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Performance of V2oIP Application via VANET

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Abstract: In Vehicular ad hoc network (VANET), vehicles are connected and communicated among themselves with different purpose, which move at their relative high speed. Much of the focus surrounding VANET has targeted the framework, model, environment or protocols. Few performance analysis studies have been carry out on V2OIP application at rural and urban area. The present paper set out to study the performance analysis of V2oIP applications between users in different distance and range. The performance are measures on jitter, delay and MOS of the applications; video call, video streaming and video conferencing. Several recommendations are highlighted related to pursue in testing on other rural and urban areas, ISPs, number of users, network monitoring tools or video and voice activities.

Keywords: Performance Analysis; Voice Over IP; Video Streaming; Video Conferencing; Video Call.

I. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) formed by vehicles equipped with wireless gadgets create as special class of Vehicular Ad Hoc Networks (VANETs) The communication in VANET do occurs between Vehicle to Vehicle and Vehicle to roadside unit which forming an intelligent transport system [21]. VANET applications require data, voice and video transmission. The use of multimedia applications such as Voice over IP (VoIP), video conferencing, online gaming, file transfer etc is increasing day by day which does demand time bounded and high throughput services [26]. This study is on the performance of V2oIP over VANET using a wireless network as a transmission medium. The performance of video call, video streaming and video conferencing are tested based on jitter, delay and MOS. The testing are done at TWO (2) different places; urban and rural areas for THREE (3) different timescale. This paper is structure as follows: Section 2 presents the background study. Section 3 discusses the related works. Section 4 describes the experimental setup. Sections 5 present the findings through the testing done. Section 6 concludes the paper.

II. BACKGROUND STUDY

2.1 Vehicular Ad-Hoc Networks (VANET)

By applying, the principles of mobile ad hoc networks (MANET), where the spontaneous creation of a wireless network for data exchange to the domain of vehicles, Vehicular ad hoc networks (VANET) is create. VANET is the key component of Intelligent Transportation Systems (ITS) [4].

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VANET, which include a network of vehicles, moving at a relatively high speed that communicate among themselves with different purposes. It can be a main purpose of improving safety on the road.

In order to improve and ease problems in transportation, information and communication technology is target to be apply in Vehicular Ad Hoc Networks (VANETs). With the technology, vehicles can exchange various data, e.g text message, videos of dangerous situations, does allow users and authorities (e.g firefighters and paramedics) [16].

2.2 Voice over Internet Protocol (VoIP)

With Voice over Internet Protocol (VoIP) technology, users are allows to make voice calls. Instead of using a regular (or analog) phone line, the voice calls are using a broadband Internet connection. There are some VoIP services do allows users to call other people as long as using the similar service. There are also some VoIP services do allows users to call any telephone numbers either local, long distance, mobile or international numbers.

There are some VoIP services that only work over users' computer or a special VoIP phone, also there are other VoIP services did allow users to use a traditional phone connected to a VoIP adapter [22]. However, with VANETs platform, Voice over IP (VoIP) may provide good services. VANETs may cover many application scenarios range either from safety or to comfort related services [2].

2.3 Video over Internet Protocol

Video-Over IP is a technology that delivers video services from one device to another over a computer network, which are connects to the internet. Nowadays most of the video content or TV services are host in the cloud and streamed to customers as per their requirement, either free or subscription-based [20]. Video communication within a Vehicular Ad Hoc Network (VANET) do allows emergency vehicles approaching the scene to understand better on the nature of the emergency, therefore VANET has the potential to be of considerable benefit in an urban emergency. However, centralized routing and network resource management within a VANET need to be improve since it is an impediment to video communication [15].

Two major applications of video-over-IP are video streaming and video conferencing.

A. Video Streaming

Video streaming is a method of delivering video content to an audience over an IP network. Streaming means sending video and audio content to a user that can be watch immediately, similar to watching a television broadcast.

