reports around 80% of traffic can be reduced if vehiclecommunication is implemented in a better way.

There are 3 major V2X communications1)Vehicle to
infrastructure
2)Vehicle to Vehicle 3)Vehicle to Pedestrains
Deep learning is another technique to get results more accurately. It is in the research process.

In **[6]** Volodymyr Miz, Vladimir Hahanov proposed Traffic management system – CTMS. The main part of the system is Smart traffic light – virtual analog of existing physical traffic light. The system generates control signals based on the information obtained during the analysis of data obtainedfrom cars and road sensors, as well as alternative sources of user data, such as social networks, the results of opinion polls and others. The logic of the Smart traffic light changes periodically, which can increase the efficiency of the control system through the analysis of relevant information obtainedin real time. CTMS is a part of e-government model, which excludes operating errors caused by the human factor. CTMS implementation enables the most efficient distribution of budgetary funds by automating the traffic management system and is a step towards the development of a global e government concept.

In **[7]** Yulian Cao WenfengLi Jian Zhang stated Wireless Network Sensors (WNS),collecting information from RFID andWNS and monitoring can improve traffic management system.

The system architecture divided into 4 types

1) Identification perception layer2)Network transport
layer 3)Data processing layer 4)Application service
layer
Vehicle RFID has the information about the vehicle ,this information is sent to wireless sensor network using RIFDreaders . Data processing is the core of the system. The information collected by RFID reader should go through a series of treatment. Time, speed, and other related data should be analysed. Traffic information monitoring module is the main function module. The system collects real-time information through this module and passes the data to the backend database to save them. In traffic informationmonitoring module, when the system detects vehicle information, they are feed backed to the system and the real-time traffic information was displayed on the monitor screen.The information is divided into the basic vehicle information, path information, monitoring point information, real-time monitoring point's flow of information.

In **[8]** Paul Jasmine Rani, L Khoushik Kumar, M Naresh K.S Vignesh stated in this paper that they uses IOT, IR sensor and Image processing to make traffic system more efficiency, including with Raspberry pi. The data is collected from the sensors like IR, ultrasonic is transimitted by the Wifi transmitter which is received by raspberry pi controller based on the code or algorithm traffic lights changes. The algorithm uses in this project is background subtraction algorithm in image processing to plot the blockage in IR sensors and the blockages are reported to the processing unit.Infrared sensors are employed at either sideways of the road, makes note of incoming vehicles towards the signal. These signals which have the 'congestion' mark will indicate the Raspberry-Pi processor, which was installed inside the signal. The denseness of the traffic is calculated and the timer display is shift dynamically. This major advantage rules out the happening of 'unwanted wait' for the vehicles in the more crowded region The Raspberry-Pi instructs the traffic controller to show the appropriate signals based on the denseness of the traffic.

In **[9]** Mehal Zaman Talukder, Sheikh Shadab Towqir, Arifur Rahman Remon, Hasan U. Zaman stated that in this paper they used microcontroller based system using sensors to control the traffic flow. A typical traffic system consists of four lanes each having a signal with a fixed on each end that operates sequentially. The problem with this system is that it cannot detect the density of traffic on each lane; therefore, time is wasted even when a lane is empty.' There are several control systems like GPS tracking; RFID technology; Image processing using CCTV cameras, Vehicular ad hoc network (VANET). A more efficient and safe traffic ecosystem has been developed which provide commuters with live update of the road condition in a website. In the fixed timer traffic system, the lane signals are operated one after another based on a fixed set time.

In **[10]** Manjunath M N Meghana S K Rajini S stated in this theyused RSU along with RFID installed at different lanes on road. Basically RSU is an microcontroller with camera inside take picture at the signals and send data to cloud. System is responsible for providing real time information about traffic timings and calculate the distance using GPS technology and hence find the speed. The Intelligent traffic control system facilitates the real time traffic information to the end users. Bythis system RS unit is implemented which consists of microcontroller having camera attached to it. This system is very cost effective and uses the latest technology which is reliable and consistent. This can be further modified or implemented when the new technology is proposed. The effective implementation of this system makes the drastic change in traffic management by reducing the congestion of the vehicles, reducing the fuel consumption and reducing therate of accidents in the traffic junctions.

In **[11]** Li Li, Jiafeng Zhu, Huawei, stated many of the accidentsoccurs at the intersection points. This paper describes a ticket-based intersection traffic control system for Internet of Vehicles.

The main contributions of this paper are

1. Introduced two graph models FIN and FRAG and proceduresto automatically derive the flow paths and the flow service times for an intersection.
2. Propose a compact traffic control and coordination protocolthat can be an extension to SAE DSRC.
3. Developed an efficient and extensible ticket based traffic control system, which includes a flow scheduler and a flow coordinator.
4. Evaluated three classic process scheduling algorithms, FCFS, SSTN and HRRN for traffic control on large scale simulated traffic data.

This paper mainly deals with the formulas, algorithms, data, statistics.

In **[12]** N. B. Soni, Jaideep Saraswat used different kind of sensors like Inductive loop sensor, Load cell, IR sensor, Radio frequency identification. Current traffic signal controlling method has turned obsolete in addressing different traffic situations arising in the course of a day. Also, it has been observed that some sort of control must be provided to onsite traffic police officer for emergency situations.

Methodology

There is a Graphic users Interface which contains layout data including bus behaviours. There were many elements to consider and to implement to get to a configuration file through which Simulation of a Traffic network was possible.

After creating the network for an exported map.

1. Creating Road Infrastructure: Roads & Street's where different parameters had to be set like number of lanes, road layout, nodes & edges, pavement type, speed limits, acceleration and deceleration rate, supported weight, slope, etc.

2. Setting Vehicle types, Driver behaviour.

3. Creating Bus stops, U-turn Traffic control, Bus-only lanes, and many other aspects which has to be inspected as some connections also gets created which generally is not considered in Real-life Traffic connections & Laws.

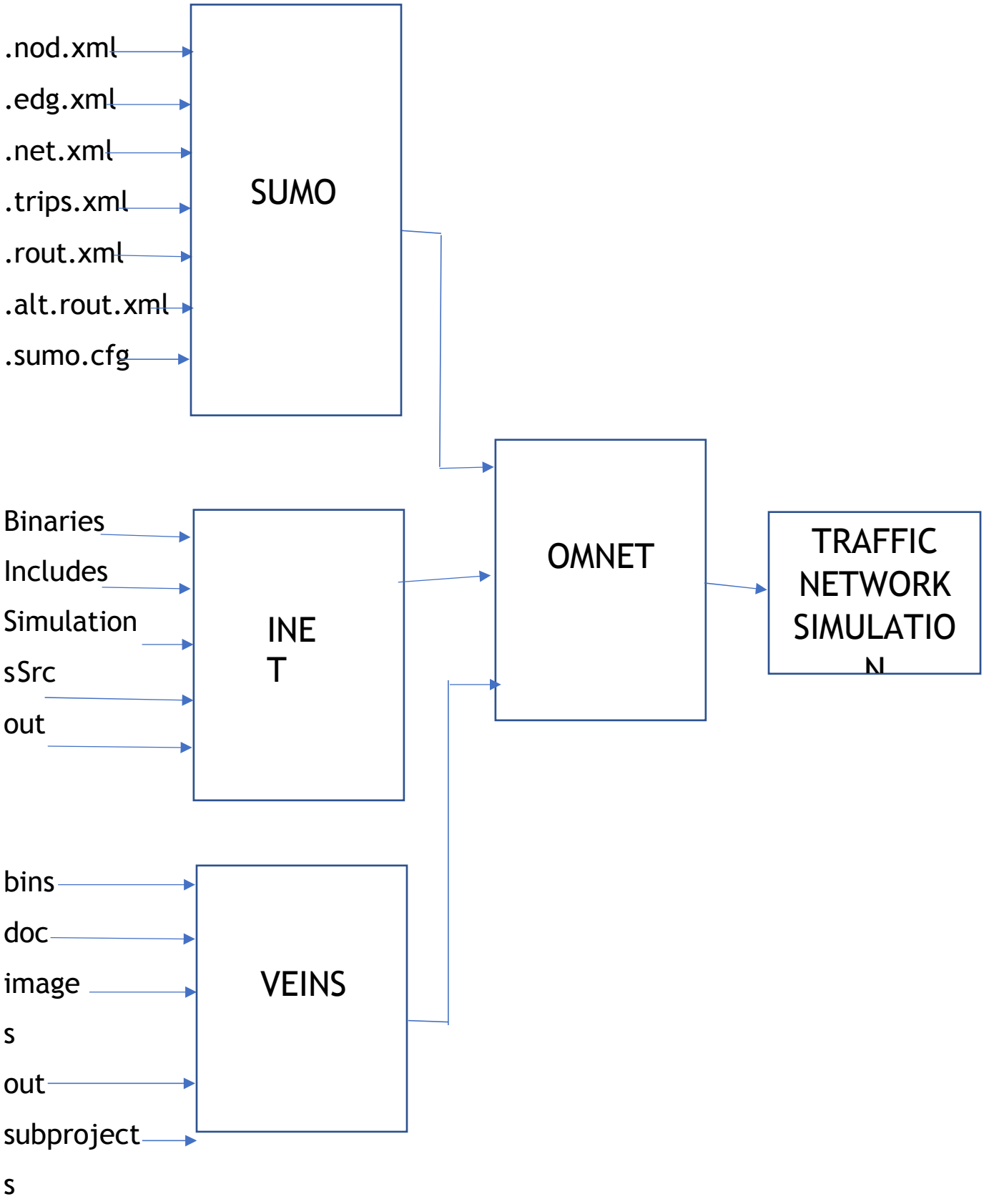
4. Trips: Each trip should be given with attributes like Types of Vehicles with their Departure & Arrival time for differentpaths.

