Reliable and Efficient Data Dissemination in VANET based on Linear Network Coding

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ABSTRACT

VANET is nowadays very popular research topic. As vehicles increasing day by day, the comfort and safety of passengers also become very important. So, the data transmission is also one big issue as vehicles are with different speeds. VANET inherent characteristics such as highly dynamic topology, frequently disconnected network, and differentand dynamic network density makes data dissemination a challenging task in these networks. One of the issue in VANET is reliability of data dissemination as VANET is frequently disconnected network. So, by using Multi-Generation Mixing(MGM) based on linear network coding reliability of data dissemination can be improve in VANET.

Keyword: - *Data Dissemination,VANET,Network coding*

1. INTRODUCTION

A Vehicular Ad Hoc Network (VANET) is a special kind of Mobile Ad Hoc Network (MANET).It is distributed and self-organized network mounted with new powerful technology to improve driving safety and traffic management.vehicles equipped with wireless and processing capabilities can create a spontaneous network while moving along roads. There are different architectures for vehicular networks in urban and rural environments, and highways to support different applications. The goal of a VANET architecture is to allow the communication among nearby vehicles and between vehicles and fixed roadside equipments leading to three possibilities as shown in Figure 1:[6]

• *Vehicle-to-Vehicle (V2V) ad hoc network*: allows direct vehicular communication without relying on a fixed infrastructure support and is mainly employed for safety,security and dissemination applications;

• *Vehicle-to-Infrastructure (V2I) network*: allows a vehicle to communicate with the roadside infrastructure mainly for information and data gathering applications;

• *Hybrid architecture*: combines both V2V and V2I solutions. In this case a vehicle can communicate with the roadside infrastructure either in a single hop or multi-hop fashion according to its location with respect to the point of attachment with the infrastructure aiming at different goals.

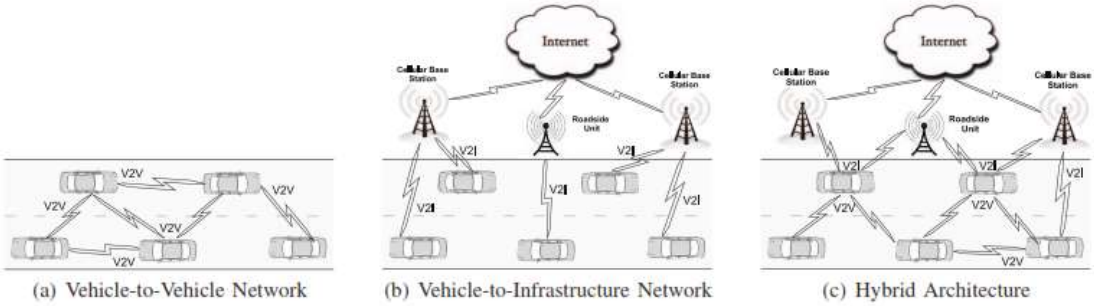

Fig-1 VANET Architectures[6]

1.2 Data Dissemination

Data Dissemination is a Process of spreading data or information over distributed wireless networks. Aim of data dissemination is the optimum use of network resources to serve the data needs of all users.

Different types of data dissemination used in VANETs are[6]:
i) V2I/I2V Dissemination (Vehicle to infrastructure or RSU)[6]:In this category we have protocols that require some sort of roadside infra-structure to perform data dissemination, which can be push or pull-based. In the pushbased approach, the infra-structure broadcasts data to all vehicles within its communication range. This is more suitable for public-interest data, such as collision warnings, since all vehicles may not be interested in other kind of information. On the other hand, in the pull-based approach, vehicles can request information about specific data. This approach is suitable for acquiring individual or specific data but it can increase data traffic causing collisions, contentions, and interference.
ii) V2V Dissemination (Vehicle to vehicle)[6]:In this category we have protocols that do not require any infrastructure and vehicles communicate solely in ad hoc mode. In the flooding approach,data is broadcasted to all neighboring vehicles that will store-and-forward it to their neighboring vehicles. This approach is more suitable for sparse networks and applications that require low delay since it results in a high data traffic (broadcast storm problem). In the relaying approach, data is broadcasted to all neighboring vehicles that will store and a neighboring vehicle is selected to broadcast it to their neighboring vehicles. This approach is scalable and works well in high dense networks but requires an efficient relay selection in order to ensure reliability. In the opportunistic approach, data is stored and carried across network partitions, making it more suitable for irregularly distributed nodes (e.g., groups of vehicles separated my multiple traffic lights) but presents the drawback of increasing the delay in data delivery as well as a high overhead in dense networks.