The user device has to have an active network connection, and the content is not stored on the device after playback is complete. For example - watching YouTube videos on PC or mobile phone. Each data stream do have different sizes which depends on various factors, including actual file size, bandwidth speed and network latency [24].

B. Video conferencing

With video conferencing, two or more people residing in separate location able to connect lively and visually for the purpose of communication. Beside provide static images and text, it does provides full-motion transmission of video images and high-quality audio between two or more locations. Apple's FaceTime, Google's Hangouts and Microsoft's Skype are few tools which offer video conferencing ubiquitous on desktops and mobile devices with embedded camera [23].

2.4 Performance Metrics - jitter, delay and MOS

Variation in the delay of received packets cause a jitter. Choppy voice or temporary glitches are the result due to high jitter. A jitter of less than 50ms is consider acceptable for high quality VoIP calls [11].

When the number of vehicles increase, the delay becomes higher. The waiting time for the message increases is the cause. Therefore, delay value will be highly increased. Due to that, only Roadside Unit Deployment (RSU) made to send beacons while other vehicles were just receiving [17].

Table 1 shows to measure and classify the conversation quality that happens over a network, the industry has adopted the Mean Opinion Score (MOS) as the universal metric [8].

Table. 1 Mean Opinion Score (MOS)

MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	>Very annoying

III. RELATED WORKS

Ahmed Aliyu et.all (2017) studied on video streaming activities also Internet of Things (IoT) related trends and issue towards vehicle. The research presents in terms of usage and evaluation capabilities through comprehensive review, taxonomy focus on major functional model, strengths and weaknesses. Video streaming in vehicular IoT (VSV-IoT) are identifies as future directions of research in the area [13].

Imtiaz Ali Halepoto et al. (2018) studied the suitable protocol use in the development of mobile applications by conducting a comparative analysis of SCTP with TCP and UDP. The proposed network for simulation shows SCTP has a better transmission rate in the proposed metrics where streams of text, audio and video to reflect the multiple paths are used [6].

Ala' Khalifeh et al. (2017) studied on how the aforementioned parameters can be optimize, as a function of the network impairments. The study proposed an optimal video adaptation algorithm that gives the user the best video quality for a certain network conditions, which is of high importance especially in todays congested and lossy networks [9].

Carlos Quadros et al. (2016) studied geo- graphic Statistical Routing Protocols (SRPs), a proposed solution to improve the VANETs disseminated quality of on-road live videos. The study proposed the cross-layer Quality of Experience - driven Receiver-based (QORE) mechanism. It is modularly pair to Statistical Routing Protocols (SRPs) to offer QoE-aware and video-related parameters for the relay node selection and backbone maintenance. Results show in vehicle-to-vehicle (V2V) topologies, Distance Method – QORE (DQORE), achieving video dissemination with QoE support, less routing overhead and satisfactory reachability, compared to SRPs [16].

Rajeswar Reddy G et. Al (2018) studied the use of Omnet++ and SUMO based veins framework in varying vehicle density in urban and highway conditions. The study involved congestion behavior of IEEE802.11p/1609.4 based Medium Access Control .The simulation results show CSMA/CA did fail to meet the required QoS when there are high vehicle density and high communication load [17].

Above studies shows different to our work on various aspects, such as model, environment, protocols or performance metrics. Our work used:

a) PRTG network monitoring tool to measure the VANET performance.
b) 3CX VoIP software to carry out the V2OIP application.
c) XAMPP software to manage web server and database.

Similar to our work, these studies are on Vehicular Adhoc Network and V2oIP.