5. Routes: The most important and tricky element in Traffic studies

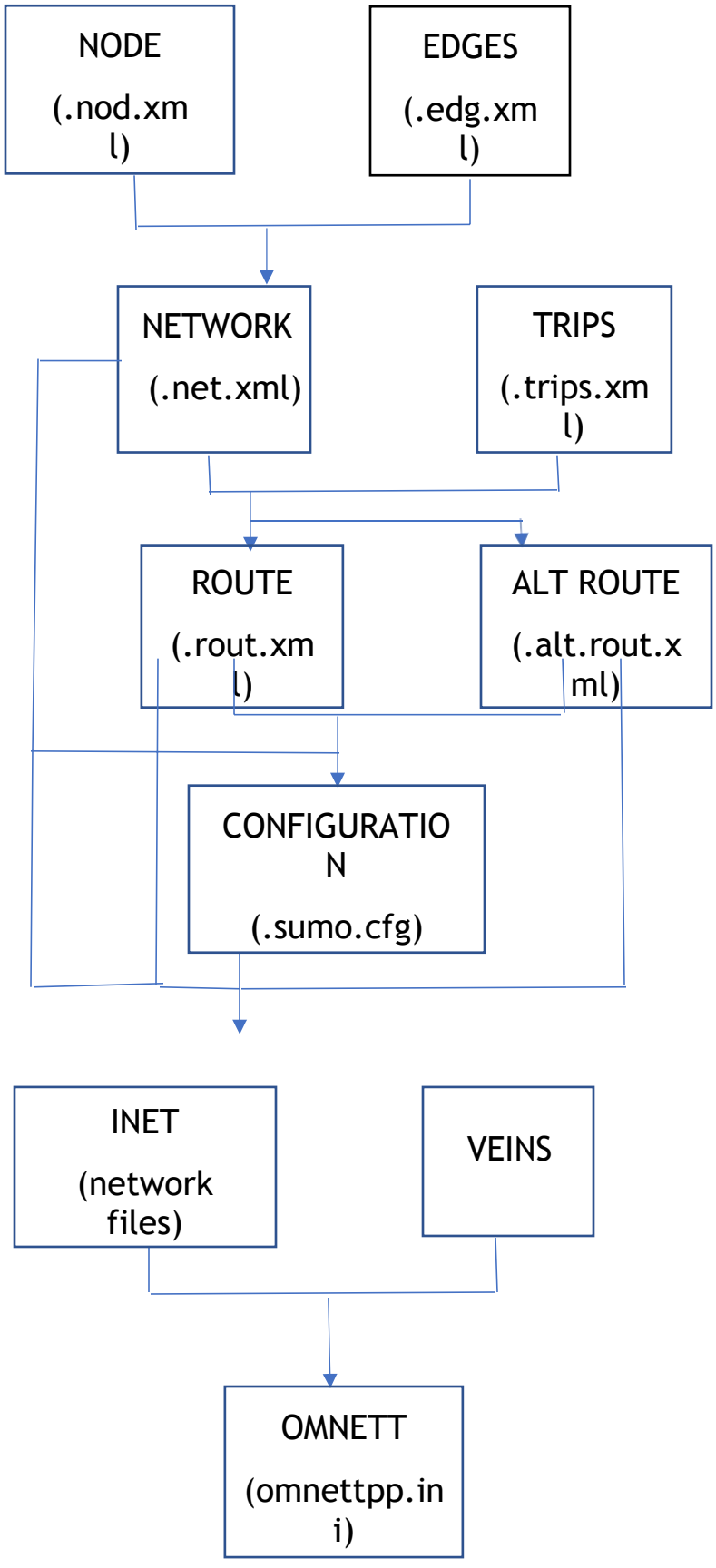
6. More attributes like Lane Change Model, Car/Vehiclefollowing Models, Junction Models etc

7. Later these files will be copied to omnet++ simulator whereV2V communication can be obtained.

Block Diagram



Flow Chart


NODE
(.nod.xml)
EDGES
(.edg.xml)
NETWORK
(.net.xml)
TRIPS
(.trips.xml)
ROUTE
(.rout.xml)
ALT ROUTE
(.alt.rout.xml)
CONFIGURATION
(.sumo.cfg)
INET
(network files)
VEINS
OMNETT
(omnettpp.ini)

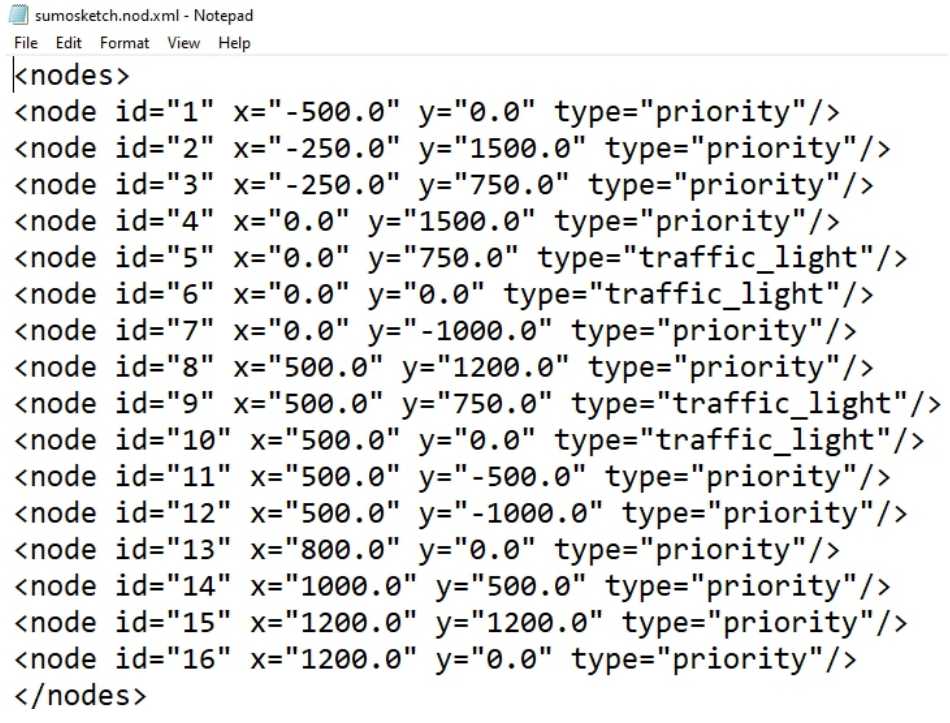
SUMO

SUMO(Simulation of Urban Mobility) is a simulation composed of
3 important files: Configuration(.sumo.cfg) => Network File (.net.xml), Route File(.rou.xml), Decals File(.xml).

Vehicular Mobility Simulations are usually divided into two main types: **Microscopic** and **Macroscopic**.

Macroscopic only focuses on flow mobility of cars not each car individually. In Macroscopic simulation, generations of vehicular traffic such as traffic density or traffic flows are defined. However, in the microscopic approach the movement of each individual vehicle and the vehicle behaviour is important.

Node File (.nod.xml): This file contains all the nodes of the roadsketch which we are designing for simulation.



