Video Streaming In Vehicular Ad-Hoc Networks

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ABSTRACT:

The rapid technology development in the transportation system is urgently needed because of increase in number of vehicles. To overcome the above problem we go for VANET. Vehicular Ad-Hoc Network (VANET) has been viewed as one of the enabling technologies that provide a wide variety of services such as video streaming, road safety, infotainment for the comfort of passengers in moving vehicles, reducing the level of accident and road congestion. VANET has two way of communication namely Vehicles to Vehicle (V2V) and Vehicles to Infrastructure (V2I) i.e, with Road Side Unit (RSU).For VANET we are using mininet-wifi as the simulator and SUMO for extracting the map.

The objective of mininet-wifi is to identify an efficient Quality of Service (QoS) for video streaming applications with respect to number of nodes used. We are also using Simulation of Urban Mobility (SUMO) for extracting the real world map. SUMO is an open source, highly portable and continuous road traffic simulation package. It is designed to handle large road networks. The aim of our project is to develop Non-Safety application i.e., video streaming for vehicles. We intend to simulate the real life scenario and check various parameters associated with Quality of Service (QOS) like Throughput, Jitter and Packet Delivery Ratio.

Keywords— ***VANET, SUMO, MAC Protocols, 802.11, Wireless Simulation,Phython,Mininet-Wifi.***

I. INTRODUCTION

Now days, the increasing number of vehicles has caused some problems. One of them is a traffic jam and often accidents occurred, so these problems lead to a need of a technological system that can help us reducing those negative effects. Intelligent Transportation System (ITS) is a combination of intelligent transportation system with information technology to improve accessibility, efficiency and security of transportation. ITS technology could provide real-time information to road users related to the road situation such as when there are traffic accidents or congestions occurred on a particular road area. This technology could give solutions or alternatives for road users can avoid the traffic jam. One of ITS technologies that is still in development is Vehicular Ad-Hoc Network (VANET) [1].

Vehicle to vehicle communication (V to V) is established when vehicles communicate with one another directly and if the communication is with a fixed unit near the road i.e., RSU, it forms vehicle to infrastructure communication (V to I) [1] as shown in Fig 1.Implementing VANET's in practically involves very high costs, exhaustive labor etc. Hence simulation is one of the best alternatives solution to this concept. In this paper the simulation for urban scenario is done by using two types of road schema, manual schema and real world.

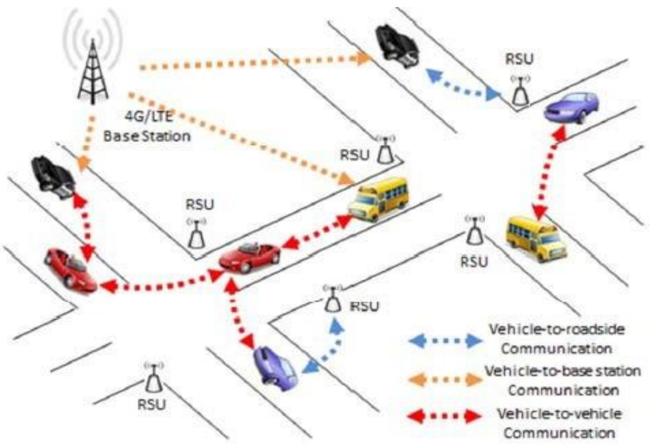

Fig 1: VANET Architecture with RSU's

for the simulation we use Mininet Wi-Fi and then measure the simulation performance namely delay, throughput, and packet drop between vehicles.

II. LITRETURE REVIEW

In[1] "Performance Analysis of VANET Simulation on Software Defined Network" this paper published by author Slamet Indriyanto, Muhammad Najib Dwi Satria, author identified problem is Vehicle collision, method used for this is software defined network is used, result for this paper is Packet transfer from one vehicle to another vehicle,and remarks of this paper is authors have considered only for packet transfer but not concentrated on video streaming.

