International Journal of Internet, Broadcasting and Communication Vol.8 No.2 49-54 (2016)
http://dx.doi.org/10.7236/IJIBC.2016.8.2.49

IJIBC 16-2-6

Handling Of Sensitive Data With The Use Of 3G In Vehicular Ad-Hoc Networks

Manish Mallick*, Subarna Shakya**, Surendra Shrestha**, Bhanu Shrestha***
and Seongsoo Cho***†

**Ministry of Information and Communication Technology, Singhadurbar, Government of Nepal*
***Department of Electronics and Computer Engineering, Institute of Engineering, Central Campus, Pulchowk, Tribhuvan University, Nepal*
****Department of Electronic Engineering, Kwangwoon University, 20 Kwangwoon-ro, Nowon-gu, Seoul, 139-701, Korea*
Email: {manishmallick, surendra}@ioe.edu.np, {bnu, †css}@kw.ac.kr

Abstract

Data delivery is very challenging in VANETs because of its unique characteristics, such as fast topology change, frequent disruptions, and rare contact opportunities. This paper tries to explore the scope of 3G-assisted data delivery in a VANET within a budget constraint of 3G traffic. It is started from the simple S_Random (Srand) and finally reached the 3GSDD, i.e., the proposed algorithm. The performance evaluation of different algorithms is done through the two metrics delivery ratio and average delay. A third function utility is created to reflect the above two metrics and is used to find out the best algorithm. A packet can either be delivered via multihop transmissions in the VANET or via 3G. The main challenge is to decide which set of packets should be selected for 3G transmissions and when to deliver them via 3G. The aim is to select and send those packets through 3G that are most sensitive and requiring immediate attention. Through appropriate communication mechanism, these sensitive information are delivered via VANET for 3G transmissions. This way the sensitive information which could not be transmitted through normal VANET will certainly find its destination through 3G transmission unconditionally and with top priority. The delivery ratio of the packets can also be maximized by this system.

Keywords: *VANET, 3G, 3GSDD, NS2.*

1. Introduction

Ad hoc network often refers to a mode of operation of IEEE 802.11 wireless networks. Vehicular Ad hoc Networks (VANET) is the subclass of Mobile Ad Hoc Networks (MANETs). VANETs are expected to support a large spectrum of mobile distributed applications that range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing VANET is one of the influencing

Manuscript Received: Feb. 22, 2016 / Revised: Feb. 26, 2016 / Accepted: Mar. 25, 2016
Corresponding Author: css@kw.ac.kr
Tel: +82-2-940-8626, Fax: +82-2-942-5235
Department of Electronic Engineering, Kwangwoon University, 20 Kwangwoon-ro, Nowon-gu, Seoul, 139-701, Korea

areas for the improvement of Intelligent Transportation System (ITS) in order to provide safety and comfort to the road users.

Data delivery in VANETs is particularly challenging due to the unique characteristics of VANETs, especially under the circumstance of sparsely connected VANETs. An integration of VANET and 3G networks using mobile gateways will improve the delivery ratio. In addition to that it will also minimize the delivery delay. A packet can either be delivered via multi-hop transmissions in the VANET or via 3G.

2. Related Theory

Vehicular ad hoc networks (VANETs) have been envisioned to provide increased convenience, efficiency and security to drivers on the road. Several approaches have been considered to improve the data delivery performance in VANETs. An approach was presented which first allocated the 3G budget to each time slot by solving the ILP formulation of the original optimization problem, and then selected those packets that are most unlikely delivered via VANET for 3G transmissions [1]. Route stability, mobility features, and signal strength of vehicles are all taken into consideration when clustering vehicles and selecting vehicle gateways. Coupling the high data rates of IEEE 802.11p-based VANETs and the wide coverage area of 3GPP networks (e.g., UMTS) improved the data delivery performance of VANET drastically. Vehicles are dynamically clustered according to different related metrics. A minimum number of vehicles, equipped with IEEE 802.11p and UTRAN interfaces, are selected as vehicular gateways to link VANET to UMTS. Vehicular gateway selection, gateway advertisement and discovery, service migration between gateways (i.e., when serving gateways lose their optimality) are all addressed and an adaptive mobile gateway management mechanism is proposed [2]. The goal to provide a reliable, efficient infrastructure-to-vehicle data delivery by minimizing the packet delivery delay subject to the required delivery probability is achieved by computing an optimal target point as packet-and vehicle-rendezvous-point with the vehicle delay distribution and the packet delay distribution, which can be obtained from the vehicle trajectory and the vehicular traffic statistics, respectively. A data forwarding scheme called Trajectory-based Statistical Forwarding (TSF) for the data delivery from infrastructure nodes to moving vehicles in vehicular networks is also thought of where the data delivery is performed through the computation of a target point based on the destination vehicle's trajectory that is an optimal rendezvous point of the packet and the destination vehicle [3].