Edges File (.edg.xml): This file contains all the edges which areconnecting between nodes that are represented in the node file.

sumosketch.edg.xml - Notepad

File Edit Format View Help

```
<edges>
<edge id="e1" from="1" to="6" priority="1" numLanes="2" speed="14.0"/>
<edge id="e2" from="6" to="7" priority="2" numLanes="2" speed="14.0"/>

<edge id="e3" from="4" to="5" priority="2" numLanes="2" speed="14.0"/>
<edge id="e4" from="2" to="3" priority="3" numLanes="3" speed="25.0"/>

<edge id="e5" from="2" to="4" priority="4" numLanes="3" speed="20.0"/>
<edge id="e6" from="3" to="5" priority="2" numLanes="2" speed="14.0"/>

<edge id="e7" from="4" to="5" priority="2" numLanes="2" speed="14.0"/>
<edge id="e8" from="5" to="6" priority="2" numLanes="2" speed="14.0"/>

<edge id="e9" from="5" to="9" priority="2" numLanes="3" speed="35.0"/>
<edge id="e10" from="6" to="10" priority="2" numLanes="2" speed="14.0"/>

<edge id="e11" from="8" to="9" priority="2" numLanes="2" speed="14.0"/>
<edge id="e12" from="9" to="10" priority="2" numLanes="2" speed="14.0"/>
```

Net File (.net.xml) : This file is the result of combining both thenode and edge files.

sumosketch.net.xml - Notepad

File Edit Format View Help

```
    <edge id=":10_0" function="internal">
        <lane id=":10_0_0" index="0" speed="14.00" length="14.40"
        <lane id=":10_0_1" index="1" speed="14.00" length="14.40"
    </edge>
    <edge id=":10_2" function="internal">
        <lane id=":10_2_0" index="0" speed="6.51" length="9.03" s
    </edge>
    <edge id=":10_3" function="internal">
        <lane id=":10_3_0" index="0" speed="6.51" length="9.03" s
    </edge>
    <edge id=":10_4" function="internal">
        <lane id=":10_4_0" index="0" speed="14.00" length="14.40"
        <lane id=":10_4_1" index="1" speed="14.00" length="14.40"
    </edge>
    <edge id=":11_0" function="internal">
        <lane id=":11_0_0" index="0" speed="29.00" length="20.66"
        <lane id=":11_0_1" index="1" speed="29.00" length="20.66"
        <lane id=":11_0_2" index="2" speed="29.00" length="20.66"
```

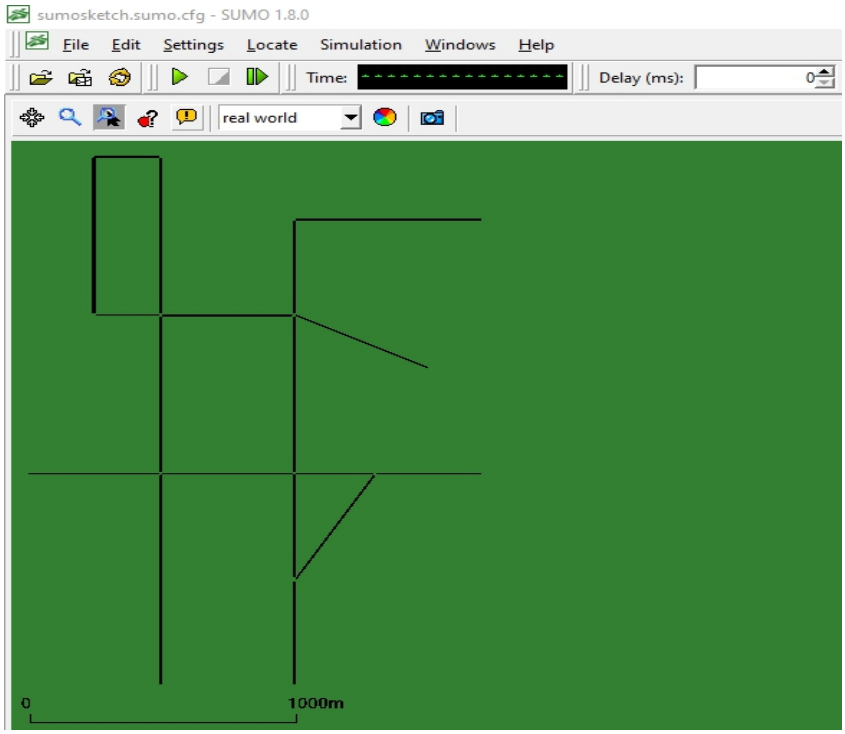
Route File (.rou.xml)**:** This file contains the movements,flow,trips & vehicle types.

sumosketch.rout.xml - Notepad

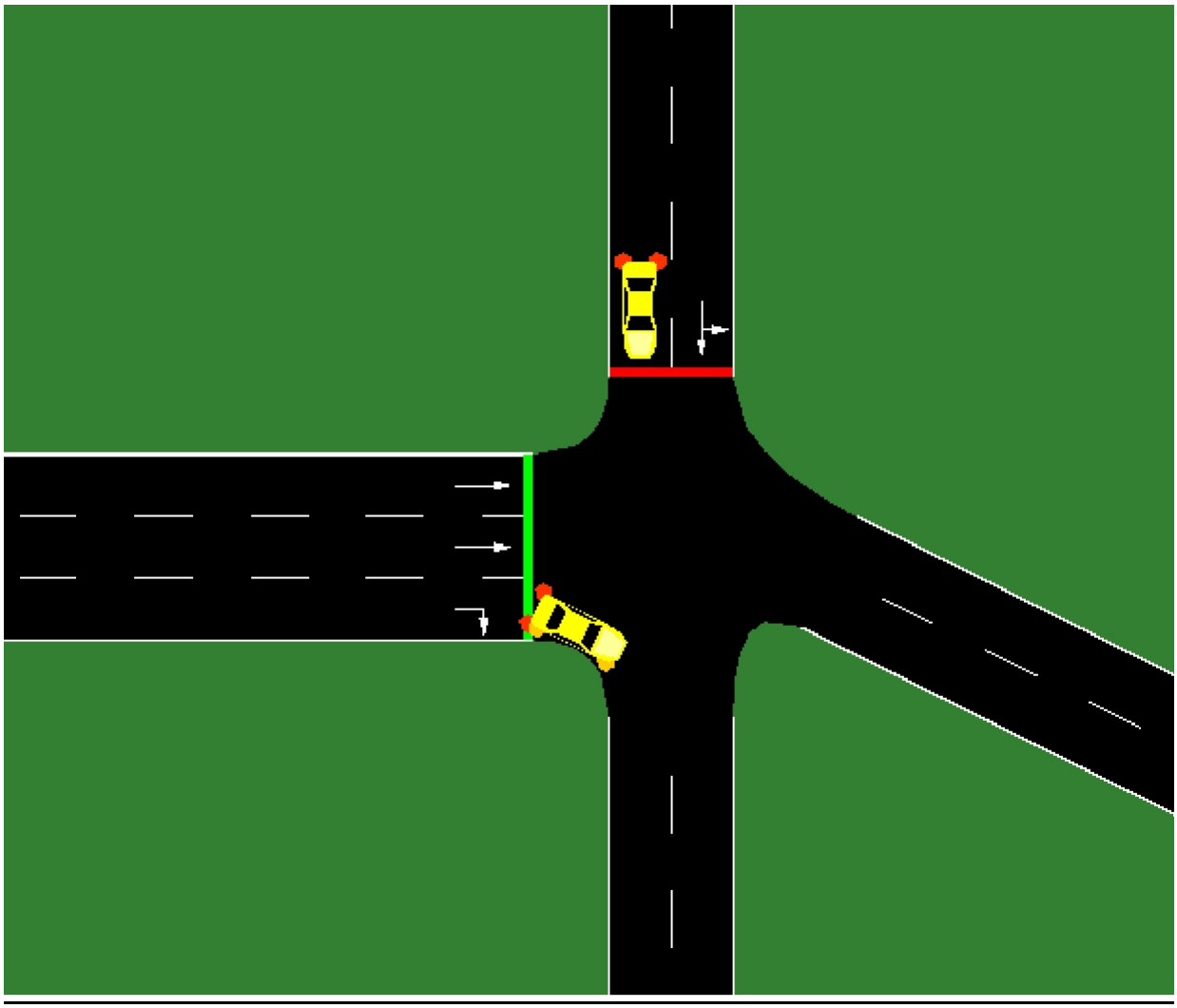
File Edit Format View Help

```
<vehicle id="0" depart="0.00">
    <route edges="e4 e6 e8 e10"/>
</vehicle>
<vehicle id="1" depart="1.00">
    <route edges="e12 e13 e14"/>
</vehicle>
<vehicle id="5" depart="5.00">
    <route edges="e12 e13 e19"/>
</vehicle>
<vehicle id="6" depart="6.00">
    <route edges="e1 e10 e13"/>
</vehicle>
<vehicle id="7" depart="7.00">
    <route edges="e5 e7 e9 e12 e13 e19"/>
</vehicle>
<vehicle id="9" depart="9.00">
    <route edges="e7 e8 e10"/>
</vehicle>
<vehicle id="11" depart="11.00">
    <route edges="e13"/>
```

Configuration File (.sumo.cfg)**:** This file contains all the configuration information to run the simulator.