In [2] "Distributed Road Traffic Congestion Quantification Using Cooperative VANETs", published by MilosMilojevic and Veselin Rakocevic, author identified problem is traffic congestion problem in urban environments , methodology used for this is congestion detection and quantification, and information disseminatio, result for this paper is they have presented an algorithm designed to enable each vehicle in the network to detect and quantify the level of traffic congestion in completely distributed way, remark for this paper is author have considered only emergency scenarios.

In[3] "Stable Clustering Algorithm based on Affinity Propagation for VANETs", this paper published by Hamayoun Shahwani, Toan Duc Bui, Jaehoon (Paul) Jeong and Jitae Shin, problem identified by author is traffic clustering, methodalogy used authors have proposed a stable clustering algorithmbased on Affinity Propagation (AP) for Vehicular Ad Hoc Networks (VANETs), result analysed They have used for the positions and end-to end trajectories of vehicles for betterment of VANETs, remarks for this paper authors here have done only traffic clustering but no solution has been provided to avoid traffic congestion.

In[4] “On Detection of Sybil Attack in Large-Scale VANETs Using Spider-Monkey Technique”, published by Celestine Iwendi Mueen Uddin ,james A. Ansere, problem identified by author is Security against Sybil Attack, method used in this paper is Security Algorithm based on nature inspired Spider-Monkey behavior, result for this paper is To detect the malicious nodes that causes Sybil attacks on honest vehicles and reduces packet beacon message loss, remarks of this paper is Author is not concentrated on the vehicle is at the expected location it should be able to receive the challenge and send back valid response packet.

III. VANET OVERVIEW

VANET is a high speed data communications technology for a vehicle. This technology is wireless based and has several protocols for data communication namely unicast, multicast, geocast, mobicast and broadcast protocol. Connectivity in VANET uses IEEE 802.11 on 5.9 GHz wave. VANET's traditional services include vehicle and road safety services, traffic efficiency, management services and infotainment services [6].

Table I. shows characteristics comparison of 802.11p, 802.11n and 802.11ac.

TABLE I. CHARACTERISTICS COMPARISON [6]

802.11 Protocol	Frequency (GHz)	Bandwidth (MHz)	MI MO	MU - MIMO	Max. Throughput
802.11p	5.9	75	NO	NO	--
802.11n	2.4/5	20/40	YES	NO	600Mbps
802.11ac	5	20/40/80	YES	YES	1.69Gbps

IV. SOFTER DEFINED NETWORK (SDN) For,VANET

Networking devices have multiple controls and data flow operations in the same device. One of the controls is network management plane. The main concept of SDN is to offer control management for user to manage hardware forwarding of each network element.

The easiest thing SDN could support for VANET is by making RSU SDN- enabled for example using a controller like in Open Flow switches. In addition, the scope of the controller could be extended to On-Board Units (OBU) that could act as end users and could be abstracted as elements included in data such as RSU and other infrastructure nodes. Therefore, the OBU could be triggered by the controller for its performance such as the deployment of multi-hop V2V data. [3]

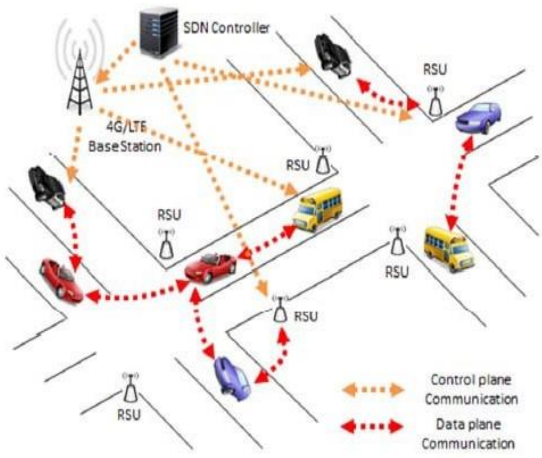

Fig. 2 Software-Define VANET Communication [3]

V. SIMULATION SCENARIO

In this case, a network simulator that is used for simulation is installed on Ubuntu . For writing the script we use python .