1.3 Multi Generation Mixing(MGM)

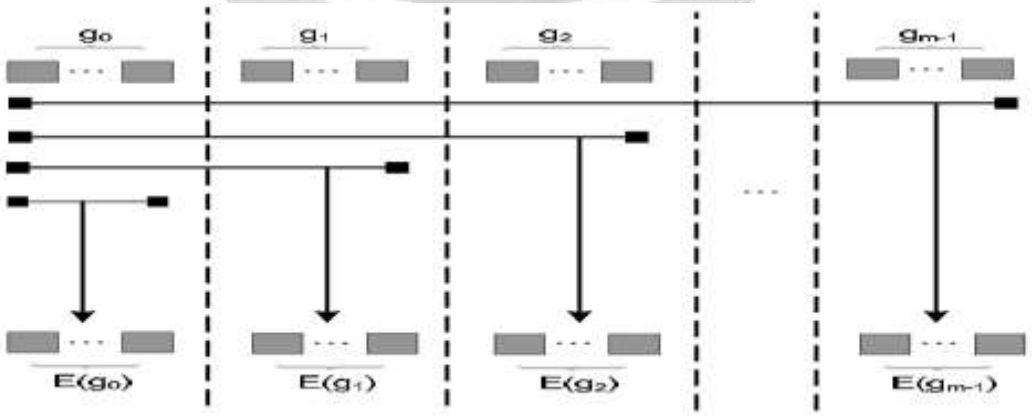

Fig-2 Multi Generation Mixing[7]

Network coding is used in byte to byte and bit to bit encoding and decoding. Network coding contain independent linear combination packets if any receiver encoded packet is loss this loss are very expensive for this solution network coding with multi-generation mixing technique is introduced in this technique packet are encoded in the form of generation if one generation packet is fail to generate encoded packets second generation easily recover this packets. In Generation basesd network coding, the data packets are encoded generation wise. In MGM, each generati on is encoded with previously generation with mixing set so if one packet is loss other packet is easily available in generation wise mixing set

2. RELATED WORK

2.1 Amarpreet Singh, Navneet Kaur "Enhanced Bandwidth Efficient Cluster Based Multicasting Protocol in VANET"

In this paper, author proposed Enhanced Bandwidth Efficient Cluster Based Multicasting Protocol **(**EBECM) to overcome the multicar chain collision problem of BEAM protocol.[1] In EBECM protocol,Clusters are created for vehicle to vehicle communication,In which all multicast group vehicle and non-multicast group vehicles get the information about the emergency situation. When RSU predict emergency situation then it will send Emergency Warning Message to the cluster heads of the multicast group members and this cluster heads send emergency information to the ordinary vehicles.Hence the multicar chain collision problem can be resolve.

2.2 G. G. Md. Nawaz Ali, Md. Ashiqur Rahman, Peter Han Joo Chong, and Syeda Khairunnesa Samantha "On Efficient Data Dissemination using Network Coding in Multi-RSU Vehicular Ad Hoc Networks"

In this paper, author proposed devising a cache transfer mechanism in the interconnected RSUs and handling the cache update mechanism intrinsically.[2] In proposed approach author applyed Network coding. Because of that vehicles do not need to upload their cache information to the server. The RSU's broadcast performance is improved by applying network coding in terms of minimizing the deadline miss ratio of the generated requests by vehicles, and it also reduce the response time of serving requests by the RSU server.