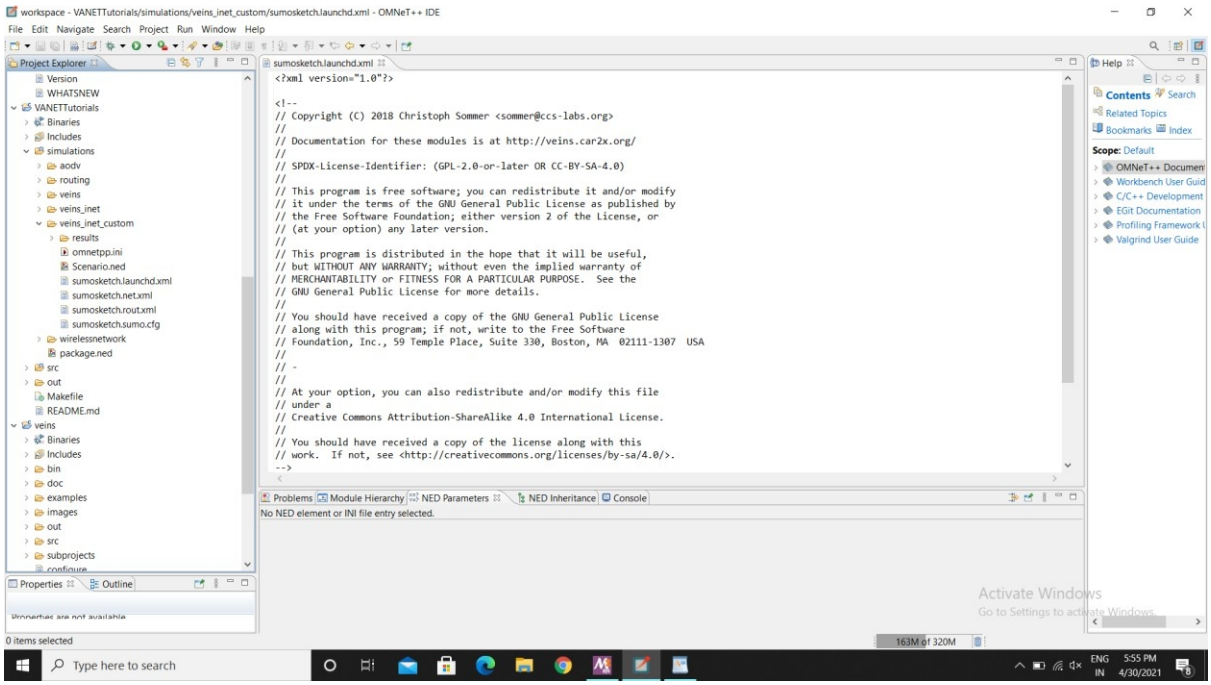
Results for SUMO



We can see that at one junction which is having traffic lightvehicles on the side of green signal are moving.

- Here only traffic scenario is created in the SUMO software now we need to implement the communication between the vehicles using OMNET++ simulator.

OMNET++



This is the Omnet++ IDE simulator where the inet files, SUMO files and Veins files resides.

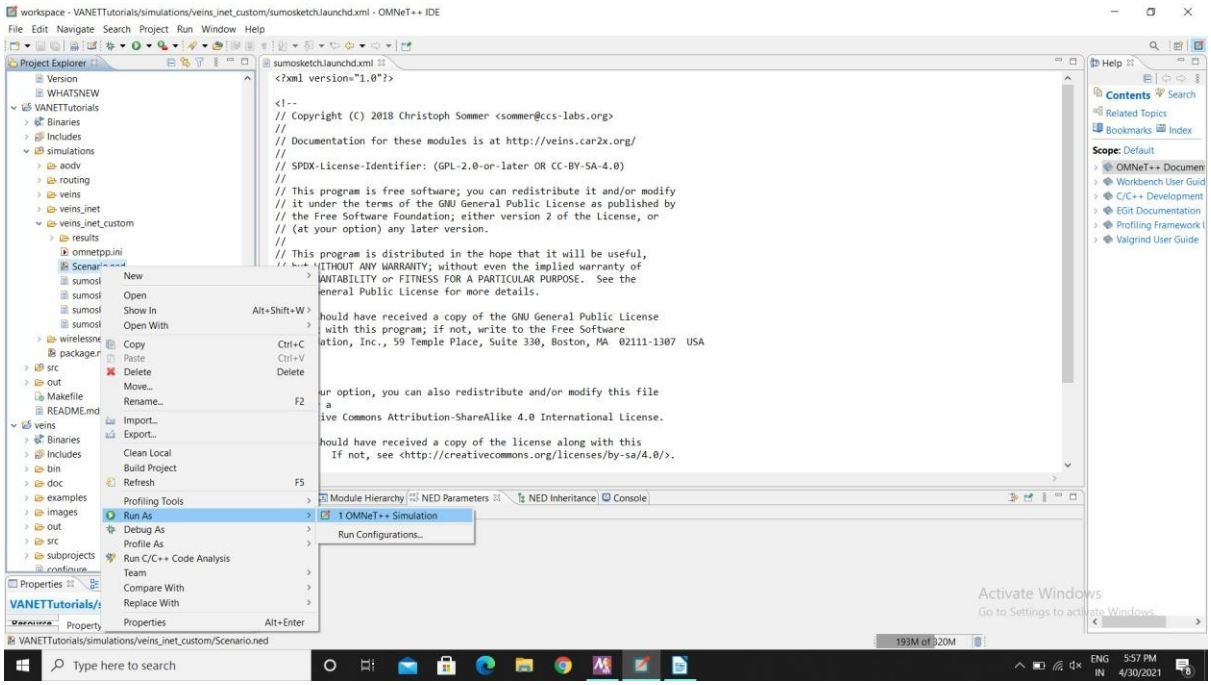
Inet contains the networking files i.e. how the networking or communication is done between the vehicles but it does not contains any vehicles in it. Only the rules are present in it.

SUMO contains the vehicles and traffic design i.e. what path must the vehicle should move at the junction etc.

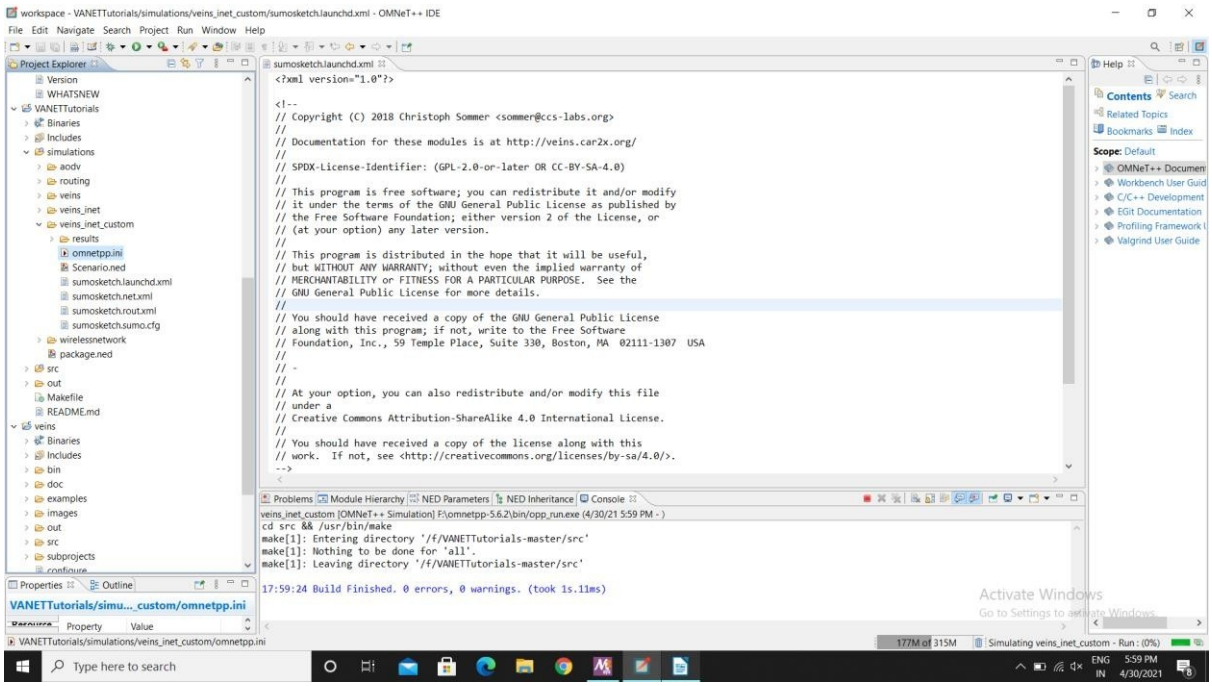
Veins is another open source code which combines these two i.e. inet and Sumo files together to create an Omnet file.

This oment file is simulated in the Omnet++ IDE software.