IV. EXPERIMENTAL

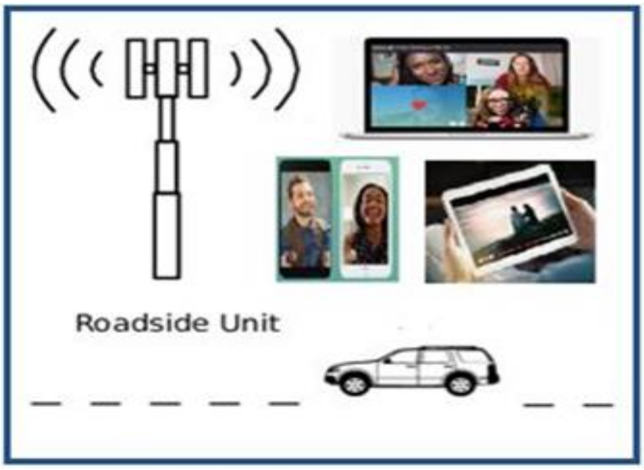

Fig. 1 V2oIP Applications via VANET

Figure 1, shows the following process:

a) Vehicle is connects to Roadside Units (RSU) and perform the V2oIP activities such as video call, video streaming and video conference by connecting to the Internet.

b) User device is install with 3CX software for V2oIP activities while PRTG network monitoring tools for performance monitoring.

c) After the installation, a video call approximately 100 meters between a vehicle and RSU is perform. The network monitoring tools will run simultaneously during the video call. The process is repeat until the vehicle is approximately 300 meters away from RSU.

d) For video streaming, the user will open a web browser and streaming a video approximately 100 meters between vehicle and RSU. The network monitoring tools will run simultaneously during the process. The process is repeat until the vehicle is approximately 300 meters away from RSU.

e) For video conference, user will establish conference approximately 100 meters between a vehicle and RSU. The network monitoring tools will run simultaneously during the video conference. The process is repeat until the vehicle is approximately 300 meters away from RSU.

f) The results are gather for analysis process.

V. FINDINGS

Testing were conduct at **TWO (2)** locations; Batang Kali, Selangor and Kampung Datuk Keramat, Kuala Lumpur. The locations represented rural and urban areas. The testing is carry out according to the timescale that has been set as followings:

- Morning - 8.00am to 10.00am
- Afternoon – 12.00pm to 2.00pm
- Evening – 6.00pm to 8.00pm

5.1 Video streaming

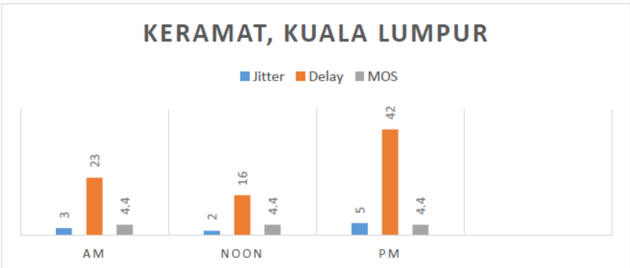

Fig. 2 Kg. Datuk Keramat, KL

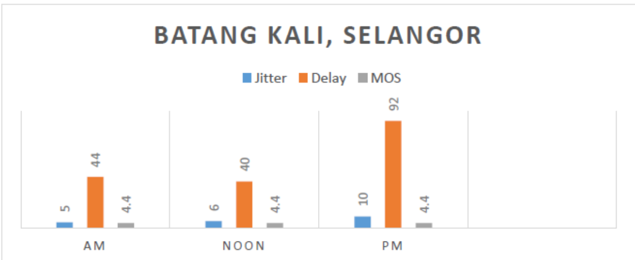

Fig. 3 Batang Kali, Selangor

Figure 2 and Figure 3, shows the comparison in jitter, delay and MOS between Keramat, Kuala Lumpur and Batang Kali, Selangor based on the timescale. Testing at Keramat and Batang Kali shows high jitter and delay in the evening. MOS is poor in the afternoon at Keramat.

