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Push-Pull Queue based Data Scheduling for VANETs

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Abstract: *Vehicular Ad-hoc Networks (VANETs) have gained much more attention of the researchers these days because of its many important applications in transportation, to improve safety on roads, reduce traffic congestion, to enable efficient traffic management system etc. In VANETs data is disseminated from data center or RSU to the vehicles and simultaneously from vehicles to the data center or RSU too. Since this pushing and pulling of data from number of vehicles is the challenging job because the delay tolerance during dissemination of these kind of information is critical in nature. The main contribution of our work lies in the efficiency of the algorithm in aggregating and scheduling the information within minimum time. The time taken to gather the information by a vehicle is modeled analytically.*
Keywords**:** *VANETs, scheduling, dissemination, road side unit.*

I. Introduction

Vehicular Ad Hoc Networks (VANETs) are a specific type of Mobile Ad hoc Networks (MANETs) that are currently attracting the attention of researchers around the world. VANETs are emerging as a new technology, integrating the capabilities of new generation Peer-to-Peer (P2P) wireless networks with vehicles. The Federal Communications Commission (FCC) has recently allocated 75 MHz in the 5.9 GHz band [1] for licensed DSRC aimed at enhancing bandwidth and reducing latency for vehicle-to vehicle (V2V) communication. The target of VANET study is to achieve traffic transport system and intelligent system. In pushed based data dissemination [2], data can be disseminated from fixed data centers, access points or road side units to the vehicles moving on the road. Similarly, in pull based data dissemination vehicles can query data from fixed data center, access points, road side units. This type of dissemination is specific to some user. Disseminating data from a server to a large number of clients has been studied by the database experts and the network experts [3, 4] and many new challenges have been arrived. First, due to fast vehicle movement, communication topology changes rapidly [5, 6]. Study of the impact of employment of repetition and piggybacking techniques on the performance of safety messages dissemination in an IEEE 802.11e based VANET has been done in [7**].** Due to the VANETs unique characteristics, like scalability, high robustness expectation, intolerable delay requirements and security issues, the design of such a technology becomes an extraordinary challenge for the wireless research community. Jiang *et al.* [8] has discussed channel congestion control issues for vehicular safety communication, and introduced feedback information to improve reliability and performance of the system. A controlled repetition technique for vehicle-to-vehicle and vehicle-to-infrastructure communications in a network with a finite number of vehicles is discussed in [9]. In that study it has been found that by using this model reliability could be improved for safety messages in VANETs. Multi-hop data delivery through vehicular ad hoc networks is complex because the vehicular networks are highly mobile and many times sparsely connected. The network density is basically the traffic density, which is affected by the location and time. For example, the traffic density is low in rural areas and during night, but very high in the large populated area and during rush hours. Although it is very difficult to find an end-to-end connection for a sparsely connected network, the high mobility of vehicular networks introduces opportunities for mobile vehicles to connect with each other intermittently during moving. Namboodiri *et al.* [10] showed that there is a high chance for moving vehicles to set up a short path with few hops in a highway model. To mitigate the excessive transmissions and congestion, Korkmaz *et al.* [11] propose a link-layer broadcast protocol to help disseminate the data. The protocol relies on link-layer acknowledge mechanisms to improve the reliability of the multihop broadcast can be. More specifically, only one vehicle is used to forward and acknowledge the broadcast packet to reduce the broadcast storm problem. However, in the case of network congestion, the link-layer solution is not enough. Furthermore, since many information sources may exist in a given urban area, the amount of broadcasted data from these sources can easily consume the limited bandwidth.

This paper studies the problem of efficient data delivery in vehicular ad hoc networks. Specifically, when delay tolerant data queries are issued by the vehicles submitted to some fixed site like RSU, and simultaneously fixed site is willing to transfer some push based information to the vehicles. Then how to efficiently schedule the data submitted to the RSU, and receive the reply and pushed information within reasonable delay.

This paper is organized as follows. In section II, we present related previous works. In section III, we have described system architecture and design requirements and proposed a scheduling mechanism to reduce latency. In section IV, we have used our own system model and gave directions of further improvement. Section V explains simulation results and finally, section VI has concluded the paper.

II. Related Works

The vehicles can cooperatively collect the traffic update information so that it can calculate time of arrival of each vehicle to the destination is proposed in [12]. A system model is discussed in [13] which predicts about the availability in parking lot based on information exchanged among vehicles. VANET is facing many challenges in regard to Media Access Control (MAC), data aggregation, data validation, data dissemination, routing, network congestion, performance analysis, privacy and security [14]. The more popular data (push data) needs more bandwidth than less popular data (pull data) is proposed in [15]. So, many schemes have been developed by the researcher in the past for scheduling the data like, first-come-first-serve (FCFS), longest wait time (LWT), most requests first (MRF) in the broadcasting environments [18]. Zhang *et al.* in [19] have given D*S and D*S/N scheduling technique to schedule the most suitable data for downloading and uploading at RSU so that the bandwidth utilization is maximum and maximum vehicle get served.