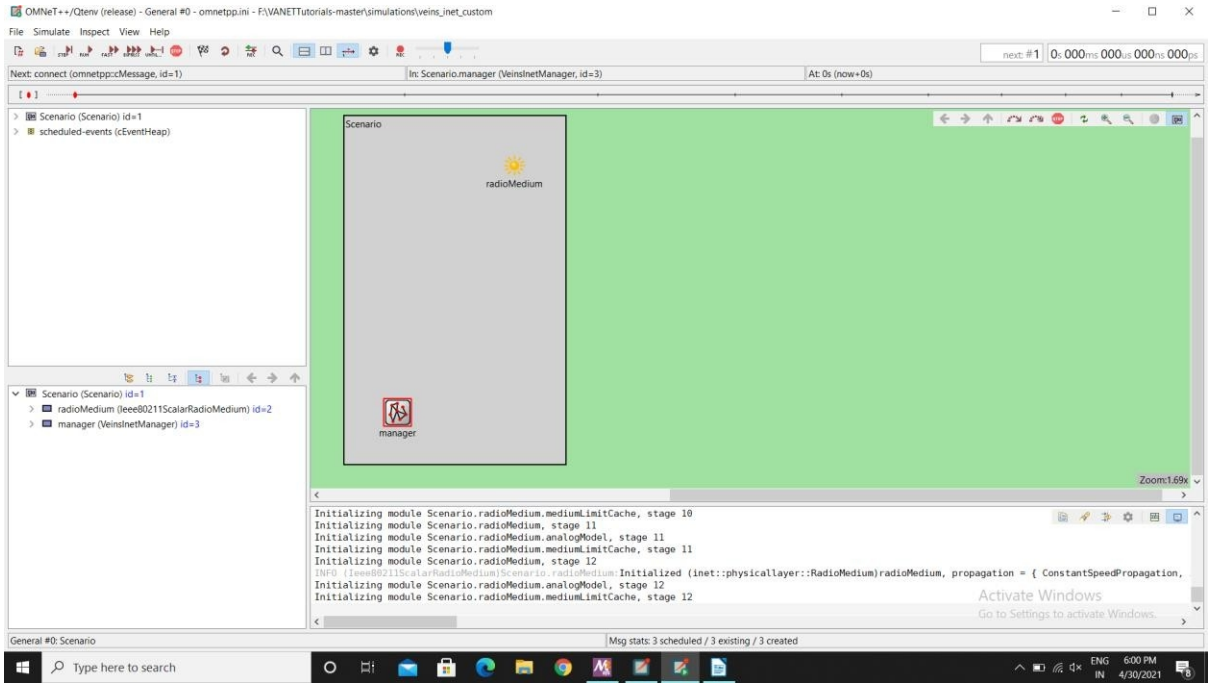
In the above picture we can see that VaneTTutorials containts the inet sourcecode in ‘src’ folder, sumo files in ‘Veins_inet_custom’ folder and veins files were also added at thelast.



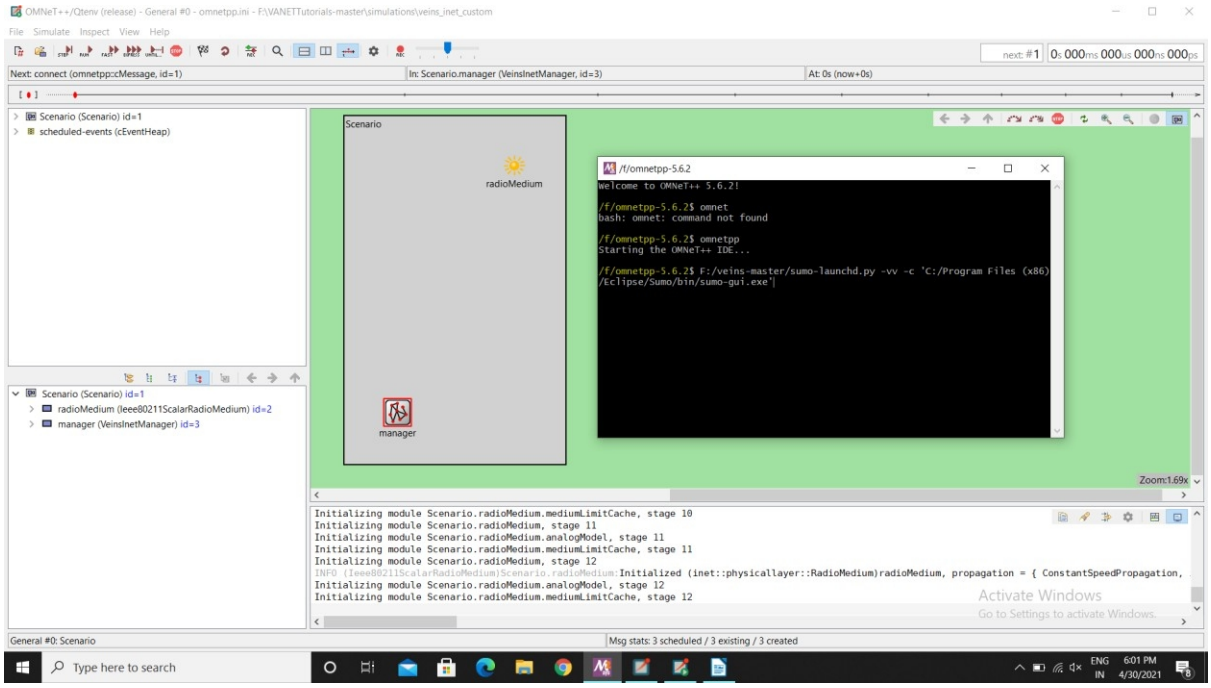
Now that we have created all the files in the omnet simulator and we are going to run the omnetpp.ini in the Omnet++ Simulator.



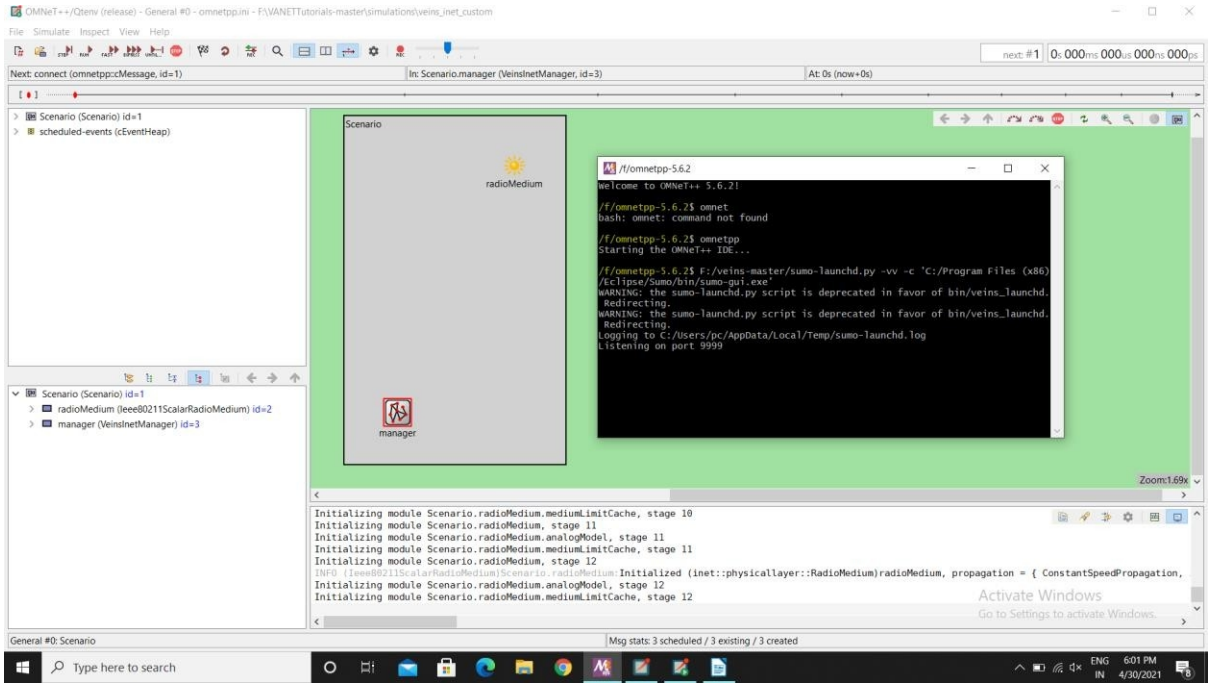
We can see that the compilation is successful with 0 errors and 0 warnings.



