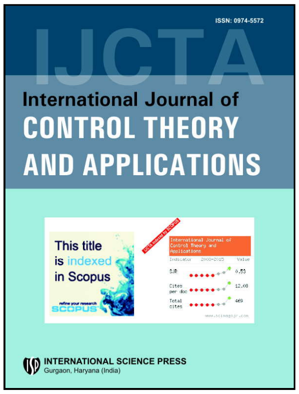


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# Communication in Vehicular Cloud Network Using ns-3

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***Abstract:*** In the past, it was not possible to do day to day activities like business, education,transaction etc evenpeople are on the move.But,it is possible today due to the adventof the wireless technology, information and communication technology (ICT) and advancement in automobile technology. The technological upgradation in the automobile sector, vehicles are now equipped with different types of sensors, GPS, cognitive radio, etc. to help in gaining ubiquitous communicationamong vehicles on the road,communication with road side unit (RSU) and static vehicle registration office (SVRO) outside the road.It also providesdifferent type of services on the road and outside the road in the vehicular cloud network (VCN) environment with the help of SVRO, cloud vehicle and RSU. In VCN, vehicles can also be equipped withstatic cloud while they are in a parking space and a dynamic cloud while they are on the move. In this paper, vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication are designed for the proposed model using AODV routing protocol and simulated using network simulator NS-3. The performance of the AODV routing protocol for VANET are also examined.

***Keywords:*** VCN, RSU,SVRO, V2V, V2I, AODV, Ubiquitous communication.

## 1. INTRODUCTION

With the technological advancement in the area of information and communication technology (ICT), the communication is possible withless infrastructure with the help of wireless technology. The communication among the nodes are through multihop technique through the intermediate node contribution. In vehicular communication there are two types of communication (i) vehicle to vehicle (ii) vehicle to infrastructure. In vehicle to vehicle communication, there is no need for involvement of any base station. Vehicle send and receive data packet from the target vehicle.Vehicular adhoc Network (VANET) is a network for the special purpose of communication in which vehicles are acting as a node and they communicate with vehicle to vehicle communication (V2V) and vehicle to infrastructure communication (V2I). It is an extension of mobile ad hoc network (MANET) and extracts and extend of properties of MANET in faster movements of nodes. In VANET system nodes are rapidly moving and network topologies are also changing. VANETs are mostly used in traffic management and sharing of information, storage of data with the help of cloud. In traditional systems, storage can be done in different static data centers. When we want to extract information from a data center it takes time, which is not beneficial for real time system users. The analysis of data has taken time, but after time elapsed the data has less impact to VANET system. Vehicular ad hoc network with information communication technology form an indispensable part of Intelligent Transportation System (ITS). Advance communication technology is used to interact vehicles and roadside infrastructure. Generally vehicles have limited resources so it is beneficial to exchange their different types of resources to the nearby vehicles. It is very difficult for a single vehicle to contain storage device, computational device, radio device for a large scale.Hence vehicles with limited resourcescan exchange their different types of resources and services to the neighboring vehicles in the influence area.

In the proposed model[1], vehicular traffic infrastructure consists of SVRO for vehicle registration, sending becon signal to the vehicle on the road every two seconds, RSU with lookup directory consists of road side services like ATM, Fuel station, motel, hotel, health centre, hospital and bank etc and act as a gateway for internet services, static vehicular cloud is placed in parked vehicle for providing different cloud services like STaaS, NaaS, PaaS etc and dynamic vehicular cloud for providing real time cloud service to the requested vehicle on the road in the coverage area.In vehicular cloud communication network (VCN), there are two types of communication vehicle to vehicle- (V2V) and vehicle to infrastructure (V2I) are possible. In V2V communication, vehicle with vehicle and vehicle with cloud vehicle while in V2I communication, vehicle with SVRO and vehicle with RSU are possible as depicted in the Figure 1.

The rest of the paper is organized as follows;Section II provide the related work; Section III provides brief overview of the technology used; Section IV is about simulation results of the proposed model [1] and finally Section V deals with conclusion and future work.