To solve the problem of 3G-Assisted Data Delivery in VANETs under budget constraints, following routing algorithms are implemented and their performance are evaluated:.

2.1 S_Random and E_Random

S_Random is the simplest where all the 3G budgets are used in starting time only. Starting packets are randomly selected and sent through the 3G. It can be said that the packets are sent in the first slot of time to live. In E_Random, the available 3G budgets are used when the packets are on the verge of loss. The loss is considered for both due to finish of ttl or due to queue fill at the source as well.

2.2 M_Average and M_Random

In M_Average, the whole ttl of the data packets are divided into s number of slots. Then the budget is also divided into equal parts. Further all the time slots give the equal budget. Let T be the time-to-live for a packet, s the number of slots, then each slot will be of length T/s seconds. Further if B is the available 3G budget, then each slot will be allocated B/s 3G budgets. The available budget in any time slot will be used for randomly picked packets in that very slot. M_Random is almost similar to M_Average in the sense that here also we divide the ttl of each packet’s ttl in to the number of slots. The only difference here is that here the 3G budget distribution is random which means that some slot may get more budget and some less or even zero.

3. Methodology

In this paper, a sensory data gathering application of a VANET in which vehicles produce sensory data, are gathered for data analysis and making decisions. An architecture that integrates 3G/UMTS networks with VANET is introduced [2]. The accidental data and the data concerning road blockage due to landslides and other such data will require immediate attention. Such data are termed as sensitive data in this paper. 3GSDD considers the availability of digital map containing the information of road map and the RSUs locations and GPS in each vehicle which will give the position & speed. The budget allocation to different time slots and the packet choice to be sent through 3G also takes into consideration the real time traffic scenario at the instant.

Through this mechanism, the data that might be lost due to the expiry of TTL can be transmitted through 3G. The data frame originated from VANET contains a reserved bit [2]. The value of 1 in this reserved bit would represent a sensitive data packet. A data frame containing 0 in the reserved bit section would represent a normal data. This way the normal data is differentiated from the sensitive data. The sensitive data, if allowed to hop through multiple hops, might be requiring a lot of time before it reaches its intended destination. The very essence of sending this crucial information might fail. So sending these sensitive data through 3G as soon as identifying it to be sensitive, would greatly minimize the end to end delay of the system. This would increase the delivery ratio.

Simulation is carried out using ns2 software [4-7]. In this paper, the performance of different routing algorithms that comes to solve the problem of 3G assisted data delivery in VANETs are checked and compared. For this purpose, five different algorithms are developed in simulation and their performances are evaluated. In this paper, city environment with road intersection has been considered. Each road has two lanes. The simulation environment is shown in the Table 1.

Table 1. Simulation Parameters for the proposed algorithm analysis

Area	4000 X 3800 (m2)
Channel	Channel/WirelessChannel
Propagation Model	Propagation/TwoRayGround
Network Interface	Phy/WirelessPhy
MAC Interface	Mac/802_11
Interface queue type	Queue/DropTail/PriQueue
Interface queue length	50
Antenna type	Antenna/OmniAntenna
Total number of VANET vehicles	39
Transport layer protocol	UDP
Mobility model	Linear
Packet type	CBR
Packet sending rate	50 packets/sec
Data packet size	500 bytes
Hello message size	48 bytes

4. Results and Discussion

The following graphs are plotted as per given simulation parameters. Also the data are obtained for different allocation of budgets.