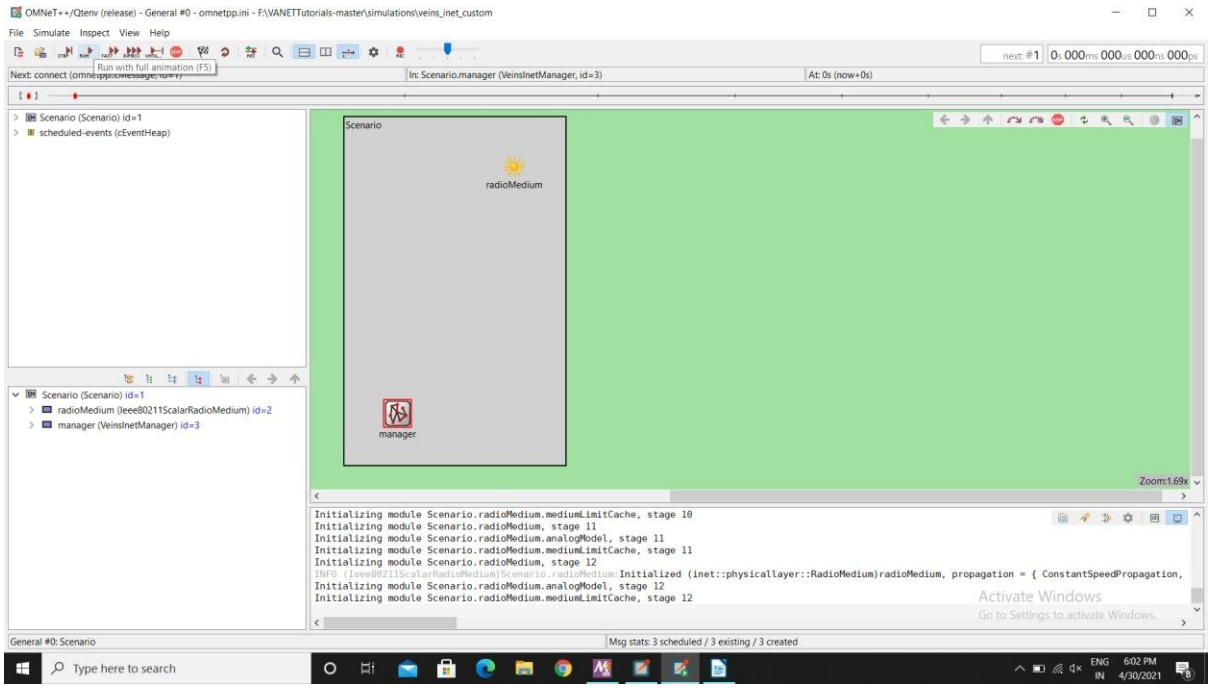
It created another dynamic simulator where we can see the vehicles(nodes) in it.



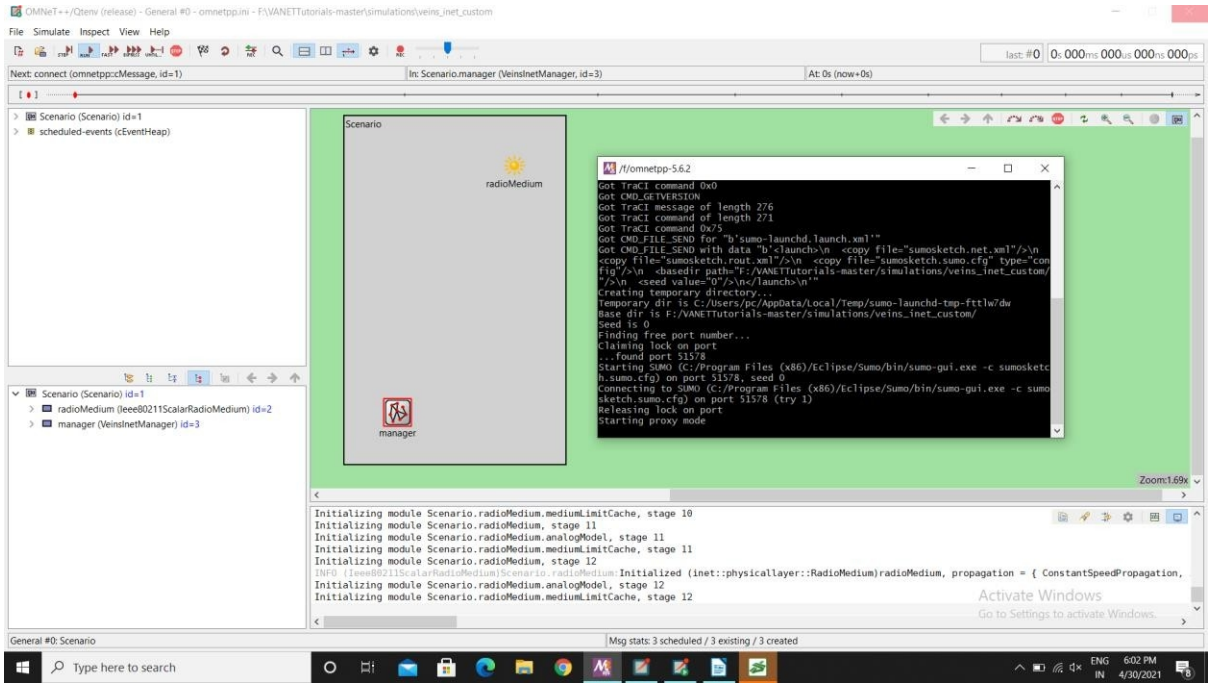
Now we have to open the sumo-gui using the above command in the mingwenv prompt, it is like cmd in windows, where it opens the sumo-gui for us.



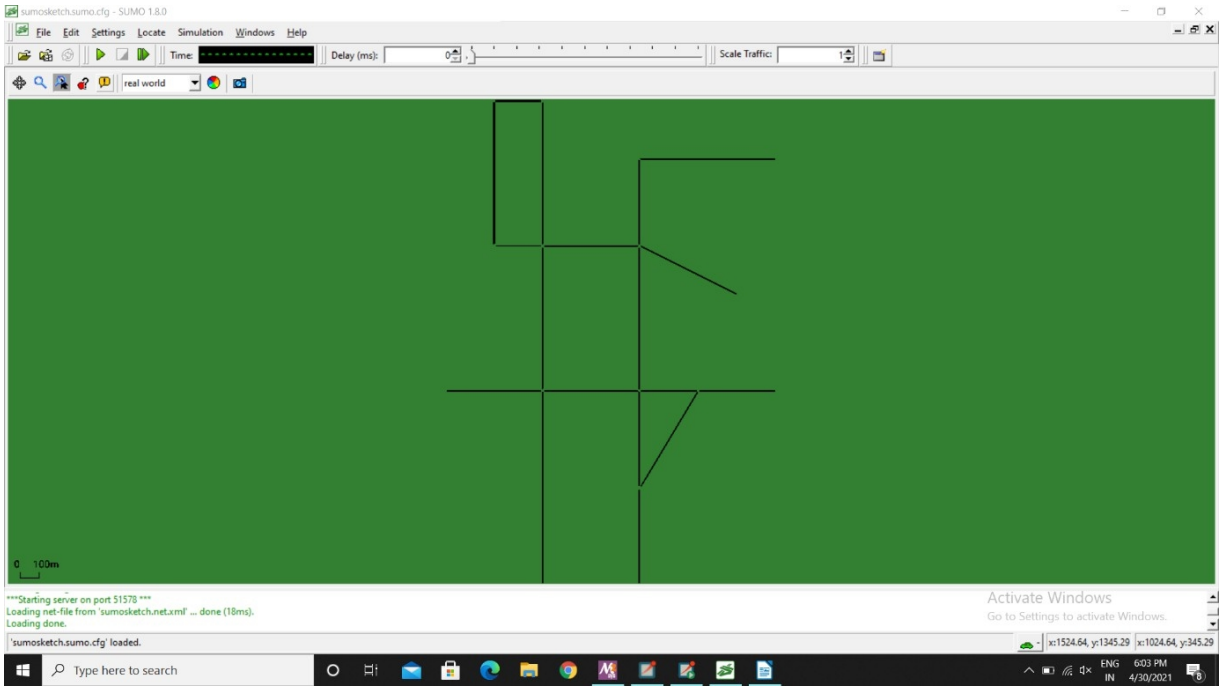
We can see after executing the above command the Omnet simulator will try to talk to SUMO simulator using 9999 port number.