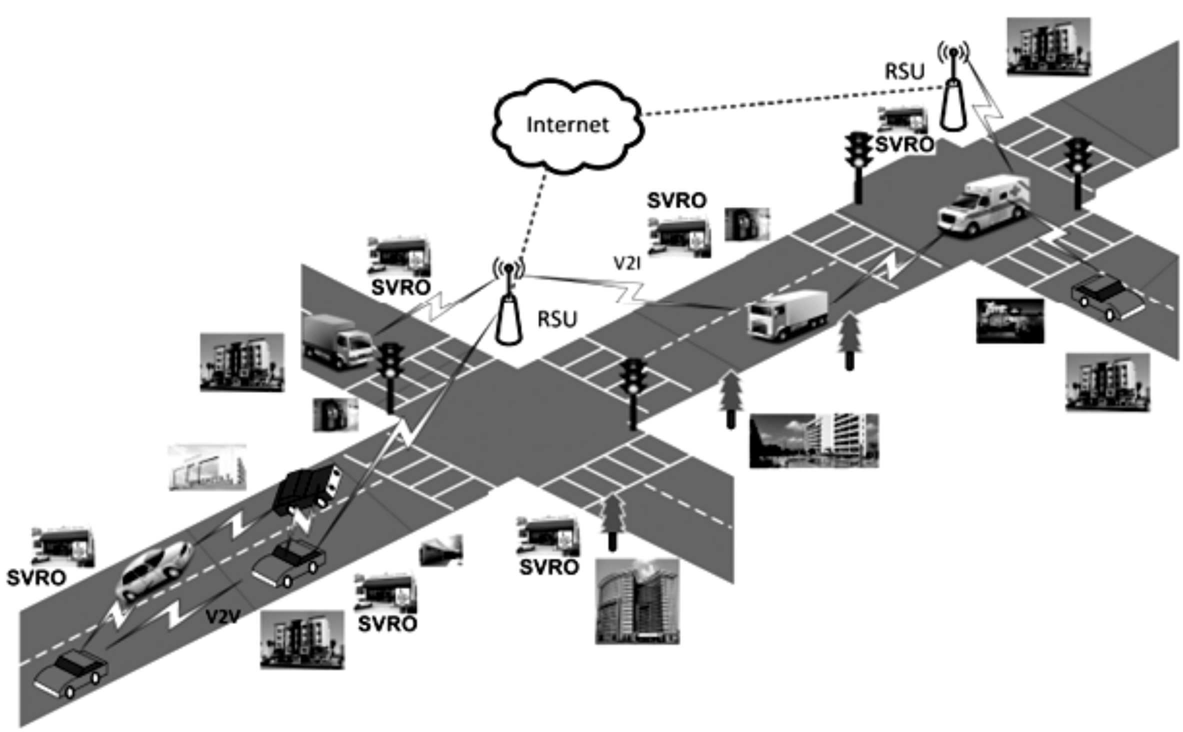


**Figure 1: Architecture of Proposed Model**

## 2. RELATED WORK

In [4], a CROWN protocol was proposed. In this protocol, the registration of the vehicles was done only at the nearby RSU. The RSU maintained the following information i) Registration of vehicle ii) Road side service information and act as a gateway for global communication. Some vehicles which had the facility of cloud known as STAR, It could hold different types of services like STaaS, NaaS and DaaS.In [7], Efficient traffic management, vehicular cloud communication system and interoperability among vehicular cloud had been discussed.The concept of vehicular cloud computing (VCC) had a remarkable impact on traffic management. In particular, the 5.9 GHz spectrum band has been allocated for licensed Short Range Communication (DSRC) between vehicles. In addition, in the near future, more vehicles will be embedded with devices that facilitate communication between vehicles, such as Wireless Access in Vehicular Environment (WAVE) [18].

## 3. TECHNOLOGY USED

The following tools are used for simulating our work:

### 3.1. NS3

It is a discrete event network simulator written in c ++ with an optional python scripting API. It is a free, open source software project organized around the research community development and maintenance[7].

#### *3.1.1. Gnuplot*

It is a portable command-line driven graphing utility for Linux, OS/2, MS Windows, OSX, VMS, and many other platforms. It can produce output directly on screen, or in many formats of graphics files, including Portable Network Graphics (PNG),Encapsulated PostScript (EPS), Scalable Vector Graphics (SVG), JPEG and many others[11].

### 3.2. TraceMetrics

It is a trace file analyzer for Network Simulator 3 (ns-3). The main goal is to perform a quick analyzis of the trace file produced by ns-3's simulations and calculate useful metrics for research and performance measurement [12].