III. System Architecture And Design Requirements

3.1 **Assumptions**

- Vehicles are equipped with wireless devices, preloaded digital maps that allow them to exchange messages with each other as Vehicle-to-Vehicle communication (V2V). The latest equipment MapMechanics [16], which includes speed related data and this system can calculate relative density of vehicles on the road.
- Each of the vehicles in VANET moves on straight or intersection roads. Vehicles can communicate to the vehicles that are within their communication range on the road. They can also Exchange messages with roadside infrastructures as Vehicle-to-Infrastructure communication (V2I).

3.2 Protocol Overview

The dissemination process is not simple at the intersections as the time devoted by vehicles at the intersection is very limited and the direction of motion at the intersection is also not very sure. Since the vehicular communication depends on two things 1) wireless coverage area, 2) speed of the vehicles, and 3) time devoted by vehicle on road due to red and yellow traffic signals. As in [17], the vehicles on road-A may need the vehicles of road-C to communicate with other vehicles of road-A. When Data center send the data, this data is needed to be buffered at the intersection points in Intersection Buffers (IBer's) so that vehicles coming at the cross road-C can also receive the data. By this way the Dissemination Capacity (DC) can be improved.

In this paper we are proposing one hybrid push-pull based scheme which is disseminating data over the network. The dissemination should be maximally reliable and scalable for large number of vehicles. Some issues still needed to be discussed so that hybrid push-pull based data dissemination could be performed.

- How do we reliably transfer the data from the access point, RSU or data center to the IBers and then deliver it to the end users?
- How to reliably collect the queries from the vehicles and send them to the access points, RSU or data center to produce the response of the query for that vehicle.
- How do we choose different broadcast cycle times for different parts of the road?

In our proposed protocol we are taking for queuing model in which first three queues are at the RSU to store the information and fourth queue is at the individual vehicle.

- Push Queue at RSU (PsQR)**-** This queue will store the information that has to be send to the vehicles.
- Pull Queue at RSU (PQR) this is the queue which will store information that may be pulled by the vehicles i.e. information that has been requested to be pulled by vehicles. Basically this queue will store the response of the queries of different vehicles and may be very large in size.
- Dissemination Queue at RSU (DQR)– DQR is the queue which stores the data elements of PsQR and PQR in sorted order. And the order of sorting is decided by the RSU agent on the basis of the priority of the message and availabile cycle time.

Finally, the data of the PsQR and PQR will be collected in the Dissemination Queue at DQR depending upon the priority of the data. Similarly, in the vehicles also, we are taking a queue to store the information that has to be requested by the RSU.

- Pull Queue at Vehicle (PQV) in PQV information stored in the queue in vehicle which may be the response of the request made by the vehicles before some time.

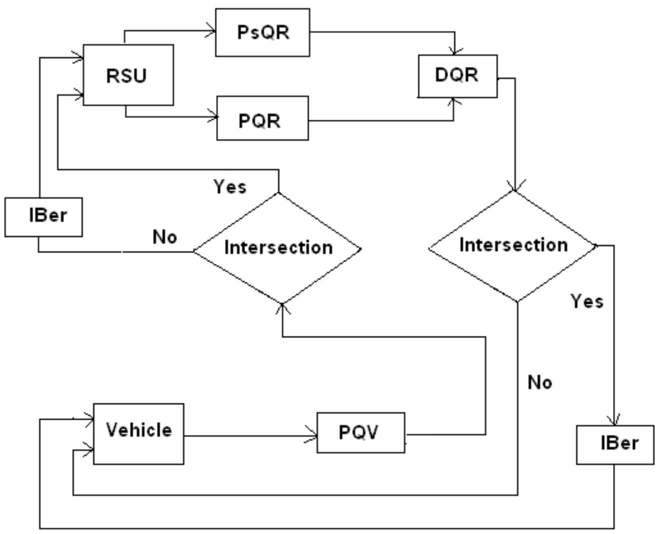
IV. System Model

The data invalidation in the Data pouring scheme [17] is not the problem because vehicles are not caching the data. When the large amount of data will be poured from different data centers, probability of data collision becomes very high. Data delivery has basically two constraints

- Data broadcast cycle: time interval between broadcasting the same data on the Axial Road.
- Bandwidth limit: the range of frequency allotted to use for transmitting data between vehicles.