2.3 Yuhong Bai, Dongliang Xie, Siyu Wang, Ming Zhong "Multi-path Transmission Protocol in VANET"

In this paper, author proposed a novel Network Codes-based Multi-Path transmission control protocol (NCMPTCP)[3]. Random linear network coding(RLNC) is applyed to solve the bottleneck problem of MPTCP. In which packets are encoded by the sender and decoded by the receiver. This approach improve the transmission efficiency and provide an efficient and reliable transmission in VANET. And author also design a redundancy control algorithm and a scheduling algorithm based on the estimated delivery time. This two algorithm reduce the transmission delay efficiently and improve throughput.

2.4 Celimuge Wu and Satoshi Ohzahata, Yusheng Ji, Toshihiko Kato "Multi-hop Broadcasting in VANETs Integrating Intra-flow and Inter-flow Network Coding"

In this paper, author proposed a network coding-based broadcast protocol for vehicular ad hoc networks. The protocol include inter-flow and intra-flow network coding approach. The protocol can significantly reduce the number of transmissions by using the inter-flow network coding, . The protocol uses backbone vehicles to reduce broadcast messages. The source node and other forwarder nodes conduct network coding. The same backbone nodes are used by different traffic flows,which provide efficiency in many scenarios in network coding approach. This can significantly reduce the end-to-end delay. By using intra-flow network coding, the proposed protocol provides a lightweight retransmission.

In the proposed protocol, data packets are forwarded by the backbone vehicles. Author use an approach which include different network coding process that are depending on the packet's transmission directions. In the proposed protocol, network coding approach is selected by transmission direction of the packets. If the two packets come from different directions, the proposed protocol uses the inter-flow network coding approach. To improve the packet dissemination ratio when two packets are required to transmit to the same direction the protocol encodes two packets.

2.5 Ryosuke Akamatsu, Masaki Suzuki, Takuya Okamoto, Koichiro Hara, Hiroshi Shigeno "Adaptive Delay based Geocast Protocol for Data Dissemination in Urban VANET"

In this paper, author proposed UGAD (Urban Geocast based on Adaptive Delay) protocol for data dissemination in VANET which adopts delay-based broadcast suppression scheme for urban environments.[5] The goal of the proposed protocol is to develop the data reachability and reduce redundant rebroadcasts. The protocol uses two delay based forwarding modes and selects the mode according to the positions of sender, receiver, and the geocast region.
(i)Intersection based forwarding mode:Vehicles at intersections can forward messages first by assigning them to preferential delay values when the rebroadcast at the intersection is needed
(ii)Greedy forwarding mode:The GF mode is when rebroadcast at an intersection is not required for reducing the rebroadcasts.
UGAD uses an angle calculated from the positions of sender, receiver and the GR as a parameter for the forwarding mode selection. This approach ncreases the packet reachability and decrease redundant broadcast.

3. PROPOSED WORK

Proposed Algorithm:

Sender()
Step1: Create n generation of k packets into each mixing set m
Step2: Encode each generation using MGM concept for each mixing set
Step3: Send packets

Intermediate node()
Step1: Forwad packets

Destination()
Step1: if id== Dest_id then
Step2: Buffer k packets of same group
Step3: Calculate the rank of received packets
Step4: Decode packets if rank is sufficient
Step5: Receive packets

In proposed algorithm,when sender want to send no of packets then it create the n generations of k packets into mixing set m and encode each generation of each mixing set using MGM and send packets. When vehicle receive packet then it checked the id with destination. If packet id will not match with destination id then packet will forwaded. After packet id is match, at destination k packets are buffered of same group. And rank of received packet calculated. If rank is sufficeint then receiver decode the encoded packets and receive origenal data.

4. RESULTS

Chart-1 represents the end to end delay vs no of nodes. It shows that comparatively convetional approach using MGM end to end dealy is decrease. Chart-2 represents the PDR results. As no of nodes increases the PDR will increases because of using meeting rate as parameter.