### 3.3. AODV Routing Algorithm

The Ad hoc On-Demand Distance Vector (AODV) routing algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication [19].

## 4. NETWORK SIMULATION RESULTS

Experimental setup for ns3: Table 1 and Table 2 show the simulation parameters taken for VANET simulation of the proposed model [1].

Communication between V2V and V2I: For the simulated architecture shown in the Figure 2, based on the simulation parameters depicted in the Table 1 and Table 2 we have generated two types communication V2V and V2I using AODV routing protocol and ns3 simulator. Figure 3 shows the packet exchange between different nodes i.e. vechicle (Normal or cloud vehicle). Figure 4 shows the communication between vehicle and infrastrure like SVRO, RSU and static cloud. For global communication vehicle can coomunicate with one of the RSU. The performance of AODV in VANET is not at par with MANET because of the high mobility in VANET. The packet

**Table 1**
**Simulation parameters and values**

| *Parameters* | *Values* |
|---|---|
| Network simulation version | 3.24.1 |
| Area | 300* 1500 m |
| Moving model | Random Way Point Mobility Model |
| Simulation time | 300 sec |
| Simulation Start time | 0 sec |
| Simulation End time | 10 Sec |
| Speed of nodes | 40 m/sec |
| Delay | 50ms |
| No of vehicular Nodes | 20 |

**Table 2**
**VANET Setup Information**

| | |
|---|---|
| No. of Moving Nodes | 20 |
| No. of Static Nodes (SVROs) | 3 |
| No of static Nodes (RSUs) | 4 |
| Data Rate | 3.84 kbps |

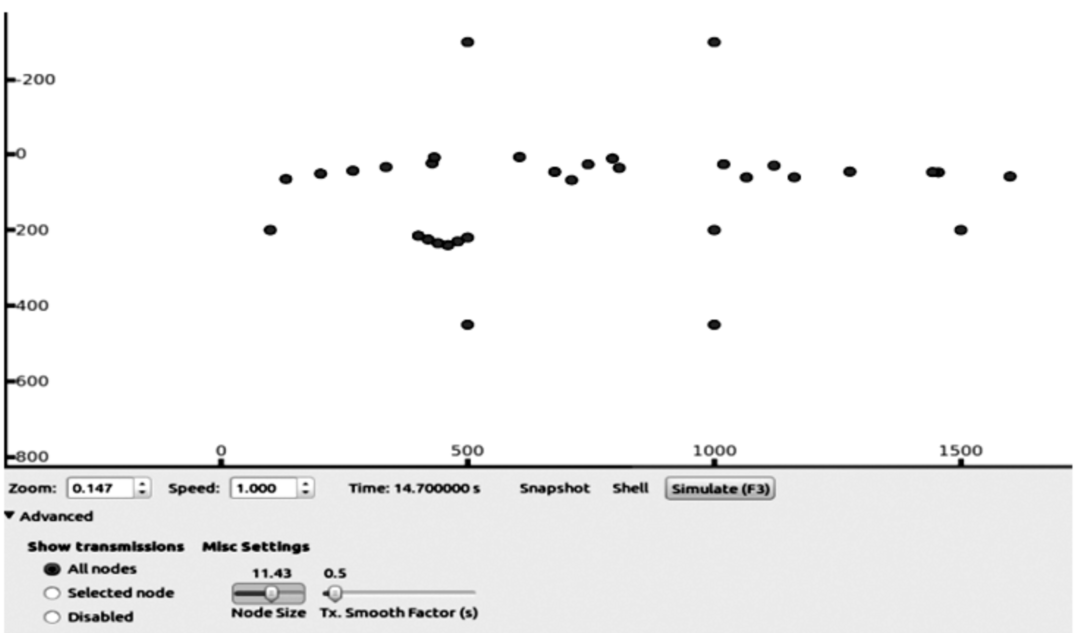


**Figure 2: Simulated architecture of proposedVANET modelusing GNUPLOT**

transfer between nodes is varied more in VANET due to jitter and communication is affected thereby. Here we have analyzed the Delay variation and IP packet delay variation of UDP packets using GNUPLOT which is shown in the Figure 5 to Figure 8. Delay variation is important for measuring the performance of VANET. In most cases it is the maximum delay variation within a high percentile that is of interest. There are two types of delay variation known as IP packet delay variation and packet delay variation.