Data Dissemination is performed under two different categories

- Push Based Dissemination
- Data center to the RSU and IBer's
- RSU or IBer's to the vehicles.
- Pull Based Dissemination
- Vehicles to IBer's or to RSU
- RSU to data centers



RSU : Road Side Unit
PsQR : Push Queue at RSU
PQR : Pull Queue at RSU
DQR : Dissemination Queue at RSU
PQV : Pull Queue in Vehicle
IBer : Intersection Buffer

Fig. 1 System Model

The Pull data at the vehicle (request of specific information by vehicle) will be uploaded in the PQV queue and this information will be transmitted to the RSU and the RSU will store corresponding response in the PQR queue. The information updated in the PsQR and PQR will be transferred in the DQR queue to finally disseminate to the vehicles and since this DQR is storing different types of data that has to be disseminated to different vehicles and IBer's.

So, the protocol applied on the data of same queue may change depending upon the data. That means if the during the dissemination of the data if the data is push based then it will be delivered to every vehicle but if

the data is pull based then it will be only forwarded to the vehicles until it will be delivered to destination vehicle. During the dissemination of data, if in the data dissemination path intersection point will meet before reaching to destination then the data will be buffered in the intersection buffer (IBer) (as shown in figure 1) and if dissemination path will be straight forward then the information will be directly received by the vehicles. Similarly, for the pulling some information, when the vehicle will request for any data, the data will be buffered in the IBer so that IBer can transmit this request to the vehicle which is probably moving towards the nearest RSU and request could be made as early as possible. But if the RSU is in the straight path of motion of vehicle, then request will directly be made by the RSU.
Since the Pull information in the PQR may vary from 0 to infinite so we can say,
If a = total number of pull information at the PQR. So, $0 \leq a \leq \infty$
Similarly, b = Total number of push information at the PsQR So, $0 \leq b \leq \infty$

V. SIMULATION RESULTS

In this we evaluate the performance of push-pull queue dependent protocol. We use the simulation environment provided by vanetmobisim/ns2, which is typically used to simulate VANETs. The following are the parameters used during the simulation:

Table 1. Parameters used in simulation

Simulation Area	5000m X 3000m
Simulation Time	1200 seconds
No. of vehicles	1000
No. of RSUs	38
Vehicle Velocity	40km/hr - 60 km/hr
Number of Intersections	20
Constant Bit Rate (CBR rate)	0.1 – 1 packet/second
Communication Range	100m
Bandwidth	20Mbps
Data packet size	1 KB

The data capacity (DC) is linearly increasing with the broadcast cycle time. From the graph (as shown in figure 2), it is clearly visible that if some loss in the data delivery ratio can be tolerated then more data can be disseminated on the road. When the small amount of data was disseminated then the delivery ratio was the maximum (approximately 98 %). But as the data traffic was increased data delivery ratio drops dramatically.

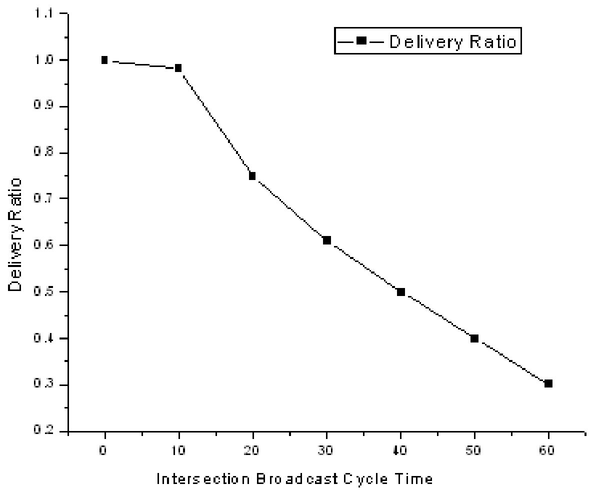


Fig. 2 Plot between Data Delivery Ratio and Cycle Time

Similarly, when the traffic load is low the data delivery ratio is low but data delivery ratio is increasing with the increase in the traffic load (as shown in figure-3) because of the continuous availability of the communication medium in form of vehicles which can carry and forward data to the destination.

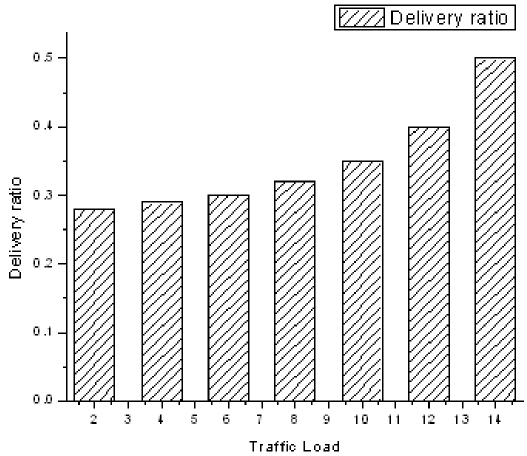


Fig. 3 Plot between Data Delivery Ratio and Traffic Load

VI. CONCLUSION

Vehicular ad hoc networks provide an exciting area of research at the intersection of a number of disciplines and technologies. In proposed mechanism the push and pull messages are scheduled in the scheduling queue in such a way that they can be forwarded simultaneously. This scheme can forward a large amount of data to the vehicle present at the axis-road and cross road. This will increase the dissemination capacity of the system and finally the performance of the system will be ameliorated.