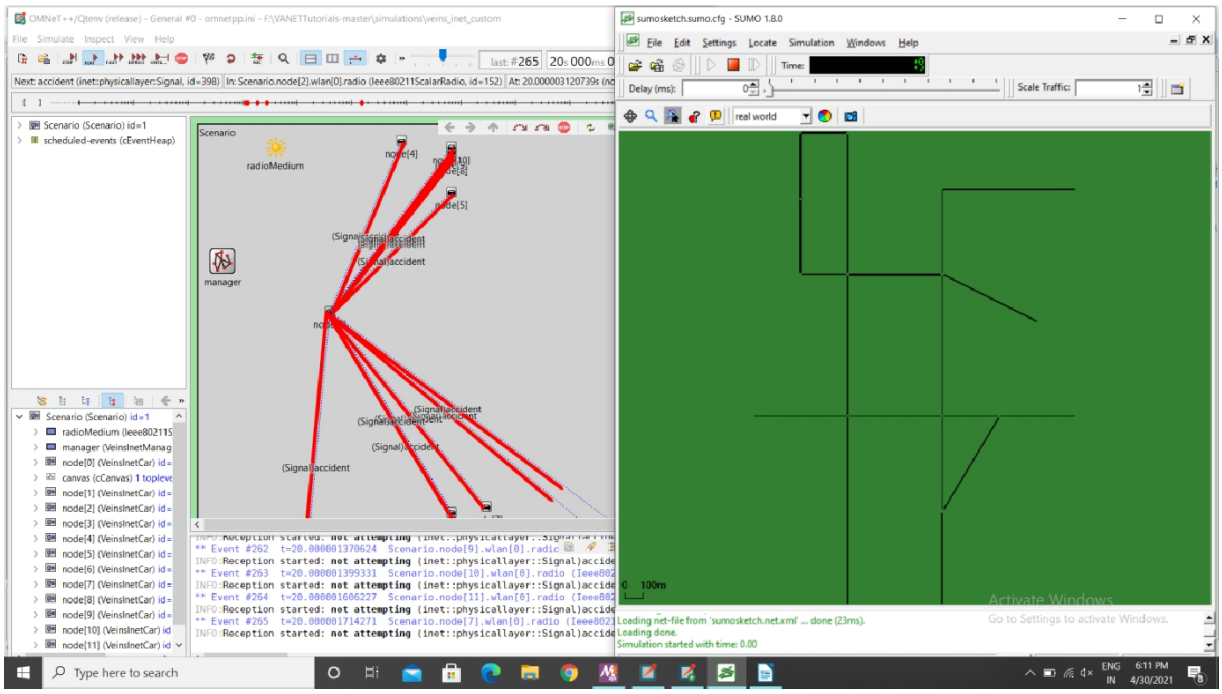
After that we have to click the run button as shown at the mousepointer.



Now after the clicking the run button the connection has been established between them and it tries to open the sumo-gui.



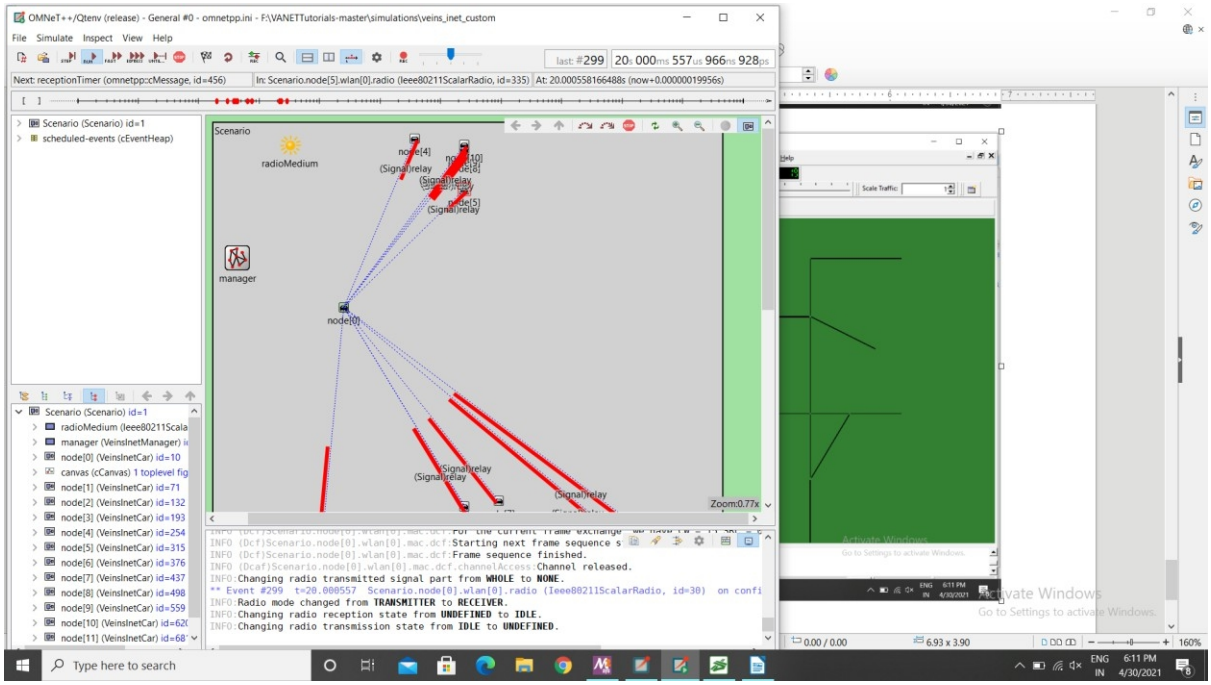
As said it opened the sumo-gui. This the manual network which we created seperately in the SUMO as we discussed the above session.



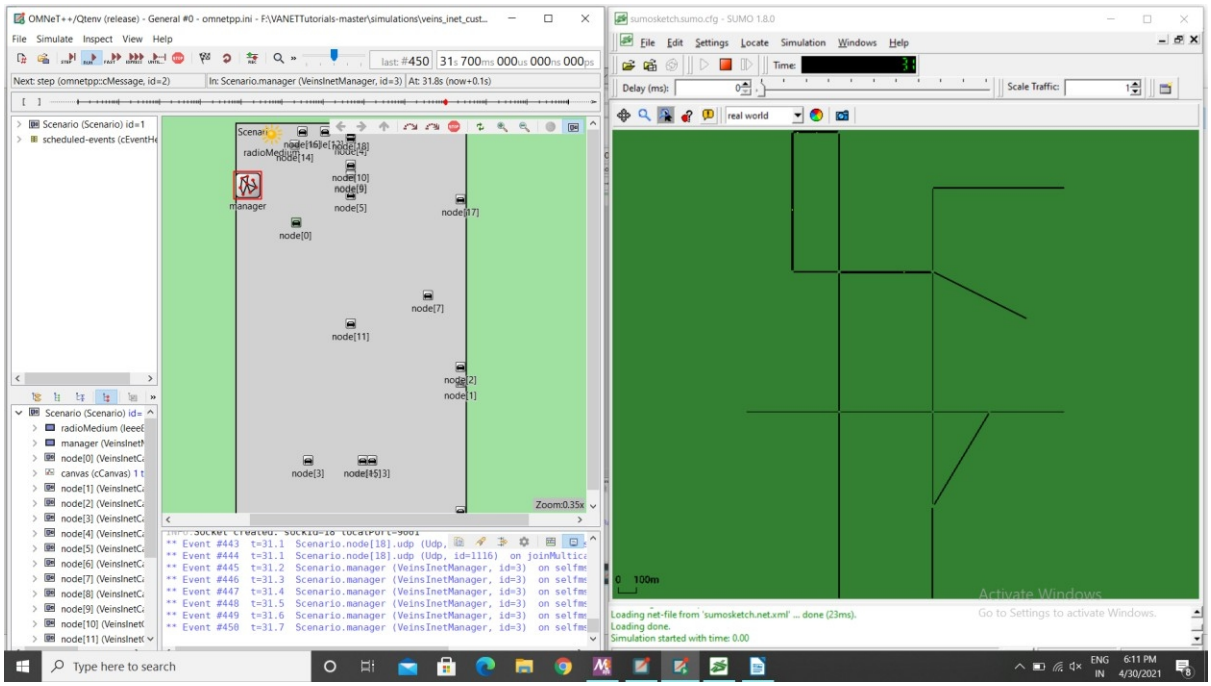
Now we click run in the sumo-gui also to initiate the traffic, parallelly we can see how the vehicles are travelling in the sumonetwork in the Omnet smulator and the vehicles(nodes) are communicating to each other.

Suppose somewhere some vehicle undergone accident itimmediately broadcast the position of the accident area to the nearby vehicles or RSU's(Road side units).