IP packet Delay Variation(IPDV): It analyzes the differenece between one way delay metrics of two selected packets within a stream. The measurement is performed by sending a stream of equally sized packets betwee the measuring nodes, two packets are selected from the stream. The two packets are time stamped at the source and destination host, and the one way delay metrics is computed. The one way delay of the two packets are subtracted and the inter packet delay variation can be measured. Low IPDV is important for VANET and is least between time 2 to 3 seconds in the simulation result as shown in the Figure 8 of packet stream 34.

Packet Delay Variation (PDV): It uses a reference packet from the interval typically the packet with the lowest delay.It compares one way delay with a reference value and will be normalized to the minimum delay. It can only take values that are either positive or zero. Figure 7 shows the PDV of packet stream 34.

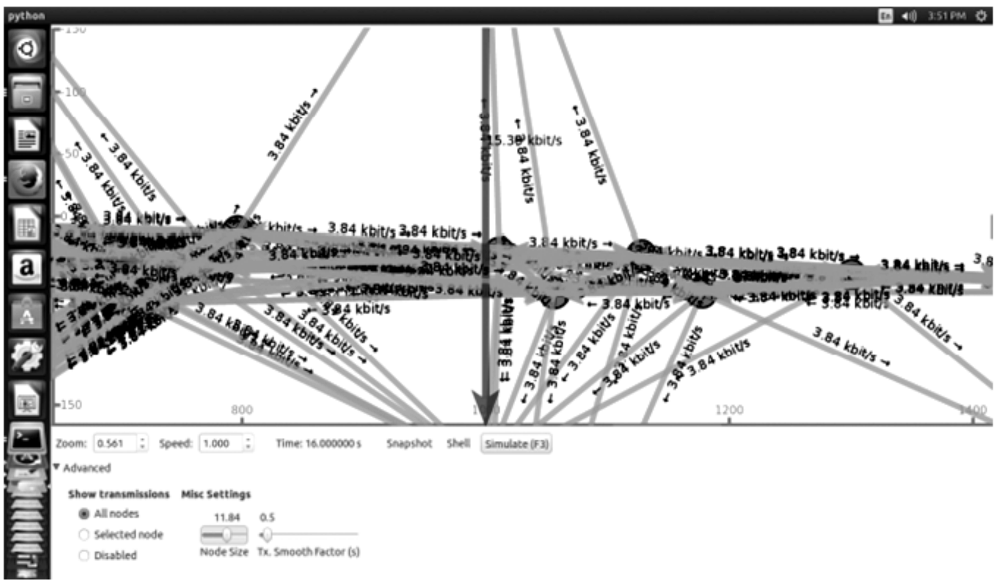


**Figure 3: Transmission of Packets among nodes**

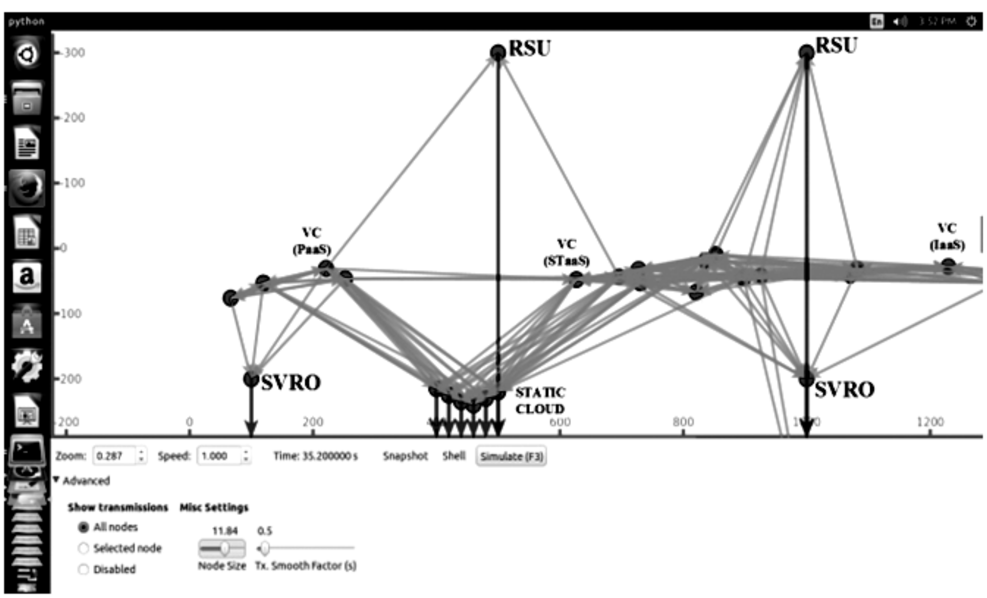