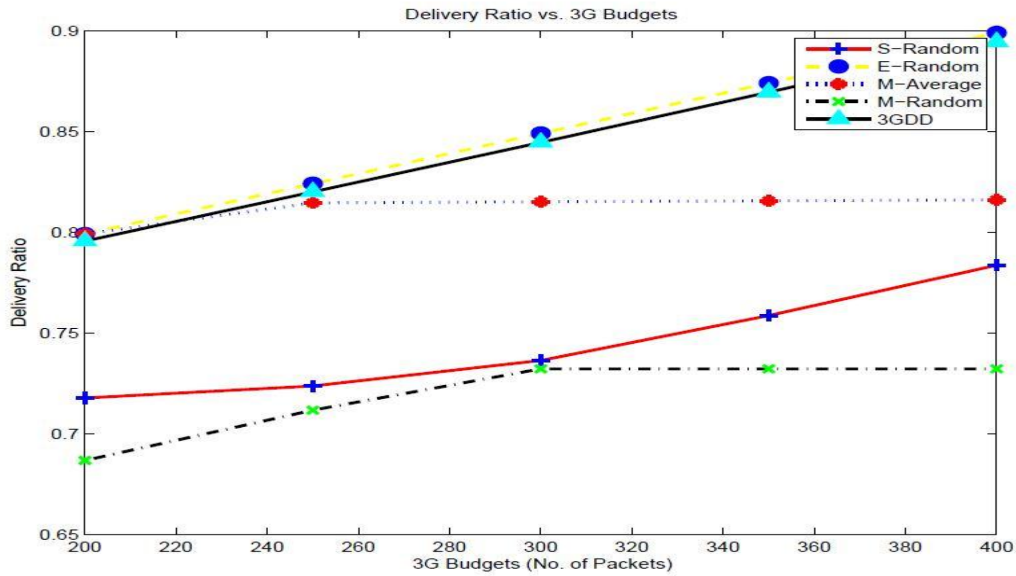

Figure 1. Delivery Ratio Vs 3G Budgets

The Figure 1 shows the delivery ratio of all five algorithms for different 3G budgets. It is quite clear that delivery ratio is highest for the E_Random. In low budget area, that is around 10% of total packets, M_average has delivery ratio near to E_Random, but as the budget increases the gap becomes more and more wide. Also in M_Average, delivery ratio becomes constant after reaching a certain budgets which indicates that the time slot to which we have allocated budget is of no use to it, as in that time slot it is already in dense traffic area, so it can send its data through normal VANET as well.