Components	Specifications
OS	Ubuntu Server 14.04 LTS
CPU	Intel core i5 3,2 Ghz
RAM	4GB
Hard Disk	1TB
Controller	POX Controller ver.0.2.0
Simulator	Mininet Wi-Fi

TABLE II: Components and Specifications

VI. SIMULATION

A. Performance parameters:

We have considered the following three performance parameters [6]:

1. **Throughput**: It is the maximum data transfer rate between two nodes of a network. It is calculated as follows:

$$\text{Throughput} = \sum P_{Rec} / (\sum T_{start} - \sum T_{stop})$$

Where, P_{Rec} = Received Packet Size,
T_{start} = Start Time,
T_{stop} = Stop Time.

2. **Packet Delivery Ratio**: It defines the ratio of the number of packets sent by the source node and the number of packets received by the destination node.

$$PDR(\%) = (\text{Packet delivered} / \text{Packet send}) * 100$$

3. **Jitter:** At transmission node the time delay between packets sent is exactly same, but at the receiving node the time delay between packets received may vary. This is known as Jitter [6].

B. Simulation Tools

The performance of MAC protocols was evaluated using the Ubuntu 14.04 operating system, SUMO and Mininet-wifi used for network simulation.

C. Simulation Scenarios

1) Network schema: SUMO tool was used to generate the following three network schema, the first and second network schemas are created manually.

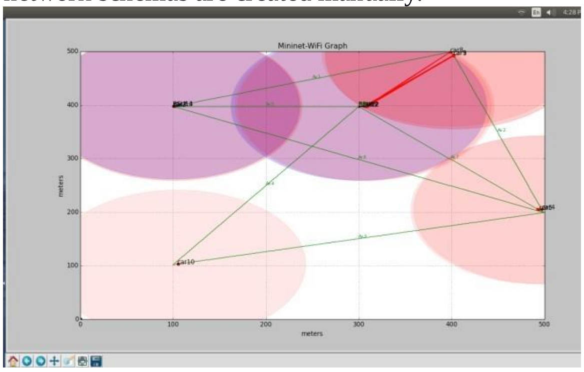

Fig 3: Manual Schema 1(100m x 100m)

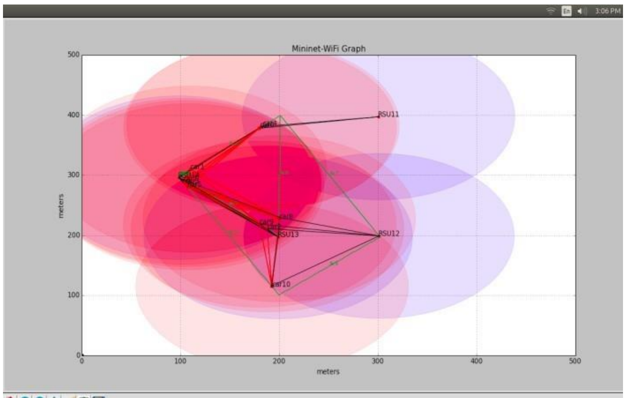

Fig 4: Manual Schema 2 (1000m x 1000m)

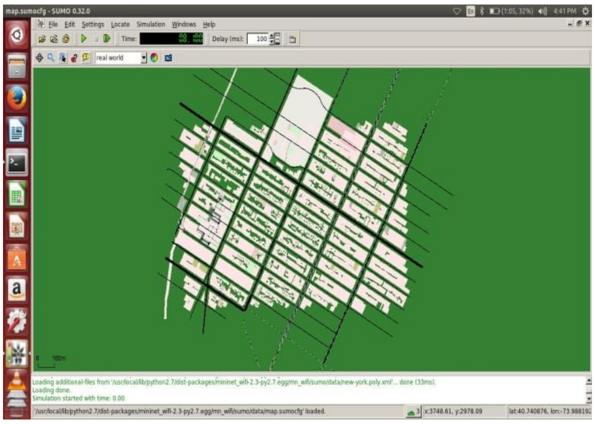

Fig 5: Real world Map

VI. RESULTS

After the topology has been designed, then perform some testing to see whether the V2V connection is already reachable each other. In this case, the vehicle is defined as 'car' .The first simulation is to evaluate V2V communication in the same RSU and its topology is shown in figure 3. It could be seen from figure 6 that car3 could communicate with car5 in the same RSU 3 coverage. Based on figure 7, it could be seen that the connection between car3 with IP address "192.168.1.5" to car5 with IP address "192.168.1.12" is verified with ICMP echo reply from the destination IP address.