**Figure 4: Communication among SVRO, RSU, static clouds and Vehicular nodes**

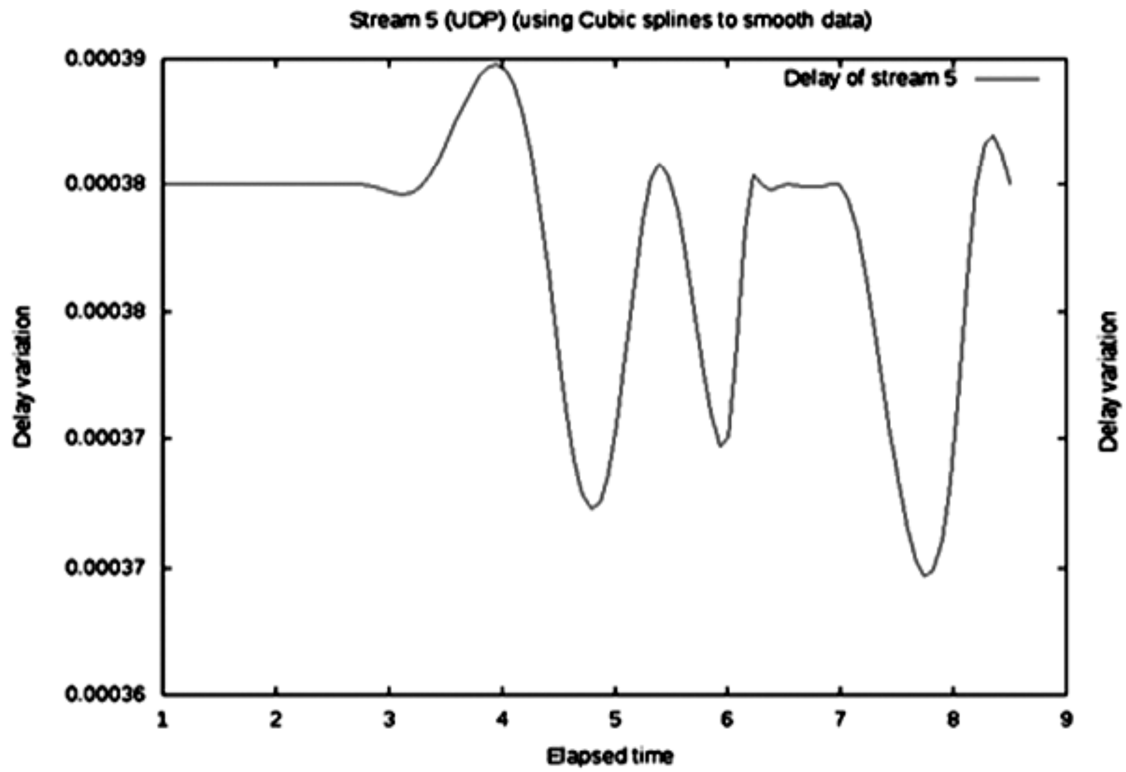


**Figure 5: Delay variation of UDP packetstream-5**

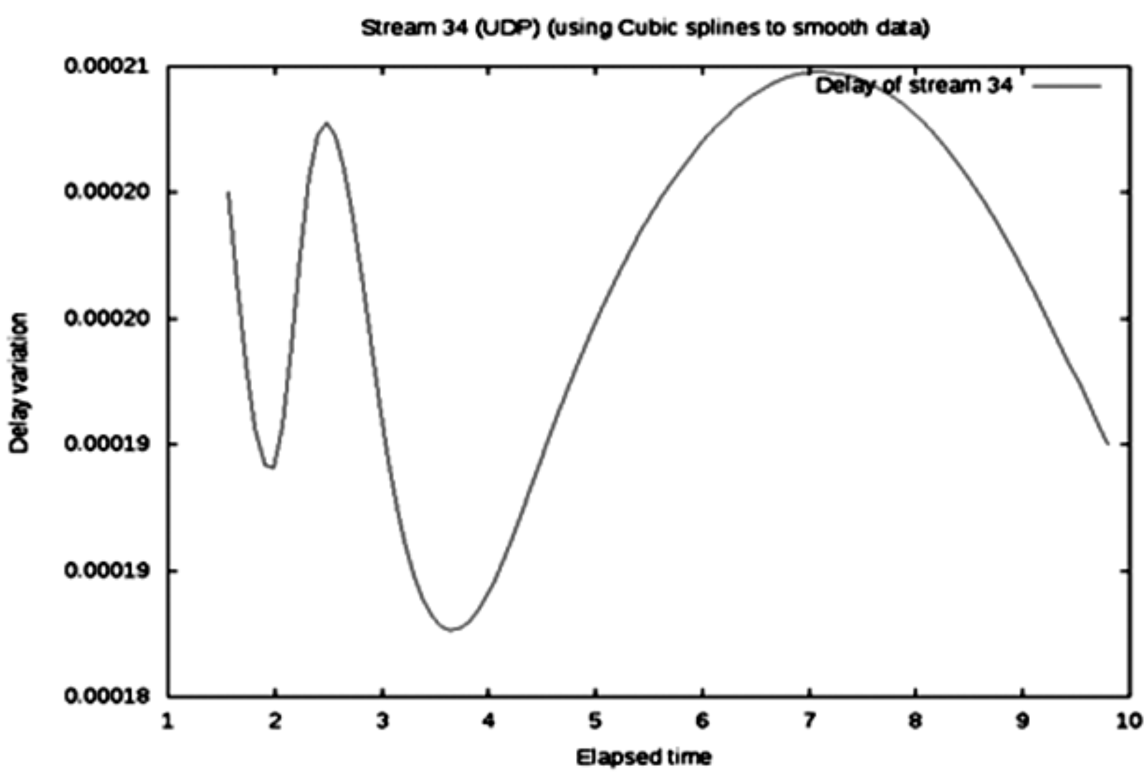


**Figure 6: Delay variation of UDP packet stream-34**

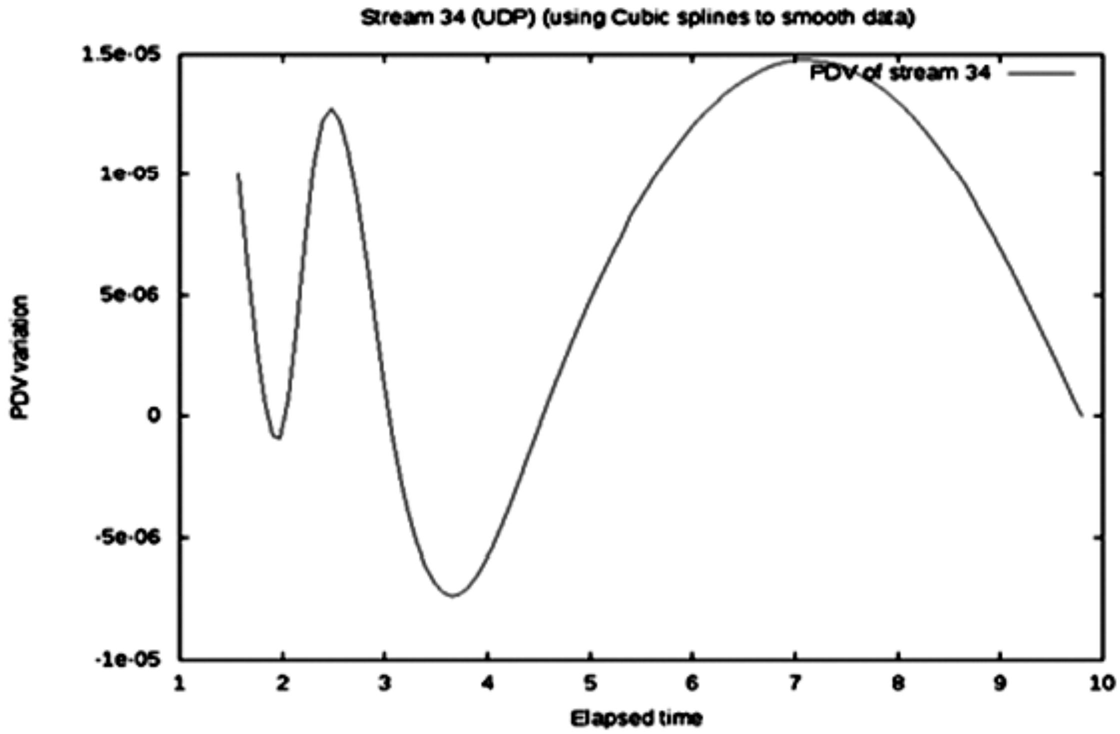


**Figure 7: Packet Delay variation (PDV) of UDP packet stream-34**

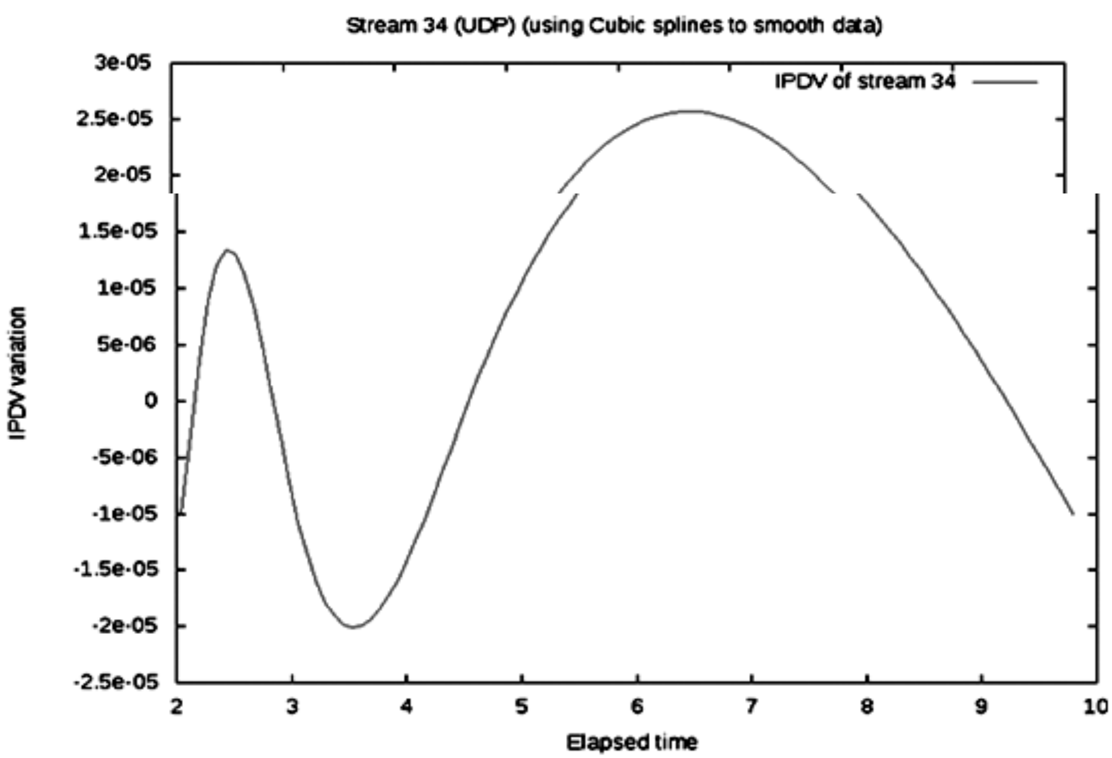


**Figure 8: IP Packet Delay variation (IPDV) of UDP packet stream-34**

## 5. CONCLUSION AND FUTURE WORK

In this paper, we have shown the communication between vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) using AODV routing algorithm in ns3.NS-3 provides a controlled environment to perform experimental evaluation of protocols when hardware islimited.From the performance analysis of AODV routing protocol in VANET using PDV and IPDV, it is concluded that least IPDV is important for VANET to get quality of service.In future, communication between V2V and V2I will be improved and service protocol can be implemented to provide different type of services in VCN.

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