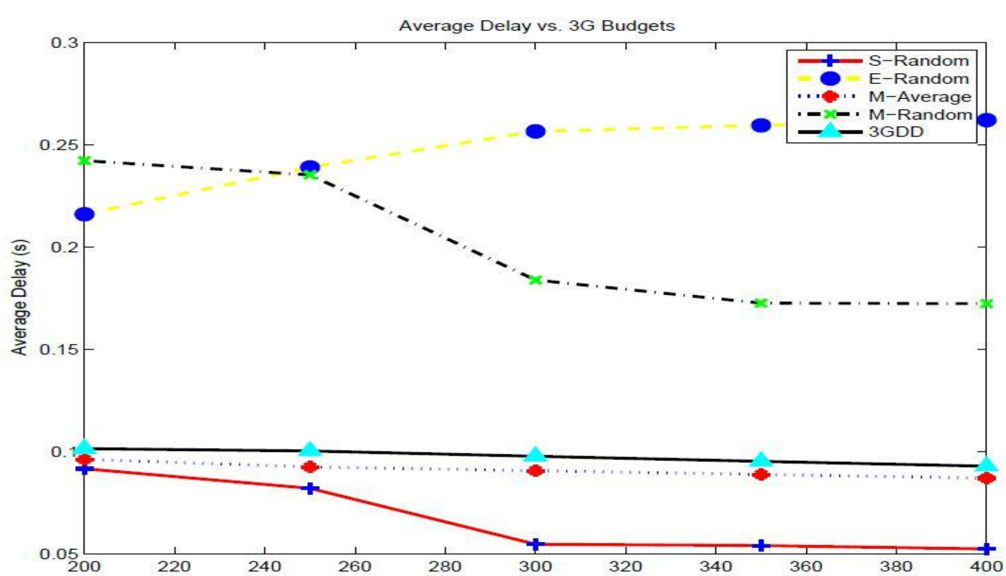

Figure 2. Average Delay vs. 3G Budgets

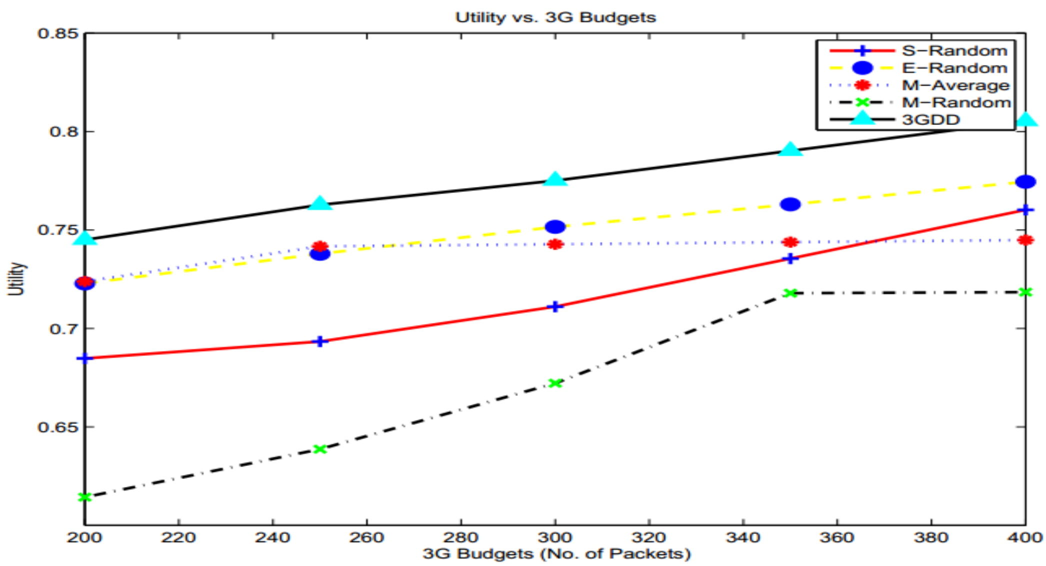

Figure 3. Utility vs 3G Budgets

Low average delay indicates the suitability of that very algorithm for real time applications. Figure 2 depicts the average delay of S_Random, E_Random, M_Average, M_Random and 3GSDD. From figure it can be seen that the delay is least for S_Random and greatest for E_Random. And most importantly the delay of 3GSDD lies near to the S_Random.

More utility indicates that the particular algorithm has both good delivery ratio as well as less delay [3]. So the algorithm that has high utility value is good from the point of view of both. Figure 3 shows the utility of all algorithms plotted against different budget value. In utility, 3GSDD outperforms all other. It has the highest utility. Next comes the utility of E_Random and then others. In the calculation, we have used a utility factor of 0.4. The utility of all algorithms increases with 3G budget except M_average and M_Random. Either the utility becomes constant after reaching a certain budget level or the rate of increase becomes very small.

5. Conclusion

The different algorithms that have been considered are S_random, E_Random, M_Average, M_Random and 3GSDD. E_Random has the highest delivery ratio but has the highest delay. S_Random has lowest delay and lowest delivery ratio as well. M_Average has both delivery ratio and average delay in between both the extremes. M_random performance cannot be predicted, since 3G budgets allocation is random for this case. 3GSDD has delivery ratio little less than that of E_Random and average delay liitle more than S_Random, but ultimately its utility outperforms the utility of all other algorithms which means that it would provide better efficiency in a situation where both the end to end delay and delivery ratio are equally important. Practically, 3GSDD also integrates 3G with VANET to sufficiently improve the data delivery performance of the critically sensitive data which could be lost due to the expiry of time to live defined for each packet.

References

[1] Qingwen Zhao et al., “When 3G Meets VANET: 3G-Assisted Data Delivery in VANETs,” IEEE Sensors Journal, VOL. 13, NO. 10, OCTOBER 2013.

[2] Abderrahim Benslimane and Tarik Taleb “Dynamic Clustering-Based Adaptive Mobile Gateway Management in Integrated VANET – 3G Heterogeneous Wireless Networks,” IEEE Journal On Selected Areas In Communications, VOL. 29, NO. 3, MARCH 2011.

[3] Jaehoon Jeong et al., “TSF: Trajectory-based Statistical Forwarding for Infrastructure-to-Vehicle Data Delivery in Vehicular Networks,” IEEE Transactions On Mobile Computing, VOL. 11, NO. 10, OCTOBER 2012.

[4] F. Glover, “Tabu Search – Part II,” ORS J. Comput, vol. 1, pp. 4-32, 1990.

[5] Kevin Fall and Kannan Varadhan, “The ns Manual”, The VINT Project, pp. 17-178, November 4, 2011.

[6] Diane Barlow Close, Amold D. Robbins, Paul H. Rubin, Richard Stallman and Piet van Oostrum, “The AWK Manual”, 1st edition, pp. 57-108, December 1995.

[7] F. Glover, “Tabu Search – Part I,” ORS J. Comput, vol. 1, no. 3, pp. 190-206, 1989.