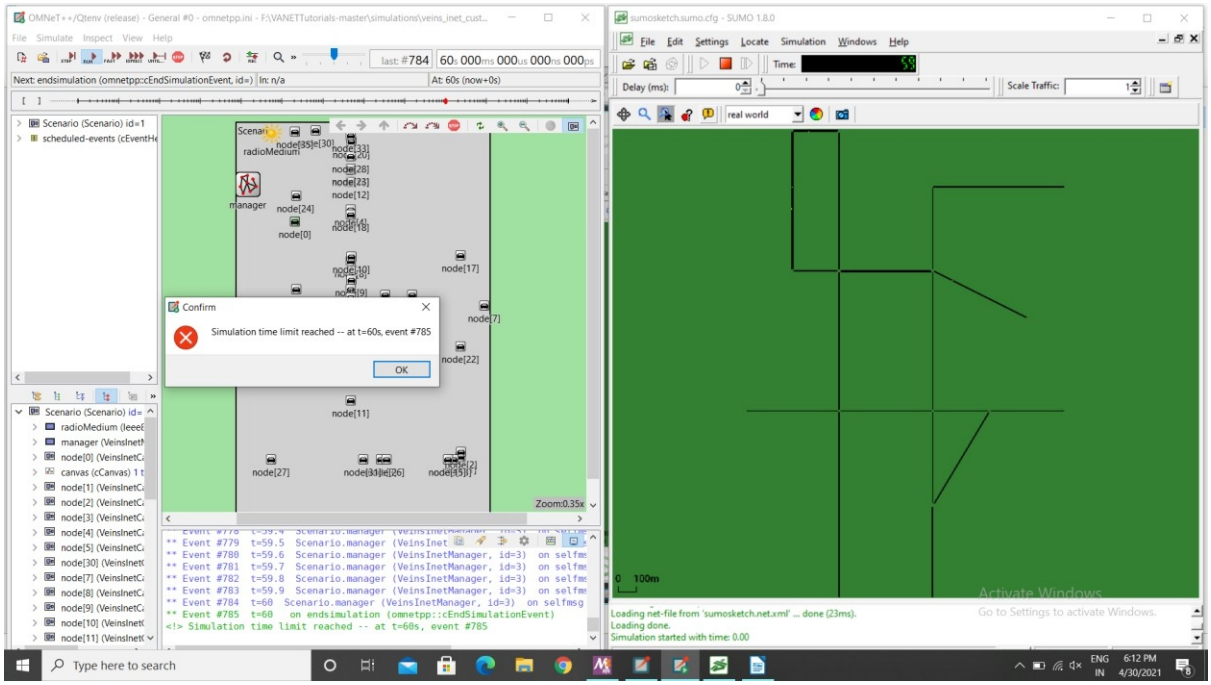
We have given 240m range that any vehicle can transmit the signals to other vehicles.



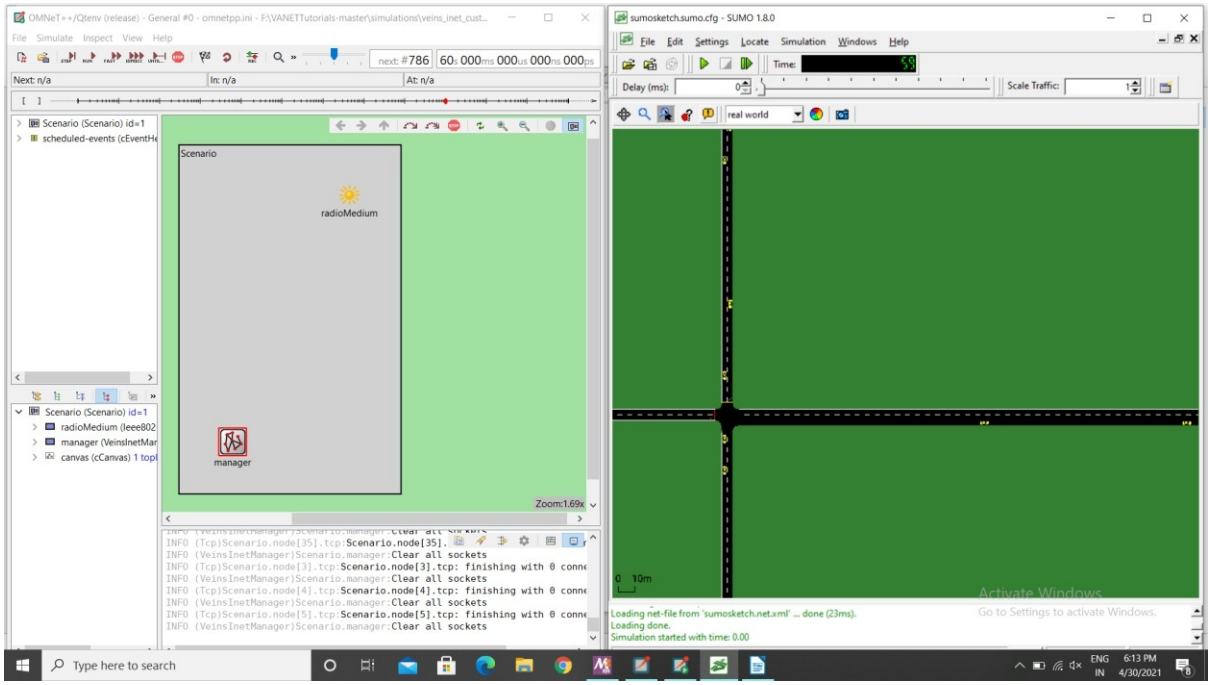
we can see that the signal transmission is about to complete. So other vehicles can take alternative route to avoid the traffic in that area.



If we zoom in we can see the exact positions of nodes in the sumo-gui also.



The time limit which we have given is reached.



This is the zoomed pic where we can see the vehicles in thesumo-gui

Conclusion

We have successfully explained our proposal of handling the situation of unnecessary excessive greenhouse gas emission by creating a virtual Traffic network simulation for specific area which includes most of the traffic scenarios and integrating it with communication network establishing Vehicle-to-Vehicle communication(V2V) in a basic manner. The use of V2V & V2I communication can be taken place with better range and efficiency with use of MIMO Technology due to the delay of communication through sectored antenna.

References

[1]. N. R. Moloisane, R. Malekian and D. Capeska Bogatinoska, "Wireless machine-to-machine communication for intelligent transportation systems: Internet of vehicles and vehicle to grid," 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2017,pp. 411-415, doi : 10 . 23919 / MIPRO. 2017.7973459.

[2]. L. Shengguang, T. Lin, Z. Yuanshuo and Z. Rucai, "Internet of Things for Special Materials Transportation Vehicles," 2013 IEEE International Conference on Green Computing and Communications and IEEE Internet of Things and IEEE Cyber, Physical and Social Computing, Beijing, China, 2013, pp. 1891-1894, doi: 10.1109 / GreenCom-iThings-CPSCom.2013.351.

[3]. P. Vijayaraman and P. J. Jayarin, "Prediction and Automation of Road Traffic using Internet of Things," 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I- SMAC), Palladam, India, 2019, pp. 173-175, doi: 10.1109/I- SMAC47947.2019.9032489.

[4]. V. Miz and V. Hahanov, "Smart traffic light in terms of the cognitive road traffic management system (CTMS) based on the Internet of Things," Proceedings of IEEE East-West Design & Test Symposium (EWDTS 2014), Kiev, Ukraine, 2014, pp. 1-5, doi: 10.1109/EWDTS.2014.7027102.

[5]. Yulian Cao, Wenfeng Li and Jian Zhang, "Real-time traffic information collecting and monitoring system based on the internet of things," 2011 6th International Conference on Pervasive Computingand Applications, Port Elizabeth, South Africa, 2011, pp. 45-49, doi: 10.1109/ICPCA.2011.6106477.

[6]. L. P. J. Rani, M. K. Kumar, K. S. Naresh and S. Vignesh, "Dynamic traffic management system using infrared (IR) and Internet of Things (IoT)," 2017 Third International Conference on Science Technology Engineering & Management (ICONSTEM), Chennai, India, 2017, pp. 353-357, doi: 10.1109/ICONSTEM.2017.8261308.

[7]. M. Z. Talukder, S. S. Towqir, A. R. Remon and H. U. Zaman, "An IoT based automated traffic control system with real-time update capability," 2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Delhi, India, 2017, pp. 1-6, doi: 10.1109/ICCCNT.2017.8204095.

[8]. M. N. Manjunath, S. K. Meghana and S. Rajini, "IoT for Intelligent Traffic Management," 2019 3rd International Conference on Computing Methodologies and Communication (ICCMC), Erode, India,2019, pp. 779-781, doi: 10.1109/ICCMC.2019.8819650.

[9]. L. Li and J. Zhu, "Ticket-Based Traffic Flow Control at Intersections for Internet of Vehicles," 2017 IEEE International Congress on Internet of Things (ICIOT), Honolulu, HI, USA, 2017, pp. 66-73, doi: 10.1109/IEEE.ICIOT.2017.17.

[10]. N. B. Soni and J. Saraswat, "A review of IoT devices for traffic management system," 2017 International Conference on Intelligent Sustainable Systems (ICISS), Palladam, India, 2017, pp. 1052-1055, doi:10.1109/ISS1.2017.83893