As future work, we will consider using vehicles from nearby road, although this will be more complex. We will also address issues on designing protocols for query data return.

REFERENCES

[1] ASTM E2213-03 - Standard Specification for Telecom. and Information Exchange Between Roadside and Vehicle Systems – 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications, available at http://www.standards.its.dot.gov/Documents/advisories/dsrc advisory.htm.

[2] J. Zhao and G. Cao, "VADD: Vehicle-assisted data delivery in vehicular ad hoc networks," IEEE Transaction Vehicular Technology, Vol. 57, No. 3, pp. 1910–1922, May 2008.

[3] N P. Deolasee, A. Katkar, A. Panchbudhe, and K. Ramamritham, "Adaptive push–pull: Disseminating dynamic web data," in Proc.WWWConf. pp. 265–274, 2001.

[4] G.Muhl, A. Ulbrich, K. Herrmann, and T.Weis, "Disseminating information to mobile clients using publish-subscribe," IEEE Internet Comput., vol. 8, no. 3, pp. 46–53, May/Jun. 2004.

[5] V. Naumov, R. Baumann, and T. Gross, "An evaluation of inter-vehicle ad hoc networks based on realistic vehicular traces," in Proc. ACM MobiHoc, pp. 108–119, 2006.

[6] H. Wu, R. Fujimoto, R. Guensler, and M. Hunter, "MDDV: A mobilitycentric data dissemination algorithm for vehicular networks," in Proc. 1st ACM VANET, pp. 47–56, 2004.

[7] G. Farrokhi, S. Zokaei and E. Ghazisaeedi, M. Khabazian, "Improving Safety Messages Dissemination in IEEE 802.11e Based VANETs Using Controlled Repetition Technique," In Proceedings of the Sixth International Conference on Wireless and Mobile Communications 2010.

[8] D. Jiang, V. Taliwal, A. Meier, W. Holfelder, and R. Herrtwich, "Design of 5.9GHz DSRC-based vehicular safety communication, " IEEE Wireless Communications, vol. 13, no. 5, pp. 36–43, 2006.

[9] E. Ghazisaeedi, Gh. Farrokhi, and Saadan Zokaei, ''Controlled repetition based communication in VANETs using IEEE 802.11e,'' to appear in Proceeding of Wireless Advanced 2010 (Formerly SPWF), June 2010.

[10] V.Namboodiri, M. Agarwal, and L. Gao, “A study on the feasibility of mobile gateways for vehicular ad-hoc networks,” in Proceedings of VANET’04, October 2004.
[11] G. Korkmaz, E. Ekici, F. Ozguner, and U. Ozguner, “Urban multi-hop broadcast protocol for inter-vehicle communication systems,” in Proc.ACM VANET, pp. 76–85, Oct. 2004.
[12] L Naoki Shibata, et. al., “A Method for Sharing Traffic Jam Information using Inter-Vehicle Communication”, http://itolab.naist.jp/themes/pdffiles/060725.shibata.v2vcom06.pdf.
[13] Murat Caliskan, Andreas Barthels, Bjrn Scheuermann, and Martin Mauve, “Predicting Parking Lot Occupancy in Vehicular Ad Hoc Networks”, 65th IEEE Vehicular Technology Conference, (VTC2007), pp. 277-281, April 2007.
[14] S. S. Manvi, M. S. Kakkasageri, Issues in mobile ad hoc networks for vehicular communication, IETE Technical Review, Vol. 25, No. 2, pp. 59-72, March-April, 2008.
[15] Navrati Saxena, Kalyan Basu, and Sajal K. Das, “Design and Performance Analysis of a Dynamic Hybrid Scheduling Algorithm for Heterogeneous Asymmetric Environments”, 18th International Parallel and Distributed Processing Symposium, (IPDPS 2004), pp. 26-30, April 2004.
[16] “GB Traffic Volumes,” www.mapmechanics.com, May 2005.
[17] J. Zhao, Y. Zhang, and G. Cao, "Data Pouring and Buffering on the Road: A New Data Dissemination Paradigm for Vehicular Ad Hoc Networks," in IEEE Transaction on Vehicular Technology, Vol. 56, No. 6, pp. 3266-3276, 2007.
[18] Wong J, “Broadcast delivery. In: Proceeding of the IEEE, pp 1566–1577, 1988.
[19] Yang Zhang, Jing Zhao, Guohong Cao, "Service Scheduling of Vehicle-Roadside Data Access," Published in Springer science Mobile Network Application, pp. 83–96, 2010.