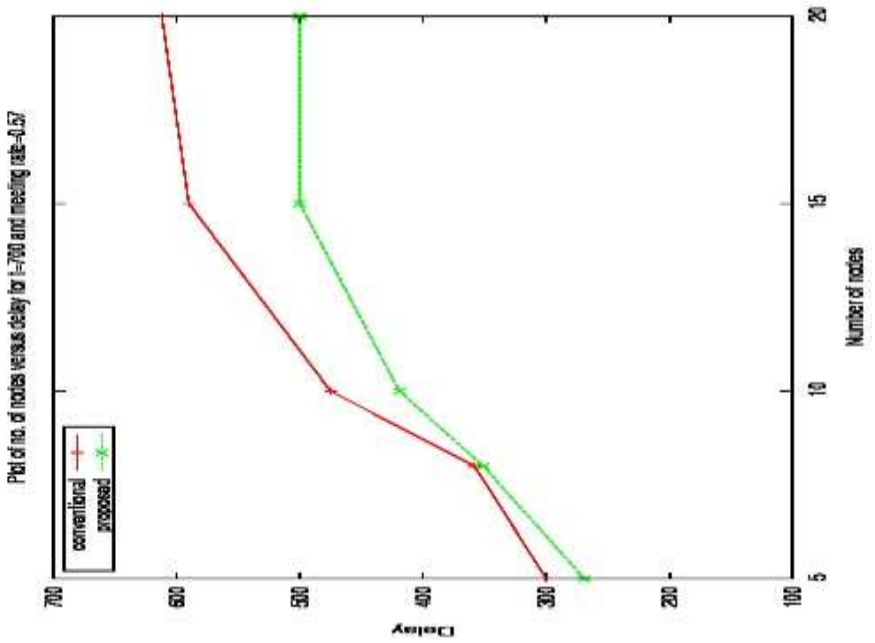

Chart -1: Dealy vs No of Node

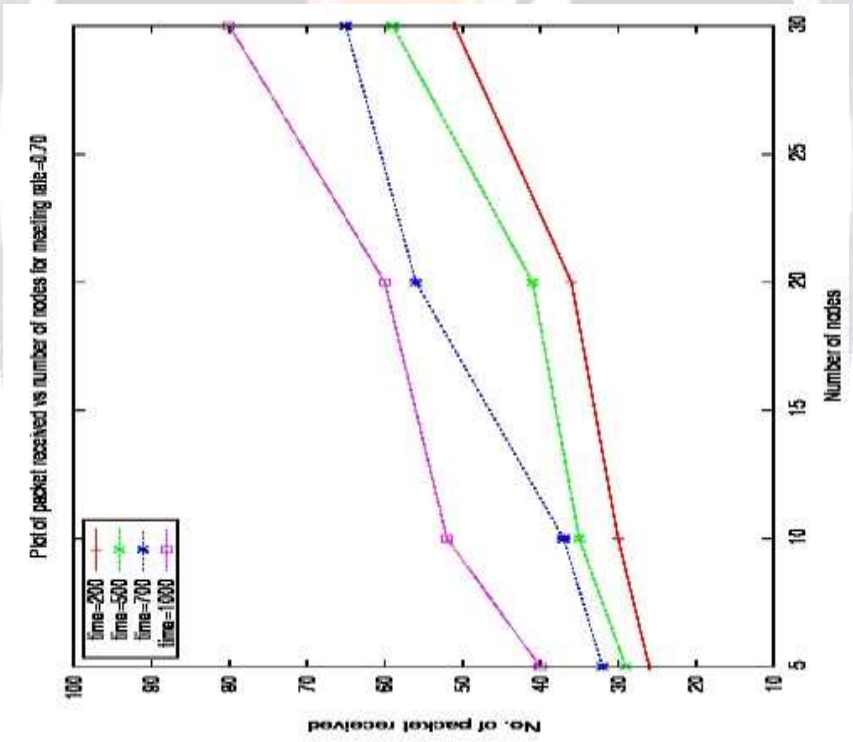

Chart -2: Packet Delivery Ratio vs No of Nodes

5. CONCLUSIONS

Vehicular Ad hoc Networks (VANET) is frequently disconnected network and it has lossy environment. In VANETS, Data Dissemination is a challenging task because of high mobility and having issues are throughput, end to end delay, reliability. So by using network coding with Muti Generation Mixing in VANET for data dissemination we can increases PDR ,decrease end to end delay and improve reliability.

6. REFERENCES

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