Network scheme	Average Throughput	Average Jitter	Average Packet Delivery Ratio
1	1.05mbps	0.712ms	100%
2	1.0mbps	0.599ms	95.9%
3	1.08mbps	0 612ms	100%

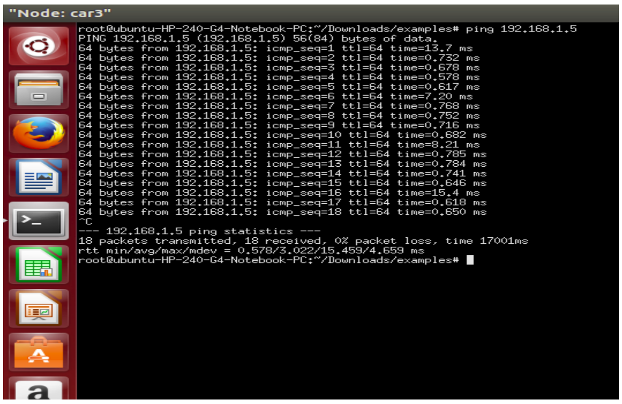

Fig 6. Ping car3 to car5

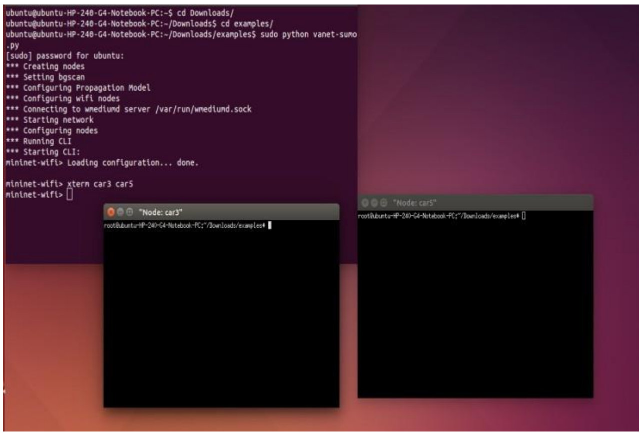

Fig 7: Xterm of car 3 and car5

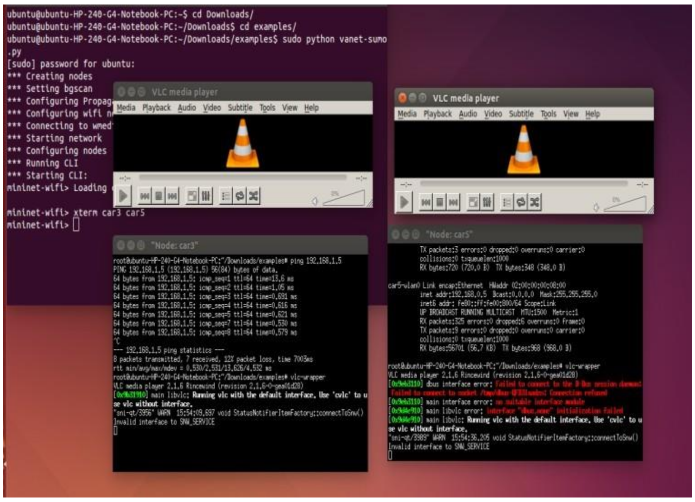

Fig 8: Video Transmission using VLC Wrapper

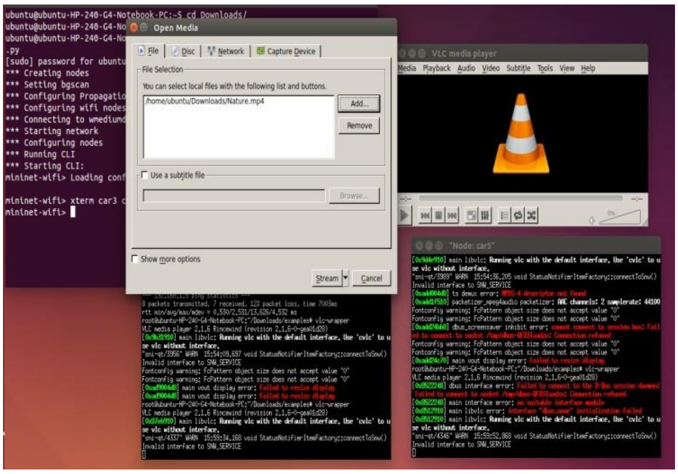

Fig 9: Adding address in VLC Wrapper

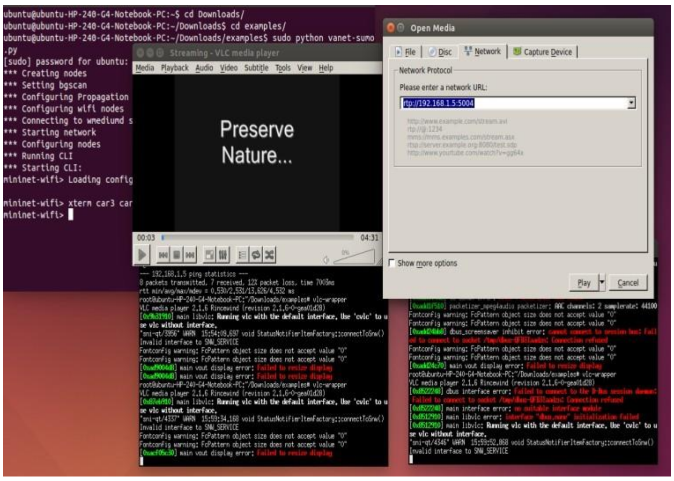

Fig 10: Entering Address For Receiving video

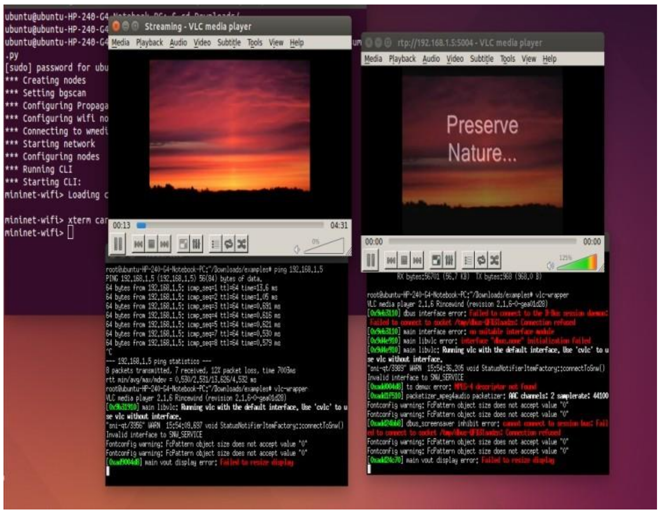

Fig 11: Video Streaming In Vehicular Ad-Hoc Network

IX .CONCLUSION AND FUTURE WORK

In this paper we have considered two manual schema and one real world map and the results have been obtained using iperf tool Here we have considered QoS(Quality of Service parameters like throughput and Packet delivery ratio .For bandwidth of approximately 1Mbps the results are promising i.e very Packet delivery ratio is above 90% in all three cases and jitter is y very less. We have also transmitted standard definition video over this network with QoE(Quality of Experience).In future we would like to improve QoE for HD(High Definition)videos by improving QoS parameters.

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