5.2 Video call

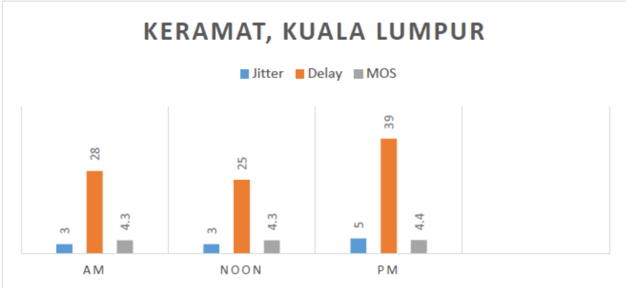

Fig. 4 Kg. Datuk Keramat, KL

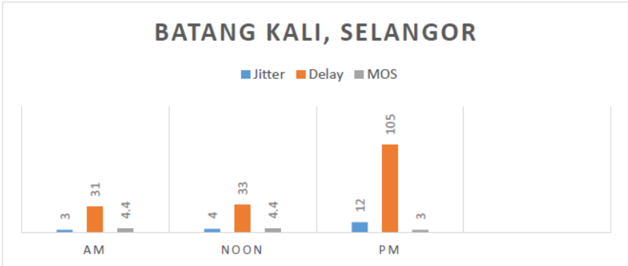

Fig. 5 Batang Kali, Selangor

Figure 4 and Figure 5, shows the comparison in jitter, delay and MOS between Keramat, Kuala Lumpur and Batang Kali, Selangor based on the timescale. Testing at Keramat and Batang Kali shows high jitter and delay in the evening. MOS is poor at Keramat for both testing in the morning and afternoon while testing at Batang Kali shows MOS poor in the morning and evening

5.3 Video Conference

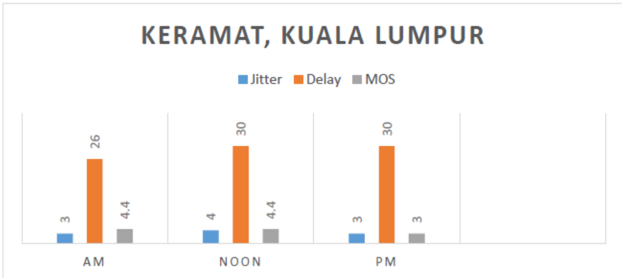

Fig. 6 Kg. Datuk Keramat, KL

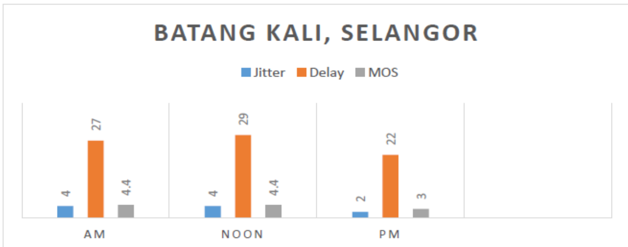

Fig.7 Batang Kali, Selangor

Figure 6 and Figure 7 shows the comparison in jitter, delay and MOS between Keramat, Kuala Lumpur and Batang Kali, Selangor based on the timescale. Testing at Keramat shows high jitter and delay in the afternoon while high delay also encountered in the evening. Testing in Batang Kali shows high jitter in the morning also high jitter and delay in the afternoon. Testing at Batang Kali shows high jitter and delay either video streaming or video call activities compared to testing at Keramat. Both activities are conduct during evening between 6.00 pm to 8.00 pm. However, video conference activities shows high jitter testing at Keramat in the afternoon also high jitter testing at Batang Kali in the morning and afternoon. Testing at Keramat shows high delay either afternoon or morning.

Video streaming activities at Keramat shows low jitter and delay in the afternoon. Video call activities at Keramat shows low jitter and delay in the morning and afternoon. Testing at Batang Kali also shows low jitter and delay during video conference activities in the evening. MOS shows good for all time scale at both locations during video streaming activities. During video call activities, MOS shows good for testing at Keramat in the evening while testing at Batang Kali in the morning and afternoon. Testing at both location in the morning and afternoon during video conference activities shows good MOS.

VI. CONCLUSION

The study shows, urban area performed better during afternoon for both video streaming and video call while worst for video conferencing activities. In contrast, rural area performed better during evening for video conferencing activities while worst for both video streaming and video call during evening.

Another line of work that may be pursuing from this research would be testing on other rural and urban areas, ISPs, number of users, network monitoring tools or video and voice activities.

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